

# POPULAR MECHANICS

## MAGAZINE



WRITTEN SO YOU CAN UNDERSTAND IT

REG. TRADE MARK GREAT BRITAIN NO. 40428

REG. U.S. PAT. OFF.

FEBRUARY 1947  
25 CENTS



SNOW TRACTOR  
PAGE 169



# FAST STARTS

ON FROZEN MORNINGS

WITH **CASITE**

**Or Double Your Money Back**

★ Casite guarantees that your car will start quickly—even in the coldest winter weather—or you get back double your money. Casite retards congealing of oil, lets the motor spin over rapidly and s-t-a-r-t. Get Casite—sold by car dealers, garages, service stations, everywhere.

## GUARANTEE

We guarantee that any motor capable of being started in a warm room will start quickly in the coldest weather when Casite is added to the crankcase according to instructions. If your car fails to start quickly, you get double-your-money-back by filling out guarantee certificate and mailing it to The Casite Corporation, Hastings, Mich. Maximum refund is \$1.30 per pint, twice the advertised price of Casite.

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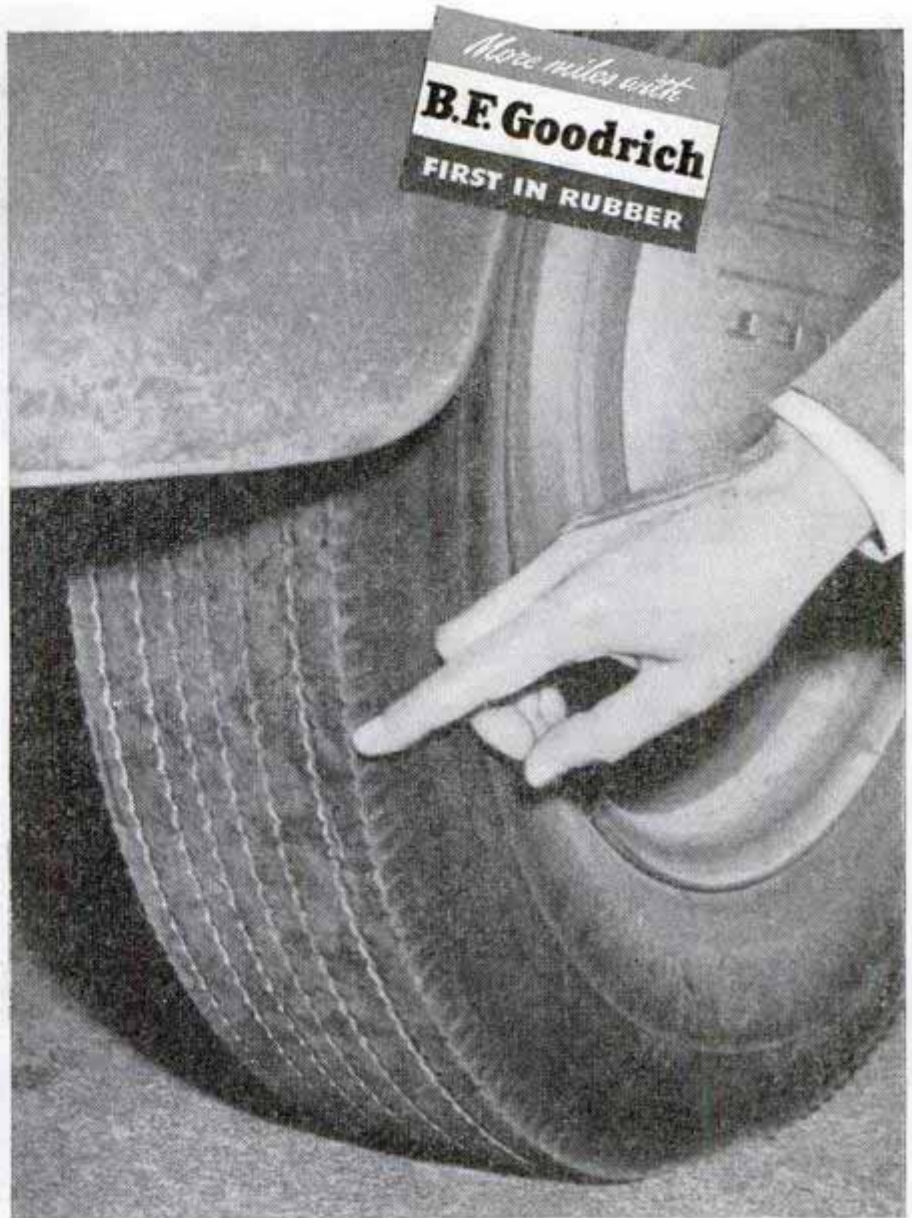
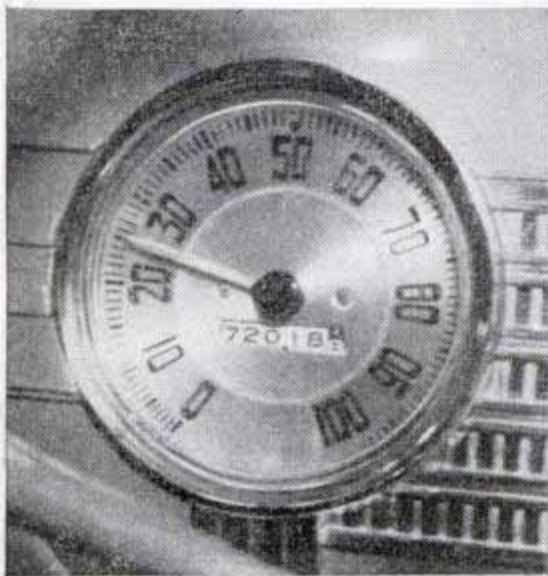
*Casite Protects New Motors  
During Break-In*



65c  
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IN CANADA

CASITE GIVES BETTER AND SMOOTHER PERFORMANCE ALL-YEAR-ROUND





## TYPICAL EXAMPLE: THE B. F. GOODRICH TIRE THAT OUTWEARS PREWAR TIRES

**R**ALPH J. MORISSETTE of Ogdensburg, N. Y. (at left in the upper picture), points to one of his B. F. Goodrich tires that still isn't worn out after 38,377 miles. Mr. Morissette writes:

"I have received 38,377 miles from these tires in very difficult service on all types of roads. Many long trips were made at consistent high speeds. Also the car was used in my plumbing business, carrying heavy loads thousands of miles, over country and unpaved roads.

"This mileage is far in excess of prewar tires used. While former tires broke down in service,

these tires were never removed except to repair a puncture. I can truly say that your new tires most certainly can and do outwear prewar tires as stated in your advertising, since I have proof of this."

When the pictures were taken, Mr. Morissette's speedometer read 72,018 miles. When the tires were put on, the mileage was 33,641.

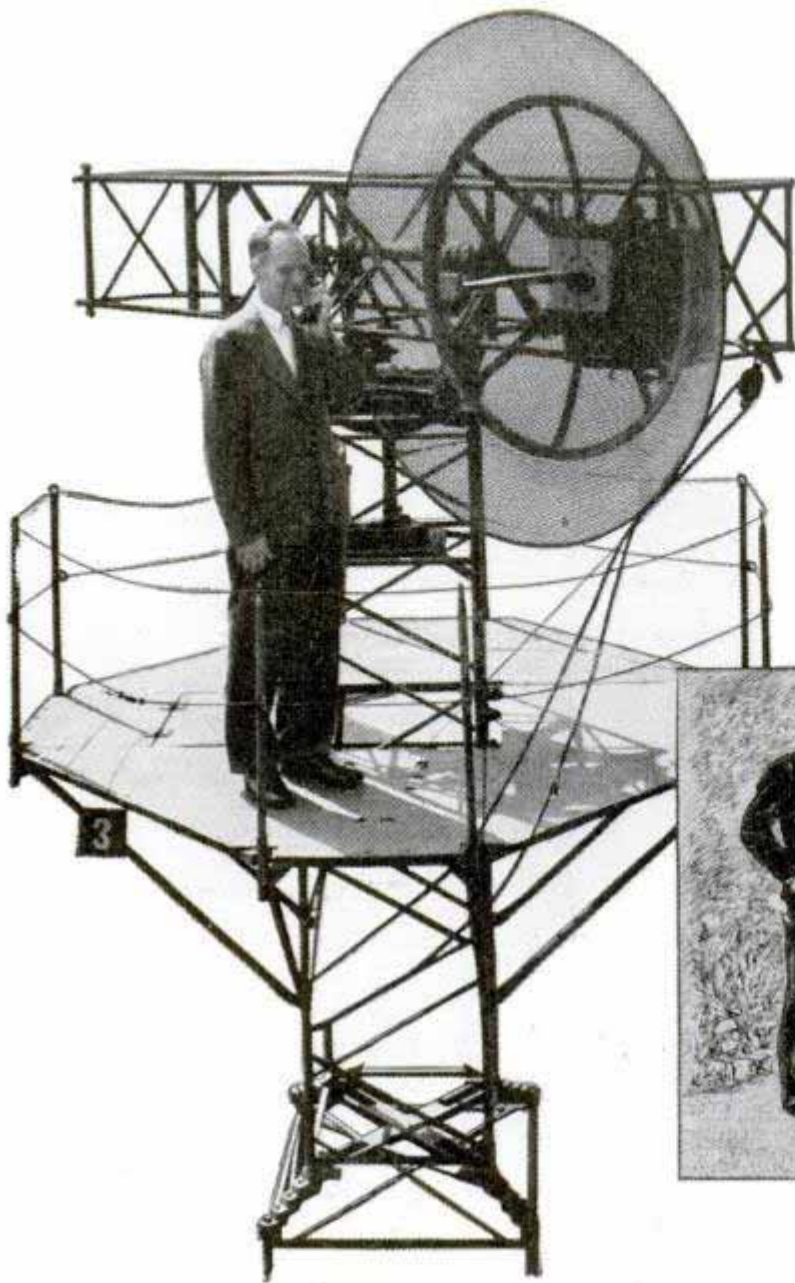
Supplies of tires are still lim-

ited, of course. Even today's increased production cannot keep up with the demand. This is particularly true of the B. F. Goodrich tire that outwears prewar tires. It's best to check your needs with your B. F. Goodrich dealer well in advance. He'll do his best to keep you rolling until he can get new tires for you. *The B. F. Goodrich Company, Akron, Ohio.*

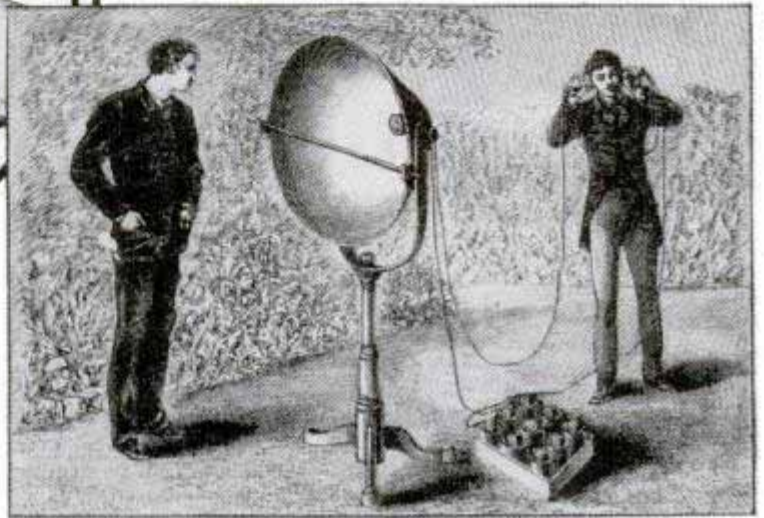
# B.F. Goodrich

**FIRST IN RUBBER**





## Words that rode on a beam of light



**I**F Alexander Graham Bell could look at the microwave antenna in the illustration, how quickly his mind would go back to his own experiments, 67 years ago!

For in 1880 the inventor of the telephone had another new idea. Speech could be carried by electric wires, as Bell had demonstrated. Could it be carried also by a *light beam*?

He got together apparatus—a telephone transmitter, a parabolic reflector, a selenium cell connected to handphones—and “threw” a voice across several hundred yards by waves of visible light, electromagnetic waves of high frequency.

Bell's early experiment with the parabolic antenna and the use of light beams as carriers

was for many years only a scientific novelty. His idea was far ahead of its time.

Sixty years later communication by means of a beam of radiation was achieved in a new form—beamed microwave radio. It was developed by Bell Telephone Laboratories for military communication. In the Bell System it is now giving service between places on the mainland and nearby islands and soon such beams will be put to work in the radio relay.

In retrospect, Bell's experiment illustrates once again the inquiring spirit of the Bell Telephone System.

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# Popular Mechanics Magazine

Registered in U. S. Patent Office and Canada

H. H. WINDSOR, Founder

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



G. H. Davis, noted British artist, at work

PICTURES of the "Whale Factory" on pages 123-125 were drawn by G. H. Davis of England, one of the world's leading diagrammatic artists. Mr. Davis, a contributor to these pages for many years, gets his material the hard way. During the war he rode subs and bombers to get some of his famous on-the-scene drawings. Recently he has been delving into the progress of jet propulsion in Europe for a March picture story on ramjets.

ALSO NEXT MONTH there's a yarn on lab research to find a better fuel for your car. Scientists hope to cut gas consumption 20 percent by 1950, a healthy saving for any penny-wise motorist. In a picture-packed feature on dude ranches you can pan for gold, eat beans from a chuck wagon and ride the sprawling range.

HOME ON WHEELS—that's the well-equipped house trailer described in a new Craftsman series beginning next month. The rolling house can be built with a few ordinary tools. Another how-to-build story features something new—a "walking" garden tractor powered by a four-cylinder engine. A timely article in the same issue gives complete instructions for painting the faithful car that lasted through the war years.

RADIO students and experimenters will find a new tuning feature in the 1947 "Little Giant" broadcast set described in the March Radio and Electronics section.

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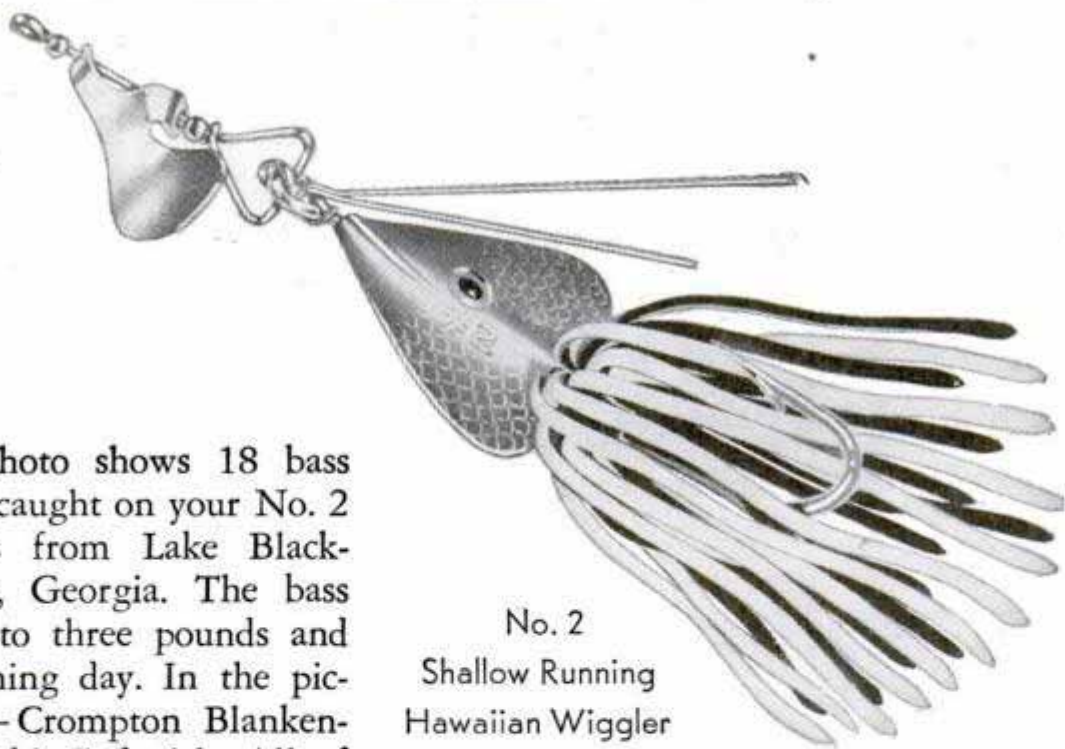
Published monthly by POPULAR MECHANICS COMPANY, 200 East Ontario Street, Chicago 11, Ill. H. H. Windsor, Jr., president; Paul H. Dunakin, vice president and general manager; D. F. Windsor, vice president and secretary-treasurer; William Harrison Petridge, vice president and assistant to the publisher; Clover L. Perkins, advertising manager; Alan M. Deyoe, circulation manager. Single copy in the United States and Canada, 25 cents; subscription rates in United States and possessions, Canada, and countries of the Pan-American Postal Union, 1 year, \$2.50; 2 years, \$4.50; 3 years, \$6.00. To all other countries add \$1.00 a year over United States prices for overseas postage. If you plan to move, notify us at least 60 days in advance so you will not miss an issue. Give both old and new addresses. Entered as Second Class Matter, September 15, 1903, at the Post Office at Chicago, Illinois, under Act of March 3, 1879. Entered as Second Class Matter at Post Office Dept., Canada. Copyright 1947, by Popular Mechanics Company. Copyright under International Copyright Union. Copyright in France. All rights reserved under Pan-American Copyright Union. Printed in the United States of America.



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*Franklin Martin  
and Party*



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"Dear Fred:

"The enclosed photo shows 18 bass and one crappie we caught on your No. 2 Hawaiian Wigglers from Lake Blackshear near Cordele, Georgia. The bass weighed from one to three pounds and were taken on opening day. In the picture left to right — Crompton Blankenship, myself and Hubie Leftwich. All of us enjoy using Hawaiian Wigglers. They sure get results." — *Franklin Martin, Marietta, Georgia.*

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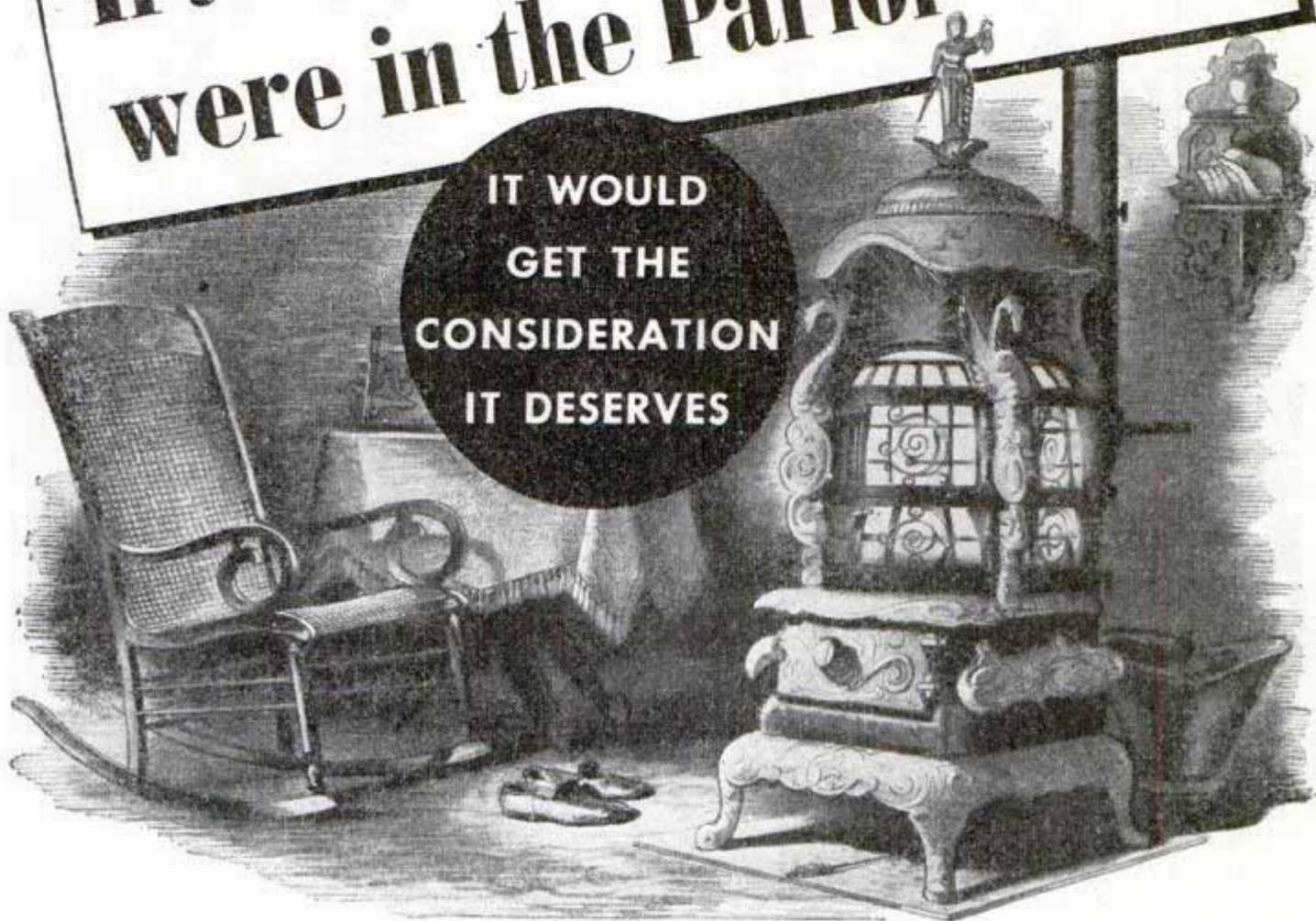
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CONSIDERATION  
IT DESERVES



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THIS ONE



# Thoughts . . . THAT MOVE MOUNTAINS



## . . . IS MIND POWER REAL?

**H**AVE YOU READ volumes on the power of thought? Perhaps you have listened to lengthy theoretical addresses on the forces of mind. You may have wondered if these same writers and lecturers on mind power know how to use it. How many mountains of personal obstacles—everyday trials and tribulations—have *they* moved? What are these subtle principles whereby man can skillfully remove the barriers that impede his progress? How can *you* displace the obstructions and hindrances to *your* goal... the mountains in *your* life? Can practical information about inner power be reduced to mere words... words for public dissemination? Or, is there a secret method especially and uniquely preserved for the worthy seeker... practicable only under ideal circumstances? If so, who has the secret method? Where can it be found?

*The*

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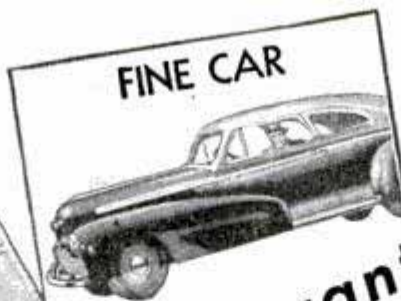
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To the man who wants to enjoy  
**an ACCOUNTANT'S CAREER**



**IF** you're that man, here's something that will interest you. Not a magic formula—not a get-rich-quick scheme—but something more substantial, more practical.

Of course, you need something more than just the desire to be an accountant. You've got to pay the price—be willing to study earnestly, thoroughly.

Still, wouldn't it be worth your while to sacrifice some of your leisure in favor of interesting home study—over a comparatively brief period in your life? Always provided that the rewards were good—a salary of \$3,000 to \$10,000?

An accountant's duties are interesting, varied and of real worth to his employers. He has *standing!*

Do you feel that such things aren't for you? Well, don't be too sure. Very possibly they *can* be!

Why not, like so many before you, investigate LaSalle's modern Problem Method of training for an accountancy position?

Just suppose you were permitted to work in a large accounting house under the personal supervision of an expert accountant. Suppose, with his aid, you studied accounting principles and solved problems day by day—easy ones at first—then the more difficult ones. If you could do this—and if you could turn to him for advice as the problems became complex—soon you'd master them all.

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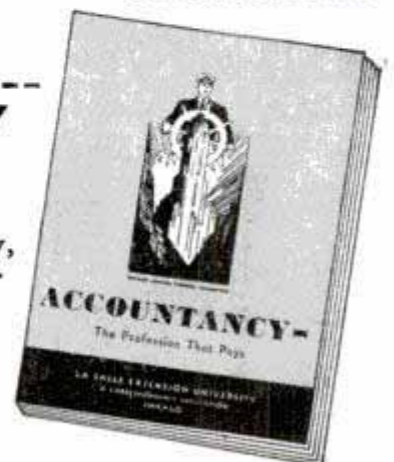
Will recognition come? The only answer, as you know, is that success *does* come to the man who is really *trained*. It's possible your employers will notice your improvement in a very few weeks or months. Indeed, many LaSalle graduates have paid for their training—with increased earnings—before they have completed it! For accountants, who are trained in organization and management, are the executives of the future.

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

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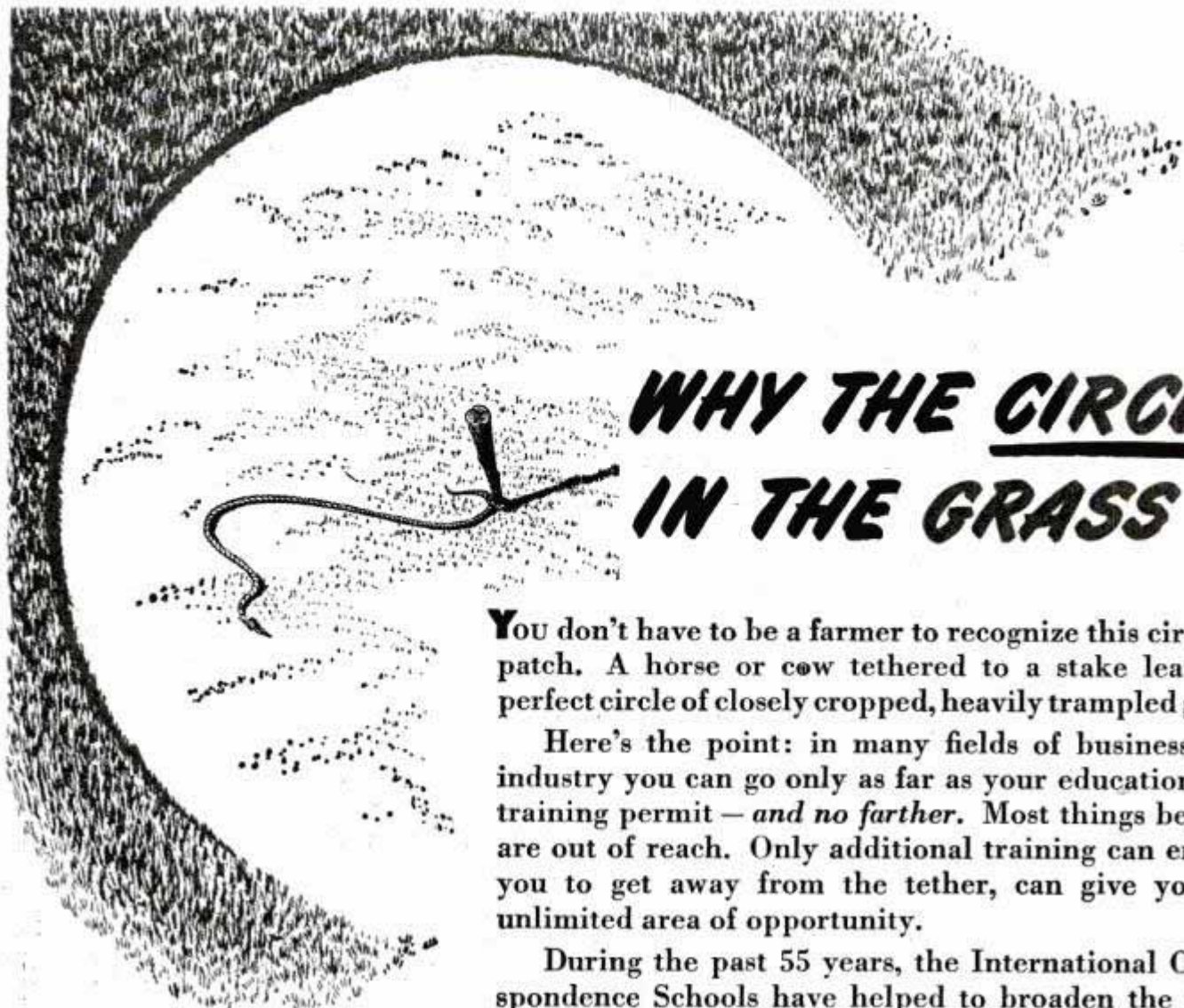
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## WHY THE CIRCLE IN THE GRASS?

**YOU** don't have to be a farmer to recognize this circular patch. A horse or cow tethered to a stake leaves a perfect circle of closely cropped, heavily trampled grass.

Here's the point: in many fields of business and industry you can go only as far as your education and training permit — *and no farther*. Most things beyond are out of reach. Only additional training can enable you to get away from the tether, can give you an unlimited area of opportunity.

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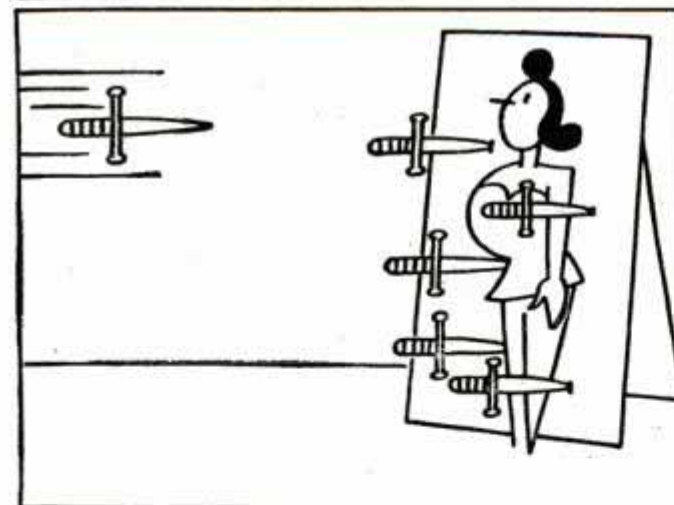
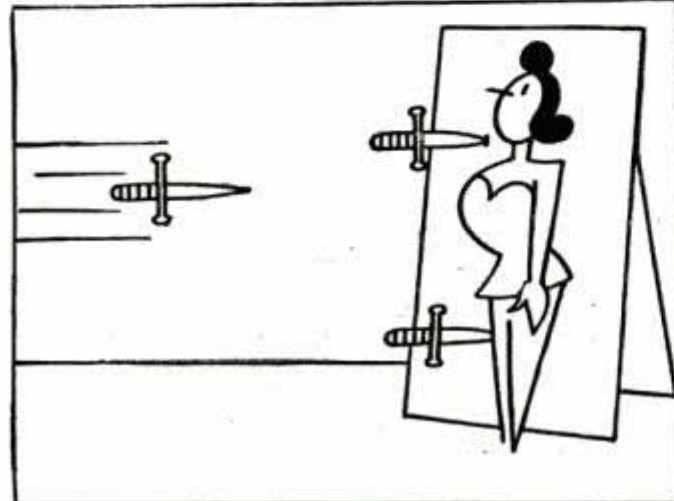
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O. SOGLOW

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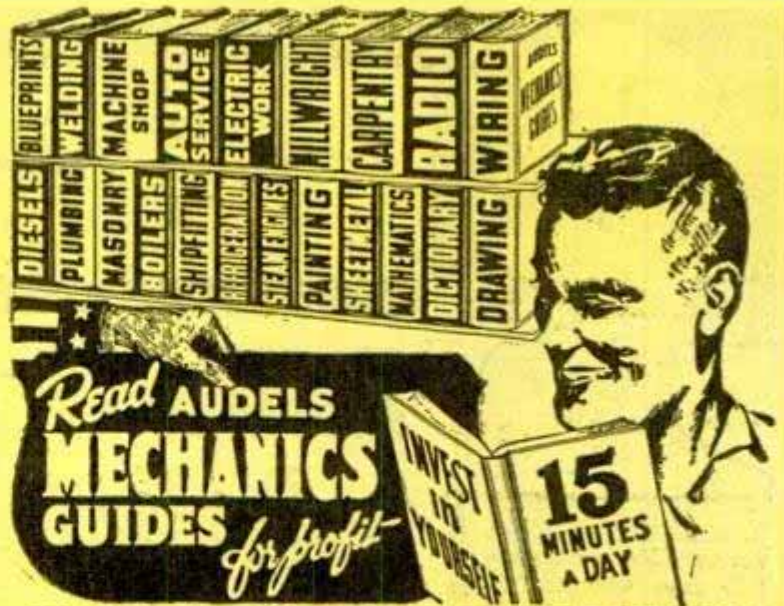
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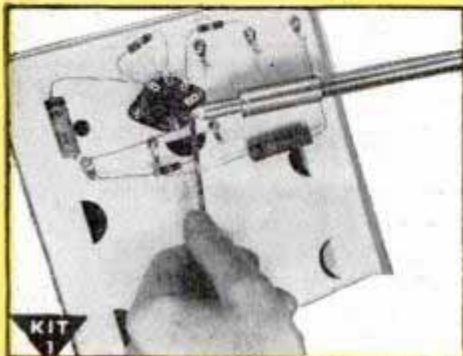
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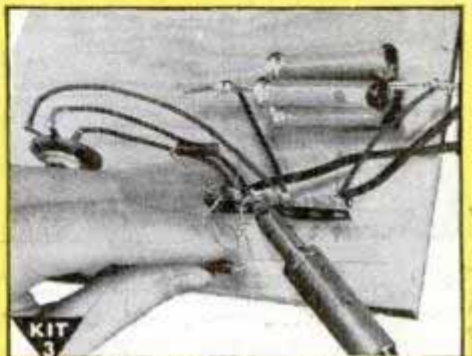
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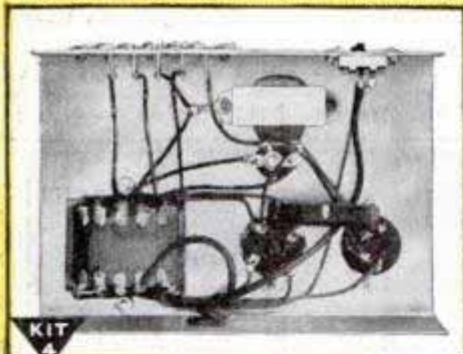
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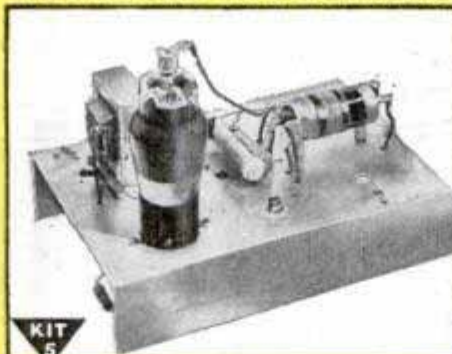
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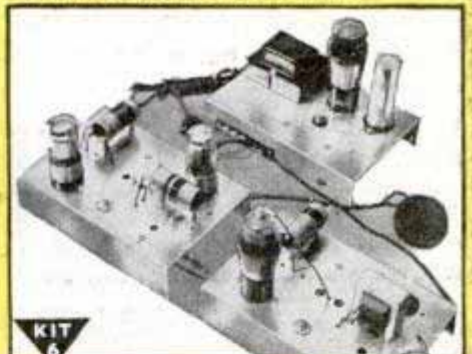
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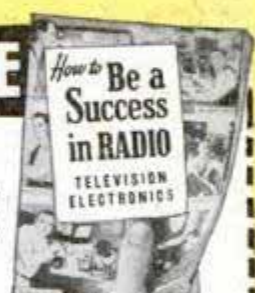
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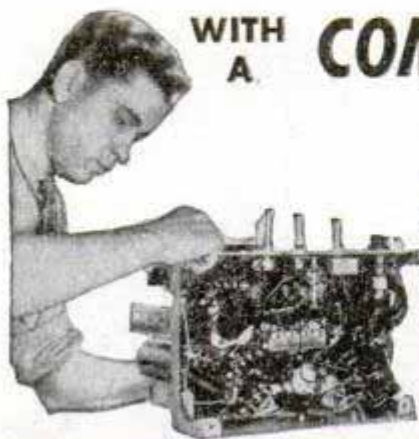
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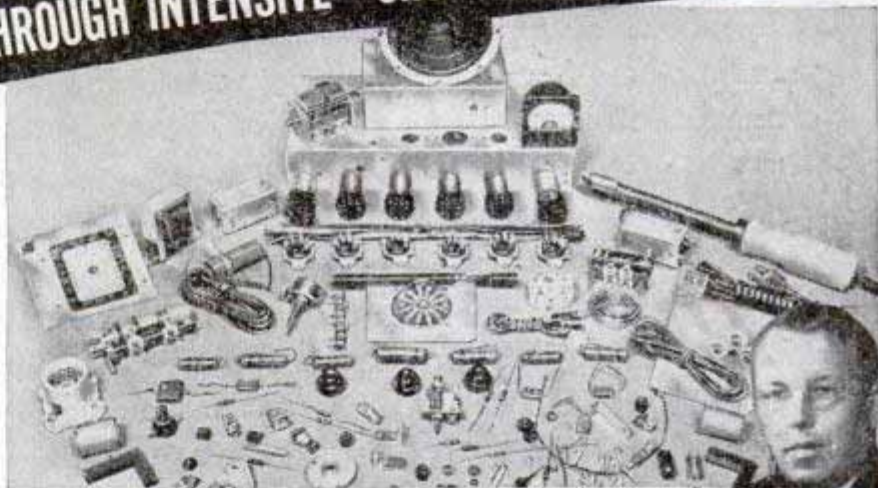


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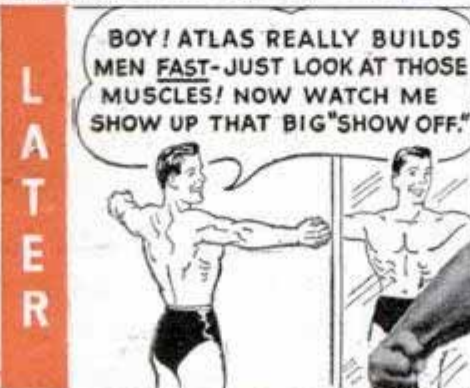
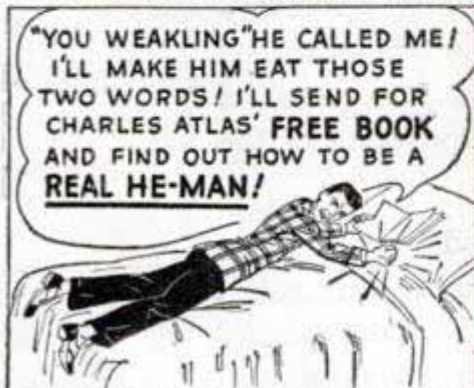
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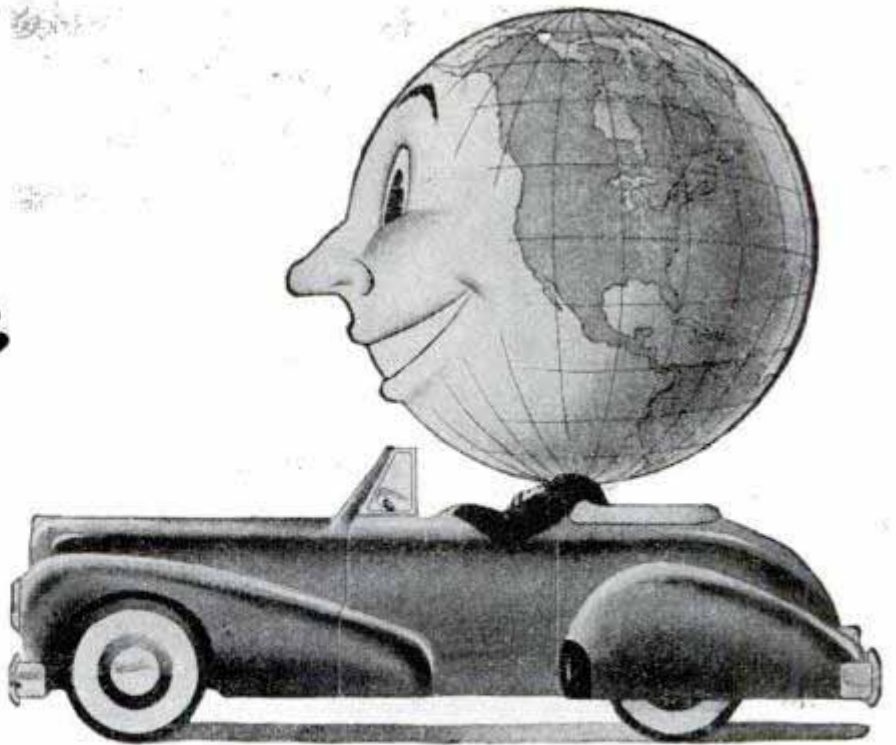
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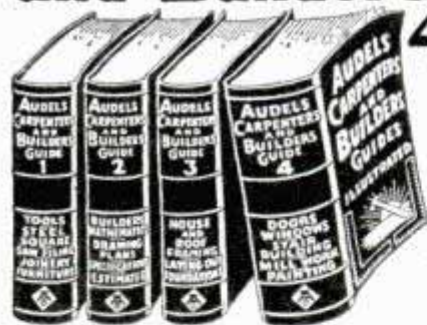
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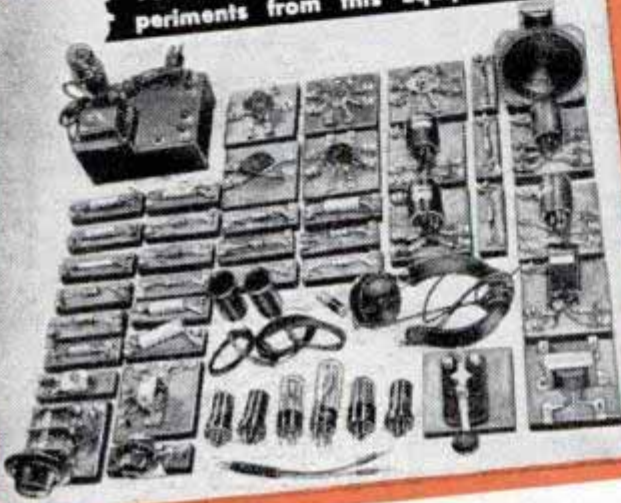
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By S. T. CHRISTENSEN

*the "Fix-it Man"*

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

### What to Charge?

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

For a while, repair parts (needed on some

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

### The Future Offers

Friends ask me about my future. And, I think I've got a grand one. Age is no handicap in repairing. I have in my files enthusiastic letters from repairmen ranging in age from 18 to 79 years. Now the war is over we are certain to see hundreds of new products on the market . . . products that the average person never dreamt of. These new products and our old appliances are all going to need at some time or other "fixing." Well, I'll still be the fellow to do it. The field open for appliance repairmen is unlimited. I don't worry at all about too much competition.

### If You Are Ambitious

To the contrary, I've prepared a complete course, chuck full of simple, easy to understand photos and drawings and written in the same non-technical language as this article. I know the course is good, because I have hundreds of men all over the country writing to me telling me how the course has helped swell their pockets with cash. If you too want to prepare now for your future, I suggest you read the next page and send me the handy coupon."

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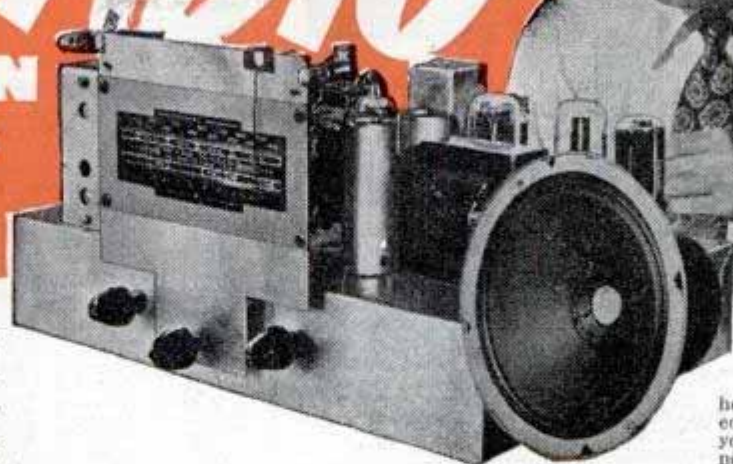
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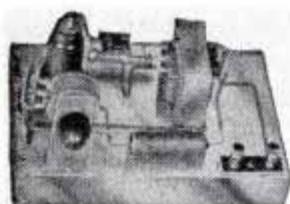
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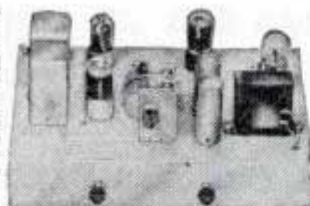
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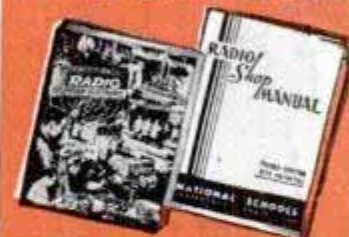
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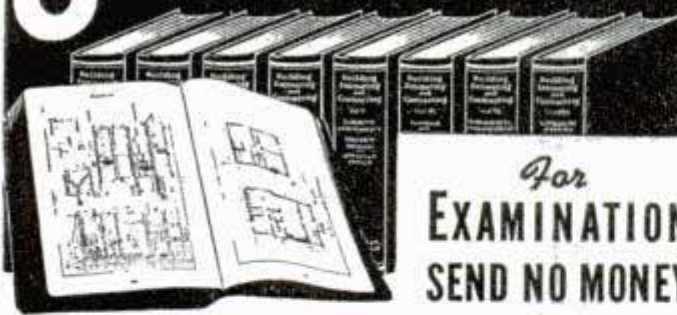
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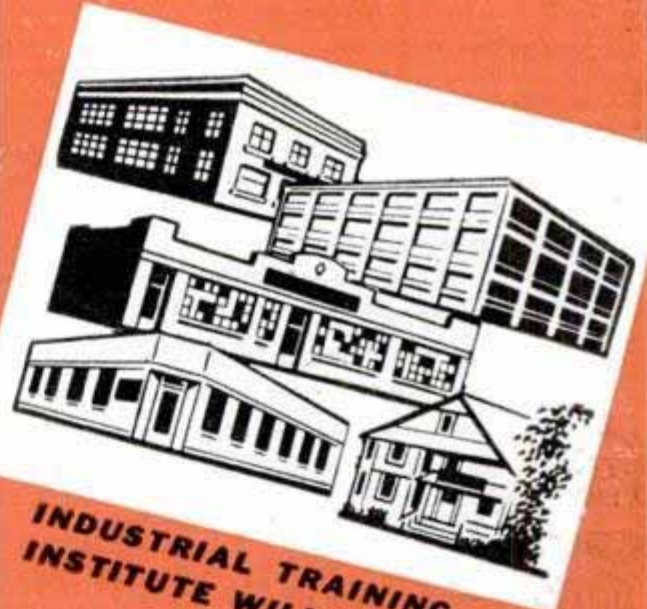
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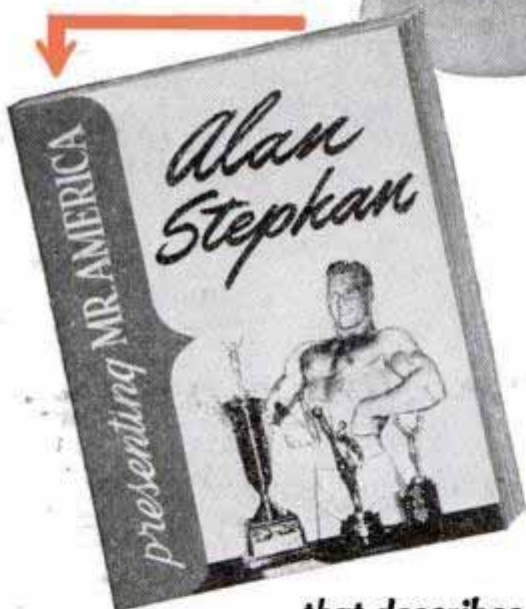
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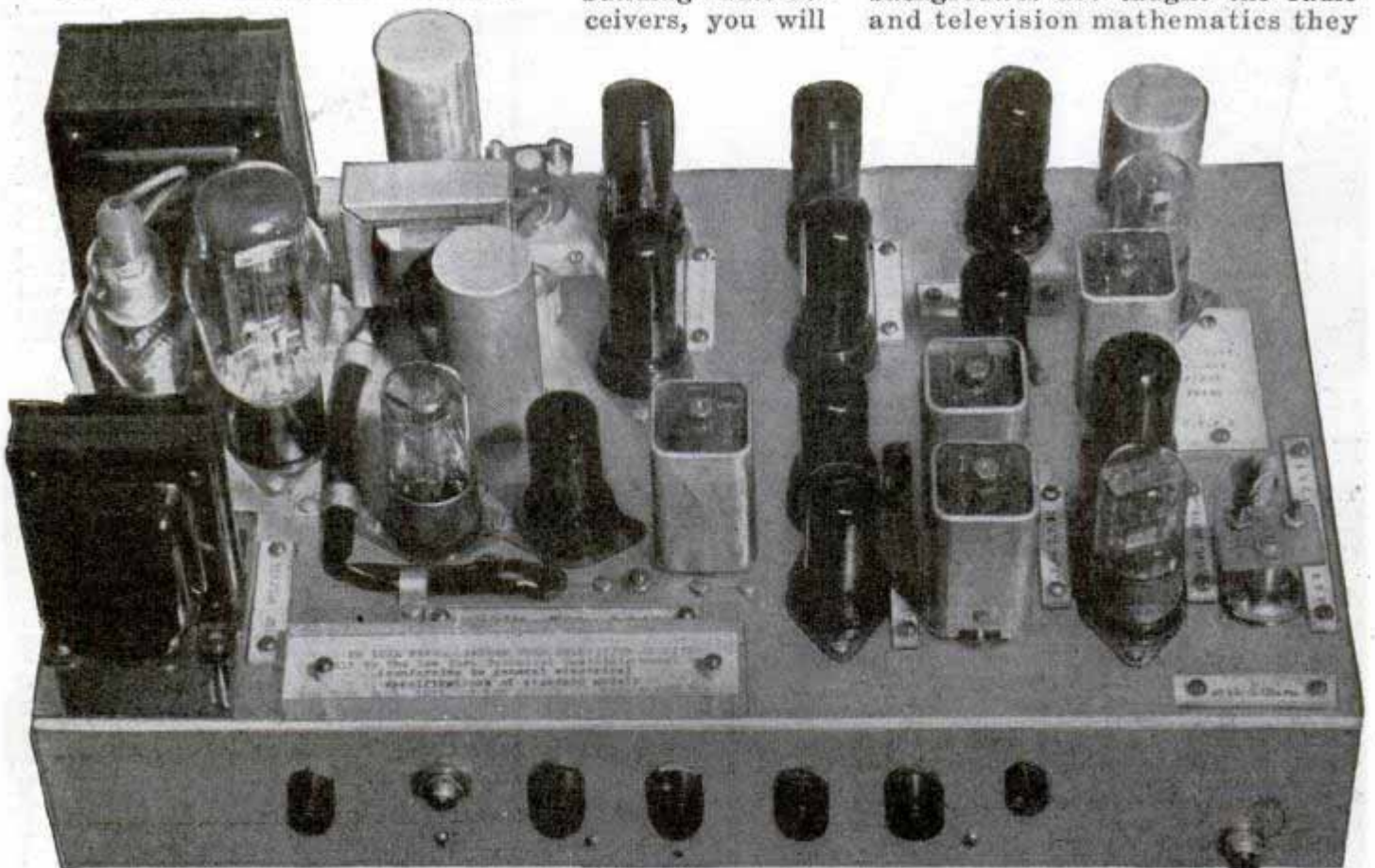
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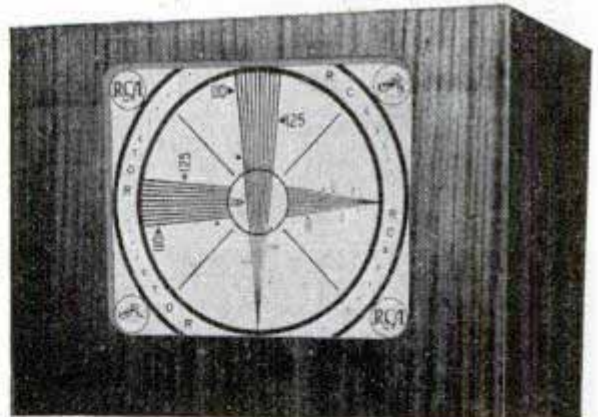
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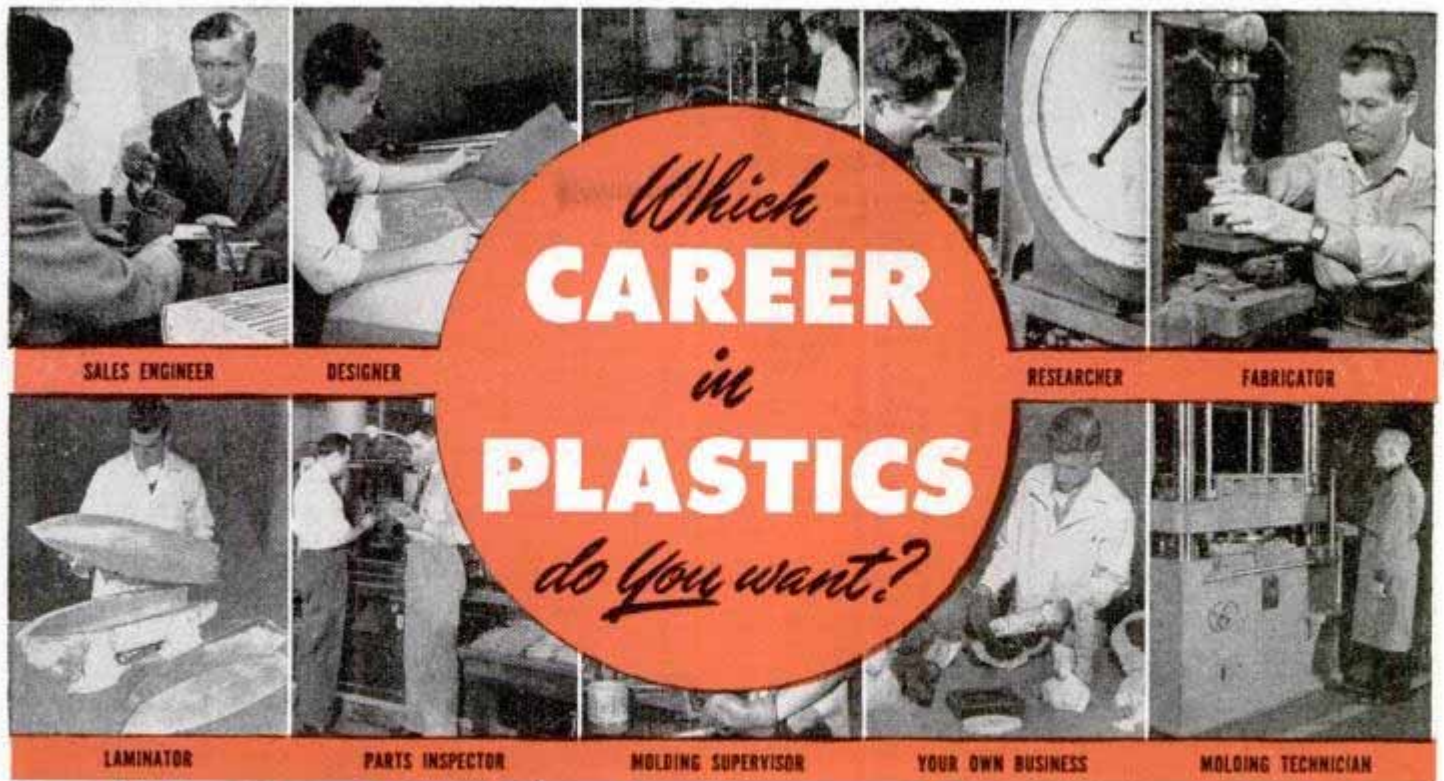
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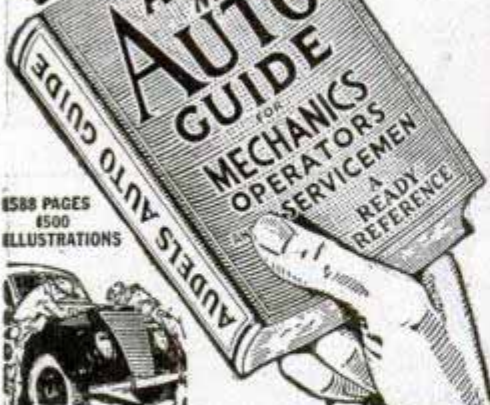
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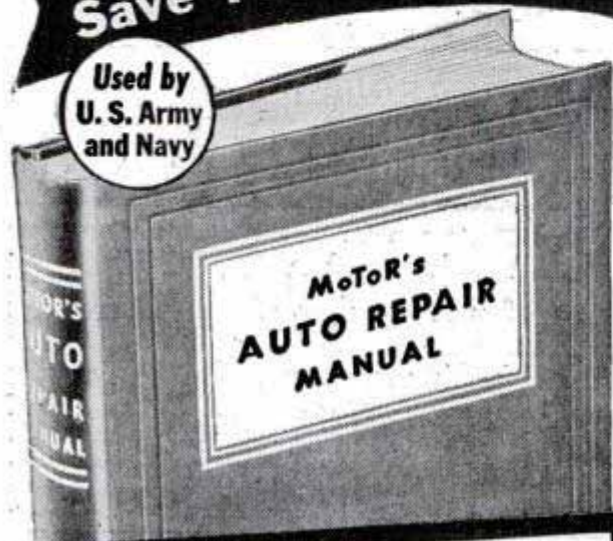
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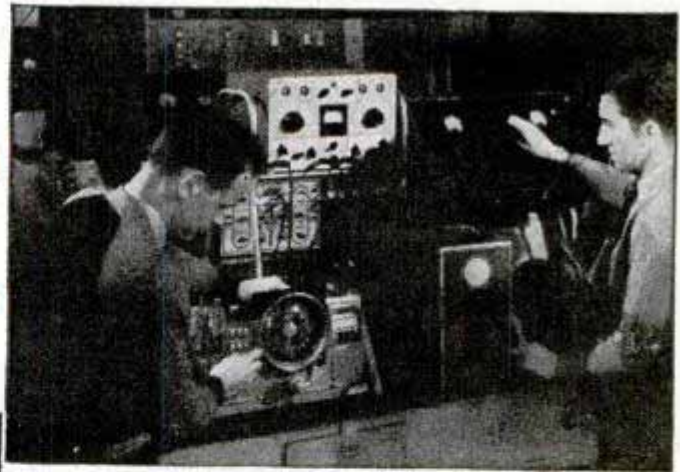
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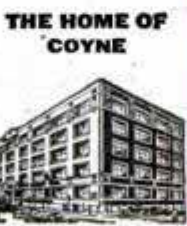
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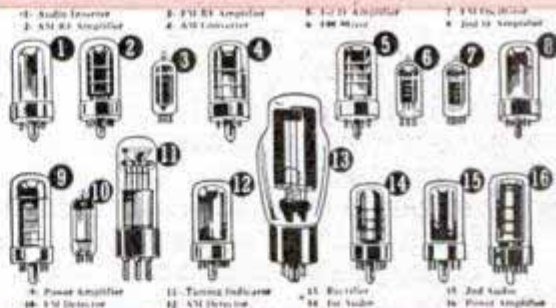


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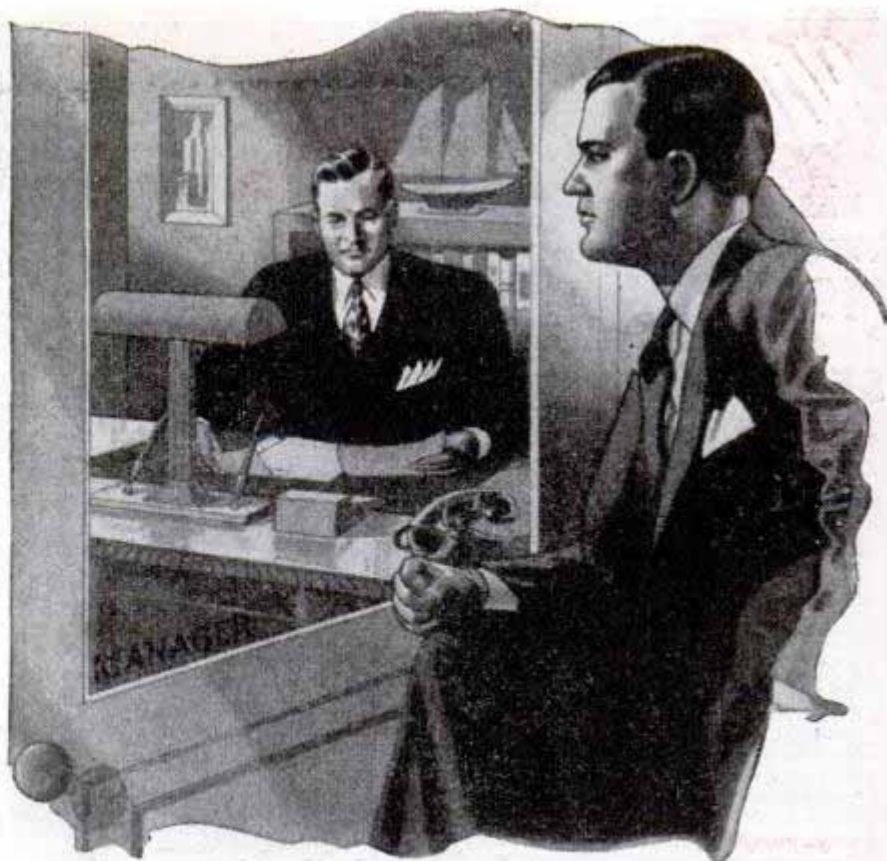
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**SUPER X liquid molding rubber.** Sample jar 25c, quart \$3.00, gallon \$10.00. Free instructions. W. Wooley, 115-A Donald, Peoria, Ill.

**WANTED: Persons** willing to co-publish magazine. 10c for samples, details. Lannich's, 7145 Greenwood Ave., Chicago, Ill.

**HOME Business** on small capital, \$1.00 makes \$6.00. No canvassing. Details 10c. Full instructions, illustrations and sample \$1.00. Sample well worth charge. Hand-I-Work Shop, Route 9, Box 612, Portland 16, Oregon.

**MONEY Making Manual** outlines 7 sure-fire ways to start profitable home business. Copy 25c postpaid. Powell Publishing, Sampler Bldg., Cleveland 3, Ohio.

**EVERYBODY Eats.** How to make money in the restaurant business. Illustrated success stories. \$1.00 postpaid. Luckock Press, 1047 Irolo Street, Los Angeles 6, Calif., Dept. 5-A.

**APEX Plastic products** presents three types of liquid latex for flexible mold makers. Simple illustrated mold making instructions 50c. Advanced \$1.00. 1915 Lunt, Chicago.

**MAKE Plaster novelties.** Special molding rubber. Free sample. Quart \$3.00, gallon \$10.50. Free instructions. Universal Sales, Box 1076-A, Peoria, Ill.

**OPERATE Simplified appliance** and building repair business. Locally or by mail. Free information. Cline-Porter, Box 6346PM, Pittsburgh 12, Penna.

**DO It with sea shells.** Big profits. Werts, 1429 - 56th Avenue, Oakland 3, Calif.

**START A full or spare time** profitable mail order business at home. This is your opportunity. Particulars free. Vails Mail Service, 3201-C Harrison, Brookfield, Ill.

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**EXCLUSIVE Territory** to men who are capable of organizing a sales force to cover a state or several counties. Must have contacts with wholesale houses, jobbers, etc. Wonder Plastic Linoleum Finish and Wonder Plastic Wood Finish. Write Wonder Plastic Products Company, 2609 S. Kedvale Avenue, Chicago 23, Illinois.

**START Home plaster novelty business.** Amazing course tells how. Literature free. W. Belfort, Engineering Building, Chicago 6.

**MAIL Order business—Your opportunity.** Start small—Grow big. Literature free. C-Belfort, Engineering Building, Chicago 6.

**LIQUID Marble—Make in any color.** Soundproof plastic flooring. Flexible molds. Cast novelties, plaques, statuary. Big money—your own business. Catalog free. Write—Bing Products, 88-A2N Broad Street, Boston 10, Mass.

**YOUR Town is ripe** for a profitable Collection Agency. \$5,000 first year easily possible. We train you, coach you, get you started and help develop your business. Send \$1.00 for Starter Course, or ask for facts. American Collection Associates, 226 State Street, Schenectady 5, New York.

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**500 GIGANTIC Money-Producing** ideas, plans, formulas. Build permanent business, limited capital. Manufacturing, mail order opportunities. Particulars free. National Enterprises-Z, 10 Waverly Place, New York 3.

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**WHOLESALE Distributor: Amazing patented** screw-holding screw drivers! Removes, holds, inserts screws hard-to-get places! Retail stores, mechanics, factories, buy quantities. Counter displays, advertising furnished. Fast sales, big profits, refundable trial offer! Millen Mfg., 457 Miller Bldg., Boston, Mass.

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**\$5,000 YEARLY Possible** in spare time selling by mail with expert assistance. Small investment. Details free. Diafas, 109 Mt. Hope, Dover 2, New Jersey.

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**CATALOG Of business opportunities** free. Carr, 1600 Second Ave. S., Minneapolis 4, Minn.

**MAKE Big money** in your own sandwich shop. My copyrighted book, "Making Money In A Sandwich Shop," tells you how to get started. Money back guarantee. Price \$1.00. Dexter Pratt, Box 1361SSS, Springfield, Missouri.

**UNPAINTED Wall plaques 2½c up.** Beautiful designs. Easily painted. Illustrated list free. Write today. Omman, 642-M2 Broadway, St. Paul 1, Minnesota.

**BIG Money in vending machine.** Smallest capital start brings immediate profits that build permanent profitable business. Starting instructions free. Becker Vendors, 105 Dewey, Brillion, Wisconsin.

**COMPLETE Mail selling setups** built-to-order, for financially responsible mail order aspirants by leading mail order association. Descriptive booklet free! National Mail Dealers' Association, 46-P King, Dorchester, Mass.

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**OPERATE Own wholesale candy business.** Sell stores. Free list. Information. Sally Dee Candies, 142-Sims, Newport, R.I.

**EARN Up to \$500 month** part or full time keeping books for small firms. Simplified system. Write Tax-Saver System, Dept. K, Ft. Worth, Tex.

**YOUR Own business metallizing baby shoes.** Complete course \$3.50. Technical Aid and Supply Co., P.O. Box 668, Los Angeles 53, Calif.

**FORMULA Buyers,** join our new formula club, get valuable formulas free. Write Alliance Chemical, 415 Laramie, Alliance, Nebraska.

**ALL Types of businesses for sale,** Southern California. Send \$1.00 for listing giving complete information. Broker, 731 W. 9th, Los Angeles 15.

**COST 8c, Retail \$5.** Mfg. mail order. Car beauty preserver—used once year. New—different. Royalty basis. Grossed \$3,000 first month, at home. Plasticize, 2254 N.W. 62nd St., Miami, Fla.

**CASTONE—Hardest coldcasting composition** on earth. Any mold; white and colors; 10 pounds \$2.00. Hundred \$6.00. New Era, 1321-N Belmont, Chicago.

**TRAVEL Everywhere.** Be your own boss. Earn \$100.00 per week. I guarantee you can or refund your money. Complete plans \$1.00. Box 112, LaGrange 1, Indiana.

**100 PER Cent profit** selling unbreakable personalized ladies' comb in your mail order business. Future Products, Box 43 Gravesend, Brooklyn 23, N. Y.

**COLLECT Names** and addresses at home. Sell them to mail order dealers. Large profits. Write MacAndrews, Box 351, Calais, Maine.

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**SOAP Is scarce.** Complete plans for the manufacture of fine hand soap. Where to buy wrappers, materials, coloring and where to market your product. Materials and equipment amazingly inexpensive. Complete plans \$1.00. Better Business, 918 State Street, Racine, Wisconsin.

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**START** Home business making statuary, plaques, novelties, garden furniture, artificial marble flooring, liquid marble. Make your own flexible molds. Amazing profits. Folder free. Creative Publishers, Box 236-L, Winnetka, Illinois.

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**FREE "Prize Contest Bulletin"** describes many contests. Money making opportunity. Cash Register-G, 210 Fifth Ave., New York 10.

**GET** Dollar orders by mail. Keep 90c of each dollar. Easy, pleasant home business. Few dollars starts you. Start now. Details free. Roy H. Davidson, Box N640 Nots, Inyokern 3, Calif.

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

**START** Your own business! Big money manufacturing novelties, plaques, statuary. Free catalog. Write Bing Products, 88-A2M Broad Street, Boston 10, Mass.

**FIVE** Million jobs available! In postwar reconstruction program. Write for free details! Robert Dyer, Box 1608, March Field, California.

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**SEWING** Machine repairmen make big money lifetime. Start neighborhood shop today. Our course repairs all makes. \$1.98 postpaid. Serviceman, Hamilton 9, Ohio.

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**EARN** Money evenings, copying and duplicating comic cartoons for advertisers. Adservice, Argyle (1), Wisconsin.

**EARN** Money at home! Thousands do! "Home Worker Magazine" tells how. Sample, 25c (coin). Six issues, \$1.00. Arthur Sizemore, Pub., Box 870-M, St. Petersburg, Fla.

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

**EARN** While you learn clock repairing. With our method your income can start immediately. Write Akron Clock Clinic, 964 Wye Drive, Akron 3, Ohio.

**SELL** By mail! Mail order business is shortest cut to profitable sales. Inspiring, constructive, instructive literature sent without obligation. Earl Cratty, 385 Lenzen Ave., San Jose 11, California.

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

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

**LEARN** Battery repairing, rebuilding. Engineer offers money making methods. Battery Bureau, 2225 North 44th St., Milwaukee, Wis.

**200 MONEY** Making deals, plans, rare formulas. Schemes. Folio free. Formico-Eng., Box 572, Dayton, Ohio.

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

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

**I MAKE** Big money in the mail-order business. You can do the same at home with my copyrighted system. Write me. I'll tell you how. F. Little, Box 8, Glen-shaw P.O., Pittsburgh, Penna.

### FORMULAS, PLANS, ETC.

**MANUFACTURE** Cleaners, flavors, cosmetics. Literature catalog free. Kemico, Park Ridge 20, Illinois.

**STRIP** Nickel from brass lamps, copper kettles, etc. No tanks or electricity. Almost instant. Simple. Cheap. Widely used written formula, directions \$2.00. Boone Products, 236 W. 63rd, Chicago 21, Ill.

**LARGE** Formula catalog. Valuable information 10c. Refunded. Obermeyer's, 358 Uneda, Fond du Lac, Wis.

**PURCHASE** Trade-secrets, formulas, processes, 30c thousand. Details for stamp. Home Education Service, 124-N. Austin, Wichita Falls, Texas.

**ROOFING** 100% Fireproof, low cost, lasts like slate. Insulates better. Apply like plaster. Formula \$1. Ray Roofing, Box 98, New Hyde Park, New York.

**6 HOME** Use and moneymaking formulas \$1.00. Kozyra, 2946 N. Meade, Chicago, Ill.

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

**NEED** Chemists? Formulas? Analyses? Products duplicated, improved? Consulting Scientific Company, Swarthmore, Pennsylvania.

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

**FORMULAS** — Latest, best. Analysis. Giant formula catalog and chemical instruction sheet 10c. Refunded first order. Belfort, Engineering Building, Chicago 6.

### PLASTICS

**PLASTICS,** Accessories from "one-stop" store. Plexiglas, Lucite, Cellulose Acetate for hobbies, money-making opportunities, sheets, rods, tubes, clear or colored. Full range of sizes. Cements, dyes, polishing compounds, buffs. Send for free price list, also details. Burgess Vibro-Tool, Handee Moto-Tool, Plasticator Injection Molding Machine, molds novelties, toys, gifts, Plastic Parts & Sales, 1157 S. Kingshighway, Dept. H-2, St. Louis 10, Mo.

**KITS**—\$1.50 Each, Plexiglas tie-rack 18" or 8"x10" picture frame. Heah Manufacturing Co., 5115 N. Neenah Ave., Chicago 31, Ill.

**PLEXIGLAS**—Everything for the plastic craftsman. Free listings. Novalte Plastic, P.O. Box 106, Brooklyn 19, N. Y.

**LUCITE,** Ft.— $\frac{1}{8}$ " \$1.45,  $\frac{1}{4}$ " \$2.05. Catalog, special offer. Midwest Plastic, 1717 No. 66, Omaha 4, Nebr.

**PLEXIGLAS:** First grade.  $\frac{1}{8}$ " \$1.50,  $\frac{3}{16}$ " \$1.85,  $\frac{1}{4}$ " \$2.00 pr. sq. ft. Clear and colors. Clear scrap, 35c lb. Shipped postage express collect or c.o.d. Rainbow Plastic Company, Arlington, Texas.

**PLASTICS,** Supplies, internal carving drills, kits \$3.00, \$5.00, \$8.00. List. Plasmet Sales and Engineering, 4648 Shirley Place, St. Louis 15, Mo.

**PLASTICS,** Material and supplies. Information folio, list free. Art Plastics of Calif., 8127 East 14th St., Oakland 3, Calif.

**PLASTICS,** Shells, jewelry findings. Free listings. Craft Plastics, Box 129M, Somerville, N. J.

**PLASTICS**—Best materials, low prices. Send for free price list. Plastex Products, 533A W. Balto St., Baltimore 1, Md.

**LEARN** At home "Working With Plastics." Full information on sheets, blocks, rods, tubes, sizes, colors for fabrication. Designing, tooling, bending, cementing, polishing. Also for homeworkshop. Only \$1.25 postpaid. Money back guarantee. Lucite plastic hobby kits available. Price \$3.00 postpaid. Free literature. Modern Technical Book Co., Dept. MMC, 55 West 42nd St., New York 18.

**PLASTIC** Sets! Build streamlined HO gauge trains, reciprocating engine that runs, cigarette boxes, jewelry. Easy new method. Postage prepaid. Complete with tools. Small \$1.69, large \$4.95. Wm. Trumpler Co., Palmer Mill Road, Media, Penna.

**PLEXIGLAS** Lucite slashed, free listings. Douglas Home Craftsman, Dept. M, Stamford, Conn.



**LUCITE**—Get acquainted with the "gem of plastics." Write for illustrated booklet, complete fabricating instructions, wholesale, retail prices, sheets, rods, tubes, supplies. Booklet, sample, 35c; booklet, 10c. Gem-O-Lite. Post Office Box 686B, North Hollywood, Calif.

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

**SENSATIONAL Plastic injection molding machine.** Low price Plexiglas, dyes, cements, shellcraft kits; molding sets, polystyrene rods. Free literature. G. Baker Company, River Edge, New Jersey.

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**THE House of Winn,** home of supplies for amateur chemists. See Winn's New Idea chemical kits and apparatus outfits for home experimenting. Send 10c for retail catalog. Established 1931. John H. Winn, Dept. 502, 124 West 23rd St., New York 11, N. Y.

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

**BIG Savings on laboratory supplies.** Catalogue 10c. National Scientific Company, 2204 W. North Ave., Chicago 47, Ill.

**HANDBOOK For chemical experimenters,** illustrated, hundreds of experiments, 50c. Experiment booklet 15c. Supply catalog 5c. Reading Scientific Company, Reading, Penna.

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

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

**FREE Catalog. Chemistry, mineralogy, biology, optics.** Tracey Laboratories, Evanston, Illinois.

**LABORATORY Supplies. Chemicals and apparatus** all descriptions. 36 page book 10c. Standard Science Supply Co., 1232 N. Paulina St., Chicago 22, Illinois.

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**RELIABLE Man with car** wanted to call on farmers. Wonderful opportunity now. \$15-\$20 in a day. No experience or capital required. Permanent. Write today. McNess Co., Dept. 25, Freeport, Illinois.

**WANTED: Mechanical and chemical engineering** development help by reliable manufacturer—full or part time—give record or facilities. Arco-Ozark Co., Hot Springs, Arkansas.

**PARAMOUNT Atmospheric conversion gas burners.** Quickly installs into any heating plant. Blowers. Gas floor furnaces. Sell and install. Peerless Sales, 4322 Sheridan, Lincoln 6, Nebr.

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**"27" AGENTS.—Salesmen Wanted!** Liberal territory allotted. Demonstrate amazing "27 Second" eye glass cleaner. Whirlwind seller. Year's supply in compact only 59c. 2 for \$1.00. \$40.00 per gross—110% profit. 27 Second Cleaner Co., Dept. 192, 6337 N. Talman, Chicago 45.

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

**CALL On friends with greeting card assortments, Easter, birthday, other occasions.** Personal stationery, gift wrappings. Big profits. Experience unnecessary. Samples on approval. Wallace Brown, 225 Fifth Avenue, Dept. E-4, New York 10.

**AT Last! Something new and sensational in everyday cards.** Gorgeous satin and velour designs never before offered. Get orders fast. Big profits. 14 assortments for year 'round occasions retail 60c to \$1. Get samples on approval. Puro Co., 2801 Locust, Dept. 740-B, St. Louis 3, Mo.

**EARN Big money.** Sunshine everyday cards. Take orders galore from friends for America's most beautiful everyday assortment. 14 folders. Costs 50c. Sells \$1. Also 1947 Sunshine notes, birthday, convalescent, everyday gift wraps. Samples on approval. Write today. Sunshine Art Studios, 115 Fulton St., Dept. EE2, New York City.

**EARN Up to \$6.00 hourly,** selling history War 2. Gold mine for veterans. Free supplies. Start earnings immediately. Gillespie, 4503 Meadow Road, Norfolk 2, Virginia.

**WE Pay you \$25 for selling fifty \$1.00 assortments birthday, all occasion cards.** Tremendous demand. Sell for \$1.00—your profit 50c. It costs nothing to try. Write for samples. Cheerful Card Co., 28 White Plains, N. Y.

**NEW Sponge wall cleaner.** Erases dirt like magic. Wallpaper, painted walls, ceilings. Saves redecorating. Lightning seller. Samples sent on trial. Kristee 132, Akron, Ohio.

**\$1 STARTS You in business.** Sell deluxe ties, 100% wool interlining. Costs you only \$7 per dozen, you make \$5.00 dozen. Send \$1.00 for special introductory offer two deluxe ties. Catalog complete line free. Phillip's Neckwear, 20 West 22nd St., Dept. K-8, New York 10.

**SELL Greeting cards—Everyday, birthday, humorous, Easter assortments.** Wrappings, stationery, correspondence notes. Over 100 money-makers. Special offers. Fast sales, big profits, extra bonus. Experience unnecessary. Request \$1.00 everyday assortment on approval. Hedenkamp, 343 Broadway, Dept. F-21, New York 13.

**AGENTS. Substantial profits.** Repeat order products. Not mere "job" but opportunity establish steady income. Additive lubricant. Limitless field. Factories, autoists, service stations, fleet owners buy in huge quantities. Write Kidder Oil Company, LaCrosse 1, Wis.

**CANVASSERS Take orders—new electric product—everyone needs.** \$3.95. We deliver. Sample \$2. Sibert Co., East Orange, N. J.

**MEXICAN Feather pictures.** Unusual novelty. \$1.00 (stamps) bring \$2.00 worth samples, details. Refunded if unsatisfied. Aztec Art-P, Apartado 762, Mexico City.

**SELL Avronmelle personalized cosmetics.** Every woman a prospect. A. C. Tembro, 189D West Madison, Chicago.

**SOAP Powder for mechanic, factory, printing trades.** Ample supplies. Big opportunity. Profits selling users, retail stores. Schuitz Laboratories, Boone, Iowa.

**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.

**NEW Cheap oil burner** sweeping the country! South Dakota manufacturer discovers how to cook, bake and heat the easy economical modern way by inventing a new low cost oil burner for coal or wood ranges, cook stoves, circulating heaters, heating stoves and laundry stoves. Larger size for furnaces. With its sensational Fuelizer Starter vaporizing system it turns cheap 130 flash furnace oil, distillate, diesel, range, kerosene and like oils into oil gas heat without clogging up the vaporizing system. No more shoveling coal or ashes—better heating, cooking and baking. Every burner has a lifetime guarantee against defects. New sales plan is one of today's most exceptional money makers and you can get your new Quik Heat for introducing in your territory. The manufacturers are so much sold on their new oil burner that they will offer you \$1.00 bonus for testing and will let you try it in your own stove, range or furnace for one month. Be first to cash in on the tremendous demand for this new oil burner by sending in your name today to North-west Mfg. Co., 416 C, Mitchell, S. Dakota.

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

**100% PROFIT On famous, popular Pines birthday, Christmas and all-occasion greeting cards.** Wonderful 12 to 24 card, boxed assortments sell on sight for \$1.00. Write today for information and extra bonus distributors' plan. R. Pines, Box 32, Flushing, N. Y.

**AT Home—Your own manufacturing business; making popular \$1.00 novelties.** Cost you 3c to 15c. Everything supplied. Write So-Lo Works, Dept. P-600, Loveland, Ohio.

**WONDERFUL Sideline.** America's fastest selling everyday greeting cards. Write, Zweifel's Shut-in Agency, Orangeville, Ill.

**EVERYDAY Cards.** Earn \$5.00 with every ten \$1.00 assortments you sell. Also wrappings and note paper. Unusual quality. Send for samples today. Howard P. Ellis, Dept. PM-2, Pitman, New Jersey.

**AGENTS: All ages, earn \$30 to \$50 weekly** selling for yourself, fibre brooms, mops, and floor dusters, start now. Write Burtz Fibre Broom Co., Columbia, Penna., Dept. A.

**A New outlook for 1947 with Silver Plating Liquid (NuSilver and Re-Plate-O Trademark Patents) and Lectrik Silver Kleener Atomic Metal Plates for de-tarnishing discolored silverware quick.** These are Demonstration products. No demonstrations, no sales. Lots of demonstrations, lots of sales. You are not supposed to be selling, just showing and demonstrating and explaining in order to get their honest opinion of the products. They will insist upon buying from you while you are demonstrating. Sells wholesale and retail. About 95% of sales are at retail prices, about 5% at wholesale. Can work business districts on retail prices in all places where they would use the products, or can work only the places where they would re-sell at wholesale prices. The better way is to work both plans and do a thorough job. Also a good-house-to-house seller for those who sell that way. We have several distributors who sell it exclusively that way and have made money for several years. One of the products is a good repeater seller. The profits are good, extra good, 3 for 1, 4 for 1, and 5 for 1. A car is not necessary, but is a big help if you cover territory. We have several distributors working without cars, one of them for over 7 years. We want exclusive, protected demonstrating sales distributors in all areas where no one is working now. You buy outright from us at low manufacturer prices. That is why your profits are big. You demonstrate and sell and deliver for cash as you work throughout your territory. You begin taking in fine cash profits for yourself within one hour after starting. You sell wholesale or retail or both. Both worked together will make you the most money. You may sell one product or both together. Both worked together we have found is the most profitable. You visit every City, Town and Village in your territory. You demonstrate and sell, appoint agents and dealers, and stock them at a good profit for yourself. Demonstrations in stores are particularly good in getting introduced into new localities. We refer all inquiries and orders from your territory back to you to handle while you are working it. We do not write to or answer anything from your territory while you are working it. Thus you are completely protected 100%. This is a good money-making appointment if you will work it energetically. Complete details will be sent by sealed letter mail upon request if your area is not being worked now. NuProcess Products Laboratories, Dept. 275, Aurora, Illinois.

**EXTRA Cash** quickly selling friends tremendous value 16 card \$1.00 all-occasion assortment; your profit as much as 50c per box. Also birthday, get-well, baby, humorous, gift wrapping, correspondence notes boxes 33-1/3c up. New 1947 line. Experience unnecessary. Extra bonus. Special money-saving offer. Request feature everyday assortment on approval and free personal stationery sample portfolio. Elmira Greeting Card Co., M-15, Elmira, N. Y.

**SELL New-Used clothing** from home, auto, store. Men's suits \$1.17. Leather jackets 85c. Overcoats 62c. Dresses 17c. Ladies' coats 38c. Other bargains. Catalog free. S & N, 565A Roosevelt, Chicago.

**AGENTS: Big profit selling unbreakable personalized ladies comb.** Special proposition for crew managers, distributors. Future Products, 1654 Dahill, Brooklyn 23, N. Y.

**WONDER Silver plating liquid.** (Plates metals without tanks or electricity.) Applied with cloth or by dipping. New, improved, concentrated, double-strength formula; plates larger surface with heavier coating. Good carded item for stores. Wonderful demonstration. Big profits. Free details. Wonder Products, 1265D Broadway, New York 1, New York.

**BIG Profits** selling used clothing, etc. Operate from home, auto, or store. Sensational low prices. Catalog free. Kadetsky & Son, 702 Barber Street, Dept. 52, Chicago 7, Illinois.

**OPERATE Profitable business** selling packaging products under your own name. Lyle A Products, 5 E. Spaulding, Wiloughby, Ohio.

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

**COLLEGE Students! 100% profits** selling costume jewelry. Wm. Morris, Maywood, New Jersey.

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



NO Money or experience required. Spare or full time writing orders for guaranteed men's hosiery. We deliver and collect. Advance profit and 33% cash bonus. Huge demand everywhere. Steady repeat business. Write for free sales outfit containing everything needed to make money. Kentcraft, 44 Court Street, Department AM, Brooklyn 2, N. Y.

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

EXCELLENT Sideline for printing and advertising salesmen. Decalcomania name plates in small quantities. Great demand. Also make money applying initials on automobiles. Free samples. "Ralco" XL-Roxbury, Boston 19, Mass.

SELLING To housewives? Double your sales with inexpensive premiums. Postal brings interesting details. A. Kinford, Wayne, Penna.

HOUSE Numbers that glow in the dark. Luminous pictures, etc. Large mfr. wants factory representative. Wonderful new product. Fast seller. Free samples. Madison Mills, 303 4th Ave., New York City.

AGENTS—Big line including food products. Fast selling premium and bargain deals. Low prices. Send card for big profit offer with gift. Ho-Ro-Co, 2796 Dodier, St. Louis 7, Mo.

AMAZING Seller: "Soilless Garden Chemical." Grow plants, vegetables, fruits, flowers all year round without soil. In or outdoors. Tremendous demand. Excellent profits. Literature free. Nega & Co., 1824 W. Dickens, Chicago 14.

SCHOOL Seniors—Sell classmates America's most beautiful, distinctive graduation name cards. 40% commission. Largest selection. Lowest prices. Free cards and sample kit. Printcraft, 1425 E. Elm Street, Scranton 5, Penna.

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

200 MONEY Making deals. Plans, rare formulas. Schemes. Folio free. Formico Service, Box 572, Dayton, Ohio.

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

SCHOOL Seniors! Your postal will bring our wonder, Kwick-Sell Cardalog of popular graduation name cards. Biggest profits! Only firm giving free souvenir chest and card case. Don't miss out! Hurry that postal! Craftcards, Box 235(L), Pittsburgh 30, Pennsylvania.

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

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WANTED Agents for house to house selling of plastic products including table cloth covers. Write for details. House of Schiller, Dept. P, 180 N. Wacker Drive, Chicago 6, Ill.

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AMAZING New zipper shoe sells on sight. Big profits for salesmen. Leads line 200 splendid styles. Territories open. Get free sample outfit. Write, Consolidated Shoe, Dept. S-754, Chippewa Falls, Wis.

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OLD Toy, new idea. Good opportunity in your territory for an additional line. Excellent item mail order or premium house. 25c brings sample prepaid. Allied Metal Products Co., 85 Prescott St., Worcester, Mass.

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\$6000 YEARLY Possible, calling on gift shops, dept. stores, etc. Amazingly new, different 15 key Tru-Tone baby grand piano. Territory going fast. Write, Presto Noveltoys Co., 1012 N. Marshfield, Chicago 22, Ill.

DEMONSTRATE Sell to taverns, amazing, original glass rinse. "Clear Glass." No toweling, no water spots. Guaranteed. Riesen Chemical, 419 Vliet, Milwaukee 12.

BIG Commissions—selling to stores celluloid pricing tickets, metal shelf moulding—to restaurants, menu covers, signs. Pricing Press, 124 White St., Dept. P, New York 13, N. Y.

POCKET Pal: The all-purpose cutting tool. Wagon jobbers-salesmen. Sell to retailers and jobbers. 50c seller. Steady repeat item. Exceptional profit. Sample 25c. Nelson Mfg. Co., 222 W. Kellogg, St. Paul 2, Minn.

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QUICK Profits with individualized belts, buckles, cap badges, tie holders, uniforms. Choice of thousand emblems. Sure repeat orders. Easy-selling outfit offer. Write Hook-Fast Company, Dept. 12, Roanoke, Virginia.

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GOOD Jobs and a sound, substantial future await you in hotel and institutional field. Men and women—all ages—needed for well-paid positions that offer color, excitement, ever-new and fascinating duties. Record-breaking travel means even greater opportunities for trained men and women in hotels, clubs and institutions. Lewis School receiving calls for managers, assistant managers, stewards, hostesses, purchasing agents and 55 other types of important positions! From coast to coast there are important positions that offer splendid opportunities for advancement in a business where you are not dropped because you are over 40. Previous experience proved unnecessary! No need to leave your job to qualify. A good grade school education, plus Lewis Training qualifies you at home, in spare time. Our National Placement Bureau helps to place you—and our amazing Certified Job Plan—actually certifies you will "make good" when placed. Write today for free book! Veterans: This course approved for veterans' training. Lewis Hotel Training School, Room LB 368, Washington 7, D. C. (First and only school of its kind—now in its 31st year.)

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INVESTIGATOR Training. Phillips Secret Service, 1917B North Kenneth, Chicago 39, Ill.

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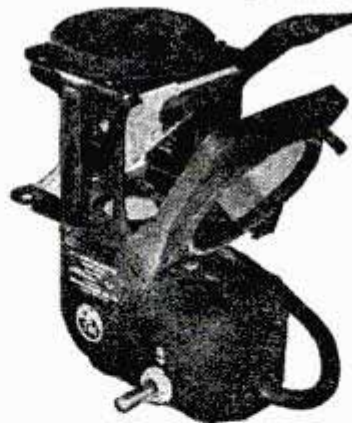
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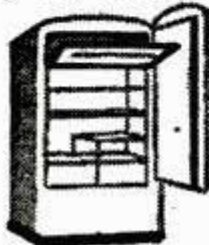
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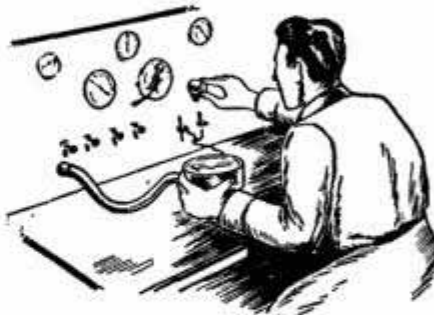
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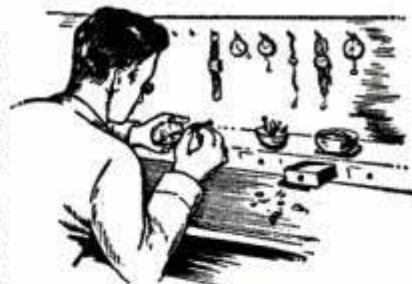
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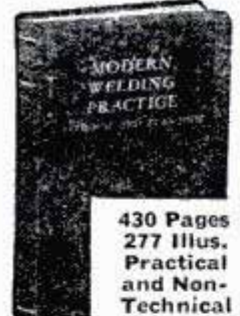
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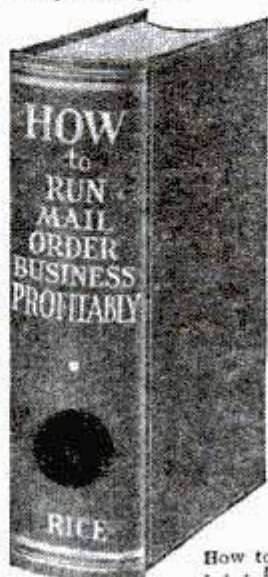
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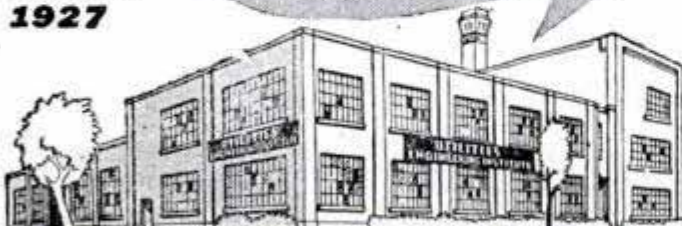
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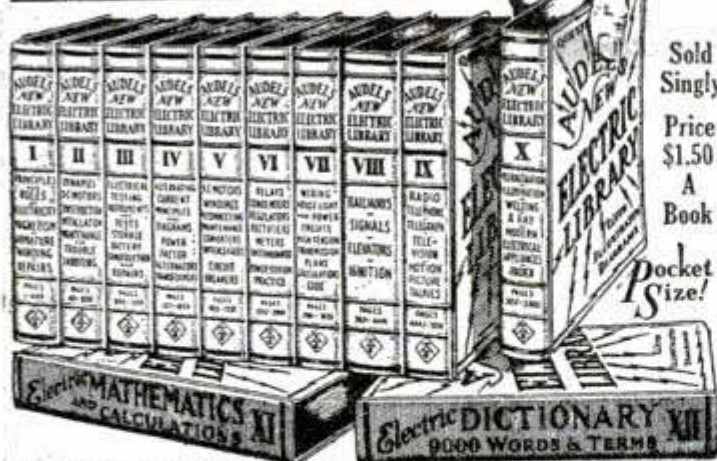
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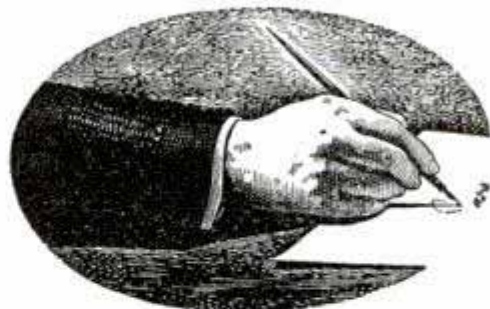
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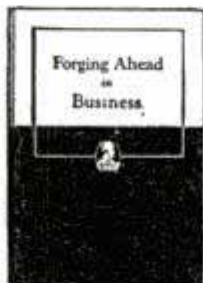
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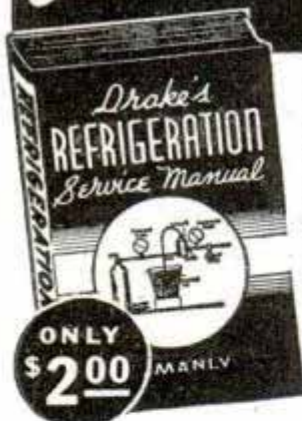
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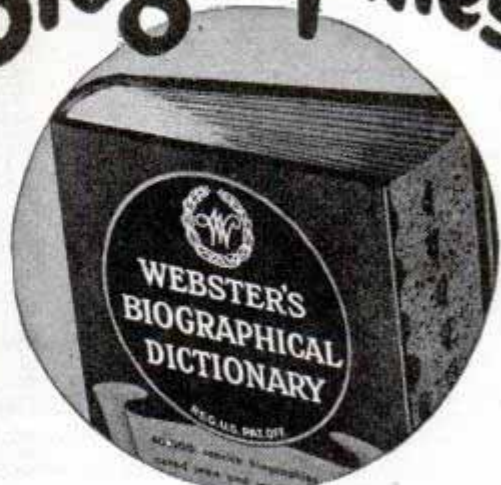
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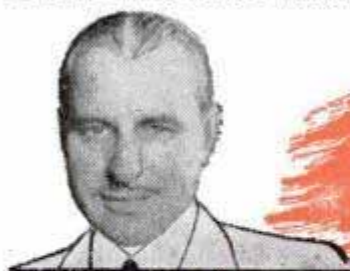
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**CITY MAIL CARRIERS**    **MEAT INSPECTORS**  
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Railway Postal Clerks, like all Government employees, are given a yearly vacation of 15 working days (about 18 days). On runs they usually work three days and have three days off duty or in the same proportion. During this off duty and vacation, their pay continues just as though they were working. When they grow old, they are retired with a pension. As Railway Postal Clerks are continually traveling, they have an excellent chance to see the country.



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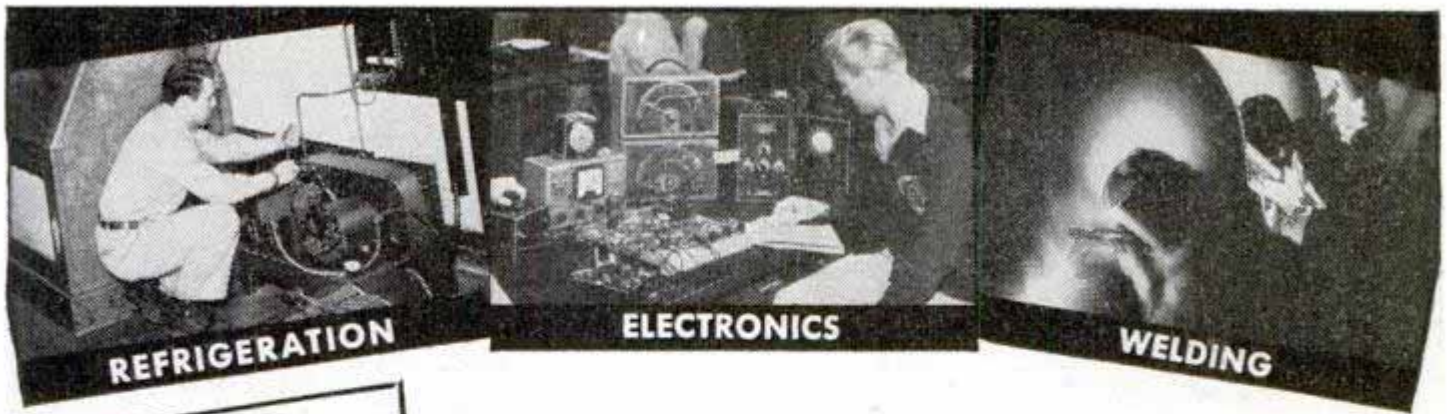
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## **JUDGE BROWN'S CAR** ~~was~~ **must be ready at nine!**

Judge Brown is a fine man and I sure wanted to help him out.

But his old car, with 87,000 miles on it, had certainly seen better days. For one thing, she was really pumping oil.

He said, "Now, Frank, I've just got to have it Wednesday morning for a case in Kirby."

Boy, I really slaved over that car. Pulled the motor down, ground the valves, put in a set of Perfect Circle Piston Rings, new gaskets, and other things she'd needed for a long time.

Then I "sewed her up," so to

speak. I certainly felt as though I'd just performed a major operation —and I had!

Well, the way that car ran was a pleasant surprise to the judge. He should have brought it in long before he did and saved himself a lot of needless trouble and expense.

Anyway, that's my job. They call me a Doctor of Motors . . . and I guess I am.

### **NOTICE TO CAR OWNERS**

Perfect Circles are available at every automotive repair shop. Your favorite mechanic—your Doctor of Motors—recommends them.

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restores power . . . saves gas  
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RINGS



WRITTEN SO YOU CAN UNDERSTAND IT  
VOL. 87 NO. 2

**PART I**

**H**AVING lifted a tentative, probing finger above his head, man is preparing to spread his arms and explore farther into the space that surrounds his earth.

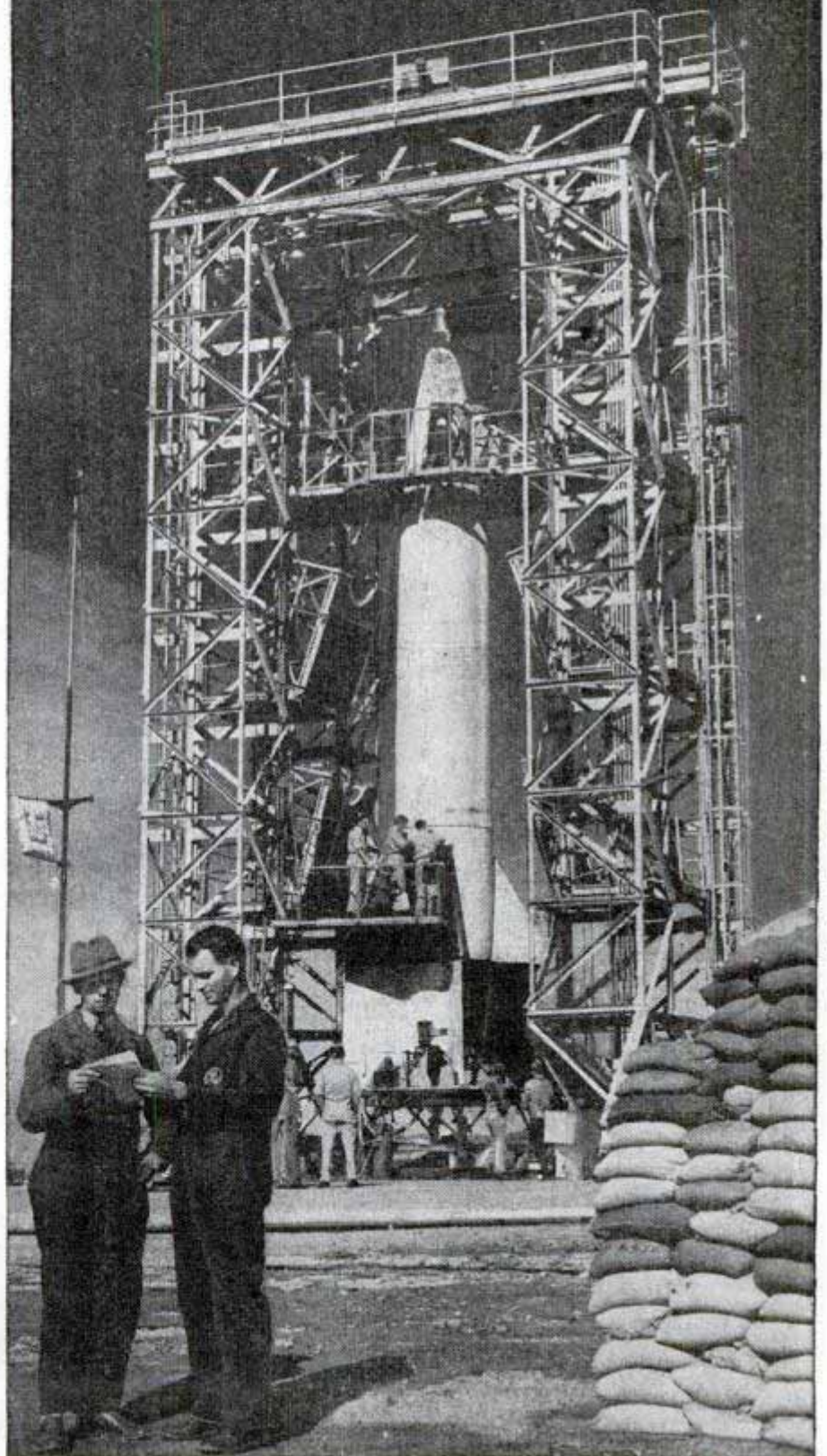
Today he is sending instruments 100 miles up into the electrified void that exists above him. He is creating his own meteors that streak through the upper air, and in the laboratory he has duplicated small wisps of the mysterious auroras that glow high above the poles.

He has snapped pictures of his own planet from 65 miles high and is wondering how soon he'll be able to obtain a moon's-eye view of half the earth on one negative. He plans to launch small satellite bodies out beyond his own atmosphere to revolve around the earth forever, and to fire rockets at the moon. He is even studying the navigation problems that must be solved if and when space ships are directed at other planets of the solar system.

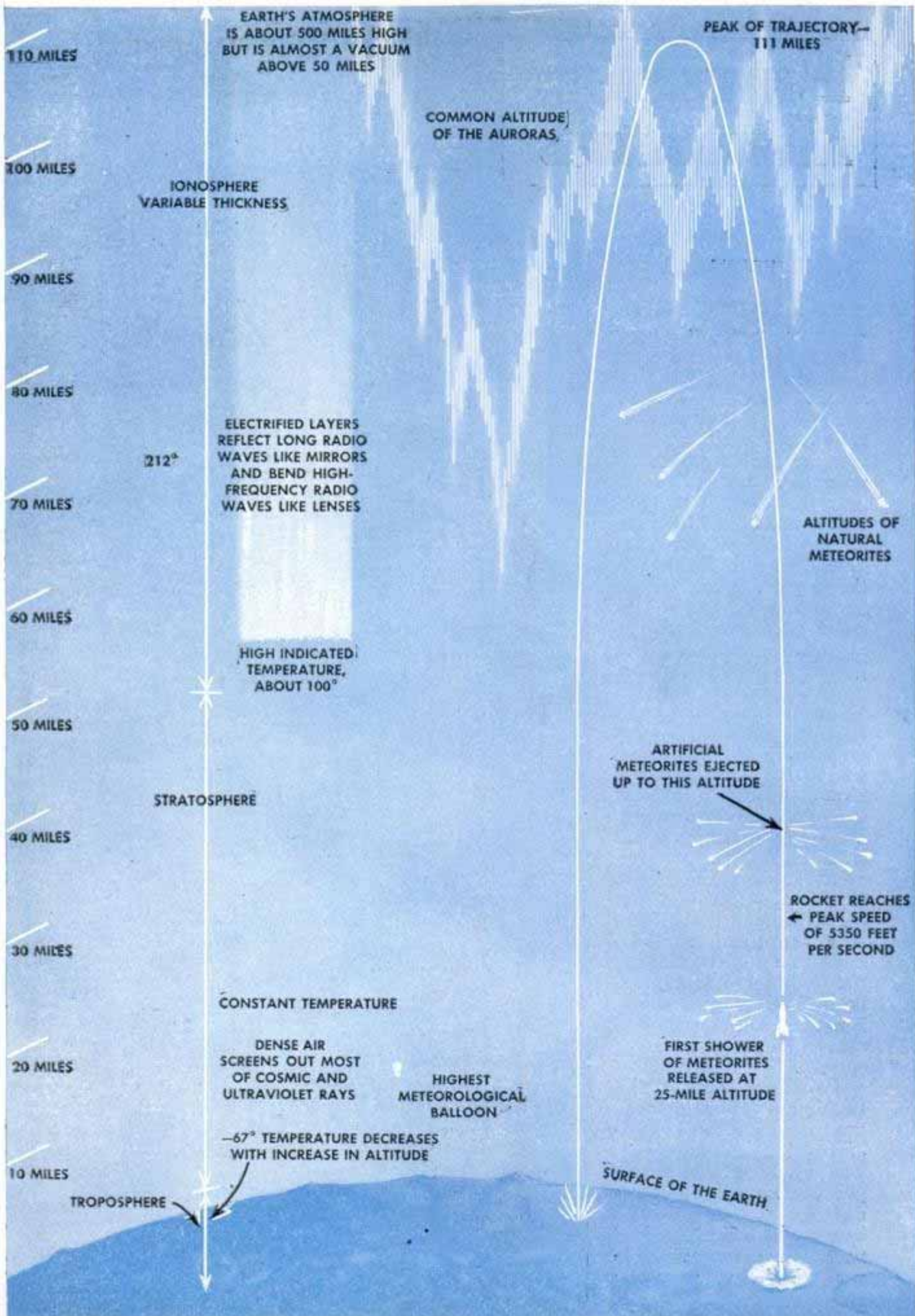
These are some of the highlights of numerous kindred research programs that are under way. The whole subject of upper air investigation received a tremendous boost when German V-2 rockets became available for peaceful scientific

Technicians prepare a towering V-2 for flight to help solve mysteries of the upper atmosphere

# LABORATORY IN SPACE







**TRAJECTORY OF THE RECORD-BREAKING ROCKET FIRED DECEMBER 17, 1946**



purposes. These for the first time provide man with vehicles that can rise high enough through the atmosphere to supply the answers to many perplexing questions.

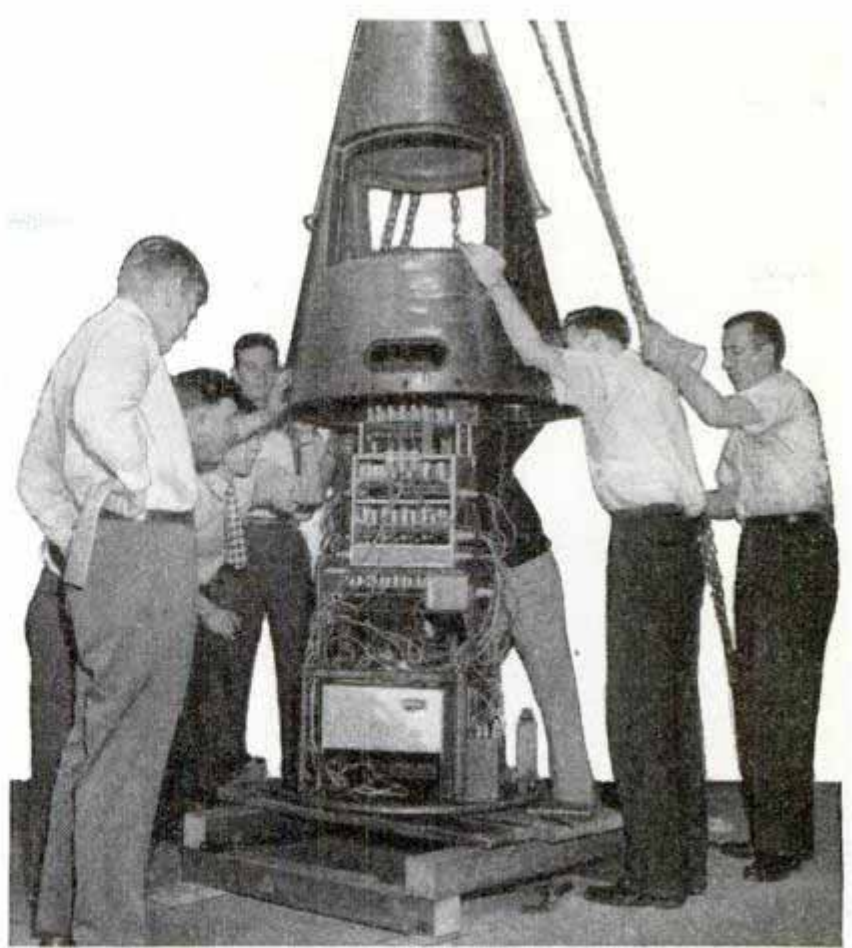
Among other things, rockets that travel to the outer reaches of the atmosphere can carry instruments that will report on the nature of primary cosmic radiation and similar rays that sweep interstellar space. Ultraviolet and other wave lengths of light that are blocked by the atmosphere can be used in studying spectra of the sun and stars.

This year, at White Sands Proving Ground, N. Mex., the Army is firing about half of a total of 50 V-2s that are to be expended for scientific studies. The warheads are "farmed out" to research groups including the Naval Research Laboratory, Johns Hopkins University, Princeton University, the University of Michigan and California Institute of Technology. Specially and sturdily built, the warheads are crammed with instruments and radio reporting equipment.

In one spectacular series of experiments with the V-2s, swarms of artificial meteors are released at altitudes of 25 to 40 miles. First proposed by Dr. Fritz Zwicky of Cal Tech and Aerojet Engineering, the experiments may affect much of what is believed about the physical characteristics and chemical composition of the upper air.

The earth-launched meteorites are smaller than you might suppose. Of various predetermined materials such as steel, graphite or glass, most of them are about the size of a dime. Embedded in so-called "hollow charges" of a high explosive material that burns furiously when ignited, the slugs are spewed out horizontally from the body of the rocket. Their initial velocities are in excess of 2000 miles per hour. Twin showers are ejected simultaneously from opposite sides of the rocket to avoid any chance of disturbing the vehicle's flight.

Astronomical telescopic cameras with interrupting shutters are stationed within a 200-mile radius of White

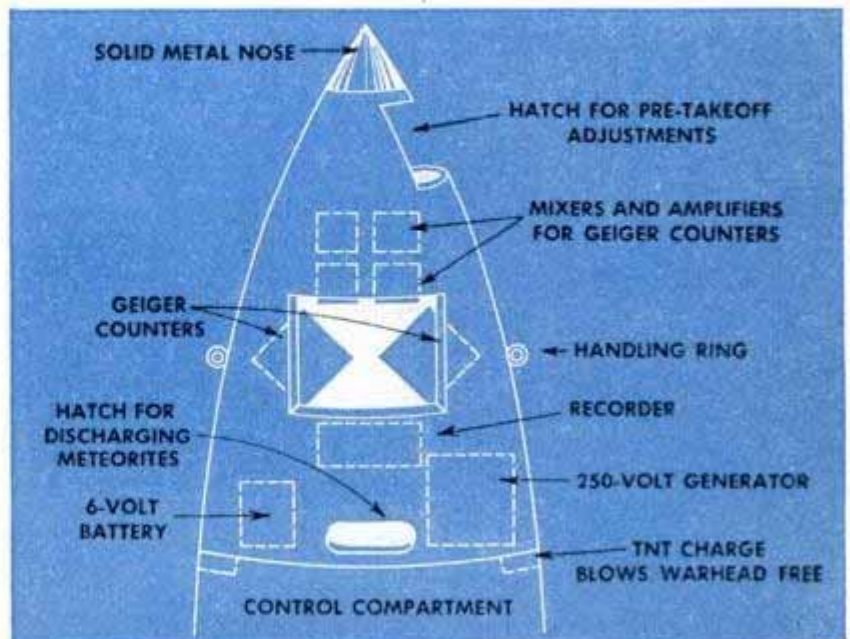


Warhead with hatch for ejection of meteorites is lowered over assembled scientific instruments including Geiger counters and recorders

Sands to photograph the meteor trails. Other pictures are taken by telescopes at MacDonald Observatory in Texas, at observatories in Flagstaff and Tucson, Arizona, and at the Palomar Observatory in California. Spectrographic observations of the meteor paths are to be made. Radar records of any ionization trails will be attempted.

The first experiment in tracing the artificial meteorites was made December 17,

Diagram shows interior arrangement of the instruments. Note the TNT charges that blow the warhead free of the rocket during the descent







Cutaway V-2 motor shows double skin in which the fuel is preheated before entering the blast chamber

1946. Observers saw either the showers of slugs or flashes from the rifle grenades in which they were encased. Scientists hope that future experiments will prove even more successful, as the meteorites are calculated to produce a luminosity comparable to that of Venus when viewed directly from below. The December 17 rocket also was successful in setting a new altitude and speed record, soaring 111 miles into the air and reaching a speed of 5350 feet per second.

Some of the artificial meteorites that are created during the experiments may travel in just the right direction and with suffi-

Artificial meteors in rifle grenade cases are inserted in the warhead



cient velocity to take up orbits around the earth instead of falling into the lower atmosphere where they are consumed by friction. Under the right circumstances some of these might circle the earth in from 60 to 80 minutes, Dr. Zwicky believes.

A very few of the fastest particles may have enough speed to escape entirely from the earth's gravitational field, never to return. These would be the first missiles launched from the earth to reach interplanetary space. Systematic attempts to do just that are planned for later dates.

"In searching for the key to space travel," Dr. Zwicky says, "we first throw a little something into the skies, then a little more, then a shipload of instruments—and then ourselves."

The artificial meteorite program as viewed by Dr. Zwicky may require from 10 to 15 years to complete. Larger and still larger bodies will be launched from rockets as the program matures. When the supply of V-2 rockets is exhausted the meteorites may be launched from new high-performance rockets of the step type. A mother rocket, fired to a high altitude, at the peak of its flight releases a smaller rocket that ascends even higher.

In another recent experiment a camera installed in the rocket's fuselage instead of the warhead took a continuous motion picture of the earth's surface at altitudes from 100 feet to 65 miles. The film was made as part of an experiment to learn the roll and pitch of the missile—information required for interpretation of cosmic ray and spectrographic data. But prints of the film stole the show from the data itself.

Immediately after the rocket was launched the 50-foot film started recording the flight. The V-2 reached the 65-mile height in three minutes and the camera

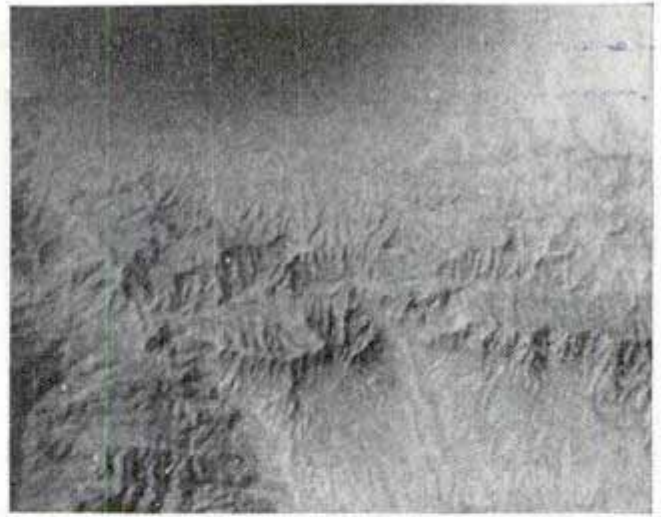
continued to operate during the descent until the missile was 45 miles above the earth. After passing the peak of its trajectory, the rocket tumbled several times, giving the camera a telescopic glimpse of the horizon. At one point the horizon was theoretically 720 miles away and the camera saw 40,000 square miles of area. If there had been an observer in the rocket who could look in all directions he would have seen San Diego, Salt Lake City, Kansas City and San Antonio, or about 1,600,000 square miles of the earth's surface.

When the warhead containing scientific instruments was severed by an explosive





Photo taken soon after the rocket started its ascent looks much like an aerial photo taken from a plane



From altitude of 60 miles the earth's mountain ranges and valleys look like wrinkles to the rocket's camera



At 65-mile altitude the horizon is 720 miles away. Cloud layers seem to hug the earth. Right, drawing shows location of the rocket's fuel tank and motor

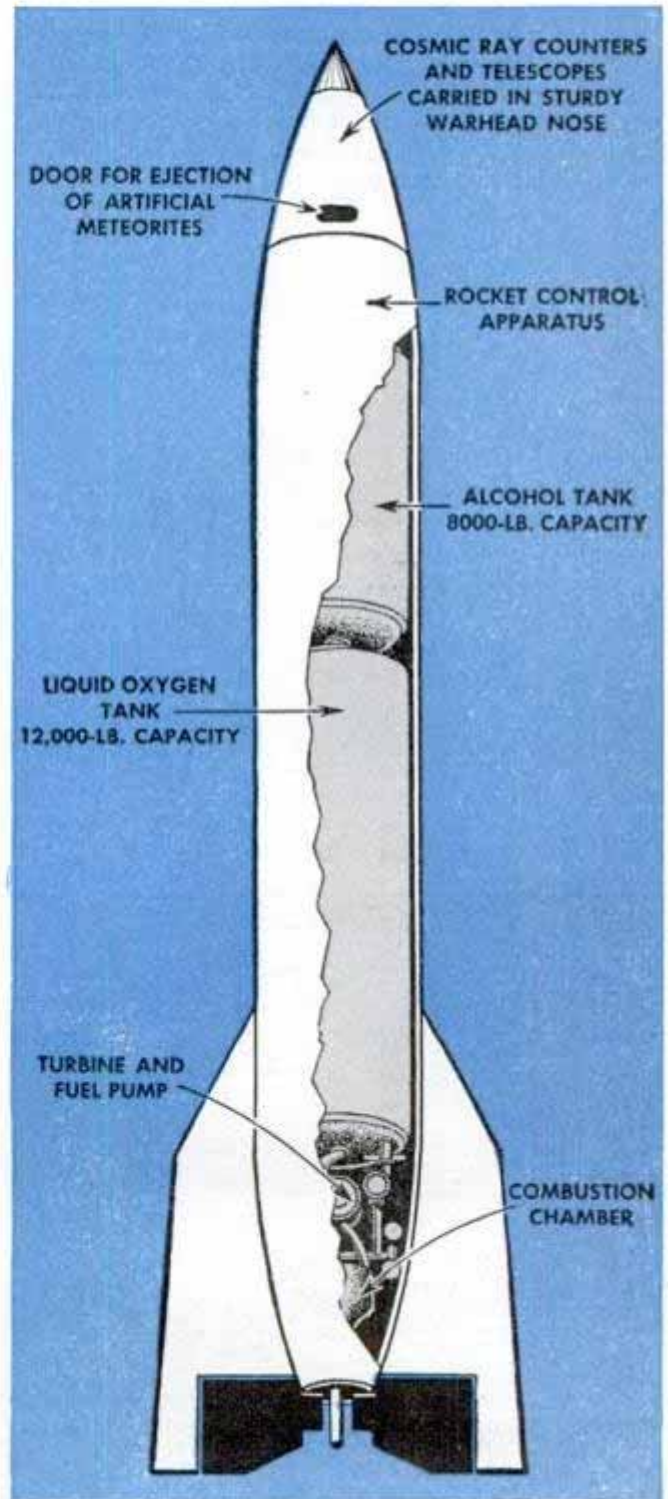
charge, the camera, too, was blown clear about 25,000 feet above the earth. It fell free the remaining distance, slowing down to a velocity of about 500 feet per second. Equipment from the rocket was scattered over an area of five square miles. When the duralumin camera box was found, the lens was broken, the batteries smashed and the camera damaged. But the magazine and film were recovered in perfect condition.

The pictures, although slightly blurred, show plainly many of the details of the earth's surface. Mountain ranges look like wrinkles and cloud formations seem to hug the earth from that height. The curve of the horizon can be seen easily.

In the meantime other instruments contained in the V-2s are studying special features of the upper air. One problem is the riddle of the ionized layers high in the atmosphere that behave like mirrors in reflecting low-frequency radio waves back to earth. High-frequency radio waves pass through the layers but are bent or refracted.

Complicated ground-to-rocket and rock-

(Continued to page 276)



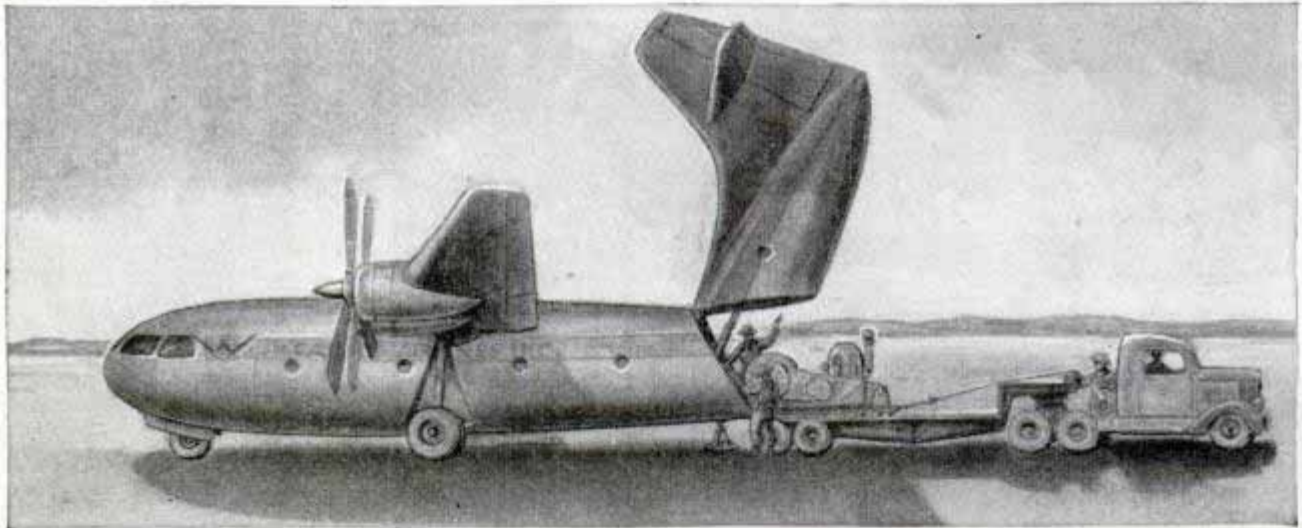
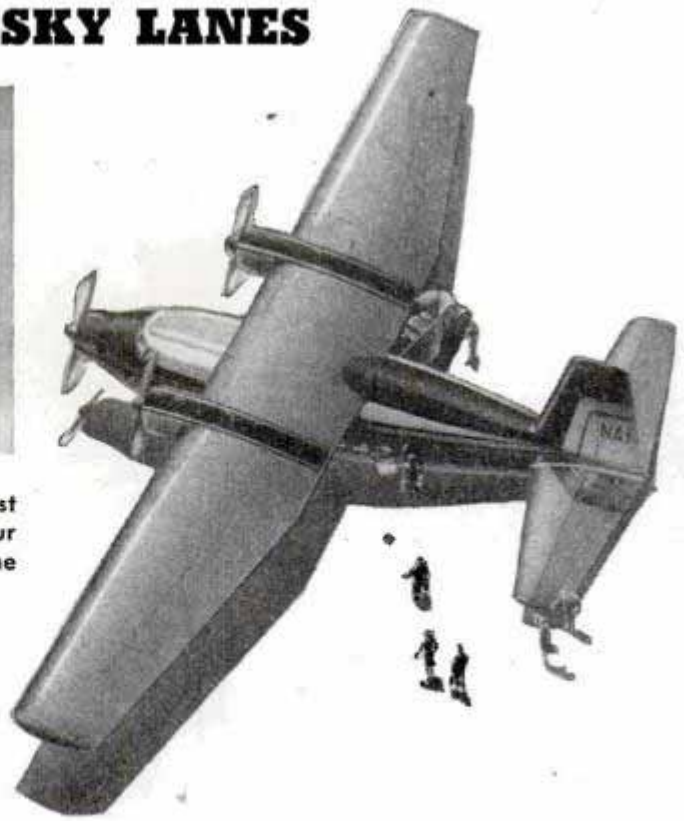


## NEWCOMERS ON THE SKY LANES

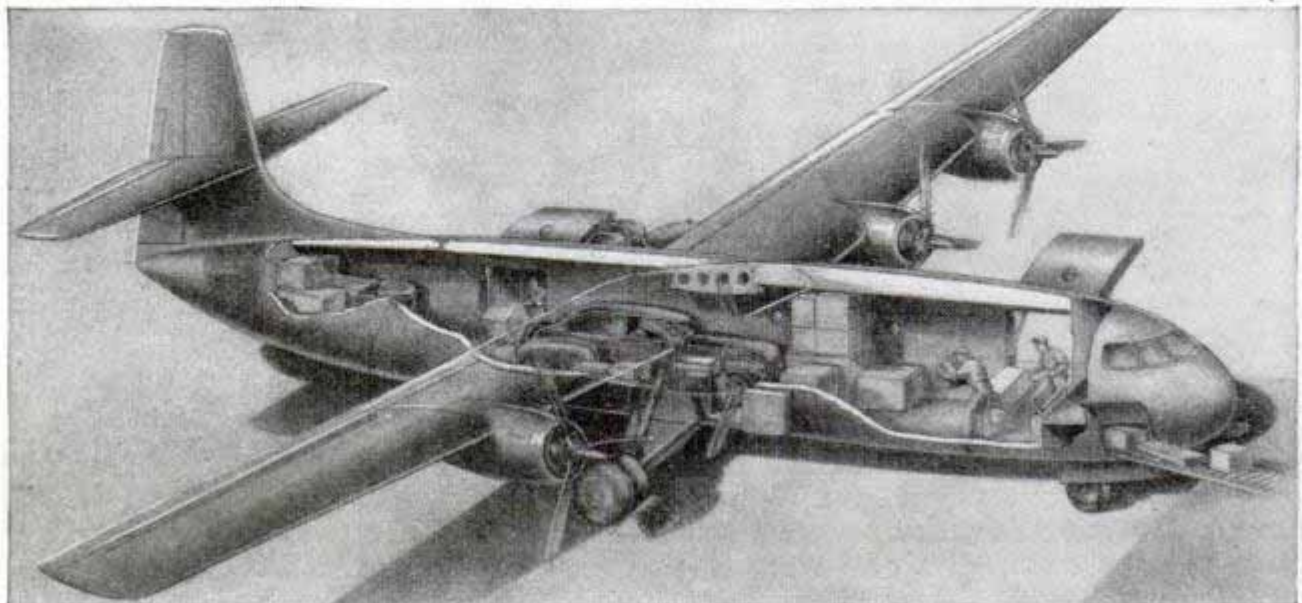


▲ Britain's Fairey Firefly, termed "world's fastest trainer," gets a maximum speed of 305 miles an hour from its 12-cylinder Rolls Royce Griffon XI engine

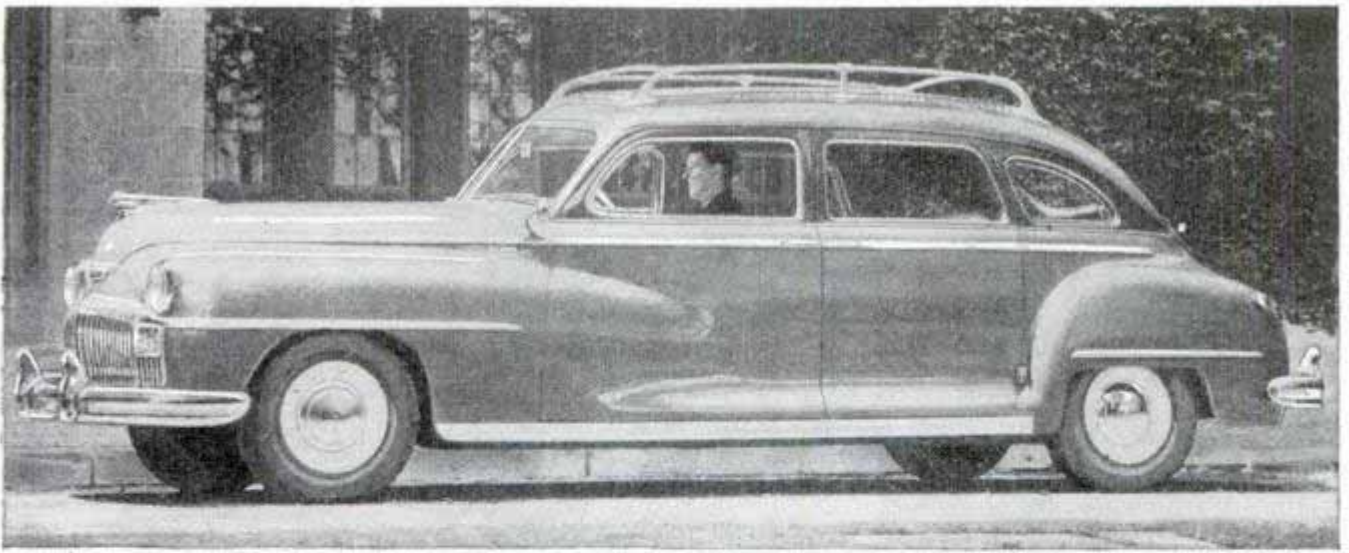
Built for cramped off-main-route airfields, the → Northrop Pioneer can take off with a 10,600-pound load in 700 feet and land in 750. Loading work is simplified by a very small floor-to-ground angle. Three-engined, its wing span is 85 feet, length 60 feet seven inches and gross weight 25,000 pounds



◆ By lifting the tail, bulky machinery and trucks can quickly be stowed in a cargo plane being built by Curtiss-Wright. It also has a low floor equal to truck bed height, 45 inches from the ground, and a nose door



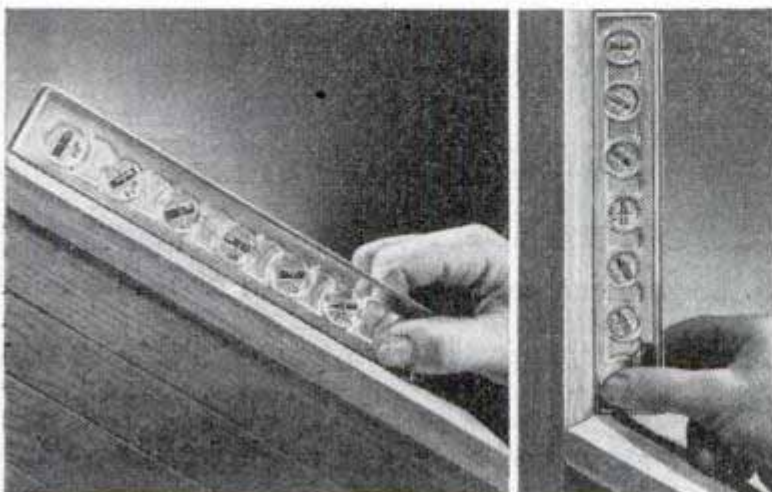
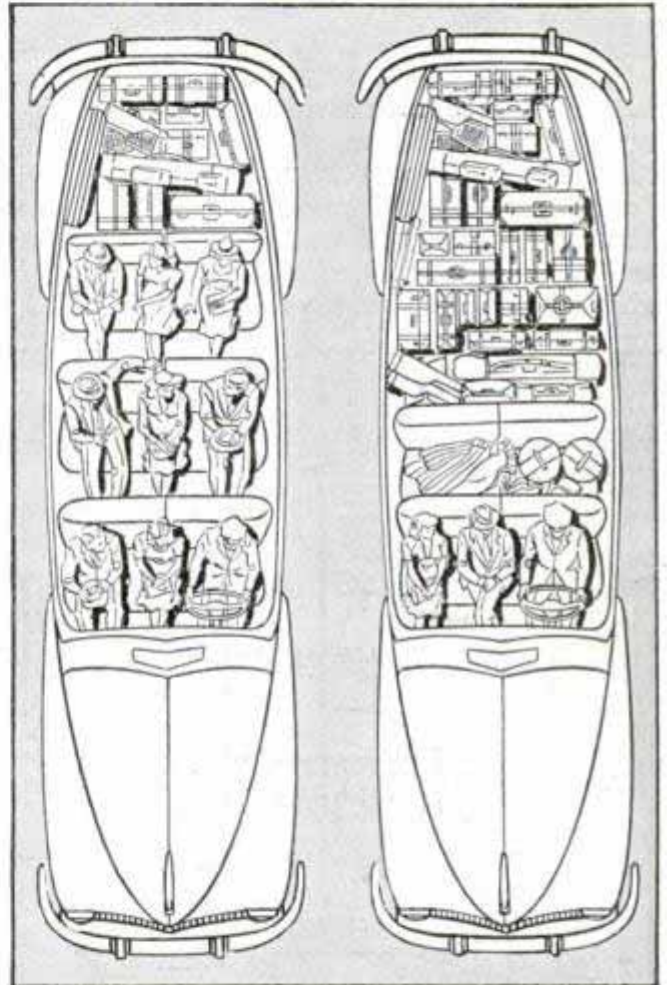




## Sedan and Station Wagon Combined in De Soto Car

Features of both a station wagon and sedan are combined in the De Soto Suburban which seats as many as nine persons and still leaves room for luggage inside the car. If additional space is required for hunting or camping equipment, virtually all of the interior can be so utilized without removing any seats. This flexibility is achieved by a three-position rear seat and adjustable front and center seats. The rear seat may be folded down to become part of the floor, and the other two seats moved forward. This arrangement creates six feet of luggage compartment space, enough for a full-size bed. The car has a 139½-inch wheelbase and oversize brakes, rear springs and tires. Attached to the top is a large luggage rack and chrome guard rail. Exterior color is a two-tone combination and the seats are covered with plastic fabric, available in several colors, which resembles leather. Plastic paneling in natural wood graining adds to the beauty of the interior, which is said to be practically scuffproof.

Three seats in De Soto Suburban are adjustable to → accommodate nine persons or allow six feet of space

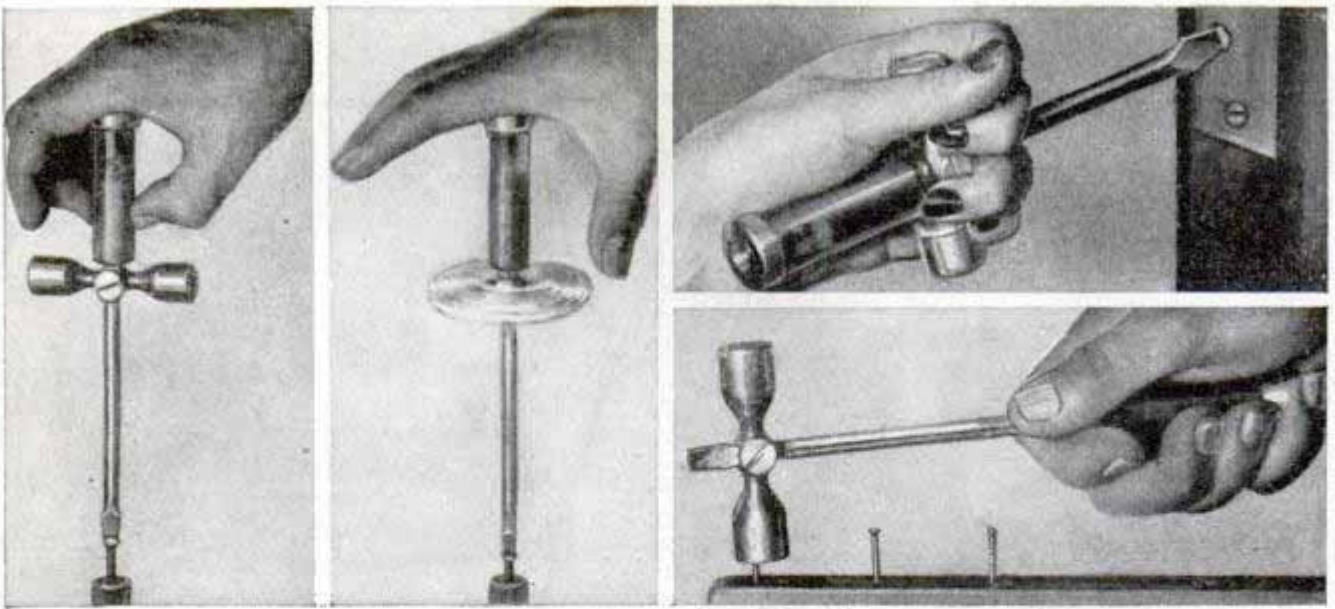


## Plastic Level Checks Angles With Six Built-in Bubbles

Surfaces at 180, 90, 60, 45, 30 and 22½ degrees can be checked with a plastic level. The tool has six leveling bubbles, each a different color. The degree of angle and a center leveling line are stamped over each bubble.

☞ "Auditioned" by a sound level meter, the circus gorillas Gargantua and Toto proved to have softer voices than a canary.

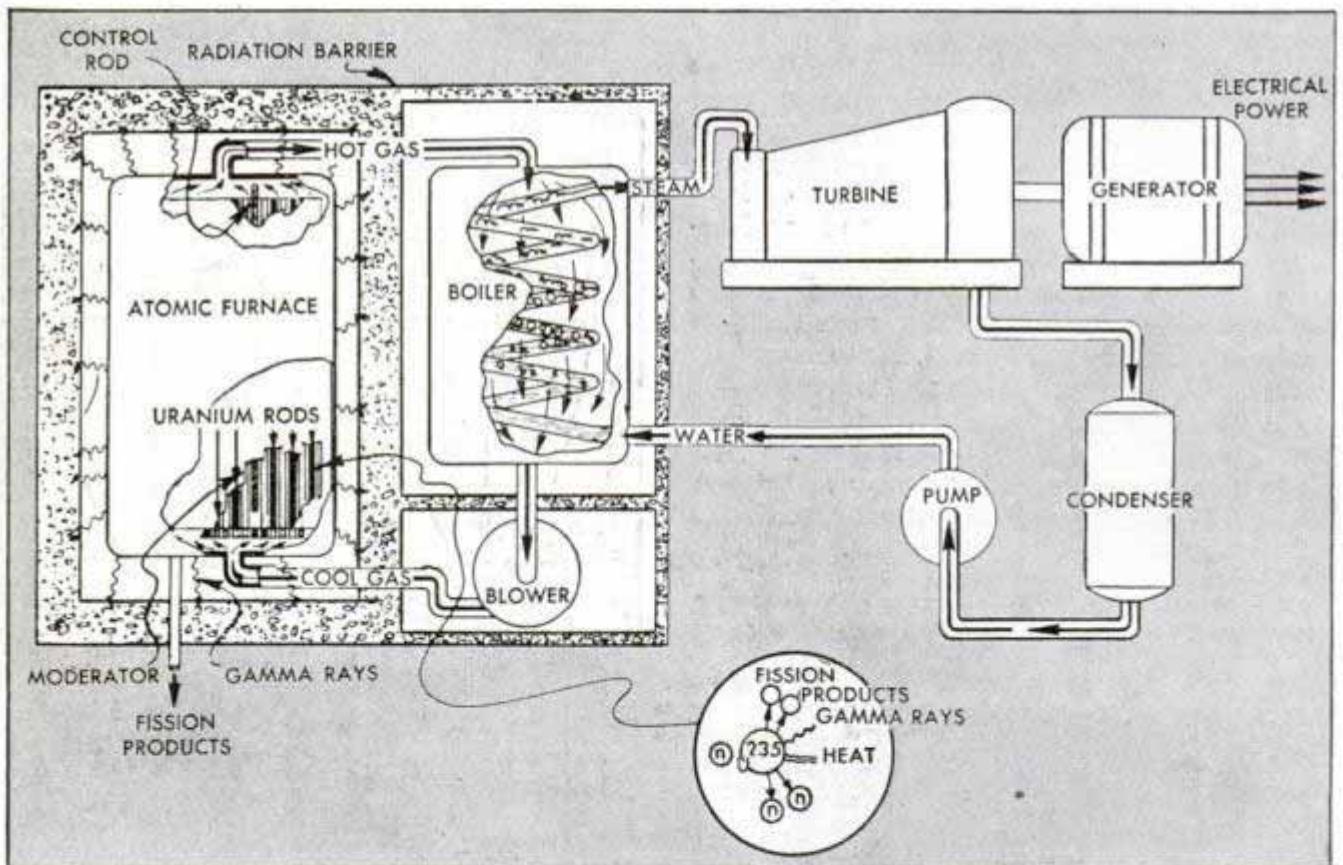




Loose-fitting machine screws can be "spun" in and out of place with a versatile tool that looks like a screwdriver and spins like a top. The operator's hand rests on a bearing on top of the handle. A heavy crossbar shaped like an hourglass is clamped half-

## Screwdriver-Hammer

way down the tool and acts as a flywheel. The same crossbar can be used as a power bar for increased leverage when the tool is applied to tight-fitting screws. The crossbar can be unclamped to slip down to the blade tip, thus converting the tool into a hammer.



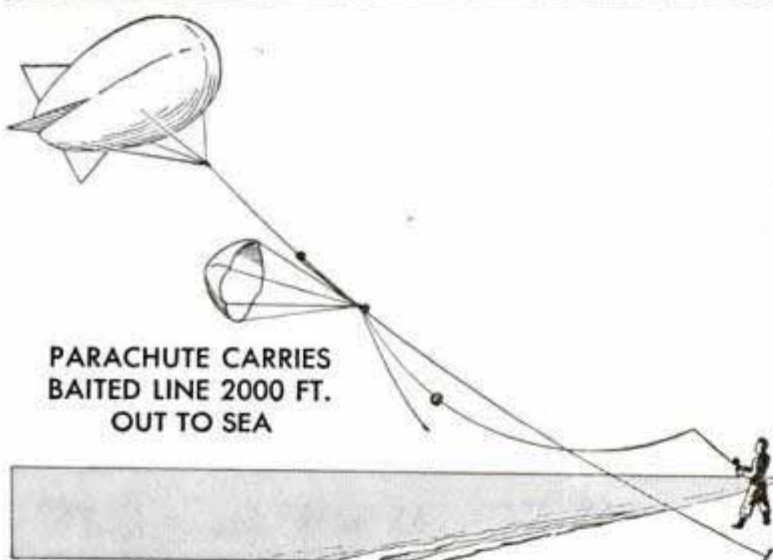
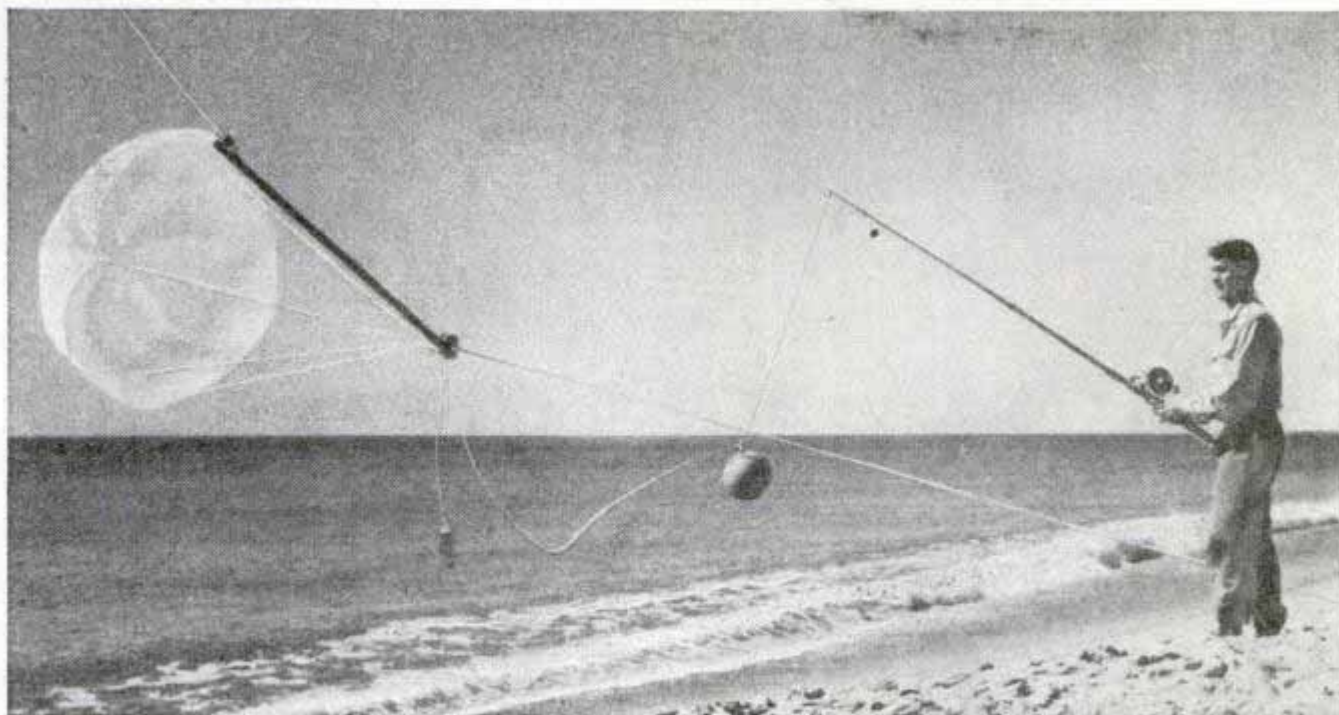
This diagrammatic sketch reveals the operating principle of an atomic power plant to be built this year at the Oak Ridge, Tenn., atom-bomb "factory." Marking man's first direct move to harness atomic energy as an aid to mankind, the plant was designed by Monsanto Chemical Company scientists. Gas will be heated through atomic re-

## Atomic Power Plant

action in the chamber at left. Then it will pass into the center chamber where it will come in contact with tubes carrying water. Steam thus generated will be conducted to a steam turbine which will operate a generator to produce electricity. After being used, the steam will be led to a condenser, converted to water and pumped back into the system.



# Balloon and Parachute Are Used to Cast Fishing Line



Scientific fishermen now use a "kytoon"—cross between a kite and balloon—to drop their line 2000 feet from shore in quest of striped bass weighing 20 pounds and up. Eighty yards is about the maximum for conventional surf casting. In this latest boon to fishermen, a six-foot-long balloon is floated out over the surf and then a parachute is hitched to the wire holding the balloon. With the fishline, bait and a rubber balloon float attached to it, the parachute catches the wind and heads for the balloon. A tripper stops the parachute near the balloon, and line, bait and float are dropped to the water. The parachute collapses and slides back to the fisherman.



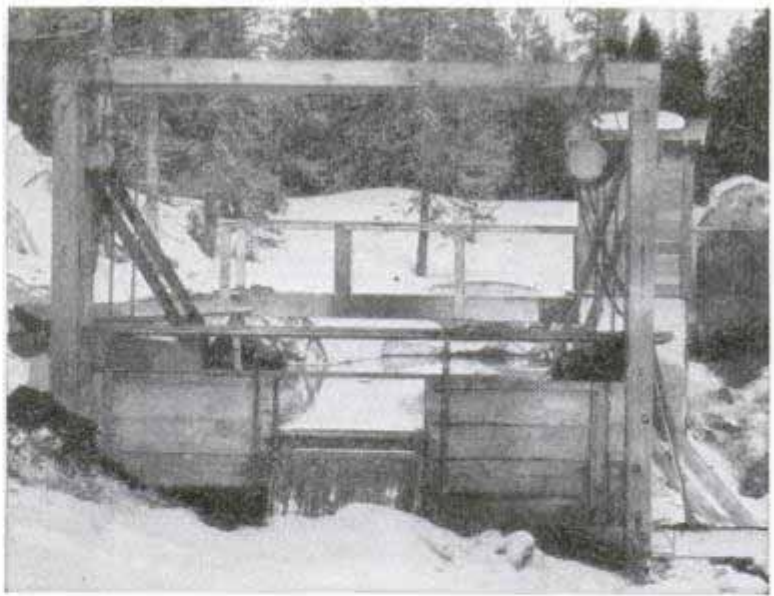
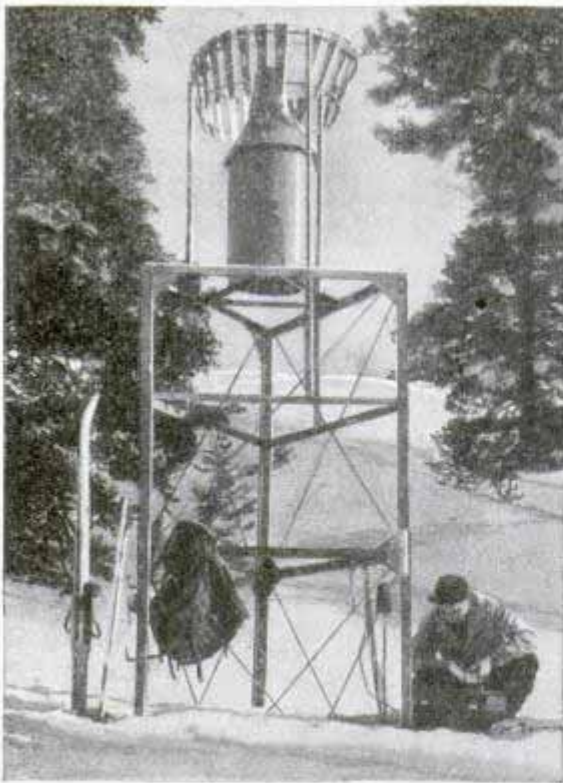
Wind-filled parachute (top) carries fishing line toward balloon and tripper which lowers bait to water. Above, the gear is easy to carry

## Fish Are Unharmful by DDT Spray Used to Kill Mosquitoes on Ponds

Spraying of ponds and lakes with DDT to kill mosquitoes does not harm fish nor the small, water-inhabiting animal forms upon which fish feed. In tests, Tennessee Valley Authority biologists sprayed inland lake

areas 16 times from the air with DDT in an aerosol mist. Mosquitoes were almost eliminated but the fish and smaller water animals were not affected. Concentration of the DDT used was  $\frac{1}{10}$  pound to an acre.

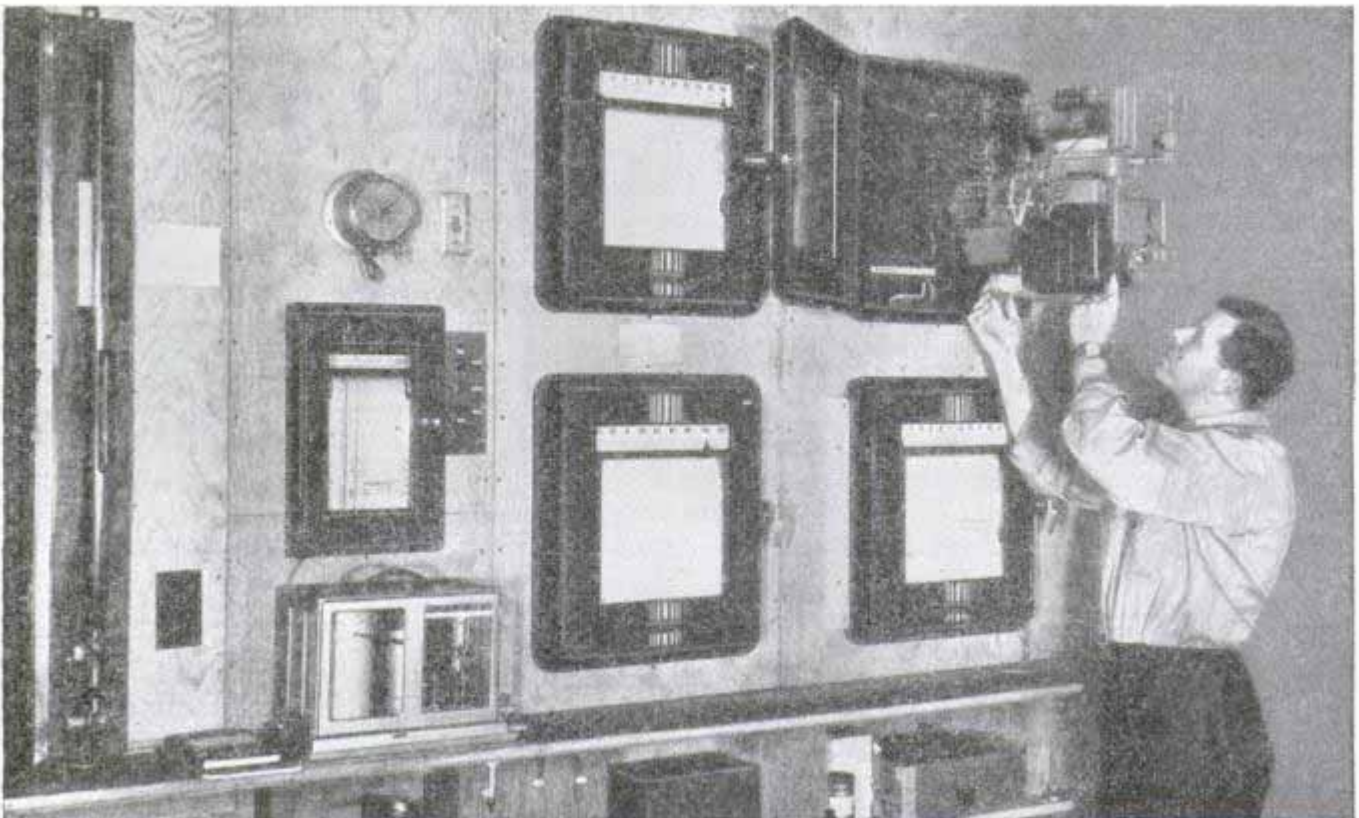




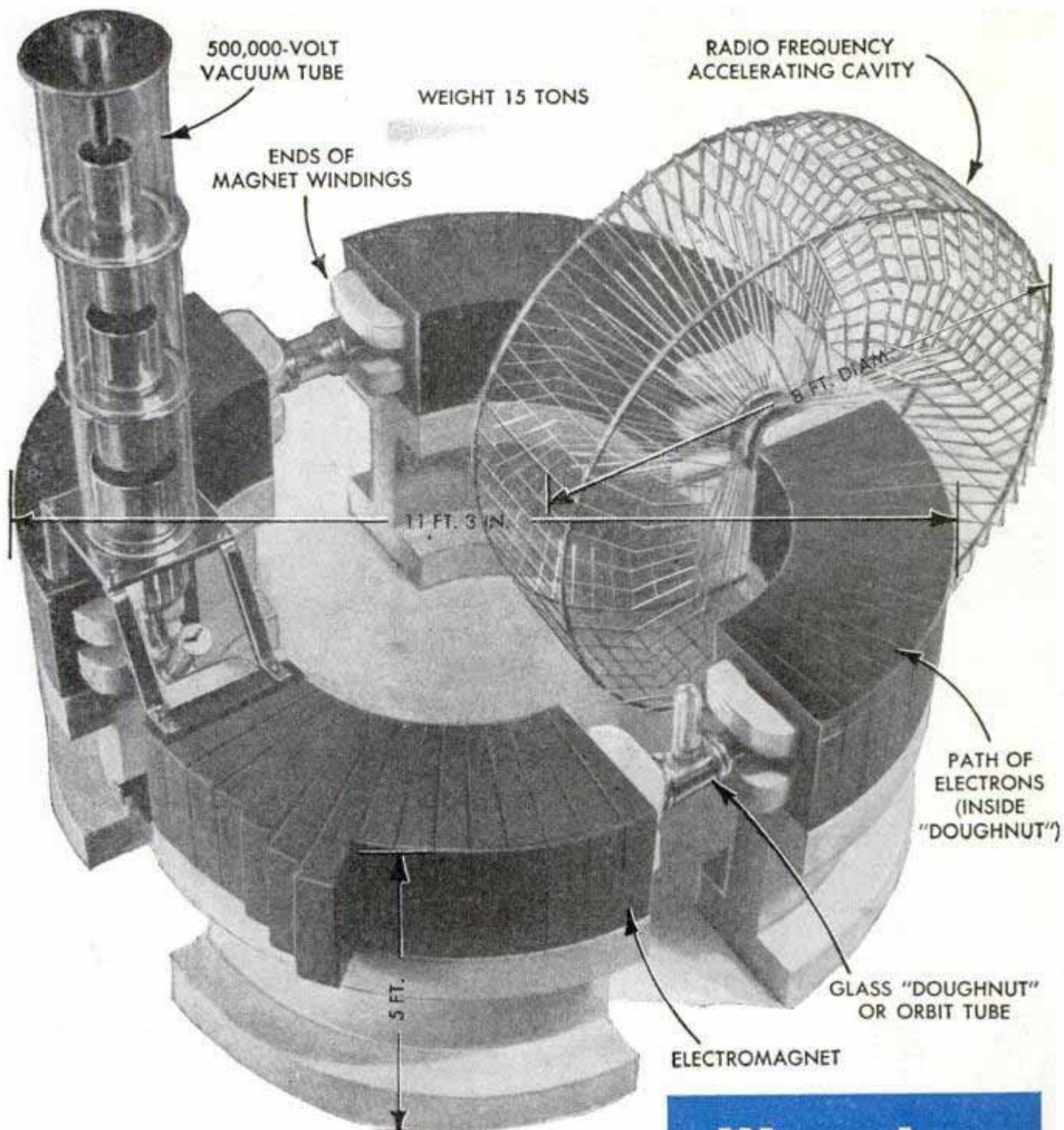
Snowfall is measured in terms of precipitation in tank at upper left and the volume of melted run-off from test basin is recorded at station above. Below, electric wires are plunged into the snow to measure its temperature. Ground and air temperature at 28 points register at one minute intervals on meters shown at bottom

## SEVEN-YEAR "SNOWMEN"

For seven years four men will huddle high in the Sierra Nevada Mountains to "count snowflakes and droplets." Representing the U. S. Engineer Department and the Weather Bureau, their job is to determine how much water flows, and how fast, from the snow-capped heights, information sorely needed by dam and reservoir engineers in northern California. The laboratory's facilities will include electrical resistance thermometers to measure snow temperature, storage gauges, a device recording duration of sunshine at one-minute intervals and a large run-off basin







Model of 300-million-volt "race track" synchrotron now under construction at University of Michigan. This "atom buster" will produce energy similar to cosmic rays

By Daniel Wilkes

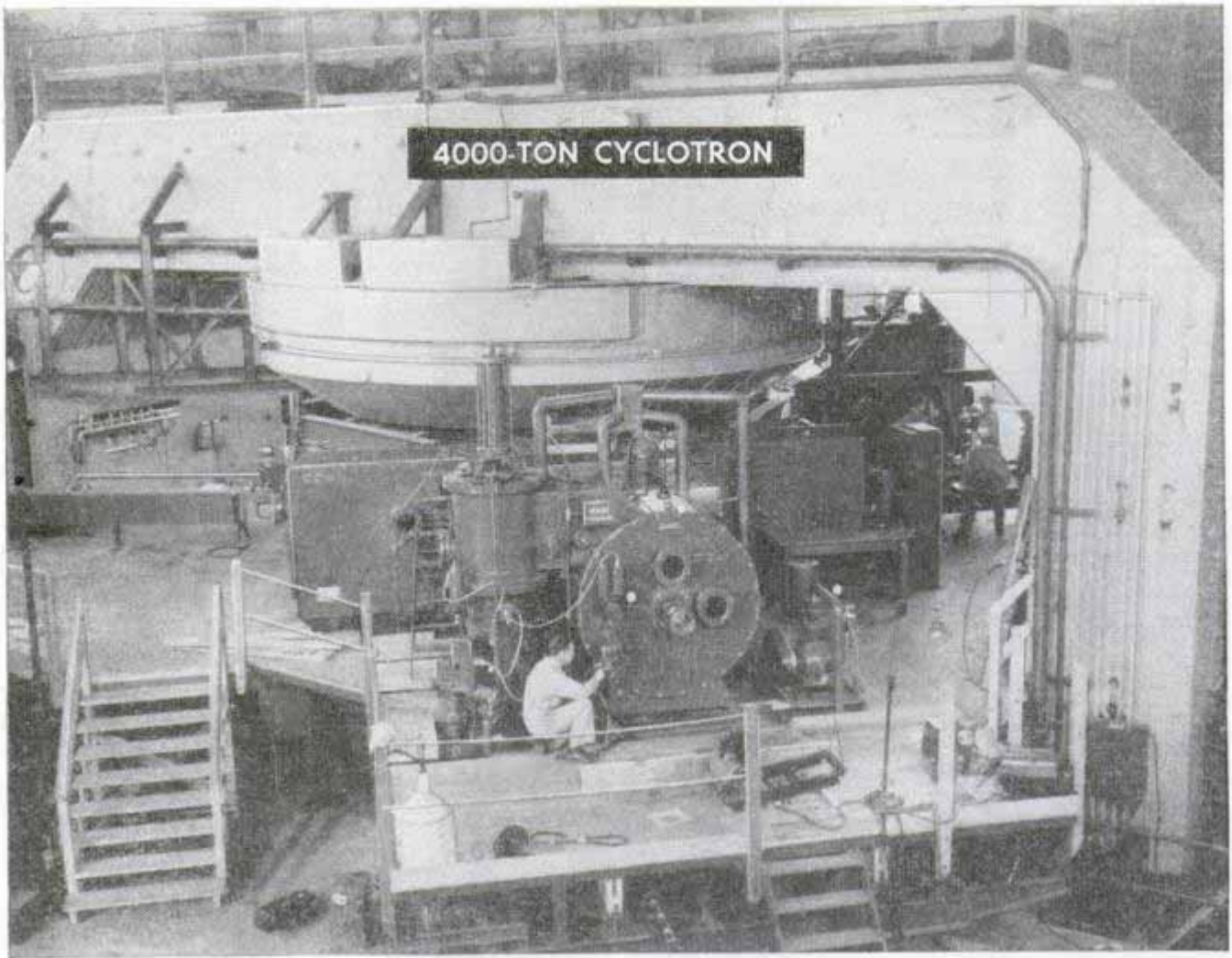
**T**HE ATOM—its structure and behavior—is as baffling to scientists today as it was 10 years ago. In view of the development of the atomic bomb and man's entrance into an Atomic Age, this may seem a surprising statement.

Yet it is an inescapable fact that the atomic bomb was only a stage in nuclear research. The men of the atom are just getting back to the main job of discovering the true nature of the atom, the basic piece of matter out of which the universe is built.

The first shot in the postwar attack on the atom has been fired—a 200-million electron volt barrage of atomic bullets—by the monster 4000-ton cyclotron just completed at the University of California

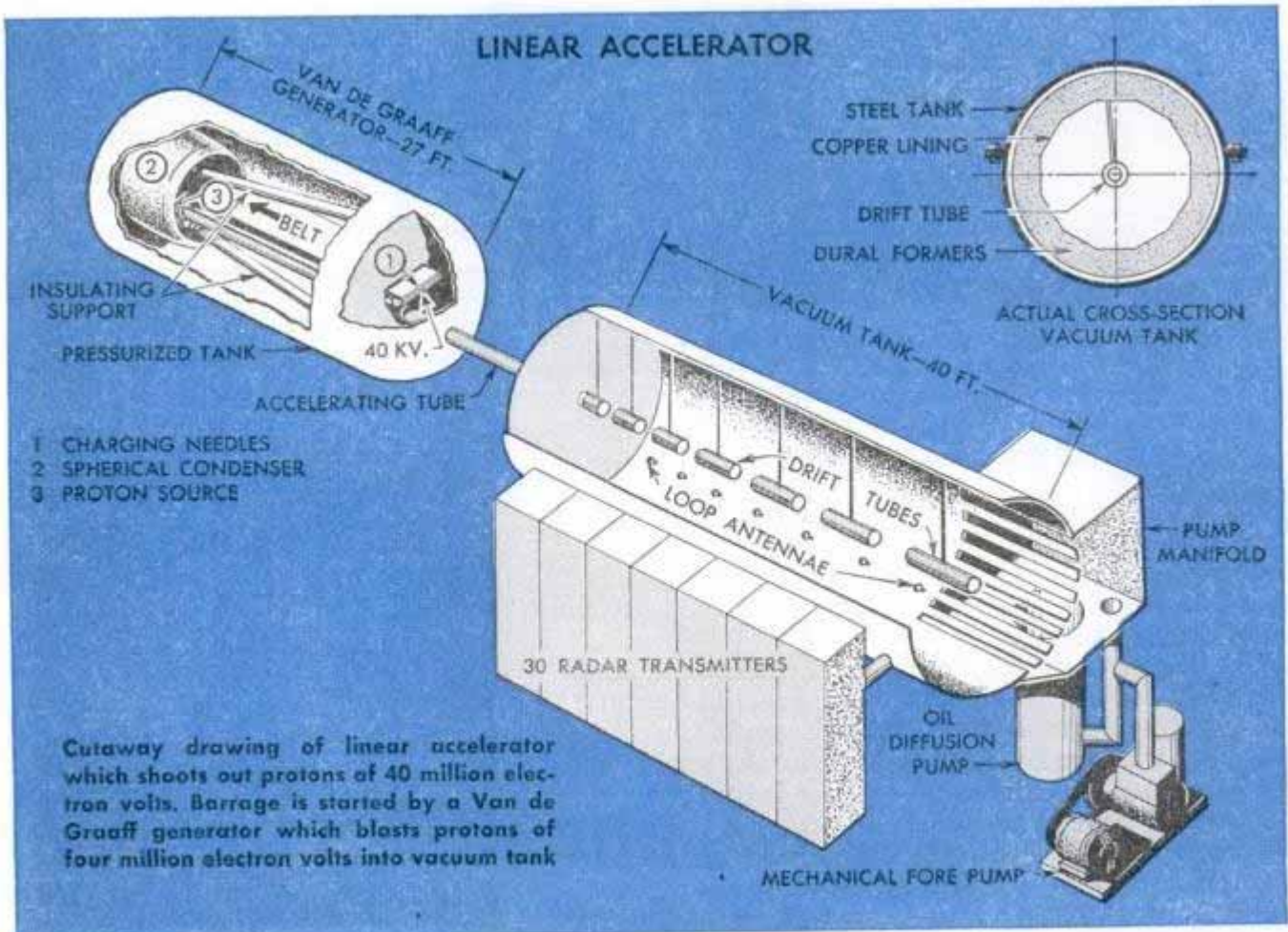
Waterloo  
for the  
ATOM



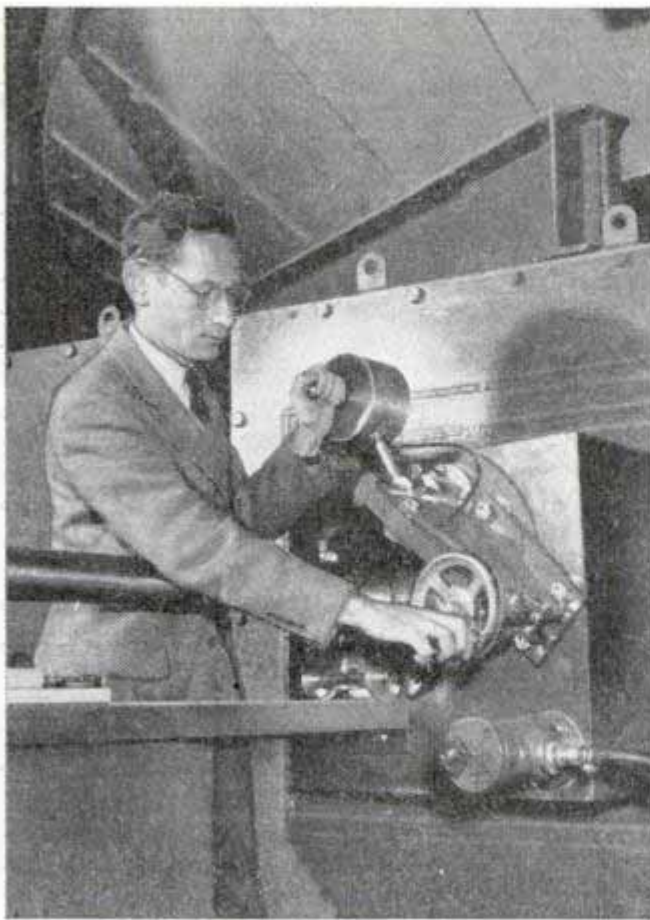


**4000-TON CYCLOTRON**

Most efficient all-around atom smasher is the 4000-ton cyclotron at the University of California. It discharges protons of about 350 million electron volts which cause complete disintegration of the nucleus of an atom







The target of the 184-inch cyclotron is operated by Professor Robert Serber at the University of California

by Professor Ernest O. Lawrence. In a few months two new machines, the synchrotron and the linear accelerator, designed for different types of atomic destruction, will join the barrage in the same laboratory. They will hurl atomic bullets from three to more than 20 times harder than have been shot before.

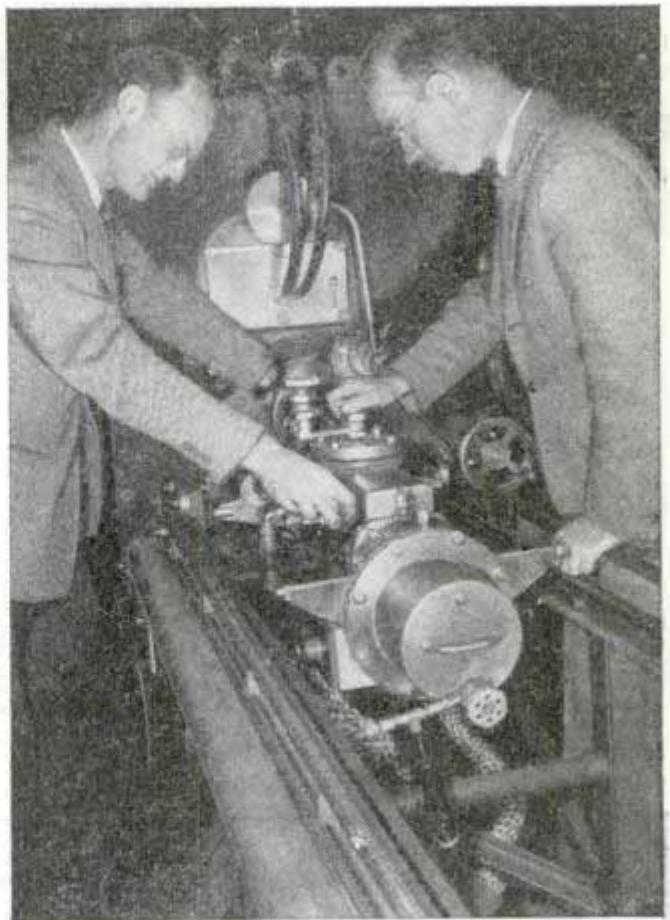
As the months tick by, more of the same type of atomic artillery, now on the drawing boards of America's laboratories, will step up the bombardment. Within 10 years scientists hope to be able to report that the atom has met its Waterloo.

This day will have arrived, says Professor Robert Oppenheimer, the University of California's eminent theoretical physicist, when scientists have laid bare the inner workings of the subatomic world; when they can say positively what particles make up the atomic nucleus, how they act on each other and what holds them together.

With this knowledge man may have entered an era in which it will be possible to take atoms apart and rebuild them at will; in other words, to alter man's environment to suit his wishes.

What is the atom holding out on nuclear scientists? Where do the scientists now stand? What tools will be used and how do they work?

First, draw a rough picture of an atom. Essentially, it consists of a tight, hard,



Professor Robert Thornton (left) and William Brobeck, mechanical engineer, regulate cyclotron's ion source

granulated core, the nucleus, made up of neutrons and protons. Around this nucleus, electrons circle in planetary orbits. Positrons, gamma rays and mesotrons are emitted by the nucleus when disturbed violently, as in a collision with a cosmic ray.

Scientists have identified all six of these atomic particles and are familiar with many of their characteristics. But they do not know what binds the particles of the nucleus together—surely the most powerful force in the universe. And they are fairly certain there are a couple more particles in the nucleus unaccounted for. The strategy by which they hope to find out about these things is to duplicate the atom smashing which occurs in nature. Atomic nuclei are constantly being exploded in collisions with high-speed particles in the atmosphere. From these explosions are liberated mesotrons, which are extremely penetrating high-energy cosmic rays, and other nuclear particles of lesser energy.

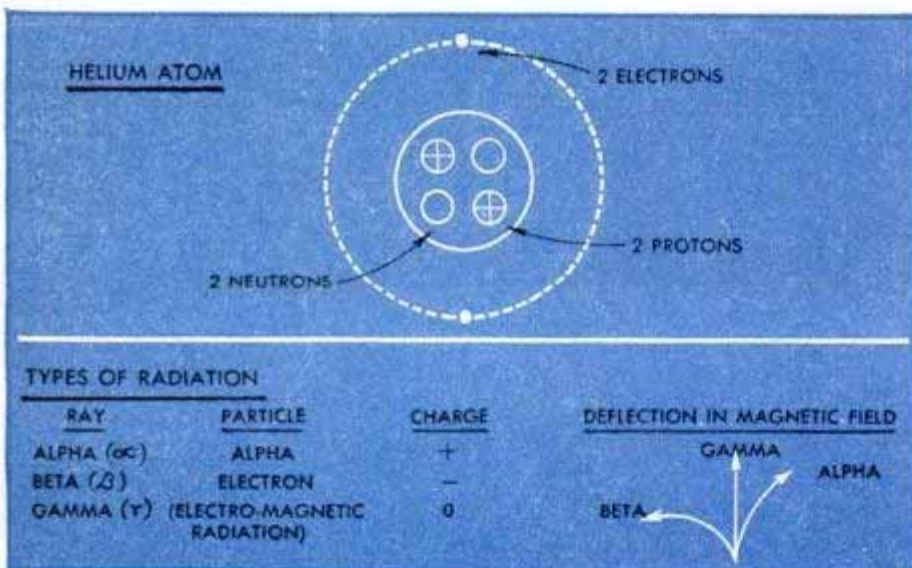
Scientists have photographed mesotrons zipping through Wilson cloud chambers, and wherever they have found an atomic explosion, mesotrons have popped out. They reason, therefore, that the mesotron is intimately connected with the energy which holds the nucleus together.

If they can hit the nucleus hard enough in the laboratory to make mesotrons pop out—in other words, duplicate nature's

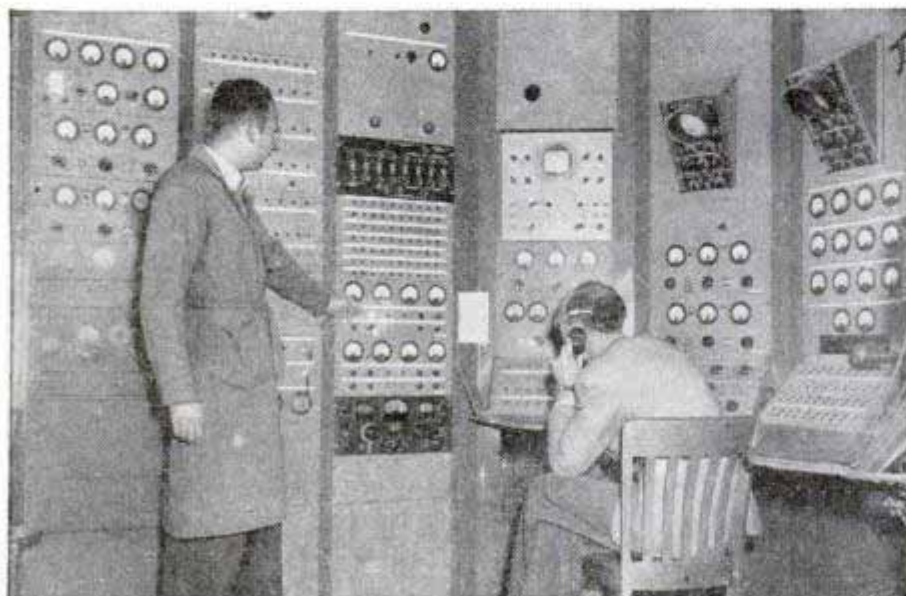




Professor Ernest O. Lawrence, noted University of California physicist, adjusts the target area of a pilot model for the giant 184-inch cyclotron



Composition of a helium atom is illustrated in the drawing, above a chart which lists various types of radiation and their characteristics. Below, every step in operating the powerful cyclotron is controlled from this room



atom smashing — the atomic strategists believe they can learn what they need to know. Special equipment can be devised to observe everything that happens in these nuclear disintegrations.

This super atom smashing should not be confused with atomic bombardments to date. Until the 4000-ton cyclotron was turned on, it was possible only to jar neutrons and protons out of the nucleus—in effect, chip it. Super atom smashing involves the complete disintegration of the nucleus.

This is the job for the new giant atom busters. In addition to Professor Lawrence's three machines, atom smashers planned or under construction include a 700-million electron volt betatron for General Electric; a 500-million electron volt cyclotron for the Associated Universities; a 300-million volt synchrotron at the University of Michigan; a linear accelerator for Massachusetts Institute of Technology; and duplications or variations of these machines in institutions all over the nation. General Electric already has a small 70-million-volt synchrotron in operation.

A complete picture of this artillery can be obtained at the University of California, where the three basic types of super atom smashers have seen or will first see action. Each type is designed for a different kind of atomic destruction and uses different types of subatomic projectiles.

The 4000-ton cyclotron is the most efficient all-around atom buster. It shoots protons (the elementary nuclear particle which incidentally constitutes the nucleus of the hydrogen atom) of 350

(Continued to page 264)





Five o'clock shadow comes off to music, above. For refreshment of clients there are two trays of ice cubes in refrigerator built into the front side of all-electric desk below

## 'All But Kitchen Sink' In Desk for the Boss

Elaborate hardwood desks designed for executive use are complete office units. One has a flared burnproof top large enough for six people to be seated around it. Three sliding ash trays are concealed under its outer rim. It has no legs but rests on runners. The desk and the accompanying chair are adjustable in height for either tall or short men. Another is designed with sliding drawer panels on its working side. On the reverse side is a built-in refrigerator, office safe and bar. It also has two electric clocks, one on the working side and one on the reverse side.



Both desks have concealed automatic dictating machines, radios and electric razors. Special compartments in all drawers accommodate papers and working tools.

## Control System Prevents Electrolytic Damage to Underground Pipes

Stray electric current which damages underground pipes can be curbed by a new control system that connects the pipe with a nearby electrical conductor. Stray current is caused by trolley wires or third rails which use standard rails as a return circuit to the powerhouse. The current sometimes leaves these tracks and enters the ground where it travels to neighboring pipe lines. When it leaves the pipe line to enter the

ground again it causes electrolytic action which depletes the metal in the pipe. The control system weighs only 40 pounds and connects the offending rail with near-by pipes. When stray current leaves the pipe it travels harmlessly through the system rather than through the soil. It is estimated that preventable electrolysis causes more than \$50,000,000 damage annually in the gas, oil and water industries alone.





## Hay Bale "Bombing" Saves Buffalo

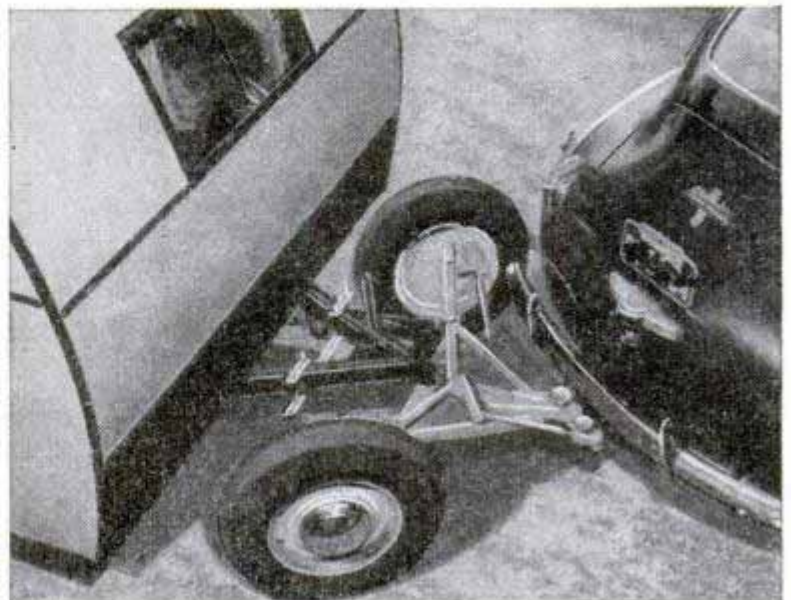
Army flyers, in an unusual mercy flight, "bombed" Montana buffalo with hay to prevent their starvation. When winter snowstorms buried the grassy feeding grounds and blocked truck roads into the reservation, the animals were without food. Flyers at the AAF base at Great Falls saved the herd, one of the last surviving large ones, by loading a C-47 transport with hay, flying over the feeding grounds and dropping bales of feed which burst open when they hit the ground.

**Snowbound buffalo on the Crow Indian Reservation in Montana are fed from the skies. Army transports were loaded with hay when it was reported the animals were starving and roads were blocked, then flew low over the herd while crewmen pushed the baled hay out through the cargo doors**

## Knee-Action Dolly on Trailer Turns at Same Angle as Auto Wheels

Knee action and improved steering are provided in a new-type dolly for automobile trailers. When the car wheels are turned to the left, the dolly wheels turn in the same direction and at the same angle. This is accomplished by an arm attached to a hitch ball installed on the auto alongside the trailer hitch. Heavy-duty steel coil springs support from 85 to 90 percent of the forward weight of the trailer and have a capacity of 8000 pounds.

☐ Airplanes can take off with a greater load when ammonium hydroxide is used as an internal cooling liquid in the engines.





Cross-country driving requires both skill and stamina. It sometimes takes an hour and 200 shifts of gear to get a heavily loaded semitrailer up a mountain grade that pleasure cars climb easily in 15 or 20 minutes



## *Highballing the Highway Freight*

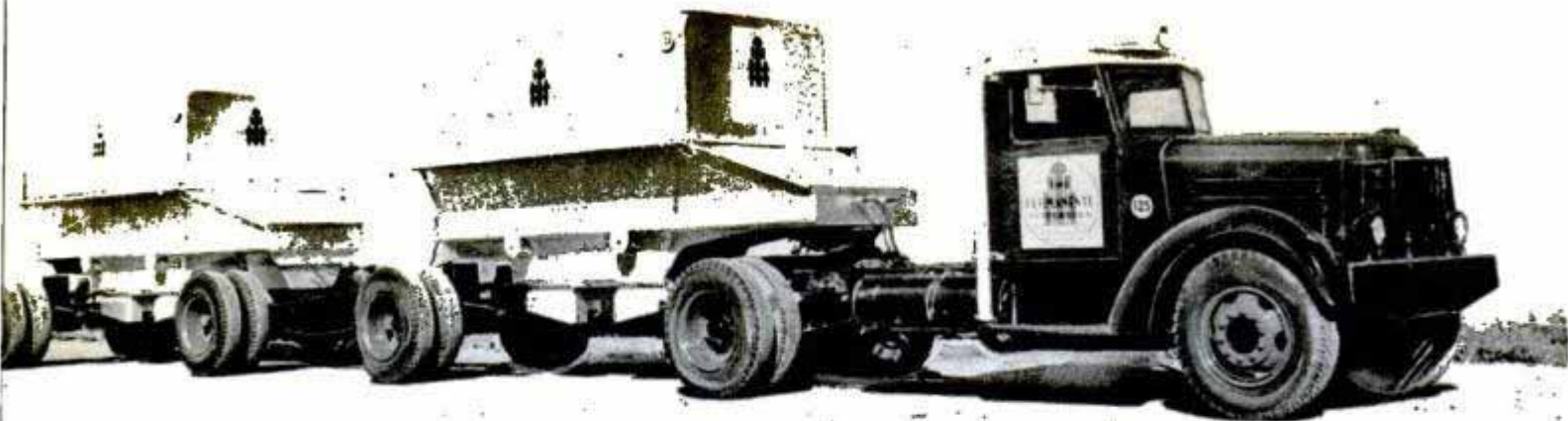
**A PLEASURE driver can climb the Cajon Pass north of San Bernardino in 20 minutes, but it was going to take Harry Karasick an hour and a quarter to reach the top of the 13-mile grade. With 20 tons of merchandise in the semitrailer, he would average 10 miles an hour on the uphill pull.** **By Thomas E. Stimson, Jr.**

Back in the cab he glanced at the air-pressure dial and eased the tractor into second gear direct. Under way, he tested the foot air brake and then, separately, the hand air brake connected to the trailer's rear duals. Everything was normal. By now the tachometer needle was hovering at 2000 r.p.m. and he shifted into second overdrive. A minute later he used both hands, one for each lever, to shift into third direct. This was the highest gear he would use until he reached the summit.

Karasick had left Los Angeles at 3:00 that afternoon. At 7:00 he would eat dinner at

First he made a routine safety stop. At the side of the road he checked the oil and water in the big 200-horsepower Diesel. Then, with a steel bar, he walked all the way around the rig, thumping each of the 19 huge rubber tires. The solid sound of the blows told him that none was soft.



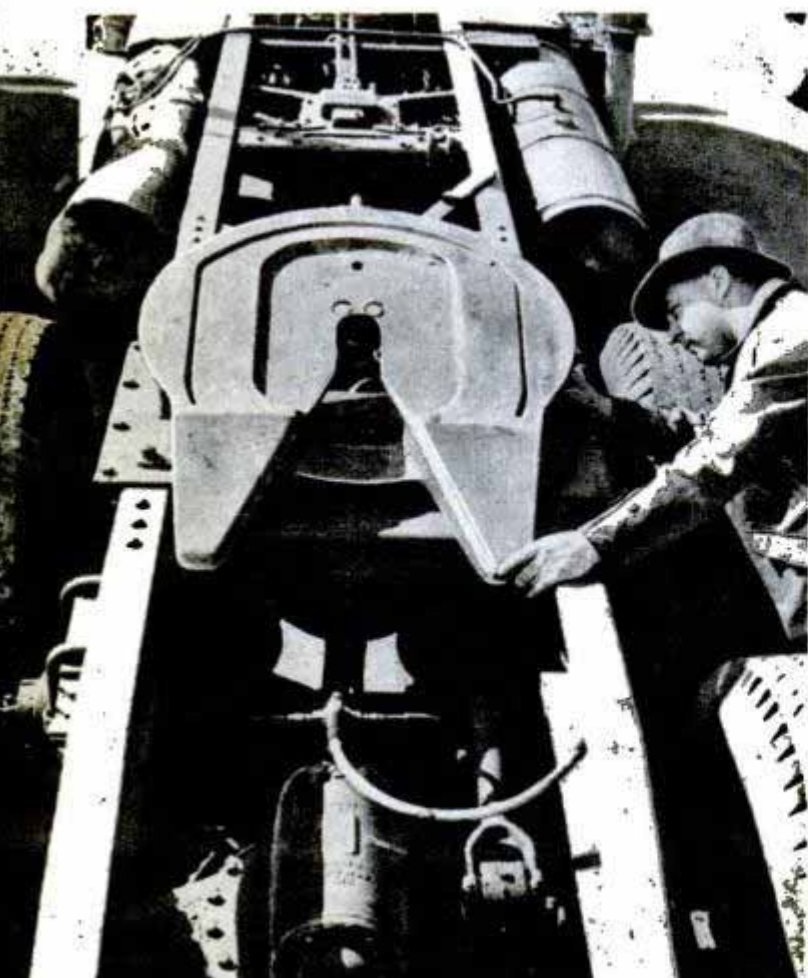


important weight savings have been made by building trailers entirely of magnesium. Because of that improvement this 60-foot truck train is permitted to haul three tons more cement than is legal with heavier equipment

the top of the grade and then highball at 50 miles an hour across the desert to Jean, Nevada. That was the division point where Bill Bethke would take over the load. Bethke would roll across most of Nevada in the moonlight and crawl up through the hills of southern Utah, reaching Cedar City at 8:00 in the morning. A third driver would take the rig into Salt Lake City. Four days later, five days out of Los Angeles, the load of merchandise would be in Chicago.

As Karasick left Los Angeles other units of the Pacific Intermountain Express fleet were leaving terminals in Chicago and St. Louis, westbound, and a tractor was moving a load east from San Francisco. Four

"Fifth wheel" of a tractor is the connection block upon which the front end of the semitrailer rests



hours later other highway units would leave the same terminals on an around-the-clock schedule that keeps them rolling night and day. Between Denver and Salt Lake City as many as a dozen westbound and a dozen eastbound P.I.E. units are put on the road every 24 hours.

Handling one of the big highway rigs is no job for an average driver. In some respects P.I.E.'s physical standards are higher than the Army's. Driver applicants must pass rigorous intelligence, driving, and reaction time tests and those who are accepted are taken on student runs by Earl French, driver superintendent. All drivers must pass a yearly physical examination.

A new driver learns that he will have to make one or more changes of gear to climb a slight upgrade that is hardly noticeable in a pleasure car. Each shift must be timed just right and he trains himself in double clutching. To shift down, he practices accelerating the engine during the shift so that he can mesh gears without missing.

He learns to drive by the tachometer instead of the speedometer and he's taught that the engine operating range is from 1700 to 2000 r.p.m. When the tach needle creeps down to 1700 he shifts to a lower gear, when it climbs to 2000 he shifts up. His top road speed is 50 miles per hour in fourth overdrive at 2000 r.p.m.

His brake pedal supplies air to all wheel brakes and the hand air lever is connected to the rear duals alone. In slippery weather this separate rear-end brake can be used as a drag to keep the equipment in line. If the tractor starts to skid the driver uses the trailer brakes as an anchor. But if the trailer starts to slide it's best to use no brakes at all. Accelerating the tractor instead is recommended.

A light fall of dry snow is no special handicap and, if necessary, a big outfit can pull through dry snow a foot deep. Wet snow is different. The big 10.00-22 tires be-



Oil in can on running board is for emergency use when the crankcase level is low



gin to spin and the driver must chain up the eight traction wheels. Usually this is a 45-minute job. Icy pavement calls for the most caution of all and to be on the safe side the driver goes down to a low gear and grinds along at slow speed.

Wrestling with the gears keeps a man warm except in bitter weather and he has a heater in his cab when he needs it. Driver fatigue is reduced by a new soft seat equipped with built-in hydraulic shock absorbers. Much of the customary roar of the Diesel exhaust is eliminated by a new stainless steel muffler.

Each driver carries an operating manual that describes his route and the location of dangerous curves and grades. The booklet tells the procedures to be followed in overtaking other vehicles and in handling various traffic situations. It notes the three or four points along the route at which safety stops are to be made. These periodic checks are vitally important, for even a soft tire could cause a disaster. Undetected, the soft tire may become flat and then heat up and burst into flames. Such fires have spread to the cargo and consumed the entire unit.

Highway drivers work six days a week and average seven hours at the wheel in an eight-hour shift, during which they travel an average of 250 miles. Over flat country a man may do better than 45 miles an hour with hardly a change of gears;

climbing across a mountain range may slow him to a 15-mile average and he may have to shift gears 200 times in an hour's driving.

Truck drivers used to have poor reputations on the road but today most of them are courteous professionals who will pull over when they can to let you pass. They go out of their way to give others a hand. They can't stop to change a tire for an able-bodied man but they are glad to haul you back on the pavement, for example, if you have dug yourself in on the roadside. Pulling cars back on the road is a routine task almost every trip during the winter months.

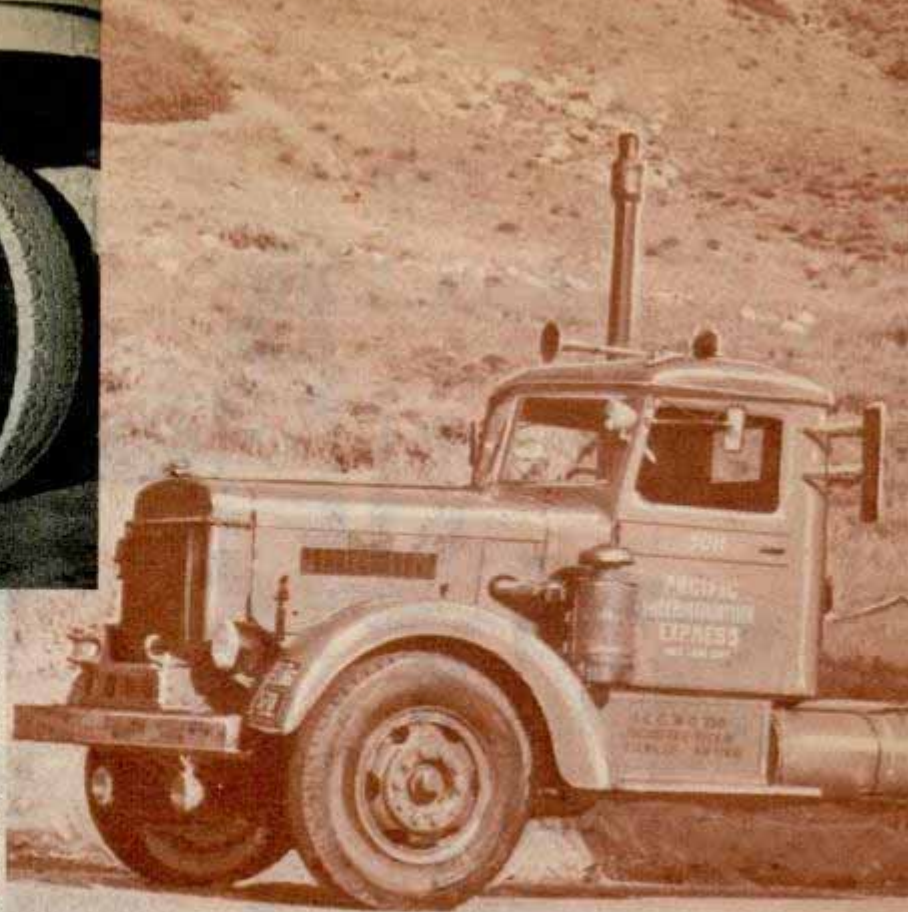
Reading hub meter that registers total mileage. This affords check on need for inspections and overhauls







Easiest change is an outside tire. Driver can run inside wheel up on a wooden block and avoid using his 10-ton jack. At right, bumping each of the 19 giant tires with a steel bar to detect any sign of softness



Scores of pleasure drivers who have been marooned in blizzards owe their lives to truck drivers who rescued them from their stalled cars. During one heavy snowstorm in the mountains one truck driver unhooked his tractor from the load and then used it as a taxi to haul the passengers of a wrecked bus to the warmth and safety of a service station seven miles away. He completed the rescue in a dozen round trips, then hooked on to his trailer again and kept going.

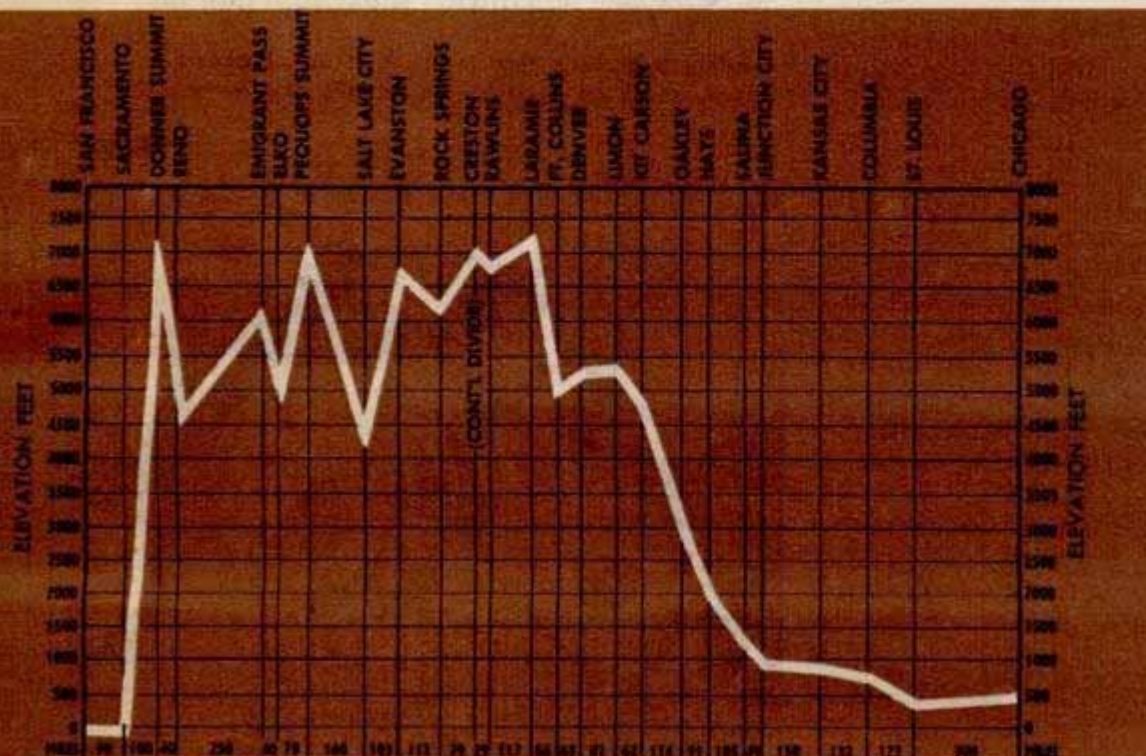
The fact is that the big highway trucking systems can't afford to employ poor or irresponsible drivers. "Mexican overdrive" (that means coasting down hill out of gear), speeding, "pinch" passing or any other reck-

less driving can cost a driver his job. He is under almost constant scrutiny on the road.

Supervisors in private cars trail the drivers to note how they obey traffic laws. Traveling engineers of the insurance companies prowl the truck routes to watch against unsafe driving practices. Each piece of P.I.E. equipment and its cargo, for instance, are insured up to a value of a million

dollars. On top of all this, truck lines employ outside road detectives who make complete reports of the good as well as the bad driving practices of drivers that they spot on the highways. Finally, the locked tachograph in the cab of every truck makes a record of road speeds, stops and the duration of the stops on every trip. Checked against the distance of the run, this record shows where the stops

Elevation scale showing heights on trucking run between San Francisco and Chicago







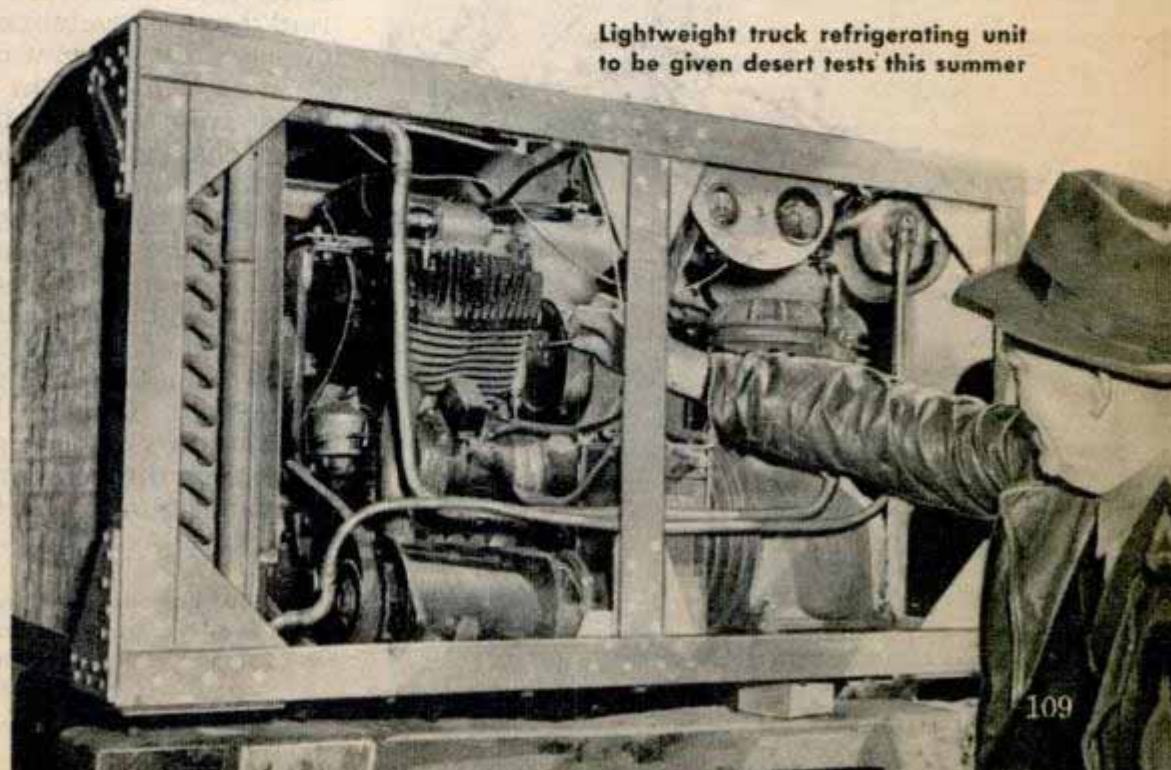
were made and the speeds that were maintained at all points.

P.I.E. uses Diesel tractors between Kansas City and the West Coast, and gasoline tractors in the flat territory from Kansas City to St. Louis and Chicago. Normally the intermountain run between Denver and Salt Lake City is made via the easy grades of Highway 30 through Wyoming. On tests, however, fully loaded vans have climbed up through the Rockies during blizzards, over the 11,314-foot summit of Berthoud Pass on Highway 40. P.I.E. has a corps of 275 "over the road" drivers and its rolling stock includes 136 power tractors and 221 semitrailers. Commodities of almost every description are carried between the nearly 200 cities and towns along its 12,000 miles of routes. By interconnections with other carriers it

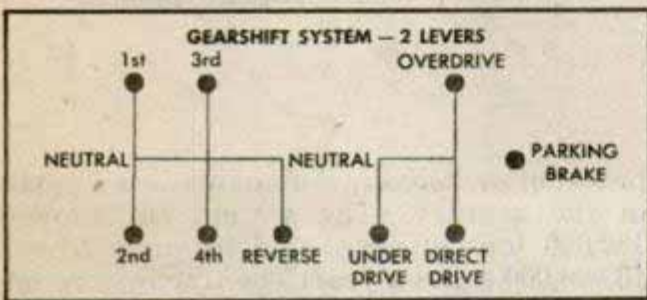
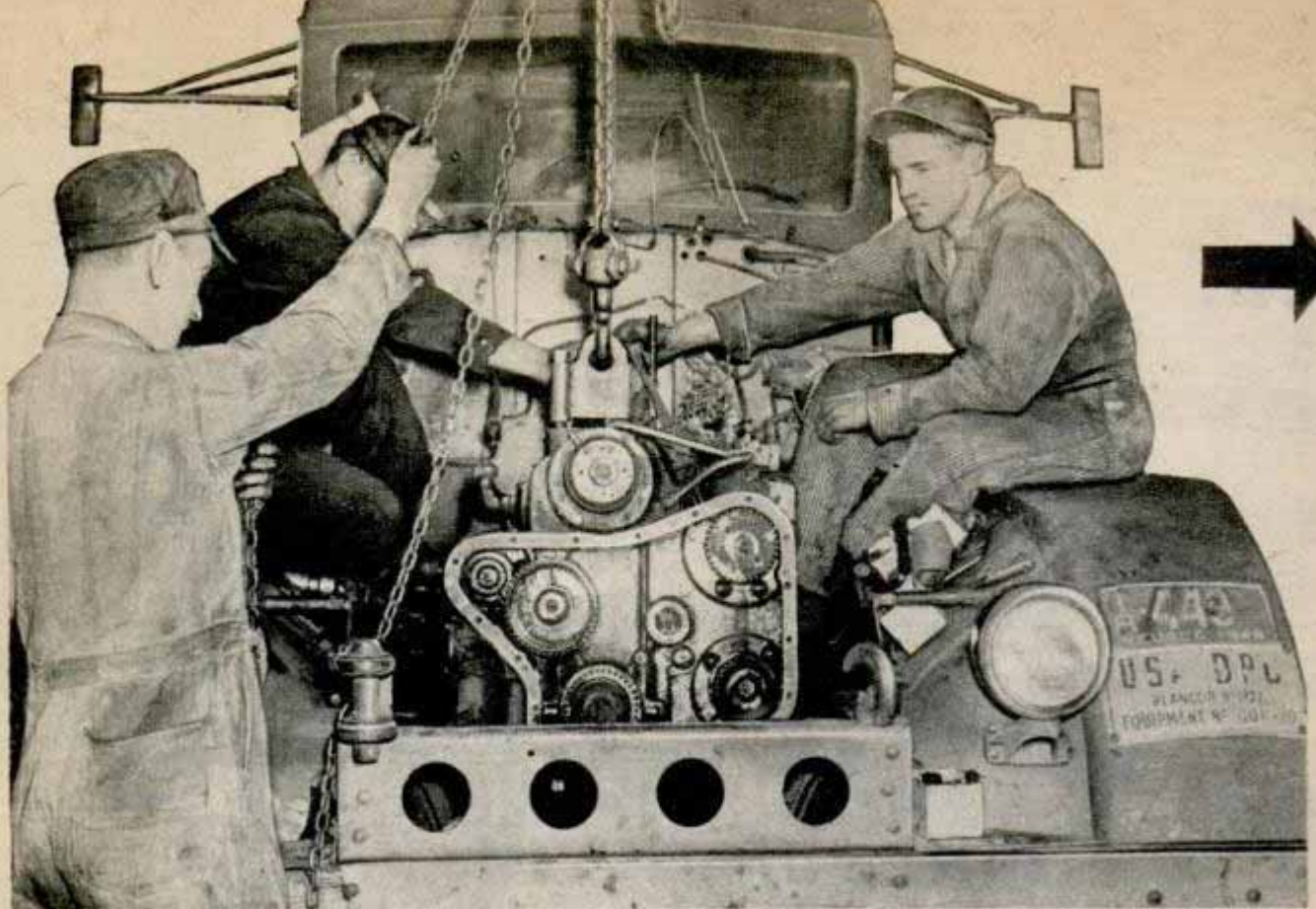
picks up or delivers shipments in all parts of the country. The system hauls over 150,000 tons of cargo and its units travel 18,000,000 miles a year. The tractors are on the road 90 percent of the time and some accumulate 200,000 miles in a year.

To keep its units moving on schedule and to avoid breakdowns on the road, P.I.E. has big maintenance and overhaul shops at its Salt Lake City headquarters. Under the direction of Harry Larson, fleet maintenance

Lightweight truck refrigerating unit to be given desert tests this summer







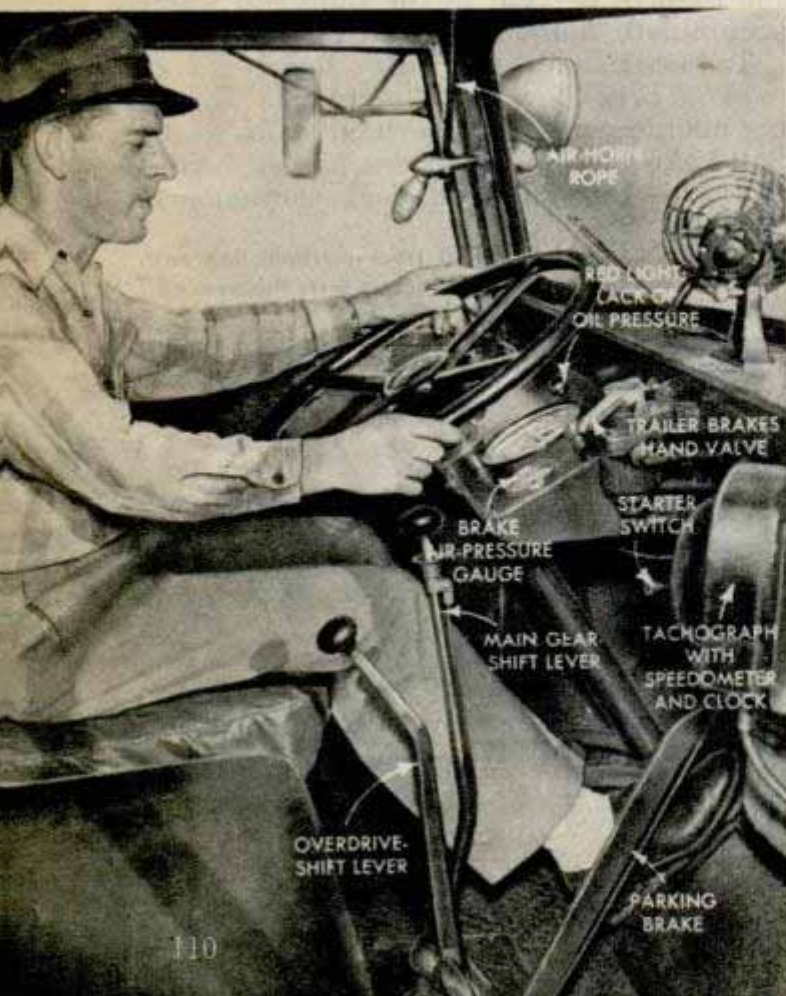
### Removing Diesel from a tractor for periodic overhaul

superintendent, a program of preventive maintenance is carried on so that all units receive inspections and overhauls based on mileage. Power plants, gearboxes, rear ends and accessory equipment are pulled out, according to mileages, to be restored to new condition, and are replaced from stock to keep the units moving. In effect, break-downs occur in the shop instead of on the road. "Squawk sheets" turned in by drivers are used as guides for incidental repairs.

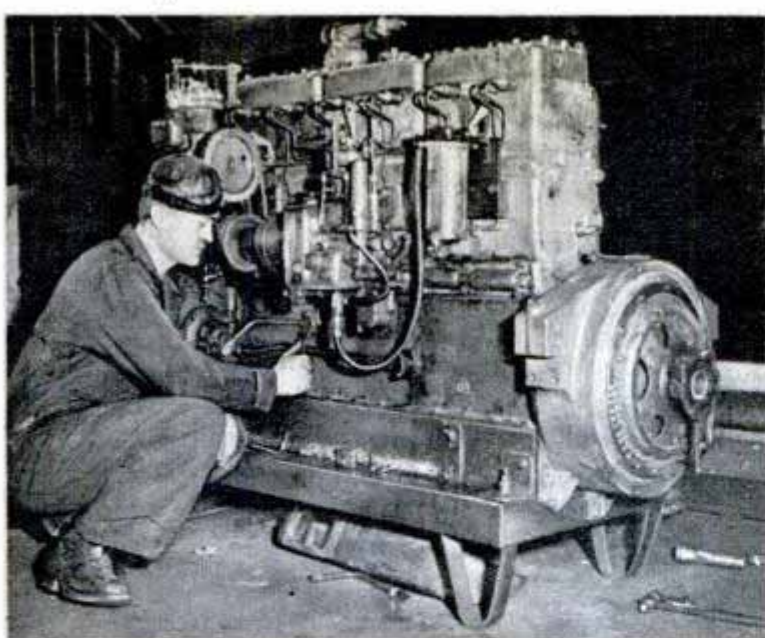
The truck lines are as vitally interested in lightweight equipment as the air lines. Every pound that can safely be removed from the gross weight of a tractor or trailer increases the amount of pay load that can be carried. One weight-saving development is the frameless semitrailer that has no heavy chassis. The sides of the van themselves are the structural members, being engineered like bridges to support the weight of the cargo, carried on cross members between the two sides.

Lightweight semitrailers 35 feet long are being built of stainless steel, and other vans consist almost entirely of aluminum and magnesium. One of the latter can carry four times its own weight. A recent development in the cement-hauling field is an all-magnesium truck train built by Permanente Metals Corporation. The tractor,

Cab of 200-horsepower Diesel tractor, with a diagram of the two-lever gearshift system. The new-type seats are equipped with built-in hydraulic shock absorbers







While another engine replaces it in the tractor, a Diesel starts disassembly for a complete overhaul

semitrailer and trailer have an over-all length of 60 feet and the unit can carry a pay load of 51,230 pounds under California highway laws, three tons more than usual.

In its campaign to save weight, Pacific Intermountain Express recently built in its own shops a big 200-horsepower tractor that weighs 14,000 pounds, two tons under the standard weight. This unit is to be the pilot model for an even lighter tractor that will weigh about 12,000 pounds. Designed by Harry Larson, the new unit will have aluminum axle housings, transmission casings, cab, fenders, running boards and engine hood.

Some time ago Larson cast a dissatisfied eye on the 1400-pound refrigeration plants that are used on the "reefer" trucks hauling frozen foods, whole sides of beef and other perishables. He redesigned the plant and brought its weight down to 700 pounds. Tested for months in temperatures as high as 120 degrees on the Nevada and California deserts, the lighter refrigeration plants have met all demands in maintaining an even zero temperature inside the insulated vans. Still dissatisfied, Larson has designed a new unit that weighs only 350 pounds and will be tested this summer.

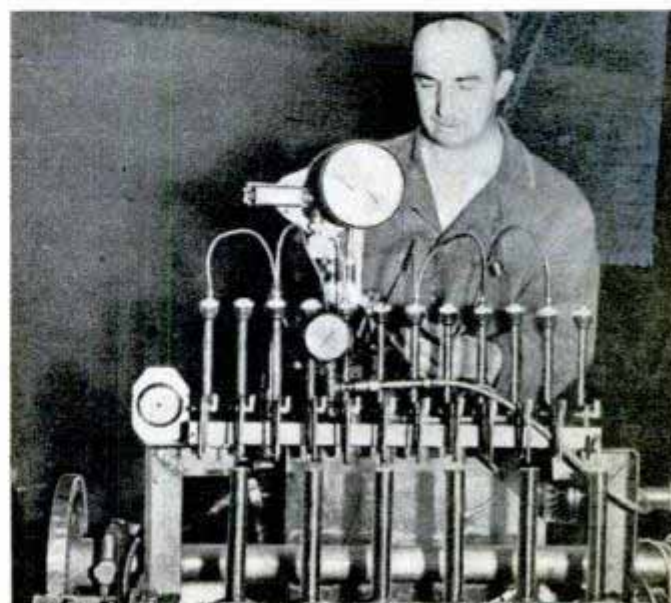
Highway trucking was pretty much a hit-or-miss industry a decade or so ago. It had its origin in the teamster business that moved goods from point to point inside a city. The industry expanded to a city-to-city basis when reliable trucks were developed. Eventually the big highway cargo systems were formed on the basis of "express service at freight rates." They make door-to-door deliveries between cities a hundred miles or a whole continent apart. Today they are a major element in the nation's huge transportation picture.



Maintenance is an around-the-clock affair. Mechanic balances pistons to match weight of six in full set



Gearboxes and rear-end gear assemblies mounted on test stand for complete teardown and overhaul. Below, a special device for testing and adjusting fuel pumps



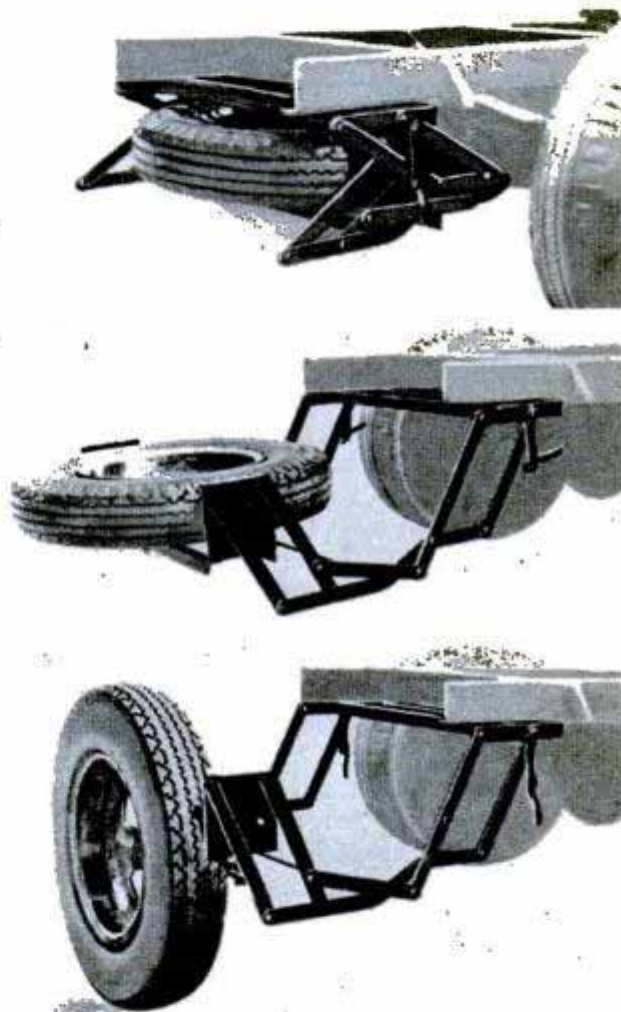




## Earphones Worn Like Stethoscope With Speaker Under Chin

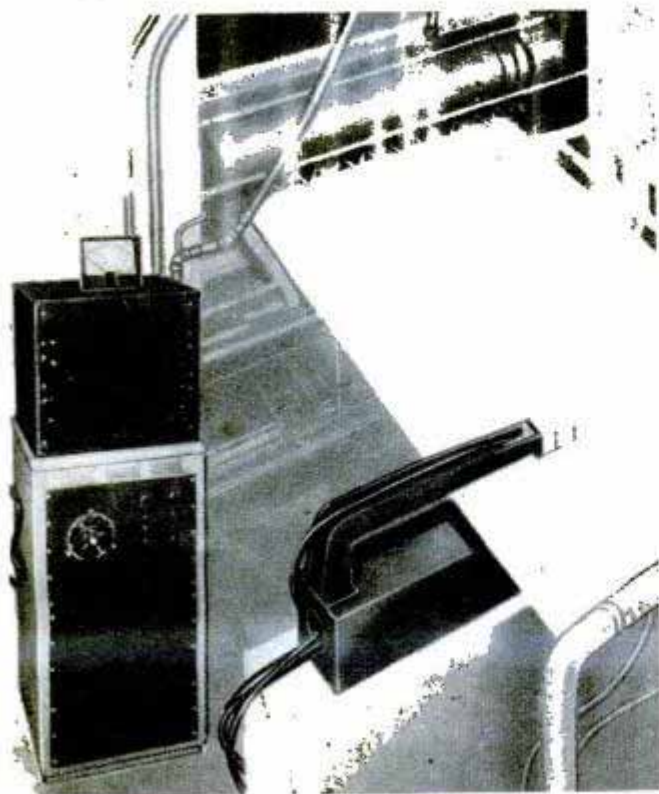
← Lightweight earphones for aircraft and railroad communications can be worn under the chin instead of over the head. Designed like a stethoscope, the earphones include a tiny round speaker and two hollow tubes with earpieces on the ends. Made of Tenite plastic, the set weighs only 1.2 ounces including the speaker and a miniature plug-in attachment. It is said to produce high-fidelity reception with a minimum of ear pressure and head fatigue.

## Tire Carrier Swings Heavy Spare Into Position for Changing



## X-Ray Gauge for Assembly Line Checks Thickness of Parts

Moving materials on production lines are measured for thickness with an X-ray gauge which does not touch the objects being manufactured. The gauge can be used on metals, paper, plastics, rubber or other material for continuous or spot-check measurements. It operates by comparing electronically the thickness of the material against a master sample with the required known dimensions. The thickness of metal tubing can be checked without cutting it.



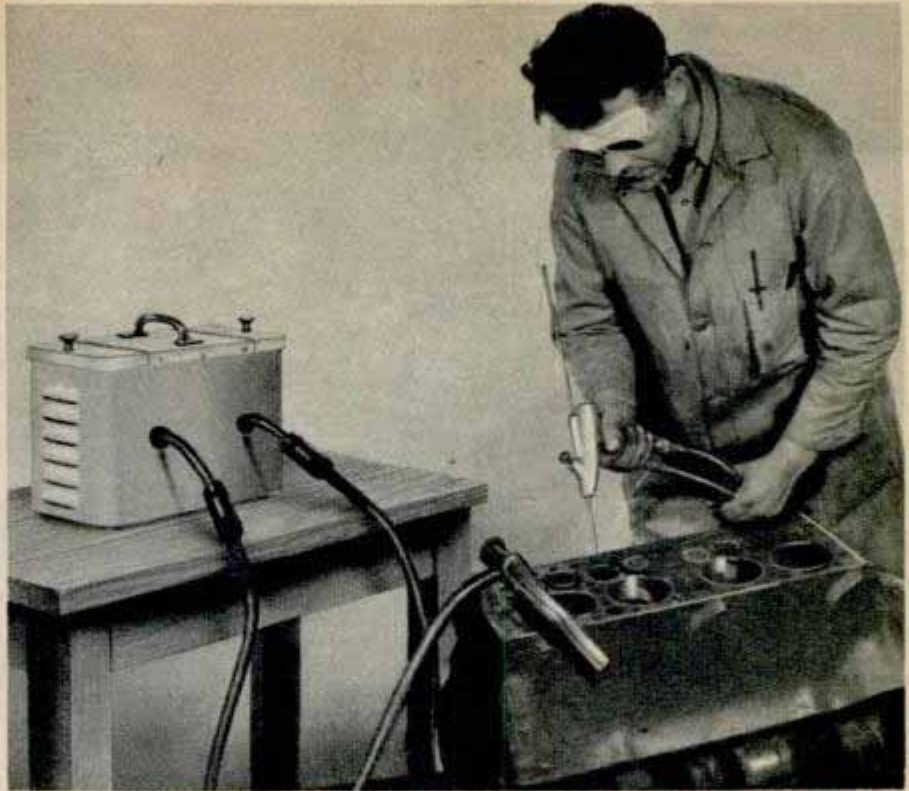
Spare truck or bus tires too heavy for one man to lift can be handled easily with the help of a tire carrier which clamps under the chassis. The carrier holds the tire out of the way under the body. When it is necessary to remove the spare, the carrier is pulled out and down so that the tire rests in an upright position ready to be detached and rolled into place. The replaced flat tire can be handled in the same way without lifting.

☛ Oatmeal porridge is now precooked and packed in hermetically sealed tin cans that need only to be heated before serving.



## Metal Applicator Provides Short Cut in Filling Engine Block Cracks

Cracked engine blocks are repaired speedily with a metal applicator that fills the crack with metal after alloy pins are put in place. Use of this electric tool eliminates the need for lining pins along the entire length of a channel, thus doing away with many drilling, tapping and peening operations. The applicator also is used to fill blow holes in castings and for brazing and soldering. Operated on 110-volt, 50-60-cycle power supply, the unit has a dual-purpose control switch which lowers the operating temperature in one position and raises the fusing temperature in another.



## Radiotelephone Service Links Remote Western Ranches to Cities

Several isolated western ranches are now linked by radiotelephone with the nation's local and long-distance circuits through the telephone exchange at Cheyenne Wells, Colo. On the ranches, a forked radiophone antenna is used. One side of the antenna broadcasts phone signals and the other receives them.

### Why Is the Ocean Blue?

Belief that the ocean is blue because it reflects the blue in the sky has been proved false by two scientists attempting to use light rays to detect submarines. They found that the millions of dirt particles in ocean water reflect sunlight back to the surface. But the light that gets back to the surface has been filtered through many feet of water. The water absorbs the red and yellow colors of light, leaving greens, blues and violets, which combined make up indigo blue, the usual color of deep ocean water. The scientists who discovered this were Dr. F. A. Jenkins, professor of physics at the University of California, and Dr. I. S. Bowen, director of Mount Wilson Observatory.







Europe's finest Alpine road—the 26-mile-long Sustenstrasse in

Switzerland—is now open to travel-hungry motorists. In 1938 the Swiss started carving this beautiful road through the Central Alps at an altitude of 7300 feet. Except for a short mobilization period, even the war failed to stop the construction work. Cold weather and snow were the main delayers, halting the project seven or eight months

## Switzerland's New Alpine Road

each year. Now the 22-foot-wide asphalt paving cushions the way for travelers from Wassen to Innertkirchen. There are well-banked, sweeping curves and the grade never exceeds 9.3 percent. Construction costs were approximately \$9,000,000. The photo above, taken at the highest point of the pass, shows the Alpine scenery typical of the area. Below, workmen complete the last section of the highway.

Authenticated News photos





## Tapered Cones on Stable End Mill Eliminate Need for Spring Collets

Two tapered cones on a new end mill fit into matching cones on the holder and cap to give the cutting tool greater rigidity and concentricity. A nut screws tightly over the conical surfaces to increase the stability. The novel holding arrangement eliminates the need for spring collets which sometimes cause ragged and uneven cutting. The tool will cut to a depth of  $1\frac{3}{4}$  inches, has a feed of  $5\frac{3}{4}$  inches per minute and a cutter speed of 202 r.p.m.



## Fluorescent Lamps Attract Insects That Threaten Japanese Rice Fields

Fluorescent lamps are now used by Japanese farmers to attract insects to death traps, replacing gasoline lights which have been blacked out by a severe fuel shortage. As dusk falls over the rice fields, the farmers turn on blue-colored fluorescent lights and leave them on all night.

## Self-Cleaning Pipe Has Lighter

For the convenience of pipe smokers a lighter is inserted in the bowl of a pipe, ready to ignite tobacco by a flick of the thumb. Another feature of the pipe is a special piston that can be pulled out of the pipe barrel easily, removing bitter tar oil and moisture and providing a sweet, cool smoke.

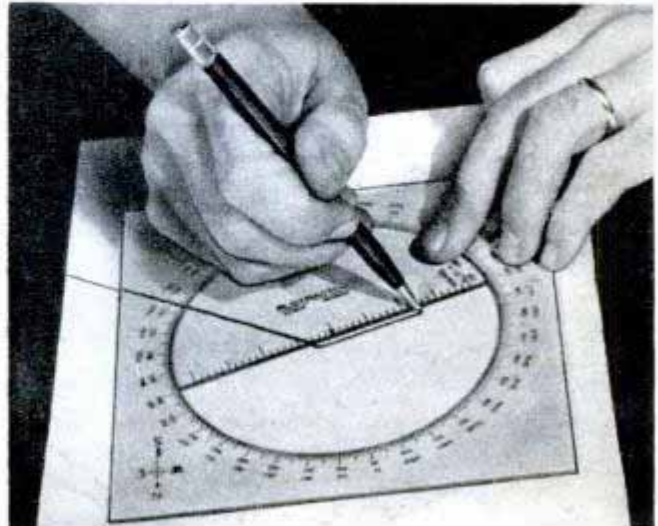


## Revolving Rotor in Protractor Calibrated Like Transit

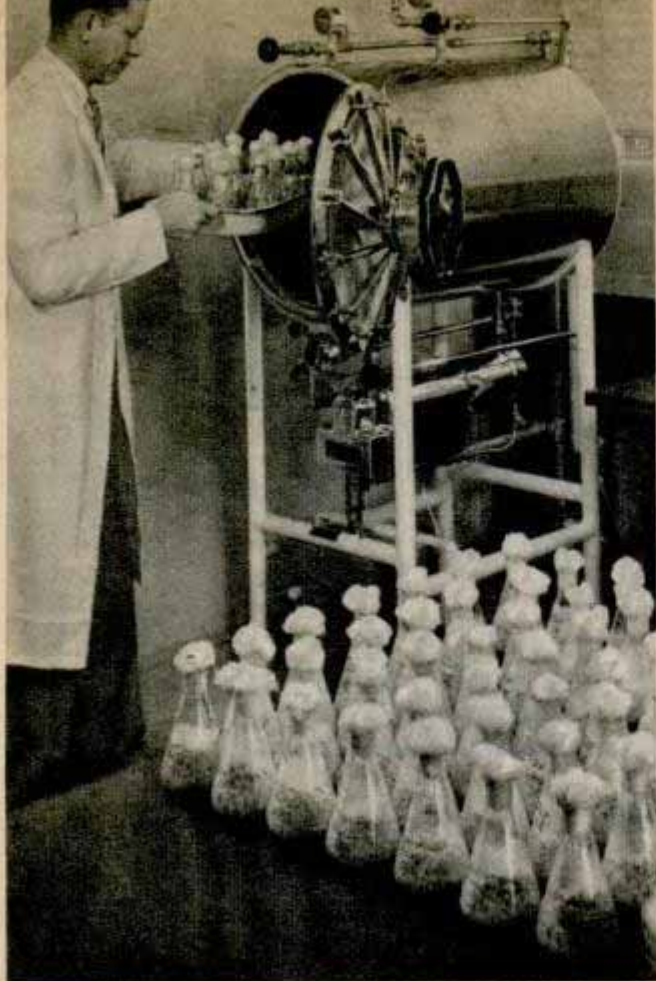
Calibrated the same as a surveyor's transit, a plastic protractor has a rotor which revolves a full 360 degrees. With the device it is possible to calculate angles directly from bearings, eliminating the figuring of interior and exterior angles. It is easy to handle and reduces the time required by usual protractor methods. It is also useful in dead reckoning navigation problems.

## "Death Ray" Machines Are Harmless

Of the 25 or more "death ray" machines invented during World War II, not one proved effective, according to Dr. Albert F. Murray, formerly with the Office of Scientific Research and Invention, who investigated all of them. Dr. Murray's specifications for a successful death ray include: (1) Burn a half-inch hole through a four-inch plank in five seconds; (2) burn a live tree six inches in diameter at a distance of two miles in three minutes; (3) kill small animals, such as guinea pigs, rats and rabbits, at 5000 feet in three seconds.



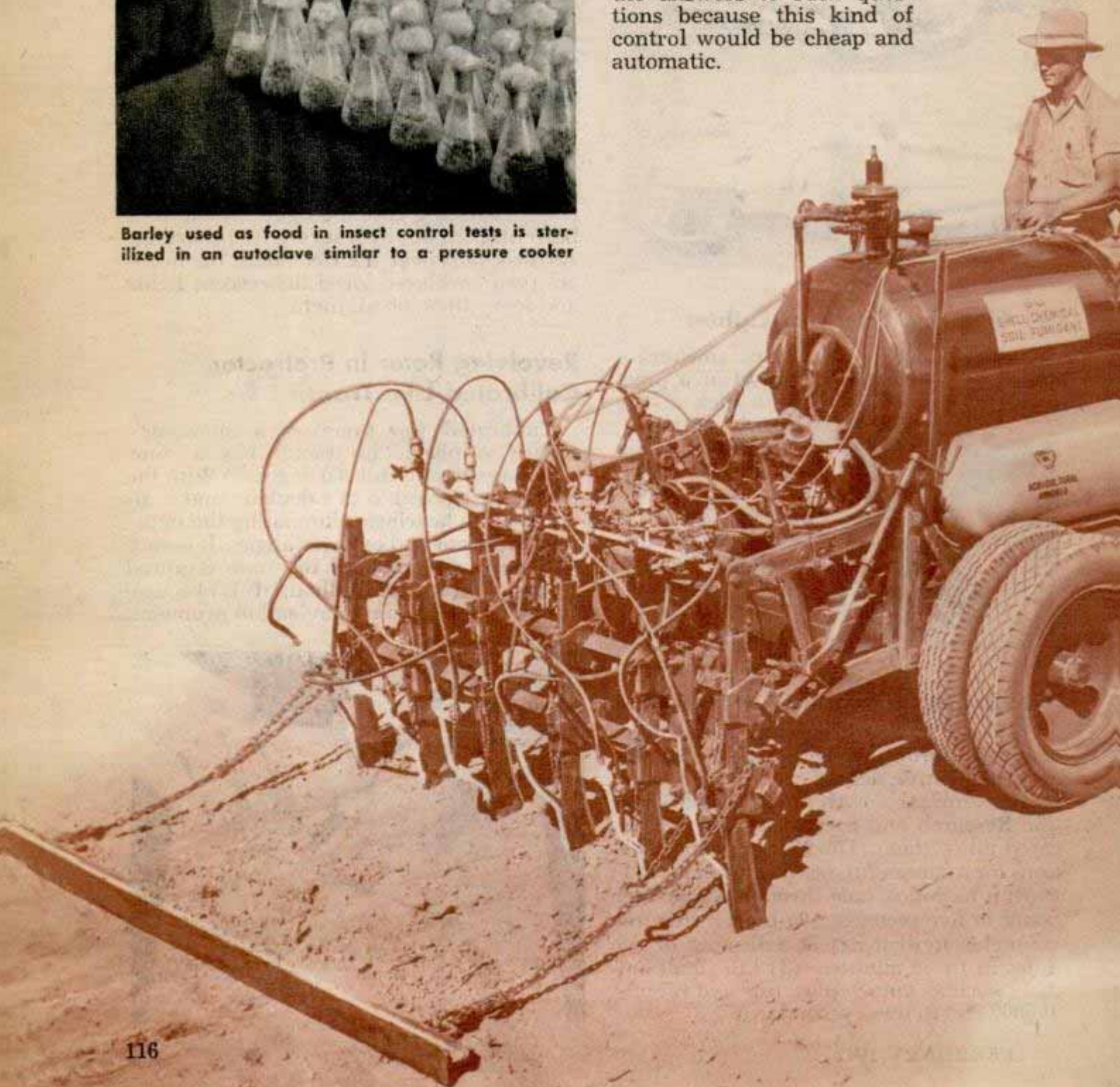




Barley used as food in insect control tests is sterilized in an autoclave similar to a pressure cooker

**B**IOLGICAL WARFARE has been opened against insect enemies of man. Taking advantage of the fact that bugs, like human beings, are subject to a variety of diseases, scientists have embarked upon a campaign to control the insects that destroy crops by spreading disease among them.

Why not annihilate a heavy infestation of codling moths in an apple orchard by starting a virus epidemic among them similar to influenza in man? How about broadcasting a deadly pestilence comparable to typhus that would decimate the chinch bugs in an area? Entomologists are seeking the answers to such questions because this kind of control would be cheap and automatic.

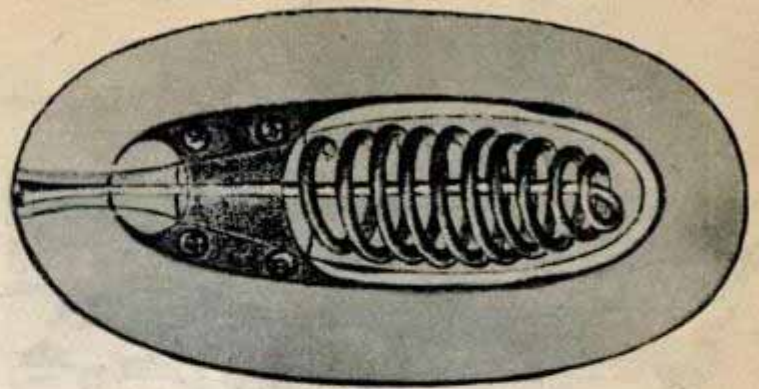




# WARFARE AGAINST BUGS

Biological warfare against insect pests has been an almost unexplored field in the past. Now it is receiving the full-time attention of a new insect pathology laboratory just established on the Berkeley campus of the University of California. Under the direction of Dr. Edward A. Steinhaus, a research group is seeking and testing microorganisms that are destructive to insects but harmless to man, animals and plants. Effective ways are being sought to make disease germs cause violent, devastating contagions among insect populations.

Such epidemics or epizootics occasionally

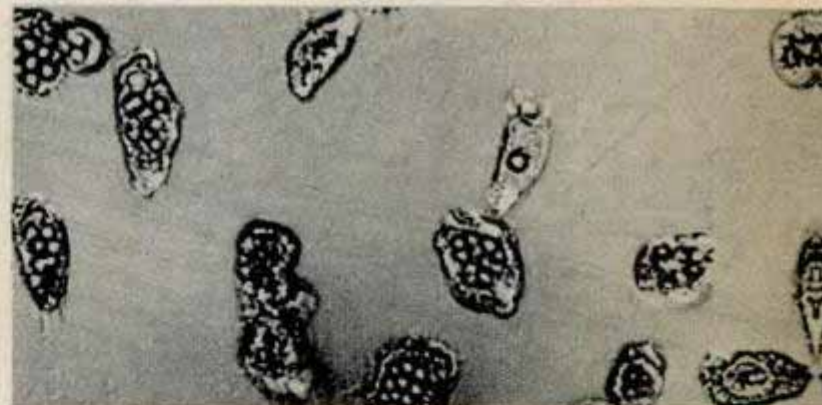


▲ Cutaway sketch shows filament coiled inside protozoan that attacks certain insects and causes disease



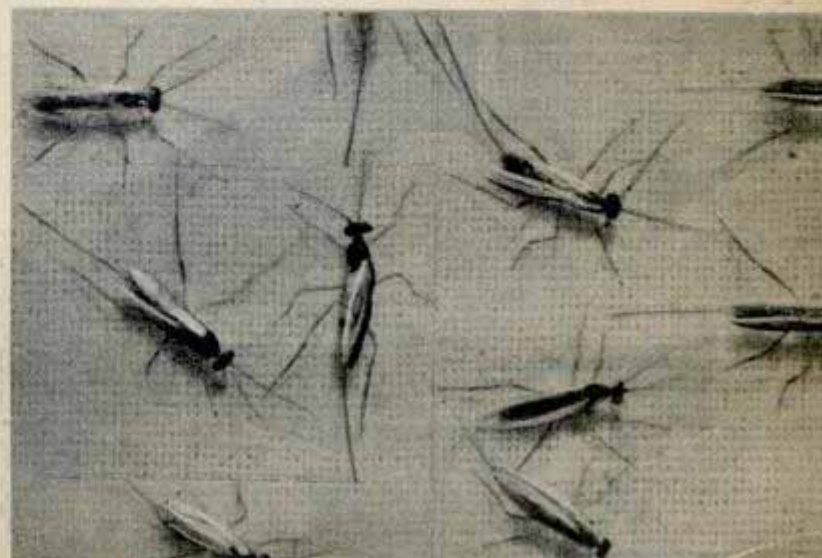
Photomicrograph by Dr. Edward A. Steinhaus

▲ Greatly enlarged photo of rodlike bacillus which induces disease in corn borers and cabbage butterflies



Photomicrograph by Dr. William Traeger

Virus injected into insect tissue cells causes the appearance of white dots. Below, parasitic wasps kill Oriental fruit moths and other insect pests



Double injection spreads fertilizer and kills destructive nematodes at same time. Expansion of liquid ammonia fertilizer has covered injector pipes with white frost





Studying effect of a new chemical on darkling ground beetles

occur in nature. Now and then a farmer whose alfalfa crop is about to be destroyed by the alfalfa butterfly suddenly finds that all the caterpillars have mysteriously died, ending the threat to his crop. Similarly, Canadian foresters have noted that a horde of spruce sawfly causing widespread ruin in a spruce forest may suddenly succumb to an unknown malady. These are only two of many instances.

Apparently each variety of insect is plagued by one or more diseases that afflict its kind. Just how or why such a disease suddenly flares up to epidemic proportions is unknown and, in many cases, not even the microorganism that is responsible has been determined. Only recently, for instance, was it discovered by Dr. Steinhaus that a certain virus is the deadly agent in California that attacks the alfalfa butterfly in its caterpillar stage.

Lack of enough knowledge may be the reason why some efforts at germ warfare have been unsuccessful in the past. Attempts to create artificial epidemics among swarms of locusts and grasshoppers have had only indifferent results although these insects are susceptible to diseases. Research workers are optimistic now about their chances of controlling these pests some time in the future.

The best-known example of successful biological control is the checking of the Japanese beetle along the Atlantic seaboard by a spore-forming bacterium that produces a so-called milky disease in the beetles. Once a fearsome threat to vegetation, the beetle to a large extent has been kept under control since the infectious agent was discovered and put to work.

Disease campaigns have been started in the University of California laboratory against scale insects that infest citrus groves, the codling moth that is found in



Potatoes are used at the University of California in production of parasitic wasps for insect control studies. Below left, inoculating test plates with plant disease organisms. Right, treating soil with a fumigant that destroys wire worms







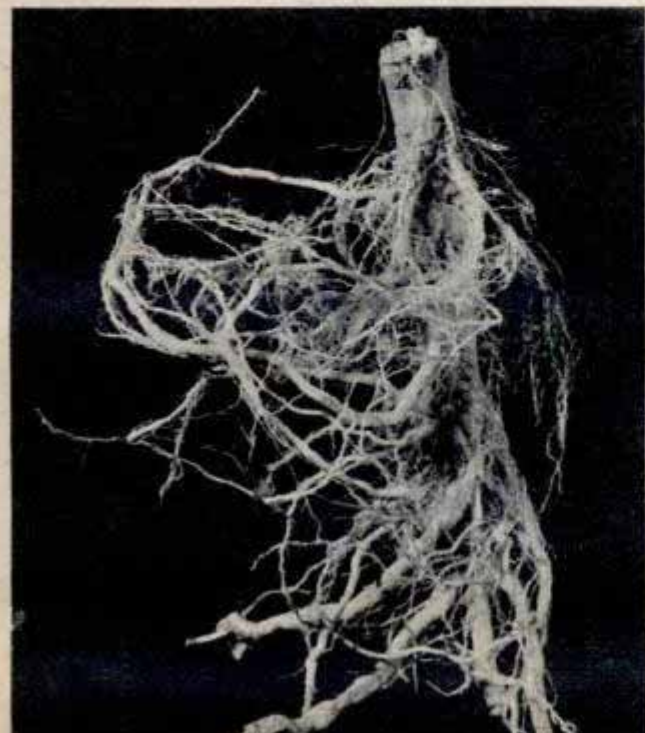
**Nitrogen fertilizer is metered from tanks and added to water in irrigation ditch to kill certain earthworms**

some deciduous orchards, the alfalfa butterfly, and certain leaf-eating caterpillars that are classed as forest defoliators. Soil pests, including grubs and weevils, also will be investigated, and experiments conducted with bacteria, fungi, viruses and protozoa that have fatal effects on certain in-

sects. Quite possibly some of the germ-dispensing agents such as mists and smokes that were developed during the war will be useful in spreading diseases among insects.

Dr. Steinhaus stresses the facts that research has just been started, that much of it will be basic in nature for a time, and

**Healthy tomato plant has many hairlike feeding roots**



**Diseased tomato plant like this produces very little**







that immediate spectacular results are not anticipated. Biological control, he adds, will be attempted mainly against those agricultural pests that are not being satisfactorily controlled by other means. Some injurious insects are kept under control by the use of predator or parasite insects that are raised in insectaries and then released in the fields and orchards. Other pests are controlled by chemical warfare that employs various insecticides. There is no immediate need for biological warfare against flies and mosquitoes, for example, since these pests are easily controlled with DDT.

In the case of some pests the scientists expect that biological warfare might be useful in over-all long-range control and that insecticides could be used for immediate protection in case of local outbreaks. In the meantime several new insecticides, just discovered, are providing farmers with new weapons against some of their most destructive pests.

Biological warfare may also be a means of eradicating weeds, wiping out whole populations of undesired or noxious plants. That doesn't mean that disease germs or insects can be made to kill off all the miscellaneous weeds on a farm, leaving the crops untouched. The problem consists rather in finding and introducing diseases or insects that are selective against certain plants that need to be controlled. The Klamath weed that got a start on the West

(Continued to page 252)

Spraying deadly virus mist on alfalfa infested with caterpillars. The plant is not affected by the virus



## Turret-Control' Tug Turns in 28 Inches

Steering controls and power unit are enclosed in a cylindrical turret on a materials handling tug designed for greater maneuverability. The engine, automatic clutch, automatic transmission and driving wheel are mounted inside the turret. The entire assembly is turned to steer the vehicle or to back up, eliminating need for reverse gears or elaborate steering mechanism. The tug is powered by a six-horsepower engine and can travel eight miles an hour. It can turn in a 28-inch radius.

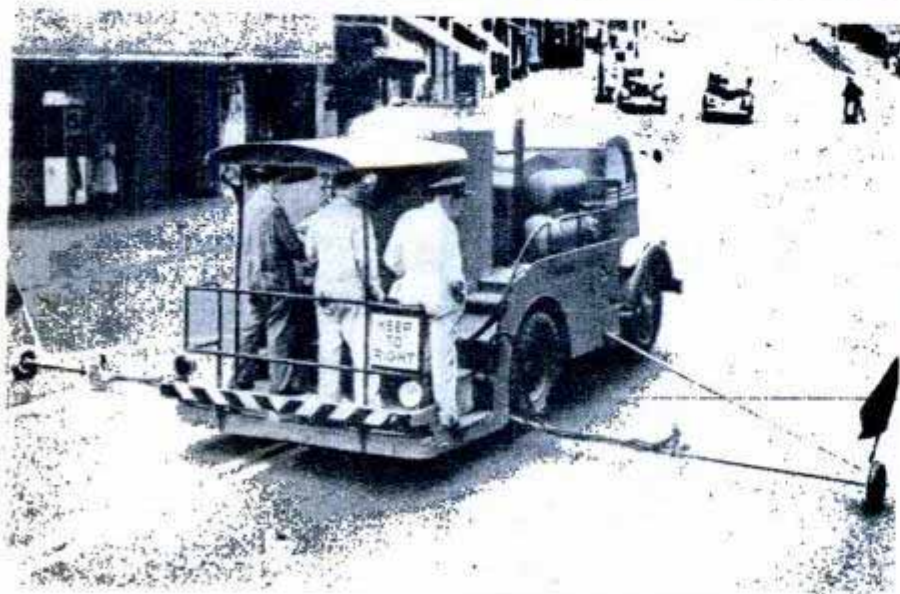


## Charcoal Canisters Keep Apples Fresh

Apples in storage stay fresh about 20 percent longer when containers of charcoal are hung in the storage room to delay ripening. Experiments at Cornell University show that if one percent of the apples in a storage chamber are riper than the rest they give off enough ethylene gas to ripen the others 25 percent faster. The charcoal canisters strain the gas out of the air in the same way a gas mask does its job. About 2½ pounds of charcoal will prolong the life of 250 bushels of apples, it is said. In addition to delaying the



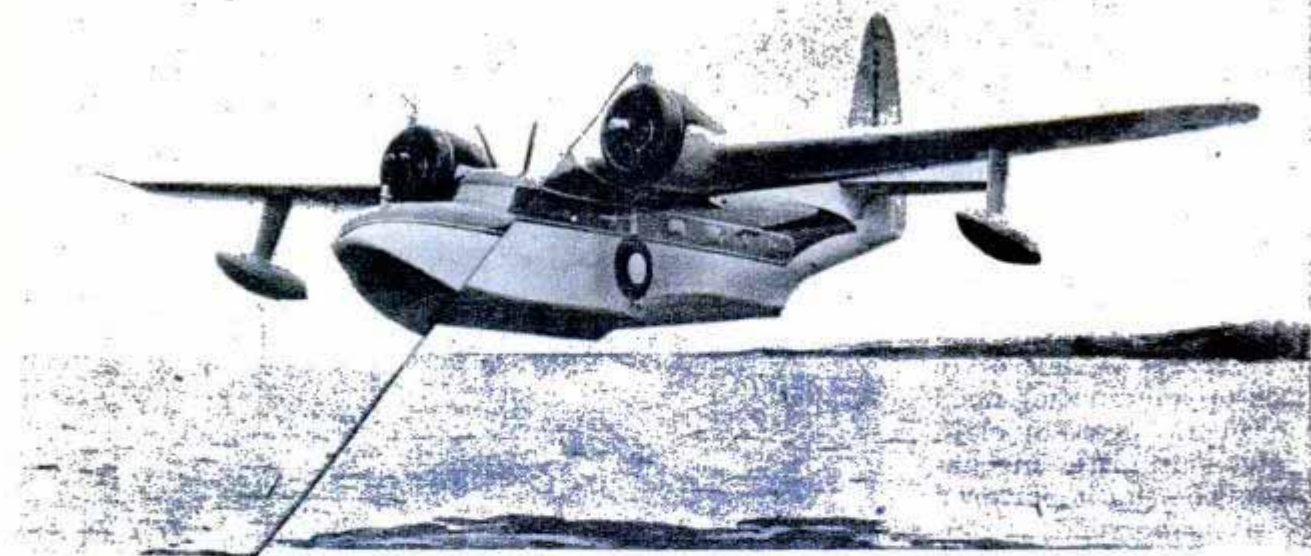
ripening process, the charcoal helps prevent a storage disease called "scald" and absorbs all odors in the storage chamber.



## Mobile Traffic Striper Paints 25 Miles a Day

Traffic stripes can be painted on 25 miles of highway in one day with a mobile striper designed and built by Carl Sohmer of Tacoma, Wash. Three men operate the machine. The paint is delivered through rolling power sprays. The power unit and compressor are mounted on a truck. The striper lines 12 blocks of city streets in 12 minutes, using 80 gallons of paint.





Safety is emphasized in the Grumman Mallard amphibian, with a rugged hull that can take wheels-up emergency landings on uneven ground with little or no damage. A deep flare in the hull bottom is designed for smoother water landings and quicker take-offs. The luxurious interior of the Mallard accommodates 10 in two compartments. Its cruising speed is 180 miles an hour, high for an amphibian, and range is over 1000 miles. Twin engined, the plane's wing span is 66 feet 8 inches, length 48 feet 4 inches and gross weight 12,500 pounds.

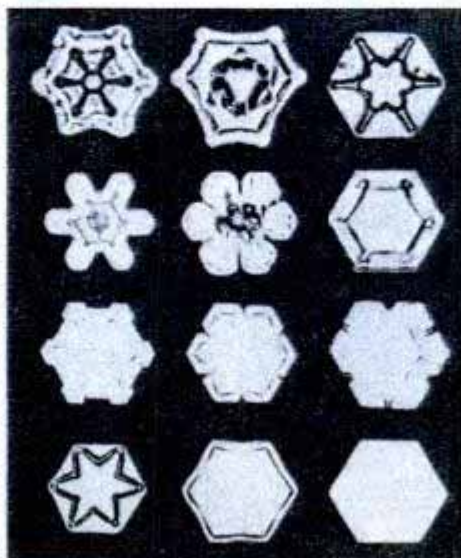


### Dry Ice "Seeds" Planted in a Cloud Produce a Crop of Artificial Snow

Snow for a white Christmas, winter sports or the storage of water for spring irrigation of crop land can be made to order with dry ice pellets and a cloud. In demonstrating the weather-making achievement for the first time, a three-mile-long cloud

was turned to snow with six pounds of pellets dropped into the cloud from an airplane flying at 14,000 feet. The dry ice serves as "ice seeds" which start to freeze the supercooled water droplets of the cloud. Once started freezing, the droplets grow

into snow crystals. In a few minutes the snow crystals replace all of the original droplets and the cloud becomes snow. Dr. Vincent J. Schaefer created the first artificial snow in a cold chamber at the General Electric Research Laboratory.



From the waters around Bikini, site of the atomic bomb test, a total of 39,000 fish representing about 250 species was obtained for the Smithsonian Institution.



# WHALE FACTORY

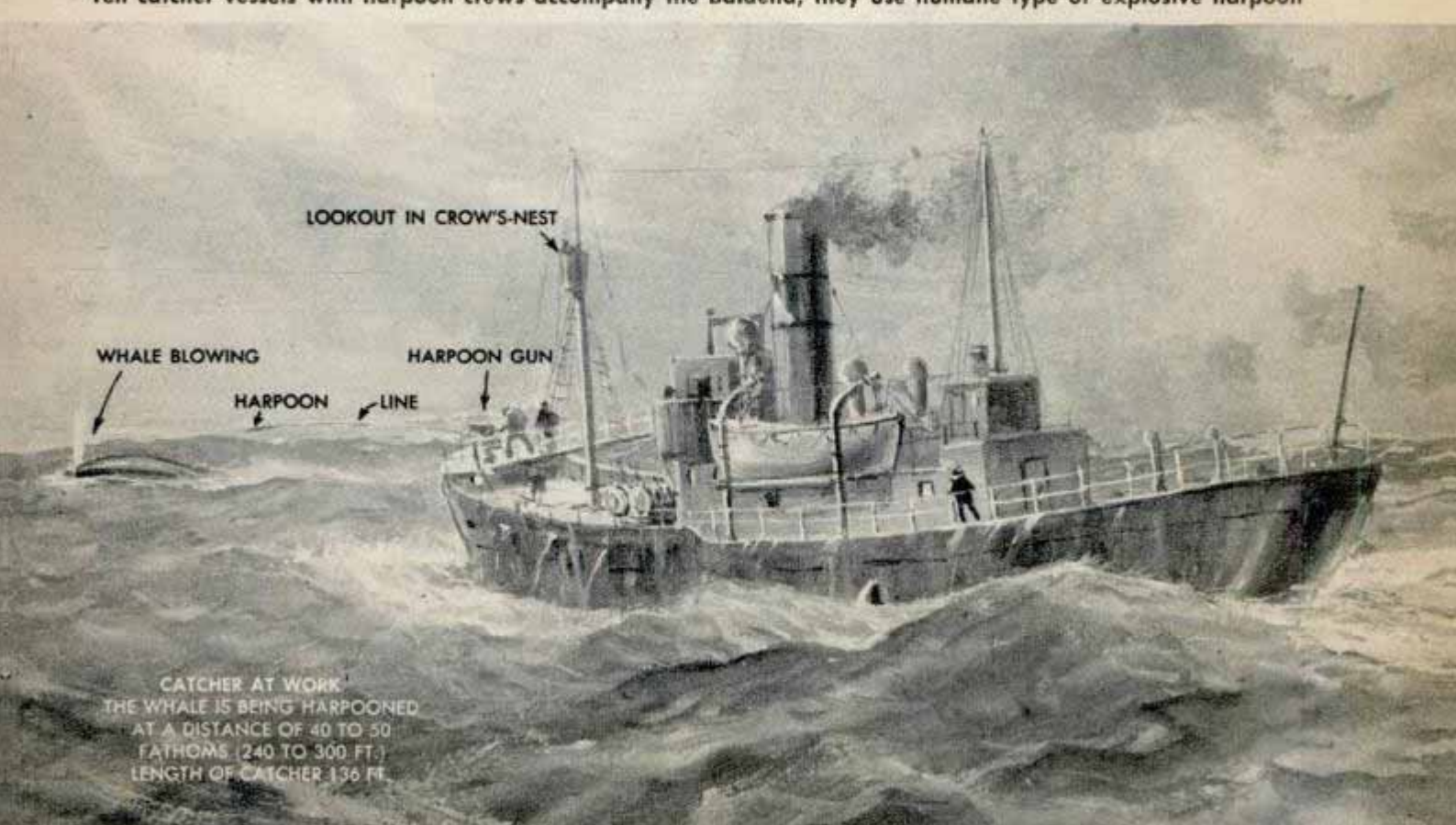
**W**HALING has gone modern in a big way aboard the Balaena (Latin for whale) which uses radar to dodge icebergs and three amphibian planes to spot its quarry. The planes, housed in a hangar on the stern and launched by catapult, radio the position of spouting whales to harpoon crews on smaller catching vessels which supply the factory ship. The Balaena, now operating in Antarctic waters, has a flensing, or blubber stripping, deck large enough to process four giants of the sea at once. Bulges to port and starboard give increased area to the deck.

The most modern machinery for utilizing every portion of the catch includes pressure boilers for treatment of blubber and bone, liver extraction plant, meat meal plant, deep-freeze lockers and other auxiliaries. The tanks in the hold (shown in the cutaway drawing by G. H. Davis, English artist, on the next two pages) have a capacity of 19,150 tons of purified whale oil. They are emptied from time to

No place for ancient mariners is the Balaena, new whaling ship equipped with radar and hangar for spotter planes. It carries crew of 430 men

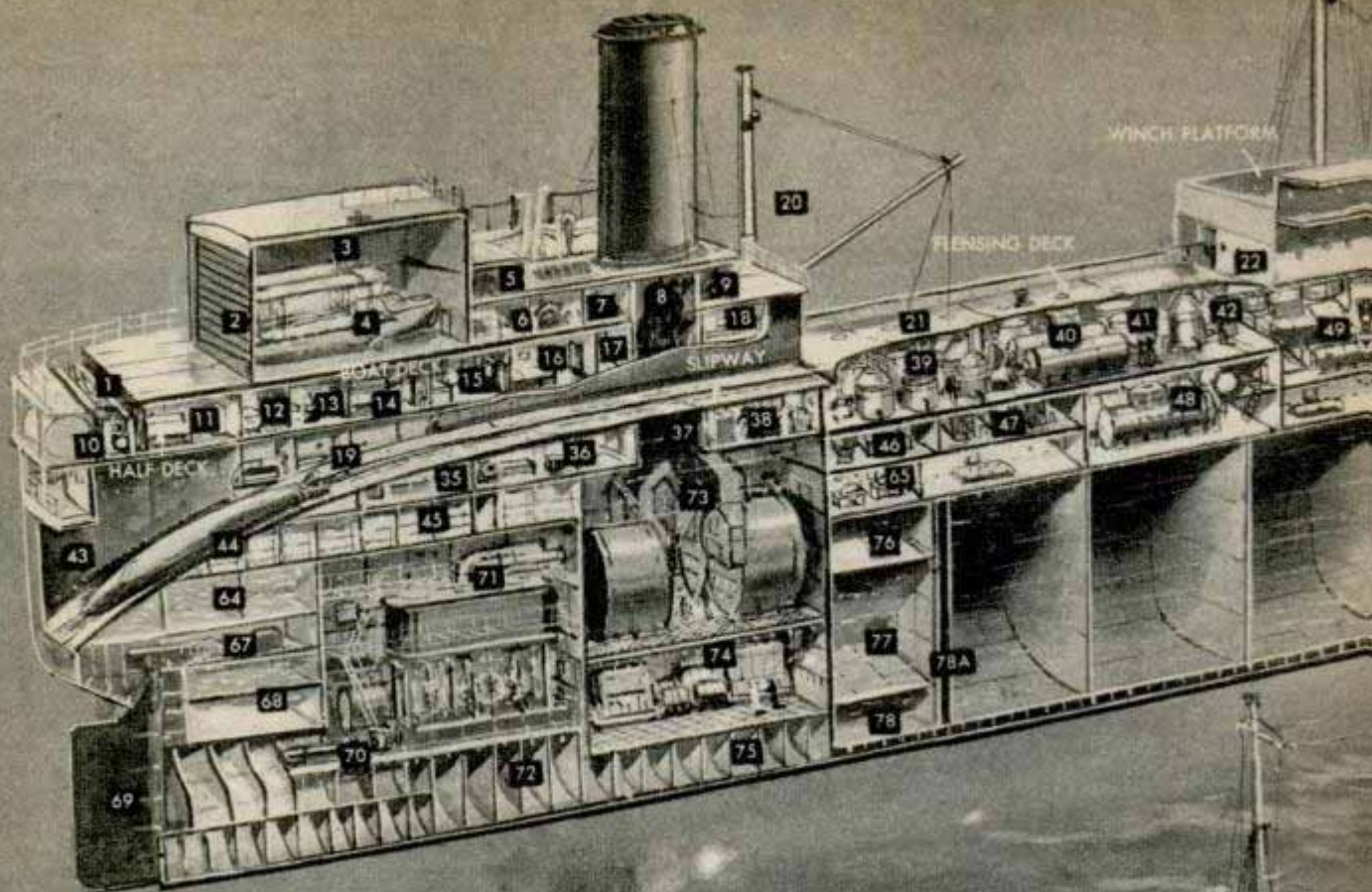
time and the oil sent home in tankers. The British hope that a good whaling season will help ease the fat shortage. Also, experts from the Ministry of Food are on board the Balaena to study ways of making lean whale meat palatable. Fully equipped laboratories are available to chemists and other governmental researchers on the ship.

Ten catcher vessels with harpoon crews accompany the Balaena; they use humane type of explosive harpoon

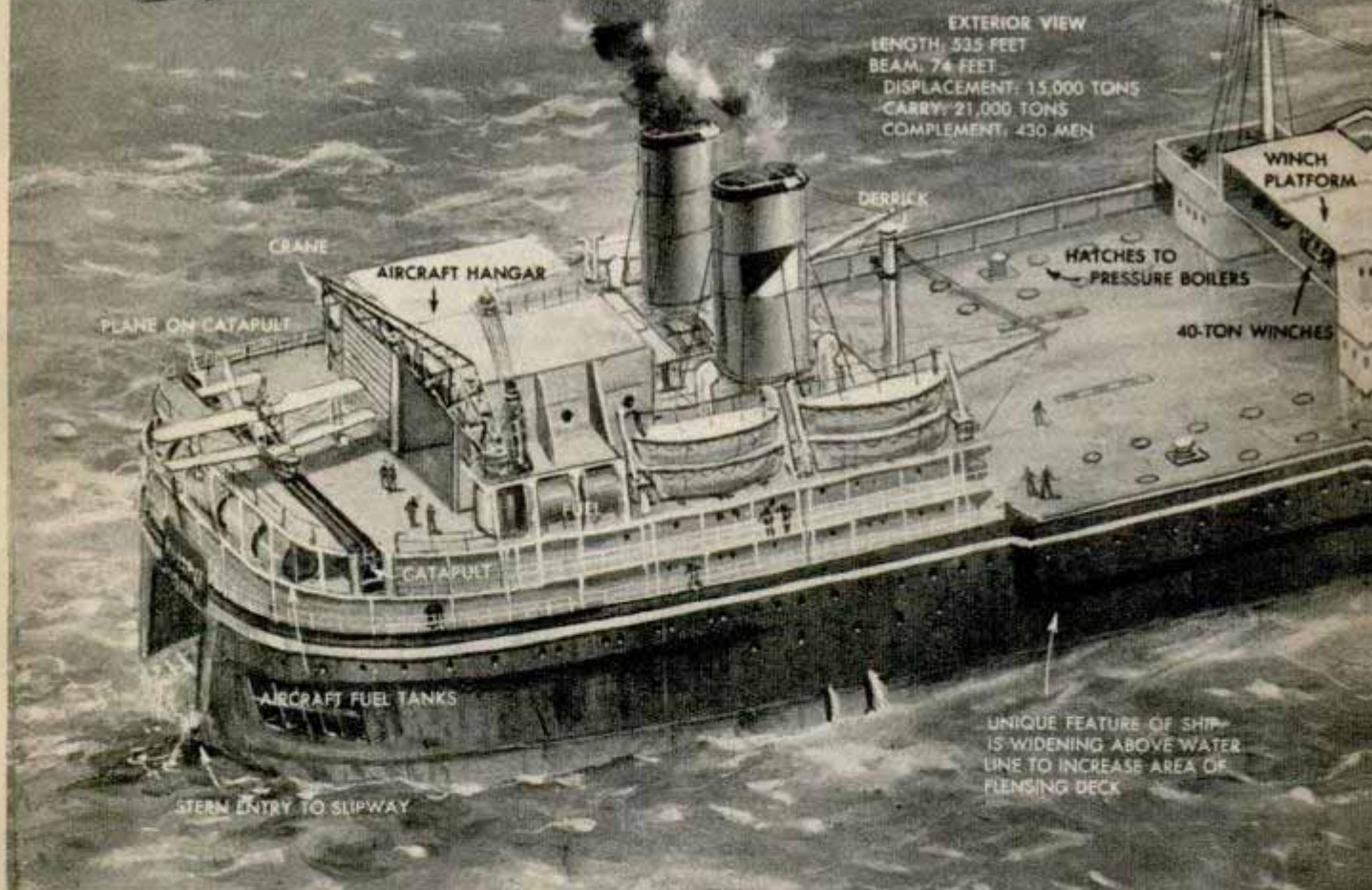


**CATCHER AT WORK**  
THE WHALE IS BEING HARPOONED  
AT A DISTANCE OF 40 TO 50  
FATHOMS (240 TO 300 FT.)  
LENGTH OF CATCHER 136 FT.





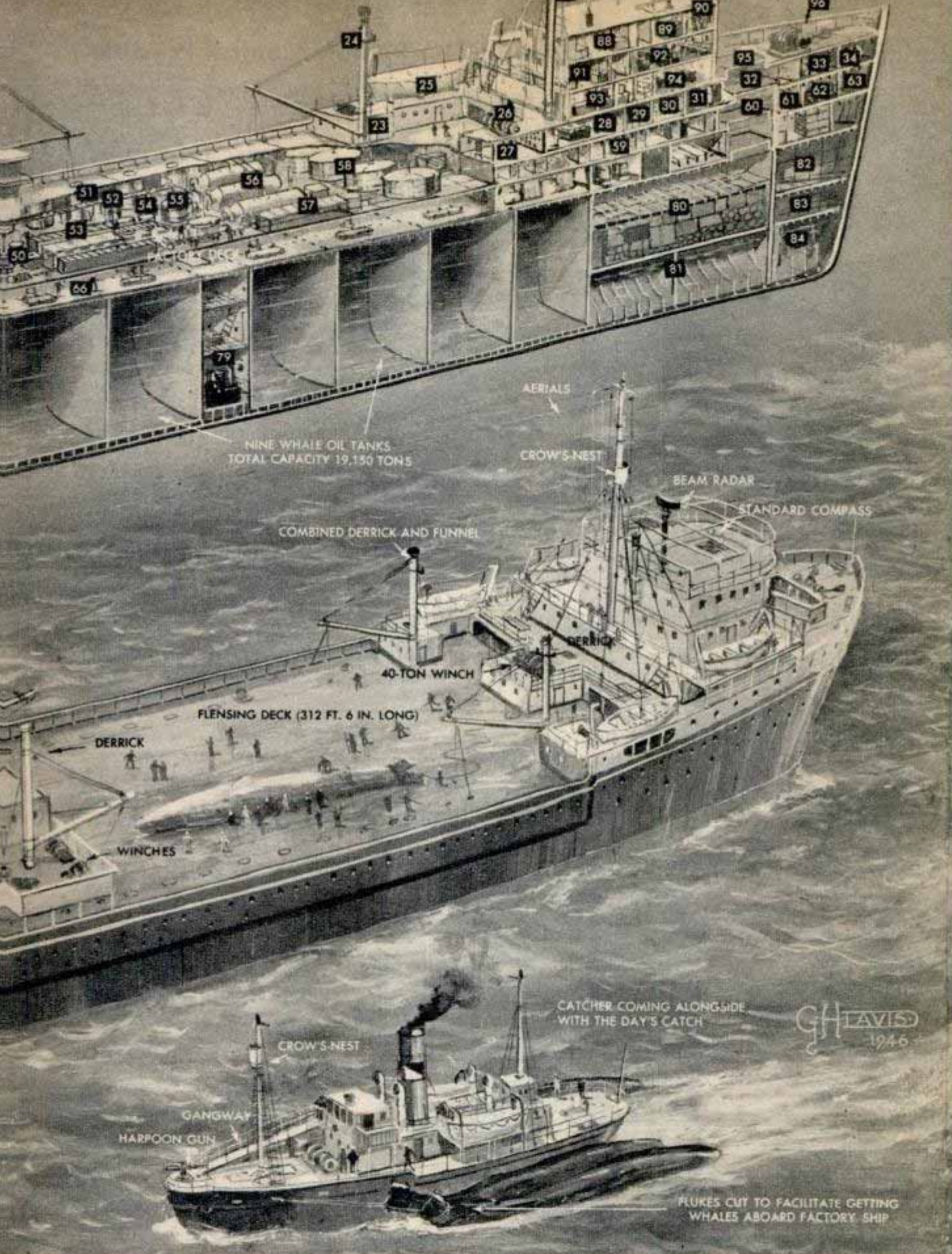
EXTERIOR VIEW  
 LENGTH, 535 FEET  
 BEAM, 74 FEET  
 DISPLACEMENT, 15,000 TONS  
 CARRY, 21,000 TONS  
 COMPLEMENT, 430 MEN



Sectional view of English whale factory ship shows, on boat deck: (1) aircraft catapult, (2) hangar roller shutter, (3) port hangar, (4) aircraft, (5) fans, (6) aircraft workshop, (7) fans, (8) port funnel uptake, (9) fans. On the halfdeck: (10) aircraft fuel tanks, (11) hospital, (12) bathrooms, (13) doctor's consulting room, (14) doctor's cabin, (15) dental surgery, (16) dental surgeon's cabin, (17) gangway, (18) assistant surgeons. On the flensing deck: (19) cookers' cabins, (20) derrick, (21) hatches to pressure boilers, (22) blacksmith shop, (23) carpenter shop,

(24) derrick and funnel, (25) lifeboat, (26) 40-ton winch, (27) electrical control room, (28) galley, (29) butcher shop, (30) pantry, (31) bakery, (32) hatch, (33) stewards' store, (34) boatswain's store. On upper flat: (35) seamen's laundry, (36) stewards' laundry, (37) funnel uptake, (38) bone drying plant, (39) blubber boilers, (40, 41 and 42) processing tanks. On the factory deck: (43) stern entrance to slipway, (44) whale being drawn up slipway, (45) cabins for workers, (46) drier, (47) meat meal plant, (48) separators, (49) liver plant, (50) mixture tanks,





(51) pressure boilers, (52) conveyor, (53) driers, (54) settling tanks, (55) separators, (56) cookers, (57) cutting machinery, (58) driers, (59) freezing compartment, (60) hatch, (61) harpoon stores, (62) chain lockers, (63) stores. Lower flat: (64) fresh water tanks, (65) knife sharpening room, (66) tank tops. Lower hold: (67) steering gear, (68) water ballast tanks, (69) rudder, (70) propeller shaft, (71) triple expansion steam propulsion engine, (72) fresh-water tanks, (73) boiler room, (74) generators, (75) fuel tanks, (76) Diesel oil tanks, (77) settling

tank, (78) fuel tank, (79) pump rooms, (80) fore-hold, (81) fore deep tanks, (82 and 83) fresh-water or ballast tanks, (84) reinforced bow frames. Bridge and superstructure: (85) foremast, (86) beam radar, (87) master compass, (88) wireless cabin, (89) captain's chartroom, (90) wheelhouse, (91) officers' cabins, (92) dining room, (93) officers' and chief stewards' cabins, (94) mess and smoke rooms, (95) hatch, (96) windlass. This cutaway drawing was made of the new Balaena, 15,000-ton whaling ship built in Belfast for United Whalers Ltd. of London.



## Radio Guided Tractors Make Plowing by Remote Control Possible



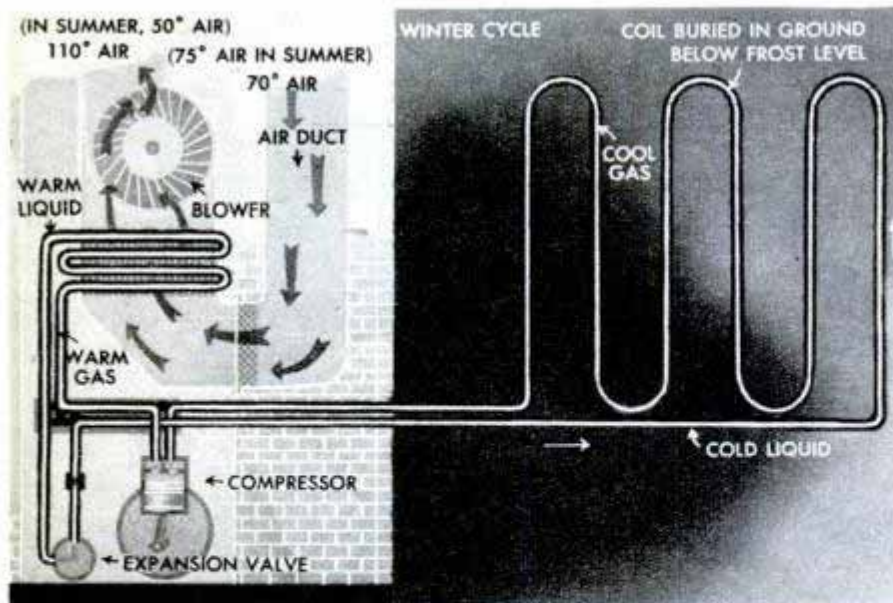
One farmer soon may be able to plow a half dozen fields at the same time with radio controlled tractors. At Barnet, Hertfordshire, England, radio signals direct the tractor along a straight furrow, raise the plow when the end of the furrow is reached and cause the machine to turn either right or left. One man directs the tractor movements through a tiny master switch. The radio impulses operate electrical relays in the receiver. These, in turn, operate compressed air servomotors mounted on the tractor and controlling its movements.

## Heating-Cooling Unit Uses Temperature of Earth as "Fuel" Source

Year-round temperature control for homes is provided by a small unit that utilizes the moderate temperature of the ground below frost level as a "fuel" source to provide heat in winter and cool air in summer. A refrigerant, Freon, circulates through the unit which operates on the same principle as an electric refrigerator. Heart of the unit is a coil buried in the

ground outside the home. The refrigerant, in a cold liquid state in winter, circulates through the coil where it picks up heat from the comparatively warmer ground and is vaporized. The vapor passes through a compressor which boosts it to a higher pressure and temperature. When the hot vapor passes through an air coil, the heat is extracted by the air stream and circulated through the home.

The refrigerant, cooled by the air, condenses and passes through an expansion valve where pressure and temperature are reduced to make it a cold liquid again. From the valve it goes to the ground coil to complete the cycle. In summer the function of the ground coil and air coil are reversed to cool the house air. No chimney is required for the unit, which is about the size of a home refrigerator exclusive of the ground coil and air ducts.

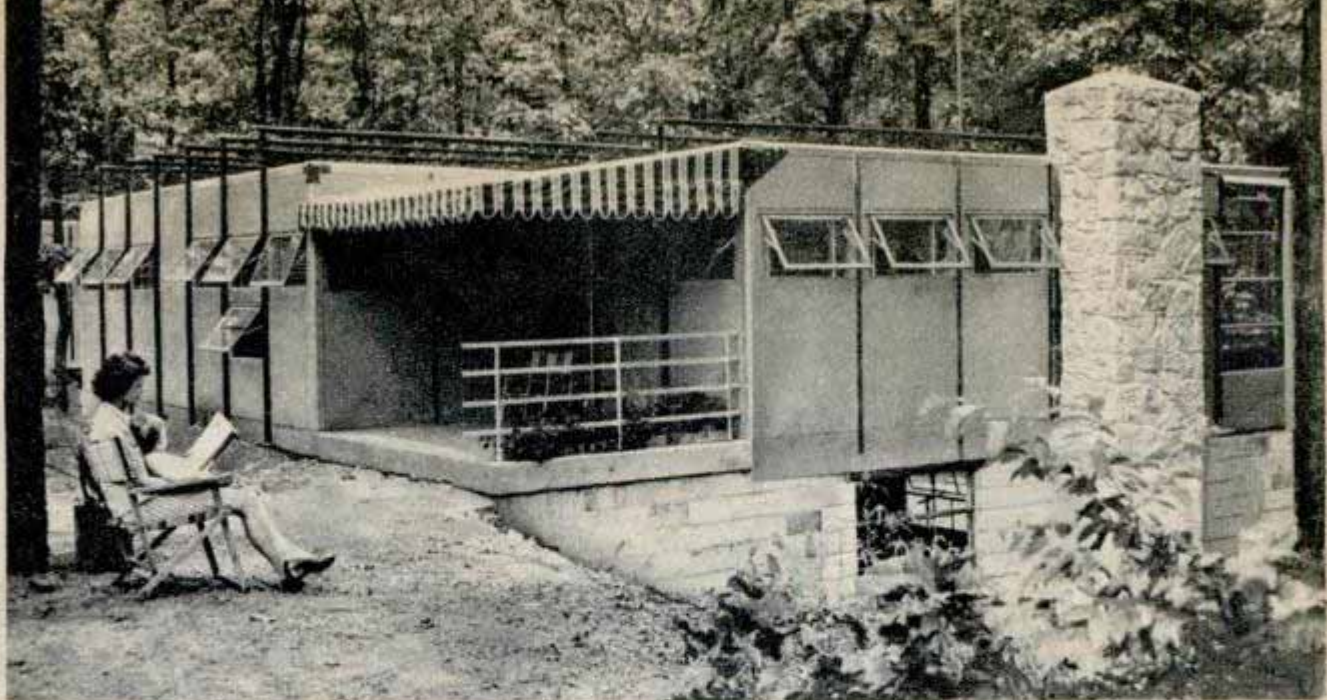


## Synthetic Penicillin Offers New Chemical Weapon Against Disease

Synthetic penicillin is providing medical science with a new weapon in its fight against disease. Produced for the first time at Cornell Medical College by Professor Vincent du Vigneaud and his associates, the

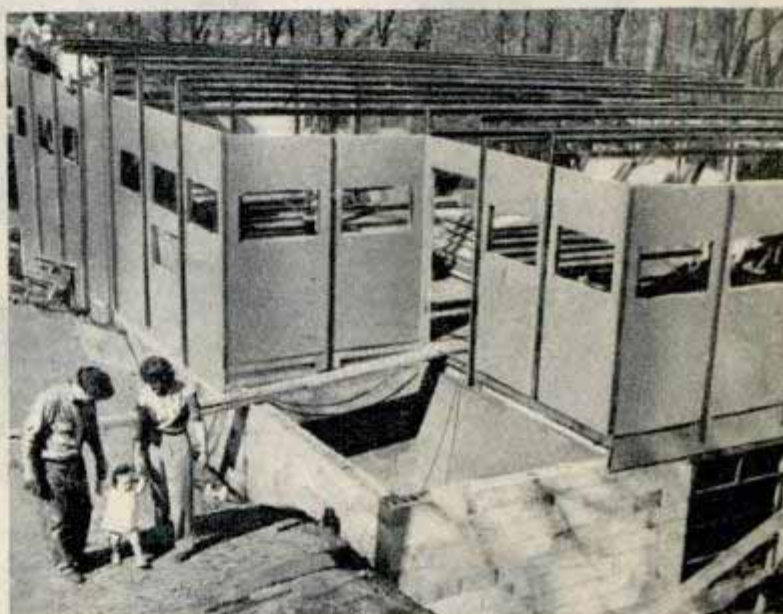
synthetic mold may prove to be superior to natural penicillin. Improvements in chemical makeup may offer remedies for such diseases as tuberculosis, the common cold, influenza and infantile paralysis.





## Aluminum-Plywood House Built of Salvaged Materials

Salvaged aluminum and plywood were the major materials used by J. L. Blackshaw in building himself an attractive one-story home in Atlanta, Ga. All window frames and molding are made of salvaged aluminum, and the window sections are bolted to steel uprights. The wall sections are two quarter-inch thicknesses of plywood insulated with two inches of spun glass. Nine fellow employees gave him part-time help with the construction.



## Odd German Helicopter Has Exhaust Jets at Tips of Rotor Blades



Small exhaust jets are mounted at the tip of the rotor blades on a German jet-propelled helicopter. The craft, considered by aeronautical experts to be one of the oddest produced by the Nazis, is under study by the Army Air Forces at Wright Field, Dayton, Ohio.



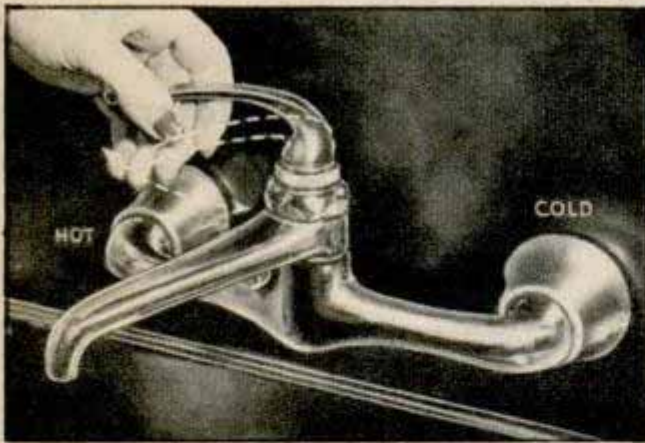
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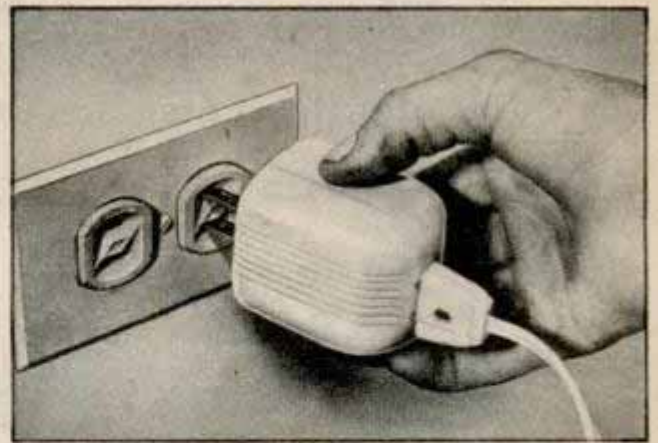


*"Inside  
Stubb"*  
for  
Your Home

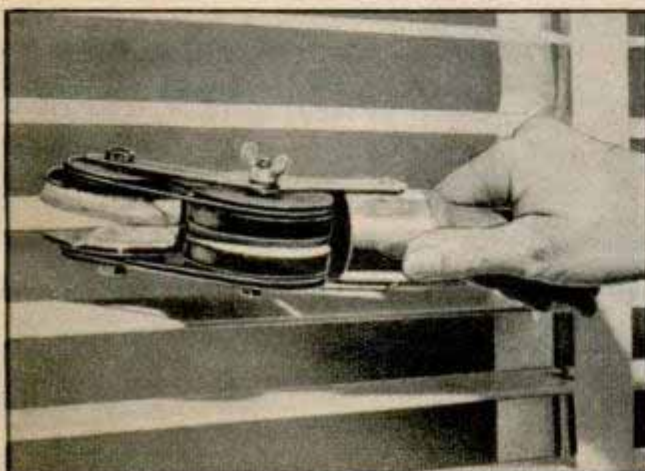
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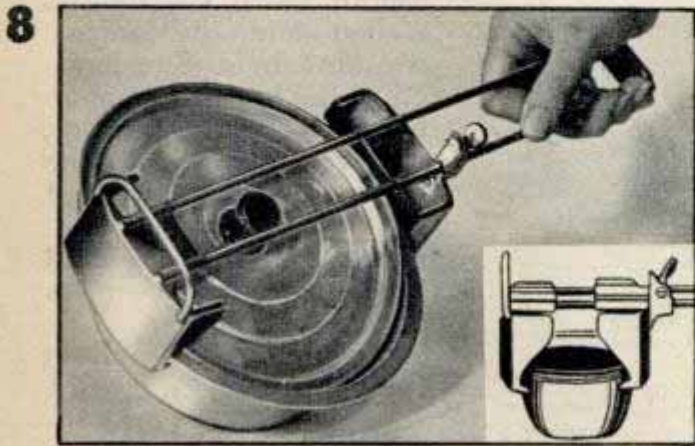




6



7



8



9

- 1 Oranges are juiced, potatoes sliced and steaks tenderized by a two-attachment kitchen utensil
- 2 Downward push on faucet handle regulates volume, sideways movement controls temperature
- 3 For electric razors working best on direct current, plug-in unit converts alternating current to d.c.
- 4 Venetian blind cleaner removes dirt from slats by rolling saturated pads across the surfaces
- 5 Like inverted pliers, a cap remover lifts jar lids by pushing down on the jar and up on the lid
- 6 Aluminum three-prong clothespin resists rust, holds clothes securely, is easy to apply and remove
- 7 Folding book and magazine stand has three-point base
- 8 Adjustable hot pan holder handles dishes of many sizes
- 9 Service tray holds 26 pieces of flatware, fits in drawer
- 10 Bagless vacuum cleaner picks up soap lather as well as dirt.

10







## Truck Salvages Boat By Hauling Overland

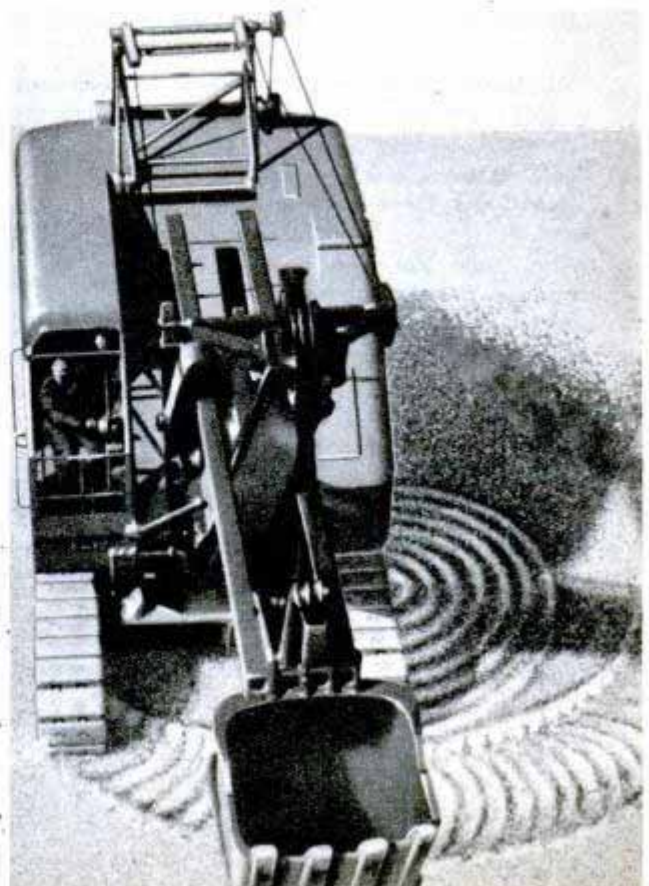
In a salvage operation at Daytona Beach, Fla., a stranded boat was rescued the "easy" way—by dragging it across two hills, loading it on a trailer and hauling it eight miles back to the water. The boat, a 10-ton cruiser 38 feet long, drifted ashore when the motors stalled and the anchor wouldn't hold. She landed on the beach during an unusually high tide and was well inland when the water receded. No boat could be chartered that was big enough to haul her back to the ocean, so an automobile salvage company was hired to do the job. A wrecking truck was placed 300 yards inland on the edge of a highway and its  $\frac{7}{8}$ -inch steel cable pulled across two sand dunes and wrapped around the boat's hull. The 100-hp. motor dragged the boat slowly across the dunes to the highway, where it was loaded on a long trailer. An inspection showed that the hull had scarcely been scratched.



## Excavator Steered From Cab Turns on Dime

Virtually turning on a dime, a crane-type excavator can be steered and brought into working position by the operator alone. It is unnecessary to block the crawlers in maneuvering. The crane is steered from the operator's cab by a system of sliding-jaw clutches and independently operated hydraulic brakes. It will make gradual or sharp turns, and in cramped quarters can be turned completely around. Separate crawler brakes prevent rollbacks or runaways.

☐ Ten matches per day for every man, woman and child in the United States are produced by the country's 24 major match companies, whose 28 factories turn out 500 billion matches each year.







# RIGGERS RIDE HIGH

By Henry F. Unger

**F**OR RIGGERS, the first cable ride is a make-or-break event. Clinging to the chokers in whirring rides over canyon chasms at 1200 feet a minute, apprentices are made or broken in a year. Money alone isn't sufficient compensation for the daily dangerous work on the high line.

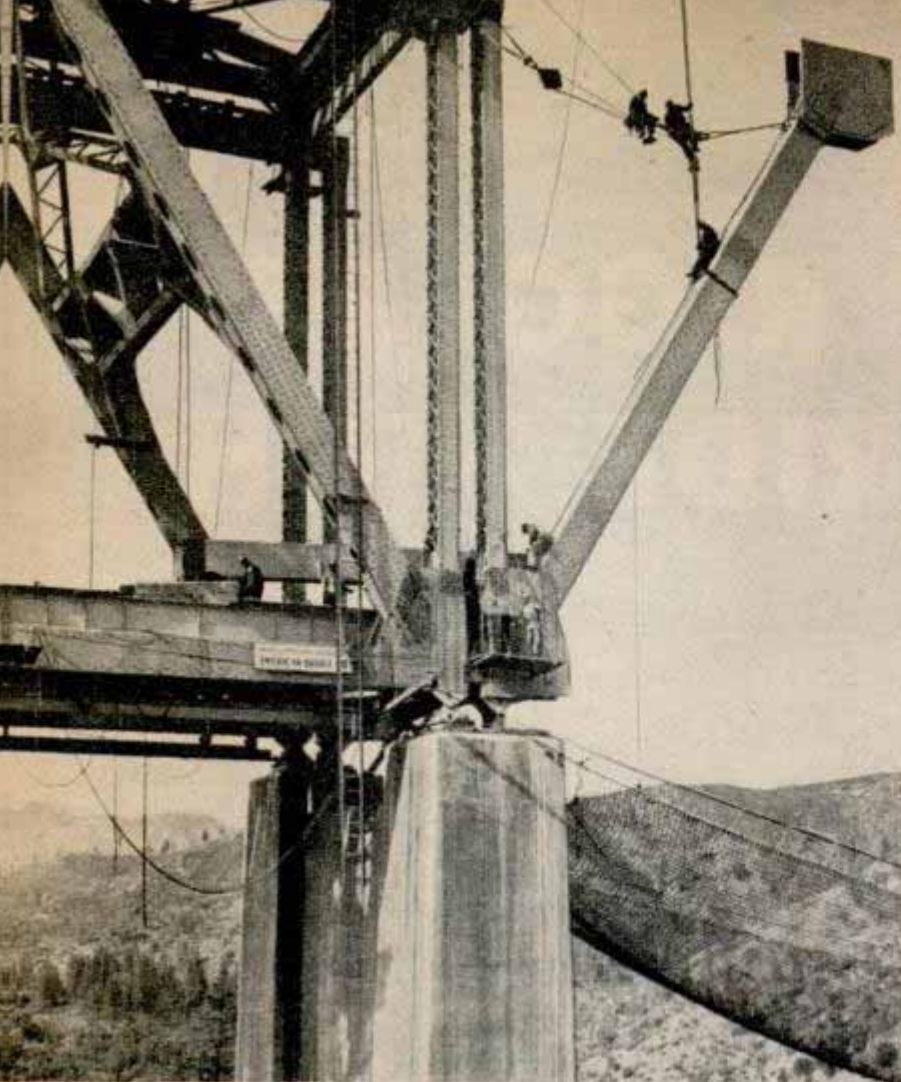
Riggers rarely rest. Without them today's huge dams wouldn't get beyond the blueprint stage, and 70 dams have been built in the last 10 years. Five were among the largest concrete dams in the world. Like circus performers, the riggers must often stand high above raging rivers and rocky embankments, without the reassuring presence of a net, and guide massive girders into place. Nerves can't misbehave at those dizzy heights.

Clambering all over the Davis Dam, on the Colorado River between Arizona and Nevada, they haul equipment and materials to workmen pushing the project to completion. Dams like the Davis, which is 200 feet high and 1600 feet long at its crest, are urgently needed for water power in the reconversion of industry.

For centuries, huge dams have been built to hold back

Iron-nerved rigger rides through space on a hook over the Grand Coulee Dam in Pacific Northwest. Drum gate and pier are in right foreground





Views of riggers at work on huge Shasta Dam in California. During the past 10 years 70 dams have been completed, five of them among the largest concrete dam structures in the world

flood waters. A mighty masonry dam was begun at Assuan, Egypt, in 1898 and completed in 1902. Emperor Nero built a dam at Subiaco that lasted 1300 years and the Moors erected a dam at Elche, Spain, with a height of 52 feet and a base width of 159 feet.

But the touch of glamor came only with the advent of the modern rigger, who risks his life on every trip into high altitudes.

Even before a dam is begun, the riggers with a survey party will scale mountains, high above wild rivers, and place anchorages on the dangerous sloping sides. From there they often dangle by ropes while scaling down the walls of the canyon with jackhammers and pinch bars.

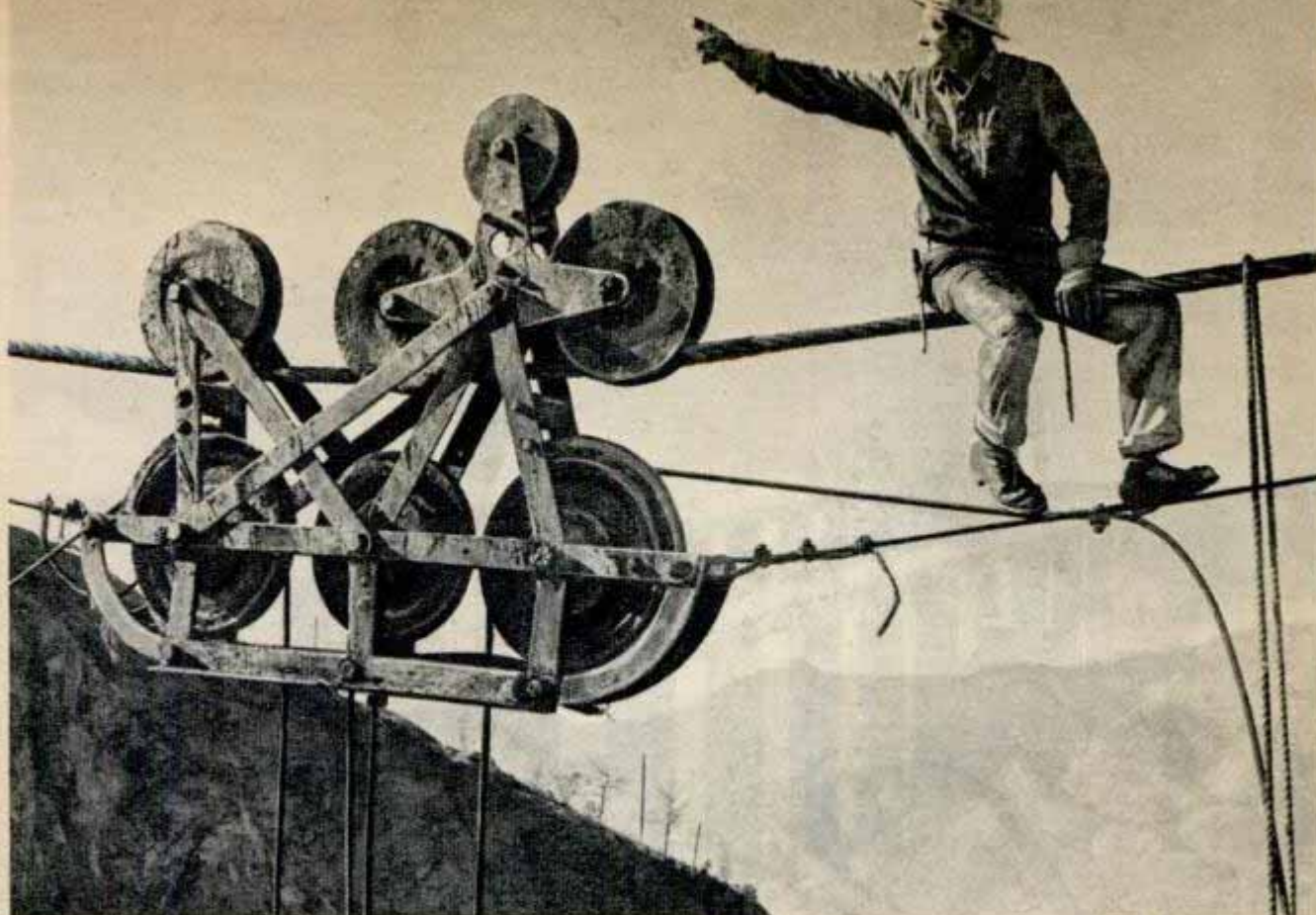
Following construction companies around the country, riggers live in barracks for the most part. Hard working and hard living constitutes their existence.

As the dam rises to completion, the role of the rigger becomes more important. He is constantly needed to carry tools and equipment to workmen laboring on the mushrooming dam. At some of the dams, like Grand Coulee, giant hammerhead T-shaped cranes were used. These ride over the steelwork and the riggers are dropped onto the steel trestles.

At the Boulder Dam, riggers rode on a railed timber platform hung from







**"Joe McGee" rig used to remove excavated material**

an eight-wheel carriage. The cableway ship tender would wave a signal to the hoistman. The ship like a graceful bird would rise from the ledge, hesitate and then whip across the wide canyon chasm. At the end of the trip the tender waved a flag. The carriage stopped, swung like a pendulum and then dropped 700 feet to the canyon floor. Three minutes after leaving the Nevada rim of the canyon the rigger was on the floor of the Arizona side.

Riggers were kept on their toes hauling materials at Bartlett Dam, the world's highest multiple arch type. A suspension bridge had to be erected there to carry an eight-inch pipe, through which concrete was pushed by means of a two-cylinder pump. Three floods drowned the infant dam, sweeping away much equipment. Undisturbed, the riggers kept their schedule.

Working like beavers, riggers are almost seeing completion of the Anderson Ranch Dam in Idaho. With a height of 444 feet, a 1350-foot-long crest and width of 2650 feet at the base, the reservoir will hold 493,199 acre-feet of water. In conjunction with the Arrowrock, Deer Flat, Deadwood, Cascade, Black Canyon and Boise River Dams, it will provide water for lands in seven counties and incidental flood control in an area now subject to periodic inundation.

Without the riggers, dams now under construction by the Bureau of Reclamation would not be built. The Angostura Dam, 150 feet high, 1900 feet in length along the

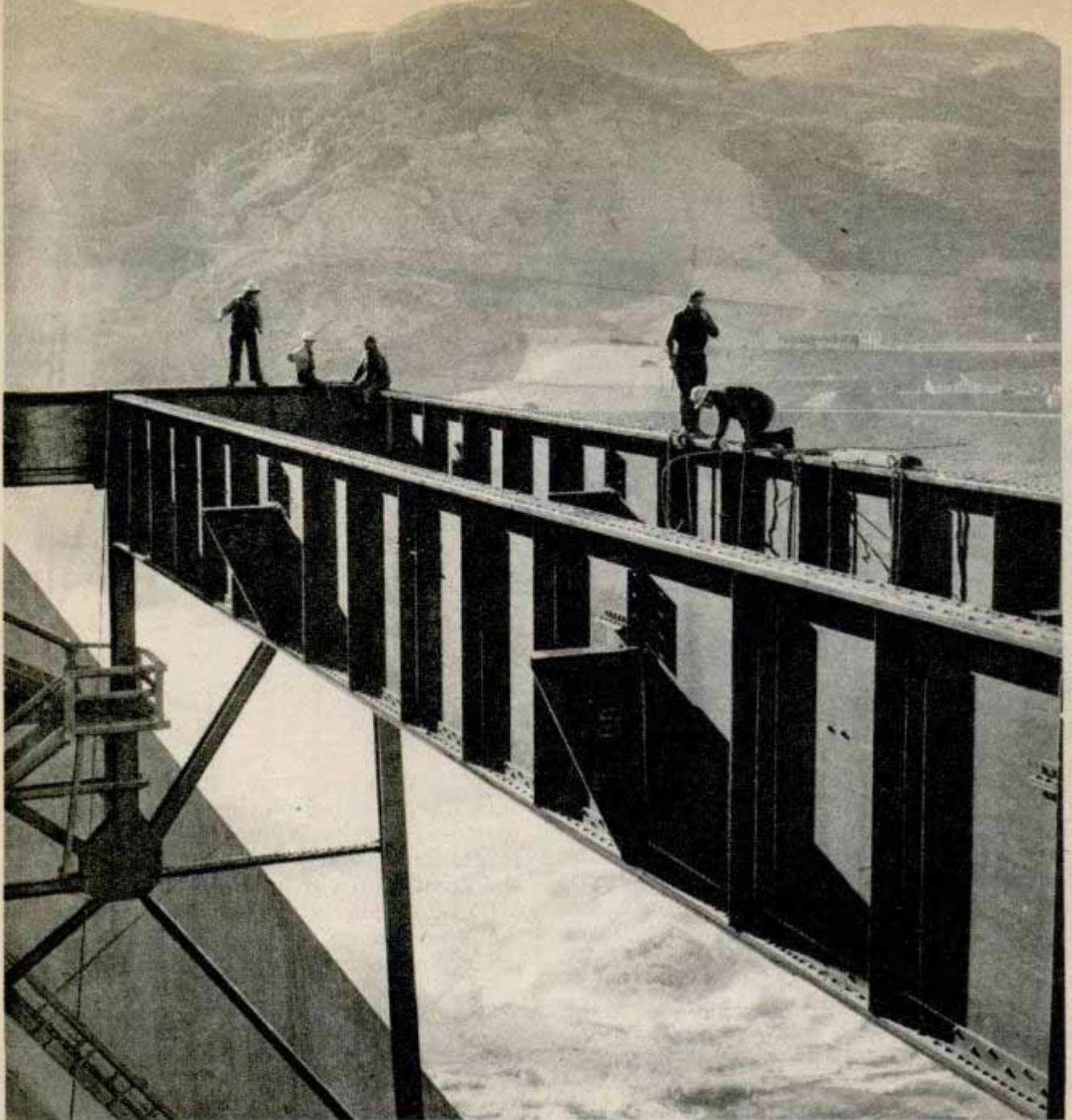
crest, with a reservoir capacity of 220,000 acre-feet, is rising on the Cheyenne River. Kortes Dam in Wyoming on the North Platte River, 200 feet high, 440 feet long at the crest and with a reservoir capacity of 5000 acre-feet, is another in the chain of dams now being erected.

Once riggers have completed their task

**Setting reinforcing for walls and columns of a dam**







High over a raging river, riggers dismantle a construction trestle with same freedom of movement an average man has on the ground. Below, fastening cableway



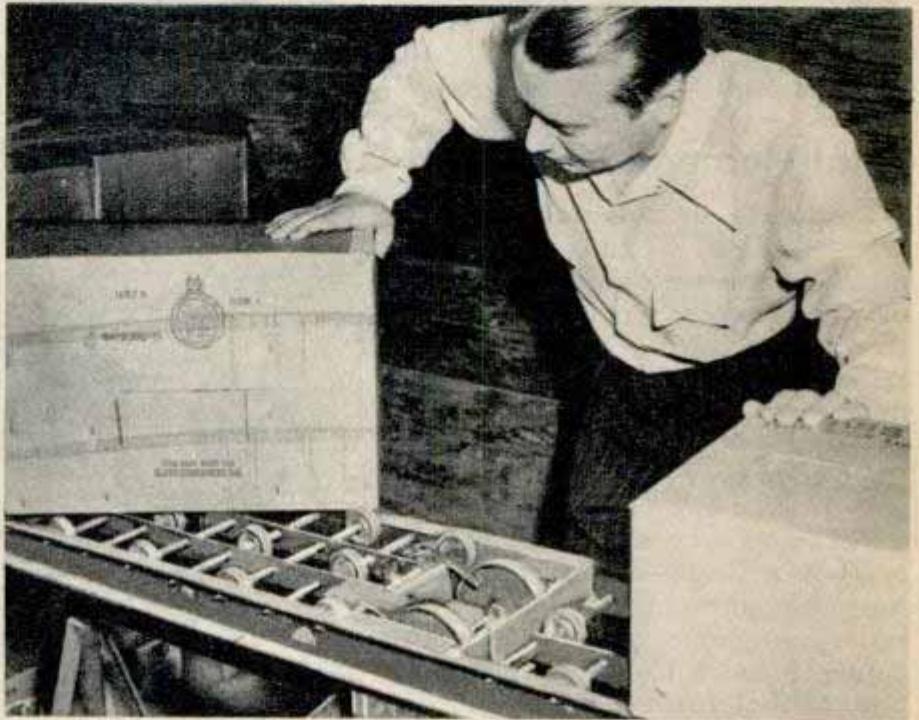
on the huge Granby Dam, on the western slope of the Continental Divide, it will store water from melted spring snow that will eventually flow east under the Continental Divide through the 13-mile-long Alva B. Adams tunnel. From the tunnel outlet, the water will fall 2800 feet through six power plants to be built along Big Thompson Canyon, and finally flow into storage at Carter Lake and Horsetooth Reservoir, which will store irrigation water for 615,000 arid acres on Colorado's eastern slope.

Bridge Canyon Dam, just below Grand Canyon, to be the largest ever built, is now on the planning boards of engineers. The riggers already look upon it as their baby. In the 38 years during which 160 dams and reservoirs were built, the Bureau of Reclamation has called upon the riggers scores of times and each time a schedule was shattered. It won't be any different this time, for danger is the rigger's business.



## Glued Cartons Avert Cargo Shifting

Cardboard cartons containing glassware or bottled goods are glued together to prevent damaging contents during shipment by freight car. Gluing the cartons together keeps them from shifting around in transit. Two strips of glue are applied to the bottom of each carton by an applicator in the conveyor line leading into the car. Two large wheels of the applicator rotate in a tank of quick-drying glue and each carton is striped with glue as it moves along. In unloading, each box may be broken loose by a blow of the hand. A similar system for wooden boxes also is being tried by the Union Pacific Railroad.



## Molded Glass Lenses Eliminate Grinding

Small optical lenses of eyeglass size can now be molded in quantity as finished articles without grinding or polishing.

The molding process is conducted in an atmosphere of hydrogen to prevent uneven chilling of the hot slug of glass on contact

with the mold. Lenses accurate enough for use in telescope systems are expected to be produced with improved presses.

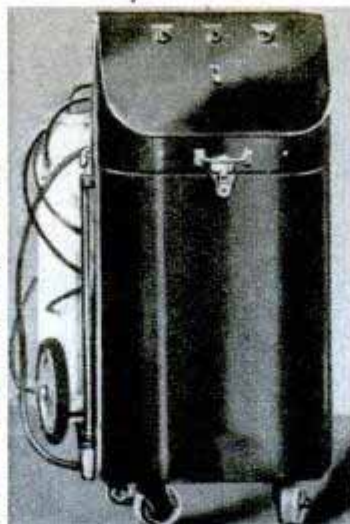


## Roll-Over Auto Top Protects Race Pilot

One of the hazards of midget car racing has been lessened with a steel top which fits over the cockpit. Designed by "Doc" Shanebrook, a veteran race driver, the "roll-top" protects the driver if his car turns turtle. Value of the design was demonstrated at a race in Detroit when a midget racer, equipped with the top, made two complete rolls. The driver was uninjured and the car suffered only minor damage to its paint job in the mishap.



## Electric Pump Cleans Up Dirty Job of Changing Crankcase Oil



Changing crankcase oil—a dirty job that usually entails crawling under a car or driving it up on a ramp—is simplified with an electric pump. A long, thin, metal tube is inserted through the oil gauge hole to the lowest point in the crankcase. The pump sucks oil through the tube into a rubber hose and waste storage tank. The mouth of the tube is cut so it cannot become stopped by sludge.

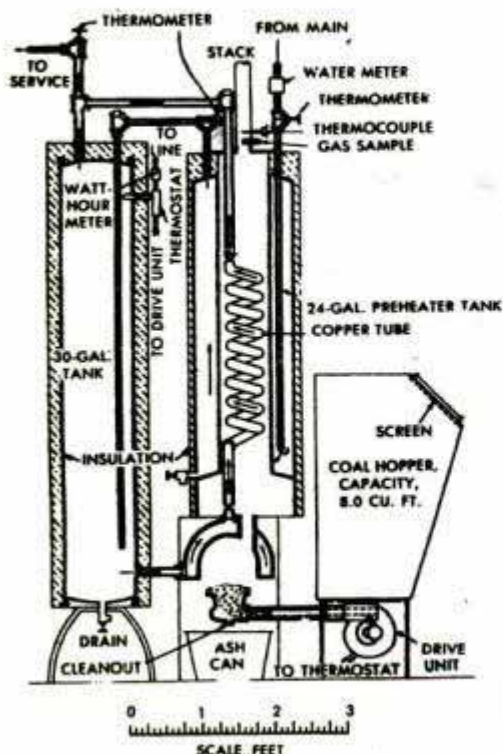
## Small Homemade Biplane Cruises at 160 M.P.H. Over 500-Mile Area

Residents in the vicinity of Wichita Falls, Texas, have been puzzled over the identity of a small private plane. It's neither a Piper, Aeronca, Ryan nor any other familiar make. Neighbors of Ted Boden, former flight engineer with the AAF's 5th Ferry Group, call it the Boden Special. He built it himself in his back yard and the job took about a year. The finished craft is a single-seater cantilever wing biplane which cruises at 160 miles per hour over a 500-mile range. It has a 15-foot wingspread and 13-foot fuselage.



## Stoker-Fired Water Heater Operates With Sub-Bituminous Coal

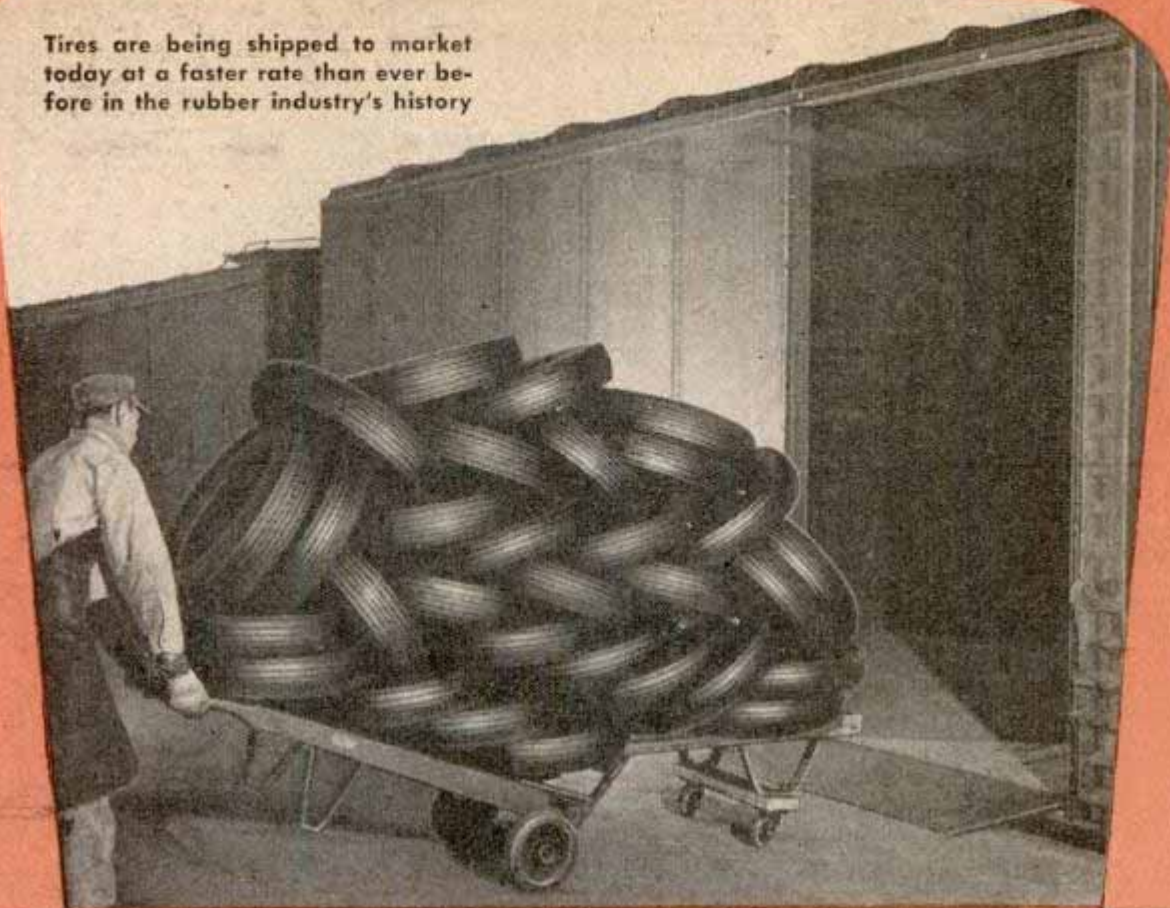
U. S. Bureau of Mines photo



Sub-bituminous coal and other low-rank fuel can be used in a stoker-fired water heater developed by the U. S. Bureau of Mines at Golden, Colo. It consists of a coal hopper and constant-volume fan, feed screw, retort and preferably a double water-storage tank. When a thermal control regulator calls for heat, the driving mechanism moves coal into the retort, where it comes in contact with low temperature air circulated by the fan. The resulting small, steady flame is controlled by an adjusting vane.



Tires are being shipped to market today at a faster rate than ever before in the rubber industry's history



## *Your Next Tires... Synthetic or Natural?*

By Clifford B. Hicks

WHEN Uncle Sam put the bite on Great Britain recently for an extra 200,000 tons of natural rubber—and got it—the ring was dusted off for the biggest bout in rubber history. The surprise shipment foreshadowed the day when there'll be rubber to burn and when synthetic, an upstart contender with a brilliant war record, can take a shot at the title that natural rubber has held for a hundred years. Biggest question of the battle is whether natural will bounce back to its prewar prominence.

To the motorist who's fed up with the tire shortage this doesn't seem the important issue. He wants a rapid-fire answer to another question. When can he buy a new set of shoes for his prewar flivver? The question of what kind of rubber he'll have

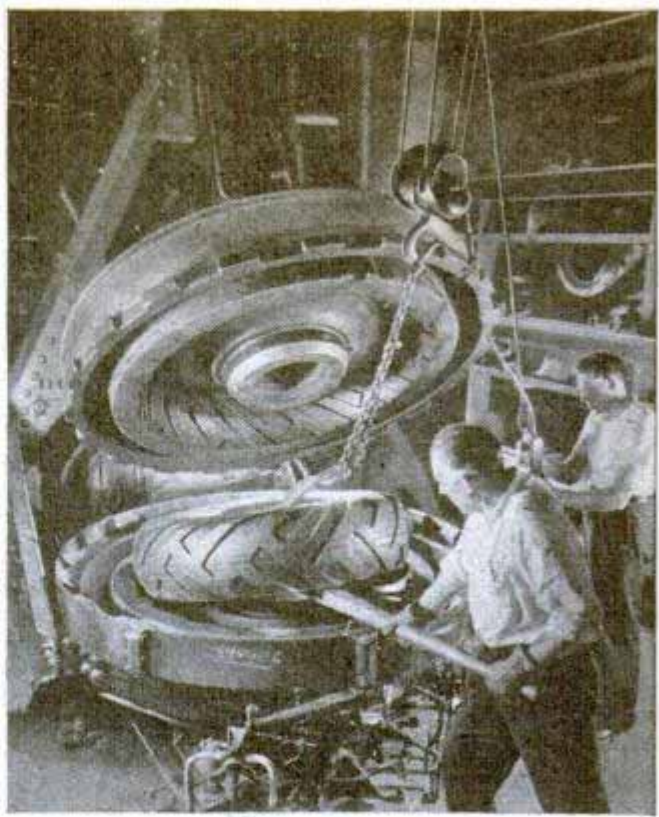
Rubber worker rolls a strip of preformed tread around the carcass of a truck tire  
Firestone Tire and Rubber Co. photo







**BEFORE:** Hand-built casing is placed in vulcanizing machine where the heat molds it into its final shape



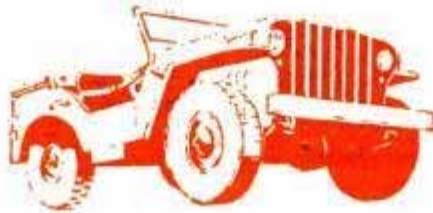
**AFTER:** Steam bag inside the tire has forced rubber into tread mold where heat caused vulcanization

on his car in the future is usually shoved into the background. Chalk up an optimistic answer from the major tire companies to his first question.

Best estimate is that the tire shortage definitely will end some time this spring with the most pessimistic answer putting tires on the shelves by the middle of the year. About 95,000,000 tires were needed in 1946 and less than 80,000,000 were built. But last year's production took the slack out of the pent-up demand and, with equal production this year, supply will almost certainly top demand within the first few months of this year. Last year's 80,000,000 tires, incidentally, beat all previous records.

In the scramble for new tires the possible revolution in rubber is often forgotten. But when the world's supply of rubber is more than the demand, the battle of synthetic vs. natural will start.

Rubber manufacturers point to an inevitable oversupply of rubber within a short time—maybe months. It's a boomerang of the near-disastrous war shortage. The United States was a "have not" nation in rubber when the war started, but when Japan folded, Uncle Sam had facilities to turn out more than 1,000,000 tons of synthetics a year. Before

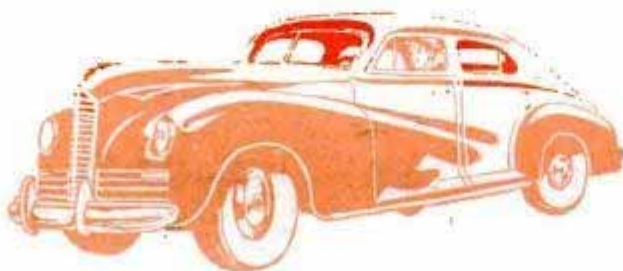


the war crude rubber was America's largest import. Obviously there'll be a rumble in the nation's economy because we can now produce at home the equivalent of our largest prewar import.

The world will find use for about 1,500,000 tons of rubber in 1947. There'll be a little less than 1,000,000 tons of natural to meet this demand. But the United States alone can more than take up the slack with test tube stuff. According to the Inter-Agency Policy Committee on Rubber the world's productive capacity will soon stretch to 3,000,000 tons of all kinds of rubber annually. With demand at 1,500,000 tons that means a serious surplus.

As soon as supply tops demand the rubber companies will have a choice of the two types. They'll make a selection after weighing two factors—the performance and price of each type. With a choice just around the corner there's many a weighty conference on records and costs to determine what kind of rubber will go into our tires and tubes, our baby pants and hot-water bottles.

Armchair experts have kicked around the relative merits of the two opponents since 1942 with an overwhelming decision in favor of natural rubber. But synthetic won't be





tossed into the heap of war relics. Not by a long shot.

There's many an indignant voice raised against the performance of synthetics. The antagonism goes back to the days when a few tires were made of reclaimed rubber and still more were made of test tube mixtures before the bugs were eliminated. Today's synthetics are far superior to those first wartime substitutes.

Tire engineers have discovered some surprising things in testing GR-S, the government-approved standard synthetic for tires. It usually wears longer than nature's product on the tread of a tire. It stays flexible at lower temperatures. It's slightly more resistant to chemical attack, one of nature's biggest drawbacks.

But you can't whitewash synthetic rubber on some counts and the big tire companies won't even try. Man-made rubber heats up more quickly and is therefore far inferior for truck tires. It's stiffer than natural rubber—harder and more costly to process. It's less resistant to bruising. It has four to six percent less skid resistance.

Many of these problems have been licked by tire engineers. They've improved the structure of the tire itself to counterbalance some of the drawbacks of synthetic rubber.

New tread designs have given these postwar synthetic-plus-natural tires a tread that most manufacturers claim will roll more miles than your prewar all-natural tires. Treads are wider and flatter and distribute the wear over a larger surface.

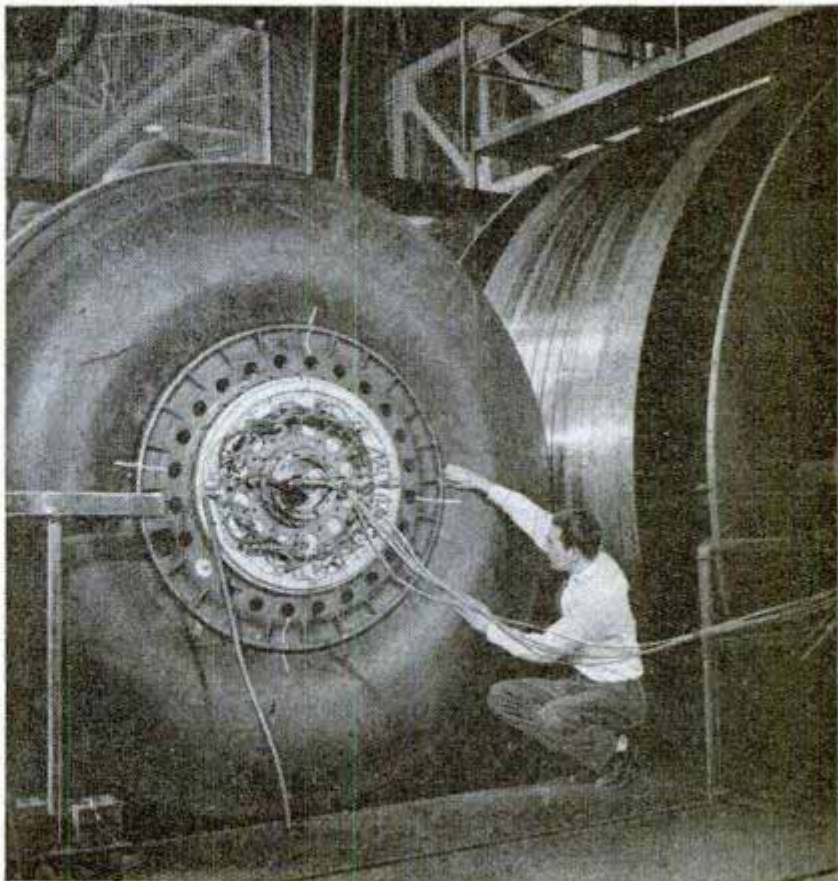
But the biggest change has come in the carcass of the tire. When synthetic rubber was first turned out in quantity, the test tube product was merely substituted for natural rubber in the old tire structure. The new tire heated and bruised more easily. Blowouts were much more frequent. It was obvious that changes must be made in the carcass rather than the synthetic.



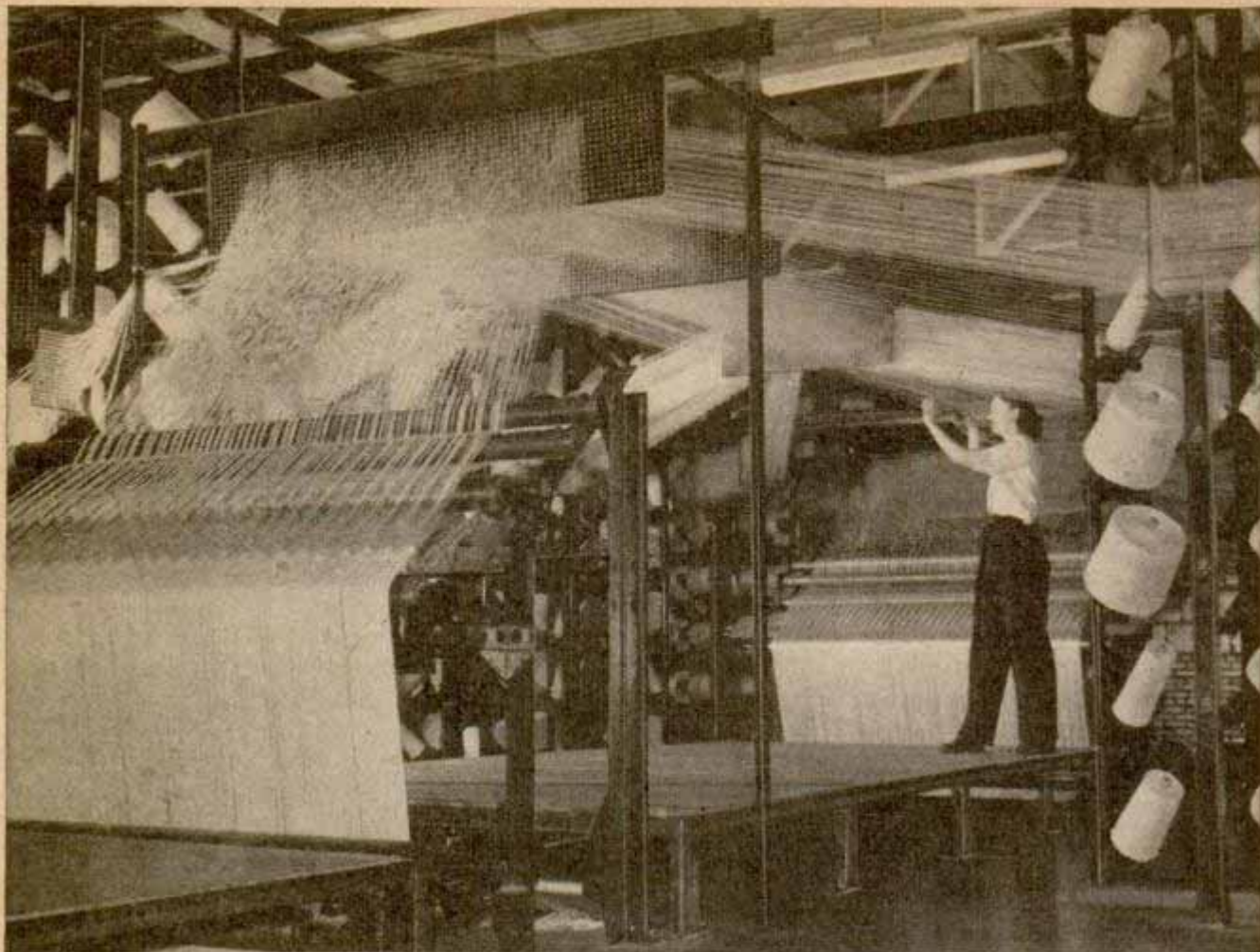
▲ New waffle-pattern inner tube made by U. S. Rubber Company has extra rubber in square pockets which squeezes around puncture

▼ Heavy testing wheel is used to check strength of a big bomber tire. The tire is slammed against turning wheel to simulate landing shock

Westinghouse photo



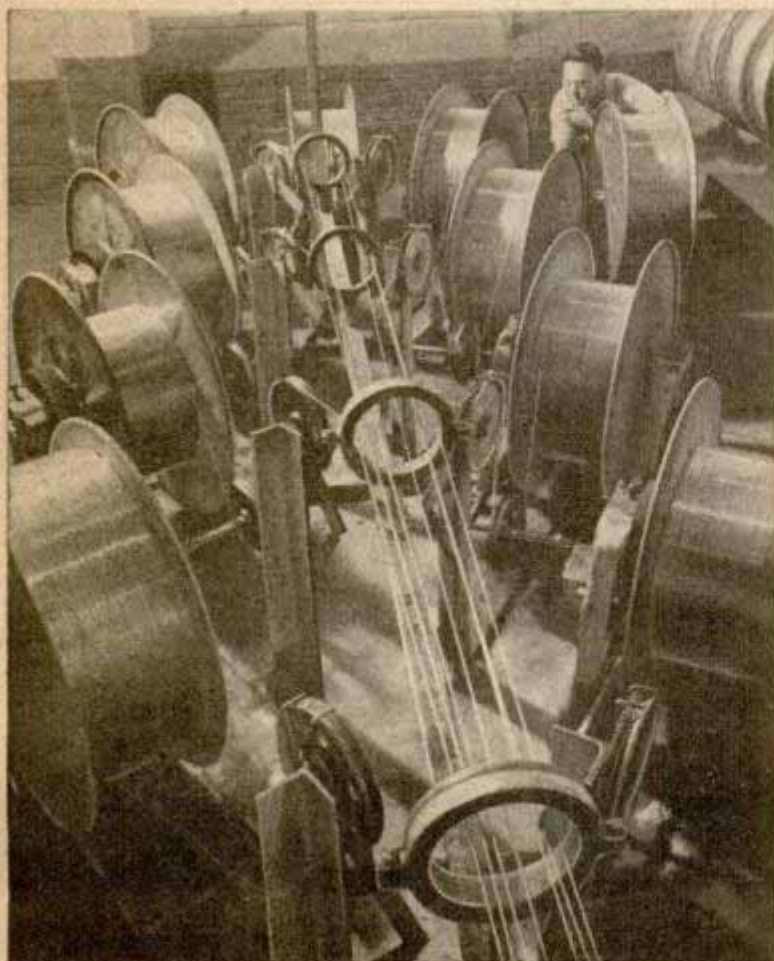




B. F. Goodrich Co. photo

▲ Maze of threads in the creel room is woven into sturdy fabric which is coated with rubber to be cut into individual tire plies

▼ Wires pulled through die are rubber-covered to become bead



So engineers went to work on the fabric. A new type of cotton cord was developed that proved much stronger than the old type. Rayon, stronger than cotton, was also used.



Tests were made with Nylon but increased costs prohibit weaving Nylon into a passenger tire at present. Changes were made in the angle at which the plies were put on the tire. The amount of insulation between plies was increased as much as 30 percent to counteract the tendency of synthetic plies to pull apart.

Stronger carcasses were required and they were produced. Today's tires made of GR-S and some natural rubber have shown by test that they're as much as 55 percent stronger than prewar tires.

Man-made rubber's lower resistance to skid hasn't been overcome but there has been some improvement. New tread designs have given the ribs slightly more grip on pavement, snow and ice.



Biggest problem of all, the tendency of GR-S to heat up at high speed, was licked when the carcass was strengthened. But truck tires under heavy loads get too hot, so synthetic rubber isn't used to any great extent in new truck casings. Heat is the major cause of failure in truck tires, even with natural rubber.

The best postwar synthetics are no more dangerous at high speed than were prewar tires, although high speeds are dangerous at any time. Firestone has issued the following statement to allay the fears of those who creep along on their new tires: "Before the war when all tires were made of natural rubber we placed no restriction upon the car owner in the use of our tires other than the normal requirements of proper inflation and reasonable care. The same situation applies today to our new Firestone Deluxe tires made of synthetic rubber."

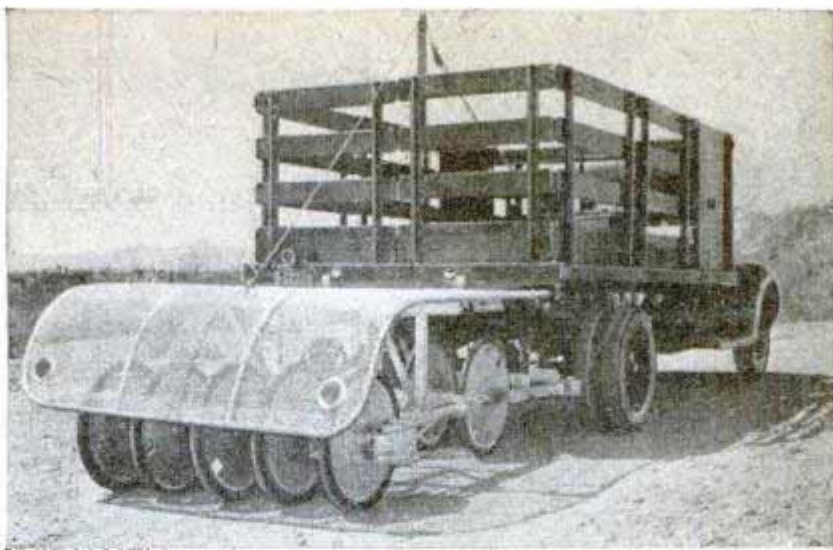
Just how good are postwar tires as a result of these improvements? The manufacturers stand pat behind the performance of today's synthetic-natural combinations.

Goodrich makes the flat statement that their best postwar passenger-car tire "will by all known tests outwear tires made of natural rubber." The top Firestone tire is "55 percent stronger and will give up to 32 percent longer mileage" than the same company's prewar natural rubber tire, according to spokesmen.

The U. S. Rubber Company's best tire of combined rubbers has a rayon cord that produces "a stronger, safer carcass than prewar tires." And a Goodyear executive refers to "the present 30,000 to 50,000-mile tire, depending upon operating conditions."

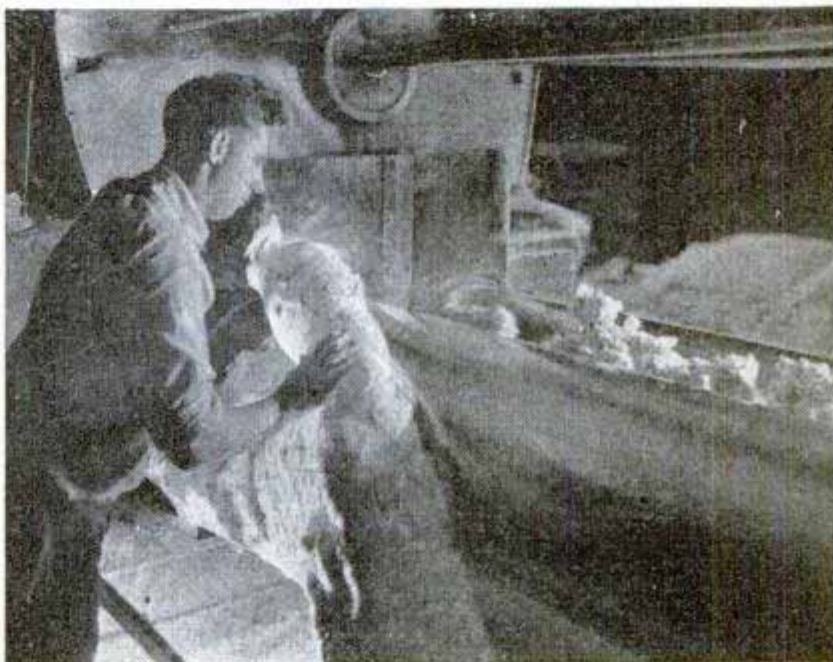
Because most of the improvements in the new casings have been made in the tire itself and not in the man-made rubber, it's a logical assumption that a tire made of today's carcass and yesterday's natural rubber would

(Continued to page 236).



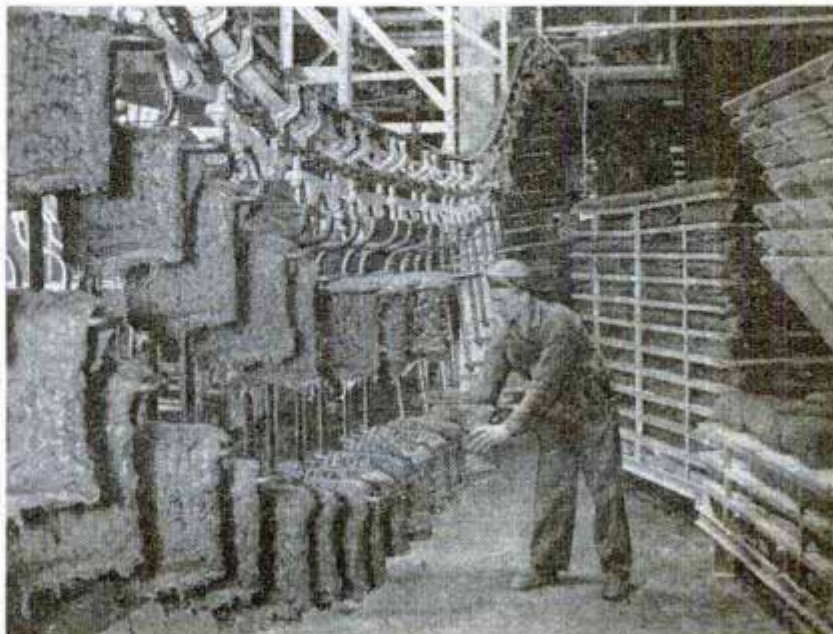
U. S. Rubber Co. photo

▲ Bicycle tires, tested over rough roads under a hot Arizona sun, are operated until they fail, then analyzed for weakness under stress

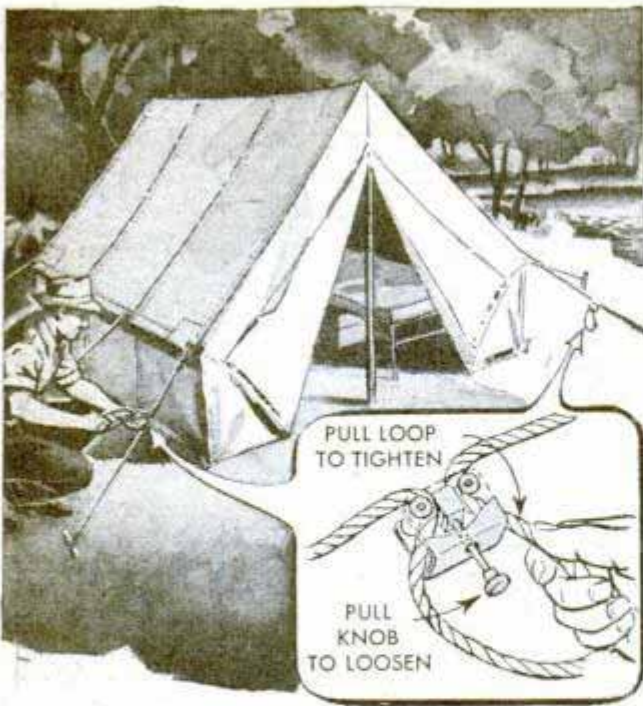


▲ Mill works like a giant wringer to mix synthetic rubber with sulphur and other chemicals. Plastic mass then is processed into tire fabric

▼ After crude rubber comes from mixer it is placed on conveyor to cool





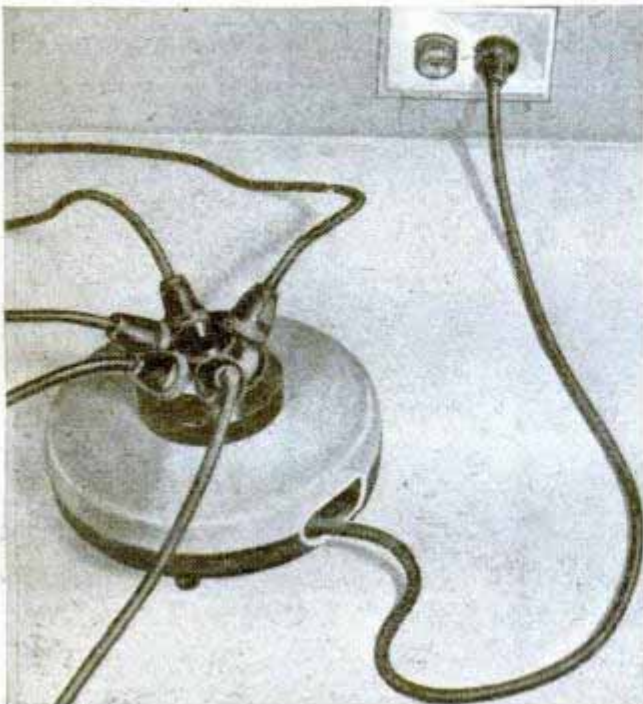


### Adjustable Rope Clamp for Tent Holds Canvas Tight

Tent ropes are held taut by a rustproof brass clamp equipped with teeth that grip the rope securely until a control pin is pulled when a camper desires to loosen the rope. To tighten the rope, the left or right side of the loop is pulled.

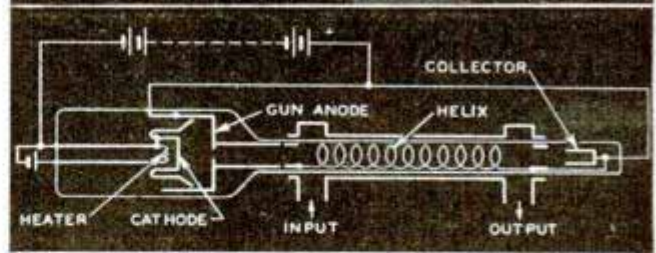
### Multiplug Extension Cord Reel Is Self-Retracting

Six prong-type connector plugs are accommodated in the plastic case of a multiple plug fixture. It is equipped with a 25-foot-long extension cord so that it can be moved about conveniently. The cord is rewound automatically on the reel in the base as the fixture is moved closer to the wall outlet.



### 10,000 Messages in One Tube Promised by New Amplifier

Tests made with a new vacuum tube indicate that it may amplify dozens of full color or black and white television programs simultaneously. It may handle more than 10,000 simultaneous long distance telephone conversations or over a hundred million words a minute by telegraph. Developed in the Bell Telephone Laboratories, the tube is entirely different from earlier amplifiers. It consists of a narrow, foot-long glass stem which flares into a bulb at one end. Inside the stem a long coil of thin



wire runs from one end to the other. The wave which is to be amplified is fed into the coil at the bulb end and is drawn off at the other end. As the wave travels along the coiled wire a beam of electrons is shot through the coil in the same direction but at a speed a little faster than the wave. The electrons give up some of their speed to the wave which becomes many times amplified. The effect is the same as that of a breeze on the ripples on a pond—the ripples grow larger as the breeze blows them along. In the tube, the electron beam “blows past” the wave on the coil and reinforces the wave by transferring energy to it.





Since building a 1½-horsepower tricycle from scrap, 87-year-old Marshall Pressley finds it easier to get around. The machine is driven by a belt transmission

Any kind of fuel serves in a two-cylinder steamboat engine built by three Manitowoc, Wis., men from a furnace boiler. The hull is an abandoned steel lifeboat



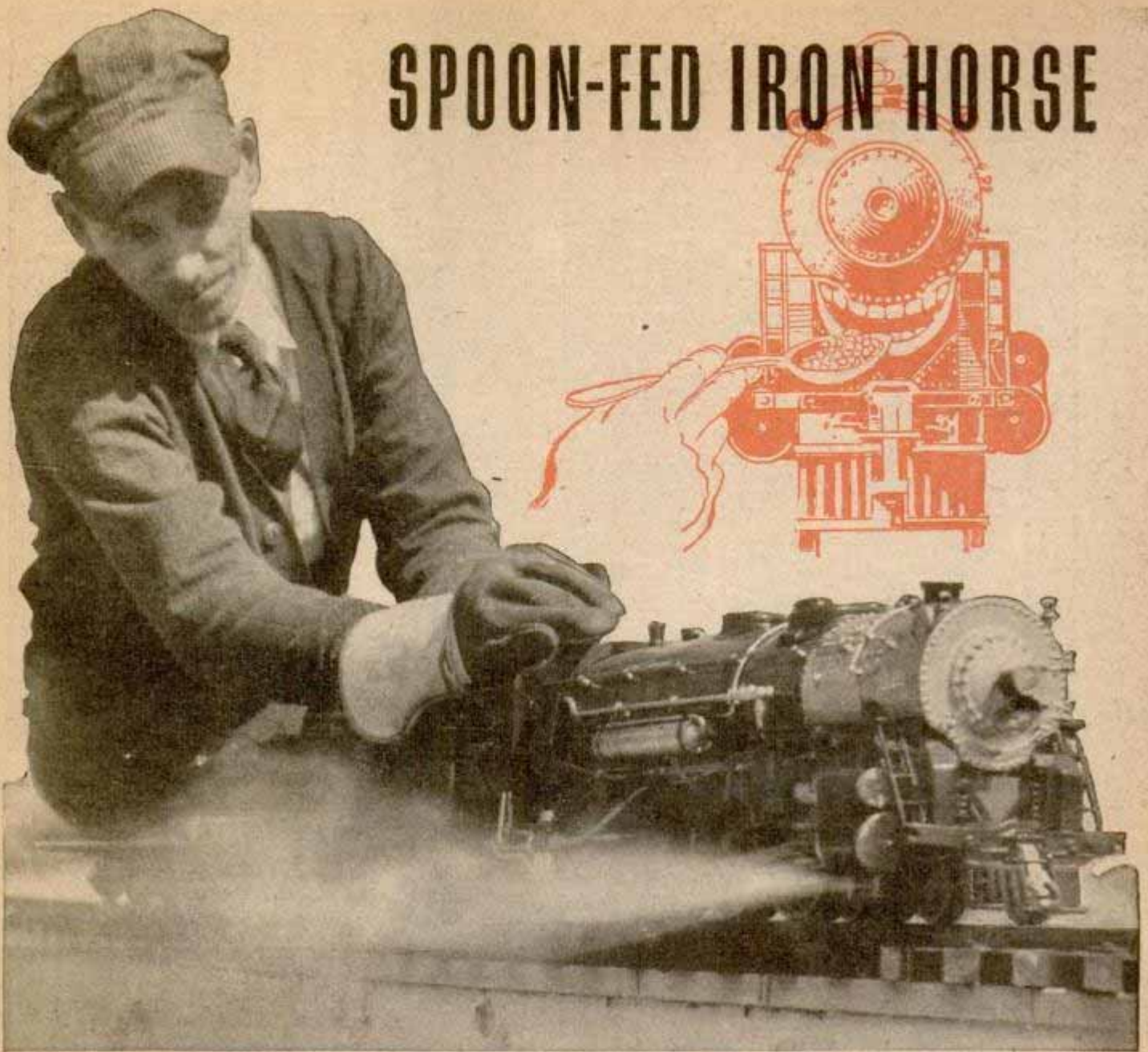
Surplus brass sprocket chains and aluminum gears, designed for use in bombsights and range finders, become costume jewelry with polishing and gold plating

All the equipment needed with an oxyacetylene cutting torch can be carried like a pack. The outfit, with oxygen and acetylene tanks, weighs 55 pounds





# SPOON-FED IRON HORSE



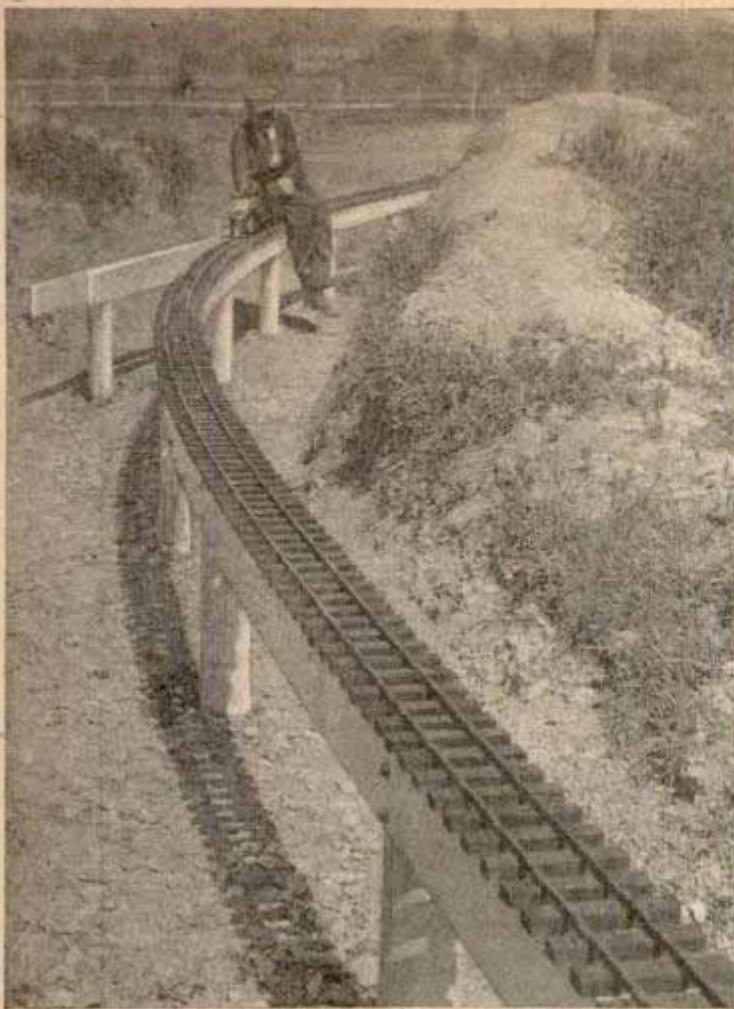
William Michael at the throttle of a live steamer built in his Racine, Wis., home shop. Below, he compares cylinder cast with scale drawing. The locomotives are built on a scale of about a half inch to the foot



**I**N A LITTLE home machine shop in Racine, Wis., William E. Michael builds midget steam locomotives from thousands of tiny parts that he makes.

His engines are working units equipped with water injectors, mechanical lubricators, safety valves, cylinder cocks, whistles and full reverse gear. They are incredibly perfect, down to the last wheel and shaft, tiny copper tube, baffle board on the firebox door, bell and cowcatcher. The small pressure gauge is scarcely a half inch in diameter. Rivets in the boiler and brass tender are escutcheon pins. Each finished model takes three to four years' spare time, rep-





The model locomotives travel over 140 feet of track

representing about 1000 hours of patient work.

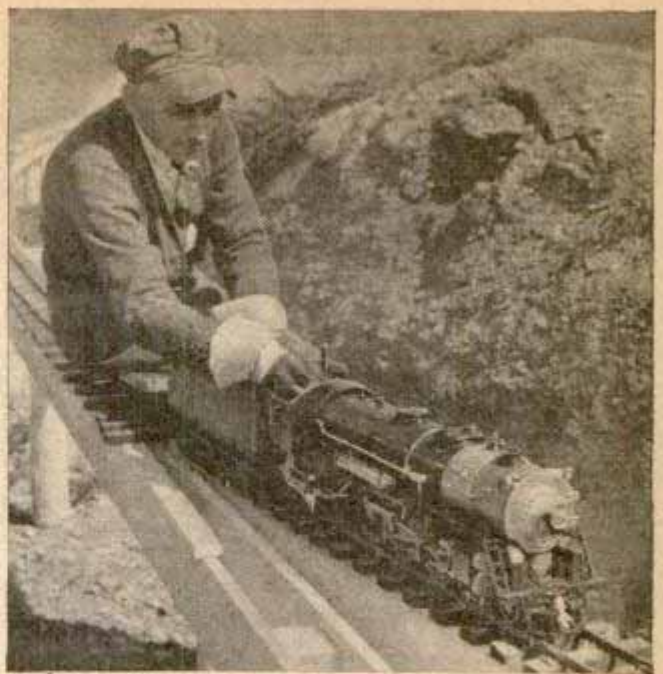
Michael's Hudson-type engines, which are 28½ inches long and weigh about 60 pounds, are built on a scale of slightly more than one half inch to the foot. He works with tolerances of 1/1000 and 1/2000 inch. He has drills no bigger than a needle, and he makes many of his own tools.

In addition, he makes his own blueprints, his own wooden patterns and castings, and does the machining to complete each part. His machinery includes a lathe and small drill press, a milling machine, larger drill presses, planer, air compressor and brazing equipment—all insured for \$3000.

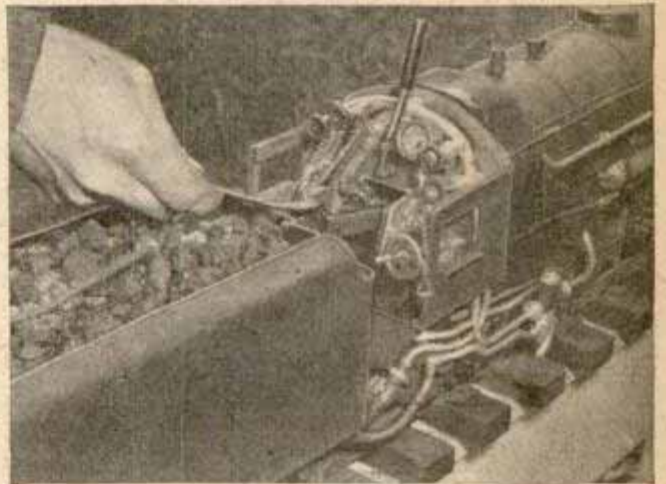
Michael's hobby of building model live-steam engines began in 1929 and since then he has built four locomotives and has the beginnings of two more.

In order to watch his handiwork in action, Michael purchased five acres of land near his home and built 140 feet of 2½-inch-gauge winding track. He sank cedar posts into the sandy soil and laid a platform on them for his winding track. The track has a 1½-percent grade, but on a level stretch one engine pulls four persons.

Each tender holds about four pounds of buckwheat size coal, but one locomotive will consume about 10 pounds a day if it is kept going.



Through cuts and up and down hills, the engines cavort on 2½-inch-gauge track on elevated platforms which are mounted on cedar posts sunk into sandy soil

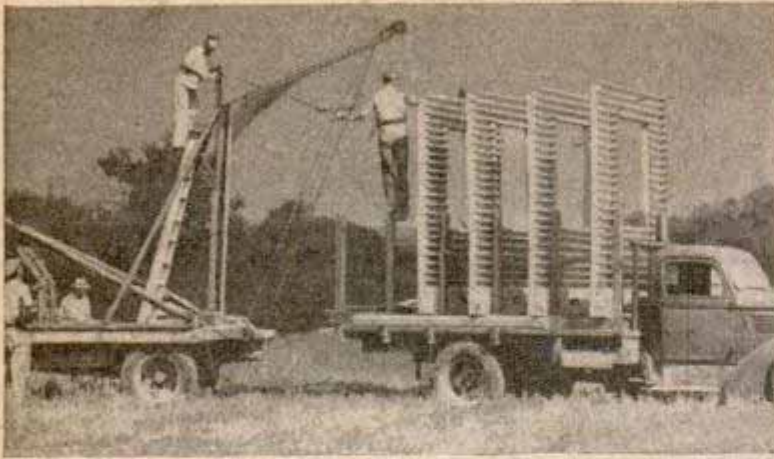


Coal is fed to the tiny firebox with a spoon. Below, tire pump is used to create a draft to start boiler

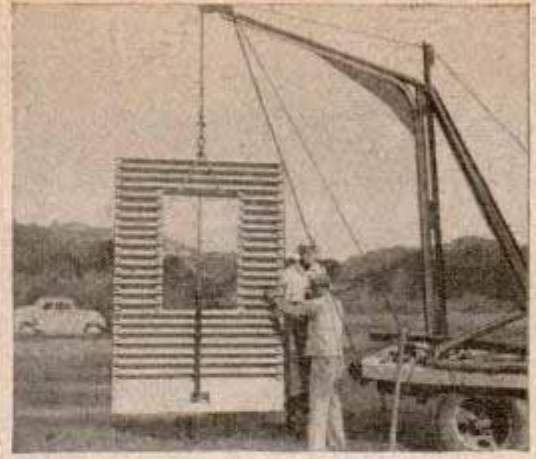




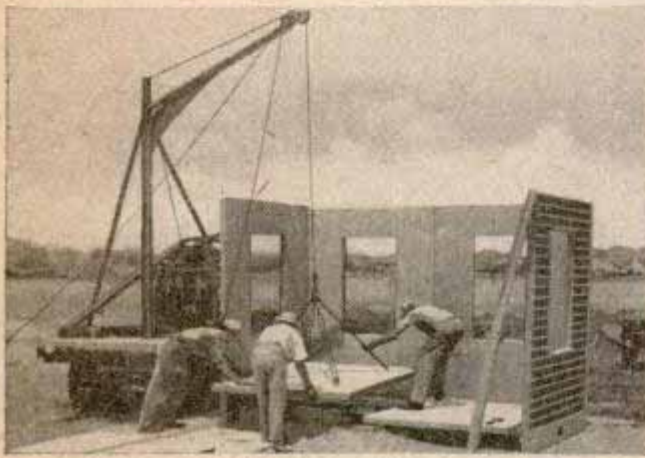
# House Built of 64 Lightweight Concrete Slabs



Completed concrete sections are trucked to the homesite where a portable crane lowers them to workmen who put them together



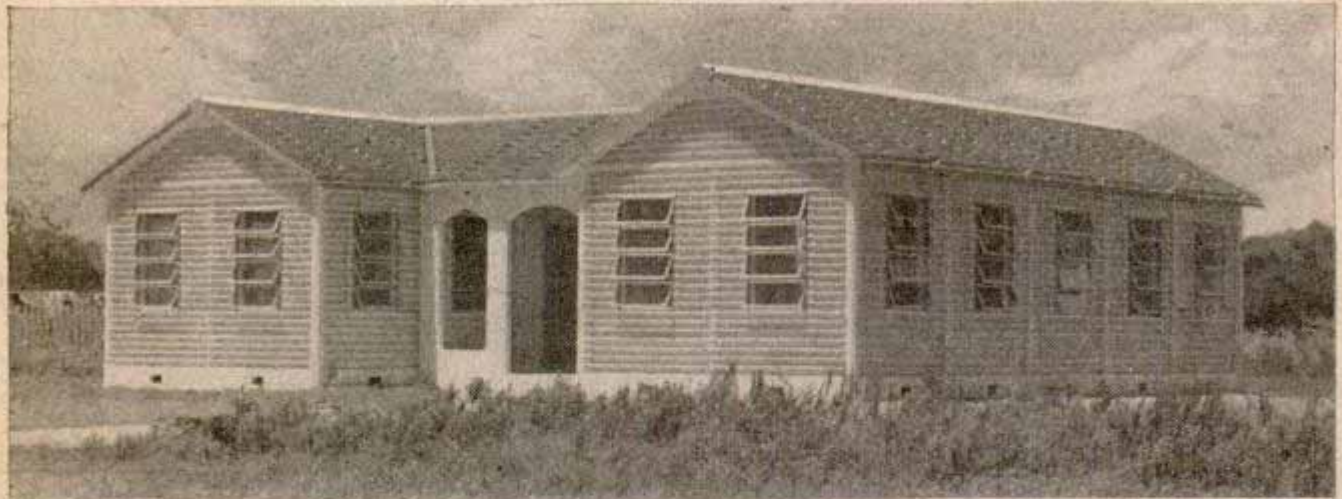
Prefabricated concrete block, six feet by nine feet, is lowered into foundation slot



Floor slab is guided into place. Slab is attached to the crane by angle irons fitted when slab is poured



Roof section is added. House has a ceiling ventilator which circulates air in all rooms and closets



The finished house. It has two bedrooms and bath on the left and kitchen and living-dining room on the right

**D**OWN IN TEXAS they're building houses that consist of 64 prefabricated concrete slabs, with window and door openings cut out. The special concrete is strong, yet it weighs 40 percent less than ordinary concrete.

When finished, the house is H-shaped, 36 feet wide and 30 feet deep, and it sells for a little less than \$4000. There are four rooms, plus bathroom and a connecting section

that can be used as a sleeping porch. Plywood partitions are employed to form the bathroom and closets.

Four-inch fins extend from the outer walls and roof to shade the house. These fins prevent the sun from shining directly against the walls except at sunrise and sunset. The roof is two thirds shaded all during the day. The walls of the concrete house are painted white and the roof red.



# Filming the Sun's Diary

Photo of artificial eclipse of sun, taken at Mount Wilson observatory, shows thin fringe of circling atmosphere

**A** PERPETUAL ECLIPSE of the sun, maintained by an around-the-world chain of high-altitude observatories equipped with coronagraphs, may be the next step in extracting useful information from our nearest star.

New facts about the atom can be anticipated from coronagraph observations, as well as information that will help us understand the solar disturbances that cause magnetic storms on earth. Improvement of long-range weather forecasting is another possibility.

The coronagraph is a new kind of solar telescope, the invention of Dr. Bernard

Lyot of France. It permits direct observations of the solar corona, the vast nebulous "atmosphere" that surrounds the sun. Light from the corona is 1/600,000th as bright as light from the sun itself and until now has been visible only during total eclipses.

The coronagraph produces an artificial eclipse by the use of a brass cone exactly the size of the sun's image. The cone, in the instrument's optical system, blanks out all direct sunlight. At the same time the instrument is designed to eliminate practically all of the scattered light and reflections that occur in most optical systems. The result is that the dim light of the corona

Twin mirrors in dome of 60-foot solar tower at Mount Wilson reflect image of sun through tower shaft to observer







Testing 10½-inch refracting telescope at Climax, Colo., observatory. Below, coronagraph photo of 50,000-mile-high prominence flaring above sun's chromosphere (thin white line). Bottom, dome of Climax observatory



may be viewed. Since the atmosphere itself scatters some light the coronagraph is best used at high altitudes.

With this device the spectral lines of the corona may be analyzed. The solar prominences and flares that extend out into the corona may be studied against the coronal background. A movie camera that is set to expose one frame of film every 10 seconds makes a record of the observations.

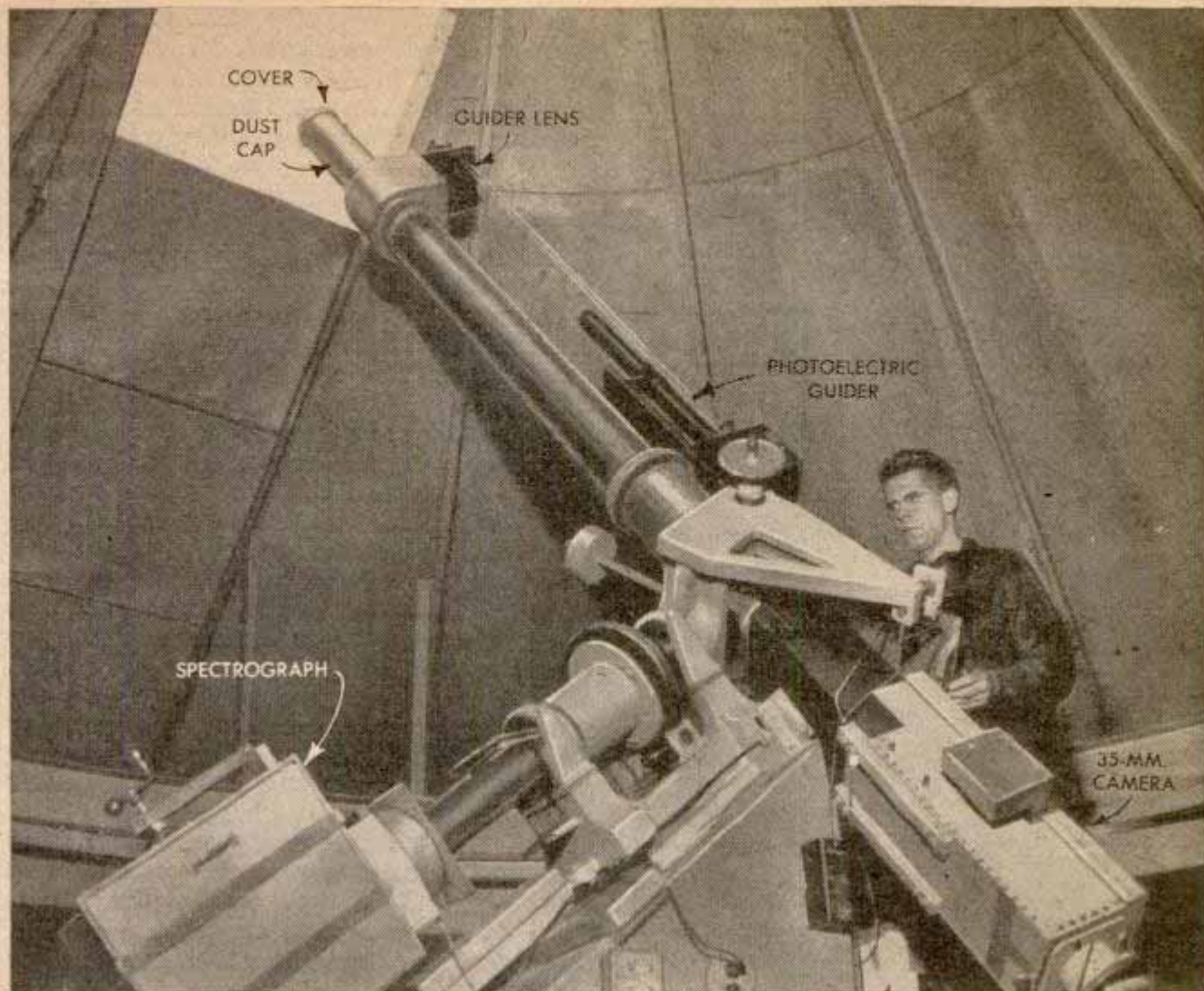
The only coronagraph in the United States is a five-inch instrument installed five years ago at a high-altitude station at Climax in the Colorado Rockies by Commander Donald H. Menzel and Dr. Walter O. Roberts of Harvard College Observatory. Elevation of the station is 11,520 feet.

Artificial eclipses of the sun are nothing new in themselves. Daily records of prominences, made by artificially eclipsing the sun, are chronicled by the Mount Wilson (California) Observatory of the Carnegie Institution of Washington, D. C. The spectroheliographs that Dr. Seth B. Nicholson and the other Mount Wilson "sun men" use to study prominences do not, however, eliminate sufficient scattered light to reveal the dim corona. That is why the new coronagraph has become an important research tool.

The astronomer's sun is a very complicated body. The layman sees only the photosphere, the gaseous body of the sun itself. When magnified by a telescope the surface of the sun has a rice grain appearance, caused probably by the turbulence of its flaming gases. On this surface appear sunspots (dark) as well as bright spots known as faculae.

The visible photo-





The coronagraph resembles a long-barrel field gun. Its photoelectric guider keeps it pointed toward the sun



sphere is surrounded by the chromosphere, a thin layer of dynamic gas that presents a spiky appearance almost like a head of hair. Outside of the chromosphere is the corona. It has no definite limits and often shows wispy streamers that project far out into space. It is visible as pearly light to the naked eye during a total eclipse.

Solar astronomers are concerned at present about the prominences that appear in the corona. These flares seem to be directly related to magnetic storms on the earth.

Astronomers have known for a long time that there is some general connection between sunspots and the upsets that affect the earth's magnetic field from time to time.

During periods of intense sunspot activity, tremendous electrical forces are released toward the earth. Practically all communication channels are disturbed.

Long-range radio communication becomes impossible. Airway radio beams can't be trusted and plane-to-ground voice communication is difficult. False signals may occur in long-distance telegraph circuits, producing garbled messages. To avoid this, the most widely used telegraph carrier circuits are protected by supplementary parallel wires that neutralize the effect of the undesired currents. Even power transmission lines are affected by the surging solar radiations.

In spite of the general connection between sunspots and magnetic storms, it has been impossible to predict all such storms on the basis of sunspot observations. Several years ago, however, it was discovered that there appeared to be definite relationship between the occurrence of solar flares, usually associated with active sunspots,





Two sun towers (150-foot unit at left and 60-foot tower at right) are used in solar studies at Mount Wilson

and the magnetic storms. Crippled communication channels can be anticipated on earth one or two days after large flares appear on the sun.

This was important military knowledge during the war. Reports concerning flares and prominences were telegraphed to Washington daily by Climax, Mount Wilson, and the McMath-Hulbert Observatory of Michigan. From such data, forecasts were made of the times when our communication channels might be faulty and, which was of even greater importance, of the periods during which the enemy would be having communication difficulties.

With the coronagraph it is hoped that more can be learned about the nature of prominences and flares. Both sunspots and prominences are thought to be manifestations of some solar condition that is not yet understood.

The physical connection between the sun and the earth that leads to magnetic disturbances seems to be via the ultraviolet rays and the soft X-rays that are emitted by the sun. These radiations have an effect on the atmosphere and are responsible for the so-called ionosphere, the layer of charged particles high in the atmosphere that re-

flects most radio waves back to earth instead of allowing them to travel straight out into space. It is because of the ionosphere that long-distance radio communication is possible. Disturbances on the sun, however, push the ionosphere down to a lower altitude. With the increase in pressure the particles lose their reflecting quality. Instead of bouncing back to earth the radio waves escape.

One of the possibilities now being explored is the chance that not all radio frequencies are affected alike by this condition. It may be that the ionosphere retains its reflecting ability for some precise wave lengths during the disturbances. If these channels exist and can be found, it may be practical to shift to them when normal frequencies are blacked out.

Directly or indirectly, all of the present research is likely to bring us additional knowledge about atomic processes. The sun is a vast atomic laboratory in which nuclear reactions are occurring constantly on a gigantic scale. Much of what we know about the atom originated from solar studies and our harnessing of atomic power stems directly from this knowledge.

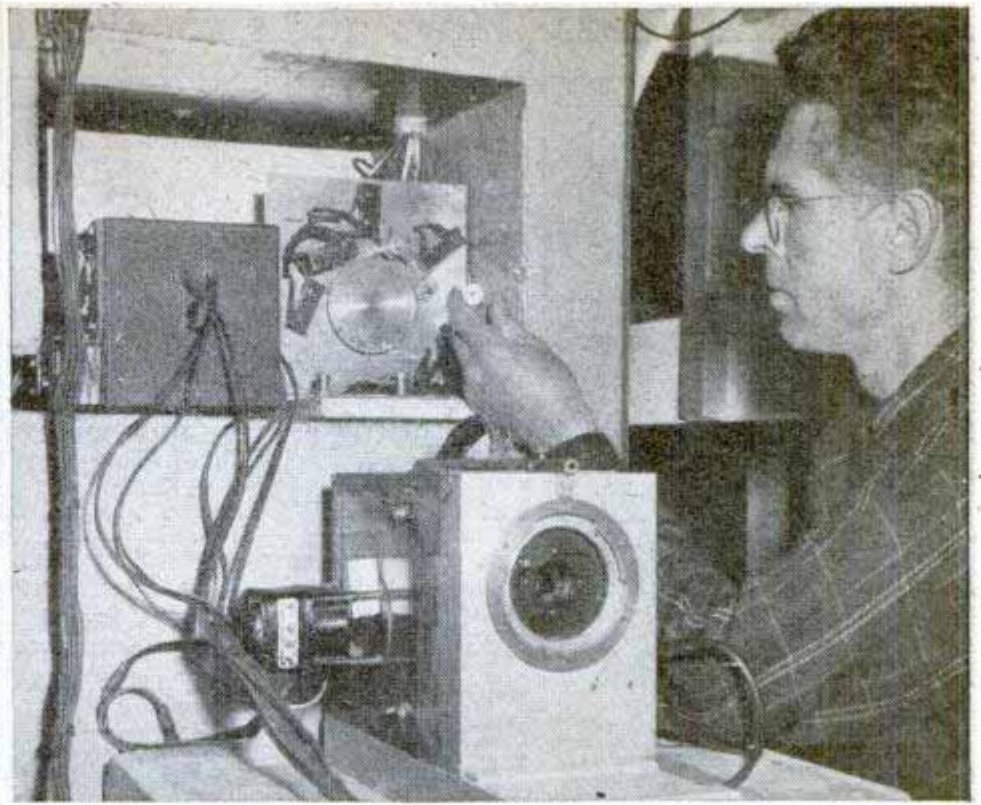
Matter in the sun is being converted at the rate of four million tons per second, each gram of which produces one hundred thousand billion kilowatts of power. So far, scientists have been able to extract power only from the heavier elements. Further solar studies may suggest ways of putting some of the lighter elements to work.

The Climax coronagraph has been used as an exploratory instrument to determine both its value and the advantages of the Climax site. Now plans are under way for a new and larger high-altitude observatory to be constructed in adjacent forest land. Two 15-inch coronagraphs that will permit the making of detailed pictures of prominences are to be used, together with auxiliary apparatus for studying spectral lines in the corona. A one-ton 10½-inch Bausch & Lomb refracting telescope will be employed for studying the solar photosphere. The new observatory will be operated jointly by Harvard University and the University of Colorado.

The present coronagraph automatically turns itself to remain pointed at the sun by means of an improved electronic sight invented by Dr. Roberts. An image of the sun is centered between four Lucite rods in the sight or pointer, each rod being connected to a photoelectric cell. When the sun's image moves off center, one of the Lucite rods receives more light than the others and this fact is transmitted via its photoelectric cell to an electrical brain that supplies power to electric motors guiding the instrument.

An elaborate filter has been designed by



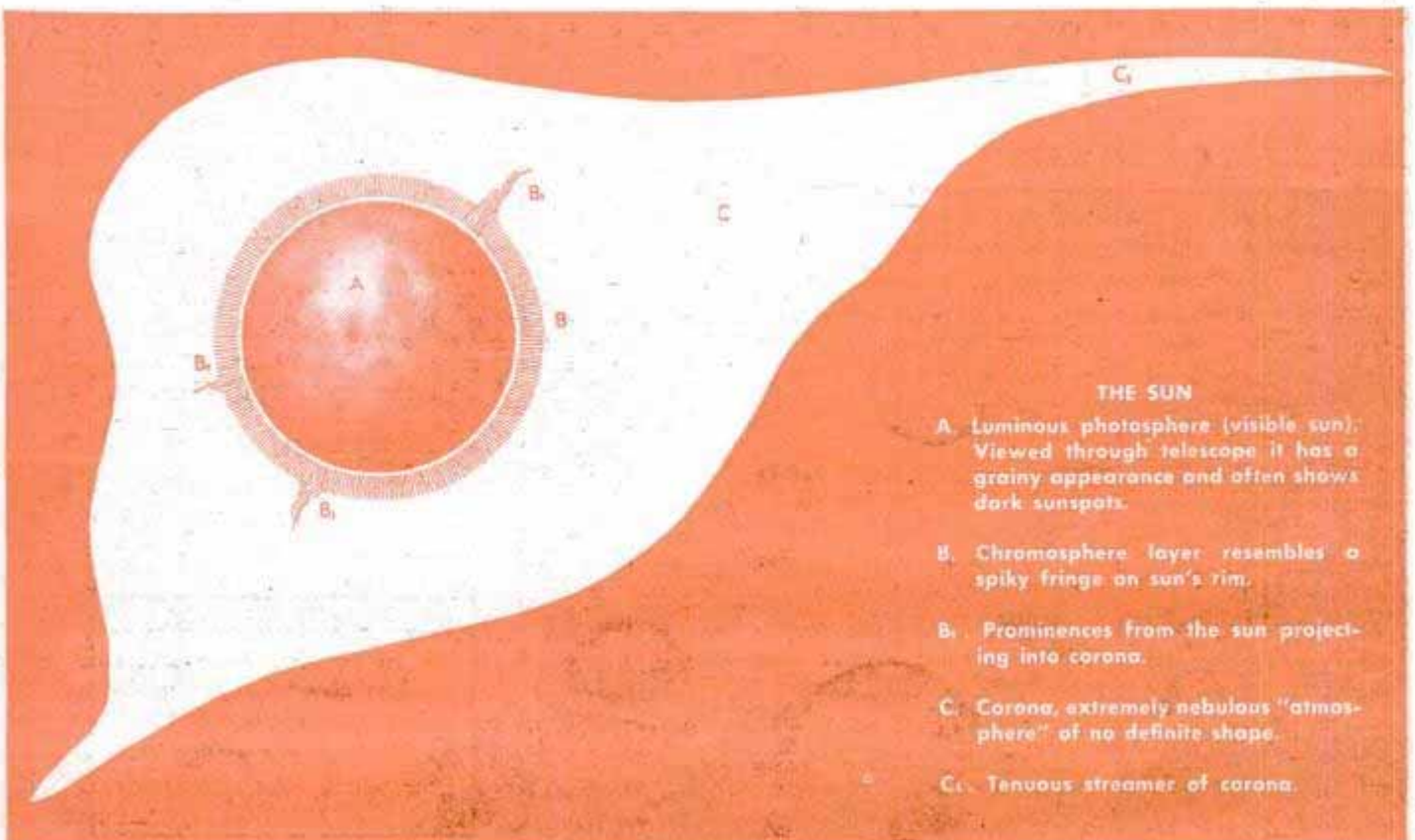


Sun's image is studied as it falls on white disk (left) at base of Mount Wilson's 150-foot tower. Right, electrically driven time clock automatically exposes frame of motion picture film in the Climax coronagraph

Dr. J. W. Evans of the Climax staff for use with the new coronagraphs. The filter will screen out all except a thin slice of visible light, permitting accurate studies of the corona's spectrum. The filter will consist of 16 layers of polaroid crystal and 15 layers of quartz and will contain heating units and sensitive thermostats so that a uniform

temperature may be maintained automatically. A slice of light only two fifths as wide as an Angstrom unit will pass through the filter. The human eye is sensitive to light ranging from 4500 to 8000 Angstrom units. Light passing through the filter will be recorded on special high-speed film several times more sensitive than usual films.

The sun is more than a fiery blob. This sketch shows the various components of Old Sol and their relationship



#### THE SUN

- A. Luminous photosphere (visible sun). Viewed through telescope it has a grainy appearance and often shows dark sunspots.
- B. Chromosphere layer resembles a spiky fringe on sun's rim.
- B<sub>1</sub>. Prominences from the sun projecting into corona.
- C. Corona, extremely nebulous "atmosphere" of no definite shape.
- C<sub>1</sub>. Tenuous streamer of corona.



## Auto-Plane Sheds Wings and Propeller in Five Minutes



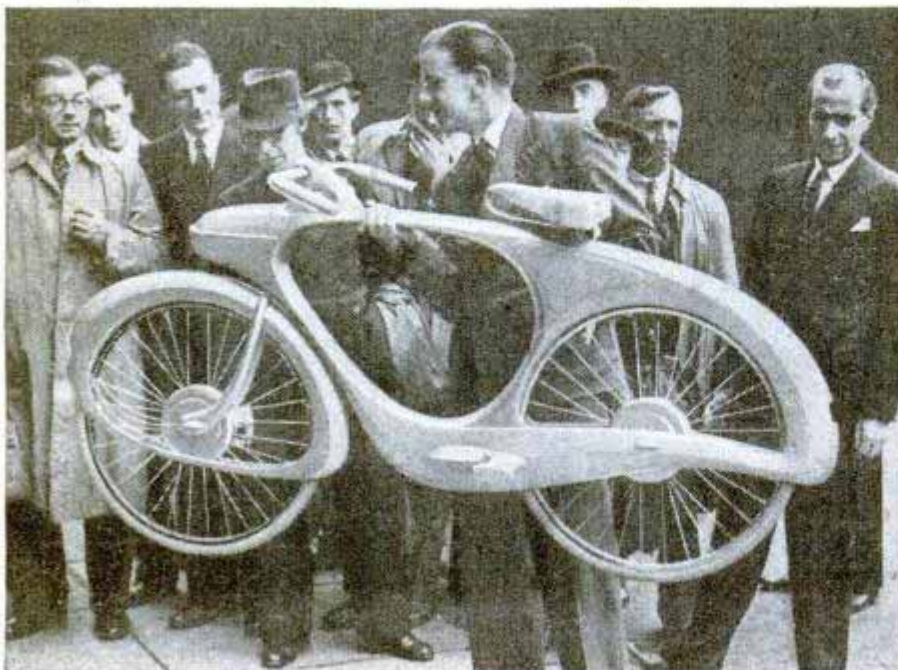
As a two-passenger automobile, left, the Airphibian can go 750 miles on a tank filled with 30 gallons of gasoline. Converting it from air to road use requires disconnecting two locks and takes five minutes. The silver colored, aluminum bodied coupe has a roll-back canvas top

Five minutes' time to disconnect two locks is all that's needed to convert the Airphibian into a two-passenger automobile. A 150-horsepower, six-cylinder, air-cooled engine propels the craft about 125 miles an hour in the air and 45 miles an hour on the ground. The plane weighs 2200 pounds fully loaded and goes 400 miles on 30 gallons of gasoline. On the road it has shown mileage of 25 miles per gallon. It carries 50 pounds of baggage as well as pilot and passenger. The three-blade propeller is removed by turning one lock and another unhinges the



wings and three-wheel fuselage. Wings span 33 feet 6 inches and the coupe's overall dimensions are 7 by 4½ feet. The same steering wheel is used at all times.

## Bicycle Hub Dynamo Stores Up Power to Carry Rider Over Hills



Coasting down one hill on an "electric" bicycle stores up power for climbing the next. Power is stored by a hub dynamo which releases it to aid the cyclist as he pedals. The streamlined "electric" bicycle was designed by B. G. Bowden of Leamington Spa, Warwickshire, England.

Popular Mechanics will supply further information to readers about various products described in any issue. Write to Bureau of Information, Popular Mechanics, 200 E. Ontario St., Chicago 11, Ill.





# Edison Started Something

Edison's lamp lighted the world. His phonograph, below, right, was the first to capture sound

By Maston M. Jacks

WHEN Thomas A. Edison discovered electricity leapfrogging from the filament of his lamp to another wire he couldn't explain why nor did he know of any way to use it. Even if someone had told him that his discovery—known as the Edison Effect—would usher in radio and electronics he probably wouldn't have been impressed because such things then had no practical value.

The results of Edison's work are as close today as the nearest light switch. Snap on the light, answer the telephone,







Outdoor sports events are televised by NBC with a 40-inch focal length lens, the longest ever used. Television and other electronic miracles stem from Edison's discovery of the Edison Effect which he found while working with externally wired lamps, right



play a record on your phonograph and you realize how his inventions reach into the everyday lives of almost every American.

This month the country observes the 100th anniversary of Edison's birth at Milan, Ohio, February 11, 1847. The whole world honors his persistent tinkering that created millions of jobs and raised living standards everywhere. Motion pictures and electric light and power, only two among many puzzles his genius solved, today employ 455,000 persons in this country alone. They pay nearly \$1,000,000,000 a year in salaries. Statisticians reckon their total capitalization at nearly \$19,000,000,000. Even the 400,000 juke boxes now in use are descendants of Edison's penny-in-the-slot machine. They spread 2,000,000,000 nickels a year among nearly 75,000 people.

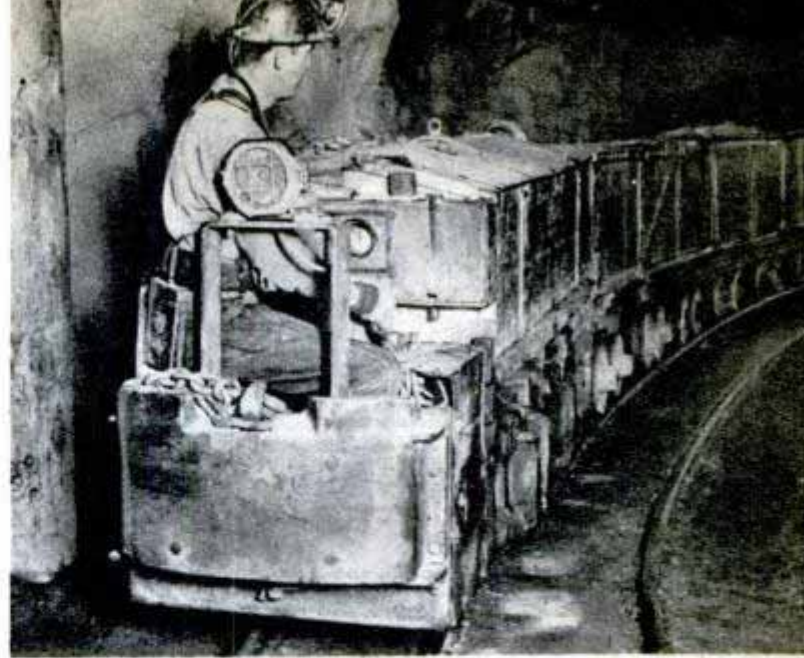
He invented the incandescent electric lamp and wasn't satisfied with it. Particles

of the carbon filament (one came from a strip of bamboo torn from a palm-leaf fan found in the living room of his home) blackened the inside of the bulb. He wanted to know why and discovered the Edison Effect. This led Dr. Lee De Forest, 23 years later, to make the vacuum grid tube needed in electronics.

What Edison found is that electrons are emitted from the heated filament of an electric lamp. He put a cold metal plate near the filament inside the bulb and wired the plate to the positive terminal of a battery. Current jumped from the filament to the plate and passed along the wire. With the plate connected to the negative battery terminal, the electrons didn't hop the gap.

De Forest added the light metal "screen" or grid between plate and filament. The grid controls the flow of electrons from filament to plate with miraculous accuracy





**Edison's alkaline battery for electric autos today lights miners' safety lamps and drives mine locomotives**

and speed. It can change stop-and-go signals on electric current more than a billion times a second.

Under control in a small portable radio, for example, the Edison Effect makes it possible for four tubes no bigger than a cigarette to multiply the power of an incoming radio signal 25,000,000,000 times between antenna and speaker.

The importance of Edison's discovery is reflected by a still growing \$6,000,000,000-a-year electronics industry. It is responsible for radio, television, radar, the electron microscope and scores of other technical changes further transforming the living habits of the world.

Industrial research projects are commonplace today. Large companies regularly spend millions to improve their products. Only a few weeks ago General Electric scientists, seeking artificial means to control weather, turned a three-mile-long cloud into snow. About the same time, Bell Telephone laboratories announced the development of a vacuum-tube amplifier that handles more than 10,000 long-distance telephone conversations simultaneously, and the Johns-Manville Company disclosed that it is planning a multimillion dollar building material research center.

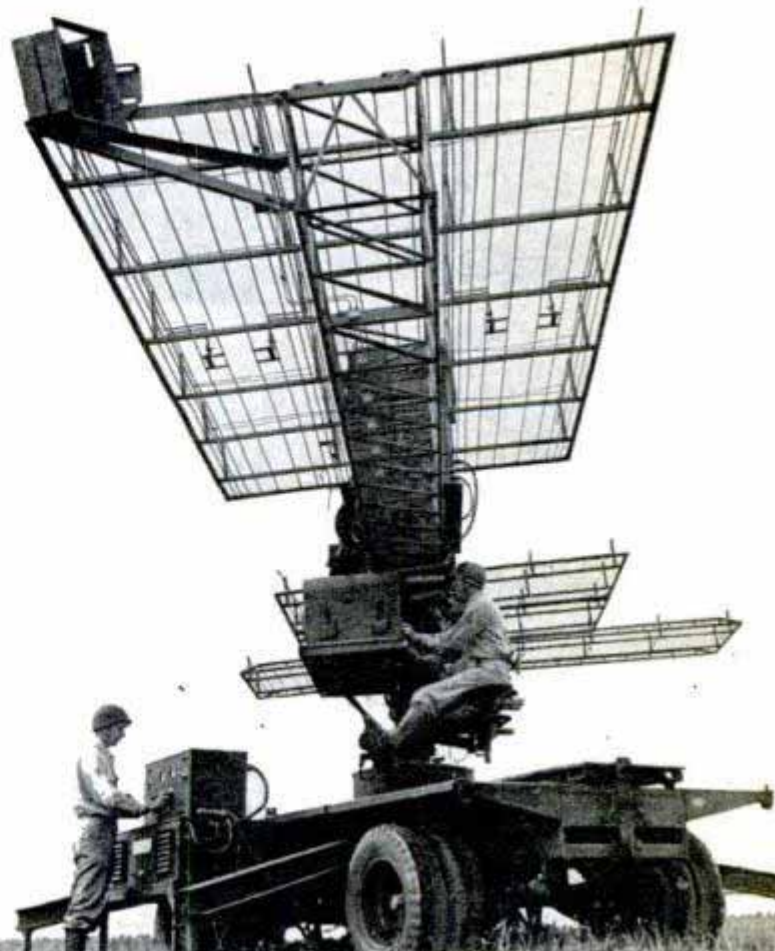
It was the establishment of Edison's laboratory at Menlo Park, N. J., in 1876 that forced industry to recognize industrial research. Until then the quest for applied scientific knowledge was haphazard and spasmodic. Edison organized the effort. While he knew little of scientific theory, he surrounded himself with trained assistants who did.

Edison invented by sheer persistence, using the tools of science in innumerable combinations whether they had any obvious connection or not. Menlo Park itself was an experiment for him. Like many oth-

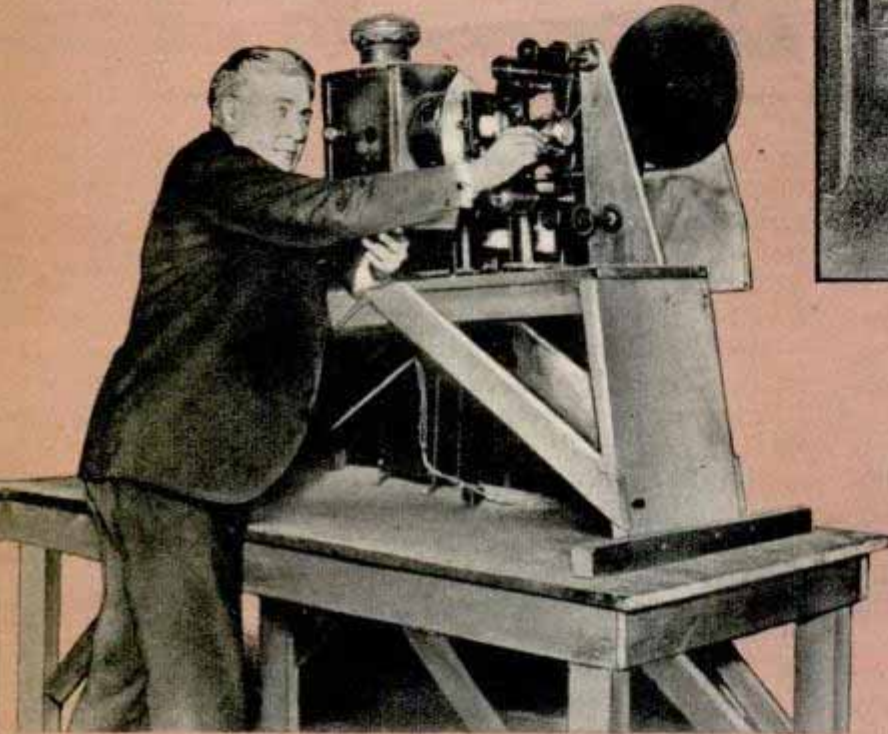
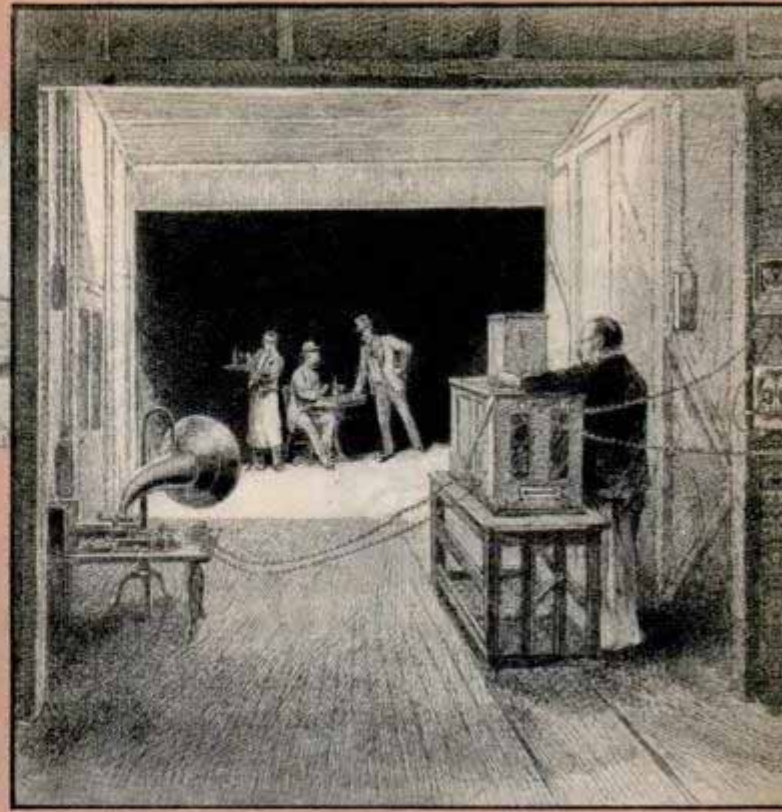
ers of his combinations, it worked. An example of his method is his pursuit of a suitable lamp filament. After he finally happened upon carbonized bamboo, he spent \$100,000 testing 6000 different specimens before he isolated three that were satisfactory.

He liked to think of himself as a practical man, although he frequently spent all his funds on experiments. At one time he was paying a New Jersey sheriff \$15 a day to withhold execution of a court order attaching his equipment until he could raise the money to pay a judgment against him.

**Radar is development of Edison Effect. Triple antennas of mobile trailer set aim and fire antiaircraft guns**



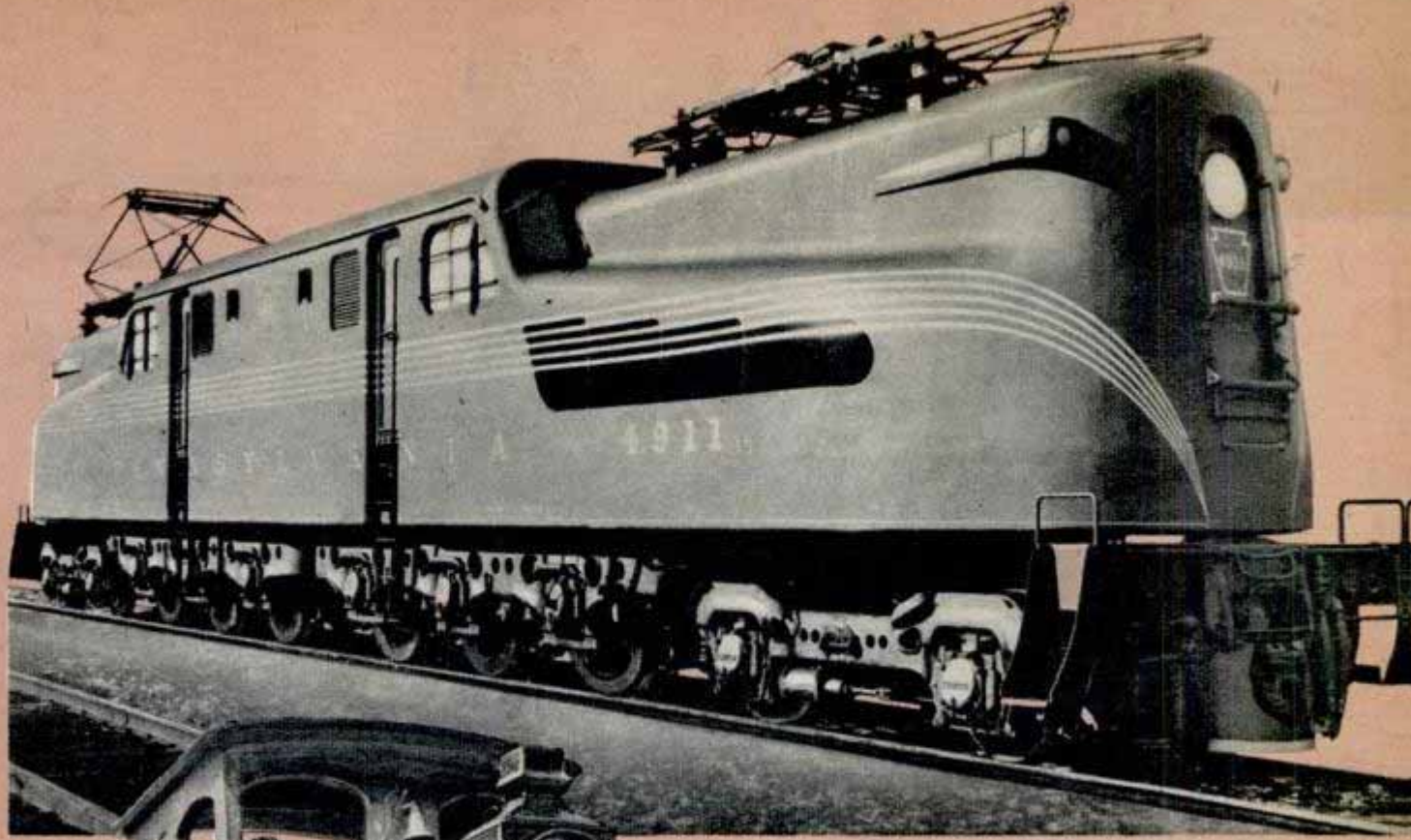




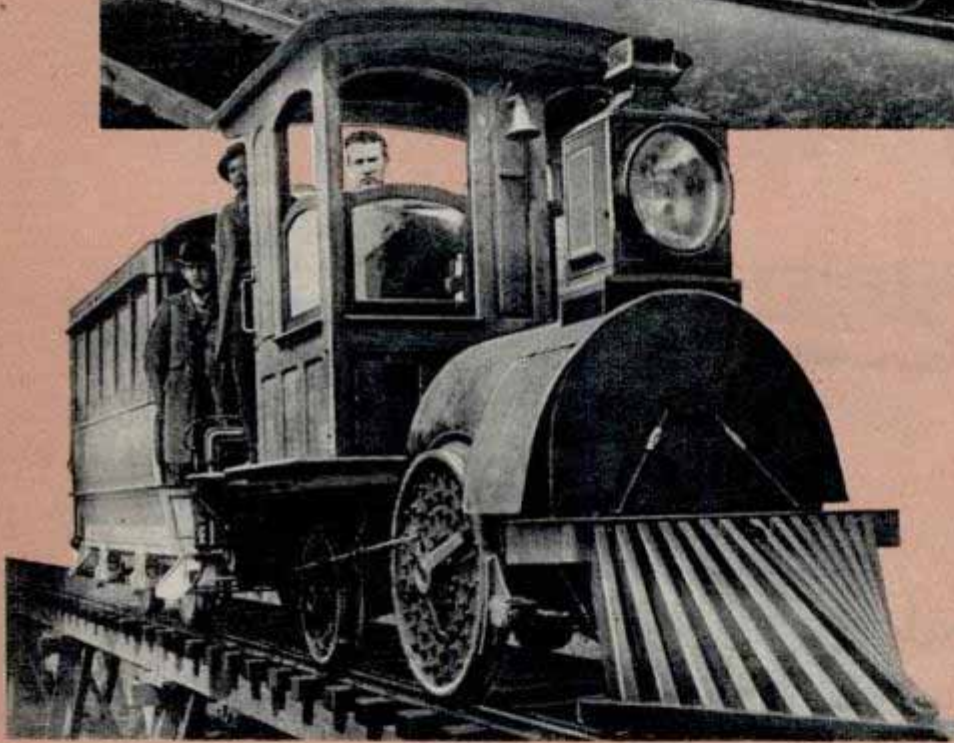
The grandpappy of Hollywood's multimillion-dollar studios was the tar-paper shack, top left, which Edison built on a circular track to take advantage of sunlight both morning and afternoon. Inside, motion picture camera devised by Edison filmed action while synchronized phonograph recorded the sound. Edison then worked with another inventor to contrive a practical projector, left, for use in nickel-odeons of the period. Modern motion picture industry is built upon Edison's foundation. Elaborate sound stage, below, for Warner Bros. film, "Night and Day," took thousands of dollars worth of equipment and many technicians







Edison devised third-rail system for electric traction and from his early model, left, electric locomotives capable of 100 m.p.h. have been evolved



the sound vibrations of the transmitter I could reverse the process and reproduce the sounds."

How well he succeeded is shown by the fact that his first crude model was a complete success. Only a little later Edison predicted how the world would use the machine. On his list are its uses for reproduction of music, for musical toys, teaching elocution and languages, preservation of speeches,

Many legends linger about him; one, that he had invented a 365-layer shirt that could be worn all year-round simply by peeling off the outer layer each day.

He once lectured a scientist for failure to appreciate commercial problems. The scientist countered by asking Edison what he had received for his lamp. Edison said he had gotten nothing. The scientist pointed out that it was Edison who failed to understand business—that for the manufacturing rights to an article not nearly so much in demand as the Edison lamp he had received \$250,000.

The phonograph was Edison's most original and his favorite invention. He said, "I got the idea while working on a telephone carbon transmitter. It occurred to me that if I could indent a yielding substance with

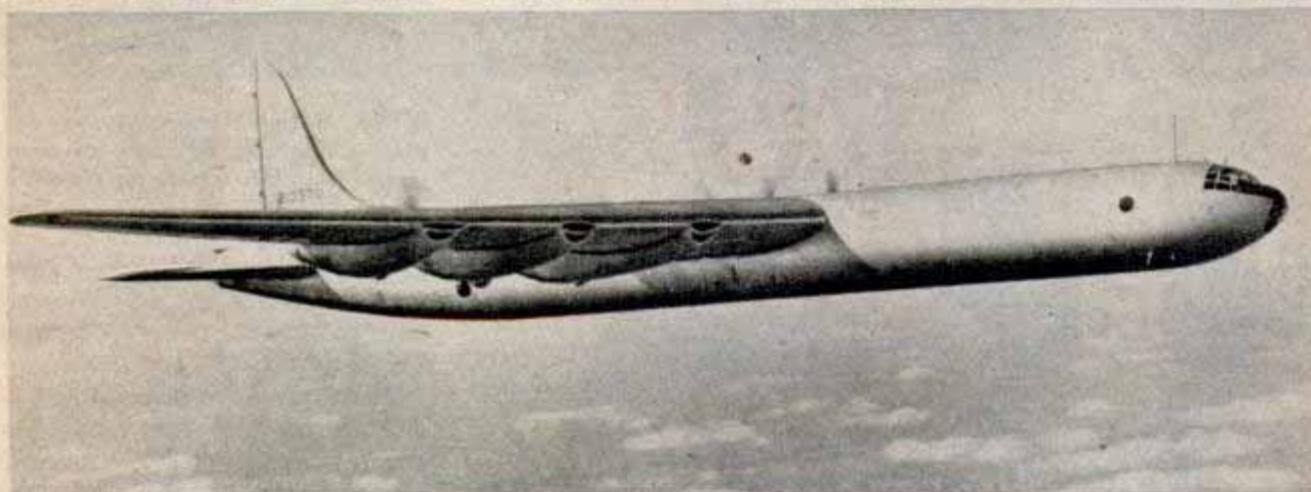
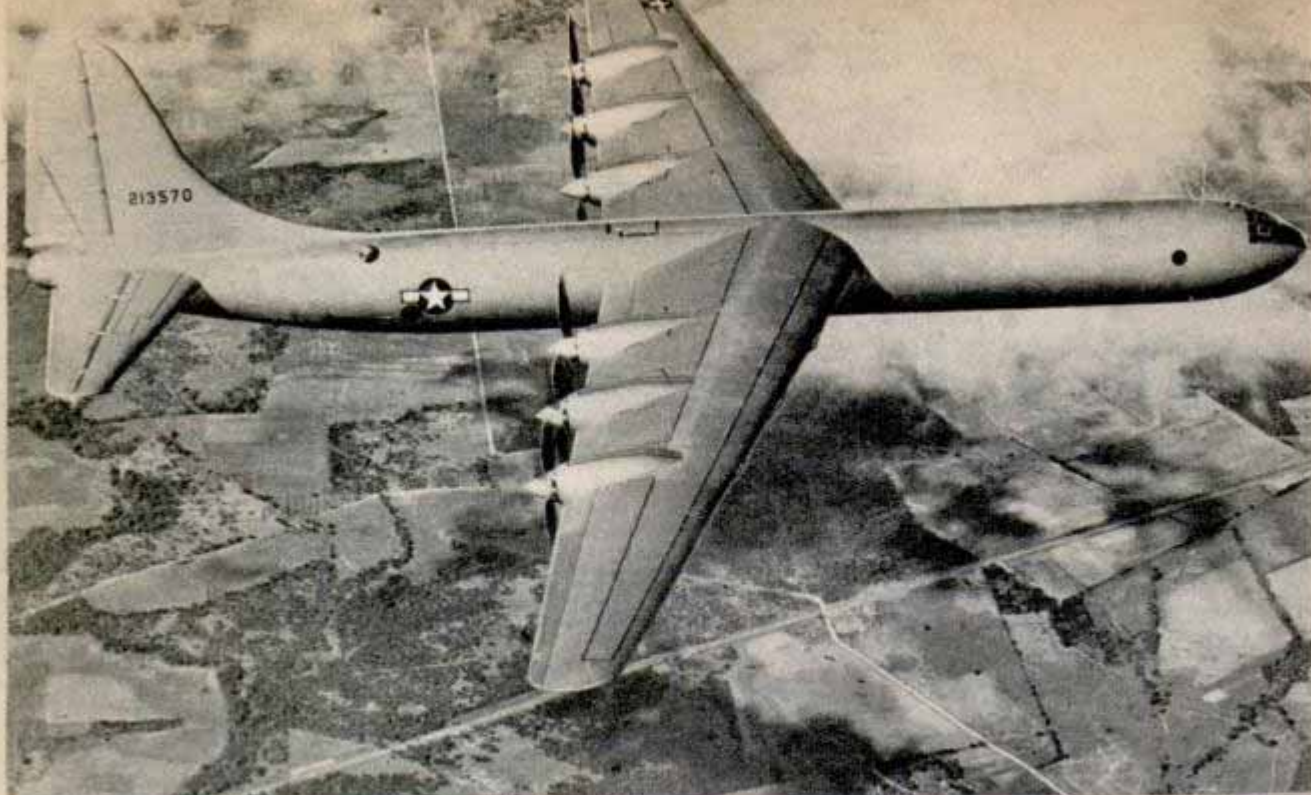
production of phonographic books for the blind, a recording device in connection with the telephone, an office dictation instrument and as a coin-in-the-slot juke box.

But his experience with the phonograph disclosed that he was never quite the "practical" man he insisted the inventing business needed. After he had invented it, he discarded the machine for 10 years until a rival company began to manufacture it. Then both Edison and the rival company manufactured phonographs as penny arcade juke boxes. The phonograph was not recognized as a musical instrument. A music merchant would have been insulted if he had been asked to sell it. Hardware stores and toy shops were the sales outlets.

Next the flat disk record was devised.

(Continued to page 260)



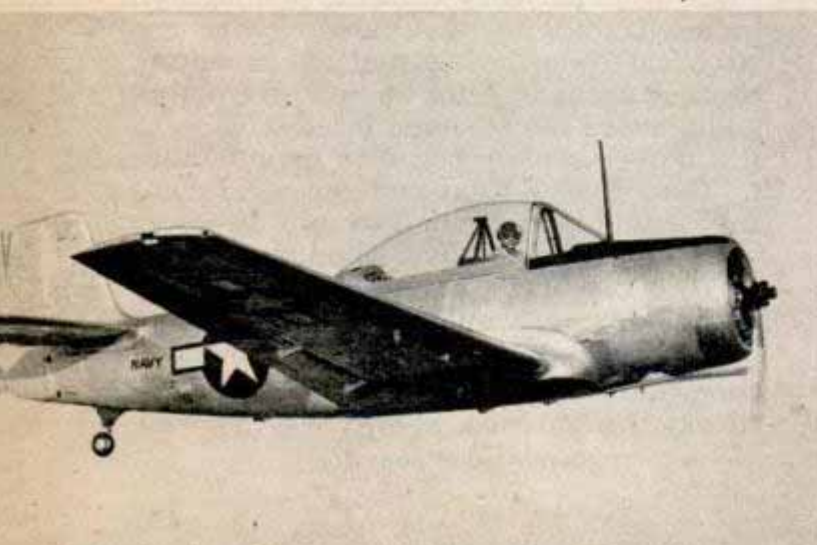


Consolidated-Vultee photos

## Largest Bomber

Eight 56-inch landing wheels are being substituted for two 110-inch wheels to support the 278,000 pounds of the Army's B-36. Arranged in four-wheel trucks, they distribute the weight of the largest bomber ever flown better than the two wheels used in test flights and are nearly a half ton

lighter. This improvement, coupled with the shortened landing runs resulting from reversible pitch propellers, permits use of a greater number of airfields. The pressurized bomber, with six pusher-type engines, has a 40,000-foot ceiling and a range of 10,000 miles with 10,000 pounds of bombs. The wing tanks hold 21,116 gallons of gasoline and 1200 gallons of oil, more than an ordinary motorist uses in 20 years.



## Trainer Has All-Around Visibility

Instructor and student have the safety advantages of all-around visibility beneath a one-piece bubble canopy in the Navy's latest primary trainer, the Fairchild XNQ-1. It has a top speed of 170 miles an hour, climbs over 1000 feet a minute and weighs 3700 pounds. The nine-cylinder Lycoming engine spins a controllable pitch propeller.

☐ Filament wire used in electric lamps is so strong that a three-inch length will support 200,000 times its own weight.



## Stylus "Reads" for the Blind By Scanning Printed Material

Ten words or more per minute can be "read" by blind persons using an electronic hand-held stylus to scan printed material. No raised type, as employed in Braille, is required. The stylus is moved horizontally across a line of type, letter by letter. A beam of light directed through a narrow slit in the face of the stylus scans the print vertically, 30 times per second, indicating the presence and extent of black portions of each letter by a warbling tone which becomes audible through headphones. Ultimate speed expected with the instrument, developed by RCA Laboratories, is 60 words a minute. If the reader gets off the line, the device transmits no sound.



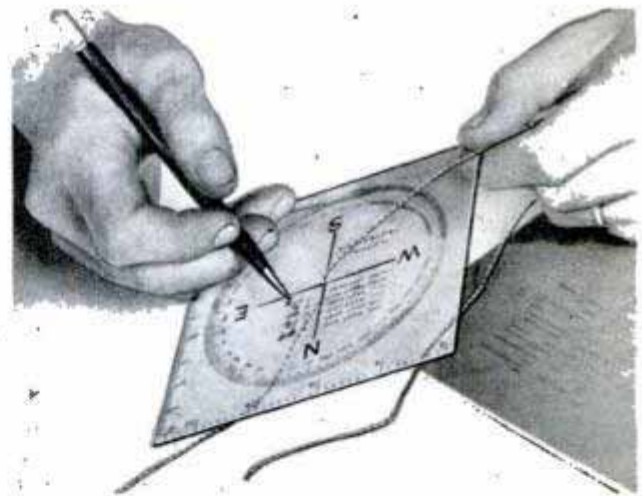
## Easy-to-Play "Sweet-Potato Flute" Has Tone Holes in Keys

Music that sounds like a cross between flute and "sweet-potato" (ocarina) tones is produced by an easy-to-play woodwind instrument designed for beginners. Equipped with a simplified mouthpiece that requires no reeds, the sweet-potato flute has a complete fingering system that incorporates tone holes in the keys, thus reducing the number of mechanical parts.



## Course Finder for Lightplane Pilots

With a unique transparent plastic protractor, course plotting for flights under contact conditions is simplified for light-

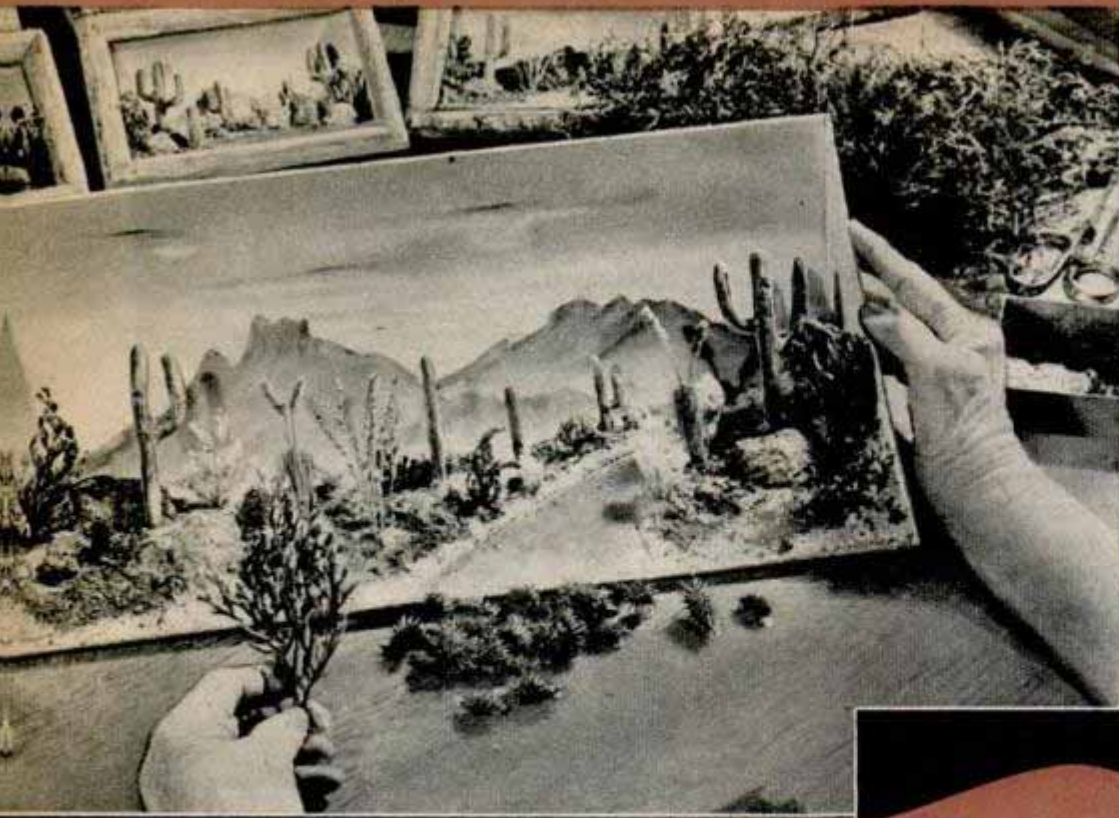


plane pilots. The protractor has a cord attached which is laid out between points on a strip-map for determination of the true course. True course, variation, magnetic course, deviation and wind velocity figures needed to determine the correct compass course can be jotted down in pencil on a frosted section of the protractor.

## Chemical Spares Useful Insects

Useful insects may be spared with a chemical which kills the codling moth, a pest that destroys apples and other orchard crops. Phenothiazine, used to control internal parasites in animals, is combined with lead arsenate to destroy the moth. It was developed by Du Pont chemists, who report it is less harmful to useful insects.





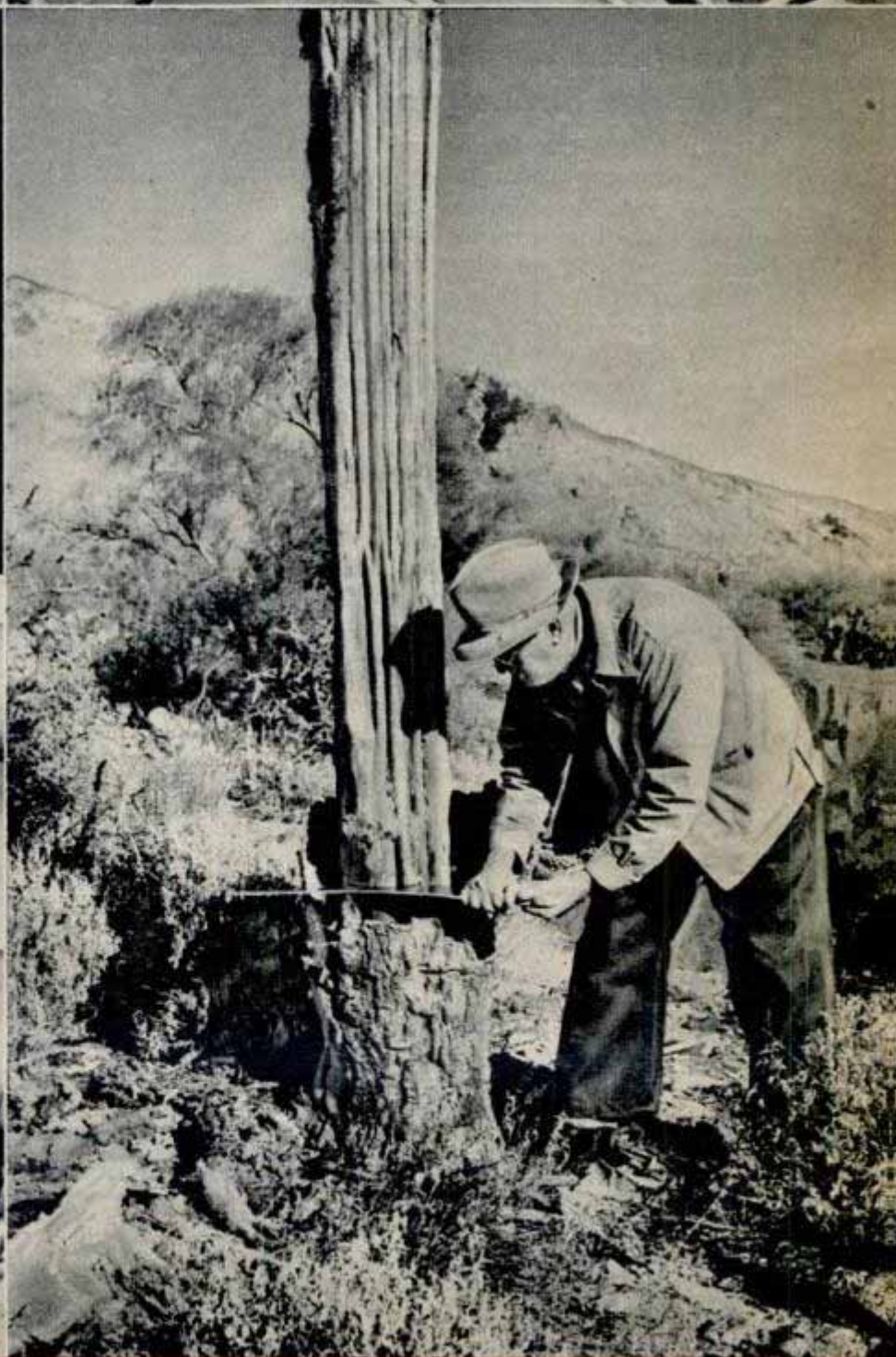
# FRAMING the DESERT







**C**OLORFUL Arizona desert scenes are reproduced in painstaking detail in dioramas made by the Guy Knauff family in Tucson. In their home shop they have constructed 46,000 of the three-dimension pictures. Most materials used are fragments of vegetation which the Knauffs gather from the desert near their home. The boxed scenes vary in size from 3 by 4 inches to 18 by 66 inches. All are made with concave background to give the illusion of horizon and sky. Some are so deep that lights can be placed between cutout mountains and the background wall to simulate a sunset



Clay saguaro is painted green and "planted" in desert. Ribs of real saguaro, right, will become diorama frames





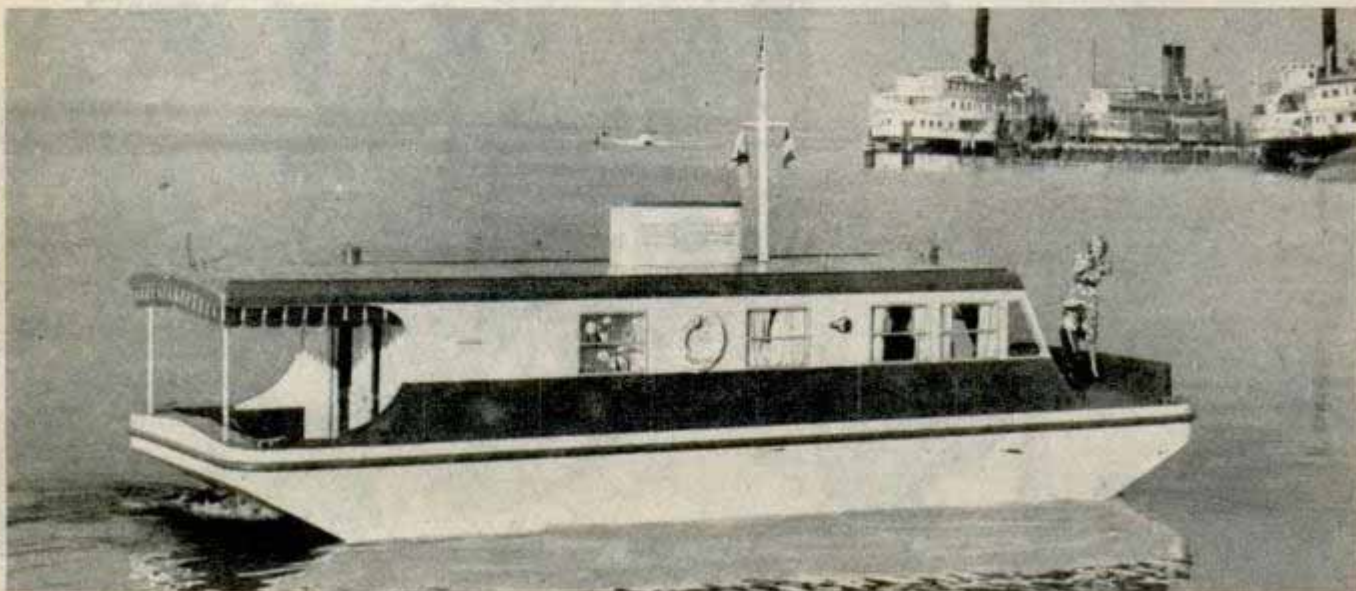
## Self-Propelled Houseboat Provides Bunks for Six

One answer to the housing shortage—and moving day worries, too—is a new 36-foot steel-hull houseboat with lines like an assault boat and a cruising speed of seven miles an hour. The craft is fireproof, waterproof, insulated with mineral wool and has a draft of only two feet. Its accommodations include a stateroom with two single and one double bunk and a lounge which can be converted into a double bedroom. The galley has a double sink, an icebox, a four-burner stove, four built-in cabinets and a drop-leaf table. The tiled bathroom has a stall shower and even boasts a medicine cabinet. The boat is equipped with 110-volt current. Powered by a 45-hp. engine, the craft is priced at \$9990.

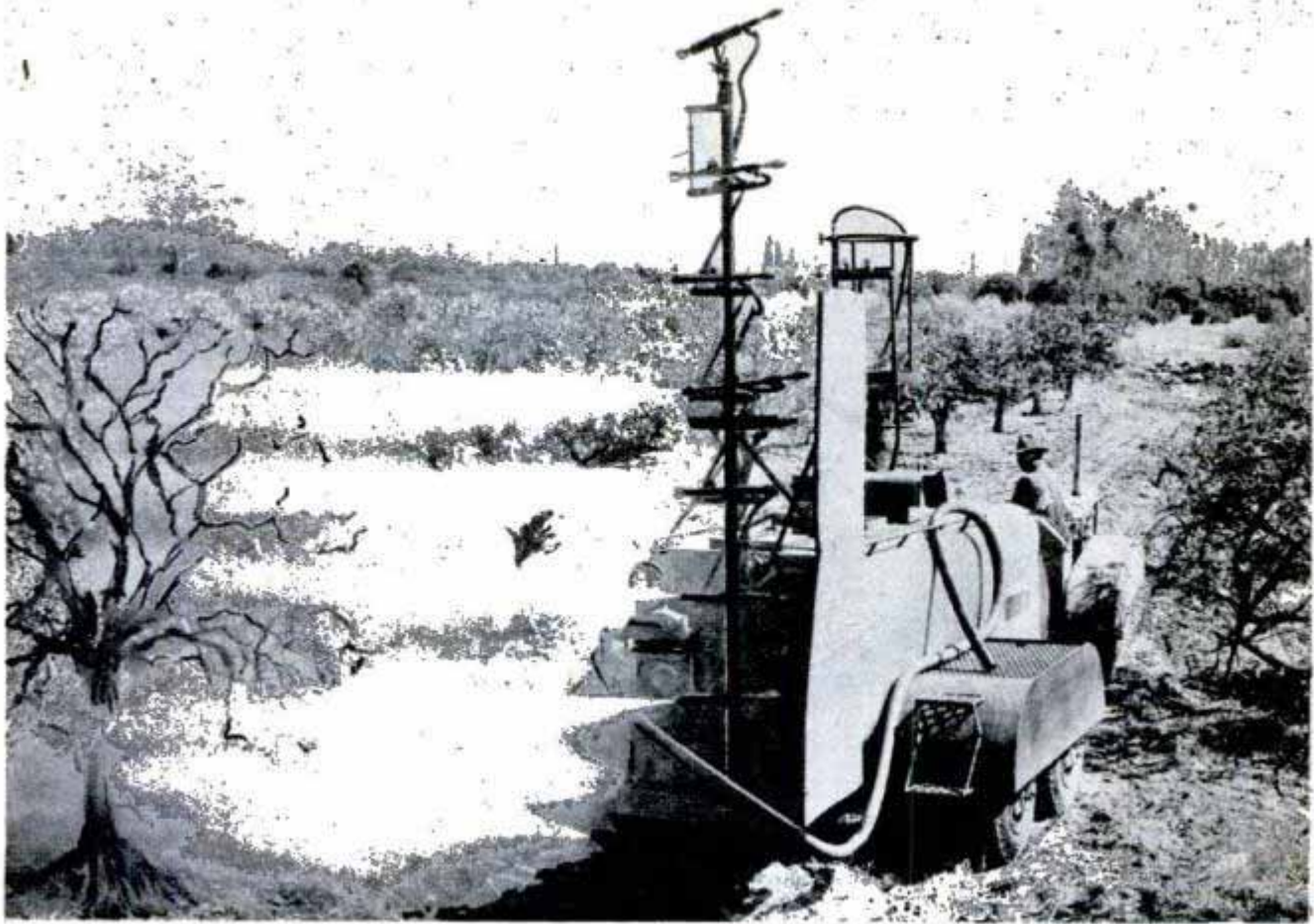
Left, awning-shaded afterdeck of the houseboat has a built-in seat where the owner can lounge or fish in comfort. Right, the cozy living room can be converted into an extra double bedroom



▲ In the galley are a double sink, a four-burner bottled-gas stove and an apartment-size refrigerator. Below, the sturdy boat, powered by a 45-horsepower engine, resembles a wartime landing craft







When the wind blows spray over the driver of the spraying rig used in the lemon groves of the Sespe Land and Water Company at Fillmore, Calif., the driver dismounts. While he walks along in the next row to avoid the spray, the driverless Diesel track-type

### Spraying Rig Follows Row As Driver Dodges Spray

Caterpillar tractor pulls the rig straight down the work row. The automatic rig is equipped with nine spraying nozzles that are mounted so that they swing back and forth by power from the sprayer motor. The spray tank holds 800 gallons of material.

### Waterproof Cover for Pickup Truck Slips Over Aluminum Frame

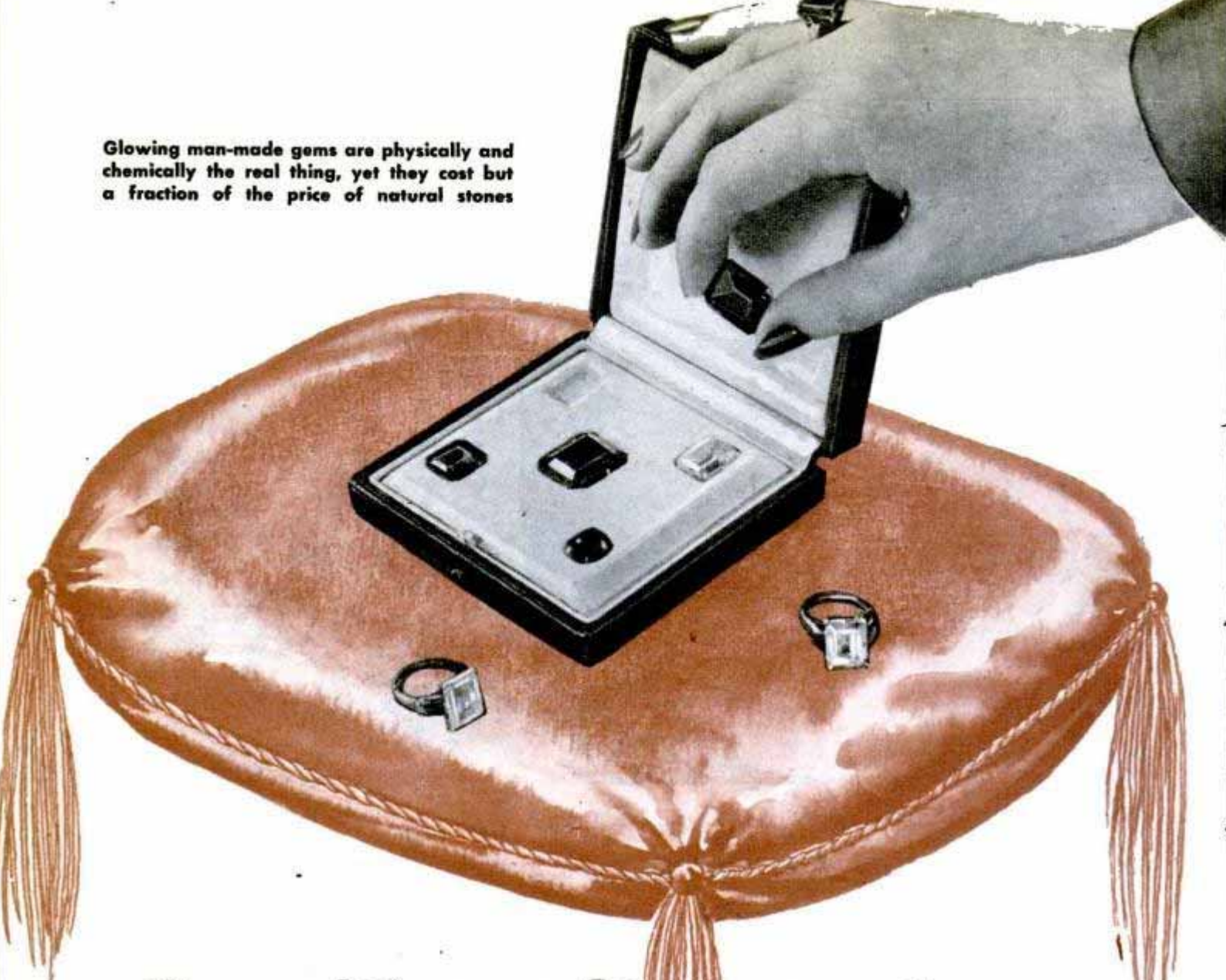
Conventional pickup trucks can be converted into waterproof vehicles with a heavy duck cover that fastens over an aluminum frame. Trim lines of the cover minimize wind resistance. The canvas across the rear can be opened easily by a zipper along each side and rolled to the roof. The unit fits most  $\frac{1}{2}$  to  $1\frac{1}{2}$ -ton pickup trucks built from 1940 to 1946 as well as many built before 1940.



Records of television programs will be made on 16-mm. motion picture film much as transcriptions are now used in radio.



Glowing man-made gems are physically and chemically the real thing, yet they cost but a fraction of the price of natural stones



## *Oven-Baked Gems for Industry*

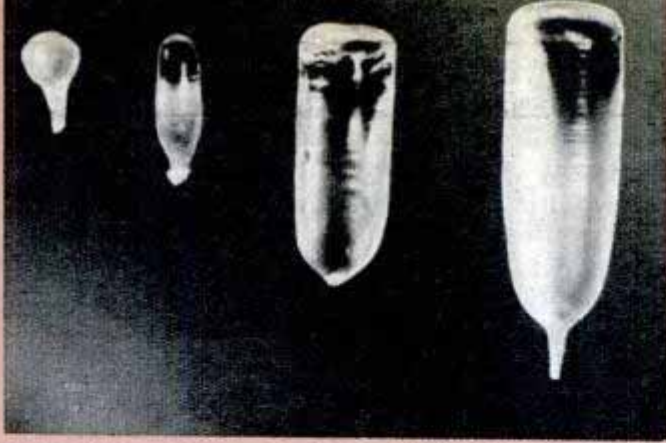
**A**LCHEMISTS of the Middle Ages searched for centuries to find the "philosopher's stone"—a mystic substance that would transform everyday materials into gold and silver—but ultimately gave up their search. More recently, men have tried sealing lumps of carbon inside iron balls, heating the balls white-hot, then dropping them in ice water. The sudden change of temperature was supposed to change the carbon into diamonds, but these experiments failed, too.

But where alchemy failed, modern industrial science has triumphed. Today, synthetic sapphires and rubies—identical in chemical and physical properties with natural gems—are being produced in America in commercial quantities. The secret of the process is controlled heat, which transforms a feathery powder into beautiful crystals, red rubies, or sapphires of many colors.

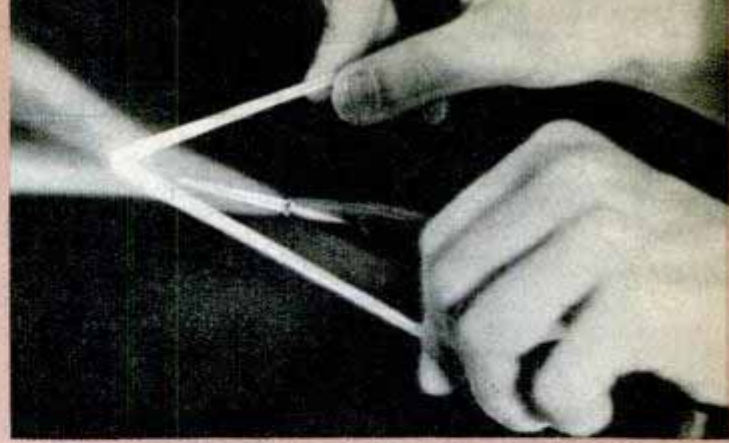
The development of man-made sapphire is significant to industry as well as the jewelry trade, for the substance has a combination of hardness and uniformity of structure which makes it ideal for bearings that wear indefinitely. Even before the war every Army or Navy plane required between 75 and 100 sapphires for instrument bearings. Range finders and other military instruments that had to be accurate contained large numbers of sapphire bearings.

Before the war the United States was able to get all the synthetic sapphires it needed—in the form of finished jewel bearings at the rate of some 30 millions a year—from Switzerland. The war ended this source of supply. American industry had to produce synthetic sapphire quickly for bombsights, speedometers, chronometers, compasses, airmeters, voltmeters, altimeters, gyroscopes, electric and fire control





Left, the first "boule" ever made; right, the most recent



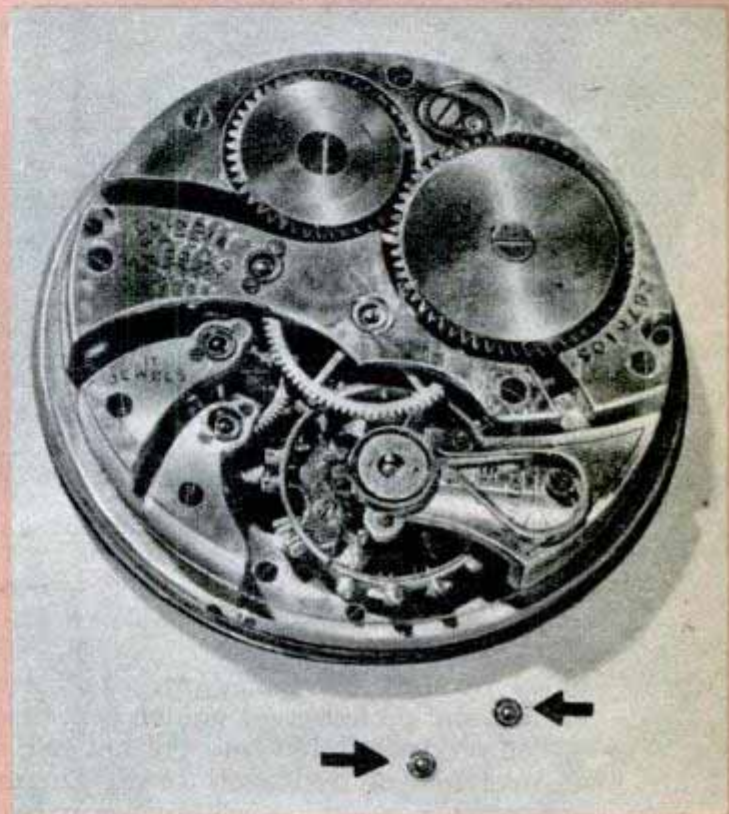
Sapphire rod torch-heated to 3100 degrees F. is bent by hand

instruments and naval instruments. Within two years engineers and chemists developed and produced synthetic corundum, a mineral family which includes sapphires, rubies and common emery.

After 16 months of intensive research the first American plant for the production of synthetic sapphire turned out the first gems. From then until the end of the war there was no scarcity of the material. A stream of synthetic jewels poured from the ovens of the Linde Air Products Company, General Synthetics Corporation and the Bulova Watch Company.

Modern alchemists start their production of sapphires and rubies by roasting pure alum crystals in a furnace at 2400 degrees F. The product is a feathery white powder—aluminum oxide. This material melts at 3750 degrees F. and the temperature range in which it can be worked is quite narrow.

The size of the particles of this powder influences the quality of the finished product. At present, particles measuring  $\frac{1}{10}$  micron are producing the purest and best synthetic gems. These particles are so small that if one of them were enlarged 50,000 times it would be about the size of a pinhead.

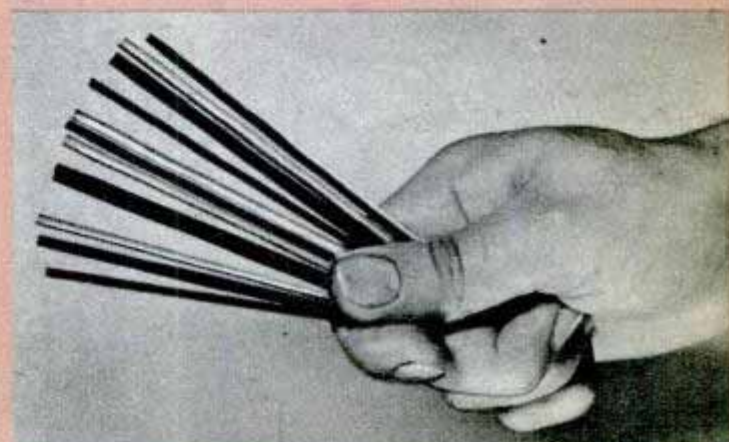
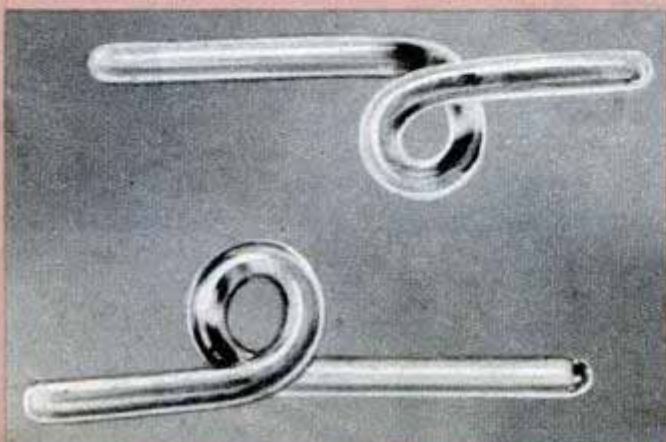


▲ Major field for man-made sapphires is in jeweled watches  
 ▼ Precision gauges made with synthetic sapphire surfaces outlast steel gauges and maintain their accuracy indefinitely  
 Linde Air Products Company photos

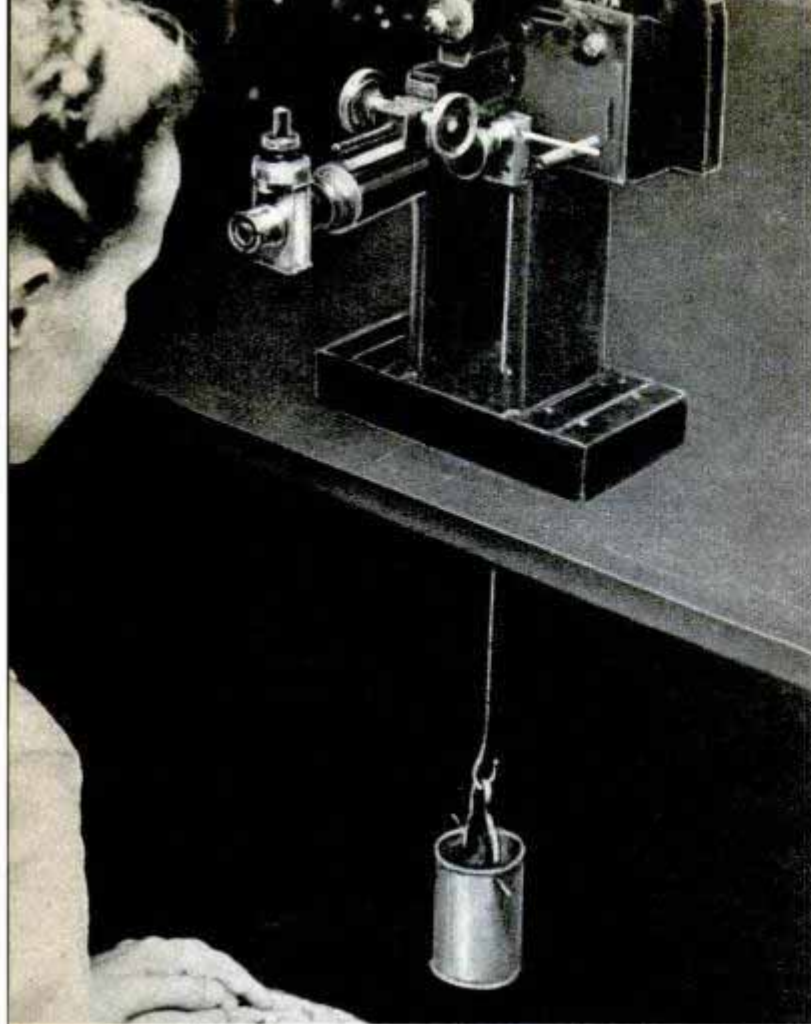


▼ Gems are made in the form of rods, then sliced into disks

Looped rod is durable thread guide for textile industry







**Test instrument checks tensile strength of sapphire rod**

To this powder is added any coloring matter desired. A little chromic oxide gives rubies; titanium and iron give blue sapphires; cobalt and vanadium produce emeralds, and nickel gives golden sapphire.

The mixture is fed into the hot flame of an inverted oxyhydrogen torch. The mass of molten material resulting from the fusion of the powder is deposited on a fireclay

**Rod is given a strength test at white-hot temperatures. It maintains its hardness up to 2912 degrees F.**

pedestal. Here the mixture piles up, shimmering with its own intense heat, to form a carrot-shaped mass known as a "boule." This boule is actually a single crystal.

As the crystal grows it develops stresses. The boule is split to relieve these stresses. Before the splitting the boule weighs about 300 carats, is about  $\frac{3}{4}$  inch in diameter and two inches long. Crystals have been produced weighing up to 800 carats.

Most bearings are made from small disks, and several expensive steps formerly were required to work such disks from a boule. Research workers decided to produce the gem material in the form of small-diameter rods, although European experts concluded years ago that this was impossible.

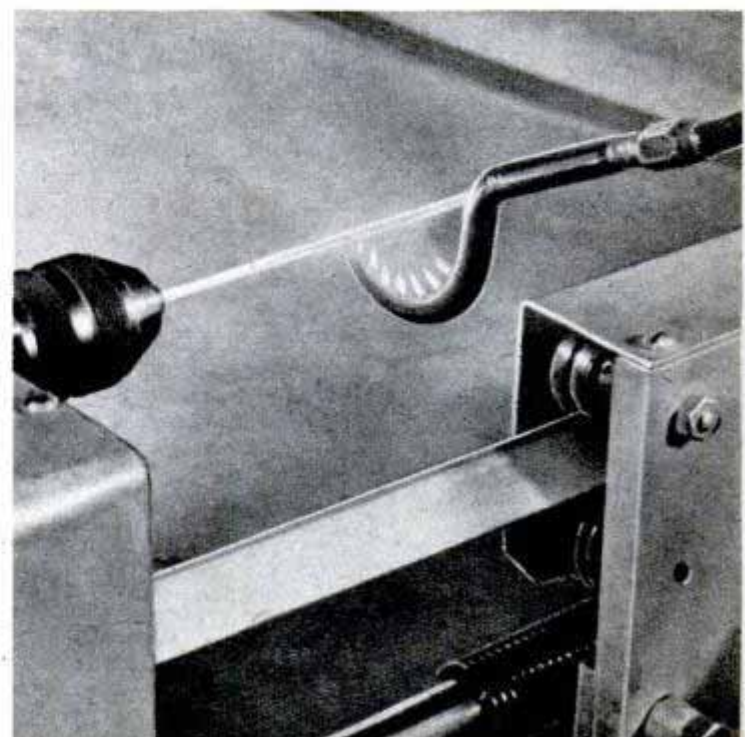
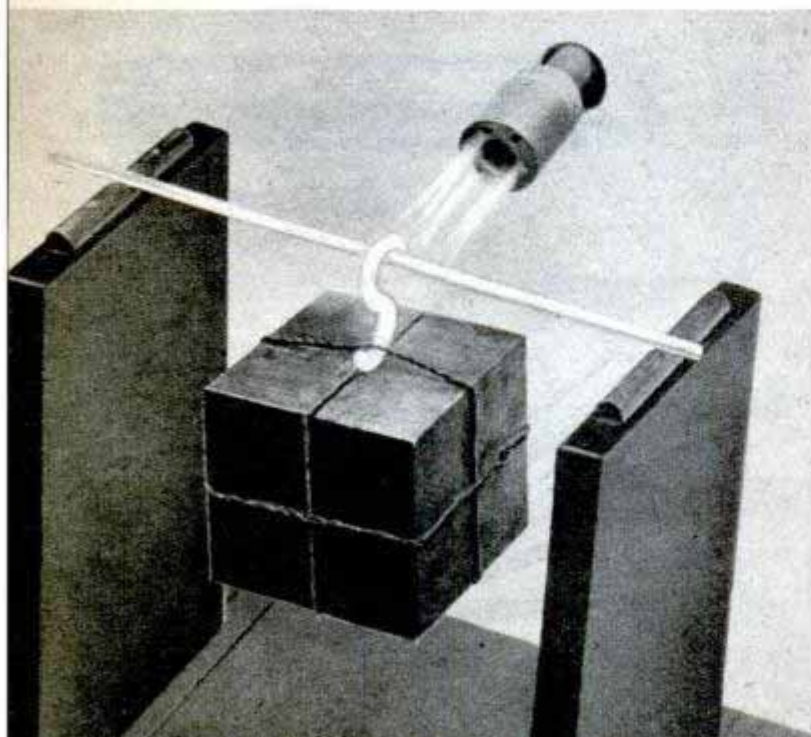
Today American sapphire is produced in rods varying from 0.065 inch to 0.125 inch in diameter and up to 30 inches in length. The rods are sliced off into disks of the required size with diamond-impregnated saws. It is estimated that this one improvement has cut waste in working with synthetic sapphire from 91 percent, as it was with boules, to only 40 percent.

Now that the wartime demand for thousands of precision bearings has dropped, man-made gems have had an enthusiastic reception in the jewelry field. Synthetic sapphire and its close relative, spinel, are made in deep colors and delicate tints that make attractive accessory jewelry. The variety of colors is increasing rapidly, and soon any desired color should be in the showcases of your nearest jewelry store. Both sapphire and spinel have superior hardness ratings that allow them to take and keep a brilliant polish.

These synthetics fill a long-felt need for jewelry materials that are above the level

(Continued to page 248)

**Rotating rod is polished by gas flame. Surface will show no scratches even under high-power microscope**





## Weasel Fights Fires In Forest Areas

Fighting fires is the latest assignment for the Weasel, the Army's amphibious twin-track cargo carrier which goes almost anywhere on land or sea. Equipped with a powerful pump, several hundred feet of 1½-inch hose, shovels, axes and fire extinguishers, a Weasel now aids in combating forest fires in the heavily wooded mountains in San Gabriel Canyon near Arcadia, Calif. Loaded with equipment, the craft can speed along on roads at 36 miles an hour and, when a fire is spotted, it can be guided into water to begin pumping. Ira C. Funk, supervisor of the Arcadia Fire Control District of the U. S. Forest Service, who converted the Weasel into a fire fighter, believes it will become widely used for this job, particularly in muddy, swampy areas.



## Photo Lamp Projects Light Patterns

Unique lighting effects for photography are possible with a new spotlight-floodlight combination. Accessories for the light include four disks for special designs, four color filters, one square and two round apertures and two glass disks. The accessories make possible special effects such as clouds, lattice light, single lines of light, silhouette lighting and novel light patterns.

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





- ▲ Living room features built-in bookcases and picture window
- ▼ Finished five-room house is fireproof and weather resistant



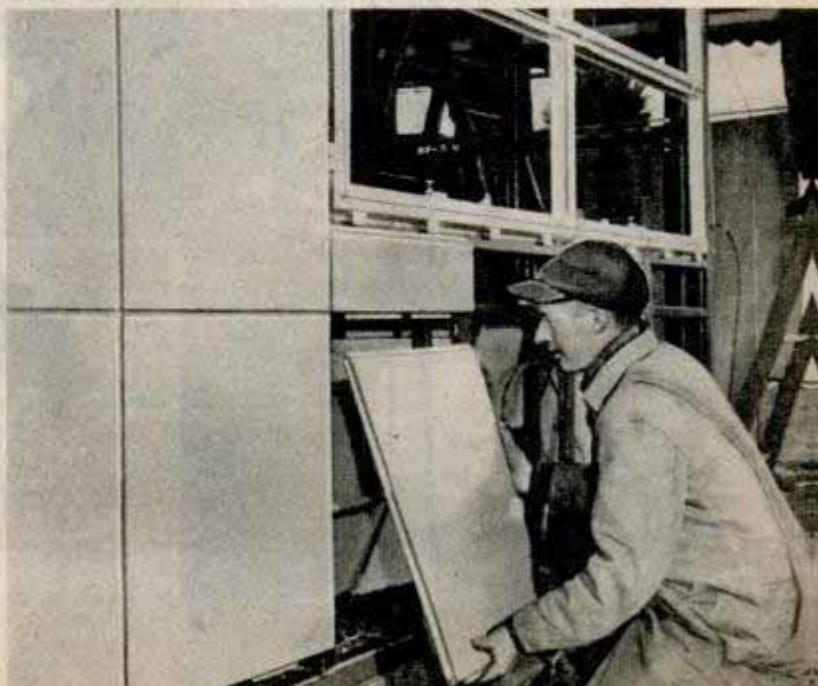
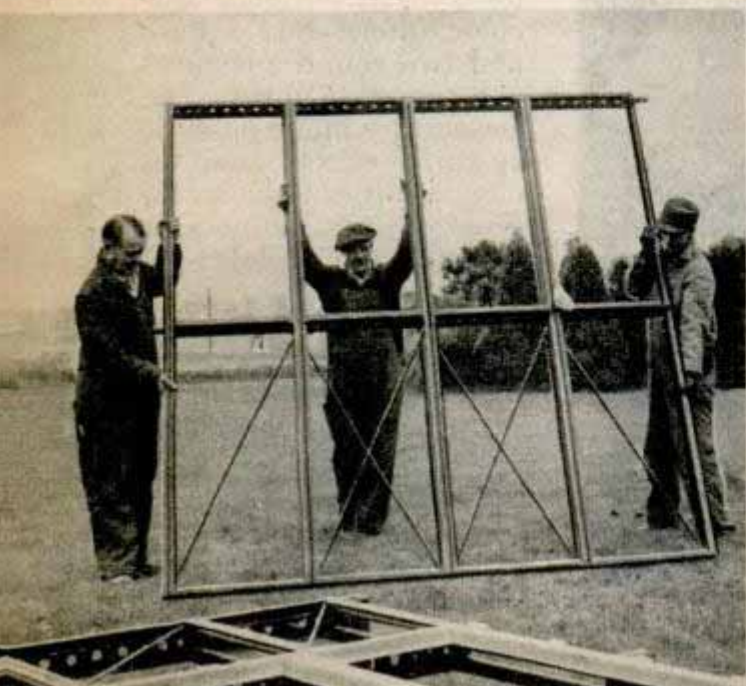
Steel wall frame is bolted to foundation

# Porcelain Enamel House



Trim bungalows made of steel with a porcelain enamel finish are being factory-built by the Lustron Corporation of Chicago for assembly on the site. Steel structural members replace two-by-fours in the house frame and the walls are made of steel panels. A variety of exterior appearances and room arrangements is possible.

Below left, a factory-built wall section is raised into place. Below, the outside panels are tailor-made to fit into the wall structure







# SNOW TANK

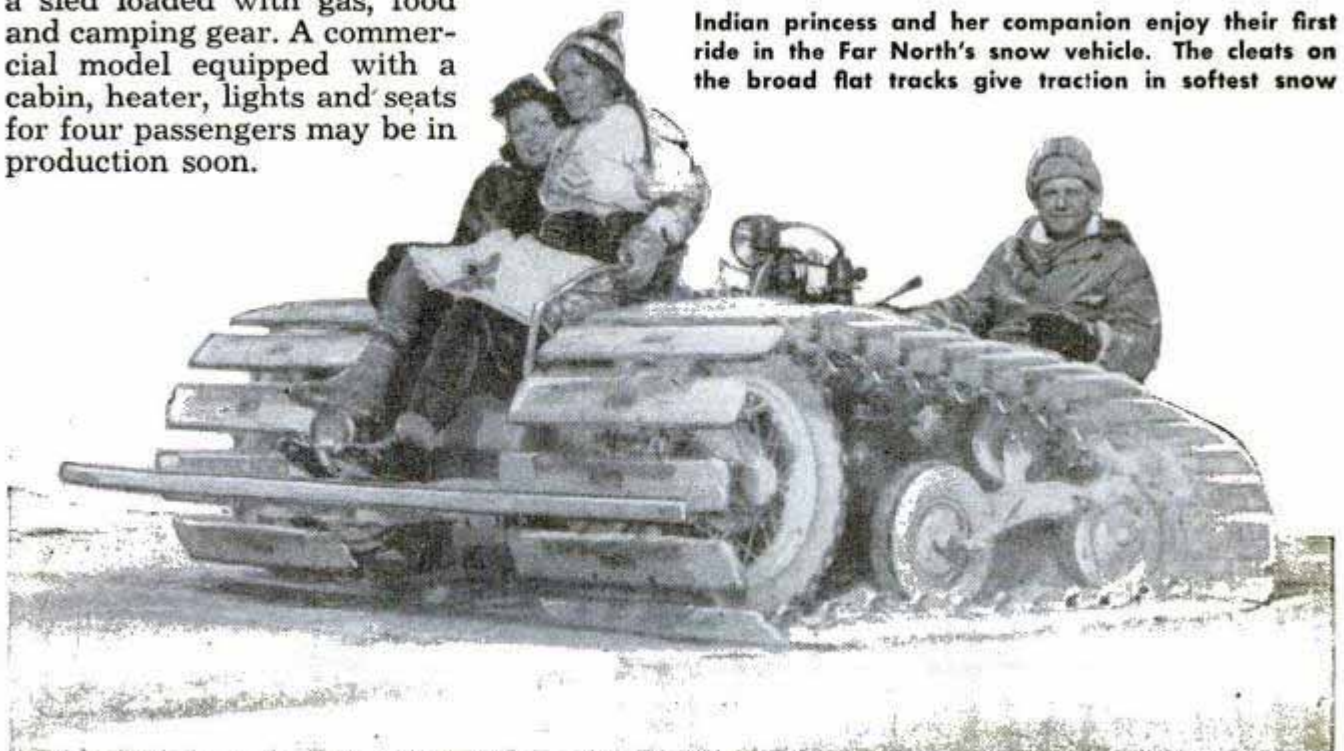
▲ Vehicle's bogie wheels work like those on a tank, forcing the track to hug the surface and distributing total weight over a large area

▼ Single passenger balances the driver's weight by riding in the front seat. A cabin model is planned that will carry four persons

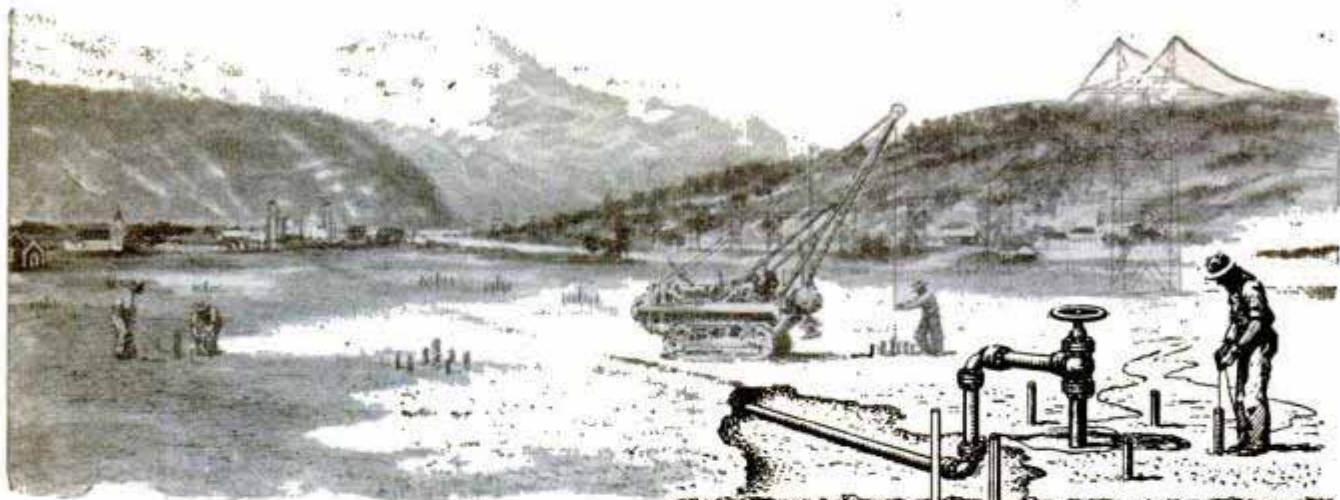
Snow banks and sheets of ice offer no barrier to the snow tank, a little vehicle that may replace the dog team as transportation in the Far North. Designed as a fast, reliable carrier for hunters, trappers, game wardens and other snow travelers, it is powered by a self-starting air-cooled 15-horsepower motor and has a top speed of 25 miles per hour. Wide tracks distribute the weight over a large area. The snow tank steers like any other track-type vehicle and turns in its own length. It pulls a sled loaded with gas, food and camping gear. A commercial model equipped with a cabin, heater, lights and seats for four passengers may be in production soon.



Indian princess and her companion enjoy their first ride in the Far North's snow vehicle. The cleats on the broad flat tracks give traction in softest snow

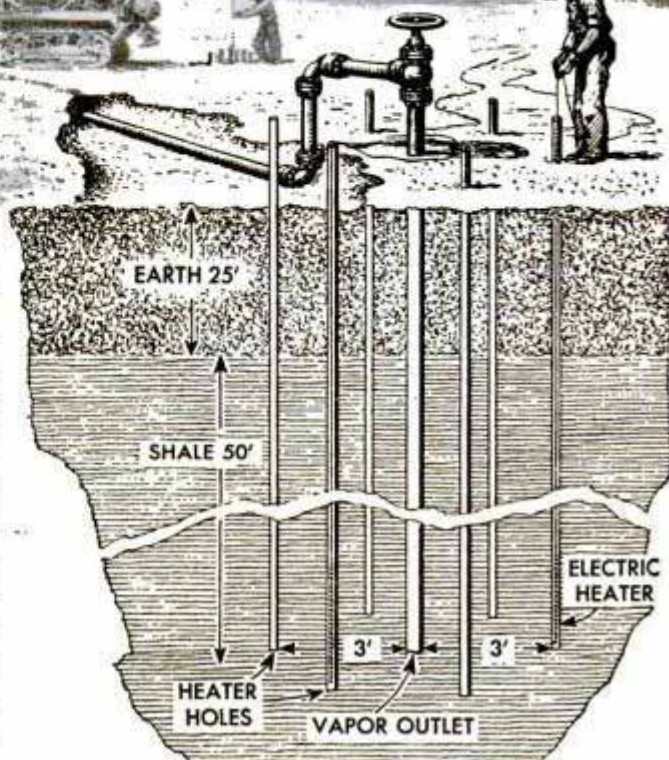




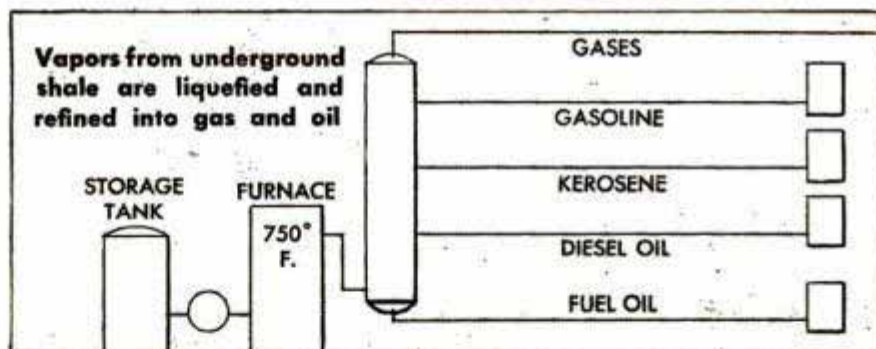


## Oil Is Produced From Shale Heated Beneath the Ground

Sweden gets much of its oil by heating shale 75 feet beneath the ground, drawing off the vapors and converting them by distillation into various petroleum products. Holes about two inches in diameter are drilled into the earth so that electric heaters can be lowered to heat the shale to 1000 degrees Fahrenheit. This temperature releases oil from the shale in the form of vapor which rises through the holes. A cooling process converts the vapor to liquid which is piped to refineries for distillation.

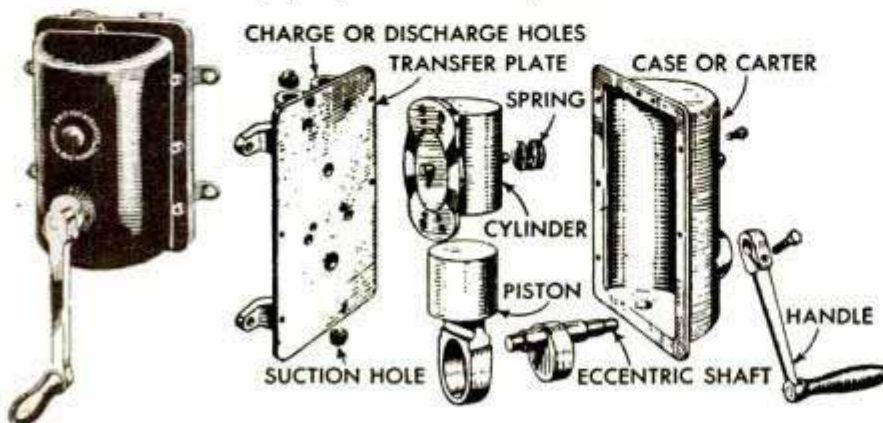


Sweden launched this unusual oil production project during the war when it became almost wholly dependent upon wood from its forests for heat and power. Dr. Gustav Egloff, petroleum engineer with Universal Oil Products Company, reported recently on returning from Europe that Sweden's wartime oil production by the underground heating method was 2000 barrels per day. An interesting by-product of the Kvarntorp oil shale project is the growth of oversized tomatoes and other



vegetables on the soil above the heated shale. Dr. Egloff said such soil probably will retain some heat for 30 years, during which improved fertility will be noted.

## French Pump Operated by Crank Produces 300 Gallons Per Hour

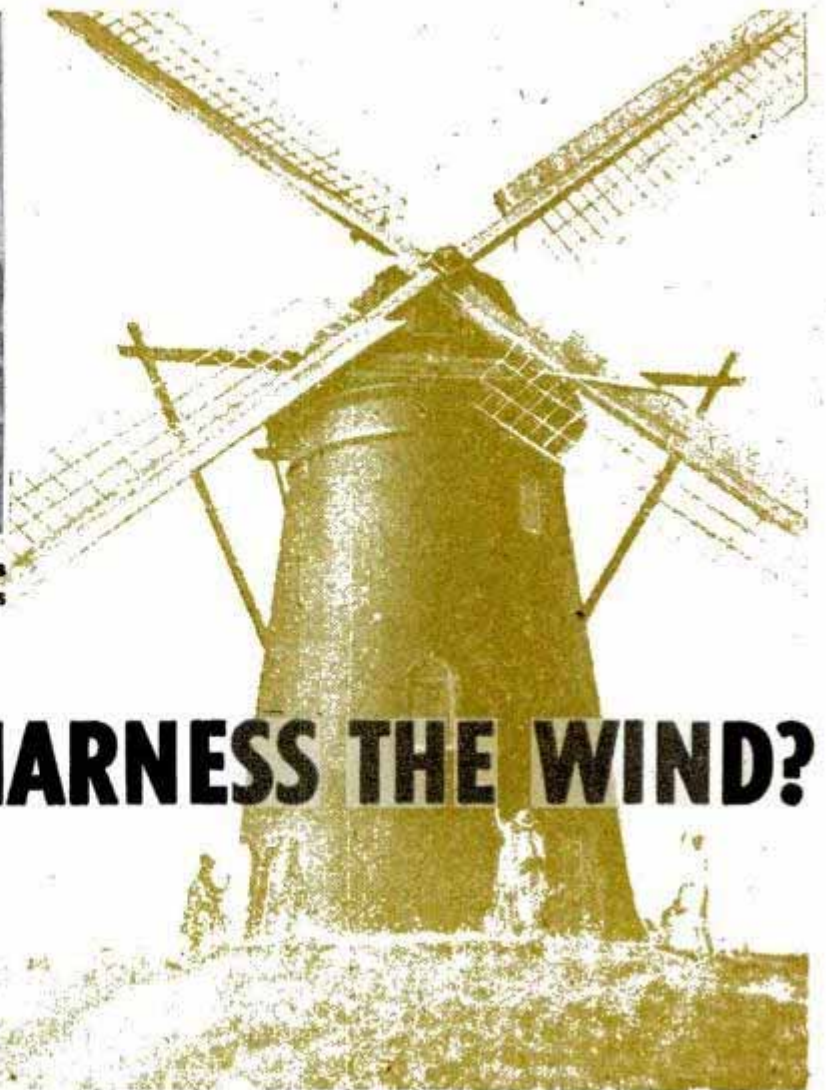


Instead of the usual up and down motion, the handle of a pump developed by a French inventor is operated with the same movement used in turning the crank of a grind organ. A steady stream of water is produced at the rate of 300 gallons per hour. The pump is suitable for farm use in connection with wells 25 feet deep or less.





Wind power turns the large wooden gears that run the machines in Dutch flour mills



# CAN CITIES HARNESS THE WIND?

By John L. Kent

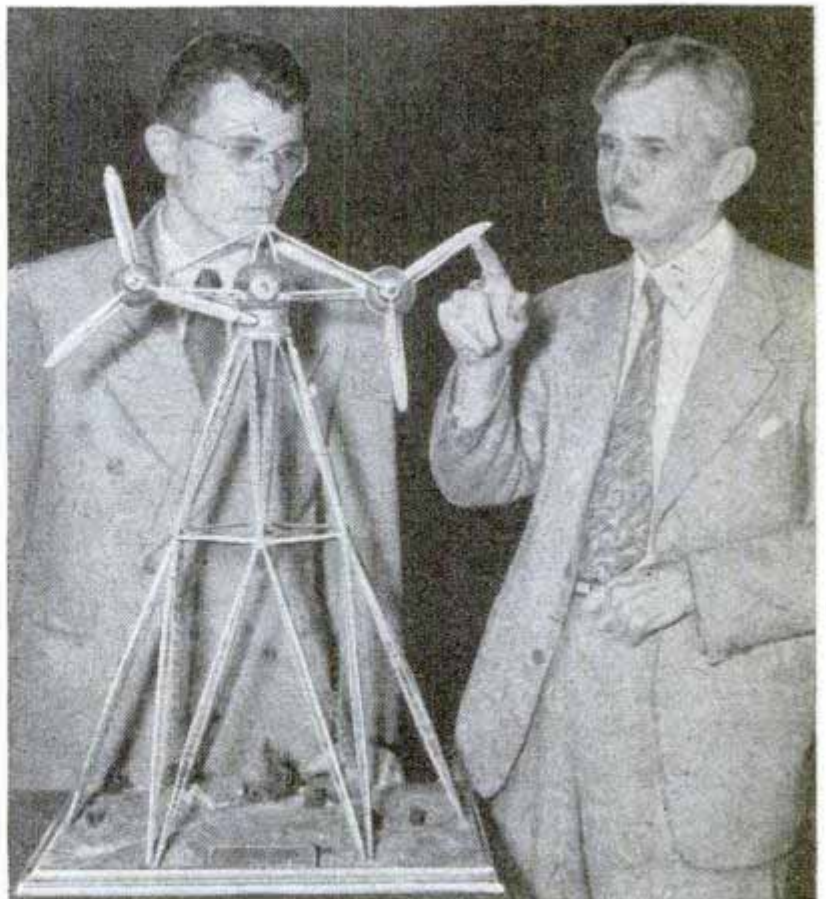
**E**LECTRIC POWER almost as free as the wind is the possibility inherent in a newly designed wind-driven generator. Mounted atop a 475-foot tower, the electric generator would be turned by two wind turbines or propellers, each with three 80-foot-long blades swinging in a circle 200 feet in diameter.

The two wind turbines would be mounted on opposite ends of a 225-foot-long steel bridge, supported on a central turntable. Propellers, gears, generator and controls, weighing more than 750 tons, would be free to swing into the wind atop the tower.

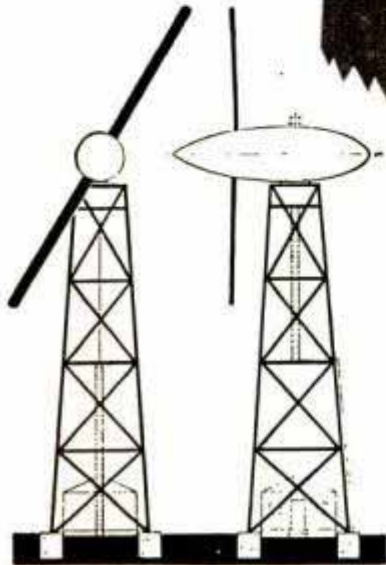
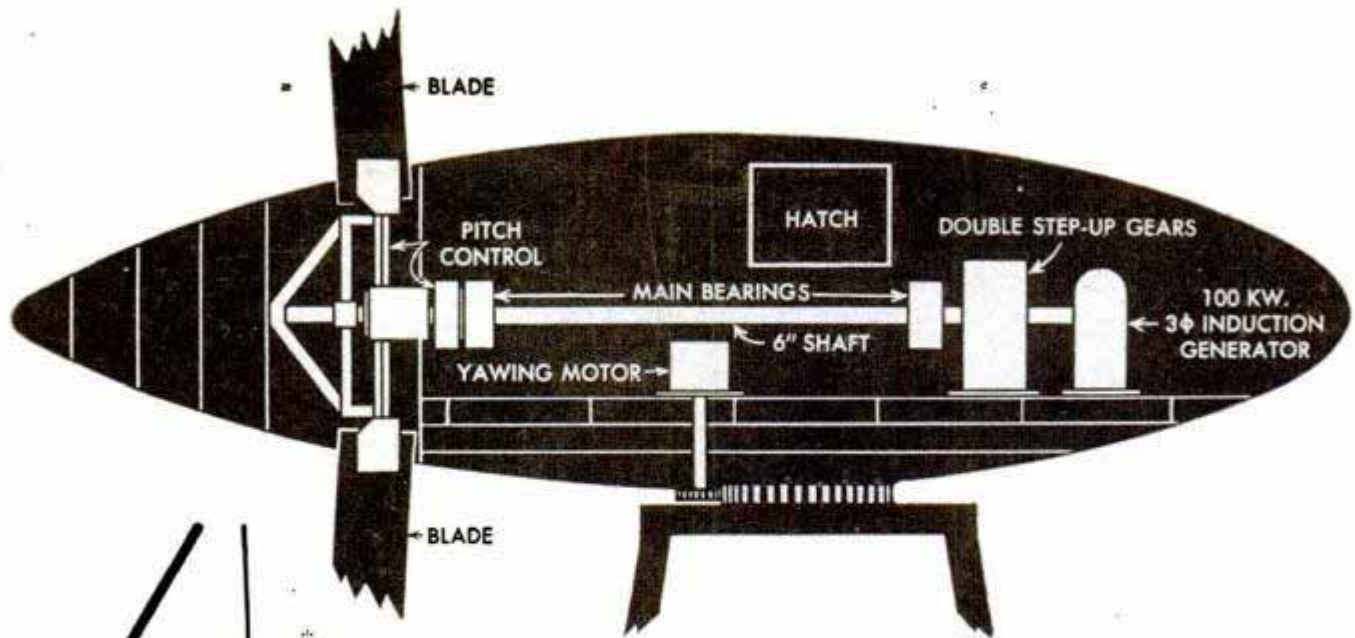
Brain child of Percy H. Thomas, engineer on the staff of the Federal Power Commission, the giant aerogenerator is estimated to produce enough electricity to supply 10,000 homes. It is the newest attempt to get electricity from the wind.

Wind and tides have been the subject of much study in the search for cheap power. For centuries, windmills have raised water, ground flour and furnished power to drive simple devices. In Belgium and the Netherlands they still grind flour just as they have done for more than 700 years. American wind-

▼ For inexpensive power, Percy H. Thomas, right, would harness the wind to a 47-story-high version of his model aerogenerator

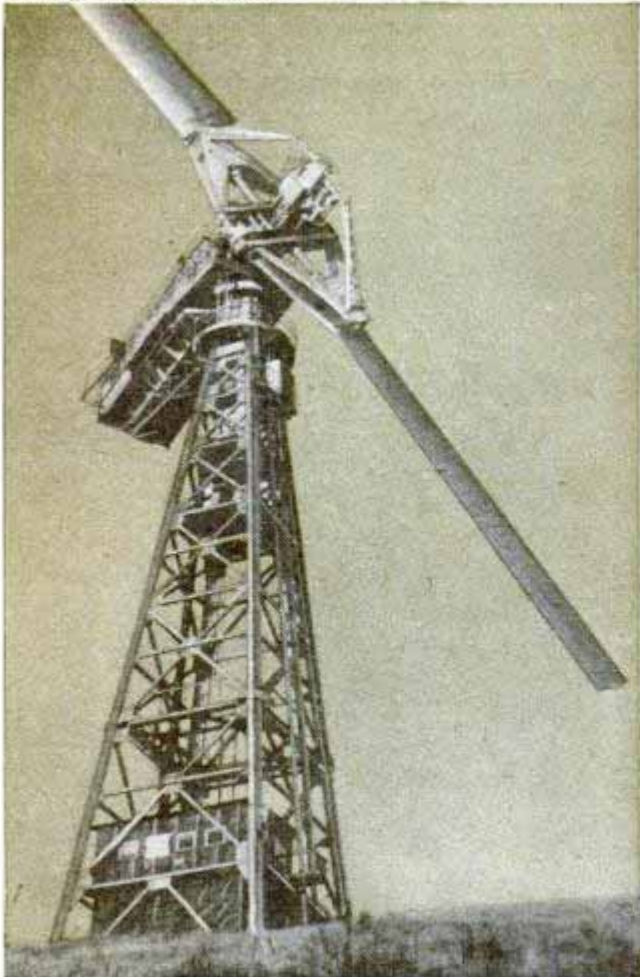






Army considered using 100-kw. wind generators, above, to supply power at its overseas bases. First practical generator was erected in 1941 on top of a 100-foot tower on a Vermont hillside, below. Its blades were 65 feet long

S. Morgan Smith Co. photo



mills with many short blades or slats instead of the four large sails of the Dutch mill, find great use on farms, especially in pumping water. A newer type equipped with a regular aviation-type propeller is used to charge storage batteries.

One of the earliest attempts to transform wind power into electric energy was made about 1880 by Moses G. Farmer. His model employed three solid wind wheels driving the armatures of three dynamos in circuit with a small storage battery.

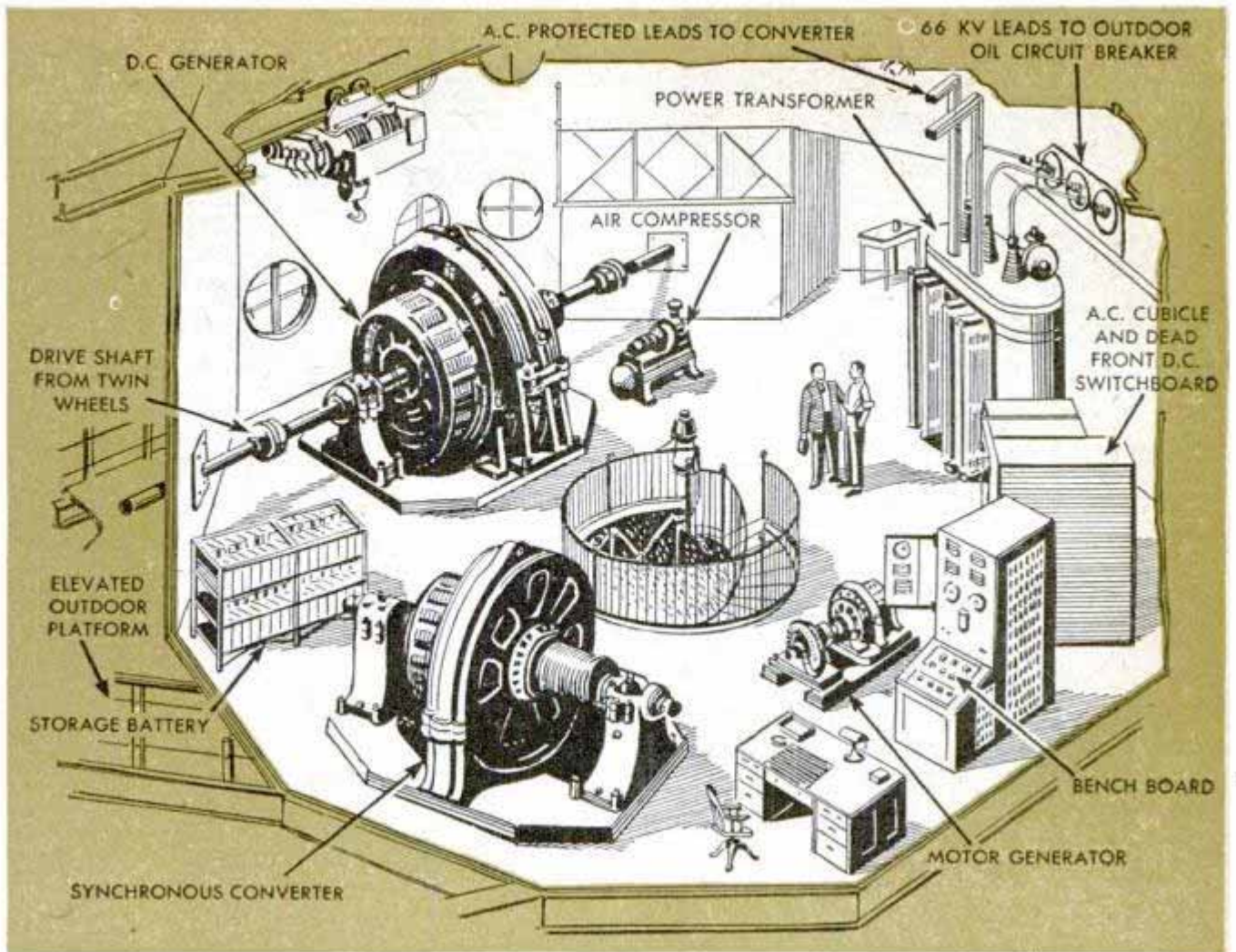
In 1934 the Russians built an experimental wind turbine generator in the Balaclava region of Crimea. It generated 100 kilowatts. Then in 1941 an American company built the first practical aerogenerator atop a 110-foot tower on a hill near Rutland, Vermont.

Designed by Palmer C. Putnam, a Boston engineer, its two rectangular blades, each 11 feet wide and 65 feet long, generated 1000 kilowatts. Although a practical success, it was recently dismantled and may be re-erected at another location.

The Thomas aerogenerator is based in part on experiences encountered in the operation of the Vermont windmill. But the new design provides for a generator five times as large, producing up to 10,000 kilowatts. Thomas has planned two different machines. One, for a maximum rated wind of 34 miles per hour, has capacity of 7500 kilowatts. Two-blade propellers, each 14 feet wide and swinging in a 200-foot circle, rotate the two turbines.

But since many desirable sites have average wind velocities of only 20 miles per hour, a second design provides for a maximum rated wind capacity of 28 miles per hour. This one uses three-blade propellers nine feet wide and 200 feet from tip to tip. The twin turbines are to have a capacity of 6500 kilowatts.



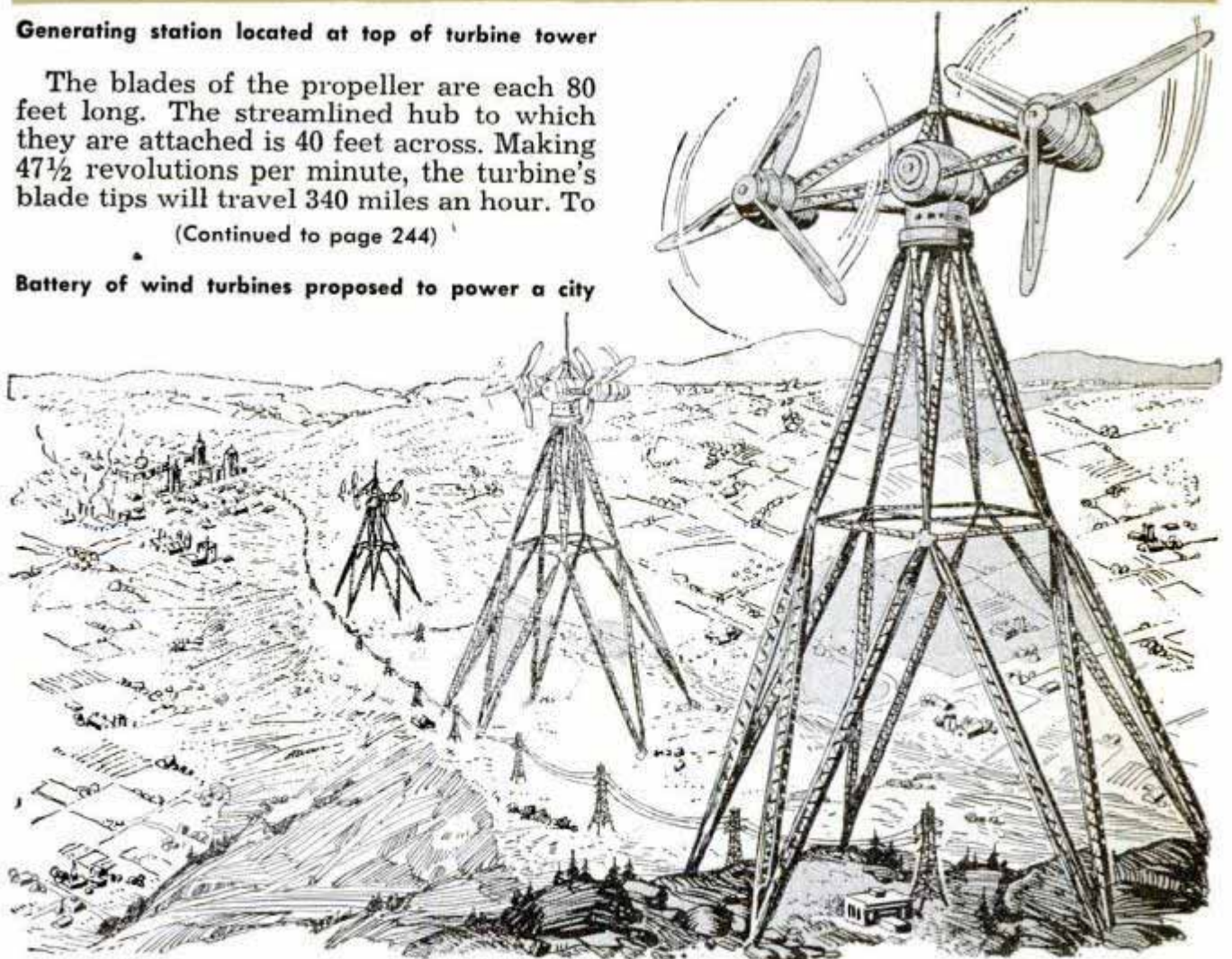


**Generating station located at top of turbine tower**

The blades of the propeller are each 80 feet long. The streamlined hub to which they are attached is 40 feet across. Making  $47\frac{1}{2}$  revolutions per minute, the turbine's blade tips will travel 340 miles an hour. To

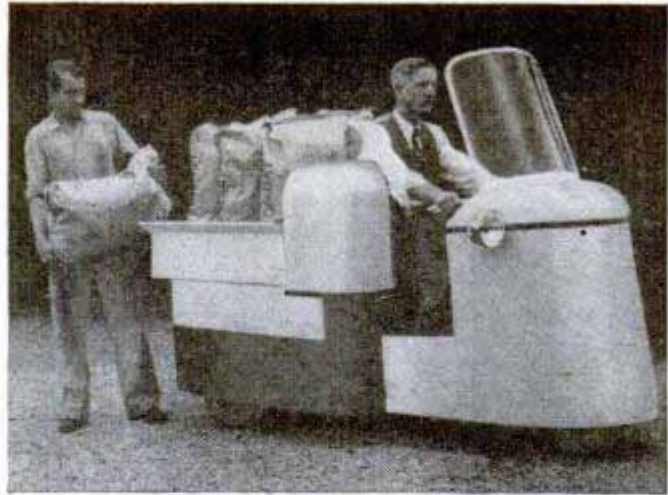
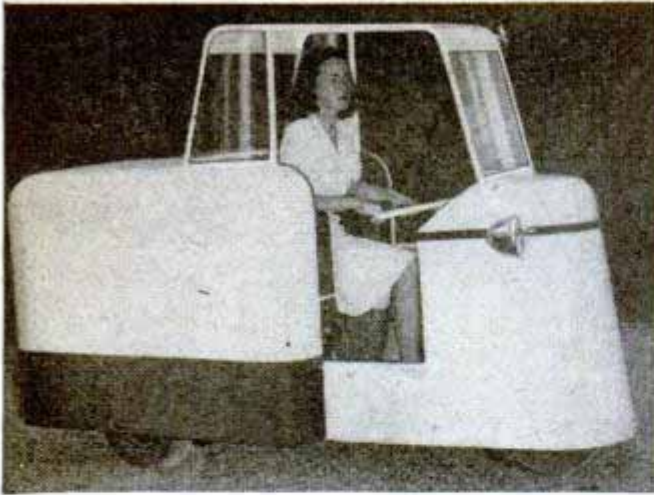
(Continued to page 244)

**Battery of wind turbines proposed to power a city**





## Three-Wheel Truck Travels 65 Miles on Gallon of Gas



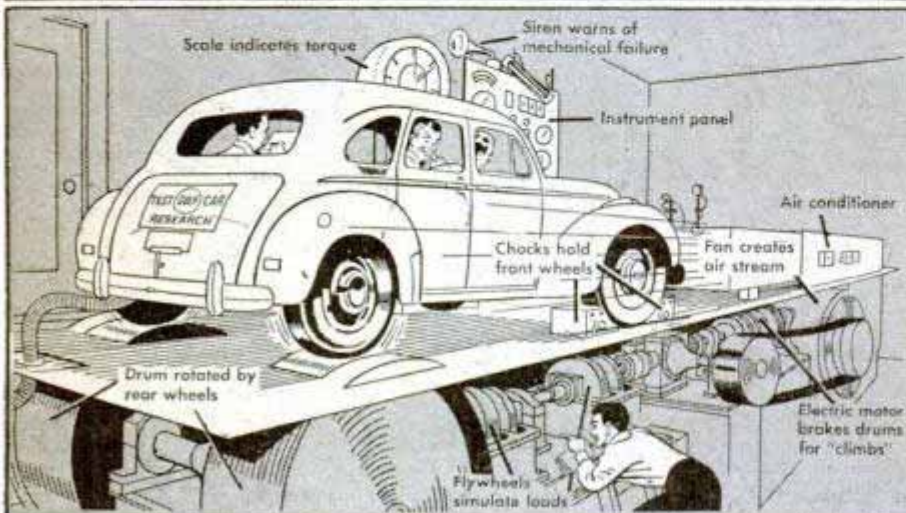
Sixty-five miles on a gallon of gasoline is the economical performance mark of a new three-wheel light delivery truck. The vehicle turns in its own space and doesn't require a gearshift lever, so the brake and accelerator are the only pedal controls. Its

10-horsepower two-cylinder motor has a top speed of 35 miles an hour. An enclosed body model is made for deliveries requiring weather protection and an open-deck type for general purposes. The load carrying capacity of each is 500 pounds.

## Road Tests Simulated in Laboratory to Test Gasoline

All sorts of conditions encountered in driving automobiles are simulated in a machine developed by the Gulf Oil Corporation to test new gasolines. The rear wheels of the laboratory car run on iron rollers

attached to intricate machinery which, by push-button control, gives the effect of going up or down hills, speeding or slowing down and stopping. Air blasts directed against the front of the tester duplicate wind resistance on highways. With a minimum of noise in the indoor tests, engineers can detect engine knocks with greater accuracy than during actual road tests.



## Muscle Grafting Renews Heart

Living muscles from other parts of the body may be used to replace dead bits of heart muscles in heart disease victims. The new muscle-grafting operation, offering hope to sufferers, already has been successfully completed on dogs. Drs. M. Weinstein and B. G. Shafiroff, of New York University College of Medicine, developed the technique. In the operation, muscle strips taken from the abdomen and legs of dogs were grafted to heart muscles. Within two or three days, the dogs were up and about their kennels.

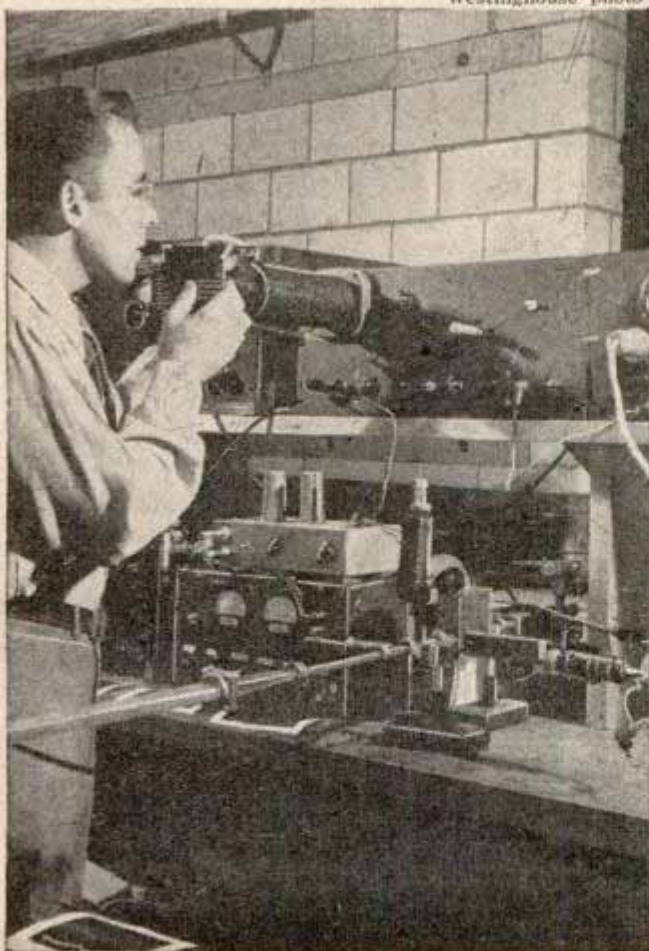




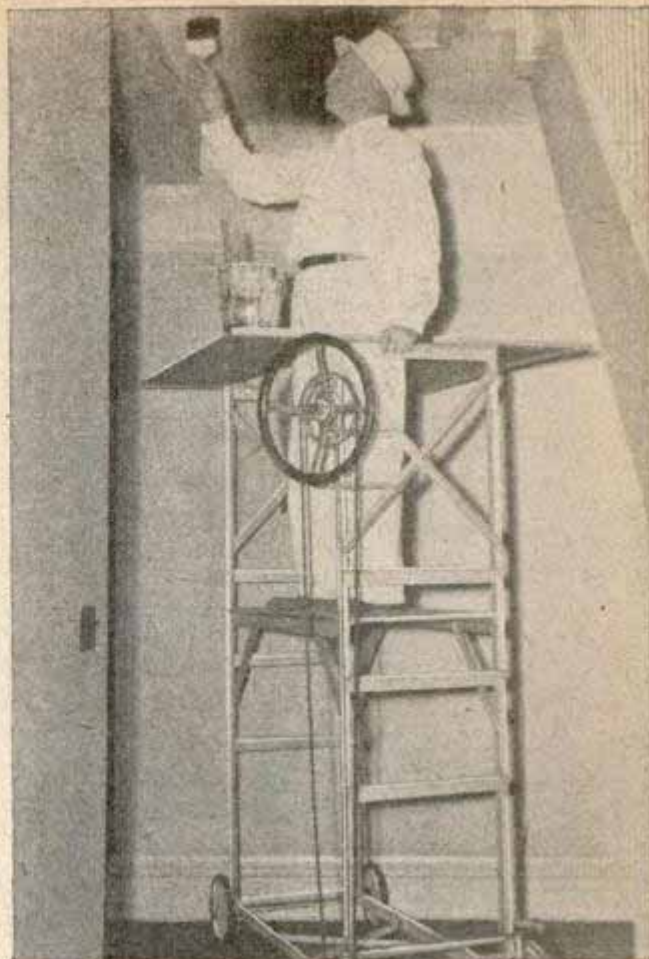
**TRACTOR** has rear wheels which automatically adjust their height to contour of land to keep machine level

**ATOMIC "GUN"** shoots ultrashort radio waves through gas molecules in an examination of their behavior

Westinghouse photo



FEBRUARY 1947



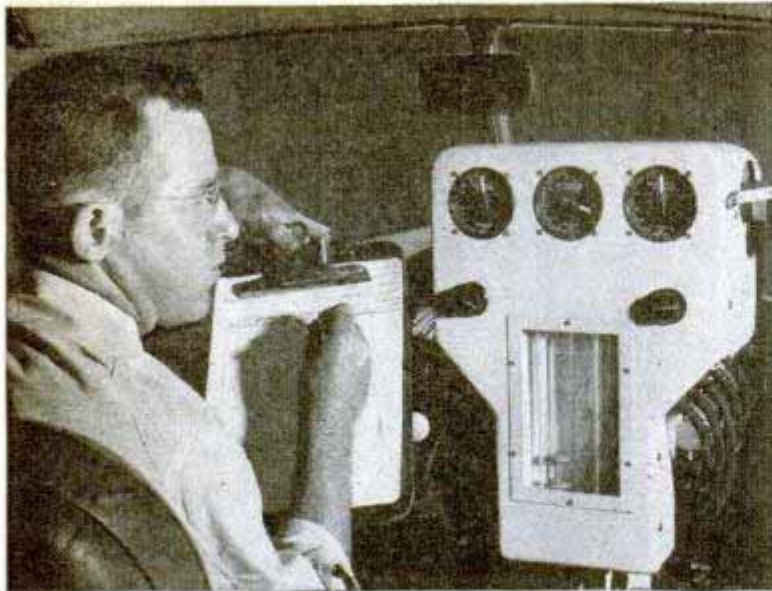
**LADDER ON WHEELS** enables painter to move to new location by operating large wheel while on the ladder

**KEROSENE-HEATED STOOL** keeps hunters warm while they wait for game to appear. Fuel supply lasts 36 hours





## Portable Test "Lungs" Measure Air Flow in Crankcase



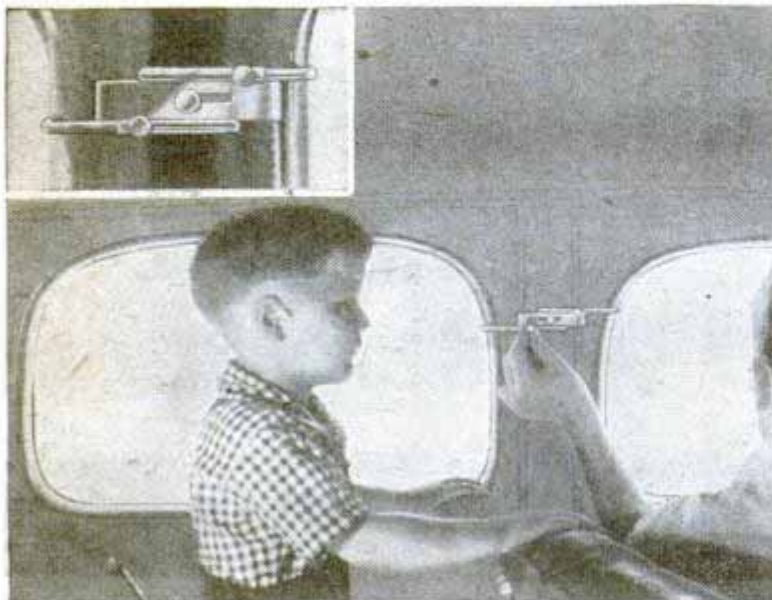
Testing "lungs" measure crankcase ventilation under various speeds and conditions to aid research on auto lubrication. The tester consists of two air flow measuring tubes. One shows the flow of air into the engine and the other measures the outflow of gases. The equipment also checks "blow-by," the flow of gases forced from the combustion chamber past the piston rings into the crankcase. The portable "lungs," developed by the Ford Motor Company, may be installed in a few minutes on any car and provide an instantaneous, direct reading of the air and gas flow.

## "Art Gallery" Phonograph Disk Has Picture Under Plastic

Novel phonograph records that have eye as well as ear appeal are covered with colorful pictures and cartoons. The illustrations reflect the theme of the recording and cover the entire surface except for a small border. The records are made in layers with an aluminum disk in the center that makes them warp-proof and shatterproof. A sheet of paper printed with a four-color illustration is fastened to the aluminum disk. The top layer of the record is a coating of transparent Vinylite plastic upon which the recording is cut. The eye-catching illustration can be seen through the layer of plastic.



## Safety Locks Prevent Children From Opening Car Doors



Danger of children opening or falling out of automobile doors while the car is in motion is eliminated by a safety lock. One clamp holds both front and rear doors shut and is operated by the turn of a thumb nut. The chromium steel lock is adjustable for quick installation on any car make or model and does not affect the operation of doors or windows.

You may want additional information about new products described in Popular Mechanics. For the name of the manufacturer or distributor, write to Bureau of Information, Popular Mechanics, 200 E. Ontario St., Chicago 11, Ill.



# The CRAFTSMAN

Yes, we've been asked for it many times—a complete how-to-build story on a deep-freeze unit. And—after taking time for designing, building and testing just to make sure—here it is, roughly 20 cu. ft. of storage capacity in two compartments, with a temperature range from zero to 30 below. Building the cabinet, less whatever refinements you might wish to add, has purposely been kept within the limits of hammer-and-saw carpentry. The story, opening on page 186, also goes into the technical problems that come up and tells how to connect the condenser unit and prepare it for service. For the shop man there's an informative discussion on cutting multiple threads on page 222, and the colorful item in craftsman-built furnishings turns up on page 178. Just build a bookcase and end tables around your studio couch and you have something decorators talk about even after hours. And finally, on page 198, there's a story giving some new angles in jigsawed novelties which will be of interest to homecrafters



CUTTING  
MULTIPLE THREADS



UNIT END TABLE

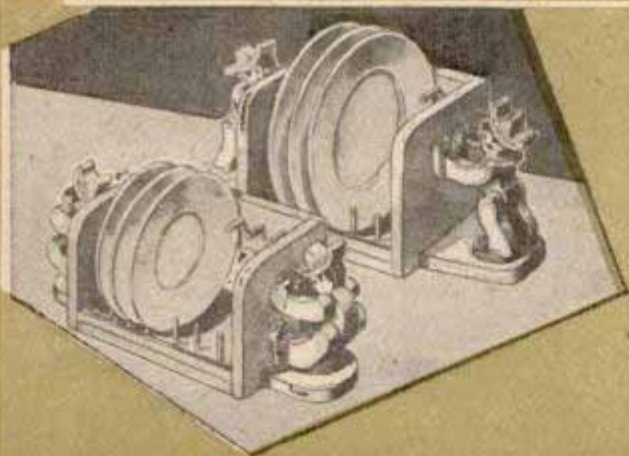
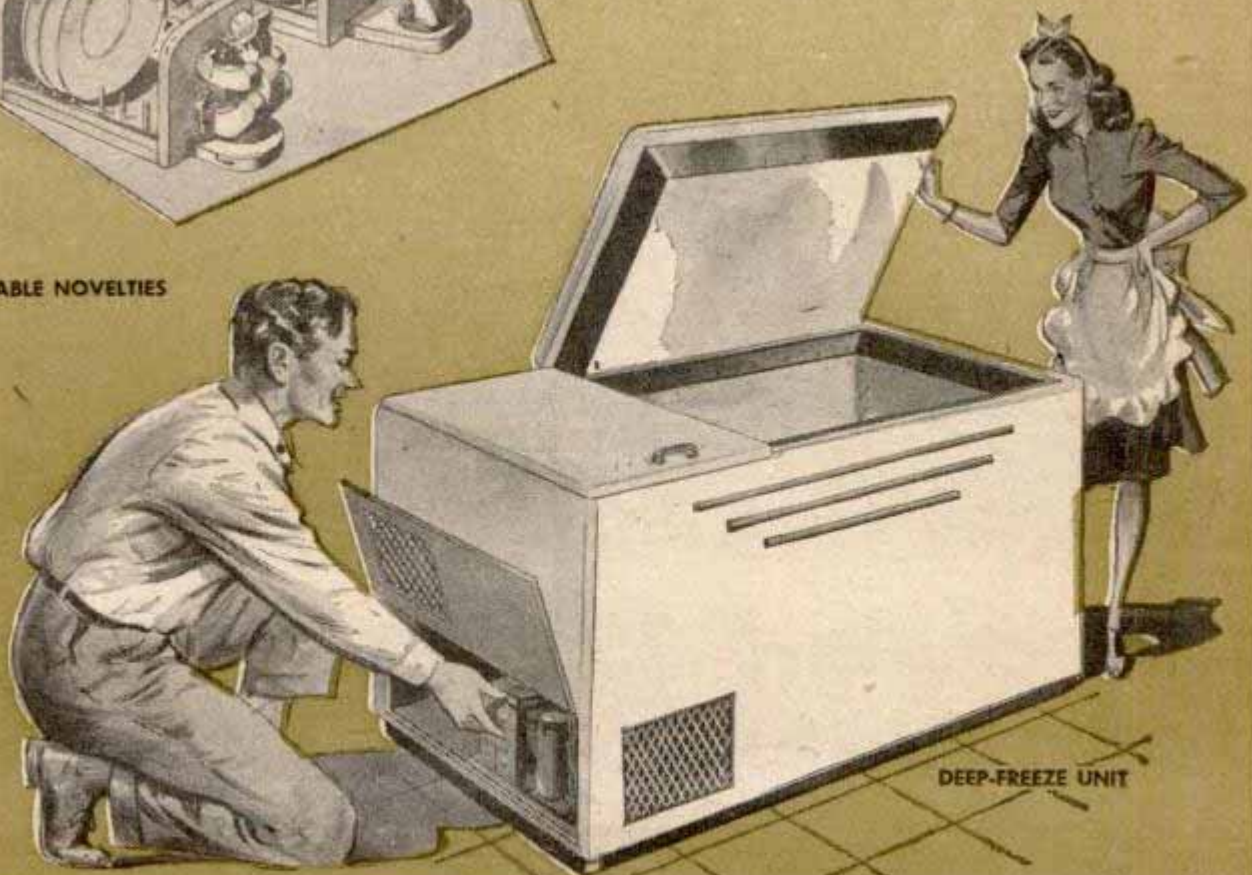
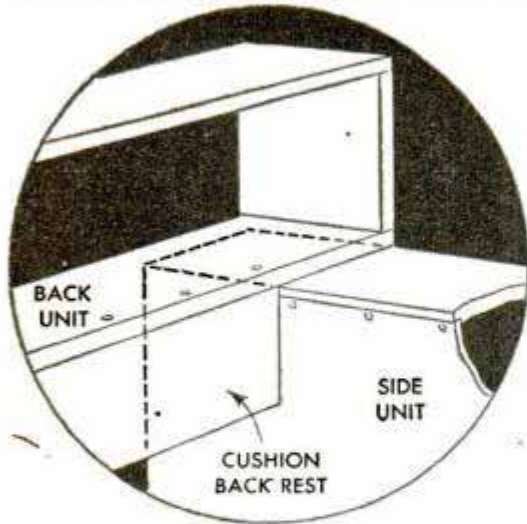


TABLE NOVELTIES

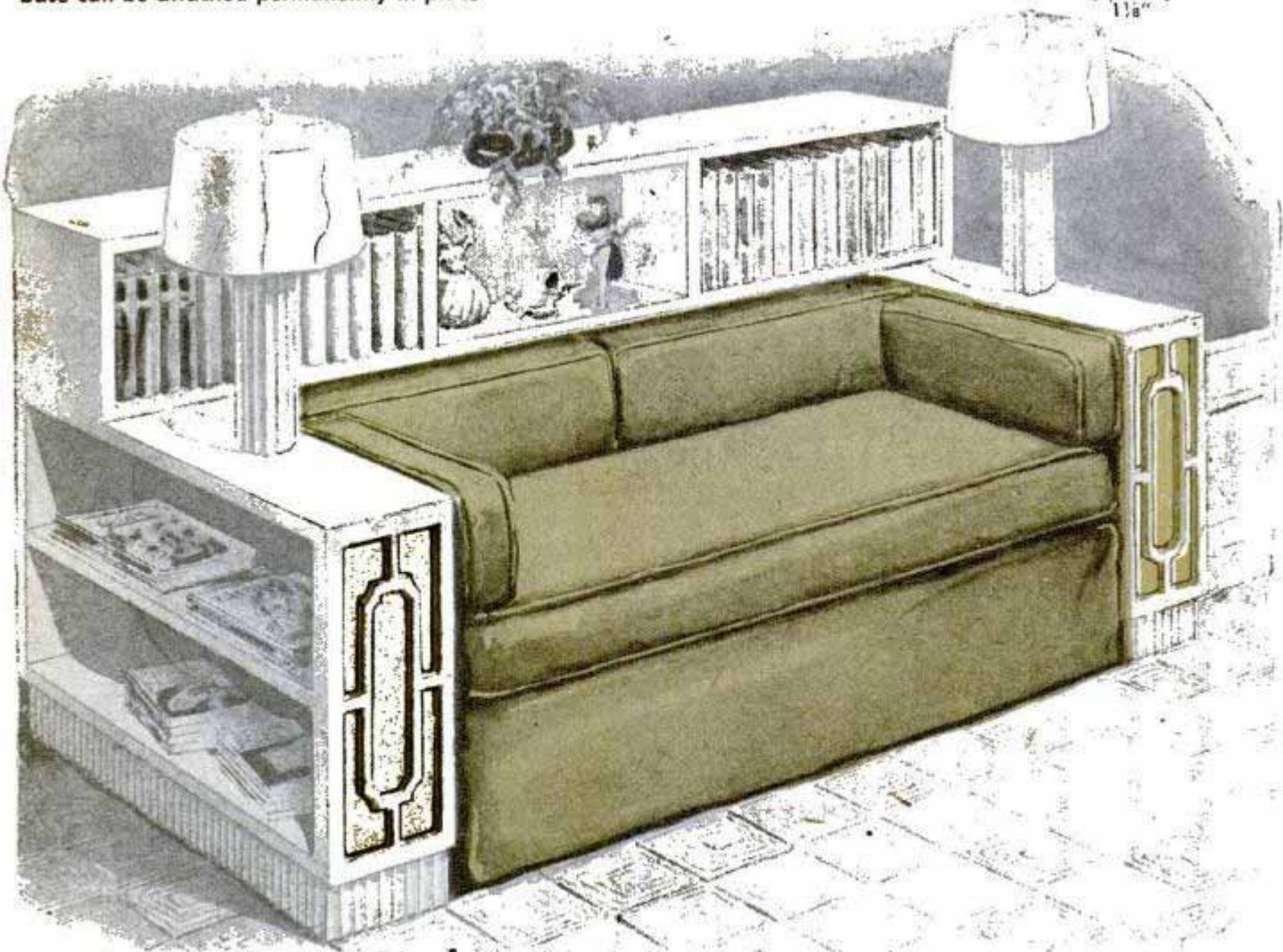
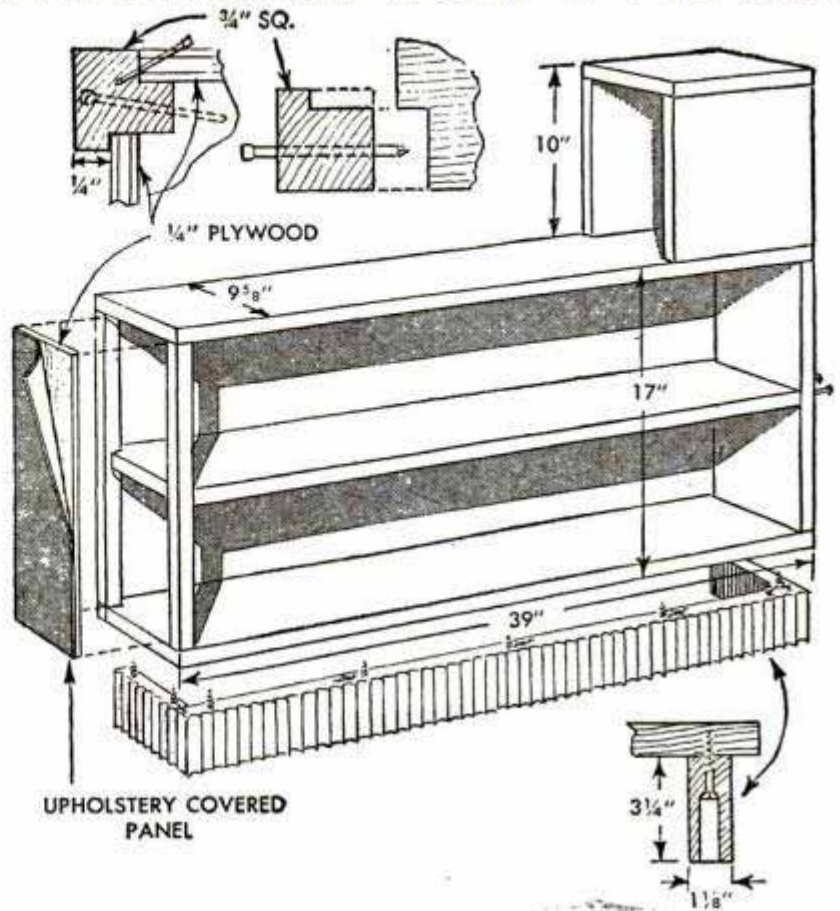


DEEP-FREEZE UNIT



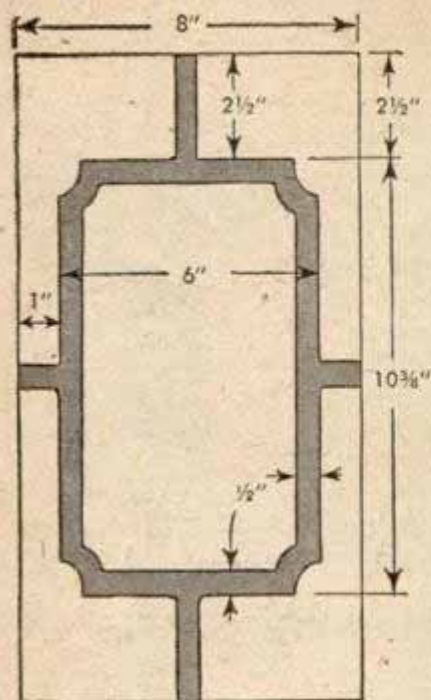


For the connecting bookshelf idea the stepped tops of the end tables are omitted as shown above. The separate book section simply sets in place, making the whole thing easily portable and especially suitable for small apartment use. Although shown open, the back of the top unit can be closed with plywood. Arm and back cushions are tailored to come flush with the tables, and twin lamps matching the fluting on the base can be attached permanently in place





# TABLES



FRETWORK PATTERN

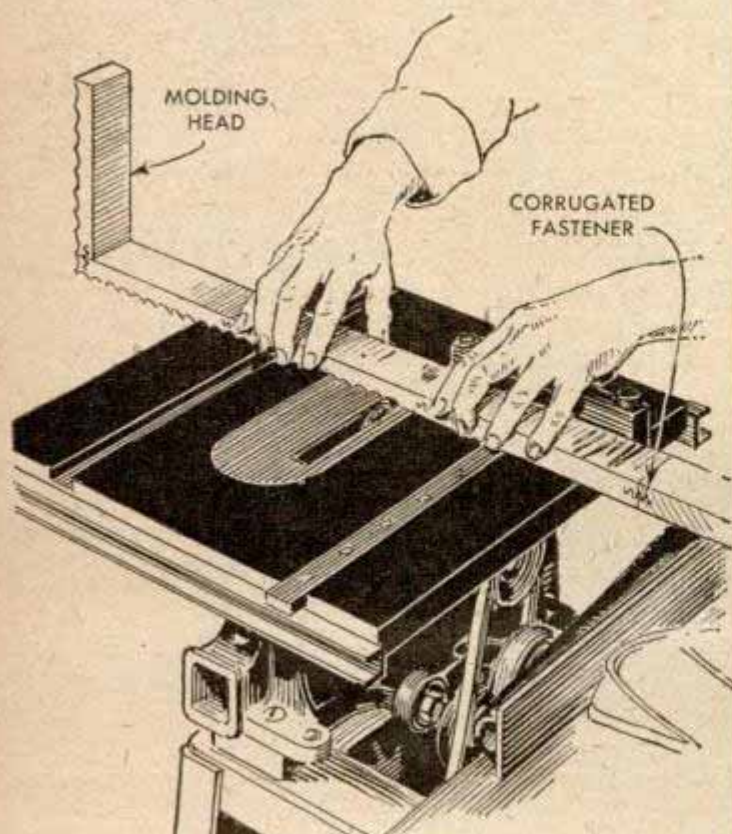


SHAPE OF CUTTER BLADE



By Wayne C. Leckey

USE them at each end, or join them across the back with a book shelf and see what a lift these unit end tables give that dated studio couch. Pine will do for a painted finish and you can "upholster" the fronts to either match or contrast with the couch covering. The couch at hand will determine the size of the tables. Using common 1 by 10 lumber (actually  $\frac{3}{4}$  in. by  $9\frac{3}{4}$  in.), you'll only have to cut the pieces to length. Two  $\frac{3}{4}$ -in.-square posts form the fretwork opening, these being rabbeted as shown to take plywood panels. The cloth-covered panel must be slipped in place before the top board is fastened and is held with small brads. Then the facing fretwork is fitted flush in the opening. The base is built up of random widths of  $1\frac{1}{8}$ -in. stock with the grain running up and down. If you don't have a molding head, the fluting can be done by hand with a 1-in. gouge and then smoothed with a sandpaper block. Screws in counterbored holes are used to attach the base to the table,  $\frac{3}{4}$  in. in from the edge.



HOW BASE BAND IS FLUTED



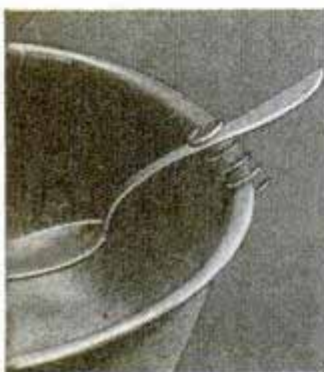
## Curing a Leaking Fountain Pen



nib. Cleaning the holes with a pipe cleaner or toothpick will remedy the trouble.

Kenneth Murray, Colon, Mich.

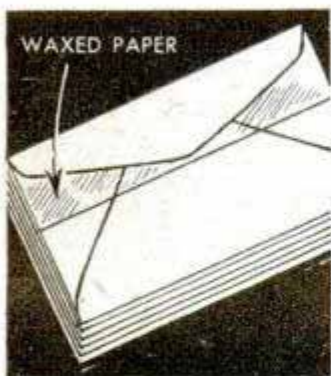
## Coil Spring Holds Spoon on Pan



inserted between the coils. This will keep the spoon, or other cooking instrument, at a reasonable temperature.

## Sealing of Envelopes Prevented

When supplies of envelopes are stored in a damp place where the flaps are apt to be sealed accidentally, place a strip of waxed



paper between each flap and its envelope. This will prevent the flap and envelope from sticking together due to the moisture in the air. The paper is removed, as envelopes are used.—J. Young, Altoona, Pa.

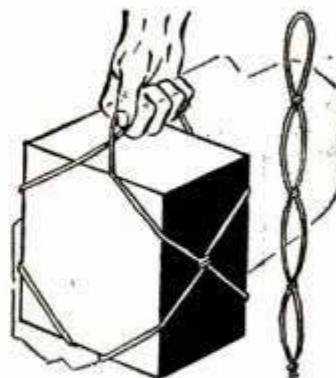
## How to Fix Worn Wringer Rolls

Should the wringer rolls on your washing machine become worn and uneven, with no replacements available, try restoring them with bicycle balloon-tire inner tubes. Select portions that do not have

patches and cut them so that, when installed, they will overlap each end of the roll about  $\frac{1}{4}$  in. Because of the tight fit in many cases, the tube is worked over the roll gradually.—Martin J. Gresbo, Chicago.

## "Sling" Helps Carry Heavy Boxes

Here's a rope sling that will come in handy when carrying a large box or carton. The ends are tied and knots are made at three equidistant points. The four loops thus formed slip over the corners of the container and the looped ends are grasped as a handle. A detachable wooden handle will make it easier to carry parcels.



C. L. Meehan, Lakeview, Ont., Can.

## Flashlight Used as Egg Candler

If you have occasion to candle eggs and don't have the proper equipment, you can use a flashlight to do the job. Take a piece of lightweight cardboard several inches wide and wrap it around the lens end to form a tube. Secure it with a rubber band. The egg is held



against the tube for inspection when the light is on.—Opie Read, Jr., Chicago.

## T-Plate Reinforces Broom Handle

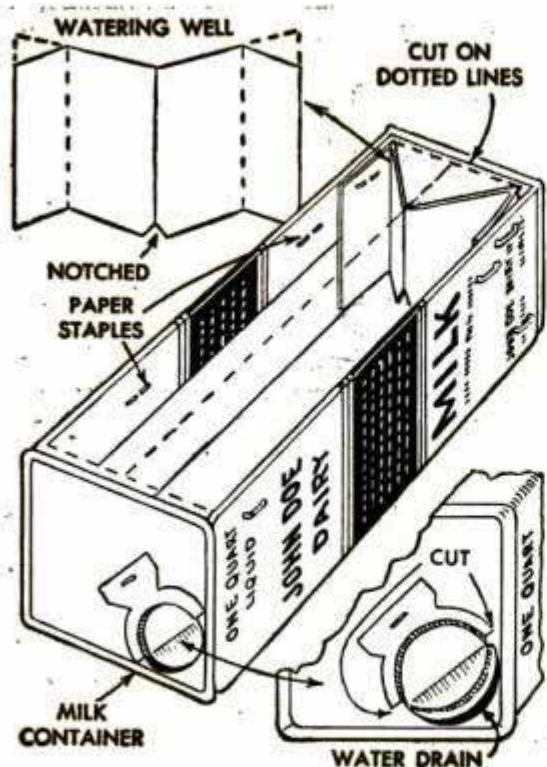
It's easy to twist or break the handle of a push broom at the point where it fastens to the brush. To prevent this, or to make a repair after it has happened, screw a T-shaped metal brace to the broom. This increases the strength of the handle at its weakest point and prevents it from twisting.—A. Vena, Philadelphia, Pa.



When paper has stuck to a varnished surface, apply olive oil, let it soak in thoroughly and you can remove the paper easily.



# Plant Boxes Made From Empty Milk Cartons



If you want to give those seedlings the proper start in life, plant them in these window-sill boxes that are self-watering and have a drain port for excess water. Paper milk cartons are used to make the containers. After the carton has been washed, place it with the opening down, center detail, and cut slits through the center and across the ends. Fold the flaps and fasten them with staples. To make the drain port, cut the lip on the cap at opposite points and fold the lower half of the cap inside the box so that the weight of the soil placed in the box will not force the cap out; see lower

right-hand detail. The watering well is cut, folded and notched as shown in the upper left-hand detail. It is held in place with staples. In filling the box, use coarse soil in the bottom and pack it carefully so the weight will not cause the box to bulge. Any excess water in the soil will drain through the opening in the side of the box. Provision should be made to catch this water in a dish or pan. When ready for transplanting, cut off both ends of the container, fold the sides down and remove the soil and plants.

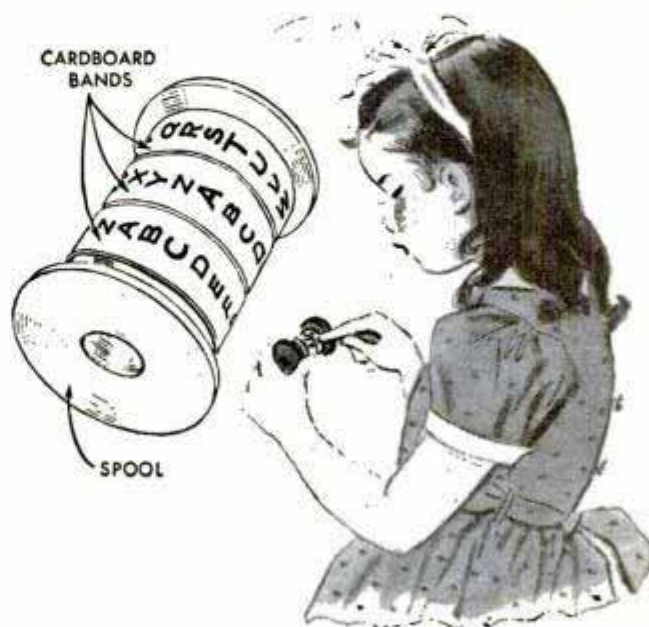
J. O. E. Dieterich, Sr., Jamaica, N. Y.

## Simple Toy Teaches Child to Spell Elementary Words

This is a simple toy, but it is effective in teaching small children to spell three-letter words. All that is needed to make the device is an ordinary thread spool and three strips of cardboard. A complete alphabet is lettered on each strip, and the strips are fastened on the spool so they can be rotated. By turning the bands, many three-letter words can be spelled.

### Preserving Finish on Linoleum

To preserve the finish on linoleum, lacquer it as soon as it is laid. This is true particularly of enameled linoleum. It should be lacquered once a year, or as soon as signs of wear appear. Before applying the lacquer, the linoleum should be washed and allowed to dry thoroughly.







When fagoting tape to the edge of a piece of cloth, holes for the stitching are made by running the material through a sewing machine. Then the hand work is done. For large, open fagoting, use alternate holes



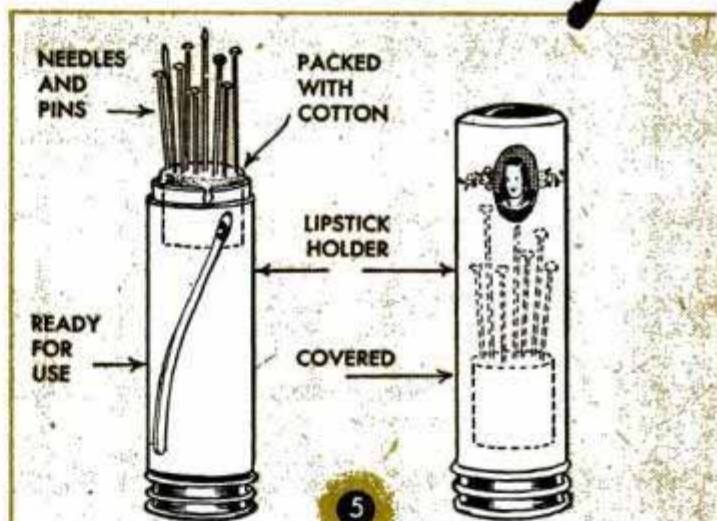
Rubber bands, slipped over spools of thread, keep the ends of the thread from unwinding and cluttering the sewing basket or drawer



## Solving



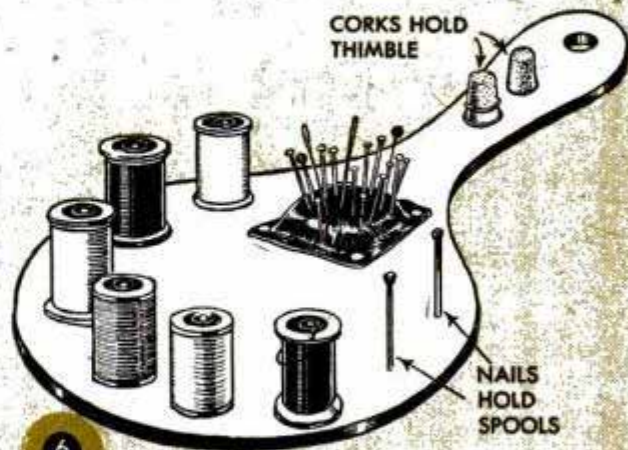
For darning fingers in gloves, a dowel inserted in a thimble is handy. Withdraw slowly so the thimble will not catch in the glove



An empty lipstick container can be converted into a pin-and-needle case. Remove lipstick and pack the holder with cotton for a cushion

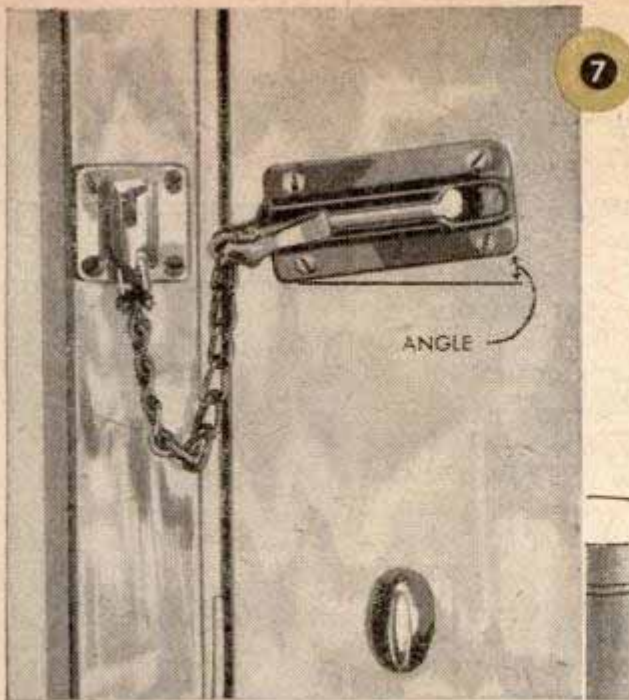


Instead of putting a shopping list inside your purse, fasten it on the outside where it can be referred to very easily



This paddle-shaped piece of plywood is ideal for sewing equipment. Finishing nails hold spools, and thimbles are slipped over corks





# HOME PROBLEMS

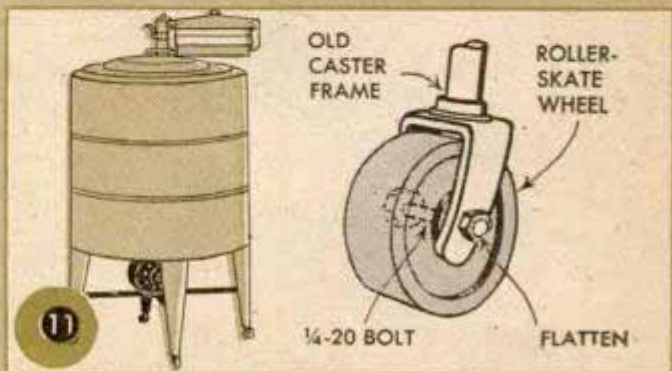
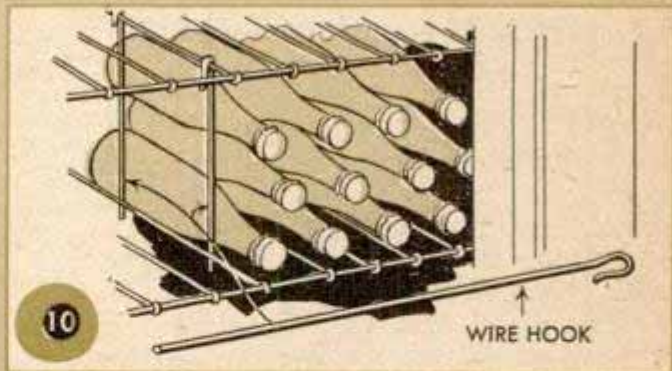
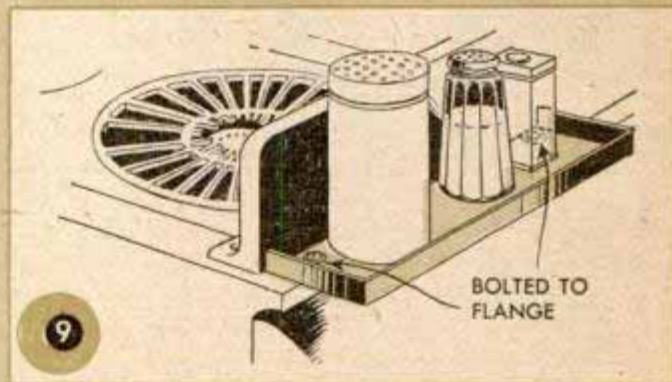
**7** If a chain-latch plate is installed at an angle, as indicated, any attempt on the part of an intruder to open the door after the lock has been forced will cause the chain to slide to the closed end of the plate and no amount of shaking will move it to the other end where it is unhooked

**8** Powdered glue and similar materials that come in tin cans with a flanged lid can be measured and poured much more accurately if the lid and the top of the can are notched. Merely align the notches to pour the powder. The size of the opening will control the amount that is poured

**9** Housewives can save many steps while cooking if the condiments are kept on a small tray that is fastened to the back of the stove. The tray, which is made of sheet metal, is about 4 in. wide and 15 in. long, having the edges bent up in order to prevent the articles from slipping off

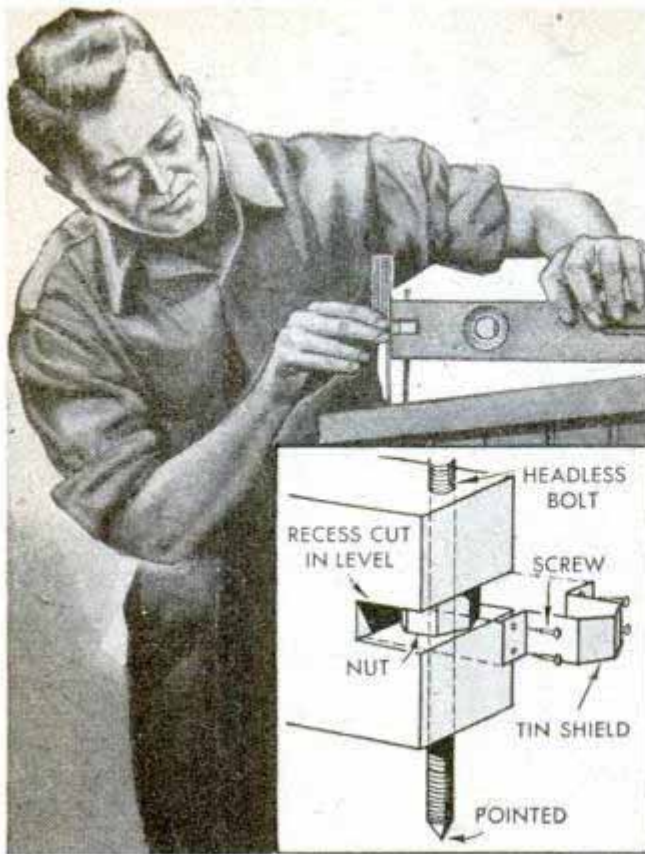
**10** To save space when storing bottles in the refrigerator, make two wire hooks that fit between the shelves to form a separate compartment in which the bottles are stacked. The hooks should be about 1 in. longer than the space between the shelves and, of course, they can be set at any necessary width

**11** Worn casters on a washing machine can be replaced with roller-skate wheels if other replacements are lacking. Remove the old casters, substitute the wheels and use a 1/4-20 bolt to serve as an axle. Trim the end of the bolt and flatten it to keep the nut from working loose and coming off





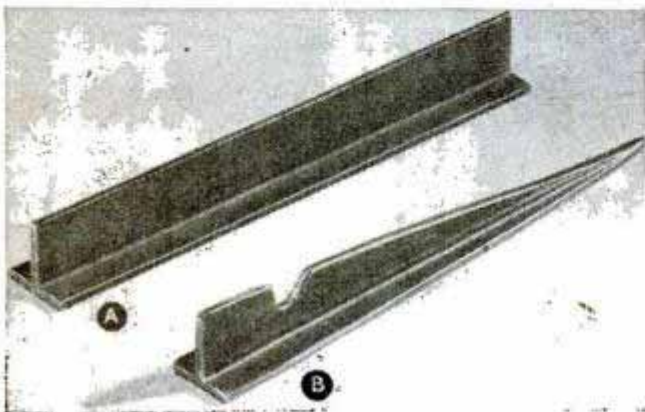
## Level Equipped With Adjustment Measures Angles Accurately



Measuring the angle or pitch of an object with an ordinary level is difficult because it is hard to hold the level steady while taking a reading with a rule. With this adjustment, which is removable, the job is easy. A recess or slot is cut in one end and a vertical hole is drilled to take a headless bolt. A nut fits into the recess and permits adjustment of the bolt. When the level is not used to measure angles, the bolt is removed. A tin shield holds the nut in place.

## Tent Stakes Made From T-Iron

Strong and serviceable tent stakes can be made from odd lengths of T-iron. Pieces 8 in. long will do for smaller tents and 10 or 12-in. lengths are about right for larger ones. Detail A shows the iron before it has been shaped and detail B shows how the stake is cut and notched. The cutting may

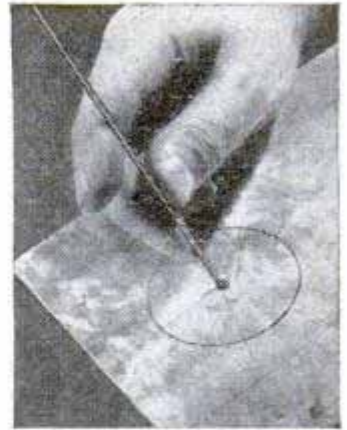


be done with a saw or a cutting torch. All rough edges should be ground smooth.

D. E. Horn, River Forest, Ill.

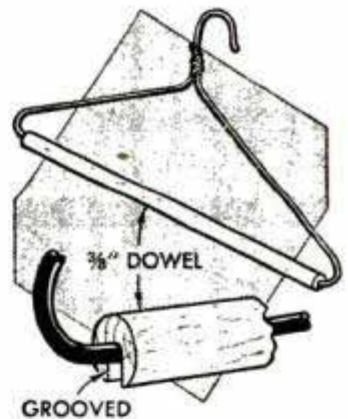
## Enlarging Holes in Sheet Metal

When it's necessary to drill a hole in lightweight sheet metal and a drill of the exact size is not at hand, you can use the next smaller size and countersink the hole with a slightly larger drill. Then you can enlarge the hole to the exact size with a round file; the countersinking operation will have removed most of the metal so the filing can be done easily.



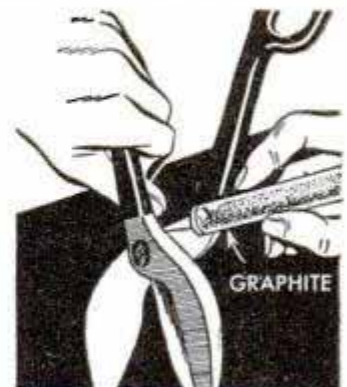
## Dowel Slipped Over Hanger Bar Prevents Trouser Creases

Creases in trousers caused by hanging them over the bar of a wire coat hanger can be avoided by cutting a lengthwise slot halfway through a piece of  $\frac{3}{8}$ -in. dowel. The rod should be a little shorter than the crossbar. After the dowel is slipped in place, put a drop of cellulose cement at each end to hold it. Dowels may be used to cover the arms of the hanger as protection for coats.



## Easier Operation of Tin Shears

Tin shears will operate easier if graphite is blown around the screw that joins the halves. Care should be taken to see that the powder penetrates thoroughly. Graphite will not pick up dust easily.



❑ Instead of throwing a ball to your dog, let him play with a rubber closet-tank ball. The double-cone shape limits the roll of the ball to a wide circle and prevents it from being lost easily.



# Getting the Most Out of Your Cigarette Lighter



Like any other piece of mechanical equipment, a cigarette lighter demands a certain amount of maintenance and repair if it is to operate at fullest possible efficiency



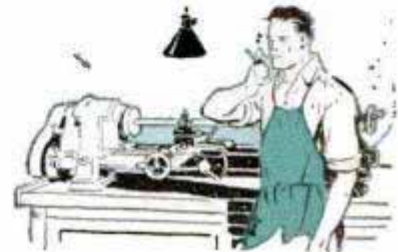
A flick of the thumb, and you get a clean, well-adjusted flame every time. There's no trick to it—all that's necessary for satisfactory lighter operation is to follow a few simple checks. First, of course, the lighter must be kept properly fueled. Use any of the fuels on the market and refuel at night so that any flooding of the mechanism will have evaporated by morning. Always keep the file wheel clean; this may be done by rubbing with a toothbrush and scraping the grooves with a pin. Also brush the wick if it is charred. Sometimes it will help to clip the top of the wick square across with shears. The flint should always line up with the file wheel as in detail A. If it tips as in details B or C, it should be replaced with one that is properly adjusted. The flint tube in many lighters can be cleaned with a pipe cleaner. Another check is to test the tension of the flint spring to be sure that it exerts the proper pressure on the flint. If the spring becomes too weak, you may be able to correct this condition by stretching it slightly, and if this does not work, a replacement part should be obtained



A large lighter with a heavy base is ideal for the house



When you carry a lighter outdoors, use a windproof type



A flip-action unit protects the file wheel from greasy thumbs



Remember that sand on a beach clogs complicated mechanisms

## Points to Check in Prolonging Life of Storage Batteries

There are a few, simple checks that will do much to keep your battery operating at peak efficiency. Examine the case for cracks or leaks at the top where the cells are sealed, and then test the battery for charge. Make sure the battery cables are not frayed or corroded and the insulation is not eaten away. Be sure the generator commutator is clean and the brushes seating properly. To reduce the current required to start the car, clean the plugs and set the gaps to manufacturer's recommendations. Examine the spark-plug cables to see that the insulation is not oil-soaked or spongy. If it is, some of the current that should be going to the plugs will be lost

on the way. Distributor points that are pitted and burned will rob the battery of more of its needed energy. Remove drag in the engine and transmission by using the proper grade of oil. While not necessarily a cold-weather driving practice alone, remember to start the car with the clutch disengaged so the battery won't have to turn transmission gears as well as the engine. Don't start the car with the lights turned on, and always keep the battery filled to the correct level, using only approved electrolyte or water. In freezing weather, use the car immediately after adding water to insure mixture with the electrolyte and eliminate the possibility of freezing the battery.



*Rep. farm ...*  
*out of print -1090 809*  
**DEEP-FREEZE UNIT**

**30° Below**

Ordinary hand tools were used in building this deep-freeze unit, which has 18 cu. ft. of storage space and a 2-cu.-ft. deep-freeze compartment that has a separate control valve

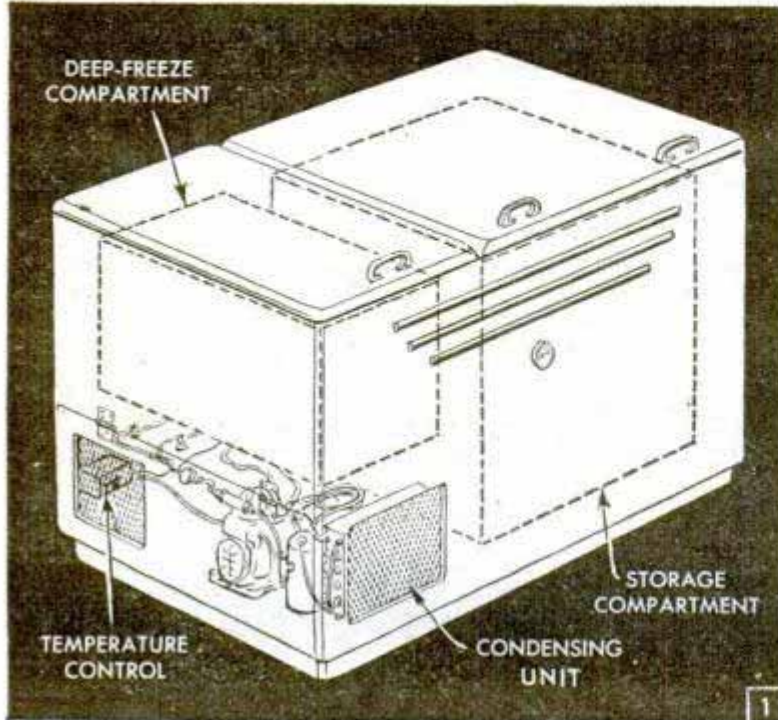
*Rep. WTM '49*



You can make the unit smaller by reducing dimensions and size of condensing unit proportionately



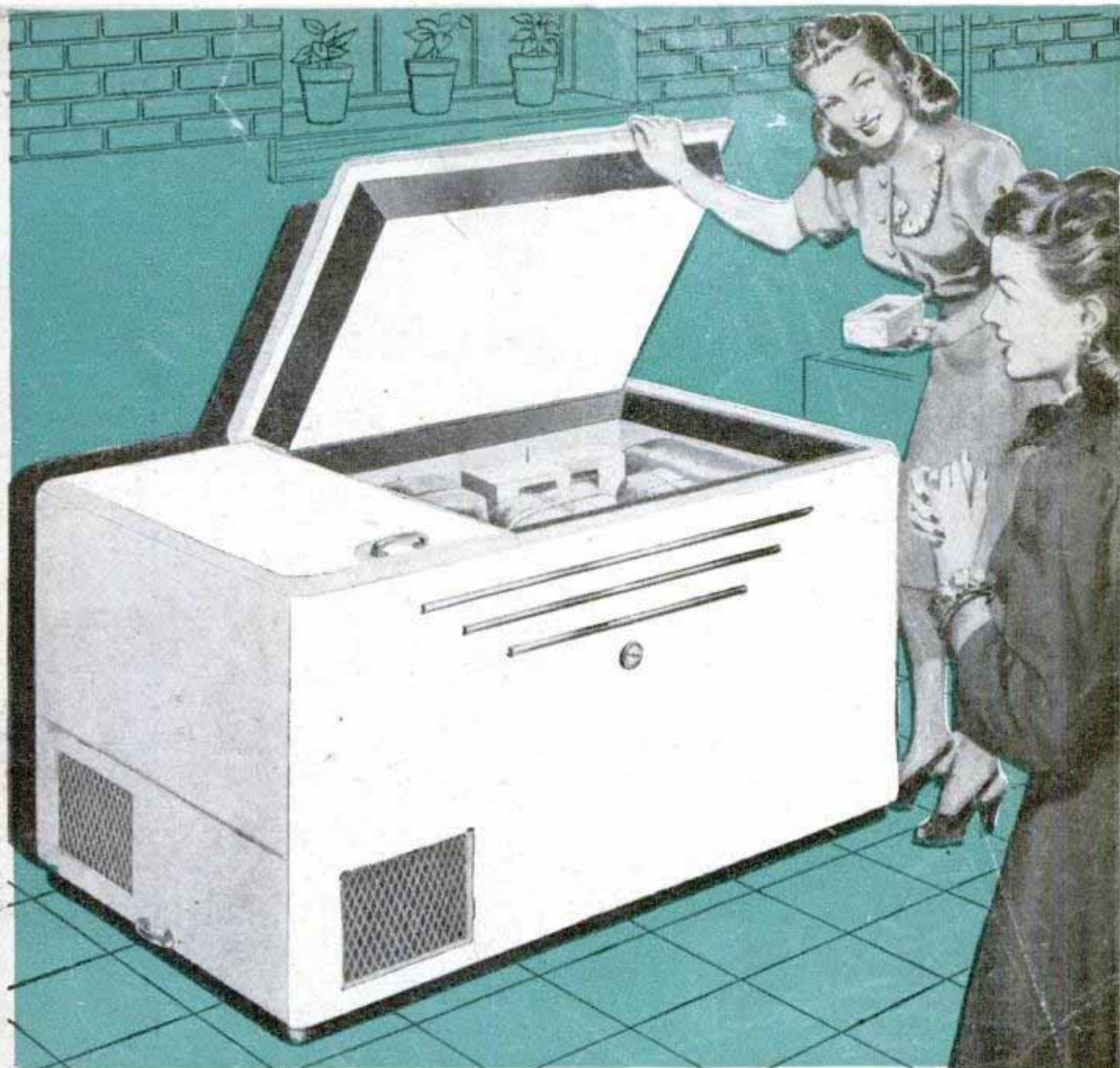
Trouble-free operation is the result of following the few simple service routines that are given



By John F. Shrock  
 3146 SHERIDAN RD., CHICAGO, ILL.

**B**UILDING your own deep freezer is not a difficult job, especially this one; it's nothing more than a well-insulated plywood box or cabinet in which a purchased refrigerating unit is installed. The freezer has been tested in actual use and also in a laboratory, Fig. 8. The deep-freeze and storage compartments can be separately controlled by shutoff valves and the deep-freeze compartment can be brought down to about 30 deg. below zero for quick freezing of meats and vegetables before putting them in the storage compartment. The latter is held at a temperature of approximately zero. When not in use, the deep-





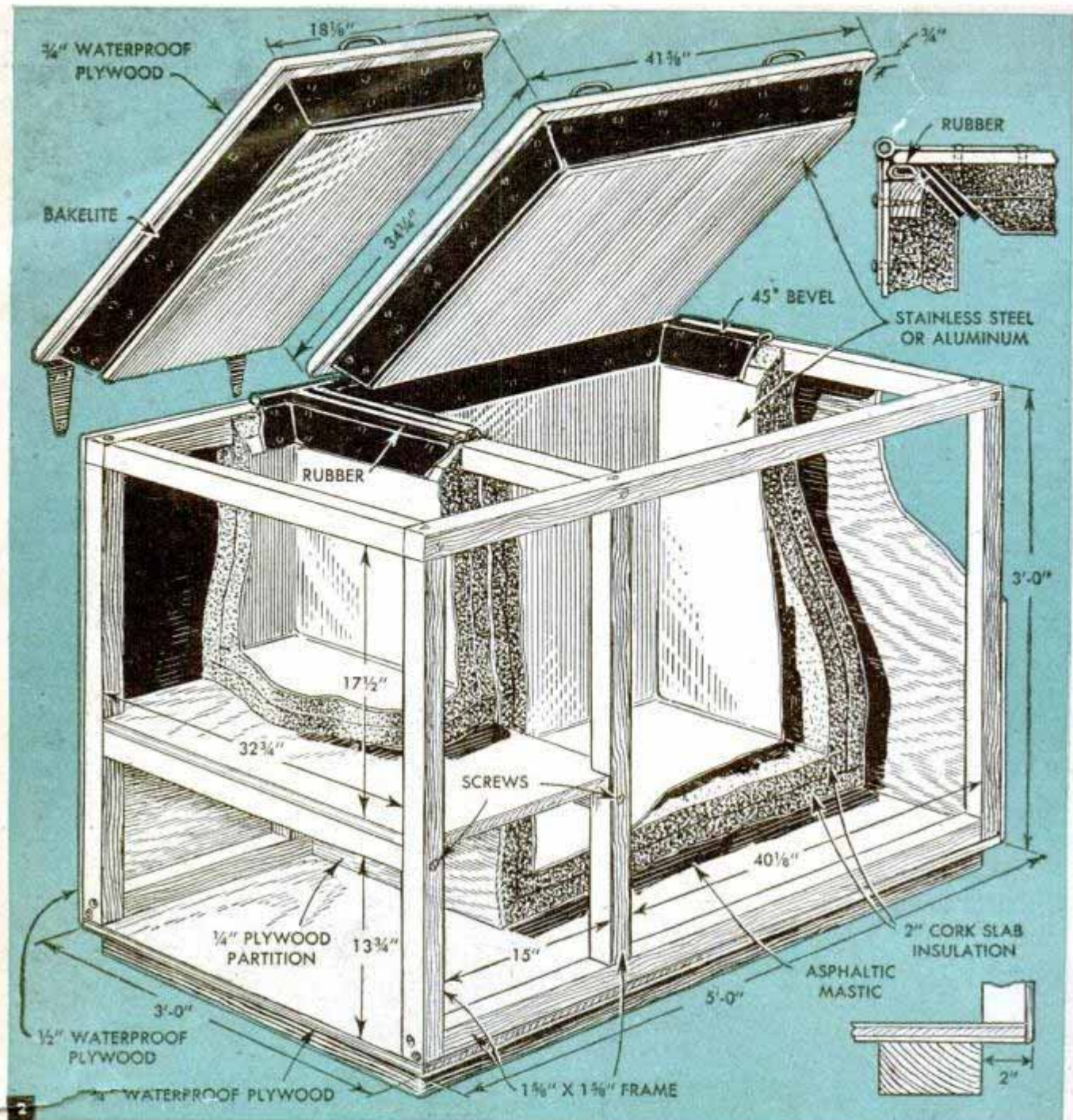
freeze compartment may be shut off to ease the load on the compressor. It's best to use a new refrigeration or condensing unit, which comes charged with refrigerant and only has to be connected to the freezer or evaporator coils inside the compartments.

Construction begins with the cabinet, Fig. 1, which is divided into three parts: a deep-freeze compartment, a storage compartment and the space for the condensing unit. Refer to Fig. 2 for the general dimensions. Since the over-all size of condensing units varies with different makes, this will affect the dimensions of the compartments because space allotted for the unit will vary. There should be several inches clearance on both sides and above the condensing unit. The dimensions given are for a hermetic  $\frac{1}{8}$ -hp. unit.

After the base is cut, a 2 by 4-in. kick board is screwed to the underside 2 in. from the edges as shown in the lower right-

hand detail of Fig. 2. The corners are mitered. The frame is of glued-and-screwed butt construction and all members are common 2 by 2 in. stock, actually  $1\frac{5}{8}$  by  $1\frac{5}{8}$  in. dressed. They are glued and screwed, using No. 14 screws 3 in. long. The screws, of course, are countersunk so the plywood panels will fit flush against the frame. The platform that forms the base of the deep-freeze compartment is cut next and screwed to the supporting members. This is  $\frac{3}{4}$ -in. waterproof plywood, the width of which is determined by the space allotted for the condensing unit. To provide a partition and backing for the insulation for adjoining walls of the storage and deep-freeze compartments, as well as to form one side of the condensing unit compartment, a  $\frac{1}{4}$ -in. waterproof plywood panel is used. This extends the full width and height of the box and is fastened to the frame members against which it rests.





Next, the plywood sides, back and front are fitted to the frame. These are all  $\frac{1}{2}$ -in. waterproof plywood, although hard-pressed board of a suitable thickness would do equally well. Before installing the front panel, cut an opening in it over the condensing unit compartment and nail expanded metal over the inside of the opening. Any decorative grillwork can be used; but it must be remembered that air passing over the condenser enters through this opening and its area should not be restricted to retard movement of air as this would affect the efficiency of the refrigerating unit. That portion of the end panel covering the unit is hinged to provide a door for access to the unit. The door should be large enough to provide easy access to all parts of the com-

partment it covers. Toward the rear end of the door an opening is cut equal in area to the one in the front panel. This is the exhaust outlet for the condensing unit and remarks concerning the type of grille apply here as well as to the front panel.

After the panels have been fitted and assembled, they are screwed to the frame. Use flathead screws and countersink the holes so they can be filled. If the panels are cut so that one end comes flush with a corner frame member and the end of the adjoining panel extends slightly beyond the post, nicely rounded corners can be made. To do this, round the corners to the approximate curve desired with a plane or saw. Then use a sanding block that has the face cut to the desired contour to finish the curve. The lids for the deep-freeze and storage compartments should extend over

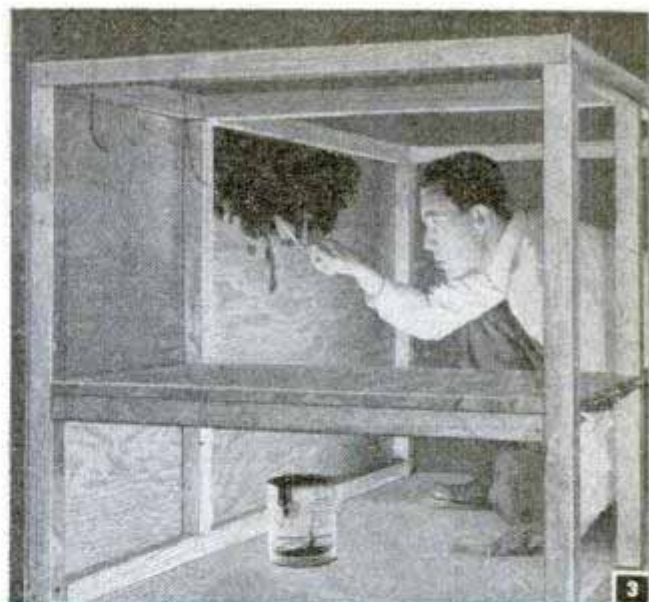


the openings about  $\frac{3}{4}$  in. on all sides, with very little clearance between the inner edges of the two lids. Approximate overall dimensions are given in Fig. 2. After the lids have been cut to size, the corners and edges are rounded in the same manner as was done previously.

The next step is the application of the insulation and sheet-metal lining. A double layer of 2-in. compressed-cork slab, which is cut easily with a handsaw, is applied to the bottom and sides of both compartments and to the undersides of the lids. An asphaltic-mastic compound, which is a neat emulsified asphalt, is used as the bonding medium. Figs. 3 and 4 show how the mastic is troweled on. When applying the two layers of cork, spread mastic on all joining surfaces of the plywood and cork. After insulating the compartments and undersurfaces of the lids, roughly bevel the insulation at the upper edges of the compartments at a 45-deg. angle, using a saw to cut them. Then bring the bevels to a perfect 45-deg. angle by troweling on a mixture of ground cork and mastic, using a template as in Fig 5.

The metal lining is next. Either stainless steel or aluminum is used. A medium-gauge aluminum will prove very satisfactory. Before the metal is cut to shape, paper patterns should be fitted against the cork to determine the exact dimensions so the joints will be a perfect fit. This is necessary since the joints are not soldered, but depend on the mastic to hold the lining in place. The upper edges of the metal should overlap the bevels about 1 in. After the lining has been applied, using mastic to bond it to the cork, a Bakelite edging is cemented and screwed over the bevels. Again, paper patterns should be cut and tried to assure a perfect fit. After completing the compartments, bevel the insulation of the lids to fit the beveled surfaces of the compartments and apply metal and Bakelite as for the compartments. When preparing the lids it's a good idea to try them on the compartments frequently as the work progresses to compensate for any error that may have been made when beveling the compartments. A refrigerator cover-seal gasket of rubber, upper right-hand detail of Fig. 2, is screwed to the frame members before the Bakelite is attached. After the lids have been fitted, the hinges and handles are screwed in place. Chromium-plated hardware is used and the hinges should be attached firmly to the frame members and lids. A refrigerator dial thermometer, flush mounted, connects to the storage compartment. Any holes that are drilled are sealed with cork and mastic.

A  $\frac{1}{8}$ -hp. condensing unit is used for a



Troweling the asphaltic mastic that forms a bonding medium between the cork and plywood



Here the final coating which forms a seal between the sheet metal and the cork is applied



A template must be used to gauge the correct bevel between the sides and lid of the unit





A cool corner of your basement is best for the deep-freeze unit, but it may be kept in a spare room, on a closed porch, or even in the garage

cabinet of this size, although smaller units can be used if the size of the compartments is reduced proportionately. The so-called "open" type consists of a compressor, condenser, receiver, motor and fan, the compressor being driven by a V-belt. Hermetic units have the motor connected directly to the compressor and a separate motor is used to drive the fan. If a rebuilt unit is used, be sure that the compressor valves are not leaking, as this will affect the operating efficiency considerably. Freon 12 is the refrigerant gas commonly used. Other required parts for the refrigeration system are a dehydrator, sight glass, two shutoff valves, two tees, two thermostatic expansion valves and a check valve, or a two-temperature valve if available. Flare fittings are used throughout. About 100 ft. of  $\frac{3}{8}$ -in. and 8 to 10 ft. of  $\frac{1}{4}$ -in. dehydrated copper tubing, as used for refrigeration work, are required. For this particular unit all parts are for  $\frac{1}{4}$ -in. connections except one tee, which is  $\frac{3}{8}$  in., as is the check valve. The expansion valves, which have  $\frac{1}{4}$ -in. inlets and  $\frac{3}{8}$ -in. outlets, must be for a  $\frac{1}{2}$ -hp. unit. A pneumatic temperature-control unit of suitable range is used to start and stop the motor. The connections to be made are shown in color.

Fig. 7 shows the complete refrigeration system installed. When making a flare joint, upper left-hand detail, the end of the tube is compressed against the seat of the fitting by screwing down the nut. The end of the tube must be perfectly round and cut off square. Carefully remove all burrs and chips of metal and keep all filings and chips out of the tube to prevent them from getting into the refrigeration system. Form the end of the tube with a flaring tool, making certain that the flare is the right length. If it is too short, it will not seat fully and the tube will pull out of the flare nut, while if the flare is too long it will not permit the nut to seat properly.

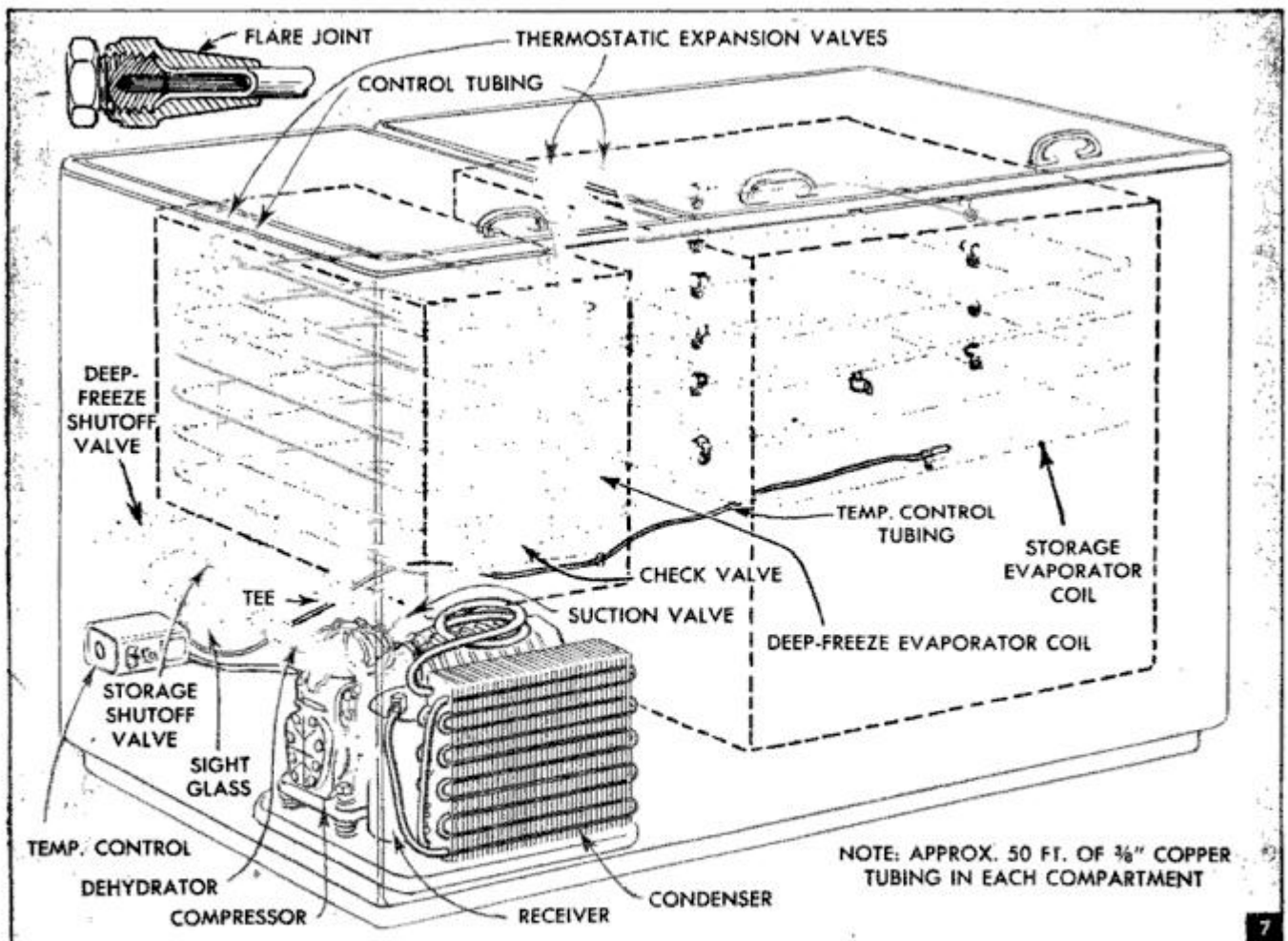
The manner in which the connections are made is indicated in Figs. 7, 9 and 10. The condensing unit, which is mounted on an integral base, is placed toward the front end of the compartment with the condenser against the grille in the front panel. The outlet connection from the receiver, which is for  $\frac{1}{4}$ -in. tubing, runs to the dehydrator, the sight glass and through a tee to the shutoff valves and the expansion valves. All these are  $\frac{1}{4}$ -in. fittings. All bends should have as large a radius as possible so the tubing is not compressed. The shutoff valves are made so they can be screwed to



the top of the compartment. The evaporator coils, which are the coils inside the compartments, are  $\frac{3}{8}$ -in. tubing. They connect to the outlets of the expansion valves and are secured with clips to the walls of the metal lining as shown in Fig. 9. About 50 ft. of tubing is required for each compartment. From the storage compartment, the line runs to a check valve and then to a  $\frac{3}{8}$ -in. tee. The return from the deep-freeze compartment goes directly to the same fitting from which a common return goes to the suction valve of the compressor, Fig. 7. Bending tools are used when making the evaporator coils, which should be formed before they are screwed to the metal lining. Two holes are drilled in each compartment, one for the  $\frac{1}{4}$ -in. inlet tubing and the other for the  $\frac{3}{8}$ -in. outlet. In the case of the storage compartment, the outlet hole should be large enough to accommodate the capillary or temperature-control tubing which connects to the temperature control. The holes are hermetically sealed with the mastic-and-cork mixture. The bulb for the control is clamped to the evaporator coil, as indicated in Fig. 7. The control tubing for the expansion valves is clamped to the coils at a point about 2 ft. from where the coil leaves the compartment. The exact spot will have to be determined by experiment. After the system is in operation, there should be no frost on the suction-side

tubing outside the compartments. If there is, the control-tubing clamp should be moved farther back from the outlet. If a satisfactory adjustment does not result, the setting of the expansion valve will have to be changed. However, this is set at the factory and should be reset by a refrigeration serviceman. The manner of adjustment varies with the different makes of valves. The completed unit is then painted and finished with metal trim, Fig. 6.

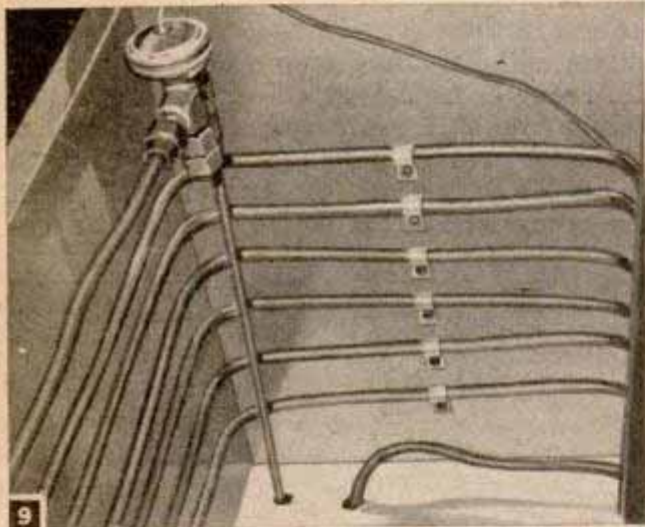
If you are unfamiliar with refrigeration work, it's best to have a serviceman connect the condensing unit to the coils and put the system in operation. This includes purging the tubing of air, checking the suction and discharge pressures, and testing for refrigerant leakage. This work can be done for a nominal sum. It is necessary that there be no air in the system because air is much less compressible than Freon and, for that reason, may ruin the valves of the compressor. The simplest way to purge the coils of air is as follows: after the connections have been made and tightened, a standard refrigeration suction gauge is installed in the port provided on the suction valve, which is then opened slightly; open the receiver outlet valve and both shutoff valves to admit refrigerant to the evaporator coils. When the gauge pressure rises to about 20 lbs., close the suction valve on the compressor and the valve on the re-



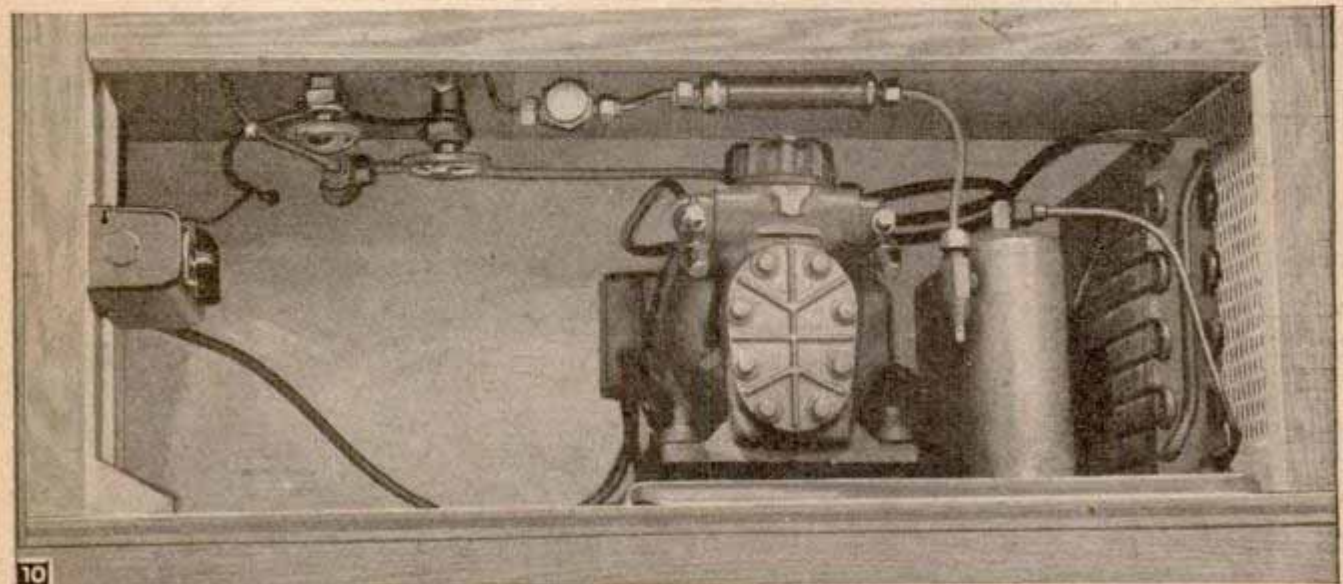




Temperature readings are being taken with a thermocouple during the initial test of this deep-freeze unit



Above: The evaporator coil is attached to the side-walls of the deep-freeze compartment with small metal clips. Below: Arrangement of the condensing unit, valves, sight glass and dehydrator is shown here



ceiver outlet. The coils now contain a mixture of refrigerant and air; loosen the flare nut that connects the tubing to the suction valve to purge the tubing of this mixture, then tighten the nut again. It will be necessary to repeat the operation about three times. Care must be taken when purging the lines. Not following the proper sequence might result in excessive loss of refrigerant or cause damage to the condensing unit when it is put into operation.

After the system has been purged, all valves are opened and the motor is connected to a power source to put it into operation. All valves should be opened fully, otherwise damage may result. The temperature of the storage compartment is regulated by the temperature control. When it is not desired to use the deep-freeze compartment, close the shutoff valve to put it out of service.

Since the deep-freeze unit is not opened as frequently as a refrigerator, it will not require defrosting as often. However, when the coils are heavily frosted, the frost should be removed with a wire brush to keep the unit operating at its highest efficiency. For easy access, food should be kept in wire baskets, or dividers should be used.

A few of the common troubles experienced in the operation of refrigeration systems follow, together with the cause and correction. (When working around a condensing unit, always disconnect the motor as the operation is automatic and the unit may start at any time.) If the compressor runs in short cycles, it may be due to the fact that the suction and discharge valves are partially closed when they should be wide open and in the back-seated position. Obstructions over the grilles may cause insufficient ventilation. Periodically the grilles should be cleaned and the condenser gone over with a brush to be sure that there are no obstructions. A low charge of



refrigerant will also cause the unit to run too frequently; if bubbles show in the sight glass or the liquid appears cloudy, this indicates the need of additional refrigerant. It should be noted that when food is put into the deep-freeze compartment, there will be a heavy load placed on the refrigeration system and it will run more frequently than when in normal operation.

If the compressor knocks, it may be due to air in the system which should be purged, or in open models it may be due to a lack of oil in the crankcase. If the latter is true, a refrigeration serviceman should add the proper kind of oil. Frost on the compressor head is an indication that the suction pressure is too high and this is corrected by adjusting the control tubing on the expansion valves. As a general rule, there should be no frost on the lines after they leave the deep-freeze and storage compartments. Compressors that are driven through a V-belt should have the drive tested for tension and alignment if belt slippage is suspected. When lubricating a unit, remember that oil deteriorates V-belts and avoid dropping any on the belts.

Moisture is seldom found in a properly maintained refrigeration system, and no system will function correctly if there is moisture in it because the water will freeze at the expansion valve and then be blown free by accumulated refrigerant pressure, resulting in erratic suction pressure. If replacing the dehydrator fails to correct this condition, the expansion valve may have to be removed and dried out as well. In either case, it's best to have a serviceman do the work since the refrigerant must be exhausted from the evaporator coils and pumped into the receiver and condenser.

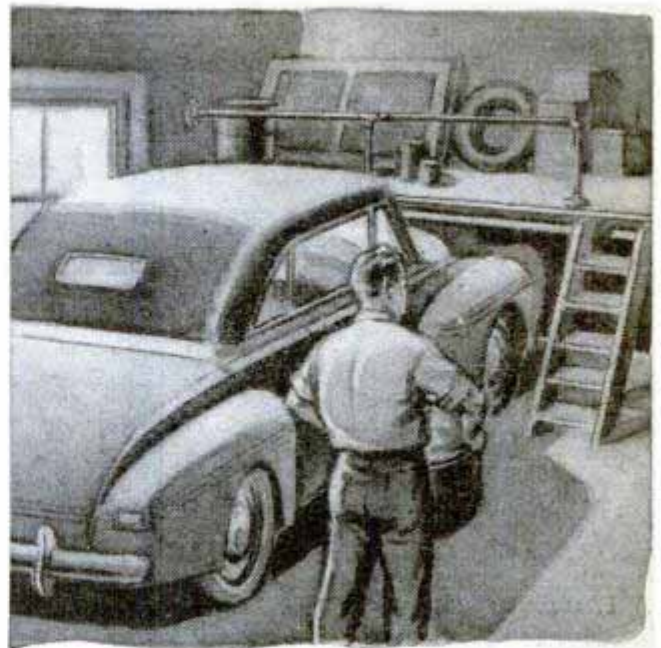
Should it become necessary to take the unit out of service, or should there be an extended power failure, dry ice can be put in the storage compartment to hold the temperature, or the food can be moved to a locker plant. However, care must be taken when using dry ice as its temperature is 110 deg. below zero and it may reduce the temperature in the box too far. The ice should not be handled with bare hands as this may result in a "burn."

## Method of Proofreading Stencils

One simple way to proofread mimeograph stencils is to insert a sheet of carbon paper between the cushion sheet and the backing sheet before the stencil is cut. The inked side of the carbon is against the backing sheet. When the stencil is finished, read on the backing what you have written. Or a sheet of bond paper under the carbon will give you an excellent copy.

Lt. Alvin R. New, Rantoul, Ill.

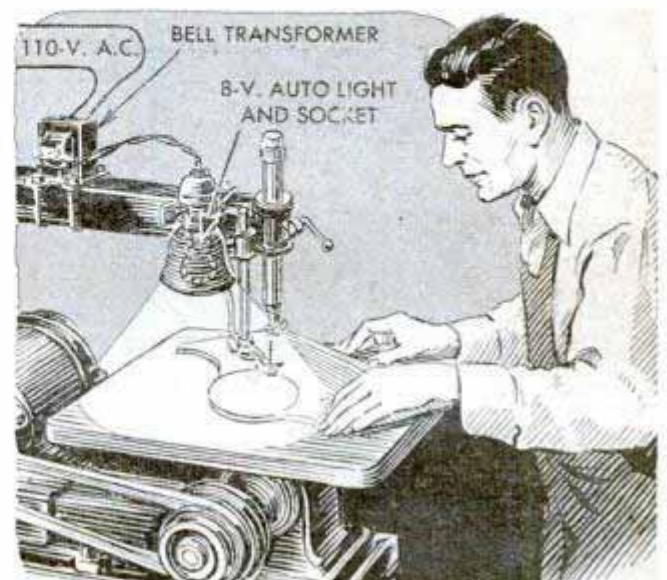
## Extra Storage Space in Garage Provided by Platform



Having a number of articles to store and no available storage space, one car owner built a platform at the end of his garage just high enough for the hood of the car to fit under. A protective railing was bolted to the platform, and a stair ladder was placed at one side. With this arrangement, none of the space needed for the car was taken, but former waste space was put to use.—E. W. Moses, Jr., Blacksburg, Va.

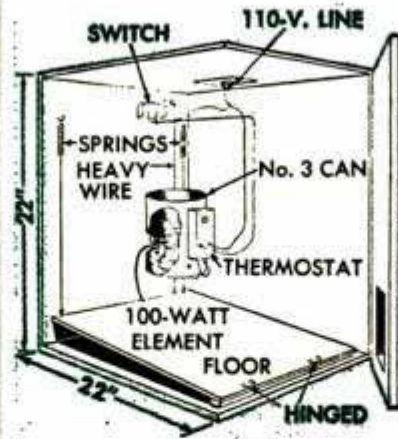
## Auto Light Placed Above Jigsaw Withstands Heavy Vibration

Because the filament in an automobile bulb will stand more vibration than an ordinary 110-volt one, a craftsman found that, after he mounted one above his jigsaw, replacements were not needed as frequently. The bulb was connected to a bell transformer wired to a 110-volt line.—Guy E. McAllan, North Vancouver, B. C., Can.





## Insulated Plywood House for Cat Has Automatically Controlled Heat



about 2 ft. square, or a little under, is ideal. As the right-hand detail indicates, there is a false floor which is hinged at one end and slightly suspended at the other by means of wire and springs. Also attached to the free end is another wire that is fastened to the arm of a micro switch. Connected to the switch in series is a thermostat set to close at 40 deg. F. and a 100-watt heating element. When the cat steps into the house, his weight causes the false floor to sink, and this closes the micro switch so

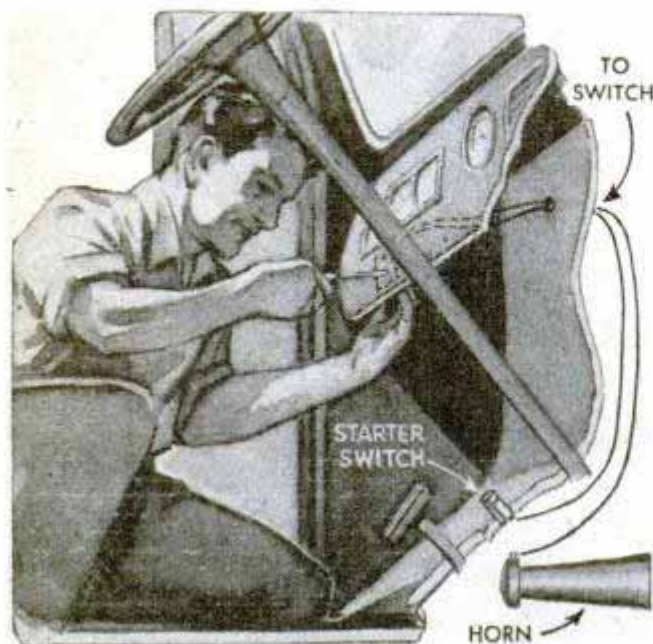
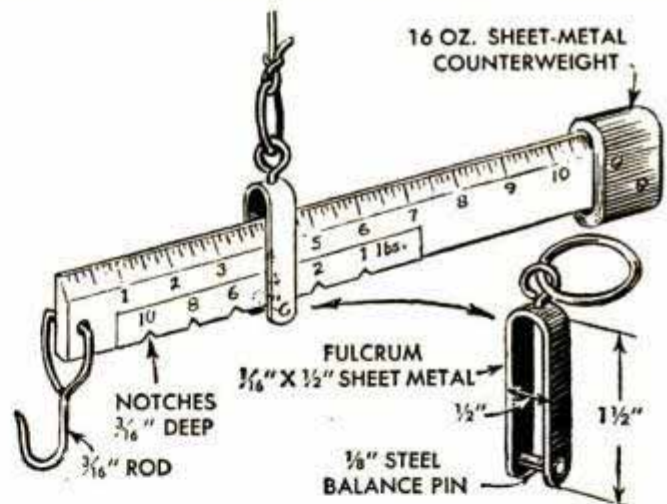
The last word in outdoor shelter for a cat, this house is insulated, lined with plywood and has automatic heat. Although the dimensions can be varied, a house that is

that if the temperature is below 40 deg. F., the heating element will turn on. A self-closing door is necessary.

Dawson G. Womeldorff, Wheaton, Ill.

## Easily Made Scale Permits Fisherman to Weigh Catch on the Spot

This combination balance scale and rule is made for the fisherman who wants to weigh his catch on the spot, and he can use it also to measure fish of a doubtful legal length. A one-foot ruler made of hardwood will serve as the beam. The end which has the 12-in. mark should be counterweighted with 1 lb. of lead or sheet metal so the scale will balance when a 1-lb. weight is hung from the opposite end. The fulcrum is made of sheet metal with a steel balance pin. Steel rod or a nonrusting material can be used to form the scale hook. Location of the notches is determined by using weights from a regular scale.—Albert M. Lindner, Jr., Cold Springs, N. Y.

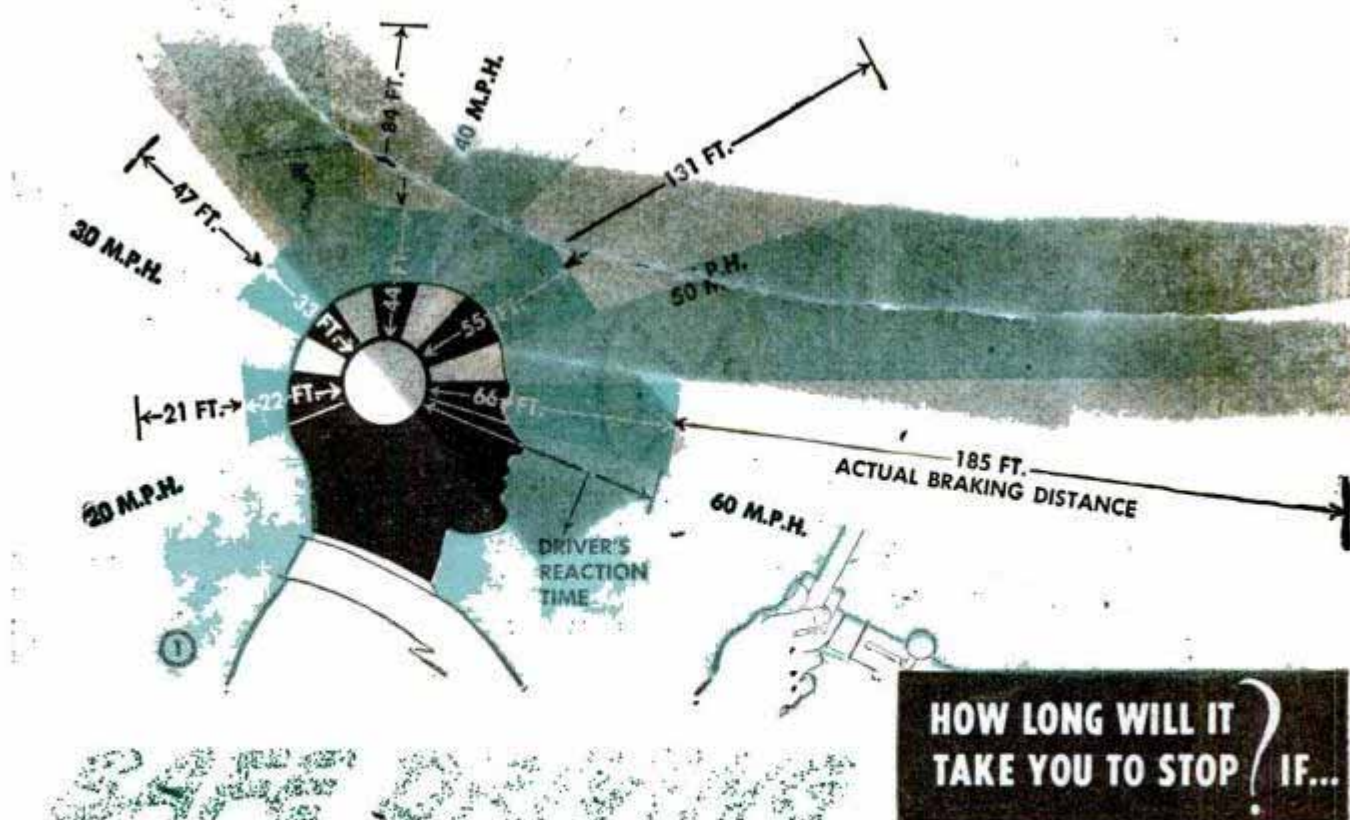


## Car Alarm in Starter-Horn Circuit Foil Would-Be Thief

By connecting the starter switch of his car to the horn, in series with a switch, one motorist is able to foil would-be car thieves. A wire runs from the "cold" side of the starter switch through a toggle switch mounted on the back of the instrument panel and then to the "hot" side of the horn. When the toggle switch is left closed, anyone who forces his way into the car and tries to use the starter will sound the horn at the same time, thus attracting attention.

☐ A good protective finish for window screens consists of a mixture of varnish, 2 parts, linseed oil, 1 part, and turpentine, 1 part, which can be applied with a piece of carpet tacked to a wood block.





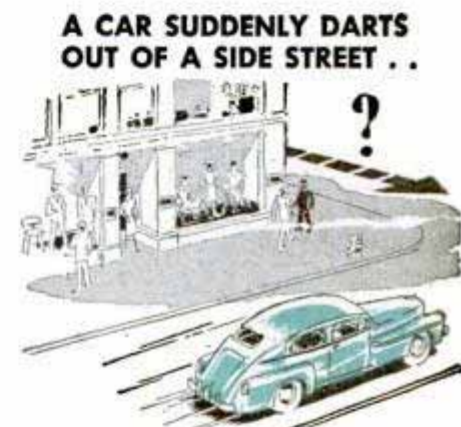
By Phil Ruskin

ONE of the major factors in the safe operation of a car is knowing how far it will travel before coming to a stop after the brakes have been applied. Knowledge of this fact is important if the car is to be kept under complete control. The distance required to stop a car on a good, dry pavement is surprising, especially at higher speeds, and this may account for many of the accidents that occur. As shown in Fig. 1, at 20 m.p.h. the average car in good condition will come to a standstill after traveling 43 ft. from the time the driver receives a signal to stop. The signal may be a car dashing out from a side street; a child running out from between parked cars or, in the country, it may be a car on the wrong side of the road when rounding a blind curve. At 40 m.p.h., 128 ft. of clear space is required to stop the car, and at 60 m.p.h., a total of 251 ft. is required.

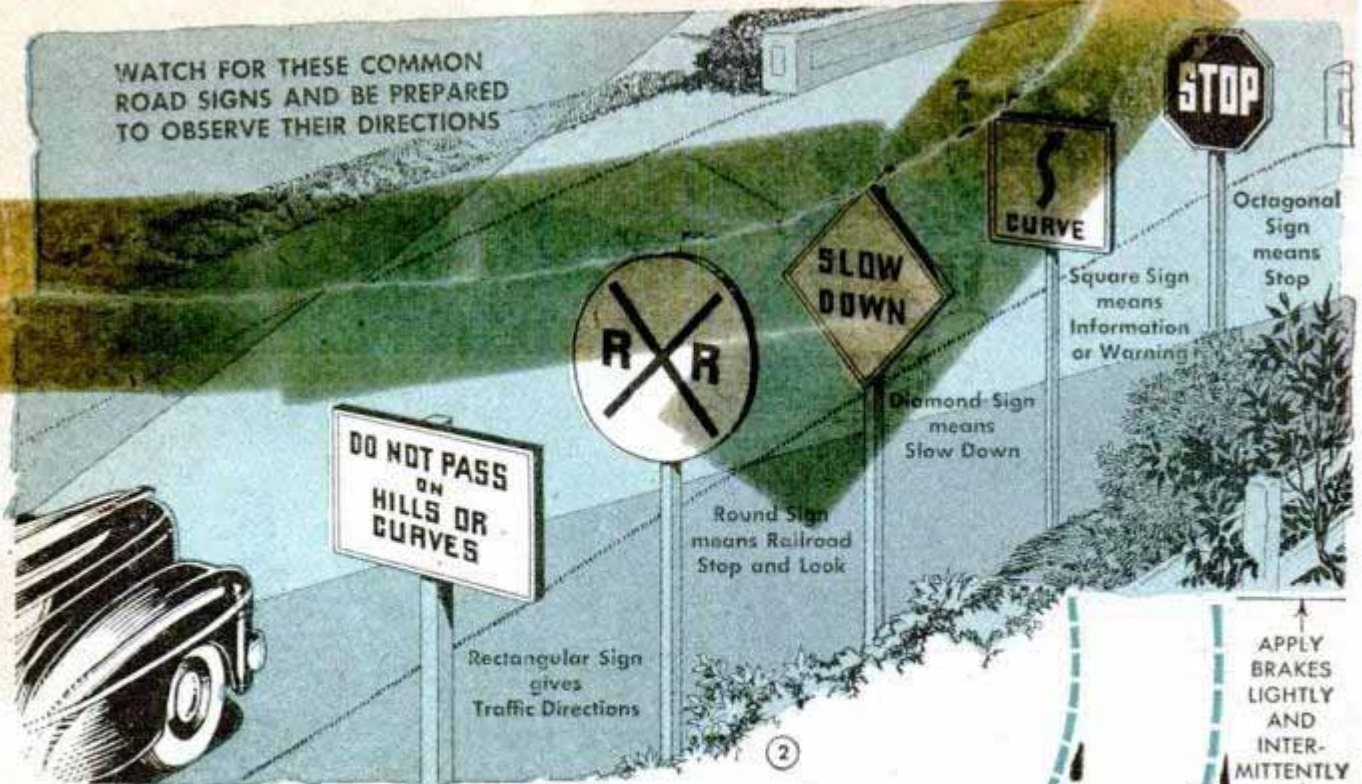
Of course, the brakes are not actually applied from the moment you receive a signal to stop. There is a period, generally called reaction time, which is the interval required to act after you receive a warning to "step on the brakes." This time varies from driver to driver, but it is estimated at approximately  $\frac{3}{4}$  second. This means that at 20 m.p.h. a car will travel 22 ft. before the brake pedal is touched. At higher speeds the car will travel even greater distances before the brakes are set. For example, at 40 m.p.h. the car will travel 44 ft. and at 60 m.p.h. the distance is 66 ft. before the driver applies the brakes. These figures apply to cars in good condition traveling on well-paved, dry roads. Under poor conditions, much more allowance should be made for stopping the car.

Another factor in safe driving is the recognition of signs giving directions, Fig. 2. Rectangular signs are used to give traffic directions, round signs indicate a railroad crossing and a diamond-shaped sign means that the driver is to slow down. A square sign contains either information or a warning and an octagonal sign means a stop. Knowing what the shape of the sign means helps

**HOW LONG WILL IT TAKE YOU TO STOP? IF...**



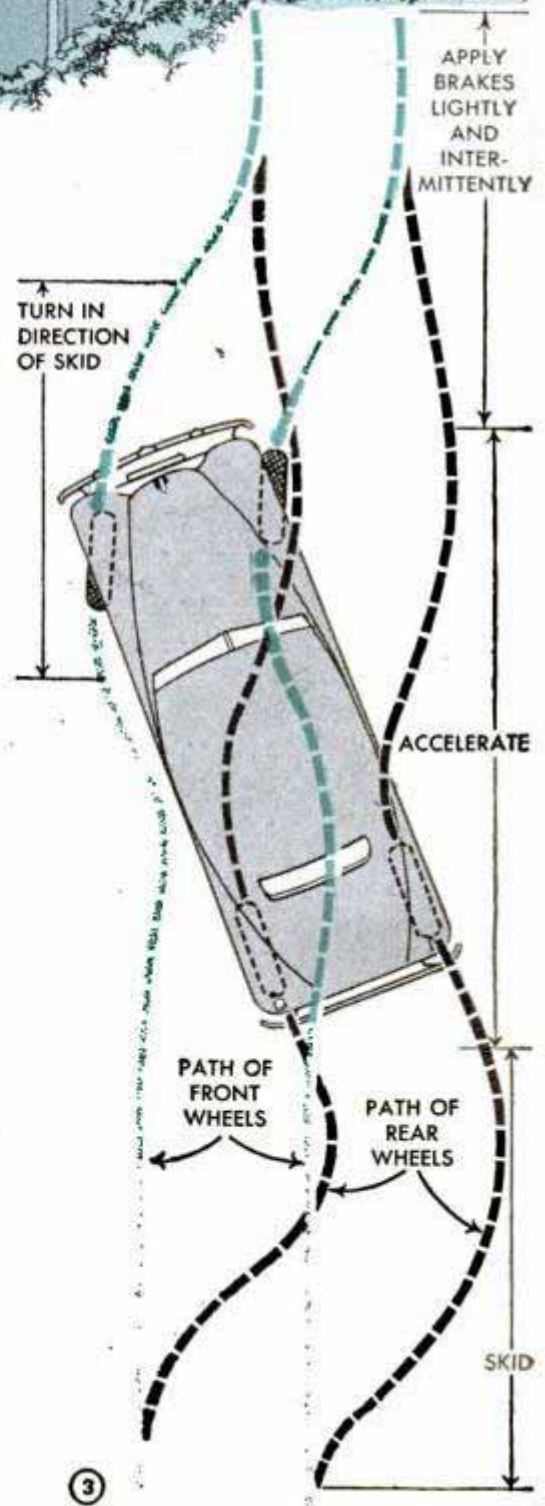




the driver prepare to act before he is close enough to read the lettering.

Knowing how to pull a car out of a skid, Fig. 3, may prevent serious or fatal injuries as well as save the owner a considerable sum of money. Always turn the front wheels in the direction of the skid and do not apply the brakes immediately. Instead accelerate slightly, and after the skid is nearly under control, apply the brakes lightly and intermittently. The natural reaction is to "freeze" on the brakes at first instead of accelerating. It might be well to practice skidding the car in some unobstructed area, and then bring it out by using the accelerator. In case there is a blowout, or the car runs off the shoulder of the road, don't try to steer back to the original line of travel by turning the wheel sharply. Accelerate lightly to keep the car under control, and in the case of a blowout bring it to a stop. Always leave the clutch engaged while the car is moving. The retarding action of the engine will save wear on the brakes and is helpful in making safe turns at faster speeds, when descending grades and on slippery roads. There is no danger of "locking" the wheels and making them slide instead of rotate when engine braking is used. The lower the gear ratio employed, the greater the engine-braking action. Thus, it is advisable to shift into first or second gear when descending hills or on icy stretches of road.

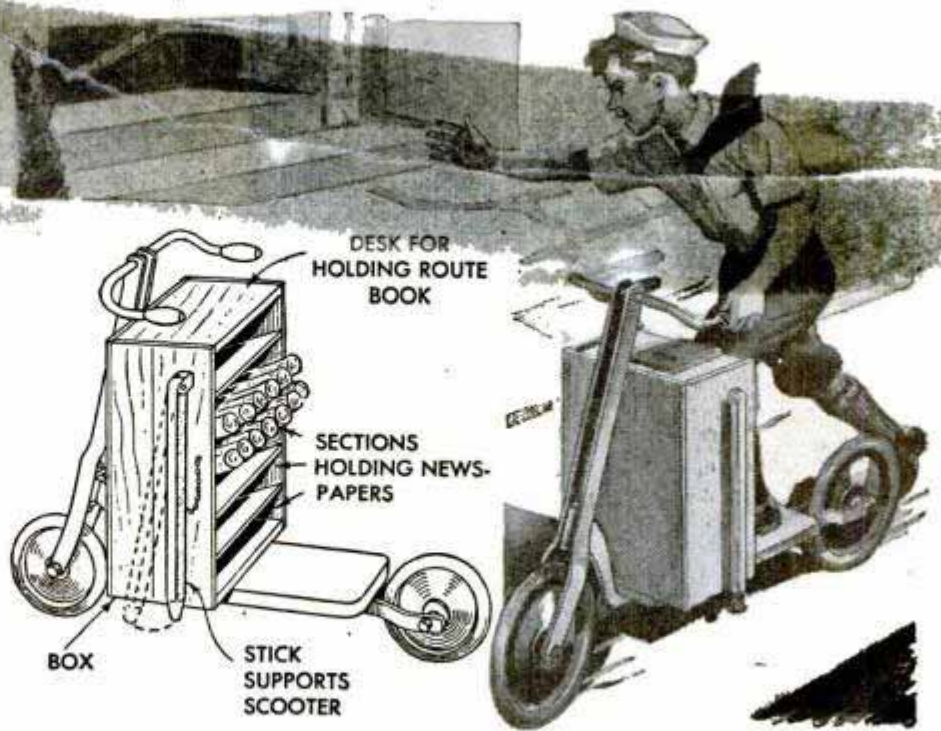
Tires and brakes suffer much from fast driving. The friction and heat generated by quick starting and stopping wear the rubber and brake lining rapidly. Making turns "on two wheels" and speeding over bumpy roads not only rubs valuable mileage off the tires but may also cause damage to the sidewalls where the rim cuts in. This is especially true if the tires are underinflated. Making a fast start away from a traffic light is not only a poor practice, it's an expensive one. Tires suffer considerably from this type of driving.





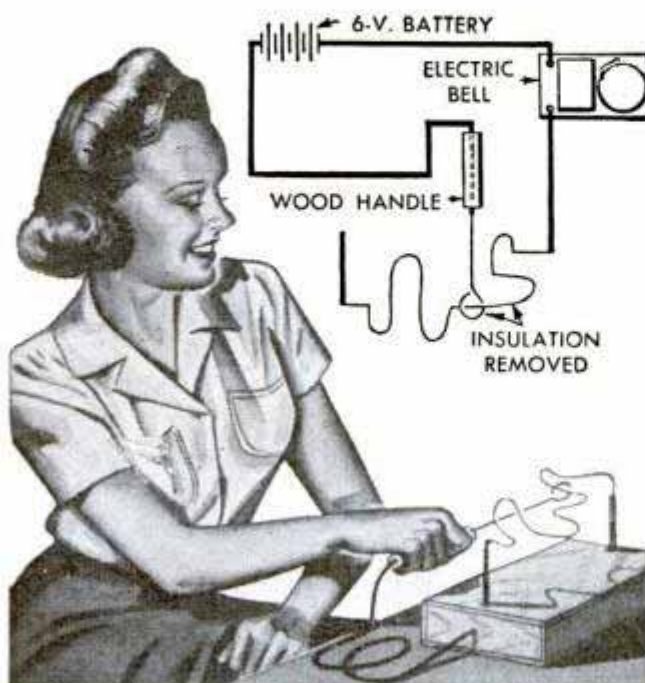
# Rack on Scooter Holds Papers for Newsboy

Made from a box of suitable size, this rack for holding newspapers is mounted on a scooter to enable a newsboy to whiz over his route. The box is divided into sections spaced so that each will take a single row of rolled newspapers. The dividers should slant downward slightly to prevent the papers from falling out. There is a "stand" which pivots to one side of the box. When standing still, the stick swings out and the scooter is leaned against it. A restraining chain holds the stick. The box top is used as a desk to hold the route book.



## Steadiness of Hand Is Determined With Testing Instrument

Young and old alike will enjoy this testing device which is used to determine the steadiness of your hand. The upper right-hand diagram shows the way in which the circuit is connected. Insulated wire is run from one terminal out of the box and through a wooden handle where it terminates in a loop. The insulation is removed from the loop. A wire from the other battery post is connected to one terminal of an electric bell, as shown. Wire connected to the other terminal runs out through the box, where it is bent in an irregular shape



and fastened between two dowels. Insulation also is removed from the part between the dowels. The trick is to run the loop over the exposed wire without touching it. If the loop touches the wire, the bell rings.

F. Toors, Utrecht, Netherlands.

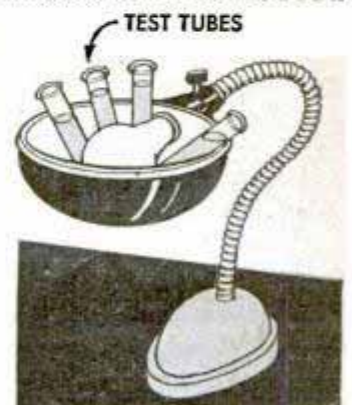
## Presser Foot Clamps Material When Ripping Cloth Seam

When ripping a seam, the task is made easier if one end of the cloth is clamped under the presser foot on the sewing machine. This leaves one hand free to do the cutting while the other hand pulls the cloth apart.



## Test Tubes Warmed in Reflector

Desiring to keep test tubes warm, one teacher reversed the reflector on his desk lamp and nested the tubes around the light bulb. Heat was sufficient to maintain the proper temperature.





# Jigsawed TABLE

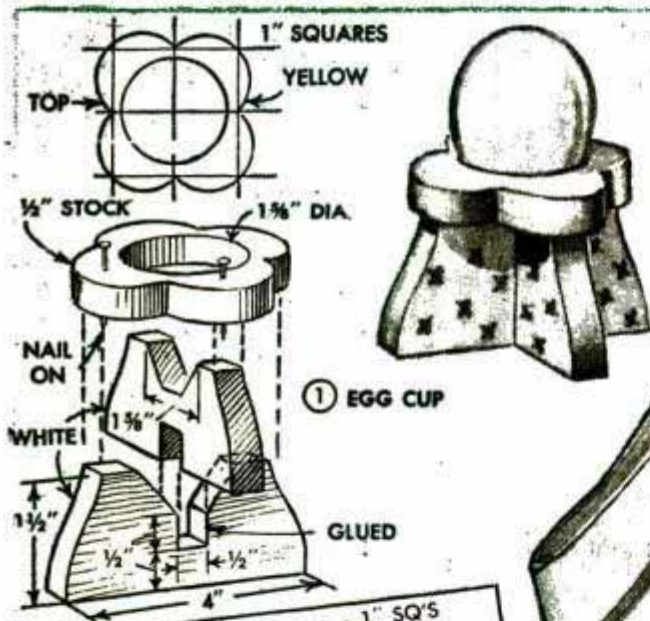
By R. L. Fairall



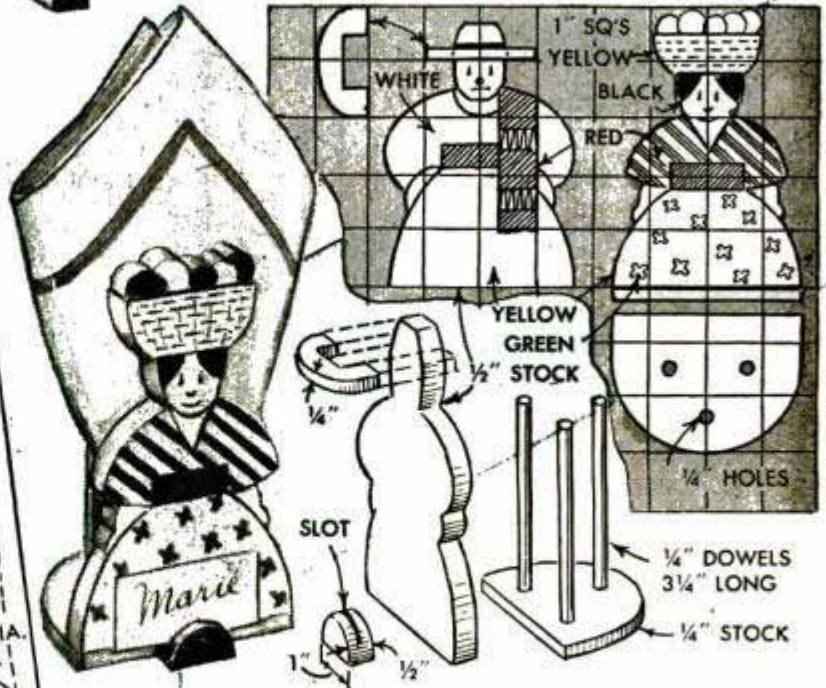
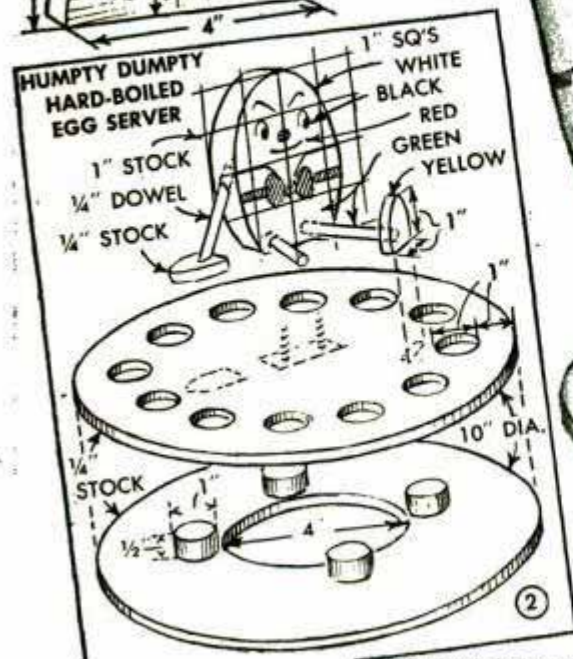
CHEERY luncheons will be made even gayer by these amusing table novelties, and breakfast will be an event when your soft-boiled egg comes to you in such an unusual cup as that shown in Fig. 1. To make the cup, the base sections are cut to shape and assembled, after which the rim is jigsawed and nailed to the base. In jigsawing, either by hand or with the power saw, a little extra care in following the pattern lines will save a lot of time in hand sanding.

The egg server, Fig. 4, is shown in detail in Fig. 2. Two disks of wood are sawed and drilled as shown. One has 12 holes for a dozen eggs, and the other has one large center opening. Four wooden plugs glued to the lower disk space the assembly to hold the eggs. A large cut-out of the world's most famous egg server not only as a decoration but also as a handle. Humpty Dumpty's body is screwed to the upper disk and his arms and legs are glued in holes drilled in the body. The tie is painted on, but you may glue a strip of narrow ribbon around his collar for added novelty.

Napkin and place-card holders are



③ NAPKIN AND PLACE CARD HOLDER



shown in Fig. 3. The figures are jigsawed to the cross-hatched pattern and nailed or glued to semicircular bases of lighter stock which are drilled for three short

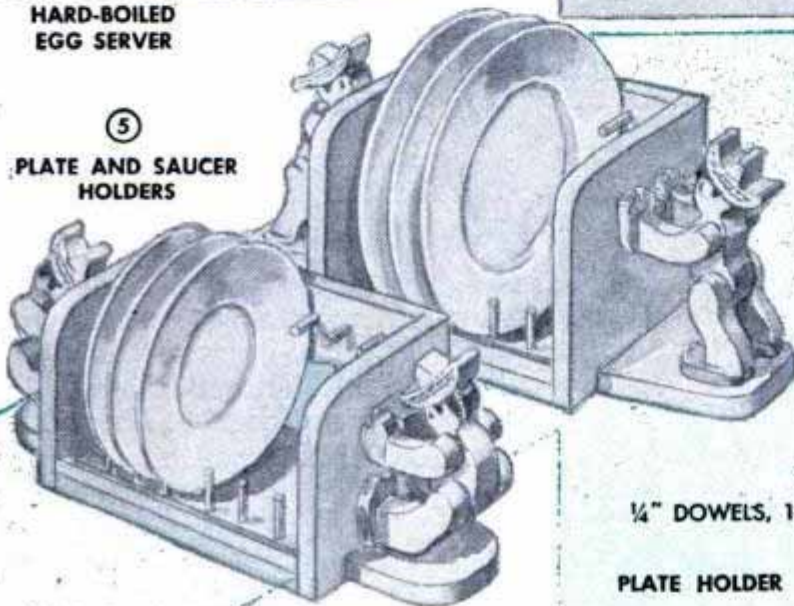


# MELTIES

add color to luncheons



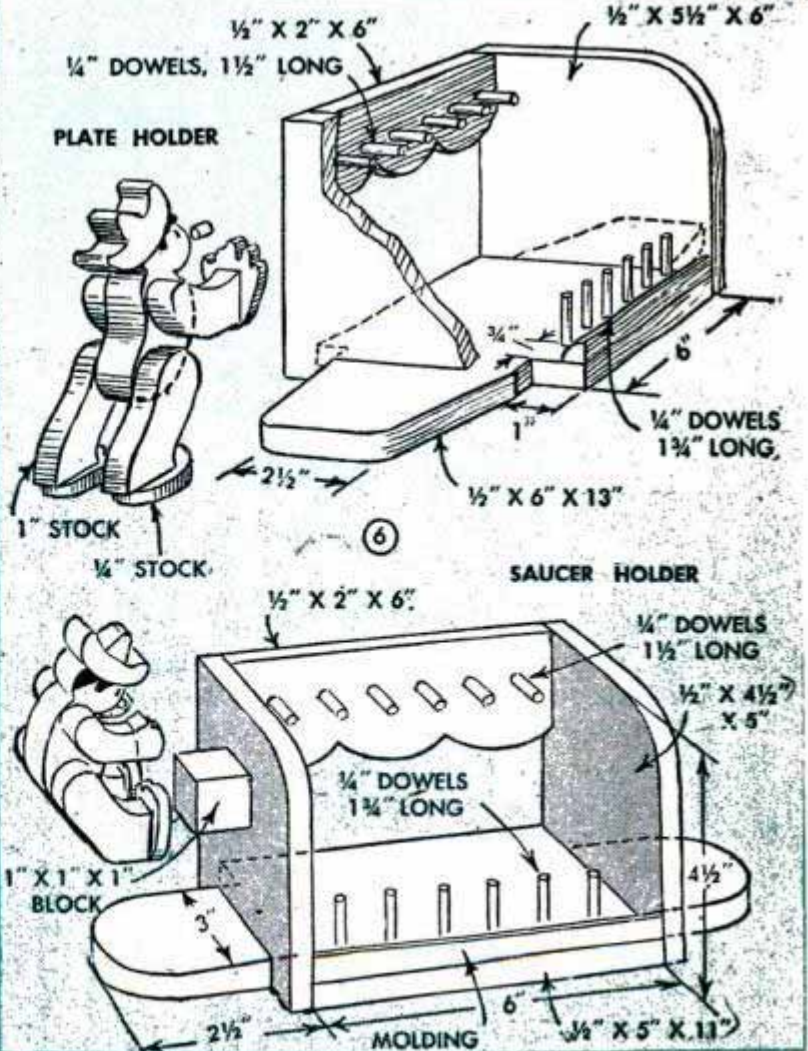
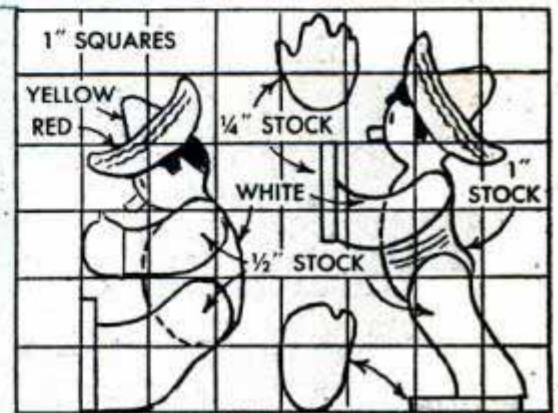
④  
HARD-BOILED  
EGG SERVER



⑤  
PLATE AND SAUCER  
HOLDERS

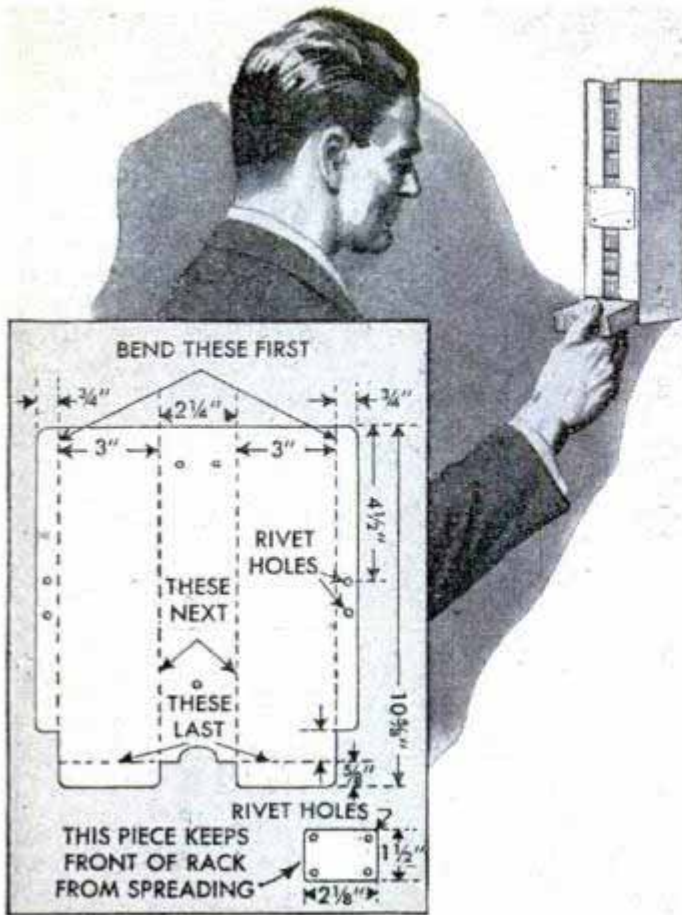
dowels to hold napkins. One half of a small disk cut from a length of dowel is slotted to hold a place card and glued to the front of each figure to represent a foot. In addition, the little man's hat brim is glued in place as shown.

Plates and saucers are held ready for use in holders supported by sturdy figures that seem to be working hard in the performance of their duty, Fig. 5. Each holder, made as detailed in Fig. 6, consists of a base, two endpieces and a backstrip, short lengths of dowel being inserted in the base and backstrip to hold the dishes. The figures, diagrammed in the cross-hatched detail, are assembled and mounted on the ends of the holder bases. Blocks of wood glued to the ends of the saucer holder give the figures a better grip on their burden and help steady them.





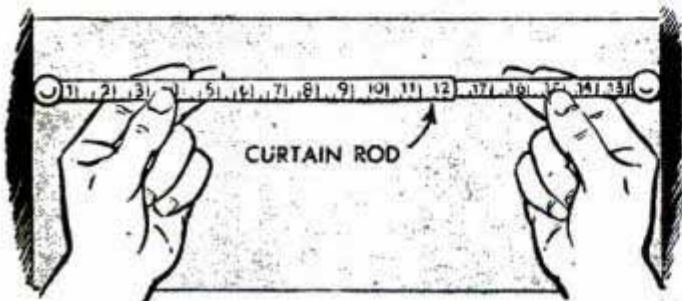
## Metal Dispenser for Cigarettes Keeps Them at Hand



Instead of searching through a drawer every time you want a package of cigarettes, keep them in a dispenser like this one and they will always be at hand. The dispenser, of any lightweight metal, can be mounted in a closet, in a cabinet, behind a door or in some other inconspicuous place if you want to keep it out of sight yet readily accessible. Dimensions given here are for the standard size package, but if you like the "king" size, increase the 3-in. dimension to 3 1/2 in. Dimensions for cutting and instructions for bending are given on the drawing. The front piece, which is to keep the sides from spreading, furnishes space for your monogram or some other decorative design.—M. W. Jeronimus, North Hollywood, Calif.

## Curtain Rod Used as a Rule

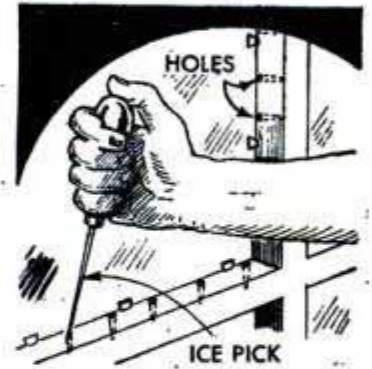
Handy for measuring inside dimensions where an ordinary yardstick cannot be used, an expanding curtain rod can be made into a rule to serve this purpose. The



left half of the rod is marked with numbers in their regular sequence and the other half, which pulls out, has the numbers in reverse order. This is necessary to obtain a correct reading.

## Holes in Sash Make Putty Stick

When setting a pane of glass, after the glaziers' points are driven punch a row of holes in the wood next to the glass with an icepick or other pointed instrument. Then apply the putty in the usual manner.

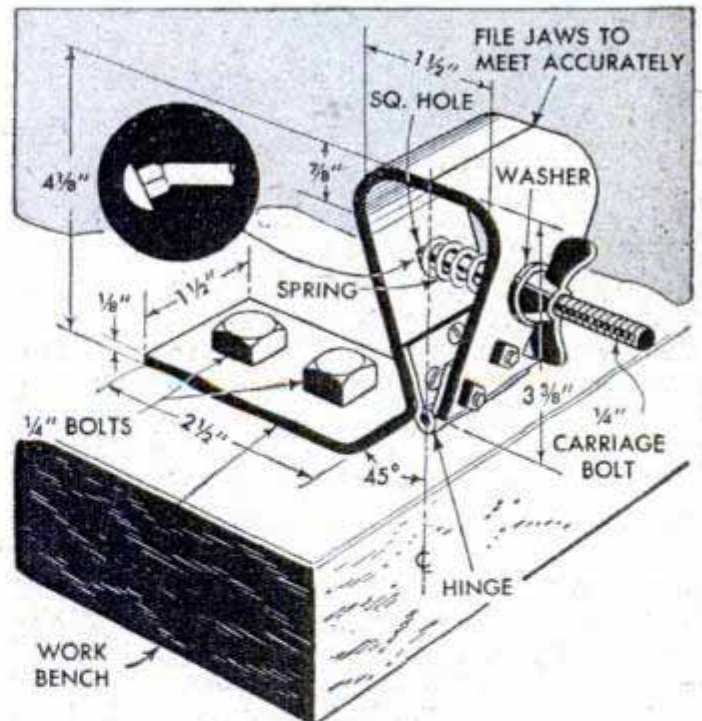


Some of it will be pressed into the holes you have punched and serve to anchor the putty better.

A. H. Waychoff, Phoenix, Ariz.

## Bench Vise for Modelmakers Holds Small Objects

Here's a lightweight vise that's ideal for modelmakers and others who work with small objects. The two jaws are made of flat iron, the rigid half being bent so that it can be bolted to the workbench. The halves



are joined with a butt hinge. A square hole is cut in the rigid piece and a round hole in the other for a carriage bolt that serves to open and close the jaws. Bend the head of the bolt so it will fit properly. Note that a compression spring is used to furnish tension on the jaws of the vise. A wing nut and washer are threaded on the bolt. After the unit is assembled, dress the jaws to fit.



# STAGE YOUR OWN SHOW

## PART III

By Kenneth Murray

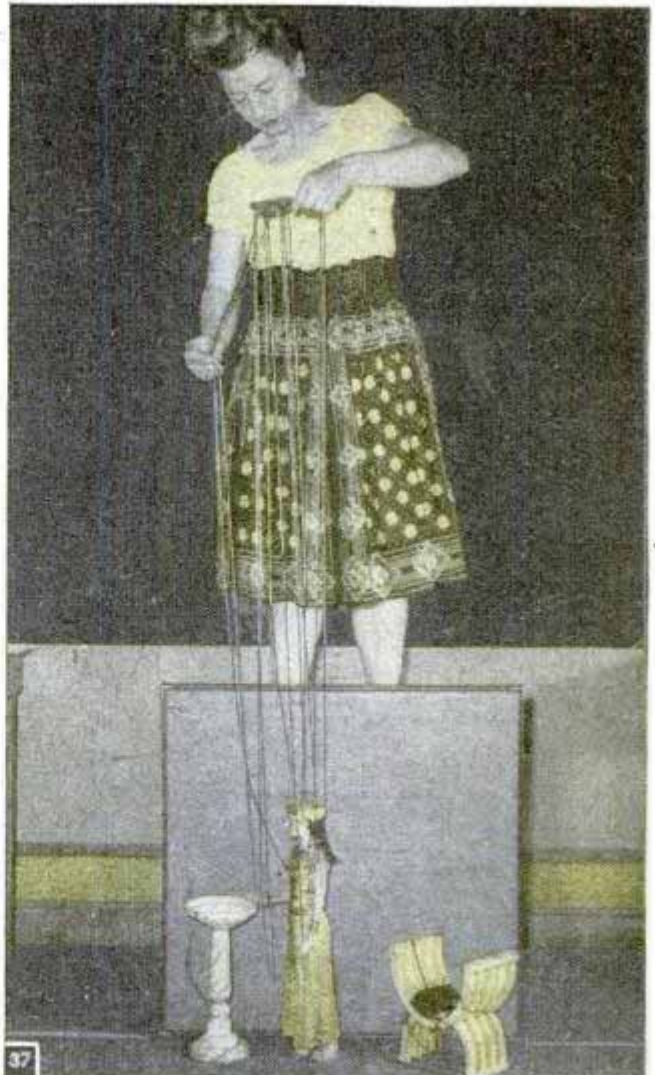
**M**OVEMENTS of marionettes on the stage are really projections of the actor-personality of the puppeteer—the fellow pulling the strings. Thinking that over, it won't take you long to conclude that marionettes will capture instantly the skills and emotions of the manipulator and convey these to the audience. The puppeteer then is the real actor, although of course the attention of the audience is always centered on the marionettes, for in a well-conducted marionette show the customers never are intentionally made aware of the puppeteer during the actual performance. All this means that one must practice until the controllers and strings perform as extensions of the muscles and nerves and impulses of the operator. Only in this way can the puppeteer acquire that smooth proficiency and sense of complete control which gives a marionette show its appealing reality.

At first you use a mirror as in Fig. 36 where the operator is demonstrating the correct position to take for early practice. The mirror should be as large, or larger, than the one shown and should be placed at the correct angle so that the manipulator can watch every movement of the puppet. The purpose of the mirror, of course, is to enable you to see the puppet just as the audience sees it. The figure must stand, walk and gesture with perfect naturalness. And right here is where you begin to think puppeteer-wise, keeping both your mind and your eyes on the doings of the miniature figure whose movements you are originating and directing. When it commits an error, an unnatural pose, gesture or method of walking, you can detect it instantly in the mirror. During the first few hours of practice, you should list all errors immediately they are made, writing these in detail on a sheet of paper for later reference. Then, during subsequent practice sessions, go through each bit of movement in which an error was committed time after time, on succeeding days, until you are sure that the corrected movements have become quite automatic to your fingers. Like the music student, you should allot yourself a regular daily practice period.

A practice stage is next set up as in Fig. 37, the purpose of this being to give one



Above, the operator is demonstrating a practice position before a mirror. Mirror enables you to see the puppet actor just as your audience will see it. Below, the operator is working a marionette on a practice stage





NORMAL STANDING POSITION—  
CONTROLLER NORMAL



SHOULDER STRING  
SUPPORTS FIGURE

HAND STRINGS TAUT  
KEEP HEAD ERECT

LEG STRINGS  
LOOSE

NORMAL AND  
WALKING POSITIONS

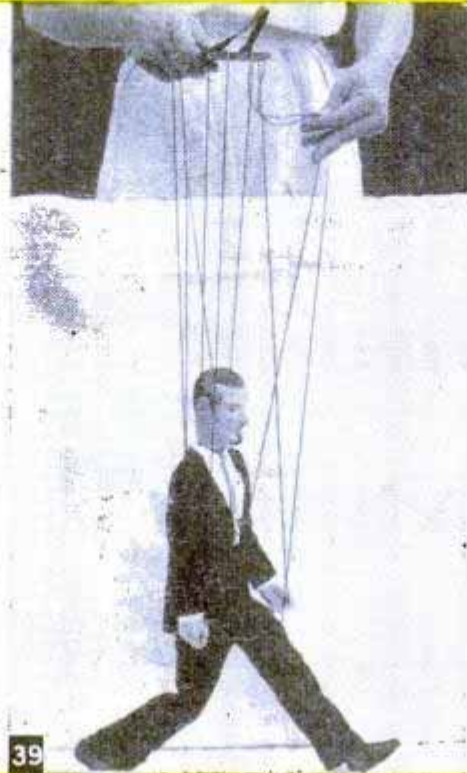
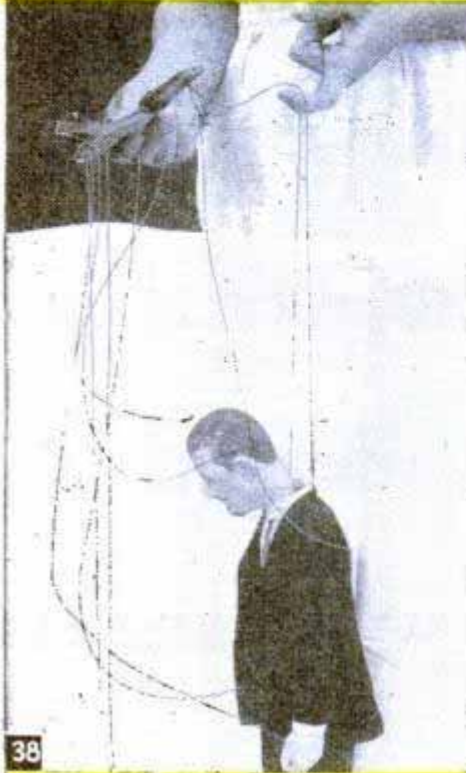


SHOULDER STRING  
REMAINS TAUT

WALKING POSITION—  
CONTROLLER HORIZONTAL

HEAD STRING

LEG STRINGS—  
GRASPED AT X  
TO CONTROL MOVEMENT OF FEET



GRASP ARM STRINGS  
AT X FOR HAND  
GESTURES

X

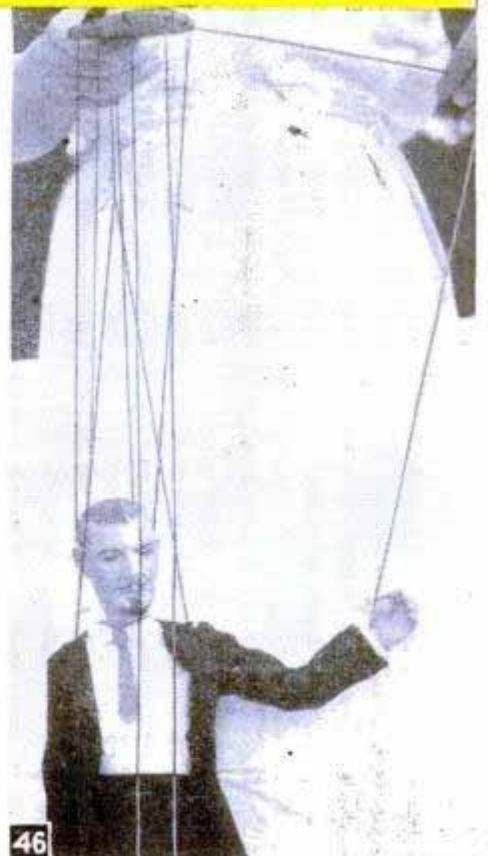
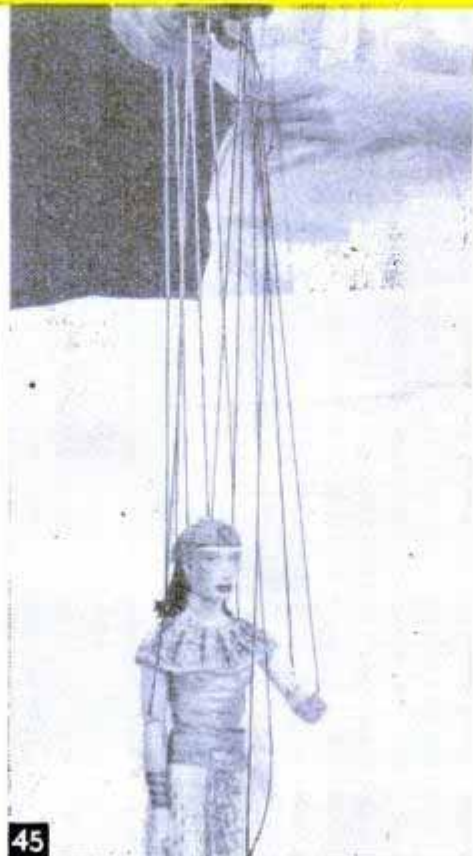
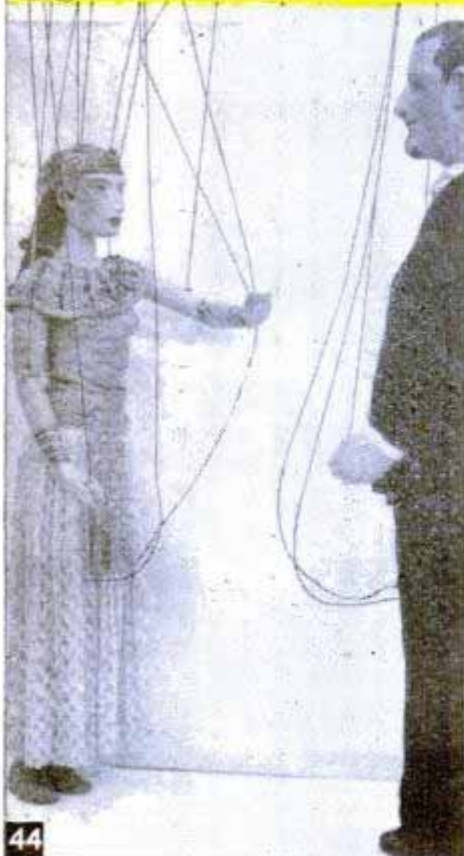
SHOULDER STRING  
REMAINS TAUT

GESTURES



GRASP BACK STRING AT X  
AND LOWER CONTROLLER

X





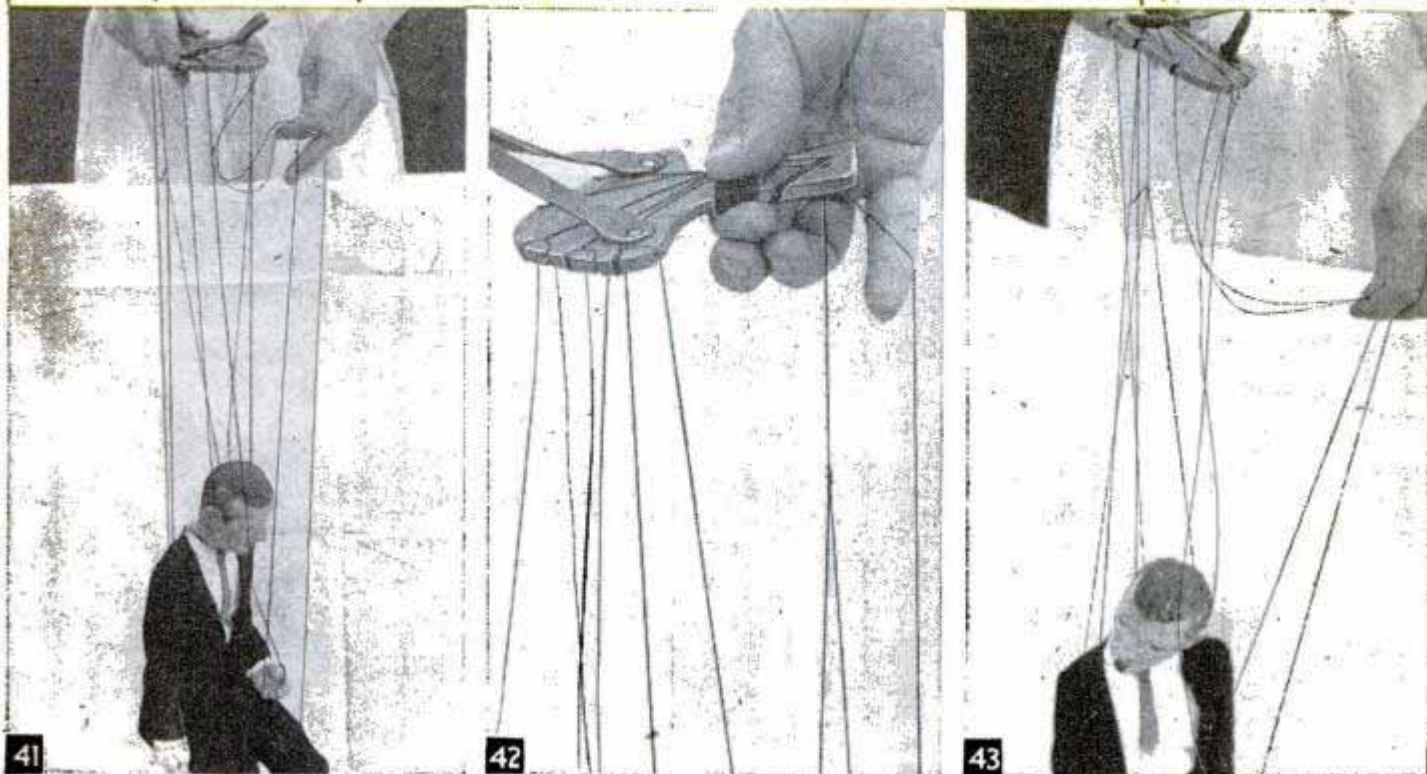
HEAD MOVEMENT

SHOULDER STRINGS  
REMAIN TAUT

FORWARD TILTING OF  
CONTROLLER LOOSENS  
HEAD STRINGS, AT LEFT,  
ALLOWING HEAD TO NOD  
FORWARD

CONTROLLER TILTED TO RIGHT  
CAUSES HEAD TO TURN LEFT  
CONTROLLER TILTED TO LEFT  
CAUSES HEAD TO TURN RIGHT

HEAD STRINGS



new at the trade the "feel" of the height and width of a marionette stage. Use a low bench on which to stand, and before it set an unopened card table on edge to serve as a background. If you wish you can still use the mirror in front of this informal setup. Mark off the stage dimensions on the floor with chalk or tape. Small wood or cardboard boxes can be substituted for props such as chairs or benches.

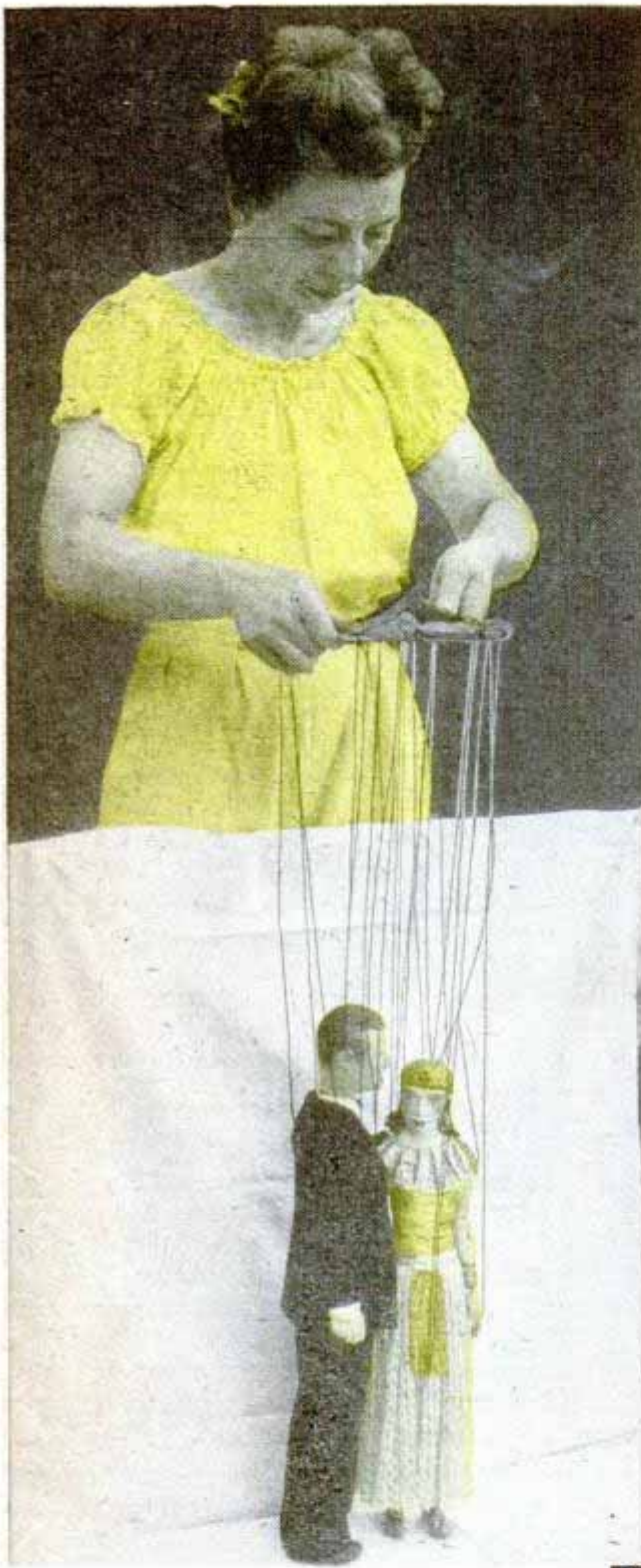
**With this advanced setup,** you work for the first time with full-length strings and enter puppets from the stage "wings," have them sit down, bow, gesture, talk and walk. From this you gain a feeling of proper distances, the stage size will become familiar and you'll get onto the trick of keeping the figures in a standing posture without sagging or "flying," a term puppeteer pros use to describe some of the grotesque positions the puppet may assume if you let things get out of hand.

**Voice of the puppet** is your voice, for you are the voice as well as the action of your marionette show. It is assumed that you will either use a professionally prepared script or write your own, which is preferable, as this makes the entire drama, comedy or other type of production entirely and originally yours. The script should feature the usual "sides," parts and cues, and particularly the different character-

izations. From this point on you become an actor or actress on your own, with your own script. It is not difficult to learn to change your voice to distinguish one character from another. Practice this with a friend acting as your audience and mentor. Yours is the inspiration but in the end the marionettes do your acting before the customers. Only consistent practice can perfect the illusion but once you've convinced your audience that you've mastered the art of puppetry, they'll forget all about you, and they'll enjoy your show.

**Now the mechanics of the thing:** To begin with, study the steps demonstrated in Figs. 38 to 53 inclusive. Notice Fig. 38 particularly, and the detail of the controller directly above it. Remember, of course, that the operator is only demonstrating the more common movements and, besides, is using shortened strings. Because of this the hand positions cannot be shown exactly as they would appear in normal manipulation from the puppeteer's bridge. Fig. 38 reveals the real inside trick in stage-managing a puppet actor. The string yoke, looped over the operator's left forefinger, is attached to the handle or "heel" of the controller by a single cord as you see in the detail. Thus, even though all the other strings go slack for any reason, the figure will remain upright so long as you hold the controller in





Puppeteers learn to be ambidextrous, that is, they become equally proficient with the right and left hand. Here the operator is working two puppet actors

a horizontal position. The important thing to learn is to keep the controller always a given height above the stage while your actor is going through his lines. These two simple rules take care of the fundamental mechanics of puppeteering. The rest is merely an elaboration of procedures. Figs. 39 and 40 are examples of this. In Fig. 39 the dapper puppet gentleman is being put through an undignified "bounce," as the puppeteers call it, which is an approved

method of practicing the walk. Here the "lift" of the normal walk is purposely exaggerated. The controller is lifted slightly while at the same time the controlling fingers are "teetered" or alternated in height, which causes the legs to reverse position, spreading on the downstroke of the controller and reversing on the upstroke. Lessen the exaggeration until the bounce of the torso is scarcely perceptible, then take the slack out of the strings and you have the gentleman strolling casually across the stage as in Fig. 40. That's all there is to it, in essential. The naturalness comes with prolonged practice. Always the figure should have the feet on the stage floor with just enough weight to give a slight drag to each foot. Actually the walk is little more than a shuffle. Puppeteers refer to the advanced leg as the "lead" leg, the other as the "lag" leg.

**When more puppets** than you can handle are on the stage at one time, those not performing are suspended by attaching the controllers to the puppeteer's bar. Hooks are provided for both sitting and standing distances and you have to determine the positions by trial after studying the set required by the script.

**Bowing is one** of the easiest practice movements and is accomplished by hooking your little finger underneath the string attached to the back of the actor as in Fig. 42. Support the figure with the shoulder string, as usual, while allowing it to take a bow. With each of these actions, practice until you can make the required movements with the fingers while keeping attention on the puppet.

**Actors are made** to kneel by grasping the leg strings with the fingers of one hand as in walking, advancing the lead leg and permitting the lag leg to bend by slightly lowering the controller heel. At the same time the controller is tilted forward as in Figs. 41 and 51. Fig. 41 is mentioned in this connection because of the head movement required in the kneeling procedure. Be careful not to allow the head to fall too far forward at the start of the maneuver. However, it should be inclined slightly as in Fig. 41. Complete the kneeling position by lowering the figure to the stage. These movements are indicated in Fig. 51. They are reversed to raise the figure to its feet.

**The head pivot** permits the head to swing in either direction while you are maintaining support of the body with the shoulder string. If you tilt the controller forward there will be sufficient slack in the head strings to permit the head to nod. Tilting the controller to either side will cause the head to turn in the opposite direction, Fig. 43. Practice until the movements are familiar, as they will be used frequently.





48



49



50



51



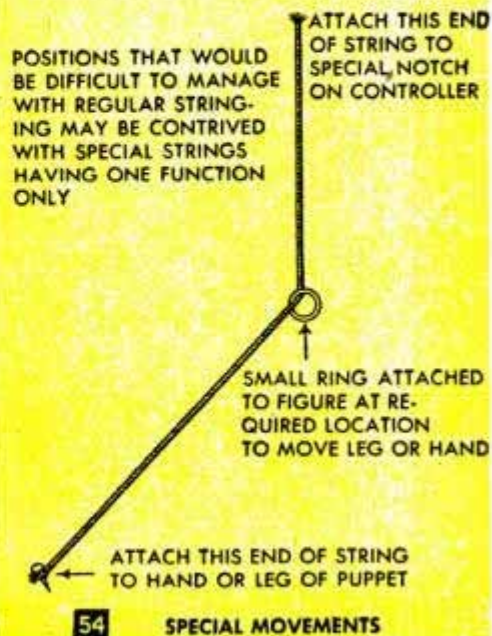
52



53

Gestures are used to indicate the speaker. A slight movement or gesture by a puppet indicates that it is speaking or as a sign to the audience that the speech is to be passed on to another actor. A natural, modified gesture, Fig. 45, is usually the practice. This consists of a gentle movement and is accomplished by lifting the string close to the controller. In general, you avoid a wide, sweeping gesture, Figs. 44 and 46, unless the figure is making a speech of such outstanding importance that it requires special oratorical or dramatic emphasis. Remember that only the puppet which is speaking should ordinarily show movement, as this bit of business focuses attention on the speaker and excites the imagination of an audience by its unexpected touch of realism.

**Puppeteers experienced in the trade** learn to be ambidextrous, which means that you must know how to handle actors with both hands, Fig. 47, even though simultaneous movement of more than one figure is rarely required. Learn to exchange controllers with an assistant so that an actor can move from one side of the stage to the other when the script calls for it. Usually it is considered bad stage practice to



54

SPECIAL MOVEMENTS





If marionettes are to make a well-groomed appearance on stage they must be stored between shows in cloth bags to protect costumes from grime and wrinkles

stand one actor in front of another and, unless required by the script, the performers never turn their backs to the audience.

**Allow your actors** to sit down occasionally during a show. People tire of watching a play in which the actors are always standing. Everybody relaxes when a player walks to a chair or bench and seats himself naturally without a flourish or fault. Figs. 48, 49 and 50 show the procedure. Of course, miniature chairs and benches, instead of practice props, are desirable for a public performance. After maneuvering your actor easily and naturally into position before a seat, tilt the controller sharply forward, holding leg strings slack so that the figure bends over. Then bend the knees by lifting on the leg strings as in Fig. 49. Lower the controller until the figure is almost level with the seat, then gently drop

him into it. If the performer is to remain seated for any length of time, fasten the controller on a hanger. A slight tug at one of the strings will effect any bit of movement that may be called for meantime.

**A lying-down procedure** is seldom resorted to unless essential to carry part of the story. Although marionettes are constructed with the balance required to simulate the movements of a human being, they lack muscles and it is difficult for them to lie flat on the stage floor, or to arise naturally from this position. Moreover, you always risk the clatter of a loosely-assembled mechanical device. The rule is, generally: Don't try it. However, in rare cases where it must be done, puppeteers use a compromise, providing a miniature couch or divan. Figs. 52 and 53 show the use of such a prop. Begin with the sitting posture and seat the actor at a slight angle. Then allow the figure to relax slowly backward by lowering the controller until the strings are slack. As you see in Fig. 53, the gentleman is in position to arise when you reverse these movements and the action will seem perfectly natural. Sometimes the script will call for movements of the puppet-actor's legs or arms that are difficult to manage with the regular stringing. Fig. 54 shows how this usually is handled by means of a special extra string. Extra stringing, however, should always be kept to the minimum. More than two extras are difficult to handle at best and you should practice handling even one until you feel complete confidence.

**Marionettes must have good care** between performances if they are to make a fresh, crisply pressed appearance on the stage. Experienced puppeteers store them in heavy cloth bags fitted with drawstrings like that in Fig. 55. After the marionette is gently dropped into the bag and the drawstring pulled, excess string is wrapped around the handle of the controller so that it will not become tangled. Both the controller and bag are marked with the name of the performer. Bags should be sufficiently large to avoid cramping and possible loosening of joints. They can be stored in a trunk or hung on wall hooks.

THE END

## Trick Matches That "Burn" Twice Will Amuse Company

The next time you have guests at your home, you can amuse them with matches that apparently burn twice. Pick up from an ash tray several matches that appear to have been burned. These are the wooden, strike-anywhere type that are commonly used around the house. After asking the guests whether they have ever seen such a match burn twice, and receiving negative

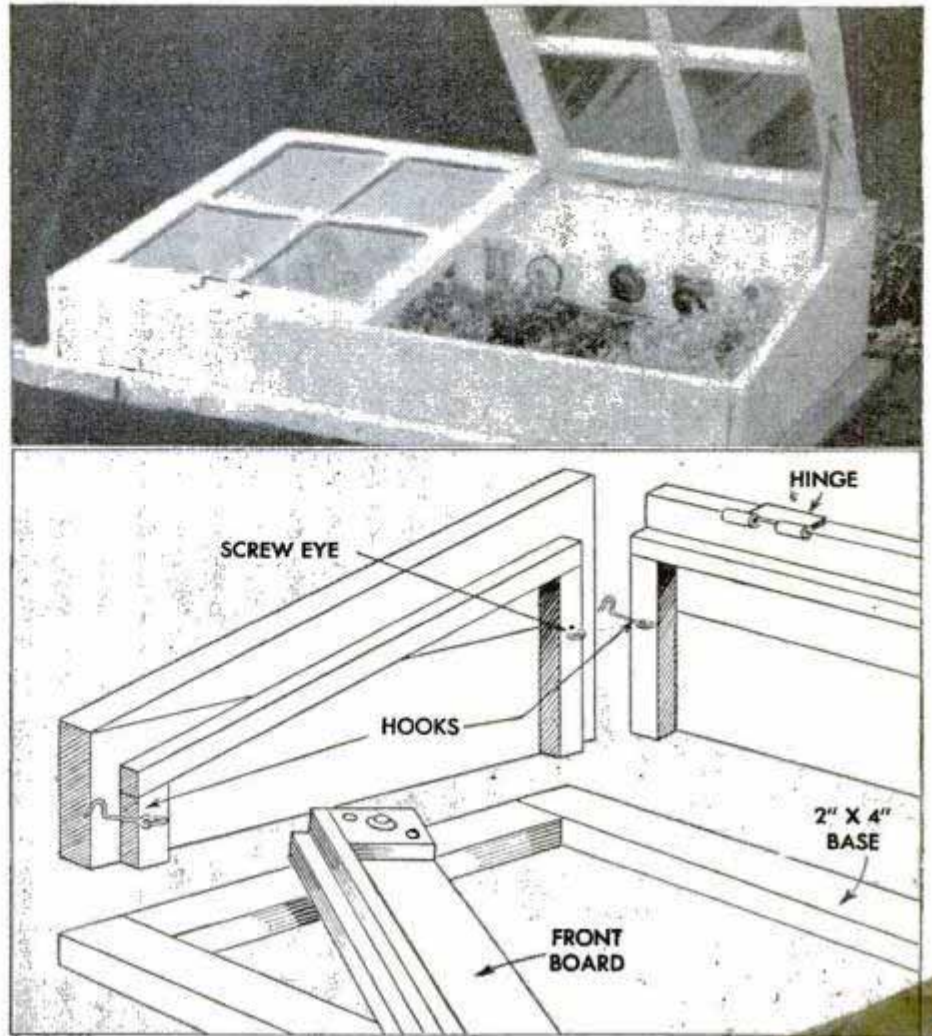
replies, strike the match on a rough surface and it will burst into flame. The secret, of course, lies in the fact that the match had been prepared beforehand. The heads of unburned matches were dipped in black ink and allowed to dry thoroughly before placing them in the ash tray. Be careful not to stain the stick.

Waldemar J. Gydesen, Milwaukee, Wis.



# Collapsible Cold Frame Stored When Not Used

After they have served their purpose in the spring, most cold frames become filled with weeds and detract from the well-ordered appearance of the garden. Here's a frame that is quickly disassembled after it has served its purpose, and can be stored out of the way until needed again. The lower detail shows the method of assembly and construction. The exact size of the frame will be governed by the size of the sash that is used. In this case, it is two four-light barn sash with 10 by 12-in. glass panes. The four sides are held together with a hook and screw eye at each corner. Loose-pin hinges are used to fasten the sash to the frame as this permits easy removal. Either 2 by 4-in. lumber or bricks can be used as a base.—Harold Jackson, Kankakee, Ill.

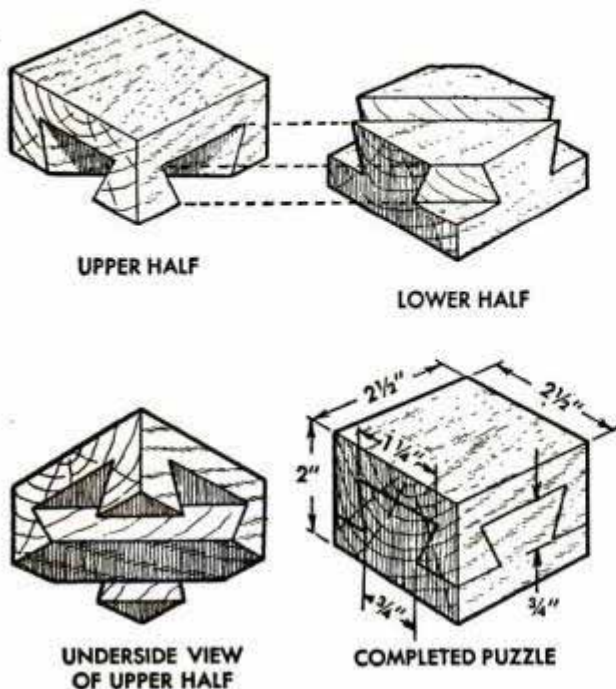


# Sliding Dovetail Joints Are Secret of Wood-Block Puzzle

If the cuts are made as pictured, these two blocks slide together smoothly and seemingly make a single block that cannot be separated. The secret is the sliding dovetails and, as you can see, they separate by

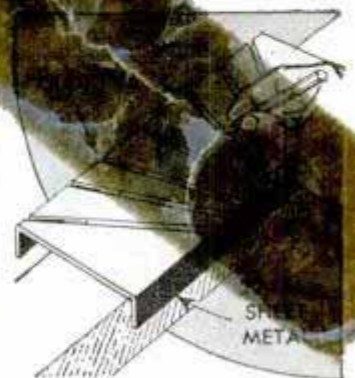
sliding along the diagonal. Maple is a good wood from which to make the puzzle and care should be taken that the grain matches in both pieces. The inside surfaces should be waxed so they will slip together easily. The outside is finished with a clear lacquer that will not mar the natural beauty of the grain.

Sgt. Emil Gaynor, San Francisco, Calif.



# Marking Jig Slips Over Work

Formed from 22-ga. sheet metal, this marking gauge will aid in scoring mortises quickly on flat-surface work. The two sides are bent to fit over the work and the top must be wide enough to accommodate work of standard dimensions. The unit can be slotted at the angles that are most common to the user's needs.



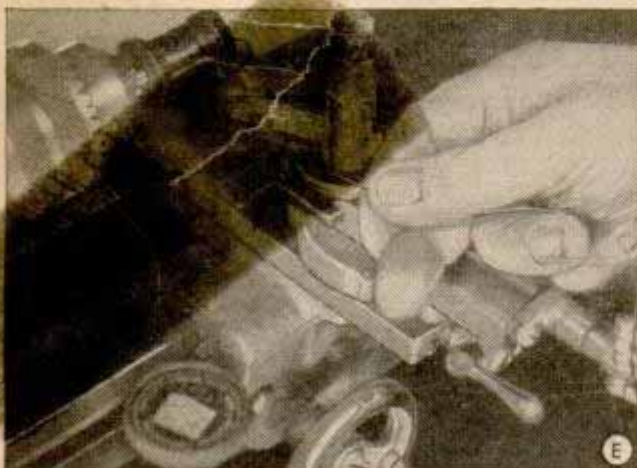
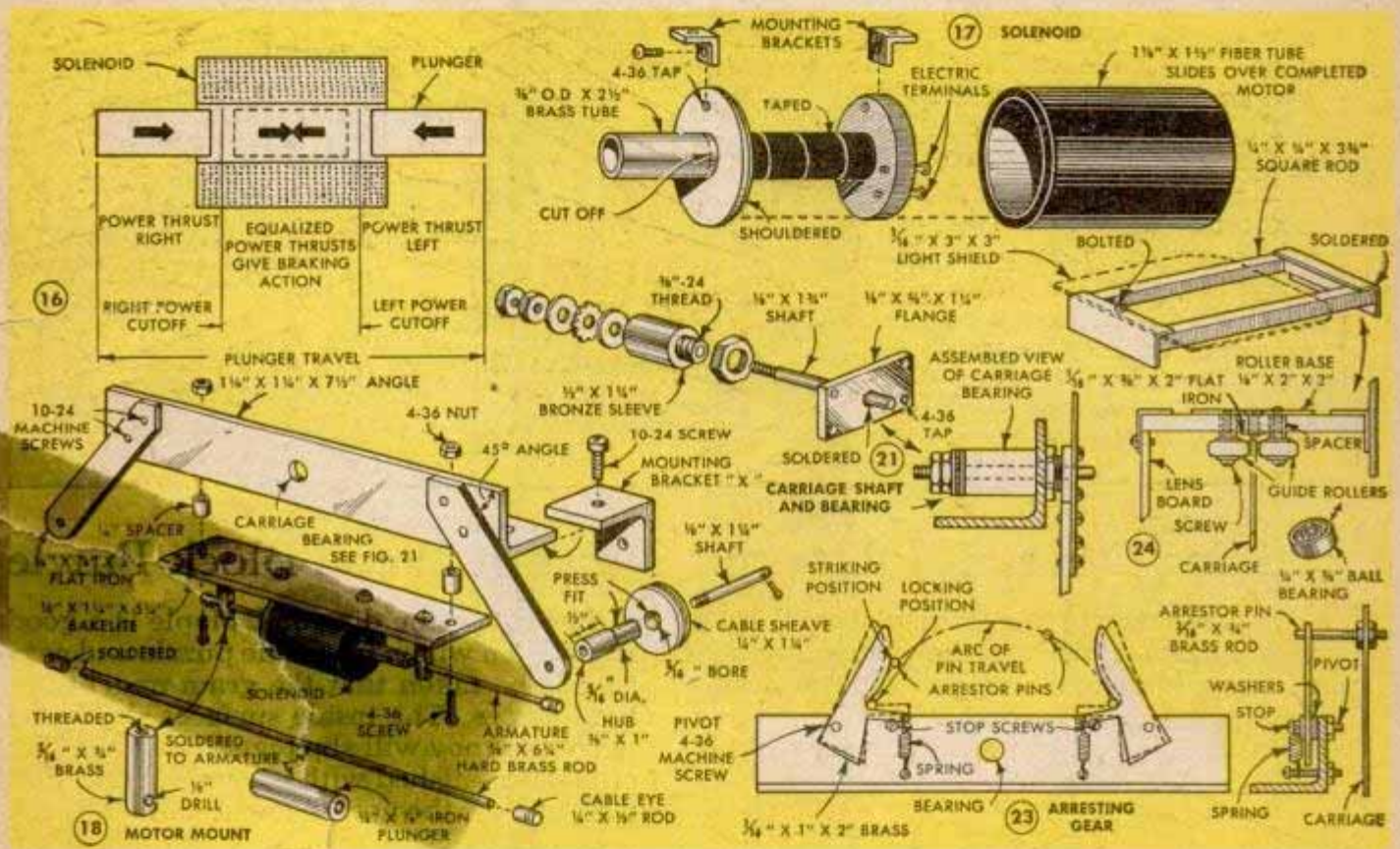


# Transparency Projector

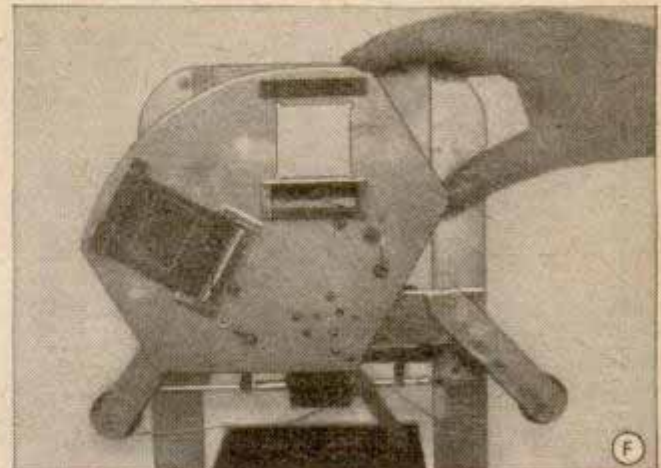
NOW that you have the frame, blower and synchronized shutter details worked out as in Part I, you're ready for the controlling mechanism and other items. A solenoid—called a solenoid motor here because of its application—is quite powerful, and with it a comparatively heavy body can be moved a short distance quickly. When the power thrust against the plunger is equalized, there is a braking action, Fig. 16, at which time power should be cut off. This occurs when the plunger reaches the center of its travel. By removing power from the carriage motor, the carriage, Fig.

19 and Photo F, is carried clear across on momentum, but by holding power on the shutter motor, the shutter is held in front of the lens until the carriage has moved over. A push-button switch on the control panel, Fig. 26, permits both of these operations to be done simultaneously with a single button.

Winding of the solenoids, detailed in Fig. 17, is done on a lathe. Set the lathe for 72 threads per inch. A wire leader or guide is made by drilling a  $\frac{1}{16}$ -in. hole lengthwise through a short length of metal rod. This is clamped in an offset tool holder, Photo E. The wire is fed through the guide and sol-



In winding solenoid coils wire is passed through a hollow guide held in an offset tool holder. Use back gears and set the lathe for 72 threads to the inch



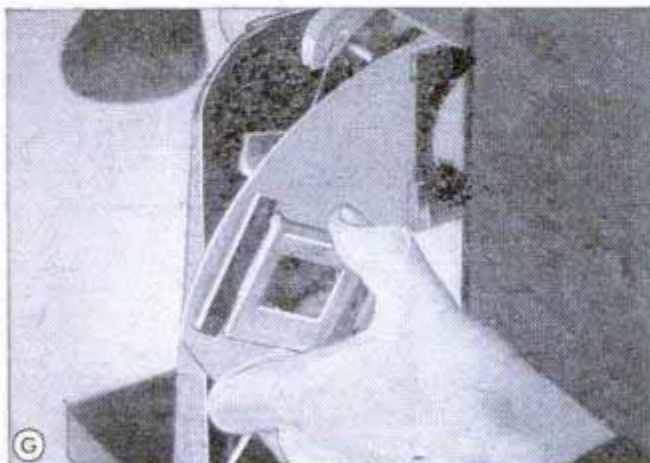
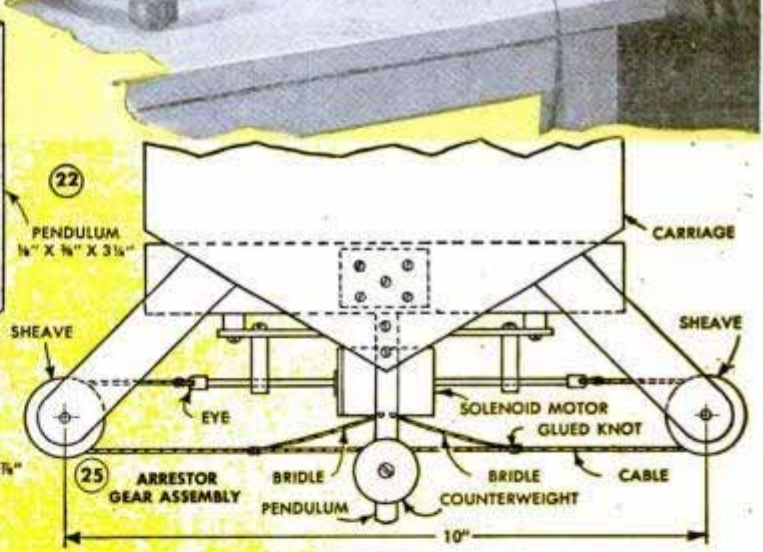
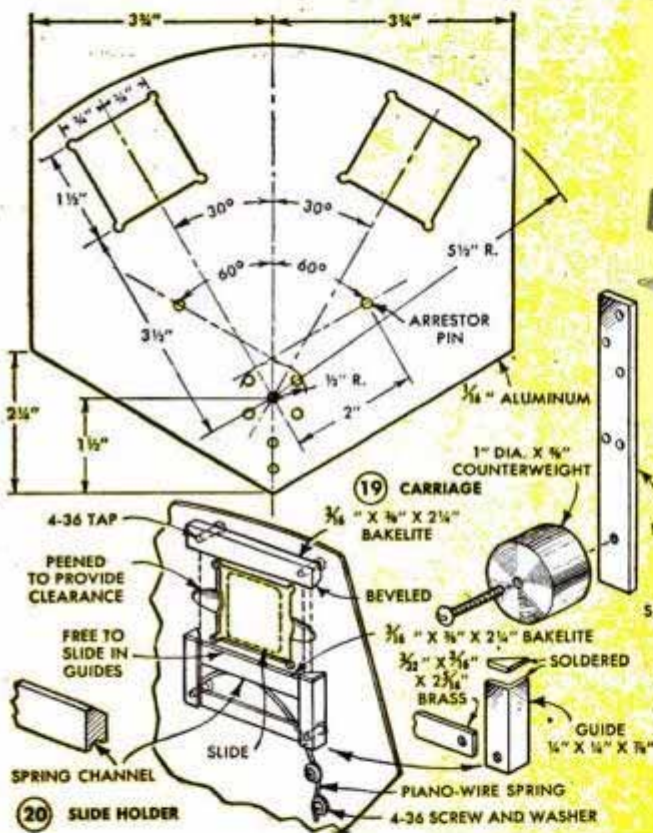
Slide holder is driven by solenoid motor controlled by a rheostat switch. Although the slide runs free, movement is snubbed at limits of travel by an arrester



## PART II

By Alexander Maxwell

dered to the inner terminal of the solenoid drum. Then, with the lathe set at lowest back-gear speed, you're ready for winding. By changing the feed from right to left, the entire coil can be wound without stopping. Each coil requires 800 turns of No. 28 enameled wire. When testing the coils, do not apply 110 volts directly, but use a resistance unit in the test circuit, Fig. 28. The solenoid motor which actuates the carriage is mounted in the subassembly shown in Fig. 18. The carriage shown in Photo F and detailed in Fig. 19 is made from sheet aluminum. The slide holder

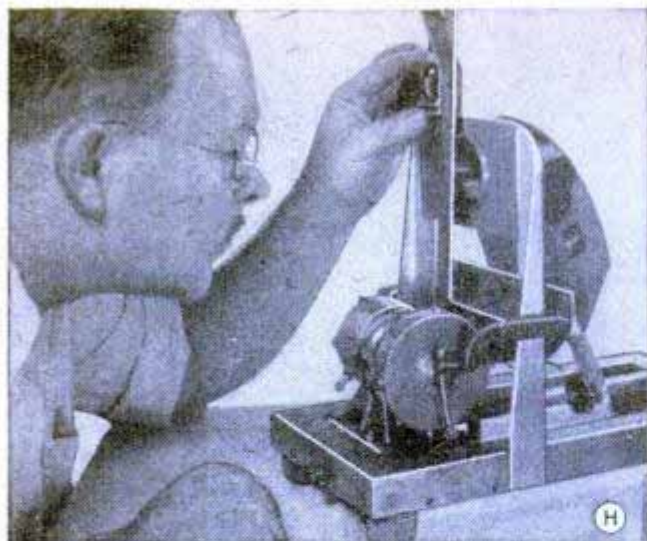


Holder is made so that slides can be held between the thumb and first finger and snapped in place. Both holders are brightly illuminated from the condenser

detailed in Fig. 20 is made so that the slide can be held between thumb and first finger and snapped in place, Photo G. Slides can be inserted and removed rapidly because the holder is brightly illuminated by light from the condenser.

Linen fishline is best for the slide-holder drive cable, Fig. 25, as this cord does not stretch. The carriage shaft and bearing are shown in Fig. 21. A pendulum and counterweight, Fig. 22, and an arresting gear, Fig. 23, bring the carriage to an easy stop at the limits of travel. The rheostat is adjusted so just enough power is applied to pull the carriage past dead center. The carriage is guided by two rollers, Fig. 24. When the carriage and motor assembly has been completed, as in Fig. 25, it is

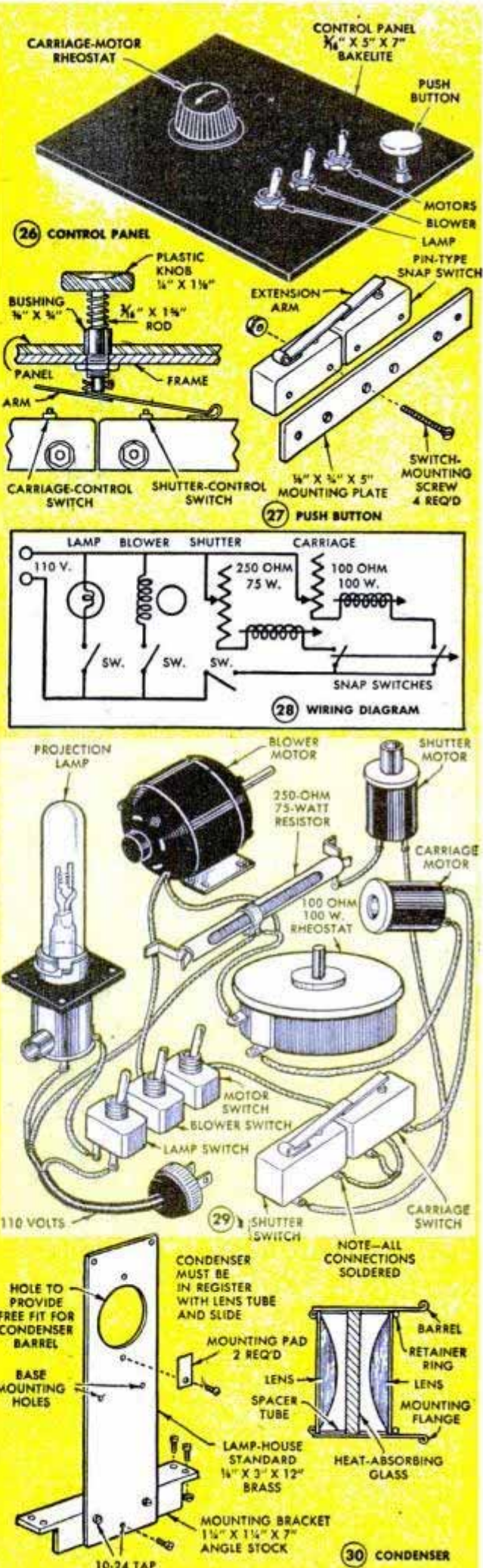




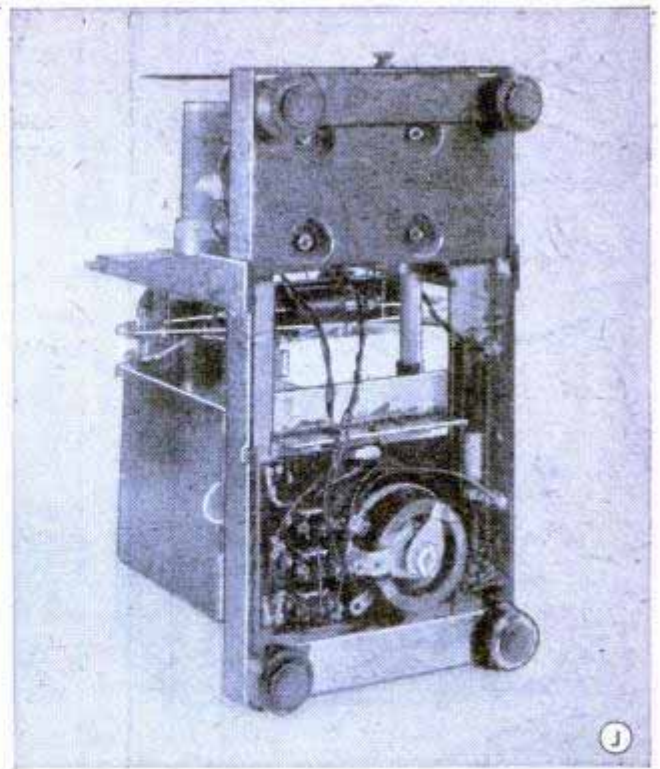
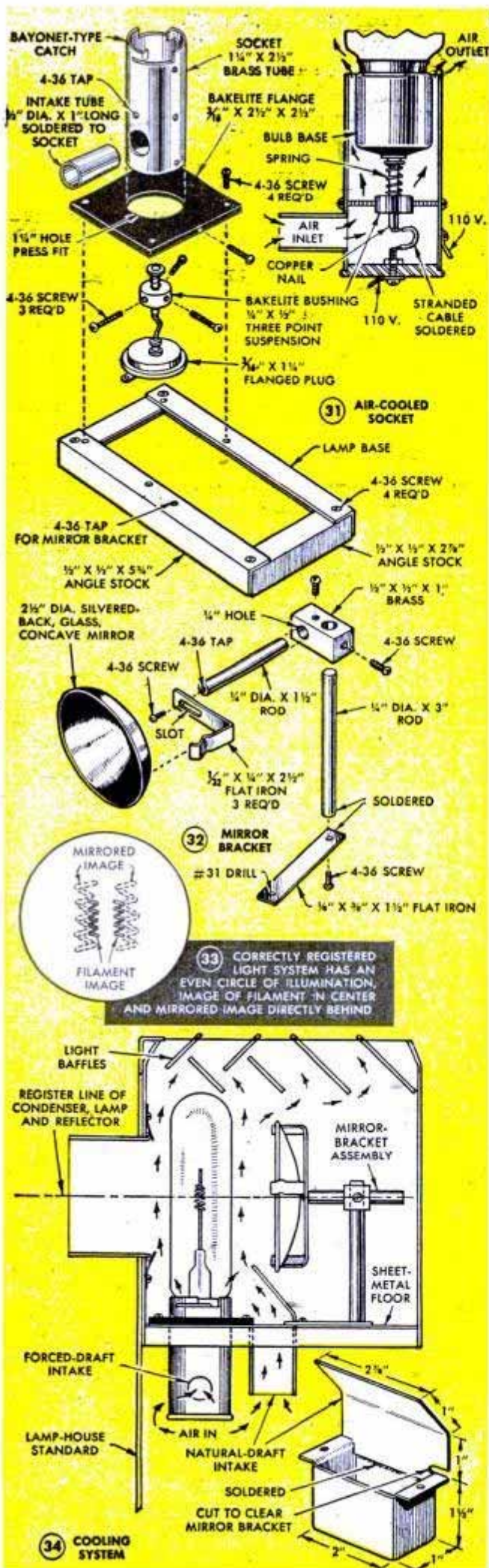
lined up with the lens tube. The assembly is clamped in place while testing as shown in Photo H. Do not drill holes in frame uprights for mounting bracket "X," Fig. 18, until you are sure the unit is in proper position. Fig. 28 gives the wiring diagram for the push-button control and Fig. 29 shows the parts in perspective. Also, you see the same thing in Photo J. The snap switches and 250-ohm resistor are mounted under the frame while the rest is located on the control panel, Fig. 26. Note carefully how the push button, Fig. 27, actuates the two snap switches. As it is pressed, the shutter switch closes first and the shutter covers the lens. There it remains until the button is pressed all the way down. The shutter does not drop until the button is released. As the shutter cuts off the light the audience doesn't see the slide change.

Switches on the control panel also turn on the blower motor and projection lamp, Fig. 29. Ordinarily the solenoid motors are turned on first and regulated. The shutter rarely needs adjustment but, when it does, the resistor slide, Fig. 29, is relocated. The carriage adjustment is somewhat more critical but usually is necessary only when the voltage supply varies. The rheostat knob provides for this adjustment which may have to be made whenever you plug into a new current supply. Turn on the blower before you switch on the lamp and when you have finished a run of slides, turn off the lamp first.

The condenser, Fig. 30, should be the 35-mm. enlarger type in a barrel mounting. However, the lower efficiency of the two-element condenser is largely offset by the fact that it is self-contained. Heat-absorbing glass is essential and must be placed inside the barrel between the two lenses. The condenser unit must be a definite distance from the slide. This is determined by experiment so don't bolt down the lamp-house standard, Fig. 30, until lamp, reflector and condenser are all lined up.





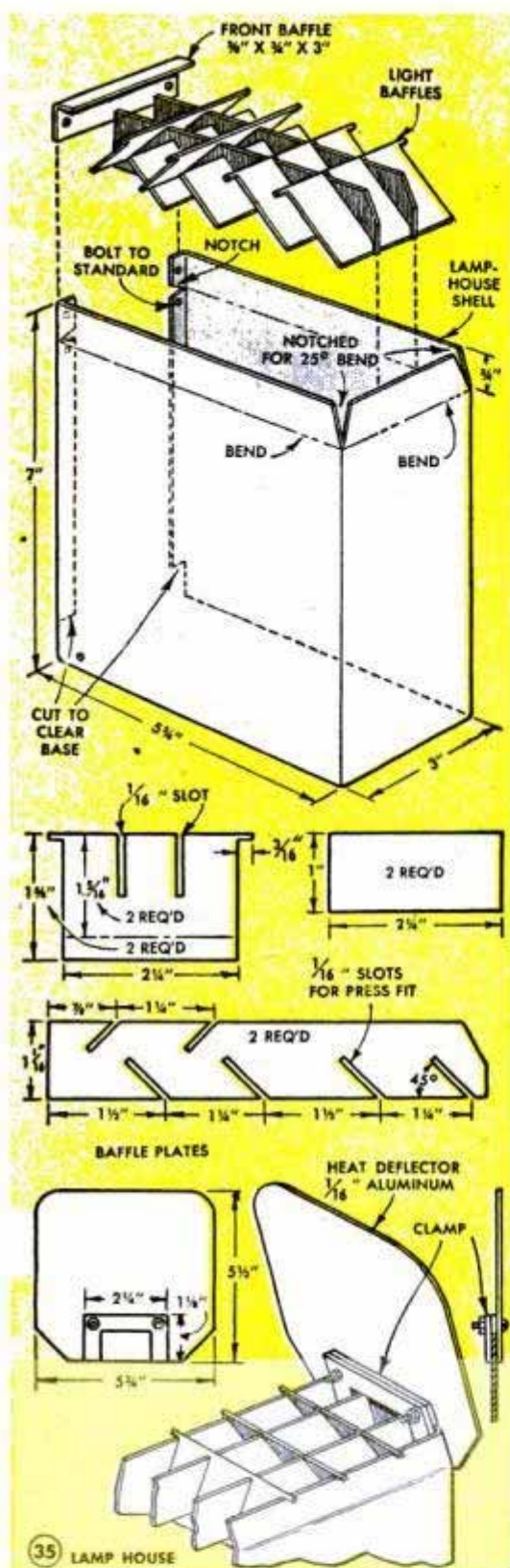


An air-cooled socket, Fig. 31, directs the blast of injected air directly against the tube itself. The lamp filament must be on a plane with the slide, and the base is so designed that the tube will fit in the socket in only one way. Although this is known as a prefocused bulb, you will have to do your own prefocusing in this case. The socket is designed so that it can be elevated, rotated or moved back and forth as well as sideways, until the filament is exactly in line. A good mirror is important, for it collects a large percentage of lost light and directs it into the condenser. The best are of optically ground glass flashed with vaporized aluminum. The mirror is mounted on a bracket as in Fig. 32.

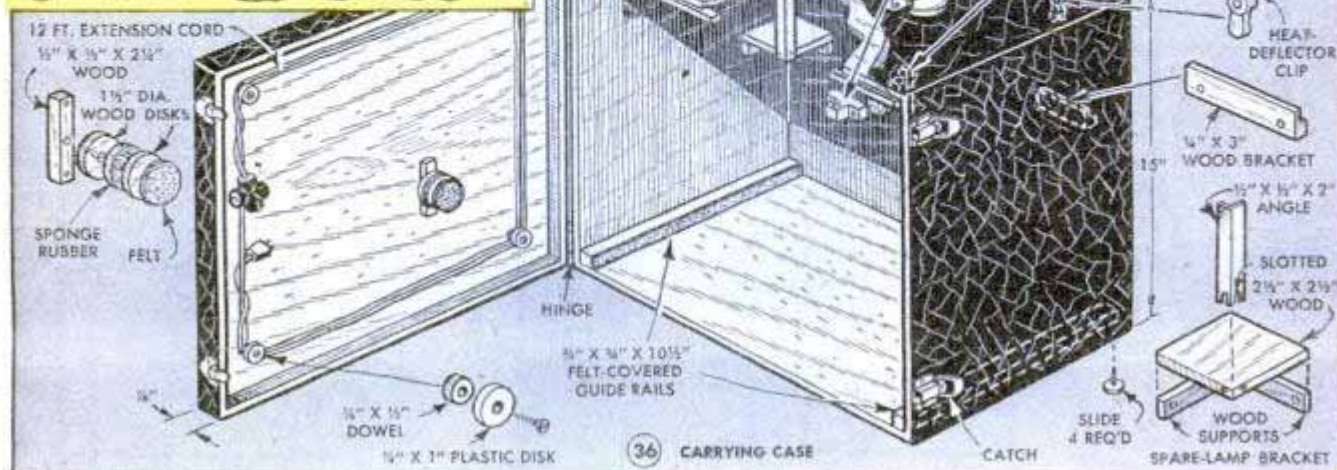
When focusing the optical system, use an electric heater or toaster in series with the lamp as a resistor. Adjust the lamp until it appears correctly centered, remove the mirror, then move the standard back and forth until the light on the screen shows uniform coverage. Unscrew the focusing lens and you'll see that the condenser throws a magnified image of the lamp filament on the screen. Center the filament image. Replace the mirror and adjust until a reflected image looms directly behind the filament, Fig. 33. This simple procedure will line up the units. Replace the lens and move the mirror backward and forward and watch for dark or bright spots. There will be one critical point where the entire screen is lighted with a uniform brilliance.

The filament of a projection bulb is heated to a temperature of about 6000 deg. F. and getting rid of this heat requires a specially designed lamp house with a system of baffles and light traps. As you can't rely





35 LAMP HOUSE



on natural draft for proper cooling, the pressure air line, Fig. 34, is coupled to the socket with a rubber hose. The lamp house itself is made of copper or aluminum as either of these metals dissipates heat more efficiently than steel. A deflector directs the heated air away from the operator. The shell, or housing, Fig. 35, is made in one piece with the front edges crimped so it can be bolted to the standard without light spill. As the housing must be removed to reach the condenser and mirror, which should be wiped periodically, the screws are located so they are easily accessible. The light baffle, Fig. 35, rests on lugs and is retained by the front baffle which bolts to the housing. Paint the inside of shell and baffle a flat black. The entire projector is given a coat of black crystal lacquer which air-dries with a crystal-figured surface. This projector is worth the little extra trouble it takes to get a real professional finish. The best way to do this is to lacquer each piece separately before assembling. In order to get a good lacquer job all surfaces must be clean, and there must be no dust about to get onto the brush or be raised by the air blast from the spray gun. Spraying lacquer is heavy-bodied and sets so quickly that it cannot be satisfactorily applied with a bristle brush, but the so-called "brush" lacquers work very well. When you use the type which dries with a crystal surface the brush marks do not show. However, once you have applied this material don't brush back over it as this will destroy the crystals which form quickly after application. Use a brush with fine bristles to get a uniform application.

The carrying case, Fig. 36, serves a dual purpose. It houses the projector and acts as a pedestal to raise it to operating position. Made of 1/4-in. plywood, it is covered with sample-case leatherette using sodium silicate, or water glass, as an adhesive. To make the unit self-contained, provide facilities for carrying an extension cord, spare lamp and screwdriver. The heat deflector must be demounted when the projector is placed in the case.

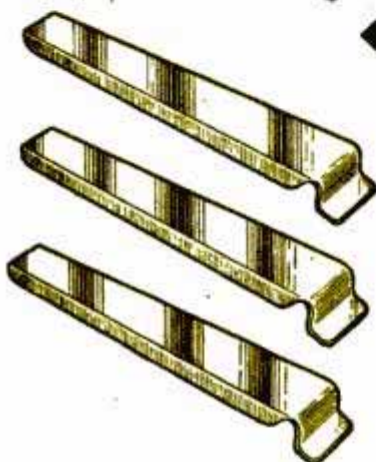
THE END



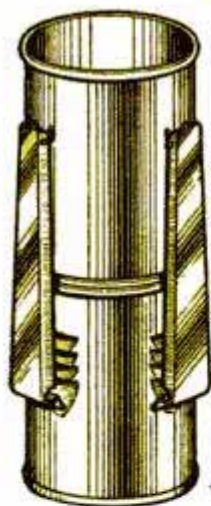
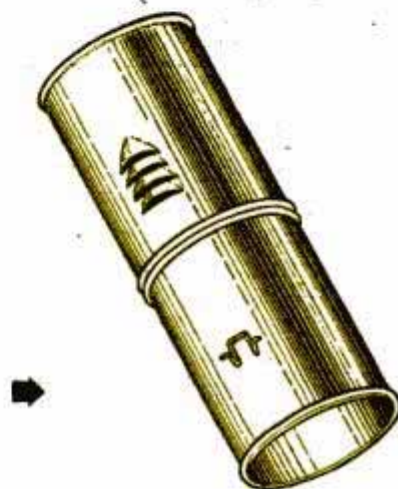


## FLOODLAMP PLUS TIN CANS EQUALS SPOTLIGHT

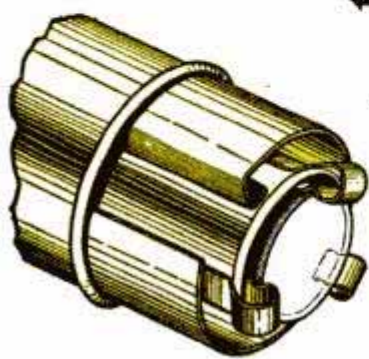
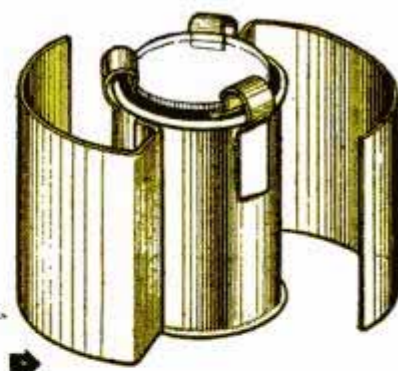
Often a spotlight is used to increase the snap and brilliance of portraits, provide back lighting, illuminate table-top scenes and serve a variety of other purposes. Here's one way to convert a floodlamp and reflector so it can be used as a focusing spotlight without marring it for its regular uses. Only a few simple materials are needed: three tin cans, some paper clips and a positive lens. As for the tools required, a pair of tin snips and a soldering iron are about all that you will need to complete the job.



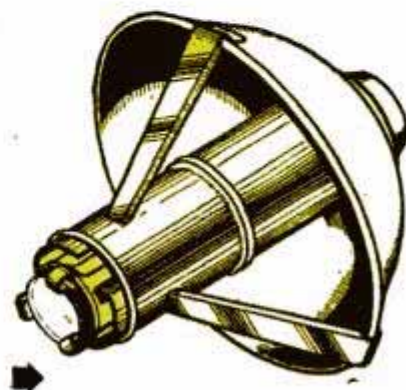
Three tin arms are required to fasten the central tube to the reflector. The arms are tapered and the edges are bent to form a channel. A clip is formed at one end to slip over the reflector and holes for hinge pins are punched in the other. The tube consists of two tin cans with the ends removed. They are soldered together and ventilating louvers are cut where the tube fits over the lamp. Hinge pins on which the arms pivot are made by bending wire paper clips as indicated and then soldering them on the can



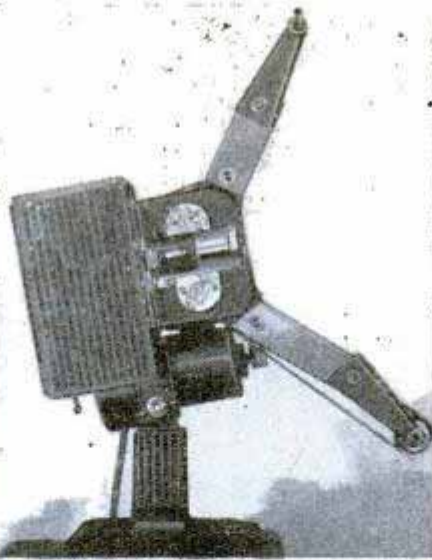
Here is the assembled tube ready to slip over the lamp and clip onto the reflector. When in place, the arms should extend at about a 45-degree angle. The lens mount at the right is a smaller tin can having a diameter somewhat larger than that of the lens used. Three metal strips are bent to form lens-holding clips and are soldered to the sides of the can. Two wings are fastened to the sides of the mount and serve to hold it in place in the central tube. The mount slides back and forth so the light can be focused



Here the manner in which the mount fits into the tube is illustrated. Right: the completed spotlight clamped to a floodlamp reflector is ready for use. Although a spotlight effect is obtained with the use of the tube alone, the intensity of the light is greatly increased by a positive lens. If you have several lenses, it might be well to try them all to determine which one gives the best results. The insides of the mount and tube are finished with aluminum paint and the outsides have a dull finish to minimize light reflections

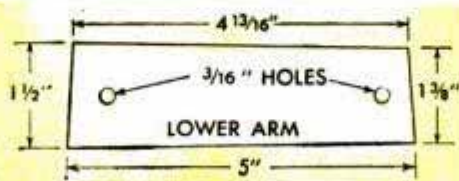
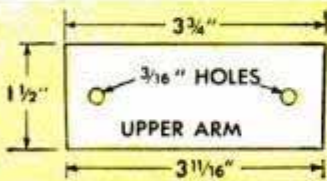






## Extension Arms For Projector

At a moderate cost you can bring your projector up to date by fitting it with extension arms that take larger size reels. Dimensions shown in the lower detail will not apply to all projectors and it may be necessary to alter them. Locate the extension pieces so the film will be in alignment. It will be necessary to install new spring winding belts and these should be checked carefully for tension.—Robert E. Merriman, Battle Creek, Mich.



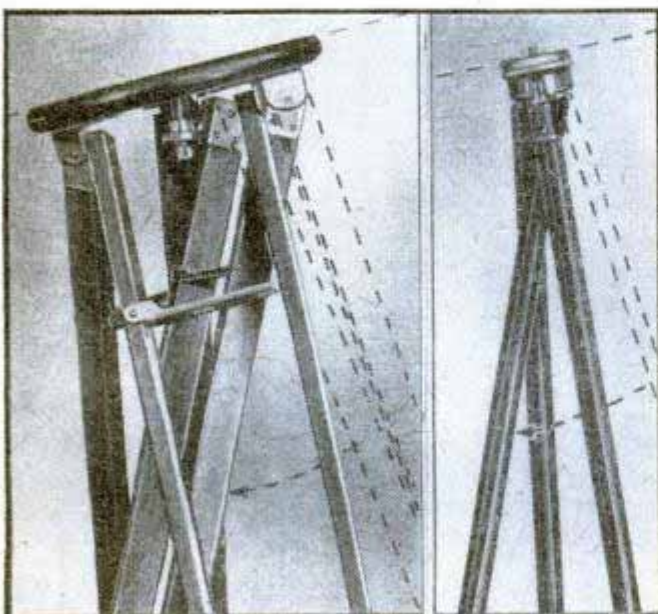
## Frayed Slide Mounts Repaired

Cardboard mountings used for 35-mm. and 2 by 2-in. color transparencies often become frayed after being used in a projector or viewer. This trouble may be prevented if the edges are coated with colorless fingernail polish before the slide is used. Another way to protect the edges is to cover them with cellulose tape.

## Tilting Head on Camera Tripod

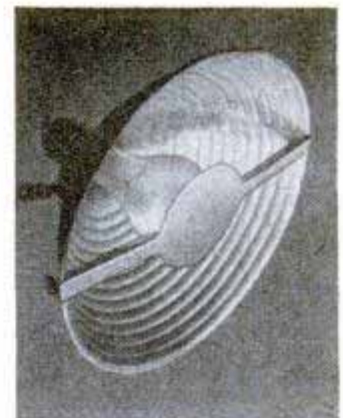
In order to point a camera up or down when you have no tilting head, it is necessary only to swing one leg of the tripod inward between the other two. This results in a support about as stable as that when the tripod is in the normal position. Don't shorten a leg as this will cause unbalance.

Fred G. Korth, Chicago.



## Easily Made Floodlight Deflector Provides Better Diffusion

With this deflector you will obtain better diffusion when using floodlights. It is a disk of light metal, approximately 3 1/2 in. in diameter, with two arms that extend out and clip over the rim of the reflector. The arms are channel shaped



and the ends are rounded. Use an exposure meter to check the over-all diffusion. It may be necessary to alter the size of the disk.

Robert Scott, Saltsburg, Pa.

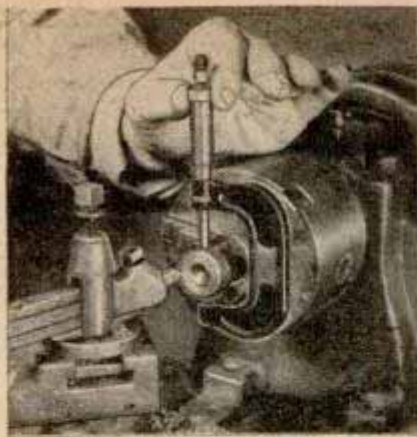
## Focusing Aid When Enlarging

To save the time required to slip a special negative into the enlarger every time it is necessary to refocus, use this aid. Make a cardboard mount to slip over the lens and paste another strip of cardboard about 1/2 in. wide across the center of the mount. When the outline of the strip is projected sharply on the easel, the negative will be in focus.



H. Klein, Pittsburgh, Pa.

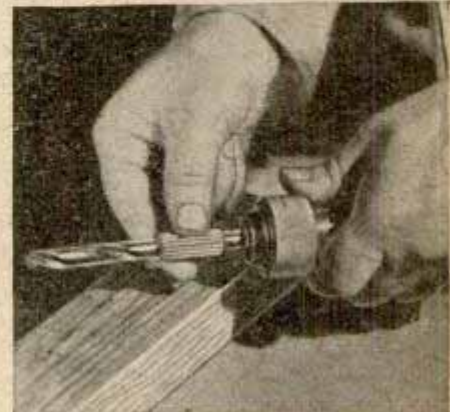




# Craft QUIZ

1. This instrument is a—  
 (A) Ring gauge (C) Micrometer  
 (B) C-clamp (D) Vernier caliper

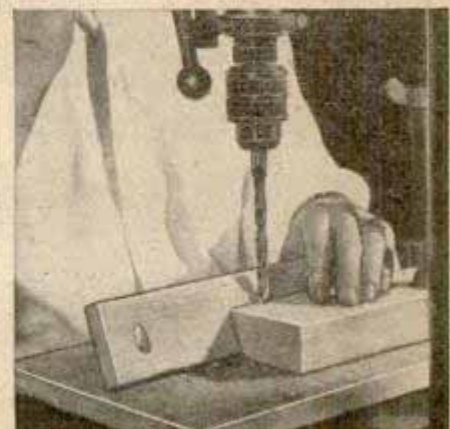
2. Scoring represents—  
 (A) Furring (C) Planking  
 (B) Battens (D) Breaching



3. Rubber tubing serves as—  
 (A) Chip remover (C) Shock absorber  
 (B) Depth Stop (D) Finger grip



4. Woodworkers call this a—  
 (A) Trimming board (C) Shoulder stop  
 (B) Hold down (D) Bench hook

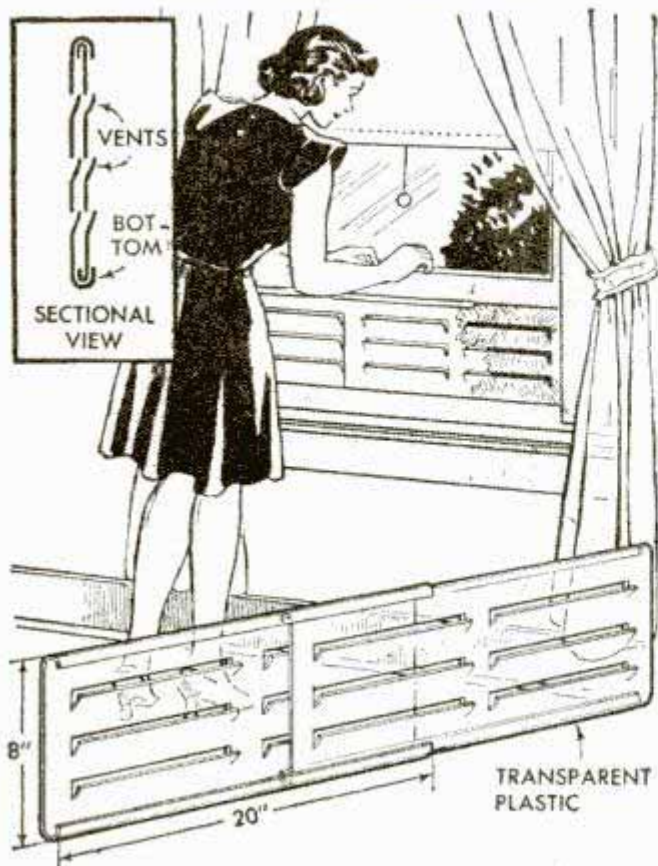


5. With this setup you can cut—  
 (A) Screw pockets (C) Fillets  
 (B) Rosettes (D) Gains

ANSWERS: 1—C; 2—C; 3—B; 4—D; 5—A  
 WHAT'S WRONG: 1—Saw blade is too high (should just clear thickness of work); 2—Stop rod is in line of cut; 3—Table insert is missing; 4—Blade is mounted backwards; 5—Dangling necktie (dangerous practice); 6—Guard is not in place on revolving jointer head; 7—Hands holding work in wrong position; 8—Wrench on saw table; 9—Rear hold-down not clamping work



## Ventilator Formed From Plastic Admits Light and Air

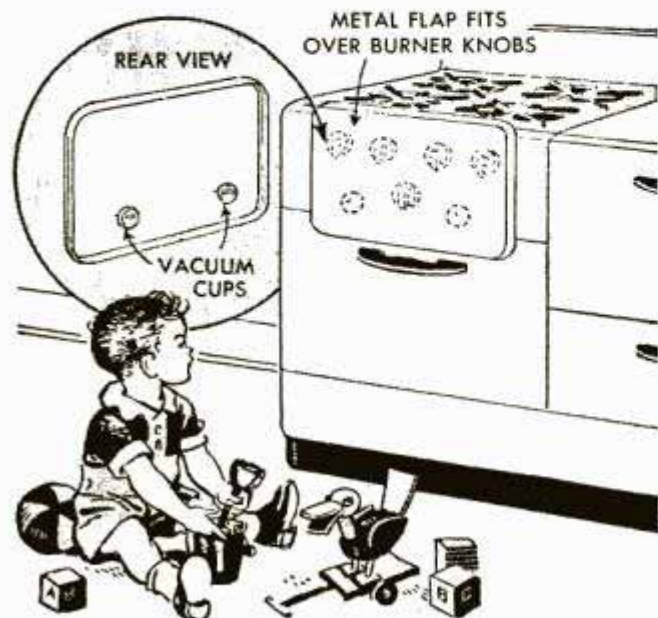


Novel because it is made of transparent plastic that will admit light, this ventilator can be made to fit almost any window. One half is formed to slide inside the other with the tops and bottoms curved as shown in the detail. The louvers are bent in to provide protection from rain and snow, and this also serves to direct drafts upward.

E. B. Wiggins, Tampa, Fla.

## Metal Guard for Burner Handles

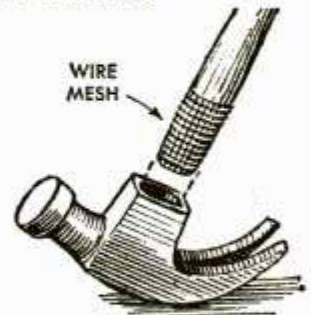
Since children have a curiosity that may get them into trouble, a metal guard over the burner handles of a gas stove will elim-



inate the possibility of an accident. This is merely a piece of sheet metal to which two vacuum cups are attached near the bottom edge. The shield is held in place by pressing the cups against the smooth surface of the stove. When the stove is to be used, it's an easy matter to remove the shields.

## Tool Head Is Secured to Handle With Wire Mesh

The head on a hammer or other tool may be fastened securely if the end of the handle that fits into the head is wrapped with wire mesh. Ordinary fly screen will serve to make a tight union.



When the handle is driven in place the mesh bites into the wood and has firm contact with the metal of the hammer head.

## Tip on Installing Brake Cylinder

When installing the master cylinder on a hydraulic-brake system after rebuilding it, frequently it is found that air is admitted to the lines, resulting in "spongy" brake action or no braking power at all. To correct this, I use the following method of installing the cylinder: After it has been honed and the new piston and cups are in place, I fill the reservoir to the correct level. Then, with the cylinder clamped in a vise, I pump the plunger arm until a steady stream of liquid is discharged. Following this, the cylinder is installed, the connection to the line being left somewhat loose. The brake is pumped until fluid comes out of the connection, which then is tightened with the pedal held down. Finally the unit is filled to the proper level. The brake can be worked from beneath the hood or under the car while watching the connection.

Robert Brunt, Rocky River, Ohio.

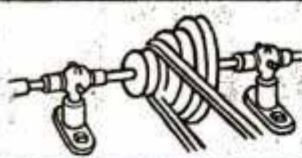
## Removing a Fresh Paint Spot

Next time you have occasion to remove a spot of fresh paint from furniture while doing a painting job, try rubbing it with a soft cloth that has been dipped in lemon oil. One craftsman found that the oil leaves the surface of the furniture glossy and is easy on the finish.



Frank Shore, New York.



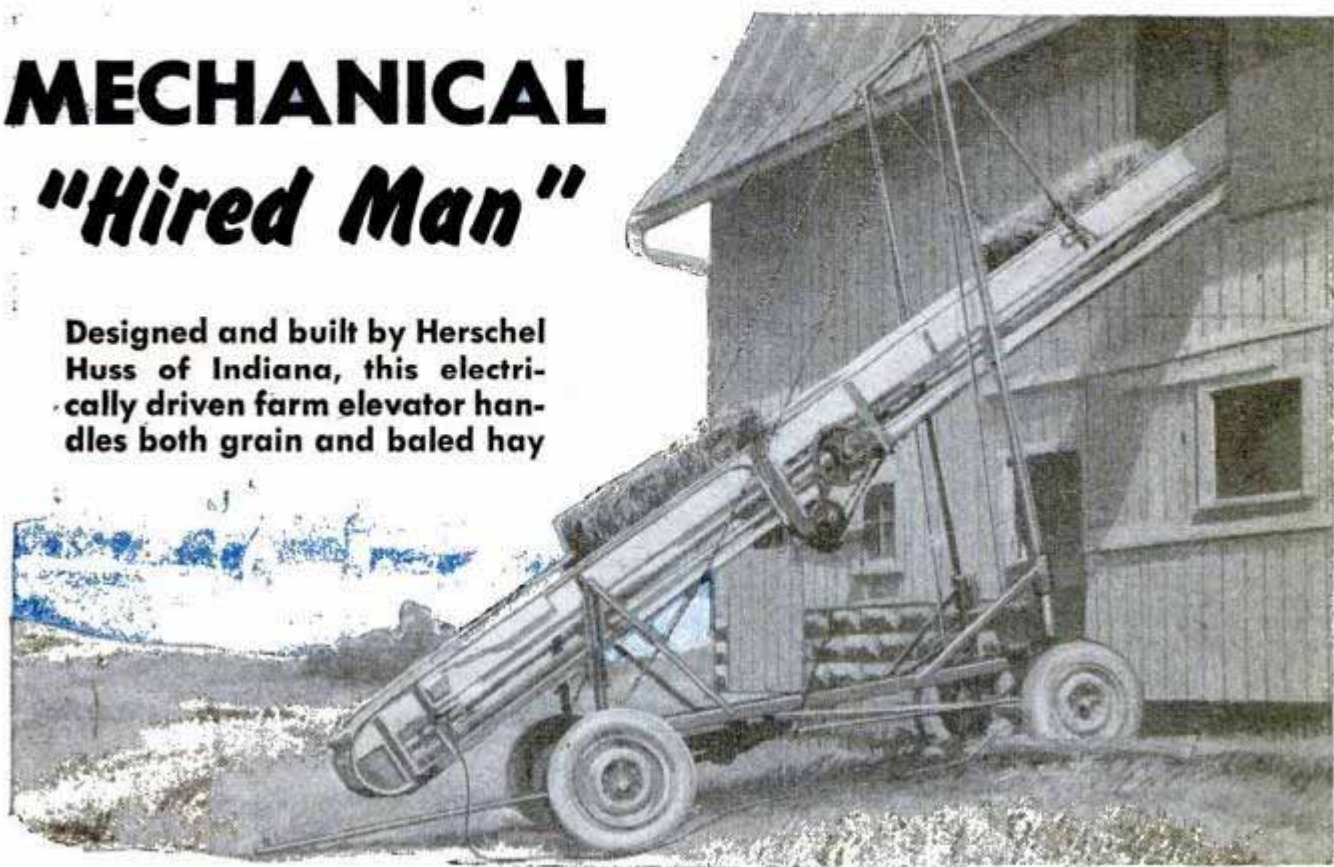


# Shop Notes



## MECHANICAL "Hired Man"

Designed and built by Herschel Huss of Indiana, this electrically driven farm elevator handles both grain and baled hay

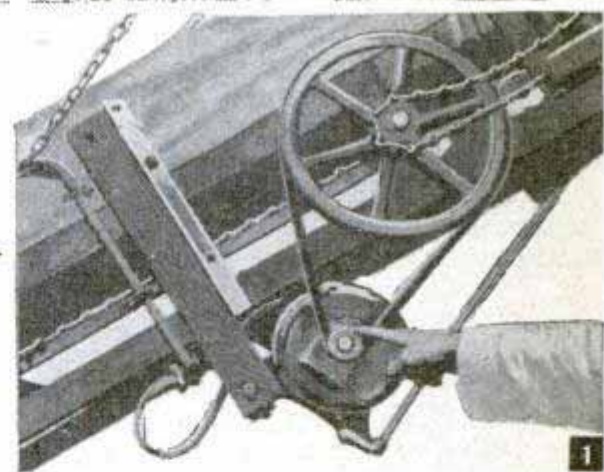


By A. E. Holden

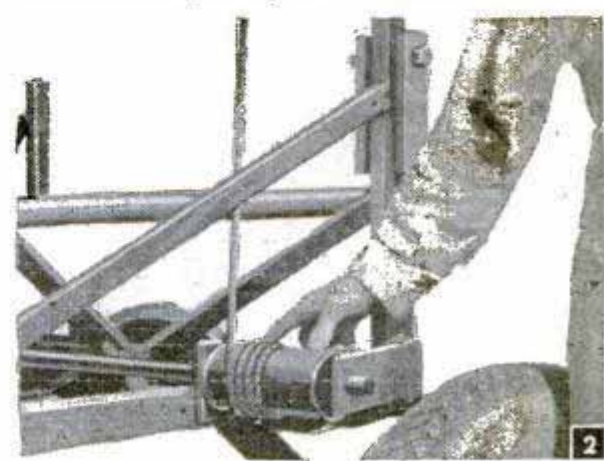
**T**OSSING bales of hay around or scooping grain from truck to bin is a dusty, tiring job, as every farmer knows. And always, during the harvest season, every minute counts. That's why elevators like the one pictured are so popular as farm helpers. This one is especially handy because it's a self-contained unit mounted on a rubber-tired trailer truck and fitted with a raising mechanism and a built-in motor drive. All that's necessary is to back it up to the barn or granary, raise the conveyor leg to the proper height to deliver the hay or grain where you want it, plug the motor into the power source and you're ready for work, all in a matter of minutes.

The builder of this particular unit used the angles from old windmill towers for the conveyor frame, the trailer or truck was made up by working over a Ford Model-T chassis, and for the balance of the construction he used salvage from the farm scrap pile and purchased, new, such parts as sprockets, shafts and pulleys. With this method of building, the unit can be put together for only a few dollars cash exclusive of the motor or engine. Wherever practical, the parts are arc-welded for greater strength and rigidity.

Fig. 3 details the whole thing. Construction



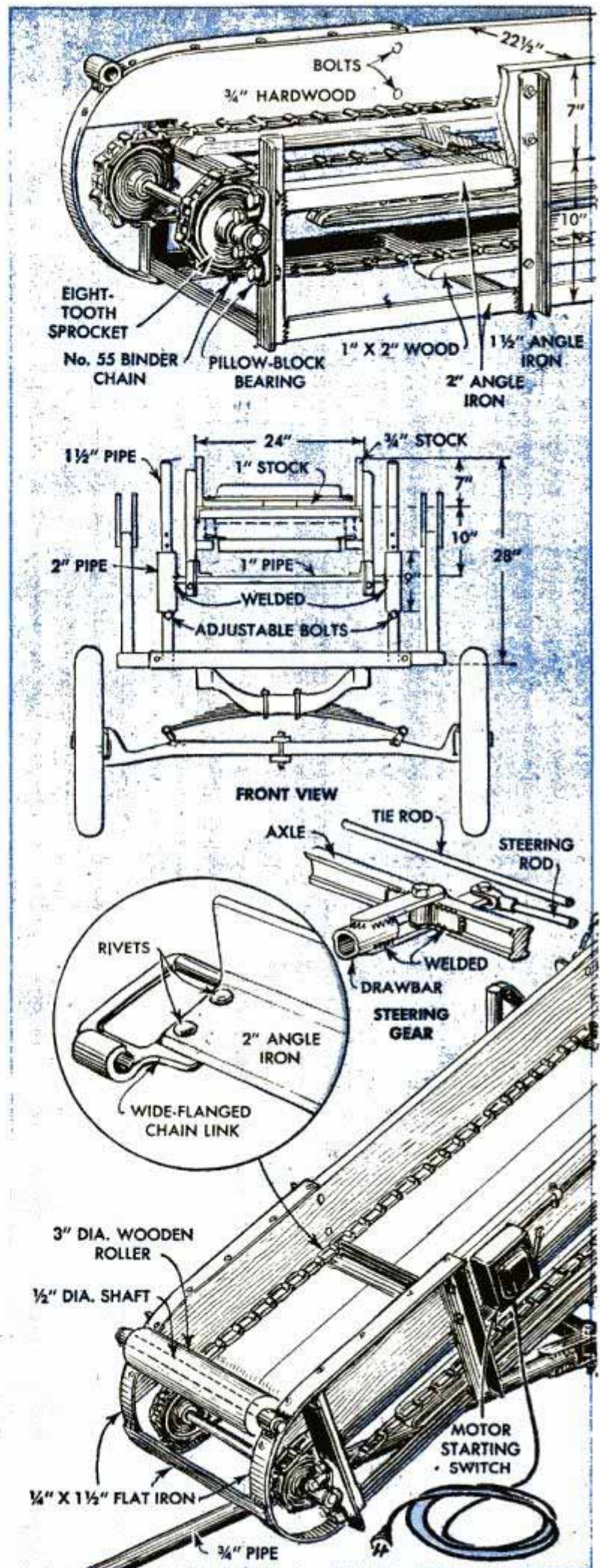
Above, motor mount is adjustable for proper belt tension. Below, raising cables wind on steel drums



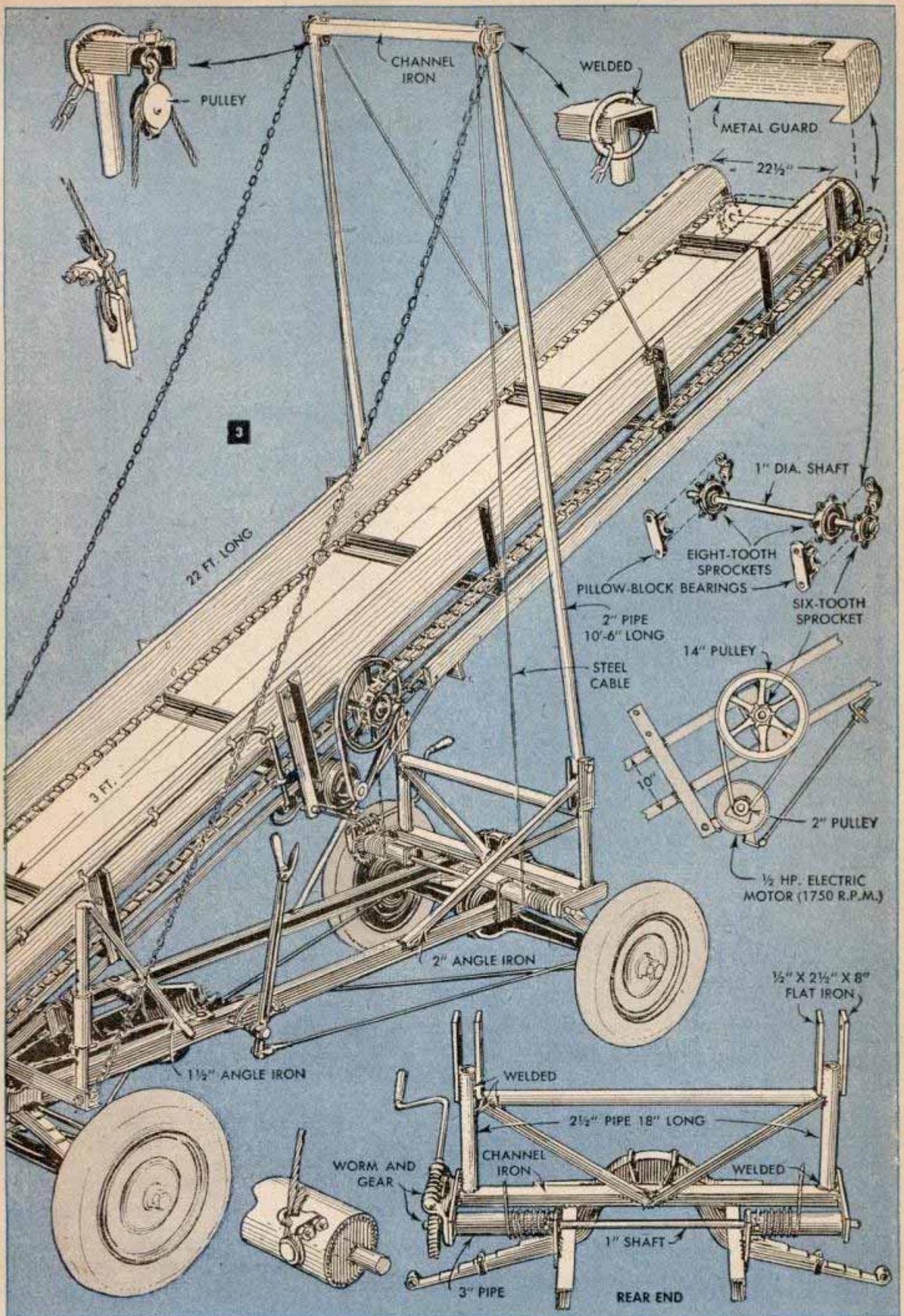


can start with either the truck or the conveyor leg, which in this case is 22 ft. long. Any changes in the length will require that the truck chassis be lengthened correspondingly, and that the driving motor be larger to handle the extra load. Notice in the front view, Fig. 3, that the forward end of the conveyor is adjustable for height. Although ordinary pillow-block bearings are shown carrying the sprocket shafts at both ends of the conveyor you can purchase standard elevator parts which consist of bearing fixtures with sliding adjustments for tightening the chain to the proper tension. You can readily see how the conveyor lift operates from study of the details in Fig. 3. The raising mechanism, or winch, is a stock item but the worm gear can usually be obtained from the scrap pile. Winding drums are made up by welding ends into sections of 3-in. pipe and then welding the drums onto a suitable shaft, Fig. 2. Other parts of the raising mechanism can be almost anything you have at hand that will serve the purpose.

The construction of the conveyor calls for a little more care. It should be of exact width throughout the length, otherwise the chain may bind. Also, the angle-iron conveyor lifts or drags should be cut to exact length for the same reason. Drags are 3 ft. apart, a distance convenient for handling baled hay but a little slow for ear corn and, of course, not suitable for small grain, except possibly an occasional job. More drags can be added to give a spacing of 1 ft. or so if you handle grain principally. Even with the narrow spacing of the drags, the elevator will handle hay bales quite well. Although not detailed, many farmers fit this type of elevator with a small sheet-metal hopper with flared sides. The hopper makes it easier to handle fine material or small grains. As shown in Fig. 1 and a detail in Fig. 3, the motor is mounted on a pivot arrangement provided with a screw for adjusting tension of the V-belt. Although a 1/2-hp. motor is specified, a 3/4 or 1-hp. motor will drive the elevator at maximum capacity. The motor should be of the repulsion-induction type to handle a heavy starting load.









## Wood Guard for Double-Bit Ax Protects Cutting Edges

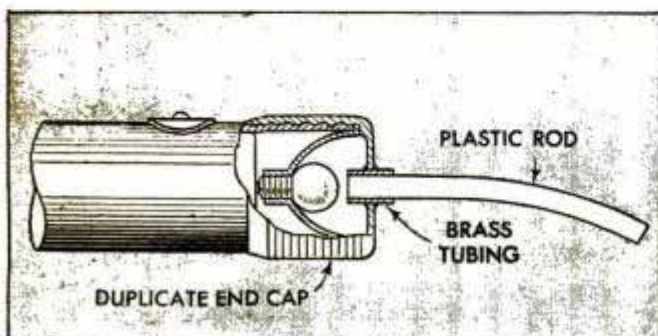


If two pieces of wood are grooved to fit over the blades of a double-bit ax and held in place with a rubber band cut from an inner tube, the cutting edges will be protected when the ax is not in use. The guard is put on easily and when removed is compact enough to fit into the pocket. The same idea may be applied to an ax with a single bit except that it may be necessary to cut out a section of the inner tube and patch it to make a rubber band of the proper length.

George T. Hewett, Salem, Ore.

## Light Reaches Hard-to-See Area

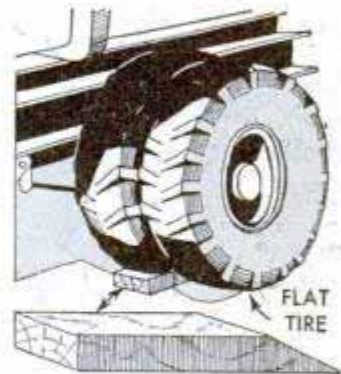
Often it is difficult to illuminate the interior of small gear boxes and housings with an ordinary flashlight. This difficulty may be eliminated by adding a plastic rod to direct the light beam. The lens and its ferrule are replaced by the end cap taken from another light of the same size. First, the cap is modified by inserting a piece of



plastic rod of the kind used by dentists to direct light into a patient's mouth. The rod is bent to the desired shape and held in place with brass tubing that is soldered to the cap.—B. L. DeMare, Aberdeen Proving Grounds, Md.

## 'Flat' on Outside Wheel Repaired

When you have a puncture in the outside tire of a dual-wheel truck, you can change it without using a jack. Simply run the inner wheel onto a large wooden block to get the required lift. The block should be tapered at one end to avoid bruising the tire when you drive onto it. Once the brake is set, you won't have to worry about the truck rolling off the jack.



## Pull-Out Mailbox Unit Is Tagged To Aid Distribution of Mail

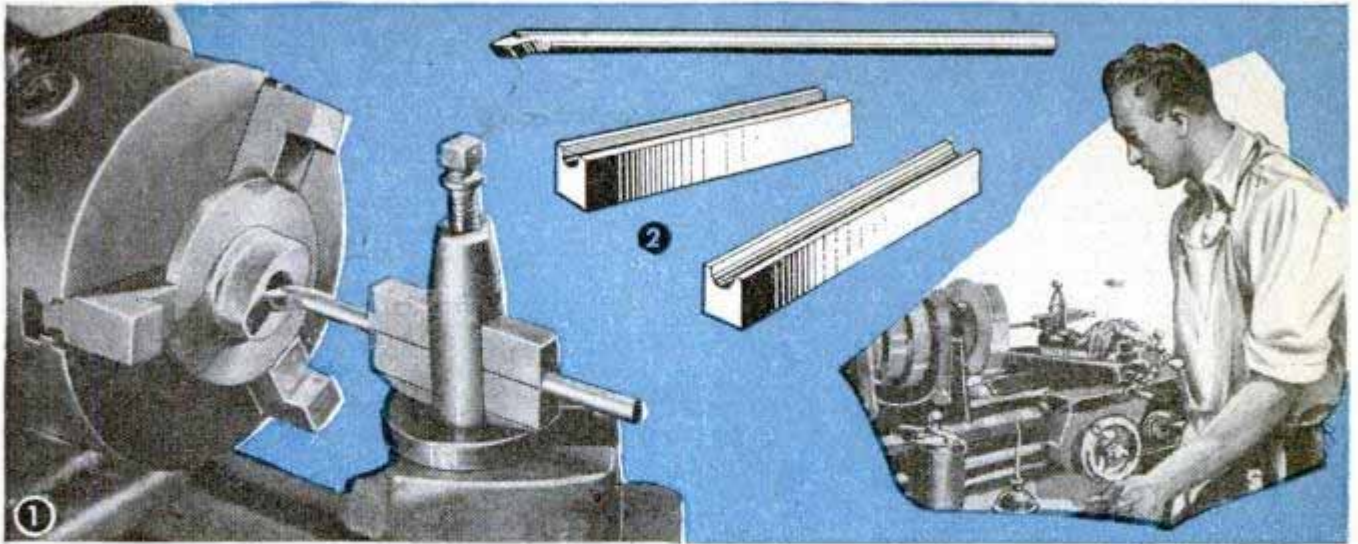
SOLDERED OR BOLTED TO MAIL COMPARTMENT



To aid in the distribution of mail, one apartment manager whose building was equipped with boxes of the pull-out type had metal pieces soldered to the top of each box to hold cards. The name of each tenant was lettered on the proper card. Then, after the box was opened, the postman could read the names and distribute the mail without having to stoop and get the names from the front of the box.

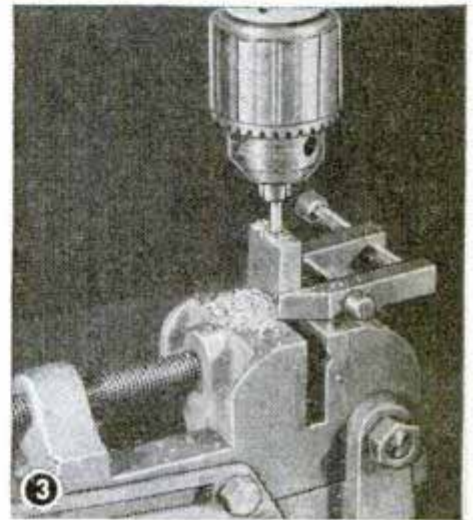


# Boring-Bar Holder Made in Two Operations

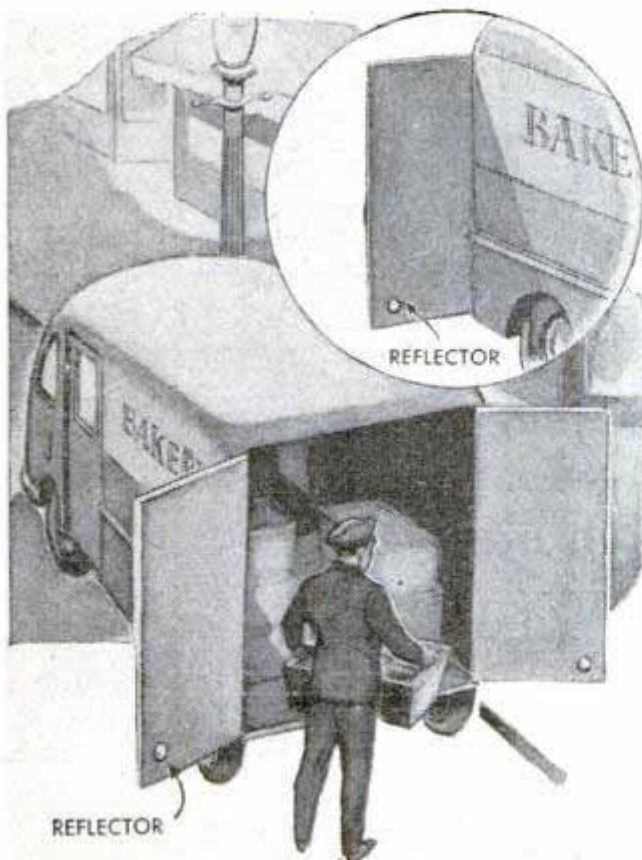


Just two drilling operations are required to make this holder: one, the pilot hole; the other, drilling to the finish diameter. The holder you see in Fig. 1 was made from two short lengths of  $\frac{3}{8}$  by  $\frac{1}{2}$ -in. cold-rolled steel. Of course this size can be varied as required to suit the boring bar being used. The two pieces are clamped together as in Fig. 3, making sure that the edges are exactly flush, and are held for drilling in the drill-press vise. Drill the pilot hole first, centering on the joining line, then follow with a drill bit of the same diameter as the boring bar. What you get is shown in Fig. 2. Draw-file the edges of the two pieces slightly so that they do not touch when clamped over the boring-bar shank as in Fig. 1. This finishes the holder ready for use.

Gary Moore, East Aurora, N. Y.



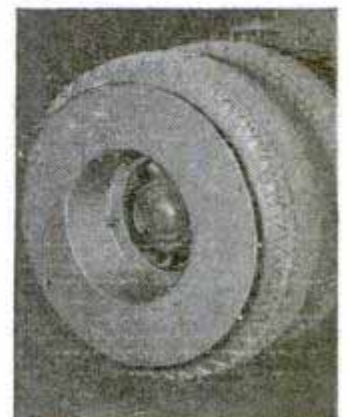
## Reflectors on Truck Doors Warn Approaching Motorists



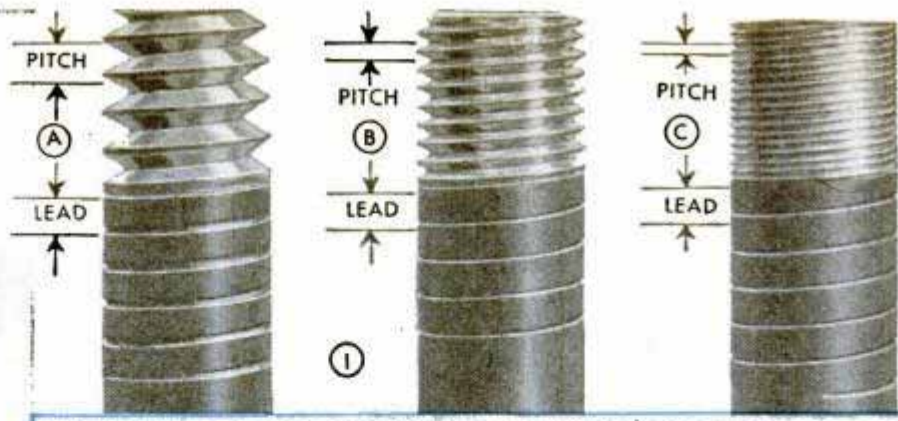
One firm that had a fleet of trucks with doors that swung outward mounted reflectors on both sides of each door for night deliveries. Thus, when the doors were opened, as well as when they were closed, approaching motorists' headlights would be reflected to furnish warning.

## Saving Sidewalls on Truck Tires

A tire guard cut from a piece of sheet metal will serve to protect the sidewalls of truck tires from being scuffed when rubbing against curbstones or other obstructions. The guards are made in the shape shown and are attached to the regular mounting lugs. Heavy sheet metal is used and the parts are welded.—G. H. Danzberger, West Chester, Pa.







1 START (SINGLE THREAD) 2 STARTS (DOUBLE THREAD) 4 STARTS (QUAD THREAD)

# MULTIPLE

By Sam Brown

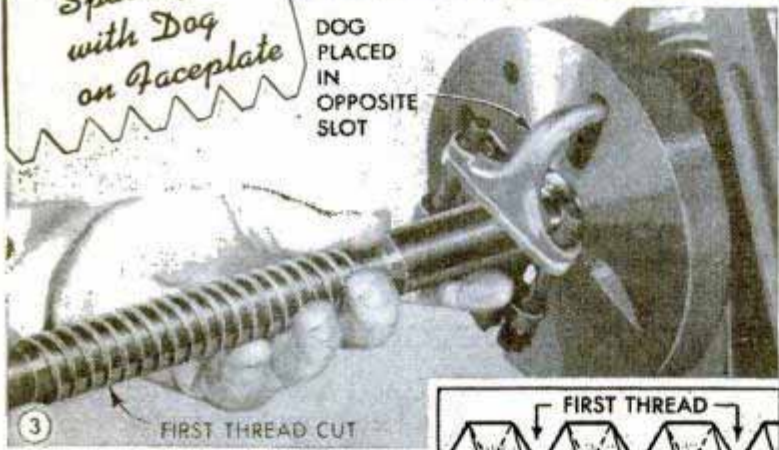
WHEN you want fast travel with a fine thread, you use a multiple thread, breaking the original lead distance into two, three or more threads as desired. The cap of a fountain pen is a good example—you want the cap to screw on quickly and a coarse thread is not satisfactory. Focusing devices on cameras and binoculars offer another everyday example of the use of multiple threads.

**General terms:** Fig. 1 illustrates the two terms used to describe any thread—lead and pitch. Lead is the distance the thread advances in one revolution; pitch is the distance between threads. In a single thread, detail A, Fig. 1, lead and pitch are the same. The second detail, B, shows the original lead broken into two threads so that the pitch is one half the lead. Detail C shows a quad or 4-start thread, where the pitch is one fourth of the lead. In all multiple

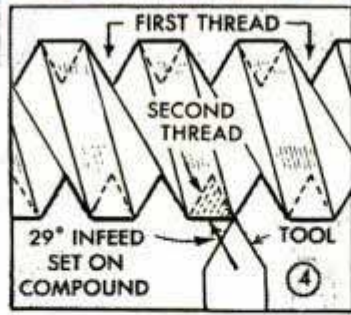


*Spacing with Dog on Faceplate*

DOG PLACED IN OPPOSITE SLOT



FIRST THREAD CUT



SPACING MULTIPLE THREADS BY PLACING DOG IN VARIOUS SLOTS IS USEFUL METHOD OF WORKING. PHOTOS SHOW DOUBLE THREAD. THREE STOPS ARE USED FOR TRIPLE THREAD

TABLE 1

USEFUL RANGE OF MULTIPLE THREADS

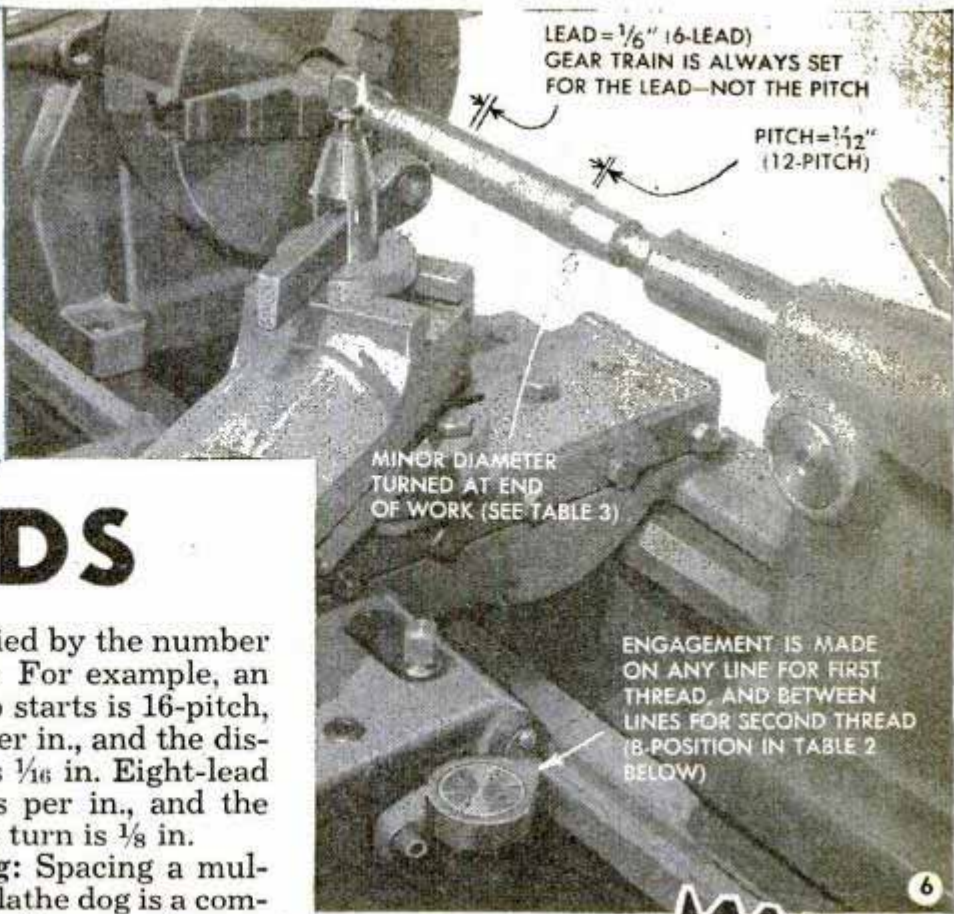
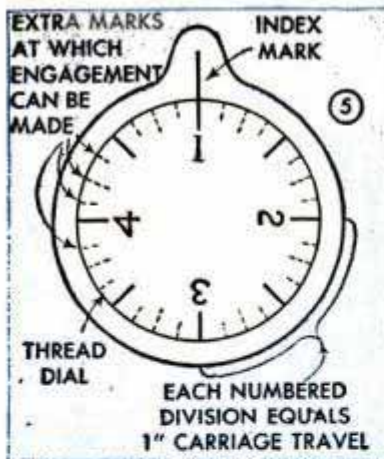
NUMBER OF STARTS	LEAD (NUMBER OF TURNS PER INCH OF SINGLE THREAD)																						
	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7	8	9	10	11	11½	12	13	14	16	18	20
2 STARTS	3	4	5	6	7	8	9	10	11	12	13	14	16	18	20	22	23	24	26	28	32	36	40
3 STARTS	4½	6	7½	9	10½	12	13½	15	16½	18	19½	21	24	27	30	33	34½	36	39				
4 STARTS	6	8	10	12	14	16	18	20	22	24	26	28	32	36	40								
5 STARTS	7½	10	12½	15	17½	20	22½	25	27½	30	32½	35	40										
6 STARTS	9	12	15	18	21	24	27	30	33	36	39												
8 STARTS	12	16	20	24	28	32	36	40															
10 STARTS	15	20	25	30	35	40																	
12 STARTS	18	24	30	36																			

FIGURES IN BODY OF TABLE GIVE PITCH OF THREAD (NUMBER OF THREADS PER INCH)

NOTES

1. FIGURES IN SHADED BOXES CAN BE CUT WITH USE OF THREAD DIAL
2. FAST LEADS FROM 1½ TO 3½ ARE NOT USUALLY SHOWN ON GEAR CHARTS BUT CAN BE SET UP WITH REGULAR GEARS





# THREADS

threads, the lead multiplied by the number of starts gives the pitch. For example, an 8-lead thread having two starts is 16-pitch, or there are 16 threads per in., and the distance between threads is  $\frac{1}{16}$  in. Eight-lead means there are 8 turns per in., and the distance advanced in one turn is  $\frac{1}{8}$  in.

**Spacing with lathe dog:** Spacing a multiple thread by using the lathe dog is a common method of working. Suppose, for example, you want to cut a double thread of 8-lead and 16-pitch. Set up the gear box or gear train for the lead. Always gear for the

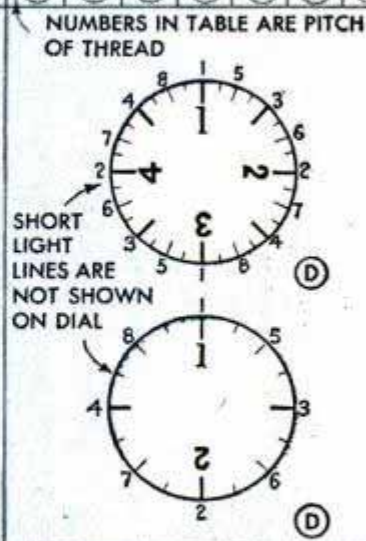
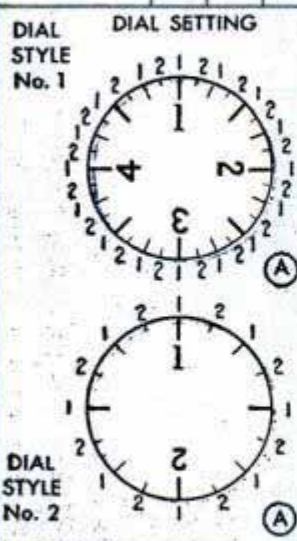
PHOTO SHOWS HOW THE THREAD DIAL IS USED TO CUT A DOUBLE THREAD OF 6-LEAD, 12-PITCH

*Using the Thread Dial*

TABLE 2

THREAD DIAL SETTING FOR MULTIPLE THREADS

STARTS	LEAD																				
	4	12	20	2	6	10	14	18	3	5	7	9	11	13	1½	2½	3½	4½	5½	6½	11½
2 STARTS	8 (A)	24 (A)	40 (A)	4 (B)	12 (B)	20 (B)	28 (B)	36 (B)	6 (C)	10 (C)	14 (C)	18 (C)	22 (C)	26 (C)	3 (D)	5 (D)	7 (D)	9 (D)	11 (D)	13 (D)	23 (D)
4 STARTS	—	—	—	8 (B)	24 (B)	40 (B)	56 (B)	72 (B)	12 (C)	20 (C)	28 (C)	36 (C)	44 (C)	52 (C)	6 (D)	10 (D)	14 (D)	18 (D)	22 (D)	26 (D)	46 (D)
8 STARTS	—	—	—	—	—	—	—	—	24 (C)	40 (C)	56 (C)	72 (C)	88 (C)	104 (C)	12 (D)	20 (D)	28 (D)	36 (D)	44 (D)	52 (D)	92 (D)



FOR DOUBLE THREAD, ENGAGE AT ANY POINT MARKED 1 (ON OUTSIDE RIM OF DRAWING) FOR FIRST THREAD AND AT ANY POINT MARKED 2 FOR SECOND THREAD. IF A QUAD THREAD IS DESIRED, ENGAGE AT 1-2-3-4 FOR THE RESPECTIVE THREADS. FOR 8 STARTS, ENGAGE AT 1-2-3-4-5-6-7-8 AS MARKED.



# Step-by-Step Example of Threading

QUADRUPLE THREAD  
4½-LEAD  
18-PITCH  
THREAD DIAL-D-POSITION

1.181" MINOR  
+ .020"  
1.201"

BORE  
1.201"

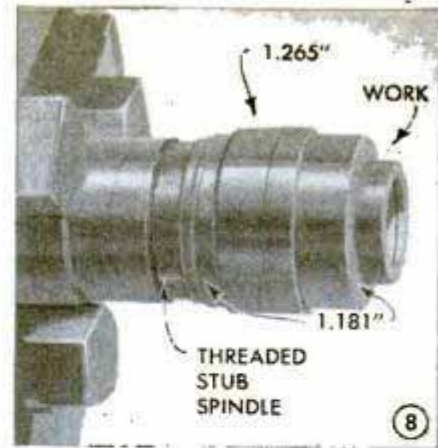
1.181"

MAJOR DIA.  
1¼"

1¼" = 1.265"  
DD = .084 (FROM TABLE 3)  
1.181 IS MINOR DIA.

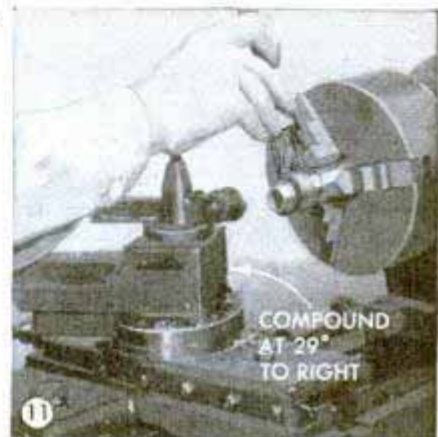
7

MAKE A ROUGH DRAWING LIKE THIS BEFORE YOU START



8

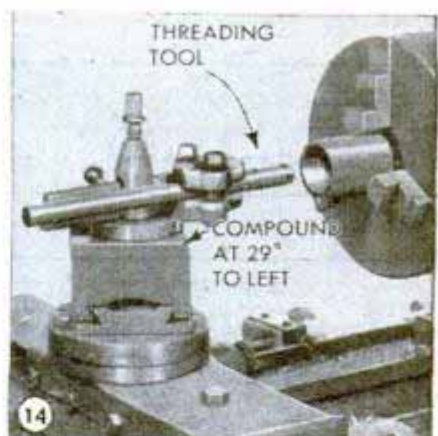
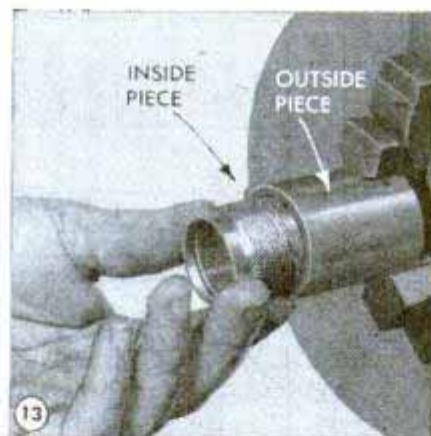
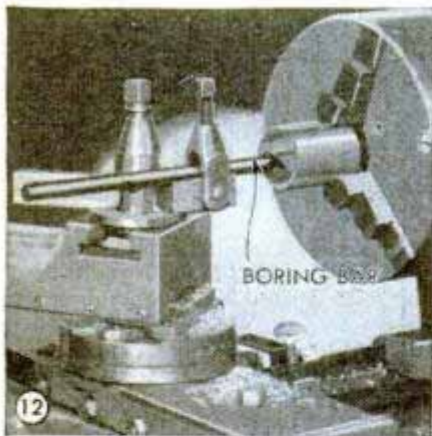
First the work is mounted on a threaded stub spindle. Then major and minor diameters are turned



Set the gear train for 4½-lead and make the first cut using the thread dial, as is indicated by D in Table 2

Engaging the dial as outlined produces four starts which are finally deepened to finish the threads

Note that the compound is in the 29-deg. position, swung to the right. Always use plenty of cutting oil



The outside piece is started by boring the hole to the required minor diameter, plus the proper clearance

The clearance allows minor diameter turned on the inside piece to fit loosely inside the bored hole

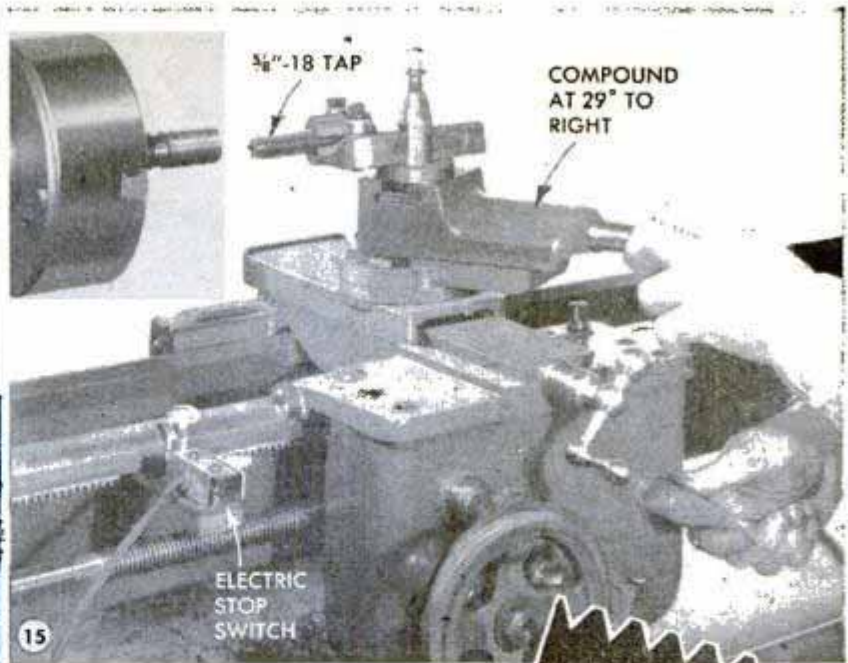
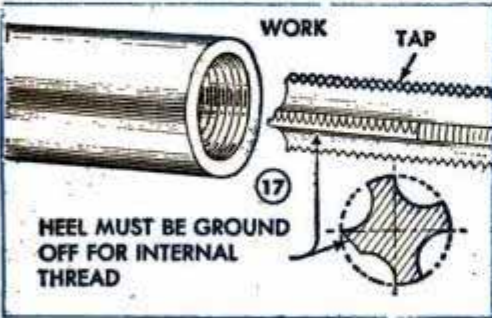
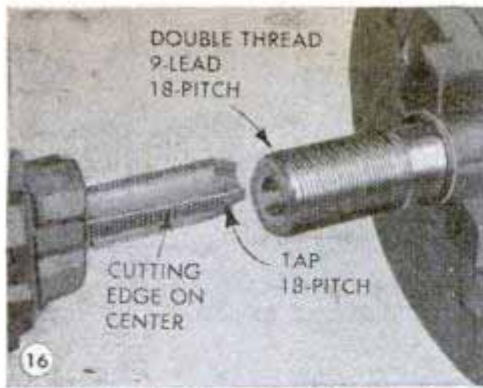
Cut internal thread same as external except compound is swung to left. Check frequently for size

lead you want, not the pitch. Proceed as for any single thread, but cut only to the depth of a 16-pitch thread. Table 3 shows this to be .047 in. or, if you use regular 29-deg. angle feed on the compound, the compound infeed is .054 in. Fig. 2 shows the first thread being cut. After cutting the first thread to full depth, back up the tailstock and fit the tail of the dog in a slot opposite to the one used for the first thread, Fig. 3. Back the compound to the original starting position

and cut the second thread just the same as the first. If you are using 29-deg. compound feed, the second thread will start along by the first thread, as shown in Fig. 4, and successive cuts will complete the thread. With the four slots of the faceplate you can cut a quad thread. If a triple or 3-start thread is desired, tap three equally spaced holes in the faceplate for studs and use a straight-tail dog.

Using thread dial: Most small lathes are





*How to Use Taps*

IF LATHE IS GEARED FOR 1/2 THE PITCH OF A TAP THE TAP WILL CUT A DOUBLE THREAD

fitted with a thread dial, and this can be employed for a wide range of multiple threads. Table 1 shows the complete useful range of multiple threads, with pitches that can be cut using a thread dial indicated by shaded boxes. A typical dial is shown in Fig. 5. In addition to the engagement points marked, you can also engage at the points indicated by the dotted lines. Table 2 shows threads that can be cut and dial settings for cutting them. Two different standard types of dials are shown. The table is based on an 8-pitch lead screw, standard on most small lathes.

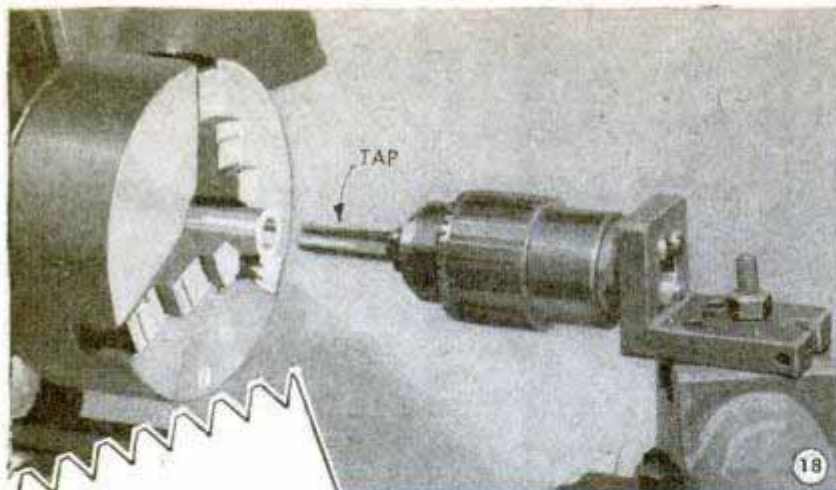
As an example of threading, consider Fig. 6. This shows a double thread of 6-lead, 12-pitch being cut. Refer to Table 2 and you will note this requires engagement similar to the B position. Gear for 6-lead and cut the first thread by engaging the dial at any point marked 1 on the outside rim of the drawing. Without changing the compound infeed, engage at any point marked 2. That's your double thread. Make successive cuts at each compound setting until the double thread is complete. With this method, no attention need be given the minor diameter since you simply go on turning until the crest of thread is sharp. However, as a matter of convenience, it is always good practice to turn the minor diameter. This can be determined by noting the double depth of thread in Table 3 and subtracting this figure from the full diameter of the work.

**How thread dial works:** It's a good idea to understand just why the thread dial splits the thread. On any such dial, numbered divisions indicate 1 in. of carriage travel. One half of a numbered division is 1/2 in. of carriage travel, etc. Fig. 5 shows that the dial can be subdivided to 1/8 in. of

TABLE 3 DEPTH OF THREADS

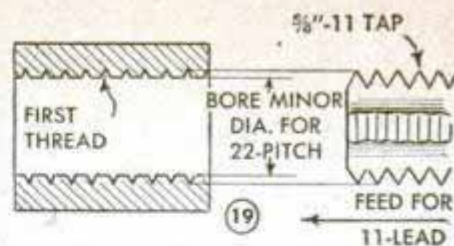
Pitch	Pitch Inches	Single Depth of Thread	Double Depth of Thread	Infeed at 29 Degrees
3	.333	.253	.506	.292
4	.250	.190	.380	.216
4½	.222	.169	.338	.192
5	.200	.152	.304	.174
6	.167	.127	.254	.146
7	.143	.108	.216	.124
7½	.133	.101	.202	.114
8	.125	.095	.190	.108
9	.111	.084	.168	.096
10	.100	.076	.152	.087
10½	.095	.072	.144	.082
11	.091	.069	.138	.079
12	.083	.063	.126	.072
13	.077	.059	.118	.068
13½	.074	.058	.116	.067
14	.071	.054	.108	.062
15	.067	.051	.102	.057
16	.063	.047	.094	.054
16½	.061	.046	.092	.053
18	.055	.042	.084	.047
19½	.051	.039	.078	.045
20	.050	.038	.076	.043
21	.048	.036	.072	.041
22	.045	.035	.070	.039
23	.043	.033	.066	.037
24	.042	.032	.064	.036
25	.040	.030	.060	.035
26	.038	.029	.058	.034
27	.037	.028	.056	.032
28	.036	.027	.054	.031
30	.033	.025	.050	.029
32	.031	.024	.048	.027



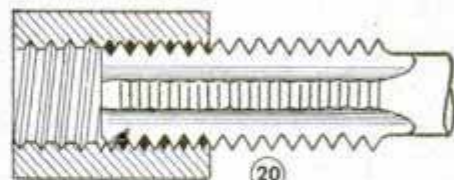


More on  
Use of Taps

REGULAR TAPPING TECHNIQUE CAN BE USED FOR SMALL HOLES. USE A TAP OF THE LEAD YOU WANT. SPLIT THE THREAD BY USING THREAD DIAL



FIRST STAGE OF 11-LEAD 22-PITCH DOUBLE THREAD

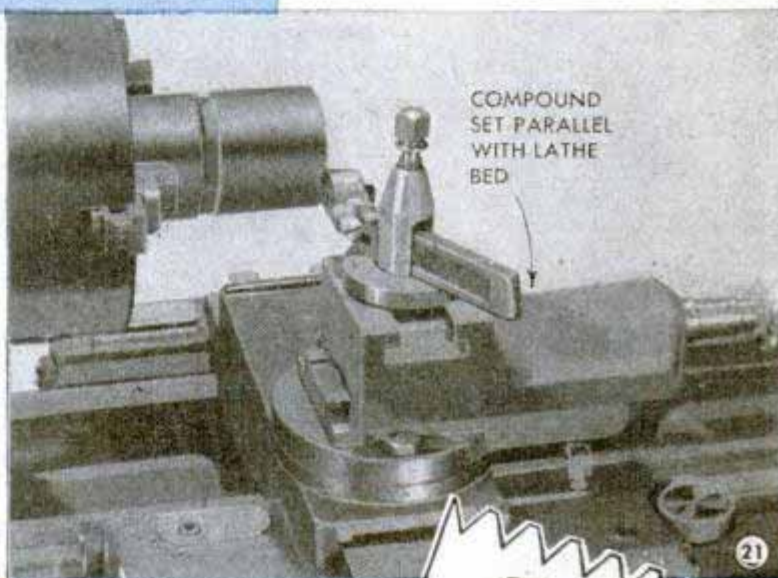


SECOND STAGE—THREAD DIAL IS ENGAGED TO SPLIT AN 11-LEAD THREAD. RESULT IS DOUBLE THREAD OF 22-PITCH

carriage travel. Now, consider the previous example of a 6-lead thread. In 1 in. of carriage travel, the tool will engage at the first and the sixth threads. At  $\frac{1}{2}$  in. of carriage travel, the tool will "hit" the third thread, but if you engage at  $\frac{1}{4}$  in. of carriage travel, the tool will hit at  $1\frac{1}{2}$  threads and will split the thread. Engagement at  $\frac{1}{8}$  in. of carriage travel will again split it producing a quad thread. This is as far as this particular lead can be split, but other leads, C and D positions, Table 2, can be split into 8 starts. Triple threads cannot be cut because the number of striking points (32) cannot be divided by 3.

**Example of threading:** Figs. 8 through 14 show both external and internal thread cutting for the work detailed in Fig. 7. The external thread usually is cut first because this commonly carries the major diameter. In boring for the internal thread, use Table 3 to find minor diameter and then add to this about one fourth of the double depth of thread. Always allow this clearance as a full thread cannot be cut. In boring the hole oversize, you are not presetting a loose thread because the fit of any thread comes from the angular contact, not the crests.

**How to use taps:** The use of taps for cutting single threads is an old lathe trick, and it can be used just as well for multiple threads. What happens here is that you have a multiple-point threading tool which will cut two, three or more threads in one operation. The example, Fig. 15, shows an 18-pitch tap being used. If you want to cut



COMPOUND SET PARALLEL WITH LATHE BED

IN THIS SETUP, THREAD DIAL IS USED AS FOR SINGLE THREAD. THE THREAD IS SPLIT BY MOVING THE COMPOUND BACK  $\frac{1}{2}$  OR  $\frac{1}{3}$  OF THE LEAD DISTANCE FOR DOUBLE OR TRIPLE THREAD RESPECTIVELY

Setting Threads with Compound

a double thread, the gear box or train is set for 9 threads, not 18. Engagement of the thread dial is normal for a 9-thread and the tap catches both threads of the double thread in one operation. Successive in-feeds are made at the compound until the thread is complete, Fig. 16. With the same tap, a triple thread would be cut with the gear train set for 6-lead; a quad thread would be cut with gear train set for  $4\frac{1}{2}$ -lead. In all cases, the pitch is the same as the tap, which in this case is 18-pitch.

If a tap is used to cut an internal thread, it will be necessary to grind away the heel of the cutting teeth, as shown in Fig. 17, in order to get needed clearance. Taps are not good for heavy cutting—use a light feed



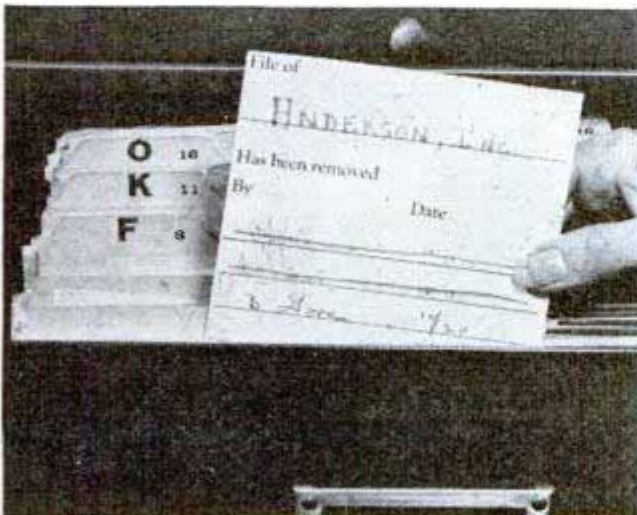
and plenty of oil. In this setup, the tap is smaller than the hole in the work and only one set of teeth does the cutting.

Another method of using a tap is shown in Fig. 18. In this instance a tap having the desired lead is used and the thread dial is employed to split the thread. This method is handy for small holes where a single-point tool could not be used. The original tap thread can be split into double or quad thread, but not triple. The example shown in Figs. 19 and 20 uses an 11-thread, or lead, tap. Splitting the 11-lead gives a double thread of 22-pitch. The bore diameter should be for 22-pitch thread, with due allowance for clearance. In this setup, all teeth of the tap cut.

**Setting threads with compound:** This method is sometimes useful, especially for roughing the thread for 3, 5 and 6 starts which are cleaned up later by chasing with a tap of proper pitch. As shown in Fig. 21, the compound is set parallel. Assuming 6 starts and 4-lead, the thread will be 24-pitch. Gear for a 4-lead and cut a single thread to the depth of a 24-pitch thread, making successive plunge cuts by infeeding the cross slide. Then move the compound back a distance equal to the pitch, in inches, of a 24-pitch thread. Table 3 shows this to be .042 in. Make the second thread and proceed with remaining threads in the same manner. Threads cut by this method may show a slight variation in pitch, but this is equalized readily by running a few chasing cuts with a 24-pitch tap.

### Card Indicates Location of File

In locating papers that have been removed from a file case, one firm uses cards that are slipped into the file when a folder is removed. Space is provided on the card for the name of the file, the person who removed it and the date it was taken. Any person seeking papers that are not in the file has only to look at the file card to see who has them.



### Clay Used as Balancing Weight Permits Close Adjustment



To balance accurately the weight of an empty container, which is often difficult with the graduated weights on hand, one laboratory worker uses modeling clay. After the container is balanced, it is filled and the contents weighed in the regular manner.

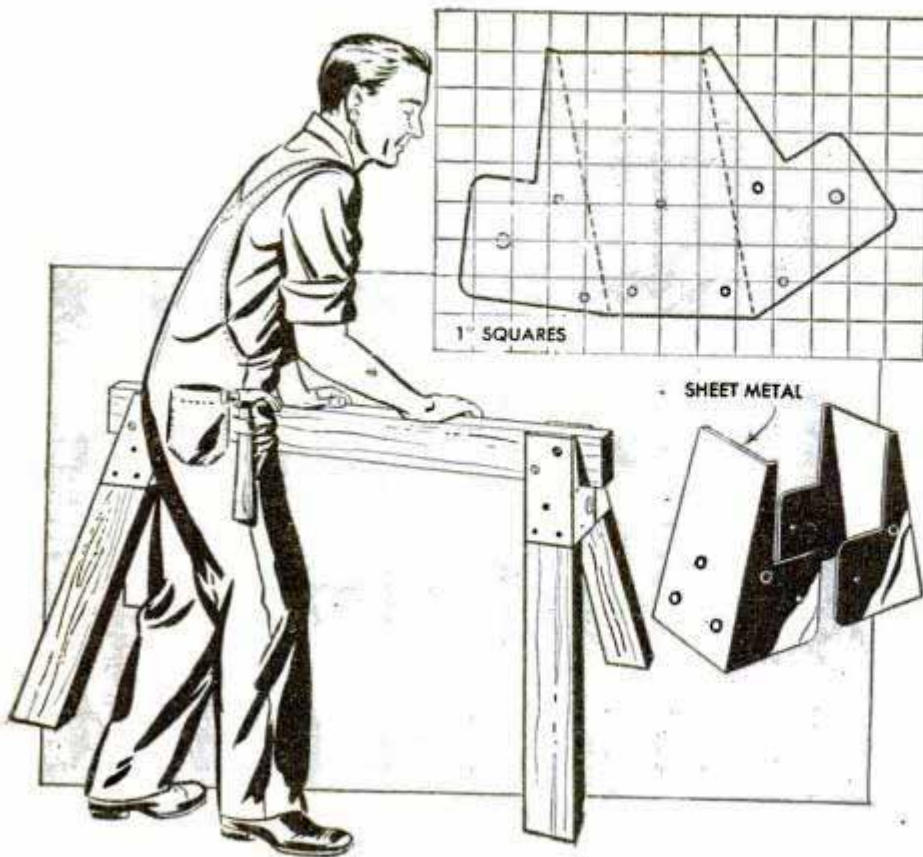
### Felt Pad Is Convenient Wiper For Gas Station Attendant

A pad made of several pieces cut from a felt hat is handy at filling stations for wiping the oil-gauge stick. The leaves are bolted in a clamp that has a hook to fasten to the attendant's belt.





## Sawhorse Is Dismantled Quickly And Takes Little Storage Space

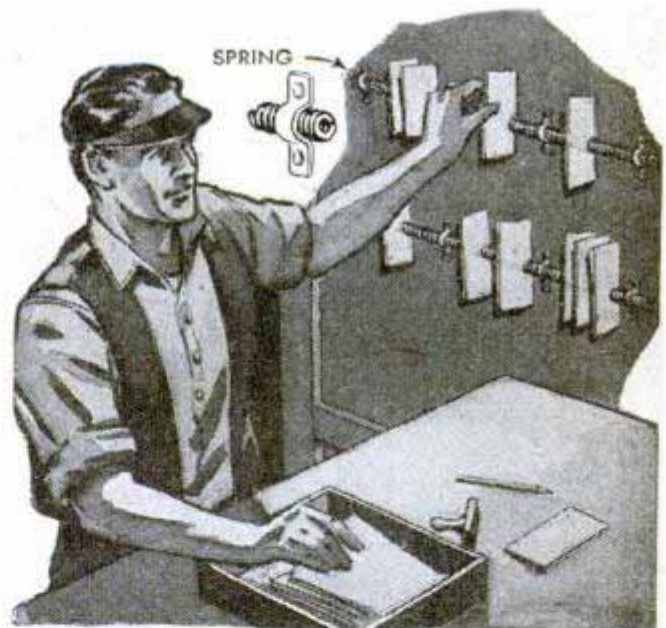
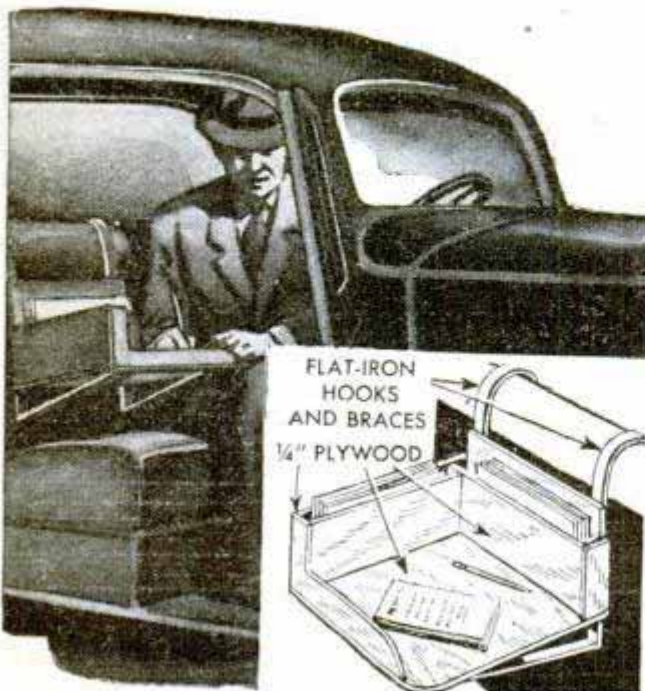


Here's a collapsible sawhorse for the carpenter who doesn't have a lot of space in his car and must carry several horses from job to job. To dismantle the unit, lift the crosspiece and fold the legs. Galvanized sheet metal is used to form the hinged pieces, which are cut as shown in the upper right-hand detail. After they are bent, they are riveted together as indicated by the lower right-hand detail. When bending, remember that the facing parts are bent in opposite directions. The legs are then inserted in the hinges and fastened with screws. Both legs and crosspiece are 2 by 4-in. lumber. One outstanding feature of this device is that the harder you bear down on the sawhorse, the tighter the legs will grip the crosspiece.

## Back of Front Seat Holds Shelf That Serves as Desk

Made of 1/4-in. plywood and fitted with flat-iron hooks to fit over the back of the front seat, this shelf serves as a small desk for your car. Several compartments are added to keep paper, envelopes and records. The size of the shelf is determined by the dimensions of the car and the size of the papers that are carried.

Wm. P. Houser, Organ, N. Mex.



## Papers Clipped in Spring Rack Are Easy to Locate

Suggested here is a simple holder for keeping receipts, orders and other records visible and within easy reach. A screen-door spring is fastened to the wall with clamps and the papers are placed in the coils. The spring should be stretched only slightly or the papers may drop out.

ⓘ Overinflation of more than 3 lbs. in automobile tires is uncomfortable for passengers and detrimental to the tires.





## Equipment For Demonstrating Microwaves

By F. L. Brittin

THE history of electronics in industry indicates that years have usually elapsed before some new device or application progresses from the demonstration stage to active use. Therefore engineers of the General Electric Company decided it would be desirable to shorten this interval for microwaves by demonstrating with simple equipment some of their useful properties.

During the war there were many effective applications of these extremely high frequencies—between 2000 and 30,000 megacycles (corresponding to wave lengths between about 6 in. and  $\frac{1}{2}$  in.). Obvious industrial control uses are interception, or reflection, of beams of these radiations for the purpose of counting and sorting; for such purposes microwaves can do things that are not possible with photoelectric relays.

Classroom demonstrations at about 2400 megacycles are made with the simple oscillator shown in photo 2. A disk-seal-type triode tube, photo 3, commonly known as the "lighthouse" tube, is employed.

The circuit diagram appears in Fig. 1. To focus the microwave beam, a parabolic reflector is used; the reflected beam is picked up by means of an intensity meter illustrated in photo 4. It will be noted that this meter unit also employs a tiny half-wave dipole antenna; the received microwave energy is fed to a silicon crystal detector. Photo 1 shows a demonstration transmission through a hollow flexible-pipe wave guide. In photo 5, classroom demonstrators are locating standing waves found by direct and reflected radiations.

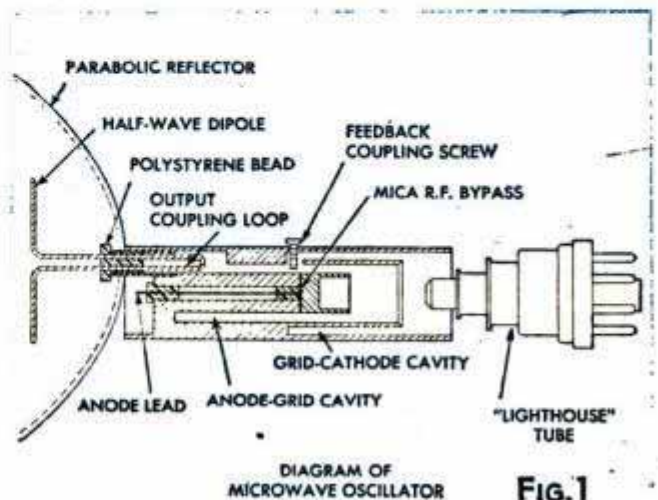
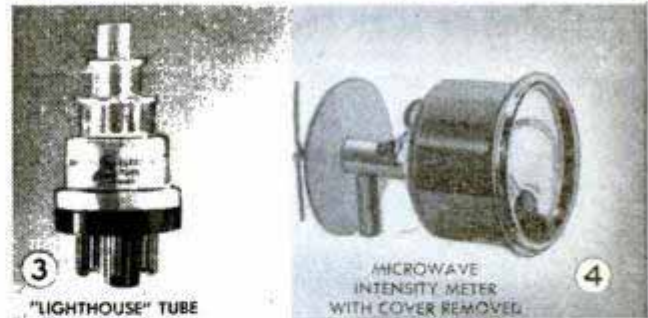
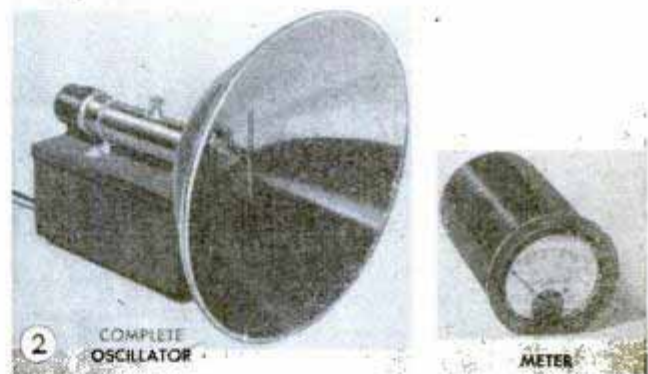
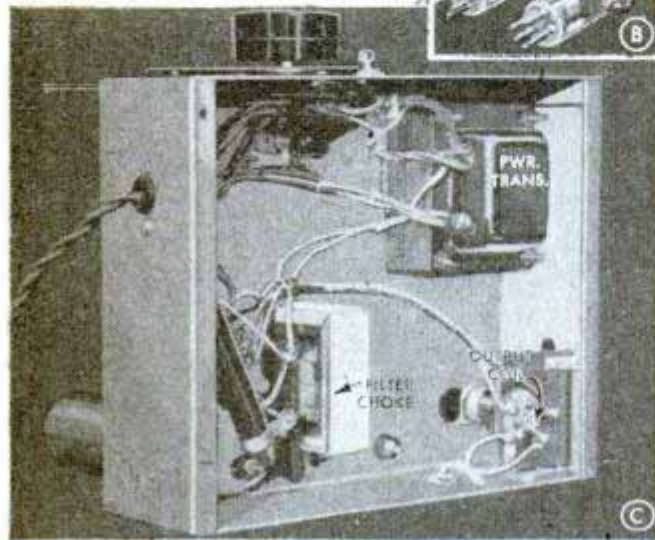
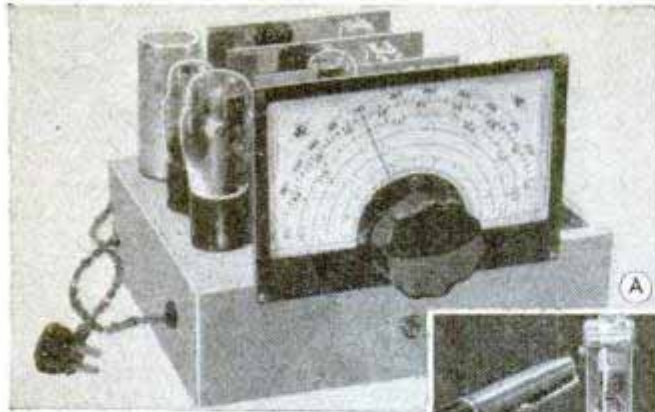


FIG. 1



# HOW TO BUILD A CONVERTER FOR

By George D. Hansen—W9FFD



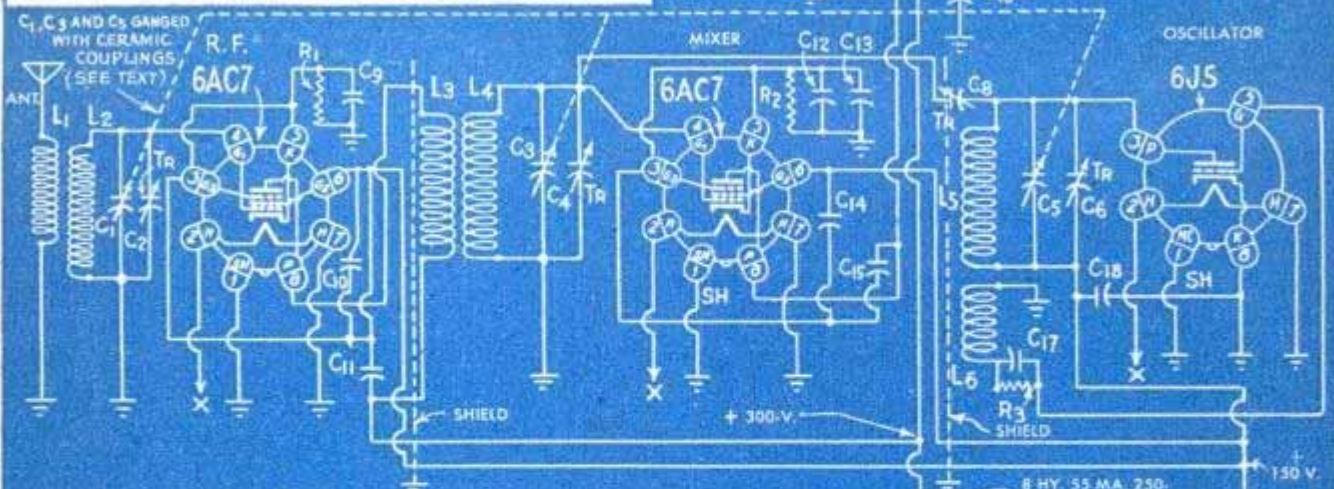
Now you can build a converter so that you can tune in the 11, 10, 6 and 2-meter bands on any standard communication receiver, including war surplus receivers such as the BC-342 and similar types that are limited to 18 megacycles at the high-frequency end of the tuning scale.

The compact self-powered converter unit illustrated consists of an R.F. stage, a mixer stage and an oscillator, ganged together under a single control. Type 6AC7 tubes are employed in the R.F. and mixer stages and the oscillator is a type 6J5. Filling the average ham's need and extending the tuning range of the short-wave listener's communications-type receiver, this VHF converter employs standard parts and the coils are all hand wound. It is designed to work its output into a receiver set at approximately 10,100 kilocycles, or at a spot where no extraneous signals appear. In this manner your receiver becomes the I.F. section of the arrangement.

All three midget variable condensers are ganged together and shielded from each other, as will be noted in photos D, E, and F. Tube sockets for the three stages and the 5-prong coil forms are mounted on the shelf above the variable condensers as illustrated in photo D. The tube sockets are of the

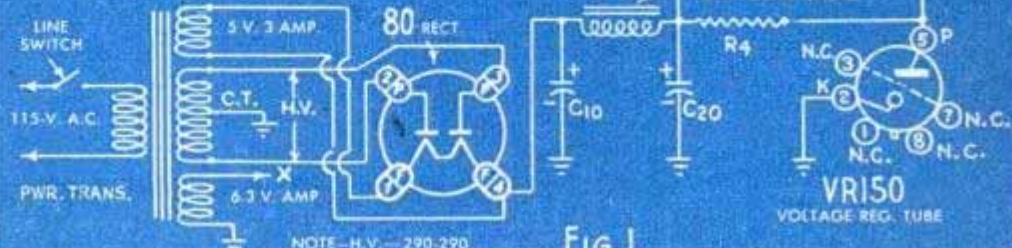
### CONDENSERS

- 2—(C1), (C3) 10 mmfd. variable condensers, (Cardwell type ZR-10-A5)
- 1—(C5) 15 mmfd. variable condenser (Cardwell type ZR-15-A5)
- 11—3(C2), 3(C4), 3(C6), 1(C7), 1(C8) (Bud type MT833) 2-36 mmfd. trimmers
- 6—(C9), (C10), (C11), (C13), (C14), (C18) .0005 mfd. mica fixed condensers, midget size (Aerovox type 1467)
- 1—(C12) .01 mfd. 400-volt paper type fixed condenser
- 1—(C15) .00005 mfd. silver mica fixed condenser (Aerovox type 1469)
- 1—(C16) .002 mfd. mica fixed condenser
- 1—(C17) .0001 mfd. mica fixed condenser
- 2—(C19), (C20) 8 mfd. electrolytic filter condensers 600-v. (Aerovox G1)



### RESISTORS

- 1—(R1) 1200-ohm 1/2 watt carbon type fixed resistor
- 1—(R2) 10,000-ohm 1/2 watt carbon type fixed resistor
- 1—(R3) 50,000-ohm 1/2 watt carbon type fixed resistor
- 1—(R4) 6,000-ohm 25 watt wire-wound resistor



NOTE—H.V.—290-290

FIG. 1



# THE NEW VHF AMATEUR BANDS

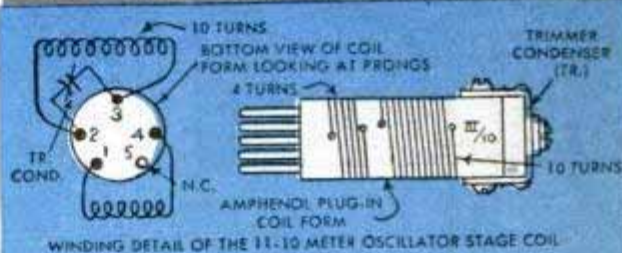
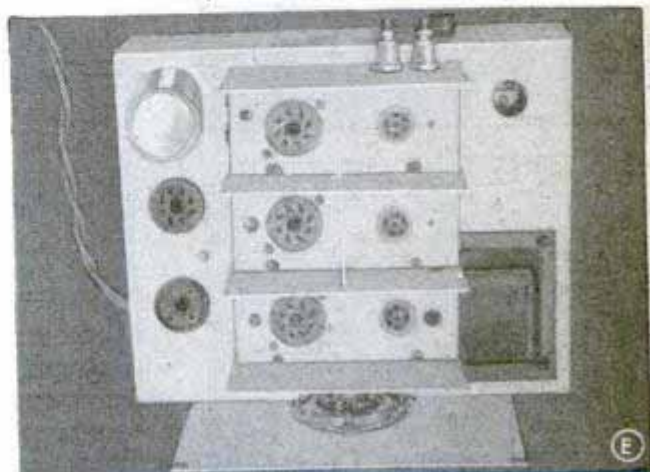
conventional chassis type and made of Amphenol polystyrene material for low-loss insulation. The plug-in coils are of the same material and all soldered connections must be carefully made; clean all points to be soldered and apply heat for as short a time as possible because of the low melting point of the polystyrene material. This converter unit is not intended for beginners and reasonable care must be taken to keep all connecting leads as short as possible.

The schematic circuit diagram is given in Fig. 1 and the coil winding details appear above the coil chart. In order to make the necessary change of coil forms for the various bands with no readjustment in each case, every coil form is provided with a small trimmer condenser, mounted across the top of the coil form by means of two short self-tapping screws, for fine and permanent alignment. The coils are in groups of three and their comparatively small size is indicated by the pen in photo B. Photo C shows the underside of the chassis base and it will be noted that output coil L<sub>7</sub> and L<sub>8</sub> is mounted on a small shelf made of 1/8-in. hard-pressed wood. The power transformer, filter choke and resistor R<sub>4</sub> are also under the chassis base. The full-wave rectifier tube and a voltage regulator tube are mounted on the chassis base.

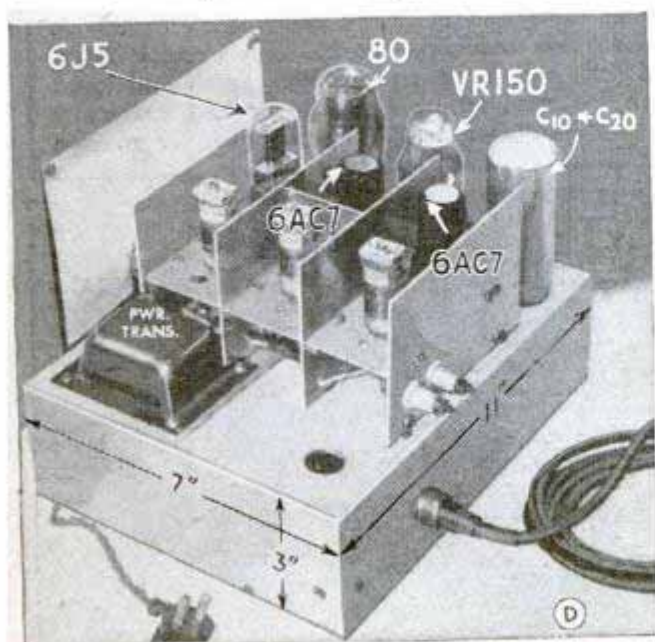
The 3-stage tuning unit is shown in photo F; each stage is identified and all dimensions given. Short lengths of 1/4-in. square brass rod were drilled and tapped to mount the partitions; angle brackets may be substituted if desired.

In ganging the variable condensers it is very important that the shafts be in exact alignment. The middle, or mixer stage,

(Continued to page 240)

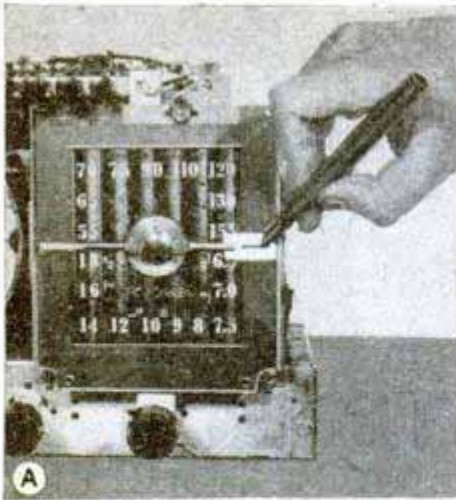


COIL WINDING CHART						
Band	Coil	Turns or In. of Wire	Wire Size Enameled	Space Between Turns	Space Between Windings	Diameter of Form or Coil
CHART No. 1 11 and 10 meters 27-30 MC	Form No. 1 L1	4 turns	No. 22	1/16"	1/8"	1/2" on outside of form
	L2	6 turns	No. 22	1/16"	1/8"	
	Form No. 2 L3	4 turns	No. 22	1/16"	1/8"	
	L4	6 turns	No. 22	1/16"	1/8"	"
	Form No. 3 L5	10 turns	No. 22	1/16"	1/8"	"
	L6	4 turns	No. 22	1/16"	1/8"	"
CHART No. 2 6 meters 50-54 MC	Form No. 1 L1	2 turns	No. 20	1/8"	1/4"	"
	L2	3 turns	No. 20	1/8"	1/4"	
	Form No. 2 L3	1 turn	No. 20	1/8"	1/4"	
	L4	3 turns	No. 20	1/8"	1/4"	"
	Form No. 3 L5	4 1/2 turns	No. 20	1/8"	1/4"	"
	L6	1 1/2 turns	No. 20	1/8"	1/4"	
CHART No. 3 2 meters 144-148 MC	Form No. 1 L1	Wire Length 1 1/2"	No. 20	1/8"	1/8"	Coil 1/2" in diameter wound inside form
	L2	1 1/2"	No. 18	3/16"	1/8"	
	Form No. 2 L3	1 1/2"	No. 20	1/8"	1/8"	
	L4	1 1/2"	No. 18	3/16"	1/8"	"
	Form No. 3 L5	1"	No. 18	1/8"	1/8"	"
	L6	1 1/2"	No. 20	1/8"	1/8"	
Permanent coil used for all bands	L7	19 turns	No. 22	Close wound	1/8"	Wound on 1/2 in. coil form
	L8	8 turns	No. 22	Close wound	1/8"	





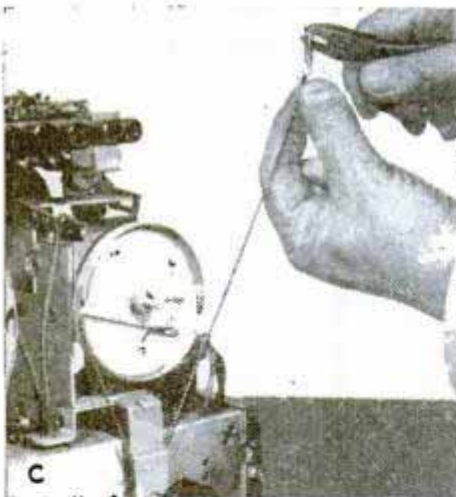
# Tuning-Dial Pointer and Drive-Cable Repairs



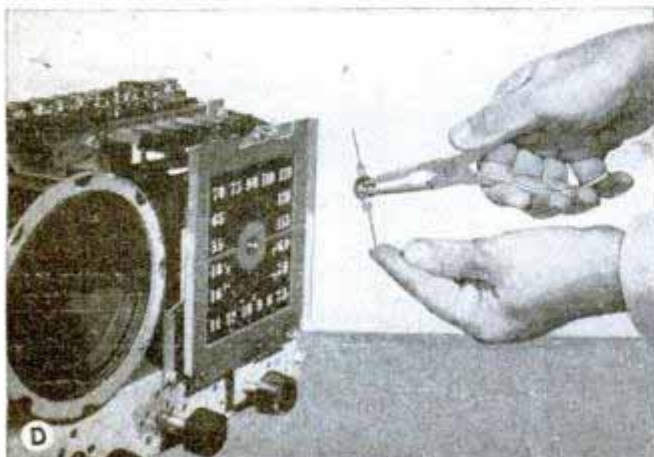
Tuning dial repairs are not difficult if proper precautions are taken to avoid disturbing the calibration of the dial and pointer. A convenient method of marking the pointer position before removing it from the shaft is illustrated in photo A. With the variable condenser plates fully meshed, place a small strip of adhesive tape on the dial and make a mark directly opposite the end of the pointer. It is then a simple matter to replace the pointer in the same position after the repairs have been made.



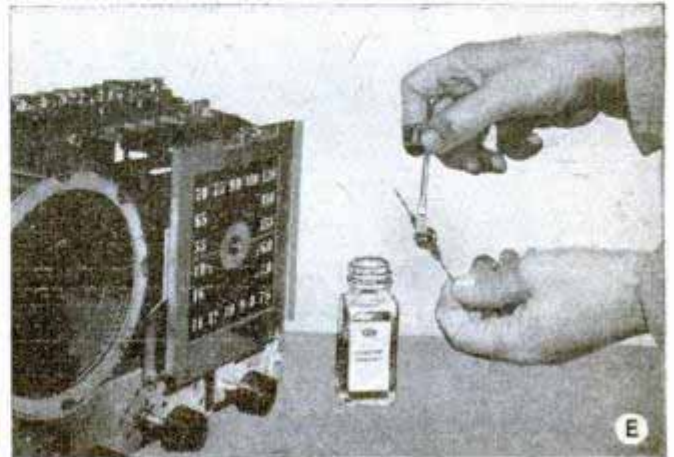
After removing the pointer and dial plate a new drive cable may be indicated if it is badly worn or too loose. If so, make a diagram of the dial-drive cable assembly, tracing the cord wrapped around the tuning shaft and drum as shown in photo B, before removing the dial cord; this will save time and avoid errors.



Even if the cord is broken it is often possible to determine its operation before removing the old cord. The system shown is fairly simple; others are more involved. If the dial cord merely is loose and slipping, a repair may sometimes be made by cutting off a small portion of one of the springs as indicated in photo C. When this spring on the end of the cord is reconnected to its hook on the dial drum, more tension will be placed on the cord. Another temporary repair is to apply rosin or a kitchen cleanser powder to the cord. Heavy fishline will often make an emergency cord or cable repair if standard dial cable is not available. Some receivers use special stranded phosphor bronze cable, others heavy linen cord. Permanent repairs on such receivers can be made by any good radio service man.



Loose dial pointers or indicators may be repaired by bending the clasps which fit over the shaft with a pair of long-nose pliers, as illustrated in photo D, to obtain a tight fit. Sometimes a light application of service cement, of the type used to repair speaker cones, is necessary, as indicated in photo E. In all cases when the pointer is replaced on the shaft make certain that the condenser plates are fully meshed and that the pointer is lined up with the guide mark. Install the set in its cabinet carefully and make sure that all chassis mounting screws under the cabinet are replaced correctly.



Blueprints covering radio and electronic construction articles in this and past issues are available for 25 cents each; detailed student material lists, additional general information and latest blueprint list can be obtained from our Radio and Electronics department without charge on receipt of ordinary letter postage





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RCA Victor table model television receiver with the exclusive "Eye Witness Picture Synchronizer" that assures you *brighter, clearer, steadier pictures*.



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# PERFECT TOOLS

for carving wood, plastics, linoleum or what have you—with special rigidity for heavy cutting

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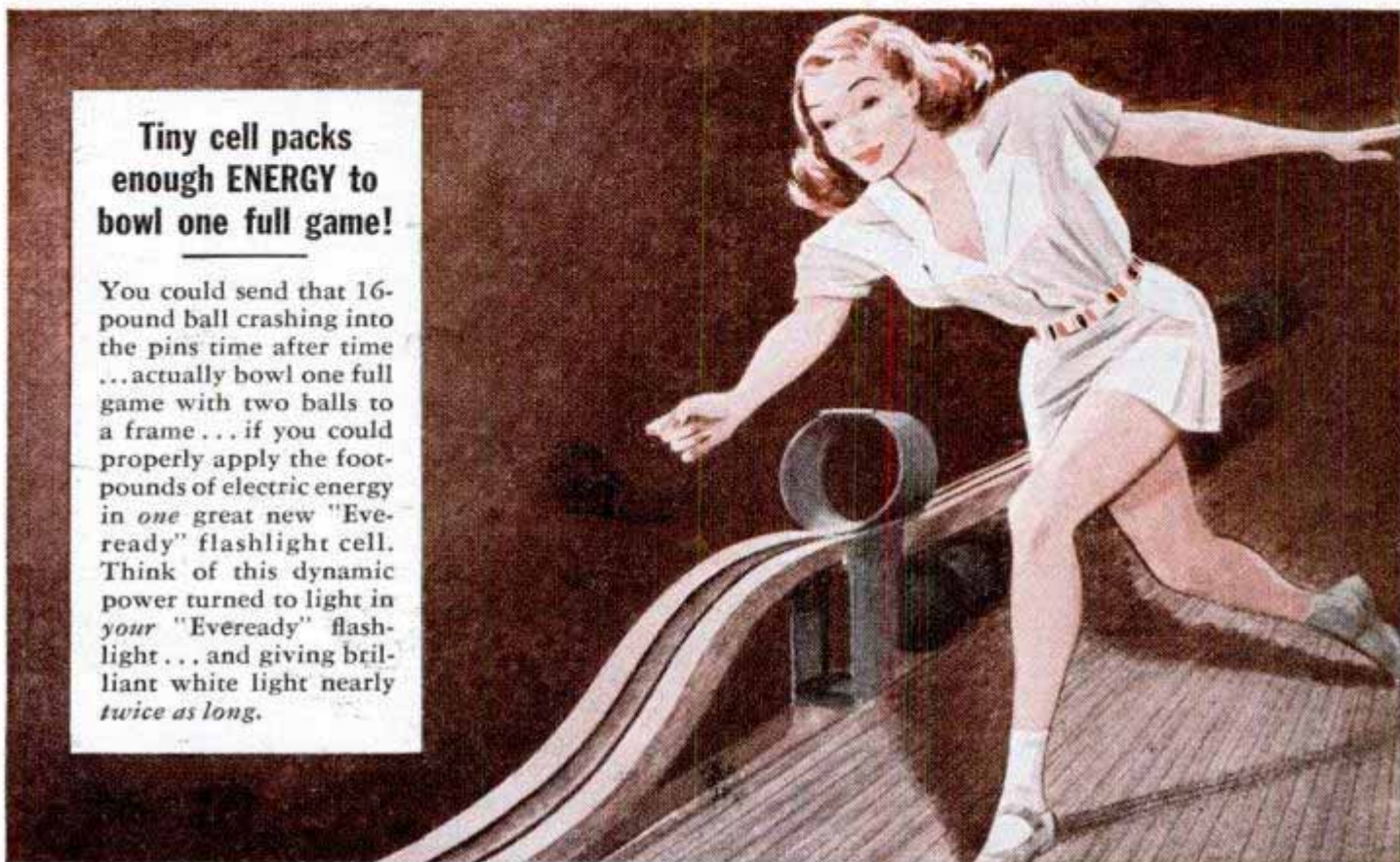


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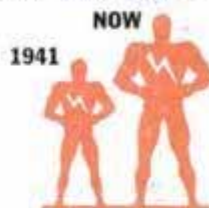
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**93% MORE ENERGY**

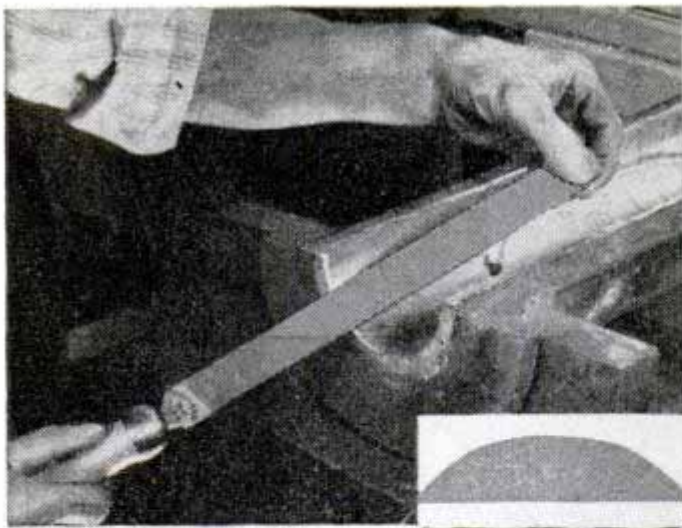


*High Energy* **MEANS**  
**BRIGHTER LIGHT, LONGER LIFE**

**EVEREADY**  
TRADE-MARK  
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Lead Float files are made in both Flat (rectangular cross-section) and Half Round shapes. In the above illustration, the Half Round back of a Lead Float file is being used to smooth up the concave edge of a babbitted bearing. This shape is also useful in reaming lead-pipe fittings and finishing off solder joints.

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## Your Next Tires . . . Synthetic or Natural?

(Continued from page 141)

outwear the new synthetics. Most rubber manufacturers, despite the highly touted synthetics, look back with nostalgia on the days of natural rubber.

With performance of synthetics adequate, the big tire companies will choose future rubber on the basis of price.

The cost of natural rubber in its hundred-year history has bounced like a rubber ball. Nothing in industry has been as unpredictable. In 1925 the price of rubber inflated to an all-time high of \$1.25 a pound. The depression pricked the price balloon and it collapsed to three cents a pound in 1932. The wobbly price factor is important when you consider that a one-cent variation means twenty million dollars to the American public.

Last year the government gave 23½ cents for the first shipment of natural rubber. In October, surprise negotiations with Great Britain resulted in delivery of the additional 200,000 tons at 20¼ cents a pound. Whether the price will continue to bounce and fall no one seems to know.

The price of GR-S can be predicted with reasonable accuracy. The wartime cost was about 40 cents a pound, but experts believe that new manufacturing methods and cheaper materials will reduce the postwar cost to 15 cents or lower. Synthetic rubber can and will compete with natural in price.

As a result the companies that turn out tires for your car will soon choose between the two types after evaluating prices quoted at that time. They'd rather use natural rubber but if the cost makes tire prices exorbitant they'll turn to synthetics.

Research men say that tomorrow's tires will be a combination of the two and far superior to today's synthetics.

John W. Thomas, chairman of Firestone, speaking for the industry as a whole, says "it is no trade secret that we expect ultimately to produce a tire that will last 100,000 miles. And it may be made of a substitute for natural rubber." Recently the Society of Automotive Engineers was told that the 100,000-mile tire is already being produced, provided it is given proper maintenance. In two or three years you may be able to buy a set of tires that will last as long as your new car.

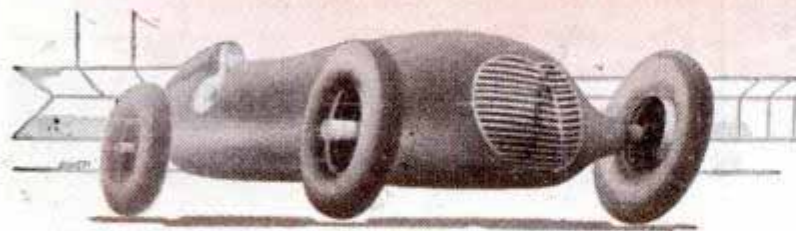
The price of natural rubber within the next few months will determine whether we'll be riding on natural or synthetic tires. Today's synthetics have proven to be good performers. If natural rubber is too costly we'll continue to ride the test tube stuff.



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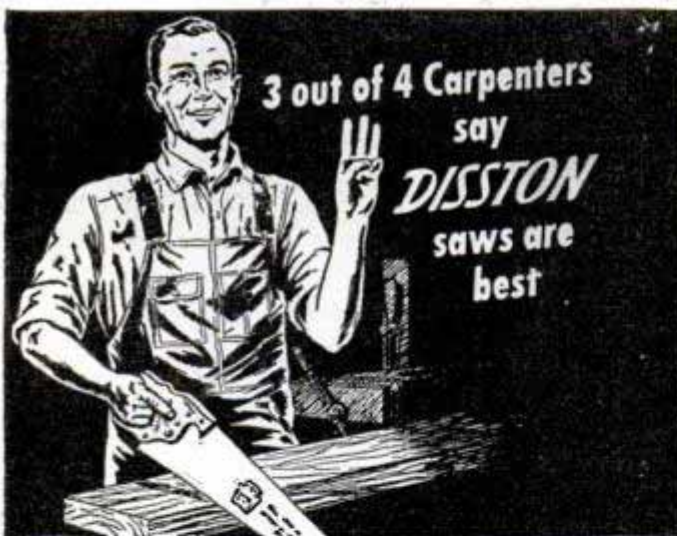
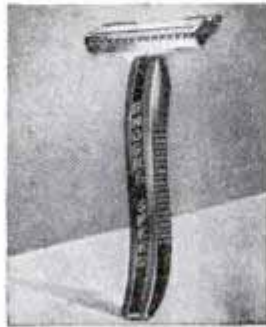
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and filed, and all saws carefully straightened. Send order  
and check today. Delivery will be made as promptly as con-  
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1/8"-3/16"-3/4"-3/8" wide, 5'6" long.....\$ .90 each  
3/8"-3/16"-3/4"-3/8" wide, 6'6" long..... .95 each  
1/8"-3/16"-3/4"-3/8" wide, 7'6" long..... 1.10 each

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a guiding mark  
Like lighted street  
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## BRUSH PLATING OUTFITS

for re-plating articles in the home and  
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## NUMBERALL Rotary Stamp

(Patented)

### 1 Tool Instead of 12

For stamping figures and letters on  
metal, etc. One stamp does away with  
12 individual hand stamps. Changes of  
characters are quickly made merely by  
rotating the indexed wheel. Wheel is  
made of finest tool steel. Sizes 1/16"  
to 3/16" figures can be furnished at  
\$5.00 each in pouch. Larger sizes and  
alphabet at higher prices. Write for  
Catalog.

**NUMBERALL STAMP & TOOL CO.**  
HUGUENOT PARK STATEN ISLAND 12, N. Y.



*"Just look at that paint!"*



**BILL:** Yeah, it *is* kind of cracking up.

**MIKE:** And I painted this garage the same time you did yours—last May.

**BILL:** What kind of paint did you use?

**MIKE:** Regular house paint. I don't remember the name. It's a brand I hadn't heard of.

**BILL:** There's your answer, Mike. You're always better off buying a *well-known* brand—with a name you can trust. Not only in paint but in tools and hardware, too.

**MIKE:** Well, maybe—but they always cost more.

**BILL:** Sure about that? Look—I won't have to paint my garage again for two or three years, but yours needs repainting right now. This time, take a tip from me and buy branded paint at the hardware store. Then you'll *know* it's good.

*Your HARDWARE DEALER  
sells QUALITY tools and  
hardware. Buy from HIM.*



**POPULAR MECHANICS**



# ANCO RAIN-MASTER

## "Dead-Locker"

### WINDSHIELD WIPER ARMS and BLADES

BLADE SNAPS ON...  
STAYS PUT

FINGER-  
TIP  
RELEASE



CAN'T FALL OFF  
CAN'T BLOW OFF

(A war-born invention—by ANCO—first  
for military aircraft—now for your car.)

## DON'T SHOOT YOUR GAS-PUMP MAN!

He's doing the best he can. Sure, he knows how dangerous it is for you to drive your car... in stormy weather... with your dull old windshield wipers that smear and smear. He'd gladly put on for you quickly a pair of keen new ANCO RAIN-MASTER Wiper Blades and Arms. He has them—Newest Models! But he forgets to remind you? Too busy? You can't shoot him for that!



PATENTS  
MAKE JOBS

After all, it's *your* car to protect. So *you* remind *him*. Get RAIN-MASTERS... patented features... original equipment on many makes of high grade cars and trucks... used in war—on our fighting tanks and trucks and ships and bombers too... because ANCO RAIN-MASTERS clean quicker, clean cleaner... last longer. May save you a costly smashup.

Ask for RAIN-MASTER Windshield Wiper Arms and Blades next time you buy gas.

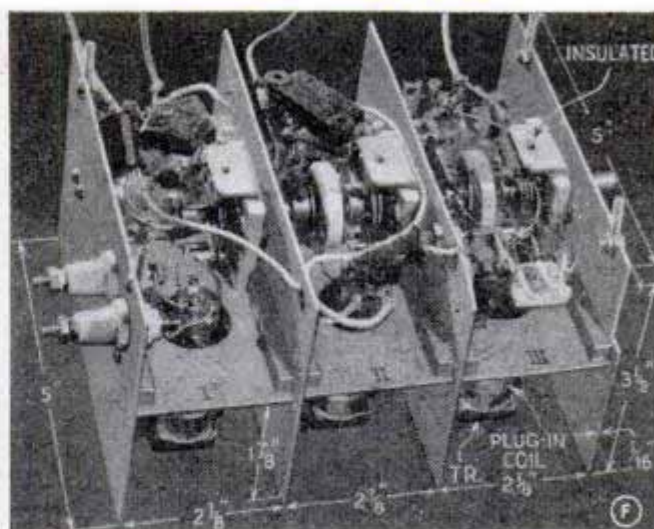
## THE ANDERSON COMPANY

Established 1918

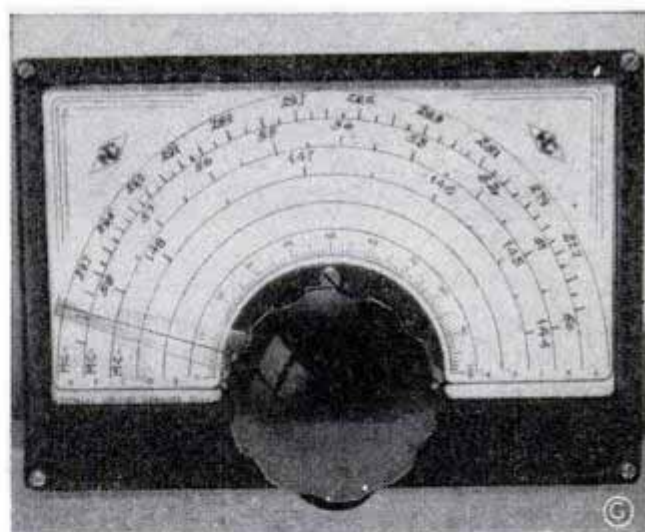
GARY, INDIANA

## How to Build a Converter for The New VHF Amateur Bands

(Continued from page 231)



variable condenser is separated from the oscillator and R.F. stage by means of flexible insulated couplings. The rotors of the mixer and R.F. stages are at ground potential while, on the other hand, the oscillator variable condenser is completely insulated, as indicated on photo F. The tuning control is a National-type ACN dial, photo G, which provides suitable space for hand calibration. Note, in coil chart No. 3, the length of wire is given in inches instead of turns.



To align the converter: with the oscillator tube and coil in position, adjust the frequency to the one in the coil group selected, less the I.F. frequency of 10,100 k.c. used. This can be done with a receiver or other measuring means, and the range should be at least from 15 to 85 on the dial. Alignment is similar to that of any superheterodyne after this I.F. frequency is set up. Detailed alignment steps are included in the student material list R-352 which is available from Popular Mechanics Radio and Electronics department upon receipt of ordinary letter postage.



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TREASURE  
CHEST  
NO. 130  
Price \$10.00

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KNIVES  
BLADES  
CARVERS  
ROUTERS  
PUNCHES  
SAWS  
SPOKESHAVES  
PLANES  
AND COMPLETE  
KITS

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*The Royalty of*

**KNIVES, TOOLS AND BLADES  
FOR HOBBY-CRAFT AND HANDICRAFT**

● These amazing new precision cutting tools, so expertly designed, so flawlessly made, so perfect in performance, will gladden your craftsman's heart. AT LAST . . . new blade shapes, new carvers, new routers, new punches (some never before available) . . . 22 in all—and each one different.

Each fits the simple yet skillfully designed aluminum handle featuring the tapered chuck with a vise-like grip. Plus King Kut's plane, curved and flat spoke shaves—all aluminum bodied. King Kut's cutting edges are made of the finest steel, expertly hardened, tempered, ground, honed and buffed to razor sharpness.

King Kut tools meet the same high standard of design and performance that champion hobbycrafters demand of themselves.

See your Hobby, Sporting Goods, Hardware, Art and other Stores for King Kut Tools.



HOBBY TOOL SET NO. 120  
... 6 blades, 6 carvers, 6 routers, 3 punches,  
1 saw, 1 handle and plastic knob. Price \$5.00

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Fair Trade Agreements.

King Kut Tool Sets range in price...  
\$1.00 to \$10.00

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THE  PARTS CORPORATION • TOLEDO, OHIO

Manufacturers of the famous  
AP Mileage Getting Mufflers



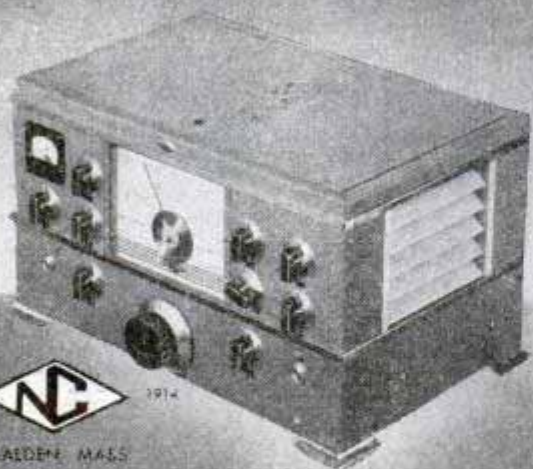
# RANGE

# RELIABILITY

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Flick the switch and turn the dial. Instantly you'll begin to sense how the "Three R's" combine in the 12-tube National NC-2-40D to bring you truly matchless performance. Range... to pick up station half a world away. Reliability... proved by the record of National sets on three-fourths of the Navy's warships. Research... untiring, never-ending, to bring you at last a thrilling new experience in radio reception. Hear the NC-2-40D for yourself. Write today for name of your nearest dealer.



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THE MOST DISTINCTIVE NAME IN RADIO COMMUNICATIONS

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• 4500 RPM

• Weighs 38-Lbs.



• COMPRESSOR OUTPUT is 1500 Lbs. High Pressure Low Volume

• IDEAL for Low Pressure Spray Gun

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Cost the Government over \$200 to build  
**BARGAIN \$15** for you

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in 10 to 24 foot sawing lengths. MECHANICAL FEED, accurate set works and positive dogs. Use tractor or old auto engine for low cost power.

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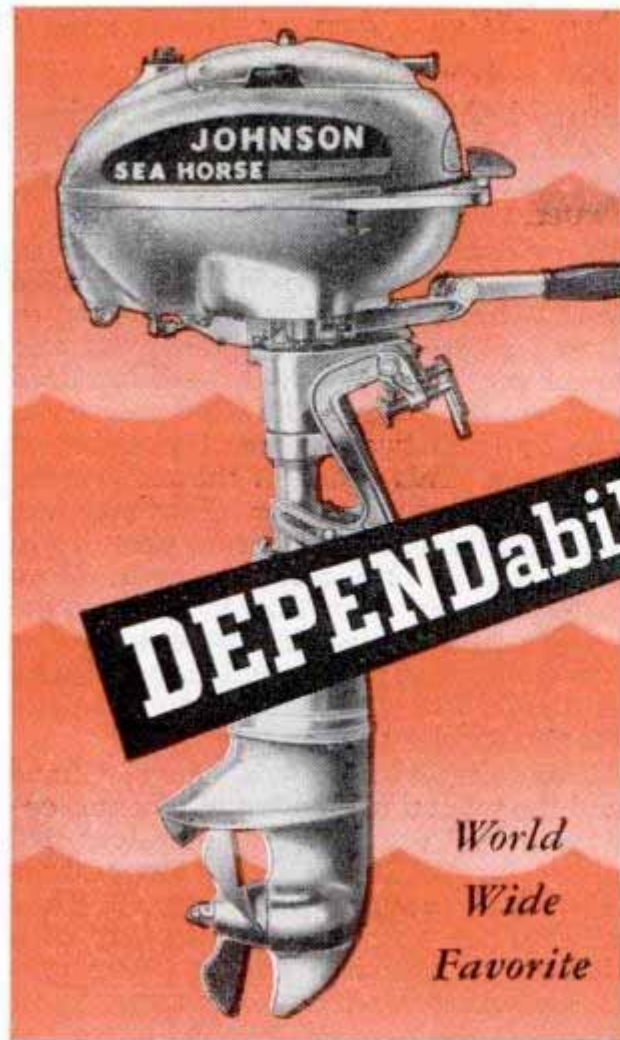
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Formerly \$15<sup>00</sup> - Now Only \$3<sup>95</sup>



GOV'T SURPLUS. A precision instrument. Easy turn of crank produces CLEAR, FULL SIREN TONE. Can be heard for great distance. Ideal for Boats, Autos, Schools, Sporting Events, etc. Dimensions 7" x 8" x 5". Wt. 4 1/2 lbs. Price includes shoulder strap and waterproof cover. SEND NO MONEY. Just name and address. We'll ship C.O.D. for \$3.95 plus postage, or send money in advance, we'll ship prepaid. Canadian price \$4.50. ILLINOIS MERCHANT MUSE MART, Dept. 400, 1227 Loyola Ave., Chicago 26, Ill.





JOHNSON is the outboard motor that leaves its wake around the world! Wherever men use boats the Johnson Sea-Horse is a familiar sight—because it is **DEPENDABLE**.

It offers users the simplicity and reliability of twin cylinder construction. It has all features that contribute to brilliant performance. Remember, outboard motoring's great improvements (Alternate Firing, Reverse, Dual Carburetion and others) are JOHNSON developments.

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*World  
Wide  
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**FREE HANDY CHART:** New. Describes the 1947 line. Write for it. See your Johnson dealer about delivery. Look for his name under "Outboard Motors" in your classified phone book.

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**1947 SEA-HORSE MODELS**

Small Alternate Firing Twin . . . 31 lbs. . . . 2.5 H.P.  
 Medium Alternate Firing Twin . . 44 lbs. . . . 5.0 H.P.  
 Large Alternate Firing Twin . . 70½ lbs. . . . 9.8 H.P.  
 Super Alternate Firing Twin . . 92½ lbs. . . 16.0 H.P.  
 Heavy Duty Opposed Twin . . 115¼ lbs. . . 22.0 H.P.

All H.P. ratings above are O.B.C. Certified Brake Horsepower at 4000 r.p.m.

**THERE IS NO SUBSTITUTE FOR EXPERIENCE**

**BUILD YOUR OWN FAST FREEZER** PLANS \$1.00

It's easy to build this household appliance and profitable to use. Save up to 75%. Operates on 110 or 32 volts. Plans show 5 sizes and are easy to follow. **ENJOY MAKING ONE OF** these freezers from new or used parts. No expert knowledge needed. Mail \$1.00 bill or check for complete plans and catalog.

**LE JAY MFG., 447 LeJay Bldg., Minneapolis 8, Minn.**

5 sizes  
8 to 40 cu. ft.

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**THE NEON GLOW** . . . LOCATES TROUBLE INSTANTLY in electric circuits, fuses, cut-outs, motors, radios, appliances. Tests everything electrical from 100 to 550 volts. Indicates hot or grounded wires. Tells AC from DC. Engineers prefer it because it has patented safety features.

**PUTS "FINGER" ON THE TROUBLE SPOT -- QUICKLY**

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**USE YOUR LEISURE TIME PROFITABLY with a BURGESS vibro-tool**

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**Vibro-Tool with Engraving Needle \$7.50**  
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Tool and 22 accessories, with sharpening stone, in handsome hinged hardwood box, complete for only **\$16.50**

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**Speed Sweep**  
**THE BRUSH WITH  
THE STEEL BACK**

Speed-Sweep brushes are replacing old style brushes in thousands of factories, warehouses, and stores because they sweep faster, cleaner and easier. Speed Sweep brushes also outlast ordinary brushes 3 to 1. There is a Speed Sweep to meet every requirement. Write for styles, sizes and prices today.

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Please send me complete information about Speed Sweep brushes.

Name \_\_\_\_\_

Address \_\_\_\_\_

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## Can Cities Harness the Wind?

(Continued from page 173)

withstand this speed, each of the three blades is supported by two braces. The propeller shafts will be geared to a centrally mounted generator.

The question of the pessimistic observer—"What will happen when the wind dies down?"—has been anticipated. The entire unit is free to swing atop the tower and face the prevailing wind. Several hundred feet above the ground, the wind velocity is generally from two to three times that at the surface. This is one of the reasons for an extremely high tower. Furthermore, the aerogenerator can operate usefully in wind as low as 12½ miles per hour. More important, however, is the plan to have the wind generator "tied in" with hydro or steam generating plants, which would take over should the wind become too weak to drive the turbines.

All investigators of wind power have found the wind undependable. Thomas envisions a "battery" of aerogenerators tied together, so that if one should stop, others will continue to supply electricity. Located several miles apart, the probability of a sudden calm descending upon every generator at one time would be remote.

There is the opposite problem—how to slow down the generator in a high wind. In the Vermont generator, the blades could be "feathered" like an airplane propeller. The speed of the propeller could be kept almost constant, no matter how high the wind velocity, by changing the pitch.

Since the blades on the new aerogenerator are fixed, and the turbine speeds will vary with the wind, a flexible electric link with the cooperating utility circuit was decided upon. This would control the speed of the turbine through automatic adjustment of the load on the generator according to the velocity of the wind.

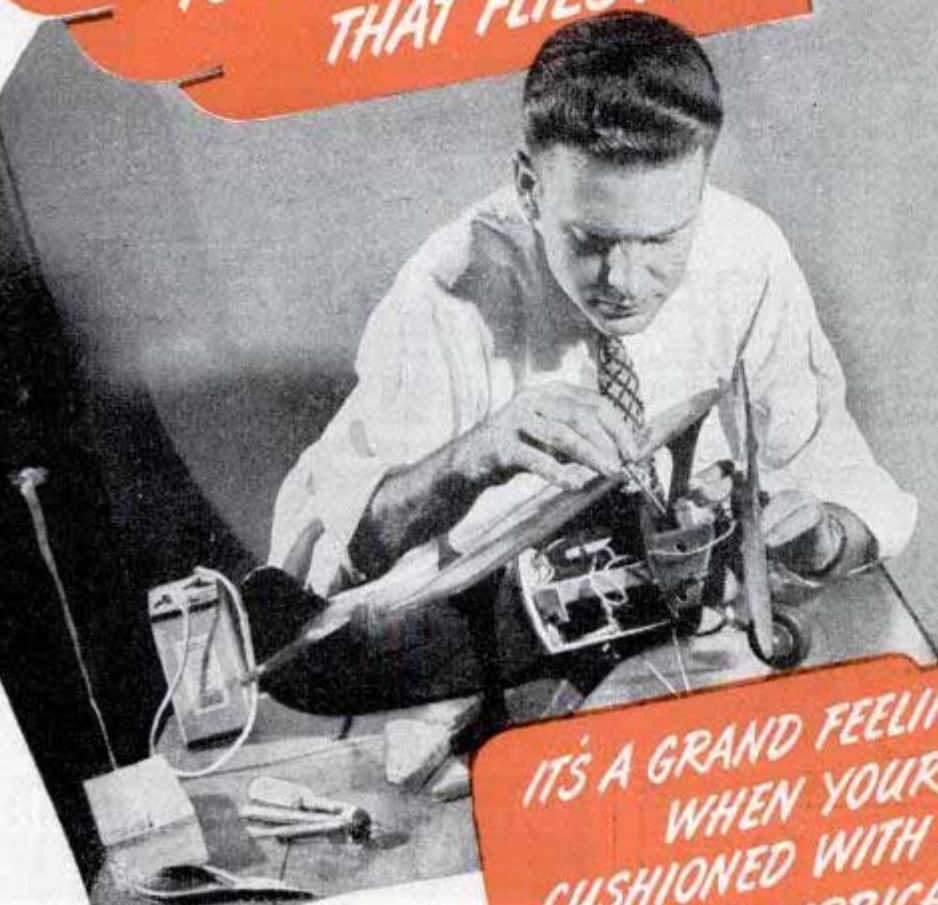
Safety devices are provided to protect the aerogenerator from damage in heavy winds. To prevent overloading the electric apparatus the turbine will slow down automatically in "over winds," and the entire unit will turn out of the wind when the velocity becomes excessive.

The War Production Board in 1944 authorized a research project at New York University based on Thomas' early reports. Four different two-blade wind-rotor models were tested in a 7 by 10-foot tunnel at the university. The researchers also designed their own 100-kilowatt wind turbine to enable the U. S. Army to determine the utility of such equipment as fuel savers.

(Continued to page 248)



IT'S A GRAND FEELING,  
TO BUILD A MODEL  
THAT FLIES...



IT'S A GRAND FEELING, TOO,  
WHEN YOUR CAR IS  
CUSHIONED WITH MARFAK  
CHASSIS LUBRICATION

... AND **MARFAK'S** CUSHIONY FEELING LASTS LONGER

It's a grand feeling to have an interesting hobby... the same grand feeling you get from your smooth riding *Marfak* lubricated car.

*Marfak* is scientifically designed to cling to bearing surfaces, resist wash-out, jar-out and squeeze-out and stick to the job for a thousand miles and more. See your Texaco Man today, and say: "*Marfak*, please!"

**TEXACO DEALERS**

in all 48 states



THE  
TEXAS  
COMPANY

Tune in: { TEXACO STAR THEATRE presents the Eddie Bracken show every Sunday night.  
METROPOLITAN OPERA broadcasts every Saturday afternoon. See newspapers for time and stations.



**GO PLACES!  
DO THINGS with**

**Cushman**  
MOTOR SCOOTER

9 out of 10  
Motor Scooters used by  
U. S. Armed Forces  
were Cushman



Solo-seat Tandem,  
Side Kar Package-  
Kar Models

On highways, in town, on the farm, at the factory, for deliveries, service calls . . . go the Cushman modern and economical way. Cushman Motor Scooters are speedy, safe. Park anywhere. "Eye-dropper" gas economy. Ruggedly built with automatic clutch, two-speed transmission, 4 H.P. Cushman "Husky" engine. Balloon tires and knee-action springing give easy riding, load carrying capacity. Convenient luggage compartment.

**FREE** Send for literature and name of your nearest Cushman dealer. Write post card today.

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UP TO  
**400 MILES**  
ON A  
**\$100**  
WORTH OF  
GAS

**BACKED BY 45 YEARS OF  
QUALITY ENGINE BUILDING!**

**IMMEDIATE  
DELIVERY!**



**\$19.95**

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ROYERSFORD, PA.

**8 in. BENCH SAW**

COMPLETE AS SHOWN

**TABLE SEGMENT**—Shows degree of table tilt—graduated. **SPLITTER**—Hard temper cold rolled steel. **GUARD**—Aluminum. **MITER GAUGE**—Aluminum. Accurately graduated 45° each side of center. **BEARINGS**—(2) Oil-ite bronze. **CAPACITY**—0 to 2 3/4". **TABLE** 12"x14". **SHIPPING WEIGHT**—44 lbs.

This Price is Below the Authorized O.P.A. Ceiling

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## FLUID PUMP

At last, a dependable, low priced coolant pump for machine tools. Fully guaranteed by old, reliable manufacturer.

Constructed of non-corrosive materials. Plastic screen quickly removed for cleaning. With this pump and small pan for fluid you obtain same results as with expensive equipment.

May be used for Evaporative Coolers, Fountains, Displays, etc.

DEPT. M **\$19.50** POSTPAID

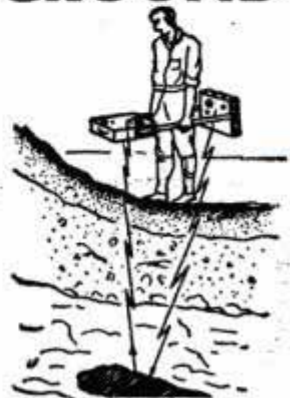
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## MACHINE SHOP EQUIPMENT



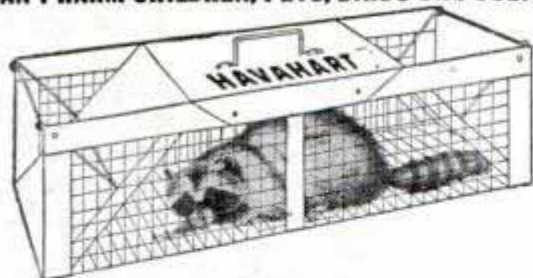
Just off the press!—Every man who owns a workshop should have a copy of the new, up-to-the-minute, 200 page catalog of Machine Shop Equipment—the latest tools made by the biggest manufacturers in the U. S. Replete with illustrations, descriptions, prices. Prompt delivery on most tools listed in this book. Available at cost of printing—50¢ a copy—get yours today! **Price of Catalog Refunded on First Order over \$5.00.** Send check or Money Order to

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# AMAZING NEW TRAP

CATCHES ALL KINDS OF ANIMALS.  
CAN'T HARM CHILDREN, PETS, BIRDS OR POULTRY



Amazing all metal galvanized "Havahart" traps beat snap traps all hollow for farm and estate use. Your good dog can't lose a toe in these traps and it's easy to return the neighbor's cat or turn your own loose unhurt.

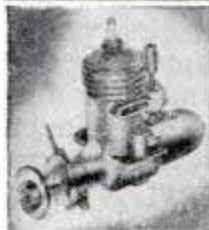
This trap works like the old box trap except it opens at both ends so the animals can see all the way through and get a feeling of confidence.

No springs to break. Some have given continuous service for over ten years.

A trap set continuously near the chicken coop will pay for itself very quickly.

Send card today for illustrated price list.  
HAVAHAART, 407 Water St., Ossining, N. Y.

## New THOR "B" ENGINE-\$6.95



The new THOR "B"—Sensational miniature gasoline engine that really works. Super-power performance. Smooth, velvety power that roars into action with a "twist of the wrist." Over 20,000 already sold. 1/6 H.P. Complete with coil and condenser. Ready to run, only \$9.95. In KIT form, fully machined, 5 minutes to assemble, \$6.95, without coil and condenser. Powers all models. Fully illustrated instructions. Send \$1.00—shipped collect same day C.O.D. or send full price plus 25c extra and we ship parcel post insured.

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LEPAGE'S MODEL AEROPLANE GLUE

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Wonderful for Homes,  
Cabins... Trailers...  
Wherever hot water  
is wanted QUICKLY

### ELECTRIC WATER HEATER

Immersion type... drop it into the water... it heats a basin or a sinkful pronto. 110 volts AC-DC. Comes with extra long heavy duty water-proof cord. Weighs 11lb. We'll mail it C.O.D.

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Plus C. O. D.  
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use **PLASTIC WOOD**



in your  
**HOME WORKSHOP!**

If you'd like a satiny smooth, professional finish on your next cabinet job—use Plastic Wood! It's an ideal filler for cracks or rough grains, dries tight and hard, sands to a swell finish and takes paint, lacquer or varnish perfectly. Here's an extra hint—knot holes or gouges just disappear when this handiest filler is used! Handles like putty—hardens into wood!

... dozens of other uses

FOR FILLING...

FOR REPAIRING...

- Countersunk screws
- Chipped furniture
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- Loose casters
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Tube or Can

A CELLULOSE FIBRE FILLER



**Now, Simoniz  
in Colors . . .  
TO MATCH YOUR  
FURNITURE AND WOODWORK**



**Easily Applied With A Cloth. Quickly  
Rubs Up To Rich Luxuriant Luster**

See how Household SIMONIZ brings out the radiant, satiny luster. A protective beauty for furniture and woodwork that helps cover scratches, lasts so much longer, requires so little care. Apply in the shade that matches the finish. Then soiled spots, spilled things, fingerprints . . . all disappear with the swish of a damp cloth. Never an oily film or stickiness to attract dust and dirt. Try this new, improved care that matches the beauty of your finest finishes . . . Household SIMONIZ in Colors.

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**SIMONIZ**  
*in Colors*

**FOUR BEAUTIFUL COLORS  
TO MATCH ALL FINISHES**

- NEUTRAL** . . . For bleached and light woods
- MAPLE** . . . Also for light oak, birch, pine
- WALNUT** . . . Also for dark mahogany, oak
- MAHOGANY** . . . Also for cherry, redwood

THE SIMONIZ CO., CHICAGO 16, ILL.  
"SIMONIZ" . . . Trade Mark Reg.  
U.S. Pat. Off. & Foreign Countries



From these studies it was concluded that wind turbines of about 100-kilowatt capacity would save 150,000 pounds of fuel oil per year at overseas military bases, or up to 250,000 pounds under favorable wind conditions.

The war's end, however, stopped further consideration of wind-power turbines for our overseas forces. The proposed overseas wind generator was to be mounted at the top of a steel tower about 72 feet high. Two blades, each 23 inches wide and 24 feet long, sweeping a circle 60 foot in diameter, would drive the generator.

The Thomas plan for commercial power production calls for a supplementary Diesel engine driving a 100-kilowatt synchronous generator matched to the induction generator atop the tower. This synchronous generator would furnish excitation current to the induction generator. It would also pick up the load as the wind decreased and power furnished by the induction generator fell off.

Operating constantly when there is sufficient wind, the Thomas generator will save coal or water of the cooperating power plant. If the wind dies down to a point where the aerogenerator cannot function properly, the stand-by plant will take over.

Although this would appear as a rather expensive approach to getting low-cost power, the abundance of wind—which is free—makes the aerogenerator economically feasible. The United States Weather Bureau and the Bureau of Reclamation are preparing studies of wind characteristics at certain locations, so that the generator can be placed most efficiently.

**Oven-Baked Gems for Industry**

*(Continued from page 166)*

of glass or imitation stones and still within the reach of those for whom natural stones are a financial impossibility. Physically and chemically identical with the natural materials, synthetics are far above the ordinary run of "costume" gems and can be purchased for a fraction of the cost of the real thing.

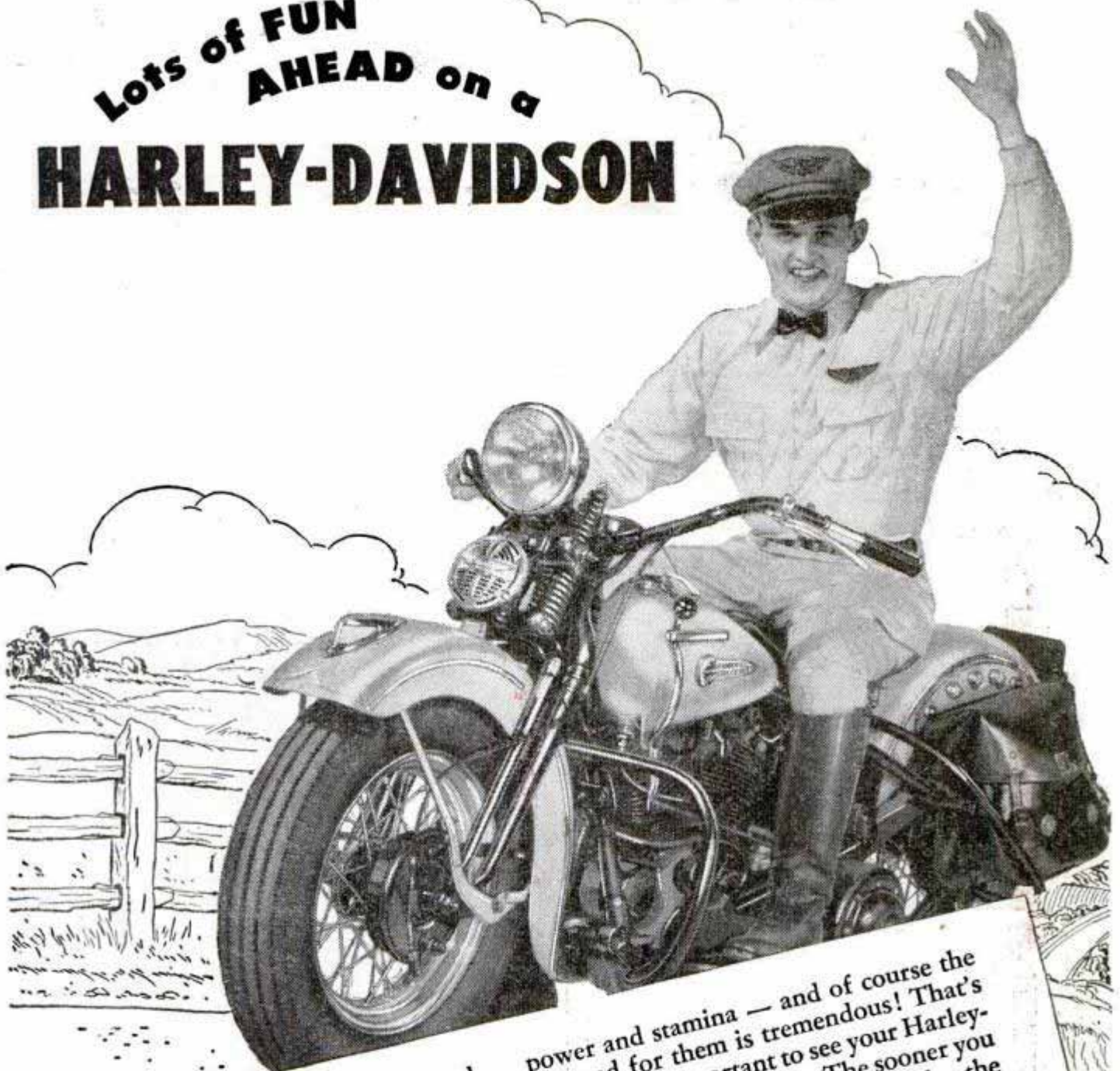
If you've been proud of a sapphire ring in the past, how would you like to own an entire watch crystal of pure sapphire? Such crystals have been produced in both clear and tinted shades. Before the war they sold for about five dollars.

There's a wide field for the gems in industry. In hardness, synthetic sapphire approaches diamond, the peer of the mineral kingdom. Man-made sapphire has a tensile strength equal to that of mild steel

*(Continued to page 252)*



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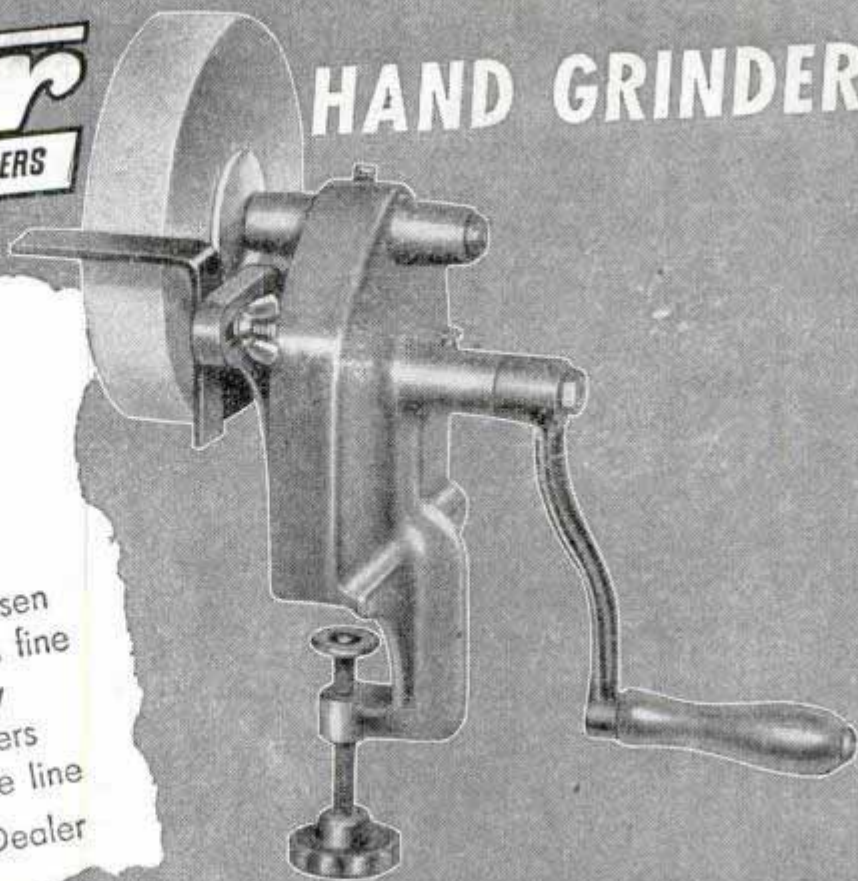
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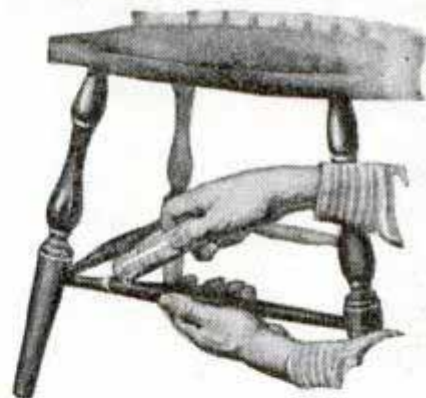
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and a resistance to crushing loads exceeding that of steel. It takes a more-than-mirrorlike polish, does not scratch easily and is not subject to the corrosive effects of most acids.

It's long been a saying in the synthetic jewel industry that "wherever there's friction there should be a sapphire." Fine watches, of course, will account for thousands of jewels every year. In addition, thread guides for the rayon industry are already being made of sapphire. The guides last indefinitely and don't develop the ragged spots that cut down the efficiency of steel guides.

Synthetic sapphire is also winning a place in the medical field. It aids in the ultraviolet treatment of blood plasma and serums because it transmits ultraviolet rays more efficiently than any other known material.

Sapphires are used in inexpensive master gauges for checking the accuracy of other gauges. Sapphire gauges maintain an accuracy of 0.00001-inch tolerance and outlast glass, tool steel and other materials.

The synthetic gems are going into extrusion dies, long-life tools for the precision machining of metals, phonograph needles with long-run performance and bearings of all kinds. Wherever a smooth, ultrahard, long-lasting, wear-resistant substance is needed you'll soon find synthetic sapphire.

**Germ Warfare Against Bugs**

(Continued from page 120)

Coast and was then checked by the artificial spreading of a beetle that attacks only that plant is an illustration of what is possible. Scientists are going after the prickly pear cactus with good results, and they hope additional research will help in the control of other weeds, particularly those affecting range lands and pastures.

In the chemical warfare field, one important development is a new soil fumigant that kills off wire worms and other nematodes in most soils. Nematodes are among the most widely spread of all agricultural pests and have been difficult to control. They attack some 1500 plant species, including cabbages, potatoes, tomatoes, corn, rice, citrus, peanuts, tobacco, pineapples and sugar beets. They are found in practically all tropical and semitropical regions and are a serious pest in the southern and southwestern parts of the United States.

Produced by Shell Chemical Corporation, the new soil fumigant is injected into the soil in spoonful quantities. The fumigant spreads through the earth, killing

(Continued to page 256)



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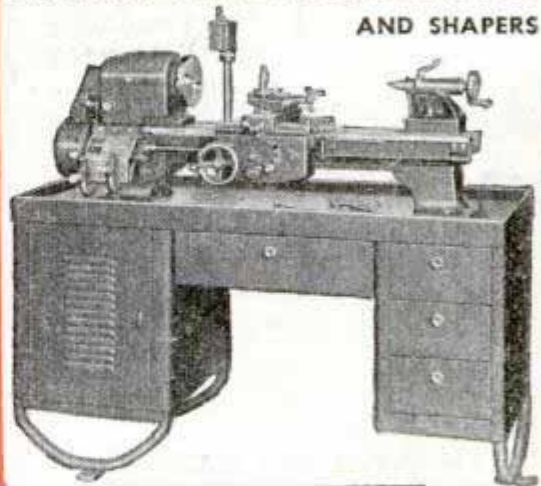
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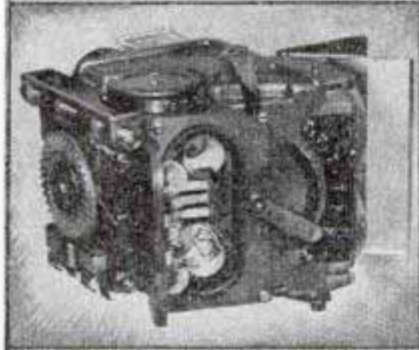
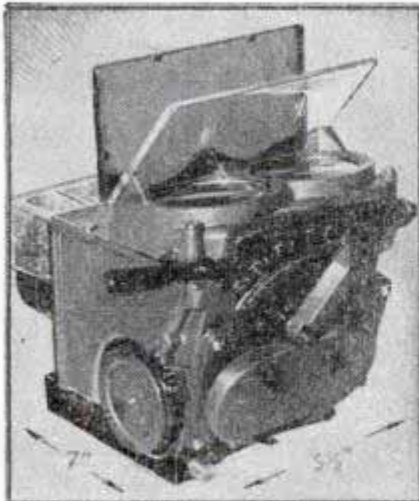
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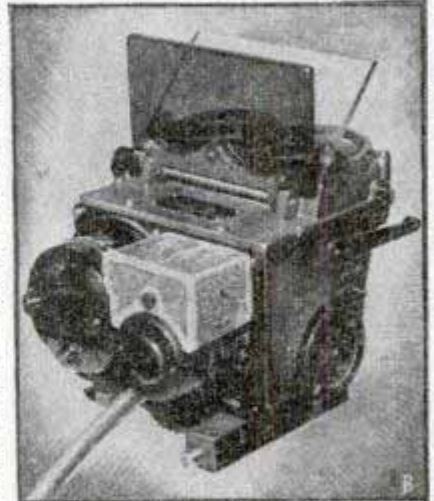
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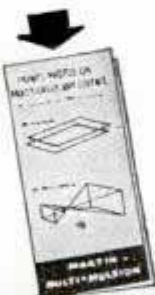
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soil pests and some few weed seeds. Within two weeks the fumigant has disappeared and the soil may be cultivated and seeded.

Results of the treatment in nematode-infested areas are spectacular. Soil that formerly produced 816 pounds of sweet potatoes to the acre produced 13,860 pounds after fumigation. Sugar beet production jumped from an original three tons to 17 tons per acre. Peach trees increased their yield 10 times. Lettuce, lima beans, carrots, beets and squash multiplied their yield by an average of six times.

Known as D-D, the fumigant is a by-product in the manufacture of certain plastics and is technically a mixture of dichloropropane and dichloropropylene. A few dollars' worth is enough for treating a 2000-square-foot plot. A stick for making a hole in the ground every 15 inches and a spoon are the only tools needed, or a special injection device that resembles a giant syringe may be used. Large acreages are disinfected by means of tractor-drawn equipment that makes the injections at the proper spacings. Often the tractor equipment does two or more jobs at the same time, such as fumigating the soil with D-D and also making injections of liquid or gaseous ammonia, now used as a fertilizer because of its high nitrogen content.

Interested in finding new uses for petroleum by-products, Shell has established a modern \$500,000 agricultural laboratory at Modesto, Calif., where it is testing the possible uses in agriculture of a wide range of organic and synthetic chemicals. The D-D soil fumigant is one such product. Continued research may produce other fumigants to destroy plant disease organisms in the ground, as well as destroying many kinds of weed seeds.

Dr. Roy Hansberry, director of Shell's new laboratory, is optimistic about a new group of oil-type vapor sprays for use against agricultural pests. The oil vapors are simply an improved vehicle for carrying pyrethrum, rotenone, DDT or other insecticides to crops that are threatened by insects. The oil particles in the vapor adhere to plant surfaces for a minimum of a week and in some cases are effective up to several months. The spray may be used effectively in wind conditions that limit dusting or the use of aerosols. It needs no bulky admixture such as water. From four to seven gallons per acre are effective for most crops, as against some 300 gallons of water spray per acre in the case of potatoes.

Among other implications, this means that the costs of applying insecticides by the use of aircraft can be slashed to the

(Continued to page 260)

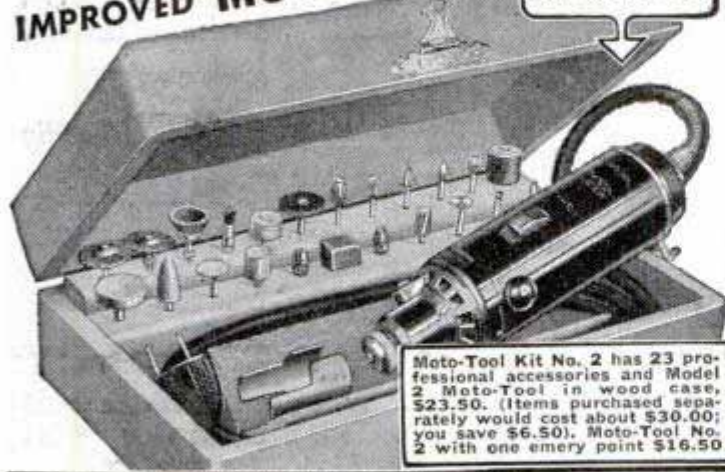




# OWN A "POCKET SIZE" MACHINE SHOP

## IMPROVED MOTO-TOOL

APPROXIMATELY  
27,000 R.P.M.  
CUTS CLEANER;  
SAVES CUTTERS



Moto-Tool Kit No. 2 has 23 professional accessories and Model 2 Moto-Tool in wood case, \$23.50. (Items purchased separately would cost about \$30.00; you save \$6.50). Moto-Tool No. 2 with one emery point \$16.50

## "MAN...WHAT A POWERHOUSE!"

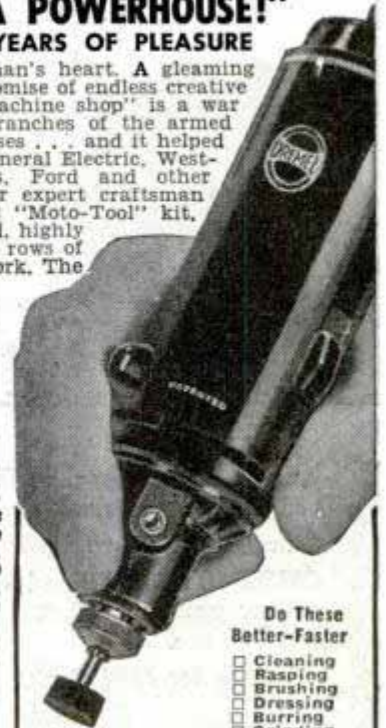
### A TOOL THAT PACKS YEARS OF PLEASURE

Here's a tool to please a man's heart. A gleaming "powerhouse" that holds promise of endless creative hours. This "pocket-size machine shop" is a war veteran... used by all branches of the armed forces in far flung repair bases... and it helped set production records at General Electric, Westinghouse, Remington Arms, Ford and other plants. Hobby enthusiast or expert craftsman... first choice is Model 2 "Moto-Tool" kit, with its handsome, felt-lined, highly finished wood case... with rows of tools begging to be put to work. The usefulness of "Moto-Tool" for precision work is increased by two versatile attachments now available at slight additional cost (see below).

### Look For These

#### Moto-Tool Features

- Housing has "pencil-type" finger grip
- Instant-action, wrenchless chuck
- Oil-less, sealed, trouble-proof bearings
- Patented automatic chuck lock pin
- Oversize armature shaft, hardened, ground and polished
- 110 volt, universal type motor
- Easily replaced commutator brushes
- Sliding snap type switch
- Handy hanger hook
- Cord protector
- Sturdy, shockproof bakelite housing
- Dust-filtered, air-cooling system
- Weighs only 13 oz. . . . shaped to fit the hand
- Dynamically balanced for vibrationless operation.



#### Do These Better-Faster

- Cleaning
- Rasping
- Brushing
- Dressing
- Burring
- Grinding
- Routing
- Sanding
- Drilling
- Inlaying
- Sawing
- Scoring
- Cutting
- Carving

### Free Both Hands With Moto-Tool Attachments



Moto-Tool Stand (left), made of heavy cast iron, holds Moto-Tool at any position or angle. \$4.50



Moto-Tool Shaping Table \$2.50. (Shown with stand, right). Aids accuracy in routing and grinding.

### MONEY BACK GUARANTEE

Buy Dremel "Moto-Tool" and Accessories from your dealer. If he does not handle them, order direct from the factory on a 10 day trial, money back guarantee.

DREMEL MFG. CO., DEPT. 117-B, RACINE, WISCONSIN



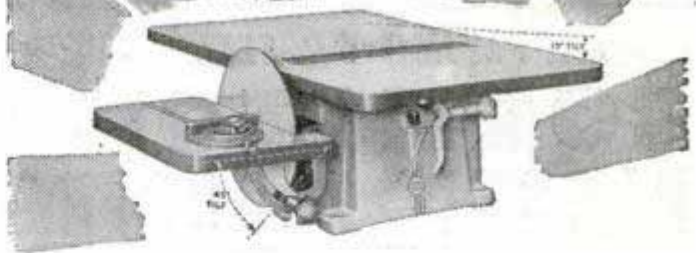
## Appliance \$10<sup>95</sup> Tester

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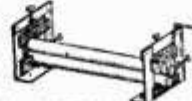
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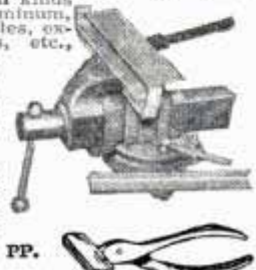


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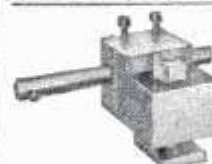
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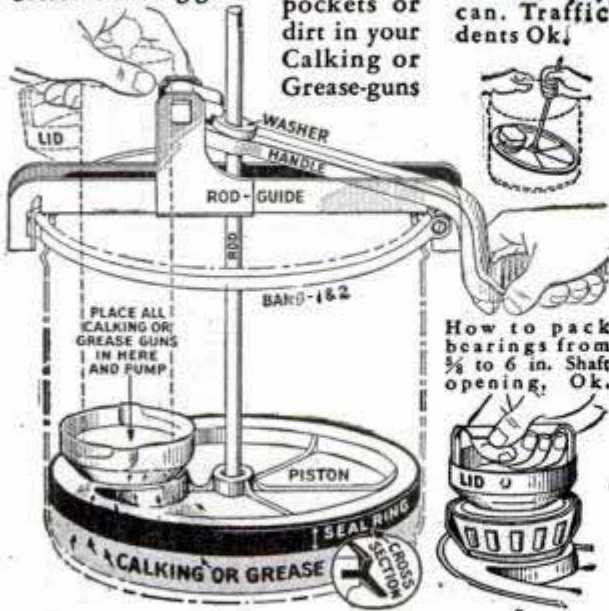
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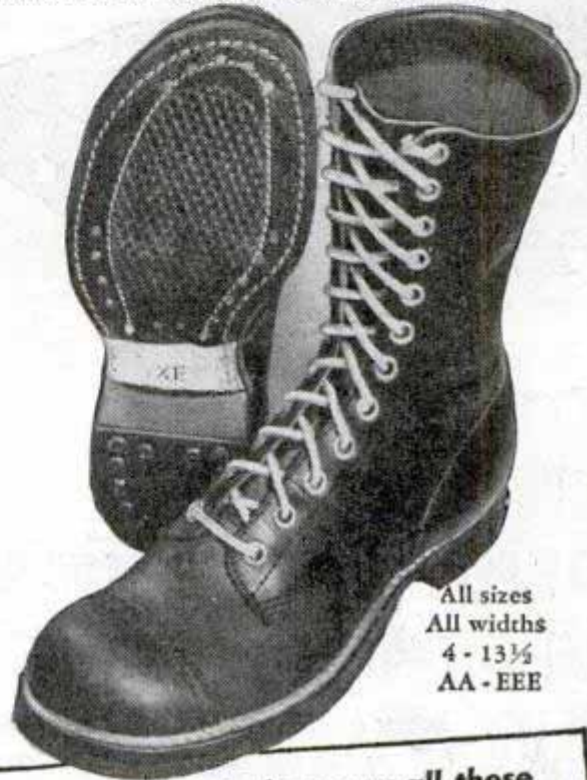
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- Made of soft, pliable leather with extra heavy oil water-proofing.
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bone. Carrying the concentrated oil vapor spray, an airplane can cover far greater acreage per trip than has been possible in the past. One pilot can spray 20 acres in five minutes, in one short trip, as against several trips for reloading that he formerly needed to make.

Application costs, in fact, are so low that for the first time it is economical to conduct chemical warfare against destructive pests that infest forests, swamps, range lands and huge grain fields.

## Edison Started Something

*(Continued from page 157)*

Then, in 1906, the Victor company made the first Victrola with the horn inside and cabinet styled as a fine piece of furniture.

Edison resisted these changes. He refused to put the awkward horn inside the cabinet and he held out for the clumsy cylinder records. As a result, sales of the Edison phonograph dropped out of sight. It was not until 1914, eight years after his competitors, that Edison agreed to restyle his machine. He agreed then only because he needed revenue to pursue new experiments and the only way to get money was to increase almost nonexistent Edison phonograph sales.

His invention of the incandescent electric lamp on October 21, 1879, is generally regarded as his greatest achievement. After he had produced the lamp, he had to devise an electrical distribution system for it. This he did, complete with dynamos, conductors, fuses, meters and sockets. More than a third of his many patents dealt with electric lighting and power distribution.

Because the first Edison electric company did not expand rapidly enough to suit him, he organized a pioneering department. His department paid for installation of lighting in small communities and then sold the system to local management. Illuminating gas companies fought with advertising pointing out that electric lamps could not be "turned down like a gas jet." Edison countered with the argument that electric lamps could not be blown out. Near all open illuminating gas jets there was a printed warning, "Don't blow out the gas." Too often just the opposite happened with the result that the person who disregarded the warning usually "went out," permanently, a few hours later.

In manufacturing lamps, Edison set standards for mass production methods acclaimed as the basis of American economy. He estimated that quantity manufacture of lamps at 40 cents each should yield a sub-

*(Continued to page 264)*



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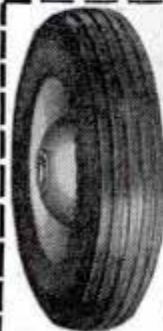
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It's THE Triple Action Oil Lubricates Prevents Rust Cleans

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## A TOOLSHOP IN YOUR HAND!

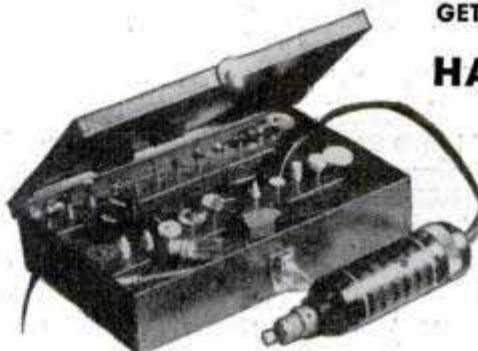
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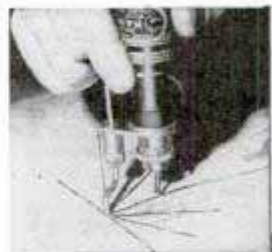
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**BETWEEN YOU AND THE COLD**

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Just press into place. Use inside or outside. Can be painted. Mortite does not shrink or crack. Also plugs cracks around drainboards, bathtubs, etc.

Roll covers about 80 feet, enough for 5 windows.



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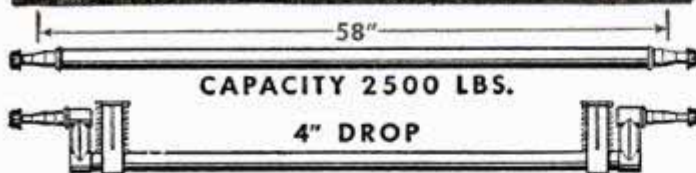
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NEW TYPE — LIGHTWEIGHT — HEAVY-DUTY STRENGTH

**UTILITY TRAILER AXLES**



CAPACITY 2500 LBS.

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Build your own utility trailer and equip it with a Ride-Rite axle. Get the advantage of its new lightweight, heavy-duty tubular construction. Available with or without patented double-coil spring suspension. Straight axle has standard 58" tread; drop axle has 60" tread. Distance between spring hangers 48" on both axles. **BIG CAPACITY:** Axles made of 1 1/2-inch O.D. steel tubing have tested load capacity of 2500 pounds. Coil springs, four per axle, have minimum capacity of 650 pounds each. Ride-Rite axles will fit hubs and wheels made by Motor Wheel Corp., Kelsey Wheel Co., Ford Motor Co., and Industrial Machine Tool Co.

PRICED LOW AS  
**\$6.75**  
PRICES F.O.B. FENTON, MICH.

Remittance with order —No C.O.D.	Axle Only	Axle with Springs
Straight Axle, Std. Tread	\$ 6.75	\$19.70
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Axles can be furnished any tread desired for slight additional cost.		

Write for descriptive literature  
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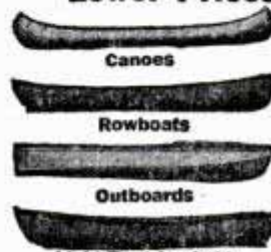
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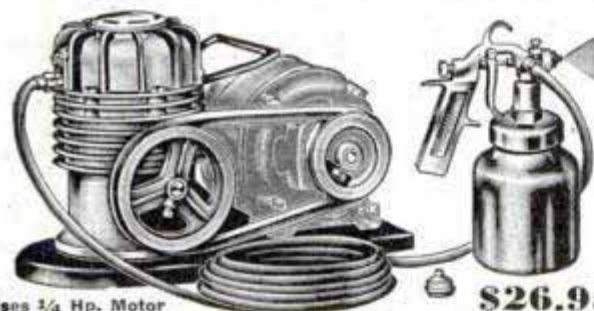


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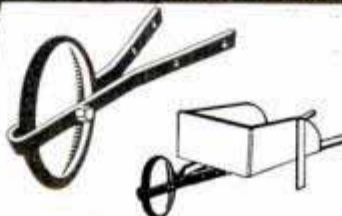
### U-BUILD-'EM BIKE TRAILER



Tru-Ball Bearing, steel welded rubber-tired wheels. Holds heavy loads. Complete with nuts, bolts and chassis. Attach box for a sturdy **BIKE TRAILER**.

No. 88 . \$8.00  
complete with  
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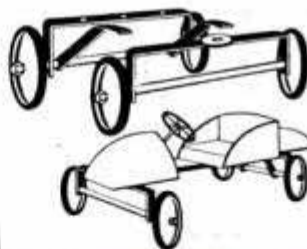
### U-BUILD-'EM WHEELBARROW



9" steel-welded wheel . . . rubber tires. All metal parts . . . you supply the wood for rugged **WHEELBARROW**.

No. 68 Ball Bearings \$3.50

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Everything but the wood . . . 9" steel-welded wheels . . . rubber tires. Complete with bolts, nuts, washers.

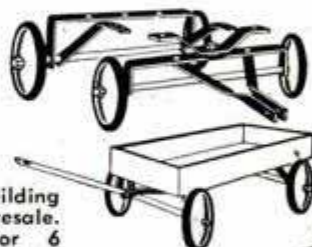
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Make a business of building Practo vehicles for resale. **SPECIAL DISCOUNT** for 6 units or more. Write at once!



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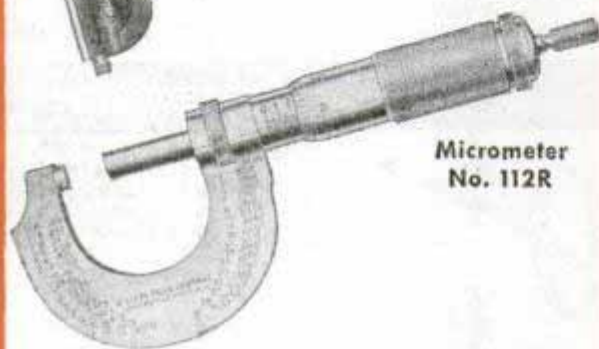
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**MAKE PRECISION WORK**  
*easier with*  
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Combination Set  
No. 391



Micrometer  
No. 112R

Here are two of the finest and most useful precision tools in the Millers Falls line—tools with many special features to simplify your work. Like all Millers Falls products, they are quality-built throughout and assure precision accuracy.

The combination set (No. 391) has a beam, a center head and a protractor. The blades are tempered steel.

The micrometer (No. 112R) has a cut-away frame to permit measurements impossible with regular frames, a lock ring, and a speeder. Decimal equivalents are etched on the frame. Measures by 1/1000 of an inch from 0 to 1".

Millers Falls also makes steel rules, thickness and screw pitch gauges, calipers, dividers, depth and surface gauges, and many other machinists' tools. See your dealer.

**One Thing In Common - Quality!**



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stantial profit. The first ones cost him \$1.25 each and he lost 85 cents on each of 20,000. The next year he lost 30 cents on each and the third year, 10 cents. By the fourth year, production was so high that he made a profit of three cents on each and sold enough to repay all losses. Soon he made them for 22 cents and earned a profit of 18 cents on each of millions.

Time has wrought many changes in the descendants of inventions that first saw the light in Edison's workshop. Science and industry have moved ahead at a fast clip in the search for perfection. But there is one Thomas A. Edison record which no one has improved upon: the 1097 patents granted him are by far the greatest number ever awarded to one individual.

## Waterloo for the Atom

(Continued from page 102)

million electron volts; deuterons (the nuclei of heavy hydrogen atoms, consisting of a proton and a neutron) of 200 million electron volts; and alpha particles (the nuclei of helium atoms, consisting of two neutrons and two protons) of 400 million electron volts.

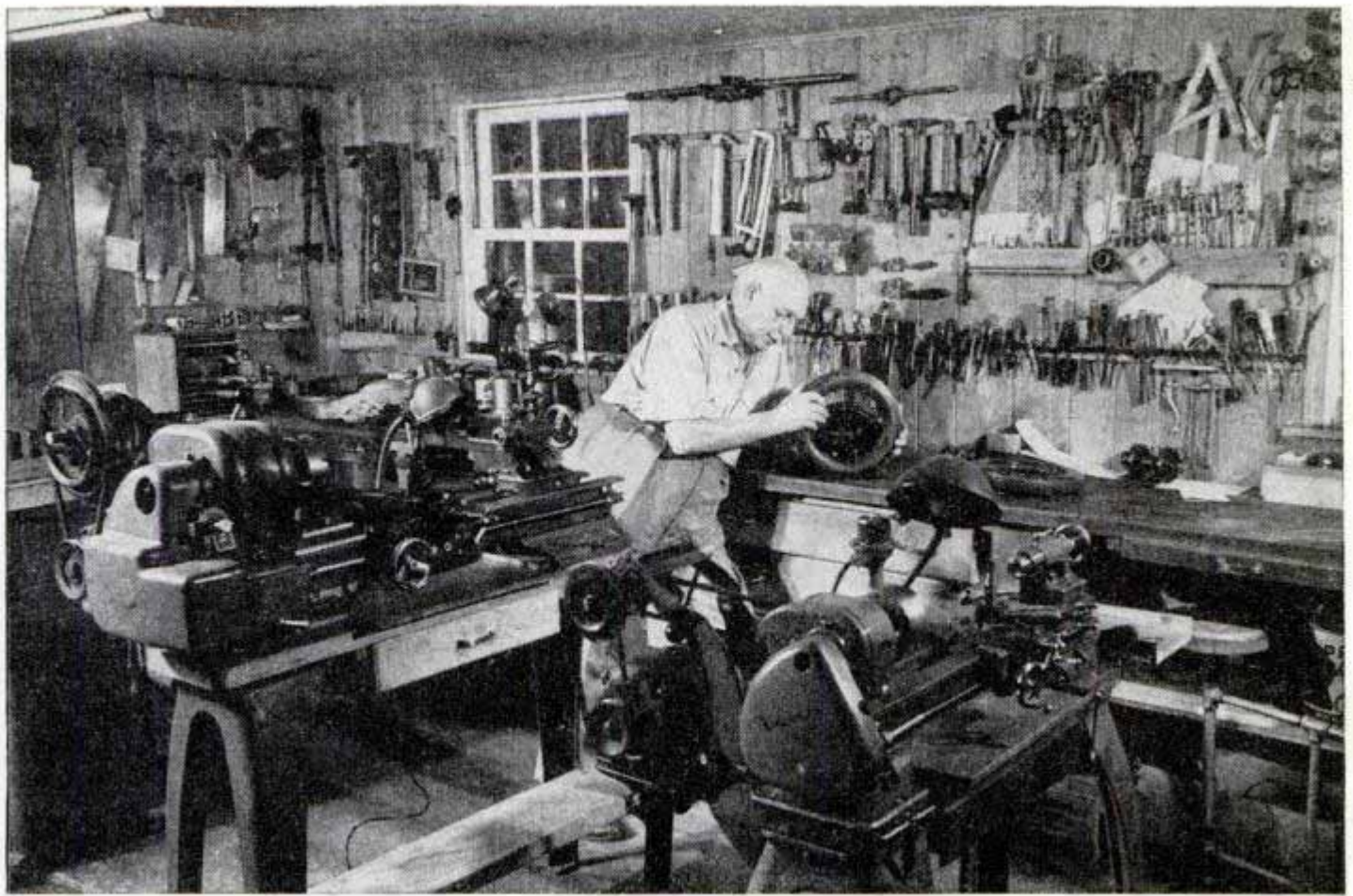
In each case this is about 10 times greater than the previous high. Deuterons and alpha particles have proved most useful in the transmutation of atoms and in the discovery of new elements, such as plutonium, americium and curium. Protons of high energy have not been widely used, since they have been difficult to manage in a cyclotron. However, a new principle upon which the 4000-ton cyclotron was built makes it a simple matter for this machine to shoot protons of 350 million electron volts. Protons are the most promising projectile for causing the complete disintegration of the nucleus because they create the greatest subatomic earthquake on collision.

The synchrotron will shoot electrons only. Betatrons and the "racetrack" synchrotron also are electron accelerators. The 300-million electron volt electrons which will be produced by the Berkeley synchrotron may be in themselves electron cosmic rays, cousins to the mesotron. With the synchrotron, scientists hope to determine a most important point: are the known particles of the nucleus really basic, or can they be broken down into smaller, now unknown units? If the splitting of neutrons, protons and other nuclear particles can be accomplished, the high-energy electrons have the best chance of doing the job.

The linear accelerator will shoot protons only. The 4000-ton cyclotron will hit an up-

(Continued to page 268)





## Far from Broadway . . . Arthur Hammerstein Keeps Young . . . and Busy . . . in his Atlas Equipped Shop

With the beautiful melodies of his 31 musical triumphs still echoing, famed producer Arthur Hammerstein, at 73, continues an active vigorous life on his 300 acre dairy farm near Chicago.

His love of tools carries over from boyhood days in his father's shop. Now he is happiest in his Atlas-equipped workshop, repairing farm and home equipment and working on unique inventions, which include a non-clogging salt shaker soon to be sold nationally.

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find Atlas industrial tools ideal for such a shop — *compact, powerful, accurate, and low cost.*

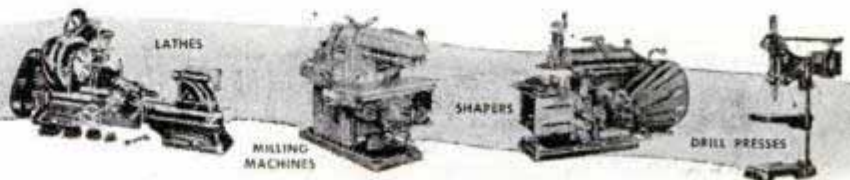
They help you master any machining need that develops as you repair home equipment or work on ambitious projects. Ask your Atlas distributor to give you the complete details about their many performance features.

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**Atlas 4 TOOL TEAM**





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IMPROVED 1947  
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a miniature plastic molding machine, built like a fine machine tool, yet so simple and safe a child can operate it.

Price only **\$54.00**  
(F.O.B. Chicago)  
Molds (22 diff.) each .....\$1.50

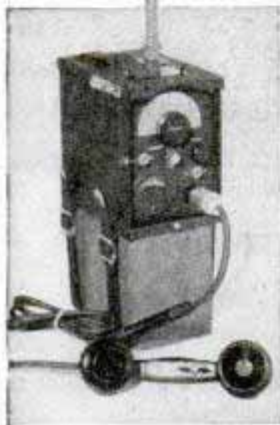


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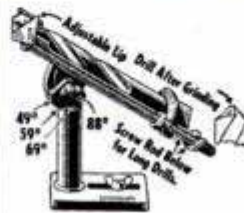


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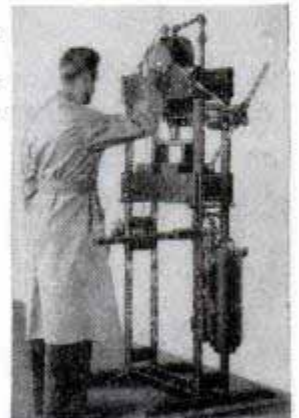
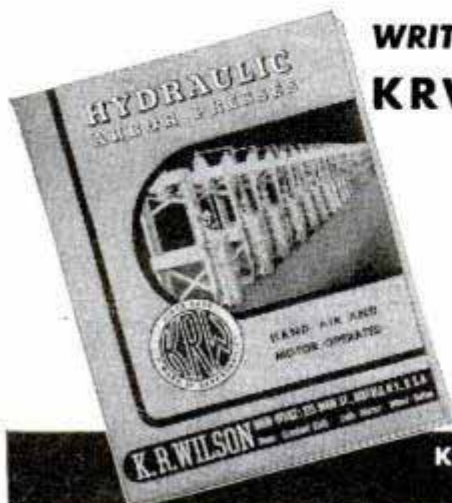
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**Because** the name Crescent\* which is forged into the handle is a registered trade mark of the Crescent Tool Company and the rights to its exclusive use have been upheld by the courts.

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And it leads now in every respect. Better steel, more accurate machining, uniform hardening, superior strength and toughness.

Most good hardware stores have sold Crescent\* Wrenches for many years—ask for them by name, then you will know you have bought the best.

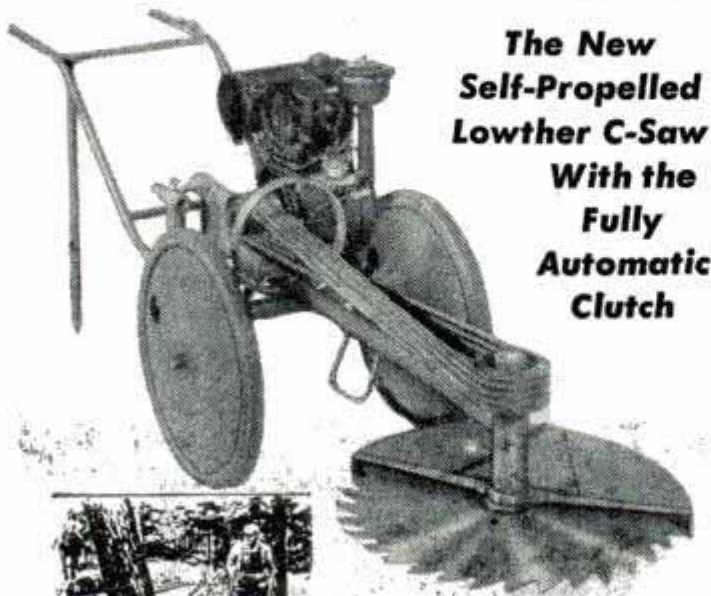
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JAMESTOWN, N. Y.

\*"CRESCENT" is our trade mark in the United States and foreign countries for wrenches and other tools.  
"Crescent" tools are made only by Crescent Tool Company of Jamestown, N. Y.





# AMAZING MONEY MAKER!



**The New  
Self-Propelled  
Lowther C-Saw  
With the  
Fully  
Automatic  
Clutch**



## FELLING TREES

30" Oak felled in two minutes and fifty-two seconds with the Lowther C-Saw—11" Pine in fifteen seconds.



## CUTTING LOGS

Cutting 10 to 20 cords of wood a day—on only 3 gallons of gasoline.



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Transforms brush covered wasteland into valuable pasture—Quickly and Easily.



Turn that standing timber on your farm and your neighbor's into cash with the Lowther C-Saw—the one-man portable power saw that has been proved in 478 Lumber Camps, in the production of millions of cords of wood!

Reap these big profits while prices are high—Do it quickly and easily—the Lowther C-Saw way!

### New Operating Ease!

Now your Lowther C-Saw may be equipped with the fully automatic Lowther C-Saw Clutch\*—so your saw is easy to start—will produce more—and eliminate the hazard of the "pinch."

Your C-Saw can be self-propelled, too! The NEW Lowther Power Drive\*—ends pushing . . . solves the cutting problem where the going is tough.

Some one near you is making money cutting wood with the Lowther C-Saw—Write us—We'll tell you where he is! He'll tell you the whole story!

\*Optional equipment

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per limit for protons of 350 million electron volts, and the linear accelerator may push the figure above a billion.

How do the new juggernauts work?

The 4000-ton cyclotron and the synchrotron are based upon a new principle called the "theory of phase stability," developed independently and simultaneously by Professor Edwin M. McMillan, one of Professor Lawrence's young associates, and a Russian physicist. It was calculated specifically to cheat the theory of relativity. Einstein's theory indicates that as a particle gains energy, it also gains weight. As it gains weight, it can be shoved up to a higher energy, but only at a slower rate. This was beginning to set a limit to the power of cyclotrons.

In a cyclotron, particles are whirled around a circular chamber placed between sections of an electromagnet. The magnet forces the particle to stay in a circular path. One or two electrodes, called "dees," are placed in the chamber; the 4000-ton cyclotron has one electrode. High-frequency alternating radio waves are transmitted to the "dee."

Particles to be speeded up as bullets begin at the center of the chamber and are whammed twice by an alternating electrical roundhouse every time they go around. The shock of the electrode on the atomic bullet is delivered at regular intervals. As the particle makes a half circle, its arc becomes wider, but its increased speed enables it to travel the longer distance in the same length of time. Thus it always makes the half circle just in time to receive a new high-frequency "hot foot." Eventually the circle is so wide that the particle emerges from a slit in the side of the chamber.

That works fine in a cyclotron up to about 100-million electron volt deuterons and 200-million electron volt alpha particles. There, relativity lays down the law. The particle has been gaining weight all the time, although not perceptibly. But at this point the particle becomes so "fat" it begins to lag noticeably. It slows down enough so that it arrives too late to receive its electrical shove. Then it is out of step and can't be accelerated any more.

Thinking of some way to circumvent this limitation, McMillan reasoned as follows: instead of keeping the particle in step with the alternating electrical charge, why not keep the electrical charge in step with the particle? When the particle begins to slow down, why not slow down the frequency of the electrical shock to wait for it?

Using the 85-ton cyclotron at the University of California as a pilot model, the

(Continued to page 272)



# AMAZING NEW SAFE MAGNETIC SAW!

READY FOR IMMEDIATE DELIVERY!

## SYNGRO

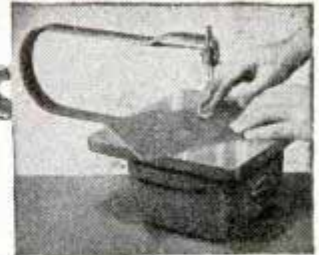
DELUXE JIG SAW

For Hobbyists, Craftsmen and Light Production

ONLY  
**\$17.50**

FOB FACTORY

Shpg. Wt. 18 lbs.  
Complete with cord, 3 blades



MODEL NO. 2000

**NO MOTOR NEEDED—JUST PLUG IN!  
PORTABLE . . . SAFE . . . CUTS CLEAN  
AND SMOOTH—NO SANDING NECESSARY!**

ANNOUNCING a remarkable, PATENTED, MAGNETIC Jig Saw—better-performing, better-quality than famous PRE-WAR SYNCROS—now ready for immediate shipment anywhere! SYNCRO needs NO belt, NO gears, NO oiling, NO motor to buy. The high-speed, short stroke action, and freedom from belts, makes SYNCRO so SAFE even small boys and girls may operate it. Get this husky, powerful, 18 pound saw . . . so easily portable . . . you can use it anywhere—even on the kitchen table . . . so smooth-cutting no sanding is necessary! Cuts intricate designs on 3/4" soft wood, 1/2" plywood and thinner hardwoods, plastics, thin metals. Leaves NO ragged undersides on plywood or heavy cardboard. The rapid action blade cuts to the center of a 27" circle. SYNCRO is a rugged, powerful power tool for exceptionally high quality work but is not for ordinary lumber cutting. Ideal for hobbyists, craftsmen, light production. Perfect for models, displays, puzzles, inlays, silhouettes, toys, marquetry, games, what nots, etc. Order yours NOW on our 10 Days Money Back Trial offer—enjoy a LIFETIME of use!

### 15 Outstanding Syncro Features

(1) **WORLD'S SAFEST SAW.** (2) **PORTABLE** . . . plugs in to 60 cycle A.C. 110-130 volt wall outlet. (3) **NO ROTATING MOTOR NEEDED.** Syncro's self-contained magnetic power unit transmits A.C. magnetic impulses to armature diaphragm—power transferred to saw blade. **COIL** contains 1 1/4 lbs. No. 19 insulated copper wire, completely taped, impregnated, baked. **Guaranteed** not to burn out! **MAGNET CORE** contains 58 layers of metal. **DIAPHRAGM** of spring steel, heat-treated under special process, suspended on L-I-V-E rubber mounting cartridges. (4) **14,400 STROKES PER MINUTE!** (5) **NO RECIPROCATING OR ROTATING PARTS TO WEAR OUT!** (6) **NEVER NEEDS OILING.** (7) **TABLE TOP** 10" x 10", a heavy, thick, durable alloy die casting 3/8" thick, ribbed base. **Surface** smooth for easy sliding. (8) **BASE** 7 1/2" x 6 3/4". . . a heavy, durable die casting. (9) **ARM** is of specially formed steel stamping 3/8" x 1". **Return Spring** of heavy duty steel. **Guide**

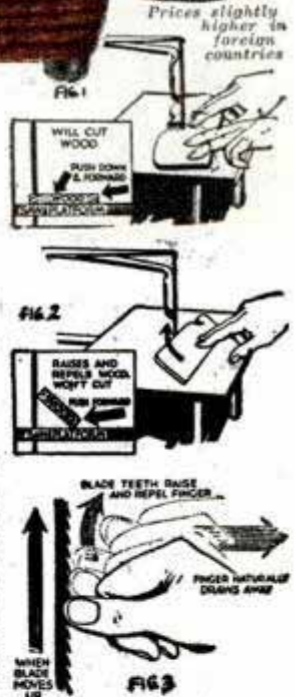
**Slide** of plated steel and adjustable to varying wood thicknesses. **Adjustment Screw** permits easy, quick changes in length of saw blade stroke to compensate for voltages of 110 to 130 A. C. (10) **THROAT CLEARANCE** 13 1/2" permitting work on square sheet of wood, metal, plastic. 27" on the diagonal. (11) 5' cord . . . extension **Underwriter's approved** electric cable with molded rubber plug. (12) **BLADES** are 5", pin end style, of finest steel, 18 teeth per inch. (13) **NO-MAR, NON-SLIP RUBBER FEET.** (14) **DURABLE**—will last a lifetime. (15) **HIGHEST QUALITY**—guaranteed by the trademark name "SYNGRO."

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SYNCRO has No continuous cutting blade nor "Long stroke" blade to pull fingers into teeth—instead there are 14,400 strokes per minute—7,200 short cutting strokes plus 7,200 upward NON-CUTTING, REPELLING strokes! (Fig. 1) SYNCRO will not even CUT wood unless piece is pushed FIRMLY DOWNWARD AGAINST blade and FIRMLY FORWARD at SAME time! SYNCRO blade teeth cut ONLY on DOWN stroke. (Fig. 2) Teeth raise, repel, push away any object on UP stroke. (Fig. 3) When blade moves UP it KICKS finger away free. On down stroke, blade does not move far enough to accidentally cut finger unless finger is intentionally, deliberately fed into blade like wood is fed in Figure 1. No wonder SYNCRO is the world's SAFEST saw . . . a feature old and young users acclaim!



Prices slightly higher in foreign countries

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So you may order with complete confidence, read this SYNCRO TRIAL OFFER: When you get your saw, plug it into any 60 cycle A. C. 110-130 volt outlet and saw according to instructions. Then, if it does not satisfy you perfectly in every way, return it postpaid within 10 days of delivery date, and we will refund your \$17.50 promptly without questioning.

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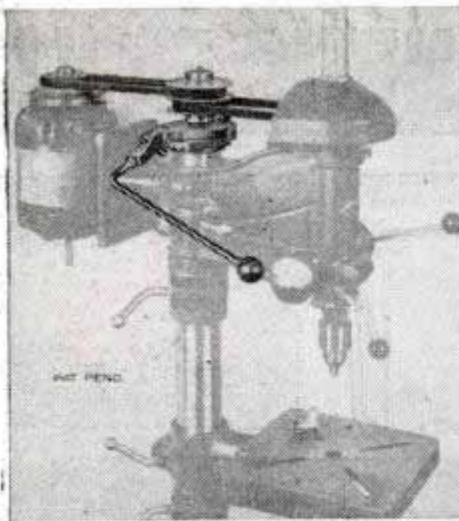
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The Era Variable Speed Drive enables the operator to provide correct speed for large or small drills by a convenient method of shifting a lever.

Designed to fit all popular makes of presses. Installed in a few minutes, without drilling of holes or changing present equipment.

Furnished with either bronze or ball bearing pulley, complete with belts.

When ordering be sure to specify make and model of press, also type of pulley desired.

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Minimum and Maximum range of speeds obtainable, as follows:

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Canedy-Otto 16	410/9250	Delta 17" L. S.	230/4100
Delta 14" L. S.	350/2240	New Model	230/4100
Delta 14" H. S.	670/5500	Delta 17" H. S.	640/5000
Walker Turner 14" L. S.	360/3100	Old Model	640/5000
Walker Turner 14" H. S.	670/5500	Delta 17" H. S.	460/6450
Price—above Bronze bearing, \$39.50; Ball bearing, \$45.50		New Model	460/6450
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		D-1100 H. S.	168/2880
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Special Model for Light Duty \$27.50 and Home Workshop . . . . .

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Now you can get up to 30% extra gasoline mileage with a Vacu-matic on your car. Quicker pick-up, smoother running, added power saves money every day. Guaranteed. **Automatic Supercharge Principle** Vacu-matic is entirely different! Operates on the Supercharge principle. Saves gas. Automatically provides a better gas mixture. Guaranteed to give up to 30% extra gas mileage, more power and better performance.

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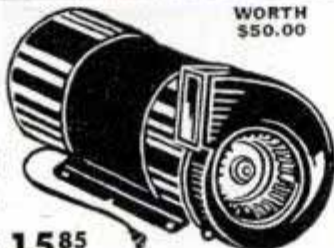
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Another Quality Product from the House of Hudson

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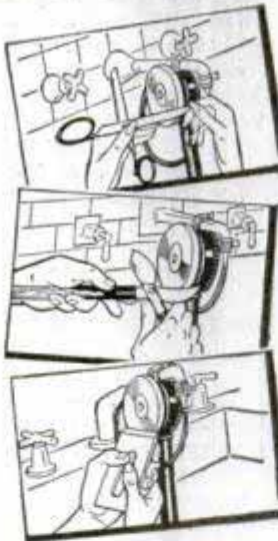
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Simplest operation possible. Just attach to any ordinary faucet, turn on the water and the sensational patented Hudson turbo-jet impeller spins the wheel at more than 3,000 revolutions per minute—almost twice the speed of a standard electric motor. Adjustable to 10,000 RPM, depending on water pressure. Ideal for the handy man, housewife, hobbyist, mechanic, farmer. Precision built, quality throughout. Super-hard silicon carbide wheel. Stainless steel shaft. Chrysler Oilite bearings (never need oiling). All metal parts gleaming chrome. Colorful vinylite tubing.

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Enclosed is a \$8.95 ( ) check, ( ) money order for which rush to me, postpaid, one Hudson Turbo Grinder with full instructions for use. I understand the Grinder carries a full, money back guarantee.

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new theory worked like a charm. Protons were marched around the chamber in perfect step. A cyclotron built on this principle is called a "frequency-modulated cyclotron" or "synchro-cyclotron." Its chief advantage is that a particle can be whirled around the chamber an almost indefinite number of times, and smaller amounts of energy can be applied to it to achieve a higher ultimate energy of atomic bullet.

The synchrotron is a cross between a betatron and a cyclotron. Professor McMillan is supervising the construction of the 300-million electron volt synchrotron on the Berkeley campus. The tank and magnet of the synchrotron will be doughnut-shaped, hollow in the center. An electron is very light, and when it is speeded up it will stay in one orbit rather than continue in widening circles as do the heavy particles used in the cyclotron. Therefore, the accelerating chamber, about a yard in diameter, is ring-shaped.

The synchrotron will operate as a betatron up to two million electron volts, the electrons being "muscled" around the orbit by the strength of the magnet. At this point it begins to operate as a synchrotron.

McMillan's theory is applied to the synchrotron differently from the frequency-modulated cyclotron. The spacing of the alternating charges on the one accelerating electrode is regular and unchanged, where it is slowed down in the cyclotron. However, the strength of the magnetic field is altered to keep the electrons in step. As the electrons being whirled around the doughnut slow down with increasing weight, the magnetic field is increased slightly, jerking the lagging particles up to the point where the next electrical push is applied. This change in the field is continued to the limit of the magnet's strength, when it can no longer compensate for the lagging particles.

With the 135-ton laminated steel magnet of McMillan's machine, this point is expected to be reached at about 300 million electron volts. McMillan says that, theoretically, with a stronger magnet a synchrotron could produce electrons of a billion electron volts.

The third of the new atom smashers at Berkeley is the linear accelerator, the modern version of which is the brain child of Professor Luis Alvarez, another young associate of Professor Lawrence. Professor Lawrence and D. H. Sloan built a linear accelerator in 1930, but it was capable of speeding up particles to only about two million electron volts. Alvarez and other young scientists now have revived the lin-

(Continued to page 276)



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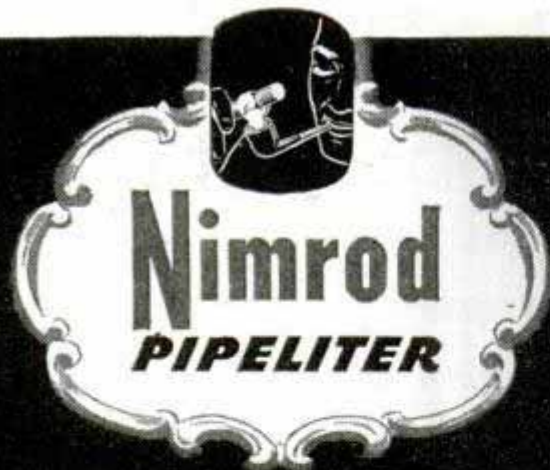
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THE ONLY DOWN-DRAFT CHIMNEY-ACTION LIGHTER  
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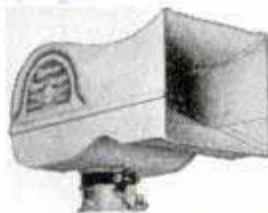


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We show you how to convert your own lawn  
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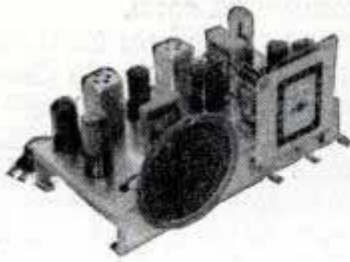
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Complete Plans \$1.00  
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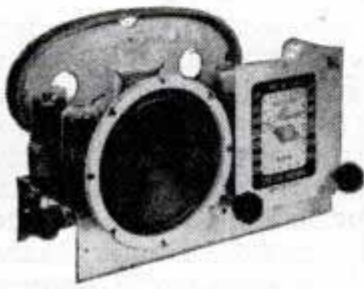




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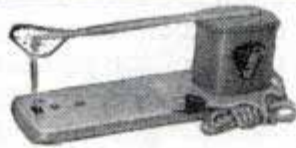
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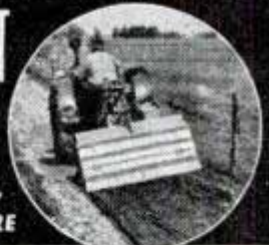
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ear accelerator idea and a 40-foot section capable of hurling 40-million electron volt protons will be completed soon.

To get the protons started on their way in the linear accelerator, a Van de Graaff generator, a potent atom smasher itself by prewar standards, will shoot four-million electron volt protons into the new gun. Attached to this generator, which looks like a tank on its side, will be a long, hollow, copper cannon. Down the center of this cannon will run a rifelike tube cut up into sections. These are called "drift tubes." The first tube is a few inches from the entrance to the cannon. On each side of the cannon is a row of obsolete radar sets. These sets, 15 on each side of the 40-foot section, pump alternating high-frequency radio waves into the copper cannon, trapping a tremendous power within it.

As a proton is shot into the cannon it receives a terrific electrical shock which speeds it even faster into the first drift tube. While it is in the drift tube the proton is protected from any effect of the electrical charge in the cannon, and advantage is taken of this period to reverse the electrical field. Just as the proton emerges from the tube, the field is once again reversed, clipping the proton another electrical blow and sending it into the next tube. This process continues until the proton emerges from the tube. Each successive tube is longer, which compensates for the increased speed of the proton as it is kicked along.

Alvarez estimates that it should be possible to get one million electron volts per foot for the machine. To get greater energy a new section will be added. After the pilot model 40-foot section has proved itself, a 240-foot model will be built later. The young scientist says that it should be possible eventually to accelerate protons to a billion electron volts with the new machine.

## Laboratory in Space

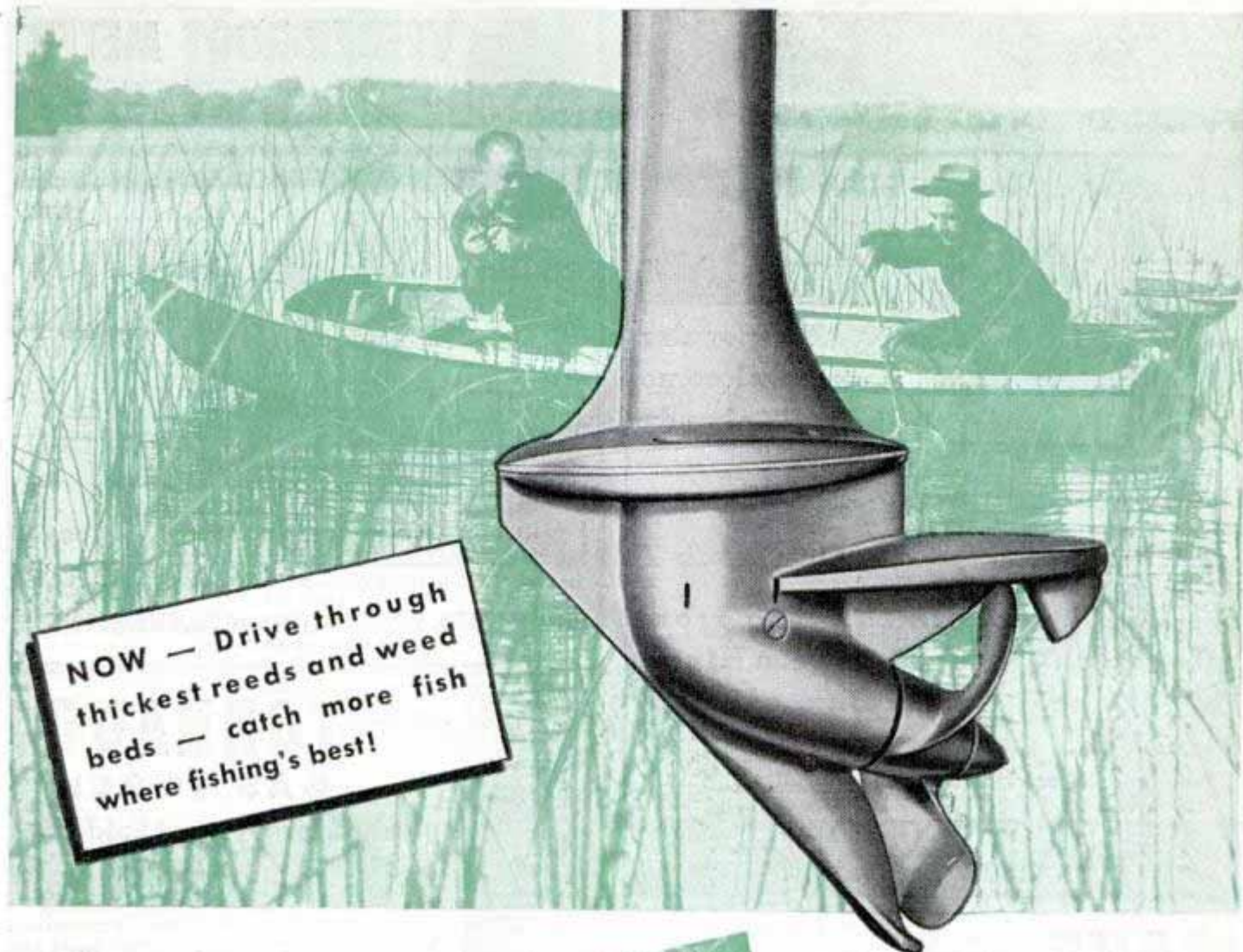
(Continued from page 93)

et-to-ground radio circuits that produce oscillograph pulse measurements are being used to study the thicknesses of the ionized layers, their up-and-down movements during night and day, and their refractive effects. Accurate radio refraction indexes will be necessary for precise radio control of high-altitude rocket vehicles or weapons.

Other instruments carried by the V-2s have confirmed previous ideas that parts of the upper atmosphere are boiling hot. This, however, doesn't mean what one might suppose. High temperatures in the thin upper air mean that the relatively few

(Continued to page 280)





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beds — catch more fish  
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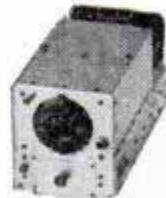
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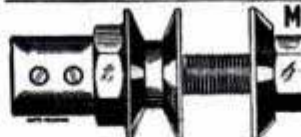
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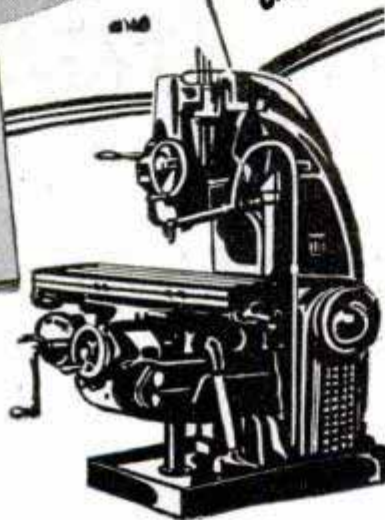
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686-2-A

air molecules present have very high kinetic energy. An object in the upper air is not heated by conduction; it becomes very hot on the side exposed to solar radiation and bitterly cold on its shady side because of its own radiation into space.

Man's knowledge about cosmic rays and their relation to the energy that runs the universe may be multiplied many times by studies that are being conducted at moderate altitudes by converted B-29s and at extreme altitudes by rockets.

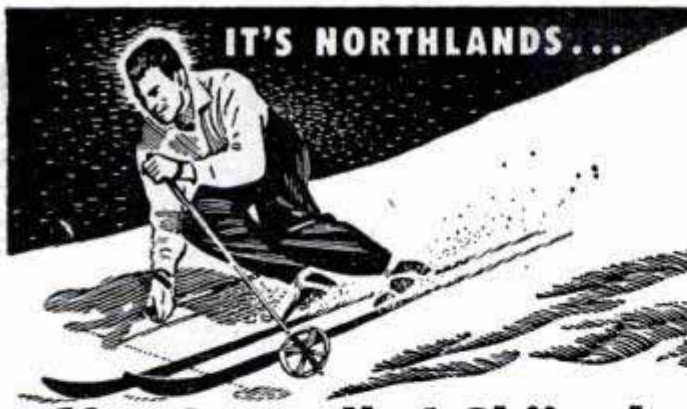
Important new data about these powerful rays already have been obtained by means of cosmic ray telescopes placed in the warheads of V-2s by the applied physics laboratory of Johns Hopkins. Showers of the rays have been recorded up to 350,000 feet. The telescopes consist of sets of Geiger-Mueller counters placed between lead plates so that only the particles that strike from certain directions can be recorded. Additional counters alongside the telescopes make general records of all the charged particles encountered.

Unique methods are employed for transmitting this information to the earth. Various objections precluded the detaching of the instruments from the V-2 at high altitude and lowering them by parachute. Instead, the cosmic ray counters are hooked up through amplifiers to a radio telemetering system in the rocket that uses 16 channels in instantaneously sending the information back to earth. Mechanical recorders inside the warhead meanwhile punch out duplicate records on brass tape. This permanent record, if the recorders are found in good condition, is a check on the accuracy of the telemetering system.

Dr. J. A. VanAllen of Johns Hopkins reports that on the basis of V-2 research it appears that cosmic ray showers are 300 times more plentiful in the upper atmosphere than at ground level. They increase in frequency up to about 200,000 feet and then continue to increase at a reduced rate for as high as instruments have been carried. Mesotrons, secondary particles generated by primary rays, are recorded in greatest numbers at about 100,000 feet. Radioactive and self destructive, few mesotrons "live" long enough to reach the earth.

One of the reasons why cosmic rays are the subject of widespread research today is that the energy of these particles is millions of times greater than can be produced by nuclear fission. This has very important implications in the field of atomic energy. It is entirely possible that in his upper air research man will find the key to a power plant by which he can travel even farther into space.





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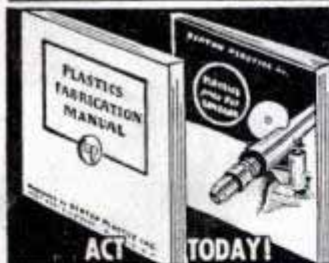
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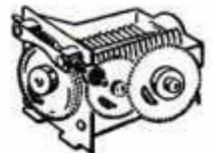
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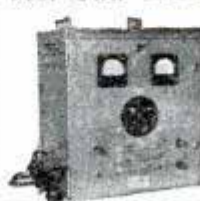
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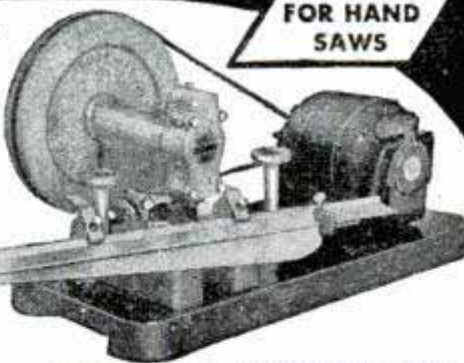
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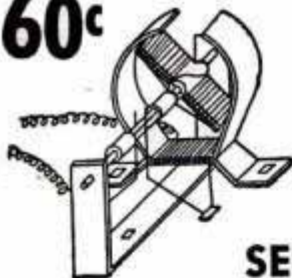
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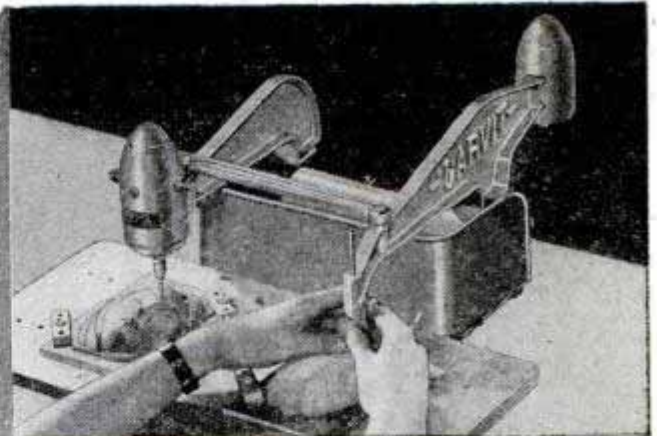
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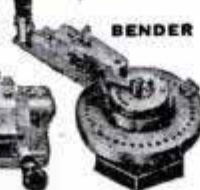
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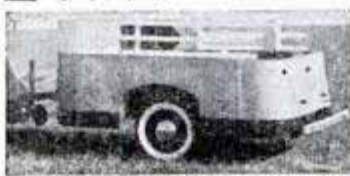
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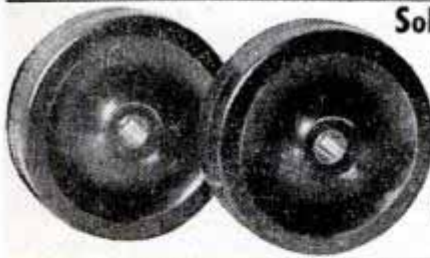
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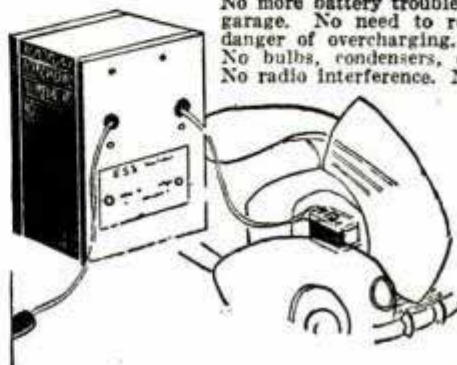
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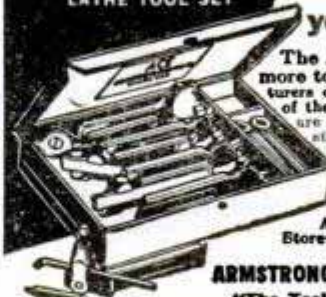
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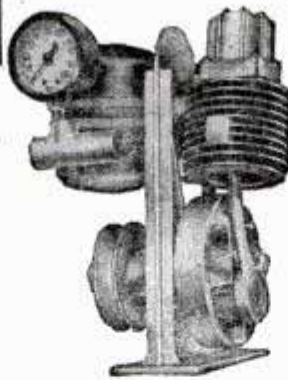


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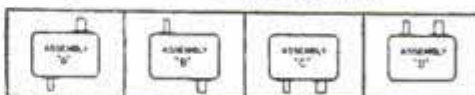


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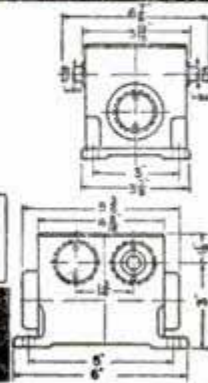
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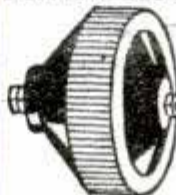


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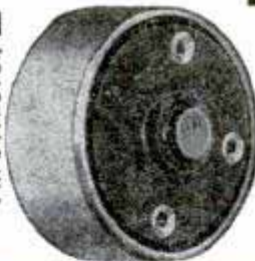


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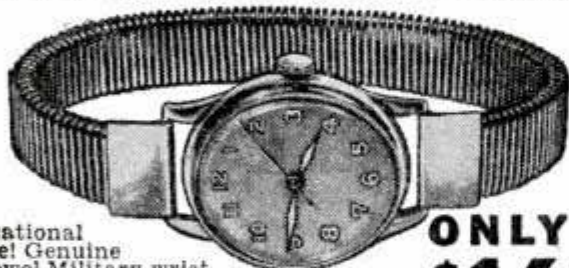
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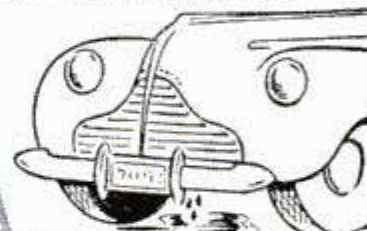
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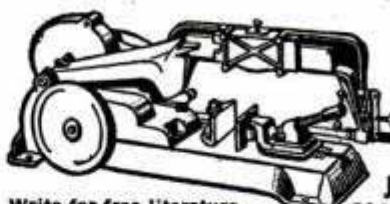


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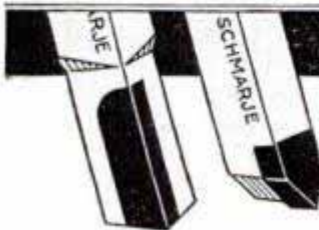
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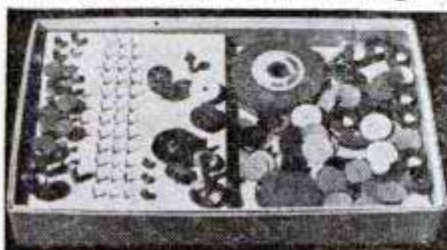
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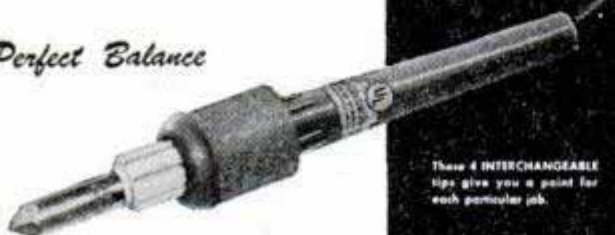
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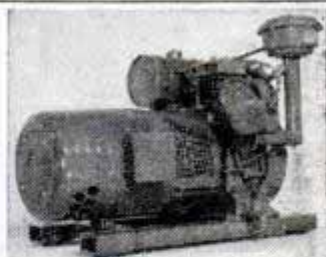
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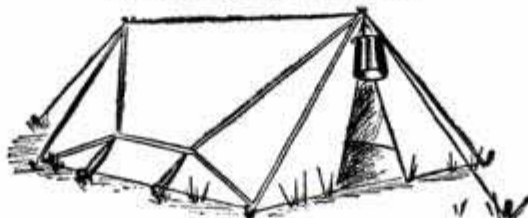
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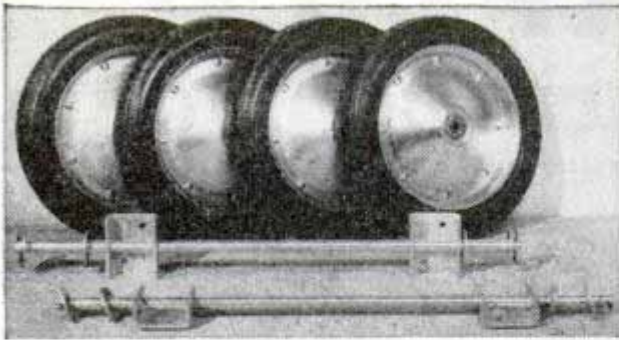
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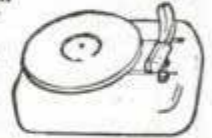


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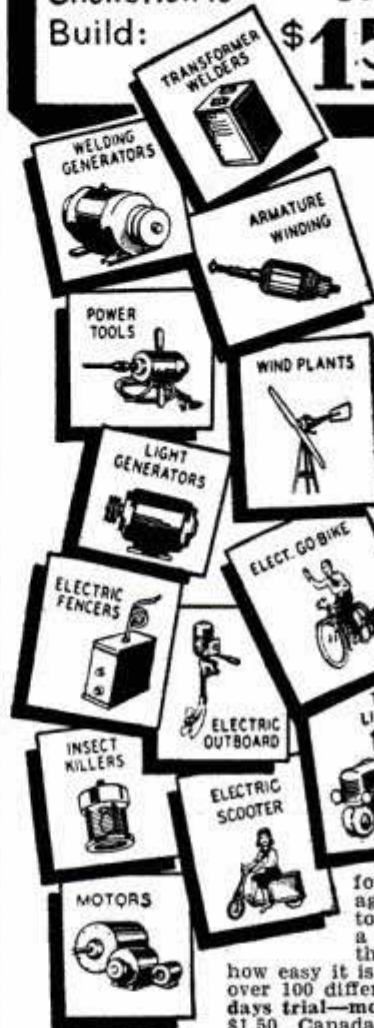


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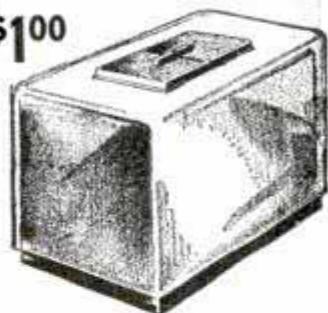
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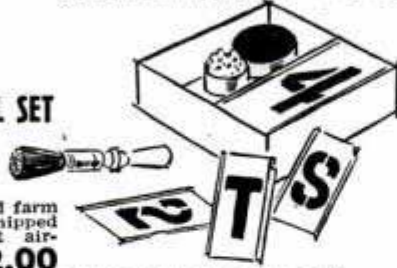


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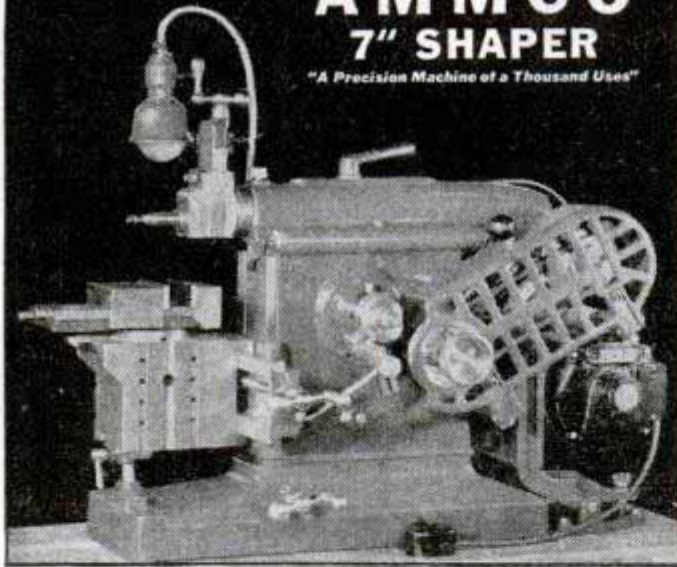
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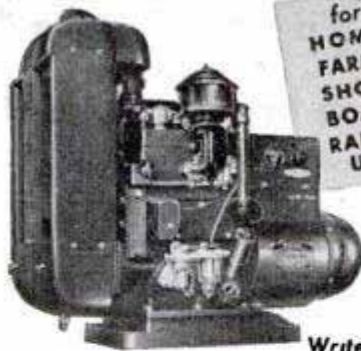
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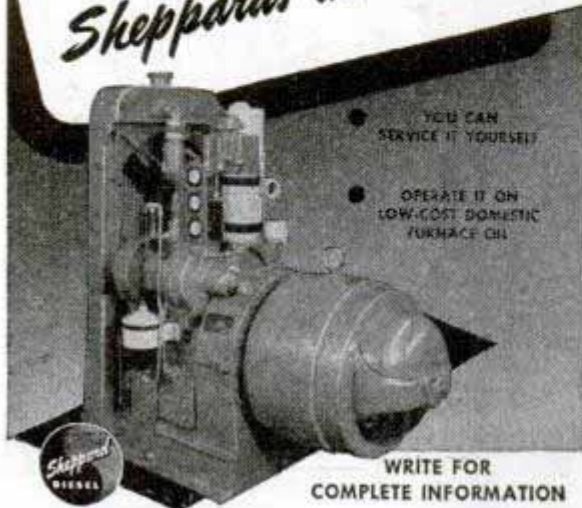
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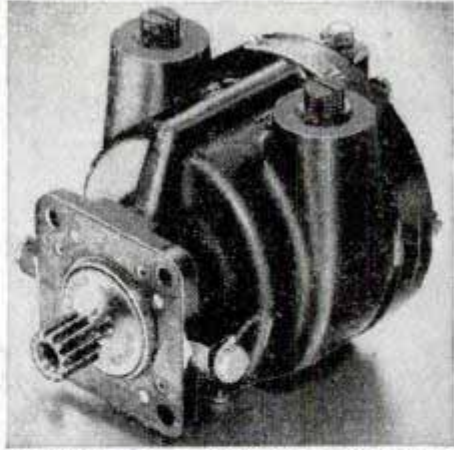
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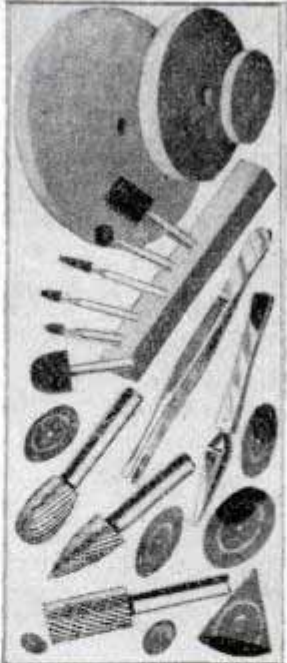
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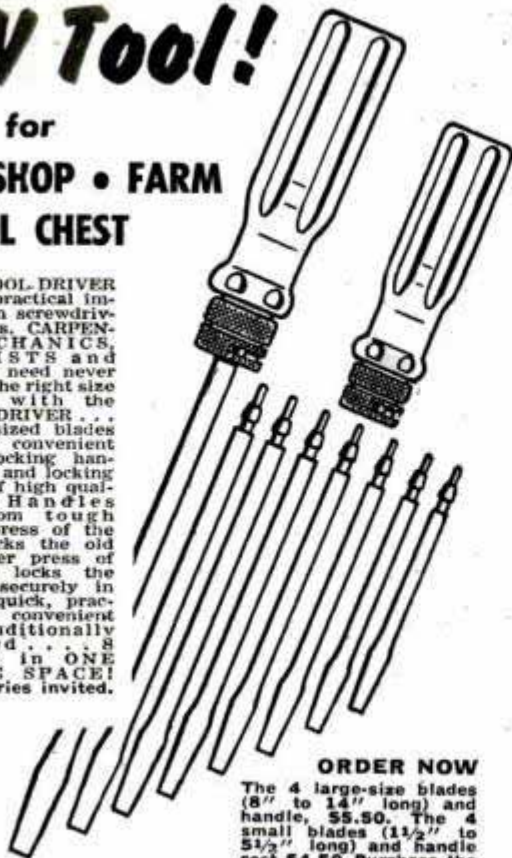
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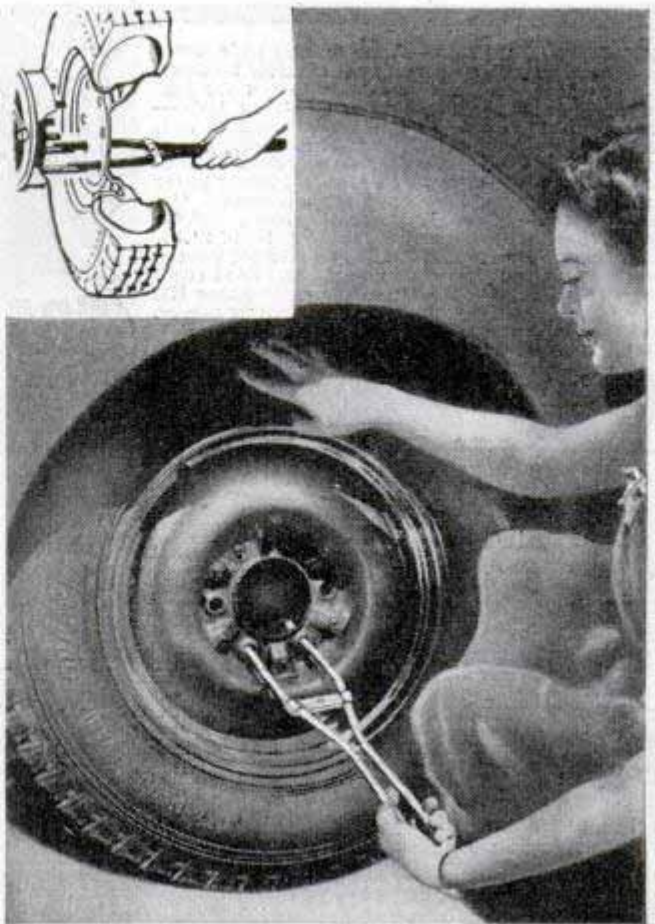


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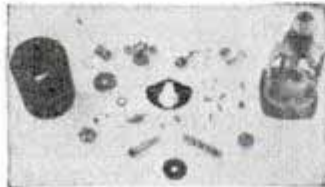
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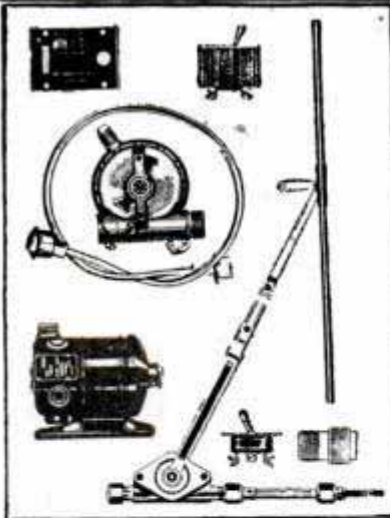
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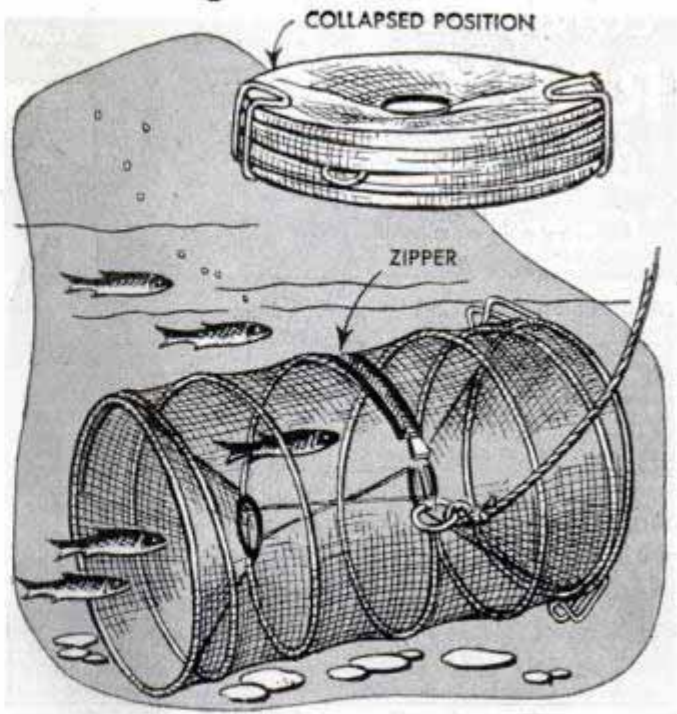
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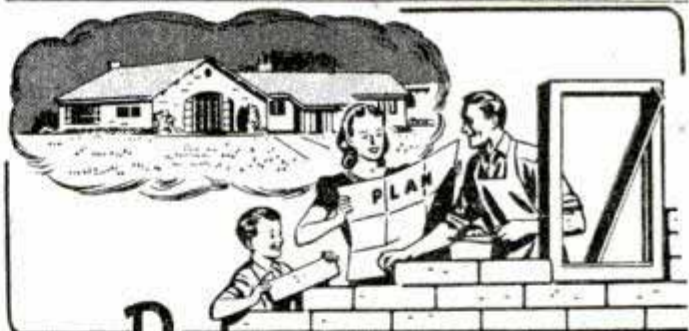
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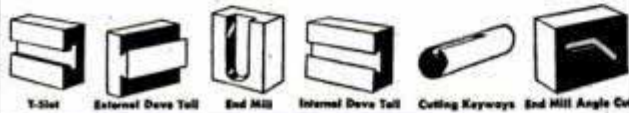
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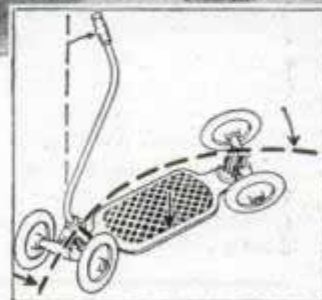
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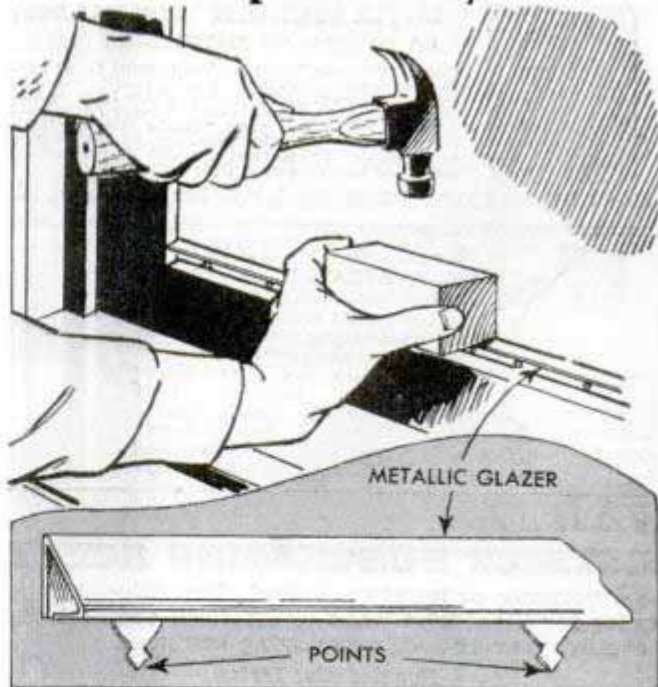
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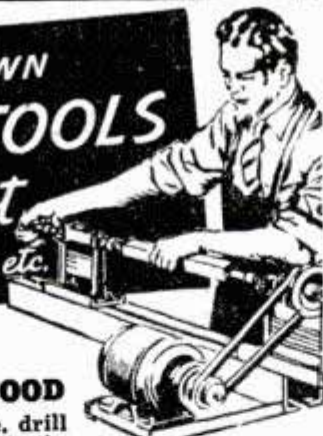
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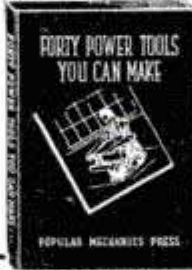
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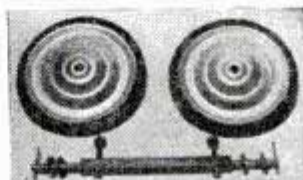
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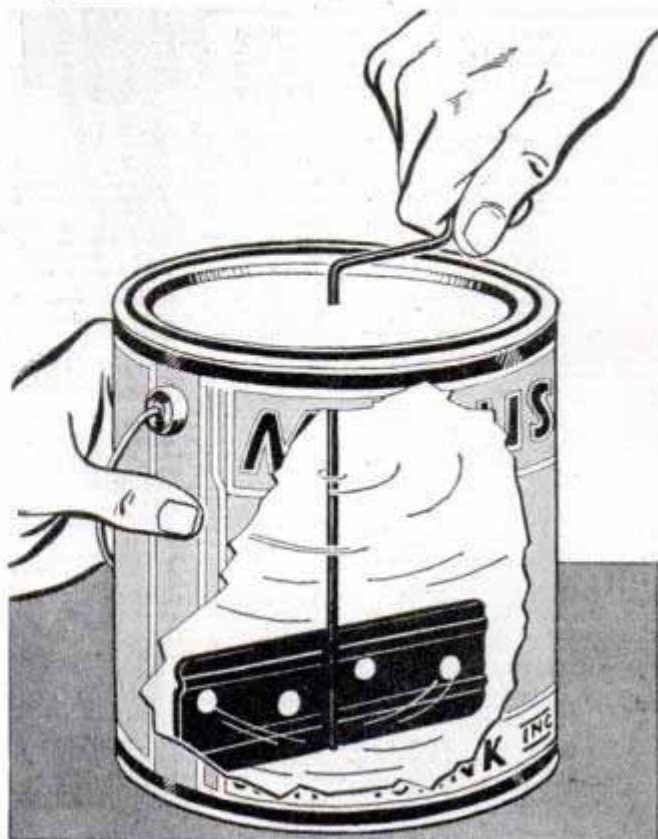
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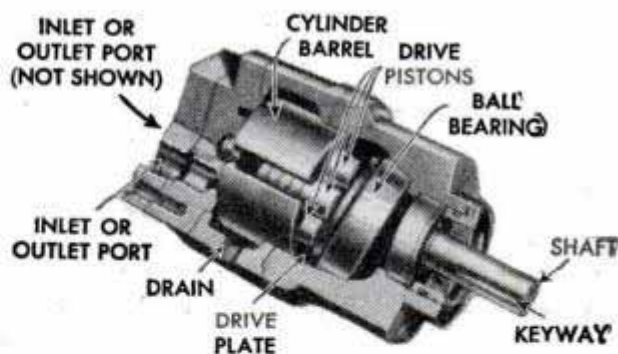
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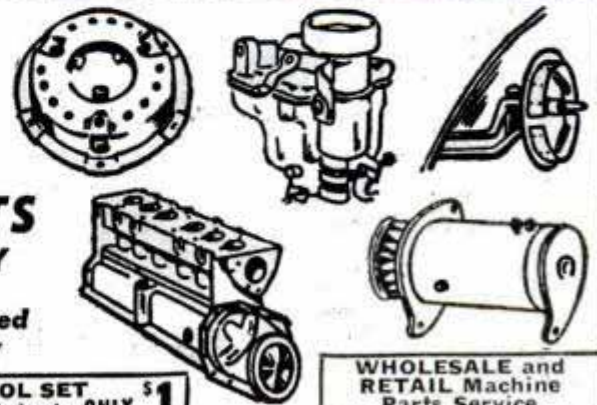
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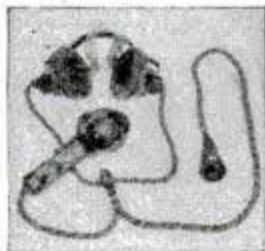
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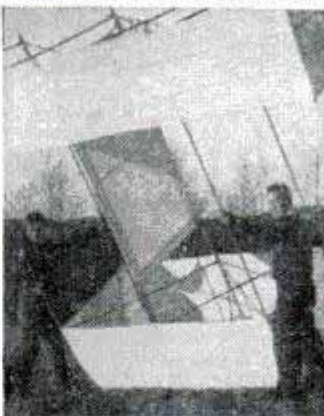
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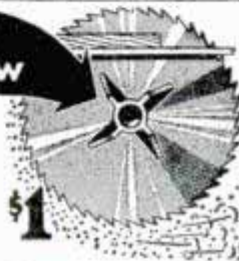
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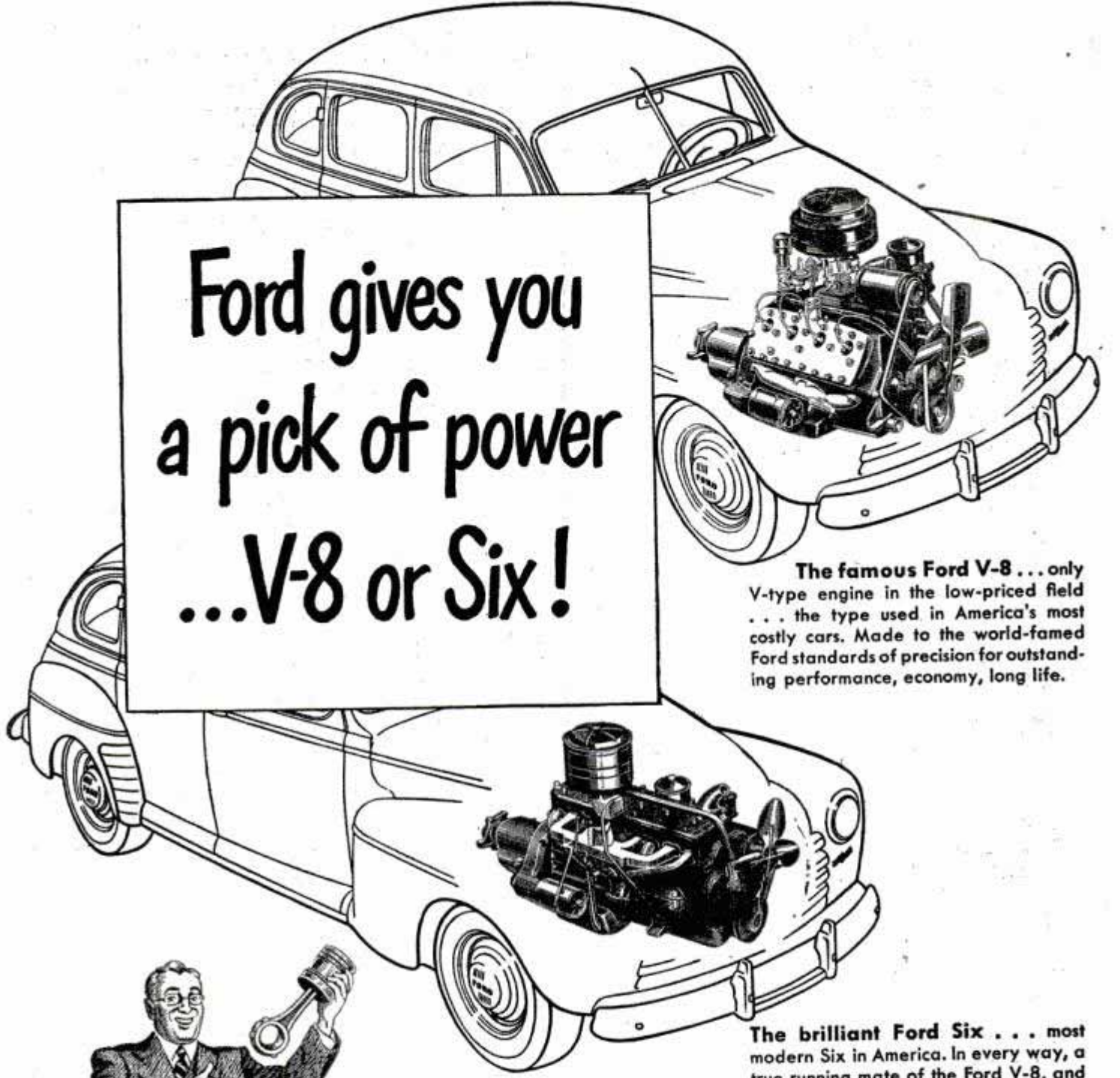
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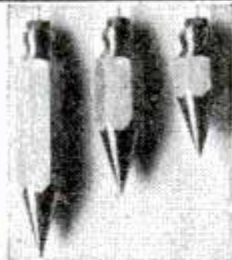


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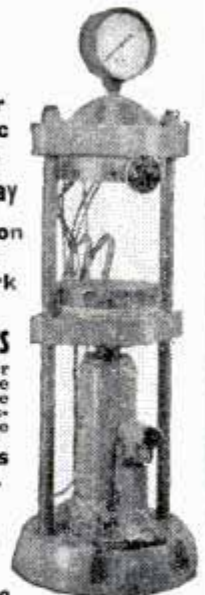
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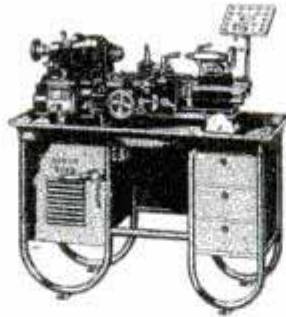
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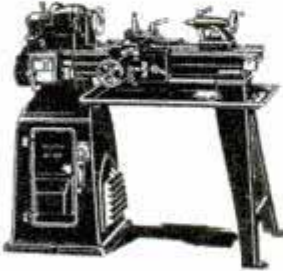




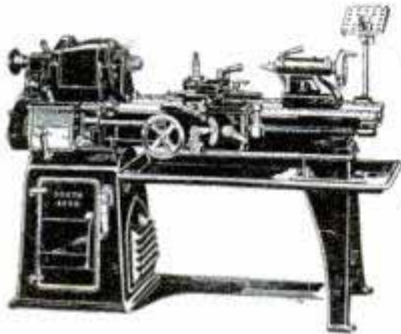
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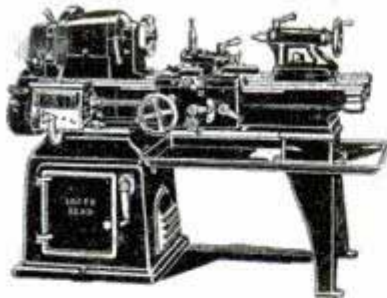
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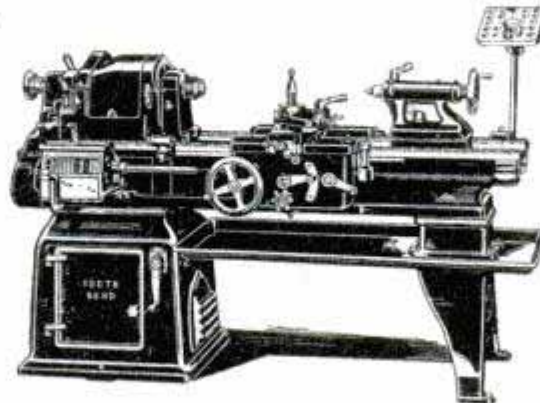
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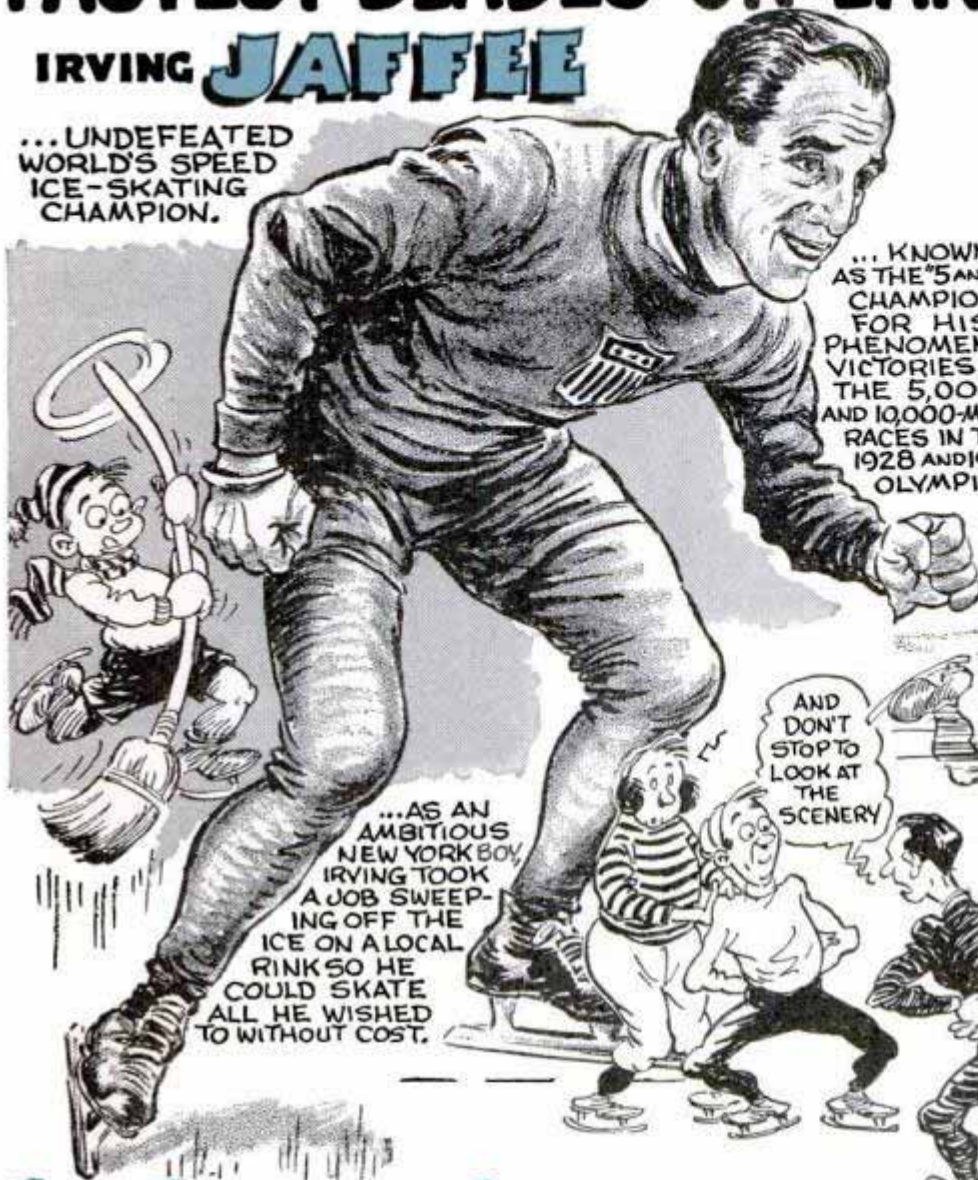
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...AS HE SKIMS DOWN THE ICE...



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A JOB SWEEP-  
ING OFF THE  
ICE ON A LOCAL  
RINK SO HE  
COULD SKATE  
ALL HE WISHED  
TO WITHOUT COST.

AND  
DON'T  
STOP TO  
LOOK AT  
THE  
SCENERY

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FARTHER AHEAD  
OF THE PACK WITH EACH  
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HE FEELS  
**SHARP!**

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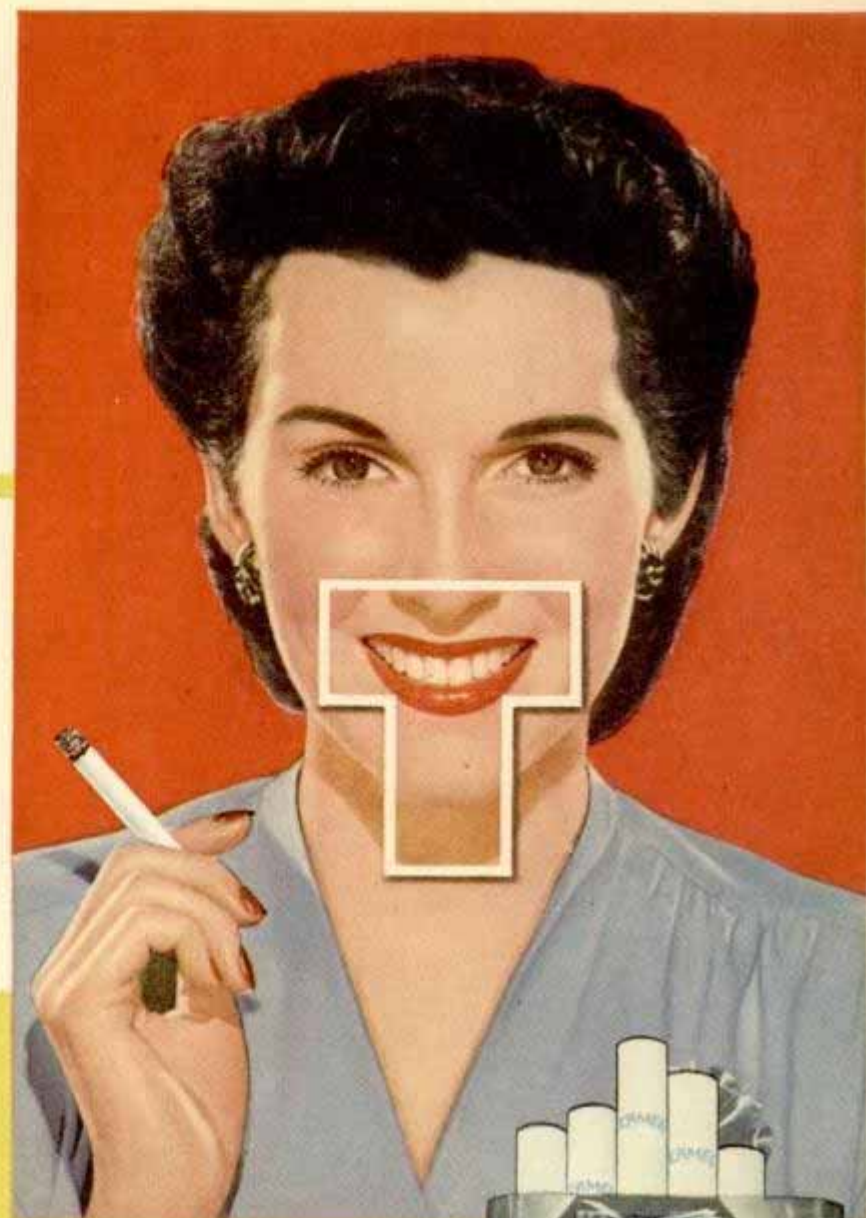
**T** for Taste...

**T** for Throat...

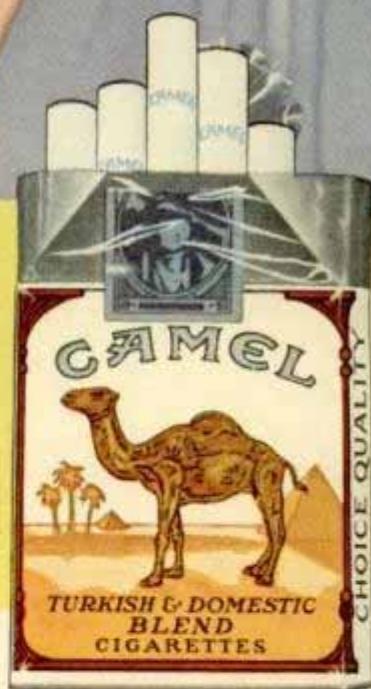
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