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POPULAR MECHANICS

MAGAZINE

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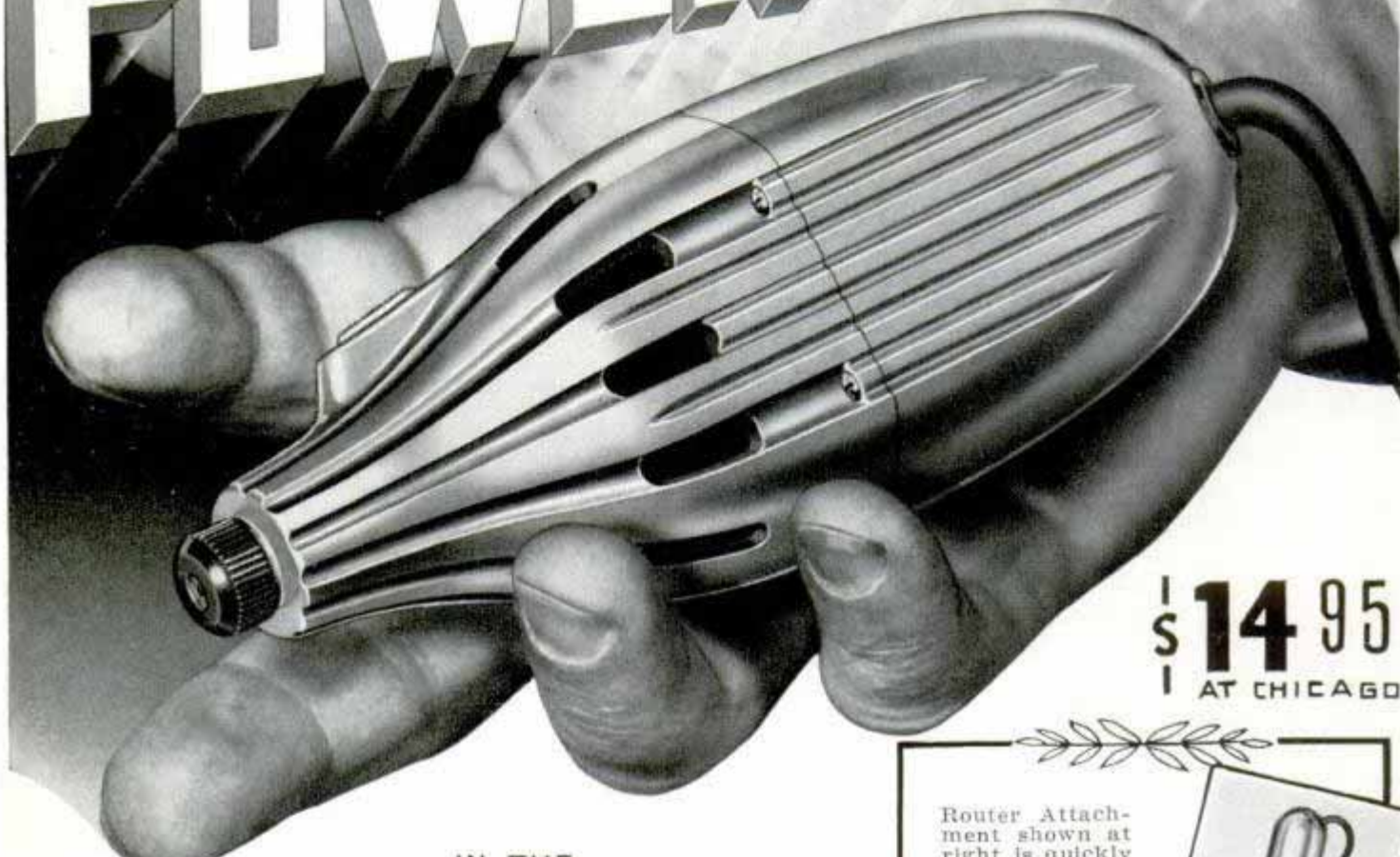
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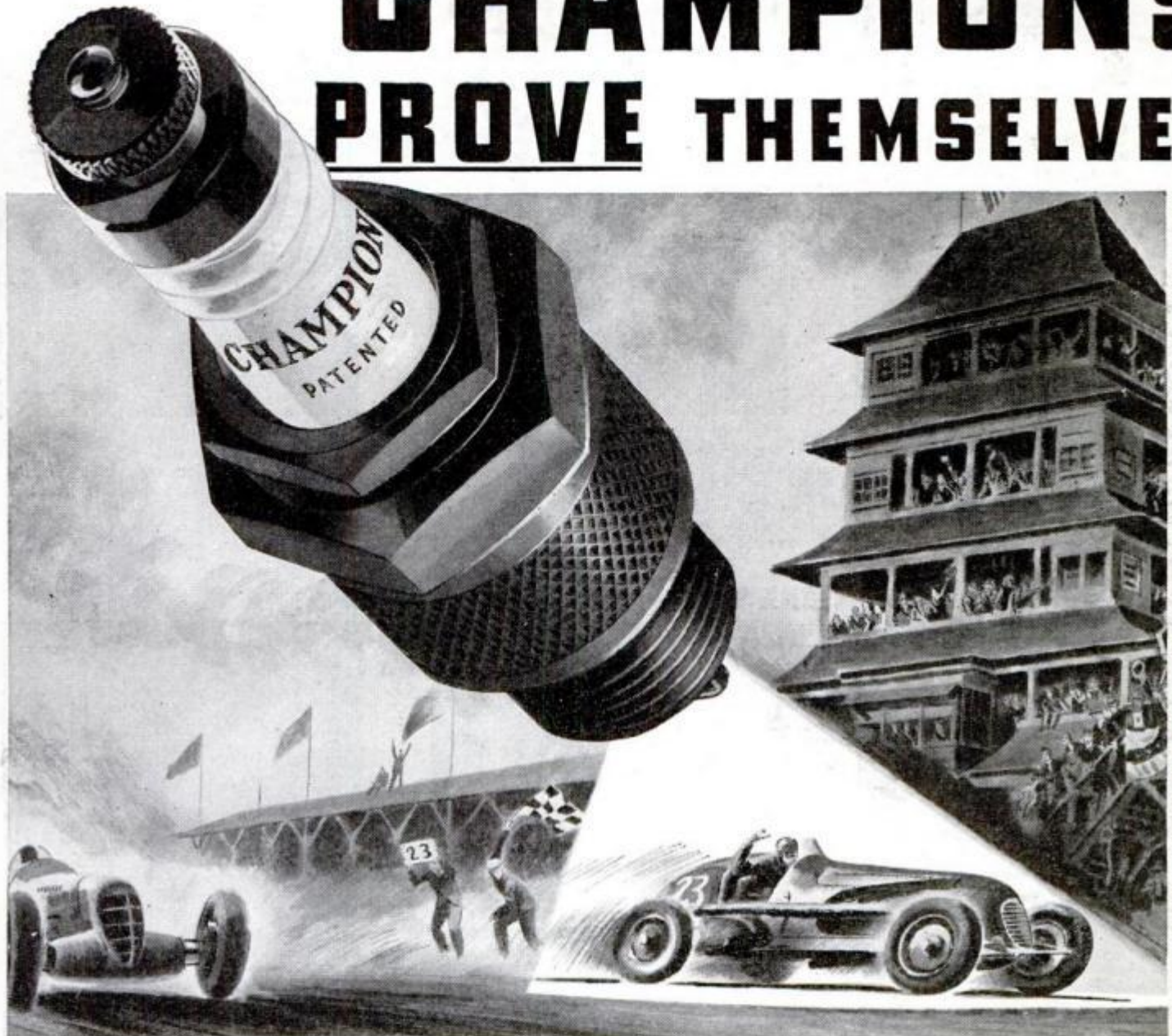
Router Attachment shown at right is quickly adjustable for depth of cut. Extremely rigid, it is ideal for routing, veining, and inlaying. Attachment for duplicate cutting is provided.

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wide. In twenty-seven years every facility and every resource of the company has been devoted exclusively to this one product and the one end—better performance with Champions.

Floyd Roberts, the winner of the 1938 Indianapolis 500 Mile Race, added a stirring chapter to Champion's history of racing achievements. His average of 117.2 m.p.h. is a new record. The first 10 cars to finish, in which not one spark plug was changed throughout the race, were all Champion-equipped.

CHECK AND CLEAN SPARK PLUGS WHEN YOU CHANGE OIL

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I asked a scientist "WHY?"



I'm a traveling man and I have to keep my car in good shape. One thing I've found out is that I need a new set of spark plug wires every 10,000 miles. If I go longer than that, the car begins to lose its pep—and my gasoline bills go up. So you can bet I have a check-up made regularly.



The last time I had my car overhauled, the mechanic sold me a set of spark plug wires called Packard 440. They were different from any I'd ever seen, with a black, rubber-like protective sheath instead of the usual cotton braid and lacquer covering. He said they would last twice as long.



I'm a curious cuss, so the next time I was driving through Warren, Ohio, I stopped at the Packard Electric factory where they make this Packard 440 cable. They took me to the Research Laboratory, and I asked the first scientist I met there—"Why is Packard 440 better cable?"

AND HERE'S WHAT HE TOLD ME . . .



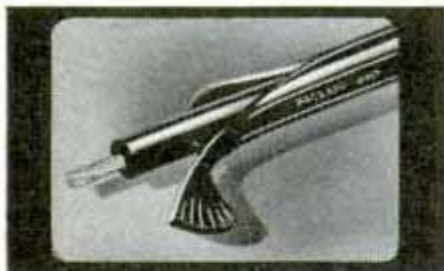
"Well," he said, "to answer that question we have to consider first what spark plug cables are. They are wires designed to carry the tremendous surge of electricity to the spark plugs without leakage; a thick rubber insulation is the only thing that will do this.



"But rubber is an *organic* material. It comes from trees, and, like all organic materials it becomes cracked and rotted by heat, oil, moisture, age and abrasion. Moreover, rubber is easily oxidized by the ozone from corona which surrounds high tension wires. Oxidation is like slow burning.



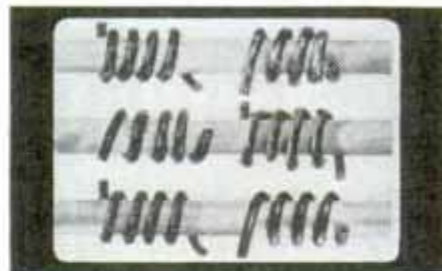
"To protect the rubber, cable manufacturers have been using cotton braid and lacquer. But these materials are *organic* too—both derived from the cotton plant! Therefore they are broken down by heat, oil, moisture, age and abrasion. Soon the rubber is exposed, to be eaten away by corona.



"So Packard set out to find some sort of protection for the rubber insulation which was *not* organic. It had to be pliable, tough, and able to stand up under the most grueling tests we could devise here in the laboratories. At last we found it—a secret-formula, *inorganic* sheath.



"This new sheath is a composition made from coal, salt and water. It looks and feels like rubber, but it resists heat, oil, moisture, abrasion, age and corona because it is *inorganic*. It's the first really satisfactory solution to the problem of protecting the rubber insulation."



Well, to prove it to me he brought out some 1-inch mandrels with six different cable samples wrapped around them. They had all been through the same series of tests—hot oven, hot oil, salt water, high voltage. The five lacquered cables were cracked and ruined. The Packard 440 was good as new!

That convinced me that he knew what he was talking about! But the *real* proof of these Packard 440 cables is the way they've stood up in my car! I'm getting better pep, power and mileage than ever, and they've been in there for 20,000 miles, with no signs of cracking. I'll say they're better!

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Popular Mechanics Magazine

H. H. WINDSOR, Founder

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

September, 1938

Vol. 70, No. 3

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The Age of Color

WE ARE spending millions of dollars for color today and, as a result, this world is being changed from a dull, drab sphere into a gay and cheerful place garbed in all the hues of the rainbow. America alone uses about \$50,000,000 worth of dyes annually. These dyestuffs sell, or help to sell, six or seven billion dollars' worth of merchandise each year because, to a great extent, we buy what pleases the eye. Not so long ago only royalty or the very wealthy could afford richly colored possessions. Today nearly everything we own or use is made more attractive by color, and the most inexpensive piece of cotton goods may be adorned with most of the hues of the spectrum. This miracle has been wrought largely by coal and chemistry, and an article next month explains not only the importance of color in our lives but the chemical magic which extracts much of it from black, unlovely coal. Eight pages of Coloroto pictures illustrate the story.

Next Month

WITH more planes being groomed for the air races this year than ever before, new American speed records are looming for 1938. Straightaway speeds of 300 miles per hour, and averages of 275 miles per hour around closed courses will probably be surpassed, say the speed fliers. An article next month describes these new racing creations.

Electrical Cowboys

MAN cannot stop bolts of lightning, but he can stop electrical energy representing 2,000,000 horsepower in just one-twentieth of a second. And because he has learned to halt this tremendous power almost instantly in an emergency, thousands of tons of falling water at Boulder Dam supply a smooth flow of power to Los Angeles, 270 miles distant, over two of the most wonderful transmission lines in the world. All of which makes an interesting story for the October issue.

Flying Wrangler

ROUNDING up wild mustangs is exciting business under any circumstances, but flying an airplane into mountain canyons to rout out the horses, then using the plane to chase them into a blind corral is not only thrilling but hazardous. That's the way Floyd Hanson earns a living, and a writer who made a trip with him describes the experience next month.

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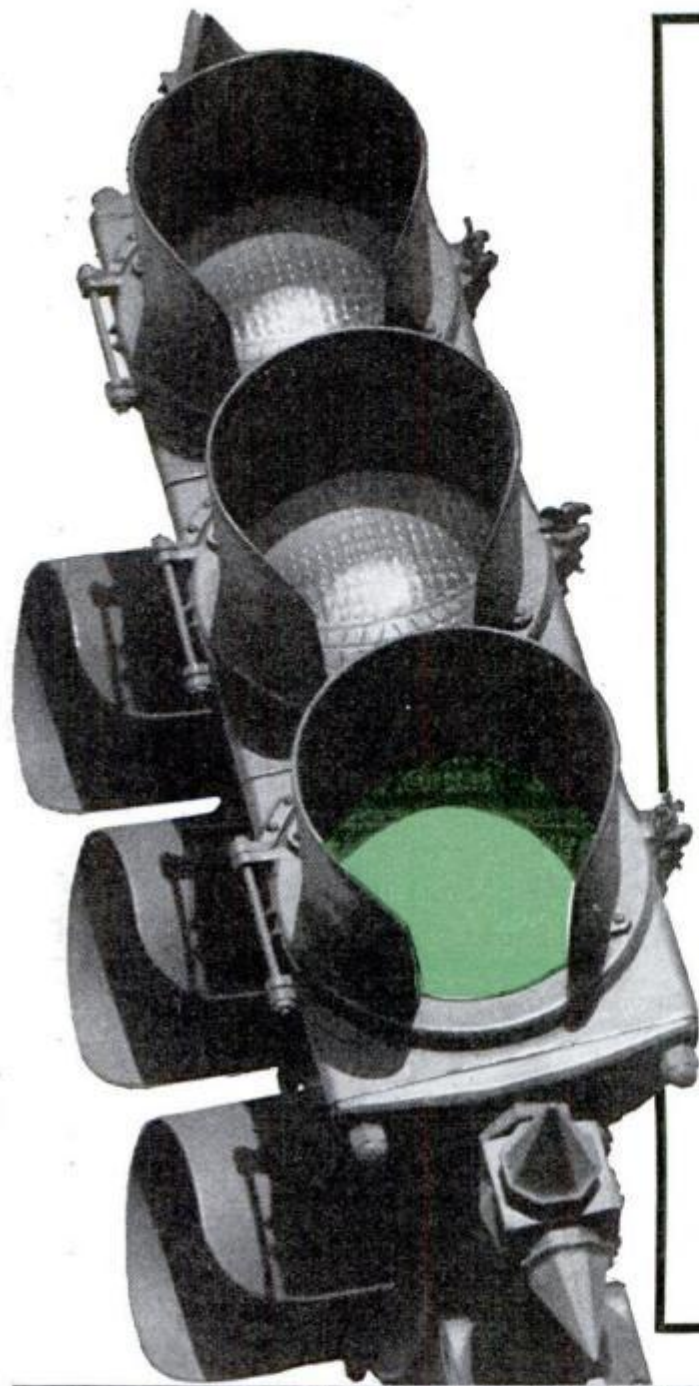
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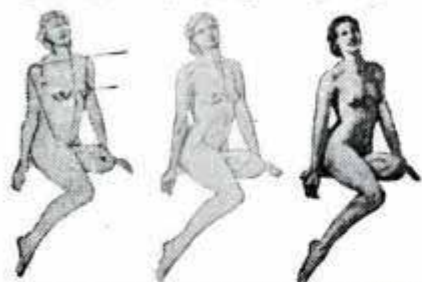
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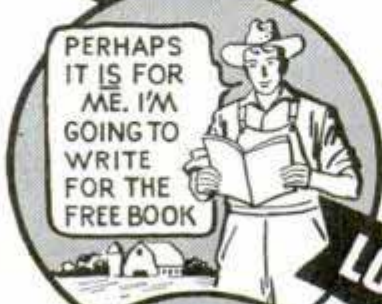
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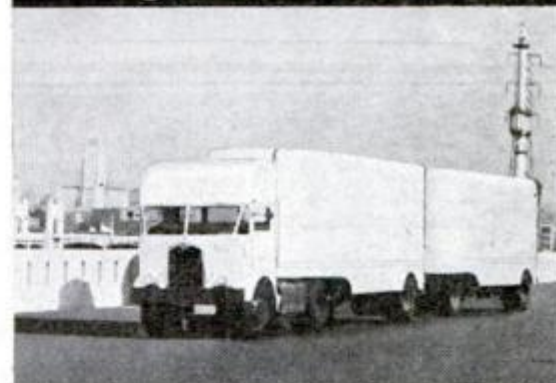
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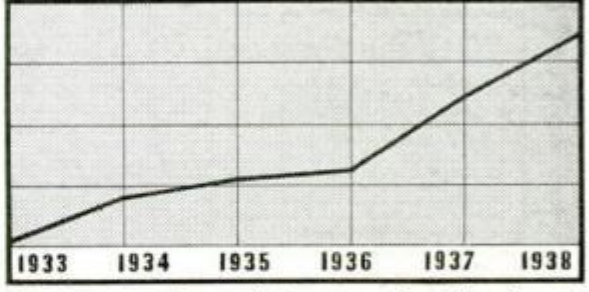
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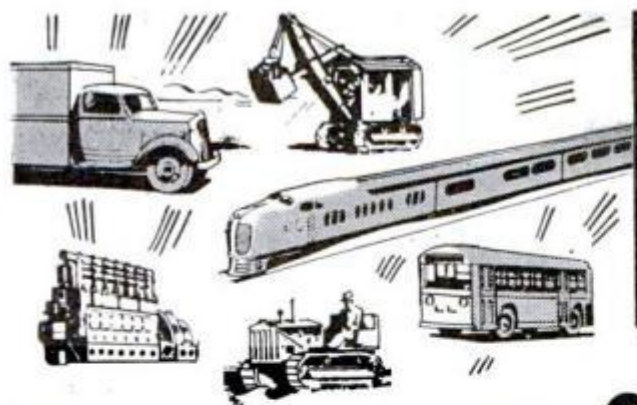
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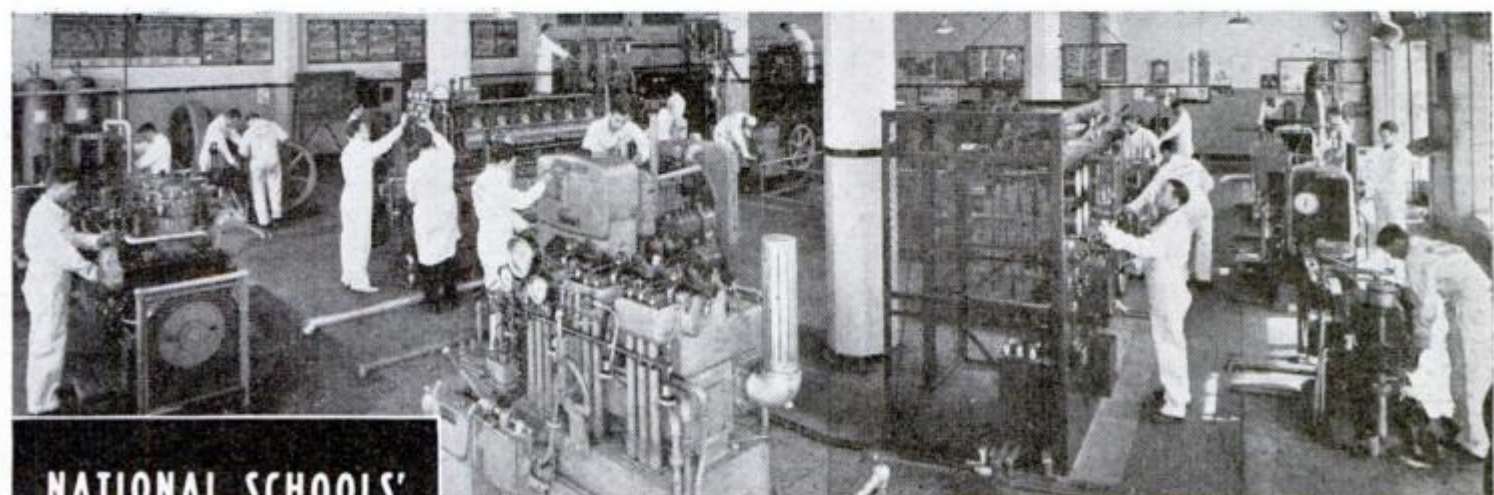
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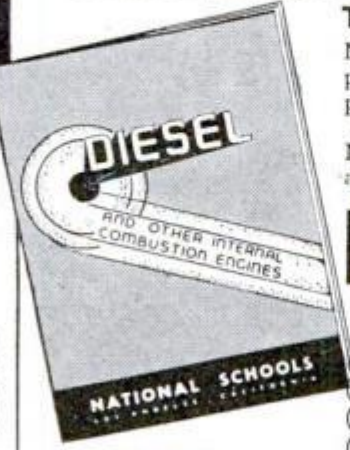
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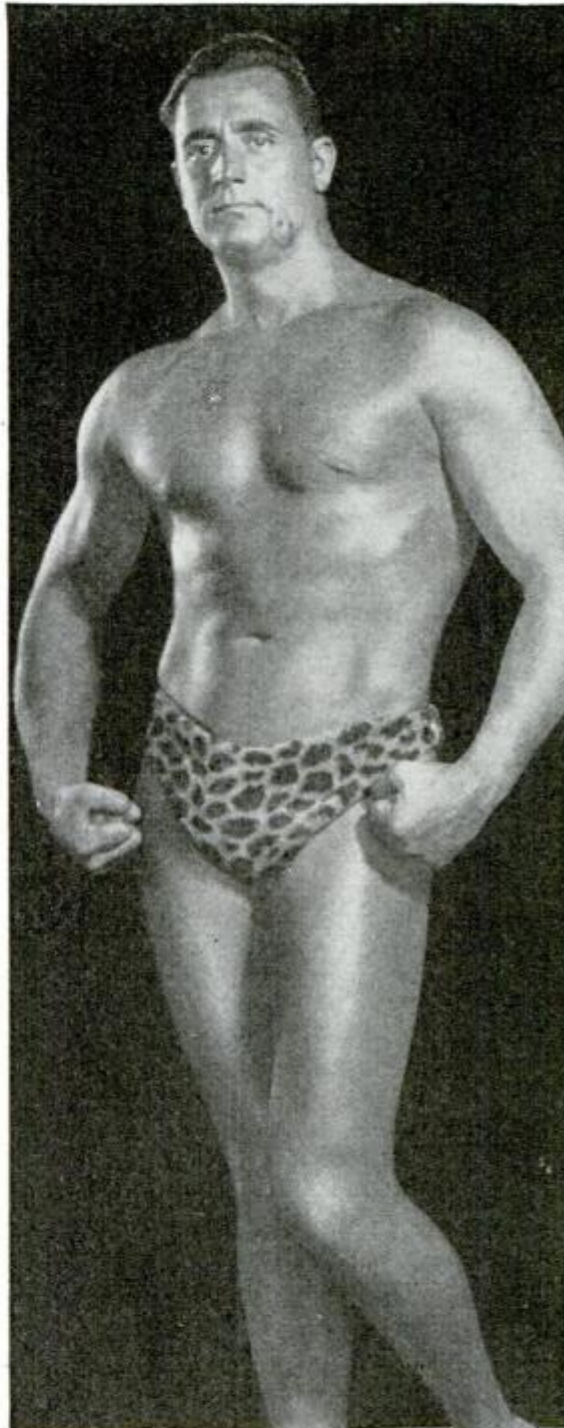
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Charles Atlas—
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97 pound weakling to "The World's Most Perfectly Developed Man." And now you can have a big, balanced muscular development like mine in the same easy way.

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NEW



INVENTIONS

PROPER application of lipstick is the purpose of a mechanical stencil patented recently.

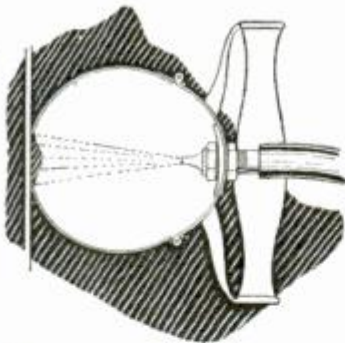


The device consists of a pair of upper and lower crescent-shaped frames pivotally mounted at both ends for swinging movement about a common axis. The stencil is placed about the user's lips, enabling her to apply the lipstick without smearing or getting it outside the range provided by the device.

stencil is placed about the user's lips, enabling her to apply the lipstick without smearing or getting it outside the range provided by the device.

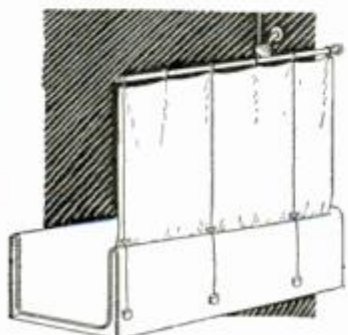
TO PREVENT paint from scattering over adjacent surfaces and into the air, a newly patented guard for spray guns confines the spray to the desired area.

The guard fits on the head of the spray gun, then extends in semi-circular fashion to close about the area to be painted. The guard is adjustable.



about the area to be painted. The guard is adjustable.

DESIGNED to keep the shower curtain in place so that it will not wrap around the bather's body nor dangle outside the tub to drip water on the bathroom floor, a newly patented curtain soon may be placed on the market. It is suspended from a



rod extending the length of the bathtub. Also suspended from the rod, and connected to the outside of the curtain, are cords at the end of which are weights. These weights, hanging outside the tub, hold the curtain against the inside of the tub.

rod extending the length of the bathtub. Also suspended from the rod, and connected to the outside of the curtain, are cords at the end of which are weights. These weights, hanging outside the tub, hold the curtain against the inside of the tub.

GREATER safety for the apartment-house dweller and the office worker is the purpose of a new-type fire escape patented recently.

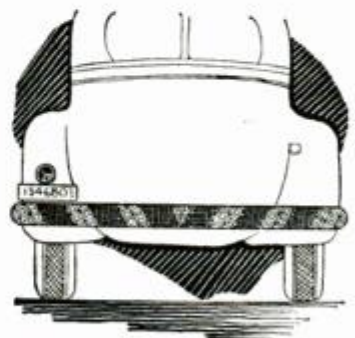
In a shaft enclosed by the walls of the building, platforms moving on sprocket chains provide for transport of persons from upper floors to the ground. The platforms fold at the bottom for the return trip to the top. The sprocket chains are of the endless type. Access to the fire escape is provided by doors from balconies adjacent the escape shaft. Much of the hazard of climbing down fire escape ladders is eliminated by the new equipment.



The platforms fold at the bottom for the return trip to the top. The sprocket chains are of the endless type. Access to the fire escape is provided by doors from balconies adjacent the escape shaft. Much of the hazard of climbing down fire escape ladders is eliminated by the new equipment.

INCREASED safety against rear-end collisions is the intent of a newly patented automobile rear bumper which has several reflector plates attached at intervals across its outer surface.

Designed to supplement the single small reflector at the rear of the car, the bumper would reflect an approaching auto's lights across the entire width of the automobile ahead.



Designed to supplement the single small reflector at the rear of the car, the bumper would reflect an approaching auto's lights across the entire width of the automobile ahead.

(Continued to page 46A)

DOESN'T IT LOOK EASY?

Yet it's from the famous
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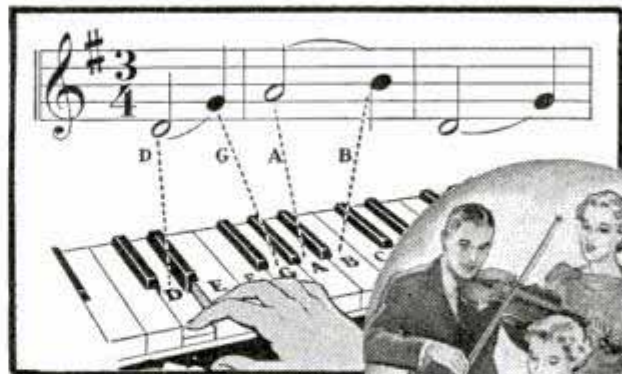
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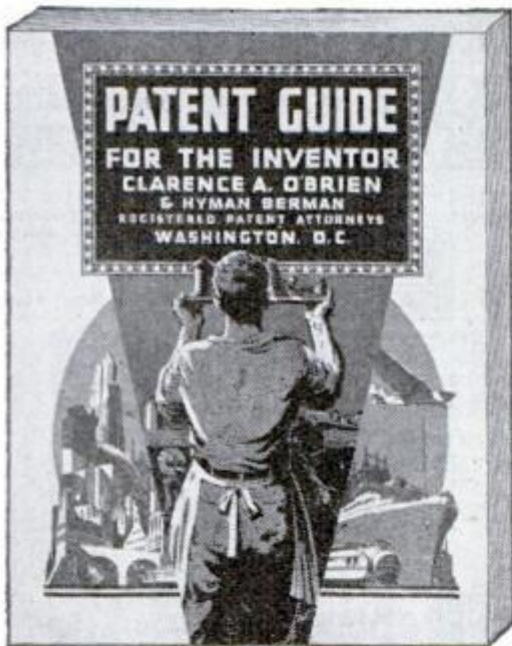
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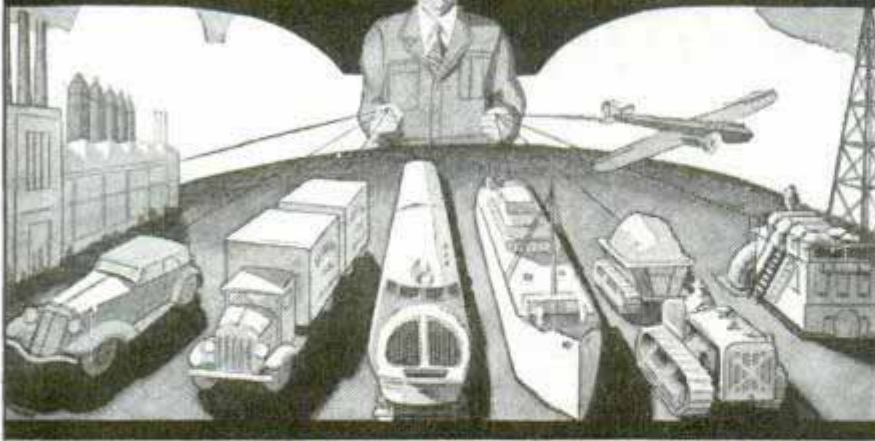
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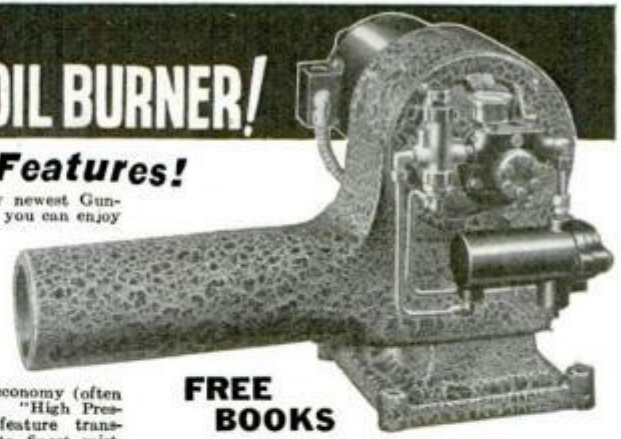
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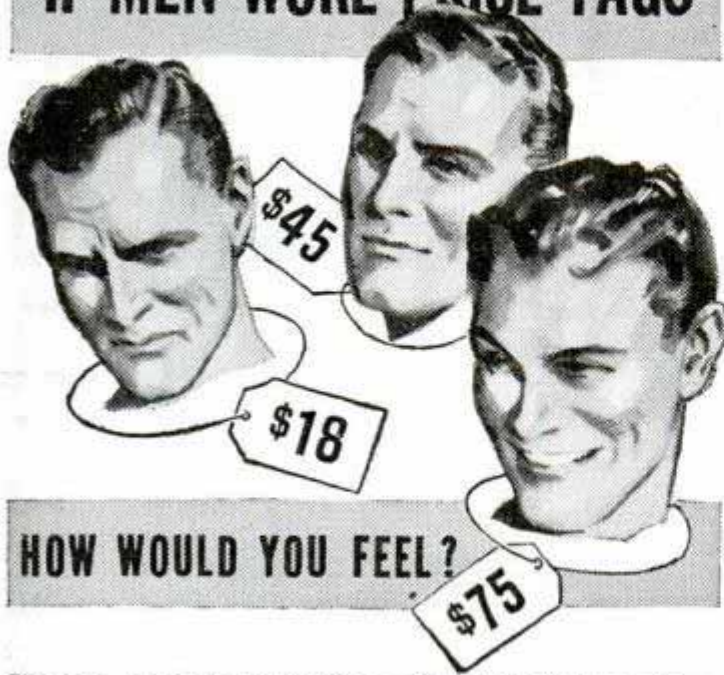
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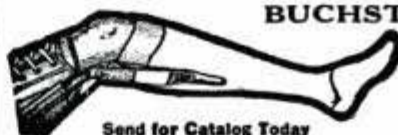
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INVENTORS—Small ideas may have large commercial possibilities. Write us for free book, "Patent Guide for the Inventor" and "Record of Invention" form. Delays are dangerous in patent matters. Free information on how to proceed. Clarence A. O'Brien and Hyman Berman, 58-F Adams Bldg., Washington, D. C.

FASCINATING Business. Repair, adjust typewriters, adding machines. Learn easily at home from factory expert. Earn up to \$15.00 daily. Complete instructions covering all makes \$3.00 postpaid or sent C.O.D. Adding Machine Equipment Service, 3601 Michigan, Dept. 3436, Chicago.

FORMULAS—Fast selling products. Guaranteed. Laboratory tested. Lowest prices. Catalog free. Kemico, 55H, Park Ridge, Ill.

HYDROPONICS: Grow plants and flowers without soil. Chemical crop culture. Interesting, educational. Unusual yields. Formulas, instructions and selected bibliography, \$1. Hydroponics, Box 613, Guthrie, Ky.

YOU'LL Like resilvering mirrors, auto-parts, reflectors, making chipped glass signs. Write, Sprinkle, Plater, 127, Mari-on, Indiana.

ROGERS Basic units! Latest opportunity! Send name. Rogers, Waverly, Va.

BUILD Own permanent business, home or office, little or no investment. Business methods with unlimited market. Booklet free. F. V. Low, 238 E. Bootfield Ave., Flint, Michigan.

"MAKE Mirrors at home." Big profits. Little outlay. Also emboss, grind—foil, gold leaf, frost, chip and make imitation stained glass. Instruction course \$1.00. Bestovall, 4047-RM N. Whipple, Chicago.

OPPORTUNITIES Aplenty! Money-makers that "click"! Unusual "idea" service! Particulars free. Cee-Tee Company P-1079 Madison St., Brooklyn, N. Y.

DECORATE Fast selling novelties, experience unnecessary. Large profits, 10 cents brings full instructions. Plastic Arts Studio, 711 Neely, Muncie, Indiana.

MONEY Making plans to fit your needs. Particulars free. Select Books Co., 2732 Woodburn Ave., Cincinnati, Ohio.

START Your own business. 50 complete methods 25c. Sam Graham, Warrenton, Virginia.

ACT Wisely and make money. Read "Inside Legal Information." 25c. Dept. B, 234 Hurst Bldg., Buffalo, N. Y.

BIG Pay made in mail order business. Write. Strauss, Owings, W. Va.

GIGANTIC Mail, unlimited opportunities, bargains. Send dime. Details sent free. Let us mail your circulars, 30c per hundred. Ippolito, 279 Myrtle, Buffalo.

CALIFORNIANS Growing plants without soil, fascinating. Sample ingredients, formula 50c. RSRC Laboratories, 4327 So. Normandie Avenue, Los Angeles.

BE Successful in business. Learn elementary and guiding principles from expert. Don't lose time and money experimenting; study and win. Complete course reasonable. Free booklet. Gardner & Gardner, 212-A Eighth Ave., S. W., Cedar Rapids, Iowa.

\$250 STARTS "Chain" of penny gum and confection vending machines. Steady cash income. Details free. Robbins Co., 1141P DeKalb Ave., Brooklyn, New York.

CHIPPING Glass signs booklet free. Beveridge, 160-22 Locust, Jamaica, N. Y.

EXCELLENT Mailorder opportunity. Interesting information stamp. JS Service, 126 Lexington, New York.

BATTERY Business answers your wish for interesting happy occupation as employee or employer. Makes you independent, brings plenty of money. You restore automobile, airplane and other storage batteries at large fees. All or part time. Need everywhere. We teach completely in few weeks. Write for booklet. Derr Institute, 26 McKinley St., Baldwin, N. Y.

SELL Opportunity books by mail, on commission. Big profits. No stock necessary. Maywood, 921 Broadway, New York.

QUIT Playing at the mail order business! Make real money—others are! "6000 word folio." 3c. Dr. Swearingen, Station "S," Los Angeles.

PERSONALITY Wins jobs! Your way to success—booklet 25c. Box 33, Wapakoneta, Ohio.

MAKE Colored pottery, statuary, novelties, souvenirs. Write. Colorcraft, 489 Arcade Bldg., St. Louis, Missouri.

MONEY Made quickly, honestly. No canvassing. "Business Opportunity" circulars free on request. Board's Distributing Center, 1912 - 14th St., Washington, D. C.

MOLD Making rubber \$1.50 quart. Instructions free. See samples. Novelty Supply Co., Grayling, Michigan.

BIG. Steady, profit business for you! Spare or full time. Marvelous discovery electroplates with small brush—easy as painting. Equals beautiful, permanent plating—gold, silver, nickel, cadmium, etc.—as costly tank outfits. No liquids. Portable—anyone can plate anywhere on the spot. No dismantling of article you plate. Complete—ready to use outfits—from \$6.85 up to \$27.50 for professional, heavy duty type. Work from dry battery or household current. Write at once for big money proposition; you can also make steady money plating for others. Warner Electric, 360 N. Michigan Ave., Dept. C5, Chicago, Ill.

MONEY In advertising. 57 Plans \$1.00. Universal, Box 546, Jacksonville, Florida.

MAKE Money growing vegetables, fruits, flowers, plants without soil. Use only water and chemicals. Formula 50c. Kemixal, 179, Park Ridge, Ill.

LATEST Booklet describing 100 best magazine markets for your snapshots and photographs, only 25c. Simmons, 1412 Great Northern Bldg., Chicago.

PROFIT With new products. Make, sell, repeat. Analysis. Research. Guaranteed formulas. Biggest catalog free. Special prices, leads. Gibson Laboratory, Chemists, BD-1142 Sunnyside, Chicago.

EARN Up to \$500.00 two months. Stamp brings particulars. Lightning Speeds, Streator, Illinois.

HUGE Profits growing plants without soil. Produce flowers, fruits, vegetables anywhere year round with chemicals. Season's supply, directions, \$2.00. Formula, bibliography, \$1.00. Both \$2.50. Chemi-Culture, 4701 Sheridan, Chicago.

SELL By mail from home; spare time. Personal contacts unnecessary. Unlimited opportunities. Become independent. Novel revolutionary plan, \$2.95 supplies everything necessary. No get rich quick scheme. Get sample, particulars 25c. Nothing free. Specialty Services, Box 515, Minneapolis.

MAN In each town to plate auto parts, reflectors, bicycles, fixtures, mirrors, by late method. Simple plan of manufacturing at home starts you in good paying business. Free particulars and proofs. Gunmetal Co., Ave. H. Decatur, Ill.

MANUFACTURE Our product. Basement suitable. 10c brings sample, information. Continental Insulation Co., 412 Watson St., Aurora, Ill.

PROFITABLE Mail order business in your home. Kessler, Box 311, East St. Louis, Ill.

MAKE Artificial marble, glazed tiles, uncanny. Tabletops, plaques, floors, hones, novelties. Hard, fireproof, inexpensive, cement secrets. Brilliant tile and liquid rubber samples 3c. John A. Payn, 945 Grande Vista Avenue, Los Angeles, Calif.

FREE—Big mail. Write now! Freclaroc, 2202 Orchard St., Chicago.

SOAP Making. Learn at home. No machinery needed. Posera, 4545C Bartlett, Milwaukee, Wisconsin.

RUBBER Mold bargains! Stamp brings catalog. Colonial Art, Derry, N. H.

MAKE Money manufacturing new building material. Low in cost, permanent, attractive. Big growing market. Equipment \$25.00 up. Equipment Co., Holland, Mich.

MEXICAN Feather pictures. 100% profit, easy sales. 50c (stamps) bring \$2.00 worth samples, details. Refunded if unsatisfied. Mexicanart-M, Apartado 1593, Mexico City.

USED Popcorn poppers, carameltcorn equipment. Northsyde, 1528 - 19th, Des Moines, Iowa.

MANUFACTURE From Phospholene. Cleaning fluid 1c gallon; bleach 2c gallon; hand soap 2c pound; and ten fast sellers. Sample 25c. Details free. Western, 6615 Denison Ave., Cleveland, O.

WHERE To buy at lowest wholesale prices. Information free. Yorena, Box P-312, Bayonne, N. J.

HOW And where to obtain capital fully explained, free particulars. Star Service, Wapakoneta, Ohio.

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

LIQUID Marble—anyone can make! Colorful, glazed! Moulded, brushed, sprayed. Rubberlastic moulds. Composition flooring. Big money in these! Particulars free. Marbleizing Service, Edwardsville, Ill.

107 WAYS To make money, in home or office, business of your own. Full particulars free. Elite Co., 214 Grand St., New York.

AFTERNOONS Free for outdoors, shows. \$340 month home. Unique plans. No canvassing. Prepare for surprise. Folio-F, Station D. Los Angeles.

WE Start you in business, furnishing outfits and instructions, operating Specialty Candy Factory home. Men and women, earn \$25 up to \$60 weekly, all or spare time. (Our 29th year.) Booklet free. W. Hillyer Ragsdale, Inc., Drawer 4, East Orange, N. J.

SUCCEED With your products. Make-sell them. Formulas. Processes. Accurate analyses. Catalog free. B. Thaxly Co., Washington, D. C.

PROFITABLE Home business. Legitimate. No canvassing. Maywood Publishers, P-923 Broadway, New York.

I WANT To send you proof of the wonderful pulling power of Popular Mechanics Magazine's classified pages. What's your proposition? Write me today. F. W. Johnson, Manager Classified Advertising, 200 E. Ontario St., Chicago, Ill.

SELL By mail. Books, novelties. Bargains! Big profits! Particulars free. B. Elfco, 438 N. Wells, Chicago.

FREE Booklet describes 107 plans for making \$20-\$100 weekly, in home or office, business of your own. Elite Co., 214 Grand St., New York.

CHARTERS: Delaware; best, cheapest; free forms. Colonial Charter Co., Wilmington, Del.

DELAWARE Charters: Complete service \$35. Submitted forms. Chas. G. Guyer, Inc., Wilmington, Del.

ARTIFICIAL Marble sanitary flooring, instruction covering wood or cement flooring 1/2 inch thick, fireproof, all colors, low cost, ornamental casting, concrete, plaster, papier-mache, garden furniture, statuary, flexible molds, particulars free. Chris Mahler, Elmont, N. Y.

MAIL Order business is your opportunity. Many began small, now earn thousands yearly. No personal contact. Boundless opportunities. Have had over 30 years experience; will help you succeed. Send 25c for valuable booklets, none free. B. Brenner, 257 S. 21st, Philadelphia.

100 PROFITABLE Mail order and local plans. Gilbert Supply, 1107 Broadway, New York.

ARC Welder bargains. Used, trade-ins, rentals, demonstrators. Write for price list. The Lincoln Electric Co., Room 21, Cleveland, Ohio.

COLOR-GLAZED Concrete pottery, tiles, walls. New method. No molds. Use only sand, cement, cheap materials. Money-making business for men. Colorplate, details free. National Potteries, 13 West 26th, Minneapolis, Minn.

PROFITABLE Home mail business, fully equipped, \$2.95. (\$15.00 value). Enormous returns. Product details 25c. Thompson, Box 241, Duluth, Minn.

AMAZING. New, economic plant fertilizer. 25c. Sanquist Co., Pomeroy, Iowa.

6 MAIL Order magazines, including all you must know about mail order business 10c. Armand Cartier, 31 Cumberland St., Woonsocket, R. I.

LIKE To draw? Earn steady income tracing and duplicating advertising cartoons. Ad-Service, Argyle, Wis.

MONEYMAKING OPPORTUNITIES

MAILORDER Opportunities, plans, formulas, information. Circulars free. Harvey Teeple, Decatur, Indiana.

MAKE Your spare time profitable; free details. Keyes Associates, Box 455, Wellston, Sta., St. Louis, Mo.

MILLION Articles. Buy wholesale. Valuable directory 10c. Ideal Service, Park Ridge, Ill.

MONEY Means pleasure. My 64 page book shows how, 25c. Write today. Gurney, 4825 So. Marshfield, Chicago.

TWENTY Money making secrets exposed \$1.00. Snyder Industries, 114 Ridge, State College, Penna.

MILLIONS Jobless! Get dollars in mail daily, like we do, for amazing employment information. Keep money; we fill your orders free. Free—"32 Ways to Make \$1,000,000"—for stamp. Co-Operative Service, 77 Swan, Buffalo, N. Y.

YOU'LL Like resilvering mirrors, auto-parts, reflectors, making chipped glass signs. Write, Sprinkle, Plater, 287, Marion, Indiana.

LATEST Sensational opportunities, money-makers—10c. B&BP, 676 Baseline, San Bernardino, California.

DIME Brings six months Our Salesman, 1202 Mathewson, Wichita, Kansas.

GROW Without soil—Flowers, vegetables, plants. Year round, anywhere. Only water and common chemicals used. Formula 50c. Bestovall, 4047-W North Whipple St., Chicago.

RABBIT Raising. We pay to \$7.00 each. Catalogs 10c. Rabbitries, Bowling Green, Ky.

MONEYMAKING And spare time ideas in the Sterling Digest. Copy 10c. 907 4th St., Sheboygan, Wisconsin.

\$10.00 DAILY Stamping names on key-checks! Outfits furnished. Sample, instructions, 25c. Bohn Co., Box 86 P.M., Wilkes-Barre, Penna.

GROW Plants and flowers without soil. Formula, instructions, and chemicals for 50 gallons of solution \$1.00. Hackard, 3816 Belmont Ave., Chicago.

ANALYSIS. Research. Newest guaranteed formulas. Biggest catalog free. Special prices, leads. Gibson Laboratory, Chemists, CS-1142 Sunnyside, Chicago.

10c BRINGS Copy National Mail Order News. Box 1773PM10, Roanoke, Virginia.

MAKE And sell small household articles yourself. Send \$2.00 for blueprints. Box 60, Mansfield, Ohio.

THIS Proposition represents an opportunity for you, no canvassing. Ten cents. George Weeks, Montebello, Calif.

FREE—100 Wonderful business, mail-order and home work moneymaking offers. Lewis Co., 828-C Carpenter, Oak Park, Illinois.

EARN Money collecting reptiles, toads, frogs. We buy all varieties. Splendid opportunity. Particulars free. Biological Research Laboratories, Dept. 14-C, Springfield, Missouri.

GROW Plants, flowers, vegetables, without soil—in water, with our chemicals, which supply ingredients found only in most fertile soils. Enormous yields in small space in home or back yard. Fascinating, profitable hobby. Send \$1.00 today for season's supply of chemicals, formula, and complete instructions. United Chemical Labs., P.O. Station U, Box 2, New York.

"INNERCIRCLE Magazine" tells how others make money. News, plans, mail-order offers. 6c. Box 7620, Kansas City, Mo.

OUR Formulas are money makers. Catalogue. Industrial Laboratories, 1200 Niagara, Buffalo, N. Y.

RUSH 10c Coin for booklets describing hundreds of novel ways to make money, spare time. Marvin Studios, Bedford Bldg., Chicago.

YOUR Name—5,000 mailing lists—25c. Get samples, opportunities galore from all over world. Pines, 583-P Monroe, Brooklyn, N. Y.

START Mailorder business. Details free. Pederson, 1609 1/2 East Fifth, Duluth, Minn.

STOP Squealing—Start crowing! Work mornings home—country drives or movies—afternoons! No canvassing! Folio-A, Station "D," Los Angeles.

MAN In each town to plate auto parts, reflectors, bicycles, fixtures, mirrors, by late method. Simple plan of manufacturing at home starts you in good paying business. Free particulars and proofs. Gunmetal Co., Ave. N. Decatur, Ill.

RAISE Earthworms for profit. Information free, stamp appreciated. Bureau Zoological Research, 106A Broadway, Peoria, Ill.

107 PLANS For making \$20-\$100 weekly in home or office business of your own. Descriptive booklet free. Elite Co., 214 Grand St., New York.

WHOLESALE Sources, 500,000 articles. Free directory. Maywoode, 925 Broadway, New York.

FREE! Celebrating 40th year, publisher "Schemer," Alliance, Ohio, presents dollar check to each sending 25c for three copies, different—contains schemes, ideas, business opportunities, formulas.

MAILORDER Opportunities. Attractive novelty, dandy plan; 5c. Daufeldt, Atalissa, Iowa.

UNEMPLOYED? Don't be! Valuable information free. Richards, 280 Broadway, New York.

FORMULAS, PLANS, ETC.

FOLDING Paper boxes, display cards, all kinds die-cutting. Lowest prices—Quality Work. Ace, 721-723 Wyandotte, Kansas City, Missouri.

OPPORTUNITIES! New money makers! Formulas! Free literature. Rokemko, Waverly, Va.

"ANYTHING In Formulas." \$1.00 each, five \$3.00. Satisfaction guaranteed. Research Bureau, 100 Chelsea, Charlestown, Massachusetts.

GUARANTEED Formulas—New fast sellers. None better. Lowest prices. Catalog free. Kemico, 49H, Park Ridge, Ill.

MODERN Formulas, good sellers, 10 formulas, creams, lotions, shampoos—50c; cleaners, polishes, moth killers—50c. Chemical Specialties, 51 Manor Ave., Oaklyn, N. J.

FORMULAS: 15 Proven moneymaking formulas \$1.00. (Not stock-formula catalogue stuff), real unusual offers. List free. Marvel Laboratories, 6629 No. Maplewood, Chicago.

MECHANICS Soap paste (1938). Inexpensive. Formula 25c. Formulas a specialty. Tom Moore, Chemist, Waterloo, Iowa.

ANALYSIS. Research. Newest guaranteed formulas. Biggest catalog free. Special prices, leads. Gibson Laboratory, Chemists, BD-1142 Sunnyside, Chicago.

NO Service like this! Certified formulas based on correct chemical analyses of today's most popular specialties! Stamp brings valuable information. Miller, Analytical Chemist, Tampa, Florida.

NEWEST Formulas, all lines. Catalog free. Hodge Lab., Elkhart, Ind.

THAXLY Formulas for perfect products. Accurate analysis assured. Resultful research. Catalog free. B. Thaxly Co., Washington, D. C.

FORMULAS. Latest money makers. Literature free. Belfort, 4042 N. Keeler, Chicago.

CHEMISTRY

LEARN Chemistry, know formulas. Lesson 25c. Boyle, Clinton, New York.

ANALYSIS. Research. Newest guaranteed formulas. Biggest catalog free. Special prices, leads. Gibson Laboratory, Chemists, CT-1142 Sunnyside, Chicago.

CHEMICAL Analysis. Practical formulas. Ideas developed. Associated Chemists, Indianapolis, Indiana.

CHEMICALS. Laboratory glassware, apparatus. Send 3c for catalog CP1. Biological Supply Company, 1176 Mt. Hope Avenue, Rochester, N. Y.

HANDBOOK For chemical experimenters, hundreds of experiments, illustrated, 50c. Experiment booklet, 15c. Chemical catalogue, 10c. Reading Scientific Co., Reading, Penna.

FREE Chemistry catalog. Supplies at 5c! Equip complete laboratory. Send 3c for postage. Kemkit Scientific Corp., 397P Bridge St., Brooklyn, N. Y.

TELESCOPES, Microscopes, chemistry, mineralogy. Scientific catalog free. Tracey Laboratories, Evanston, Illinois.

AGENTS WANTED

AMAZING Opportunity—Give away valuable premiums and samples with famous quality coffee, spices, 400 other necessities. Steady work—excellent pay. Your groceries at wholesale. \$500.00 yearly bonus and free samples to all qualified dealers. Experience unnecessary. Togstad Co., Dept. 634, Kokomo, Ind.

EVERY Man needs shirts! He will gladly buy from you when you offer choice of 90 sizes for customized fit, huge selection and sensational one year guarantee backed by 45 years of shirt making experience. Half price offer creates terrific values. Repeat orders give permanent income. Simply write orders, we'll deliver prepaid and collect. World's largest concern of its kind. We paid over \$100,000 commissions past year. Get your share! Big cash commissions daily, cash bonuses regularly. Experience unnecessary. Complete self-selling outfit free. Write quick to Dept. 101, Rosecliff-Quaker Corp., 1239 Broadway, New York.

LEADING Shoe manufacturer, established 35 years, is enlarging national sales organization. Big money-making opportunity for sincere men. No experience needed. Everything furnished. Complete line of 300 styles for men and women, including free demonstrator of famous Velvet-Eez air-cushion nailless insole shoes. Prices low as \$1.98 pair. Write: Mason Shoe Manufacturing Co., Dept. B10, Chipewa Falls, Wisconsin.

CHRISTMAS Card box assortments selling like "wildfire." People who have never sold a thing in their lives are reaping harvests with our sensational 21 folder "Champion" assortment. Costs 50c—Sells for \$1.00. Also amazing etchings, gift wrappings, religious, humorous and everyday assortment. Write today. Samples on approval. Silver Swan Studios, 320 Fifth Ave., Dept. 74, New York.

SANTA Claus card talks like phonograph, speaks the greeting, Merry Christmas. Sensational seller. Sample 10c. Talking Card Company, 4451 Irving Park Blvd., Chicago.

CHRISTMAS Card bargains. Sell 50 personal Christmas cards for \$1. All beautiful folders with customer's name inscribed. Liberal profit. Free samples. Also marvelous value \$1.00 box assortments. General Card, 400 S. Peoria St., Dept. P-309, Chicago.

OPPORTUNITY—Curitoe for athlete's foot. 100% satisfaction. Money back guarantee. Curitoe Laboratories, New Britain, Connecticut.

AT Home, your own manufacturing business, making popular \$1 novelties. Cost you 3c to 15c. Everything supplied. Write So-Lo Works, Dept. J-842, Cincinnati, Ohio.

STOP Experimenting. I'll show you how to make a fortune without capital. I did. You can. Free details! Peris, East Rochester, N. Y.

MAKE Amazing profits with our line of Christmas cards. Literature free. Atlas Art Shoppe, 126 Lexington Avenue, New York City.

EASY Christmas money. Sell large 12x16 bas-relief Santa Claus heads. Stores buy eagerly. Two models, (one decorated) \$3.95. Casting instructions free. Chantex Products, Box 2766, Miami, Fla.

PROFITS That talk. Extra rapid immersion water heater. Minute demonstration. Get details. Sample \$1.00. Speed-ee Mfg. Co., PM8, Goshen, Ind.

BIG Money taking orders: shirts, ties, hosiery, underwear, raincoats, pants, dresses. Sales equipment free! Experience unnecessary. Write Nimrod, 4922-AN Lincoln Avenue, Chicago.

"LAUGHING Dogs." \$1.25 ends feet, skin troubles. Agents wanted. Flockers, Sharpsburg, Penna.

450% PROFIT Quick-Action automatic gas lighter. No flint. 25c seller to every home, office and restaurant. Sample 10c. New Method Co., Box PMG-69, Bradford, Penna.

MEXICAN Novelties! 100%-300% profit. Free particulars. Samples 10c stamps. Marquez-PB, Apartado 1176, Mexico City.

SENSATIONAL New sellers, free catalogue. Samples. Paty Company, Somerville, Mass.

MAKE \$35 Weekly passing out free baking powder. Write Blako, 9459 Alstyn Ave., Elmhurst, New York.

BUSINESS Proposition: Resilvering mirrors, autographs, reflectors, making chipped glass signs. Write, Sprinkle, Plater, 128 Marion, Indiana.

FASTEST Selling Christmas cards. Earn more with my 8 Christmas money-makers. Profits galore. 21-folder \$1 Christmas box a knockout! Pays 100% profit. Full line of leaders. Free sample offer. Schwer, Dept. H-29, Westfield, Mass.

MONOGRAMMING Automobiles biggest money maker today. New type requiring no varnish to apply. Write for samples. International Monogram & Transfer Co., Box 9360, Philadelphia, Penna.

MEN Wanted for coffee routes. Earnings up to \$42.50 first week. Brand new Ford sedan given you as bonus. I send everything; you don't risk a penny. Details free. Albert Mills, 6227 Monmouth, Cincinnati, Ohio.

NEW Foglite invention. Strange amber material snaps on headlamps. Pierces fog. Knockout seller. Samples sent on trial. Rush name, Kristee, 678, Akron, Ohio.

CHRISTMAS Cards. Get biggest line—make more money. Personal cards, stationery, box assortments galore. 1938 leader \$1 assortment 21 folders. Your profit 100%. Experience unnecessary. Samples free. Wallace Brown, 225 Fifth Ave., Dept. 71-C, New York.

SELL Magic Kote. New sensational product. Guards hands against paint, grease, etc. Free particulars. Paramount Products, Box 74, Sta. A, New Haven, Conn.

MARVELOUS New toy. Big 10c seller. 300% profit. Write immediately. Sample free. Send dime for packing, mailing. General Supply Co., Dept. 618-PM, Piqua, Ohio.

MAKE Money quick. Sell personal Christmas cards. Brand new ideas. 50 for \$1. up. Also 7 gorgeous \$1 assortments. Up to 100% profit. Free sample offer. Wetmore & Sugden, 749 Monroe, Dept. CK, Rochester, N. Y.

CHRISTMAS Cards. Quick profits. Sensational "Ruby" 21-folder assortment. Sells \$1—you make 50c. Novel, unique. Everybody buys. Also gift wrappings, etchings, religious, humorous, others. Portfolio personal Christmas cards. Write for free sample offer. Chilton Greetings, 179 Lincoln, Dept. 2-C, Boston, Mass.

TRANSPARENT Day and night signs. 8"x14": 4c retails 25c. Over 1000 designs. Sample free! Lowy, Department 812, 8 West Broadway, New York.

FREE Information! Three daily necessities. Repeaters. Burlite Company, Hudson, Ohio.

DISTRIBUTOR Wanted, clean, quick moving articles. Evans, 537 West Garfield, Glendale, California.

PROFIT With new products. Make, sell, repeat. Analysis. Research. Guaranteed formulas. Biggest catalog free. Special prices, leads. Gibson Laboratory, Chemists, BD-1142 Sunnyside, Chicago.

SELL Best canned coffee. Samples free. Box 1518, San Juan, Puerto Rico.

SILENCE That noisy toilet \$1.00. Raise the water in bath tub \$1.00. A sure cure for clogged drains \$2.00. 3 new money getters. All prepaid. Silent Valve Co., 3420 Fletcher, Eagle Rock, Calif.

DISTRIBUTORS, Dealers, agents, tradesman, to sell new ladder roller, just out. Particulars, write Marriess Safety Rollers, Appleton, Wisconsin.

SELL Guaranteed hosiery. Full-pair \$15.44 samples and your hosiery free. Dime appreciated. Box 1518, San Juan, Puerto Rico.

POCKET Knife, uses razor blades. 200% profit. Lorrac, Albany, N. Y.

CERTIFIED Formulas duplicating agents biggest selling specialties. All lines. Stamp brings valuable information. Miller's Chemists, Tampa, Florida.

NEW Beauty thrill—"Valizon Bubble Bath." Sample 10c. Valtex Products, Rochester, N. Y.

FAST Selling cleaning crystals. Cost 2c, sell 25c. Sell homes, stores, employ agents. Linnell, Box 1963-E, Cleveland, Ohio.

SENSATIONAL New electric shaver. \$5.00 seller. Costs \$1.95. Sample \$2.95. Free details. Goldenrules, Kalamazoo, Michigan.

MEN And women agents: Articles sold to taverns, confectionaries and homes. J. J. Frank, 525A Palm, Rockford, Ill.

CHRISTMAS Cards. Sell 50 assorted folders, name imprinted \$1.00. Cost you 50c. Samples free. Dunbar, New Brunswick, N. J.

CHRISTMAS Cards. Absolutely finest assortment. Big profits. Write for samples. Robinson Cards, 400 Orange, Clinton, Mass.

AGENTS: Smash go prices! Santos coffee 12c lb. 4-oz. vanilla 8½c. Razor blades 10 for 8½c. 100 sticks chewing gum 12c. Christmas cards, 21 in box 14c. 150 other bargains. Premiums. Experience unnecessary. Carnation Co., PO. St. Louis, Mo.

STARTLING Invention—Pocket adding machine. Nationally advertised \$2.50. Whirlwind seller. Big profits. Baby Calculator Co., Box 1118, Chicago.

400% PROFIT—The Perennio Calendar 640 years. Vest pocket size, 24 pages. \$5.75 hundred. Sample 10c. Box 388, Baltimore, Md.

DO You want agents for your proposition? Your ad in this space will place your message before hundreds of men seeking fast-selling products. My folder "How to Secure Agents," is filled with proof. I'll gladly send you a copy free. F. W. Johnson, Manager Classified Advertising, Popular Mechanics Magazine, 200 E. Ontario St., Chicago.

AGENTS Make bigger profits on food products-bargain deals. Low wholesale prices. Big display case sent on trial. Ho-Ro-Co, 2810-R Dodier St., St. Louis, Mo.

BIG Money applying initials on automobiles. Write for particulars and free samples. American Letter Company, Dept. 40, Dunellen, New Jersey.

BIG Money applying initials on automobiles. Easiest thing today. Free samples. Also, sideline salesmen for name plates and tire cover transfers. "Ralco," 1305 Washington, Boston, Mass.

500% PROFIT! Gold and colored sign letters for windows, offices, trucks, signs. Auto monograms. Easily applied by agent or customer. Neonite, Akron, Ohio.

AGENTS—To mail our literature. Good profits. Home business. Maywood, 149 Fifth Ave., New York.

SUCCEED With your products. Make-sell them. Formulas. Processes. Accurate analyses. Catalog free. B. Thaxly Co., Washington, D. C.

AGENTS—Opportunity to make money; book containing 107 successful business plans; home or office; send for free introductory booklet. Elite Co., 214 Grand St., New York.

FREE Sample—Amazing cleaner; sells homes, taverns, everywhere. Big profit—fast repeater. Betco, 5007 Irving Park, Chicago.

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 Degraw St., Brooklyn, N. Y.

MANUFACTURE Specialties, hire agents yourself. Big money. Free literature. Gilbert Supply, 1107-P Broadway, New York.

ENGRAVED Name plates, numbers, signs, etc., easily sold, profits large. Brett Bros., Winthrop, Mass.

\$100 WEEK Selling Artisan paints. Exclusive territory. Washable, fireproof exterior, interior, silos, dairies, kitchens, factories, homes; all colors, dry powder, mix with water. For wood, brick, concrete, plaster. Send \$1. Makes one gallon, covers 350 square feet. Wood Company, 5326 Virginia Ave., Hollywood, California.

REVOLUTIONARY Window cleaning tool. Good Housekeeping approval. Only ten \$2.25 sales daily to housewives, factories, schools, stores will make you \$350.00 monthly. Carter Products Corp., 900 Front Ave., Cleveland, Ohio.

BIG Profits. The perfect eyeglass cleaner. Wonderful demonstrator. Prevents steaming. Sample 15c. Shurberg Chemical, Hartford, Conn.

GUARANTEED Gold leaf letters for store and office windows. 300% profit. Free samples. Metallic Co., 438-B N. Clark, Chicago.

ATLAS Window sign letters. Large sizes, penny each. Beautiful free samples. Atlas, 7941 Halsted, Chicago.

CHRISTMAS Cards—50 beautiful folders, name imprinted, cost you 65c, sell for \$1.00. Also marvelous box assortments, 100% profit. Samples free. Write! New England Art Publishers, North Abington, 256, Mass.

WANTED—District purchasing agents. No experience or money required. Write Purchasing Manager, 174 N. Halsted, Chicago.

CHRISTMAS Cards. Earn \$2 an hour. Take orders galore from friends. 50 exquisite folders with name at \$1. Free album 20 designs. Fastest selling 21 folder box in America. Costs 50c. Sells \$1. Request samples. Sunshine Art, Dept. E, 154 Nassau, New York.

HIGH-GRADE SALESMEN

YOUR Own suits and overcoats free. Other attractive bonuses and free raincoat offer plus big cash profits for selling your friends quality all wool tailored to individual measure suits. Five popular new low price ranges. Exclusive sport styles no extra charge. Prices defy competition. Elaborate selection new fall and winter all wool patterns. Satisfaction or money back guaranteed by reliable twenty-nine year old tailoring firm. No experience needed. Sample outfit free. Jay Rose & Co., Dept. P-9, 330 So. Wells, Chicago.

SALESMEN Sell suits on our easy credit plan. Free suits and pants given as bonus besides large cash profits, premiums and gifts. Sell only (5) suits to get a free suit. No limit to number of free garments you may earn. Wholesale prices \$17.99 and up. Sample line free. No experience needed to make easy sales. All garments individually cut and tailored to measure. Satisfaction or money back guaranteed. Square Deal Tailoring Co., Inc., 316 W. Van Buren St., Dept. CA-1, Chicago, Ill.

YOUR Own suits given as bonus and big profits. Show friends movie star styles in made-to-measure clothes at big savings. New fashions and fabrics, inspired by Buddy Rogers, Cesar Romero, other movie stars—\$14.95 up. Guaranteed to fit and satisfy. Big commission for you on every order. 100 large samples and big book movie star pictures and styles free. Jim Foster, Inc., 2250 So. Spaulding Ave., Dept. C-9, Chicago, Ill.

SELL Business cards \$1.50 thousand. Business stationery, book matches, gummed tape, paper towels, drinking cups, pencils, salesbooks, labels, rubber stamps. Free sales portfolio. 35% commission daily. Order getting specials. David Lionel Press, 312 South Hamilton, Dept. AG, Chicago.

START Exterminating business. Enjoy steady-ever-increasing, income the year around. No store, etc., necessary. We furnish everything. By-Products, 1758-B Lunt, Chicago.

SELL Political candidates. Not affected by "recessions." Get orders now for finest line auto signs, printing, novelties. Big commissions. Ad-Nov-Co., Newton, Iowa.

RAWLEIGH Men make good money. Supply everyday household necessities to Raleigh routes of 800 family users. Ambitious men can start making \$30 weekly and up. We furnish everything but the car. Write today. Raleigh's, Dept. I-A-PPM, Freeport, Ill.

BIG Money taking orders; shirts, ties, hosiery, underwear, raincoats, pants, dresses. Sales equipment free! Experience unnecessary. Write Nimrod, 4922-AP Lincoln Avenue, Chicago.

SALESMEN! Collect \$3.00 profit from every service station and garage. New invention revolutionizing industry. Airpower Co., Newton, Iowa.

POPCORN Machines, caramelcrisp, crispettes, cheese coat, potato chips. Long Eakins, 2035-J High St., Springfield, Ohio.

SELL Every gasoline station daily record books. Profitable. Send 25c stamps for sample, kit. Refunded first order. Owen Record Company, Moberly, Missouri.

CALENDAR Salesmen make quick profits with new line of advertising calendars. Opening for producers. Tell us your territory, we will send samples for fall calendar season. Levey Printing Co., Indianapolis, Ind.

MAKE \$1200 Per month. Tremendous opportunities. Box 283, Mansfield, Ohio.

BRUSH Salesmen. If you ever sold brushes write for our money making proposition. Donald Brush Co., Dept. P.M., Camden, N. J.

SALESMAN—Experienced, educational field. References required. Jourden Schools, Philadelphia, Penna.

REAL Salesmen-Distributors. Do you want something new to sell with over 2 million sales outlets? It will surprise you! Extraordinary repeater and money-maker. Sell business places only. A product of merit. Mail postal for details. Protected territory going fast. The Cumberland Corporation, Fayetteville, North Carolina.

BIG Commission selling celluloid pricing tickets, metal shelf moulding, menu covers, signs, celluloid buttons, cards. P. Pricing Tickets, 124 White St., New York.

SALESMEN. Amazing magnetic brush, pocket size, creates static electric suction. Excels vacuum cleaner. Neway Brush Co., Hartford, Conn.

ZIRCON Diamonds from mines of far-away Siam; in exquisite mountings or un-set. Inexpensive. Catalogue free. Box 388-E, Wheeling, W. Va.

MAKE Up to \$50.00 weekly part time selling Top Quality advertising book matches. Low prices. Experience unnecessary. Full time profits unlimited. Free sales kit, zipper case. Match Corporation of America, Dept. E-9, 3433 West 48th Place, Chicago.

SELL The Driving Master—Shows miles per gallon when driving. Analyzes motor. Exceptional opportunity for men of ability. Driving Master Company, Sioux City, Iowa.

MANAGERS, Supervisors, age 25-60; also distributors wanted at once for established firm; to appoint, manage authorized exclusive dealers, every town 200 population up. "New automotive method and proposition alone in field"—product makes spectacular, truly convincing demonstration. Past turnover, conducting new Super Sales Parades and Circuses; large profits now and on repeat business, based on sales. If desired, a dealer-consignment plan available with 100% insurance protection for you. A guarantee for you under Plan "A". Write, wire, today for details. Craver-Jay Corp., Dept. 107, Kansas City, Mo.

MAKE Simple, costless cylinder oil reclaimers—save hundreds. Instructions 50c. Also information other processes, fast-sellers, money-makers for manufacturers and salesmen free. Thermo Laboratory, Peoria, Illinois.

TIRE Accessories. Guaranteed 10,000 mile Tiger Grip Tire Patch, and complete fast-selling line auto accessories. Salesmen-distributors easily make up to \$75 weekly, and over. Protected territory. Economy Rubber Products Co., 642 Burkhardt, Dayton, Ohio.

SALESMEN: Sell advertising novelties, calendars, fans, thermometers, etc., for nationally known firm. Liberal commissions. Stanwood Hillson Corp., 21 Station St., Brookline, Mass.

SALESMEN—Sell calendars, complete line, all sizes, including jumbos; beautiful subjects. Samples free! Fleming Calendar Co., 6539 Cottage Grove, Chicago.

OUR New 1938 complete line of brushes now ready. Largest commissions. Write for sales plan. Wire Grip Sanitary Brush Company, 2300 5th Ave., New York.

NEW Speciality—Sells every business and professional man. Four \$15 sales daily pay \$280 weekly. Farrell cleared over \$1,000.00 monthly. Write, F. E. Armstrong, President, Dept. PM, Mobile, Ala.

GUARANTEED Gold leaf letters for store windows. Free samples. Liberal offer to car owners. Metallic Co., 438-A N. Clark, Chicago.

MAKE More money with Red Comet Automatic Fire Extinguishers. Low price. Proved seven years. Splendid sales outfit free. Some good territory open. Exclusive. Write quick. 704 Red Comet Bldg., Littleton, Colo.

FREE Booklet describes 107 plans for making \$20-\$100 weekly, in home or office, business of your own. Elite Co., 214 Grand St., New York.

AUTOMOTIVE And tool salesmen—write for details on profitable C-S line for garages and service stations. Central Sales Company, Hastings, Nebraska.

SALESMAN—Make over \$12.00 daily now, and a harvest at Christmas time, selling 25c to \$1.00 ready-to-fly model airplanes to stores. Western Aircraft, 1271 S. Norton, Los Angeles.

SELL Quality portraits, frames. Lowest prices—big profits. Good foreign market. Catalogue free. Friedman's Studio, 528 Cornelia, Chicago, Ill.

SALESMEN Sell ink remover to cleaning plants. F. R. Welch Co., Bridgman, Mich.

HELP WANTED

WEAR Fine hose I send without cost with outfit while taking orders for amazing new hosiery. Replacement guaranteed against holes, snags, and runs. Rush name and hose size. Wilknit, Desk 37-I, Greenfield, Ohio.

IF You need money—here's a genuine opportunity to make up to \$45.00 in a week. Operate grocery route business from your own home. I send everything; no money risk. Automobile given as bonus. Details free. Albert Mills, 6221 Monmouth, Cincinnati, Ohio.

EDUCATIONAL AND INSTRUCTION

SIMPLIFIED And mental arithmetic, you can understand. Pay postman \$1.98 plus postage or sent postpaid for \$2.00. Arith-Magic, 60, Elmhurst, Ill.

LEARN Watchmaking at home. Send \$1.00 for book. R. Carter, 1107 N. Mayfield Ave., Chicago, Ill.

FOR An extremely profitable lifetime business, operate a collection-credit agency. Free folder. Cole Associates, Syracuse, N. Y.

STRONGMAN Course 10c. (Write now). Sid's System, Southgate, California.

GET A government job. \$105-\$175 month. Prepare for next examinations. List positions—full particulars, free. Write today. Franklin Institute, Dept. A3, Rochester, N. Y.

BECOME Practical scientific investigator. Modern, illustrated course. Thorough training by former agent U. S. secret service. Particulars free. International Secret Service Institute, PM-98, Hoboken, N. J.

SHORTHAND For you, everybody 7 to 70. Easy, rapid, plain. Writes foreign languages. Phonetic drill, very great educational value. Improves speech. Satisfaction guaranteed. Complete, 30c, coin preferred. Linford Upton, 3650 West Ohio Street, Chicago.

MATHEMATICS. Arithmetic, algebra, geometry, trigonometry, physics, drafting, airplane, mechanical, electrical, ship, structural, surveying, blueprint reading, building estimating, preparation licenses, civil service engineering examinations. Mondell Institute, 112 W. 42d, New York.

DRAFTSMEN—Increase your income hundreds of dollars. Introductory instruction. 25c. Draftsmen's Foundation, West Medford, Massachusetts.

SUCCESSFUL Men are realists. Treatise on realism 10c. Realist League, 45 Abbey Court, Brooklyn, N. Y.

SHORTHAND—Touch typewriting. Easily learned at home. Details free. Severance, 220 Garden, Fountain City, Tenn.

UNEMPLOYED! Discouraged? For results try our job hunting methods. Write Employment Counsellors, Box 1283K, Milwaukee, Wis.

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PREPARE For big jobs. Drafting for diesel, welding and streamlining; blue print reading. Manager, 7050 Kimbark, Chicago.

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TELEGRAPHY Taught thoroughly. New railroad retirement act creating renewed openings for operators. Enroll now. Expenses low. Catalog free. Dodge's Institute, Hiatt Ave., Valparaiso, Ind.

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GOV'T Jobs start \$1260-\$2100 year. Men-women age 18-50. Former examiner's tested method helps qualify you. Particulars, list jobs free. Write today. Patterson School, 8C Mercantile Bldg., Rochester, N. Y.

LEARN Machinist trade, tool, die making. Automatic and hand screw machines. Modern shop methods. Actual work. Jobs open for trained men. Employment help. Illustrated booklet free. Allied Screw Machine Co., 601 Lake St., Chicago.

LLARN Auto mechanics, body, repairing, welding, electricity, refrigeration, Diesel. Stevinson's, 2008A Main, Kansas City, Mo.

DEGREES Earned through home study—Psychology, theology, law—others. Air-conditioning and Diesel courses. Request free bulletin. No obligation. Temple Bar College, Missoula, Montana.

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CARTOONING? Get individual instruction! Excellent, economical system! Free details. Write: Gyca Service, 10505 Dove Avenue, Cleveland, Ohio.

CARTOONING, Sketching, etc. 46 lessons. 600 illustrations, including drawing paper, pens, pencils—\$1.00 complete. Fraba Service, Poplar Bluff, Missouri.

PAINT Signs for profit. Speedway patterns are modern, unique, and develop lettering ability. Enclose stamp for sample alphabet. Literature free. Display Letters Co., Station 235-G, New York City.

LETTERING Artists wanted! Earn \$50 to \$200 a week lettering headings, etc., for advertisements. Easy, fascinating, steady work. Big future. Surprising information on this profitable profession in our free booklet. The Guild School of Lettering and Advertising Design, 155 East 44th Street, New York City.

EARN Money, sensational cartoon program, 10c and stamp. Moe Gross, 972 Leggett Ave., New York City.

EARN cash income, copying and duplicating simple cartoons for advertisers. 3-M Service, Argyle, Wis.

CASH In! Copying advertising cartoons. Paisley, Kinloch Bldg., St. Louis, Mo.

PLAYS, STORIES, MANUSCRIPTS

MANUSCRIPTS Expertly typed. 35c 1000 words. Martin Keaveny, 538 Belden, Chicago, Illinois.

SHORT Stories revised, typewritten, marketed. Hursh, Box P-1013, Harrisburg, Penna.

PLAYS, Stories, manuscripts, etc. Stories rewritten in forceful, appealing style. Markets suggested. Welton Tinney, Winnsboro, Texas.

WANTED, Original poems, songs, for immediate consideration. Send poems to Columbian Music Publishers, Ltd., Dept. 209, Toronto, Can.

SHORT Stories, novels, sold! Dollar and manuscript for report and details of free course. Desmarais, Station E, Cincinnati, Ohio.

STORIES Wanted for screen sale. Adeline Alvord, 6605 Hollywood Blvd., Hollywood California. Dept. M.

POEM Writers, songwriters. Send for free Rhyming Dictionary, Songwriters' Guide. Submit best poems, melodies today for bonafide, superior offer. MMM Studios, Dept. 33H, Portland, Ore.

ADVERTISING AGENCIES, LETTER WRITERS, FOR ADVERTISERS

LEARN Advertising quickly at home. Easy practical plan. No text books. Common school education sufficient. Interesting booklet and requirements free. Page-Davis School of Advertising, 3601 Michigan Avenue, Dept. 3432, Chicago.

ADVERTISE 25 Words 25 magazines 3 months \$1.50. Inch \$6.00. List special offers free. Bucknam, 177 State, Boston.

LETTERHEADS That dominate bring more business! Artist designed letterhead especially for you, and cut \$10. Modern lettering and illustration. Gill Art Service, Huntsville, Alabama.

500,000 CIRCULATION. Advertise national magazine. 6 words \$1.00 cash. Results guaranteed. Hurry for October issue. American Advertising Agency, Stockton, California.

INCH Display advertisement 30 magazines year \$24. Wood's Popular Services, Atlantic City, (N. J.)

ADVERTISE: 24 Words in 250 newspapers \$10. Lists free. Advertising Bureau, 4515-C Cottage Grove, Chicago.

FREE—New Advertisers Rate Guide, 44 pages. Includes everything. Lowest rates. E. H. Brown Advertising Agency, 140 S. Dearborn, Chicago.

ADVERTISE Your products through selected mediums! Free manufacturing recommendations. If it can be sold we can sell it. Write giving all information. Arrow Advertising, Kearney, Nebraska.

MAILORDER Ad reaching 1,500,000 families throughout United States \$15.40 inch. Newspaper, magazine, ratebook free. Chicago Union Agency, 20-P West Jackson, Chicago.

ADVERTISING Placed anywhere. Helpful, free service. Rate guide book free. Baker Advertising Agency, 189 W. Madison, Chicago. Successors to Ankrum Advertising Agency. Established 28 years.

BUSINESS SERVICE

PERSONAL And business mail received and forwarded, \$2.00 monthly. Dunn Mail System, Box 42, 216 West 69 Street, New York, N. Y.

CHICAGO Mail address; business, personal. Mail reforwarded to you. \$1 monthly. General, 56 West Washington.

WASHINGTON, D. C., mail address; branch office; business, personal. Hawkins Mail Service, 817 Fourteenth.

INFORMATION—Where to buy anything! Addresses of any manufacturers, wholesalers. 50c (coin). Universal Buyers Service, Lakewood, New York.

RUBBER STAMPS AND OFFICE SUPPLIES

ORIGINAL, Cushion mounted. One, two lines 25c; three 35c; four 45c. Stamp Works, 814 Bradley, Peoria, Illinois.

NAME, Address, 2 lines 25c; 3 lines 35c. Stamp Works, Auburn, Nebr.

CUSHION Mounted one-two lines 25c; three 35c. 100 letterheads, 100 envelopes \$1.00. Hauer Press, 1314 Ford, Youngstown, Ohio.

2 LINES 25c, 3 Lines 35c. Stamp Works, Centerport, N. Y.

TYPEWRITERS, DUPLICATORS, OFFICE DEVICES

TYPEWRITERS, Duplicators, multi-graphs. Write for free list office machine bargains. Save half. Pruitt, 518 Pruitt Bldg., Chicago.

INCREASE Business now. "Excelsior-graph" Rotary Stencil Printer reprints thousands everything you typewrite, hand-write, draw or trace. Colors, \$19.75 to \$44. Terms. Illustrated literature free to business or professional men. Pittsburgh Typewriter Supply, Department K-2, Pittsburgh, Penna.

NATIONALLY Advertised portable typewriters delivered at 20% discount from regular prices. Catalogue free. Typewriter Exchange, Sac City, Iowa.

PRINTING, MULTIGRAPHING, MIMEOGRAPHING, GUMMED LABELS

HAMMERMILL Letterheads, 300 8½x11, any color paper and ink, \$1.48 postpaid. Free particulars. Woodruffs', 217 Lewis, Duluth, Minn.

FREE 1938 Pricelist, samples letterheads, envelopes, statements, blotters. McCall Press, 1326 South 27th, Omaha, Nebraska.

1000 CARDS, Letterheads, envelopes \$2.85 each postpaid. Altort, 4059 White Plains, New York City.

250—\$1.00 POSTPAID—8½x11 Letterheads, envelopes, billheads. Benneville, 907 West Roosevelt, Philadelphia.

LETTERHEADS, Envelopes, statements, cards \$2.50 1000. Milk tickets 50c. Advertiser, Columbus, Neb.

SALES-STIMULATING Letterheads! Attractive layout on watermarked bond. 100 prepaid—\$1.00. Cee-Tee Company, P-1079 Madison St., Brooklyn, N. Y.

100 ENVELOPES Printed, 2 colors, 75c. Press, Box 3232, Rochester, N. Y.

EASY Embossing method and sample embossing powder 10c. Hayes, 60 E. 18th, Chicago.

500 LETTERS Multigraphed exactly as if typewritten, \$1.70 (20 lines). Multigraphers, Box 8275, Ashland, Virginia.

LETTERHEADS, Envelopes, cards, statements, labels, 250 \$1.95; circulars 1000, \$1.85. H. Wilson, 1724 Monroe, Madison, Wisconsin.

1000 LETTERHEADS \$2.75. Special prices on quantities. Mercantile Service, 203 Middleboro, Mishawaka, Indiana.

LARGE Selection stationery. Attractive prices. Circulars. Croydon Press, 108 Fourth Avenue, New York.

LABELS: All kinds. Write, samples. JBSCO, Box 93, Holyoke, Mass.

125 EACH Letterheads, envelopes \$1.00. P. P. Tucker, Box 65, Indianapolis.

SUPERBO Print, 912 Towne, Los Angeles. 1000 business cards \$1.00 postpaid.

1000 6x9 CIRCULARS, Letterheads, envelopes, postcards, \$2.95; 5000, \$9.45. All printing reasonable. Samples. Cuts. Goodprint, Harrisonburg, Va.

500 ¾x2¼ FOUR Line gummed stickers, 25c. Moritz Printery, Saginaw, Mich.

500 STICKERS, Four lines, 25c. Fine labels. Cott's, Spickard, Missouri.

MATCHES—Advertising book matches. Extraordinary! (Salesman wanted). Sanderson's, Ottawa, Illinois.

PRINTING OUTFITS AND SUPPLIES

SIEGWALDT Hand printing press, type, complete. Send offer. Burson, Robinson, Illinois.

PRESSES \$5.00. Complete catalog. Send stamp. Bradshaw, 3214P Huron, Chicago.

PRESSES \$7.00 Up, type, supplies. Lists 3c. Landis, Richland, Penna.

PRINT Your own cards, stationery, circulars, advertising. Save money. Easy rules furnished. Print for others, big profits. Junior outfit \$9.00; job presses \$11 up. Details free. Kelsey Presses, E-11, Meriden, Conn.

STOCK Cuts 40c up. Catalog 10c. Gregor's, 79-N Main Street, Belleville, N. J.

HAND Press, type and complete printers' supplies. Advise equipment you need and we quote prices; or send stamp for catalog. P. Peiffer, 12-C; 6 Columbia St., Newark, N. J.

BLOCK Printers make press of scraps. Self-adjusting. Speedy operation. Plans 15c. W. E. Powers, Route 3, Box 451, Lodi, Calif.

IF Setting type annoys, but like printing, use linotype. Send your copy, style, for quotation. Oakdale Composition, North Philadelphia, Penna.

FOUNDRY Type, \$1.00 fonts, postpaid, popular faces. Also hand presses, complete outfits, large or small. Write us your wants, or sent 3c for complete circulars. Star Supply, 921 South Washington, Minneapolis, Minnesota.

BARGAINS, Presses, type. List 3c. Exchange D-15, 22 Orient, Meriden, Conn.

BARGAINS — Presses, type, supplies. Send stamp. 159 Harvard, Cambridge, Mass.

PRINT Your own cards, stationery, circulars, advertising. Save money. Easy rules furnished. Print for others, big profits. Junior outfit \$9.00; job presses \$11 up. Details free. Kelsey Presses, D-11, Meriden, Conn.

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FREE Books tell all! What to do with your invention? Patent facts clearly explained. 63 years' experience at your immediate service on easy budget payment plan. Write today for free copies of interesting booklets and "Certification of Invention" form. C. A. Snow & Co., 195 Snow Building, Washington, D. C.

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INVENTORS. Protect your rights before disclosing your invention to anyone. Form "Evidence of Conception"; "Schedule of Government and Attorneys' fees" and instructions sent free. Lancaster, Allwine & Rommel, 411 Bowen Building, Washington, D. C.

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We Successfully sell inventions, patented and unpatented. Write for proof, and tell us what you have for sale. Chartered Institute of American Inventors, Dept. 4-C, Washington, D. C.

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SOLUTIONS For transformer, gadget, relay circuit problems by experienced designer. Moderate charge. Idea remains yours. Give particulars. References furnished. Dept. A-7, 1838-40 W. Van Buren, Chicago.

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INVENTORS: "Making Inventions Pay," our 32-page illustrated book, mailed upon receipt of 3c postage. Crescent Tool Co., Dept. Z, Cincinnati, Ohio.

I SELL Patents. Established in 1900. Charles A. Scott, 773PM Garson Ave., Rochester, N. Y.

HAVE You a sound, practical invention for sale, patented or unpatented? If so, write Chartered Institute of American Inventors, Dept. 4-A, Washington, D. C.

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SMALL Inventions wanted by manufacturers. I'll help you sell your invention. Write for free circular. Stanley Hull, 7829-K Euclid Avenue, Cleveland, Ohio.

WANTED—Product to manufacture and sell by well equipped, well financed manufacturer. Interested in product with merit; royalty basis or outright purchase. Especially interested in products for air conditioning, refrigeration or allied industries. Reply in detail—confidential. O. R. French, 4235 Lindell, St. Louis, Mo.

CASH For unpatented ideas. Stamp for particulars. Mr. Ball, 9441-A Pleasant, Chicago.

WANTED — Prominent manufacturer wants ideas or inventions pertaining to automatic coin-operated devices of all descriptions. All correspondence confidential. Western, 925 W. North Ave., Chicago.

SIMPLE, Practical inventions wanted by manufacturers, patented or unpatented. For information write Chartered Institute of American Inventors, Dept. 4-D, Washington, D. C.

PATENTS FOR SALE

JUST Out! Patented seat post for tractors and riding implements. United States Pat. No. 2,115,830. Will sell outright or royalty. Richard Thiele, Valley Mills, Texas, Route 3.

POCKET Tablet dispenser. A. Pearson, 5012 Lioga Street, Duluth, Minn.

JUST Patented—Labor saving anchor bolt. Also pre-fabricated finished plaster. Outright. Geo. Wellner, 745 Lee St., Des Plaines, Ill.

PATENTED Household article. Paul DeMartini, 75 Rico Way, San Francisco, California.

MANUFACTURING

MANUFACTURING Tools, dies, models, metal stampings. Federich Tool Co., Box 12, East McKeesport, Penna.

INVENTIONS Manufactured by an experienced company, in any quantity at low cost. Metal specialties, novelties, stampings, dies, and models. Free estimates. Our booklet "Mind vs. Matter" sent upon receipt of 25c. Rex Engineering Co., Cincinnati, Ohio, Dept. C.

ANALYSIS. Research. Newest guaranteed formulas. Biggest catalog free. Special prices, leads. Gibson Laboratory, Chemists. DS-1142 Sunnyside, Chicago.

DIES, Stampings, wire forming, complete manufacturing. Southern Products, Independence, Missouri.

SPRINGS, Wire specialties, stampings, special machines, tools. Wilkie, Independence, Mo.

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SIXTY Page model airplane, train, boat, catalogue 5c. Spencer's, New Castle, Penna.

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CATALOGUE Of over 40 engines, castings, supplies, 25c. Refunded. Howard Co., A-2417 North Ashland, Chicago.

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RAILWAY Models. Catalog handbook 25c. Walthers, 247 E. Erie, Milwaukee.

MODELS—Practical models put over your ideas. We develop models from the crude to perfect working devices. Your idea might have large commercial value. Services confidential. Bank references. Registered graduate engineers at your service. Send 25c for our 68 page booklet "Mind vs. Matter." Rex Engineering Co., Cincinnati, Ohio, Dept. B.

MINIATURE Boat and airplane supply catalog 5c. Selley, 1377 Gates Ave., Brooklyn, N. Y.

MODEL Railroad supplies catalog 10c. Box PM, Dunellen, New Jersey.

MODEL Supplies for the inventor. Send 3c stamp for catalog. Pierce Model Works, Tinley Park, Ill.

SHIP And yacht model fittings; construction sets; model yacht sails; illustrated catalog 20 cents. A. J. Fisher, 1002-1 Etowah Avenue, Royal Oak, Mich.

MODELS—Your ideas developed into practical working models. 30 years' successful experience; thousands of satisfied customers. Confidential service guaranteed. Bank references. Send 3c postage for 32-page book—"Making Inventions Pay." Crescent Tool Co., Dept. Y, Cincinnati, Ohio.

BUILD Better miniature motors than you can buy. New design. No castings. Details 10c. Wright Motor Works, 3256 Lake Park Ave., Chicago.

RAILROADERS. Fans and modelmakers. Send for second and greatly enlarged edition of interesting and instructive book on trains. Only one of its kind. 25c in coin. Trains, 1069-D Transportation Bldg., Chicago.

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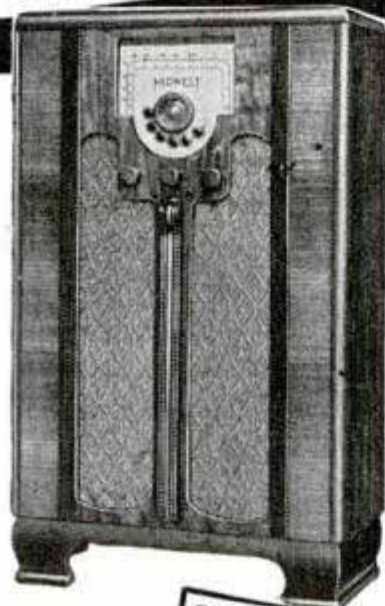
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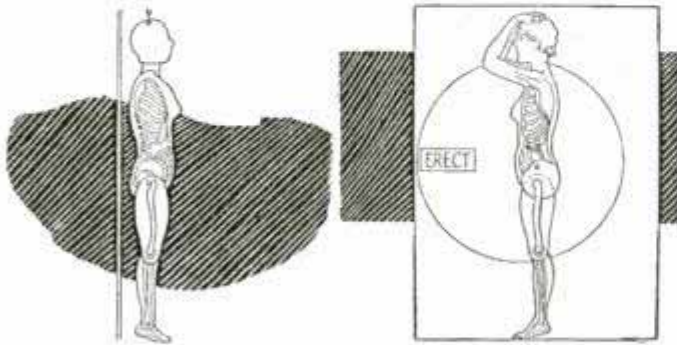
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NEW INVENTIONS

(Continued from page 20A)

IMPROVEMENT in posture is the objective of a device, patented recently, which enables an instructor to show the pupil wherein he or she does not stand in the proper position. The device consists of a two-dimensional jointed figure having the profile contour of the human body.



Various portions of the figure are movable. The exposed area between the various parts may be varied so that collapse and extension of the abdominal region of the body in fatigue and other postures may be represented. A support at the head portion of the figure facilitates movement of the various parts.

ORNAMENTAL and useful, a newly patented mirror is expected to find wide acceptance for the lady's dressing room. Of the pedestal type, the mirror is gripped firmly at the lower edge by jaws. The base has a broad flat bottom which makes

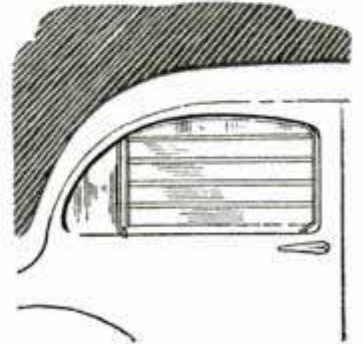
it difficult to overturn the mirror. The mirror proper is round, attractive to the eye and offers full visibility.

FOR the sportsman who carries his own golf bag, a handy support eliminates the necessity for laying the bag on the ground each time he makes a play. Secured to the side of the bag at the top, the support extends downward to prevent the bag from



falling to the ground. When the bag is being carried, the support folds against the side, out of the way. The support and the handle are so arranged that pressing the handle downward moves the support into place for keeping the bag in a leaning position.

LAATEST for the summer tourist is a sunshade, patented recently, which is designed for attachment to the automobile window. A frame, fitting in the window after the glass has been rolled down, holds the shade firmly. The device does not interfere with No-Draft and similar windows. The shade keeps out the hot summer sunshine, helping to make the interior of the car more comfortable and to protect the occupant's eyes from glare.



MOTHERS would find a new combination vehicle very useful, since it may be converted from a baby walker into a high chair. The walker was patented recently. The seat is arranged so that it may be pulled into high chair position in conjunction

with an elevating stand. A tray for feeding the baby or for holding his playthings may be moved into or out of position, as desired. It is used with both the walker and with the high chair. All parts of the vehicle fold or unfold into position to form the high chair, or the walker, as the mother wishes.

Due to the fact that many of the devices described in this department are still in the patent office stage and are not on the market, Popular Mechanics Magazine cannot undertake to supply further information regarding them.

NOW! Anyone without experience can do a thousand and one **REPAIR JOBS!**

WELDING **BRAZING**
SOLDERING

Quickly - Perfectly - Easily

with the **NEWLY INVENTED 3 IN 1 Electric TORCH**

COMPLETE WITH POWER UNIT
WORKS OFF 110 VOLT AC OR DC LIGHT CIRCUIT

Here at last is a portable machine that does real welding, brazing and soldering, yet is priced within the reach of all. The 3 in 1 comes to you complete with goggles, carbons, various types of welding rod and all accessories needed to do various repair jobs. It is all ready to plug in a light socket—nothing extra to buy. Simple instructions make it possible for you to do first class work without any previous experience or mechanical skill. The 3 in 1 instantly creates a terrific flame by just touching the carbons together. No necessity of knowing how to strike an arc. Easy to handle—nothing dangerous about it—cannot short circuit. Does any number of first class repair jobs.

REPAIRS FENDERS, AUTO BODIES, TANKS.
BICYCLES, RADIOS, ETC.

With the 3 in 1, you will be able to do a professional type of work irrespective of whether you have had any experience. You will be able to do first class fender weld jobs. The 3 in 1 is ideal for auto body repairs—steam fitters, plumbers, sheet metal shops, engineers, maintenance men and janitors will find it indispensable. Bicycle and radio repair men can find many uses for it. By following simple instructions, heavy work such as bumpers, tanks and industrial repairs can be done. It is ideal for the man who does his own repairing. There are countless jobs around a home or farm that can be done easily and well.

WORKS ON ALUMINUM, BRASS, COPPER,
IRON, STEEL AND OTHER METALS

With the 3 in 1 Electric Torch you are not limited to repairs on any one type of work. The outfit comes to you complete with various kinds of rod, even including aluminum. The 3 in 1 does exceptionally fine work on aluminum, excelling that of many much higher priced welding outfits.

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AGENTS! There is big money in introducing the 3 in 1 Electric Torch to the many places that have an absolute need for it. You will find quick easy sales waiting for you in repair shops, garages, factories, sheet metal, radio and bicycle repair shops, and many other places. Write at once for free particulars and learn how you can get your own 3 in 1 Electric Torch absolutely free for demonstration purposes by helping to introduce it to others. Send coupon today.

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OL' JUDGE ROBBINS'

TRAILER TRIP

COUSIN EDGAR CERTAINLY SHOWS US A GRAND TIME WHEN WE VISIT HIS CAMP DOESN'T HE, CHUBBINS?

AT LAKE WINNIPESAUKEE, NEW HAMPSHIRE

YES, AND I'M ALL EXCITED ABOUT YOUR BEING THE CHIEF AND I THE PRINCESS, IN THE CAMP COUNSELLOR'S PLAY TODAY!

HELLO, UNCLE! HELLO, CHUBBINS! HURRY AND GET INTO YOUR COSTUMES. WE'RE ALMOST READY TO START

AT COUSIN EDGAR'S CAMP

HAIL, CHIEF SHINING WATERS. I BEAR MESSAGES OF PEACE FROM OUR TRIBE TO YOURS

LET US DISCUSS PEACE, BRAVE WARRIOR. I AM WEARY OF OUR ETERNAL WARFARE

FATHER, HE IS HANDSOME. I AM PLEASED

A PLAY BASED ON AN OLD INDIAN LEGEND

LAST ACT: AND NOW, CHIEF SHINING WATERS, WE HAVE MADE THE PEACE. TO KEEP IT FAITHFULLY AND LASTINGLY, I ASK YOU FOR THE HAND OF YOUR BEAUTIFUL DAUGHTER, THE PRINCESS

MY DAUGHTER SMILES, AND IT IS WELL WITH ME TOO. BE IT SO. WELCOME, SON, INTO OUR TRIBE

I AM GRATEFUL AND HAPPY. I HUMBLY OFFER YOU THIS GIFT OF OUR FINEST TOBACCO FOR THE PEACE-PIPE

CONGRATULATIONS, JUDGE, YOU MAKE A GRAND INDIAN CHIEF

WELL, SIR, I CAN SEE YOUR GUIDING HAND BEHIND THE PRINCE ALBERT FOR THAT PEACE-PIPE

AFTER THE PLAY....

JUDGE, I THINK YOU'LL AGREE, THAT FOR A PEACEFUL, FRIENDLY SMOKE, THERE'S NOTHING TO BEAT PRINCE ALBERT!

RIGHT YOU ARE. IT'S REALLY SURPRISING HOW SUCH A MILD TOBACCO AS P.A. CAN BE SO RICH-TASTING AS WELL

"AND IN THIS CORNER... THE WORLD'S CHAMPION PIPE TOBACCO"

(UNBEATEN, TOO, FOR "MAKIN'S" CIGARETTES)

PRINCE ALBERT IS RICH-TASTING TOBACCO... COOLER, MILDER, BECAUSE IT'S 'NO-BITE' TREATED

PA'S 'CRIMP CUT' ROLLS FASTER... STAYS ROLLED! I GET AROUND 70 SWELL 'MAKIN'S' SMOKES TO THE TIN!



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Winston-Salem, N. C.

50 pipefuls of fragrant tobacco in every 2-oz. tin of Prince Albert

BETTER SMOKES - OR YOU DON'T PAY!

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Popular Mechanics Magazine

REGISTERED IN U. S. PATENT OFFICE AND CANADA

WRITTEN SO YOU CAN UNDERSTAND IT

Vol. 70

SEPTEMBER, 1938

No. 3

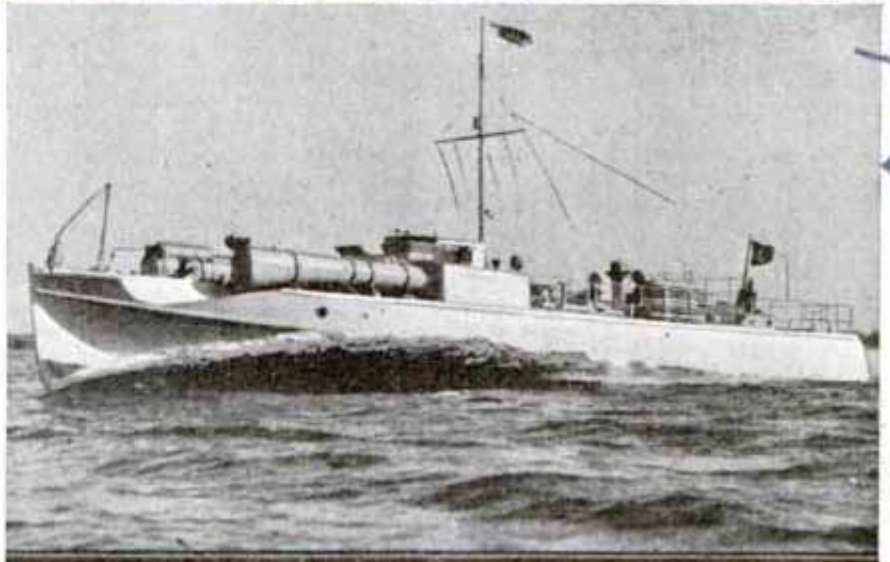
MOSQUITO WARSHIPS



SHORTLY before dawn on a June morning in 1918, Commander Luigi Rizzo of the Italian navy was patrolling the upper Adriatic with two small, twenty-knot motor torpedo boats, "M.A.S. 15" and "M.A.S. 21," when columns of smoke, plainly visible in the moonlight, were sighted to the north.

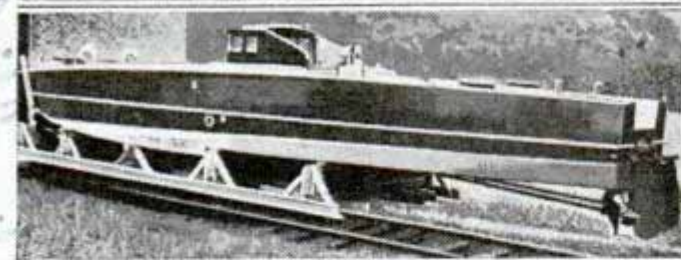
Rizzo's tiny boats reconnoitered and found two large battleships, accompanied by a number of destroyers. Coming from the north, these ships must be Austrian and enemies! Rizzo ordered his miniature warships to reduce speed so their engines would run almost noiselessly. He slipped between two of the destroyers screening the leading battleship, the proud 20,000-ton "Svent Istvan."

Increasing speed, his boat, "M.A.S. 15," dashed to within 300 yards of the floating fortress and fired two torpedoes,



Top, latest type of British "mosquito warship." Center, Siamese coastal motor boat. Bottom, one of Germany's motor torpedo boats

Robinson, Abell Ave. Baltimore Md.
3042
Capt. Walton S.



All photos courtesy "Jane's Fighting Ships"

Greek coastal motor boat, top. Below appear, top to bottom, one of Italy's largest motor torpedo boats, a British "mosquito warship" and a French boat

striking the dreadnaught amidships and rending gaping holes in her side. Simultaneously "M.A.S. 21" fired torpedoes at the other Austrian battleship, the "Tegetthoff," but missed. Then both motor boats fled in the breaking dawn. A destroyer chased them, but Rizzo stopped her by discharging depth bombs, one of which exploded under her bow.

Two and one-half hours after the attack, the battleship sank, taking with her eighty-

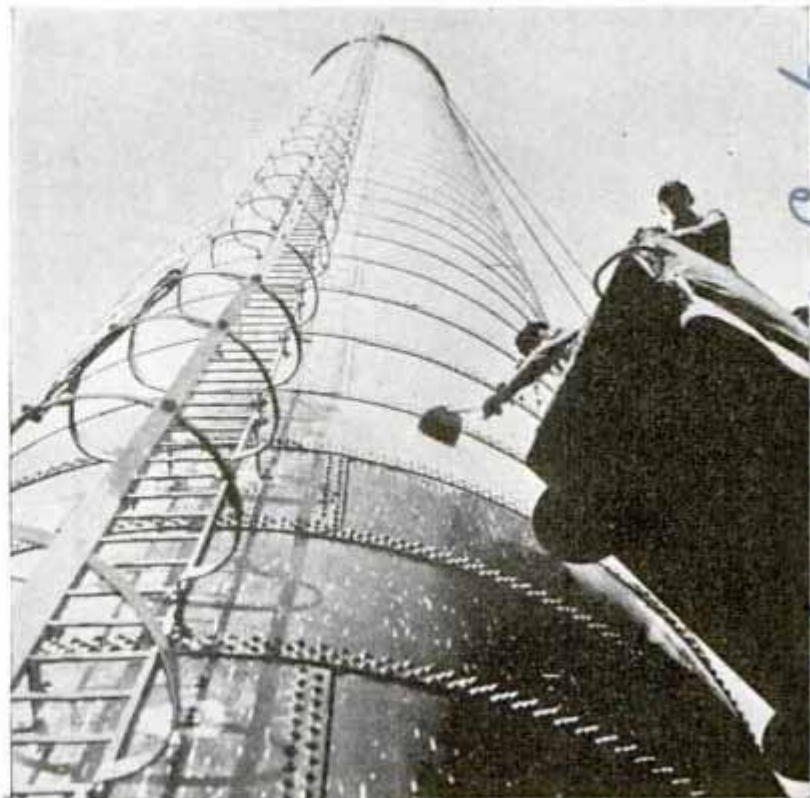
nine of her crew of 1,000 officers and men. The remainder were rescued by the "Tegetthoff" and the destroyers, which then returned to the fleet base, their attempted surprise attack on the anti-submarine barrage in the Otranto Straits disastrously repulsed.

The sinking of the "Svent Istvan" revealed a new threat to the battleship—the motor torpedo boat; and since the war many European navies have built fast boats of this type. The United States has also fallen into line recently, and our navy will soon possess several of these craft. Curiously enough, however, Japan seems uninterested in them.

With the exception of Russian and Italian boats, those in service or being built are for experimental and training purposes only. But in the event of war, each nation soon could have scores of them ready for service, for, being small, they can be produced quickly and in large numbers. During the world war, for example, Italy and Britain each built several hundred. Both nations retain their faith in these tiny, but highly efficient boats, and today are in the forefront in developing new and swifter types.

Perhaps the finest of these "mosquito warships" are Great Britain's M.T.B.'s or motor torpedo boats, fourteen of which were completed in 1936-38. They are a big improvement over the wartime C.M.B.'s, or coastal motor boats, which were able to operate only in the calmest of waters and bounced about so much at high speed that

Daring Painters on Tall Stack Ride Wheeled Platform Down



Novel wheeled platform which rolls downward around giant smokestack, is shown at right with painters at their work

Suspended by cables from the top, painters recently were given a thrilling, dizzy ride on a platform used in painting a giant smokestack. The platform was equipped with wheels, permitting it to be rolled around the stack while the cables lowered the platform as the work progressed downward.

it was almost impossible for crews to remain at sea more than two hours. The M.T.B.'s are splendid sea boats and can maintain full speed for hours without any undue fatigue to the crews.

The first twelve boats are sixty feet long, weigh only fifteen tons, and are armed with two eighteen-inch torpedoes, discharged from troughs in the stern, and eight anti-aircraft machine guns. They can also carry a number of depth charges, so are capable of battling surface ships, airplanes and submarines. Their designed speed of thirty-five knots was increased to over forty knots in trials and is obtained by three 500-horsepower gasoline engines. At a speed of twenty knots their radius of action is 500 miles. Each boat is equipped with a powerful radio and carries a fourteen-day supply of provisions for a crew of seven. The cost for the twelve boats was a little more than \$1,300,000, a trifle compared with the cost of a single modern dreadnaught.

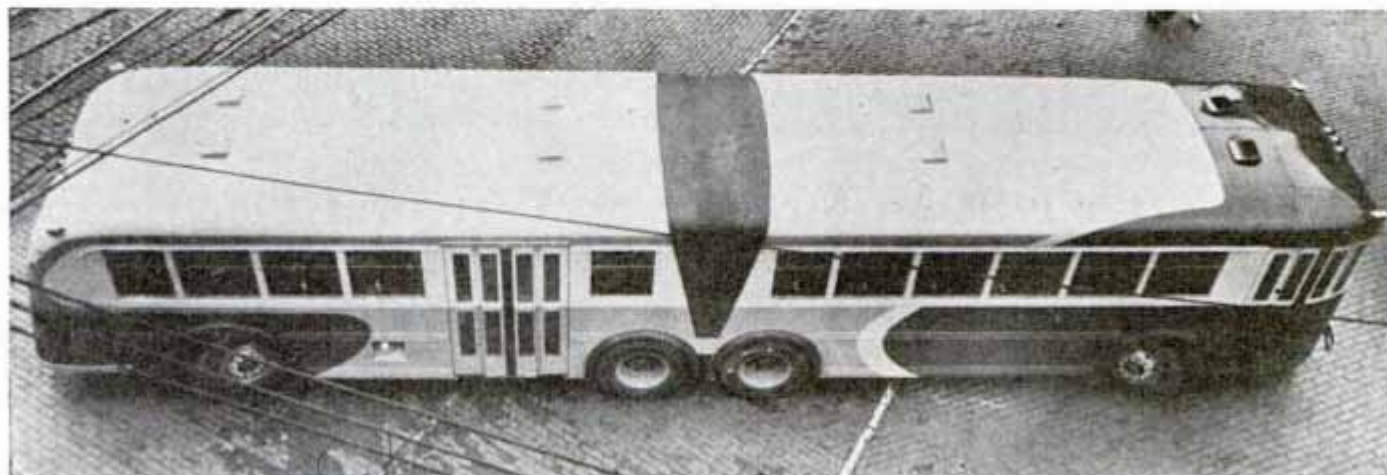
Britain's latest motor torpedo boats are "M.T.B.'s 101" and "102." Little is known about the former,

(Continued to page 136A)

City Bus Has Four-Wheel Steering, Center-Wheel Drive

Latest to challenge the trolley car is a city bus with four-wheel steering. Front and rear wheels turn in unison, enabling the driver to maneuver easily around street

corners. The center wheels, meanwhile, supply the drive. This super-twin coach, tested on the streets of Akron, Ohio, seats fifty-eight passengers.



Notice that both front and rear wheels of this twin-car bus are turning at once as the driver maneuvers it around a street corner in Akron, Ohio. The driving wheels are those at the center

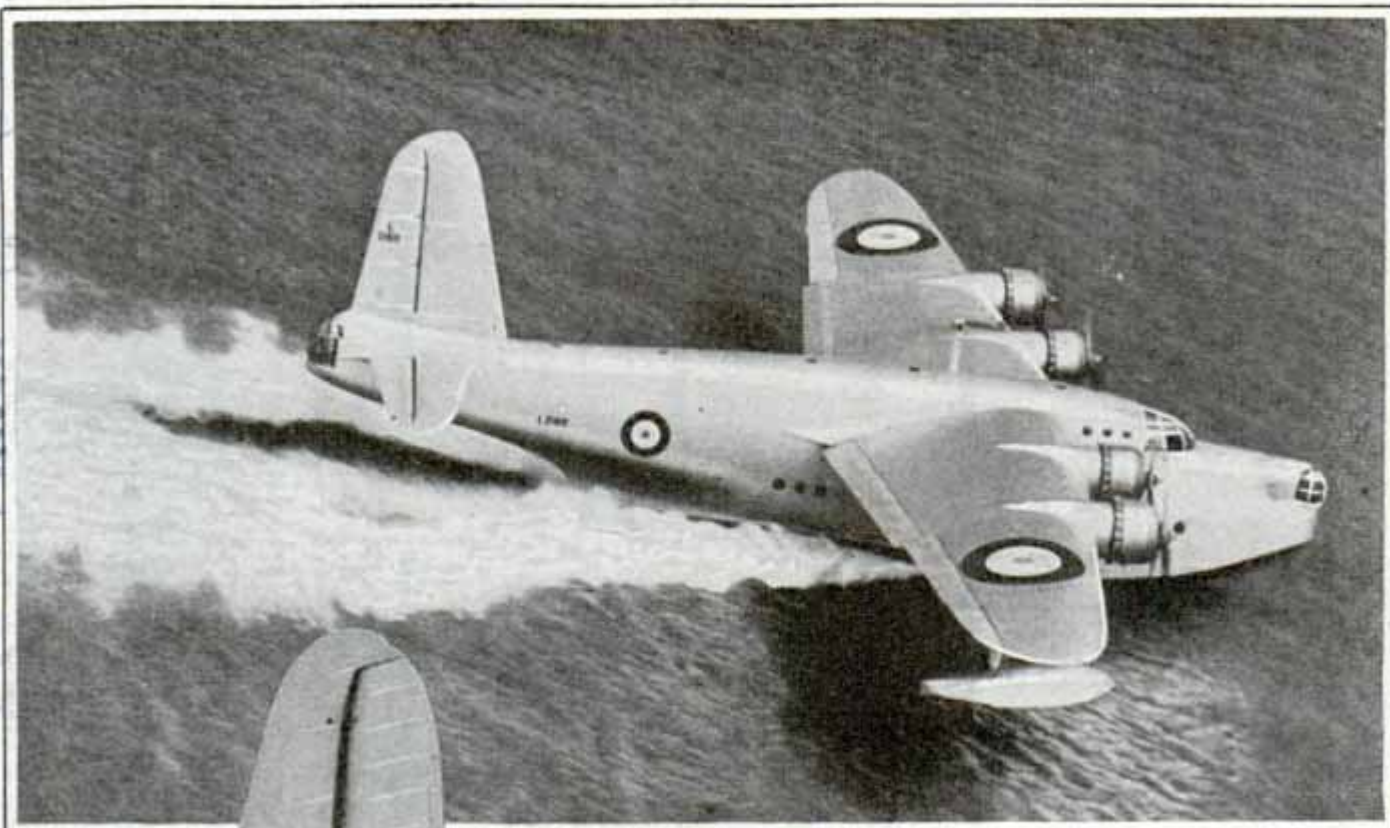
Aluminum Company
 of America, 1856

H676

make substitution

England

12696
 "Flying Battleship" Has Gun Turret in Tail



acme

Two views of "flying battleship." Top, the big fighting craft taking off. Bottom, the tail with its revolving gun turret to give protection against attackers approaching from rear.

Sunderland

Among the features of England's new "flying battleship," a fleet of which is under construction, is a revolving gun turret which guards the tail. The turret is arranged to give the gunner full vision and to facilitate training his weapons on the enemy, no matter from what direction the attack is launched. It is understood the flying battleship is capable of 3,000-mile flights with full load of bombs and guns. The warplane is a development of the Empire type of commercial flying boat now in service on Imperial Airways routes.

H 1261
 Paper Cutter Is Kept Straight by Watchful Electric Eye

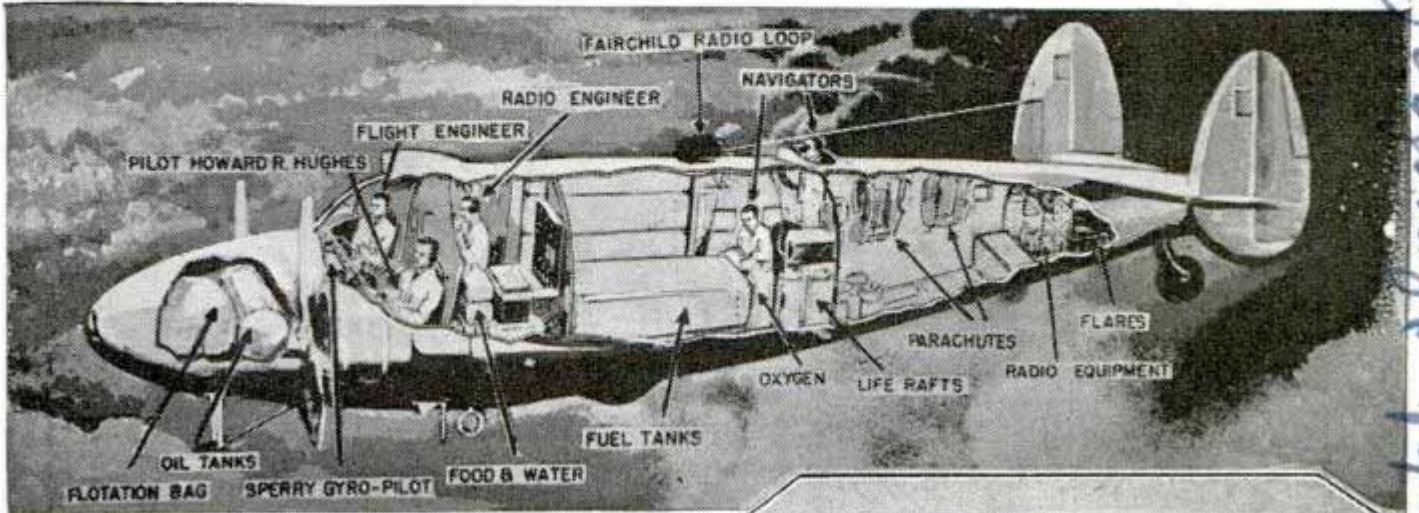
Even the business of cutting paper rolls is now kept straight by electricity. A Westinghouse engineer has found a way to guide the paper roll by means of a sensitive phototube. Light from a small lamp passes through four small lenses revolving 1,800 times a minute on the shaft of a synchronous motor, and strikes the roll of pa-

per as four revolving light beams. The light is reflected back to the phototube. Whenever the beam strikes a dark guide line on the paper, the decrease in reflected light increases resistance in the phototube, and this signals to a reversing motor which adjusts the position of the paper roll to bring it into a straight line again.

1933 Norman ...
Los Angeles, Calif.

AROUND *the* WORLD

in 91 HOURS



BY FLYING around the world in a little more than ninety-one hours, Howard Hughes and his four companions dramatically demonstrated that airplane speeds virtually have doubled since the epochal flights of Col. Lindbergh and Wiley Post.

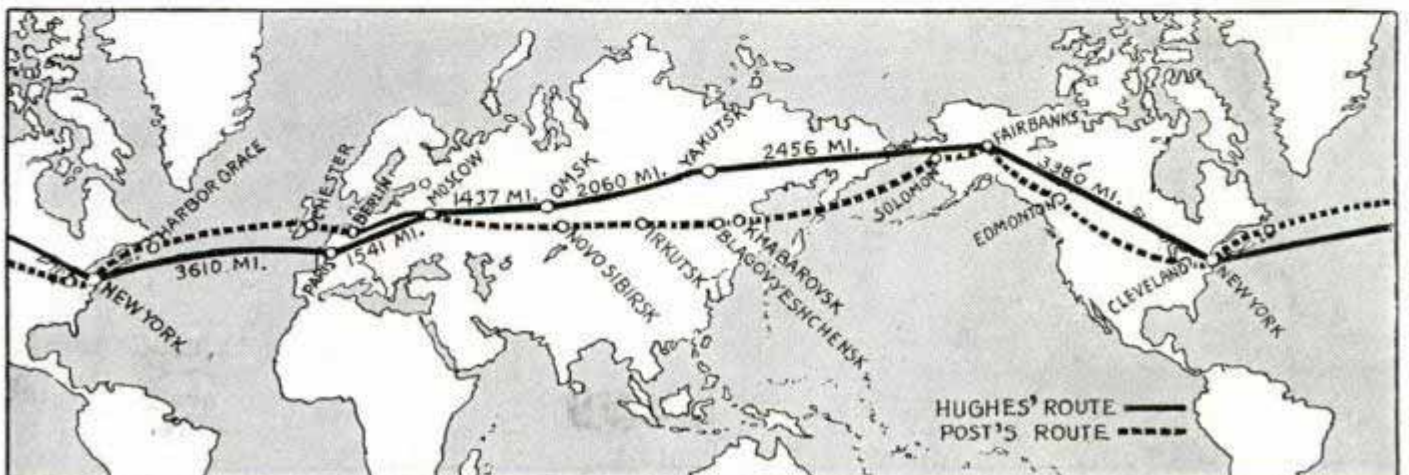
Every stage of this amazing achievement—a trip of approximately 15,000 miles in only seventy-one hours' flying time—reflected the great strides aviation has made in the past few years.

Lindbergh flew from New York to Paris in 1927 in thirty-three and one-half hours. Hughes and his crew covered the same route in half the time. Post, in 1933, circled the globe in seven days and eighteen hours. Following virtually the same course, the Hughes flyers set a new record of three days and nineteen hours, almost four days faster than Post's time.



Hughes and companion in cockpit of round-the-world plane, and cross-sectional diagram of ship. Below, routes followed by Post and Hughes, showing approximate distances of each lap

Lindbergh's "Spirit of St. Louis," one of the best of its day, was driven by a 220-horsepower motor and carried 451 gallons of gasoline and twenty gallons of oil on the Paris flight. It had a fixed-pitch propeller,



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 New York, N.Y.



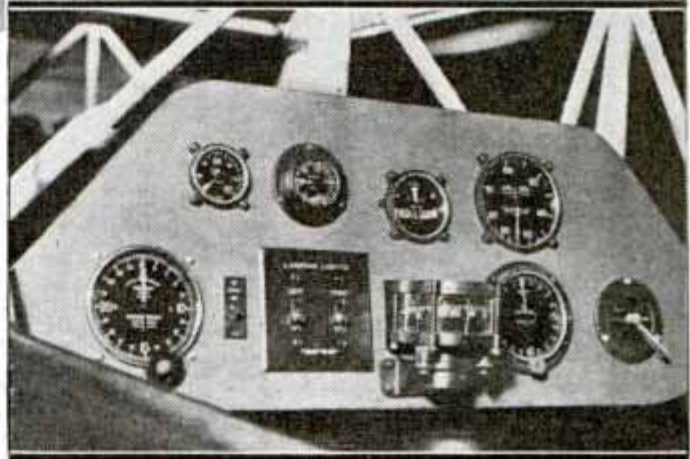
fixed landing gear and was built of spruce and metal tubing covered with cotton fabric. Its top speed was 120 miles an hour.

Hughes' \$85,000 "New York World's Fair of 1939" has two 1,100-horsepower engines and carried 1,650 gallons of special aviation gasoline on the trip to Paris. It has adjustable pitch propellers, retractable landing gear and is constructed almost entirely of metal. Its top speed is 260 miles an hour.

Post's "Winnie Mae" had a 500-horsepower engine and a cruising speed of about 145 miles per hour. As for instruments, Lindbergh and Post had almost none compared to the vast array which aided Hughes in piloting his twelve and one-half ton ship.

The "Spirit of St. Louis," for example, had an oil-pressure gauge, oil-temperature gauge, turn-and-bank indicator, an earth inductor compass, air-speed indicator, engine crankshaft speed counter, navigation and landing light switches, altimeter and an ignition switch—that was all. Most of these few instruments, it will be noted, indicated engine performance but were of no value in navigation. Lindbergh did not even have a radio and, once over the Atlantic, depended entirely on a compass and the stars to fix his course.

Now take a look at the Hughes instruments, most of them developed since Lindbergh's flight. First of all, there's an auto-

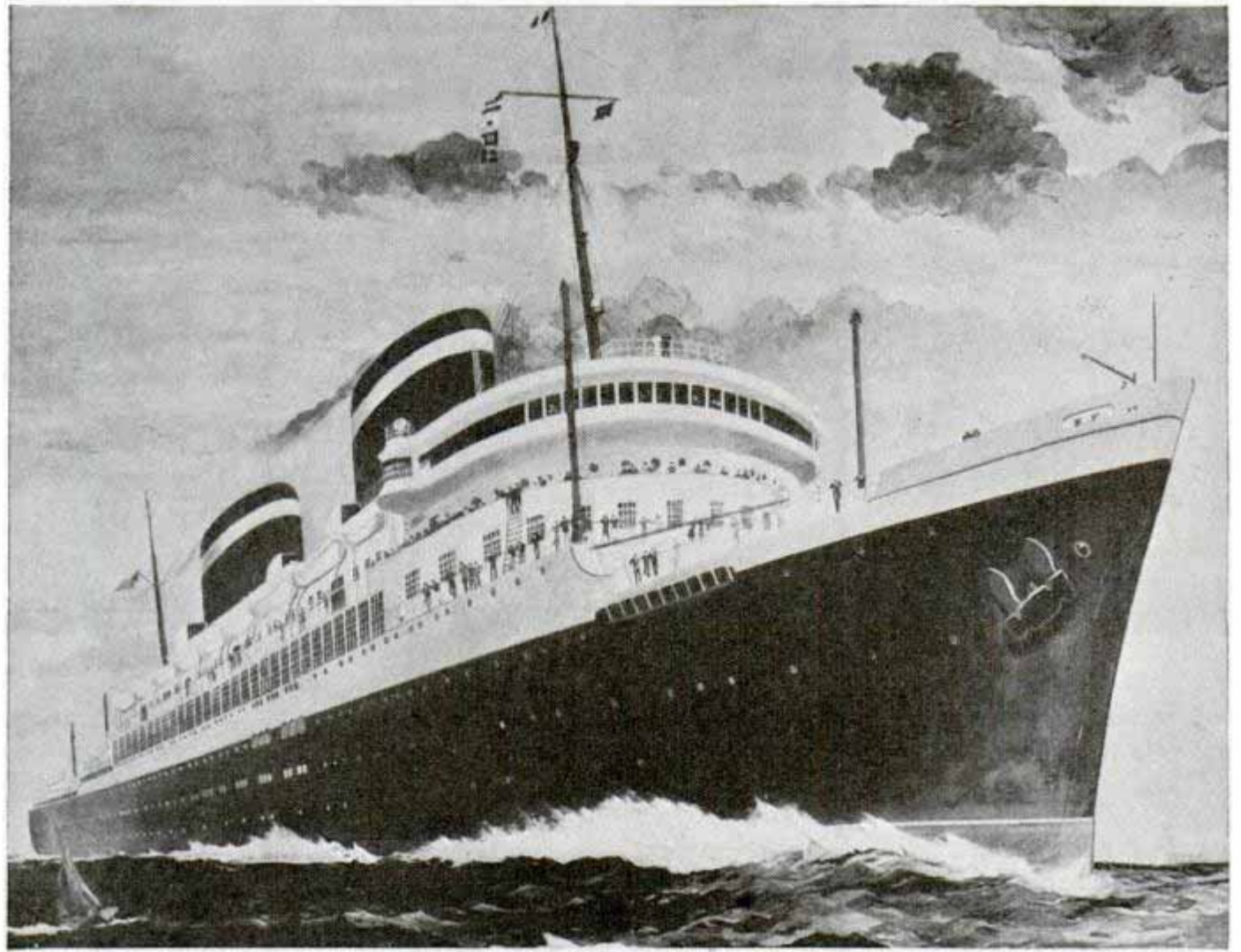


Tuning up motors of Hughes plane at New York. Bottom, instrument panel of Lindbergh's "Spirit of St. Louis." Compare these instruments with the array on facing page

matic pilot, capable of flying the ship on a predetermined course for hours at a time. The 100 instruments also include oil-pressure and oil-temperature gauges for each engine, cylinder-head temperature gauges for each engine, four fuel-capacity gauges, air-speed indicator, dual manifold pressure gauges, dual artificial horizons, directional gyro compass, engine exhaust-analyzer, two sensitive altimeters, flap-position indicator, wheel-position indicator, revolution counters for each engine, oil-pressure gauges for the ship's hydraulic system, light switches for the entire ship and instrument panel, radio-control switches, tuning grinders, volume rheostats, propeller pitch controls, flap controls, landing gear switches, fuel mixture con-

(Continued to page 141A)

How Giant U. S. Liner Will Look at Sea



Artist Worden Wood's version of the new American liner which will be started soon. The ship will carry 1,219 passengers and a crew of 639 in the North Atlantic service

being built at Newport News, Va.

How the big U. S. Lines passenger ship, which will replace the historic "Leviathan," will look when ready for the sea has been visualized on canvas by the marine artist, Worden Wood. Costing \$15,750,000, the ship will be a companion craft to the S.S. "Manhattan" and S.S. "Wash-

ington" in the North Atlantic service, but will be slightly larger than either of them. It will have accommodations for 1,219 passengers and a crew of 639, with a displacement of about 34,000 tons. The length will be 723 feet and the beam ninety-three feet and three inches.

Governor Holds Car to Any Speed Set by Turn of a Key

Your car, or even an entire fleet of trucks, can be held to any maximum speed

from thirty miles an hour up by means of a variable speed governor just brought out. By turning a key on the dashboard the top speed is set at the desired rate, and when the key is withdrawn at that setting the car cannot be driven any faster. About six turns to the right removes all governing action and the car can be operated at its own capacity. This governor is operated by the vacuum in the intake manifold, and it allows use of full power when climbing steep hills or under similar load.

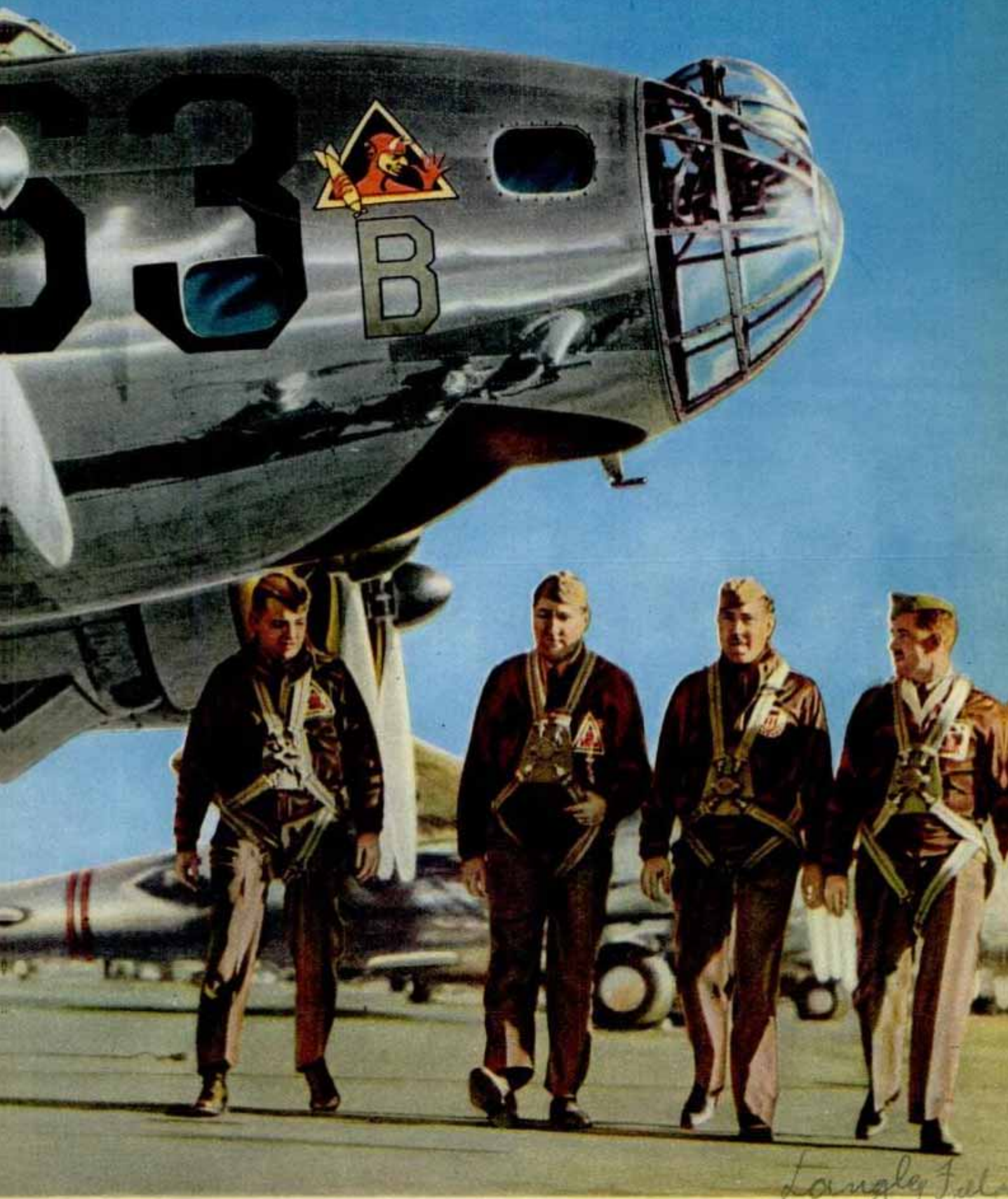


Diagram of variable governor which controls speed of automobile at rate set by turning key

Monarch Governor, Co.

H 967

UNCLE SAM'S FLYING FORTRESSES



THE START of a new day for the men who man a "Flying Fortress." With parachute harness adjusted, they are ready to board one of Uncle Sam's big bombers.

doing a training use
 Air Corps form



COMBAT CREW					TAXI OUT	MISSION	INSTRUCTIONS	
PLANE	PILOT	NAV-BOMB	RADIO	GUNNER				
31	MURTHA LIGIN	MCINTYRE	LARZANO	GUYVER	KYLE	6:00 AM	33	PERFORMANCE FLIGHT
	CHUSTON	KREPS	LT HENDERSON	ROBINSON	YARSH	"	31	ORIENTATION RE AS. AND SWING ON
	HUGLIN	FISHER	SCHMITT	HUNTLEY	KORHAN	"	"	" " " "
	FINCH	GIBSON	CHILDRE	NEWLIN	WILLARD	"	"	" " " "
MAINTENANCE INSPECTION								
COMBAT CREW OF 31					1:15	46-13	9Bombs 100 AC36	Shows in Form 6.10
COMBAT CREW + HENDERSON					7:00	N7	MF-LA MOA-CMC	
					7:10	"		
					7:20	"		
					7:30	"		
					8:15	12	CAMERA OBS	

OFFICERS of bomber inspecting board containing flight instructions. Below, releasing weather balloon to gather data for Uncle Sam's pilots.

If you have what it takes, Uncle Sam wants to put you on his pay roll while he teaches you to become a pilot for one of his great "Flying Fortresses." It's a great opportunity for those who wish to follow aviation as a career if they can make the grade.

If you are between twenty and twenty-six years of age, physically and mentally fit, and have had two years in college or the equivalent, you have a chance to become a pilot or a member of the crew of one of the great bombing planes of the Army Air Corps and be assigned to active duty as a reserve officer on the same pay as a Regular Air Corps officer at one of the great air bases like March Field in southern California, one of the nation's most important "Wings."

The expansion of the nation's air-



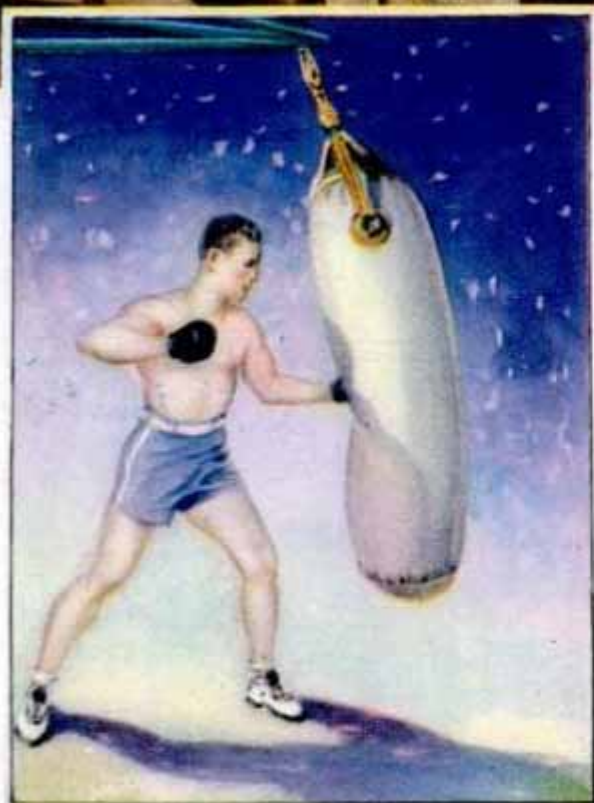
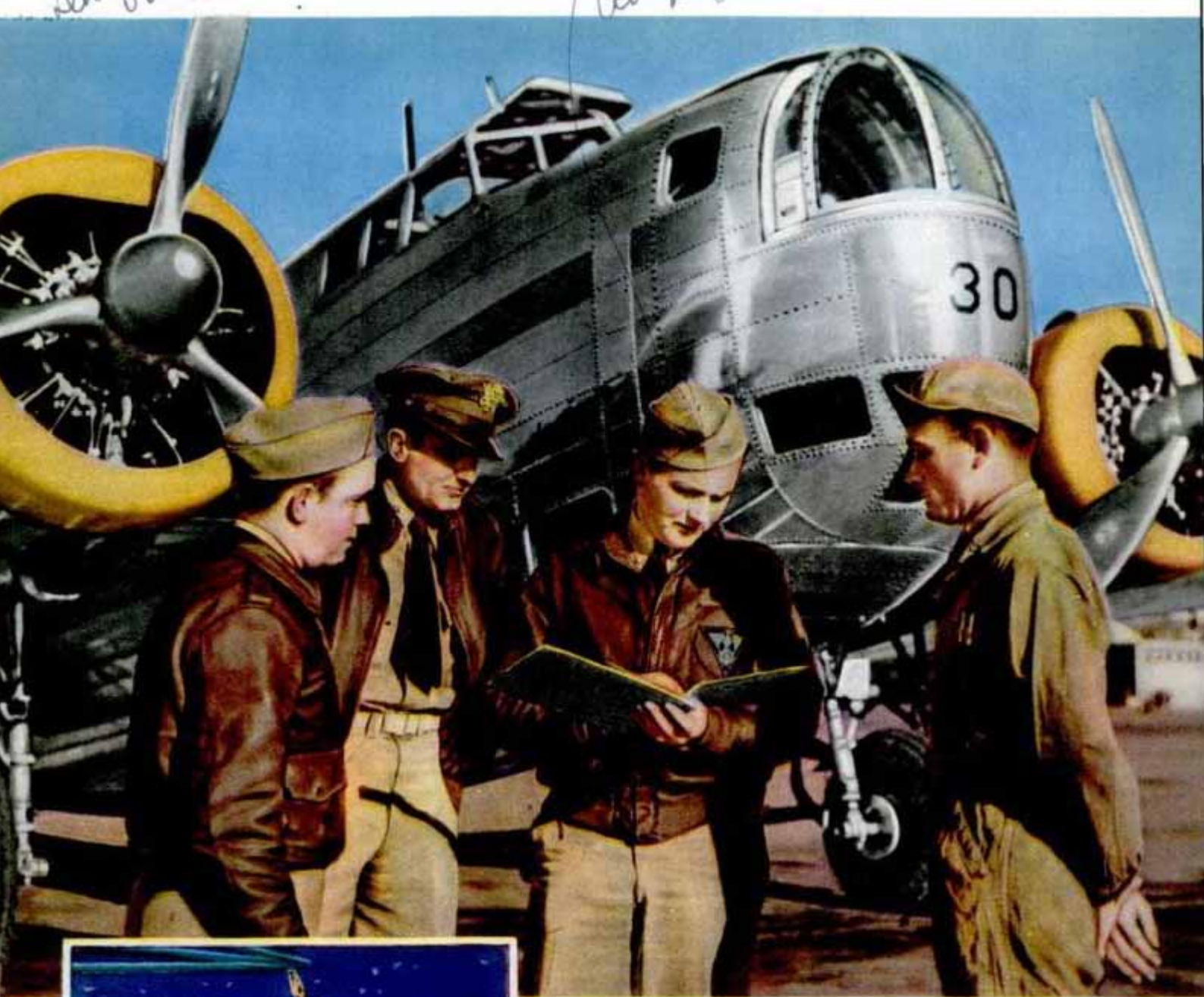
fighting forces and the addition of many new planes of various types create the demand for young men to fill positions as officer pilots for the new equipment. This sudden call for prospective Army Air Corps pilots is one of the most unusual ever made by the Army which, in addition to throwing open the doors of the service, has gone a step further by creating special flying boards which will visit every college in America which has an R.O.T.C. unit in the search for desirable young men to be trained as pilots for the Army Air Corps.



Map photo courtesy U. S. Army Air Corps

CONSULTING weather charts at March Field, above, before donning parachutes for a flight, right. Map shows area comprising "First Wing," except Alaska.



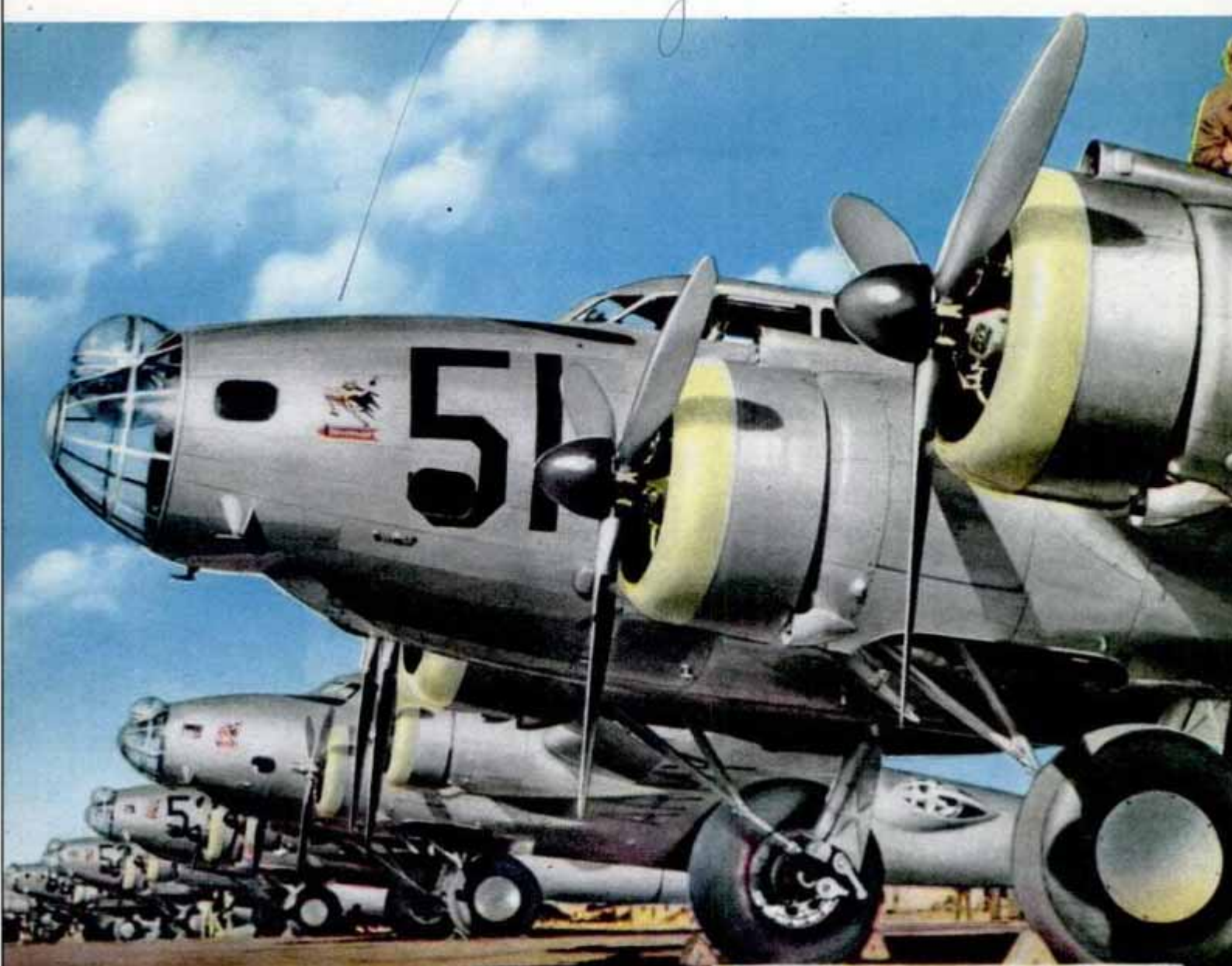


FLIGHT commander receiving mechanic's report before taking off with a bomber. Below, flying personnel must keep in first-class condition, mentally and physically.

America, within the next few months, will have one of the greatest air forces in the world. The amazing "Flying Fortresses" pictured here are soon to be dwarfed by even larger "Forts of the Air." The Air Corps plainly states that flying these planes is a business strictly for young men. There is no room for "old soldiers," who are being weeded out and replaced by men whose qualifications automatically fit them to become a part of a gigantic, smooth working machine.

At March Field activity is the keynote of the air force. Physical as well as mental fitness is necessary. If you have these qualifications and can prove you have had two years of college, you are eligible to apply to become an officer in Uncle Sam's Air Corps. If you have not gone to college but have had the equivalent of the first two years of study in college, you may take a written examination after first having passed the physical tests which are thorough.

An outstanding feature of the new plans for receiving enlistments for Army Flying Cadets is that after you have completed your training at



the Air Corps training center, at San Antonio, Tex., and served with a tactical squadron, compiling the coveted 1,200 hours' flying time, you will be eligible to obtain a rating from the Bureau of Air Commerce, Department of Commerce, as an airline transport pilot if you do not wish to continue as an officer in the Army Air Corps.

The Army Air Corps is divided into three "Wings." March Field, the base of the First Wing and one of the most important of the three, is prepared, on a few minutes' notice, to protect the entire west coast of the United States, this area extending far out over the Pacific ocean. The area of the First Wing also includes Alaska, making this wing the largest of the corps.

The protection of all of the territory of the United States west of a line stretching from the Canadian border to Mexico and from the eastern boundary lines of Montana, Wyoming, Colorado and New Mexico is the responsibility of the March Field base. The bombing squadrons and attack groups at March Field can be reinforced



Lower photo courtesy U. S. Army Air Corps

SOME of the reasons why America feels secure from foreign invasion—a line of "Flying Fortresses" ready to take to the air. Below, swimming pool at March Field.



MACHINE gunner, top, left, manning high-powered rifle in cockpit of an attack plane. Above, right, attaching dummy jumper to a parachute for a test drop from an airplane. All parachutes are thus tested at March Field at regular intervals. Below, control tower at March Field where the landing and takeoff of planes is directed with the aid of two-way radio.

by the bombers, attack and pursuit units of Hamilton Field at San Rafael, near San Francisco, in an emergency, and also by units to be established at Seattle.

The amazing thing about the Air Corps is the speed with which it can swing into action, covering thousands of miles of territory in a few hours. In case of emergency, in just twelve hours the entire air-fighting forces of the nation based within the United States could be in action all along the west coast. The same fighting force could strike on the east coast if necessary.

Life in the Army Air Corps does not consist entirely of flying or the building and rebuilding of equipment. There are social as well as sport activities. The latter are designed

to keep Uncle Sam's men of the air, in "the pink" for admittedly the Army Air Corps personnel must consist of men who more nearly approach mental and physical perfection than any other branch of the service. At March Field a gymnasium, bowling alleys, hand-ball courts and swimming pools offer healthy recreation.

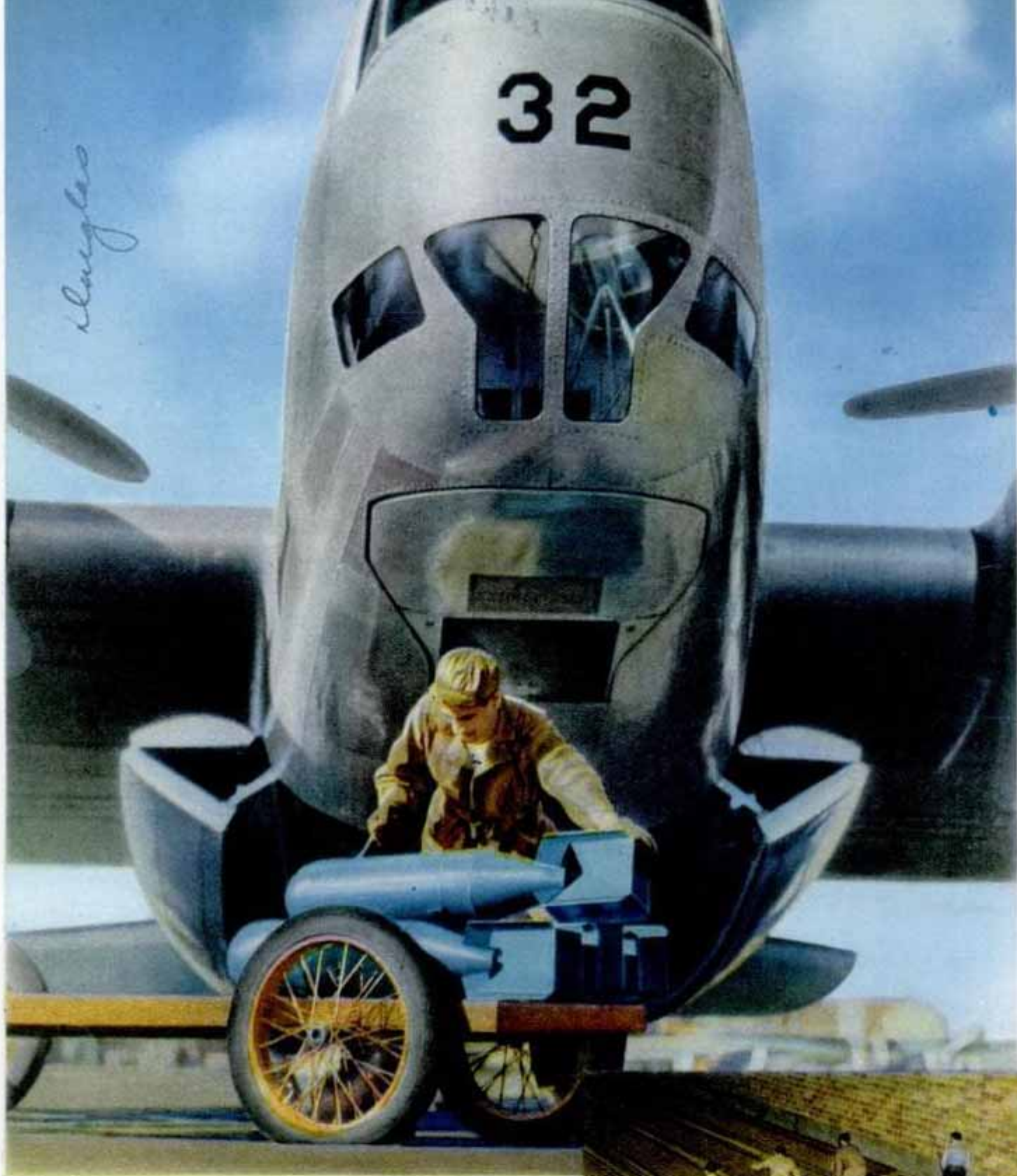
Unlike other branches of the service, there is little pomp at March Field. The usual army formalities, such as reviews, seldom are held. However, squadron inspections and some of the other routine "chores" of army life are in vogue at this famous air base.

Some of the most famous of all Air Corps groups have their base at March Field. Records of long



MECHANICS, top, checking Army plane after a flight. Right, preparing an attack plane for a smoke screen flight.





standing, contributing to the high efficiency of the corps, have been made by the squadrons based there and, as a strategical location of the air force, March Field ranks high in importance as a national defense headquarters of the nation and the west coast in particular.

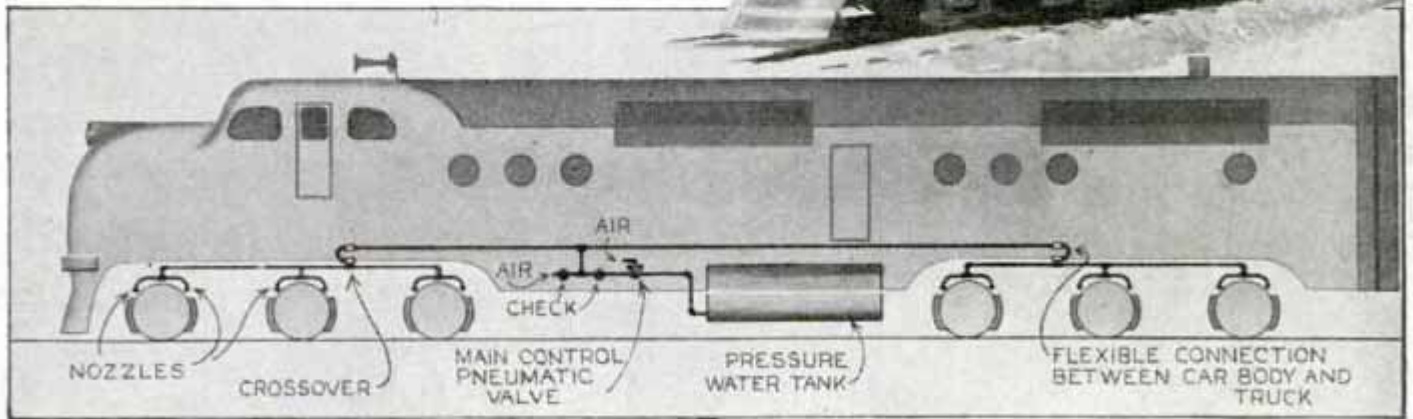
According to recently announced plans, America is now establishing and in the future will maintain the largest and most efficient and modern air force in the world. In this program, March Field is likely to play an important part.



DUMMY bombs being loaded aboard a "Flying Fortress" at March Field. Right, bowling helps keep the men in trim.

Fast Train's Wheels Cooled by Spray System

To prevent overheating caused by prolonged application of brakes, the Southern Pacific company has installed a wheel-cooling device on its fast trains. It consists of an outlet from a water tank, operated by an air-controlled valve with longitudinal pipes and lateral branches at each wheel, terminating in spraying nozzles.

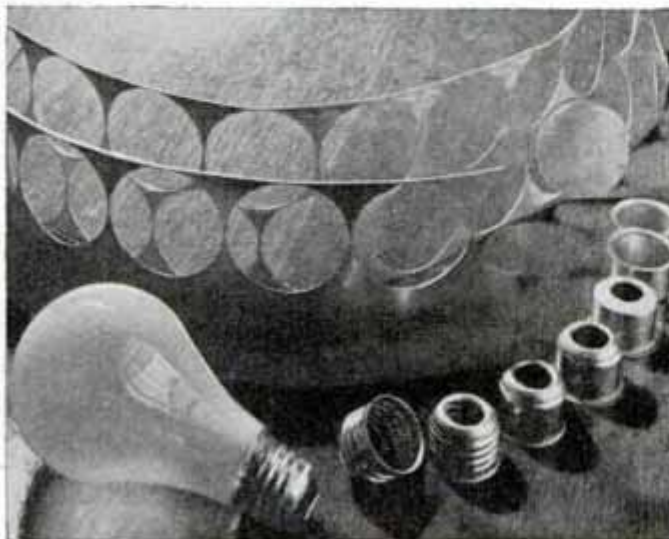


Top, one of the latest streamliners. Bottom, sketch of wheel spraying system designed to keep brakes cool. Note nozzles located to play stream of water directly on wheels

When the engineer applies the brakes, he also opens the control valves of the system, causing a sufficient amount of water to flow on the wheels to counteract the heating effects of the brake shoes. The system also works automatically by pneumatic or electrical means. The main control valve operates electrically from thermostats applied to the brake shoes when wheels have become heated to a predetermined temperature, or by air pressure each time air is applied to the brake cyl-

inders. An electric relay allows for air from the brake system to blow water out of the pipes following each application to prevent water freezing in the pipes in cold weather. Use of the wheel-cooling system has resulted in a considerable saving in use of brake shoes. Another device to prevent operating delays consists of an arrangement by which roller-bearing boxes are equipped with odor bombs which discharge an obnoxious odor to warn trainmen when journal bearings run excessively hot.

From a Sheet of Brass to a Finished Electric Lamp Base

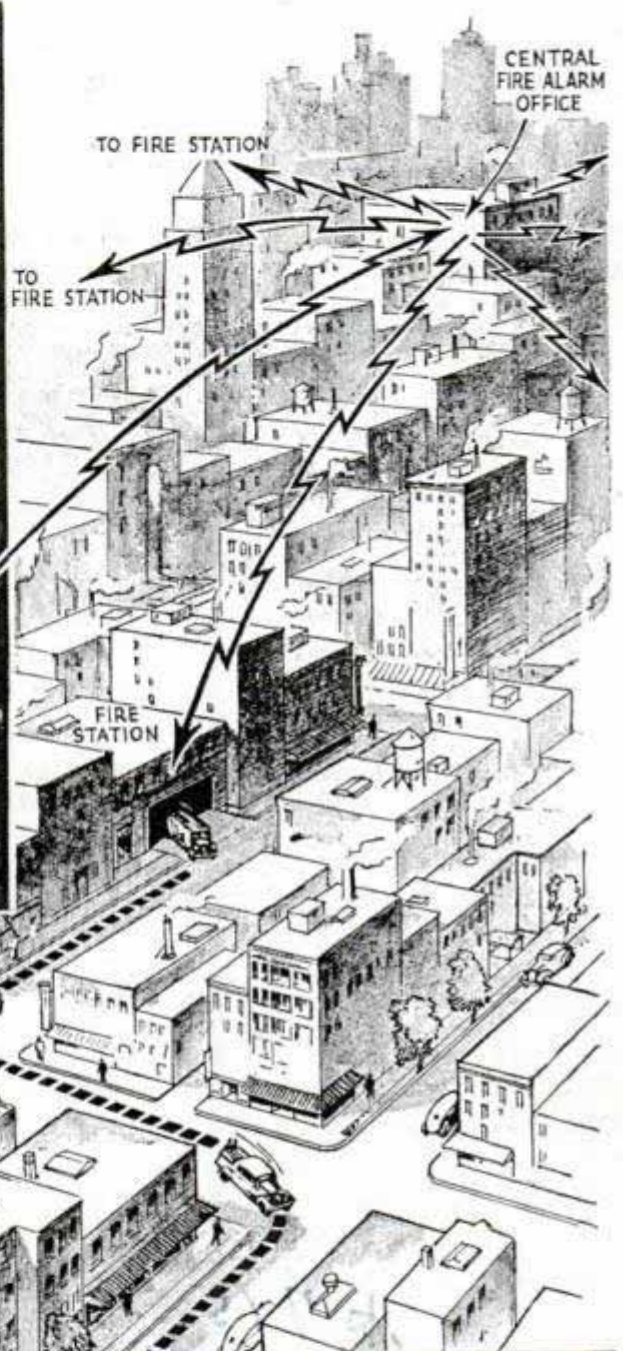


Steps in the making of electric lamp base

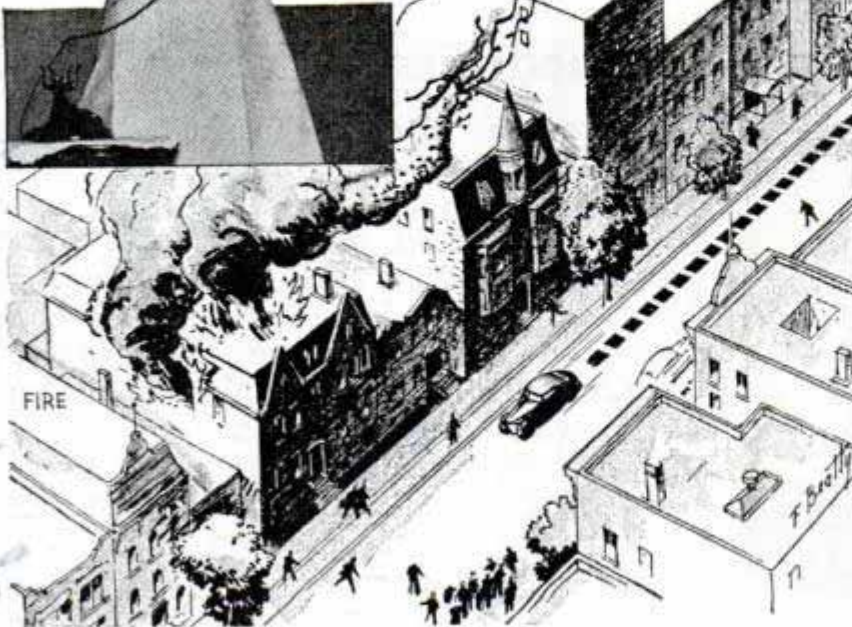
From brass sheet to finished electric-lamp base there are a number of interesting steps taken in the Westinghouse plant. First, round disks are cut from the sheet and formed into a cup. Then the cup is drawn, pierced, formed, trimmed and threaded before being assembled to the center contact eyelet with glass insulation to form the completed base. A photographer recently followed the metal sheet through the various steps, finally snapping a picture of the finished lamp.

Send return postage to our Bureau of Information to learn the name of the maker of any device described in this magazine.

Loudspeakers Speed Dispatch of Fire Squads



Kralygar



Seconds count in fighting fires, and loudspeakers are cutting twelve to twenty seconds from response time of city fire squads. Still alarm reaching central office, top, is dispatched to speaker in every station

1655 1/2 Holman Cir.
Los Angeles, Calif.

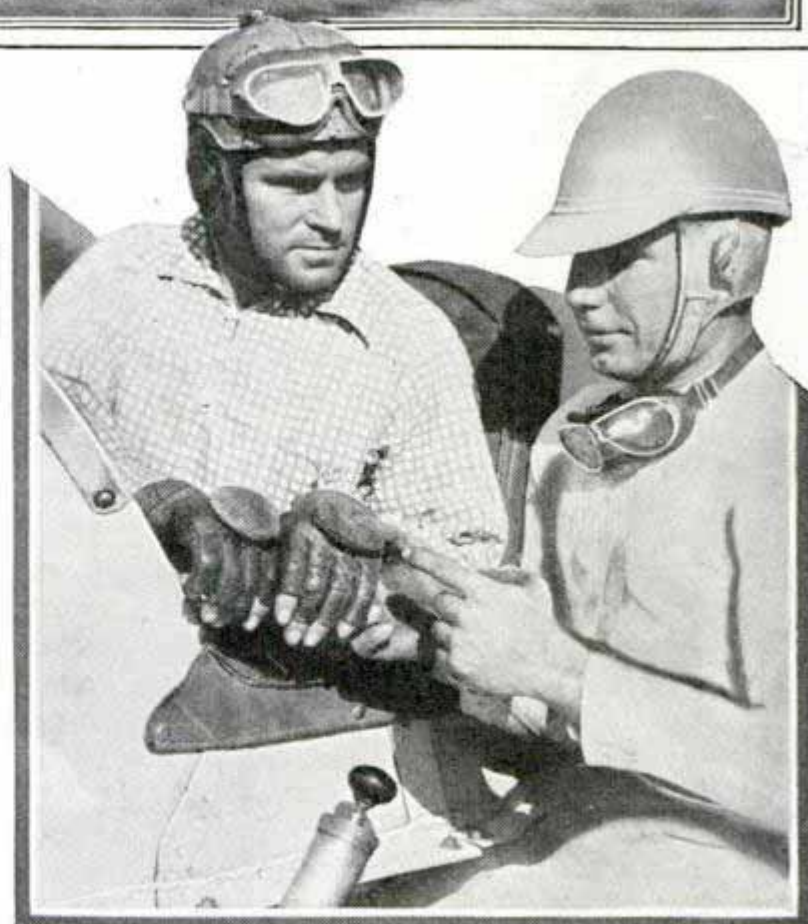
SPEED RACES *for* AMATEUR DRIVERS



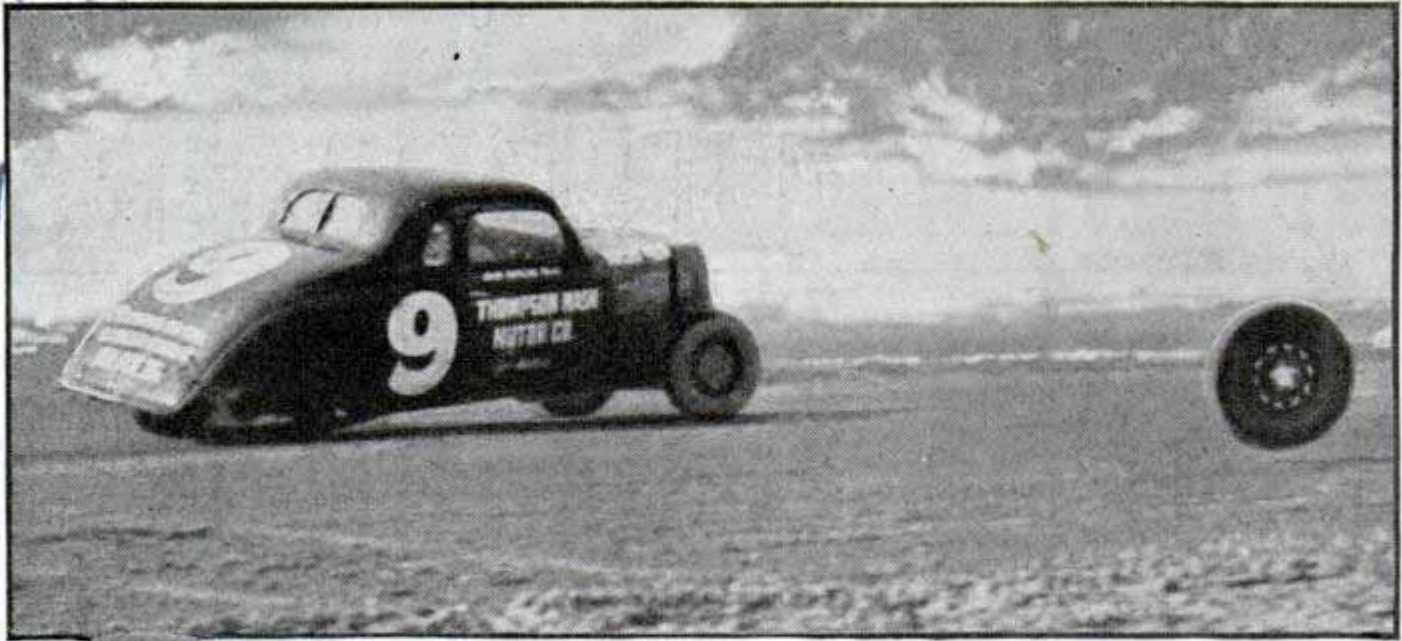
GETTING more power and speed out of their cars is the hobby of thousands of young drivers. In every neighborhood they are trying to make their cars go faster by changing the valve timing or installing racing pistons and "high heads." Then they wonder how they can safely try out their "hopped up" cars.

In southern California 500 young men have an answer. Instead of chancing death on the highways, they hold regular racing meets. Each owner drives his car wide open and finds out just how fast he can go. One of their race days is a sort of junior Indianapolis meet.

The drivers have their own contest board, starters and judges. They use electric timing to clock their cars and a portable telephone system for starting and keeping the course clear. Scores



Midget racers, top, fighting for lead as they come out of a turn. Bottom, powder puffs on backs of driver's gloves are used to wipe goggles clean during a dusty road race



Coupe at top has lost wheel during stock-car race. Bottom, cockpit of modified roadster. Note thin steering wheel

of their cars have exceeded 100 miles per hour and half a dozen or so have qualified at close to 120 miles per hour. Yet carefully planned safety rules make the races safer than ordinary highway driving.

This type of amateur racing started last winter when two dozen neighborhood speed clubs organized the Southern California Timing Association. They incorporated as a non-profit organization and picked Muroc Dry Lake as the race site. This lake bed, on the desert 100 miles from Los Angeles, is fifteen miles long and as flat as a table top. Four races are planned

each summer. In the first meet this summer 226 cars took part. So many were present that it was necessary to start the qualifying dashes at four o'clock in the morning to complete the program before the midday heat set in. More than 10,000 people got up early and made a trip to watch the trials. No admission was charged.

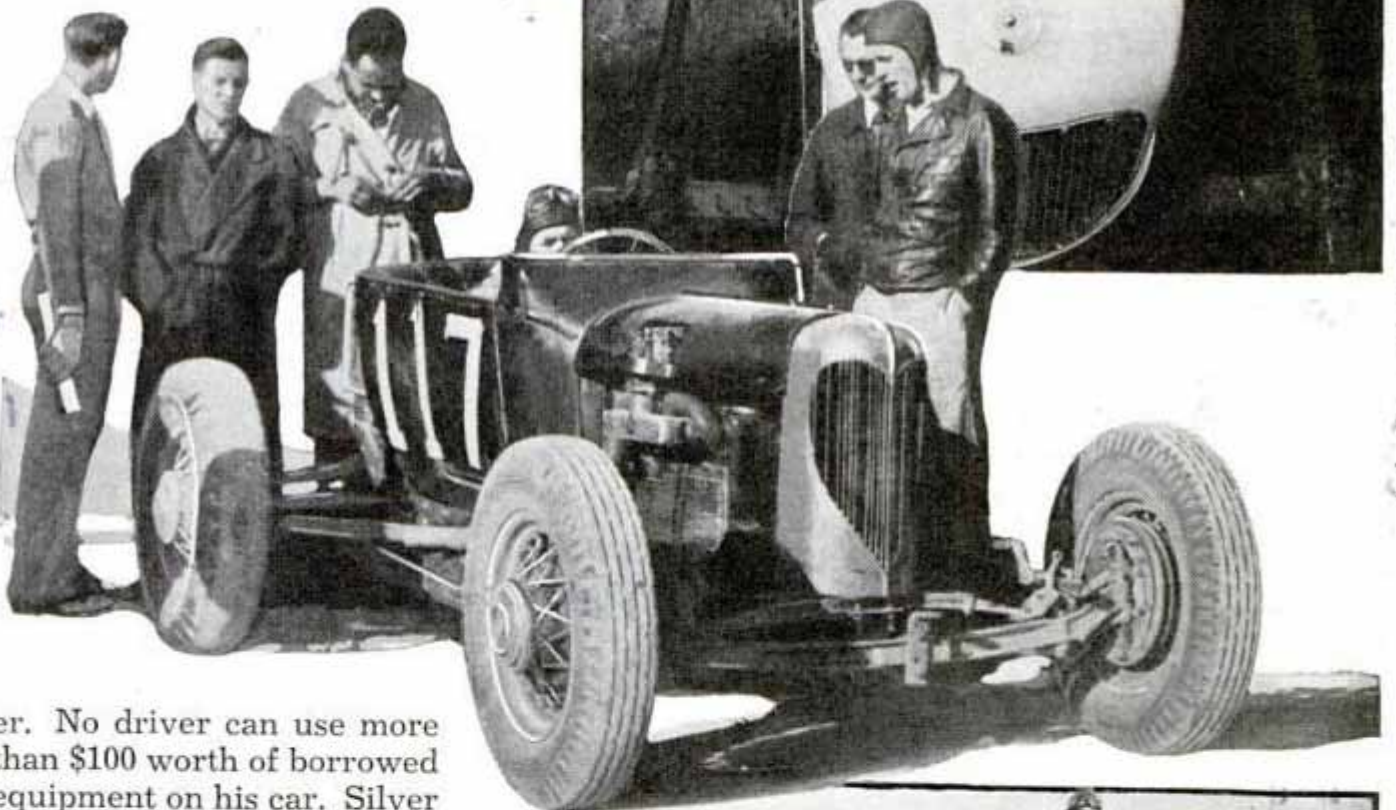
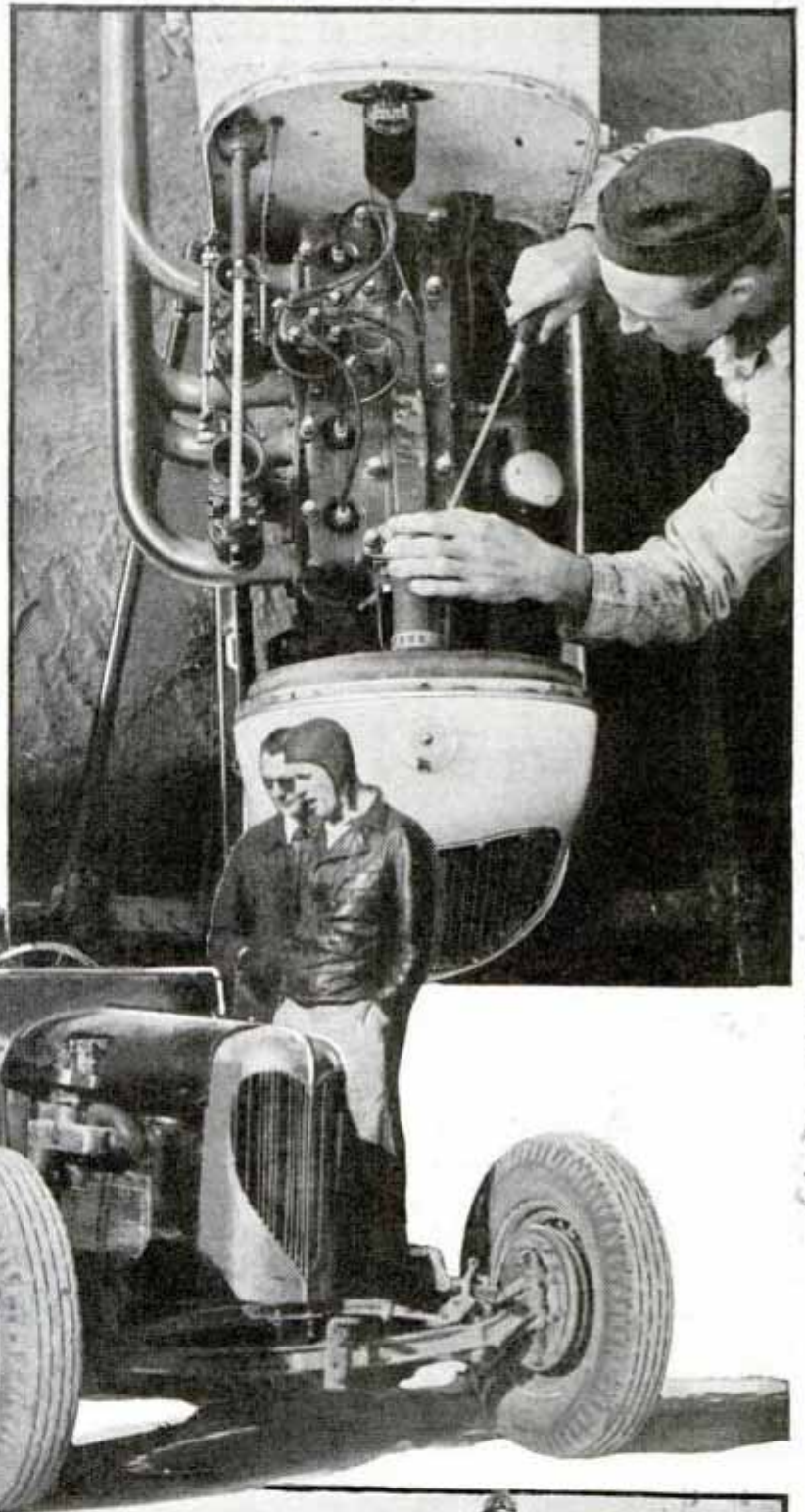
No closed course races are held because straightaway speed dashes, with no corners, are safer. The course is seventy-five feet wide and about three and one-half miles long, marked along each side with red flags at thirty-foot intervals. The finish line is one and three-fourths miles from the starting pit, the last quarter-mile being the "time trap" over which speeds are electrically obtained. In making a time trial, a driver uses the first mile and one-half to

get up to full speed before he hits the trap. After he has driven through it he has about two miles in which to slow down before turning off the course. The home-made electric timer is accurate to within one ten-thousandth of a second in twenty-four hours.

Safety rules prohibit a car from participating until it has been checked by the technical committee. Tires must be good, the steering assembly must work easily and without play, the exhaust pipe must be attached firmly and body and hood must be fastened securely. Only one man is al-

lowed in each car. No driver is allowed to follow closely in another's air wake.

Almost the only motor restriction is that it must be American-made. Special high-compression heads, overhead valves and extra racing gear are permitted. An owner can do almost anything he likes to get more speed. Model A and B Fords, V-8s, and Chevrolets are the most popular engines and four-cylinder engines win nearly all races. Cars are raced as stock roadsters, as modified roadsters on which changes to convert them into racing cars have been made, and as coupes and sedans. The two latter classes compete togeth-



er. No driver can use more than \$100 worth of borrowed equipment on his car. Silver cups are awarded by the different racing clubs as prizes, and service shops put up equipment prizes.

Each driver is allowed two qualifying time trials, his average determining the class in which he will race. There are five racing classes, from eighty to ninety miles per hour, from ninety to 100, and up to the fifth class in which are cars qualifying at 120 miles per hour or more. An entrant who oversteps his class division by more than one mile per hour is

(Continued to page 125A)



Driver at top is tightening water hose on his "flat-head" high-compression engine. Center, modified roadster with special racing engine. Bottom, touring car, dilapidated in appearance, but equipped with a racing engine which gives it a speed of 100 miles an hour

H 735 Schenelady ref

Forty-Miles-an-Hour Punch Is Timed by Electric Eye



Professional boxer's fist travels past photocells at forty miles an hour; amateur's best was twenty

How fast does a boxer's fist travel? No one—unless it was the fellow who tried to dodge the punch—knew until a photoelectric measuring device was put to the test recently. A heavyweight boxer shot his right arm under the dual "electric eye" controls at the rate of forty and two-tenths miles an hour; spectators at the ringside tried their punches, too, but could do no better than thirteen to twenty miles an hour. The speed is computed by an electric meter which calibrates the time required in intercepting two light beams about a foot apart.

644.

How Near Is the Nearest Star? The Answer Is in Tons

How far is it to the nearest star? Measured in miles, the figure would trail such a long string of ciphers as to be meaningless. Measured in tons, the answer is startling. If a spider should spin a thread around the earth, that thread, rolled into a little ball, would weigh about a pound. But a spider's thread spun across space to Alpha Centauri, the nearest star, would weigh not fifty nor 10,000 pounds—but 500,000 tons! That neighbor star can be seen only in regions near the equator. In

the northerly latitudes the nearest star, Sirius, is twice as far away and a million tons of spider thread would be needed to cross the gap between it and the earth.

H 691

Street Flusher Does Extra Duty Fighting Farm Fires

To help protect farms from fire, a street flusher truck built for rural communities doubles as a fire truck, carrying water, hose and pumping equipment. With a tank, varying up to 3,000 gallons capacity, kept always full of water, the truck is ready to speed to a farm fire and throw water immediately. The flusher pump can be used to discharge water or to pump it from cistern or creek.

H 692

Automatic Reel on Rug Cleaner Winds Up Electric Cord

No need to tangle and trip on the excess loops of your vacuum-cleaner cord. An automatic takeup reel just introduced pays out just enough cord to reach from the wall socket to the site of operations; reels it in at the touch of a finger loop and keeps it stored in a metal container that is an integral and decorative part of the vacuum-cleaner handle. It works on a principle much like that of the measuring-tape reel. The exact length of cord needed is always payed out automatically.



Reel in circular housing on shaft of cleaner pulls in the cord at touch of finger-loop control

Big Bombers Are Loaded in Practice for War

How the giant bomber would be loaded with explosives in time of war is shown in a group of pictures snapped recently in France during aerial maneuvers at Rheims. The various steps include hauling the explosives on small carts to the big bombing planes. Next comes attachment of the bomb to the underside of the ship, then an aide adjusts the fuses to permit detonation and finally the loaded planes are drawn up ready for flight, with the deadly "eggs" in place for unloading on their objective. In a test flight, French air force pilots destroyed an artificial village with bombs.



Series of photos showing how big bombing plane is loaded. Top, rolling bombs to ship. Center, attaching a bomb. Bottom, setting detonating device on the explosive

about a winged to - 1 30 Rochester May a
 practice Camp of America

#658

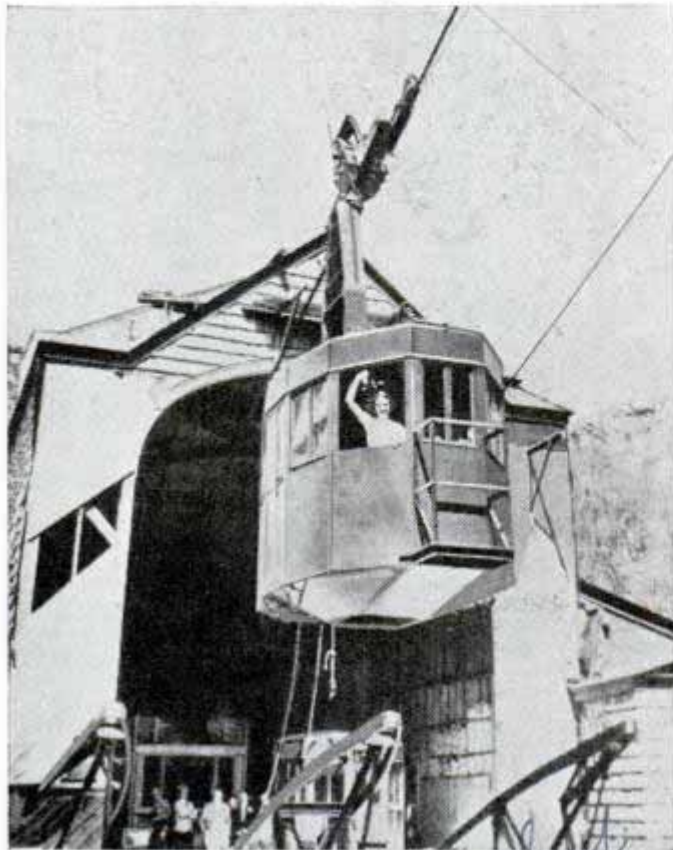
clerk

Radio Clock Is Kept on Time by Signals Varying a Beam

Its time set and corrected by signals sent out from a master clock at the broadcasting station, a radio clock that can be installed as part of an ordinary radio receiver has just been patented. It tells time to the nearest five minutes, but can be modified to show correct time to the nearest second. Without interfering with the regular broadcast program, the clock is set by low-frequency modulations below the audible range. The signals cause reeds to vibrate, and the reeds interrupt or let pass a light beam directed toward a screen. The position of the beam indicates the time.

Photo

Aerial Car Lifts Passengers To Mountain Summit



Twenty-seven passenger cable car starts up Cannon mountain, N. H. It's an eight-minute trip to summit

Twin tramcars are gliding up and down the slope of Cannon mountain in New Hampshire, taking passengers to and from the 5,410-foot summit. First of its kind in America, this aerial cableway in the White mountains was opened in June and will be used by tourists in year-around service.

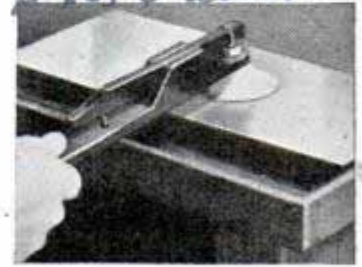
Steel Pipe Lined with Sulphur Used to Carry Acids

Sulphur lining for steel pipe has made it possible to carry acids and salt brine through the same pipe for several years without corrosion. Ordinary steel pipes have been known to fail in four months from the corrosive action of these liquids. One method of coating steel pipe is to cover the interior of the pipe with a bituminous material, then center a steam-heated core inside the pipe and pour into the annular space a mixture of molten sulphur and aggregate. After this mixture solidifies the core is removed, leaving a pipe with a homogeneous lining of sulphur. Such a pipe is unaffected by moisture, temperature change or corrosive liquid,

and has high resistance to pressure. Another method of fabricating sulphur pipe is to pour the mixture of molten sulphur and aggregate into a rotating mold, a technique similar to that used in making centrifugally cast-iron pipe.

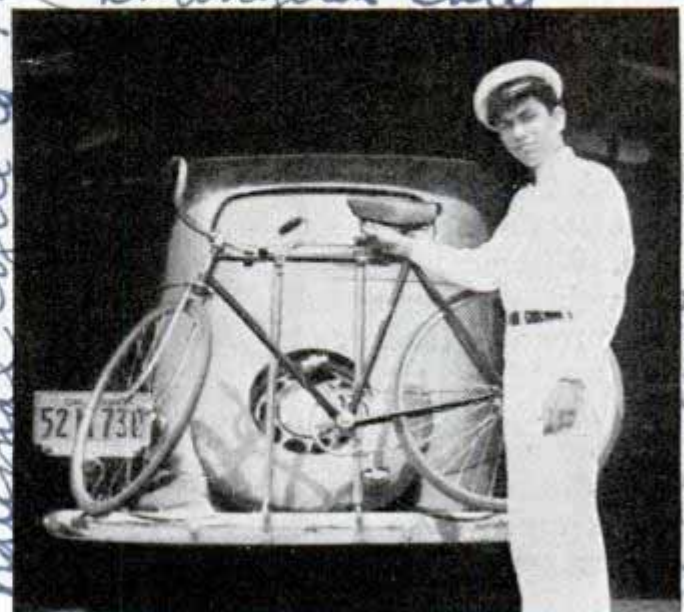
Vacuum Lifter for Sheet Metal Protects Operator's Hands

Danger to the workman's hands in lifting and feeding sheet metal during stamping and die press operations is eliminated by the use of a vacuum lifter. The vacuum cup grips the metal firmly and is released by pressing a lever with the thumb.



Bicycle Carrier on Car Bumper Installed in a Few Seconds

Convenient for bicyclists in getting a start from the city on pedaling expeditions, a "bike" carrier can be attached to the rear bumper of an automobile in fifteen seconds. It carries one or two bicycles safely. Garages, too, use this carrier in picking up and delivering automobiles to customers, since it provides the driver an inexpensive way to ride back. Felt padded screw grips hold the carrier to the bumper, and no tools are needed.



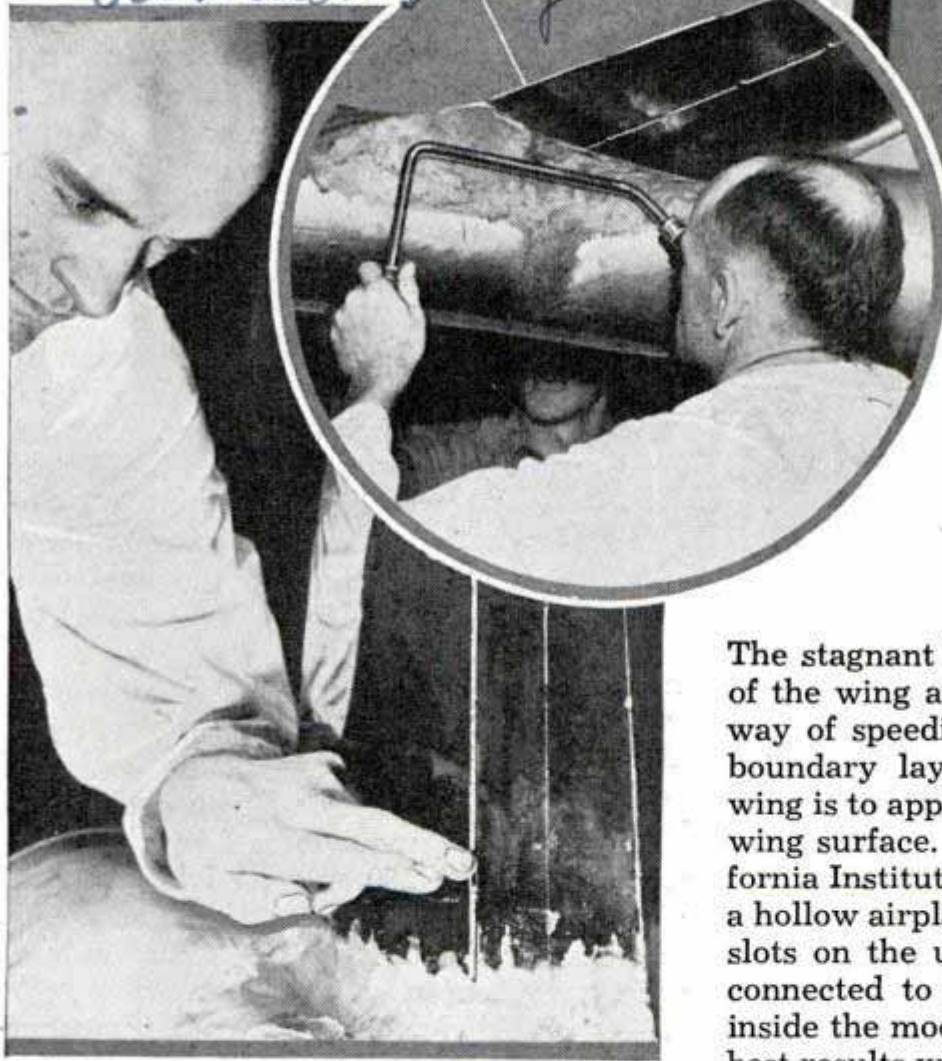
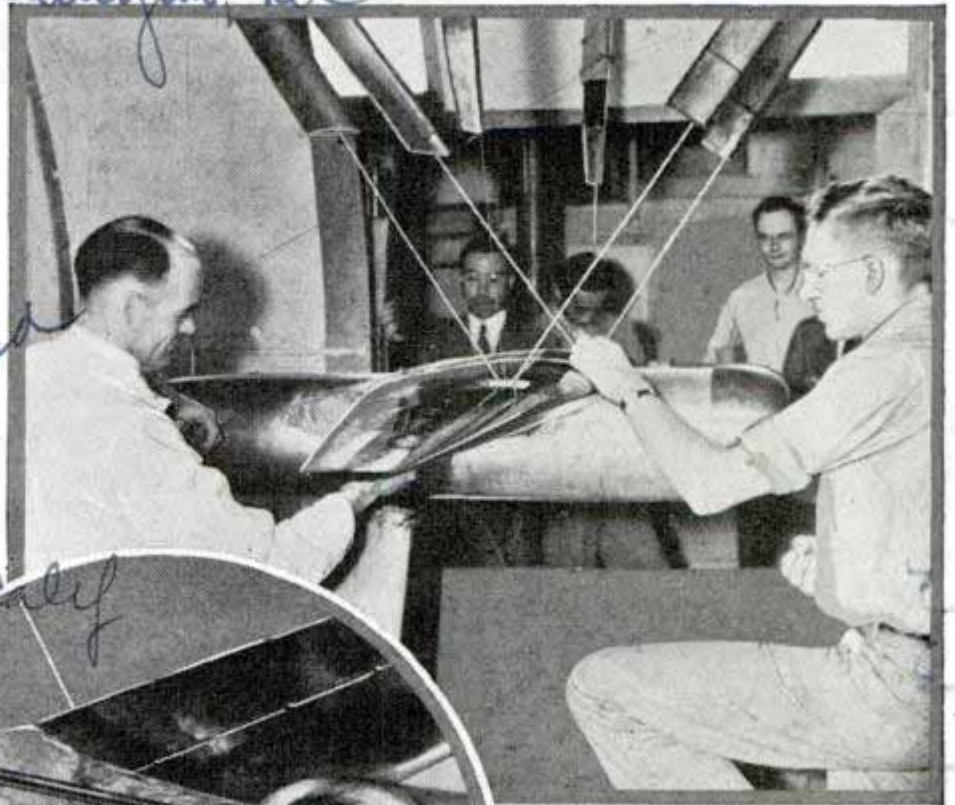
Garage man delivering auto fastens bicycle on rear bumper and then pedals back to his garage

H 29
H 752
H 722
H 693
58
45
26
N. Y. C.
724
National Cycle Co

\$1.50 each
Los Angeles Calif
Garage

"Sticky" Air Studied to Make Planes Faster

Large transport planes of the future may have wings only one-half the conventional size, and as a result, may fly much faster than they do today. This is one possibility indicated in experiments being conducted by the National Advisory Committee for Aeronautics, California Institute of Technology. Air takes on some properties of a liquid when a body moves through it at high speeds,



Several views of scientists at work, studying "sticky" air with aid of models. Top, model plane suspended in laboratory test tunnel. Circle, working on fuselage. Bottom, applying plastic to wing

it has been found, and its viscosity is such that some of it tends to stick to the surface of the moving body. On an airplane the size of the Douglas "DC-4," this boundary layer of "sticky" air is more than an inch thick twelve feet back from the leading edge of the wing and increases to as much as three inches thick at the trailing edge.

The stagnant layer of air leads to stalling of the wing at high angles of attack. One way of speeding up the movement of the boundary layer across the chord of the wing is to apply suction to open slots in the wing surface. In experiments in the California Institute of Technology wind tunnel, a hollow airplane is used and a line of open slots on the upper surface of the wing is connected to a motor-driven suction fan inside the model. The suction required for best results would be three to five per cent of the total engine power in a full-scale plane. The effect of the slots is practically to double the lift of the wing. That means that higher wing loadings may be applied, permitting use of much smaller wings than are needed without the slots. Smaller wings provide less weight and less drag, permitting higher speeds.

The MISSING LINK



The author and his Kellett autogiro. Top, scene on roof of Chicago post office just after Miller had landed autogiro there

By John H. Miller

Chief Test Pilot, Kellett Autogiro Corp.

IN 1934, I thought I was buying my last automobile. The old bus now is much the worse for wear but I still hope my next car will be a roadable autogiro.

With it lies the future of transportation for the motorist who wants to fly and the flier who must motor when his trip is short or the weather is bad. It puts three whirling wings on the automobile and forges new measures of protection and conven-

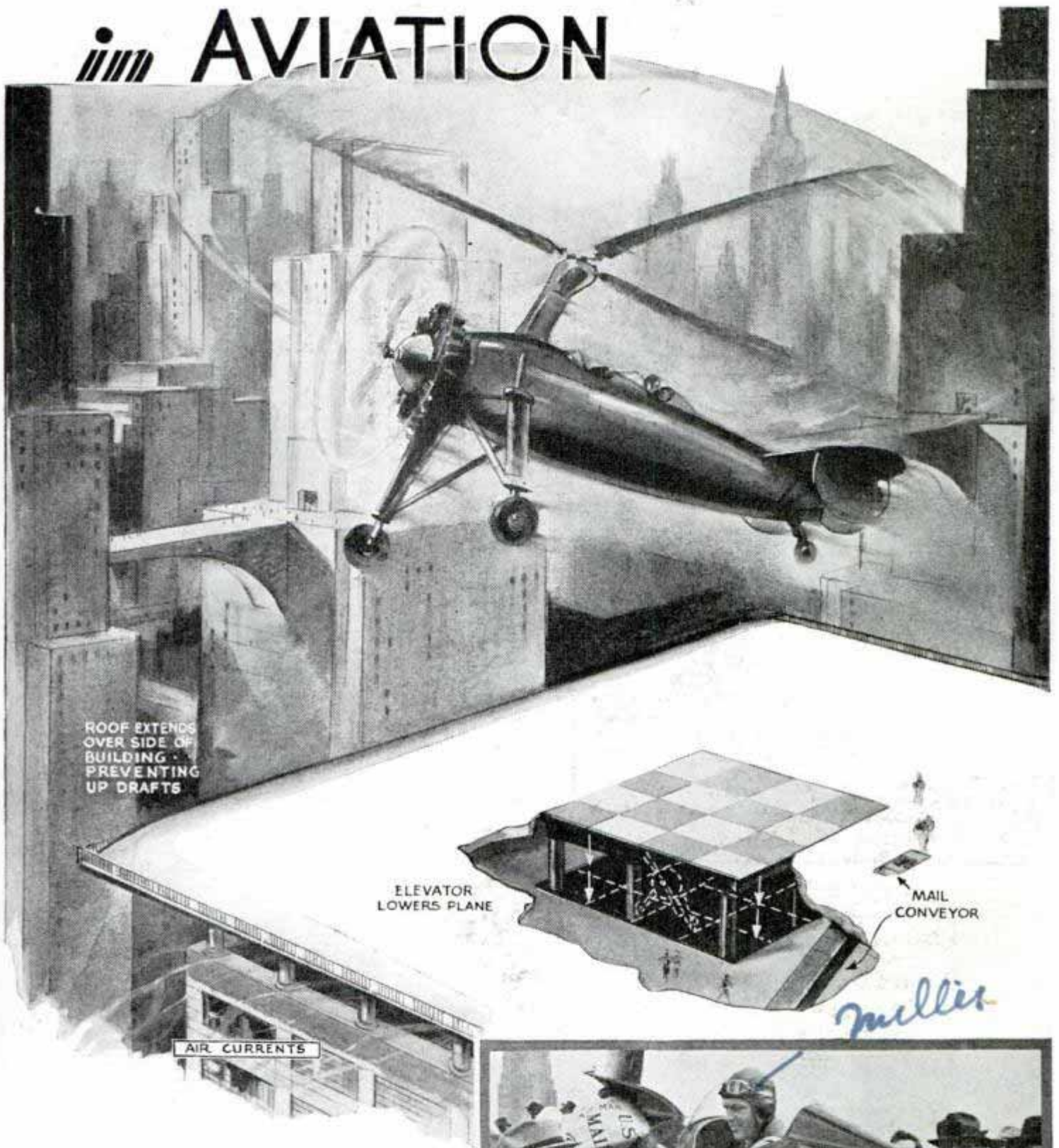
ience for the aviator. Get this picture:

From my suburban home, I duck out to my one-car garage, where the giro waits, its three rotor blades folded back over its tail. Slipping the road gear into reverse, I back out and drive off in the city-bound stream of traffic. A half mile and I come to an open lot, turn in over the curb and stop to break out the rotor blades. It's simpler than putting up the one-man top on a convertible roadster.

I rev up the rotor system, having switched over from the traffic gears to the flying gear, and a moment later I am flying at 100 miles an hour, high above the crawling stream of traffic. I can go faster or slower but I know that in less than ten minutes I shall be dropping into a city parking lot beside my office, twelve miles distant. I can land, fold back the blades and become a motorist if upstairs weather gets bad. I can use the city streets if I have errands there. Family week-end trips can be projected hundreds of miles beyond auto range. I have an automobile and an airplane, all in one.

This is no dream. Such a machine has been built, driven and flown. You can or-

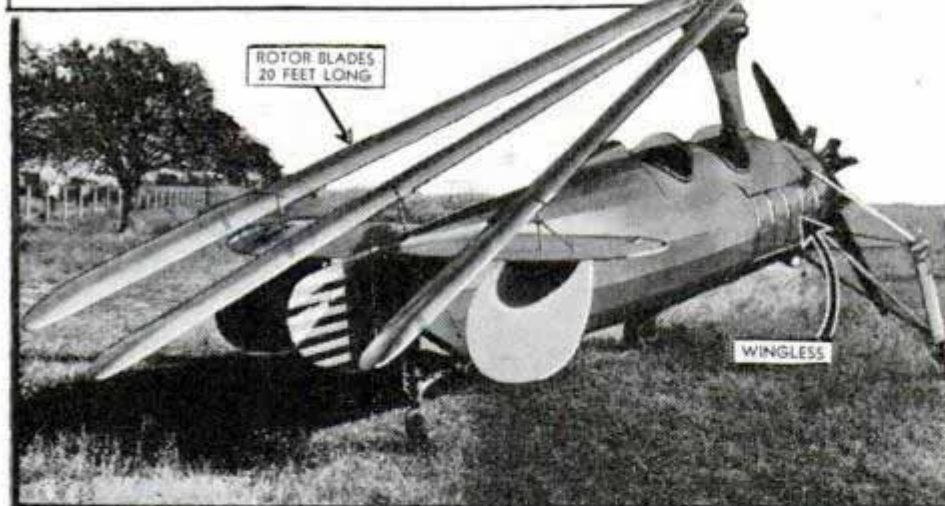
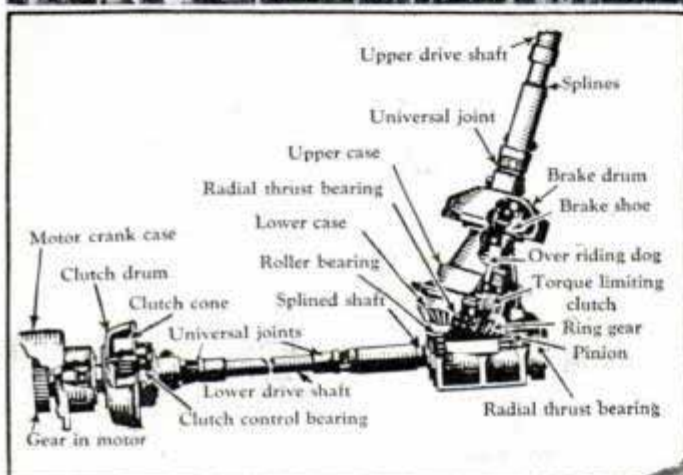
AVIATION



der one today if you are willing to pay the price. But the price as yet is high and the engineers have not completed the studies which will make the roadable autogiro the nearly perfect transportation machine it is sure to be some day. As yet, it cannot carry the load or afford the comfort I have been taught to expect in my car. The price will not come down appreciably until hundreds of models can be sold. And so, I still am



Artist's conception of landing platform atop city building as visualized by Miller to speed up handling of mail. Below, Miller delivering bags of mail to Chicago postmaster after landing his autogiro on roof of the post office



Top photo © Underwood and Underwood

Autogiro, top, landing on capitol plaza, Washington, D. C. Center, details of rotor starter of Kellett autogiro. Bottom, autogiro with rotors locked back, showing small space occupied by machine

waiting for the production fellows to turn out a giro which will compete favorably with my 1934 car.

The autogiro is an aircraft without wings. It is supported in flight by its whirling vanes, a set of overhead blades which operate like three individual gliders. In

descending flight, each blade becomes identical with a glider flying downward in a spiral. Together, the three follow each other in a tight spiral or helix. If three gliders were to execute this maneuver, they would bank more and more steeply as the spiral became tighter. But if the three gliders are joined at a hub, much of this bank is eliminated by the balancing of their opposing forces.

That is exactly what happens in the flight of an autogiro. The gliders or blades are joined on a ball-bearing hub so they neutralize to a degree and provide lifting energy. In forward flight under power, the gliders still have a tendency to spiral downward but this is checked by the forward propeller which pulls the ship and rotor horizontally. Likewise, as the advancing blade rises, the retreating blades drop, so that though the same spiral exists, the glider skids around its forward turn and slips as it crosses the tail of the ship.

The weight of the giro or propeller thrust provides the only energy to revolve the rotor once the ship is in the air. The motor has nothing to do with it and neither has the slip stream. Most of the maneuvering is done by tilting the rotor hub so the direction of the blades points the nose of the ship upward, downward or in a lateral direction. The ship follows its nose. We have effective control at any speed that will keep

the ship off the ground for we do not need a rush of air over any control surface to operate. The rotor turns automatically when the ship is flying and as long as it turns the ship can be piloted normally.

An autogiro can land in a tennis court, and can take off in the length of a football



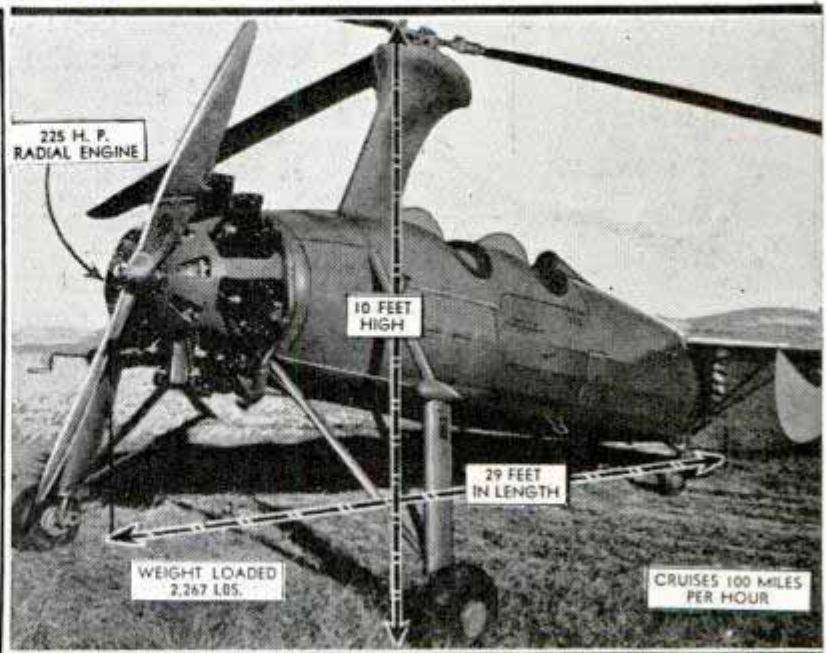
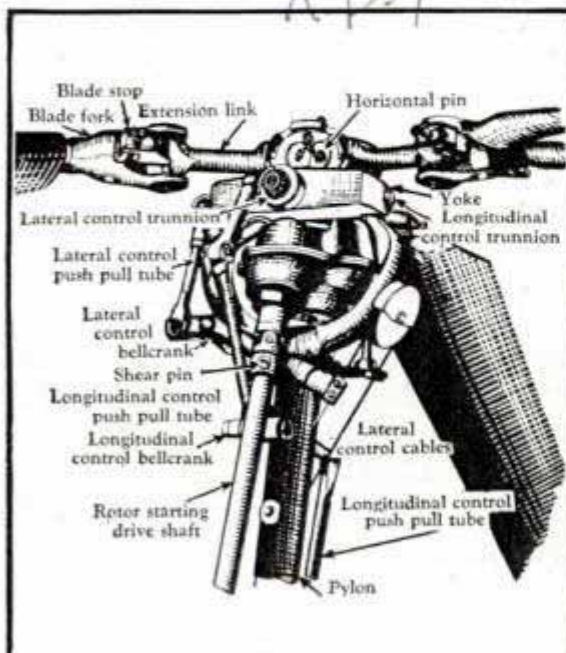
field, no matter how bad conditions are. It can fly at zero or 125 miles per hour. It can climb 1,200 feet per minute and go well above 15,000 feet. It performs as well at thirty to fifty miles per hour as at 100 and, in a wind of twenty miles per hour, it can stop, hover, and gently move off sidewise, if that is desired.

American-built giros need a stiff breeze to leap into the air with a forward run of only ten or fifteen feet but the British makers have built—though perhaps not wholly perfected—the direct jump-off giro which goes into the air from scratch, pulling itself from the ground by its rotor en-

ergy. The Pitcairn Autogiro company hopes to have such a ship, possessing roadable characteristics, on demonstration here later this year.

The autogiro differs from its cousin, the helicopter, as much as it does from the airplane. The helicopter has no propeller but actually flies itself through the forward pull of its rotor system. That means the power at all times passes directly into the rotor, turning it mechanically. In the autogiro, the rotor blades turn automatically.

Today, there are about thirty-six privately owned and licensed autogiros in the United States. In addition, there are seven



Top, loading mail at Chicago airport, preparatory to trip to roof of post office. Below, view of Kellett autogiro, showing dimensions, and detail of rotor head



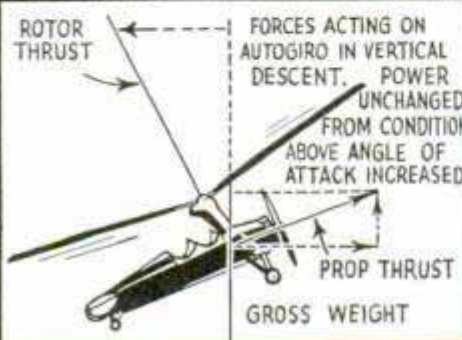
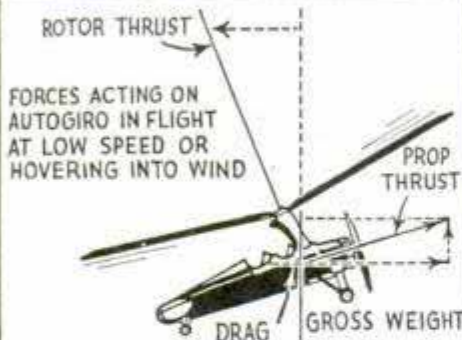
LANDING ATTITUDE OF
AUTOGIRO IN CALM



LANDING ATTITUDE OF AUTOGIRO
IN WINDS OF ABOUT 10 M.P.H.



LANDING ATTITUDE OF AUTOGIRO
IN WINDS OF 15 M.P.H. OR OVER



Autogiro landing on Italian cruiser. Left, landing attitude of autogiro under various conditions, and forces acting on craft in flight and in vertical descent

Kellett giros being flown by the army. The seven army giros and one of the private, licensed ships, are of the wingless, direct-control type. These differ from the obsolete kind in that the wings have been eliminated to give control independent of the airplane limitations which the short, stubby wings introduced. The last of the winged type was built in 1932. Many of them, however, are doing good jobs, crop-dusting, scouting for plant and tree pests, serving as sport planes and for banner-towing and short-hop taxi assignments.

The giros produced during the next year will enlist in the army for observation, communication, mapping and similar uses where their slow flight and freedom to land and take off become invaluable.

Inauguration of feeder mail services by autogiro may begin within a few months, for recent experimental flights have proved them practical. Congress has passed a law deputizing the postmaster general to begin such tests. The giros will be used to bring the mail from outlying towns to airports on the main air-mail routes or to fly the mail to and from central city post offices and distant airdromes.

I have been flying autogiros for seven years. During this period I also operated conventional planes, so I know what each type of aircraft can do and where each out-performs the other. Six years ago I was looping the old wing-type giros at air meets. I flew the first autogiro from coast to coast and I owned a giro and used it to make my living for several years. Therefore, I know the shortcomings of those early cranky, unpredictable ships.

But those old "babies" could fly like no other aircraft before them. One time, I was towing a banner in northern New Jersey when my engine cut out. Below me was a woods bristling with trees, and a cemetery full of tombstones. I chose the graveyard and squeezed that little crate into a space about 100 feet square. The giro's prop nestled against a mausoleum, its tail gently rubbed a granite cross. That's as near as I want to come to a cemetery while flying. And it's a certainty I would have landed there for keeps if I had been flying anything but a giro.

When the wings were dropped, the engineers gave us

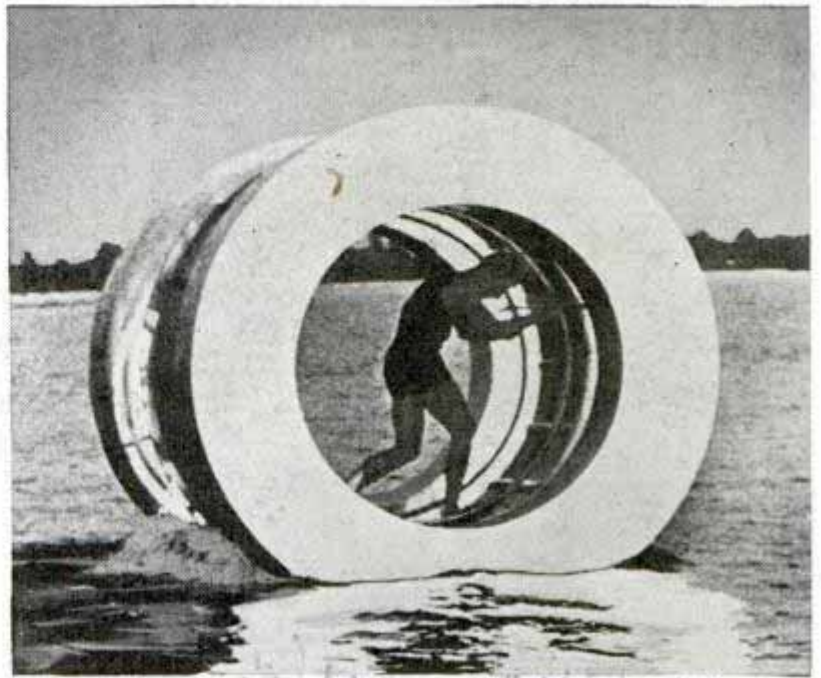
a machine which will come down slower than a parachute, even with all power cut off. With one of the new ships, I might have made a safe landing on top of the mausoleum.

Learning to fly such a giro is no more difficult, and may be easier, than learning to fly an airplane. It is a different proposition entirely. Being a good airplane pilot may help or hinder a new man's giro skill—but airplane experience is quite unnecessary. There is this to say for the giro: If you get in trouble you can slow down or let the ship land itself. You will probably walk away unscratched even if your ship "dents a fender."

In 1935, two direct-control autogiros were landed on the roof of the Philadelphia post office. This year, I did the same thing with a Kellett giro, sitting it down on the roof of the Chicago post office with an air-mail shipment from the Chicago airport. The trip beat truck time by forty minutes. A few days later, the KD-1 giro and

(Continued to page 134A)

Riding Wooden Water Wheel Is Latest Seaside Sport Thrill



There's plenty of leg work in maneuvering this "squirrel-cage" on the water. It is built of light metal and wood

Sea-going squirrel cages are introducing a new water sport in Germany. They are huge water wheels of wood and light metal. The wheel is big enough to accommodate one to four persons who maneuver it by running on treads inside. Steering and keeping it rolling demands nimble feet.

"Pigeon-Toed" Motorcycle Tests English Road Surface



Notice the angle at which the "outrigger" wheel is attached. Its skidding tendency is used to test highway surfaces

Highway surfaces in England are being tested with specially built three-wheel motorcycles whose sidecar wheel "toes in" at an angle of eighteen degrees. Safety engineers are trying out new road materials and examining highway topping where accidents occur in an effort to reduce the number of highway fatalities and injuries. The third wheel of the test motorcycle is set at such an angle that it partly revolves and partly skids, while its behavior is recorded on a graph carried in the sidecar.

Names and addresses of manufacturers and dealers in articles described in this magazine will be furnished by our Bureau of Information upon request accompanied by stamped envelope.

Quakes Applied to Music Bring Backless Violin



Without sounding boards, this violin produces music by means of crystal in container under strings

Earthquakes and violins are, after all, distant relatives. So the violin can thank a seismologist for its latest style, a backless, faceless model that issues its beautiful tones through a loudspeaker. Dr. Hugo Benioff of California Institute of Technology started his violin experiments with the premise that music and earthquakes are both vibrations. He produced a "seismographic fiddle," similar in outline to the conventional violin but lacking the wooden soundbox; instead it has a small aluminum container beneath the strings. Inside it is a crystal, which the strings cause to vibrate and generate a small electric current. This weak current travels by a small wire to amplifiers. In the new violin, which is said to have finer tone than the old, the bow plays the part of the vibrating earth crust and the strings represent the pendulum of the earthquake recorder.

U. S. Spends More for Radios Than All Exports to Japan

Japan bought nearly \$300,000,000 worth of goods from the United States in 1937, yet Americans spent more than \$400,000,000 on radios for their homes and automobiles! That is just one item on the \$1,500,000,000 bill American housewives and husbands paid last year for electrical

appliances. We sold \$43,000,000 worth of merchandise to Russia, but we spent that much for electric flashlights and electric razors. China ordered goods worth \$50,000,000 from us, and we put that amount into electric ranges. The American housewife's expenditure for vacuum cleaners in 1937 equaled the \$77,000,000 bill we sent Italy for our exports. Our purchases of electric laundry equipment at home compared with our \$124,000,000 exports to Germany. Our exports of all kinds of merchandise to the British Isles were valued at \$535,000,000, and we spent that amount for electric kitchen equipment. The French people took \$164,000,000 worth of our goods; we paid that much for electricity to run our electric refrigerators. Our total export trade for 1937 reached \$3,000,000,000 — only twice the amount America spent in America for electrical merchandise alone!

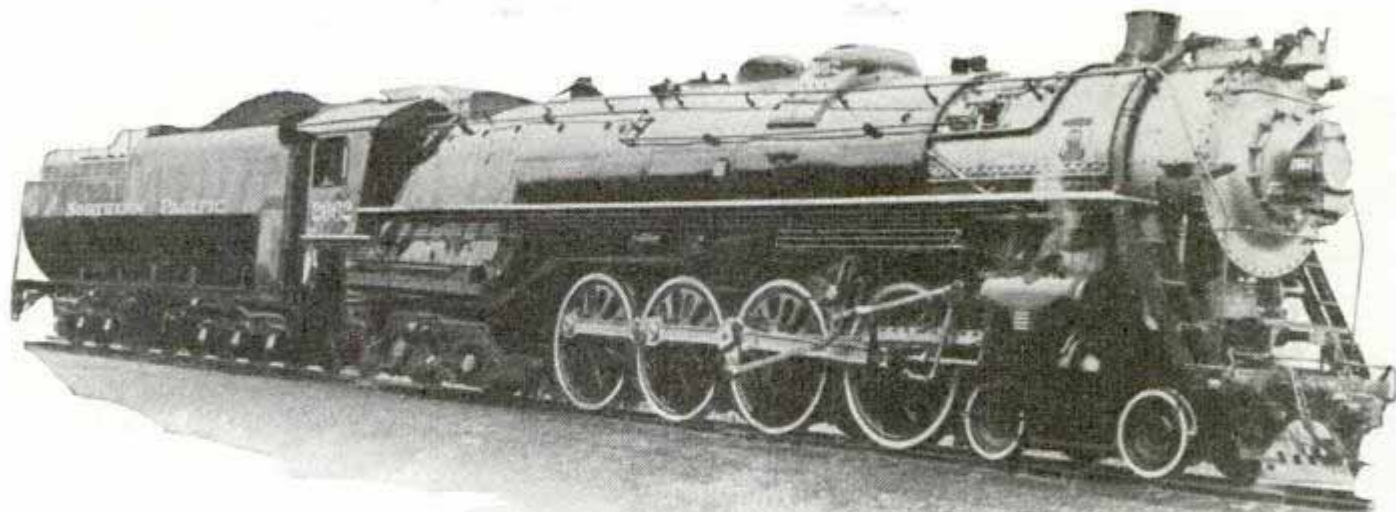
Picture Guideposts at the Zoo Point Way If You Can't Read

Even if you can't read, you have no trouble finding your way around at Chicago's Brookfield zoo. Pictorial signs point the direction to the various animal houses, the nearest streetcar stop, and so on. The signs are topped by caricatures carved in wood, stained brown. The restaurant is indicated by the figure of a chubby chef toting a tray with a cup of coffee and a "hot dog" on a bun. Figures of giraffes, monkeys, elephants, gorillas, lions and other animals point the way to their dens.



Carved wooden caricatures in Brookfield zoo show the way to various attractions and concessions

Iron Horse Packs Power for Mountain Run



There's nothing fancy, nor streamline, about this Northern Pacific locomotive, but its four pairs of seventy-seven-inch driving wheels can haul twenty and more passenger cars over the Rockies at high speed

There is ample power packed into the new locomotive giants that are hauling passenger trains over the Rocky Mountain grades on the Northern Pacific line this summer. No streamline armor nor fancy skirts decorate these monsters of the rails; theirs is the conventional pattern of the old iron horse, with built-in strength and speed to meet 1938 standards. In a test run, one of the new fleet hauled 100 box-cars without effort and ran smoothly at seventy-five miles an hour. It is expected

to haul twenty to twenty-five-car passenger trains in regular service. The engine is 111 feet long, nearly seventeen feet tall and weighs, with tender, above 438 tons. The four pairs of driving wheels are seventy-seven inches high and are capable of a 70,000-pound tractive effort. A feature of the design is the one-piece bed; the huge steel casting weighs thirty-eight tons and includes frame, air reservoirs, back cylinder heads and other parts. The throttle is operated by compressed air.

Phonograph Needle Tests Paint for Thickness on Auto

Whether the proper thickness of paint has been applied to the automobile is determined by means of an instrument of which a phonograph needle is an important part. The needle is attached to a micrometer and hooked into a sensitive electrical circuit. First adjusted flush with the painted metal surface, the needle is then depressed by degrees of 1/10,000 of an inch. The moment the needle touches the sheet metal, it completes the electrical circuit and a light flashes on inside a portable cabinet. Proper contact is made by rocking the instrument back and forth. Its design permits tests on curved as well as flat surfaces. It is used by Cadillac-LaSalle engineers.



Demonstrating how the paint-testing instrument is applied to metal surfaces

☐ One whale will yield about as much meat as 100 cattle.

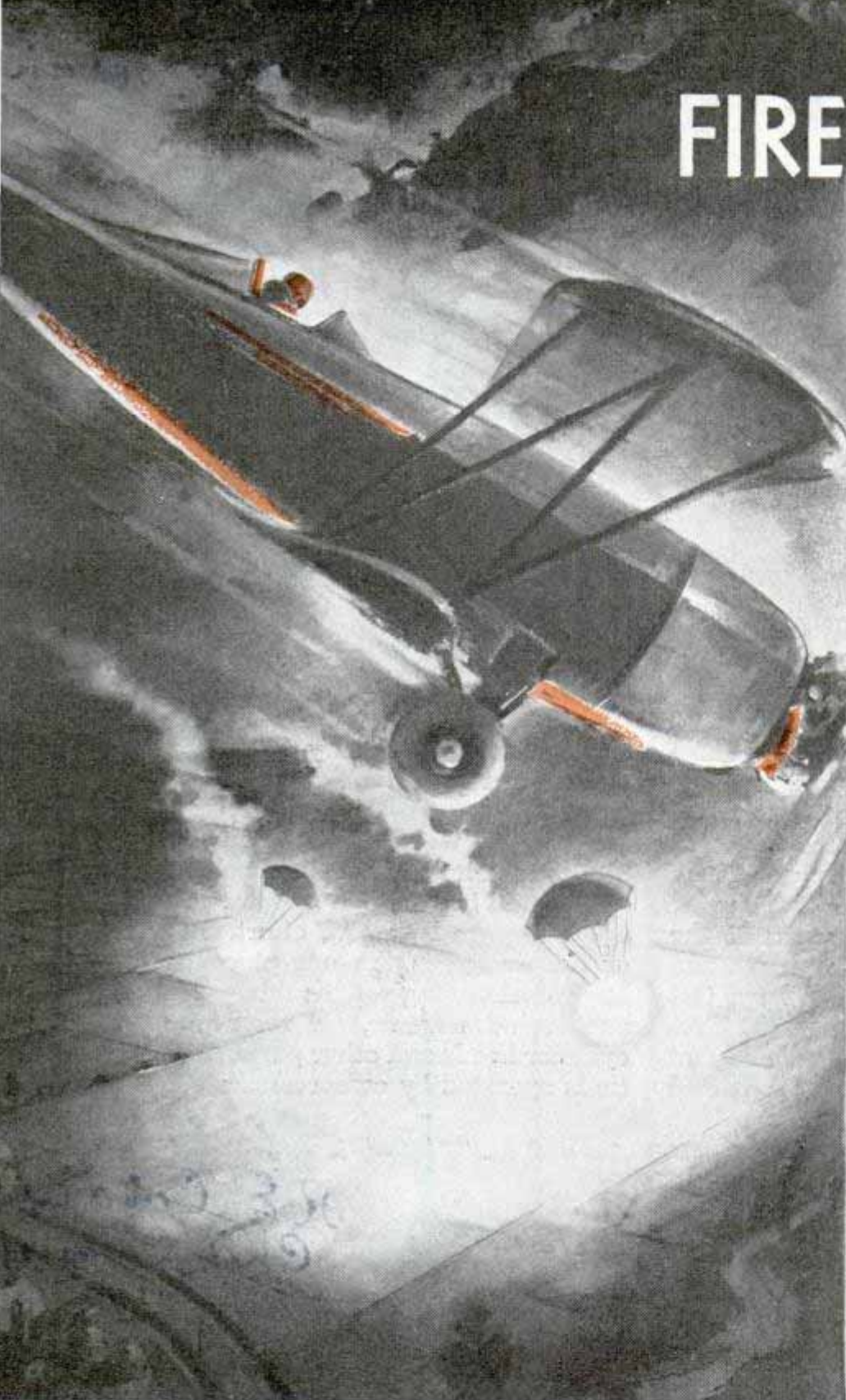
FIREWORKS

trains from rear-end collisions, and drivers find it useful when their trucks stall on dark roads.

Crowds are fascinated by the "bombs bursting in air," but this type of fireworks also is employed by ships in distress, by airplane pilots making forced landings in the dark, by polar explorers to ascertain wind directions and by the army and navy in maneuvers. The bombs can be fired from a submerged submarine to send a signal from the depths of the sea into the air.

Red fire, burning on railroad tracks, is a familiar sight to all who travel. Known as railway fusees and carried by every train, this type of signal has a spike in one end so that it may be stuck in the roadbed. So built that the top may be removed and used for a scratching surface to ignite the fusee, a brakeman can light one without matches. Fusees must burn not less than five minutes nor more than six and one-half minutes, and they must be capable of burning under water. When a train stops for any purpose, the

flagman or brakeman must go to the rear to protect the train. If it is an unusual stop not on the schedule, when the engineer blows the whistle for the rear flagman to come in before resuming the trip, the flagman must light a fusee and place it on the track. This fusee gives the train at least five minutes protection since no train following is permitted to pass the signal. Dynamite caps also are put on the tracks



Showing how the pilot uses white parachute flares in his search for suitable spot to land when an emergency forces down his plane

FIREWORKS play a major role in safety wherever man travels, on the land, on the sea and in the air.

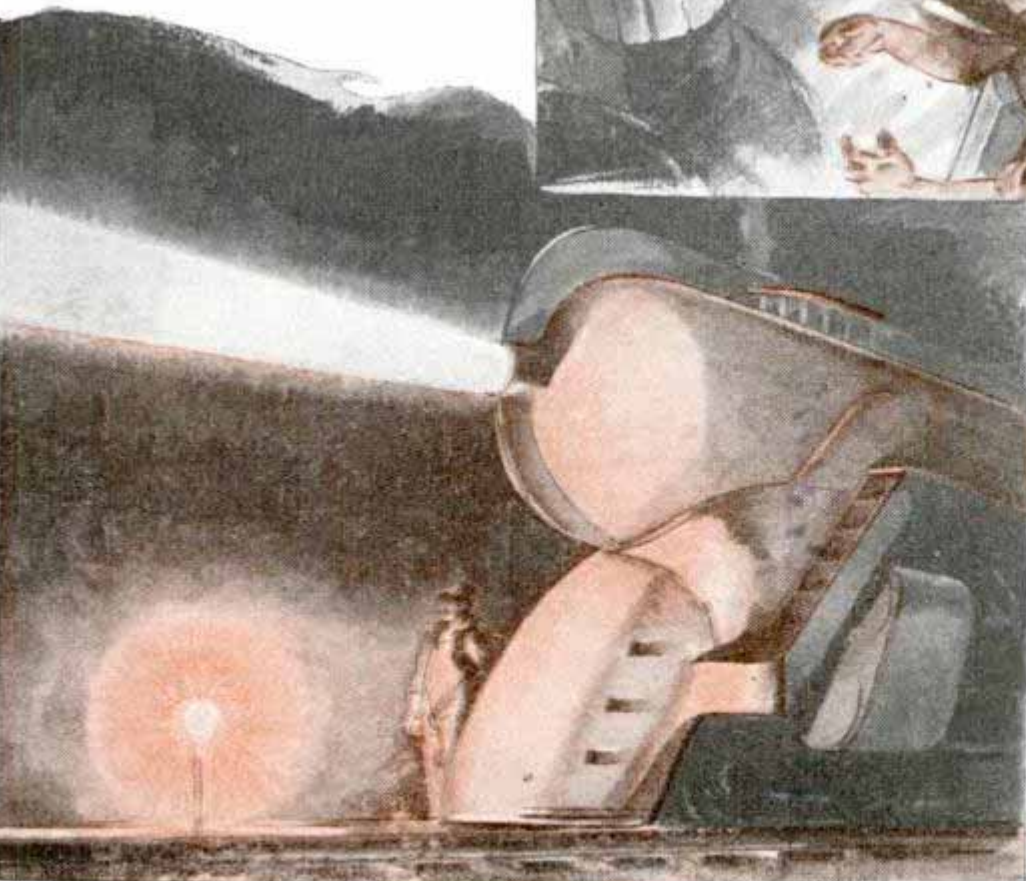
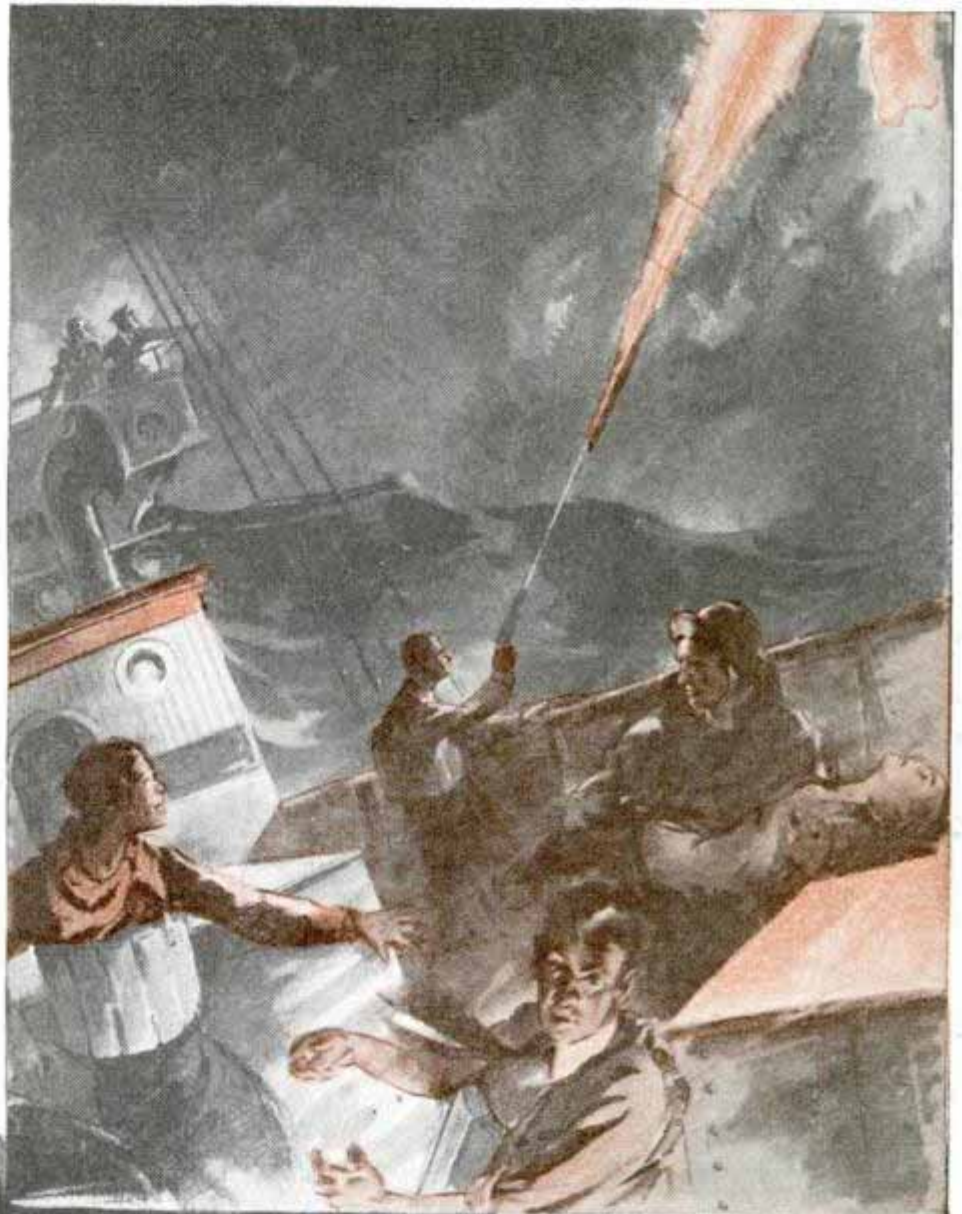
The "red fire" which is carried in parades and burned on festive occasions, has a far more serious purpose. Coast guardsmen use it to warn ships that come too close to shore; ships burn it to guide lone fishermen lost in small boats off the Grand Banks; brakemen set it off to protect their

Richard D. 2097
in Carline Photo

that **SAVE LIVES**

to explode and warn an engineer following. Some railroads use not only red, but also yellow and green fusees, but in all are warnings, lasting for at least five minutes, that there is a train ahead. On single-track railroads, when there is an unexpected stop for any reason, the brakeman must go ahead of the train, while the flagman protects the rear with fusees.

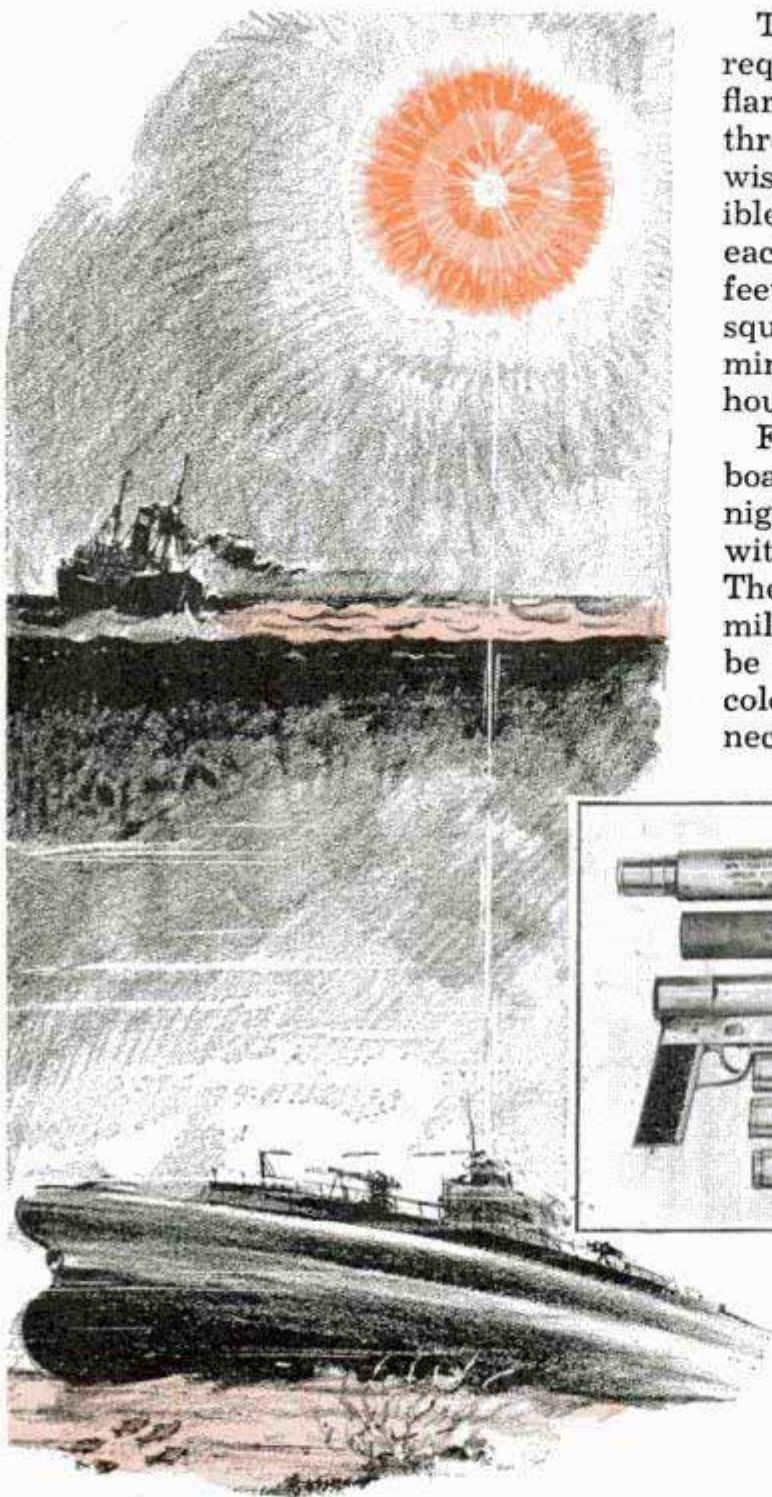
The great volume of truck traffic on interstate highways is a hazard when one of these vehicles stops or stalls on a road. All trucks now must carry at least three fusees, or "red fires," of fifteen-minute burning duration, to be set off when a night stop is nec-



essary. Wire tripods and other devices have been worked out to support highway fusees where hard concrete makes it impossible to use a spike.

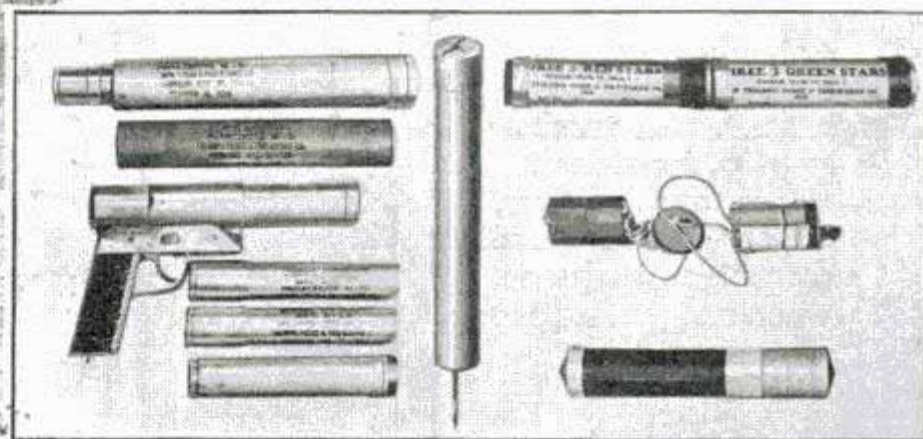
At sea fireworks reach their greatest use as distress and safety signals. Despite the progress of radio communication at sea, there are still many vessels not so equipped, vessels of the smaller types, especially fishing boats. In time of shipwreck, there is always the task of finding the lifeboats carrying survivors. With huge waves

Top, flare fired from pistol in lifeboat guides rescuers. Bottom, fusee warns streamliner's engineer that another train is not far ahead. The red fusee burns for five minutes and all trains stop when one is sighted



The United States Bureau of Navigation requires a pistol and twelve red parachute flares to be carried in one out of every three lifeboats on transoceanic or coast-wise vessels. Red parachute flares are visible for a distance of twenty-five miles in each direction at sea, at a height of 250 feet. This covers an area of almost 2,000 square miles, and the flare, for its half-minute of burning, is equivalent to a lighthouse 250 feet high.

For emergency work, such as man overboard, or entering an unknown harbor at night, white flares of the parachute type with a candlepower of 50,000 are available. The hand flare has only a visibility of five miles. Colors of the parachute flares can be so arranged that, by attaching various colored bombs by asbestos cords and connecting them by fuses, they burn in se-



Left, submarine fires flare which shoots out of the water and into the air. Right, signaling pistol with various types of flares, signal light bombs and fusee

quences, producing signals of different colors.

The distinctive flare of the United States Coast Guard is white-red-white. These flares burn forty per cent white, twenty per cent red and forty per cent white, identifying coast guard vessels through the sequence of colors. The white light furnishes illumination to see the boat, while the red is a signal.

Marine stick rockets, much like the rockets used at Fourth of July celebrations, for use on small fishing boats, attain heights of 800 to 1,000 feet, before exploding in a shower of red stars. They are distinctly a distress signal. Among the marine signals are water lights attached to life rings, which are so made that they automatically ignite and burn with an in-

tossing a small boat about in a storm, it is often difficult for the lookout on a rescue ship to see the boat unless a signal light is used.

The hand Red Fire, similar to the railway fusee, is still used, but it has been obvious for a long time that something else was needed to give a wider range of visibility. So a cartridge was made for the Very light pistol which would send up a shell three to four hundred feet, at which point the shell would burst into a red flame of 30,000 candlepower. A silk parachute held the burning signal suspended in the air for at least thirty seconds.

color

color

Rescue Pistol



tense white light for as much as forty-five minutes while floating on the water. They are small cans filled with carbide. At one end is a hole to permit water to enter the carbide chamber, covered with a cap, and at the other end, where the resultant gas is liberated through holes, is a piece of phosphorus, also covered by a cap when the water light is not in use. Before throwing the life ring, the caps are torn off. The phosphorus ignites instantly upon exposure to the air and sets off the gas generated when water reaches the carbide after the signal is tossed overboard. This light can be used to illuminate the scene for a rescue boat hunting for a man overboard.

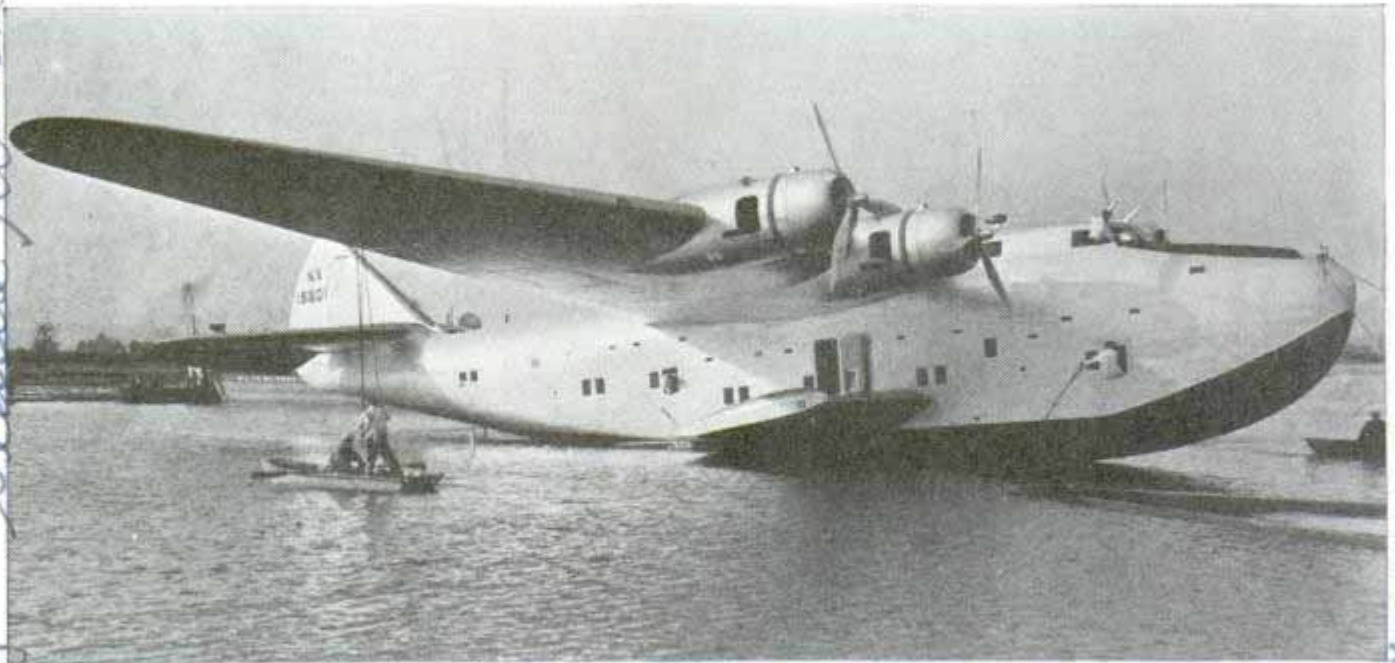
Aviation has called upon the fireworks scientist to make a variety of flares principally for light in making forced landings at night. Here the maximum illumination for the maximum time is required. A parachute flare, giving a white light of an intensity of 200,000 candlepower and burning for three minutes, is on the market. This flare descends less than 550 feet per

(Continued to page 118A)



Three uses of flares; top, determining wind direction; center, warning ship against approaching shore too closely; bottom, protecting stalled truck

Greatest of Sky Clippers Takes Her First Dip

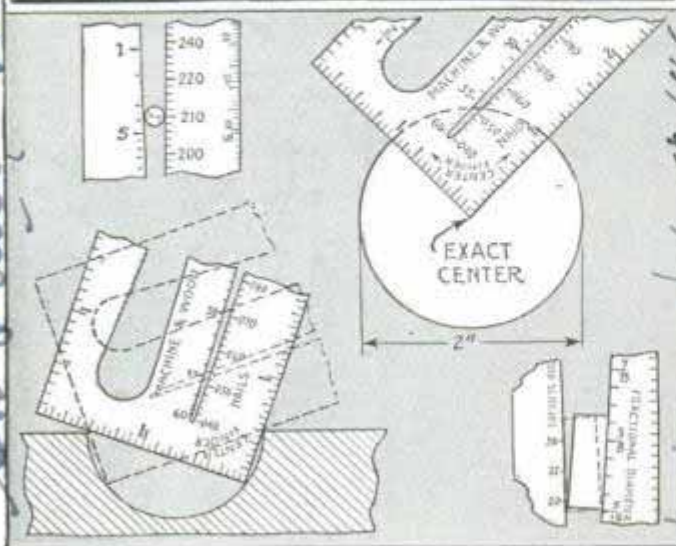
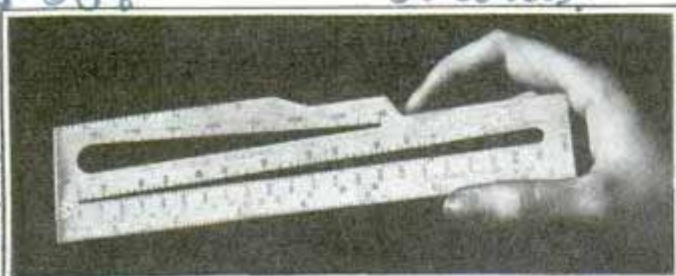


Still mounted on its fifteen-ton cradle, which is under the surface, the seventy-four passenger Boeing 314 Clipper "tastes" sea water for the first time. Men in rowboat are helping balance the big ship

Mightiest queen of the transoceanic sky lanes is the Boeing 314 Clipper, seen here as she took her first "baptismal" dip in the Duwamish Waterway adjacent to the Seattle plant where the big ship was built. The new clipper, accommodating seventy-

four passengers, is destined for a Pan-American Airways oversea route. In the scene above, men in rowboats are steadying the ship as it still rests on its fifteen-ton cradle, just beneath the surface. Loaded, the clipper weighs forty-one tons.

Twelve-In-One Gauge Aids Wood and Metal Workers



Handy gauge, with sketches of how it is used in wood and metal working

Designed to do the work of a whole drawerful of gauges, a twelve-in-one measuring instrument is available for wood and metal workers. It may be used in grinding both cutting lips of a twist drill to the same length and angle; for measuring nails, drills, bolts, screws and other round objects; for finding the center of circles; for checking the accuracy of a half-round concave cut, as in core box making, and for innumerable other jobs. The instrument is made of metal and is small enough to slip into a pocket.

Transparent Wrapper of Clay Is Fireproof and Durable

From a powderlike clay known as bentonite comes a new transparent wrapping film which is fireproof and highly resistant to water, acid, alkali and oils. Bentonite clays contain large amounts of tiny particles of colloidal size. When these particles are separated in a centrifuge and then con-

Boeing Aircraft Co. Seattle Wash

Newbury St. Boston

H 698

H 698

Research Corp.

Science Service

centrated they form strong jellies, which when dried, become translucent films without any binder. Under pressure the translucent film turns transparent. The result is a strong wrapping material that will take print like paper and has an electrical resistance comparable to mica.

18662 *Alright*

Wind Charger Is "Tortured" by Blower in Tests

Capable of producing a gale of sixty mile an hour force, a blower tests wind chargers in an Iowa factory. The wind charger is placed six feet in front of the blower for the test. A tunnel arrangement prevents the wind from losing its force before striking the propeller of the charger. The test ranges from a seven and one-half mile an hour breeze to a sixty mile an hour wind, the results of which enable engineers to design chargers which will produce smooth, steady flow of electricity from the generators and which will withstand vibration and overspeed two to three times greater than that the machine is ever expected to encounter. One torture test of



Wind charger's propeller turning at full speed in blast from tunnel blower

the charger propeller calls for turning at maximum speed, 1,200 revolutions per minute for hundreds of hours. Thus, the engineers discover tendencies of metal propellers to become brittle from vibration, of wooden propellers to splinter, and of both to shatter from vibration and pressure before production is started on them.

Motor Bicycle Is Miscellany of Secondhand Parts



Half-horsepower motor that drives this homemade bicycle used to run a washing machine

Everything secondhand except its three-by-twelve-inch wheels, a motor bicycle built by a Colorado man is a miscellany of odd parts. The wheels represent more than half of its total cost of twenty dollars. The half-horsepower motor once ran a washing machine. The transmission came from one automobile, the brake from another, the seat from a third. A gasoline stove contributed the gas tank. The handlebars were three-quarter-inch gas pipe. The "bike" travels twenty miles an hour.

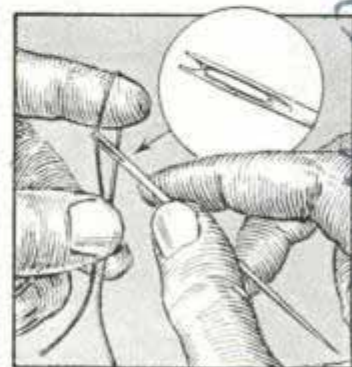
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Needle's Eye Has Slot in Top for Attaching Tag to Cloth

Tags can be attached securely to clothing and materials by means of a special needle just brought out.

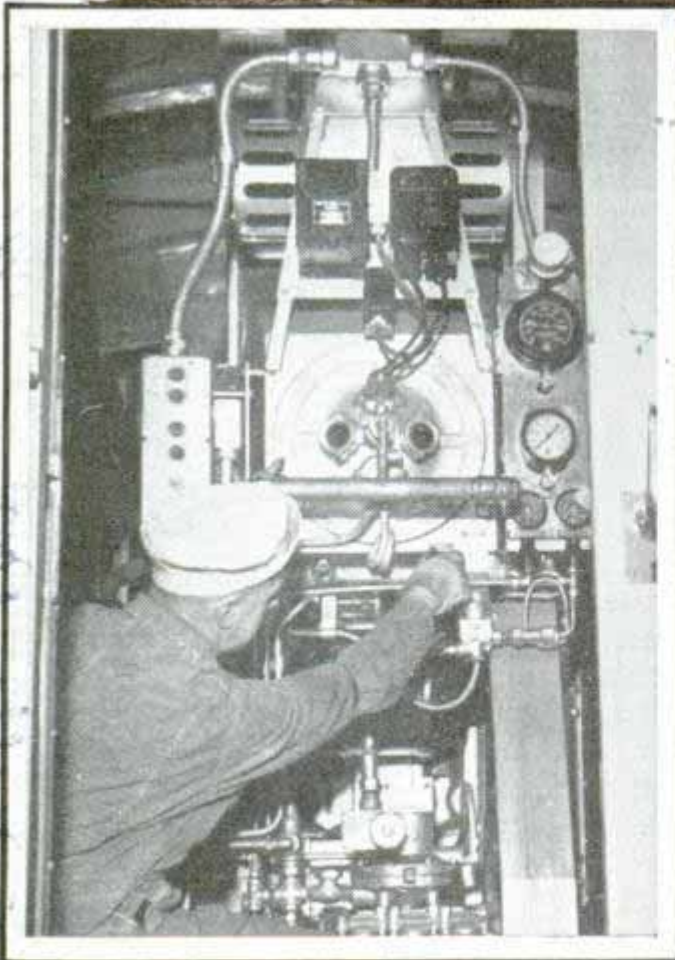
Instead of the conventional eye, it has an eye with a slot at the top through which the tag string is inserted. String and needle are passed through the garment, and in doing so the needle disengages from the string.

Tags thus attached cannot be lost, nor removed and replaced by outsiders.



Mrs. D. S. L. Davis
Chemical cleaning and
dry cleaning
18662
Alright
may be
18674
Chamber
18674
Chamber

MANICURING



Adjusting electrically controlled steam-boiler unit of Diesel locomotive which automatically maintains desired pressure

THE hearts of railroad men still thrill at the sight of a big steam locomotive pounding down the main line, but their pet today is the pampered streamliner, the dainty high-speed racer of the rails.

Steam goes on the siding while stainless steel swishes across the switchpoints at 100 miles per hour. Dispatchers tilt their eyeshades for a look and telegraphers at mountain junctions listen for the blare of its horn. In the terminal yards, inspectors and machinists drop their work when a streamliner is due and prepare to swarm over her.

Let's swing aboard the M-2, latest of Santa Fe's Super Chiefs, as she finishes her 2,225-mile dash from Chicago to Los Angeles in less than forty hours. Passenger coaches are dropped at the terminal station to be shunted to the coach yard for cleaning and servicing. Then the locomotive with its additional power car moves to the roundhouse. The engineer pulls his throttle to idling, spills enough air to brake the two cars and drops a yoke over the

70598 Holman Ave
Los Angeles, Calif

the DIESELS

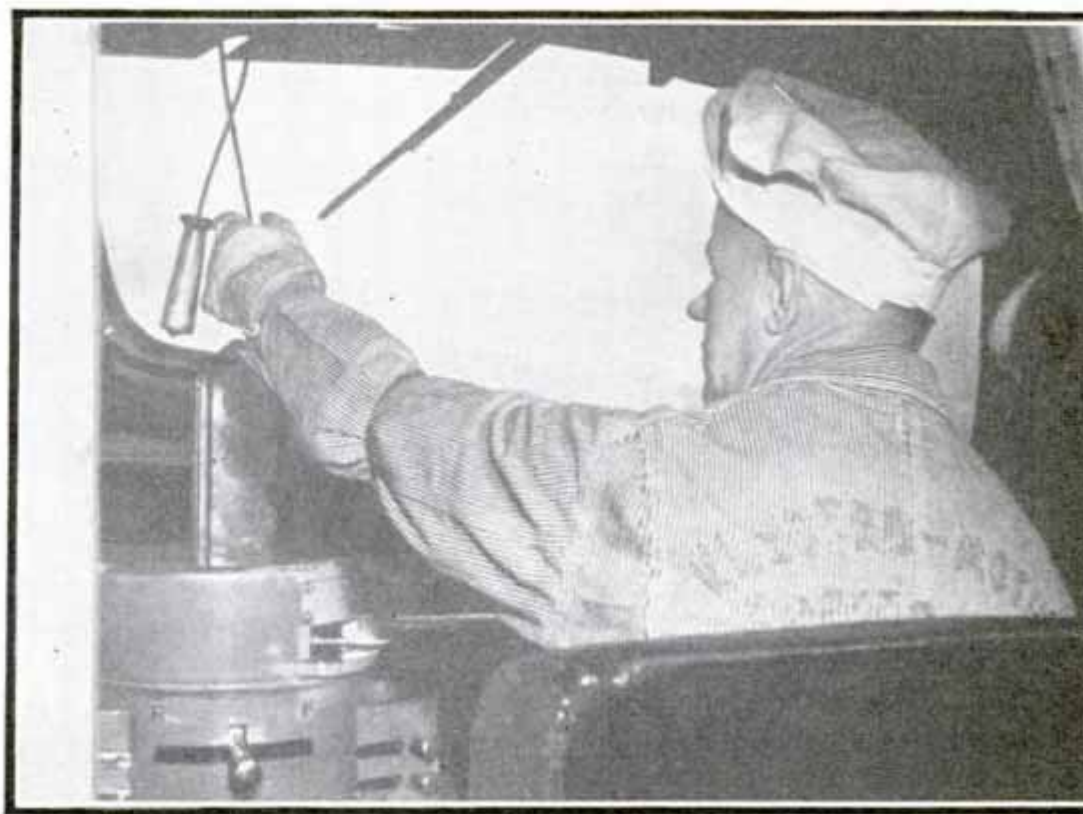


Part of Santa Fe streamline fleet. All are Diesel electrics except the steam engine in center. Below, engineer of streamliner signaling for crossing

control buttons to lock the power off the wheels. Then the yard crew takes over.

During the next eighteen hours the two power units receive the same scrupulous attention that an air liner gets at the end of a flight. Inspectors go over every moving part. Report sheets from the crew and the expert who rode with the great engines from Chicago are studied, and every inch of the power cars, inside and out, is washed and cleaned until paint and metal sparkle.

First, the power cars are moved to the wash rack where the dust and grime of mountains and desert are scrubbed





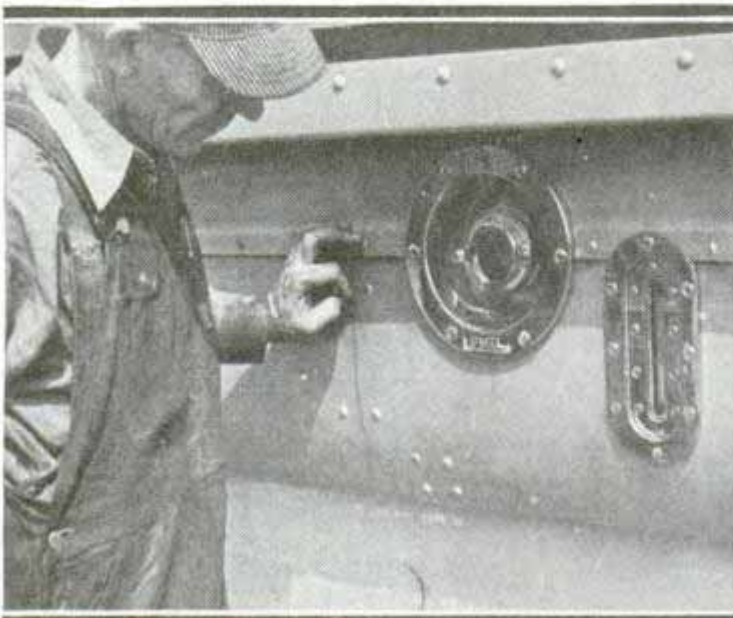
away. Close behind come the inspectors, scrutinizing everything from brake shoes to air horn. Worn parts to be replaced are marked with yellow chalk. Some brake shoes will be replaced, and all of them are replaced at the end of each round trip. All of the cars are moved forward foot by foot while inspectors examine every inch of the wheels, looking for cracks or other defects.

There are two twelve-cylinder Diesels

in the locomotive and another pair in the following power car, and part of the engine inspection includes a look at the condition of each piston. The "wind box" cover between each bank of cylinders is removed and pistons are examined through open air ports while the engines are turned by hand. As a final check, the heads of one bank of cylinders are removed for close inspection at the end of each run. Oil and air-cleaning units are removed and cleaned. Crankcase covers are removed for a look at the crankshafts. Covers are taken off the traction motors, the brushes inspected, and the motor compartments cleaned with compressed air.

Meanwhile, new supplies are being taken on. Lubricating oil flows in through a hose, sand is poured into the sand boxes, radiator water and boiler water are replenished, and the 1,200-gallon fuel tanks in each car are filled. It takes only enough fuel oil to make a mark the size of a pea to feed a cylinder at full power but the 2,400 gallons in the two cars must be replenished before the trip is over. Including oil for the steam boilers, the Super Chief averages two gallons of fuel per mile while drawing a nine-car train.

The fireman and maintainer have little to do when the train is under way except make routine inspections of such things as water temperatures and oil pressures. Depending upon outside air temperature, they adjust the air intake shutters that direct blasts of air through the overhead water-cooling radiators. Automatic safety

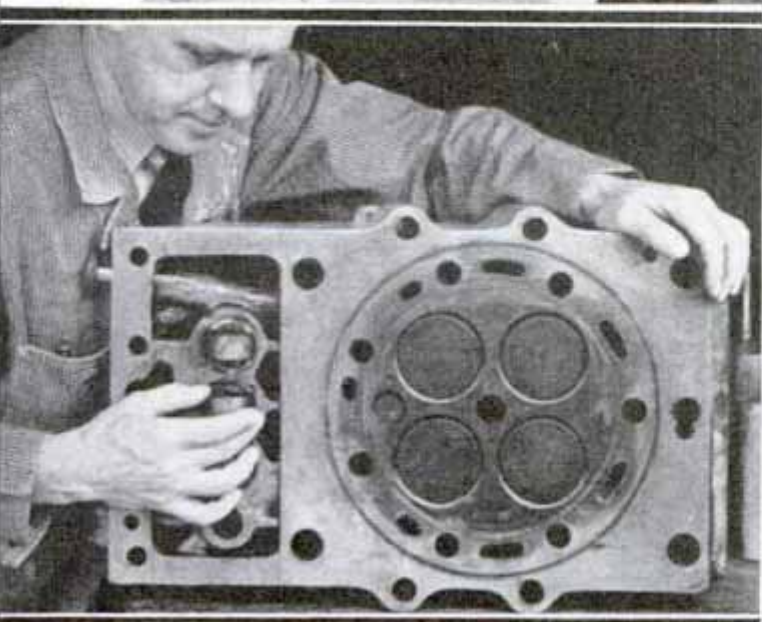
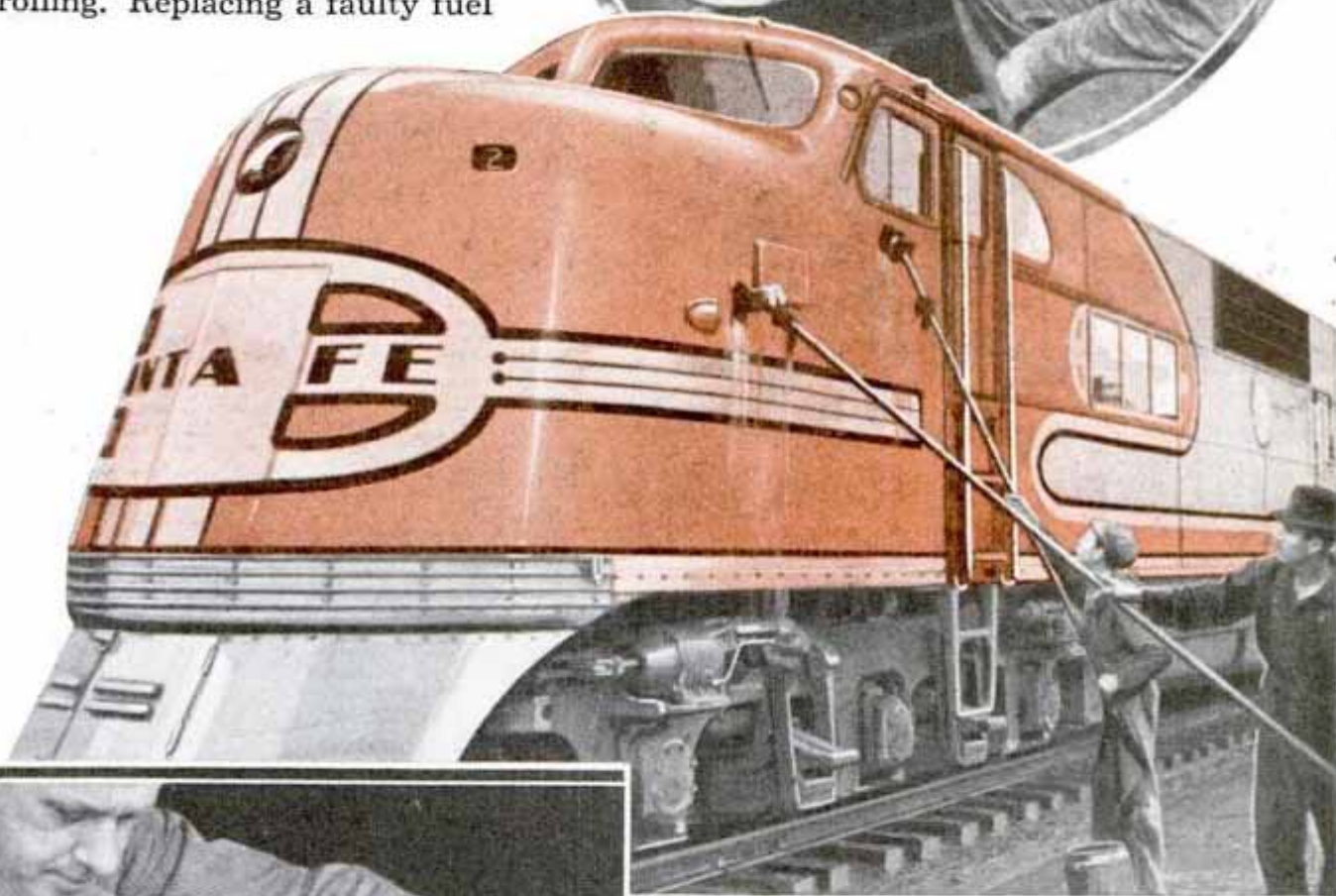
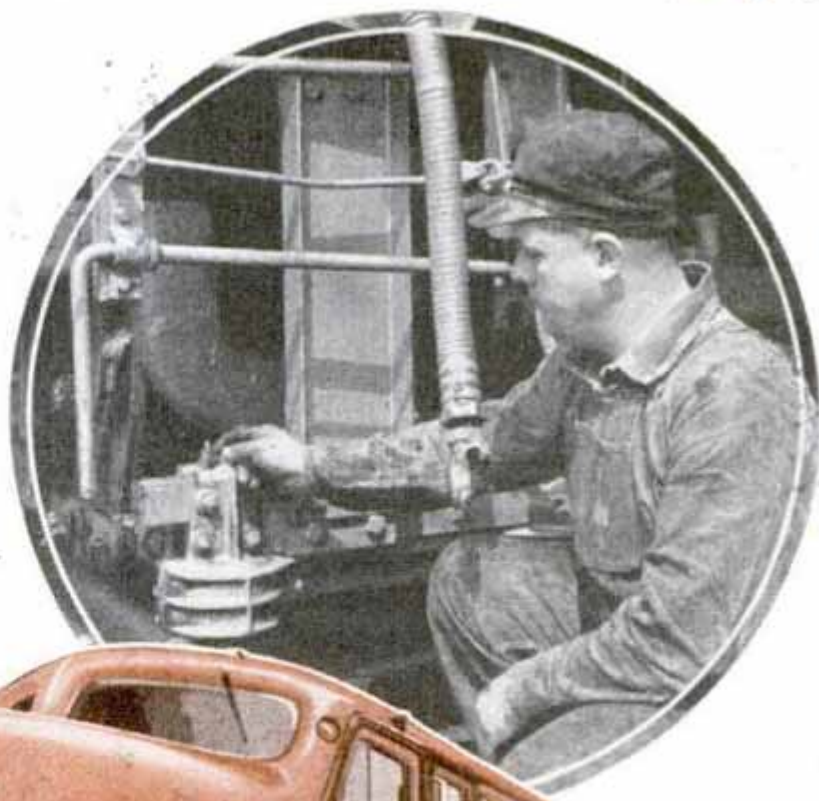


Fuel-hose connection and gauge on power unit. Right, inspecting 750-volt generator coupled to one of Diesels. Top, unloading Diesel piston and connecting rod for overhaul

alarms attract their attention if anything goes wrong.

A pyrometer on each engine records exhaust temperatures of individual cylinders, and if the temperature of one rises or falls from normal the crew gets busy. Since there are four engines in the power cars, any unit can be stopped and repaired without stopping the train. Often, except when going up-grade, the engineer can't tell by the performance that one engine has been cut out.

Almost any kind of necessary repair can be made while the train is rolling. Replacing a faulty fuel



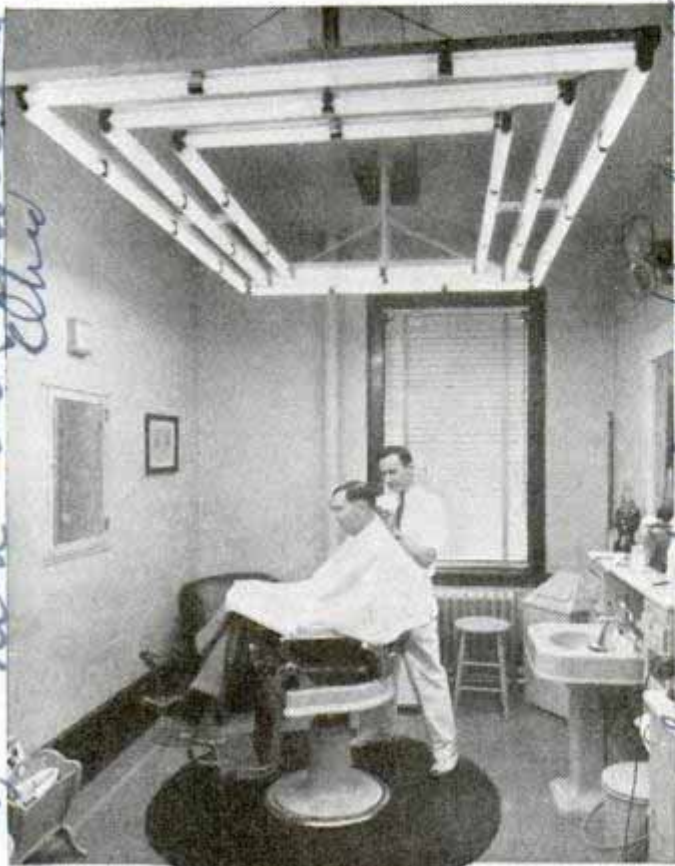
injector in a cylinder head takes about fifteen minutes. Even such a major breakdown as a scored piston head and cylinder liner can be remedied by the maintainer without stopping. If, however, he decides to have the work done at the terminal, the faulty cylinder is cut out and its water ports blocked so the remaining cylinders can be put back to work.

The locomotive contains two General Motors 900-horsepower, "V" type, twelve-cylinder two-cycle Diesels similar to those used in submarines. The locomotive is really a Diesel electric because each main

Manicuring a streamliner. Top, detector of train control pickup which receives signals from rails. Bottom, head of Diesel cylinder

(Continued to page 128A)

"Daylight" for Barber Shop in Fluorescent Lamps



Showing how fluorescent lamps give soft illumination where light is needed most

Delivering nearly 100 foot-candles of illumination on all sides of the customer's head, fluorescent lamps have been installed in a barber shop. Despite the wealth of illumination provided and the 600 watts consumed by the thirty-four lamps in the installation, both brightness and heat are absent. The result is lighting that permits easy and safe seeing and comfort for both customer and barber. Producing the cool, soft illumination are eighteen twenty-watt daylight lamps, each twenty-four inches long, and sixteen fifteen-watt lamps, each eighteen inches long. With the aid of narrow reflector troughs, the lamps produce an illumination almost comparable to daylight at an efficiency ten times that of filament-type lamps. Within each bulb is a trace of mercury, a small amount of argon gas at low pressure and a coating of fluorescent powder. A fraction of a second after the lamp is turned on, a feeble blue light with

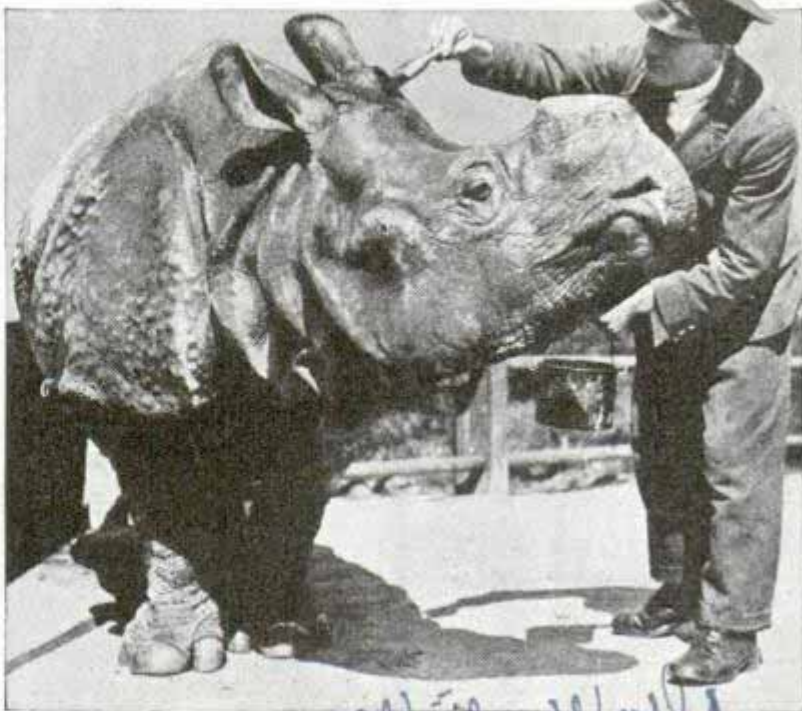
a large component of invisible ultraviolet light is generated. This radiation strikes the fluorescent coating and is re-radiated in the visible range of the spectrum. The lamp attains brilliancy in a few seconds.

Volcano Harnessed for Power and Mineral Products

Too often volcanoes are a source of death and destruction, but in peaceful moods they are sometimes exploited by man as a source of power and valued minerals. In Italy, superheated steam of volcanic origin is harnessed to turbines generating electricity, and at the same time volatile products—boric acid, ammonia and carbon dioxide—are recovered and used industrially. Hot springs are of therapeutic and commercial value, and in Iceland the warm water is used for laundries, home heating and other purposes.

Rhino Is Given New Coat of Oil to Save His Hide from Heat

You could scarcely call it a beauty treatment. Rather it is a redecorating the rhinoceros in the London zoo undergoes every spring, when the keeper brushes a new coat of oil over the big expanse of thick hide to prevent it from cracking during the hot summer.



Even a rhinoceros can suffer from "chapped" skin, but this coat of oil will keep his hide from cracking in the hot summer

Cont. of W. Macdougall's "General Electric" series

Magnitizing, Carnegie distribution

Scientific Monthly June 1938

#652

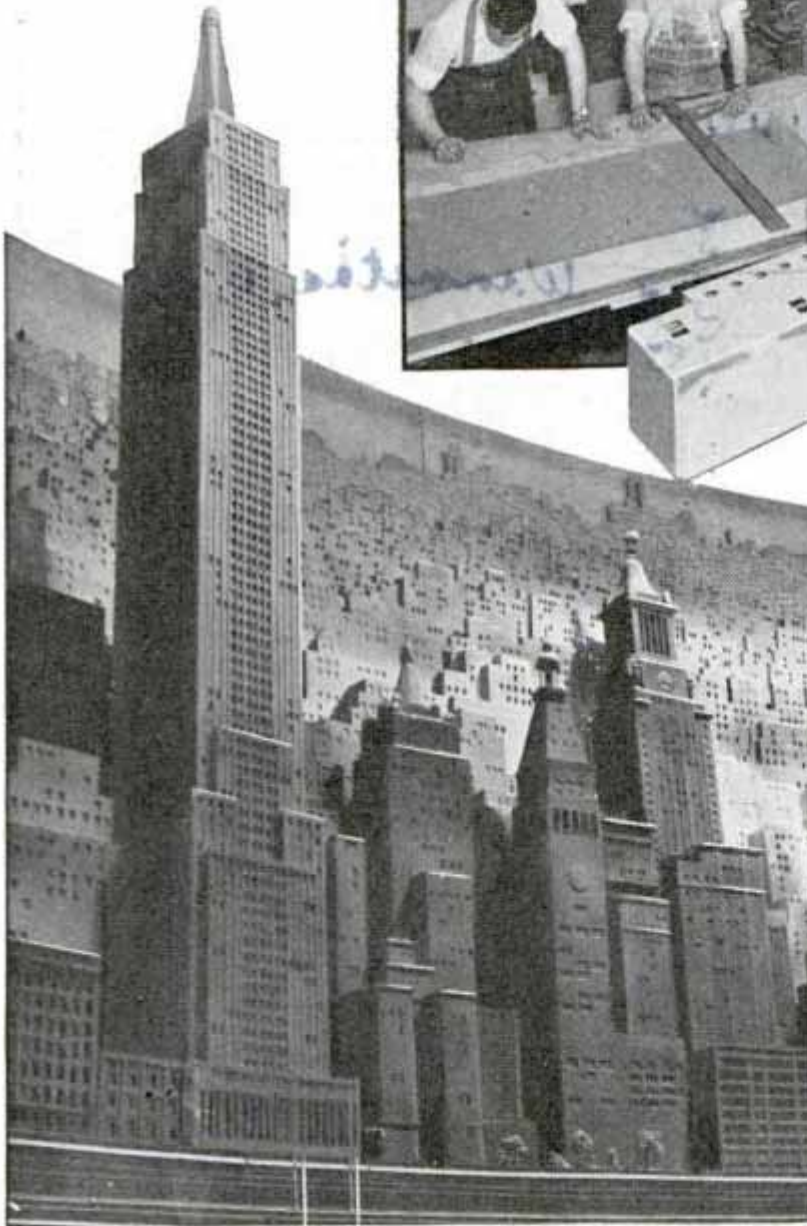
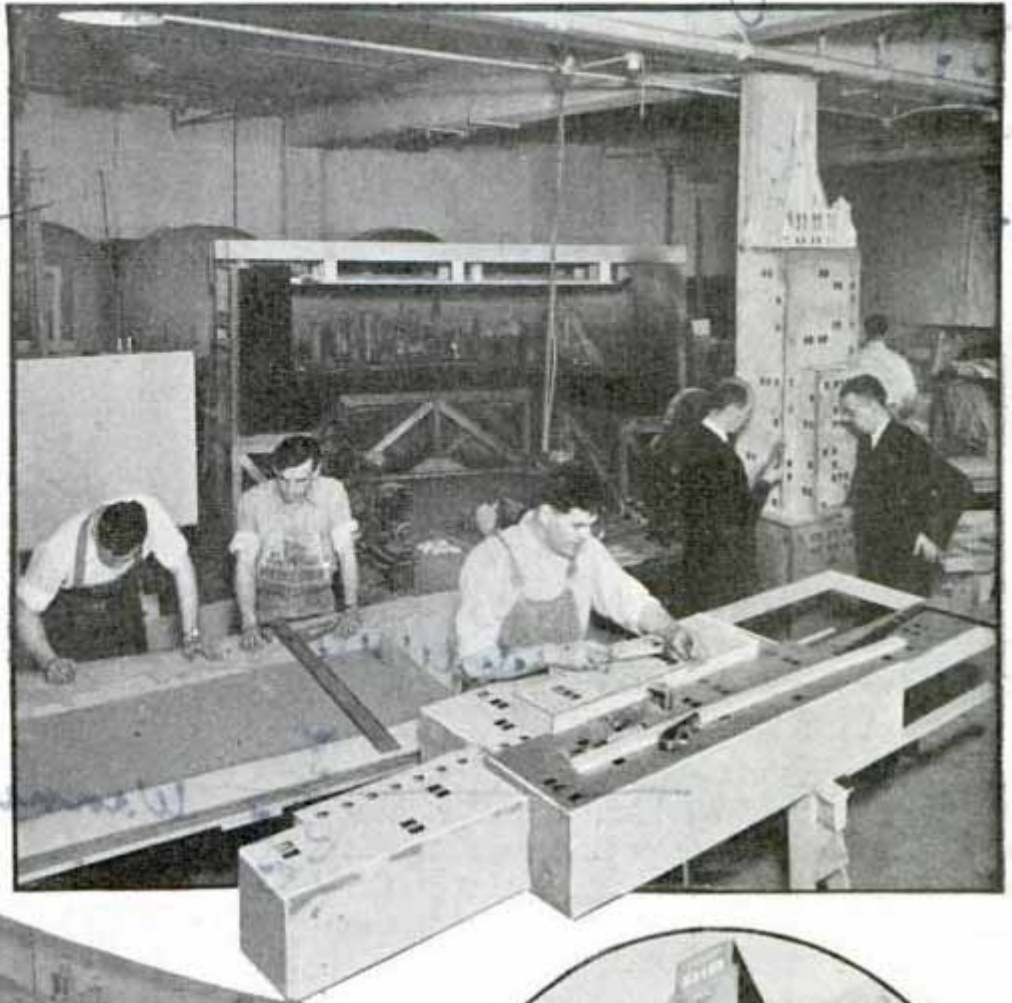
Washington

#660

Wide World

Giant Diorama Squeezes City into One Block

Covering 7,000 square feet and standing three stories high, a remarkable diorama being prepared for the New York world's fair of 1939 will have the effect of squeezing New York City into one city block. At right workmen are shown putting together some of the 4,000 buildings which will appear



Above and right, two views of the diorama. It will be animated to present in twelve minutes a twenty-four-hour period of activity in New York, including movement of subway trains, elevators in office buildings, motor traffic and roller coasters at Coney Island. Then will come a thunderstorm, later nightfall with gradual lighting of skyscrapers. Total illumination will call for 204,000 watts of electricity

Life Vests Protect Workers at Grand Coulee Dam

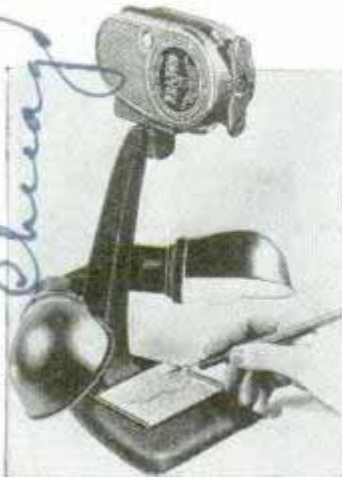


Workers wearing safety vests which support them if they fall from dam into river

Workers on the Grand Coulee dam project in the state of Washington are protected by life vests. Occasionally a worker will drop into the river from some point on the dam and the life vest supports him in the water until he can be rescued.

Titler for Home-Movie Films Makes Animated Drawings

Built for the eight-millimeter movie maker, a titler just introduced permits the amateur to produce animated maps, drawings and cartoons. It consists of a base and camera stand of cast aluminum made in one piece, with an arm carrying two lamps, and reflectors providing illumination without glare.



The copying lens, to which the camera is fastened after removing its regular lens, is prefocused on the title card holder at the base and has a depth of field of more than one inch, so that the titler can be used to photograph insects, flowers, etc. The holder takes title cards three and one-

fourth by two and nine-sixteenths inches. If the camera is capable of single exposures, the stand can be used for animation.

Big Slide Rule Helps Student with Mathematics Problems

Mathematical problems may be worked faster with the aid of a giant slide rule constructed recently. It has seven scales, all of which are based on logarithms. The main two, which are used for multiplication, are made by multiplying the log of the numbers by the length of the scale, which is thirty-six inches. This means about 400 calculations. There also are two half-log scales, which were made by dividing the original calculations by two. These scales can be used for finding squares and square roots. There are two third-log scales that were made by dividing the original calculations by three, while the last scale is based on an arithmetical



Giant slide rule which any student would find helpful in working his problems

progression. It is used to find logs and anti-logs. Although the basic scales are used in multiplication and division, the others also can be used for these purposes.

Inquiries as to makers of articles described in Popular Mechanics, will be answered by our Bureau of Information upon receipt of return postage.

654

Antoine 33

1801 Larchmont Ave

Rafael

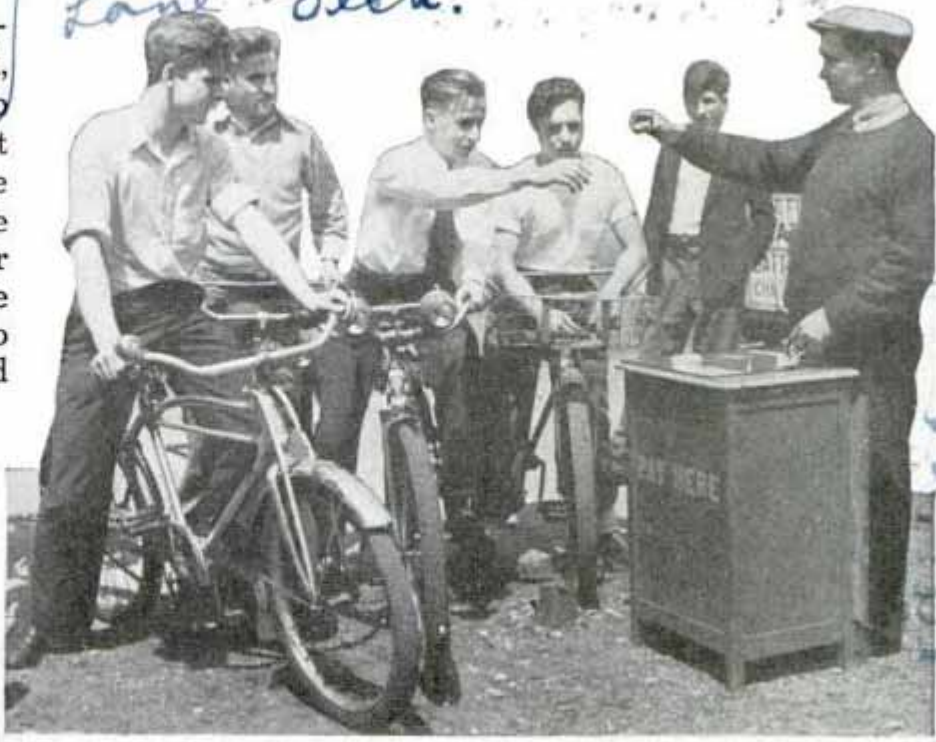
Wid Wolf

Wanneth, J. C.

Harold Erschenow 217 Woodland Ave

Parking Lot Cashes In on Bikes at Two Cents

Parking worries of high-school bicyclists were solved, to his profit, by a Chicago parking lot proprietor who set up racks in a lot opposite one of the large high schools. He charges only two cents for parking space for one bicycle all day. There are 500 to 1,000 bikes parked in his yard every day.



Chicago motorists envy these bicyclists the bargain price for parking space. A two-cent fee allows high-school boys to park their "bikes" all day close to school, and the proprietor gets plenty of business

14656.

New Source of Meat Supply Seen in Coal, Water and Air

Fresh meat from coal, water and air? German chemists, seeking to make their country self-sufficient, believe they have found the formula. Its key is yeast. The scientists have isolated strains of yeast that are nourished by carbon compounds such as lactic acid, acetic acid, glycerin and ethyl alcohol, plus nitrogen from the air;

synthetically some of these chemicals can be produced from coal and lignite. Yeast protein, unfit for consumption by man, can be fed to livestock and transformed into meat and milk. Thus it appears that in time of need Germany might dine on beef fattened on yeast from synthetic products of coal, air and water.

Handwritten notes on the right margin: 'Lane Tech.', 'wants to talk', 'member', 'June 1920'.

Auto- and-Boat Will Run on Land or Water

on Walby, elev. 1000 ft. Col. m.



Left, the amphibian vehicle as it appears on land. Below, ready to start across lake. It weighs three tons



Capable of eighty miles per hour on land and twenty miles per hour on water, a combination automobile and boat has been constructed. It has space for twelve passengers. The vehicle is an automobile chassis built into a watertight twelve-gauge steel boat-like covering, which is composed of six welded air tanks, one under each running board, one just ahead of the front axle, one at the rear of the machine and two back of the motor on either side of the flywheel. The underside of the frame is welded watertight and the brakes are protected from water by rubber washers. The drive-shaft housing is allowed to move by a collar of heavy rubber near the point where it connects with the rear axle. Thus, the machine may float in water like a boat. A motorboat propeller is attached

back of the differential, in position so that its blades clear the ground when the vehicle is on land. The machine has two transmissions, one for the car and one for the boat propeller. The vehicle may travel from land to water or back simply by shifting from one transmission to the other.

Trailer for Mowing Roadside Is Towed by Heavy Truck



To trim the right of way along rural roads, the Kansas Highway Department has devised a trailer mower that is towed by cable attached to a heavy truck which remains on solid footing on the pavement. The operator can steer the front wheels to dodge around culverts, road signs and other obstacles, and a break pin protects the machine when the mower strikes an obstruction. Three of these mowers can be hitched one behind the other and pulled by the same truck. A foot brake on the front wheels makes a fast trip to work safe.

Hauled by truck which stays on pavement, driver of this roadside mower can steer around obstacles

☐ The output of ocean fisheries is estimated at one billion dollars a year.

Life Boat Co. Starby and Station Col. Me. 1669

Two Centuries Old Robot Pens Verses Again

One hundred fifty or two hundred years ago a French mechanic built a marvelous automaton, a mechanical boy who could pen drawings and verses at the touch of a spring. Sometime since the eighteenth century it was all but destroyed by fire; only the "works" remained, an intricate arrangement of tiny cams and pinions. Now, with a new figure, this ancient robot has been restored to working order by a mechanic at Franklin Institute in Philadelphia. It



Center, robot built by eighteenth century mechanic; around it, some of the intricate drawings and poem penned under impulses of spring, cams and pinions. Nearly destroyed by fire, automaton has been restored at Franklin Institute

can again write verses in French and English and draw pictures. The figure, seated at a small desk, even imitates the human habitual movements as it writes; the hand pauses in the momentary delay between

operation of the various cams; the figure raises its eyes, then the head bows over the paper again and the hand resumes writing. The work of restoring the automaton took Mr. Halsey Roberts three years.

Removal and Cure of Organs Outside Body Predicted

Removal of diseased organs from the human body, their cure and then replanting in the body is the prediction of Dr. Alexis Carrel and Col. Charles A. Lindbergh. The work would be done with the aid of the Lindbergh pump, which bathes whole organisms from the animal body with life-maintaining liquids. Dr. Carrel, who helped to develop the pump, sees the day when the diseased portions of the body may be removed and sent to large

Lindbergh pumps, as patients now are sent to the hospital. A kidney removed for tuberculosis or a leg amputated because of some disease possibly would heal under the influence of an artificial medium in the glass organ hospital. Dr. Carrel believes that replanting the portion of the body would offer no difficulty, as surgical techniques for the suture of blood vessels and the transplantation of organs and limbs were developed long ago.

2049 n. Park Ave
Phila

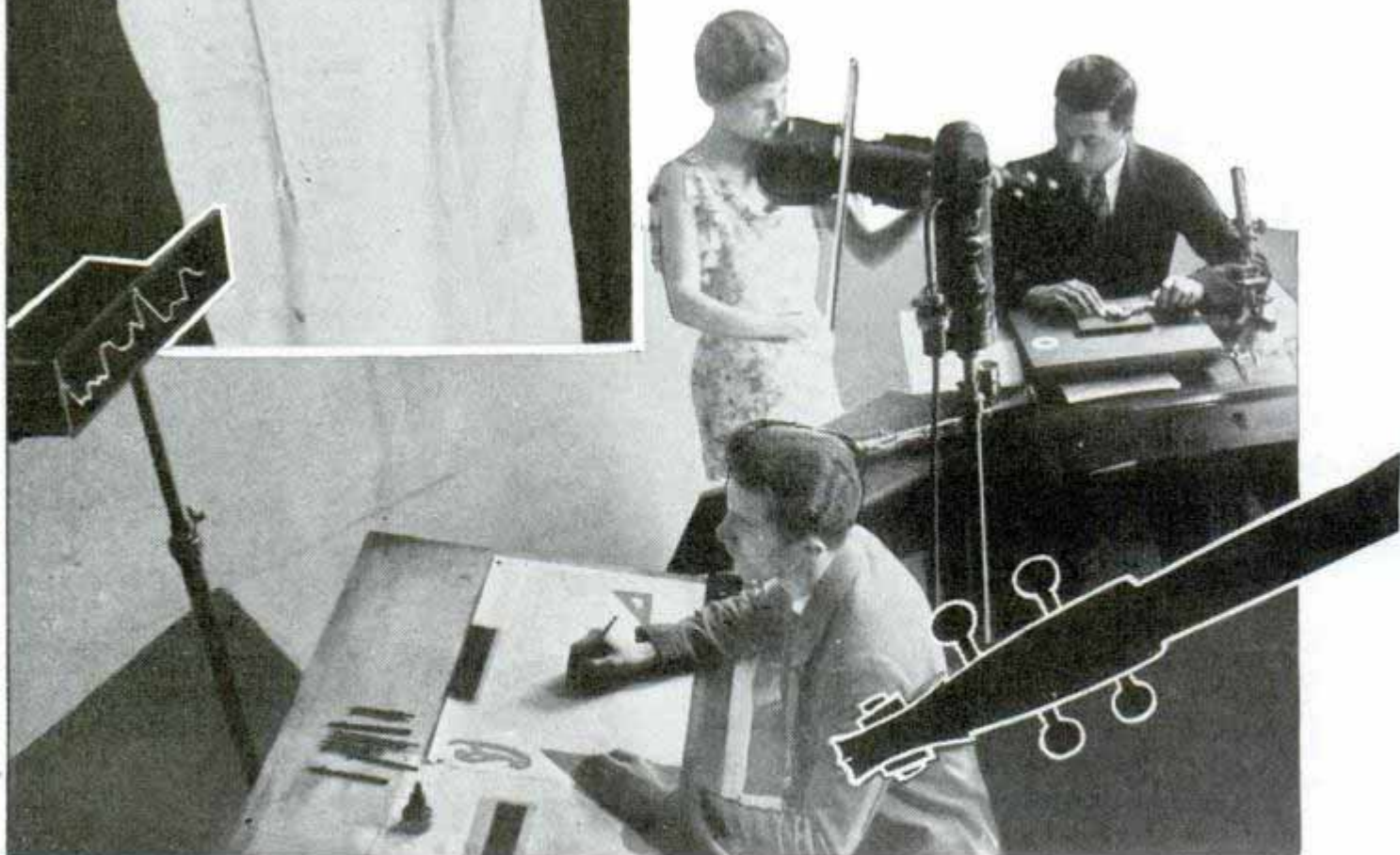
SECRETS of the MASTER



BY LOOKING at the tones of rare old Stradivarius violins, instead of merely listening to them, man today is learning some of the secrets of a master craftsman who, more than two centuries ago, made the finest musical instruments the world has ever known.

Few man-made products of 200 years ago have defied some improvement but one of the few has been the violin, perhaps the most remarkable acoustical instrument man has ever devised, and certainly one of his best examples of woodworking. Better violins were made in the seventeenth and early eighteenth centuries than ever have been produced since.

More than fifty years before the Revolutionary War, Antonio Stradivari, a gifted Italian craftsman, was turning out violins by the hundreds, each with superb tonal qualities which never since have been excelled or even equalled. All told, he pro-



"Skeleton" violin, above, made without a body and used for practice purposes, since it produces only a weak sound. Playing violin before microphone, below, and using oscillograph to see and study the wave pattern

VIOLIN MAKER

Violin maker
130 S. 18th
Phila.
14457

Dimensions		
	Length of body, inches	Length of strings, inches
Quarter size . . .	10	9
Half size	11	10
Three-quarter size	13	12
Seven-eighths size	13½	12½
Full size	14	13

duced some 2,200 instruments which he sold for about \$20 each. Perhaps he realized \$40,000 or \$50,000 for them all.

About half of the instruments he produced are still in existence. And the average price of a "Strad" today is about



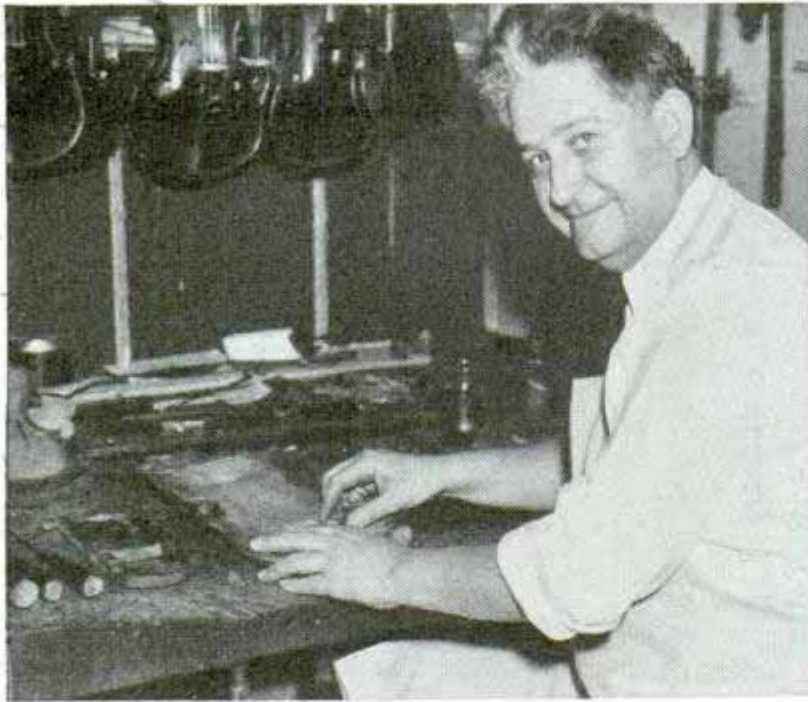
Violins come in various sizes, as shown by the photograph and chart. The man is holding a genuine Stradivarius

\$10,000, while some have sold for as much as \$100,000. Hence this man made with his own hands woodwork valued today at \$11,000,000! Probably no other man in history has ever fashioned anything from wood which has even approached so great a value.

Stradivari died 201 years ago and his se-

cret died with him—which is why his violins are so valuable today. For two centuries men have tried to make violins with tones as pure and sweet as the instruments turned out by this Italian master. And everyone has failed.

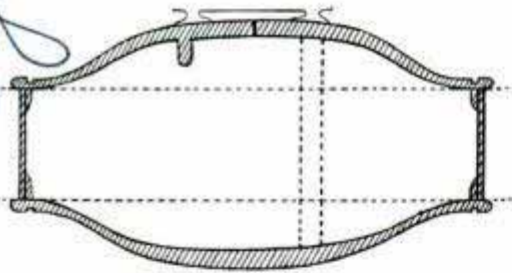
"Strads" have been X-rayed, their dimensions have been carefully measured and copied with micrometer precision, the varnishes have been analyzed and the aging of the wood has been duplicated in accurately controlled kilns. Chemists, wood experts and instrument designers all



beautiful tonal qualities are said by authorities to compare favorably with those of the old masters, including Stradivari. By determining how a violin "breathes" when the bow is drawn across the strings, the sound engineer perhaps has gone farther than anyone else toward solving the Stradivarius mystery.

To see, instead of merely hearing, what happened when a fine violin was played, the sound man employed an oscillograph, an electrically actuated instrument which makes visible on a screen the wave pattern of a sound. The distinctive pattern of a sound wave thus can be sketched or photographed, and a study of the pattern often reveals much concerning the sound itself.

All sound, of course, results

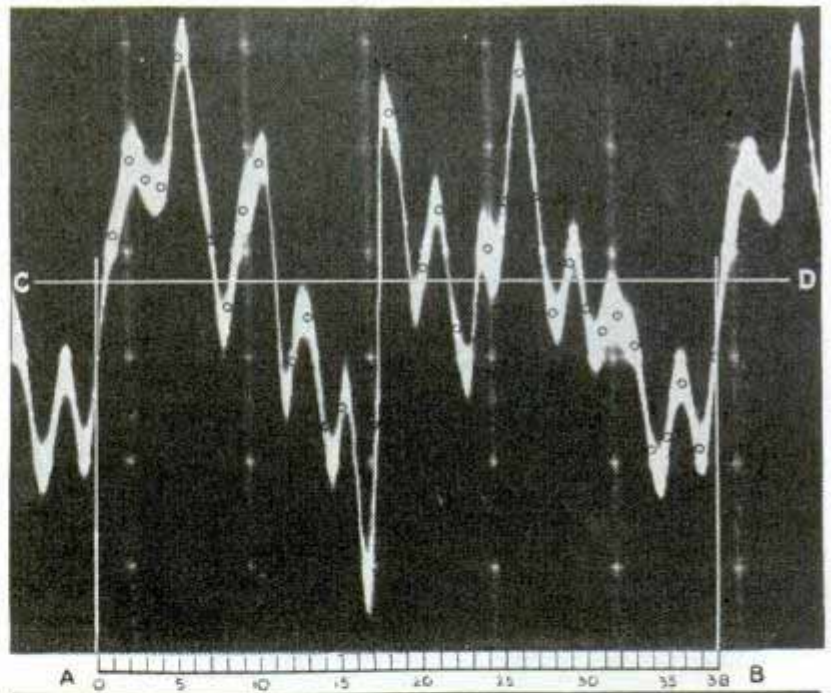


have conducted research work on "Strads" with indifferent results.

The sum of human knowledge has increased, we have developed new tools, new processes and new materials—but no one has found out how to make a Stradivarius!

Recently, however, Poul (correct) Jarnak, using the methods of the modern sound engineer, has solved some of the secrets of the "Strads" by an entirely different process, and with much more promising results. Instead of studying the violin as an inanimate object, he has investigated it as a living, vibrating body and has found out exactly what goes on inside an instrument when it is played.

As a result of the investigations, Jarnak has not only found out why Stradivari achieved his amazing results but, by applying this knowledge, he has built violins and other stringed instruments whose



Shaping part of violin body, above. Cross-section of violin shows base bar under top plate which provides for distribution of weight and tension. Bottom, photograph of oscillogram of open G-string of fine violin

from vibrations and the number of these vibrations per second gives the pitch or note. The amplitude, or depth of the waves, determines the loudness of the sound while the shape of the waves produces the quality which distinguishes the note of a violin from the note of some other musical instrument.

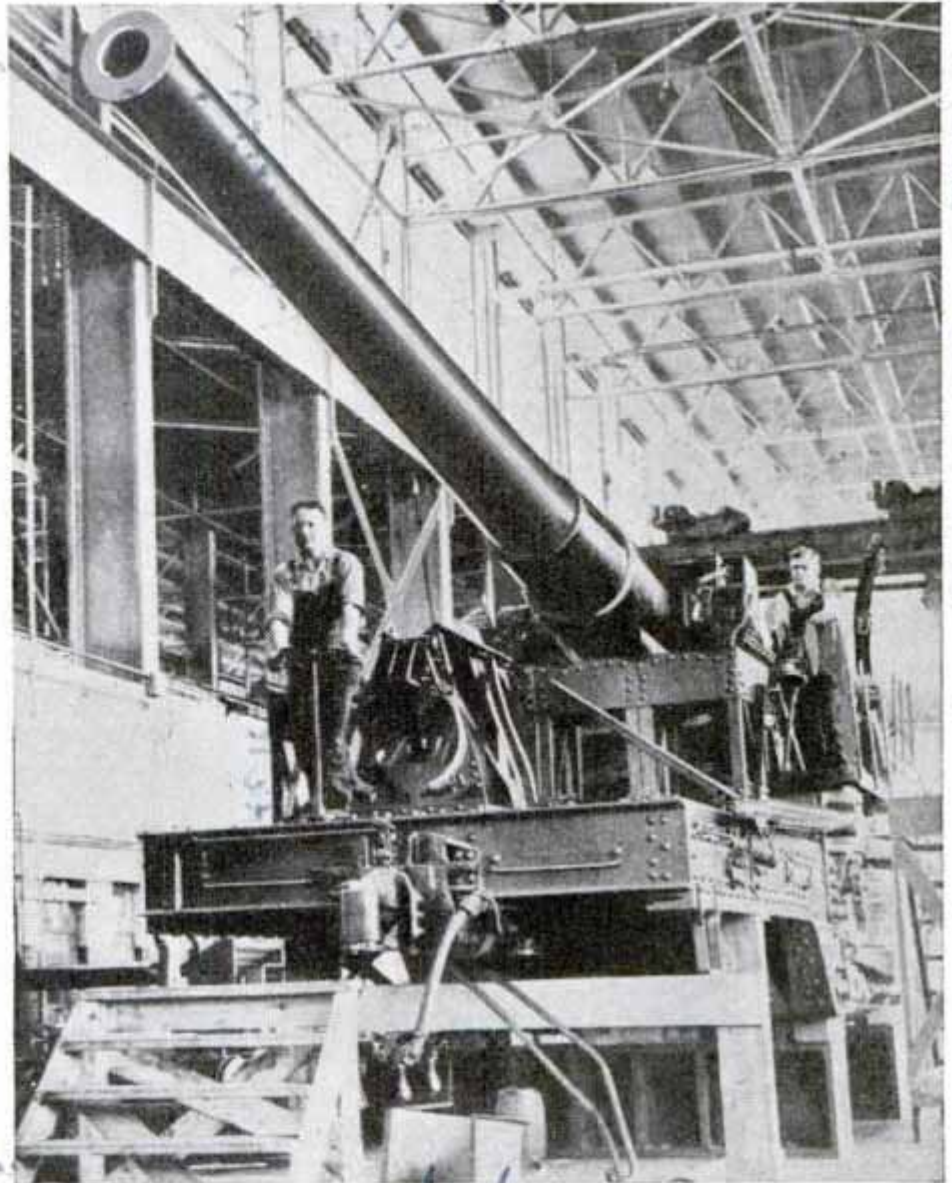
(Continued to page 116A)

65 W. 50th Street
New York

Coast Gun Strikes at Foe Twenty Miles at Sea

Enemy ships twenty miles off the United States shore are within range of the giant coast-defense gun just completed. It is mounted on a railway carriage, ready for quick transportation across the continent to defend either seaboard. The gun points a deadly finger toward the ocean, and can fire four 200-pound projectiles a minute with high accuracy. Similar to world war weapons but considerably refined since, this eight-inch gun has a secret recoil mechanism that shortens its "kick" from feet to inches, comparable to the recoil of a three-inch anti-aircraft gun.

Built on a railway carriage for swift movement to any threatened sector of the coast, this gun sends four 200-pounders a minute with deadly accuracy against an enemy ship twenty miles out.



Bed "Dashboard" Controls Radio, Weather and Phone

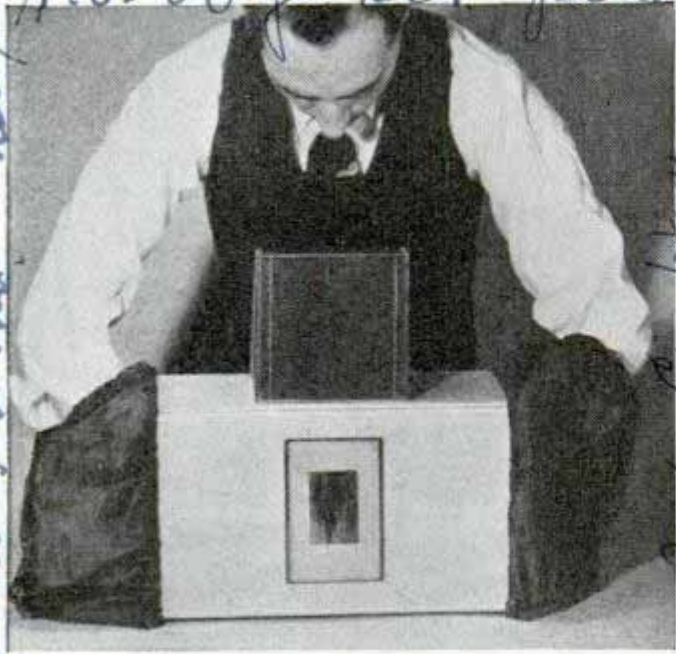
Even the weather is wired to the "electric bed" invented by a Chattanooga electrician. The headboard is a veritable dashboard, with a compartment on one

side inclosing a telephone, and on the opposite side a bookshelf. The radio is set to play for ten-minute periods, and if the listener drops off to sleep it turns itself off automatically. There is also a loudspeaker for communicating; if a caller knocks at the door, a flick of a switch on the headboard makes it possible to converse with the caller by means of this speaker. And if the loudspeaker is accidentally left connected, another automatic device reminds the sleeper before his snores are broadcast to the neighborhood. A thermostat causes the window to close if the temperature drops too far, or turns on a fan if the room is too warm. The alarm clock cannot be turned off without the sleeper getting out of bed, and if he goes back to bed within a half hour it rings again.



Radio, alarm clock, telephone, loudspeaker communication system and heat controls are wired to bed

Portable Photo Darkroom Has "Safety" Window



Photographer wearing light-tight sleeves watches printing through safety window of portable darkroom

Photo negatives can be developed and prints up to four by six inches made in a portable darkroom with a "safety" window through which the process can be watched. The daylight workroom is a lightweight, hardwood box sixteen inches long, containing all the necessary trays and holders. Lightproof sleeves for the photographer's hands are snapped over the open ends of the box, and top and side windows have safety glass so that contact prints can be made in brilliant light without fear of fogging. Darkening boards that fit the safety glass holders make the box light-tight.

Engineering Salaries Are High and Unemployment Low

High-school graduates looking toward college and the choice of a profession should examine the salaries of engineers. Prof. R. W. Sorenson of California Institute of Technology points out that graduates of a four-year college engineering course may start at \$25 or \$30 a week but most of them soon are promoted. Some, in the highest ten per cent, eventually reach an average salary peak of \$12,000 to \$13,000 a year; for a fourth of them the peak will be \$7,500, and a half of them will reach the \$5,000 class. Furthermore, the earning period is long and the peak salary is not

reached until the age of sixty, thirty-seven years after graduation. Less than three per cent of American engineers were unemployed during the depression.

Ring to Repair Valve Guide Stops Oil and Air Loss

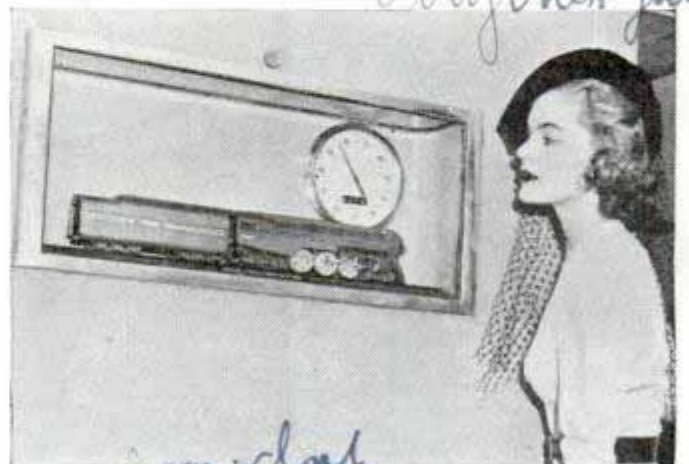
Resembling a miniature piston ring, a new permanent valve guide repair ring is on the market to prevent oil and air from leaking past worn valve guides. It is installed on the center of the valve stem, where it is said to act as a seal to prevent air from leaking into the combustion chamber of the automobile engine. This allows accurate adjustment of the carburetor. The ring may be installed quickly with an inexpensive grooving tool.



A 702

Streamliner Has Speedometer in Observation Car

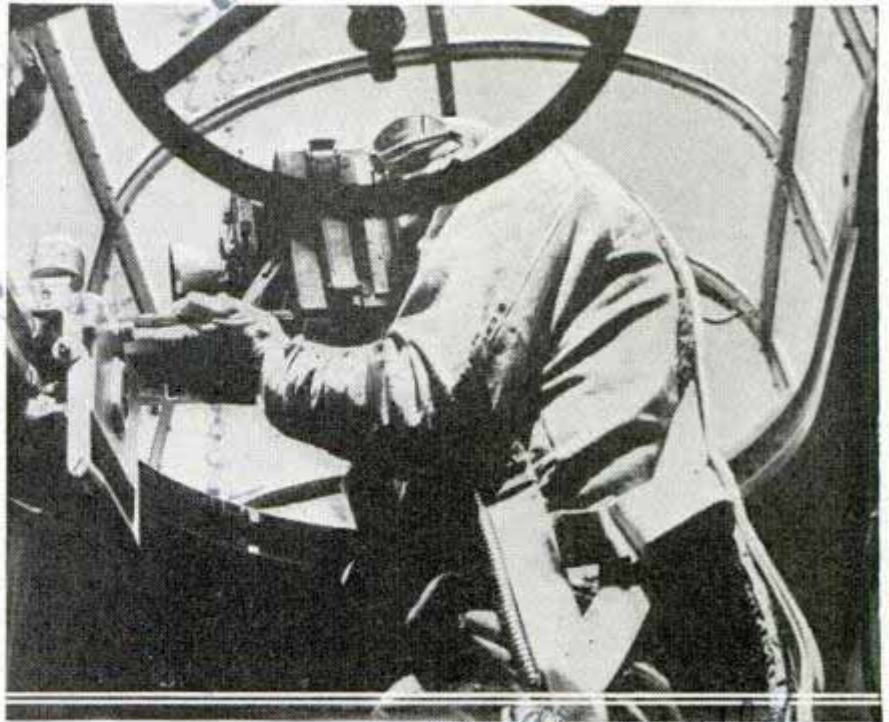
Until recently the speed of a train was a matter of considerable speculation among its passengers. But guesswork has been removed for passengers on the new Twentieth Century streamliner. A speedometer mounted in a panel of the observation car shows at a glance the train's pace and records the trip mileage.



Passenger checking streamliner's speed with the speedometer mounted in observation car

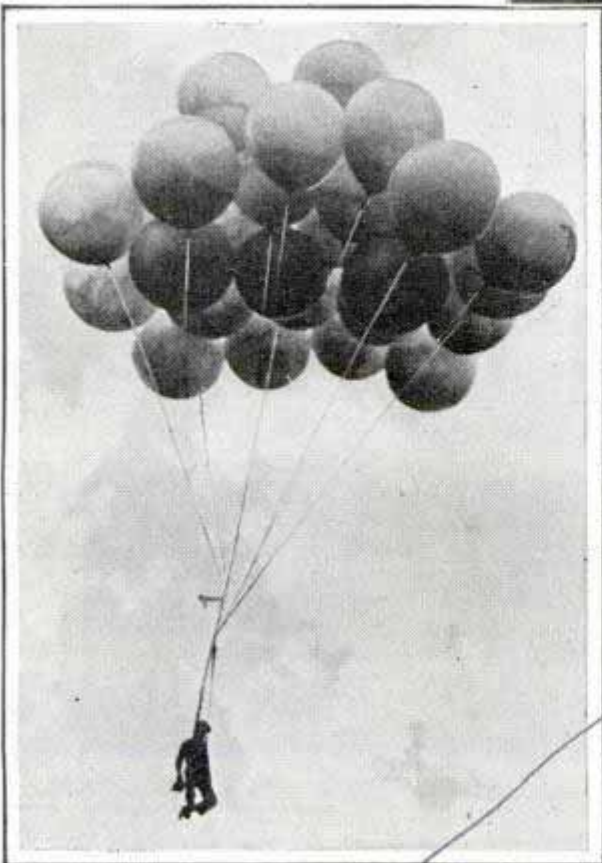
Vertical handwritten notes on the left margin: 'Marine', '220 cell of 2nd hand', 'mag', '2 726', 'Calif', 'of a car', 'Virginia Judd', 'also Toronto, Canada', '7666', 'Valve Ring', 'Fastening, much', 'Dartmouth', 'Co. Quincy', '7683', '410.00 for set send'

Cameramen Hunt Pictures in Thrilling Places



Wild World
The men behind the lens must follow the news wherever it is. When Don Brinn, above, was assigned to cover army air corps maneuvers he put on flying togs and parachute and went up to "shoot" from turret of army plane.

If you were given the job of photographing Yosemite Valley from the overhanging rock above, you might decide to take up studio portrait work instead. It's 3,000 feet to the valley floor, but it's comforting to know the rock itself is quite steady



Chapman
Kill
When at sea, the wise photographer wears what the sailor wears, so the cameramen above donned oilskins while "covering" a yachting regatta in "dusty" weather. Left, a New York newsreel cameraman accidentally goes sky-riding solo. He was making stunt pictures of golfers and traffic from his novel perch when the anchor rope broke and the balloons hoisted him up for a thrilling thirteen-mile ride that might have been his last. Fortunately a sharpshooter who had been following the drifting balloons took careful aim and punctured several of the gas bags. The cameraman came down with a bump, but unhurt

Image of Filament Enlarged to Measure Its Expansion



Measuring expansion of lighted filament with ruler as enlarged image is projected in laboratory

Remember the early days of the movies, when the projector lamp would suddenly snuff out and everyone would whistle and clap while the notice "One moment, please" flashed on the screen? The coiled-coil filaments of projector bulbs are several times as big and much hotter than your household lamps, and too often they would buckle and snap from lack of room for expansion. In their research to find out how much space these coils need and thus to improve projection bulbs, engineers of the Westinghouse lamp division projected a tremendously enlarged image of a lighted filament on a screen and measured with a ruler the rise and fall of the expanding and contracting coils.

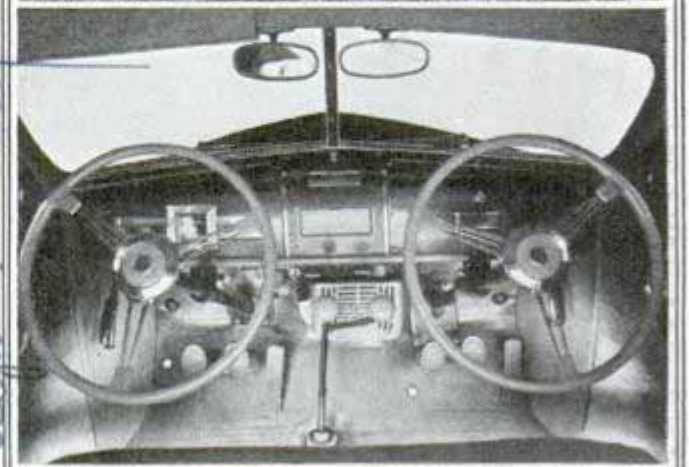
Candid Snapshot of Auto Thief Leads to Capture by Police

Quick work by a candid camera fan in Roxbury, Mass., brought about the arrest and conviction of an automobile thief whose picture was snapped before he escaped. A stolen car in which two men

were riding had collided with another automobile on a Roxbury street, and as the pair struggled with the other motorist, a pedestrian happened along with his camera and caught the scene. One culprit was captured, but the other broke away. The candid picture was printed in a Boston newspaper, however, and a policeman recognized the fugitive and arrested him the same day.

Dual Controls in Postman's Car Handy on Rural Mail Routes

Eliminating the nuisance of sliding back and forth when mail boxes happen to be on opposite sides of the road, one rural carrier has his automobile equipped with dual controls. The car is similar to those built for use in driving instruction, a complete set of controls being installed on each side of the front compartment. Now, the postman drives along, putting mail into boxes on the right side of the road until he comes to a box on the left side. After sliding over to put mail into the box, he remains under the wheel on the left side of the car and continues his journey.



Top, handling mail from right side of car. Bottom, dual controls in postman's car

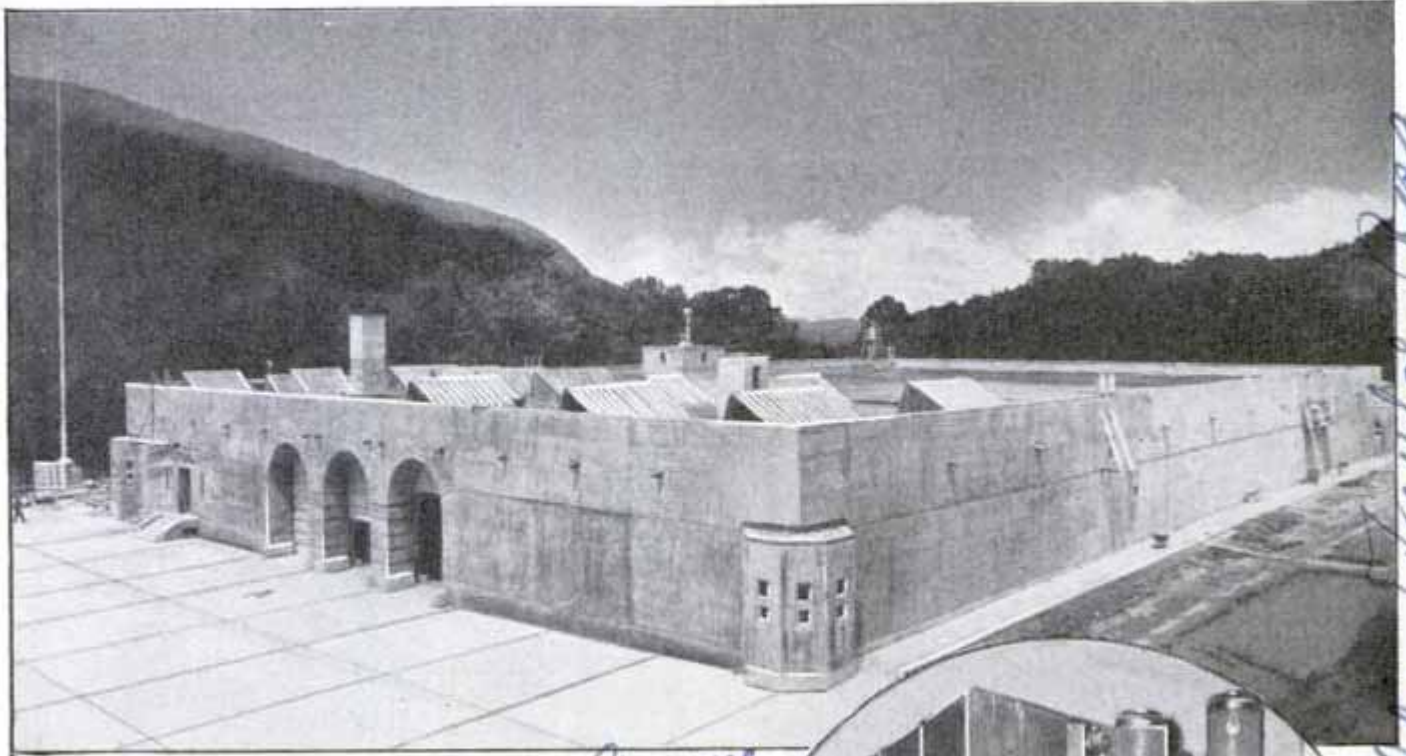
John Duckwall, Boston Globe

Blomfield, N.Y.

682

Walsford, Mass.

Concrete Fort Guards Two Billions in Silver



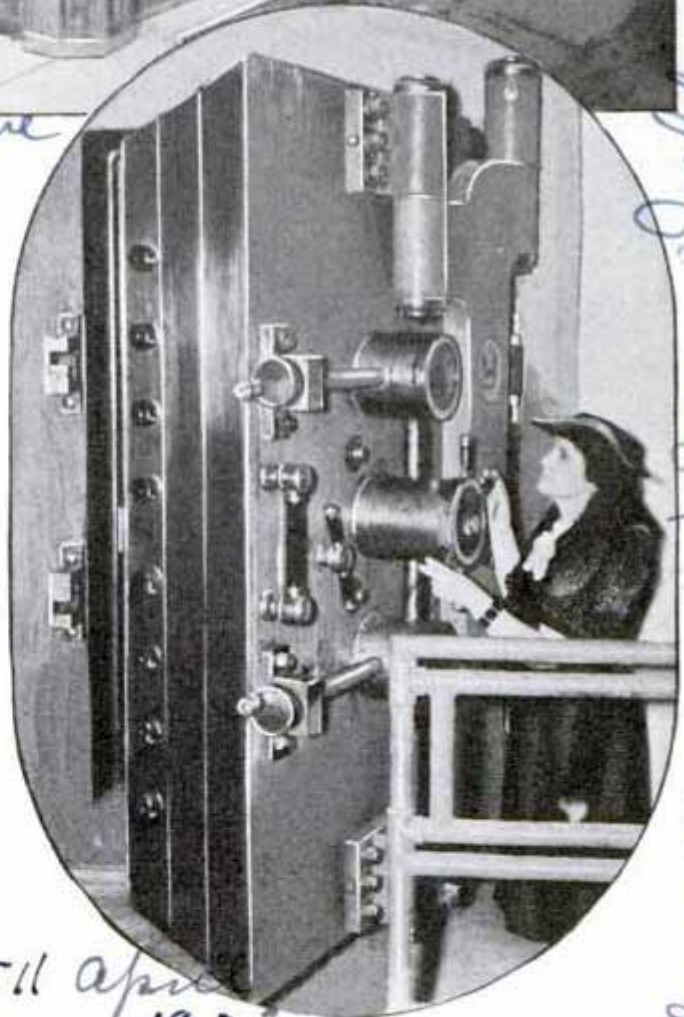
Every approach to silver repository at West Point, above, is well guarded. Note sentry boxes at corners. Right, fifteen-ton vault door

Uncle Sam's hoard of gold lies well protected in the vaults of Fort Knox. Now his silver has vaults of its own in a fortress of concrete on the West Point military reservation. Eventually there will be nearly two billion dollars in silver bars from the mints of Philadelphia, Denver and San Francisco stored in this repository. The walls of the one-story building are a foot thick, and a fifteen-ton door of flameproof, drillproof steel stands between the government treasure and any who would dare to raid it. The twenty-three vaults inside it have storage room for about 100,000 silver bars weighing seventy pounds each.

H 70 3

Plywood Fuselage for Plane Speeds Manufacture

Opening up new possibilities for rapid manufacture and assembly of airplanes, a plane whose fuselage is made from two pre-molded pieces of laminated plywood bonded by a synthetic resin is undergoing tests. With a gross weight of 4,500 pounds, the plane is about the same size as the larger private planes. It is equipped with a 450-horsepower engine. Planes made of plastic materials have been tried in the

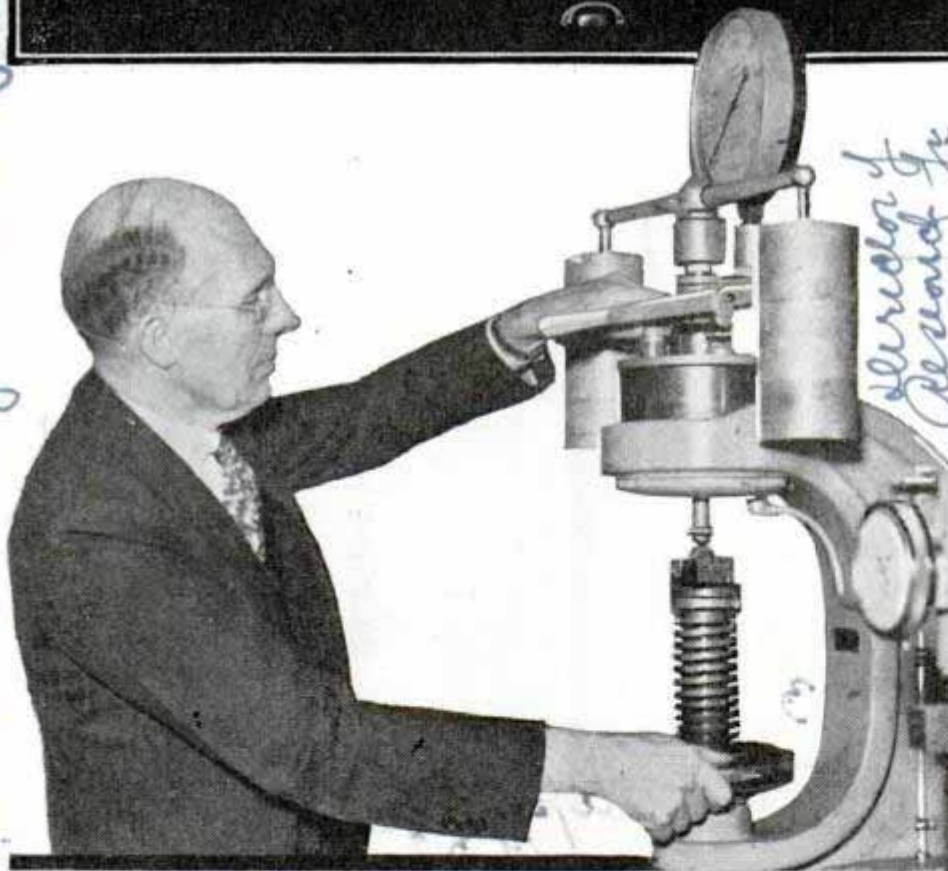
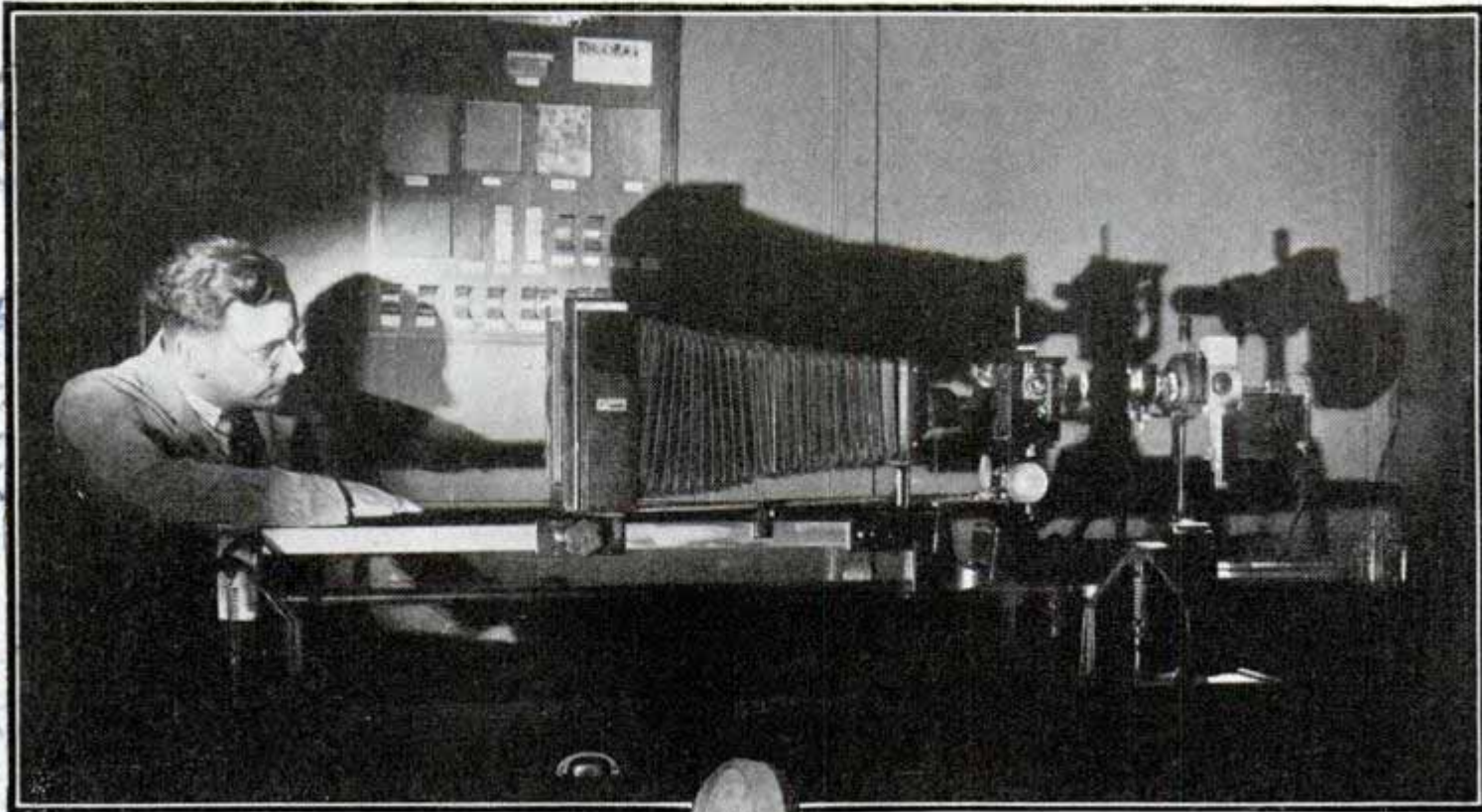


see 511 April 1937

United States before, but progress has been slow. An advantage derived from use of the material is speed in assembling the fuselage. Since airplanes are still largely hand-assembled, this is a factor of importance. Laminated plywood of the type used has a high strength to weight ratio, which is another important consideration in aircraft construction.

Handwritten notes on the right margin: "See 511 April 1937" and "Laminated plywood of the type used has a high strength to weight ratio, which is another important consideration in aircraft construction."

The MYSTERY TIE



Spectroscope with photographic attachment, above, used to measure active radiation of chlorophyll. Left, Charles F. Kettering, who established foundation for study of chlorophyll, in research laboratory

one of the most common materials and the ultimate source of more than ninety per cent of all energy in use. It is the basis of productive radiation, the active tie between the sun's energy and life. Better understanding of it ultimately may provide a new key to health and usher in a new age of cheap power.

German chemists already have made the working equivalent of gasoline directly from green leaves. It is an excellent motor fuel but the cost of extraction is prohibitive for practical use. Refining one quart costs approximately \$1,000. But hundreds of products now in popular use were first produced at fabulous expense.

Though scientists believe that chloro-

By Charles Morrow Wilson

WHY are leaves and grass green?

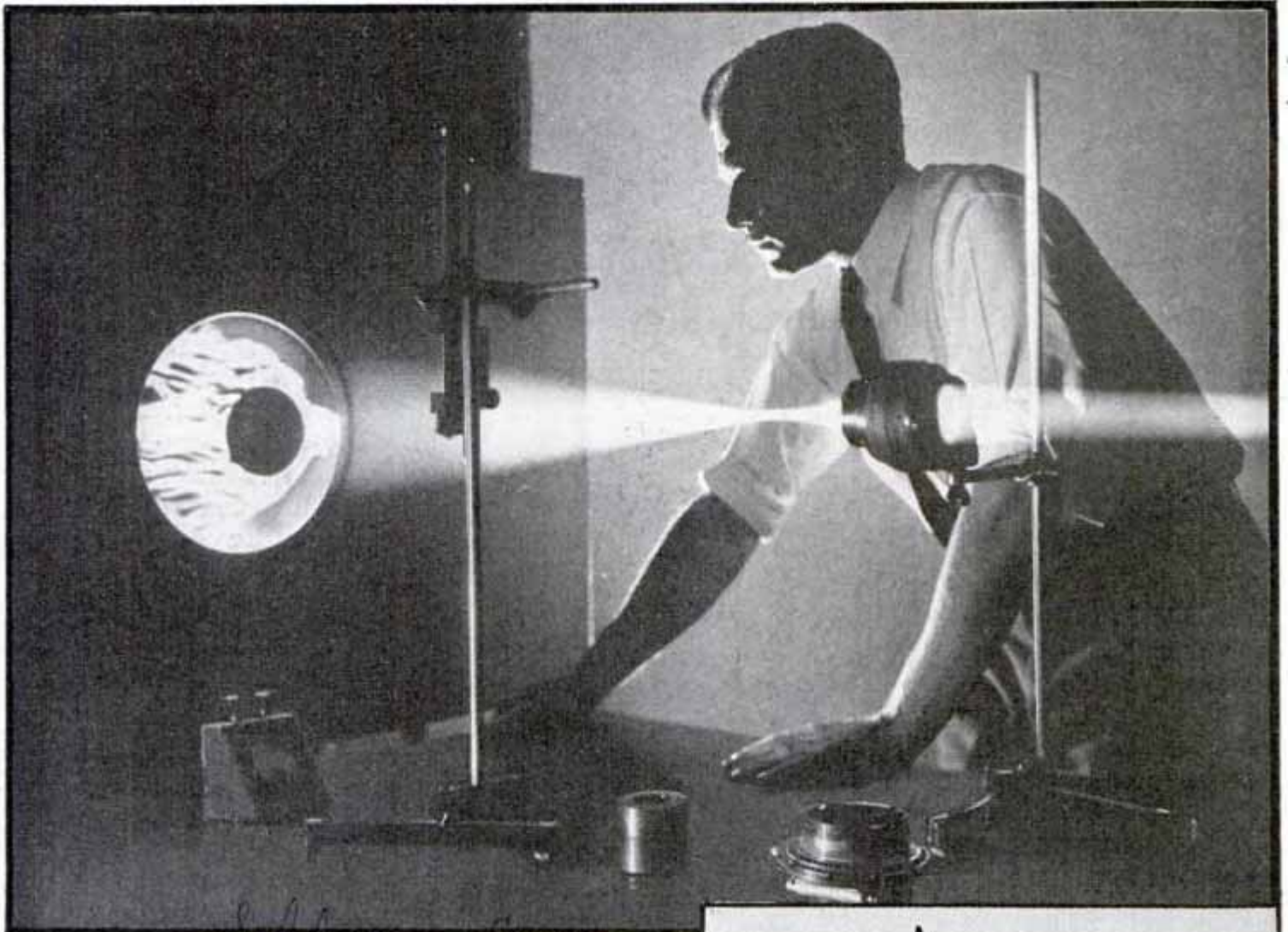
From a standpoint of science, this is one of the world's most important questions, one to which men have no complete answer.

Chlorophyll, meaning "green leaf," is

10015. D. Ooley Dr. Fayetteville Ark

secretory of second photosynthetic

Between SUN and LIFE

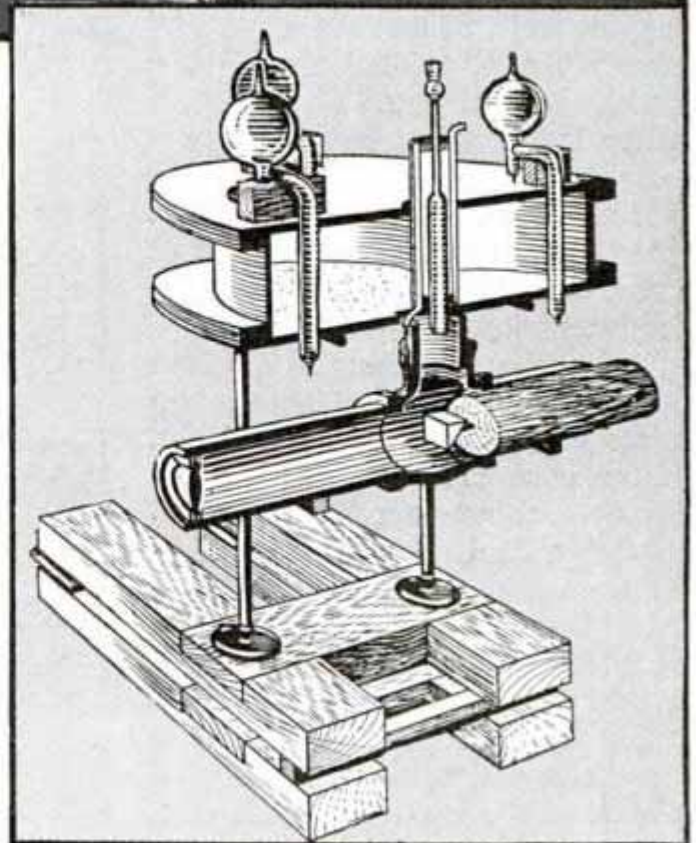


Schlieren lens

Instrument employed to measure fuel efficiency and test shapes of hydrocarbon molecules

phyll preceded animal life by thousands or millions of years, green leaf remains a challenging material. Certain facts about it, however, are well known. We know it is the machinery for storing light energy of the sun in the many chemical compounds which make up plants, for we know plants create food only from visible light, and that light given off from burning wood, coal, and other vegetable sources is similar to light from the sun. We know everything which is illuminated absorbs some light and that this absorption tends to influence the chemical composition of the illuminated surface. Modern photography is merely an elaborate demonstration of this truth.

In estimating "sun power" we know the average radiation received by the earth is 1.92 calories per square centimeter per



Illuminator which is used in studying the fluorescence of chlorophyll



exist on land. It is the ultimate source of materials. Without it this magazine page could not be printed. The chlorophyll molecule seems highly complex but appears to have an astonishing similarity to blood.

Scientists now believe the only molecular difference between chlorophyll and blood is that the center atom of the chlorophyll molecule contains manganese while the center atom of blood contains iron. But chlorophyll cannot be formed without the presence of iron as a plant food. This similarity of structure may some day make possible leaf transfusions just as we now have blood transfusions. This might prove of far greater value than a mere first-aid to ailing gardenias.

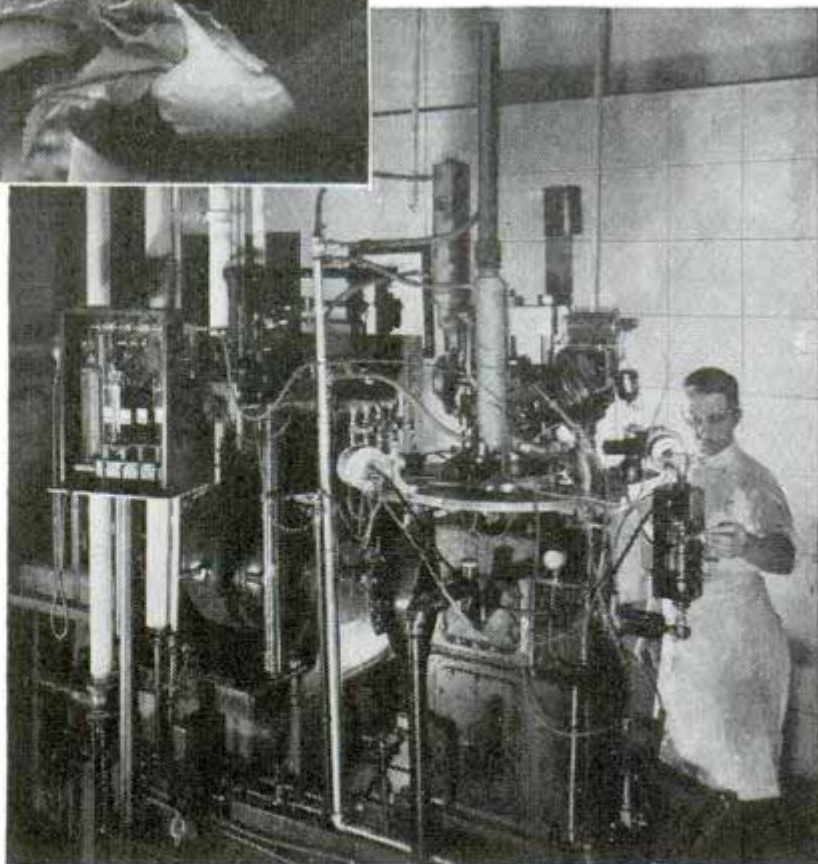
From a standpoint of industrial chemistry and power development, the opportunities for making

minute. At this rate continuous employment of the sun's rays at the equator could melt a 424-foot layer of ice in one year.

But there is a difference between merely receiving sun energy and actually making use of it. As a whole the earth merely receives energy. The green leaf uses it. In favorable sunlight a square yard of leaf surface actually makes about one gram of carbohydrates per hour, or enough in two months to feed one man one good meal.

It has been estimated that an acre of corn exposes about two acres of leaf surface to sunlight. If the corn produces 100 bushels per acre, this means the leaf actually manufactures with the aid of sunlight about seven tons of material, including about three tons of carbon. The latter represents at least eleven tons of carbon dioxide taken from the air. It also has been estimated that growing plants of the earth's surface each year manufacture at least one cubic mile of sugar.

Without chlorophyll no life could



Top, instrument which measures fuel efficiency. Center, green leaves are the source of most of power used today. Bottom, testing fuel efficiency in General Motors research laboratory

practical use of green-leaf material depend not upon "atom smashing" but upon more enlightened methods for varying the design of the chlorophyll molecule.

America's greatest industrial problem today is fuel. In the modern auto only about one-tenth of the fuel energy actually propels the vehicle. Roughly ten per cent is lost in friction, forty per cent through the cooling system and forty per cent through the exhaust. Animals, including man, apparently "catch" about one per cent or less of the sun's energy. Plant-leaf material "catches" about two per cent. Industrial scientists believe a way may be found for recovering the sun's energy from green leaf more efficiently than it has yet been recovered from any fuel source. In theory, at least, it might be possible to increase the efficiency of the reception of the sun's energy by plants five or even ten fold. From a fuel standpoint, this would be far superior to the hydrocarbons from which we now make motor fuels. There also remains the possibility that at some future date, our natural supply of coal and petroleum may be exhausted.

Fame and fortune wait anyone who can solve the mysteries of chlorophyll. The final answer, however, probably will come, not from one man, but from the findings of many. The outstanding center for chlorophyll study is the C. F. Kettering Foundation at Antioch college. This foundation began a systematic study of chlorophyll eight years ago.

This study has clarified the fact that plant respiration is just as necessary as animal breathing. It has shown that, in company with chlorophyll, the plant tissue contains a yellow pigment called carotinoid which also seems to be influenced by temperature and quality of light waves. It has shown that few, if any, plants of value could exist without radiation from the sun and indicates that the green plant is either the immediate or indirect source of most organic materials. This has led to a careful study of plant cells. Indications are that the plant cell, in general, is far less developed than the animal cell.

When illuminated, chlorophyll has fluorescence—the ability to give off color differing from its own. The Ohio researchers are seeking to learn what connection this

(Continued to page 123A)

"Cellophane" Oxygen Tent Promotes Comfort



Demonstrating transparent oxygen tent. It relieves feeling of imprisonment since patient can see around

Cellophane has been enlisted as an aid to doctor and patient. To relieve the patient's feeling of confinement during treatment under the early type of oxygen tent, a tent of Cellophane has been developed. The oxygen equipment and exhaust vent are mounted over the hospital bed and a transparent curtain draped around the patient, permitting him to rest without feeling "caged."

Appliance Plug Breaks Circuit When Line Is Overloaded



To end the inconvenience of blown fuses, a manufacturer is introducing an electric attachment plug which has its own circuit breaker. It can be used with any electric appliance in place of the ordinary plug, and when a short circuit or overload occurs on the line it shuts off the flow of current instantly. Then it can be restored to operation time after time merely by pressing a reset button.

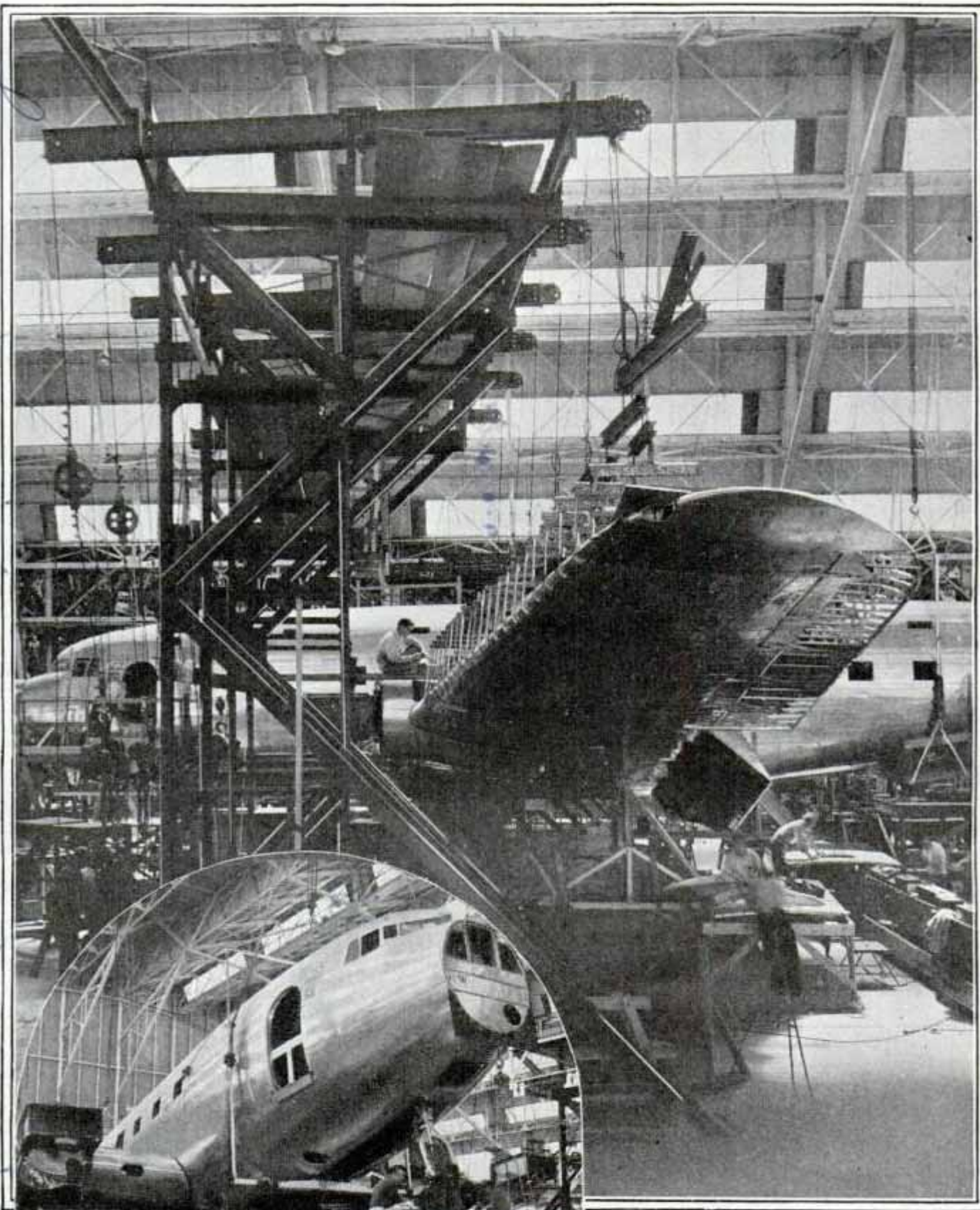
American Industrial Subst. Co.
Wabash 1739

Pharm at convenient
Sentry Sales Dept.
Sentry Sales Dept.

Sentry Sales Dept.

Test-Flying and Landing a Sky Liner Indoors

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Before the fledgling Douglas "DC-4" risked its wings in the sky, the forty-two passenger air liner proved itself in indoor tests equal in severity and duration to a flight nearly three times around world. In hangar above is structural steel framework from which load of 180,000 pounds was applied to wings, reproducing forces encountered in actual flight. At left, nose of the big ship is pointed up as loads simulate stress of steep climb

Ninety-Ton Load Shows Ship Has 'Backbone'

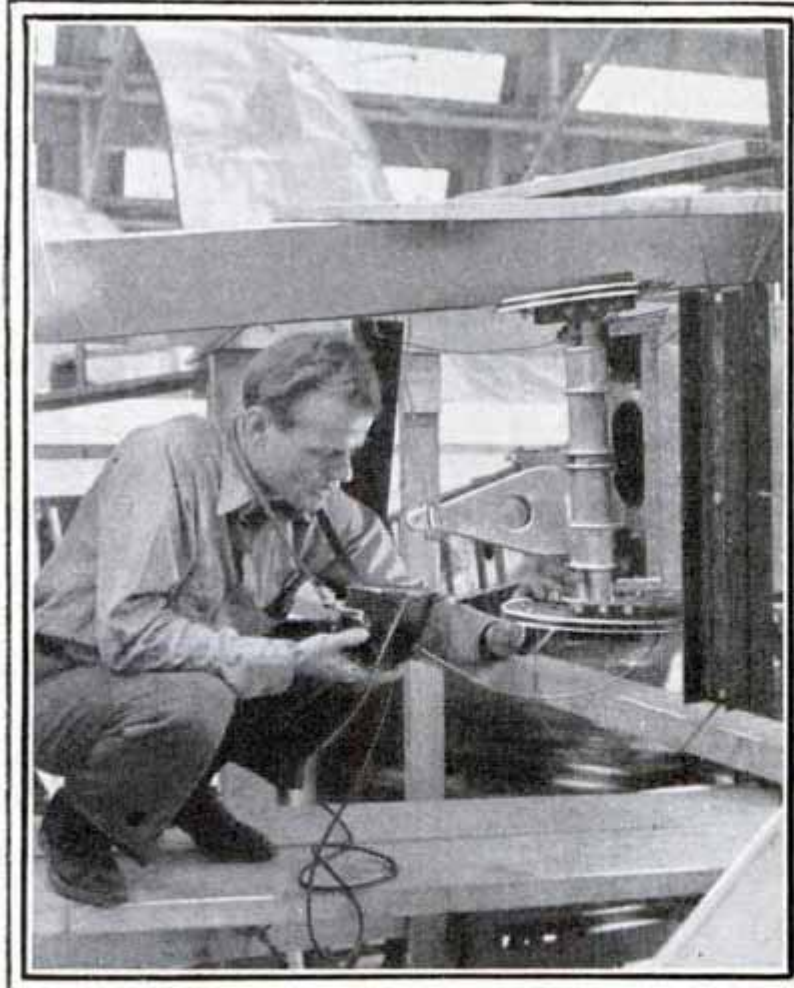


Up-loads of 180,000 pounds applied to outer and inner wing sections by pulleys and hydraulic jacks under wings

Down-loads totaling 180,000 pounds applied to the several engine nacelles reproduce weight and pull of motors

Putting Douglas DC-4 super skyliner to test. Ship is mounted and loaded to reproduce weights and stresses anticipated when plane, fully loaded and traveling 235 miles an hour, is sent into climb at 2,000 feet per minute

Hydraulic control board. Landing gear takes 170,000-pound up-load and 35,000-pound side-load; nose wheel, 42,000-pound up-load, 10,000-pound side-load



Top, piling on test loads with ballast and hydraulic jacks. A million pounds of lead bars were used in tests. Below, workmen in tail and cockpit of this biggest American land plane were so far apart they talked over ninety-seven foot telephone cable. Plane measures 139 feet tip to tip, weighs 65,000 pounds loaded. During load tests, sensitive instruments took deflection readings at 201 points on structure

*Washington
Road. Upper Levee*

Steamer Pumping an Island Dry Digs Its Own Grave



Old steamer at work pumping floodwaters out of island. The water is pumped up over the levee and down into the river

Mandeville

Literally digging its own grave with its paddlewheel, an old steamer has just completed the job of pumping dry a flooded island in California. It is one of four brought into the island through a break in the levee when the island's farms were flooded. Then the break was closed, converting the island into a lake 6,500 acres in extent and ten feet deep, surrounded by levees. The old river steamer then was maneuvered stern first to a kind of trough and lashed to the bank, its ancient boilers were fired up and the engines started. When the wheel began to revolve, at full speed ahead, the moored boat did not move but the paddlewheel threw a mighty surge of water into the trough, uphill to the top of the levee and down into the river. Three high-capacity pumps and three large automatic siphons also were used to help empty the island of water. The steamers will be shored up and used as bunkhouses on the island. The farmers expect to produce a normal crop next year.

*San Francisco
river. Well just used of
carbon. Caled*

at the post office and postage determined by weight rather than by individual piece, and it was found that the material had absorbed considerable moisture on the way to the post office. There was a difference of 5,750 pounds, or four and six-tenths per cent, between the original weight and that determined by the postal authorities.

County Jail Housed Temporarily in a Railway Car

It wasn't practical simply to nail a sign on the county jail: "Closed for remodeling," so the sheriff of Calhoun county, Mich., shopped around for a temporary lockup. He picked up an interurban car on the market, moved it to the courthouse lawn at Marshall, had the windows barred and opened up a temporary jail for minor offenders. Lacking any statistics on the escape-proof qualities of a railcar jail, the sheriff sent the more dangerous prisoners to other neighboring jails for safekeeping.

Marshall

Rain Lifts the Cost of Mailing as Moisture Adds Weight

Mail your parcels in dry weather! Rain may add to the cost of postage. One company actually found that a rainstorm added \$460 to its bill for a large mailing of "permit" matter. The shipment was weighed



Its doors and windows barred, this erstwhile interurban car is a county jail during remodeling work

clnt.

Clarence Schneider membership, Tenn

Patron Prints Food List in 'Automatic' Store

Customers don't have to carry their packages in the latest "automatic" grocery. They merely print their shopping lists and let the clerk serve them. The canned and packaged goods are all displayed in glassed showcases. In front of each article is a tag indicating the price, the tag being connected to a slot on one of the panels between the sections of shelves. As the customer enters the store he is given a small magazine, he inserts a projecting arm of the magazine into the slot corresponding to the article desired, and the name of that article and its price are printed on a roll of paper in the magazine. The customer then presents the magazine to the cashier, pays the bill and the list is filled by a clerk.



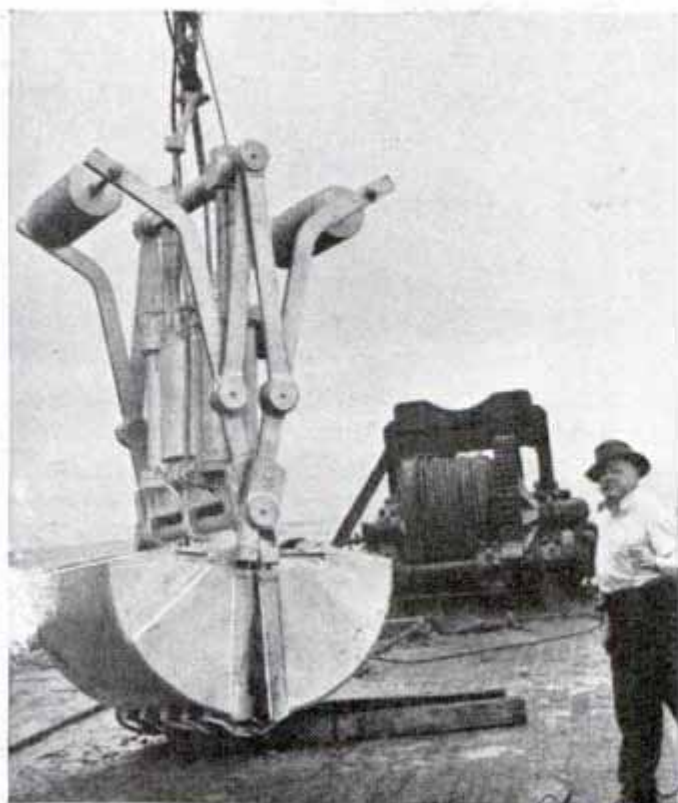
Pressing arm of magazine into various slots, as at left, customer obtains printed shopping list, below. Cashier totals bill and clerk fills order



14619

Wide World

Dredge Brings Up Sea Bottom from Seven Hundred Feet



Deep-sea dredging machine brings up first load of ocean floor from 700 feet down

Through the invention of a deep-sea diving dredge, large quantities of ocean bottom can be brought up from depths of 700 feet. The ten-ton machine converts the terrific pressure of water at great depths into kinetic energy by a system of valves and pistons which takes the dead weight of water and changes it into live power. The inventor, John C. Williams, said that the machine could work at 1,000-foot depths, 300 feet more than in its demonstration recently before scientists. The dredge may revolutionize gold mining on the ocean floor, since it makes possible operations at greater depths than ever before attempted.

Popular Mechanics Magazine can furnish the name and address of the maker of, or dealer in, any article described in its pages. If you wish this information, write to the Bureau of Information, inclosing a stamped, self-addressed envelope.

see page 385



Thrills of the

from under him and he's in for a dunking. The thrill hunter can stick to straight riding or he can go in for bronco riding over choppy stretches or making wide, sweeping turns at speeds up to forty-five miles an hour.

Some incurable freeboarders can do stunts on their frail ironing boards that make even surfers envious. Dwight Hart, southern California expert, gets the greatest enjoyment out of this sport when he's riding backwards, balancing on a chair, or standing on his head. The knack of freeboarding, Hart explains, can be picked up in a short time. A towline about fifty feet long should be used at the outset but it can be lengthened to eighty feet later. The longer the rope, the greater the speed on the turns.

He advises the beginner to lie flat on the slab a little to the back so its nose will tilt upward. As the boat gains in speed, shift into a kneeling position. Then with one foot at a time, stand up, being careful to keep your feet wide enough apart to retain your balance. A firm, steady grip on the line will keep you from being pulled forward while getting into an upright stance.

"Steering is done by shifting the weight," Hart adds. "All you do

is slightly submerge the board on the side you wish to go. For the first few times, it's a good idea to stay on one side of the boat's wake to avoid the ruffled water. In making an arc after getting outside the wake, lean away from the direction in which you are going, at the same time shuffling the board with your feet in such a way as to keep it from shooting out from beneath you."

Someone is about to get a ducking as these aquaplane riders fight a duel with poles with padded tips

THE family ironing board has invaded the sport world and is providing water enthusiasts with a batch of new heart-pounding thrills.

It all happened when somebody decided to do some surfboarding where there wasn't any surf. A motorboat and a long towline were substituted for the swell of the sea. The result was freeboarding.

A step-brother to aquaplaning, freeboarding is more exciting. The rider balances on a cigar-shaped board holding the towline as he skims through the water. If he loses his balance, the board flies out

Hart's formula for the more spectacular stunts is simply lots of practice. For the average water enthusiast, aquaplaning can be a mild recreation or a tingling thrill. It

Catalina Island
 Santa Monica
 Santa Monica City
 Santa Monica

"IRONING BOARD" SPORT

Lake Monroeville of aquabatics

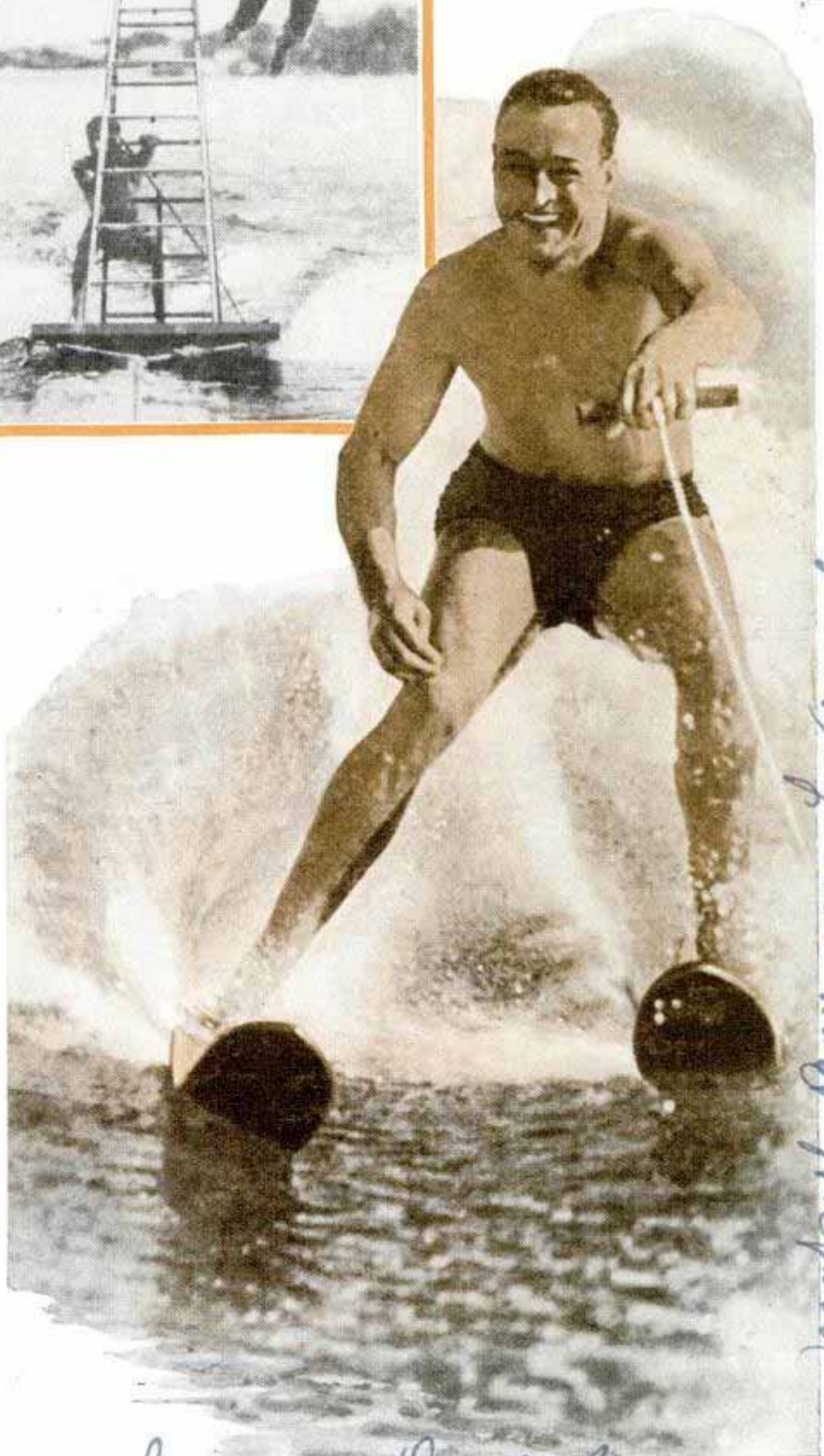


Two aquaplanes, two ladders and an iron bar provide all the "props" necessary for the "aquabatics" at left. Below, skiing on water

falls in the latter category when the pilot boat starts making sharp turns and the "ironing board" jockey at the end of an eighty-foot line is sent whirling around with only one corner of the board touching the water. Before starting a swing of this type, you must first get outside the wake or you are apt to be thrown overboard.

If, for example, the boat is going to turn to the left, you must be on the right side of the churning water. In order to do this, lean backward and to the right. As the boat starts a left turn and you start your arc, your weight should be shifted to the left foot. By leaning heavily on your left foot at the beginning of this swing, the board's speed can be diminished.

Aquaplane races are becoming a feature of



Newport Bay near Los Angeles

George Lucas



How to aquaplane in five lessons. Lie flat as boat starts, then pull yourself slowly to your knees. Rise up, let go board and grasp ropes. To turn, push one foot down and pull opposite rope

water carnivals and small boat regattas. The blue-ribbon ironing-board classic is the open sea jaunt from Catalina island off the coast of southern California to Hermosa beach. This yearly race attracts the finest men and women aquaplanists in the country.

Here backyard boats compete against faster runabouts and hydroplanes. Movie stunt men, amateur daredevils, firemen, policemen, football players, socialites and swimming stars match their skill against the sea on boards thirty inches wide, seven feet long, and not to exceed sixty-five pounds in weight. A 100-foot towing line separates them from the speedboats. Each entry is handicapped according to the speed of his pilot boat with its displacement, length and horsepower being the deciding factors.

Riding the hurricane deck of an ironing board over forty-four miles of open sea makes heavy demands on an aquaplaner's stamina. There must be perfect coordination between the driver and the board rider. Not only does the driver act as navigator but he is also pacemaker and must know how fast the aquaplanist can go.

The course itself is beset with difficulties. Flying fish constitute one of the hazards and at least one racer has been upset by a collision with one. Riding into a kelp bed, another entrant suffered a leg injury. Accidents abound along "suicide stretch," an eight-mile run in mid-channel between the island and the mainland. Here the prevailing winds meet the prevailing current and the sea fairly boils. The coast guard cutters and navy planes patrolling the course keep a sharp eye on this stretch. The unofficial record for the run is one hour and sixteen minutes, made in 1935 by Jack Burrud.

Regular surf riding, as old as the Polynesians, has undergone many changes in recent years. This is particularly true of the boards. Along famed Waikiki beach, Tom Blake, American champion, has introduced many innovations and these have been brought back to the mainland. The boards have grown longer and narrower, and, with the introduction of new woods, much lighter. Moreover, Blake has hollowed out their centers to give them greater buoyancy and make them more manageable. The larger boards range from

fourteen to twenty feet in length and weigh as much as 130 pounds.

Formerly, a board was headed directly into shore and at right angles to the wave. Today, the topnotchers "slide" down the wave diagonally. Experts say this gives more speed and greater distance. An adept surf rider paddles with sweeping arm strokes out to a location beyond the breakers and sitting astride his board, waits for the wave that will carry him farthest. Hawaiians have a saying that waves run in series of threes and the last is generally the fastest and largest.

As it approaches, the rider lies prone and paddles shoreward at top speed, waiting for the moment when the lift of the board tells him the wave is with him. Proper balance and the final flick of the cupped hands will usually send him speeding down the forward slope. Balancing, he guides the board by shifting his weight. He increases his speed and the length of the ride by steering across, rather than with the line of motion of the wave. This sliding makes it possible for the surf rider to travel twenty-five or thirty miles an hour—faster than the wave itself. On he soars, sometimes half a mile.

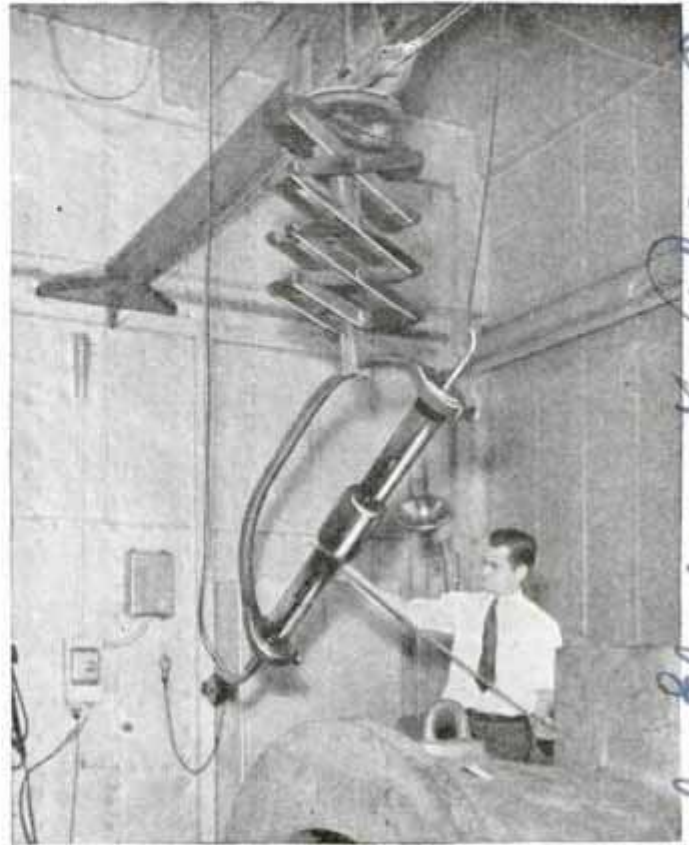
The experienced rider scorns the easy prone ride. He likes to do tricks. Commonest of these is the standing ride; less common, the head stand, and least common, the tandem where one rider carries another on his shoulders. Then there are beach boys who change from one board to another while they are skipping along at a dizzy speed. This is great fun—if your insurance is paid up.

Time for Next Dose Is Shown on Prescription Bottle Top



When is the next dose of medicine due? You have only to glance at the "hour cap" on the prescription bottle to know. Raised numerals on the bottle cap designate the hours of the day and a tiny steel bearing is inserted in a ribbed groove at the hour when the next dose should be taken.

X-Rays "See" Inside Plants or Big Steel Castings



Big X-ray equipment testing steel for flaws in its inner structure

Delicate details of flower petals or the inner makeup of huge steel castings may be studied with the aid of opposite varieties of X-ray equipment. Many inner details of flowers can be photographed with a new apparatus which utilizes a low-voltage transformer and a special thin glass window that allows extremely "soft" X-rays to pass from the tube and make impressions on the film. Soft, or low-voltage X-rays must be used on such delicate subjects because rays of ordinary voltages would penetrate almost completely, resulting in loss of many details on the negative. In examining heavy steel castings with X-ray equipment, gas pockets, shrinkage areas and internal cracks can be distinguished, if present. In the General Electric laboratory, 400,000-volt equipment is used for such studies in steel to show internal structure of a section of the metal five inches thick.

Cement for splicing movie film is now available in a fountain-pen type applicator holding enough for 1,000 splices and sealed against evaporation when not in use.

'Safety Sallys' Guard Children at Intersections Near School



Since this smiling troop of "Safety Sallys" was posted at Long Beach school crossings last January, there have been no accidents

"Safety Sally" has proved such an efficient protector of school children that she has been officially adopted by the city of Long Beach, Calif. Originally sponsored by a club, the troop of Safety Sallys was stationed at school crossings throughout Long Beach last January 1, and there has been not a single accident at the crossings since.

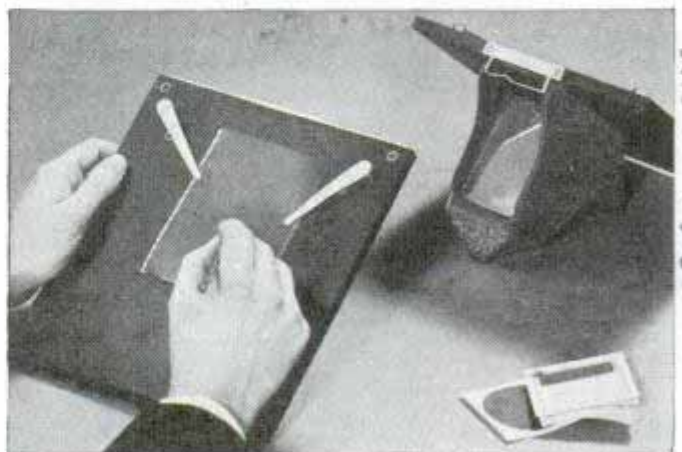
Milky Way Is Not So Crowded There's Danger of Collision

When you gaze at the Milky Way you wonder how the stars get around without serious collisions in such dense traffic. They seem to be packed like sardines, yet there is really plenty of room for them to travel their circuits without bumping. In

fact, the chances of any two colliding are far less than the chances of two billiard balls meeting if there were a dozen or so floating at random inside a hollow sphere the size of the earth! Or put it another way: two small boats put out to sea, one from Australia, one from New York. The captains sail without charts or destinations; their chances of the boats bumping into each other are very slim. Yet they would be far more "crowded" together than any two stars.

Retoucher's Panel Reveals Defects of Negative

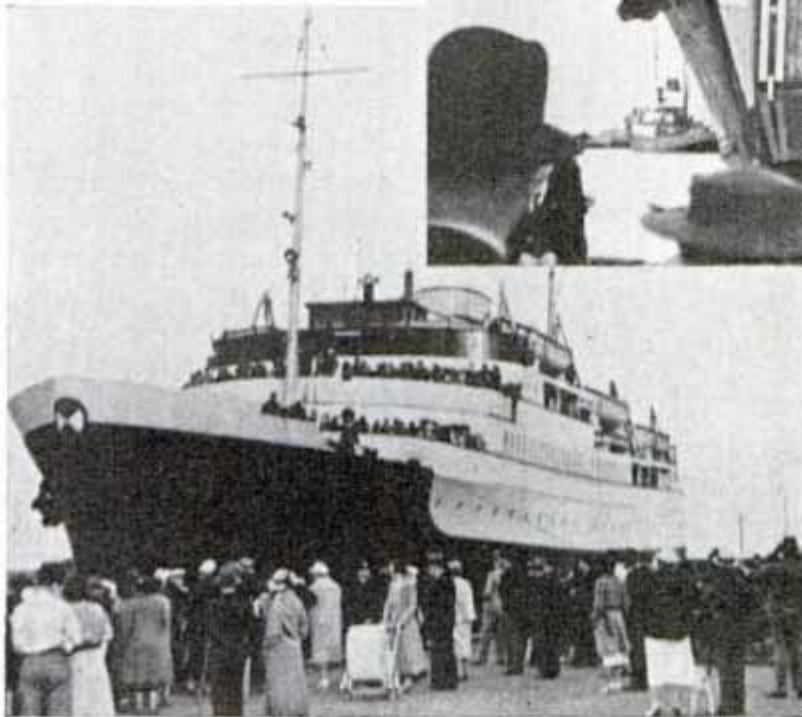
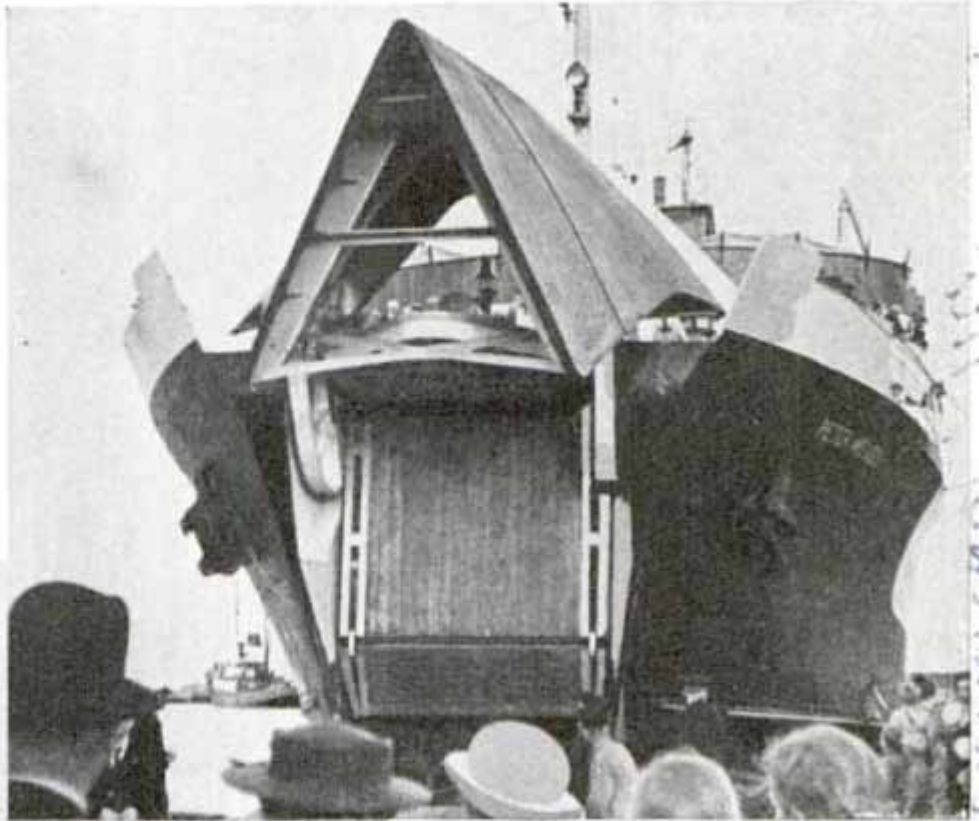
Defects such as pinholes and tiny scratches on the photo negative are spotted instantly with the aid of an illuminated panel just put on the market. Two spring fingers are adjustable to hold various sized negatives over a glazed circle. When placed over a light, the circle is brightly illuminated and the operator can retouch the negative while it is held in a convenient position on the panel.



Touching up defects in photo negative with aid of lighted panel which shows up tiniest of scratches

Denmark and Larvik Norway
Ferry Opens Its "Jaws" to Lower Gangplank

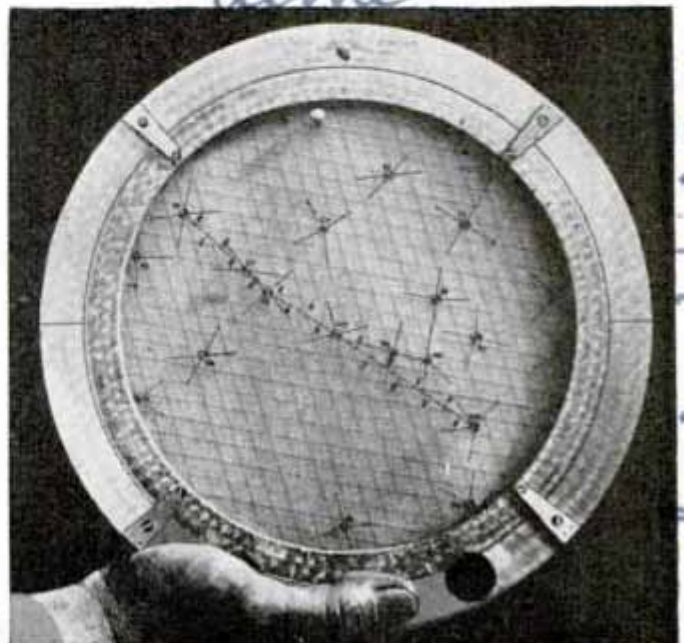
Below, the "Peter Wessel," North Sea ferry, with its prow in conventional position. At right, the vessel noses into its dock and lifts its bow to lower gangplank for passengers and automobiles



Opening like the jaws of a sea-going monster, a European ferry lifts its bow high and wide to make way for the motor vehicle and passenger gangplank. The novel arrangement is on the "Peter Wessel," a streamline ferry operating across the North Sea. Cabins and staterooms are furnished with aluminum furniture decorated with bright fabrics.

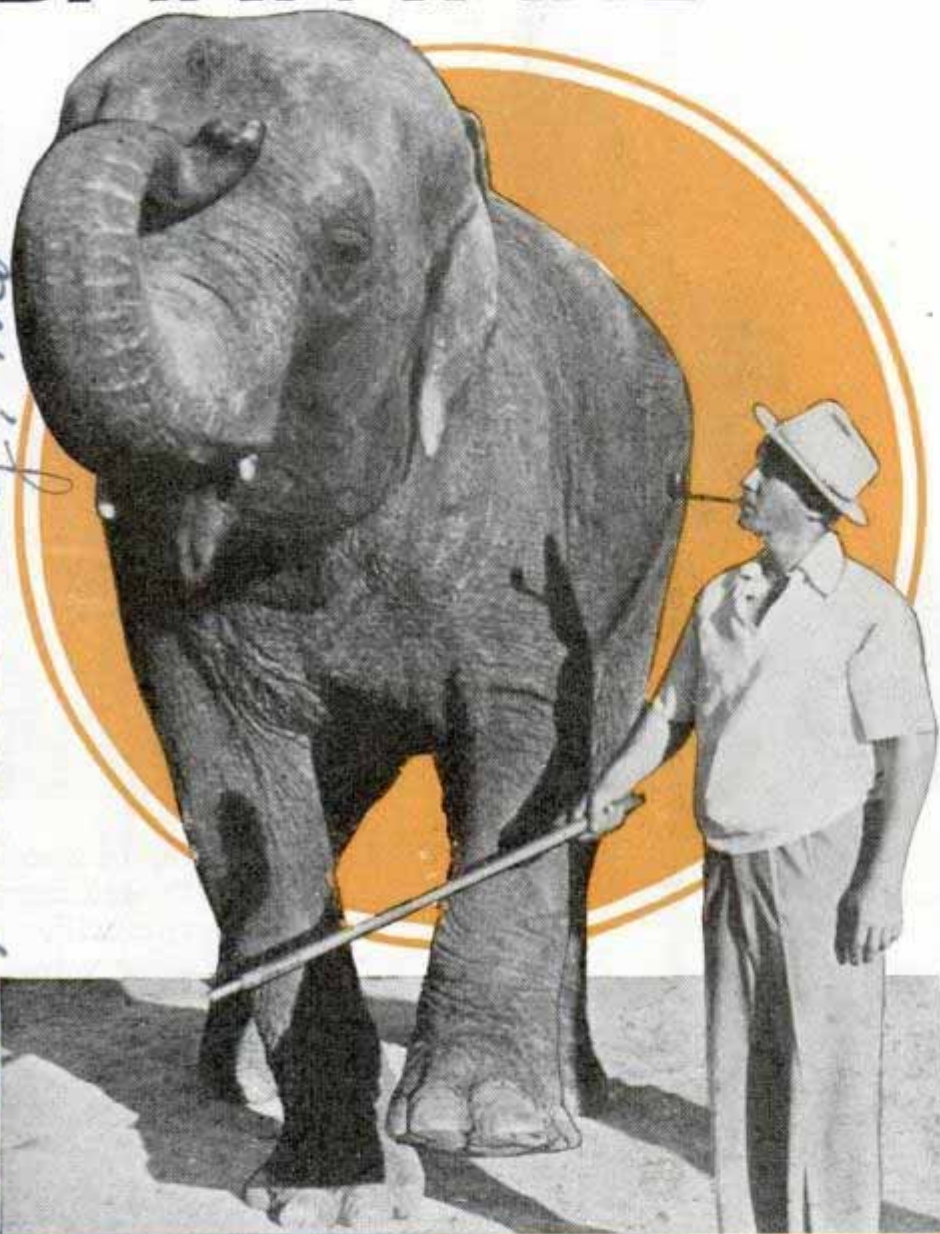
H642
Simple Airplane Position Finder Is Useful to the Pilot

Airplane pilots are expected to find useful a newly invented position finder perfected by an experienced aviator. It consists of a circular frame containing three movable disks. A map of the route being followed is placed in the upper disk. The other two disks are marked with parallel lines conforming to the map scale. Frame of the device is marked with points of the compass. After the map is orientated to the compass course, the pilot tunes in a radio station and uses those bearings to line up one disk bearing parallel lines. Another station is then tuned in, and its bearing is used to line up the other disk bearing parallel lines. Where these lines intersect is the position of the plane.



Denmark and Larvik Norway
same
Dr. J. Horace Stark

BARNYARD WIZARDS

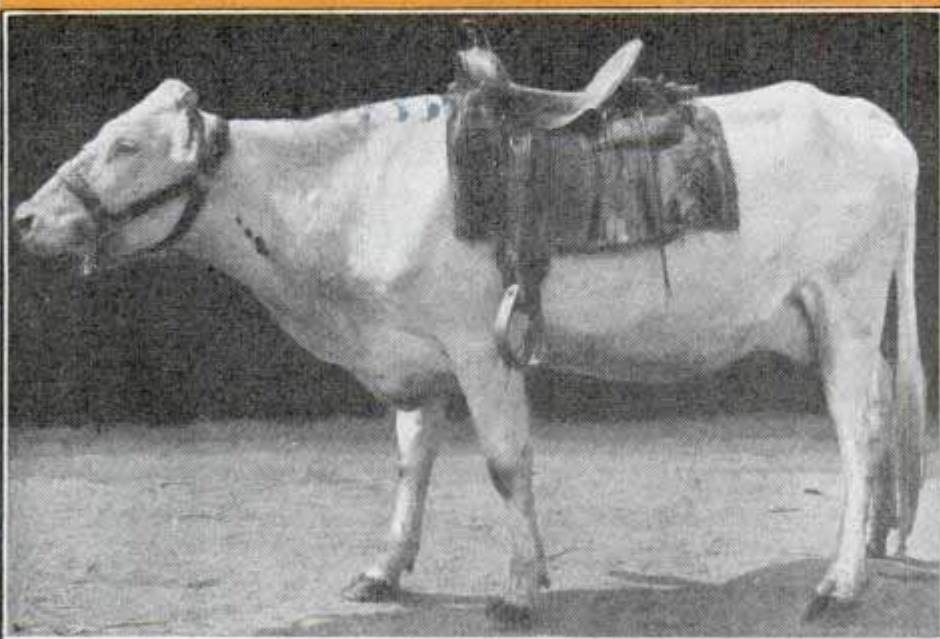


WHEN a "live" requisition reaches the property chief's desk at Paramount studios in Hollywood, Russell Pierce never knows what a director may want. That's why he is ready to produce anything from a cross-eyed cat to a herd of mountain goats.

At his fingertips he has the names of all the animal specialists in the film capital. Dogs constitute the biggest percentage of animal rentals and a dozen kennels are engaged in developing and supplying canine screen talent. The big training schools have fifty or sixty educated dogs of all breeds on tap for studio calls, and within an hour any of them can round up another hundred extras.

Canine performers are typed just as are human actors. For a homey picture, a mutt dog is used; the atmosphere of a drawing room can be impressed on a movie audience with two slinky Russian wolf hounds but in a mystery thriller, there's nothing like the sudden appearance of a Great Dane to scare the daylights out of the detective—and the audience. Formerly dog colleges carried Scottish deerhounds, schipperkes and other unusual breeds in stock but calls for them were so rare that property departments today rely on private owners to supply the dog rarities.

When a dog receives an



Top picture © Paramount Pictures, Inc.

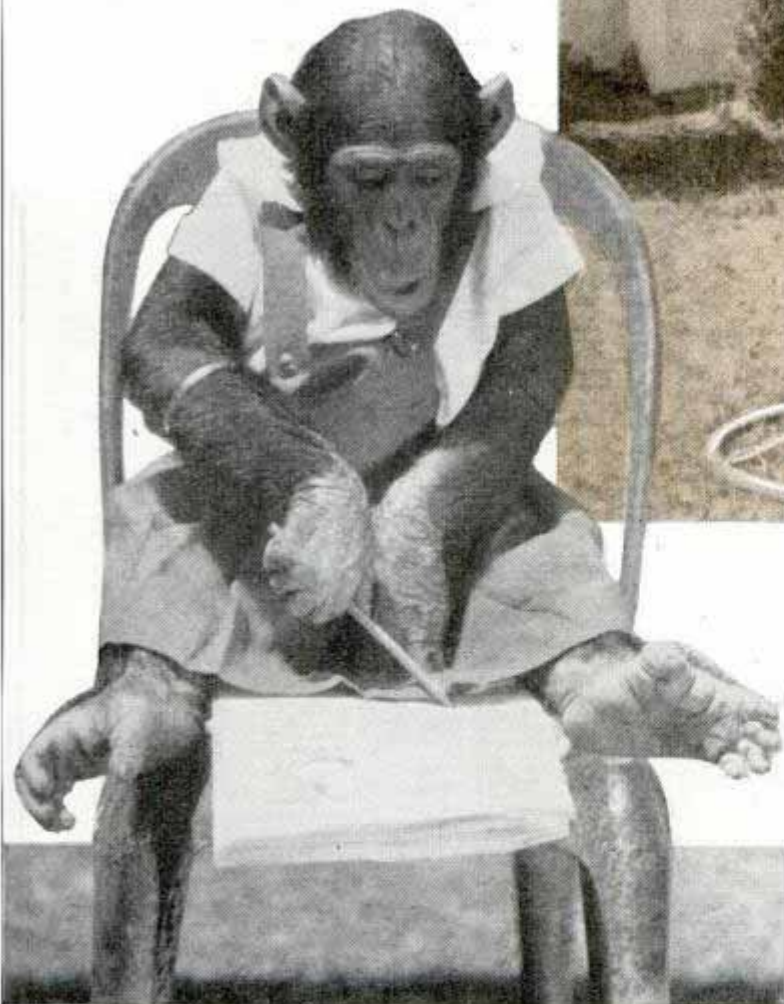
Bing Crosby tries his hand at training a trained elephant. Below, Whitey, a trained cow, has made \$12,000 during her years on the screen

Cont. James the Dull... 4/3/11... 60th
Harrison City, Mo.
Crosby

of the FILMS

important assignment, his trainer is given a copy of the shooting script so he may acquaint the dog with the routines. Otherwise, the dog is brought to the studio and the director explains what is wanted. Two or three times through the scene with his trainer and the dog is ready to rehearse with the players. Then the dog takes his place before the cameras. When the director says, "Cut," he knows the scene is ended and sits down or walks off the set to get away from the lights.

A trainer must rely on silent cues in directing a



Toughy, talented canine movie actor, being put through his paces by his trainer. Below, a talented baby chimpanzee of Hollywood

dog except when he can sandwich in a command between actors' speeches, which later can be cut out of the sound track. Hand signals are generally used. A palm held outward is a signal to stop, a beckoning gesture to move forward. The index finger revolved in a circle is the cue for a growl; one finger raised for a bark, and one finger down is a sign to get down on all fours.

Teaching animals to follow silent cues is not as difficult as getting them to work with strangers. In one scene a dog may have to regard one person as his master,



It was tailor-made for the situation, and scored a big hit."

Screen writers and directors frequently get new ideas during the actual shooting of a film and a dog must be equal to any last-minute script changes without prolonged rehearsal. One writer thought it would be a novelty to have a dog sit up and clap his paws with glee and was disappointed to learn this was an anatomical impossibility. The script of one picture called for an actor to go up to the front door of a home and wipe his feet on the mat. Corky, a mutt, following at his heels, was supposed to do the same thing. The director thought he would be lucky to make the shot in a day but he didn't reckon with Corky. His second try was letter perfect. Shooting time, twenty minutes.

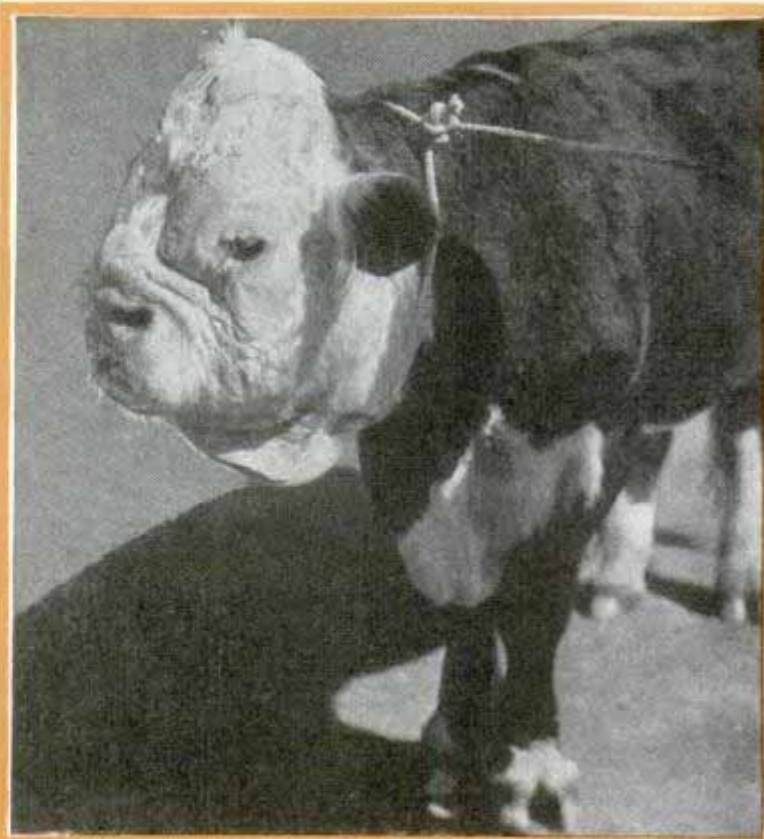
others as his master's friends, and, perhaps, some other player as his mortal enemy. Later in the same picture, the whole order may be reversed. Often as not, a villain whom a dog is supposed to dislike in a picture will unwittingly complicate matters by petting and praising him between scenes.

Apart from their general education in acting, film dogs are given a thorough grounding in such stunts as scratching, yawning, "praying," assuming various positions and holding them, and picking up designated objects. Some, too, have their own specialties and one of these is Skippy. Whenever the terrier's ear itches, relates Henry East, his owner, he puts his head down and circles. East decided the peculiar action had the makings of a good gag. After some coaching, all he needed to say was, "Go crazy, Skippy," and the dog would go through the stunt.

"In the first Thin Man picture," East explains, "Nick, the leading character, was giving a party in his apartment for his 'bum' friends. The dog was supposed to stick his head in the front door and then run. I explained Skippy's specialty to the director, so the script was changed to have him take a quick look at the guests, dash into a bedroom and go into his crazy act.

Perhaps you've wondered how those cute expressions dogs assume in pictures are obtained. Trainers use lures—sticks, old shoes, rubber balls, and other play items.

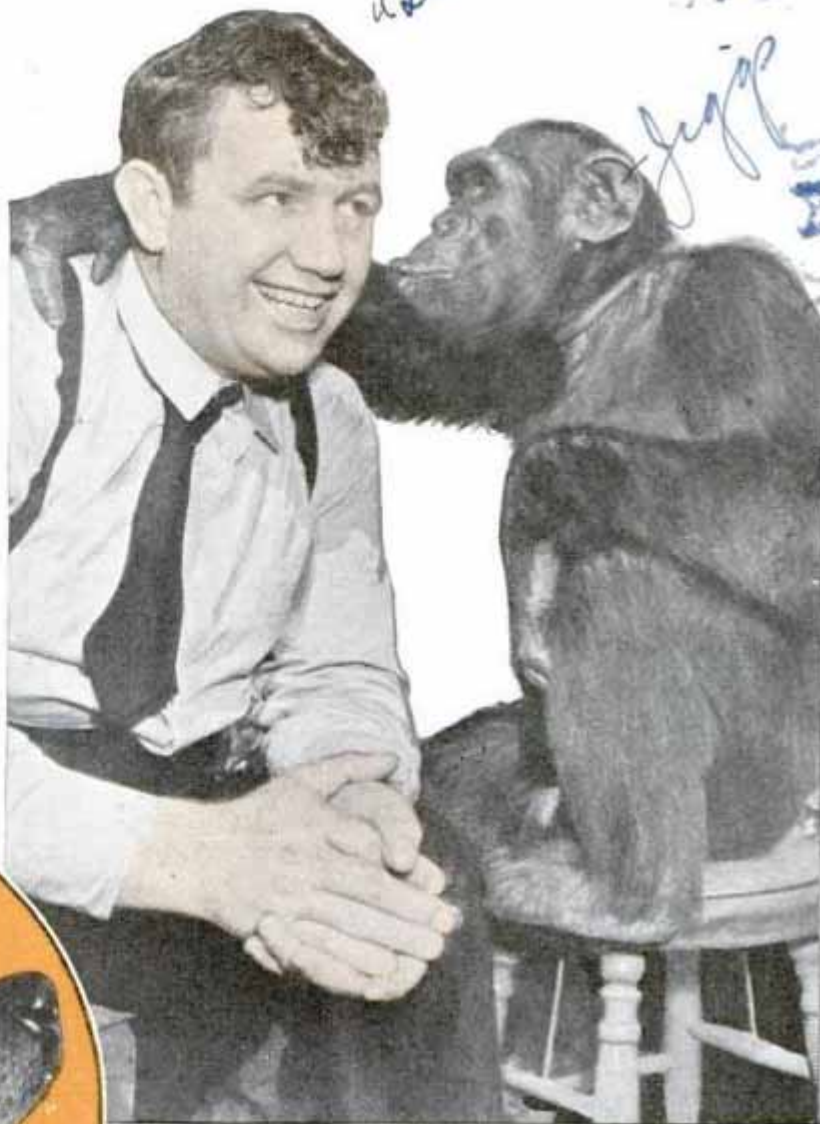
"If a director," points out East, "wants to make a shot of Skippy with a puzzled



This animal's face is worth \$25 a day in comedy sequences. Above, a pair of actors before the camera

look, head cocked to one side, we can get it with the help of a rubber mouse—the lure. The mouse is Skippy's favorite play toy. Skippy is placed in position and, putting his rubber mouse in my pocket, I squeak it a few times. He hears the sound but doesn't know where it's coming from. He becomes puzzled and looks it. If a dog is to chase a man, we have the actor place the dog's play ball in his pocket and run."

Dog salaries vary according to the dog's ability and the part. Outstanding performers are paid from \$125 to \$200 a week and for piecework, a minimum of \$3 and a maximum of \$25 a day. Fre-



A Hollywood chimpanzee whispers sweet nothings to Andy Devine. Left, Prince, a Great Dane movie star *The Country Beyond* frequently a dog collects a full day's wage for merely spending a minute or two before the cameras.

Great Danes pick up extra work by doubling for tigers in the long shots of animal pictures. With a false head and a paint job supplied by the make-up department, a Great Dane becomes a tiger. If a tiger is supposed to get loose in a circus tent, a close shot is made of a tiger hopping out of a cage wagon into the open arena, which, of course, is simply a larger steel enclosure. The dog carries on from this point.

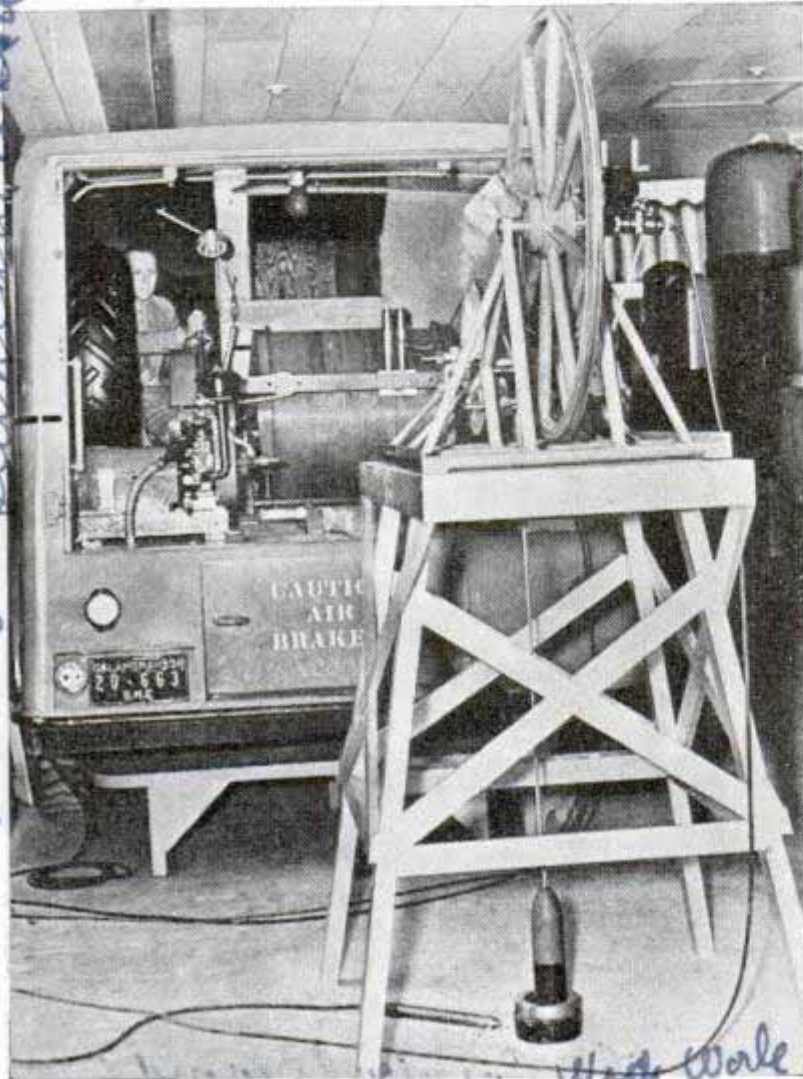
The zoological parks, animal farms and circuses supply elephants, lions and tigers. Some of the latter have been "killed" dozens of times. In virtually every jungle film some tiger is supposed to be dropped by a native's spear. Screen technicians have a number of ways of obtaining this effect, the most common being with a strip of



Scene from a comedy which was made with an all-barnyard cast of characters

(Continued to page 119A)

Electric Line 'Fishes' for Oil Hidden in Deep Earth Pools



Dropping electrode into well to "fish" for oil. The hidden pool can be located by taking electrical readings

Oil men go "fishing" with an electric line in search of hidden petroleum pools deep beneath the earth's surface. In this new prospecting method an electrode is lowered into the oil well, and a second electrode is plugged into the surface. By readings of the electrical potential and impedance, the operator can determine the location of the pool.

"Canned Energy" from the Sun Is Goal of Research Scientists

Conversion of the sun's energy into power to operate man's world, or storage of that energy for future use, is the goal toward which research scientists at Massachusetts Institute of Technology will shortly bend their efforts. Dr. Karl T. Compton, president, in announcing receipt of a gift of \$647,700 for the project, pointed out that the sun pours an average of four

million calories of heat daily into every square yard of the temperate zones. In the three months of maximum sunshine, he said, each acre of land receives from the sun heat equivalent to that produced by burning about 250 tons of coal. Scientists believe that means can be found through chemical, electrical and mechanical studies to harness this tremendous energy. At Harvard University, research workers are studying the possibility of speeding up growth of trees.

63-Pound Quartz Crystal Unearthed in Brazil

One of the largest and finest quartz crystals ever to enter the United States has just been brought from Brazil. It weighs sixty-three pounds and cost eighteen dollars per pound. Based on optical quality, experts believe the crystal surpasses any museum piece of this type in the country. Although quartz, a form of silica occurring in hexagonal crystals, is distributed throughout the world, no deposits of suitable optical quality have been found in the United States. Brazil is the chief source of supply. The giant crystal is now in the vaults of Bausch and Lomb, an optical company which uses quartz crystals for



Measuring and testing huge quartz crystal recently brought to the United States

Developed by Halliburton Co. Houston, Tex.

Cambridge Mass.

H 611

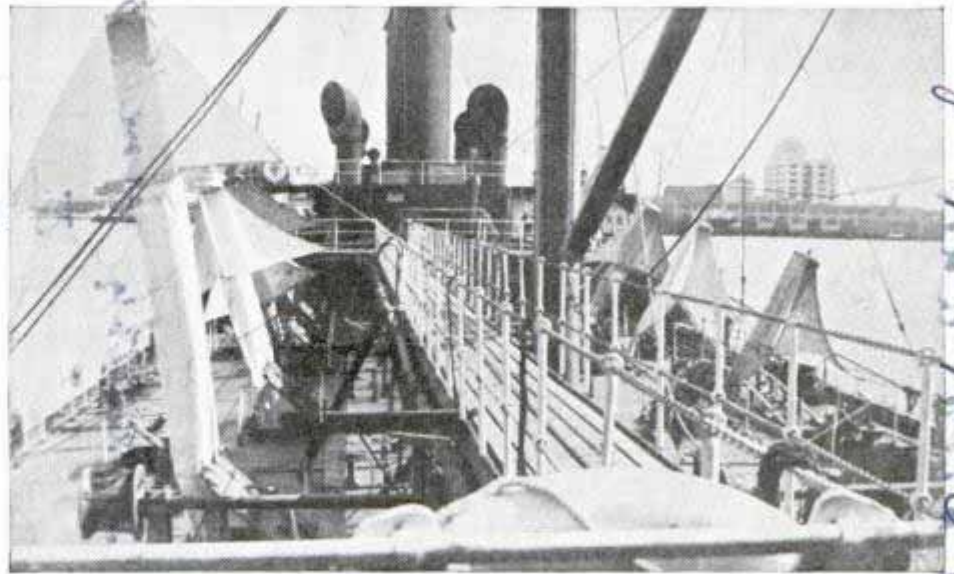
H 618

W. S. Work

626 St. Paul
Rochester, N.Y.

lenses and prisms. Quartz crystals are employed because of their high transparency and the superior resolution obtained with this material in the shorter wavelengths of light. The shorter the wavelength, the greater the resolving power. Although the microscope is now equipped with special ultraviolet accessories, it is in spectrographs, spectrometers and monochromators that the chief necessity for quartz optics exists. Biologists, cytologists and histologists benefit by the use of quartz accessories for the microscope because of the ability to differentiate better between various cell and tissue structures, while the spectroscopist utilizes quartz instruments in detecting various elements whose identifying lines lie in the ultraviolet portion of the spectrum.

Tanker Frees Self of Fumes for Safety While under Repair



While oil tanker stands off a safe distance from harbor shipping, air is forced into tanks to drive out explosive gas before beginning repairs

Danger of explosion necessitates the utmost precaution to free an oil tanker from gas fumes whenever repairs are made on the ship. When an oil carrier was rammed by another vessel while carrying gasoline and other highly inflammable cargo, the damaged tanker had to return to port and discharge all her cargo, then put out to sea to gas-free by forcing air into every tank, ventilating thoroughly. Then the tanker could return to dry dock for repairs. Welding operations are perilous if all the gas has not been expelled.

Bombing Planes Drop Flares to Light "Blackout" Area



Bombers spot their target by light of flares. Army camp can be seen at right and searchlights of anti-aircraft guns in left foreground

Flares dropped from army planes shed an eerie light over the region of Farmingdale, Long Island, during a test "blackout" while "invading" air squadrons bombarded the coast. With all lights in the area extinguished, U. S. air corps bombers flew high overhead and made photographs by the light of the flares to determine the accuracy of their "bombing" aim

Our Bureau of Information will answer questions regarding articles in this magazine, if accompanied by return postage.

Washington, D.C.

Tractor Tire Is Knife-Edged for Better Steering in Mud

Smith King



Inch-deep rubber flange on front tires of tractor prevents side-slipping and improves steering. Tires do not pick up mud

Knife-edged tires are being installed on the front wheels of tractors to make steering easier, allowing sharper turns and preventing sidewise slipping. This new tire has a one-inch flange of rubber projecting out from its center, but is otherwise smooth. It does not clog with soil.

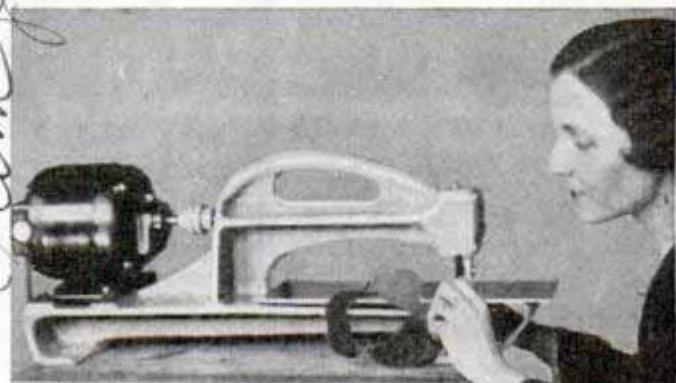
employs the force of vacuum to withdraw fuel vapors, acid vapors and blowby gases from the crankcase and discharge them into the intake manifold to be remixed with the gas and returned to the cylinders as fuel. Oil vapor from the crankcase is also used to lubricate the cylinders by feeding it back through the intake manifold.

Earth Is No Perfect Sphere So Gravity Plays Tricks

Because this earth is not a perfect sphere, gravity plays strange tricks. A plumb line does not always point exactly toward the center of the earth, and astronomers must take this into account in making observations of the heavens. Variations from the true sphere affect variations in gravitational force, a fact which is strikingly revealed by changes in the rate of a clock timed by a gravity-pendulum if it is moved to different parts of the world.

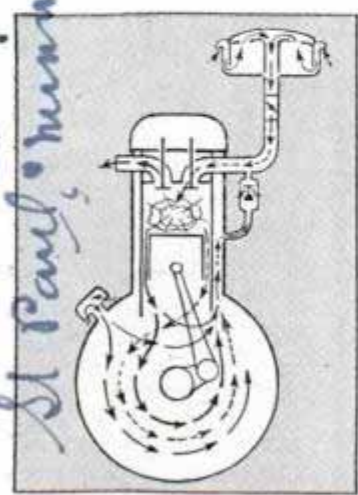
Power-Driven Metal Jig Shear for Cutting Sheet Steel

Its upper knife reciprocated at high speed by a quarter-horsepower motor, a jig shear offered at moderate price cuts eighteen-gauge sheet steel. Compound curves as small as a one-inch radius can be cut easily. The two knives are of hardened tool steel, the lower blade being retractable below the worktable to enable starting and completing inside closed holes of any shape without a previous starting hole. Both knives are two-edged and reversible.



Cutting design through steel with jig shear whose upper blade is driven by quarter-horsepower motor

Positive Crankcase Ventilation Prolongs Engine's Life



Dependent in no way upon the speed of the vehicle for its effectiveness, a new system of crankcase ventilation is said to prolong engine life by aiding in prompt evaporation of raw fuel and removal of gasoline, water and acid vapors.

Installed between the crankcase and the intake manifold on the engine, the system

St. Paul, Minn. 66 Pelham St. 609

See monthly June 1938

article by A. See he met, Sept. 1938

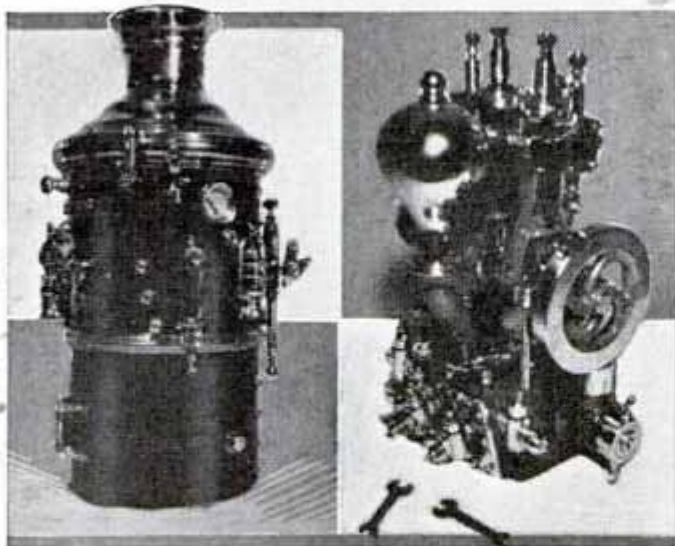
Power Jig Shear

Tiny Fire Engine Hurls Twenty-Foot Stream

Reminiscent of the dashing days of horse-drawn fire engines, a working model built by two Cincinnati electricians from a picture of one of the old "Continental" engines throws a twenty-foot stream of water from its one-sixteenth inch nozzle. The model builders, Fred Batsche and Carl Doll, worked eight years on the miniature and turned out every part except the steam gauges. Constructed on a two-inch scale, the vehicle is twenty-



Top, the model builders with the "works" ready for assembling on chassis. Left, the completed twenty-eight-inch fire-engine model. Below are the boiler and the engine and pump



eight inches long, seventeen inches high at the stack and eleven inches wide; with shaft and team it measures four feet from tip to tip. Every part operates as it did in the "granddaddy" of fire engines. The boiler is coal or blowtorch-fired, taking ten minutes by the latter method to raise fifty pounds of steam. Its capacity is 100 pounds

steam, and the pump can supply four hose lines. The boiler has safety valve, steam gauges, whistle, water glass and innumerable valves. The nozzles deliver water at thirty pounds pressure.

Flashlight with a Flexible Neck Reaches around Corners

Its bulb at the end of a long, flexible neck, a flashlight just introduced can look around corners and throw light in inaccessible places. The neck is made of flexible conduit and will bend in any direction. This neck is removable, and a regulation head can be attached to the battery case, if desired.



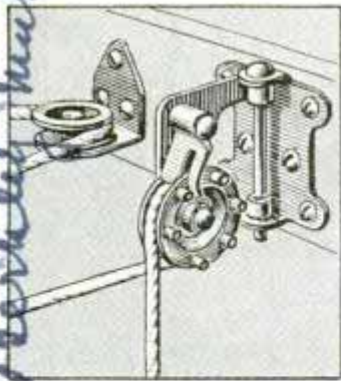
Fence Is Made of Auto Wheels from Wooden-Spoke Days



This garden fence at the rear of a San Antonio home is made of wooden-spoke wheels from early autos

It took some time to collect the material for the back-yard garden fence at the home of C. A. Givens in San Antonio. He built it of discarded Ford auto wheels from the days of wooden spokes, and some of the wheels were still on the early 1920 models when he found them.

Handy Clothesline Stretcher Prevents Knotting



Eliminating knotting and tangling, a clothesline stretcher now on the market saves time and saves the line on washday. It consists of hook, pulleys and master pulley which support the line without sag. The master pulley is used for taking up slack in the line. It may be removed when not in use.

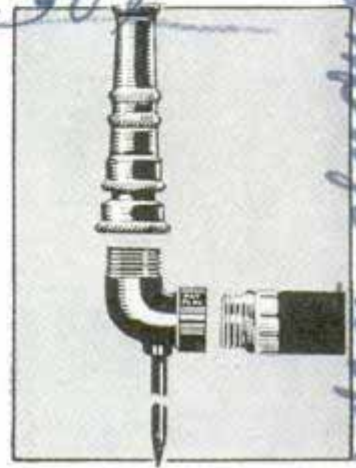
News on Star Is Ancient History Before It Reaches Earth

It may be news on earth, but events on the stars are ancient history when they are rushed here by telescope. Because of the time light takes in traveling from the stars, the facts of astronomy printed in our textbooks deal not with the universe of today but the universe as it existed millions

of years ago. The star you see through an observatory "eye" may not be there today. Even when an astronomer discusses conditions on the nearest neighbor star, he must wait four years to learn whether the star was actually existing when he discussed it. It is as if news from Europe took four years to reach us and the daily newspapers recorded as events of today what happened back in 1934.

Hose Converted into Sprayer by Inexpensive Elbow

For converting the garden hose into a sprayer, an inexpensive elbow of aluminum alloy is on the market. The purchaser uses his own hose nozzle and hose. A spike attached to the elbow permits setting the hose on lawn, terrace or rock garden, in vertical or inclined position. The elbow will not corrode.



Exposure Meter Worn on Wrist While Sighting Camera

For fast shooting, an exposure meter worn on the wrist like a watch gives a quick reading while both hands sight and focus the camera. The one-dial meter shows relationship of film speed, stop and exposure time at a glance.



With the meter attached to your wrist, figuring proper exposure is a quick prelude to snapping picture

Cleveland Ohio
50 Church St. New York

619
643
Paul from Hassan

Odd Pineapple Harvester Speeds Field Work



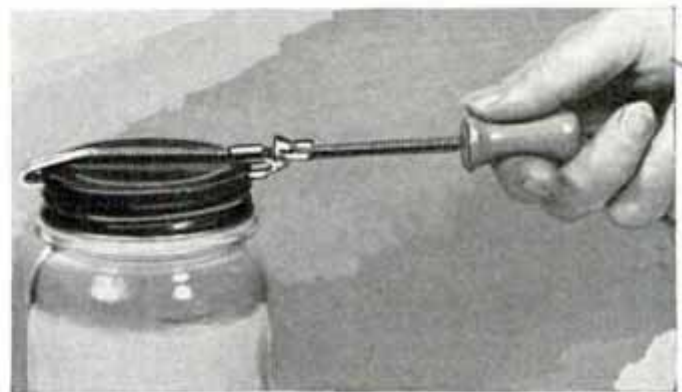
Strange-looking vehicle in pineapple field straddles the plants. As shown, the driver sits sidewise to watch loading and the path his machine is to follow. The vehicle speeds harvesting

Methods of harvesting Hawaii's pineapple crop may be changed radically by a field carrier which can be driven through the fields over rows of ripe fruit. The motorized equipment enables growers to banish the drudgery of having heavy bags of ripe pineapples carried long distances on men's backs. The carrier is powered by an eight-horsepower engine and is equipped with four wheels on which are mounted nine-inch soft balloon tires. Power is applied through a single drive wheel which extends out in front so that it may follow the middle of the inter-row. When the operator is running on a straight course, a locking device causes the offset castor wheel to follow the course without wobbling. The locked wheel is released automatically when the driver makes a turn in either direction in excess of a predetermined angle. The wheel base is ten and one-half feet and the tread six feet. The steering gear turns the wheel 110 degrees in either direction, so the machine can be reversed in its own length on narrow field roads when it reaches the end of a row. Fruit is put on carriers, which stick out behind like squirrel tails. Each carrier

consists of a metal trough holding an endless belt. Workers lift the topped fruit to the carrier and men standing in catwalks on either side of the truck then place the fruit into boxes. Four tracks lengthwise of the machine hold about one ton of fruit.

Adjustable Bottle-Cap Opener Fits Lids of All Sizes

Whether that sticky cap is on a half-ounce bottle or a gallon jar, an adjustable cap remover just introduced will take a firm grip on it. A wing nut adjusts the saw-edge clamp to a tight hold.



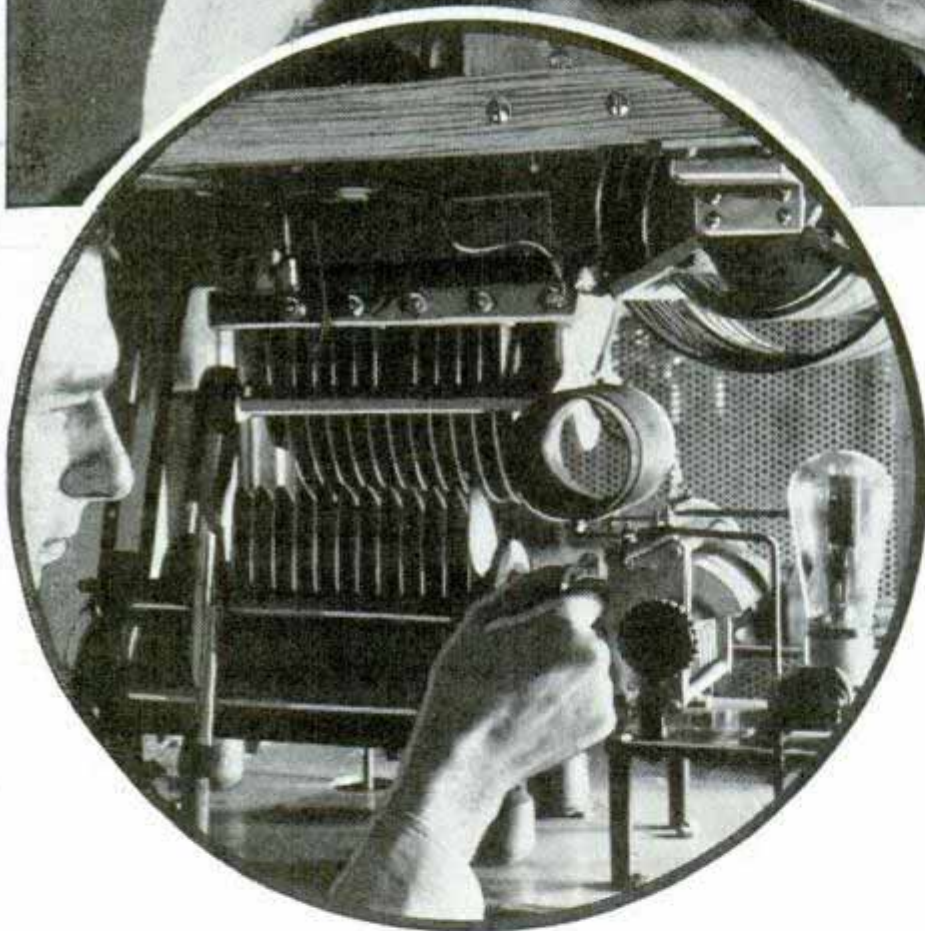
Wing nut adjusts clamp to width of bottle cap

Casadena Calif
 used by Hawaiian Pineapple

The

MIRACLE MEN

*Press Division, National
Broadcasting Co.
2 C. A. Golds Radio City, N.Y.*



Top, handling big rectifier tube with asbestos gloves. Bottom, station engineer placing emergency clip lead on control apparatus at WEAF

for the radio broadcasting industry must function without interruption.

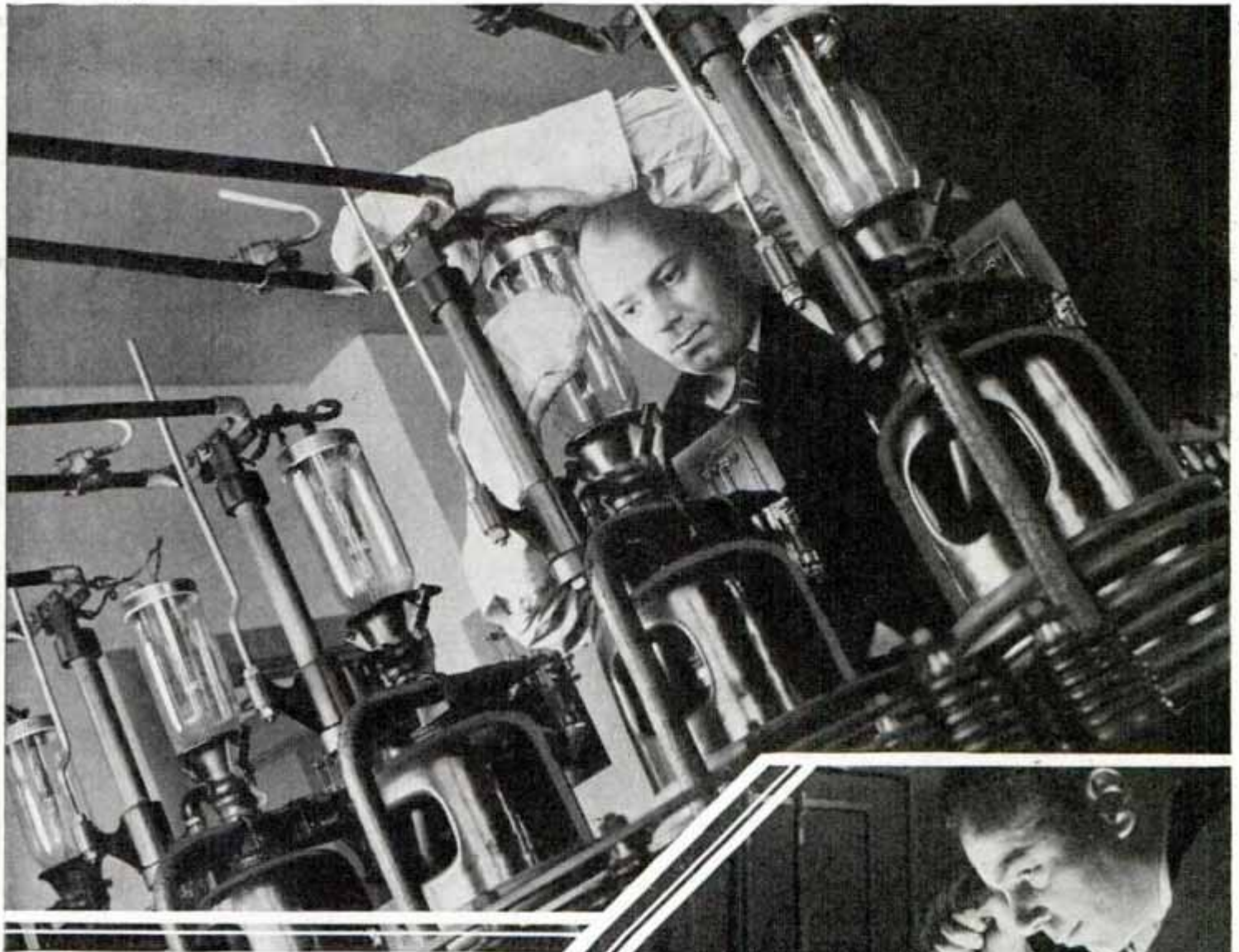
During 1937, WEAF's time off the air due to equipment failure was three minutes and twenty-nine seconds out of 6,380 hours and twenty-four minutes. Only ten seconds off the air were chargeable to personnel errors, giving an efficiency of 99.9992 per cent.

WHEN the transmitter staff of Station WEAF, on Long Island, recently received a trophy for a 99.9992 per cent record of efficiency during 1937, radio suddenly remembered its half-forgotten men.

They are the super-sleuths, engineers and vigilantes who stand behind your radio programs. Theirs is the task of caring for a temperamental mechanism whose working parts are as sensitive as those in a fine watch. A highly important task it is,

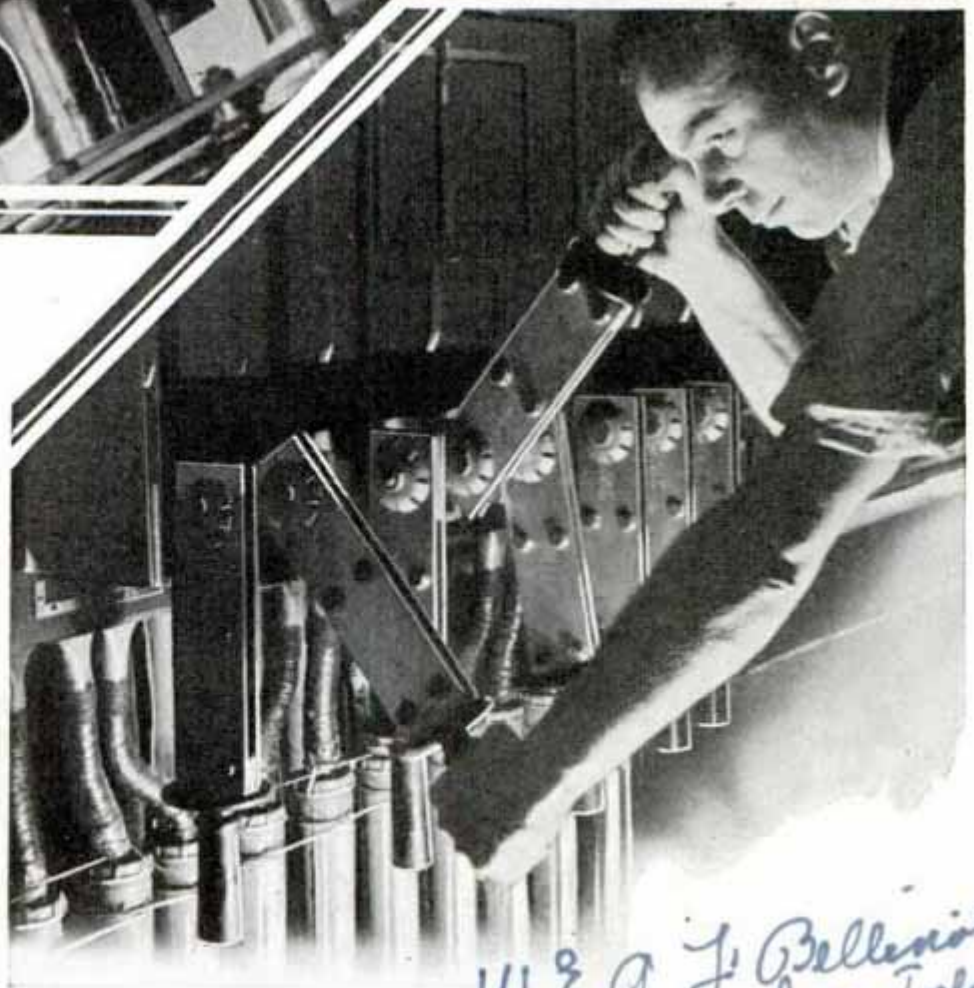
Railroads pride themselves on a ninety-five to ninety-eight per cent average in arrival and departure accuracy; air lines, on an efficiency of ninety-three to ninety-nine per cent. No other form of communication or transportation has attained the efficiency ratings of broadcasting stations. In 1937, a total of 47,121 programs, totaling 16,838 hours, passed through the master control board of National Broadcasting company at Radio City in New York. Time lost due to

of RADIO

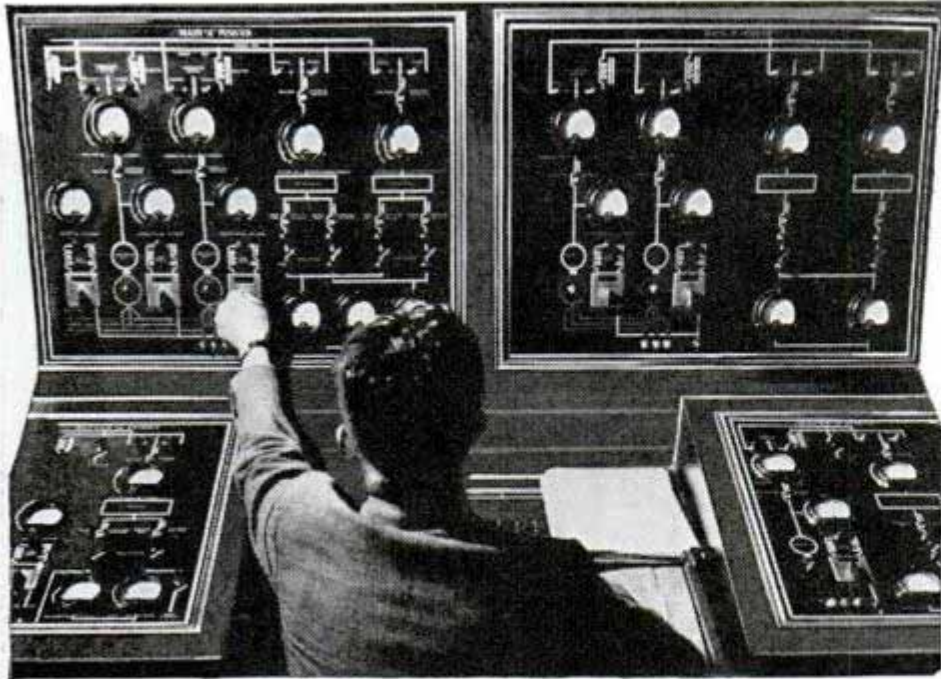


equipment failures totaled but thirty-two minutes, giving a 99.9968 per cent efficiency.

To run a modern 50,000-watt broadcasting station requires the most elaborate precautions possible. The aim of the engineers is to prevent trouble at its source, but failing that, they meet emergencies as they occur. Literally speaking, a particle of dust is sufficient to interrupt the operations of a station, and hence the first mandate of a boss engineer calls for cleanliness. In WEAJ's transmitter, the



*W & A J. Bellini
Long Island*
Top, changing power tube in transmitter station. Bottom, changing main filament machine switches at WEAJ transmitter station



relays are adjusted to a thousandth of an inch and an insignificant speck of dirt may cause breaks, noises, or low level in the transmission.

Attending a transmitter means a twenty-four-hour vigil for the engineering staff. The men work in eight-hour shifts, and two are always on duty. Functioning of the transmitter is reflected at once in meters, dials and gauges. If something happens, the men on watch spread an alarm which rings a loud bell on the outside of the building. Even after the WEAf announcer says "Good night" to the radio audience at 1:00 a.m. every morning, the transmitter staff may be found working.

completely. The station went off the air for several minutes before the emergency antenna went into operation.

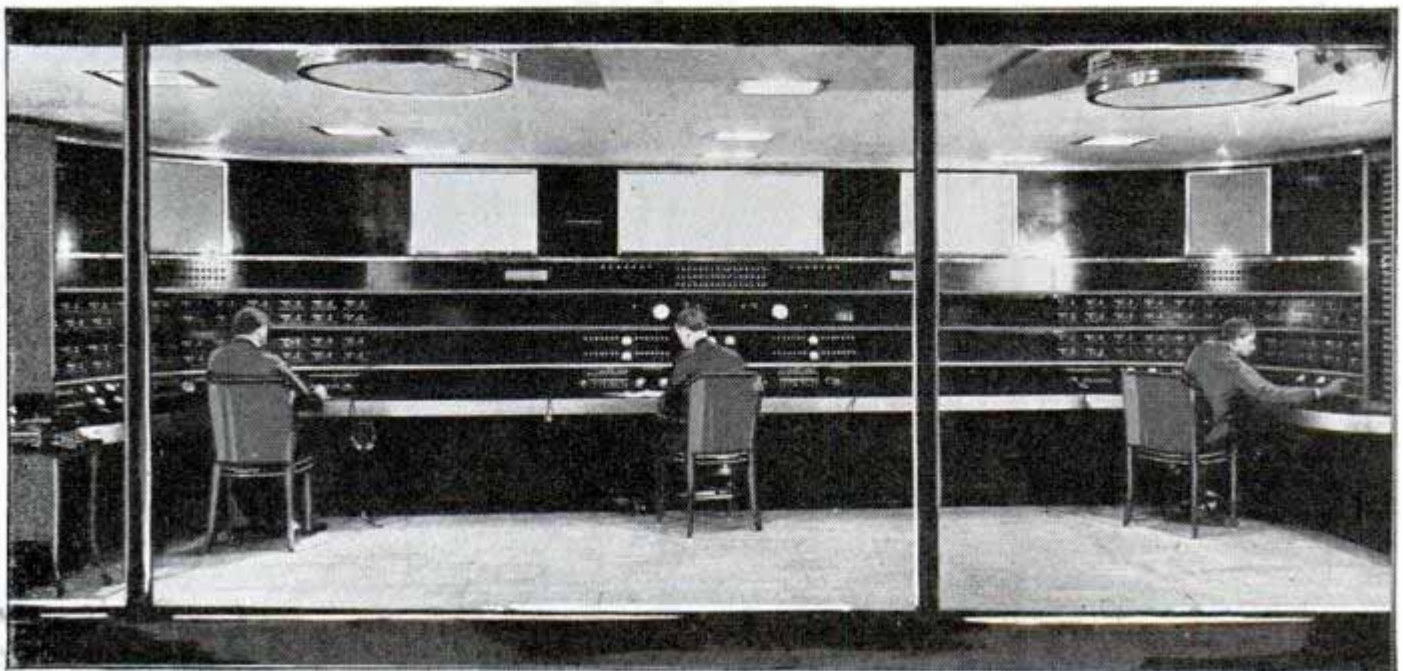
The pyrotechnic display around a radio station during electric storms seems to make such a place dangerous. Although the towers may attract lightning, a transmitting station is a safe harbor in an electric storm, since the antennas are ideal lightning rods and conduct the high-voltage shocks into the ground.

The Long Island transmitter is linked to NBC's Radio City studios by land wires. The nerve center or "bottle neck" of the system is the master control board. Leading to and from the master control board

Only during the night is it possible for many replacements and repairs to be made.

Many amazing things happen, despite all precautions. Once a bat flew through an open window and short-circuited the condenser plates so that they fused together. This kept the station off the air for eight hours.

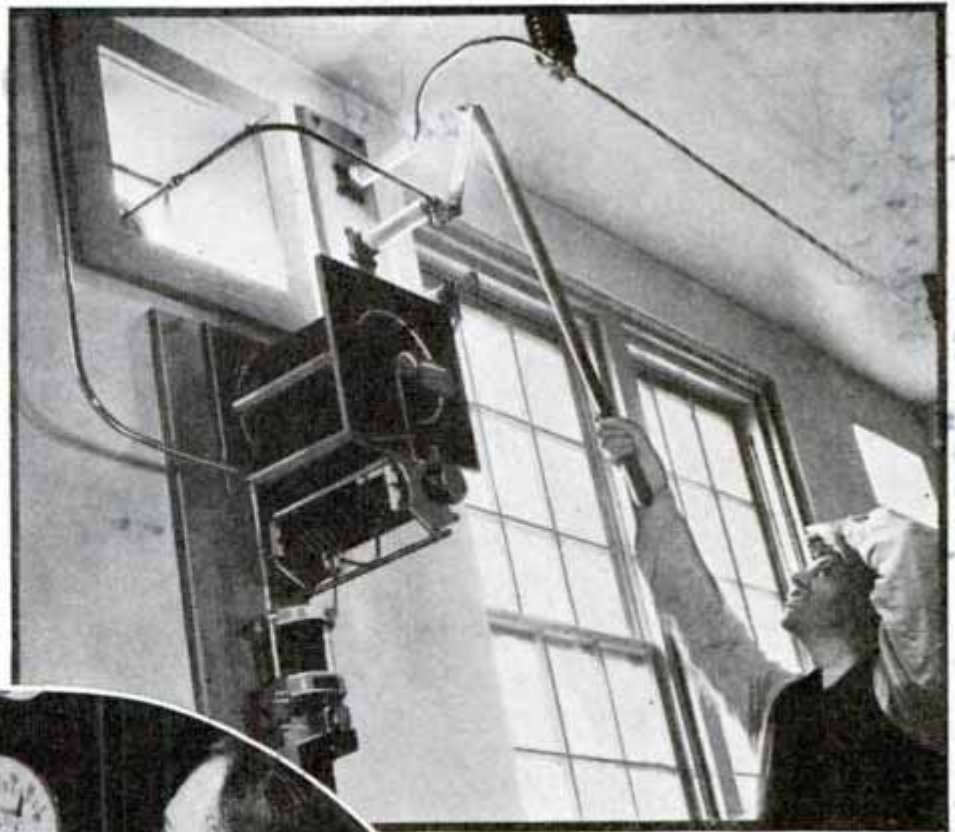
When the present transmitter was being installed, the contractor's truck, carrying a high case, caught the transmission line and carried it away



Top, power-room control board which regulates flow of electricity for broadcasting station. Bottom, master control board through which thousands of radio programs flow each month

are thousands of wires which convey the sensitive electric currents that make possible your radio programs.

Twenty vigilantes are assigned to the job of maintaining the studios at top efficiency. About 3,000 relays and 10,000 contacts in the switching system must be watched. Here again, a speck of dust can cause trouble. Nobody is admitted to the relay rooms, and the air is washed and purified



Photos courtesy National Broadcasting Co.

Top, throwing in antenna switch during thunderstorm. Bottom, throwing in power breaker and regulating filament machine rheostat

before it is admitted to the sanctums of radio. After the networks sign off for the night, the maintenance men go through the daily routine of "exercising" all relays and circuits to detect possible faults.

The eastern division engineer leads a hectic day-by-day existence. After a decade of doing this job, he has become more or less accustomed to such orders as "Set up an Australian circuit between 1:50 and

2:10 p.m." Or, "Arrange to broadcast from a stratosphere balloon over North Dakota." His job does not stop with the actual arrangements. He must take every precaution to guard against possible program failures.

In practice, the corps of vigilantes in the National Broadcasting company work on the theory that prevention pays. This is illustrated by Department File No. 323867-H. Every tube used in engineering operations is pre-selected at the factory, then checked by NBC. One day the engineer assigned to tube-checking rejected three tubes as defective.

Back they went. But the following week, the same three tubes turned up in a new factory shipment. They went back the second time.

"We give up," concluded the factory manager, "we put those three tubes into the second shipment to see whether you were really on the job."

When an emergency occurs, one of the

(Continued to page 121A)

Schenectady, N.Y.

Disappearing Tractor Lugs Retract within Rim

patd.



Top, cranking the retractable lugs out of sight within rim; below, the lugs fully extended

Lugs that disappear into the rim of the tractor wheel have been invented by a Wisconsin farmer. The long, spiked or wedge-shaped lugs are attached to the edge of a circular metal plate inside the wheel, so as to pivot freely. The plate is revolved by a hand crank, pushing out or withdrawing the lugs through slots in the wheel surface, extending out as far as five and one-half inches. The inventor found he could save both fuel and time with the retractable lugs, plowing considerably more ground with the lugs withdrawn than extended, on the same amount of fuel.

H677

X-Ray Inspects Your Groceries for Rot or Foreign Objects

Whether it's breakfast food or luncheon ham or sweet potatoes, your groceries soon may be labeled "X-ray analyzed." Already many oranges and grapefruit are inspected by means of the fluoroscopic screen for woody texture or incipient decay, and this method—used, too, to dis-

cover flaws in steel—is being extended to other food products. Tooth-cracking pebbles can be discovered in a shipment of salted nuts; foreign objects in breakfast foods and other packaged goods can be caught as they cast their shadows on the screen, and black-hearted potatoes are thrown out before they reach the customer. One fruit company using the X-ray to examine citrus fruits on the conveyor belt saved thirty per cent of suspected fruit that had been cast out on first examination but was proved sound by the X-ray eye.

H661

Quiet Portable Braille Writer Invented by Blind Youth

Weighing slightly more than five pounds in carrying case, a quietly operating Braille typewriter for use of the blind is easily portable. Developed by a blind youth in four years of working by touch, it is ten inches long, five inches deep and four inches high. The machine has six keys which operate simultaneously in combinations to perforate the Braille alphabet on special paper that is stored in a cylinder within the typewriter's base. Two other keys, which work the back spacer and tabulating mechanism, and a folding space bar, complete the operating parts. A bell warns the operator when a line has been completed. Speeds comparable to that attained on standard machines can be maintained on the Braille writer.



Blind person operating small typewriter designed especially for the sightless

may well
W. B. Water

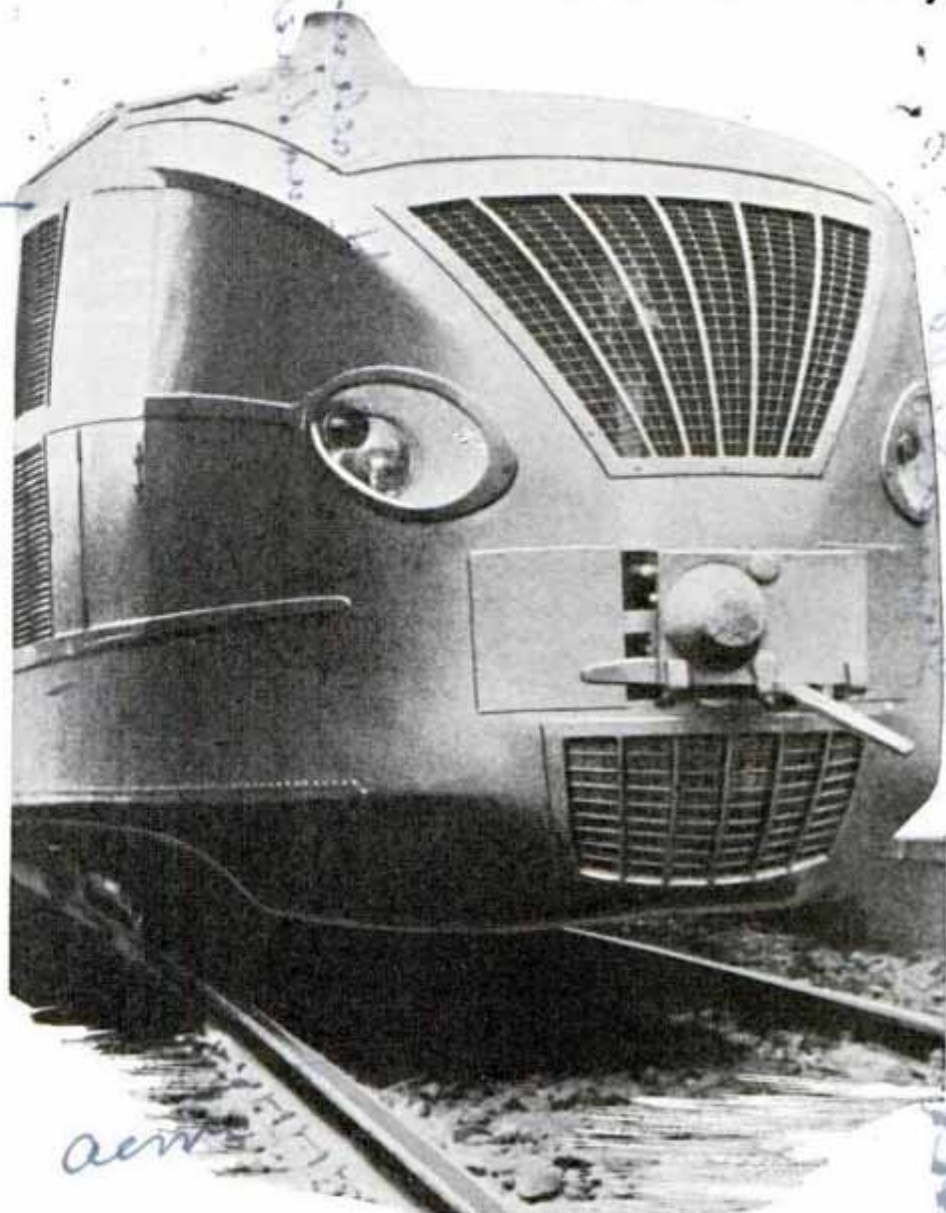
mineral water

maxwell
W. B. Water
maxwell
W. B. Water
maxwell
W. B. Water
maxwell
W. B. Water

Schenectady, N.Y.
Arthur P. Schenck
and Bend, and

Diesel 'Silverfish' Starts Rail Run in Germany

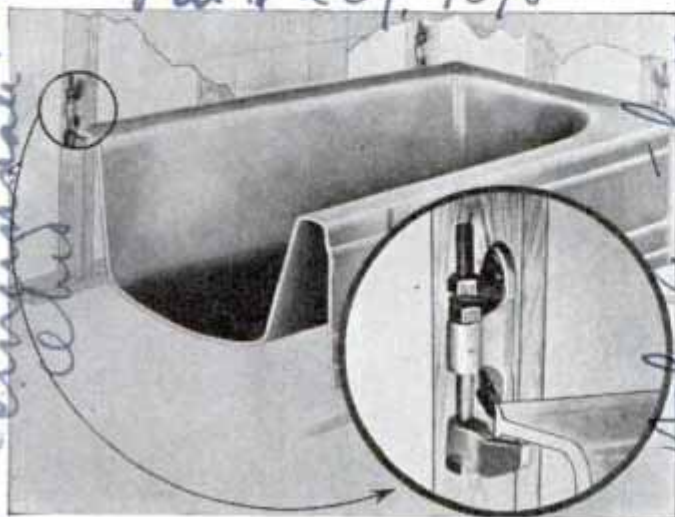
Grotesque in "facial" appearance is the newest of streamline trains in Germany, christened the "Lower Saxony Silverfish." It is built entirely of light aluminum, and is powered by two 600-horsepower Diesel engines. The train made its first trial run at Hanover recently. It is more than seventy-five yards long.



This grinning mechanical monster with wide eyes and button nose is the new Diesel streamline train operating out of Hanover, Germany

Hangers Anchor the Bathtub in Place

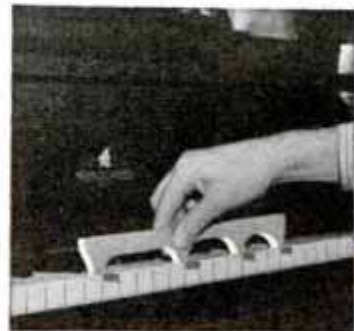
Firm anchorage for built-in bathtubs is provided by special hangers which eliminate the settling usually encountered where wood supports are used. The rim and sharp lugs of the tub rest on metal. The tub, during installation, may be raised or lowered to proper level by turning a nut conveniently located above the rim of the tub. Installation is easy. One feature is that the hangers reduce the chance that settling will cause cracks at the tile or plaster line. The hangers are attached to studding with only two lag screws.



Cutaway showing how hanger (seen in inset) supports the built-in bathtub

Chord "Bridge" for Piano Novice Helps to Teach Harmony

Piano students are helped in the study of harmony by a chord "bridge" that picks out combinations on the white keys. It is a half-inch piece of wood eleven inches long, with four "legs" tipped with felt. When the left center leg is placed on a key, for example C, the other three legs strike notes in harmony: those to the right, G and upper C; the left leg, lower E. In this manner the novice can pick out chords and memorize them.



Hallander's Hanger Patent 209,1098

acw

4629

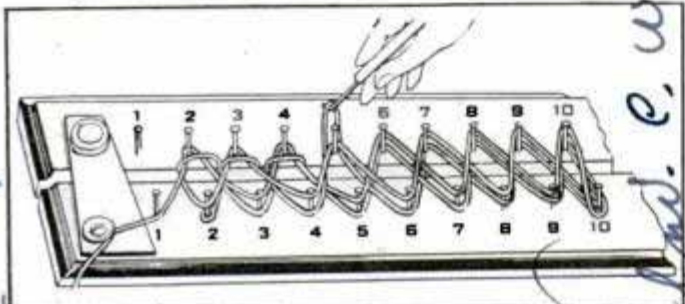
850

Hand Loom Speeds Knitting and Simplifies the Work

5-9-35
Jan. 11. 1935



725 N. Belmont Ave. Tacoma Wash



Simple hand loom with which the beginner may knit. Below, how the work is done

Designed to speed up and simplify hand knitting, a small loom has been introduced. It weighs slightly more than two pounds and is thirty-three inches long by three and one-half inches wide. It is made of Philippine mahogany. There are two sections, one fitted with sixty-five keys, each numbered to facilitate instruction in types of stitches. On each end are stainless-steel metal plates and thumb screws to adjust the opening in the loom. This opening determines the tension of the knitting, as differently sized needles do in hand knitting. A celluloid-handled steel device called a pik is used to lift the yarn over the keys, while the keys serve as the loom. A counter at one end of the loom keeps track of the number of rows knitted, registering from one to 100. Cupped disks on each end of the loom hold the yarn, which is simply twisted once or twice around the disk. The inventor claims that most women learn how to use the loom in fifteen minutes and that after becoming acquaint-

ed with its use, they are able to knit four times as fast as by hand. Previous knitting experience is said to be unnecessary. A small model turns out doll-size articles.

H 681

Watt's Horsepower Formula Found in Scrapbook

How James Watt computed horsepower in 1782 is revealed in a scrapbook now in the library at Birmingham, England. At that time, horses were employed to drive mill machinery. Watt estimated that the average cart horse developed 22,000 foot-pounds of work per minute. Anxious to give good value to purchasers of his steam engine, Watt, in using the term "horsepower," increased his estimate by fifty per cent, and thus the 33,000 foot-pounds per minute formula was evolved.

H 685

Flashlight with Tilting Head Handy in Close Places

Constructed so that its head may be slipped forward and tilted, a new flashlight is handy in close quarters. The head is connected to the flashlight body by metal strips into which narrow channels have been cut. Small brads on which the channeled strips slide prevent the head from being detached. Electrical contact is maintained between flashlight head and body through the metal strips, whether the head is tilted or not. A clip permits fastening the flashlight to the belt, with head tilted to throw the beam in the user's path or on his work, thus leaving the hands free.

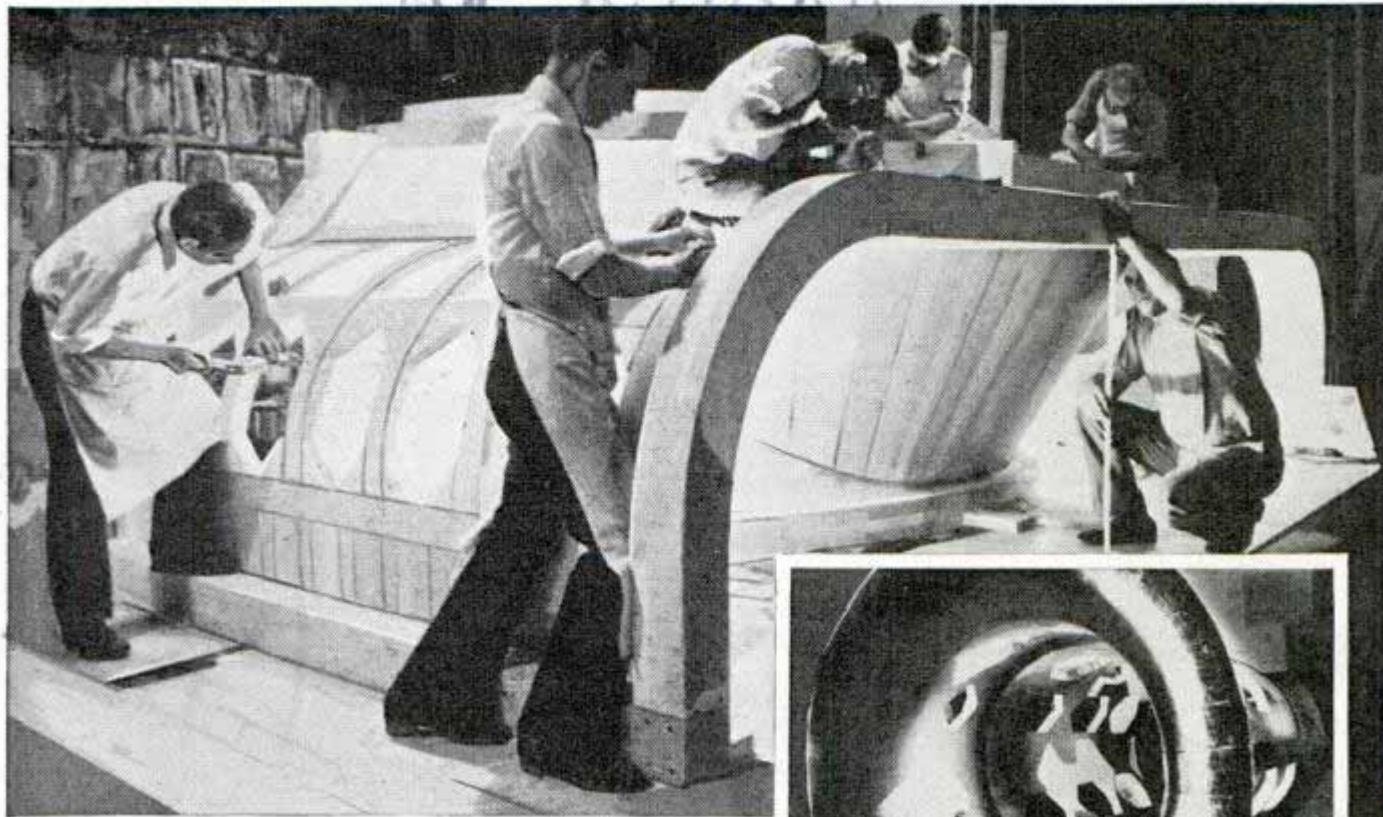


Showing how head of flashlight may be tilted to direct beam where desired

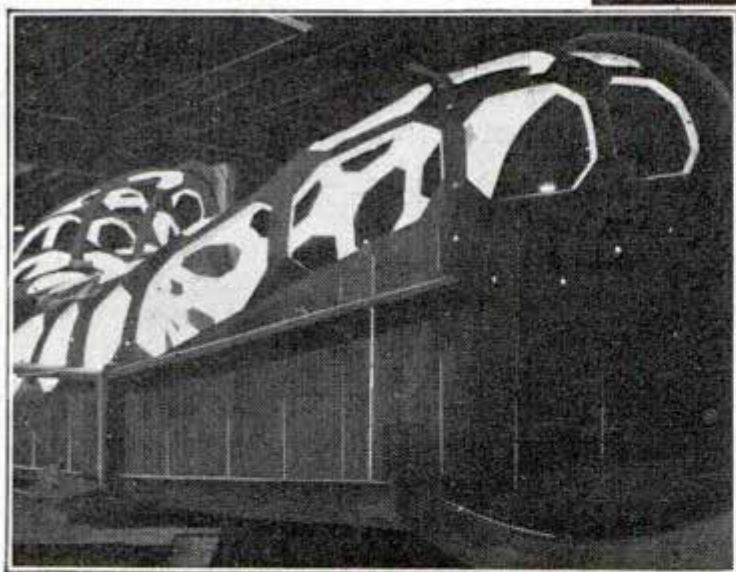
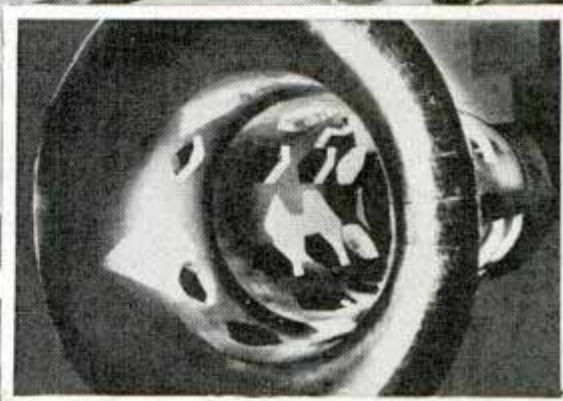
Vertical text on the left margin: The Scrapbook Co. Tacoma Wash

Vertical text on the right margin: Chicago

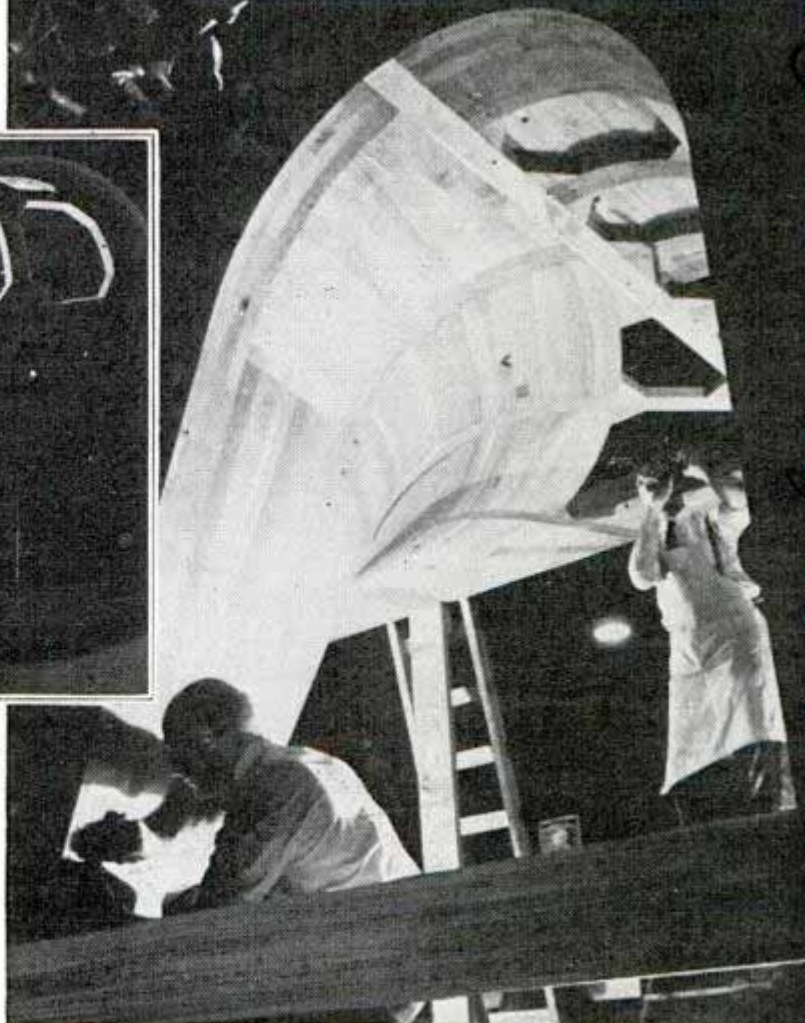
Cutting Patterns for Giant Turbine's Skeleton



Here you see the patternmakers of power. Above, they are shaping a gangling "daddy longlegs" for casting the fifteen-ton intermediate pressure section of a 60,000-kilowatt condensing turbine. It measures twenty-two feet across arch. Tubemouthed skeleton, right, is pattern for suction inlet of a propeller-type pump



No illuminated night-crawler is skeleton above, but pattern for low-pressure section of cylinder cover of 60,000-kilowatt single-cylinder condensing turbine. Each piece is shaped with precision of a telescope mounting; this nineteen-foot pattern has over-all tolerance of less than one-thirty-second inch. Photos were taken in pattern shop of Westinghouse steam division at South Philadelphia. Right, cutting design for cylinder base



Cmt. Dr. Edward Pennington

Editorial Service Bureau,
Eastman Kodak &

TRICK PHOTOS *and*

Rockefeller



No, the camera wasn't cockeyed, nor was the subject a monster with huge hands. Just a simple photographic trick. The lens was held close to the hands, and back of camera was tilted

WHOEVER said the camera does not lie was only partly right. Used with careful attention to the rules, the camera doesn't lie—it gives an accurate, literal transcript of whatever is placed before it, with correct mathematical perspective and truthful rendition of values.

But by certain simple tricks and devices, one can make the camera tell all sorts of untruths. Distorted viewpoints, twisted reflections, combination exposures and other stunts can be used to present things as they aren't and as they couldn't be. The camera isn't fooled—it just sets down exactly what it sees—but people who look at the final pictures are likely to suspect black magic.

Anybody who has a camera can play with pictures of this sort. They are fun to make, and the results are usually quite startling.

Convex and concave reflecting surfaces

such as a bent sheet of polished tin, a silvered lawn globe or a chromium-plated bowl; two or more pictures on the same film; a tilted paper holder in enlarging, all can be used to make the obedient camera record things in disconcerting fashion.

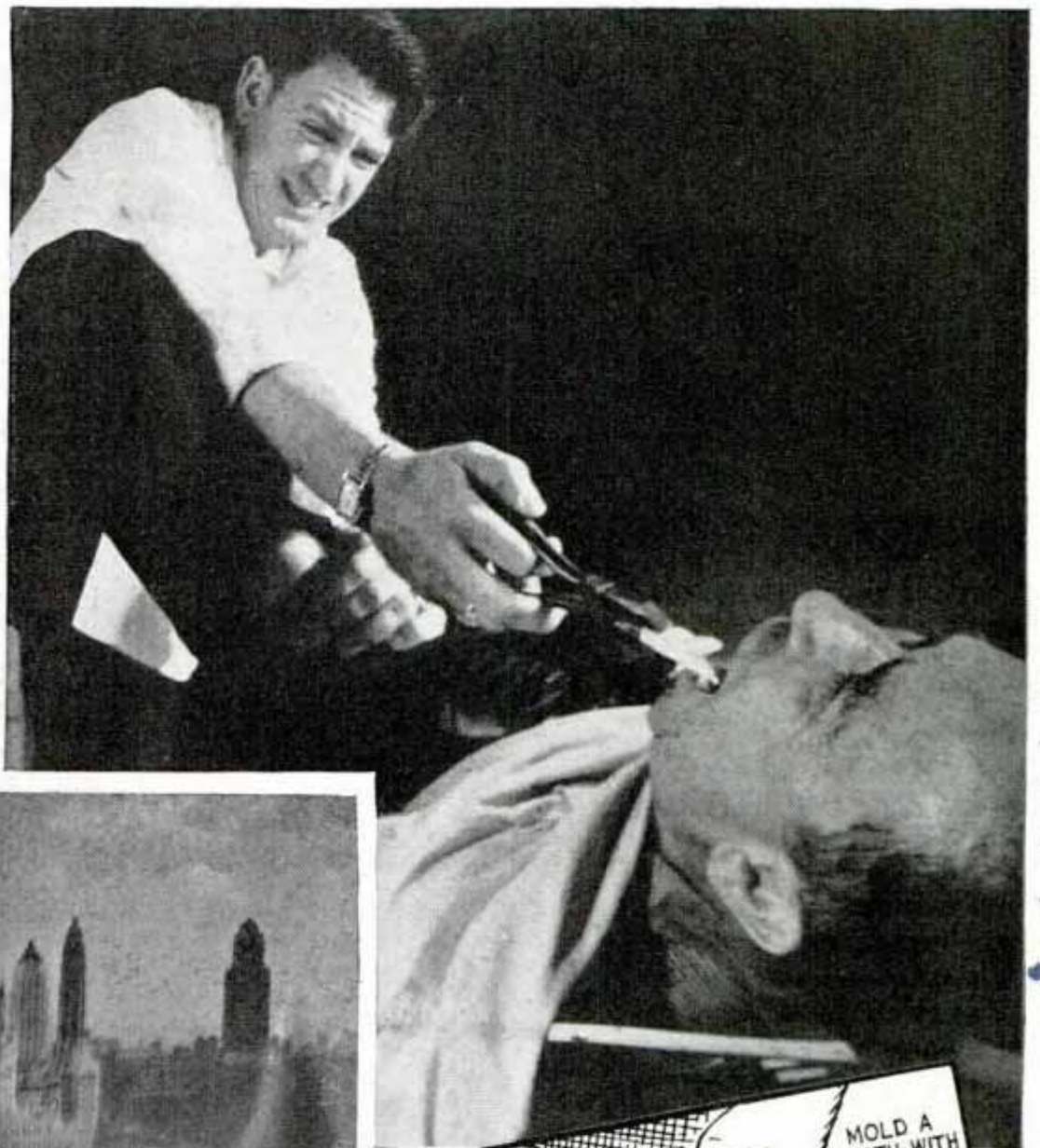
Highly polished curved subjects, such as a chromium-plated automobile hub cap or headlight shell, pick up weirdly distorted reflections which can be recorded by the camera. A negative made from such a subject may be masked in enlarging so that the outlines of the reflector are concealed; by such masking, the source of distortion is hidden, and persons observing the print are baffled until the photographer gives them the key of the puzzle.

Reflecting surfaces curved in only one direction distort only one dimension, but a bowl-shaped or hemispherical reflector distorts in all directions. Chromium-plated kitchen utensils present a variety

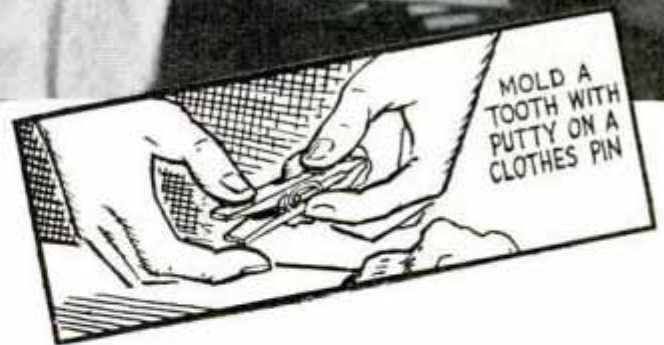
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HOW *to* MAKE THEM

Jerking that giant molar, at right, was no operation at all. Tooth is made of putty; camera back was tilted for distortion. That spectacular skyscraper fire, below, never happened. Effect was obtained by melting emulsion with hot water sprayed on opposite side of film



RUN HOT WATER ON UNDER SIDE OF NEGATIVE



MOLD A TOOTH WITH PUTTY ON A CLOTHES PIN



of surface shapes, and by utilizing reflections in them the photographer can give ordinary subjects many curious twists.

Refraction produces as many quaint effects as reflection. Try, for instance, photographing the images of objects in a large goblet filled with water, or a round goldfish bowl.

When photographing reflections in sharply curved surfaces—such as a globe or bowl—it is good practice to focus on the reflecting surface, and use a small lens opening to insure sharpness in the reflec-



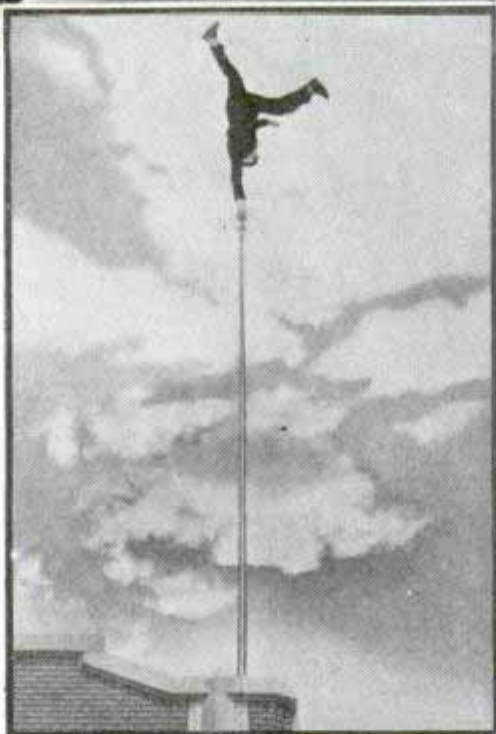
tion. With some subjects, distortion can be introduced without the use of reflections. The classic example of direct distortion is a closeup of a man lying with his feet extended toward the camera, so that the head photographs small and the feet enormous.

This exaggeration of perspective where objects are placed very close is characteristic of all lenses—including the eye. Try viewing the tip of a long pencil an inch or two from one eye, and note how the tip gains in size while the rest of the pencil appears to taper away. The closer an object is placed to the lens, the more violent the perspective; as distance is increased, objects return rapidly to normal size relationships.

Most amateur cameras are not designed to permit such extreme closeup work; indeed, their focusing is restricted so as to prevent it, because in ordinary picture work it is likely to be a source of unintended distortions,

and the inept photographer tends to blame the camera. However, amateurs owning cameras with long-extension bellows and ground-glass focusing can work as close to a subject as they like, with results as interesting as the photographer is clever. By choice of angle, remarkable twists can be introduced into close-up pictures of people, and judicious distortion of prominent features, such as naturally large ears or long noses, will produce genuine photocaricatures.

The nearer the camera is brought to a subject, the less "depth of field" the lens has, and it must be stopped down considerably to keep the near and far parts of the subject in sharp focus. Here again a ground-glass focusing back on the camera is an advantage, as the photographer can view his picture exactly as it is before he shoots.



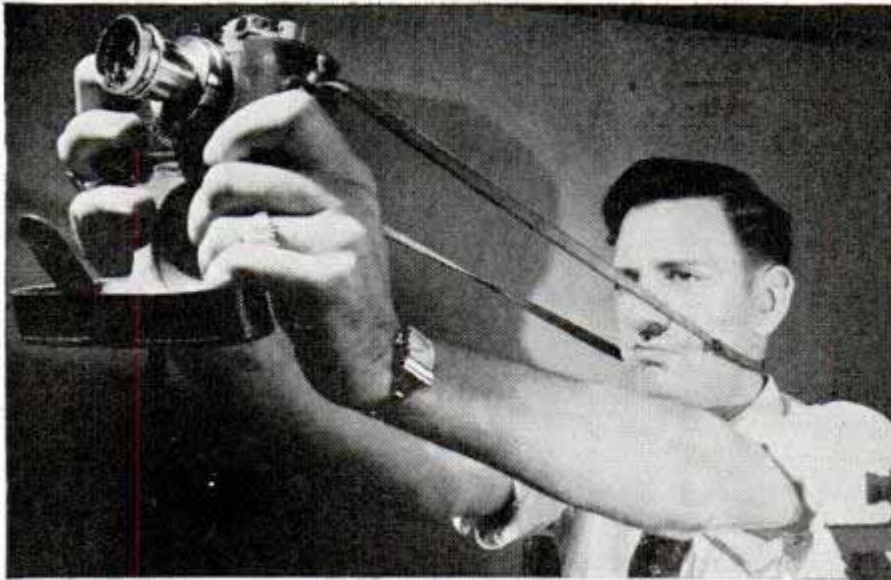
Odd angle shot, top, is under side of typewriter seen from floor. Acrobat stunting on flagpole was merely jumping; three films made that picture. For big feet, put lens close up, stop down diaphragm and tilt camera back



Looks like a heat wave in the big city, doesn't it? The cameraman put waves in the skyscrapers by tacking the enlarging paper in waves. That toothy fellow at right is grinning through magnifying glass. Focus on image through magnifier, and stop down diaphragm to keep eyes in focus



At left, the photographer caricatures himself by "shooting" his reflection in a polished automobile headlamp. Then the trickery is concealed by trimming away the headlight, as in enlargement below. Trick shot of juggler at right was made with cutouts on a sheet lighted from behind



Is that a miniature camera or miniature cameraman? It's all in the point of view. To exaggerate perspective, lens must be close to subject—in picture below, camera shot from base of stepladder; small diaphragm opening increases depth of focus. The "hear no evil, see no evil, speak no evil" girl was not triplets. The same youngster posed for three exposures



Double or multiple exposures are a source of many laugh-provoking pictures. They require no special camera equipment, but careful control of the light is essential and generally this makes it necessary to work indoors.

There are three general groups in the double-exposure field; multiplications, as of a person playing a three-handed card game with himself; impossible situations, as of a man fading into thin air, and giant-and-pygmy pictures, in which human figures are made to appear absurdly large or absurdly small.

A picture of the one-man threesome at cards calls for a dark-surfaced table and a dark background. The player should wear a light-colored suit. The camera is set firmly on a tripod, and one exposure is made while the player sits at the left side of the table, another as he sits at the right, and another as he faces the camera from the far side of the table. Exposure is adjusted so that the lighter parts of the picture receive full exposure each time the camera shutter is opened. Of course, the film is not wound during the series of exposures, and camera and table are not moved.

The shot of the man fading away, mentioned above, is also made without moving the camera or winding the film. It calls for two exposures. The first exposure is just long enough to show details of the room. After this exposure, the man is placed before the camera, and a light carefully arranged so that only the upper part of his body is lighted while the rest of him and the room are kept in deep



(Continued to page 114A)

Salt-Water Police Guard New York's Harbor

Covering New York's waterfront is the job of the salt-water police. In fair weather or foul, the police department's marine division has the task of patrolling an area of 580 miles with ten launches and a force of 150 officers and men. Rum runners and river pirates have passed out of the picture, but there remain the smugglers and dock thieves. In the course of a year, the marine police



Top, cleaning one of patrol boat's guns. Left, inspecting papers of junk boat. Right, fast boat on patrol duty in New York harbor

are involved in dozens of rescues, and they regulate traffic and help federal agencies to enforce navigation rules. In addition they have the task of grappling for the bodies of hundreds of accident and suicide victims. To aid them in the work, the salt-water police have radios similar to those in police squad cars with which they keep in touch with headquarters. Among the

patrol boats is a fifty-eight-footer formerly owned by William B. Leeds, the tinsmith magnate, who presented it to the police department in 1929. Powered by two eight-cylinder engines, it has a maximum speed of thirty-five miles per hour. Each boat carries submachine gun, gas and smoke bombs and small arms, as well as grappling hooks and first-aid kits.

*Wide
World*

Business Records Put on Film by Microphoto Recorder



Simple photo-recording machine in operation, putting book pages on tiny film

Business records, valuable papers, manuscripts, books and the like may be preserved in small space by recording them on film through microphotography. A new instrument, the Photorecord, does the work, recording as many as 800 newspaper pages on one roll of thirty-five-millimeter film four inches in diameter and two inches thick. In this manner, the contents of thirty-two filing cabinet drawers may be filed in one drawer in film form. The film lasts as long as record paper of the highest quality. Duplication is easy. Once desired material is recorded on film, it is a simple matter to make positive film copies of the original negative, or enlarged prints of any size. Thus, any business house may keep a permanent file of original material and make copies for use in branch offices. The Photorecord is compact, a completely portable camera apparatus weighing only forty-two pounds packed. In it is combined everything necessary to photograph anything occupying a relatively flat plane up to and including a full newspaper page and record it in miniature form on a small strip of film. It produces 800 double-frame pictures and 1,600 single-frame pictures from a single loading of 100-foot film. Operation of the unit is effected by a foot

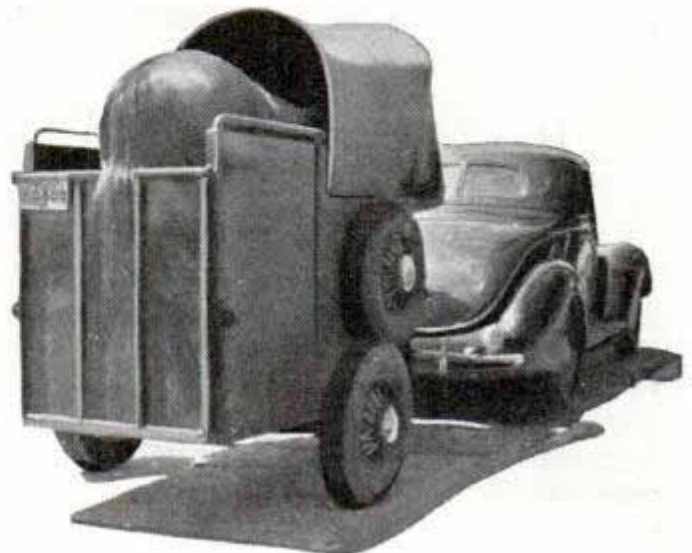
pedal which leaves the hands free to handle the subject being photographed. Each time the pedal is pressed, the film is positioned, the lights are turned on from half to full photoflood intensity and the shutter is actuated. So simple is its operation that speeds of 500 to 1,000 exposures per hour may be made. The film comes in daylight loading cartridges. A counter on the machine indicates film consumption. Industrial firms, research institutions, governmental agencies, libraries and historical societies are using the machine.

Vibration in Ships and Buildings Stopped by Steel Coil Springs

Huge multiple coiled steel springs are being installed in buildings and ships to absorb vibrations and protect power plants. One New York department store has a large Diesel power plant "floating" on thirty-six giant springs, each with a load capacity of 25,000 pounds. Engineers have developed ways of supporting loads up to 900,000 pounds on coil springs, thus isolating big machines from the building or ship hull and improving performance and wear of the power plant.

"Bonnet" Canopy on Trailer Protects Horse from Sun

Over the front of a trailer in which his horse travels, a Nevada rancher has raised a "bonnet" canopy to protect the animal's head from the desert sun and wind. When the back gate of the trailer is lowered it becomes a gangplank for the horse.



Thinking of his horse's comfort, rancher put this canopy on trailer for protection from sun and wind

RADIO



Simplified TELEVISION *Demonstration*

TWO standard oscillographs, of the type widely used today by radio servicemen, can now be employed to demonstrate television for experimenters by merely making a few slight circuit changes and equipping the instruments with special tubes.

This simplified television demonstration is made possible by means of a recently developed DuMont



tube known as a "phasmajector," (Greek for image emitter) which takes the place of the usual cathode-ray tube in oscillograph No. 1 shown in the upper photo. This instrument serves as the transmitting unit.

In place of the fluorescent screen, there is in the "phasmajector," a metallic plate on which is printed the desired picture, or test pattern, as will be noted in photo Fig. 4. Also, the tube includes the conventional cathode-ray tube gun and deflecting electrodes. When used with the proper sweep circuits and amplifiers, the picture on the metallic plate can be scanned and transmitted to a television-type cathode-ray tube in oscillograph No. 2 which acts as the television receiver.

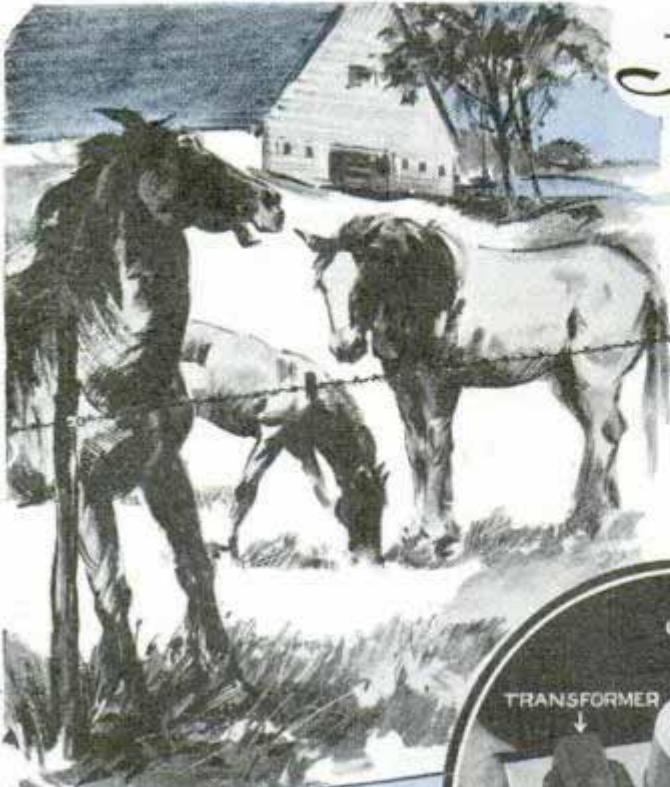
As the cathode-ray beam scans the image, varying amounts of secondary electrons are released, depending upon whether the beam strikes upon metal or special ink used to print the picture. A larger number of electrons are released when the ray impinges upon the metal than when it strikes the ink. The varying voltage is picked up by the collector electrode and fed to the grid of the video signal amplifier; Fig. 3 shows a close-up of the transmitted image. Both oscillographs may be restored quickly to normal service by throwing switches and changing tubes.



M. Paul Martin

Four DRY CELLS

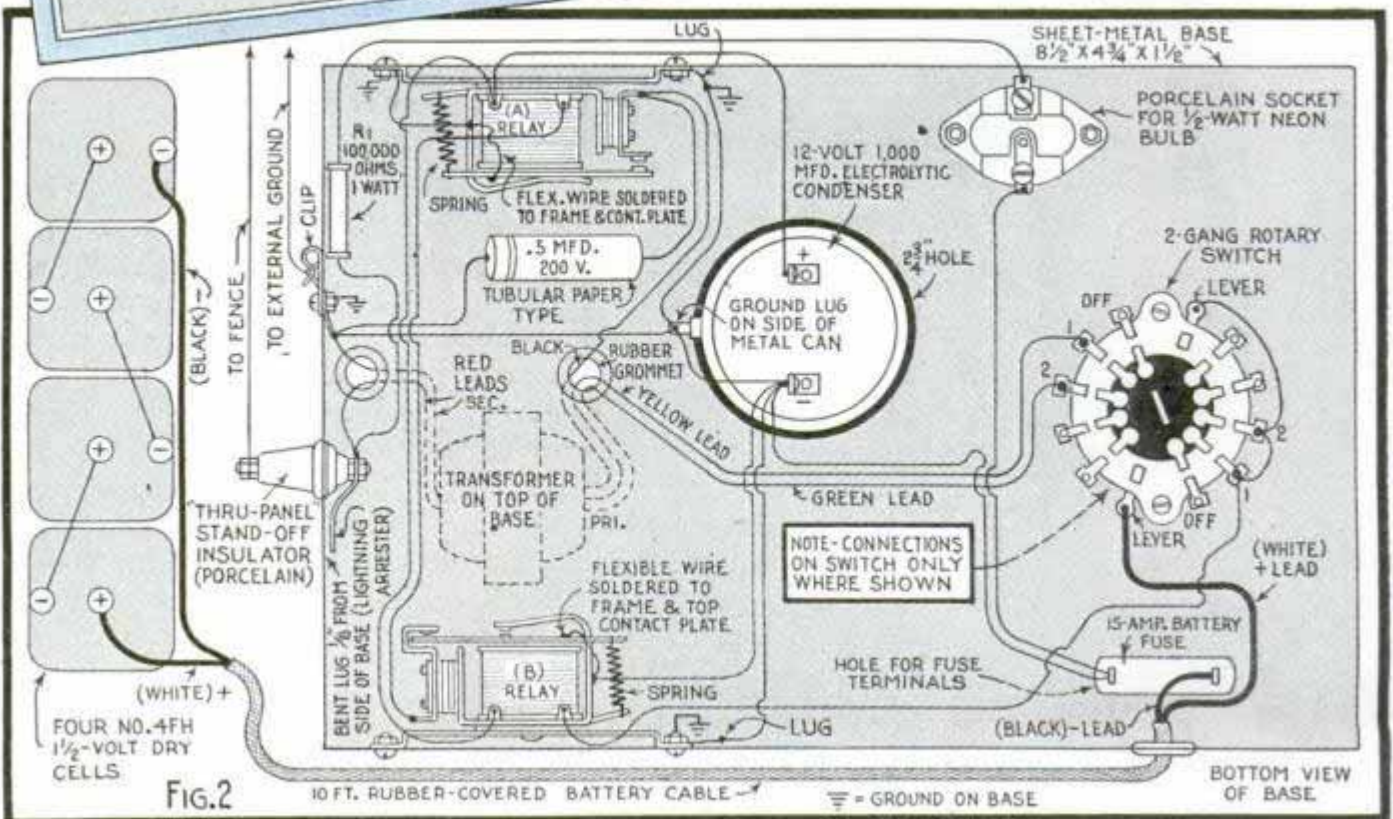
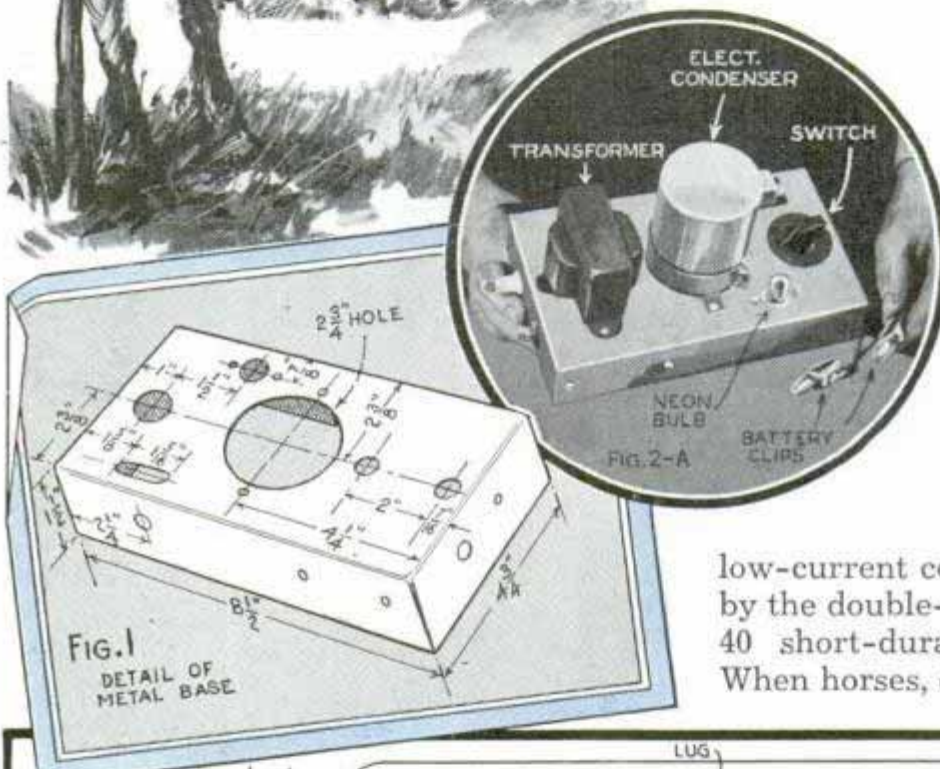
By M. N. Beitman



PERHAPS one of the most useful, money-saving applications of electricity on the farm is to be found in electric fencing. This harmless but effective method of keeping livestock within bounds prevents wire cuts and greatly reduces fencing costs, as less wire and posts are required.

Designed for battery operation only, the electric fence unit to be described will control up to five miles of fence in wet or dry weather and is easily assembled from ordinary radio parts. Operating tests, made by the manufacturer of the relays employed in the unit, have demonstrated that four 1½-volt dry cells will power the device with full effective voltage for three months and one week. This economical

low-current consumption is made possible by the double-relay action which produces 40 short-duration shocks per minute. When horses, cattle, hogs or sheep come in



Operate this ELECTRIC FENCE CONTROLLER

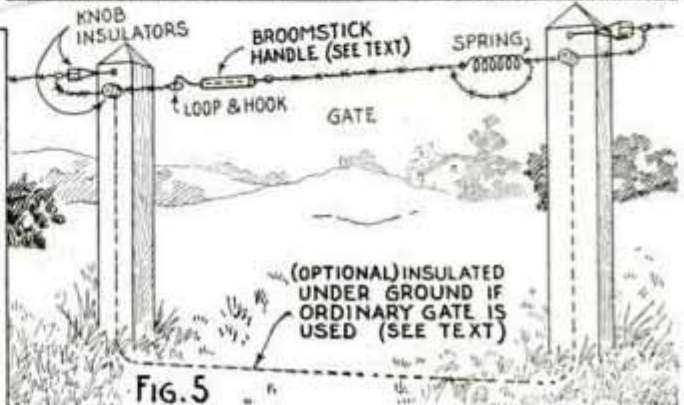
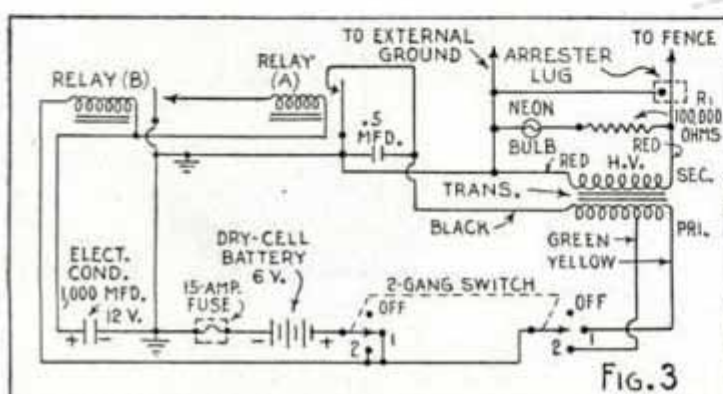
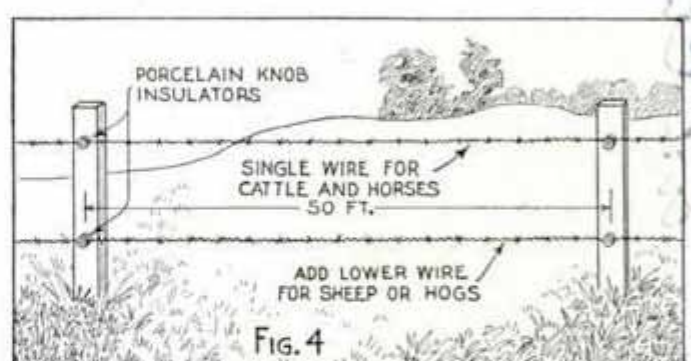
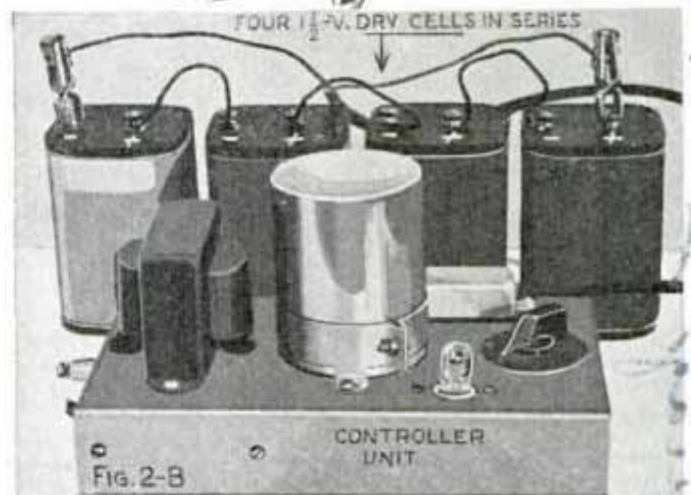
contact with the wire, they receive an effective but harmless "sting" which drives them away. One or two contacts with the wire will teach stock to stay within the fenced area.

No particular skill is required to assemble the unit; anyone who can use ordinary tools and a soldering iron can follow the detailed diagrams. Fig. 1 shows the sheet-metal base which may be formed by clamping the sheet metal between two pieces of wood in a vise. This base is also available formed and drilled. All parts are standard; although the materials are not expensive they must be of good quality and just as specified.

The simplified wiring diagram, Fig. 2, is a bottom view of the unit with all parts in their relative positions. It will be noted that the Guardian relays (A) and (B), are mounted on the inside edge of the base, and soldering lugs are placed under the mounting screws for convenient grounding points, the external ground being provided for by means of a Fahnestock clip mounted directly on the end of the base. A "thru-panel" type porcelain insulator is employed to bring out the "hot" lead to the fence wire. Solder all connections carefully and tape any exposed wires that might short on the metal base. All wiring under the base is done with No. 18 hook-up wire having push-back insulation.

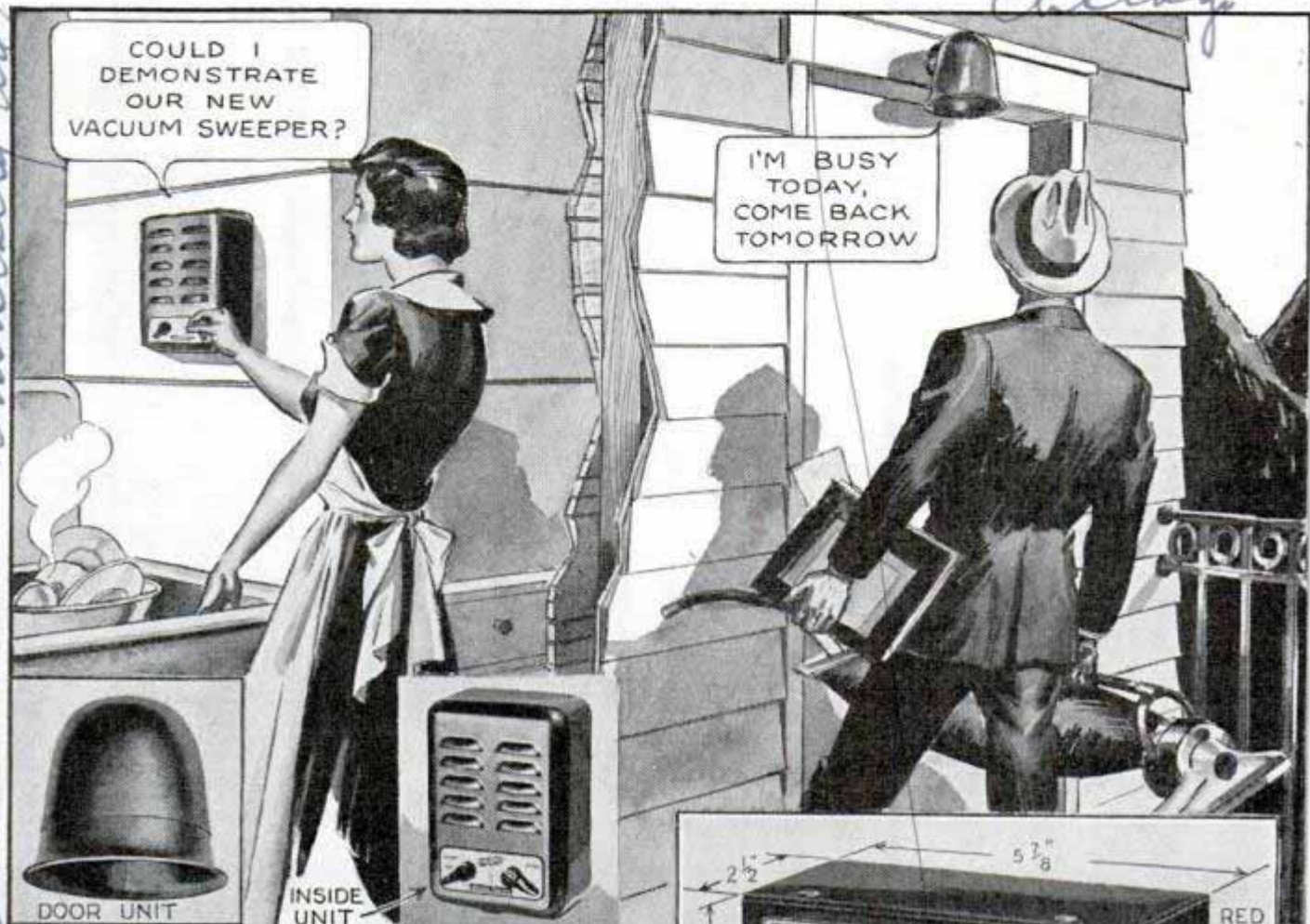
The 1,000-mfd. electrolytic condenser is mounted by means of a clamp which permits it to extend down about 1/2 in. through the hole cut in the base. This 12-volt con-

(Continued to page 130A)

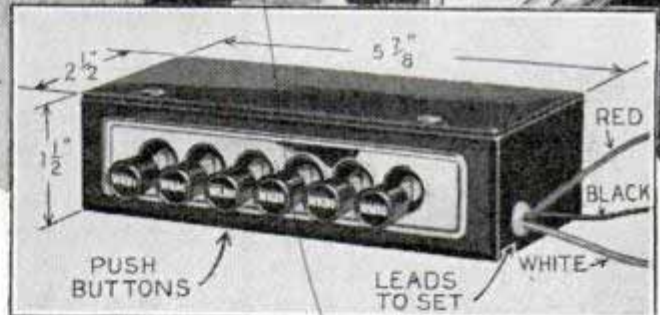


Easy Solutions for Everyday Radio Problems

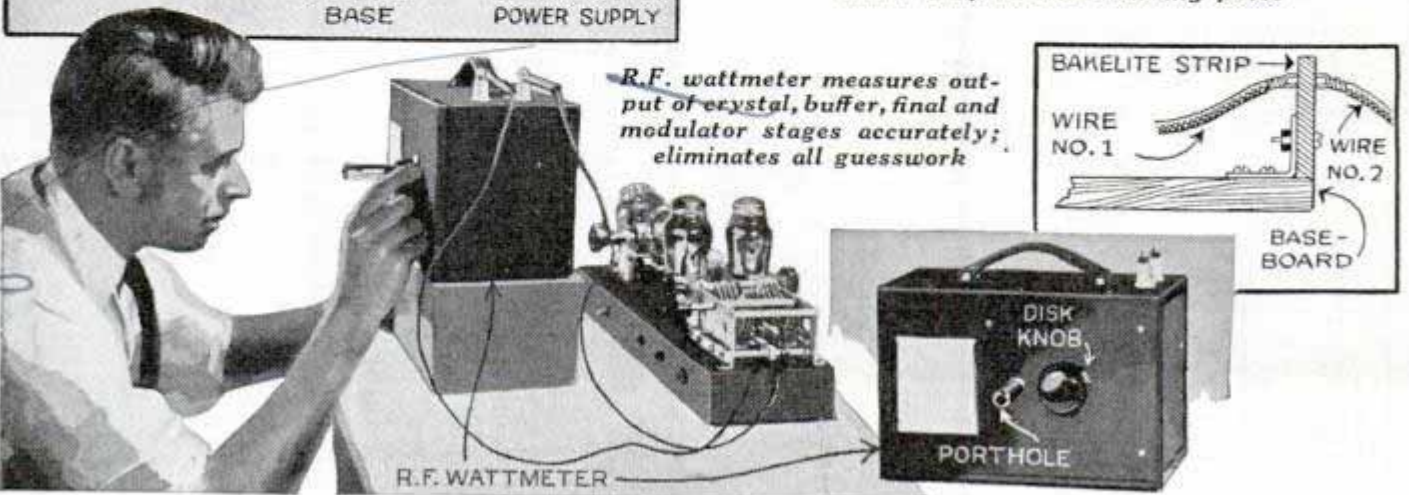
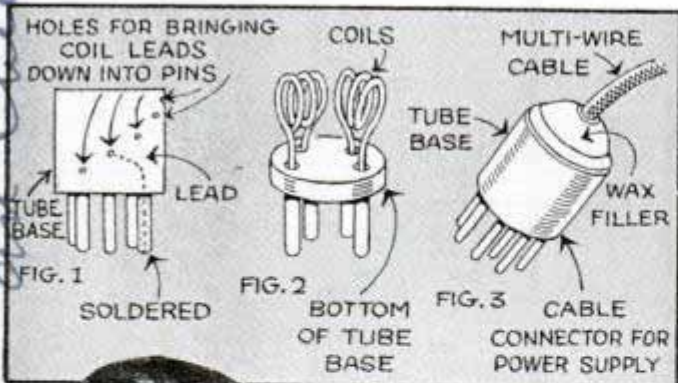
Associated Engineering, 1120 N. Dearborn, Chicago, Ill. 2-2333
W. E. G. 4243
Chicago



Door telephone saves time for busy housewife and serves as a protection as well as a modern convenience. Inside unit mounts on wall in kitchen; bell-shaped weatherproofed units, over front and back doors, permit two-way conversations



Above, shielded automatic push-button tuner now available for mounting ~~directly on your broadcast receiver~~. Black wire is soldered to frame of variable tuning condenser in set; red connects to oscillator (stator) section of condenser and white wire goes to antenna-tuning (stator) section. Left, suggested uses for old tube bases: Fig. 1 provides a practical plug-in form for winding short-wave coils; ultra-high frequency coil assemblies can be arranged as indicated in Fig. 2; a useful battery-cable connector is illustrated in Fig. 3. Below, terminal strip without binding posts



BEGINNER'S RECEIVER *for Short Waves*

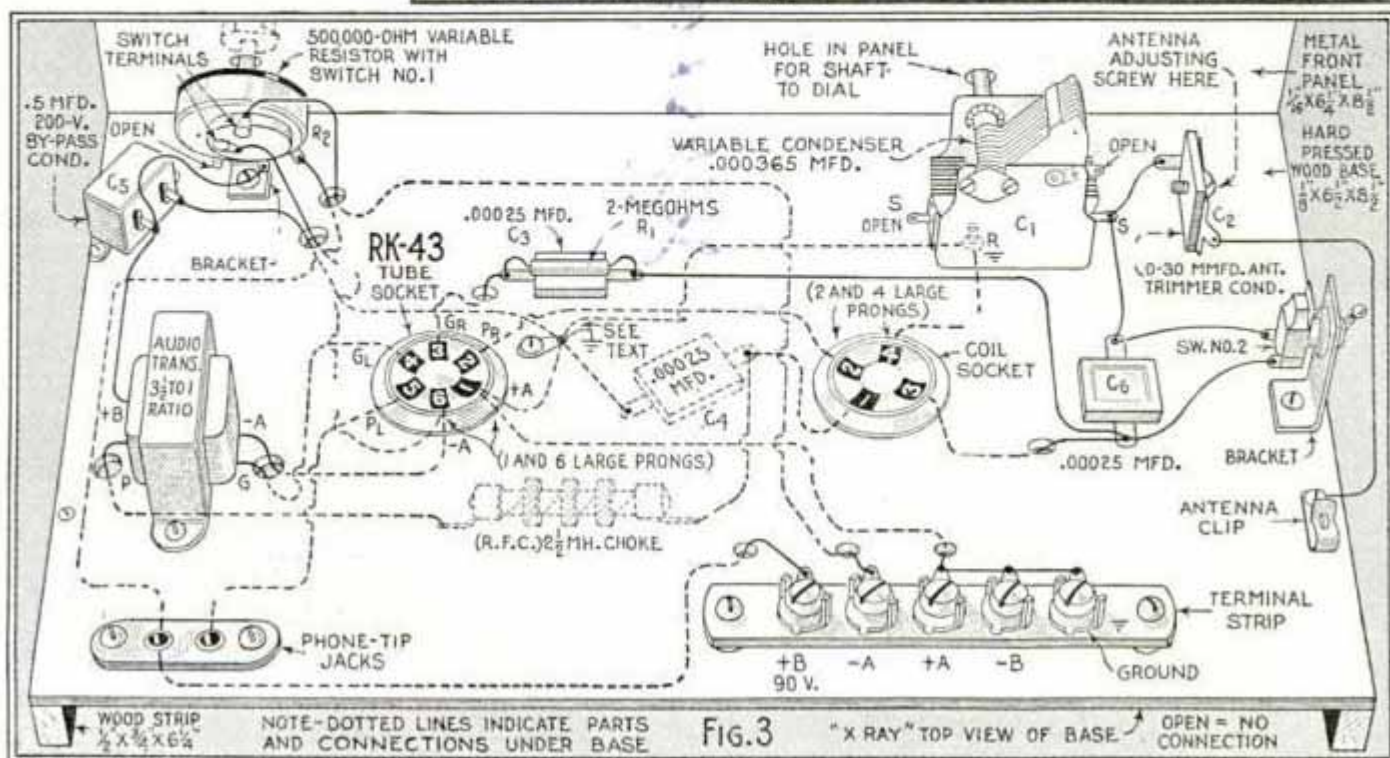
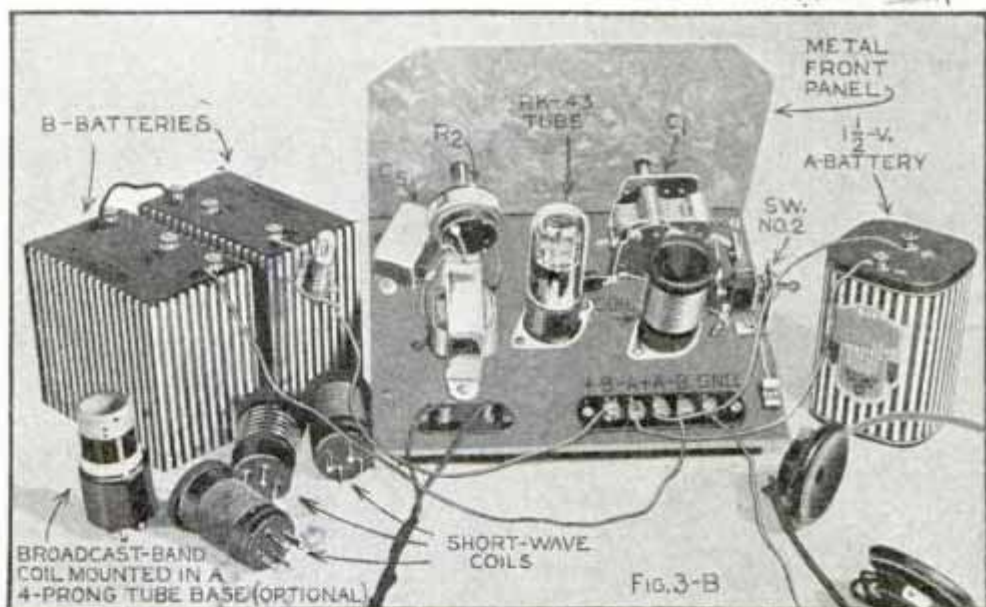
Part II

ONLY a few parts were added to progress from the crystal set to the one-tube broadcast receiver described in the July issue. These parts will be used also in the short-wave set which is to follow.

If the variable resistor is of the type which has three terminals, use the center lug and whichever outside terminal gives the smoothest control. In tuning the broadcast set, advance the regeneration control slowly until a station carrier wave is heard in the headphones. Now immediately back off the control until the program quality is good.

To convert the broadcast set to a short-wave receiver, several additional parts are required, and the converted set cov-

(Continued to page 133A)



Automatic Radio Tuning Device

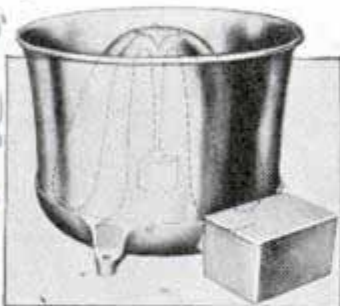
Programs from eight different stations can be tuned in automatically 672 times a week by means of a clock-operated device recently developed by a New York



City mechanical engineer. A cylinder, mounted in the receiver, is provided with holes spaced for every 15-minute interval; small keys placed in these holes change the programs as the clock, on top of set, rotates the cylinder.

Speaker for Marine Service

Designed for emergency marine loud-speaker systems, this unit is completely weatherproofed. Used as a loud-speaker for highly concentrated sound, and also as a microphone, it will pick up sound outdoors, with small amplifying gain, from distances up to 100 feet, and will deliver 100 db. of sound 10 feet from the horn with an input of one watt.



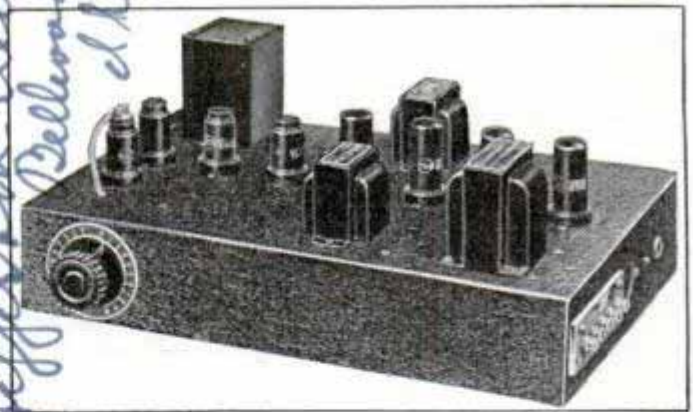
Portable Voltage Regulator

Voltages between 0 and 140 are available with this portable auto transformer for voltage regulation. Radio servicemen can use it for regulating the soldering iron for a quick heat, also for proper operation of test oscillators. In the primary of an "A" eliminator it provides variable d.c. voltage for testing farm, auto, and 2-volt battery sets. Amateurs and experimenters will find it useful for adjusting filament and plate voltage on transmitters and rectifiers, also in many applications requiring the control of speed and power.



Amplifier for D.C. Operation

Operated from a 115-volt direct-current line, this compact amplifier utilizes four type-25L6 metal tubes in the final stage to develop 10 watts of audio power. It is designed for operation in those sections of city and country which have only direct current as a source of electrical power.



Blueprints covering radio construction articles in past issues are available for 25 cents each; original material lists and additional information can be obtained from our Radio Department without charge upon receipt of postage.

NEXT MONTH—How to Build a Simple Two-Tube Push-Button Broadcast-Band Receiver. Designed to show push-button tuning construction in simplified form so that the average experimenter can assemble a good low-cost set. Also—complete details for a **Portable Tool and Parts Box for Amateurs and Servicemen**



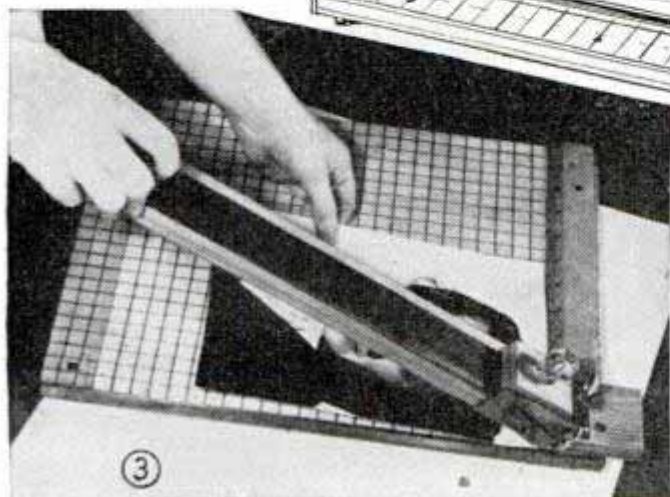
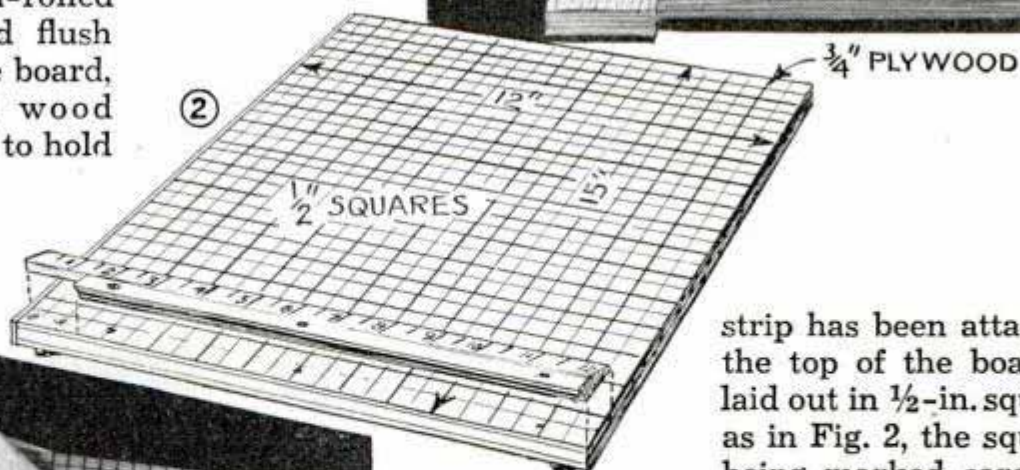
PHOTO TRIMMER

has removable sliding blade

By DANIEL REYNOLDS

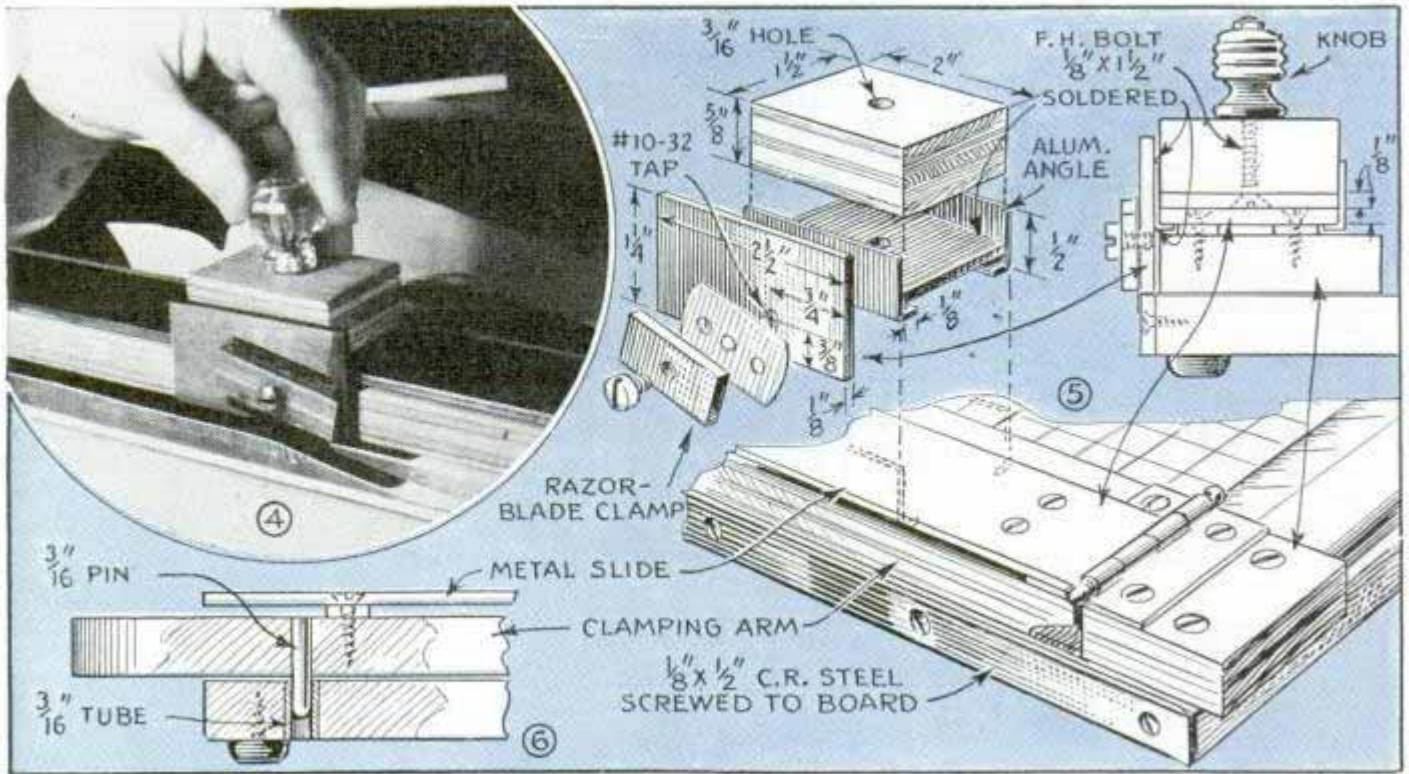
DIFFERENT in action than the usual photo-print trimmer of the shearing type, this homemade one has a sliding, renewable cutter, a razor blade, mounted on a hinged arm which drops over the print to hold it in position after it has been lined up carefully for cutting. Then it's a simple matter to pull the cutter back with one hand as shown in Fig. 1. With this cutter you can take off a very narrow sliver from one edge of the print when squaring it.

The base of the trimmer consists of a 12 by 15-in. breadboard or a piece of $\frac{3}{4}$ -in. plywood, along one side of which a piece of $\frac{1}{8}$ by $\frac{1}{2}$ -in. cold-rolled steel is mounted flush with the top of the board, three flat-head wood screws being used to hold it in place. This strip serves as a guide for the blade. After the



strip has been attached, the top of the board is laid out in $\frac{1}{2}$ -in. squares as in Fig. 2, the squares being marked carefully with a sharp, hard pencil. Then the surface of the wood is given two or three coats of shellac or varnish, allowing each to dry thoroughly before applying the next. When the board is dry, a 12-in. ruler is screwed along the upper edge as indicated.

The hinged print-clamping arm, shown raised in Fig. 3, is detailed in Figs. 5 and 6.



It is 2 in. wide and about 2 in. longer than the board. The edge of the arm must be in line with the edge of the board. To assure that the clamping arm remains in perfect alinement, the pin arrangement illustrated in Fig. 6 has been found effective. The sliding carrier on which the blade is mounted is shown in Fig. 4. It should be assembled carefully and the blade placed in position, after which it is slipped on the carrier guide, being worked back and forth until it slides on the latter freely. The

guide is 14½ in. long and is bolted in place on the clamping arm, using flat-head screws. When locating the guide, it is adjusted so that the razor blade will travel in contact with the steel strip screwed to the edge of the baseboard. To permit free movement of the carrier, washers are slipped under the carrier guide to provide a space between it and the clamping arm. To assure clean edges on all prints, the razor blade should be replaced by a new one as soon as it begins to get dull.

This Jig Assures Accurate Miter Joints on the Circular Saw

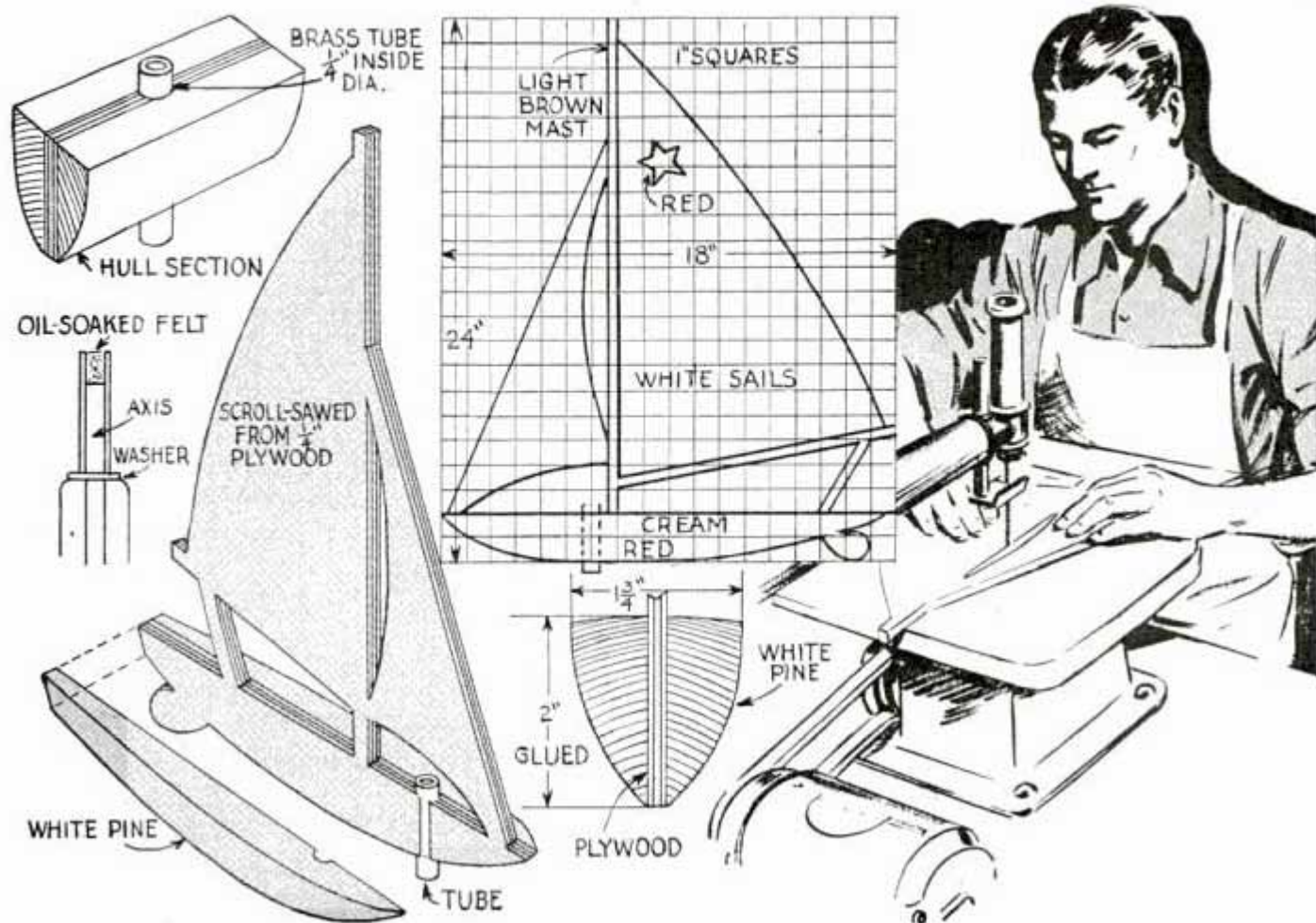
Mitering moldings and other small work on a circular saw can be done accurately with this jig. It consists of a wood table, fitted with two strips on the underside to engage the slots in the saw table. The upper side has two guide pieces, these being fitted at an exact 45° angle to the saw cut, which is run part way through the wood table. In use, the molding is first cut to exact length. Then the miter cut is made by holding the work against one of the guides. Once this jig has been checked for accuracy, it will save considerable time and always make perfect joints.



This jig will save considerable time when mitering moldings and other small work

☛ Silverware should never be wrapped in bleached linen as the sulphur, used in bleaching, will tarnish it; unbleached cotton flannel is best for this purpose.

Waterside Weather Vane That Is Self-Oiling



Resembling a miniature sloop, this weather vane is ideally suited to a home or club at the beach. A piece of oil-soaked felt keeps the pivot or axis bearing well lubricated to avoid sticking or squeaking. To assemble the weather vane, saw out a miniature sloop in profile, like the squared diagram, from $\frac{1}{4}$ -in. plywood. Then cut two side pieces of white pine and casein-glue them to the hull to give it shape. A

little carving and sanding will bring the hull to the correct contour quickly. Next bore a hole near the bow for a brass tube, which is forced in place tightly to serve as a bearing. The pin or axis is shorter than the tube, leaving space at the top for the oil-soaked felt. Give the little craft a thorough paint job, taking special care to get the edges of the plywood sealed against entrance of moisture.

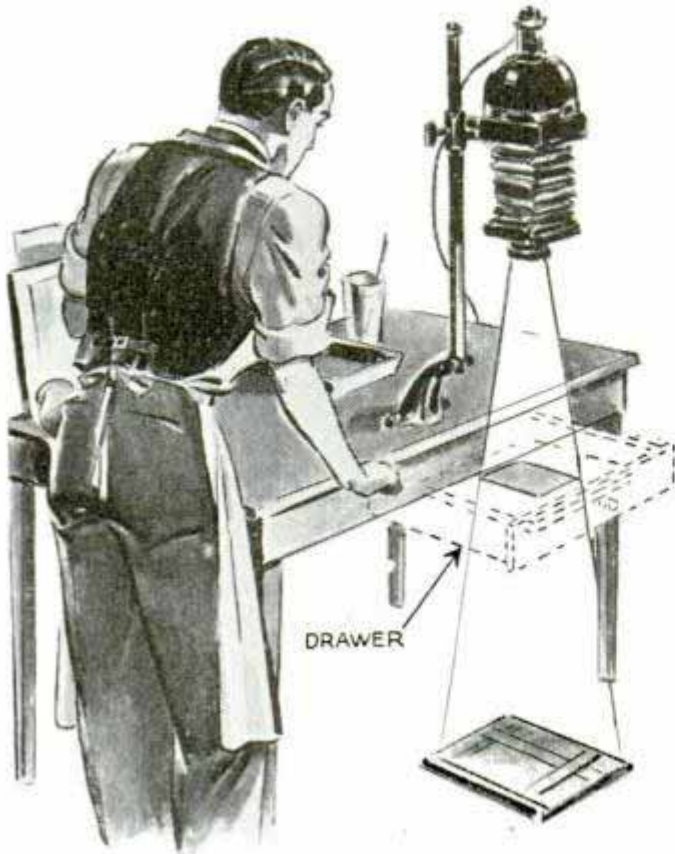
Piece of Cardboard Holds Coin Safely in Sealed Envelope

A coin is not likely to be lost from a sealed envelope if it is slipped into a piece of corrugated cardboard as indicated. Two slits are cut in the surface of the cardboard to take the coin, spacing them a distance equal to its diameter. Then the cardboard between them is undercut and the coin pushed in place. It takes only a minute to do this and it's easy to remove the coin by tearing off the paper surface of the cardboard.—G. A. Ferrell, Hurtsboro, Ala.



☐ A piece of dried orange rind kept in the box with tea gives it an orange flavor.

Photo Enlarger Mounted on Table Uses Drawer or Floor as Easel



Your photo enlarger has a greater range if you mount it on a table above a drawer as shown

When you set up a vertical photo enlarger, mount it on a table directly above a drawer so that you can pull out the drawer and use it to support the easel for a normal enlargement, or you can lay the easel on the floor to make an unusually large one. This idea is especially handy where a low ceiling does not permit the enlarger to be raised as high as desired.

Bumpers on Ends of Seesaw Protect Children



Bent to the shape indicated and bolted to the undersides of teeter-totters in a playground, leaves from old auto springs provide bumpers, which tend to cushion sudden bumps when the end of

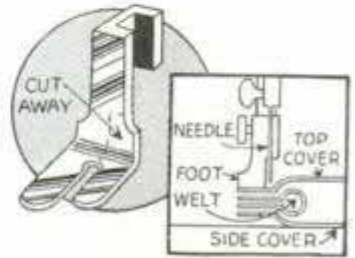
the plank comes in contact with the ground. Besides absorbing the bumps, the springs also prevent the plank from coming down

on a child's foot should it accidentally slip between the plank and the ground. It will be necessary, of course, to anneal the ends of the springs so that they can be drilled for bolts, after which they are re-tempered.—Bob Poulson, Los Angeles, Calif.

Altered Machine Foot for Sewing Welt Seams

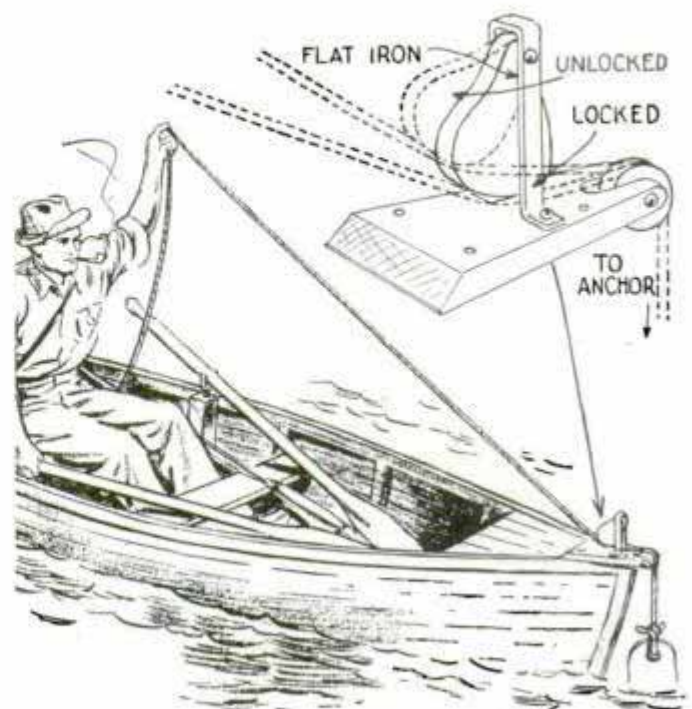
Lacking a special foot for stitching welt seams, one home craftsman made one from an extra standard foot for the household sewing machine. A portion of it was cut

away as shown. This enabled him to bring the welt under the foot, close to the needle.



Automatic Stop on Boat Anchor Controlled Remotely

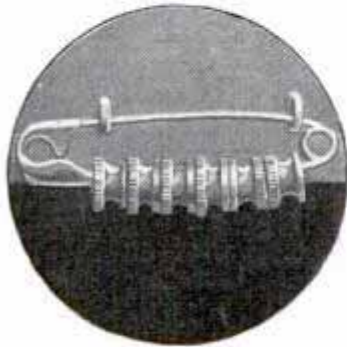
Lone fishermen who dislike to move forward to raise or lower the anchor, will find this automatic stop just the thing. A horizontal pull on the rope raises it, after which an eccentric block in the stop drops down to hold it at any desired point. To drop the anchor again, the fisherman merely lifts the rope above his head to pull up the eccentric block, then pays out the



The rope is pulled horizontally to raise the anchor and is held above the head to lower it

line slowly when held in this position. The stop consists of a U-shaped piece of flat iron, between the legs of which is pivoted a block of wood to provide an eccentric as indicated in the detail.

Small Nuts Stored on Safety Pin Are Not Lost



When working on a car, a large safety pin provides a good holder for small nuts, such as those used on spark-plug terminals and electrical connections about the car. The pin also will be handy for storing other kinds of small nuts in the home workshop.

Dog's Dish Set in Brake Drum

If your dog has a habit of overturning the dish in which you feed or water it, or moves the dish about until the contents are spilled, get a discarded brake drum to serve as a holder. The weight of the drum will discourage the dog from further attempts to waste its food.



square. Directly under the shaft is placed a hard steel die plate with a hole in it exactly the same diameter as the shaft.

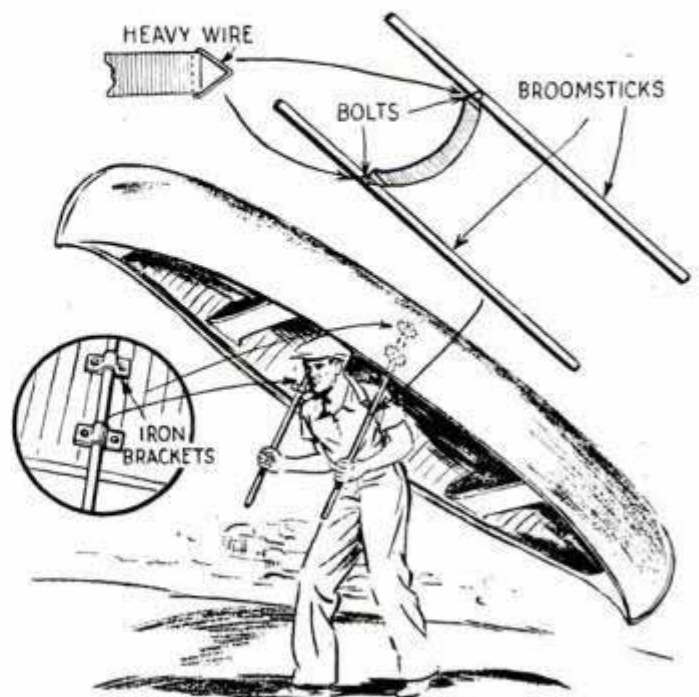
Punch from Old Document Seal



A hand seal of the type shown can be converted into a powerful hand punch for perforating sheet metal, and even saw blades. The seal is removed from the punch and the end of the shaft is filed or ground perfectly

square. Directly under the shaft is placed a hard steel die plate with a hole in it exactly the same diameter as the shaft.

Canoe Carried Single-Handed on Shoulder Sling



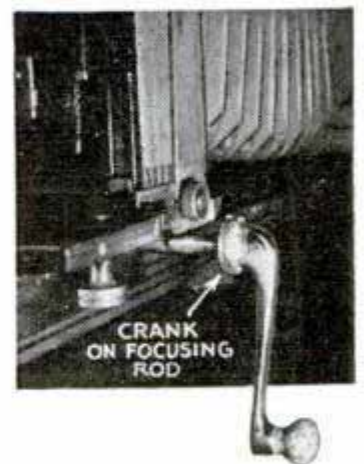
Carrying a canoe around shallows and rapids is less back-breaking when you use this sling

Sportsmen who employ a light canoe on their hunting or fishing trips are often obliged to carry it around rapids or shallows. If two pieces of broomstick are provided with a canvas shoulder strap, as shown, they may be used to carry the boat much more conveniently. The ends of the handles fit into iron brackets screwed to the inner surface of the canoe.

—G. E. Hendrickson, Argyle, Wis.

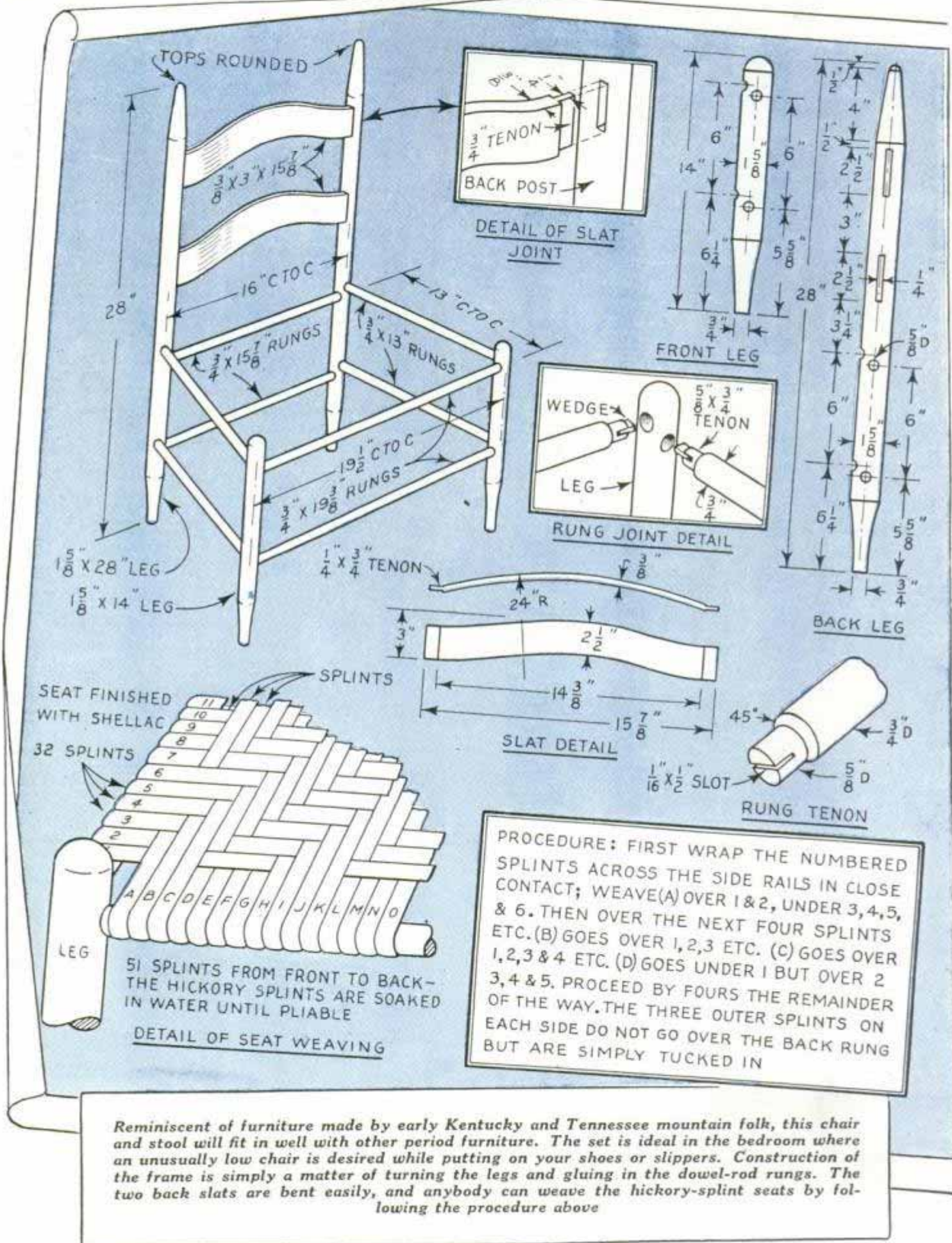
Focusing Knob on View Camera Has Crank for Turning

I have found that considerable time can be saved by providing the focusing knob on my view camera with a crank so that it can be operated faster and easier than with a regular knob. The crank I used was taken from an old car window-raising mechanism. It was soldered to the knob. However, if desired, the end of the shaft can be shaped to fit and the crank keyed to it.

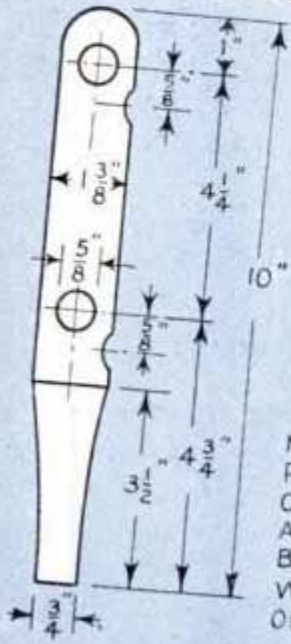
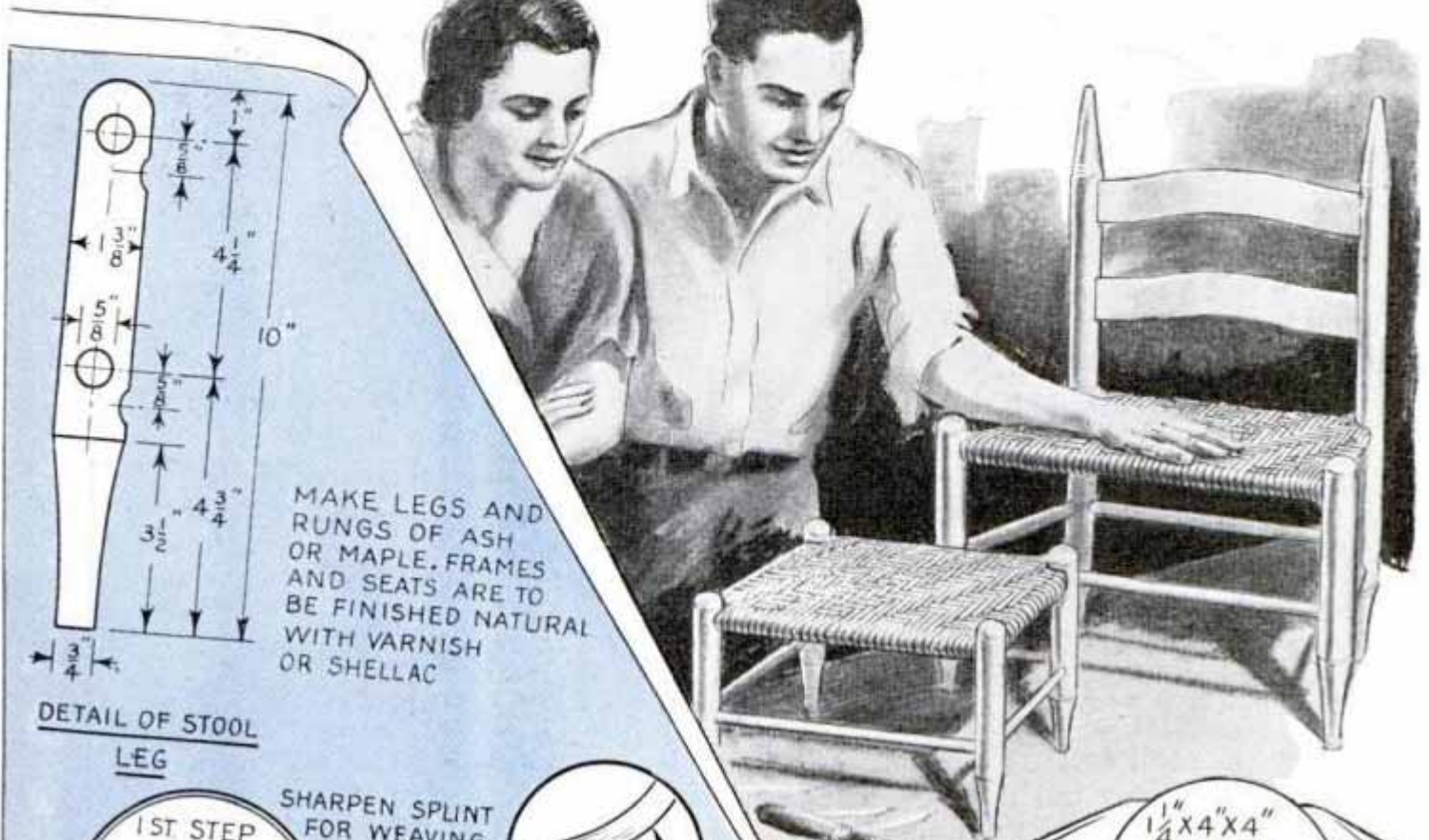


—Arthur Trauffer, Davenport, Ia.

SLIPPER CHAIR and STOOL



for your Colonial Room

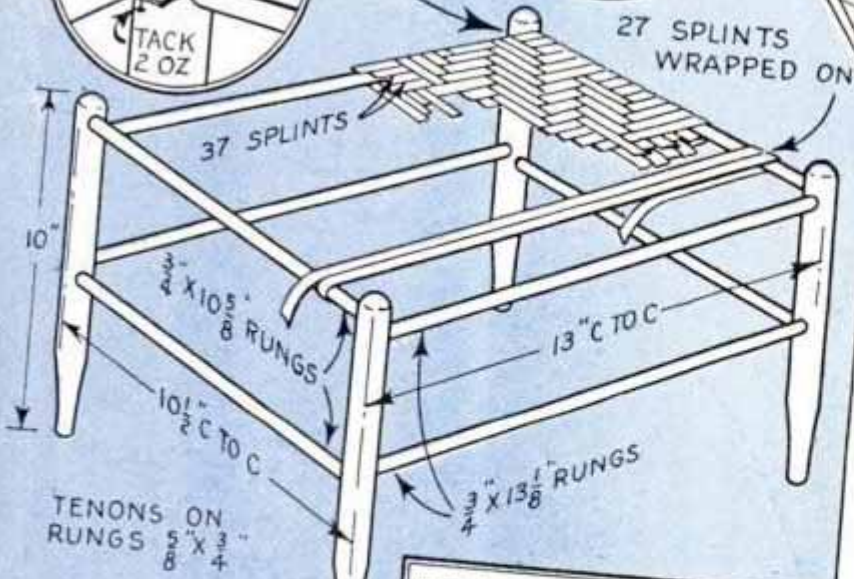


MAKE LEGS AND RUNGS OF ASH OR MAPLE. FRAMES AND SEATS ARE TO BE FINISHED NATURAL WITH VARNISH OR SHELLAC

DETAIL OF STOOL LEG



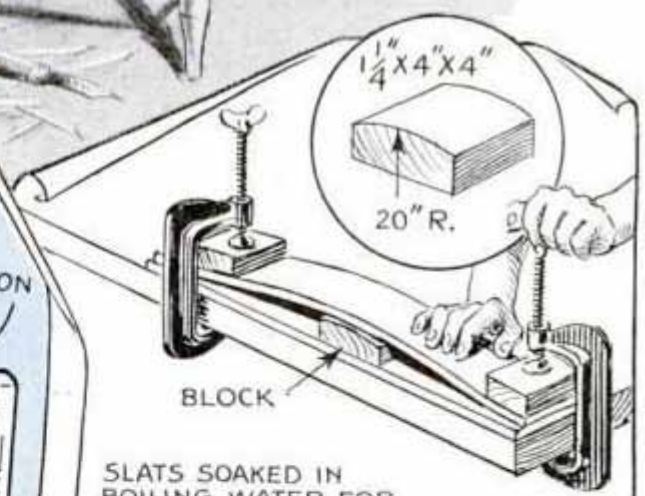
SHARPEN SPLINT FOR WEAVING



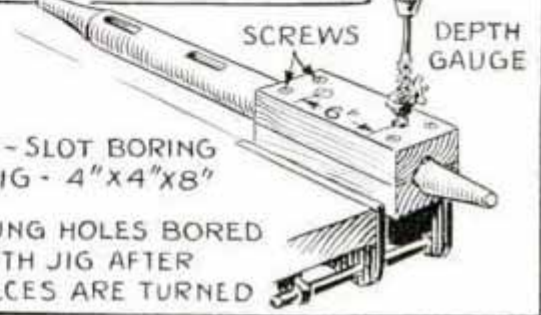
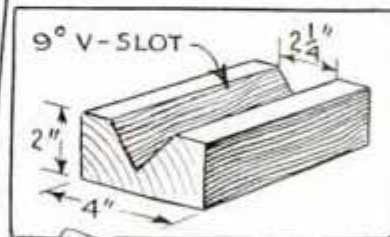
NOTE THAT SEAT WEAVING IS IDENTICAL TOP & BOTTOM

STOOL CONSTRUCTION

SPLINTS ARE OVERLAPPED 2" ON UNDERSIDE TO FORM SPLICE. ALL SPLINTS ARE APPROXIMATELY $\frac{1}{32}$ " X $\frac{3}{8}$ " HICKORY



SLATS SOAKED IN BOILING WATER FOR BENDING - THEN SAWED TO SHAPE



RUNG HOLES BORED WITH JIG AFTER PIECES ARE TURNED

Block Chained to Steel Fence Post Simplifies Driving



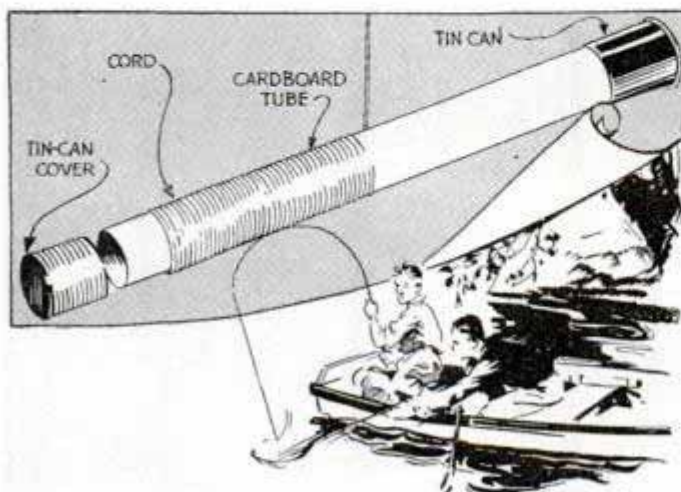
Block is easily slipped over the post which can then be driven down by striking the block

Driving of steel rods or fence posts is simplified by using a hardwood block, which is chained to them as indicated. Notches should be cut in the sloping side of the block to keep the chains from slipping, and the rear side should be rounded or cut to a V-shape to fit snugly against the post.

—Alfred E. Dolph, Montour Falls, N. Y.

Case to Carry Fishing Rod from Cardboard Tube

An ordinary cardboard tube of the proper length and diameter is readily convert-



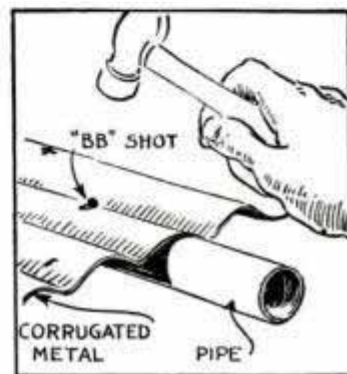
Cardboard tube impregnated with hot paraffin and wrapped with cord provides a case for fishing rods

ed into a handy case for carrying two or three fishing rods. After impregnating the tube with hot paraffin—applied with a brush—take two small tin cans, remove the tops and slip them snugly over the ends to provide a cover and bottom for the case. The latter should fit tightly so that it will not slip off, while the cover should be a snug sliding fit. Wrap the tube closely with stout cord or fishing line, also wrap each can. Then give the entire assembly several coats of varnish or shellac.

—J. D. Taylor, Detroit, Mich.

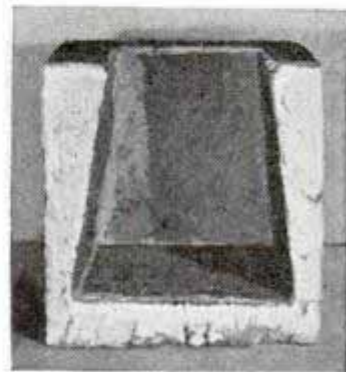
Air-Rifle Shot Repairs Roofing of Corrugated-Metal Type

On a job where I had to use some old corrugated-metal roofing, which had a good many nail holes in it, I quickly repaired them with air-rifle shot. The roofing was laid on a 2-in. pipe that served as an anvil, after which a shot was placed in each hole and riveted into it with a hammer. It's best not to pound the shot any more than necessary to seal the hole tightly. This method of repairing is also ideal for small holes in any metal or tin container.—A. L. Toews, Angwin, Calif.



Heat Retainer for Torch Flame

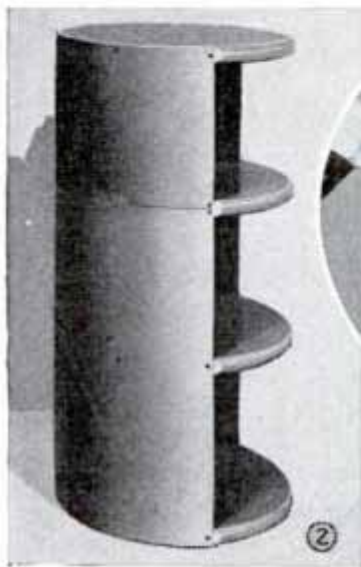
An inexpensive "furnace" that will concentrate the heat of a small blowtorch is constructed from asbestos stove lining. For the one shown in the photograph, a wood frame was built the required size, and the lining material was mixed according to instructions and packed into it. After the mixture had set thoroughly, the frame was removed and for several days it was kept on the workshop stove.



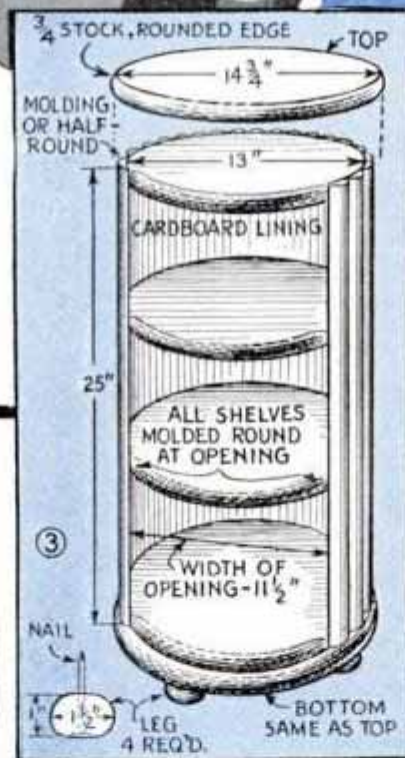
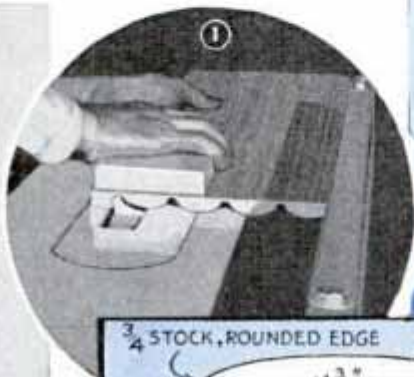
—W. F. Messenger, Ballston Spa, N. Y.

Circular NIGHT TABLE

WITH its reeded, column motif, this table is in keeping with the modern trend in design, and if desired, it can be reduced in size to make a smoking stand, or enlarged to form a corner cabinet. Two of these units provided with a rectangular top having round ends, make a smart dressing table when combined with a large



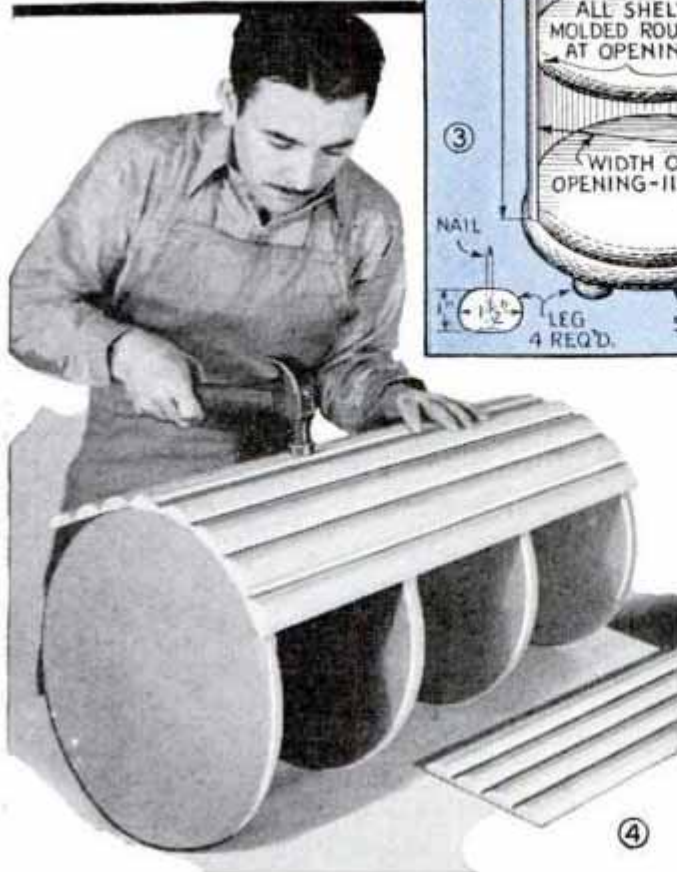
Cardboard forms a false backing over which the molding is applied



circular wall mirror. The reeded effect is best secured by molding wide stock on a circular saw, as shown in Fig. 1. After the molding has been completed, each

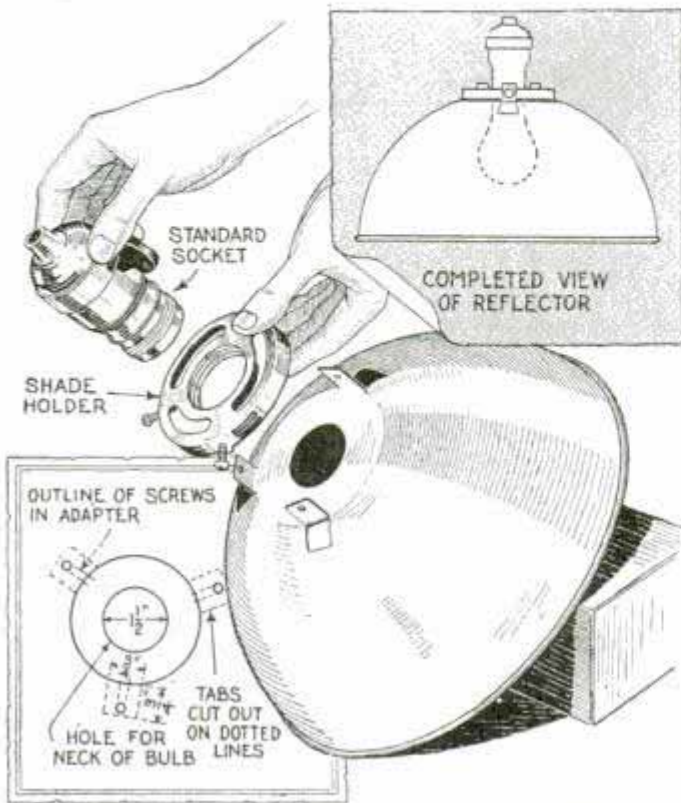
bead is sawed almost apart on the flat side, so that it will bend without breaking. Lacking the equipment to cut the molding, excellent results can be obtained by using strips of half-round molding. Fig. 3 shows the general construction and dimensions of the table. The top and bottom are beaded all around on

a shaper or circular saw, the four intermediate disks or shelves being molded for the width of the opening only. As the molding will not seat snugly against the disks, they are first covered with thin cardboard, Fig. 2, to give a finished inside effect. The cardboard should be the same color as planned for the rest of the project. The molded strips are then nailed in place, Fig. 4, after which the top, bottom and legs can be added. The finish is preferably lacquer or paint, either in a single color or a two-tone effect.



4

Easy Way of Mounting Reflector on a Lamp Socket

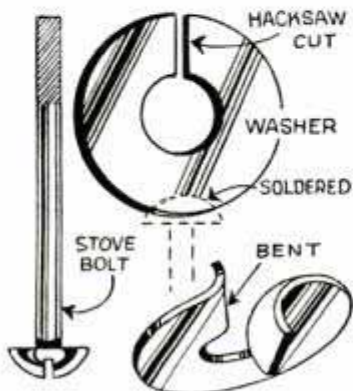


You can attach a homemade reflector to a lamp socket easily by using a holder that takes a glass shade

When you have occasion to attach a homemade reflector, such as the type made from an aluminum mixing bowl, to a lamp socket, try the method shown. First get a regular glass-shade holder of the type that screws onto the end of the socket. Then form tabs in the reflector and bend them up and drill them to take the screws in the holder.—John G. Roberts, Chicago.

Paint Mixer for Drill Press from Bolt and Washer

Adaptable to a hand drill or drill press, this simple paint mixer can be assembled by anyone in a few minutes. Just get a long stove bolt or rod with one end threaded and a washer that will almost slip over the head of the bolt, or one that is a tight fit on the rod. Then cut through one side with a hacksaw, and bend the severed edges in opposite directions as indicated.

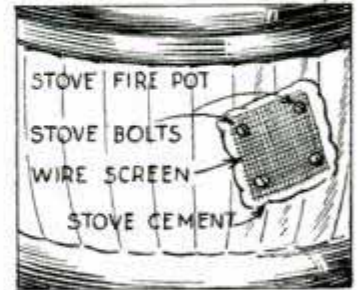


Solder this to the head of the bolt or the rod, chucking the assembly in the drill and you are ready to mix the paint.

—Dale Van Horn, Lincoln, Nebr.

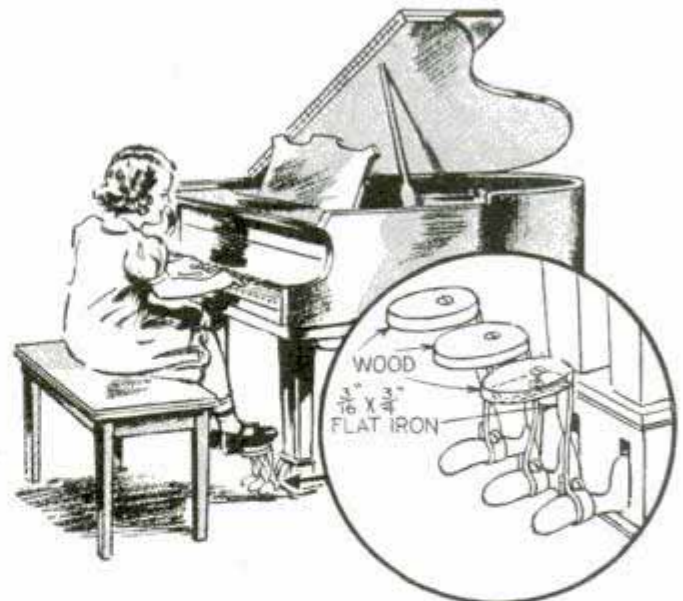
Reinforcing Patch on Stove

When used to patch a cracked firepot of a stove or furnace, cement usually breaks away unless the mended surface has been filed down to clean



metal before the cement is applied. To avoid this, clean the surface of the metal as much as possible, then drill several holes through it for large stove bolts. After applying a coat of cement, which should be forced into the cracks, place a piece of screen wire over the repair and then apply another coating. Follow this by inserting the stove bolts. A slow fire in the stove will dry the cement so that it will adhere safely and the bolts and wire will keep the patch from breaking.

Extensions on Pedals of Piano for Young Musician



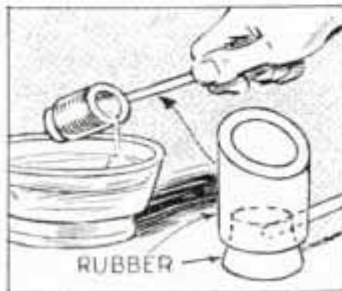
Extensions clamped to pedals of piano enable small child to operate them easily

Young musicians whose legs are too short to reach the pedals of a piano, can operate them if these extensions are attached. Each one consists of a length of flat iron, bent at right angles at one end

for attachment of a wood pad, the other end being bent around the pedal and clamped with a stove bolt. When properly located, the extensions are not in the way for an adult. It is also a good idea to put a piece of rubber or felt around the pedals to avoid marring the plated metal.

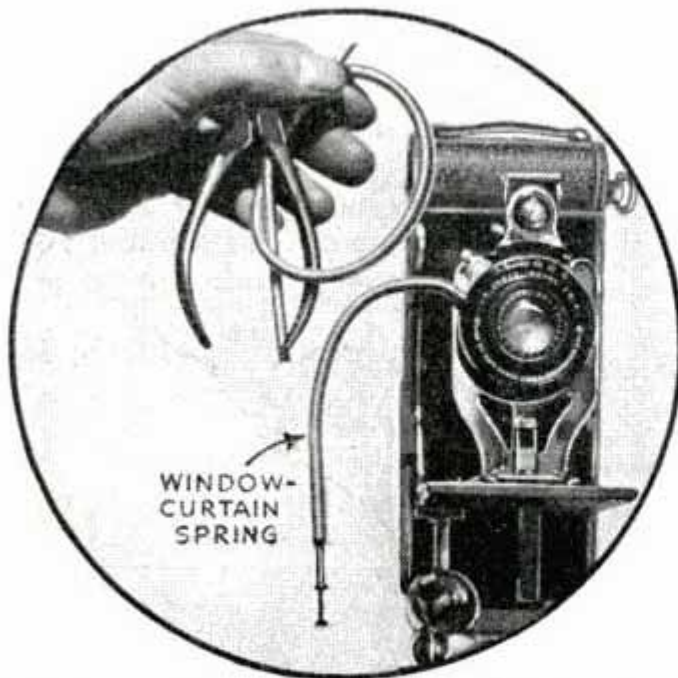
Emergency Acid Dipper

When the acid dipper in the school laboratory became broken, necessitating a substitute, the teacher improvised a suitable one from a piece of rubber hose and a rubber cork. With these two pieces assembled, a hole was drilled through the side, at an angle, to receive a glass tube for a handle.



Camera-Release Cable Shielded by Flexible Armor

Slipped over the shutter-release cable of your camera, a length of window-curtain spring will prevent it from kinking, which may cause it to break. The spring should



Window-curtain spring slipped over shutter-release cable of camera prevents kinking and breaking

reach within an inch of each end of the cable. A spring $\frac{3}{16}$ in. outside diameter is about right, and can be picked up in almost any department or hardware store.

Strap on Golf Bag Is Cushioned to Protect Shoulder

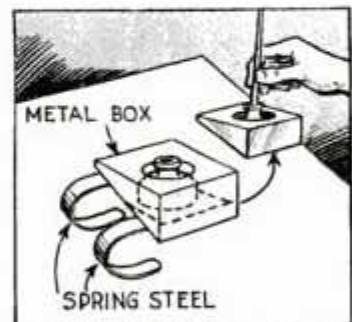


Piece of sheepskin on golf-bag strap serves as cushion against your shoulder when bag is heavy

If the strap on your golf bag makes your shoulder sore, take a piece of old sheepskin and mount it on the strap with the wool inside, as indicated in the circular detail. If there is no sheepskin available, an old coat lining will serve the purpose, or you can use a ten-cent car polisher.

Holder on Your Drawing Board Keeps Ink Bottle Vertical

The problem of keeping an ink bottle in a vertical position on a drawing board was solved with this simple holder, which can be made from thin sheet metal or a small tin box. If the latter is used, remove the bottom and taper the sides so that they are about one third as wide at one end as at the other. Then solder the bottom in place, and rivet two spring-steel clips to it, bending them as indicated, to slip over the board.



—Opie Read, Jr., Chicago.

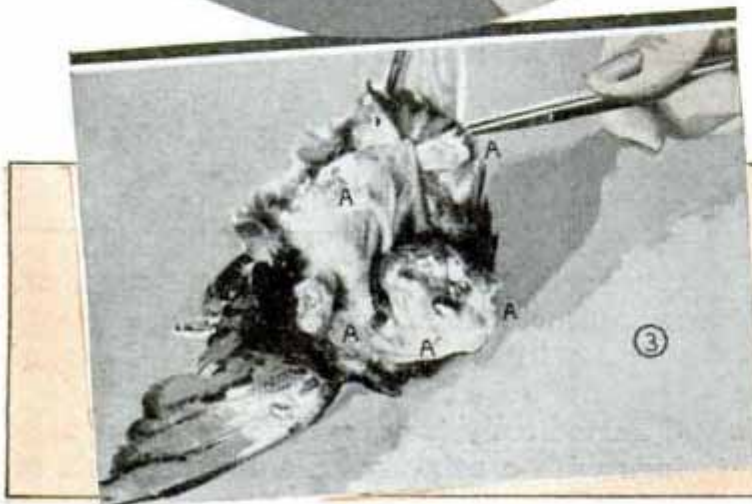
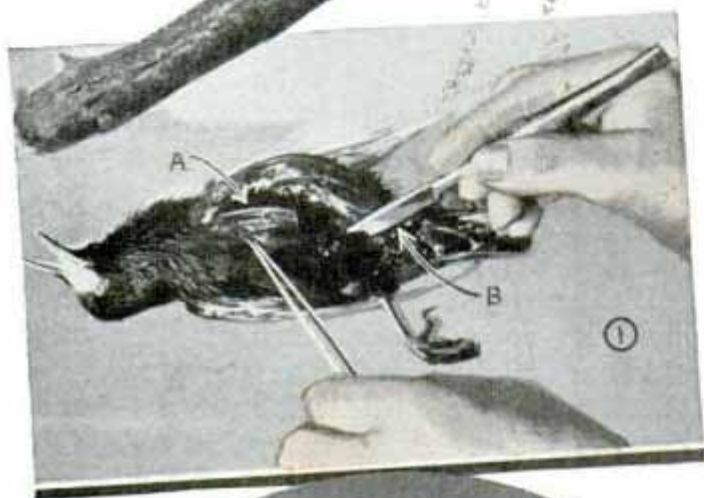
☐ Periodically treating leather book bindings with a mixture of equal amounts of castor oil and paraffin, will preserve them.

It's Fun to

By

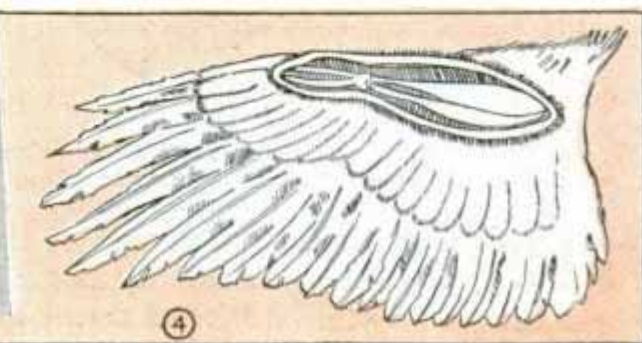
John William Moyer

Staff Taxidermist
Field Museum of Natural History



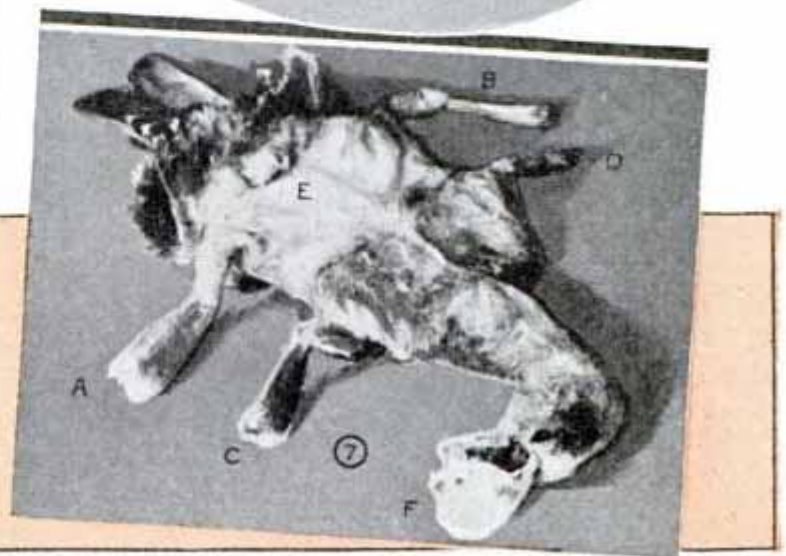
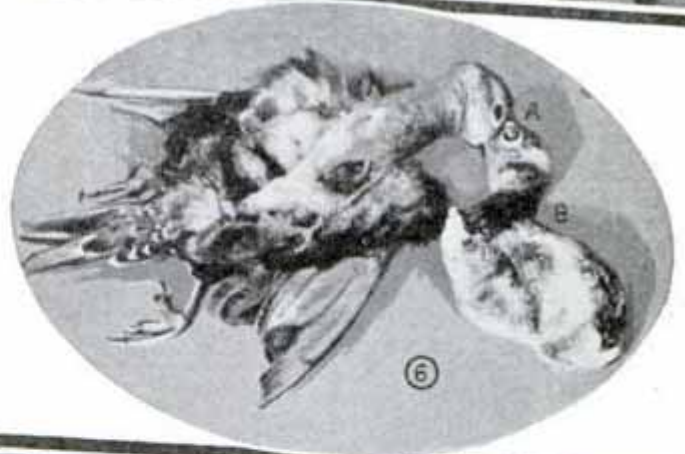
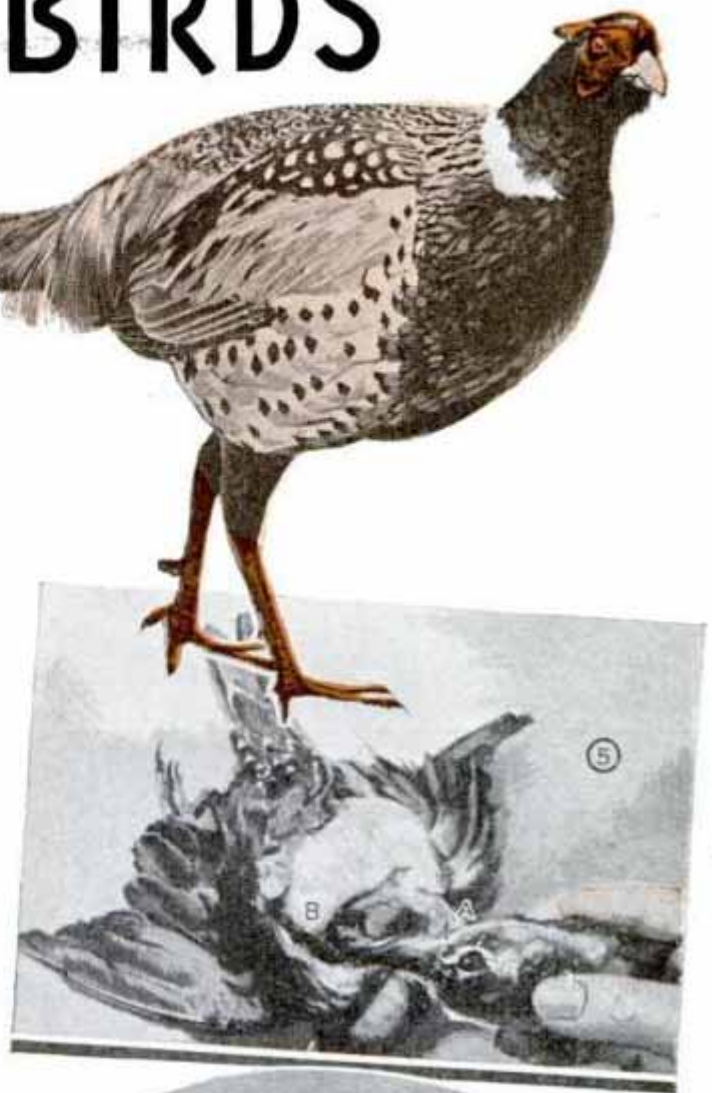
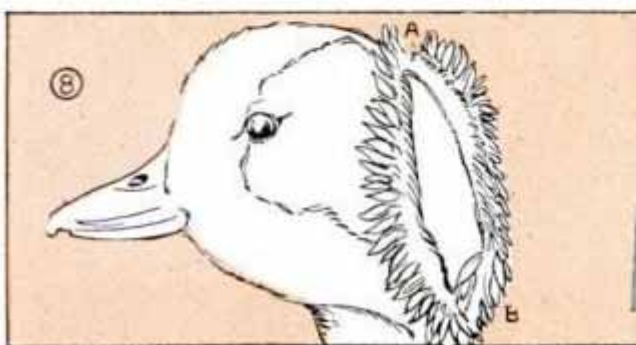
FEATHERED trophies of hunting trips, pets and wild birds large or small, can be mounted in lifelike poses if you know the methods used by the taxidermist. A razor-sharp penknife or scalpel, wire, excelsior and a bit of patience are about all you need for the job. However, when you go afield for specimens, remember that practically all songbirds are protected by law. There are many common species not classed as songsters which may be taken lawfully at any time of the year, but for humane reasons and the fact that the plumage is generally at its best during the late fall and winter months, one should not take any birds during the nesting season.

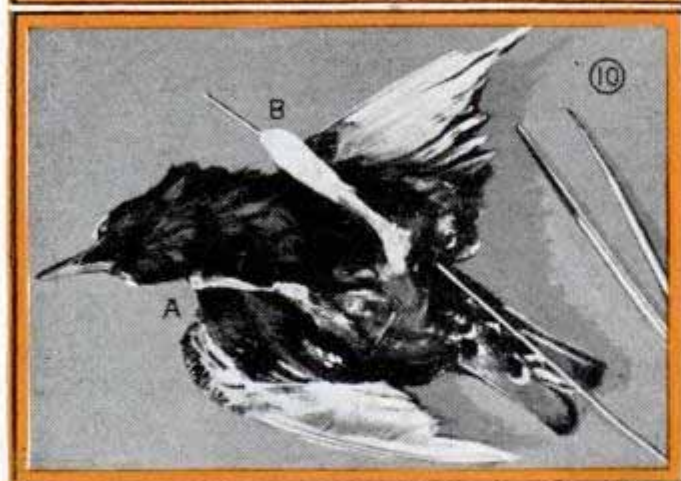
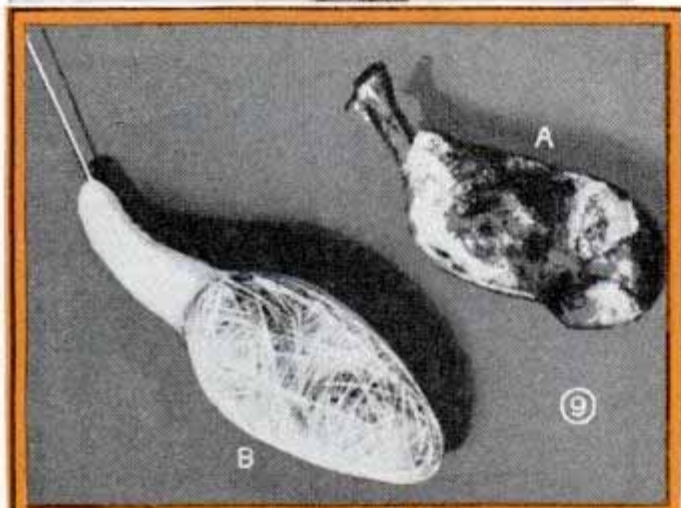
A starling is a good subject to begin with as this bird is quite common, not classed as a songster and is easy to skin and mount. Get one that is without broken bones, and is free from blood



MOUNT BIRDS

and dirt. In the mounting of birds, remember to keep the feathers clean and in order at all times. The first step is to make a note of the color of the eyes, bill and feet, also any other fleshy parts, so that the colors can be restored later with paint. Wipe off any blood on the plumage, using a wad of cotton. Plug up the mouth and nostrils with cotton, to keep blood and body juices from running out and staining the feathers while skinning the bird. Now lay the bird on its back, with its head pointing to your left, and part the feathers along the breastbone with the fingers. With a scalpel, or sharp knife, make an incision from the tip of the breastbone to the vent, as shown in Fig. 1, A to B. Be careful not to cut through the abdominal wall which is very thin at this point and sift plenty of common borax in the incision as soon as made. The borax absorbs the body juices, and keeps them from running over the feathers. It also preserves the skin. Work the skin down each side of the bird with the fingers and blunt end of the knife toward the backbone until the legs are reached. Holding the leg on the outside, the knee is forced upward from the body. Now, with a pair of scissors, or the knife, cut the leg from the body at A, Fig. 2. Do the same with the other leg.

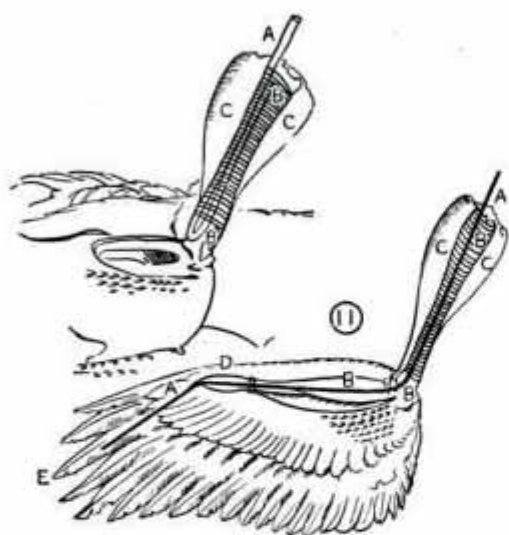




The next step is to stand the bird up on its breastbone and cut the tail close to the body. Using your fingers and the knife, carefully work the skin down over the back toward the wings. The legs and tail are severed as in A A in Fig. 3. When the wings are reached, use the scissors and sever them from the body. In Fig. 5, A, the

wing is still attached to the body and at B it has been severed. Work the skin down over the neck, being careful not to stretch it while doing so; keep on working it until the skin goes over the head. Birds with the head larger than the neck opening, such as ducks and geese, will have to be skinned from the outside, as in Fig. 8, making the cut from A to B. In skinning the head, care must be exercised not to cut the skin around the ears and eyes. The skin is worked down over the head to the bill and left attached as at A, Fig. 6. The head is now severed from the neck where it joins the skull, at B, Fig. 6. After the head is cut away from the body, the legs and wings are skinned down from the inside. Work the skin of the legs down to the joint where the feathers end. In the wings, work the skin down over the bones, so the flesh that is on the outer part of the wing bones can be reached. Use plenty of borax at all times in the skinning so the skin will be well preserved. The skin, skull, leg and wing bones and the tail must now be cleaned of all remaining flesh and muscles. With a pair of forceps remove the eyes from the skull. Make a larger opening in the brain cavity and remove the brains. Cut away all flesh and face muscles and clean the skull thoroughly. The leg and wing muscles must be cut away, but leave all the bones as they must be used in the mounting of the bird. In Fig. 7, A shows the muscles on the leg bone; B, the leg bone cleaned; C, the muscles on the wing bones; D, the wing bones cleaned; E, the flesh around the tail cleaned and F, the skull cleaned of all flesh. On large birds, the wings will have to be opened on the underside to remove the meat and muscles. In Fig. 4, we see how this is done. In cutting the muscles away from the wing bones, do not disturb the feathers on the opposite side which are attached to the wing bones.

Any flesh remaining on the skin must be removed by scraping with a dull knife. Birds such as ducks, geese and others that are very fat, will have to be cleaned thoroughly to remove all fat and grease from the skin. After scraping, the skin is sponged over with naphtha, or benzine, to remove this grease. When the skin is thor-

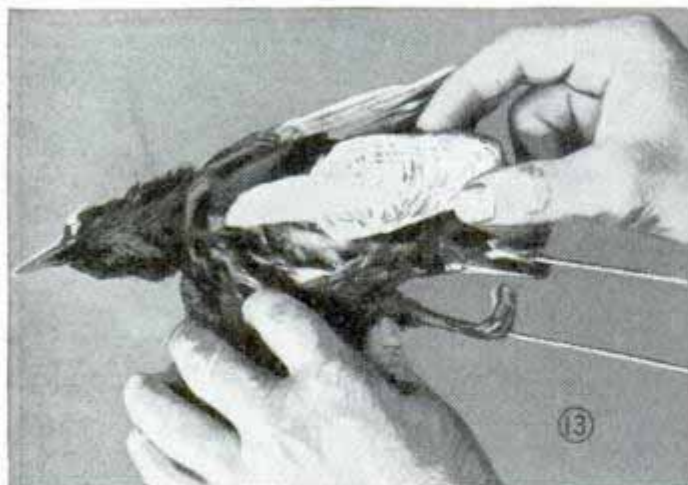


oroughly cleaned of all flesh, fat and dirt, it is ready to be preserved. A good preservative is a saturated solution of borax water, made as follows: Warm water, 1 quart, carbolic acid, $\frac{1}{2}$ teaspoonful, and add all the powdered borax the water will take up. Keep in a glass container. Before applying this solution make certain the skin is clean and free from all powdered borax. Then, paint the borax water over the inside of the skin taking care to cover all parts. Insert cotton into the eye cavities and turn the head and neck right side out. Do the same to the legs and wings. Straighten out the feathers so they will take their proper order in the feather pattern. Now you're ready to proceed with the mounting. Remember that the skull, and the wing and leg bones are left attached to the skin, as these are needed to shape the bird. To get the natural contour it is necessary to make an artificial body and to cut wires that are to support the bird. For the starling, the wires do not have to be heavy. Cut two leg wires, No. 18-ga., about 12 in. in length and sharpen each on one end. Cut one No. 20-ga. wire about 8 in. in length and sharpen on both ends. This is the neck and body wire. Cut another No. 20-ga., about 6 in. in length and sharpen on one end. This is the tail wire. One will soon learn to judge by the size of the bird he is mounting just what size wires to use.

Now to make the artificial body that is to go into the bird. Take some very fine, damp excelsior (having it damp makes it easier to handle) and using the natural

body we removed from the bird as a model, carefully wrap the excelsior with a strong, fine thread until it takes on the same size and shape as the original body. Be sure and copy the body correctly in all details in the excelsior. After you have the body made, run the neck and body wire through it and clinch one end securely. Now measure the original neck of the bird and by wrapping cotton around the neck wire, build it up, layer by layer, until you get the artificial neck the same size as the natural one. In Fig. 9, we see the natural body of the bird, A, and the artificial body and neck, B. The wiring of the legs is next. Take each of the leg wires and, starting at the bottom, or pad, of the foot from the outside, run the wire up the inside of the leg and along the leg bone. Now wrap cotton around both the wire and leg bone, to take the place of the muscles that were cut away. In Fig. 10, is shown at A, the leg bone before being wired and at B, the leg is wired and the muscles are replaced with cotton.

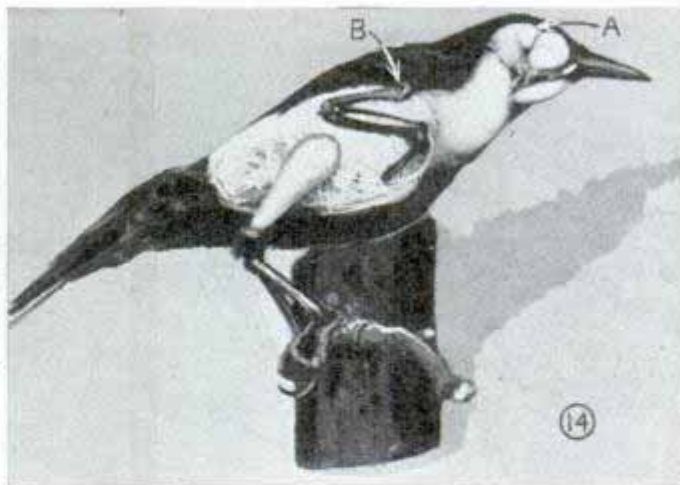
In the mounting of a bird of this size, it is not necessary to wire the wings, but we must do so in larger birds. In Fig. 11, the upper detail, we see how the wings in a large bird are wired. The wing wire, A, is laid along the wing bone, B, and tied securely in place. Cotton, or tow, is wrapped around the bone and wire to take the place of the muscles that were cut away. This is shown at C. In the lower detail, we see how the wings are to be wired if we should want to mount the bird in a flying position.



The wing wire, A, is laid along the wing bones, B (the wire follows along the wing bones, making a sharp bend at D and is then inserted into the base of the third feather, E). The wire is tied to the wing bone and cotton, or tow, replaces the muscles, C.

We are now ready to put the artificial body into the skin. Fig. 13 shows how this is done by inserting the neck wire up and out through the top of the skull. Fig. 14 shows the mounted bird with one-half of the skin and feathers removed. We see here how the different parts are joined together. The neck, with the neck wire protruding through the skull (to hold it firmly in position) is shown at A. The wings are next wired into position in the body, at B; then the legs, and the tail last. After all the wires are anchored in their proper places, the skin is ready to be sewed together. Using a small needle and fine thread, start at the bottom of the cut and sew toward the breast. Take small stitches and do not catch any feathers as you sew. When finished, lift the bird up by the legs and give it a gentle shake. If the body has been made correctly and the wires anchored in their proper places, the feathers will fall naturally into position. The bird is now ready to be placed on its perch, which can be made of any natural tree branch, or log, that suits your taste. It is fastened to the perch by running the leg wires down through two small holes bored in the branch and fastening them into place on the underside. See illustration above Fig. 9.

Now comes the most interesting part of the whole process—giving the bird a life-like position; one that will look natural when finished. The neck, wings, legs and

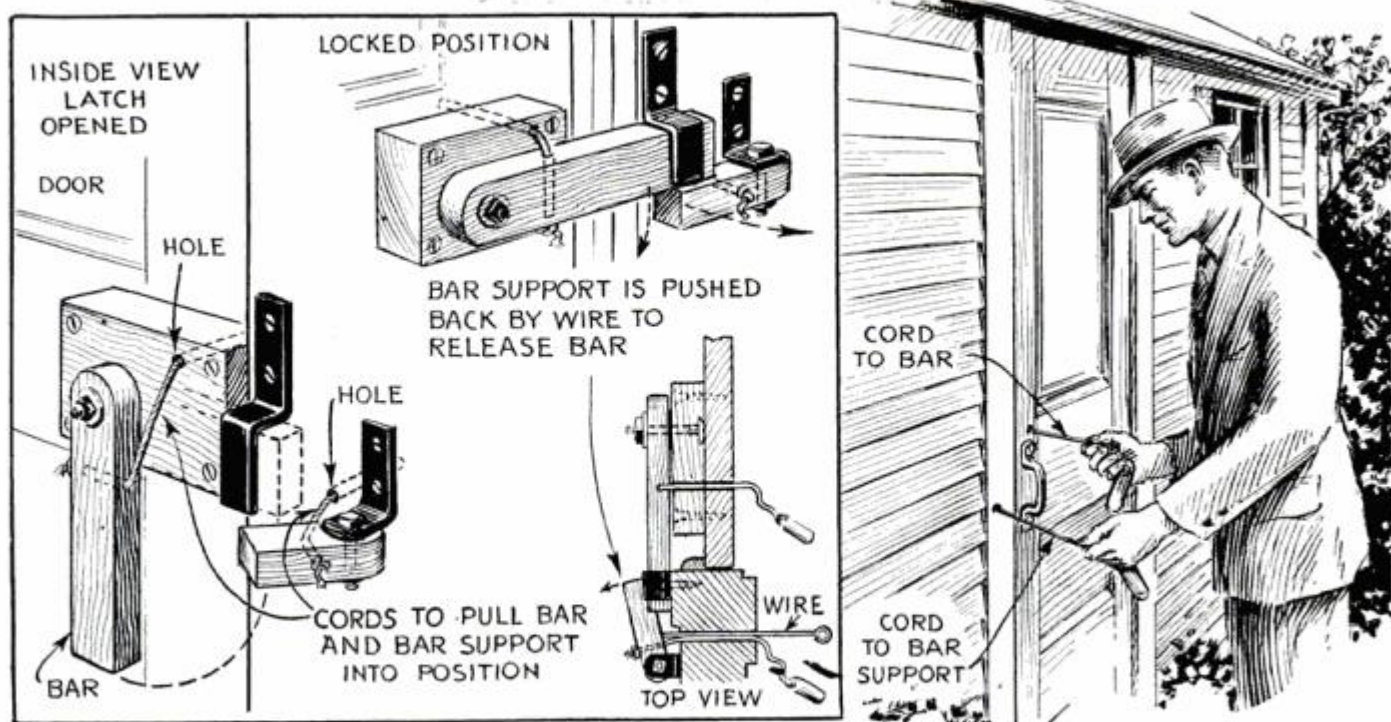


tail are manipulated until the mounted bird takes on a natural-looking pose. To do this, one must know and observe the position live birds assume in their natural habitat. Arrange the feathers in their proper order and by the use of small wires, or pins, the wings are held in position. Put a small wad of cotton in the throat cavity, to fill it out, not too much, and tie the bill securely shut. Pin the toes to the branch and spread the tail feathers, holding them in position with two strips of cardboard until dry. Small pieces of cardboard can be used to hold down any feathers that have a tendency to bulge out of place. After the bird is shaped and all feathers arranged in order, wind them down with a very fine, light thread to hold in position until dry. Fig. 12 shows the bird (a Mallard duck) ready to be put away to dry, which will take about 3 or 4 weeks for a specimen of this size.

While working on the bird, have damp cotton in the eyes to keep the eyelids relaxed. The eyes are now set in place with thick library paste. In selecting the eyes, refer to the color notes taken at the time the bird was collected and obtain from a taxidermy supply house the proper pair of glass eyes for this particular specimen. Use plenty of paste to hold them in the eye sockets and be sure you get them set at the correct angle and depth.

When the specimen is thoroughly dry, remove the thread and cardboard and cut off all protruding wires. Now, again referring to the color notes taken, restore to the bill and feet the colors that have faded, or disappeared entirely. Oil colors are best for this, but do not apply too heavy, or you will get a painted and not a natural appearance.

Keyless Garage Lock Is Operated by Strings

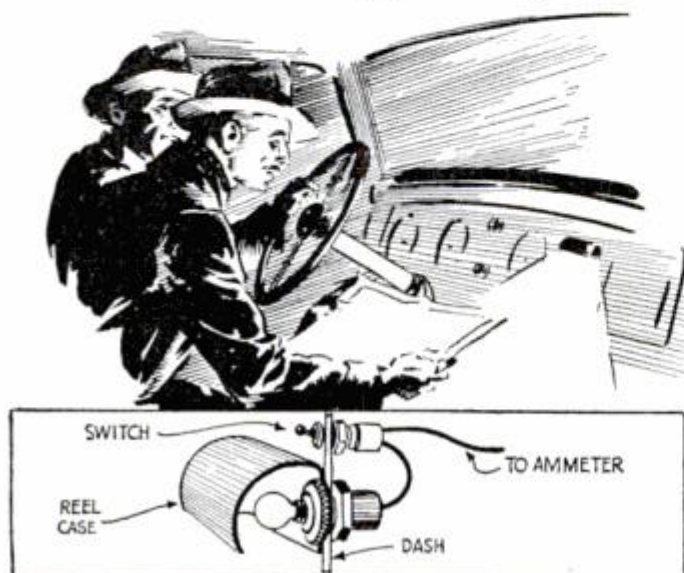


Unless you know the "combination," this trick door lock is a real poser, for there is nothing on the outside of the building that even looks like a lock—merely two cords hanging from holes, one in the door and the other in the frame. However, it's an effective and practical lock for a garage, poultry house or other outbuilding. Looking at the details you will see that there are two pivoted members, the larger supported by the smaller when the arrangement is in the locked position. And now for the secret of the whole thing: To re-

lease the lock you insert a short length of wire into the hole in the door frame. This pushes the bar support back and allows the bar to fall, whereupon the door can be opened. To lock the mechanism you close the door, then pull the cord which swings the bar up into position. Hold this cord tight and pull the second to swing the support under the end of the bar. That's all there is to it. Use hardwood for all parts except the bracket and stop, which should be of $\frac{1}{4}$ by 1-in. flat iron.

—C. N. Livings, Batavia, Ill.

Shaded Reading Lamp on Car Instrument Panel Is Handy

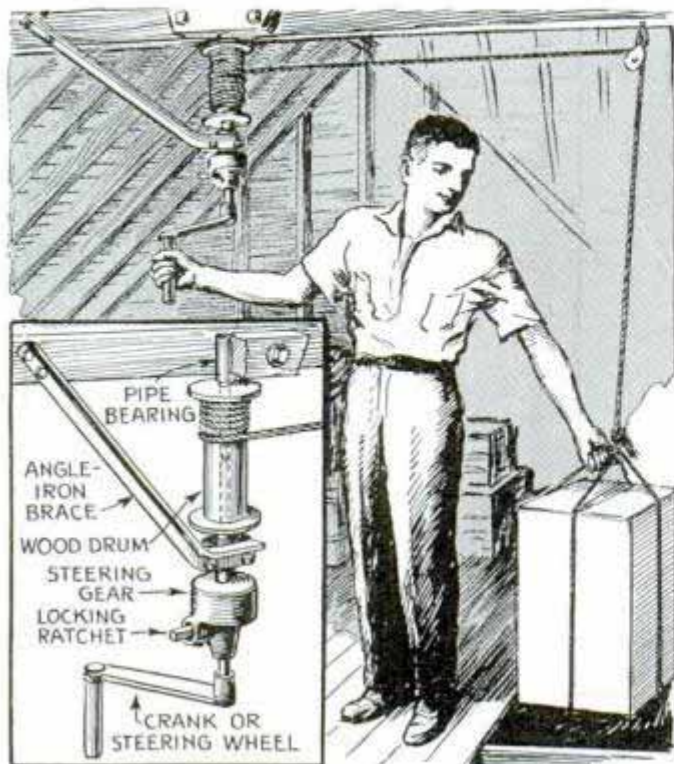


Road maps, shopping lists, etc., are read easily with this lamp on the instrument panel

Some motorists like a shaded lamp on the instrument panel to read road maps, shopping lists, etc., or as an aid in writing notes and addresses. To install a lamp for this purpose just drill the panel to take a 6-volt lamp socket, preferably one of the type that is clamped in place by a thin nut on each side of the panel. A switch to operate the lamp can be installed wherever convenient, and a shade can be shaped from sheet metal and clamped behind one of the nuts. In the one shown, a reel case from a cigar lighter was used. To connect the lamp, run one wire from the socket to the switch and one from the latter to a terminal of the ammeter.

—Ernest F. Hines, New London, Conn.

Small Windlass from Auto Parts Has Many Uses

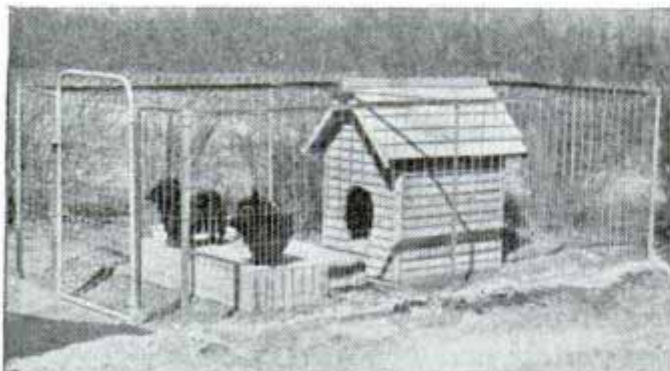


This windlass will save your back when storing heavy articles in the attic

Especially handy for lifting heavy objects around the home, this small windlass is made from the steering gear of a model-T Ford. A wheel can be used instead of a crank if desired. With this hoist, a woman or child can raise articles too heavy for two or three persons to lift without mechanical means.

Compact Dog Kennel Is Neat and Sturdy

Here is a kennel for two small dogs that is very sturdy, and it can be made portable if desired. It consists of a neat, weather-tight house, which is surrounded by a fence strung on a steel frame, this being



Top rails of angle iron welded between the posts prevent sagging of this neat dog fence

nothing more than steel posts braced at top by lengths of 1-in. angle iron welded between them. If the fence is to be located permanently, the posts are set in concrete, but if portability is desired, angle-iron rails are also welded between them at the bottom of the wire. The posts are then cut off about 4 in. from the lower rails, and set temporarily in shallow holes.

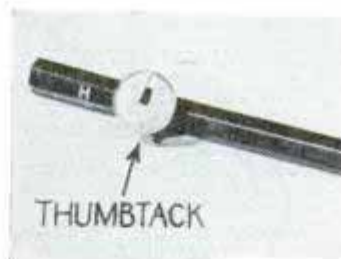
Cracked Concrete Wall Repaired with Flat Iron

When cracks appeared at the corners of a concrete-block wall, flat-iron clamps of the type shown prevented further damage. Long iron rods, which extended diagonally



from opposite corners inside the building, tied the corners together, turnbuckles being used to draw the rods up tightly.

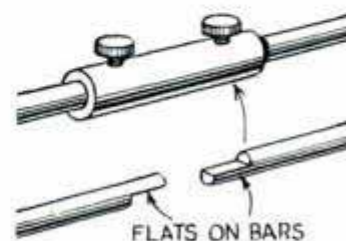
Pencil Kept from Rolling on Desk by a Thumbtack



The office worker who is annoyed by having his pencil roll off his desk when it is laid down, can avoid this trouble by merely sticking a thumbtack into it near the upper end. When not needed, the tack is removed and kept in the desk for future use.

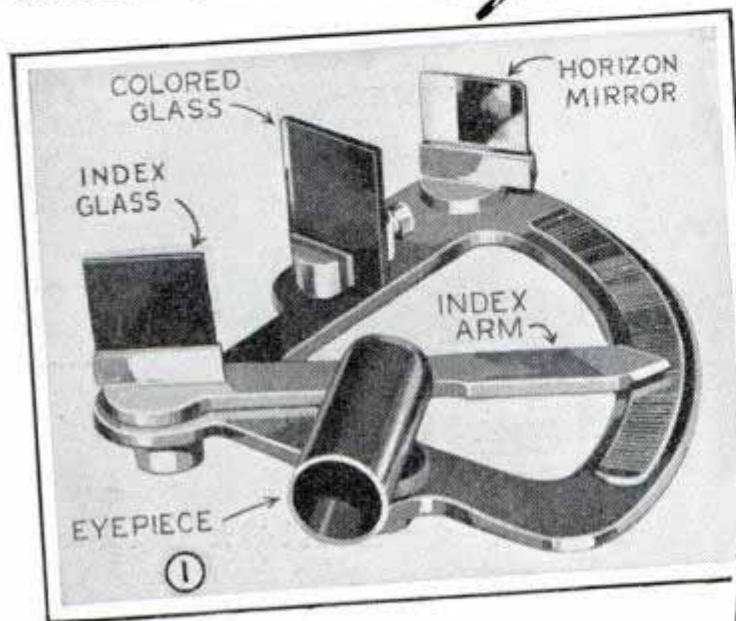
Improvement on Bar Compass

Here is an effective method of preventing the extension bars of a beam compass from turning in the sleeve. The ends of the bars that slide into the sleeve of the compass are merely flattened so that when they are pushed into the sleeve they form a lap joint.



MEASURING DISTANCES

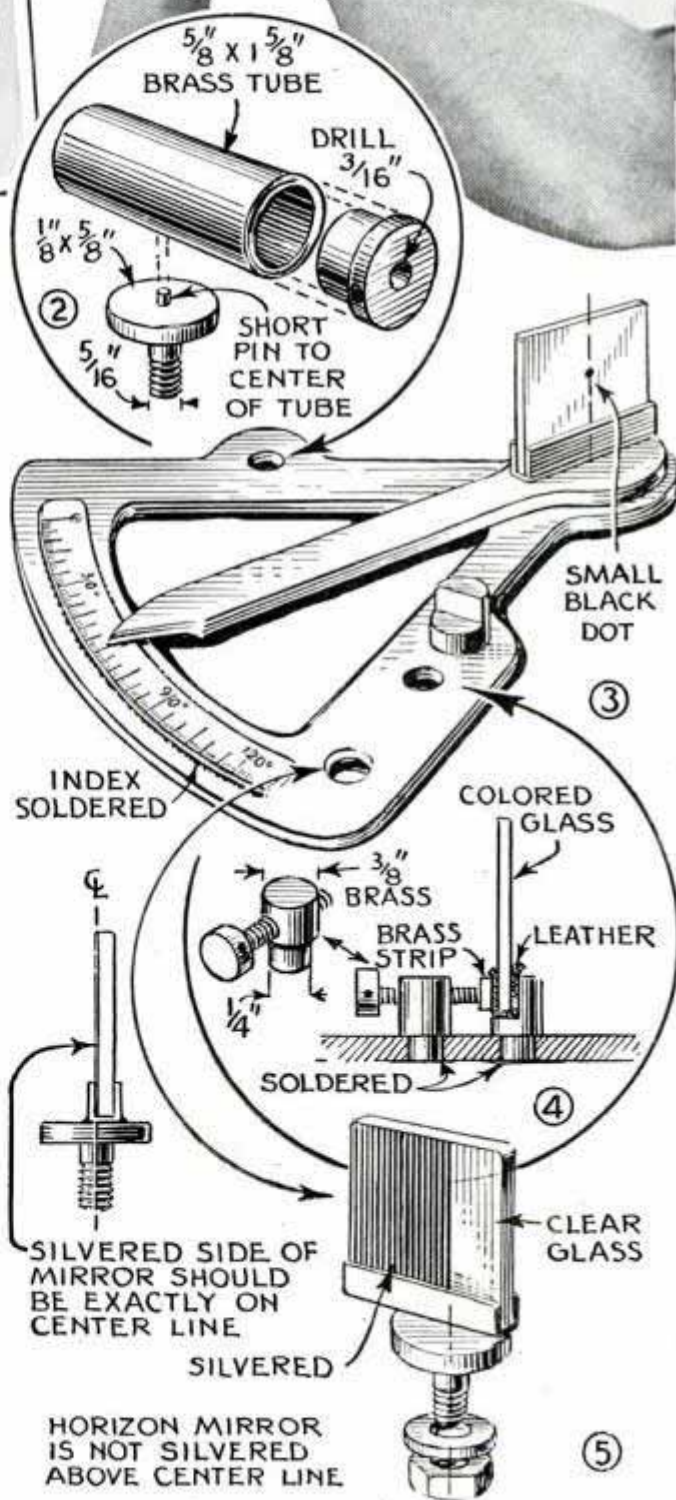
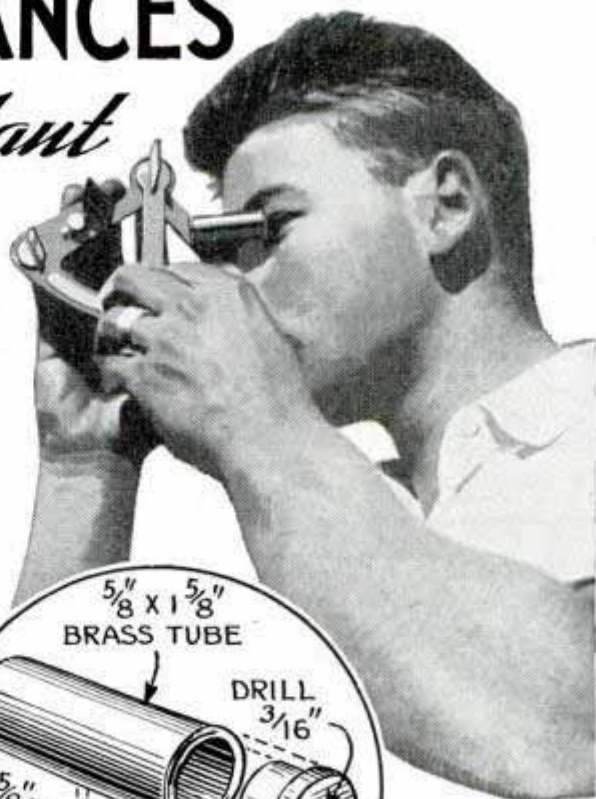
with this simple sextant

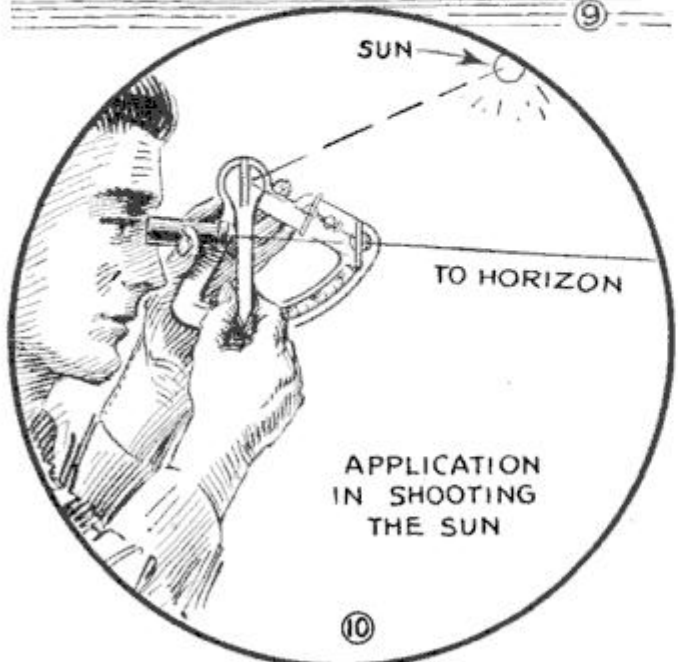
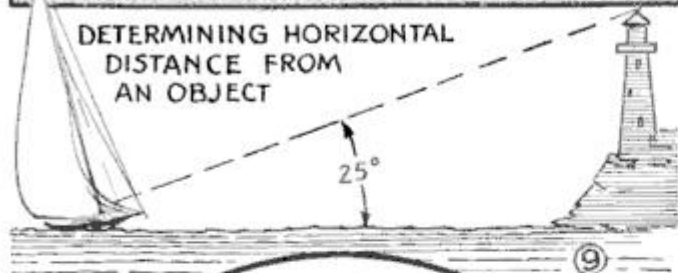
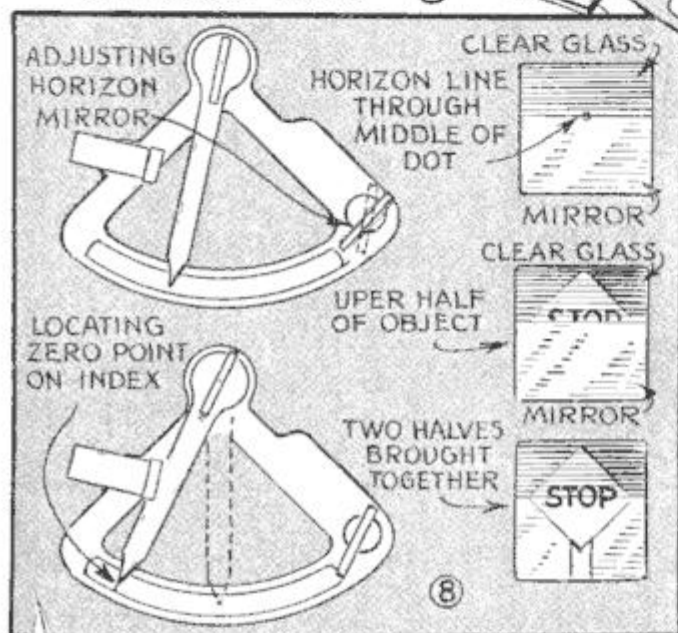
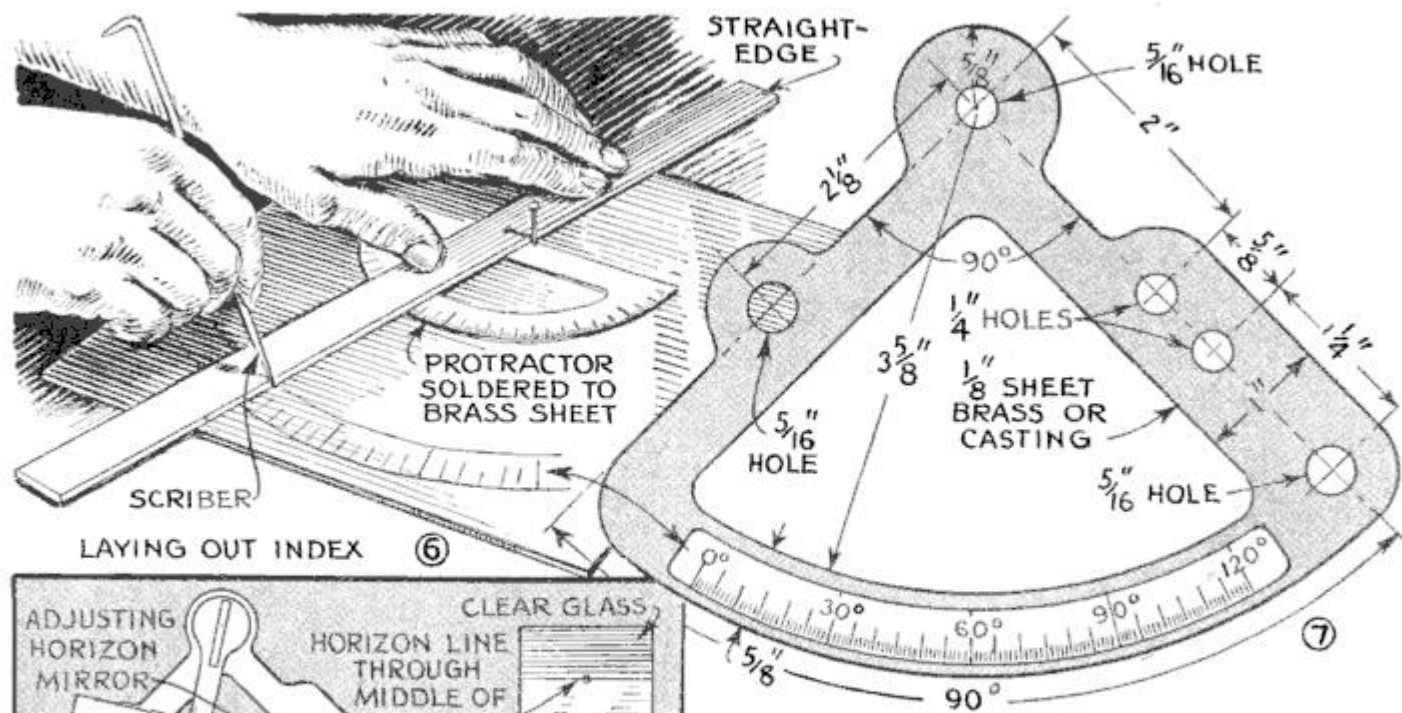


HERE is a sextant with which the amateur can learn the rudiments of navigation. While it is not a precision instrument, it will be found sufficiently accurate for navigating safely out of sight of land under favorable conditions. Other interesting uses are determining the width of a body of water—a very simple problem—or the height of buildings and mountains, or the horizontal distance to an object.

The frame can be cut either from $\frac{1}{8}$ -in. brass sheet or it can be cast in brass. To cast it, you make a wood pattern $\frac{3}{16}$ in. thick and $\frac{1}{8}$ in. larger over-all, to take care of shrinkage in the casting. Figs. 1 and 7 give the relative positions and dimensions of the various parts. The index is only a 60-degree sector, marked in 1-degree intervals. However, for sextant use, each degree counts as two so that the total reads up to 120 degrees. When the index arm points to zero the index and horizon glasses will be parallel. The "eyepiece" has no lens in it, consisting merely of a brass tube with a cap having a hole drilled in the center, Fig. 2. It should be focused in a line with the dividing line of the horizon glass—that is, on the line between the silvered portion and clear glass.

Make the index arm from heavy sheet brass and mount the index glass on the upper end so that the silvered side is exactly on the center line of the axis. This





mirror is 1 in. square and is forced into a brass channel soldered to the arm. A tiny hole should be scraped in the silvered back and a black dot painted thereon, exactly on the line of the axis, Fig. 3. Black shellac on the back of the mirror protects the silvered surface. The horizon glass, Fig. 5, is a mirror of the same size, with a portion of the silver scraped away to a straight line directly on the axis. A square of dark glass is installed between the two mirrors to soften the glare of the sun, and is clamped in the manner shown in Fig. 4.

Fig. 6 suggests a good way of making the index segment. Lay out the arc to 60 degrees at 1-degree intervals. The figures are stamped on with dies and the segment is soldered in place. Now, to adjust the horizon mirror, Fig. 8, the nut holding it on the underside of the frame should be loosened slightly. The index arm can be in any position. Sight through the eyepiece and turn the horizon mirror one way or another slowly until the center of the black dot on the index glass comes right on the line of the horizon mirror, then tighten the nut. To locate the proper position for zero on the index, Fig. 8, sight through the eyepiece at some object a block or two away. Hold the sextant so that just half of the sign appears over the top of the horizon mirror, as in Fig. 6. Then move the index arm until the image of the lower half comes up to meet it, as in the detail, Fig. 8.

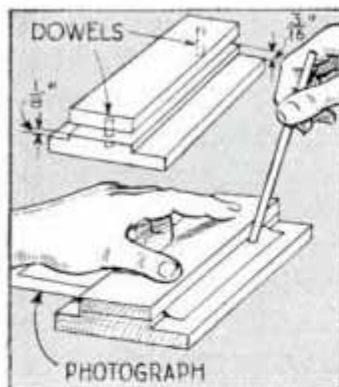
For making simple observations such as the width of a body of water, Fig. 7, select

some prominent object, such as a house, on the other shore. Now pick another object, such as a tree, on your side, but a hundred yards or more along the shore. Hold the sextant in a horizontal plane and set the index arm at 90 degrees. Sight on the tree, and move back and forth until the house across the river comes into view. Mark this point on the ground with a stake, set the index arm at 45 degrees and walk along the shore in the opposite direction until the house again comes into view in the horizon glass. This plots a right-angle triangle, the base of which you measure with a tapeline. The distance across the river will be the same as the number of feet measured.

In Fig. 9 is shown the method of computing distance to shore, given the height of the lighthouse. This method is complicated unless the observer happens to strike a 30 or 45-degree angle to the top of the lighthouse and work it out by geometry.

The method of shooting the sun for out-of-sight-of-land navigation is illustrated in Fig. 10. Of course, making these computations involves a knowledge of the subject acquired only through study.

Mounted Photos Held Securely While Embossing

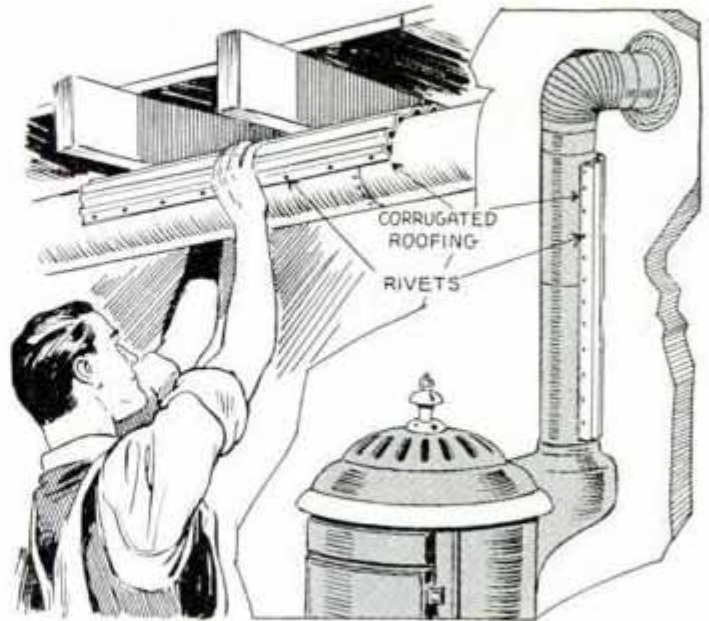


Here is a simple jig that will enable you to emboss or sink the edges of your photo mountings easily. The mounting to be embossed is placed in the jig as shown in the lower detail, and a round-nosed instrument is used to do the sinking. It's a good idea, of course, to dampen the mounting slightly before trying to sink it. The jig consists of two wood blocks, one having $\frac{1}{8}$ -in. rabbets cut in the top surface along the outer edges. The other block, which is smaller, is mounted on the first one, two dowels being provided to hold it in place.

—M. L. Harmon, South Bend, Ind.

ⓘ When removing electric plugs from utensils, grasp the plug, not the cord.

Shielding Walls and Ceiling against Heat of Stovepipe

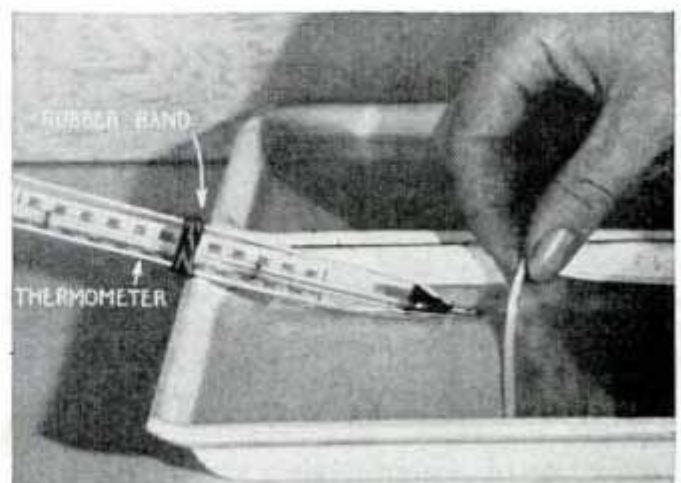


Air spaces under corrugations of sheet iron keep heat from damaging wall

When you have to run a stovepipe close to a wall or ceiling, a good shield can be made from thin, corrugated sheet iron. This is bent about half way around the pipe next to the wall and riveted in place as indicated. Air spaces under the corrugations of the metal keep it from getting hot enough to damage the wall.

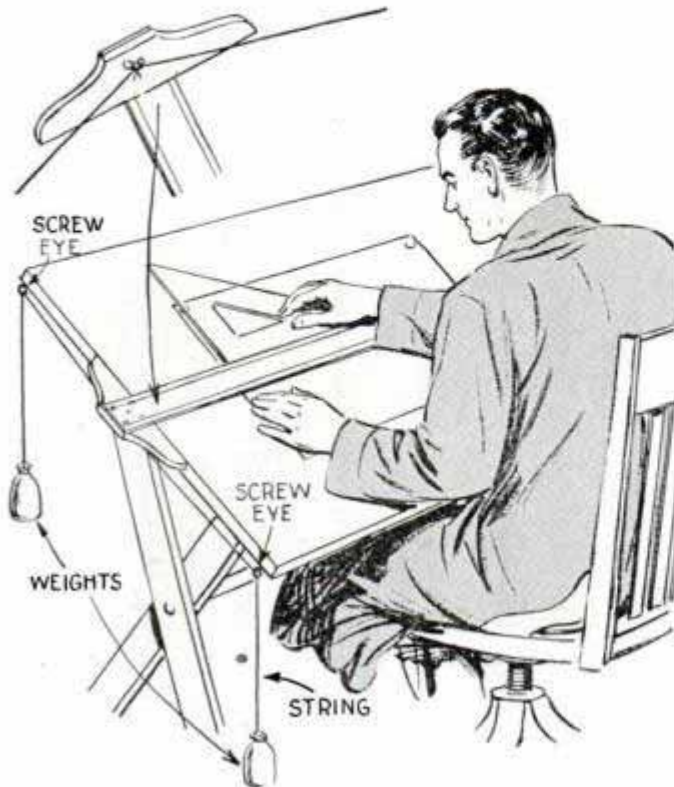
This Thermometer Can't Slip into Developer Solution

Why worry along with a thermometer that slips down into the solution where it is in the way while developing photo prints? Just slip a couple of rubber bands over the thermometer as indicated, so that they will rest against the edge of the pan.



Rubber bands wrapped around thermometer keep it from slipping into trays while developing photos

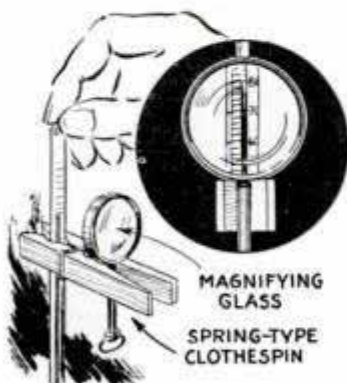
Counterweighted T-Square Stays in Place



Weight-and-string arrangement to hold your T-square in any position on a drawing board

Difficulty in holding a T-square on a drawing board while adjusting a triangle, or doing other work, may be eliminated by the application of two weights and a string as shown. The string is tied to a small screw eye fastened to the T-square and runs through screw eyes driven into the corners of the drawing board, after which weights are tied to the ends. Small tobacco sacks filled with sand will serve as weights. The square is placed on the board in the usual position, where it will remain at rest until moved up or down.

Magnifier for the Thermometer



It consists of a magnifying glass held in a spring-type clothespin, which can be clipped to the instrument in any desired

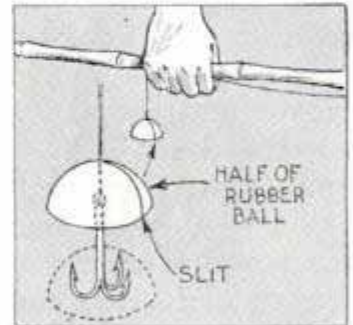
Chemists and others who have to work with thermometers and similar gauges that are sometimes difficult to read from a distance, can improve them with this simple magnifying attachment.

position. A glance through the glass will show the reading, which normally would require very close inspection.

—George J. Vias, Chicago.

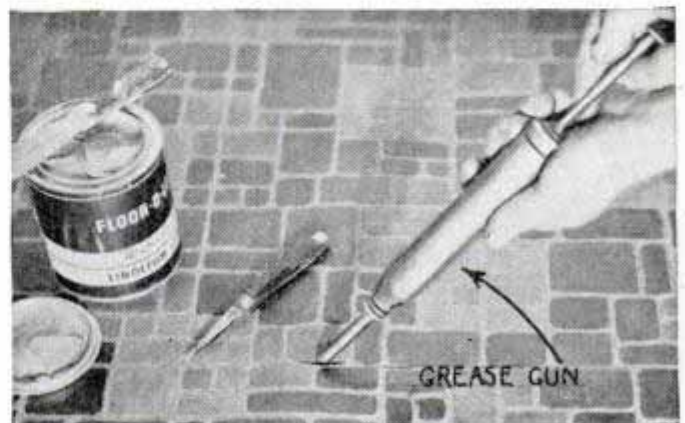
Fishhooks on Line Shielded While Carrying Pole

When moving from one location to another with your fishing pole, a rubber shield to slip over the hooks will keep them from catching in weeds, brush or clothing. The shield is one half of a hollow rubber ball, which is slit from one side to the center so that it can be slipped quickly over the line above the hooks.



Re-Cementing Bulges in Linoleum with Grease Gun

When the cement under linoleum loosened and allowed the latter to bulge slightly in spots, new cement was applied under the bulges, without lifting the linoleum, by means of a grease gun. Just cut a small slit in the linoleum to take the nozzle of the gun and force the cement in place. Then take a rolling pin and roll it in all directions to spread the cement underneath. Wipe up the adhesive that works out of the hole, letting some of it remain in the opening to seal it. The hole usually can be cut in some part of the pattern where it is not noticeable. The repaired spot is covered with paper and a weight applied until the cement dries.

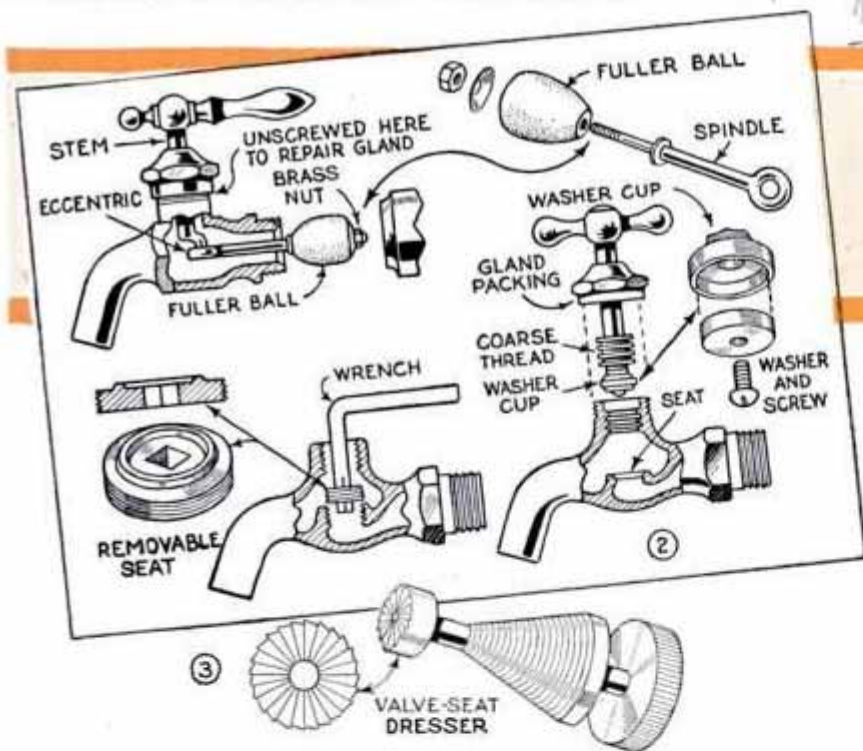


Cement forced under linoleum with grease gun, where the adhesive has loosened to form bulges

Minor HOME PLUMBING REPAIRS

WHEN you do your own servicing and repairing of plumbing you will save money in two ways—the cost of the servicing and also the cost of water that may leak through a faulty fixture. By attending to these minor repairs on time you may save a major repair bill. Renewal parts for most fixtures are inexpensive and easy to install. No special tools are needed.

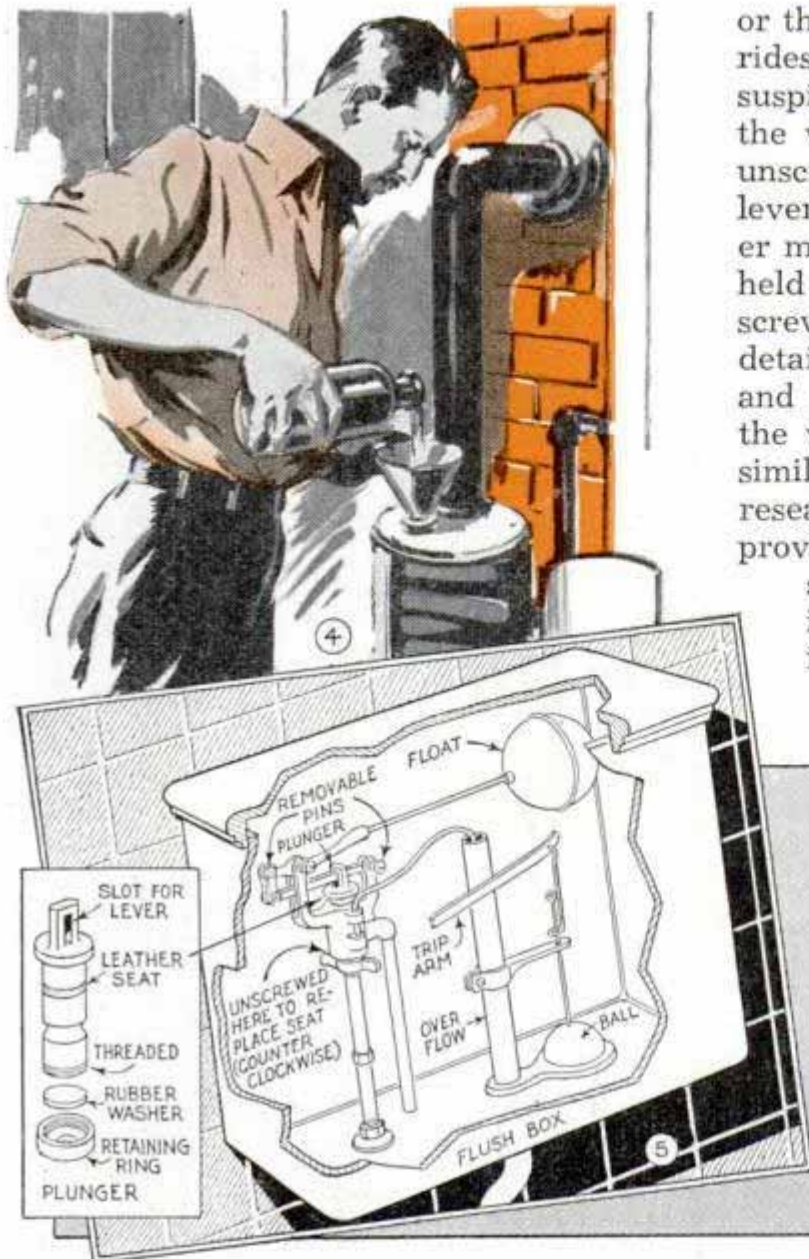
Faucets usually require the most frequent attention. There are two types in general use, the compression and the Fuller, although manufacture of the latter has been discontinued recently. The type usually can be determined by movement of the handle. If the flow of



water is shut off by screwing down the handle, the faucet is the compression type. On the Fuller faucet the handle can be turned a full revolution repeatedly, in either direction, alternately shutting off and opening the flow. Quarter-turn faucets are of the quick-compression type, and are simply a compression faucet having a triple thread which permits of quick opening and closing. Either faucet must be taken apart to renew the ball or washer. Removing the handle is unnecessary. You simply fit

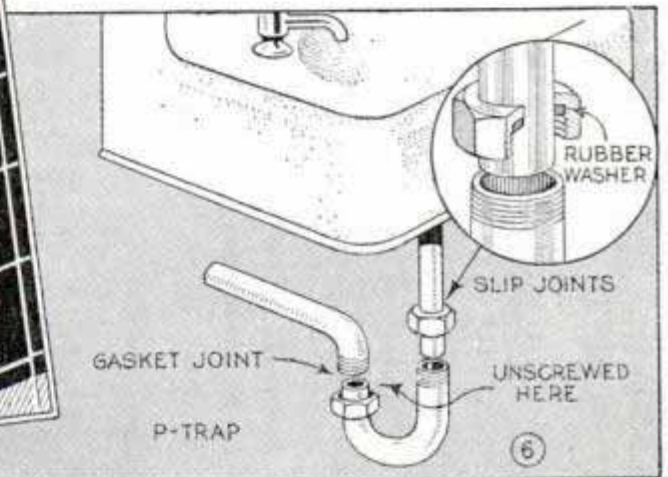
a wrench to the hexagonal gland nut as in Fig. 1. To avoid marring the faucet use a piece of adhesive tape as shown. Faucets of the Fuller type all separate at the body, as shown in the upper details in Fig. 2, after which the worn ball may be removed and a new one installed. Moving the handle

while blowing into the spout determines just how far to draw up the nut to seat the ball properly. Compression faucets are re-washed as shown in the lower-right detail in Fig. 2. Soft rubber washers are used for cold water and hard fiber ones for hot water. If the washer seems badly cut and the faucet leaks again after a few days, the seat is probably nicked or corroded. In most cases this can be remedied by using an inexpensive seat dresser of the type shown in Fig. 3. The tool is simply re-



or the intake valve is at fault. If the float rides high up on the water it is beyond suspicion and the blame must be laid on the valve. To remove the valve plunger unscrew the two pivot pins which hold the levers, remove the float rod and the plunger may be lifted out. A rubber washer is held on the end of the plunger by either a screw or retaining ring, as shown in the detail, Fig. 5. Remove the ring or screw and renew the washer, then reassemble the valve. Older tanks have brass seats, similar to those in faucets, which can be resealed with the same tool. New and improved tanks have renewable porcelain seats which are replaced by unscrewing the body of the valve at the point indicated.

Clogged toilet bowls require drastic



involved on the seat until a true edge is formed. Many of the new faucets have renewable seats. These are threaded into the body of the faucet and have a hexagonal hole in the center so that a special wrench can be used to unscrew them. Should either type faucet leak around the stem, repacking is required. Unscrew the gland nut, remove the stem from the faucet and wrap several turns of wet cotton twine around it. Now replace and screw down the gland nut moderately tight. If the leak persists, wind on more twine.

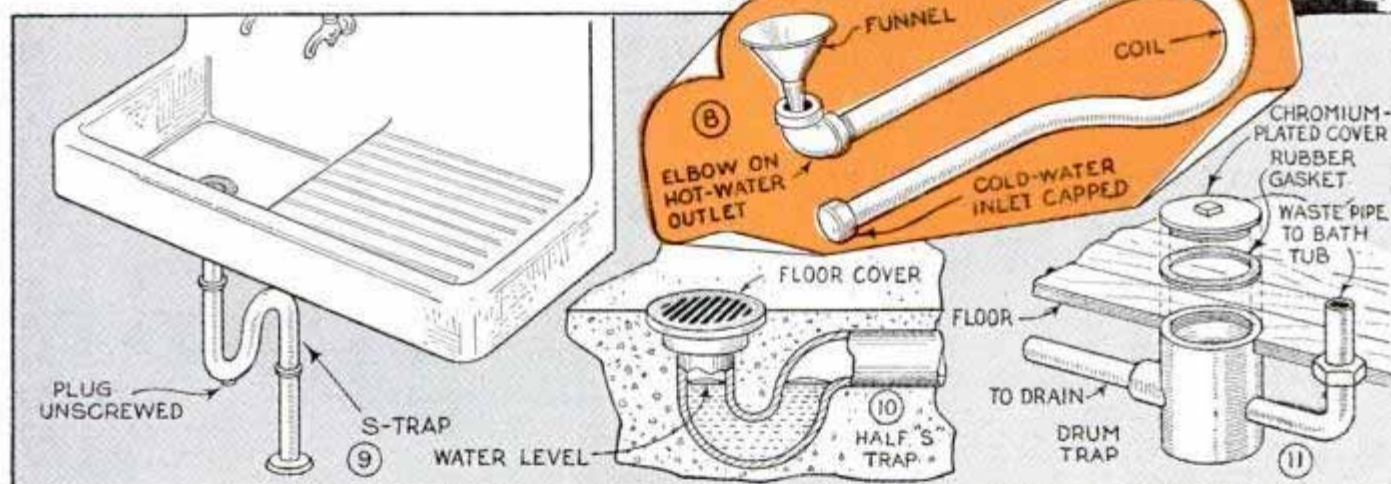
One of the vulnerable spots in the plumbing system is the flush tank of the toilet. Fig. 5 shows the mechanism. If water continues to run into the bowl, the rubber ball valve is not seating properly. The remedy is a new ball, which is quite inexpensive and easily put in place.

Should the water rise above the overflow and drain into it, either the copper float

measures as the passages through the bowl are winding. A rubber suction cup usually forces the obstruction loose. Should the suction cup fail to remove the obstruction a spring auger often will do the job. Clogged sink, lavatory and bathtub drains offer much the same problem. Sink and lavatory drains are generally of the type shown in Figs. 6 and 9. Grease is the usual cause of stoppage in a sink drain, and sometimes can be removed with boiling water, which dissolves the accumulation. To avoid the trouble it's a good idea to do this once a week. However, should this fail, pour a tablespoonful of potassium hydroxide (caustic potash) in the drain, taking care to keep it off the enamel, then pour a quart of hot water over it. Care must be taken to protect the face and hands as this mixture boils vigorously. Stoppage caused by material other than grease may necessitate the removal of the plug in the bot-

tom, Fig. 9, so that a wire may be inserted. Lavatory traps are usually clogged with hair and may be cleaned with sodium carbonate (washing soda). Should it be necessary to rod them out they may be taken apart as shown in Fig. 6. Drains of this type are frequently used on kitchen sinks also. Bathtub traps are of the type shown in Fig. 11, and require only a small quantity of sodium carbonate applied like the potassium hydroxide in the sink and with the same precautions. If this does not open up the drain, the cover must be removed. A new cover and gasket probably will have to be secured as it is almost impossible to remove these covers without damage.

Floor drains in the basement floor are usually large enough so that you can reach in with your hand and remove accumula-



tions of thread and other debris. If the stoppage is beyond the point that can be reached, use a long wire or a spring auger. Floor drains are often the cause of sewer-gas leakage in the basement, manifest by a rank, musty odor. Frequent flushing of the floor so that the level of the water in the trap does not get below the level indicated in Fig. 10, is important, as the gas is dangerous to health. A half pint of crankcase oil poured into the trap will tend to prevent evaporation if the house is vacant for any length of time.

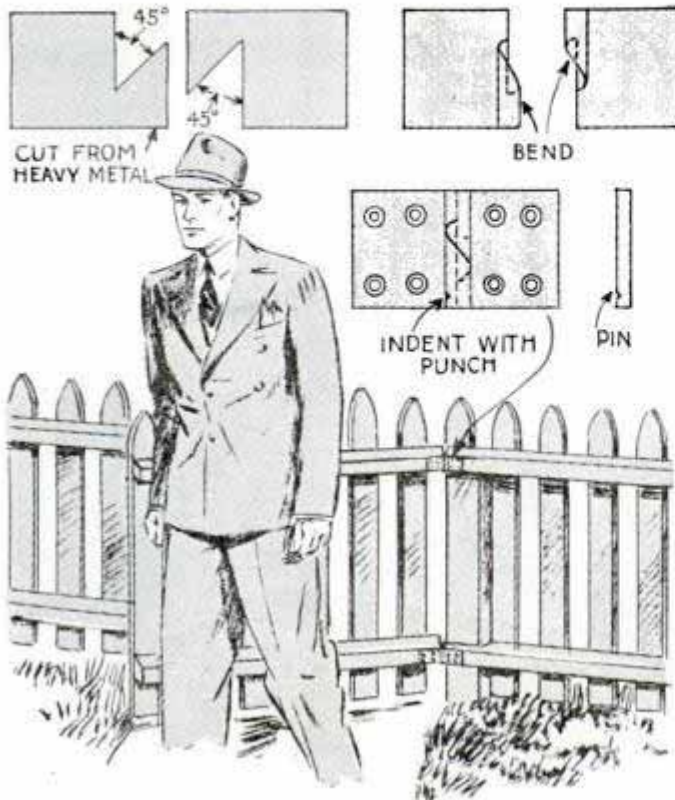
Hot-water heater systems, especially in locations where the water is hard, are subject to a liming-up process which reduces the diameter of the pipes and retards the circulation of the water. For the hot-water coil in the furnace the remedy is to disconnect the pipes at the unions, usually just outside the furnace, cap the lower end of the coil as in Fig. 8, and with a funnel

pour dilute hydrochloric acid (muriatic acid) into the section until it is full, Fig. 7. Allow to stand for 15 minutes and drain. Then flush thoroughly with water. Should one filling be insufficient the process may be repeated several times.

Gas water heaters of the type shown in Fig. 4 can be cleaned in a similar manner. Simply disconnect the coils at the unions, cap or cork the lower end and fill the copper coils with the hydrochloric acid as before, to dissolve the lime. Do not plug the drain, coil or pipe at the top when using caustics or acids and provide good ventilation for the escape of the gases.

Measuring photographic solutions in a glass fruit jar is easy if labeled strips of adhesive tape are applied to the outside of the glass and spaced so the desired quantity is measured out when the solution just reaches the top of the tape.

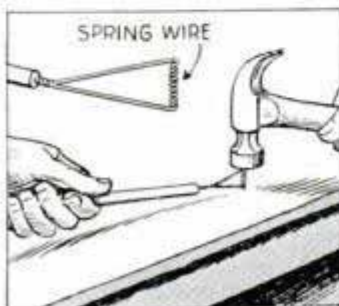
Gates Fitted with These Hinges Close Automatically



Weight of a gate or door causes these hinges, which are made of heavy sheet metal, to close when released

Quickly cut from heavy sheet metal with a hacksaw and drilled for screws, these hinges can be used on gates, doors and cabinets to close them automatically. After cutting two pieces of metal to the shape indicated in the upper left detail, the projecting tabs at the sides are rolled over a large nail or small rod, which serves as a hinge pin. This fits loosely in the upper half of the hinge and tightly in the lower half, a punch being used to indent the metal to lock the pin securely. When the gate is opened, one half of the hinge tends to slide up on the other, raising the gate a trifle. If the gate is released, its weight causes it to return to the normal position where it is closed.—L. Malecki, Chicago.

Small Coil Spring Holds Brads for Driving



To avoid bruised fingers when driving a number of small brads, one mechanic uses the coil-spring holder illustrated. It consists of a length of

fine spring wire, which is coiled and bent as shown, and attached to a small dowel, which serves as a handle. A brad is slipped into the coil, which grips it until driven into the wood a sufficient depth to remain in place. The coils of the spring should be large enough to pass just over the heads of the brads.

Cotton Protects Glove Fingers

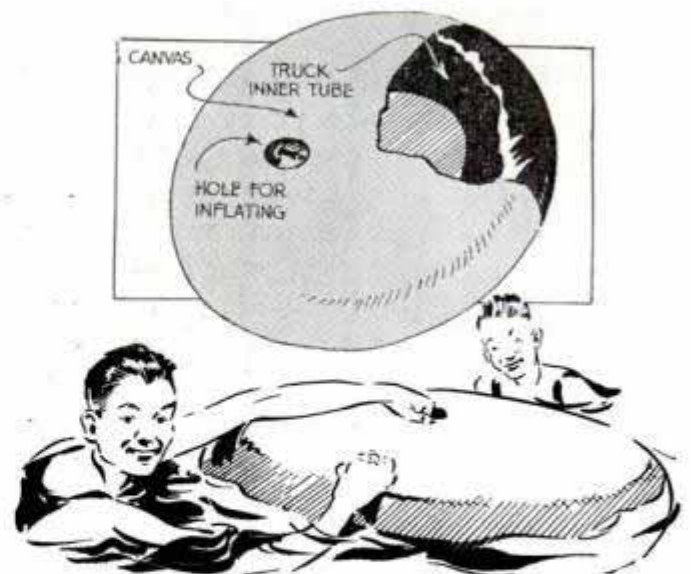
You'll find that rubber gloves last much longer if the tips of the fingers are protected by inserting small wads of cotton in each one. The cotton serves as a padding to prevent sharp fingernails from cutting the rubber, and also improves the fit.

—Kenneth Murray, Sturgis, Mich.



This Inner-Tube Water Float Is Canvas Covered

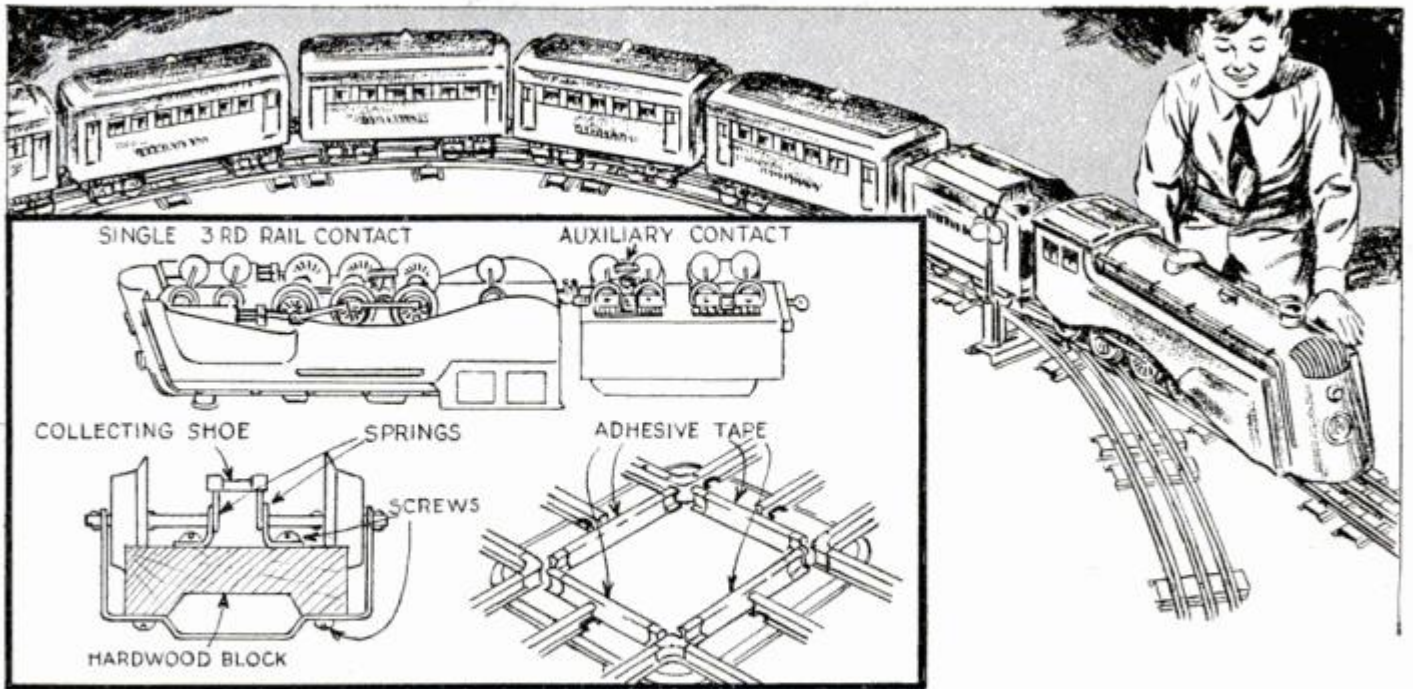
Completely inclosed in a canvas bag, a large truck inner tube provides a dandy float at the beach for children. When the tube is inflated through a hole cut in the



Inner tube encased in canvas bag provides dandy water float for children to play with at beach

canvas, the latter is stretched tightly across the tube so that children can sit on it easily. A float of this type will support two or three children weighing 50 or 60 lbs. each.

Extra Current Collector Improves Toy Trains



If your toy train stalls when passing over "dead spots" on switches and crossings, likely it has only one current-collecting shoe on the locomotive. This trouble can be avoided if you add an auxiliary shoe to one tender truck, connecting it to the third-rail contact of the locomotive. The shoe is taken from an old electric-iron connector, and is soldered to springs made from the heels of two safety pins, which, in turn, are screwed to a hardwood block.

The wire to the locomotive is soldered to one of the screws holding the springs. Care should be taken to keep the wire away from moving parts that might wear off the insulation. Old-style crossings should be covered with strips of adhesive tape at the points indicated to prevent short-circuiting, which might burn out a transformer. If desired, the strips may be shellacked for permanency.

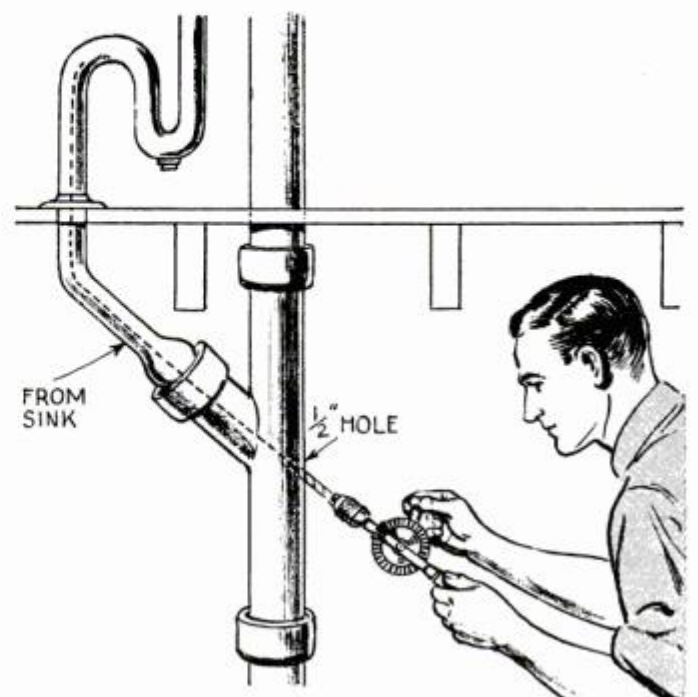
—John Little Story, Oklahoma City, Okla.

Cleaning Drain Pipe of Kitchen Sink from the Basement

The drain from my kitchen sink was bent so that it was impossible to do the cleaning from the top. To overcome this trouble, we drilled a hole as shown. A long flexible wire was run through the hole and pushed up into the drain and twisted with a hand drill. This cleaned the drain to the trap, the sediment being removed from the latter by running a wire down from the sink.—L. R. Dickens, Stratford, Ont., Can.

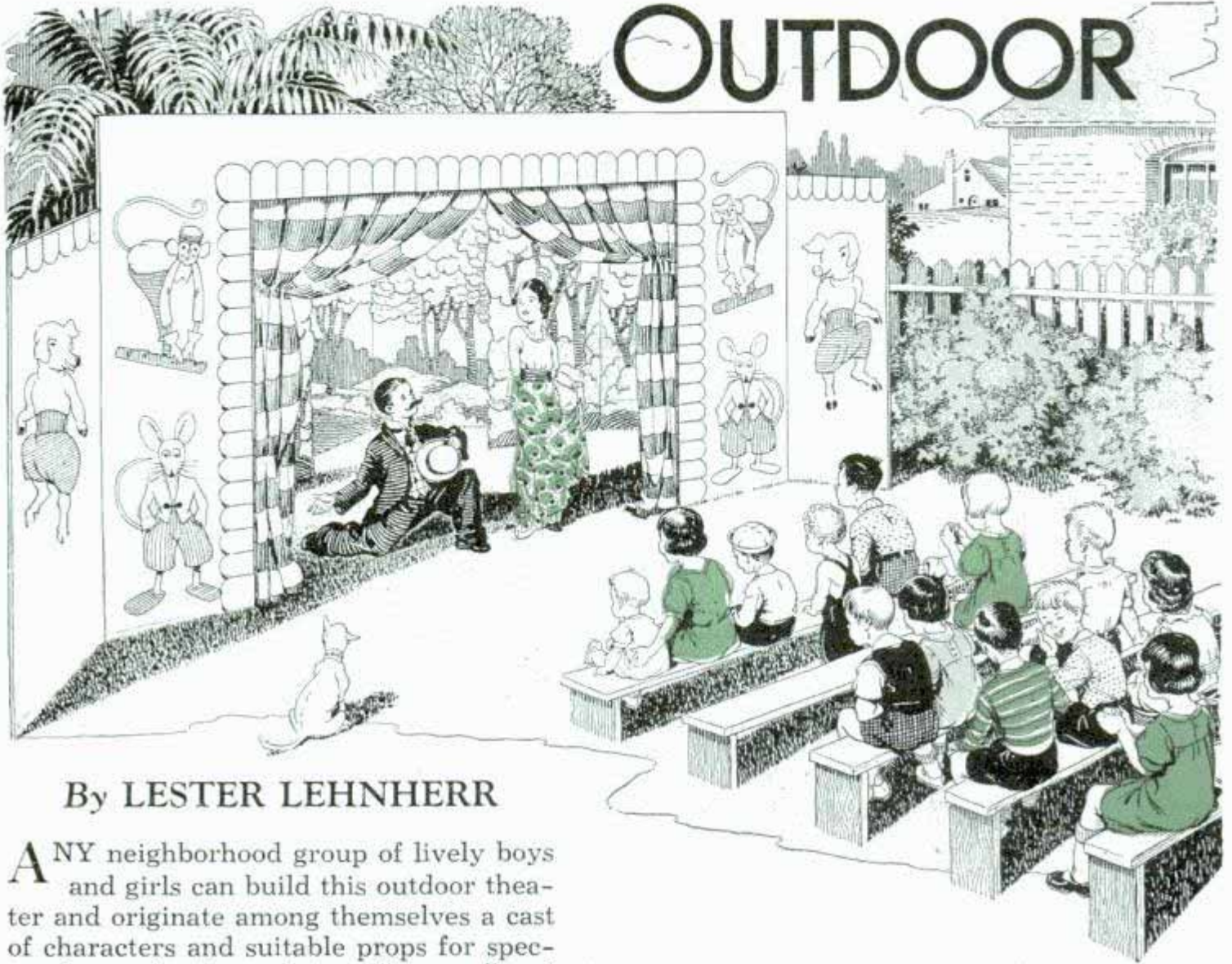
Finishing Wrought Iron

Wrought-iron articles can be finished cheaply by painting them with a semi-paste mixture consisting of black shoe-maker's wax melted in turpentine over a low flame. After the coating has dried on the work, polish the iron lightly with a soft, woolen cloth.



Long drain pipe from sink cleaned by drilling hole and feeding wire through it

OUTDOOR



By LESTER LEHNHERR

ANY neighborhood group of lively boys and girls can build this outdoor theater and originate among themselves a cast of characters and suitable props for spectacular productions of stage "dramas" and hair-raising mysteries. The simplicity of materials and their availability dispose of the money problem right at the start.

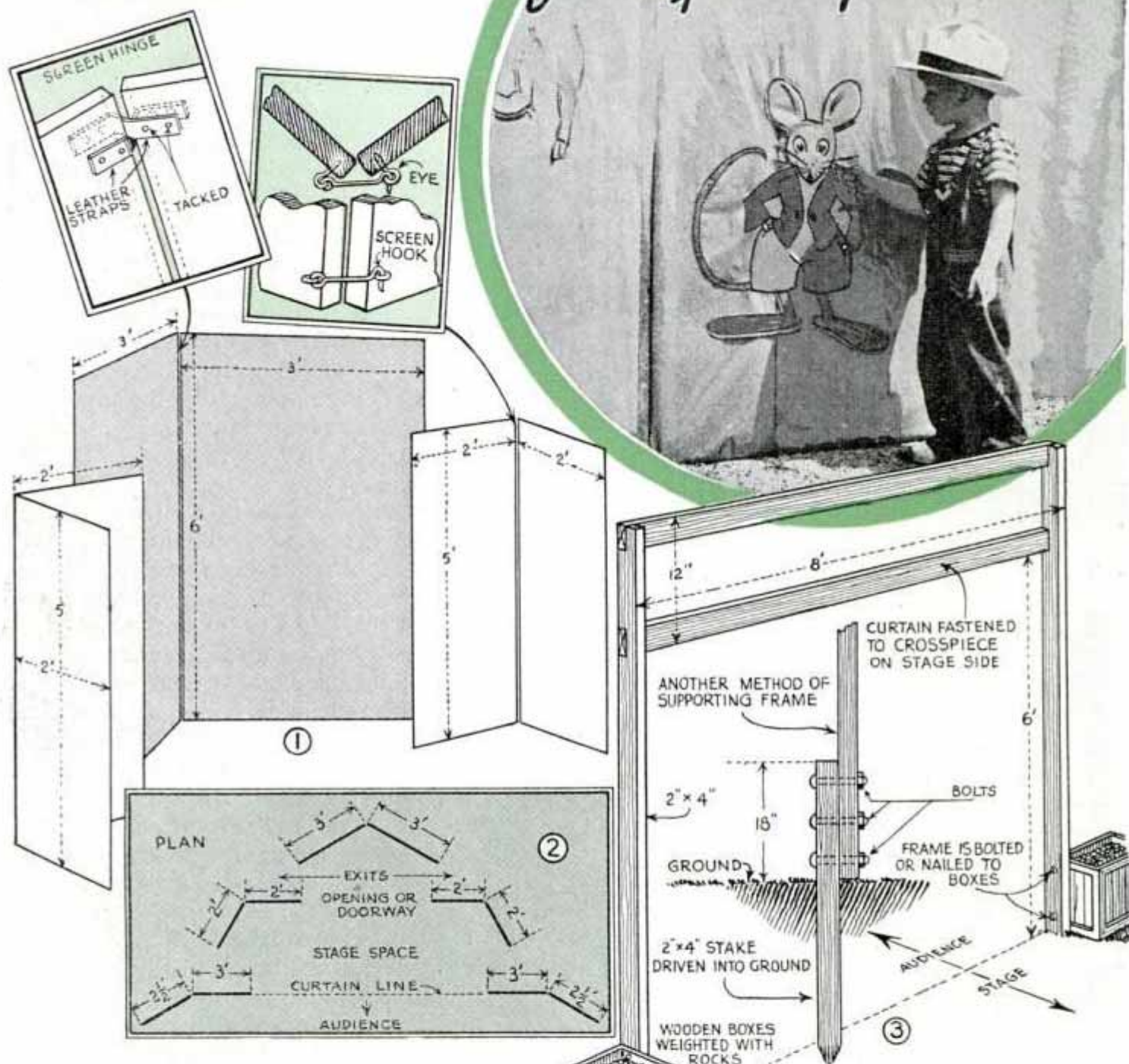
Almost any sort of lumber or materials can be utilized for the stage, Figs. 1 and 2. The frame which forms the arch, or proscenium opening as it is called, Fig. 3, should be of pine 2 by 4-in. stock. Two pieces 7 ft. long and two 8 ft. long are required. Once you have decided on the location, you can set up the frame, anchoring it with either of the two methods shown in Fig. 3.

The frames for the screens are of lighter wood so that they can be moved easily. Four screen panels form the front of the theater; two 3 ft. wide and 7 ft. high, and two 2½ ft. wide and 6 ft. high. See the lower detail in the plan view, Fig. 2. For the stage scenery, two pairs of screens 5 ft. high and one pair 6 ft. high are sufficient to start. They can be either hinged or hooked together as shown in the details in Fig. 1.

After the frames are made, they can be covered with unbleached muslin tacked on and then shrunk and stiffened by painting it with thin glue sizing. Lacking funds for the muslin, corrugated mattress cartons can be used. These make splendid scene panels when merely tacked to the wood frames and painted. Regular wallpaper may be applied to the panels instead of painting them. One of the group is sure to find several rolls of leftover wallpaper in an attic.

If no cartons of any kind are available, newspapers can be used. Heavy sheets of the right size are made by laying several thicknesses of overlapped newspapers together with flour paste or clothes starch as a binder, Fig. 7. The process is continued, layer upon layer, until the whole built-up sheet is ⅛ in. thick or more. In a day or two the starch or paste will have dried and you have a stiff, strong sheet to cover the frame. When painted and decorated it is not possible to tell that these sheets are

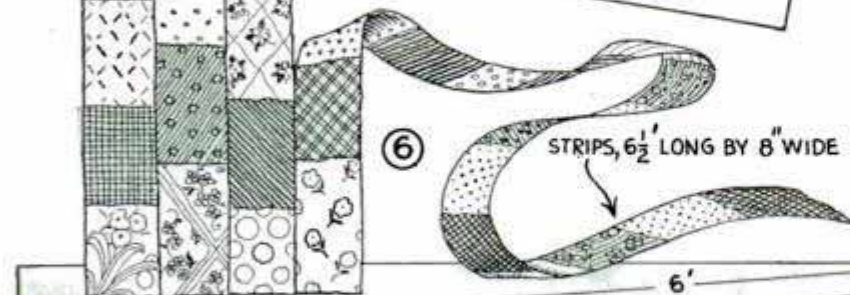
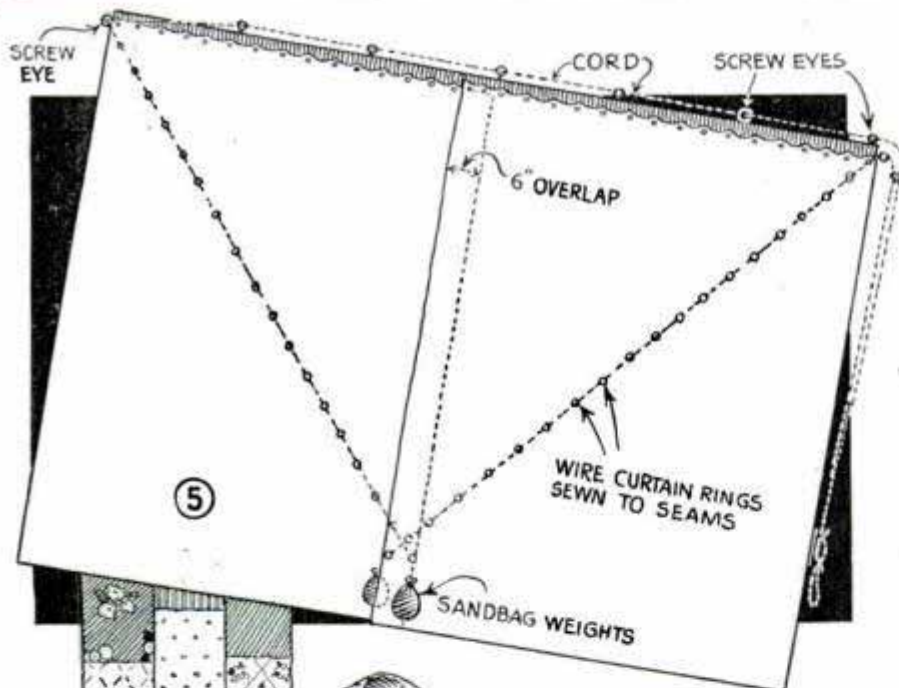
THEATER *for Young Actors*



made of newspapers. Needless to say, this is a "fairweather" theater only; on rainy days there can be no show unless it is set up in some vacant barn or garage.

A front curtain is needed to close the stage opening between acts and, while a pair of white bed sheets or blankets will serve, a much more unusual and really attractive curtain can be made from odd scraps of cloth sewn together in hit-and-miss fashion, that is, without any definite arrangement as to color or pattern, Figs. 4 and 6. If each actor in the company produces a few odd pieces, there will soon be

more than enough. Use only materials of about the same relative weight; thin, sheer materials and heavy woolen suitings will not work well in combination. Since most of the materials to be obtained will be very light in color, or small figured with white backgrounds, it's best to dye them. By closely following the directions on the package and with some supervision and assistance by one of the mothers, this can

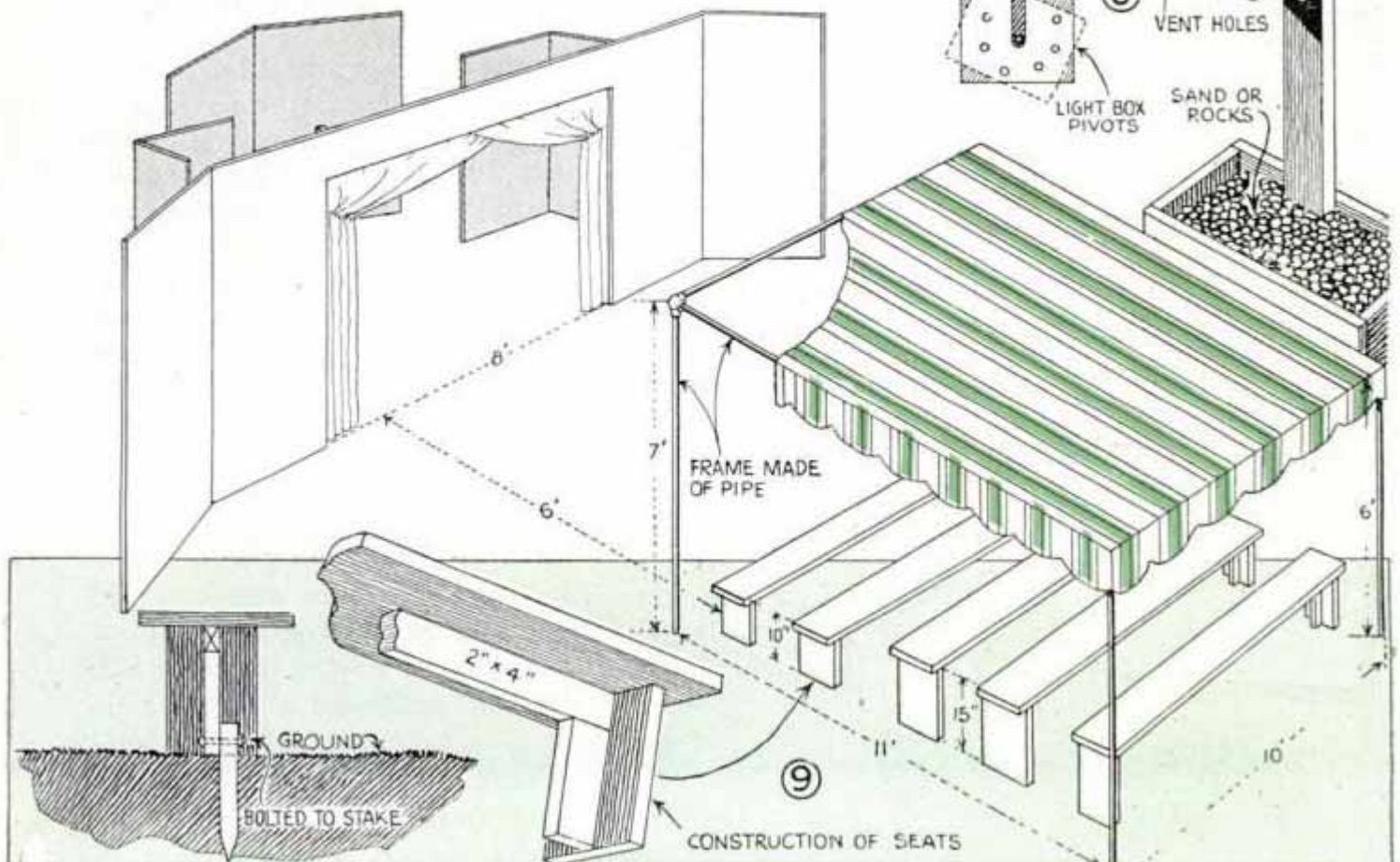


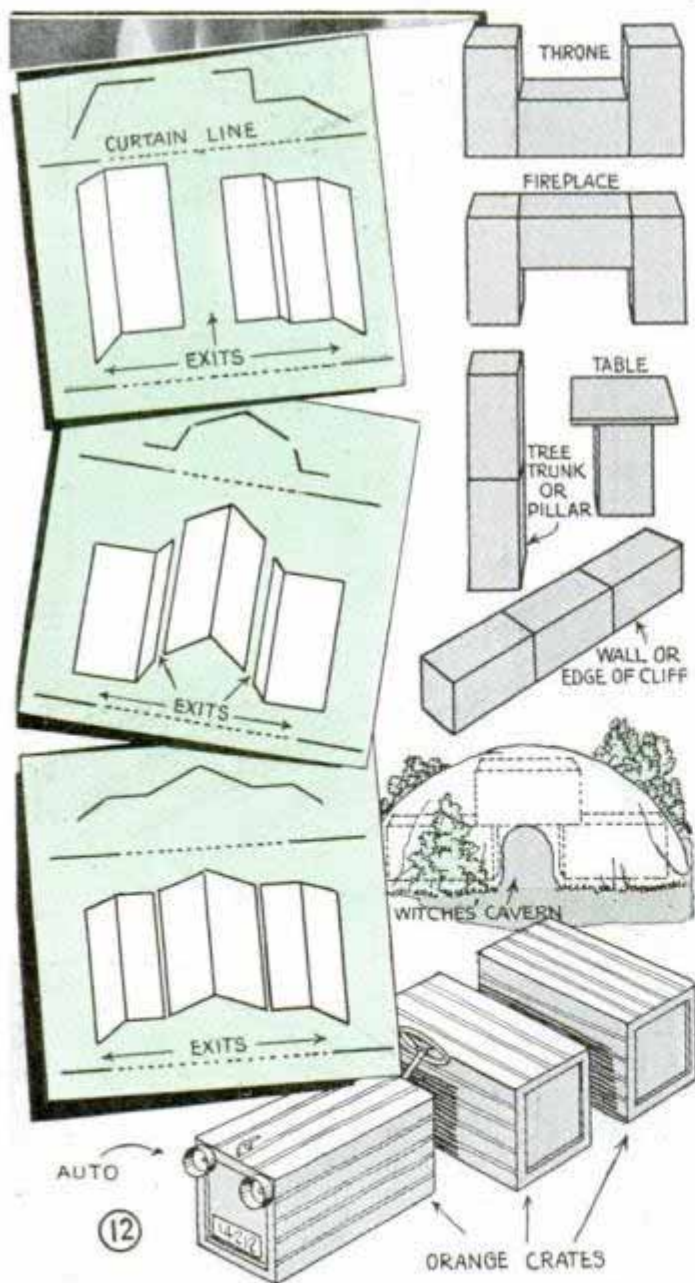
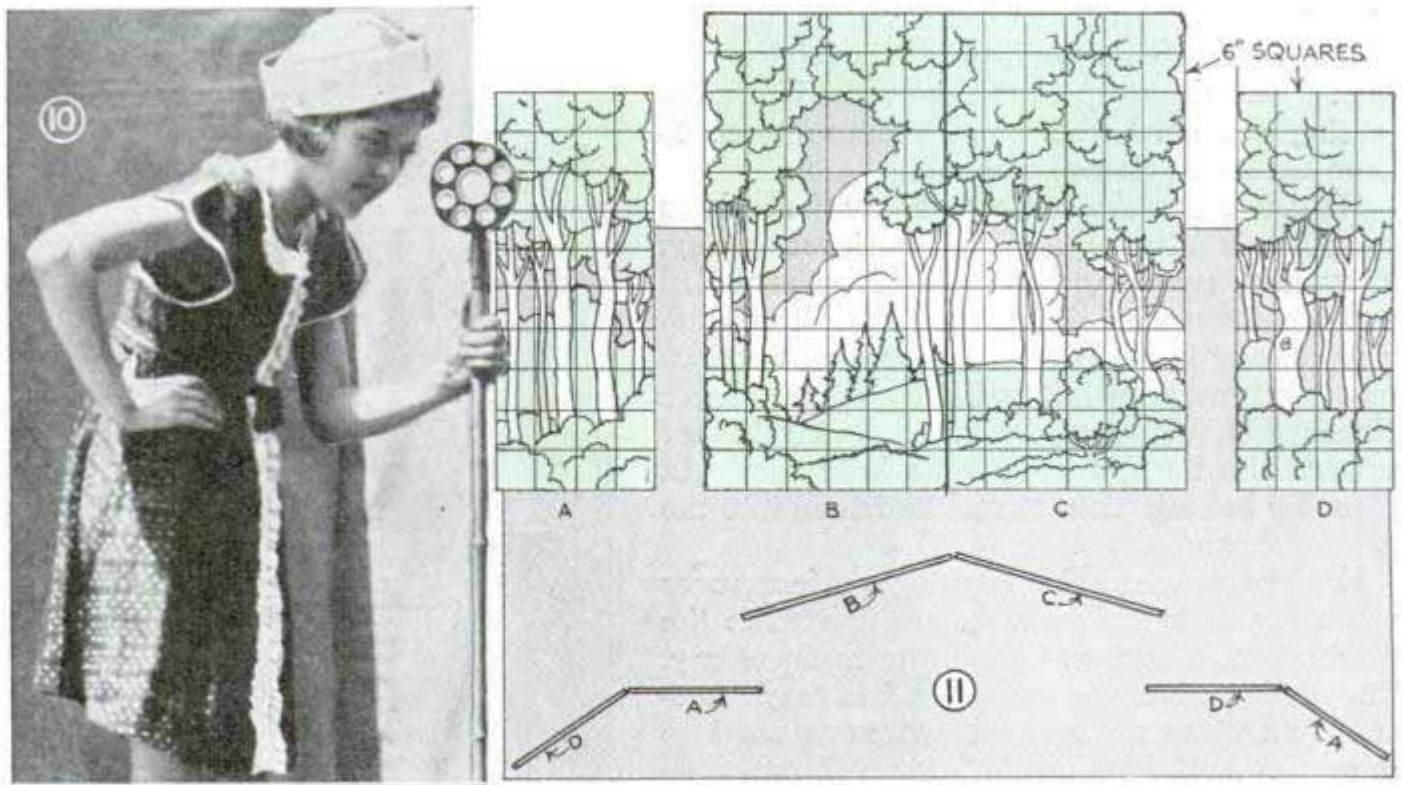
be done very successfully. The materials first should be sorted into groups according to the color they will take best. Only three packages of dye need be purchased to secure all possible colors; red, yellow, and blue. Green can be obtained by equal amounts of yellow and blue mixed together; red and yellow will make orange, and blue and red make purple. The curtain is made in two equal pieces so that it may be parted in the center. There should be more than enough material to cover the stage opening so the curtain can hang in folds. For an opening 8 ft. wide, two 6-ft. pieces will allow for ample fullness. The tableau-type curtain is, perhaps, the easier style to arrange and looks very effective. The two halves of the curtain are tacked directly to the crosspiece on the upper edge of the stage opening. The halves should hang in folds and overlap at least 6 in. at the center. To open the curtains, wire curtain rings are sewn to the seams on the back-stage side as shown in Fig. 5. A weight, which may be a small cloth bag with a little sand in it, is sewn to the inside of the lower center corner of each half. Heavy cords are tied to the lowest ring at the center and run up through the rings to screw eyes on the frame. One cord is run across the top through screw eyes or staples and fastened to the other cord

so that both halves will work simultaneously. When the cord is pulled, the two curtains part neatly and draw up to the corners. Upon releasing the cord, the weights cause them to drop back and close the opening.

Now, to make the audience as comfortable as possible is always a good business policy. Therefore, some benches should be provided and a canopy over them will help. See Fig. 9. The canopy is fitted over a frame of wood or pipe and may be altered in size or shape. Benches should vary in height, being higher toward the back, and may be held firmly in place by bolting them to stakes driven into the ground as shown.

For "parent benefit" evening performances when the dads and mothers are invited to the production, a system of lighting is necessary. The arrangement shown in Fig. 8 is easy to install and there are no loose wires or parts to move around. The floodlights are boxes pivoted on angle brackets so they may be turned to direct the beam of light in various directions. They are provided with slides to produce colored lights for special effects; blue for moonlight, green for storm or haunted house, red for fire, amber for sunshine, etc. These slides are formed of two pieces of screen wire taped together with a sheet of colored Cellophane or tissue paper between them. Since large lamps are not necessary on so small a stage, the cur-

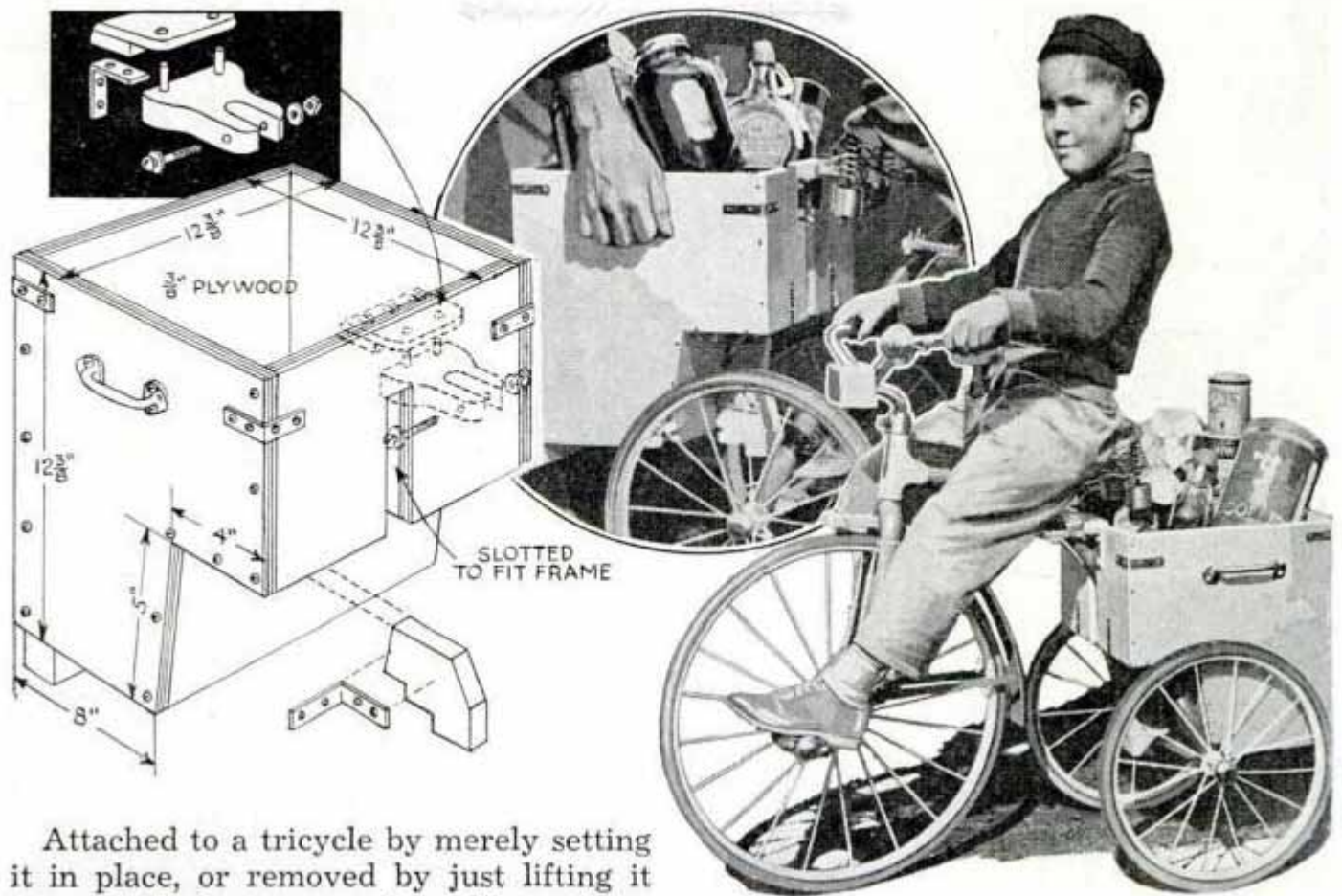




rent can be brought from a near source with rubber-covered extension cord.

A suggested design is given in Fig. 11 for the exterior or scenery which can be painted on one side of the scene panels used for the interior setting, that is, the screens shown back in Fig. 1. The drawing can be enlarged without difficulty by sketching squares on the panels before blocking-in the scene. Merely divide the screen panel into the same number of squares that the small drawing has. Then, starting in one corner of the panel, draw in all the lines that the small drawing has in the corresponding square. This is quite easy to do and when all the squares have been copied, an enlarged sketch of the small drawing results. Paint in bright colors, using simple broad strokes to create the proper atmosphere. Don't attempt to make the scene realistic and detailed. Dry colors can be mixed with whiting or cold-water paint, to make a very clean and economical paint. Figs. 10 and 12 suggest a number of props and ways to arrange the screens to utilize them. Young actors with a lively imagination will be able to build up others to suit special requirements of the play or dialogue. For example in Fig. 10, a few disks of cardboard, a curtain pole and a block of wood make a realistic microphone. Three orange crates, an old steering wheel and two headlights form an automobile and so on.

Tricycle Luggage Carrier Is Quickly Removed

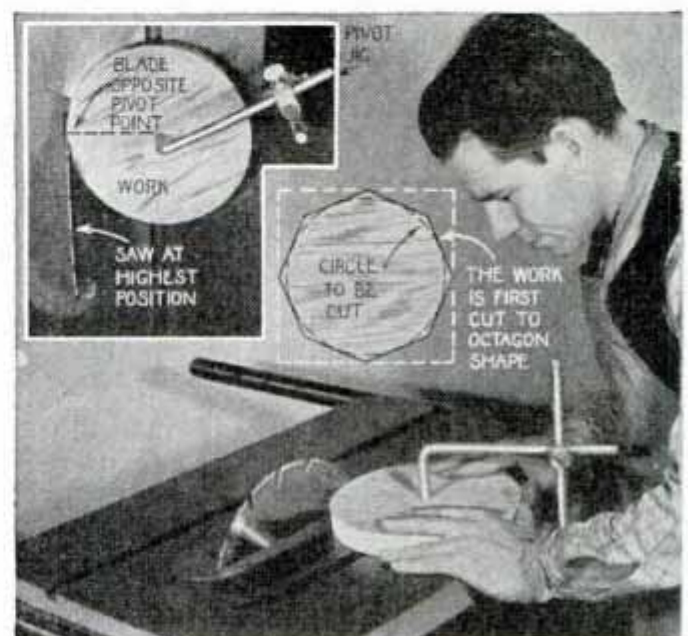


Attached to a tricycle by merely setting it in place, or removed by just lifting it upward, this luggage carrier will save busy mothers many steps because a child can easily deliver loads that an adult would find difficult to carry. Dimensions and shape of the carrier shown can be altered to suit any tricycle frame. It is assembled from plywood with wood screws, the joints being reinforced with flat-iron angles, which are also screwed in place. The car-

rier rides on the rear axle and a wood block, notched to fit over the axle, keeps it from slipping off, the block being fastened to the carrier with a flat-iron angle. At the top, a slotted block, clamped to the tricycle frame with a bolt, has two pins, which engage holes in a metal plate screwed to the carrier, as shown.

Wood Disks Cut to Size Accurately on Your Circular Saw

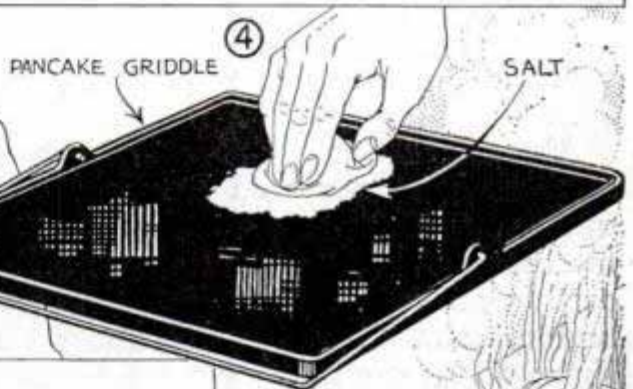
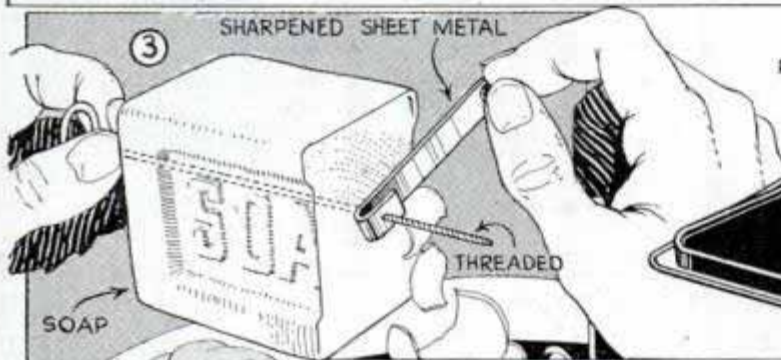
When a band saw is unavailable, disks can be cut on a circular saw. A circle is scribed on the work, after which it is cut to form an eight-sided figure. The saw is then raised to its highest point, and then the work is placed exactly opposite the rim of the blade, and is fed against the blade by rotating it on a pivot. A nail driven through a piece of wood, which is clamped to the table, can be used for this purpose. The circular form is not, of course, obtained in one rotation of the work. About five settings of the pivot point, taking off $\frac{3}{16}$ in. at each cut, will be necessary when working standard 1-in. stock. The edges are cleaner than similar work done on a band saw.



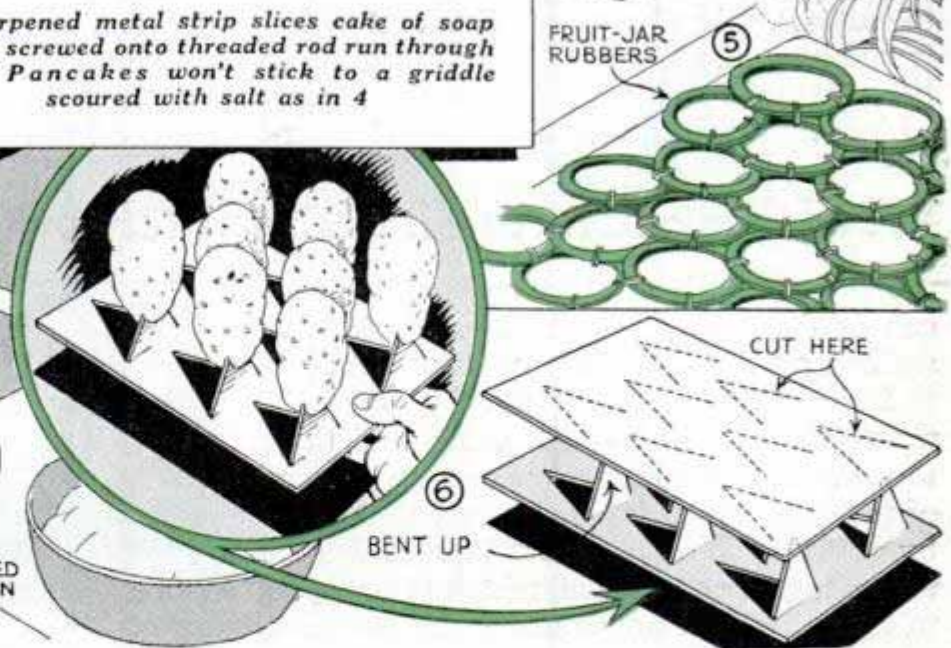
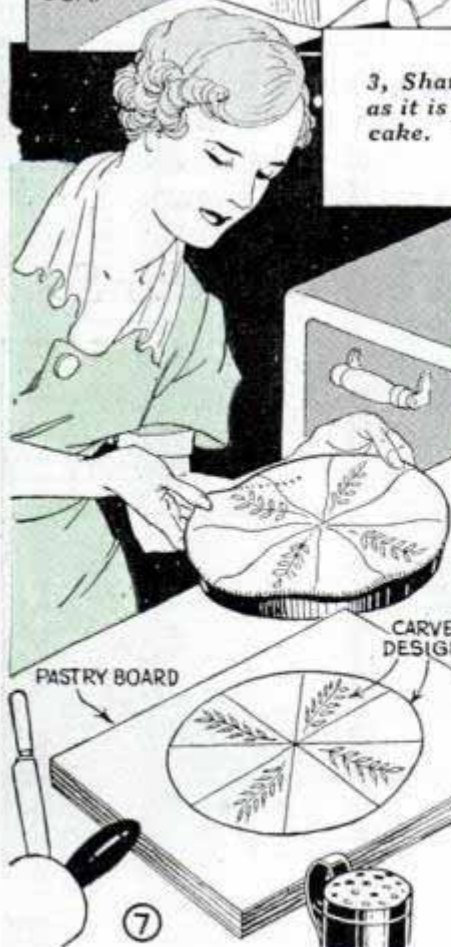
Solutions HOME



A man's belt is just the thing to open fruit jars when used as in 1. Small bottles and phials placed in an ice-cream carton lid or any paper-box lid, 2, aren't upset easily

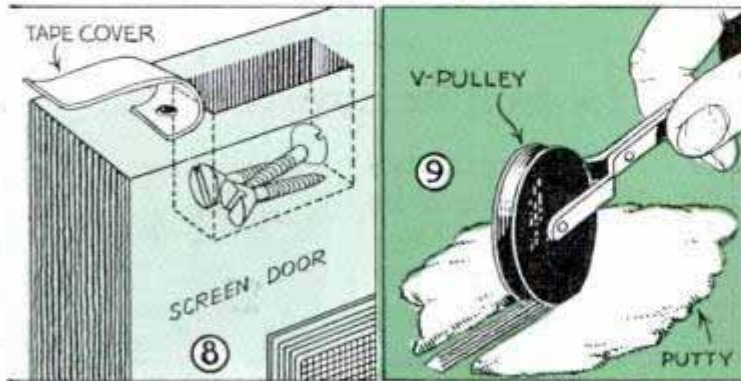


3, Sharpened metal strip slices cake of soap as it is screwed onto threaded rod run through cake. Pancakes won't stick to a griddle scoured with salt as in 4



A rubber mat made by tying fruit-jar rubbers together, 5, protects dishes on sink drain board, while vegetables are baked readily on the sheet-metal holder, 6, without burning or the bother of turning them. The tedious job of decorating pie crusts is simplified by the carved pastry board shown in 7. A design, and lines to indicate width of pie cuts, are carved in relief on the board, after which the pie dough is rolled out on it

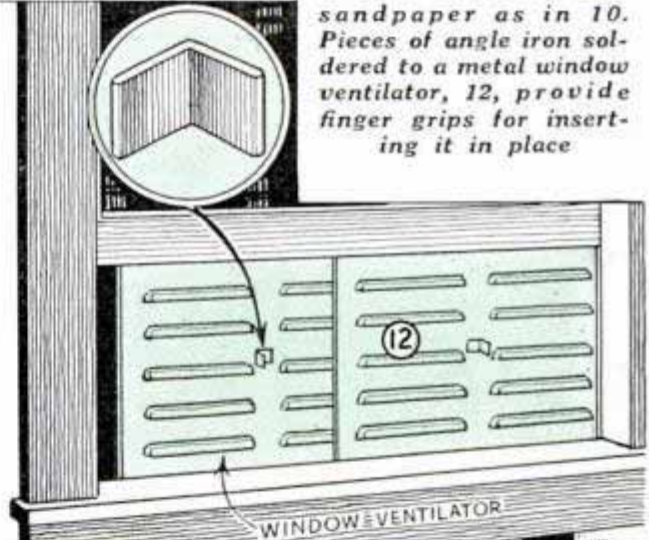
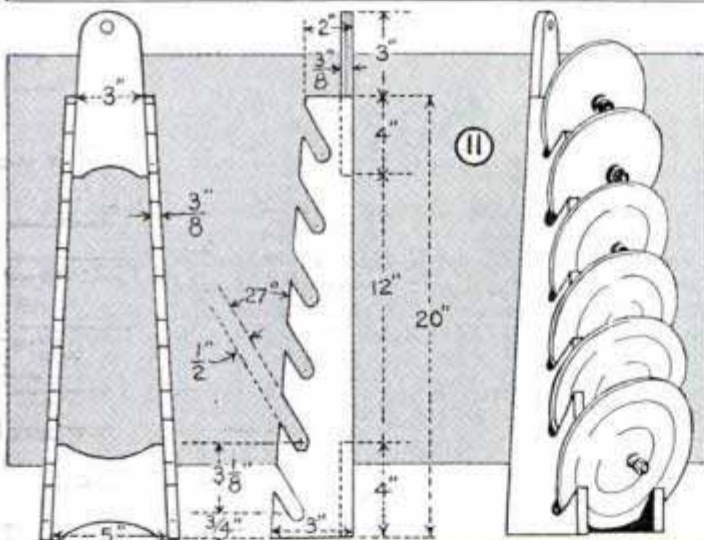
for Your PROBLEMS



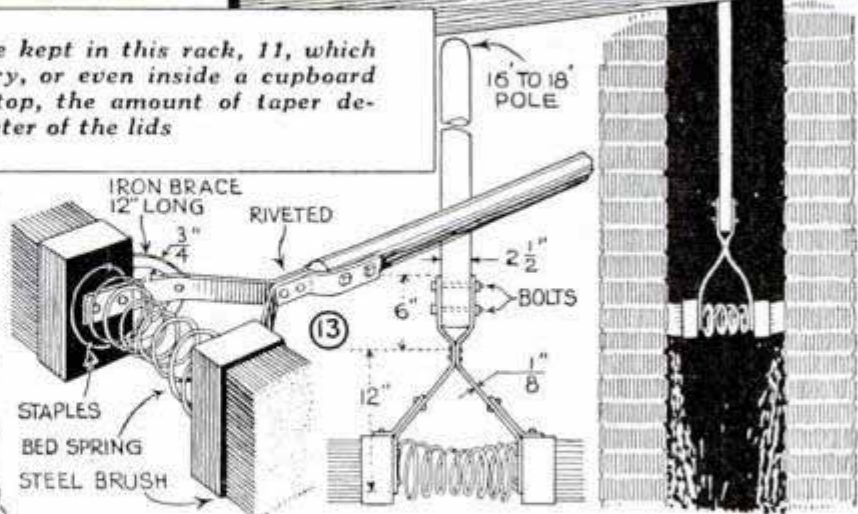
Hinge screws stored in recess in screen door, 8, when latter is taken down, while a V-pulley cuts putty into strips, 9, for glazing windows



Dragging door smoothed on bottom by swinging it back and forth over sandpaper as in 10. Pieces of angle iron soldered to a metal window ventilator, 12, provide finger grips for inserting it in place

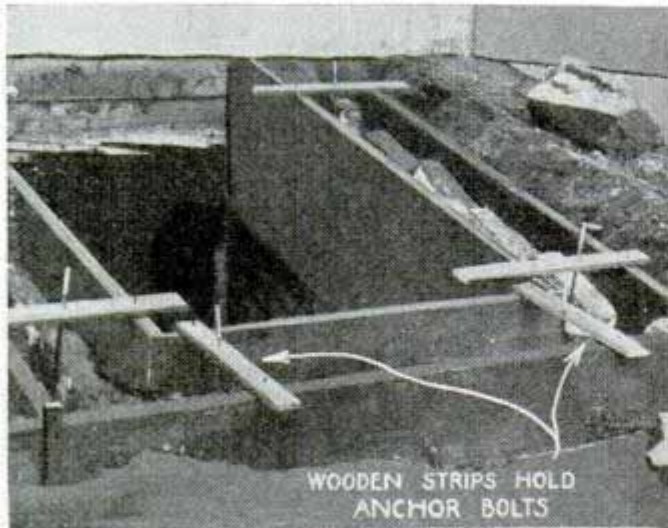


Six of your most used potlids can be kept in this rack, 11, which is hung near the stove, in the pantry, or even inside a cupboard door. The rack tapers toward the top, the amount of taper depending on the diameter of the lids



A dirty chimney with irregular, inside surfaces is no problem with the cleaner shown in 13, because a coil spring presses steel brushes tightly against the sides of the chimney regardless of the contour. Nails can be removed from plaster board or wallboard with minimum damage if you use the puller in 14, which consists of a gouge chisel with the end ground to simulate the claw of a hammer

Bolts Held in Concrete Forms by Wood Strips



WOODEN STRIPS HOLD ANCHOR BOLTS

Wood strips across tops of concrete form hold anchor bolts while pouring

The amateur concrete worker who has trouble in holding anchor bolts in concrete

forms while pouring, will find that this method solves the problem. Wood strips, drilled to take the bolts securely, are nailed across the tops of the form at the locations desired for the bolts. The latter are then inserted through the holes where they are held in place. After the concrete has set, the strips and forms are removed.

Hot Iron Removes Grease Spots

Grease and candle spots can be removed from fabrics by means of a hot iron and a blotter. The latter is placed on the spot to be removed and the iron is pressed on it. Move the blotter often.



Move the blotter often.

Plenty of Fun at a Safe Speed



OTHER THINGS TO BUILD

"ROAMER"—765 to 770: Outboard cabin cruiser. 16 ft. long, 66 in. beam. Requires outboard motor of 20 to 36 hp. Set of six prints \$1.00.

"SEA SAUCER"—893: 9½-ft. sail boat. Deck, bottom and sides are 3/16-in. plywood. 25c.

"ZIP," MODEL RACING YACHT—880 to 883: 50 in. long. Four prints \$1.00.

17-FT. KAYAK—928 and 929: Light framework covered with canvas. Two prints 50c.

LAWN CHAIR—529: Plain sawed from ¾-in. stock. Easily made with hand tools. 25c.

ORNAMENTAL WOOD FENCES—640: Five artistic designs for standard wood stock. 25c.

VENETIAN BLINDS—926 and 927: Three different styles covered on two prints. 50c.

This small car, having a 58-in. wheelbase and 28-in. tread, is very easy to operate and may be powered by a ½ to ¾-hp. gas engine of the washing-machine type. It is equipped with effective brakes and pneumatic tires. Plans show three alternate methods of body construction. Easy to build. Our blueprints Nos. 906 to 909 incl. give you all the information necessary. This set will be sent postpaid on receipt of \$1.00.



LAWN AND GARDEN FURNITURE—920 to 922: Collection of designs for arbor-and-seat combinations and swings. (3 prints.) 75c.

METAL WEATHER VANES—520: Scroll-sawed from sheet aluminum. Complete assembly details. 25c.

Any six of these blueprints (not sets of prints) will be sent postpaid upon receipt of \$1.00

Blueprint Department, Popular Mechanics Magazine, 200 E. Ontario St., Chicago

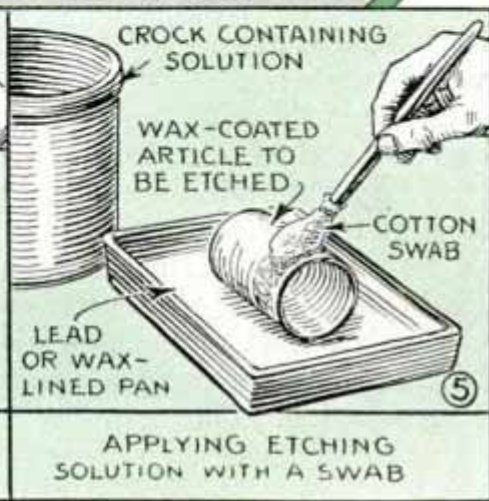
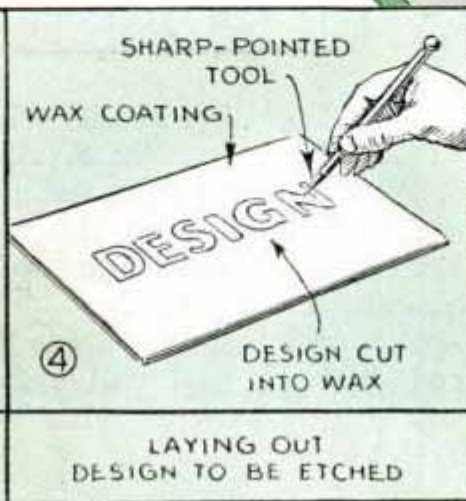
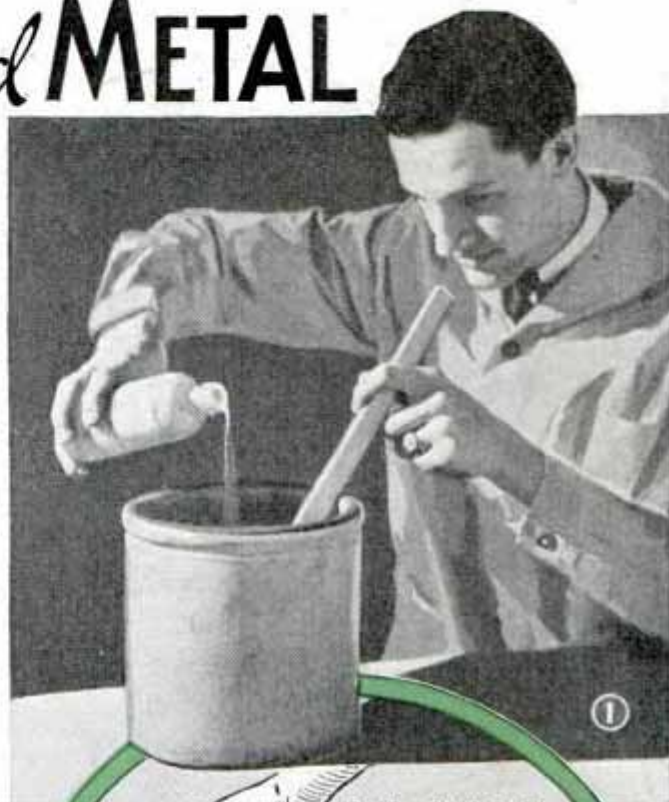


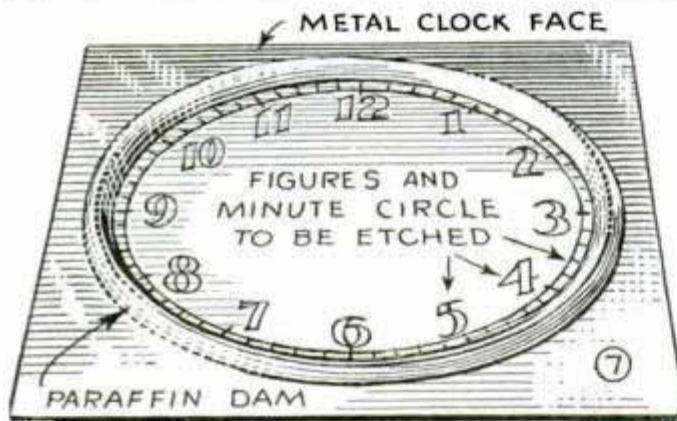
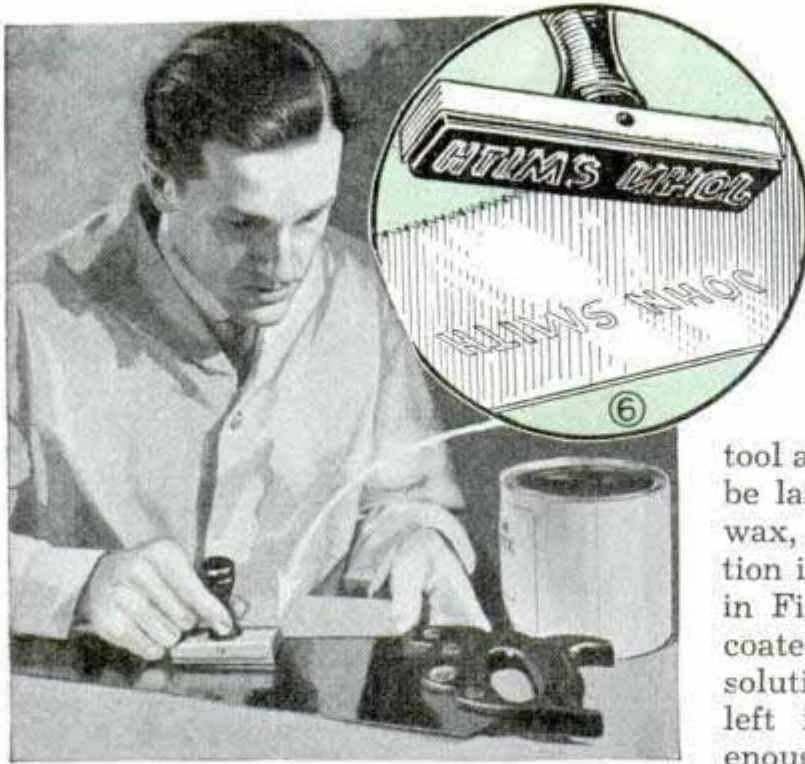
SHOP NOTES

Etching GLASS and METAL

By JOHN B. MULLEN

WITH the use of proper solutions anyone can etch unlimited designs on metal and glass articles at home or in the small shop. Tools can be marked permanently with the owner's name, glassware can be etched with almost any type of design, and ornamental metal work can be made more beautiful. A great number of etching solutions are composed in part or in whole of acids that are caustic to the skin and will damage materials such as wood and clothing. Great care is necessary in their use, and spilling, splashing, or inhaling of the vapors must be avoided. If acid is accidentally spilled on your skin, flood the surface immediately with water to wash it off, spreading the acid as little as possible, and then cover the affected area with a paste of sodium bicarbonate (baking soda) or sodium carbonate (washing soda). When the etching job has been finished, the solution should be stored in a glass-stoppered bottle (unless it contains hydrofluoric acid) and clearly labeled, or





it should be poured down the floor drain and rinsed away with a large quantity of water.

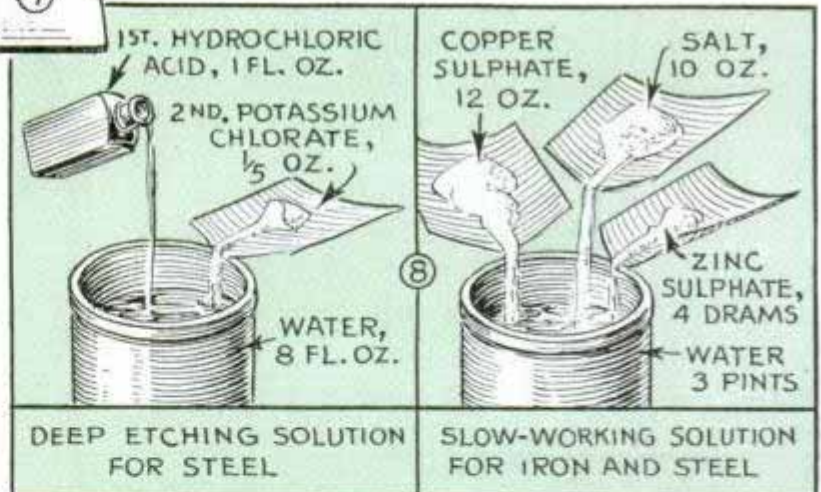
In diluting, always add the acid slowly to the water in a stoneware crock with constant stirring, as shown in Fig. 1. Acid solutions should be kept only in glass or stoneware vessels, except hydrofluoric acid, which attacks glass and is sold and stored in lead or wax containers.

Etching Glass: Designs and lettering can be etched on glass with a solution made by dissolving sodium fluoride, 1 oz., in distilled water, 25 fl. oz., in a lead tray or bottle, Fig. 2. No material other than lead should be used for the container. To this solution is added glacial acetic acid, 10 drams, after which the mixture is stirred with a stick. The solution is extremely caustic to the skin and causes painful sores that are slow to heal. As the solution does

not keep well unless stored in an airtight wax or lead bottle, only a small amount should be mixed at a time. Glass to be etched is cleaned thoroughly with soap and water, rinsed thoroughly, and then covered with a mixture of tallow, 1 lb., and yellow ceresin wax, 2 lbs., applied while molten with a brush, Fig. 3. The design or lettering is scratched through the wax layer with a sharp-pointed

tool as in Fig. 4. If you like, the design can be laid out on paper and traced onto the wax, or a stencil can be used. The solution is then applied with a swab as shown in Fig. 5. If more convenient, the wax-coated article can be dipped in the acid solution. The surface to be etched must be left in contact with the solution long enough to etch as deeply as required. The etched article is washed well in plain water, after which the wax can be removed either with gasoline or hot water.

Etching Steel: An effective etching solution for use on steel is composed of nitric acid, 2 fl. oz., and glacial acetic acid, 1 fl. oz. A deeper etch with more contrast can be made by adding hydrochloric (muriatic) acid, 1 fl. oz., to water, 8 fl. oz., and dissolv-



ing in this solution potassium chlorate, $\frac{1}{5}$ oz., Fig. 8. After cleaning the metal, designs, lettering and monograms can be laid out on the metal with asphaltum paint. When the paint has dried, the etching solution is swabbed on with a wad of cotton string tied to the end of a pine stick. The acid will etch all exposed parts of the metal with which it comes in contact. When the etching has reached the desired depth, the solution is washed off with wa-

ter, and the asphaltum paint removed with gasoline.

To mark tools and other metal articles with the owner's name, stamp the name on the metal surface, using a rubber stamp and asphaltum paint in place of ink, as in Fig. 6. The paint may be applied to the rubber stamp with a small brush if a little care is used. After the impression has dried, the solution is swabbed over the area to be etched, which should be sufficiently large to contrast the non-etched letters. When the work has been completed, the lettering will stand out in relief above an etched background. A less corrosive etching solution for iron and steel is made by dissolving copper sulphate, 12 oz., zinc sulphate, 4 drams, and common salt, 10 oz., in water, 3 pints. This works slower than the other solution, but produces excellent sharp-line etching. In this case, the parts that are not to be etched can be protected with paraffin wax, which is applied over the entire surface either by brushing or flowing on while molten. The design is cut in the wax film with any sharp tool such as a knife or scribe. The edges of the design should be left sharp and clean cut. If a dam of paraffin is built around the parts to be etched, as in Fig. 7, the etching solution can be poured in the space thus formed and allowed to remain until the etching is completed. The paraffin dam can be removed from the work by softening the wax with hot water or with gasoline.

Etching Copper and Brass: A good etching solution for copper and brass is made by dissolving potassium chlorate, $\frac{1}{2}$ oz., in water, 1 qt., and adding to this solution nitric acid, 1 oz. A less corrosive solution for copper can be made by dissolving common salt, 5 oz., in ferric chloride solution, U.S.P., 13 fl. oz. A solution of ferric chloride, 10 oz., in water, 10 fl. oz., can be used in place of the U.S.P. solution.

Etching Other Metals: Silver articles can be etched with a solution of nitric acid, 1 oz., in water, 4 fl. oz. From three to ten minutes will suffice for etching. A solution of sodium hydroxide (caustic soda; lye), 1 oz., in water, 1 pint, will etch aluminum in about five minutes. Etching can be hastened in many cases by jarring the metal occasionally to loosen the bubbles that collect on the surface.

Squeegee for Dairy-Barn Floor from Hose and Rake

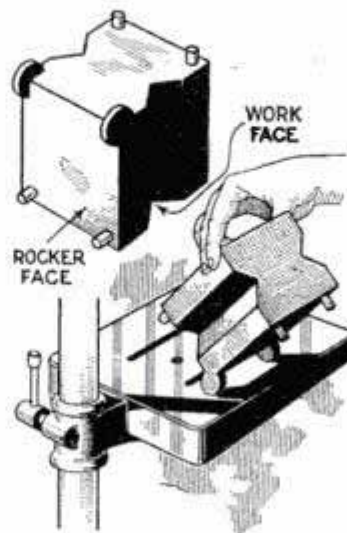


Squeegee to clean floor of dairy barn made by impaling garden hose on rake teeth

A substantial squeegee for scraping a dairy-barn floor after scrubbing, may be made from a length of garden hose, which is impaled upon the teeth of a garden rake. Such a scraper will prove especially effective if hose having a corrugated surface is used. When worn off on one side, the hose may be turned.

—G. E. Hendrickson, Argyle, Wis.

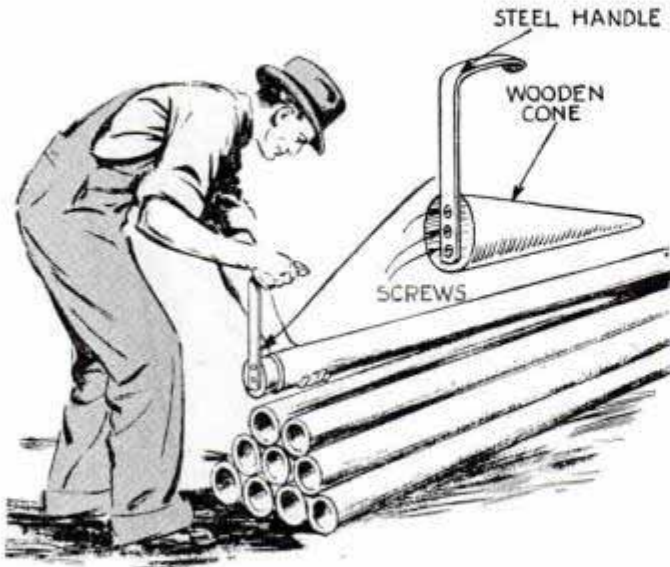
Self-Cleaning Drill Block



Time lost in brushing chips from the face of a drill block after each piece of work has been drilled, is saved with this block, which is cleaned by merely rocking it. It has two faces machined identically, tiny rockers being formed on the edge between

them as indicated. Pins at the other edges of the two surfaces permit the block to set level.—H. Moore, Leeds, Eng.

Handling Heavy Lengths of Pipe Simplified with Lifters

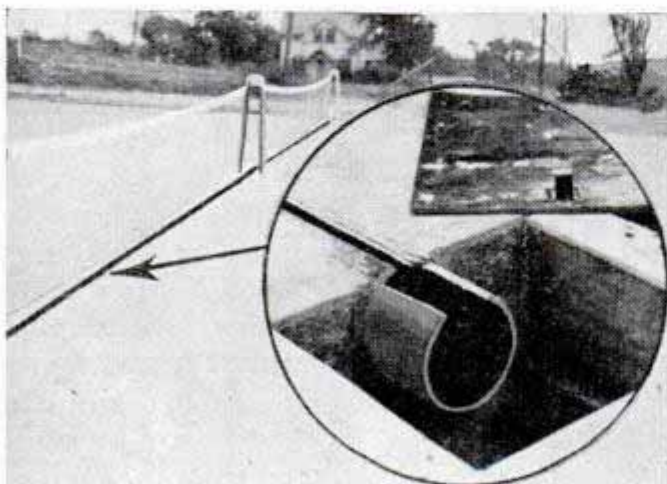


Workmen can carry long lengths of heavy pipe quite easily with these simple lifters

Workmen who carry lengths of heavy pipe will find these lifters convenient. Each one consists of a cone-shaped piece of wood to which is screwed a length of flat iron or steel bent at right angles to form grips. The cones are merely inserted into the ends of the pipe as indicated.

Tennis-Court Drainage System

Here is a novel but effective drainage system for a concrete-surfaced tennis court built in a middle-western city. Directly under the nets of the double court, an 8-in. pipe, having a wide slot cut in it, was laid in the concrete with the slotted side exposed so that water could drain directly into it, the court sloping slightly from both ends toward the pipe. Water is



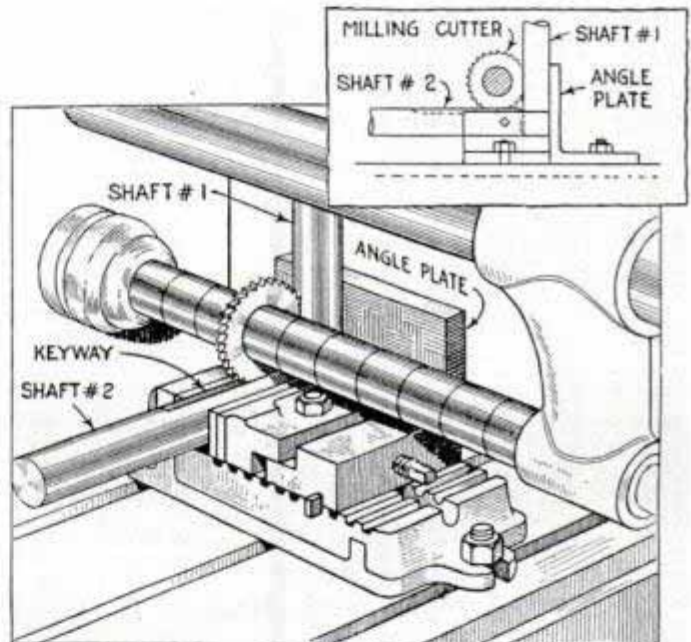
Concrete tennis courts drained by slotted pipe set flush with surface under nets

conducted to the square concrete basin at the edge of the court and a tile line delivers it to the sewer. A piece of heavy metal covers the basin to keep out leaves, papers, etc. Besides serving as a drainage system, the pipe also serves as an expansion joint for the concrete courts. The net supports are built double to straddle the pipe and are set in sleeves flush with the concrete surface.

—Hugh P. Haynes, Santa Fe, N. Mex.

Time Saved in Milling Keyways with This Setup

Keyways near the ends of shafts often can be cut quickly with the milling-machine setup shown, which saves the time necessary to sink the cutter to the re-

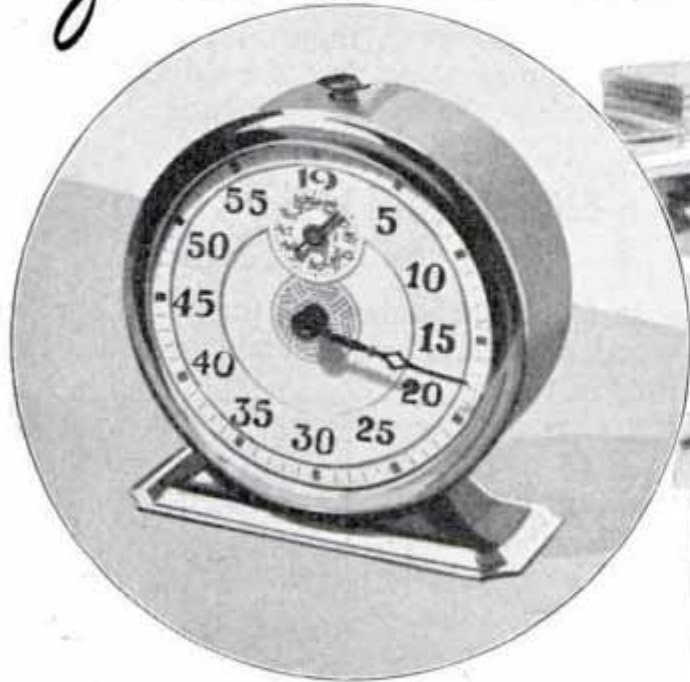


Milling cutter automatically starts keyway in one shaft while finishing keyway of another

quired depth by hand before starting each cut. The cutter sinks in one shaft while it is finishing the cut in another one. One shaft is stood on end at the side of the vise and backed up with an angle plate, while the second shaft is laid on a parallel at a certain distance from the other. The cutter is sunk to the correct depth for the first one and continued to the other end of the keyway, after which the stop is set. You will see that when the cutter reaches the end of keyway in shaft No. 2 it has also sunk itself into shaft No. 1. If the latter shaft is now laid on the parallel and a new one set up vertically, it will not be necessary to sink the cutter.

DARKROOM TIMER

from alarm clock



This darkroom timer can be set to ring at any predetermined time within an hour, and it is especially handy when developing negatives in total darkness. After removing the face and works from the case, the large gears, Fig. 1, which drive the hands and actuate the alarm, are carefully pried off the spindles. The small pinion indicated in Fig. 2 is also removed and the teeth are filed off, after which it is replaced as in Fig. 3. Next, the minute-hand shaft is filed flat on two sides and tinned with solder. The gears are returned to their proper position and the sleeve on one gear is sweat-soldered to the shaft. The reassembled mechanism, Fig. 4, is replaced in the clock case. The dial is renumbered to read as shown. To set the timer, first wind up the alarm and turn the alarm-setting key until the bell rings. Then mount the alarm hand and also the minute hand so they both point to 60. Set the alarm hand on the number of minutes interval desired. Always return the large hand to 60, and be sure to always turn it in clockwise direction



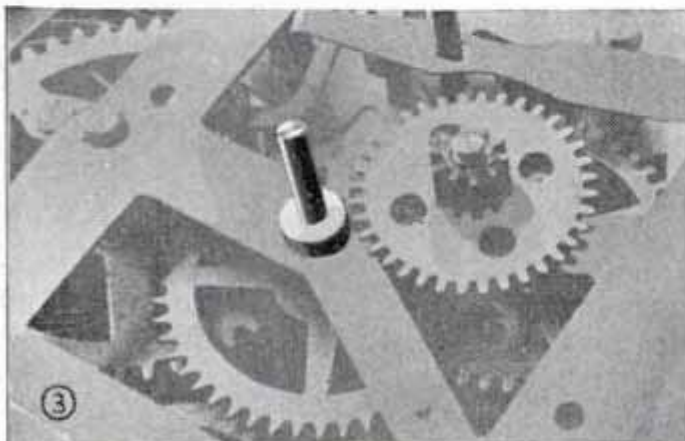
①

GEARS WHICH DRIVE HANDS AND ACTUATE ALARM ARE PRIED OFF SPINDLES



②

THIS PINION IS PRIED OFF AND THE TEETH FILED AWAY



③

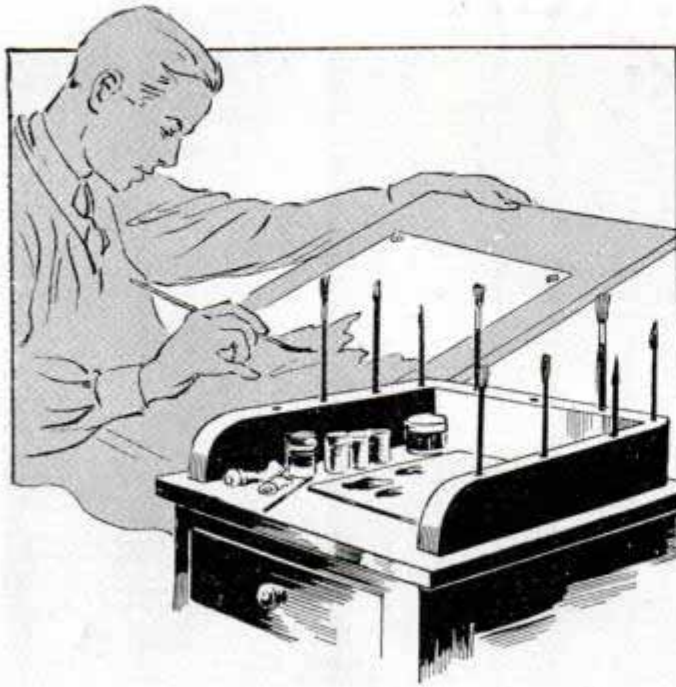
PINION IS RETURNED TO ORIGINAL POSITION



④

THEN THE MECHANISM IS RE-ASSEMBLED

Rack to Store Artist's Brushes Fits on Cabinet

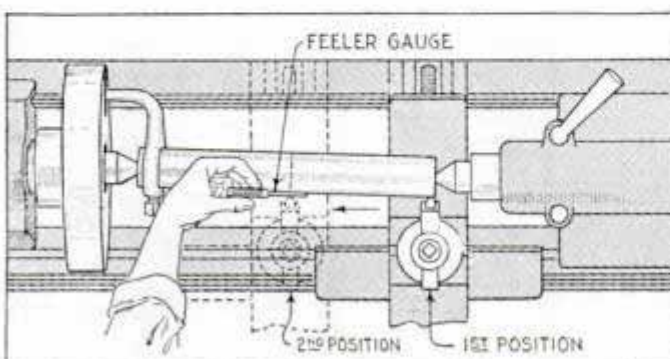


Wood frame with holes bored in top edge and set on artist's cabinet provides handy place for brushes

A three-side frame of narrow 1-in. wood strips with holes drilled into the upper edges provides a handy place to store pencils and brushes, when set on the cabinet beside the drawing board. Also, the frame tends to keep small articles from rolling off the top of the cabinet.

Tailstock Set for Taper Turning with Aid of Feeler Gauge

Setting a lathe tailstock off center to turn a taper can be done quite accurately with nothing more elaborate than a feeler gauge. First smooth up the work, then adjust the tailstock for the taper cut as nearly correct as possible by sight. Now set the tool to just touch the work at the end that is to be the small end of the taper. Run the carriage back to the por-

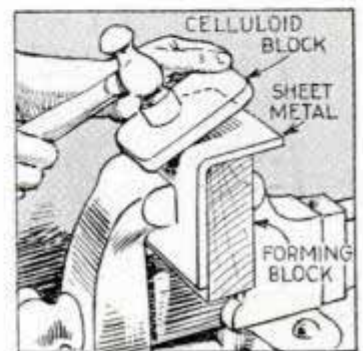


Use of a feeler gauge to check setting of tailstock, when turning taper, has been found quite accurate

tion of the work that is to be the large end of the taper. Then slip a number of leaves of the feeler gauge, equal in thickness to one half of the taper that is to be cut, between the tool and the work, after which the tailstock is adjusted so that the gauge just slips between them. Also, the tool, left at the same setting, should just touch the work at the end to be turned down.

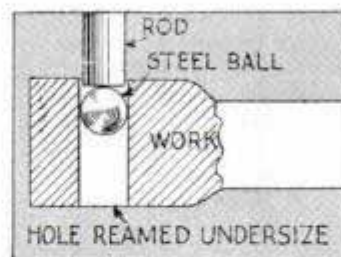
Sheet Metal Is Bent Easily with Celluloid Block

In forming sheet-metal parts, a fiber or wooden block is usually employed to avoid marring or denting the surface, and to assist in making uniform bends. If a celluloid block $\frac{1}{8}$ to $\frac{1}{4}$ in. thick is substituted, the results will not only be superior, but the progress of the forming can be observed without lifting the block from the work. The celluloid will withstand considerable hammering.



Sizing a Reamed Hole

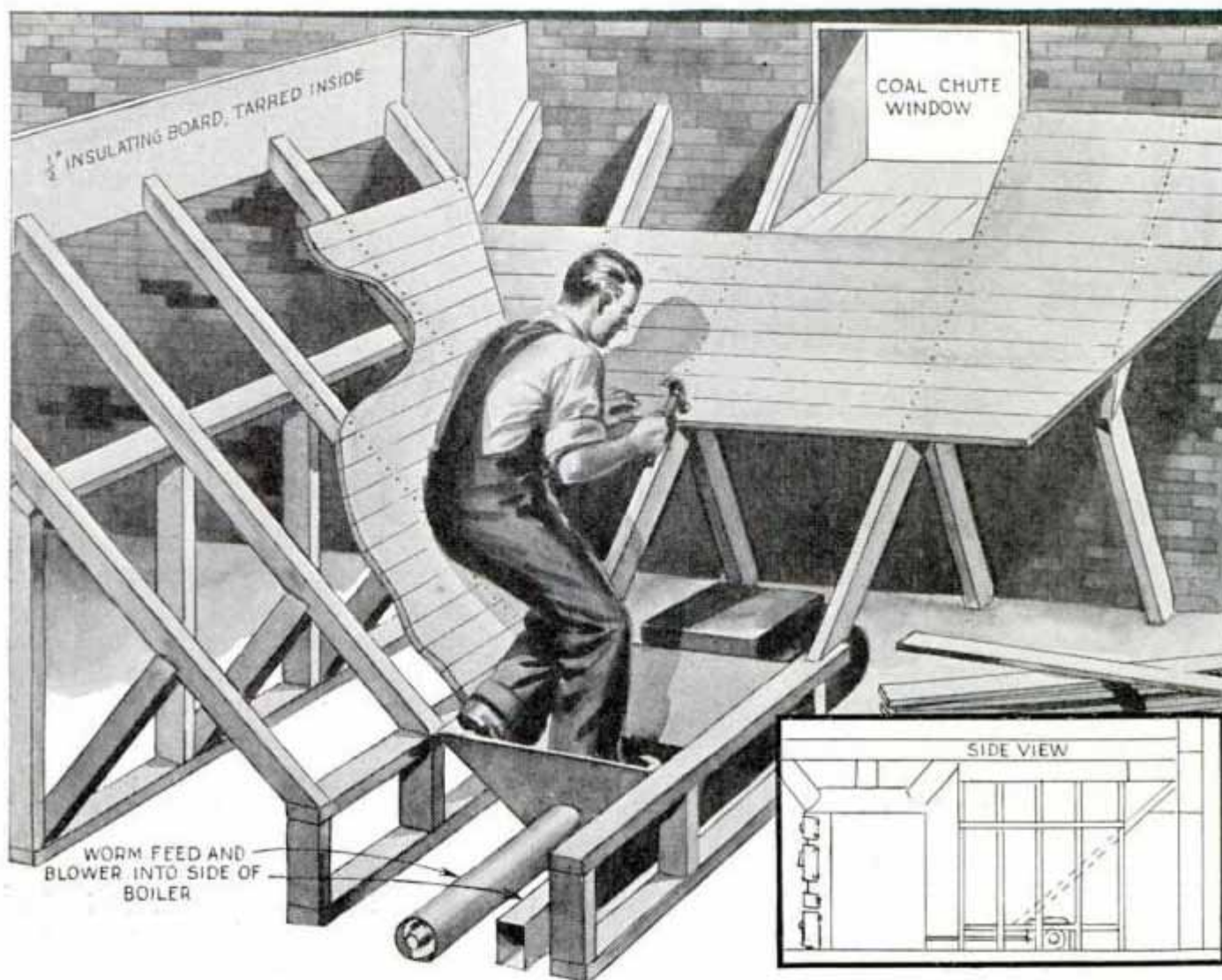
If your reamers have become worn so that the holes in which they are used are slightly undersize, the latter can be enlarged by forcing a steel ball of the proper diameter through them. Sometimes several passes of the ball are necessary. This method is especially effective in soft materials such as brass, mild steel, etc., and produces a mirror finish.



Belled Crow Scares Others Away

A Texas farmer claims that he has successfully kept his fields free of crows by catching one alive and then turning it loose with a small bell attached to its neck. The belled bird, in trying to join the flock, scared the others away but remained in the vicinity itself.

Self-Feeding Bin for Hopper-Type Stokers



Disliking the daily job of refilling the hopper of my coal stoker, I built this large bin or hopper, which holds four tons of fuel, and feeds the stoker automatically. Location of a heating plant in relation to an outside wall determines the size and shape of the bin to some extent, keeping in mind that at least three of the sides must slope to the stoker so that the fuel will work down. The side next to the heating plant can be vertical so that the bin can be built close to it. The framework is fastened rigidly to the floor. The timbers should run up close to the ceiling, but should not be attached to it as they would transmit vibration to the rooms above. The space between the bin and the ceiling is boxed-in tightly with $\frac{1}{2}$ -in. fiber insulation board, which has little tendency to transmit vibration. This is given a coat of tar on the inside. Also, it's a good idea to cover the joists above the bin with insulating board to prevent dust from working through the

ceiling. The bin sides are tongue-and-groove stock, and the joints are sealed tightly with asbestos flashing compound. This is applied to the groove of each board, which is then nailed in place and the tongue of the next one forced tightly into it. It's best to cover the outside surface of the wall next to the heating plant with asbestos. Use well-seasoned lumber in the bin to reduce shrinkage to a minimum which perhaps would open some of the joints. It is very important that a chimney-draft check be used to prevent the fire from burning too low in the stoker retort during idle periods, as this may cause smoke and gas to back up into the bin when the coal supply in the bin is low.

—A. L. Mills, Chicago.

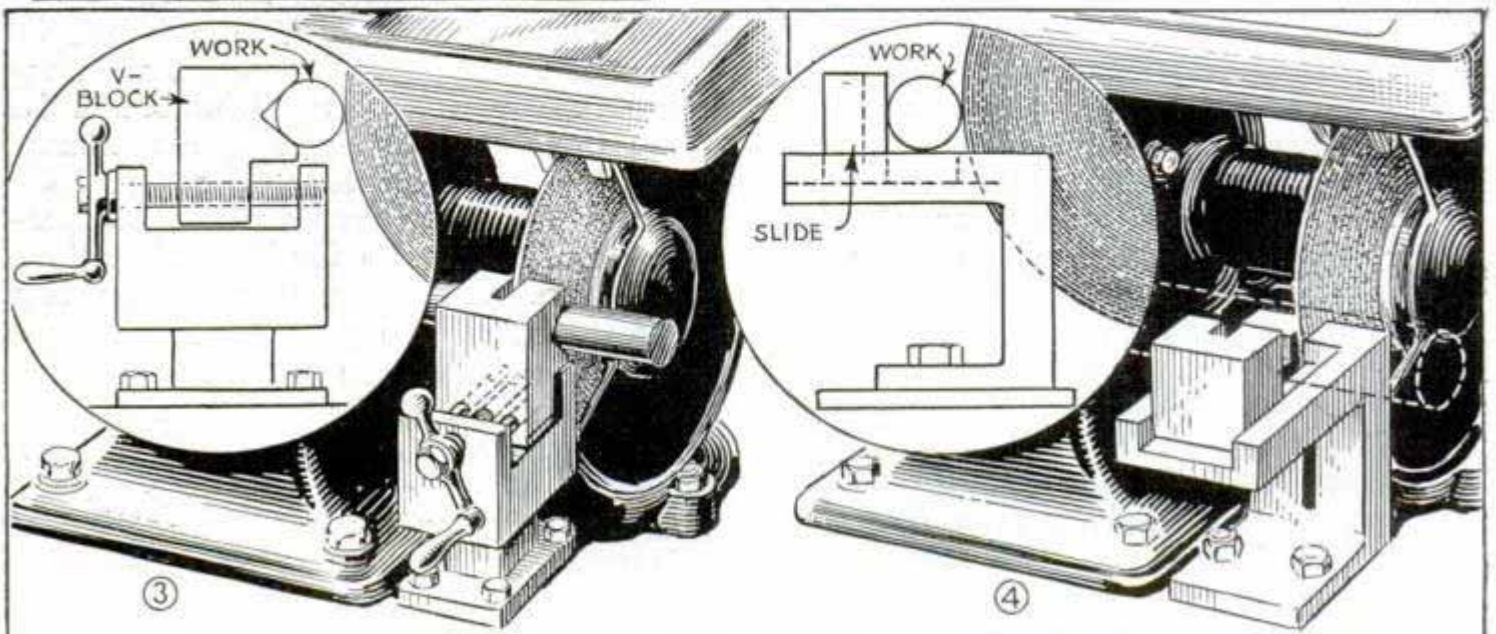
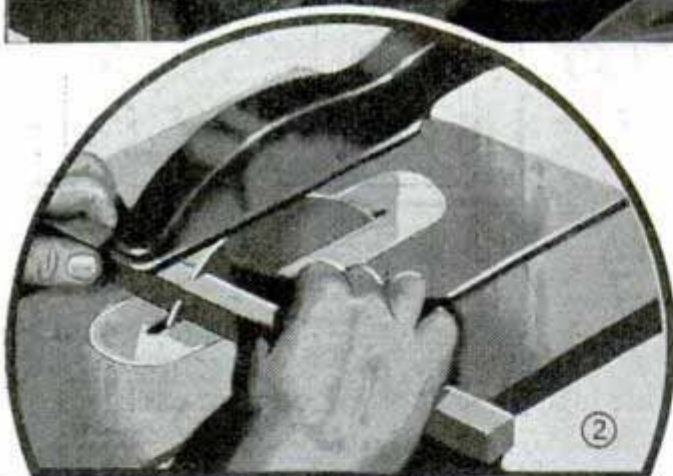
☐ After washing oiled wallpaper, such as is used in bathrooms, apply a coat of wax and the finish will be restored so the paper will be almost like new.

HIGH-SPEED CUTTING



WHERE you have any appreciable number of metal or non-metal rods, tubes or squares to cut into short and exact lengths, an abrasive wheel will speed the job a hundredfold over ordinary methods. Practically any material, even glass, can be cut with a wheel of the proper abrasive characteristics. By providing suitable guards and a rigid support for the work you can use these wheels on most any true-running spindle as in Figs. 1 to 6 inclusive. However, in using them on varying types of spindles certain simple precautions must be observed carefully for, while the wheels are very strong radially, they are comparatively weak axially.

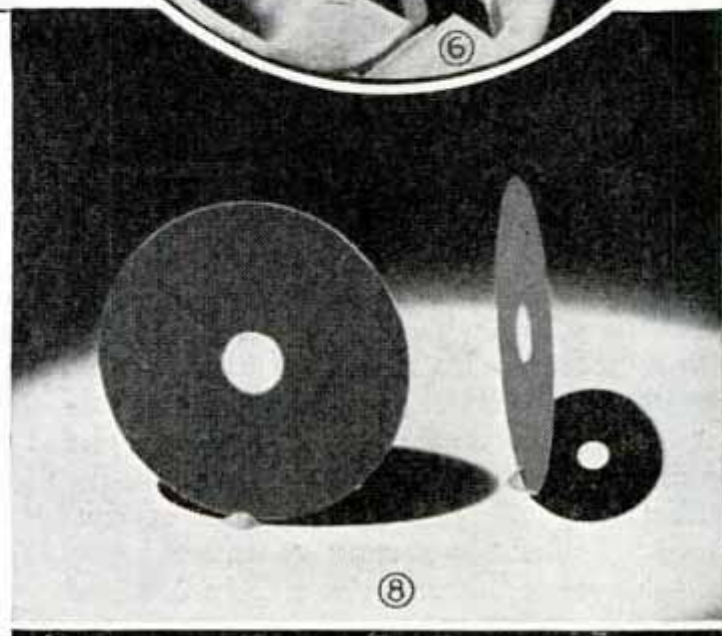
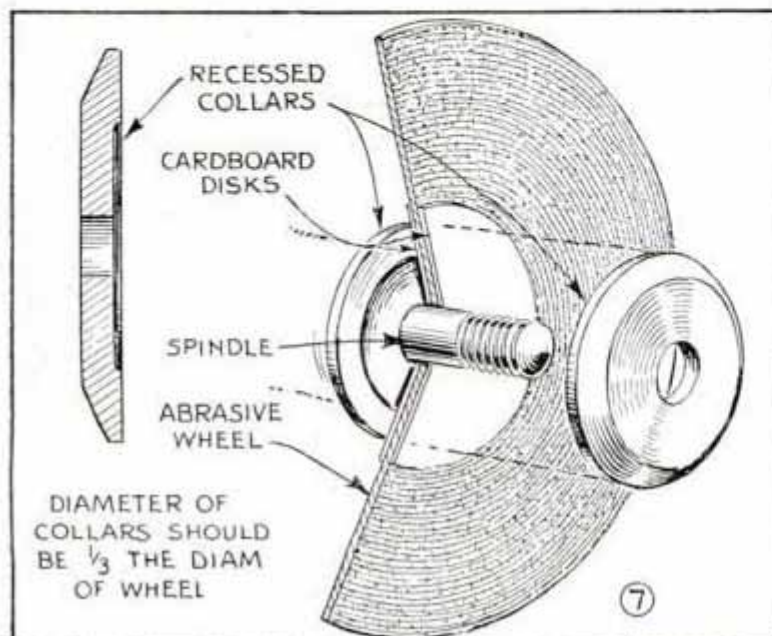
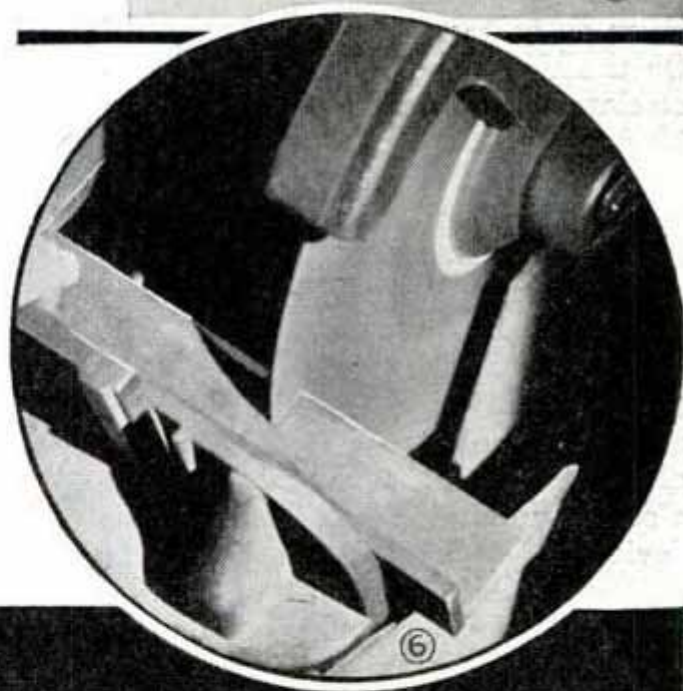
Wheel diameters range from 7 to 12 in. The thickness is usually $\frac{1}{8}$ in. and as the work is cut without a coolant the so-called "rough-sided" wheel generally should be used. The latter is a comparatively new development and points which recommend it are elimination of side rubbing and consequent generation of a minimum amount of heat. Special bonding agents permit operation at very high speeds although these are practical only on production jobs where the spindles and equipment are specially designed for abrasive wheels, such as the machine shown in Fig. 9. Lower-speed equipment, such as pedestal and bench grinders both belt and direct-motor driv-

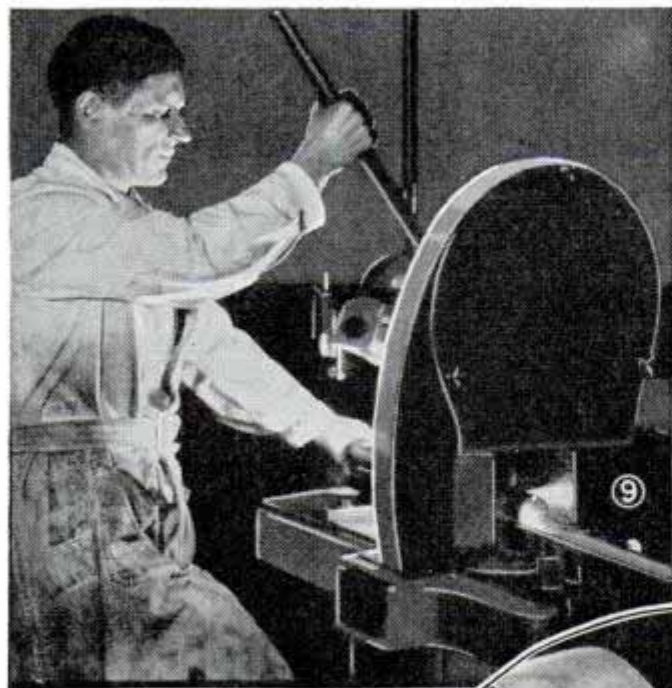


with ABRASIVE WHEELS

en, portable grinders like that in Fig. 5, and the circular-saw table in Fig. 2 will be the principal types of drive the individual user has at hand. Naturally the size of the stock which can be cut with these drives will be limited to 1 in. and under for solid rounds and squares of steel. Non-metal materials, such as hard rubber, marble, slate and tile, can be somewhat larger in sectional dimensions. Metal tubing 2 in. in diameter and under can be handled very nicely. Of course, these sizes of materials do not represent the absolute limit but rather the most practical when the way in which the stock must be fed into the wheel is considered.

Figs. 3 and 4 suggest two fixtures for supporting light stock when feeding it to an abrasive wheel mounted on a bench grinder. The one important thing in connection with any fixture for supporting the work is that it be rigid, even though the stock is held against a guide with the hands as in Figs. 1, 2, 3, and 4. A loose, wobbly support is not only impractical for accurate work; it is unsafe as there is danger of shattering the wheel should the material twist suddenly out of line while the cut is being made. Aside from this precaution the work rest may be most any homemade device that accomplishes the purpose. For example, you can make up a support out of flat steel with a provision





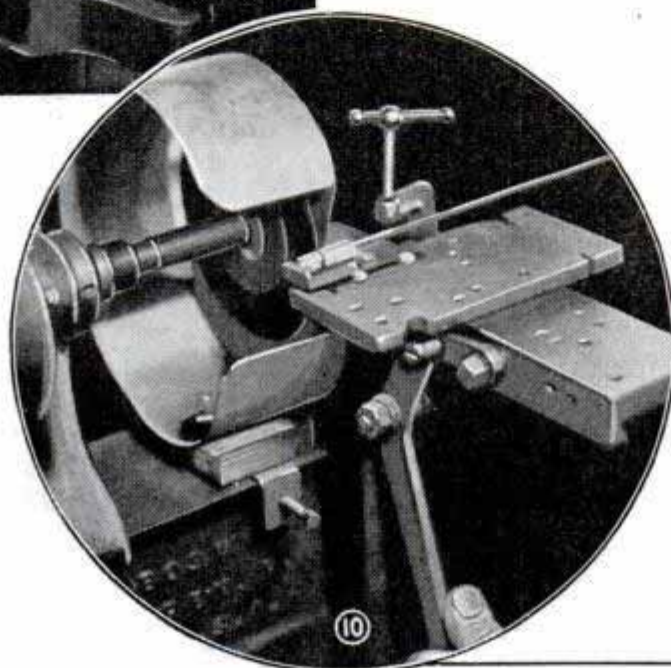
for clamping the work to a movable carriage or slide controlled by a hand lever as in Fig. 10. Or the work could be clamped to a solid fixture and the wheel and drive mounted on a swinging vertical arm operating in much the same fashion as a swing saw. This arrangement can be supplemented with a cord and weight to give a semi-automatic feed. The same driving device can be controlled with a lever feed similar to that in Figs. 9 and 10.

For light jobs your wood or metal-turning lathe can be adapted easily, provided you can arrange to get a spindle speed of at least 2,500 r.p.m. Usually you can improvise an adapter readily enough. In such a set-up the collars are an important detail. In order to assure adequate support, the collars should be at least one-third the diameter of the wheel as in Fig. 7. On very thin wheels, such as those in Fig. 8 which are .005 in. thick, the diameter of the collar in relation to that of the wheel may be even greater. The size of the collars on the wheel in Fig. 10 is an example of this. Here the wheel is cutting 1/4-in. steel rods and the work is carried on a fixture bolted to the cross slide of the compound rest on

the metal-working lathe, a very simple and effective arrangement. This set-up is not by any means restricted to very small stock, as it will serve well for any shapes up to about 1 in. diameter and especially for cutting pieces from strip stock. A small vise with split jaws can replace the holder shown and is most practical. An 8-in. diameter wheel will cut well at 2,500 r.p.m. but much better at 3,500 r.p.m. A 1/8 by 10-in. wheel may be used with this set-up provided the construction of the machine permits using a wheel of this diameter.

Driven by a portable grinder, cut-off wheels excel most other methods of cutting.

Note Fig. 5 and see what the abrasive wheel is doing here. After surfacing the composition cement floor, a square design is laid out previous to applying a two-tone coloring. A long board is used as a straightedge to guide the grinder. Driven in the same manner, the cut-off wheel does a clean, fast job cutting



Materials	Wheel Recommendations
All Steels, Solid or Tubing	46—Q—8—T—2 Alun. B
Brass,	30—S—6—T—2 Alun. B
Copper Tubing	3780—R—2—R—1 Crys. R
Hardened Tools	24—S—8—T—2 Alun. B
Aluminum	24—S—8—T—2 Alun. B
Hard Rubber	3736—Q—6—T—2 Crys. B
Cast Iron Pipe	30/2—W—7—T—3 Alun. B
Marble, Slate, Comp Shingles	3724—R—8—T—2 Crys. B
Tile	3736—Q—8—T—2 Crys. B
Imitation Stone	3724—W—7—T—3 Crys. B
Insulating Materials	3730—N—6—T—2 Crys. B
Glass	3790 K—O—R Crys. R

(11)

artificial stone. A novice can do work which would take years of experience to accomplish by other means. Marble, tile, slate, asbestos slabs, roofing and side-wall materials can be cut free-hand easily. Where a number of pieces have to be uniform and perfectly square cuts are desired, the portable grinder is used with an improvised fixture to guide the wheel in

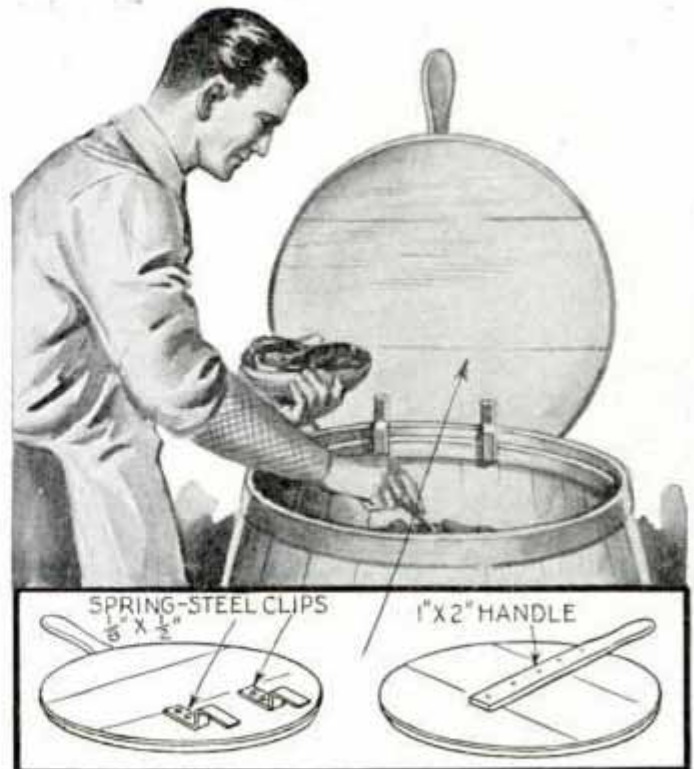
making the true cuts. In such work it's generally wise to make the fixture up from flat steel in such a way that the machine is supported on a slide so that it can be moved into the work, which is held or clamped against a rigid stop.

As mentioned, it is also quite convenient to use a cut-off wheel on a bench saw, Fig. 2. Any amateur craftsman who handles Bakelite or certain plastic materials will appreciate the value of cut-off wheels set up in this manner. This also applies to anyone who works ceramics, either as a hobby or commercially. With either the portable or bench-saw equipment, all insulating materials can be cut not only faster but cleaner as compared to saw results. A wheel as large as 10 in. diameter may be used on most bench saws, while portable grinders are adaptable for 7 by $\frac{3}{32}$ -in. wheels and the surface speeds are low compared to other equipment.

The table in Fig. 11 will serve to make wheel selections easy and although the markings may vary with different manufacturers, the characteristics will be essentially the same. No matter what the size of the wheel or what it is to cut, it always should be housed in a suitable guard. Note especially that the latter, whether it is already fitted to the machine or improvised, always should come down over the top of the wheel. In other words, only from 30 to 45 degrees of the wheel periphery is exposed and the top, or that portion turning toward you, is covered. This prevents sharp grains of grit or tiny bits of steel reaching your eyes. Although it's a good idea to wear goggles, they are not essential where the wheel is well guarded and the work properly supported. Heavy galvanized iron bolted to light angles will do very well for an improvised wheel guard. For the larger diameter wheels you can use $\frac{1}{16}$ -in. flat iron and the parts that join at an angle can be brazed for extra strength and rigidity. The guard should always be bolted securely in place, either to the machine frame, or a supporting bracket.

☞ When the threads of a bolt are slightly burred, they can be cleaned up quite satisfactorily by screwing on a castellated nut, with the castellations facing the head of the bolt.

Clips on Barrel Lid Support It Vertically When Raised

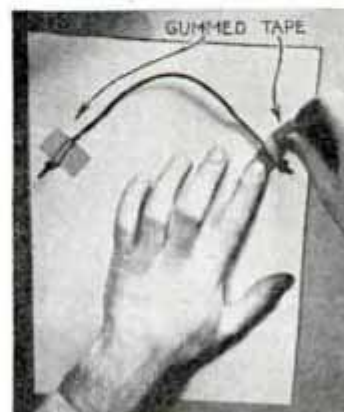


Small spring-steel clips on barrel lid support it in vertical position while removing contents

Grocers who dispense various items from barrels, or farmers who store feed in them, will find that these spring-steel clips are handy for supporting the lid in a vertical position while removing part of the contents. The clips should be shaped from fairly heavy metal to support the weight of the lid. A handle nailed to the lid is an added convenience.

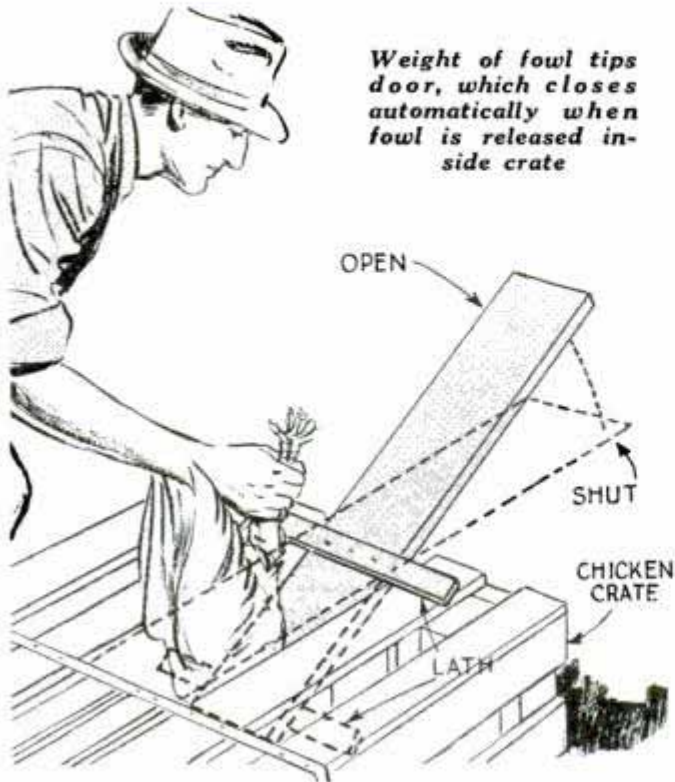
Hanging Unframed Pictures

Unframed pictures and photographs mounted on cardboard, calendars, signs, etc., can be hung on the wall like framed pictures by fastening a string or wire to the back with gummed tape. Knots tied at the ends of the string or wire prevent it from pulling out of the fasteners. Pictures hung in this way look better than those put up with visible tacks as is often done.



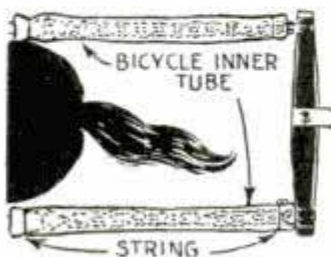
—A. H. Waychoff, Phoenix, Ariz.

Trap Door in Poultry Crate Saves Time



In transferring fowls from feed pens to shipping crates, much time is wasted in opening and closing the slides of the crate. To avoid this, one poultry shipper employs a simple detachable door or trap. This consists of a board about 4 ft. long and wide enough to close the opening of the crate. Two lath strips are nailed across the board, one on each side and spaced apart as shown. When placed in the crate opening, the weight of the projecting end of the board keeps the trap closed until opened automatically by the weight of a fowl that has been deposited upon it. The trap may be removed quickly as soon as the crate is filled.

Chain Harness Traces Locked on Singletree



To keep the chains of my harness traces from falling off of the singletree hooks, I slipped a piece of rubber tubing such as a length of bicycle inner tube over each trace. When the traces are fastened to the singletree, the tubes are slipped down over the

clips. Besides holding the traces in place, the tubes also tend to protect the horses legs if they happen to rub against them.

—Joseph Kielec, Jr., Amherst, Mass.

Eraser Aids in Make-Ready on Job Press

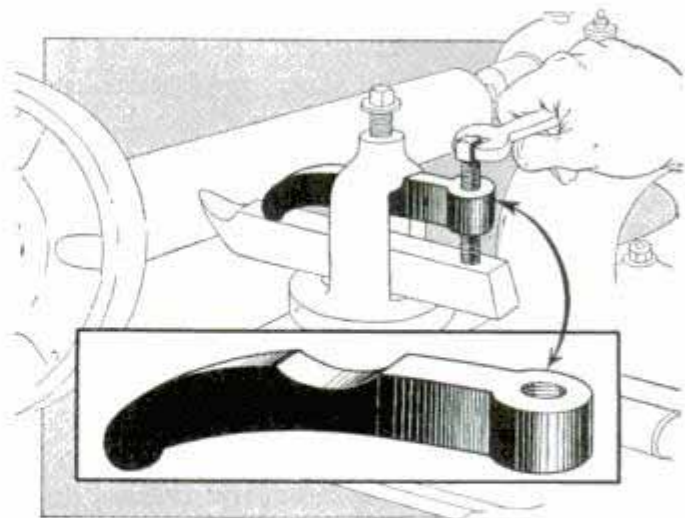
Difficulty of make-ready for some printing jobs is increased if a brass rule is included in the form, as the rule is often higher than the type and scores



the printed paper too deeply. To save the time required to lift the tympan and cut out from the impression sheet, use a pencil eraser to reduce the top sheet to the desired thickness. The eraser is especially handy when the deep score appears at the line ends, as is usually the case.

Rigid Clamping for Tool Post

One of the most troublesome features of the ordinary single-screw lathe tool post—that of the tool moving under a heavy cut or feed—can be eliminated by the use of this clamping finger. It must be made of high-grade, tough tool steel which is well tempered and drawn. The pressure



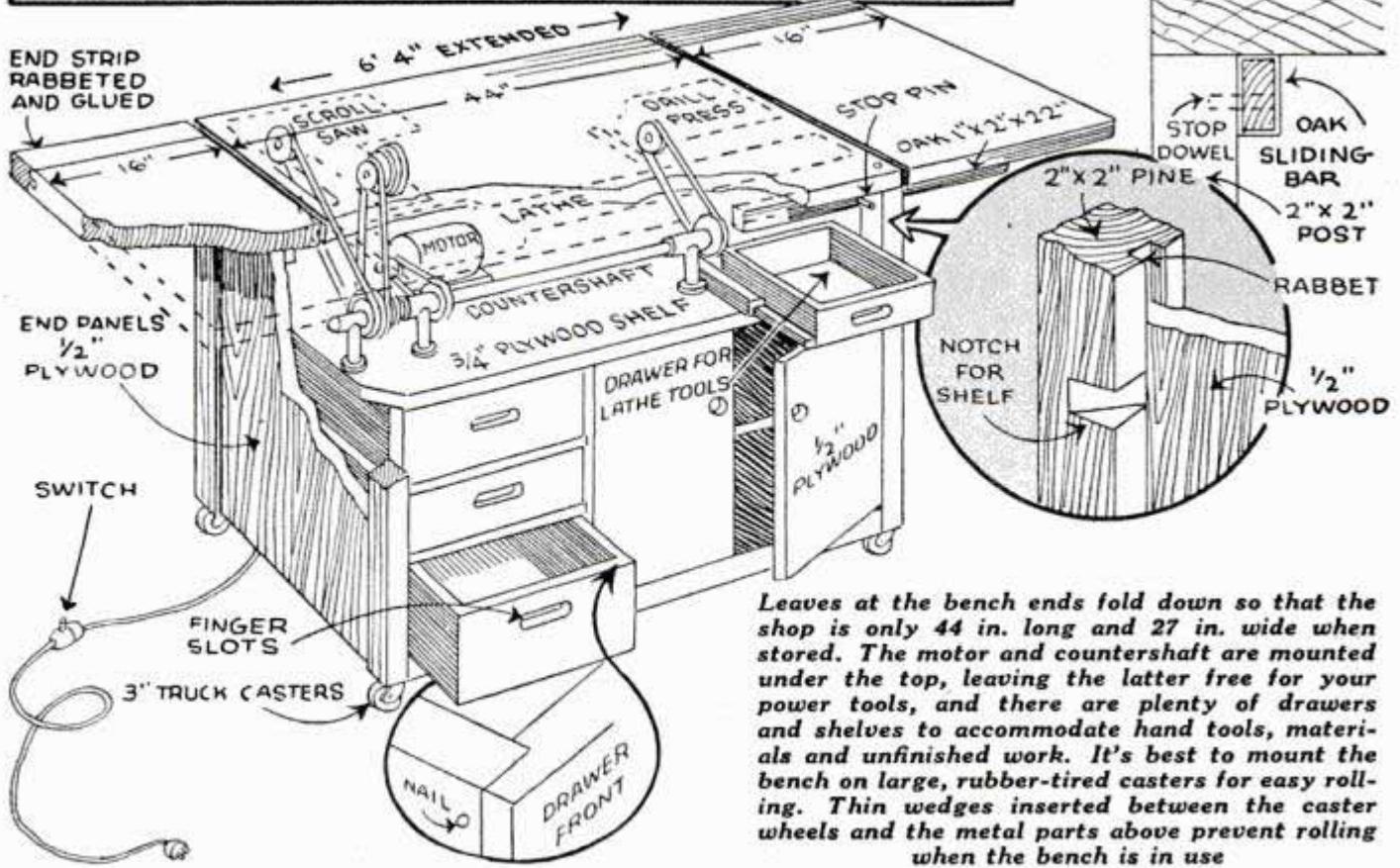
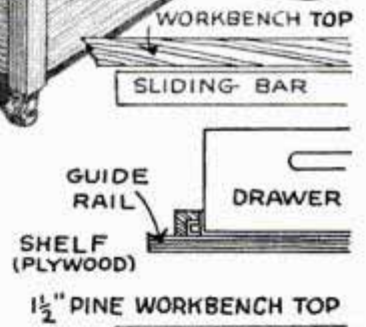
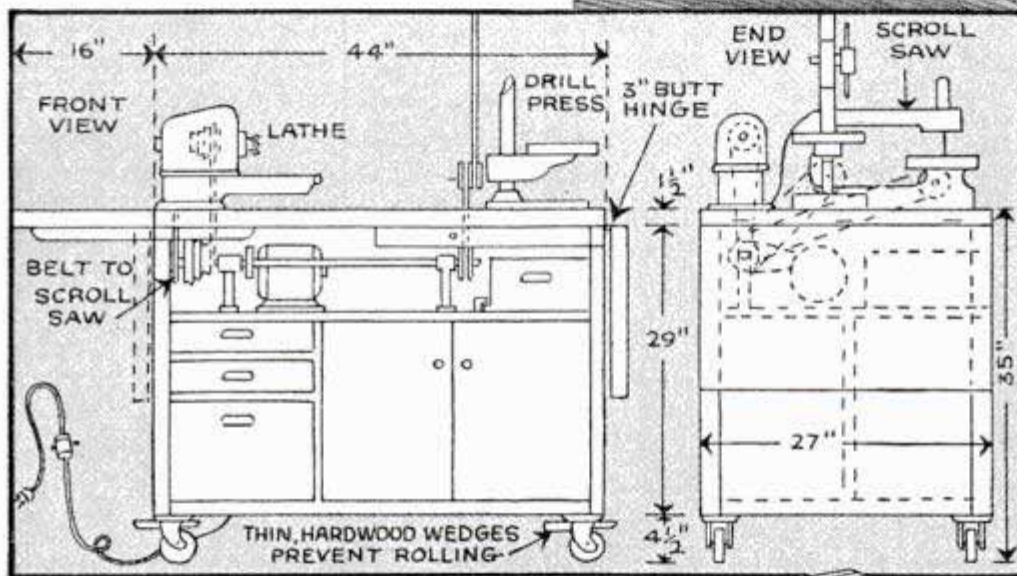
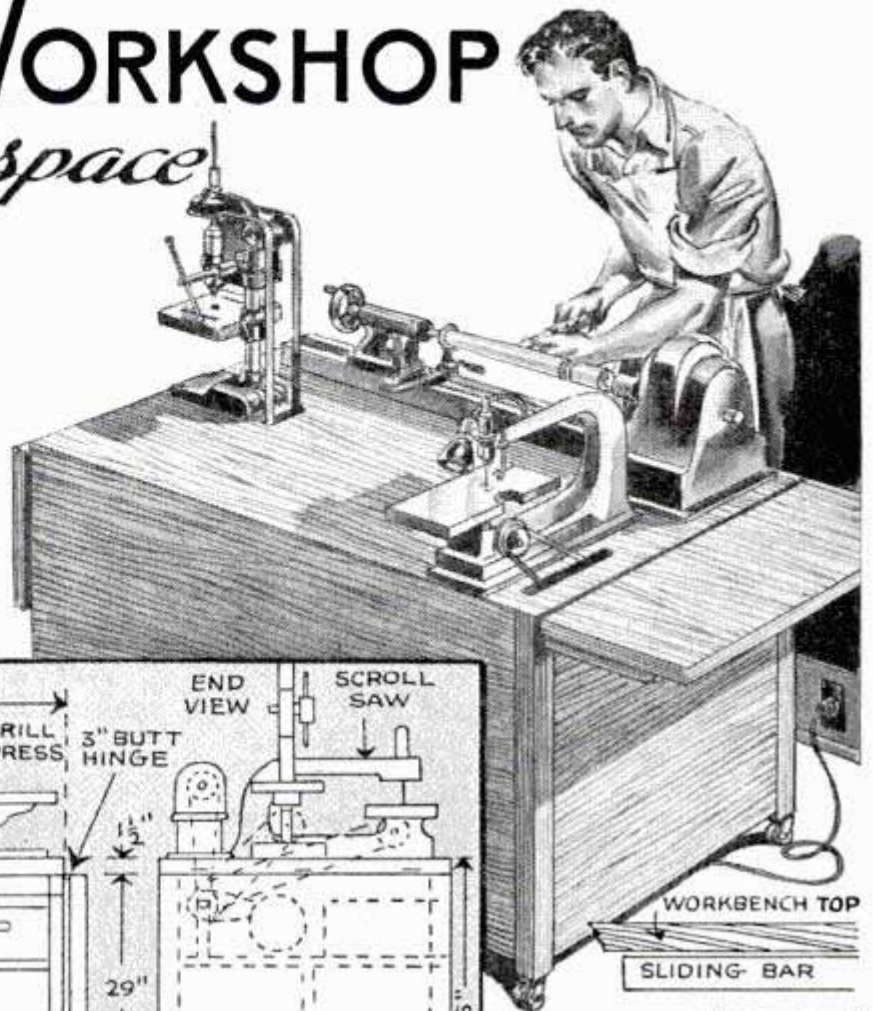
This clamp prevents lathe cutting tool from moving under a heavy cut or feed

and gripping power are placed where they are most needed and two screws are used to prevent pivoting of the tool under one screw.—Chas. H. Willey, Penacook, N. H.

ROLLING WORKSHOP

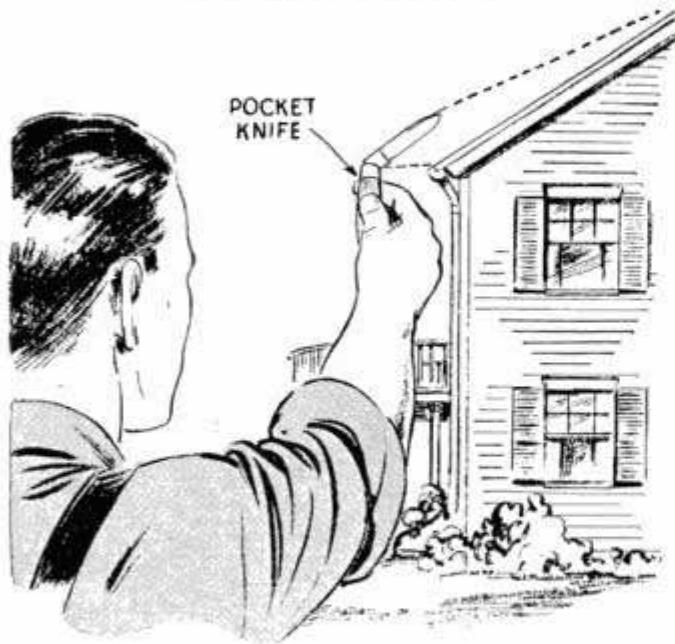
for limited space

If you have foregone the pleasure of a home workshop because of limited space in your house, apartment or small garage, this compact, rolling one may solve the problem. By spreading a tarpaulin on the floor, your shop can be established temporarily in any unoccupied room. When the job is finished, simply roll the shop out onto the porch and throw the tarpaulin over it. The tools can be arranged compactly because the user can stand at any side of the workbench



Leaves at the bench ends fold down so that the shop is only 44 in. long and 27 in. wide when stored. The motor and countershaft are mounted under the top, leaving the latter free for your power tools, and there are plenty of drawers and shelves to accommodate hand tools, materials and unfinished work. It's best to mount the bench on large, rubber-tired casters for easy rolling. Thin wedges inserted between the caster wheels and the metal parts above prevent rolling when the bench is in use

Roof Pitch Easily Estimated with Pocketknife

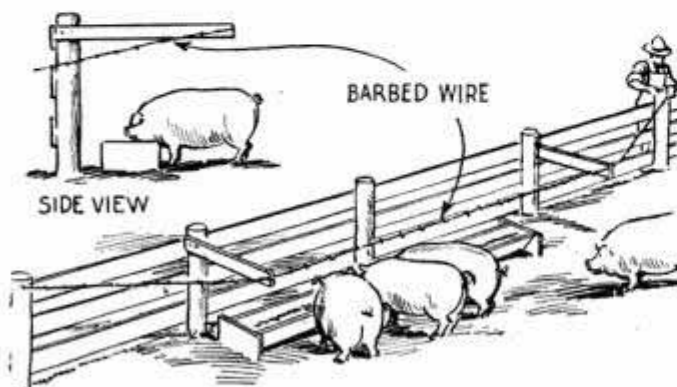


Knife blade opened to same angle as pitch of roof enables carpenter to estimate latter

A carpenter who has frequent occasion to figure the roof pitch of buildings employs a pocketknife as shown. The handle of the open knife is held at arm's length so that it is parallel to the side of the house. The blade is then adjusted to the same slant as the roof, and the resulting angle is measured or estimated.

Extension Fence Keeps Cattle Out of Hog Trough

When cattle and hogs were kept in the same yard, one farmer overcame the difficulty of feeding the latter without having the other stock drive them away, by use of an extension fence. Horizontal bars were attached to fence posts, near which the troughs were located. At the ends of the horizontal bars a single barb wire was attached, this being anchored at either end



Barbed wire supported above hog trough keeps other livestock from bothering hogs while feeding

to the fence. The arrangement permitted the hogs to have access to the trough while cows were kept at a distance.

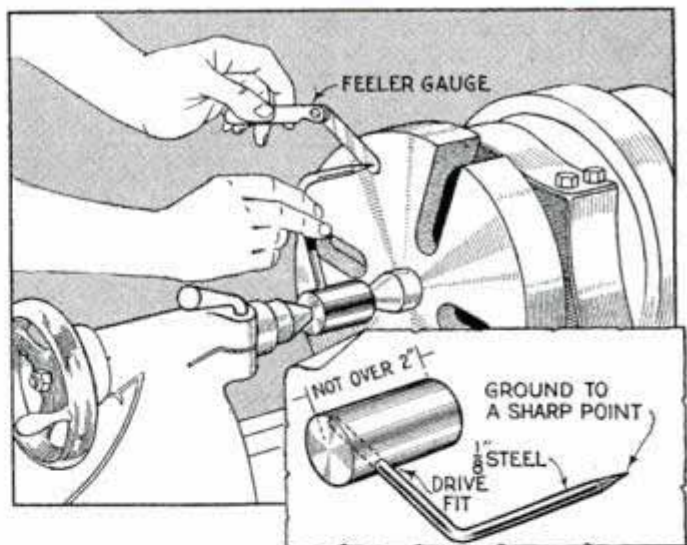
Cardboard "Wings" on Flywheel Are Cooling

One printer inserted 4 by 12-in. strips of cardboard between the spokes of a press flywheel and bent the flaps toward the press. The breeze set up by the motion of the flywheel circulates air where an electric fan would be impractical.

—A. K. Brill, Peoria, Ill.

Simple Tool Aligns Lathe Centers

Here's a simple tool that is fairly accurate in aligning lathe centers, provided the latter are in good condition and the faceplate runs true. Each end of a piece of round stock about 2 in. long is trued up and drilled with a countersink drill to fit the lathe centers. A hole is drilled through it for heavy stiff wire which is filed to a point and bent so that it will touch the



When lathe centers are true, the pointed end of this tool will touch the faceplate uniformly all around

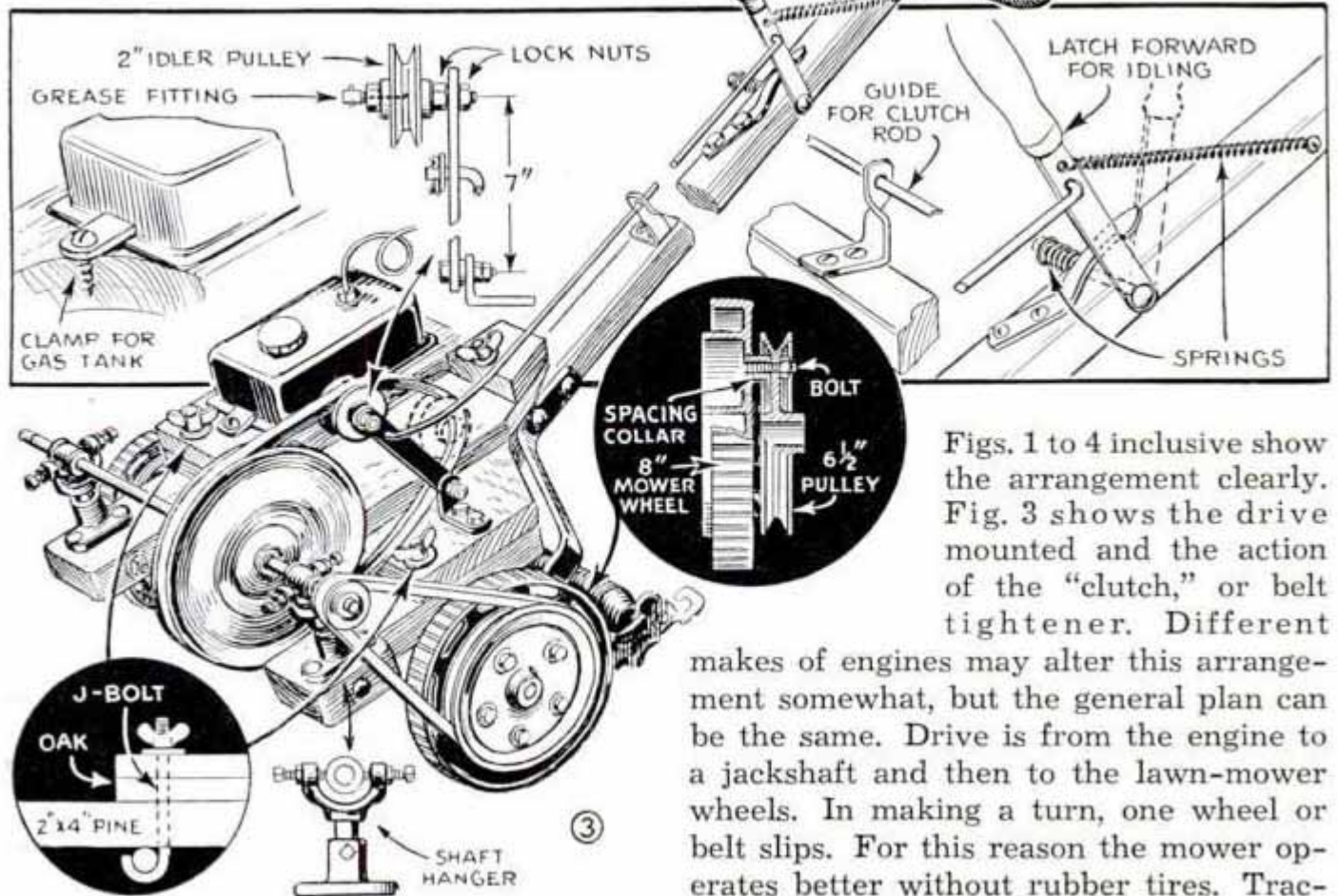
faceplate near the edge indicated. To use the tool, place it between lathe centers, and turn it with the fingers until the wire touches the faceplate evenly all the way around. A feeler gauge used between the faceplate and the point of the wire may help.—Clarence E. Hill, Groton, Conn.

☞ To remove small rivets from sheet metal when no grinder is at hand, hammer the upset part of rivet until very thin, after which the rivet can be punched out.

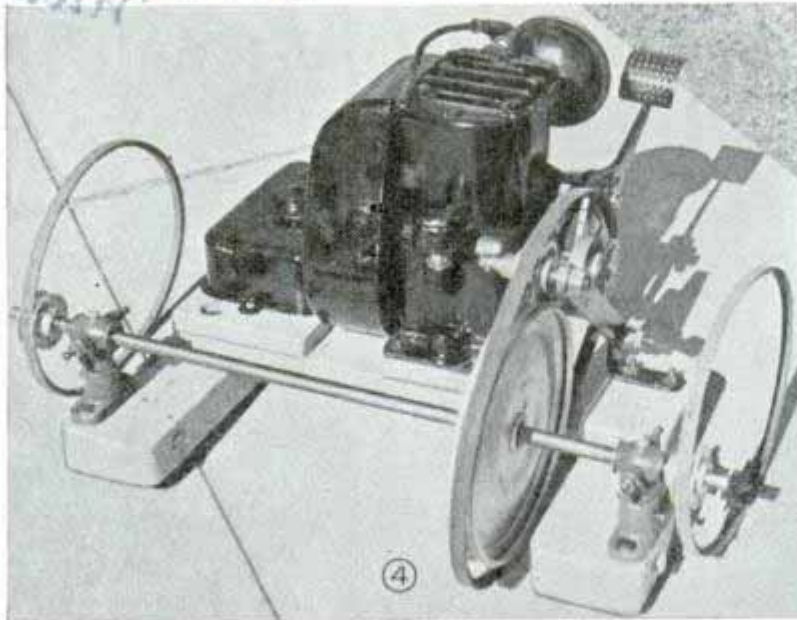
MOTORIZE YOUR LAWN MOWER



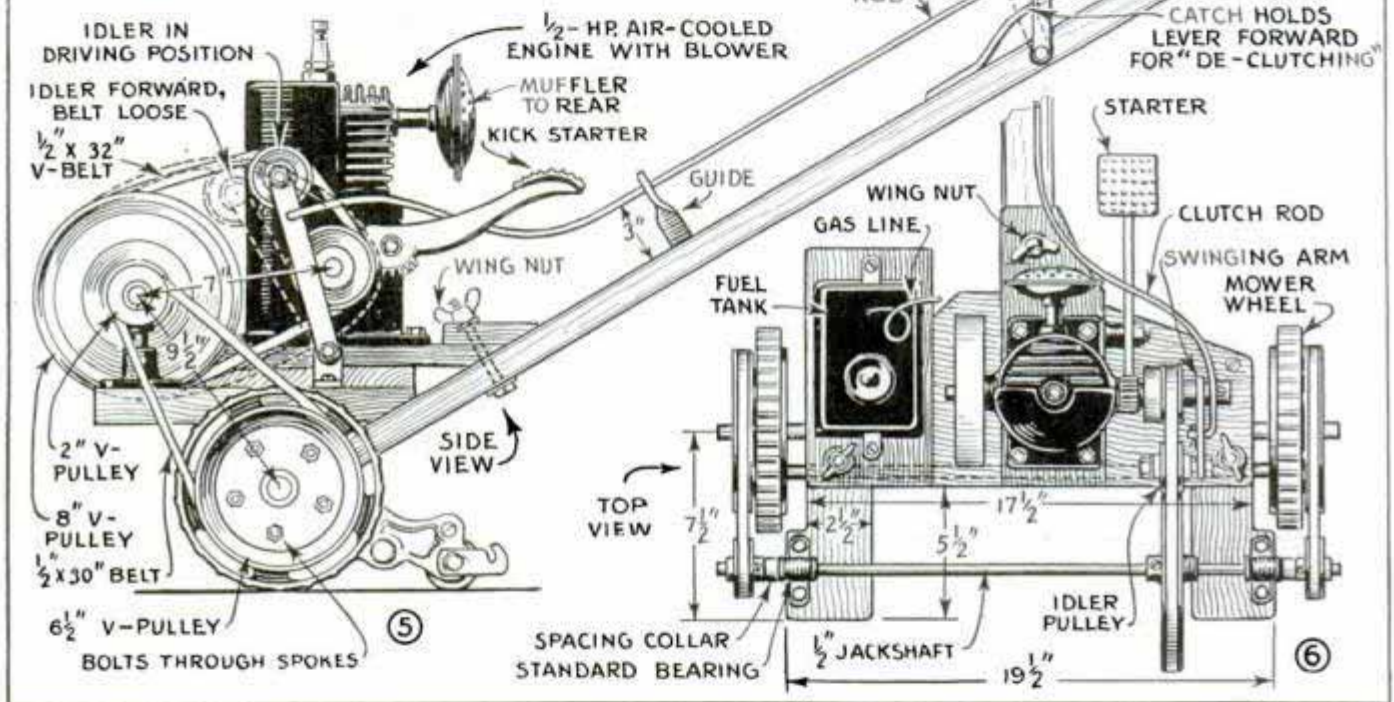
POWERED with a compact $\frac{1}{2}$ -hp. gas engine equipped with a kick starter, your lawn mower will cut faster than it does by hand, and in an hour's continuous operation will use only about $\frac{1}{2}$ pt. of gasoline. Pulleys, belts, shafting, bearings, etc., required for the conversion are inexpensive and obtainable almost anywhere.



Figs. 1 to 4 inclusive show the arrangement clearly. Fig. 3 shows the drive mounted and the action of the "clutch," or belt tightener. Different makes of engines may alter this arrangement somewhat, but the general plan can be the same. Drive is from the engine to a jackshaft and then to the lawn-mower wheels. In making a turn, one wheel or belt slips. For this reason the mower operates better without rubber tires. Trac-



are fastened to the webs of the mower wheels with machine screws using washers or spacing collars between, Fig. 3. The idler pulley is mounted on a flat, iron bar and can be fitted with a grease cup by drilling a $\frac{1}{8}$ -in. hole into the shaft at right angles and one along the length for passage of the grease to the bearing, Fig. 3.



tion is entirely adequate on the iron ones.

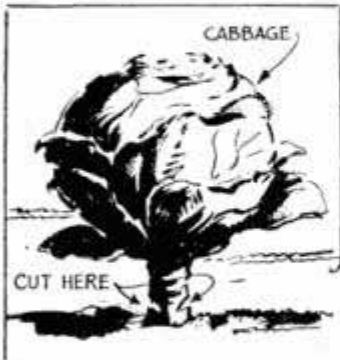
Figs. 5 and 6 show side and top views of the mower complete. The oak engine base is mounted on two sills, cut from pine 2 by 4-in. stock. These also support the jackshaft bearings. By unscrewing three wing-nuts and disconnecting the rod on the loose-pulley arm, the entire power plant can be lifted off and used for other purposes. Two J-bolts hook under the cross-bar of the mower frame to hold the mounting in place. These are made by cutting off the heads of $\frac{1}{4}$ -in. carriage bolts and bending them over as in Fig. 3. A third machine bolt passes through the lower end of the wood push bar and the motor base, as in Fig. 5. For the final drive on 8-in. mower wheels, which are standard on most machines, use $6\frac{1}{2}$ -in. V-pulleys. These

The starting or clutch lever is in a convenient location high up on the push bar. A coil spring holds the pulley against the belt. When the lever is pushed forward it engages with a fixed latch, Figs. 3 and 5. Three standard $\frac{1}{2}$ -in. V-type rubber belts are used. Get $\frac{1}{2}$ -in. adjustable shaft hangers for jackshaft bearings so that the belts can be tightened. To start the mower with the engine running, the operator simply releases the lever from the catch on the handle bar, a tension spring pulls back the idler and the mower moves forward. To stop, the lever is pushed into the latch.

☛ A good way to hold a nut in an awkward place, such as between the coils of a spring, is to twist the end of a pipe cleaner firmly around it.

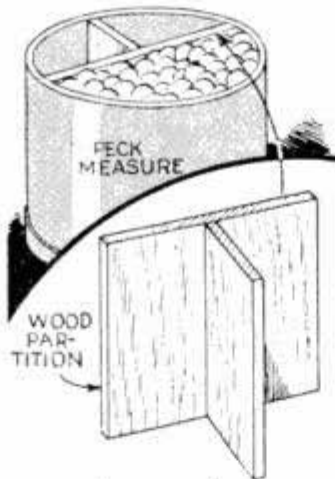
Cabbage Ripened in Wet Weather

Late cabbage in the home garden is often delayed in maturing on account of fall rains and cold weather. A few warm days at this time will cause the cabbage to grow rapidly, so that the heads burst and decay. To avoid this, one gardener advises severing part of the root stalk by cutting a deep notch in each side. This reduces the supply of moisture considerably so that the head of the plant will mature more quickly and further growth or bursting will be prevented.



Storekeeper Divides Peck Measure into Three Parts with Partition

One storekeeper who often has to dispense some of his merchandise in one-half and one-quarter peck quantities, divides a peck measure into three parts with the wooden partition shown. This gives him a half-peck measure on one side and two quarter-peck measures on the other.

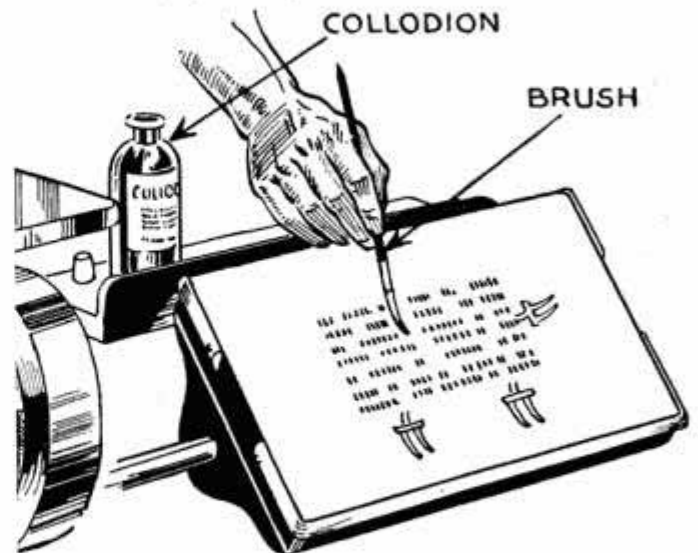


Repairing Worn Bicycle Chain

When a bicycle or motorcycle chain becomes badly worn, its life often can be prolonged in the following manner: After cleaning the chain well, lay it flat on a bench with the heads of the rivets uppermost. Then with a solid metal block beneath, center-punch each rivet by one or two taps. When every rivet has been treated, repeat the operation on the other side.

¶To clean copper, pewter, and brass, apply a paste made of equal parts of flour, vinegar and salt; let the paste stay on the metal for an hour, then wash and polish.

Collodion Aids in Make-Ready on Job Press



Collodion on tympan sheet of job press used to build up letters and punctuation marks

While gummed tape is often used to increase impression over certain areas of a form on a job press, there are times when the area is so small that it is difficult to use the tape. In such cases, one printer brushes collodion on the tympan sheet. The collodion dries rapidly and may be used to build up a letter, punctuation mark or any spot which fails to print clearly.

Culvert Filled with Concrete Provides Land Roller

Finding himself unable to obtain a land roller, a farmer made one from a 12-ft. length of regular corrugated steel culvert. A long shaft to serve as an axle was centered in the culvert, after which it was



Corrugated steel culvert filled with concrete and provided with axle makes emergency land roller

filled with concrete. A wood framework fitted with bearings to take the ends of the projecting shaft provided a handy hitch for the roller.

Bottomless Pail in Sack Mouth to Dispense Seed

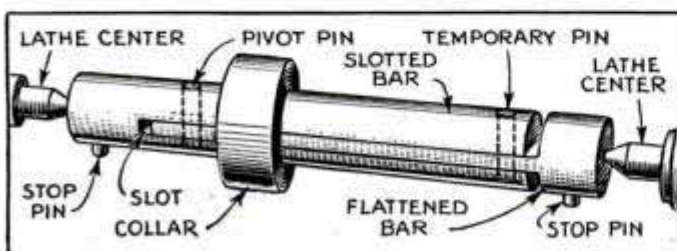


Pail keeps small seeds from spilling on floor when dispensing them in store

When sacks of expensive grass or field seeds are opened in a store for dispensing in small quantities, repeatedly opening or closing the container allows much of the contents to be caught in the folds and scattered about the floor. By placing a bottomless pail in the opening of the sack, and securing it with a stout rubber band, the seed may be removed without loss.

Universal Lathe-Center Tester

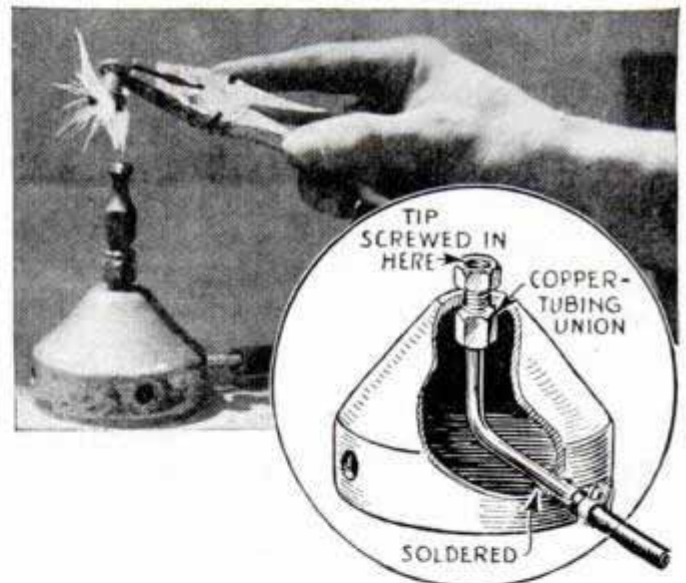
This lathe-center tester is different from others in that it not only shows whether the centers are in line horizontally, but vertically, as well. This is desirable especially when accurate reaming is to be done, as many lathes are "out" vertically unknown to the operator. To make the tester, a bar is slotted down the center and another is milled flat to fit it, both parts being centered and pivoted together. A



This tester shows whether or not lathe centers are true both vertically and horizontally

temporary pin holds the two parts in line while the complete bar is being turned to take a collar with a snug, sliding fit. Then the temporary pin is removed and two stop pins are driven in to keep the collar and bar together. In use, the tester is placed between the centers and the collar is slid back to the stop pin. If they are exactly in line, the collar will slide along the bar. But if they are out, even a fraction of an inch, the collar will not slide. The reason for this being that the slotted half of the bar will always lie parallel to the center upon which it is bedded. If the tail-stock center is out of line, it will pull the flattened bar over so that the flat portion will project at one side of the slot, making it impossible for the collar to slide along. To test the centers horizontally, the flat is horizontal and to test them vertically, it is upright.—H. Moore, Leeds, England.

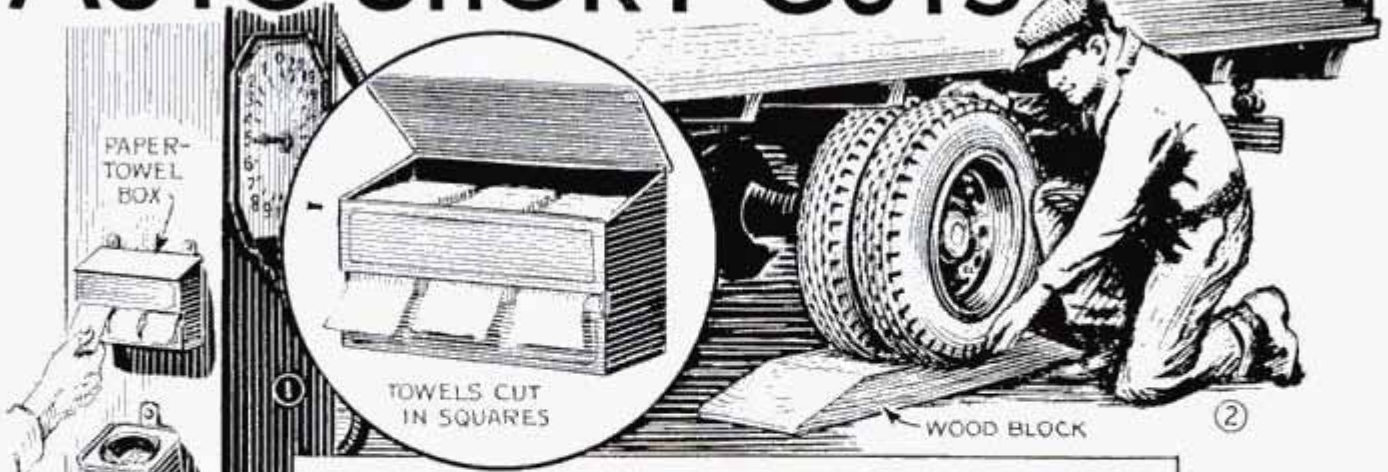
Torch Tip Supported on Base Leaves Hand Free



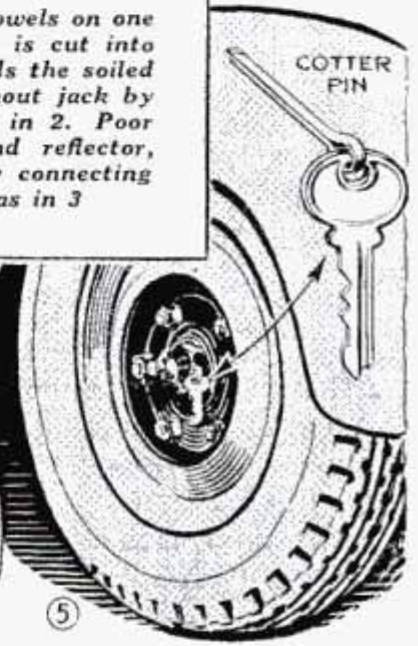
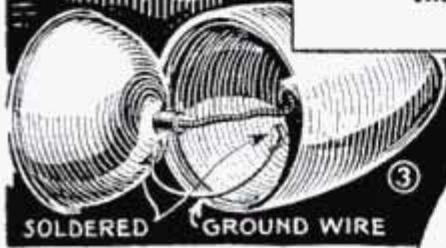
Supporting a torch tip in this base enables you to heat parts or melt metal without constant attention

The case of an old model-T Ford timer to support the torch of an acetylene soldering outfit leaves one or both hands free for certain jobs. Drill and tap the end of the case for a brass union to take a short length of $\frac{1}{8}$ -in. copper tubing. Bend this as indicated, and pass it through one of the holes in the timer and attach it to the torch hose. Solder the tubing to the case at the hole and screw the torch tip into the union. If a horizontal torch flame is desired, use a street elbow between the union and the torch tip.

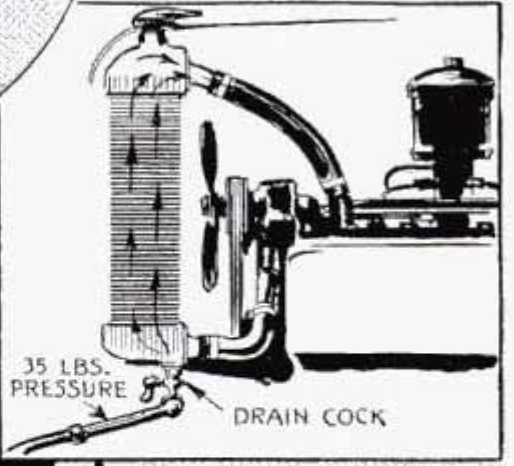
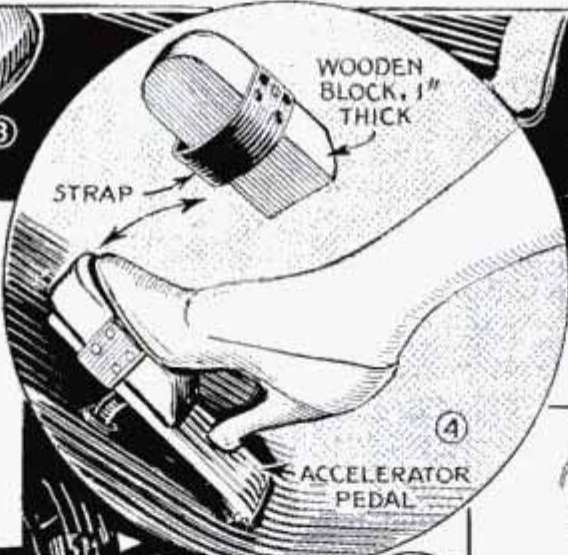
AUTO SHORT CUTS



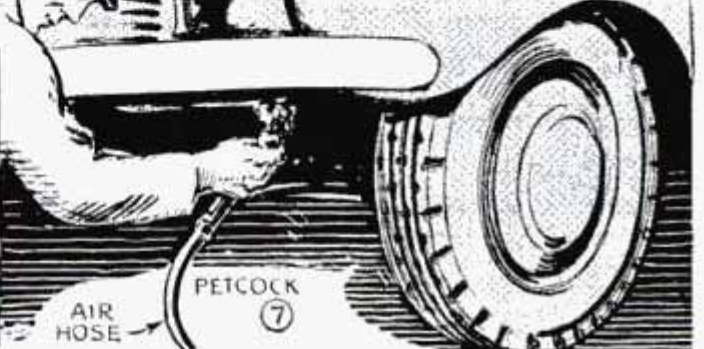
1, a filling-station owner keeps a box of paper towels on one of his pumps to wipe oil rods. The paper roll is cut into three sections, and a waste box underneath holds the soiled paper. Outside tire of dual wheel removed without jack by running inner wheel up on a beveled block as in 2. Poor ground connection between headlamp case and reflector, which often results in dim lights, remedied by connecting them with a copper wire soldered in place as in 3



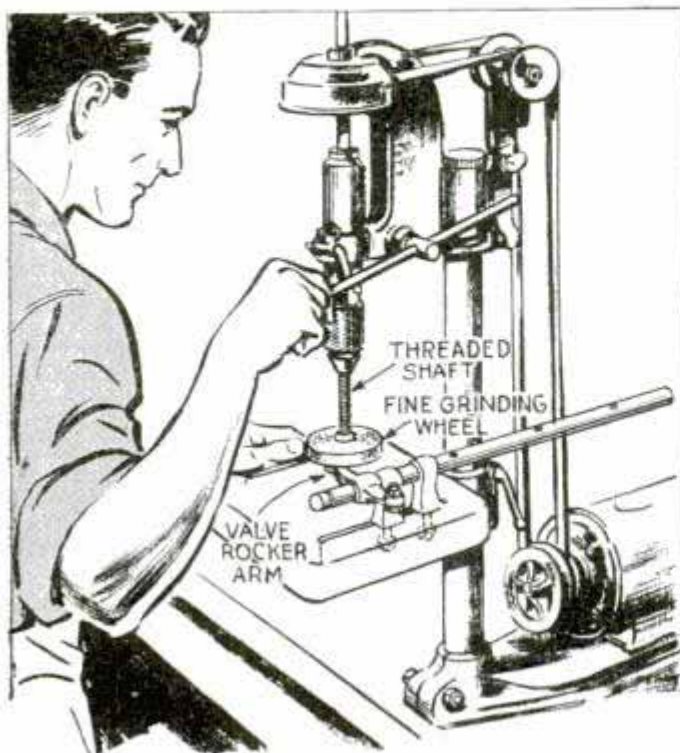
4, Removable block held by strap at upper end of accelerator pedal raises toe of woman's high-heel shoe to reduce foot strain when driving. 5, spare key kept on cotter pin that locks rear-axle nut



Air compressed inside differential housing with oil-spray gun helps to force out stiff grease as in 6. Grease flowing out of hole prevents escape of air. Clogged radiator tubes often can be cleaned while the radiator is full, by forcing air into the drain cock. Air pressure should be less than 36 lbs., and the cock must be located at the bottom of the radiator as in 7



Surfaces of Valve Rocker Arms Ground on Drill Press



Pits removed from underside of valve rocker arms quickly with this drill-press setup

After considerable use, the rocker arms on an overhead-valve motor usually wear and cause depressions where they contact the ends of the valve stems and they should be ground down in order to set the tappets correctly. Unless this is done, a feeler gauge will bridge the depressions so that the tappet adjustment is indicated as correct, while in reality the adjustment will be off equal to the depth of the depressions. A quick and easy way to remove these depressions is to grip a flat grinding wheel on an arbor in a drill press and grind the ends of the rocker arms as indicated. You can remove the entire rocker assembly from the motor and fasten it in one of the slots on the drill-press table so that it can be moved along to rapidly and accurately surface the ends of the rocker arms.

—Milton Monson, Hines, Ill.

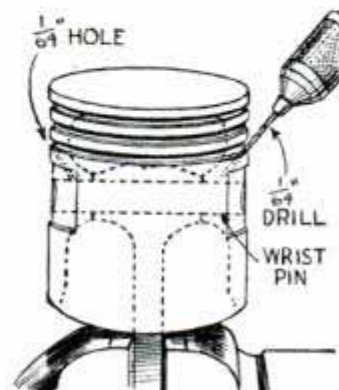
Sluggish Idling of Motor Caused by Valve

Sluggish idling of a model-A Ford motor, after a tune-up, can be traced usually to a worn butterfly shaft in the carburetor. The shaft is worn so that it lets the butterfly cover the idling jet in the throat of the carburetor. If another shaft is not at

hand, this trouble can be eliminated by holding the throttle fully open and filing a small groove in the butterfly valve itself at a point that comes over the idling inlet hole. It is easy to file this groove and it will not affect a perfect shut-off in the throat of the carburetor. After this has been done, readjust the throttle-stop screw and the idling air adjustment.

Lubricating Piston Wrist Pins

Often a wrist pin of a piston wears unduly because of insufficient lubrication. Usually this trouble can be prevented by drilling a small hole through each piston boss from the ring groove as



indicated. The small holes will not affect compression, and the oil scraped from the cylinder wall by the ring will tend to pass through the holes to the wrist pin.

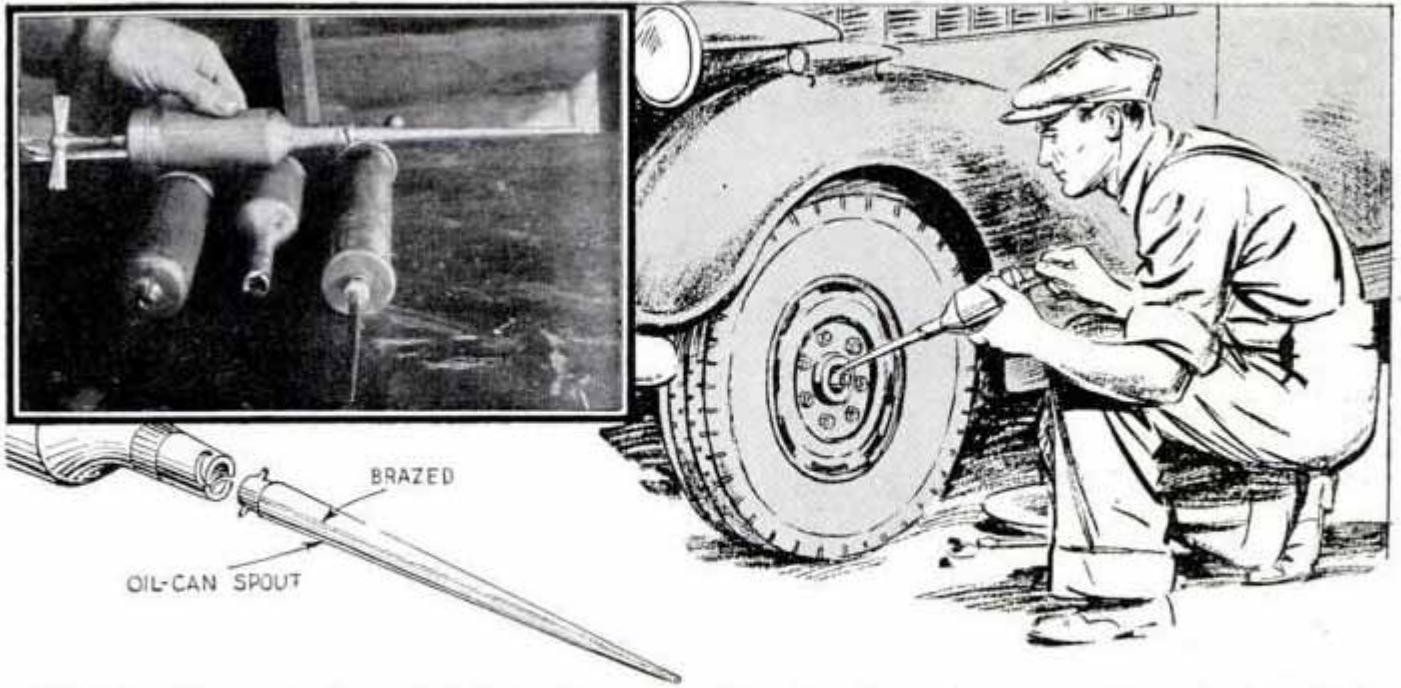
Grease-Pit Door Has Rubber to Stop "Drifting" Leaves

To prevent leaves and other debris from blowing into grease pits when the doors were open, the owner of one filling station stretched pieces of rubber across the doorways as indicated. Cars can be driven over the rubber without damaging it.



Split inner tube stretched across doorway of grease pit checks debris blowing along on ground

Nozzles Adapt Grease Guns to Many Uses



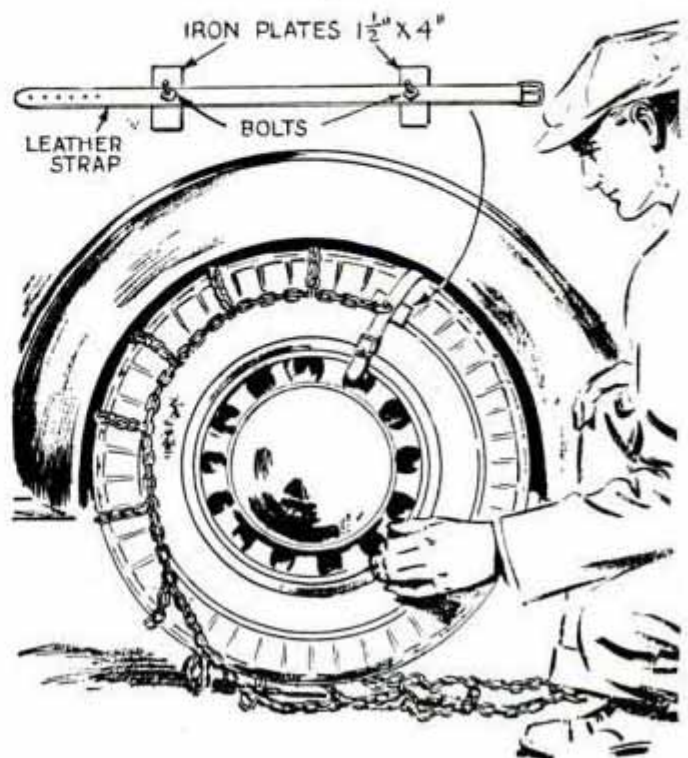
Fitted with a set of special, interchangeable nozzles, a regular pressure grease gun, such as an Alemite or Zerk, is handy around the small service station or even the home garage. The nozzles are oil-can spouts of different lengths and diameters, soldered or brazed to regular grease fittings for quick attachment or removal. Those in the photo are designed for re-packing rear and front-wheel bearings with grease without removing the wheels. The small nozzle is used where the outer

bearing is not removed, and should be placed in the openings in the bearings to force grease to the cavity behind the bearing. The long nozzle has a larger bore and is handy to quickly fill the cavity around the axle shaft when the outer bearing is removed, or where both bearings are removed and washed. Oiling of shackle bolts, or filling of steering-gear housings is simplified with the nozzles, and when cleaned, they are ideal to fill hydraulic shock absorbers.

Putting Skid Chains on Wheels under Large Car Fenders

Putting skid chains on wheels under modern car fenders is simplified with this leather strap. Before attaching the chains, the strap is put around the tire, after which the end of the chain is hooked to bolts projecting from the strap, and the wheel is turned to pull the chain around the tire. Two small iron plates are bolted to the strap as indicated in the detail so that the ends of the bolts project $\frac{1}{2}$ in. or more. After the chain has been slipped in place by rotating the wheel, the strap is removed and the chains fastened in the regular way.

—Kenneth Schwartz, White Plains, N. Y.



When penetrating oil is not available for loosening an obstinate, rusty nut or bolt, household vinegar will make an excellent substitute.

Funnel from Headlight Reflector Handy Around Garage



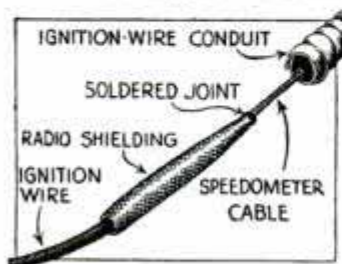
When you can't find a funnel an old headlight reflector will serve the purpose

An old headlight reflector with the lamp socket removed, will provide a good emergency funnel around the garage. If desired, a metal tube can be soldered over the socket opening to provide a longer spout.

Loosening Cylinder Head

To simplify loosening the cylinder head of a motor when making repairs, try this simple trick. Remove all the cylinder-head bolts, leaving the spark plugs in place. Then step on the starter and the compression of the motor will break the gasket seal easily.

Wires Easily Fed Through Cable When Rewiring Ignition



carrying spark-plug wires, etc. The tool is nothing more than a short piece of woven

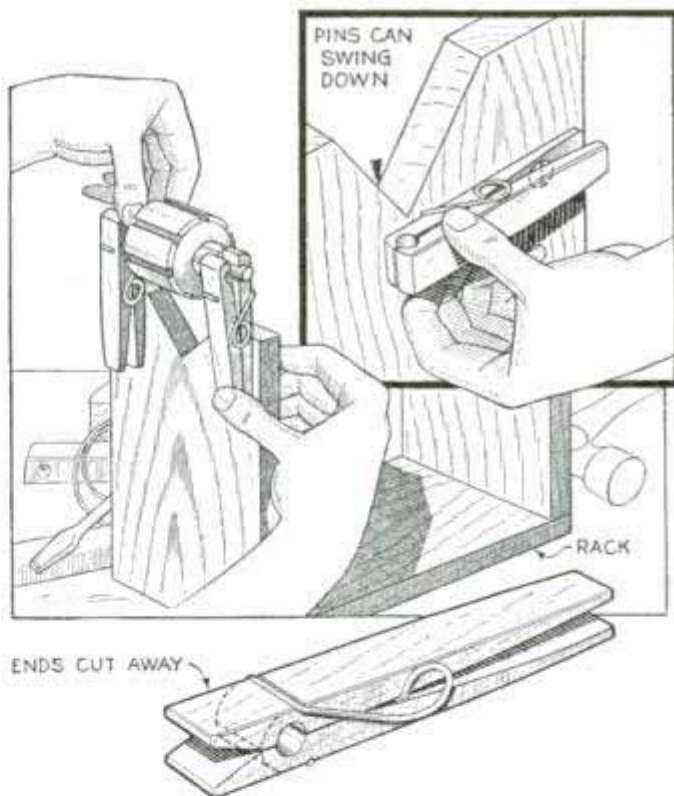
I have had considerable rewiring to do on cars, and find this tool handy in feeding the wires through cables, such as those

radio shielding soldered to a speedometer cable. The wires to be pulled through the cable are inserted into the open end of the radio shielding, which tends to grip and hold them as pull is exerted. In fact, the greater the pull the harder the shielding grips the wires.

—Frank Dorn, Brooklyn, N. Y.

How to Hold Small Armatures in Large Rack

Finding that his regular rack to hold generator and starting-motor armatures was too large for small armatures from horns and heater fans, one mechanic fitted the rack with two spring-type clothespins to do the job. The ends were cut off the pins as indicated, after which they were mounted upright on each side of the V-cut at one end of the rack. A large wood screw



Spring-type clothespins screwed to one end of armature rack for holding small armatures

holds each pin so that it can be swung down out of the way when the rack is used for a large armature. In testing for grounds in small armatures, one test lead is clamped in one of the pins and is held tightly against the armature shaft.

Ⓜ A tire valve can be loosened and unscrewed with a cotter pin, the ends of which have been spread apart slightly.

SMOKE CURLED UNDER OUR BEDROOM DOOR!



Their Home in Flames the Sweetman Family Slept on

1. Arthur E. Sweetman, of 336 Durham Ave. Metuchen, N. J., still has his "Eveready" flashlight. It's still working, he says, with the original batteries in it. He lost everything else he owned . . .

and but for the flashlight, his wife, his baby son and he would have lost their lives as well.



3. "Quickly, we wrapped the baby in blankets and climbed out the window just as the room burst into flame.



4. "Safe! But there we stood shivering in our night clothes watching everything else we owned burn up.

5. "Not quite everything, however. Firemen found the flashlight still burning where my wife had dropped it in that flaming bedroom . . . and because it, and those *fresh* DATED 'Eveready' batteries saved us from a living cremation, I shall treasure it all my life.

(Signed)

Arthur E. Sweetman



2. "My wife waked out of a sound sleep when the baby coughed," writes Mr. Sweetman, "and picked up our flashlight from a chair by the bed as she got up. In its bright beam smoke was curling under the bedroom door!



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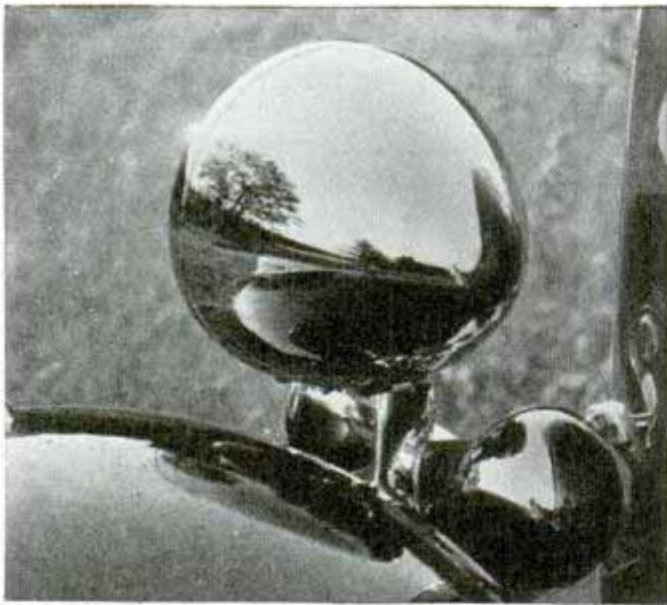
Trick Photos and How to Make Them

(Continued from page 414)

shadow. Then the second exposure is made, with the same timing you would give to an ordinary indoor picture.

If the lower part of the man's body is properly shaded, he will appear to have no legs in the resulting picture. Control of the light calls for no special equipment; use a cardboard box, or hood of newspaper or cloth, to limit and direct the illumination just where you want it. Proper action can heighten the effect of such a picture; for instance, let the man lift his arms in horror, and stare down toward his feet and legs (which in the picture, of course, will have vanished).

Ghost pictures are made by giving a full exposure for the room, and a short exposure for the "ghost," someone wrapped



Simplest way to get distortion in pictures is to shoot at a curved mirror—here, an auto headlight

in a white sheet. The short exposure keeps the image of the ghost thin, so that details of the room show through him.

Giant-and-pygmy pictures are less easy, but still more interesting. Take a head-and-shoulder closeup picture for the "giant"; then move the camera farther away from the subject until he shows up very small in the view finder, and make a second exposure for the "pygmy" image. Don't forget to use a black background and focus properly for each distance.

Such pictures are easiest to make with a camera that has a ground-glass back, on which subjects can be outlined with a wax

crayon. Positions should be marked carefully, so that the images will be placed properly in relation to each other. Many amateurs get good results with only a view finder on which to mark positions, but their results are largely luck.

In all double-exposure pictures, it is necessary to confine the light to the objects that are to show. If other objects are lighted, they appear on the film and spoil the picture.

Interesting combination pictures also can be made by the "cut-and-paste" method. Enlargements are made from several negatives, and parts are cut out and arranged together to make a different picture. For example, a small figure cut from a bathing-beach scene can be pasted on an enlarged picture of the kitchen sink, in such fashion that it appears to be taking a shower under the sink faucet. In the same manner, a tiny figure could be shown fishing in a teapot, or climbing the leg of an enormous chair.

Such paste-up work must be done neatly, with special attention to the edges of the cutouts. When the combination picture is completed, it can be copied with the camera, and prints made from the copy negative. A little careful retouching on the paste-up picture, with black, gray and white show-card color, will eliminate evidence of your trickery, and help give more realistic "feel" to the final copy prints.

Distortion in home enlarging is introduced in two ways: by tilting the enlarger easel, or by curving the print paper. A variety of effects can be obtained in this fashion—fattenings, elongations, tapering "dissolves," ripples in features, and the like. If the easel is tilted sharply, it is necessary to stop down the enlarger lens to maintain sharp focus and to give shorter exposure to the end of the paper lifted nearest the lens.

Our Bureau of Information keeps on file the names and addresses of makers of, and dealers in, all devices described in the pages of Popular Mechanics Magazine. We are glad to furnish this information to our readers upon request, accompanied by stamped, self-addressed envelope.

“Velvet’s
right up
my street

..made to order
for me and
my pipe”



*Better
Smoking
Tobacco*

Velvet

- the **MILDNESS**
of fine old
Kentucky Burley
aged in wood
- the **FLAVOR**
of pure maple
sugar for extra
good taste

*Velvet packs easy in a pipe
Rolls smooth in a cigarette
Draws right in both*

"I can't be bothered."



till you get a Barbasol Face"

HERE'S a little test you can try on yourself. Let your mind dwell on the prettiest girl you know. Now look into the mirror and rub your hand over your cheeks and chin and jowls.

If the skin feels supple and soft, if it looks smooth and youngish, you can bet it's okeh by her, because that's what any woman likes.

But if the skin feels tight and roughened, if it looks a bit wrinkled and oldish, then you'd better change your shaving methods and get yourself a Barbasol Face.

For Barbasol not only gives a cleaner, sweeter, quicker shave no matter how wiry the whiskers . . . its beneficial oils soothe the skin, keep it from getting dry, tight, coarse and rough.

Try Barbasol for just ten days. On sale at all druggists, large tube, 25¢; giant tube, 50¢; family jar, 75¢. Five scalpel-sharp Barbasol Blades, 15¢.



Secrets of the Master Violin Maker

12-457
(Continued from page 372)

So when the sound engineer drew a bow across the open G-string of a violin and photographed the wave pattern produced on his oscillograph screen, he obtained a picture of the sound of that particular note on that particular instrument. The tone of the open G-string is produced by a frequency of 196 vibrations per second which is the "fundamental." But the wave pattern in the photograph was much more complicated than this fundamental.

The sound man knew, however, that a vibrating body, such as the violin string, sets up sympathetic vibrations in other bodies under certain conditions. These secondary vibrations, known as "harmonics" or "partials," are multiples of the fundamental, or in this case, 392,598,784, etc., vibrations per second. The fundamental vibration plus the secondary vibrations or harmonics represents the sound which the ear hears.

It was easy for the investigator to deduce from whence the harmonics came. They must come, he decided, from the body of the violin, from the lively spruce of the top and the heavier maple of the bottom, both of which had been set in motion by the vibrations of the string. If this is correct, said the engineer, perhaps the distinctive quality of a violin is due primarily to the body which produces the harmonics.

When a violin is played, he reasoned, the fundamental note or frequency of the string sets up numerous harmonics in the body and the mixture of these harmonics determines the quality of the violin. The virtuoso plays the fundamental notes, but the violin provides the harmonics—which is why an old master like Stradivari left something of himself in each instrument he made.

To determine the harmonic properties of a violin, it was necessary to analyze the wave pattern and find out how many harmonics were present and measure the amplitude or loudness of each. Finding the length of the waves of the harmonics was easy, for their frequencies can be determined by applying the laws of physics.

But figuring the height of each curve to determine the amplitude or loudness of each harmonic was more difficult. It is

possible to break down the complicated wave pattern into its individual harmonics by elaborate mathematical calculations, but the sound man found an easier way. He used a volume meter and a series of electronic filters which shut out all sound waves except the particular one desired. For example, if the apparatus were set for 196 vibrations per second, the resulting oscillograph pattern showed only that frequency. Thus he measured the loudness of the fundamental and of each harmonic. All of them combined represented the sound heard by the ear.

The same procedure was followed for each note on the four strings of any violin being tested. Thus, by breaking down the wave pattern of the violin into its simple components, the engineer was able to ascertain the exact amount of each component in the complete pattern. This analysis of violins by the old masters gave the engineer a starting point for designing instruments of comparable quality. He had definite measurements of the sounds made by the rare instruments and a means of determining how near he came to duplicating the sounds.

By changing the proportions of an experimental violin a trifle, by taking off a bit of wood here or leaving a bit there, or by moving the bridge and sound post about, he could alter the sound pattern of a violin until he approached the pattern of an instrument made by one of the masters.

Of course, wood and varnish still entered into the problem, but even these could be checked by the visual sound-wave method since using a particular varnish or wood will affect the wave pattern of the instrument.

While the solution of these problems has enabled modern man to make violins whose tonal qualities approach those of the old masters, and to measure just how near they come to such standards, there remains one riddle which has not been answered.

Did Stradivari and the other old masters arrive at their remarkable results by applying acoustical principles, or did they simply use a tedious process of trial and error, coupled with intuition and a highly developed sense of hearing? How they worked to produce their magnificent instruments is still a mystery, but science has now explained why they achieved their results.

Treet Topics

IF YOUR
FACE IS
YOUR
FORTUNE ~



OR IF
IT DOES
THIS ~



IT'S STILL
THE ONLY FACE
YOU'VE GOT!



SO GRAB
A THIN DIME ~

DO THIS ~

TREET
BLADES!

YESSIR
4 FOR 10¢



-AND TREET YOURSELF
TO A PACK OF
PERFECT SHAVES!



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Fireworks that Save Lives

(Continued from page 357)

minute after being fired electrically from a device attached to the structure of the plane. Other smaller flares of 110,000 candlepower, each burning for about one and one-half minutes, come three in a nest which is attached to the plane, and they also can be fired electrically. Ordinarily, the pilot is provided with smaller flares that are fired from a pistol similar to the marine Very light pistol, but the air pistols are made so they can be handled by a man wearing gloves.

For work over water, an air-light has been made which operates much like the water-light. Thrown overboard it ignites on the water and floats. It is used for making landings on water.

Smaller parachute flares that can be fired from the hand after a friction surface is rubbed against a primer surface, emit a red smoke, and are used by Arctic explorers to ascertain wind directions.

In military work, the flare reaches its highest degree of perfection, for here actual cost is secondary to other factors. The most important type is the red or green star, three of which are attached to an asbestos string, suspended from a parachute. The U. S. army fires this signal from a discharger attached to a rifle. The navy launches it from a submarine by means of compressed air. It is buoyant, and as it reaches the surface, a grenade is shot in the air, releasing a parachute bearing a chain of three red or green stars.

The army has perfected a bomb for aerial photography at night. The light is so intense that it approximates daylight for a fraction of a second and makes night aerial photography possible to a degree of detail almost impossible in daylight.

In all practical fireworks, three chemical elements play an important role. Red comes from strontium salts, principally the nitrate; green from barium salts, and intense white from magnesium powder. Lithium carbonate is sometimes used to give a better red, but it is expensive and finds its widest use in military flares. Yellow is obtained by the addition of sodium salts.

☛ Send return postage to our Bureau of Information to learn the name of the maker of any device described in this magazine.

Barnyard Wizards of the Films

(Continued from page 395)

tiger fur and some wire. The spear is fastened to the fur belt, which is placed around the big cat's middle. To the handle of the spear is affixed the invisible wire. The tiger is commanded to lie down so the spear appears to be protruding from its side. For an instant the animal lies in this position, then gets up as the camera is turning. The trainer jerks the wire and the spear flies out. When these shots are



When the movie script calls for a trained seal, Curley is ready and waiting

reversed in the cutting room, it appears that the tiger was dropped by the spear.

Of the group who supply ordinary birds and livestock for screen purposes, Lionel Comport is dean. The studios spend \$250,000 annually on bird and animal rentals and he gets a big chunk of the business in his field. Twenty-seven years ago, Comport was a dairyman but when producers kept renting his cattle for pictures, he decided to go into the business. The barn that once housed a herd of Holsteins and Jerseys is now filled with a collection of animals the average farmer wouldn't keep ten minutes. Out of one manger eats a

(Continued to page 120A)



Spark Plug Cleaning

"BY THE AC METHOD"
Saves much more than it costs

If you have driven your car 4,000 miles without having the spark plugs cleaned, those plugs may be wasting as much as 10% of the gas you buy. "Flowmeter" road tests, observed and verified by the University of Michigan Department of Engineering Research, have established this waste as fact.

The explanation is the little known fact that dirty, worn, or oxide-coated plugs misfire often enough to produce this fuel waste.

Cleaning costs 5c a plug. You know how much gas you buy. It is easy, and very much worth-while, to calculate how much you'll save by having your plugs cleaned, "by the AC Method," every 4,000 miles.



Look for this
SIGN
when you need plugs
or plug service



Every 10,000 Miles
**REPLACE WORN PLUGS
WITH AC
QUALITY
SPARK PLUGS**

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Alka-Seltzer
TABLET IN A
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in a few weeks earn big income in service fees,—not medical nor chiropody—easy terms for home training, no further capital needed, no goods to buy, no agency. Established 1894. Address **Stephenson Laboratory, 1 Back Bay, Boston, Mass.**

(Continued from page 119A)

waltzing mule and a billy goat skilled in "pulling his punches" when butting an actor; in other stalls are pack burros, a ridiculously sway-backed horse, a cow ready to be saddled and ridden, and another which will sit down, kick or moo on order.

His fowls and animals are schooled in the demands of the screen and are quite at home amid the excitement, lights, and cameras of the sound stages, an important consideration with the studios. Excitable or inexperienced animals would cause unnecessary delays, and time losses in picture-making mean extra expense. Fifty dollars a day is Comport's charge for a typical barnyard scene—a cow, two mongrel dogs, forty chickens, a few ducks and a horse. The trick mule is a \$25 a day star; goats, \$7.50 to \$15, depending on their skill in butting, and the same wage scale is asked for trained sheep, ducks, raccoons and other small animals.

Of all the educated bovines he has trained, none in his estimation can compare with Whitey, a twenty-four-year old cow, who has earned about \$12,000 during the fifteen years she has been in pictures. Sway-backed horses on the screen are productive of sure-fire laughs and they're always in demand. Comport has had seven, the current one, Barney, having been purchased for \$35, which is less than his daily wage when he's working. This trainer's success is due to the fact he can train anything. The pig is the easiest animal to handle, he has found; the cat, the most contrary if not the dumbest. Comport's secret lies in acquainting an animal with a certain routine by easy stages but he has, in addition, a whole batch of tricks like putting a few grains of corn in the cuff of an actor's trouser leg to get a chicken to follow him or making a cow moo by taking her calf away.

For a sequence in a mystery film, the animal wizard was asked to dig up fifty bats. This necessitated a drive deep into the desert country. During southern California's rainy season he received an order for an army of red ants to be used in a torture scene. He traveled 385 miles and spent \$18.85 before he delivered the jar of ants. They were not used after all.

Probably his most unusual request was for cockroaches. He telephoned an exter-

minating company and after making a few stops with one of their agents obtained the necessary number. He placed them in a glass case but found only half the original number there the following morning. They were cannibalistic and he had to keep the remainder in individual containers until the scene was completed.

Every day, the Paramount property chief receives letters from pet owners, from a lumberjack in Washington who has a pet moose; an Iowa farm hand with a dancing pig, or a Brooklyn widow whose canary can turn a somersault—all are ready to come to Hollywood. All the letters are filed in Pierce's card index because he never knows what is likely to find its way into a moving-picture script.

The Miracle Men of Radio

(Continued from page 405)

vigilantes signals an SOS on a special telephone circuit, which connects five vital points in the studio control system. Immediately five men answer the phone, and within a space of seconds one of these five can state positively where the trouble lies. Ordinarily, fast foot-work will not bring a dead network to life, but fast thinking will. The procedure in most cases is to "patch" or reroute the program around the defective link, which takes but a few seconds of phone work. Then an emergency crew makes repairs.

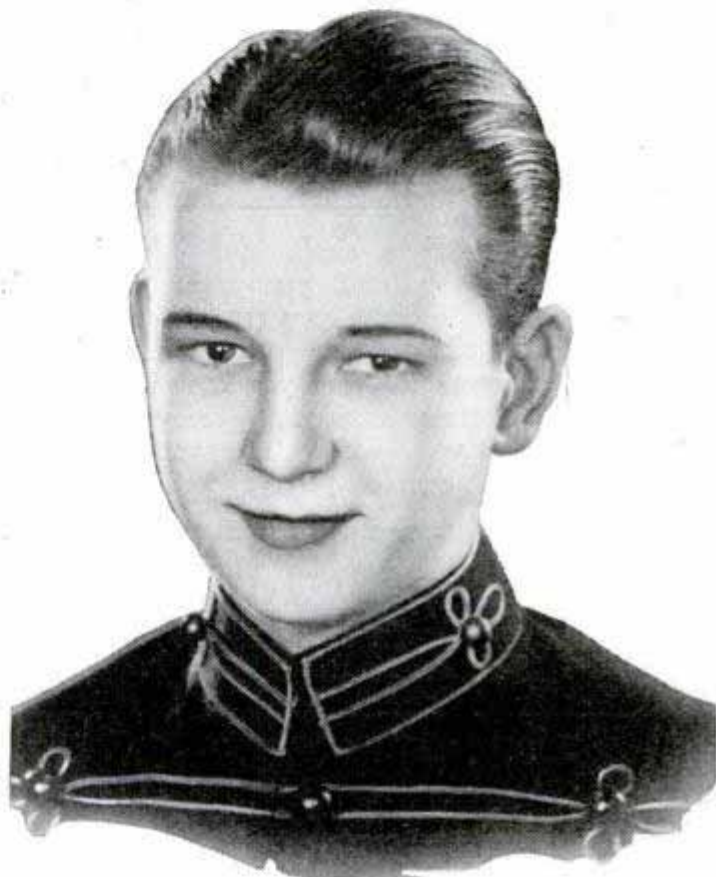
Vigilance at the controls of the broadcasting engine has prevented many a program from going haywire. When multiple pickups are necessary for a program—that is, when several remote points are joined—the switching from one place to another is made by the master control supervisor. He waits for a cue from a speaker or announcer, but if this cue fails to arrive precisely, he must make the switch on his own initiative. Little does the army of listeners suspect that the smooth running of multiple-pickup programs depends upon such swift decisions.

The master control is the funnel through which everything passes before it is released for nation-wide distribution. Ninety per cent of the time the master control men appear to have absolutely no cares or headaches. They merely relax and listen to the best programs. In terms of super-

(Continued to page 122A)

UNRULY HAIR

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Glostora
FOR THE HAIR

(Continued from page 121A)

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efficiency, that is as the supervisors want it to be. When things run smoothly, the men have little to do but press a few buttons now and then, but when things go wrong, they must act swiftly.

In England and on the continent a few minutes' delay between programs causes no annoyance, but in America, super-precision is necessary because many stations are linked to a single network. Unless programs are switched on time, there is utter chaos. One minute's delay may mean that the outlying stations lose an opening announcement. An advertiser hearing of this applies for a rebate, and the broadcaster must pay it. Rebates are quite rare, but they would be common were it not for the present system of synchronizing time. The hundreds of electric clocks in Radio City are checked twice daily by men who carry a master chronometer. Twice daily also, when the U. S. Naval Observatory broadcasts correct time, the master clock is synchronized with the movements of heavenly bodies.

Outside the studios and transmitter station, NBC maintains a force of vigilantes who operate the mobile unit, a broadcasting station on wheels, which frequently takes them to danger zones such as floods, earthquakes, fires, and other major disasters. Last year these minute-men were assigned to the Youngstown flood district, where they lived on a railroad flatcar for several days, and frequently broadcast news and warnings while standing knee-deep in water. For days they had no lights, and little food or drinking water.

When land communication failed, they loaded a portable transmitter on an air transport and broadcast an eye-witness account of what was happening in the flood zone, besides performing mercy missions such as directing rescue craft and Red Cross workers to refugees.

That fine old theater motto, "The show must go on!" applies with equal force to the radio vigilantes who serve the public interest behind the scenes.

Popular Mechanics Magazine can furnish the name and address of the maker of, or dealer in, any article described in its pages. If you wish this information, write to the Bureau of Information, inclosing a stamped, self-addressed envelope.

H 544

Mystery Tie Between Sun and Life

(Continued from page 381)

may have with energy furnished to plants by the sun. It has been shown that light is necessary for forming chlorophyll, since plants grown in darkness have none of it.

A side road in this research is concerned with learning how to preserve green leaves so the best use can be made of the many food substances they contain. Preservation of chlorophyll is important from a standpoint of human and animal food. Dairy feeds, which strongly affect human health, have received particular attention.

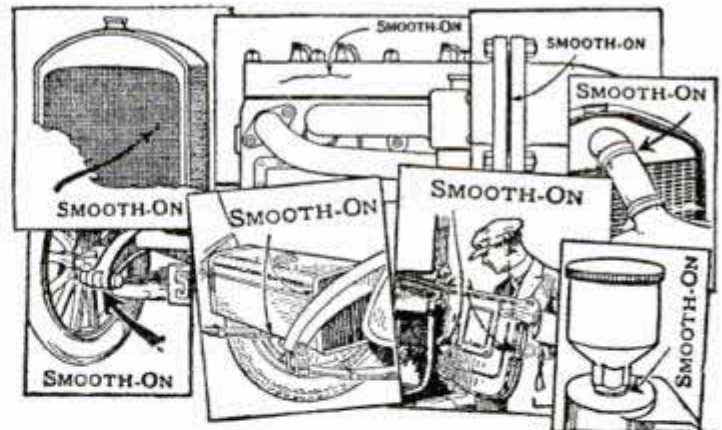
It has been found, for example, that alfalfa cut and brought into shelter immediately and dried artificially by blowing hot air through it, retains at least four times as much animal food value as field-cured hay. A still better method for preserving chlorophyll and related food substances is treating the hay with Dry Ice in an airtight silo. This "cooks" the green leaf by forming gaseous carbon dioxide which acts as a preservative for many valuable foods ordinarily lost.

The manner in which chlorophyll influences flesh cells is also being studied. It is now known that chlorophyll, broken down into more simple substances, is present in the walls of the stomach and bile. In such a condition it is closely related to our own red-blood pigments. When fed experimentally to rats, it stimulated the formation of red-blood cells and pigments.

But there remains the puzzling truth that chlorophyll, as it exists in a plant, is not the same as chlorophyll in a test tube. Actually the green-leaf substance of plants is dissolved in a still unknown solvent, seemingly a wax or resin. Further, the chlorophyll seems to be created by a process of oxidation.

The study of chlorophyll is of particular importance to the auto and airplane industries because the hope of improving auto and plane motors is dependent upon improvements in fuels. Ethyl fluid has been a basic factor in engine progress because elimination of "knock" increases the efficiency and reliability of engines and adding lead tetraethyl to gasoline has enabled engine designers to increase the compression of motors so more power can be realized from the same quantity of fuel.

(Continued to page 125A)

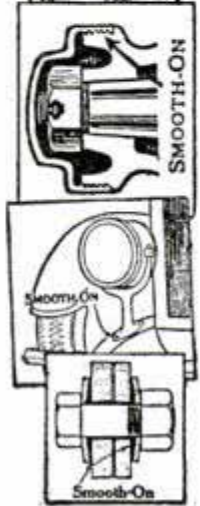


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(Continued from page 123A)

Basically, gasoline is a product of chlorophyll. It is a hydrogen-carbon mixture compound and both these elements are apparent in green leaf. Chemical engineers are now studying engine fuels from a standpoint of molecule structure. They find that atoms of hydrogen and carbon can be arranged in many different patterns and that the actual value of a fuel largely depends upon the design of its molecule.

In general, the gasoline molecules with long chains of carbon atoms cause motor knocks, the longer the chain the worse the knock. The best motor fuels, as a rule, are those made of "round molecules," that is, with the same number of hydrogen and carbon atoms squeezed most closely together. The great challenge is to find an efficient means for producing round molecules. It is now possible to change the shape of fuel molecules though the process is still costly and complex. Many scientists are convinced that a new technique of shaping fuel molecules for maximum efficiency depends largely or entirely upon a better understanding of green leaf.

Thus the answer to the question, "Why are leaves and grass green?" may mean longer life, better health, absolute conservation of natural resources, a reduction in living costs, a rise in standards of living and a new era of power and energy in which an auto might average 200 miles to the gallon and a plane might span the earth without refueling.

Speed Races for Amateur Drivers

(Continued from page 341)

disqualified and must compete with cars of the next highest class. Races are divided into heats of four cars each.

Drivers try many ingenious ways of getting more speed. One owner used butane gas for fuel while another hooked up a belt-driven supercharger. Some design and build their own carburetors while others experiment with special combustion chambers.

Every race has its engine casualties. Some owners do not even get their cars started when their turns come. Cracked heads and crankshafts, blown head gaskets, broken pistons and connecting rods

(Continued to page 126A)



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KEEPS RADIATORS CLEAN



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GUNMETAL COMPANY

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DECATUR, ILL.

H. 62.5

(Continued from page 125A)

and burned bearings are the most common failures. Most drivers remove generator and starter before the races and the cars are started by pushing and towing.

Aside from tuning up his engine to deliver perhaps twice the revolutions per minute it was intended to give, the owner of a stock roadster prepares for the time trials by stripping his car of every unnecessary piece of equipment. Fenders, headlights, horns, bumpers, windshield, spare tire, and splash pan all come off. He balances the wheels, and removes the fan belt or trims down the fan blades to half their original size. Springs are bent down to give the car a lower center of gravity. He substitutes an open "tail pipe" for the muffler. A manual fuel pump is almost a necessity for keeping the carburetor supplied.

The modified roadsters are hybrid speedsters assembled from half a dozen makes of automobiles. Don Miller's car, which has been clocked at 120 miles per hour, has a 1925 Star frame because it is light and easy to cut down, a 1929 Chrysler front axle because of its strong tubular design, 1928 Whippet front springs because of their shortness, a 1924 Franklin steering assembly for ease in steering, and a cut-down Auburn radiator. The transverse rear springs, axle, and rear-end gears are from a 1930 Ford. The body is part of the body of a 1925 Model T, cut down and shortened. The clutch, gears, and block are from a Model A Ford, the first and reverse gears having been removed from the transmission to reduce drag, and the flywheel is cut down to eight inches in diameter. Changes in the engine include overhead valves in a special high-compression racing head, a high-speed camshaft ground for racing, and racing types of pistons, carburetors, and ignition. Special alloy is used in the bearings. The car has two-wheel Ford brakes and a six-gallon fuel tank behind the driver. The wheel base is ninety-six inches.

Not counting labor, this car cost about \$260, of which \$85 was spent on the chassis and \$175 on the engine. Other cars range all the way from \$75 to \$500.

Some of the best modified roadsters have competed in dirt-track races. Likewise, some of the best midget and dirt-track drivers got their start in these neighborhood speed clubs.

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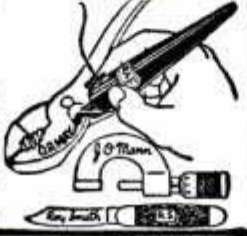
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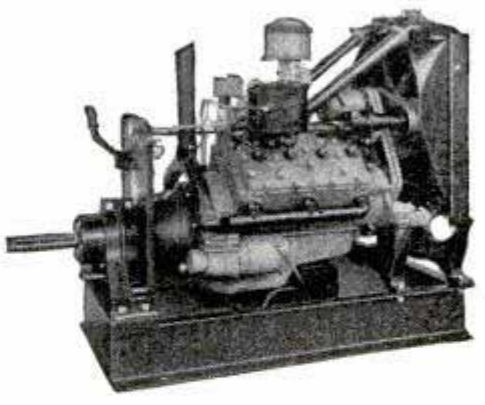
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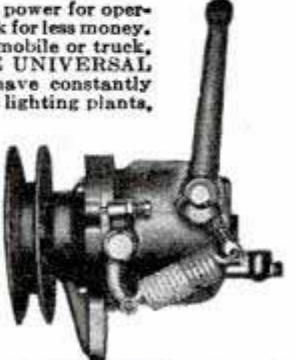
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PIERCE GOVERNORS THE BRAINS OF ANY GAS ENGINE

Manicuring the Diesels

(Continued from page 363)

engine spins a generator which supplies current for two traction motors on one of the wheel trucks. Each engine also operates a five-kilowatt auxiliary generator for charging the starting batteries, an exciter generator which supplies current for the main field of the big generator, drives a



Scrubbing front of streamliner with a mixture of steam and soap solution

centrifugal blower that supplies air for cooling the traction motors, and operates an air compressor that maintains pressure on the air-brake system. Coupled behind the locomotive is an additional power plant identical with the front one.

The power combination provides 3,600 horsepower but the train requires less effort to drive than an automobile. Virtually everything operates automatically and the controls in the cab perform multiple duties, reducing the burden on the engineer. The controls lead to a high-voltage control cabinet in the engine room where they operate a small compressed-air engine which moves the automatic grouping switches, the reversing switches, and where protective relays such as the wheel-slip relay and the current-limit relay are located.

Each power car contains an electrically operated steam boiler for the train's air-conditioning system. The boiler is an example of efficient self-operation. A continuous 10,000-volt arc combusts the flow

of vaporized fuel oil, and an electric eye focused on the flame rings an alarm if anything goes wrong. It takes only seven minutes to raise 200 pounds of steam from a cold start, and the boiler maintains a desired steam pressure after it has been started.

Among the safety devices are the "dead man control" foot pedal that stops the train if the engineer removes his foot, and the train control pickup, an electrical induction device that responds to a flow of current in the rails, warning the engineer by a system of colored lights of track conditions and signals ahead, blowing a warning whistle when the yellow caution light or the red danger light at the engineer's elbow flicks on, and bringing the train to a stop after a fifteen-second interval if the engineer fails to slacken speed. An overheated journal will explode a strong stench bomb in each wheel journal box, warning the crew by the odor of an impending "hot box."

Ordinary steam locomotives average 12,000 miles per month but the M-2 has averaged more than 20,000 miles per month. The streamliners now make round trips of about 4,500 miles every week, loafing in the yards between runs because train schedules can't yet take full advantage of the new speedsters.

While the power cars are getting the attention of the roundhouse crew, the passenger coaches are given just as thorough inspection in the coach yard. The single cars one at a time go over an inspection pit where rolling gear, couplers, and vestibules are examined. Passenger compartments are scrubbed and polished and the air-conditioning apparatus is inspected. Lubrication alone requires a special crew, since there are 122 automobile-type grease fittings on each car, as well as eight journal-box fittings, to be serviced.

Finally, when the locomotive and its power unit have picked up the rest of the train, come the check-up tests. The steam system, air-conditioning, plumbing, wiring, and air-brake systems are given operating tests to make certain everything works properly. Then the streamliner is ready for another trip two-thirds of the way across the continent.

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about POWER TOOLS



• Every man interested in modern motor-driven tools for the home shop and small shops, for building or industrial use, will want to know all about the sensational new Delta tool soon to be announced. For seven years Delta engineers have been working on this new development. The result has been a motor-driven tool so *revolutionary* in design, so *basically improved* over anything hitherto available, that it is considered Delta's greatest contribution to the power tool field. The full story of this remarkable new tool is so comprehensive that it cannot be given on a small circular or a few catalog pages. A special booklet is being prepared that will be sent free to all those who are interested. Send for this booklet today. It will be mailed with the new 1939 Delta Catalog.

New 1939 DELTA CATALOG

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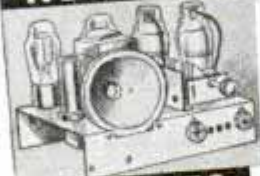
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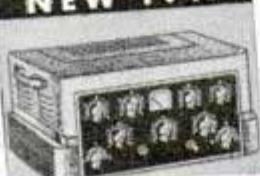
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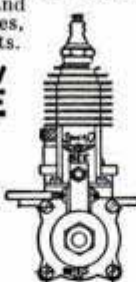
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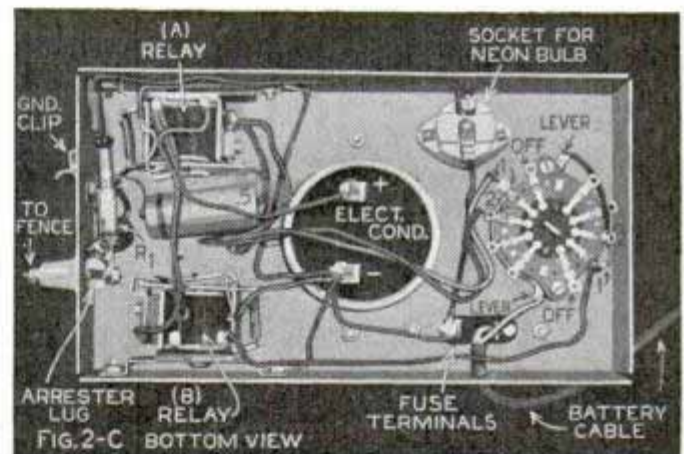
WRITE FOR FREE OUTFIT

Electric Fence Controller

(Continued from page 419)

denser introduces the time-delay action, the relays making 40 contacts a minute; on each contact the high-voltage surge lasts about 1/20 of a second. The neon bulb included in the circuit will glow if the equipment is operating correctly. There will be no glow if the fence is shorted. Should any part fail to operate, no voltage will be present on the fence. A list of all materials used in the original model, and additional operating data, can be obtained from Popular Mechanics Magazine, radio department, without charge. The blueprint number is R-257.

Photos Figs. 2-A, 2-B and 2-C show various views of the completed unit which may be operated inside a building, or outside if weatherproofed. The schematic dia-



gram appears in Fig. 3; Figs. 4 and 5 show suggested fence and gate details. The 4-point barb wire is strung on porcelain knob insulators which may be mounted either on wood or metal posts. A short length of broomstick or a large wooden handle from a kettle will provide an insulated hand grip for the gate. A piece of stiff wire is run through the handle and terminates in a hook as indicated in Fig. 5. If the builder prefers to use an ordinary wood gate, the fence wire can be continued by burying a sufficient length of insulated, lead-covered wire several inches under ground as indicated by the dotted line. All fence posts may be of light material and widely spaced. The external ground lead should be connected to a 5-ft. metal rod driven into moist ground.

The switch terminal setting No. 1 should be used for moist and average conditions; while terminal No. 2 will give a greater voltage required for extremely dry days.

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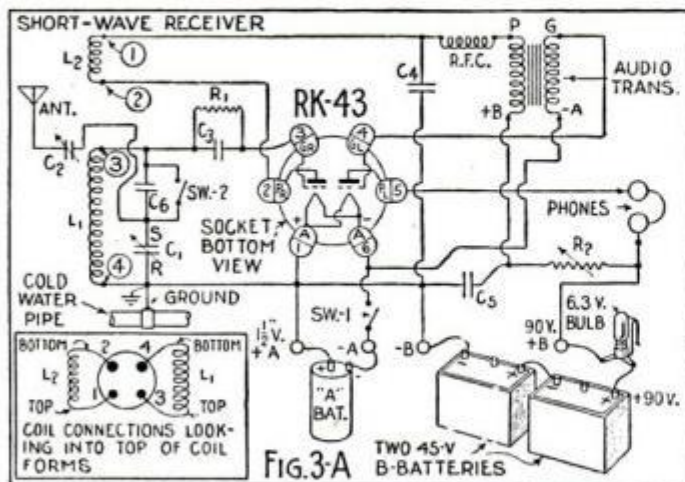
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Beginner's Receiver

(Continued from page 421)

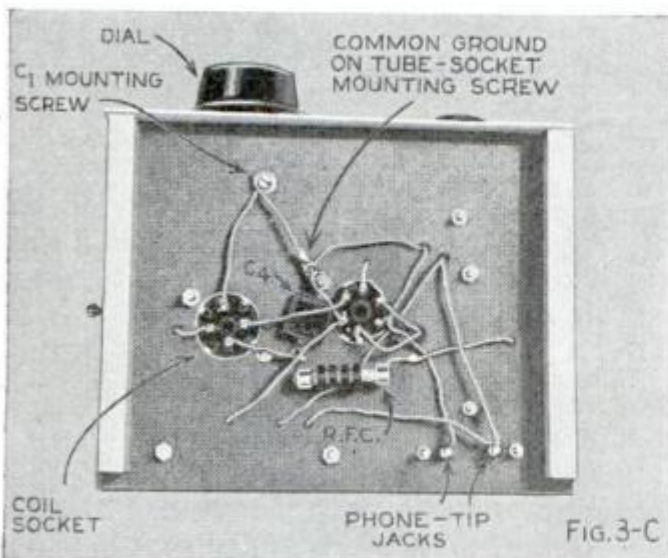
ers both the short-wave and broadcast bands. This is accomplished by connecting a .00025 mfd. fixed condenser in series with the tuning condenser used in the orig-



inal set. A toggle switch is used to short out the fixed condenser for broadcast-band tuning.

The broadcast-band coil is removed and in its place is mounted a 4-prong socket for a kit of four "Meissner" 15 to 200-meter 4-prong short-wave plug-in coils. The broadcast coil can be mounted in an old 4-prong tube base.

All added parts are clearly shown in the simplified wiring diagram Fig. 3 and photos Figs. 3-B and 3-C. The schematic cir-



cuit diagram is given in Fig. 3-A. A list of the original materials used in all three sets, including additional tuning data, can be obtained from Popular Mechanics radio department without charge. The blueprint number is R-256. Adjust the screw in antenna-trimmer condenser to eliminate dead spots in tuning range.

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H 591

The Missing Link in Aviation

(Continued from page 351)

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We used a muddy golf driving range first, picked up the mail there and flew in to the main post office. There we landed in a half-pint, tree-rimmed park. The same day, I twice landed in "E" street, directly between the Department of Commerce building and the Willard hotel. Mail

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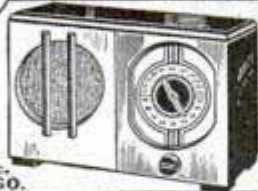
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German helicopter, above, propelled by engine-driven rotors. Below, autogiro equipped with floats

was put aboard and I flew it back to the Washington airport. No right-minded person would dream of making any of these landings in an airplane.

Such demonstrations point the future for the autogiro. They explain why the chiefs of army artillery, infantry, cavalry and coast artillery; spokesmen for the coast guard, national guard, forestry service, Department of Agriculture, the navy, and private flying interests all went on record before a congressional committee recently in favor of immediate development that will take the autogiro out of the experimental stage and put it to work where it can save time, money and lives.

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needs is the investment of money and brains to produce them by the scores and put into them performance for the tasks where more performance is required. Uncle Sam has spent \$500,000,000 in the last five years on airplanes while the autogiro has received just \$485,000 in that time. That is why we are in a stage corresponding roughly to the state of the automobile in 1916. Today, for example, a good giro, custom-built, would cost about \$25,000. My company figures it could sell a better ship for the price of an automobile if it could find a market for 1,000 a year.

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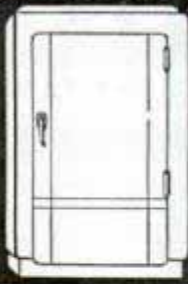
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Mosquito Warships

(Continued from page 323)

but the latter is sixty-eight feet long, is armed with two twenty-one-inch torpedoes and two twenty-millimeter anti-aircraft guns, and has touched forty-eight knots in trials. It has been reported that one of the torpedoes is fired from a trough in the stern and the other from a bow tube. Nine new "M.T.B.'s" are being constructed.

Soviet Russia possesses the largest number of these much-feared craft, some reports crediting her with at least 130. Japan claims about 100 are stationed at Vladivostok, in the north Pacific, from where the largest could threaten her sea communications with Asia or seriously oppose a Japanese landing on Soviet territory. These Russian torpedo boats vary in size from six to thirty-five tons and are armed with two torpedoes.

Italy possesses, next to Russia, the greatest number of motor torpedo boats, but many are old world war veterans. Including old units, the Italian navy has about 120 "M.A.S." boats. Of these, about twenty-five were completed in 1936, about forty-five in 1937, and at least twenty more are expected to enter service during 1938. They vary in length from fifty to seventy feet, and in displacement, from eighteen to twenty-five tons. They carry two eighteen-inch torpedo tubes, several small anti-aircraft guns, a number of depth charges and can make more than forty-five knots.

The largest motor torpedo boats yet built are Germany's fourteen "Schnellboote," ninety-three feet long and of sixty-two tons displacement. They are armed with a single anti-aircraft gun, two 19.7-inch torpedoes fired from tubes mounted forward, and several depth charges. Top speed is only thirty-six knots but they are very seaworthy. Six new "Schnellboote" are being built.

Probably the fastest motor torpedo boats are those of the French navy, but they have many of the bad points of Britain's wartime "C.M.B.'s." France has only three completed and two building. The former are sixty-two feet long, displace twenty-three tons, have reached fifty to fifty-five knots on trials and carry two eighteen-inch torpedoes which are discharged from troughs in the after end of the boats.

Experimental motor torpedo boats also

(Continued to page 139A)

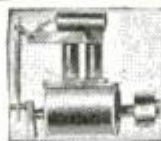
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(Continued from page 136A)

are being planned for the United States navy. It is expected they will have a speed of about forty-three knots and will be equipped with one torpedo bow tube and one stern trough. The navy has invited private builders to submit designs for four types of motor torpedo boats and submarine chasers, including a seventy-foot motor torpedo boat of wood or metal, and a fifty-four-foot wood motor torpedo boat.

The future of the motor torpedo boat is promising, although its employment is largely restricted to narrow, more or less landlocked, waters. As it exists today, it is a particularly grave threat to large warships at anchor in port. This was demonstrated during the world war and in the British operations in the Baltic against the Bolsheviks. In 1917 the old Austrian battleship "Wien" was destroyed in Trieste harbor, the attacking boat being the "M.A.S. 13," commanded by the then Lieut. Luigi Rizzo, who, a few months later sunk the "Svent Istvan." In the second case, eight British "C.B.M.'s" dashed into the harbor of Kronstadt, Russia, and there torpedoed and sank the dreadnaught, "Petrovlovsk," another battleship, an old cruiser and a large destroyer. The British loss was two "C.B.M.'s" sunk, two officers and sixteen men killed.

The next step in the development of the motor torpedo boat quite possibly will be radio control. If so, a future war may well witness whole fleets of these little boats, without anyone on board, dashing against the enemy battle line, firing their torpedoes, then returning to the parent ship for a fresh load. The successful employment of crewless warships is not without precedent, for in the world war, a German motor boat, electrically controlled and carrying a charge of about 400 pounds of high explosives, was sent against the British monitor "Erebus," which it hit amidships and damaged. The boat, running at some thirty knots, was steered electrically by means of an insulated cable connecting it with the shore. An airplane signalled steering directions to the control station.

Should radio-controlled torpedo boats become a reality, they will revolutionize warfare at sea. A whole fleet of them could be built for the cost of one dreadnaught. Indeed, it is possible that they might replace airplanes as the most serious threat to the battleship's supremacy.

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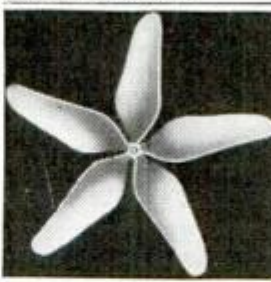
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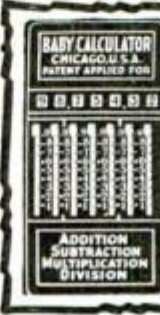
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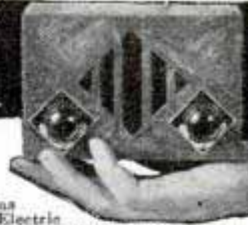
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(Continued from page 327)

trols, carburetor heat controls, propeller "full feathering" controls, trim tab controls, fuel-tank selector switches, dual magneto switches, wobble pumps for the hydraulic system and fuel tanks, fuel flowmeters, dual controls for engine cowling cooling gills and throttles.

These instruments, despite their apparent complication, enabled Hughes to know a great deal more about his ship and the atmosphere through which it was flying than Lindbergh or Post could possibly glean from their meager equipment. Knowledge of conditions enabled the Hughes crew to adjust their delicate high-compression powerhouse to its highest performance, thus making faster time.

In addition to all the aviation instruments, the Hughes ship is equipped with the most elaborate radio apparatus ever installed in a non-commercial, long-distance plane. There are three radio transmitters and seven radio receivers by means of which the crew was able to keep in almost constant contact with flight headquarters in New York and radio operators on land and sea.

The radio expert in Hughes' crew took constant radio bearings on shore stations and on ships at sea and, in addition, two navigators constantly took sights upon the stars and calculated their position with this information. By checking against each other to prevent errors, they were able to give the pilot a fresh and highly accurate position report as often as requested.

While the navigators thus kept the ship on a true course, the radio furnished constant weather information which enabled the pilot to select the best flying level. For instance, between Paris and Moscow, Hughes learned by radio that ice was forming at a certain air level and climbed to 17,000 feet to negotiate this area, thus avoiding one of aviation's greatest perils. At that height, the oxygen tanks with which the plane is equipped were brought into use.

Hughes probably received more complete weather information at every stage of his flight than was ever before supplied to any private flyer, thanks both to his elaborate radio facilities and to careful

(Continued to page 143A)



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advance planning. Before the New York takeoff, Hughes was handed a detailed report of all the weather conditions over his Atlantic route. This report was prepared by William Curtis Rockefeller, young meteorologist of the California Institute of Technology who has given Hughes the "go" signal for most of his record-breaking flights in this country.

While the plane was in the air, nine men in his New York flight headquarters analyzed reports of weather conditions in his path, transmitting this information to Hughes by radio at regular intervals. Weather information was available every thirty minutes while the ship was in the air and detailed weather reports were supplied at every stop, thus enabling the crew to plan their flight possibly hours in advance so they could take advantage of every favorable wind.

Contrast this elaborate weather coverage with the limited information available to Lindbergh and Post. Lindbergh had a report of weather conditions over the Atlantic as they existed before he was in the air. Once in flight, he had no way of knowing what changes he might encounter. Post was forced to rely mostly on whatever data were available wherever he happened to land.

Hughes' plane was the result of many months of experimentation by the country's foremost aeronautical experts. Its base is a high-speed Lockheed monoplane introduced a year ago. After purchasing his ship, he called in technicians to whom he outlined the problems of his proposed flight. As a result, the regular engines were replaced by two specially super-charged motors and other details were altered to compensate for changes in weight distribution, flight characteristics and other features of strength and performance. All the work was done in secret.

From beginning to end, Hughes and his companions left nothing to chance. Science was the invisible pilot sitting at the controls, ever ready to correct any human error or warn of any possible mechanical failure. Without the scientific achievements of the last decade, Hughes in his \$85,000 plane would have faced about the same odds as Lindbergh and Post, each of whom staked his life on his own skill as a flyer—and won.



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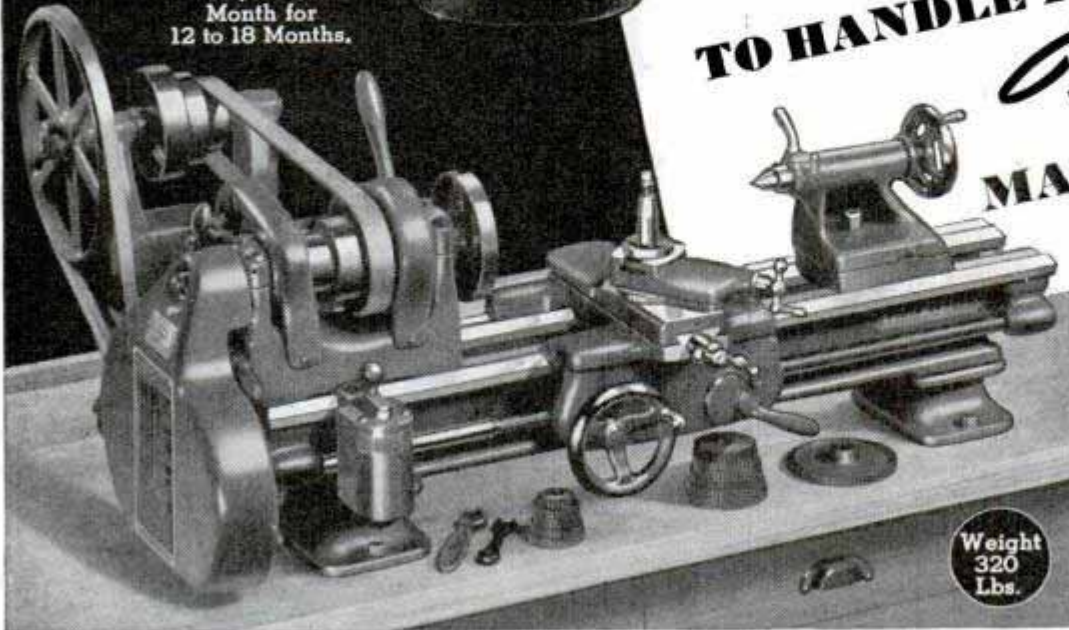
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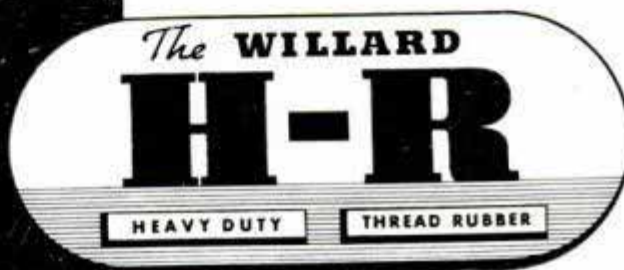
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