

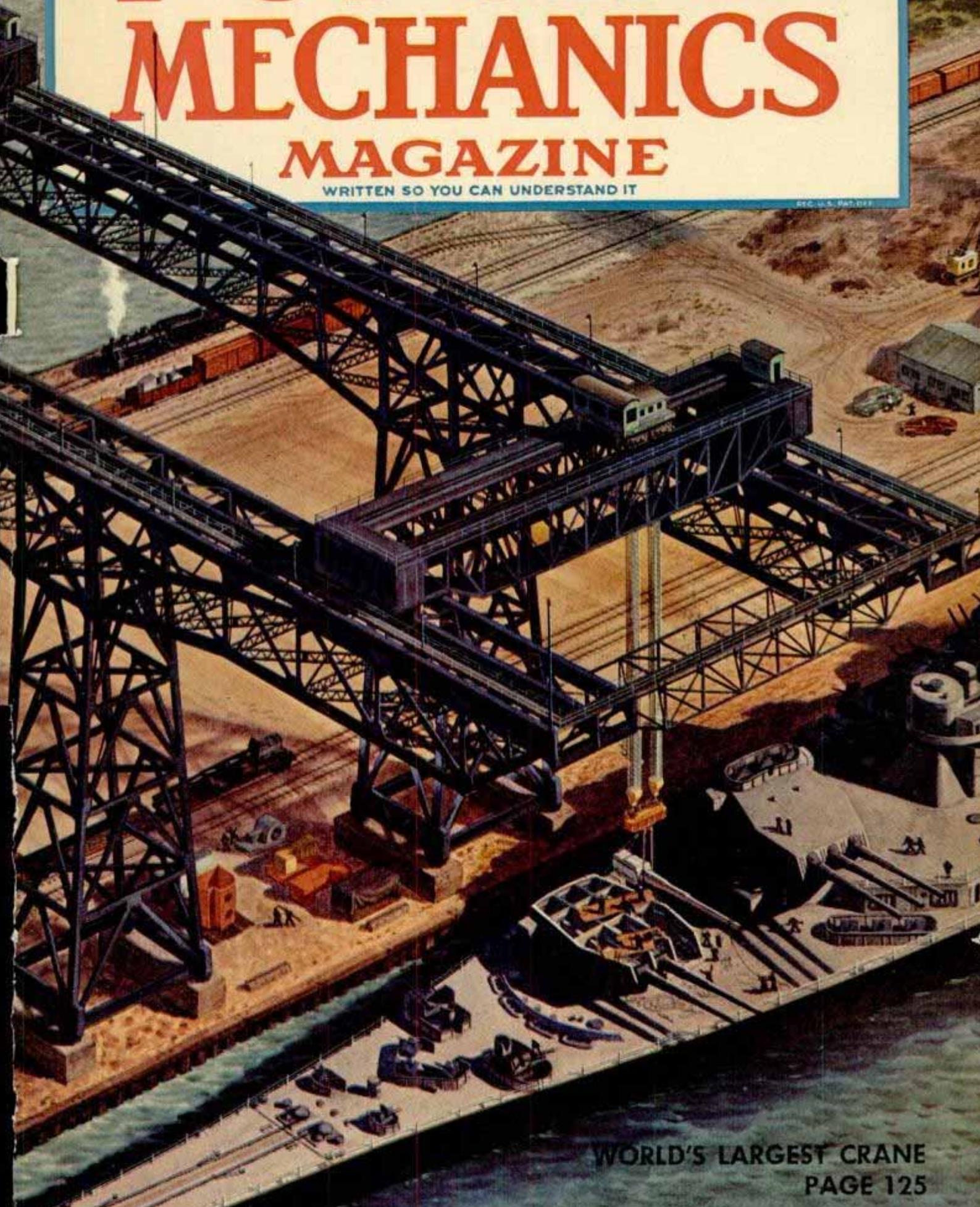
ANC

POPULAR MECHANICS

MAGAZINE

WRITTEN SO YOU CAN UNDERSTAND IT

REG. U.S. PAT. OFF.



WORLD'S LARGEST CRANE
PAGE 125

Dependable

CHAMPION

AMERICA'S FAVORITE SPARK PLUG



The roaring midgets are in full cry again, dispensing their spine tingling thrills to enormous crowds nightly, on race tracks all over the nation. Tremendous acceleration, and keen driving skill are their stock in trade as they race literally hub to hub. Neither car nor driver can falter for a split second, and that's precisely why dependable spark plugs are of paramount importance. The overwhelming majority of midget car pilots use dependable Champion Spark Plugs. Here is testimony by experts that Champions make every engine a better performing, more dependable engine. Champion Spark Plug Company, Toledo 1, Ohio.

FOLLOW THE EXPERTS

**DEMAND NEW
DEPENDABLE CHAMPIONS
FOR YOUR CAR**

Listen to the CHAMPION ROLL CALL . . . Harry Wismer's fast sportscast every Friday night, over the ABC network



Typical example: the B. F. Goodrich tire that outwears prewar tires

SOUTH of the Mason-Dixon line, scorching highways provide tough testing grounds for any tire. Yet a Georgia automobile dealer writes that B. F. Goodrich tires are still going strong after 40,000 miles.

Pictured above in the light suit is J. A. Wynche of the John Alden Motors Company, Macon—who writes: "According to my speedometer I have gotten 40,742 miles of service out of two B. F. Goodrich Silvertown tires installed in February, 1945, and 33,260 miles from two other B. F. Goodrich tires installed later.

"These tires have been subjected to all types of driving conditions, including rough country

roads. Yet their condition is such that they could be safely driven a few thousand miles more before recapping.

"I have been in the automobile business since 1907, and it is nothing unusual for me to observe and note exceptional performances. This is by far the greatest mileage I have ever secured from any set of tires. I can truthfully say that the new B. F. Goodrich Silvertown tires outwear prewar tires . . . or any other tires I have used."

One reason these tires outwear prewar tires is their wider, flatter tread. This tread puts a greater span of rubber on the highway, takes a firmer grip, spreads car

weight over a larger area, and distributes road impacts more evenly. The extra rubber shares the wear, and as a result gives more mileage with greater safety. Other B. F. Goodrich features include: sturdier top ply, extra breaker strip, 35% stronger cords to resist blowout.

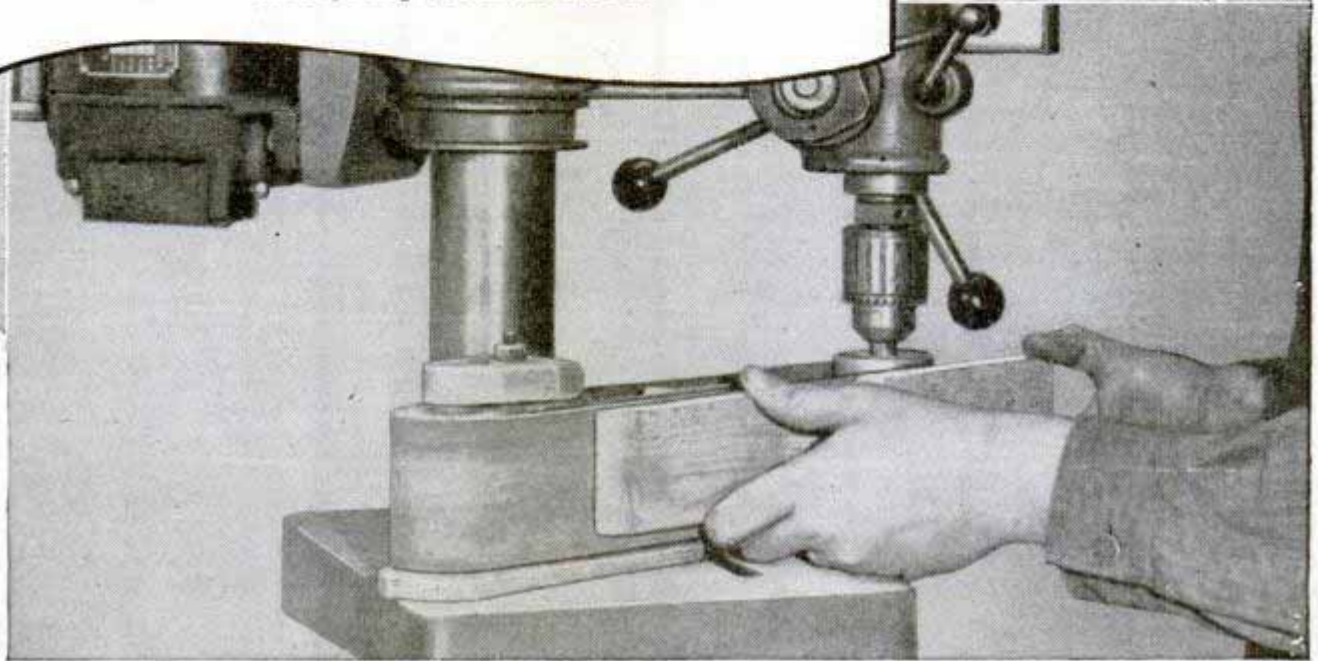
Prices Now Reduced!

Now you can get the tire that outwears prewar tires in all popular sizes at less than prewar prices! And there has been no lowering of quality. *The B. F. Goodrich Company, Akron, Ohio.*

B.F. Goodrich
FIRST IN RUBBER

Ingenious New Technical Methods

To Help You
Simplify Production



NEW BELT SANDER FOR DRILL PRESS Does Finishing Jobs Faster, Better

A new, simple, faster method for many surface finishing jobs on wood, metal, plastic and other materials has been announced by the OK Specialty Company of Chicago. The new finishing method takes the form of the OK Belt Sander, a drill press attachment.

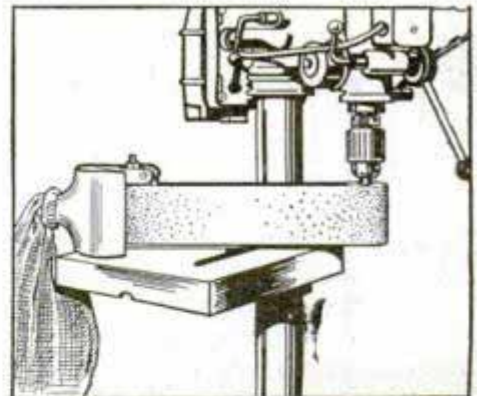
The new sanding device weighs less than 5 pounds. It is made up of an aluminum base with backing plate or platen, a driven pulley mounted on ground steel shaft and running on precision ground ball bearings, and cast aluminum driver pulley mounted on $\frac{1}{2}$ " ground steel shaft to fit into the drill press chuck.

The base of the sander is bolted to a drill press table. Merely by moving the drill press table, the attachment can be adjusted to handle sanding belts from 26" to 36" in length.

The sander takes belts from $\frac{1}{2}$ " to 3" in width. Two sanding belts, one coarse grit and one fine grit, are furnished with each attachment. The device comes assembled ready for use with any drill press. Most efficient performance is achieved at 3500 to 5000 RPM. The sander stands 5" high, and the base measures $10\frac{1}{2}$ " long by $3\frac{1}{4}$ " wide.

Another time-saver on the job is chewing gum. Chewing gum may be used even when hands are busy; and under dust conditions helps to keep the throat moist—prevents "false thirst." For these reasons many plant owners make Wrigley's Spearmint Gum available to everyone.

*You can get complete information from OK Specialty Company
4655 N. Clark St., Chicago, Ill.*



OK Belt Sander
Assembled, Ready for Action



AB-73

Popular Mechanics Magazine

Registered in U. S. Patent Office and Canada

H. H. WINDSOR, Founder

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



STORMY WEATHER makes a hit with the Army pilots at Wilmington, Ohio. With the latest weather map in his hand, the pilot above will hightail after the darkest clouds he can find, happily exposing their private lives. It's part of a plan to make all-weather flying safer. Editor Jack Kinsey's report on this high-altitude game of tag is on page 117. "Too darn bad," one pilot grumbled. "Looks like a nice sunshiny day today!"

NEXT MONTH "Science HQ of the Navy" will describe a lab where peacetime miracles are born—whistles that disperse fog, and quartz crystals that grow from seeds. A feature for "sidewalk superintendents" takes you aboard the walking dragline, a giant that gobbles a carload of earth in a bite. And movie star Chester Morris explains some tricks for amateur magicians.

SKIERS "waxing up" for the winter season will find complete details on building a ski tow in next month's Craftsman section. An article for hunters looking forward to the bird season is titled "Shotgun Chokes and Gauges." Another feature tips off the prospective buyer of a used motorcycle on points to be checked.

SIGNAL "BOOSTER" described in next month's Radio section increases the sensitivity of short-wave receivers.

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Tank blows its top

MEET "Calliope," a medium tank, "souped-up" with a 60-rocket launcher developed for the U. S. Army Ground Forces. "Calliope" can perform like any other tank. Then, at a moment's notice, it can take a fixed position and let fly with a rocket barrage equal to 60 artillery pieces.

"Calliope" is an all-steel model of the enormous strides which the Ground Forces have made in the field of mechanization. At much less danger to itself, one crew can perform missions which would formerly have taken many times the number of men.

Then, too, "Calliope" shows the interesting research and development being carried on by the Army. Any young man with any kind of mechanical bent will find the U. S. Army Ground Forces a fascinating workshop in which to learn skills and trades and give his new-found knowledge the practical application it needs.

There are other advantages, too, to a Ground Forces career. Good pay, steady work, living essentials provided without charge, travel, adventure, and the thrill of doing a worth-while job for your country. Get the facts at your nearest U. S. Army Recruiting Station.

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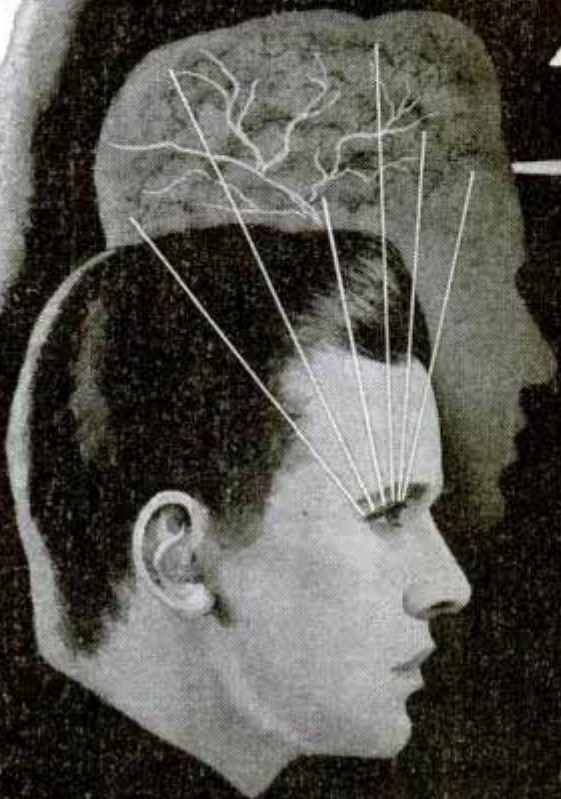
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All things begin with thought—it is what follows that may take your life out of the class of those who hope and dream. Thought energy, like anything else, can be dissipated—or it can be made to produce actual effects. *If you know how to place your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

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Be honest now—

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So send it today—right now—tomorrow never comes for the man who consistently puts things off.

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Jerry, the talking dog, is entertaining hospitalized veterans, by courtesy of the PYROIL Company. Picture of Jerry, sent on request.

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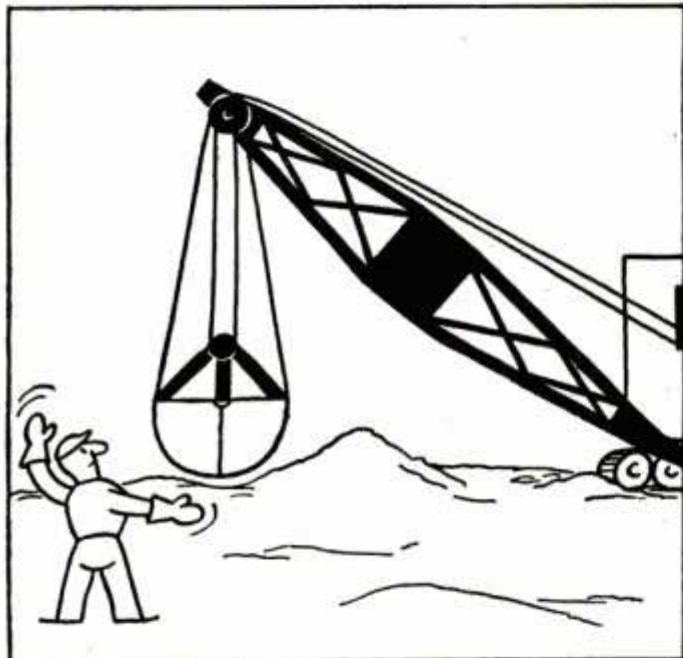
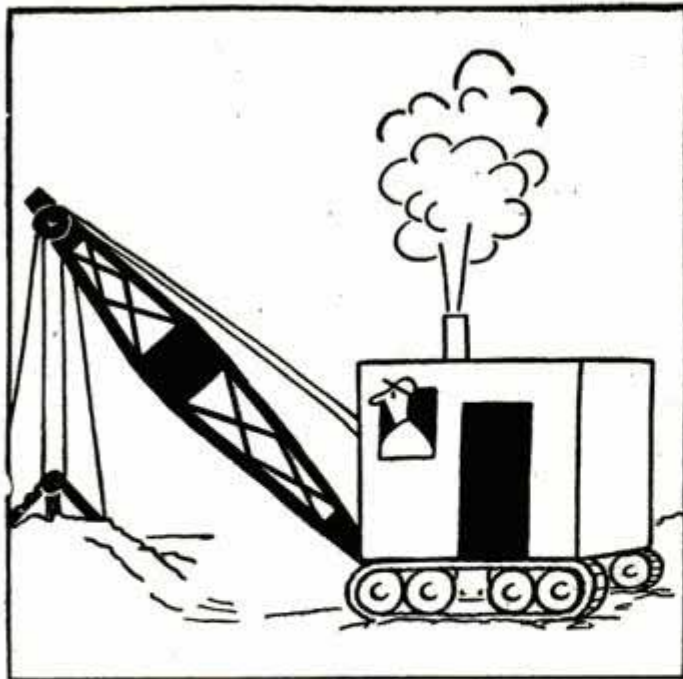
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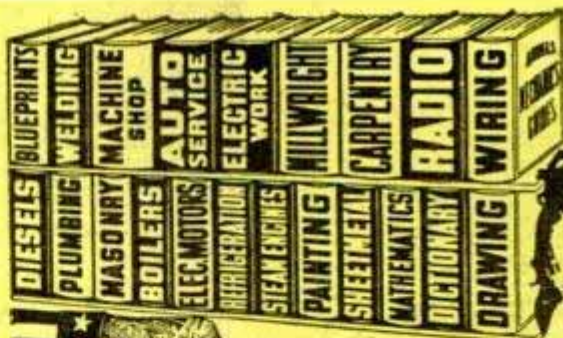
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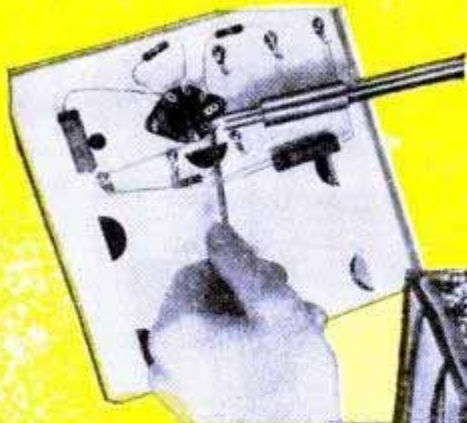
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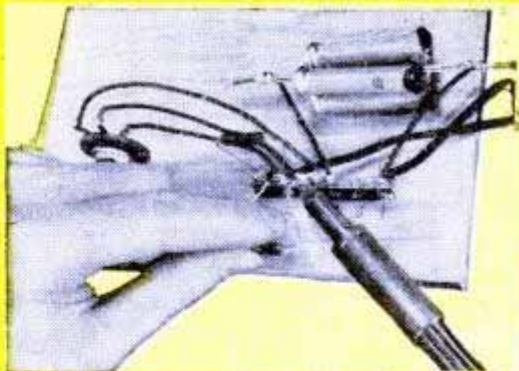
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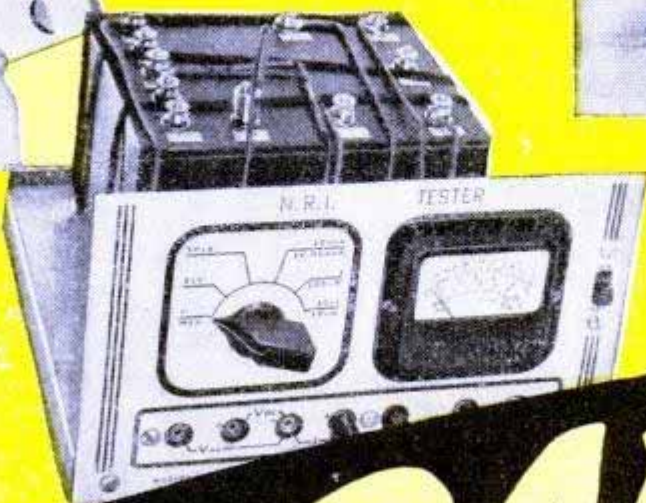


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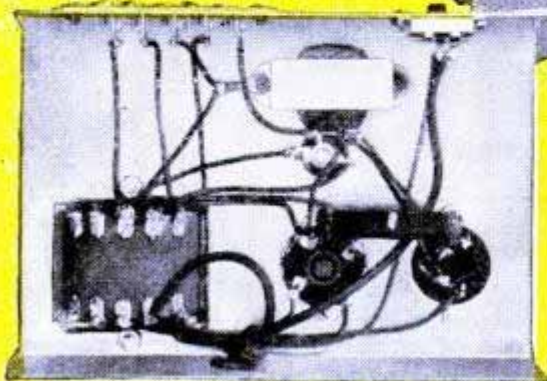
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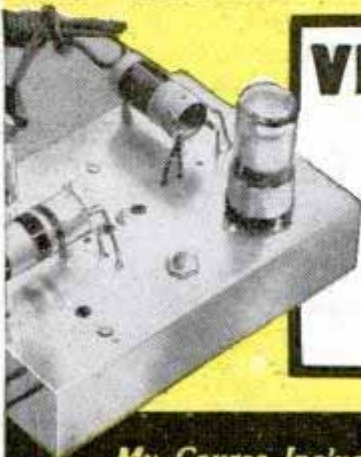
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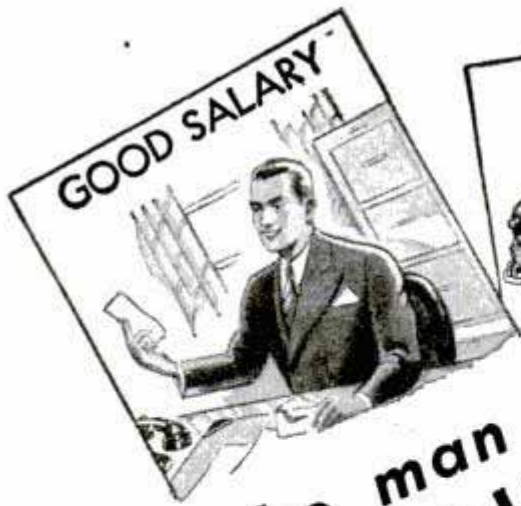
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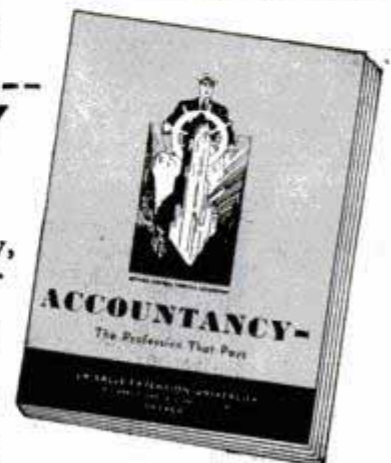
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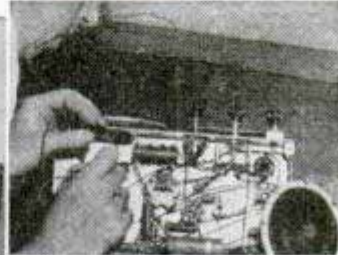
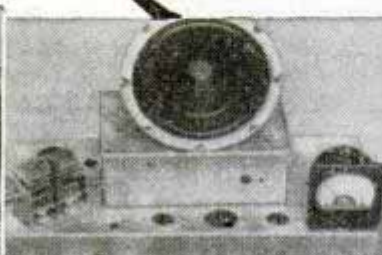
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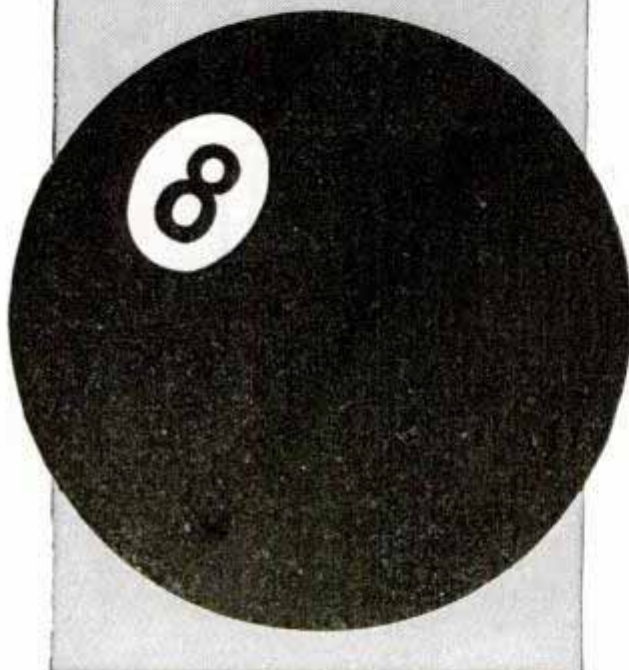
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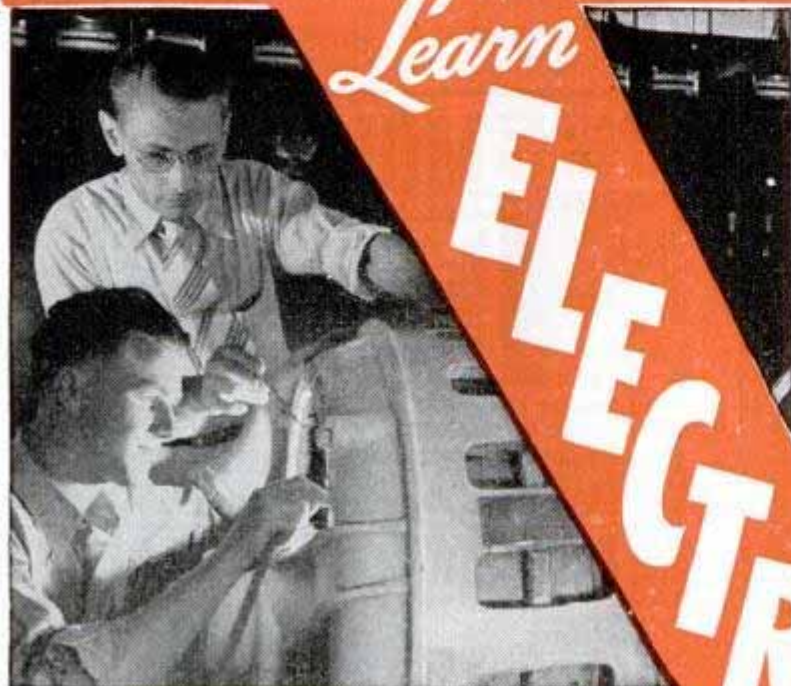
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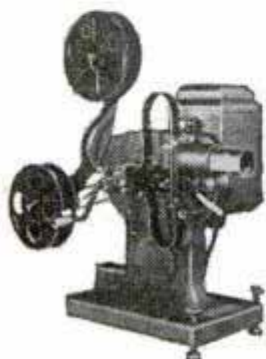
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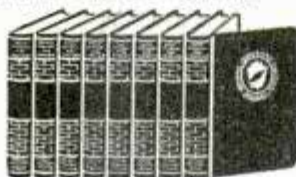
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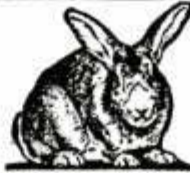
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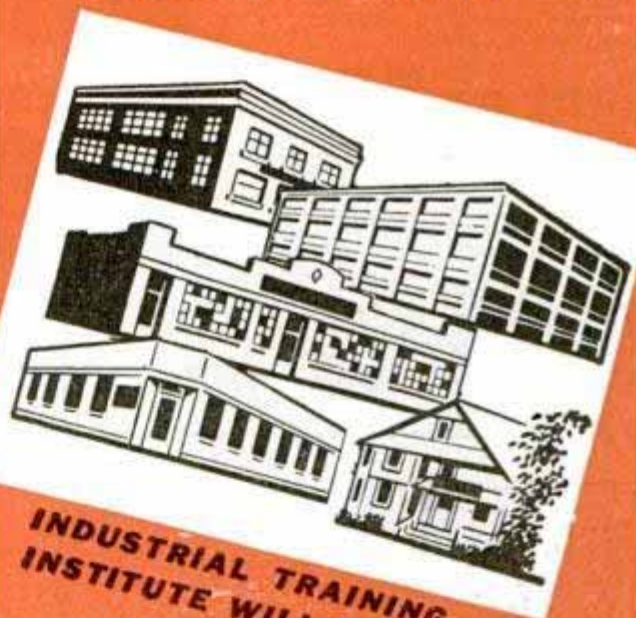
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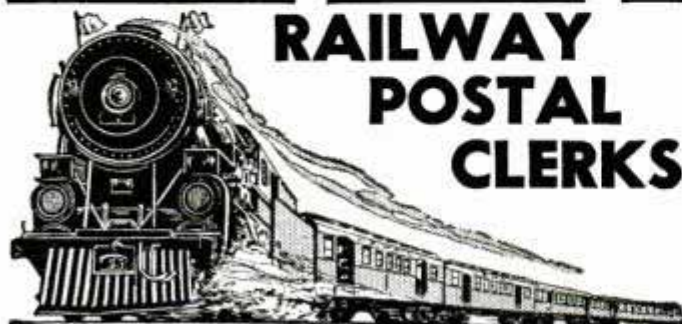
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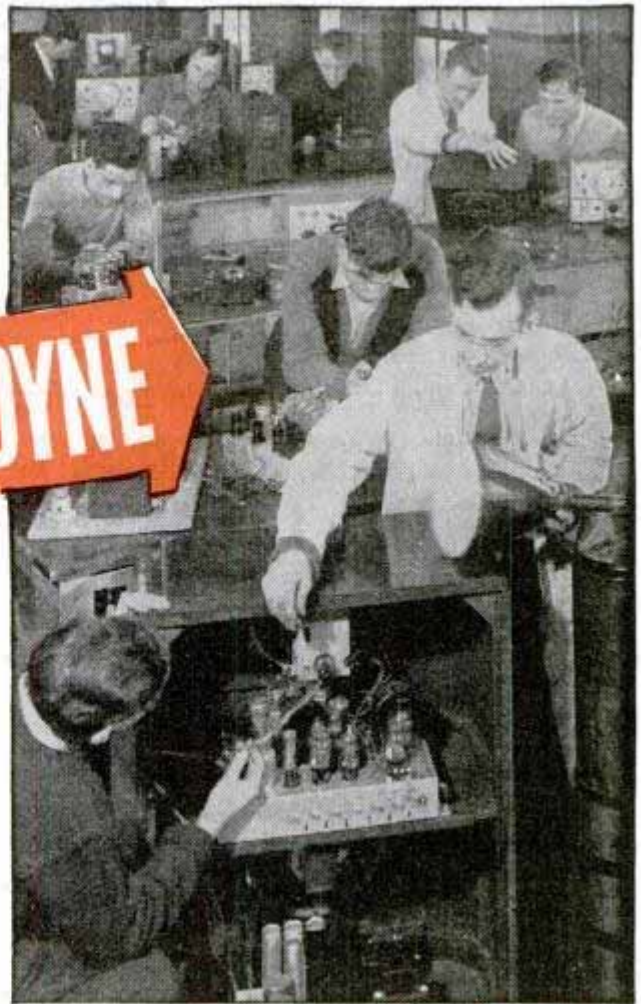
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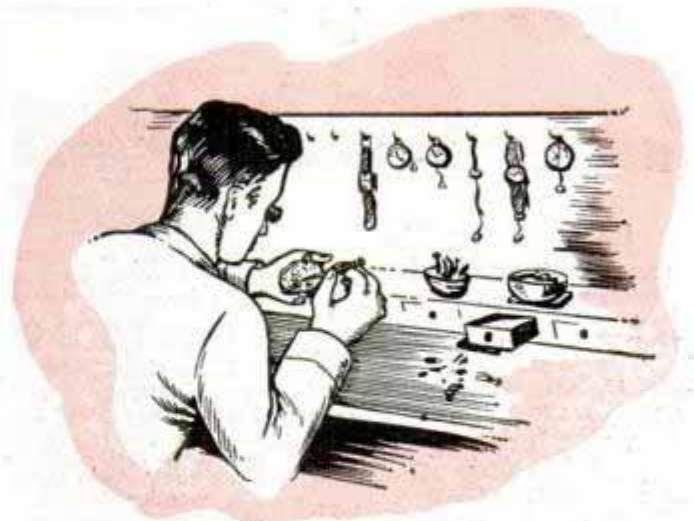
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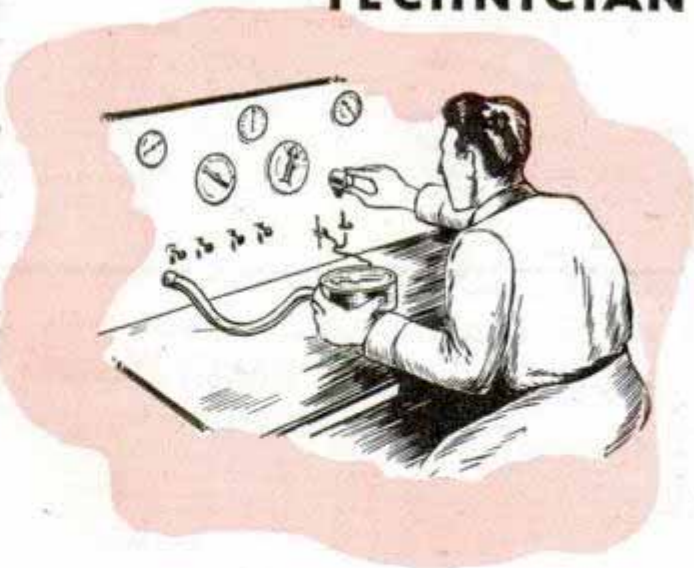
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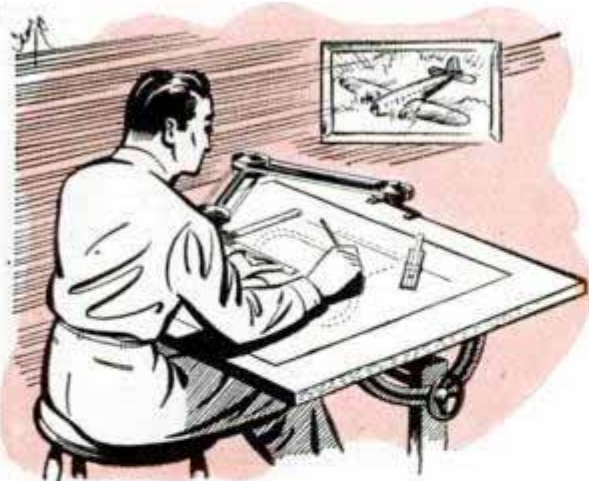


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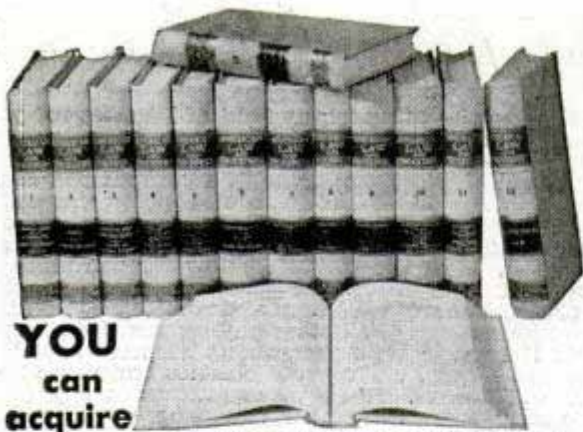
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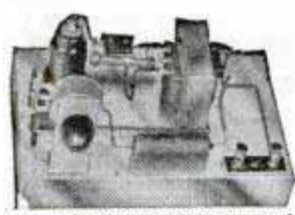
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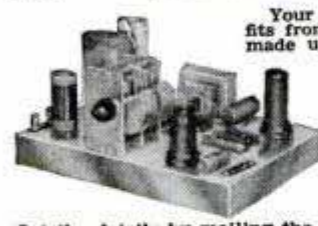
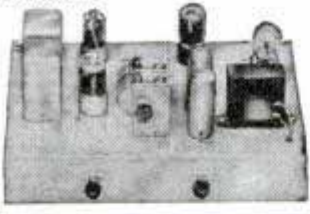
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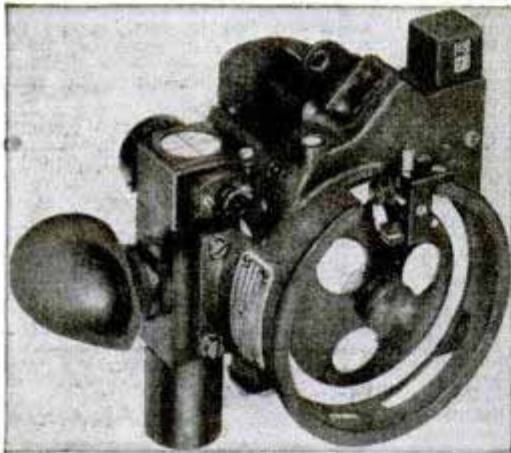
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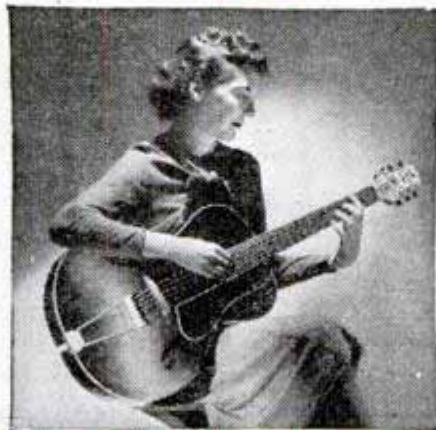
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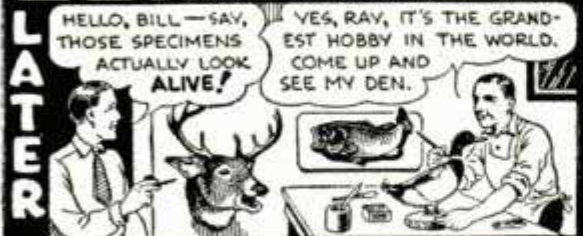
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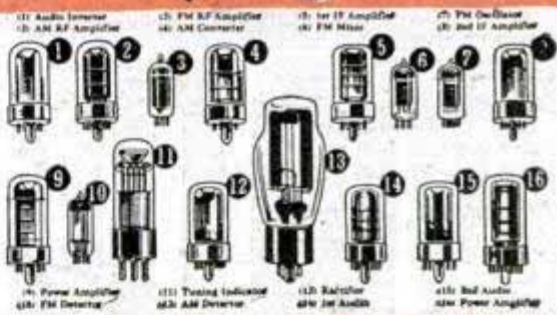
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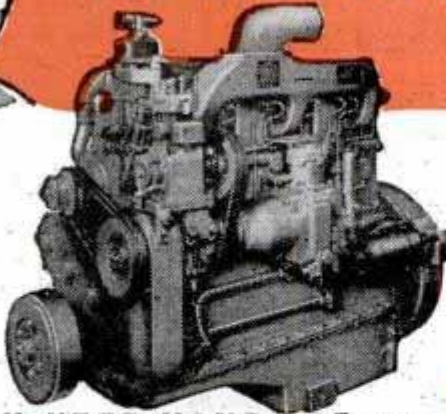


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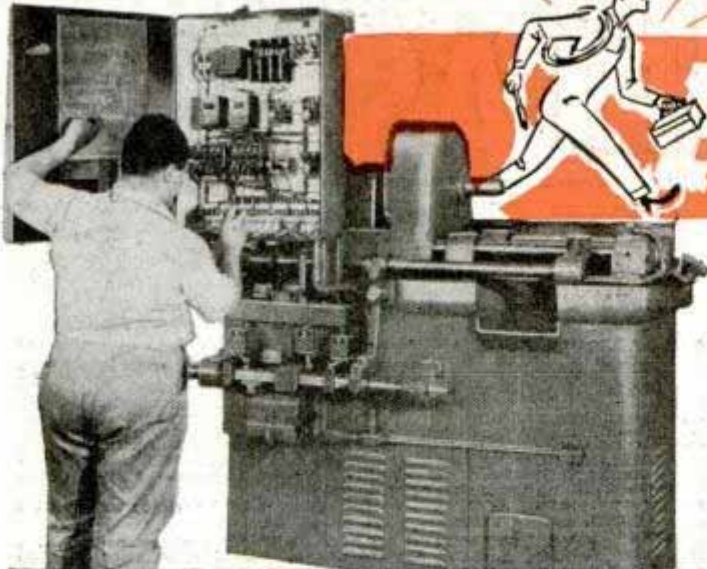
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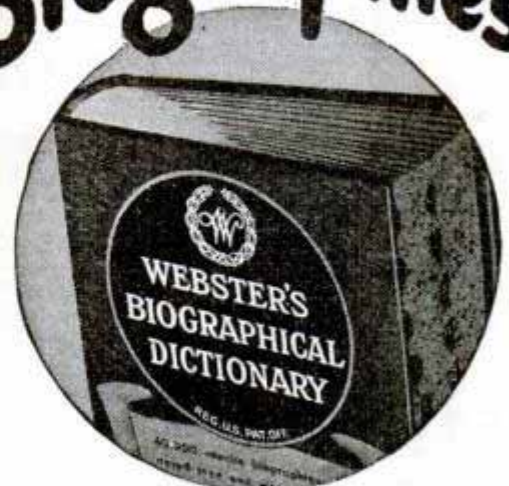
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I MAKE Big money in the mail-order business. You can do the same at home with my copyrighted system. Write me. I'll tell you how. F. Little, R.D. #1, Glenshaw, Penna.

START Home mail business! Exclusive setups built-to-order for financially responsible beginners, by leading M.O. Association's expert staff. Booklet free! N.M.D.A., 33-B Vassar, Dorchester, Mass.

1947 GIGANTIC Directory of opportunities, advertisers' supplies, sources, trade information, mail order ideas, products, wholesalers, valuable tips—just published! Descriptive literature free. Wilkin & Co., Hillsboro, Ohio.

REVOLUTIONARY Mail order plan! This isn't guess work but a newly-tested practical idea that can help you put extra dollars into your pocket every day. Quick action necessary. Send for convincing details today. Kutz, National Mail Sales Service, P.O. Box 2001, Natural Bridge, St. Louis, Mo.

METALLIZE Baby shoes. Further information free. Metal Crafts, 5501 Suwanee, Tampa, Fla.

WHOLESALE Anything imaginable. New guaranteed list 25c. Refundable. La-

EXTRA Money. Send for new plan. Free. Inspirational Books, Box 106 Old Chelsea Station, New York 11, N. Y.

WOULD You pay 3¢—first \$350 made? Color-illustrated book "505 Odd Successful Enterprises" free! Proven! Work at home, office. Expect something odd! Pacific, Oceanside, Calif.

MAKE Big money. Build your own lamps and sell. Write for free factory photos. Buddy Products Mfg. Co., Dept. 25, 1123 West Belmont, Chicago, Ill.

BEAT Higher costs of living by extra money, spare time, own home, no personal contacts. Provenly successful methods. Write Postway, Box 882, Fort Worth, Texas.

THOUSANDS Articles wholesale. "Supply Source Directory", 10c. Ideal Service, Park Ridge 40, Illinois.

WHY Earn profits for somebody else? Build your own business, spare or full time. Small capital start, grow big! Be your own boss! Start today! Details free! Elliott, 177 Columbia, Edgewood 5, R. I.

METALLIZE Flowers for profit! It's new, easy, sure fire! Free details. Joseph B. Kushner, Metal Finishing Consultant, Stroudsburg 3, Pennsylvania.

EARN Money at home! Thousands dol. Free details. Sizemore, Box 7, 4917 Kostner, Chicago 30.

WIN Money on contests advertised in magazines and on radio. General Contest Bulletin, published monthly, gives hundreds of tips. Lists current contests and rules. Sample 25c. General Contests, 1609 1/2 East 5th, Duluth, Minn.

EXCELLENT Profits raising mink. Details furnished. Franklin Young, Riverhead, New York.

MANUFACTURE Costume jewelry at home for profit, hobby, therapy. Free wholesale supply catalogue. Instructions. Florida Supply House, Bradenton, Florida.

\$25 WEEKLY Working two hours daily. No canvassing or manufacturing. Lycke, Box 2471, Cleveland 12, Ohio.

THERE'S Big money in junk," and repairing batteries. Write, Batteryman, Grand Junction 5, Colorado.

\$246.50 MAKING Unusual secret device without skill, machinery, from former war material costing \$1.50! Simple, baffling invention, unbelievably profitable! Illustrated proofs free. Rolls Enterprises, 115-D West 16th, New York 11.

EARN Money at home—steady income. Write Successful Income Builders, 508-A, Hollywood 28, California.

FORTIFY The future! Start own business; home, office. Booklet describing "Collection of 137 Tested Plans" free. Elite Co., 220-A Grand St., New York 13.

PUBLISH Your own magazine. Hand-some 52 page format, well edited, illustrated. Cost low as \$1.00 month. Brings you prestige, profits. 25c brings sample. Details. National. Ord. Nebr.

AMAZING Possibilities! Greater profits spare or full time. New sensation gives "easy carving" safely-handly refrigerator "storage drawer." Cox Enterprises, 601E S. Vermont, Los Angeles 5.

FORMULAS, PLANS, ETC.

HORSERADISH And beet relish. Delicious, appetizing, make it at home. Send 50c in coin for recipe. John Bock, 1108 East 35th Street, Tacoma 4, Wash.

MARBLEHEAD Fish chowder. Delicious. Economical. Personal recipe 25c. Rosamond C. Hodges, Marblehead, Mass.

PHOTO Kit prints any photo on cloth, paper, etc. \$1.49. Formula \$1.00. Mediant Company, Box 123 Blythebourne Station, Brooklyn 19, N. Y.

NEED Chemists? Formulas? Analyses? Products duplicated? Consulting Scientific Company, Swarthmore, Penna.

THOUSANDS Formulas, plans, trade secrets. Free literature. Kogan, 1032-DF, New York 8.

FORMULAS, 15 Money-makers 25c. Willies, Rt. 14 Box 595A, Milwaukee 14, Wis.

100 SINGLE Ingredient formulas, 25c. Tes-Co., Box 189-MS, Wilkes-Barre, Penna.

ROOFING, 100% Fireproof, low cost, lasts indefinitely; make yourself; formula with instructions. \$1.00. Ray Roofing Co., P.O. Box 255 Petersburg, N. Y.

21 POPCORN, Candy apple, etc. formulas. All money-makers. \$1.00. We can supply equipment. Concession Supply Co., Dept. "A," Box 133 Sta. "B," Toledo, O.

MANUFACTURE Cleaners, soaps, polishes, flavors, cosmetics. Literature free. Kemico Park Ridge 16, Illinois.

10,000 FORMULAS And trade secrets. Free literature. Stillman, 555 Kingston Ave., Brooklyn 3, N. Y.

REAL Manufacturing formulas. Lists free. Cummings, Chemist, Gordon Ave., Syracuse 4, N. Y.

PLASTICS

PLEXIGLAS Masked sheets 12"x12"—1/16" — \$1.00, 1/8" — \$1.25, 3/16" — \$1.55; 1/4" — \$1.85. Include 10% postage. Dyes, rods, cements, shells, buffing compounds, jewelry findings, tools. Free listings. Craft Plastics, Box 129-P, Somerville, New Jersey.

RENEW Leather and leatherette—Make cloth into imitation leather with plastic discovery called Leather-New. Opportunity to make real profits taking care of sales resulting from national advertising. Write for free sample of Leather-New covered material and complete deal. 704 Land Bank, Kansas City, Missouri.

PLASTIC—Sheets, rods, tubes, etc. Free list. Plastic Supply Co., 2618 St. Louis Ave., St. Louis 6, Mo.

TEN Fascinating detailed Plexiglas projects, \$1. Original Plasticplans, Box 181, Cincinnati 1, Ohio.

PLASTIC Costume jewelry, beautiful designs. Free catalogue. Howard Schultz, 115-83 229 St., St. Albans 11, N. Y.

PLASTICS, Supplies, kits. List. Plasmet Sales and Engineering, 4648 Shirley Pl., St. Louis 15, Mo.

CEMENT For Plexiglas, lucite. Red, yellow, blue, clear. 2 oz. each of any three, \$1.00, postpaid. McCormick, 3328 N. Newhall St., Milwaukee 11, Wis.

LEARN Internal carving of plastics for pleasure and profit. It's easy. Exciting. Carve flowers, animals, landscapes of colorful, thrilling beauty in solid Plexiglas plaques and cubes. Send 10c for complete instructions folder, plus jewelry findings catalog and big plastics price list. Plastic Parts, Dept. H-29, 1157 S. Kingshighway, St. Louis 10, Mo.

PLASTICS—Sheets and rods, 8 colors. Stamp brings free list. Hanson Plastics, 7625 South Parkway, Chicago 19, Dept. 90.

WONDERFUL New thermoplastic. Literature free. Sample 25c. Jalco, 161 Dille, Memphis, Tenn.

PLASTICS Trade secrets. Write for free details. Plastics Research, Box 346, Alhambra, Calif.

EDUCATIONAL Offer! Learn by doing! Sample kit containing odorless resin, accelerator, rubber mold, dye, lubricant plus all equipment necessary to make quick castings in lustrous Formalin! Complete with instructions and price lists for quantity orders of these excellent plastics casting materials: \$3.00 f.o.b. Formalin, Romeo, Michigan.

LUCITE —Findings, Tenite rods-tubes, catalog dime, refunded first order. Special offer. Mid-West Plastic Supply, 1717 No. 66th, Omaha 4, Nebr.

PLASTIC Injection machines; toy, industrial, commercial. Jewelry findings, Plexiglas, dyes, Polystyrene rods; tenite; kits, etc. Low prices. Free list. G. Baker Company, River Edge, New Jersey.

METALLIZE Plastics for profit! Free particulars. Joseph B. Kushner, Metal Finishing Consultant, Stroudsburg 3, Pennsylvania.

MAKE Money assembling our pre-fabricated plastic kits. Sample kit 50c. Catalog free. Fabros, Box 156, Station F-1, Buffalo 12, N. Y.

CHEMISTRY

THE House of Winn, home of supplies for amateur chemists. See Winn's New Idea chemical kits and apparatus outfits for home experimenting. Send 10c for retail catalog. Established 1931. John H. Winn, Dept. 509, 124 West 23rd St., New York 11, N. Y.

GET "Planning Your Laboratory," 25c. Catalog, 10c. Pilgrim Chemical, 348C Edith Avenue, Salt Lake City 4, Utah.

CHEMICALS Of all kinds. Special attention to small orders. Write for free catalogue. Lab Chemical Co., Box 206, Oak Park, Ill.

FREE Catalog: Chemistry, mineralogy, biology. Tracey Laboratories, 1907 Harrison, Evanston, Illinois.

SPECTROSCOPE For quick chemical analysis \$3.00. Cutting Co., Box 457, Campbell 1, Calif.

NEW Laboratory supply catalog of chemicals and apparatus, contains over 5000 items with illustrations, 212 pages. Send 50c. Standard Science Supply Co., 1232 No. Paulina Street, Chicago 22, Ill.

CHEMICALS—LAB. Supplies. New catalogue 10c. Mel-Glo Chemical Co., 258 Fourth Avenue, Brooklyn 15, N. Y.

CHEMICALS And apparatus for industrial, analytical, and private laboratories. Complete supply service for correspondence school students. Send 3c for catalog. Dept. M-43, Biological Supply Co., 1176 Mt. Hope Ave., Rochester 7, New York.

APPARATUS, Chemicals, ounce quantities, catalog 5c. Fleischer's Laboratories, Everett 49, Mass.

HELP WANTED

PATTERN Maker, grader, designer, and cutter. Fine Calif. position for a top man experienced in sweaters and knit sportswear. Gantner & Mattern Co., 1453 Mission St., San Francisco 3, Calif.

SELL Christmas Cards, stationery, gift wraps. Gold imprinting free. Samples on approval. Carleton, 25a W. 17th, Bayonne, N. J.

SALES Engineers to place large unit combustion equipment which pays for itself in from 8 to 30 months. An energetic go-getter should make more than \$7000 (per annum) commissions. Give experience. Address—Sales Manager, P.O. Box 1367, Chicago, Ill.

MAKE More money selling individualized buckles, belts, tie holders, cap badges. Choice of 2000 emblems. Quick profits—repeats. Special outfit offer, write Hook-Fast Products, Dept. A, Columbus 6, Ohio.

AGENTS WANTED

GOLDEN Money making opportunity. Sell friends, others new 1947 assortment 21 irresistible Christmas cards and outstanding 50 for \$1.00 personals. Extraordinary gift wrapping, religious, everyday, economy boxes. Up to 100% profit. Tremendous demand, sensational values. Easy sales. Experience unnecessary. Request free samples name imprinted Christmas cards and customer winning 21 box on approval. Holiday Card Co., 463 Congress Street, Dept. C, Portland, Maine.

AMAZING Daily profits. Big repeat business. Sell top-quality, lowest-priced men's dress, work hosiery, full, part-time. Experience unnecessary. Take orders. We deliver. Outfit free. Write Colt Shoe Company, 242-D9 Purchase, Boston 10, Mass.

"27" AGENTS—Salesmen wanted! Liberal territory allotted. Demonstrate amazing "27 Second" eye glass cleaner. Whirlwind seller. Year's supply in compact only 59c. 2 for \$1.00. \$40.00 per gross—110% profit. 27 Second Cleaner Co., Dept. 49-L, 6337 N. Talman, Chicago 45.

MAKE Money easily. Sell 50 for \$1.00 Christmas cards. Cost you as low as 45c. Big line Christmas and everyday assortments. Sell only 50c to \$1.00—your profit 25c to 55c per box. Extra bonus. Write for free samples personal Christmas cards, name imprinted stationery and leader 21 card Christmas, 16 card feature all-occasion assortments on approval. Special offers. Elmira Greeting Card Co., M-71, Elmira, N. Y.

AGENTS—Big line including food products. Fast selling premium and bargain deals. Low prices. Send card for big outfit offer with gift. Ho-Ro-Co, 2725 Dodier, St. Louis 7, Mo.

CHRISTMAS Cards. Earn big money. Take orders galore from friends. 25 exquisite folders with name, \$1.25. Free samples 10 designs. America's fastest selling 21 Christmas folder box, costs 50c. Sells \$1. Request samples today. Sunshine Art, Dept. E-9, 115 Fulton St., New York 8, N. Y.

BUILD Your own local shoe business. No investment. Free outfit starts you. Advance commissions plus bonus. Amazing comfort features. Tanners Shoes, 100, Boston, Mass.

AMAZING New Glow in the dark house numbers, switch plates, decals, pictures, religious articles, etc. Factory representative wanted. Wonderful opportunity. Free samples. Madison Mills, 303 Fourth Avenue, New York, N. Y.

AT Last! Something new and sensational in Christmas cards. Amazing "Oilette" cards. Like costly oil paintings. Designs never before offered. Quick orders. Beautiful 50 for \$1 cards, name imprinted. Big profits. 20 other assortments 60c to \$1. Samples on approval. Puro Co., 2801 Locust, Dept. 740L, St. Louis, Mo.

SELL Ultra blue stock signs to stores, 1000 slogans, comedy, general, religious. 7x11, cost 6c, sells 35c. Make money. Sample free. Lowy, 8 West Broadway, Dept. 333, New York City 7.

YOU Make \$25 for selling fifty \$1.00 boxes. 50 beautiful assorted Christmas cards sell for only \$1.00, your profit 50c. Write today for free samples 50 and 25 for \$1.00 and other boxes on approval. It costs nothing to try. Cheerful Card Co., 157, White Plains, N. Y.

QUICK Money—Profit to 100%, bonus. Sell friends peak value Christmas, everyday cards, gift wrappings, stationery. Free samples 50 and 25 for \$1.00 personals, etching-type Christmas card, initial stationery. 21-card \$1.00 Christmas, 14-card \$1.00 everyday assortments on approval. Special offers. Regal Greeting Card Co., 17394 Mendota Ave., Dept. B, Detroit, Mich.

EVERY Housewife a prospect for Automatic Speede-waxer. Send for details two big profit sales plans. Darby Mfg. Corp., 241 Centre St., New York 13, N. Y.

IMMEDIATE Big profits! Full or part time. Take orders for amazingly beautiful hardwood laminated lifetime plastic reproductions of any picture or negative. Customers everywhere! Write now, Gotham Products, Dept. A, Box 5427, Philadelphia 43, Penna.

CHRISTMAS Cards. Earn \$5.00 with every ten 21 card \$1.00 boxes you sell. Also new plastic cards, wrappings, imprint cards. Write for samples today. Howard P. Ellis, Dept. PM-10, Pitman, New Jersey.

OUR Business booming! Get in on it now. Take orders Water Saver hose nozzles. Car washers, service stations, greenhouses, homes, factories. Water Master Sales Co., 19465 P4 Ward, Detroit 21, Mich.

CHRISTMAS Card moneymakers. Write for descriptive folder. Greenport Art Company, Dept. 928P, Brooklyn 15, New York.

AMERICA'S Finest stainless steel tableware sells on sight. Money back guarantee. Sales kit \$1.00 deposit. Semco, Box 211, Lynwood, Calif.

BE Amazed. Fast profits selling Miracle Cushion Wonder Worker shoes. Also complete line, men, women, children. Advance commission, bonus. Experience unnecessary. Free outfit. Samples supplied. Paragon Shoes, Dept. M1, 716 Columbus, Boston.

QUICK Cash. Sell friends wonder-value 50 for \$1.00, extraordinary 25 for \$1.00 personal Christmas cards. Personal stationery. 32 sensational money makers. Up to 100% profit. Bonus. Write for 6 free self-selling sample portfolios of 50 for \$1.00 to 25 for \$2.50 name imprinted Christmas cards. Special offers. Rainbow Greeting Card Co., 36 East 12th St., Dept. 17-B, New York.

PAST Seller pocket clip cigarette holder. 20 water proof fillers. Cash in now, write for details. A.I.I. Mfg. Co., Hartington, Nebr.

SILVER Plating liquid. Apply with cloth. Renews silverplated ware. Cleans, silverplates, polishes, one rubbing. Genuine silverplate. Also silverplates brass and copper. Female and male selling representatives wanted. Part or full time. Big profits. Exclusive territory. Sells by demonstrating. Retail and wholesale. Nu-Process Products, Aurora, Illinois.

CHRISTMAS Cards. Earn easy money. New 1947 leading, luxurious, box assortments. Sell on sight. 100% profit. Free literature. Torres, St. Francis Place, Brooklyn, N. Y.

\$50 CASH For selling 100 assortments of 21 Christmas cards at \$1.00. Complete line. Free samples 50 for \$1.00 cards. Special offers. Write today. Hedenkamp, 343 Broadway, Dept. S-21, New York 13.

\$1 STARTS You in business. Sell deluxe ties. 100% wool interlining. Costs you only \$7 per dozen, you make \$5.00 dozen. Send \$1.00 for special introductory offer two deluxe ties. Catalog complete line free. Philip's Neckwear, 20 West 22nd St., Dept. K-15, New York 10.

BE Renewal headquarters for all magazines. Christmas gift sales starting now. Big profits. No experience. No capital needed. Free catalog tells how. Write: McGrount Magazine Agency, Dept. PM-2, Mount Morris, Ill.

AGENTS—Make big money from now on, selling the sensational new low priced transparent plastic table cloth cover. Saves on laundry bills. Every woman a prospect. Sample swatches free. Carwell Products, 330D South Wells, Chicago 6.

SELL 10 Boxes of personalized Xmas cards, and we'll pay you \$8.50. Also 7 other beautiful assortments, 50 and 25 for \$1.00 with name. Free samples. Ed-Brite Co., Dept. C, Mount Vernon, N. Y.

FREE — Mexican novelty curiosities. Fast selling. Exceptional profits. "Products," Apartado 9318, Mexico City, Mex.

SCHOOL Seniors—Earn 40% commission selling classmates America's most beautiful graduation name cards. Largest selection. Outsells all others. Send for free sample kit. Printcraft, 1425 E. Elm St., Scranton 5, Penna.

COMIC Greeting cards. Christmas and everyday. Terrific laugh provokers! People love them. Sensational sellers. 100% or more profit. Write now! Novo Products, 922 Diversey, Chicago, Ill., Dept. 105.

STAINLESS Steel, 17 jewel, water and shockproof wrist watches, radium dialed, with flexible bracelet, only \$17—formerly \$42. Wodicka, 339 East 11 St., New York.

PROFITS To 100%, selling Xmas and everyday greeting card assortments. Details and assortment on approval. Glorian, (Dept. 10) 515 East 45th St., Brooklyn 3, N. Y.

WHITE Shirts, pajamas. Sell direct from manufacturer. Free sales kit. Jarod Mfg. Corp., Rockville Centre 4, New York.

SELL Joe Louis's (champion) cosmetics to colored men and Marva Louis's (his wife) cosmetics to colored women. Sells on sight. 100% profit. Joe Louis Products Co., Dept. P, 6 E. Garfield Blvd., Chicago 15, Ill.

SHINE Shoes without "polish." New invention. Lightning seller. Shoes gleam like mirror. Samples sent on trial. Kristee 113, Akron, Ohio.

100% PROFIT For agents to sell Tip-Toe shoe rubbers! Write for details to the Perry Rubber Company, P.O. Box 182, Dept. P, Massillon, Ohio. Send 50c for sample.

PLASTIC Tablecloth covers, curtains, drapes, baby pants, bowl covers and other plastic articles selling like wildfire! Make big money now! Free details. Write Plastics, Dept. 58J, 206 N. Fourth, St. Louis, Mo.

MAKE UP to \$50 a week in spare time selling greatly in demand oil burners for kitchen stoves. Oil Burner Supply, Box 327, Cambridge, Mass.

AMAZING Daily profits, steady repeat business selling Colt's 216 shoe styles. Featuring Whippets—miracle post-war super-flexible, super-durable quality shoes at \$6.95. Exclusive features make selling easy. Experience unnecessary. Free outfit. Colt Shoes, 601-D9 Atlantic, Boston 10, Mass.

SELL Delicious candies, nuts, gum. Immediate delivery. Write Casterline, 2031-R Sunnyside, Chicago 25, Illinois.

UNUSUAL Photographic products, good profits, free sample. Kingston, 3500 Avenue H, Brooklyn, New York.

AGENTS, Dealers, distributors. Handle Porck Glider Head Rest. No competition. Gilrest Co., 145 East Philadelphia Ave., Youngstown 5, Ohio.

JUST Take orders. We deliver. "Gadgets," 210 5th Ave., New York City.

MAKE Money the easy way. Be an agent. Get our giant 1947 Agent's Guide listing hundreds of large companies hunting agents. Free details. Roy Kramer, 329 Gates, Maryville, Tenn.

"SOLVEX" Cleans dirty hands without water. Exclusive territory. Solvex, Monticello, Iowa.

MANUFACTURER Would like to contact shoe, dry goods, and jewelry stores. Profitable proposition. P. O. Box 4967 Florence Branch, Los Angeles, Calif.

300% PROFIT Selling Miracle cleaning powder to homes, taverns, restaurants, garages, etc. Quick sales. Steady repeats. Henry, 2815 Hudson Blvd, Jersey City 6, N. J.

CHRISTMAS Cards — Earn big money selling personals, boxed assortments. Samples. Lincoln Press, X220 Hartwell, Fall River, Mass.

WINDOW Shades, new, side hemmed, sample 39c. Particulars free. Lin-Tex, Box 51, Greenville Sta., Jersey City 5, N. J.

BIG Money selling "Bobby-Jo" baby shoes. Everything furnished. Tested successful mail plan free. No-Co-Ro, Oakland, 6-M, Calif.

EARN Big money selling new line 1947 greeting and Christmas cards. Liberal bonus. Sample on approval. Forest W. Kimball, New London, N. H.

GET Free folio on 200 money making deals. Success plans. Rare formulas. Write Reynard, 108 Maple, Smithfield, Ohio.

SCHOOL Seniors! Your postal will bring our wonder, Kwick-Sell Cardalog of popular graduation name cards. Biggest profits! Only firm giving free souvenir chest and card case. Don't miss out! Hurry that postal! Craftcards, Box 235(L),

PROFITS And fast sales with famous Timex French Dry Wax Polish. A sensation! Different luster for all new and old cars, furniture, etc. Made by a long-established manufacturer. Good looking package that's a proven fast-seller with plenty of rapid repeat business. Quick and easy to apply. Gives hard, glass-like surface that lasts up to 6 months. Every car-owner, garage, service station, housewife, store-owner a live prospect. Good territories open on a money-making basis for aggressive representatives. Write for full details and quantity prices. Send \$1 for regular \$1.50 size. Money refunded on first order. Fully guaranteed. Timex Products Co., 5504-A Virginia, St. Louis, Mo.

THE Most irresistible gift ever created. Economy Distributing Co., 308A West Superior, Cleveland 13, Ohio.

NO Peddling. No capital. Home spare time work. Instructions 25c. Charles, 12-AT, Norwood, Ohio.

AGENTS. Sell finest food products direct to homes. Successfully sold for 25 years. Big profits. Powerful combination sale plans make sales easy. Permanent repeat business. Samples furnished. Live territories open to distributors. Mother Hubbard Products Co., 4139 Grand, Dept. P.M., Chicago.

DECALS—Name plates for imprinting, window letters, pinups, model plane, made to order. Industrial—good sideline. Poster Stamp Press, 4009 Ogden, Chicago 23, Ill.

DISTRIBUTORS. Fast selling item. 100% profit. Repeats. Details free. Morrison's, Box 9312-N, Station 8, Los Angeles 5, Calif.

DISTRIBUTORS. Unusual \$2.98 photograph product. Fine profits. Repeats. Morrison's, Box 9312-N, Station 8, Los Angeles 5, Calif.

NO Money or experience needed. Spare or full time. Steady income writing orders guaranteed men's hose. Variety 20 styles. We deliver and collect. Liberal advance profit. 33% cash bonus. Write today for complete free sales outfit. Kentcraft, Dept. SM, 44 Court St., Brooklyn 2, N. Y.

SCHOOL Seniors: Sell classmates superb Craftcards for super profits. Write Craftcards, Box 235(AK), Pittsburgh 30 Pennsylvania.

\$50 UP, Spare time. Magic money making opportunity. Sell beautiful personalized Xmas cards, 25 and 50 for \$1. Costs nothing to try. Samples free. Victory Studios, Mt. Vernon, N. Y.

ARE You an agent? Free \$1.00 sample. Burns Company, Johnstown, Pennsylvania.

EARN Steady income selling beautiful nylon hosiery. Amazing written guarantee gives free replacement if Kendex hose runs or snags within guarantee period! No money or experience needed. Full or part time. Write orders. We deliver and collect. Write today for complete free money-making sales outfit. Kendex Co., Dept. 105, Babylon, N. Y.

AGENTS-DISTRIBUTORS: \$28.00 daily possible. Flo-Glo Plastic wood-linoleum finishes. Acme, Box 404, Mount Vernon, N. Y. Puerto Rican Distributor, A. R. Torres & Associates, San Juan, Puerto Rico.

AMAZING New rust remover actually "foams" off rust. Works miracles for metal, fabric. 100% profit. Sales guaranteed. Free details. Arch Macdonald, Box 21, Winnetka, Illinois.

\$20 TO \$30 A day easy; sensational new raised letter nameplate, beautifully framed in mahogany; amazing seller to homes, stores, offices, etc. Get our tested plan. Write to Raised Letter Metal Company, Dept. 200, Fox Bldg., Philadelphia 3, Penna.

SMOKE Without fire. Sensational cigarette invention. Quick money. Safe-Gard, Perry-Payne Bldg., Cleveland 13, Ohio.

CHRISTMAS Cards: America's outstanding lines. Free literature tells all! Evers, Elmhurst, N. Y.

AGENTS—Sell nurses, beauticians, doctors and utility uniforms below store prices. 25% commission. Write Medi-Kote Co., Rockville Centre, N. Y.

HUNDREDS Direct selling, local, mail order money-making plans, ideas, etc., in big 32 page 8 1/2 x 11 magazine. Copy free! Opportunities Preferred, 33-P Vassar, Dorchester, Mass.

A NATURAL! Big money, selling new line one piece, lace plastic tablecloths! Sizes to 54x108. Also women's aprons; novel, embroidered cotton pillow cases. Free "interesting" details. Royalty, Box 748-K, Passaic, N. J.

WE Buy old type Singer sewing machines. Your profit up to \$25.00 on each. Write for literature. Essex Shop, 172

VETS. Students, teachers, men, women. Successfully different. Personally desired. \$5.00 business surprise. Write Dysart's Gift Service, 2352 Hawthorne Ave., Louisville 5, Ky.

BIG Commissions. Boost income quickly. Sell stores, restaurants, bars. Plastic tickets, shelf moulding, menu covers, signs. Write today. Pricing Press, 124 White St., Dept. P, New York 13, N. Y.

DISTRIBUTORS. Unusual \$2.98 photographic product. Levine's, 15-X, Boulevard Station, New York 59, N. Y.

BIG Profits! Plastic lace tablecovers. No laundering. Terrific demand. Free swatches. Star, 261 Fifth Ave., New York.

NEW. Extra money plan. Up to 100% profit showing friends unusual personal Christmas cards, box assortments, gift wrappings, humorous, all occasion, religious, social notes, personalized stationery. Extra bonus. Request free 50 for \$1.00, 25 for \$1.00, 25 for \$1.95 name imprinted Christmas cards and personalized stationery folder. Special offer. Thomas Terry Studios, 60 Union Avenue, Westfield, Mass.

100% PROFIT With new electric gas lighter, eliminates matches, pilot. Write Optical Research Products, Fairview, N. J.

SIGNS. Metallic letters for store windows, trucks, etc. Looks like gold leaf. 3 complete alphabets with numerals and catalog \$2.00. Globe, 61 W. Cordova, Vancouver, B. C., Canada.

AGENTS. Big profits, fast selling plastic aprons and accessories. Free details. Texcraft Co., Manchester, N. H.

300 MONEY Making deals. Ideas, formulas, plans, schemes. Folio free. Formico Service, Box 572, Dayton, Ohio.

MAKE Money taking orders for "C-E Automatic Water Heaters." Write Crane Electric, Eugene 4b, Oregon.

LARGE Variety fast selling items from \$1. Manufacturers, 264-5th Ave., New York.

MAGIC Cleaner and laundry soap deal. Hotter than a firecracker. Big profits. Sample free. Bestco, 5007 Irving Park, Chicago.

AMAZING Spare time earnings, sell name imprinted Christmas cards 50 for \$1.00. Leader box pays to 50c profit. 25 big moneymakers. Stationery. No money or experience needed. Approval samples. Empire Card, 155 Fox, Elmira, N. Y.

CHRISTMAS Card agents! New, exclusive, patented children's linenette books. Four books in attractive packet. Retail 50c. Sample on approval. Also cut-out valentine assortment. Elmcraft Card Co., 5928 South Western, Chicago 36, Illinois.

AMBITIOUS. Sell Xmas cards, stationery, big profits, colored catalog free. Beacon Hill Greetings, 115 Chauncey M, Boston, Mass.

FOOT-MASTER Tablets. Amazing seller to those afflicted with foot trouble. Proven seller 45 years. Good profit. Repeats fast. Write Master Products Co., 6 East Oak Avenue, Moorestown, New Jersey.

EXCELLENT Sideline for printing and advertising salesmen. Decalcomania name plates in small quantities. Great demand. Also, make money with our line of automobile initials and sign letters. Free samples. "Ralco" XL-Roxbury, Boston 19, Mass.

SELL Personal Initialed individualized belts, buckles, cap badges, tie holders, 2,000 emblems to choose. Fast profits. Repeats. Write today special outfit offer. Hookfast Specialties, Box 1425, PM, Providence, Rhode Island.

JUST Out! History of World War II. Huge volume. Popular price. Authentic text. Official photographs. Big profits. Riverside Book Company, Iowa Falls, Iowa.

BIG Bargains for big profits. Over 100 sensational values. Men's used suits \$2.00, pants 35c, topcoats \$1.25, overcoats \$2.00, shoes 20c. Experience unnecessary. Free wholesale catalog. Superior, 1250-B Jefferson, Chicago 7.

90c PROFIT Each \$1 sale. Sell positive mothproofing solution to housewives, stores, agents. Experience unnecessary. Postal brings details. Kinford, Wayne 3, Penna.

GREETING Card agents, "line up" with "Pines" for bigger, better, quicker profits. Rush name, address on postcard today. Box 32, Flushing 5, New York.

AGENTS: Stamping names on pocket-key protectors. Sample check with your name, address, 25c. Stamping outfits. Emblem checks, check-fobs, name plates. Hart Mfg. Co., 303 Decatur St., Brooklyn.

137 COMPLETE Plans for starting own business: local—mail order. Particulars free. Elite Co., 220 Grand St., New York 13.

AGENTS—300 % Profit selling genuine gold window letters; stores and offices. Free samples. Metallic Letter Co., 438-B North Clark, Chicago.

\$3 FIRE Extinguisher; quick sales, wholesale or direct; liberal profits. "Fire-Killer," 109 N. Franklin, Syracuse 1, N. Y.

PLATING Outfits for autoparts, reflectors. Connect to a battery. No tanks necessary. Free booklet and particulars. Gunmetal Co., Ave. N. Decatur, Ill.

GOLD Lacquered window sign letters. Large sizes penny each. New foils. Absolutely beautiful. Free samples. Atlas, 544 W. 79th, Chicago 20.

SELL Personalized soap. Name on every cake. Ideal for gifts. Get sample offer. Dunbar Soap, New Brunswick, N. J.

AGENCIES WANTED

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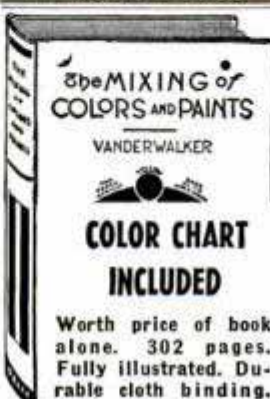
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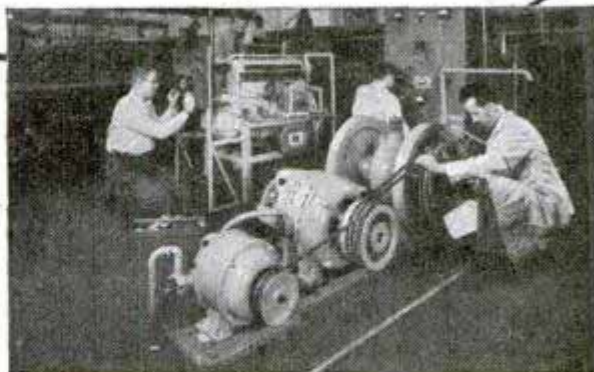
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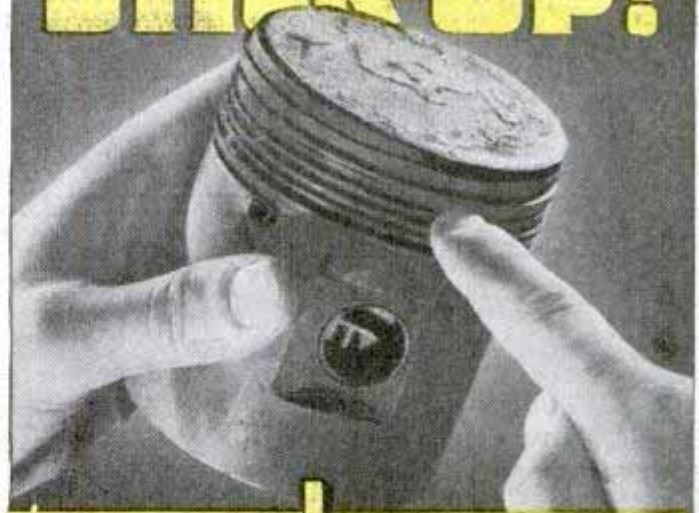
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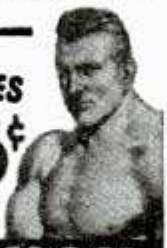
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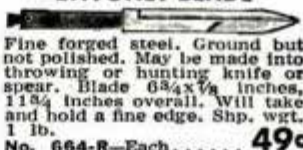
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Here is a buy! All rubber suit with parka. Fits over your regular clothes and shoes. Can be cut apart for waist high waders, hip high or knee high boots, also arm length rubber gloves. Heavy gum rubber over fabric. Fine for those who work in the water, commercial fishermen, sewer diggers, etc. Use it as is or cut it up for waders. All brand new! Wgt. 14 lbs. No. 183, Each... **\$4.95**

**7 LB. EXPERIMENTER
PARTS ASSORT. KIT**



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Extra heavy. For farm, home or jungle use. Blade of Govt. formula cutlery steel. Walnut riveted handle. 3 1/2 inch bit, 10 1/2 inch blade. You'll find hundreds of uses for a Bolo knife. Blade will take and hold a keen cutting edge. Wt. 2 lbs. A112-with Army Sheath..... **\$4.95**

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Ideal trouble shooter's flash light. Flexible neck lets you direct light around corners and inaccessible spots. Brand new! Plastic case with BX type neck. Uses 2 standard flash light batteries (less batteries). Shp. wgt. 2 lbs. No. 205-Each... **\$1.69**

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The leather coat buy of the year! Brand new Army Air Force Type A2 with full length zipper, shoulder straps, knitted waist band and wrists and full satin lining. Finest horsehide - finest tailoring. Order by chest size. Shp. wt. 5 lbs. No. 201-Each... **\$19.95**

MEDICAL STERILIZER



Consists of alcohol burner and sterilizing tray in hinged metal case 1 1/2 x 1 1/2 x 2 1/4 inches. Burner may be used separately. Bright nickel finish. All brand new. A125-Ea. **98c**

Officers Watch Compass



Brand new gov't. surplus. Army-Navy model. Single jewel mounted needle. Silver colored dial. A splendid value. Shp. wgt. 1 lb. A174-Each... **98c**

BERNARD WIRE PLIERS



Parallel acting jaws. Wire cutter at top. Brand new. Wgt. 2 lbs. No. 168. Each..... **\$1.29**

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Our coach forgot a rule!

"YOU GOTTA KNOW ALL THE RULES," I reminded our high school coach the other day, "if you expect your team to win."

"It's the same way with your car," I said, "from the way it looks and runs, you're playing a losing game."

When he asked what I meant, I told him, "You call me your Doctor of Motors and expect me to make sure that your car gives you trouble-free, economical transportation. If you make it a rule to come in regu-

larly, I can spot little troubles before they get big and costly."

Well, I fixed his car—ground the valves, replaced the gaskets, put in Perfect Circle Piston Rings to stop her oil pumping, tuned her up—and from the way he smiled you could tell he felt like he had another winner.

Then, he agreed that it was just plain common sense to bring his car in for regular checkups—that he would make it his No. 1 car rule and never forget it again.

NOTICE TO CAR OWNERS. Perfect Circles are available at any automotive repair shop. Your favorite mechanic—your Doctor of Motors—recommends them. Perfect Circle Corporation, Hagerstown, Indiana, U. S. A. The Perfect Circle Company, Ltd., Toronto, Ontario, Canada.

Your Doctor of Motors
restores power... saves gas
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POPULAR SEPTEMBER 1947 MECHANICS

WRITTEN SO YOU CAN UNDERSTAND IT
VOL. 88 NO. 3

So You've an Invention to Patent

By John L. Kent

SO YOU THINK you've invented something? Slaved every night and solved the big problem. It's all over now, you say. All you need is a patent and a financial backer to put it on the market.

Well, your troubles are just beginning. It's true that Uncle Sam has a Patent Office, but whether you'll get a patent is another matter. Since you're determined to market your baby, you're not going to stop now when you are so short of your goal. So sit down and look over the obstacles ahead.

First of all, the secrets about your brain child which you've managed to keep to only yourself and a few trusted friends will have to be told to a lot of strangers.

Although inventors are warned to be careful to whom they describe their invention, the patent office must know every detail. Obviously, they cannot tell if a device or method is patentable if you don't give them all the facts. And, it is the details that most often determine patentability. Therefore, you must come clean with Uncle Sam.

The patent office advises that you first seek the advice of a patent attorney. The Commissioner of Patents is not permitted to recommend any attorney, but will furnish a list of those attorneys who are authorized to practice before the Commissioner of Patents. Such attorneys are permitted to include in their advertisements the words "registered patent attorney."

Aviation's birth: Orville Wright clings to one of the world's first planes which overturned during a flight test. The Wright brothers introduced a new field for patents





Included in this composite painting of 19th century inventors are McCormick and Colt (third and fourth from left), Goodyear (seventh from left), Mott (ninth from left), Morse (seventh from right) and Howe (far right)



Copyright by Harris and Ewing

↑ In the public search room attorneys look for similar patents
 ↓ Attorneys can order copies of proceedings upon which previous patents were issued to determine validity of clients' claims

Copyright by Harris and Ewing



Seeking a patent is rather complicated and the expense of a lawyer usually is worth-while. If your invention is unpatentable, the attorney, after making a "preliminary search" will give you the reasons. If, on the other hand, he finds that there is a possibility of getting a patent on your invention, he will send you further papers and have the drawings made in the form required by the patent office.

All this can be done by mail, as patent attorneys gladly will send you the first "disclosure" or "record of invention" forms on which you can draw a sketch and write a description of the invention. Accurate English or exact dimensions are not important on this first form. The idea, however, must be put across. Tell what it is, for what use it is intended, how it works, and if an improvement, why it works better than previous products.

Based on this information, your attorney prepares the patent-office papers and final drawings, which are usually done by specialists who know just what details to include and what to omit. Although at one time the patent office required the submission of a model, this is no longer necessary. It's optional.

Your attorney will file a petition which will describe your in-

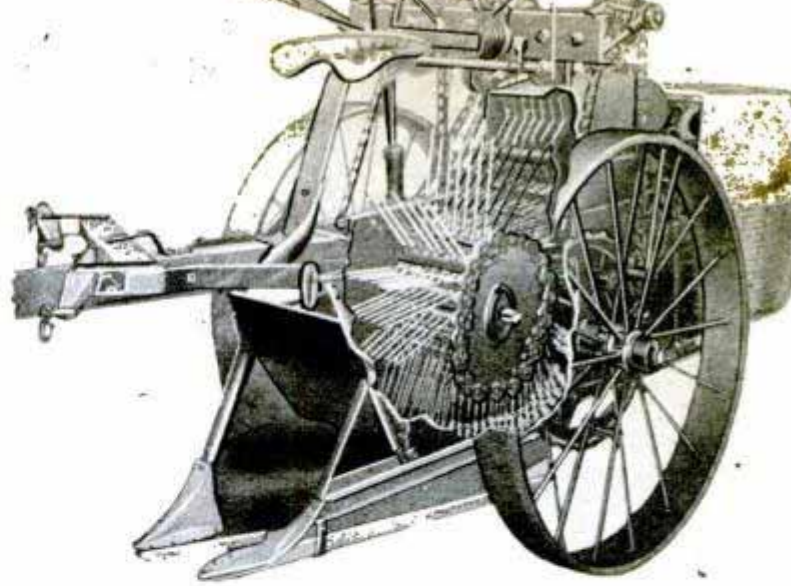
vention and list the claims you are making. When it is received at the patent office, it is assigned to a search examiner. All examiners are specialists in some art or science. Thus Jim Jones gets all patent applications for gasoline engines while Tom Brown searches only on patents for sewing-machine mechanisms and attachments. The search is carefully done—it may take the examiner as long as three days to look through all related fields to discover whether or not there is a similar invention already patented.

Each of your claims is investigated and you are permitted to amend your claim according to instructions from the examiner handling your application. You are permitted to resubmit your application until the examiner finds that your remaining claims are not covered by any prior invention and are therefore patentable. The final judgment may result in refusal to grant a patent, for it is possible that all of your claims have been previously patented by others.

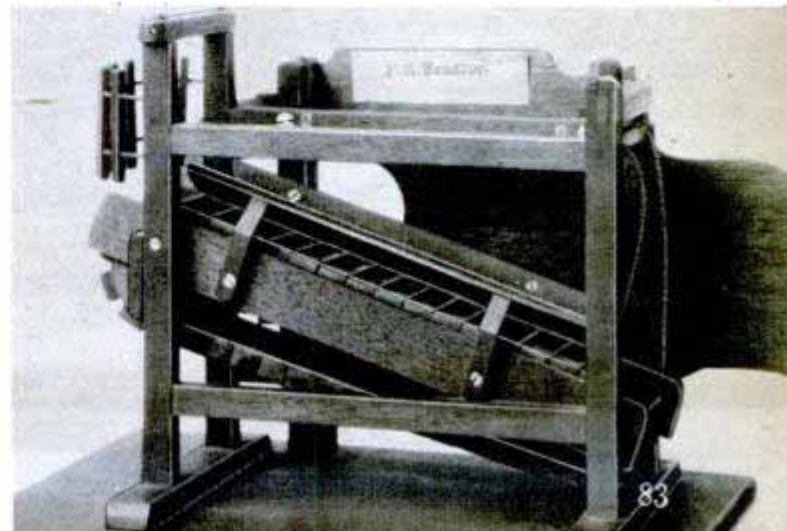
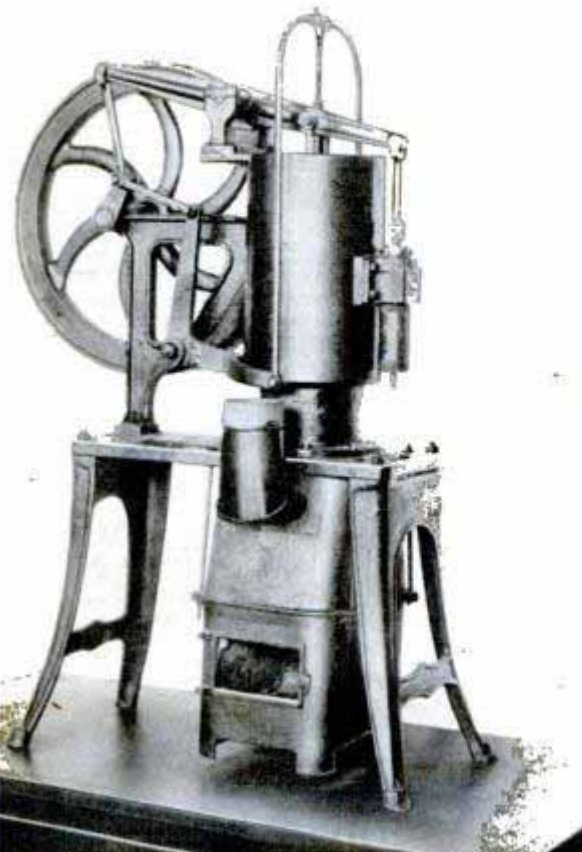
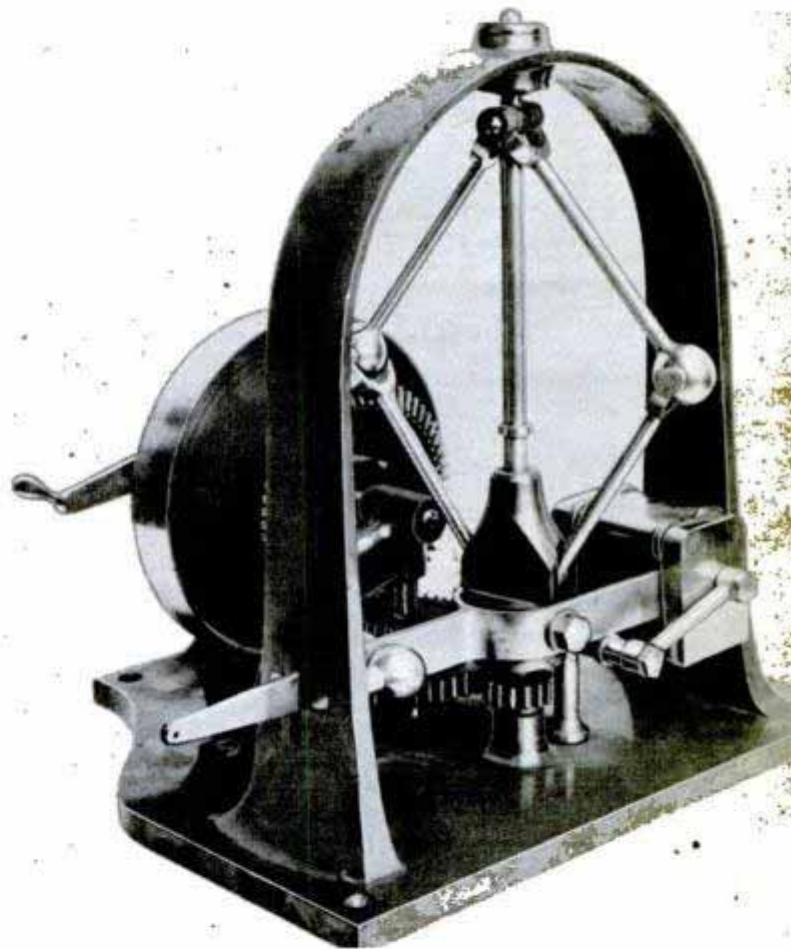
If you are issued a patent, you have the sole right to keep others from making, using or selling your invention for a period of 17 years.

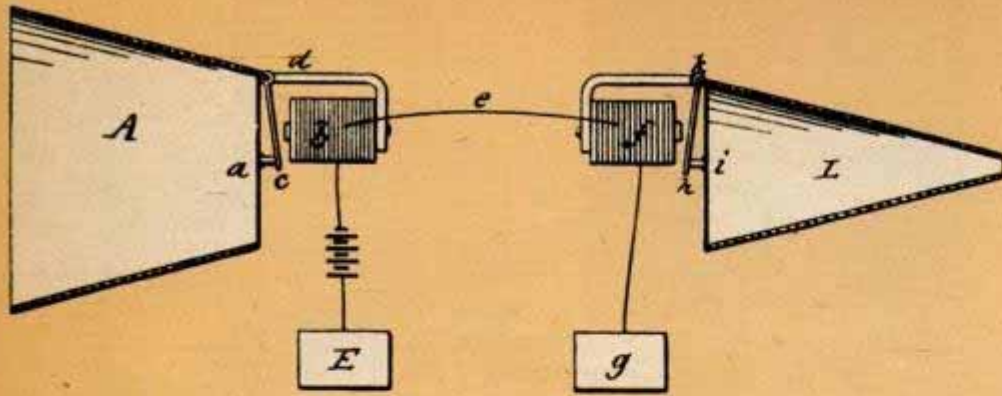
A patent may be granted for any new and useful art, machine, manufacture of article, or composition of matter—or for an improvement on these. The three elements considered in determining what is patentable are novelty, invention and utility. The

Below, John Ericsson developed this caloric engine, similar to early steam engines except that hot air actuated the large piston. Below right, "one dog-power engine"—a canine-operated treadmill—is one of the many patented inventions using animal power

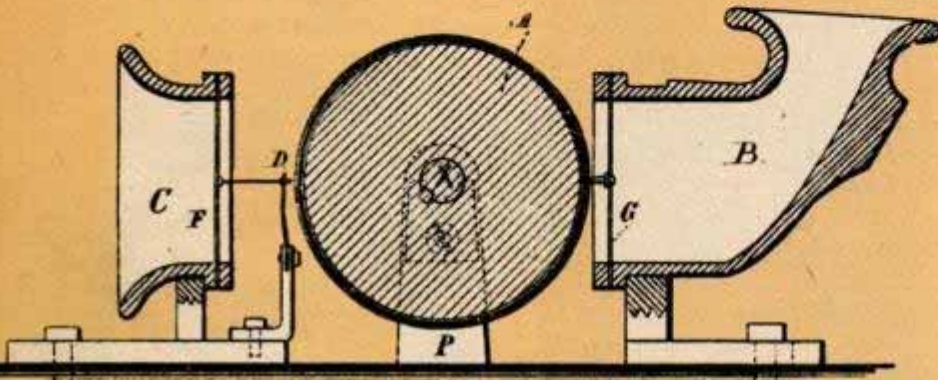


↑ Early model cotton picker, invented about 1910, failed to make the grade. Below, brass working model of a governor for steam engines was submitted in 1858



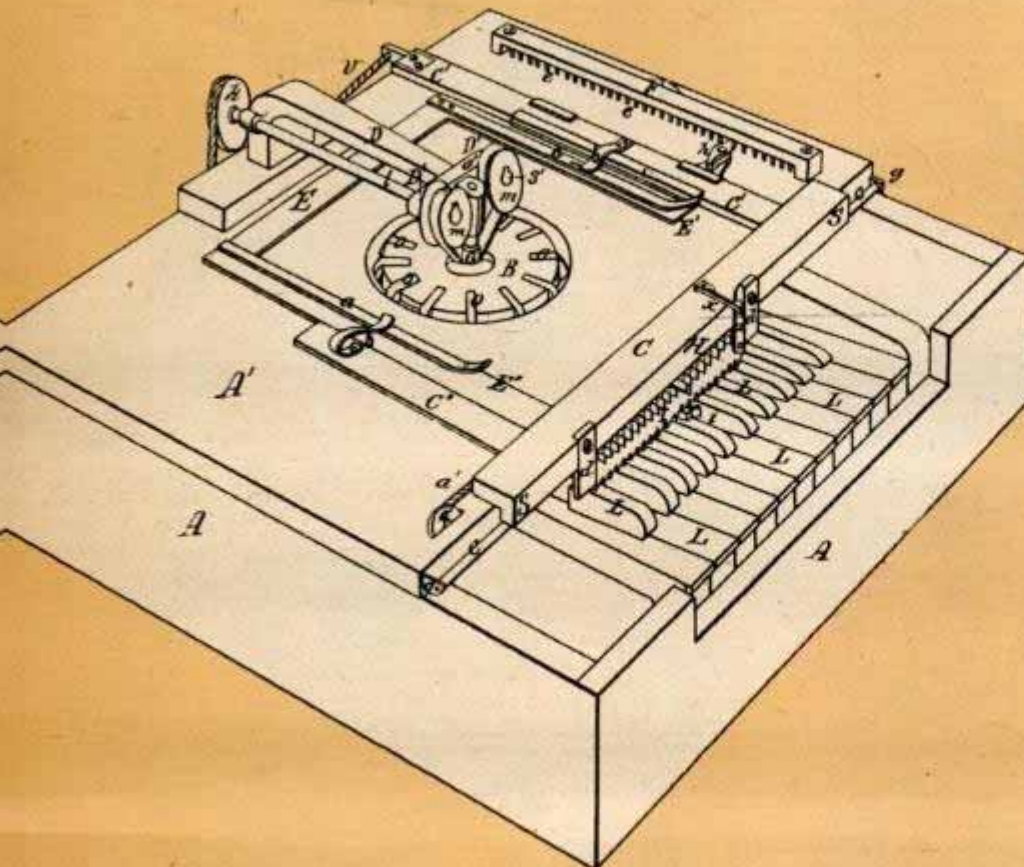


Telephone, as sketched in Bell's patent application, has cone (A) which funnels sounds against membrane (a), causing variations in electromagnet (b). Similar sounds then come through earpiece (L)



First juke box: Edison, in his patent application for this phonograph, said its purpose was to "record and reproduce the voice"

↓ Sholes-Glidden-Soule typewriter, patented in 1868, was taken over by Remington, arms manufacturer, and produced in quantity



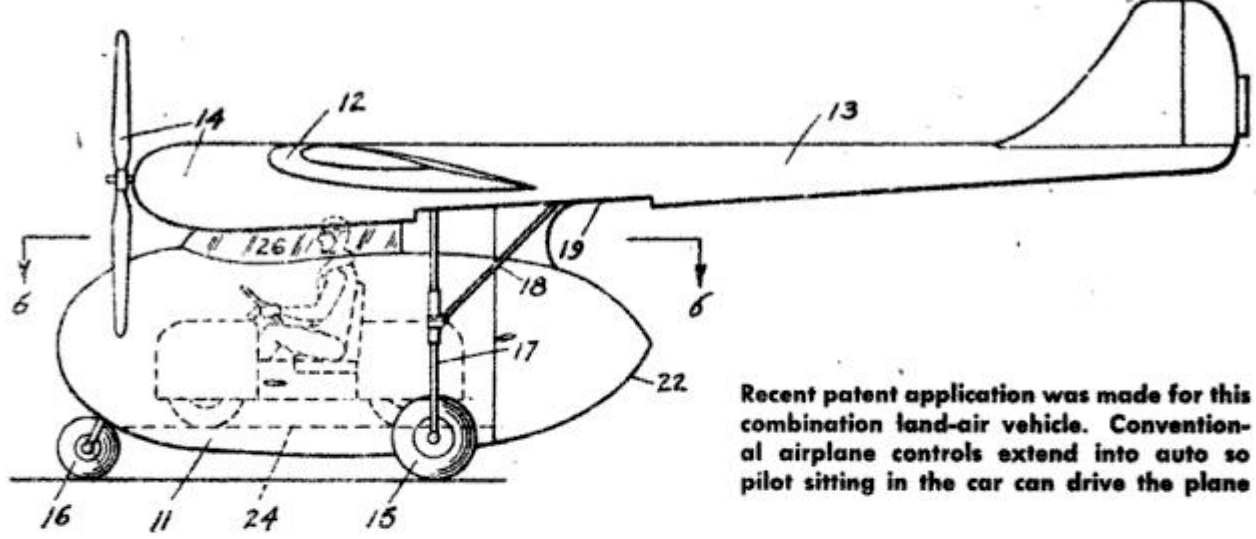
invention must be new, must be a product of inventive ingenuity and discovery and must be capable of being advantageously used for the purpose for which it is created.

No patent will be granted on a useless device, printed matter, a method of doing business, an improvement of a device which is the result of mere mechanical skill, or a machine which will not operate. A mere idea or suggestion is not patentable. The patent office does not recognize that there is such a physical manifestation as perpetual motion.

An inventor often has doubts about his brain child. He wants an opinion and advice from someone other than his friends. If your invention has a military application, contact the National Inventors Council of the Department of Commerce in Washington. Members of the council are 16 outstanding scientists, engineers and industrialists, headed by Dr. Charles F. Kettering, retired research director of General Motors. During the war the council reviewed more than 200,000 inventions and ideas. Those believed to have merit were referred to the Army and Navy.

Veterans of World War II and inventors in general have been asked to continue sending in ideas for new or improved military equipment and devices. Dr. Kettering recently said that many of the best ideas coming to the council are from returning veterans.

Thomas Spooner, head of the Engineering Laboratories of Westinghouse Electric Corporation, made a study of



Recent patent application was made for this combination land-air vehicle. Conventional airplane controls extend into auto so pilot sitting in the car can drive the plane

150 scientists' inventive output over a 20-year period and found that although sudden flashes of inventive genius occur among young scientists, most of their contributions were made after they were past 30. Patents on inventions, he declared, take a sudden spurt upward as research men reach the 40-year mark. More than half of 100 outstanding inventions made by Americans were contributed by men past 36, while 35 percent of the total were made by inventors who had passed their 40th birthday.

Since a patent is granted for 17 years only, thousands of patents expire every week. These are available for use by any American citizen. The patent office does not publish a list of expired patents, but a private firm in New York issues a weekly publication which lists them. You may send the numbers of any of these expired patents to the Commissioner of Patents

and obtain copies of the patents themselves.

The early legislators who fixed the term of patent at 17 years wanted to encourage invention by giving the inventor a financial stimulus—the sole control of his invention—but still did not wish to create a monopoly. Eventually all patents are for the public good.

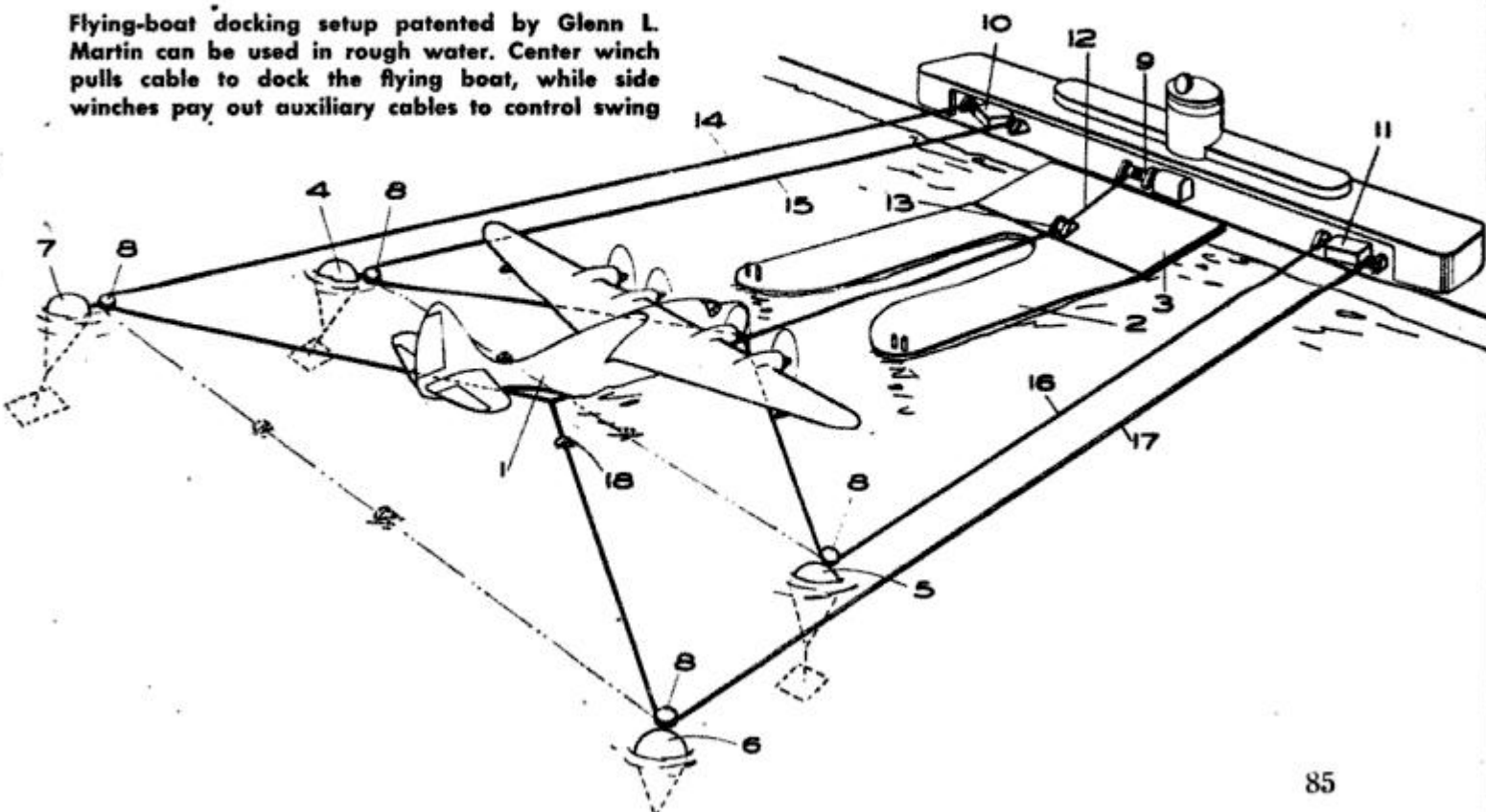
When the Constitution was being debated, a clause to establish a national university was proposed. That clause was dropped in favor of one calling for the promotion of the progress of science and useful arts "by securing to authors and inventors their respective writings and discoveries," on the ground that such an action would benefit more people than would a national university. Our patent system is based on the interpretation of this constitutional provision.

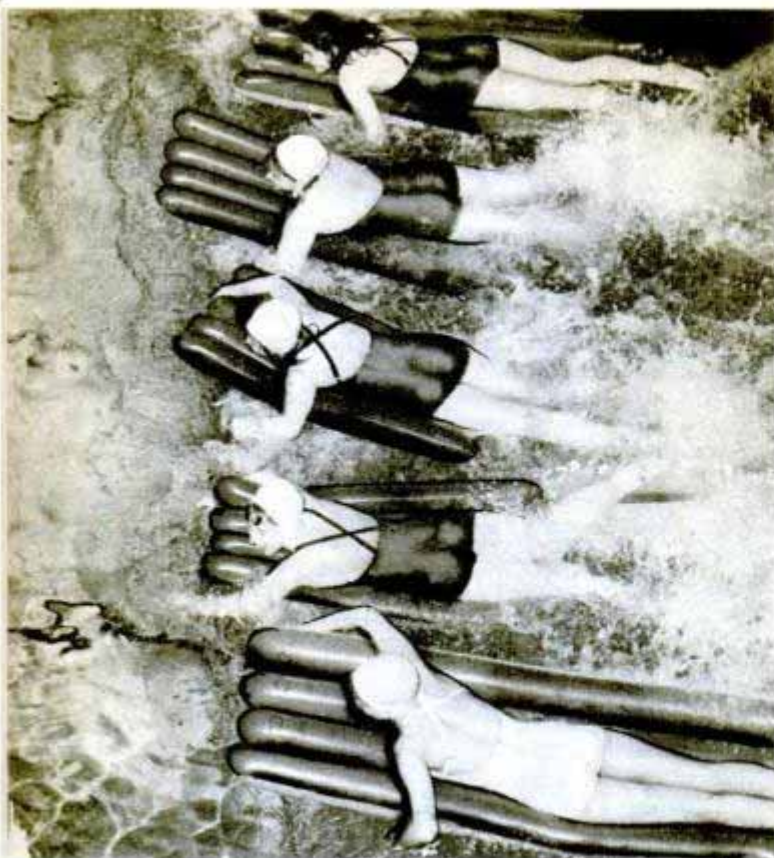
The wealth of inventions bears witness to

(Continued to page 248)

*PUBLIC DOMAIN SCIENTIFIC PUBLISHING CO.
 411 2nd St. N.Y. Out of Business
 New York, N.Y.*

Flying-boat docking setup patented by Glenn L. Martin can be used in rough water. Center winch pulls cable to dock the flying boat, while side winches pay out auxiliary cables to control swing





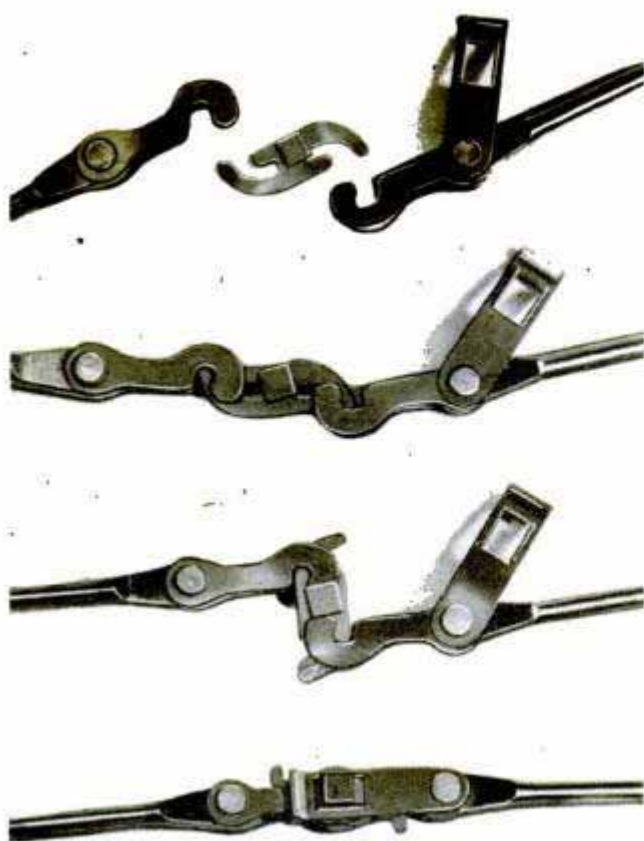
Plastic Surf Sled

Both "belly floppers" and floaters can use a plastic surf sled, two feet wide in sizes four or six feet long. It will support a 200-pound person. The sleds were first put through a practical six-month test by children 6 to 16 years old at a Chicago laboratory school.



Cables Guide Trailer Dolly

Trailers equipped with a combination dolly and jack can be backed into position easily because a cable and pulley system automatically turns the dolly wheels whenever the car is turned. The dolly's guide system permits one man to turn the trailer completely around by hand. No separate jack is needed to level the trailer, as a jack is included as part of the dolly. The two wheels are equipped with airplane-type tires. Two tanks for holding butane fuel can be mounted on the dolly frame for trailers that have stoves. The dolly can be used on almost any size or type of trailer.

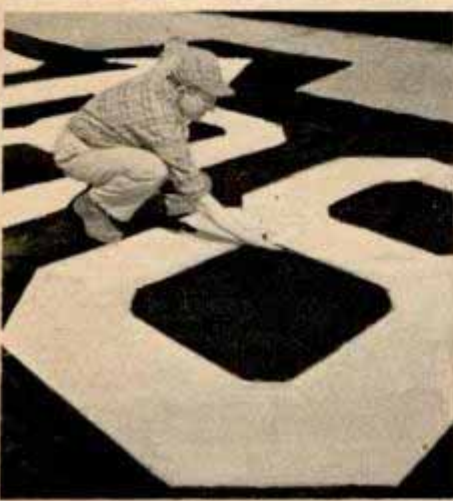


Hook System Eliminates Turnbuckles

Designed primarily for use in aircraft in arctic operations, a hook system provides a quick method for connecting or disconnecting cables under tension. Unscrewing and reassembling a turnbuckle is unnecessary and there is no need to test the tension of the cable every time the parts are re-engaged, as the hook system always returns the cable to the same tension. To disconnect the members, a safety spring is disengaged from a nut and swung aside. The nut is then rotated with a wrench, disconnecting the hooks to free the cable. The procedure is reversed in reassembling the cable. The hooks are available in various sizes, cadmium or chrome plated.

Electric Lock for Auto Gasoline Tanks

Gasoline thieves are thwarted by an electrically operated lock for the metal flap in an automobile fender which provides access to the gas tank. To open the flap, a push button inside the car is pressed. The lock is not connected to the car's gasoline filler pipe.



Porcelain Enameled Airway Marker

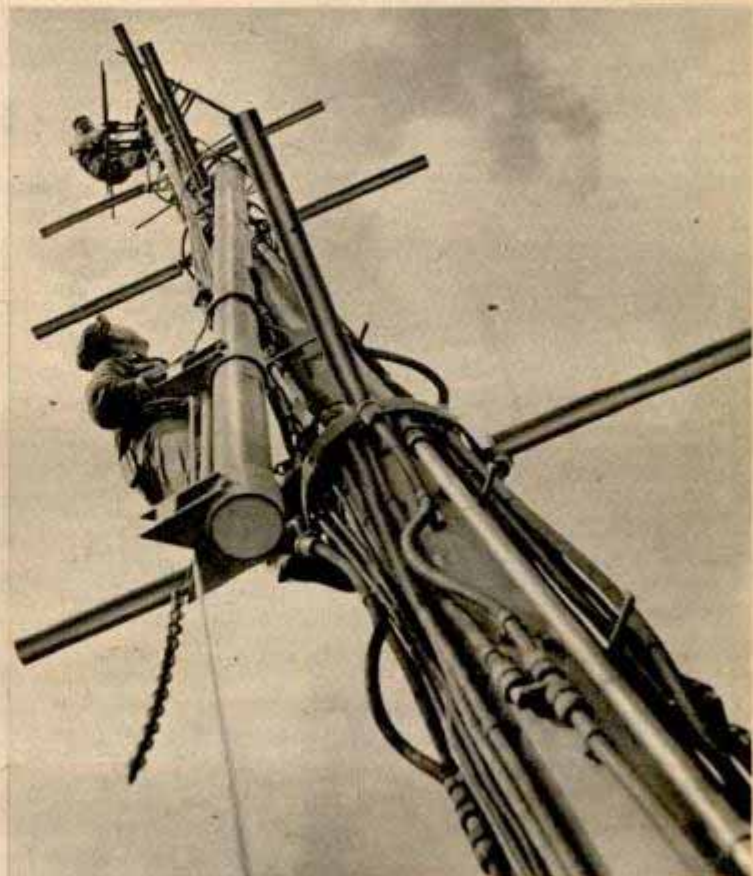
Porcelain enameled airway markers can be fastened to either flat or curved roofs without puncturing the surface or requiring framework. Identifying legends are formed from combinations of 10 differently shaped basic units. The letters, some of which are 15 feet high, are set in a bed of felt, mopped down with pitch or asphalt and coated with asbestos fiber asphalt plastic cement and portland cement. The glass-like coating increases legibility at a distance.

General Electric photo

Skyscraper Lightning Gauge

Lightning striking a million times faster than sound is recorded by a new device atop the Empire State Building, world's tallest skyscraper. It supplements cameras and oscillographs used in studies from 1935 until war forced their discontinuance in 1941. These studies have provided detailed knowledge of the frequency of lightning strokes, its wave shapes, currents and amplitudes. Much of the information is used to improve production of natural lightning in the laboratory. One common belief disproved by earlier studies conducted by General Electric was that lightning never strikes an object twice—bolts hitting the building 42 times in one year.

☐ Although Boeing's Stratocruiser is much larger than the B-29, its wing is 650 pounds lighter due to a new high-strength alloy.





THESE DOGS COUNT SHEEP!

Dewey Jontz' piercing whistle drops Tess instantly no matter what she's doing. He uses spoken commands, too, in ordering his canine "hired hand" to help with the chores



During field test the dog must drive a flock of sheep through three "hurdles." Above, Tess guides them quietly through the narrow opening. Here Jontz signals her around to the left to pick them up after a successful "drive"



TESS IS ONE of Dewey Jontz' Border Collies, a breed with a mission in life. These dogs from the hills of southern Scotland are hard-working farm hands that tend sheep, cattle and poultry.

With a spoken command or a flick of his hand Jontz can send Tess in a great circle, sweeping up a scattered flock of sheep. She'll hold them together or guide them straight through the gate to Jontz. She'll separate one sheep from the rest of the flock and bring it to him.

At the end of a day of hard work there's still the evening chores, and she'll start by driving poultry into the hen house. And regardless of where she is, Jontz' whistle will drop her motionless to the ground.

Sheep men regard Border Collies as the finest working dogs in the world and their ability to handle livestock makes them as valuable as good hired men.

Jontz pays about \$500 to import a prize dog such as Tess, breeds it on his farm near Altoona, Iowa, and sells the pups. After nine years of breeding he has developed a substantial business, as the pups bring about \$50 apiece at weaning time and there are an average of six to a litter, with three litters every two years.

But Jontz has difficulty in buying excellent dogs as the Scottish hill shepherds would rather part with their flocks than sell their favorite Border Collies. A shepherd once turned down an offer of \$1600 for a single pup. And 39-year-old Jontz declares that "\$1000 wouldn't even buy the hairs on Tess' tail."

For centuries the Scottish shepherds have been breeding dogs for only one quality—"workability." The result is a highly specialized dog that instinctively loves commands and is eager to obey.

Most of the dogs you see streaking in great circles around livestock on the nation's farms aren't Border Collies. The breed is comparatively new to this country—the first dogs made their appearance here with shipments of livestock imported from Scotland about 1900. But it's impossible to supply the demand for good Border Collie pups today and likely you'll see a lot of the dogs within 10 years.

The first field trials to test workability were held in this country in the 1920s, although similar trials have been conducted in Scotland for almost a century.

Jontz' dogs—the ones he retains for breeding and trains himself—have won

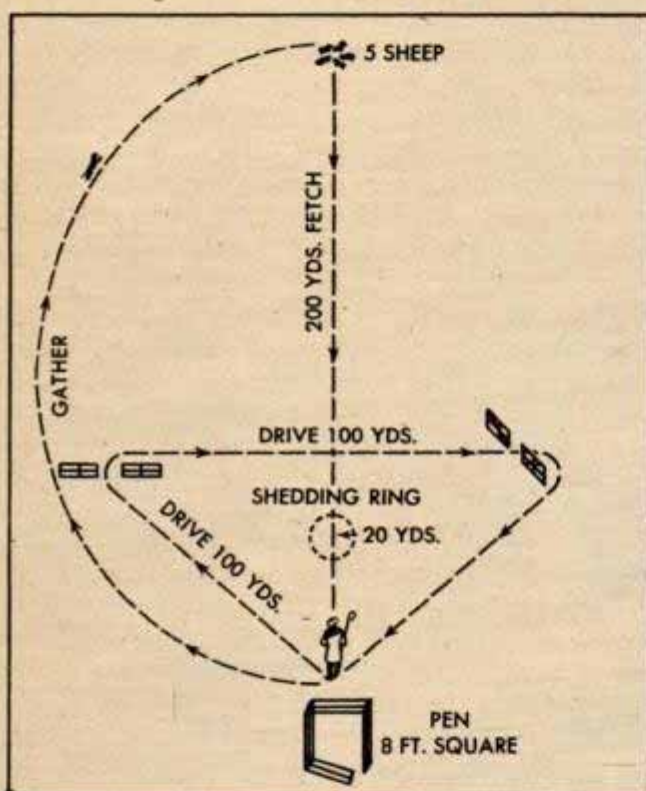
Jittery sheep sometimes turn in the wrong direction. Here the dog dashes through a hurdle to head them off



SHEDDING



To separate one sheep from the flock, the dog approaches cautiously, then darts through a narrow opening



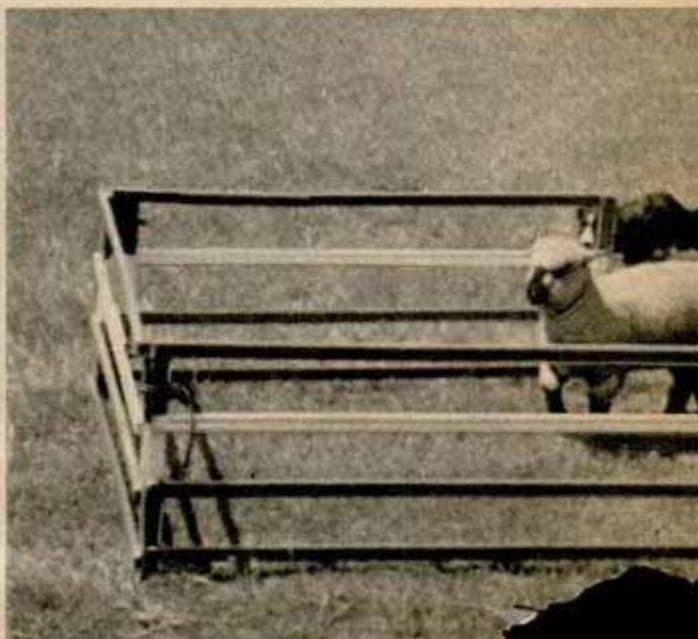
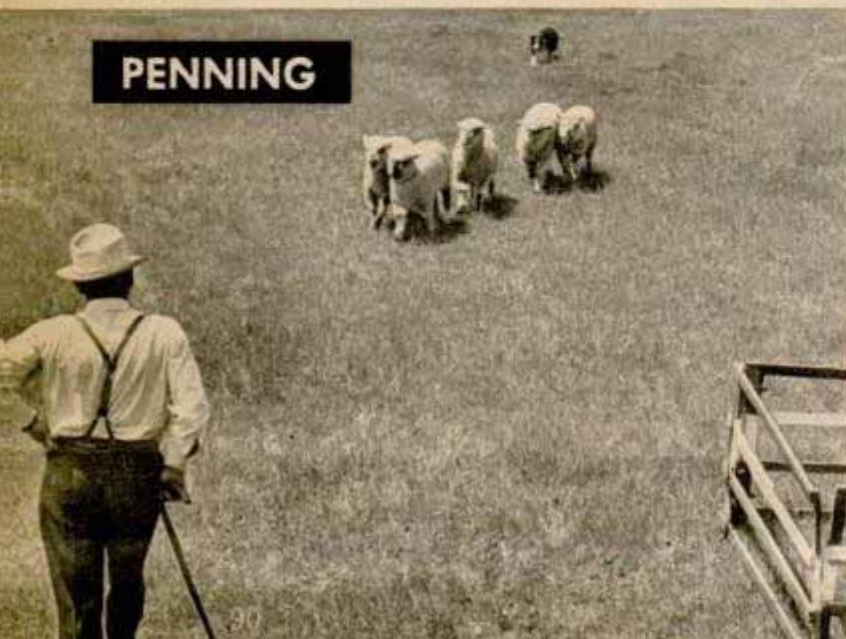
several national field trials including those at Ohio and Rhode Island. His dog Wull won first place in the Virginia trials of 1944 and in 1946 Jontz took second place despite the fact that he was on crutches as a result of an auto accident and had very little opportunity to work with the dogs before the trials.

The feats that the dogs must perform to win a field trial are remarkable, although they are not designed as a set of tricks but as a test of the dog's ability to handle livestock in routine farm work. Jontz runs his dogs through the "qualification course" in his frequent demonstrations before farm groups, fairs and livestock shows.

During such a demonstration Jontz remains in one spot while the dog handles the sheep alone. Upon a signal, five sheep are released 200 yards in front of the man. Jontz then sends his dog in the "outrun" and the dog streaks off in a great semicircle that will bring him up behind the sheep for the "lift." As the dog approaches the

↑ To pass the field trial a dog must cover this course, including shedding and penning, within 15 minutes.
↓ Border Collie guides the flock in a straight fetch to his master—the first step in the penning test

PENNING





Dog's sudden charge frightens the single sheep away from the flock. The stray is then brought to the "shepherd"

flock, Jontz starts using whistle signals and spoken commands. One sharp whistle means "stop" and the dog immediately drops to the ground. "Come by" means to circle to the right, and "Come away" means to move to the left.

As Jontz says, "Even at 200 yards you can guide the dog as though he had a steering wheel."

In fetching the sheep, the dog first moves in narrowing semicircles to bunch them. He then drives them straight toward Jontz. One hundred yards in front of the man are two 12-foot sections of fence with a narrow space between them representing a gate. The dog must drive all five sheep straight through the gate as part of his "gather."

After negotiating the gate he drives them to Jontz' feet, then guides them 100 yards to the left through another "gate," 100 yards to the right through still another, and then back to Jontz.

After returning the sheep the dog must keep them within a ring 20 yards in di-

ameter while he "sheds" one or two from the remainder of the flock. This is one of the most difficult tests. Jontz watches carefully until a slight opening appears between one of the sheep and the others. Upon his sudden command the dog dashes through the opening and the sheep is frightened away from the rest of the flock. The dog then "wears" this sheep—drives it back and forth until the judges are satisfied he has it under control.

Final requirement is the penning test. The dog reassembles all the sheep and must drive them into a pen only eight feet square, holding them there until Jontz locks the gate.

To pass the trial the dog must complete the entire course including fetching, driving and penning in 15 minutes.

This is only the qualification course and the championship course, used in Scotland, is much more difficult, involving an outrun of 800 yards to gather in two separate groups of 10 sheep which neither the dog

Below, the "shepherd" holds open the gate of the eight-foot-square pen but may not touch the sheep. Right, all sheep must clear the gate before the Border Collie can pull out after successfully penning the flock





↑ Sweeping gesture of the left hand and the words "Come away" start Risp on a wide sweep to the left
 ← Pointing right arm is signal for outrun to right

nor his master can see at the beginning of the trial. The dog also must shed only marked sheep from the rest of the flock.

Such a test requires remarkable canine intelligence and Border Collies have been the only breed able to pass even the qualification course for a number of years. The dogs learn quickly—one of Jontz' dogs won a trial when it was only 7½ months old.

Jontz likes to tell a story about Shep as an example of the reasoning power of Border Collies. One day Jontz was walking across a farm when Shep grabbed a woodchuck by the scruff of the neck. Jontz waited to see what the dog would do with his prey. Shep trotted to a nearby stream with the animal and attempted to drown it by dunking its head under water. But every time the animal went under, so did Shep's nose. Finally Shep trotted back to the bank, placed the animal on the ground between his paws, and surveyed first the water, then his prey. Suddenly he jumped to his feet and grabbed the animal by the tail. This time he dunked the woodchuck without even getting his nose wet.

Although Jontz directs the dogs by command during field trials and demonstrations, the dogs easily can be trained to do farm chores without help. For example, they can drive hundreds of sheep to particular pasture in the morning, fetch them at night, handle the cattle and drive poultry

into a hen house. In one remarkable demonstration Jontz' dog, Risp, stalks chickens, quietly driving them through an opening a foot square.

Border Collies have an instinct to herd livestock and often untrained pups, released in front of a scattered flock, will start to round them up.

Not only can they handle livestock but they protect them as well. Jontz recently received a letter from the owner of one of the pups he sold without training. Topsy had learned to stay a half day in the pasture with the sheep. One day she came streaking toward the house, barking at the farmer's son. The boy ran to the barn, grabbed his rifle, mounted a horse and followed Topsy. He arrived at the pasture just as a wolf was moving in on the flock. The boy's shot missed but the wolf never showed up again.

Another dog, Ring, which Jontz sold to a farmer, was installed in a stable beside the owner's prize horse. One night the farmer was awakened by Ring barking beneath his window. When he went to the stable he found the horse extremely sick. Only a quick visit by the veterinary saved the animal.

Although Border Collies are essentially working dogs, they make fine pets and are especially gentle with children. Wull, one of Jontz' former pups, is the "best outfielder the neighborhood baseball team ever had." Another owner reported that his dog watched the youngsters play football for several hours and then joined the game. To this day, he says, the dog will pick up the football by the laces, run with it a little way, place it on the ground, back



Border Collies, when raised from pups, make fine pets and are exceptionally gentle with children

Canine "fence" suddenly appears around a small flock and the sheep remain motionless. The dogs can be trained to work as a team around the farm. ↓ Three prize dogs roundup the sheep and start them up a loading chute

off, and then kick it with his paw!

Ross, a Border Collie that Jontz imported from Scotland and then sold, was given a role in the movie "Bob, Son of Battle." His dramatic ability was quickly recognized and he's had parts in several movies since.

Jontz prefers to sell untrained pups, as Border Collies are easy to teach and will do better work when trained by their lifetime master from the start. However, he has trained his own dogs and often gives training advice to farmers who buy his pups.

Fifteen minutes a day usually is sufficient time to train the dog, especially in the first stages. Jontz puts a collar on the pup, calls him by name from the start and feeds the dog himself in order to gain his confidence. With a leash on the collar he teaches the pup to lead and heel, merely by giving the command and controlling the pup with the leash. By the same method the pup is taught to stop.

When the pup is six or eight months old, Jontz exposes him to a small flock of quiet sheep. With broad arm motions, the trainer indicates that he wants the pup to circle the sheep. After practice, the dog will learn to circle the flock on either side.

In all phases of training the "stop" com-



mand is most important. With it the trainer can immediately stop a dog when he makes a mistake. The average Border Collie can be a well-trained dog in one year and a completely finished worker in two.

With the shortage of farm help in this country, Jontz feels that dogs can do a man's share of the work on the nation's 3,000,000 livestock farms.

"After all, show me a man who can roundup and bring in 100 sheep from a large pasture in 15 minutes." With a flick of his hand Jontz sends three dogs after his sheep and a moment later the flock is motionless in the middle of a canine triangle. "Best hired hands a farmer ever had."



GIANT PLOW

When Monroe Terrell of White Horse, Colo., purchased five sections of farm land he figured he'd need big implements to cultivate it so he built a disk plow 60 feet long. The plow is made of five 12-foot sections fastened to a frame hinged in the middle to

permit efficient operation over uneven surfaces. Three bomber tires support the forward frame, which is of X-type construction, and other parts from a bomber's landing gear were used in building the plow's carriage. With his 85-horsepower tractor pulling the 22,000-pound giant, Terrell can plow 170 acres in 10 hours.

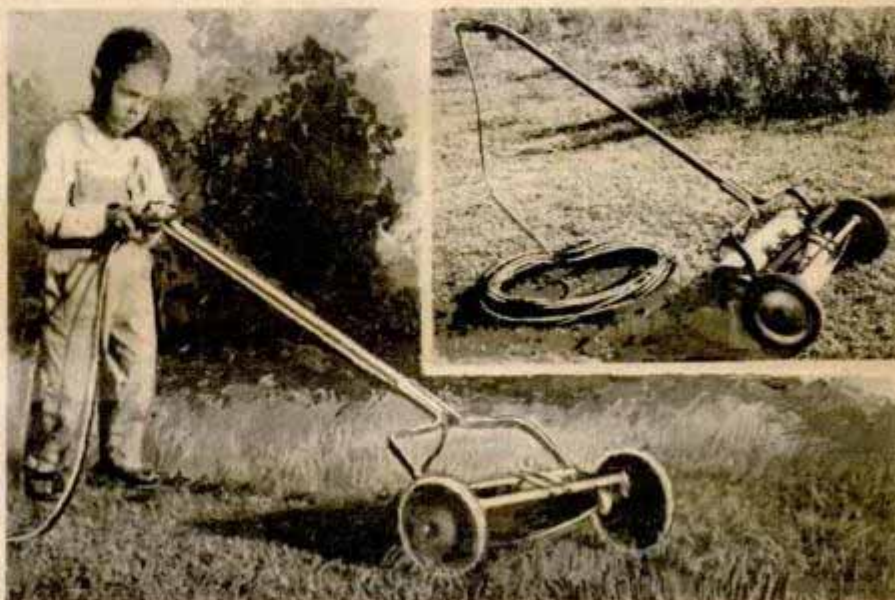


Cessna Business Plane

One of the biggest 4-5-place business planes is Cessna's Model 195, which cruises over 165 miles an hour and has a range of more than 700 miles. It is over a mile-a-minute faster than its predecessor. The luggage compartment holds 200 pounds and is accessible from the rear seat. With a gross load of 3350 pounds, the plane climbs 1200 feet a minute and operates at a service ceiling of 18,300 feet. It has a fixed landing gear made of spring steel.

Electric Mower

Only one hand is needed to steer and operate a lightweight electric lawn mower. This leaves the other hand free to adjust the 75 feet of extension cord while mowing. The mower is built low for clearance in cutting under shrubs and the depth of cut can be changed by turning one thumbscrew. The two front wheels have rubber tires and the two smaller rear wheels are of metal to assure grounding the machine.

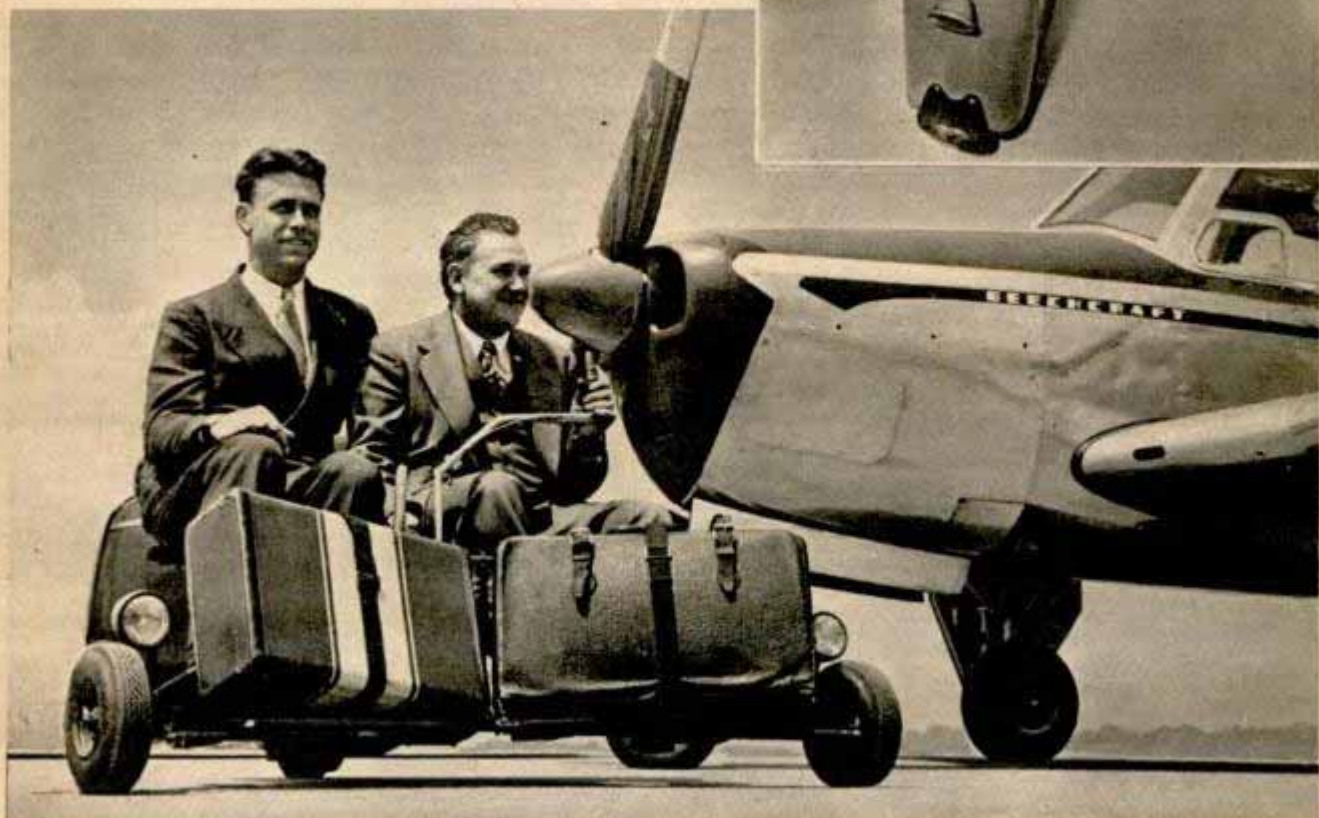


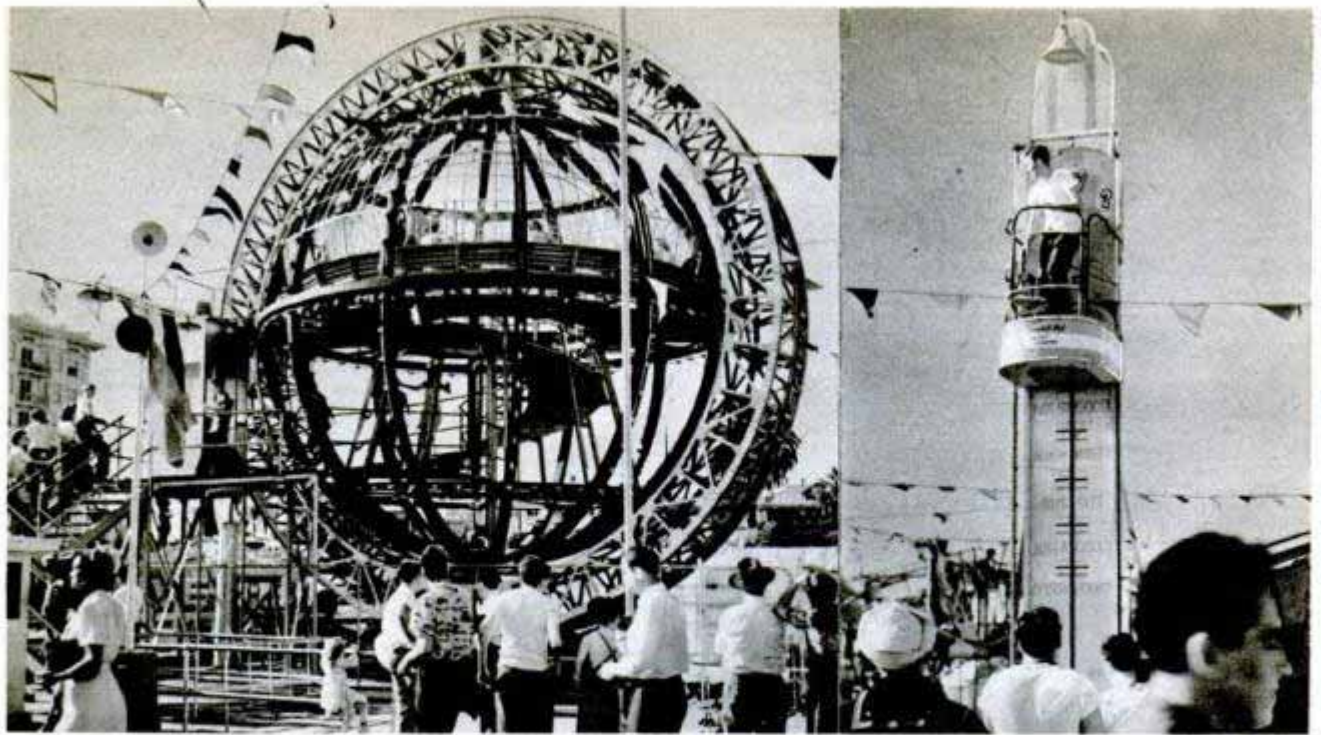
Fold-Up Auto

Right, midget motorcar, designed as transportation for private plane owners from airports, collapses into suitcase-size parcel. Below, seats, wheels and luggage rack unfold



Right, the one-cylinder motor can move the loaded vehicle at a top speed of 25 miles per hour. Below, a few seconds after landing at an airport the owner and his passenger roll off the runway toward home. The midget auto weighs only 72 pounds and is 37 inches long. Built of lightweight tubing, the car will average 60 miles on a gallon of gas, although the tank holds only $\frac{3}{10}$ gallon and can be filled for six cents. The auto supports a 450-pound "pay load"





Whirling Globe and "Bootstrap Lift" Provide Thrills

Two unusual "rides" in a southern California amusement park are giving boardwalk strollers a thrill. One is a giant 50-foot globe, built at a cost of \$30,000, that operates like a gyroscope. Heavy steel girders form the framework. Patrons walk up a spiral ramp and are strapped to 75 seats installed at the "equator." When the globe is revolving at maximum speed, it begins to tilt right and left, producing an illusion of still greater speed and the sensation of falling. The other machine is a test

of athletic prowess in which the customer "lifts himself by his bootstraps." A small circular platform is fitted to a track on a 20-foot backboard. Two handles protrude through the floor of the platform. To test his strength the customer stands on the platform and pulls up on the handles. The harder he pulls the higher the platform rises on the backboard, working on the principle of a hydraulic lift. When the operator can lift himself no higher, the platform descends to street level.

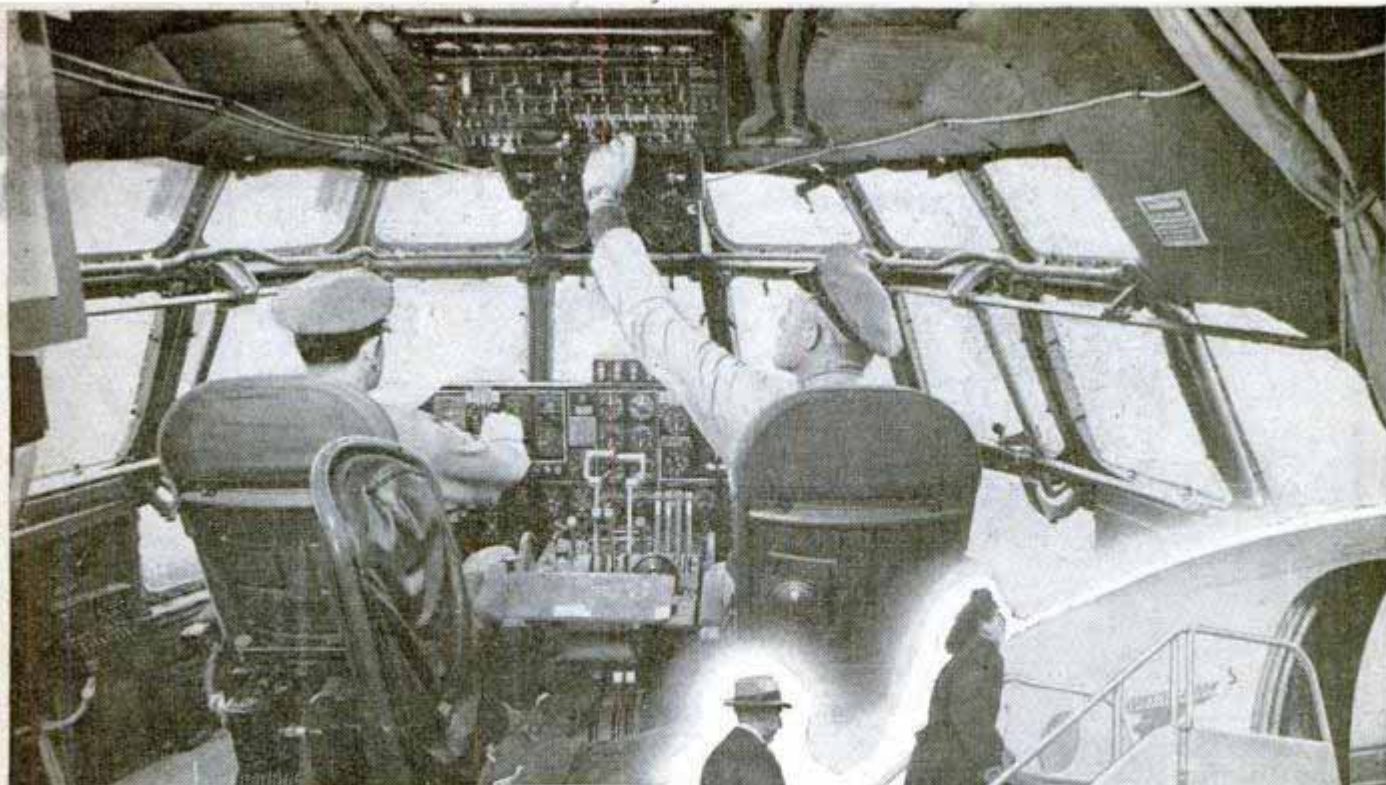
"Broadcasting Station" for Medical Treatments

Heat treatments are "broadcast" to medical patients by a portable diathermy machine that radiates microwaves of energy. Equipment emitting short waves at 27,000 kilocycles per second has been used in the past, but the new machine steps up

the frequency into microwaves at 2,450,000 kilocycles per second. The super-high-frequency radiation is quickly absorbed in the body to produce a penetrating heat. Because of the short wave lengths the energy can be directed at any part of the patient's body like a beam of light, eliminating electrodes that formerly had to be strapped to the patient and permitting the doctor to view the area being treated. The diathermy equipment, complete with a director, weighs 35 pounds and can be plugged into any 115-volt 60-cycle a.c. outlet. The Federal Communications Commission has assigned a radio band for medical applications.



Alaska is the "air travelingest" area in the world, with 69 percent of the population as passengers during a year, compared with 10 percent in the United States.



Boeing Aircraft photo

Your captain-pilot has plenty of room for his work. More spacious cockpits, like the Stratocruiser's, greatly aid safety and efficiency



FLIGHT PLAN FOR LONDON

ICEAN FLYING seems disarmingly simple, but probably nothing you've ever done was more painstakingly planned. It is a far cry from 20 years ago—when such a trip was a wild, blind adventure, warranting a ticker-tape reception.

Behind the soft, steady hum of the engines now is a story of countless hours of preparation, accomplished to make your lap on the world's 300,000 miles of air network a safe and speedy one. Knowing what happens behind the scenes will help you understand why crossing an ocean by air is almost

as safe as an auto ride to the corner grocery. Several of the 62 international airlines, for example, have gone from 6 to 17 years without a fatality. With better equipment and more experience, everything points to even greater safety in 1948.

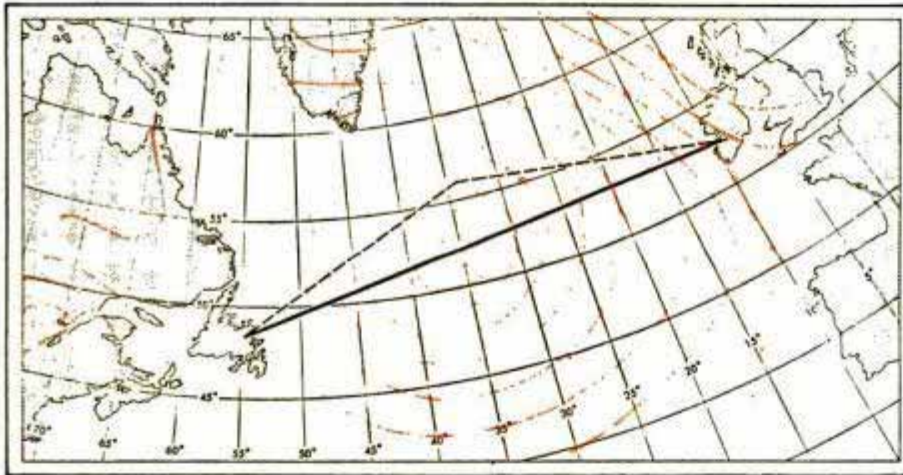
Let's see what makes the operation tick so accurately. For our close-up examination we'll take a typical run of American Overseas Airlines between New York and London. That's not too long, in this age of flight, just over 3000 miles in half a day!

Your first concern is likely to be the kind of

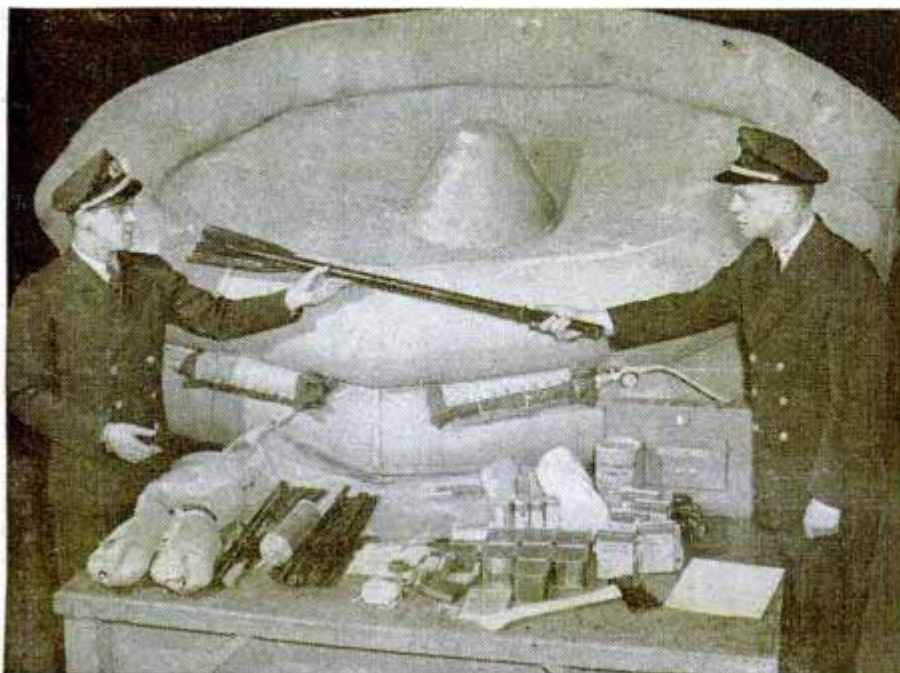
By Aubrey O. Cookman, Jr.



One predeparture "must" is the crew's session with an aerologist. A course is chosen only after careful study of his last-minute weather reports



Sometimes the longest way is the quickest. Assisting winds made the broken line Shannon-Gander flight route faster by 33 minutes. Below, checking emergency equipment for one of the plane's three life rafts



plane you'll fly. AOA uses seven Lockheed Constellations and 10 Douglas DC-4s now for 24 round trips a week, with eight giant Boeing Stratocruisers due to join the fleet in early 1948. All are sound, four-engine craft, cruising between 250 and 300 miles an hour with 60 daytime or 45 sleeper passengers. They've already completed over 14,000 crossings for this line alone, so don't get fidgety about their ocean-hopping ability. The Atlantic has been bridged by air over 91,000 times since Lindbergh's flight.

So you've gotten a U. S. passport and a British visa, and a reservation is set for morning departure. If you're a U. S. citizen, the company's passenger-service representative can check you through in five minutes and no customs visit is necessary.

With all that has been said about the red tape of international travel, it is appropriate to mention that a plan is in motion to combine passport and visas in a world travel card. Nations approving the card would permit their citizens to move freely between their respective countries. The card would be valid for a year and issued only to citizens of countries approving the plan.

An army of maintenance men is already swarming over your air steed for tomorrow's trip, giving her careful attention varying from the 12 to the 24-hour "big check," depending on expert diagnosis of her needs. The propellers had barely stopped whirling from the last crossing before a mechanical "mule" towed the shiny bird into a hangar for checkup. And at about the same time her most recent

flight engineer was in for a talk with maintenance chiefs, giving them a detailed account of her trip behavior.

The treatment runs from cleaning and minor repairs to complete engine changes. Certain parts of the airplane are automatically checked or replaced, even if a fault isn't detected. Five specialist groups go over assigned sections with a fine-tooth comb, looking for trouble or anticipating it. In air-line language this is the turnaround process, your assurance as well as the company's that everything mechanical is working perfectly.

After the maintenance crews finish, the plane is pulled out and gassed for predeparture engine run-up. Cargo, mail and baggage are trundled into position on a chain of small trucks and loaded into the ship's cavernous belly. Your own share is a 66-pound baggage allowance. Beyond that you pay an extra one percent of the one-way fare for each additional 2.21 pounds.

The human element of your trip was set in motion several days earlier, when a flight crew was designated and given the departure time. AOA has 200 pilots split up among its 65 full crews, so there is always a fresh unit available. On the other



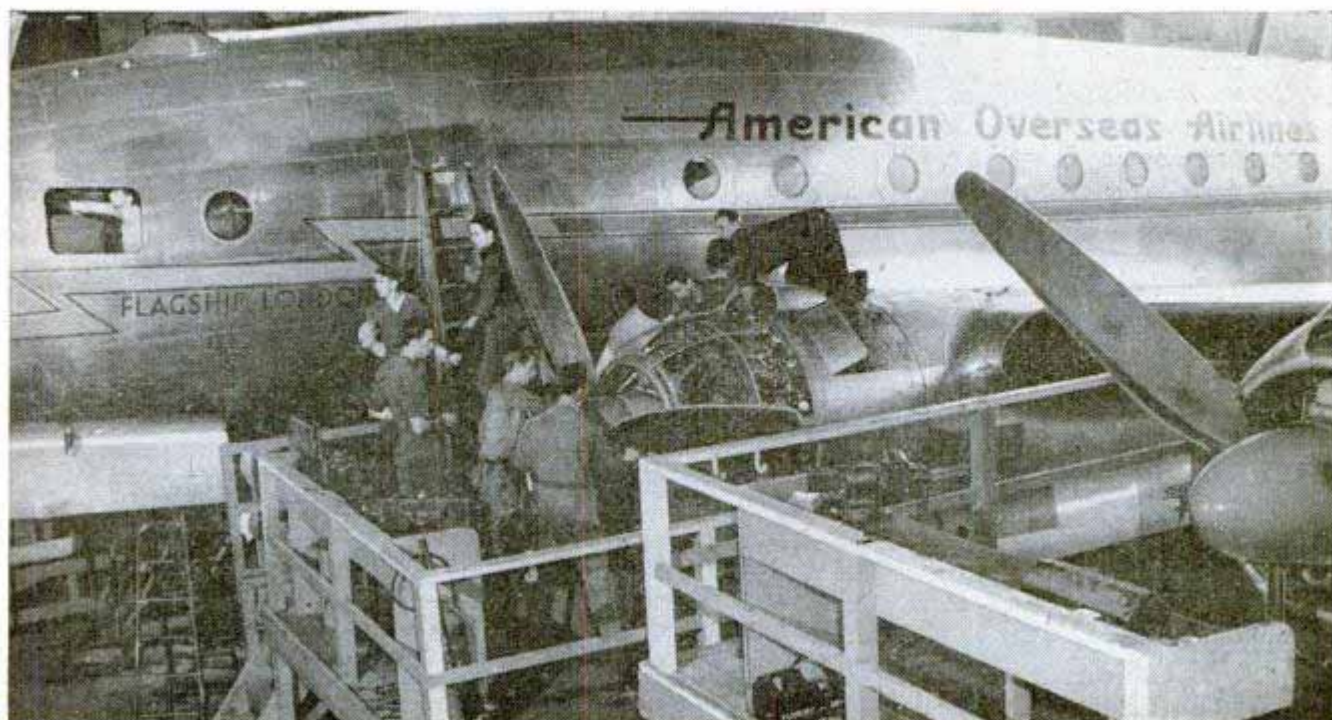
Hoisting cargo into the craft's belly. Although there's a 66-pound baggage limit per passenger, additional mail and express quickly swell the total

side they'll get a two-day layover before returning. Pilots are held to a maximum, 85 flying hours a month.

Two hours before airplane boarding time the crew assembles at operations for a general briefing session. They are told of pertinent changes in lighting, field conditions, airway-control procedures, communications and anything else unusual along the route, as well as being brought up to date on new company operational rules.

Afterwards the captain-pilot, first officer and navigator confer with a meteorologist,

Between flights maintenance crews swarm over the plane for checks that take from 12 to 24 hours or more





Behind the two pilots sits the flight engineer, keeping a running check on the operating condition of the big bird. Right, all the lines pride themselves on attractive en-route meals. Here a purser prepares dinner salads

who describes the weather en route and forecasts what can be expected later. This is a service of the United States Weather Bureau, augmented by hourly reports from international weather ships, 13 of which will shortly be dotting the North Atlantic, and from radioed messages sent by aircraft en route. From it the captain has to decide how he'll operate as to altitude, speed and course, the time it will take to cover each zone or leg, and the amount of fuel he'll need.

Your London trip, for example, could call for stops at both Gander, Newfoundland, and Shannon, Ireland, instead of going straight through to the latter, then on to London in little more than an hour. Such a flight might carry 2200 gallons for the first leg, though 1700 would presumably be enough, and add 2600 to 2800 gallons at Gander for the Shannon leg, with the alternates protected. Sufficient fuel is always loaded to get to the destination, then to an alternate field,

and still allow for a two-hour hold in case of bad weather. Gander is 1135 statute miles from New York and the next leg to Shannon is just under 2000.

A new method of long-distance flight planning puts schedules and timetables on a precision basis and greatly cuts point-to-

Planes joining the fleet early next year will have a lower-deck lounge. It is connected with the main passenger sections by a circular stairway

Boeing Aircraft photo





American Overseas Airlines photos

Altimeter readings give the navigator, left, a height check on the accuracy of upper-air forecasts. Right, the communications officer takes a hot meal, steak and all the trimmings, without deserting his desk

point air time. Known as Best Time Track Operation, it works on the pressure-pattern flying principle that sometimes the longest way takes the shortest time. Captains and navigators select the fastest path not only on the basis of the best altitude, but by deciding which wind pattern offers

them the greatest push across the ocean.

The North Atlantic's prevailing "lows" are spotted and a route chosen that takes advantage of the airflow circling counter-clockwise around them, giving aircraft passing to the right an added tail wind of many miles an hour. With high-pressure

Though there's scant possibility of using them, once airborne a stewardess tells passengers how to use the life belts. First-timers listen avidly

areas the effect is gained by passing to the left and picking up speed from the clockwise wind currents.

The conventional method has been to compute flight time for two or more altitudes, but over a single route. With Best Time Track, to provide a mathematical basis of comparison, a system of standard routes was worked out so that one or another would normally fit a favorable wind pattern and offer a sizable time saving. The necessary data is extracted directly from weather maps.

While on short flights it isn't practical to make long detours to take advantage of wind currents, it can shorten long trips by more than an hour, considerably shrinking the required fuel load.



FLIGHT PLAN - Long Range

A.O.A. Form 319-A

Aircraft: 906 Cruise: CON. From: EINN To: VOGA Trip: 41-15 Date: 16TH FEB 47

FLIGHT ANALYSIS

Zone	Dist	Eff Wind	TAS	GS	Time	Eff Wind	TAS	GS	Time	Den Alt	Den Alt
GREAT CIRCLE											
4	440	-19	183	164	2:36	-11	182	171	2:38	173	187
3	432	-20	163	163	2:38	-5	167	176	2:27	176	187
2	413	-10	173	173	2:23	-6	176	182	2:17	182	187
1	436	-8	171	171	2:33	-7	175	173	2:31	173	187
TOTALS											
Fuel 12500 Time 10:04 Fuel 11500 Time 9:37											
BEST TIME TRACK											
4	441	-5	183	169	2:42	-6	182	176	2:34	176	198
3	446	+3	186	186	2:28	+7	189	193	2:18	193	198
2	441	+17	200	200	2:12	+19	201	201	2:11	201	211
1	444	+1	184	184	2:25	+2	184	181	2:27	181	211
TOTALS											
Fuel 11800 Time 9:47 Fuel 11550 Time 9:31											

FLIGHT PLAN

Route #2 Via		Initial Heading: T.C. 290° Var. 18°W		M.C. 308 M.C.A. -13° M.H. 255°						
Alt	Zone	Eff Wind	Speed	Zone	Time	Zone	Time	Zone	Time	Howzit Totals
			Air	Dist	Zone	Dist	Zone	Dist	Zone	Fuel-lbs.
8000	4	-6	182	176	441	441	2:34	2:34	2:34	3400
	3	+7	184	184	446	446	2:25	4:55	4:55	6300
	2	+19	201	201	441	441	2:11	7:06	7:06	8850
	1	+2	184	184	444	444	2:23	9:30	9:30	11520
Altn VOGA										
Altn 18 171 153 343 2:15 2470										
Gross Weight										
Take-off	71,800 lb									
Fuel to Destination	11,520 lb									
Landing	60,280 lb									
Howzit Data										
4 Eng. P.N.R.	5:33 Hrs									
3 Eng E.T.P.	6:39 Miles									
Time to E.T.P. 3	3:15 Hrs									
3 Eng time from E.T.P. 3	4:00 Hrs									
3 Eng fuel from E.T.P. 3	560 gal									
Fuel to Deth & Alt.										
Fuel to Deth & Alt. 13990 2033 gal										
Heater Fuel 125 gal										
Hold Fuel 1800 22 gal										
600 10 gal										
Total Fuel Req'd 16515 2753 gal										
Total Fuel Aboard 16650 2775 gal										

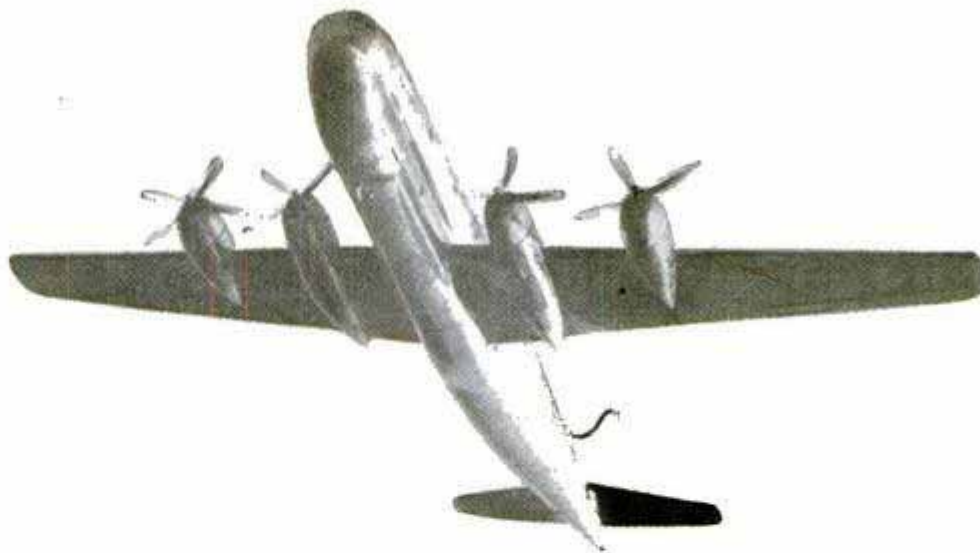
Illustrating Best Time Track planning with an actual Ireland-to-Newfoundland flight. While the Great Circle estimates represent shorter mileage at three altitudes, Best Time Track is based on the pressure-pattern flying principle that sometimes the longest way takes the shortest time—when the wind lends a hand. The analysis weighs plus and minus effects of the wind, true air speed and ground speed, and the probable block-by-block time required. Because of anticipated bad weather at lower altitudes, Capt. Toth selected Track #2 at 8000 feet and actually bettered the alternate Great Circle route time by more than half an hour. The mysterious term "Howzit" is actual performance record. Fuel for the chosen path also ran 650 pounds less than for the alternate route.

Dispatcher **R.E. MITCHELL**
 Navigator **H.C. MYERS**
 Captain **S. TOTH**

The technique was tried experimentally over AOA routes for more than six months before its formal adoption. It is expected eventually to lower operating costs and help reduce transatlantic fares.

Meanwhile the flight engineer is learning from maintenance what work was done on the plane since its last trip. Then he goes aboard and checks all the instruments himself, staying to see that the gas load is correct. The radio officer is studying the latest communications instructions and changes in the operations-office file before checking equipment at his station. En-route meals to be put on the plane and expected personal wants of passengers are the main concern of the stewardess and purser. Comfort has a high priority.

As the plane moves into place on the runway, the navigator gives the captain the first compass heading to be flown, while the copilot and radio officer contact the control tower for take-off clearance. The captain handles the throttle and the flight engineer adjusts the propellers, later setting the power controls for climbing when



Stratocruisers will look like this to surface ships below. Over 110 feet long, it can cruise around 340 miles an hour

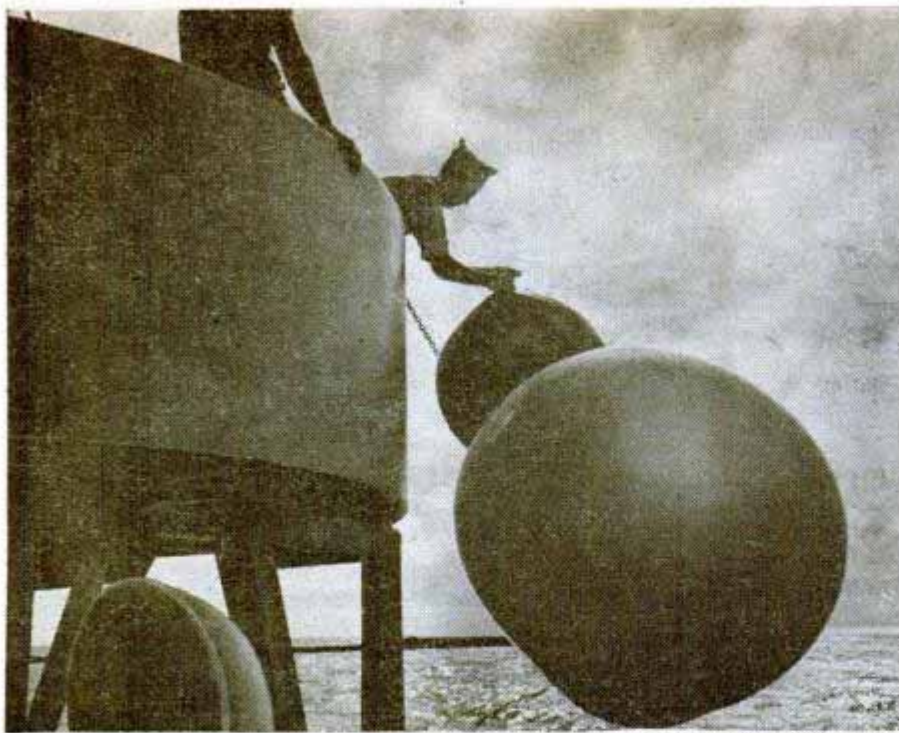
the ship has sufficient speed and altitude. His station is one of the busiest—from now on he'll be constantly working with slide rule and engine calculator, coaxing the best possible performance from the thousands of "horses" at his disposal.

As the plane levels off, the navigator checks his compass for deviation and plots the first position or "fix" on the chart. From then on, working closely with the captain, his primary responsibility is to know the plane's position accurately at all times. Every hour on the hour, a position report is radioed to the ground-control stations, so the plane's progress may be monitored.

Eating, is one of the plushiest items in transoceanic air travel. Breakfast, lunch or

Passengers aboard and four engines roaring, next time this "Connie" comes down she'll be on foreign soil





U. S. Coast Guard photo

Launching weather balloons. The larger one lifts equipment to record temperature and humidity, while the smaller checks wind velocity and direction

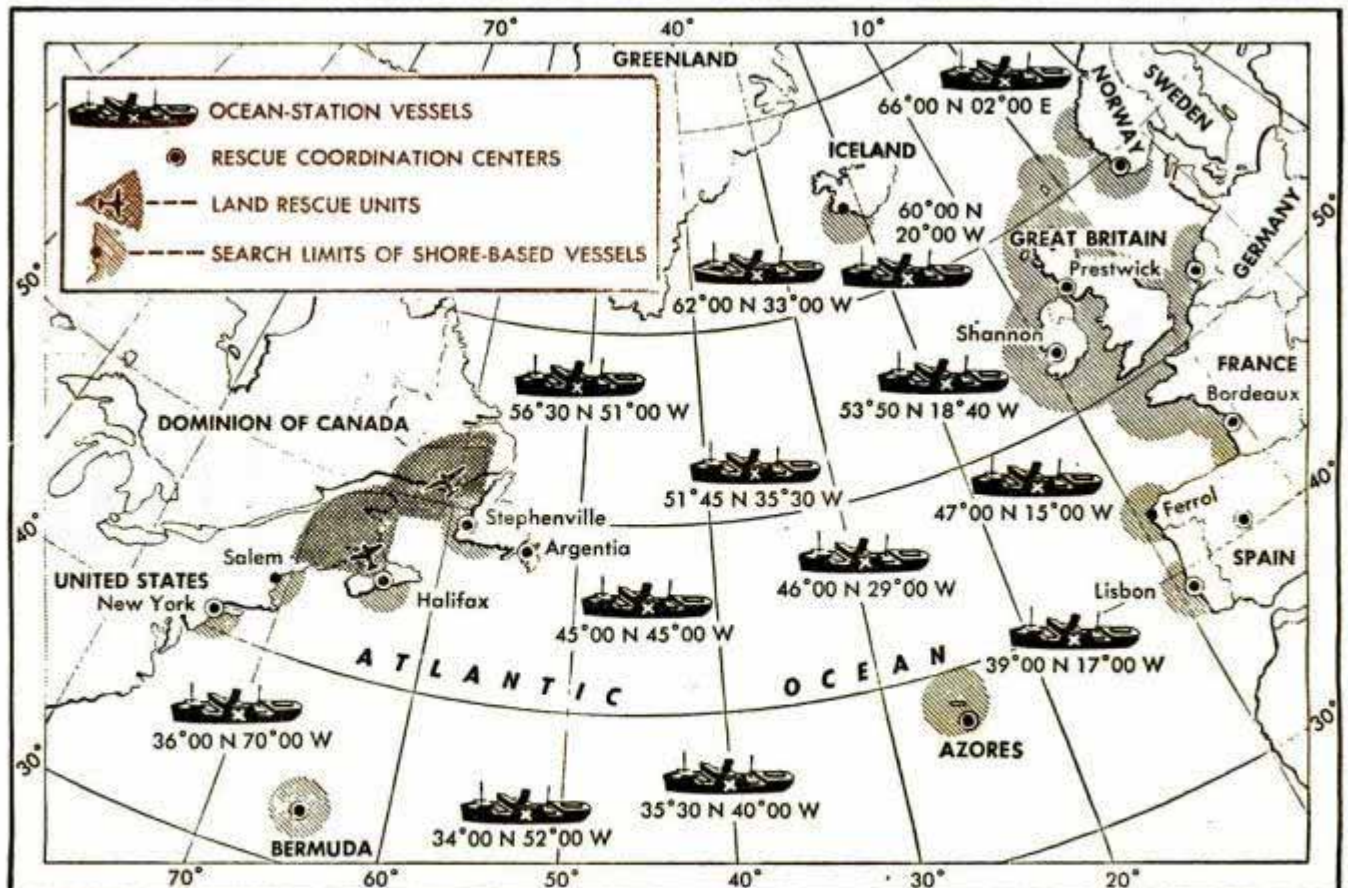
dinner, depending on your time of travel, are full-course repasts with all the trimmings. Most of the food is prepared in the air line's kitchens at the terminal, then reheated in the plane's galley just before serving. Some meals, like steaks for dinner and good old bacon and eggs for breakfast, are prepared en route.

About an hour out, after you've had time

time it takes radio waves to travel from shore-based stations at known locations to a receiver in the aircraft. Since the signals travel at a constant speed, measurement of the difference in the time it takes the two to arrive becomes a measurement of distance. By taking Loran measurements on a second pair of stations, in the same manner, a

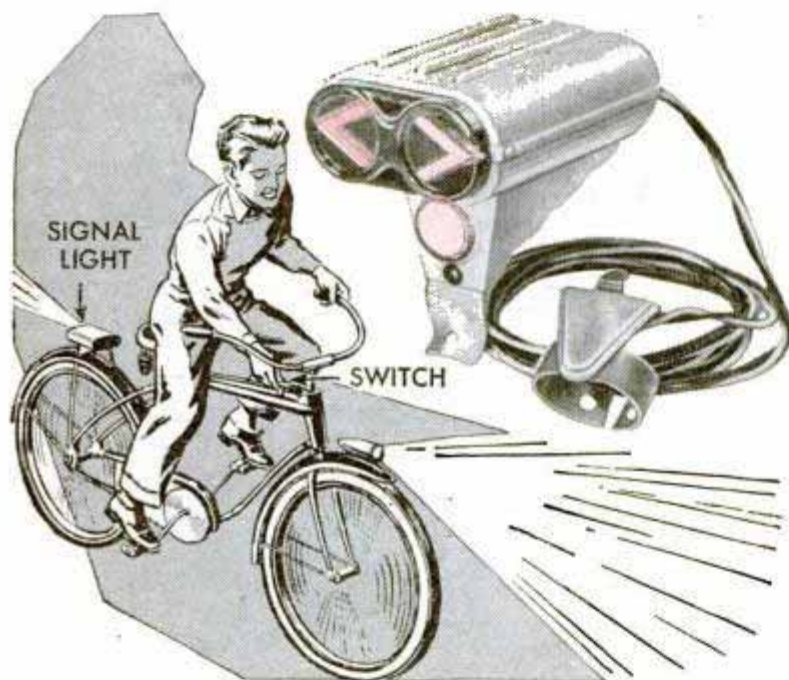
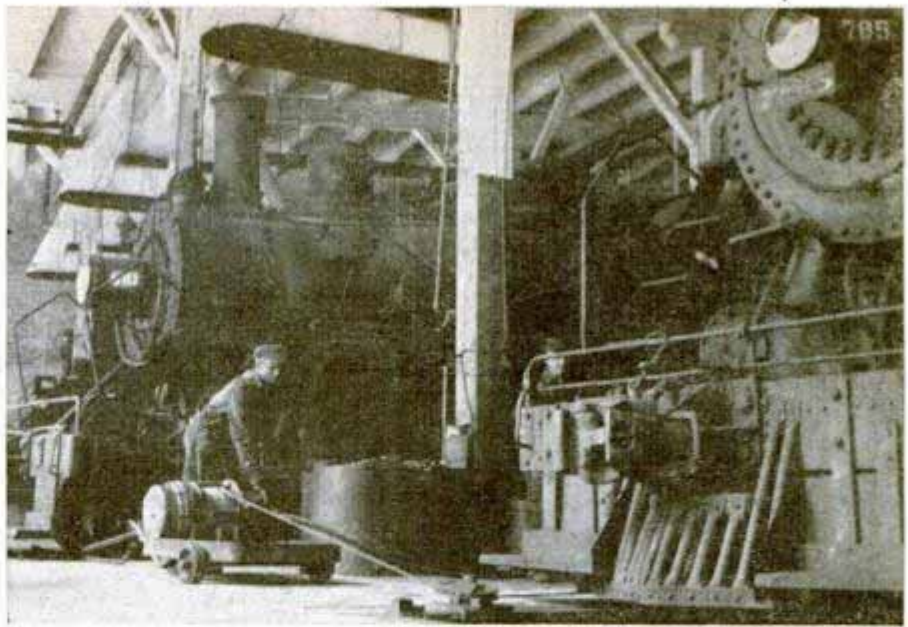
(Continued to page 232)

Maintained by international agreement, weather ships and rescue facilities will cover all air-traffic lanes



Locomotive Mover

Huge freight locomotives are moved around the Tyler, Tex., roundhouse of the Cotton Belt Railroad by a husky machine less than six feet long. The powerful mid-gut is an air winch mounted on a rubber-tired wagon. After it is anchored to a nearby rail, a cable is run out at right angles to the engine, turned with a pulley and fastened to the locomotive. The winch winds up the cable to move the engine.



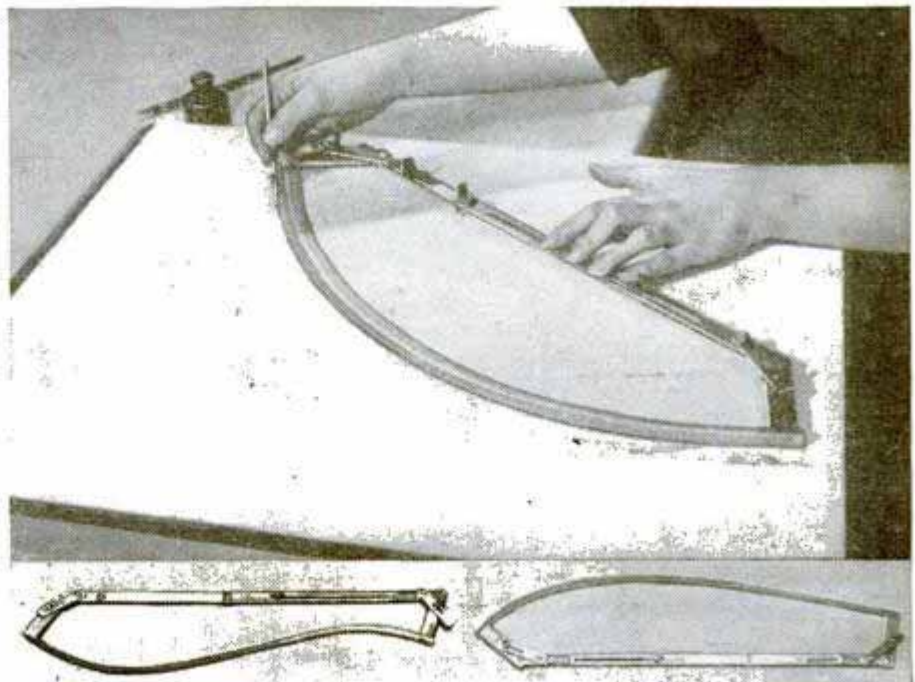
Directional Light for Bikes

Twin-arrow lenses on a rear light for bicycles point out the direction the cyclist intends to turn. The switch for the light is located on the frame of the bicycle in front of the rider. The lamp has a split aluminum case housing two standard flashlight batteries and the arrow lenses. A reflector beneath the lamp serves as a taillight for the bicycle.

Operating a 33-mile run between Belfast and Burnham Junction, Maine, is America's only municipally owned rail line, the Belfast and Moosehead Lake Railroad, which uses two GE Diesel-electric engines to pull the trains.

Plastic Curve Plotter Used for Road Layout

Draftsmen can use a flexible curve-plotting instrument to plan highways and other types of drafting involving long radii. A flexible plastic strip can be adjusted to form various curves. The instrument is available in two sizes. The small one, 1½ feet long, has an adjustment range from 0 to 6 degrees, or infinity to 10 inches actual radius. The larger instrument, 2 feet long, has a range from 0 to 4 degrees, or infinity to 1-foot radius.



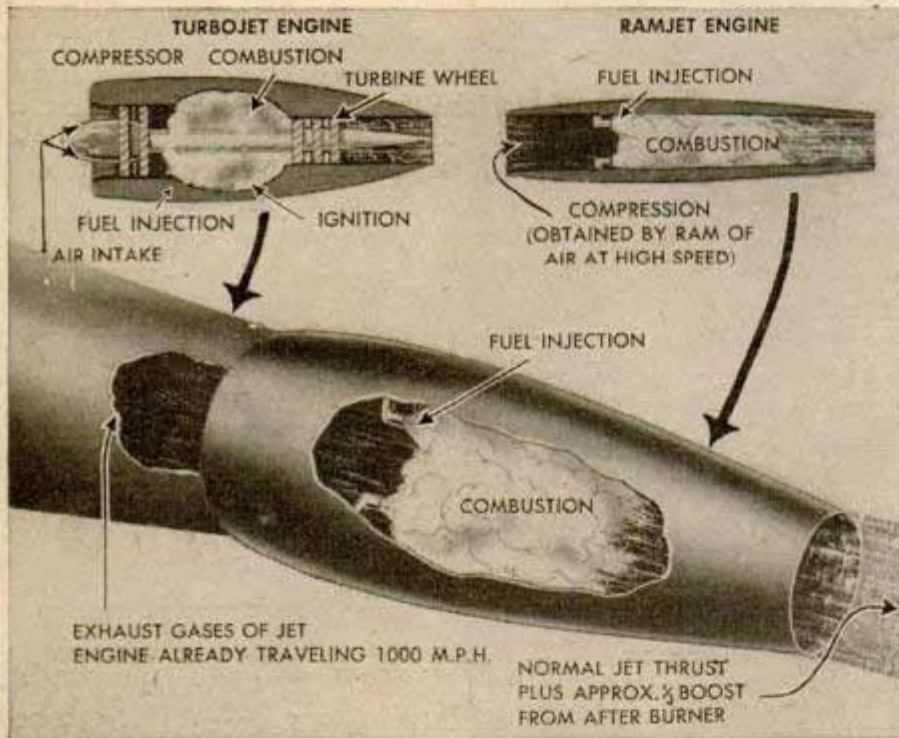


NACA photo

"Silent" Plane Has Five Fan-Shaped Prop Blades

Only a very slight "whish" can be heard at 300 feet from a "silent" plane tested by the National Advisory Committee for Aeronautics. A 90-percent noise reduction

was gained by gearing down the 185-horsepower engine to produce full power at fewer propeller revolutions and fitting the plane with five fan-shaped blades.

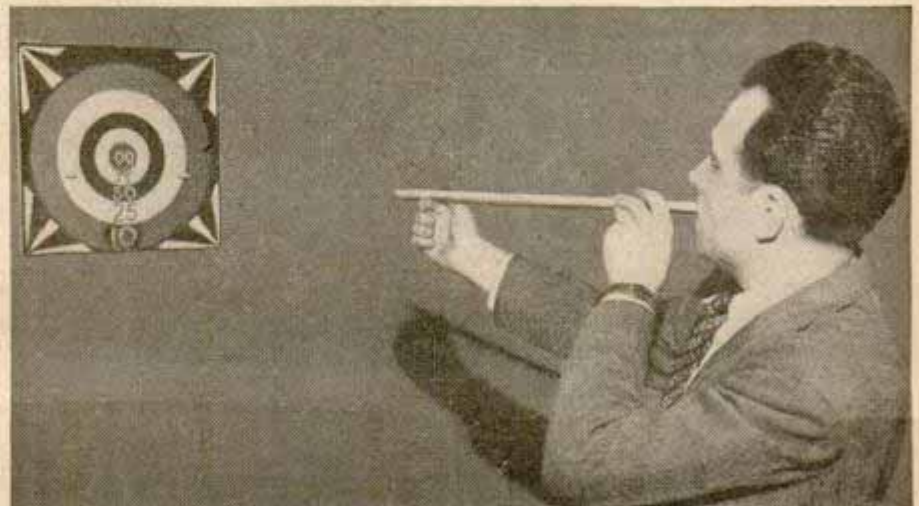


After-Burner Unit Boosts Jet Thrust

Thrust from turbojet airplane engines is boosted one third by an after burner that works like an attached ramjet unit. Fuel sprayed into the tail pipe burns and adds greater mass and velocity to gases already in the turbojet's exhaust stream. Developed for the Navy by Ryan Aeronautical Company, it is intended for use only when emergency bursts of power are needed. Wasteful at low speeds, at high speeds the "ramjet" attachment uses fuel more economically than the turbojet.

Blow-Dart Game

Darts are blown from a 28-inch tube in a new game patterned after the South American Indians' method of killing small game with darts tipped in curare poison. The game equipment consists of the blowgun, $\frac{7}{16}$ inch in diameter; removable plastic mouthpiece; steel-pointed darts—without the poisonous tips; cork target, and carrying case.





After Ott makes a final adjustment on the lens, the robots will expose a 16-mm. frame every five minutes

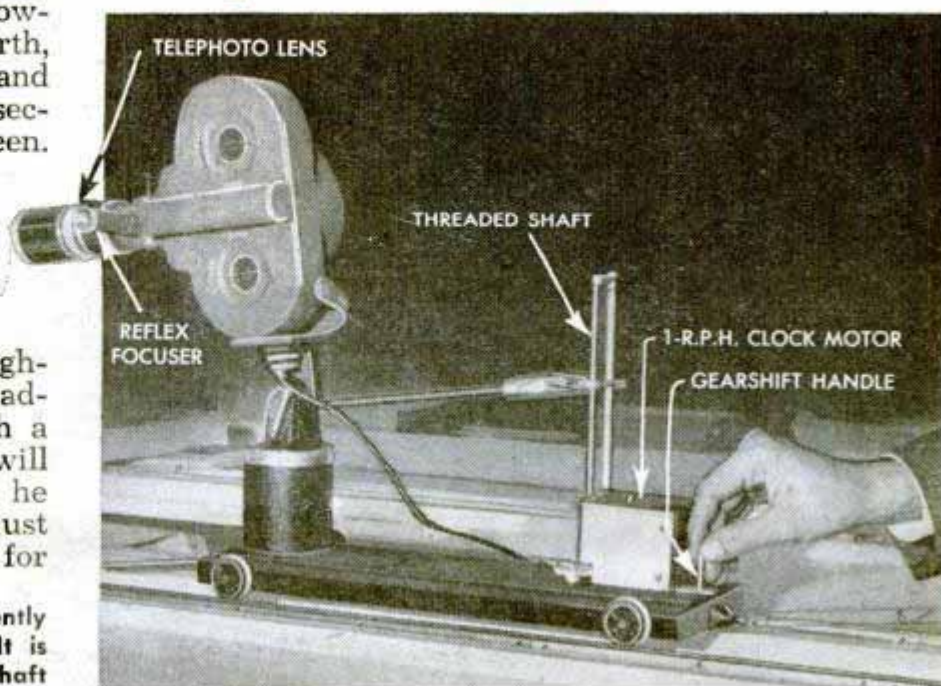
By Clifford B. Hicks

TIME SWIRLS through a basement studio in Winnetka, Ill., 10,000 to 50,000 times faster than it passes on the street outside. By harnessing quickened time to his motion-picture cameras, John N. Ott, Jr., makes flowers push through the earth, bud, burst into blossom and wilt—all within a few seconds on the theater screen.

Until just recently Mr. Ott was a banker with a hobby. Now time-lapse photography has usurped his full time; from occasional showings for neighbors and clubs he has graduated to a contract with a Hollywood studio that will buy his films as fast as he can make them. And just ahead are research jobs for

Camera mounted on car patiently "grows up" with the plant. It is elevated by a fine-threaded shaft

The WALTZ of the FLOWERS



industry, already knocking at his door for time-lapse studies of chemical reactions, medicines, crop fertilizers and weed controls, and food-preservation processes.

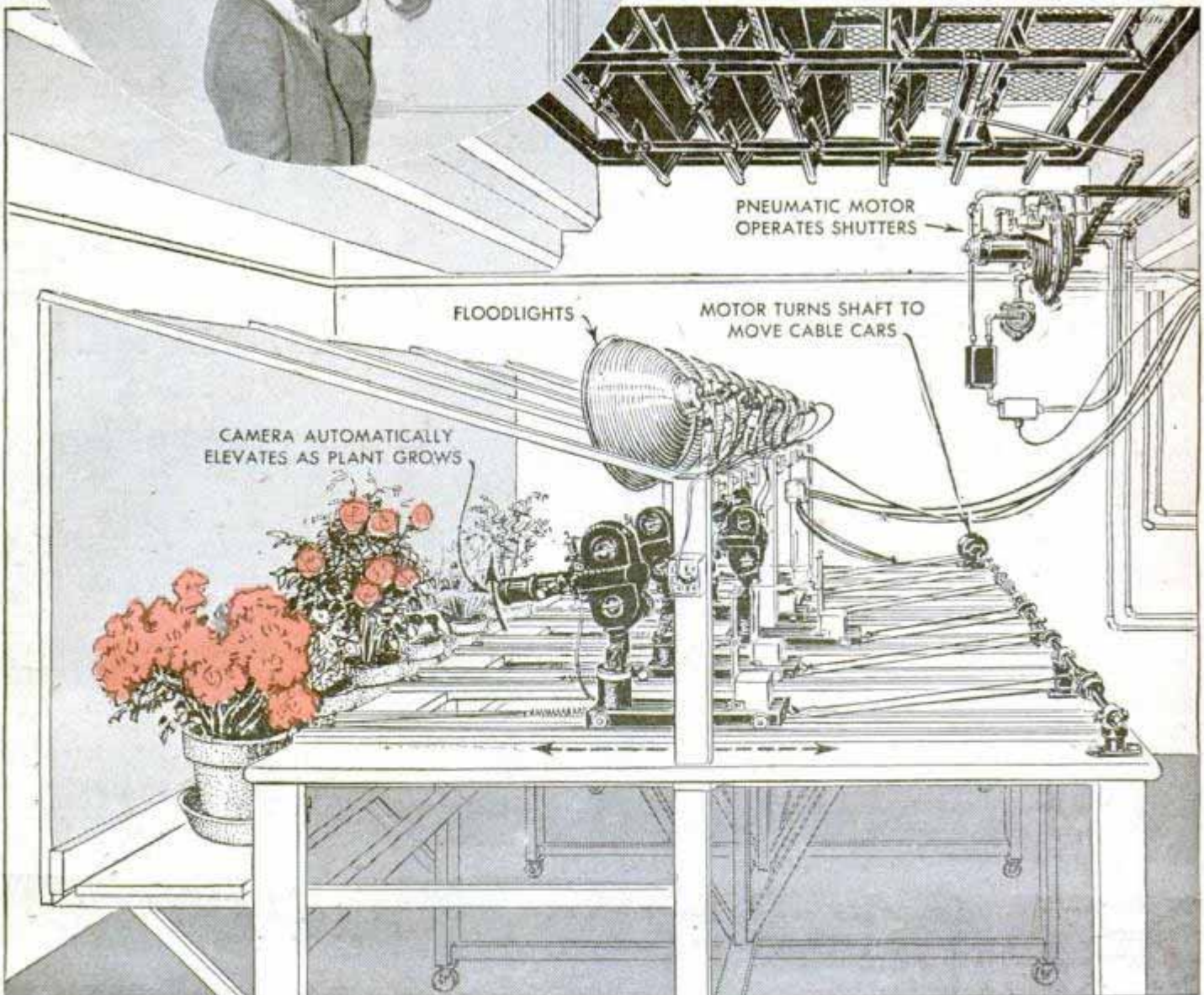
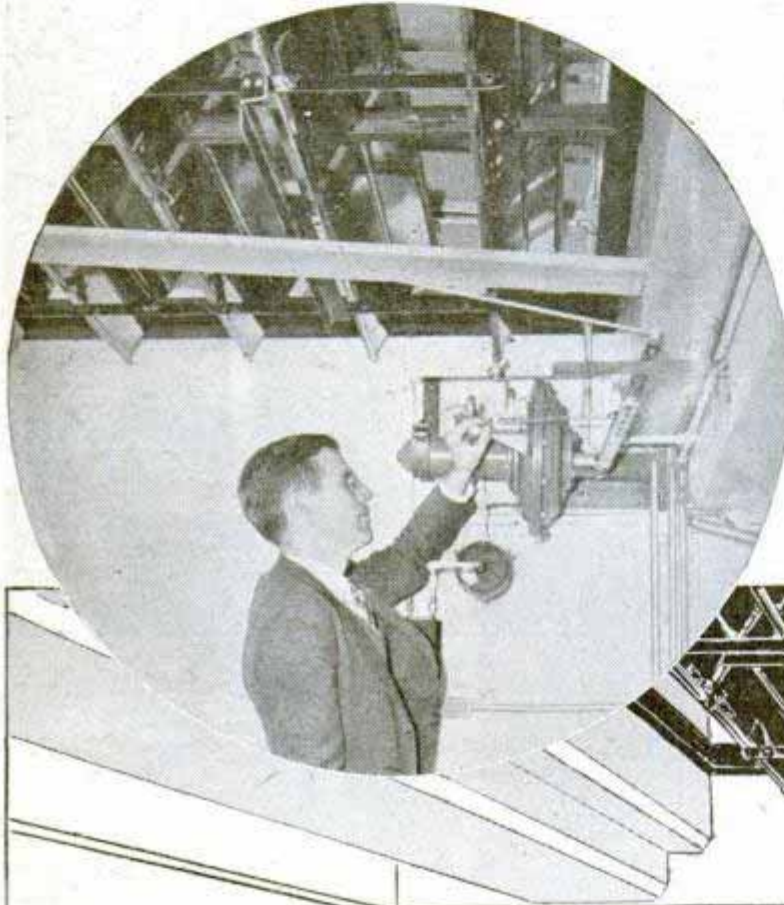
Filmed over a period of years, Ott's motion picture, "Flowers in Action," shows rare plants growing from seedlings to maturity within seconds. In the climactic scene, the "Ballet of the Primroses," eleven

botanical dancers swirl, dip, wave their arms and weave in and out to the strains of a Strauss waltz. This single scene took five years to photograph, yet lasts but two minutes on the screen.

Ott's basic idea is to expose single frames of a 16-millimeter film at specified intervals—usually three minutes to an hour. When the film is developed and projected, the rate of growth of the plant is multiplied thousands of times on the screen. It's just the opposite of a slow-motion film.

Time-lapse photography is not new, but Ott has designed his own equipment to regulate automatically the passage of time, and his resulting films are unique. Now Ott wishes he could slow down the passage of his own busy hours, as he hasn't enough time to keep up with the demand to show his motion pictures. He has incorporated

← Timed to the second, this damper closes overhead shutters when exposure is made
 ↓ Sketch shows Ott's elaborate studio including the panel of controls on right wall



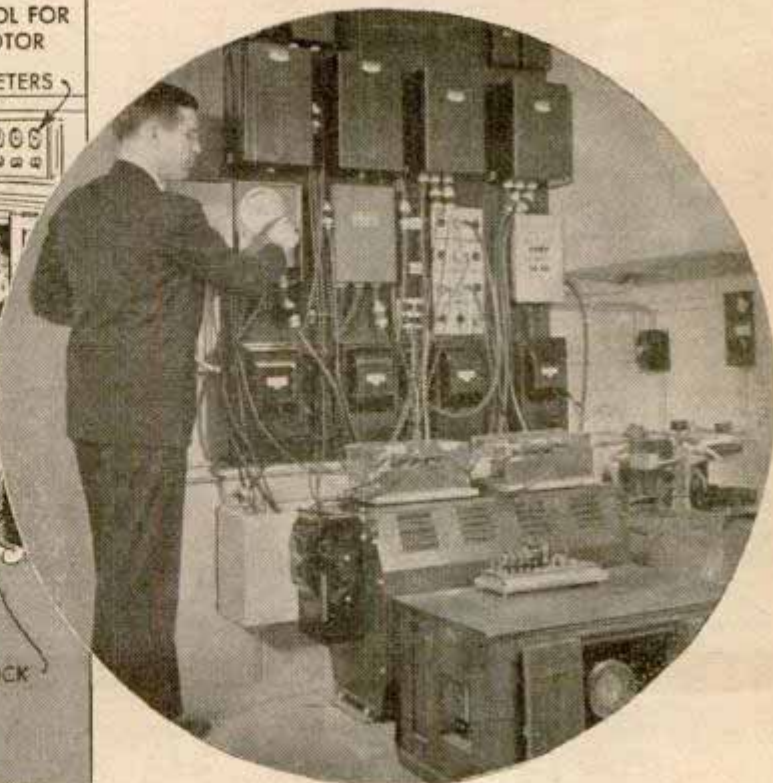
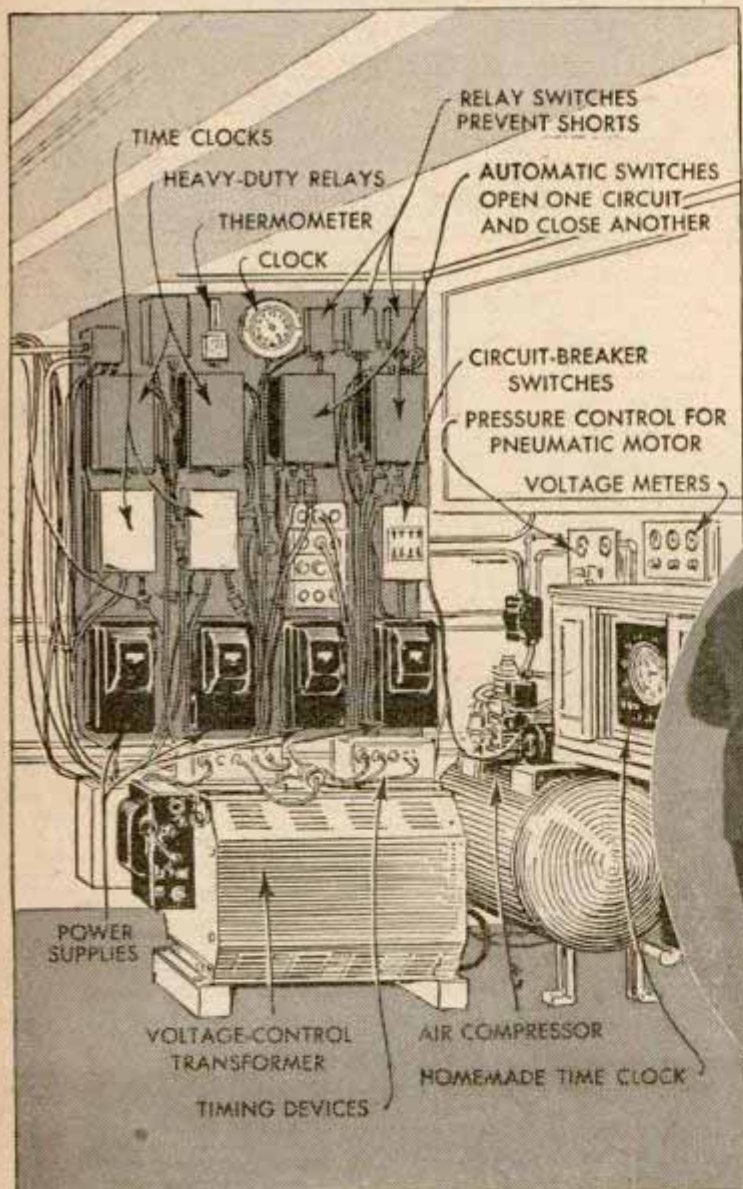


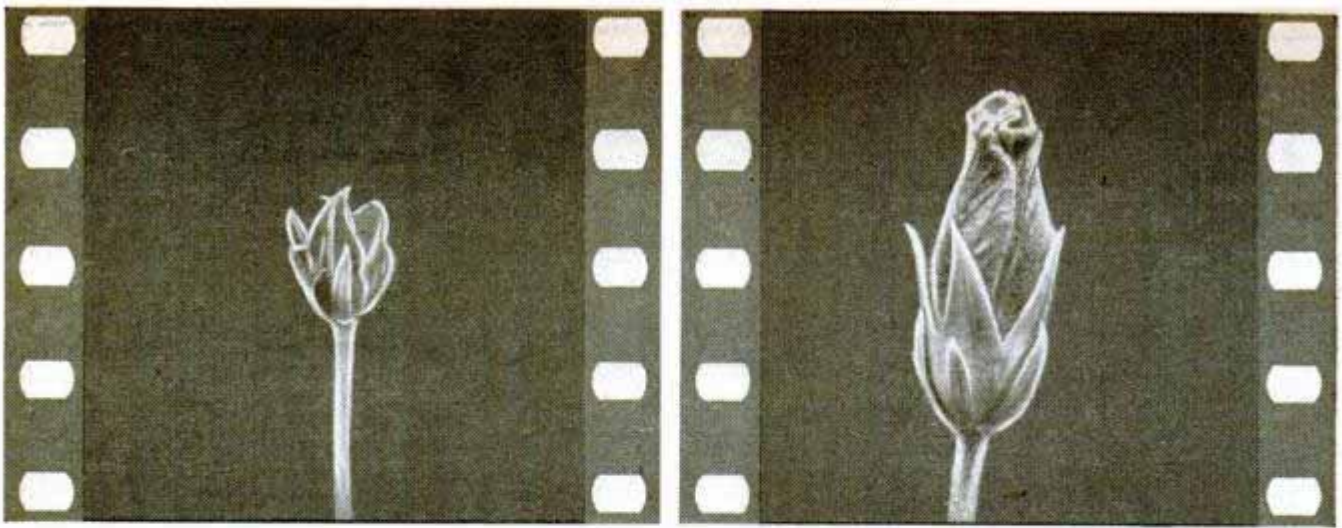
Six robot-operated cameras are lined up on six different subjects. Note variations in lens elevations

his undertaking under the name Phototronics, Inc.

Every few minutes in Ott's basement studio the overhead shutters slam closed, the room lights go off, a bank of photo-floods suddenly springs to life, the camera clicks, the lights go off and the shutters

Ott adjusts a time clock to photograph a new subject. In foreground is original timer he built 20 years ago





Time-lapse photography—exposing frames at intervals—speeds plant's growth thousands of times on screen.

snap open. It's an extremely complicated and automatic operation to expose one tiny frame of film. His equipment represents 20 years of patient work to overcome the problems of exposing that frame properly.

In order to shoot the sequence titled "Ballet of the Primroses" he built a special stage including a backdrop and a curtain. From wing to wing across the stage ran a track along which the plants were pulled in a cable-car train. Inside each flower pot were a watering pipe and heating element. By alternately watering the flowers and wilting them with heat, Ott made them do realistic dance steps. With two banks of lights opposite each other he made the flowers turn and reach in either direction. The entire sequence was planned in advance to match the musical score. He could determine weeks ahead of time the exact position and condition of each plant in the chorus of floral dancers.

There's only one flaw in the film—a sud-

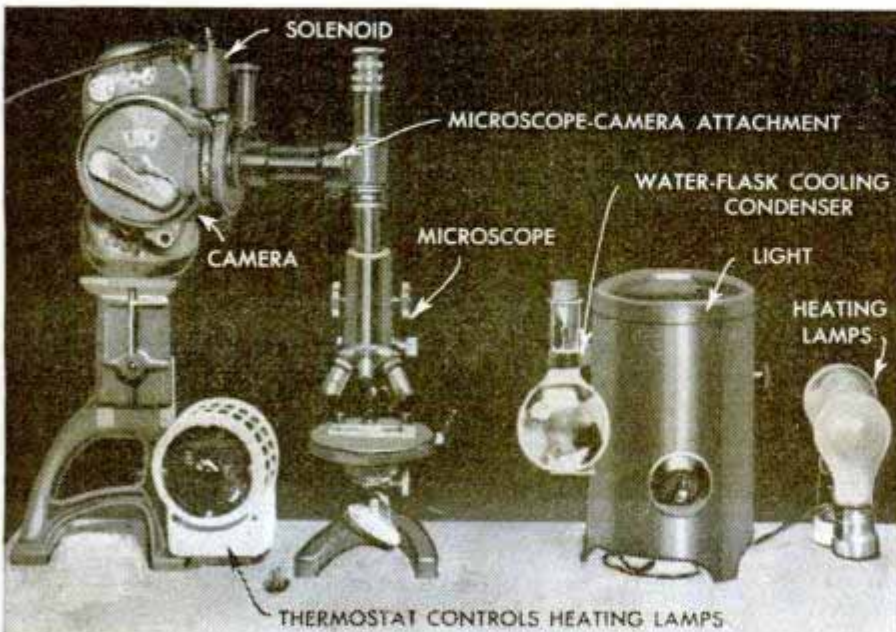
den movement by all the plants. The unscheduled movement represents Ott's two years in the Navy when he had to postpone his work.

When Ott was 17 years old he bought his first motion-picture camera and decided to combine photography with gardening, his other hobby.

"My first subject was some apple blossoms which I brought into the house," he says. "I knew I had to take a picture at regular intervals. At first I decided to take a picture every hour, but by the time the second night rolled around I thought maybe every two hours would do as well. About dawn of the fourth day I imagine I missed a few frames—I blamed it on the alarm clock. When finally completed, the picture showed blossoms opening so fast that it was impossible to see motion—there was a bud and all of a sudden it was wide open!"

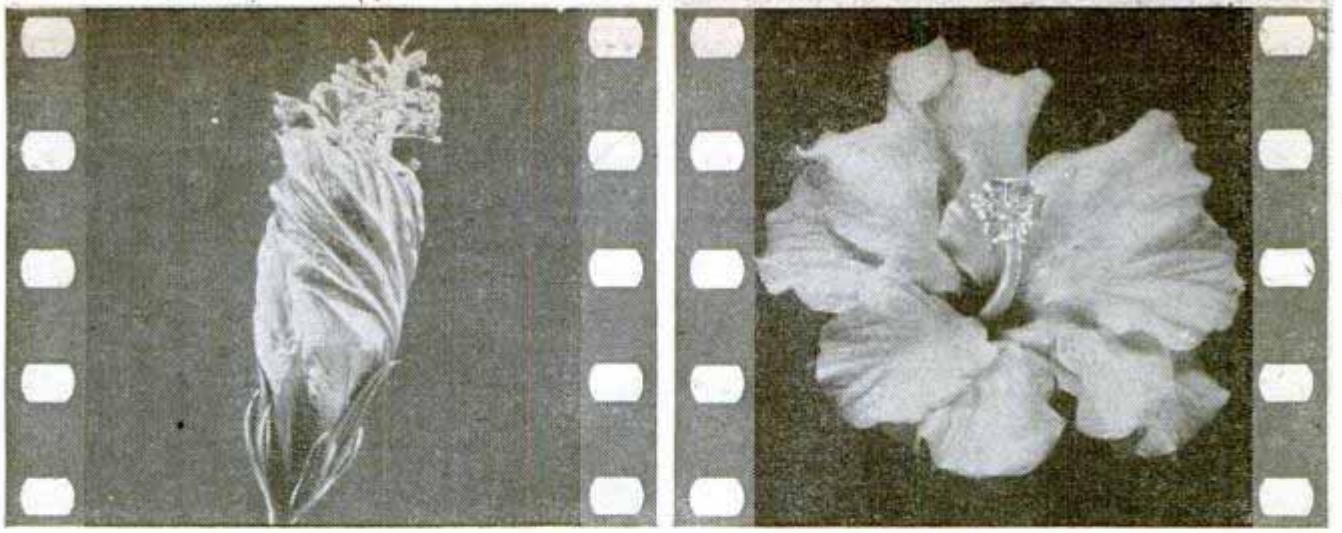
Ott decided that running home every few minutes to take a picture was too much

Attachment permits photographing through a microscope for study of the development of bacteria and molds. The water flask cools the light rays



trouble so he built his own timing apparatus from the kitchen clock. He still uses the same clock to regulate part of his equipment. Soon he discovered that he would have to regulate the light, as some of the frames were overexposed and some underexposed. But this brought up still another problem—if he took the pictures in artificial light, how could he give the plants the necessary sunlight?

A more complicated hookup was the answer. He developed his timing mechanism so that it would close a large window shutter whenever a



These four frames show development of hibiscus from bud to blossom. Plant in finished film grows up in seconds

picture was taken and open it again immediately afterward. Artificial light filled in the slight interval to give the plants the same illumination for every picture regardless of day or night, bright or cloudy weather.

"I ground out two or three short scenes a year until 1929 when color film became available," he says. "Then I bought a second camera and started again in color. Several years later this first type of color film was so greatly improved that the old movies were outmoded. I really started making today's movies all over again."

But around every corner was a new problem. Every time-lapse movie he tried to make of an orchid was returned by the processor with a new roll of film and a polite letter explaining that something seemed to have gone wrong in developing the exposed roll. Upon investigation, Ott found that the high humidity necessary to grow orchids was spoiling the film. Finally he developed a method of packing the camera with moisture-absorbing chemicals.

Today Ott's studio, projecting out from his basement, is a wonderland of automata. The ceiling is glass-paneled to admit the sunlight necessary for his growing plants, and a bank of shutters operated by pneumatic pressure slams shut for exposures. The complicated robot that performs all split-second tasks is a control panel that covers one wall. The panel includes six time clocks and timing devices, a voltage-control transformer to give exact control over the light, relay switches, circuit breakers, power supplies, an air compressor and a pneumatic damper to operate the shutters. An air conditioner controls temperature and humidity.

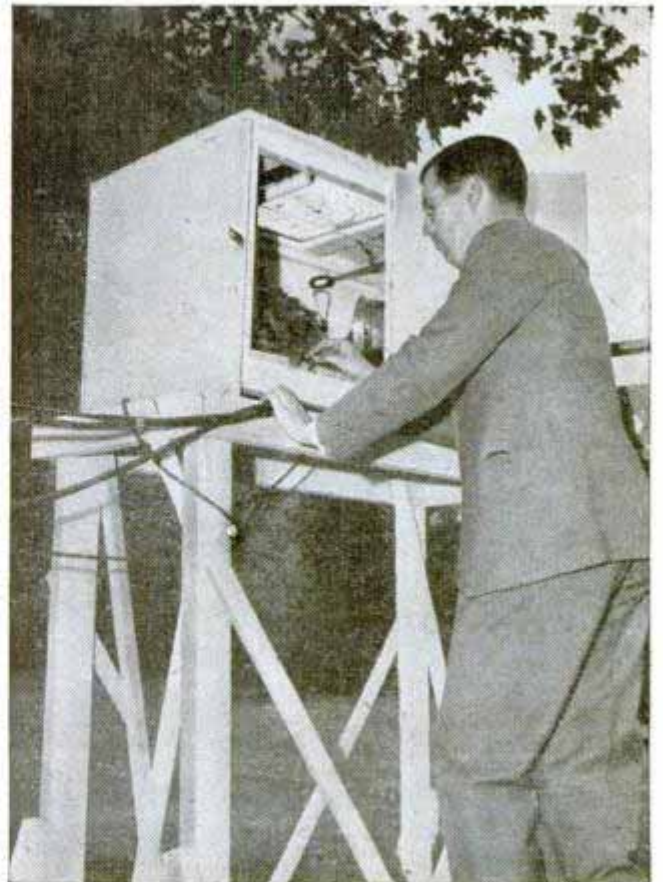
Occupying most of the room is a large table mounted on rubber wheels. By moving the table with the passing of the seasons, Ott assures his plants of the greatest possible amount of light. On the table are

six two-rail tracks and on each track is a miniature cable car that holds a camera. Above the cameras is a bank of 14 floodlights with reflectors, and in front of the cameras are plants he is photographing.

But Ott has built into the table refinements so precise the cameras need no attention for weeks at a time. For example, a tiny clock motor on the rear of each cable car turns a fine-threaded shaft so slowly that it makes only one revolution every hour. The shaft in turn elevates the camera. By setting the mechanism at a predetermined speed, Ott literally can make the camera "grow up" with the plant. When

(Continued to page 240)

With miniature time-lapse setup in his back yard, Ott records the development of maple leaves and buds





Grass Catcher Easy to Empty

Removing grass from the catcher of a lawn mower just introduced is accomplished without bending and without removing the catcher. A handle raises the catcher a foot off the ground. Then the mower handle is raised and pushed forward so that grass falls into a basket.



Robot Household "Maid"

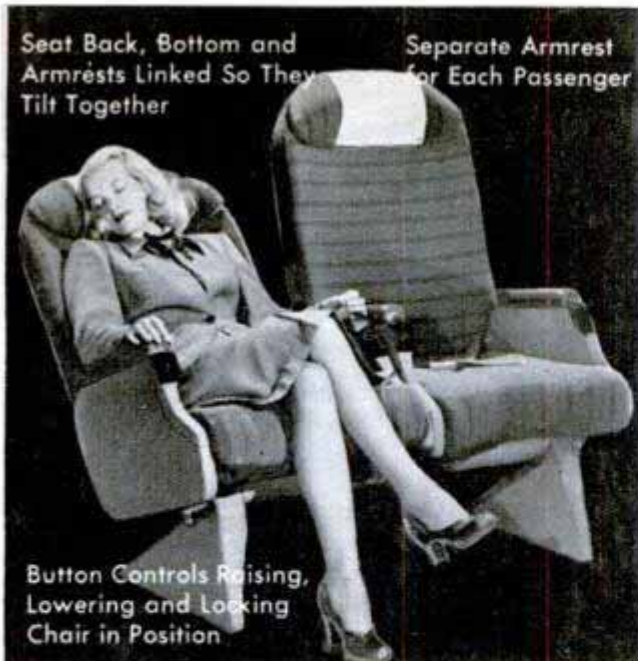
Several housemaid tasks are performed by a bedside electrical robot invented by A. D. Granger of London. The device turns on a heater at a predetermined time, heats water and siphons it into a teapot or coffee pot. When the tea or coffee is ready, the robot rings an alarm, lights a bedside light and turns on a radio to arouse the sleeper. The automatic "maid" can be regulated to perform as many of the six operations as desired. The device was demonstrated recently at an exhibit in Enfield, England.

Warning Sign for Motorists

Visible 350 yards in either direction, a warning sign helps protect motorists who stop along the highway for any reason. The sign folds up for storage in the rear compartment of the car. Two reflectors on the sign can be seen at night.

Synthetic Glycerin to Increase Supply

Commercial production of synthetic glycerin soon will relieve shortages and add to the supply now being made by soap manufacturers. Glycerin is used in making many articles, including Cellophane, films, toilet articles, drugs, inks, dyes and papers. War demand for glycerin in explosives exhausted the supply available from natural sources and requirements were met by the salvage of kitchen fats in homes. The new synthetic-glycerin plant will be established at Houston, Tex., by the Shell Chemical Corporation and will start operations early in 1948.



Doak Aircraft photo

Plane Seat Tilts Cradle Fashion

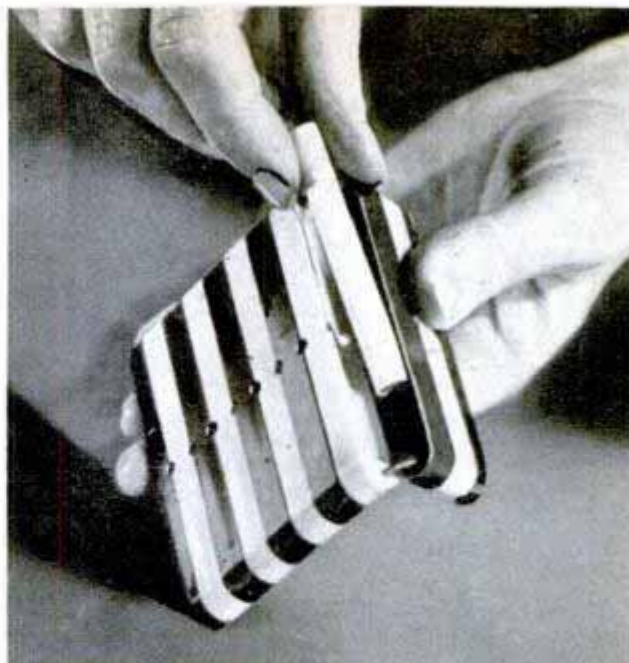
Because some passengers slide down in reclining air-line chairs and bunch their clothing, a seat is being built with back and bottom linked so both tilt together in cradle fashion. The front of the seat curves in to accommodate either the shorter legs of women or the longer legs of men. A button near the right hand operates a hydraulic mechanism that automatically reclines and raises the chair and locks it in any position. Each seat has two individual armrests that tilt with it, maintaining a comfortable elbow height. Both headrest and back are slightly concave to prevent rolling from side to side.

Weed Sprayer

Dandelions, plantains and other lawn weeds are given individual applications of a weed-killing solution by a sprayer that screws to the top of an ordinary gallon jug. The sprayer consists of two tubes and a spray head made of Tenite plastic. The smaller of the two tubes is inserted through the cap until it almost touches the bottom of the jug, serving as an air intake. Attached to the end of the larger tube is the spray head. Tipping the jug shoots a stream of weed eradicator down the tube and out through the sprayer for a direct application to individual weeds. A valve on the cap permits the spray to be shut off at any time.



Attached to the end of the larger tube is the spray head. Tipping the jug shoots a stream of weed eradicator down the tube and out through the sprayer for a direct application to individual weeds. A valve on the cap permits the spray to be shut off at any time.



Flexible Cigarette Case

Cigarettes are extracted from a new pocket case by applying slight pressure to open any of 10 plastic compartments held together at top and bottom by coil springs. As soon as a cigarette is removed and pressure released, the case snaps back to its original position. Small holes in each compartment reveal whether a cigarette remains in that section. The case is decorated in contrasting stripes.

Color Tester for Fluorescent Tubes

Fluorescent tubes used in commercial signs are now color-tested by a device which emits ultraviolet rays to make the tubes fluoresce in their true colors. Thus the sign assembler has no difficulty in selecting various shades from "warm white" to "daylight."





1. OFFSIDE



Football's Sign Language

Illustrated by Jay Berwanger, former All-American halfback and present Western Conference official, and members of the Northwestern University squad



2. DELAYING GAME



3. INCOMPLETE PASS
NO PLAY—NO SCORE



1. Offside: Five-yard penalty, called when any part of player's body is ahead of ball when it is put in play

2. Delaying Game: Five-yard penalty resulting from tactics that prevent putting the ball in play promptly

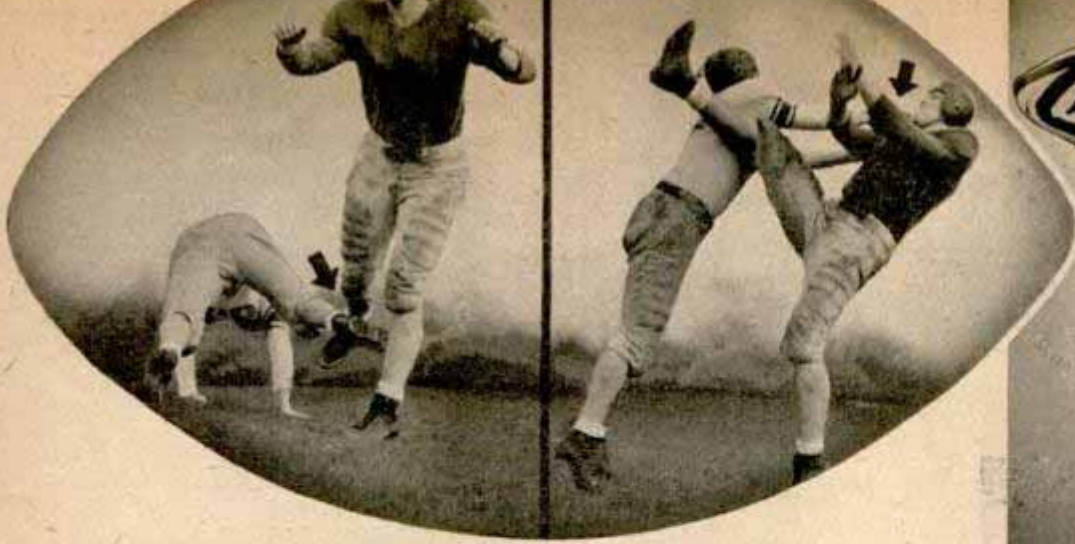
3. Incomplete Forward Pass: Signal shows pass was not successful. It also indicates no score or no play

4. Time Out: Signals team is taking one of four two-minute rest periods to which it is entitled in each half

5. Illegal Motion: Called when man in motion is less than five yards back of line when ball is snapped

6. Holding: Players on offense must keep hands and arms against body when using them against opposition





UNDERSTANDING the officials' signals makes football more enjoyable to watch. Besides, if you don't know what they mean you're likely to miss a great deal of what's happening, because their whistles blow an average of 500 times during a game. The rules list more than 70 fouls, with penalties ranging from the loss of a down to forfeiture of the game. Conferences between officials and team captains, often misconstrued from the stands as an "argument," are usually the officials' explanations of the nature of the foul and the options involved for the offended team's captain.



7. Interference: A player cannot interfere with another attempting to receive a pass, except in his own bona fide effort to catch the ball

8. Score: Holding arms overhead indicates touchdown or a field goal

9. First Down: Vigorous pointing motion toward offensive goal means team has made the required 10 yards

10. Illegal Pass: Only one pass forward is permitted during each down

11. Illegal Contact With Ball: Most generally occurs when an ineligible man on offense touches forward pass

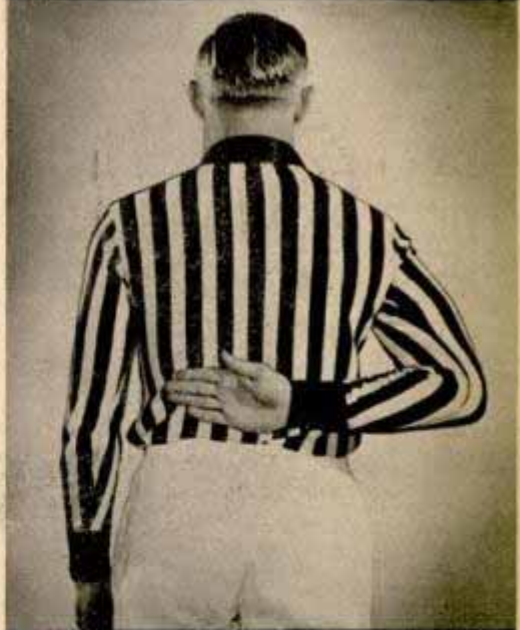
12. Roughing, Clipping: Most of the serious bodily contact fouls are signaled this way. For clipping, official also taps back of his leg



12. ROUGHING, CLIPPING

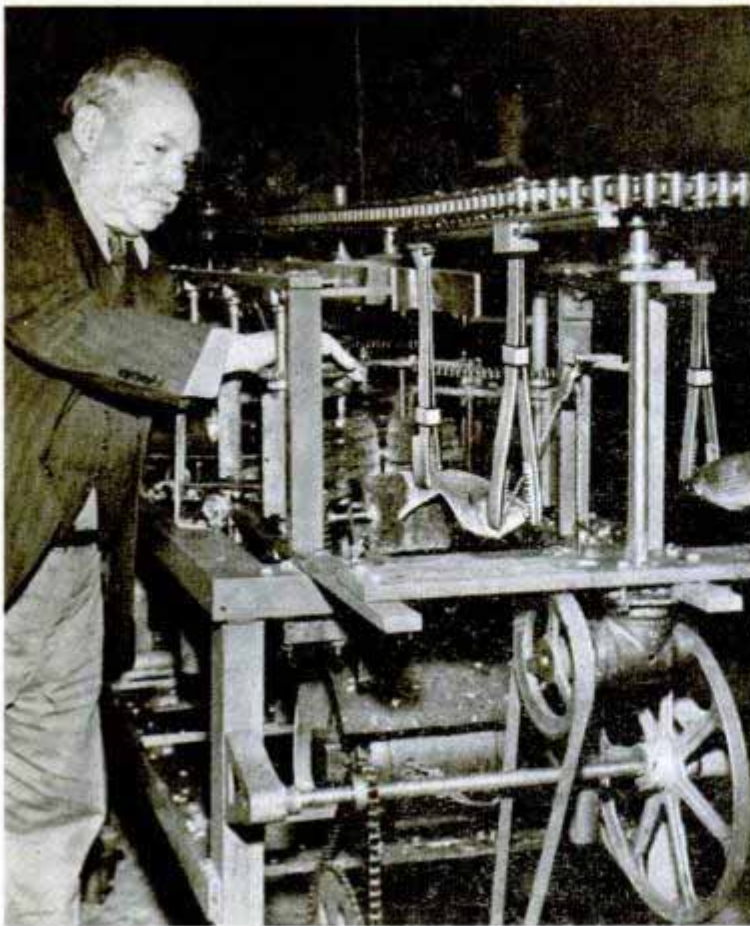


11. ILLEGAL CONTACT WITH BALL



10. ILLEGAL PASS





Automatic Fish Cleaner Handles 10 a Minute

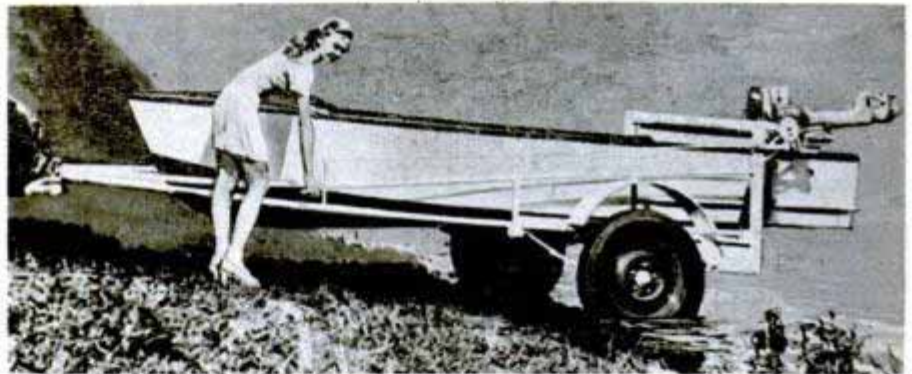
As many as 10 fish a minute, untouched by hand, are cleaned and scaled by an electric machine designed for fish markets. Adjustable clamps hold the fish while a conveyor belt carries them through five pairs of rotary brushes which remove the scales. Near the end of the line the fish are split open and cleaned automatically. The machine handles fish ranging in size from half-pounders up to 12 pounds.

Fewer Knocks Per Gallon

Better antiknock gasoline can be produced by vaporizing the gas and straining it through bauxite crystals. The process removes sulphur impurities that cause engine knock. Bauxite is the ore from which most aluminum comes. A single batch treats up to 15,000 gallons at a cost of less than one cent a barrel.

Trailer Lowers Boat For Launching

Boats up to 16 feet in length can be loaded or launched by one man with a boat trailer that has a winch assembly. The stern of the boat rests in a canvas sling and the bow on a cross brace of the trailer. In launching the boat, the owner backs the trailer to the edge of the water, then turns a crank to lower the sling until the boat floats free. To reload the boat he propels it over the sling and



raises it with the winch until he can slide the bow over the cross member. Two models of the trailer are available for boats with beams up to 54 and 64 inches.



Over-the-Belt Fishing Tackle Box Opens to Form Shelf

Anglers are given an "extra hand" with a tackle box that straps to the belt and opens to form a shelf which serves up flies and lures. The fisherman's belt passes through a slot in the outer of two lids. The inner lid swings out into a horizontal position to form a shelf on which tackle can be placed while a change is being made. Made of Tenite plastic, the box is available in two different styles, one compartmented for leaders, large tackle and small bait, and the other for flies and odd hooks. A secure catch on the tongue of the outer lid insures tight closure of the box.



THUNDER HUNTERS

BY FLYING specially instrumented planes through storms and using radar to probe the skies, scientists have discovered new facts about thunderstorms which may lead to safe all-weather flying and effective flood control.

From 38 rocky flights at the Weather Bureau's Thunderstorm Project near Orlando, Fla., it was learned that every thundercloud consists of several cells resembling huge lopsided balloons and containing strong air currents and water.

But between each pair of cells is a layer of calm air, extending from one half to three miles. If a pilot could guide his plane between the stormy cells, the flight would be smooth and safe.

No detection instrument exists today which shows a clear outline of thundercloud cells. Consequently, planes caught in storms are sometimes turned upside down or swept upward several thousand feet.

One of the nation's top weather experts believes that radar sets of the future may be able to distinguish thunderstorm cells from the calm air between them to guide the pilot on a safe course.

By John R. Kinsey

Dr. Horace R. Byers, director of the Thunderstorm Project,

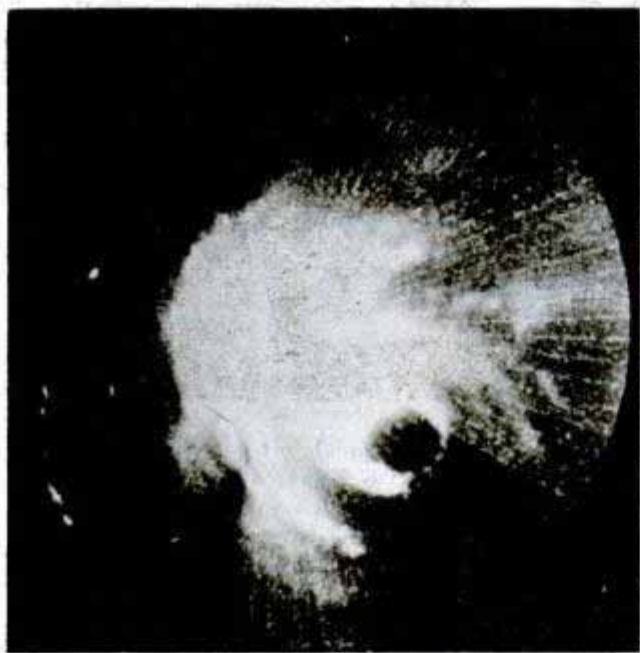
points out that present radar locates thunderstorms by the reflection of its beam from rain-filled clouds. Tests at Orlando also revealed that radar detects the height in a thundercloud where icing begins. The ice level shows up as a bright line on the scope as a warning to pilots.

Tomorrow's radar equipment also may help prevent floods, Dr. Byers predicts. In place of several thousand rain gauges, he visualizes radar sets scanning the skies throughout the country, night and day, to locate thunderclouds and reveal how much water each cloud contains. Radar sweeping through a radius of 50 miles would cover approximately 8000 acres.

The benefits of such a system can readily be seen. In the Tennessee valley, for example, radar forecasts would warn—well in advance—when reservoirs should be opened to let out water to make room for approaching rainfall. The speed of radar in measuring rain before it falls will eventually outmode rain gauges, reports Dr. Byers, on leave from the University of Chicago during the thunderstorm studies.



This is how it looks from a B-29 when approaching a hurricane at an altitude of 30,000 feet. Below, "eye" or center of a hurricane shows up on scope of radar



He and his Weather Bureau associates form their conclusions by studying data obtained by a daring group of Army Air Forces pilots and radar observers who fly P-61s through the storms. This summer the flights are being made at the All-Weather Flying Division's Headquarters Field, Clinton County Air Field, Wilmington, Ohio. Actual flying missions began May 12 and will continue until the middle of September, during which approximately 40 frontal-type storms are expected.

Last summer the thunder hunters played tag with storms over the Army Air Base at Orlando, Fla., where 38 tropical-type storms were encountered. In addition to nine P-61s, three sailplanes provided by the Soaring Society of America took part.

The pilots, particularly the glider operators, had some rough times but they and their recording instruments supplied considerable scientific data that may be important to aviation, agriculture, the electrical industry and mankind in general.

Being in a plane hit by lightning has become routine for the pilots, with burn marks leaving their "fingerprints" on the metal skin of the plane. Lightning, despite the belief of many people, presents no great hazard to metal airplanes. The electrical charge, striking the outer surface of a plane, has no effect on the occupants, unless possibly to frighten them.

At Wilmington the pilots and observers are on 24-hour call, waiting for the arrival of a thunderstorm. The moment a ground radar spots an approaching storm (usually at night), five pilots and five radar observers hop in their specially equipped Black Widows.

Other men climb into two F-15s—one outfitted with automatic cameras to take pictures, and the other equipped with an instrument to attract lightning and measure its power and duration.

Guided by radar and radio, the planes enter a storm a minute apart to prevent any possibility of collision. They knife through a thundercloud at various levels—perhaps 6000 feet, 11,000, 16,000, 21,000 and 26,000—to collect data throughout the entire storm.

While rain, snow, wind and lightning bombard the planes, the automatic instruments "take the pulse" of a storm to provide Weather Bureau analysts with measurements to piece together into a complete picture of what takes place inside a thunderstorm.

Accelerometers measure turbulence and drafts; control position indicators differen-

Antenna is maneuvered by man at left to track radio beacon from balloon-borne transmitter. Messages reveal weather conditions at altitudes to 70,000 feet

tiate between air accelerations and accelerations caused by motions of the plane; thermistors take the air temperature; wire recorders preserve comments the sky probers make as they observe the behavior of storms from a "top balcony" seat.

In addition to the airborne instruments, the Weather Bureau studies thunderstorms at ground level by means of 63 surface observation stations located in checkerboard fashion across a 160-square-mile area on the outskirts of Wilmington.

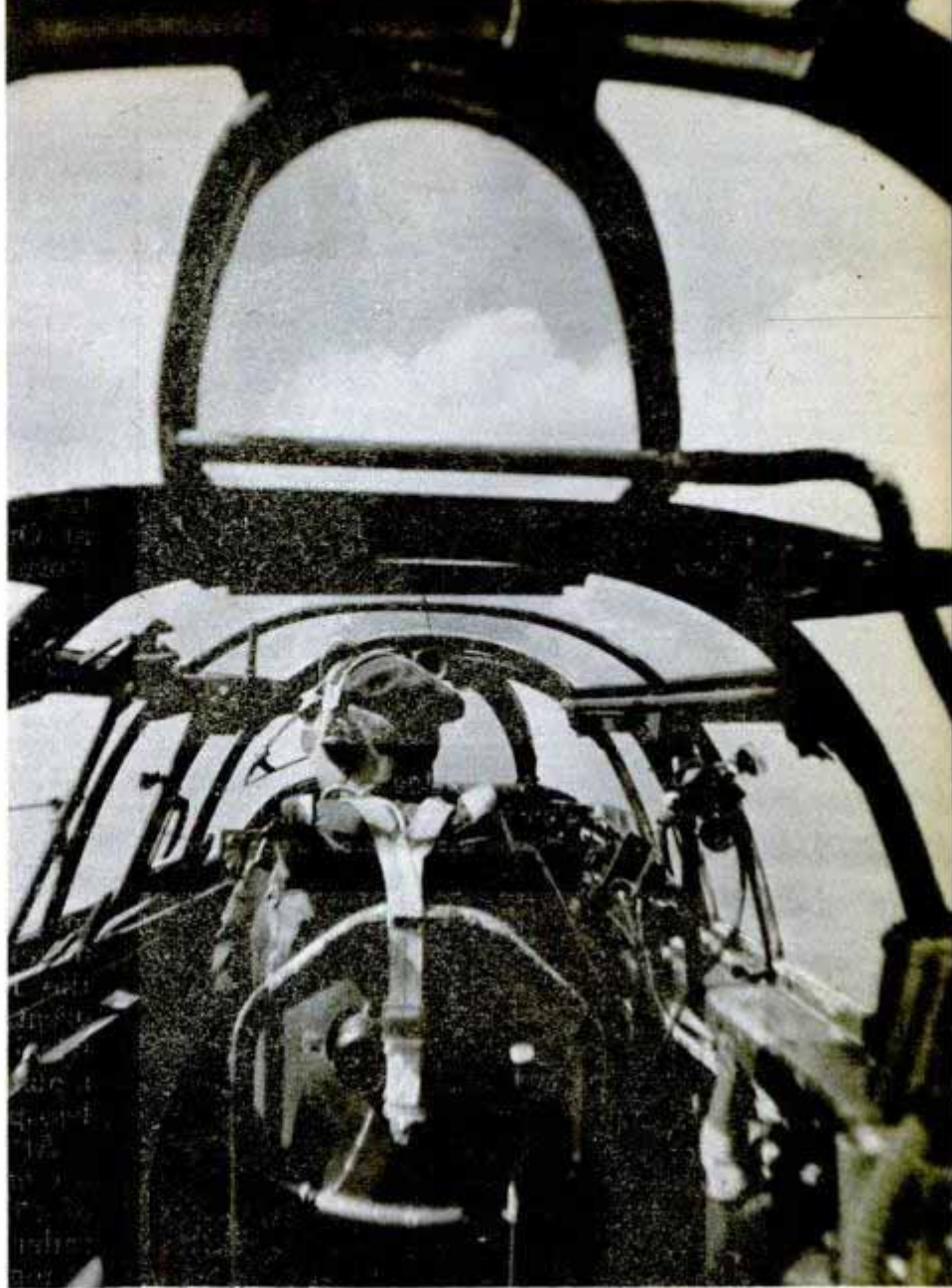
Delicate instruments, operated by clockwork and electricity, give precise readings of wind speed, wind direction, temperature, humidity, atmospheric pressure and the amount of rainfall for each minute of the 24-hour day. Each automatic, self-recording station is visited daily to remove charts containing the data.

Seven radio direction finding units (called SCR-658) are spotted throughout the test area to track balloon-borne radio sets which transmit meteorological data to the ground receiving stations. Wind direction, wind speed, temperature, atmospheric pressure and humidity at air levels up to 70,000 feet are learned from the radio messages.

By plotting and analyzing weather measurements obtained by instruments in planes, balloons and ground stations and by radar, the Weather Bureau now has a more complete understanding of a storm's structure.

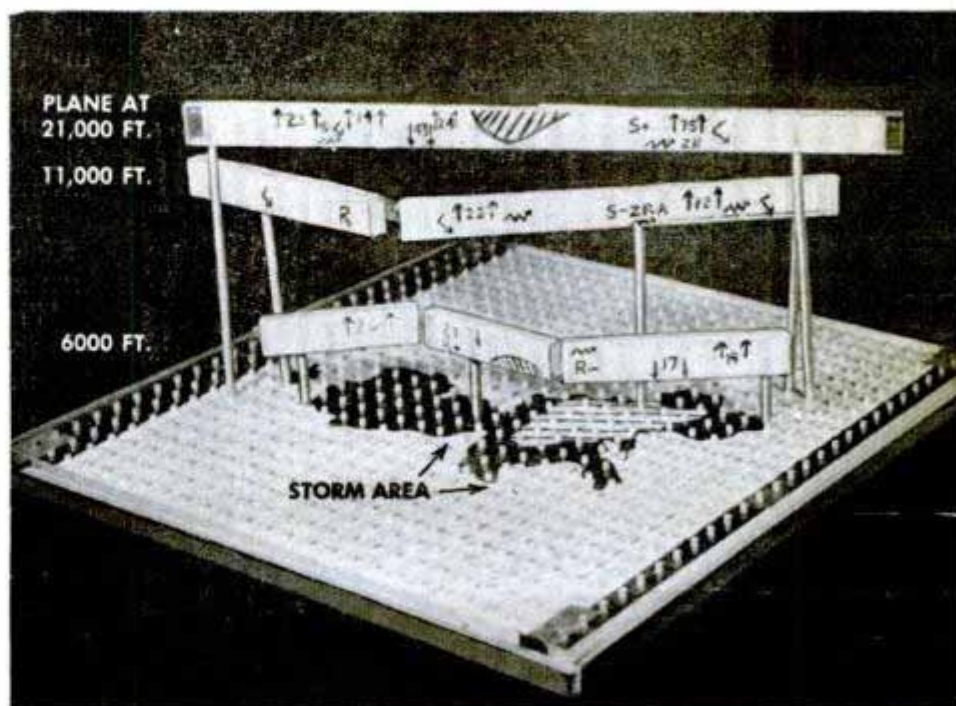
As mentioned earlier, a thunderstorm consists of several cells, between which planes may some day chart a smooth, safe course. The height of cells varies from a few thousand feet (at the building stage) to 40,000 feet (at the peak).

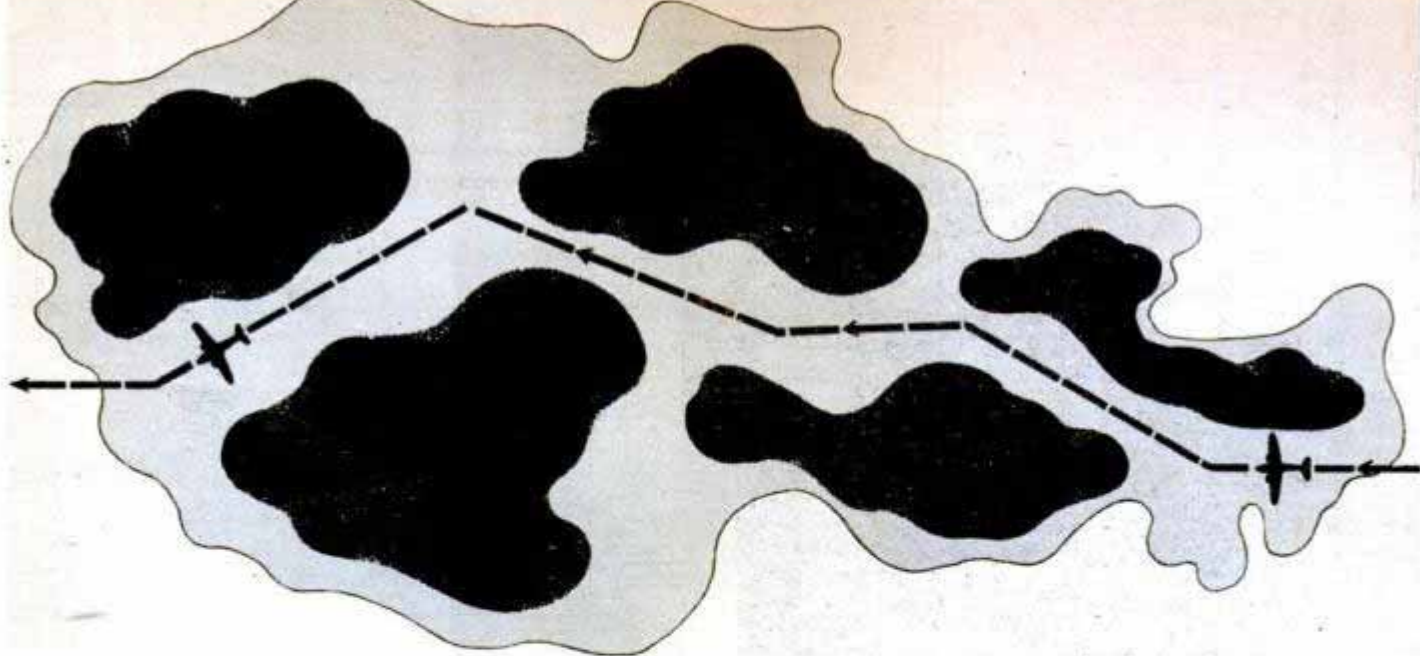
Each cell goes through (1) the development or building stage, (2) the peak stage, and (3) the dissipating stage. In the development stage, vertical currents are all upward and continue upward until condensation within the cell reaches such proportions that the rising current no longer is able to carry the increasing amount of water. As water begins to fall through ascending air currents, a downdraft develops.



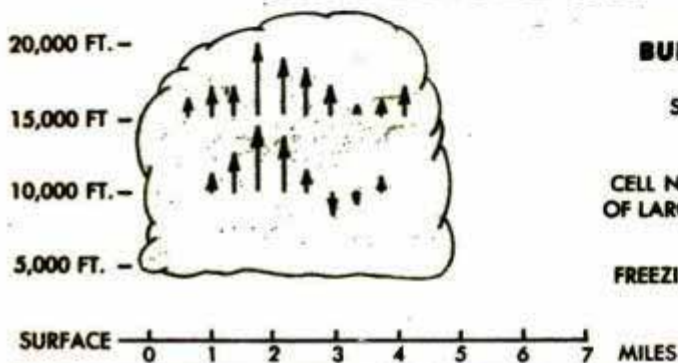
Official AA" photo

When heading into a thunderstorm, this is the view as seen from the radar observer's position in a P-61 Black Widow. This plane is equipped with special automatic instruments to record weather data. Below, model represents the data for weather studies





THUNDERSTORM CELL

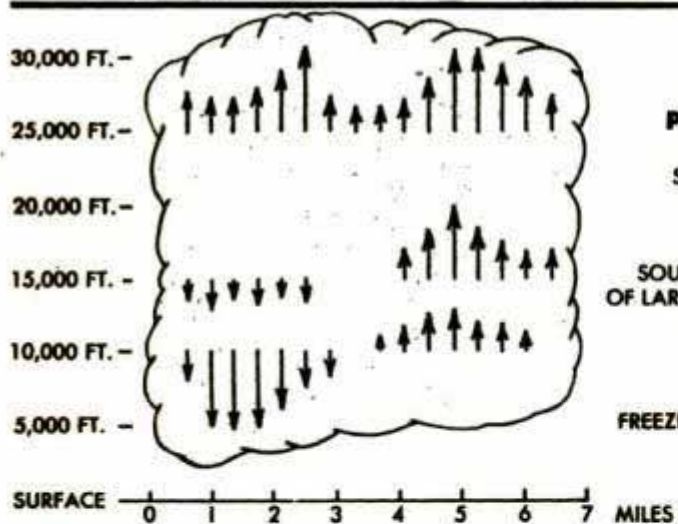


BUILDING STAGE

ST. CLOUD, FLA.

CELL NEAR WESTERN EDGE
OF LARGE MULTICELL STORM

FREEZING LEVEL 15,000 FT.

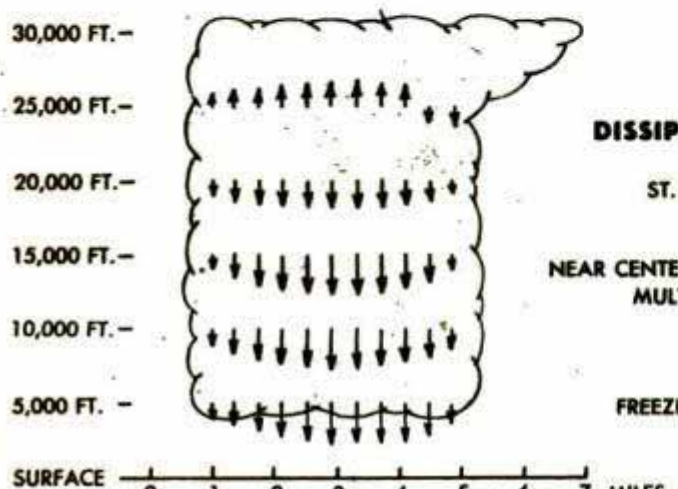


PEAK STAGE

ST. CLOUD, FLA.

CELL NEAR
SOUTHWESTERN EDGE
OF LARGE MULTICELL STORM

FREEZING LEVEL 15,000 FT.



DISSIPATING STAGE

ST. CLOUD, FLA.

NEAR CENTER OF AN ELONGATED
MULTICELL STORM

FREEZING LEVEL 14,000 FT.

Artist's conception of a thunderstorm shows turbulent cells (shaded dark) and calm spaces between them. Radar may be able to locate calm course for planes. Left, thunderstorm cell at three stages

At this point the cell passes into the peak stage.

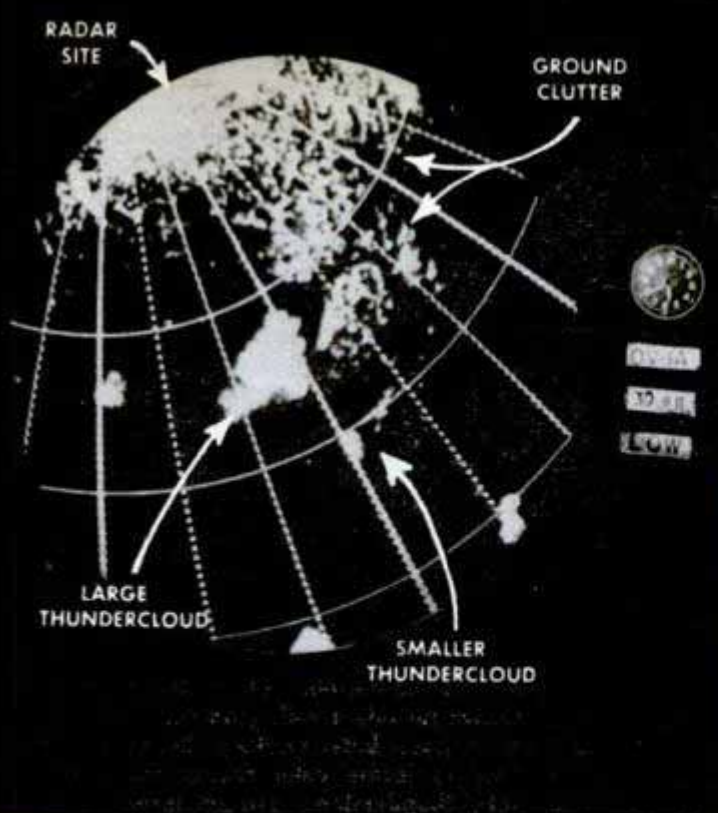
In the peak stage, the lower portion of the storm contains both updrafts and downdrafts. By the time the downdraft area at the base of the storm exceeds the area of the updraft, the cell passes into the dissipating stage.

In the dissipating stage the downdraft predominates the cell in all but the top section. The speed of the draft is less than it was in the peak stage and the rain under the cell has decreased to light rain.

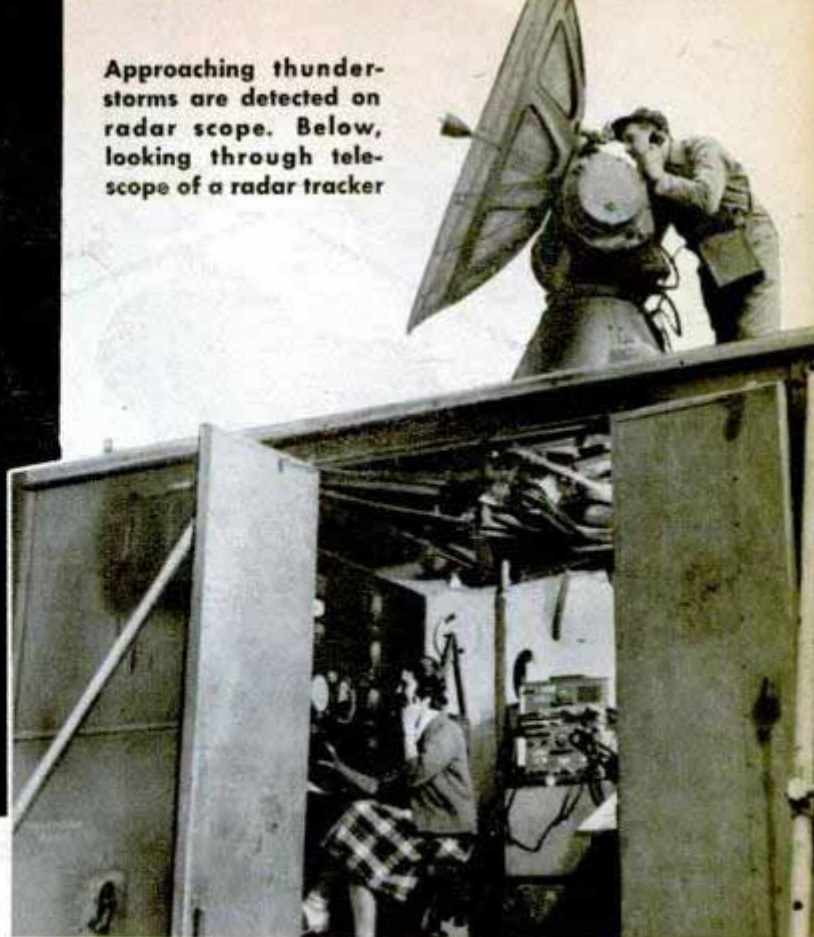
The downdrafts of the thunderstorm cell are caused and maintained by the rain produced within the cell. Throughout the storm, gusts of wind are concentrated in the cells, with a minimum of gusts between the cells.

While the Weather Bureau and Army Air Forces are exploring thunderclouds, the Navy is spotting and flying through hurricanes in the Guam area. Previously, seven Navy planes flew more than 1000 hours during hurricane patrol flights off the coast of Florida.

Such meteorological studies have increased our knowledge of weather phenomena and techniques of forecasting. For example, it formerly was believed that only about a half dozen typhoons occurred in the Pacific in a single year. Actual investiga-



Approaching thunderstorms are detected on radar scope. Below, looking through telescope of a radar tracker



tion, however, showed that at least two dozen such storms could be expected annually in the Pacific area.

With the application of radar to storm detection, Navy flyers are able to spot hurricanes at distances up to 150 miles. Even the structure of a hurricane, with its calm, precipitation-free eye in the center, is distinguishable on the scope. An echo-free circle within the spiral arrangement of a typhoon's storm clouds locates the center.

By spotting the hurricanes 150 miles away by radar—and flashing a warning by radio—forecasters now provide coastal residents with better protection of lives and property.

Another innovation is the use of the wire photograph to deliver weather reports to AAF pilots. Networks of facsimile sets are being installed across the United States for transmitting weather maps.

Use of the facsimile transmitters for relaying weather information was developed by Air Materiel Command Headquarters at Wright Field, Ohio. Present plans call for dividing the nation into four large networks to receive this modern weather-forecast service.

Weather analysts in a centrally located weather station will prepare maps, insert them into the transmitter, and relay copies to stations all over the country.

Shortage of skilled weather analysts has been making it increasingly difficult for AAF pilots to obtain clearances for their aircraft at some fields. Use of the facsimile transmitter will reduce the number of skilled analysts required, and will effect a considerable savings after the initial cost of the installation is met. The system will



Official AAF photo

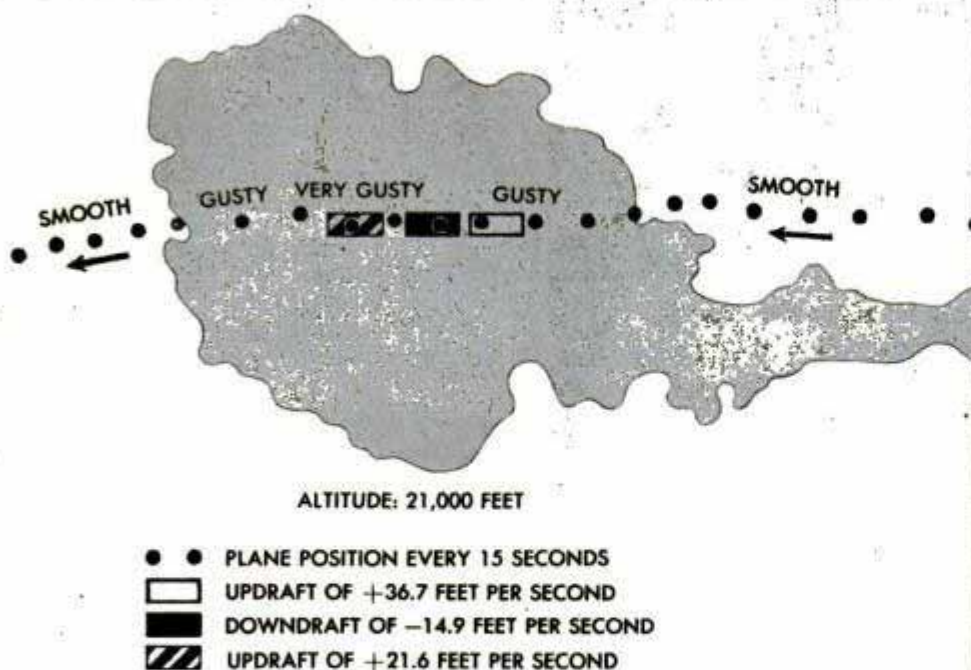
In this "skiatron," radar operators control air traffic at All-Weather Flying Center and within a radius of approximately 40 miles, preventing aircraft collisions

provide even the smallest airfields with the services of the most skilled weather forecasters assigned to the AAF.

The facsimile set is somewhat similar to the teletype. It operates on impulses which are controlled by the blackness of the picture being transmitted. Now that science has developed improved means to find out and tell the world what kind of weather lies ahead, the only thing needed is some



Another view of an instrumented P-61 in which AAF pilots and radar observers battle through thunderstorms to learn more about rocky weather to make flying safer. Below, analytical chart of a plane's flight through a storm



method of changing the weather — in case it doesn't suit us.

Such an idea sounds fantastic, but Dr. Vladimir K. Zworykin of the Radio Corporation of America believes that weather control, within certain limits, is entirely possible.

First, he predicts that electronic devices of the future will make it possible to forecast, in a matter of seconds, the weather outlook for days in advance. With this advance knowledge, two novel methods are suggested by Dr. Zworykin to cause storm centers to alter themselves and dissipate.

In the case of a hurricane developing over an ocean, the RCA engineer recommends spreading a combustible material, such as oil, over a considerable area at the storm center. By igniting the material, energy would be added directly to the building storm. The fire would cause updrafts of surface air, followed by condensation at higher levels. This action would modify the motion of the air masses in the surrounding area.

The second weather control method involves changing the reflection and absorption characteristics of a particular area. In fact, Dr. Zworykin believes radiation from the sun may be used to modify weather. He visualizes the establishment, at strategic points, of "weather control patches," areas of land which eventually would become blackened by deposits of carbon. These highly absorbing areas could be quickly converted to highly reflecting areas by use of fog created artificially.



Fairchild photo

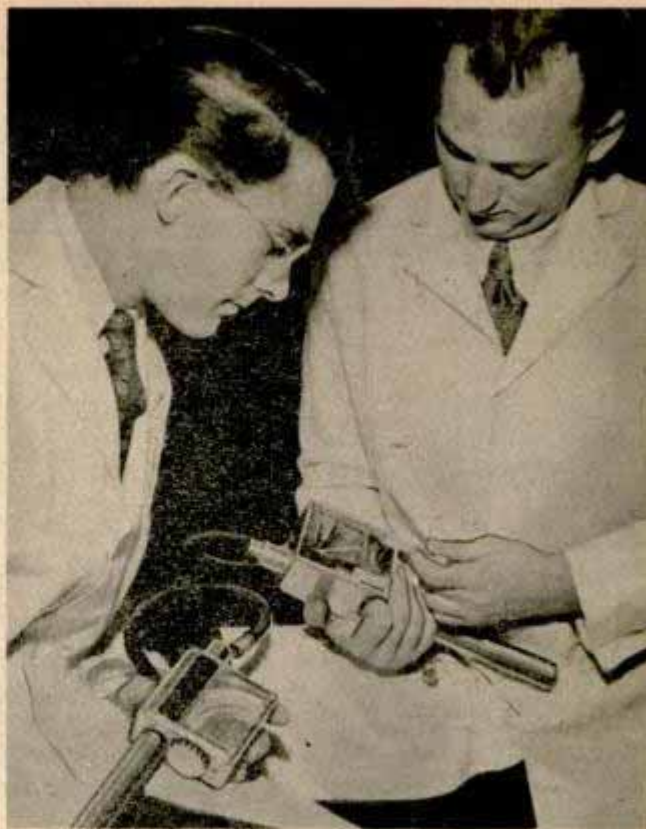
Portable Copy-Printer

Plugged into an electric outlet, a portable photographic printer reproduces any printed material or pictures without the need of a darkroom. It is small enough to be taken to a court or library to copy bulky records or reference material. A sheet of light sensitized paper is placed over the copy and the printer rolled over it. Either negative or positive copies can be made and processed in subdued daylight or ordinary office light.

Mouth-Blown Blowtorch

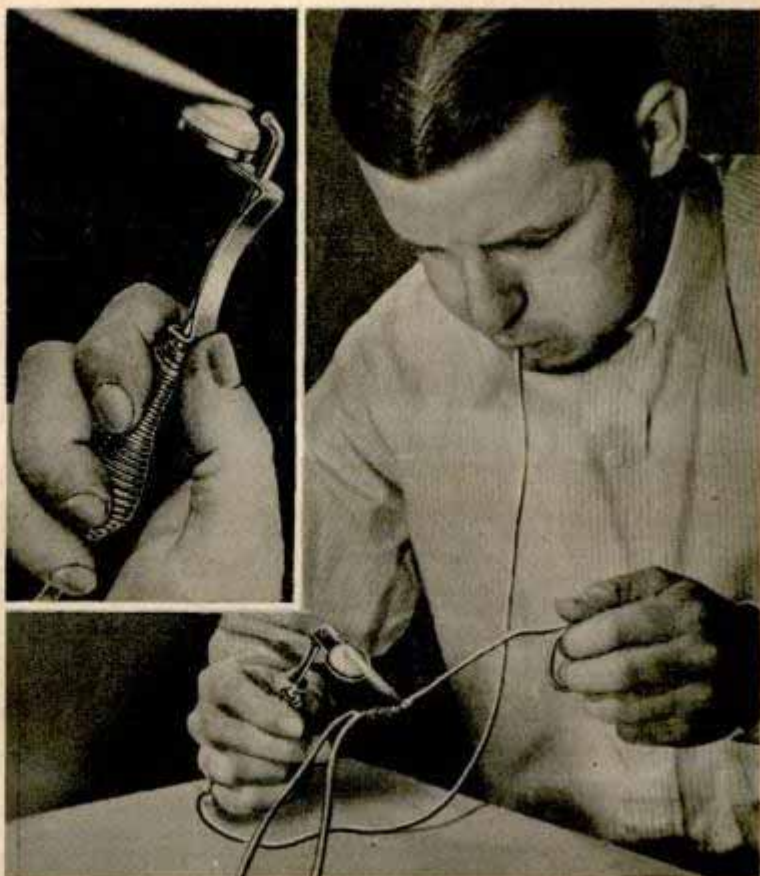
With the jet supplied by blowing gently into a mouth tube, a lightweight blowtorch uses dry chemical tablets for fuel. A fuel tablet is placed in a holder and lighted to form a flame which is directed against the soldering work by blowing air through the tube. Each tablet burns about 10 minutes and creates heat in excess of 2000 degrees. The tablets may be extinguished and relighted.

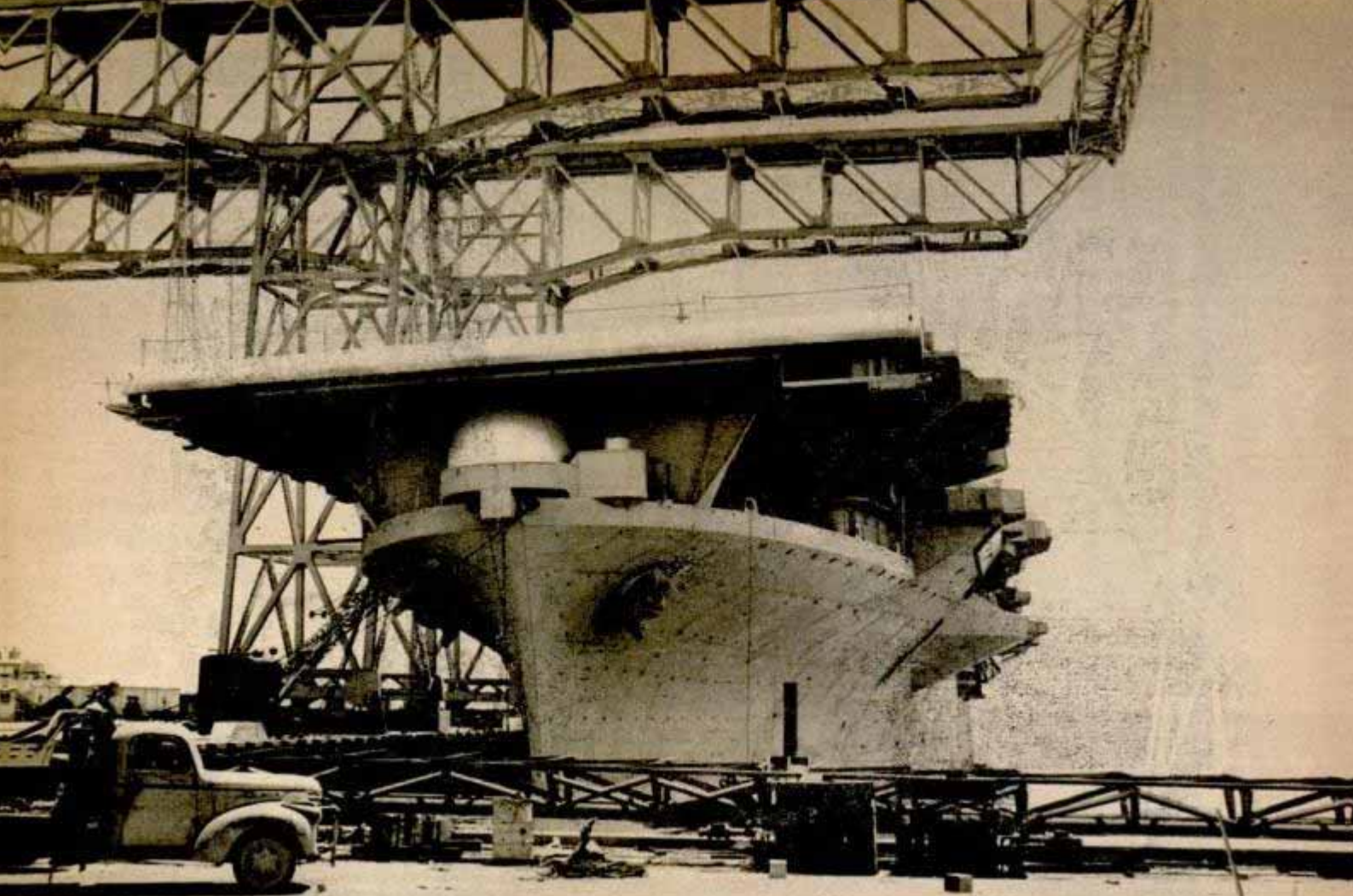
You may wish to obtain additional information about the new products described each month in *Popular Mechanics*. If you want to know the name and address of the manufacturer or distributor, just write to Bureau of Information, *Popular Mechanics Magazine*, 200 East Ontario Street, Chicago 11, Illinois. Your letter will be answered promptly.



Automatic Rip Cord

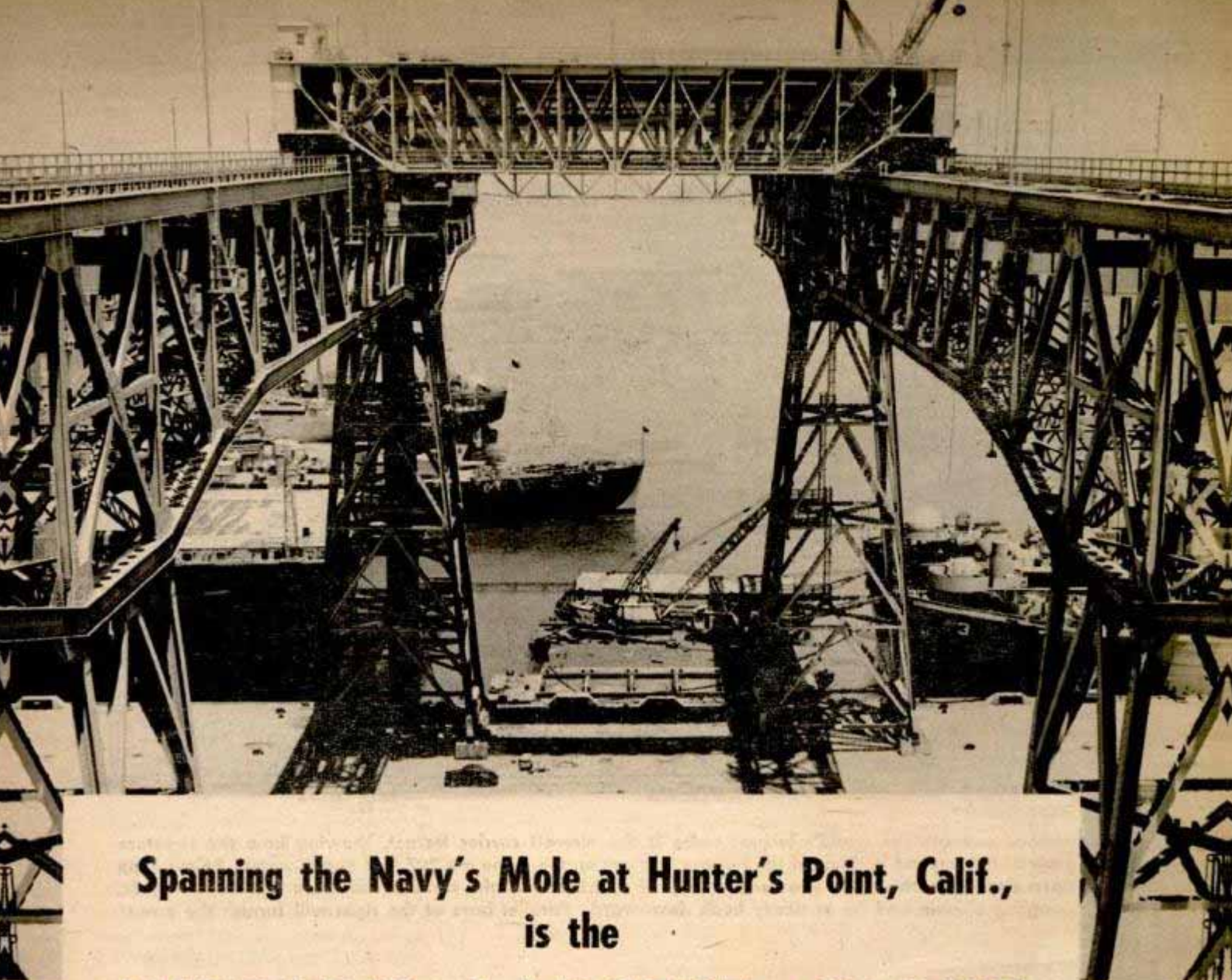
Some of the hazards of bailing out at high altitudes are eliminated by an automatic rip cord mechanism "triggered" by atmospheric pressure. Scarcely bigger than a watch, the device has an aneroid barometer that responds to increasing pressure on the downward plunge, opening the chute automatically at a safe altitude.





Berthed beneath the world's largest crane is the aircraft carrier Hornet, showing how the structure projects out beyond it. Tops of the trolleys that run on the crane are 207 feet above water. Below, long open slot inside the crane structure, on top of which one of the trolleys will move from side to side, dangling a main and an auxiliary hook downward. Parallel bars at the right will furnish the power





Spanning the Navy's Mole at Hunter's Point, Calif.,
is the
WORLD'S LARGEST CRANE

*Its steel arms can pick up
a 400-ton battleship turret*

THE WORLD'S BIGGEST HOOK, capable of picking up a battleship's turret with ease, will be ready for business this fall at the San Francisco Naval Shipyard at Hunter's Point, Calif.

So huge that its operating crew uses short-wave radio for communication with each other, the great crane has a built-in 15-story passenger elevator, aerial beacons to warn aircraft away and its own electrical substation.

The crane will speed up the regunning of battleships whose big 16-inch rifles, weighing 80 tons each, have worn out. It can regun two ships at the same time or lift an entire turret, minus its guns and weighing 400 tons, in case of battle damage to the turret or a change in design. Formerly it was necessary to cut a turret into pieces for hoist-

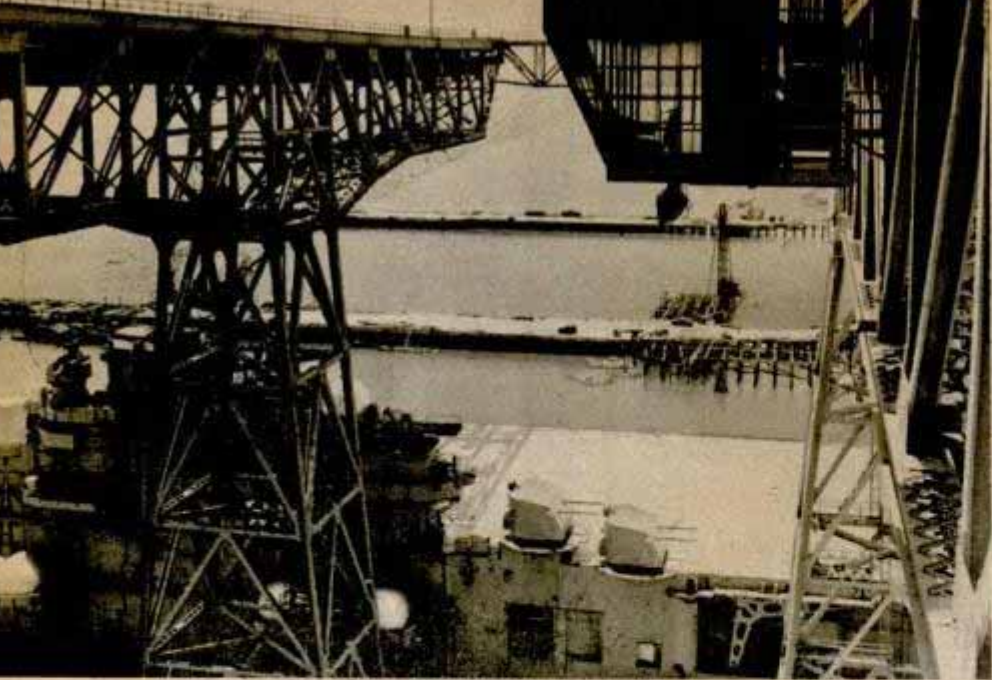
ing ashore one at a time, a tedious process.

The crane can lift other miscellaneous heavy loads far beyond the capacity of any other crane in the world. Most of the big cranes used in ship construction have lifting capacities of 50 tons or less.

The biggest hook consists of a pair of overhead traveling cranes mounted side by side on a bridgelike runway that is 182 feet above ground and 730 feet long. This huge runway is built across a special mole or pier and extends 162½ feet out over the water on each side of the mole, towering high above battleships or aircraft carriers berthed below it. The runway rails are 142 feet apart.

Each crane contains a traveling trolley from which is suspended one main and one auxiliary hook. Direct-current motors in the trolleys

By Thomas E. Stimson, Jr.

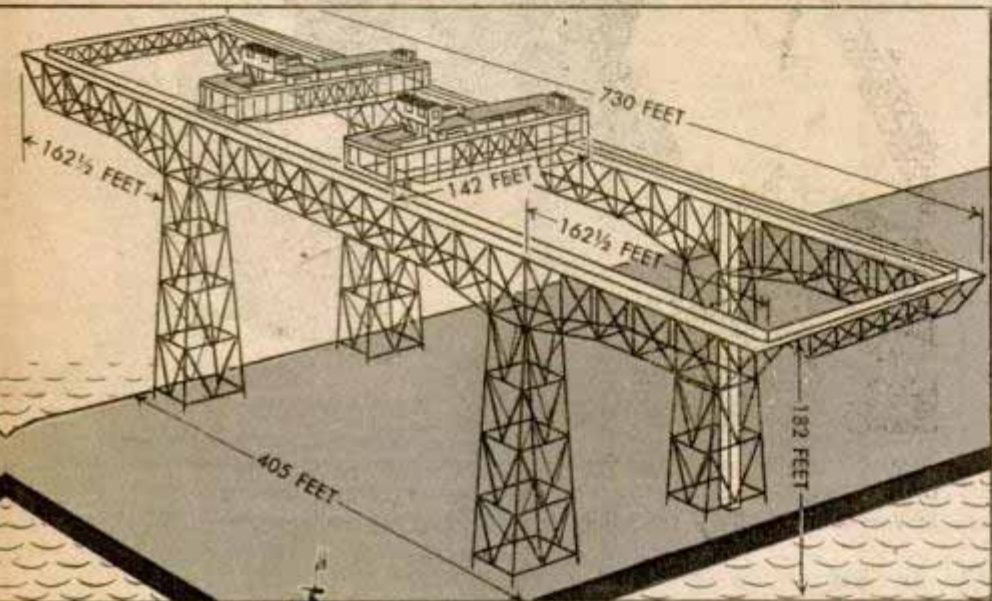


operate the hoisting drums, obtaining their power from parallel rails contained in the crane. The cranes in turn take current from three insulated pieces of railroad trackage that extend the length of the runway.

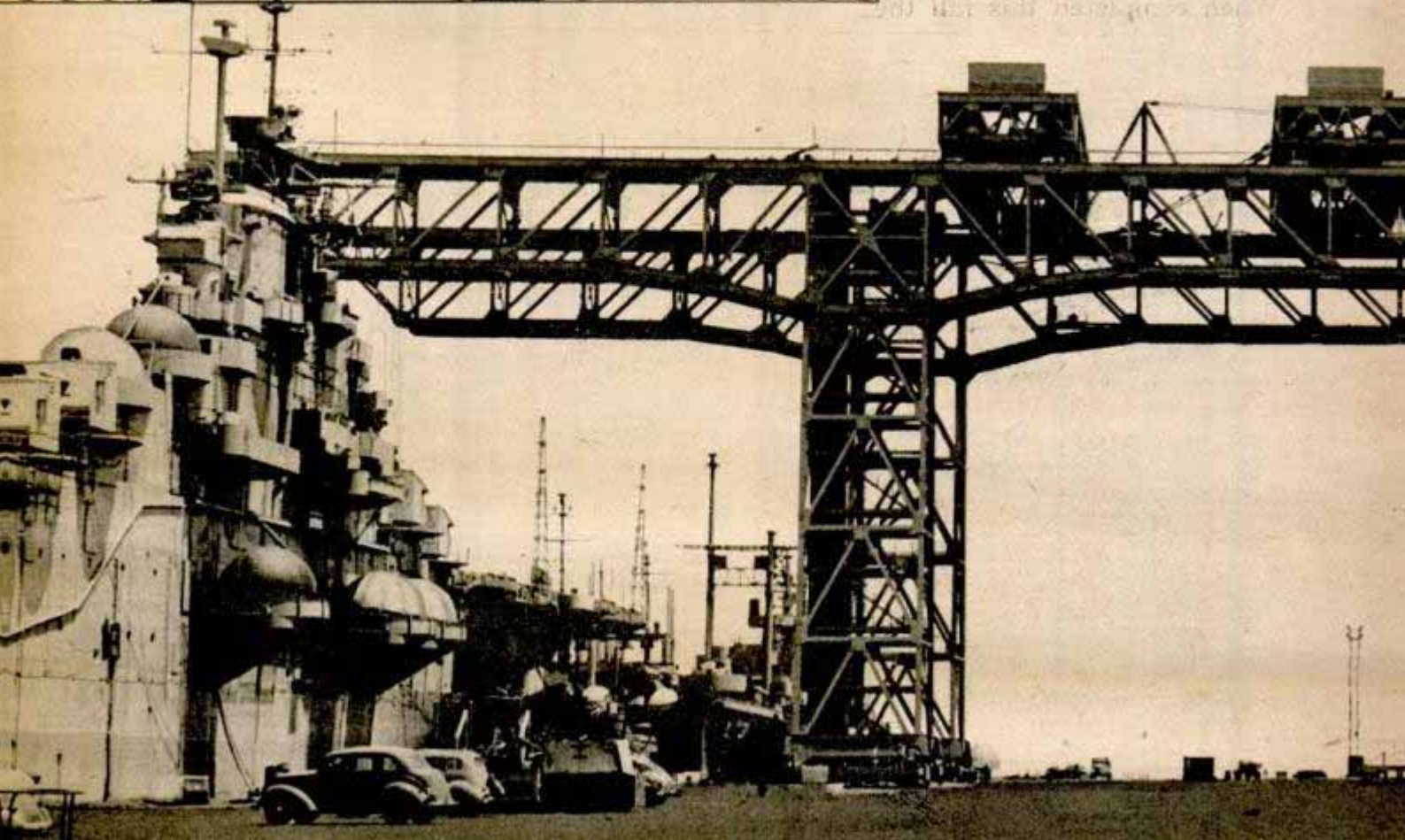
Each main hook is supported from its drums by 24 parts of $1\frac{3}{8}$ -inch steel rope and has a rated capacity of 245 long tons. Each auxiliary hook has a capacity of 50 long tons. Portions of the trolleys are built of aluminum to conserve weight and their tops are 207 feet above water.

When major loads are to be lifted the two cranes are first brought together and joined by ordinary railroad couplers. Then each main hook is lowered to the ground and attached to its end of a 40-ton steel equalizer beam. Hanging from the middle of this beam is the "biggest hook" itself, a sturdy 5-ton casting with a shank 12 inches square. Cables from this swivel hook will lift approximately 450 long tons.

The hooks can reach 25 feet below the water line and lift loads



Above, control booth of a traveling crane is in the upper right foreground. Operators use two-way radio to talk with men at the hook. Drawing at left gives crane's dimensions. The whole unit weighs 8400 tons



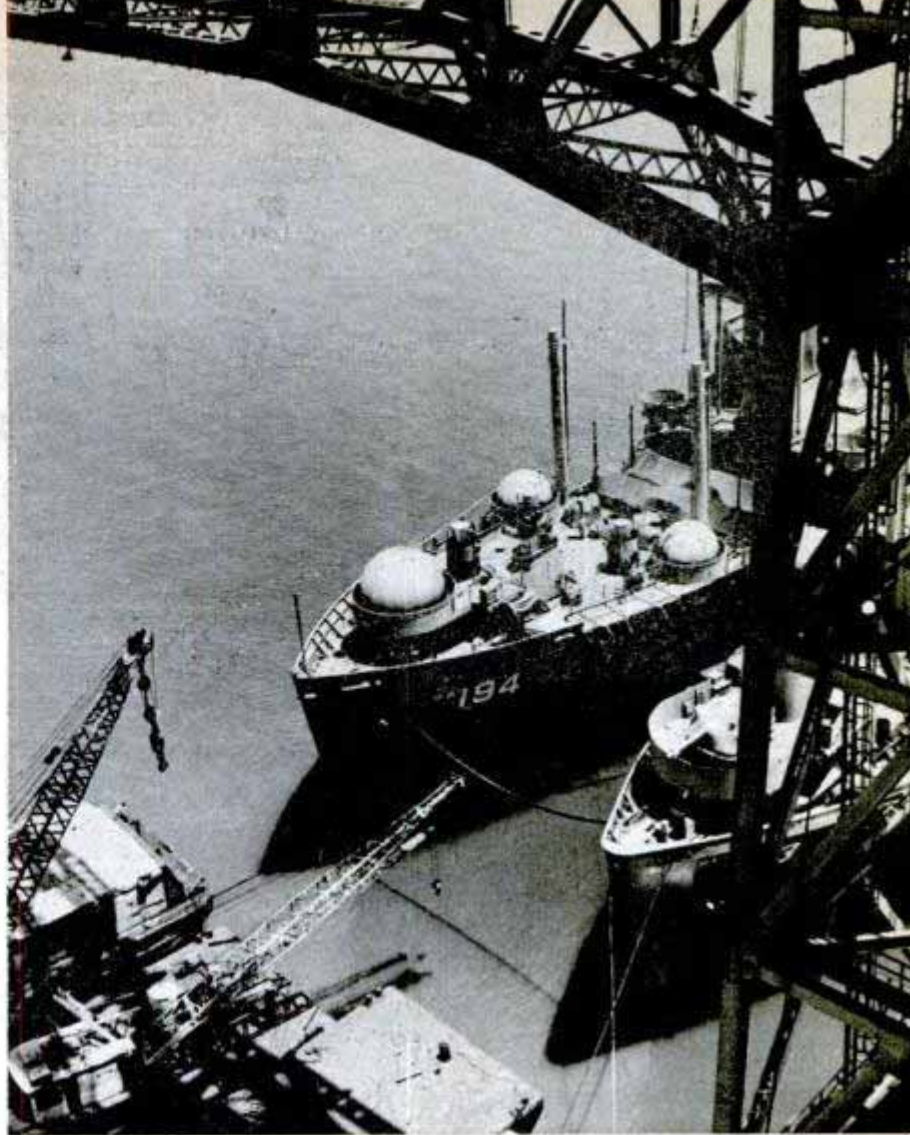
160 feet into the air. To take care of falling tide conditions when a hook is attached to a load that is still secured to a ship, the brakes of the cranes automatically slip when an overload of 150 percent occurs. Depending on the load, hoisting speeds range from 10 to 30 feet per minute.

Green lights on the equalizer beam remain lighted while the beam is horizontal so that the crane operators can tell if they are hoisting in unison. They are replaced by red lights if the beam tilts five degrees or more. Battery powered, the lights are operated by mercury switches.

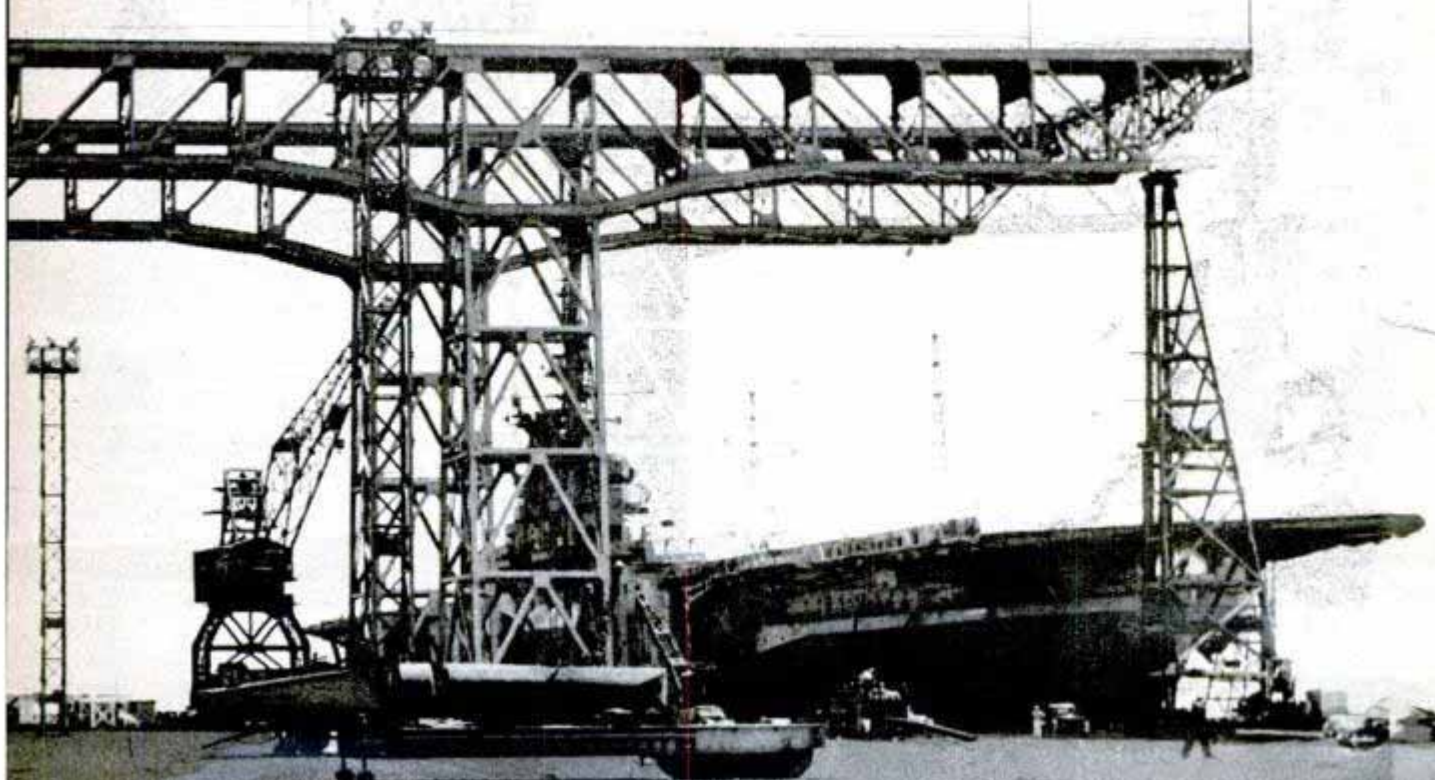
The two outboard ends of the main runway structure were built with an upward camber of 12 inches. Even under the deflection of a record load they will not sag below the horizontal. There are hydraulic jacks in the bases of each of the four supporting towers for realignment purposes in case the structure settles out of plumb. Complete, the whole unit weighs 8400 tons.

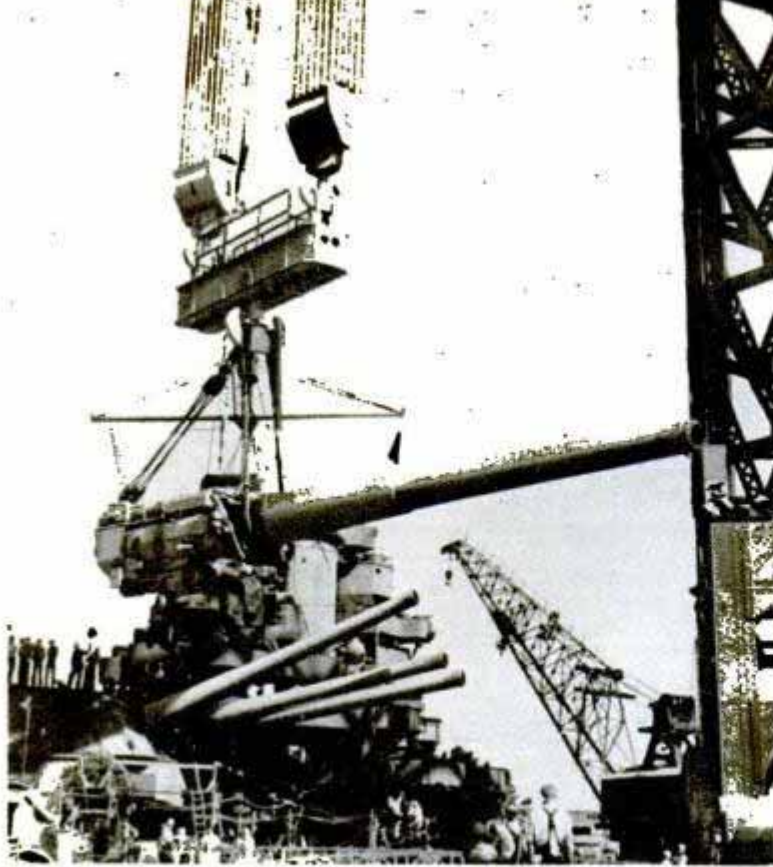
Incoming 11,500-volt power is stepped down to 480 volts at a substation located in one of the towers. Four a.c. motors drive each of the cranes. Hoisting drums in the trolleys use d.c., the conversion being by motor generator sets.

When completed this fall the



Armed transports are dwarfed by overhanging runway of world's biggest crane. Below, 15-story passenger elevator runs in the tower at left. Two traveling trolleys rest on railway above



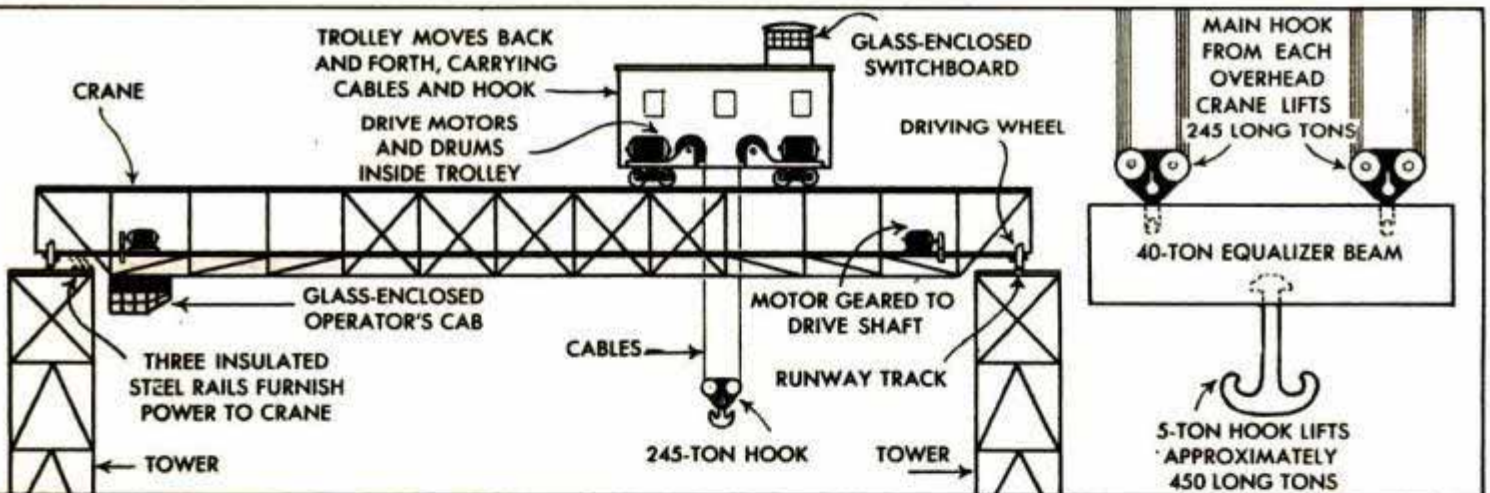


To impress you with the new crane's lifting power, here is one half as large easily hoisting 14-inch guns off a battleship. The Hunter's Point "monster" is designed to lift about 450 tons

entire structure will be subjected to a series of strength tests under the direction of Capt. W. T. Eckberg, officer in charge of construction, before being placed in use. Huge concrete blocks that already have been poured in forms sunk into the mole will be used for the hook tests. Overloads amounting to 125 percent of rated capacity will be applied to the hooks.

The regunning mole was created by driving cellular sheet piling around its dimensions, 1700 feet long and 405 feet wide, and filling in with 3,000,000 cubic yards of sand and rock. Concrete foundations under the towers of the crane structure rest on steel H-piles driven to a depth of 100 feet. In addition the four towers are tied together by huge reinforced concrete beams that are buried in the mole. Including its special mole and appurtenances, the monster crane at Hunter's Point

(Continued to page 256)



At left is the biggest hook of all, a 5-ton casting that will hang from the equalizer beam when weights near 400 tons are being handled. Right, 245-ton capacity hooks that will be suspended from each of the cranes

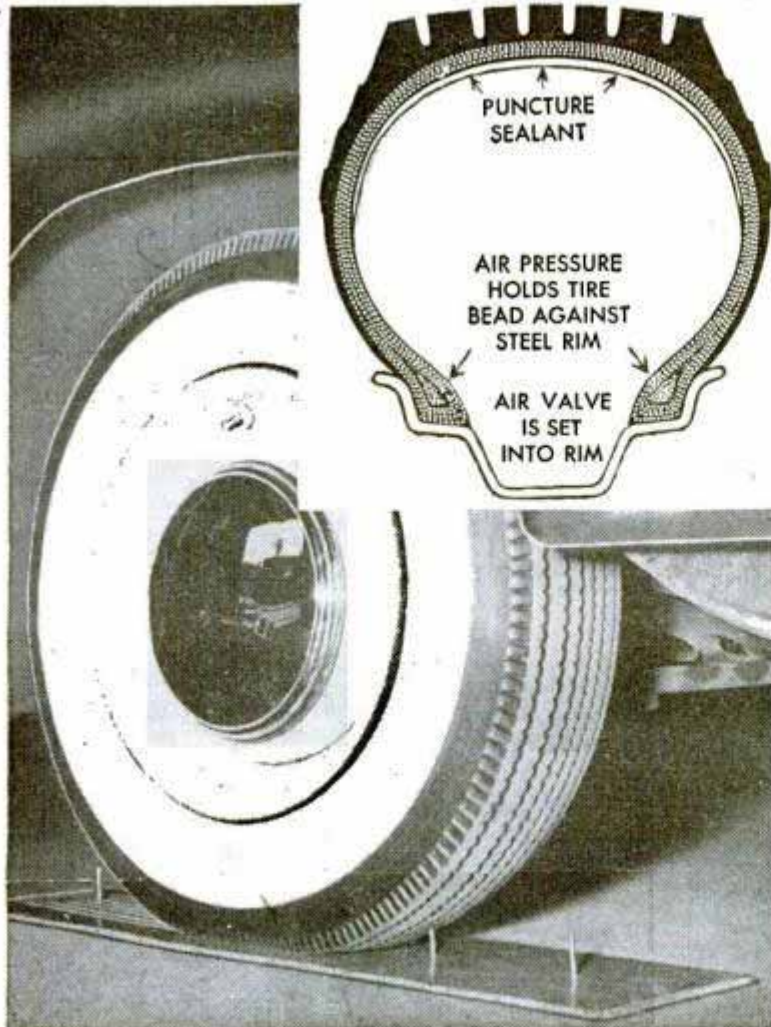


Bank's Cement Mixer Unwraps Coins

Standard equipment in one Los Angeles bank is a cement mixer that removes paper wrappers from rolls of coins. The bank deposits its surplus in a Federal reserve bank that accepts coins in cloth bags but not in paper rolls. Removing the wrappers by hand was a time-consuming job so bank teller Bill Ream suggested breaking the rolls in a cement mixer. The mixer now breaks up 200 rolls in four minutes, a job that required 20 minutes by hand. A blower expels wrappers from the machine.

Vast Oil Reserve Is Under Water

If the world's supply of oil runs low, the continental shelf would yield at least 1000 billion barrels of oil, estimates Wallace E. Pratt, petroleum geologist. About one tenth of this vast underwater plain of roughly 10 million square miles borders on U. S. and Alaska. This tremendous oil reserve is approximately 500 times the world's present annual consumption.



Tubeless Tire

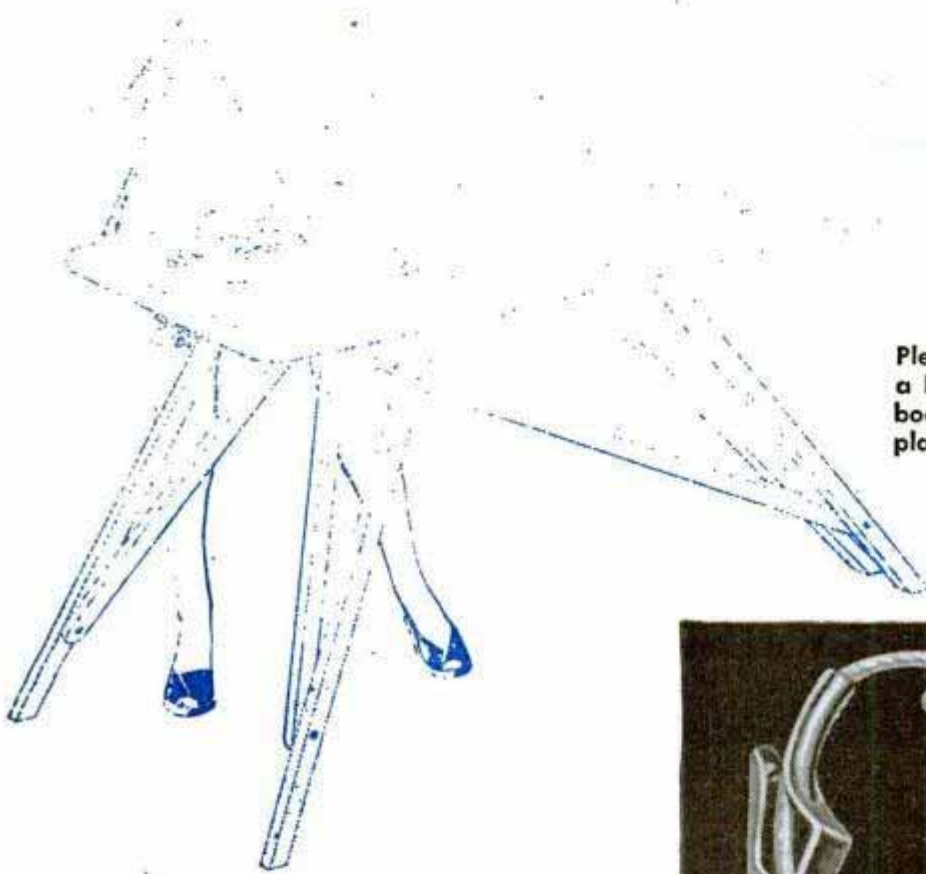
Tubeless tires have undergone high-speed road tests and now are available in limited quantities. The bead of the tire is held against the rim by air pressure and forms an airtight seal, eliminating the need for a tube. The air valve is installed in the rim. A gum-rubber puncture sealant coats the inside of the tire, flowing around the piercing object in the event of a puncture and quickly closing the hole when the object is withdrawn. The tire, which was developed by Goodrich, has a rayon-cord construction.

Synthetic Cloth From Antifreeze

By mixing a synthetic antifreeze liquid with synthetic petroleum products, British chemists have developed an artificial fiber to compete with Nylon and rayon. Called Terylene, it is reported to differ from all other fibers. Textiles made of it are said to resemble silk and can be washed and ironed. Fibers of Terylene can be very fine, or coarse if great strength is desired.

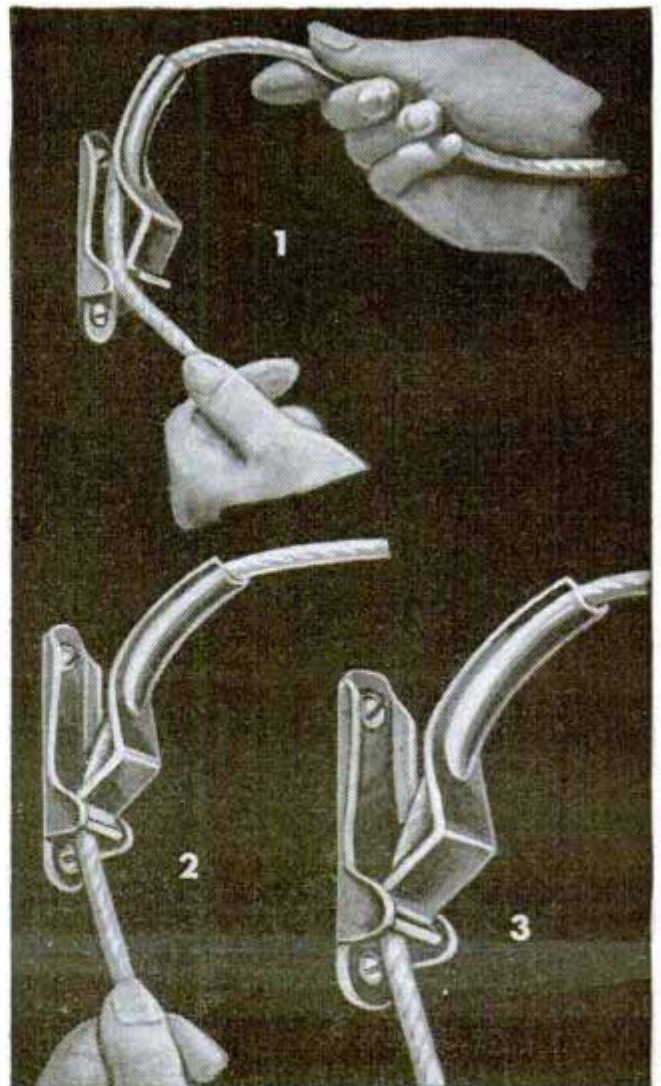
WHAT'S NEW *For Your Home*

A four-page "shopping section"
dedicated to modern homemakers



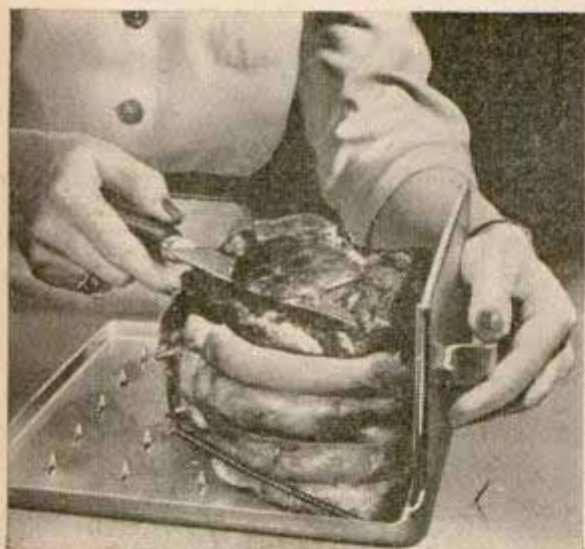
Pleats are pressed more easily with a holder that clamps to an ironing board. The pleats are fastened in place top and bottom by prong clips

Wall plugs with finger grips can be removed easily without jerking, which tends to break the wires. Right, a clothesline holder uses the weight of the hanging clothes to hold the line taut automatically





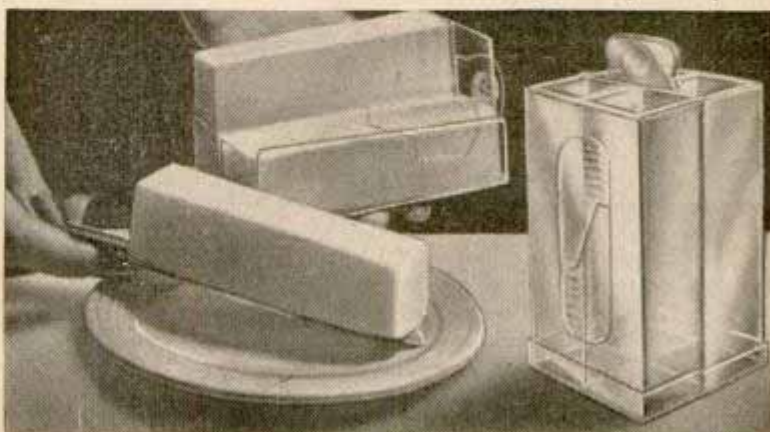
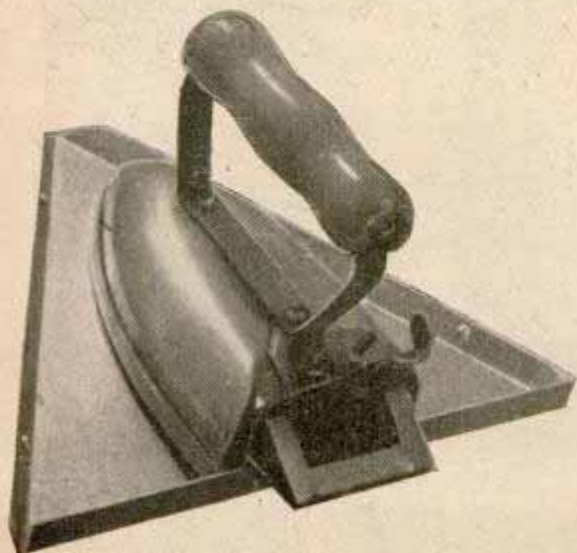
Double-looped wire clips fasten skirts and slacks on hangers so they will not wrinkle, fold or crease. They adjust to any size waistband. Below, roasts carve more easily on holder with spiked base and a spring grip to hold meat in place



↓ Most hazards arising from hot irons are eliminated by using a small metal shelf that can be attached to any wall corner



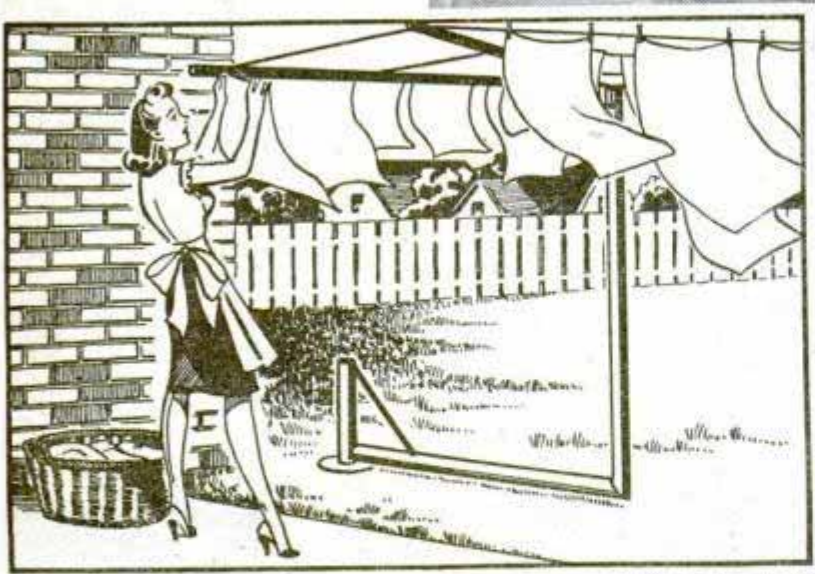
Paper draperies that look and feel like fabric can be cleaned with wallpaper cleaner. Below, plastic cuber molds home-colored margarine and freshly churned butter into quarter-pound packs



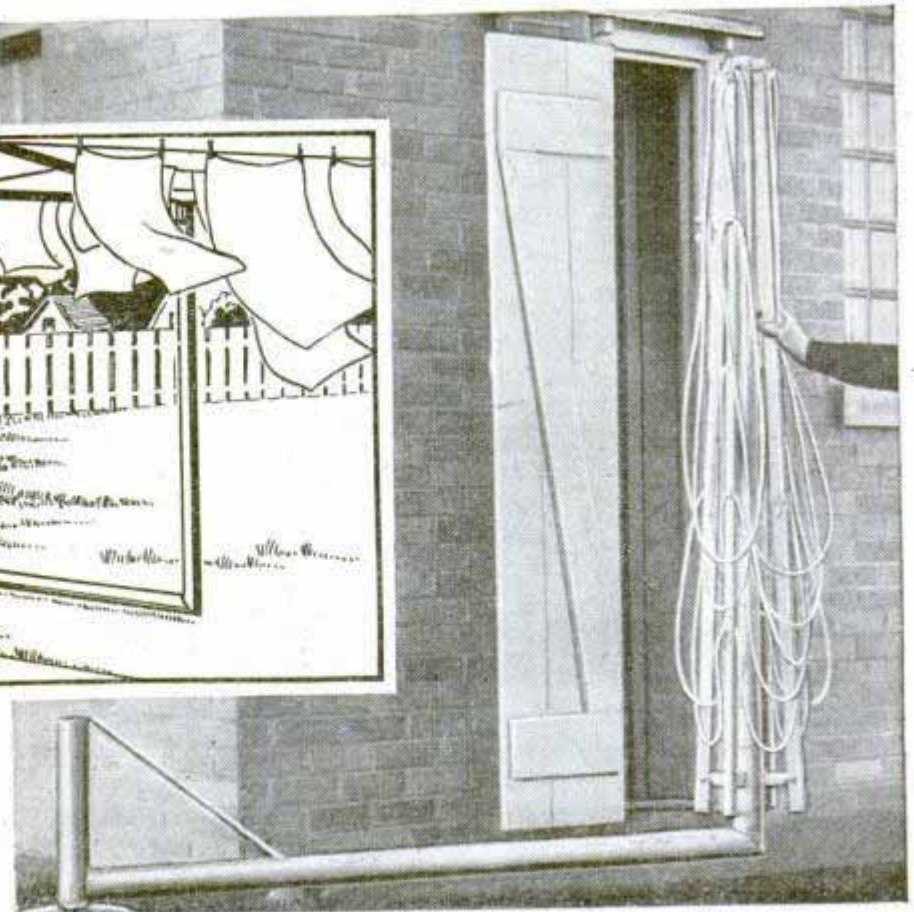
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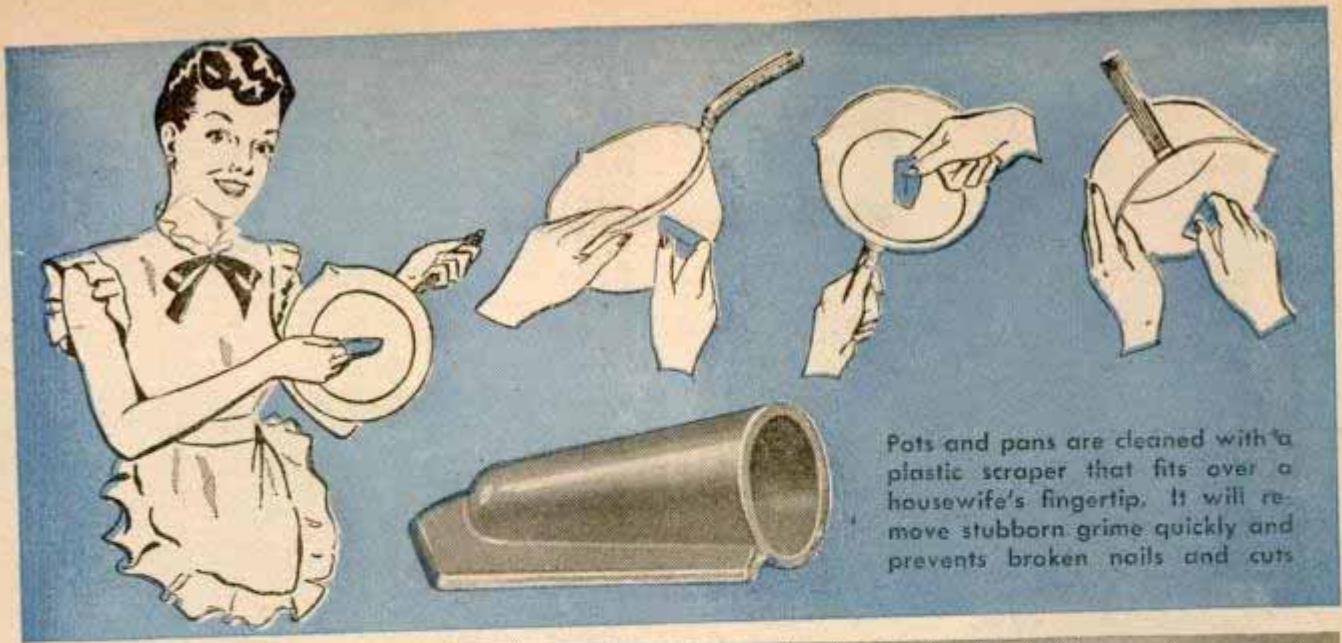


Using a plastic clothes hanger that can hold nine garments in space one usually takes saves both space and pressing bills



Especially valuable when damp underfoot is a collapsible pivoting clothesline that can be loaded from the walk. When not in use, it folds into a cabinet. For a fast dry, the arms can be allowed to rotate in the wind

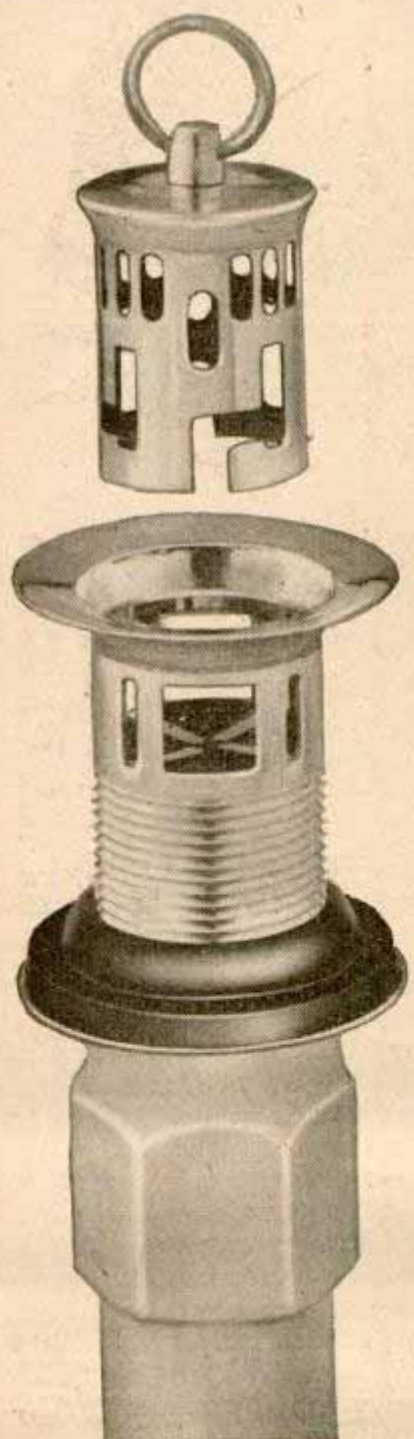




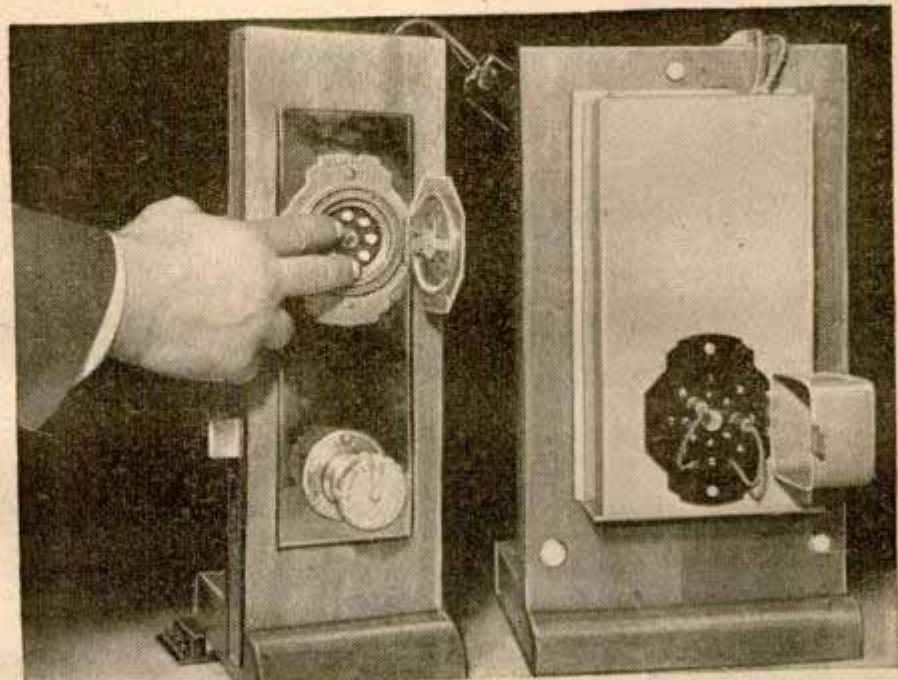
Pots and pans are cleaned with a plastic scraper that fits over a housewife's fingertip. It will remove stubborn grime quickly and prevents broken nails and cuts



By adding four sections to a square bridge table it is speedily converted into a round poker table



Old washbowls can be modernized with a pop-up drain, left, that takes the place of a rubber stopper. Below, all but one of the 764 possible combinations for this push-button combination door lock ring an alarm





Rake Is Adjustable for Sweeping

For sweeping or raking lawns, a new spring-steel rake is now available. By removing the wing nut and bolt and reversing the position of the rake head, the handle is adjusted to either sweeping or raking position. The 18 raking prongs are welded between two 18-inch crossbars for strength. The extra length handle is 4½ feet long.

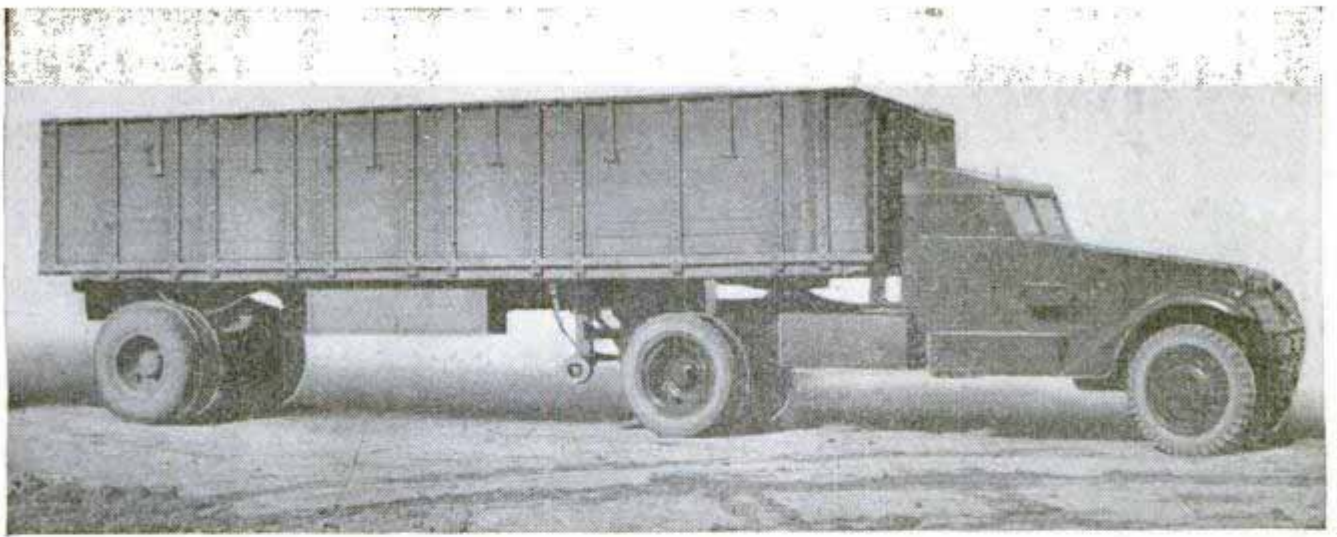
Golf Course Scooter →

Arthritis prevents R. J. Jackson, Houston, Tex., auto dealer, from walking long distances, but it doesn't stop him from playing golf. He designed a special motor-driven scooter to carry him, his clubs, and three or four friends. The car is lightweight and equipped with six-inch tires to prevent sinking down in fairways and making ruts.



Mortar Resembling Giant Popgun Tests Equipment at 100-G Loads

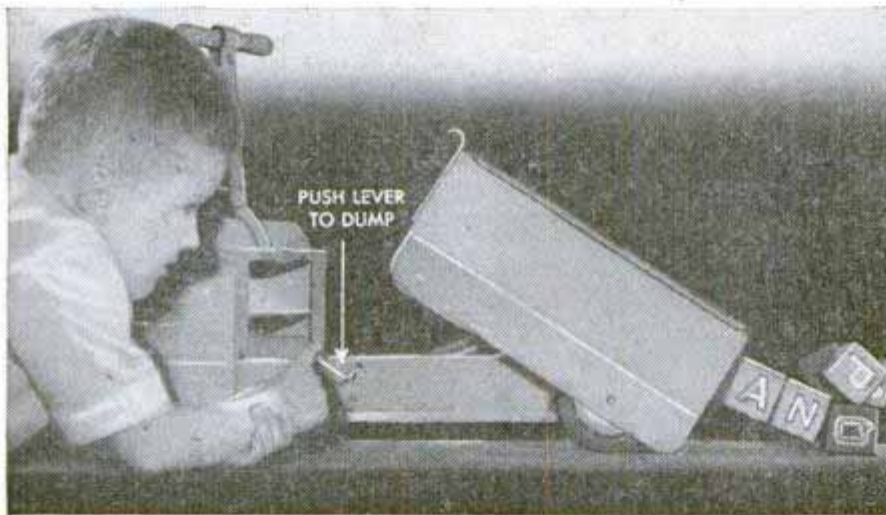
Aviation equipment is tested with 100-G loads (100 times the force of gravity) by an air-pressure mortar that operates like a giant toy popgun. Carrying as much as 50 pounds, the cartridge or car reaches top speed of 50 miles an hour in nine inches. It is placed in the lower of two cylinders before firing and held in position by a trigger catch. Then the gates are closed and compressed air fed into the cylinder until sufficient firing pressure develops. As the cartridge shoots into the upper cylinder it is slowed and stopped within 90 to 100 inches by a cushion of air created by its own momentum. It was developed by Boeing Aircraft for guided-missile tests.



CONVERTED HALF-TRACK AND TRAILER HAULS WHEAT

From an Army half-track and a 10-ton semitrailer, Thomas D. Campbell of Hardin, Mont., has built a huge carrier for wheat. The conversion was simple and the finished unit cost \$2000. Mr. Campbell, op-

erator of a 95,000-acre farm, bought the half-track from the War Assets Administration for \$300 and the semitrailer for \$1100. The conversion was done with a cutting torch, welding torch and electric drill.



Boy's Dump Truck Serves as Scooter

Three toys are combined into one which serves as a dump truck, pushcart and scooter. A hydraulic steel cylinder dumps sand or other materials and automatically lowers the tail gate. When used as a pushcart or scooter, the backboard is lowered to become a seat or knee rest. The toy weighs 14½ pounds.

Folding Harrow

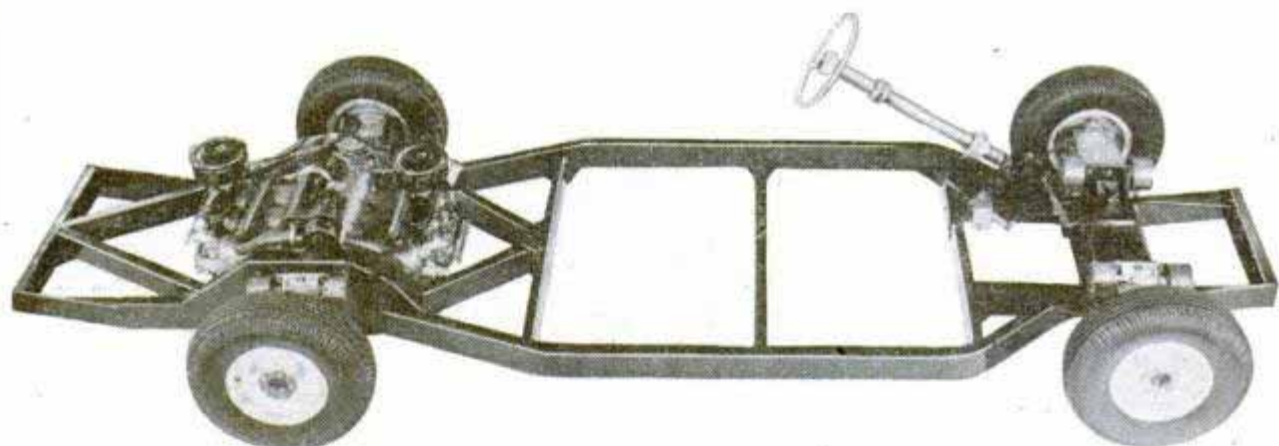
Time-consuming disassembly work is eliminated with a harrow that folds flat, reducing the width of three, four or more sections to two sections wide. This feature enables a farmer to pull it through the opening of a standard farm gate without taking the harrow apart. To fold, levers are thrown forward and the outer sections are folded inward.

☐ One out of three trucks on the highways today is at least 10 years old.



Unveiling the TUCKER

Only 60 inches high, the Tucker is designed to cruise at 100 miles per hour. Its six-cylinder, 150-horsepower engine is mounted between the rear wheels



FROM the world's largest factory comes promise of a new automobile incorporating many engineering principles born of Indianapolis Speedway experiments and wartime advances.

It is the Tucker car, a rear-engine sedan with disk-type brakes, luggage compartment under the hood, a windshield that breaks free for safety in impact, and a headlight that "sees" around corners.

Its home is the 500-acre wartime Dodge plant in Chicago, 20 baseball parks bigger than famed Willow Run. Its designer and builder is Preston Tucker, who learned by working for Ford, Cadillac,

Studebaker, Chrysler and Pierce Arrow, and by building racing cars.

In 1926 Tucker and the late Harry Miller became associated in designing and building racing cars. In 15 years, Miller Specials won 11 Indianapolis Speedway classics. The team of Tucker and Miller brought many refinements to the automotive industry, including one of the first conversion heads which changed the shape of the combustion chamber for higher compression and bigger valves.

Now, after 15 years of experimenting and testing, Tucker is building a passenger car that embodies many racing-car ideas. The first Tucker—a hand-built job recently unveiled—is only 60 inches high. It has a third "Cyclops Eye" headlight mounted in the center of the hood. This light is connected to the steering apparatus so that a beam of light turns and illuminates

curves as the front wheels turn right or left.

The Tucker's six-cylinder, 150-horsepower engine is mounted at the rear, directly between the rear wheels. The main parts are aluminum, making the engine 500 pounds lighter than conventional engines of comparable horsepower.

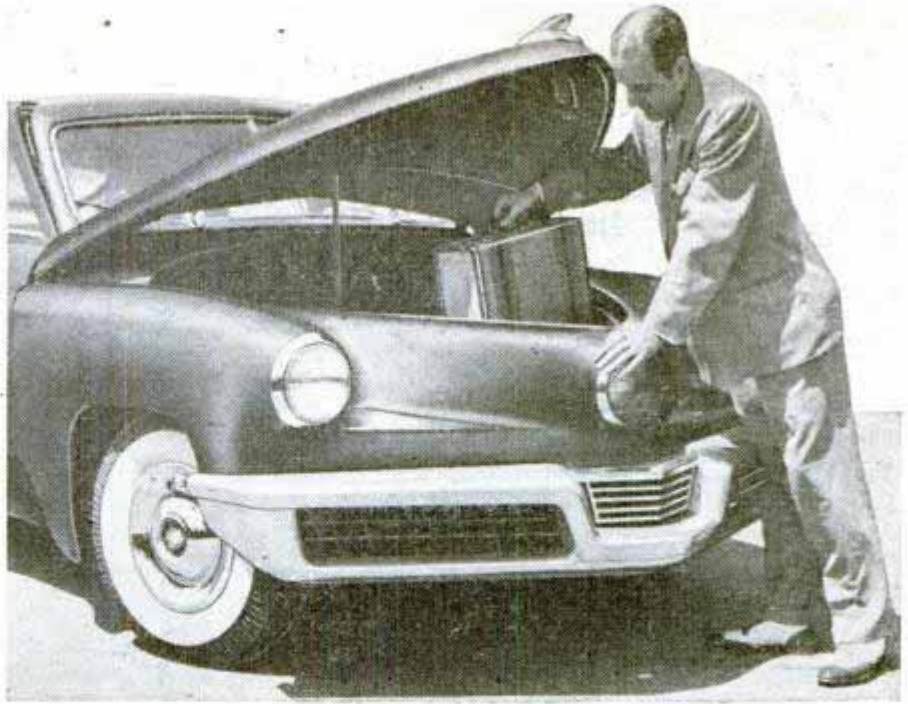
The Tucker is designed to cruise at 100 miles per hour and the speedometer registers up to 140. With fuel injection, high-frequency ignition, light weight and elimination of about 800 parts used in the average auto, the Tucker—its manufacturer predicts—will travel 35 miles per gallon of gasoline at moderate speeds.

With a wheelbase of 128 inches, the new car weighs approximately 2800 pounds, roughly 1000 pounds less than other cars the same length. Door tops extend a few inches into the roof to provide additional headroom for a person entering the car.

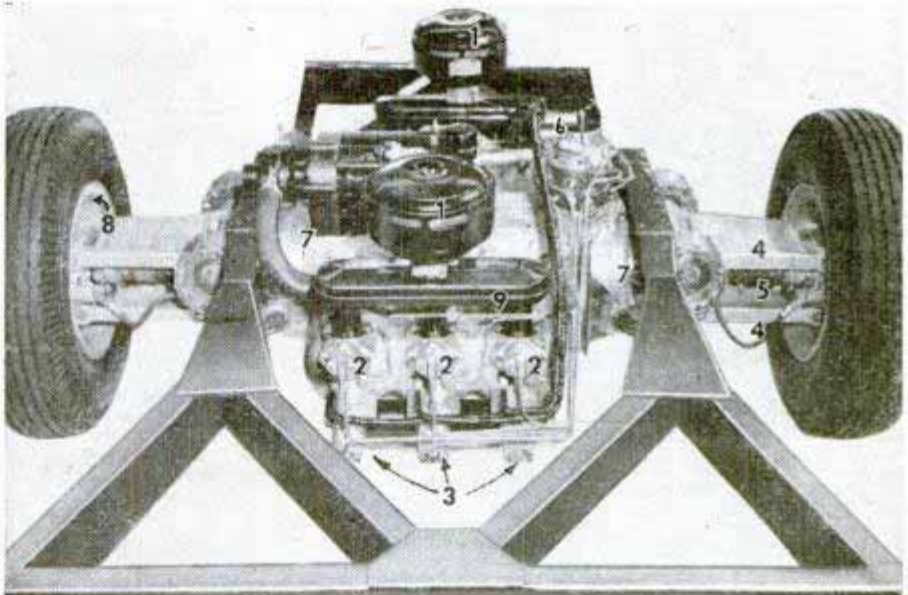
Safety is emphasized in the design. A sponge-rubber crash panel, covering the entire dash and front passenger compartment, acts as a cushion in case of accidents. Gauges, instruments and electrical controls are mounted beneath the steering wheel.

The windshield is held in place by channels designed to give way and let the entire piece of safety glass push out, if a crash hurls the driver or a passenger forward. All windows and the windshield are made from case-hardened glass which pulverizes into coarse, gravel-like particles when broken, instead of splintering.

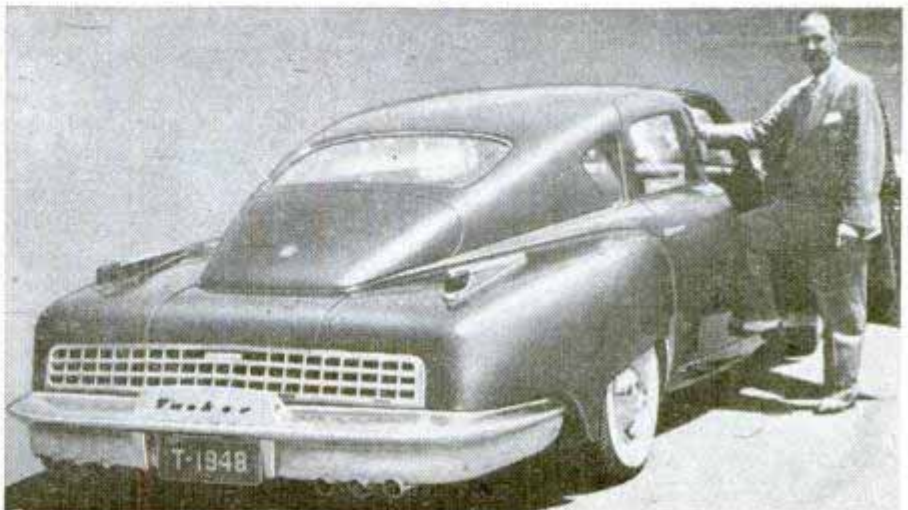
Locating the engine at the rear produces additional safety, according to Tucker. It puts 60 percent



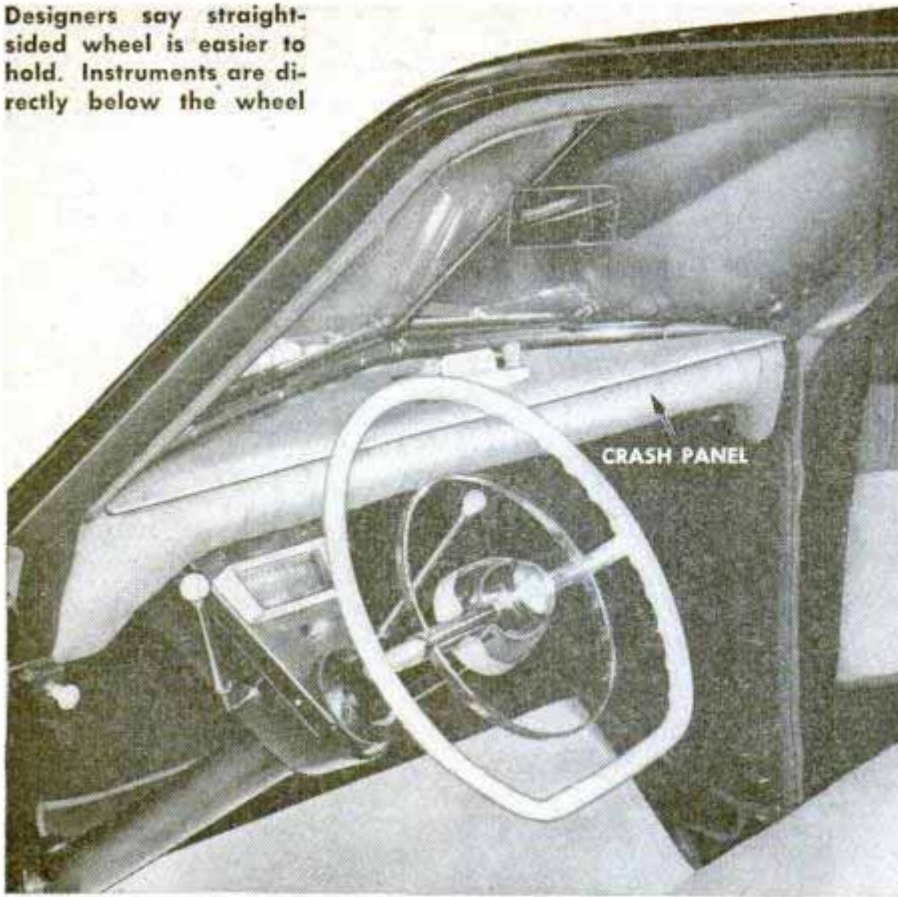
Preston Tucker, designer and builder of the convention-defying car, demonstrates how the space under the hood is utilized as a luggage compartment



Main engine parts are identified: 1, air filters; 2, intake valves; 3, exhaust valves; 4, wheel-suspension arms; 5, propeller shaft; 6, distributor; 7, torque converters; 8, disk-type brakes; 9, intake manifold. Rear grille releases air that reaches engine through ports at front of back fenders. Six exhaust pipes permit individual gas analysis for each of the six cylinders



Designers say straight-sided wheel is easier to hold. Instruments are directly below the wheel



ventional drum brakes, Tucker engineers report. The disk brakes are similar to those used on some airplanes to assure a quick stop after landing.

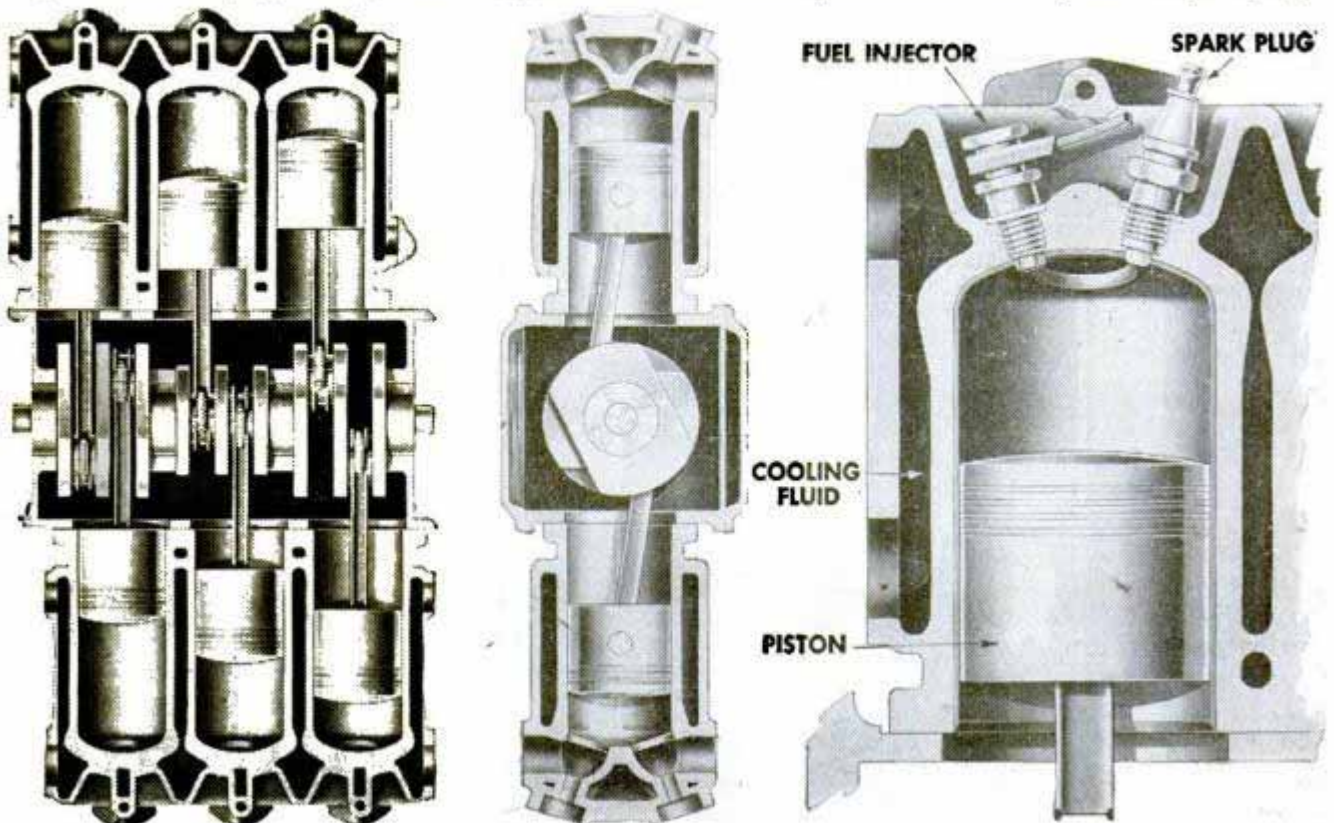
A single aluminum disk between two friction surfaces provides much greater braking area than drum-type brakes, Tucker explains. Instead of relining disk brakes, the entire brake assembly on the new car can be replaced when necessary.

Advantages of the rear engine listed by the engineer include improved roadability and elimination of engine odors and noises. The block and head are made from a single aluminum casting and since the block and pistons have the same coefficient of expansion, Tucker predicts that his engine will give trouble-

free service three times as long as ordinary engines with a cast-iron or steel-sleeved block. In the conventional engine, Tucker declares, the pistons expand about eight times as much as the piston wall, causing wear and eventual oil pumping.

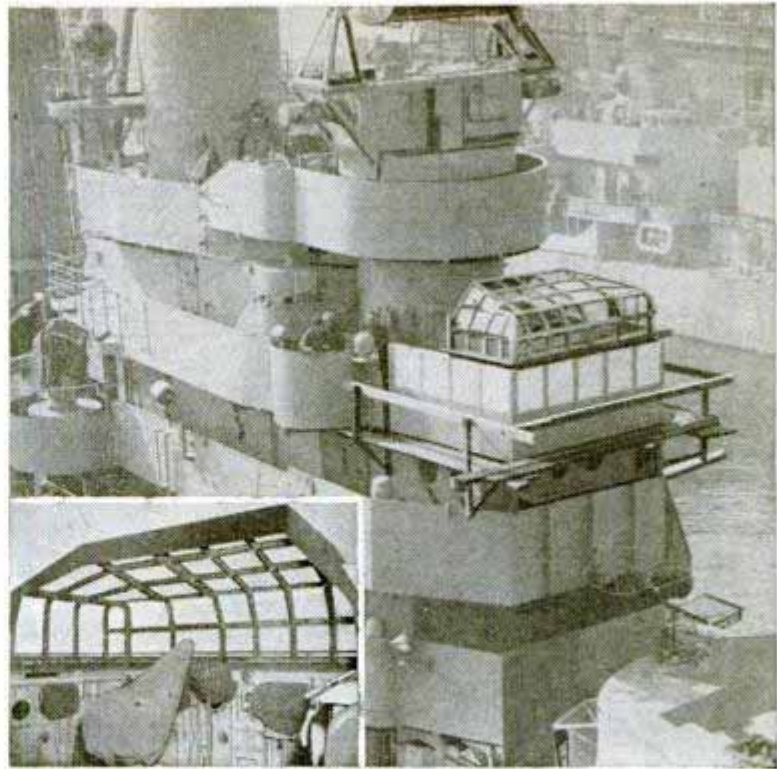
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Six-throw crankshaft and four main bearings are shown (left) in cutaway view. Center, cross-section drawing of horizontally opposed cylinders. Right, cross-section view of cylinder shows fuel injector and spark plug



"Greenhouse" for Warships

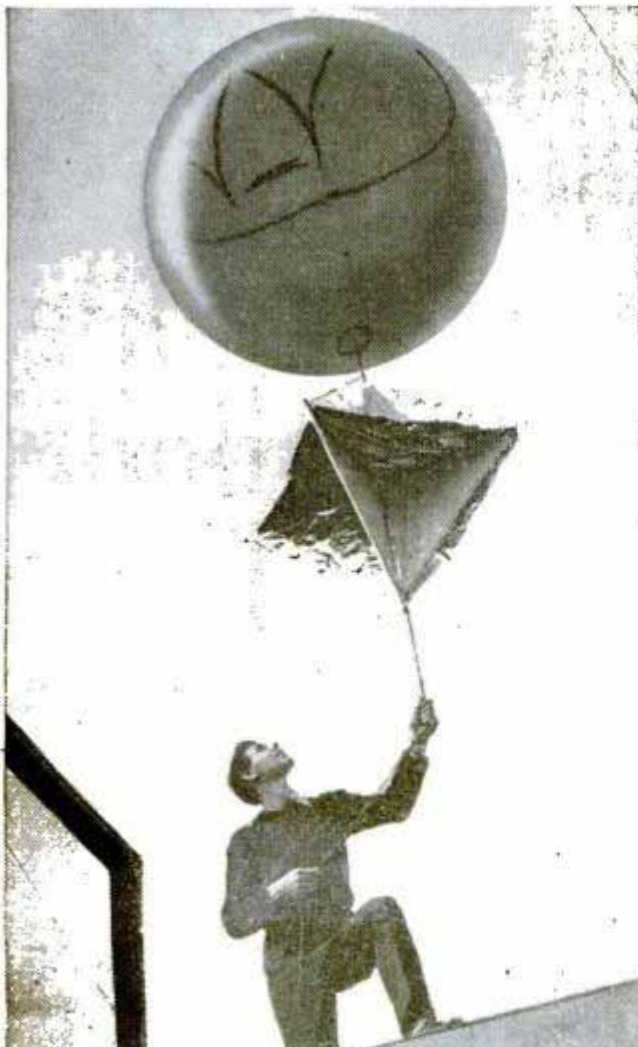
Plastic panels form a "greenhouse" above the open bridge of the Navy's light cruiser USS Manchester. The transparent enclosure is being tested as a means of providing protection from blast, weather and fumes on the bridge of combat ships. The plastic panels are mounted in a metal framework, forming a hood over the Manchester's bridge. Two types of plastic, Lucite and Plexiglas, were installed in the test unit built by naval personnel.



Chemical Poisons Quack Grass

Hard-to-kill quack grass can be eradicated by applying a chemical called IPC which was developed by the British during the war. Recent experiments by the U. S. Department of Agriculture show that the chemical first stops growth of the shoots and then kills them. It is a slow-acting poison. In the experiments the chemical was applied as a dry powder, from 5 to 60 pounds per acre. Sand was used as a carrier. Even in the lowest concentration

quack grass was killed without affecting broad-leaf plants. The chemical is ineffective against some weed grasses including crab grass. It has no toxic effect on experimenters but reasonable precautions are recommended pending further research.



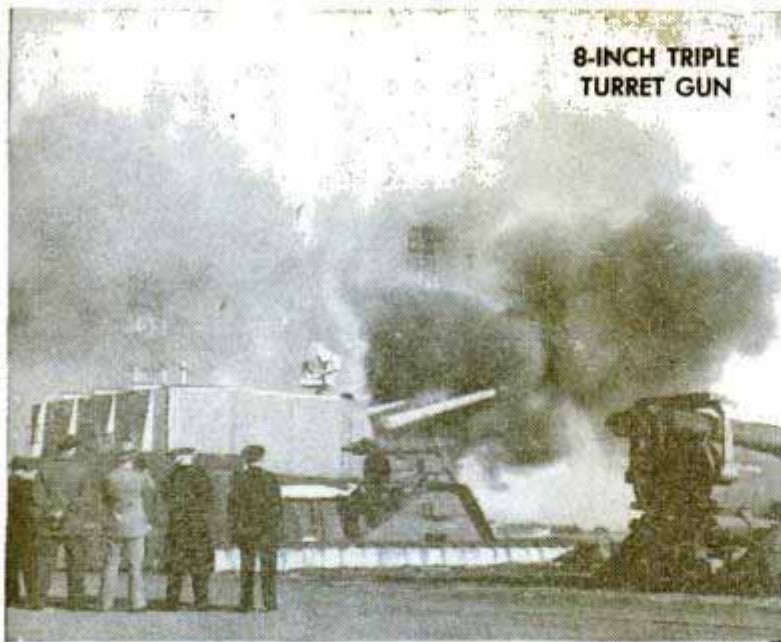
Balloon Targets Reflect Radar

Blasts of ultra-short radio waves are being fired by radar experts at a balloon floating 600 feet in the air in experiments to develop accurate radar-aimed aircraft guns. If the fire-control apparatus is successful it will direct gunfire with the greatest efficiency ever achieved, eliminating the inaccuracies of human gunners. In the experiments carried out by Westinghouse, a five-foot balloon inflated with helium carries aloft a reflector made of balsa wood covered with aluminum foil. Radio waves directed at the reflector bounce off the foil and are beamed back to a receiver. Airplanes will be used in later experiments.

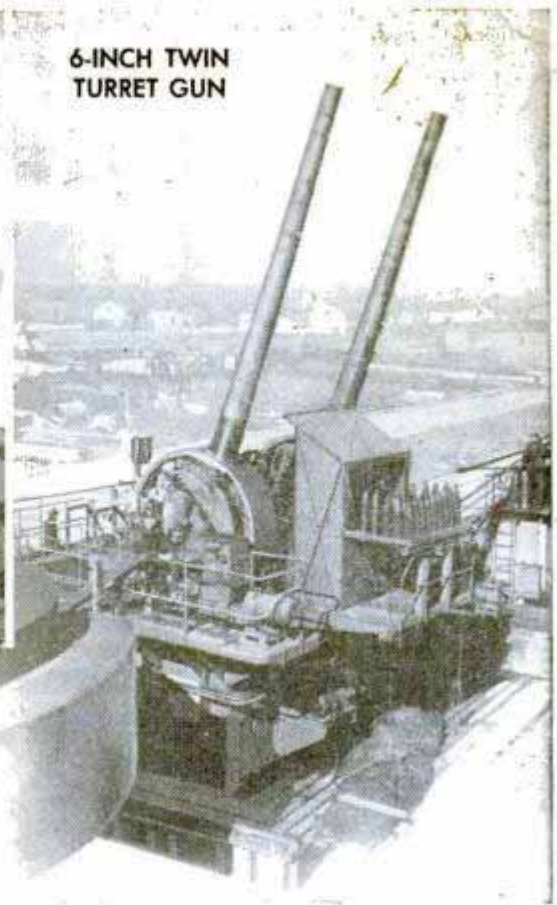
"Half Size" Motor for Machine Tools

Particularly adapted to machine tools, a Fairbanks-Morse electric motor is half the size and a third lighter than conventional types. It ranges in size from $\frac{1}{3}$ to 10 horsepower and can be mounted horizontally as well as vertically, or on an angle base for belt drive.

Information, including manufacturers' names, concerning products described in this issue may be obtained by writing Bureau of Information, Popular Mechanics, 200 E. Ontario St., Chicago 11, Ill.



8-INCH TRIPLE
TURRET GUN



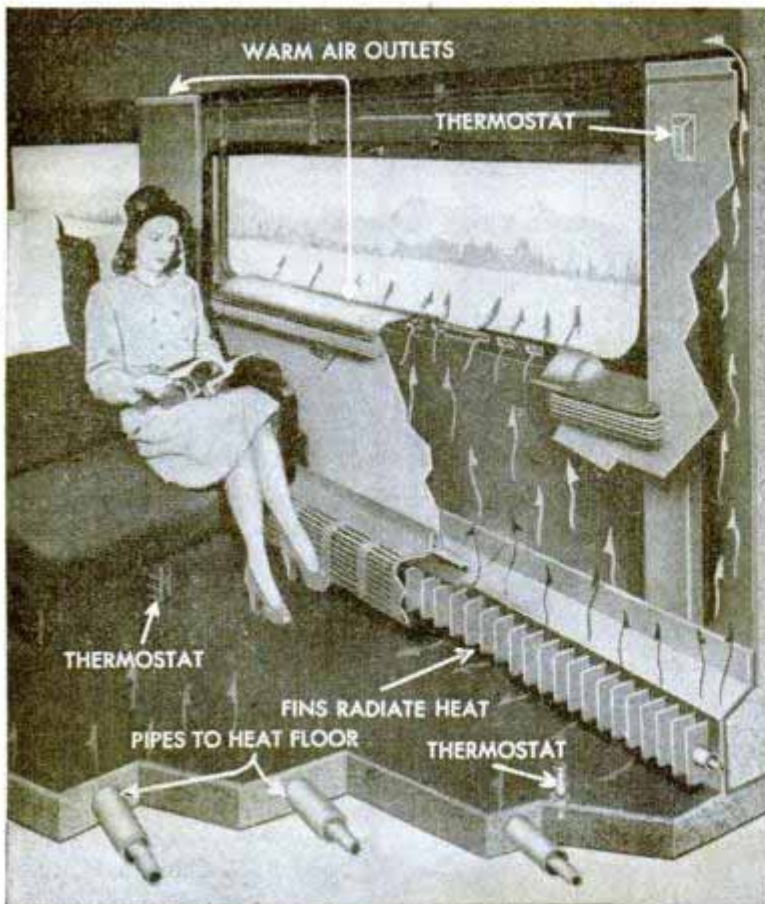
6-INCH TWIN
TURRET GUN

U. S. Navy photos

FIRING SPEED QUADRUPLED

Eight-inch turret guns developed for the U. S. Navy fire nearly four times faster than any gun of the same or larger caliber. Automatic from ammunition handling to muzzles, the batteries eject cartridge cases from the mounts. The cases are used instead of powder bags to speed firing. Fuzes are set automatically in the eight-inch and six-inch mounts. Interference eliminators prevent guns of adjacent mounts from "locking horns" while under the individual control required for following different targets. A control-and-trouble-indicator

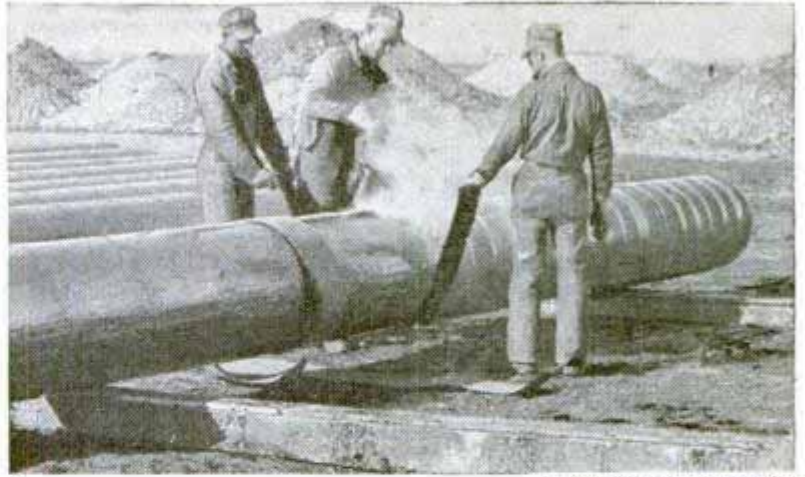
panel shows the position of ammunition in the entire loading system and indicates the location of any electrical failure. Similar improvements have been applied to a six-inch dual-purpose gun on light cruisers, and a three-inch antiaircraft weapon.



Radiant Panels on Rail Car Heat Interior by Sections

Cold floors and window drafts on railroad cars are eliminated with a semi-radiant heating system being installed on Chesapeake and Ohio cars. The system permits rapid adjustments in the heat of various parts of a car. Thermostats are placed at intervals along the floor and sides of the car, dividing the interior into both vertical and horizontal sections. Each thermostat regulates the admission of heat into its section. Steam from the locomotive's boilers passes through pipes in the car to provide the heat. Part of the heat is released through radiant panels in the side walls, part through an opening just beneath the windows, and the remainder through coils in the floor of the car. Fins on the heating pipes improve the radiation. The design permits temperature variations in parlors and other sections of the car.

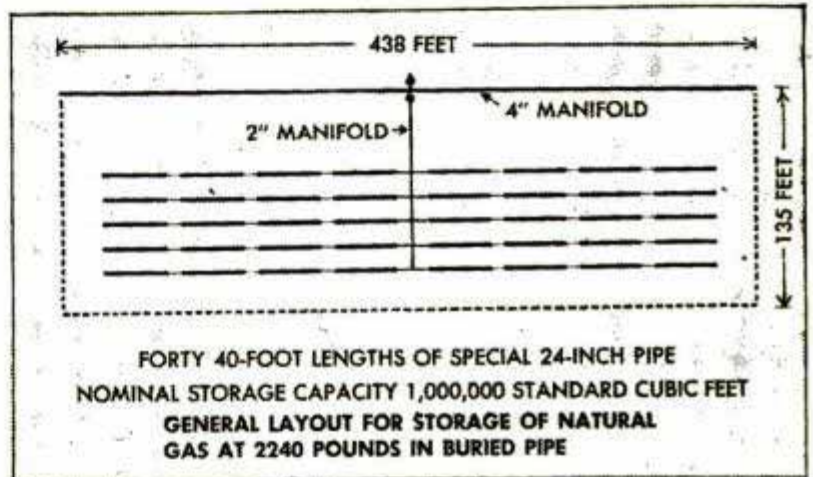
NATURAL GAS IS STORED IN UNDERGROUND STEEL TANKS



U. S. Steel Corp. photos

Crane lowers pipe into trenches for underground storage of natural gas. The pipes are waterproofed and weatherproofed (above) by a special wrapping which prevents corrosion. Below is a general plan for the subterranean natural-gas storage facilities

Natural gas at Mount Prospect, Ill., will be stored in underground pipe instead of in conventional storage tanks above ground. This innovation may revolutionize the storage of natural gas. The finished project will have a storage capacity of 40,000,000 cubic feet. The gas is to be stored in 40-foot seamless molybdenum-steel pipe sections nosed in at the ends and machined for connection, one to another. The pipe is 24 inches in diameter with walls $\frac{1}{2}$ inch thick. Each pipe will have a capacity of 25,000 cubic feet at 2240 pounds pressure. The company for which the tanks were made reports that underground gas

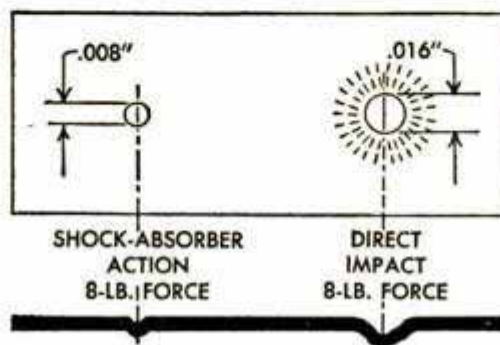


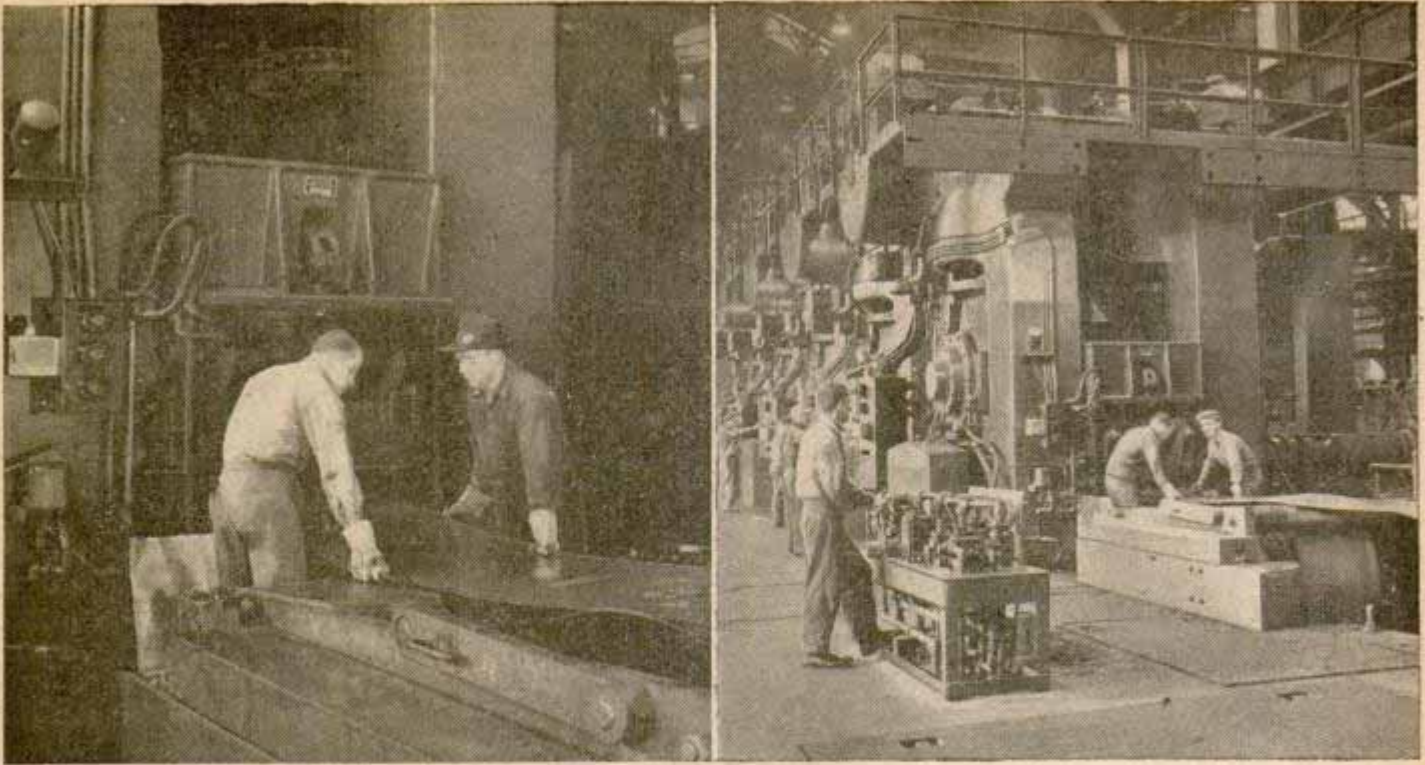
storage costs less for initial installation and maintenance than above-ground tanks. Also, since gas storage is in numerous small pipe sections, it is easy to increase or decrease the capacity. A third advantage is that above-ground hazards are eliminated.

Center Punch Delivers Blow Through Adjustable Spring in Handle

Metal, glass or wood can be center-punched without using a hammer with a punch that delivers an impact through an adjustable spring built into the handle. Only one hand is needed to operate the punch, as the point merely is pressed down to release the spring and mark the surface. A screw adjustment in the handle permits regulation of the spring tension so a blow of 10 to 20 pounds can be delivered. Through a controlled impact the distortion in marking light metals is minimized and the diameter of the impression decreased for greater ac-

curacy. The punch is available in a kit with accessories that include a tungsten-carbide point for marking hard steel, self-centering attachment for countersunk holes, hole-cutting point for punching paper, rivet point for delicate riveting operations and chisel point for tooling soft metals.





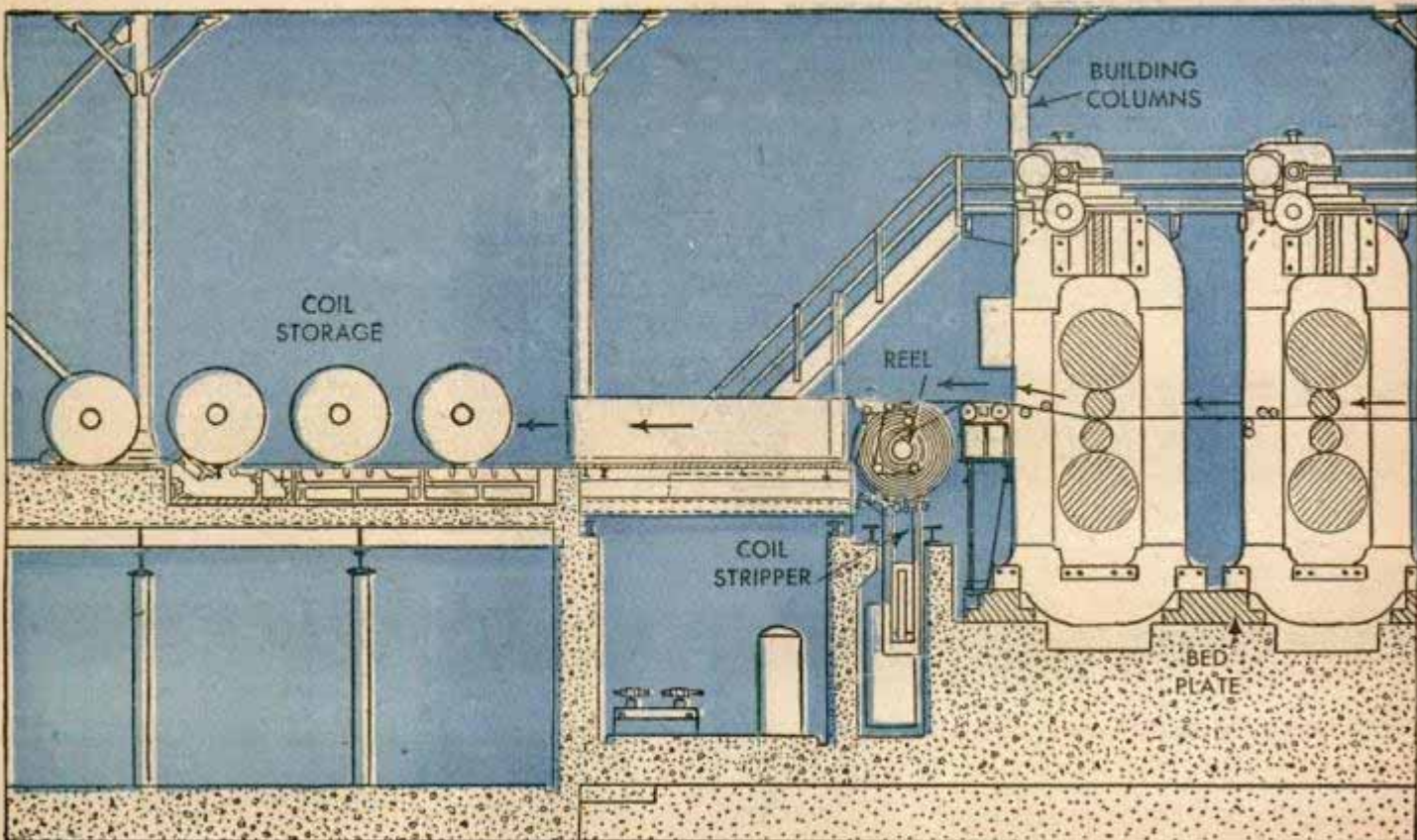
↑ Already reduced to cardboard thickness in previous operations, a steel coil is threaded into the mouth of the mill. It will be secured on the winding reel at the opposite end

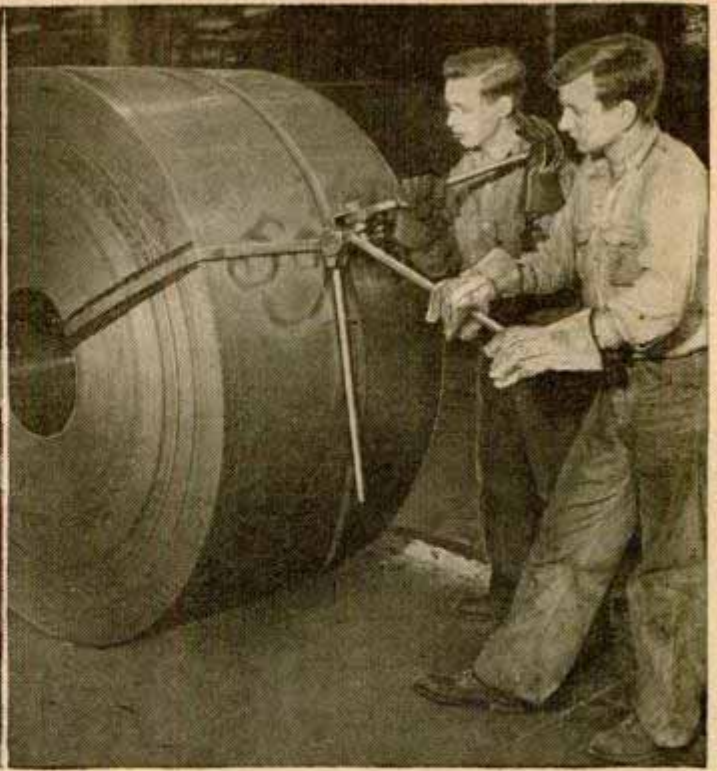
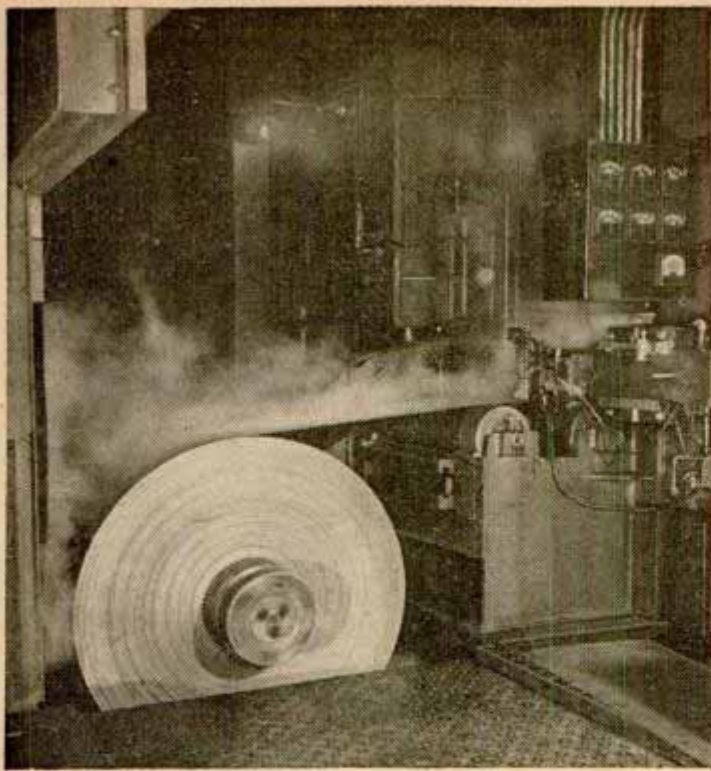
Above right, each successive "stand" of the high-speed mill reduces the thickness. Worker at left operates controls governing the speed

↓ Diagram shows layout of the mile-a-minute mill. The prepared coil is mounted on a reel at the right end. Steel rolls out the opposite end at a rate of 1,650,000 square feet an hour

Mile-a-Minute

STRIP STEEL zips through a new rolling mill at a mile-a-minute rate. The mill, installed by the Weirton Steel Company, rolls out strips of "tin can" thickness or heavier, coiling it on a reel at a rate of 1,650,000 square feet an hour—enough for



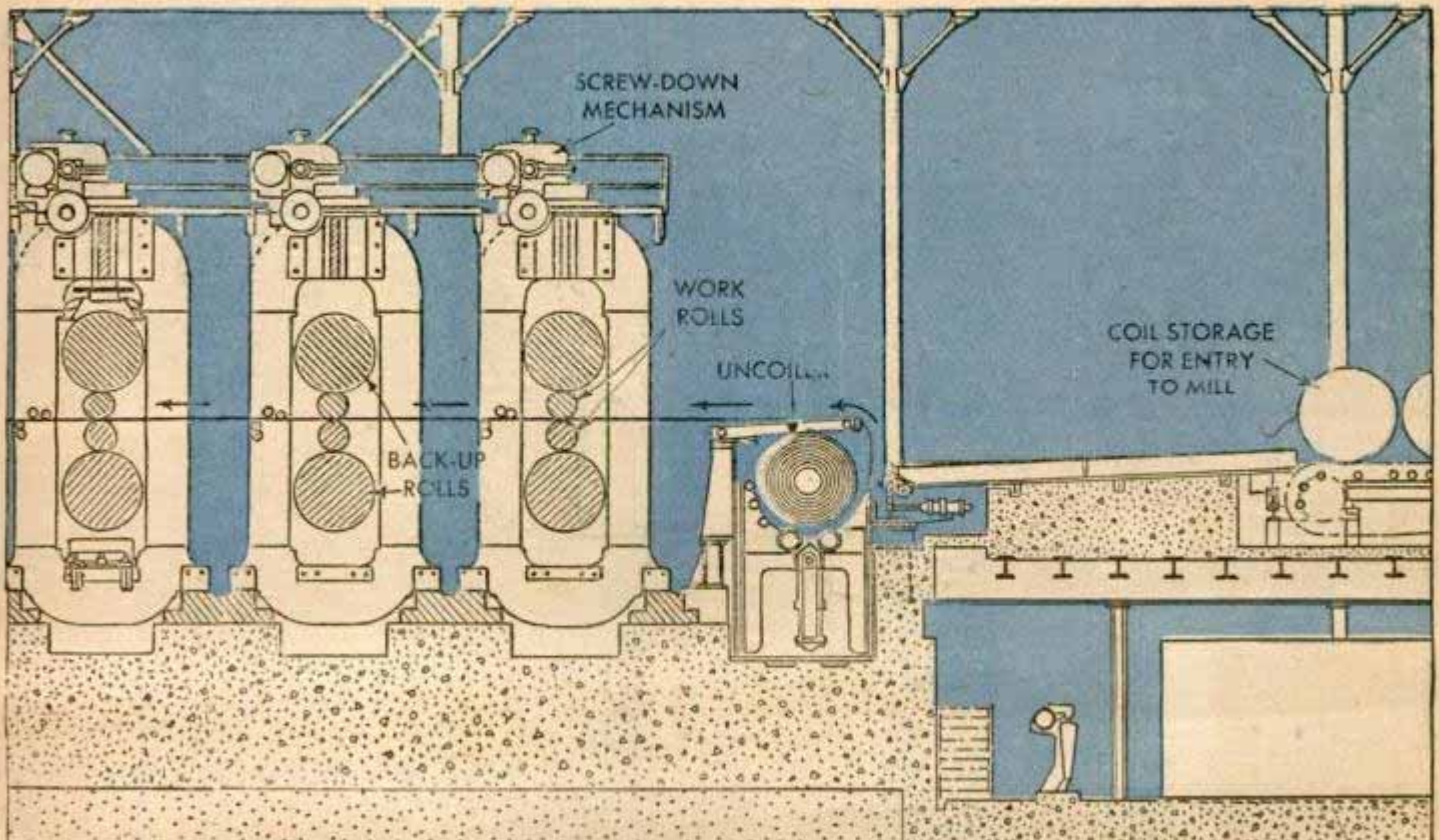


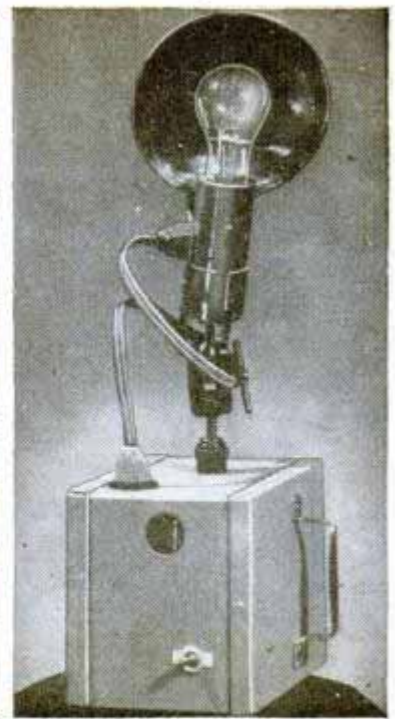
Ribbon of Steel

Left, strip steel flashes out of the rollers and around the winding reel. Above, "bundlers" strap the shining steel coils for shipment

750,000 vegetable cans. A coil of prerolled steel about $\frac{78}{1000}$ inch thick is installed at one end of the mill and threaded through several sets of rollers. The rollers reduce the thickness to $\frac{22}{1000}$ inch or less. In the mill's first stand the ribbon moves 650 feet

a minute, but increases speed in succeeding stands until it flashes out of the mill at more than 5000 feet a minute. The mill is powered by six reel motors of 17,550 horsepower. Tensiometers, designed especially for the mill, control the slack of the steel.





Left photo was taken with an ordinary press flash bulb. Center photo was illuminated by the same equipment plus another bulb fired by a photoelectric cell. Right, light passes through window in the case to fire the bulb

PHOTO-CELL LIGHTS SECOND FLASH BULB

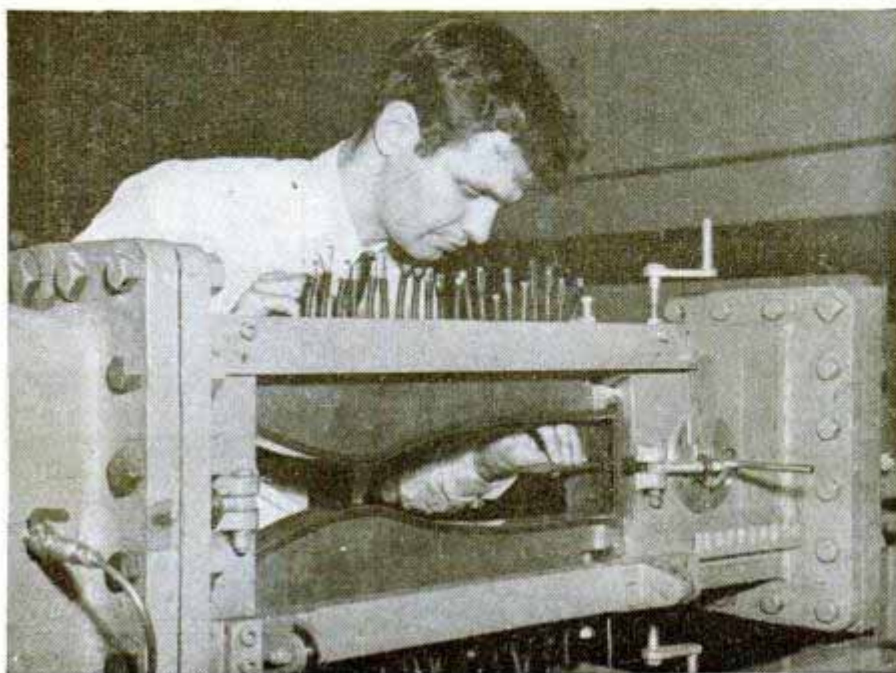
Flash bulbs for side lighting are fired by a photoelectric cell when the bulb on the camera is flashed, eliminating the need for an electrical connection. The electronic circuit, invented by Robert Ritchie, a Los Angeles newspaper photographer, is mounted in a case six inches square. A conventional photo-flash socket and reflector are fastened to the top of the case. In the side is a one-inch hole which admits light to the

photoelectric cell. When the bulb on the camera is fired the sudden change in illumination actuates the cell, which fires the extension bulb. In night tests the unit has fired a bulb a city block away from the flash of the camera bulb. Only a sudden bright light will actuate the cell. Flashlights can be waved in front of it without tripping the light. The small case is fitted with a tripod and weighs only 10 pounds.

Supersonic Wind Tunnel Tests Models at 2500 M.P.H.

Models of projectiles and aircraft that are expected to reach speeds faster than sound are tested in a miniature supersonic wind

tunnel in Los Angeles. Speeds of 950 to 2500 miles an hour are simulated in the tunnel to aid basic research in the design of projectiles. Instruments are attached to tubes around the model to record the pressures.



Food Value of Hay Decreased by Rain

It pays to make hay while the sun shines because one rain can cut the feeding value as much as 38 percent. A heavy shower, Cornell University scientists found, reduces sugar, protein and mineral content.

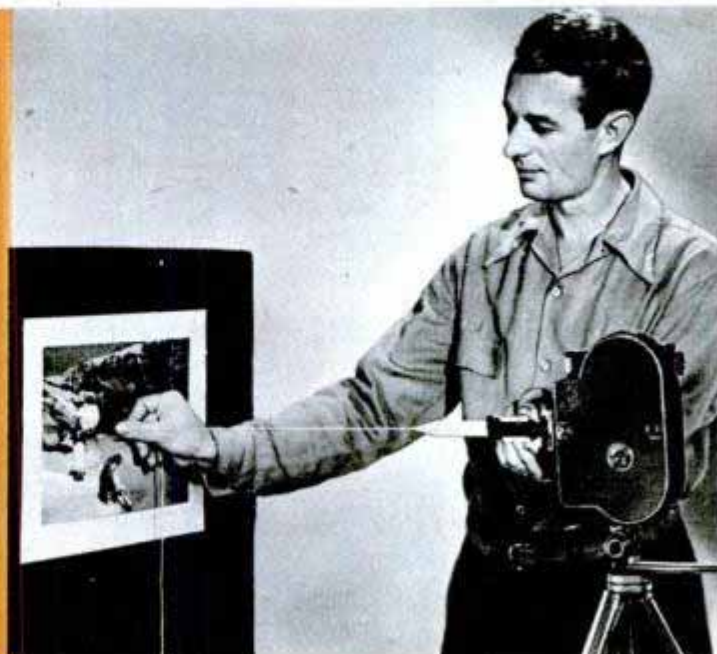
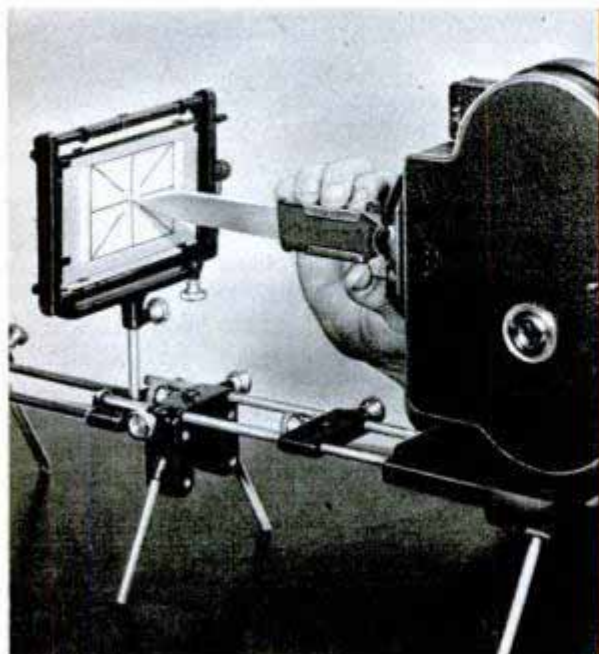
☛ Faucet washers are being made of Nylon to resist heat, cold and acids as well as wear.



↑ **AUTOMATIC FILM-CHANGING** feature of a portrait camera enables a photographer to make exposures every two seconds. Camera is equipped for use with stroboscopic lights. It can be concealed behind wall (dotted line) and operated entirely by remote-control release

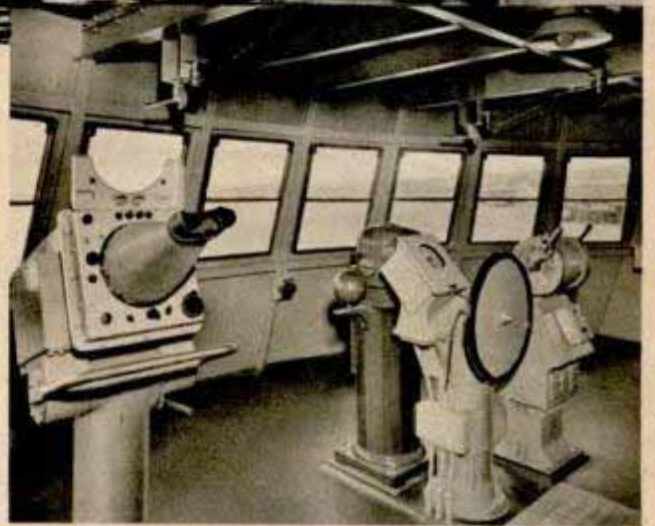
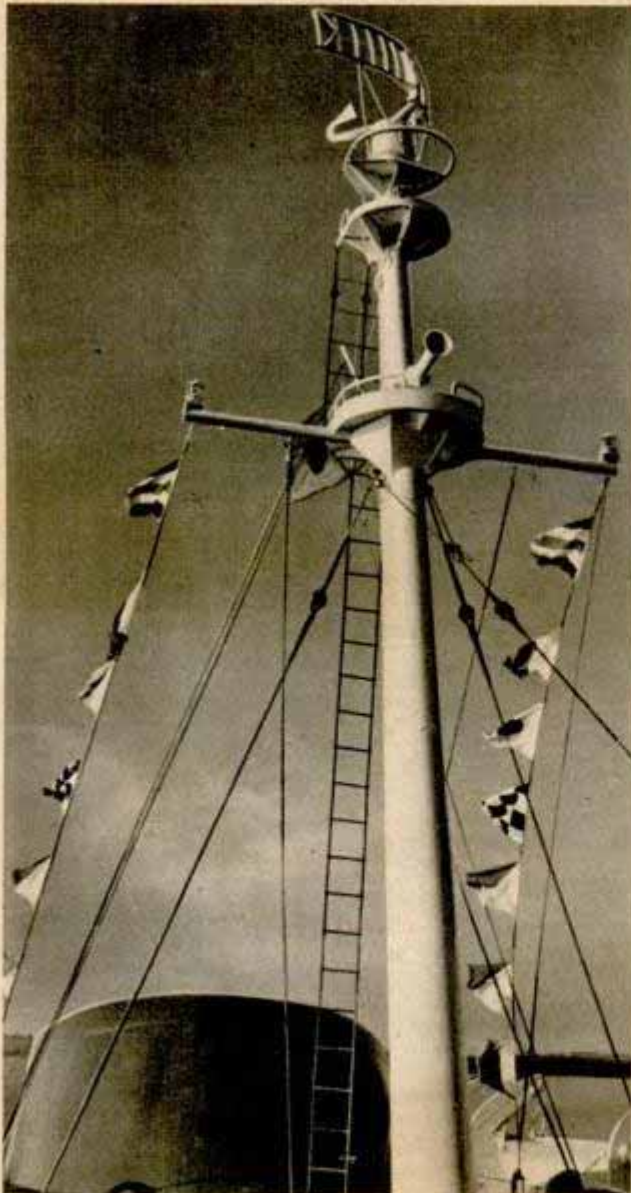
SOUND ADAPTER for silent movie projectors uses a radio for amplification. The film is threaded around the sound drum before being wound on take-up reel. A radio-film adapter transmits sound-track impulses to the radio. A separate amplifier can be used, if desired

↓ **EXACT CENTERING** of small objects and titles on movie film is assured by a sliding wedge and centering guide. The wedge is held against the lens and its point aligned with the centering guide by adjusting the camera or titler. If the object to be photographed is beyond the wedge, a short string is used





On its trial run the Chinook clipped off better than 18 knots. It has a radar receiving unit (left, in pilot house view). The radar antenna is pictured below



FLOATING "HOTEL"

Costing approximately \$2,000,000, a streamlined ship with the comforts of a deluxe hotel carries passengers on the 92-nautical-mile run between Seattle, Wash., and Victoria, B. C. Owned by the Puget Sound Navigation Company, the ferry has a capacity of 1000 passengers and 100 automobiles. There are sleeping accommodations for 208 persons in 100 air-conditioned staterooms. The M. V. Chinook is an all-steel, twin-screw vessel with a cruising speed of 18.5 knots. Her over-all length is 318.2 feet; over-all beam, 65.8 feet, and mean draft, 13 feet. Four 16-cylinder Diesel engines drive four 490-volt electric generators coupled to four electric propulsion motors. These motors deliver power through reduction gears to two propeller shafts. Electricity is supplied by two Diesel-driven, 200-kilowatt generators. In case of failure of the main power supply, a 100-kilowatt emergency generator automatically goes into action. Lifeboat winches are electrically driven.

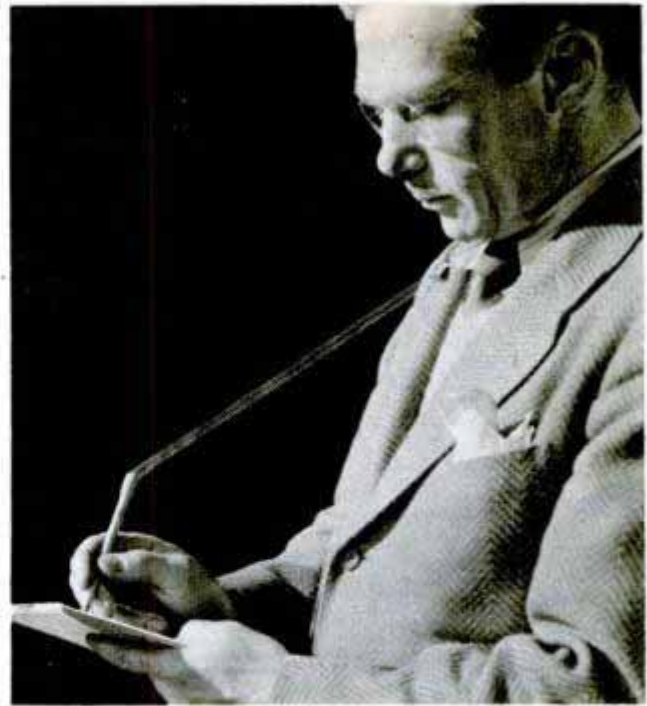
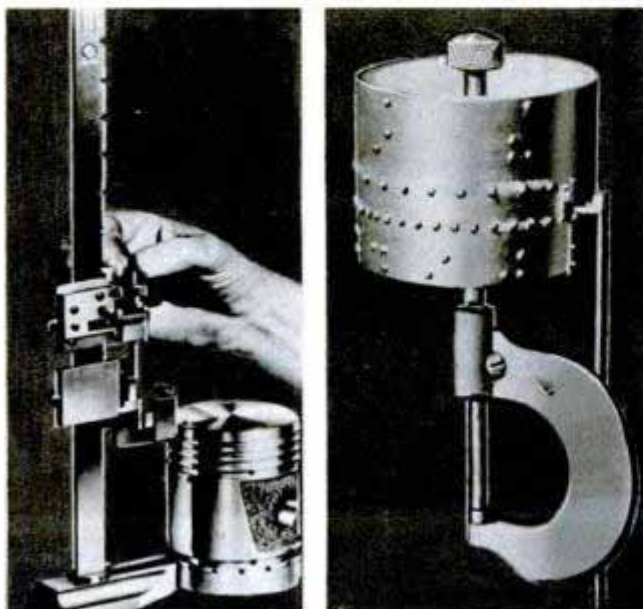


Spring Motor Powers Baby Boat

Skipper of her own little boat, five-year-old Sally Worth navigates the canals around a park in St. Petersburg, Fla. The six-foot boat was built by her father, Frank Worth, who installed a spring motor salvaged from an old-fashioned phonograph to power the craft. Mounted on deck, the motor is coupled to a drive shaft by a belt and pulley. Sally winds the motor with a crank between her knees and controls the flow of power with a lever in her right hand. She steers with a lever on her left that is coupled to a bronze rudder. The motor provides $\frac{1}{8}$ horsepower which pushes the boat four miles an hour. One winding carries Sally a quarter of a mile.

Blind Man Operates Micrometer

As part of Great Britain's war rehabilitation program, blind British veterans perform precision measuring jobs by means of special micrometers including one equipped with Braille numbers. In the photographs below, a blind man is operating a micrometer and slip gauge. At right is a Braille micrometer which the operator can "read" by touch.

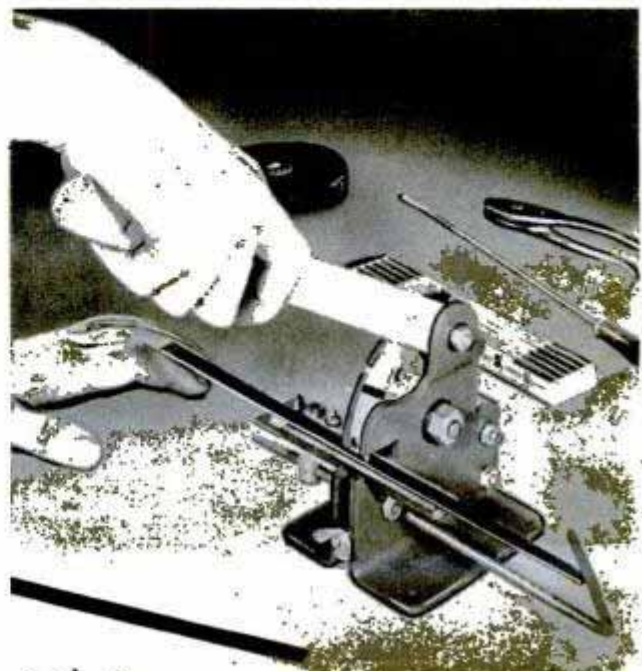


Pencil "Stretches" Three Feet

Always within reach, a pin-on pencil is equipped with a coil spring that stretches more than three feet. Attached to a plastic clamp above the spring is a pin for fastening the pencil to coat or dress so that it can't be lost.

Four-in-One Bench Tool

Metalwork ordinarily performed by four tools is accomplished by one that will punch, form, shear and rivet. Made of hardened steel, it is five inches high, four inches wide and is held to the workbench by four bolts. The punch sizes are $\frac{2}{16}$, $\frac{3}{16}$ and $\frac{4}{16}$ inch and there are sets for solid rivets and eyelets. The punches and rivet sets are interchangeable. All working parts are heat-treated to insure long life.



TASK FORCE FURNACE



Sun and dust are the worst tropical enemies. With the temperature at 120 degrees a "cat" roars across the desert

By J. Alvin Kugelmass

UNDER a broiling desert sun in southwestern Arizona the Army is sweating out an ordeal by fire. Military equipment designed for the tropics is checked for efficiency in temperatures that soar up to 122 degrees. Men, too, are being subjected to tests to find out just what happens physiologically and psychologically to a soldier fighting in the desert.

Task Force Furnace, military opposite of Task Force Frigid, the arctic experiment that checked equipment under extremely cold conditions, already has tested many new items designed to make desert warfare less painful and more efficient.

For example, there's a pressed-cork helmet that looks like a cross between a Chinese coolie's hat and an inverted coal scuttle.

"The helmet," explains Lt. Col. Walter D. Richardson, who commands Furnace, "sucks up stray air currents and guides them gently under the brim on the back of the neck where it pours a cooling stream into the shirt."

Many soldiers in the encampment wear glistening, lightweight, Nylon uniforms—with long sleeves. The sleeves are there because the Army wants to test the old bromide that whatever keeps out the cold also keeps out the heat. For the most part, the ex-

After a test "cat" has had a grueling workout under the desert sun, the temperature of the special rubber treads is recorded



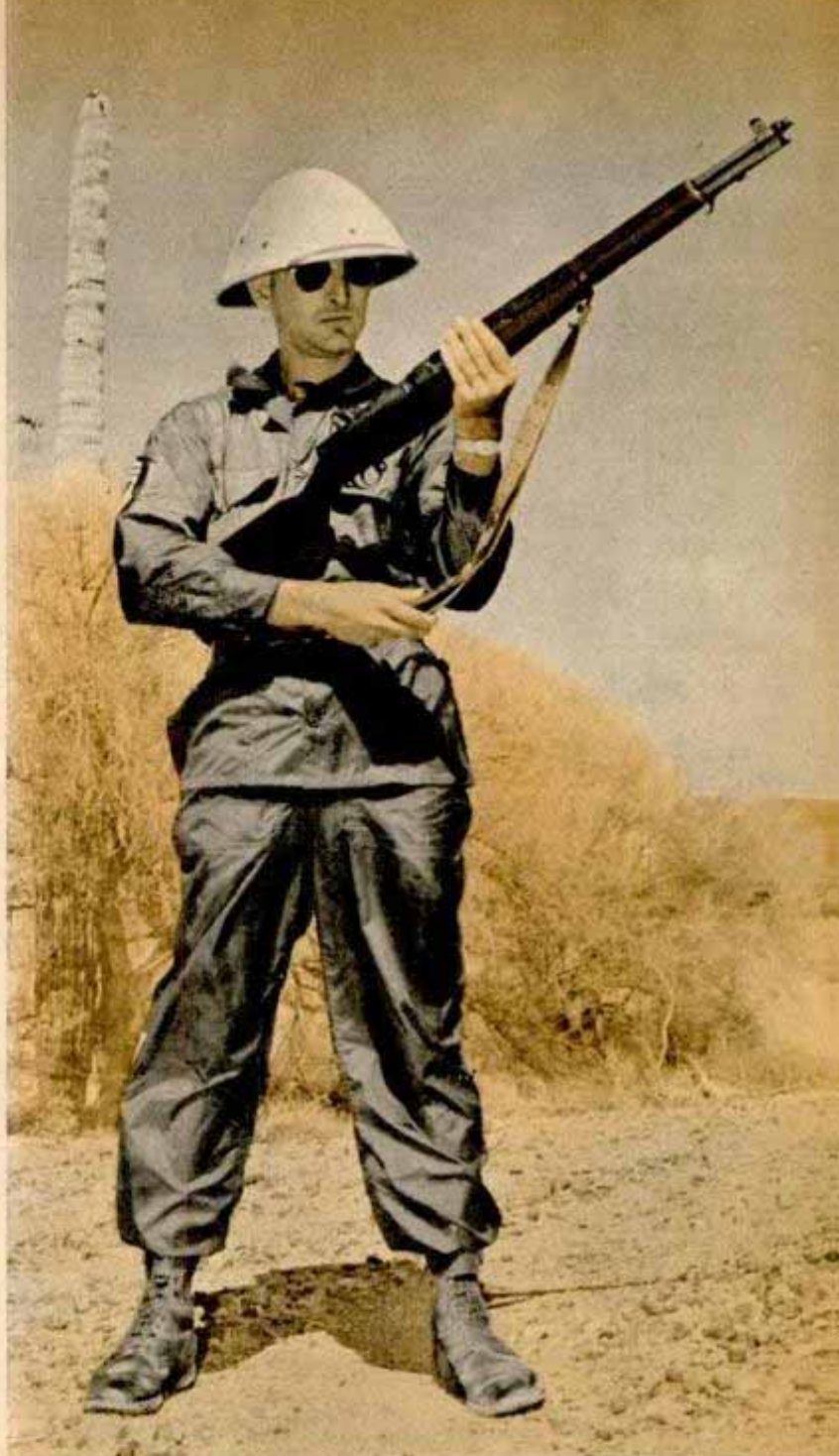
periments have proven that the soldier with the most skin covered is the coolest. As a result, the Army will not recommend shorts such as the British wear in Bombay and Palestine. Nylon coverings, perhaps as leggings, perhaps just as trousers, are more effective in keeping the foot soldier cool in the tropics.

Underwear is cut down to a minimum and is made of a net material as thin as gauze. New Army shoes are made with thick cork soles and high canvas uppers. They hook up instead of lacing. "That way," says Col. Richardson, "less sand gets in." For men who handle machines and metals which become too hot to touch under the unrelenting sun, there are gloves with thick canvas palms and backs made of strong netting.

Modern warfare means armored equipment. "And in the desert, the worst sufferers are the men in the tanks," the colonel says. "But we've solved that," he explains, exhibiting a baggy, Nylon suit. This new tank suit envelops a man from neck to ankles. Thick rubber bands are slipped over the wrists, ankles and neck to keep it snug. Then air is piped in, the air valve is sealed, and the body is air-insulated against heat for 8 to 12 hours.

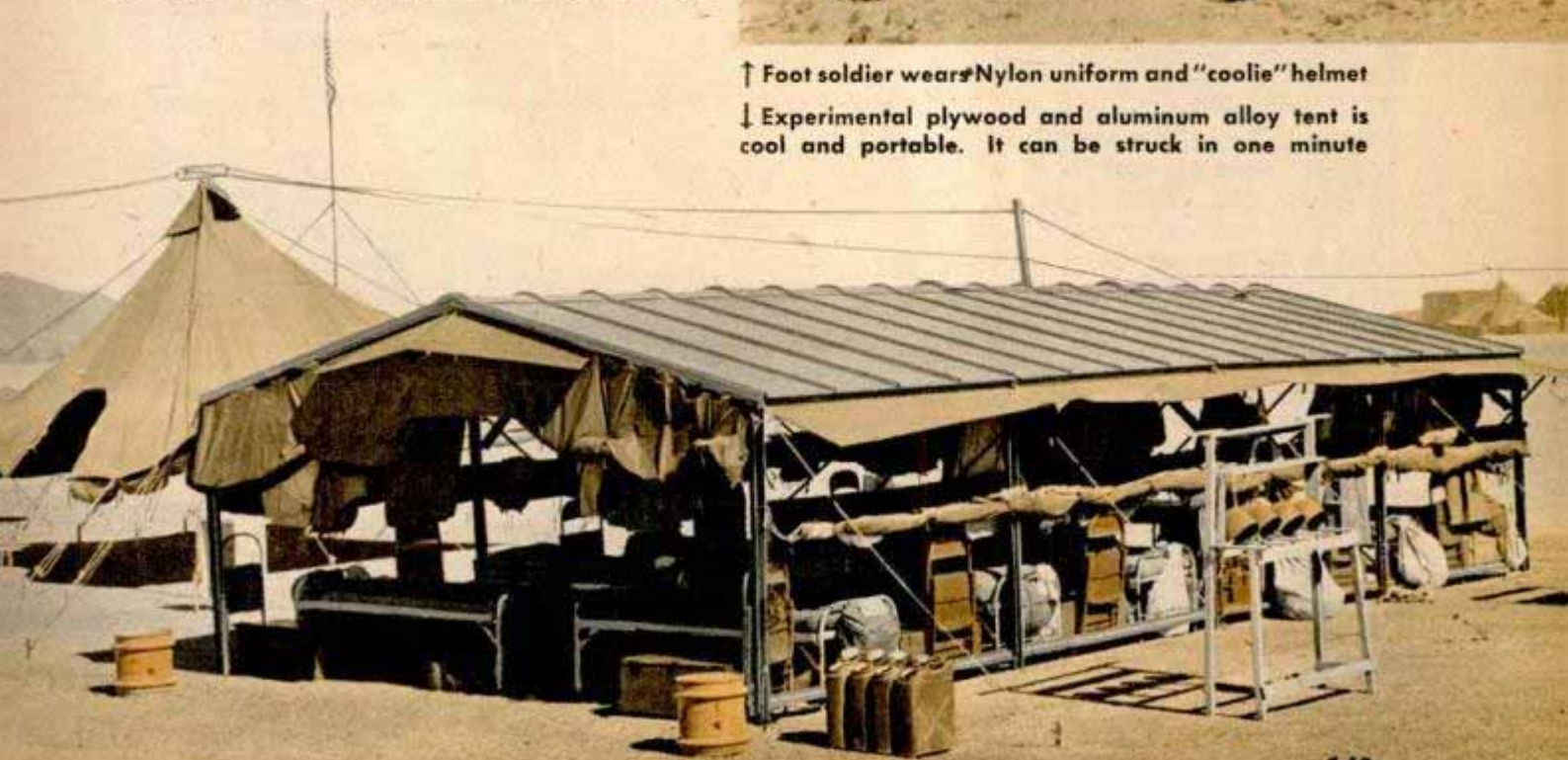
Tanks, too, are being equipped with air-conditioning systems. A stream of water circulates through a container filled with excelsior, and a fan, powered by the engine, blows moist, cool air from the damp excelsior into the tank's interior.

Gasoline feed lines on tanks are insulated with rubber and asbestos to prevent fuel evaporation. Some tanks are equipped with skis mounted on the front end. They've been found effective in traversing soft mounds of sand, and were borrowed for



↑ Foot soldier wears Nylon uniform and "coolie" helmet

↓ Experimental plywood and aluminum alloy tent is cool and portable. It can be struck in one minute





Above, even desert cooks don't swelter. Kitchens have a cooling system and flues carry heat from the stoves. Right, desert well water is filtered and cooled. Without water for two days, a man can be injured for life

the desert tests from Task Force Frigid.

Members of the command live in experimental tents made of pressed plywood, cork and open-weave green canvas. The roof is aluminum painted a pale green. The men like the tents—they say they are cool and comfortable.

Mess equipment made of light plastics has been found to be easier to clean and carry than metal gear. Mobile kitchens have been redesigned with a water-cooling system and flues over the cooking ranges to carry off hot gases. A new field ration similar to the C ration, has eliminated crackers and added bread, which stands up better under desert heat.

Water is carried in a new evaporation bag made of loose-weave canvas to hasten the evaporation process which cools the fluid. Old-style Army water bags were made of rubber. The new ones have three spigots set at the bottom and are so loosely woven that beads of moisture form on the outside.

Other equipment under test includes mobile showers and portable Diesel air-conditioning units for cooling mess halls.

The idea for Furnace had its beginning during the North African campaign

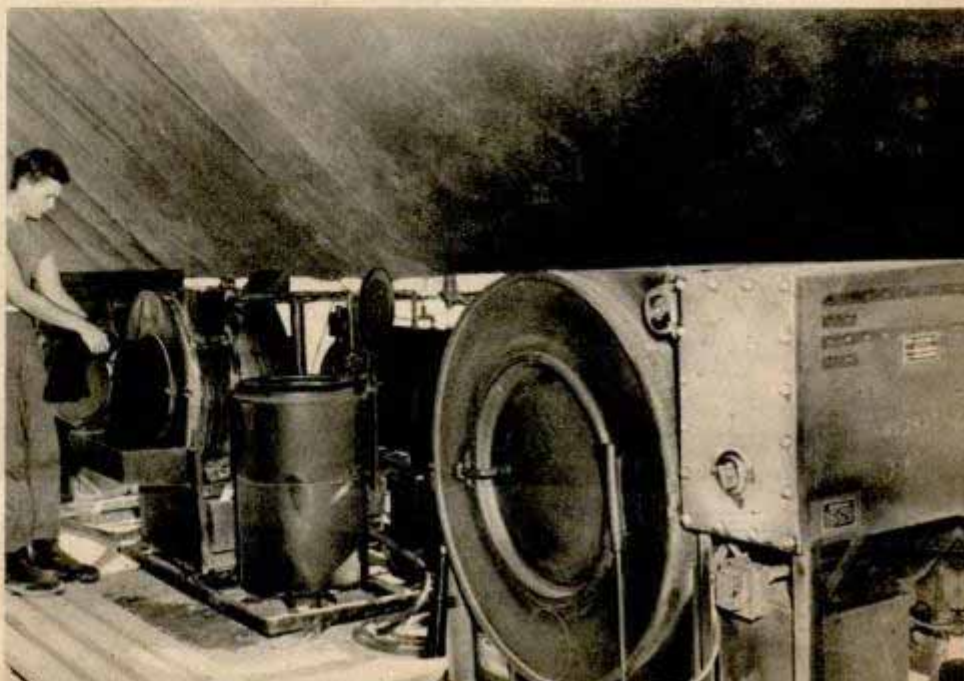
when much equipment was junked or modified in the field to meet extreme heat conditions. Big guns cooled less rapidly and barrels had to be rifled after firing 200 rounds rather than after the usual 400 rounds. Expansion of bullets in the sun was another problem which plagued forces in North Africa.

As a result, extensive field and laboratory tests are being made on guns and ammunition by Furnace with most of the findings classified top secret.

Most tests are made by the men themselves with laboratories double-checking

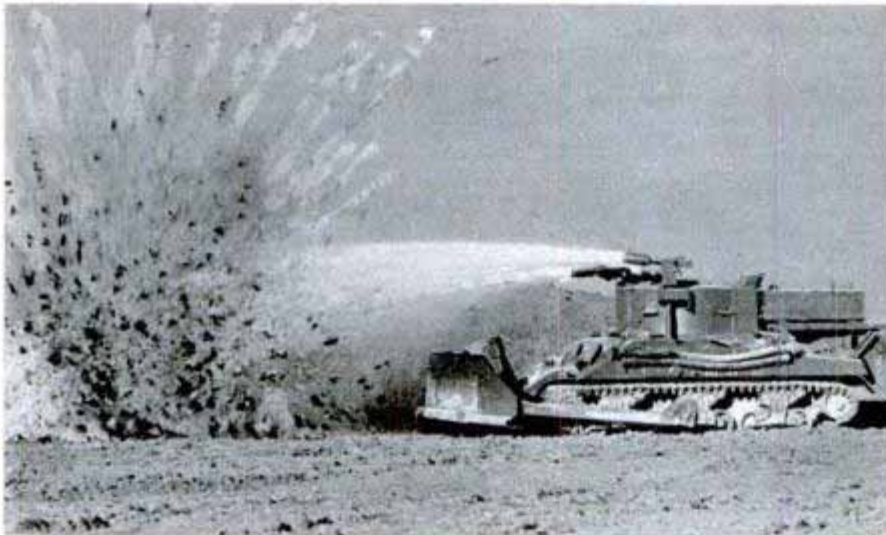
(Continued to page 256)

Nylon clothes go through a mobile laundry made of heat-resistant alloy



Piano Exerciser

Pianos are transformed into exercise machines by an attachment that retains the music sounds but increases the pressure necessary to strike the keys. The machine was designed for disabled veterans and others who need therapeutic treatment for the hands and wrists. Key pressure can be adjusted by turning a knob on the attachment, with pressures ranging above six pounds. The attachment was developed by Dr. Bruce Armstrong of the Navy and Ben Ross of the Musicians Emergency Fund.



Fire-Fighting Tank

Sherman tanks are being converted into armor-clad fire trucks to fight blazes in ammunition dumps and airfields where explosions threaten firemen. Water nozzles instead of cannon are installed in the tanks. The armored fire trucks are expected to help extinguish fires quickly by permitting fire fighters to ignore explosions when entering a blaze.

Lincoln Electric Company photo

Lightweight Utility Roller

Weighing just a ton, a gasoline-motor roller has been devised for preparing new lawns, driveways, golf courses and for other jobs where full-size rollers are impractical. As rugged as larger models, the machine has a 42-inch body and a 3½-foot wheel base. The watertight welded rollers are filled through an inlet in the side wall. Weight can be increased by placing a 600-pound concrete block in the machine bed.



Information, including manufacturers' names, concerning products described in this issue may be obtained by writing Bureau of Information, Popular Mechanics, 200 E. Ontario St., Chicago 11



With pen's sides forced together, antelope are easy to seize
↓ Portable pen is made of rope netting. Canvas clipped to the bottom dissuades the antelope from charging the sides

ANTELOPE ROUNDUP





"Antelope cowboys" force the herd into the rope corral. The animals shy away from white canvas strip



Tying the animals for easy transportation is more than a one-man job. Sportsmen volunteer for the work

EACH YEAR officers of the Montana Fish and Game Commission, assisted by volunteer sportsmen, ride the range in an antelope roundup, capturing antelope in areas where they have multiplied too rapidly and transplanting them to areas that need restocking. The "antelope cowboys" set up a rope corral with fences angling out from the gate to form a funnel. Then the men take to the range to spot and roundup the antelope herds. When a herd is captured the sides of the corral are forced together to enable ropers to tie the antelope for easy handling. Each animal to be moved is tagged on one ear with the date and location of capture. The roundups have been so successful in spreading Montana's antelope herds that antelope hunting now is a prime sport in the state.

Herd is driven into this capture gate where individual animals are easily seized and hog-tied for tagging



Tag clipped to ear tells date and location of capture. ↓ Antelope are released in areas that need restocking



WAR-SURPLUS ITEMS

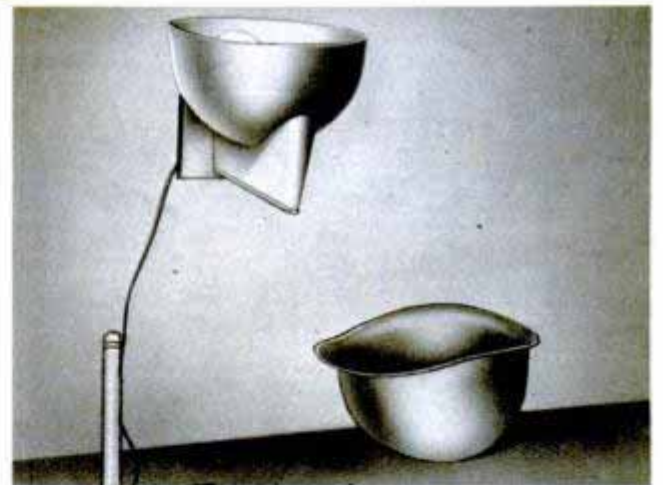


Surplus Army flag kit covers are easily transformed into quivers to carry arrows in a bow-and-arrow set

Paperweights, nutcrackers and tack hammers are made from shell casings. Book straps and belts are cut from hand-grenade bandoliers. Cigarette lighters and children's piggy banks emerge from the metal in empty grenades. The list of civilian items created from war-surplus supplies is almost endless. Some of the adaptations are conceived by inventive citizens, but most have been developed by the Products Research Division of the War Assets Administration. This group of experts, organized early in 1946, found countless civilian uses for thousands of specialized war devices which first seemed of no value for peacetime uses. However, there are still many war supplies which defy conversion. What, for example, can be done with millions of jars of black cold cream used as camouflage by Rangers and assault troops? And who wants to buy several thousand cloth labels made up when the Women's Army Corps was still the WAAC?



Civilian defense helmets become ornamental flower-pots. Below, airmen's cushion packs which held medicine and food serve as canoe seats and chest protectors



War helmets are converted to wall lamps after rim is cut off. Below, parade periscope made from two tank prisms and a length of plastic tubing

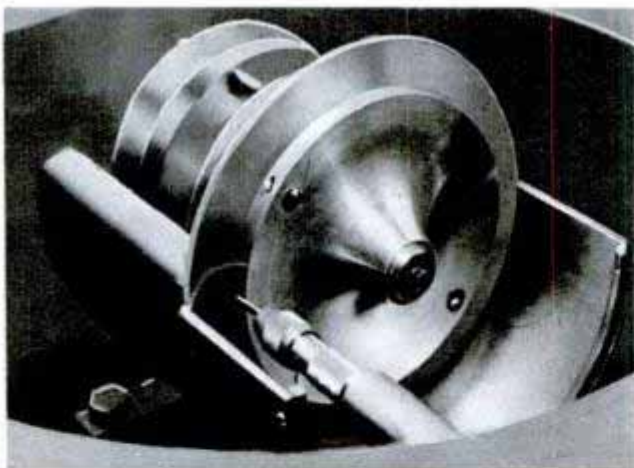




Multiengine Dock Permits Indoor Servicing

Service docks adaptable to all types of multiengine aircraft are part of an international overhaul and maintenance center at Sayville, N. Y. Designed to prevent bad weather from interrupting 'round-the-clock maintenance, they have permanent elevated platforms inside that are expected to prove safer for mechanics than movable

stands and ladders. The most significant variation between engine entry places is that between the outboard niches, for the outboard engines of four-engine craft, and the slots for the inboard engines. Large inner openings are required because the Constellation's engines are closer to the ground than those of other large planes.



Wheel Turns 123,000 R.P.M.

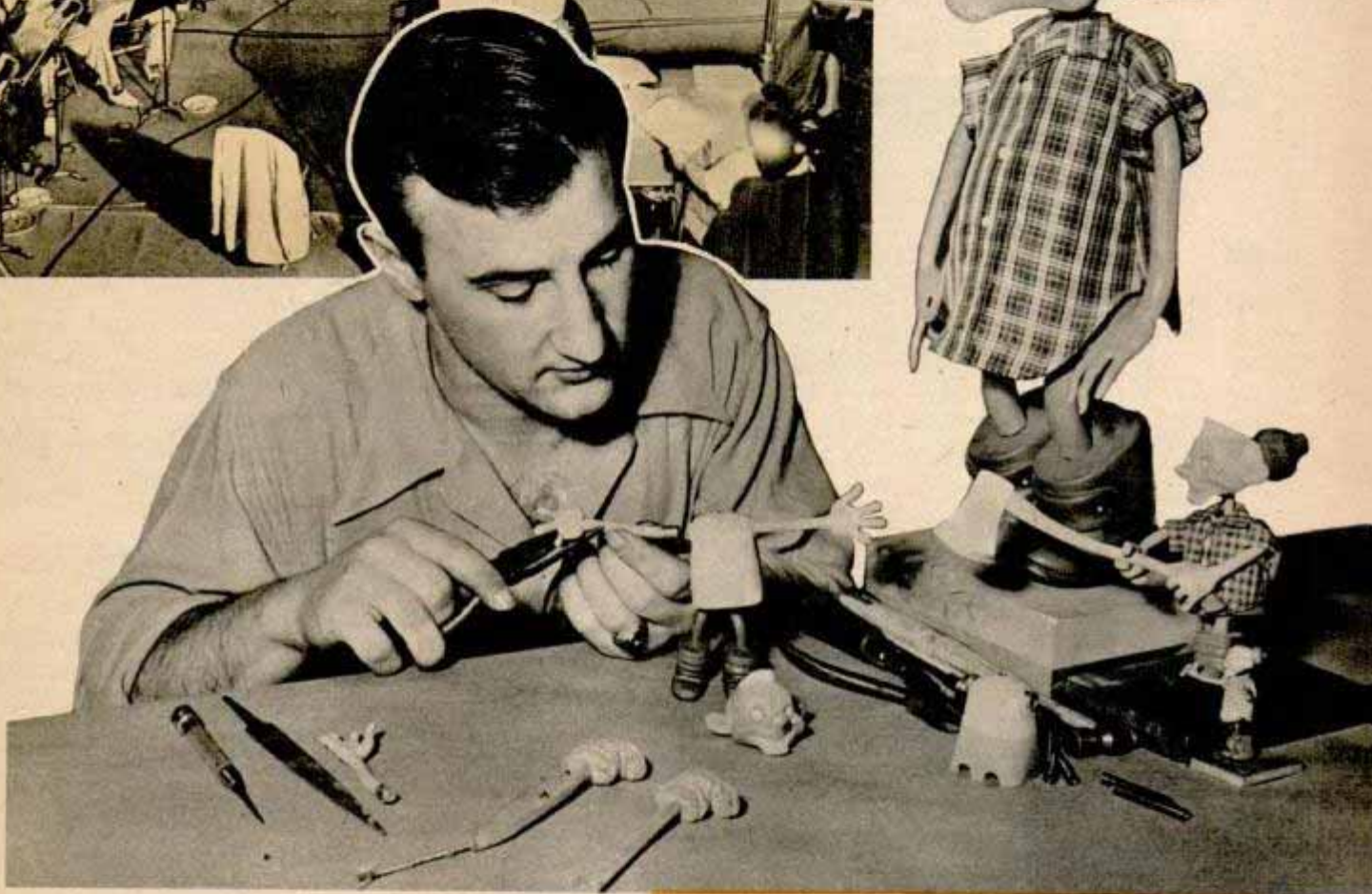
Spinning at 123,000 revolutions per minute, a small wheel equipped with a razor blade slices ultra-thin specimens of plastic, metal, textile, animal or plant tissue, bacteria and other specimens for examination under an electron microscope. The cutting device, designated by the General Electric Company as a microtome, slices specimens to a "thinness" less than one micron (1/25,400 inch). The speed with which the motor-driven wheel revolves is a new world's record for rotational speed using a rigid shaft, according to GE engineers.

Cockpit Makes Truck-Sedan

By attaching the cockpit of a B-25 plane to the body of a pickup truck, John Page of Kansas City built himself a roomy "sedan." He, his wife and four other persons recently left Kansas City for California in the truck and a house trailer. California law prohibits passengers from riding in a trailer, so Page had to convert his truck into a sedan. He found that the plane cockpit provided plenty of room for all of his passengers.



Music for movie of puppet orchestra is dubbed in by musicians led by director who follows puppet director on screen



Puppetmaker assembles wood chopper in three sizes. Below, miniature instruments for a tiny orchestra



Putting LIFE in Puppets

POPULAR MECHANICS

HOLLYWOOD'S smallest motion-picture studio produces almost as many movies in its single one-story building as does a major studio which has dozens of huge sound stages.

Pal Productions shoots all its pictures in miniature.

On a visit to the 200 by 300-foot studio you are apt to find a camera crew filming a tiny beach scene on a table top while alongside them another crew makes panorama shots of a miniature oil-well field. Nearby a third crew shoots close-ups of two puppet actors 10 inches tall. All the scenes will appear full size when projected on theater screens.

The Pal puppets are animated by stop motion, a slow and painstaking process by which a single frame of film is exposed in the camera, then a puppet's arms or legs are moved a few millimeters, another frame of film exposed, and so on. When the series of pictures is run through a projector at normal speed, the puppets seem to come to life. They dance, roll their eyes and talk.

George Pal created his animated puppets in Holland, then six years ago Paramount brought him to Hollywood to produce the "Puppetoon" series of short subjects. Since then Pal Productions has pioneered other animation effects and today the studio produces a wide range of entertainment and industrial films.

Animation is an old trick, one example being the movie cartoons. These are a series of drawings, each showing a succeeding step of action, that are filmed one after the other. Pal uses three-dimensional puppets and actual miniature sets to achieve an illusion of perspective and reality such as is suggested by movies of living actors and actual sets. All his pictures are in color.

One picture combines live actors and diminutive lifelike puppets in the same scenes. Part of the picture shows Duke Ellington playing the piano and at the same time watching a genie that dances on the piano top in front of him. Ellington's performance was filmed in a single day, then a month of hard work went into animating the puppet.

When Ellington was being filmed he was told to act in response to off-stage directions and to turn his head from side to side, smile encouragingly, and behave just as if he were actually watching a genie.

After this film was developed and inspected, an imitation piano top was placed in front of the camera to match the position of the real piano in the original picture. Then the genie was filmed in its dance on this stage. Care was taken to move the puppet back and forth to coincide with the direction of Ellington's glances.

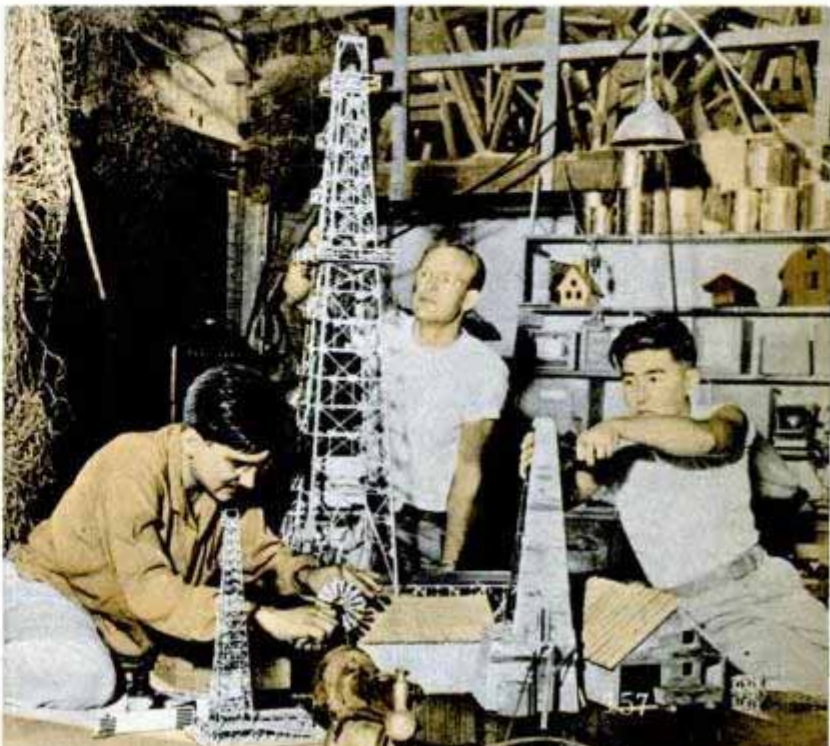
Five to 10 frames of film were exposed



Frog and animated musical instrument compare notes in a Pal production. "Water" is glass with salt rings

to show the genie taking a single step. Blinking his eyes or tilting his head took three to five frames. Depending on the number of adjustments to the puppet per shot, from six to eight frames of film were exposed each hour. The Pal technicians figure that on the average an hour's work in front of the camera lasts no longer than a second on the screen. A five-minute

To make a movie showing how an oil well operates, modelmakers build replicas of derricks and other parts





Oil men use the name "horse" to designate one part of an oil-well pump. So, in puppet movies illustrating how a well works, horse heads are used

movie production requires about 300 hours of camera work.

The Ellington film and the genie film were combined into a single composite by a difficult double-printing process. Now that the technique has been perfected for color, other pictures that show live people and puppets performing in the same scenes are planned.

Pal has applied his animation process to all sorts of inanimate objects. He makes submarines appear to dive and surface in an imitation ocean. Tiny aircraft take off from a field and maneuver in front of the camera. An ocean usually consists of ripple glass lighted to show sparkling wave caps. A submarine is made to dive by using a whole series of models in stop motion, each model consisting of a smaller part of the submarine. Aircraft are suspended on threads or wires for animation.

Recently Pal had the problem of making

ground projection screen. From behind the screen you see a clear picture of the movie being projected on its other side.

Behind the screen and placed so that it matched up exactly with the derrick floor on the screen, the technicians built a miniature replica of the derrick floor. Below this they placed a flat wall modeled and painted to represent underground formations. A groove was cut out of the wall, straight down from the derrick floor, and a string of miniature oil-well pipe with a drilling bit at its end was suspended from the derrick so that it fit into the groove.

Then the whole scene, part background movie and part miniature, was filmed by a camera. The audience sees something that would not be possible to film otherwise, an oil-well-drilling rig at work on the surface and with its bit steadily boring into the formations below it.

One close-up in the same picture called

Stagehand changes position of puppet in underwater scene. Ripple glass represents the surface of the water

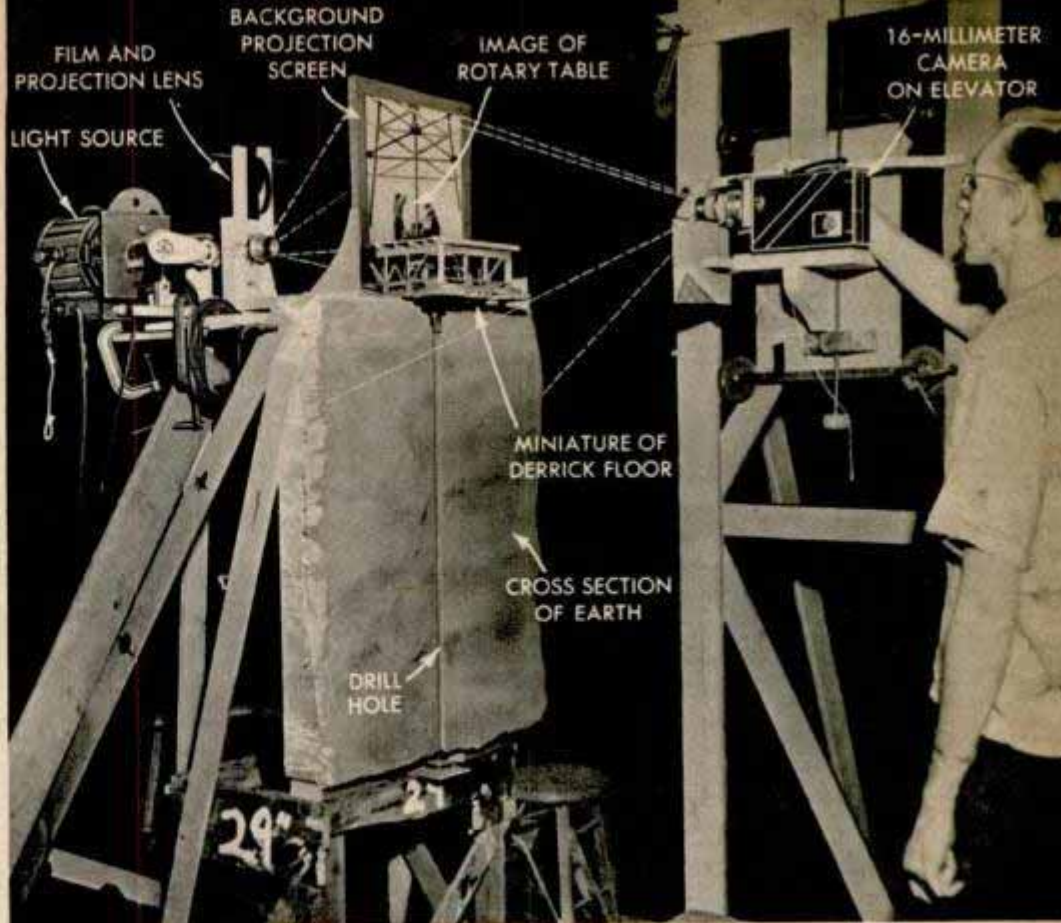


for a visual explanation of how oil-well mud is circulated down the inside of the drill pipe to the bit and then is forced back up to the surface outside the pipe, carrying with it the chips and debris produced by the bit. Pal's technicians built a separate cutaway of the earth and laid it horizontally on the floor. Then a groove was cut in the model, a cutaway section of drill pipe laid in the groove, and muddy water flowed along the inside of the drill pipe. Escaping through the bit, the water reverses its flow and travels back along the outside of the pipe.

Another stunt for the same picture was to show what happens underground when bullets are fired from a gun perforator device to open up a formation and expedite the flow of oil.

A model of the tubelike gun was placed in position against a cutaway of the earth and a piece of clear glass on which tiny flashes of flame had been painted was placed in front of the gun. The flashes were lined up with the holes in the gun. After a picture had been taken, the glass was removed and a second substituted for it, showing larger flashes of painted flame. Another picture was taken and a third glass was put in position. This kind of animation permits an audience to see the flashes of flame, the bullets plowing into the formation, and the released oil flowing into the well.

Pal's organization consists of 30 technicians and animators under the direction of George Jordan, production supervisor. Virtually every department of a major studio is represented in miniature. Cameras, lights, set construction, make-up, wardrobe, and property departments



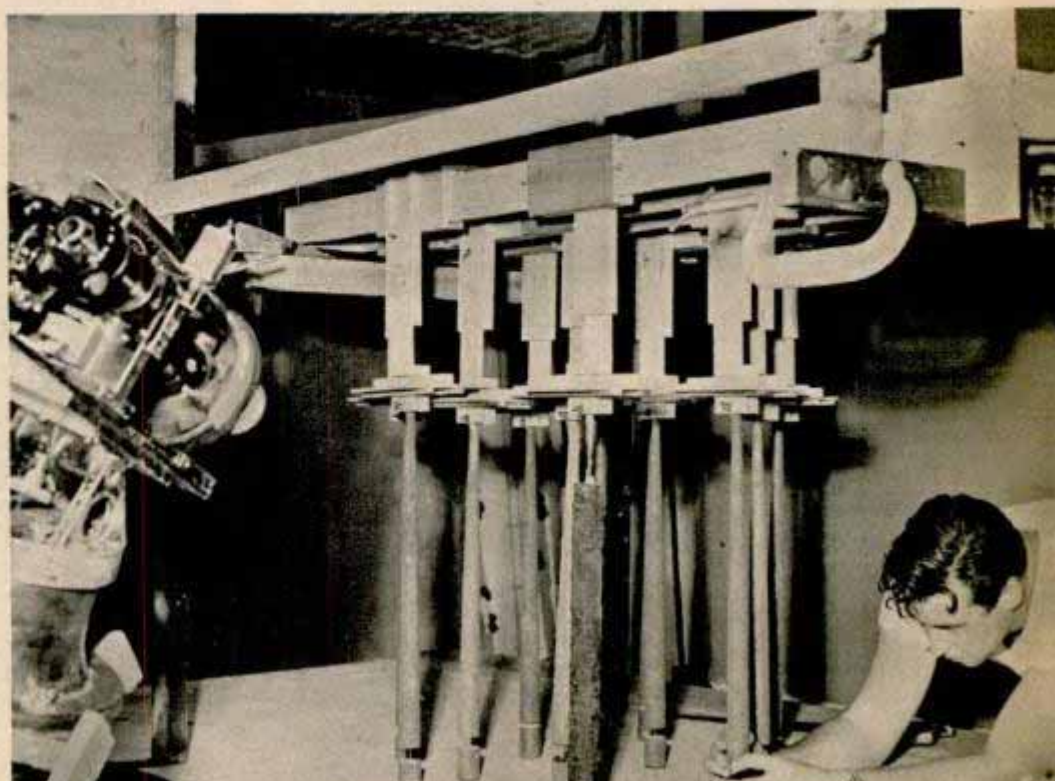
By combining a derrick and drill-hole model with a motion picture projected on a screen one frame at a time, movie is made to show how an oil well works

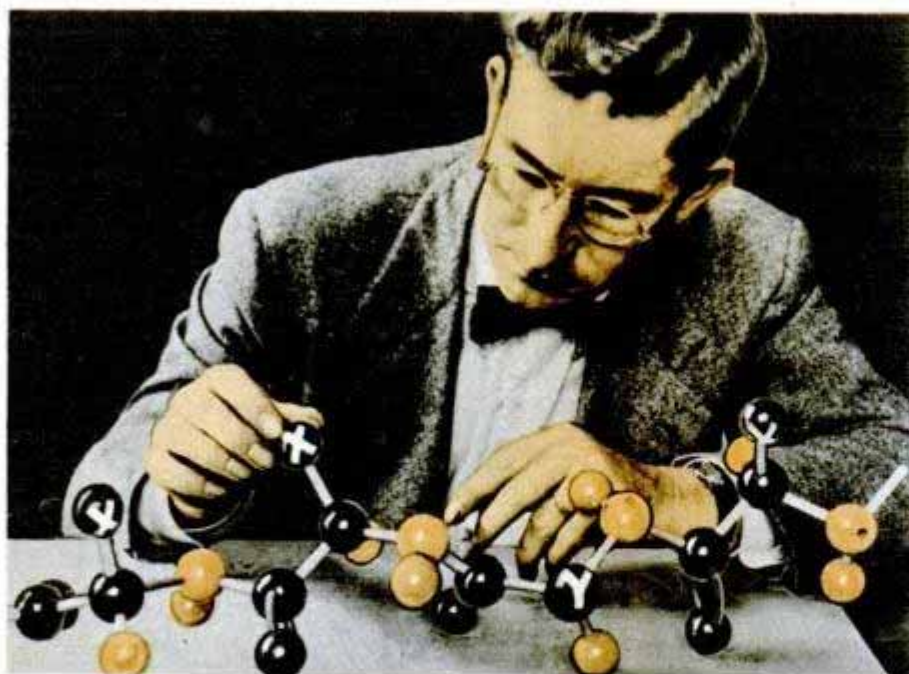
all play their parts in producing the pictures. Designing and manufacturing the puppet actors requires the work of another department.

After a story idea has been worked out and sketches are made of the puppets, a sculptor creates models of each puppet actor. Most of the puppets are 10 inches tall although important characters may be

(Continued to page 244)

Complex jig is used to animate bare tree trunks in a scene that will show dancing trees. Camera at left will take pictures of trees bowing and swaying





Basic molecular structure of protein shown by Dr. Woodward. Only elements "X" and "Y" are changed in different proteins

ducing these molecules was in the natural growth of plants, animals and human beings. Because it may provide a model for the manner in which the body produces proteins, the new discovery is expected to be especially significant in medicine. Also, by extending the length of natural molecules, the process may be used to modify harmful proteins into harmless substances. The process begins with alpha amino acids which are obtained

PROCESS DUPLICATES NATURAL GROWTH

Wool that doesn't come from sheep, and fur that has never been worn by an animal may result from the discovery by a Harvard University chemist of a process for producing protein-like substances almost identical to those in living cells. Starting with small molecules, Dr. Robert B. Woodward produces complex protein-like molecules comparable to those in hair, muscle, nerves, skin and other forms of living matter. The only previous method of pro-

readily from natural products like meat, or by synthesis from coal, air and water. Synthetic silk-like thread has been produced already. It is the first man-made thread with a molecular structure very similar to that of the natural protein, silk. Although Dr. Woodward declines to forecast the industrial possibilities of the process, it may open the door to synthetic materials that are almost identical in every respect to animal-made products.



DOUBLE-JOINTED BUS

Despite its unusual length, a new double-jointed bus with front and rear-wheel steering maneuvers as easily as smaller vehicles. A rubber hinge connecting the front and rear sections permits the 47-foot bus to pivot on its two middle wheels. This articulation also smooths the ride over bumpy roads. Front and rear wheels are

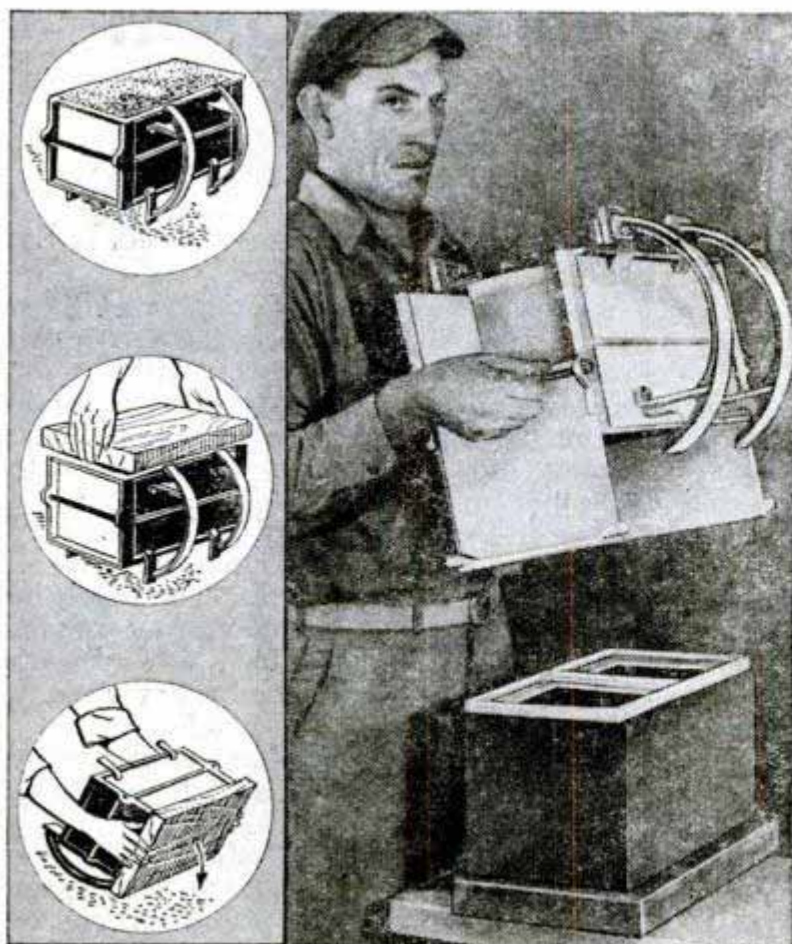
coupled for steering and the rear wheels automatically "track" the front pair around turns. Powered by two 180-horsepower gasoline engines that are connected to the middle drive wheels by torque converters, the bus needs no differential. Rubber-in-torsion springs and a special "de-gasser" that eliminates engine fumes add to the passengers' comfort. It seats 58 and has been under development since 1938.

Curb Climber for Crippled Persons

To help crippled persons walk and climb curbs, Frank E. Carter of Minneapolis designed a lightweight four-wheeled device equipped with crutches and handles. If the user wants to rest, he flips down a seat which folds out of the way for walking.

Chemical Treatment for Boils and Ulcers

Bacitracin, a new germ-killing chemical, is the medical profession's latest weapon to tame such infections as boils, carbuncles, sties and ulcers. Bacitracin originally was obtained from a germ found in the badly infected wound of a seven-year-old girl who had suffered a compound leg fracture. Dr. Frank L. Meleny and Miss Balbina Johnson of Columbia University tested infectious matter from the wound and discovered that the germs were powerful destroyers of bacteria. Further tests revealed that a filtrate from the germs was effective against boils and carbuncles. Months of research were required to produce small test samples of the new chemical. In subsequent trials, bacitracin was used on 100 patients and 62 were saved from the surgeon's knife. Bacitracin will be of clinical importance, according to its discoverers, only if it can succeed where penicillin or the sulfonamide compounds fail. The chemical is made up in an ointment which melts at body temperature.



Concrete-Block Maker

Concrete blocks are made quickly and easily with a portable roll-over machine which consists mainly of two rockers attached to a mold box. To form a cement block, the operator fills the mold box with mix, tamps it down with a shovel, levels off the excess, places a smooth board on the mold box and, holding the board against the top, rolls the machine on its rockers over onto the board. Then he lifts the machine straight up, leaving a block 8 inches by 8 inches by 16 inches. Blocks can be produced at the rate of one a minute, according to the manufacturer. The machine weighs less than 30 pounds.

☐ About a million plants now are known and have been named by botanists, according to Prof. Liberty Hyde Bailey of Cornell University, who estimates that at least another million plant species await naming and description.

Brother Joe built this bristling bike to mount part of his gun collection. With a grin, he says it's "a means of transportation for gangsters who can't afford a car"



HOBBYISTS OF THE MONTH

The Bicycling Steinlaufs

EVER SEE a square-wheeled bicycle—or a bike with legs instead of a rear wheel? A family bike that seats five—or a 12-foot "strato-cycle" for looking over the ball-park fence?

These are just a few of the wacky bicycles built from scratch by the Steinlauf clan of Chicago. Four Brothers—Joe, Charley, Maurice and Dave—and their respective families, are happy only when there's a bicycle within reach.

The Steinlaufs will build any kind of a bicycle for a laugh. Take the time Joe's brass bedstead fell apart. He kept the foot, gave Charley the head, and each of them built a bicycle by attaching a sprocket, chain, seat and a couple of wheels. They're still riding the bedstead around the streets of Chicago.

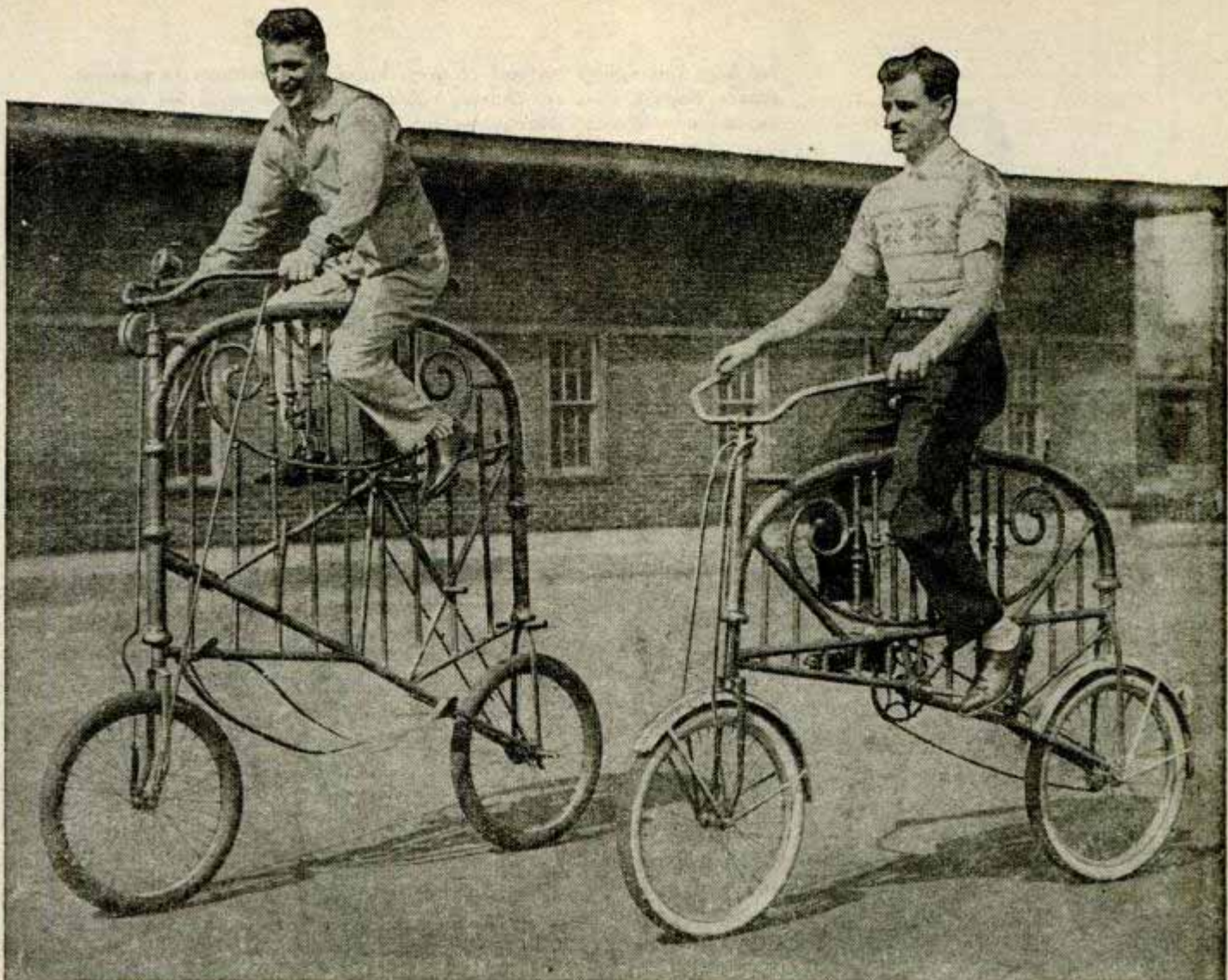
Joe's family takes Sunday-afternoon spins on a custom-built five-seater with Joe guiding from up front while his wife,

two sons and a daughter-in-law pedal from the rear.

When his son Fred was a year old, Joe built him a bike with a sidecar. At two Fred could ride the bicycle without the third wheel, and at 15 he graduated to one wheel. Today he's a unicycle expert, performing atop the 12-foot wheel-and-stem his father built for him.

One of Joe's other hobbies is collecting firearms, but some of his guns have been sacrificed to make a bicycle. The result he laughingly describes as his "two-seater for gangsters who can't afford a car." It's equipped with 10 rifles, three pistols, a searchlight, bayonets and handcuffs.

When his other son Colman couldn't find his ice skates one winter day, Joe whipped together an ice bike. Instead of tires it has four-inch spikes on the wheels that bite into the ice to keep the bike from slipping, and it's equipped with special mittens on



↑ When Joe's brass bedstead broke, two of the bicycling brothers attached wheels and built a couple of bikes
 ↓ Family cycle has five seats, three wheels. Right, when Charley pedals, dummy walks him down the street



Ice bike has spikes instead of tires, handle-bar mittens to prevent frozen fingers. Center, Charley rides the boulevards in his complicated "uno-wheel." He guides by leaning in the proper direction



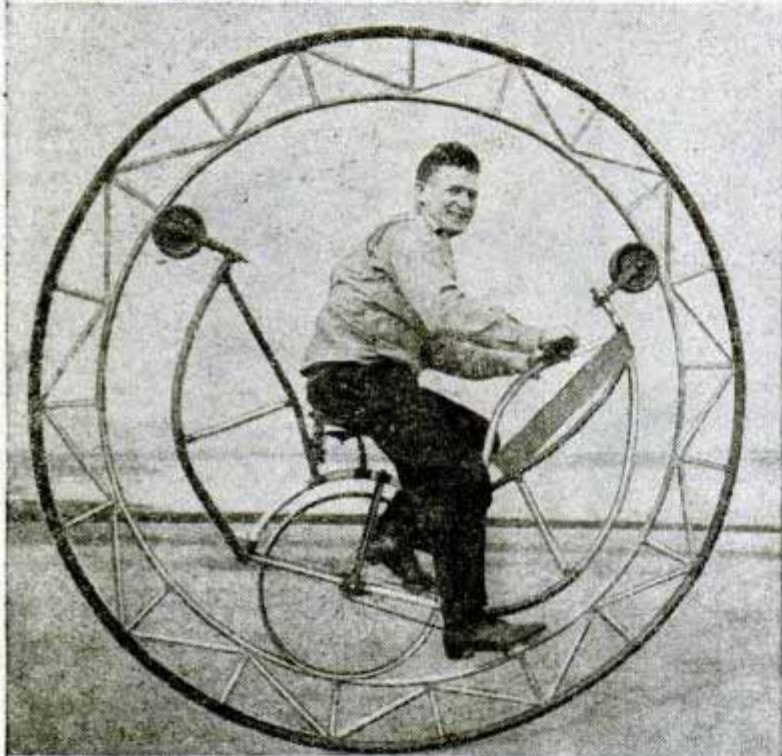
the handle bars for zero weather.

The brothers are well-equipped to build anything they dream up. All four are mechanics and Joe owns a cycle-and-tire shop, Charley has a garage, Dave runs a service station and Maurice is in the bicycle-toy shop business.

Strung high on the walls of Charley's garage are the queerest bikes of all. To Charley the building of a unique bicycle is an art. He's the man who built the "strato-cycle," the 12-footer that gives him a free seat above the ball-park fence.

The most ingenious of his mechanical marvels is his "uno-wheel." When Charley takes this contraption out for a spin, pedestrians see a giant wheel rolling down the street with Charley inside. The 7½-foot wheel is made of metal tubing. Welded to spokes radiating from the tubing is a

Lower left, the brothers seem proud that the square-wheeled bike is the "roughest riding cycle in existence." Below, Joe's son is an expert atop his 12-foot unicycle



Several days after Charley's wife sent her sewing machine to his garage for repairs he rode it home. Now the whole family goes for a spin when there's mending to be done



slightly smaller wheel. An ordinary bicycle wheel, minus the tire, rolls along the inside wheel. Charley sits on a seat atop a strange assortment of chains, sprockets, frames and wheels. When he pedals, the bicycle wheel turns, rolling the big wheel. He guides by leaning in either direction.

"It's all the application of simple principles of physics," Charley explains, without explaining the principles.

One day Charley's wife sent her sewing machine to his garage for repairs. A few days later he rode the sewing machine home, as he'd built a complicated bicycle frame around the machine. Now the whole family rides the bike when Mrs. Steinlauf has clothing to be mended. Charley guides with a steering wheel, his daughter sits in front operating the brake, his son pedals from the rear and Mrs. Steinlauf sits side-

saddle in the middle doing the mending.

Charley once built a bike with a pair of legs instead of a rear wheel. The legs move alternately, lifting up and stepping forward. But that wasn't complicated enough so he removed the rest of the bike, mounted a seat atop the legs and rode the legs only. This provided laughs for a while, but eventually it, too, seemed tame. So he re-installed the rest of the bike and added to the legs a life-size dummy dressed in street clothes. Now when he pedals the bike, the dummy walks along behind as though it were shoving Charley. With a system of controls, Charley can make the dummy turn its head, wave and smoke a cigarette.

Sons, daughters and in-laws of the brothers have been bitten by the bicycle bug, too. Even the father, 78-year-old Bernard Steinlauf, is an active cyclist.

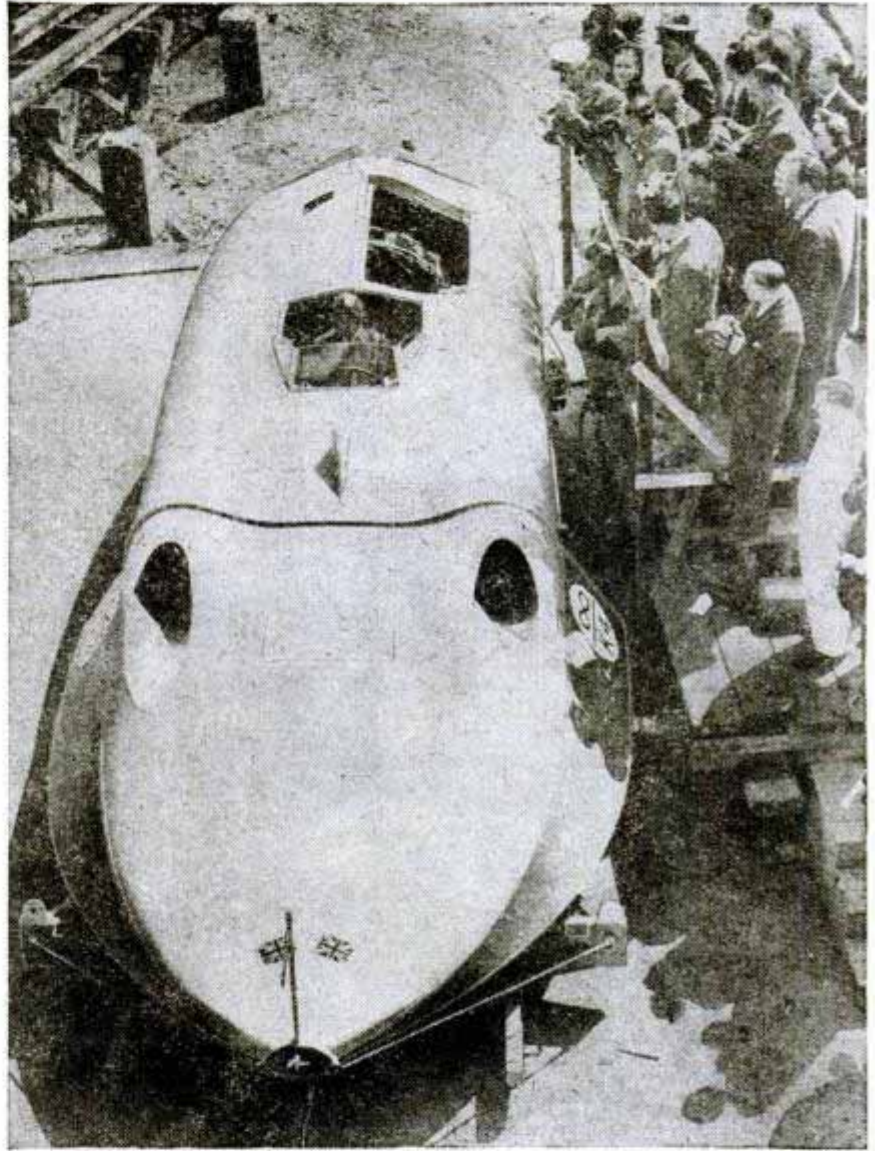


Ballpoint Pencil Applies Perfume

There's no "underwater" use for a new ballpoint perfume pencil but it's a convenient applicator for perfume or cologne. Slight pressure on the point releases a tiny amount of perfume. The leakproof applicator is about the size of a lipstick tube and holds a half dram of fluid. The case is available in satin silver or gold finish with screw-on caps in ebony or dubonnet.

Jet-Propelled Speedboat → To Attempt Record

Engineers are redesigning Sir Malcolm Campbell's jet-propelled Blue Bird II to give the British speedboat racer another chance to break his own speed record of 141.74 miles per hour. The 27-foot boat failed to perform properly in its first trial. Equipped with a 3000-horsepower De Havilland "Goblin" jet engine which burns a refined kerosene, the boat is a reconstructed model of the original Blue Bird in which Sir Malcolm set the speed record in 1939 on Lake Coniston, England. The potential speed of the new boat is 160 miles per hour. The noise of the engine is so great that the pilot wears sound deadeners in his helmet for protection.

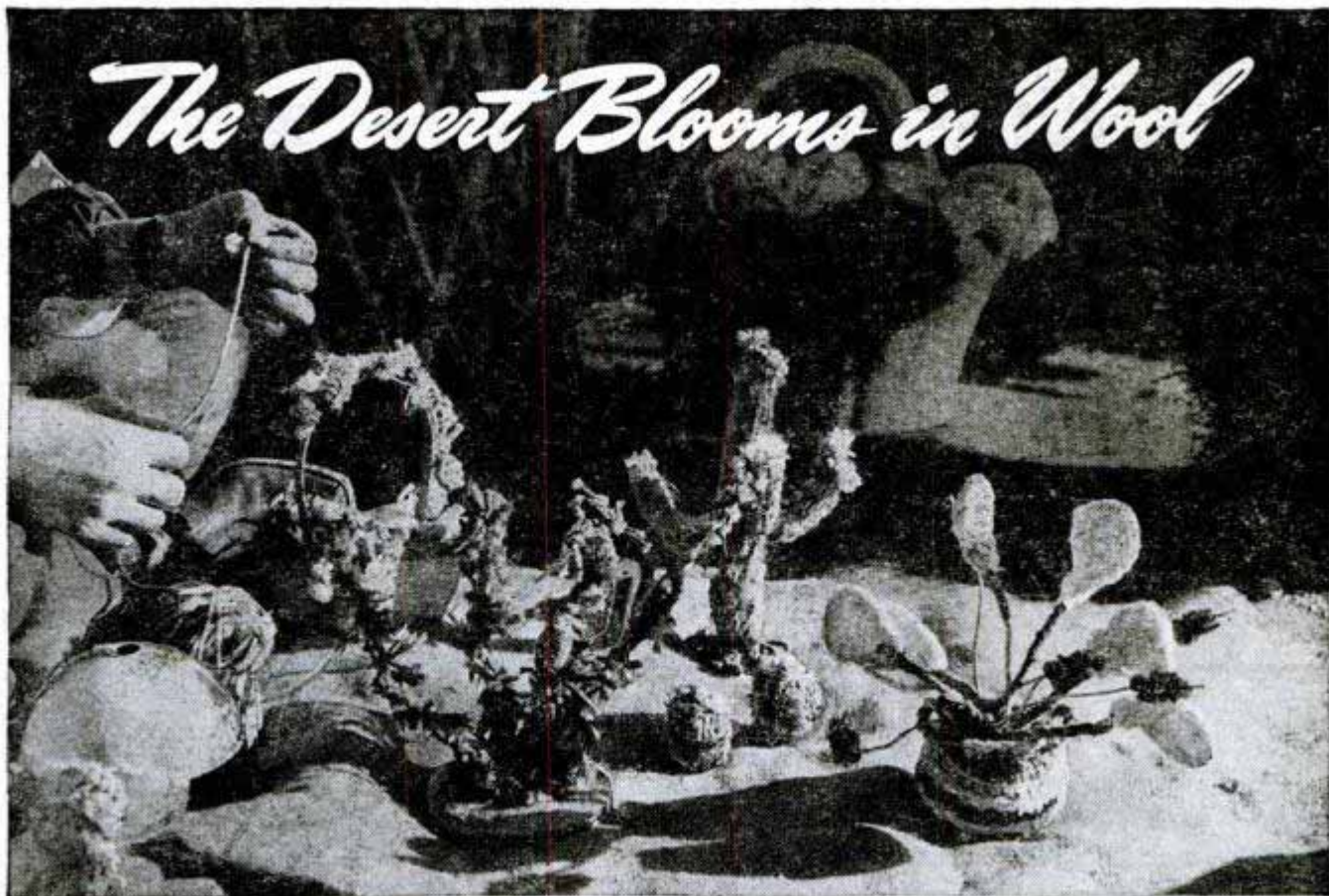


Interlocking lug and frame serve as sink hanger. Tightening screw forces bowl under inside flange of frame and pulls outside flange tightly over sink top covering.

Watertight Sink Frames

"Packaged" sink frames aid in the installation of new sinks and provide a watertight seal between sink and cabinet. The frame is available in 15 sizes to fit most stock sinks and can be installed with only a keyhole saw and a screwdriver. A set of lugs for the cabinet interlocks with the frame to serve as a hanger for the sink. Screws through the lugs force the sink up against the frame to form a seal. The frame can be used with standard plywood tops $\frac{3}{4}$ inch thick plus linoleum or other covering up to $\frac{1}{8}$ inch thick.

The Desert Blooms in Wool



Photos by Dunaway & Haythorne

Lifelike cactus plants and colorful dolls are made by covering wire with bits of wool. Anne Schrank of Tucson, Ariz., trims a wire spine (right)



Photo by Alfred A. Cohn

Miss Schrank started making the decorations as a hobby, but now it's a big business. Above, Indian dolls and wigwam are made into a wall plaque. Right, creating a miniature desert



2,000,000-Pound Test Ram Checks Strength of Dome-Roof Car

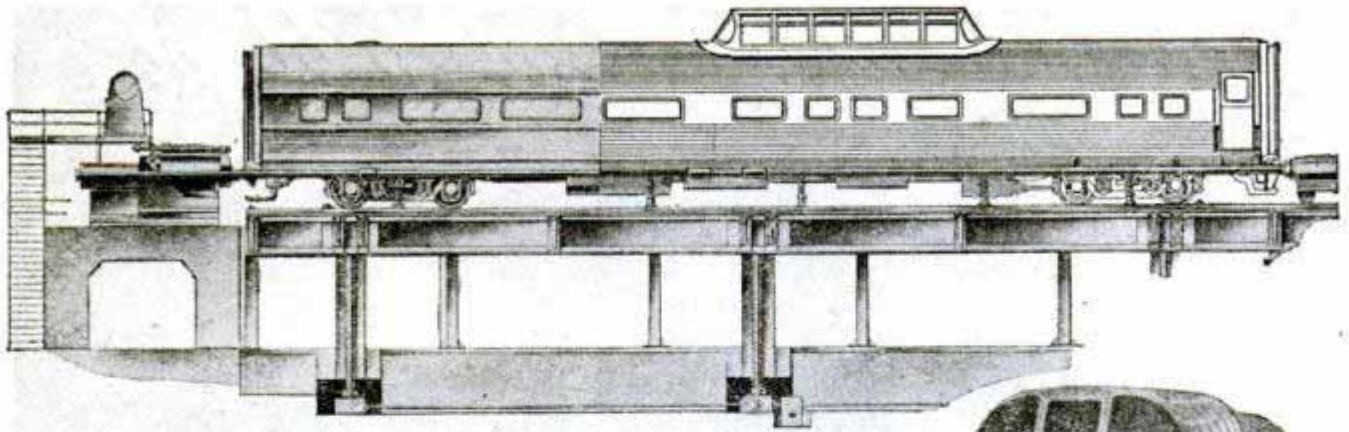
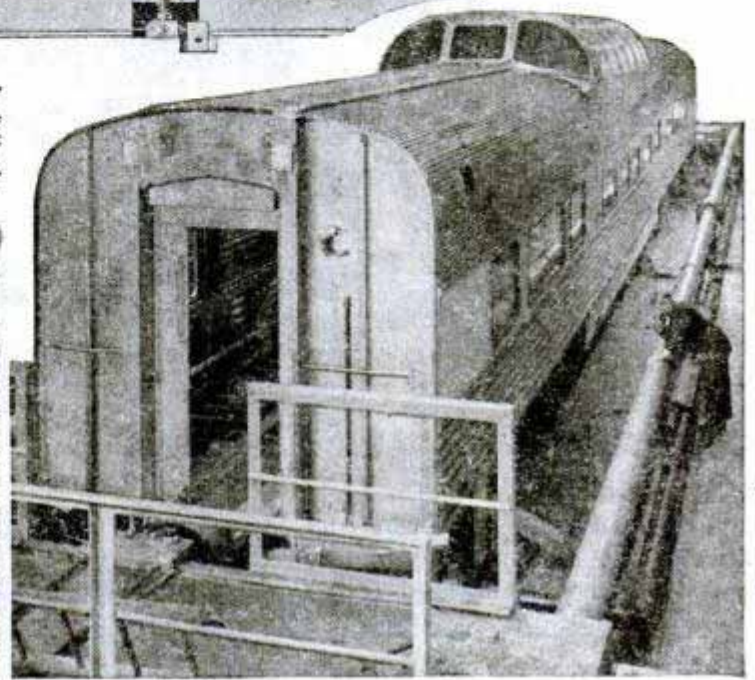
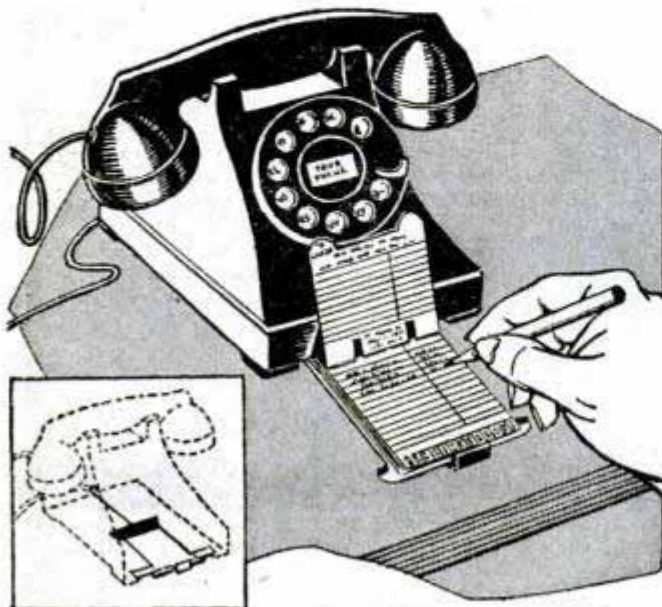


Diagram shows how a car 95 feet long is installed in the ram for a strength test. Below, the ram power unit exerts pressure against end of car. Right, engineer checks car during the test



In the railway structural-test laboratory of the Budd Company huge machines test the strength of new railway cars and provide information for designing cars of the future. One machine tests horizontal strength with a giant ram that exerts 2,000,000 pounds pressure on the ends of cars up to 95 feet in length. A large temperature room recently has been added to the research equipment to determine under

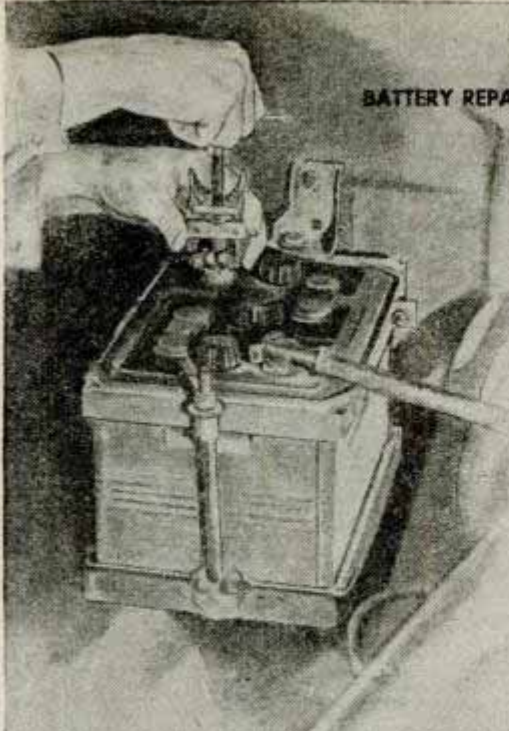
operating conditions the heating and cooling requirements of railway cars. The room is 103 feet long, 20 feet wide and 16 feet high and is insulated with cork. Refrigeration and heating units vary the temperature from minus 20 degrees to plus 130 degrees F. Tests are conducted under changing wind and moisture conditions. The laboratory also tests motor truck trailers and automobile bodies.




Directory Fits Beneath Telephone

Telephone numbers can be found quickly in a directory that fits beneath the base of the phone. The indexed tablet for the numbers is fastened to a metal drawer held in place beneath the phone by a light spring. When the drawer is pulled out the spring automatically lifts the cover of the directory to reveal a page of numbers called most frequently. When the cover is closed the drawer snaps back in place.

Information, including manufacturers' names, concerning products described in this issue may be obtained by writing Bureau of Information, Popular Mechanics, 200 E. Ontario St., Chicago 11, Ill.



BATTERY REPAIRS



APARTMENT WORKSHOP

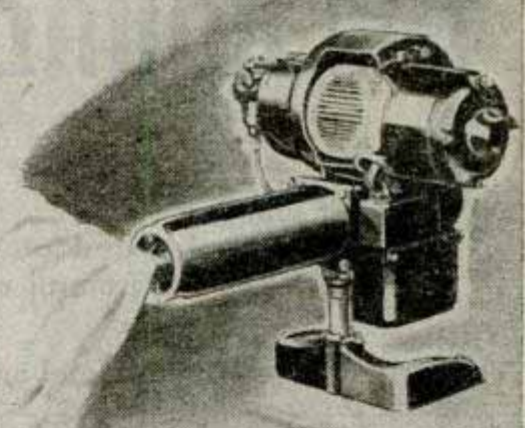
The CRAFTSMAN

★ A home shop in a box—that's one way of describing the apartment workshop detailed on page 184. Closed, it makes an attractive studio couch. Open, the underside of the lid forms a handy tool panel. There's a bench with vise, and storage room for additional equipment and partially completed work.

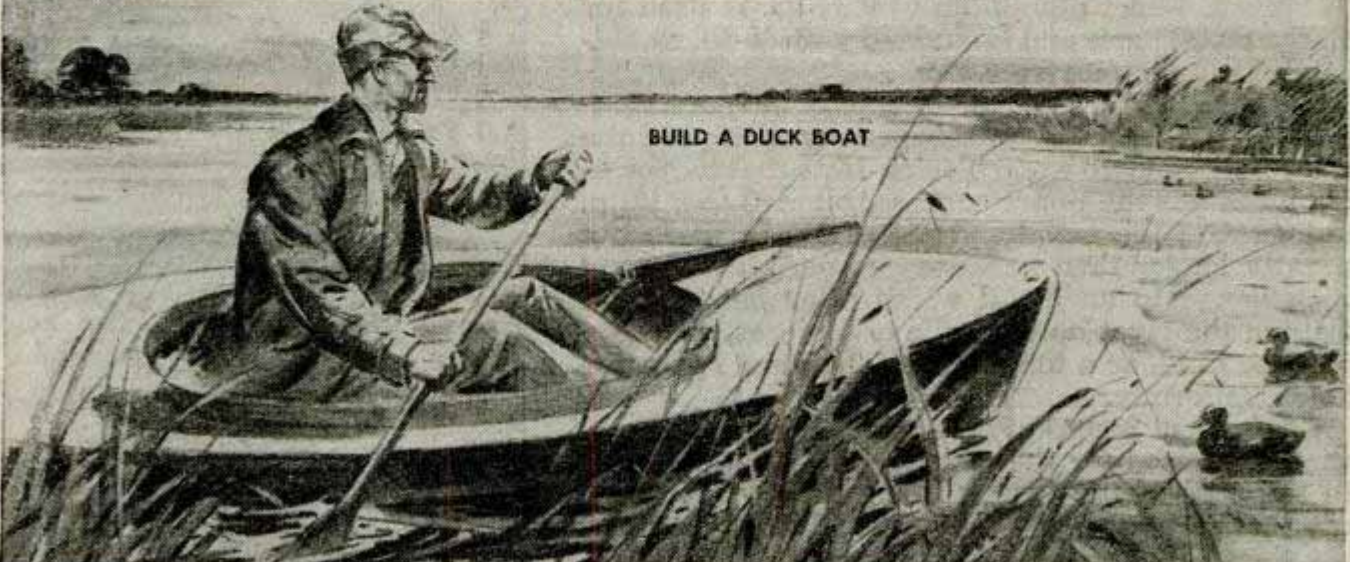
★ A regular maintenance schedule keeps your oil burner working at peak efficiency. Knowing the various parts of common burners, how they work, and how to detect and analyze minor troubles can save both you and your serviceman a lot of time. An article on page 210 goes into this angle.

★ In battery servicing it's the little things that count. Maximum life from your car battery depends on periodic attention to a simple service routine. Each step is pictured clearly in a story on page 188.

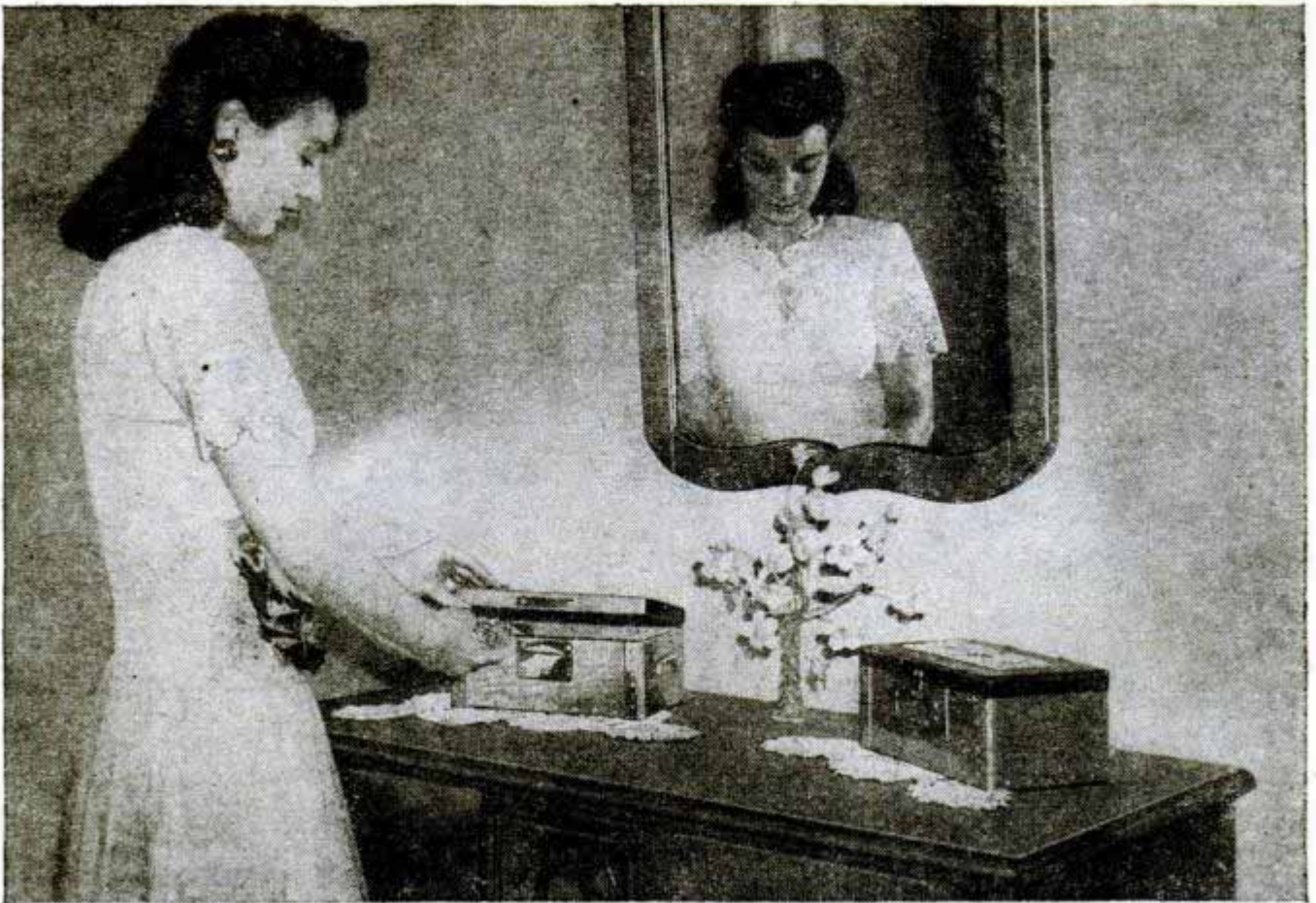
★ A duck boat can get you places where you can't go afoot. With the hunting season just ahead, we present plans for building your own boat on page 178.



OIL-BURNER
MAINTENANCE



BUILD A DUCK BOAT



THE ROYAL PAIR

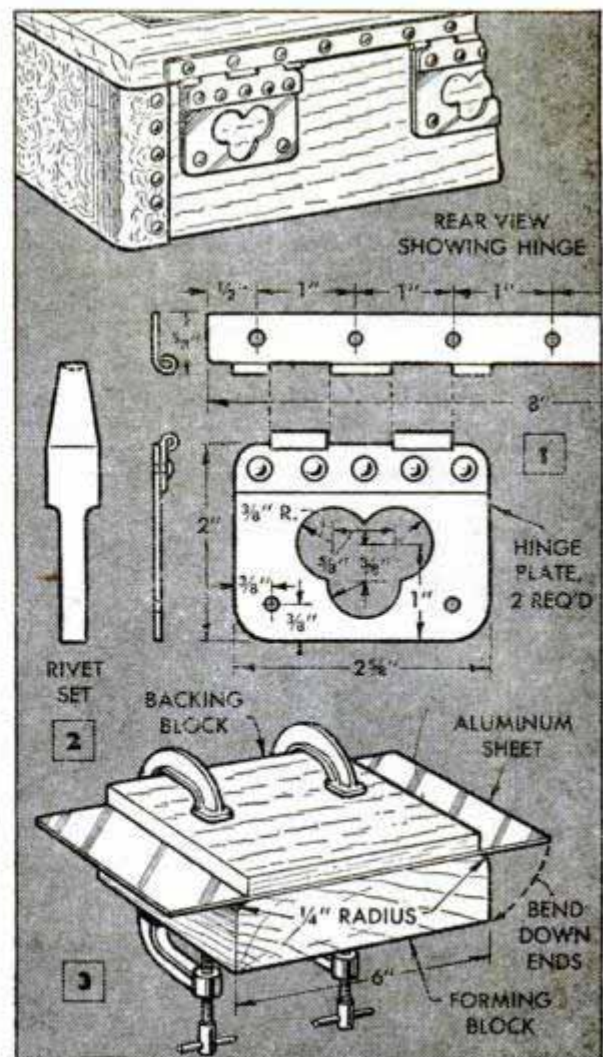
By R. J. DeCristoforo

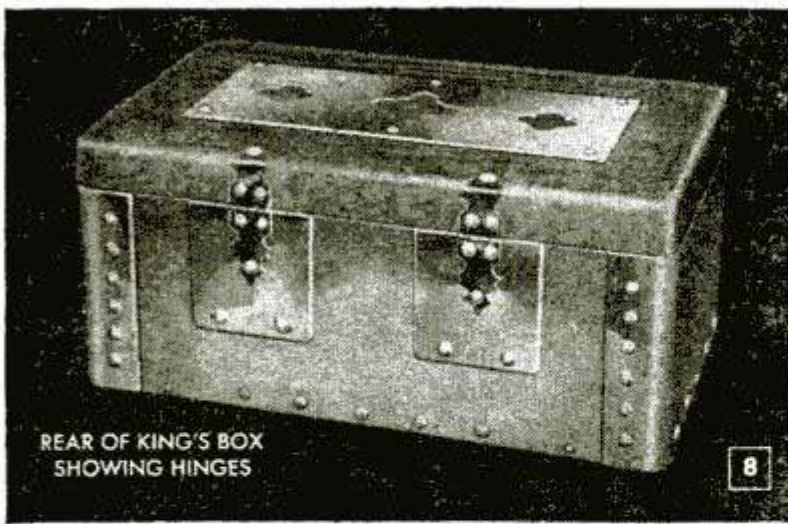
An attractive "strongbox" dresser set of aluminum and wood safeguards jewelry and other personal items from small children

YOU GET a taste of both metal and woodworking in making these exquisite jewel boxes, and there's just enough hand work involved in making each one to test your skill in duplicating fine craftsmanship. Construction of both boxes is practically the same, the main difference being achieved by the overlay treatment. Sheet aluminum of .064 ga. is used for all the metal parts and is studded with $\frac{1}{8}$ -in. round-headed aluminum rivets.

Fig. 3 shows how the metal ends, which are identical for either box, are shaped by clamping the work between two wood blocks. Note that the forming block has the upper corners rounded to a $\frac{1}{4}$ -in. radius. Cut the metal end pieces $3\frac{1}{2}$ in. wide but slightly longer than necessary to permit trimming each flange to an equal width after bending. In drilling the rivet holes in the end pieces, use a jig of some kind, or a template, to align and space the holes uniformly.

Only select pieces of rare and fancy-grain wood should be used for the wooden parts of the boxes. In the case of the Queen's box, a two-tone effect can be had by making the cover of mahogany and the sides of a lighter wood, such as maple. Select a





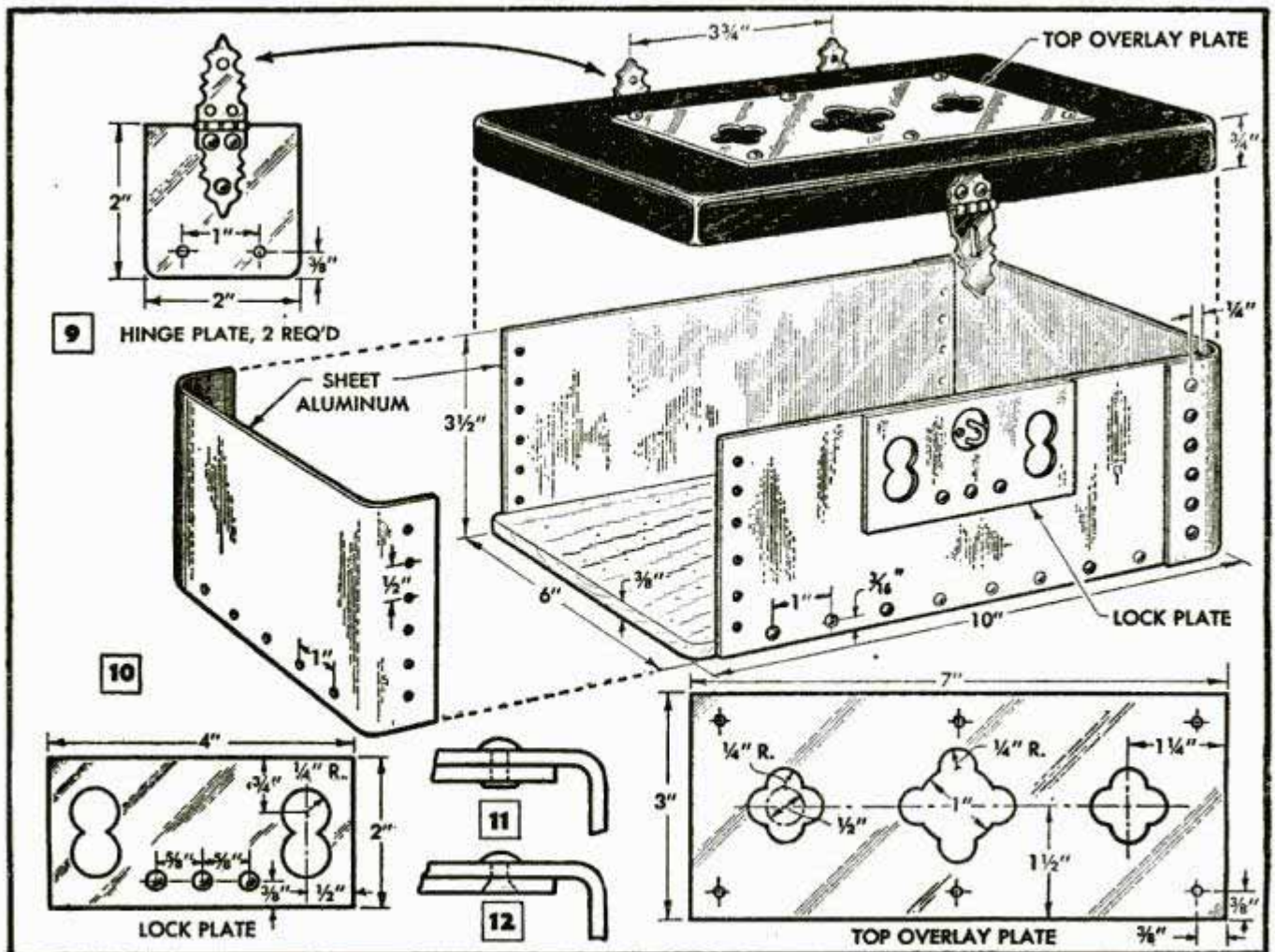
REAR OF KING'S BOX
SHOWING HINGES

8

With the wood parts finished, you can rivet the metal ends to the box. Fig. 5 shows how the rivets are peened flush with the surface on the inside. For this you'll need a rivet set like the one shown in Fig. 3. It can be made from a length of $\frac{1}{2}$ -in. iron rod and shaped accordingly for clamping in a vise. A small depression is formed in the end to seat the rivet head. The hinge plate for the Queen's box is detailed in Fig. 1. The scrollwork in this, as well as that in the cover overlay, Fig. 4, can be cut with a circle cutter in a drill press, or with a coping saw, using a fine jeweler's blade. The part of the hinge which is riveted to

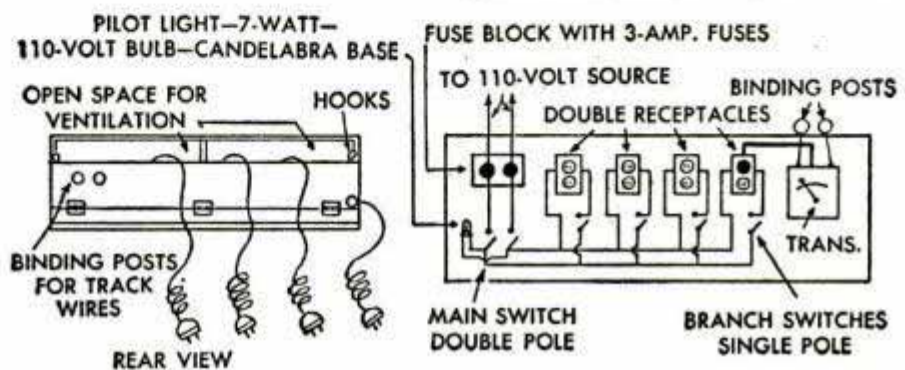
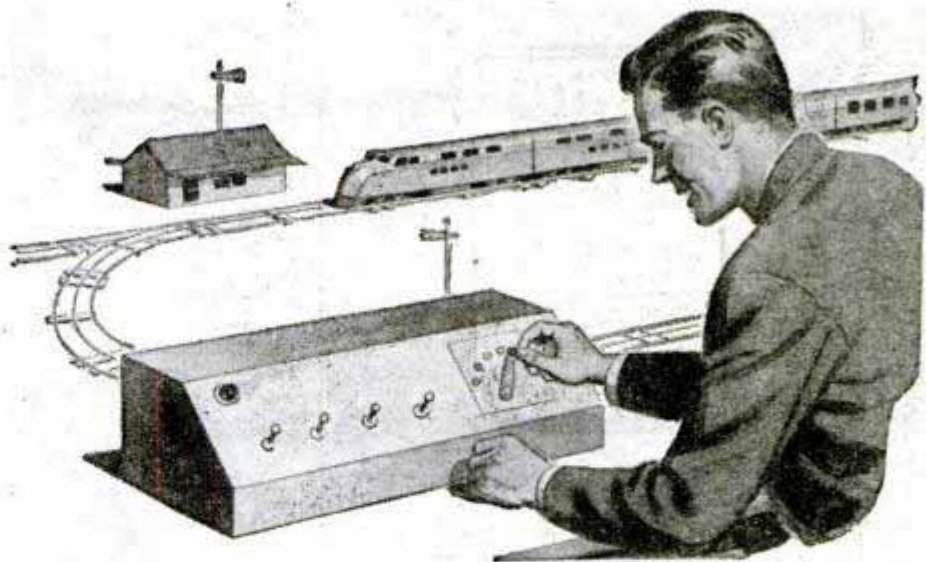
the rear edge of the box cover is fastened by driving the rivets tightly into undersize holes. A piece of extruded aluminum angle is used to make the lock plate, Fig. 7, which is drilled to take a small padlock and then riveted to the box. This leaves the handles which are formed as shown in Fig. 6. The ends are flattened and bent as shown in the side view and finally riveted in place.

Figs. 8 to 12 inclusive detail the King's box, which is entirely of metal except for the cover and bottom. Forming the ends is done as before and these in turn are riveted to sides of metal instead of wood. Figs. 11 and 12 show two methods of peening the rivets; in one, the rivet is simply flattened against the surface, in the other it is expanded in a chamfered hole and then filed off flush. The bottom is attached by drilling undersize holes in the edge of it to take the rivets. Fig. 8 shows how the hinge plates are riveted to the back of the box and how the leaves are bent up over the edge of the cover. Adding the overlay plate and the lock plate and hasp completes the job. Cover the bottom with felt and line the inside with silk or plush.



Multiple-Control Panel Made From Radio Cabinet

This is an ideal control panel for electric-train enthusiasts because it has plenty of outlets, a variable-speed transformer, fused power source and, as a safety feature, no exposed wiring. A radio cabinet with an inclined panel provides the housing for the unit. Remove the old panel and substitute one that is drilled for four toggle switches—the number can be varied to suit individual needs—a pilot light and the top of the transformer. The shutoff switch for the power source is mounted on one side of the cabinet. Four receptacles and the fuse block are mounted on the base. For the latter, 3-amp. fuses should be adequate. Extension cords connecting to the outlets pass through the back of the cabinet, which is left partially open to provide ventilation. For a pilot light to indicate that power is on the panel, use a 7-watt bulb with a candelabra base. Cover the light with a red bull's-eye. Binding posts are mounted on the back of the cabinet for quick connection to track wires.

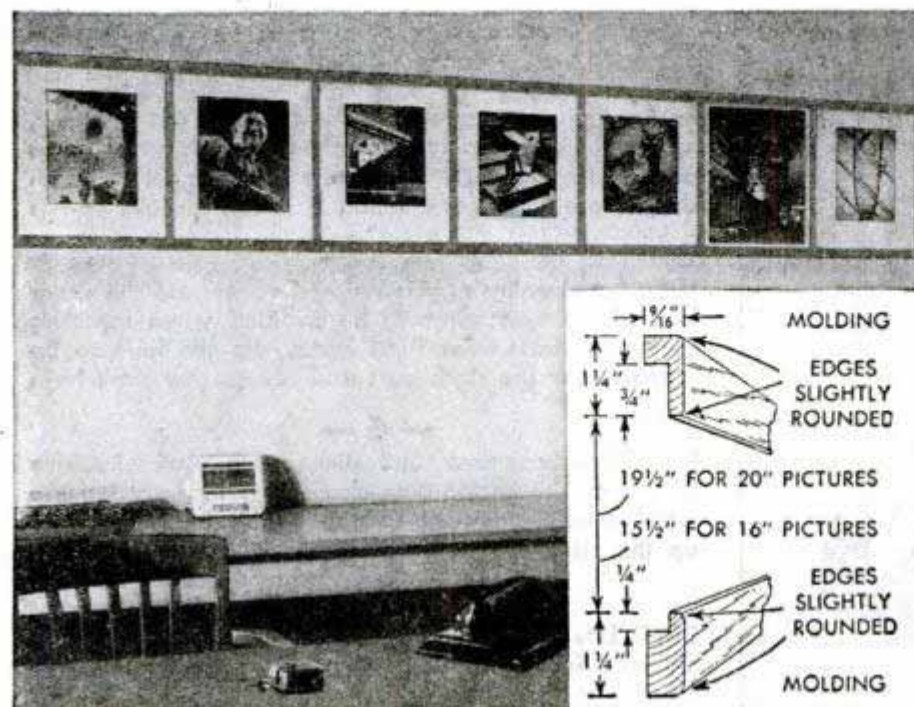


Wm. W. Jacob, Millvale, Pa.

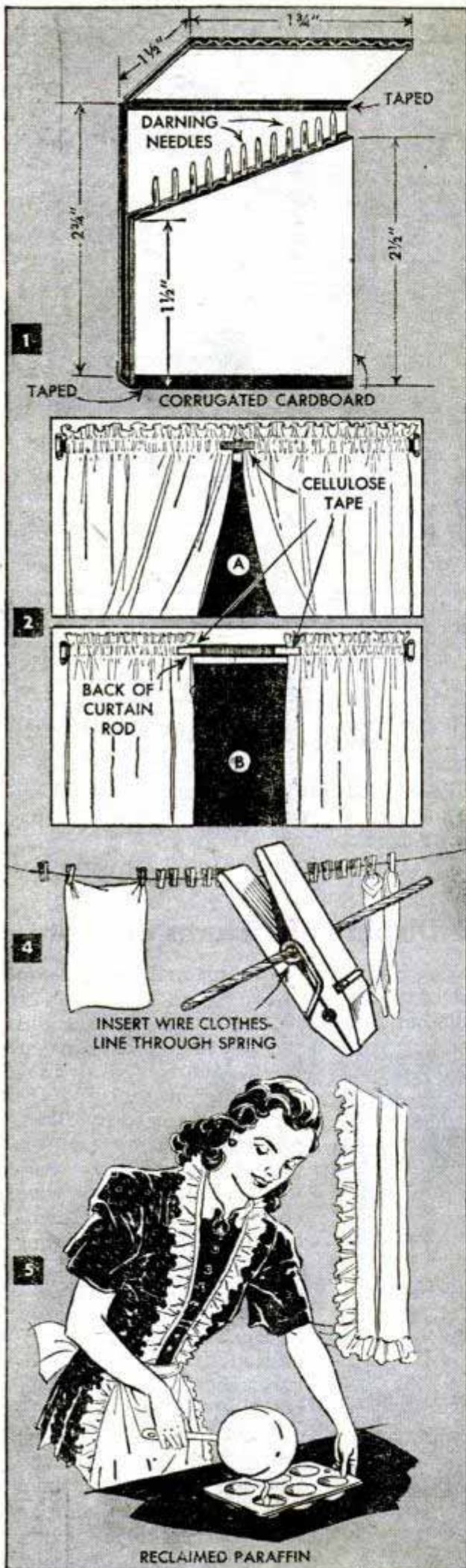
Horizontal Strips of Molding "Frame" Display of Pictures or Photos

One way to display a number of pictures or photographic prints is to mount them in rows, using horizontal strips of molding as

racks. Suggested dimensions for the top and bottom pieces are given in the lower right-hand detail. The distances between the two strips, 19½ in. for 20-in. pictures and 15½ in. for 16-in. pictures are



for mounting 16 by 20-in. photographic prints either horizontally or vertically. Prints this size are about right for an ordinary-size room. Smaller pictures are pasted on mats to make them fit. Stock sizes of glass that fit the frame can be purchased. To change a picture, bend the pieces of molding out slightly—not enough to pry them loose—and removal and insertion will be easy. Finish the wood to harmonize with the rest of the room. —Fred G. Korth, Chicago.



Solving HOME

- 1 -

Made from a piece of medium-weight corrugated cardboard, this needle holder will accommodate a variety of sizes. Cut the cardboard to the dimensions indicated in the drawing and then fasten the holder and cover to the back with lengths of heavy cloth tape

- 2 -

To keep curtains or drapes from sliding out of place, secure them to the back of the rod with small strips of cellulose tape. Detail A shows the manner in which drapes are taped and detail B is for straight panels

- 3 -

If half a darning egg is painted white and the other half black, eyestrain will be avoided when mending socks and hose. For light socks, slip the hole to be darned over the dark part and reverse for dark hose

- 4 -

Permanent basement clotheslines, usually of wire, can be fitted with spring-type clothespins by inserting the wire through the coil of the spring before putting up the line. Then the pins will always be at hand

- 5 -

Small bits of paraffin left over from preserving, or removed from jelly glasses, can be molded into cakes for storage by melting and pouring into muffin tins



PROBLEMS

— 6 —

Marks left by upholsterers' nails when the back of a chair rubs against the wall can be eliminated by coating the nailheads with colorless fingernail polish

— 7 —

Here's an easy way to peel an orange: First, roll it lightly on a flat surface such as a table top. Then cut through the skin to divide it into halves, being careful not to damage the fruit. Finally, using the handle of a table fork, pry the skin completely off

— 8 —

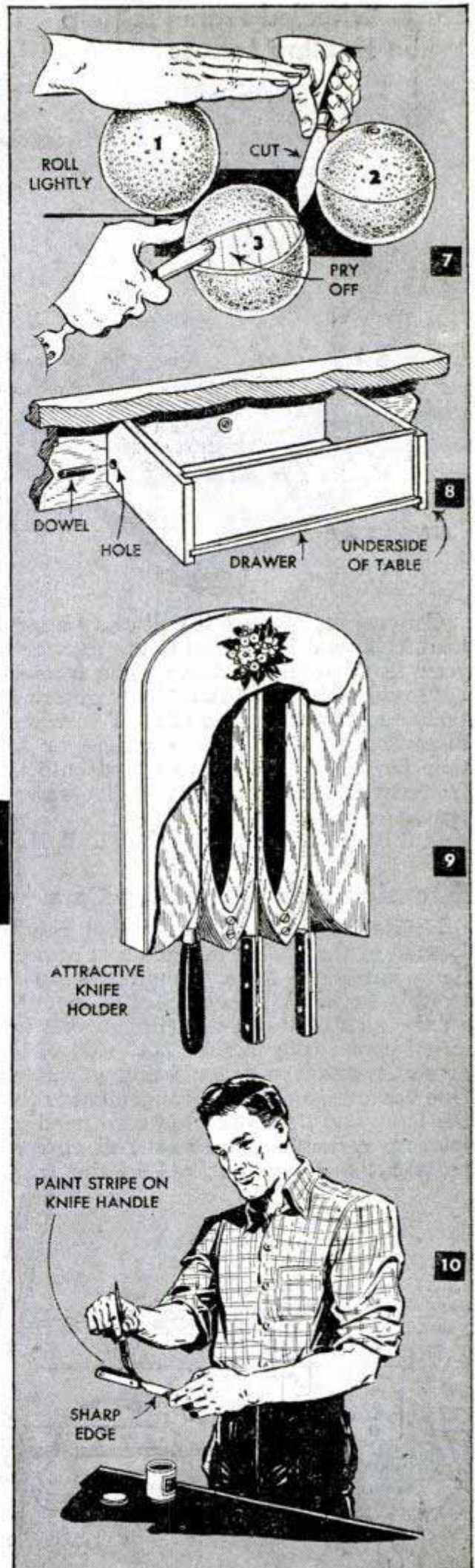
When there are small children around the house, it's difficult to keep them from getting into table drawers and spilling the contents. To prevent this, drill a hole in the side of the drawer near the front and insert a dowel to serve as a stop. Remove the dowel by reaching underneath the table to open the drawer

— 9 —

Knives are kept out of the way safely, yet handy when needed, in this attractive holder. Pressure between the sections holds the blades in place. The cutaway view indicates the manner in which the holder is made

— 10 —

Painting the top of a knife handle shows at a glance which is the sharp and which the dull edge. With this identification, it won't be hard to avoid cut fingers



Large Wheeled Frame Is Help When Hauling Leaves

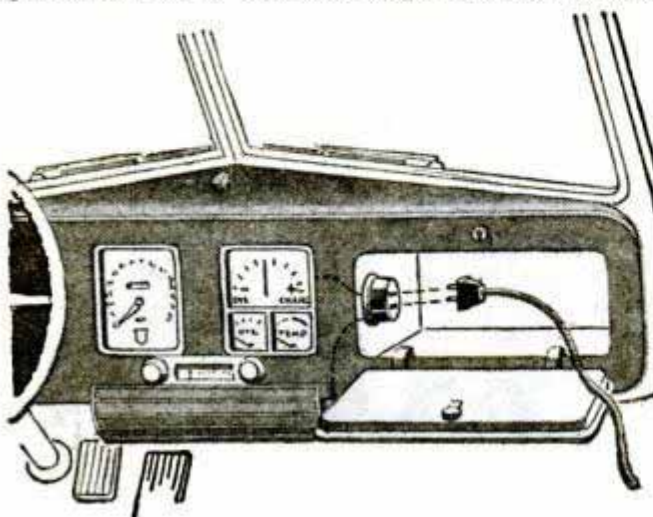


Convenient because it will carry a large load, this wheeled frame is the answer to your leaf hauling problem. The frame is approximately 5 by 7 ft. and has wire mesh tacked to the underside of it. Two wheels discarded from a baby carriage or toy may be used. Leaves are raked onto the frame in the same manner that dirt is swept onto a dust pan.

Elliott McClung, Campbell Hall, N. Y.

Extension-Light Outlet for Cars

Here's an electrical outlet that can be located in the glove compartment of a car for connection to a camping lamp or trouble light. A female plug is mounted on the side of the compartment, one terminal connecting to the "hot" side of the ammeter and the other being grounded. One advantage of this arrangement is that the lamp and its connecting cord need not take up valuable space in the glove compartment but can be kept in the trunk



until needed. The trouble light would only require a cord long enough to reach all parts of the car, while the camping-lamp extension should be considerably longer.

Hand Position Indicated on Hammer

After determining by experiment the best way to hold a hammer, mark the spot covered by your thumb. Then, when you pick up the hammer, you will know where to grasp it. A light-colored paint or lacquer should be used to make the marks. If each of your hammers has a different colored "spot," they can be identified in a hurry.

Kenneth Murray, Colon, Mich.



Vacuum Bottle Kept in Pocket With Elastic Strap

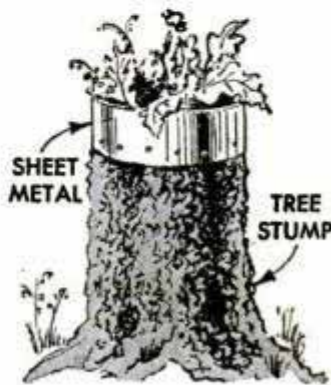


When carrying a vacuum bottle in a coat pocket, you can keep it from falling out and breaking by tacking a short length of elastic above the pocket, as in the illustration. The bottle slips under the strap which serves to hold it in place.

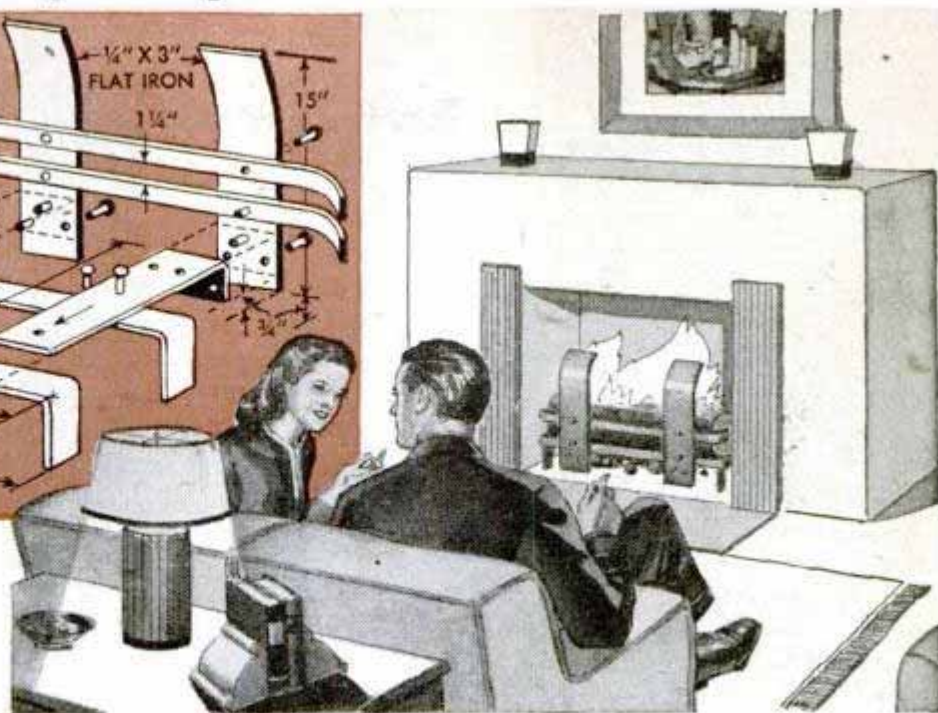
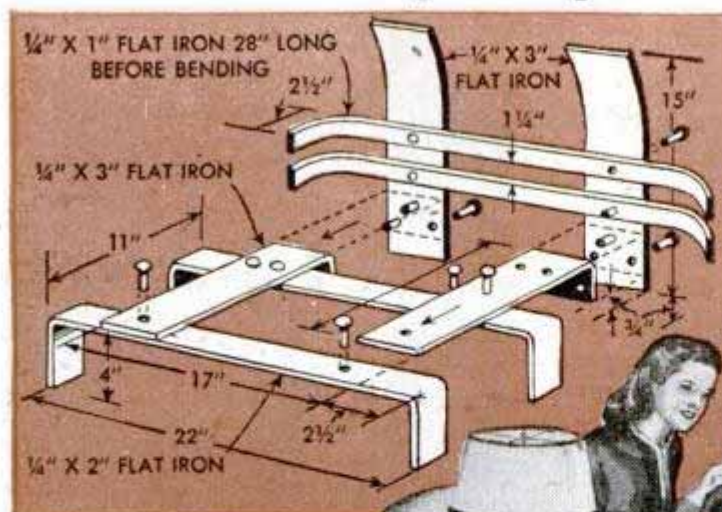
Use an elastic band with a good deal of stretch so the bottle will "hug" the coat tightly.—Benj. Nielsen, Aurora, Nebr.

Sheet-Metal Collar Around Stump Forms Flower Box

If you have an unsightly stump in the yard and want to put it to some use, nail a strip of sheet metal 7 or 8 in. wide around the top to make a flower box. Plants that flower profusely are best and will add a quaint and rustic touch to the appearance of the yard. Paint the top of the stump with creosote.—L. Cloutier, Quebec, P. Q., Can.



This Hand-Wrought Log Grate Has Built-in Andirons



Here's an attractive fireplace grate that differs from the ordinary in that both grate and andirons are all in one. It's primarily for holding logs, although it can be adapted for burning coal by placing a grille, such as a piece of expanded metal lath, over the bottom. All the parts can be hand-wrought cold from stock pieces of $\frac{1}{4}$ -in. flat iron. The dimensions given in the drawing may have to be altered to suit the size of the fire pit. A machinist's vise will aid in making the sharp right-angle bends of the bed pieces, while the curved bends can be formed by working the pieces through the jaws of a monkey wrench. This is done with a slight sideward thrust

as the metal is advanced through the jaws. In the case of the 3-in. pieces, the ends can be curved by clamping the work vertically in the vise, allowing about 4 in. to extend, and then grasping the end with an adjustable wrench. If necessary, a length of pipe slipped over the wrench handle will provide good leverage. All parts are riveted together. The andirons and the connecting horizontal pieces can be given a hammered finish, or the whole unit can be given a coat of flat black paint.

Wayne Snowden, San Francisco, Calif.

False Front Conceals Tilting Clothes Hamper in Chest of Drawers

A built-in clothes hamper in a chest of drawers—that's really novel and is a good reason to bring back that old chest from the attic. The illustration gives the general idea; three or four lower drawers are removed, including the frames, and dismantled. Then a hamper of plywood is made to fit the opening, the front of which is assembled from the original drawer fronts. The sides of the hamper should be rounded at the top to allow it to tilt outward when the unit is hinged across the front at the bottom. A series of holes should be provided in the sides of the hamper for ventilation.

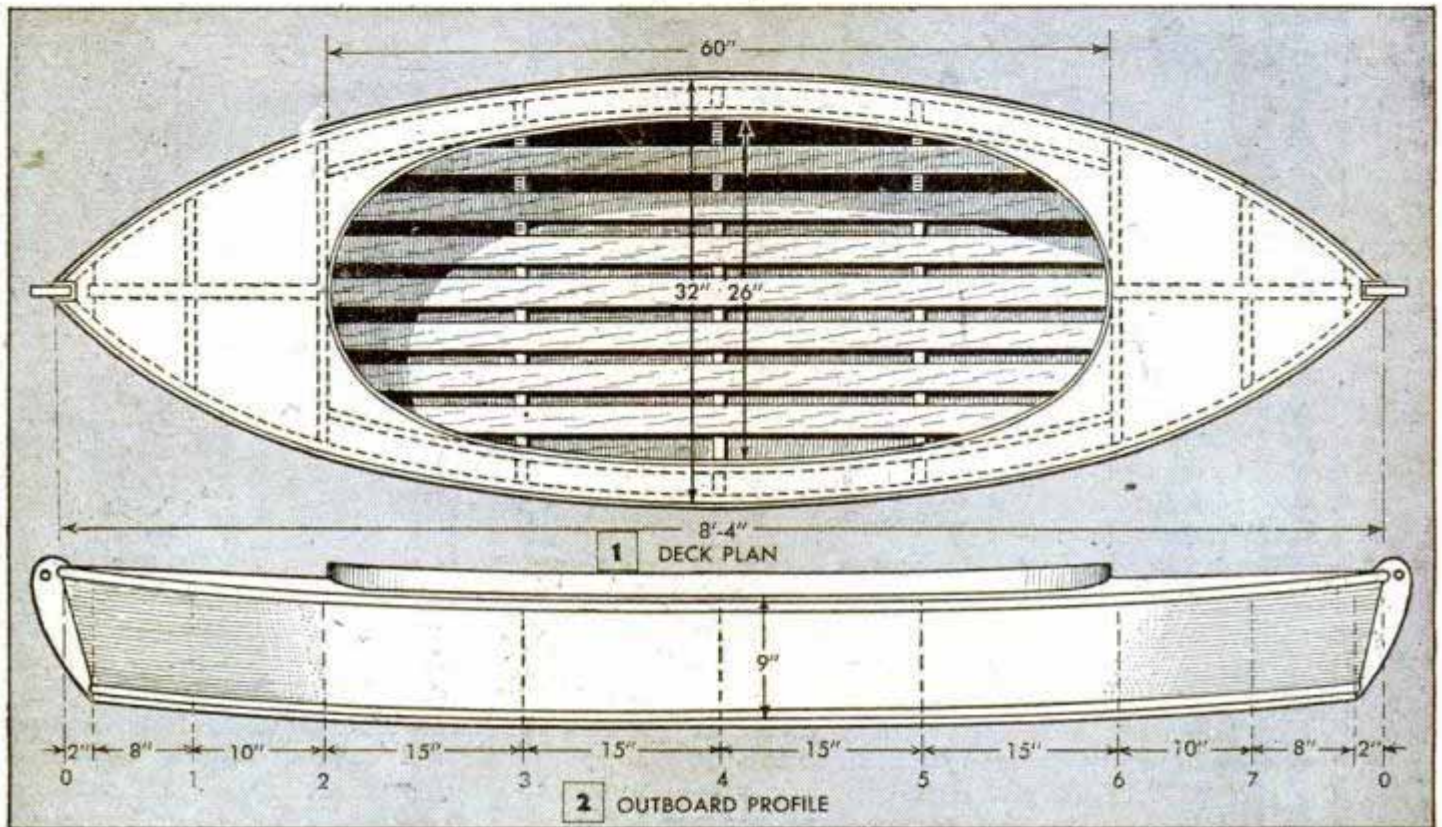
Tin Foil Tightens Loose Screws

Tin foil has been found better than wood plugs to tighten loose screws in hinges. Simply fold the foil into a strip about $\frac{1}{2}$ to 1 in. long and insert it in the enlarged hole. When the screw is replaced the threads will cut into the metal and embed it in the wood, producing a tight connection.



Featherweight

AN EIGHT-FOOT DUCKBOAT

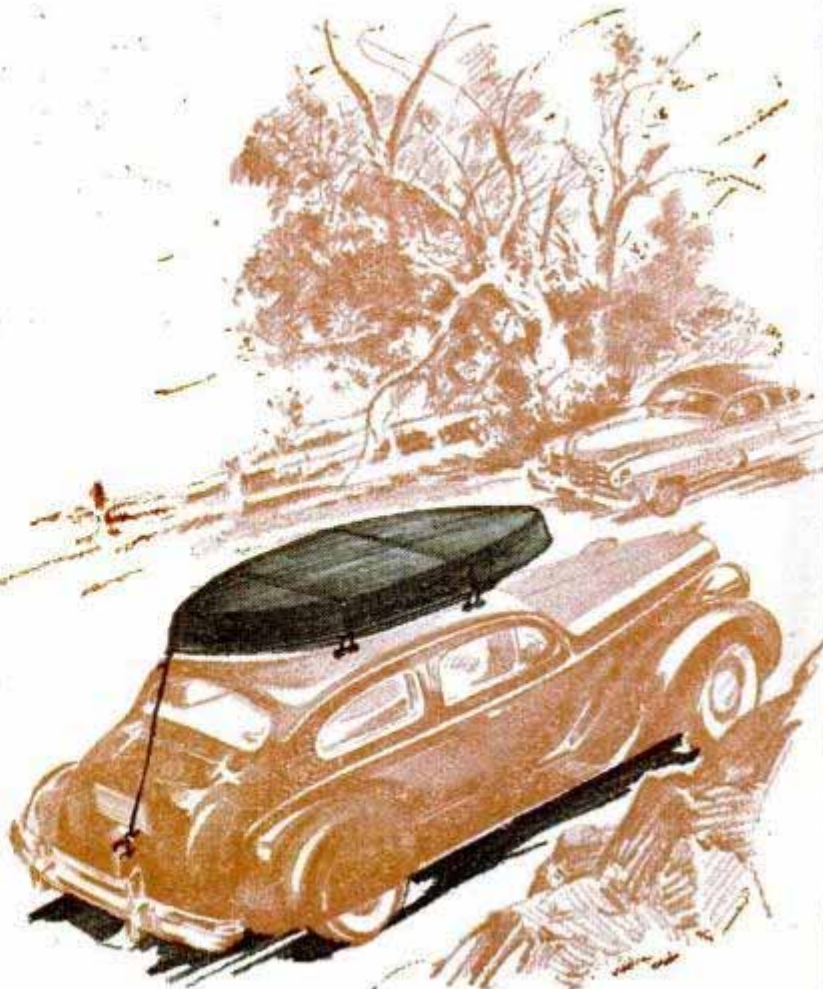


By Hi Sibley

LIGHT ENOUGH to carry on a car or even on your shoulders, this boat will enable you to reach hideaways that are inaccessible with heavier craft. It is sturdy enough to push through dense weed growths and light enough to navigate the shallowest waters. Although only 8 ft. 4 in. long, Featherweight has a capacity of well over 300 pounds. Its construction of $\frac{1}{4}$ -in. waterproof plywood over light pine framing gives it the well-proportioned lines that are shown in Figs. 1 and 2.

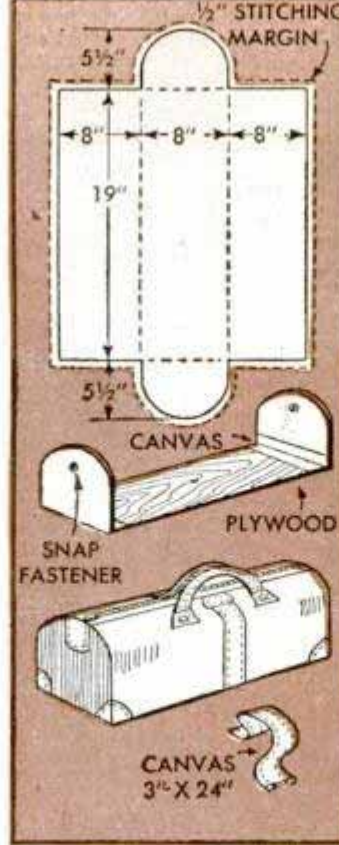
Featherweight is built upside down on an erecting frame as shown in Fig. 8. Construction begins with the boat frames, Fig. 4. These are made of $\frac{3}{4}$ -in. (net) pine or other light wood that will not split easily. Full-size patterns drawn on heavy wrapping paper will aid in laying out the pieces to exact size and serve as a guide for assembling them after they are cut. Waterproof glue and No. 8 brass screws are used to join the parts as indicated in Fig. 3. Temporary braces are installed on the open frames 3, 4 and 5.

The strongback of the erecting frame, Fig. 11, is made from a 2 by 8-in. plank. A $\frac{7}{8}$ by $\frac{7}{8}$ -in. batten may be used to mark



Purpose Bag

Using a twofold purpose, this utility bag will hold ample provisions for a meal and, when the cover is removed, the bottom and ends can be used as a table top. Bottom and ends are made of plywood to fit inside the canvas cover, and these parts are hinged together with strips of canvas. Note that the two ends are fitted with snap fasteners to attach the cover, and the bottom is drilled for a bolt attached to an upright when used as a table. Either canvas or leather reinforcing is used at the places indicated on the drawing. Regular utility-bag handles are riveted on and the addition of a zipper completes the job. When cutting out the bag, be sure to allow the $\frac{1}{2}$ -in. margin required for stitching and, for a neat appearance, make the cover a snug fit over the bottom and ends. Use a



medium or heavy grade of canvas which can be purchased as remnants, either in a solid color or a striped material. Dimensions of the bag can be altered to suit individual requirements.

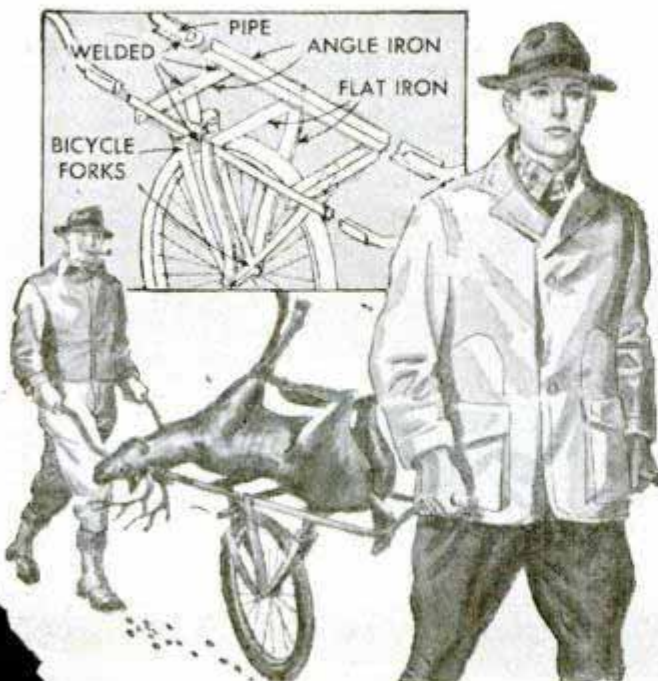
G. E. Harrington, New York.

Hunters Cart Heavy Game Out of Woods on "Stretcher" With Bicycle Wheel

After the first flush of pride at bagging a fine deer has passed, and you still have to carry the animal to a camp miles away, that's when the deer begins to "take on weight." This wheeled stretcher is designed to take that weight off your shoulders. The longitudinal members of the frame are

angle iron with flat-iron cross members welded to them. Lengths of pipe are bent to shape, slipped over and welded to the angle iron. Dimensions are not given for the stretcher so they can be of a length and width to suit the user. Two bicycle forks, which are connected to a bicycle wheel, are welded to the end cross members. Two additional flat-iron braces are welded to the forks and to the angle iron, one on each side of the frame.

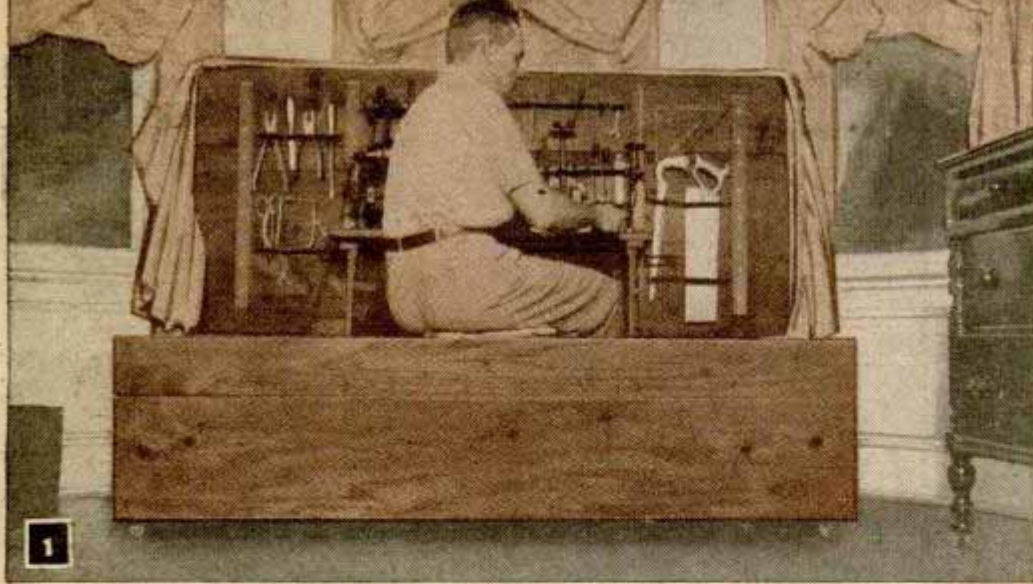
Geo. R. Harrison, Valparaiso, Ind.



Metal Glider Conceals Screwhead

When a screw-head cannot be countersunk and filled over, it can be covered neatly with a metal glider of the kind used for chair and table legs. Break off the anchor points and attach the glider directly to the head with cellulose cement. If it's ever necessary, this covering can be pried off with a knife to get at the screw to remove it.



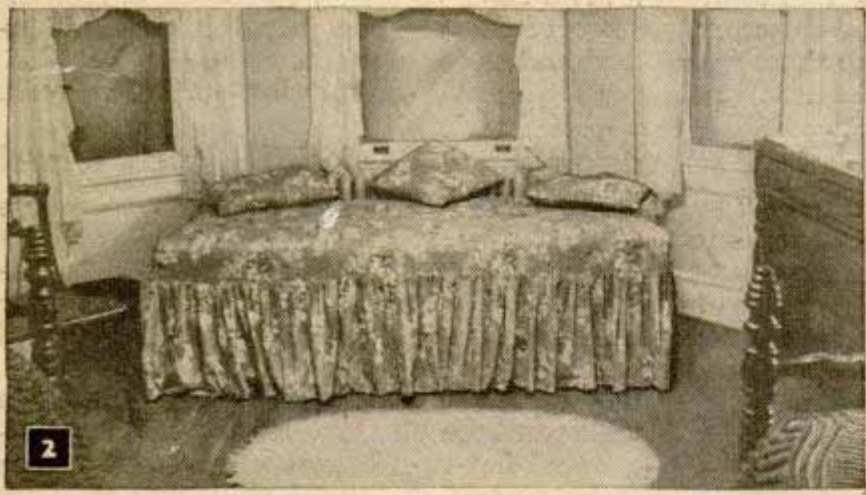


Made to...
ment craft...
portable "w...
disguised as a studio couch, is just the thing for modelmaking, hobby work and tinkering. It keeps everything together and out of sight. Mattress top makes a comfortable couch

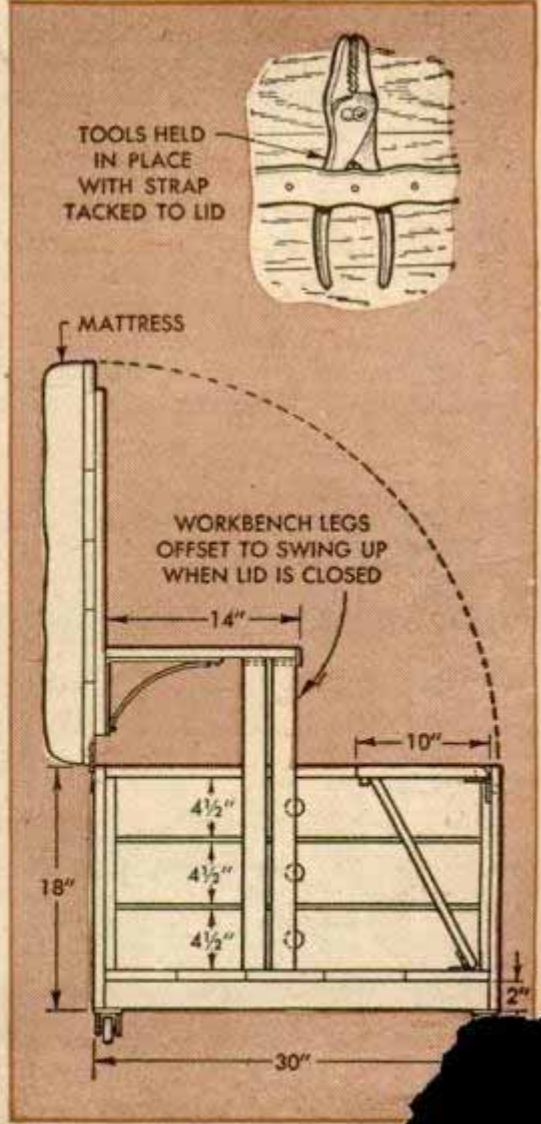
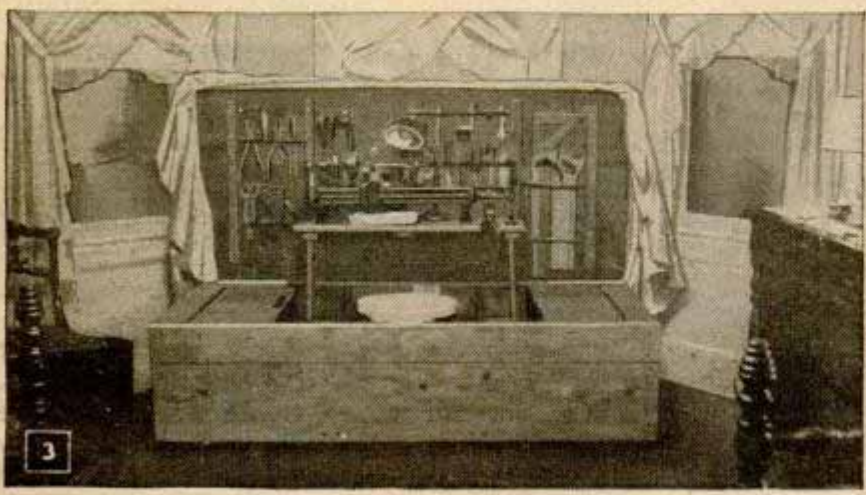
By
H. R. Howser

AFTER having had a complete basement workshop for many years, I was like a fish out of water when we moved into an apartment. Trying to carry on by using the kitchen table as a workbench and having to stow away everything each time led me to build the portable, self-contained workshop pictured in Figs. 1 and 3. Not only does it solve the problem of a place to work with everything at finger

tips, but it can be transformed quickly into a comfortable and attractive studio couch by simply closing the cover as shown in Fig. 2. There's really nothing to making it. Fig. 4 will give you a good idea of the construction which amounts to making a large box with a hinged cover and upholstering it with a mattress and slip cover. I used inexpensive, common-grade lumber, although 3/4-in. fir plywood could be used.



No one would suspect that this studio couch houses a complete "workshop." Just lift the cover and presto!—there it is all before you—everything in readiness to begin work. No time is wasted putting things away



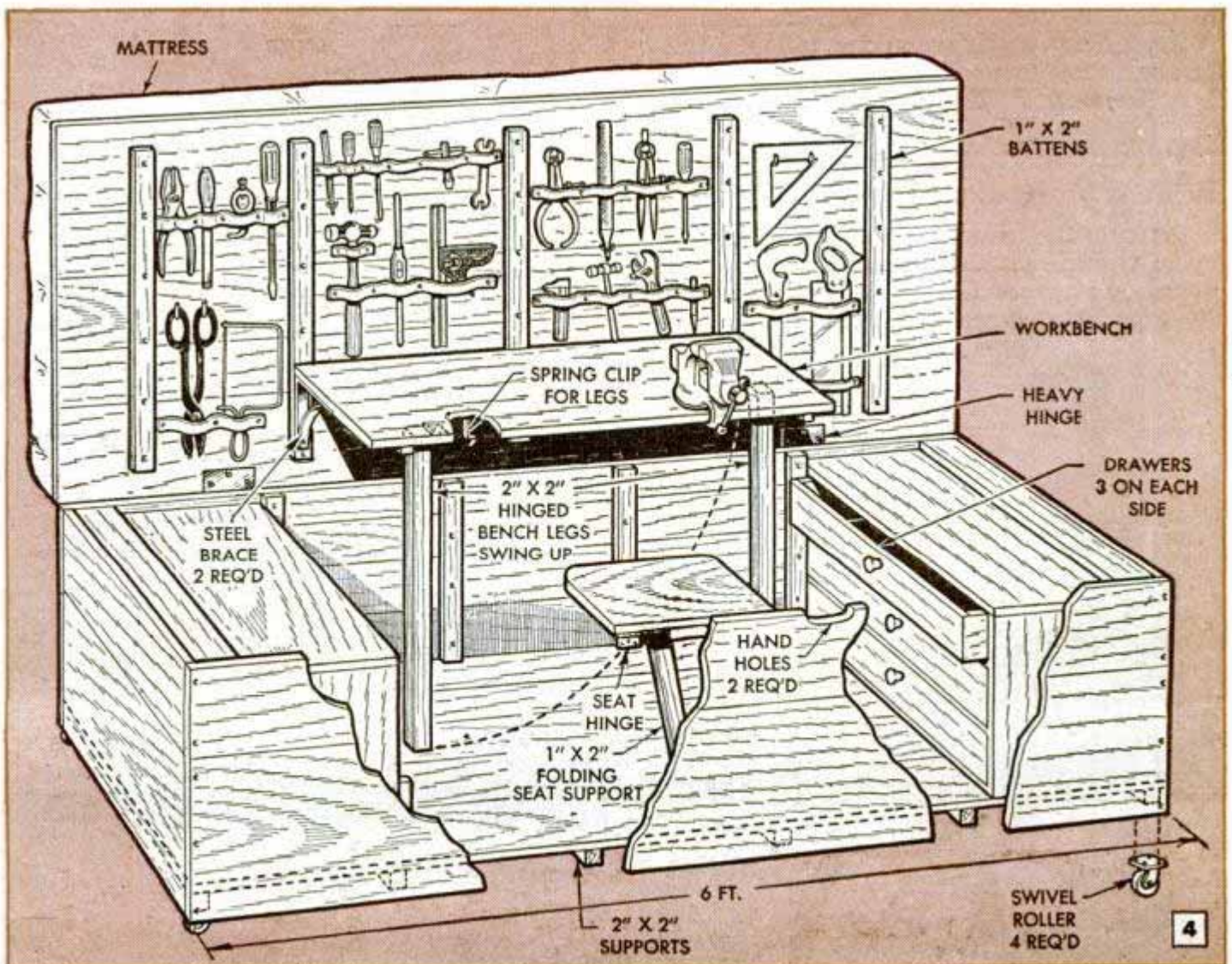
STUDIO-COUCH "WORKSHOP"

This would eliminate the work of building up the sides, top and bottom with battens. Notice that the bottom of the box rests on 2 by 2-in. sills, equally spaced, and that a caster is fastened to each corner.

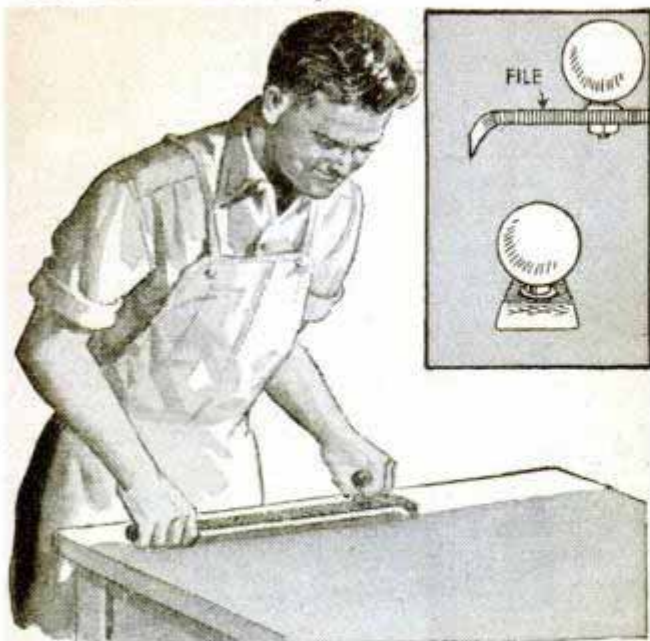
Each end of the box is fitted with a removable three-drawer cabinet, which is made separately and slipped into place. For these you may be able to purchase a ready-made chest of the unpainted variety, such as is sold in large department stores, and adapt it to fit the box, or the drawer compartment of a discarded piece of furniture might do. It wouldn't be necessary for them to extend the full width of the box either. Regardless, the cabinets should simply set in place so that the whole thing becomes a knockdown affair to facilitate moving. I used flathead screws in assembling the box, and loose-pin hinges in attaching the cover so that it could be dismantled without too much trouble. The side view in Fig. 4 shows how both the workbench and seat are hinged to fold compactly. Regular metal shelf brackets

support the bench top rigidly at right angles to the cover, and the legs are hinged offset to allow them to nest side by side when folded. Midget-type power tools such as a lathe, saw, drill press, etc., are ideal for use in this "shop." Mounting can be such as to allow the machines to be quickly interchanged, and there's ample room to store them in the bottom of the box. A piece of linoleum on the floor of the box will prevent sawdust from seeping through the joints of the boards.

The top is fitted with a standard cotton mattress, 30 by 74 in. This was spot-tacked around the edge to hold it in place and then covered with a slip cover having a pleated flounce. Note the hand holes that are cut in the top edge of the box at the front. This allows you to get a grip under the cover to raise it. Although not shown, a cleanout drawer in the bottom of the box, or a trap door, would facilitate removing shavings and sawdust. This necessitates raising the box higher off the floor to provide access for removal of the sweepings.



Converted Mill File Will Serve As Cabinet Scraper



Convenient for heavy-duty work, an old mill file can be converted to serve as a cabinet scraper. Heat the file to a cherry red and shape the end as shown in the detail. Allow the file to cool slowly and do not restore the temper. Treated in this manner, the edge can be sharpened easily. A handle and knob are added to make the scraper easy to use.

Kenneth F. Petersen, Newark, Ohio.

Newspaper Sack Attached to Bike With Wire Hooks

Because the usual wire basket on his bicycle would not hold enough papers, one newsboy attached hooks to the handle bars to support a large bag. The hooks are

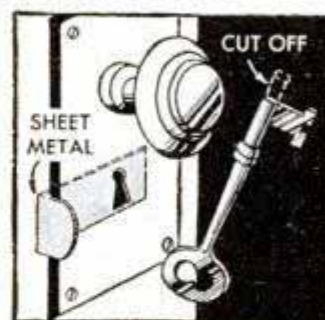


formed from $\frac{3}{16}$ -in. rod and threaded to fit drilled and tapped holes in the handle bars. In use, the strap of the bag is looped over the hooks and the bottom rests on the fender.—Wm. Riederich, Elmhurst, Ill.

Keyhole Guard for Door Lock

If you have a lock of the type shown on an outside door, you can make a guard that will prevent a skeleton key from being used to gain entrance. Cut a slot in one side of the keyhole plate so a strip of metal can be inserted to cover the keyhole. This is on the inside of the lock. Then file off the end of the key so that when it is flush against the metal strip—inserted from the outside—the key will engage the lock to open the door.

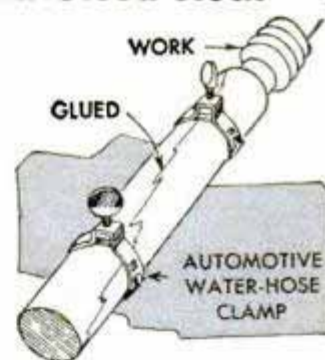
A. H. Waychoff, Phoenix, Ariz.



Hose Clamps Hold Glued Stock

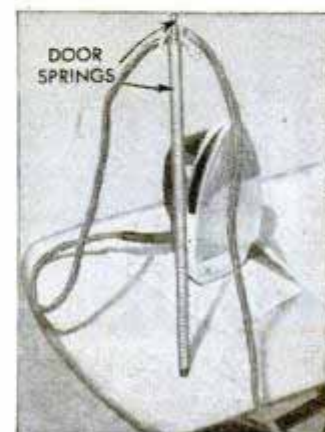
When gluing round stock, one craftsman uses several automotive water-hose clamps of the adjustable type. They can be used for work ranging in size from $\frac{3}{4}$ to $3\frac{1}{2}$ in. in dia. Use of these clamps applies an even, over-all pressure to the work, and they are especially useful for pieces such as screwdrivers and file handles.

Wm. Avellino, Philadelphia, Pa.



Spring Supports Electric-Iron Cord

Two screen-door springs, one of which will fit inside the other to provide rigidity, will make an inexpensive support for an electric-iron cord. After the smaller spring has been slipped inside the larger, one end is fastened to the board and the other is tied to the cord, allowing enough slack in the cord for free movement of the iron.—C. P. Fitz Patrick, Philadelphia, Pa.

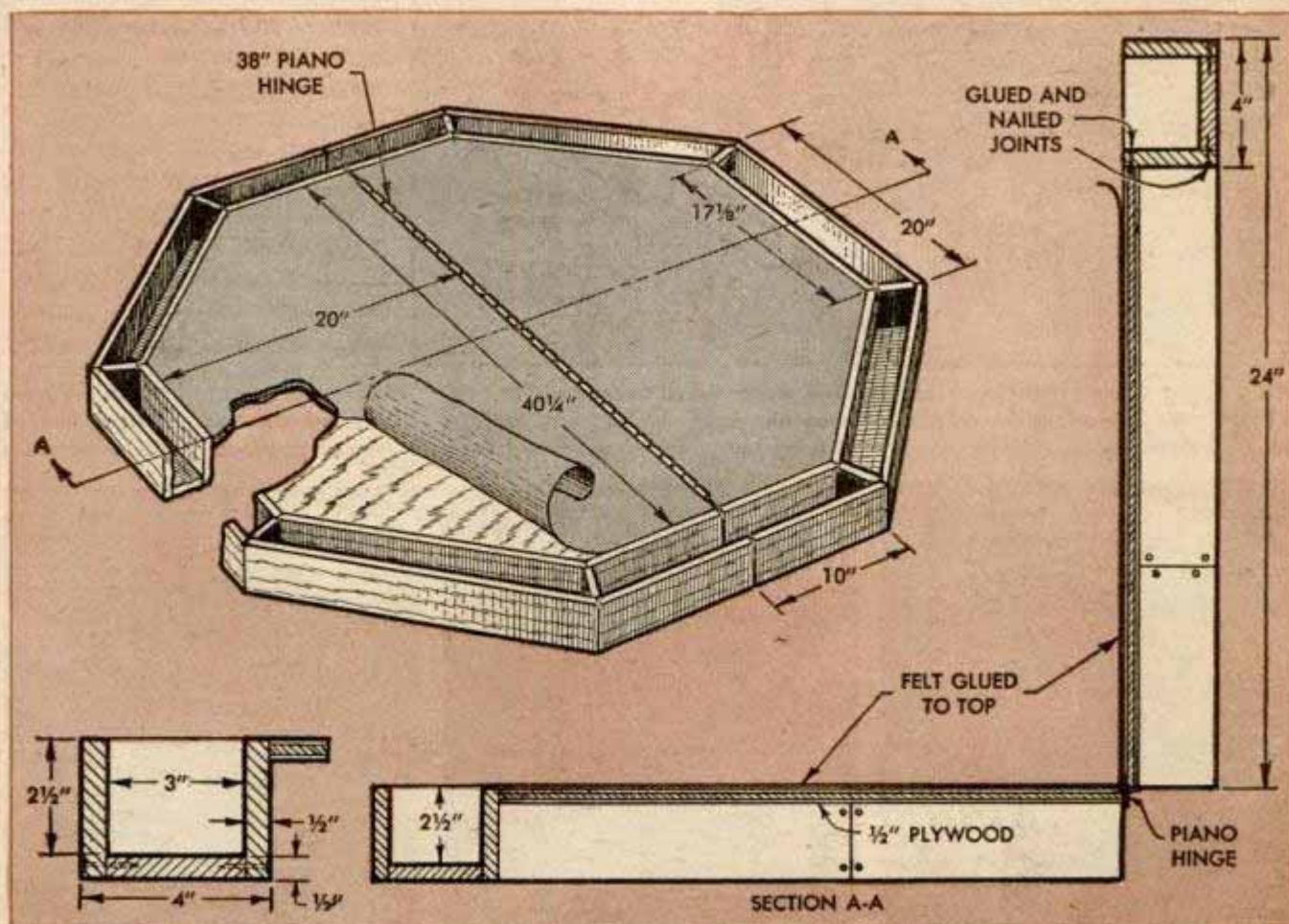


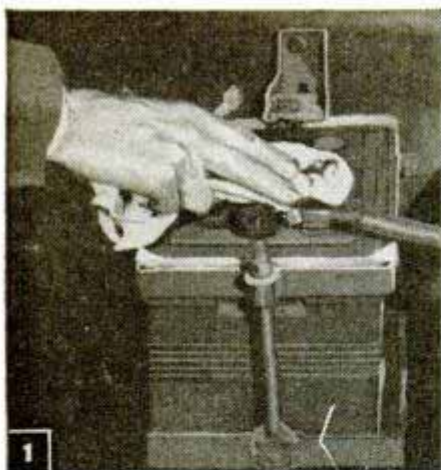
Auxiliary Table Top Increases Playing Surface



Where to play when the gang comes in for an evening of cards is solved in a hurry when you have this auxiliary top, which is designed to set over an ordinary card table. Hinged at the center, it takes up little storage space in a closet, and when open, it forms a large-size playing surface which seats eight persons comfortably. Construction consists of adding trough-like compartments around the edge of an octagon-shape centerpiece. The whole thing can be assembled as one unit and later sawed in half, or each half can be made up separately. Start by laying out and sawing the eight-sided centerpiece. The compartments are

added to the edge of this by first fitting and nailing $\frac{1}{2}$ by 3-in. pieces all around, mitering them where they meet at the corners. Next, the 3-in. pieces forming the bottom of the trough are nailed to the lower edge of the previous piece, mitering it as before. This is followed by fitting the outside piece, and then the trough is divided into compartments by inserting partitions at the eight points. A continuous (piano) hinge makes the neatest job, although two or three butt hinges will do. Complete the job by gluing felt to both top and bottom. Finish with enamel or varnish to match your furniture.—M. A. Zinser, Chicago.





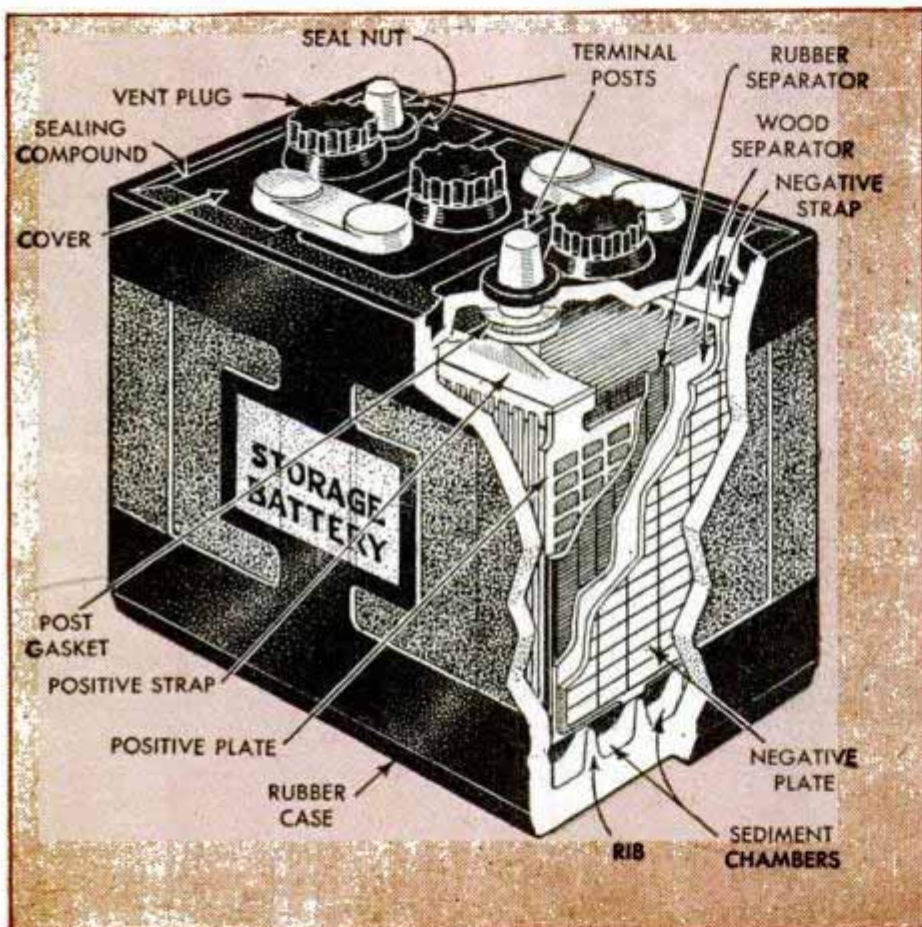
1 Remove white coating from battery terminals with a soda-and-water solution. Wipe dry with clean cloth



2 Check sealing compound for cracks. Repair with compound, using in a tarry consistency that does not run



3 Inspect the battery cradle for acid damage. If the cradle is in poor condition it should be replaced



GIVE

By Phil Ruskin

BEFORE one attempts to service any mechanical or electrical device it's a good idea to know how it works. Being well acquainted with your car battery helps you to service it regularly.

A storage battery consists of three identical 2-volt cells connected in series, making a total of 6 volts across the terminals. Each cell has positive plates of lead peroxide and negative plates of lead, the number of plates depending upon the ampere-hour rating of the battery. An electrolyte solution of distilled water and sulphuric acid sur-

State of the charge is checked with a hydrometer. Reading should never go below recommended levels

Add water when necessary. In cold weather add water just before driving car, otherwise it may freeze

Before removing the cables from an old battery, note and, if necessary, mark positive terminal





7 Disconnect ground terminal first. Use a puller and work carefully if clamp is "frozen" to the post



8 When replacing battery, tighten bolts uniformly. Renew rubber washers. Don't draw nuts too tightly



9 Worn or frayed cable should be replaced. Note bends in old cable and install new one in the same way

YOUR BATTERY A BREAK

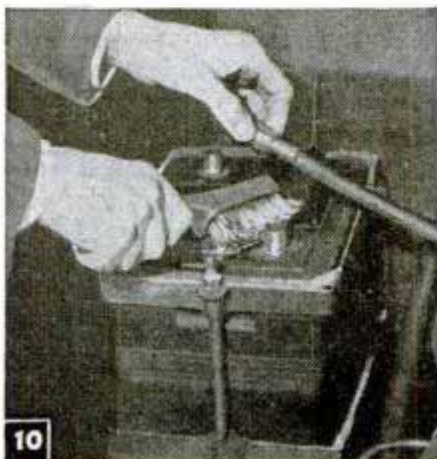
rounds the plates. In order to keep positive and negative plates from touching each other and shorting the battery, nonconducting separators are placed between each pair of plates. In addition, some batteries have Fiberglas sheets to retard the loss of active material from the plate grids. The case is of hard rubber with a space in the bottom for sludge deposits and the cover is a separate piece held in place by sealing compound.

The plates are not solid, but consist of a framework or grid composed of an alloy of lead and antimony. The mesh of the positive plate is filled with lead peroxide and that of the negative plate with sponge lead. These fillers are porous to allow the electrolyte to penetrate them freely. When the battery is in use, lead peroxide and sponge lead gradually drop off the grids and fall to the bottom of the battery case. The speed with which this happens depends upon how nearly the battery charge is kept normal, how it is charged and how used. To get the

most out of a battery, the active material must be kept on the grid or framework as long as possible, the separators must be kept in good condition and the case protected from damage and leakage.

When the electrical circuit is closed between the positive and negative terminals of the battery, as when the lights are turned on or the car is started, the sulphuric acid in the electrolyte combines with the material on the plates, both negative and positive, to form lead sulphate. Electric current then flows through the electrolyte to the positive terminal and out to the electrical system. As this happens, the amount of acid in the battery solution decreases. This action gives the basis of testing battery strength with a hydrometer, which measures the amount of acid in the solution in proportion to the water present, by the difference in the specific gravity of these two liquids. There is no change in volume of liquid in the battery, as the absorbed acid is replaced by water in the

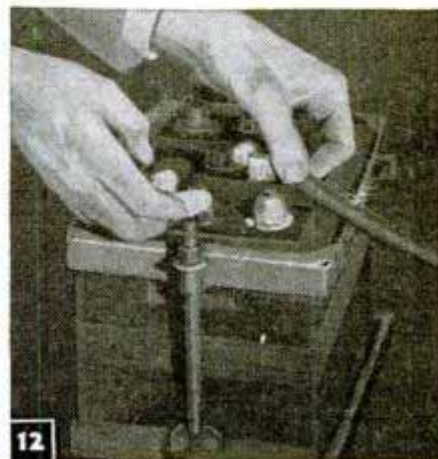
Clean and brighten terminal posts with a wire brush. Be careful not to get dirt into the cell-cap vents

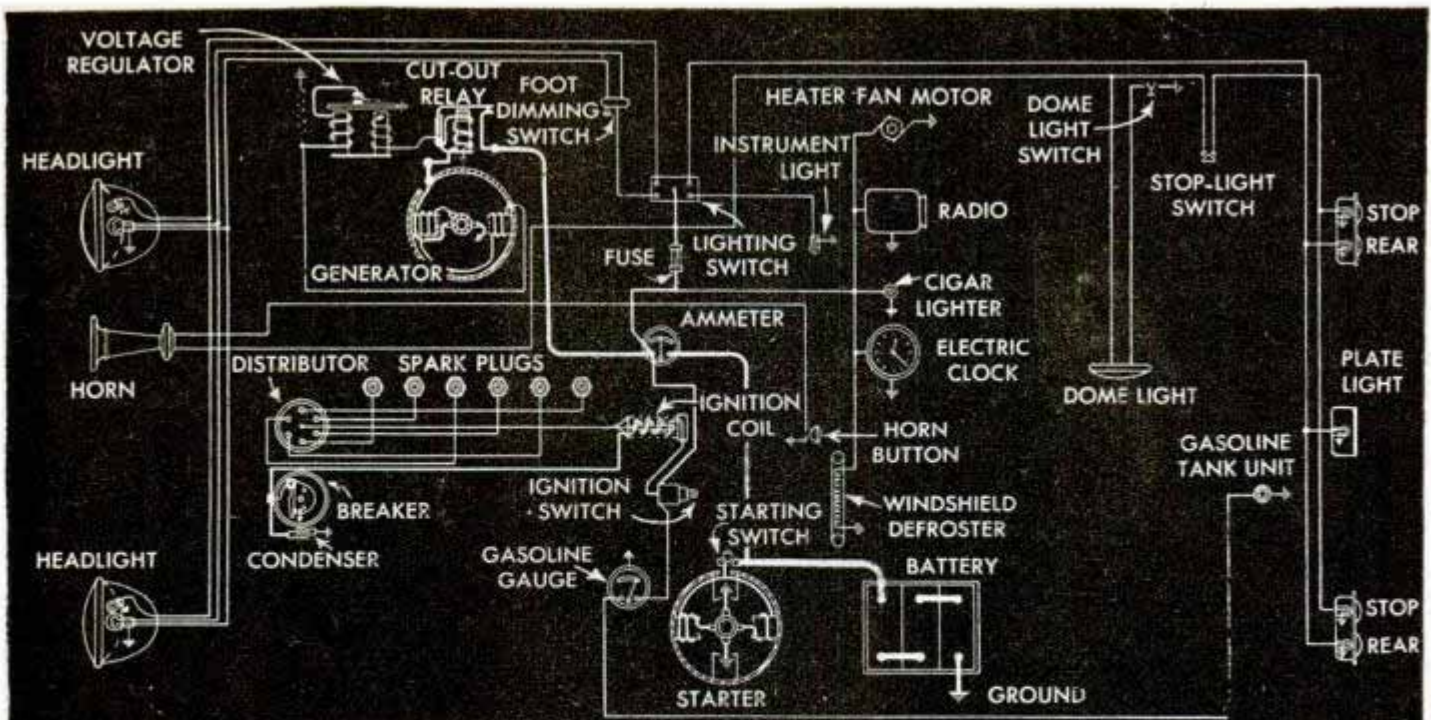


Clean inside of terminal clamps with sandpaper. Grit in the clamp slot will interfere with tightening



Apply mineral grease or white petroleum jelly to battery posts and terminal clamps. Cover thoroughly





TYPICAL ELECTRICAL CIRCUIT OF AN AUTOMOBILE

Courtesy The Electric Storage Battery Co.

TABLE A
CURRENT LOAD OF A MODERN CAR

HEADLIGHTS.....	14.0 AMPS.
IGNITION.....	1.7 AMPS.
INSTRUMENT LIGHTS.....	0.8 AMPS.
TAILLIGHTS.....	1.2 AMPS.
LICENSE LIGHT.....	0.6 AMPS.
HEATER AND DEFROSTER.....	7.0 AMPS.
RADIO.....	7.5 AMPS.
	32.8 AMPS.

SUMMER STARTING...125 TO 300 AMPS.*
WINTER STARTING...300 TO 700 AMPS.*

*Varies with engine size and oil viscosity

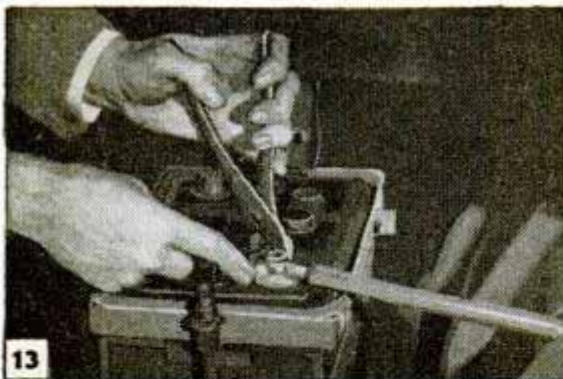
Take a minute to study this typical wiring diagram and you'll have a better idea of the heavy load on your car battery

chemical process. A fully discharged battery contains nothing but water, with the acid completely absorbed in the plates as lead sulphate.

Charging simply reverses this process, and by this means the battery can be restored to full charge, provided the lead sulphate has not been allowed to remain on the plates too long. When it is impossible to recharge a run-down battery, it's usually because the plates have remained sulphated too long, or the active material has dropped off the plates.

When you buy a battery rated at 100 ampere-hours, this theoretical rating means that the battery will deliver 100 amperes of current for one hour, or one ampere for 100 hours. Normally, careful testing and charging of a battery is a job for a fully equipped service station, but a hydrometer to test the strength of the electrolyte is inexpensive to own and easy to use. Make a test only when the battery solution is thoroughly mixed, never immediately after adding water. Hydrometer readings are set for one temperature, usually about 80 deg. F. A temperature correction of "4 points" of gravity must be made for each 10 deg. of variation from 80 deg. F. Add for above 80 deg. and subtract for below 80 deg. For example, the gravity of a fully charged battery, at 80 deg. F., is 1.280. At 100 deg. F., it will be about 1.288. At 10 deg. F., it will be 1.252. These are battery-solution temperatures, not air temperatures.

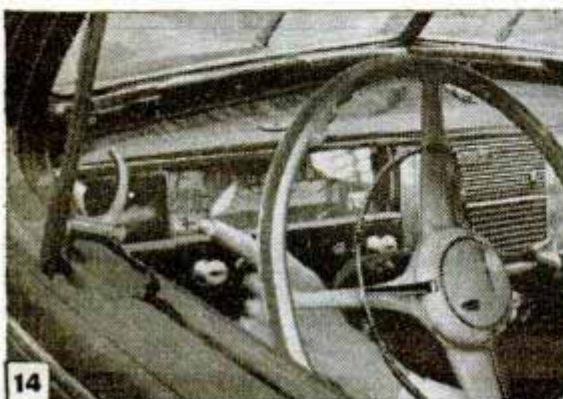
Figs. 1 to 14 picture the steps necessary in ordinary periodic care of a battery. Table A lists the average current requirements of a modern car with the usual accessories and the detail directly above table A shows a typical wiring diagram.



13

Photos Courtesy Auto-Lite Battery Corp.

Above, tighten clamp nuts with battery pliers. Make sure that the clamp is pressed down on the post as far as it will go. Below, ammeter should read discharge when light switch is on

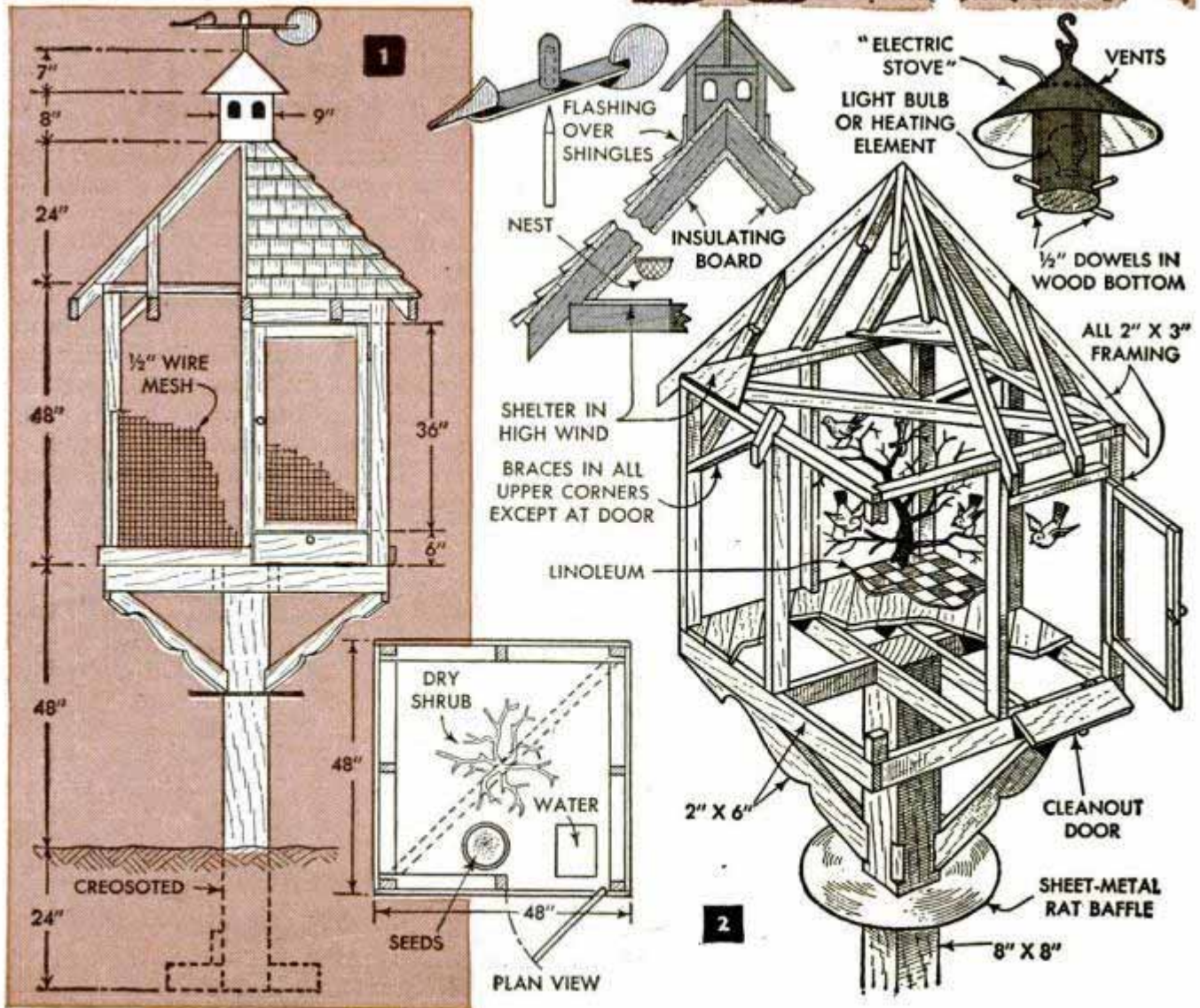


14

King-Size "Bird Cage"



By enclosing this outdoor aviary with glass in winter and providing adequate ventilation through the cupola, it will furnish a home for canaries, lovebirds and other feathered pets the year 'round in sections of the country where the weather is not too severe. By insulating the roof and adding one or two electric "stoves" like the one shown, a satisfactory temperature normally can be maintained. Stock lumber is used for the framing which is erected on a sturdy post, creosoted below ground and anchored with a cross brace at the bottom. It may be set in concrete, if you wish, and should be fitted with a metal baffle to discourage rats from climbing and gnawing their way into the cage. The dry shrub is suspended from the top so that the aviary floor is unobstructed for easy cleaning. Note that in each corner under the roof there is a platform where the birds can take refuge during high summer winds, and that wire nests are installed in the loft. Linoleum is laid on the floor of the cage and covered with clean, sifted sand. Water and seed pans should be placed near the door for convenience in replenishing; never set them under a perch or the shrub



Inner Tube Used to Inflate Balloons With Lighter-Than-Air Gas



To inflate toy balloons, use an automobile inner tube with the valve core removed. Fill the tube by connecting it to a tank of gas, using rubber tubing. Then slip the opening of the balloon over the valve stem and inflate by rolling up the tube, as shown, to obtain sufficient pressure. After some practice, it will be easy to fill the balloons without losing gas. Because of the fire and explosion hazard, flammable gases should be avoided. As a further safety precaution, always fill the balloons outdoors. To save unused gas, screw a valve cap over the inner-tube stem when not filling balloons; otherwise use your thumb as a cap.

A. O. Kriegel, Austin, Tex.

Converted Oilcan Holds Gasoline



An empty 2½-gal. oilcan can be converted to make a handy container with an attached funnel, for extra gasoline. A ring is soldered to the cap of the can and a short length of chain is fastened to this ring. The other end is soldered to the handle. A suitable funnel or spout can be made by obtaining a cap that fits the can and drilling a 7/16-in. hole in it. Solder a 1-ft. length of flexible tubing to

this and fasten a metal ring to the other end of the tubing to make a smooth job. The spout is held on the can with metal brackets. Finally, paint the can a bright red.

D. E. Horn, River Forest, Ill.

Hammer Shielded to Protect Work

If working in close quarters, the exposed claw or top of a hammer head may mar adjoining woodwork accidentally. This can be avoided by cutting a strip of auto inner-tube rubber and making holes at the ends so that it can be slipped over the head as indicated.



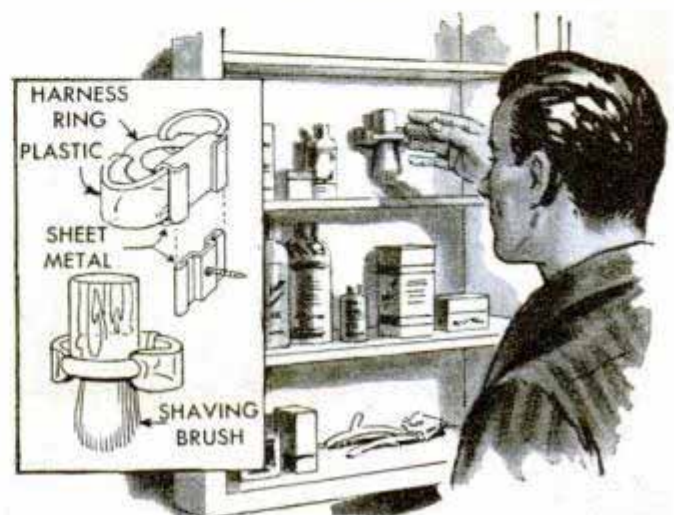
Eliminating Window Streaks

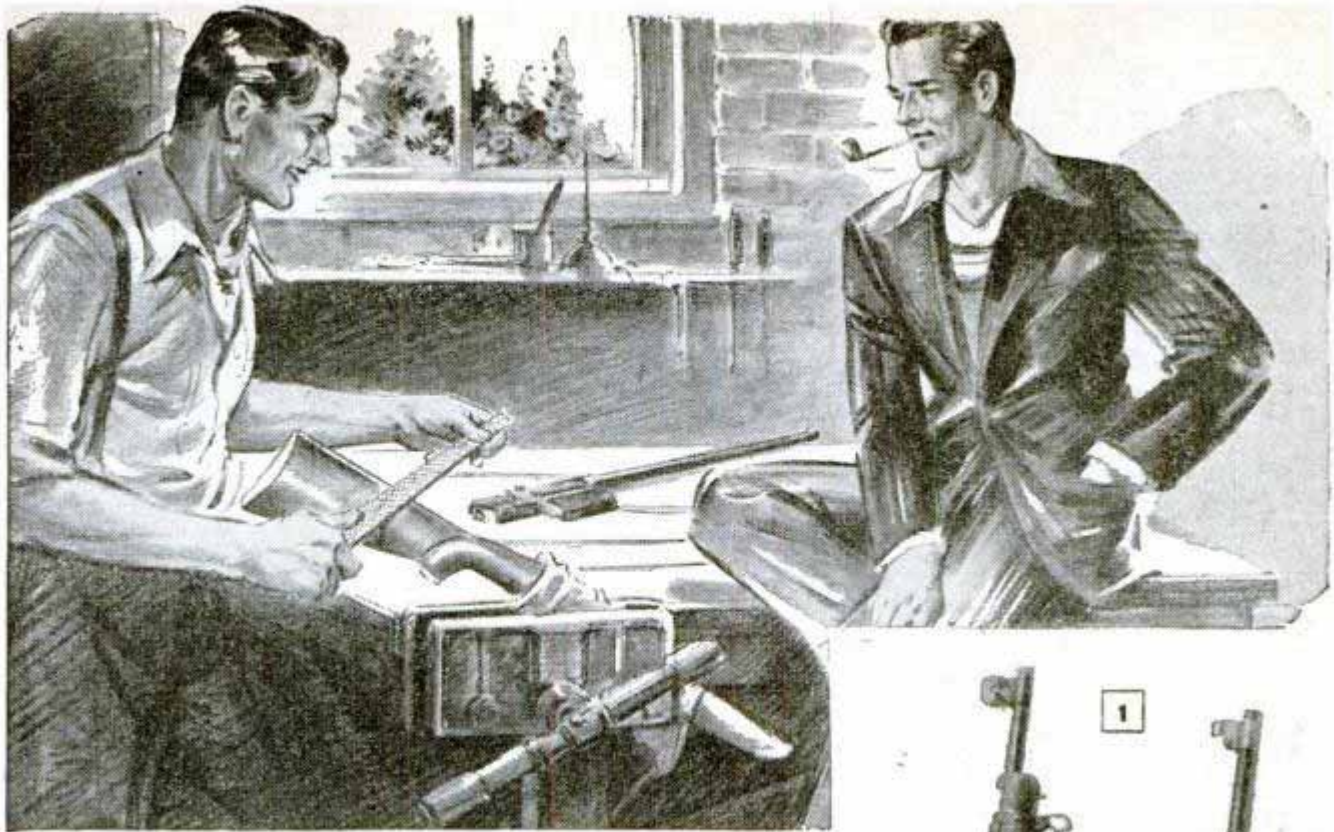
When washing windows, it's a good idea to dry them on the outside with vertical strokes and on the inside with horizontal strokes. Or just the reverse, as long as the direction differs for each side. Then you can tell at a glance whether any remaining streaks are on the outside or inside and remove them.

Plastic Holder for Shaving Brush Mounted in Medicine Chest

Useful as well as attractive, this shaving-brush holder is mounted on the inside of a medicine chest. It is especially designed for shaving brushes having fairly large plastic handles. The brush fits inside a composition harness ring that is held between the jaws of a strip of transparent plastic bent to an oval shape. The ring should have an inside diameter slightly less than that of the brush handle so that the brush is easy to insert or remove but will not slip through. A sheet-metal clip secures the holder to the medicine chest.

Robert Scott, Saltsburg, Pa.





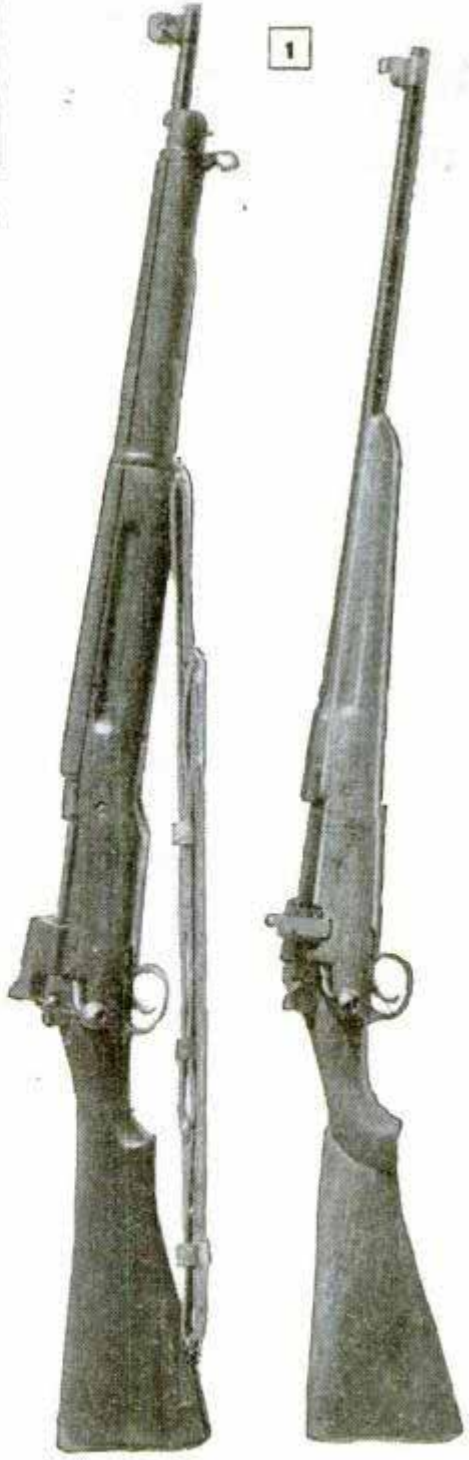
RIFLE CONVERSION

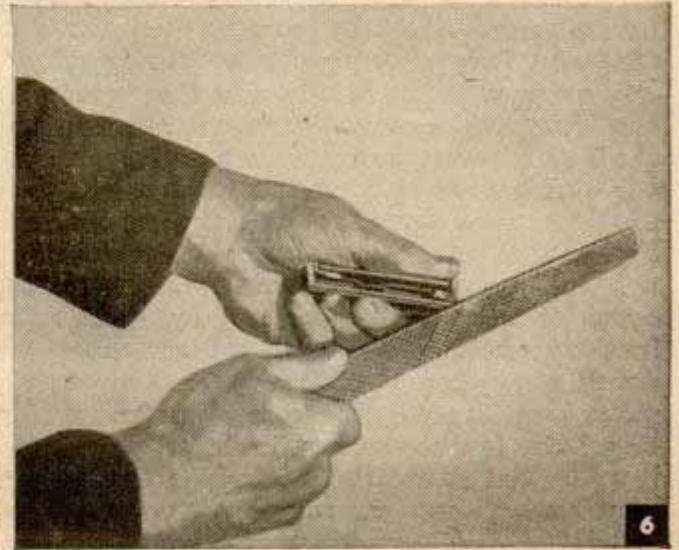
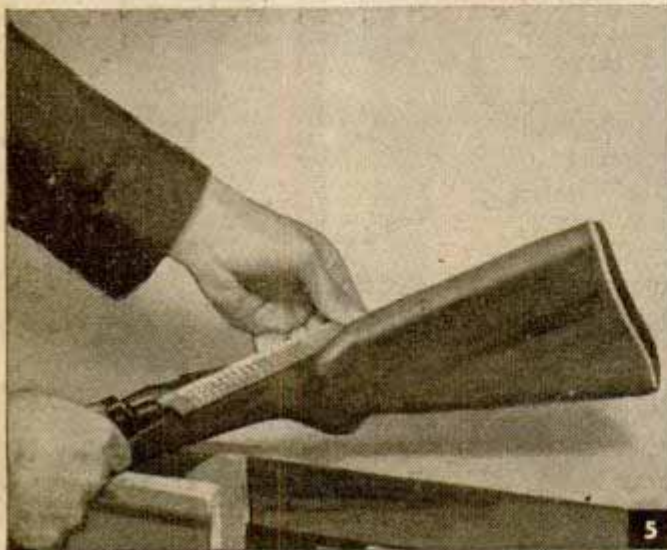
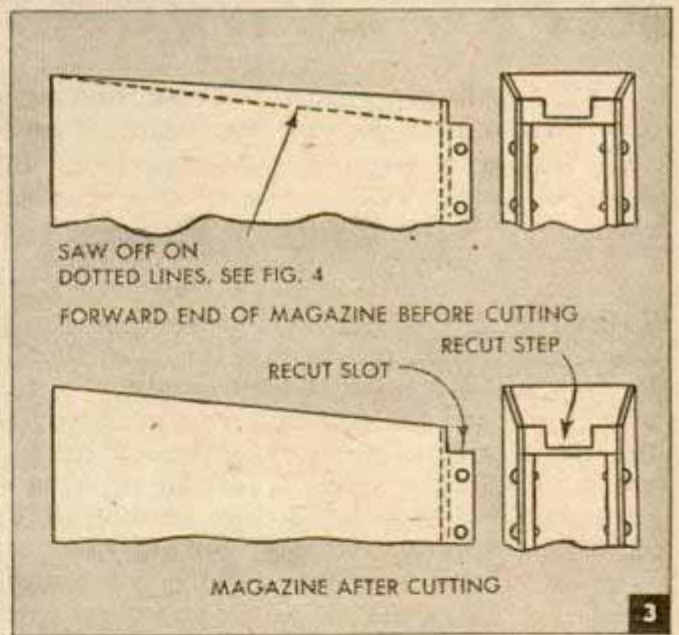
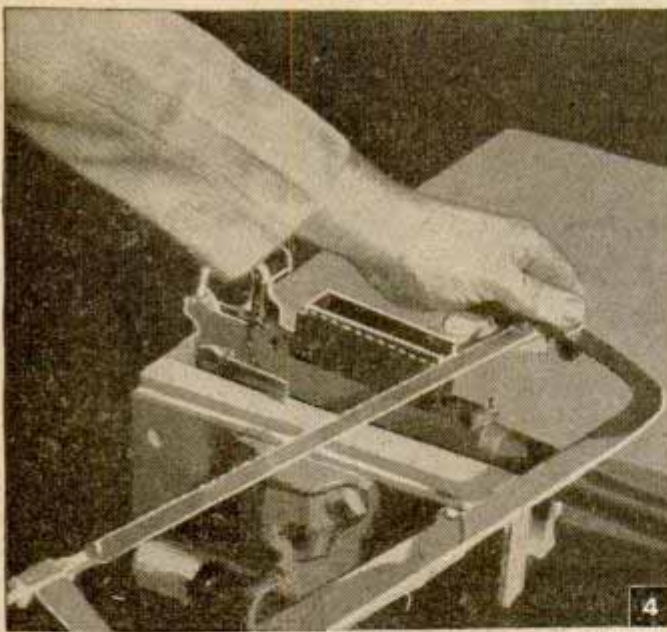
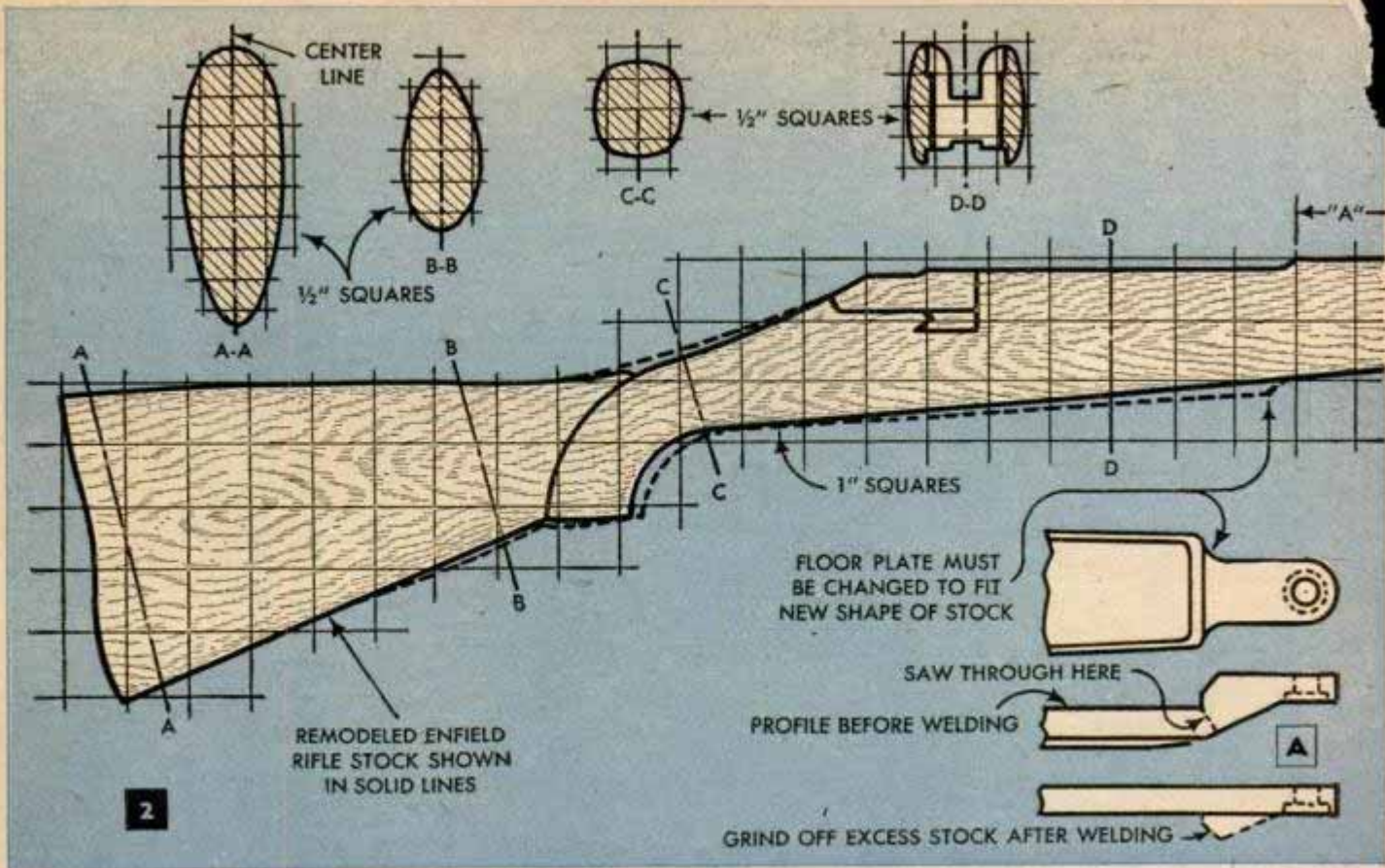
By reshaping the stock and making other minor changes you can make a fine sporting rifle from the Model 1917 Enfield

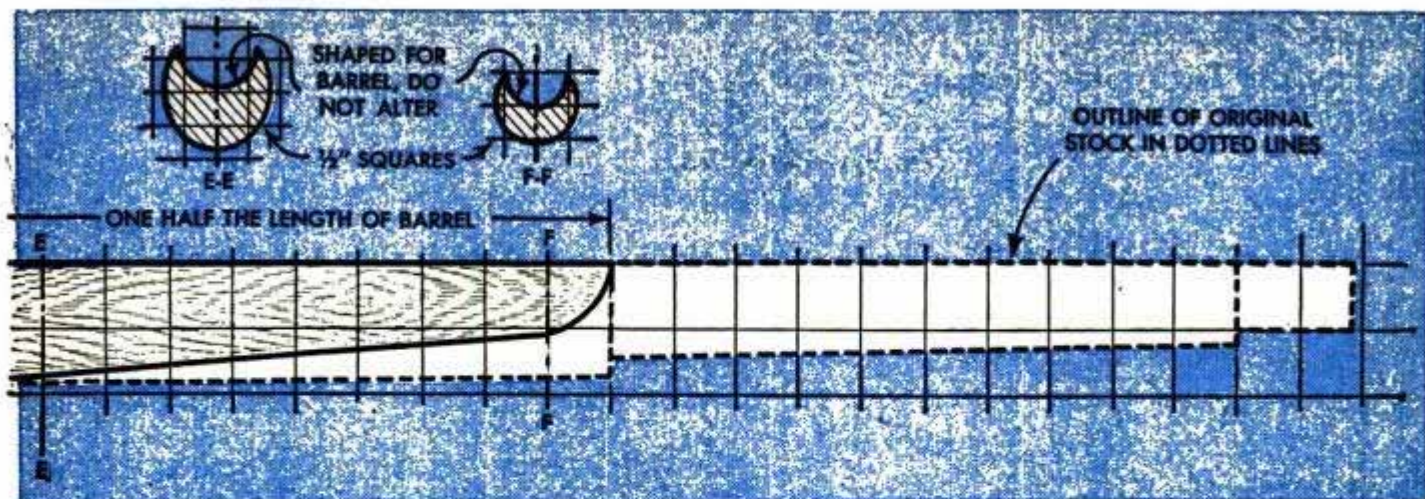
By Edward R. Lucas

THERE'S A GOOD, high-power sporter just underneath the rough, military exterior of the Enfield rifle. Briefly, all you have to do to convert it to a sporting rifle is remove the barrel cover, cut away a portion of the stock, and take off an eighth of an inch or so of wood here and there. This will provide a neat and serviceable rifle on which can be mounted almost any sighting equipment suitable for big-game hunting.

Before doing any work, there are several points to consider. The pull length or the drop of the original stock can't be altered easily except by the use of leather comb and butt pads, but you can determine the fore-end length quite easily. Some riflemen have a longer reach than others and they grasp the fore end well forward, especially when taking quick, off-hand shots at running game. One should take this point into account before cutting the fore end to length. Ordinarily a fore end one half the length of the barrel, Fig. 2, will be about right. Also, if you want to install a barrel band for a forward sling swivel you should consider the position of the band with relation to the fore-end length. Another thing is the height of the comb at section B-B in Fig. 2. Although the Enfield stock is quite straight the comb height at this point may be a little low for some shooters. You can either build it up by flattening the stock from the grip back to the heel and gluing on matching wood, or shape it as indicated and then raise the comb to desired height







with a cheek pad of the lace-on type. Of course, using the former method would make it necessary to fit a new butt plate of the type used on sporting rifles.

First disassemble the rifle, removing stock, barrel cover and sights. Then make a full-size template of the stock profile, following the solid lines in Fig. 2. Also make templates of one half of the sections A-A, B-B, C-C and D-D. Saw off the fore end square at the point determined. At some points where considerable wood is to be removed a sharp spokeshave can be used. This is faster than a wood rasp. Check frequently with the sectional templates to be sure that you do not cut below the curves. Don't try to finish to exact dimensions with a spokeshave. Come down only part way to remove most of the excess wood, then finish up with a fine rasp and sandpaper. You can't remove all of the finger groove on each side of the fore end without getting the wood too thin at the breech ring. There will be a little of the finger groove left as shown in the right-hand view of Fig. 1. Notice in Fig. 2 that the underside of the grip and the top of the tang are cut down considerably from the original profile. Here care is required because you are working directly across the grain and at an angle with it in a comparatively small area. A

strip of fine-grit abrasive cloth 1 in. wide is ideal for finishing the rounded surfaces.

The magazine floor plate is altered as in Fig. 2, details A, so that it will fit flush with the new profile of the stock. A gunsmith or expert welder can do this job. Before sawing, transfer the location of the two holes to a piece of flat steel. Later, after sawing, this will serve as a welding jig. Both parts can be bolted to it. The floor plate must be reblued. Next, the magazine is altered as in Figs. 3 and 4. The final alteration is chamfering the step at the rear end of the magazine follower so that the bolt can be closed easily when the magazine is empty. Do this with a file as in Fig. 6.

Leaving the barrel its original length generally is recommended, but some riflemen prefer a shorter barrel for hunting. Some cut it back to 22 in. It's recommended that this be done by a gunsmith but you can cut the barrel with a hacksaw and then countersink and crown the muzzle as in Figs. 7 and 8. Use the greatest care not to damage the rifling in this operation. Before you use the rifle have a competent gunsmith check the head spacing. This is important, not only as an aid to accuracy, but is a safety precaution as well. A rifle with excessive head space may be dangerous to fire with standard ammunition.



Oversize Copper Fittings Soldered To Smaller Diameter Tubing

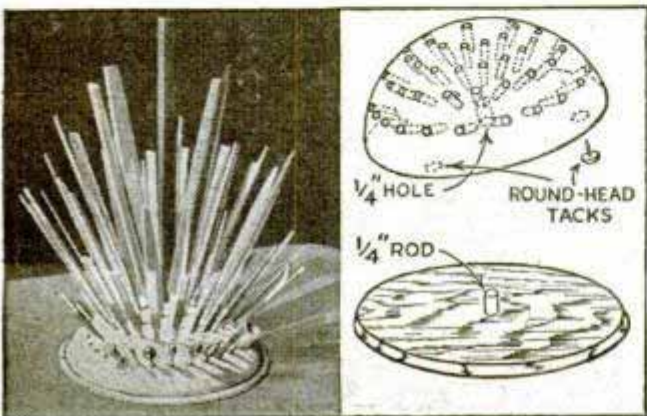


Once in a while, when soldering copper fittings to pipe or tubing, the right sizes aren't at hand. However, if it's the former that is too large, the tube can be made to fit by wrapping it with copper wire and soldering in place. As an example, to fit a 1/2-in. pipe into a 3/4-in. ell, first tin the end of the pipe and solder one end of the wire to it at point No. 1. Then wind the wire around the pipe until it will fit snugly into the fitting. Tuck the loose end of the wire, No 3, under one of the coils, No. 2. Finally, heat and solder as you would if both tube and fitting were of the same size. The wire will keep the solder from flowing out of the joint.

John A. Lerch, Cleveland, Ohio.

Shop "Pincushion" for Light Tools

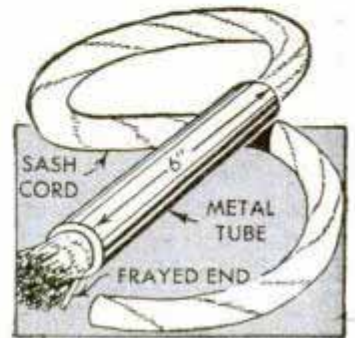
For those craftsmen who are particular about the care of small tools, the "pincushion" shown here can be made in short order and is an ideal holder for files, punches, scribers, drills and other items



that often are scrambled together in a drawer. A wood block about 4 to 6 in. high is turned to a semicircular shape about 10 in. in diameter. Then mark concentric circles 1 in. apart and drill 1/8-in. holes 2 in. deep at 1-in. intervals along the circumference of each circle. These holes are the holders and can be enlarged as needed. Drill the holes at an angle so the tools will "fan" out. Fasten the holder to its base with a length of 1/4-in. rod and nail round-headed tacks to the latter to serve as coasters.—John Mracek, Oak Park, Ill.

Glue Brush Made of Sash Cord

Here's a useful glue brush that you don't have to clean after use. Instead, just cut off the used end and form a new end. It's made from a 6-in. length of 1/4-in. tubing and a short piece of sash cord.



The cord is inserted in the tube with one end projecting slightly. This end is frayed, and when dipped into the glue, it acts as a brush. Whenever a new one is desired, pull the frayed end out a little, cut it off and fray the new end.

Gummed Labels Stored in Fruit Jar

Gummed labels, such as are used to mark canned fruit and preserves, can be stored in sealed glass jars to keep them from sticking together. When the stickers are kept in a drawer or box between canning seasons, moist air will dampen the glue enough to cause the paper to stick. A chemical dehydrating agent, such as lime or silica gel, should be placed in the jar along with the gummed labels.



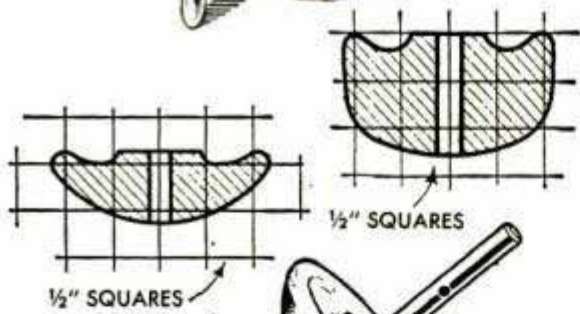
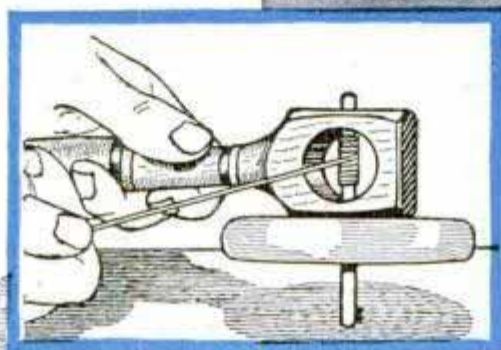
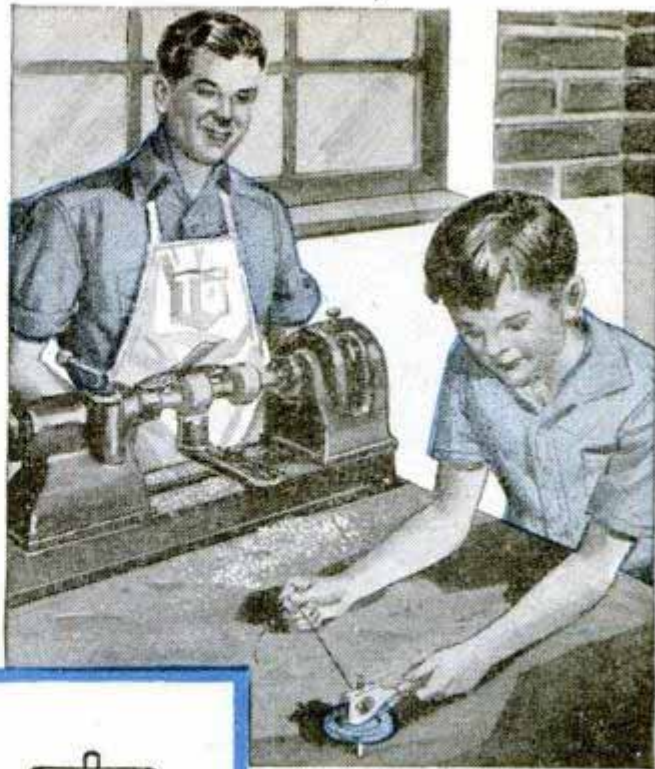
Boiling Water Loosens Fish Scales

When bluegills, bass or any similar fish are kept out of water for any length of time, the scales set and are hard to remove. This may occur also when fish are shipped or kept on ice. Should this happen, dip the fish quickly in boiling water and the scales can be removed more easily.

R. A. Jenkins, Los Angeles, Calif.

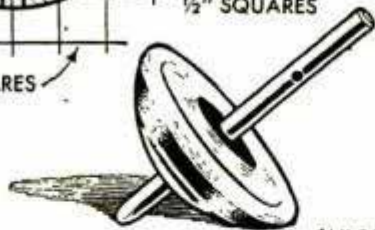
Tops in TOPS

"Handle" tops you can call these for they're spun by holding them with a handle. The top is placed in a wood handle, a strong cord is threaded through the "eye" of the shaft and wound around it like a bobbin. With the top resting on a flat surface and held with the left hand, the cord is given a quick pull, the handle is lifted off and whizz—it's spinning. Making these tops is a lathe job even to the handle, although two other types of handles are given which do not require turning. The tops themselves are finish-turned right on their shafts by first driving 1/4-in. drill rod through an undersize hole in the center of a rough-turned block and then chucking the whole thing in a lathe. Maple or any other hardwood from your scrap box will do. Draw a full-size half pattern of each top and cut a contour template of stiff cardboard to follow in turning. Paint them with bright colors and finish by varnishing.—Michael F. Frieders, Aurora, Ill.

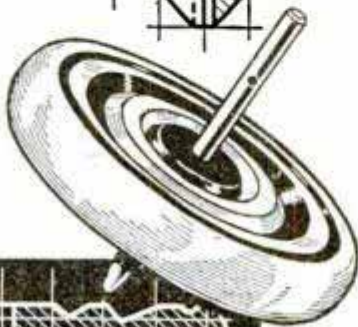
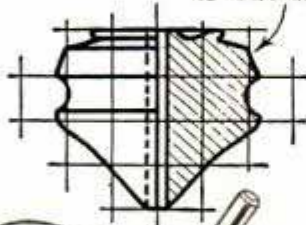


1/2" SQUARES

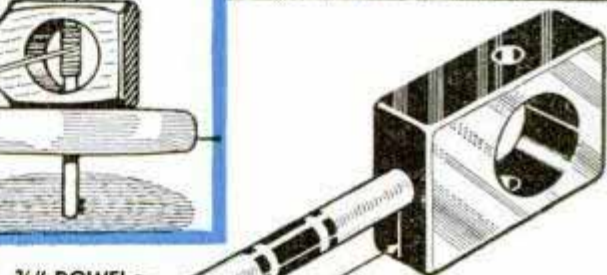
1/2" SQUARES



1/2" SQUARES



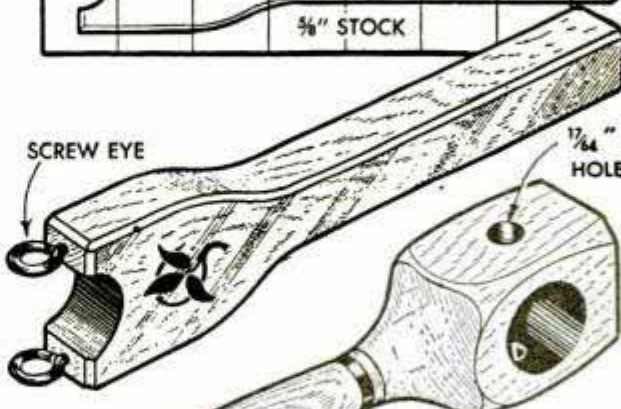
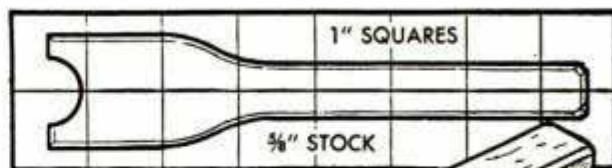
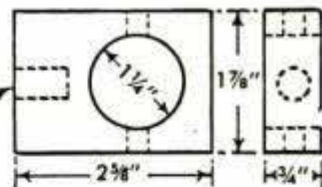
1/2" SQUARES



3/8" DOWEL

5"

3/8" HOLE



SCREW EYE

17/64" HOLE



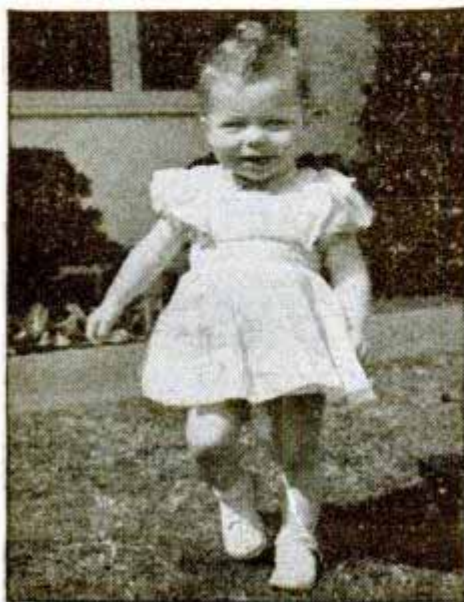
1" SQUARES



Above: Bracing elbows against body and holding breath as picture is snapped helps minimize camera movement. Right: For a close-up like this, sharp focusing and accurate framing are a must



It's easy to "scalp" your subjects, especially at close range, if you are careless in aiming the camera. Make sure that you frame all of the subject



Photos by
Ray Chapin

Five Steps

GETTING OFF to the right start with a new camera is just a matter of remembering five simple, yet important steps—little things that mean the difference between taking a poor picture and a good one.

Step one is to aim the camera accurately. Sharpness and clarity mean little if the subject has been "scalped" by careless sighting. Getting all of the subject within the camera's field is easy if you proportion the subject to fit the film, so to speak. For example, in taking a full-length picture of a person the camera should be held so that the long way of the film is up and down, or vertical. Thus, you'll be able to get closer and the subject will fill the frame without waste area along each side. If you are taking a group picture, where the subject is wider than it is high, then the camera should be held

so that the long way of the film is horizontal. Of course, with reflex-type cameras, which take a square picture, proportioning the subject as to the long and short way is disregarded. The closer you are to the subject the more exacting you must be in aiming. Make it a practice to always check the top, sides and bottom of the sight picture and see that a margin exists all around the subject. Many small cameras are equipped with view finders which are sighted by holding them close to the eye as you would in sight-

Here's the result of "freezing" action with a slow shutter speed





Reflex-type cameras (above) employ a ground glass for focusing, while cameras with coupled range finders are focused by super-imposing split image

to Better Outdoor Photos

ing through a telescope or a gun sight.

Step two to consider is focusing. Here, a camera works similar to field glasses, the lens must be adjusted back and forth to bring the subject within sharp focus. As with sighting, focusing becomes more critical as you approach nearer to the subject. At a distance of 16 ft. you can be off in focusing as much as 6 in. without it being perceptible in the sharpness of the picture. On the other hand, a 6-in. discrepancy at a distance of 4 ft. will result in a very blurred image. Cameras with coupled range finders and ground-glass viewers take the guesswork out

of focusing. Without these a tape measure should be used to determine the lens-to-subject distance. Keep your position once the camera is in focus, as a step forward or backward, especially at close range, will change the distance and throw the subject out of focus. To take a picture of a fast-moving train, auto, etc., select a spot where the subject is to be "stopped," focus on this point and then shoot when the action reaches that particular spot. It's wise to avoid such shots directly broadside.

Step three is getting the right exposure. When the aperture (shutter opening) is small, a camera

By R. W. Emery

Increasing the shutter speed to 1/100th still isn't fast enough

At 1/200th and a larger aperture opening the blur is disappearing

While better, even 1/400th has failed to "stop" action completely





"sees" sharply for a greater distance in front of and behind the point of focus than it does when the opening is large. Thus by stopping down the opening you increase the depth of focus and overcome, to a certain degree, loss of detail through error in focusing. However, in reducing the size of the aperture it must be remembered that the amount of light that can enter the shutter is being reduced, also. This means that the picture must be taken at a slower shutter speed to compensate for this. Other factors that enter in determining shutter speed are the degree of action to be stopped and the speed rating of the film used.

Shutter speed and aperture are determined most easily with a photo-electric exposure meter, although any of the printed exposure guides available will give good results. With a fairly fast film, a camera setting of $\frac{1}{100}$ th (shutter speed) at f:16 (aperture) is an average setting for bright sun. Where the action dictates use of a faster speed, say $\frac{1}{200}$ th, then the aperture is opened to about f:8 to make up for the loss of light at the greater speed. For future reference it's a good practice to keep a record of each shot as to shutter speed, aperture, film speed, lighting and subject, whether it is light, medium or dark.

←
Best way to stop camera movement is to support camera on a tripod



Bright sunshine adds good contrast and sparkle to pictures of children. If care is used to get the exposure correct, you will capture detail in the shadows. Avoid having subject face directly into the bright sun
←

Best time to take pictures is in the forenoon or afternoon. Strong sunshine at midday casts shadows under eyes and nose
←



→
This shot was made in strong sunlight with the subject backlit. This is done by shooting into the sun but not directly. Use a small aperture to obtain detail in the shadows



Step four calls for lighting the subject. A good rule to follow here is to shoot with the sun at your back. With an early or late sun watch to see that your own shadow does not fall into the foreground of the picture. In photographing a person or a group of people do not have them face directly into the sun. Forenoon and afternoon are the best periods during the day to "shoot" people. Noonday sun is objectionable in that it casts long shadows under eyes and nose. A bright but overcast day eliminates the shadow

problem and is considered the best type of lighting for average shooting.

Step five—hold the camera steady. All of the other steps are wasted if you allow the camera to move at the time the picture is snapped. A tripod is the best means for supporting a camera, but if this is not always feasible, you should adopt the practice of bracing the elbows against the body and holding your breath momentarily as the picture is taken. A chair, table or whatever might be handy for support can be used. If it's a car door, be sure that the engine is not running; vibration will spoil the shot, too. In operating the shutter either by a cable release or by the tripper itself, learn to "squeeze off" the shots. A lot of camera movement is caused by snapping the picture jerkily. It should be remembered, too, the slower the shutter speed, the more chance there is for camera movement when held by hand.

Finger Pads Keep Prints Clean



Frequently a great deal of time and effort is spent on an enlargement, only to find that when the darkroom light is turned on there are finger marks that ruin the print. Usually this is caused by handling the paper with fingers that are damp with perspiration or chemicals. To prevent this, wear

rubber finger pads when handling dry paper. Not only will this prevent marking the paper, but it also will assure a firmer grip when the sheet is pushed against the margin stops on the easel.

Extension Cord Wound on Reel



If you have some empty 8 or 16-mm. film spools on hand, they can be used as reels on which to wind extension cords. They will fit nicely into your camera case and when

setting up lights, it won't be necessary to waste time untangling the cords.

H. Klein, Pittsburgh, Pa.

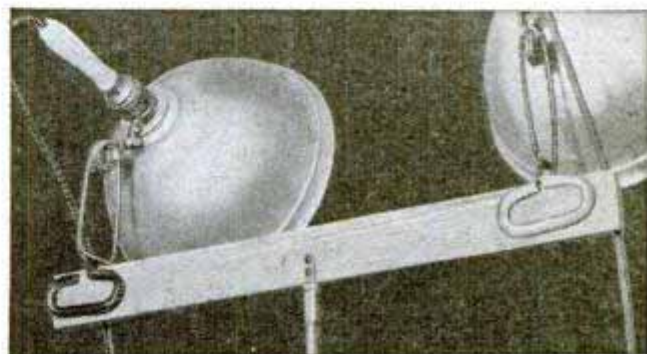
Metal Clip Holds Cable Release To Take Time Exposures



The shutters on many cameras are equipped with only a bulb setting to make time exposures, and in many cases, while the cable release is being held, the camera is jarred and a poor negative results. The metal clip shown in the upper right-hand detail is designed to hold the plunger down and the shutter open for time exposures. A notch is filed in one end to slip over the base of the plunger. To use, press the plunger down and slip the clip in place. After the correct exposure has been made, remove the clip.—Bob Hurst, Chicago.

Dual Rack for Photoflood Lamps

Often the crossarm provided with photoflood-reflector stands is too small to allow the clamp to grip without slipping. However, this condition can be prevented by substituting a wide, flat piece of wood for the metal crossarm. The wood should be as long as the original bar and just a little wider than the narrow dimension of the clamp.—R. F. Donovan, Jersey City, N. J.



SYNCHRONIZED

Shows how you can synchronize the shutter of any box camera to fire a homemade flash gun. Conversion is simple and does not affect regular use of camera for ordinary outdoor shots

By M. C. Anderson



SHOOTING flash pictures with a box camera is something hard to believe and yet it can be done with remarkable results as shown in Fig. 1. Furthermore, the conversion involves only a minor shutter alteration which anyone can do, and the flash gun is assembled for practically nothing, from a couple of discarded flashlights and a small aluminum pie plate.

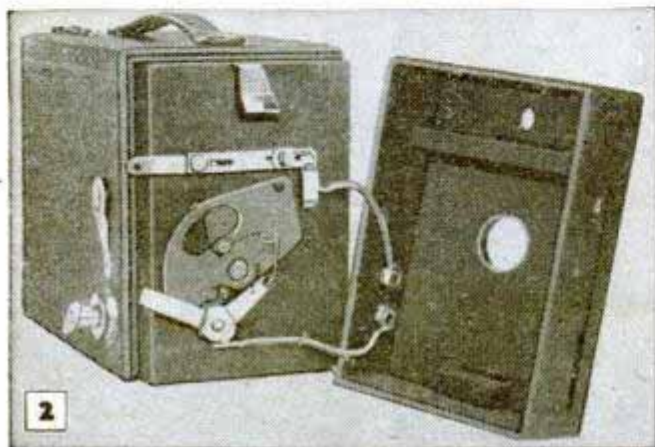
To convert the camera, first remove the front cover from the shutter mechanism. Most box cameras have a time-exposure setting, Fig. 5, consisting of a metal slide which, when pulled out, serves as a stop to hold the shutter open. However, if the camera is not equipped for time shots, a suitable slide can be installed easily as shown in Fig. 3. Make it L-shape and slot it to slide back and forth on two small nails. Where the time slide is already built-in, it must be insulated from the rest of the mechanism with a piece of adhesive tape, applied to the slide between it and the shutter plate. This will necessitate removing the plate to get at it.

The slide serves as one pole of the synchronous switch and is wired to one of two phone jacks which are installed in the side of the front cover as shown in Fig. 2. The other phone jack is wired to the shutter plate. Thus when the slide is set for "time" and the shutter is tripped, the little tip on the shutter leaf makes contact with the slide and completes the circuit, causing the bulb to flash. After the bulb is fired, a second movement of the shutter lever is required to close the shutter. In this respect it should be noted that when the camera is not supported by a tripod the subject should be in subdued light so that the interval between the flash and the second tripping of the shutter will not allow movement to be recorded on the film. With the time slide pushed all the way in, the shutter is restored to normal operation.

While you can sight by the regular view finder on the camera, an eye-level one will be found more convenient, especially in framing the subject in poor light. Such a finder can be formed of wire to fold flat in the manner shown in Fig. 6. Both front and rear parts of this can be aligned fairly



Sample shot shows what can be done with box camera using supplementary portrait lens to get close-up



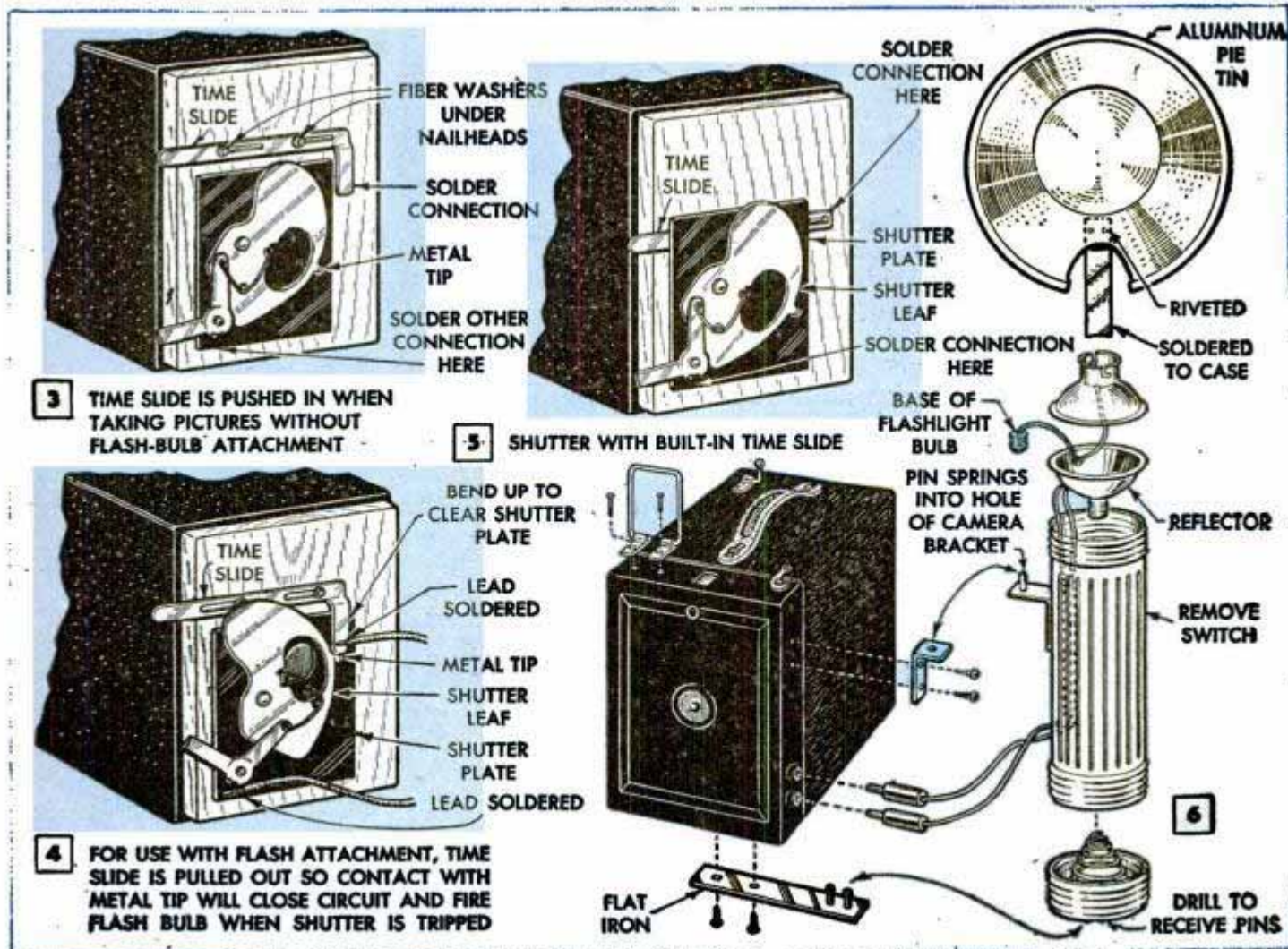
FLASH for your BOX CAMERA

accurately by placing the camera on a firm support, sighting an object through the regular built-in finder and then adjusting the wire finders to coincide. A portrait-lens attachment for taking close-ups can be provided, too, by cementing a ring cut from a cardboard pillbox over the shutter opening. You may have to experiment some with the lens in determining the minimum and maximum lens-to-subject distance. This can be done with the portrait lens in place, the camera set for "time," the back of the camera removed and then focusing on a ground glass of tissue paper. The point where the image is sharp on the paper is where you set the camera for distance.

The flash gun is improvised from the metal case of a flashlight. The side switch is removed and the lens is replaced with a reflector from a second flashlight as in Fig. 6. The socket part of this is cut off and an auto-headlight socket of the bayonet type is soldered in its place to take the so-called "peanut" flash bulbs. Next, a flashlight bulb is taken apart, a burned-out one will do, and the tiny wire attached to the brass shell is removed. Then a length of wire is

soldered to the center contact and the base of the bulb is filled with cellulose cement. The base in turn is screwed into the flashlight reflector and the attached wire is run inside the case and out through a hole just above the screw cap. A second wire is soldered to the center contact of the bayonet socket, after which both wires are fitted with phone-plug tips. An extension cord with phone jacks at one end and plugs at the other should be provided for times when the flash gun is used remotely from the camera, as when taking close-ups.

The bracket which supports the flash gun on the side of the camera is designed to allow the gun to be removed quickly by simply pressing downward. A metal arm is screwed to the bottom of the camera and pins in the end of the arm engage holes in the screw cap of the battery case. Two other L-shape brackets, one screwed to the camera and the other soldered to the gun slightly below, engage each other as shown in Fig. 6. Finally, the lens cap is screwed down against the inverted reflector, and the pie-plate reflector is added. This can be soldered permanently to the gun.



Toothbrush Applies Compound To Pipe Threads



Compound will be spread uniformly over pipe threads if a discarded toothbrush is used. Another toothbrush can be used to clean the threads after they have been cut but before the compound is applied. A thread that is not clean will result in a poor joint.

Clarence Klumb, Rockfield, Wis.

Simulated Hull of Wrecked Ship Decorates Fish Bowl

An unusual bit of decoration for a fish bowl, the model of the hull of a wrecked ship, will add a novel touch. Either copper metal or redwood is satisfactory material, but if the latter is used, it must be weighted to keep it from floating. Ends of the ribs and keel should be cut to look like broken

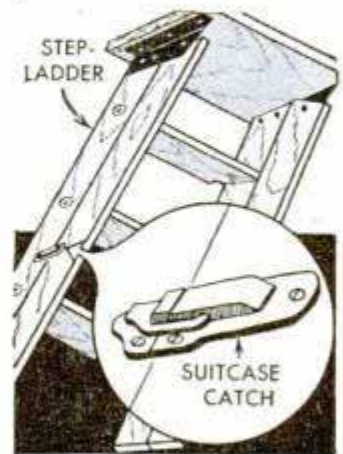


timbers. If the model is placed in a spherical-shaped bowl, it can be fairly small because of the magnifying effect of the curved surface of the glass.

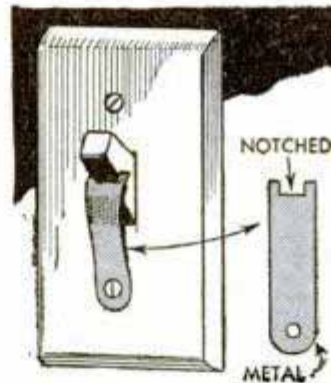
Charles H. Hardy, Los Angeles, Calif.

Catches Hold Stepladder Folded

Neat and practical clamps for holding legs of a stepladder so it may be carried are made from the catches of a discarded trunk or suitcase. Unlike hooks, the catches will not tear clothing and they are easily fastened and unfastened.



Guard on Electric-Light Switch Prevents Accidental Use



To prevent turning on an electric-light switch accidentally, and also to keep children from playing with the switch, use this spring-metal guard. A short length of flat spring is notched at one end and the other end is

rounded and punched. Then it is bent so that when bolted to the switch plate the notch will engage the toggle but still lift over it easily.—Dr. B. Matzen, Napa, Calif.

Vise Handle Kept From Slipping

You won't pinch your fingers in the handle of a vise if spring tension is applied in such a manner that the handle will not slip. First drill a hole in the handle at right angles to the ball and tap it for a $\frac{3}{8}$ -in. screw. The latter has a coil and washer soldered to the end so that when the screw is in the ball of the vise, the spring exerts sufficient pressure on the handle to keep it from slipping.



What's WRONG?

CIRCULAR-SAW OPERATIONS



1 CUTTING A MITER

- Miter gauge in wrong slot
- Saw too high
- Table tilted wrong way



2 CUTTING DUPLICATE PARTS

- Poor hand position
- Method is not accurate
- Fence used as stop



3 SAWING A RABBET

- Wrong kind of saw
- Piece cut out is trapped
- Splitter should be used



4 STANDARD RIPPING

- Work is too thin
- Wrong hand used for feed
- Blade is too high



5 RIPPING A THICK BOARD

- Splitter should not be used
- Hold-in in wrong position
- Push stick is too short



6 FREEHANDING A TENON

- Cheek cuts made last
- Saw is too high
- Poor hand position



7 DADO SETUP FOR 1/4 INCH

- Wrong kind of saw
- Saws not placed right
- Wrong combination



8 RABBETING WITH DADO HEAD

- Wrong kind of fence
- Work is not supported
- Hold-in should be used



9 CUTTING A BLIND GROOVE

- No splitter
- No stop
- Poor hand position

Answers:

1—Miter gauge in wrong slot—it will strike saw in this position. 2—Fence used as stop will cause work to bind—right way requires clearance.

3—Piece cut out is trapped and may be kicked back like an arrow—better way is to cut rabbet on outer edge. 4—Wrong hand. 5—Hold-in in wrong position—too far forward. 6—Cheek cuts made last—this reduces even more the scant area of contact. 7—Saws not placed right—teeth should point to same side to allow set clearance.

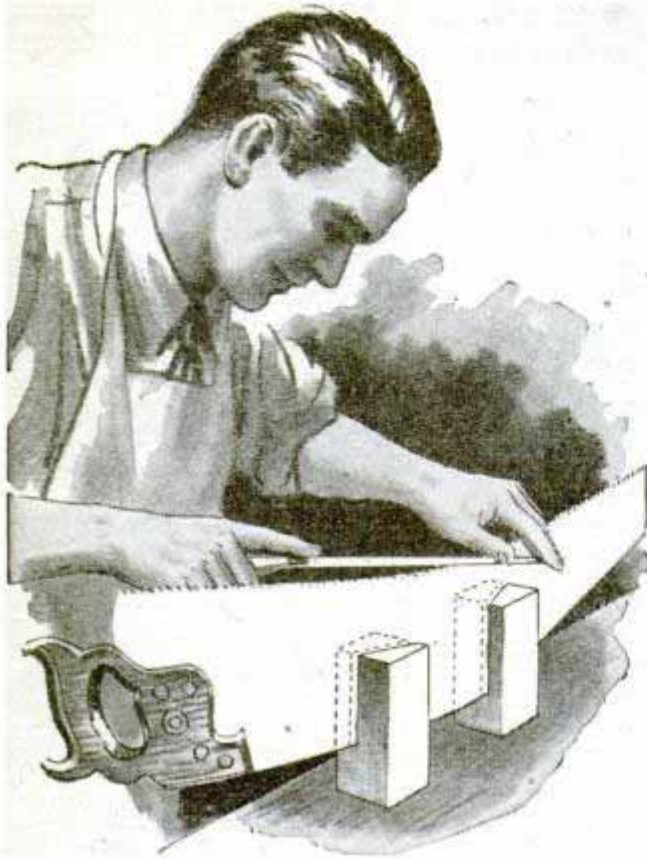
8—Work not supported over table. 9—No stop slot. 9—work will be kicked back. 10—Cut is too deep.



10 RESAWING (1ST CUT)

- Cut is too deep
- Hold-down poorly placed
- Wrong kind of saw

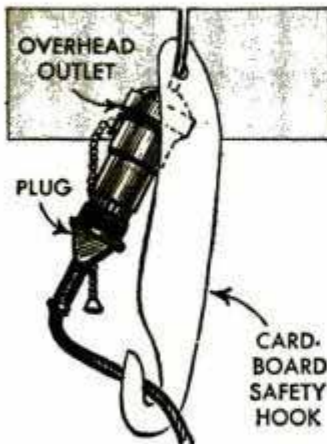
Slotted Bench Stops Hold Handsaw In Filing Position



For those who do not have a saw vise, a handy substitute can be made from a pair of bench stops. Slot each stop at an angle and insert the saw by bowing it slightly. This "pinching" action will hold the blade in place, yet its position can be changed easily by bending and sliding it.

Safety Hook for Overhead Outlets

Cut from heavy cardboard, this safety hook will hold two cords together where an extension and overhead outlet are being used. If the outlet is used mainly for extension cords and not for lights, the hook can be left in place permanently so that it will always be there when needed. If you have a piece of fiber or insulating board on hand, it will serve better than cardboard because it is more durable.



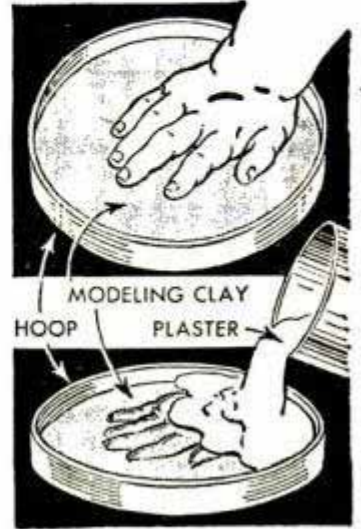
Fixing Loose Furniture Casters

When the casters in furniture work loose, they can be made to fit tightly again by filling the caster hole and reboring it. Select a dowel or whittle a plug that is a

tight fit in the worn hole. Coat the plug well with glue and drive it home, then saw it off flush with the bottom of the leg. When reboring the hole, use a bit of slightly less diameter than the caster pin. The latter is coated with soap before it is driven into place.—Francis W. Henry, Pottsville, Pa.

Plaster Cast of Infant's Hand

Cast in plaster, an impression of a baby's hand or foot will be a pleasant keepsake for years to come. Use ordinary modeling clay that has been warmed until it is soft. Then place an embroidery hoop around it to form the side of the mold. Make an impression of the infant's hand or foot and pour a mixture of plaster of paris into the mold. After the plaster has set, remove the hoop and lift the disk from the clay. The plaque should be painted in decorative colors.

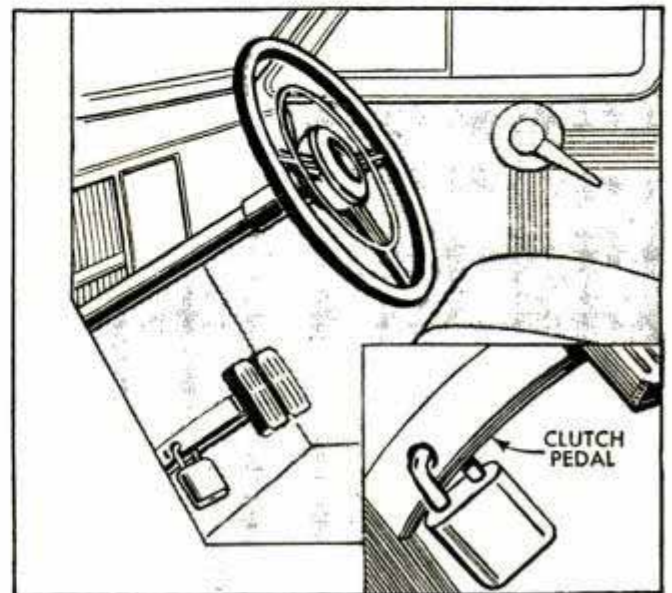


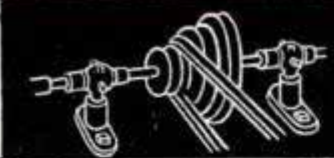
G. E. Hendrickson, Argyle, Wis.

Padlock Fastened to Clutch Pedal Prevents Theft of Auto

If a hole is drilled in the arm of a clutch pedal as indicated and a padlock is fastened through it so the clutch cannot be depressed, it will not be easy to drive the car away. It's a good idea to leave the car in reverse gear also, should anyone succeed in starting the motor or attempt to tow it away.

Herbert E. Fey, New Braunfels, Tex.





Shop Notes



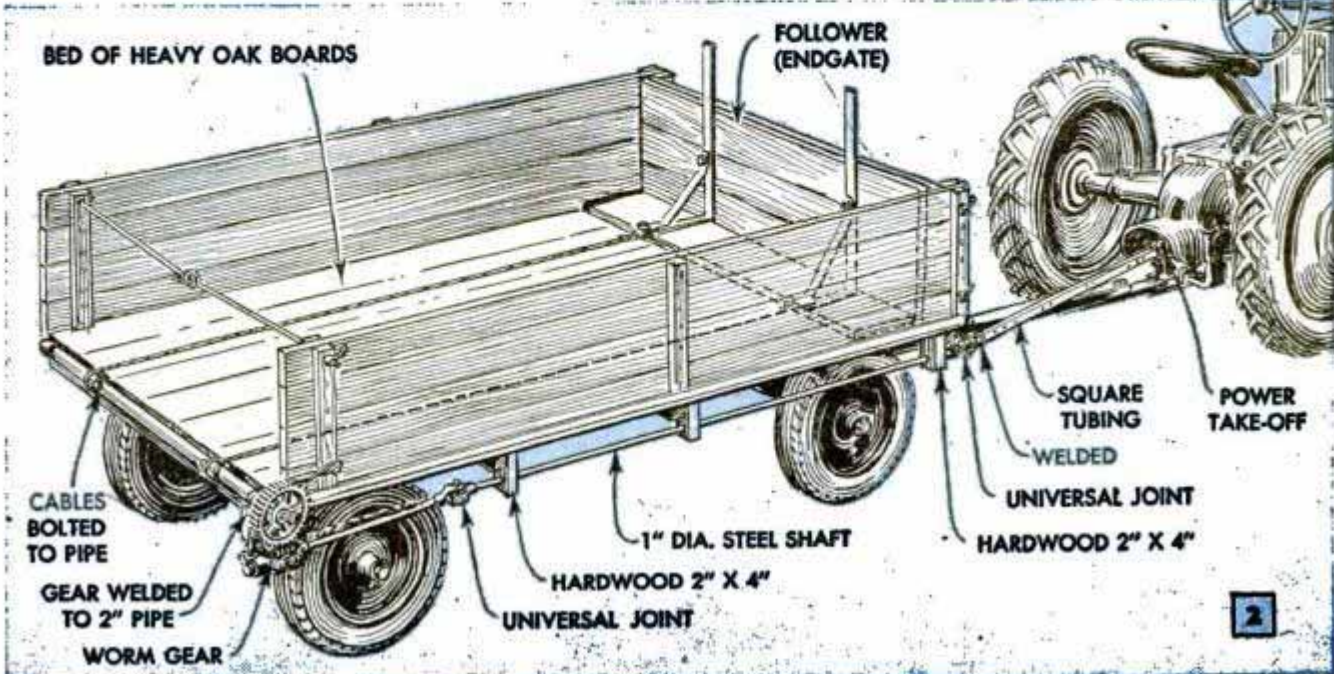
POWER "SCOOP"

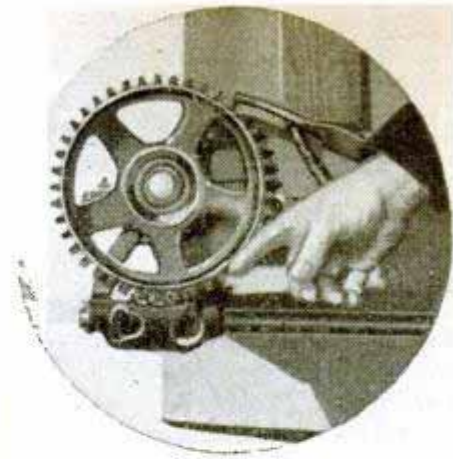
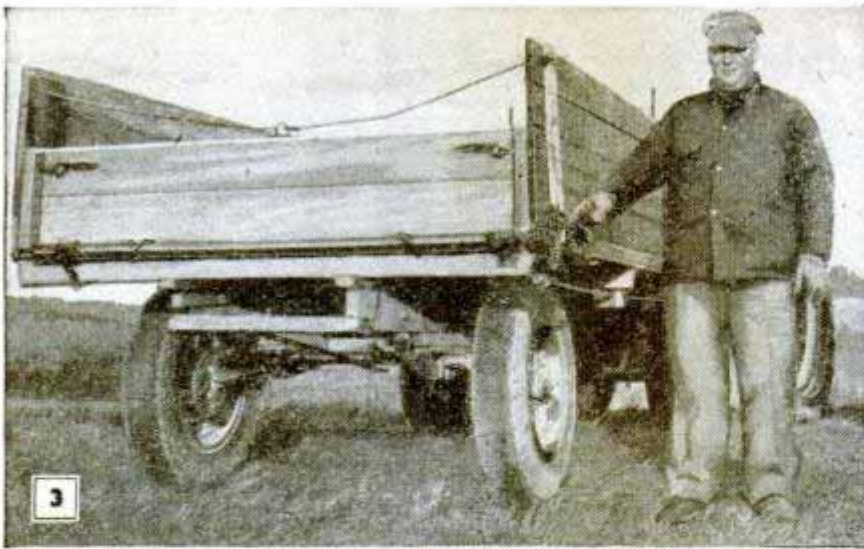
By A. E. Holden

An old grain binder contributed some of the principal parts used to build this speedy unloader and Charles and Max Stevens, Indiana farmers who built the original for their own use, say that it will unload ear corn faster than a two-row picker can gather it from the field. That's counting in the time traveling from the field to the crib, too. Of course, most farmers will want to

equip at least two farm trailers as two or more usually are necessary when handling corn, chopped hay or ensilage from machines working in distant fields.

One look at Figs. 1, 2 and 5 and you will have in mind the general idea of how the unloader works. When in position for loading, the follower, Fig. 2, acts as the front endgate. After unloading it is pulled to the front of the bed by hand. It must be a fairly loose fit to prevent binding between the sides of the trailer bed when it is pulled to the rear by the windlass mechanism. Usually only intermittent operation of the unloader is necessary when unloading ear





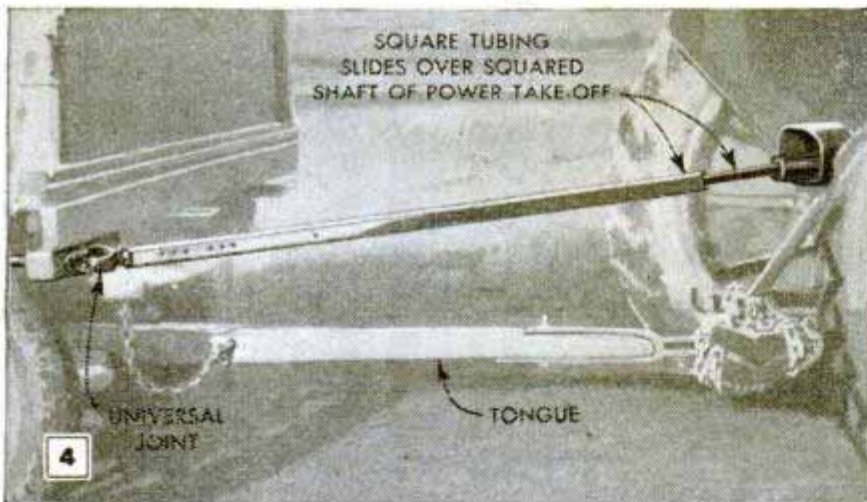
It's not necessary to remove the gear when trailer is used for other work

corn into an elevator, or dumping chopped hay or ensilage into a blower hopper. This requirement is taken care of in the manner shown in Figs. 1 and 5. The worm is driven from the tractor power take-off. One end of a steel bar is inserted in a loop or stirrup made from flat iron, as in Fig. 5. Lifting on the bar, as the operator is doing in Fig. 1, engages the worm with the gear. Dropping the bar slightly disengages the worm and

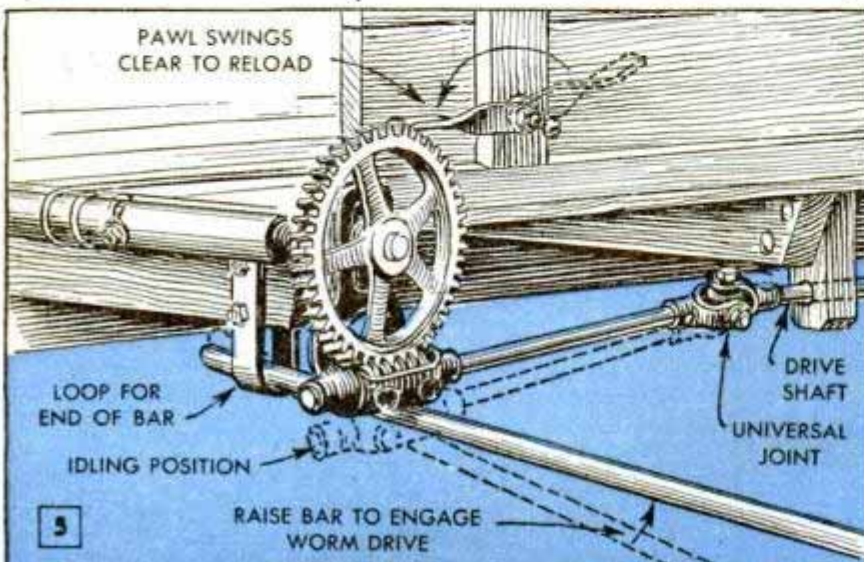
stops movement of the load. The pawl, Fig. 5, prevents slack in the cables attached to the endgate. As the worm is turning slowly, with the tractor engine throttled to idling speed, it engages and disengages quite smoothly. The load can be moved only a few inches at a time with this arrangement.

The gear and worm are taken from the device provided for raising and lowering the drive wheel of a grain binder. Of

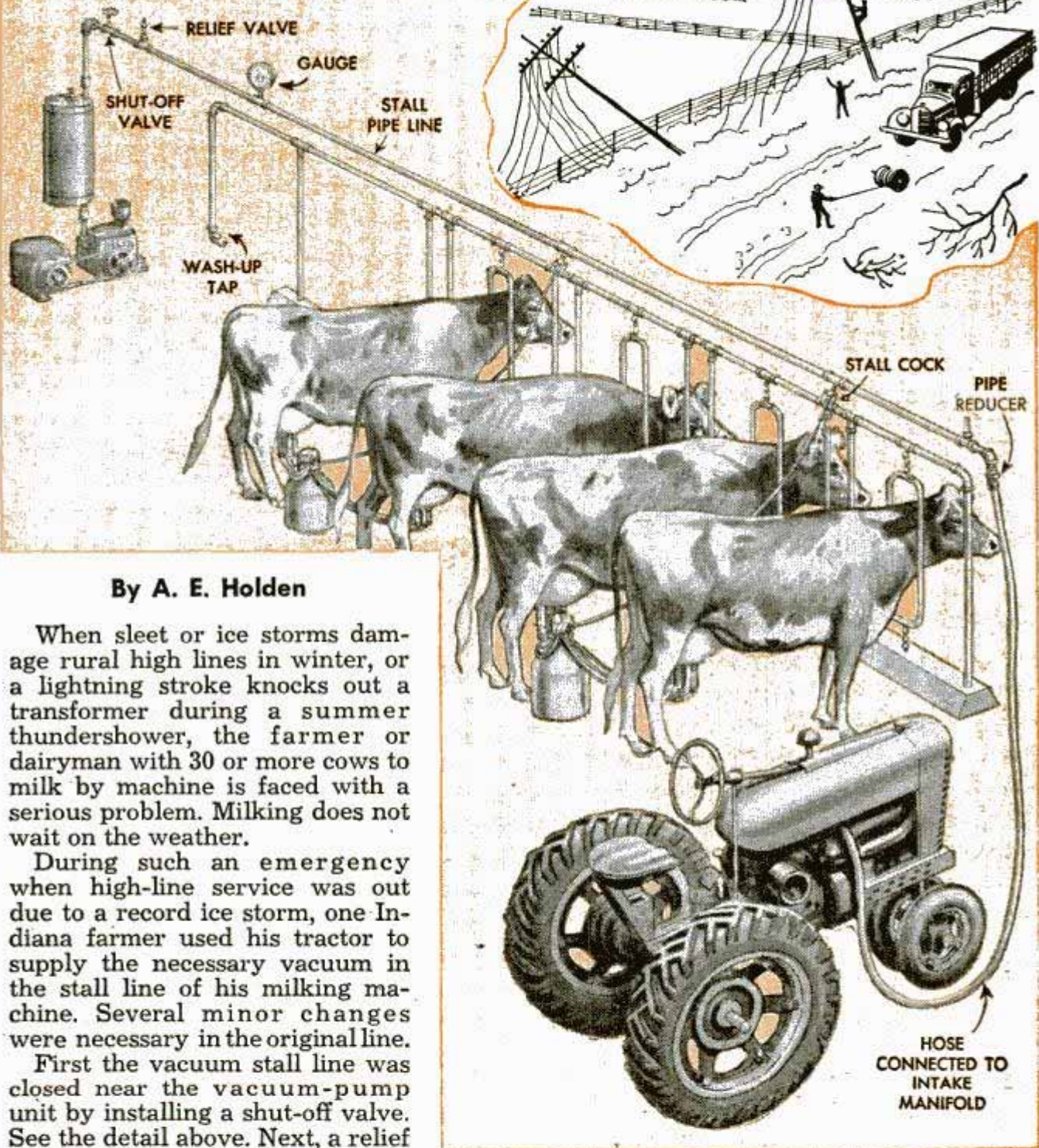
course, any similar gear can be used. For example, the worm gear which drives the apron on some older types of manure spreaders can be adapted to this purpose. Just how the gear is mounted will depend largely on the type used. In any case, the gear is welded to a 2-in. pipe which is mounted in bearings and extends the full width of the bed, Figs. 2 and 3. Steel cables bolted to the pipe and to the front endgate, or follower, finish this part of the assembly. In Fig. 3 the rear endgate is shown in position. The worm is connected to the power take-off through two lengths of round steel shafting, two universals and a length of square tubing, Fig. 4. Hardwood bearings attached to the bed supports carry the long length of drive shaft. Some provision must be made for supporting the worm in the idling position, Fig. 5, and it probably will be necessary to fit washers and shaft collars at one of the bearings to take the end thrust when the worm is engaged with the gear.



Above, unloader is driven from tractor power take-off through square tubing. Below, slow speed of worm makes it easy to engage it smoothly



TRACTOR OPERATES MILKING UNITS WHEN ELECTRIC POWER FAILS



By A. E. Holden

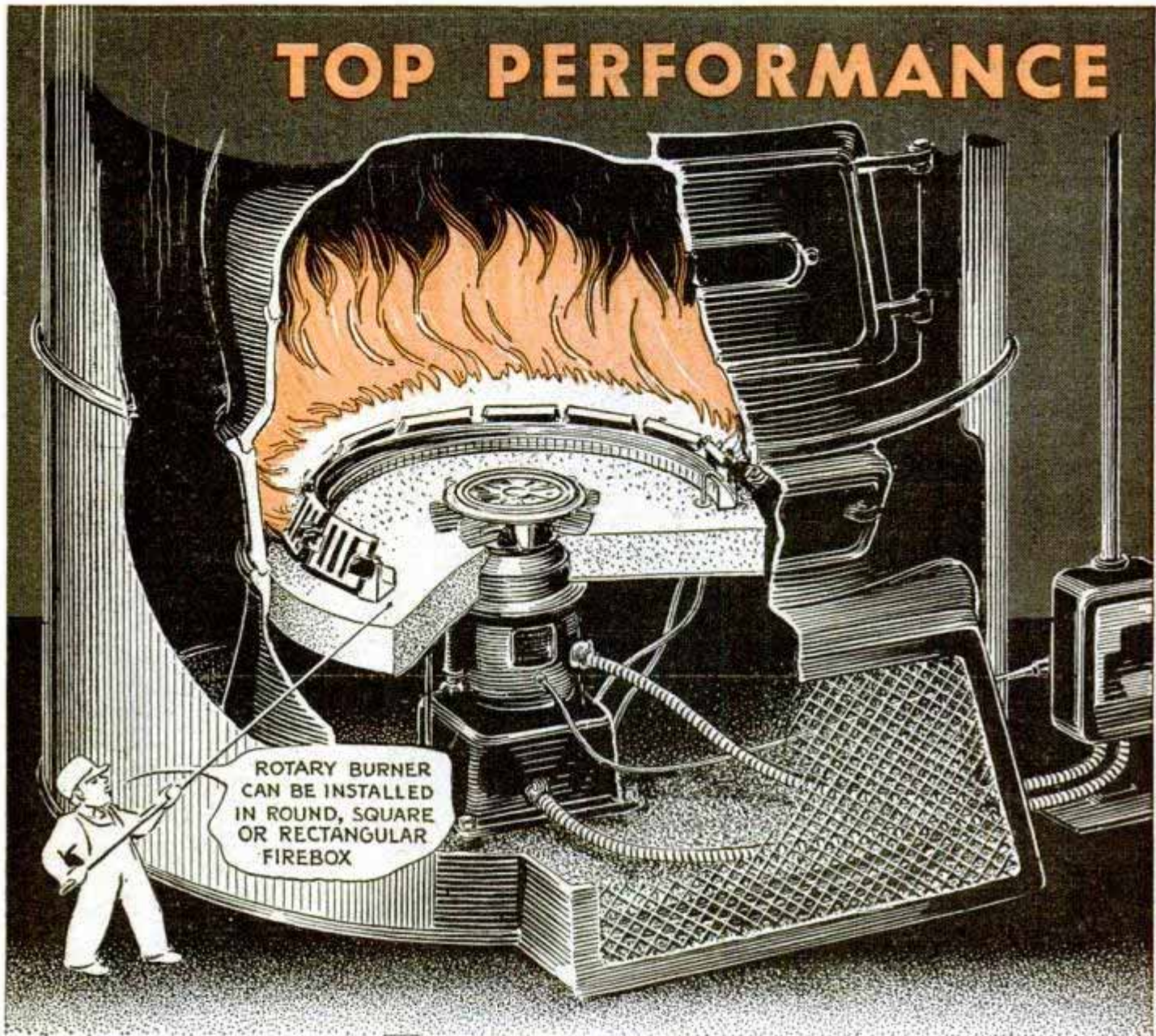
When sleet or ice storms damage rural high lines in winter, or a lightning stroke knocks out a transformer during a summer thundershower, the farmer or dairyman with 30 or more cows to milk by machine is faced with a serious problem. Milking does not wait on the weather.

During such an emergency when high-line service was out due to a record ice storm, one Indiana farmer used his tractor to supply the necessary vacuum in the stall line of his milking machine. Several minor changes were necessary in the original line.

First the vacuum stall line was closed near the vacuum-pump unit by installing a shut-off valve. See the detail above. Next, a relief valve of the ball-cock type was installed in the line to prevent the possibility of building up too high a vacuum at any time during the milking operation. Many tractor, truck and auto engines have an opening into the intake manifold which is tapped and closed with a 1/8-in. pipe plug. This simplifies hooking up the manifold to the vacuum line by the use of standard pipe fittings and a length of heavy hose. That's all there is to it. All connections must, of course, be vacuum tight. Although the family car will do, a large truck or trac-

tor performs best for this purpose because of the greater displacement of the engine. It should be kept in mind, too, that this hookup will work only with those milking units fitted with pulsating-type heads. This method of hooking up a tractor or truck engine to operate the milking units is recommended only as an emergency measure. Make sure that the plug closing the threaded opening in the intake manifold is screwed in tightly when the engine is removed from this emergency service.

TOP PERFORMANCE



1 VERTICAL ROTARY BURNER

OWNERS of household oil burners have come to expect uninterrupted performance as a matter of course. This is due largely to the cooperative research and ingenuity of manufacturers, dealers and servicemen in an effort to produce ever-better burners and more efficient installations.

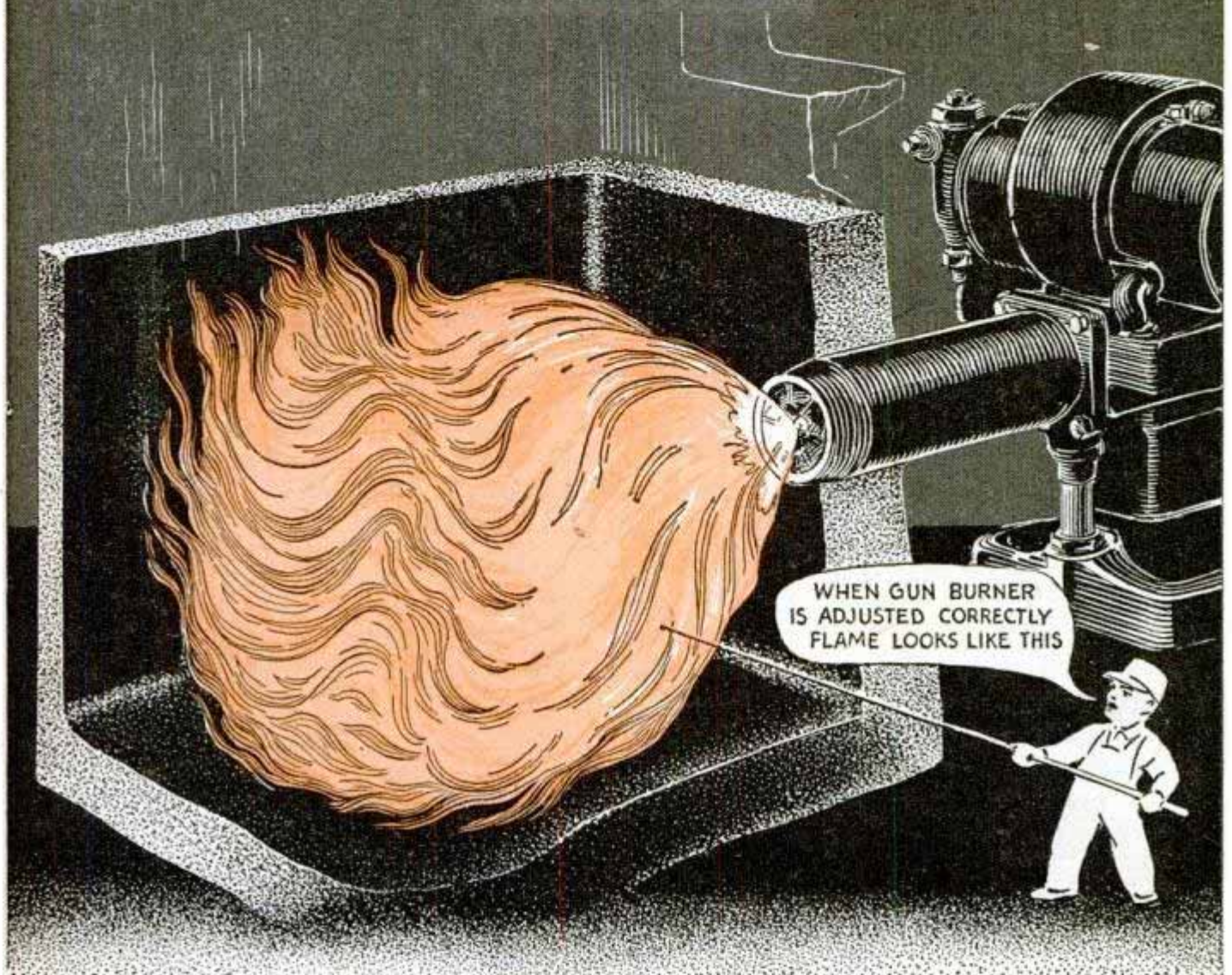
Because of its ease of handling and its own peculiar burning characteristics, oil is one of the comparatively few fuels which lend themselves readily to fully automatic control. To the average user, efficiency of the burner is measured by the amount of useful heat delivered per dollar expended for fuel and maintenance. Owners can do much toward maintaining a high efficiency by proper selection and care of a burner.

Figs. 1 and 2 show two types of oil burners commonly installed in home-heating plants. There are variations of these types. All are good, and the problem in selection of a burner is not so dependent on any spe-

cial merit of the burner unit as on its suitability for the

heating system, the average seasonal heating load in your locality, and the peculiarities of the individual centrally fired plant, the building and its immediate surroundings. In addition to the two burners shown in Figs. 1 and 2, one of which operates by mechanical draft, the other by a combination of natural and mechanical draft, there is the natural-draft pot burner, sometimes called the vaporizing bowl burner. This burner usually is supplied in oil-burning space heaters, but also is furnished in oil-fired furnaces as in Fig. 10. This latter type of burner operates with a forced or mechanical draft. When installed in correctly designed furnaces and supplied with uniformly high-grade fuel it is very efficient. With mechanical draft, the burner is somewhat less sensitive to fuel characteristics than the natural-draft pot burner. It is especially suitable in small homes where

FROM YOUR OIL BURNER



2 GUN-TYPE BURNER

the fuel required runs less than $1\frac{1}{2}$ gallons per hour. The vertical rotary burner, Fig. 1, also made in the horizontal type, is simple in design and construction and is noted for its quiet operation. Oil is fed either by pump or by gravity to a rapidly rotating distributor which combines a fan and oil "slinger." The distributor projects the oil against a hot flame ring, which may be made of metal or refractory material. Heat from the ring vaporizes the fuel and the air-oil mixture burns with a yellow-tipped blue flame that sweeps or "wipes" the walls of the firebox. Because of this characteristic it is often called the wall-flame burner. The flame ring can be installed in a round, square or rectangular firebox. Fig. 3 shows the principle of operation more clearly. Burners of this type often are recommended for installation in older-type heating plants and in small homes where fuel requirement in gallons per hour is quite low. The so-called gun burner, Fig. 2, is per-

haps the most common type installed in centrally fired home-heating plants. These burners operate on two principles, atomization by oil pressure and atomization or emulsification of the fuel by low-pressure air. Low-pressure burners of this type, Fig. 8, can provide the low flame necessary in heating small homes, and because of the large openings through which oil and air flow together, the nozzle does not clog so readily when lower-grade fuel oils are used. Fig. 9 details the nozzle of a burner of the high-pressure type. Here oil is fed from a pump through an oil line to an atomizing nozzle under high pressure, as much as 100 lbs. per sq. in. in some burners. This burner is more sensitive to the quality of the oil but is a highly efficient unit when supplied with high-grade fuel. Although both high and low-pressure burners are similar in design and installation requirements, the low-pressure type differs from the former in that a portion of the combus-



Courtesy Timken Silent Automatic Div., Timken-Detroit Axle Co

Because fuel oil is so easy to handle and requires comparatively small space for storage of a season's supply, oil-fired heating plants are among the first requirements of present-day homeowners. Clean-burning characteristics of oil make it easy to have fully automatic heat in any home

4 HEAT LOSSES:

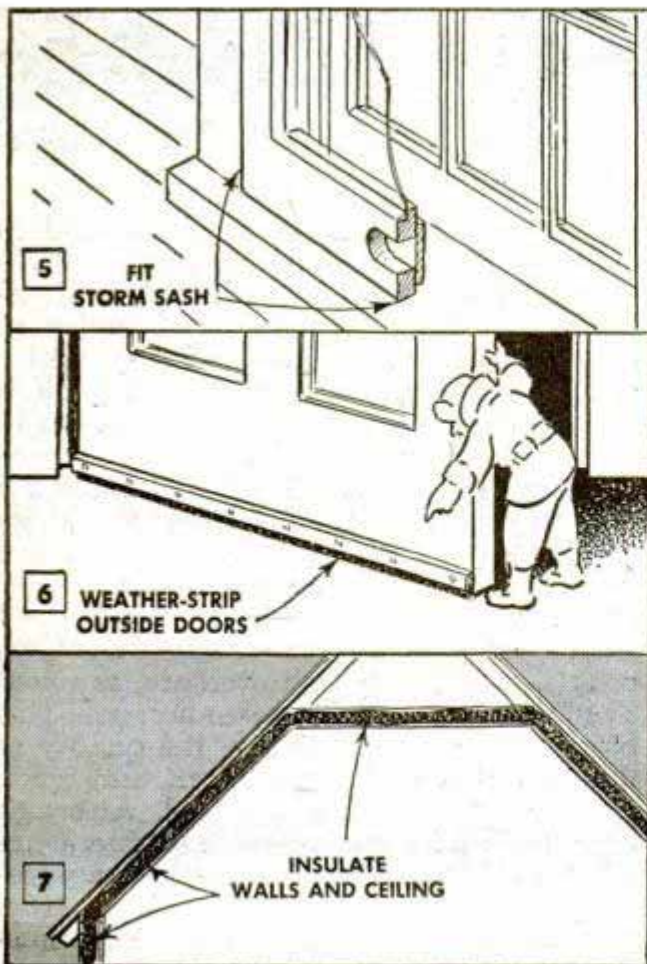
Walls and Roof.....	44.4
Glass and Doors.....	26.0
Cracks.....	20.8
Floors.....	8.8
Total	100.0

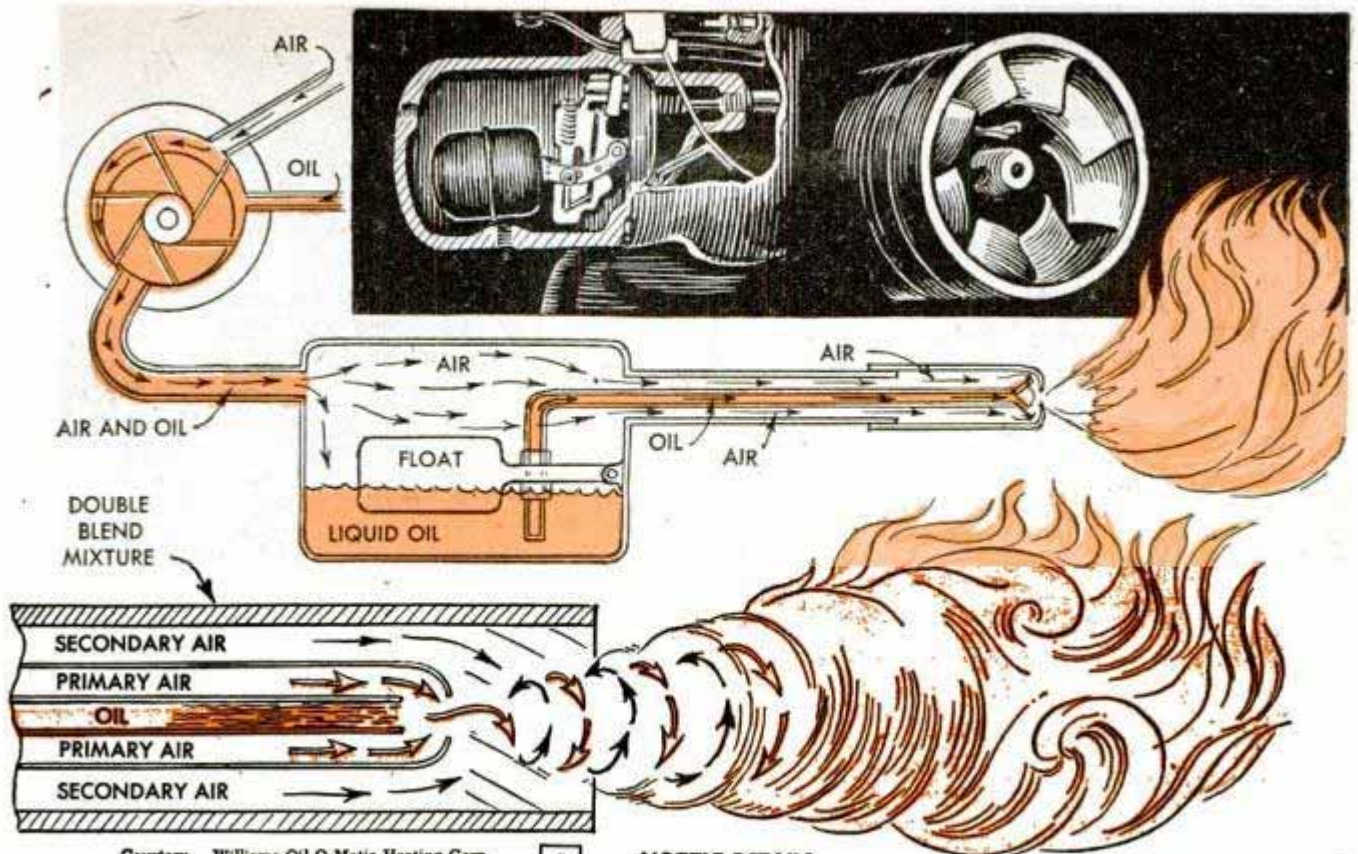


tion air is drawn in with the oil by an atomizing pump. Expansion of the air causes the oil to froth or emulsify and thus enables the burner to deliver an oil-air mixture to the combustion chamber under low pressure through a comparatively large orifice. For this reason the low-pressure burner will operate satisfactorily on a wide range of fuels.

With the exception of the pot burners, in which the fuel is ignited manually and thereafter burns continuously, all late-type burners have some means of automatic ignition. There are several methods, the most common employing a pair of electrodes with high-voltage current supplied by a transformer built into the burner unit. Some burners are fitted with a resistance coil which is heated to incandescence to ignite the air-oil mixture. A few burners use a gas-pilot ignition which burns continuously; others a gas-electric system.

A control unit for an oil burner is designed to maintain automatically the desired room temperature with very little variation from the manual setting. It consists of a room thermostat, a primary control and a limit control. The ordinary room thermostat is the most used. Several types are available for special conditions. Some are clock controlled to give variable



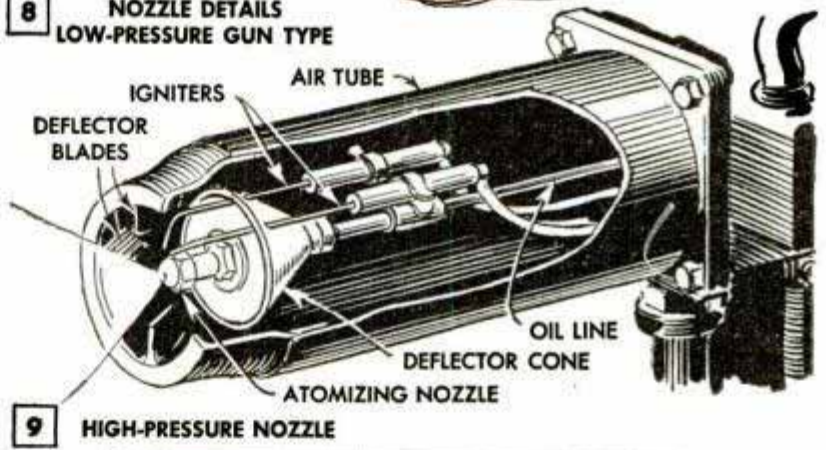


Courtesy Williams Oil-O-Matic Heating Corp.

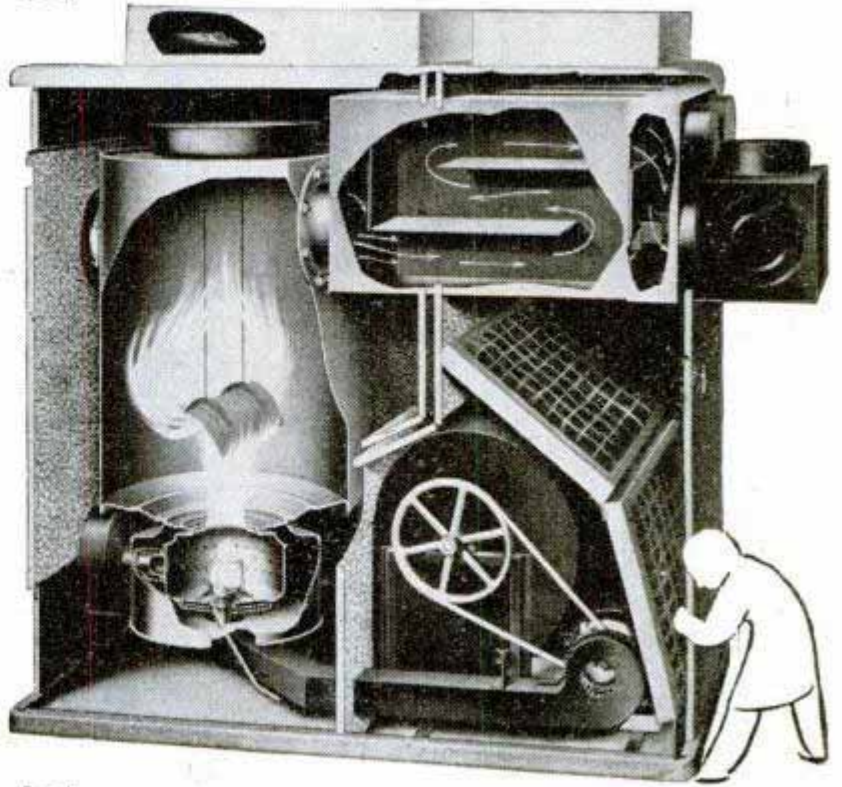
8 NOZZLE DETAILS
LOW-PRESSURE GUN TYPE

day and night temperatures, and automatically change the settings according to a predetermined schedule. Others are special double-contact types for controlling mechanical-draft pot burners that operate continuously with several stages of fire. When the room temperature is in the range between the two sets of contacts the flame is at "medium fire"; when below, "high fire," and when above, at "pilot fire." In the event of power failure this type of thermostat automatically places the burner at pilot fire with natural draft. Some thermostats are more sensitive than others but usually adjustments are provided for varying the range, or differential, between the "cut-in" and "cut-out" points. This makes it possible to adjust performance to the needs of the individual installation.

Most primary controls are merely safety devices. This control usually is installed between the thermostat and burner and, in addition to closing motor and ignition circuits when the thermostat calls for heat, it will cut out the motor if the fuel oil fails to ignite on starting and also will stop the burner in case of flame failure at any time during the running



9 HIGH-PRESSURE NOZZLE



10 POT-TYPE BURNER, FORCED DRAFT

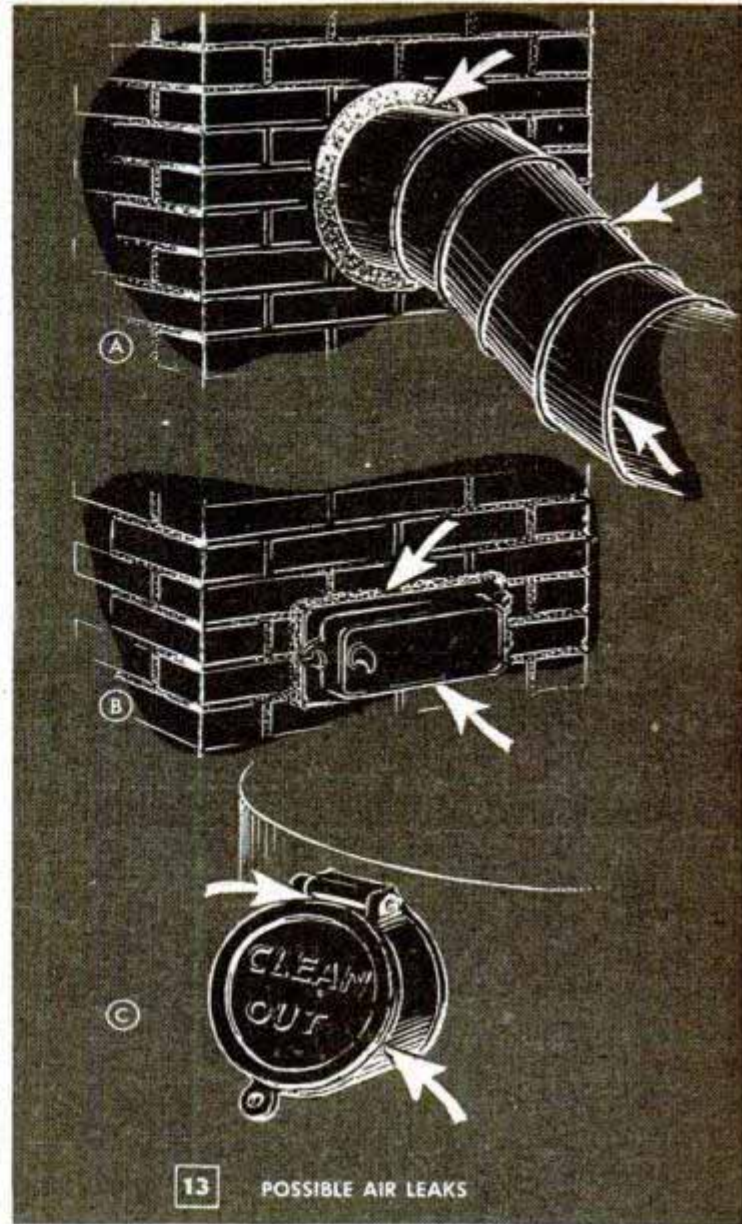
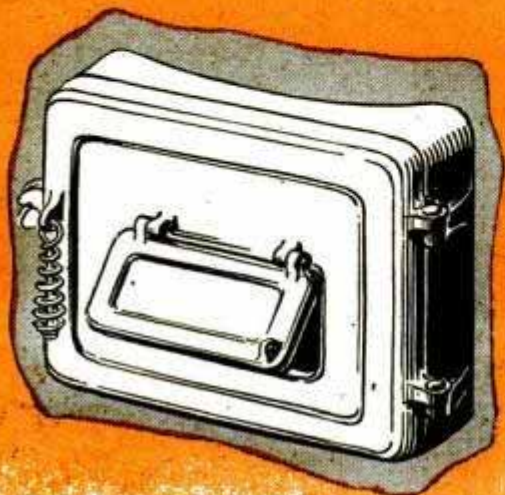
Courtesy Perfection Stove Co



11 BE SURE THESE JOINTS ARE PRESSURE-TIGHT

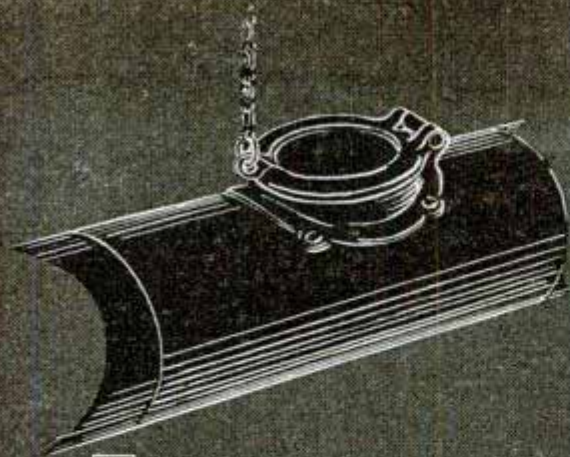


12 SEAL DOORS WITH FURNACE CEMENT



13 POSSIBLE AIR LEAKS

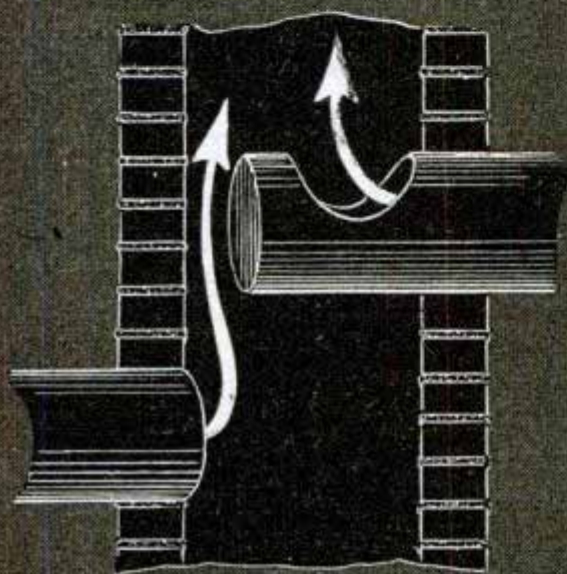
period. At a time of current interruption it prevents starting of the burner until all safety devices are in starting position. Primary controls are designed to meet various conditions and should always be installed in accordance with the directions of the manufacturer. Purpose of the limit controls is to prevent the generation of excessive temperatures or pressures in the furnace or boiler. When, for any reason, the room thermostat is still calling for heat after the safety limits of pressure or temperature have been reached, the limit control "takes over" and shuts off the burner. When pressure or temperature returns to the predetermined "cut-in" point, the control again closes the burner circuit and the burner resumes operation. A pressure limit control is installed on a steam boiler, while a temperature limit control is required for a warm-air furnace or hot-water boiler. In addition, other controls are often furnished. The burner manufacturer's directions and recommendations should always be followed when making the installation.



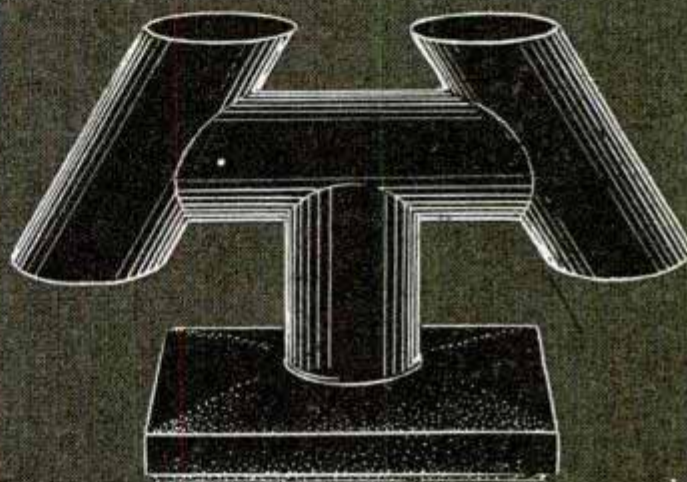
14 SEAL CHECK DAMPER OR REMOVE IT



16 SWINGING HOOD



15 FLUE CONNECTIONS

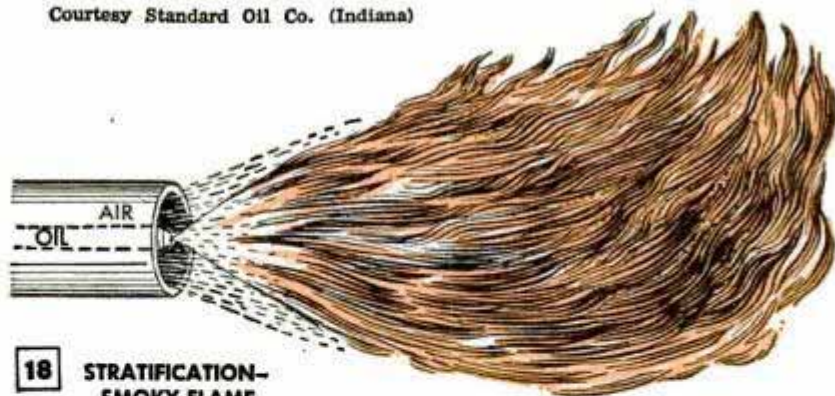


17 T-TYPE HOOD

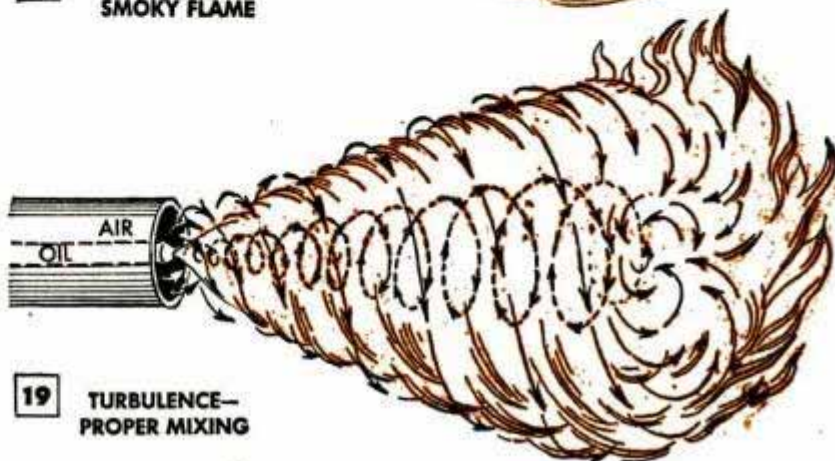
Courtesy Standard Oil Co. (Indiana)

When installing the fuel-storage tank either inside or outside the building, the requirements of the local codes should be carefully followed. General requirements are that unenclosed tanks inside the building should be not less than 7 ft. from any fire or flame and should not exceed 275 gallons capacity. Certain universal requirements that govern the installation of underground tanks outside buildings also are subject to the installation codes in your locality. Specifications usually cover size and spacing of the tank or tanks, depth, footings, fill and suction lines, venting, location with respect to property boundaries, swing joints in the fill and vent pipes if these are of iron, distance of tank from foundation wall, etc.

Although many experienced servicemen can set a burner



18 STRATIFICATION-SMOKY FLAME



19 TURBULENCE-PROPER MIXING

What's Wrong??

A. High oil consumption.

1. Excessive air infiltration.
2. Boiler too small—insufficient radiation.
3. Boiler controls improperly set.
4. Dirty heat-absorbing surfaces.
5. Incorrect firing rate.
6. Excessive temperatures carried.

B. Burner starts and burns satisfactorily but fails after one minute of operation.

1. Air in suction lines.
2. Excess draft.
3. Strainers clogged.
4. Oil-tank vent obstructed.
5. Dirt or water in oil.
6. Controls out of order.
7. Insufficient fire.

C. Burner puffs when first started.

1. Poor or delayed ignition.
2. Insufficient draft.

D. Carbon forms in combustion chamber.

1. Improper or defective nozzle.
2. Nozzle clogged or dirty.
3. Insufficient air.
4. Oil spray impinges on walls. May be caused by misalignment of burner.
5. Drip from nozzle.
6. Excessive oil-burning rate.

E. Burner starts, runs properly and has proper oil pressure, but fails to ignite.

1. Nozzle may be clogged.
2. Electrodes out of adjustment.
3. No spark.

F. Objectionable odors or smoke.

1. Insufficient air admitted.
2. Excessive baffling of flue passages.
3. Combustion chamber too small.
4. Leaks in fuel-oil lines.
5. Insufficient draft.

Certain of the above suggestions are applicable only to gun-type burners.

Courtesy Standard Oil Co. (Indiana)

very accurately "by eye," most careful workmen will check performance with special instruments just to make sure before they okay the job, whether it be a routine seasonal servicing or a checkup on a new installation. One of the visible evidences of good or poor performance is indicated in Figs. 18 and 19. Poor or defective atomization forms large particles of oil which take a longer time to burn. Many particles do not burn at all and form coke deposits and soot. If the air supply is insufficient and mixing inadequate, unburned gases leave the furnace, resulting in a material loss of heat. Partly clogged nozzles or deflector vanes coated with soot deposit, often cause stratification of the oil-air stream, Fig. 18, which results in only a part of the atomized oil mixing properly with the air. This slows the burning rate, thereby producing smoky flames and undue quantities of excess air. Some excess of air over the theoretical quantity required to burn a given amount of fuel oil is always necessary. The quantity of excess air can be gauged by checking the percentage of carbon dioxide in the flue gas with a special instrument made for the purpose. This is an important test in determining the efficiency and performance of an oil burner. The carbon-dioxide, CO₂, content of the flue gases should be at least 10 percent with the burner properly adjusted. When everything is working correctly you get a flame something like that shown in Fig. 19. It's also important that the flames from a gun burner do not impinge on the sides of the combustion cham-

ber at any point. Manufacturers specify the size and shape of the combustion chamber in their installation instructions and these directions should be followed in detail.

Insufficient draft is a common cause of minor oil-burner troubles. In some basements there is so little air infiltration due to a lack of ventilation, that the furnace room may be "air locked." Such a condition can result in insufficient air for complete combustion. The chimney may be inadequate, partially clogged with soot, a piece of tile lining or other material, and the top may be lower than the roof ridge or a nearby tree or building. Any of these conditions can affect the efficient operation of the burner. In older heating plants, air leaks in the furnace firebox, especially in a cast-iron warm-air furnace, Fig. 11, and in the cleanout and fire doors, Fig. 12, may affect the operation of the burner and also can be the cause of objectionable odors in the house. Any openings in the smoke pipe, chimney or furnace cleanout doors, Fig. 13, details A, B and C, act as tiny check dampers. Figs. 14 to 17 inclusive suggest methods of remedying other chimney and smoke-pipe defects. Inspect the draft regulator supplied with the burner periodically to be sure it is working properly. Fig. 20 lists a number of ordinary troubles that sometimes occur. Although the remedies vary with different types of burners, in most cases correction of the trouble is quite simple.

In addition to the hints mentioned on care of your burner, remember that what

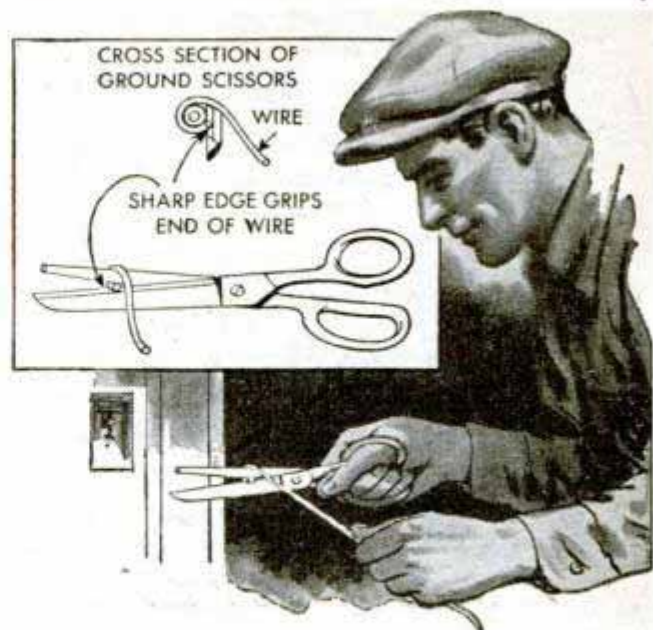
is true of almost all home-heating plants fired by other fuels is equally true of the oil-burning installation, that is, in rating efficiency the whole plant should be considered, and not merely the burner alone. Some of these points to be taken into account in both new and old installations do not relate directly to the operation of the burner, but do affect its efficiency indirectly. Take, for example, the heat loss from a building of average construction. Where the temperature inside the house must be maintained at a level higher than that outside—even though the variation is only a few degrees—there will be a constant loss of heat to the atmosphere. The variables which affect the rate of heat loss during a season are outside temperature, rain or snow, sunshine or cloudiness and wind velocity or exposure. Fig. 4 gives the average percentages of loss through various parts of the structure. Since the greatest loss is through the walls and roof, it is easy to see the value of insulation, Fig. 7, in slowing the rate at which heat is lost. Tight-fitting storm windows and storm doors, Fig. 5, will materially reduce the second percentage value given in Fig. 4 and weather stripping, Fig. 6, and caulking will stop infiltration of air through cracks. In many cases these inexpensive installations will reduce heat losses as much as 50 percent or more in old buildings as well as in new construction. Repeated opening and closing of doors in cold weather, windows open at night in sleeping rooms, hot water for baths, laundry, and dishwashing all add to the load on the heating plant and require extra fuel. Roughly, depending on locality, fuel consumption increases $2\frac{1}{2}$ percent or more for each degree that the inside temperature is maintained above 70 deg. F. This can be offset by lowering the inside temperature 10 deg. during the 8-hour sleeping period. However, as heat loss is directly related to outside temperature, it is likely that, as an average, the greatest saving will be effected by insulation on walls and ceilings and by installation of storm sash or double-glazed windows, and weather stripping.

Ruling Small Squares on Paper

If you want to rule small squares on a number of sheets of paper, the job can be done in a hurry with an old wooden ruler. After removing the metal straightedge, notch the ruler at every inch, half inch, quarter inch or other spacing you wish to use. Then draw a line with the ruler. This will leave a slight indentation wherever there is a notch and these marks are used to space the lines for the squares.

G. C. Steckley, Inglewood, Calif.

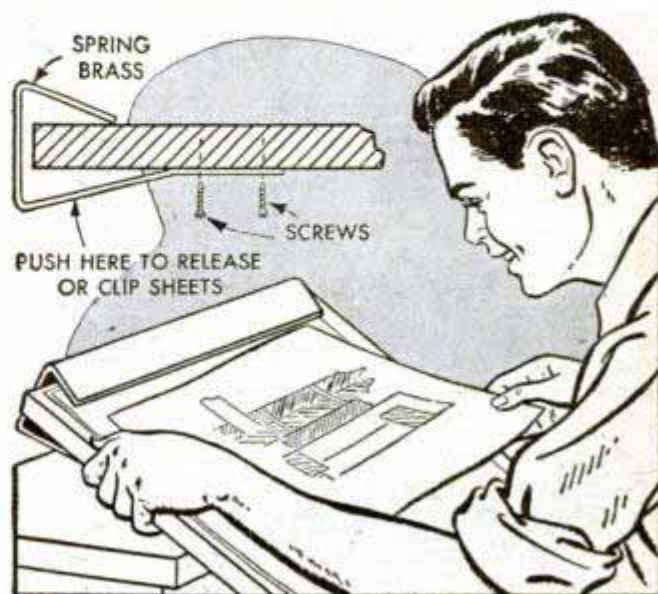
Eye-Forming Tool for Electricians Made From Old Shears



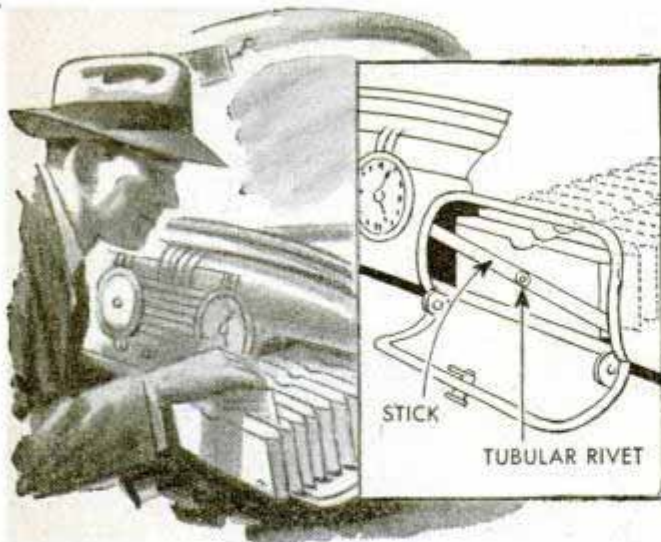
Electricians who are required to make eyes in the ends of wire will find that this forming tool speeds their work considerably. Grind one blade of an old pair of shears so that it has a tapering, round shape. Leave the other blade as it is. To use the tool, bend the wire around the tapered part, holding the free end as shown in the illustration above. Then complete the loop by closing the shears.

Drawing Board Has Spring Clip To Hold Sketching Paper

For those "on-the-spot" sketches, here's a drawing board that will do the job. A clip holds paper firmly on the board, and when you have finished the sketch, pressure on the underside of the clip will lift it to remove the paper. The clip is made of spring brass bent as shown in the detail. It extends the entire width of the board to provide a uniform grip on the paper.



Glove Compartment Has Envelope To Hold Miscellaneous Papers



Safesmen and others who are compelled to carry prospect lists and miscellaneous papers with them will find this expanding envelope, which fits into the glove compartment of a car, a handy file. An envelope to fit the compartment can be purchased in most stationery stores and is cemented to the back of the compartment. A wooden stick that acts as a stop is riveted crosswise to the front envelope. The stick should pivot easily on the rivet.

Opie Read, Jr., Chicago

Metal Arrows on Control Chains Aid Operation of Hoist

To aid in identifying the "up" and "down" control chains on an electric hoist, metal directional arrows were attached to indicate which chain controlled the lifting

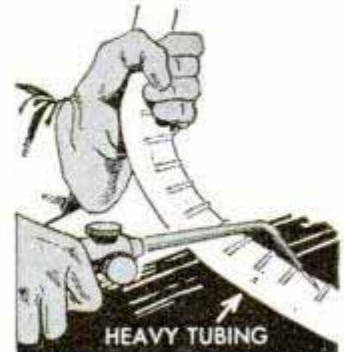


and which controlled lowering of the hoist. The arrows are made of sheet brass and are about 12 in. long. Each one is large enough to be seen at a glance.

John W. LaLonde, Newport News, Va.

Smooth Curve Bent in Heavy Tubing With Oxyacetylene Torch

Having to form a 90-deg. bend in a length of heavy steel tubing, I used an oxyacetylene torch to heat the inside radius of the tubing at equally spaced intervals, as shown. Pressure was applied at the same time the tube was heated to form the curve. This method left slight ridges across the tubing, but these were not objectionable.



R. L. MacClean, High Bank, P. E. I., Can.

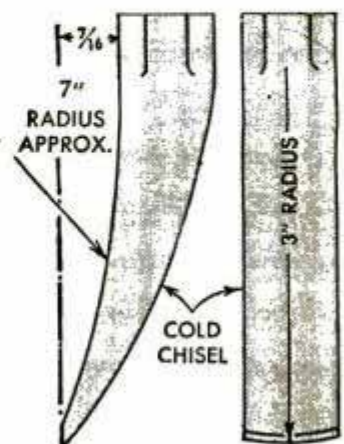
Hanger Bolts Are Set Quickly

When installing lavatories, water closets and other fixtures that are anchored to a wall or floor, one plumber has devised a quick way to set the bolt at the correct height. The number of threads required to extend through the fixture and allow for the cap nut are marked on the bolt end, which is then chucked in a brace at that point. The screw end is driven in up to where the end of the chuck touches the floor. The bolt is then at the correct height. Care should be taken when chucking the bolt not to damage the threads.

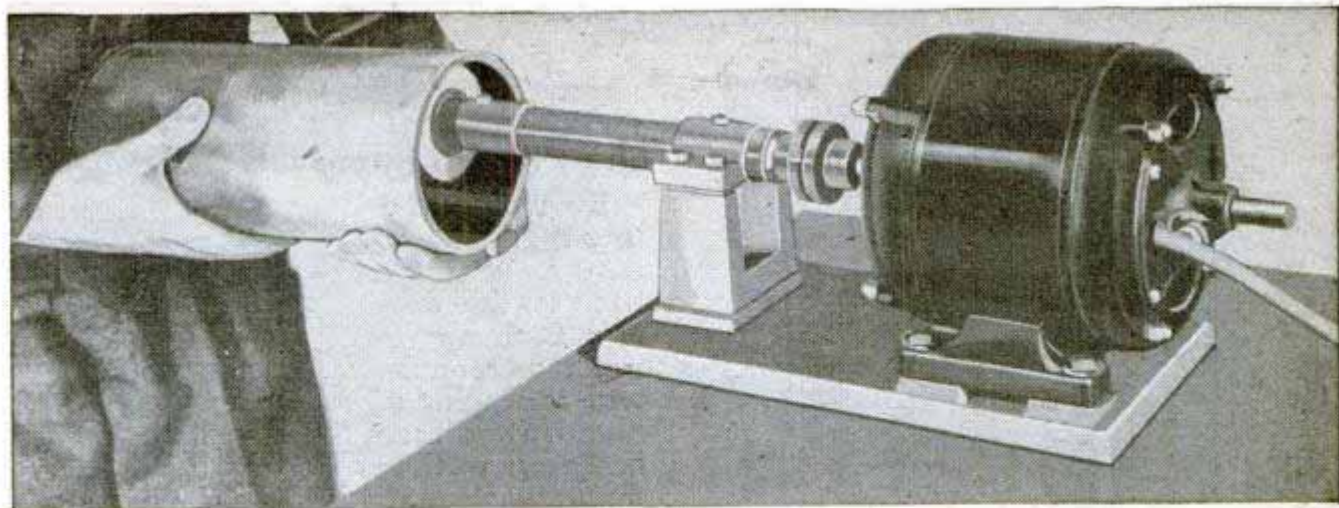
Arthur Davis, Vallejo, Calif.

Special Chisel for Concave Surfaces

For chipping inside the rounded surface of a shell or tank, or to cut off rivet heads, a special chisel with a curved end will do a neat and clean job. The curve is formed on a radius of about 7 in. by heating, bending and hardening. The edge is curved also, as shown in the right-hand detail. For smooth work, grind and oilstone the outer edge to produce a clean cut and to remove rust and scale easily.

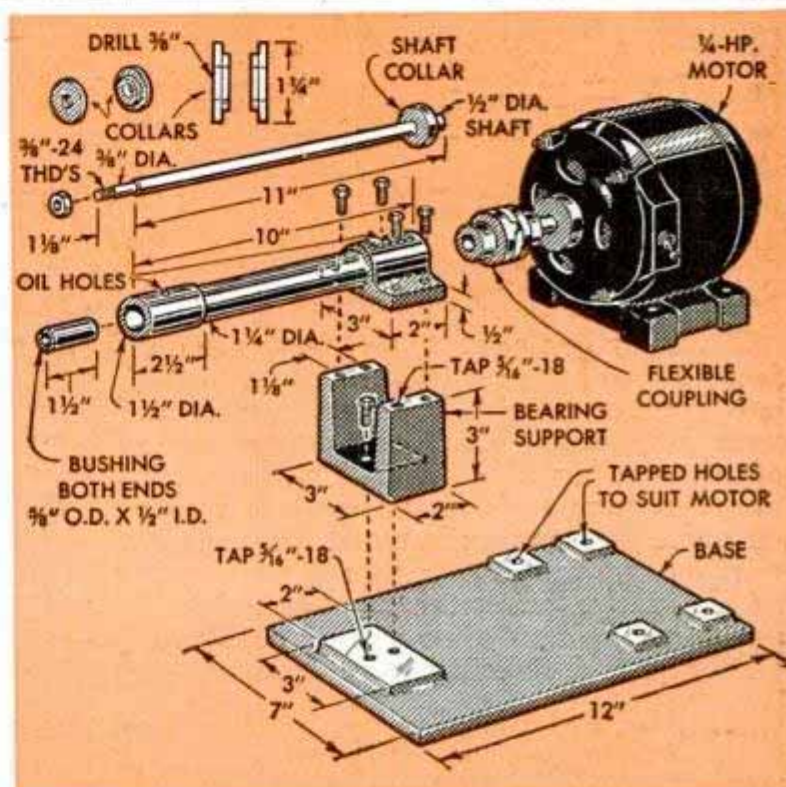


'Long Tom' Extension Grinder For Internal Work



Practically every small machine shop at some time or other runs into a job that requires deep internal grinding, such as the inside of tubes and bearings where a casting or a welded joint may need smoothing. This outfit is designed for just such jobs as well as for deep external grinding and general all-purpose work. As detailed, it consists mainly of three cast-iron parts, namely, spindle housing, bearing support and base, which are cast from wood patterns made according to the dimensions given in the drawing.

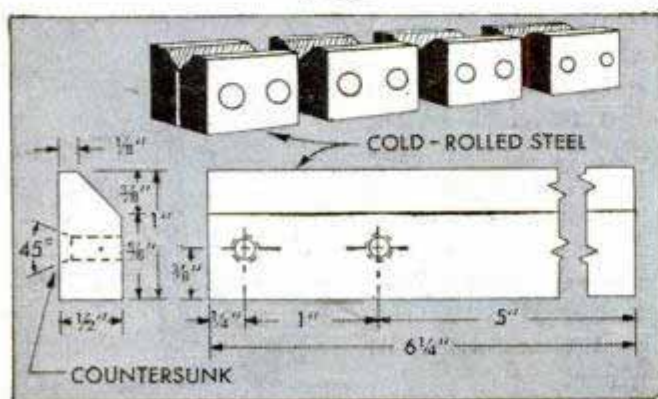
First, machine the end of the spindle housing and then drill a $\frac{1}{16}$ -in. hole through it lengthwise. Next, counterbore the ends for $\frac{5}{8}$ -in. brass bushings. These can be purchased and should be a drive fit in the housing. The spindle itself is machined to fit the bushings. As standard 4-in. grinding wheels generally take a 1-in. arbor, two brass retaining collars are needed to adapt the wheel. Pack the housing with grease before installing the spindle. The bearing-support casting is faced top and bottom and then drilled and tapped for



bolting to the housing and base, and a flexible coupling is used to connect the motor to the spindle. The height to make the bearing-support casting is determined by the motor used.

Jack Mellinger, West Orange, N. J.

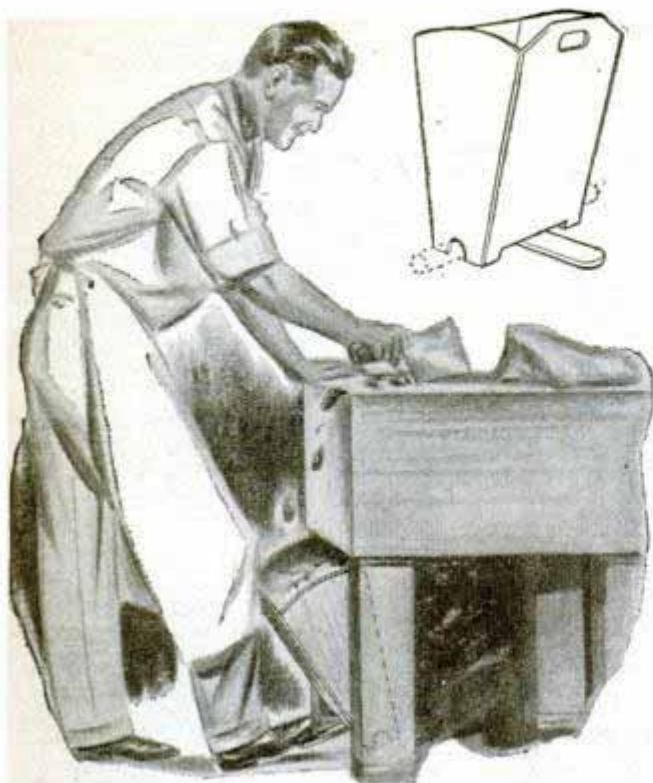
Chamfered Metal Blocks Placed Face to Face Form Neat V-Blocks



Needing several V-blocks, and not having the equipment to machine them from solid stock, I made some from two lengths of cold-rolled steel. One edge of each length was chamfered, after which the two pieces were riveted together to form a V-shape and then cut into sections. I roughed the 45-deg. chamfers on a grinder. Rivet holes were drilled through both pieces at once, and by countersinking the holes I was able to expand the rivets.

E. R. Goddard, Denver, Colo.

Bin Set Under Butcher's Block Receives Meat Scraps



Disliking the unsightly scrap box usually placed on the floor beneath a meat block, one butcher provided his cutting blocks with disappearing bins. These may be made of plywood or sheet metal and are cut at the bottom ends of the sides to rotate on a rung extending between the legs of the block. A projecting piece of wood acts as a pedal to bring the bin to the "out" position. The bins are removed easily for emptying and cleaning.

Calf Feeder Kept in Position With Spring and Hinge

Here's a calf feeder that will keep calves from tipping a bucket over while feeding. An old bucket with the bail removed, a spring and a T-hinge are the materials re-

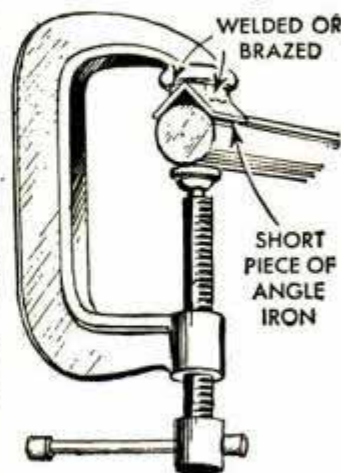


quired. The bucket is fastened to the bottom board with the hinge, and the spring runs from the top of the pail to the upright. The feed pail is set in the larger bucket.

Les Graff, Granger, Wash.

Short Angle Improves C-Clamp

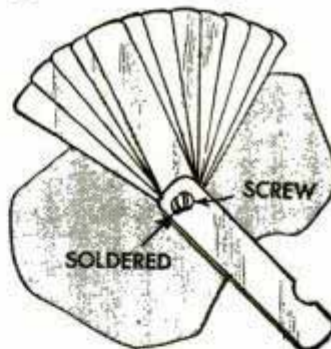
By welding or brazing a short length of angle iron to the anvil of a C-clamp you won't be troubled with it slipping off round work. Such a clamp will be found particularly handy in holding both rod and flat stock together for welding. A shallow V-groove filed in the swivel jaw of the clamp will allow it to ride the work also, and a block placed in the angle iron permits clamping flat work as before.—Jerry Pokorny, Kewanna, Ind.



Solder Holds Gauge Screw Tight

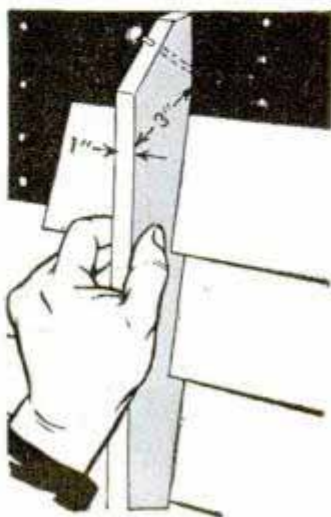
Machinists and mechanics who use feeler gauges often find that the screw holding the blades together becomes loose and the gauge falls apart, resulting in lost or damaged blades. To prevent this, place a drop of solder so it covers part of the screw head and side of the gauge. This will keep the screw from turning.

Walter Peggar, Milwaukie, Ore.



Hanger—Gauge to Apply Siding

It's easy to apply beveled siding with this combination hanger and gauge. A board about 2 ft. long is used to make it, the notches being cut to fit the siding. The top notch should be cut a little deeper so the board will slide under it after the gauge is nailed in place.



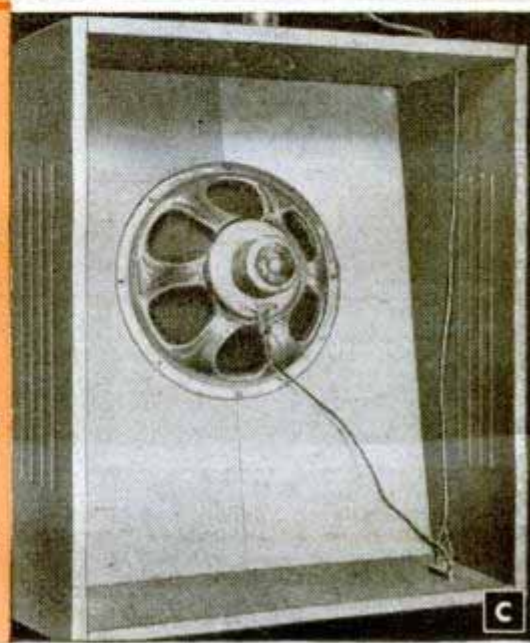
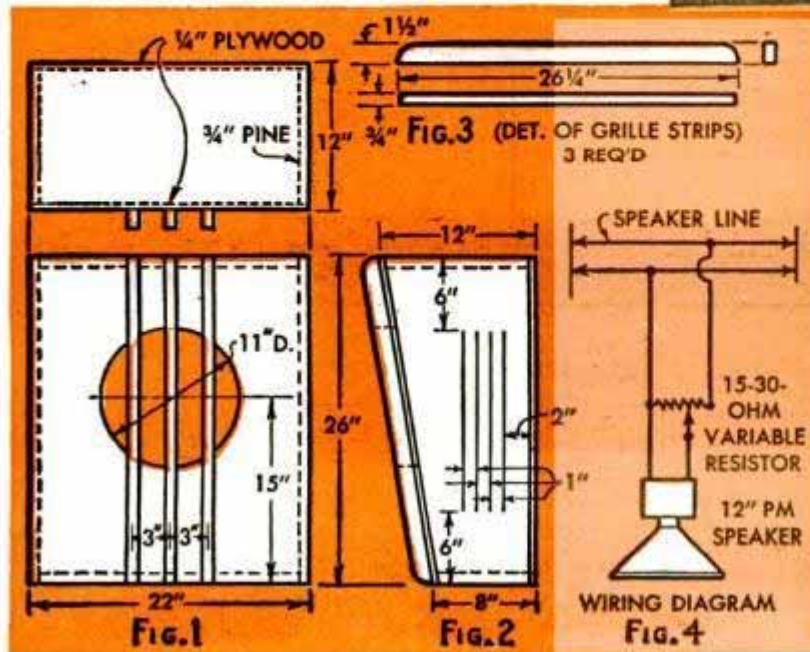
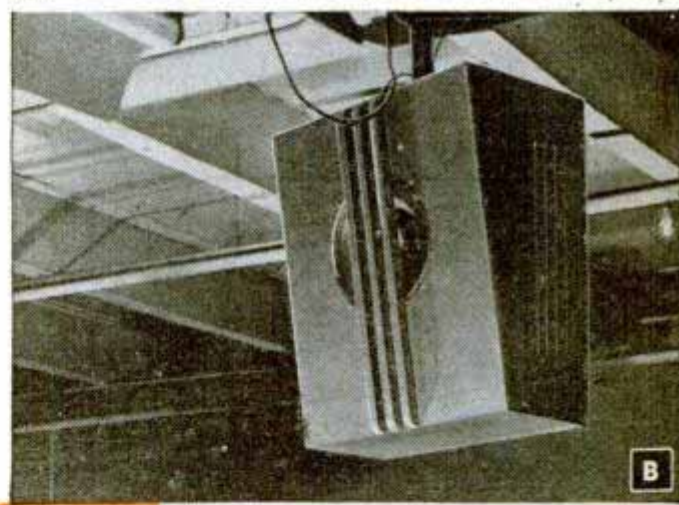


SPEAKER BAFFLE FOR P.A. SYSTEM

By Darrell Ward

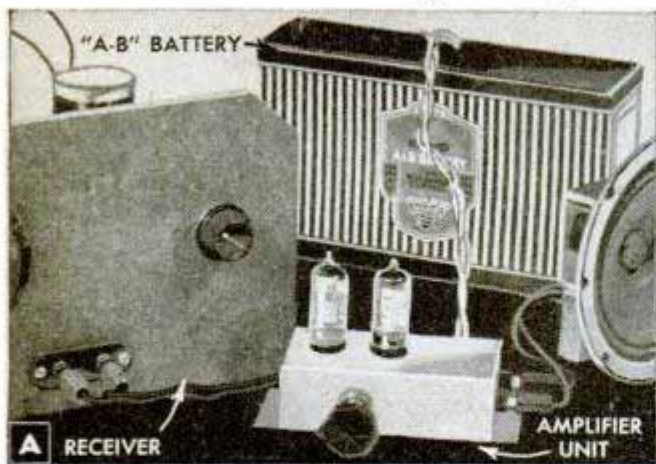
WHERE several large speakers are required for sound installations in schools, and for industrial music systems, a baffle of good design is necessary for maximum results. The baffle detailed in Figs. 1, 2 and 3 is not difficult to build and is designed for a 12-in. PM speaker. For a small music system as illustrated in photos A and B, several speakers housed in these baffles can be connected in parallel with an adjustable shunt resistor of 15 to 30 ohms, as shown in Fig. 4, at each unit for controlling the volume. In this manner music can be beamed to various areas at desired volume levels.

The front and back panels of the baffle are made of $\frac{1}{4}$ -in. plywood. Please note that the 11-in. cutout for the speaker in Fig. 1 is not centered in the front panel as the enclosure tapers from top to bottom. The top, bottom and sides are made of standard $\frac{3}{4}$ -in. white-pine stock. Mount the front panel to the sides, top and bottom with small nails and glue, and glue the grille strips across the speaker opening. Grille cloth may be used to back this opening, but is not necessary; a narrow ring of linoleum or rubber can be used as a gasket for mounting the speaker. In open areas, or when suspended from ceilings, a back panel should be firmly screwed in place.

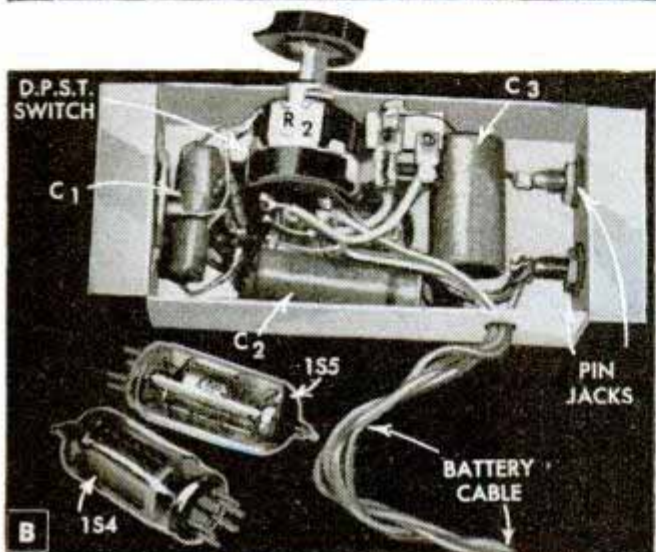


... Battery-Operated Amplifier for

By Joseph Vanella



NOW YOU CAN convert that hand-wound portable phonograph into a full rich-toned electronically amplified record player and use it at the beach, or on picnics, with this simple 2-tube battery-operated audio amplifier. All that is necessary is to replace the mechanical pickup with a crystal pickup arm, and install the amplifier unit, batteries and speaker inside the portable case. This speaker replaces the conventional sound box and there is usually room in the case for all of these units. If not, the speaker with its universal output transformer may be mounted on a small hard-pressed-wood baffle, and the amplifier unit operated separately.



The speaker plugs into the insulated pin jacks on the side of the base; the connecting lead between the crystal pickup and the amplifier should consist of a short single-conductor shielded cable terminating in a standard phono input plug. Solder the center conductor to the insulated plug, then solder the woven-wire shield to the cap on the plug that makes contact with the grounded side of the phono input jack. Students and experimenters who have built the 1 and 2-tube headphone receivers described in past issues of the magazine can use this amplifier unit and obtain excellent volume with any small PM loud-speaker. When used with a small receiver, ordinary binding posts can be substituted for the phono input plug and jack. Connect the ground post directly to the base and be sure to in-

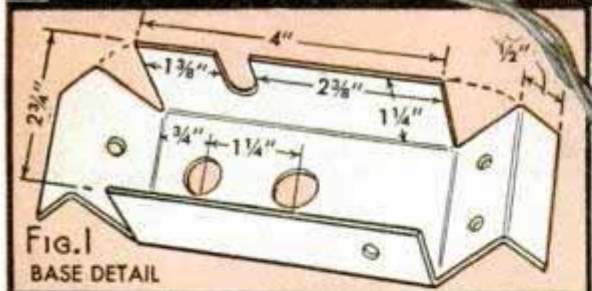
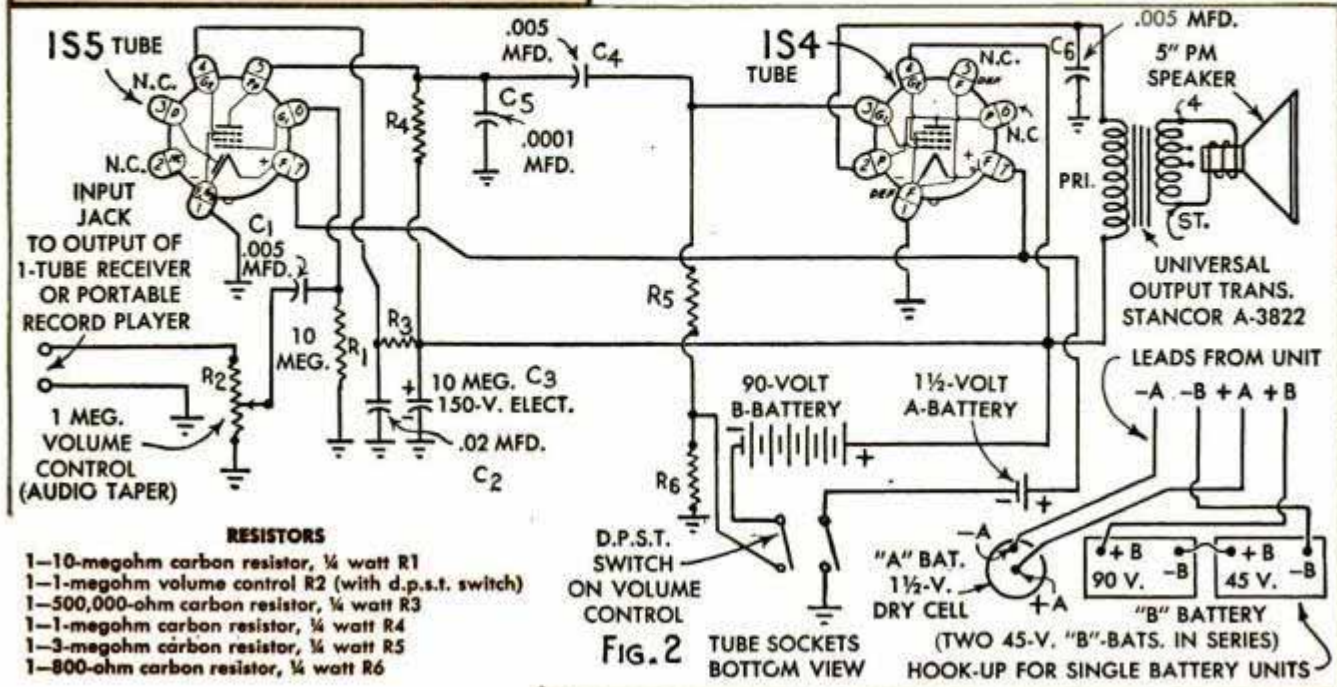


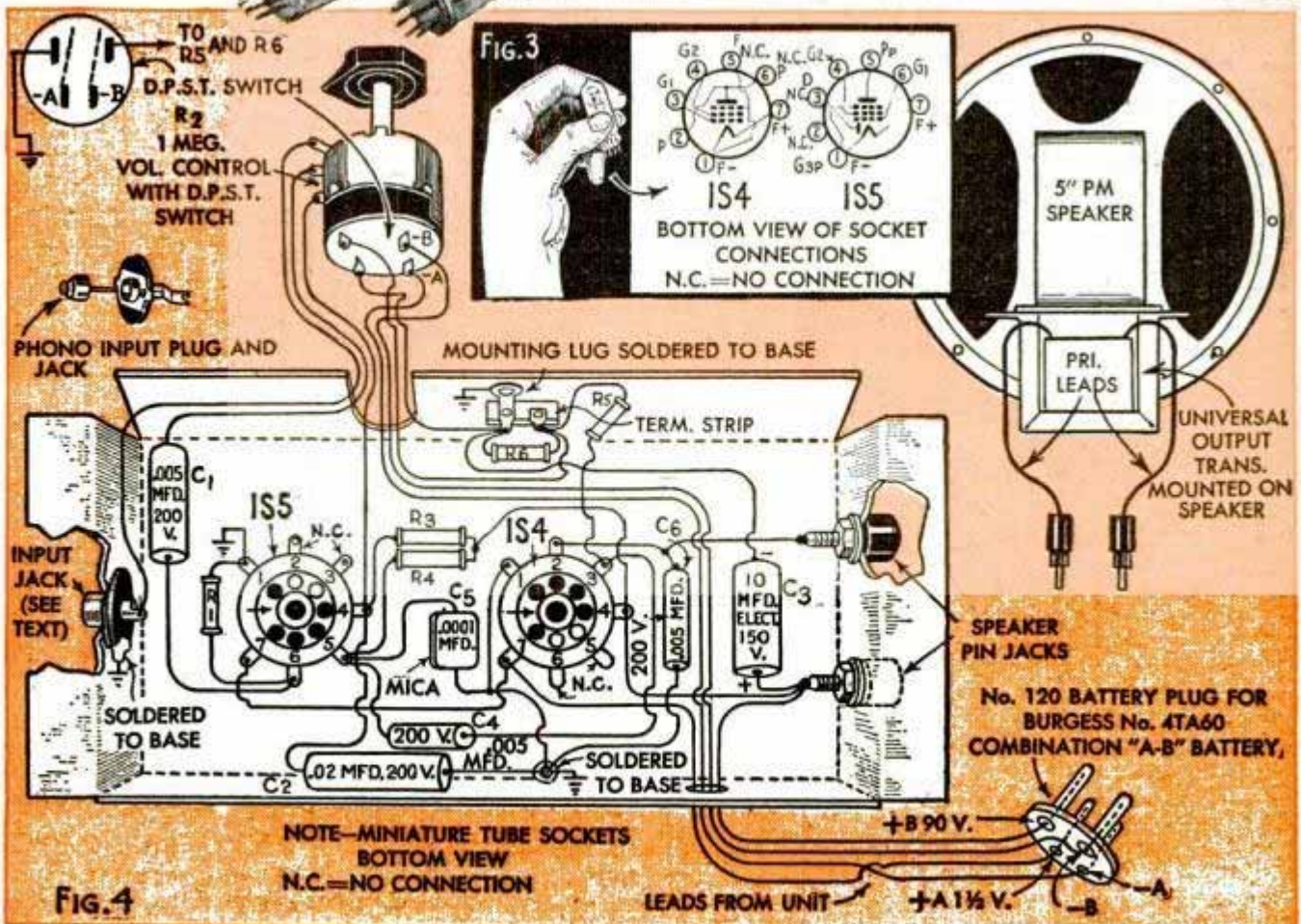
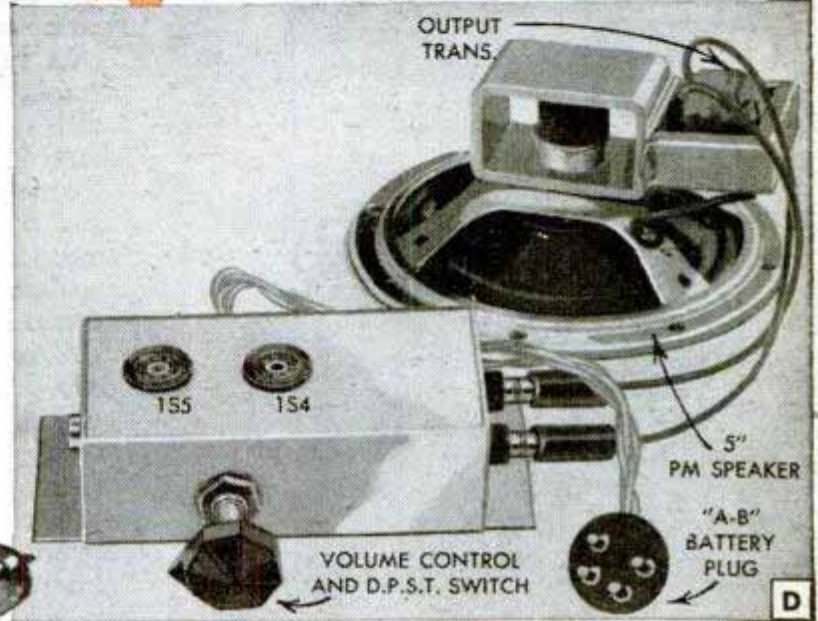
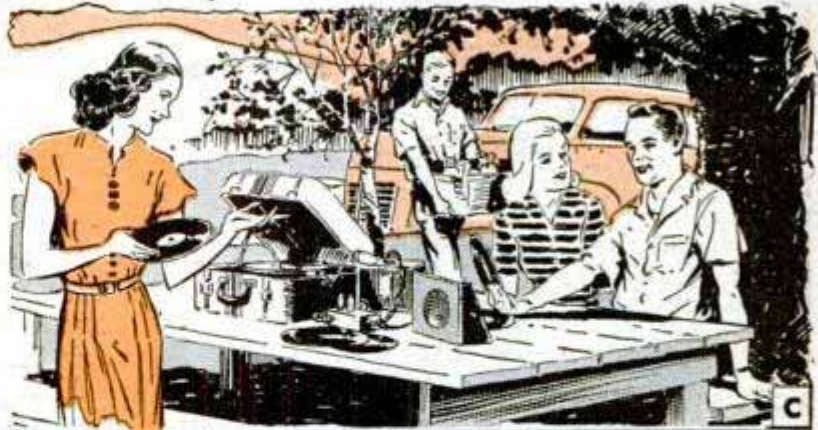
FIG. 1
BASE DETAIL



Portable Record Player or Small Set

sulate the post that feeds directly to variable resistor R2. Leads from these posts run to the phone posts on your receiver.

A sketch of the metal base appears in Fig. 1; the holes for the tube sockets are $\frac{5}{8}$ in. in diameter. The schematic circuit diagram is shown in Fig. 2, and the pictorial wiring diagram is given in Fig. 4. This amplifier may be powered either with a combination 1½-volt A-battery and 90-volt B-battery unit as shown in photo A and sketch C, or by a separate 1½-volt dry-cell A-battery, and two 45-volt B-batteries connected in series, as indicated at lower right in diagram Fig. 2. In this case, the battery plug illustrated in Fig. 4 and photos B and D, is not used. Detailed student material list R-359 is available from Popular Mechanics Radio and Electronics department upon receipt of ordinary letter postage.



Simplified Volt-Ohm-Milliammeter

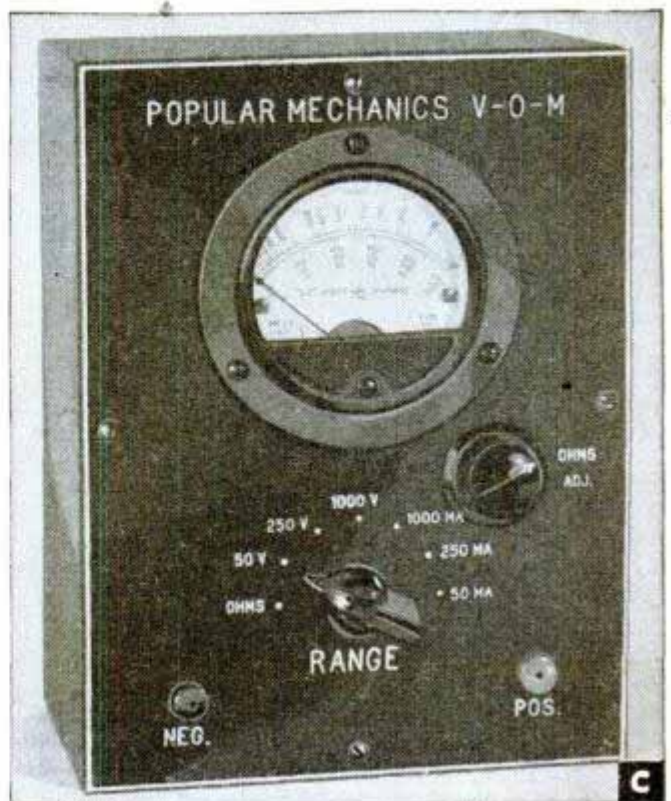
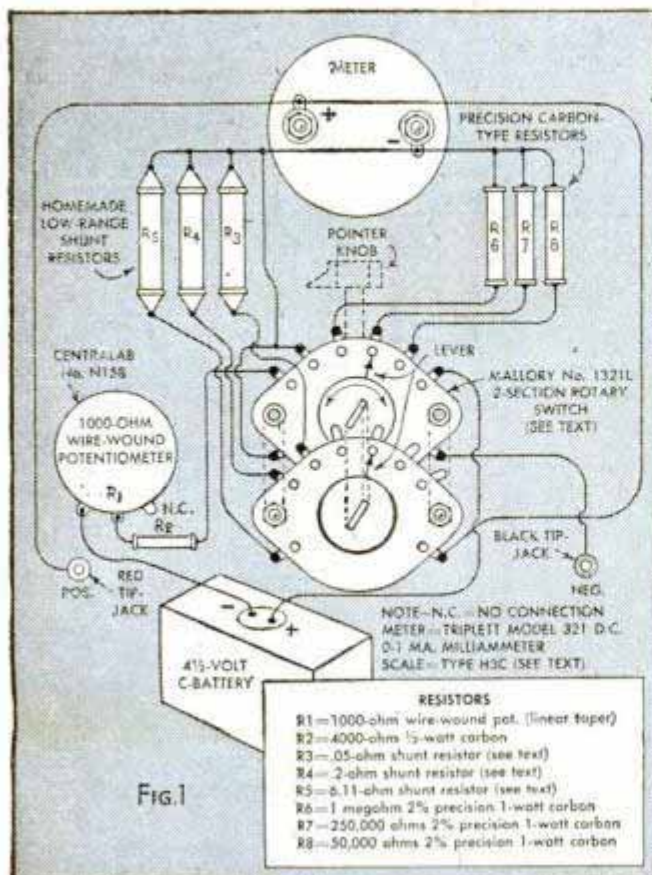
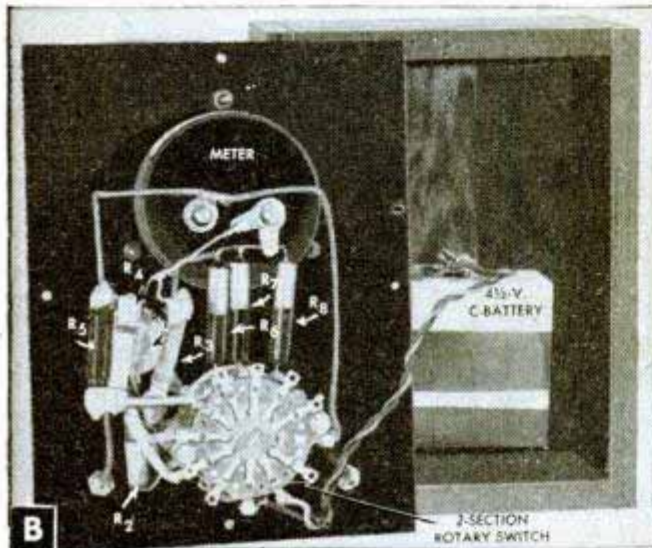
By L. M. Dezettel

One of the most important test instruments on the workbench of a radio serviceman, experimenter or "ham" operator is a combination unit known as a volt-ohm-milliammeter. It combines a voltmeter, ohmmeter and milliammeter in one compact low-cost instrument. The unit illustrated and described can be built from parts available at all radio supply houses.

The unit is based on a single 0 to 1 ma. d.c. milliammeter provided with a new paper dial having all the ranges to be used. This paper dial is listed as "Ham Crystals brand" H3C dial scale and is to be used with a Triplet model 321 d.c. 0-1 ma. milliammeter. All parts are specified in circuit diagram Fig. 1, and, at present prices, will cost the builder about \$12.00. The case is made from 1/2-in.-plywood stock; it is 3 1/2 in. deep, 6 in. wide, and 8 in. high, outside dimensions.

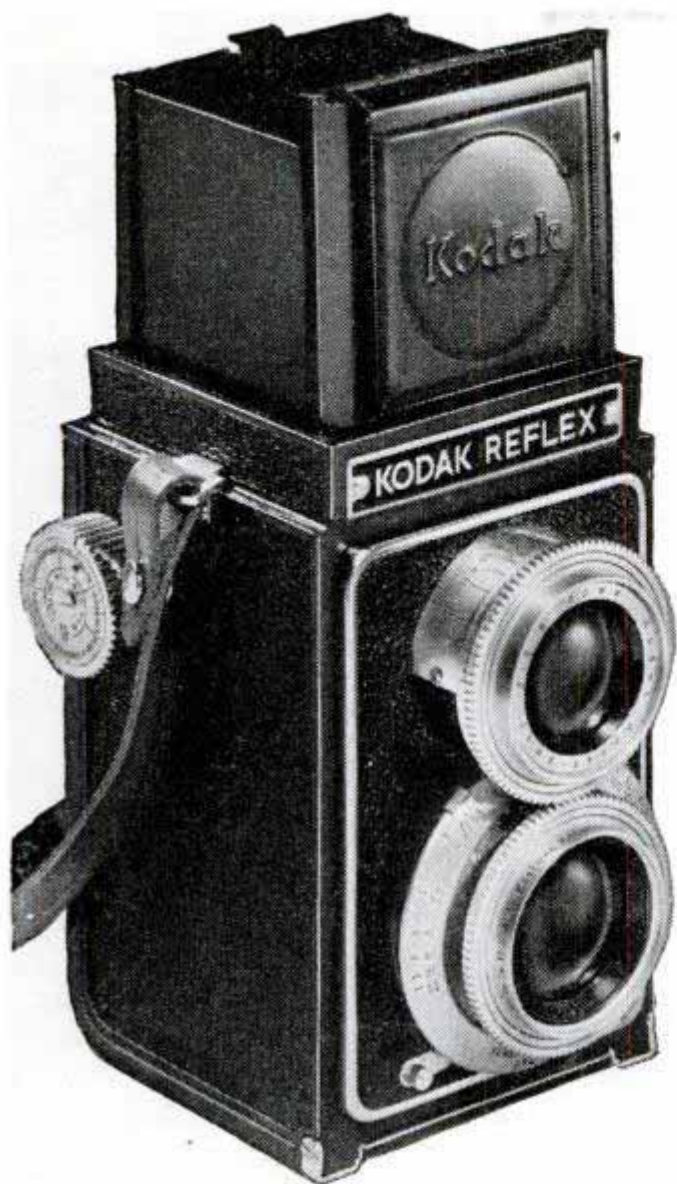
A 3/16-in. Bakelite panel, 6 in. wide and 8 in. long, is used to mount the entire assembly as shown in photos B and C; the panel employed was laminated Bakelite with alternate layers of white and black. An engraving machine was used to cut through the black layer and thus show the white letters and figures. It also can be hand tooled in the same manner. If a metal front panel is employed the test-lead tip jacks must be insulated by using shoulder-type fiber washers.

(Continued to page 228)



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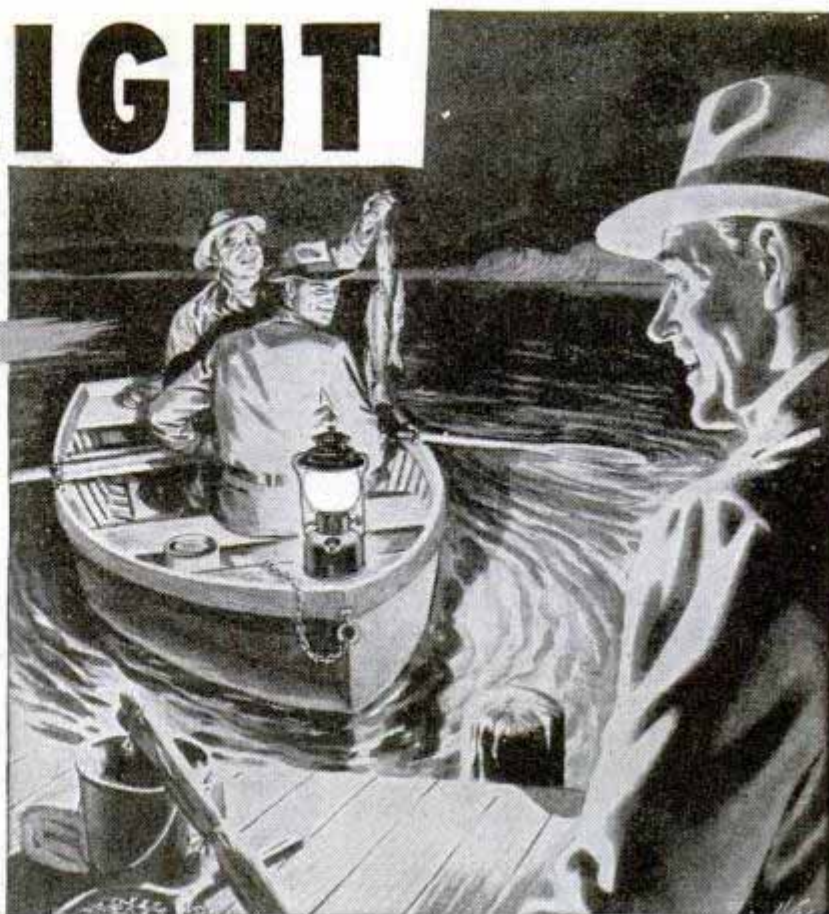
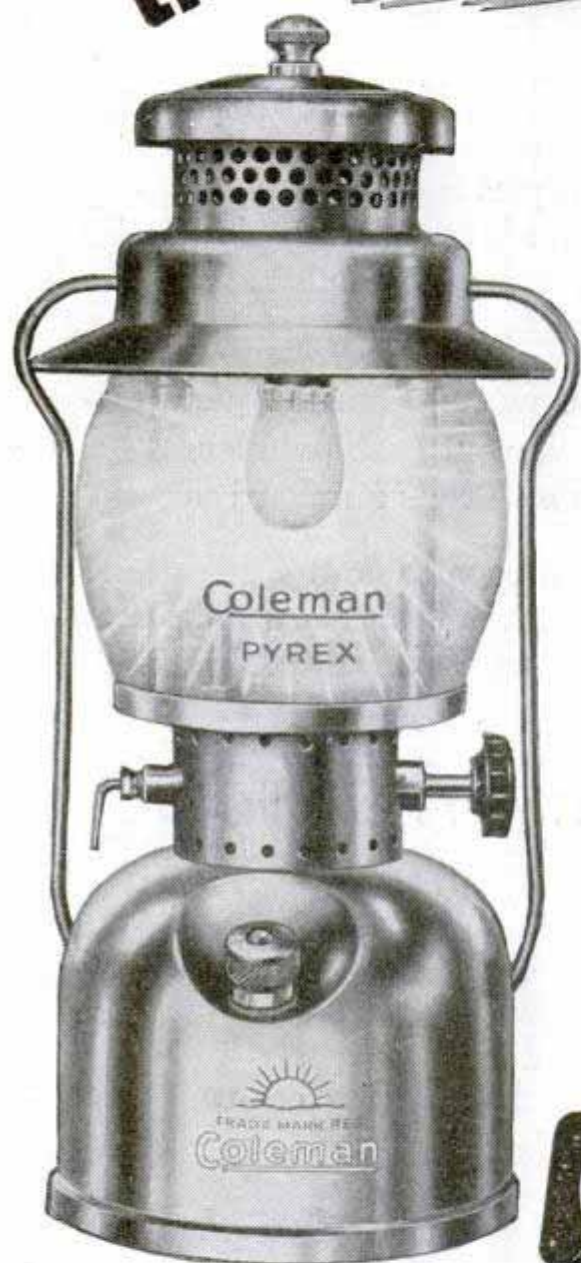
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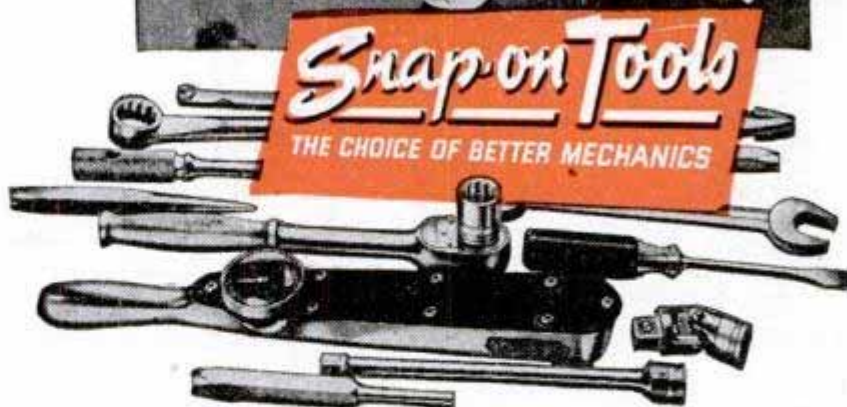


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Simplified Volt-Ohm-Milliammeter

(Continued from page 224)

The ohmmeter range requires the use of a 4.5-volt C-battery or, three 1.5-volt flashlight batteries connected in series, for the zero reading adjustment. This battery is held in the case with a metal strip. The rotary switch is a 2-section, 11-position nonshorting type, but only 7 of the switch positions are used. The switch has an adjustable stop which prevents the rotating contact from going beyond the 7 positions. It is necessary that the 1-megohm, 250,000-ohm, and 50,000-ohm resistors be of the precision carbon type. While wire-wound precision resistors would result in better-maintained accuracy, they are quite expensive, and not required in a simple test-bench unit of this type.

All of the low-range shunt resistors must be handmade. Three old r.f. chokes were stripped and rewound with resistance wire from spools which are available from radio supply houses marked with the ohms-per-foot resistance they are designed for. These wires can be cut to proper length for the shunt resistances specified for R3, R4 and R5. In the original model, these shunt resistors were made from plain copper wire and the values calculated on a Wheatstone bridge. Two of the resistors were wound to the proper resistance value with the wire that was on the r.f. chokes; the third resistor, R3, was wound with heavier No. 20 enameled wire for the .05-ohm value. The 4000-ohm carbon resistor R2, in series with the 1000-ohm potentiometer R1, need not be of the precision type. The variable resistor R1 is a standard midget volume control.

The voltmeter sensitivity of this instrument is 1000 ohms per volt. This means that when using the 50-volt range the total resistance is 50,000 ohms. When using the 250-volt range the total resistance is 250,000 ohms, etc., this high sensitivity voltmeter therefore is useful in circuits where the "loading" effect must be kept to a minimum. It is the standard sensitivity employed when servicing radio sets as in photo A. Most commercial radio receiver service diagrams show correct checking voltages at various points based on a "1000 ohms per volt" instrument.

Blueprints covering many simplified radio and electronic construction articles in this and past issues are available for 25 cents each. Detailed student material lists, additional general information or latest blueprint list can be obtained from our Radio and Electronics department without charge on receipt of ordinary letter postage



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Flight Plan for London

(Continued from page 104)

true fix can be established at the point where its line of position intersects that of the first.

One of the most important safety factors, the weather ships monitoring zones in the North Atlantic, came into being during the war when vessels could no longer safely transmit weather information. When the full fleet of 13 is finally installed, there will almost always be one within an hour's flying distance. Three cutters rotate on a station, each getting relief after a 21-day patrol. They have a crew of 125, along with weather observers and meteorological equipment comparable to that at a first-class airport. On board are air and surface-search radar, complete ocean-rescue equipment—which is soon to include a helicopter, and a powerful radio beacon.

The ships are normally on station within a 10-mile-square area, but they can move short distances away on distress missions. Surface weather observations are made every three hours, winds-aloft observations four times daily and upper-air radio soundings twice a day. The results are fed into principal weather centers for international distribution.

They keep constant guard on four radio frequencies, two used by surface craft and two aircraft-to-ship voice frequencies. In addition, they have a 24-hour radio-beacon service in action at 05, 20, 35 and 50 minutes past each hour. It sends a signal strong enough for vessels 200 miles away to use in obtaining bearings.

On meeting a weather "front," the airliner captain will include in his hourly radio report all the essential information he can on cloud height and amount, outside temperatures and rain. This gives forecasters at stations on both sides of the Atlantic data on which to plot the course of the weather front for air traffic. In return, the captain from time to time gets messages altering earlier forecasts on weather ahead, based on reports from planes just passing through the zone and from weather ships.

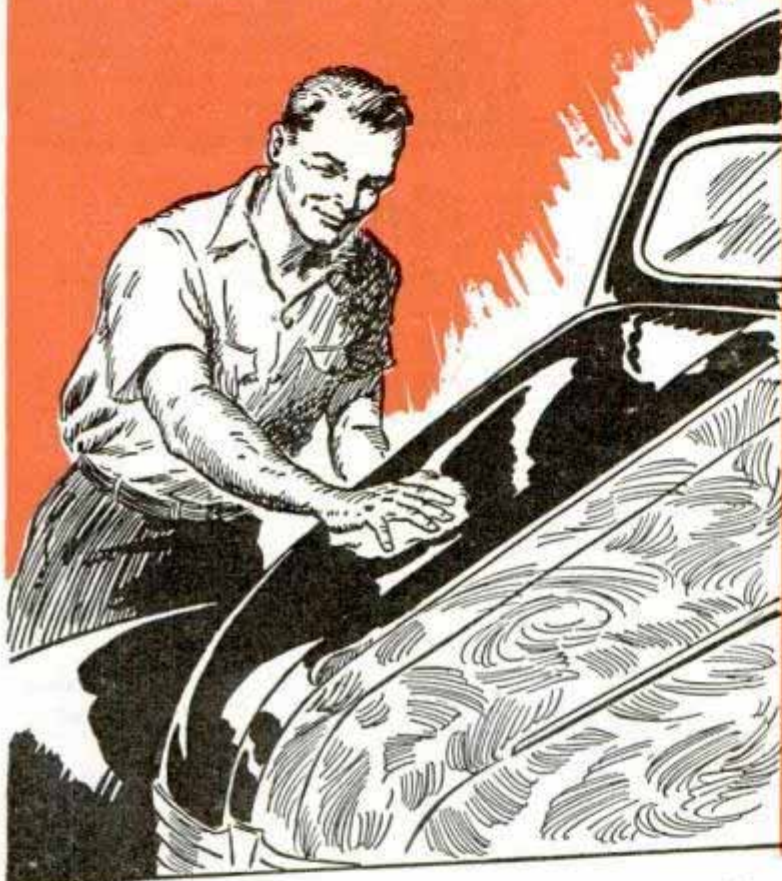
A few hours before landing the captain receives a forecast on the weather expected at the terminal and at the same time sends a corrected time of arrival. If weather indications there are bad he still has ample time to decide on one of the alternate ports.

As soon as land is seen, the radio officer contacts the field for clearance, the pilot, copilot and engineer work as a team to bring the plane down to approach level, and the navigator checks ground points for

(Continued to page 236)

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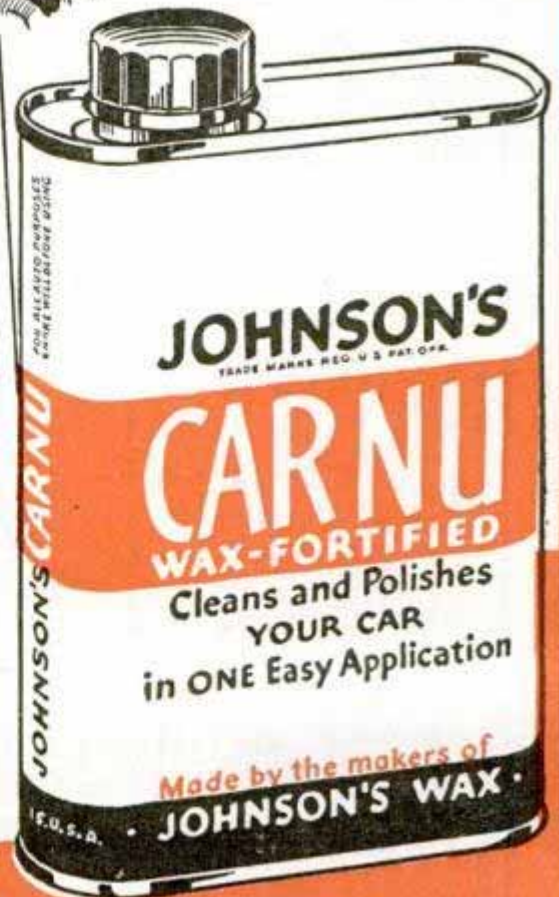


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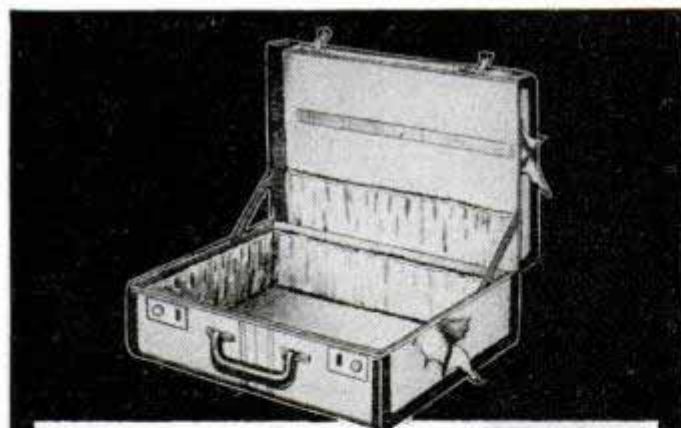
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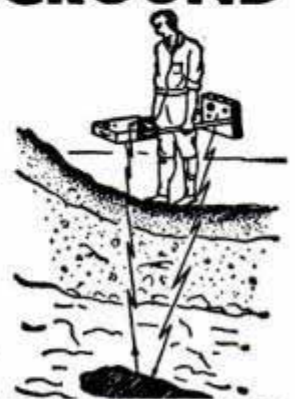


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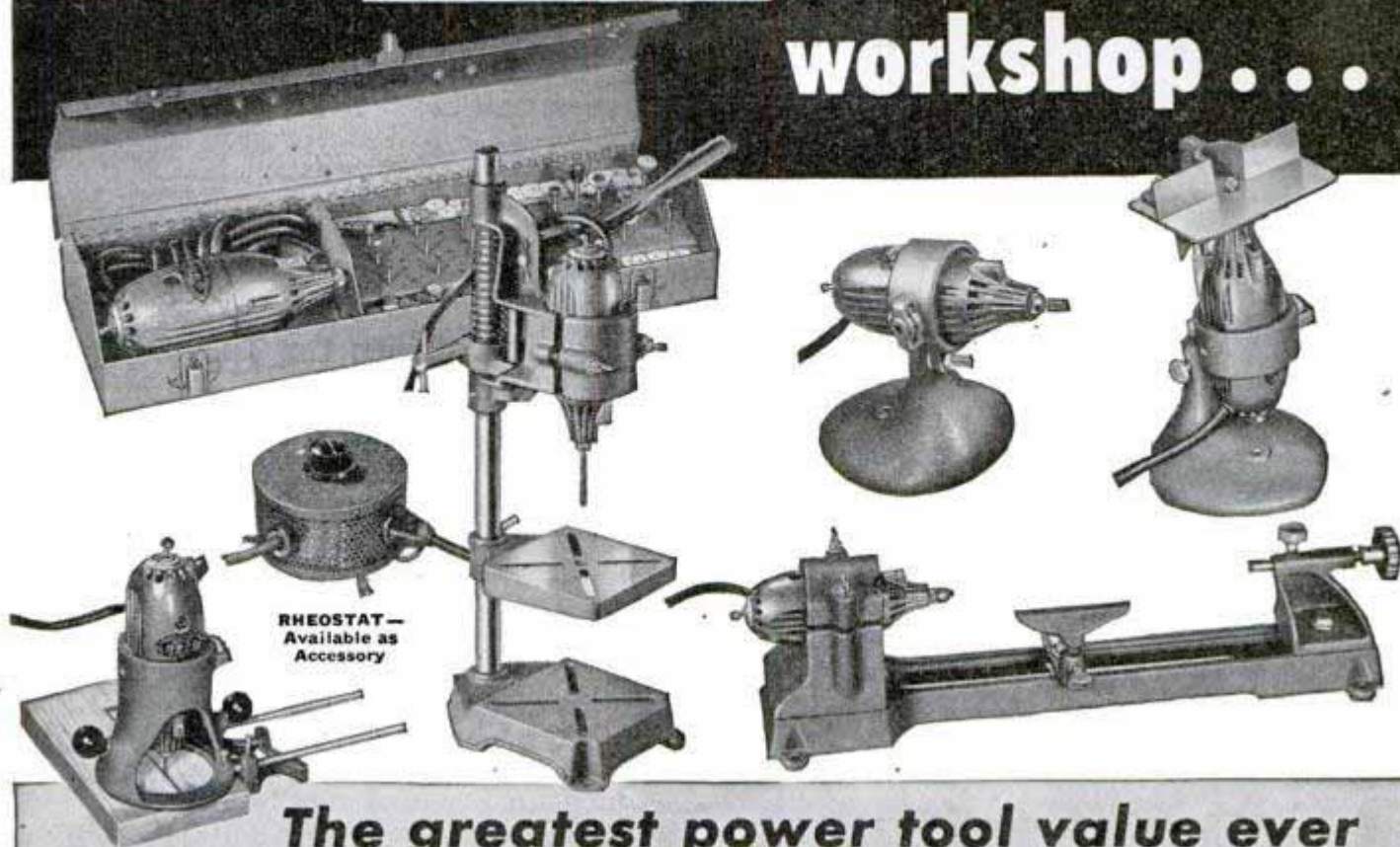
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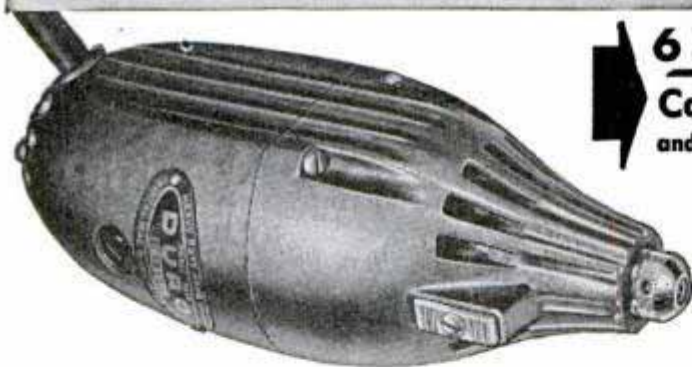


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Made by a long-established power tool builder, many thousands of Duro tools have been used for years in home workshops, schools and industry. The motive power of this shop—the sturdy, rugged, Duro Hand Grinder—has long been recognized as one of the finest light grinders on the market—and is today in wide use in both industry and home shops.

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Please rush me your free illustrated circular giving complete specifications and photos of the New Duro Workshop . . . plus a list of dealers where I can see the shop on display.

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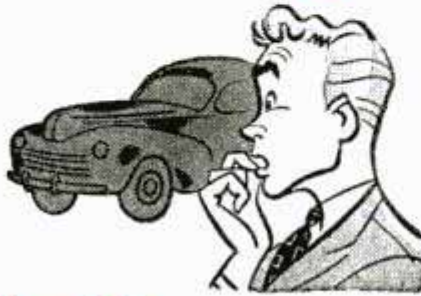
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his craft's position. Lights flash as the familiar "No Smoking—Fasten Seat Belts" sign goes on and a whirring noise tells you the landing gear is lowering into place.

Soon the big ship touches ground, so gently that you are not even fully awakened from the pleasant nap that occupied the last part of your trip. Just long enough here on Irish soil at Shannon to stretch a bit before you're whisked back into the clouds for the final hour-and-a-half leg to London. It was a speedy voyage, luxuriously comfortable, and so simple—for you.

Unveiling the Tucker

(Continued from page 138)

The six cylinders are opposed but slightly offset, with a six-throw crankshaft that has four main bearings. Valves are operated by a hydraulic mechanism. If the oil supply gets low, the valve mechanism shuts off the engine to prevent any damage.

The engine is cooled by a sealed liquid system, with Prestone providing a temperature range from 250 degrees above zero to 50 below. Thermostats will keep the engine temperature at approximately 210 degrees, which Tucker considers ideal.

Mounted by only four bolts, the engine can be replaced in the manner of a storage battery in less than an hour. Airplane-type connectors for electrical, gasoline, oil and hydraulic lines can be unfastened in a single operation.

Under the service plan, Tucker dealers will keep a number of replacement engines on hand. When a Tucker owner brings his car in for engine repair, the old engine will be removed and a replacement engine installed so the car will be ready for use in an hour. Then the old engine will be sent to the factory for servicing.

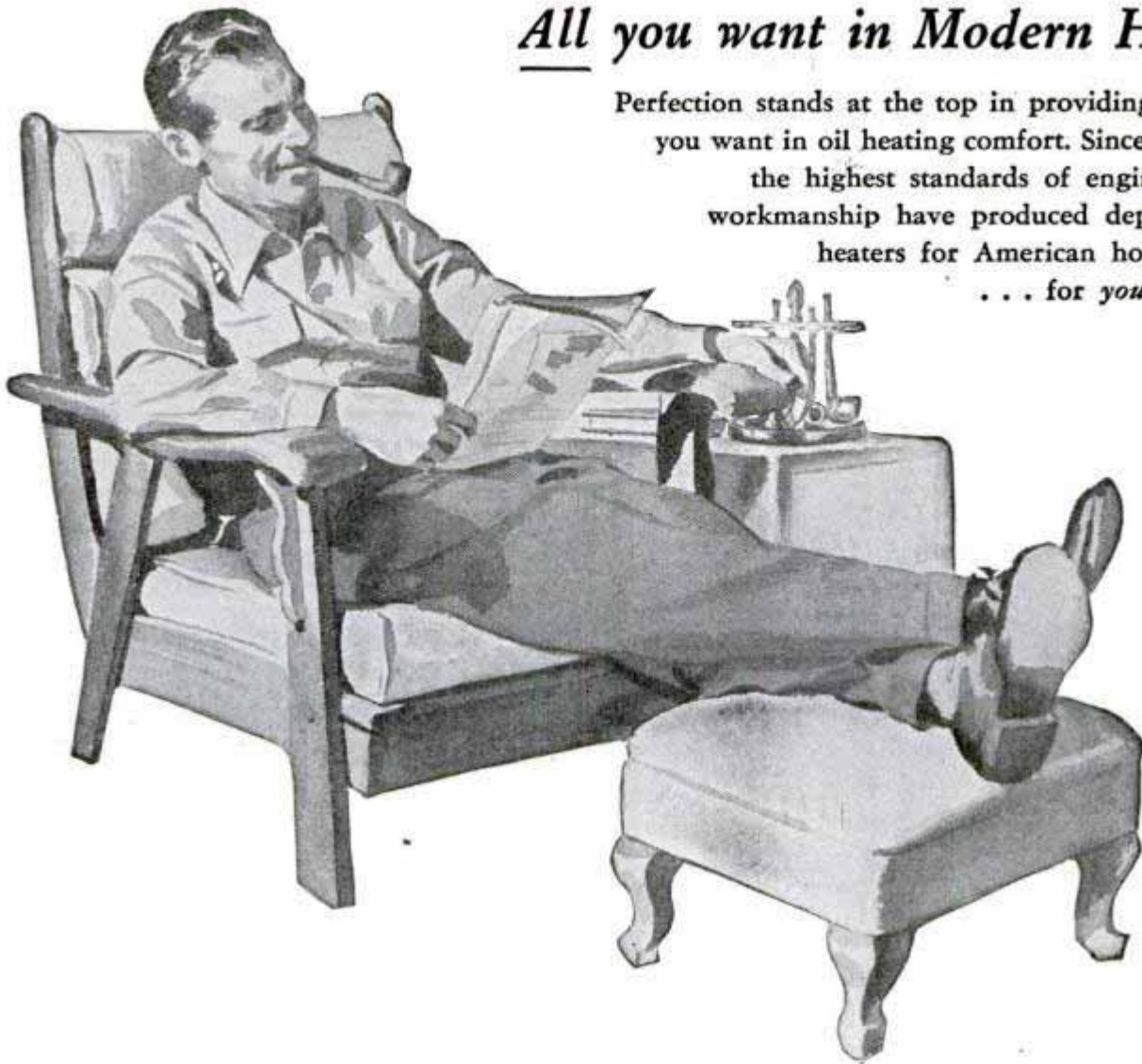
In the Tucker engine the conventional power-transmission assembly is eliminated; in its place, hydraulic torque converters transmit power from both ends of the crankshaft to the rear wheels. This does away with transmission, clutch, drive shaft and torque tube, full-width rear axle and conventional differential. The Tucker has no drive-shaft tunnel to make a hump on the floor.

Each of the four wheels is individually suspended by heat-treated aluminum forgings that act independently when the car goes over obstructions or rough roads. Rubber assemblies replace leaf or coil springs. Up-and-down motions of the suspension arms are controlled by rubber "biscuits" fastened to the frame. Inside these biscuits, metal disks are bonded to

(Continued to page 240)

All you want in Modern Heating!

Perfection stands at the top in providing all the things you want in oil heating comfort. Since 1888, the highest standards of engineering and workmanship have produced dependable heaters for American homes . . . for *your* better living.



Enjoy the clean, comfortable warmth of Modern PERFECTION Oil Heat!

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Space Heater, other sizes
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*Firelight Portable
Model 750 for "spot"
heating anywhere*

Keep Brushes like New

BEFORE



AFTER



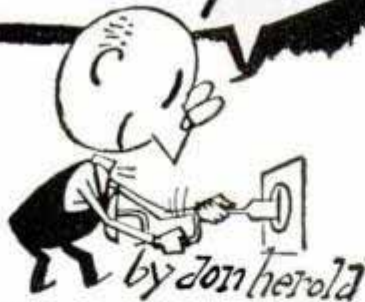
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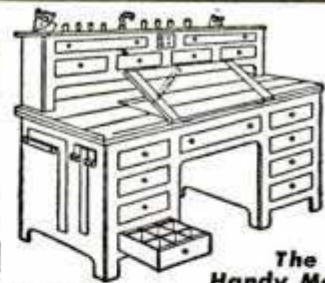
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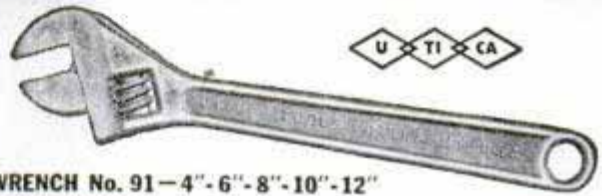
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WHY BREAK YOUR BACK
MOWING FIELD OR LAWN?

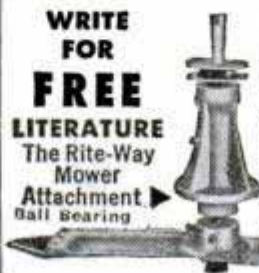
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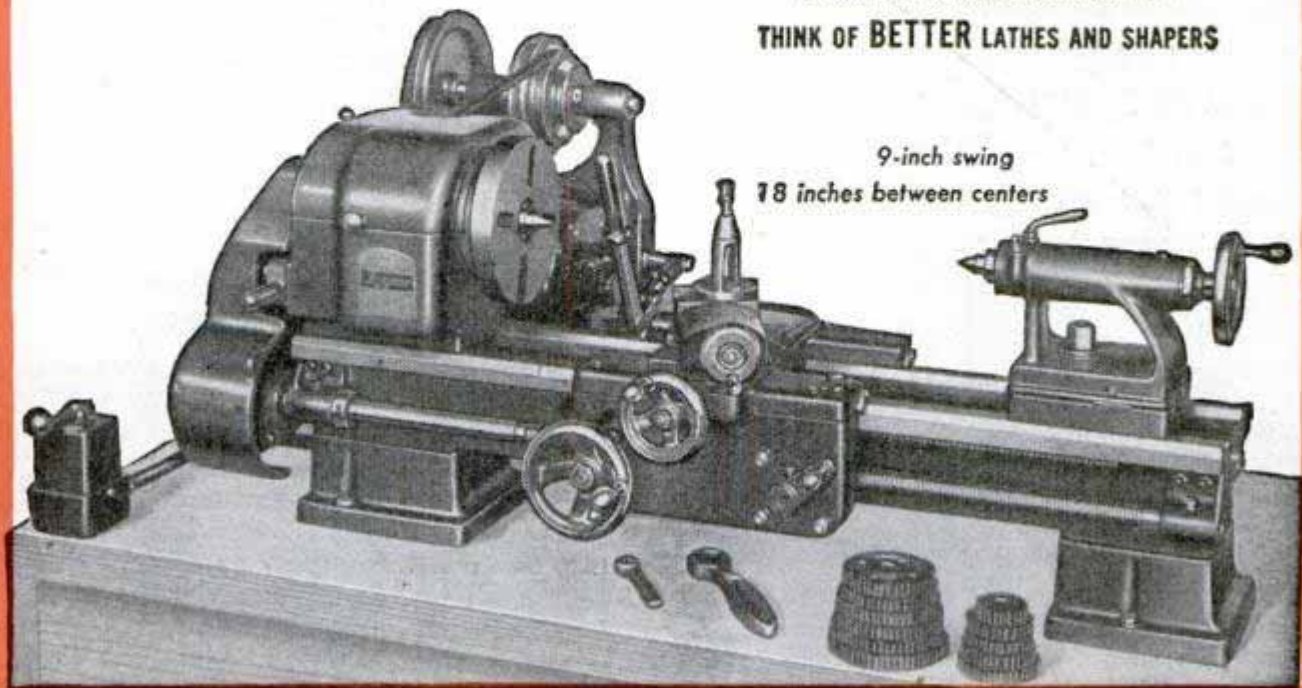
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THINK OF BETTER LATHES AND SHAPERS



9-inch swing
18 inches between centers

**NEW 9-inch
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Logan performance
In a New Size
At a New Low Price

Here is something new in 9-inch lathes . . . Logan advanced design, accuracy, ruggedness, and all-around dependability built in a 9-inch size. The Logan 9-inch Lathe has all the basic features that have made larger Logan Lathes outstanding industrial performers. The spindle turns on ball bearing mountings inherently well adapted to high speed work. The two V-ways and two flat ways of the rugged bed are precision ground to within .0005" of parallelism. Massive construction insures steadiness on heavy cuts and durability. Self lubricating bronze bearings protect vital wear points. The result is a versatile lathe with the traditional Logan sustained accuracy, effective in precision manufacturing operations, general machine shop and tool room work, auto, and appliance repair, and for home workshop use. Complete information is available at your Logan Lathe dealer's, or on written request.

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**UTMOST
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Dairies and milk producers use factory-recommended AC Spark Plugs to assure utmost reliability in milk delivery. Your AC dealer can supply you with factory-recommended AC's for your car, truck or tractor, designed for today's fuels and driving conditions.



Look for this sign



Spark Plugs cleaned and adjusted "By the AC Method" may save as much gas as 1 gallon in 10



**AC
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rubber with bars extending to each side of the upper suspension arms.

To increase safety and driving ease, the 13-inch wheels (which carry 7.00 by 13 tires) have a $\frac{1}{32}$ -inch toe-in in front and $\frac{1}{16}$ -inch toe-in in the rear. The front wheels have a special mounting which Tucker says will eliminate any swerving if a front tire blows out at high speed.

Tucker says the major operating parts—such as bearings with sealed-in lubricant—will require no repairs for "at least 100,000 miles." If the Tucker does everything its creator claims, it may revolutionize the automobile industry. Time will tell!

Filming the Waltz of the Flowers

(Continued from page 111)

the plant first pushes through the earth the lens is focused down on it, and when the plant is full-grown the camera still is on a plane with the subject.

Another little motor turns a shaft that runs across the table behind the cameras—but the shaft revolves so slowly the motion can't be seen. A cord runs from the front of each cable car to a pulley in front of the subject, then back beneath the car, over a wheel on the shaft, and back to the rear end of the car. As the shaft turns, the camera moves patiently up the track toward the subject, or if the cord is reversed, away from the plant. The camera may take a month to travel only two or three feet, yet when the resulting film is shown, the spectator rides the cable car in from a distance for a close-up. The sequence, which required months to film, may take only 5 or 10 seconds on the screen.

Other refinements in Ott's equipment include a solenoid attachment that automatically snaps the picture and a voltage transformer to prevent variations in the floodlight illumination.

Today he makes his equipment do specialized tasks outside his studio. One timer automatically waters the orchids in his greenhouse. Another is connected by cable with a box mounted on stilts beneath a maple tree in his yard. One of the branches of the tree runs into a hole in the front of the box. A camera inside the box is taking time-lapse movies of the development of maple leaves and buds. The mechanism works just like his basement equipment—shutting out all sunlight for a few seconds while a floodlight comes on and one frame of the film is exposed.

His experiments with plant nutrients, insect poisons and flower preservatives show the comparative value of similar products.

(Continued to page 244)

You change blades in a flash with the modern
Gillette

ONE-PIECE RAZOR

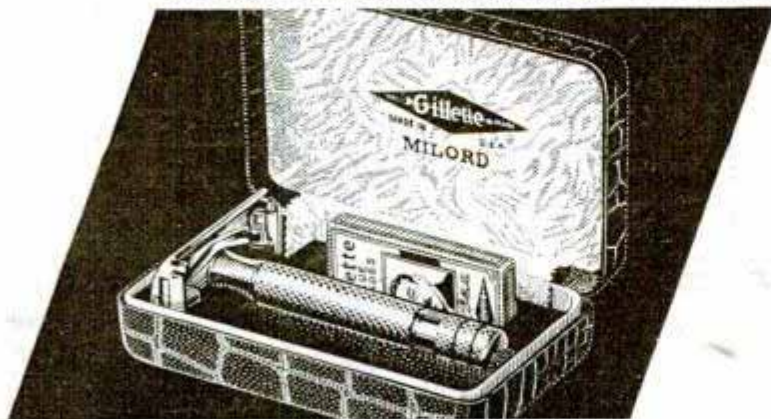
SHAVING is mighty quick and easy when you use a modern Gillette One - Piece Razor. There's nothing to take apart or put together. You change blades in jig time. Twist . . . the razor opens. Twist again . . . your blade's locked in position. For cleaning both razor and blade just loosen the holder, rinse and shake.

Enjoy utmost shaving comfort and convenience. Get a superb Gillette Aristocrat or Gillette Milord One-Piece Razor. They're the finest shaving instruments money can buy!

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 Boston 6, Mass.



Gillette Aristocrat One-Piece Razor, gold plated, \$379
 with case and ten Gillette Blue Blades



Gillette Milord One-Piece Razor, gold plated, \$250
 with case and five Gillette Blue Blades



Twist...It's Open



Twist...It's Closed

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WITH THE SHARPEST EDGES EVER HONED

NEW! EASIER, FASTER, STRONGER OUTDOOR PROJECTS



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CASCOPHEN Resin Glue

"Easi-Bild Full-Size Patterns" take the mystery out of making things.

Just trace the pattern on the wood, saw it out and glue it together. There are 94 projects for furniture, toys, gifts, buildings, home needs.

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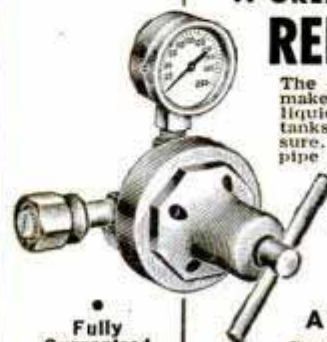
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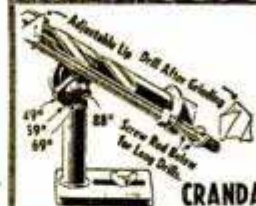


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FASTEST PLANER in the WORLD at this Low Price... \$195⁰⁰

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Needed by every saw mill owner and woodworking shop to Speed Up Production — Increase Profits.

Belsaw high speed thickness planer provided for single surfacing stock up to 12" wide by 8" thick at the high speed rate of 24 lineal feet per minute for HIGH PRODUCTION. Planes GREEN or DRY sawed lumber into higher priced, valuable smooth and worked forms. Machine has welded all STEEL frame... nothing to break. Safety-type all Steel cutterhead runs in heavy duty ball bearings. Three HIGH SPEED Steel knives make 42 cuts per inch for smooth finish.

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a new
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It's not a motorcycle, not a bicycle. It's *the* lightweight, complete powercycle. Safe? You bet! Top speed 35 m. p. h. Exceeds all International Powercycle Association safety rules! Ride it, park it... easy as a bicycle!

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Drive your Servi-Cycle to and from work... for shopping, errands. Save wear, tear on your automobile. Your Servi-Cycle is built to last... and last... and what a money saver!

INCREASED PRODUCTION
PERMITS OUR APPOINTING
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For example, his film proves which of the nutrients does the best job on particular plants. The evidence is undeniable—it's on the screen for you to watch.

He's turned up several curiosities in his experiments. Once he photographed a soil-filled box covered with dead, dry leaves. When he developed and projected the film, the leaves were absolutely motionless at intervals and at other times they jumped around with amazing vitality. At first he thought the leaves might be affected by a slight movement of air in the studio, or that they weren't completely dry. He made another film strip of the same subject, but speeded up the exposure intervals to slow down the action on the screen. When he projected the new film the mystery was solved—angleworms in the soil had been coming out every night and shoving the leaves into new positions.

Today Ott is venturing into microscopic time-lapse work. With a special lens attached to a microscope he is photographing subjects so small they barely can be seen with the naked eye.

He hopes and expects that his technique will be used in many fields of research. He suggests many applications—by coupling time-lapse equipment to X-ray machines, medical research could have a visual history of the knitting of broken bones. With microscopic equipment the gradual change in the cells of aging lumber could be studied. Films could show the growth of bacteria and mold, and the effect of medicines on bacteria.

Ott has only a few cans of film representing 20 years of work in time-lapse photography. But his hobby has become a business and his patient work may pay dividends in wide fields of research.

Putting Life in Puppets

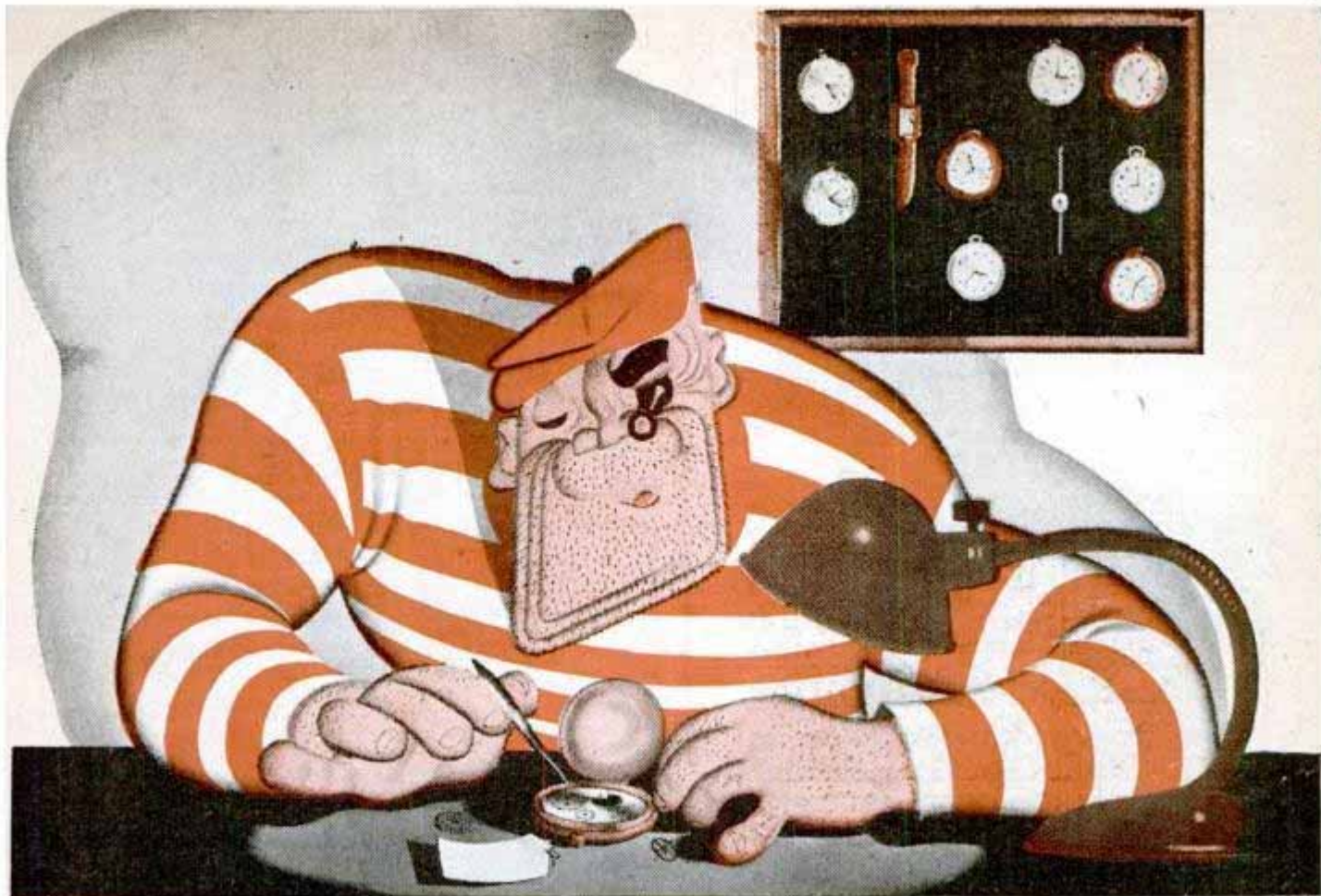
(Continued from page 159)

made up in three sizes ranging from 1½ to 14 inches in height, for use at different camera distances.

A puppet's body consists of wood or composition material and is provided with plug-in holes into which the arms, legs, and heads are inserted. Arms and legs usually consist of soft rubber molded around wire skeletons so they may be bent to any position. Half a dozen sets are made up for each character as replacements when the original arms and legs wear out during animation.

Often, too, a series of legs and feet imitating the different positions assumed in walking or running is made up. These are

(Continued to page 248)



Piston Rings

WEAR OUT, TOO!

● Piston rings are designed to "take" the wear... to protect your engine. When they wear out they waste oil, cause loss of power and lead to excessive cylinder wear. Fortunately, piston rings can be replaced—again and again—restoring engine performance each time.

So, when your car first begins to smoke, use too much oil or lose power,

install Hastings Piston Rings at once. They *stop* oil-pumping, *check* cylinder wear, *restore* performance.

Remember that name, Hastings Piston Rings—the best money you can spend on your car.

HASTINGS MANUFACTURING COMPANY
HASTINGS, MICHIGAN
Hastings Ltd., Toronto

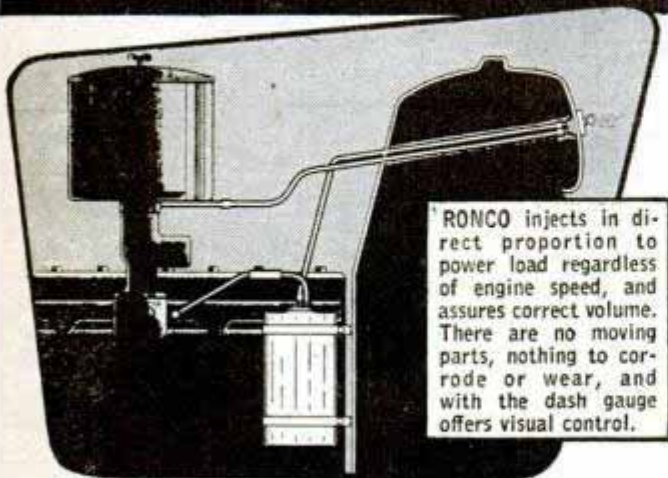


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TOUGH on Oil-pumping
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More POWER! More ECONOMY!
Amazing war development
increases POWER & ECONOMY
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stationary motors!



RONCO injects in direct proportion to power load regardless of engine speed, and assures correct volume. There are no moving parts, nothing to corrode or wear, and with the dash gauge offers visual control.

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POSITIVE PRESSURE INJECTION

Install it yourself on any gasoline motor

RONCO INCREASES POWER

Applying the same principle used by fighting planes during the war, RONCO injects water into the gasoline mixture making your engine run smoother, cooler, and with more power, also prevents the formation of hard carbon on the valve stems and in the piston ring grooves.

RONCO SAVES MONEY

RONCO guards against costly repairs by removing waste deposits. RONCO adds MORE OCTANE to regular gas and INCREASES gasoline mileage.

- RONCO helps prevent hard carbon
- RONCO helps prevent excessive oil consumption
- RONCO Prevents detonation pre-ignition (PING)
- RONCO prevents dirty spark plugs
- RONCO increases gasoline mileage
- RONCO gives more power with all grades of gasoline
- RONCO adds life to your engine

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used one after another, one per frame of film, in animation.

Different facial expressions such as smiling, frowning, laughing and the attitudes of conversation can't be imitated in a single head and so as many as a dozen heads, each with a different expression, are made up for each puppet. One head is removed from the body and another one is plugged in, between frames of film, to carry on the animation.

It takes ingenuity to costume the puppet actors because most striped or decorated fabrics would appear out of proportion on them. Often special fabrics must be woven for the characters; sometimes tiny designs are worked with thread into the cloth so that the material will appear in the proper scale. Real fur often is used. Jewelry and other tiny properties for the diminutive characters are fashioned with the aid of strong reading glasses. Infinite care goes into making the puppets and miniature sets, for a tiny mistake would be magnified greatly when it appears on the screen.

So You've an Invention to Patent

(Continued from page 85)

the wisdom of the founding fathers. More than 2,500,000 patents have been issued and there are estimated to be some 400,000 living patentees.

Business at the patent office began in 1790 when three patents were issued under authority of Thomas Jefferson who served as first administrator of the patent laws. In those days, obtaining a patent was simple. You merely sent an application, and in due time a clerk in Washington mailed you your patent certificate.

In 1836 with the growing complexity of invention, the patent regulations were revised and made part of our organic laws. Two men share the honor of being first to receive a patent; under the old regulations, Samuel Hopkins of Vermont was first; under the patent system established in 1836, Senator John Ruggles of Maine was first.

Making farming easier was the main spur to invention in those days. McCormick was granted a patent on his reaper in 1833 and Moore a patent on his harvester in 1836.

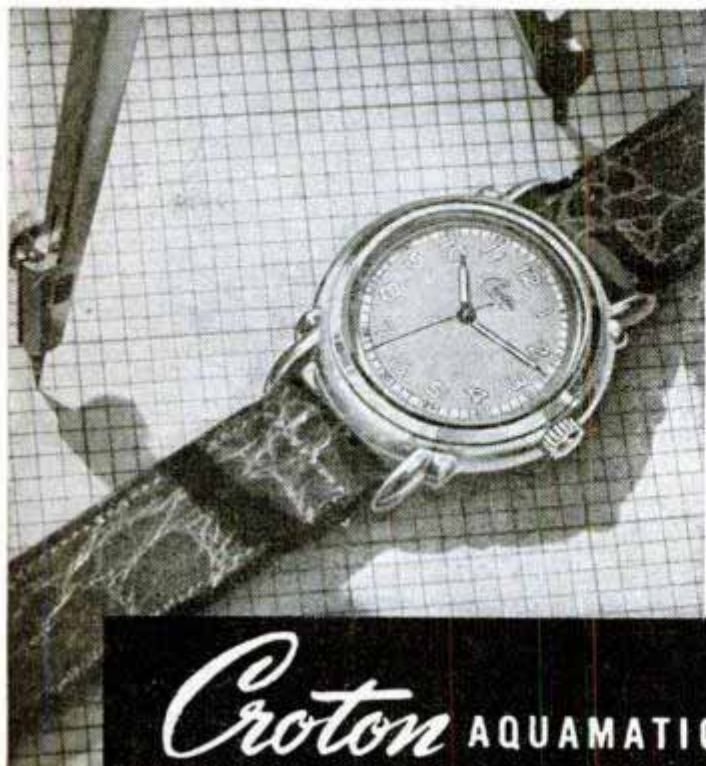
The electrical age began with Morse, who in 1832 obtained a patent on his electromagnetic telegraph. Thomas Davenport, a village blacksmith of Brandon, Vt., obtained patent No. 132 in 1837 on his method for obtaining rotary motion from an electromagnet. His model, submitted with his application, has all the essentials of a modern direct-current motor with a

(Continued to page 252)

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Axle only, \$6.50—With Springs, \$22.00; Axle, wheels and hubs, \$30.50; Axle, wheels, hubs and springs, \$43.70.

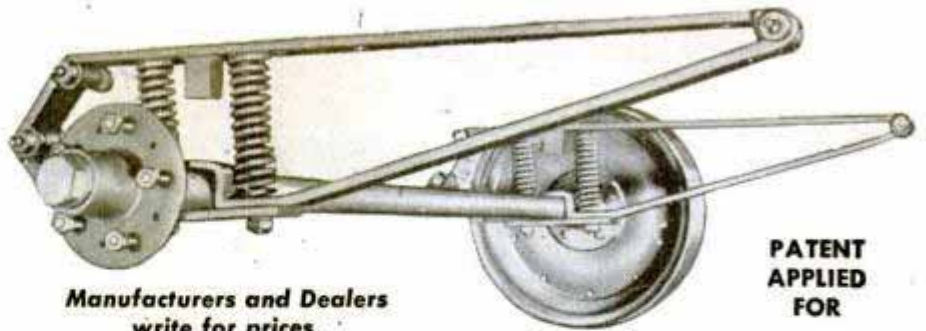
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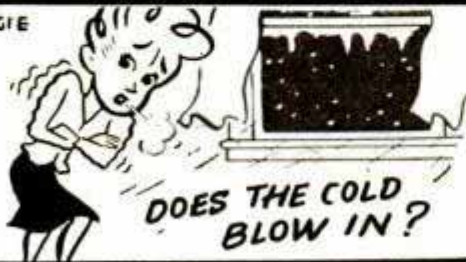


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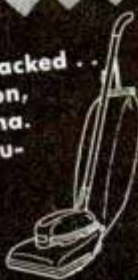
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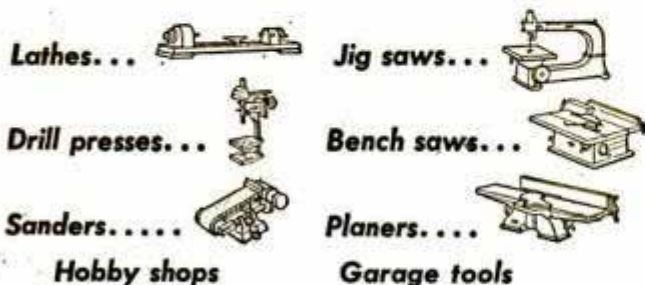
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By 1876 electricity began to be understood in experimental laboratories and Bell patented his battery-operated telephone that year. Edison appeared on the scene, patenting his talking machine in 1878 and his incandescent lamp in 1880. Tesla patented his induction motor in 1888, Hall his method for obtaining aluminum in 1889, and Mergenthaler his Linotype in 1890. An inventor was no longer viewed as a crank or a curiosity. Inventing became a profession that commanded respect.

An amazing number of inventions has come from a small group of men whose patented discoveries run several hundred or a thousand. One of these men was John F. O'Connor, a specialist-inventor whose 1000 patents were all in the railroad field. Another was Francis H. Richards, who required the services of ten draftsmen to put his ideas regarding weighing and packaging apparatus on paper. He patented 850 inventions.

A prolific inventor in a special field is John Hays Hammond, Jr., holder of nearly 800 patents in the electronic group. Starting with an invention at the age of 16, he collaborated with Alexander Graham Bell on long distance telephony and pioneered in vacuum tubes, frequency modulation and television.

With the notable exception of O'Connor, the "mass production" inventors started alone, but soon acquired a staff of assistants to multiply their genius. In this category may be placed important inventors such as Edison, Ford, and DeForest. Many of the leading patentees are found in the research laboratories of the nation's large industrial firms such as General Electric, Westinghouse, General Motors, Ford Motor Company, Chrysler Corporation and Du Pont.

War accelerated the flow of inventions, and a sudden increase in applications for patents early in 1945 showed that the nation's inventors were giving serious thought to new war devices.

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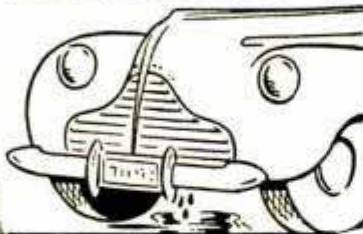
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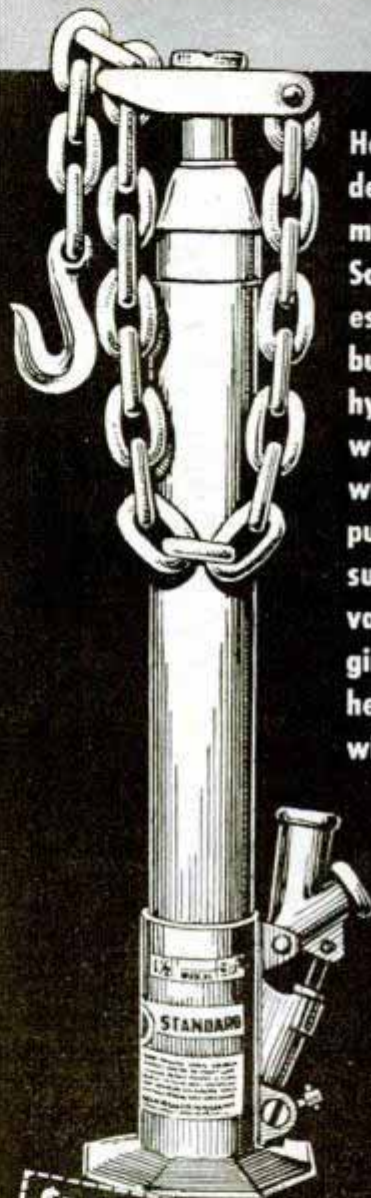


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Miniature type headphones. Ideal for hearing aids, listening to radio in noisy places, in bed, etc. Complete with headband, cord and two sets rubber ear plugs. Shipping Weight 1 1/2 lbs.

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An experimenter's paradise. Five pounds of new condensers, transformers, coils, switches, sockets, resistors, etc. Enough parts to try dozens of electrical experiments. All new useful parts. Shipping Weight 6 lbs.

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The heart of the Army transmitter-receiver BC745. Contains transmitter crystal and tank coil, receiver coil, tuning condenser and crystal, ideal foundation for small amateur set. Shipping Weight 1 lb.

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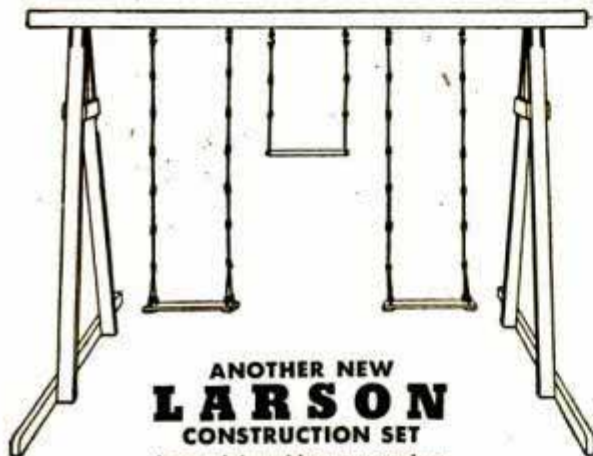


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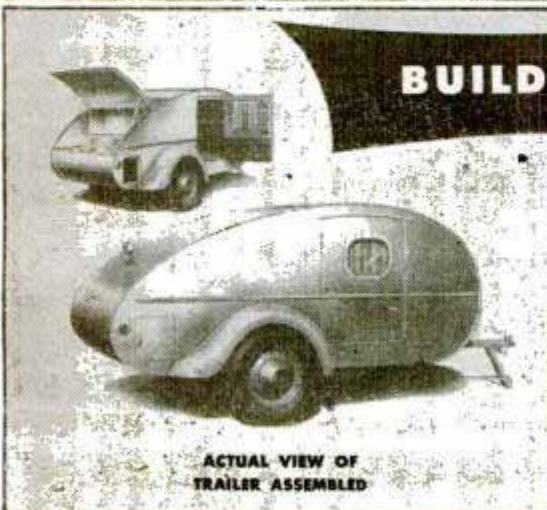
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World's Largest Crane

(Continued from page 128)

represents a cost of about \$10,000,000.

Started during the war, the cost of the project is regarded as cheap wartime insurance when a capitol ship's guns must be replaced in a hurry. The present world record for regunning a battleship is 5½ days, set by the Navy's floating crane Kearsarge when it regunned the Pennsylvania during the war. The new crane at Hunter's Point can do the same job faster and carry on other work at the same time.

Mounted on the hull of an old battleship, the Kearsarge has a capacity of 250 tons. This was our largest floating crane until a 350-ton-capacity floating crane was brought to the United States from Germany recently. Of jib-type lever-luffing construction, that unit has an over-all height of 375 feet. It floats on a 17-foot-deep pontoon 205 feet long and 108 feet wide, displacing 5000 tons, and has propellers both fore and aft. A crew of 23 are quartered in the pontoon. It is now being assembled at the Terminal Island Naval Base in California.

But the Hunter's Point monster tops them all. Completion of the giant lift makes Uncle Sam fastest on the draw among all nations in replacing a battleship's guns.

Task Force Furnace

(Continued from page 150)

their findings. Each soldier fills out a questionnaire each week, listing his reactions to the gear he has worn or tested. These reports are sent to the Quartermaster Corps headquarters in Washington where they will be passed on to manufacturers after approval.

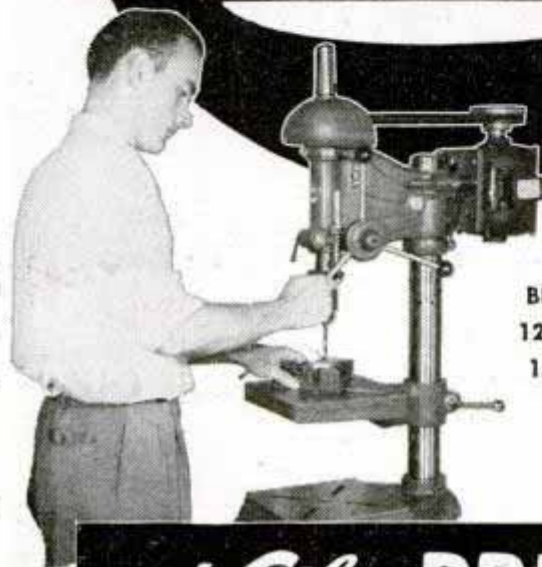
Field laboratories set up by Furnace are conducting exhaustive tests in the canning of foods and medicines. "Our canned goods must be specially vacuum-packed," says Col. Richardson. "The tiniest air hole in a can causes it to swell in the heat until the can explodes."

Medicines are affected, too. Iodine, aspirin, boric acid, tooth powder—almost any of the medicine-chest items that require a measure of humidity—dry up, change color, or lose potency in the desert heat unless they are properly canned. The desert soldiers, for example, carry sulfa powders and other antiseptics in sealed cans or tubes that can be ripped open by pulling a little tab.

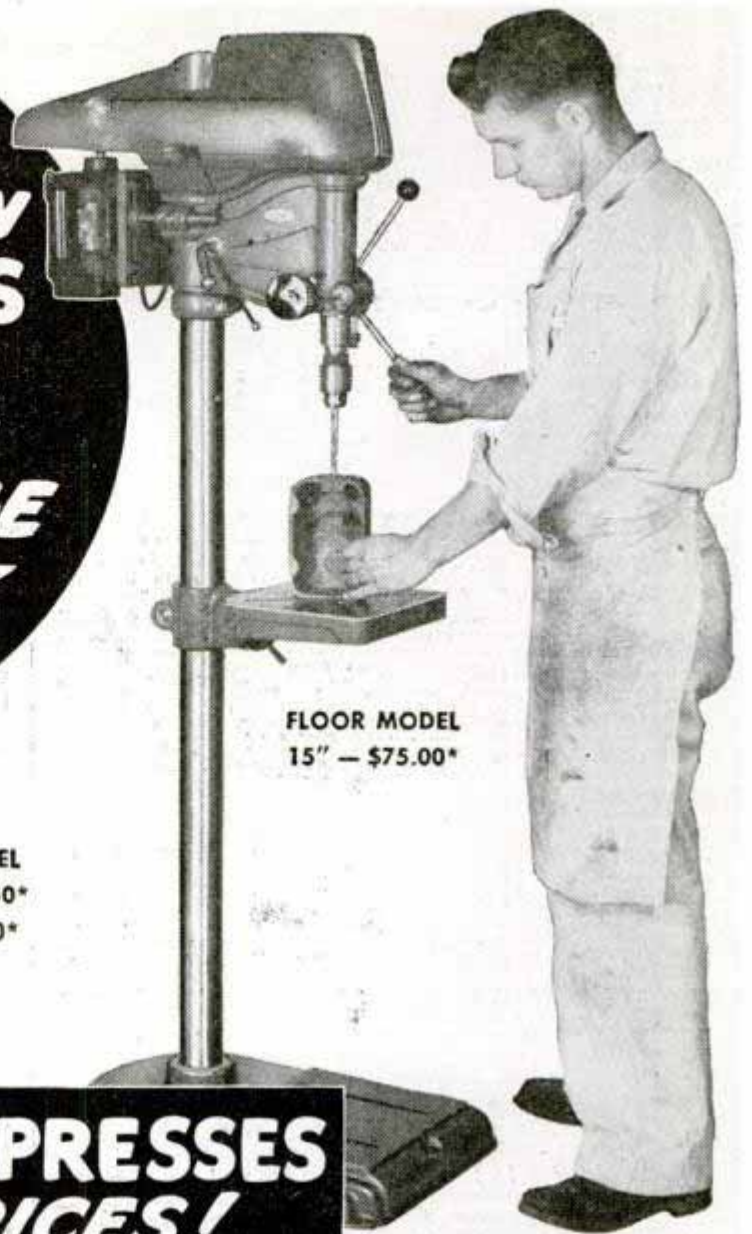
Already the regulation pack of the desert soldier has been cut by 25 percent

(Continued to page 260)

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TO YOUR SHOP'S
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AT LOWER PRICES!**

Now you can equip for the most productive winter you've ever had in your shop! Atlas drill presses are again available at your distributors — at prices near pre-war levels!

**Amazingly Versatile — Give You
10 Different Types of Work**

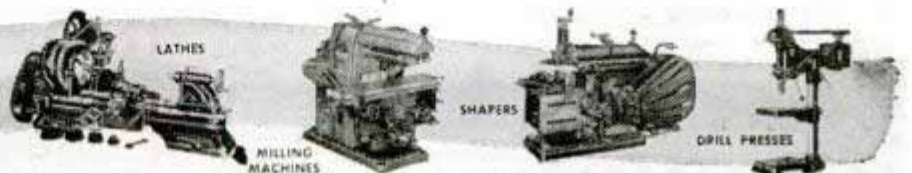
Here are some of the operations you can handle easily and quickly with any Atlas drill press and its low cost accessories: precision drilling, tapping, reaming, and routing in metal and plastics; mortise and tenon joints for tables, chairs, doors, book-cases, cabinets, storm windows, screens; inlaying carving, dovetailing, shaping, and drum sanding — *all important additions to the practical "capacity" of any shop.*

Industrial Precision for Your Home Shop

From its finely balanced pulleys to its solid base an Atlas drill press is built to give you rigidity, smoothness, and life-time accuracy. Head, column, table and base are extra heavy. Precision-ground table tilts 90° right or left. The exclusive Atlas "floating-drive" spindle design — with deep-grooved ball bearings — keeps the precision-ground spindle accurately aligned for smooth operation. Ask your Atlas distributor to show you the bench and floor types in his display room, or send for latest literature. Atlas Press Co., 943 N. Pitcher St., Kalamazoo 13D, Mich.

* Prices, less motor, F.O.B. Kalamazoo.

Atlas 4 TOOL TEAM

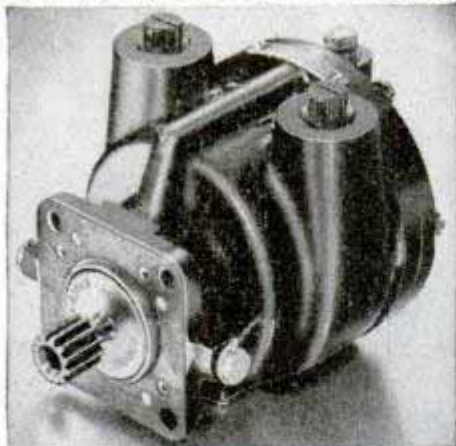


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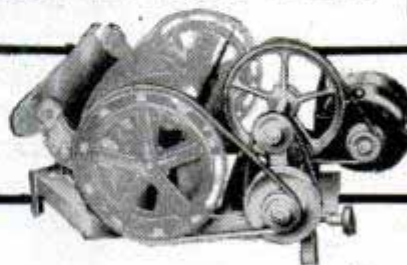
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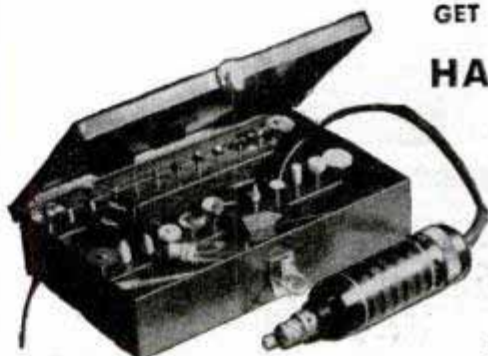
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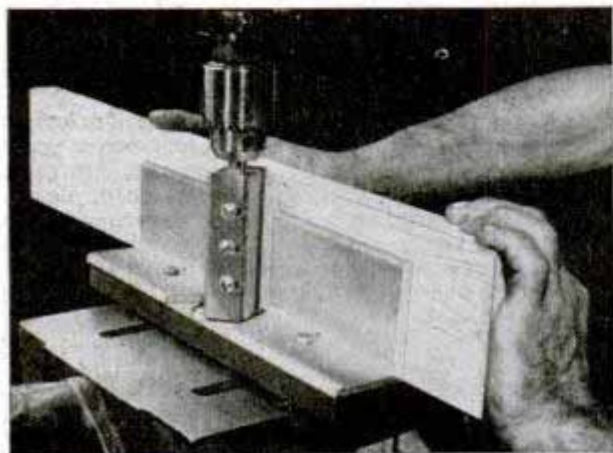
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[10"x14" smooth machined cast iron TABLE WITH GUIDES; 1 4-in. wide JOINER CUTTER; 1 SHAPER CUTTER; 1 set hardened fine-ground tool steel BLADES. A complete unit!]

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and Furnace command hopes to lighten the burden by 40 percent. Battle helmets, buckles, all metal objects that mean weight have been manufactured out of the same tensile aluminum and alloy found in refrigerator units. They're light and almost indestructible.

Much research has been conducted on what happens to the body under heat. The amount of heat produced by an adult, relaxed and warm in bed, is about 160 B.T.U.s per hour. This rises to 380 B.T.U.s per hour when seated at rest, to 1000 B.T.U.s per hour for normal home activity, and to 2500 B.T.U.s per hour for vigorous exercise or hard work. About 80 percent of this heat is carried to the skin surface by the blood and dissipated through the skin.

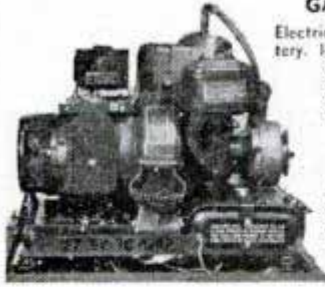
The body heat may leave the skin surface by radiation, conduction, convection and evaporation. When the air temperature is higher than the body temperature, both conduction and convection add to the body heat load. All cooling sources of the body fail when the relative humidity is 100 percent and the air temperature is over 100 degrees F. Even as it approaches these conditions, the heart is overworked and heat prostration may result.

The process of evaporation is controlled by the amount of moisture that reaches the skin surface, which is generally only enough to equal the amount evaporated. When the demand for heat removal increases beyond this point, Furnace specialists determined, perspiration is the effort of the heat-regulating system to try to increase the evaporation. If the heat-control system is not in frequent operation, it loses the flexibility required in an emergency. And war is a series of emergencies. Other bodily functions may slow down.

Clearly, the almost savage dryness of the desert requires apparel that will retain humidity. A thick lining for the Nylon uniforms is being developed that will carry with it a sustained moisture. This lining is a wool mixed with rayon that appears resistant to rapid drying. Worn against the skin in the desert, the lining gives a continuous feeling of coolness.

There is little doubt in the Furnace command that at the end of the experiments, perhaps some time next year, there will be a tremendous impact on the manufacture of civilian clothing and on house and car-cooling schemes, as well as radical alterations in what the well-dressed desert soldier will wear.

ⓁFoot-wide radar scopes on which airmen can "see" obstructions 100 miles ahead will be installed on Navy transports next year.



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GASOLINE GENERATOR**

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Powered by Ranger Aircraft 2 cycle, 9 hp, gasoline engine.

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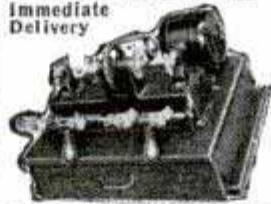
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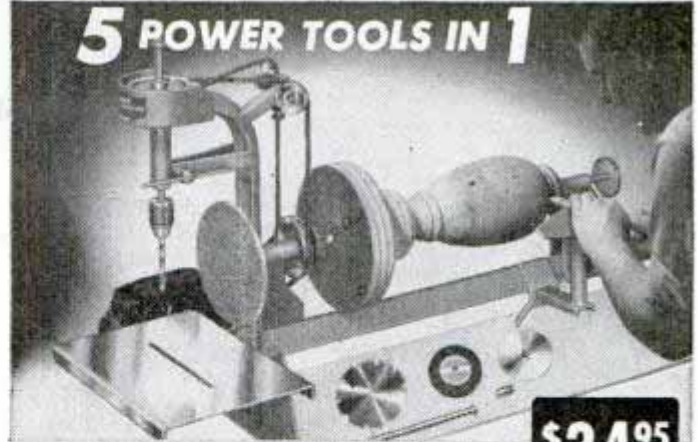
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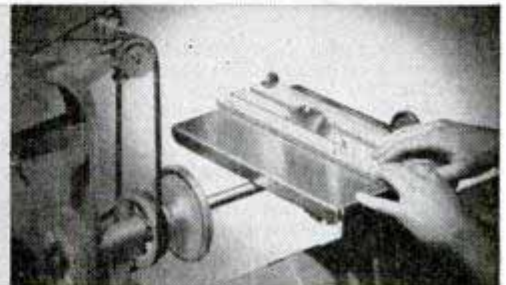
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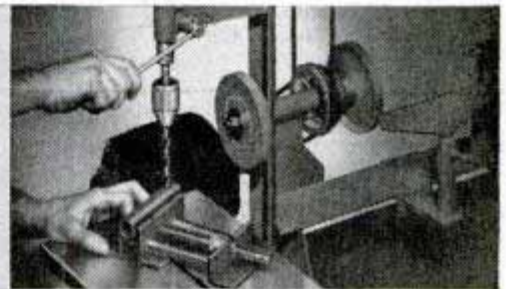
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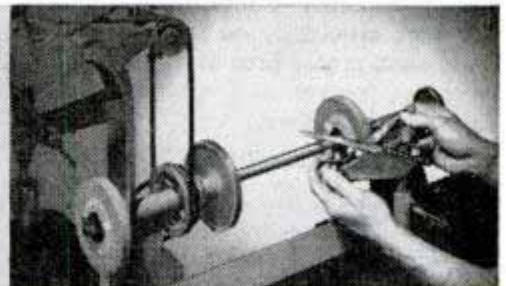
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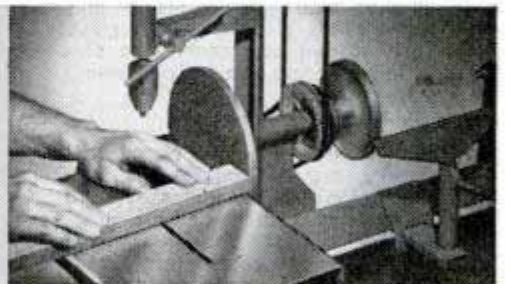
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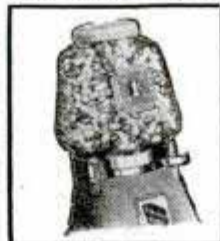
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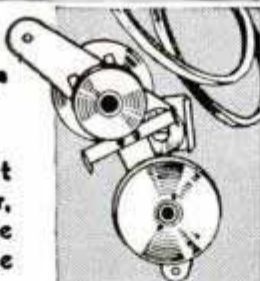
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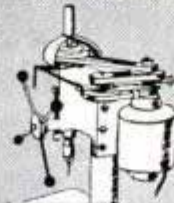
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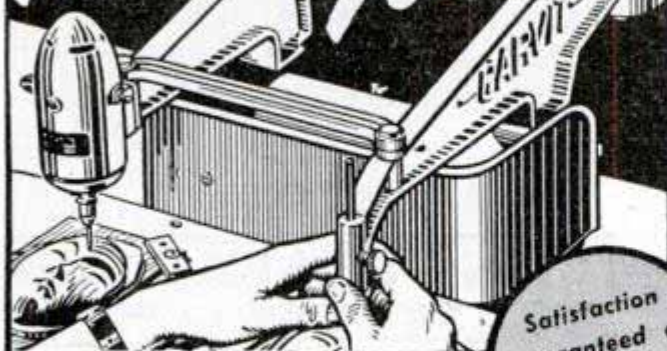
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Carving with the Carvit is fascinating fun for everyone. The Carvit is the ideal gift for your sweetheart, husband, or son! See this exciting new tool at your local hardware store today — or mail us the coupon below!

Satisfaction guaranteed or your money back in 10 days!

No skill or training needed to do work like this



Carve useful ornaments for the home — distinctive gifts for friends — fine carvings that sell!

Tear out coupon and mail today!

The Dumore Company, Dept. J-51, Racine, Wisconsin

- Please send complete information on the Carvit.
- Please send one Carvit. \$48.50 enclosed.
- Please send one Carvit with index attachment. \$58.25 enclosed. Shipping charges C.O.D.

Name.....
Address.....
City..... (.....) State.....

H-5

Get in on the ground floor! Be first in your area to enter this

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YOU'RE CERTAIN TO SUCCEED

BECAUSE DRYEX SUCCEEDS

WHERE EVERYTHING ELSE HAS FAILED!

DRYEX

**makes wet walls DRY
... and keeps them DRY!**



SELL OR APPLY DRYEX . . .
the great wartime discovery that will make big money for you!

Easy to brush on, easy to sell, DRYEX spells "opportunity" for you. Every owner of a leaky wall is your prospect, and there are thousands of them! Amazingly effective, DRYEX is the miracle plastic that seals leaky exterior walls definitely and enduringly. Stays tough, flexible and waterproof in all weather, all climates.

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New "THERMO-SAW" (cuts with heat)

MAKE THINGS FOR THE HOME or FOR SALE

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No Noise—No Vibration—No Sawdust
Boys and Mechanics thrill over the many interesting things that can be made with this NEW ALL-STEEL THERMO-SAW. . . You can cut out any pattern or design in 1/2 the time. . . Difficult patterns are made QUICK and EASY. . . No turning of work. . . Cuts in every direction! . . . Cuts plywood 1/8" or 1/4" . . . Cuts 14" x 36" board. Will cut 1/8" Plexiglas very well. . . A special transformer produces high frequency current in a tough steel wire "blade" from ordinary Alternating (AC) Current. . . IMMEDIATE DELIVERY!

Extra Blades ONLY 30c per dozen. ORDER TODAY
Machine Measures 11" x 4" x 3 1/2" High. Throat 7" Deep. PATTERN INCLUDED FREE.

AN IDEAL GIFT

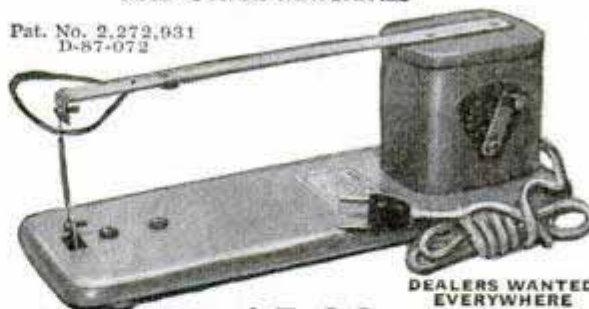
NOTE: Operates on 110-volt Alternating Current; 50 to 60 cycle.

\$6.23 in Canada & Mexico. \$6.48 elsewhere. On C.O.D. Orders Mail \$1 Deposit.

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Plain Spindle models less threads and collars C-4—\$8.00, C5—\$8.00, C6—\$9.00, D8—\$16.00 all P.P.

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Special Saw Arbors with 4 in., 5 in., 6 in., 7 in., housing length, add \$1.40. 1/2, 5/8, 3/4 models only. (30 day delivery).

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DESIGNED TO DO HIGH GRADE WELDING INEXPENSIVELY!

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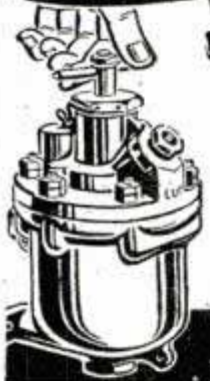
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Automatic, Self-Acting • Needs No Adjustments • Jet Type • Cannot Backfire • Powerful in Performance Natural, Manufactured or Butane Gas

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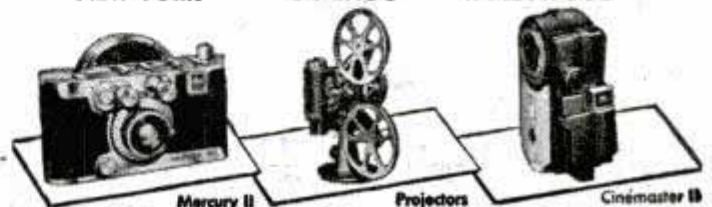
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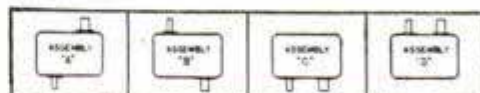


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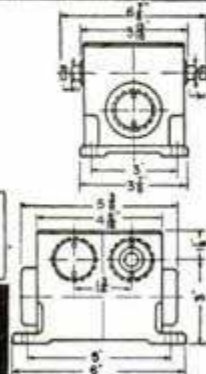
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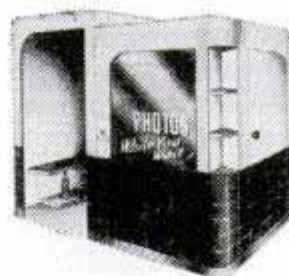
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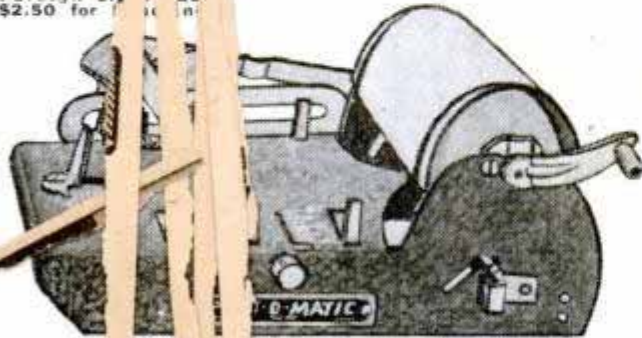
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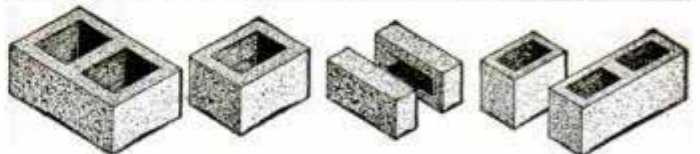
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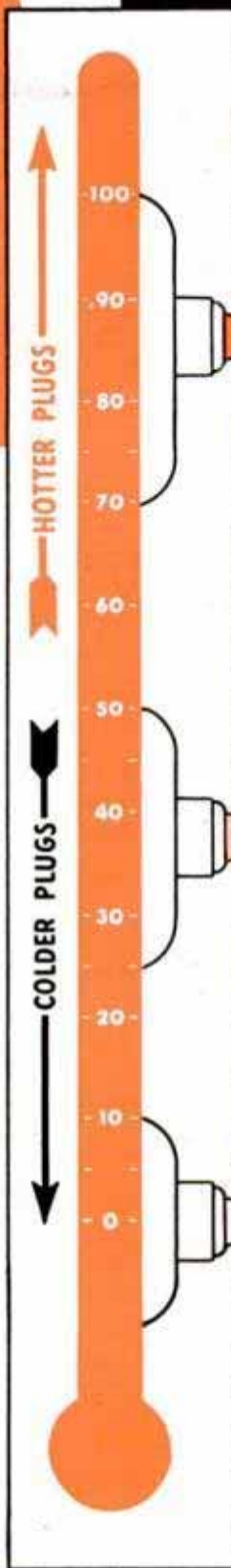
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Have you ever checked the Heat Range of your Spark Plugs?

THE HEAT range of a spark plug can be varied through such design factors as length of firing tip, insulator material, volume distribution in the firing end of the plug and material used in electrodes. Make sure your spark plugs are of the correct heat range for your engine. Auto-Lite spark plugs operate for any throttle range and load. Spark Plugs of correct heat range and a "Plug-Chek" at regular intervals using the Auto-Lite "Plug-Chek" Kit, will help stop power loss, gas waste and spark plug trouble. Mail the coupon today for the Auto-Lite "Plug-Chek" Kit which quickly helps you find spark plugs that are causing trouble or are of incorrect heat range. All you do is match plugs with pictures on the "Plug-Chek" Indicator—each example refers to a page in the "Plug-Chek" Data Book that shows you what needs to be done.



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AVERAGE DRIVING—The plug normally specified is of the proper heat range to handle all requirements under average driving conditions where the car is in reasonably good condition.



CONSTANT HIGH SPEED—Cars required to operate for long periods at high speed usually use colder plugs than normally specified, for best results.

Send for Auto-Lite "Plug-Chek" kit...only 10¢!

THE ELECTRIC AUTO-LITE COMPANY, Department PM4, Toledo 1, Ohio
Enclosed find ten cents for the Auto-Lite "Plug-Chek" Kit that includes both the "Plug-Chek" Indicator and Data Book.

Name _____
Address _____
City _____

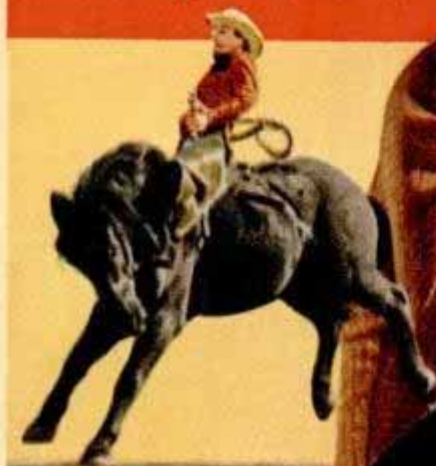
Switch to
AUTO-LITE
SPARK PLUGS

"EXPERIENCE IS THE
BEST TEACHER!

... in bronc riding
... in smoking too,"
says bronc-riding star

Jerry Ambler

EXPERIENCE? 18 years of rodeo.
Most recent crown is the saddle
bronc championship
of the world.



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EXPERIENCE WITH
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DURING THE WAR...
IT'S **CAMELS**
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More people are smoking CAMELS than ever before!

The wartime cigarette shortage was an experience
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BRONC-RIDING champion Jerry Ambler
is just one of millions, but his *experience*
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"I took any brand I could get. I couldn't help
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It's swell to get Camels again regularly."

Yes, those choice Camel quality tobaccos
are available again in sufficient quantity
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According to a recent Nationwide survey:

**MORE DOCTORS
SMOKE CAMELS**
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When 113,597 doctors were asked by three independent
research organizations to name the cigarette they smoked,
more doctors named Camel than any other brand!



YOUR "T-ZONE" WILL TELL YOU
... T for Taste... T for Throat...
that's your proving ground
for any cigarette.
See if Camels don't suit your
"T-Zone" to a "T."

R. J. Reynolds Tob. Co., Winston-Salem, N. C.