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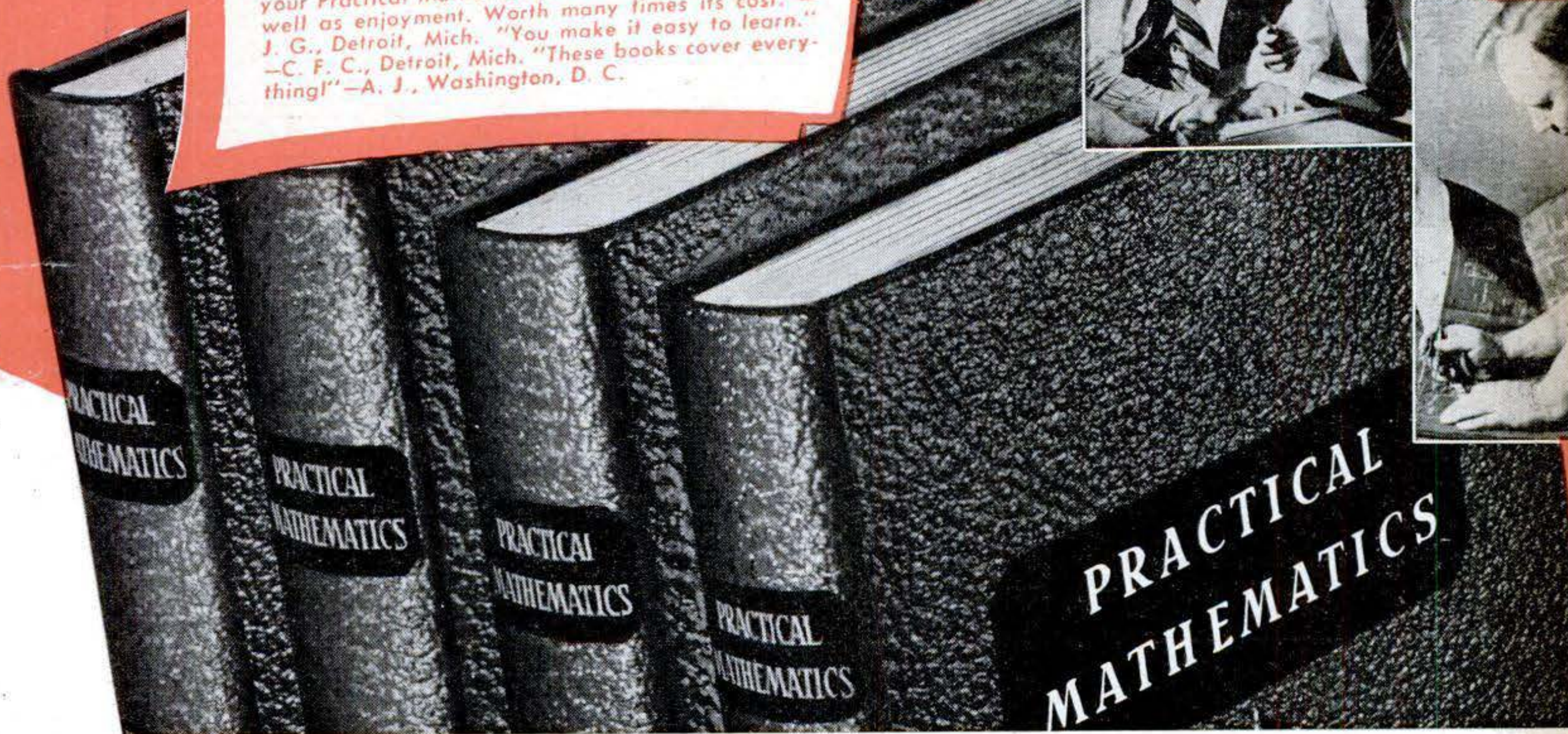
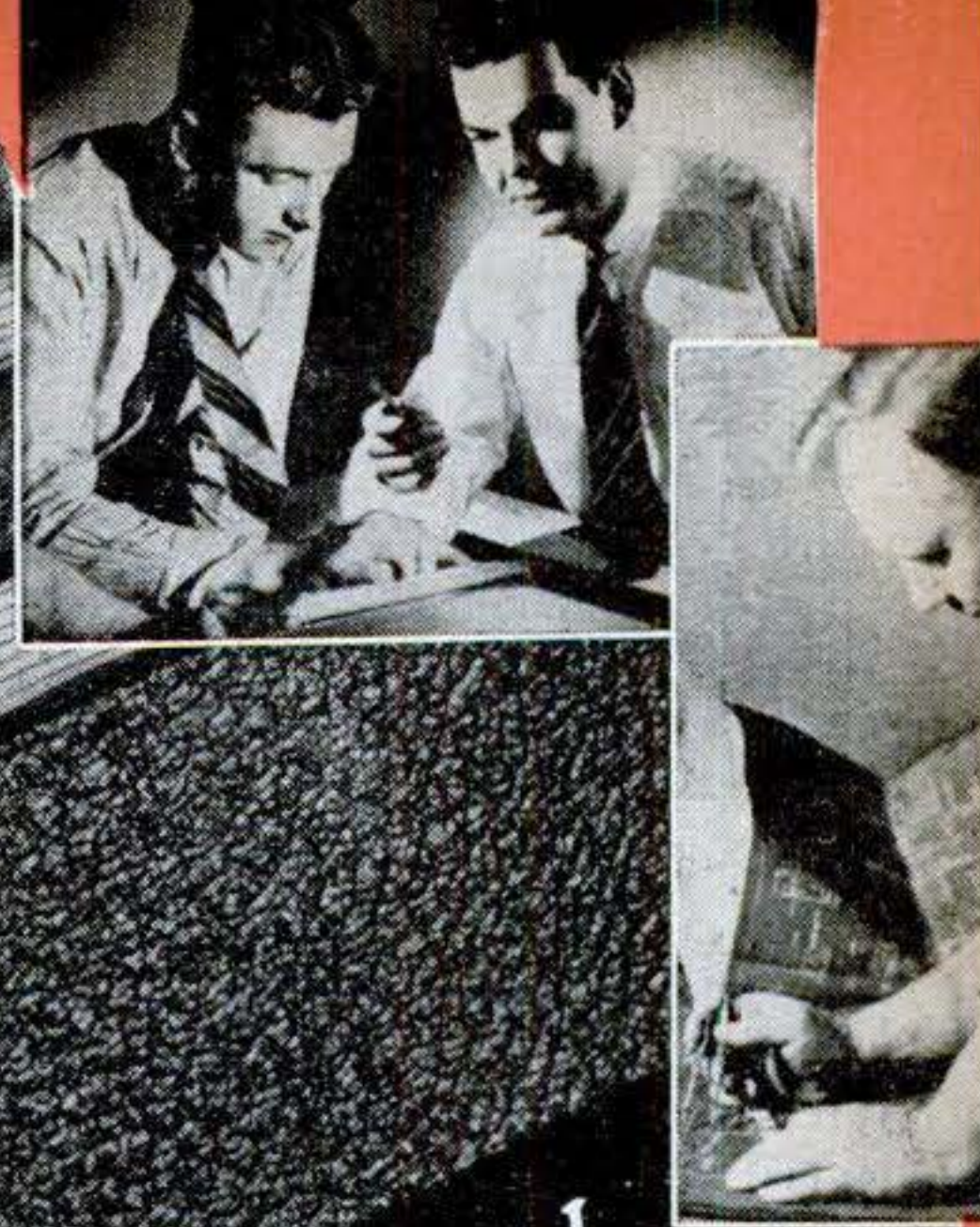
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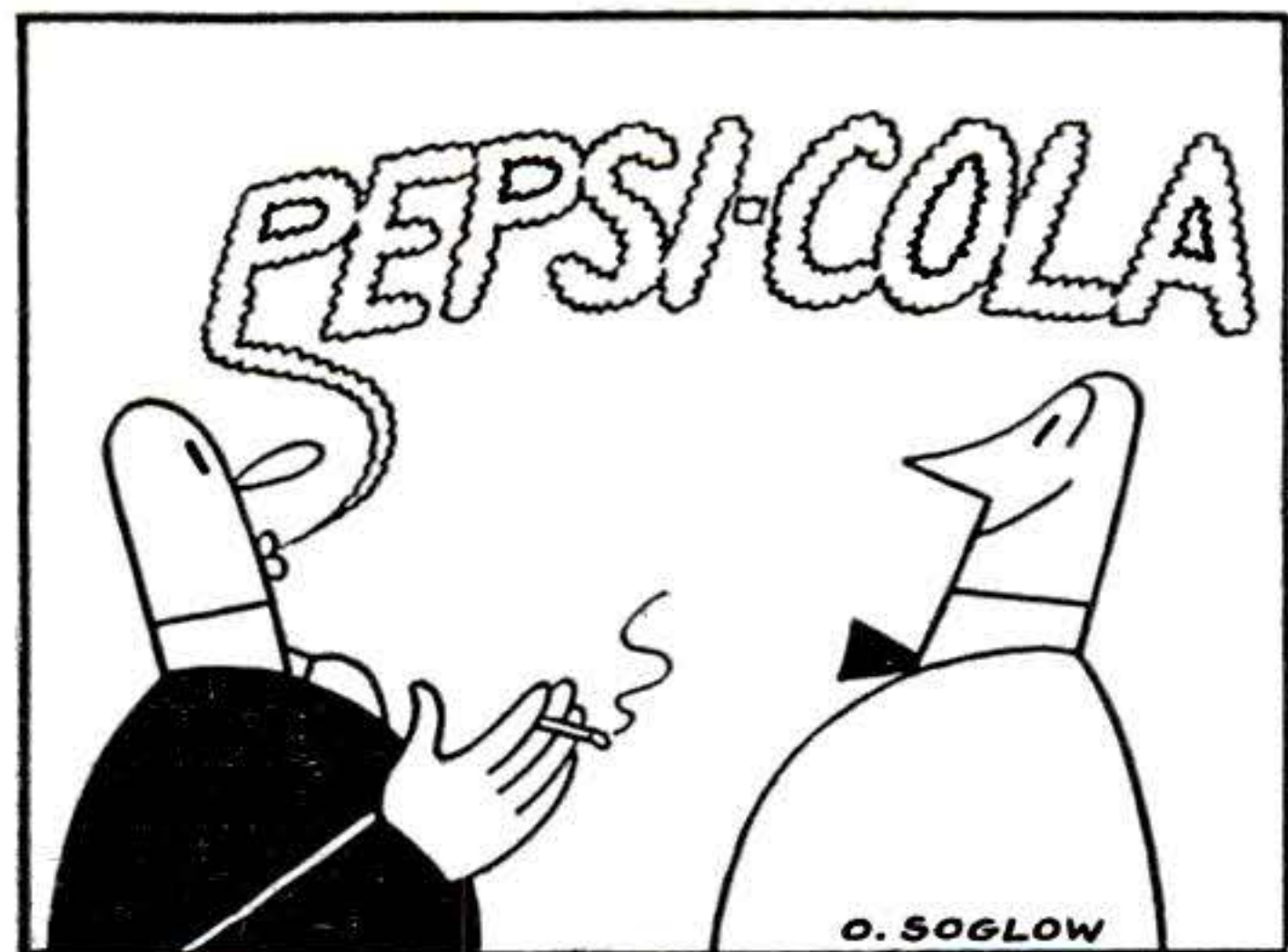
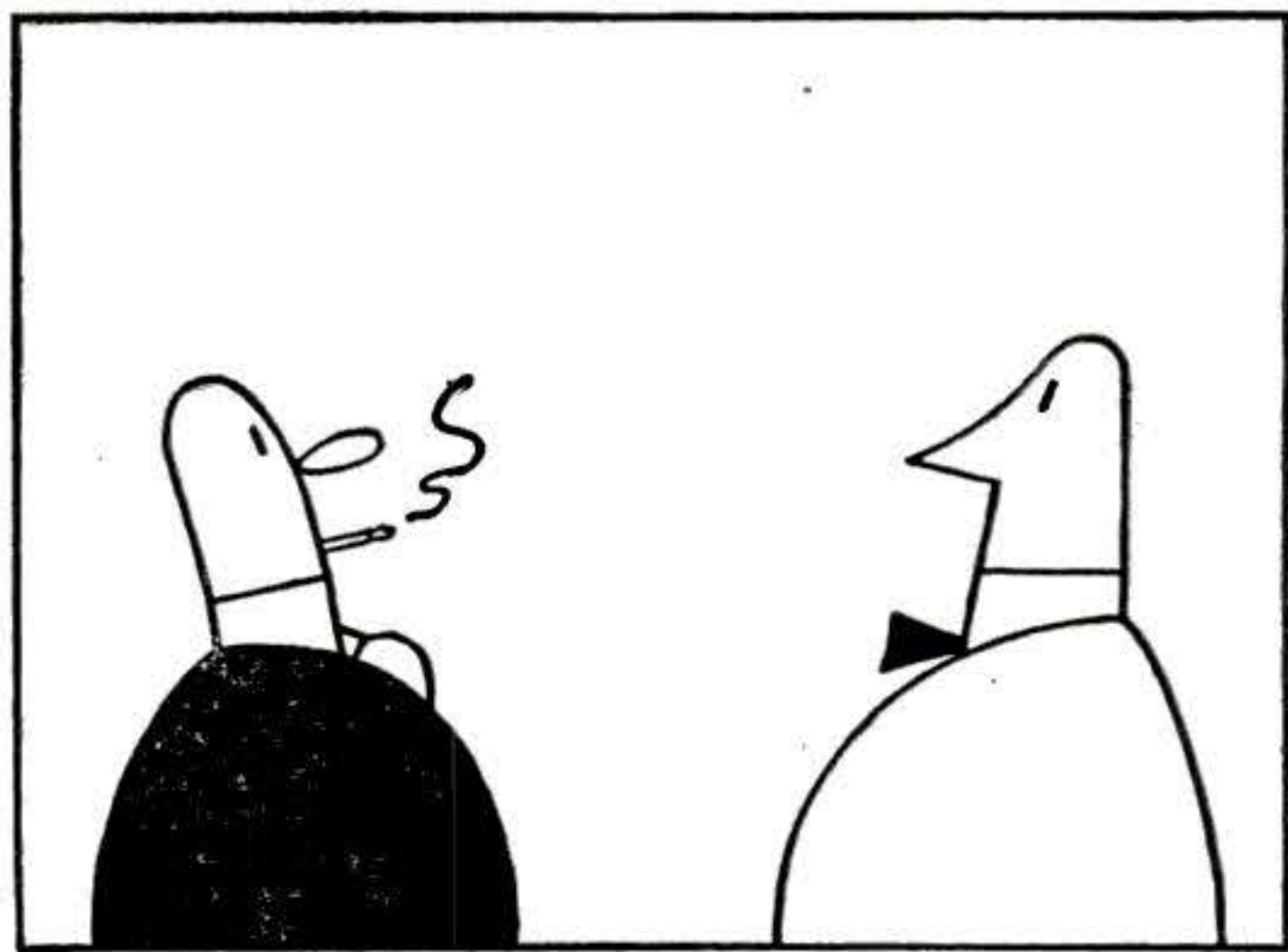
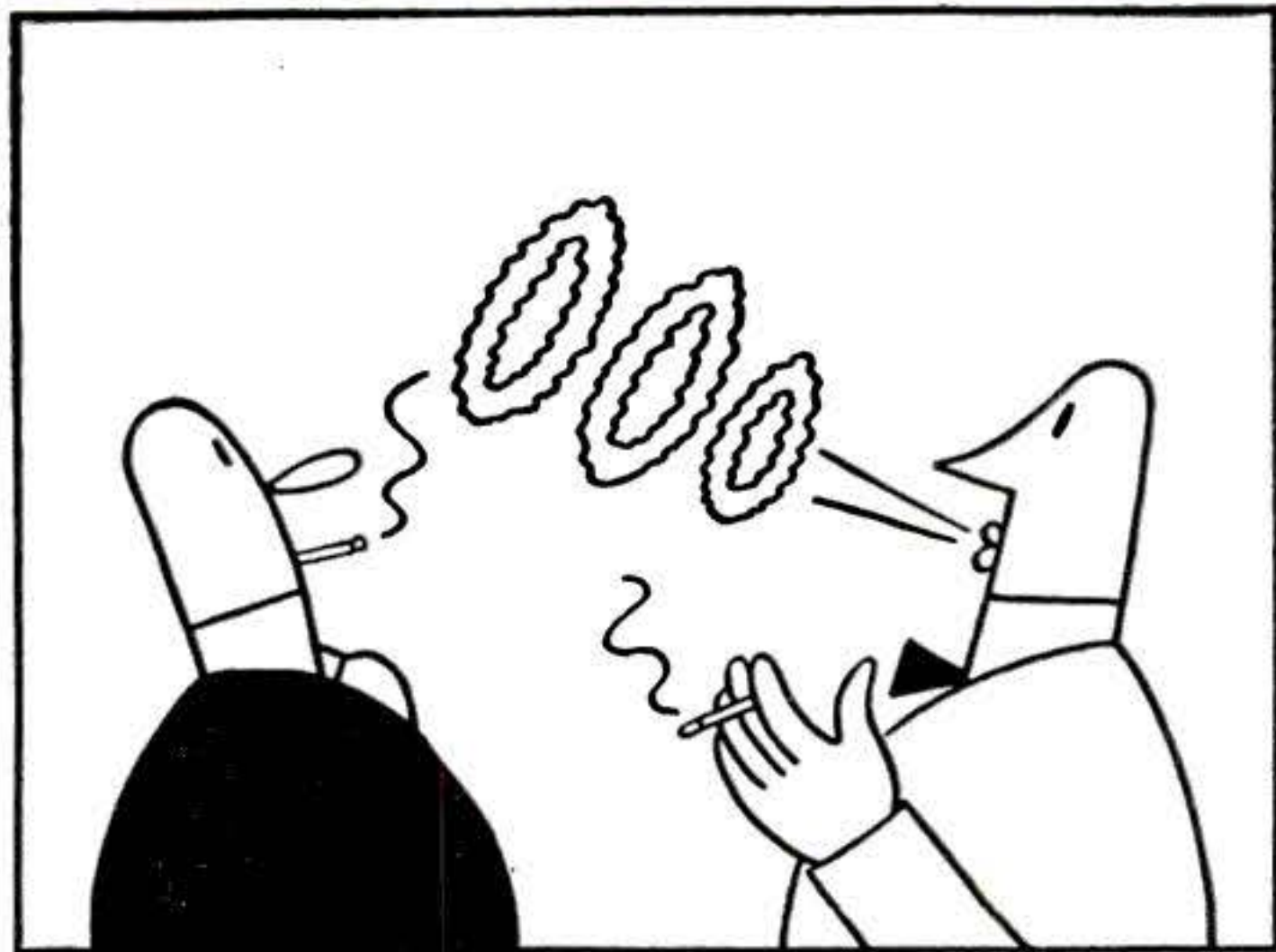
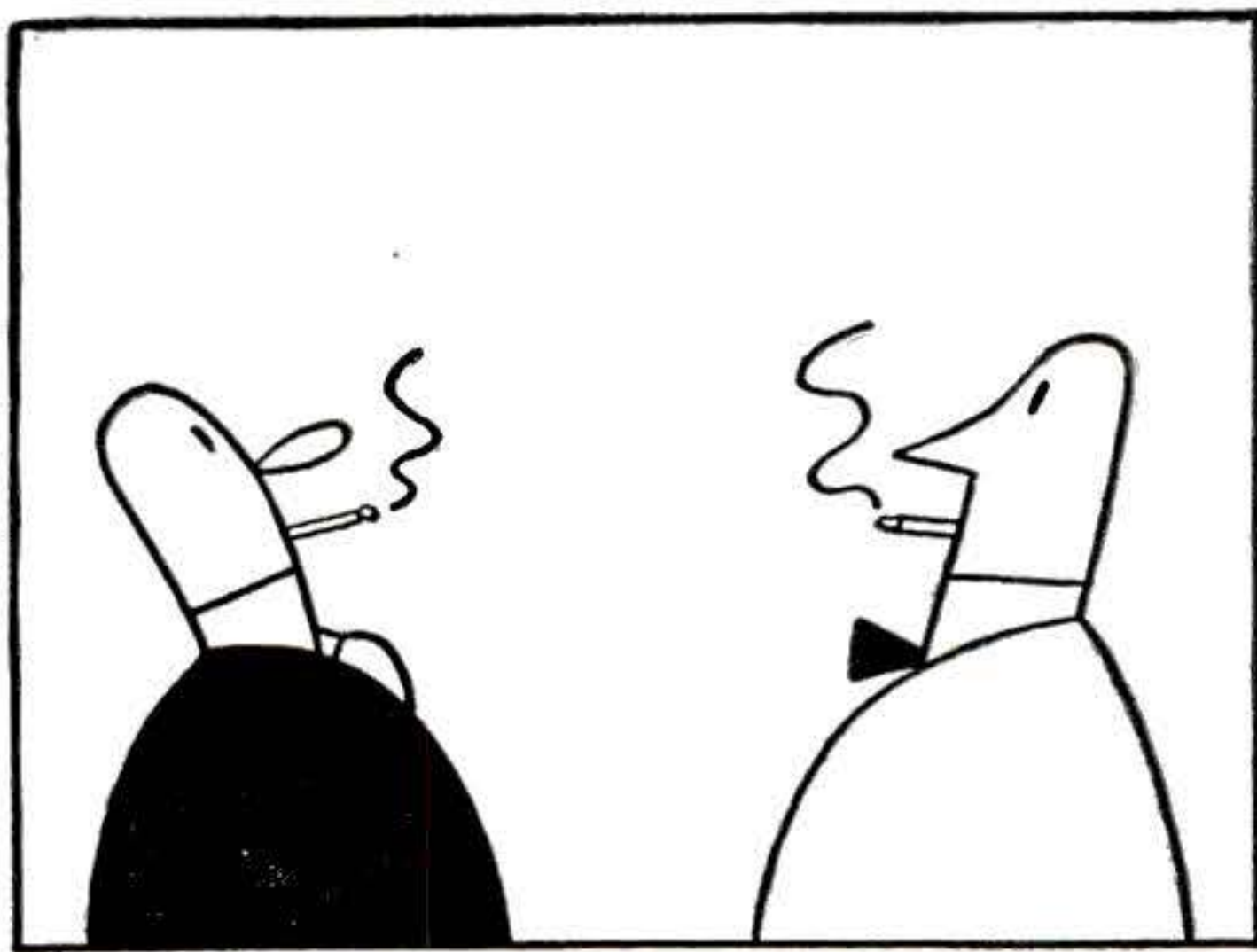
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When TVA wired the backwoods for readin', freezin', and cookin' a few years ago, nobody in the barefoot crowd would believe electricity. David Lilienthal, then a director of TVA, told me himself they had to go out into the kerosene country with demonstration kits to show how the invisible stuff that ran along the wires could light lamps and turn machinery.

Lilienthal, as head of the Atomic Energy Commission, might sleep better these nights if he could do the same thing with atomic power, and send out samples of the world's greatest force. A baby bomb that would kill only mice; or a little bottle of radiation that would get rid of moths.

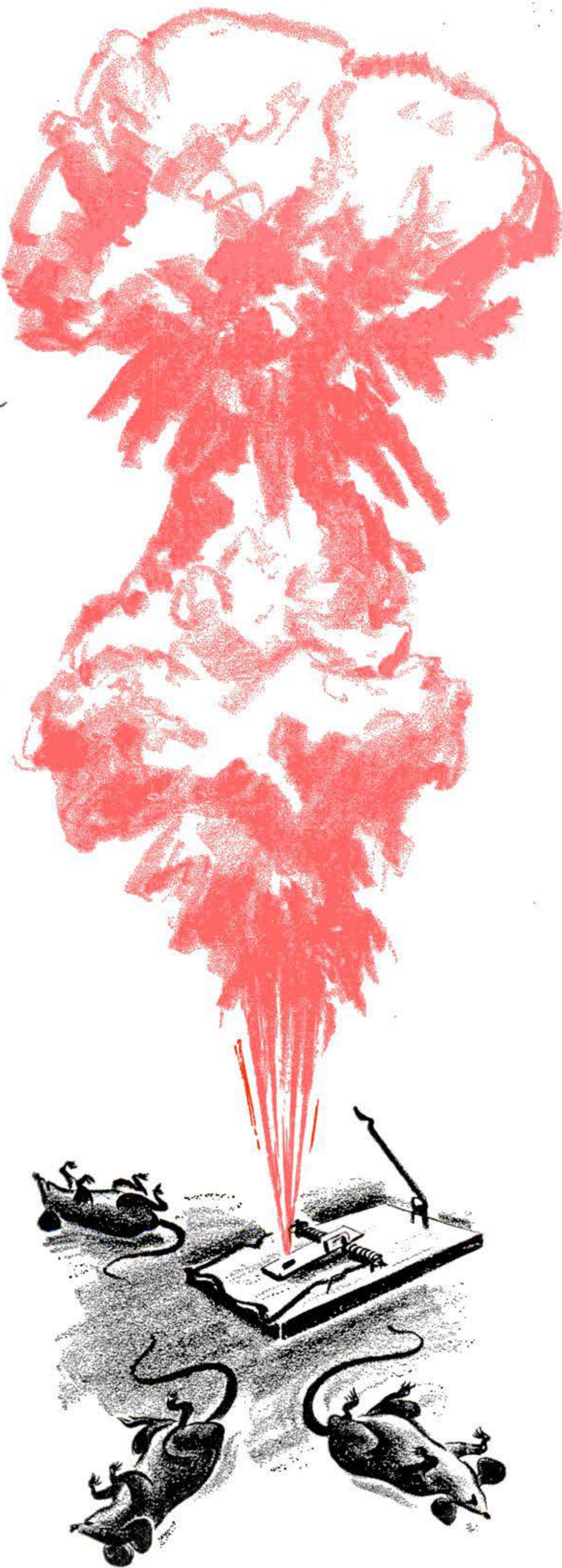
But, so far, there aren't any vest-pocket power piles. Nuclear fission comes only in the big, all-family package. Only the *idea* can be put out in handy, one-brain doses.

So the story of atomic power is being told in many ways in many magazines—including this one. There are books about it in your public library, feature pieces in your newspapers. Read and believe—don't let strange words stop you. Like the intelligent hillbilly seeing his first electric light, it is something to appreciate the power of the smashing atom, whether or not you fully understand it.

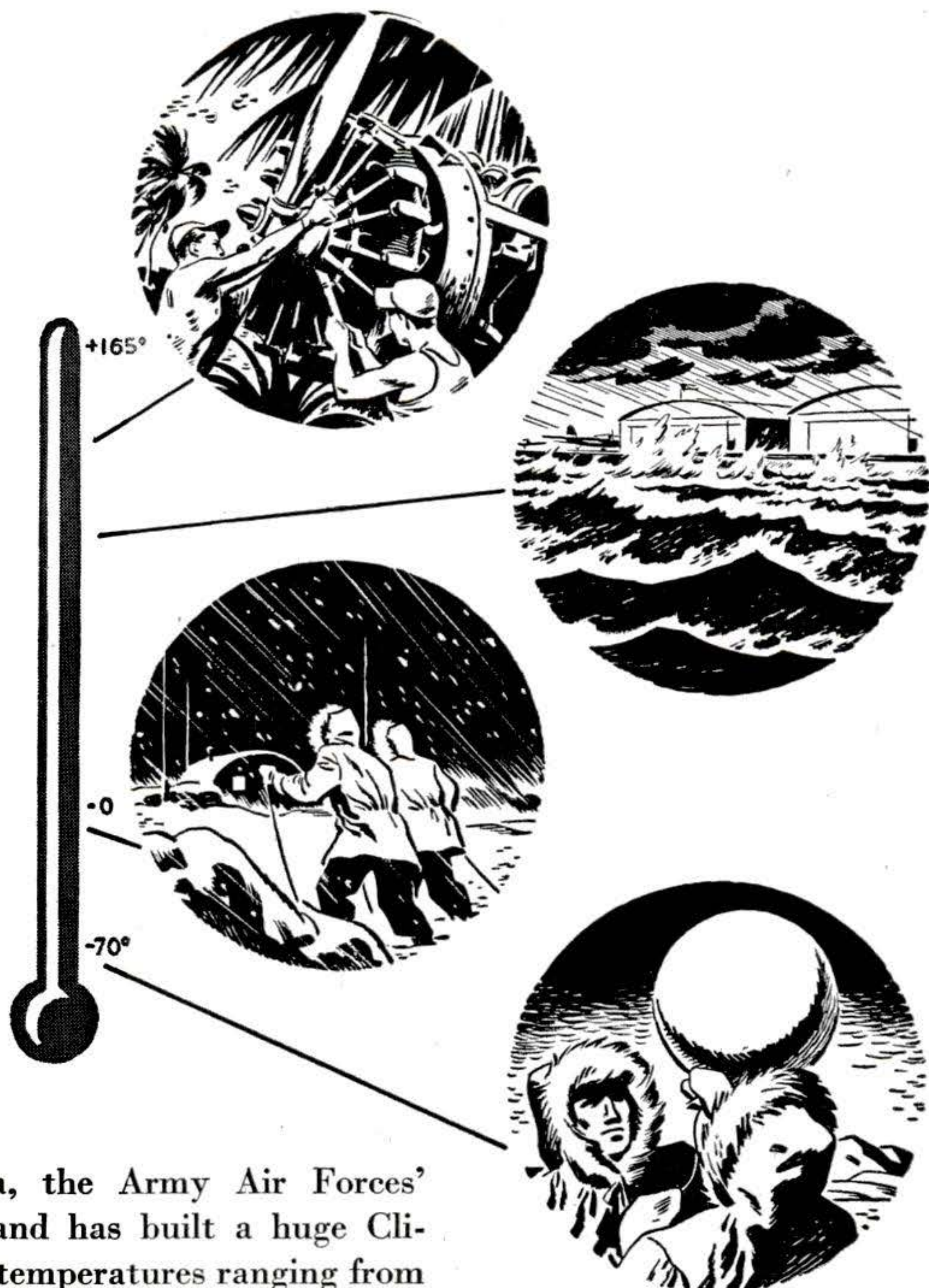
Certainly the best thing we can do as participants in this gigantic job of public education is to explain to our children the elementary new facts of their life and death. And we can learn, ourselves, by teaching others. For we are all children in a new world.

Perry Gillman

AUGUST 1947 7



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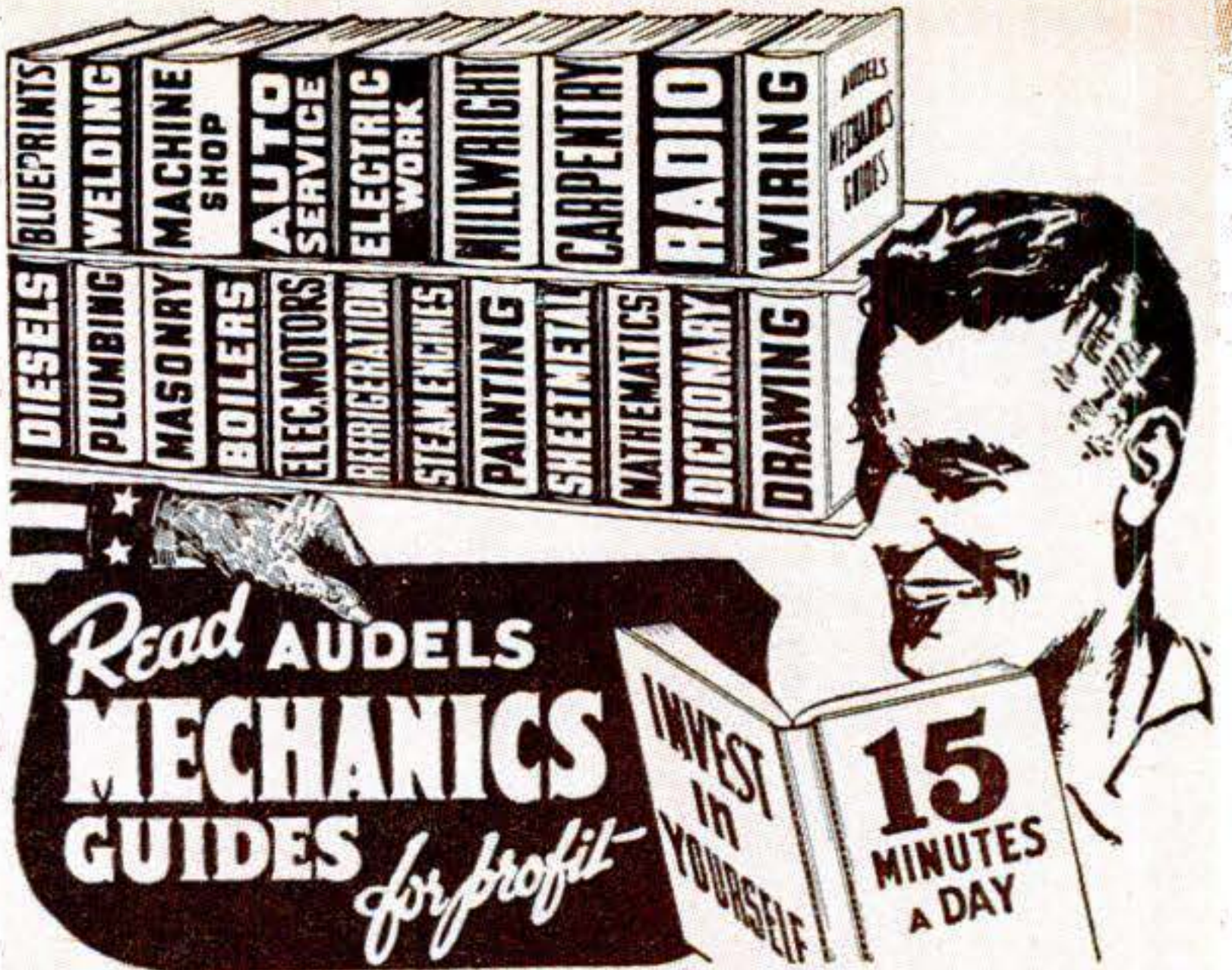
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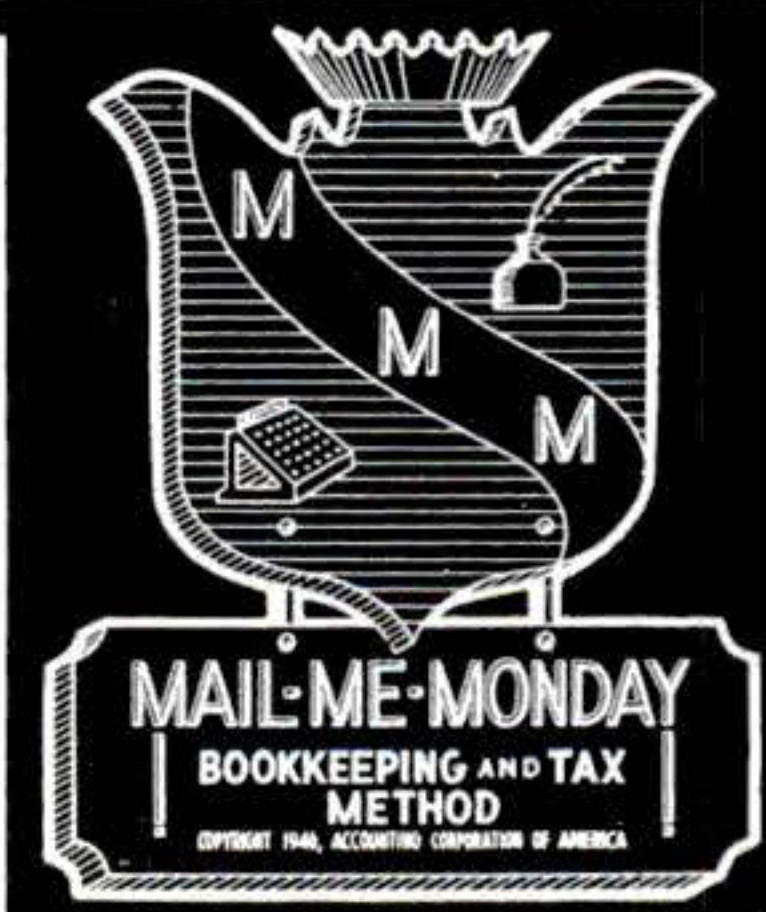
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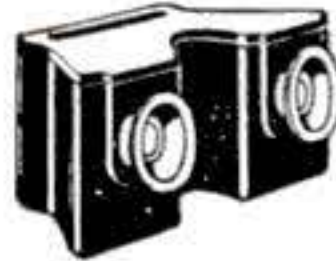
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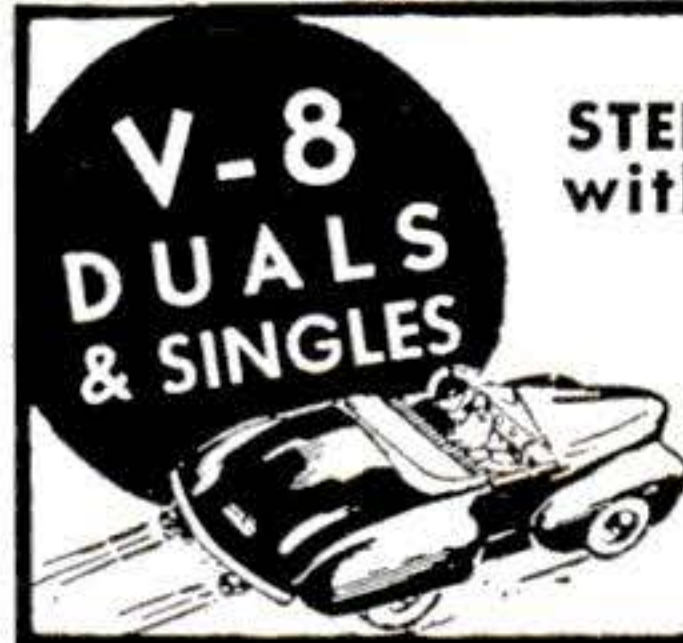


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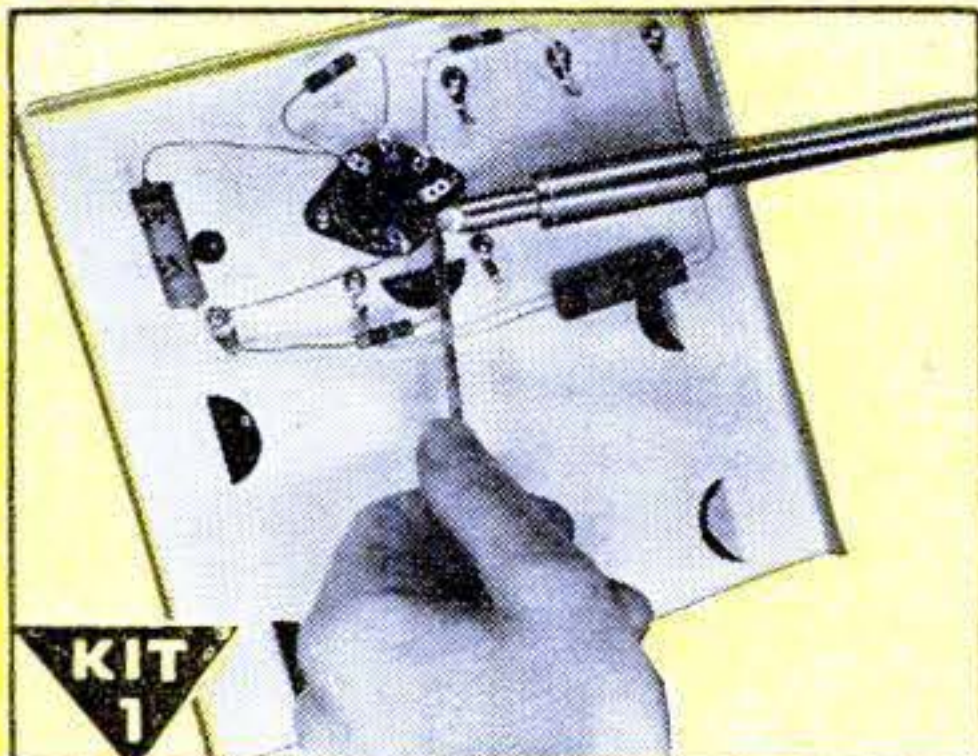
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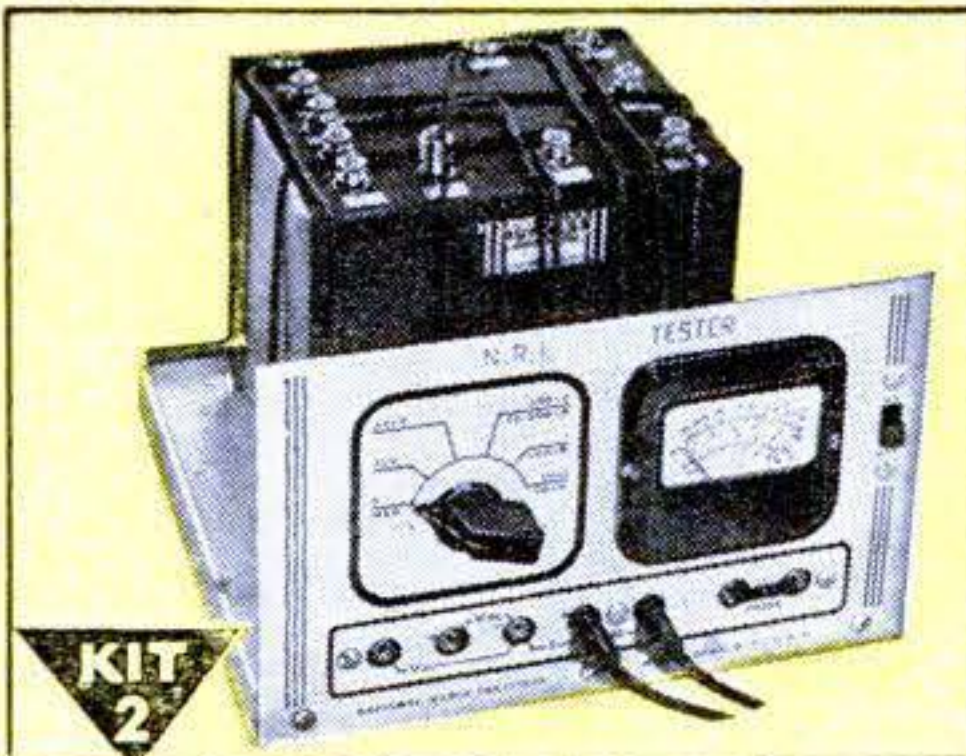


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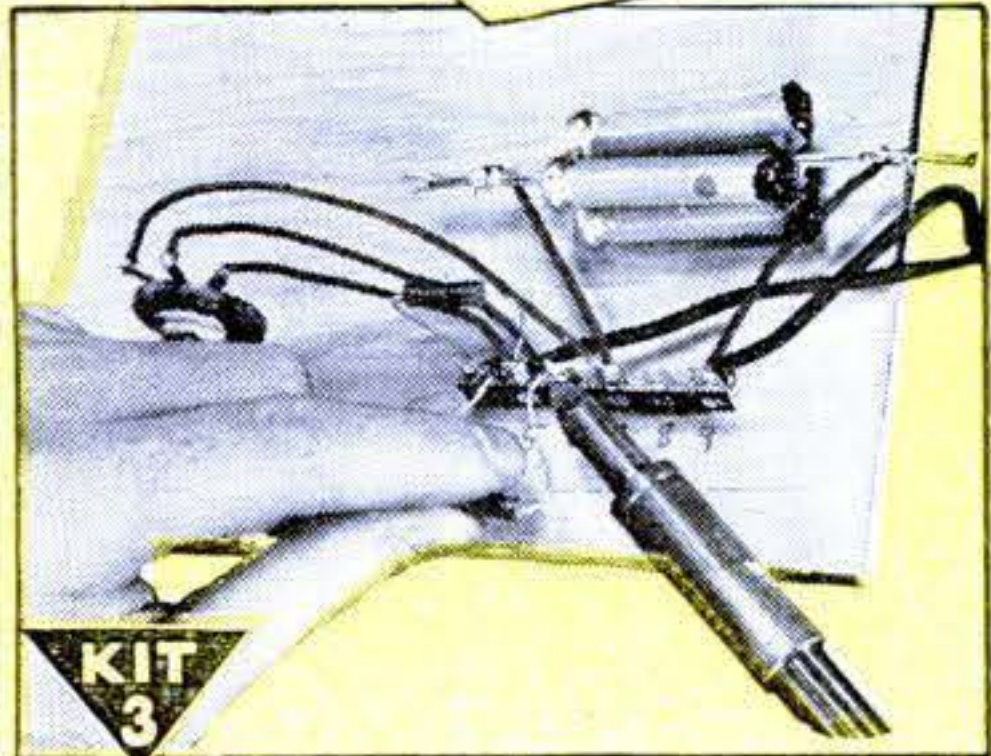
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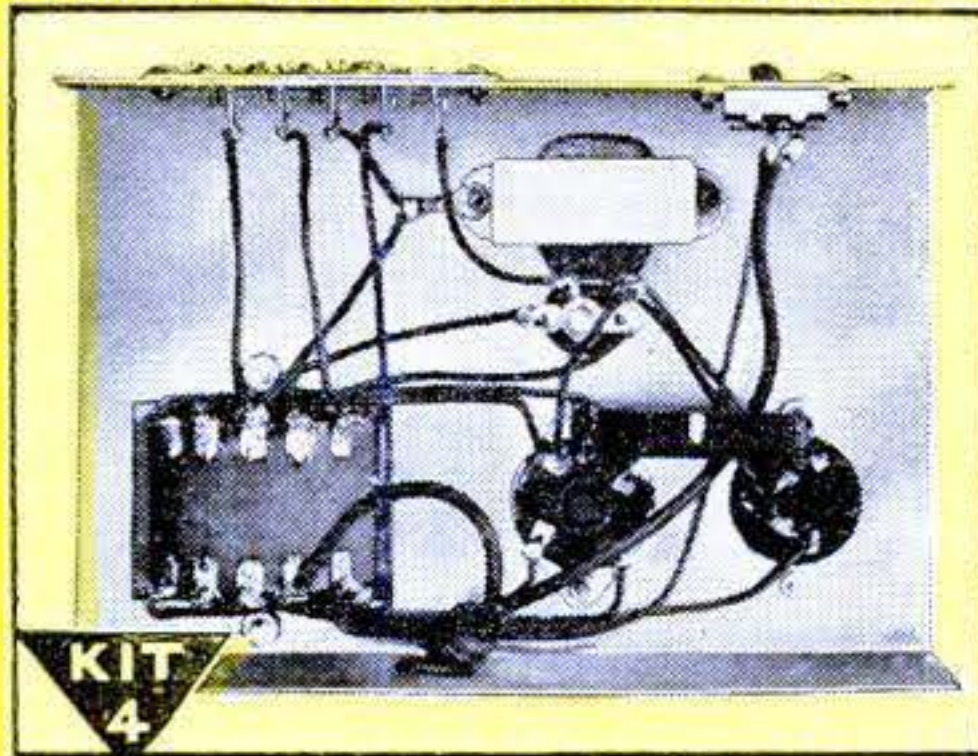
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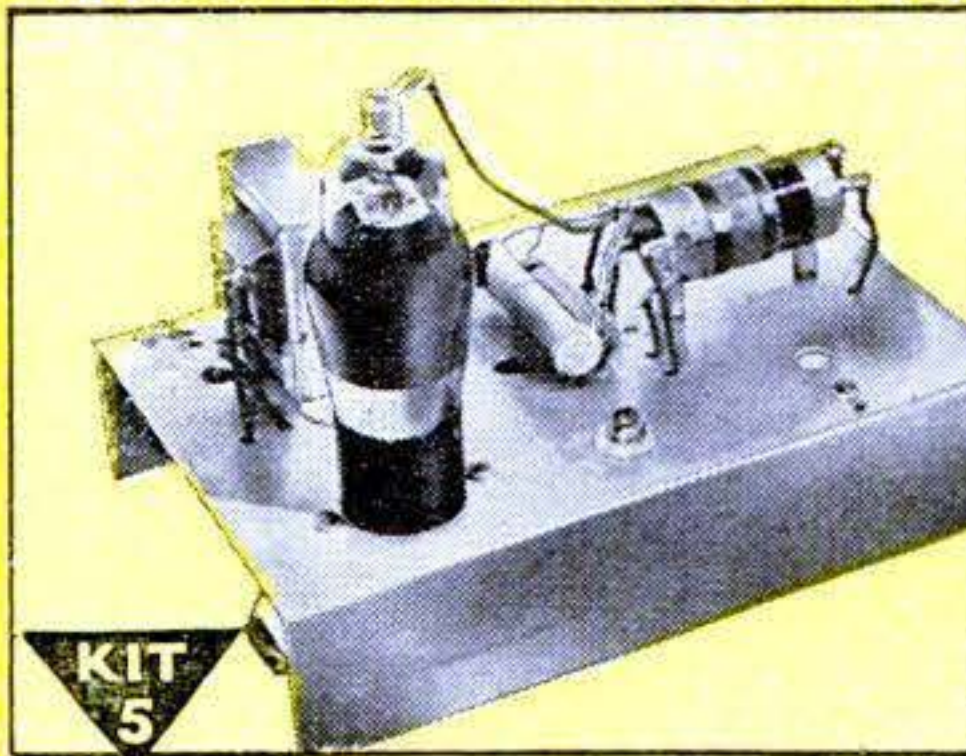
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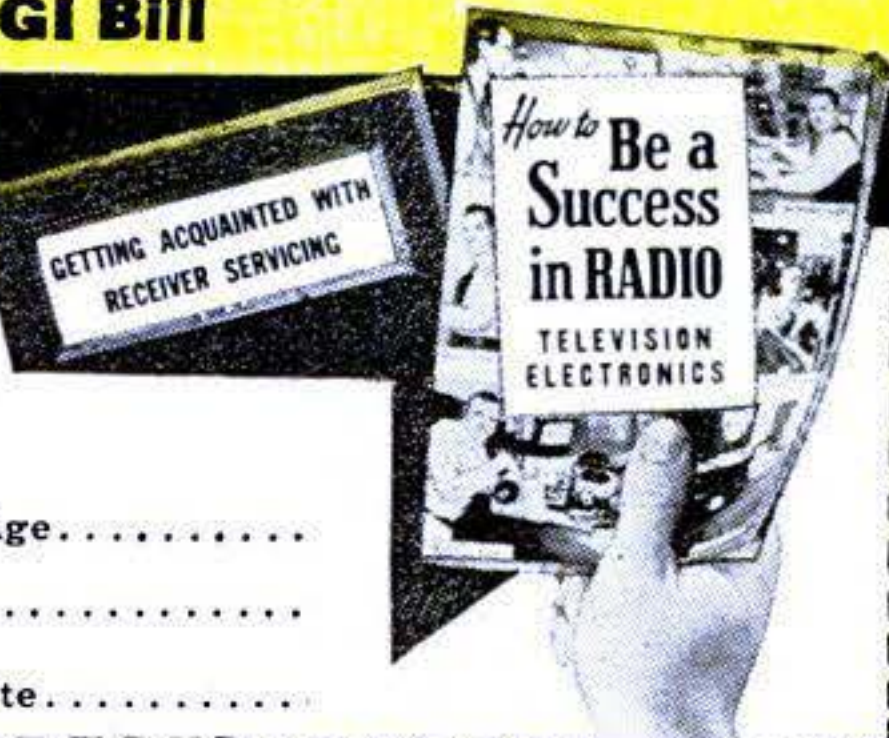
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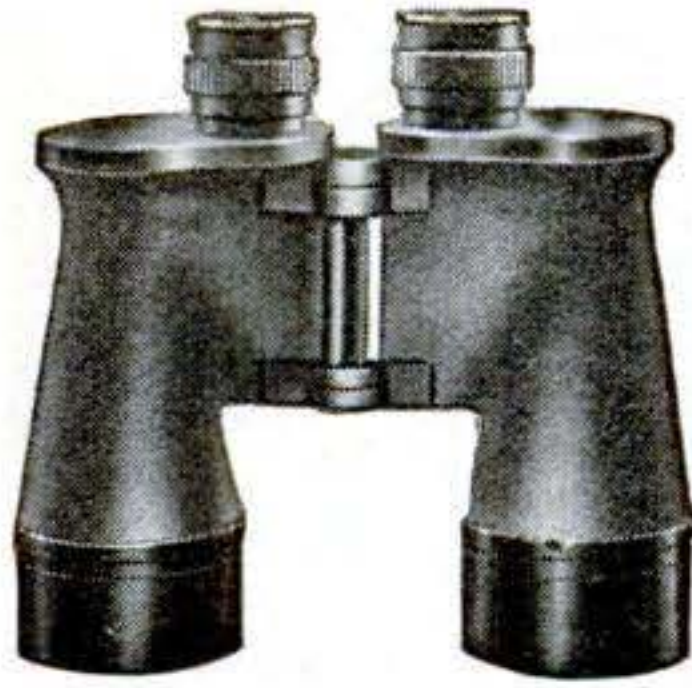
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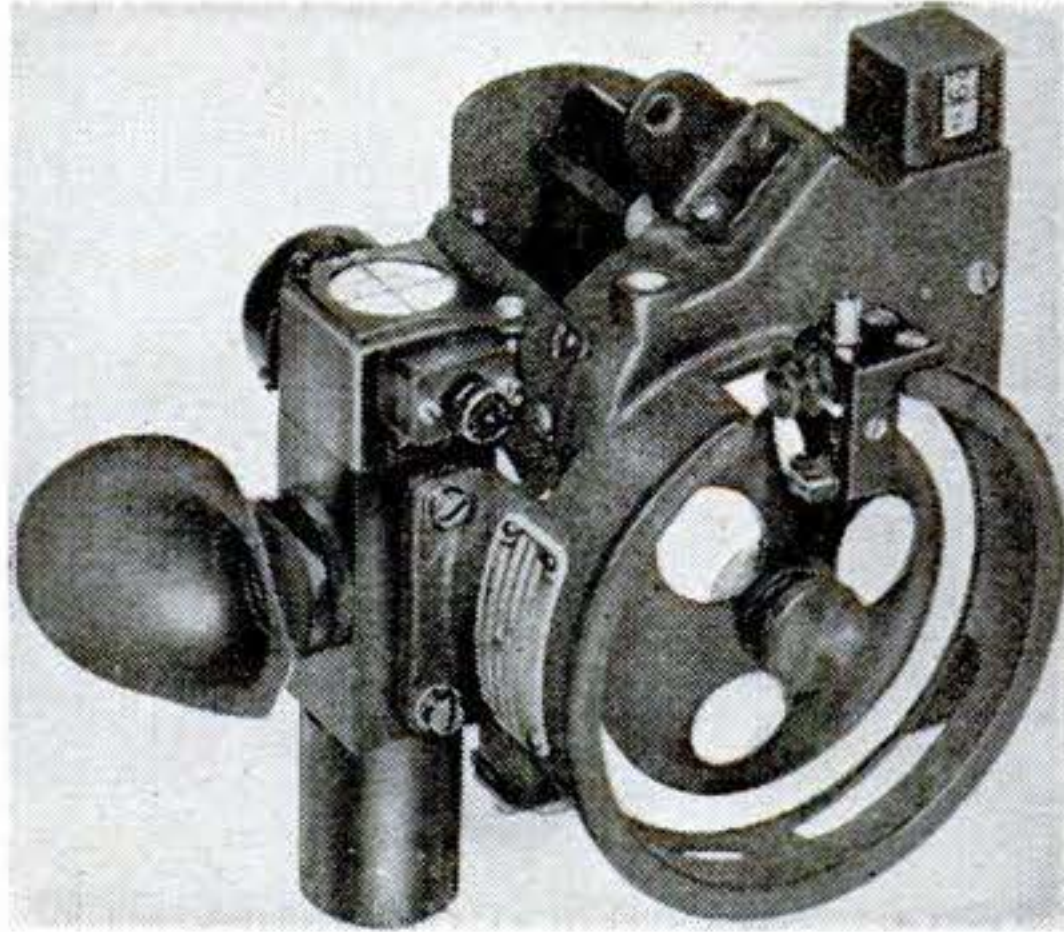
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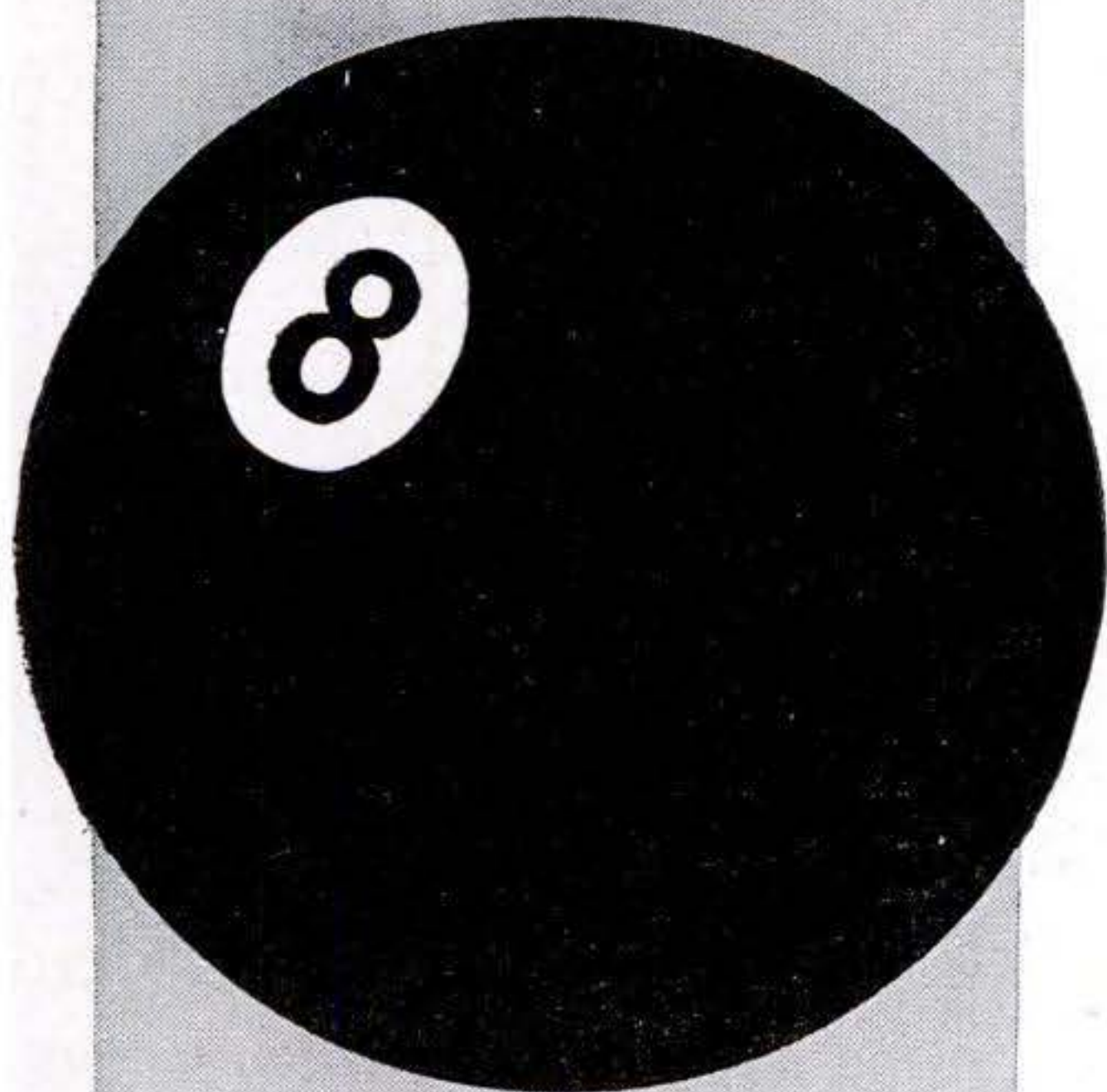
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Jerry, the talking dog, is entertaining hospitalized veterans, by courtesy of the PYROIL Company. Picture of Jerry sent on request.

LETTERS

Statistics Don't Lie

Sir:

. . . On page 90 of the June number I find: ". . . the coal miner may be released from his daily struggle with death in the dark." Now don't you think that is laying it on just a little thick? Why don't you take a trip to a modern coal mine? I am sure you will find that (1) mechanized methods eliminate the "struggle," (2) modern methods eliminate the "dark" and (3) no one is under the constant fear of "death." A check-up will reveal that coal mining does not have the highest of all poor safety records.

JAMES V. THOMPSON

Calhoun, Ga.

The National Safety Council ranks coal mining as the most hazardous of all occupations in the severity of injuries. Its accident rate on that basis is more than 10 times the average for all industries. And the last decade has seen more than 10,000 miners die—most of them in the dark. Is that laying it on too thick?

Why Not Crash Pads?

Sir:

I read your article "Cars Can Be Safer" (April '47, p. 82), and you stated that the car companies would lose business if they came out with crash pads, safety belts, etc. But if these were put on all cars at once, like the sealed-beam headlamps, I doubt that the sales would decrease much.

BILL KIRKNESS

Burlington, Vt.

Sir:

. . . Your article "Cars Can Be Safer" interested me because of the crash-pad feature. You see, I've been thinking of some such thing for quite some time. . . . What I had in mind was a crash pad so constructed that it would automatically be released either through the braking action or at a certain speed so as to rise upward and cover



INVENTORS



Learn how to protect your invention. The U. S. Patent Laws provide that any new and useful art, machine, article of manufacture, or composition of matter, or any new and useful improvement thereof, may be patented if the act of invention is involved. Therefore, every inventor with a valuable invention should take advantage of the Patent Laws and proceed for patent protection in order to safeguard his rights.

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A specially prepared booklet entitled "Patent Guide for the Inventor", containing detailed information with respect to patent protection and procedure, together with a "Record of Invention" form will be promptly forwarded to you without obligation upon request.

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the area that a body would come in contact with when the car operator finds it necessary to make a sudden stop. . . .

MORRIS GREEN

Brooklyn, N. Y.

Readers Kirkness and Green, approaching different aspects of the same subject, may both be on the right track.

Which Way Is Time?

Sir:

Maybe you can set me straight on the "Vertical Clock Face" (June '47, p. 115). It is supposed to be 5:15, but I'll be doggone if I can figure it anything but 5:20. If, as it says, it is 5:15, shouldn't the lower portion be at 3 instead of 4?

J. N. RIGGS, JR.

Oyden, N. C.

As stated in the clock's description, the minutes are read, not vertically, but from left to right in the horizontal width of the column's higher portion.

What an Eye!

Sir:

"Sculping a Television Lincoln," page 119 of the June issue: You fooled me for a minute with that "mirror shot" in the upper left-hand corner that shows the bust of Lincoln with the hair part on the right, the mole on the left and the actor's wrist watch on his right arm. . . .

CLARENCE M. HALL

Pittsburgh, Pa.

It wasn't meant to fool anybody. That's why the lower edge of the mirror and its frame were allowed to show in the picture.

Sense vs. Semantics

Sir:

Practically all flammable materials burn or combust spontaneously, for once the reaction has started, heat from an external source is no longer needed. . . .

The technically correct word for the phenomenon described by Mr. Swezey (May '47, p. 212) . . . is "spontaneous ignition."

MELVIN C. BERGEN

Grosse Pointe Farms, Mich.

"Spontaneous combustion" is far more

INVENTORS

Patent Laws Encourage The Development Of Inventions

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If an inventor believes he has an invention, a search of the most pertinent prior U. S. patents should be made and a report obtained relative to its patentability. Where such report indicates that the invention appears patentable, in order to secure protection, diligence should be exercised in making application for a patent.

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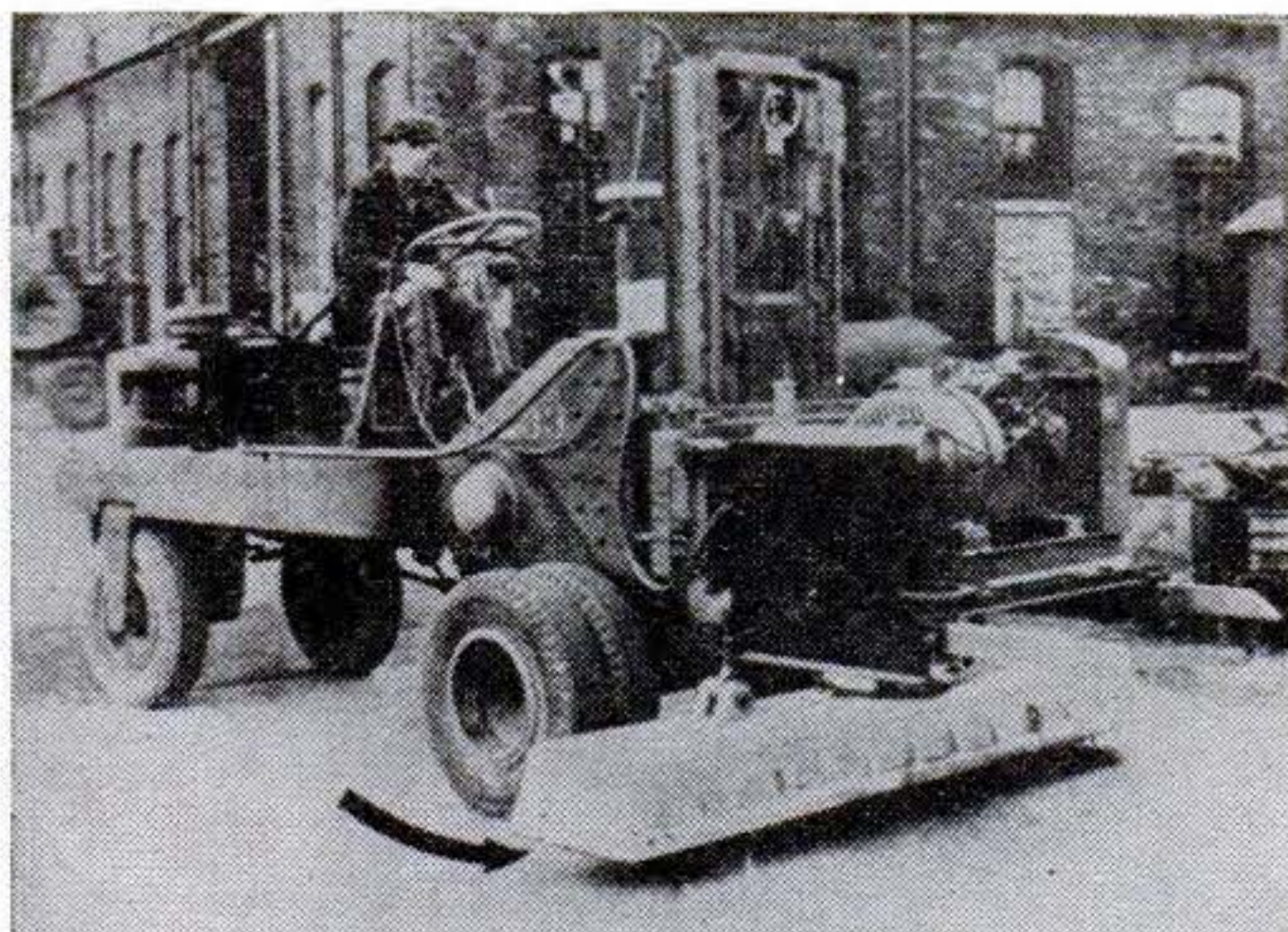
Wouldn't You Know It?

Sir:

One of the things that interests me most is your "I'd Like to See Them Make" page. With reference to your March issue and one of those ideas, entitled "Magnet to Save Tires," I herewith enclose a cutting from another magazine. . . .

C. S. P. JAYAWARDENA

Katana, Ceylon



Shown above, the device described in Reader Jayawardena's welcome clipping is a truck-mounted, road-sweeping magnetic unit in use in India to pick up sharp nails and other tire-damaging metallic fragments. In its first day's use, it is said to have collected 300 pounds of nails. The machine, incidentally, is manufactured in America.

Watch Your Atoms

Sir:

. . . In your Letters column recently (June '47, p. 18), one of your readers attempted to devise a sort of "atomic energy machine," using the "well known" chemical principle that "water cracks into hydrogen and oxygen when passed through a hot iron pipe." The Editor, in refutation, merely said something to the effect that "machinery required too cumbersome, etc."

Here is the fly in the ointment. Water does *not* "crack" into hydrogen and oxygen when passed through a hot iron pipe. Its hydrogen is replaced by a metal. The oxygen is *not* released. It combines with the red-hot iron to form magnetic iron oxide. The reaction—plain electron transfer, no nuclear

ADVICE

for the

INVENTOR

The United States Patent Office advises the inventor, unless he is familiar with such matters, to employ a competent, registered patent attorney or agent as the value of patents depends largely upon the skillful preparation of the specification and claims.

PRELIMINARY STEPS *toward* PATENT PROTECTION

The Evidence of Invention form mentioned below is offered as a convenience to the inventor in making his disclosure of invention. The inventor should date and sign his disclosure and have it witnessed by two or more persons who are capable of understanding his invention. The disclosure should then be mailed to the registered patent attorney or agent whom he selects to assist him. The disclosure should be accom-

panied by a letter authorizing the patent attorney or agent to conduct a preliminary search at the U. S. Patent Office among previously granted U. S. Patents for similar types of invention. The patent attorney or agent then prepares a report of the probable patentability of the invention and recommends the further course the inventor should take, provided the report indicates possible patentability.

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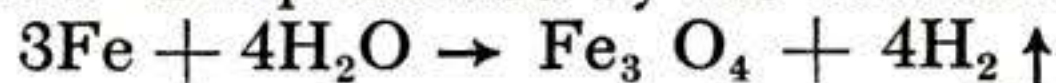
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ARTHUR TAUB

Brooklyn, N. Y.

Reader Taub uses chemistry to get the same answer PSM got without it: The idea wouldn't work.

There Will Be Licenses

Sir:

Reference is made to the article entitled "Transmitters Shrink to Lipstick Size" appearing on page 101 of the May issue:

Contrary to your report, the Commission does not and has not at any time contemplated the operation of the Citizens Radio Service in an unlicensed status. It has, however, stated that it is considering every means of making the licensing as easy and convenient as possible . . .

T. J. SLOWIE
Secretary,

Federal Communications Commission
Washington, D. C.

PSM is glad to correct its mistaken assumption that the program envisaged mere registration, rather than licensing in the usual radio sense.

More Power to You

Sir:

In reference to your article on (radio) power supplies in the June issue (p. 204), let me say that it was a good one.

I have two suggestions on how to improve the 400-volt supply. As long as there is an unused filament winding, why not bring it out to two binding posts? Then you would have a source of filament voltage for your power supply.

Another thing that could be done—and should be done for safety's sake—is to put a pilot light in the circuit somewhere. This could be done by placing a 110-volt miniature bulb across the primary of the transformer or a regular pilot light across the filament winding of the transformer.

MARTIN PRAGER

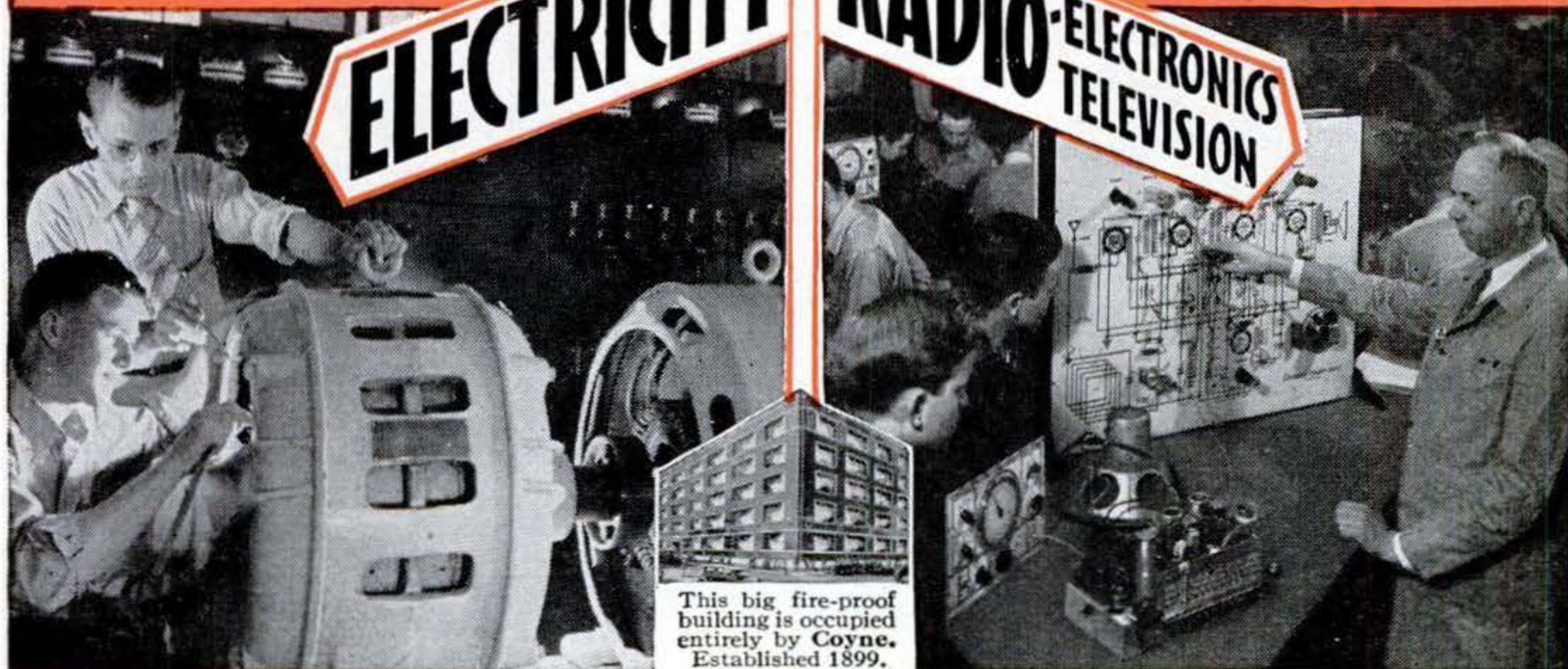
Brooklyn, N. Y.

PSM did not wish to alter Carl Andresen's original design but agrees that these would both be worthwhile improvements.

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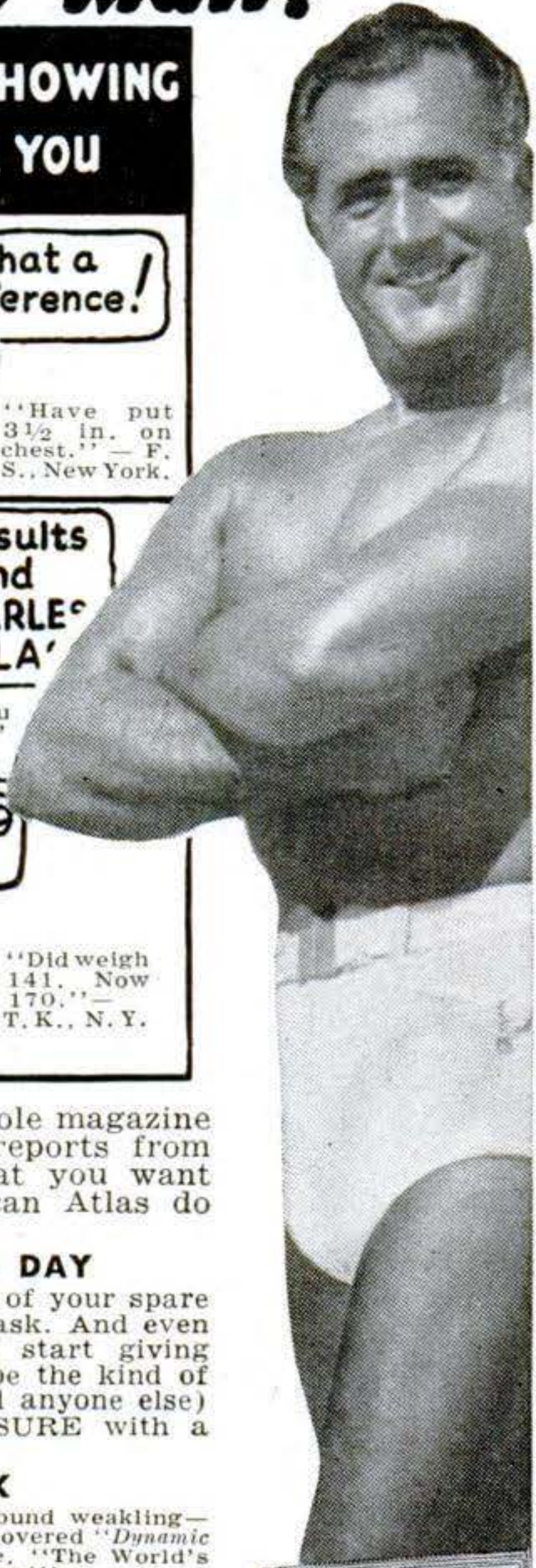
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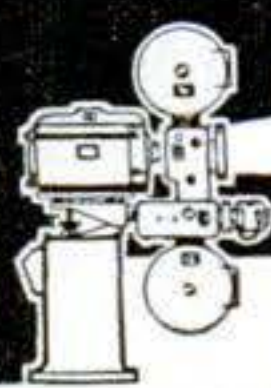
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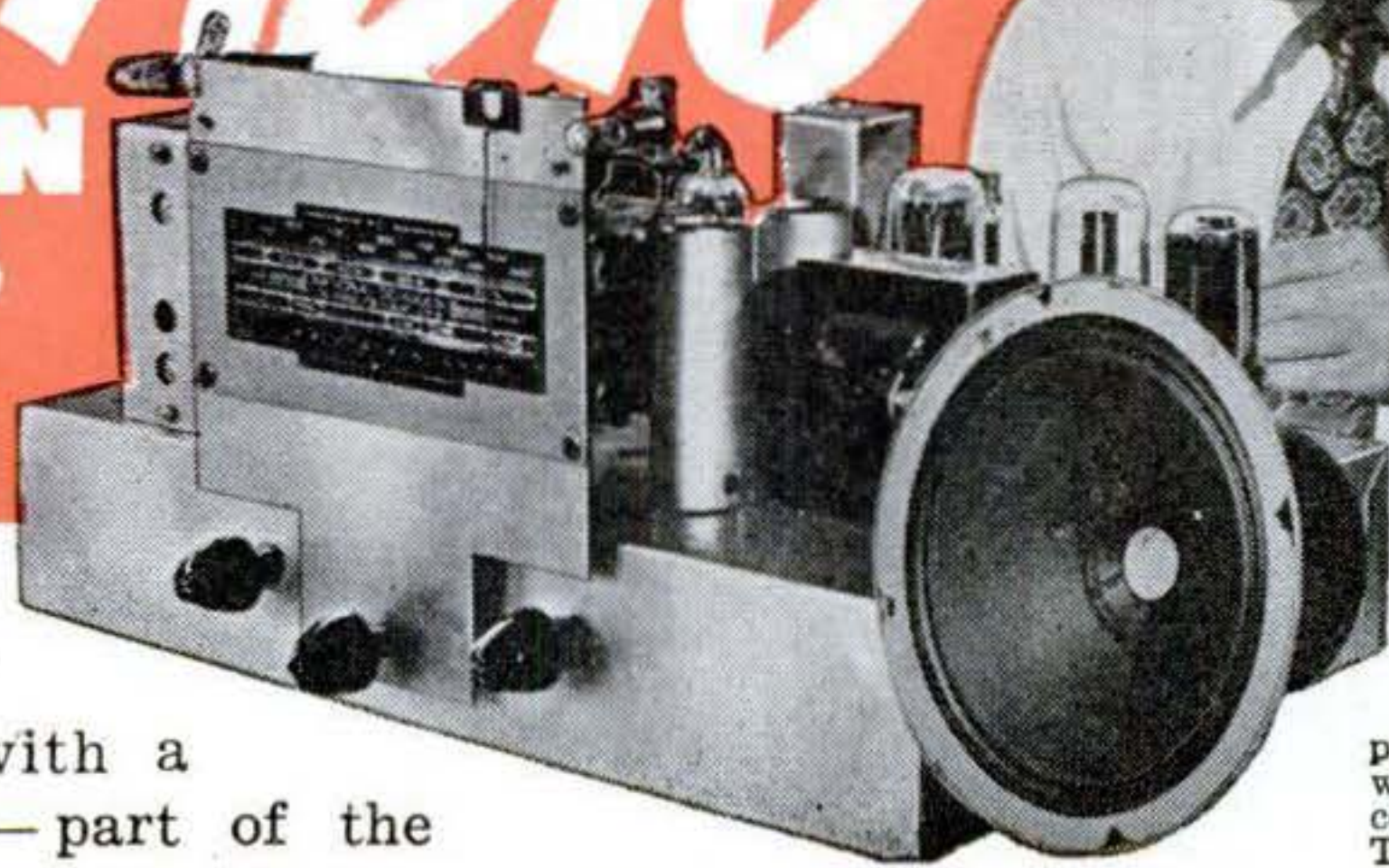
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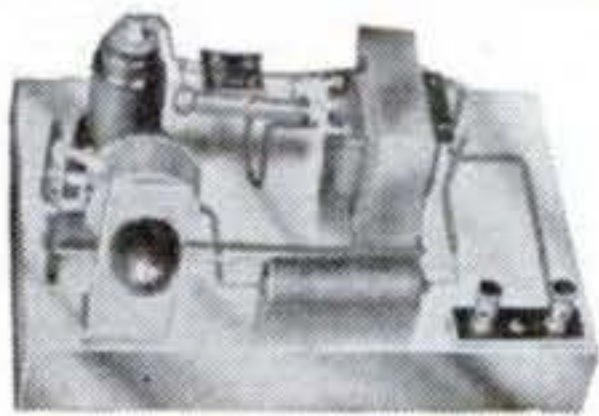


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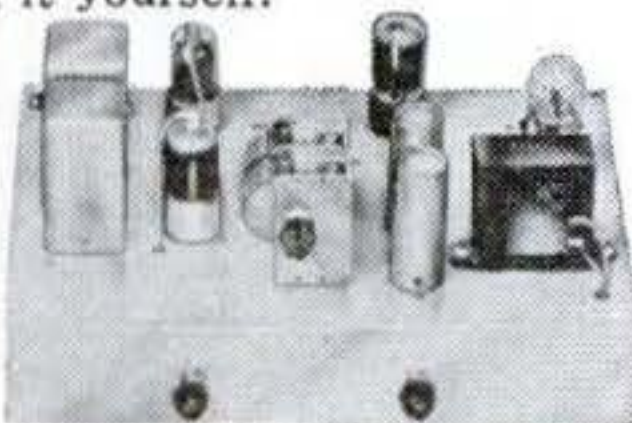
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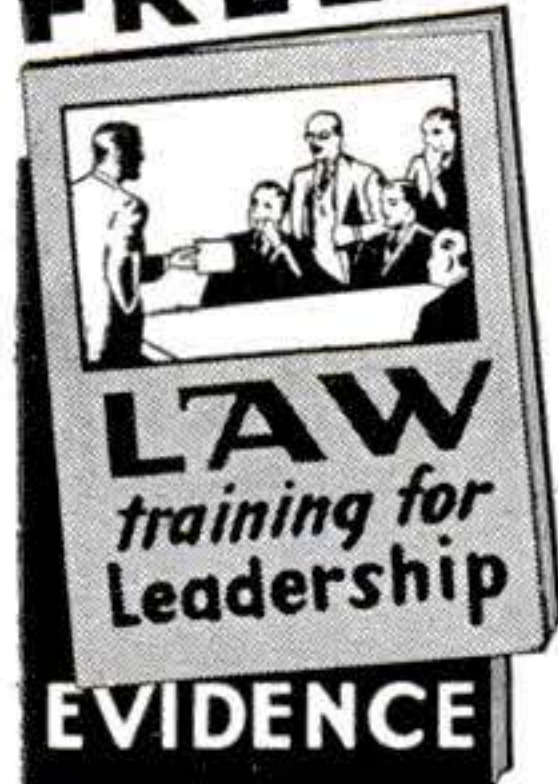
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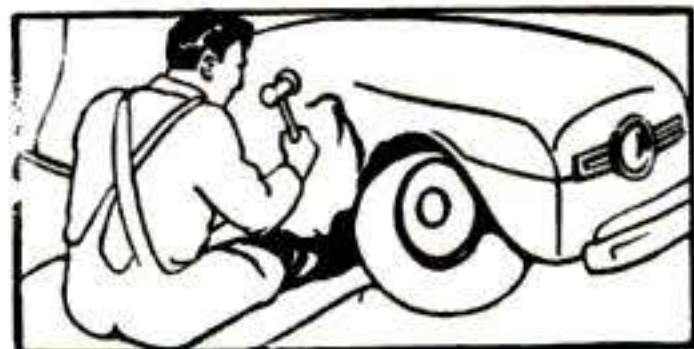
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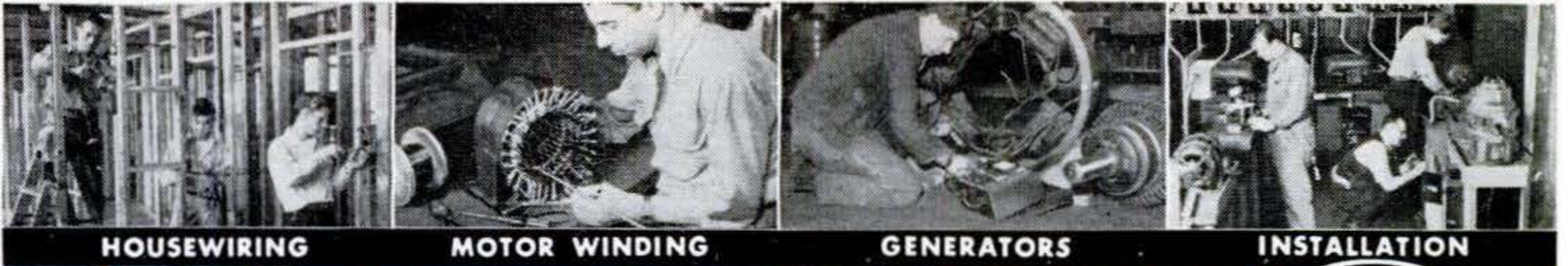
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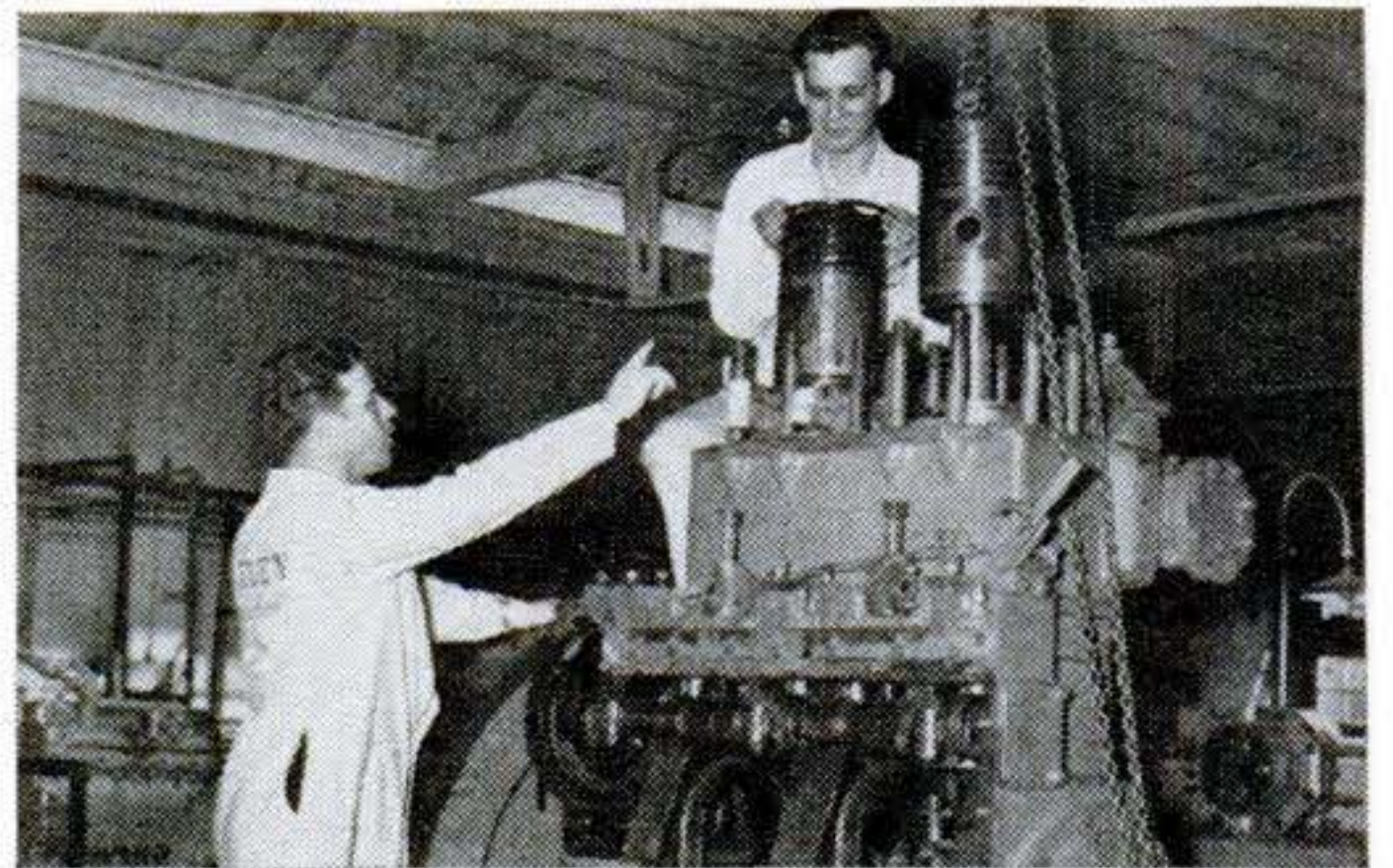
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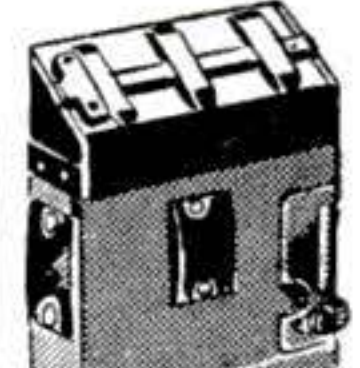
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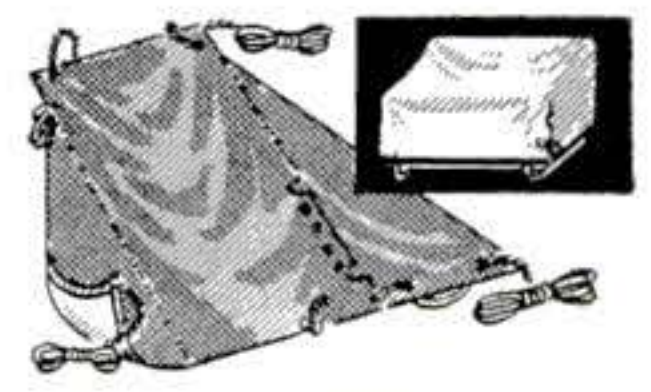
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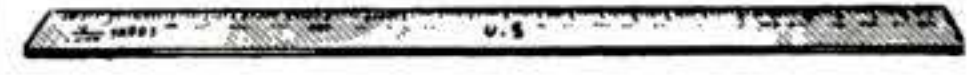
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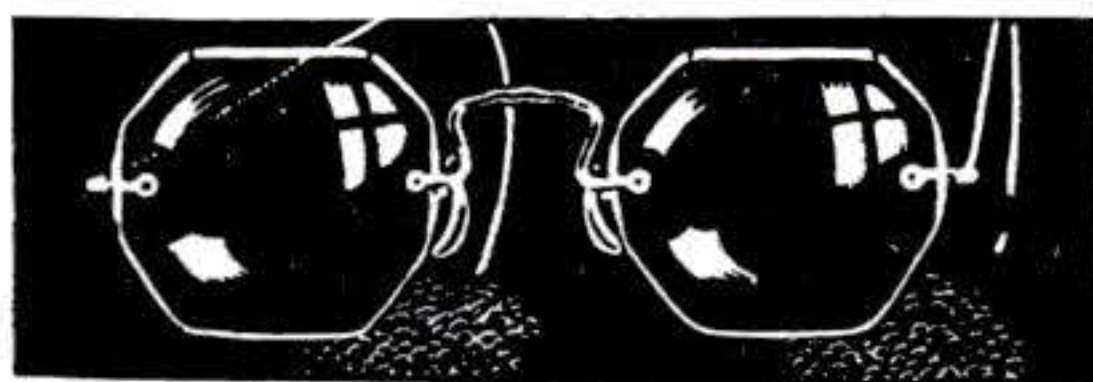
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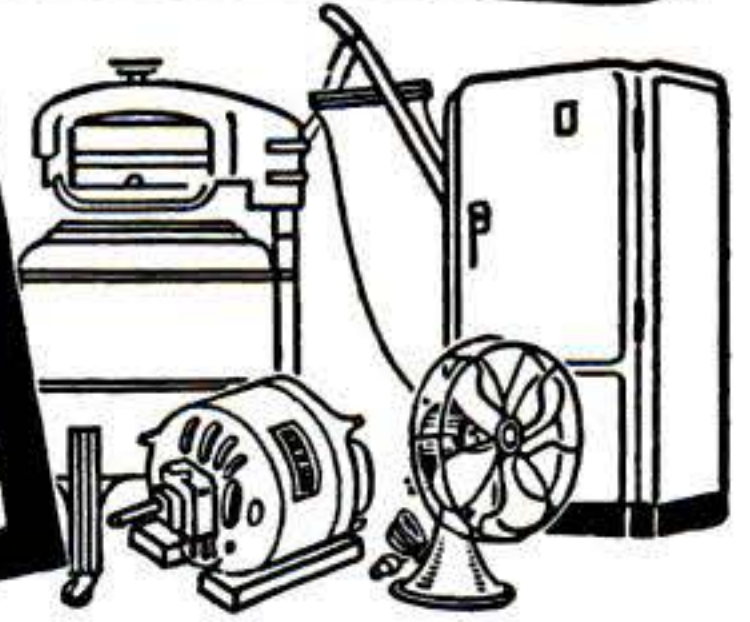


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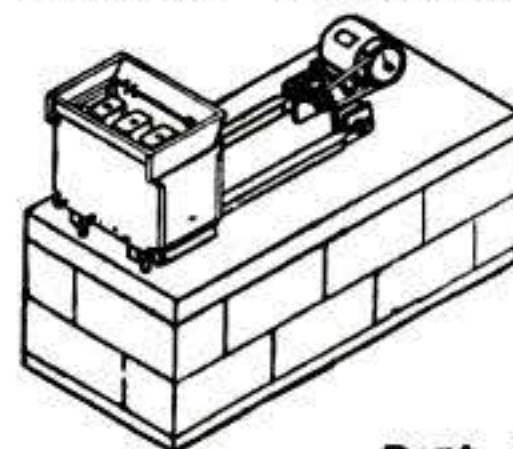
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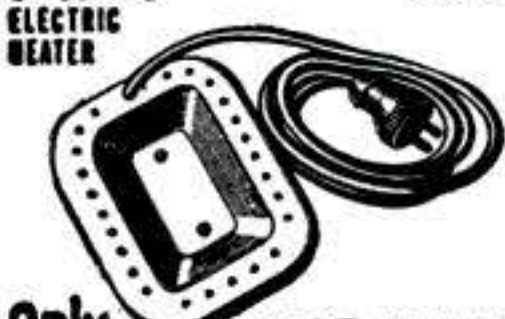


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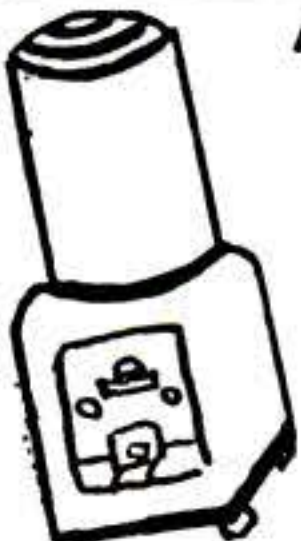
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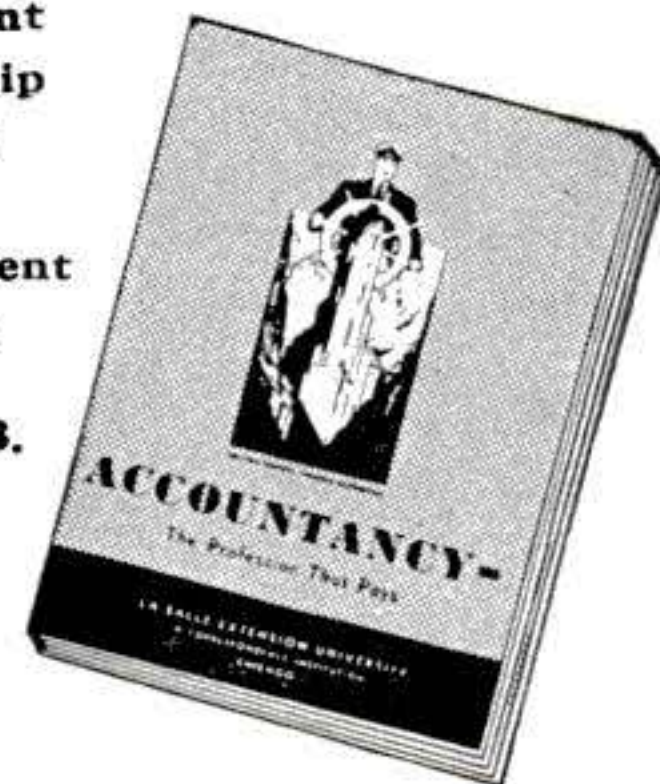
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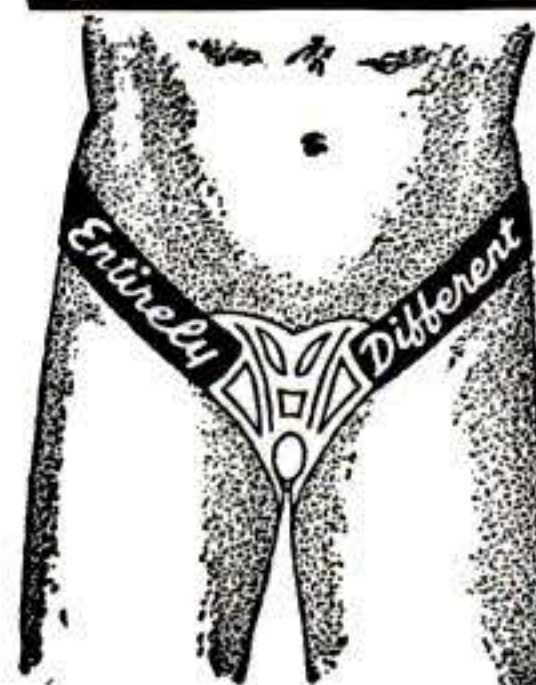
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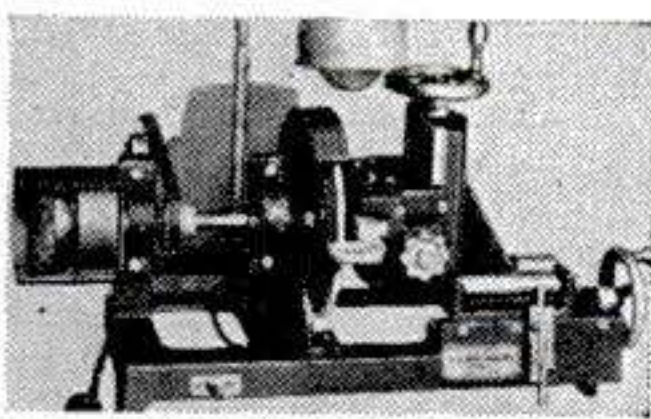
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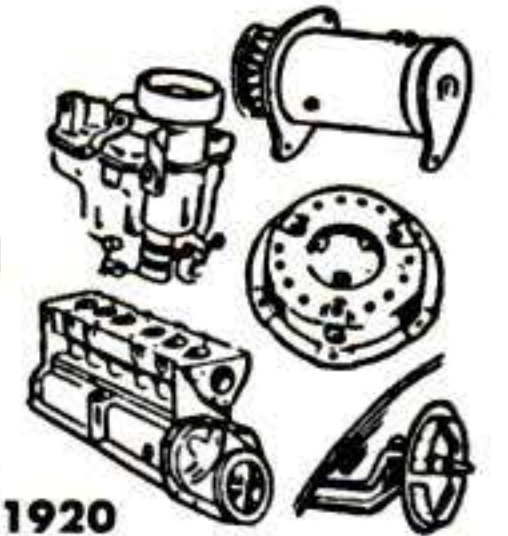
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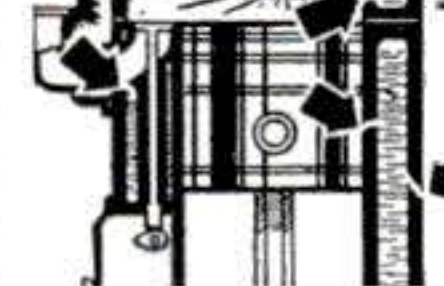


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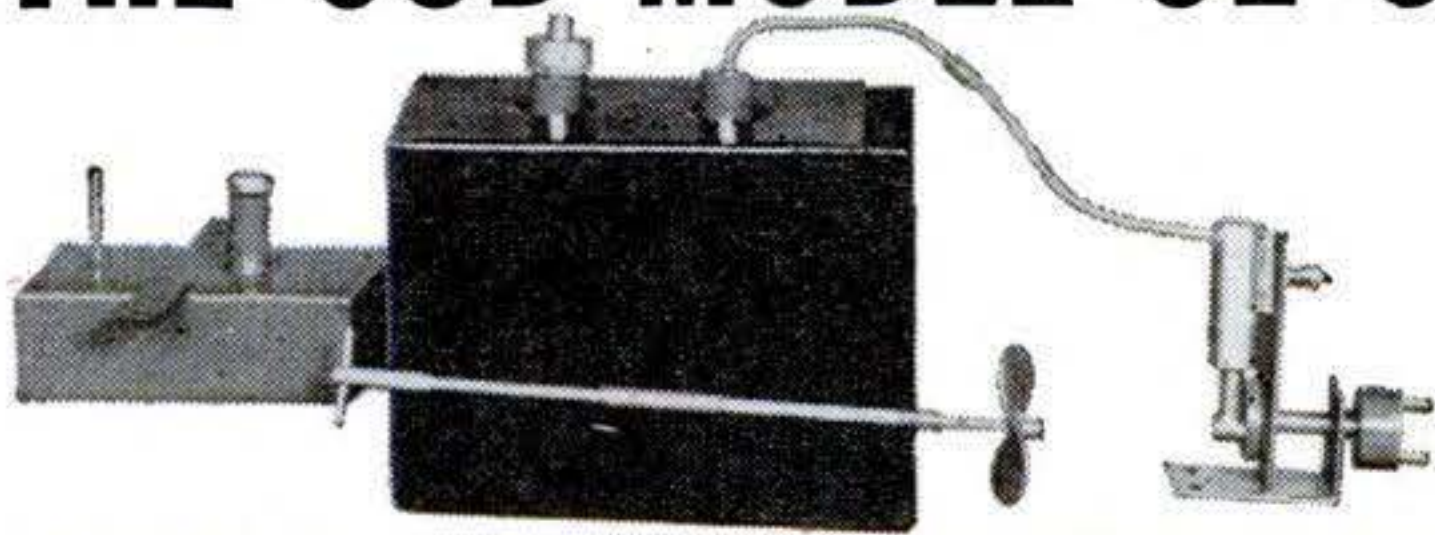
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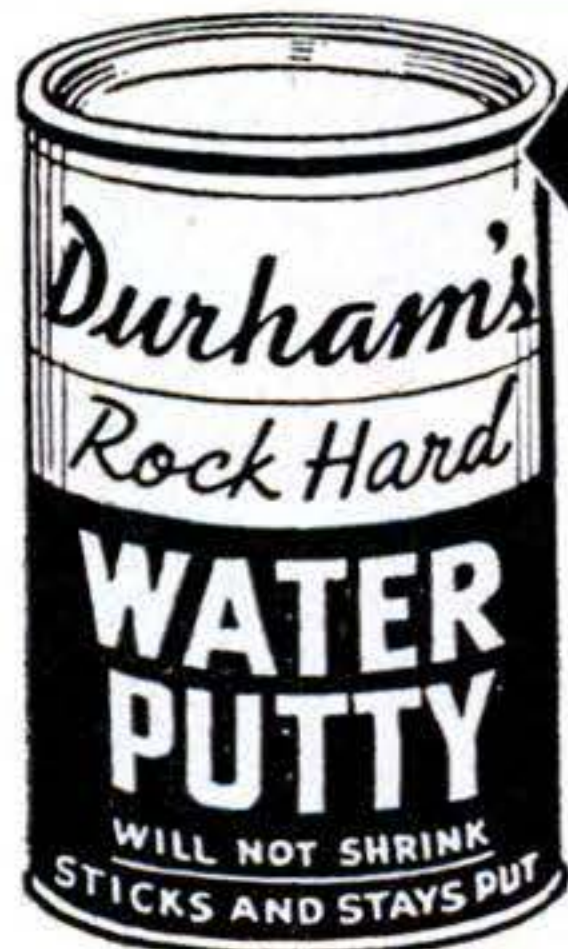
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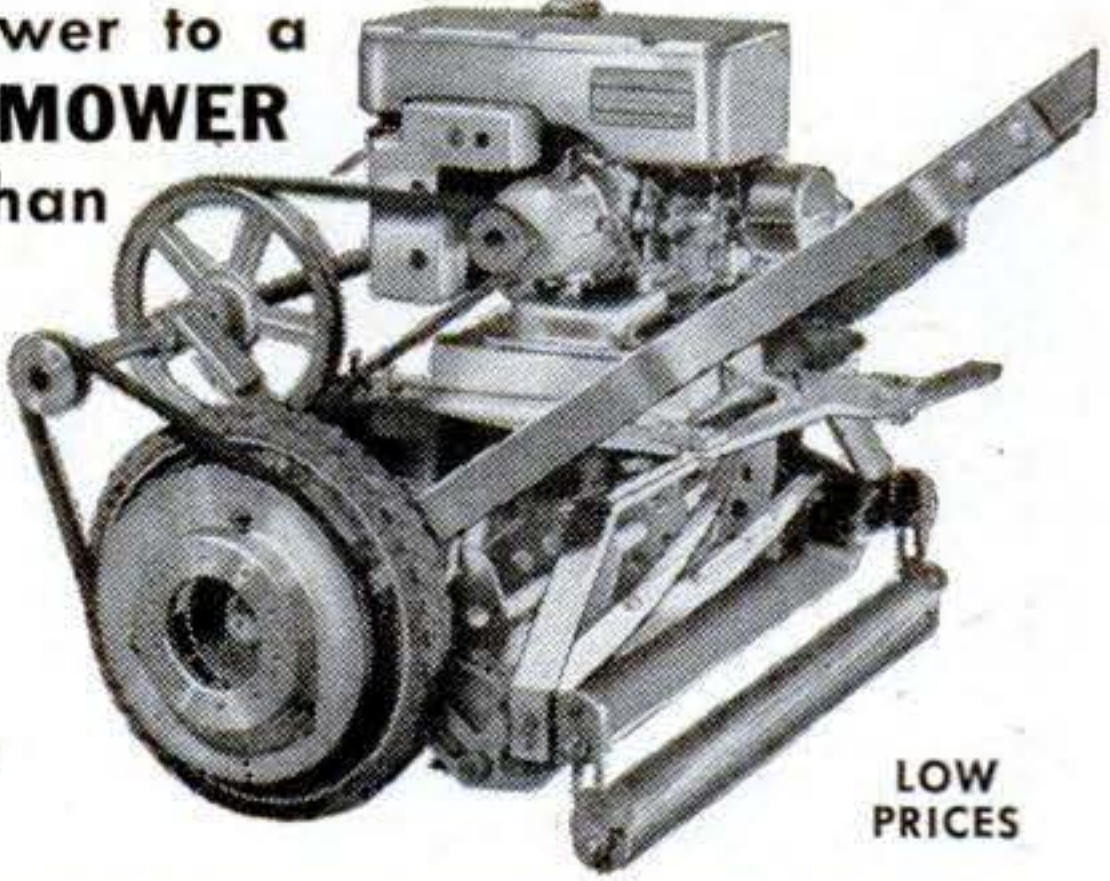
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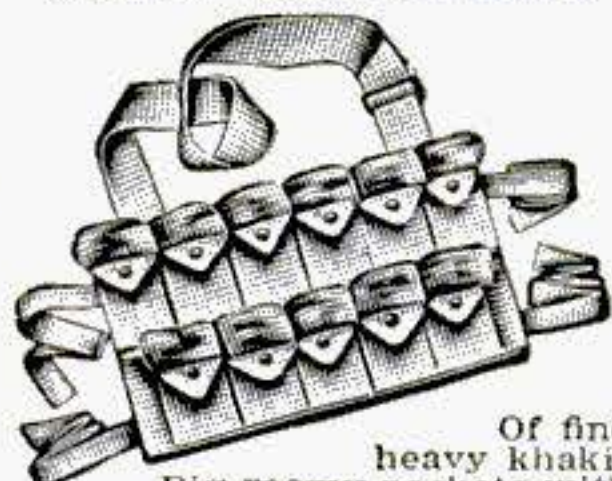
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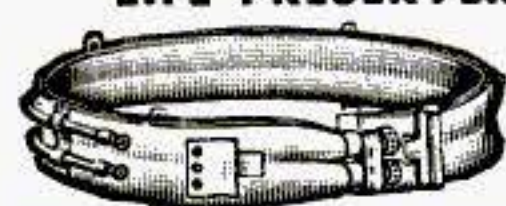
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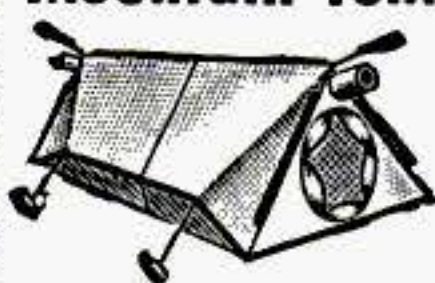
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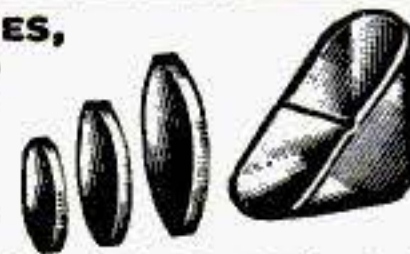
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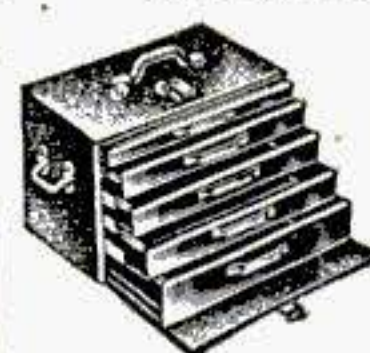
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HOW To Set Up and Run A Mirror Shop! Resilver Mirrors. For Price write—John Sprinkle, V90, Marion, Indiana.

TYPEWRITER Repairing instructions, standard typewriters. Webers', Box 1008, Canton, Ohio.

FELLOW Workers—Down with Bosses—Start own business—Be Independent—Booklet describing 137 Tested Plans, free. P. Padney, 307 York St., Jersey City, N. J.

MEN—Women. All types mail order businesses for sale. Full or part time. Priced from \$100.00 up. L. Turnipseed, Box 681, St. Louis, Mo.

DISTRIBUTORS wanted for unusual \$2.98 Photographic product. Fine Profits. No competition. Fast seller. Repeats for hundreds of dollars. Complete sample \$2.00. Details Free! E. E. Morrison, Box 9312 Sta. S. Los Angeles 5, California.

MAILORDER Beginners. Save money by getting started right! Our new booklet may save you dollars! Only 10c, postpaid. Mail Order Mecca, 30 West Washington St., Chicago 2, Ill.

START a home business in spare time. Make extra money. Experience unnecessary. Literature free. Ellmar Service, Muncy 3, Penna.

QUICK Money! "Repairing Car Batteries." At home! Easy too! Write, Batteryman, Grand Junction 1, Colorado.

"FREE Booklet" "Key To Greater Earnings". James Williams, Box 2215, Hollywood, California.

WOULD you pay 3%—first \$350 made? Color-illustrated book "505 Odd, Successful Enterprises" free! Some offer occasional "day off." Work home. Expect something odd! Pacific-K, Oceanside, Calif.

MAKE Shell Jewelry—Easy, profitable. Illustrated book instructions 75c. Free Catalogue. Florida Shellcraft Co., Box 1840, Sarasota, Florida.

FLEXIBLE Molds to order, also originals. Professional course manufacturing molds and cast novelties. Latex, lacquers, flocks, flocking equipment, supplies. Plastics, Box 1574, Boston 4, Mass.

BRONZING and Metallizing baby shoes! Gold, Silver, Copper, Nickel, Bronze, Pearl, Ivory and "Luminous glow" colors! Big profits! New Field! Details free! Write R. O. Morgan, Box 349, Long Beach 2, Calif.

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HOW To Sell By Mail. "Planned and Profitable" Mail order selling. New, different work-book of ideas and instruction for beginners, aspirants, established dealers. Send 25c for copy of leading mail order trade magazine and complete details. Year's subscription \$3. Mail Order Monitor, 356 South Broadway, Suite 706 PS, Los Angeles 13, California.

NAMES—Addresses. Wholesalers, Manufacturers, etc. Dime each. Three 25c. National, 3537-A South Hoyne, Chicago 9.

PROFIT Opportunities Galore each issue! Home-worker's Money-Maker's Leading Magazine. "Monitor". Rush 25c, sample, Special offer! Jackson, Newfoundland 4, Kentucky.

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DO it with Sea Shells. Big profits. Werts, 1429 56th Avenue, Oakland 3, California.

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OPERATE Profitable Mail-order business. Write—Gallagher Publications, Box 6911, Kingsport, Tenn.

METALLIZING baby shoes makes you money! Learn this simple, profitable business from Nationally recognized authority. Get professional results with professional "know-how"! Free particulars. Joseph B. Kushner, Metal Finishing Consultant, Stroudsburg, Penna.

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SYNTHETIC Latex with Neoprene base for making flexible molds! Quick drying! Safe! For home, classroom, or industry! Quart \$2.00. Gallon \$5.95. Full instructions. Beginners booklet on molding and plaster casting 25c. Plastercraft Supply Co., 1406 E. 43rd St., Cleveland 3, Ohio.

PROFITABLE mail order business can be yours. Details Free. Coast to Coast, Box 63-B, Station H, Buffalo 14, N. Y.

SWISS Musical Units, install powder. Cigarette boxes. Lloyd Kelley, Hanover, Mass.

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

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DON'T be Mr. Average man. Be your own boss. Earnings unlimited. Operate from home. \$25.00 adequate investment for immediately earning \$200.00 weekly. Postal brings details. J. T. Van Zile, A-79 Mills Street, Morristown, New Jersey.

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UP to \$1500 yearly selling by mail in spare time interest you? New ideas and plans every month. Details free. Idea of Month Club, 3023-B Greenmount, Baltimore 18, Md.

MAKE strange plastics—1c pound. Makes durable attractive floors, walls. Build with waste—Save half. Bays Laboratory, Oklahoma City 9.

SELL embossing kits by mail. Profitable circular plan. Small capital. Large returns. Operate spare time. Sample kit and details \$1.00. Kelley Service Bureau, 215 South Monroe, Kansas City 1, Missouri.

"INVESTIGATE Mail Order or Home Business, 140 new ideas. Write Marshall, Box 655, Centralia 12, Washington."

SEND \$1 for pattern and directions for manufacturing "Cute Baby Shoes". Parks, 1618 Rhode Island N. W., Washington, D.C.

START a clock shop while clock repairing is booming. Our easy to learn home study course with pictures and illustrations teaches you how to repair all kinds of clocks. Information free. Houston Clock Shop, P.O. Box 5086B, Houston 12, Texas.

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BUSINESS Starters \$7,000 winners money-making opportunities. Chronicle—quarter, McPlastens, PS1430 Monroe, Chicago.

EARN Big Money metal plating with or without battery. Complete instruction folio \$1.00. Tes-Co, Box 189-SJ, Wilkes Barre, Penna.

RUBBER Molds—We create, for making ash trays, novelties, Religious figures, plaques, book ends, etc. Make big money duplicating hundreds of items, own your own business, start in spare time. Latest factory and shop methods. Also molds made to order. Get our prices. Information free. Write Shop Technician, 314 Westport Rd., Kansas City, Mo.

WOULD you like a profitable, steady business of your own? A business that you can build up in your spare time, at home, with small capital, and gradually expand it into a worthwhile enterprise? Bookkeeping offers just such an opportunity! The demand for a streamlined bookkeeping service is tremendous. No experience necessary. We show you how. Our experience will save you hundreds of dollars in seeking a worthwhile career as your own boss. Now is an ideal time to start. Write for free details. James Argodale & Associates, Zumbro Building, Rochester, Minnesota.

MOTHPROOFING and Cleaning Business Pays Well. I'll show you how to start on amazingly small capital. Write today for details on Eight practical plans. Howard Robinson, Ph.G., 1304-B South Ohio Street, Sedalia, Missouri.

SAVE 550 sprinkling hours. Spectacular Walking Trav-El-Awn Sprinkler. Turn on hose—Set "It" Forget "It". Automatic Shutoff. Dealers Wanted. Free Circular. Gateway Materials Co., 4867 Milwaukee Ave., Chicago 30, Ill.

ELECTRICALLY inclined men: \$100-\$200 weekly possible installing, rebuilding, maintaining Fluorescent Lighting. Amazing literature Free. Write Willis Fluorescent Lighting, Box 6, New York City 35.

OPERATE profitable mailorder business. Large profits. Small's, 6713 Baxter, Cleveland 5, Ohio.

88 MONEY MAKING OPPORTUNITIES

ELITE Collection describes 137 money-making plans; local, mail order. Particulars free. Elite Co., 220-A Grand St., N. Y.

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

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

START Your own business! Big money manufacturing novelties, plaques, statuary. Free catalog. Write Bing Products, 88-B3K Broad Street, Boston 10, Mass.

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SEWING Machine Repairmen make big money lifetime. Start neighborhood shop. Complete repair manual, covering all makes, \$1.98 postpaid. Money Back Guarantee. Sewmachine Serviceman, Hamilton 10-D, Ohio.

DETECTIVES Earn Big Money. Experience unnecessary. Particulars free. Wagoner, P-125, West 86th, N. Y., N. Y.

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

137 TESTED, proven, money-making plans, formulas, sources of supply. Literature free. James Boyle, 29B High, New Brunswick, N. J.

21 POPCORN, Candy Apple, etc. Formulas. All money-makers, \$1.00. We can supply equipment. Concessions Supply Co., Dept. "B", Box 133 Sta. "B", Toledo, Ohio.

METALLIZE baby shoes. Further information free. Metal Crafts, 5501 Suwanee, Tampa 4, Fla.

MAKE big money, build your own lamps and sell. Write for free factory photos. Buddy Products Manufacturing Co., 1123 W. Belmont Ave., Chicago 13, Ill., Dept. 35.

MAKE money six ways. Get orders by mail \$1.00 to \$20.00. Keep half. Complete Guaranteed plan, 25c. Franklin, 22219-S Telegraph, Detroit, Michigan.

SHELLCRAFT Sells! Have fun making genuine marine shell jewelry. Make money selling to stores and friends. Save money buying direct from wholesaler. Large kit \$1.00. Jumbo \$2.49. Instructions free. Eastern Shellcraft, 985 Myrtle Ave., Brooklyn 6, N. Y.

MAKE Perfume, Make Money. Free book tells how. Lawson, 21 Joiner, Saint Augustine, Florida.

WIN money on contests advertised in every magazine and on radio. General Contest Magazine, published monthly, gives hundreds of tips. Lists current contests and rules. Sample 25c. General Contests, 1609-A East 5th, Duluth, Minn.

"THERE'S Big Money In Junk," and repairing Car Batteries! Batteryman, Grand Junction, Colorado.

PRIZE Contest Fans Reap Rich Rewards. Enclose 3c stamp. National Contest Bulletin, Box 2685-S, Miami 31, Fla.

200 OPPORTUNITIES to make money selling by mail, only 50c. Roy Kramer, 329 Cates, Maryville, Tenn.

METALLIZE flowers for profit! It's new, easy, sure fire! Free details; Joseph B. Kushner, Metal Finishing Consultant, Stroudsburg, Penna.

EARN Up To \$2,000 year, inventing simple items for special cash markets. Hendrickson, Argyle 8, Wisconsin.

EARN Money Evenings, copying and duplicating comic cartoons for advertisers. Adservice, Argyle 2, Wisconsin.

PROFIT Opportunities Galore each issue "Monitor"! Home Sparetime workers Leading Magazine. Rush 25c for sample copy, special offer, details! Monitor, Dept. C, 506 1/2 S. 15th St., New Castle, Indiana.

SHELLCRAFT! Make beautiful seashell jewelry! Large! Illustrated! Wholesale! Catalogue 40 designs! plus instructions! Including sensational violet corsage! Scottie! Rooster! Lamb! Butterflies! Barrettes! Indian Head! Tally and Place Cards! etc. \$3.00 Value! 100 shells identified, designs and instructions, (complete 25c) Shells Colored! Package or Gallon! Earrings! Cameos! Chains! Plastics! etc. Complete Line. All illustrated! (Buy direct.) Paces, Box 279, Bradenton, Florida, Dept. G.

EXCELLENT profits raising mink. Details furnished. Franklin Young, Riverhead, N. Y.

VETERANS! Be financially independent. Changes in loan guarantee not generally understood offer amazing possibilities for income and profit. Don't miss your greatest opportunity. H. B. Smith, Box 747, Dept. H, Youngstown, Ohio.

SEE rare snake-headed flesh-eating plants devour live insects. Unequaled in sales appeal. Bring sensational profits. Free particulars. (Sample Guaranteed seeds \$1.00.) Enterprises, 157 Golfdale, Toronto, Canada.

1947 GIGANTIC Directory of Opportunities. Advertisers Supplies, Sources, Trade Information. Mail Order Ideas, Products, Wholesalers. Valuable tips—just published! Descriptive literature Free. Wilkin & Co., Hillsboro 2, Ohio.

START Home Mail Business! Exclusive setups built-to-order for financially responsible beginners, by leading M.O. Association's export staff. Booklet Free! N.M.D.A., 33-A Vassar, Dorchester, Mass.

SOMETHING different, 900% profits. Experience unnecessary. J. W. Arrington, La Grange 5, Georgia.

SEND \$1 for Money Making Career! Parks, 1618 Rhode Island N. W., Washington, D. C.

SHELLCRAFT Instructions—Free! Make beautiful seashell jewelry! Wholesale Catalogue of complete line shells! Plastic discs! Animal Shapes! Pinbacks! Earrings! Cameos! etc. (Buy Direct). Pace's, Box 279, Bradenton, Florida.

UPHOLSTERING Start your own Shop beginners Kit and Instructions. Write Wynn and Graff, 5116 Charlotte, Nashville, Tenn.

SPARE Time Home Work Plans. Write. Business Plans Co., 1242 Park, San Jose, California.

59 FORMULAS, PLANS, ETC.

137 MONEY-making plans, also formulas for salable products. Descriptive booklet free. Elite Co., 220-A Grand St., N. Y.

FORMULAS—All kinds. Latest money-makers; literature Free. Kemi-Kal, Park Ridge, Ill.

10,000 FORMULAS and Trade secrets. Free Literature. Stillmans, 555 Kingston Ave., Brooklyn 3, N. Y.

FORMULAS — Latest Best, Analysis. Giant formula catalog and chemical instruction Sheet 10c. Refunded first order. E-Belfort, Engineering Building, Chicago 6.

100 SINGLE ingredient formulas 25c. Tes-Co, Box 189-SG, Wilkes-Barre, Pa.

106 PLASTICS

PLASTICS, Free List. Swiss Music Box Units \$3.50—New Plexiglas Manual \$1.50. Plastic Supply Co., 2618 St. Louis Ave., Dept. PS70, St. Louis 6, Mo.

MAKE money assembling our pre-fabricated plastic kits. Sample Kit 50c. Catalog free. Fabros, Box 156, Station F-2, Buffalo 12, N. Y.

PLEXIGLAS—Masked—12x12—1/16" 95c Plus 10% postage. Free Listings. Craft Plastics, Box 129-S, Somerville, New Jersey.

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PLEXIGLAS Sheets 1/10" x 12" x 12" 78c; 12" x 15" 96c; 1/8" x 11 1/2" x 12" 98c; 13" x 17" \$1.60; 6" dia. x 12" length x 1/4" wall clear cylinders \$1.60; Ten color rod assortment including phosphorescent \$4.00. Include postage. Julian Rhodes Muench Co., 1527 W. Alabama, Houston 6, Texas.

NEW liquid plastic. Clear, colors. Cast without heat. Embed flowers, insects, coins. Saw, drill, carve. Manual tells how. Send \$3.35 for complete 20 project kit including one pound liquid Castolite. Castolite, Dept. J-24, Box 211, Kenilworth, Ill.

33 CHEMICALS AND APPARATUS

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. 607, 124 W. 23rd St., New York 11, N. Y.

CHEMICALS-Lab, Supplies New Catalog 10c. Mel-Glo Chemical Co., 258 Fourth Avenue, Brooklyn 15, N. Y.

SPECTROSCOPE For Quick chemical analysis \$3.00. Cutting Co., Box 457, Campbell 2, California.

LABORATORY Supplies At Wholesale Prices. Chemistry, Biology, Physics, Geology. Catalogue 10c. National Scientific Company, Established 1908, 2204 W. North Ave., Chicago 47, Ill.

LUMINOUS Paints will glow in dark. Six colors. Fairmount Chemical Co., 136 Liberty St., New York City 6.

FREE Catalog: Chemistry, Mineralogy, Biology. Tracey Laboratories, 1907 Harrison, Evanston, Ill.

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CHEMICALS and apparatus for industrial, analytical, and private laboratories. Complete supply service for correspondence school students. Send 3c for catalog. Dept. M-26, Biological Supply Co., 1176 Mt. Hope Ave., Rochester 7, N. Y.

CHEMICALS, ounce quantities, apparatus, catalog 5c. Fleischer's Laboratories, Everett 49, Mass.

NEW laboratory Supply Catalog of Chemicals and apparatus. Contains over 5000 items with illustrations, 212 pages. Send 50c. Standard Science Supply Co., 1232 No. Paulina St., Chicago 22, Ill.

SAVE!! Get "Planning Your Laboratory". 25c Catalog. 10c. Pilgrim's Chemical, 2435 South State, Salt Lake City 6, Utah.

5 AGENTS WANTED

GOOD Paying Business Silvering mirrors, plating autparts, reflectors, bicycles, bathroom fixtures, etc., by late method. No tanks or shop required, outfit furnished. Free Booklet. Gunmetal Co., Ave. G. Decatur, Illinois.

FREE! Latest issue Opportunity Magazine, Salesman's Guide. Inspiring, constructive. Shows how to earn money selling for others or in your own business. Hundreds postwar opportunities. Send name and describe what you have sold or are selling. Illustrated copy sent Free. Opportunity Magazine, 620 N. Michigan, Dept. 18, Chicago 11, Ill.

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

LICK After-war layoffs; Start own business; home, office. Booklet describing "Collection of 127 Tester Plans" free. Elite Co., 220 Grand St., New York.

AGENTS—300% profit selling genuine gold window letters; stores and offices. Free samples. Metallic Letter Co., 437 N. Clark, Chicago.

SELL Personal Initialed Individualized Belts, Buckles, Cap Badges, Tie Holders, 2,000 emblems to choose. Fast profits. Repeats. Write today special outfit offer. Hookfast Specialties, Box 1425, PS, Providence, Rhode Island.

90c PROFIT Each \$1.00 Sale. Sell Positive mothproofing solution to housewives, stores, agents. Experience unnecessary. Postal brings details. Kinford, Wayne 4, Pa.

\$1. STARTS you in business. Sell DeLuxe ties, 100% wool interlining. Costs you only \$7.00 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. P-14, New York 10.

GOLD lacquered Window Sign Letters. Large Sizes Penny Each. New Foils. Absolutely Beautiful. Free Samples. Atlas, 544 W. 79th, Chicago 20.

MAKE money in your spare time! Helps furnished. Easy sales. Voluntary repeat orders. Liberal commissions. Write for Free Wholesale Price List Today! McGregor Magazine Agency, Dept. PS-7, Mount Morris, Ill.

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

GREETING Card Agents: "Line Up" with "Pines" for bigger, better and quicker profits. Rush name, address on postcard today. Box 32, Flushing 6, N. Y.

START Your Own Business on Our Capital. Always your own boss. Hundreds average \$6,000 to \$25,000 annual Sales. We supply stocks, equipment on credit. 200 home necessities. Selling experience unnecessary to start. Wonderful opportunity to own pleasant, profitable business backed by world-wide industry. Write Rawleigh's, Dept. H-U-PSC, Freeport, Ill.

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

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

QUICK Profits selling full or part time, individualized buckles, belts, cap badges, tie holders, uniform shirts, caps, ties. Choice of thousand emblems. Sure repeat orders. Easy-selling outfit offer. Write Hook-Fast Co., Dept. 14, Roanoke, Va.

ADVERTISING Book Matches—Cash In On Political Campaigns—sell Union Labels matches. Cuts for all businesses and political parties—Free powerhouse selling kit—low prices—protection guaranteed on repeat orders—Cash Commissions. Superior Match Co., Dept. P87, 7530 Greenwood, Chicago.

\$50 CASH For Selling 100 Assortments of 21 Christmas cards at \$1.00. Complete line. Free samples 50 for \$1.00 cards. Special offers. Write today. Hedenkamp, 343 Broadway, Dept. T-22, New York 13.

CHRISTMAS Cards. Earn Big Money. Take orders galore from friends. 25 exquisite folders with name, \$1.25. Free samples 10 designs. America's Fastest Selling 21 Christmas Folder Box. Costs 50c. Sells \$1. Request samples today. Sunshine Art, Dept. NC-8, 115 Fulton St., New York 8, N. Y.

AT last! Something new and sensational in Christmas Cards. Amazing "Oilette" Cards. Like costly oil paintings. Designs never before offered. Quick orders. Beautiful 50 for \$1 Cards, name imprinted. Big Profits. 20 other assortments 60c to \$1. Samples on Approval. Puro Co., 2801 Locust, Dept. 741K, St. Louis, Mo.

"PRESSURE Cookers." Now available. Selling like wildfire. Amazing profits. Write quickly. Morris Mandell, Inc., 131-W W. 14th St., New York 11, N. Y.

CHRISTMAS Card Agents! New, exclusive, patented children's linenette books. Four books in attractive packet. Retail 50c. Sample on approval. Also Cut-out Valentine Assortment. Elmcraft Card Co., 5928 South Western, Chicago 36, Ill.

NEW, extra money plan. Up to 100% profit showing friends unusual Personal Christmas cards, Box assortments, gift wrappings, humorous, all occasion, Religious, social notes, personalized stationery. Extra bonus. Request Free 50 for \$1.00. 25 for \$1.00, 25 for \$1.95 name imprinted Christmas Cards and personalized Stationery folder. Special Offer. Thomas Terry Studios, 60 Union Avenue, Westfield, Mass.

SILVER plating Liquid. Apply with cloth. Renews silverplated ware. Cleans, silverplates, polishes, one rubbing. Genuine silverplate. Also silverplates brass and copper. Male and female selling representatives wanted. Part or full time. Exclusive. Wholesale and retail. NuProcess Products, Aurora, Illinois.

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MAKE Money Selling Genuine Leather Jackets. Prospects everywhere. Top quality, full cut, exclusive features. Big Cash Commissions. Also 250 styles fine Shoes. Sample Outfit Free. Consolidated, Dept. S-803, Chippewa Falls, Wisc.

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

YOU make \$25 for selling fifty \$1.00 boxes 50 beautiful assorted Christmas cards sell for only \$1.00 your profit 50c. Write today for free samples 50 and 25 for \$1.00 and other boxes on approval. It costs nothing to try. Cheerful Card Co., 130 White Plains, N. Y.

SHINE Shoes Without "Polish". New Invention. Lightning seller. Shoes gleam like mirror. Samples sent on trial. Kristee, 112, Akron, Ohio.

AMAZING New Zipper Shoe sells on sight. Big profits for salesmen. Leads line 200 splendid styles. Territories open. Get Free Sample Outfit. Write Victor Thomas, Dept. V818, Chippewa Falls, Wisc.

QUICK cash. Sell friends wonder-value 50 for \$1.00, extraordinary 25 for \$1.00 personal Christmas cards. Personal stationery. 32 sensational money makers. Up to 100% profit. Bonus. Write for 6 Free self-selling sample portfolios of 50 for \$1.00 to 25 for \$2.50 name imprinted Christmas Cards. Special offers. Rainbow Greeting Card Co., 36 E. 12th St., Dept. 18-A, N. Y.

FAST Selling Carded Auto Accessory and Other Items. write Steele Plastics Co., Ashland, Ky.

EXTRA money so easy. Sell friends beautiful 50 for \$1.00 name imprinted Christmas cards. Extensive line assortments 30c up. Profit to 100%. Extra bonus. Request free samples personal Christmas Cards, stationery and leader \$1.00 Christmas. Everyday assortments on approval. Special offers. Tom-Wat Studios, Dept. PS, Bridgeport, Conn.

FRIENDLY social visits bring you big Christmas card profits. Show 33 different top-quality assortments as low as 30c each. Odd cards 2½c. Up to 100% for you. Cash bonus. Send at once for free samples 25 and 50 for \$1.00 personals, name imprinted stationery and feature \$1.00 assortment on approval. Special offers. New England Art Publishers, Box F, North Abington, Mass.

BIG First Commissions. Sensational automatic repeats, with new Sales Building Plan for retailers. First since V-J Day. Customers get big value tableware; cost retailers nothing. Positively hottest deal in selling. Rush name for facts. Alco Sales Company, 215 West Ontario, Dept. C-616, Chicago 10, Ill.

NO investment. Throw rugs. Big profits. Good repeaters. Investigate this opportunity. Warren Rug Mills, Box 243B, Phillipsburg, N. J.

SALESMEN—Free advertising and demonstrating sales kit to qualified men. Product sold 15 years. Prospects everywhere. First ad for new men since the war. Write 707 Red Comet Bldg., Littleton, Colo.

SELL Christmas Cards! Choice of forty Assortments! Earn 60c on dollar sales! Bulletins Free! Elfco, 434 North Wells, Chicago 10.

"SHOW Jiffy-Till, the midget tractor with "The Magic Hoe". All gardeners want it. Exclusive compact design, gives scientific tillage without fatigue. Box 394, La Mesa, Calif.

SELL Delicious Candies, Nuts, Gum. Immediate delivery. Write Casterline, 2031-L Sunnyside, Chicago 25, Ill.

AGENTS Wanted for our Slot Machines and coin operated amusement games in every town and community. Sell to clubs and homes, or start a route. Webb Distributing Co., Dept. P40, 6 So. Kedzie Ave., Chicago 12, Ill.

SELL Ultra blue stock signs to stores, 1000 slogans, comedy, general, religious. 7 x 11, cost 6c, sells 35c. Make money. Sample free. Lowy, 8 West Broadway, Dept. 328, New York City (7).

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

DISTRIBUTORS Wanted For Unusual Products. Levine's, 15-S Boulevard Station, New York 59, N. Y.

AGENTS—Salesmen. Make \$75 and up weekly on our capital taking orders fast selling Cosmetic line write for Special outfit offer. Lady Raye Cosmetics, 517 E. 43 St., Chicago 15, Dept. PS.

SELL Hangover Tablets for alcoholic hangover. Thousands sold on West Coast. Send \$1.00 for sample and information. Research Clinic, Box 302, Altadena, California.

NAMES—Addresses. Wholesalers, Manufacturers, etc. Dime each. Three 25c. National, 3537-L South Hoyne, Chicago 9.

SENSATIONAL power mowers—\$66.00 up (net). Gas-electric. Rotacut, M-2014, Ex. Springs, Mo.

POPULAR SCIENCE OPPORTUNITIES

SELL New, Different, Exclusive Christmas Cards. 50 with name imprinted \$1. Extra \$\$\$ New Bonus Plan earns you up to and over 100% Profit. Compare our 21-folder "Champion" Assortment, sells for \$1. sent on approval, no investment. Etchings, Panoramas, Florals, Religious, Gift Wraps, Birthdays, also stationery. Free Samples of many extra-profit Imprint Lines. Work with a leader! Write today. Pen-n-Brush Studios, Dept. PS-8, 154 Nassau St., New York 7, N. Y.

\$3 FIRE Extinguisher sells wholesale or direct. "Fire-Killer", 101 Franklin, Syracuse 1, New York.

"**PRESSURE Cookers.**" Now available. Selling like wildfire. Amazing profits. Write quickly. Morris Mandell, Inc., 131-W W. 14th St., New York 11, N. Y.

CHRISTMAS Cards.—DeLuxe, Scripture Text, Oilettes, Mellotone, Humorous, Etchings, Economy Assortments, Personalized Papeteries. Raum, 4154b Fifth Street, Philadelphia 40.

FREE! Big 32 page 8½ x 11 magazine, that tells how to make money in local or mail order selling! "Opportunities Preferred", 33-S Vassar, Dorchester, Mass.

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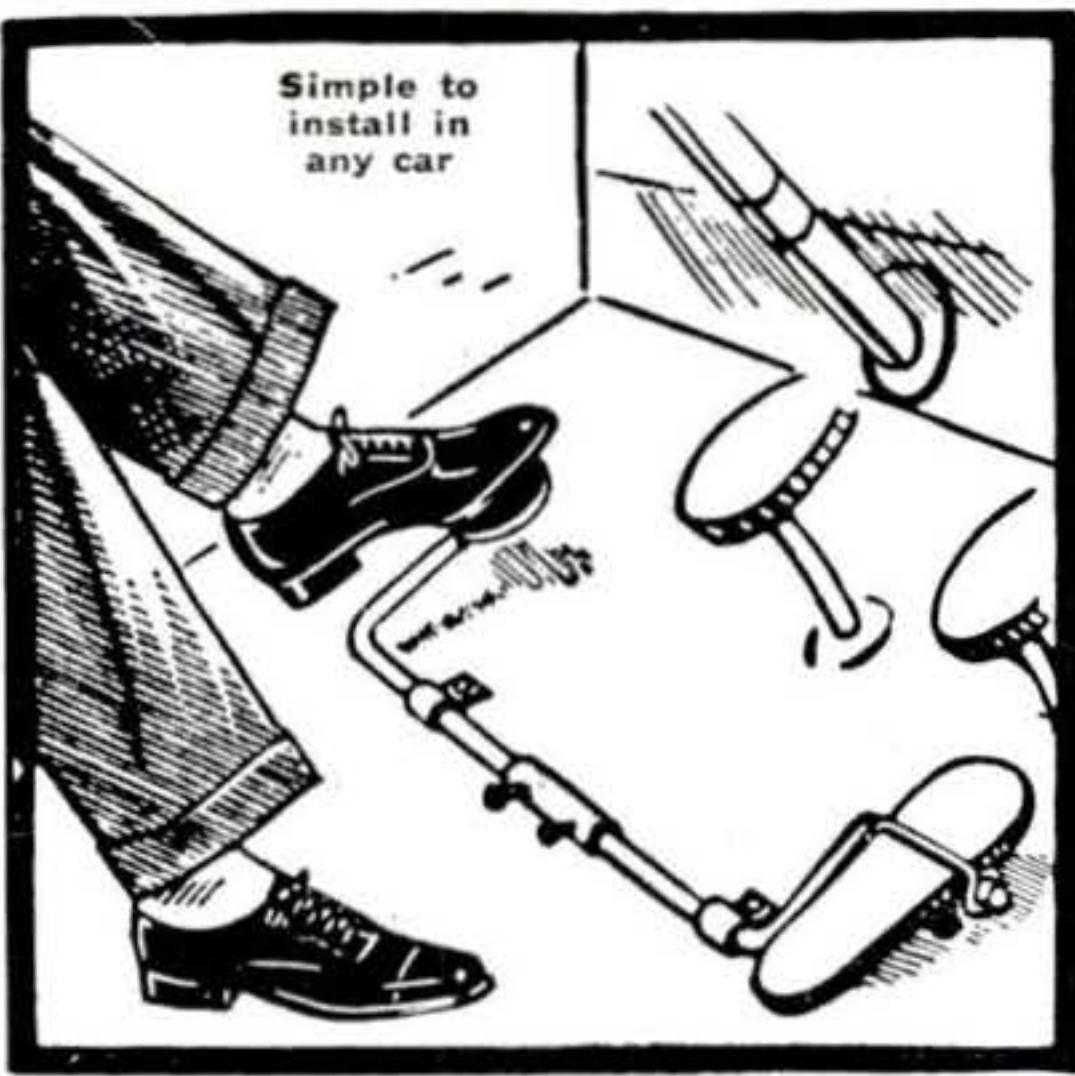


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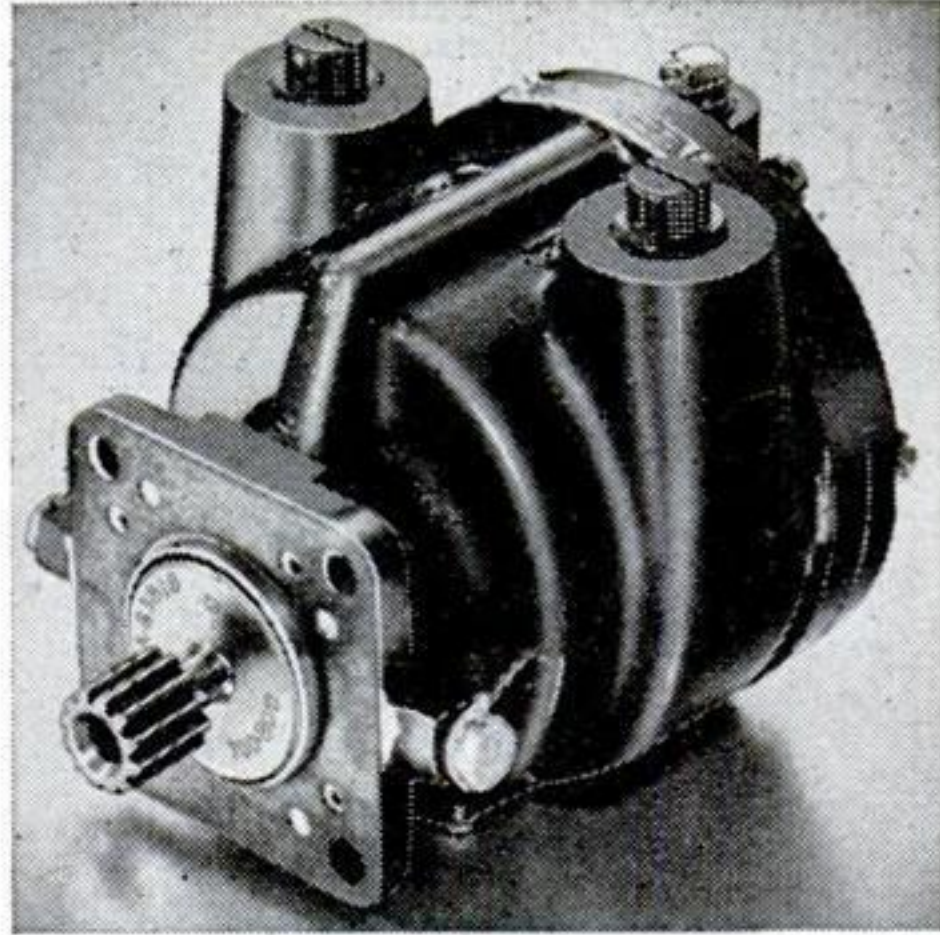
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YOUR FUTURE ON ICE—12 billion dollars a year, when the ball gets rolling! That's what the experts are predicting for the Frozen Food field! Read the forceful, enlightening article by Hiram K. Smith, Jr., who gives you the lowdown on how to break into this promising industry.



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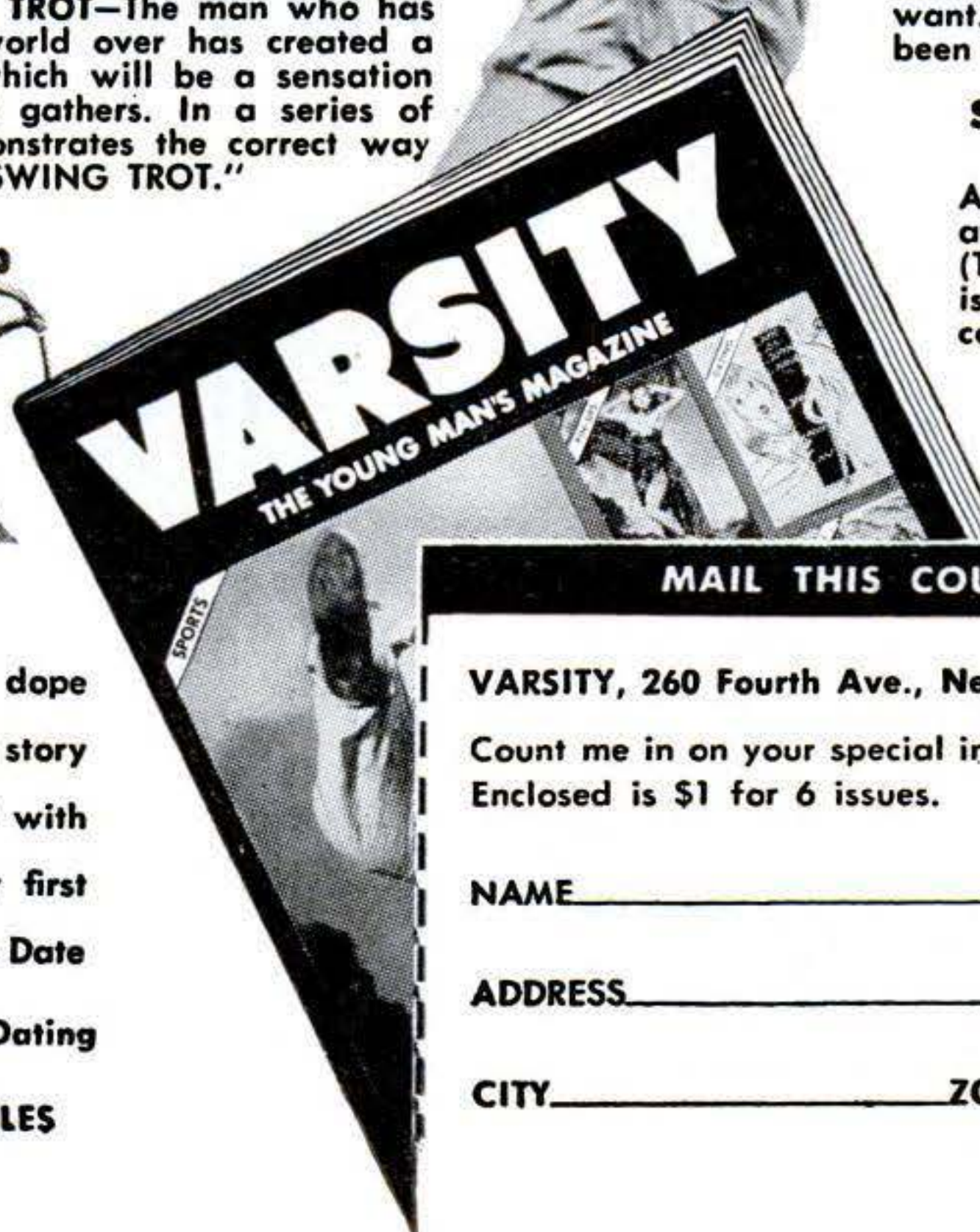
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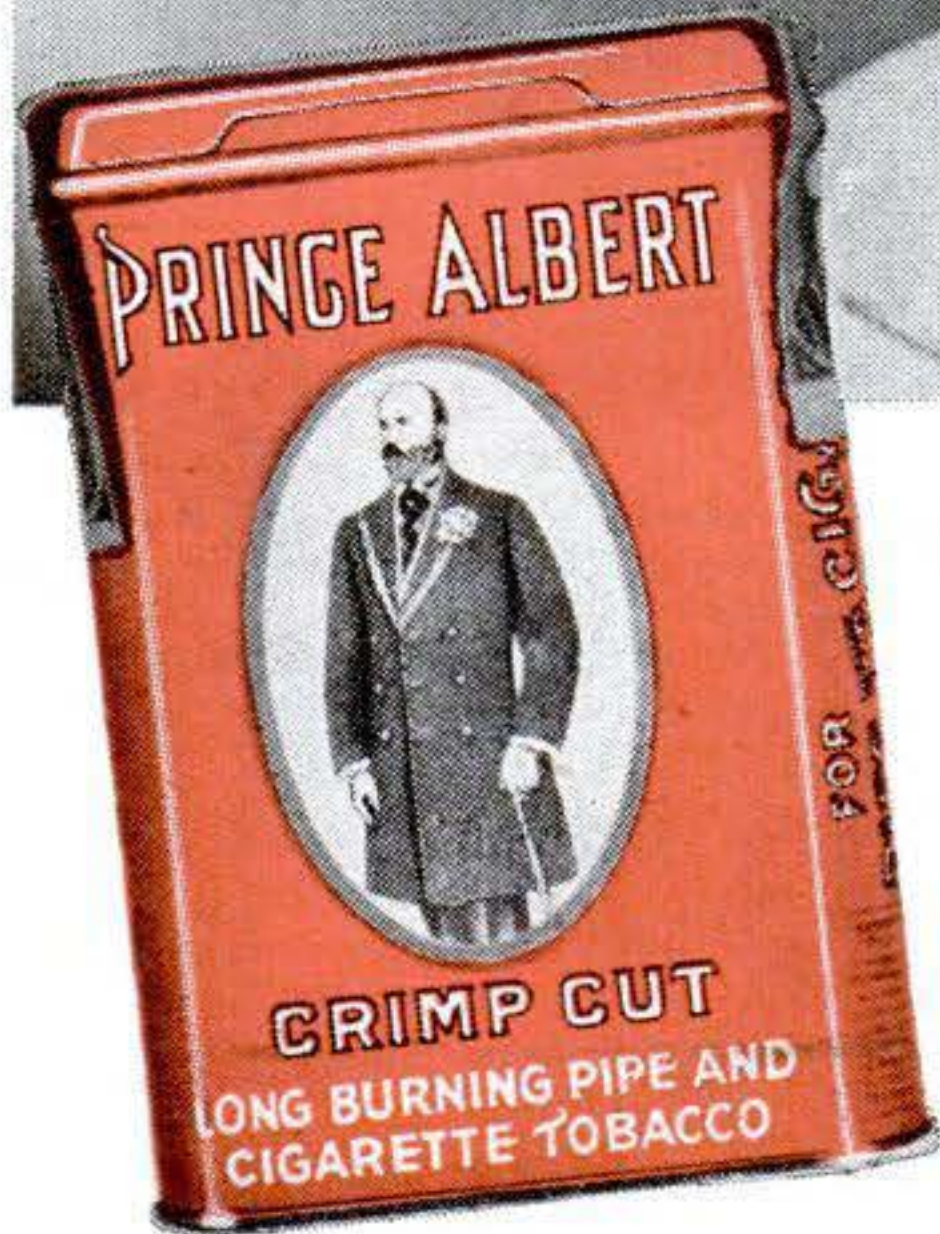
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AUG. 1947

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Reaching for Lightning . . . Thirteen hundred feet above Manhattan, these riggers are installing a lightning rod atop the television antenna on the Empire State Building. The installation marks the resumption of General Electric's studies, discontinued during the war, of the thunderbolts attracted by the towering structure—as many as a dozen of them in a single storm. Limited to instrument recordings at first, the research program will later include further photographic studies.

AUGUST 1947 65



Polar Prowl Cars Will

By Fred Sparks PSM Special Correspondent

In this airborne age the shortest route between many great nations is across the top of the world—over the North Pole itself. For two years now the Army and Navy, working with private scientific groups, have been studying polar living conditions. They hope eventually to establish and maintain permanent bases near the pole.

Last winter, when darkness and extreme

cold halted operations in the Far North, the Navy sent an expedition to Antarctica, then enjoying summer. Although poles apart, many conditions in the two polar regions are similar. At Little America 197 men, including this writer, lived for a month. This is a report on how we and our machines reacted to the polar clime, and how our findings will be used.



These two Marine Corps LVTs pushed 125 miles into the unknown wastes of Antarctica

without mishap. Trek leader is now using data to design prowl car for future polar travel.



Trail flags are often the only guide in this milky world of white—without them the traveler might never get home. Dropping them off end of sledge train is a cold job.



Hitched to the rear of a sled and connected to a meter, these bicycle wheels are the only accurate way to measure mileage. As a double check, each wheel is attached to separate meter.

Mechanize Arctic Living

Photos by Fred Sparks and U.S. Navy. Drawings by Phil Santry

TO THE regret of all Jack London fans, the dog sled as the sole means of polar travel is a thing of the past. Its limited load and slow speed are all right for a small exploring party but rule it out for hauling the ponderous tackle needed for permanent stations, mining or oil developments—or a modern army.

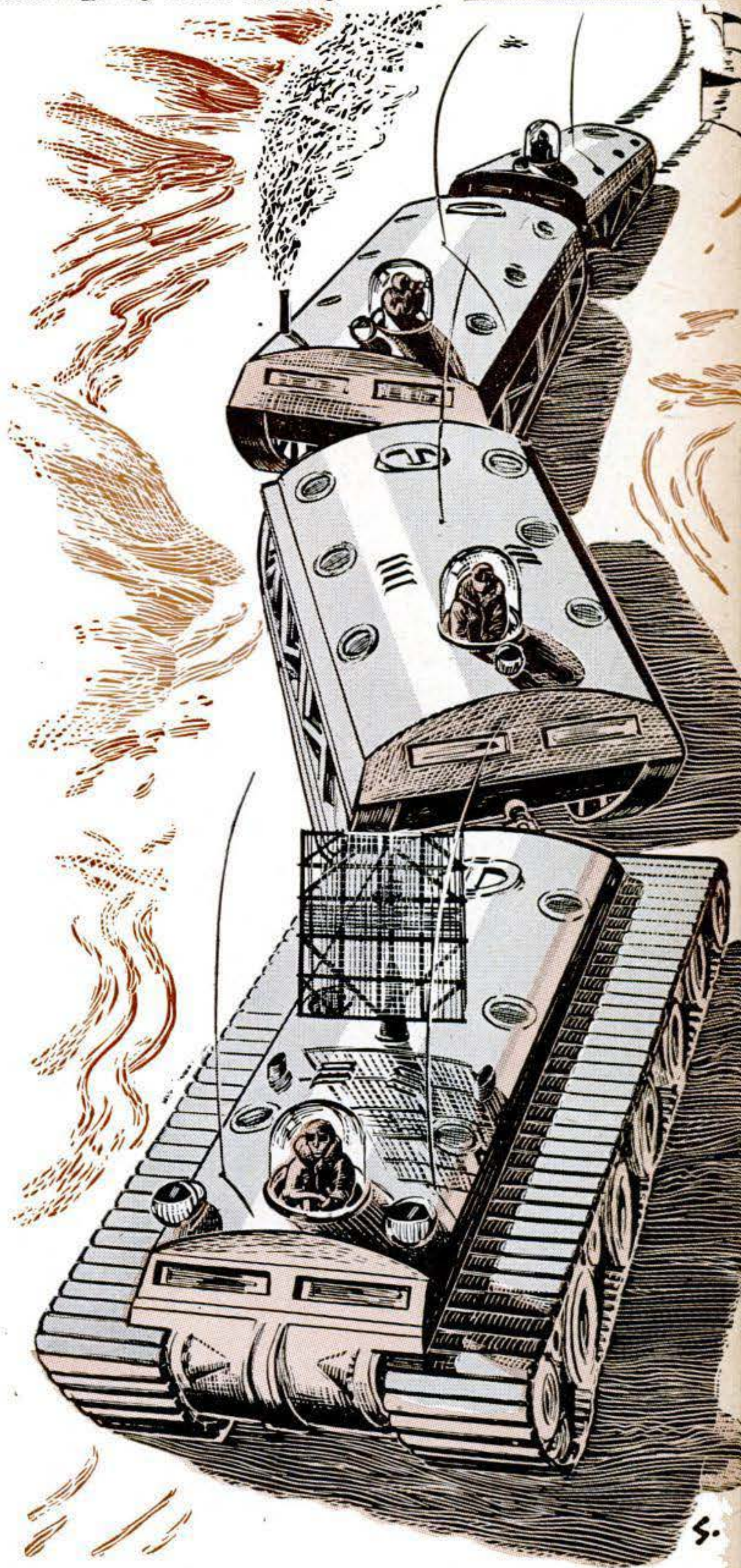
At Little America, tracked vehicles designed for amphibious operations proved almost as good at crossing icy terrain as they were at landing on palm-fringed islands. And the weasel turned out to be an excellent polar jeep where true jeeps were useless.

But for regular polar travel over land a new vehicle, to be designed along the lines of the Marine Corps LVT-4, an alligator tractor, will prove invaluable. Captain Vernon Boyd led two LVTs in a cross-country trek, hauling giant sleds loaded with supplies. Now he is working with the Navy's Bureau of Ships on a machine that may well become the polar "locomotive."

"Snowshoes" for Tractors

As shown at right, proposed special features include a bubble turret to protect a driver while enabling him to sit high enough to see crevasses lurking ahead. One thing any caterpillar vehicle for polar use requires is "snowshoes"—steel additions to the treads making them wide enough to distribute the weight. Otherwise they sink in soft ice.

The Navy has already experimented with snow trains in northern Alaska. There the Construction Corps has used them to supply its remote Naval Petroleum Reserve. They have gone 300 miles without support, hauling hundreds of tons of equipment. Men slept and cooked meals on sled-mounted cabins hauled by the trains, and put on weight doing it. Speeds averaged five m.p.h. Much information about different types of tractors and equipment has been gained in the last three years—and will pay off at the poles.



Polar tractor of the future pulls streamlined personnel-carriers. Third vehicle spews aluminum foil to permit radar tracking of party. Automatic device on last sled drops trail flags. ➔

It Takes Polar Ships To Navigate Polar Seas

ONE night last January, I stood on the bridge of the Coast Guard icebreaker *Northwind* with Rear Admiral Richard H. Cruzen, commander of the Navy's Antarctic task force. We were watching a great six-hour battle. Four Navy ships, helpless in the grip of floating pack ice, were threatened as gigantic bergs closed in.

The *Northwind* pushed her spoon-shaped bow over slabs of 15-foot ice, then crushed them under her 6,000 tons and cut the ships free. But the Admiral summed it up:

"If we mean to navigate freely through these waters we'll have to throw our concepts of ship building out the window; we'll have to build a truly polar fleet."

This means that every ship must be designed like an icebreaker. Because our ships were not, it took us two weeks to cross 750 miles of pack ice to Little America. On the way, the pack twisted frames like empty toothpaste tubes, smashed one ship's bow, sheared two propeller blades off another, and knocked the rudder off a third so that it had to be towed to New Zealand.

Diving Isn't Easy

A submarine with us bogged down in the pack after a few miles on the surface, and was towed to safety. It was supposed to dive under the solid floe and come up in ice-free spots. But to do this, subs are going to need vastly better sonar gear to warn of the reef-like underbodies of icebergs. And shipborne radar also needs improvement to pass polar tests. Our scopes looked as if they had the measles when we passed through heavy ice fields: You couldn't tell heavy bergs from thin sheet.

Until radar improves, the bow lookout is the ship's eyes—and he can't do a good job when the sub-zero wind howls about him. He needs a shelter, largely of glass treated to protect his eyes from ice glare.

Unloading at a polar destination is a tedious job. The ice is too weak to support concentrated weight. Telescoping Bailey bridges from ship to thick ice or land, with widespread supports to distribute their weight, may be the answer.

Whalers, explorers, Navy men—each has his special knowledge of the Arctic. We need it all if polar navigation is to become a matter of operations, not expeditions.



The helicopter, shown above flying over a sub trapped in the ice, was useful but because of its short range too often guided ships up a "dead-end street" in the pack. Invaluable to polar sea



A thin-skinned cargo ship feels its way through the ice pack. Sharp chunks like these punched holes in all the ships. For pack travel, ships should have several inches of steel armor.

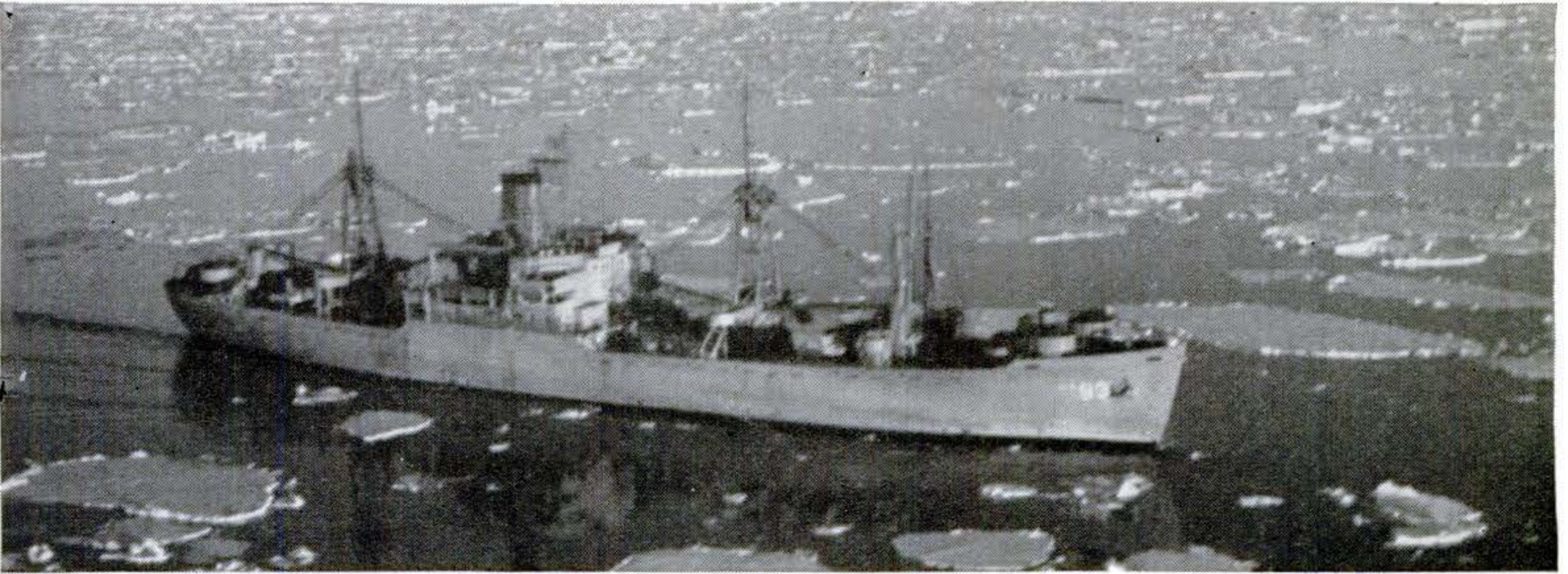


This ship is moored to the ice by a "dead man"—an eight- by eight-inch timber placed in a hole chopped in the ice and secured by pouring in sea water, which freezes immediately.



travel would be a long-range helicopter that could scout the entire ice pack while flying low at slow speeds to check thickness of ice. The ships above cannot turn over their screws

because pack ice endangers the propeller blades. To avoid contact with floating blocks of solid ice, a ship's screw and rudder should be well below the level of its waterline.

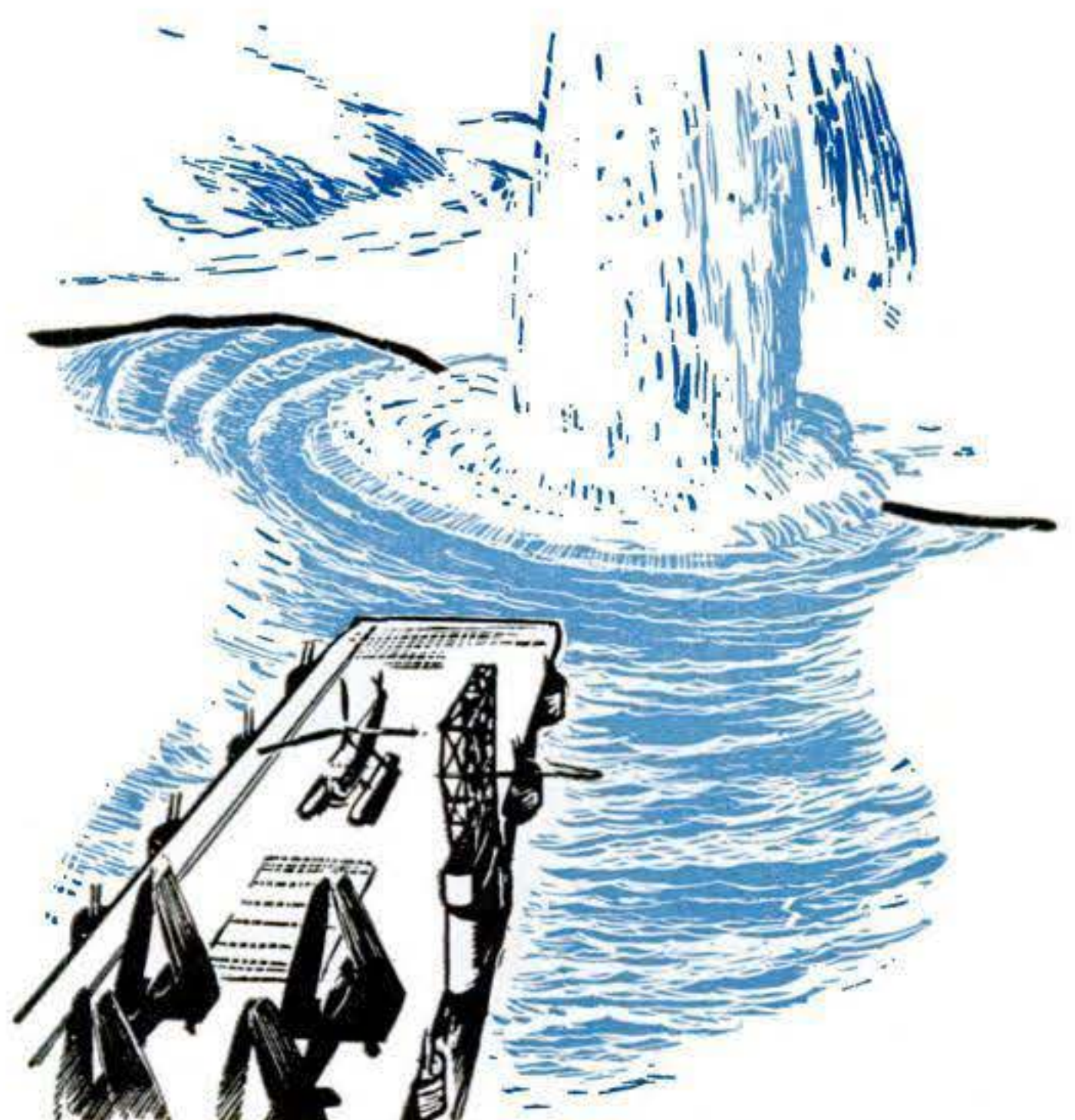


This ship is gingerly nosing her way through the guardian of the poles, the floating ice pack. This is the most dangerous navigation in the world today. Recent experience shows that any

ship not especially strengthened must have an icebreaker escort through the pack. For really efficient polar sea travel, a fleet of specially designed ships is needed.



1. Artist's sketch shows how explosives could be used to blast a path for a carrier. During the 1947 pack crossing one ship rode atop floe, could not break through or back down.



2. Specially trained demolition squads were put on the ice and buried explosives in end of floe. Blast cracked ice, freed ship. Navy is trying out various ways of blasting ice pack. ➔

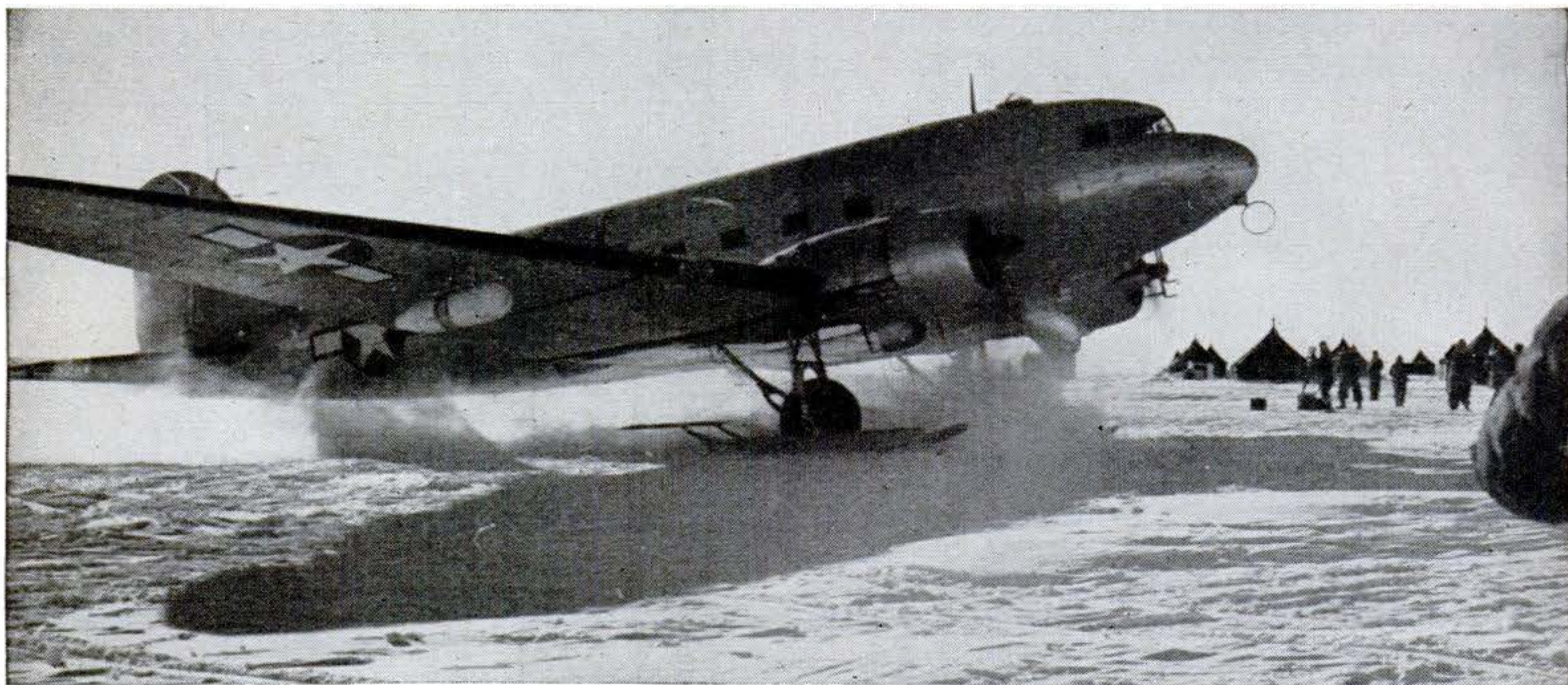
Polar Flying Is World's Toughest, Most Risky

I WAS sitting with a group of pilots around an old fashioned, pot-bellied stove. They were awaiting clear weather for their first flights in Little America. Their C.O., Commander Bill Hawkes, spoke:

"If anyone's forced down in the interior, sit tight. We'll try to get you out. Don't leave the plane. If you try to walk to camp

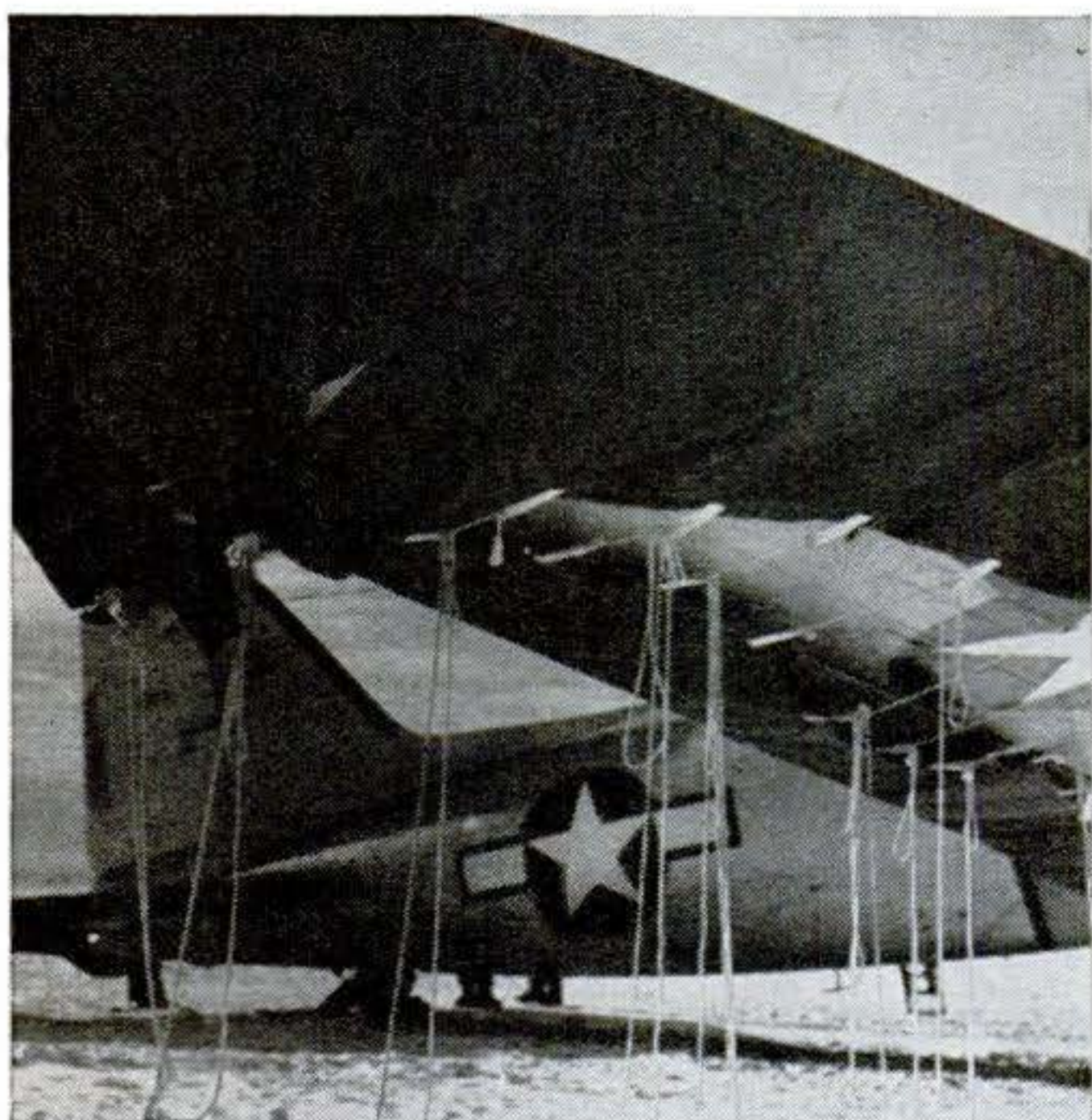
—even if it's only 50 miles—I give you five miles the first day, two miles the second. The third day you'll be dead."

Flying over polar wastes is the most dangerous flying in the world. There are no accurate charts, no weather reports 200 miles out. A forced landing away from the coast usually means frozen death. A ship rescued six survivors of a plane crash along the coast early in our expedition. Three died in the crash, a fourth froze his legs, which were later amputated above the knees.



This plane used wheels to take off from a carrier—and is landing at Little America on skis. The wheels were inserted through the skis,

raising them six inches above the deck. When the wheels hit the snow on landing, they sank in until the skis took over the load.



Experts want to see what happens to the six planes left, like this one, at Little America. Tail ski is buried in the ice; wings are covered with a tarpaulin anchored in the ground.



This plane's skis are frozen to the airstrip, so a crew must rock its wings up and down to pry them loose. Wheels would be preferable to skis if they could be adapted to Arctic conditions.

The plane was flying low when it rammed a small mountain of ice on a "white day." On such days, haze curtains the sun, there are no clouds, no shadows and no horizon—earth and sky meeting in a cottonlike sweep. As Commander Hawkes put it: "It's like flying in a bottle of milk." Pilots need airborne radar to warn of invisible ice hills ahead, and should drop trails of "window" to provide a radar track to base.

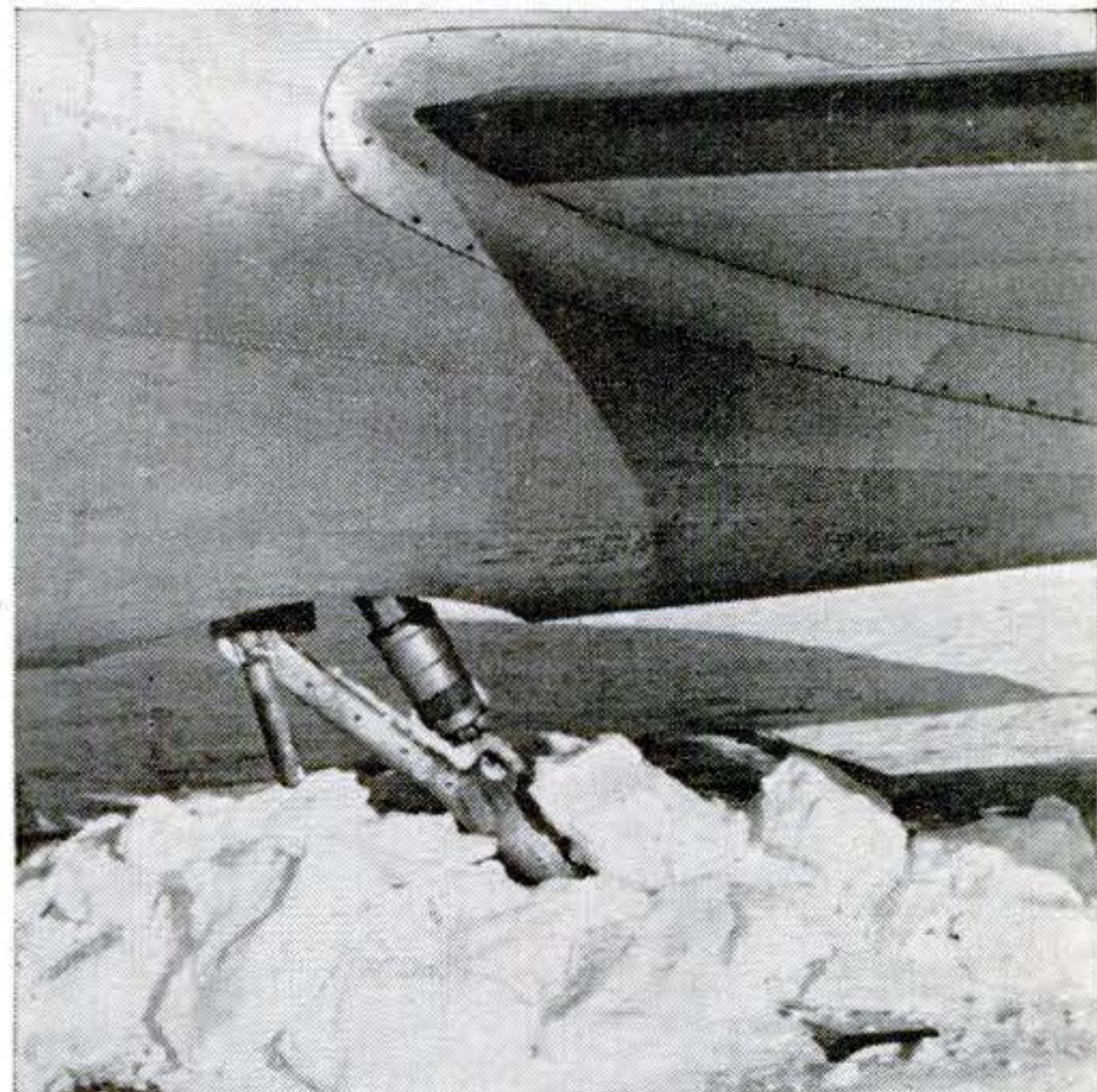
In flight, metal instruments often fail as they contract from the cold. Oil-pressure

gauges sometimes give no positive reading at all. Heating systems fail regularly when feed lines freeze, dropping the cabin to -45° . Planes should be pressurized. Designers must allow for the contraction of every metal part.

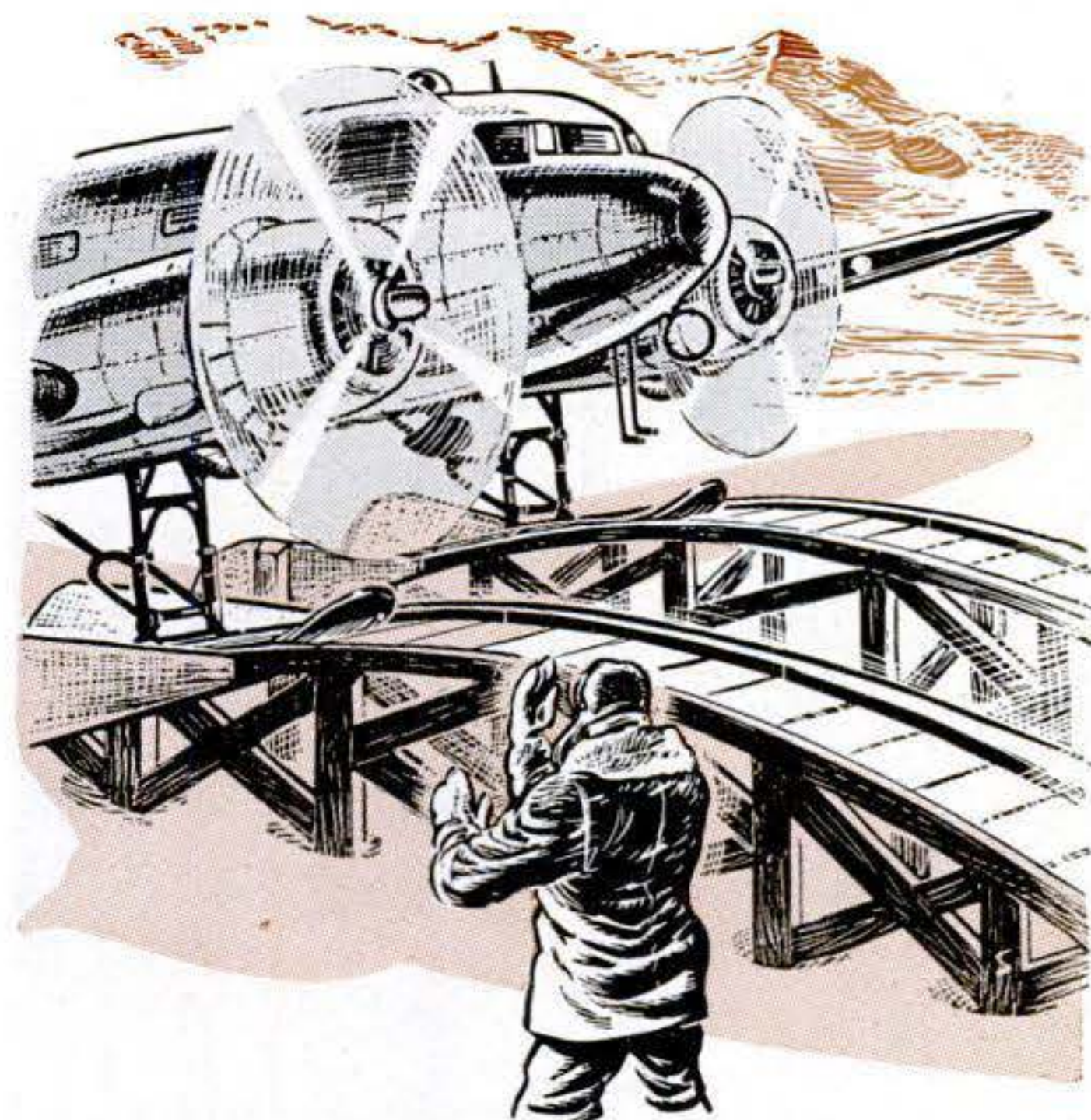
The miseries of the fliers were mild compared to those of the ground crewmen. Working in the open, their skin stuck to metal, which sears like a flame at -30° . A silk glove prevents metal burns, but no glove gives them both freedom and warmth.



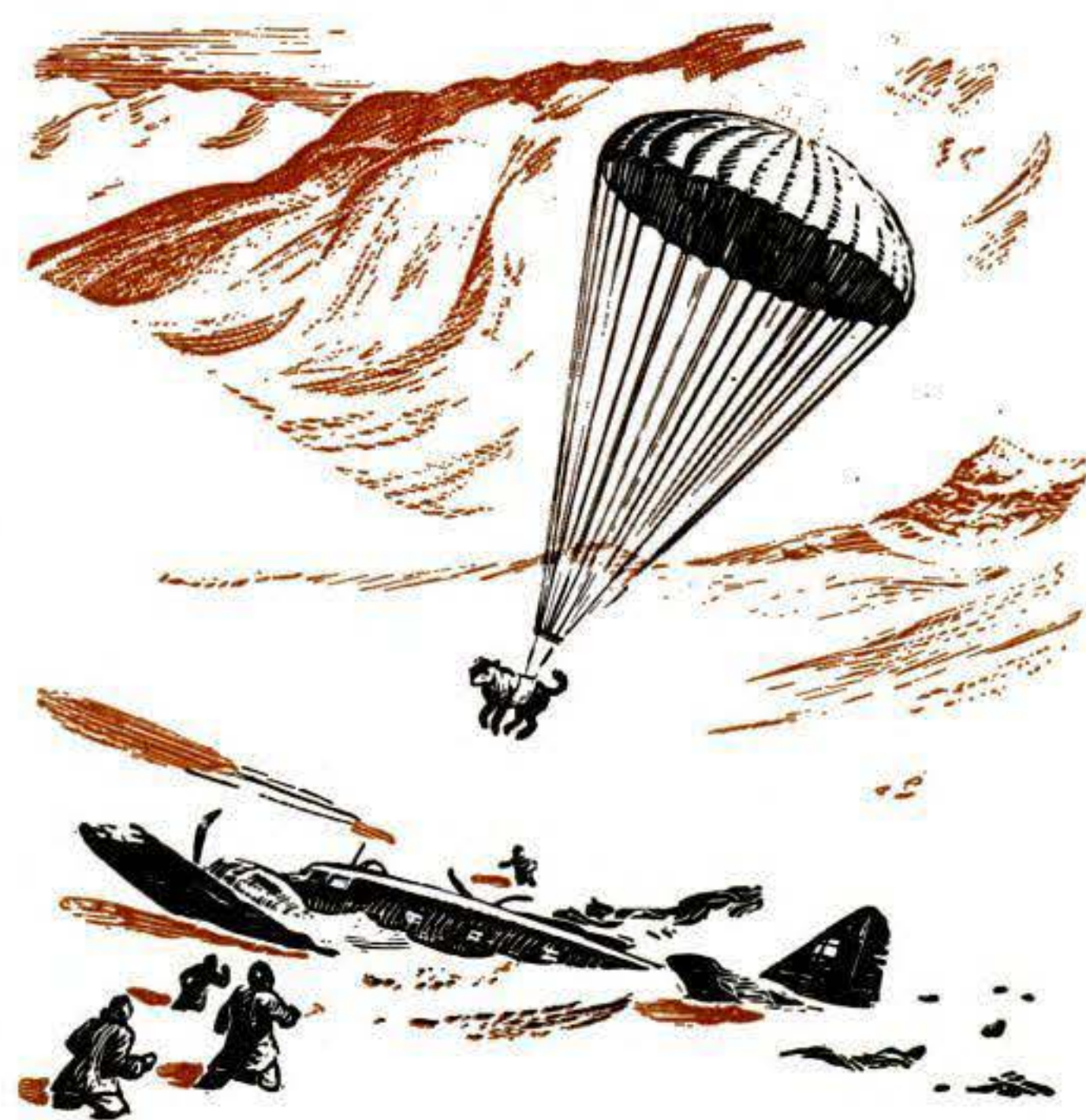
Planes must be kept clear of snow, for the tiniest opening lets it drift in. Hours must also be spent preheating planes before they take off.



This plane's take-off was delayed when a polar squall buried its skis. Tools left outside disappear in snow; tool rack on skis is planned.



To protect planes from drifts and keep skis from freezing down, an elevated structure like this arched bridge has been suggested. A protective "horse blanket" is also planned.



Future rescues of personnel from polar plane crashes might be made by dropping completely equipped dog teams and their drivers. Another way would be for each plane to carry a weasel.

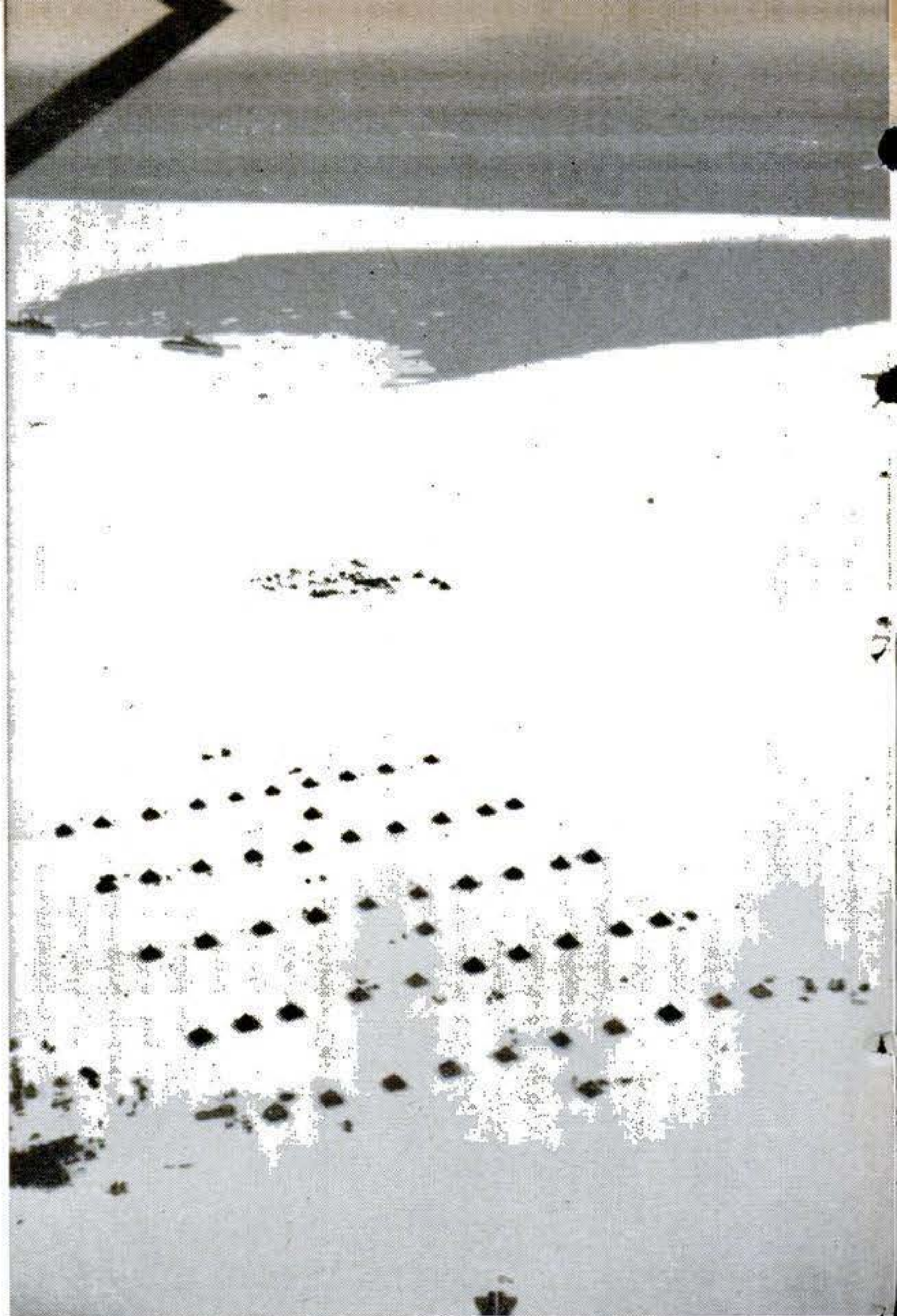
Polar Housing: Men Burrow to Escape Cold

WE TOOK the temperature in our tent at Little America one day. My roommate held the thermometer a few feet away from the stove; it read 50° . Then he held it over my cot, which was at the far side of the tent. It read -10° .

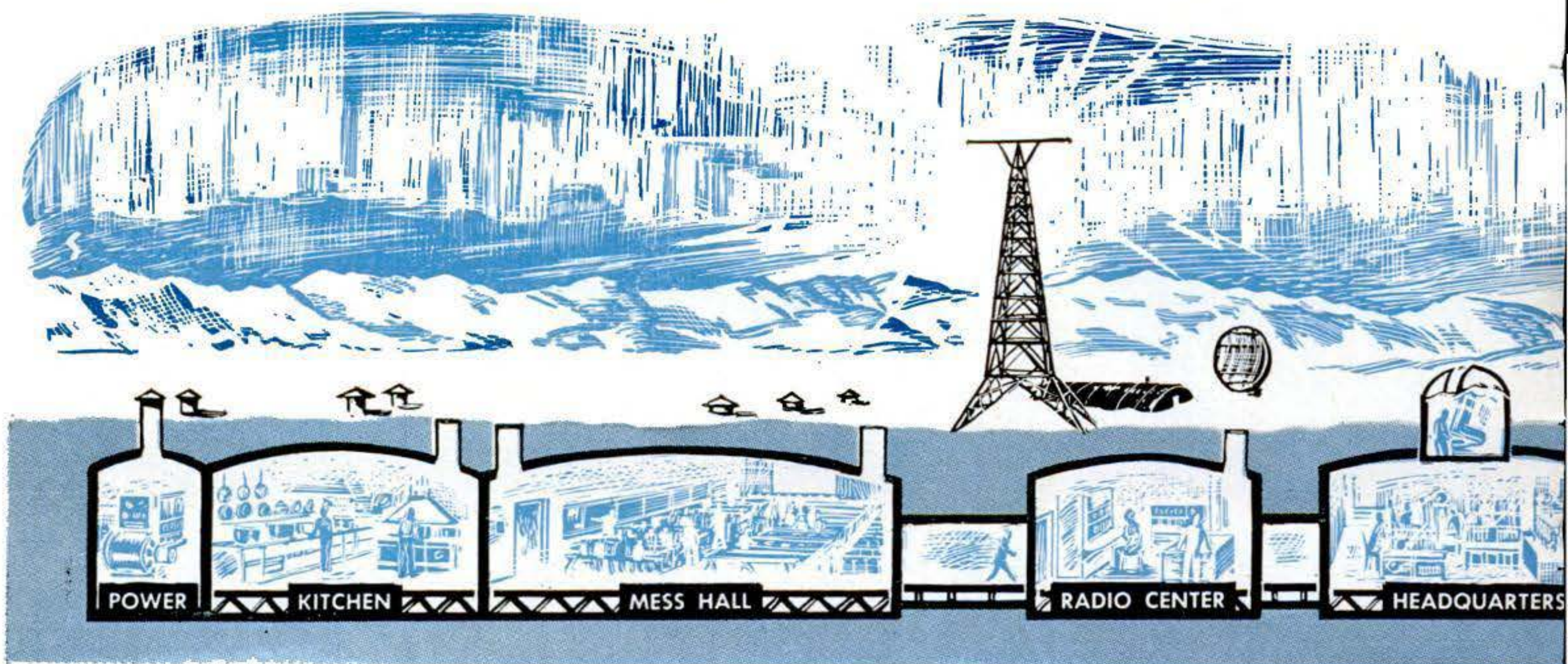
The tent was originally intended for use in the Pacific. It was flimsy canvas, had no insulation, and there was a naked opening around the top of the tent pole. The cots, from the same tropical unit, came complete with mosquito bars. We used the netting to stuff the hole; before we left it supported a small mountain of snow.

Commander C. O. Rheinhardt, the Seabee engineer who built Little America, has recommended the design of a new type of prefabricated house. Two men should be able to assemble this structure without screws, bolts, nails—or anything that cannot be handled with mittens. Sealed joints would prevent the entrance of snow. The house should have a better heater than the pot-bellied stoves we used. And it will have to stand polar winds of 100 m.p.h. Important is some kind of protected latrine system; Chic Sale isn't so funny at the poles.

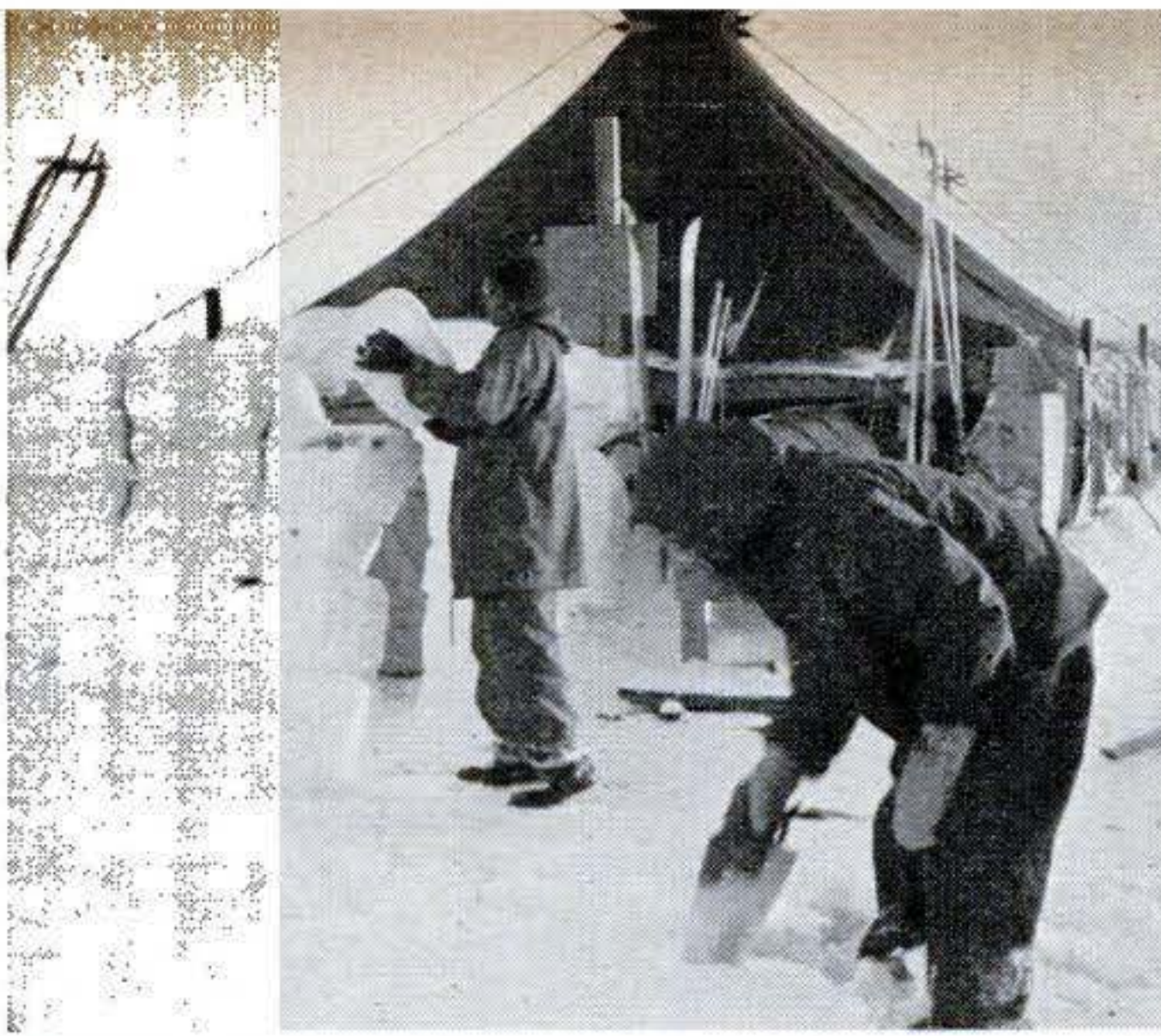
When I recall the pile of snow that filtered in through the flap during one night's blizzard and buried our shoes, I know Commander Rheinhardt is on the right track. Housing is a big factor in polar morale.



This tent city is Little America IV. Break in solid ice in background is Bay of Whales, where Byrd's ships unloaded. Galley and mess tents are at lower left, air operations are in center.



Surface travel is almost impossible during the long winter nights, so bases will be buried.



Walls of ice blocks were built waist-high around tents to protect them from polar winds. Man in foreground is sawing a block out of the frozen ground. Plexiglas formed tent windows.



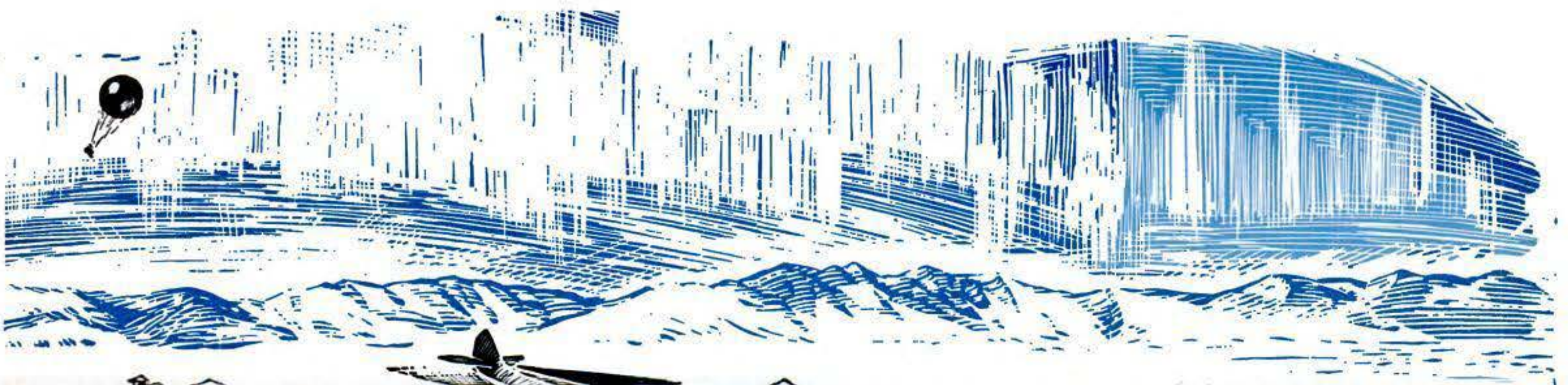
It took 600 man-hours to erect this Quonset hut. Although very warm, the Quonset is not practical on deep snow because of the difficulty in obtaining support for the foundation.



Refrigeration is no polar problem. This bread was baked a month ago—and is still fresh. A rough framework, lined with ice blocks and covered with tarpaulin, makes perfect icebox.



These men have dug out the skylight of Byrd's old snow melter and are lowering in Captain Vernon Boyd. Polar snows bury a house in a few days, so roofs must bear a load of 50 lb. per sq. ft.



Buildings will be connected by tunnels, with exits at central hatches. Elbowroom helps morale.

Living at the Poles Means New Way of Life

THE challenge of the poles is for us to adapt ourselves to a way of living utterly unlike anything we have known. From mittens to airstrips, we have a lot to learn.

Most Americans see their country from automobiles. Let's assume you are in one of the new tractors crossing a polar region. You'd find no landmarks or signposts. Unless you're near a charted, ice-free mountain—and there are no mountains at all in the Arctic Ocean—sun navigation is your only guide. The magnetic compass is as reliable as a Ouija board because of the proximity of the magnetic pole. Hills of ice and snow grow or disappear overnight, for this world is still gripped by the ice age, and the great glaciers move as much as 100 feet a day. Outposts must be set up if radio beams are to guide vehicles across the wastes.

The wick in your lighter will freeze if you step outside. Until a foolproof gadget is found, you'll have to keep your vehicle full of freezing air while "motoring," or your windshield will freeze over from the heat inside. And your car will pitch and toss like a ship in a heavy storm.

World's Healthiest Region

But in planning the polar city of tomorrow there is a lot to be thankful for:

Hospital facilities need not be expensive, for the polar regions are the healthiest places in the world. Germs are smarter than explorers—they shun extreme cold. Past records show that base personnel often grow sick only after a new ship arrives. When permanent polar settlements are established, new men and gear will be isolated until proven germ-free. One thing that is essential is a heated sled-ambulance, since it is impossible to treat injured men in the open.

Garbage disposal is a cinch. One man in the mess hall poured a bucket of hot water on the snow the first night. It made a four-foot hole. Whenever garbage reached the top more hot water was added. When we left, the hole was more than 60 feet deep.

Camouflage is relatively simple: To match the countryside you just have to look white. A Nazi freighter avoided our ships near Greenland during the war by covering every inch with white canvas. It was only revealed and captured when a gale tore off chunks of the canvas.

END



This weird face mask breaks the wind, but in a few minutes your breath freezes into chunks of ice around the nose and mouth pieces. An electrically heated glass helmet is being considered.



This crevasse—a huge crack in the ice—is a threat to anyone leaving the immediate camp area. Often crevasses lurk in ambush, covered by a carpet of snow so that you walk into them.



Seals, high in nutritional value, are a major item in the polar larder and would be a valuable food source for a permanent base. All hands on the Navy's expedition were served "sealburgers."



Here's how to get water near the pole. First step is to spade up a solid chunk of ice from the millions of tons of it about you.



Put the ice inside a GI can, packing the can until it is filled to the top. It's a tedious job—so men tend to go without washing.



Next, start the automatic steam-making machine, operating on Diesel oil. Expedition found need for more than the one steam-maker taken along.

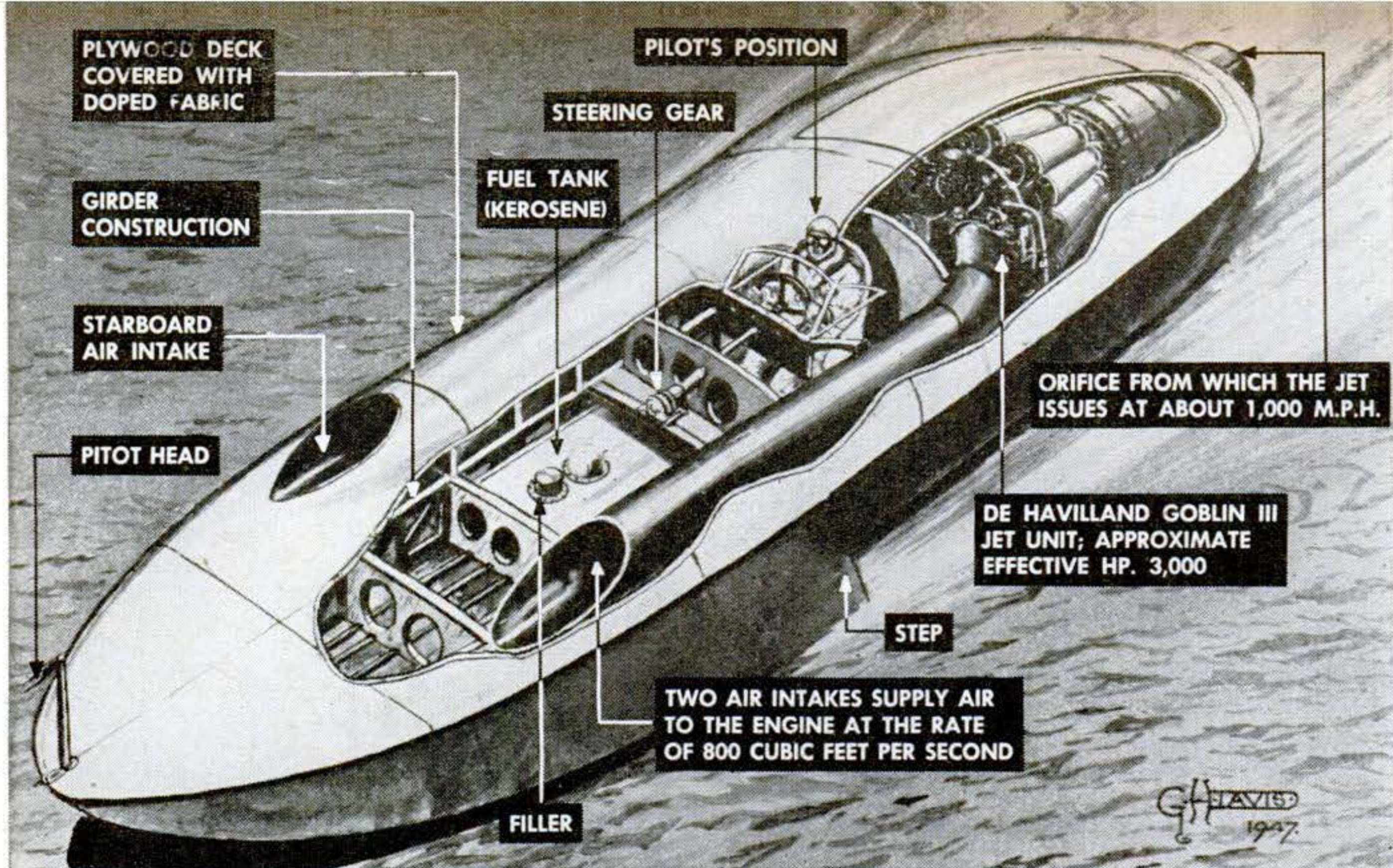


Finally, you turn the live-steam hose into the can. Soon you will have pure drinking water. All polar barracks need hot-water machines.



It is important to put shoes and socks near the stove before going to bed at night. Otherwise the moisture on the bottom of shoes and inside socks will cause them to freeze solidly to the

floor. One man dropped his socks on the floor when he turned in. In the morning, when he tugged at them, they broke—not tore—in half. The same thing happens to damp shoelaces.



Jet version of Bluebird II is shown in cutaway view. The Goblin engine occupies approximate-

ly the same position as the Rolls-Royce reciprocating engine did in the vessel's original hull.

Jet-Driven Bluebird II Aims at Record

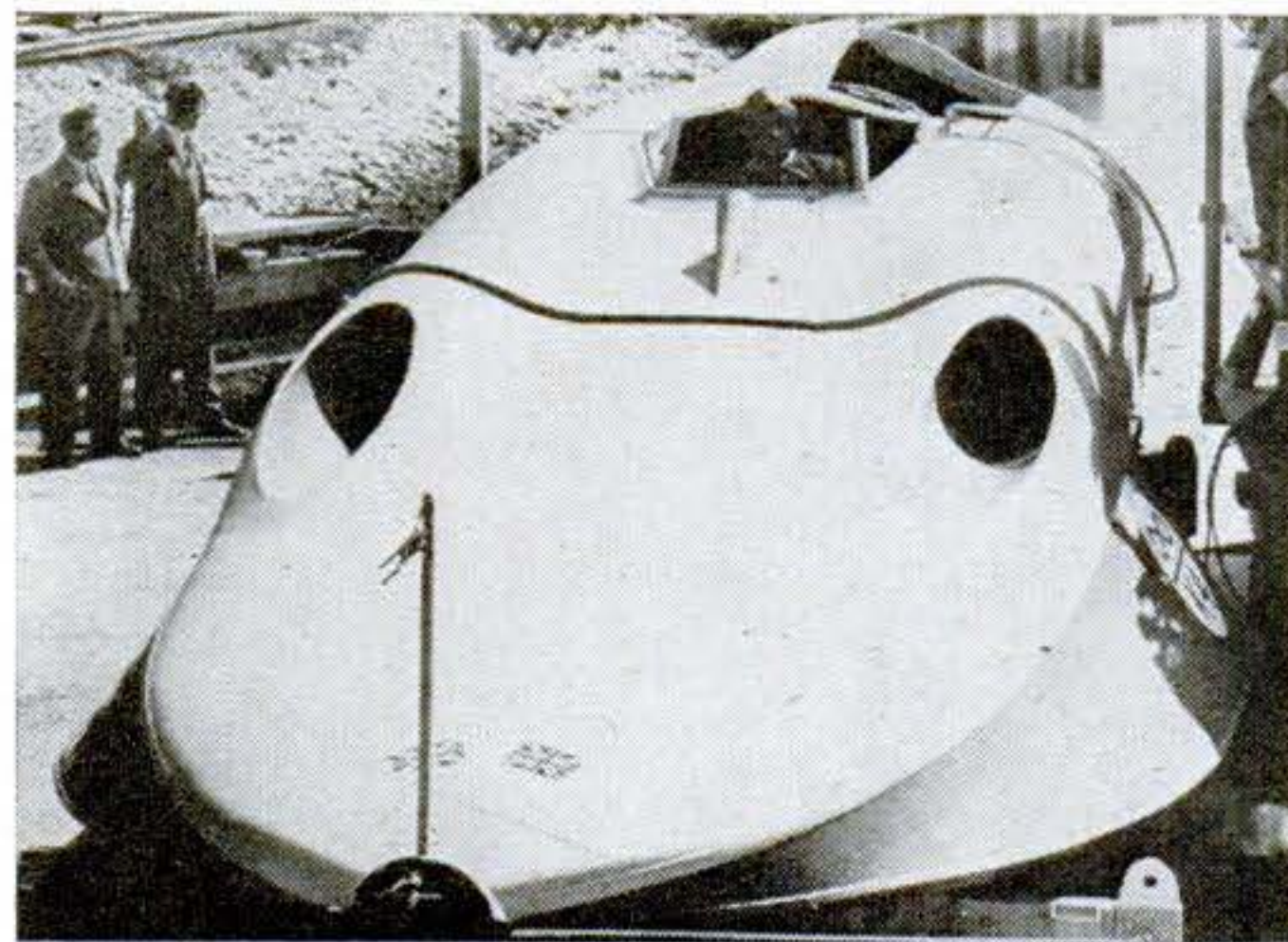
JET propulsion has taken to the water in a spectacular way. With the announced purpose of surpassing his prewar world speedboat record of 141 miles an hour, Sir Malcolm Campbell has converted his famous Bluebird II and fitted it with a 3,000-pound-thrust De Havilland Goblin jet power plant.

Before redesigning the hull of the Bluebird, its original designers wanted to obtain knowledge of the aerodynamic factors involved at the greatly increased speed they hoped the boat would achieve. To do this, they called upon British jet aircraft experience for assistance and tested a scale model of the motorboat in a wind tunnel.

Although not in a class with Sir Malcolm's major effort, some interest has been shown recently in adapting jets to water transportation. One example is a three-horsepower outboard jet engine for rowboats (PSM, Sept. '46, p. 85), said to be capable of eight m.p.h. Another, using a water jet, is a propellerless boat powered by "hydropulsion"—the pushing force of a solid stream of water ejected at high velocity under hy-

draulic pressure (PSM, July '47, p. 214).

Compared to these, the new Bluebird is a jet water monster. The two forward intakes will supply air to the engine at the rate of 48,000 cubic feet per minute. The hull has been streamlined to improve its performance at the high speeds the Goblin engine is capable of producing.



Bug-eyed look is created by the twin ports that carry air to the jet. Lower hull is much like 1939 version. Redesigned Bluebird has a beam of 10 feet 10 inches, is 27 feet 2 inches long.

Mysterious Liquid Acts Like Atoms

Scientists of U. S. and U. S. S. R. race to explain the baffling tricks helium plays as a fluid near absolute zero.

By Herbert Yahraes

A LIQUID that behaves like an individual atom instead of like any other liquid on earth is being scrutinized by American and Russian physicists to determine how its curious properties can be put to work for science and industry.


This strange substance is liquid helium. Its characteristics are so peculiar that no one can say where the present research—a race between scientists here and in the U.S.S.R.—will lead. It may lead to the development of a superconductor that would chop your electric bill by carrying power over great distances without loss.

It may also lead to delicate heat-measuring machines—for astronomers, perhaps, and rocket-ship pilots.

It will almost certainly be of immense assistance in enabling us to understand and harness our friendly enemy, the atom.

Liquid helium is the oddest fluid man ever dabbled with, and the coldest. It exists only at temperatures close to absolute zero, which is 459° below the zero of our back-porch thermometers.

At the temperature of liquid helium, gold, which is ordinarily an excellent conductor of electricity, becomes worthless as such, while tin and lead, ordinarily worthless, become perfect conductors. Following up this lead, Westinghouse researchers are considering the possibility of encasing certain con-



Dr. Cecil Lane decants some liquid air. Liquid helium, far colder, would vaporize much faster.

ductors in liquid helium. Other scientists point out that by studying what happens to metals in the realm of absolute zero, metallurgists may be able to develop an alloy that will conduct electricity perfectly at normal temperatures.

All liquid gases do strange things—liquid helium by far the strangest. It can run uphill. It can make the ancient legend of the bottomless pitcher come true. Also, it has what the chemists call an extremely low viscosity—so low that if you put some of the stuff into a pan at absolute zero and stirred it with a circular motion, it would go 'round and 'round almost indefinitely.

A Dual Personality

Strictly speaking, there are two kinds of liquid helium. The first, designated liquid helium I, is liquid helium in the temperature range between 4.2° and 2.2° on the Kelvin thermometer, which means it is that many degrees Centigrade above absolute zero. It is a colorless, odorless, effervescent fluid that looks like carbonated water.

The second is liquid helium II, in the temperature range between 2.2° K. and absolute zero. It is helium II that has physicists excited because it runs uphill and behaves like an atom. It, too, is without color and odor, but it is also without bubbles. Even if a red-hot poker were thrust into it, helium II would not fizz—because it is an excellent conductor of heat. Other liquids bubble because of differences in temperature; in a good conductor, no such differences exist.

The current chapter in low-temperature physics begins with the work of Dr. Peter Kapitza, now of the Institute for Physical Problems, Moscow. Kapitza developed a machine for liquefying helium while he was working at the University of Cambridge, in England.

One of the outstanding American workers in the field, young Dr. Cecil T. Lane, associate professor of physics at Yale, wrote to England for drawings of the Kapitza machine. He got some, but he had to fill in an awful lot of the lines himself. Nevertheless, working in spare time for three years, he had a helium liquefier in 1941 that was even better than Kapitza's.

It was a long time, though, before he was to get much use of it. For, strangely enough, the war curtailed work in low-temperature physics in every country except Russia. Why? Did the Russians see that liquid helium might lead to a new, all-powerful

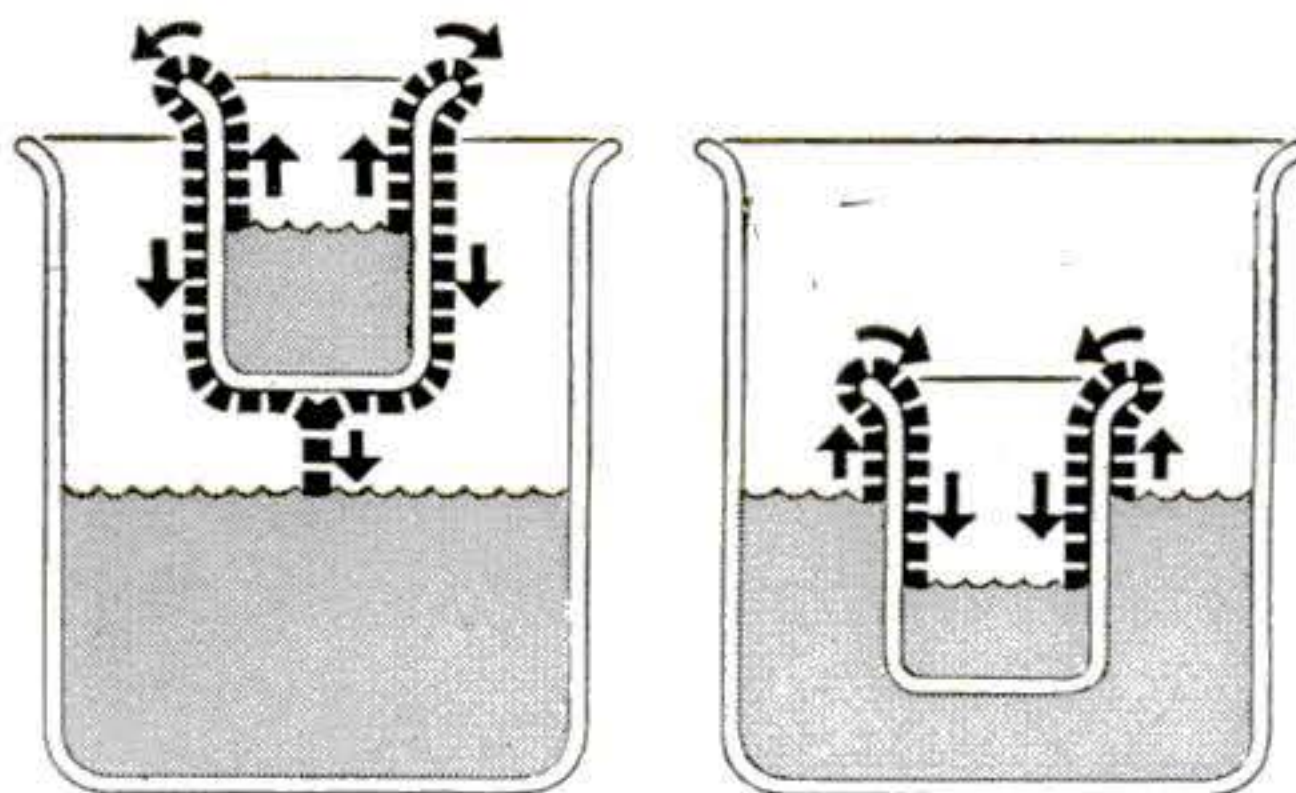
weapon? American physicists don't know. They do feel sure that in this field there has been no iron curtain. During the shooting and since, the Russians have published their findings, apparently with nothing held back.

In any event, the Kapitza-type helium liquefier built at the Sloane Physics Laboratory at Yale was the first in the United States. But with scientists, and governments, eager to explore the possibilities of the strange fluid, five more machines have been put into operation within the last year.

The Kapitza machine produces liquid helium at a fraction of the cost and time and without the danger of earlier methods, in which hydrogen—explosive and inflammable—is used.

Currently the Americans and Russians are working on "second sound," which was discovered and named by a Soviet scientist in 1944. Second sound is a phenomenon that occurs only in helium II. It travels through the liquid at 70 feet a second, whereas the speed of the normal sound wave in this fluid is 10 times as great.

The name is a little confusing, for second sound is really a temperature wave. It is produced by sending an alternating current through a wire in a flask of helium II. This current causes a fluctuating evaporation at



Flowing uphill is one of liquid helium's neatest tricks. Drawing shows how it climbs out of a full cup suspended over a larger quantity, and how it climbs into an empty one partly submerged. In the first case, the process goes on until cup is empty; in the second, until it is full.

the surface of the liquid, and therefore creates changes in pressure.

In ordinary sound, what the ear detects are changes in pressure. In the case of second sound, these changes are not heard directly because second sound travels only in liquid helium, but a microphone can pick up the pressure changes.

What it sounds like depends upon the current used to generate the heat waves;

researchers at Yale used a 1,000-cycle alternating current and heard a thin, organlike sound. If the heat had come from a telephone circuit, says Dr. Lane, the sound would have been of voices—or whatever other noise was coming over the wire.

So far, no one knows the implications of second sound. At the moment it is only further—and the newest—evidence of the peculiar properties of helium II.

Lane calls the stuff “a magician’s substance”; another physicist has described it as “the most exciting fluid in nature.” It is exciting because it does not obey the usual mathematical laws—the laws that apply to ordinary substances.

Here’s an example: Place an empty cup in a saucer containing the stuff, and the liquid will immediately start creeping *up* the outside of the cup and then down the inside. Or suspend a tiny cup partly filled with helium II over a large saucer of the same liquid, and immediately the stuff in the cup will start climbing out to join the fluid in the larger container.

Flasks Balk Heat

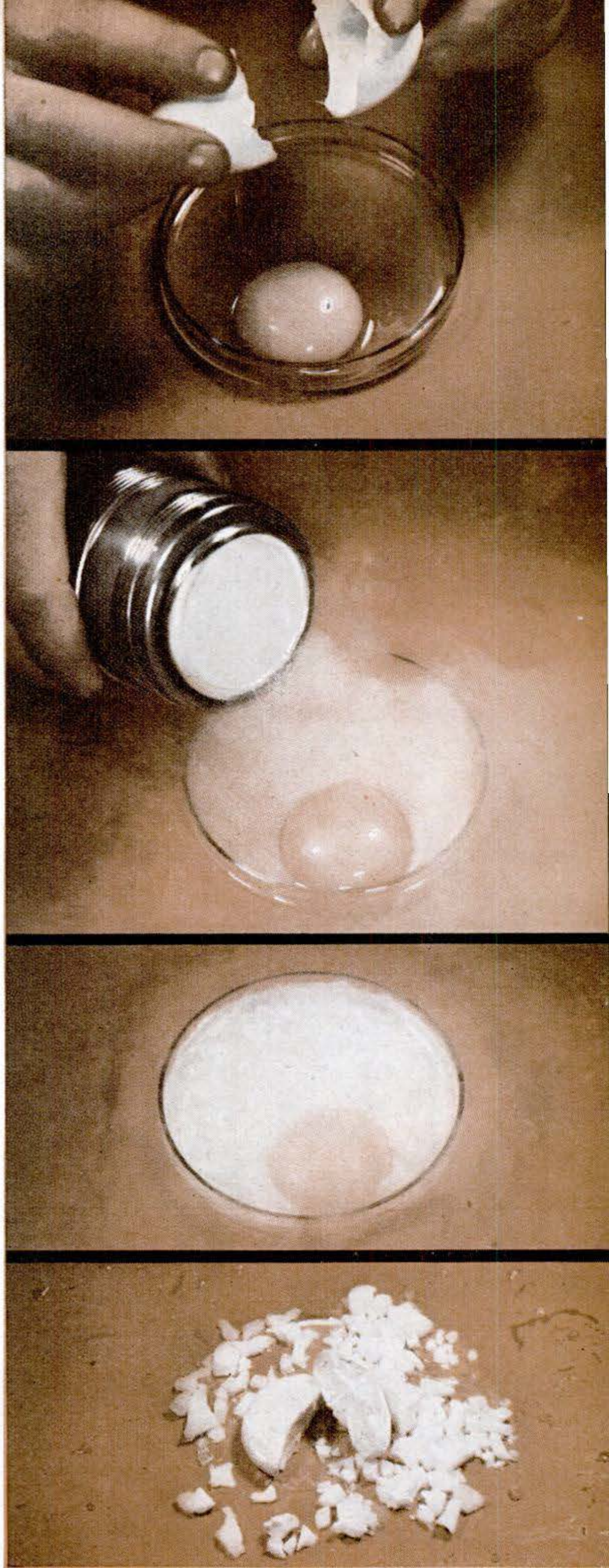
Because of the intense coldness of liquid helium, physicists take great pains to prevent evaporation during such experiments. Instead of a saucer they use a Dewar flask, with a vacuum between its inner and outer walls to prevent heat transference. To turn back heat rays, its outside surface is silvered except for a couple of slits through which the experiment can be watched—and projected, if desired, on a screen.

Cups that fill and empty by themselves are odd enough, but helium II makes possible something still odder. A tiny bottle filled with the stuff is placed on its side in a bath of the liquid. At the mouth of the bottle a little paddle wheel is rigged up, its aluminum blades not much bigger than a bee’s wings. Current is passed through a wire in the base of the bottle, and almost immediately the paddle wheel begins turning.

What is happening is fairly simple. The liquid helium, warmed by the electric current, is flowing out of the bottle and making the blades revolve. But here’s the funny part: There is always just as much of it in the bottle as there was at the beginning.

Evidently the liquid is flowing not only out of the bottle, but also back into it. But if it is flowing back into it, why doesn’t it stop the paddle wheel?

The answer to that one explains some of



The fate of an egg, frozen in a saucer of liquid air, illustrates effect of extremely low temperatures. Egg is so brittle it shatters like glass. Liquid helium does this even to steel.

the peculiarities of this substance. Helium II is two kinds of atoms. Ordinarily its atoms are what physicists designate as *superfluid*—the kind that run uphill. The heat at the base of the bottle changes them into the other, or *normal*, kind. The normal ones flow out and turn the wheel. Once outside they become superfluid again and slip back, ghostlike, into the bottle.

Obviously, the ordinary mathematical laws can no more explain the behavior of liquid helium II than they can solve the behavior of atoms, neutrons and protons. To explain the action of such particles, scientists have resorted to quantum mechanics—atomic mechanics, in other words. Now physicists find that they have to use quantum mechanics, too, in dealing with this magic fluid. Because when liquid helium II flows uphill, or runs two ways at once in the same place, it is obeying the rules that govern atomic activity—defying time-honored principles of physics just the way a nuclear particle does when it feels inclined. So researchers who watch the odd tricks of liquid helium II are actually getting a blown-up picture of how an atom acts.

What the commercial uses of helium in its liquid state will be, nobody yet knows. Some other liquid gases (sulphur dioxide, am-

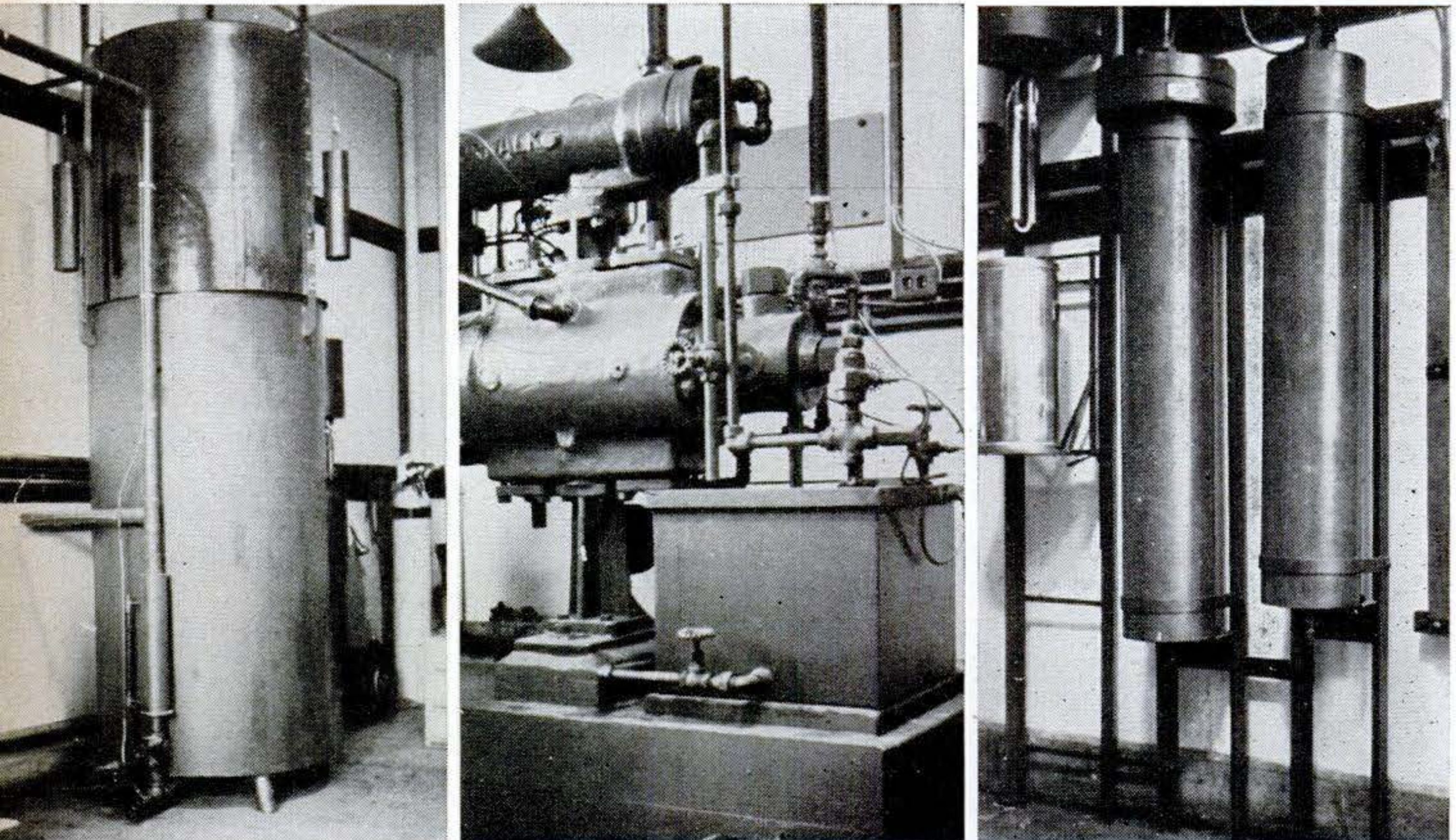
monia, Freon) are used as refrigerants, but their temperatures are comparatively high, about -35° F. Liquid oxygen, at -280° , is one of the propellants of the V-2 rocket. Liquid nitrogen, at -300° , helps preserve the toughness of carbon steel drills.

Liquid helium presumably is too cold for any such applications. Instead, more exciting possibilities lie ahead. For liquid helium makes it possible to study materials at temperatures so low that there is no interference from heat. This is because heat is a manifestation of molecular energy, and at absolute zero, molecular energy ceases.

"The removal of heat," says Dr. Lane, "strips away a sort of mask and permits the scientist to study the material unhampered by interfering phenomena."

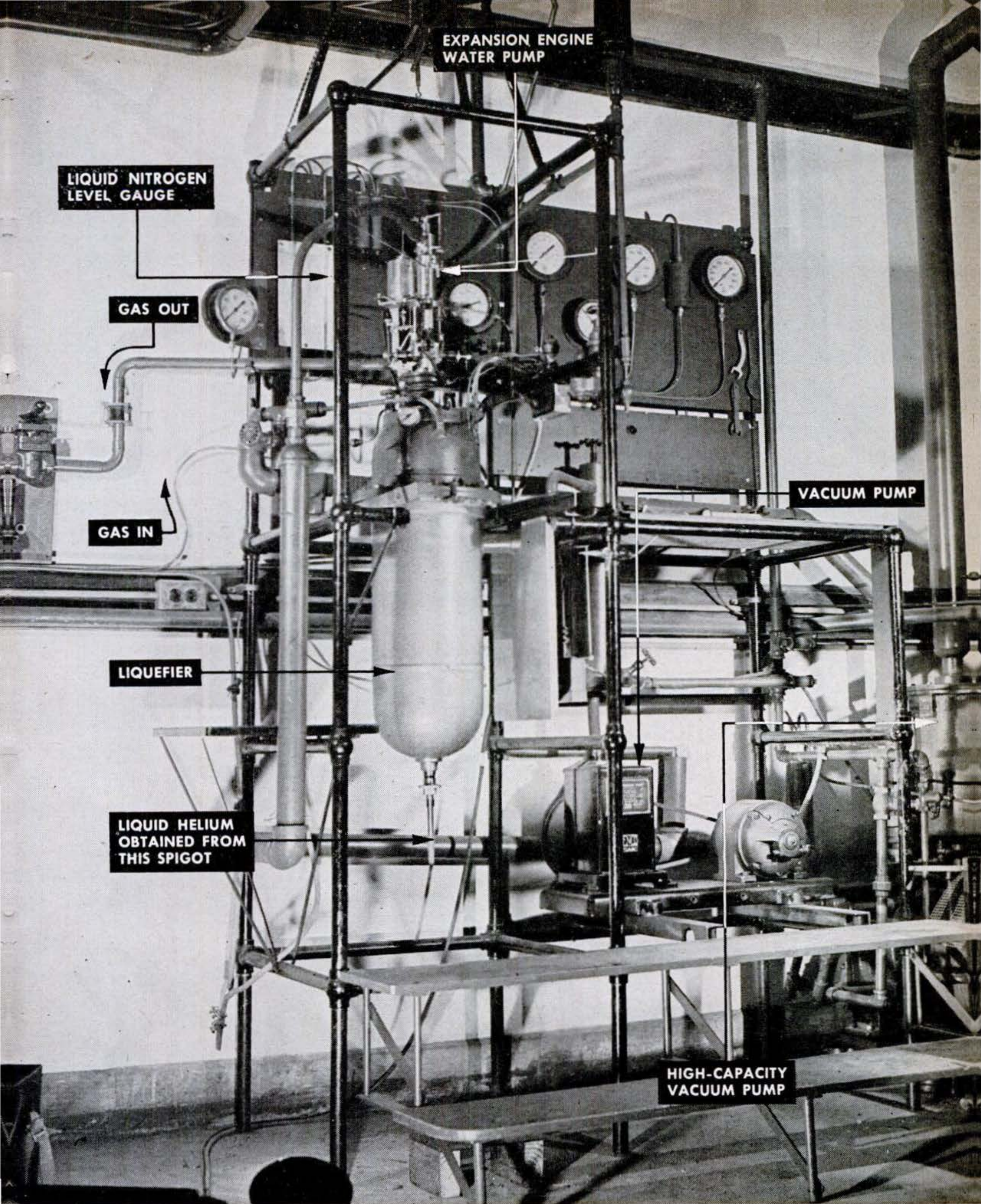
So far as Lane can see, the work with liquid helium is not likely to lead to a practical development in the immediate future. However, he points out that the atomic bomb was the outgrowth of work like that in low-temperature physics.

And of course there is the fact that the Russians, who have some of the most intelligent physicists in the world, continued to explore the strange territory of absolute zero even when Moscow was in danger of being overrun. END



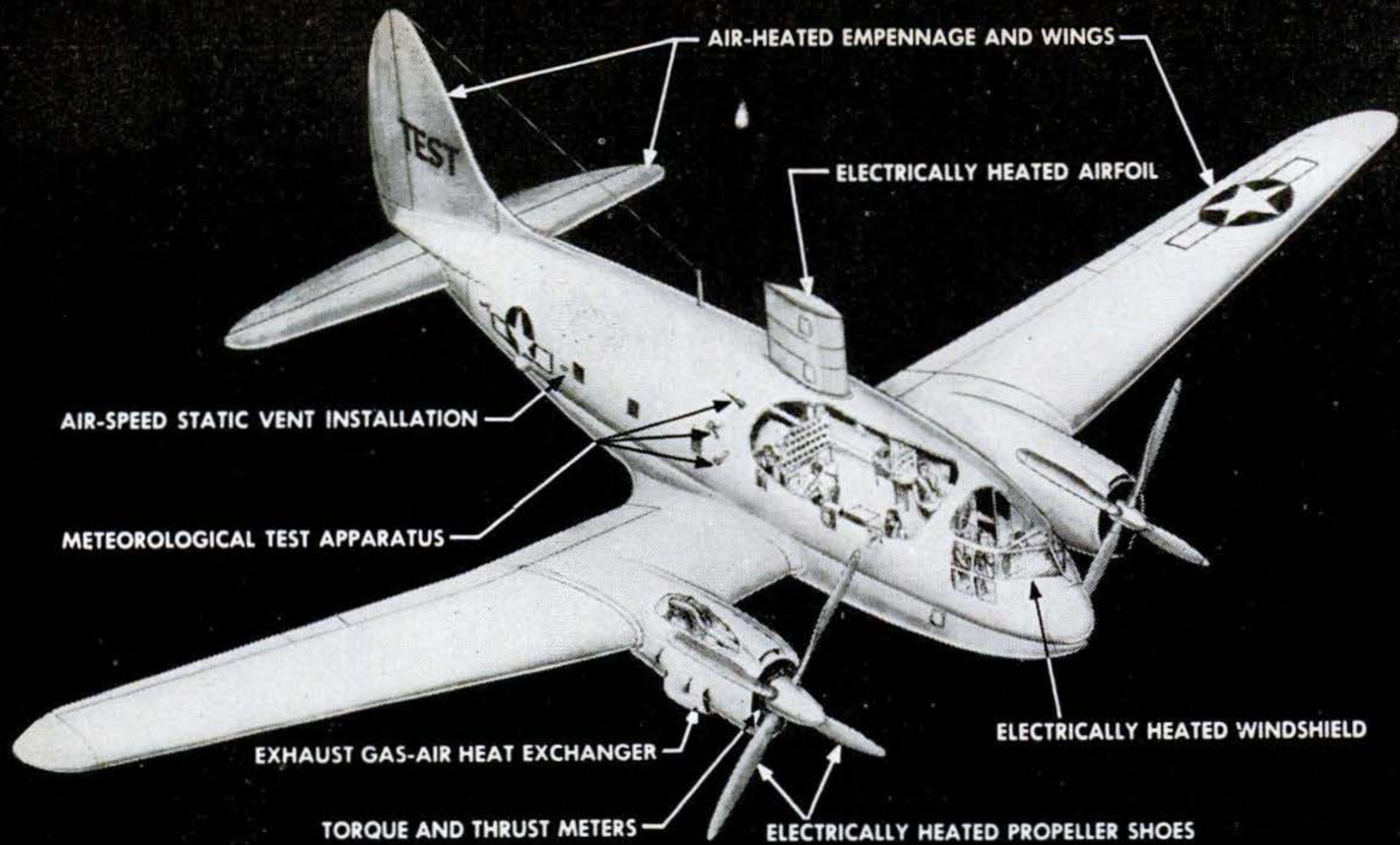
First stages of Kapitza-type helium liquefier are (left to right) the gasometer, which holds 44 cubic feet of gaseous helium; the compressor, which puts it under a pressure of 500 p.s.i.;

and the three purifiers, which remove oil, water, nitrogen and oxygen. Freed of these dangerous impurities, helium flows to the final stage of liquefier, shown on opposite page.



Cooled to -300° F. by liquid nitrogen, helium enters an expansion engine, which takes it down to -425° . Continuing to expand by itself, the helium begins to liquefy at -452° . About five

percent of the gas liquefies each hour, and the rest goes back to start final process again. Drawn off in Dewar flasks, liquid is measured in liters; one liter equals 25 cubic feet of gas.

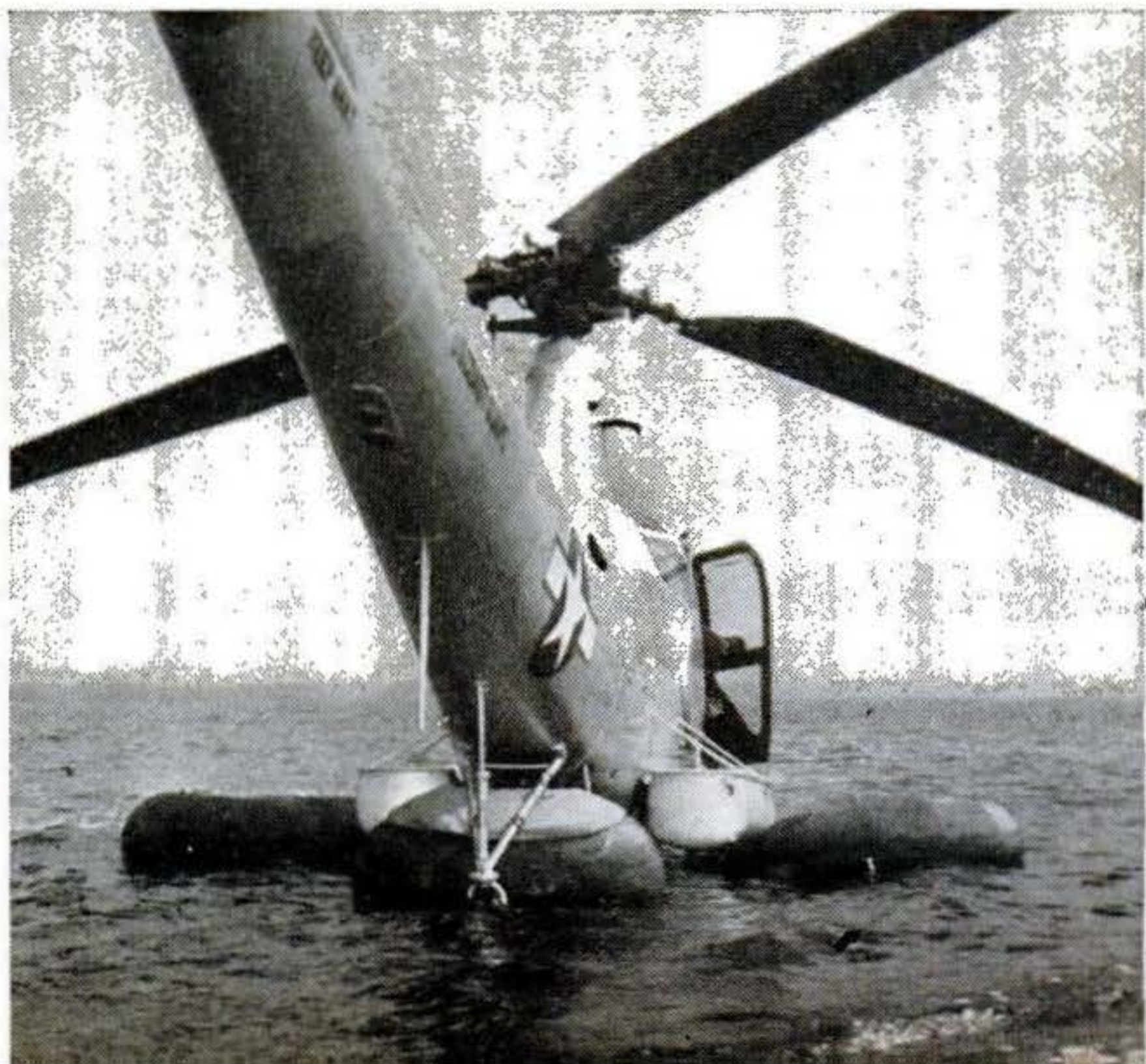


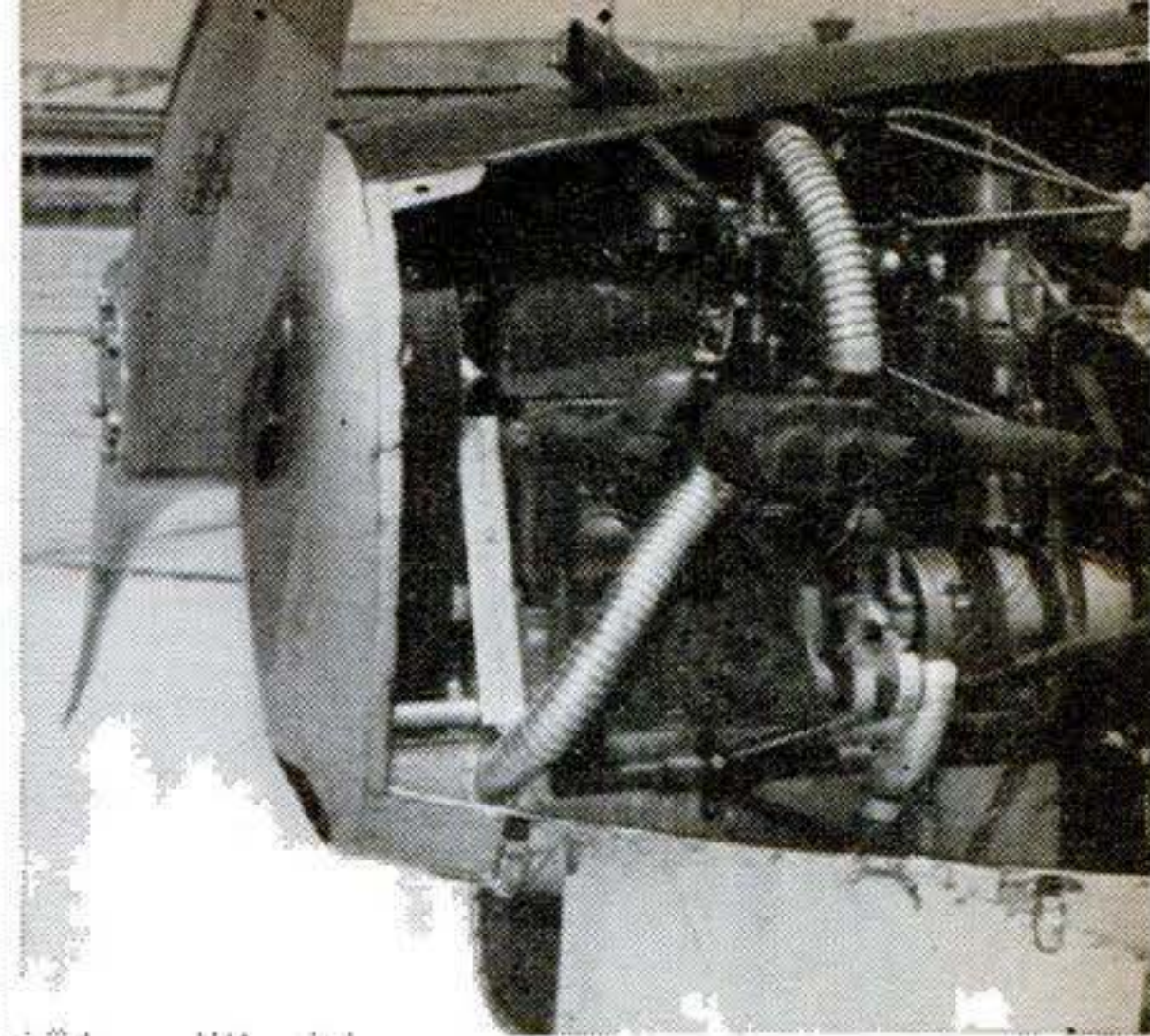
Flying Ice Laboratory. Cutaway drawing above shows the special C-46 Commando used for icing research by the National Advisory Committee for Aeronautics. With a crew of eight technicians, it goes up in bad weather to study icing conditions and to test equipment for ice prevention and removal. The *electrically heated airfoil* shown is one of the NACA low-drag series,

being tested to obtain data on the exact amount of heat needed to guard wings against ice formation. The *torque and thrust meters* are important because their readings provide an index of propeller efficiency, which varies with temperature. The *exhaust gas-air heat exchanger* protects the research plane against ice formation, permitting flight even under severe icing conditions.

Helicopter Dons Floats. The doughnut-shaped "water wings" attached to the three wheels of a Coast Guard helicopter enable it to land on water or marshy

ground during rescue operations. The rubber floats are deflated for land operation (left), and can be inflated by the pilot for a water landing (right).





Midget Tries Its Wings. Designed around the 25-hp. Crosley auto engine (right) by Mooney Aircraft, of Wichita, this little job cruises at 100 m.p.h. and is said to

get 400 miles out of its eight-gallon tank. It weighs 415 lb., is 18 feet long with a 27-foot span, and has retractable tricycle gear. An experimental model is under test.

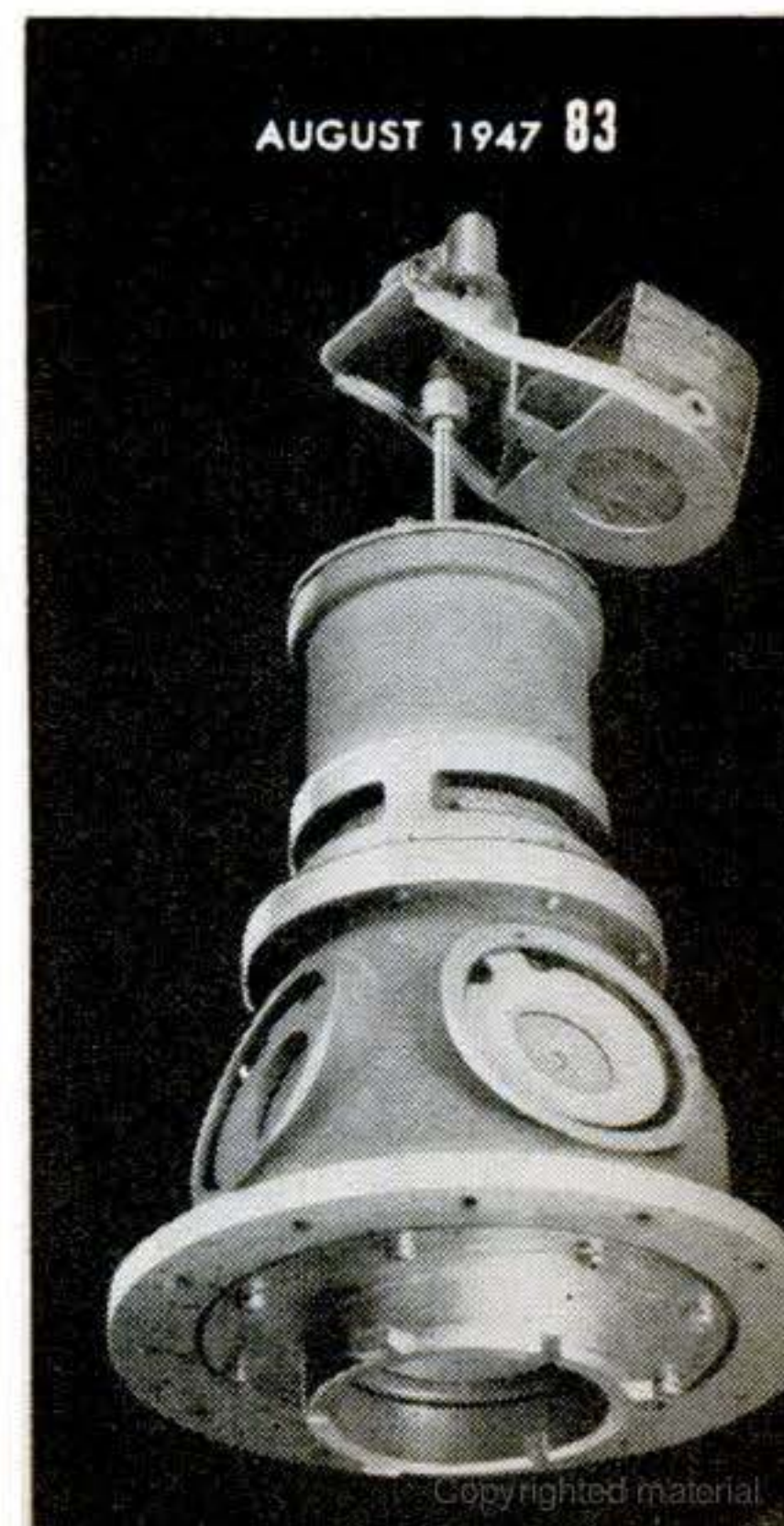
WHAT'S NEW in AVIATION

Improved Cub. More than 100 new features are credited to the latest version of the Piper tandem-seat Cub, shown at right. Called the PA-11, it is a successor to the J3, which it resembles. The range of the new model has been nearly doubled; it can cover more than 300 miles with 16½ gallons of fuel. It is powered by a 65-hp., four-cylinder Continental engine.



Fueling "Up". Delivering up to 200 gallons of gasoline a minute, a new underwing system speeds fueling of such planes as this Martin 2-0-2 transport. The heart of

the unit, designed by the Parker Appliance Co., is the valve shown on the right. Built into the wing, it automatically cuts off the flow when the tank is full.



AUGUST 1947 83

The Truth About Germ Warfare

Startling official report on bacterial warfare reveals that U. S. is specially vulnerable as a target for it.

By Alden P. Armagnac

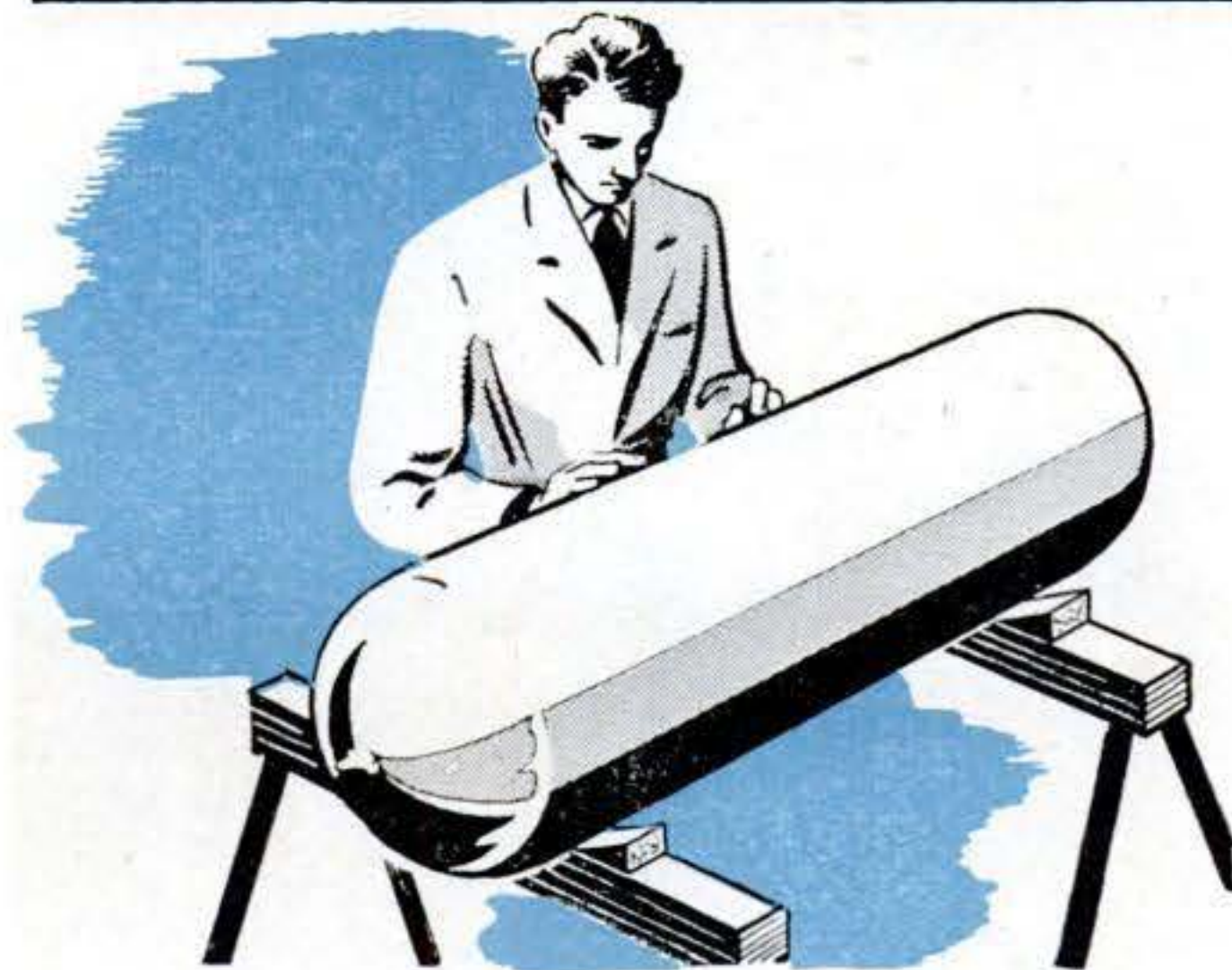
BEHIND guarded laboratory doors, as World War II ended, finishing touches were being applied to a new and untried weapon—an instrument of mass annihilation comparable to the atomic bomb. Bacterial warfare, no longer a fantasy of sensational fiction, was ready for action.

Today, any country bent on aggression could launch a germ offensive overnight. Few countries upon the globe would make a more tempting target than the United States.

So that Americans may know what we face, and what can be done about it, military authorities recently approved publication of one of the most remarkable documents that ever passed censorship in this or any other country. Originally prepared for the National Research Council—and kept secret for five years—a printed, 89-page wartime report reveals exactly what the objectives and technique of biological warfare would be, what germs would be used, and what countermeasures would be available to the defense.

Strategic aims of germ war would be to knock out the enemy's troops and all the complex home-front organization needed to support them in modern war: munitions factories, home industries, transportation

RESERVOIRS MAKE IDEAL TARGETS



Holding 350 pounds apiece of botulism toxin, an ultradeadly poison, glass "bombs" like this could be carried by the hundred aboard a plane.

lines and power plants. Any "terror" effect upon civilian morale would be purely incidental to this fundamental purpose, whose speedy accomplishment should suffice to crush an enemy's resistance and dictate the terms of his surrender.

Spearhead of a germ offensive, the report anticipates, would be specially fitted aircraft bearing capacity loads of bacteria-laden dust. Transocean and carrier-borne planes, adaptable with equal ease, could be equipped like the airplanes used for crop-dusting. Over the target area, their crews could spread a blanket of the lethal powder at a height beyond the range of effective anti-aircraft fire, unheard and unseen from the ground. Slowly settling, the invisible dust would descend upon crowded city streets and military encampments in sufficient concentration to launch a deadly epidemic. To vary the technique, planes might use a harmless-looking smoke screen of a standard type such as titanium chloride, whose particles would actually be teeming with germs.

While these raiders were rendering a city's air unfit to breathe, others would attack its water supply with "germ bombs"—thin-walled glass capsules filled with germs or toxin, and designed to burst, under gas pressure, after being dropped in reservoirs.

Far from a fantastic idea, it would be perfectly feasible and perhaps militarily useful for planes to toss out screened cages that would open automatically on reaching earth, liberating swarms of plague-bearing insects that would spread disease by their bites. Air bombs of fragmentation type, shrapnel

shells, and hand grenades might carry germs to complicate the injuries they inflict, if the highly resistant spores of some bacilli could withstand the explosion of a projectile.

Not only would human beings be attacked. Animals furnishing meat and milk, and food and industrial crops, would be certain targets of a total germ war.

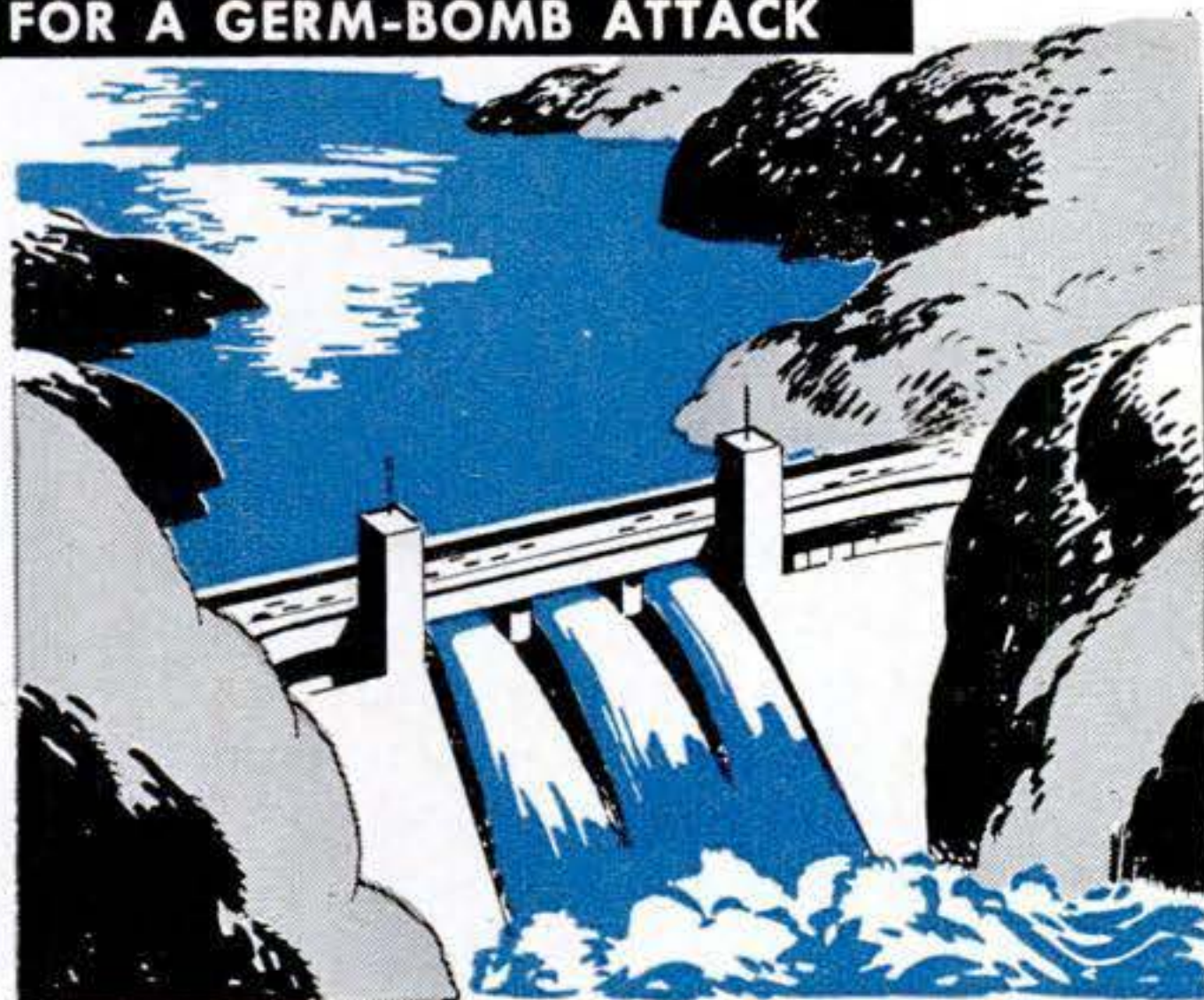
What particular germs would be used? Weighing the pros and cons of known human maladies from a cold-blooded military standpoint, the authors of the report—Drs. Theodor Rosebury and Elvin A. Kabat, of Columbia University College of Physicians and Surgeons—reach surprising conclusions.

21 Germs for War

Some of the most dreaded scourges of mankind, including cholera, tetanus, typhoid, and smallpox, head a list called clearly unsuitable for use in warfare. Sure protection by preventive measures, such as vaccination, rules them out. Others are eliminated as not "catching" enough, too easily cured, or impossible to spread artificially. There remain exactly 21 diseases affecting man that might be expected to be used in combat.

Often mentioned in past discussions of biological warfare, the germ of botulism, or canned-food poisoning, produces the deadliest stomach poison known to man. Drop 350 pounds of it into a 10,000,000-gallon reservoir, and one sip of the water would be fatal! It might be done in wartime, Drs. Rosebury and Kabat anticipate. But constant tests made by inoculating white mice with the water would immediately detect

FOR A GERM-BOMB ATTACK



One bomb of this size, dropped from an airplane into a 10,000,000-gallon reservoir of drinking water, would suffice to poison it.



A single sip of toxin-poisoned water would be fatal. Lethal quantity is less than a fourth of ounce, or amount in bottom of glass above.

the toxin; mice can survive less than 1/100 of the lethal human dose. Warned in time, users could make the water perfectly safe to drink simply by boiling it.

"Almost ideal choices" for bacterial warfare, in odd contrast, prove to be the measles and the mumps! Introduced on a fighting front by picked troops, who have recovered from these so-called "childhood" diseases, the germs would work havoc among the defenders, while the attackers would be immune. Disabling your foe may be just as effective as killing him, to win a battle or a campaign.

Strange and little-known maladies may figure prominently in germ war, the report indicates: parrot fever, or psittacosis; "Rift Valley fever," of which there was an African epidemic in 1930; and others such as the mysterious and usually fatal Far Eastern disease, melioidosis, of which available medical literature records only 95 cases up to 1933. Readily obtainable from biological laboratories, these viruses and bacilli would rate high in military favor, since difficulty in diagnosing rare diseases would hamper defense efforts to control an epidemic.

Better-known germs that might be unleashed against a populace include those of anthrax, influenza, meningitis, and pneumonic plague, the last called a "superlative" weapon. A single bacillus of pneumonic plague can kill a guinea pig and, the report states, "there seems no reason to believe man less susceptible." The germs could be released from planes in heavy smoke that would not only take effect in the open air, but would also penetrate closed windows.

Former Concepts Outmoded

When Major L. A. Fox, of the U. S. Army Medical Corps, wrote in 1933 that bacterial warfare seemed to him of doubtful feasibility, he was fully justified by the state of medical knowledge at that time, the Rosebury-Kabat report states. Later developments have changed all that. By way of example, yellow fever has long been thought transmissible only by the bite of the tropical *Aedes aegypti* mosquito. But accidental cases of infection among laboratory workers handling the concentrated virus of yellow fever, in the form of a dry powder, now lead to the remarkable conclusion that it can be contracted simply by breathing air containing the organisms. Implications are startling. Hitherto the disease has been limited to equatorial regions, which provided

the climate required by its mosquito carriers. Now, virus-spreading planes might introduce yellow fever anywhere on earth.

Much has been made in the past of the argument that an attacker would hesitate to use germ warfare for fear that it would boomerang upon his own forces, if they entered the affected area. That argument, shaky at best, falls down completely for a geographically isolated target—an island naval or air base, say—that the attacker simply wants to put out of business, with no intention of occupying it. An attack upon Hawaii with malaria-bearing mosquitoes (unknown there, despite a favorable climate) might mean a second Pearl Harbor.

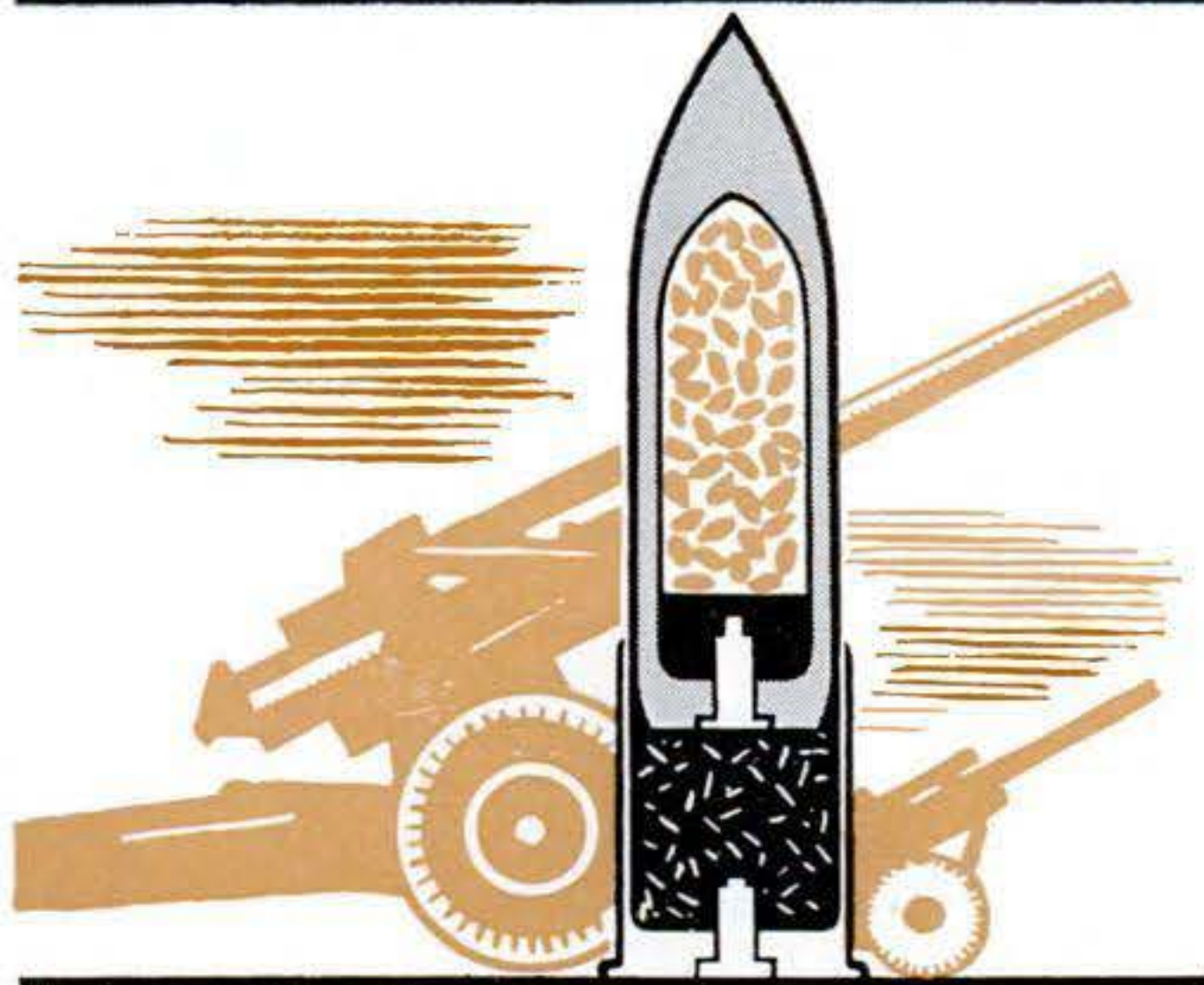
Safeguards Are Gone

Likewise, on a larger scale, America's isolation by two oceans now becomes a liability rather than an asset to defense. It renders this country peculiarly vulnerable to all types of germ attack that might be launched from the safety of another continent. That its mere size would offer any protection is a dangerous fallacy. Actually a third of its population, and half of its industries, huddle together in 33 key locations *totaling less than two percent of its land area!* Our own Department of Commerce saves any potential enemy's general staff the trouble of mapping the targets in order of priority, according to number of industrial workers: No. 1, New York City-Newark-Jersey City; No. 2, Chicago; and so on, down to No. 33, Toledo. Raiders could hardly ask a more perfect setup.

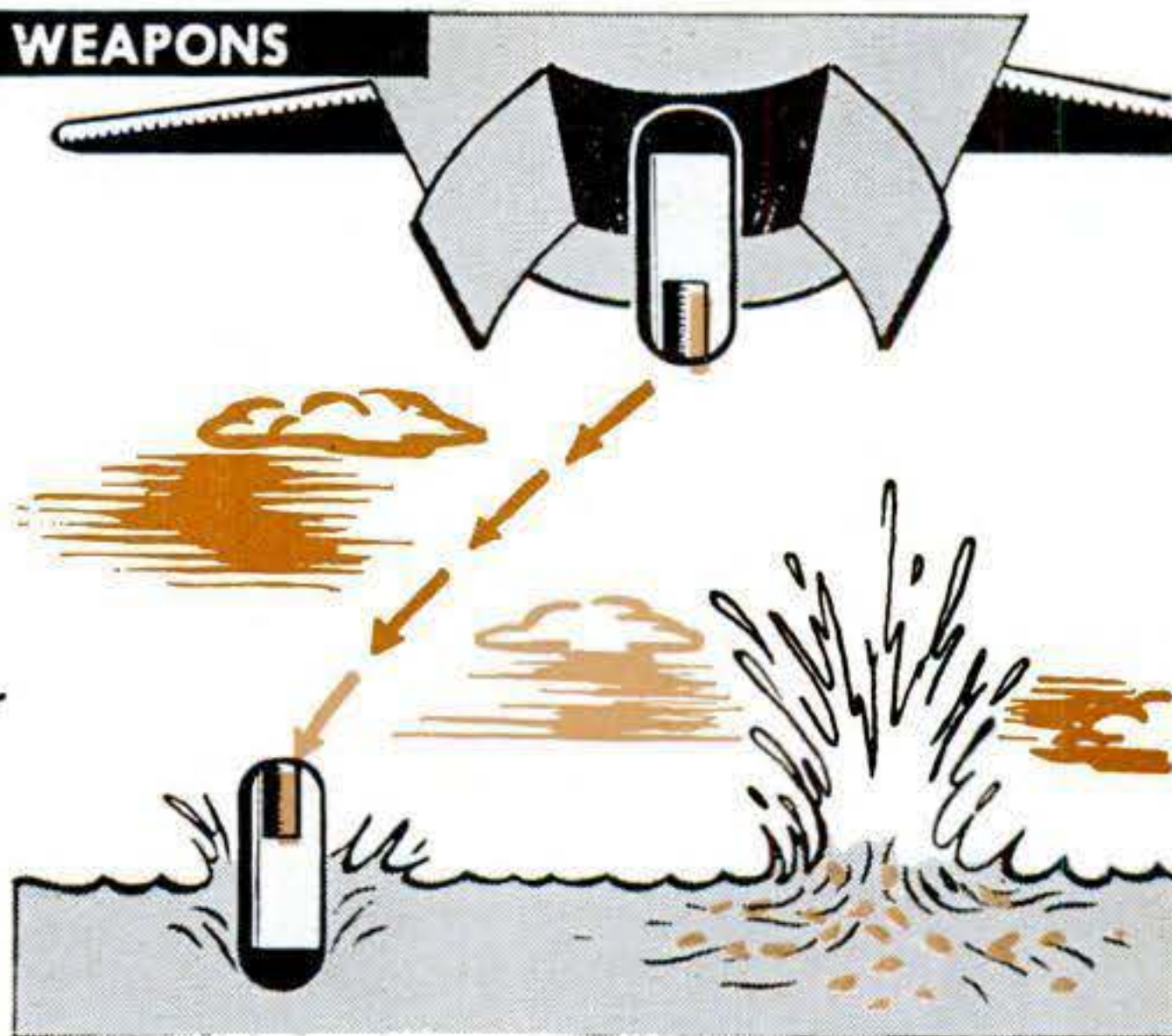
Until we can abolish war altogether, there is only one way we can prevent that nightmare from coming true, Drs. Rosebury and Kabat declare. *It lies in grim preparedness to guarantee an aggressor a double dose of his own medicine—to promise retribution in kind, so swift, so sure and so terrible as to banish any temptation to attack us with germs.* Just such a warning from President Roosevelt and Prime Minister Churchill, they point out, stopped Axis use of poison gas in World War II, for the enemy well knew we could and would carry it out.

Fortunately we are prepared today to back up a similar ultimatum against germ warfare, as a result of top-secret biological research by the Army at Camp Detrick, Md., and by the Navy at the University of California. We can preserve the lead in research that insures our safety, just so long as Americans support these programs. END

FRONT-LINE AND LONG-RANGE GERM WEAPONS

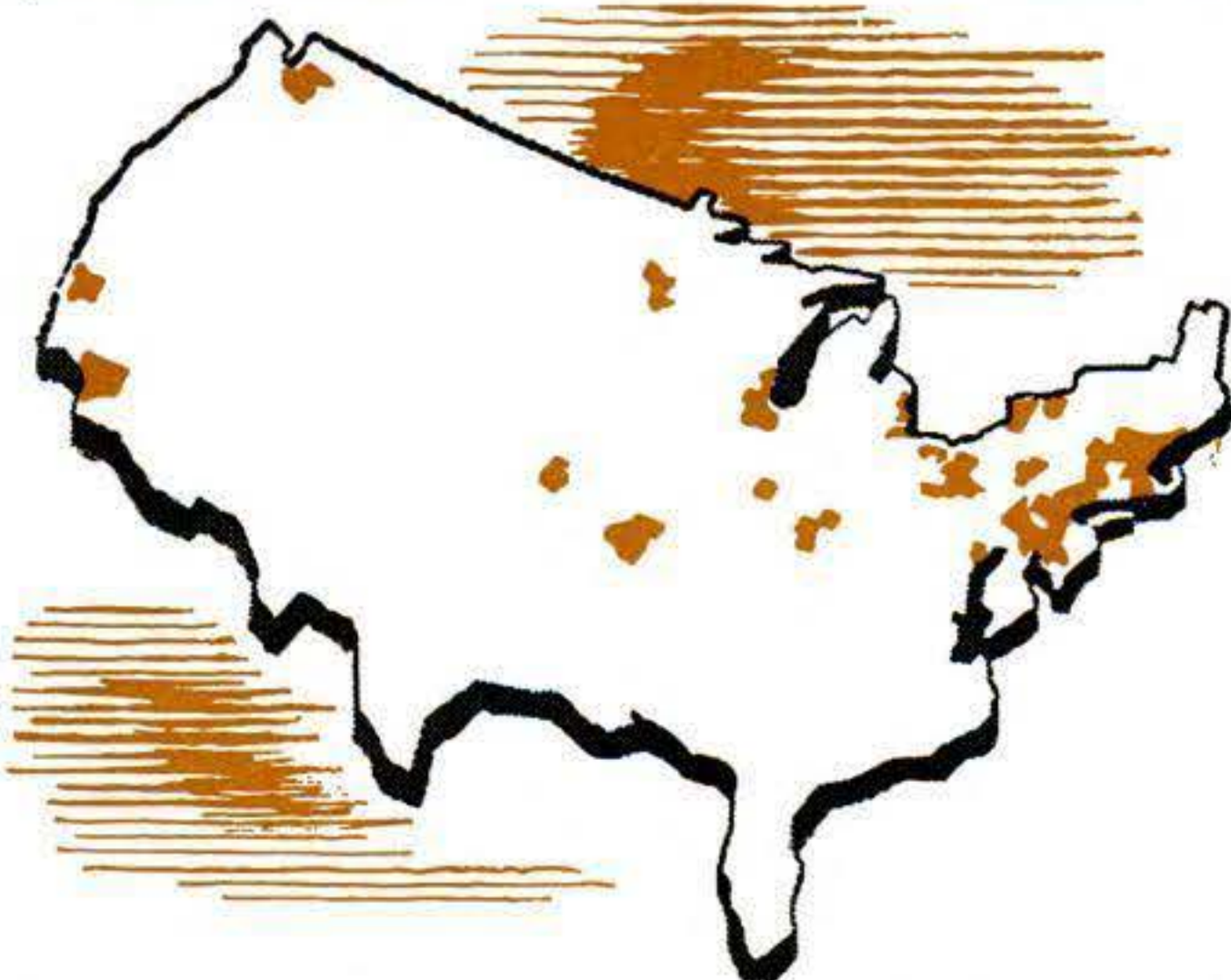


Projectiles may scatter germs, if experiments confirm the ability of some kinds of spores to withstand the heat and pressure of detonation.

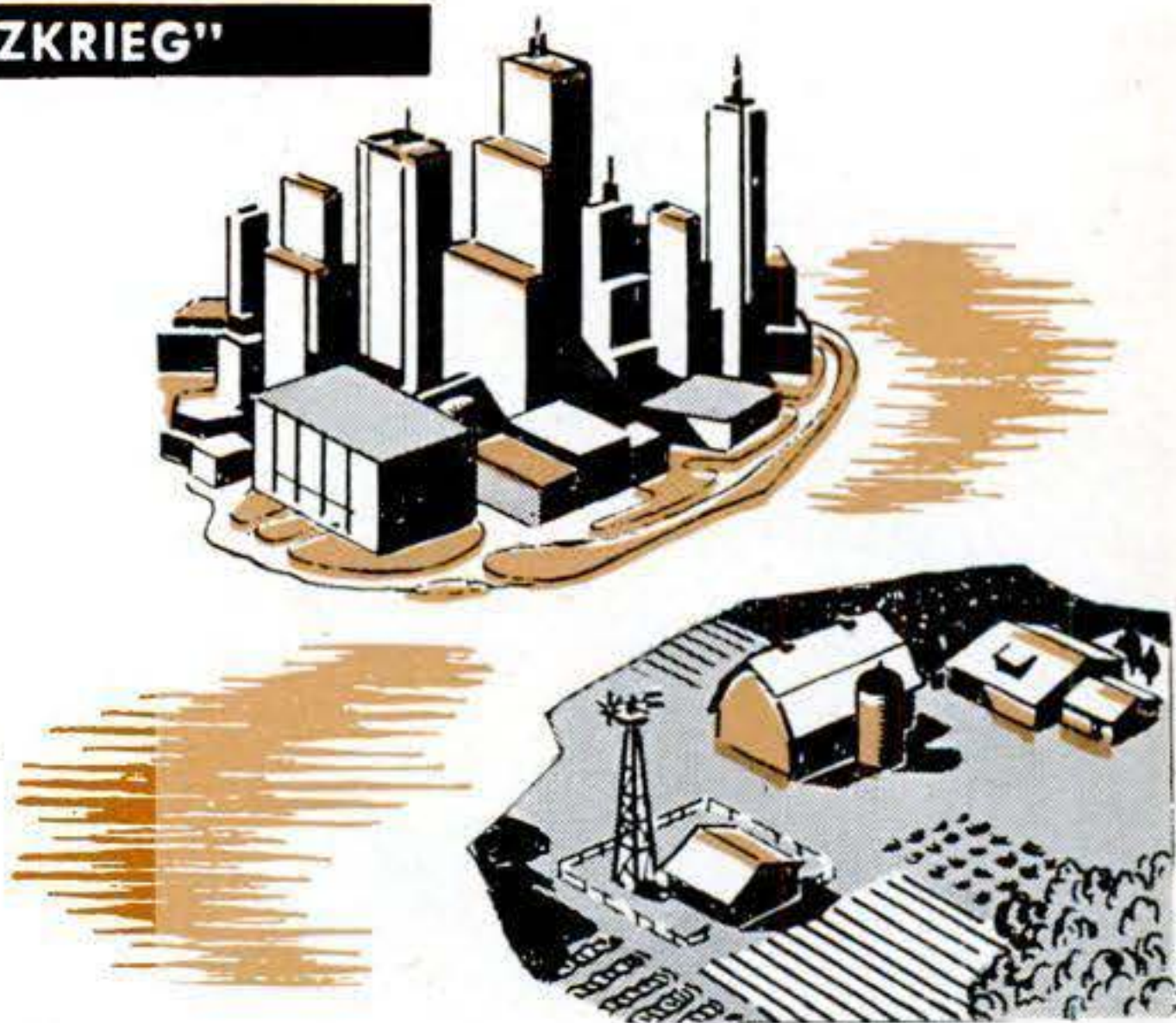


Glass "bombs," weighted to turn over in water, loose germs or toxin when burst by gas pressure generated as in inverted fire extinguisher.

OBJECTIVES FOR A "BACTERIAL BLITZKRIEG"



U. S. is setup for germ attack. Hitting only 33 key points would strike a third of country's population and paralyze half of our factories.



Great cities rank as top-priority targets for planes sowing human epidemics. Other types of germs can be used against animals and crops.

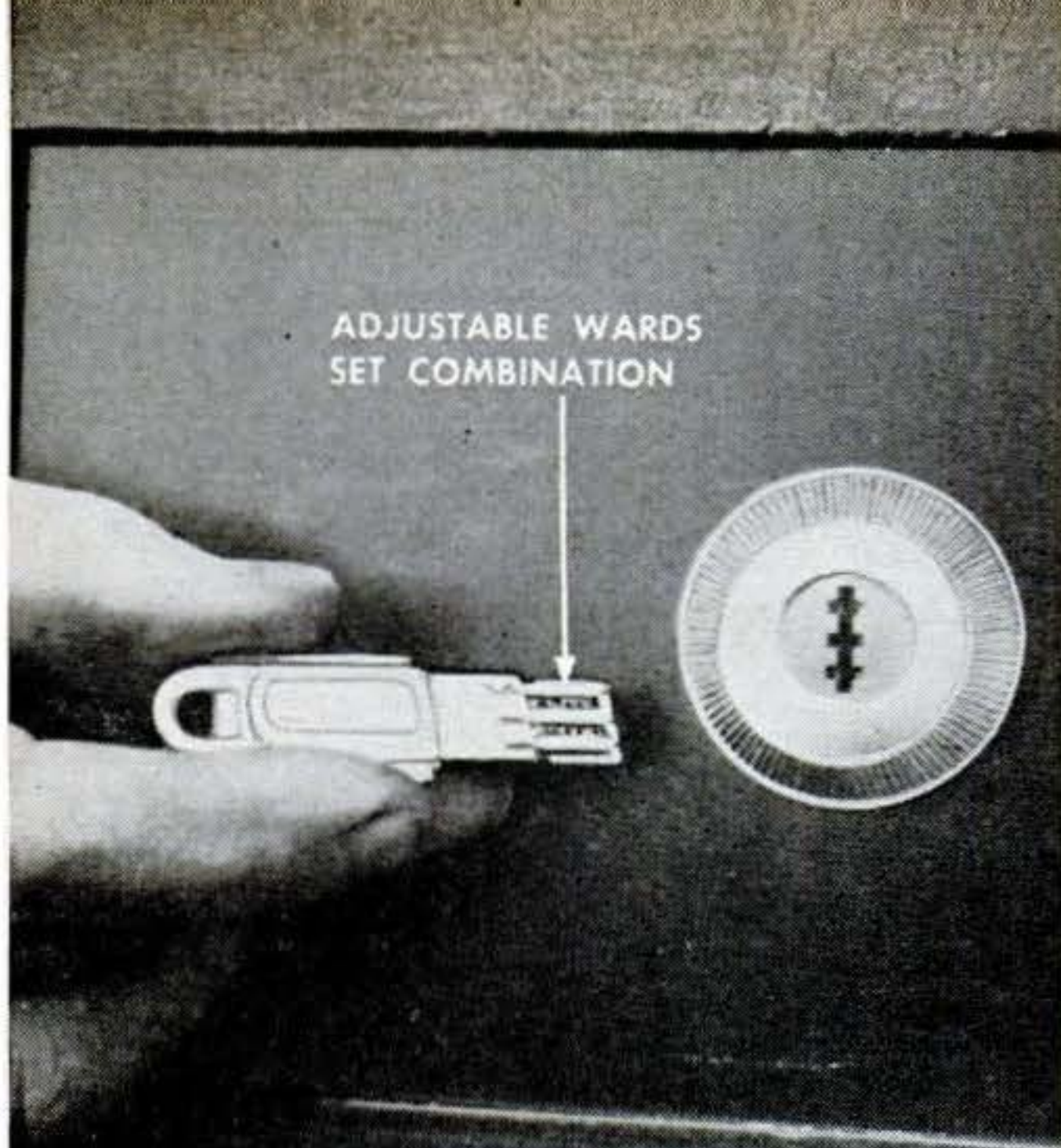
COUNTERMEASURES AGAINST GERM WARFARE



Specialists in diagnosing rare diseases, and experts constantly testing water supply on white mice, will lead defense against germ war.



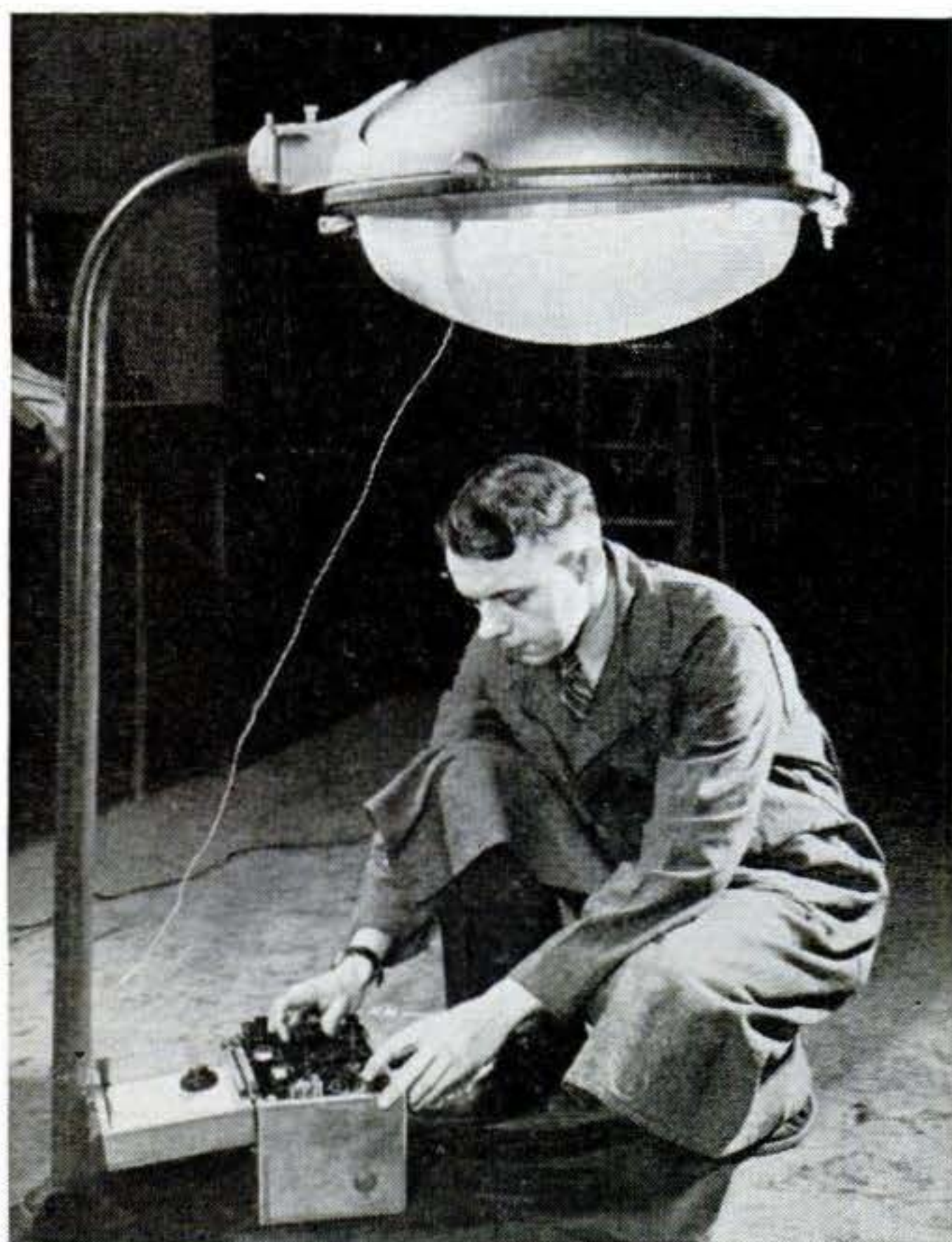
Decontamination squads must sterilize everything that falls from air—including enemy planes shot down, which may be germ-laden.



Key Uses a Code. Having at least a million combinations, this lock and key, developed by the British government and Scotland Yard during the war, is now being placed on the market. The key has six adjustable wards, and the code or combination is automatically changed by inserting the key in the lock.



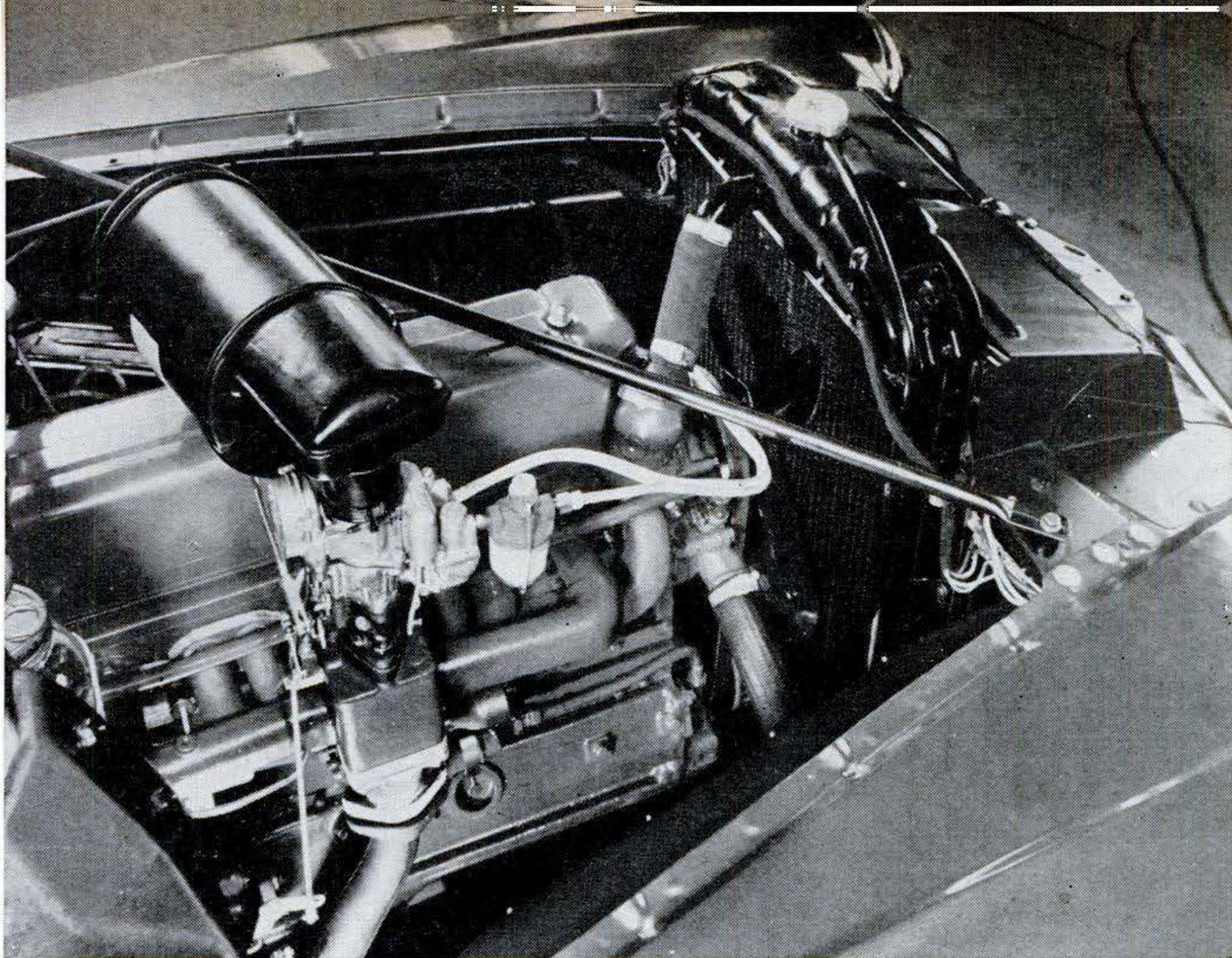
Conveyer Turns Corners. Taking advantage of the open network of a new wire conveyer belt, these doughnuts are drying on the way from oven to loading platform. Made by a U. S. Steel subsidiary, the versatile steel belt can turn corners without tipping, move a product up- or downhill, and even run in circles.



More Light for Highways. To lessen the hazards of night driving, this unit utilizes a powerful new 400-watt, 20,000-lumen mercury lamp plus its oval shape to throw a larger pattern of glareless light on the roadway. Resembling a two-foot long silver football, it was developed by Westinghouse lighting engineers.



"Black Light" Guards Freon. More delicate than chemical methods, this infrared light helps produce water-free refrigerants of the Freon type by detecting one part in a million of trouble-making moisture. The new technique, developed by du Pont, promises refrigerators that run 10 years without requiring service.



Under the hood of a stock car, this looks like any other engine. But it packs a compression ratio almost double that of present-day cars of equal power, burns 33 to 40 percent less gas.

Super Engine Cuts Gasoline Bills

Kettering's high-compression design saves on 100-octane—but don't look for it in new cars this year or next.

ENGINES and fuels that together cut gasoline consumption by one-third are possible today, so far as engineering goes. GM's famed Charles F. Kettering has built a high-compression engine that uses 100-octane gasoline. With it, he gets 26.5 miles to the gallon at 40 m.p.h., compared to 18.5 for a six-cylinder 1946 model of the same weight and power.


"Boss" Kettering warns, however, that there is no prospect of immediate production of the new engine. Overnight retooling by the auto industry is impossible—and so would be the conversion of the gasoline industry to a 100-octane product. The engineer hopes, however, that his experimental

model will point the way to the design of an engine in which the compression ratio can be increased from time to time with a minimum of retooling. In this way, successive models can be adapted to ever-higher ratios, while at the same time higher octane gasoline is put on the market.

Compression ratio of the experimental engine is 12.5 to one, almost double the 6.4 ratio of the standard type. This is made possible by designing it with great rigidity to withstand the added stress.

Kettering mounted his engine in a stock car for tests and reported that the economy was gained with no loss in smoothness or performance.

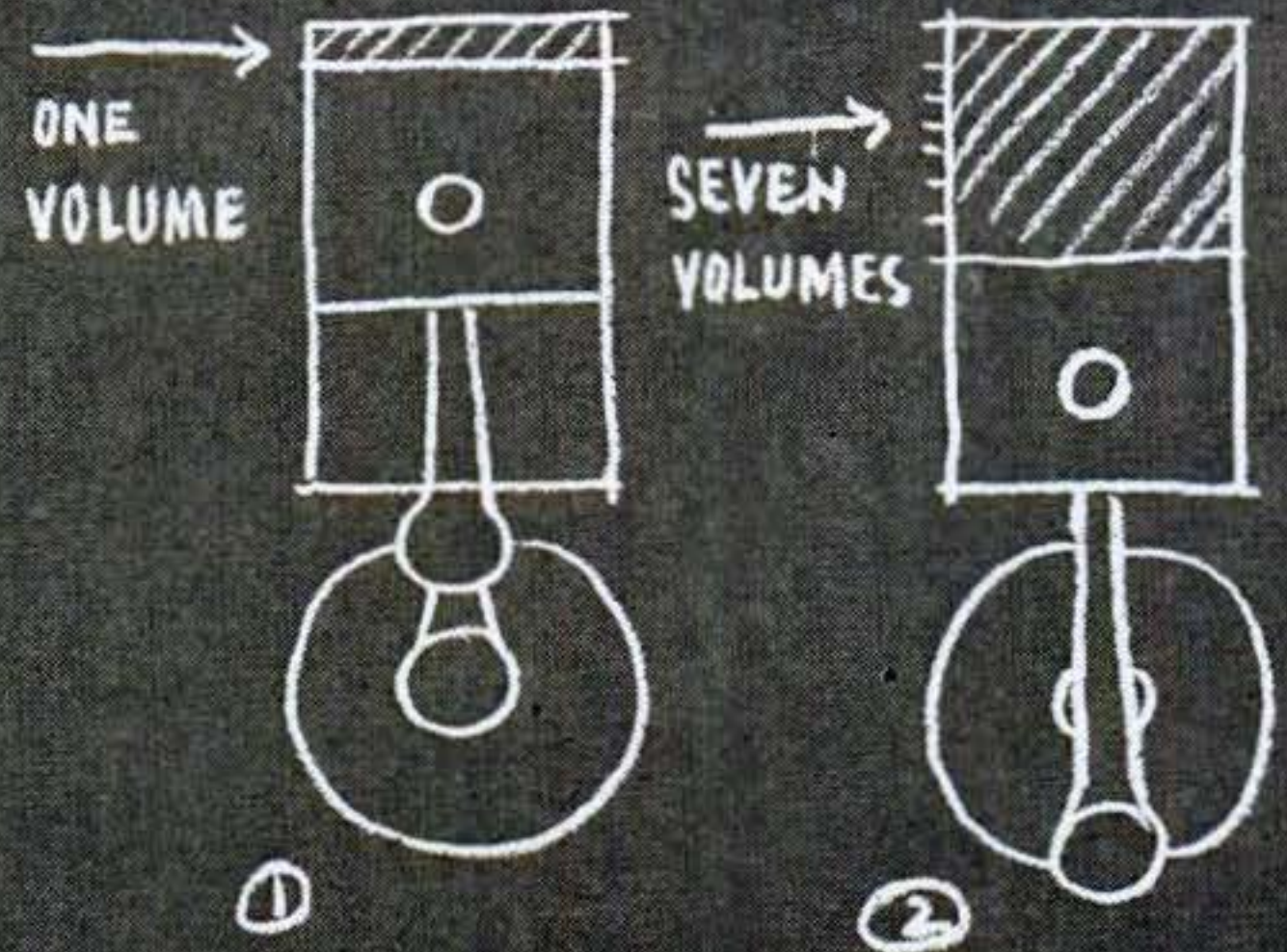
Kettering is now looking forward to the eventual use of triptane gasoline. If it comes, it will require ratios as high as the efficient Diesels—15 or 17 to one.

For a chalk-talk on what high compression means to you, turn the page. 

HIGHER COMPRESSION RATIO IS KEY TO RAISING EFFICIENCY AND REDUCING FUEL COST

HERE'S WHAT
"COMPRESSION RATIO"
MEANS!

- ① At upward limit of piston travel, fuel is compressed to minimum volume
- ② At downward limit of travel, exploding fuel expands to maximum volume



$$\frac{\text{MAXIMUM VOLUME}}{\text{MINIMUM VOLUME}} = \text{COMPRESSION RATIO}$$

(IN THIS CASE - 7 TO 1)

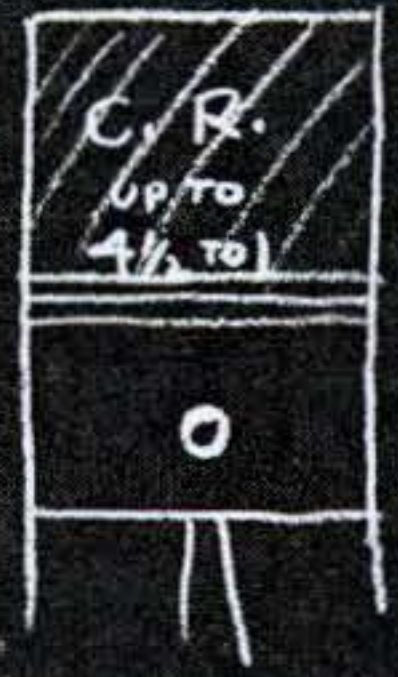
1. MODERN DIESEL ENGINE

The remarkable efficiency of the Diesel engine (up to 40%) shows advantage of high compression ratio



2. CARS OF 1917

Low efficiency of early gasoline engines meant high gasoline consumption



3. PRESENT-DAY CARS

Efficiency of 1947 gasoline engines (up to 25%) has reduced gasoline consumption by 1/3 saving motorists \$1,000,000,000 a year

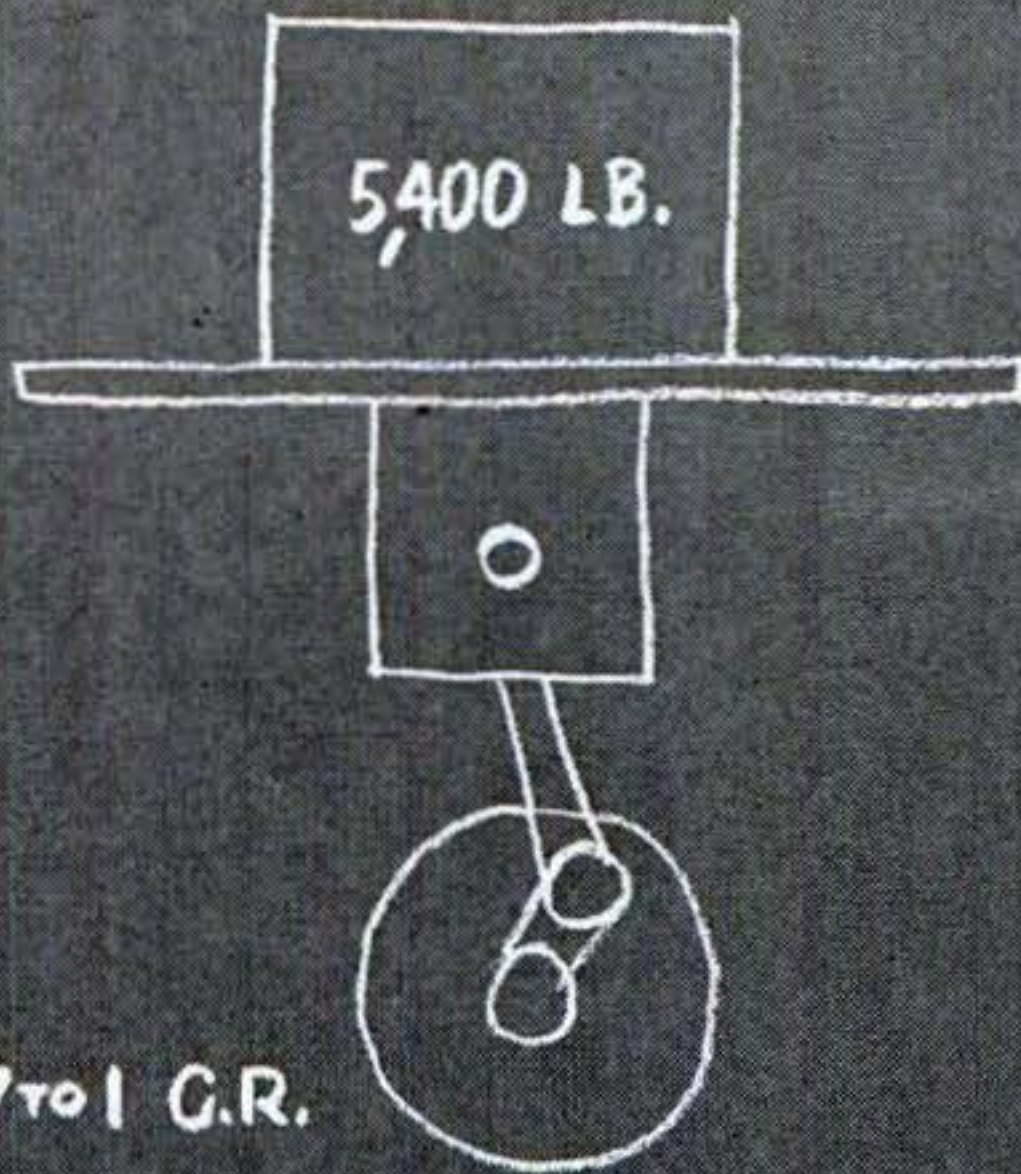


4. FUTURE CARS

Experimental motors indicate future efficiency up to 40% and only 60-67% of present gasoline consumption

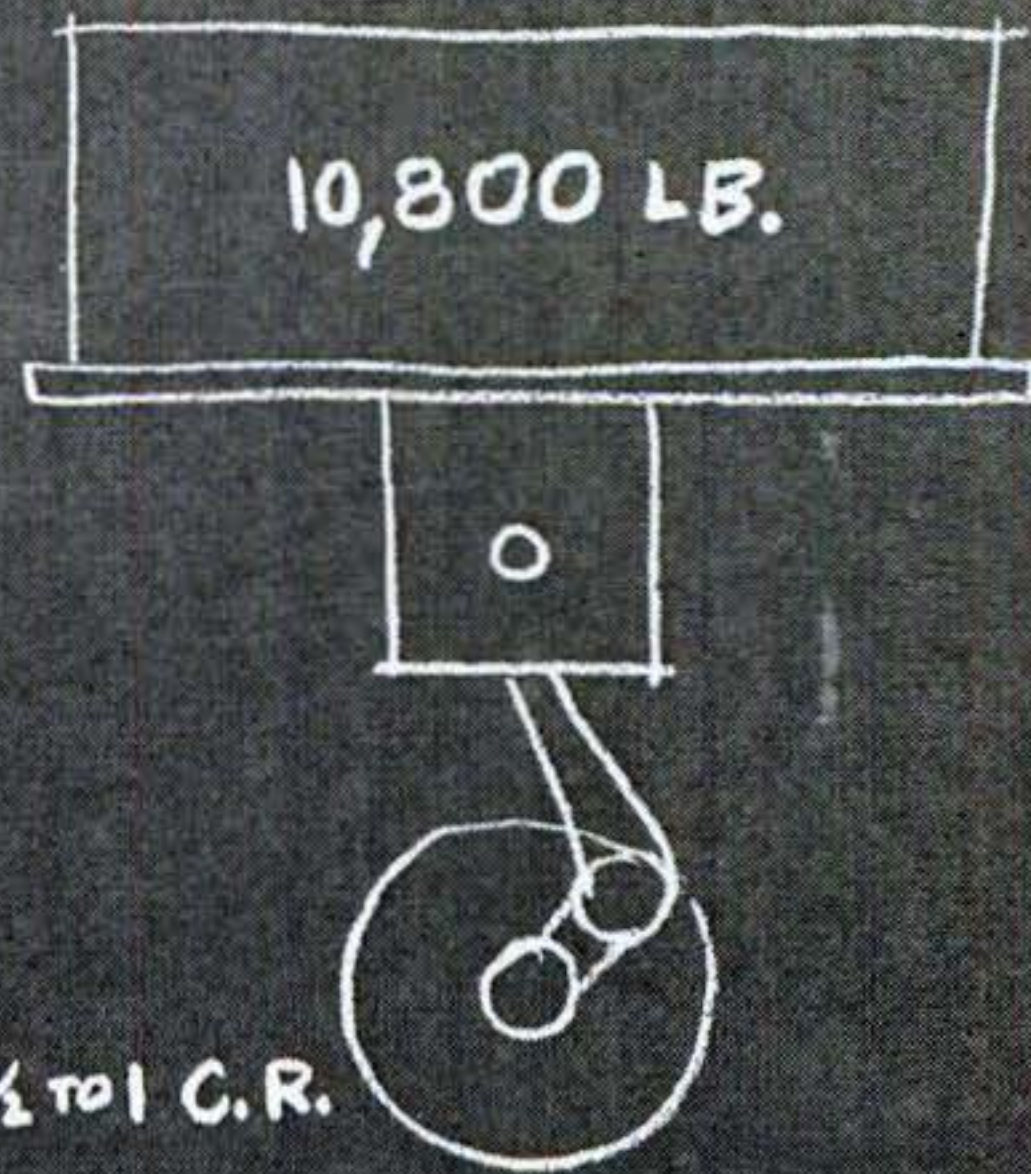


MOTOR PROBLEM IS ADDED STRENGTH



7 to 1 C.R.

Peak pressure on piston of auto engine with 7 to 1 C.R. reaches 600 lb. to square inch — equivalent to about 2½ tons



12½ to 1 C.R.

Peak pressure on piston of engine with 12½ to 1 C.R. will reach 1,150 lb., or a force of about 5 tons

FUEL PROBLEM IS PREVENTING KNOCK

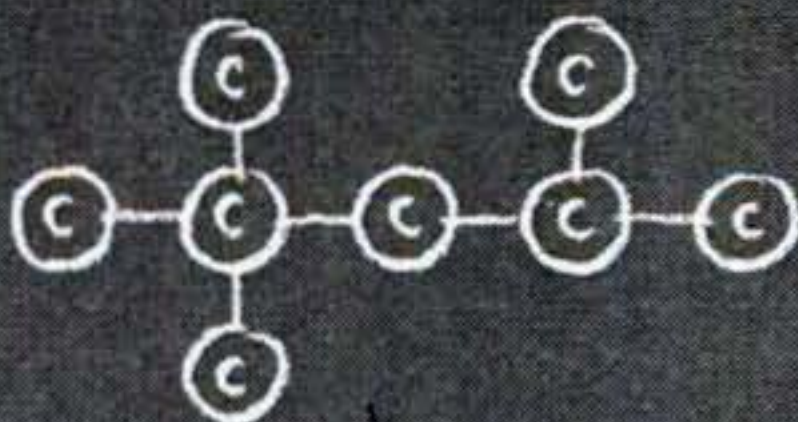
Fuel for proposed engines would not be required for the 30,000,000 cars on road today. Solution will probably be to make change to new motors and fuels gradually

1. HEPTANE



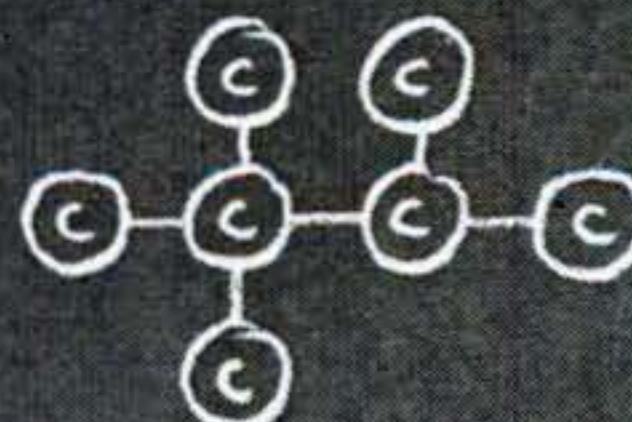
Long chain of carbon atoms in heptane (common gasoline ingredient) gives tendency to knock at high compression

2. ISO-OCTANE



More "bunched" arrangement in iso-octane fuel improves anti-knock characteristics

3. TRIPTANE



Compact atoms in triptane permit even higher compression ratios

Hams Are Radio's Vanguard

The amateurs, a rapidly growing clan, are still cooking up improvements for the industry they helped to create.

By George H. Waltz, Jr.

PSM Photos by Hubert Lockett

THE headlines that remind you of America's 80,000 radio hams are deceptive. You have seen them: "RADIO AMATEUR SENDS HELP TO FLOOD AREAS" is one, and "HAM SAVES PLANE CREW ON ICE FLOE" is another.

These news items, of course, are true, but saving the lives of stranded, desperate people is only part of the tremendous service for which everyone is indebted to the radio amateurs. They are the unsung explorers and conquerors of the electronic world, and the developers of its tremendously useful industries.

Such achievements have not been so spectacularly publicized. Yet even Marconi proudly spoke of himself as an amateur, and from the dots and dashes and tinkering of such "hams" as Lee DeForest, FM's Major Armstrong, and RCA's David Sarnoff, and

the thousands of hams who have followed them, have come our present-day high-fidelity broadcasting systems and our super-de-luxe, multiple-tube home receivers.

Without the hams, Fred Allen's voice would still be in a theater rather than in your parlor, and we would not know what rockets encounter in the far reaches of the atmosphere. The radio amateur, moreover, is still pioneering, still contributing, not only to radio and communications techniques, but also to the creation of a truly international fraternal understanding.

Who is the average ham? What is he like? What makes him spend a good portion of his spare time in his "shack," which may be anything from a corner of his crowded attic to an outbuilding in his back yard? How does he earn a living?

According to the latest cross-sectional portrait made by the American Radio Relay League—the hams' father confessor, guiding hand, and fraternal lodge—the ham is just a typical science-minded American. He is married, about 31 years old, and in what statisticians call "the middle-income bracket." Mentally, he leans toward mechanics and electricity. Socially, he is fairly gregarious. He likes people and he likes to talk—particularly to people in out-of-the

How the Hams Talk

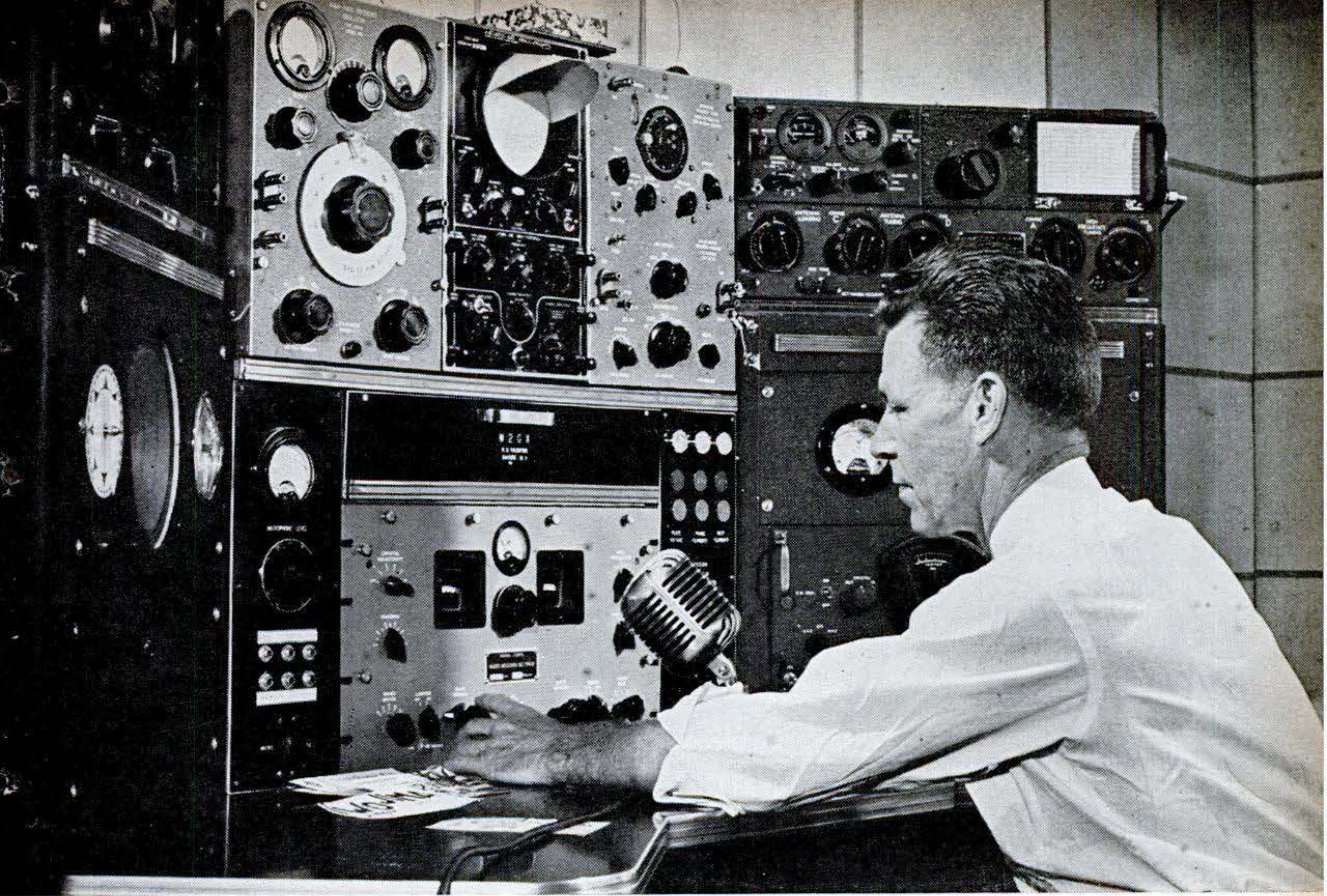
Amateur radio jargon is unintelligible to the average layman, but many of its terms are only a sort of telegraphic shorthand. For instance, a ham message might go something like this:

"W9YMV de W1PEK R ge om tnx fr cl. Thot ant bkn fr cld CQ 3 times wid nd. Ur sigs RST 599 hr Hrtfd Conn. Wx clr es cld. Xmtr hr 5514s in fnl wid abt 400 wts. Rcvr hr SX28A; ant is 3.5 mc folded dipole. Use xtal mstli but nw hv VFO. QTH? Hw? ar W9YMV de W1PEK K."

Freely translated, this would run as follows:

"W9YMV from W1PEK, your last transmission received OK. Good evening, Old Man; thanks for call. I thought my antenna

had broken, for I called the general inquiry call, CQ, three times without results. Your signals were perfectly readable, extremely strong and had purest direct-current note as received here at Hartford, Conn. The weather is clear and cold. The transmitter here is push-pull type 5514 vacuum tubes in the radio frequency final amplifier stage with about 400 watts input. The receiver here is a manufacturer's type SX28A; the antenna is a folded dipole dimensioned to resonate at 3.5 megacycles. I use crystal frequency control mostly but now have a variable frequency oscillator. What is the location of your station? How are you receiving my signals? End of message. W9YMV from W1PEK. Go ahead with your answer."



Like many hams, Russell Valentine finds it hard to tell where business stops and hobby begins. Chief engineer of New York's WQXR, which he

has built and rebuilt more than 10 times, he has no trouble in giving his ham rig, W2GX, a professional look—as its control panel testifies.

way places. His wife is at least mildly tolerant of his pastime; many wives become so enthusiastic that they, too, acquire amateur licenses.

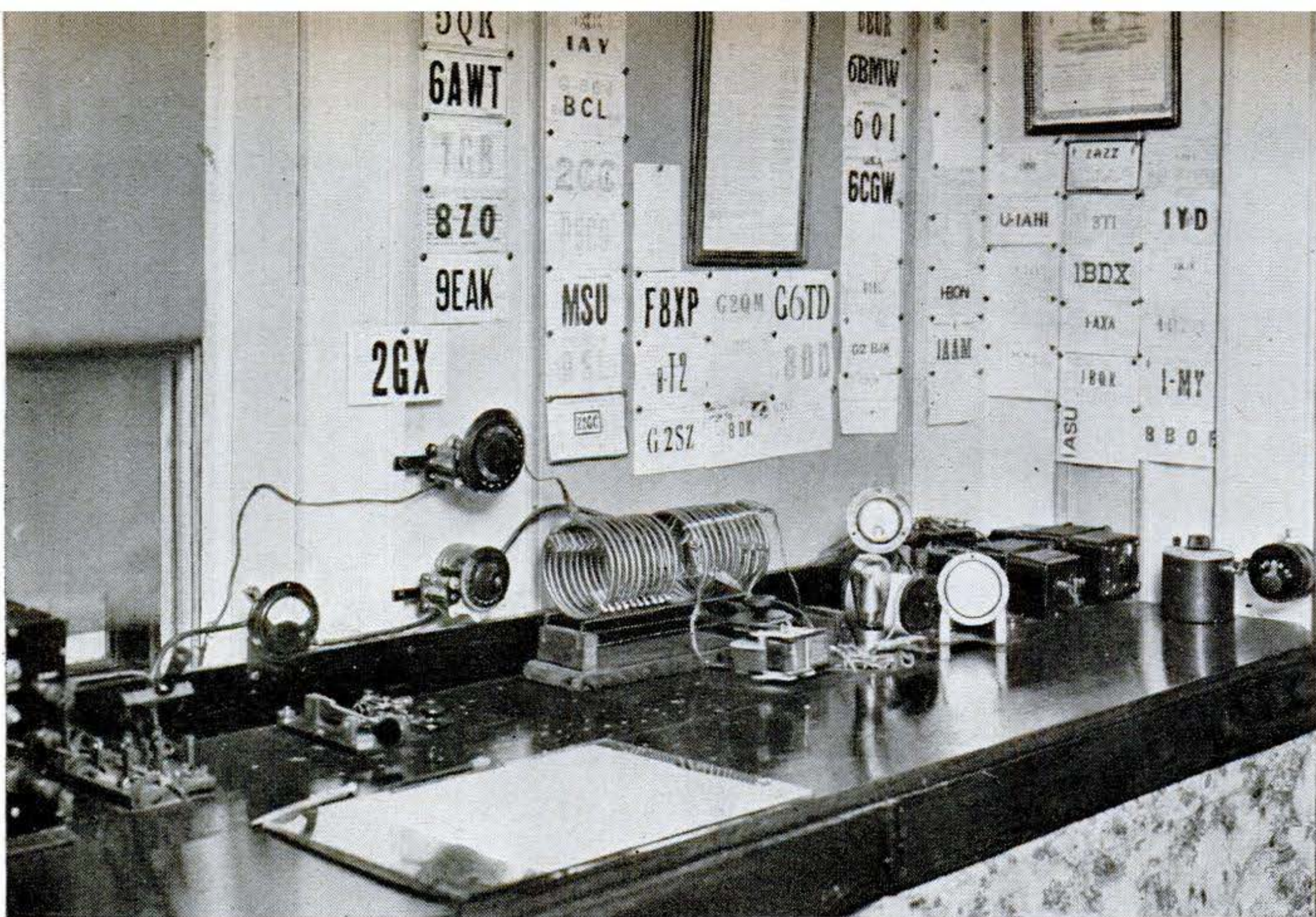
Significantly, the ham is a tinkerer, an experimenter. His station represents an investment of about \$400, and he spends about \$150 a year to keep it operating and up-to-date. His receiver is probably factory-made, but his transmitter is apt to be pretty much a product of his own know-how.

He averages about 96 minutes a day on the air. Of this total, 38 minutes go for normal "over-the-back-fence" gossip with other hams ("ragchewing," he calls it); 26 minutes are spent contacting stations that are a long distance away (DX); 20 minutes go for trying out new experimental rigs and equipment; and 13 minutes are taken up with "traffic," or relaying messages from one corner of the globe to another.

If the radio ham has a second hobby, it is likely to be photography. The Morse code and camera-toting seem to go together. Nobody knows why.

The ham's job is likely to be in some branch of the electrical or communications industries. At last count, a check of executive positions in the radio industry showed that 45 presidents, 16 vice-presidents, 5 general managers, 69 managers, 37 owners, 324 engineers, 19 announcers, and 11 directors had started out in their own ham stations. In one of the largest broadcasting stations, nearly all of the operators and engineers are licensed amateurs. About nine-tenths of all the broadcasting engineers and operators in the country are, or have been, amateurs. In radio manufacturing, the figures are similar.

To those of us whose main interest in radio is twisting a dial or pushing a button to hear a comedian, a ball game or a newscast, this wedding of full-time business and spare-time hobby is important. It is a union that has brought, and will continue to bring, many advances in radio and electronics. Because the ham is a born experimenter, and generally not hampered by the preconceived ideas of the experts, he often



Back in 1923, Valentine's "shack" looked like this. The array of QSL cards, acknowledgments

from stations with which he had communicated, typifies DX efforts by amateurs, then and now.

attacks problems that far more learned men have thought unsolvable. Sometimes he solves them.

Nothing illustrates this better than the early history of amateur radio itself. In 1912 there was a great clamor among the commercial operators to limit the upstarts who called themselves amateurs to specified frequencies. On Aug. 17, President Taft signed the Alexander Bill, which provided for the licensing of all ham stations and operators, limited them to 1,000 watts of power (a ruling still in effect), and confined them to a wave band of 200 meters. The 200-meter band and any of the shorter wave lengths then were considered worthless for communications.

The amateurs, however, not only found a way to make good use of the "worthless" 200-meter band, but also helped to pioneer the way into the shorter and shorter wave lengths—the ultra ultra-short waves. In 1912, head-wagging theorists thought that a radio wave that measured as little as 200 meters (a little over a tenth of a mile) from crest to crest was useless, but radio amateurs today are playing successfully with tiny wavelets about .06 of an inch long.

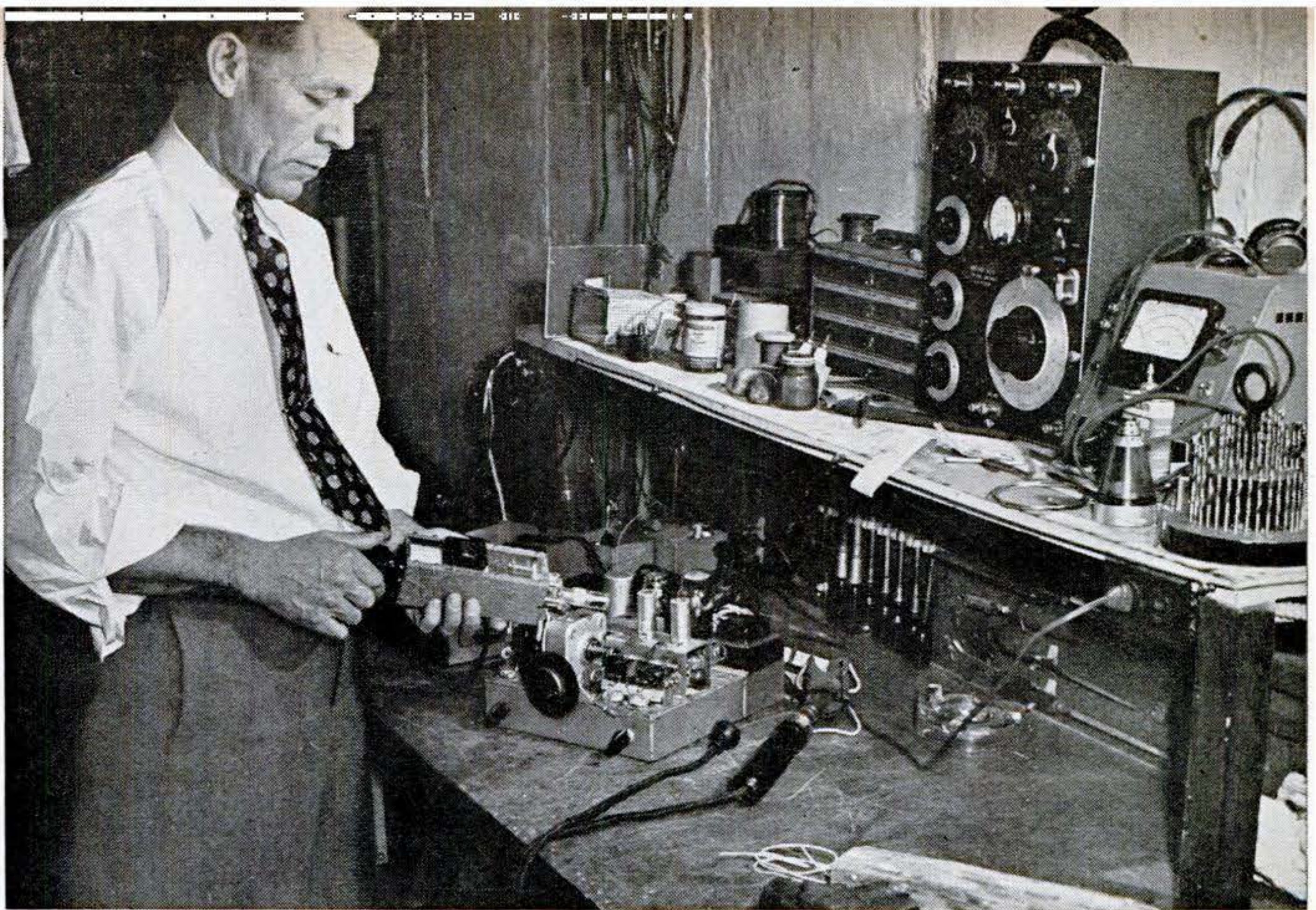
Relegated from the beginning to the shorter waves and the higher frequencies, the radio ham has made the most of them—a

fact that opened the relatively new and valuable fields of radar and microwaves. The future of the microwaves—the shorter and still shorter wave lengths—should be watched, and you can bet your radio-phonograph combination that the amateur is watching—and what's more, experimenting. Microwaves provide a region for communication far wider than that of all the other wave lengths combined.

There's a Ham Behind It

Find some new radio development and you will find at least one ham or ex-ham mixed up in the maze of wires and tubes. Not long ago, for example, the Army announced that it had bounced a radar beam off the moon. Four out of the five experts operating the Army's equipment in that test were hams. The lieutenant colonel in charge of the project had attempted a similar experiment with homemade equipment in his own ham station down in Tennessee some years before!

It is seldom that a single radio amateur's name is attached to a new radio development. There have been exceptions, of course, such as the perfection of the radio noise eliminator by James Lamb, a ham who later did a great deal toward developing the television guided bomb. On the whole,



Hams are a creative bunch. Valentine holds "grid dipper" made by W. M. Scherer (W2AEF)

to measure resonant frequencies. Black cabinet on shelf is a hand-made impedance bridge.

however, the ham's contribution to radio is made on a teamwork basis. A good portion of that 38 minutes a day that the average ham spends in chewing the rag on the airwaves is spent talking to other hams about what he found out during his daily average of 20 minutes of experimenting. In this way, no ham's idea is ever completely his own; it's a group achievement.

The National Bureau of Standards in Washington makes good use of this tendency whenever it has a broad radio-testing project. By mustering amateur observers, the Bureau has a large reservoir of first-rate, widely scattered monitoring stations to help study what happens to radio reception during solar eclipses, or investigate the skip effect in short-wave transmissions. Each participating amateur spends specified hours listening in on assigned frequencies and forwards his reports to Washington. How else, except for the amateurs, could such large-scale, nation-wide research be carried on? Not even the largest commercial research organization could afford the cost if the thousands of monitoring stations had to be built and manned by salaried employees.

During the war years—from December 8, 1941, to August 21, 1945, to be exact—the ham, as such, was off the air. His "shack" was closed and his frequencies were taken

over by the War Department. He wasn't silenced, though. About 26,500 U. S. hams served with the Armed Forces (17,700), the Merchant Marine (900), Civil Service (3,600), and in industry (4,300). And along with the hams went many of their cherished receivers and transmitters.

Reconnaissance — with Cash

War caught the Signal Corps without much in the way of modern communications equipment. Many of its transmitters had seen service in World War I. Where could a supply of modern rigs be obtained quickly? The radio manufacturers could not meet the demand immediately. The one answer was the amateur. With the aid of the American Radio Relay League, caravans of Signal Corps trucks, each carrying an officer armed with a pocketful of money, spread out across the country. Pulling up in front of a ham's house, the officer would pay off in cold cash and stow another up-to-date transmitter or receiver in his truck.

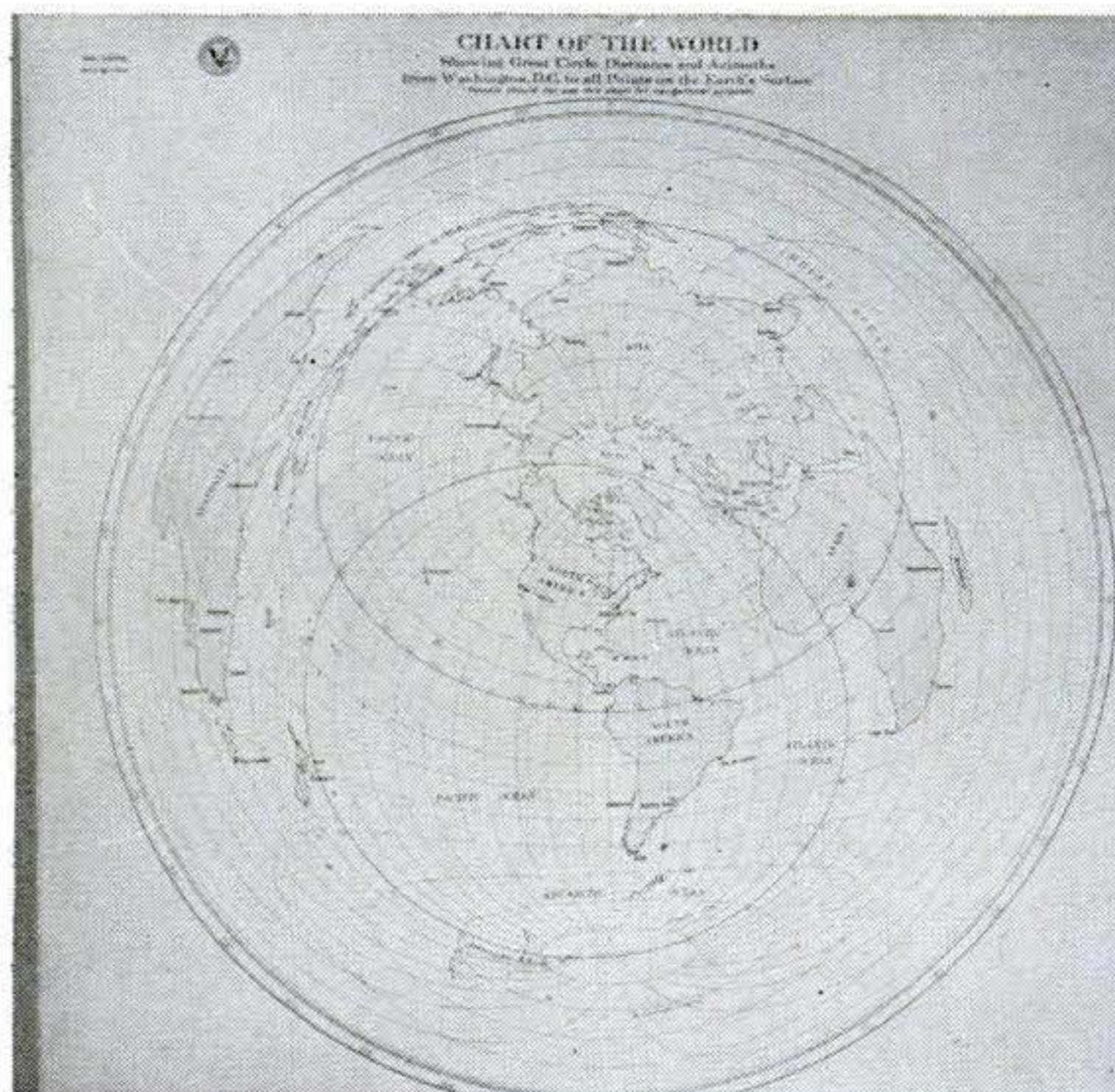
The story is told about one amateur who sold his receiver to the government in this way and not long afterward was drafted and assigned to the Signal Corps. When he reported to his field station in North Africa, he took one look at the equipment and gulped. There stood his own receiver, with

his amateur call letters painted across it! Since the war ended, the ranks of the hams have grown considerably, and the rate of growth is increasing. According to the latest figures available, some 1,000 new licenses are being issued every month. At the war's beginning, there were approximately 60,000 amateurs in the U. S. Today's count shows upwards of 80,000, and 250,000 are forecast in five years.

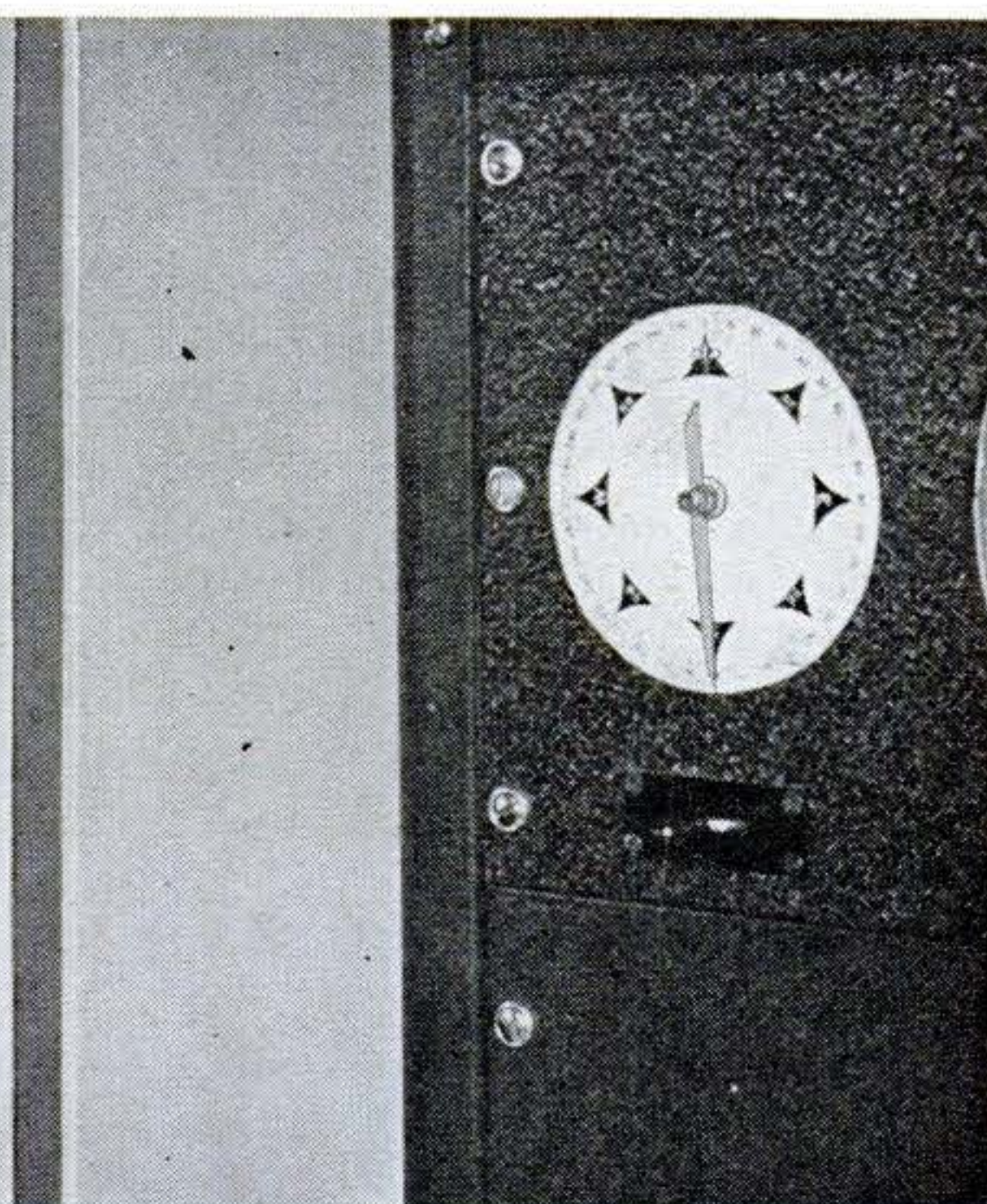
That should be a good omen for radio. With three times as many amateurs, there are sure to be a larger number of new developments. But it goes farther than that. With 250,000 American hams chewing the rag with about 25,000 foreign hams, there should be a better meeting of minds on a good many subjects besides radio. You can't call a man OM (ham language for "old man") and end up with 73s ("best regards") without feeling pretty friendly. National and military barriers are harder to overcome than geographical ones—contact with Russian amateurs still is a rarity, and there aren't many hams in an occupied zone—but the gregarious, information-sharing ham is on the right track. **END**



Mounted in a tree over his Bayside, N. Y., home, Valentine's directional antenna can be rotated by a switch on the control panel to aid signals.



Long-distance work is more than luck. A world map and a compass rose, above the antenna



direction switch, help Valentine find the most favorable radio path to any point on the earth.

This Month's Pin-up

NORTH AMERICAN'S XB-45, powered by a quartet of General Electric J-35 jet engines, is one of several multiple-jet bombers being tried out by the AAF. Sleekly streamlined

for extremely high speeds, the plane carries its engines in two twin-unit nacelles that project well forward of the wing. Length is 74 feet; wing span, 89½ feet.

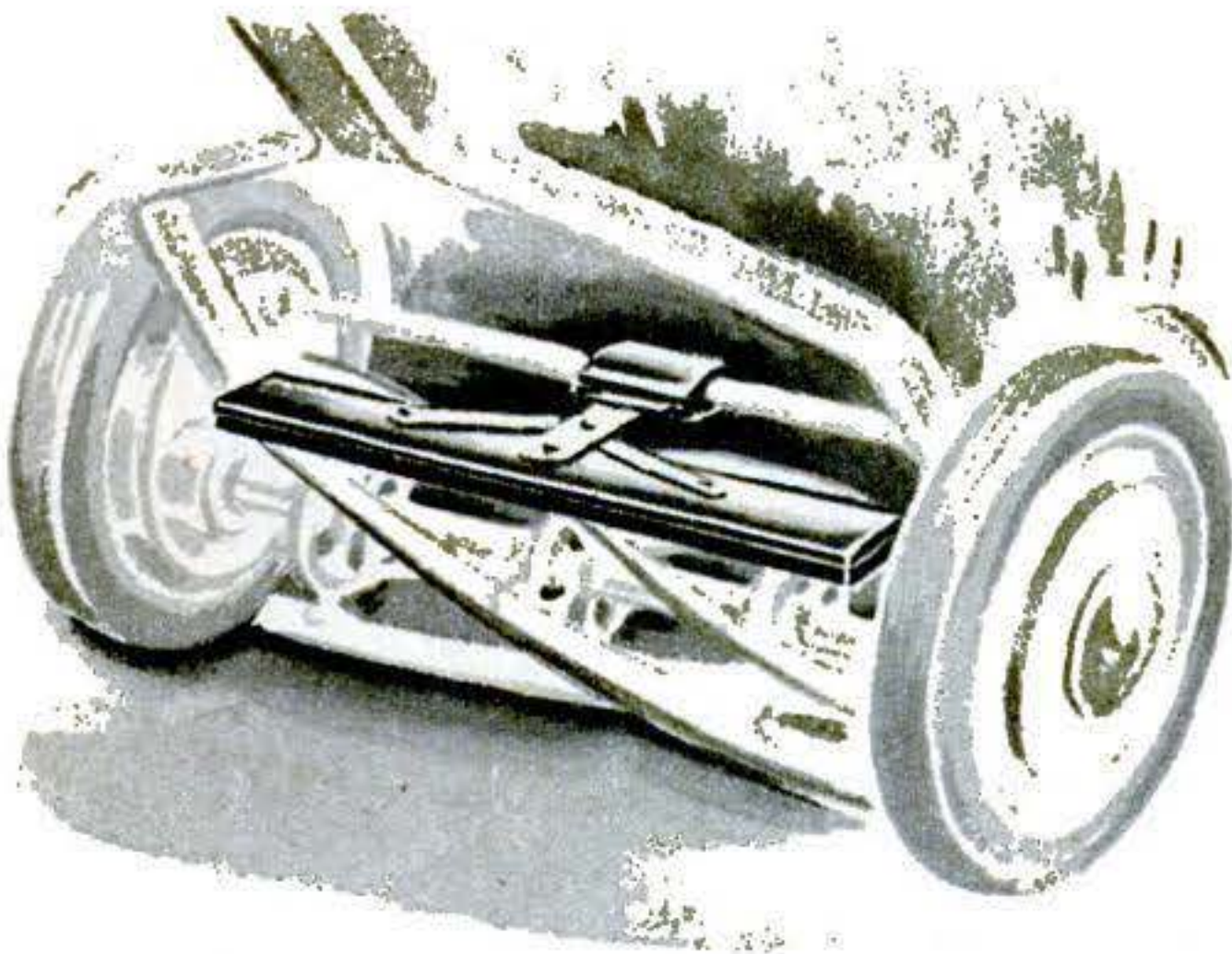


NEW IDEAS
from the
INVENTORS



Fire Trucks Spread Life Net. A life net that can operate virtually unattended, releasing valuable fire-fighting personnel for other duties, is the invention of George

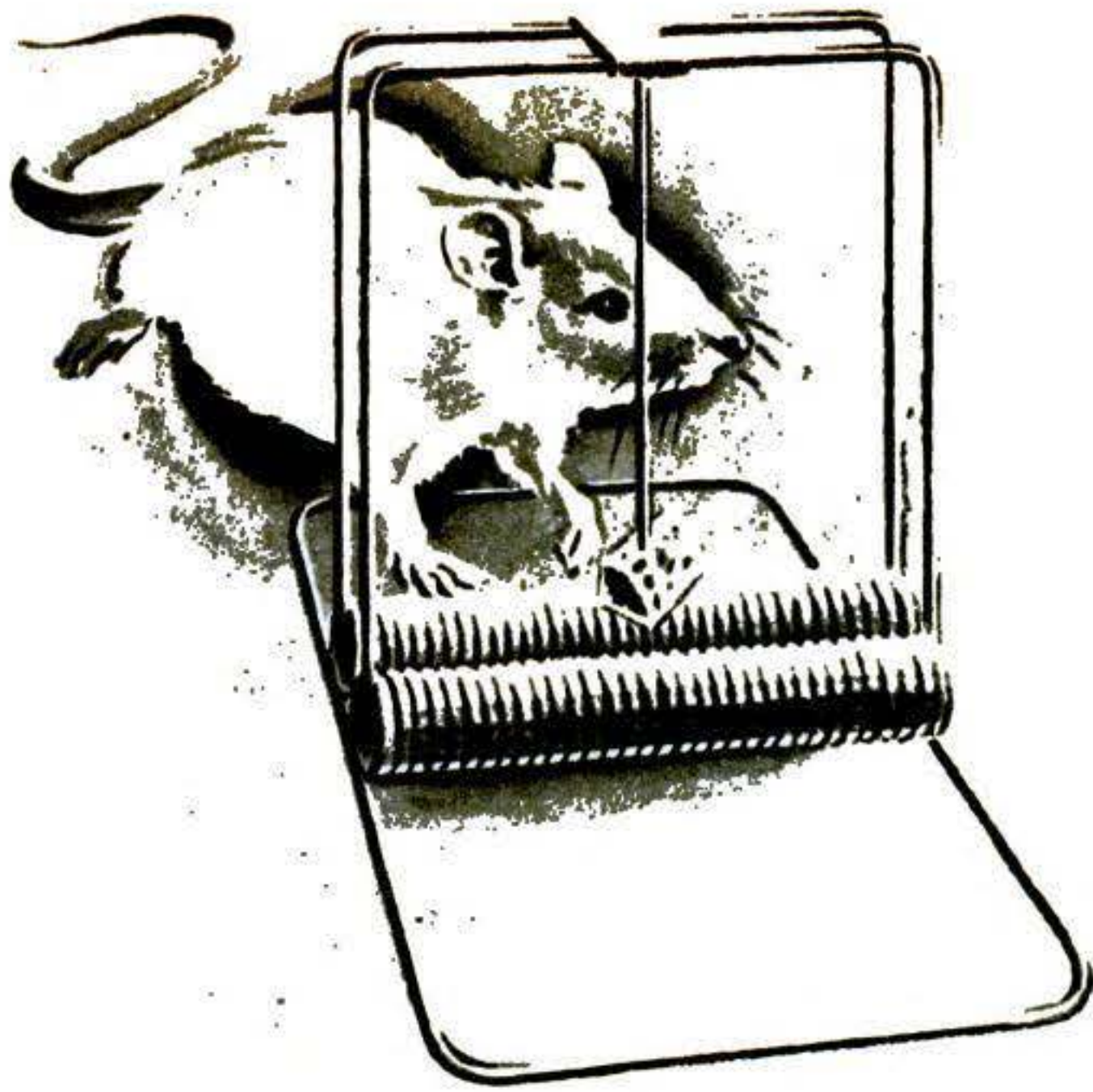
Bauerlein, Sr., of Talladega, Ala. Stretched between two fire engines, it is wound on square poles that cannot slip once the net has been pulled taut.



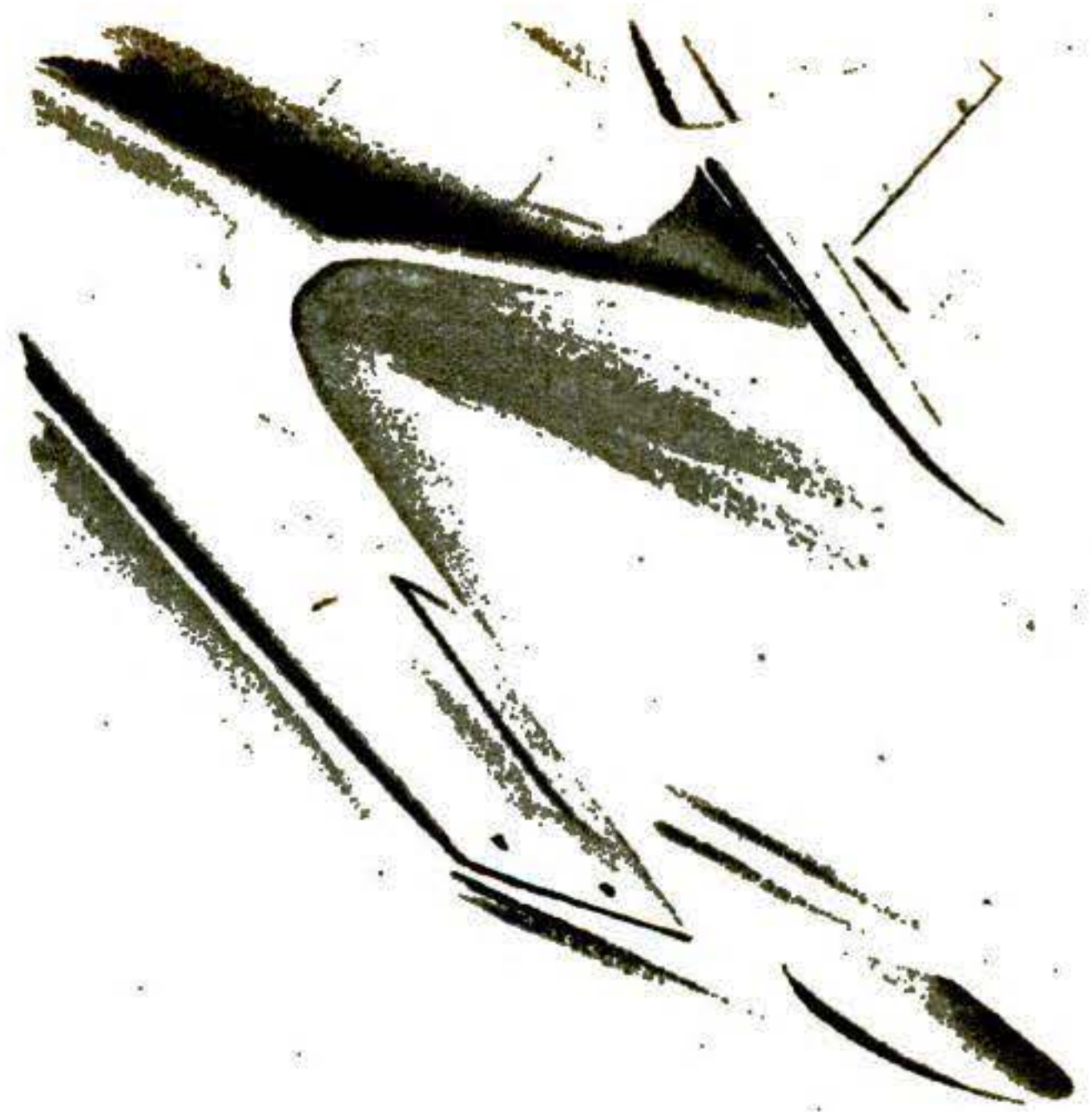
Lawn Mower Sharpens Itself. You won't have to stop in the middle of cutting your lawn to put a fresh edge on the mower blades if an invention of Theodore Brien, of Cherry Valley, N. Y., is put into use. This device is designed to clamp onto the mower's guard bar and hold a long strip of abrasive material against the blades as they turn. You just keep cutting, and the blades sharpen themselves at the same time.



Pilot's Aid Measures Maps. A computing instrument for pilots that shows flight time and distances by simply rolling across a map has been patented by Franklin Reece, of Brookline, Mass. To find the time necessary to travel between two cities, you set it at your speed, roll it along your course on the map, and then read the result directly. The instrument will also tell how far you can go in a given time.



Two-Way Trap Leaves No Exit. Built like two traps set back to back, this double-spring rat-killer is calculated to catch the wariest rodent no matter on which side he stalks the cheese. Its inventor, William Hayden, of Bryn Mawr, Pa., claims also that its wire base has more mouse appeal than wooden ones and is easier to keep clean.



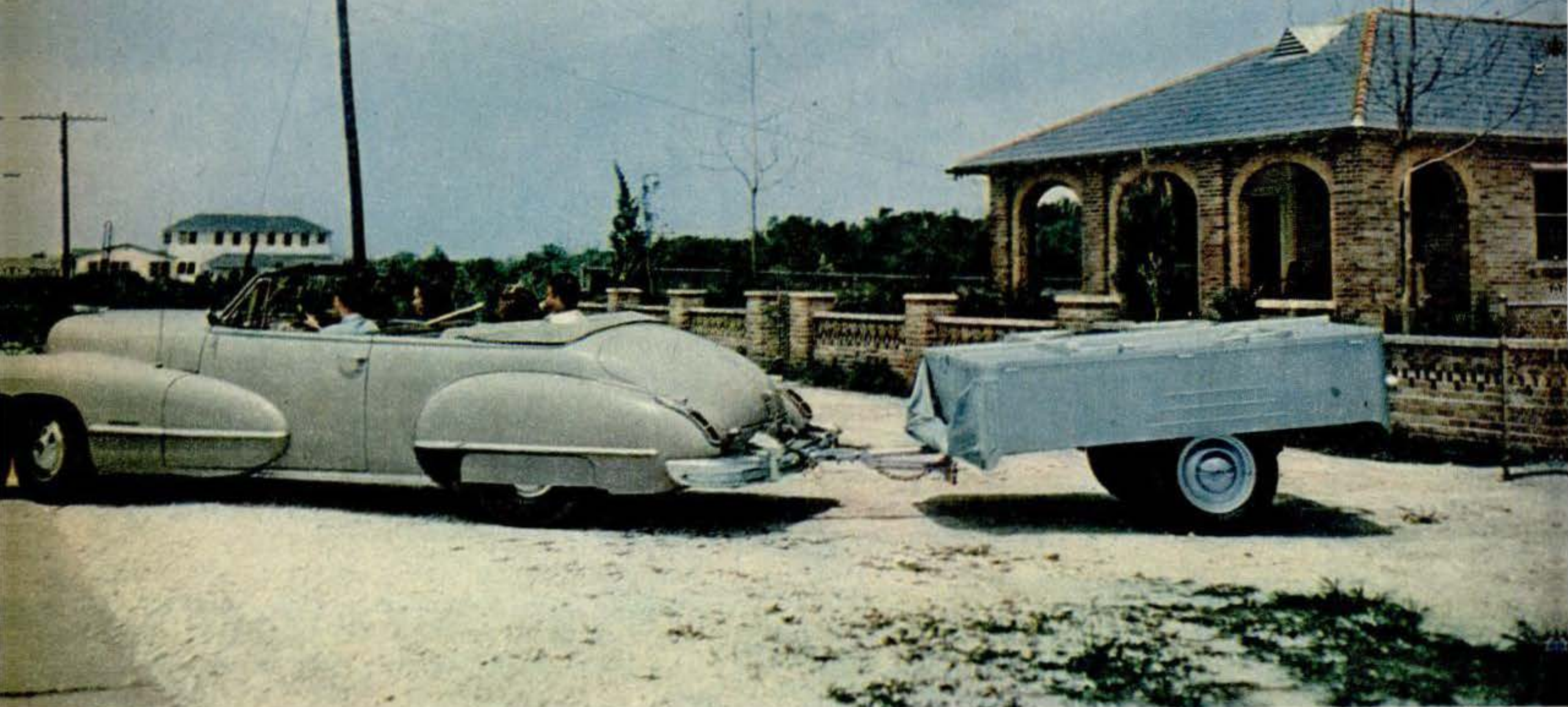
Tank Forms A Wing Tip. To replace the external type of auxiliary fuel tank, Myron Lerche, of Hilbert, Wis., has invented a tank that forms part of an airplane wing, eliminating drag and contributing to the lift. The tank is jettisoned when empty, by means of a cockpit control, leaving a finished wing tip where it was fastened.



Propeller Does Rudder's Work. Like an outboard motor, this steering assembly for inboards combines rudder and propeller in a single unit. A universal joint in the propeller shaft plus a ball and socket (inset)

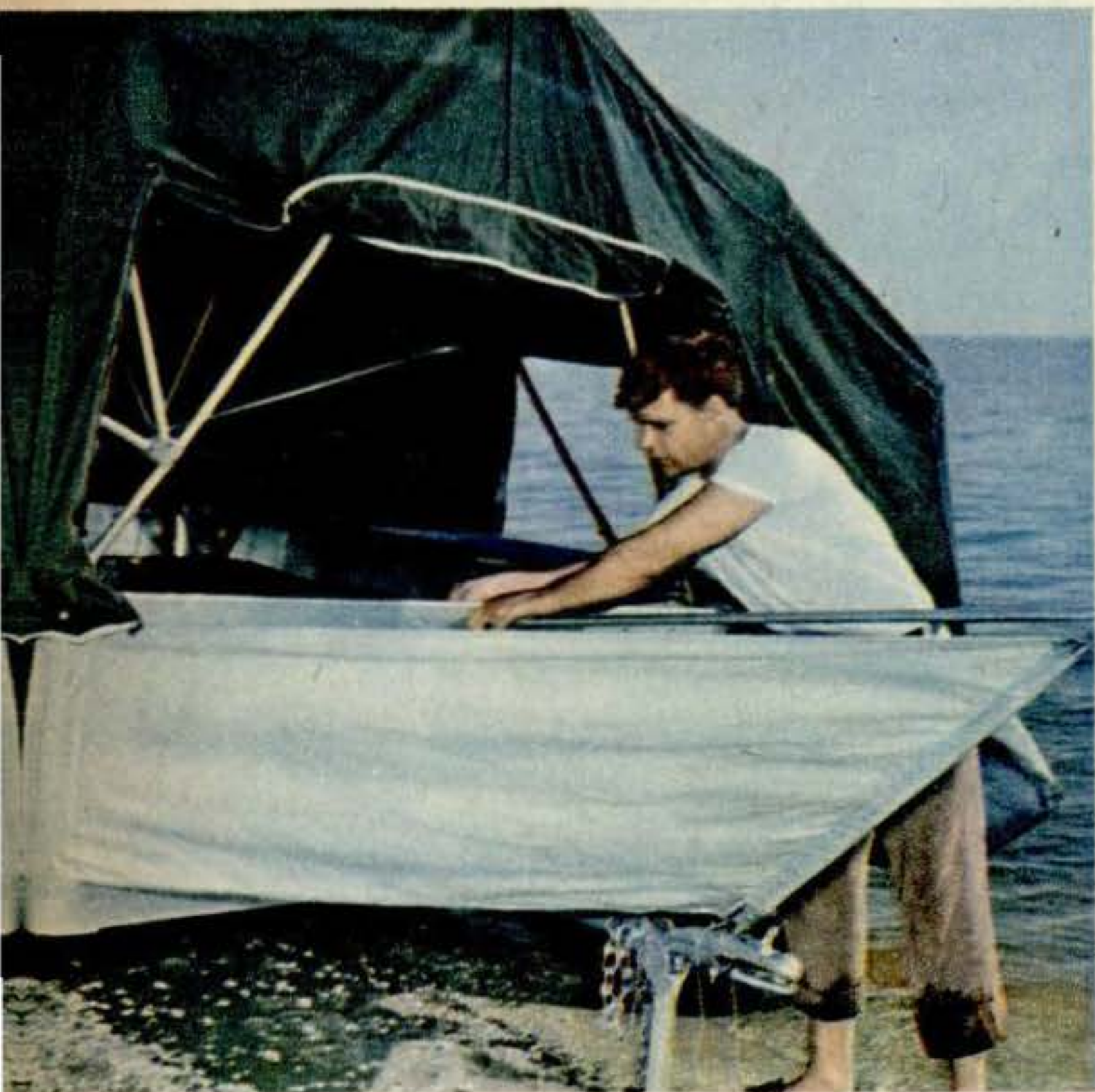
allow the whole assembly to move freely in all directions. A vertical fin protects the propeller, while a horizontal one keeps it at the proper depth and angle. It is patented by Brett Law, of Merced, Calif.

Trailer Becomes Pleasure Boat



Here's a trailer that goes to sea. A new development in camping equipment, you can take it anywhere your car or an ordinary boat can go. It is like any small auto-towed, two-wheeled trailer when on the road, but can be converted in a few minutes into a

canopied, pontooned raft when you hit the beach. It operates under its own power with the aid of a small outboard motor and, for even faster travel, can be towed by a speedboat. When you reach your camping place, you just haul it ashore and use it as a tent.



A separate bow, formed of canvas over a metal frame, increases speed and maneuverability when craft is towed or propelled.



Stability of the wide-set pontoons is so great that all aboard can concentrate their weight on either side without danger of capsizing.



Its pontoons pumped full of air at a nearby gas station, the amphibious trailer begins to take shape. Next, the top will be opened out like a double door over the rubber-lined, canvas air bags, increasing the width of the usable space to about 12 feet.

With the erection of its tentlike top, the transformation from trailer to boat will be nearly complete. Made by Higgins, Inc., the 10-foot-long, 829-pound all-aluminum raft sleeps up to four on bunks equipped with air mattresses and can sleep six.



To make the most of the weather, the flexible covering is adjustable to let in the sun or keep out the rain as desired. In addition

to compartments for ice, food, clothing and equipment, there is also space for a table large enough to seat four or five persons.

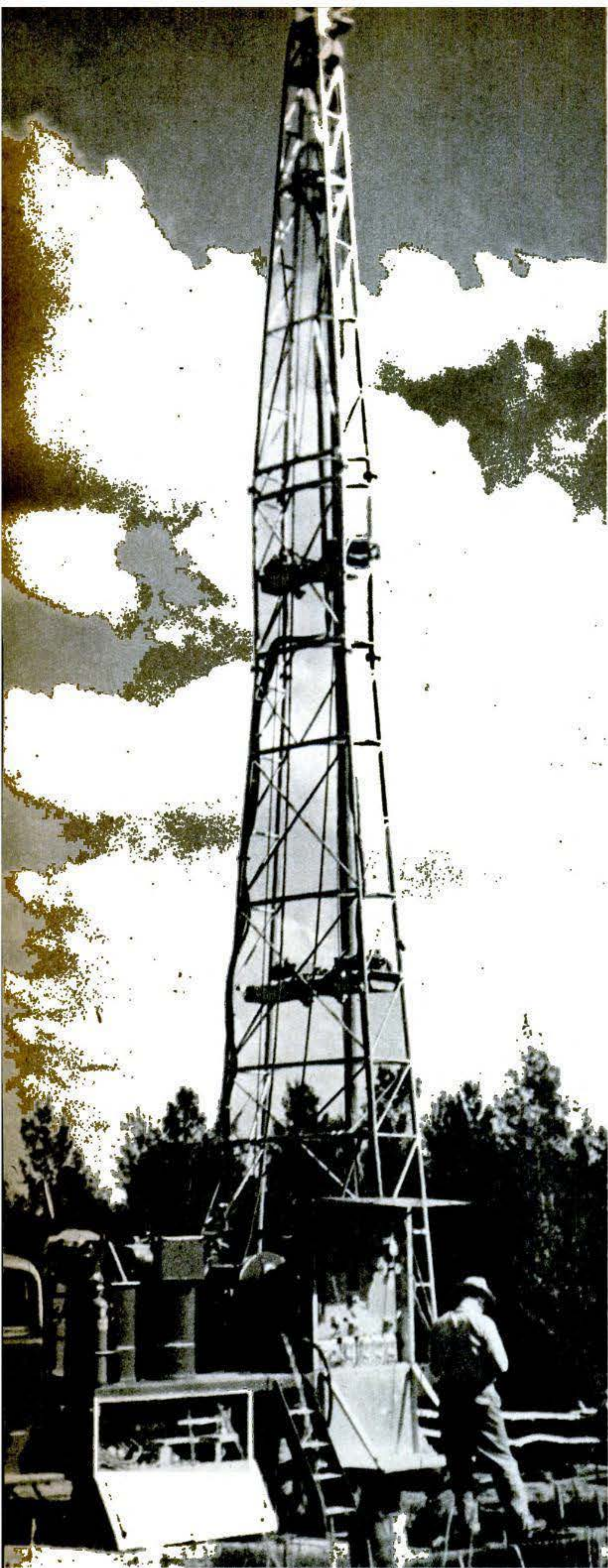
Mining with

Flame-piercing process helps iron miners by melting charge holes for explosives in obdurate ore.

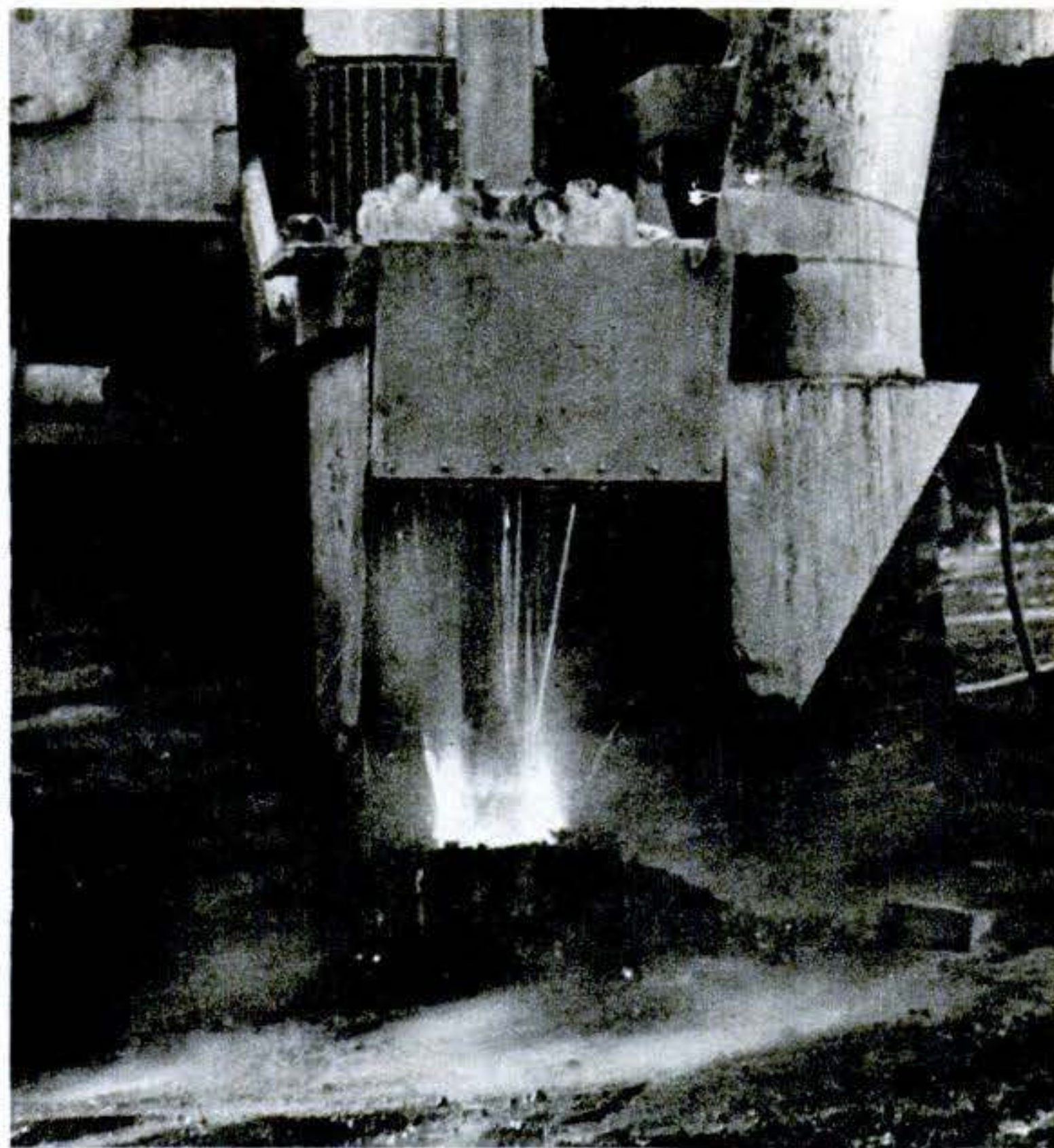
A 4,000° flame is opening up large new areas of native American iron ore.

Literally melting the rock, this revolutionary fusion-piercing method makes six-inch blast holes 10 times faster than drilling. This high speed makes it profitable to work the very hard iron ore (taconite) deposits in northeastern Minnesota. Too hard to be mined economically with ordinary drilling methods, these ores are an important future supply of iron.

A high-temperature flame from a rotating blowpipe is directed against the surface of the rock. This flame is fed by oxygen and a flux-bearing petroleum base fuel, which emerge from separate openings in a multiple-port burning tip. The flux-bearing element is important, reducing the melting



Experimental fusion-piercing gear set up ready for test run. Oxygen is supplied by cylinders on truck at left. In commercial model, one man can control operation.



Blazing tip of blowpipe begins to burn through rock. By means of winch, operator adjusts lowering of blowpipe to piercing speed, which depends on hardness of rock.

a Blowtorch

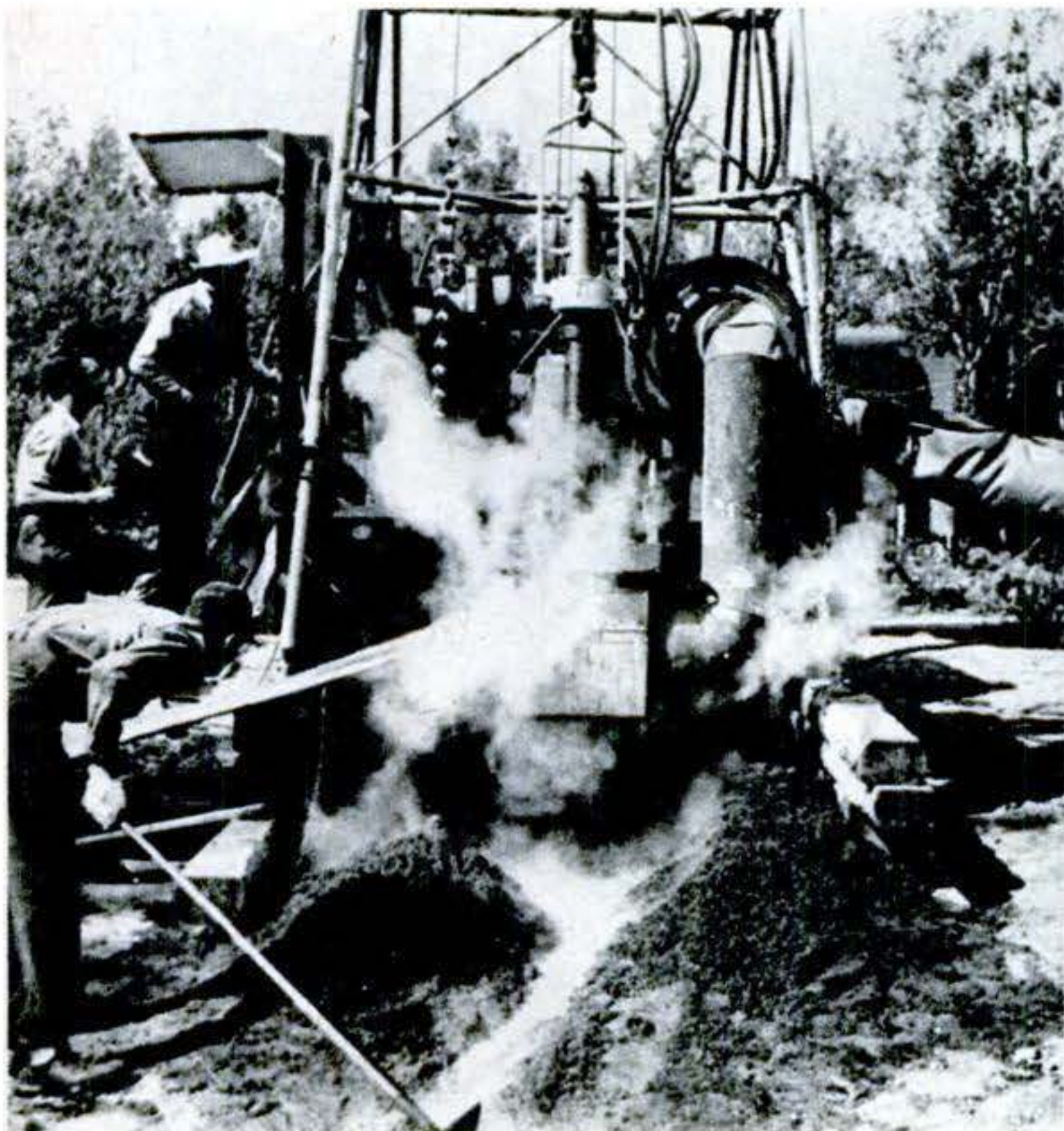
point of the rock by as much as 600 degrees.

As the flame burns down into the rock, a water spray keeps the burner tip cool and makes the molten rock brittle. The water also produces steam that combines with the exhaust gases to force the slag up to the surface through the space between the blowpipe and the side of the hole.

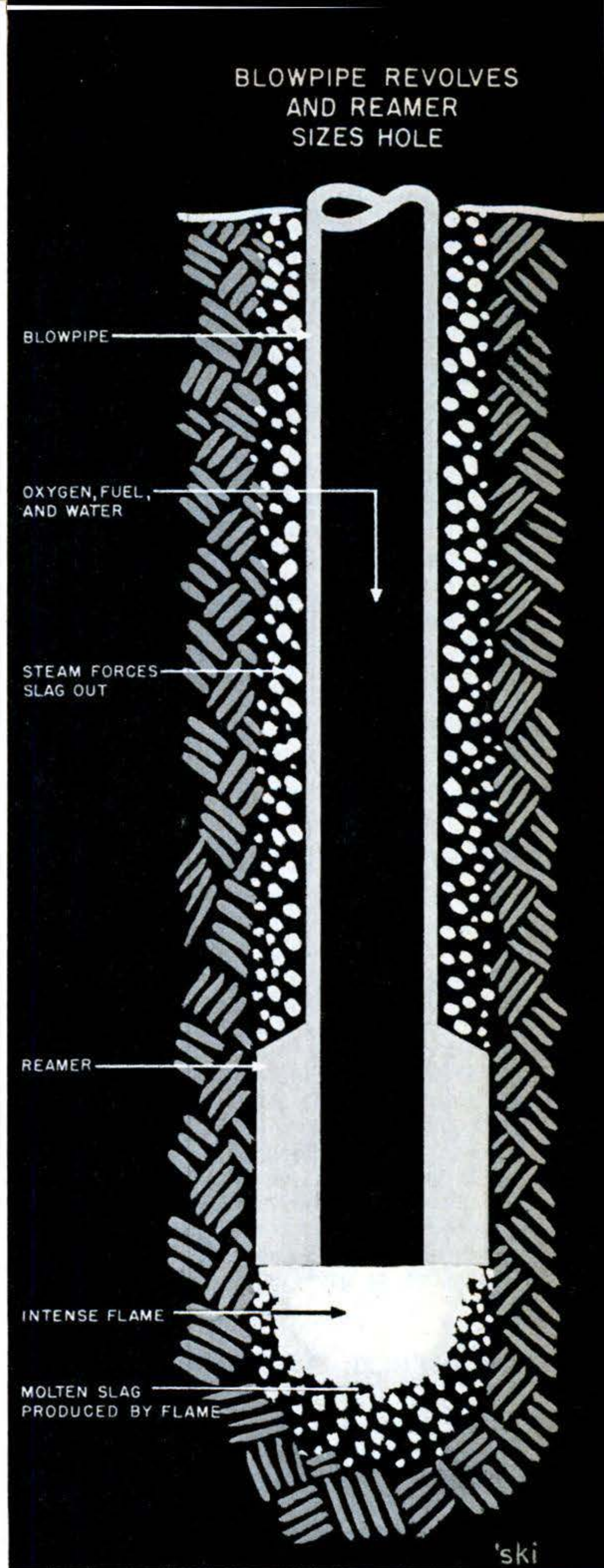
Blades mounted on the shaft above the burner tip and water ports are not for reaming, but serve to break up large particles and to smooth the sides of the hole.

Extensive experiments with fusion piercing have been made on Reserve Mining Co. property at Babbitt, Minn., by the Linde Air Products Co., developers of the process. The flame seared through the rock at an average rate of 10 feet an hour, and hit 17 feet an hour for short periods.

Fusion piercing has other advantages for mining taconite. Cracks radiating from the hole during piercing produce better fragmentation during blasting. And the hole tends to enlarge by chipping, permitting the use of economical split charges.



Fusion piercing under way, with blowpipe approaching full depth of pierce. As slag is forced up around hole, it is removed by helper. Gas-exhaust outlet is seen at right.



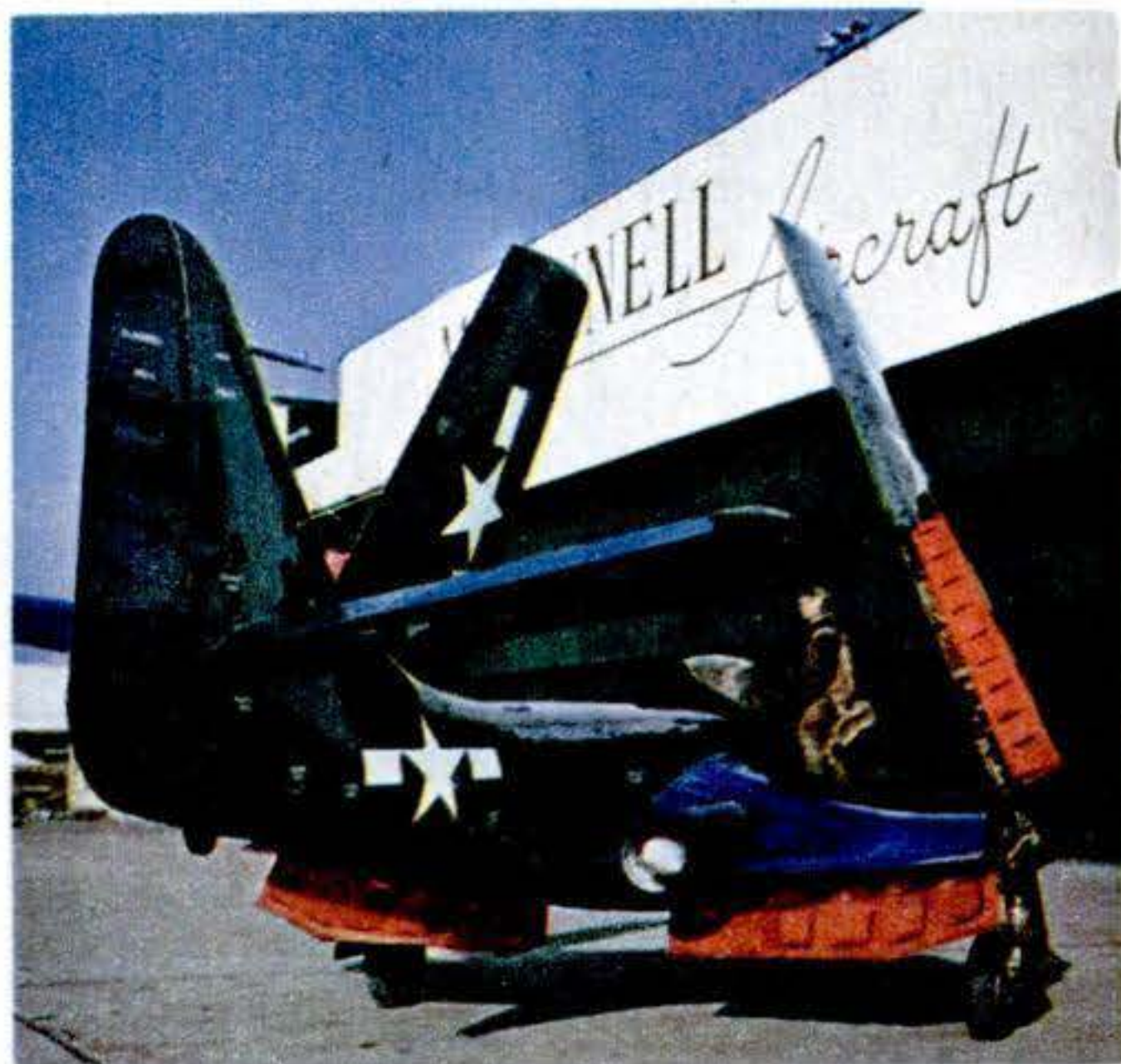
Cutaway of 30-foot blowpipe that does the job. Oxygen, fuel and water flow through separate channels in blowpipe, and are ejected from individual ports at operating end.



Two Twins Join Navy

THE Navy's "egg beater," first twin-engine helicopter to join the U. S. fleet, hovers above another Navy first, the XF2D-1 Phantom, a twin-jet fighter. The McDonnell Whirlaway helicopter has an 87-foot span, cruises at better than 100 miles per hour, and carries 12 men including crew.

With wings folded as shown at right, the span of the McDonnell Phantom is reduced to 16 feet 3 inches for compact storage aboard ship. It is powered by two Westinghouse 19B jet engines, each developing a 1,600-pound thrust. Packing four machine guns, its combat weight is 8,580 pounds. Its long nose helps pilot's aim. Fifty Phantoms are expected to join carrier squadrons soon.

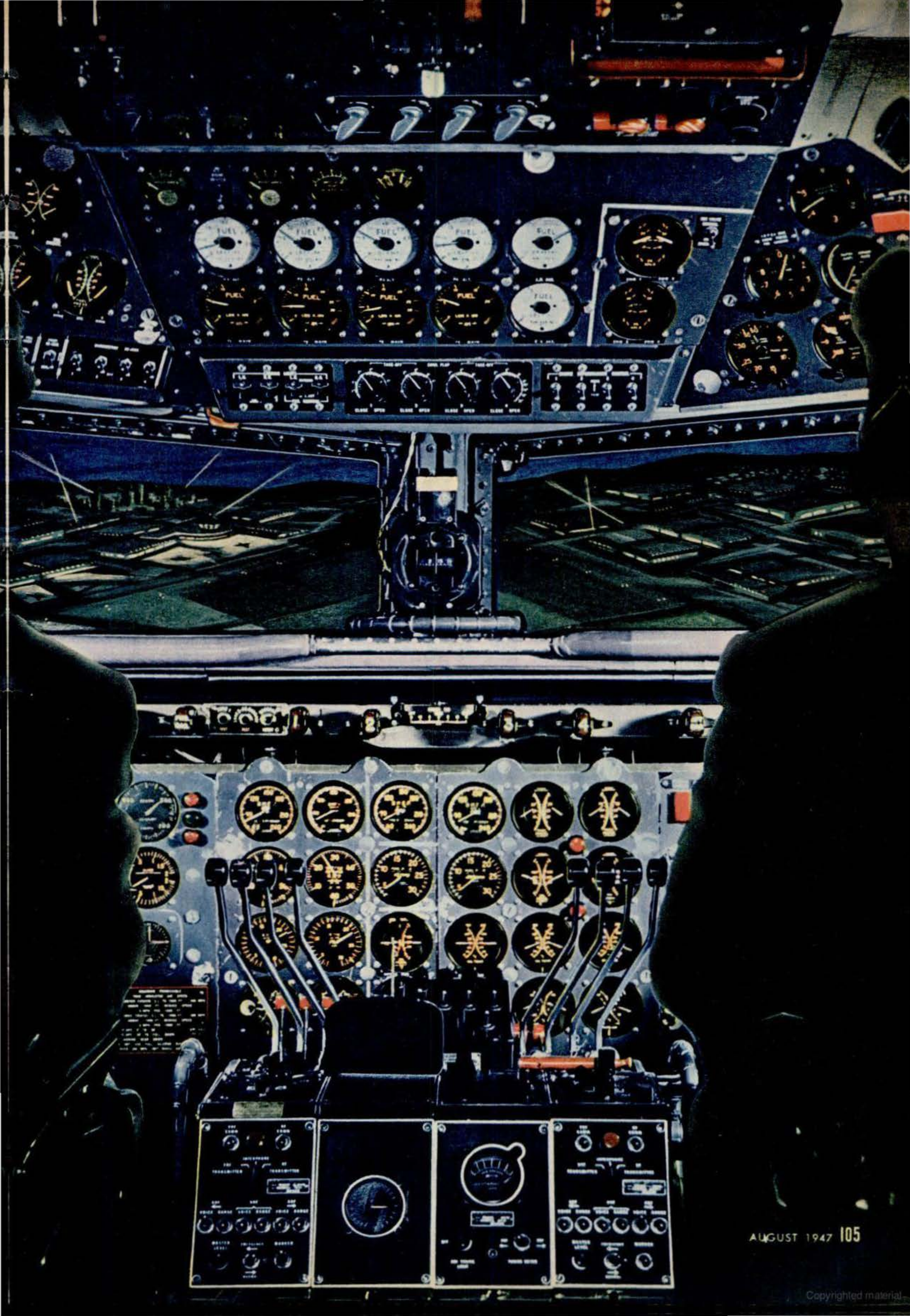


Take a Seat—in the Cockpit of a DC-6! →

WOULD you like to take this 52-passenger DC-6 into Los Angeles Municipal Airport, gleaming ahead? Then you'll have to know every dial in that bewildering maze.

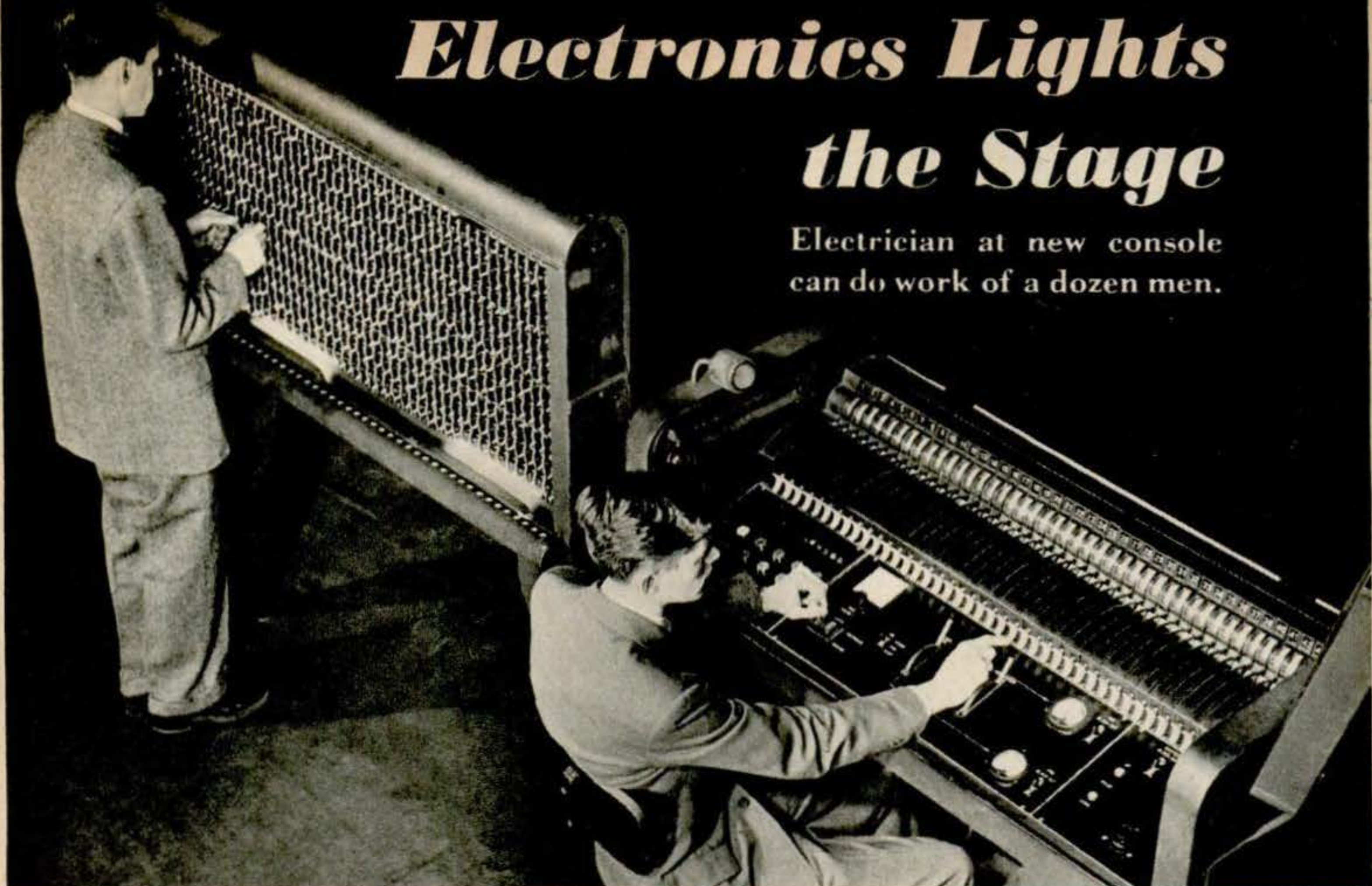
At extreme top center you see part of the ignition- and electrical-control panel. The white dials directly below are fuel-quantity indicators. Fuel-pressure gauges and carburetor gauge are at far left and cabin-supercharger control instruments at far right. The device between the windshields is a magnetic compass. The red buttons di-

rectly below the windshields control automatic fire extinguishers for engines and baggage compartments. The collection of dials in front of the duplicate sets of throttles comprises the main engine-instrument panel. At each side, mostly hidden by pilots, are identical sets of flight instruments, including radio compasses, for pilot and co-pilot. The four panels below the throttles are (l. to r.) pilot radio-selector, automatic direction-finder indicator, tuning meter and co-pilot radio-selector.



Electronics Lights the Stage

Electrician at new console
can do work of a dozen men.

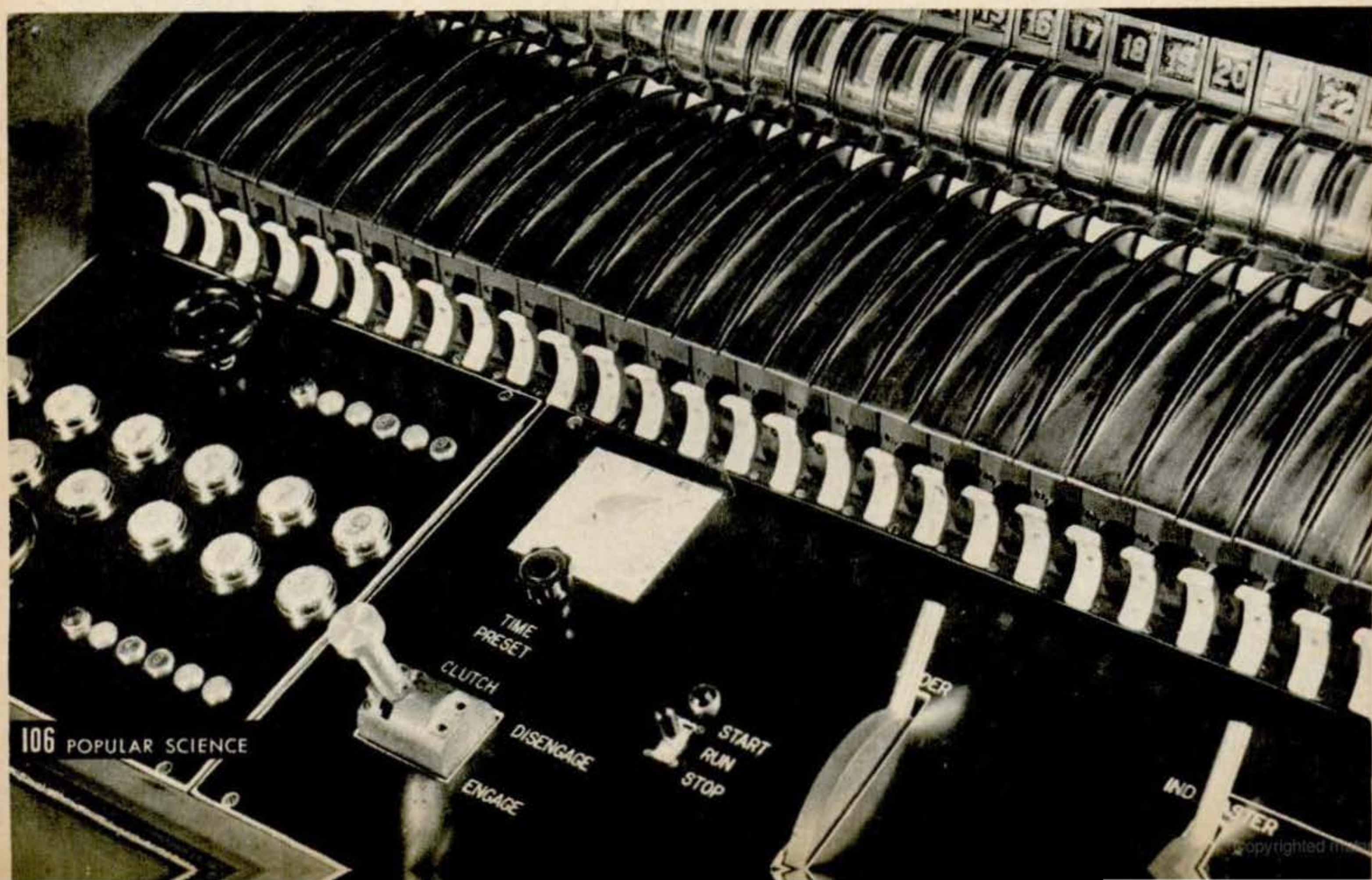


One pair of hands does a better job than a dozen with this new electronic control unit for stage lighting, now in use at Yale University. Instead of the large crew of electricians usually needed, one man at the

console at right can adjust 44 different lights, change from one complete lighting design to another, and produce striking theatrical effects never before possible. Panel at left sets lighting designs in advance.

A close-up of the console's "keyboard" shows the centralized controls. The dials and switches for individual lights are at the top. Numbered pilot lights at left indicate which one of the 10 preset designs is on and which

is next. The clutch (center) engages a motor that automatically fades one design into the next, while knob above it sets fading time. The levers are manual faders, the right for individual lights and the left for groups.



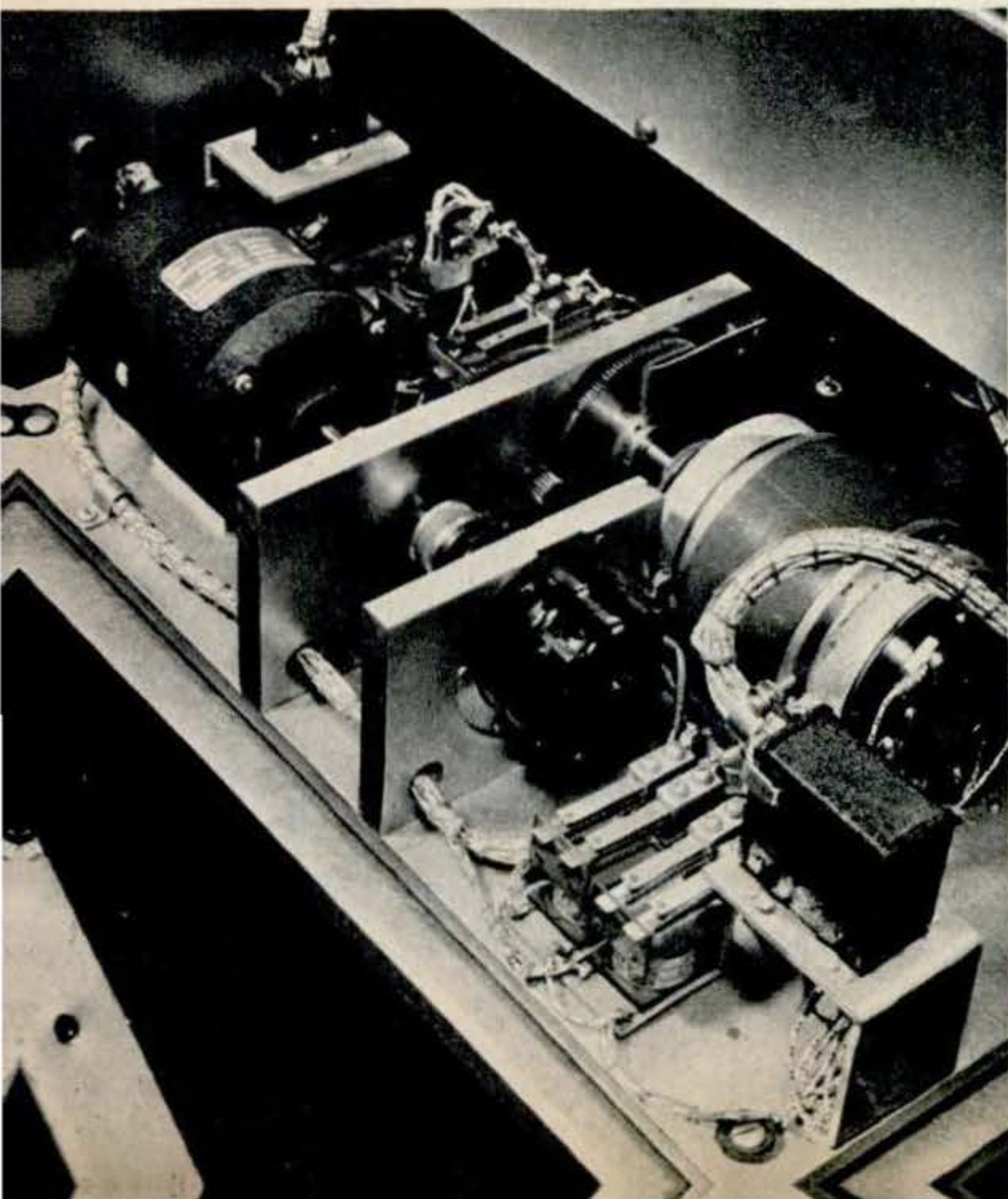


Professor George C. Izenour of Yale University, inventor of the electronic lighting control, adjusts one of the 44 switching and dimming units operated from the console. Each unit has one vacuum tube that controls

two thyratrons carrying the heavy current for the circuit. Professor Izenour, whose field is drama rather than electronics, expects his device to inspire new lighting techniques, expanding the scope of the theater.

To fade designs together, the left motor drives a potentiometer regulating the vacuum tube circuits, while also moving the selsyn motor at right that controls indicator dials and provides manual fading.

Small levers on this panel set potentiometers controlling light intensity. One horizontal row handles all 44 lights—a complete design. With 10 rows, 10 designs can be made up for later selection from the console.



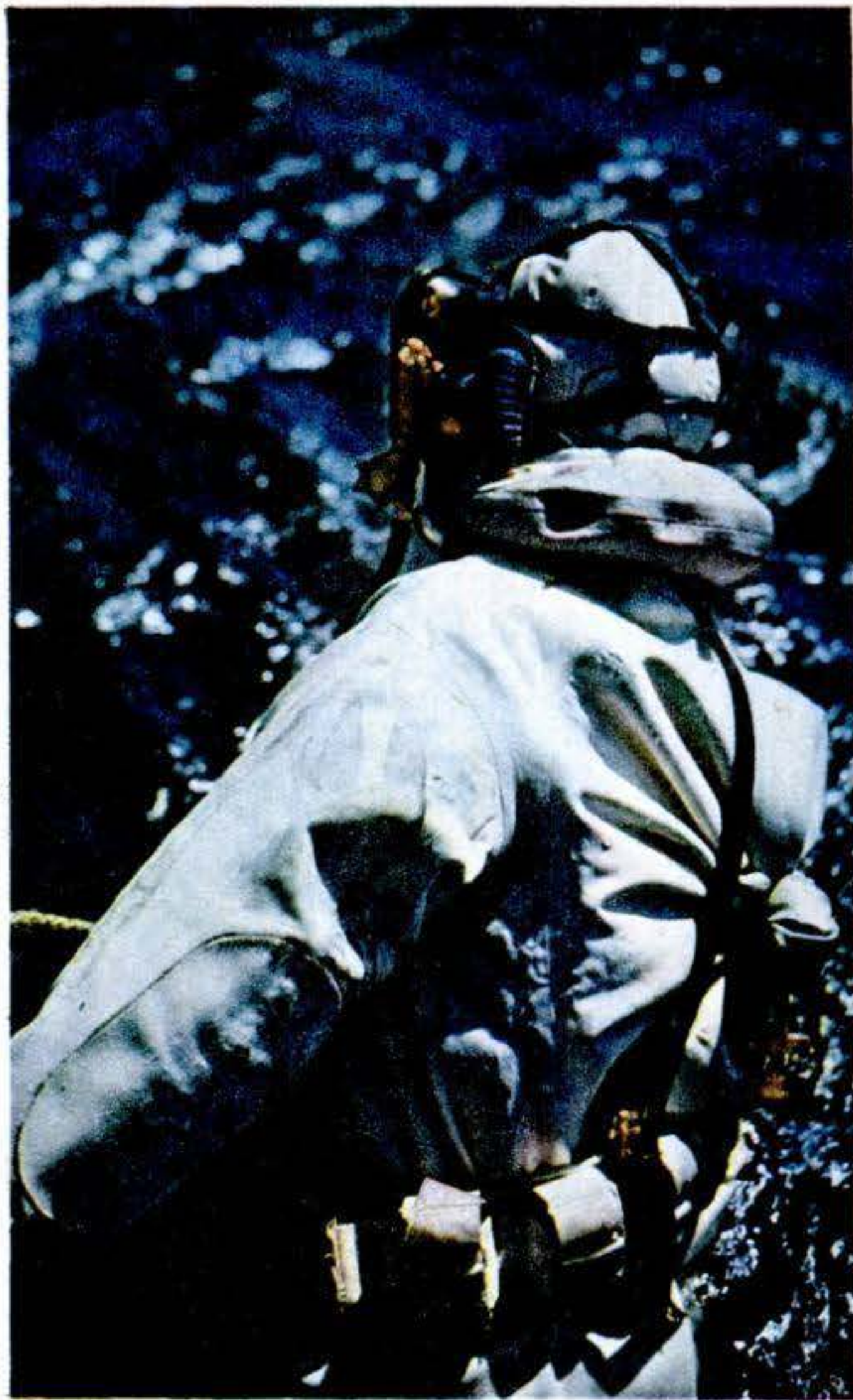
"Zoot Suit" Reduces Diver's Burden

WEIGHING only 10 pounds without shoes, as against 85 pounds for the regulation brass-helmet diving dress, a new light-weight suit is making life easier for men in the Deep Sea Diving School at the Washington Navy Yard. It is made of rubberized canvas, and a face mask straps around the diver's head. A canister worn around the neck purifies air for rebreathing. Eighteen-pound shoes complete the dress, which is used for moderate depths.

Mosaics Go Modern

USING a single piece of ceramic-like plastic instead of the hundreds of tiny pieces that make up a true hand-set mosaic, two artist-inventors have patented a method that permits quantity production of what they call "Mosamics." The process can be adapted to framed pictures like the one shown below, or to colorful plates, trays and other furnishings.

The design is cast in one piece of the plastic, which is then colored and glazed. Then the spaces between the "stones" are filled with a cement to give the outward appearance of hand-set work. The Mosamics Co., of Brooklyn, produces the designs.

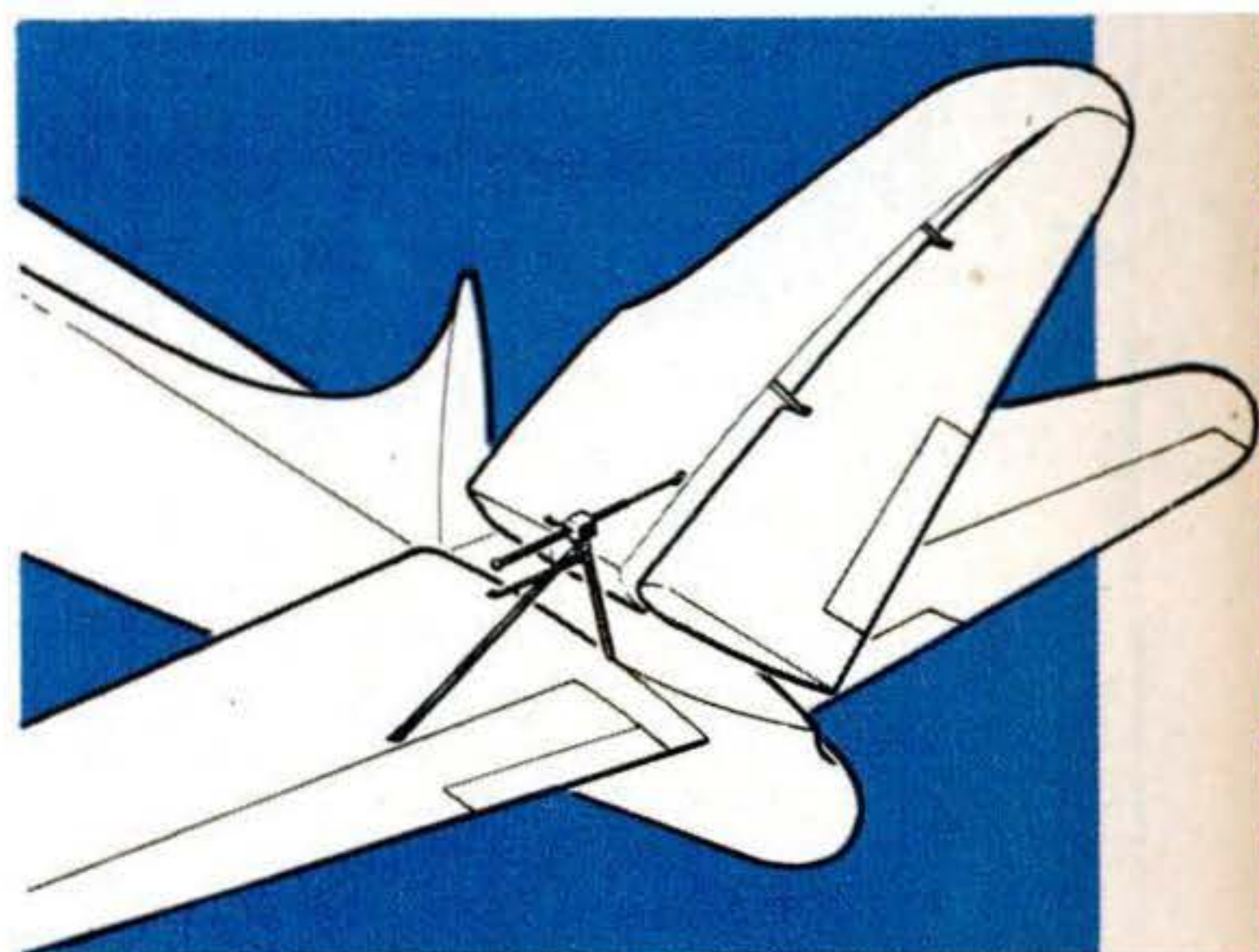




The towering tail of this AAF C-97 Stratofreighter illustrates the problem of getting it to fit inside the hangar.

Tails Down!

BIG airplanes need big tails; tall tails call for a lot of hangar clearance. To avoid the need for new hangars big enough to admit Stratocruisers and Stratofreighters, with their four-story vertical fins, Boeing designers worked out a hinged tail that folds down like a box top. Besides cutting the planes' height to less than 27 feet, this engineering trick also simplifies tail-assembly servicing. The rudder can be more easily removed from the "down" position, eliminating the need for the usual overhead crane.



"Fin-folding jack" has a tripod that fits onto the left stabilizer to support the fin on its way down.

With hinge pins substituted for four bolts, the fin is lowered to a horizontal position on the right stabilizer.



How Ocean Cables Are Mended

MAINTEINING more than 23,000 miles of submarine cable, resting on ocean bottoms to depths of three and a half miles, is a big job. The fleet of repair ships maintained by the Commercial Cable Company may be called to the mid-Atlantic or the mid-Pacific. Their task may be to repair damage caused by Newfoundland icebergs or the ravages of a Philippine Sea earthquake; to mend breaks made by razor-sharp coral reefs or the drags of fishing trawlers.

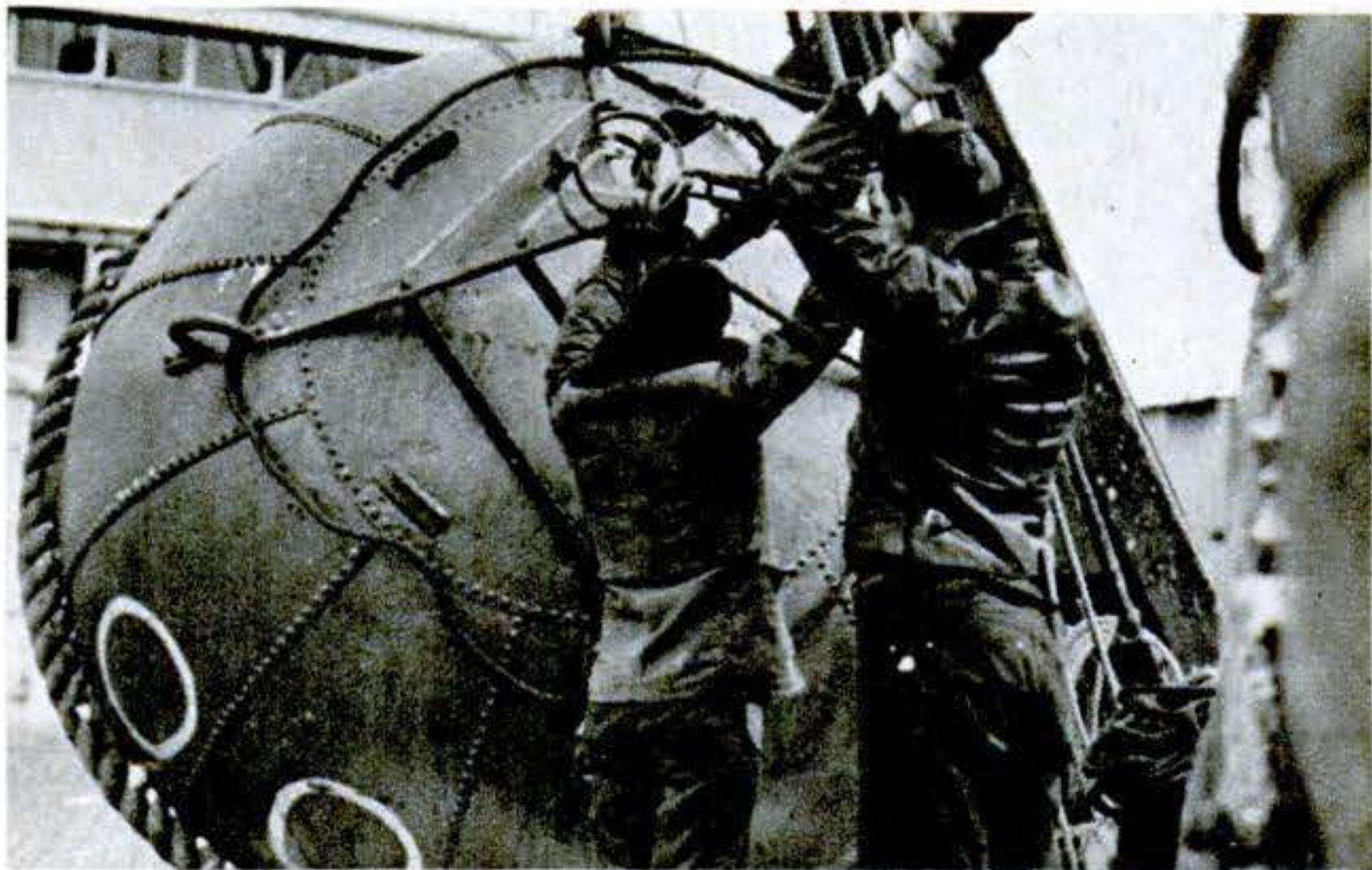
Submarine cables vary in size from more than four inches in diameter at the shore ends to one inch in the deep-sea sections.

Although the cables rest on the bottom of the ocean, they are laid with sufficient slack so that they can be lifted by a repair ship's grapnel without excessive strain.

When a break occurs in a cable, special testing apparatus on land determines the location, and a cable repair ship is sent to the spot. On arrival at the break, the ship drops a marker buoy. It then steams to a point several miles off to one side of the cable and drops the grapnel and "fishes" until a dynamometer, registering strain on the grapnel rope, indicates that the broken cable has been hooked.



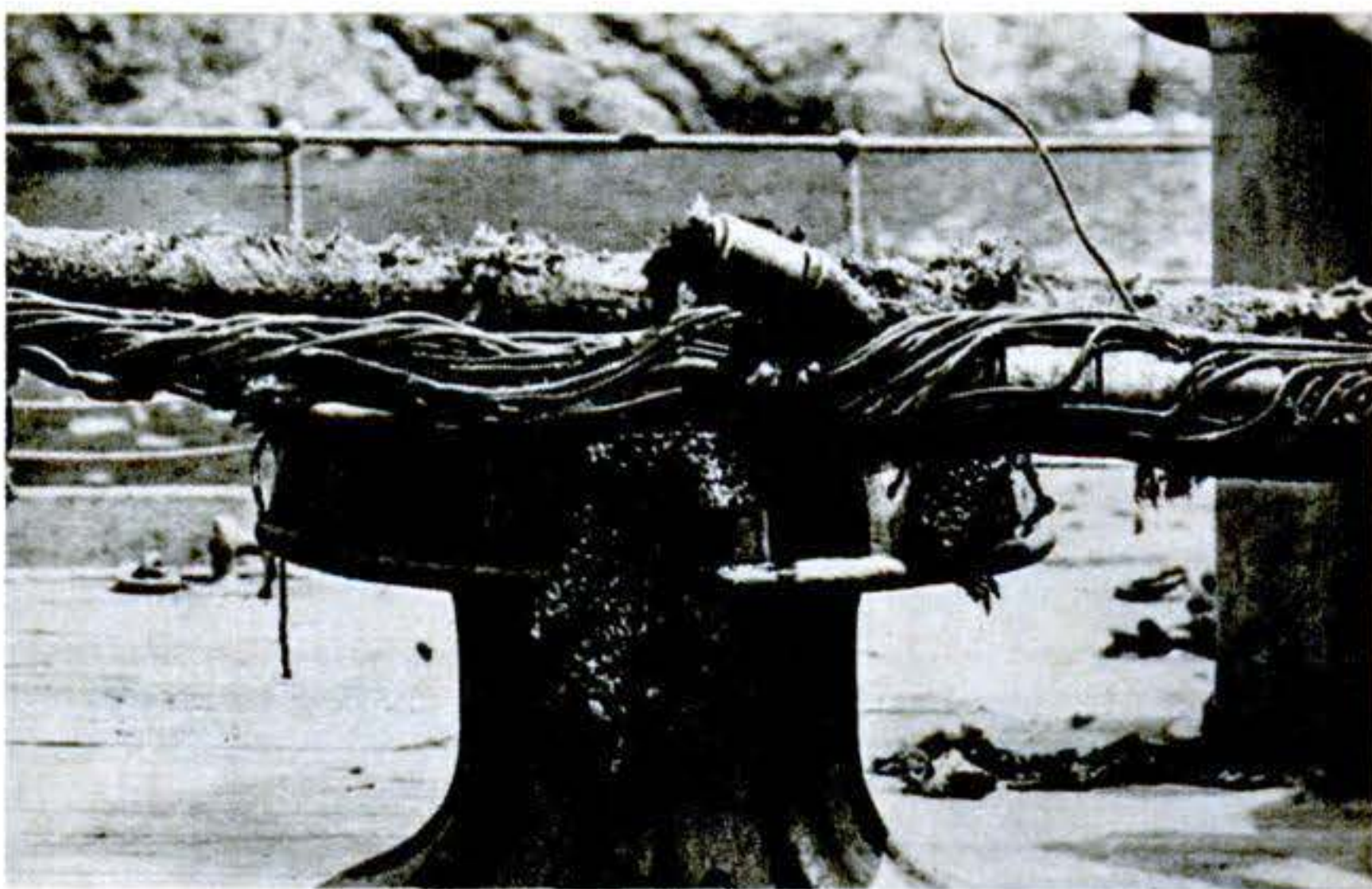
3. On the ship's foredeck is the machinery that picks up and pays out cable as desired. Accuracy in controlling speeds under all sea conditions requires the steam-operated machines to be manned by experts.



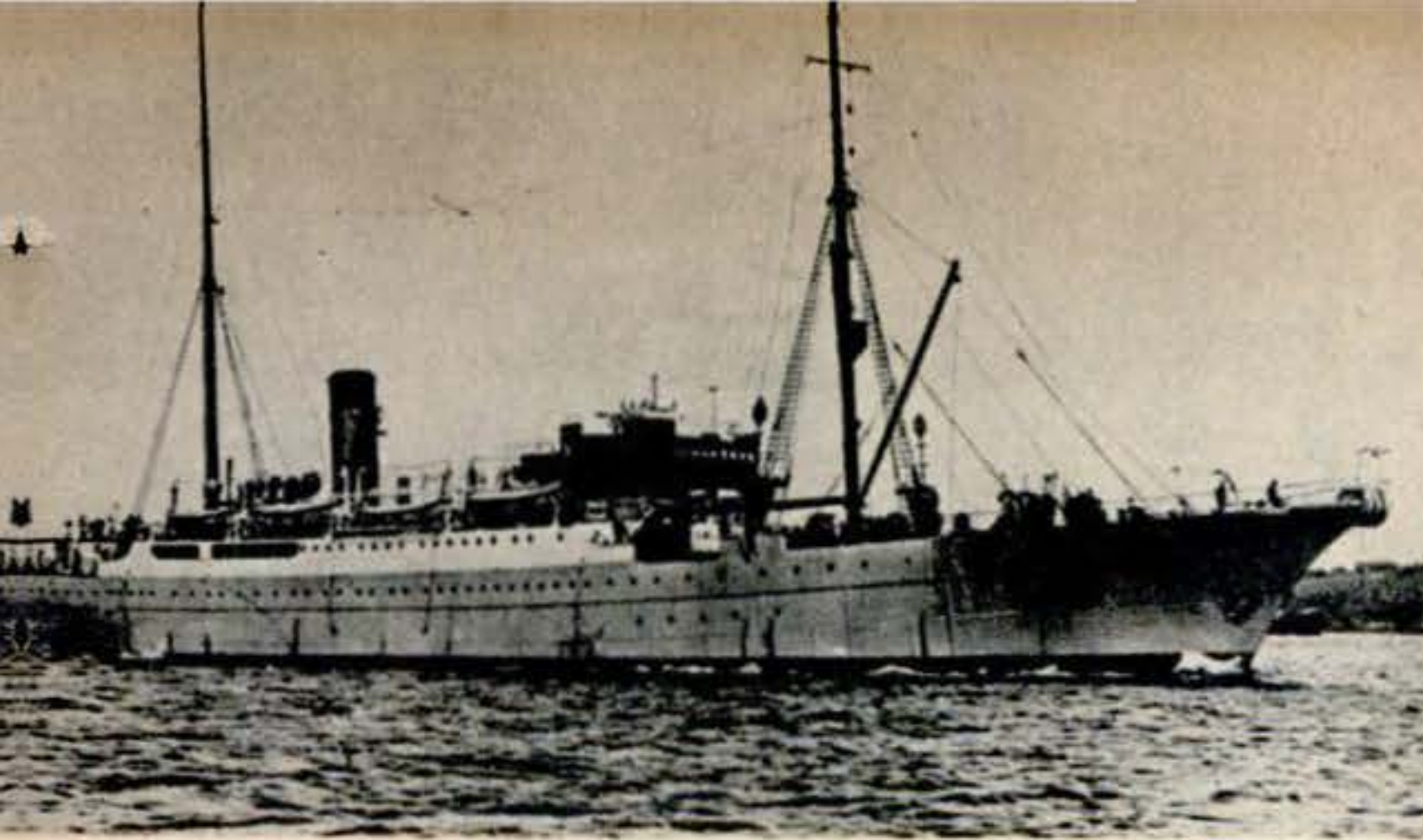
4. A cable buoy is fitted with a long staff. When the trouble area is located, the buoy is lowered over the ship's side by means of skids and moored to ocean bottom. The staff guides ship in grappling operations.



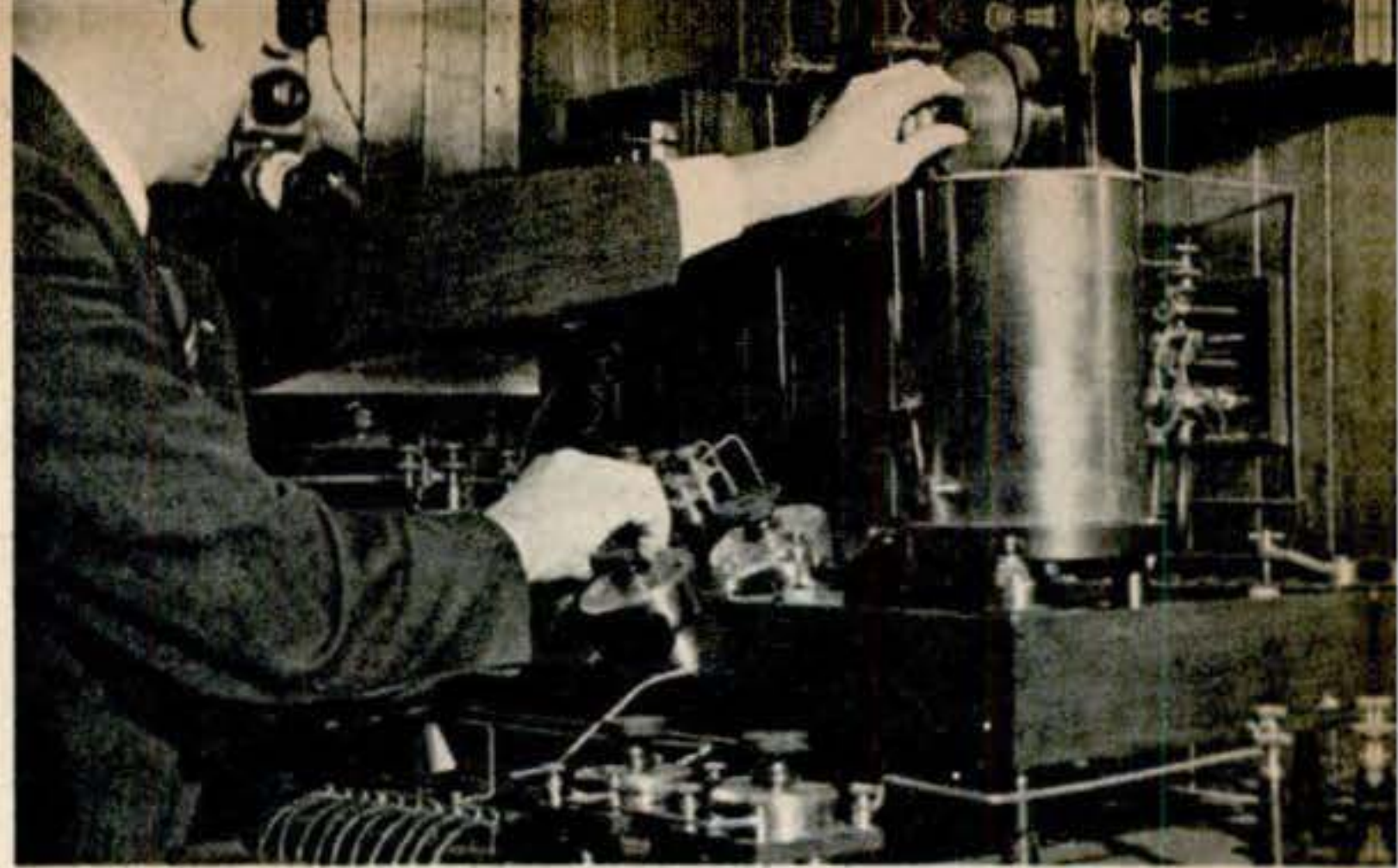
7. A damaged cable, crushed by an iceberg, is lifted up by grapnel off St. Johns, Newfoundland. Man over the side is putting on a "stopper" to permit one end of smashed cable to be brought into ship for repairs.



8. Close-up of a damaged cable shows what can happen when it meets an iceberg. Although infrequent, such accidents have sent cable ships speeding north three times in a year. Heavy seas often impede repairs.



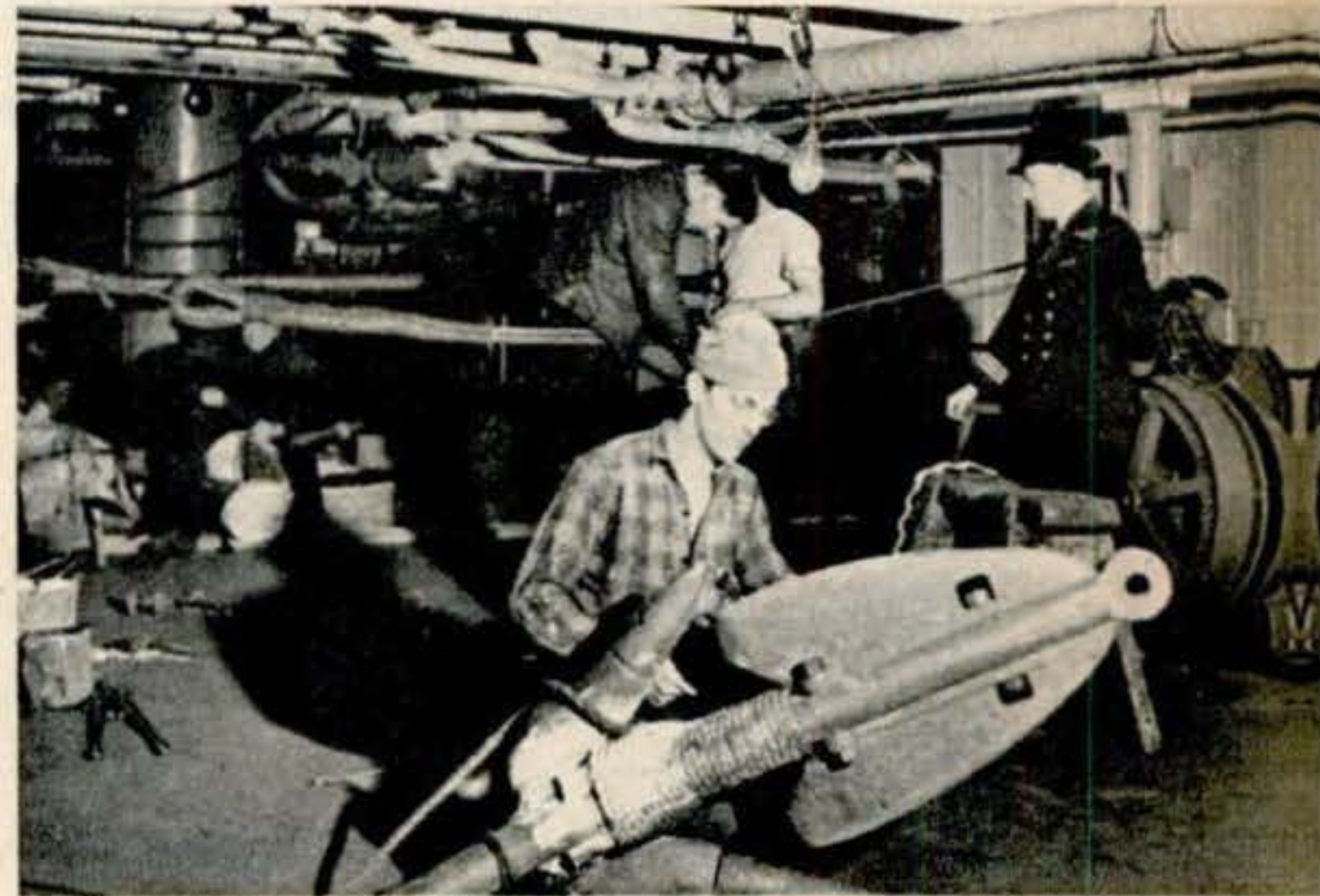
1. Since its launching in 1923, cable ship *John W. Mackay* has made ocean-bottom repairs the world over. Its trouble-shooting career includes hazardous operations in the Atlantic Ocean during World War II.



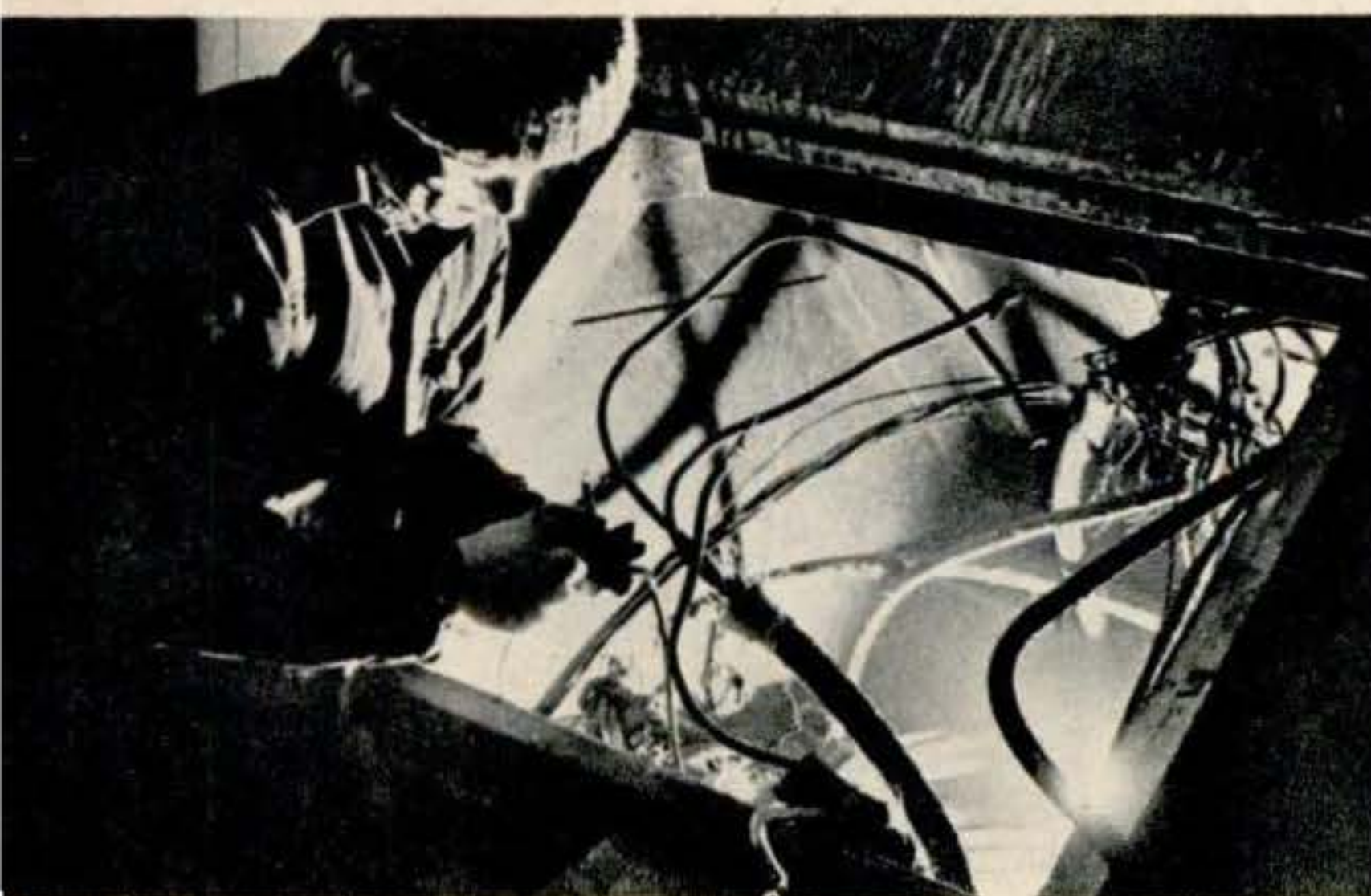
2. Brain of the cable ship is the testing room. Electrical apparatus locates breaks and determines what is wrong. After the cable has been hooked and repaired, the equipment checks it for proper functioning.



5. Swift current swirls a wake around a marker buoy during operations in the Gulf Stream. Bracket on the staff holds two lamps that are visible for nine miles. Buoy is hauled back on ship after repairs.



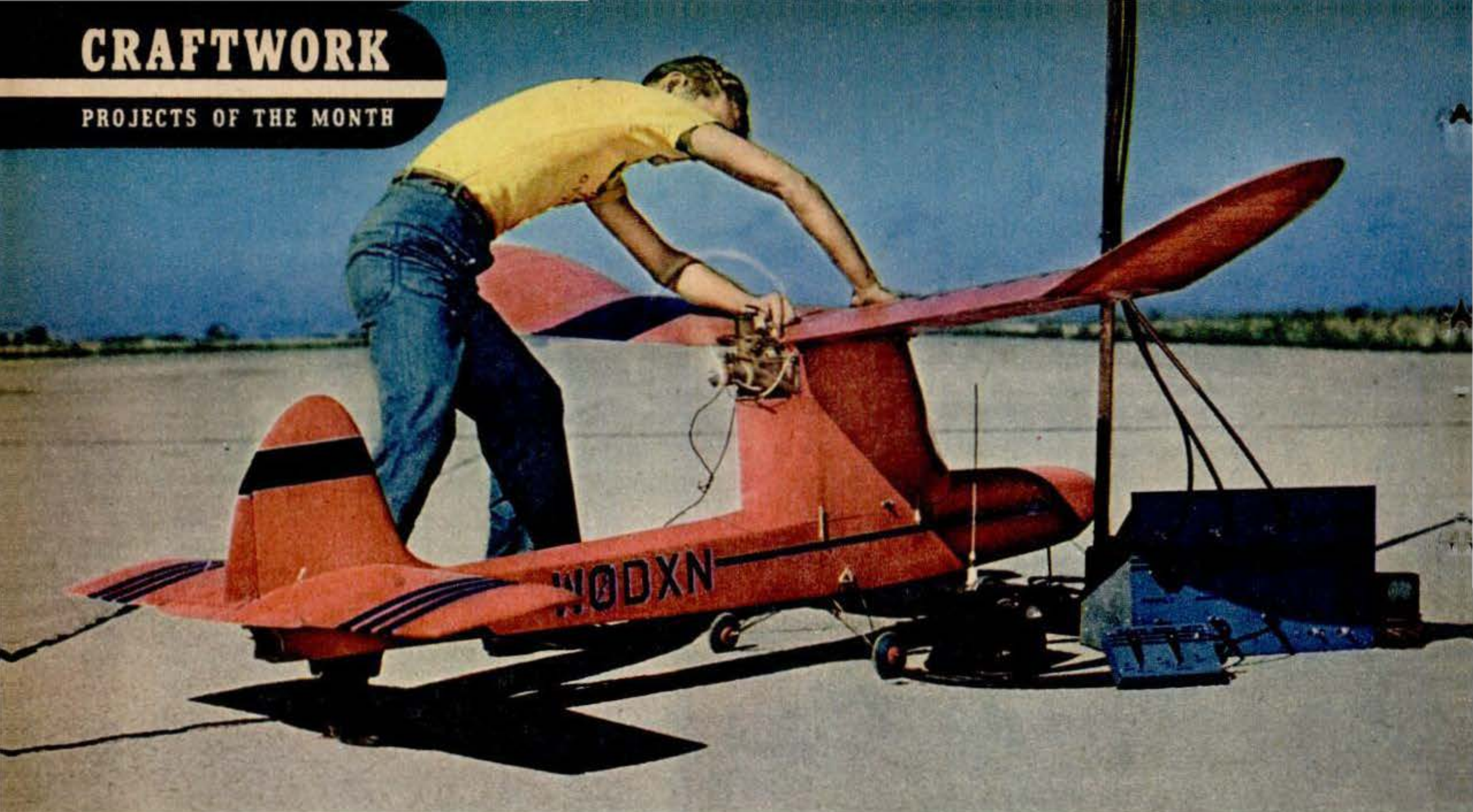
6. Cable machinery and machine shop are located on lower deck where the general repair work is done. Crew members are largely recruited from Nova Scotia and, like these men, dress lightly even in winter.



9. In this operation, called "connecting the ends" of the cable, electrical tests are made prior to starting repairs. The apparatus is the Cable End Box, a central point inside the cable ship's well-equipped testing room.



10. Storage tanks for cable are located below decks. Numerals on back wall indicate the amount of cable available at all times. There are four such tanks, each having a storage capacity of 300 miles of cable.



Push-Button Pilot. Telecontrol of model airplanes, using one or more radio channels, receivers weighing but a few ounces, and clever actuating mechanisms,

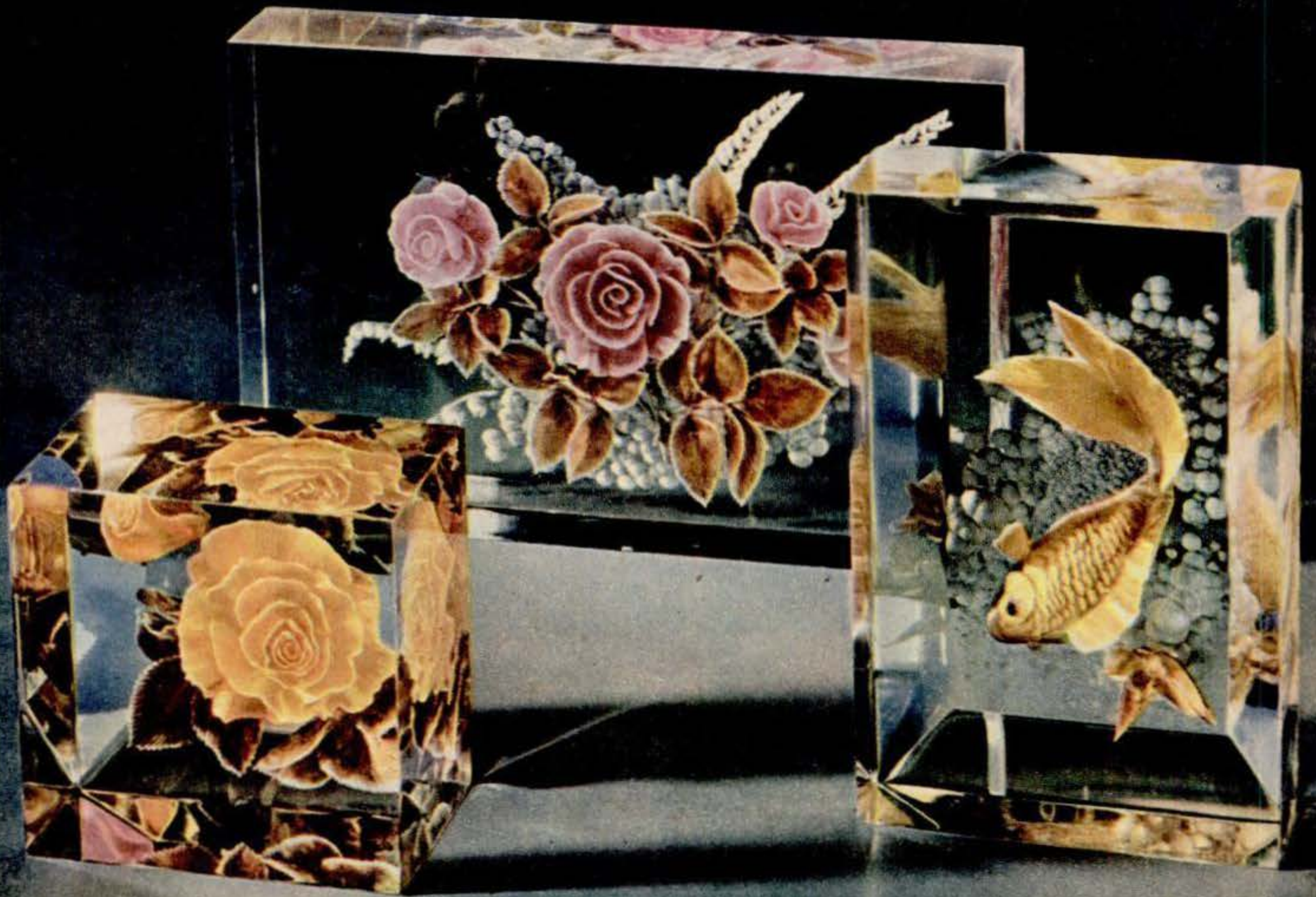
is a fast-growing hobby among modelers. Claude McCullough, whose three-control, $\frac{3}{4}$ -hp. plane is warming up above, tells how it's done in his article beginning on page 152.



Crayon Craftwork. Plaques for children's rooms, Colonial or Pennsylvania Dutch projects, and leather work can be ornamented with wax crayons. Outlines are burned with an electric pencil. It's quick, clean, and permanent. See page 185.



Plastic Beach Sandals. The craftsman who likes working with plastic can mold these sandals right to the wearer's feet. With colorful canvas straps, they're smart, modern, and sure to please. Easily followed instructions are on page 148.



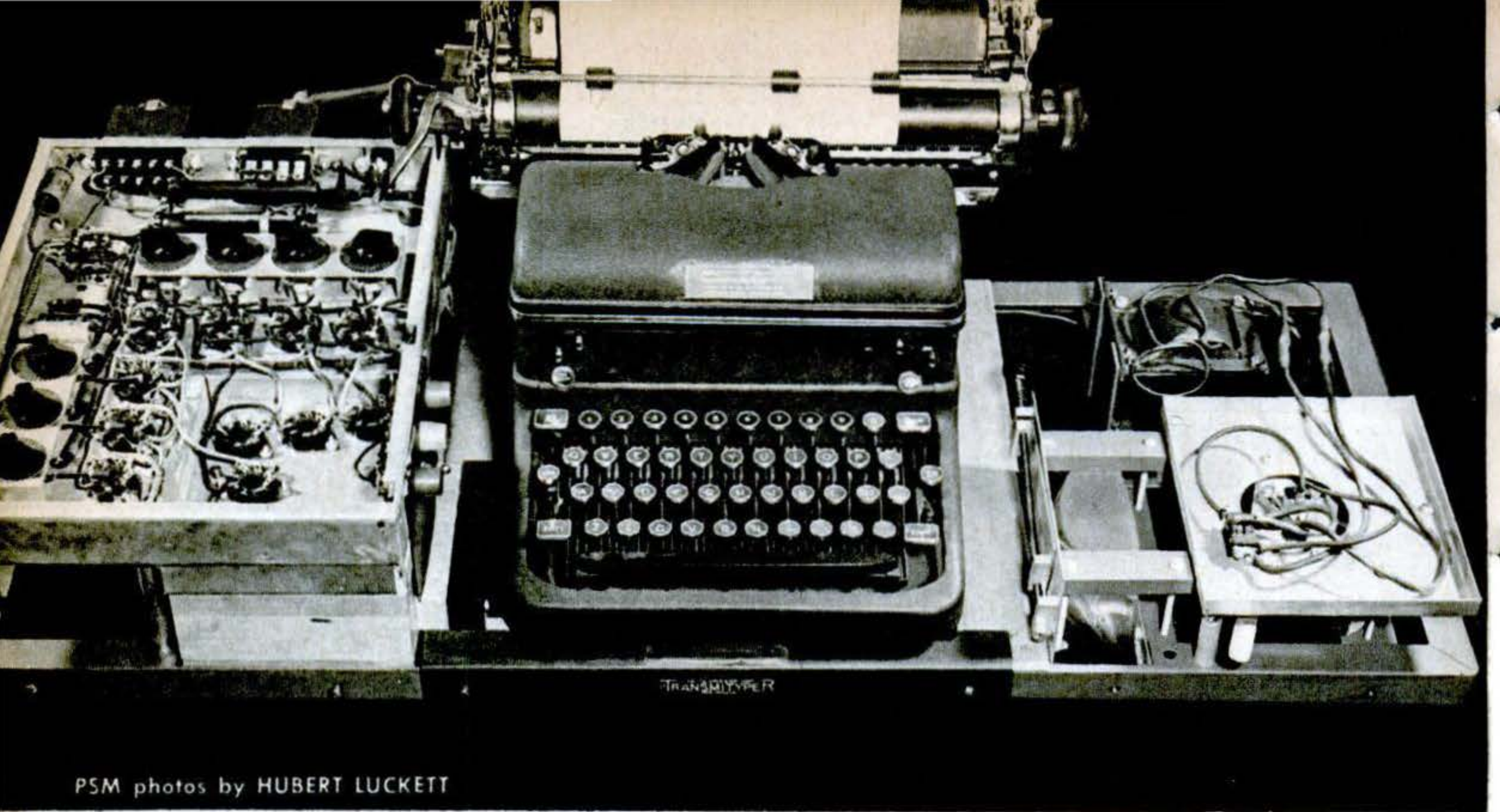
Inside-out Carving. In this kind of craftwork, you're looking at what isn't there. Three-dimensional forms are created inside clear plastic by drilling holes, the shape of which determines what you see. The technique is so different from any other that even the craftsman is amazed as flowers, leaves, fins, and feathers take form

under his hands. Invariably others ask him, "But how do you get the flowers in?"

Not only flowers, but submarine scenes, birds and butterflies in flight, abstract design, and a world of possibilities challenge your initiative. These fine examples are by Robert Barry, of the Rohm and Haas Company. Instructions start on page 160.

PSM color photos by Robert F. Smith

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PSM photos by HUBERT LUCKETT

A Transmityper ready for work. Covers have been removed to show arrangement of tubes and light source.

Typewriter Turned Into Telegraph Key

SENDING typed messages over telegraph lines now takes no more skill than pecking out a letter. A new conversion unit turns ordinary typewriters into teletypewriters, using light beams, shutters and photoelectric cells to change typewriter key strokes to electrical impulses.

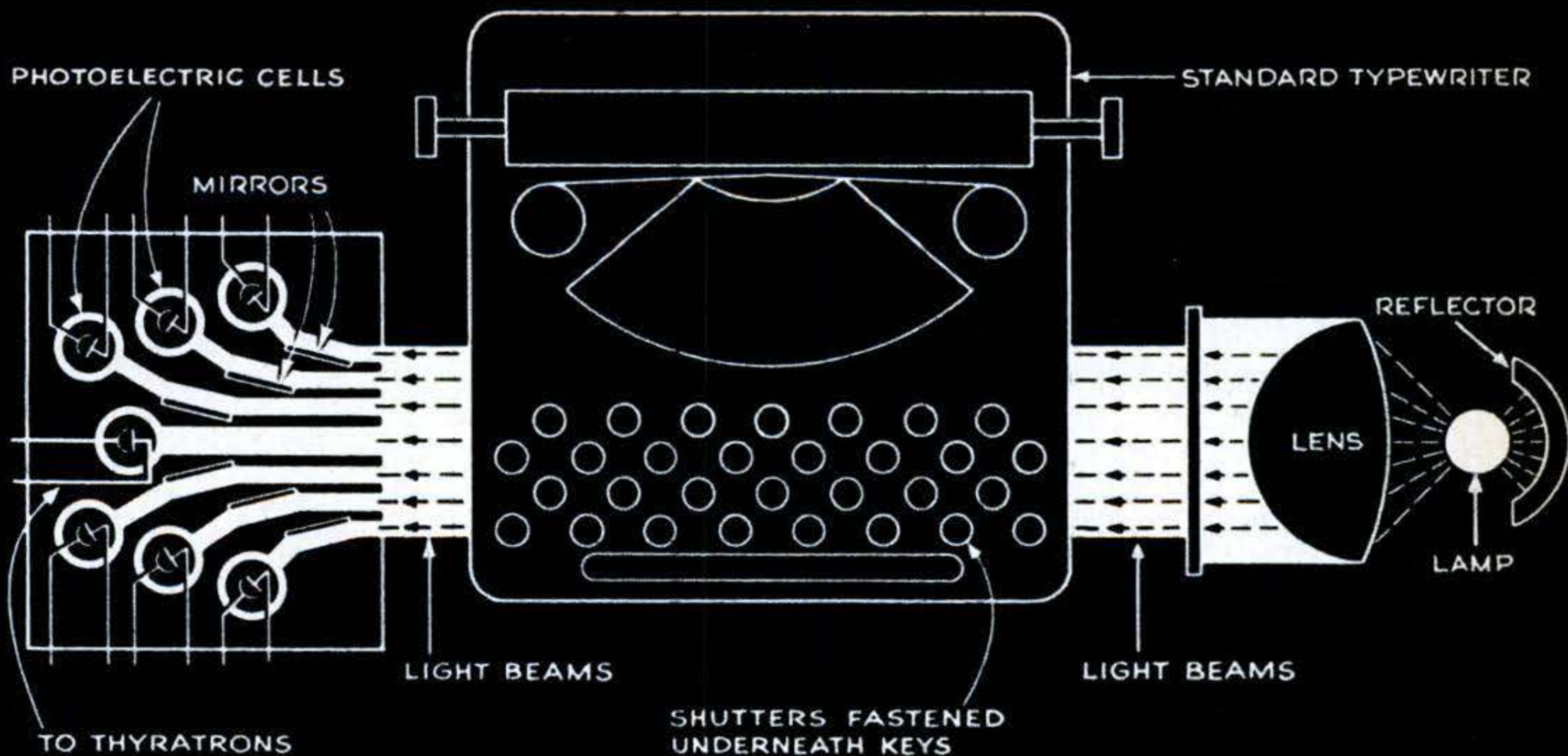
Designed by the Teleregister Corporation, of New York, as part of an automatic air-traffic control system, the device permits operators to send messages as fast as they like, unlimited by mechanical restrictions inherent in teletypewriter machines. On a typewriter an expert can reach 800 letters a minute in spurts, but a teletypewriter does not work in spurts. It must be keyed at an even rate below 400 letters per minute. By using a standard typewriter and the conversion unit, control-tower operators may type as they please—and save time, too.

The "Transmityper" uses an automobile headlight bulb and a spherical parabolic condensing lens to send light into seven metal-separated channels passing from right to left across the bottom of the typewriter keyboard. Notched aluminum shutters attached to the key levers interrupt one or more of these seven light beams when the

keys are pressed, the notched arrangement determining which light beams are cut off. Pressing the "g" key, for example, moves the "g" shutter into position and blocks all beams except number one, number three and half of number six.

Each light beam is aimed at a photoelectric cell at the left side of the unit. When a shutter cuts off one of the light beams, the companion photocell stops producing current. This tells a thyatron "trigger" tube to send an electric impulse over the line. Carriage return and line spacing have their own signals originating in relays attached to the typewriter.

The receiver used with the Transmityper is a standard teletypewriter, which has only capital letters and uses the upper-case position of each letter key for numerals and symbols. For shifting to these upper-case positions, channel six is used. The typewriter shift key blocks half of this channel, while the shutters on most of the letter keys block the other half. Thus, when both shift key and letter key are pressed at the same time, channel six is completely shut off and the shift signal is sent to the receiver. The numeral keys on the Transmi-

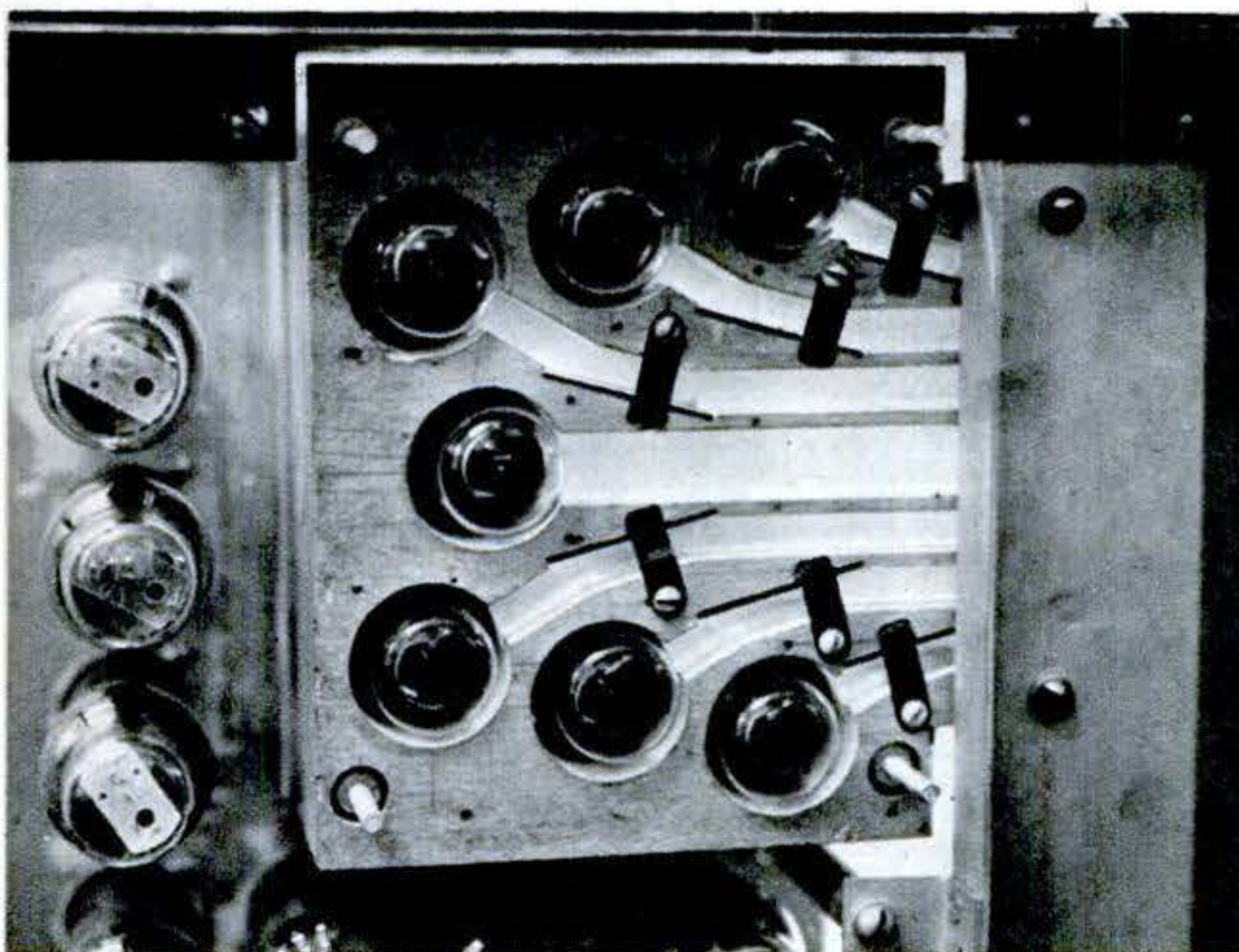


Diagrammatic drawing shows how mirrors route light beams to the proper photocells when channels are open.

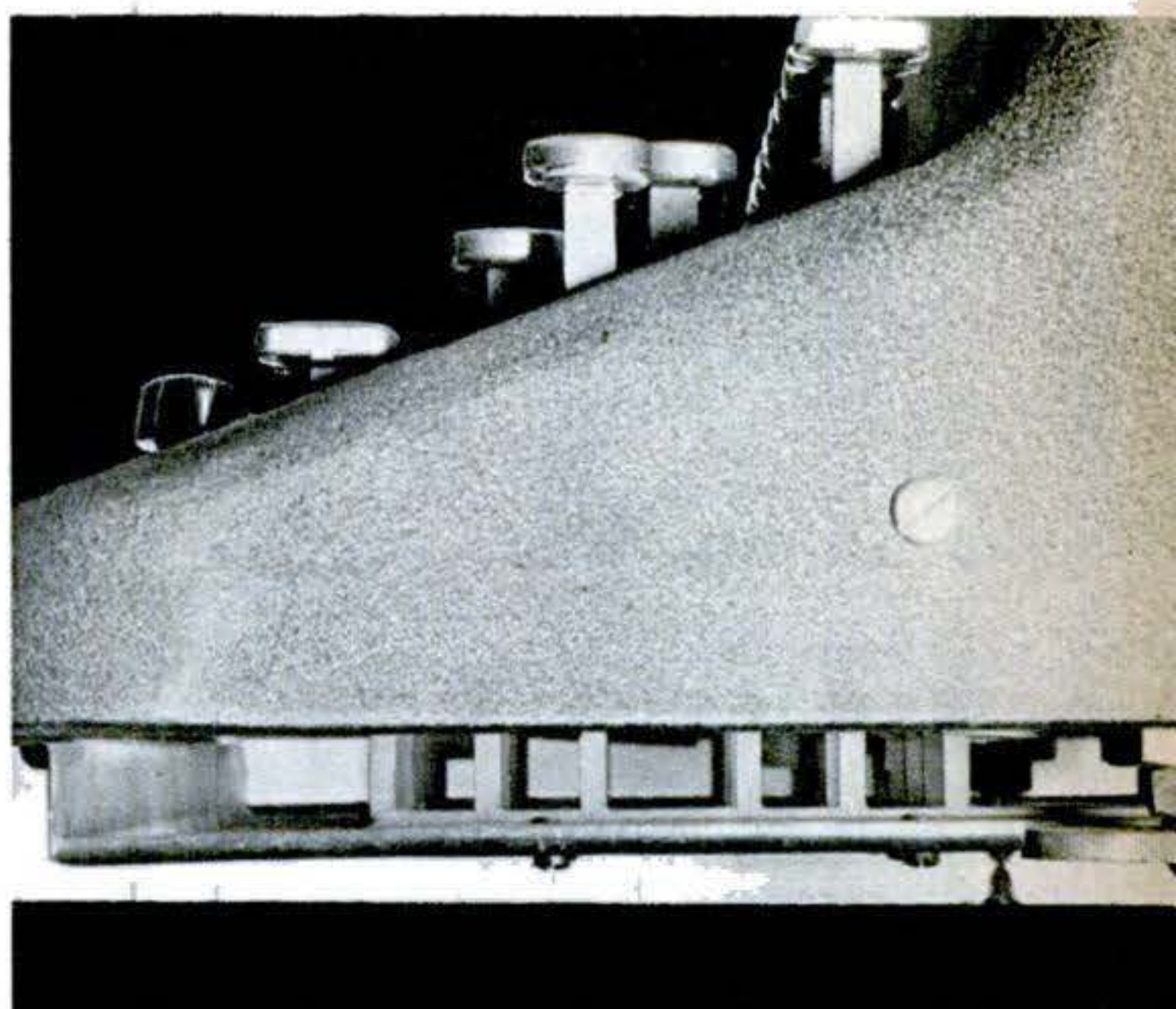
typer have shutters that block all of channel six, so they also send the shift signal.

In practice, impulses from the Transmitter are fed to a tape perforator, which punches holes in a paper tape to correspond to the various letters. This tape then passes through a standard transmitter, operating relays that send out impulses to the teletypewriter at the receiving end.

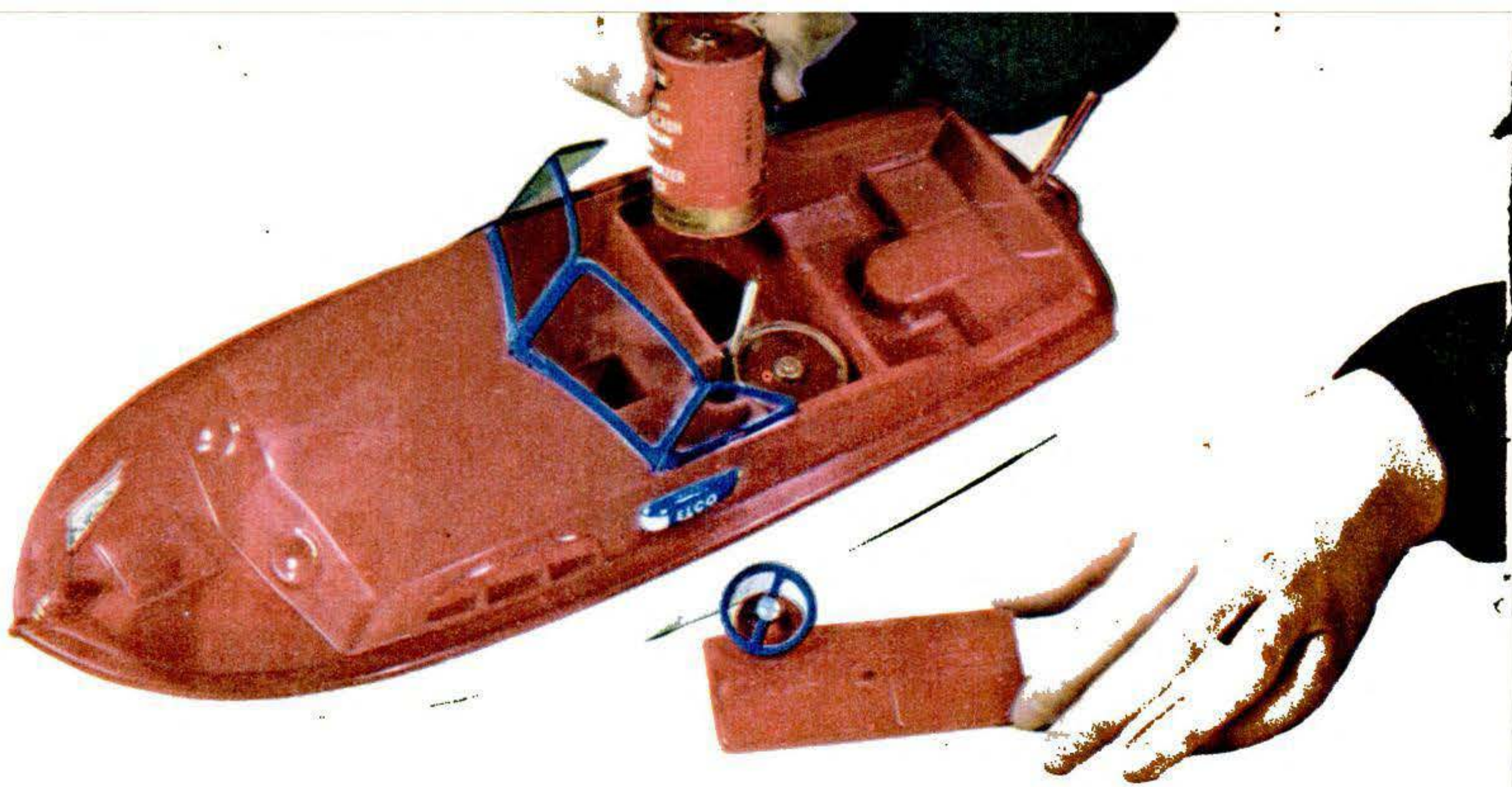
In addition to its application to air-traffic control, the new unit is expected to be used wherever specialized teletype operators are not available—possibly for wire press service from small towns, or interoffice communication in large industrial plants. Its cost, complete with the tape perforator and transmitter, is about the same as that of a standard teletypewriter. **END**



The unit was turned upside down for this view of the photoelectric cells, which hang down from the chassis. Because of their size, these tubes had to be arranged in a rough semicircle. A new model will have smaller tubes set in a straight line at the ends of light channels, eliminating mirrors.



Looking straight down the light channels, one of the shutters can be seen part way toward the closed position as a letter key is pressed. Even when several keys are in motion at once—as they often are in fast typing—only the one that is actually striking the paper produces the impulse.



A 1/200-hp. electric motor, operating on two hidden flashlight batteries, drives this plastic repro-

duction of the 27-foot Elco Sport Cruiser for as long as eight hours. Made by J. L. Schilling Co.

Toys Mirror A New Age

THE history of toys has long been described as the history of the world in miniature. Never before, however, has this been so graphically evident as it is today.

Never before have toys so accurately imitated their adult models and offered such variety and versatility; never before have they kept so closely abreast of the times, achieved such realism, and sought so effectively to instruct as well as to amuse.

As evidence of the importance of toys in our economy and culture, Americans are spending well over \$200,000,000 a year on more than 10,000 different types of playthings made by nearly 2,000 manufacturers.



A tiny hose sprays real water on a toy car in this model Keystone garage. Also featured are a lubrication shaft that can be raised and lowered, an elevator to an upper floor, and an inclined exit ramp.

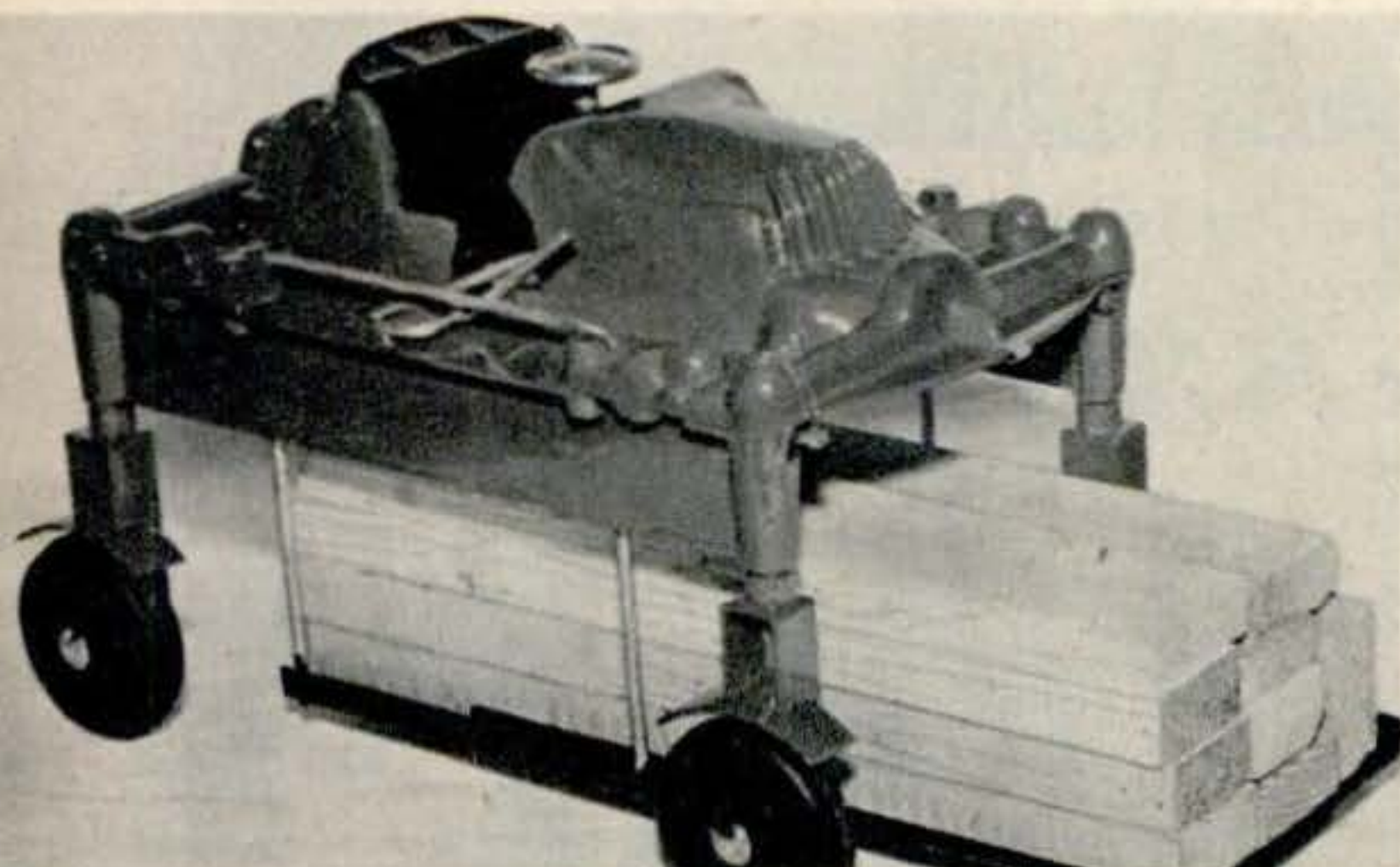


A fifth wheel keeps this novel windup Magikar from plunging to destruction. Concealed underneath, the transverse wheel catches hold when toy encounters a table edge, reversing car's direction.



Samples of uranium ore, a radioactive screen, and a spintharoscope showing radiation help children to

learn the principles of atomic energy in this newest Chemcraft set, made by Porter Chemical Co.



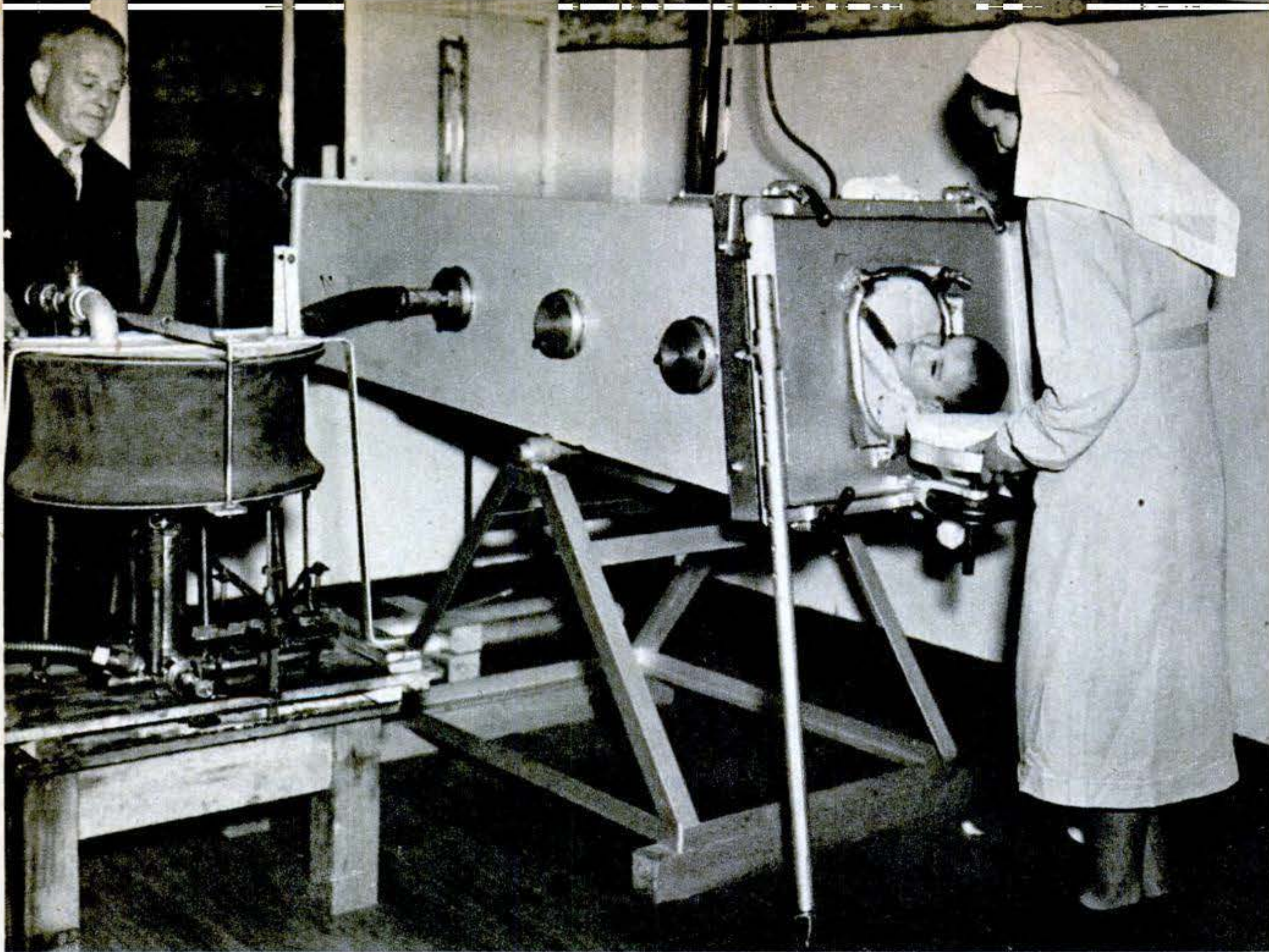
A lever loads and unloads this rubber-tired steerable Mason, Beall & Horton toy lumber carrier.



Real pumps dispense syrup and soda water from five concealed containers in this Kamkap fountain.



A miniature cement mixer that can make real concrete is the latest in a series of scale-model road machines made by the Charles Wm. Doepke Mfg. Co. It is a model of the Jaeger mixer.



The inventor operating the first working model of his respirator, powered by water supply.

Water Powers \$300 "Lung"

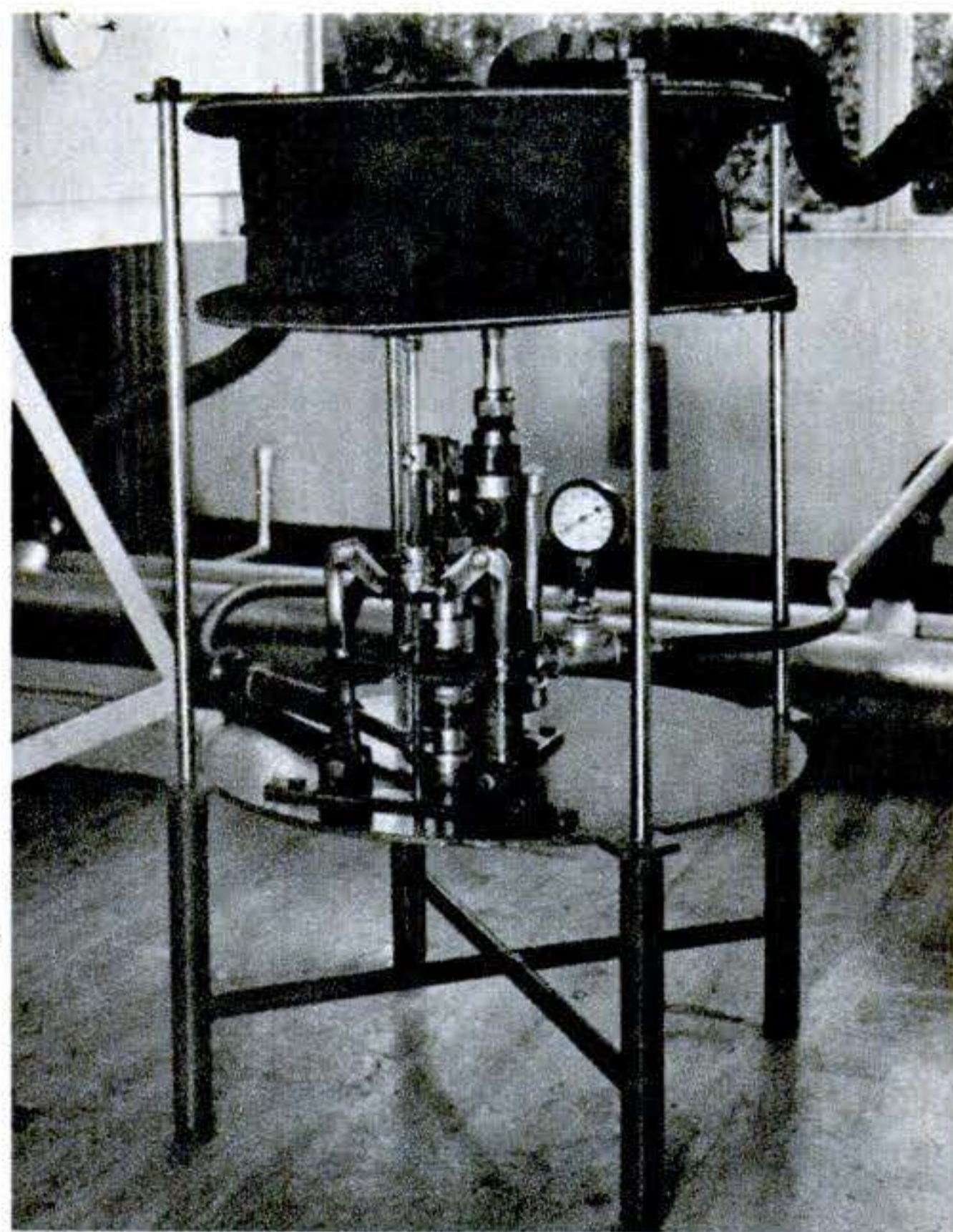
WHEN an Australian polio sufferer died in an iron lung because of power failure, E. O. Cartwright, an engineer in a Melbourne hospital, decided to do something about it. Seven weeks later he came up with a simple respirator that can be operated from almost any household water supply.

The "lung" of the machine, a cylindrical rubber and fabric bag 22 inches in diameter and 9 inches high when expanded, is connected by a rubber hose to the respirator cabinet in which the patient lies.

Underneath the bag is a double-action hydraulic ram. First action of the ram is to expand the bag, withdrawing air from the cabinet and causing the patient to breathe in; this is followed by a contraction of the "lung," forcing air back into the respirator, making the patient exhale.

A bridle valve controlled by the motion of the ram directs the flow of water for the two actions of the "lung." From eight to 40 respirations a minute are claimed for the pulsator, as compared to the 17 to 36 of an electrically operated iron lung.

The inventor has patented his respirator, but has made plans and details available free to anyone who needs them. He estimates that it can be built for about \$300.



A water pressure of only 40 pounds is required to operate the ram that inflates and deflates the "lung" of the pulsator.

Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? *Popular Science Monthly* will pay five dollars for every such suggestion that its editors decide to publish. Suggestions cannot be acknowledged or returned.

I'd like to see them make

Cartoons by SYD LANDI



Easy-Reach Washbowl. There would be no stooping or stretching at a sink that could be adjusted to suit the whole family; says Louis Goodman, of Los Angeles.



Self-Extinguishing Matches. For the absent-minded, Joseph Krosetz, of Bethlehem, Pa., suggests matches that would die out before burning down to the fingers.



Safety Side Lights. A light on the left front fender would mark a car's outer parts, often obscured by its headlights, claims George Morton, of Bristol, Tenn.



Adjustable Bumpers. Extended when parking, they would keep other cars from crowding you into a tight spot, points out Marcella Wilkinson, of Gaylord, Mich.



Tin-Can Detopper. To keep can tops from falling in after removal, Paul Johns, of Berkeley, Calif., would equip the can opener with a suction cup to grip them.



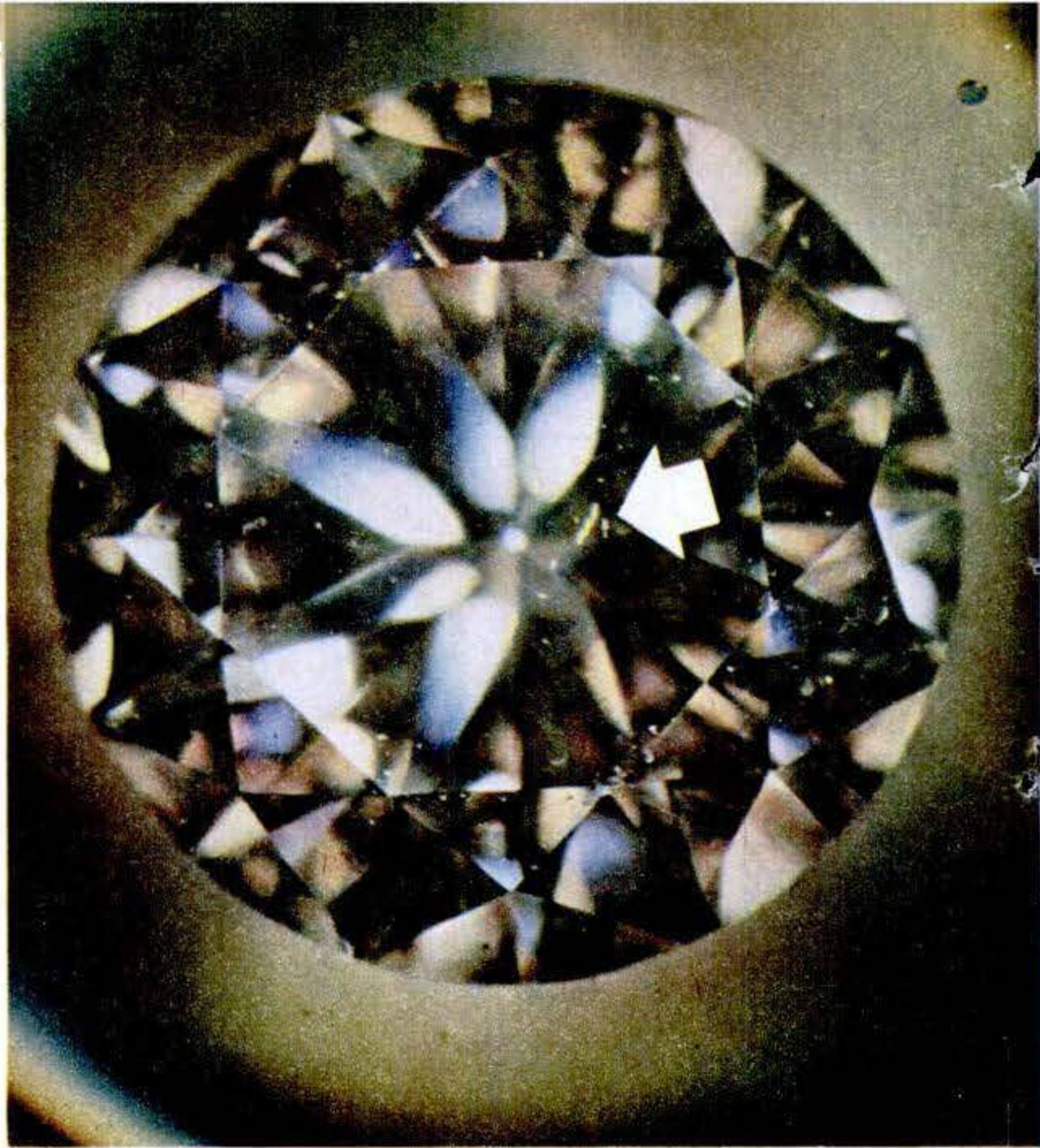
Circular Refrigerator. One with revolving trays would end hunting for food that is always at the back, declares Donald Rademaker, of Detroit, Mich.

Fingerprinting Diamonds

TAKE a good look at this microphotograph of a diamond and you'll see tiny flecks—there's one just to the right of center. With their help, it may become impossible to disguise a stolen diamond. For these specks may identify the gem as surely as the ridges on your fingertips identify you.

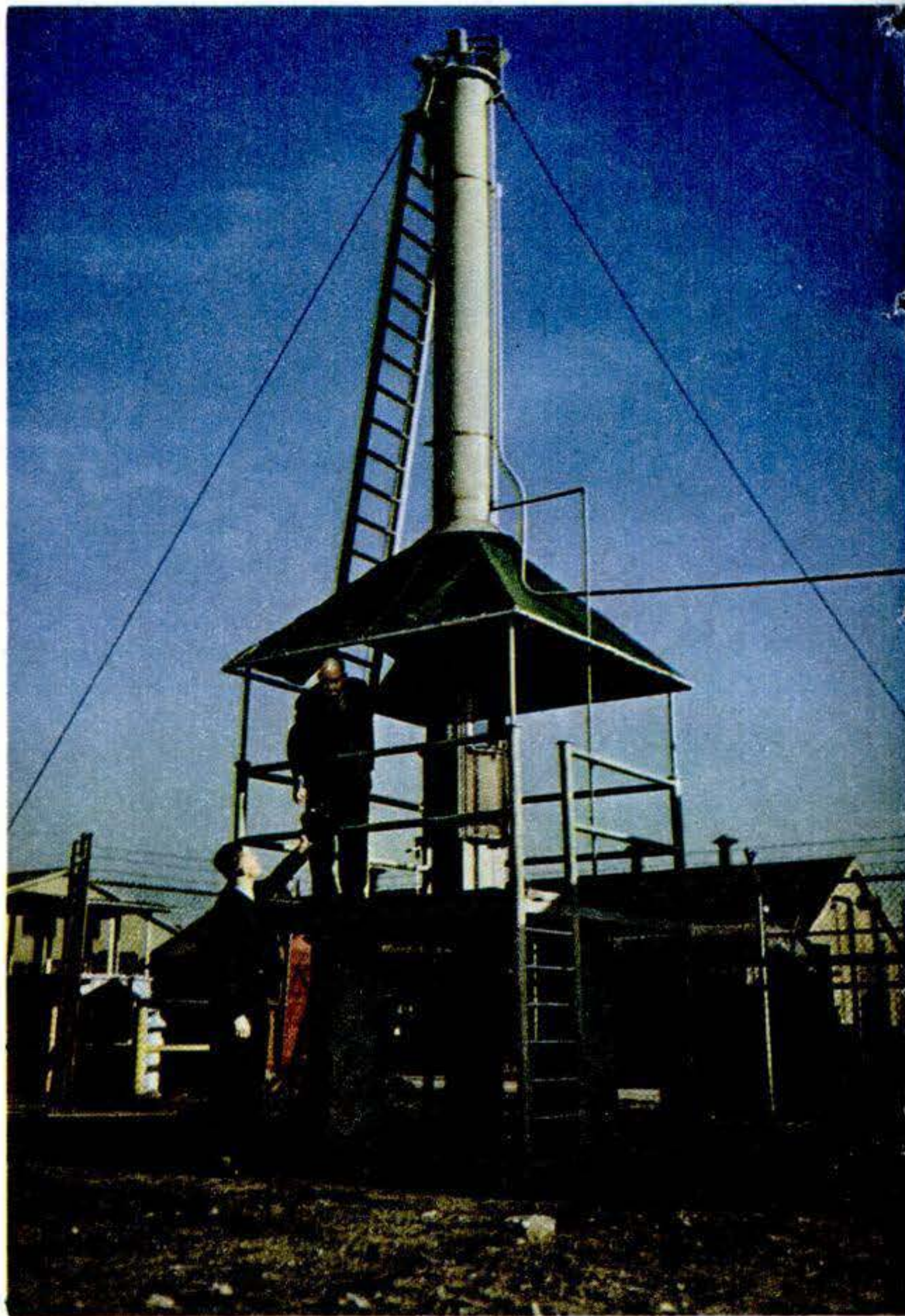
Each fleck is an "imprint," a natural variation in the stone's structure. Experts of J. R. Wood & Sons, diamond ring makers, believe that the imprints of every diamond differ from those of every other. If so, a microphotograph provides a permanent record that even recutting cannot alter.

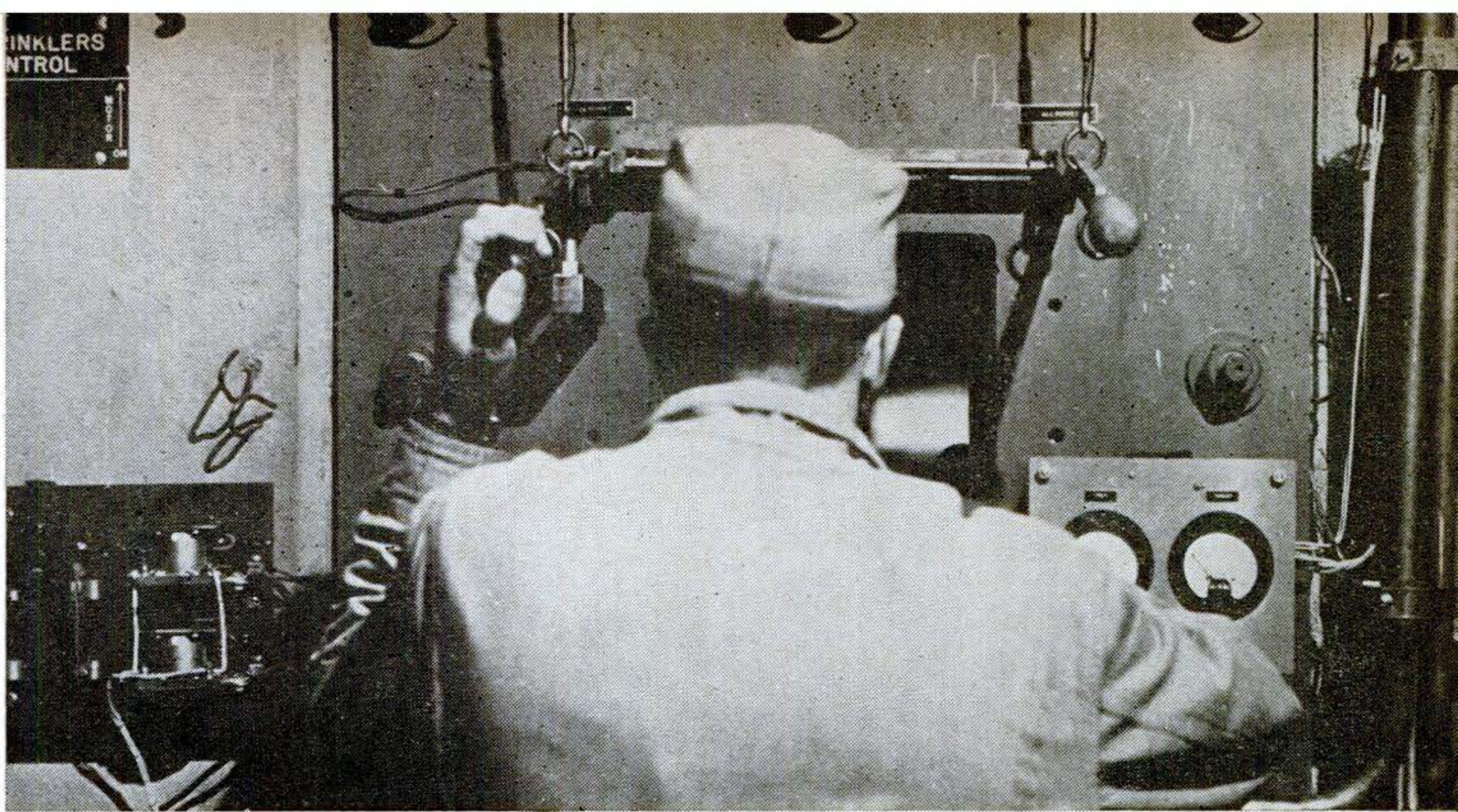
Officially, a "perfect" diamond is one that shows no flaws under a 10-power microscope—even the finest is believed to reveal an imprint when photographed through a 30-power lens. The "huge" gem pictured is really less than a carat.



Air Gun Tests Plane Parts

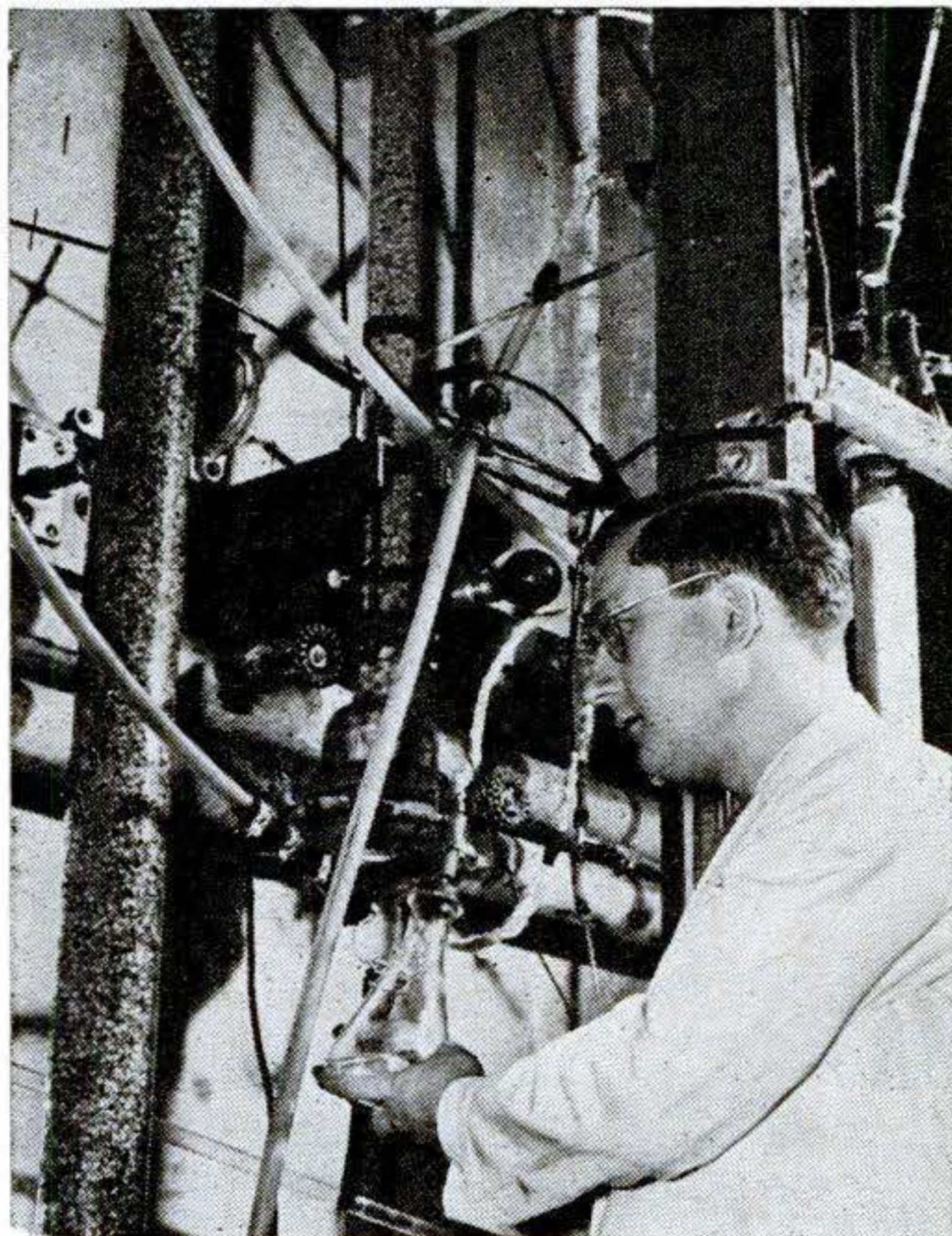
BOEING'S Accelerator Test Mortar at right is probably the biggest popgun ever made—and every time it goes off it helps make aircraft safer. Compressed air fires a cartridge carrying parts for high-speed planes or guided missiles. Fifty m.p.h. is reached in just nine inches, testing the equipment with a strain equal to 100 Gs. A cushion of compressed air halts the cartridge in 90 to 100 inches. The mortar's control board is shown below: the engineer at left stands by the trigger. Gauges on board show air pressure while the oscillograph and scope record the behavior of electrical equipment under test.



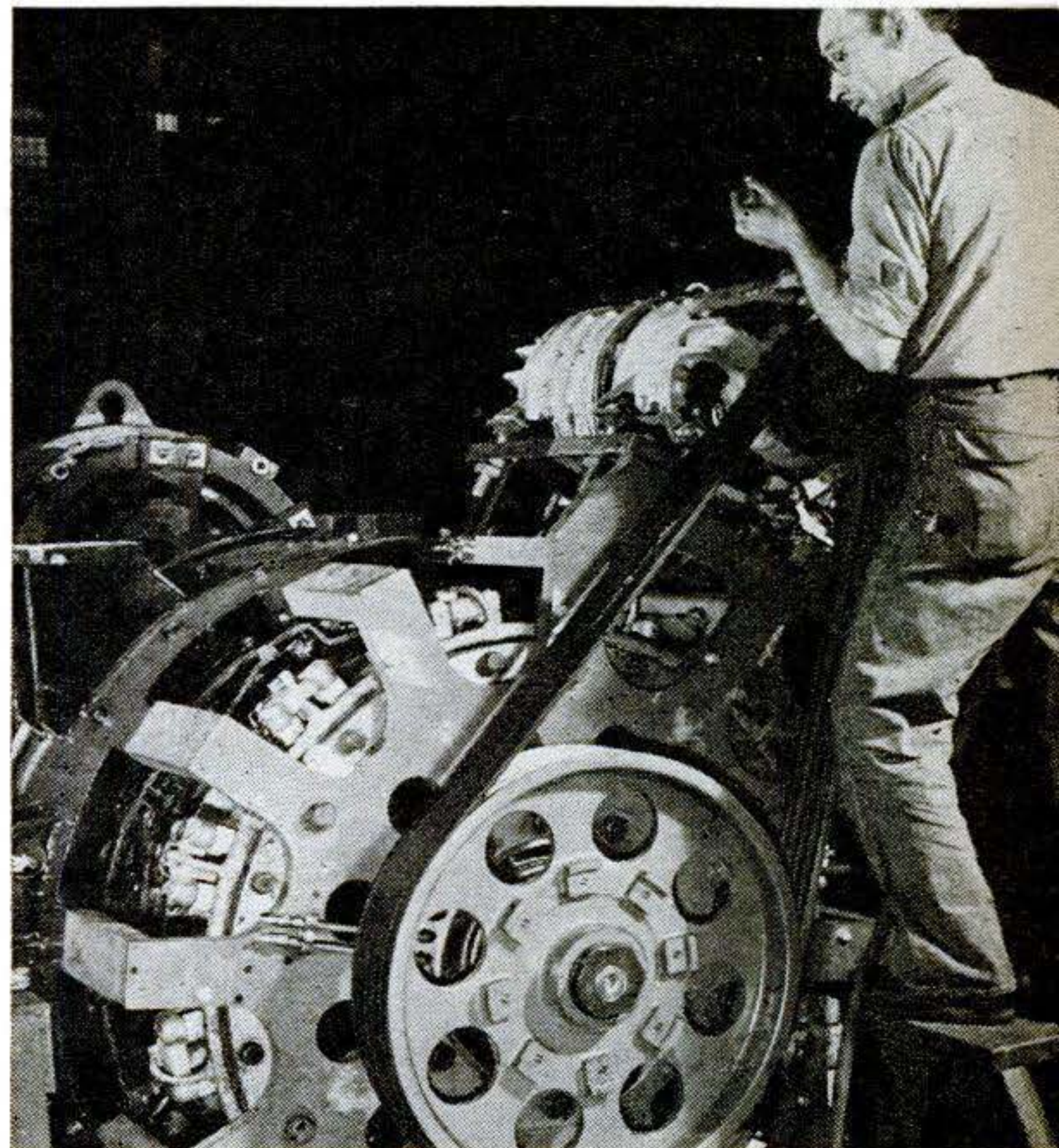


Watching Rockets at Work. Protected by three feet of concrete and nine inches of bulletproof glass, this technician is observing the exhaust blast of a rocket motor he has just set off in a test pit at the GE-

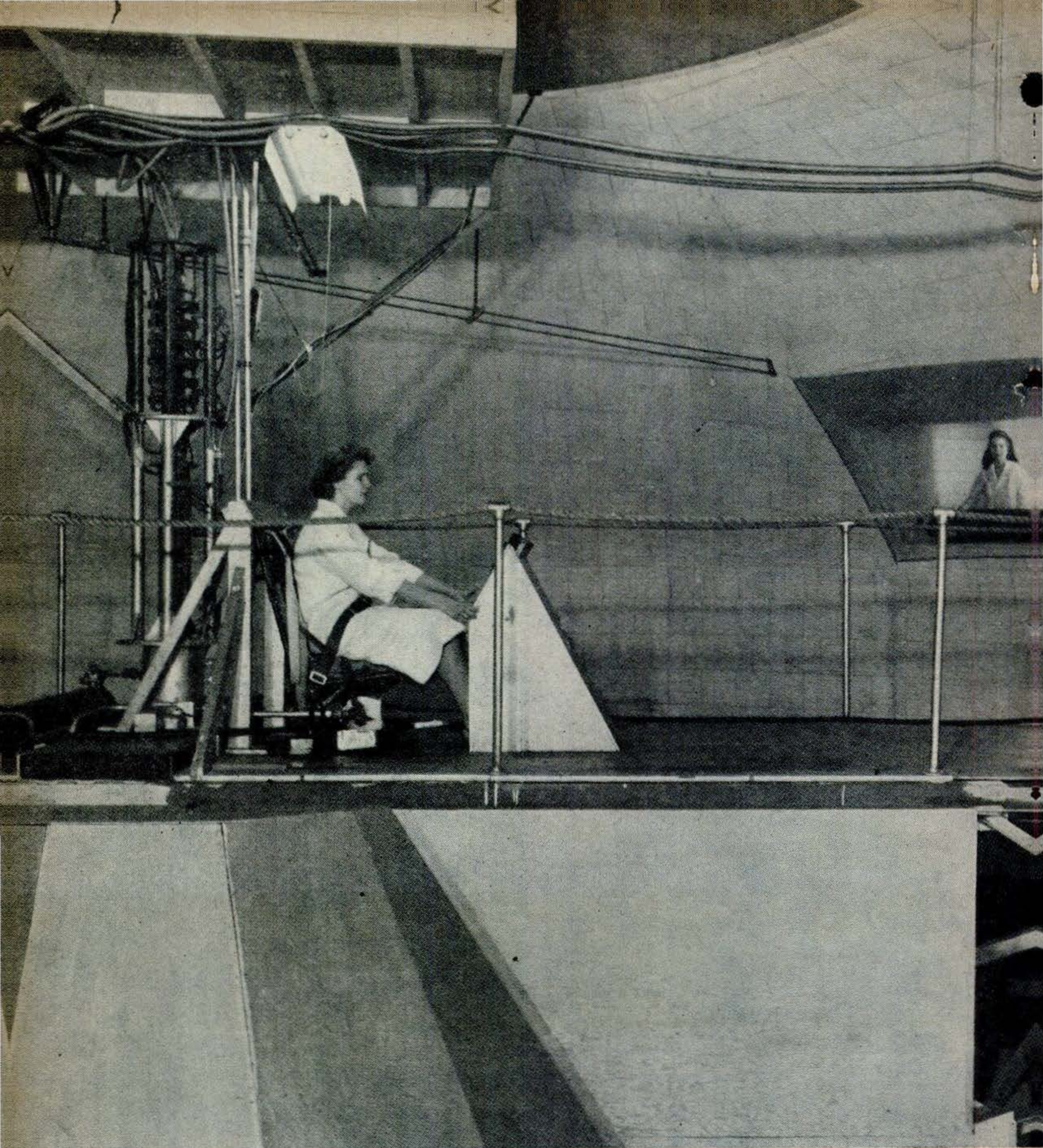
Army Ordnance rocket research station near Schenectady, N. Y. First of its type in the U. S., the isolated station has been providing ground-test data on rocket performance for more than a year.



Catching an Isotope. Carbon 13 for "tracer" research on cancer is being produced by Eastman in concentrations twice as rich as previously available. Here some of the 50-percent concentrate is drawn from one of two new fractionating columns.



Powering an Iron Horse. This husky generator, being assembled at the Westinghouse plant in Pittsburgh, will feed 1,500 hp. to the driving motors of a Diesel-electric locomotive. One engine of the latest type has five such generators.

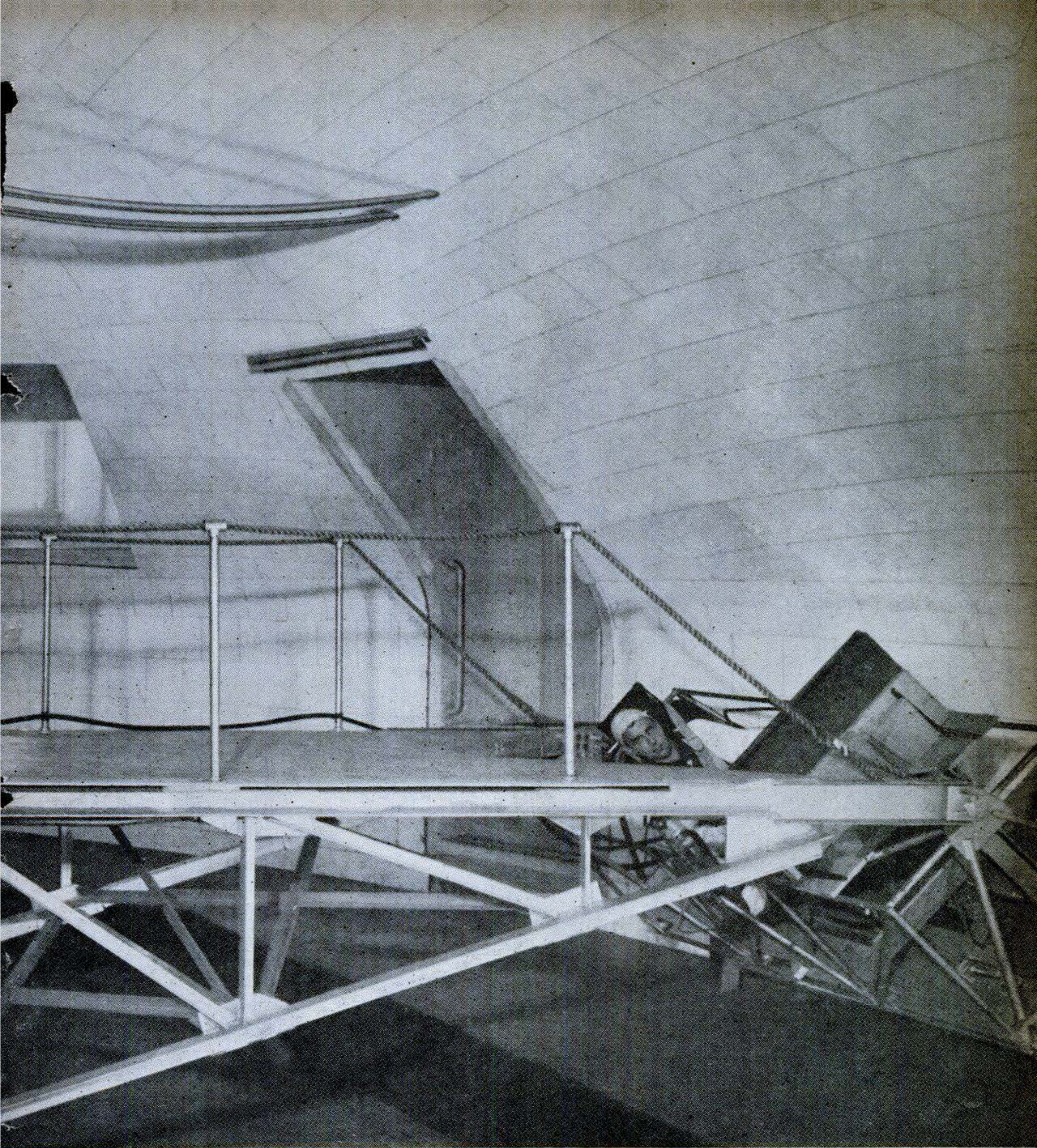


Pilot under test sits at end of turntable arm, at right. To test him under 5G strain, the 46-

foot turntable revolves 32 times a minute. It can make 166 r.p.m., but the pilot couldn't take it.

Battling the Gs

X-rays taken on "Whirling Dervish" show what internal stresses do to pilots.



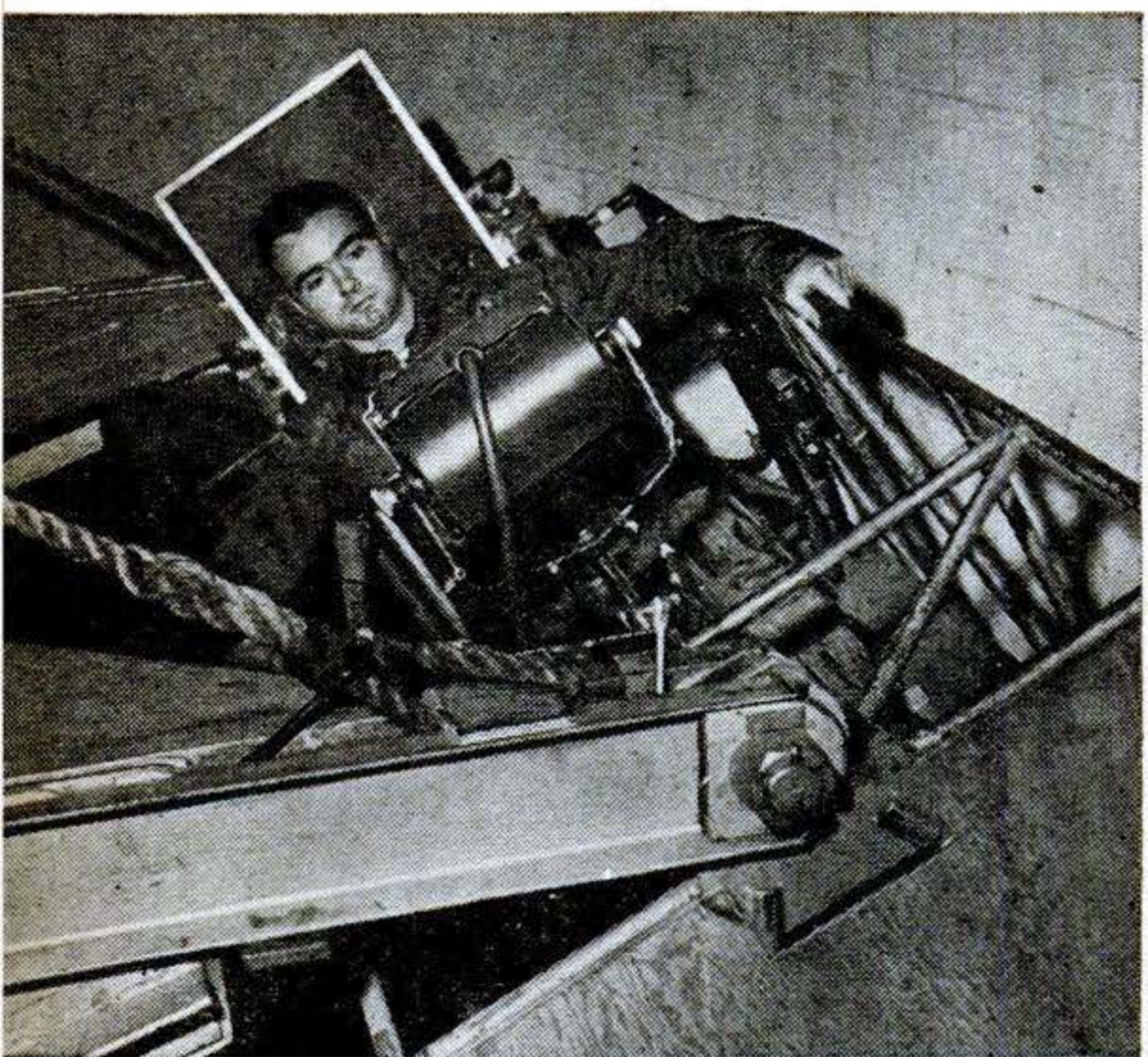
WHAT happens to a pilot's innards when he pulls his plane out of a screaming dive? With new experimental superspeed planes coming up, that's an increasingly important question, and University of Southern California scientists are getting an inside view of the answer. A portable X-ray camera snaps pictures as a turntable whirls

a pilot at high velocity, producing internal stresses similar to those caused by sharp changes of speed or direction during flight.

The X-ray plates reveal the resulting distortion of his internal organs. From them, Army and Navy researchers have learned that under 5G pressures the abdominal wall bulges, while the diaphragm and heart drop



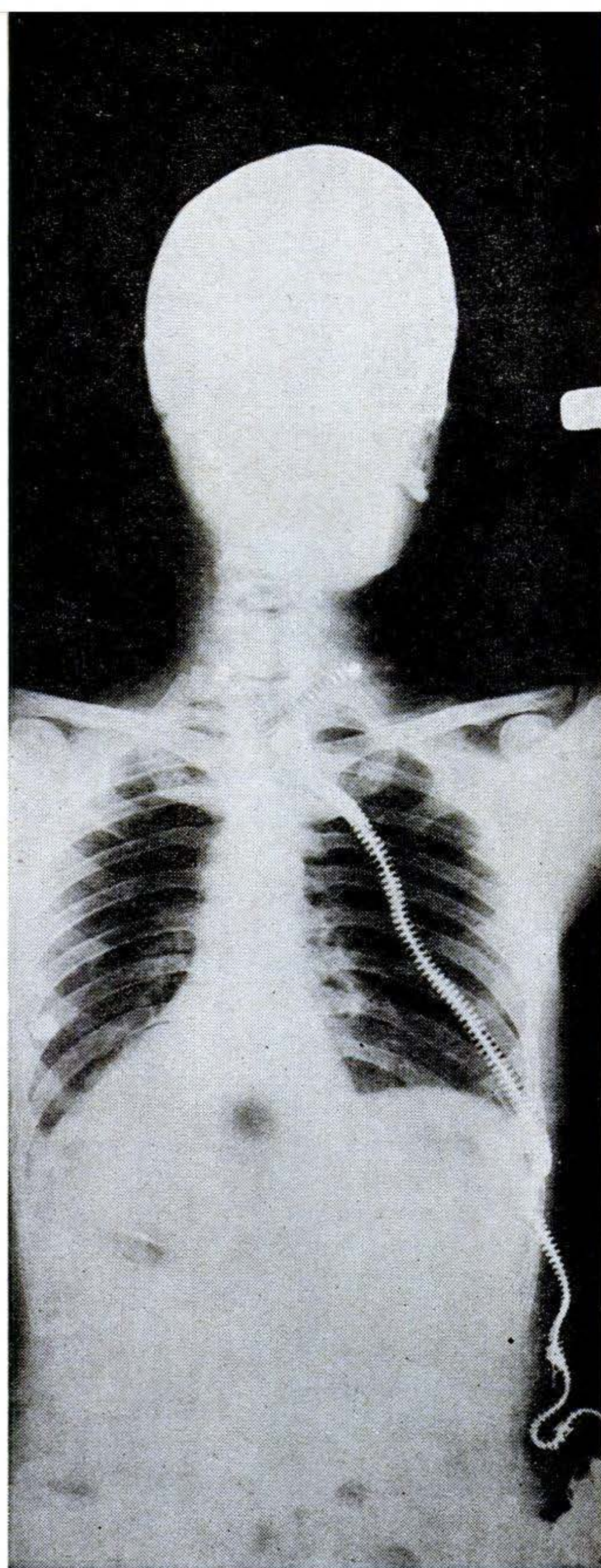
This pilot is about to be tested under negative G—a force pushing the blood and organs toward the head, as in an outside loop.



Testing a Navy G-4 antiblackout suit, pilot sits back against a 14- by 36-inch X-ray negative. Wide-angle X-ray machine faces him.

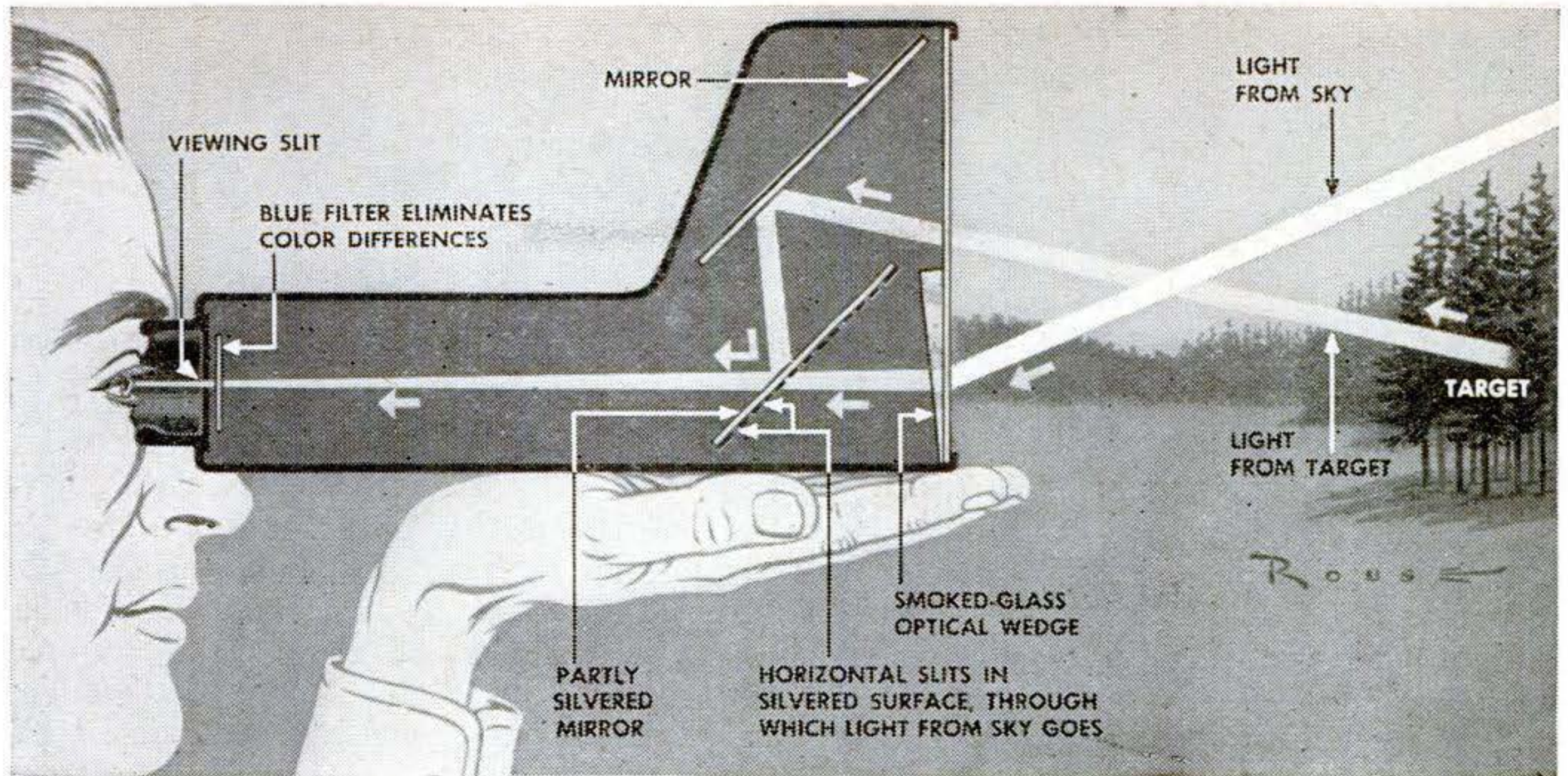
as much as two inches. With an antiblackout suit, however, pressure on the abdomen lifts the diaphragm as much as $3\frac{1}{2}$ inches. The heart is elevated a lesser amount to provide about $\frac{1}{2}$ G protection, altering blood pressure in both heart and brain.

The turntable arm also carries a meter that passes the air flow in and out of the



X-ray of pilot under 5G shows distortion in distance from heart (in center) to skull, and position of lungs (large dark areas).

subject's lungs through a fine-mesh copper screen. The slight change in pressure records the rate of flow. At the same time, a spirometer catches each breath in a water-sealed, oxygen-filled bell that bobs up and down, inking a graph. This measures the rate and volume of breathing and the changes of volume inside the lungs. **END**



How meter works is shown in cutaway drawing. Periscope view of trees, and strips of sky

seen through wedge and clear parts of lower mirror, give a composite image.

Meter Aids Fire Patrols

New optical instrument for foresters tells how far off a blaze can be seen and where watchers must be posted.

HOW far away can a forest fire be spotted? The answer to that puzzler is given by a meter invented by George M. Byram, of the Appalachian Forest Experiment Station, Asheville, N. C. With its aid, forestry experts find how far apart to space lookout towers, and when to order emergency lookouts to intermediate points.

What the meter measures directly is the amount of haze in the air. To use it, the observer points the cameralike device at a target (such as the shady side of a clump of trees) a known distance away. He sees 13 horizontal bands of graduated brightness

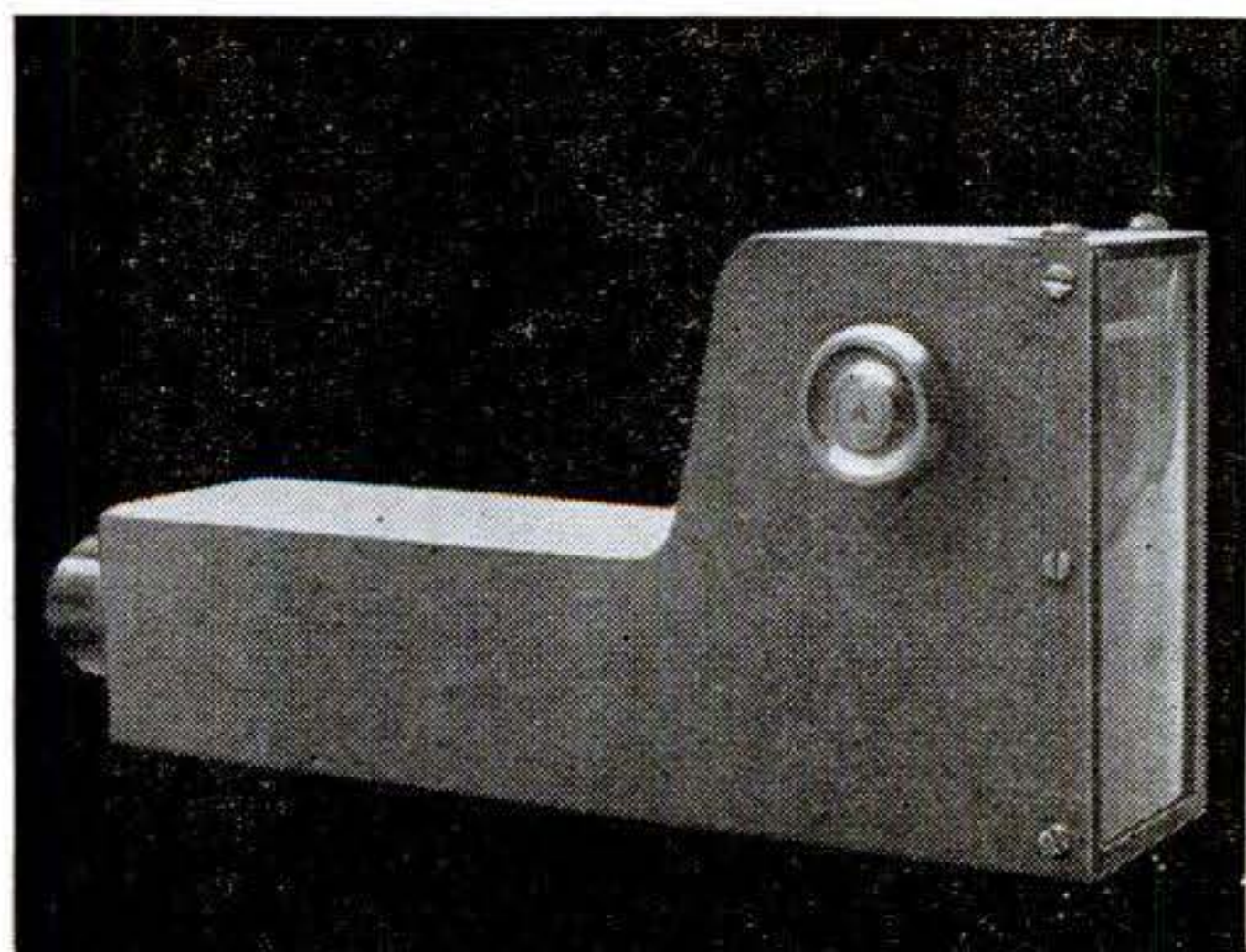
Haze meter is compact and simple to use. What observer sees is shown at right, below. Meter is registering No. 2 haze. (Middle band

alternating with glimpses of the landscape.

Tilting the meter, he brings different bands against the target until one band matches and merges with it. Noting the number of this band and referring to tables giving visibility in terms of haze, he finds the greatest distance that smoke from a small fire would be visible.

Two mirrors give a view of the target, as through a periscope. The lower mirror, not completely silvered, has narrow clear strips. Through these and a wedge-shaped glass prism, transparent at its point and darkening toward its base, light from the sky completes the composite image of a target crossed by bands. When a band disappears, target brightness must equal that of sky light through an indicated thickness of the wedge. Calibration of the wedge thus gauges target brightness and haze.

disappears against target.) Some of bands are omitted and differences in gradation are greatly exaggerated for the sake of clarity.



Lens Puts "Zoom" in Television

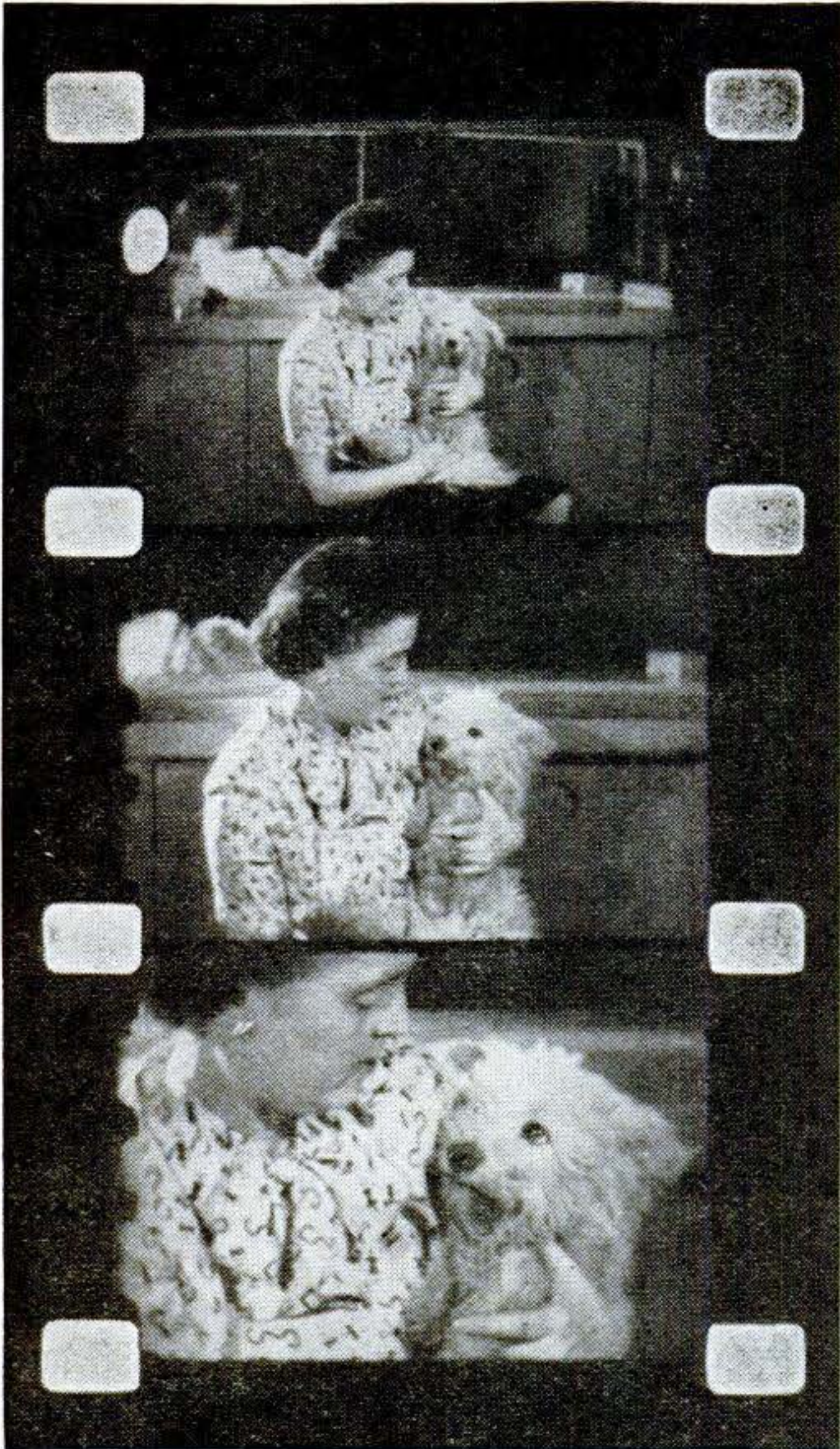
OUTDOOR television programs, long restricted by photographic difficulties, may soon rival studio techniques with a new varifocal lens that permits tricky changes from long shots to close-ups—formerly obtained only with moving dollies or booms.

Called the Zoomar lens, it is a combination of movable and fixed lenses that enables a photographer, using one stationary camera, to exert slight pressure on a lever or grip that will enable him to "zoom" from an over-all shot to a close-up.

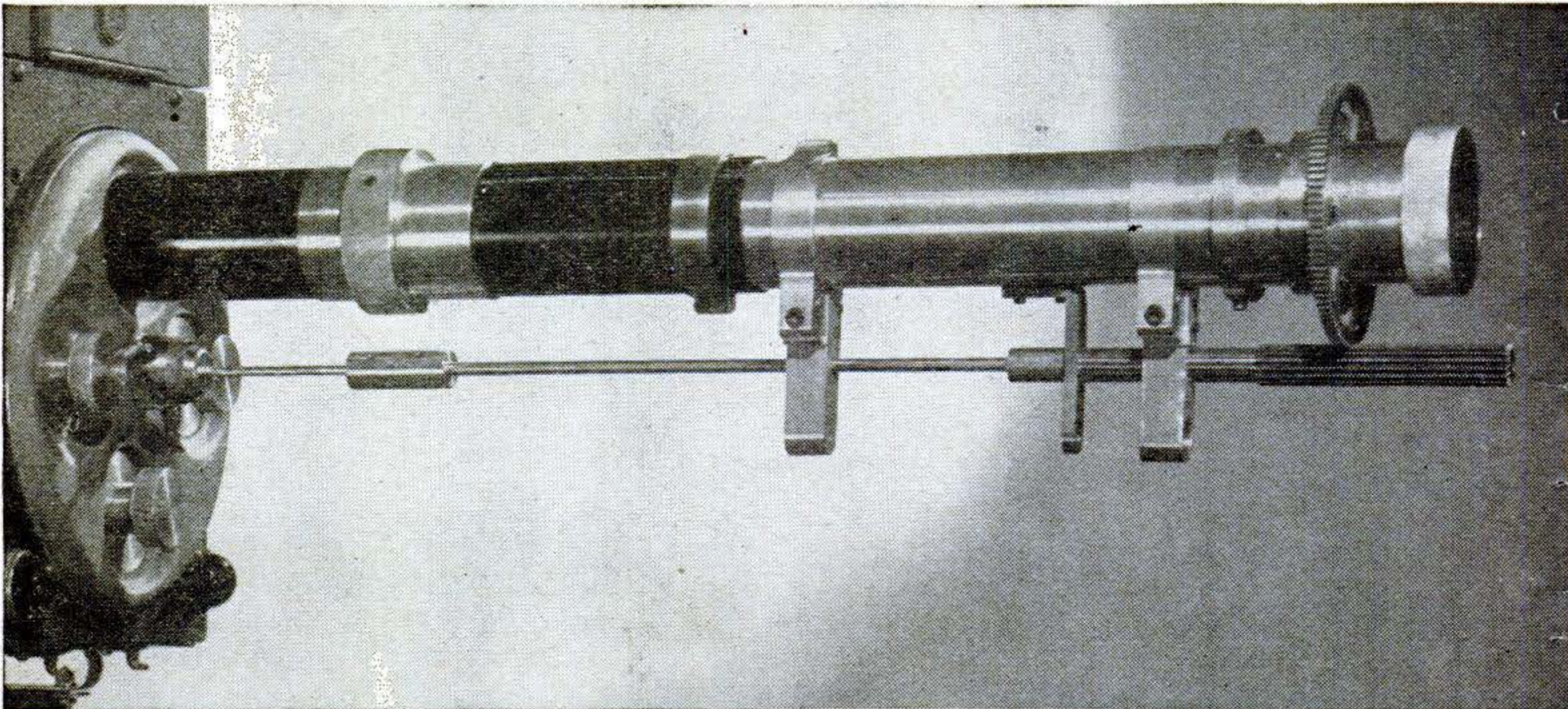
In televising a large outdoor ceremony, for example, he will be able, without moving the camera or changing the lens, to shift from a long shot of the crowd to a spot pick-up of any individual.

Although not designed to replace standard lenses, the Zoomar will also aid studio shots, supplementing dollies and booms.

The Zoomar lens was invented by Dr. Frank G. Back for use with a 16-mm. movie camera, and has recently been developed for 35-mm. filming and television in association with Jerry Fairbanks, an independent movie producer.

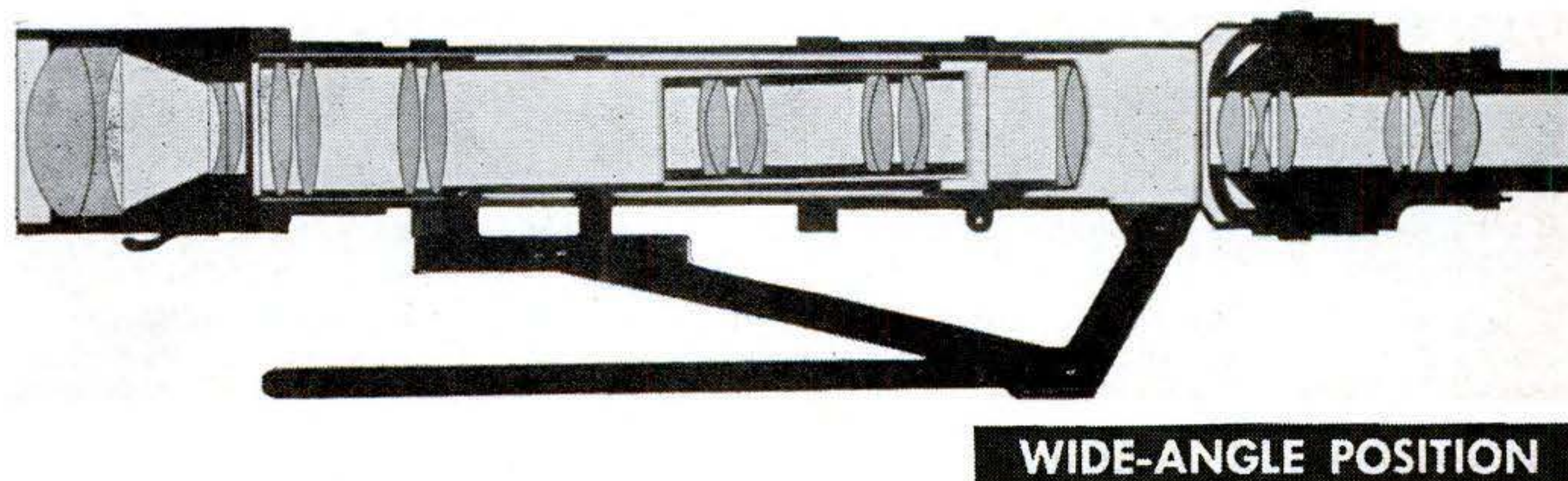
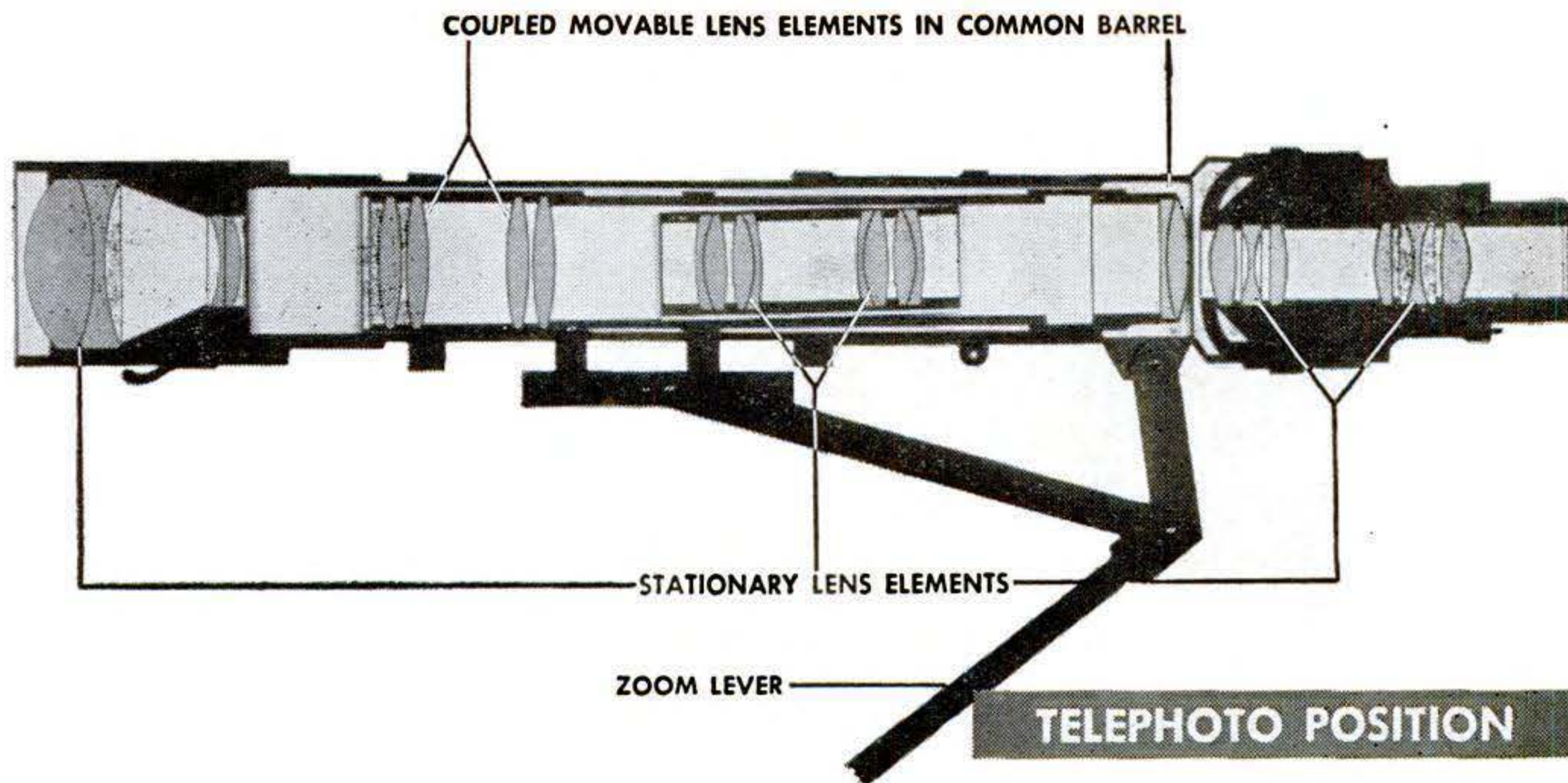


Three pictures, taken from one position without moving camera or subject or changing lenses, show zooming effect of the new lens.



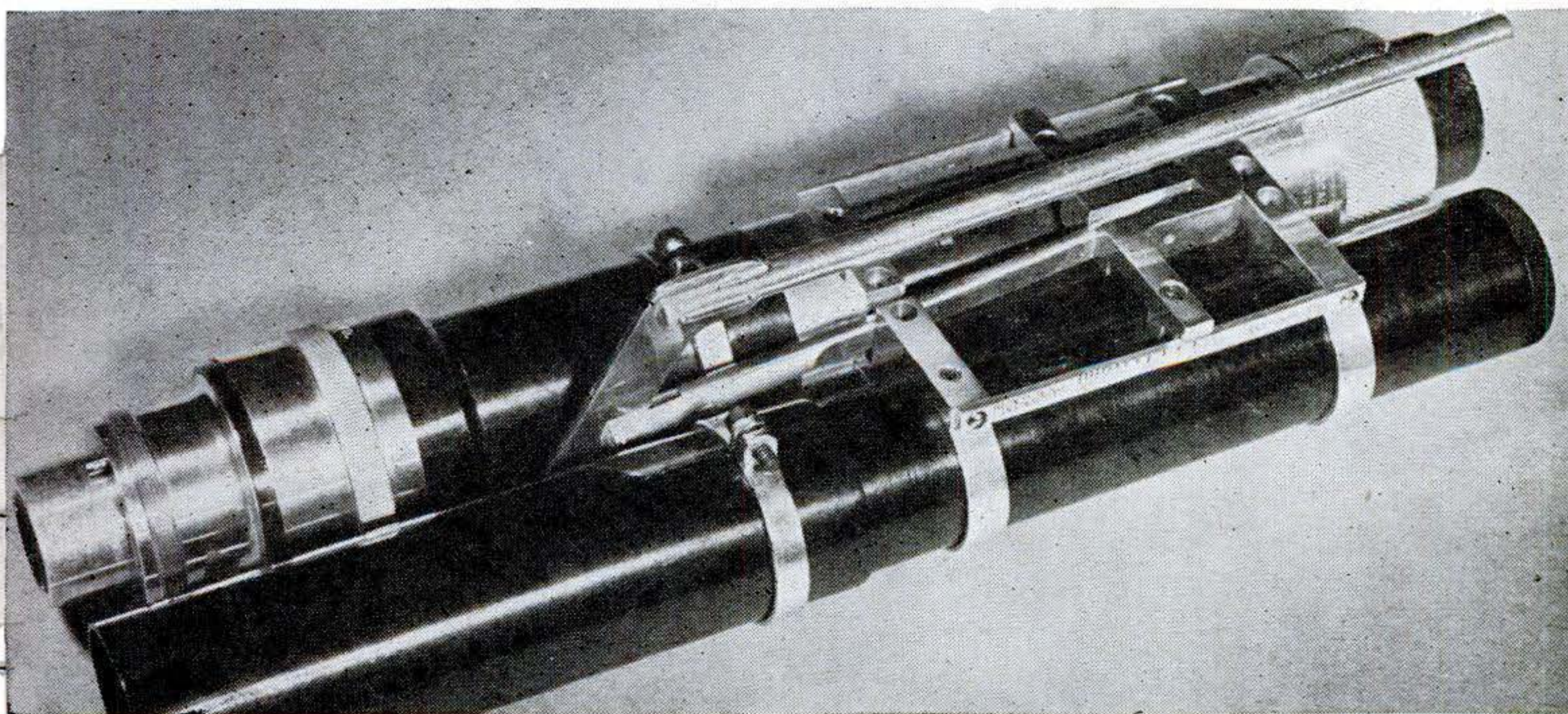
A television camera's Zoomar lens. Pistol-grip handle on camera (not visible in photo) enables photographer to shift smoothly from extremely

short to extremely long focal lengths in a continuous presentation, thus doing job of present battery of turret lenses.



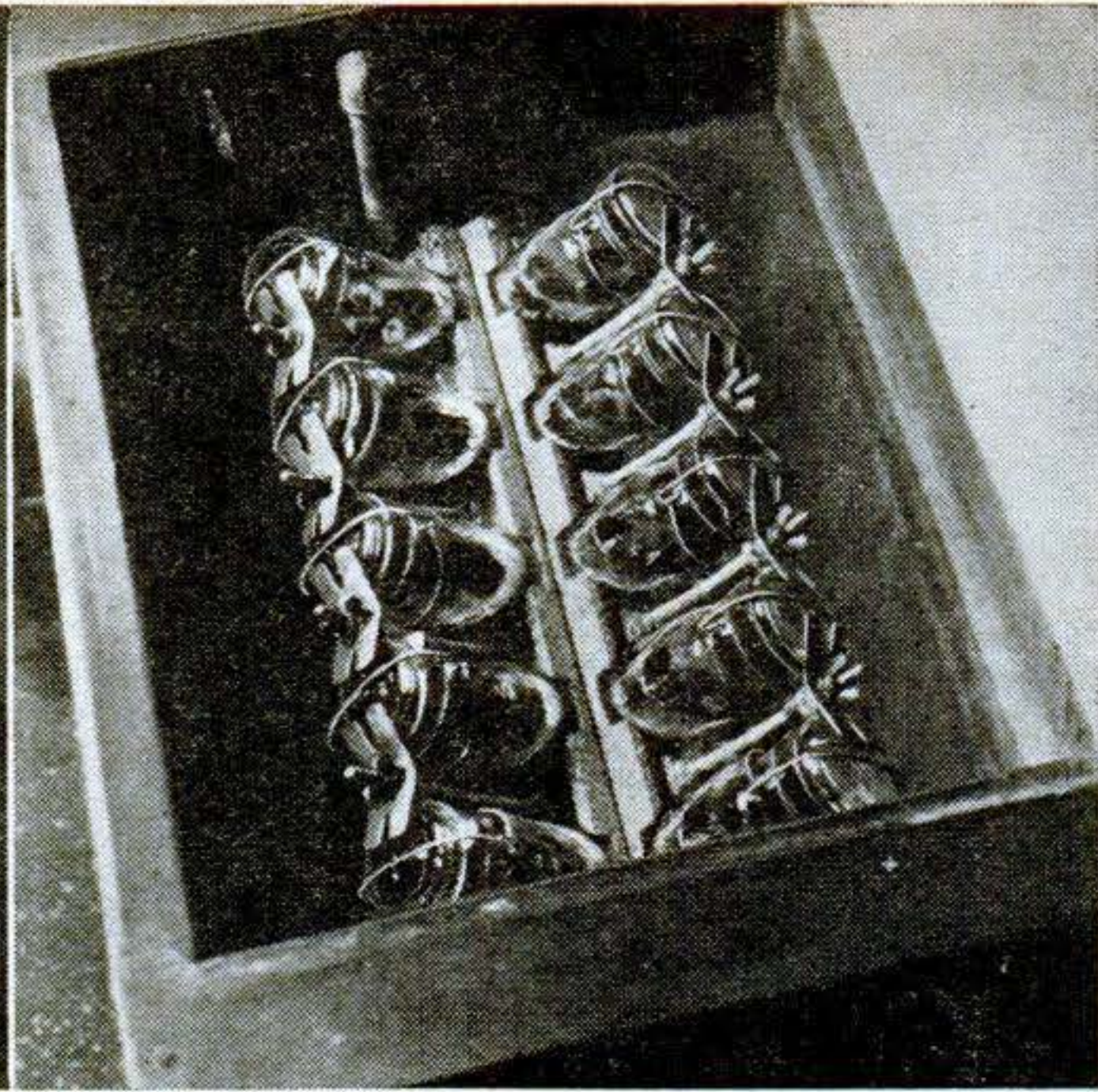
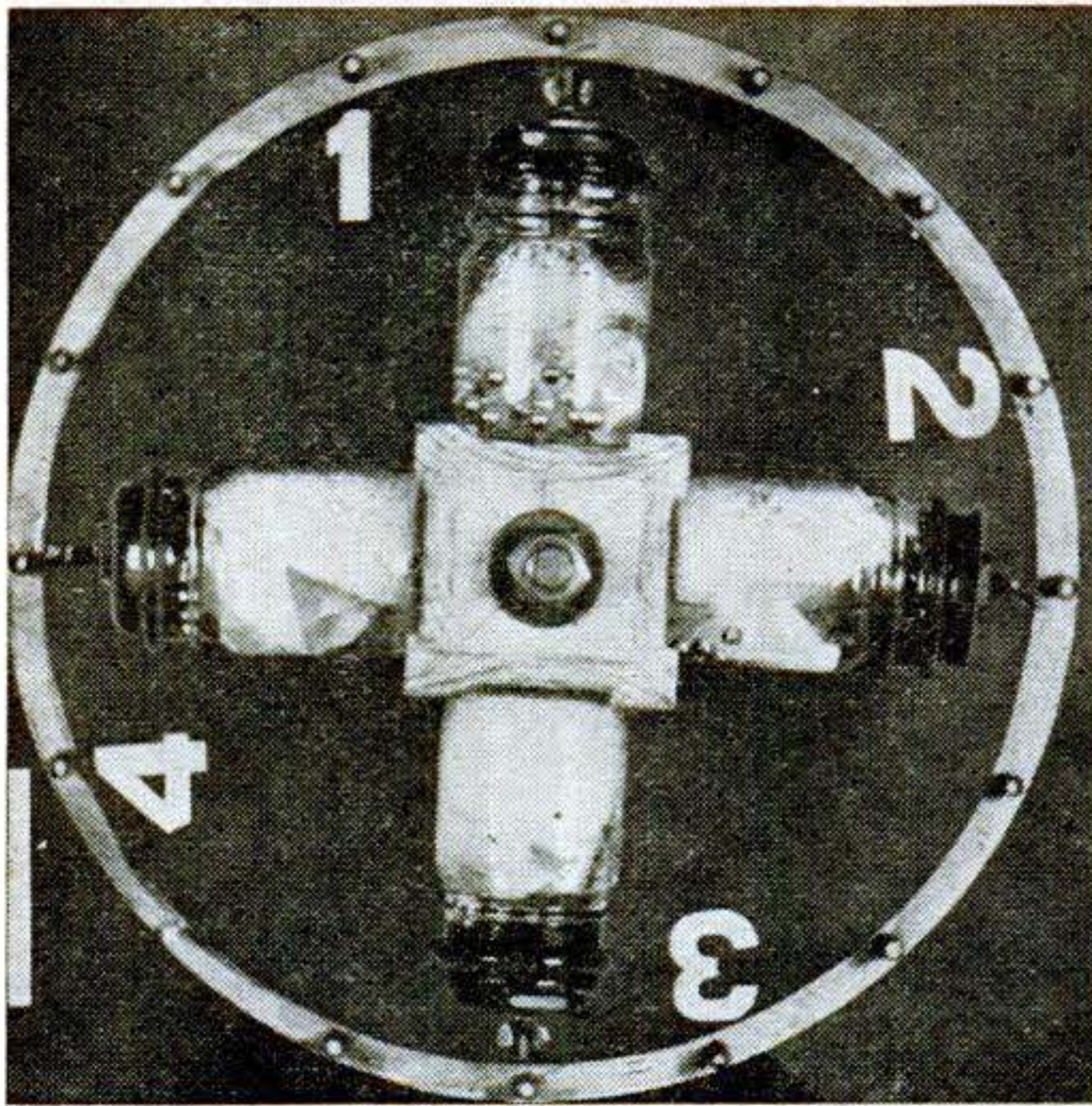
Lever action: Top drawing shows Zoomar lens with lever down for close-up shot. In bottom drawing it is in position for over-all shot. Zooming effect is obtained by shifting from one to

the other. Note changed positions of the movable lens units. The Zoomar technique is ideal for newsreels, sports films, or where a shift to details or individuals is desirable.



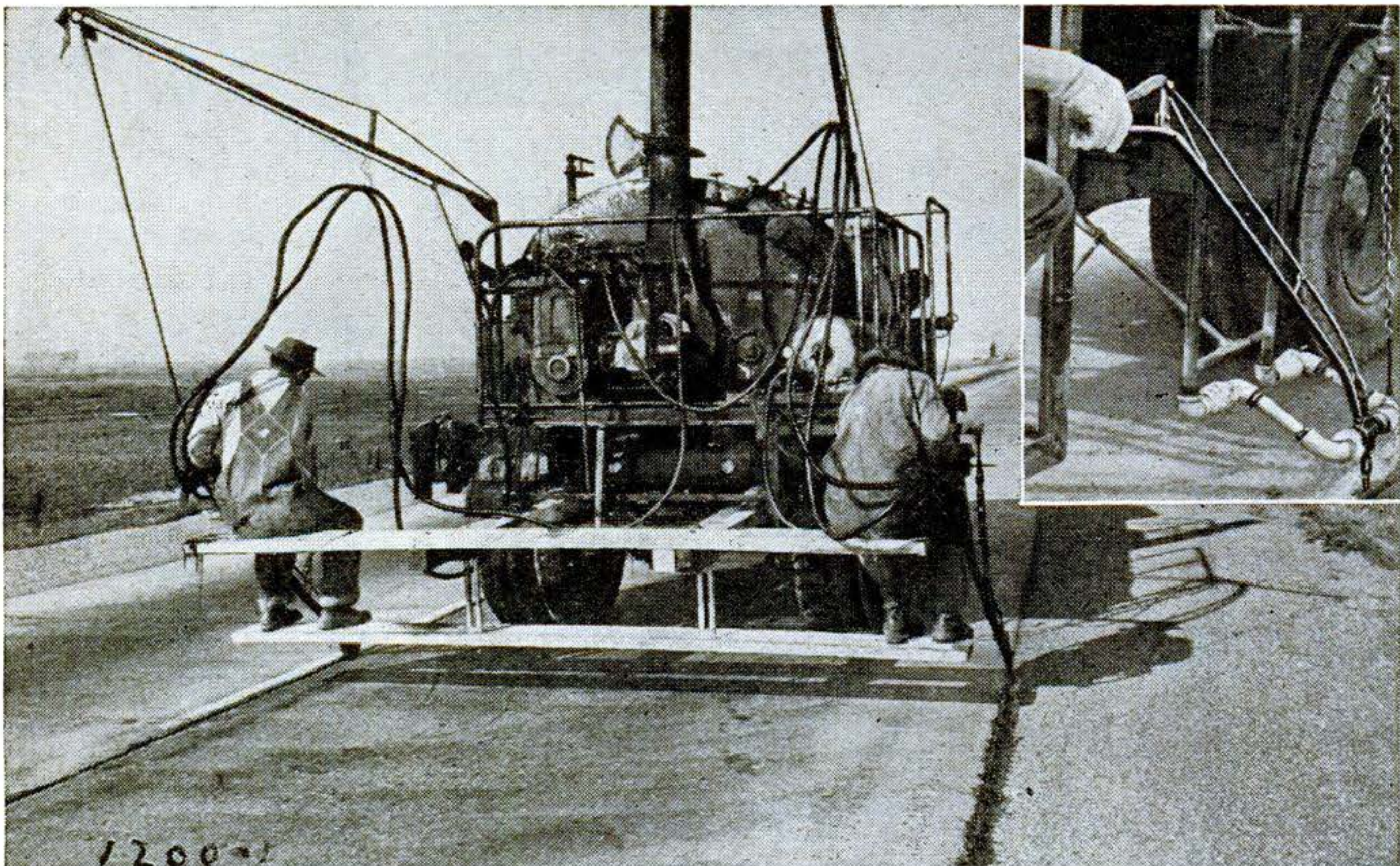
Close-up of a 16-mm. Zoomar unit now on the market. The view finder (outside tube) operates in conjunction with the zoom lever, and shows

exactly the same frame that the lens produces on the film. Television and 35-mm. units have not yet reached the production stage.



How Good Is a Soap? Du Pont researchers now measure the cleansing power of various soaps with the Launderometer, a machine that whirls jars containing small steel balls and squares of dirty cotton. The balls move up and down as the jars spin, and the amount of work they do in beating out the dirt can be calculated from their

weight, the speed of rotation and the time required. Since soap merely loosens dirt, the amount of work needed tells how good a soap is. The photo on the left, above, taken at 1/500 second, shows the machine at work; the steel balls are just falling to the bottom of jar No. 1. On the right is a whole battery of jars arranged for testing.



Joint Sealer Rides the Roads. Highway workers in California are able to seal expansion joints in concrete roads at the rate of 15 miles a day with this tank-truck unit. Air-blown liquid asphalt, heated to 350° in the tank, flows through pipes or

metal hoses to swivel assemblies, then out through nozzles directly into the joints. Inset shows hand-operated lever and rod controlling flow of asphalt. Proper sealing keeps out pebbles and other material that might prevent expansion of the concrete.

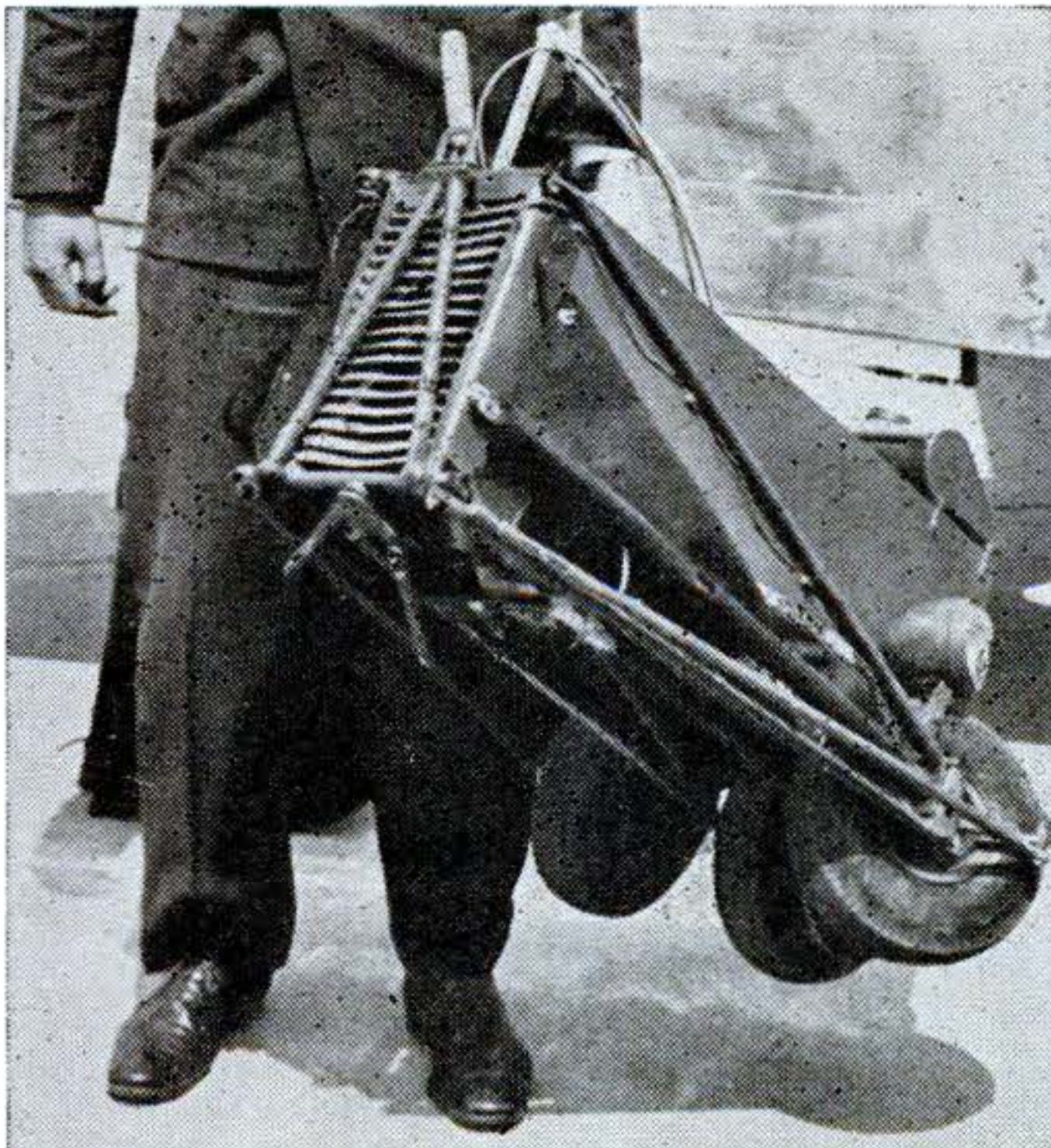
Car Folds to Suitcase Size



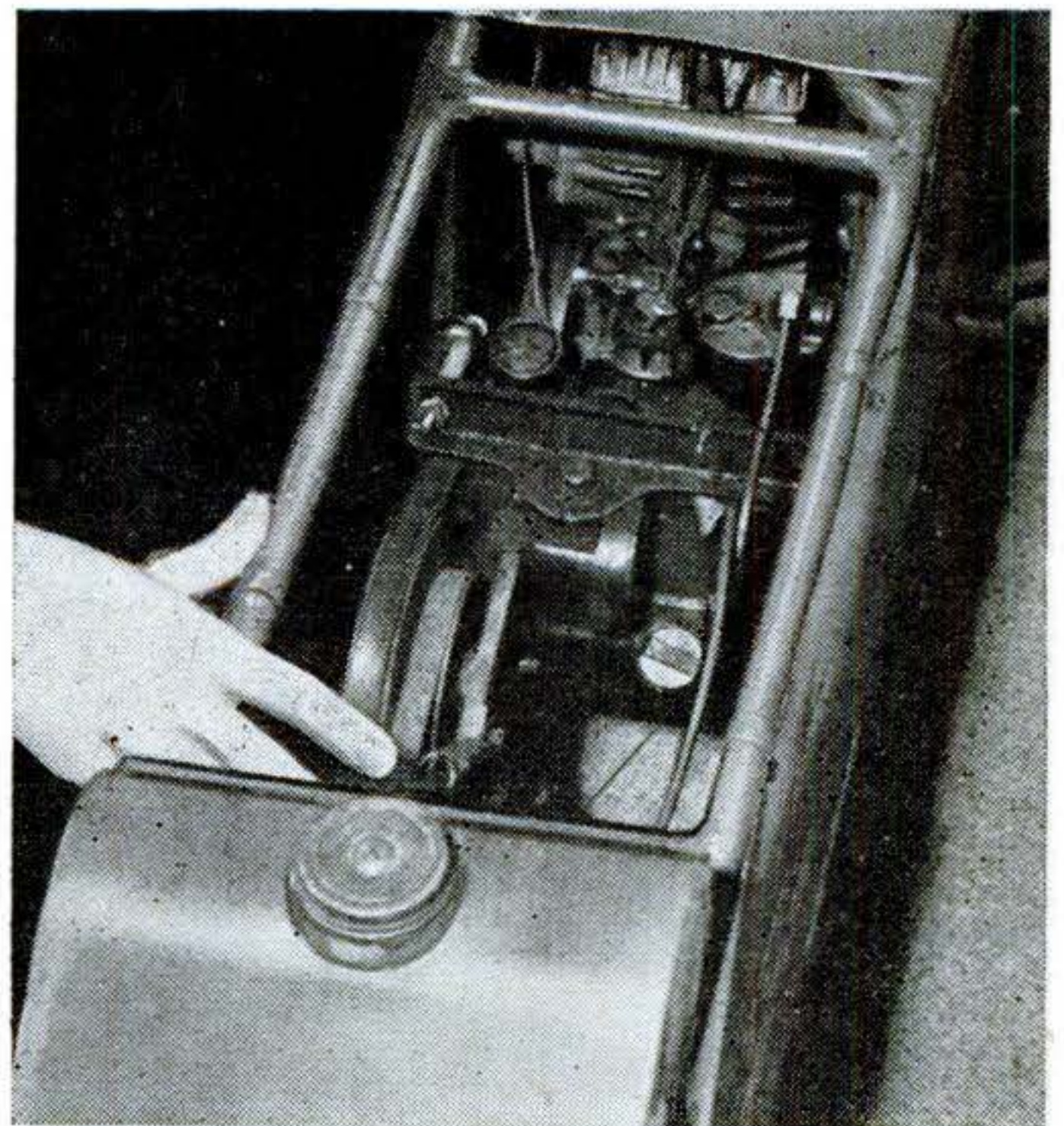
After unloading luggage, these motorists can fold up the car and check it with their bags.

MIDGET is really the word for this compact folding car that can carry two full-grown men, yet folds up into a package no bigger than a suitcase. Designed by the Aircraft Products Co., of Wichita, Kan., for transporting private plane owners to and

from airports, the "Airscoot" carries a payload of 450 pounds, weighs only 72 pounds, is 37 inches long and 20 inches tall. It has a top speed of 25 miles an hour, holds three-tenths of a gallon of gas and can average 60 miles to the gallon.



Made of aluminum and magnesium tubing, the folding car is carried like a suitcase. It can be unfolded and under way in one minute.



Close-up of the "Airscoot's" small, one-cylinder, four-cycle, 2.6-horsepower engine. Using no battery, the lights work off the generator.

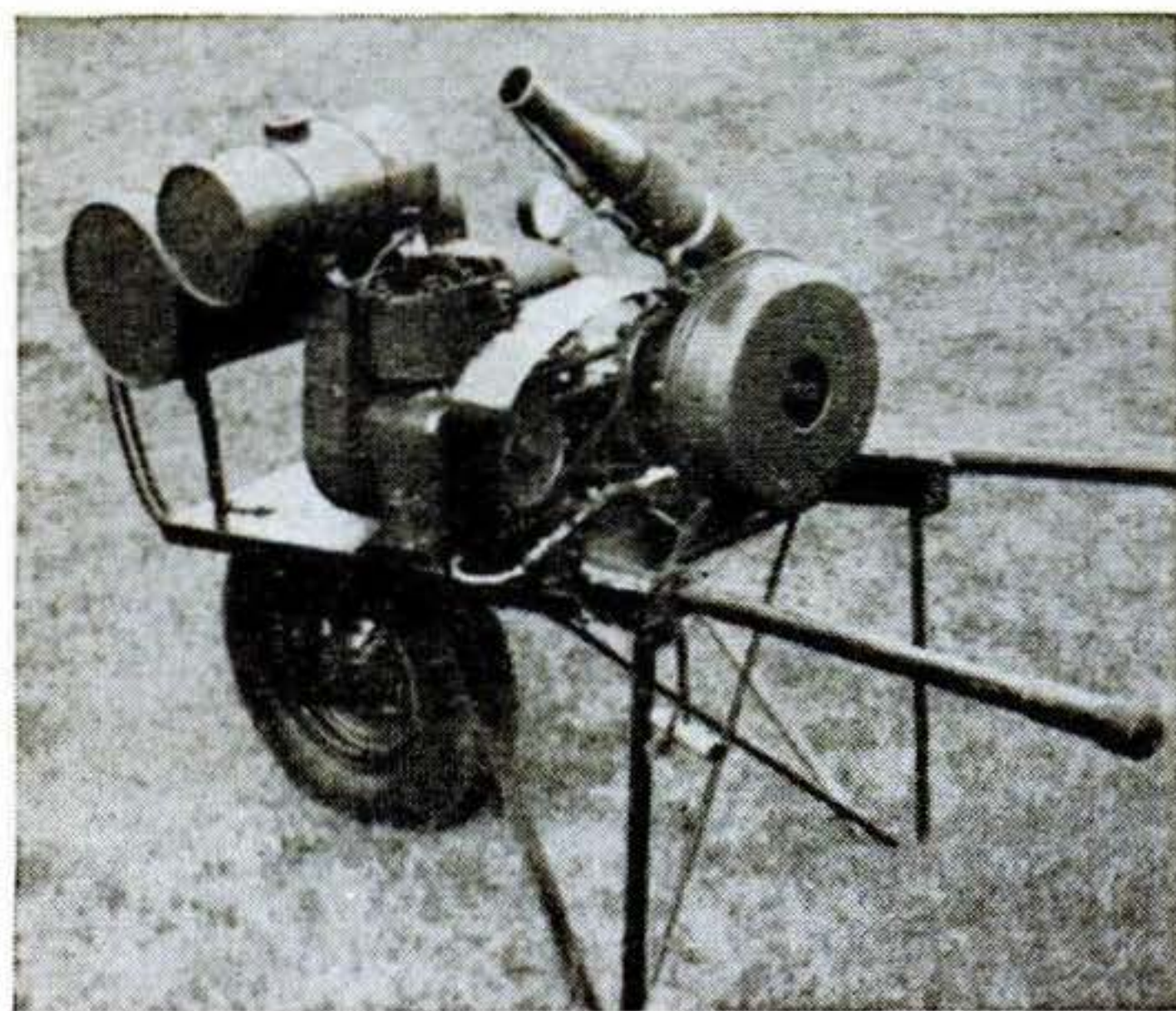
Mist Sprayer Steps Up War On Insects

Hurling a concentrated airborne fog, new power blower puts older types of pest-control apparatus in the shade.

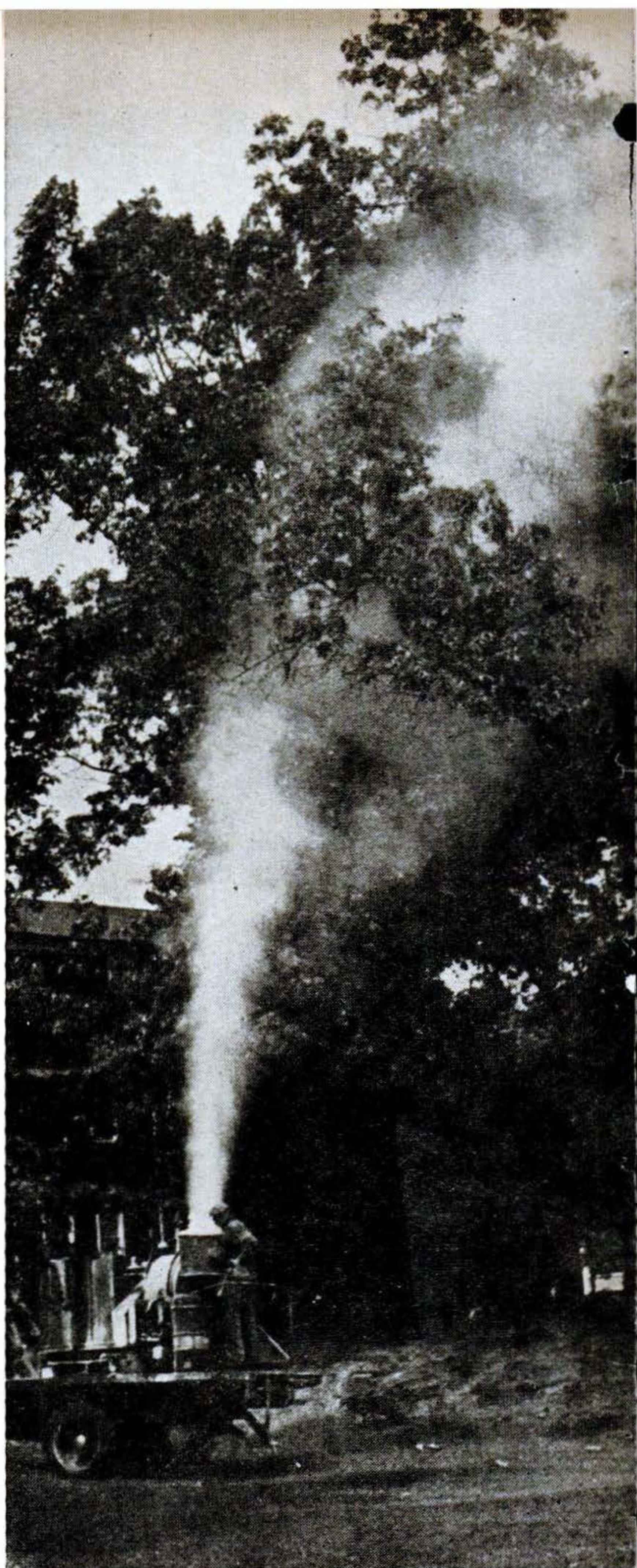
ON THE old principle of making a little go a long way, two Connecticut agricultural experts have developed a "mist sprayer" for trees and crops that is said to be up to 1,000 times more efficient than conventional equipment. Lighter and more compact than ordinary sprayers, it throws an atomized fog that can cover tall trees or float downwind for several hundred feet without losing insect-killing power.

Like ordinary power-spray apparatus, it consists of an engine, pump, tank, blower and nozzle. But it depends on air instead of liquid as a carrier and is designed to handle a small volume of concentrated spray instead of a large volume of a dilute solution. With a half-pint mixture containing two ounces of DDT, the mist blower can cover a sizable tree that would require six to seven gallons in an ordinary spray.

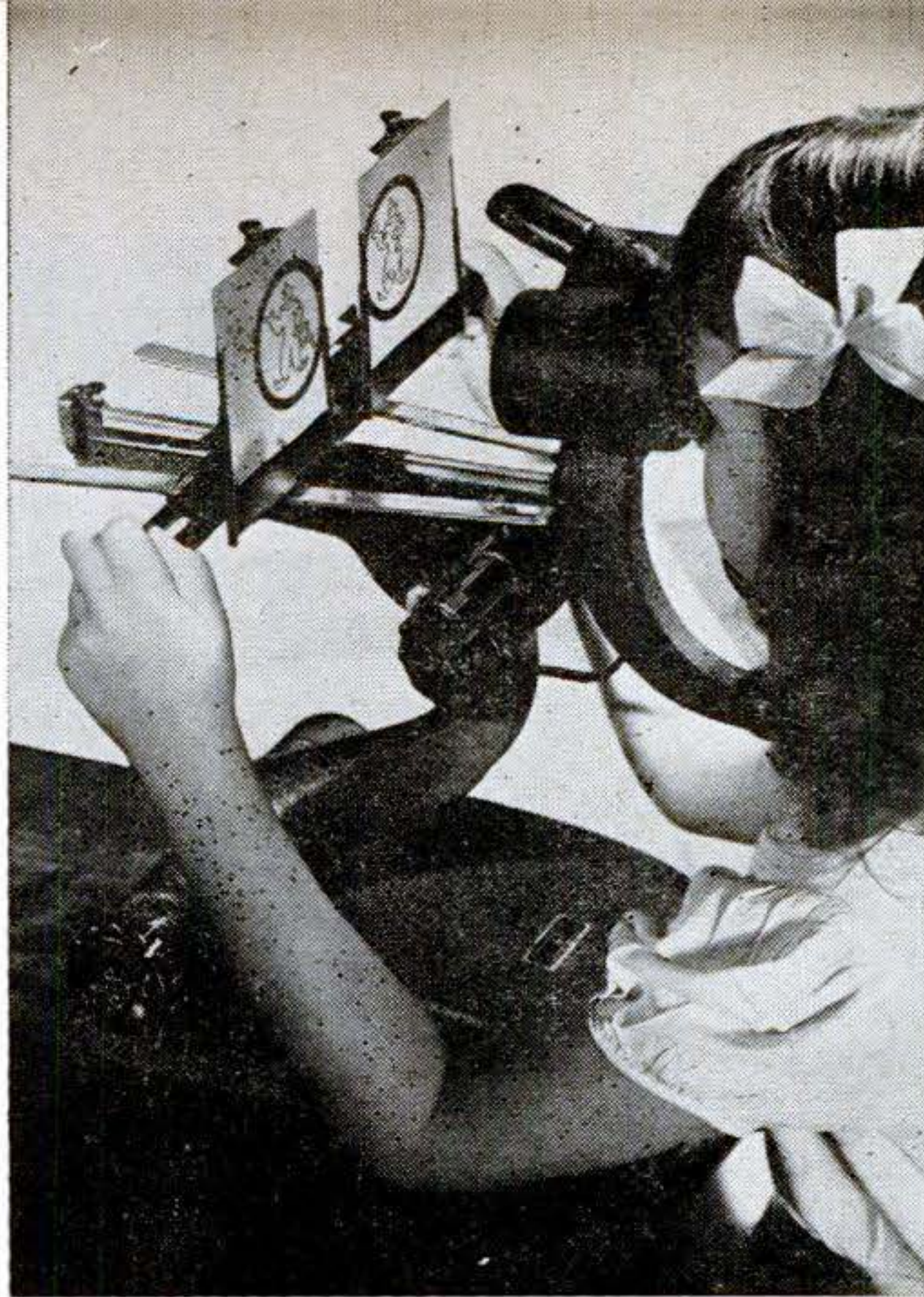
Developed by S. F. Potts and Dr. R. B. Friend, both members of Connecticut's agriculture research staff, the new blower is to be produced in several models.



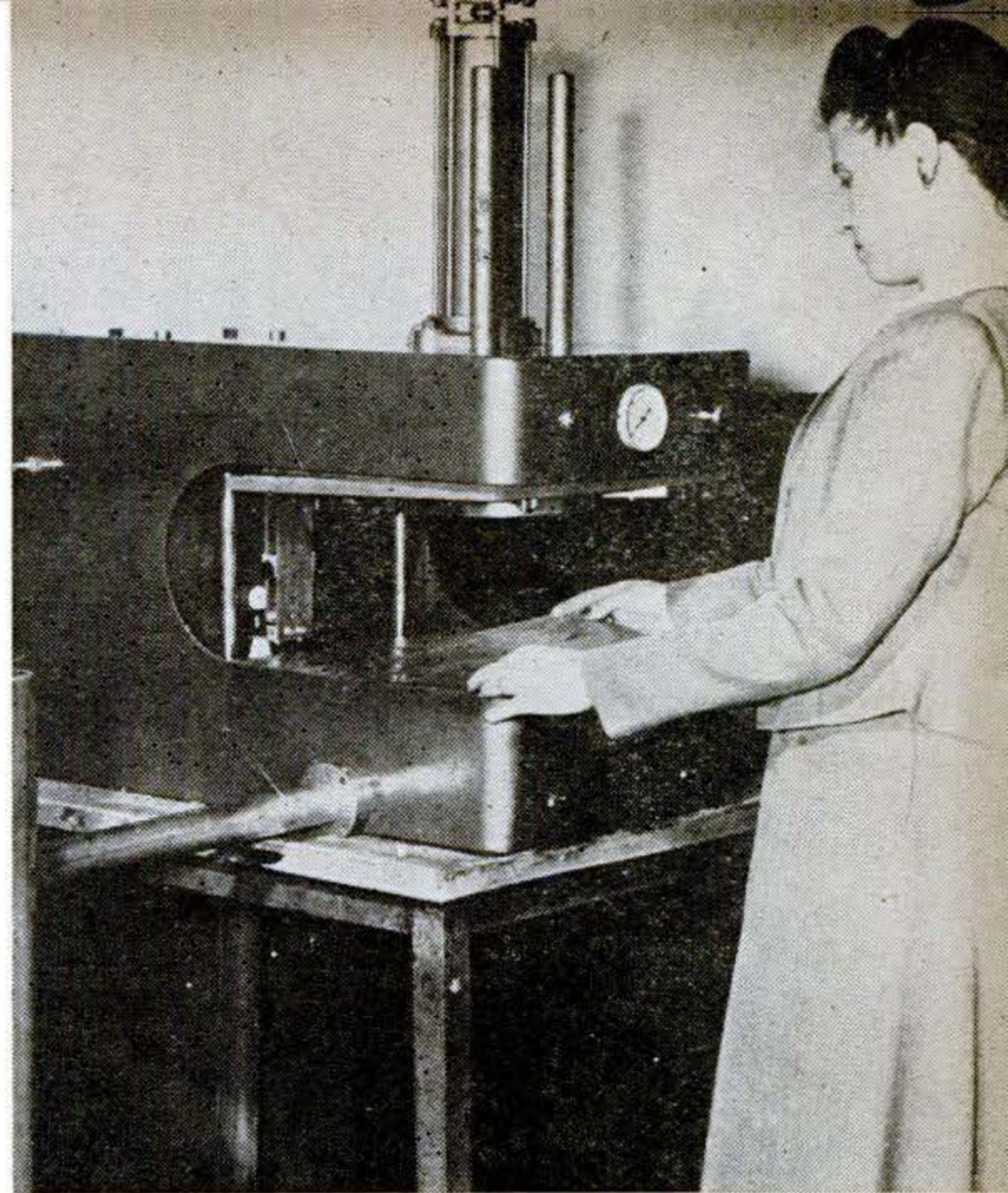
Wheelbarrow model has 1½-hp. motor, throws spray as high as 35 feet. Turning left handle of barrow controls amount of spray; turning right handle rotates spray nozzle through 180° arc.



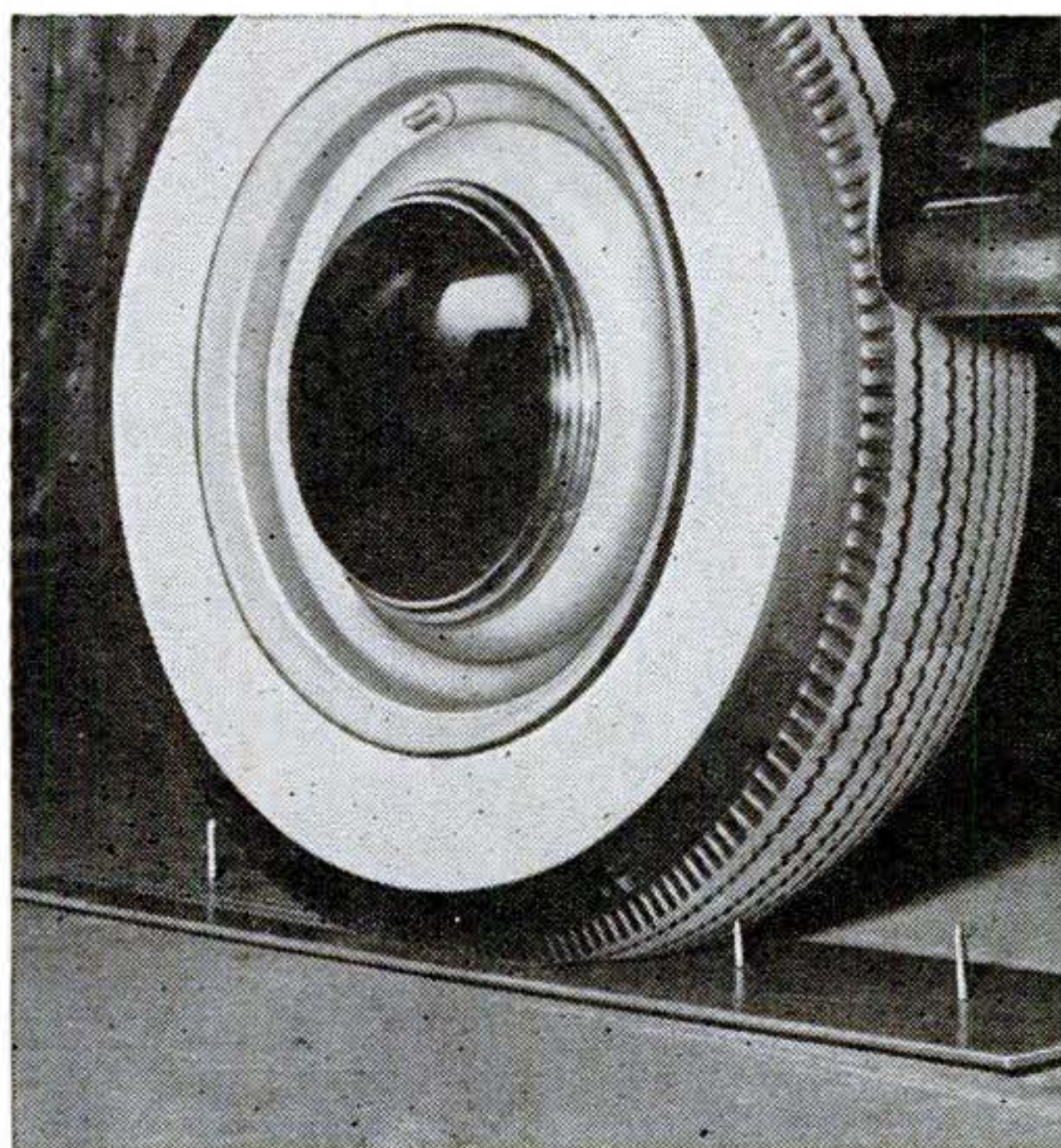
Truck model, with 25-hp. motor, can blow spray as high as tallest trees or up to 300 feet horizontally. Sprayers can handle dilute mixtures, if desired, and can do wet- and dry-dusting.



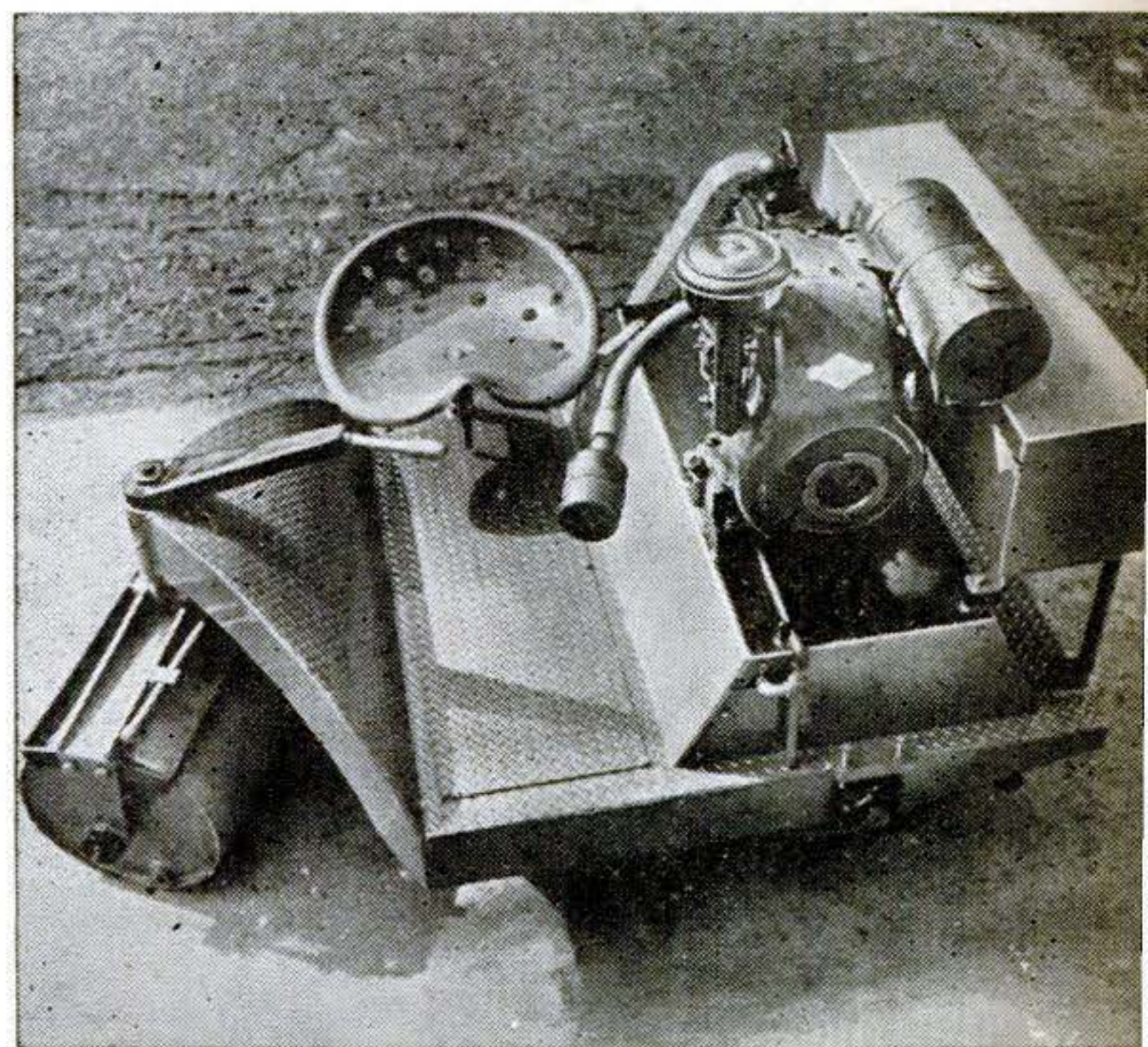
Pictures Train Eyes. It looks like an ordinary stereoscope, but adjustable tracks for the pictures on this AO-Renshaw Stereo Disparator train the eyes by allowing them to focus and converge simultaneously, as in normal vision.



Press Seals Plastics. Completing intricate seams on thermoplastic material in a single operation is the job of this RCA electronic sealing press. Adjustable to fit any pattern, it eliminates the need for a variety of expensive machined dies.



Tubeless Tire Seals Holes. This tubeless tire undergoes rigid spike-board test at the Goodrich Akron plant. A gummy inner layer closes hole when the piercing object is withdrawn. At present, distribution of the tire is limited.



One-Ton Midget. Small but husky is this midget roller, developed by the Steel Equipment Co., of Cleveland. It has a 42-inch wheelbase and weighs about a ton, but can carry an extra 600-lb. concrete block for rolling lawns, golf courses, etc.

How a Combine

CYRUS McCORMICK invented the reaper in 1831; its big brother, the combine, came along about 1875. But only in recent years have the full benefits of mechanical harvesting been available to thousands of American farmers. The machine that did it is the small, self-propelled combine, or reaper-thresher, capable of one-man operation and specially designed for efficient harvesting of 200- to 400-acre grain stands.

Inside the combine is a complex mechanism that cuts the standing grain, beats out the kernels, blows off chaff in one direction while dropping the kernels in another, lifts the cleansed grain into a hopper, and spreads straw in its wake.

As the combine makes its way through a field of grain at two to three miles an hour, curved *dividers* separate the grain in its path from that in the remaining stand. Then a six-bat *revolving reel* pulls the upper part of the grain backward and into position for the *cutter bar* to sever the stalk close to the ground.

The *augurs* take over next, forcing the grain onto an *endless conveyer canvas*. Slats hold the grain against an *endless conveyer chain* moving at the same speed as the can-

vas, preventing bunching. From the conveyer the grain passes under a *beater and retarder* that holds the grain and distributes it to the *threshing cylinder*, where it is rubbed and dropped through slots onto a corrugated *grain pan*. This removes three-fourths of the grain.

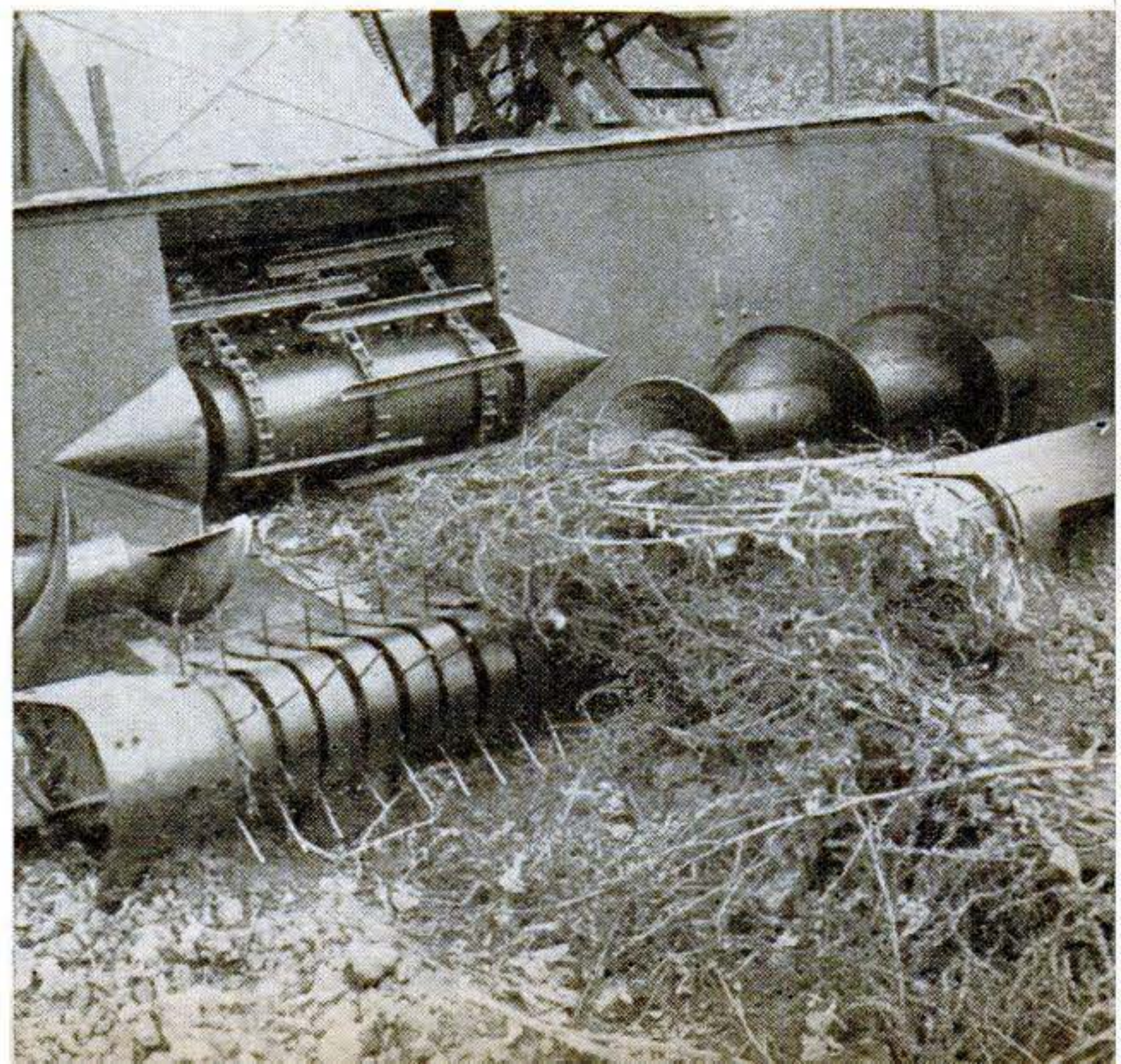
From this point, straw goes in one direction and grain in another. The straw is first thrown against a *straw beater* cylinder that knocks some more grain into the pan; then it passes onto *straw walkers* where most of the remaining grain is removed before the straw is ejected.

Going back to the grain that has fallen into the pan: A pitching motion delivers it to the *chaffer*, which separates grain from rough material. The grain then drops into a *shoe sieve*, is shaken onto an incline and slides to *grain augurs* that move it to an elevator for delivery to *grain tank* or bags. Meanwhile, coarse material and rough heads have moved to the *chaffer extension* and to a return elevator for rethreshing.

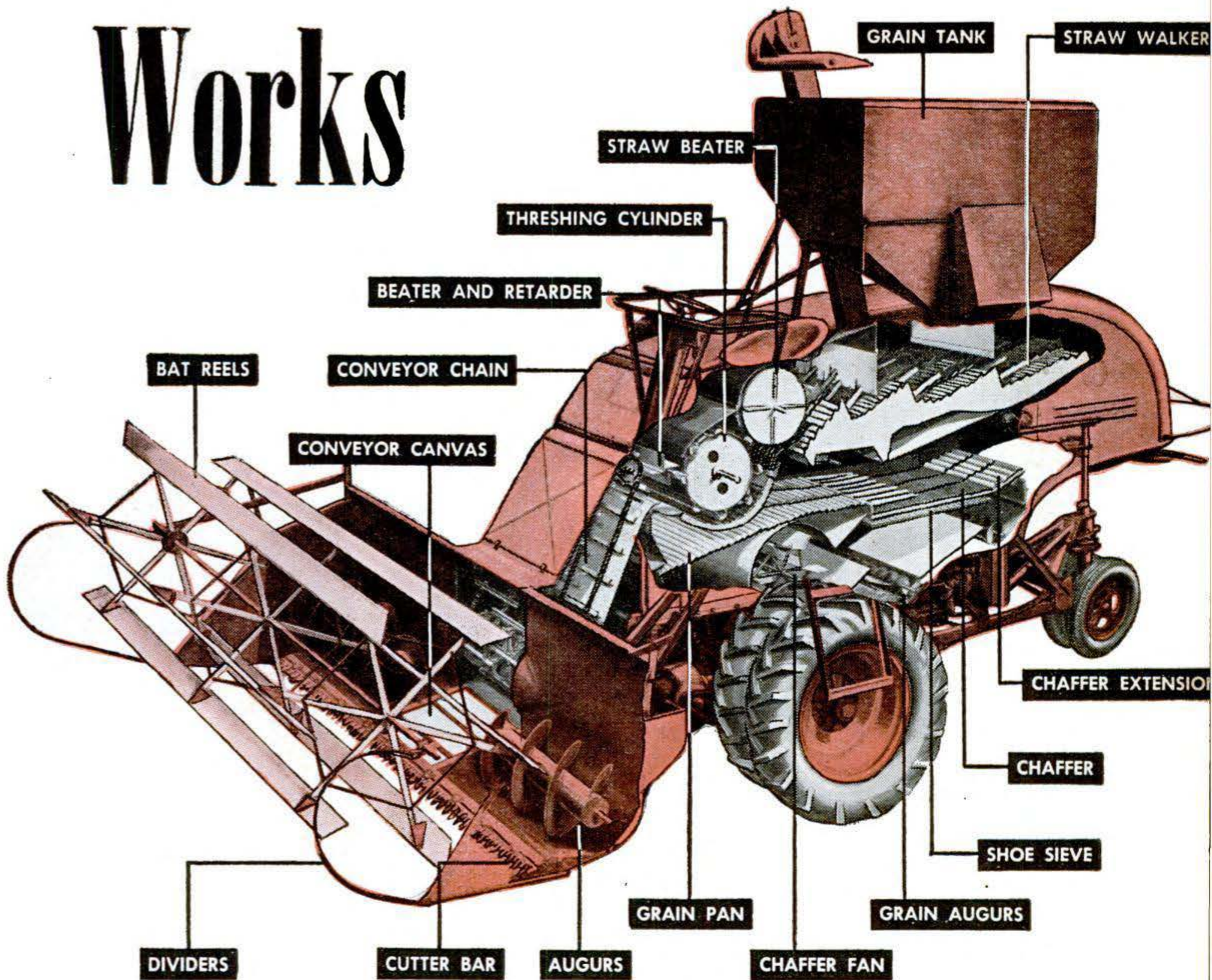
These operations are assisted by the *chaffer fan*, which blows air through the *chaffer* and *shoe sieve*, helping push lighter stuff away while the grain drops through.

Two helpers are needed to operate this model, equipped with bagging platform and chute. It has an International six-cylinder engine with four speeds forward, one reverse.

Pickup attachment shown here is for gathering a windrowed or already cut crop such as these beet stalks. The pickup platform "floats," thus following any unevenness of the ground.



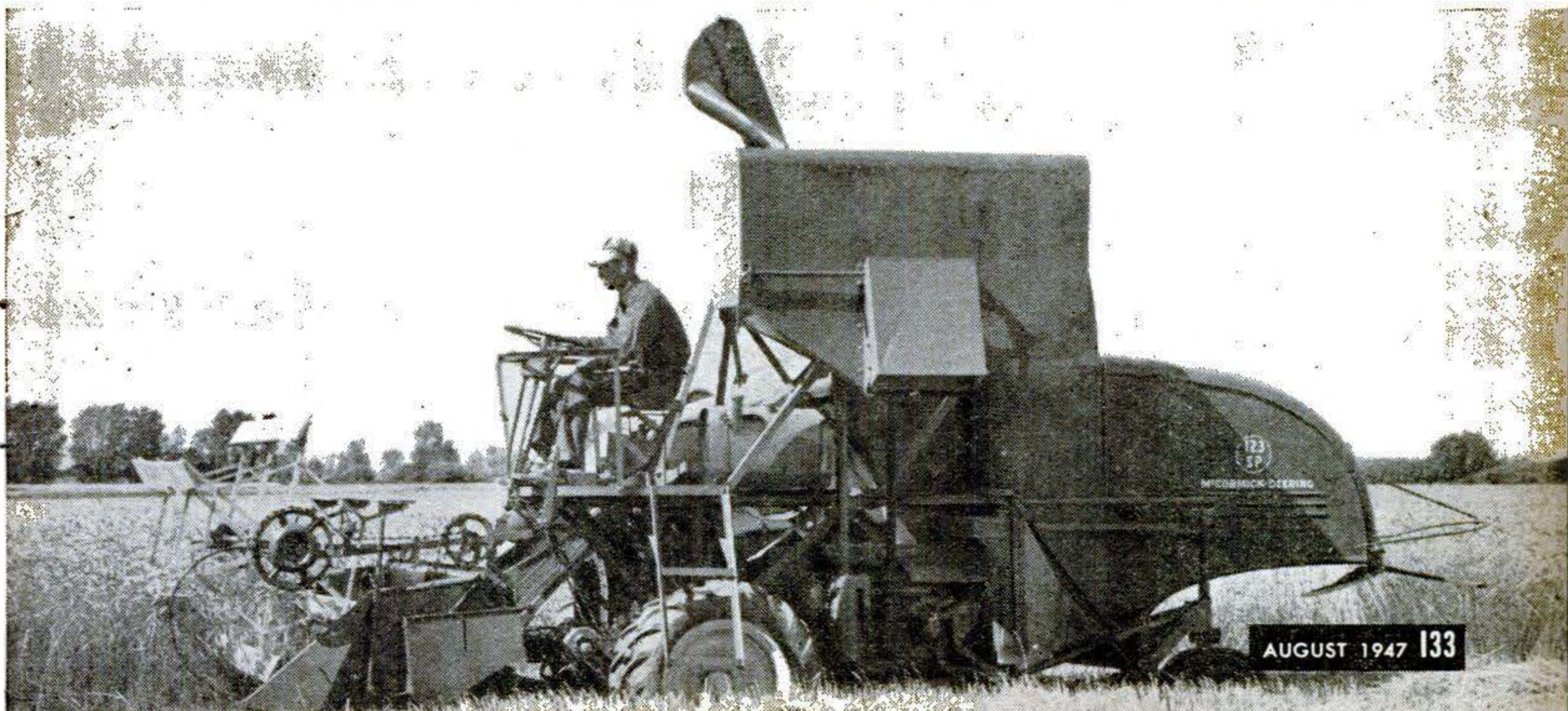
Works



Cutaway shows operating parts of the McCormick-Deering self-propelled, one-man combine.

Only six seconds elapse between the instant a stalk of grain is cut and the moment its life-sustaining grain is delivered into the storage tank. This model permits one-man operation,

since the driver can empty the tank into a truck without leaving the platform. Straw presents no handling problem; it is ejected from rear of combine and left to fertilize the field.



Test Planes Tooled to Tap Sonic Wall

When Skystreak and XS-1 try to slam past speed of sound, instruments will know more about it than their pilots.

WHEN two of the world's fastest airplanes attempt to smash the sonic barrier, a quarter of a ton of intricate research instruments will go along to record what happens.

To learn the exact behavior of wings, fuselage and control surfaces at transonic speeds (600-900 m.p.h.) and thus help to determine the most efficient characteristics for supersonic aircraft, the Bell XS-1 rocket plane and the Douglas D-558 jet will carry similar sets of more than 20 precision instruments for collecting, transmitting and recording the valuable flight data. Chief among these are:

Slide resistors: Attached to all control surfaces, small slides moving along wires change electrical resistance and record the control's movements.

Strain gauges: Mounted on spars within the wing, these measure structural stresses. Similar gauges, attached to the plane's controls, register the force the pilot has to exert in moving them.

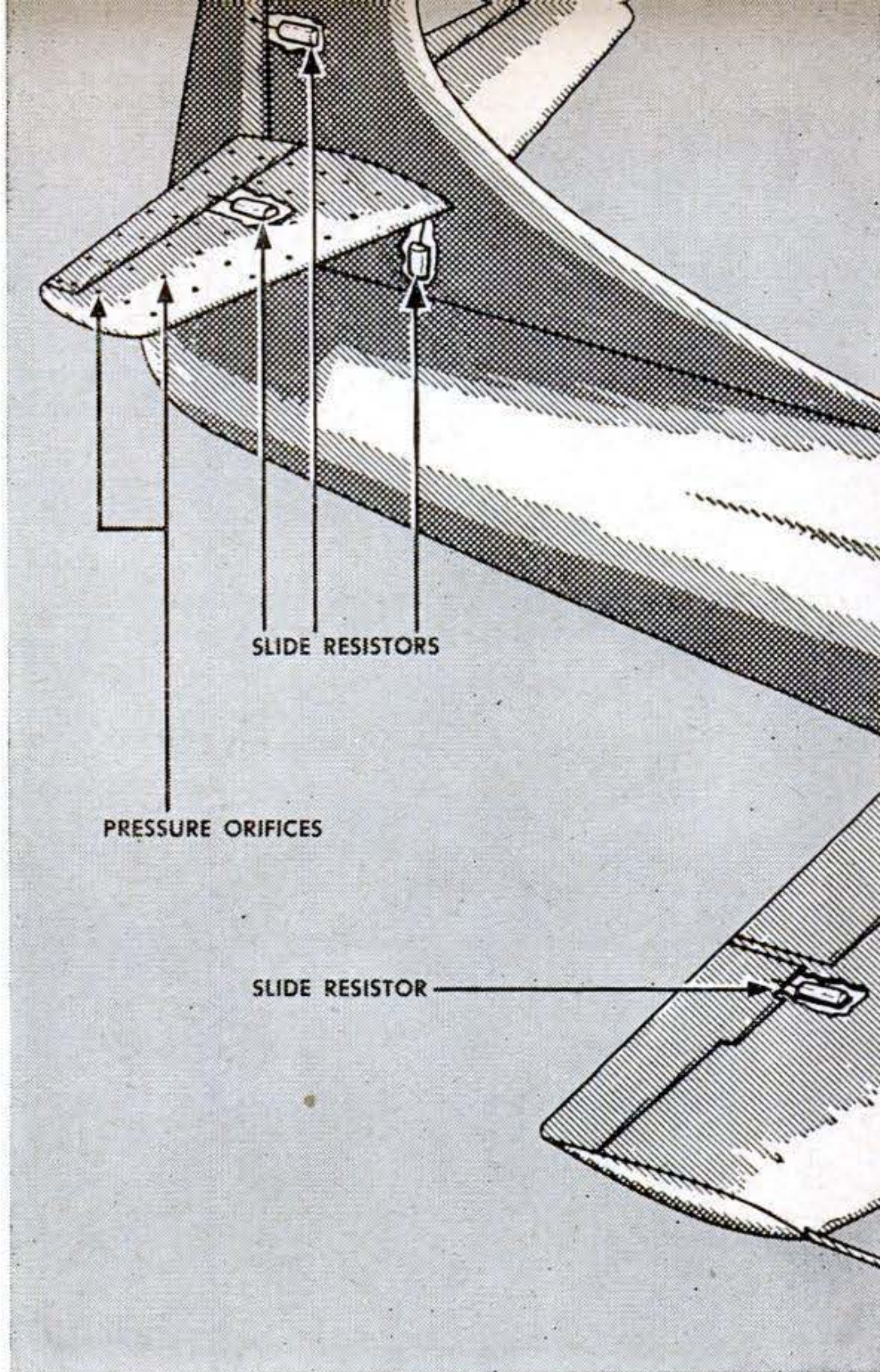
Recording accelerometer: Three vanes, displaced by sudden movement of the plane, record deviation from steady flight.

Airspeed indicator head: This records static and dynamic pressure, the difference between the two roughly equaling airspeed. The difference between the static pressure in flight and that at the point of take-off approximates the plane's altitude.

Sideslip vane: Always headed into the wind, it provides a constant measure of the plane's angle of sideslip.

Pressure orifices: Four hundred tiny holes in wing and tail register air pressure, from which aerodynamic loads, pressure distribution and air-flow changes are analyzed.

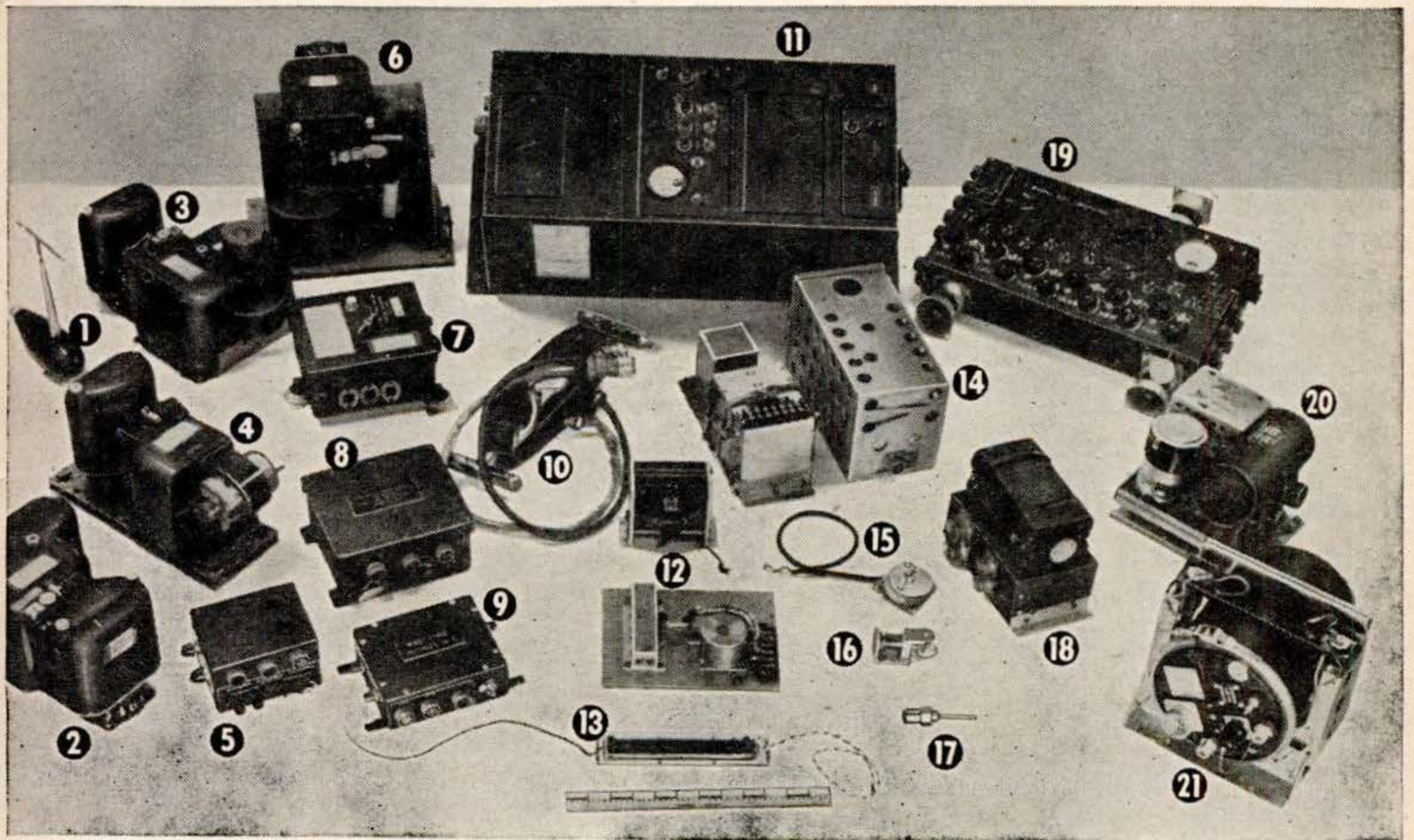
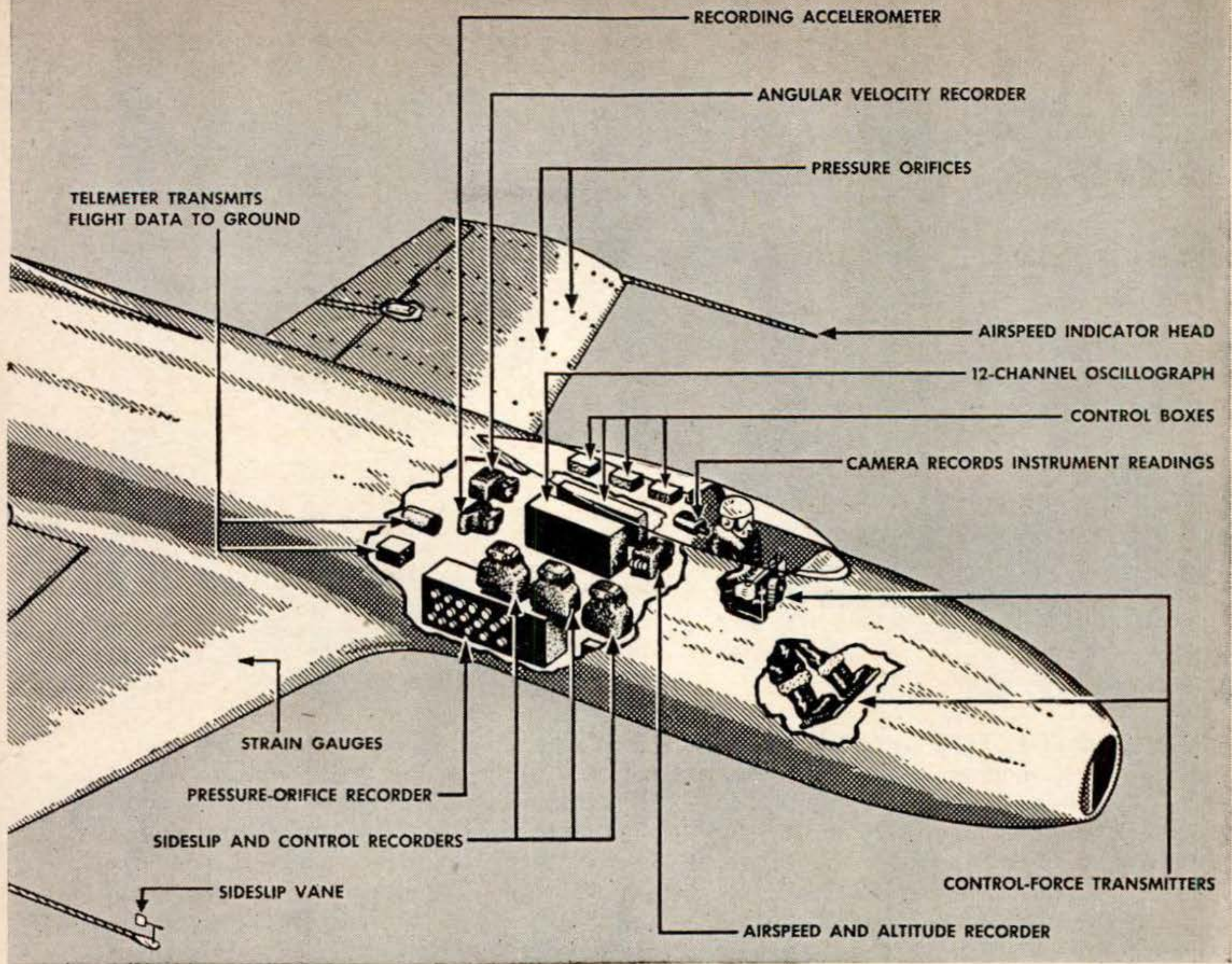
Because of the possible destructiveness of transonic turbulence, the most important



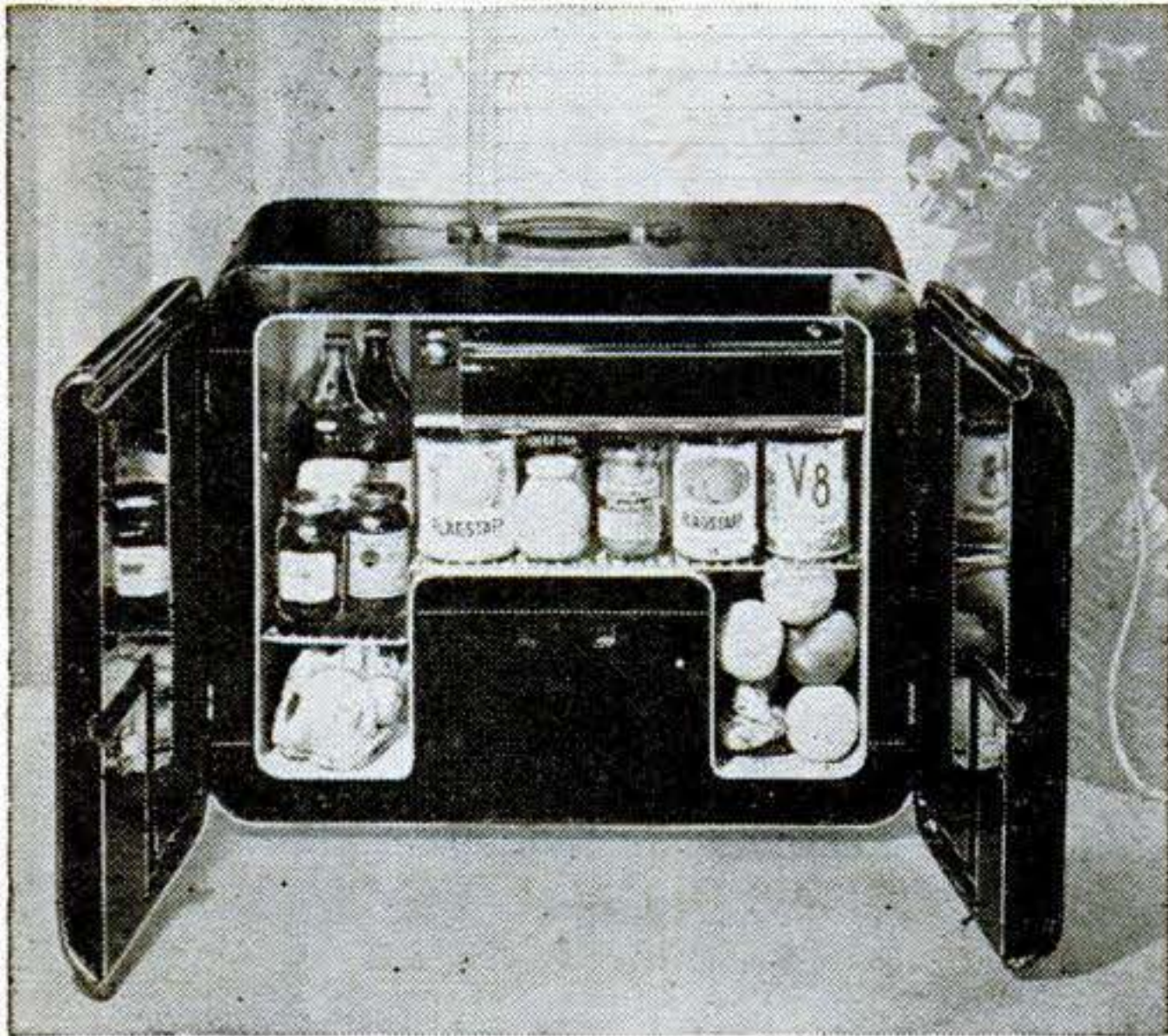
records are telemetered to the ground regularly throughout the flight. In addition, ground radar, tracking the plane, permits geometric analyses of its speed and altitude.

In the plane's recording instruments, tiny beams of light, tracing wavy lines on photographic film, provide a permanent record of the information collected at various points in the plane. A gunsight camera, located behind the pilot and aimed at the instrument panel, makes a motion-picture record of the instrument readings.

Virtually identical to those on the D-558, shown in cutaway above, XS-1 instruments assembled at right are: (1) sideslip vane, (2) recording accelerometer, (3) turn meter, (4) airspeed and altitude recorder, (5) control box, (6) sideslip recorder, (7) timer, (8) power supply, (9) pilot's wheel force recorder, (10) pilot's wheel force transmitter, (11) 12-channel oscillograph, (12) altitude and acceleration pickups, (13) control transmitter, (14) telemeter transmitter, (15) airspeed pickup, (16) control pickup, (17) thermocouple for temperatures, (18) sideslip dynamotor, (19) oscillograph control box, (20) telemeter dynamotor, (21) telemeter channel selector.



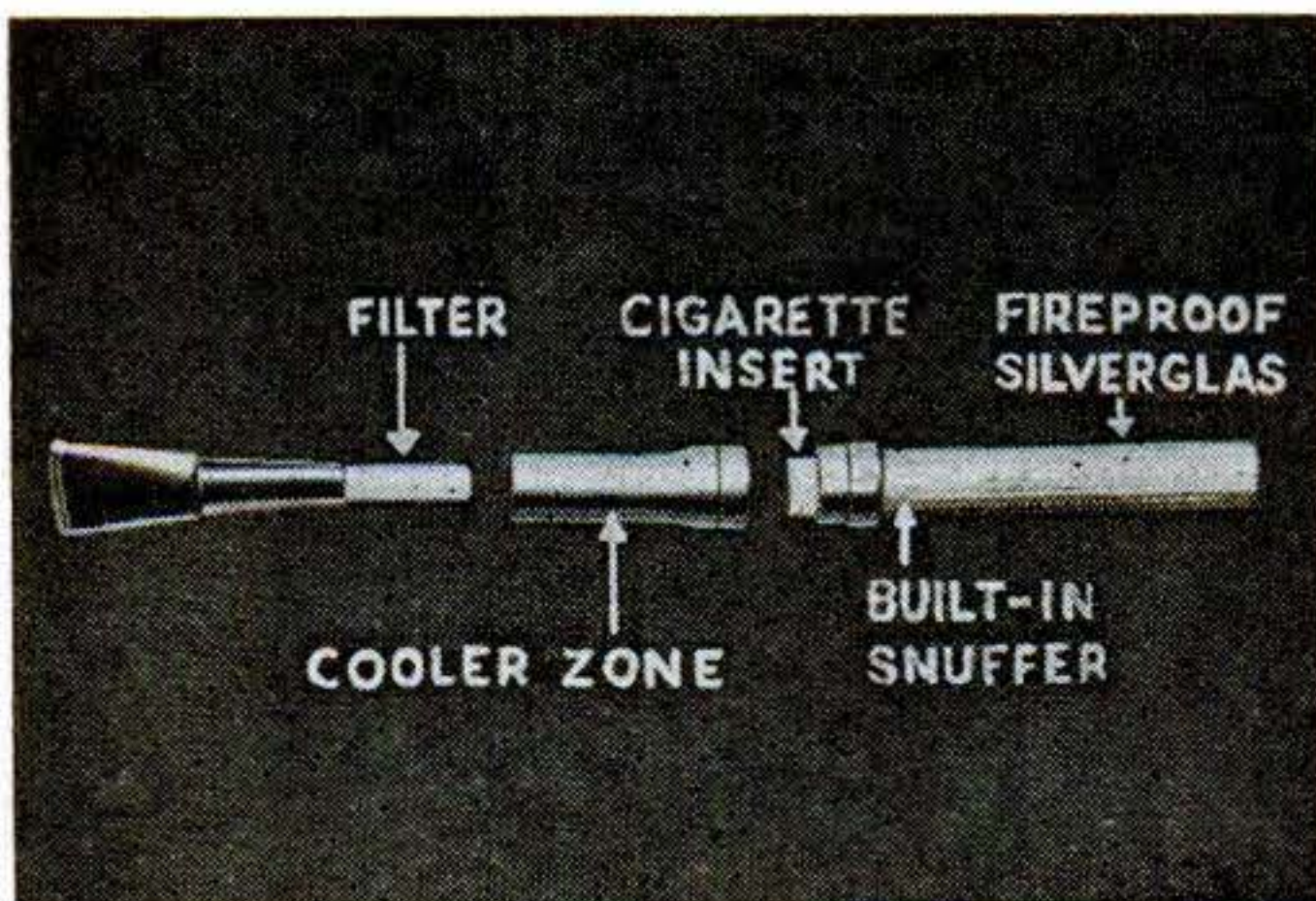
AIDS TO MODERN LIVING



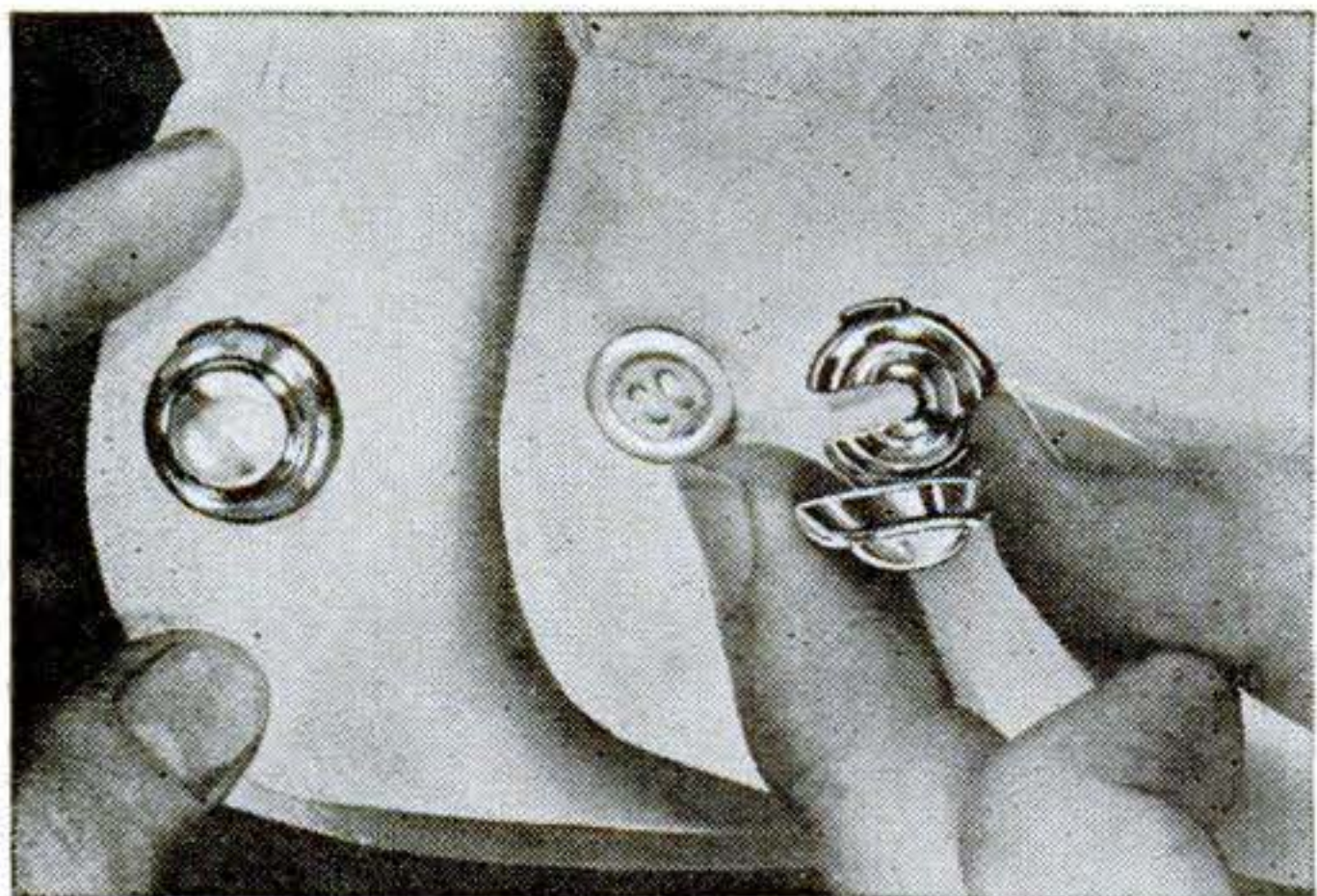
Refrigerator Is Portable. Weighing only 55 lb. and usable wherever AC or DC is available, this compact portable refrigerator has a capacity of 2½ cu. ft. Measuring 16" deep, 22" high, and 28" long, it is built with an inner and outer aluminum shell between which 2" of insulation is sandwiched. The refrigerator sells for about \$130 and is manufactured by the Freez-Pak Corporation, of Royersford, Pa.



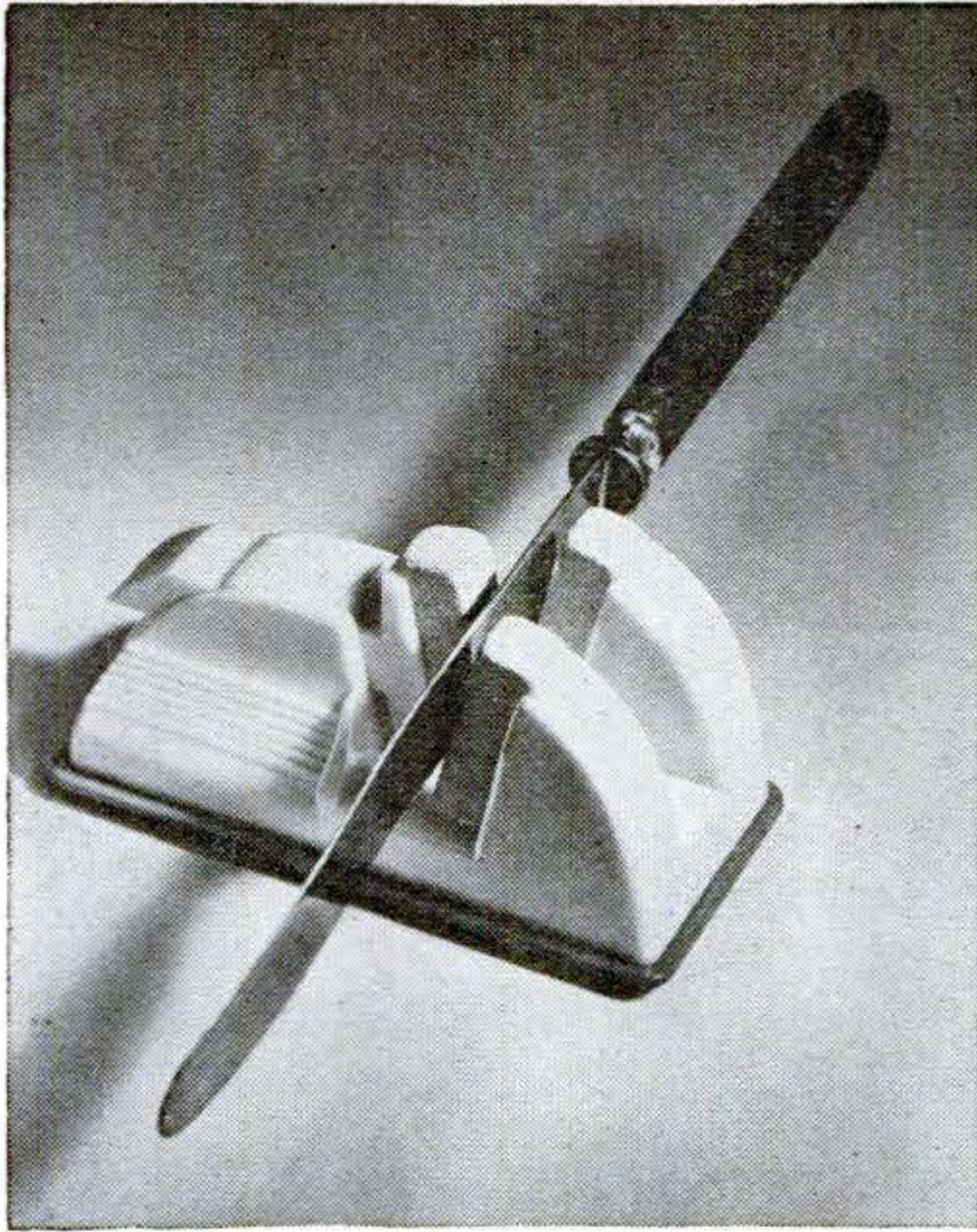
Elevator Raises Turntable. A chairside radio-phonograph manufactured by Electronic Laboratories, Inc., of Indianapolis, has a built-in electric mechanism to raise and lower the automatic record player. When a knob on the radio dial is turned, the turntable rises out of the set. After the records have been put into place, another turn of the knob causes the player to descend out of sight. The set retails for approximately \$350.



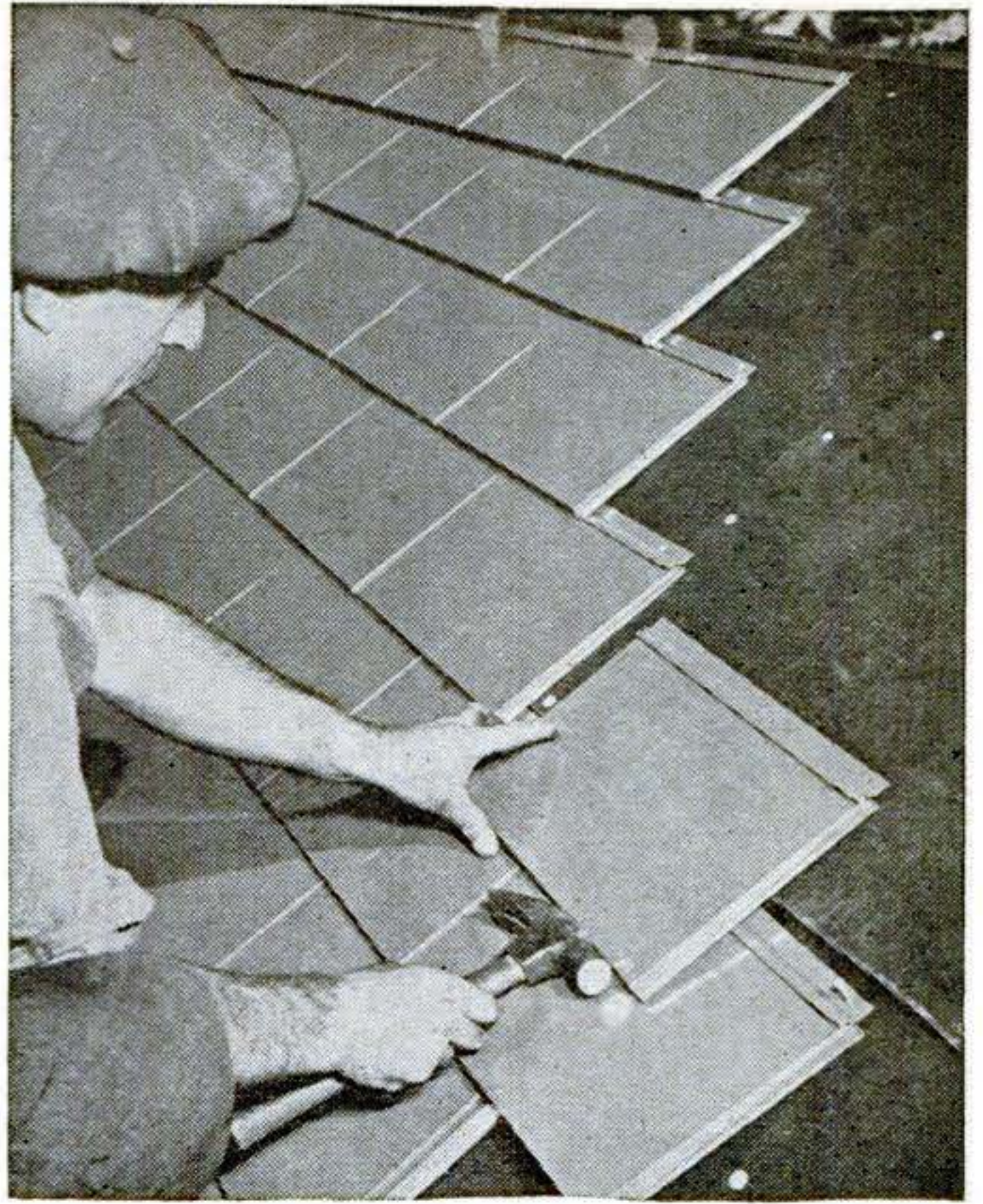
Makes Smoking Safer. This cigarette holder produced by the Safe-Gard Mfg. Co., Cleveland, does almost everything except puff the cigarette. In addition to cooling and filtering the smoke, the holder keeps the ash from scattering, while a built-in snuffer puts the butt out. Since the cigarette is inside a fireproof cylinder, it cannot set a fire if put aside and forgotten.



Imitation Cuff Links. If you'd like to give the appearance of wearing cuff links with an ordinary sleeve-button shirt, a new product put on the market by Crafters, Inc., Chicago, will do the job. They can be installed right on the buttons. A bottom disk, with a cut-out center, slides under the button, and the hinged top then may be snapped down, locking the "link" securely.



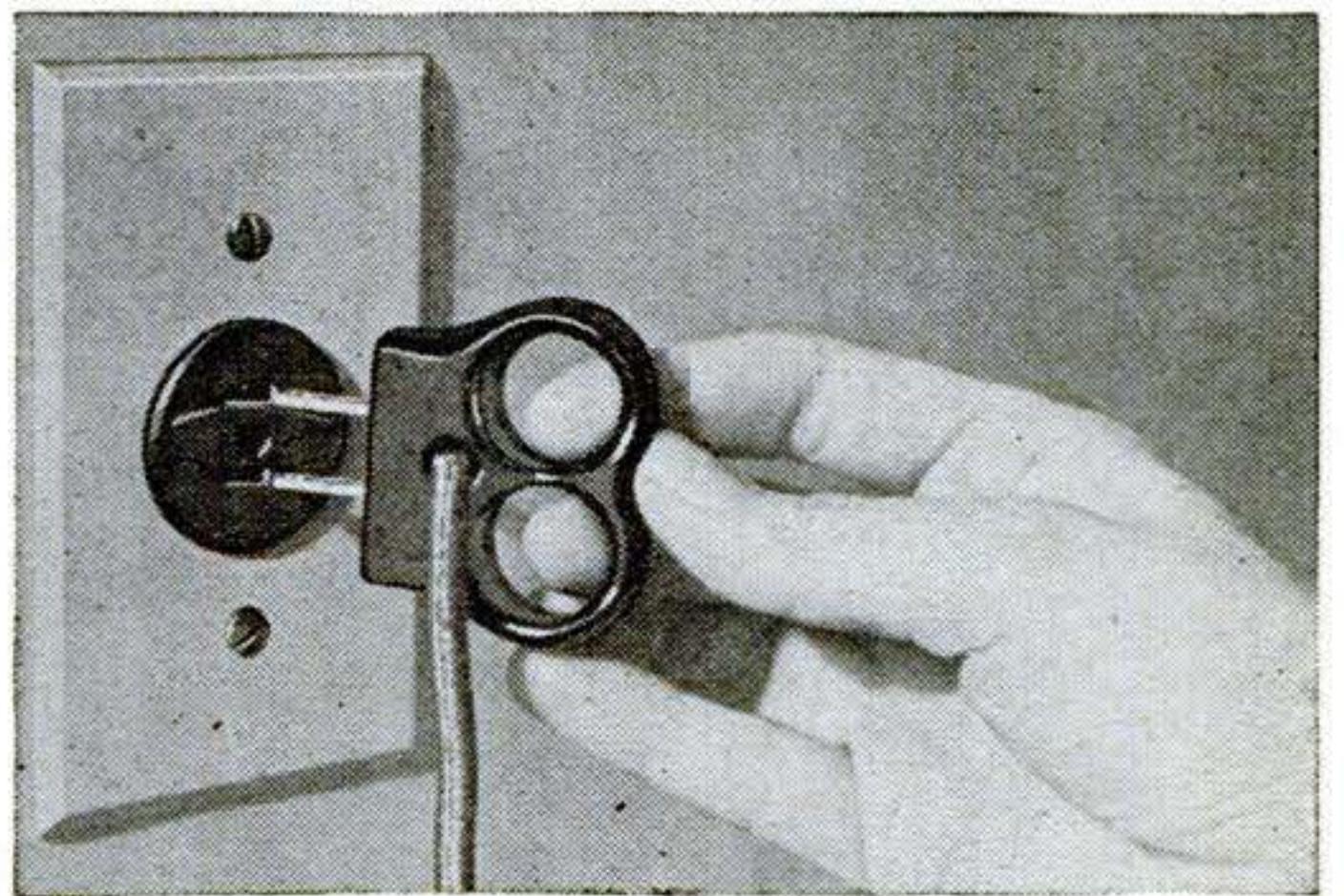
New Knife Sharpener. Modern styling is a feature of a knife sharpener just put on the market by Superedge Products, Inc., of Erie, Pa. Honing stones, angled to form a V-shaped cutting edge, are spring-held in constant contact with the knife as it is pushed forward and down between the stones in a motion similar to that used in cutting bread. The body of the sharpener is made of plastic.



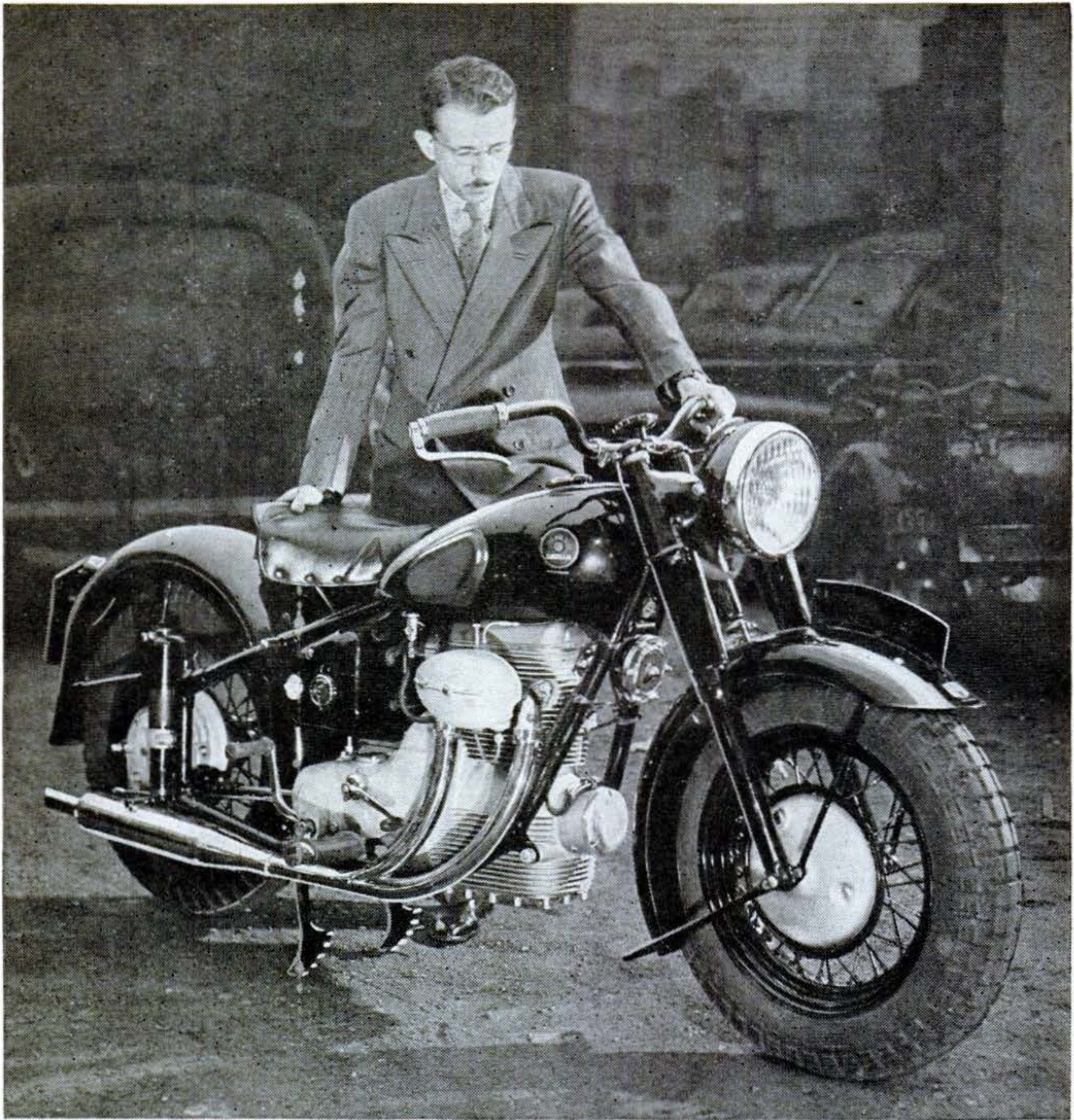
Aluminum Shingles. Rotproof, rust-proof, and fireproof metal building materials are said to give extra safety and service. The shingles pictured above are part of a new line of aluminum building products made by the Reynolds Metals Company. It includes clapboard, roofing, and large-unit sidings. The shingles are raised, forming an air space which increases the metal's ability to reflect heat from either direction.



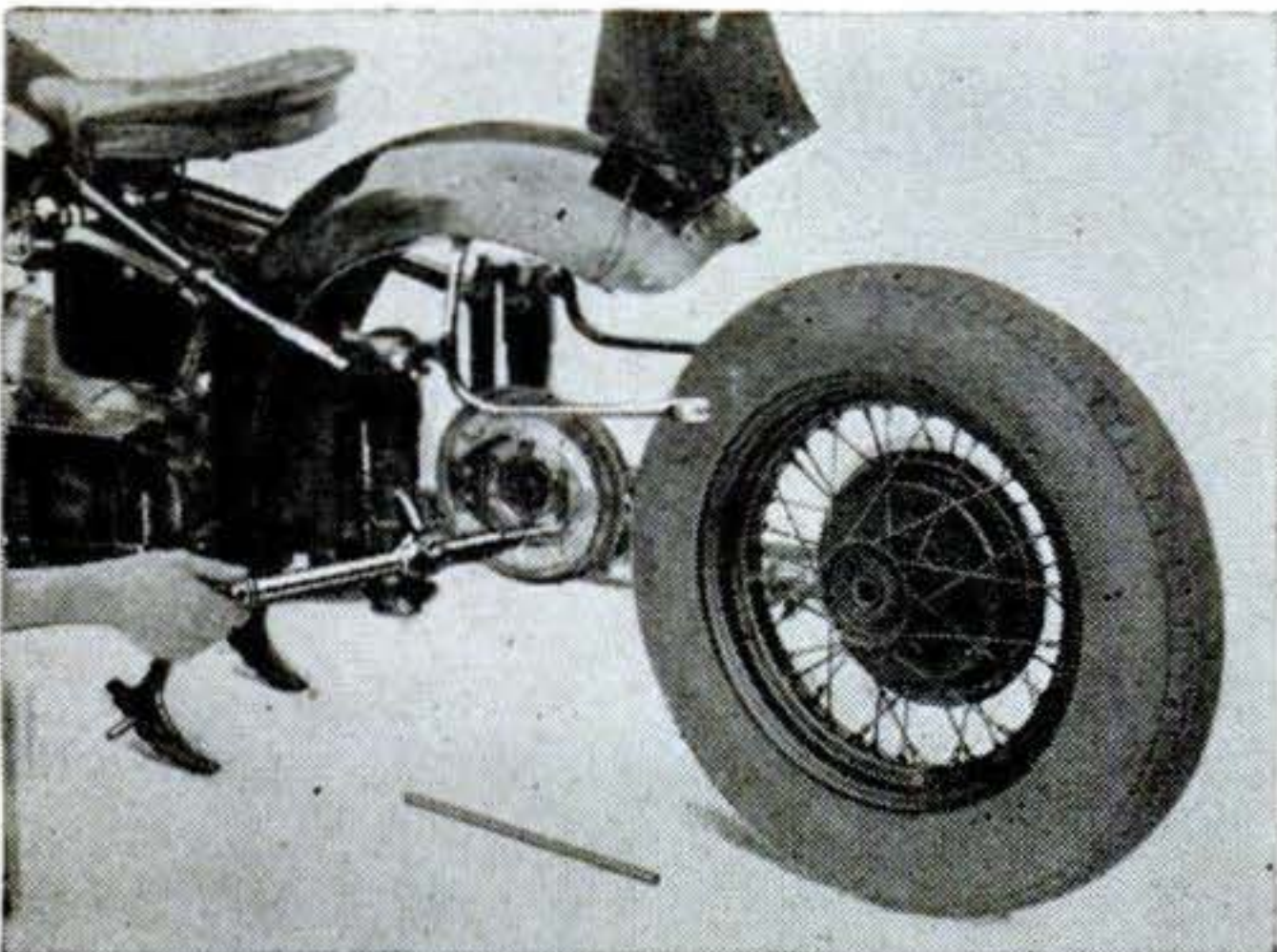
Soap Dish Folds Up. A molded plastic soap tray made by the Waldonn Corporation, Greenwich, Conn., lifts up to conceal a cake of soap inside a neat pastel-colored box. Shaped to hold soap clear of water, the tray is readily removable for cleaning, and the entire unit can be glued or screw-fastened to any wall. It is offered in a variety of colors and color combinations.



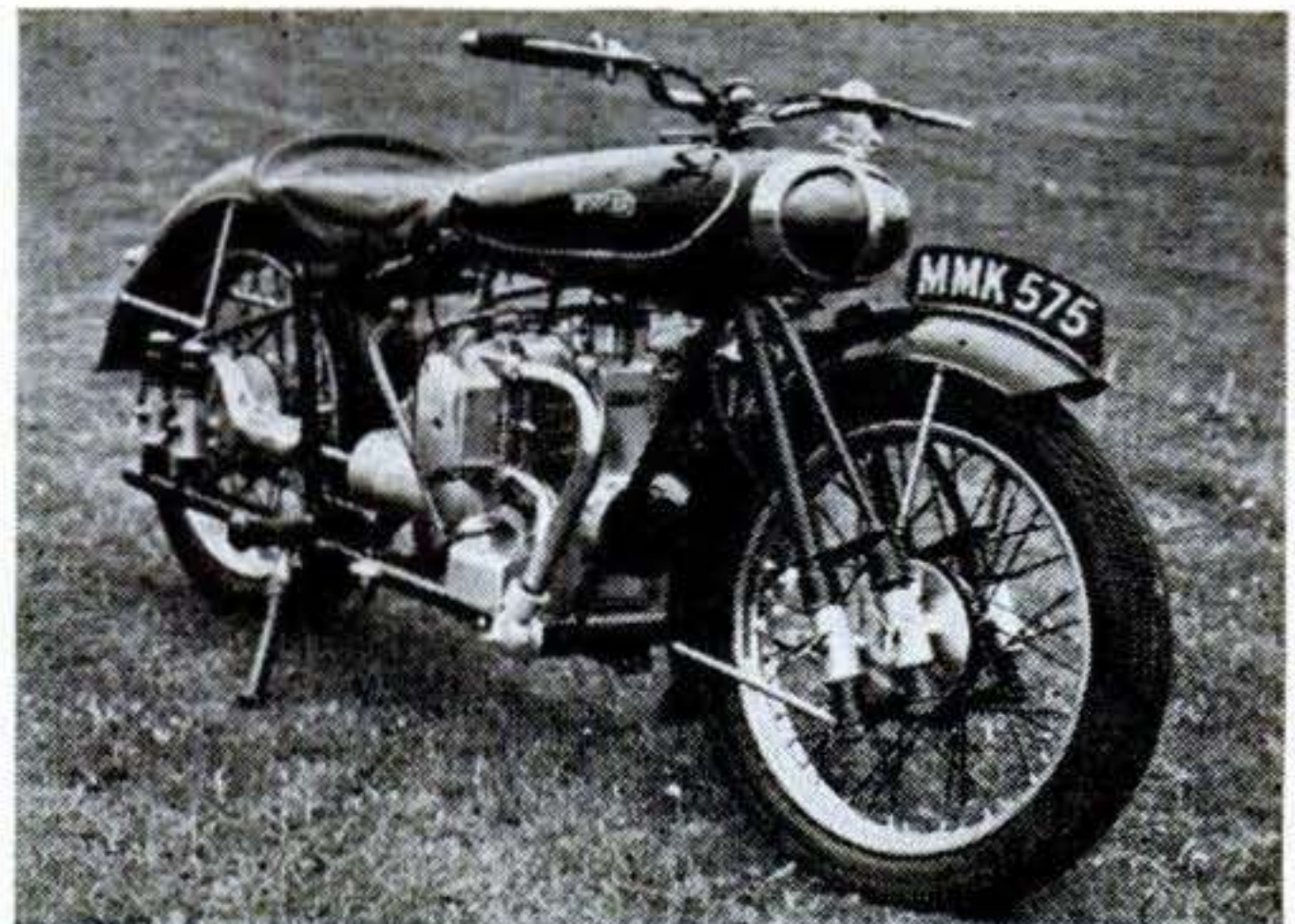
Plug Fits the Fingers. Especially suitable for appliances that are frequently plugged into outlets, this new device makes it easier and safer to pull a plug from its socket. Two finger holes are placed behind the line-cord opening so that none of the pull is transferred to the wire or contacts. L. G. Fiske Co., of Los Angeles, distributes the item.



Designed for luxurious touring, the 385-lb. Sunbeam has a shaft drive and a vertical twin in-line engine.



For repairs, the Sunbeam rear wheel may be quickly removed. Power is transmitted from the shaft by an internally splined worm wheel and sliding sleeve.



A four-cylinder opposed engine, a shaft drive, and a car-type shift lever are features of the Wooler. This is one of Britain's newest motorcycles.

Europe Puts Its Best Wheels Forward

New motorcycles from abroad strike out along experimental lines with radical design features.

By R. P. Stevenson

EUROPEAN motorcycles now arriving here in considerable numbers are remarkably light in weight and clean in line. The majority have a foot shift and hand clutch. Compact, high-compression engines zip them along with pleasing power and speed. Telescopic front forks, many of them hydraulically damped, and various types of ingenious rear suspensions produce an unusually comfortable ride.

In price, limited-production imported motorcycles aim to meet the domestic price lines between \$600 and \$900. Several exceptionally light utility vehicles are delivered in the United States for a little less. A few de-luxe machines, such as the shaft-driven Sunbeam and the Ariel Big Four, sell for slightly more than \$1,000. Most of the imports are coming from Great Britain, with some from Czechoslovakia and France.

The British Sunbeam would take anybody's eye. Built as a unit with the four-speed transmission, the 500-cc. (30.50 cu. in.) vertical twin, overhead-camshaft engine

bears little resemblance to the power units we are accustomed to seeing in motorcycles, and its quiet performance equals its clean appearance. The transmission shaft has a sliding joint and drives an underslung worm, an internally splined worm wheel transmitting power to the wheel by a floating sleeve splined at both ends. A light-alloy crankcase and cylinder unit help keep down the total weight of the machine to 385 lb. The maximum speed is 77 m.p.h.

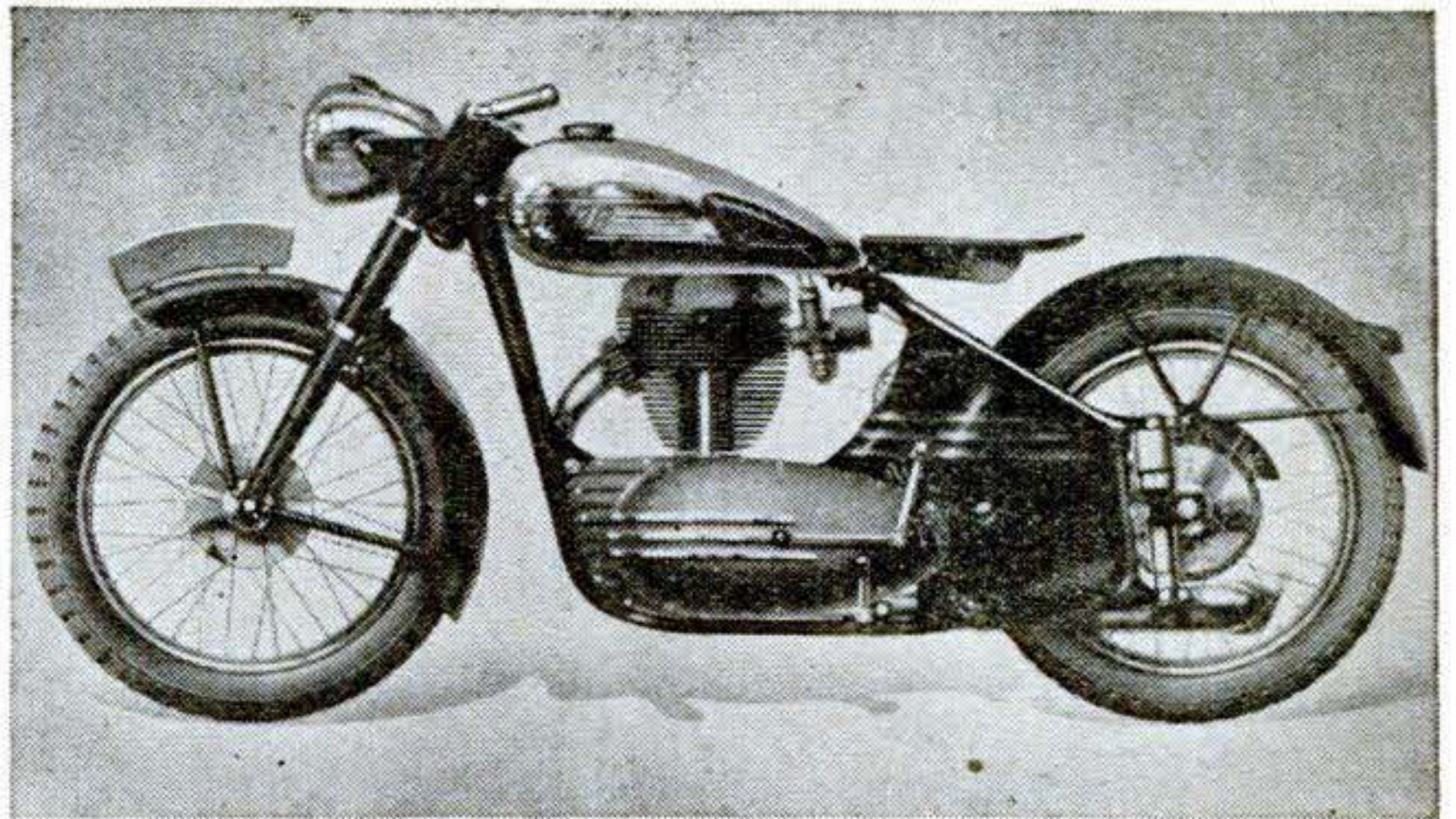
Another British motorcycle with a shaft drive is the new Wooler. This machine is also one of only a few European motorcycles with a four-cylinder engine. In this case, the 500-cc. engine is horizontally opposed. Gears are shifted with a car-type lever on the side.

Working in hidden shops, Czech engineers secretly designed several new motorcycles during the war. One of these, the streamlined Jawa, is now being advertised in the United States for about \$500. This machine introduces a novel transmission to motorcycling. The hand clutch lever is used only when low gear is engaged in starting out. Thereafter, all shifts in the upper three ratios are made with the foot pedal alone, movement of the pedal automatically disengaging the clutch while the shift is being effected. Lights on a dial atop the tank indicate the gear that is engaged.

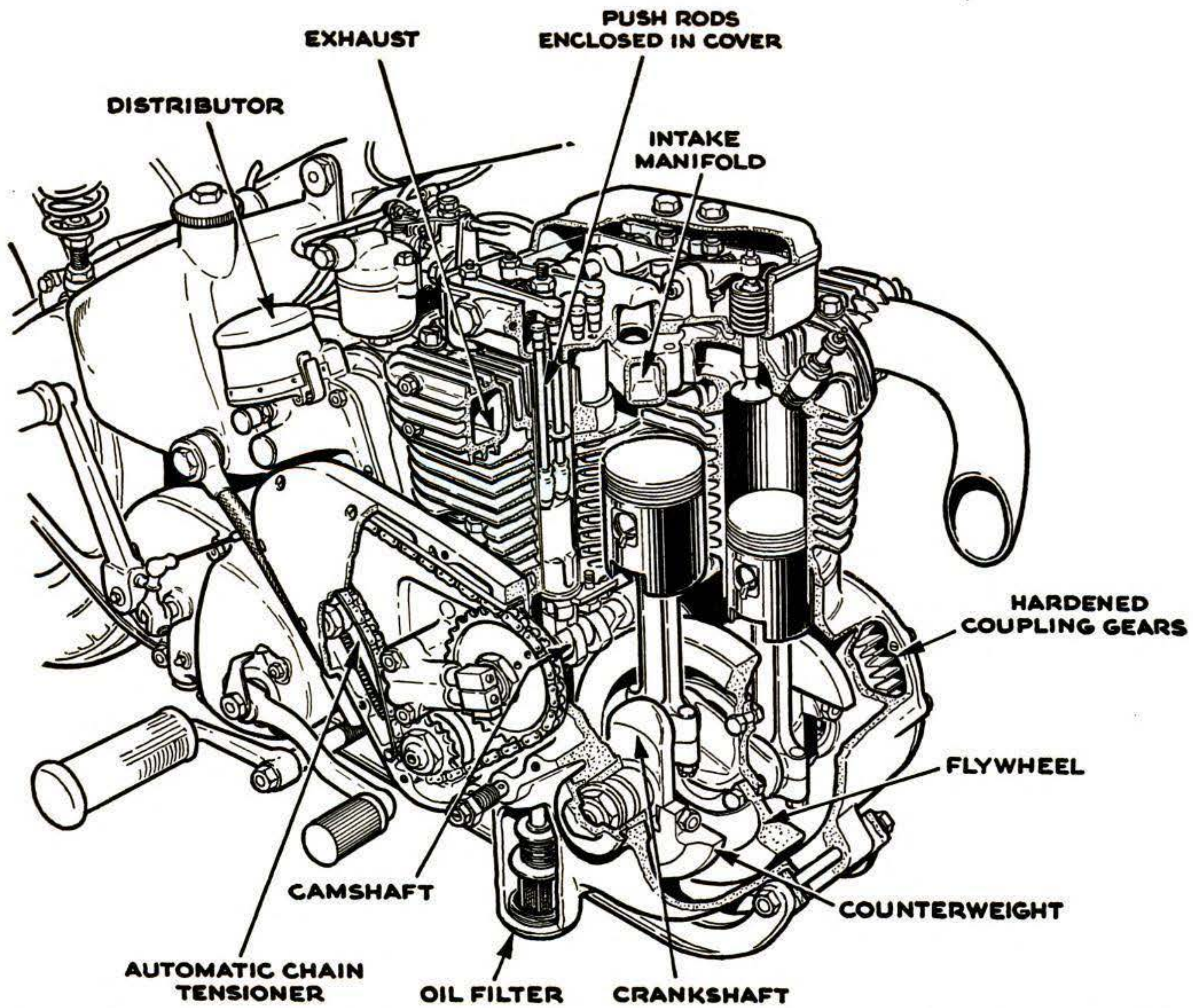
Powered by a one-cylinder, two-cycle



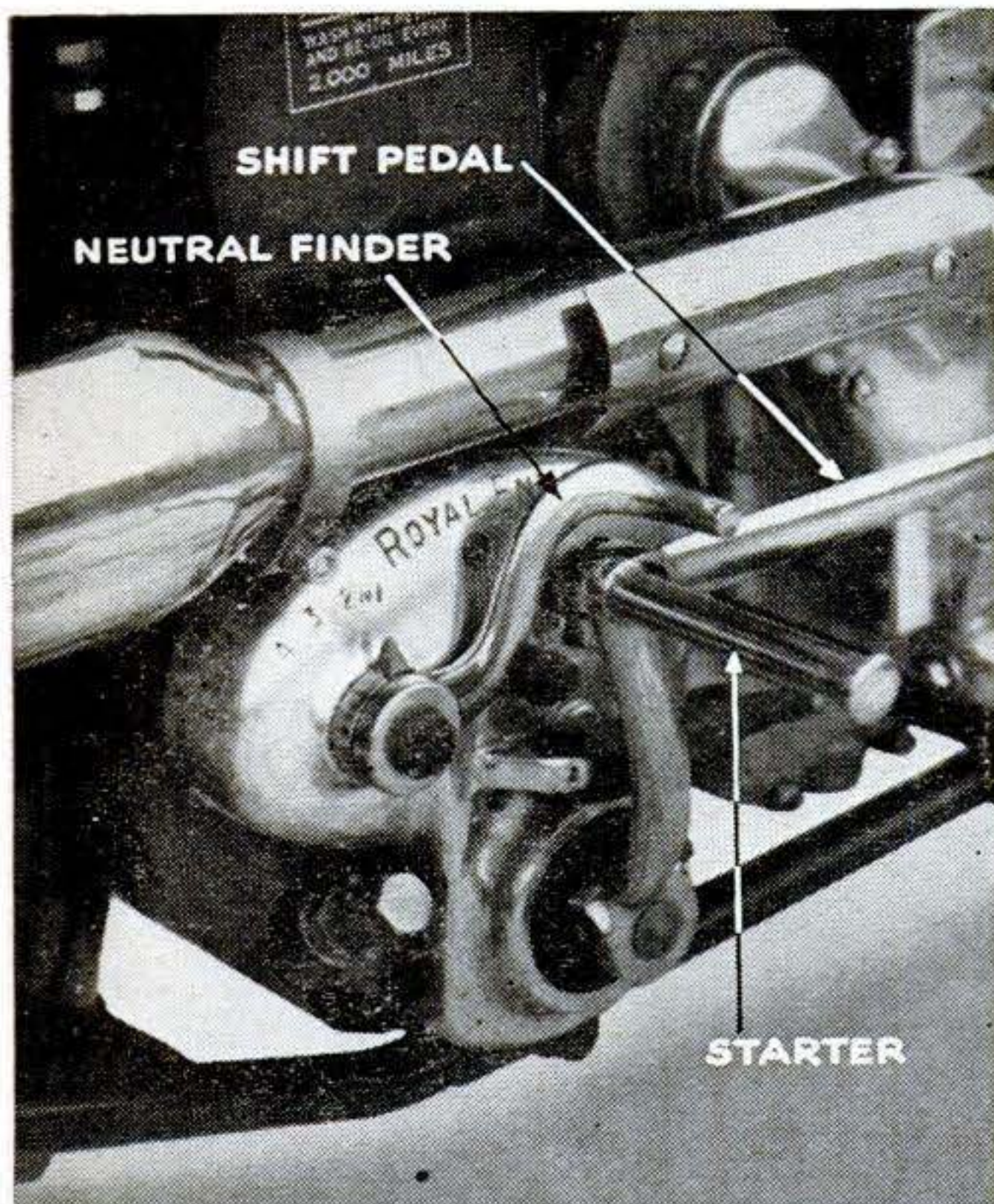
Enclosing the springs in telescopic forks gives a neat appearance in front. This is a Matchless.



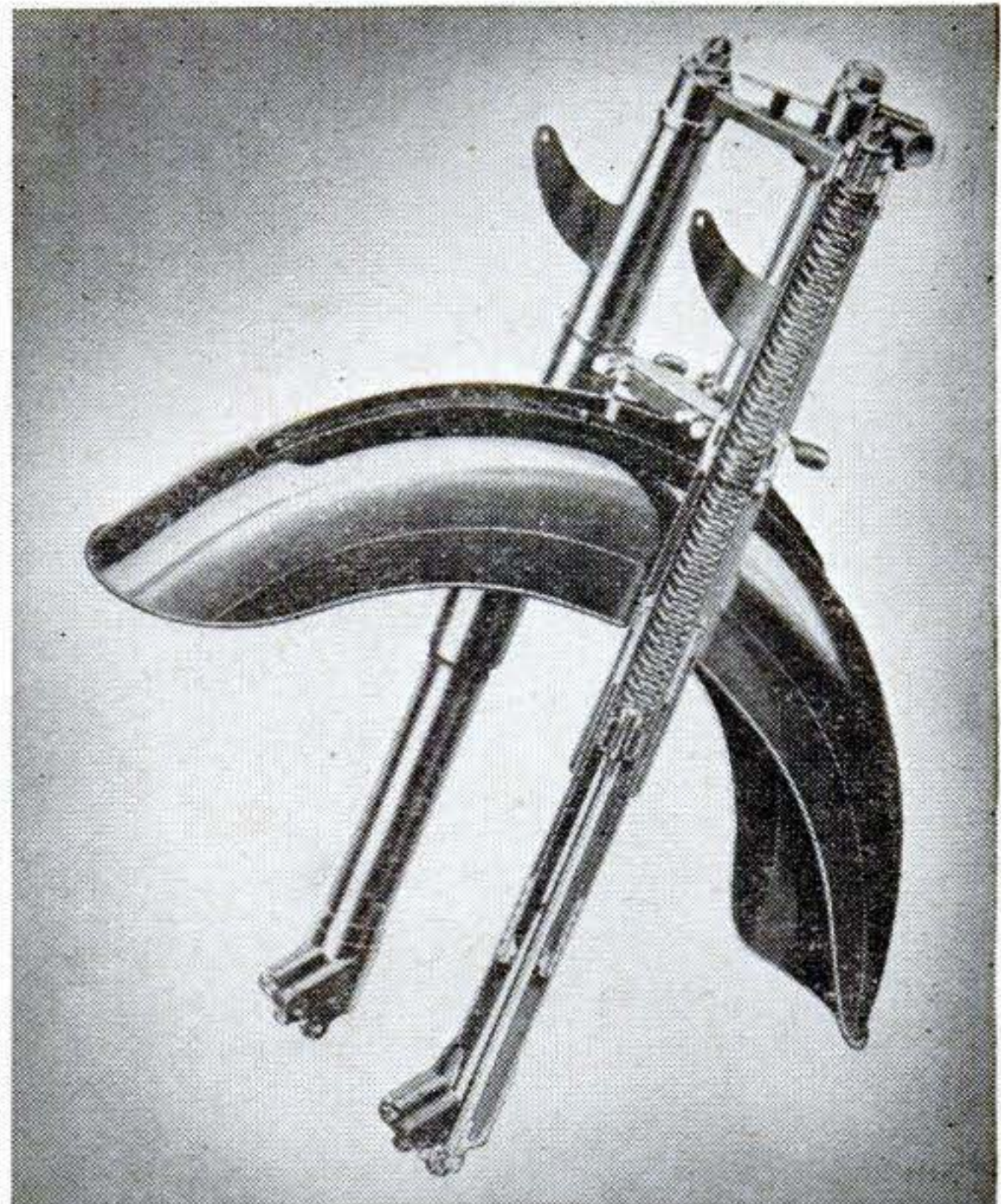
Czech engineers secretly designed this streamlined beauty during the war right under the noses of the occupying Germans. It is an Ogar, powered by a one-cylinder, 350-cc (21.35 cu. in.) engine.



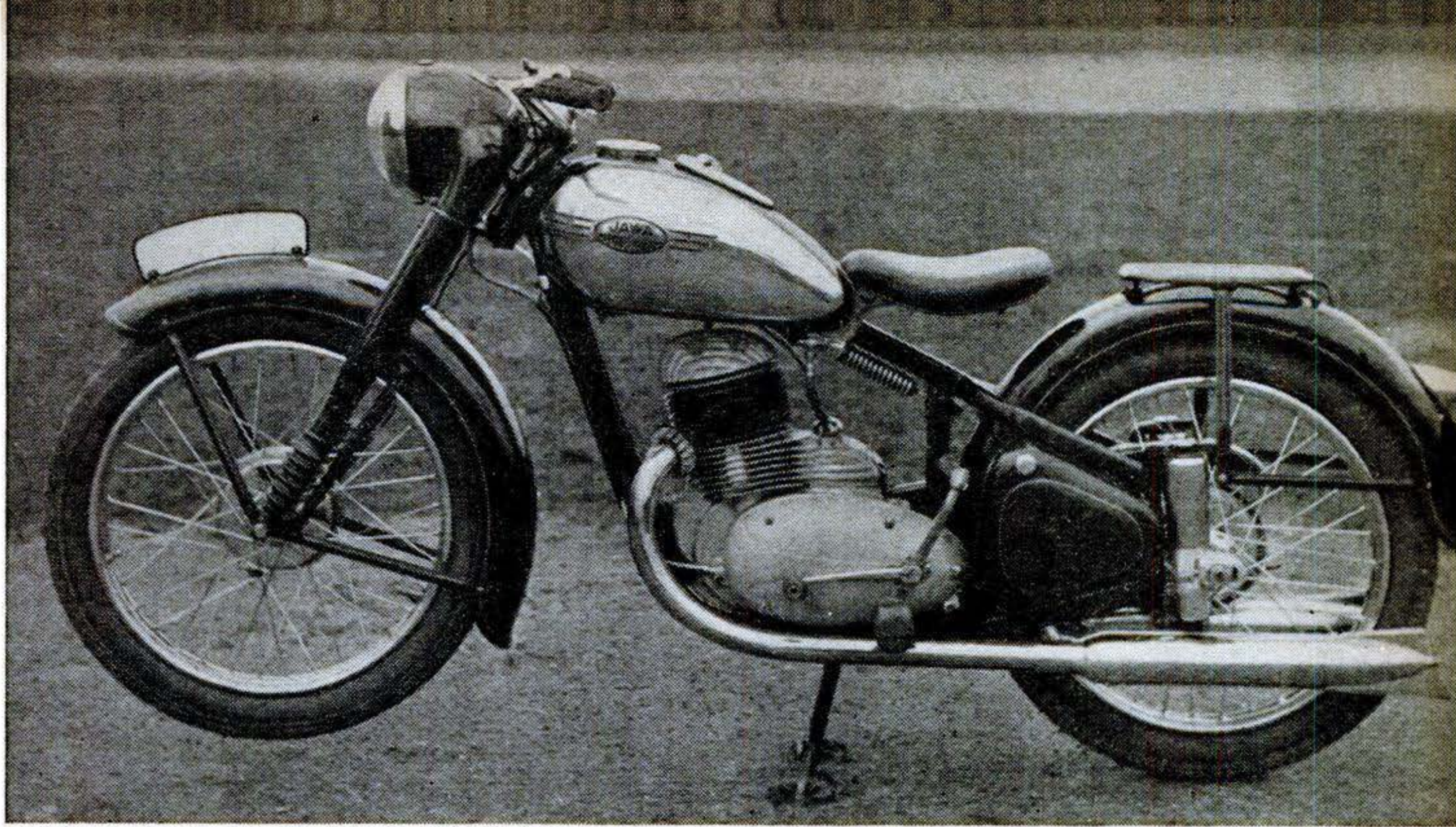
In the Ariel Square Four engine, four cylinders are cast in square formation, each pair driving one of the twin transverse crankshafts that transmit power through spur gears. The capacity is 1,000 cc. (61 cu. in.).



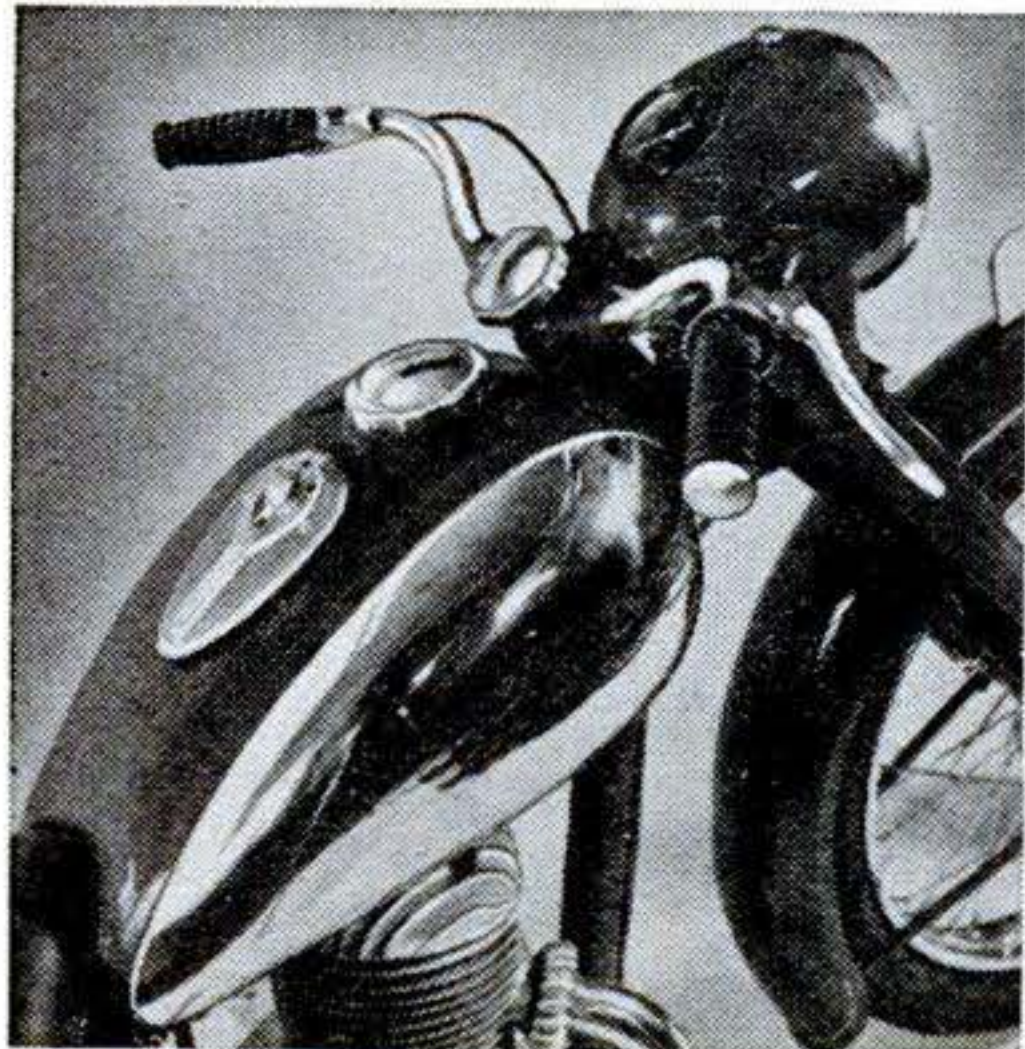
With a foot shift, it is sometimes hard to locate neutral, but a special finder on the Royal Enfield gives positive selection if touched with the heel.



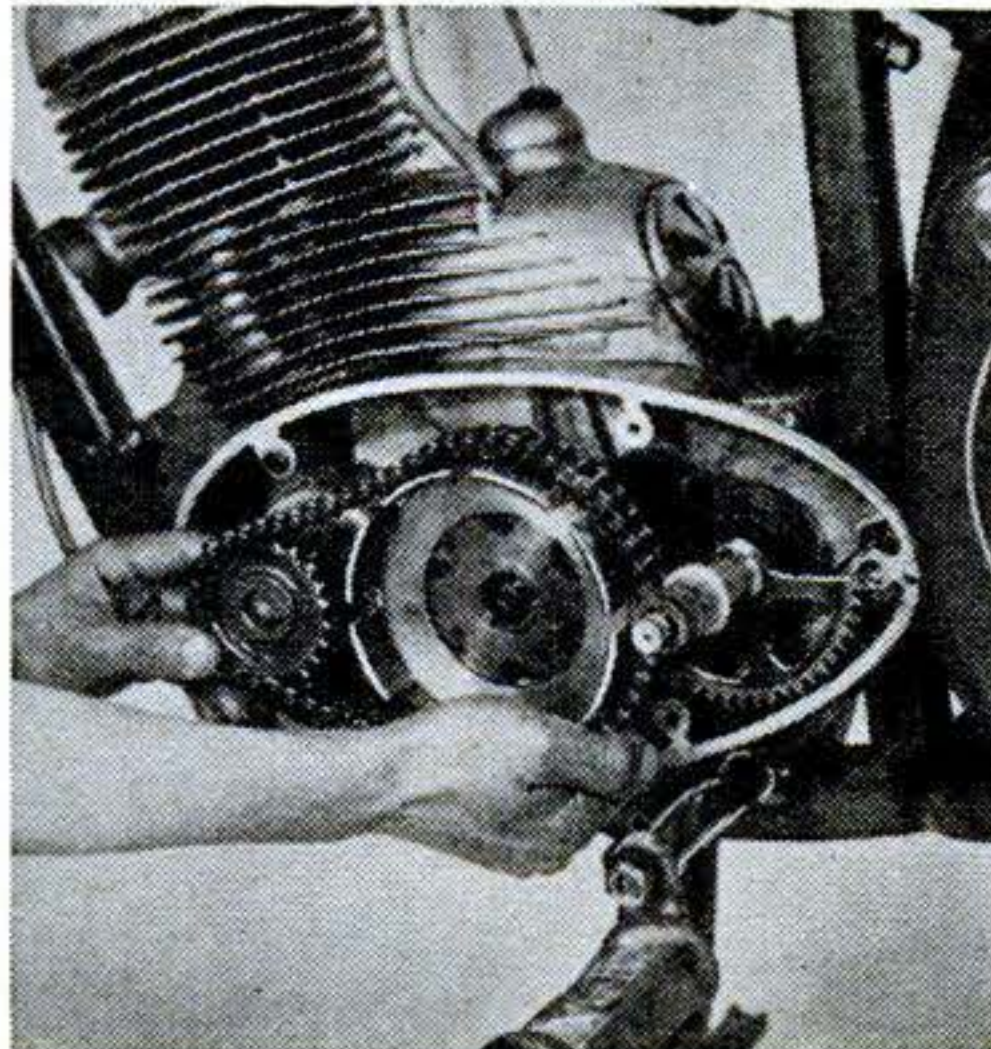
Telescopic forks with hydraulic damping are common in Europe. The Royal Enfield fork, above, allows a 3" movement on either side of the normal position.



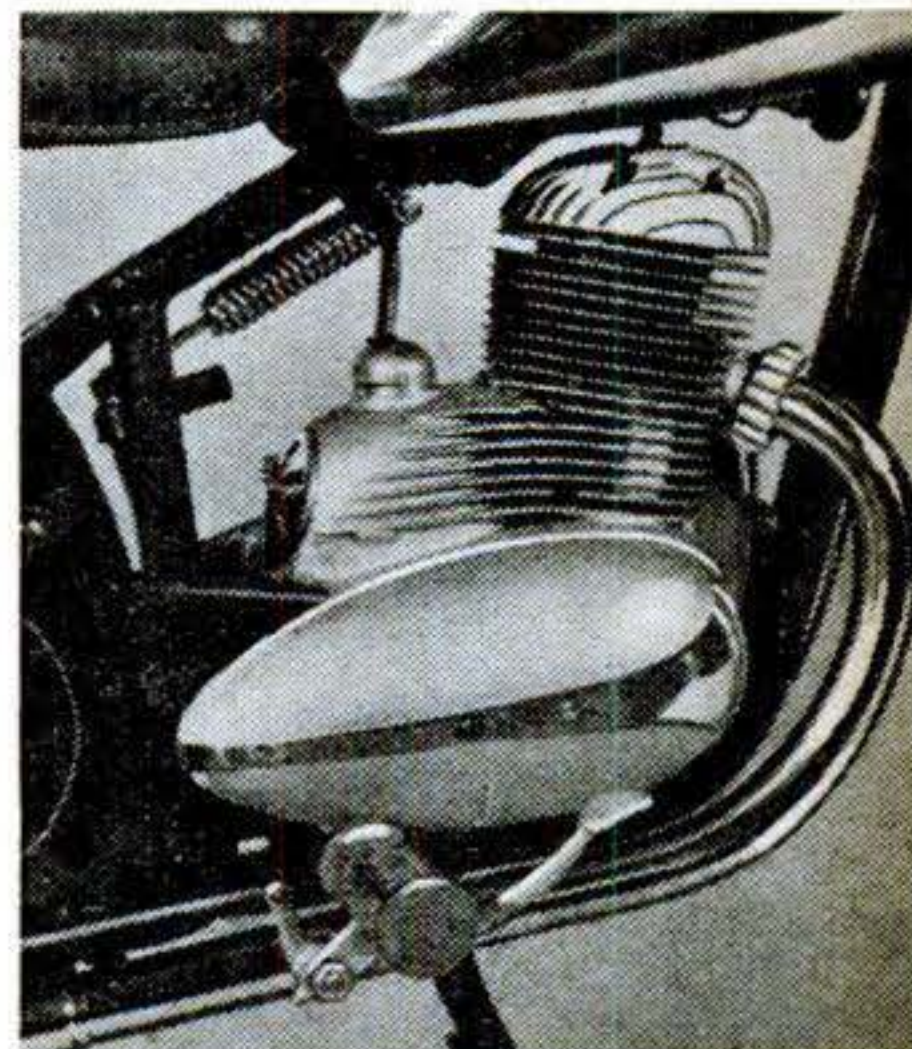
Produced in Czechoslovakia, the clean-lined Jawa introduces a new type of transmission to motorcycling.



When starting, a clutch is used for low gear, but other changes are made with the foot shift alone. An indicator on the tank shows the gear engaged.



The 250-cc. engine and four-speed gear box form a unit. An air filter also is a feature. A spring under the top frame tensions the seat.



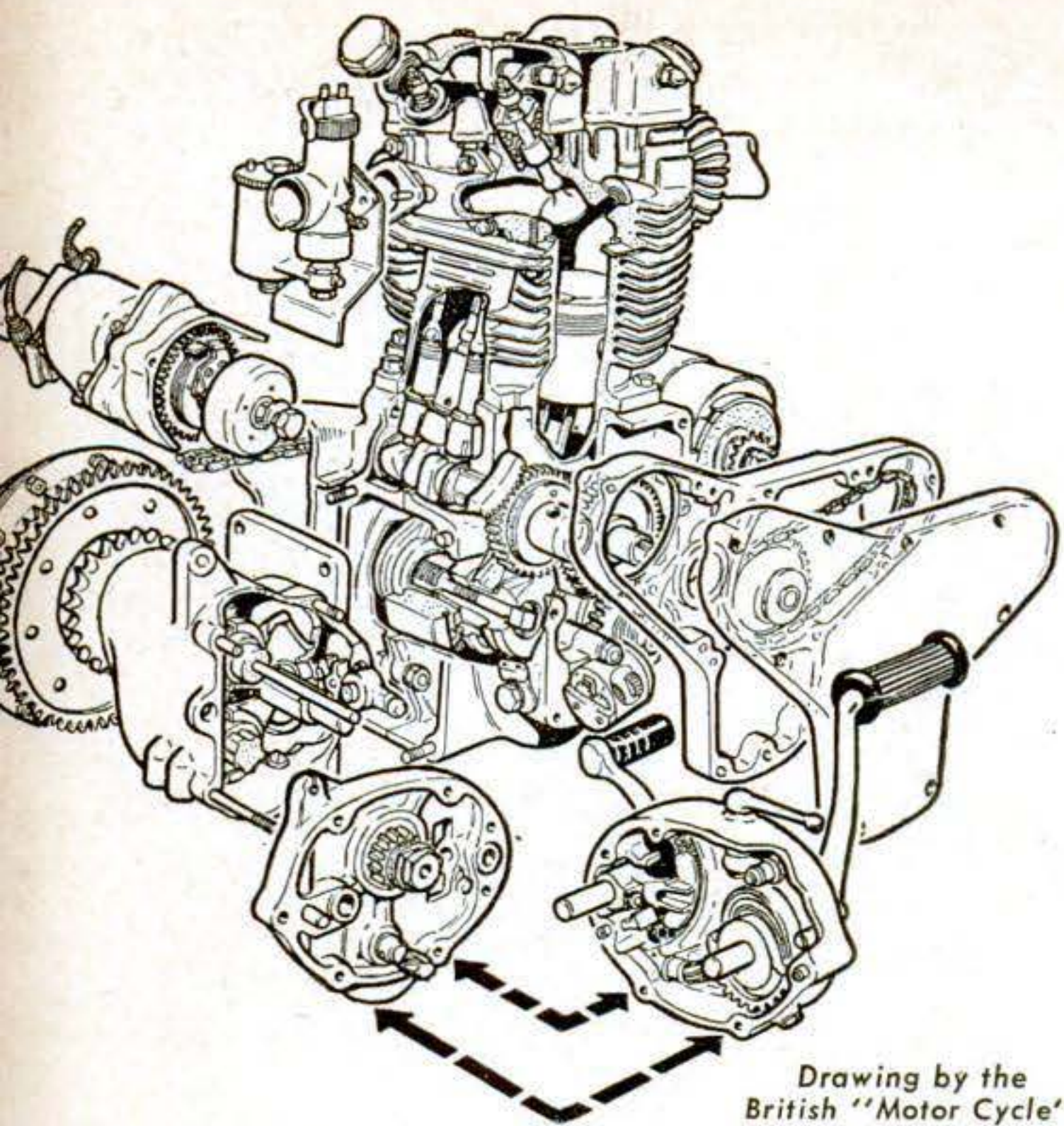
engine that develops 9 hp., this 240-lb. Czech motorcycle has a maximum speed of 62 m.p.h. and gives 94 miles per gallon at an average of 30 m.p.h. Engine displacement is 250 cc. (15.25 cu. in.).

At the international motorcycle show in Switzerland this year, a V-belt drive on a small Swiss machine, the Motascoche, drew considerable attention. This vehicle has no gear box, variation in ratio being achieved by lateral movement of the pulley flanges to alter their effective diameters. A hydraulic mechanism actuated by the oil pump produces this movement automatically.

Consistent with their objective of keeping down the overall weight, Europeans always

have favored a small capacity power unit of high efficiency. British motorcycles show considerable variety in twin-cylinder layout. The vertical cylinders of the Sunbeam are placed in line with the frame. In the Triumph models and in the new BSA vertical twin, they are side by side across the machine. The Douglas uses a flat twin, positioned transversely. In the big Vincent H.R.D. "Rapide," the arrangement is a 50-degree V.

Developed in 1939 but delayed in production because of the war, the new BSA 500-cc. vertical twin was especially designed for good cooling. By placing all the overhead-valve push rods in a tunnel cast in-

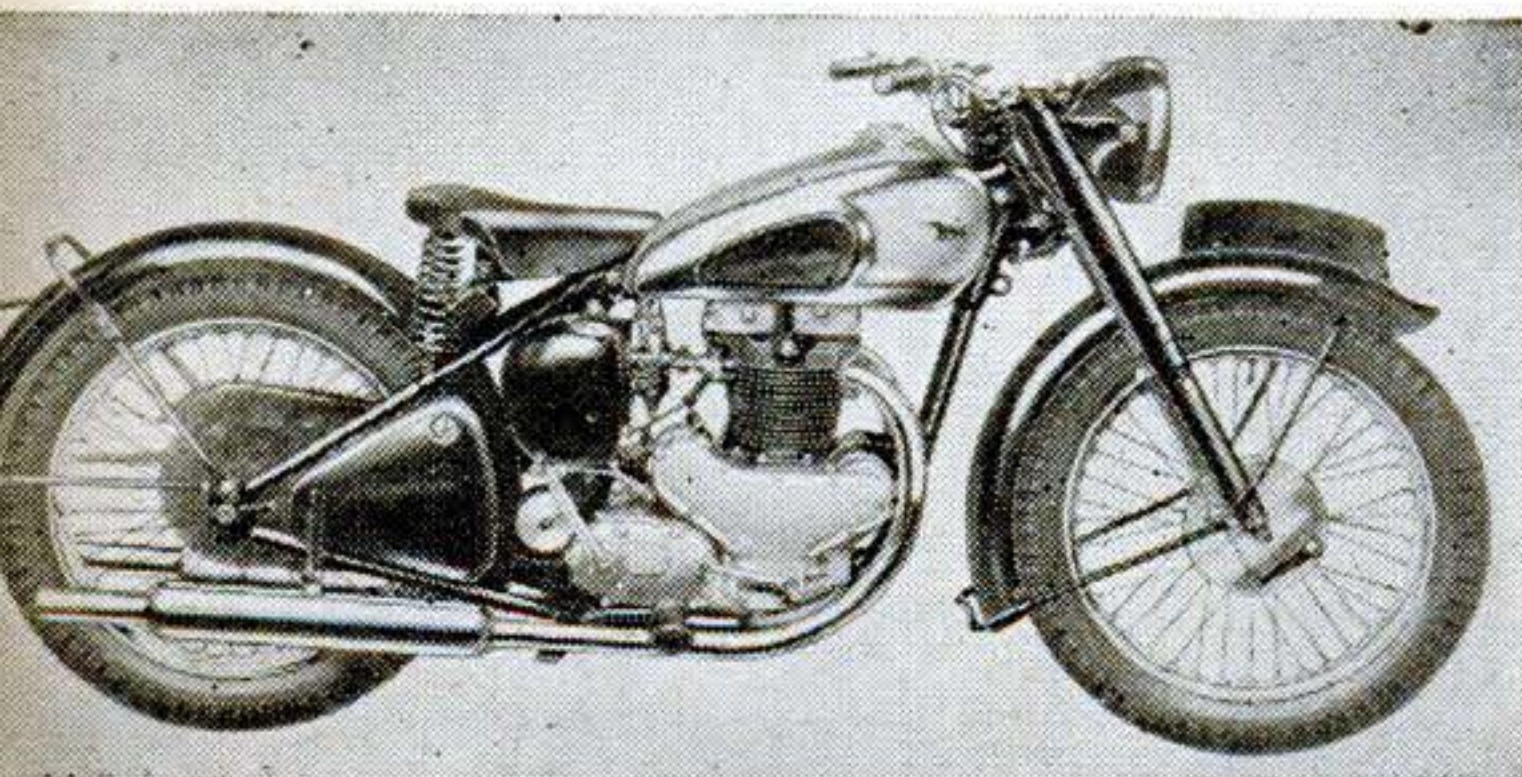


tegrally with the rear part of the block and also locating the camshaft at the rear, the designers produced an engine with nothing to impede the air flow around and between the barrels. Operating on a compression ratio of 7-to-1, this engine develops 26 hp. at 6,000 r.p.m. The top speed is above 90 m.p.h.

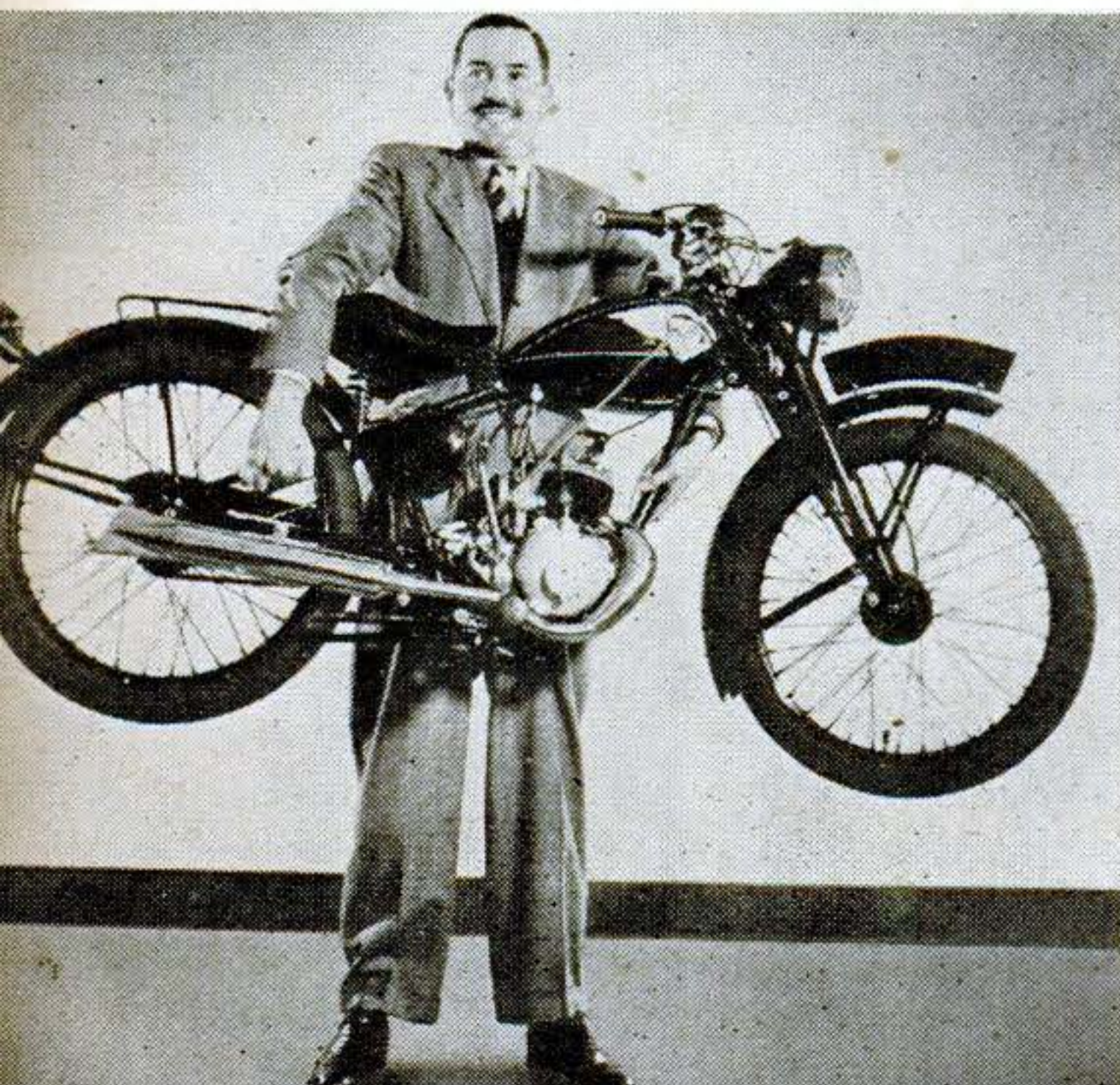
An engine that would attract attention anywhere is the 61 cu. in. Ariel Square Four, four vertical cylinders being cast in one block in square formation. Each pair drives one of twin transverse crankshafts and transmits power through a pair of ground spur gears. This machine, weighing 466 lb. without fuel, does around 100 m.p.h.

Water cooling never has been considered a particularly practical idea for motorcycles, but it is employed in the Scott Flying Squirrel, a British machine driven by a two-cylinder, two-cycle engine displacing 36.29 cu. in. Top speed is 80 m.p.h.

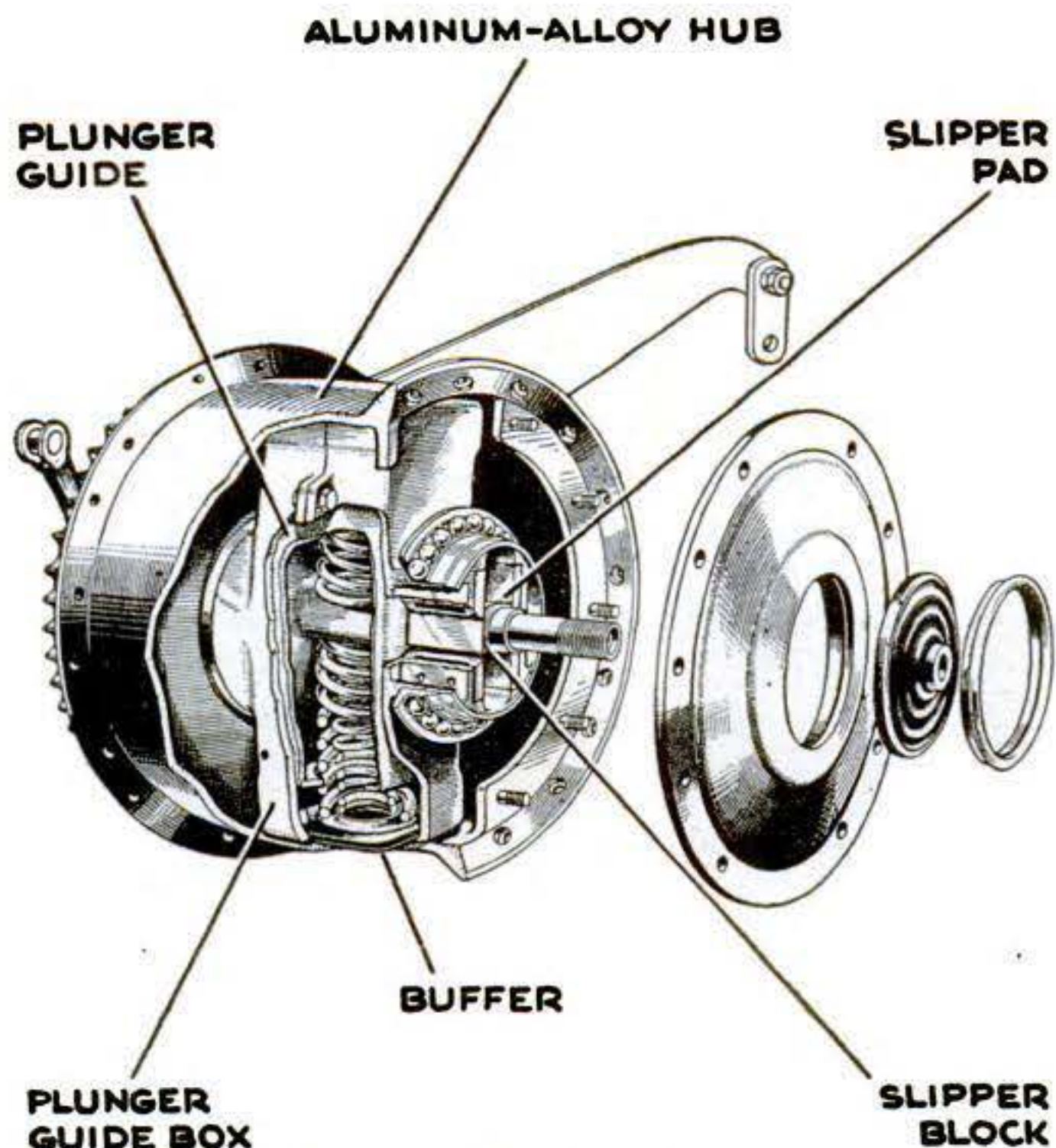
Triumph has just introduced a neat type of rear suspension. Hidden inside the hub shell, the mechanism includes three springs—one above the spindle and two below, one inside the other. These springs are curved like the plunger guide in which they operate. Embracing the guide and springs is a two-part guide box, free to move up and down in an arc of a radius equal to the distance from the center of the gear-box sprocket. Chain tension thus remains constant. **END**



In the new BSA vertical twin, air flow around and between the transverse cylinders is unimpeded, the push rods and camshaft being located at the rear.



Light enough to heft around, this 135-lb. Enfield travels at about 40 m.p.h. and does 100 miles per gallon. It is typical of European utility cycles.

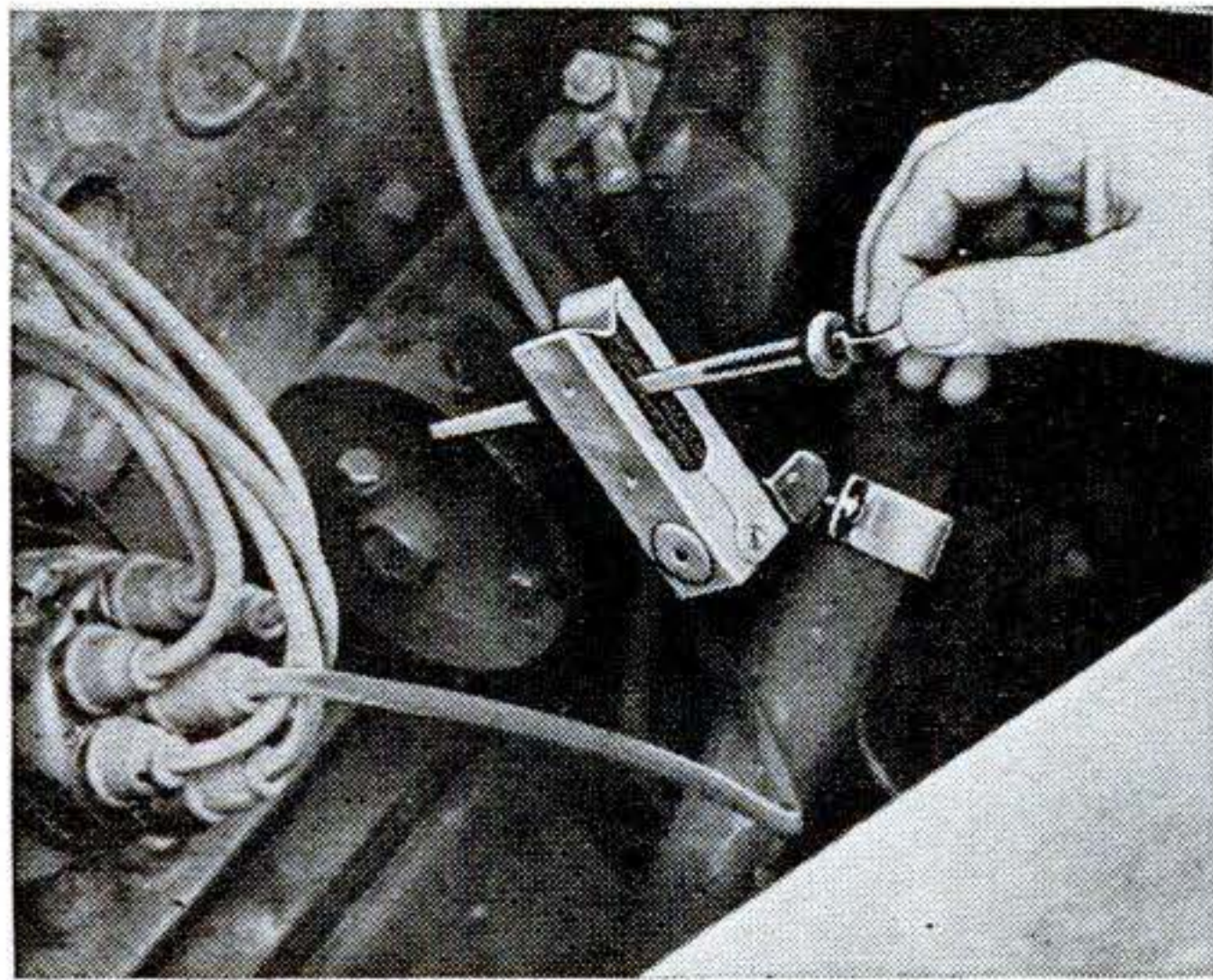


In the Triumph rear wheel, coil springs above and below the spindle operate inside a plunger guide. Replaceable slipper pads absorb the wheel thrust.



Magnet Forestalls Punctures.

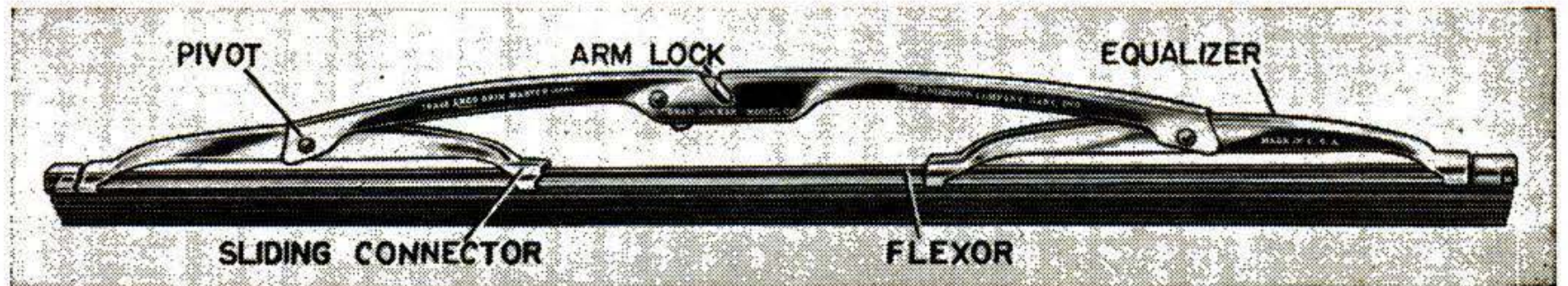
Designed to locate nails and other ferrous metals in tire casings, a magnetic tool introduced by Modern Merchandisers, Inc., of Chicago, contains a bulb that glows when the magnet comes near the embedded metal. Said not to be affected by the rim, lugs, or reinforcing wire in tires when properly used, the device is furnished as either a self-contained battery model or for 115 volts.



Pads Clean Dip Stick. A dip-stick cleaner made by Bishman Manufacturing Company, of Osseo, Minn., makes it unnecessary to search for a wiping cloth each time you check the oil. Consisting of two felt pads held together by a spring, the unit may be mounted in a convenient spot.



Powder Suppresses Static. Powder that is said to overcome the insulation property of rubber tires and prevent static electricity from building up in a moving car will soon come on the market. An air hose and a special container are used to inject a tablespoonful into each tube after the valve core has been removed. The United States Rubber Company developed the powder as an outgrowth of research on conductive tires for vehicles in industrial plants where a spark would be dangerous.



Flexible Wiper Blade. A new wiper blade made by the Anderson Company, of Gary, Ind., bends to conform to a curved windshield or to reach depressions in a flat one. Pressure exerted by the arm is

transmitted through a spanner to two equalizers that slide on a thin flexor forming the backbone of a one-piece molded wiping element. The flexor bends freely up and down but resists sidewise flexing.

Gus Is Taken for a Ride

By Martin Bunn

IT WAS just the sort of Saturday afternoon that Gus Wilson had been wishing for all summer. Hot and sticky, the outdoors couldn't tempt him, and the coolness of his Model Garage shop was doubly inviting. For the first time in many months, there was no unfinished job on the floor.

As he packed the bowl of his brier, he laid out his afternoon. He'd be back from lunch by two, and then he'd get busy on his old coupe. Of course, there wasn't anything really wrong with it, but he had been so busy with other people's cars in the past six months that it needed a couple of hours' work to bring it back to the operating perfection he considered only normal.

Then along about four o'clock George Knowles and Doc Marvin, and maybe a few of the other regulars, would drift in and fill the shop with tobacco smoke and argument. It would be, Gus told himself as he scratched a match on the seat of his coveralls, just like one of those lazy summer Saturdays he used to enjoy before the war.

The urgent honking of a horn jarred him out of his pleasant thoughts. A car rolled in through the open door and stopped with a jerk. Gus recognized it as the sedan for which—and a nice piece of cash—the Millers had traded the ancient Rolls-Royce with which Mrs. Miller had for a while outshone her friends and social rivals.

"Now what," Gus thought, his jaw sagging, "does *she* want?"

According to habit, Mrs. Miller got out talking. "Oh, Mr. Wilson," she burred, "this is just too, *too* provoking. I must be in Middleburg by two o'clock—but *positively*, I mean—and something's gone wrong with my transmission or carburetor or something. But I know you'll be able to fix it for me in a *jiffy*—you're so wonderful with cars."

Gus had learned from experience never to pay any attention to what Mrs. Miller says about her car. He motioned her to a chair, closed his mind to her nonstop chatter, and started checking. In a few minutes he discovered the clutch was slipping badly.

"Half a day's job," he told her. "I'll start first thing Monday morning."

"But I absolutely *must* get to Middleburg right away," she wailed. "If you're *sure* you can't fix my car now, I'll just have to drive it the way it is."

Gus shook his head. "That clutch will never get you over those hills," he warned. "You'll get stalled on the road."

"But I've *got* to be there by two o'clock," Mrs. Miller insisted, dabbing at her eyes with a tiny handkerchief. "It's *vital*—you can't realize how *utterly* vital!"

Gus looked at her suspiciously, but the tears that were beginning to well in her eyes convinced him that she must have some urgent reason for wanting to get to Middleburg, some 40 miles upstate. He would never admit it, but he's a soft touch for a sob story. Foreseeing the ruin of his afternoon of tinkering and talk, he glanced without having to at the shop clock. It was half past twelve, and there wouldn't be a bus or train to Middleburg until three.

"If you really have to get to Middleburg," he said grudgingly, "I'll drive you up in my car."

"Oh, Mr. Wilson," Mrs. Miller gushed, now all smiles, "that's just *too* sweet of you. But I wouldn't *think* of putting you to all that trouble. If you'd just work on my car so I could have it when I get back, and let me drive yours . . ."

Gus blanched—he knows what Mrs. Miller can do to a car. "Oh, my old jalopy is so out-of-date and cranky it would give you no end of trouble," he hedged hastily. "I'll be glad to take you. But we'd better get going to get there by two."

Clear of town and on the highway, Gus speeded up to the State's 45-mile limit and held his old car there. Mrs. Miller, sitting beside him, chirped cheerily on.

"Your car," she told Gus, "runs like a dream—an absolute *dream*. Why don't my cars ever run like that?"

Gus could have told her, but he didn't. He was thinking hard about something else. Halfway to Middleburg they had turned into a short-cut dirt road with a series of steep grades, and the car was beginning to lose power, finding each succeeding hill harder than the one before. Gus was thinking that, if he had had a chance to go



Gus took out the fuel pump, looked at it, and scratched his head discouragedly. "I must have been a nut . . ."

over his car in the past six months, this would never have happened. Then, 50 yards short of the crest of the longest hill they had come to, the engine sputtered and stopped.

"Now, Mr. Wilson," Mrs. Miller giggled as Gus applied the emergency brake, "don't tell me *you've* run out of gas."

"Not out of gas," Gus answered ruefully, "out of luck." He pressed the starter button, and the engine turned over but wouldn't take hold. "It seems to be the fuel pump—and we're at least five miles from a garage."

"You don't mean we're stuck, do you?" Mrs. Miller squeaked. "That would be perfectly *terrible!* I've just *got* to be in Middleburg by two, and you *promised* to get me there!"

Without replying, Gus got out on the dust-thick road. Perspiring in the humid atmosphere, he removed his coat, rolled up his sleeves, raised the hood, and began checking. He removed the carburetor feed line and found what he expected—that the fuel pump wasn't pumping. When he took

off the fuel pump, his face turned red—and it wasn't from the hot sun.

"This would have to happen right in front of the gabbiest dame in town," he told himself. "She'll spread it all over. I'll never hear the end."

Mrs. Miller's eyes were becoming moist again. "What are you fooling with *that* thing for?" she sniffled. "*Do something!*"

Gus turned redder, and this time it was anger instead of embarrassment. "If you'd just keep quiet for a minute, maybe I could do something!" he snapped. "I can't even think with you jabbering."

"O-o-oh, Mr. Wilson," she moaned, but she cut short her talk, and Gus saw why the fuel pump had stopped pumping. Long wear on the push rod and rocker-arm linkage had progressed so far the movement of the push rod was no longer sufficient to take up the play and still move the diaphragm enough to pump gas.

"No answer to that but a new fuel pump," he told himself discouragedly. "I must have been a nut . . ." Then he said out



loud: "By gum, that might work at that!"

Mrs. Miller forgot her feelings had been hurt. "Why, Mr. Wilson," she gurgled, "I do believe you have an *idea*."

"Yes," Gus grinned. "It may be a nutty one, but it's worth trying."

She watched him paw hurriedly through the tool box and then quickly reassemble the fuel pump and lower the hood.

"Jump in," he told her, "and we'll see if it works."

It did. Gus stepped on the starter, and after it had ground for a few seconds the engine took hold and ran smoothly. "Let's go," Gus laughed.

They made Middleburg on time. The clock on the town-hall tower showed exactly two as they drove into the village.

"That's the place," Mrs. Miller pointed excitedly as they reached a tumble-down old house in front of which a small crowd was gathering. "I won't be long."

She darted up the path, and when Gus got out to see what was going on, his eyes caught a sign that proclaimed, "Auction."

He had to laugh. "So that's it," he muttered. "I *am* a fall guy."

Ten minutes later a large and opulent

limousine stopped at the gate, and a chauffeur helped a large and opulent woman out. As she started up the path, Mrs. Miller came out of the house, an expression of triumph on her face and a large green-glass pitcher in her arms.

"Good afternoon, Mrs. Grigsby," she smiled sweetly to the rapidly purpling Mrs. Grigsby. "I'm *so* afraid you're late." Then she got into Gus's car. "It's *hideous*," she told Gus confidentially, "but it's *authentic* Colonial or early Federal or something, and Mrs. Grigsby has been after it for *ages*. I was determined to beat her to it, and I knew she had a club meeting that wouldn't let her get here until after two o'clock."

HENRY MILLER strode into the shop about six that evening while Gus was at last working on his car.

"What's this about you stalling your car on a back road with my wife?" he began.

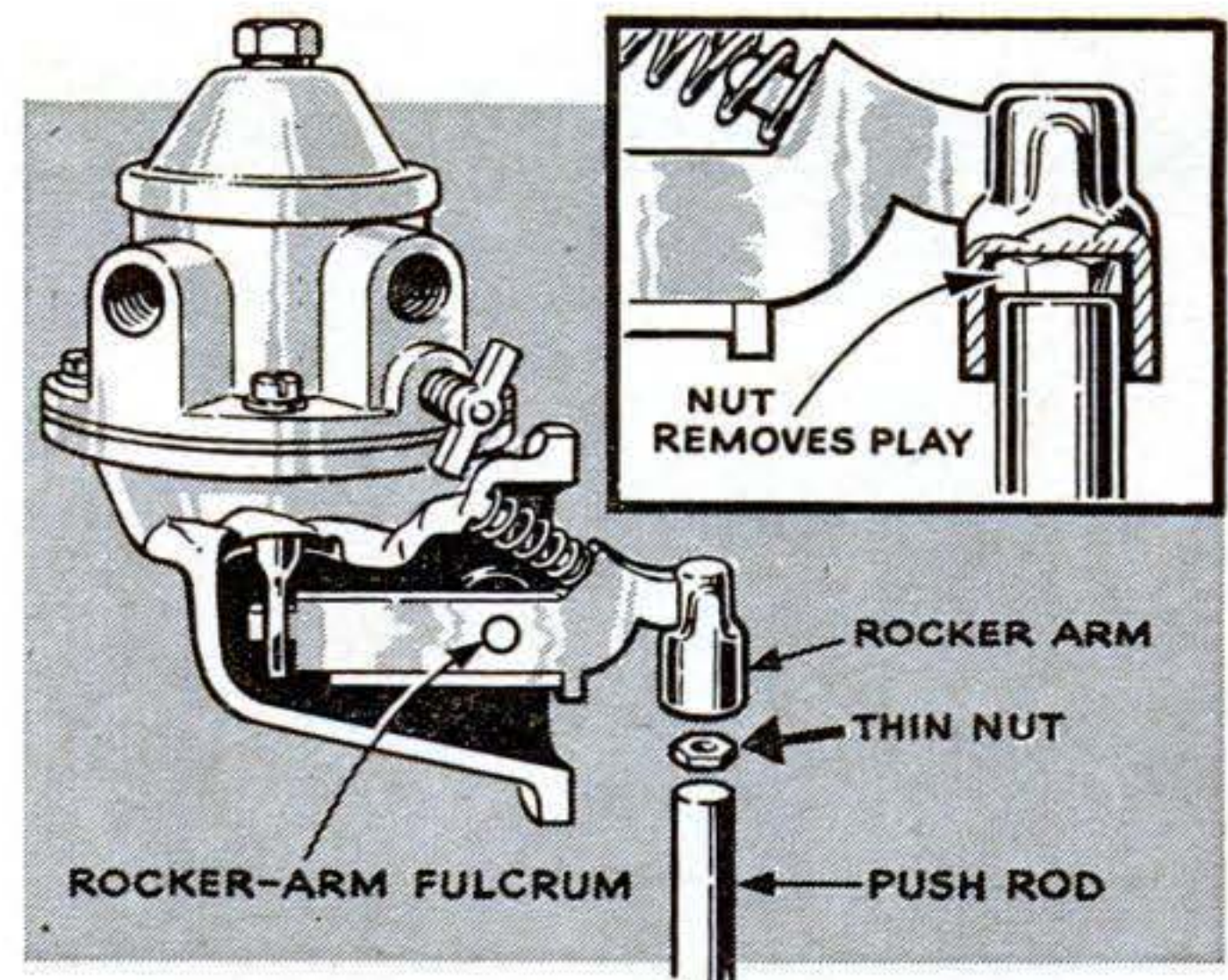
For the third time that day, Gus turned red. "Now, Henry," he interrupted.

Miller laughed out loud. "What I want to know," he demanded, "is how you fixed a busted fuel pump. I've always thought when one went you needed a new one."

"Oh, that," Gus grinned with relief. "You see, the push rod and rocker-arm assembly had worn so much the movement of the push rod wasn't enough to work the diaphragm and pump gas. I laid a thin nut on top of the push rod to take up play."

"Say," Miller whistled, "what in the world gave you that bright idea?"

"I was thinking what a nut I had been not to have checked my car sooner," Gus grinned sheepishly. END

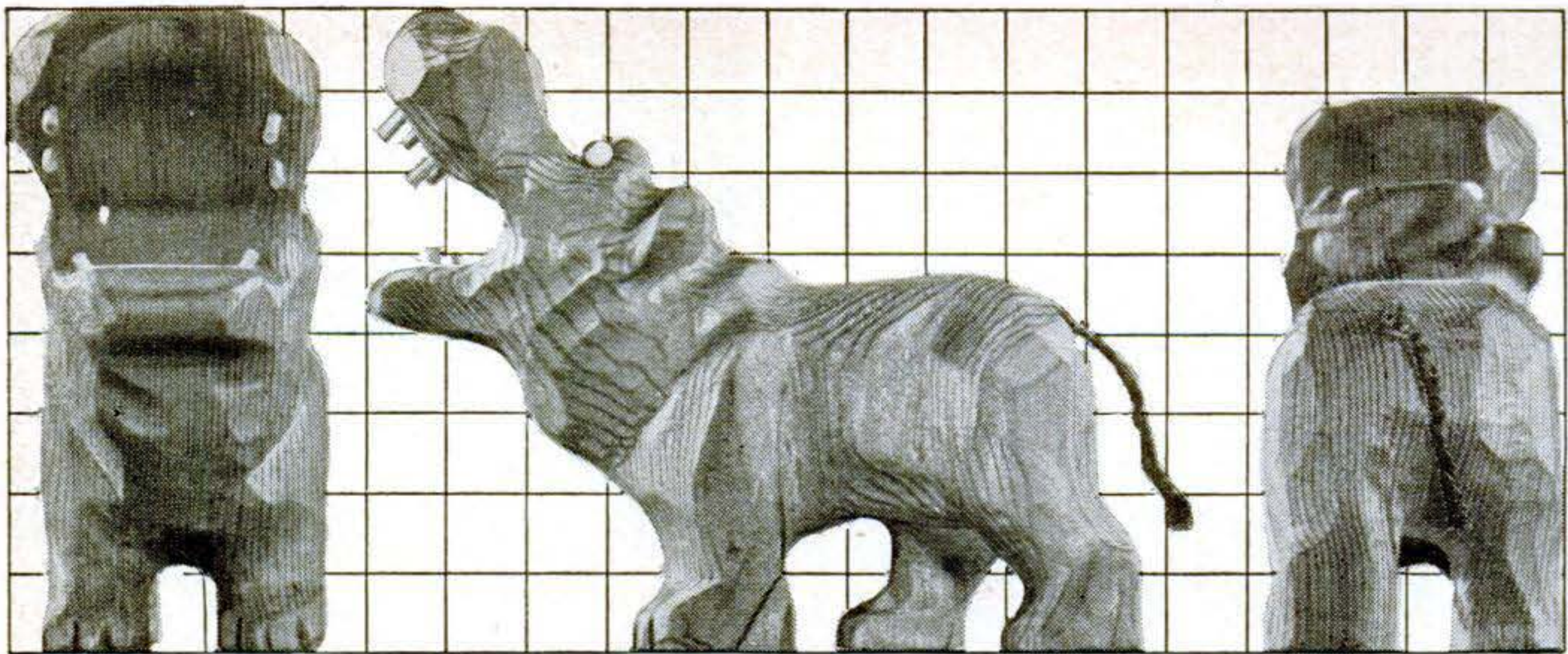


Laying a thin nut on top of the push rod took up the play of the worn parts and enabled the rod to work the diaphragm to pump gas.

MECHANICS AND HANDICRAFT



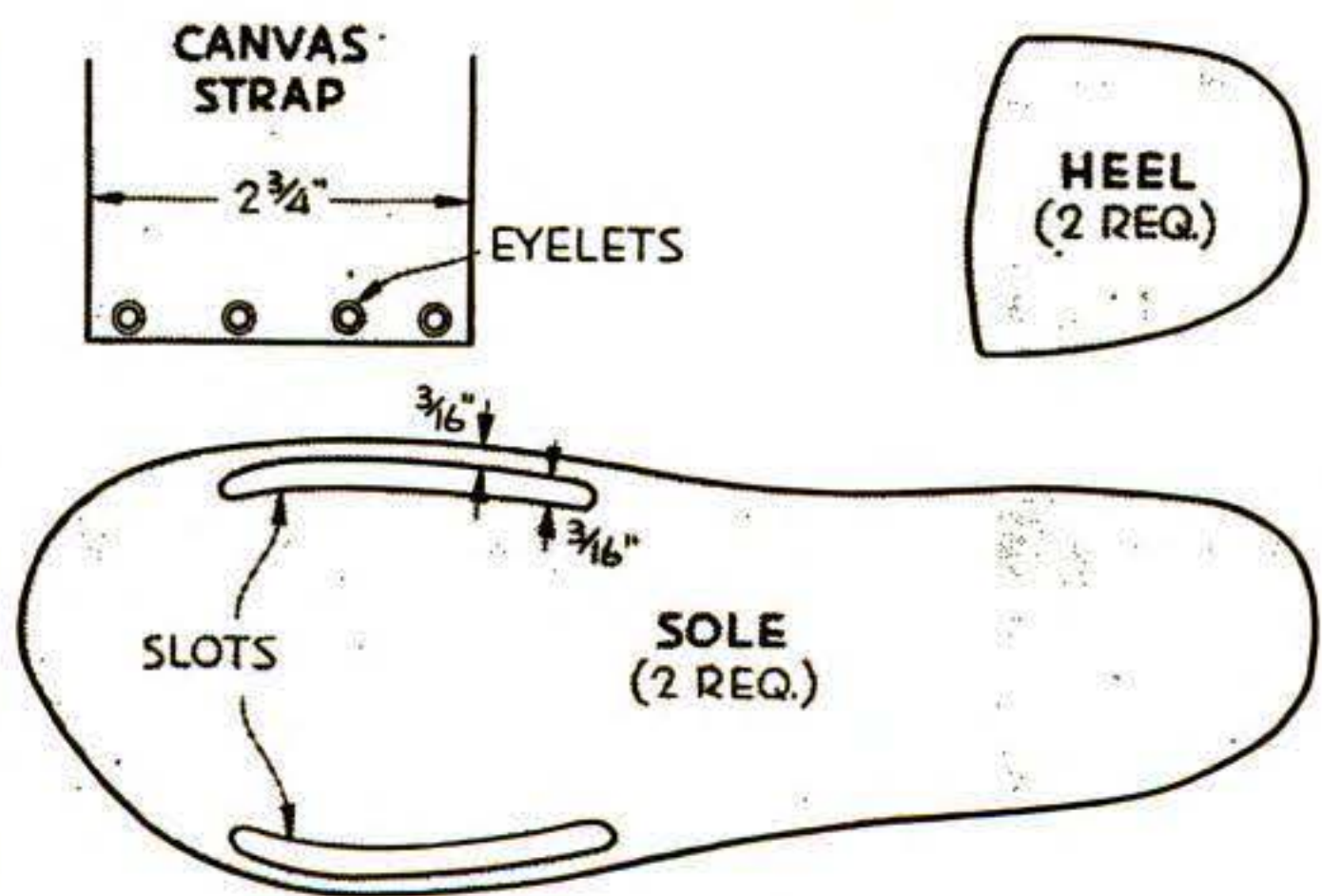
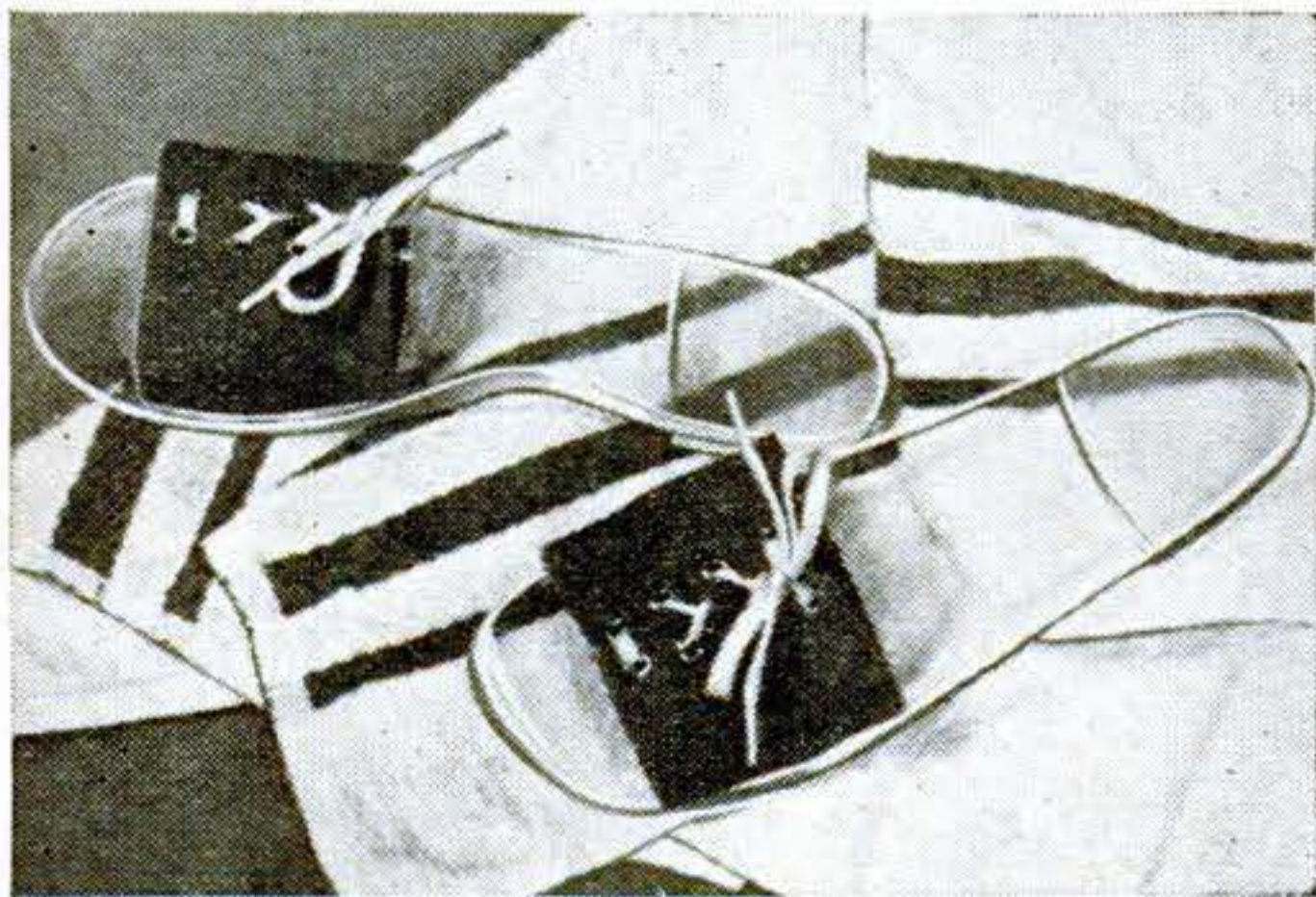
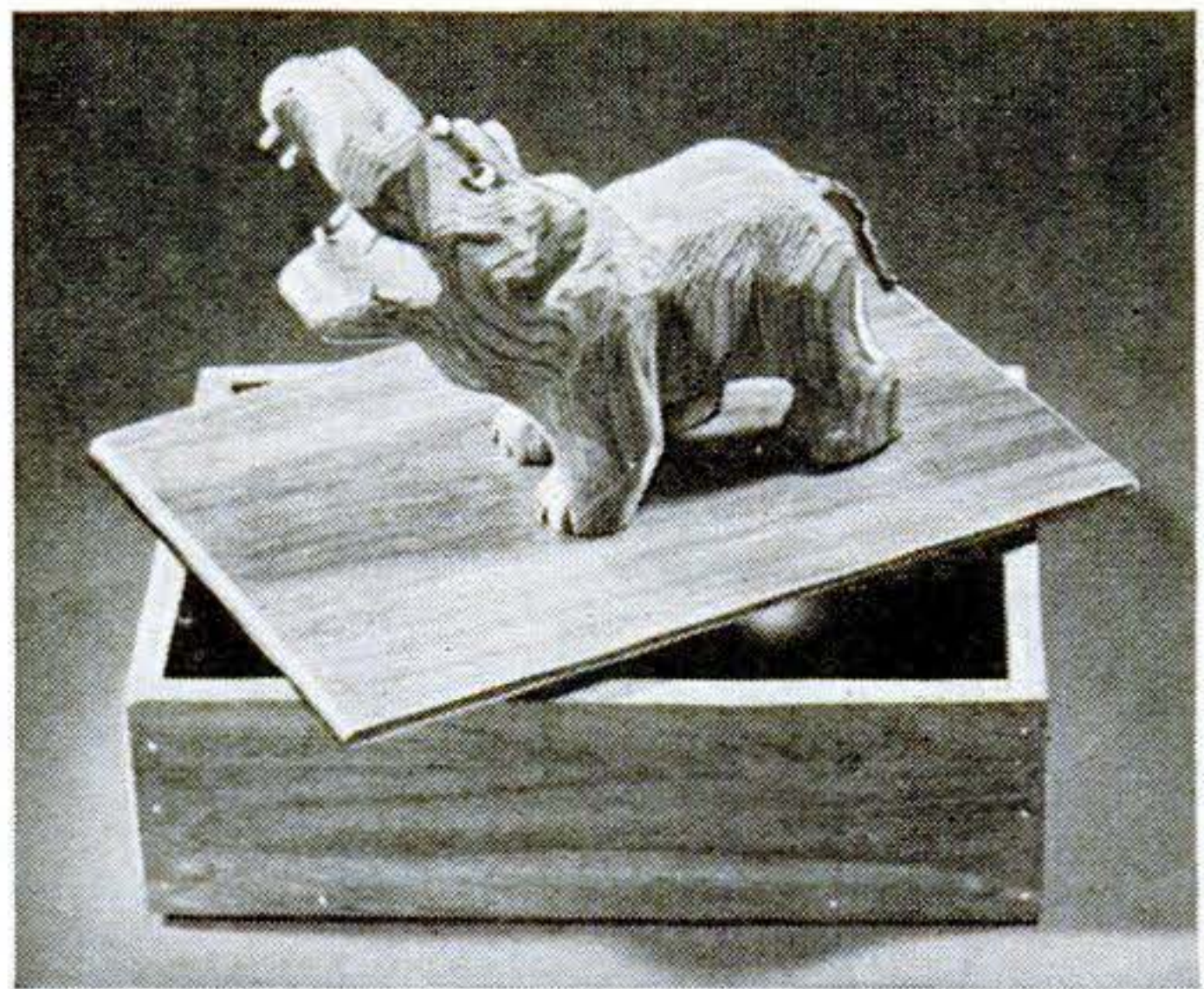
- **Overshot Water Wheel**
- **Radio Control for Models**
- **Carving Inside Plastic**
- **Aluminum Dinghy**
- **Chemistry of Hydrocarbons**



Hippo Tops Box

HANNIBAL HIPPO, with his toothy grin, makes an eye-catching handle on the lid of a handkerchief or stamp box. The project is a rough carving and should be sanded only sparingly.

Complete the squares across the front and side views with ink and transfer the profile to $\frac{1}{2}$ " or larger squares. You'll find the front and back views a help in carving. Glue in bits of round toothpicks for teeth. Eyes are map pins with painted pupils, and the tail is cord.—ELMA WALTNER.



Plastic Shower Shoes Are Molded to Fit Foot

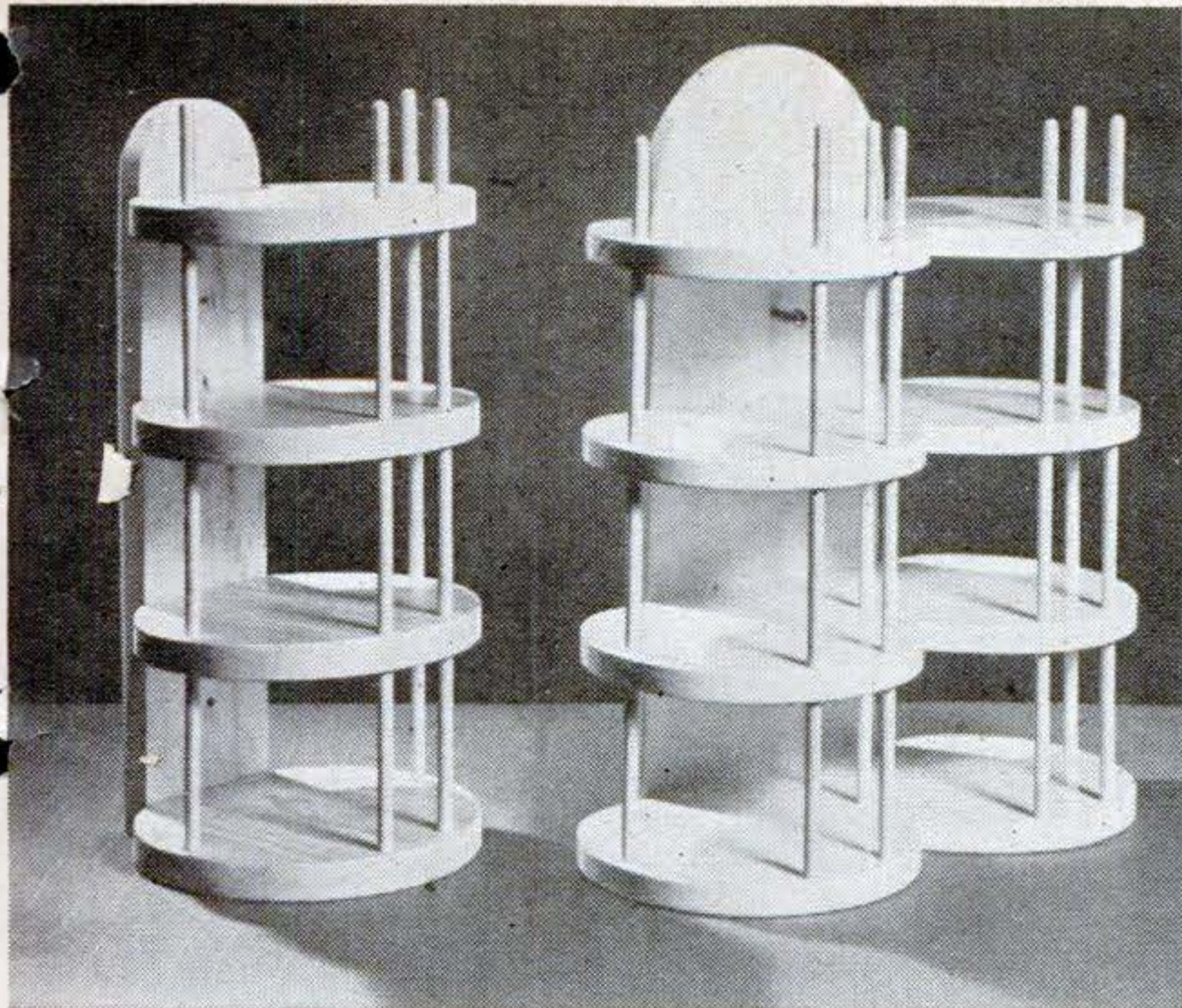
THESE plastic-sole shower shoes with colorful canvas toe straps, shown in color on page 112, take advantage of the hot-shaping characteristics of the material.

Have the wearer-to-be place each foot on a sheet of $\frac{3}{16}$ " plastic, and trace around it on the masking paper. Saw out two soles and two heels; then drill and saw strap slots.

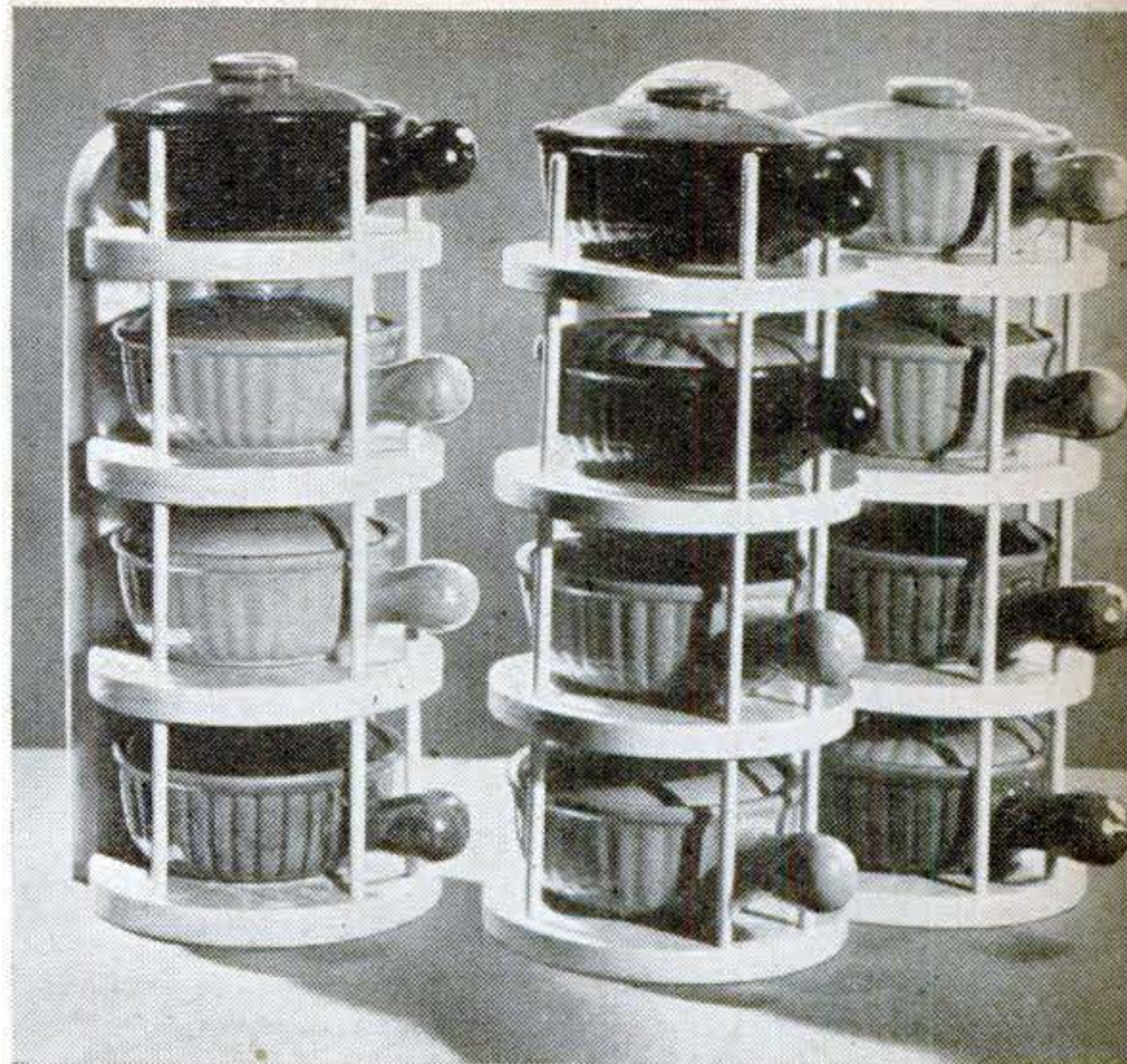
Fit one sole at a time. Heat it until pliable in a 250-deg. oven, and have the wearer,

protected by heavy wool socks, place a foot on it. Slip the unheated heel underneath and, with gloved hands, press the plastic snugly against the instep and curve the front up. Hold in place until the plastic cools. Cement the heel on.

The straps are doubled pieces of canvas cut to length and provided with eyelets for lacing. Under the soles, they serve as a non-skid surface.—DORIS ALLER.



Loose dowels in the front of the racks are easily withdrawn to permit the removal or replacing of casseroles. The other dowels are glued in.



Each of these racks will hold a set of casseroles—the single one at left, a set of four, and the double rack at right, a set of eight pieces.

Kitchen Wall Rack Holds Set of Casseroles

IN A KITCHEN where storage is at a premium, a wall rack for casseroles will save needed space. These pottery utensils, attractive in themselves, when so displayed become a decorative asset as well.

Lay out circles for the shelves 2" larger than the greatest diameter of the casseroles, and scribe a chord at the back as long as the width of the backplate. Clamp the four together for drilling so the dowel holes will be perfectly aligned. The pairs at the

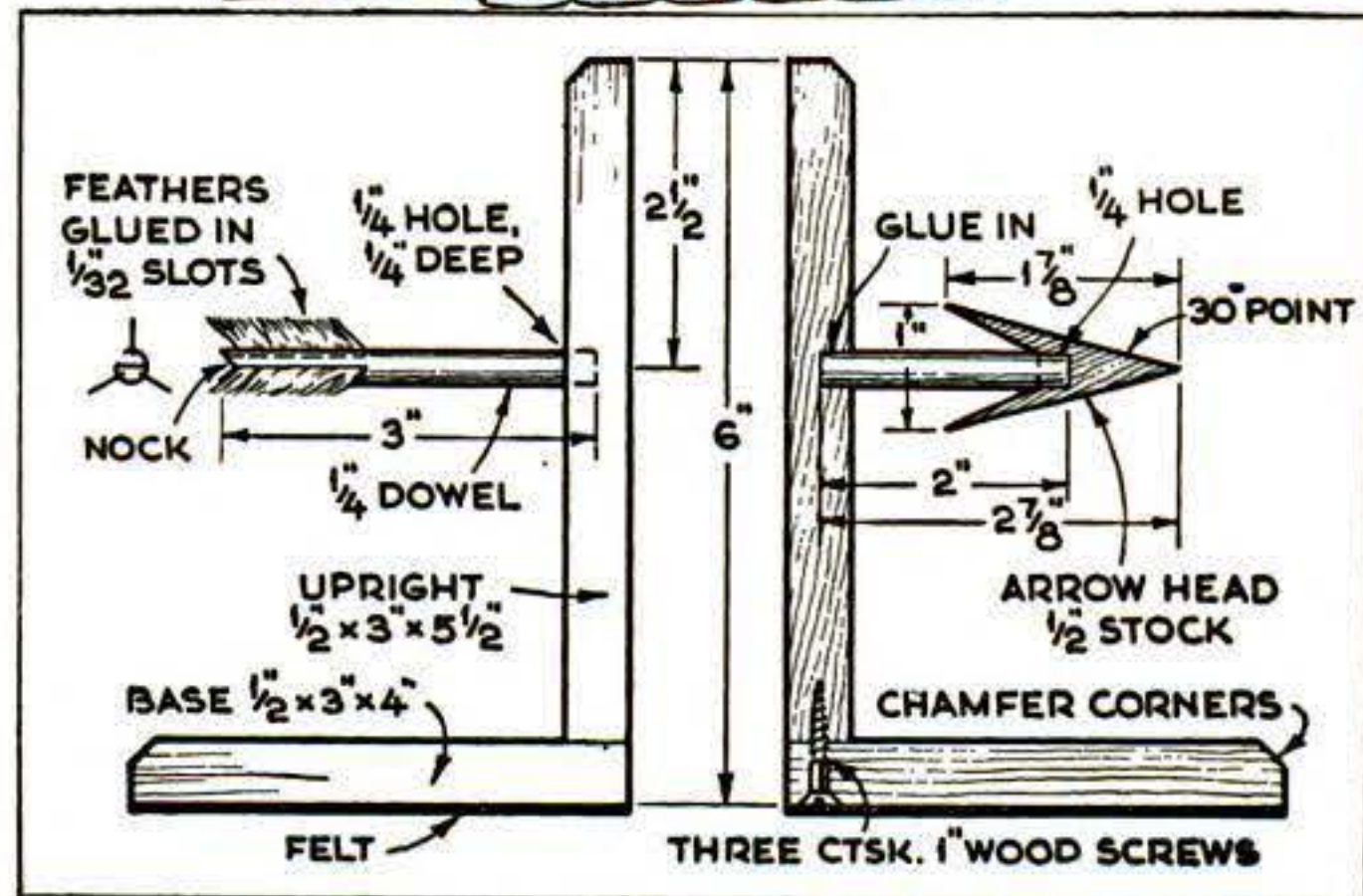
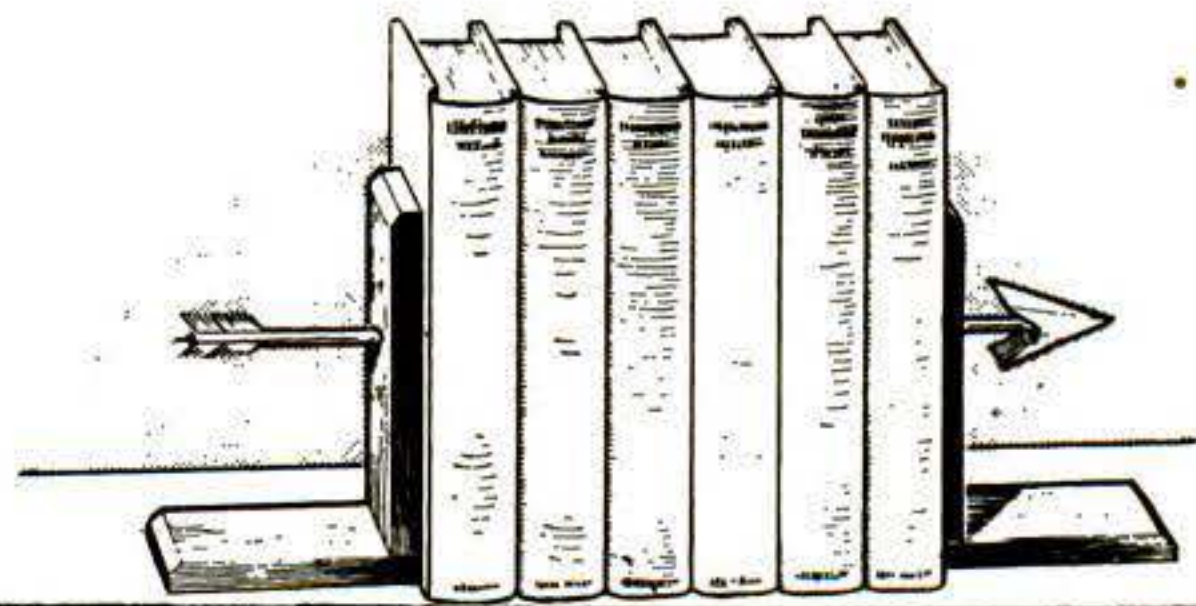
front should be a free sliding fit for $\frac{1}{4}$ " dowels and those at the sides a push glue fit. Stop the drill at a depth of $\frac{3}{8}$ " in the bottom shelf.

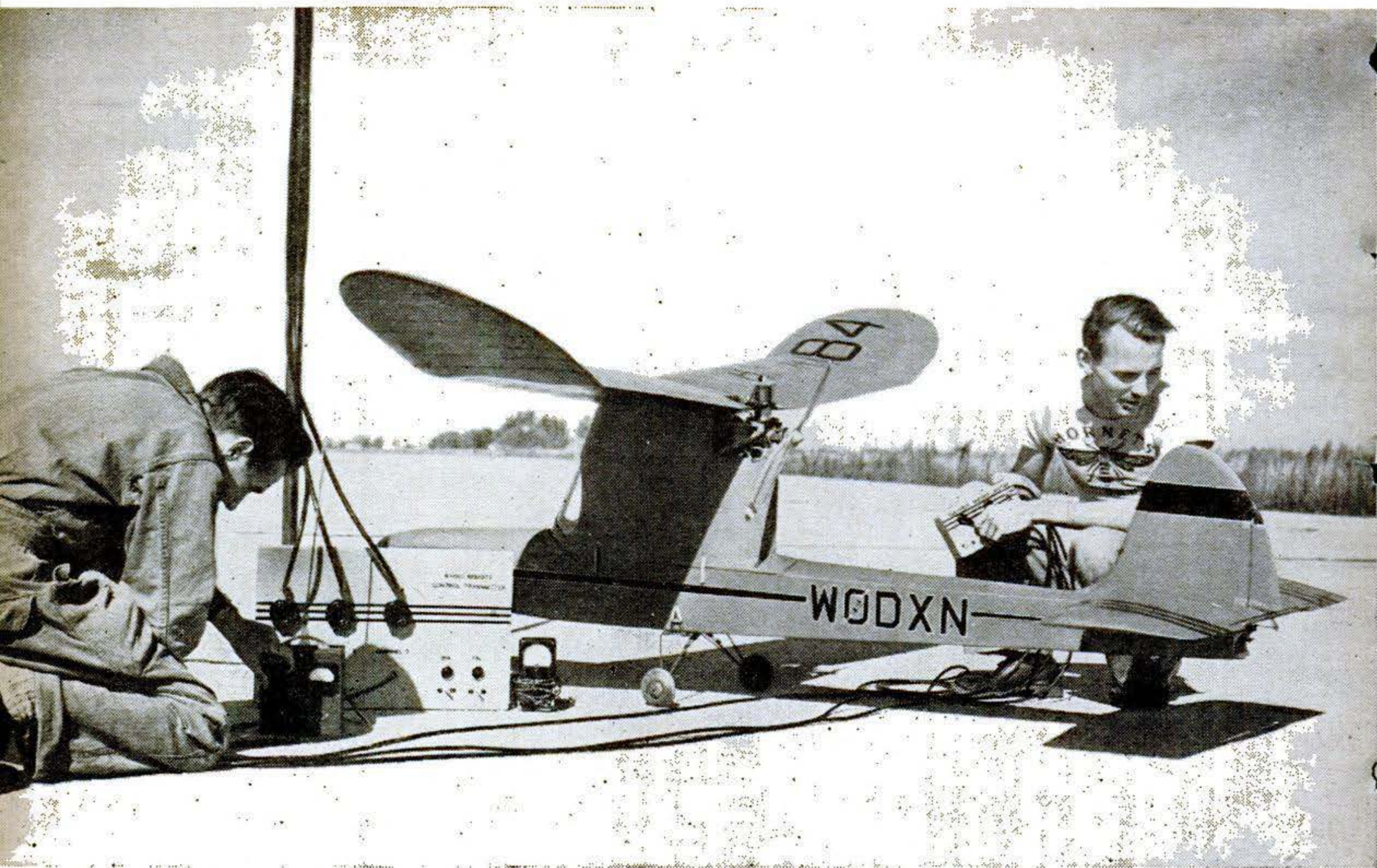
Dimensions are not critical, except that the space between shelves should just be high enough for a casserole and its cover. Stock $\frac{1}{2}$ " thick is suitable. Assemble with long flathead screws driven through the backplate into the shelves, and mount with two roundhead screws.—N. D. HARTLEY.

Glued-In Arrow Shaft Adds Novelty to Book Ends

DESPITE their simple construction, these arrow book ends are a pleasing accessory for a library table, especially if they are made of nicely grained hardwood. Cut the bases and uprights to size, and chamfer the ends. Take care in spotting the holes to receive the arrow shaft, for the slightest misalignment will spoil the illusion that the books are being pierced.

Taper the stock for the arrow head only at top and bottom; there is no need to bring it to an actual point. The three slots for feathers in the nock end of the shaft may be routed in the drill press with a $\frac{1}{32}$ " bit; but saw kerfs will serve if they are cut a trifle long and the tapered inside ends plugged with filler.—E. J. WIECZOREK.





The author and a friend check the operation of the controls on the author's 14-lb., 8'-span radio plane.

Push-Button Pilots Fly Model Planes

Homemade drones, ingeniously controlled by radio signals, do aerobatics at the command of craftsman-fliers.

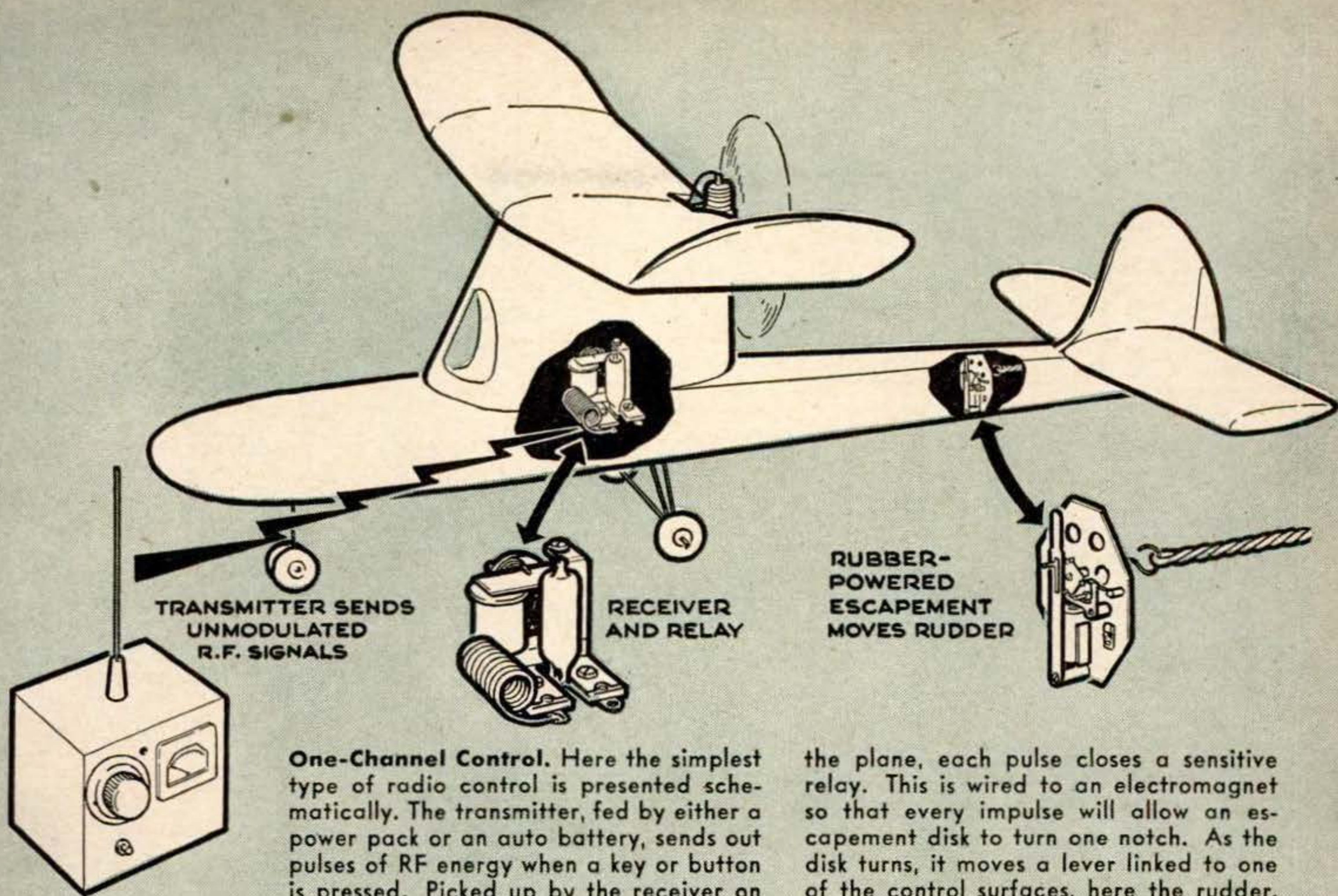
By Claude McCullough

THE coming king of all workshop hobbies may well be the radio control of model planes and boats. Since V-J Day, many new war-developed parts and techniques have given a boost to this fast-growing hobby. Here's a primer on amateur radio-control flying as it is practiced today:

Tiny receivers, light enough to be borne aloft in a tissue-and-balsa aircraft, and tough enough to withstand takeoff and landing bumps and the vibrations of a high-speed

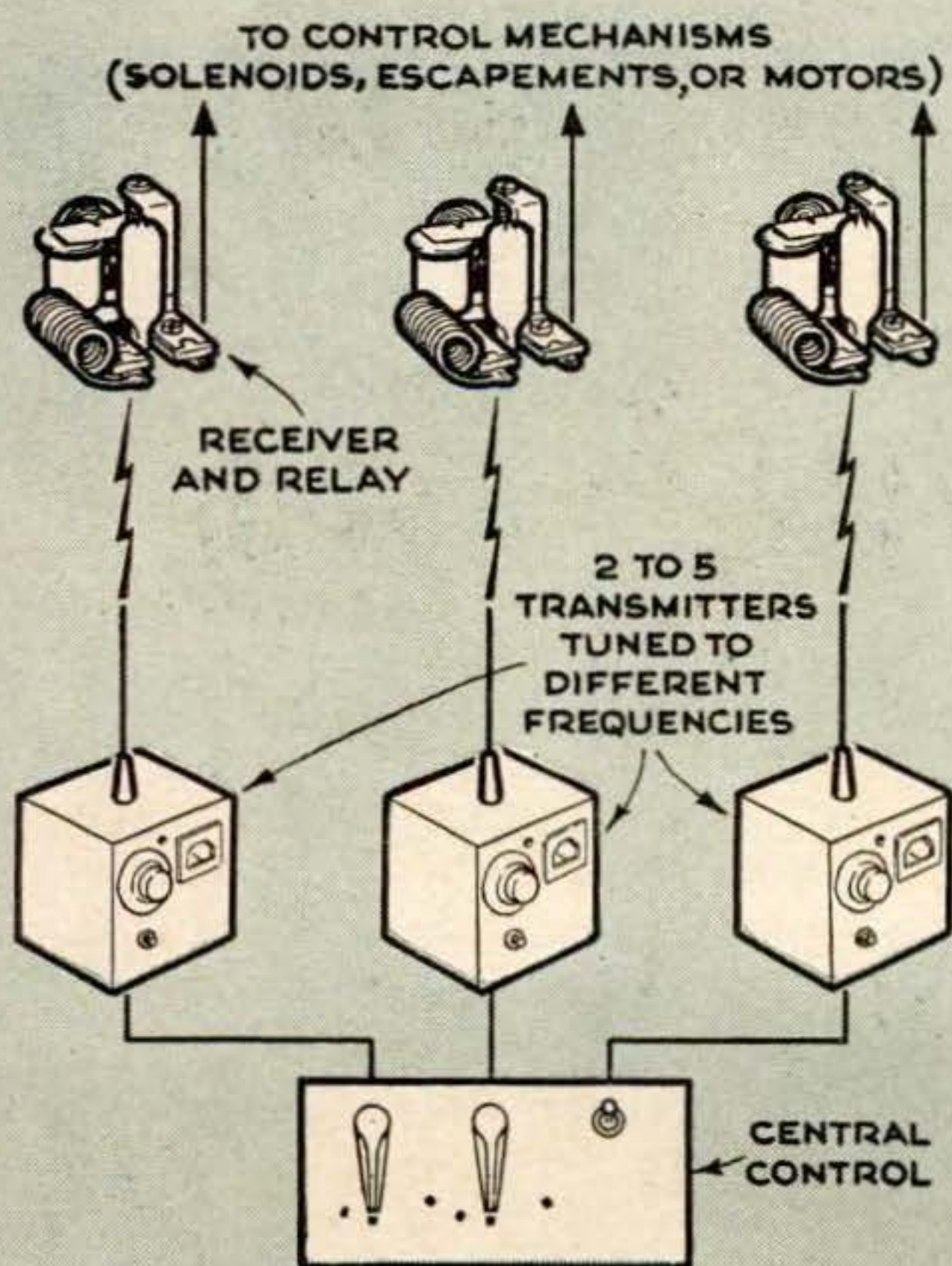
gas engine, are at the heart of radio control. Built with hearing-aid and proximity-fuse components, a receiver typically employs a single tube in a sensitive superregenerative circuit. A tube frequently used is the Raytheon RK-61, a minute triode that contains a trace of an inert gas. Ionization of this gas causes a great variation in the plate current, triggering a relay that in turn operates electric motors, solenoids, or escapements to move the controls. Operating in the 50-54-megacycle amateur band, the transmitter is often a one-tube oscillator with an output of a few watts, providing control over a range of several miles.

Probably the most popular setup uses a single transmitter and receiver to control movement of the rudder. Rudder control alone, in the hands of an experienced push-

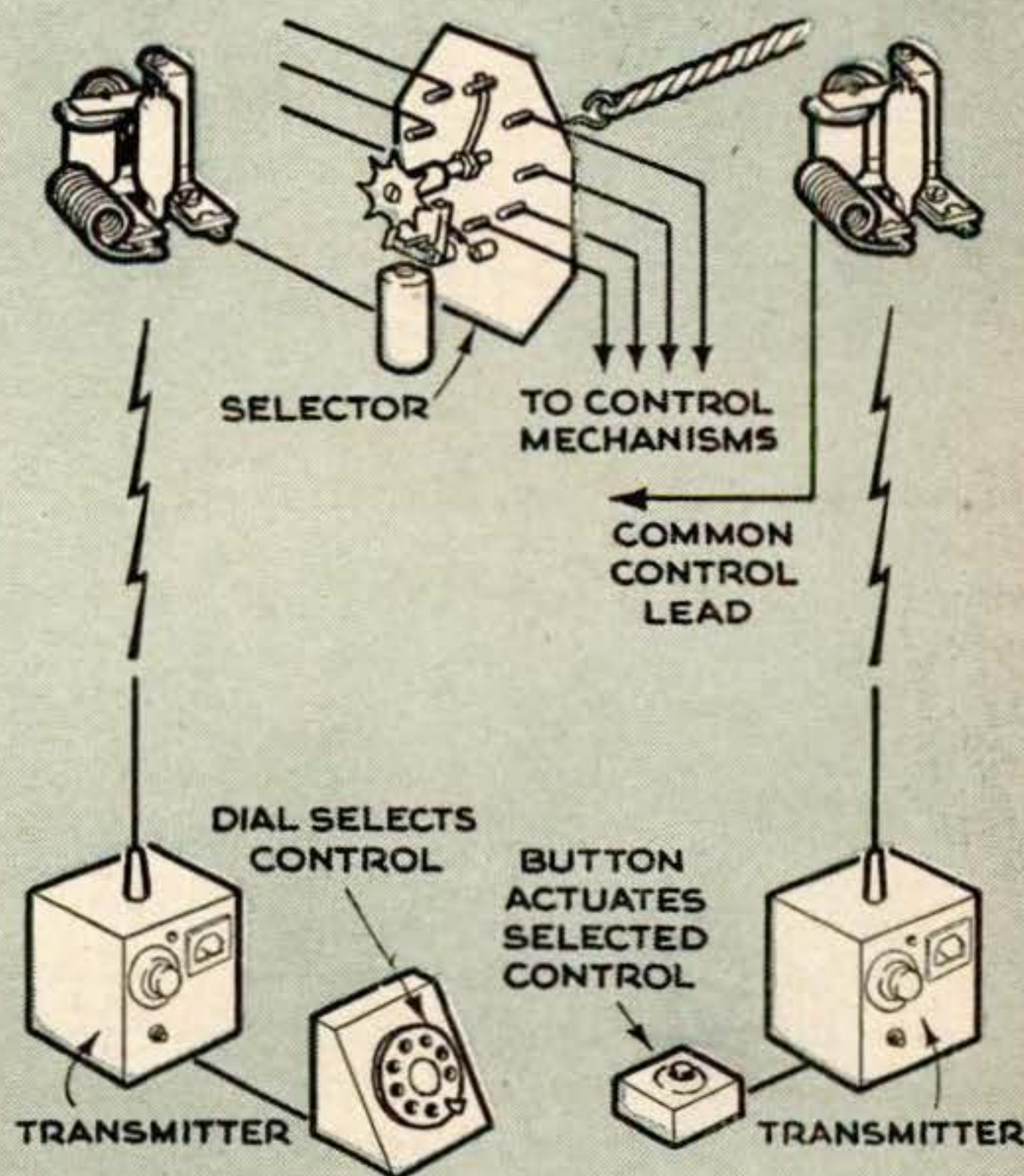


One-Channel Control. Here the simplest type of radio control is presented schematically. The transmitter, fed by either a power pack or an auto battery, sends out pulses of RF energy when a key or button is pressed. Picked up by the receiver on

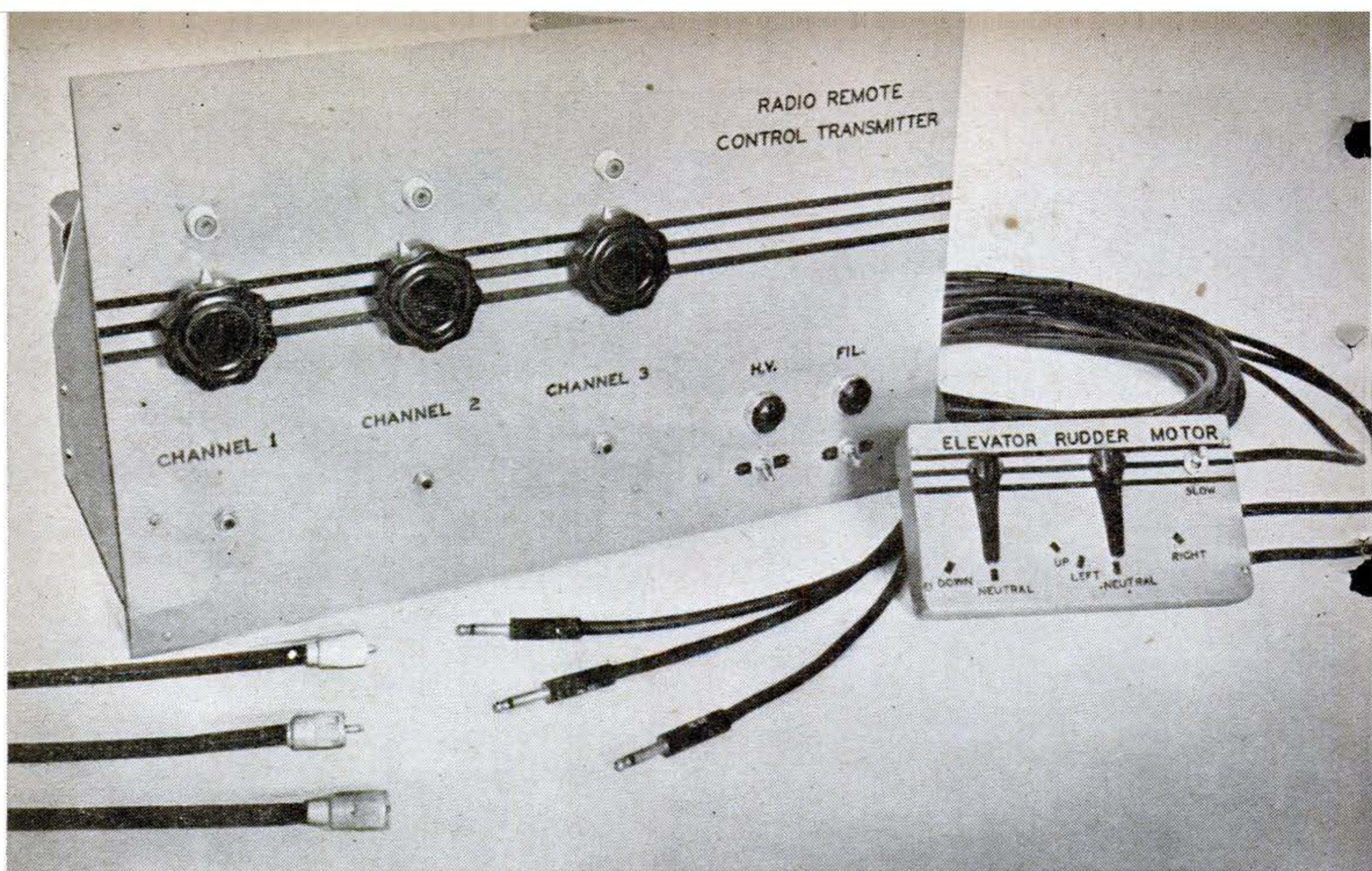
the plane, each pulse closes a sensitive relay. This is wired to an electromagnet so that every impulse will allow an escapement disk to turn one notch. As the disk turns, it moves a lever linked to one of the control surfaces, here the rudder.



Ganged Transmitters and Receivers. This is one way of adding extra control channels. It has the special advantage of permitting the simultaneous operation of different controls.



Selector Control. A magnetic selector switch in the plane picks out the particular control circuit desired, while the signal to operate this control comes from a second transmitter.



The transmitter the author uses to fly the plane on pages 112 and 152. A Federal radio license is needed.

button pilot, gives an astonishing variety of maneuvers; not only right and left turns but circles, figure eights, spiral climbs and glides, and even loops are possible.

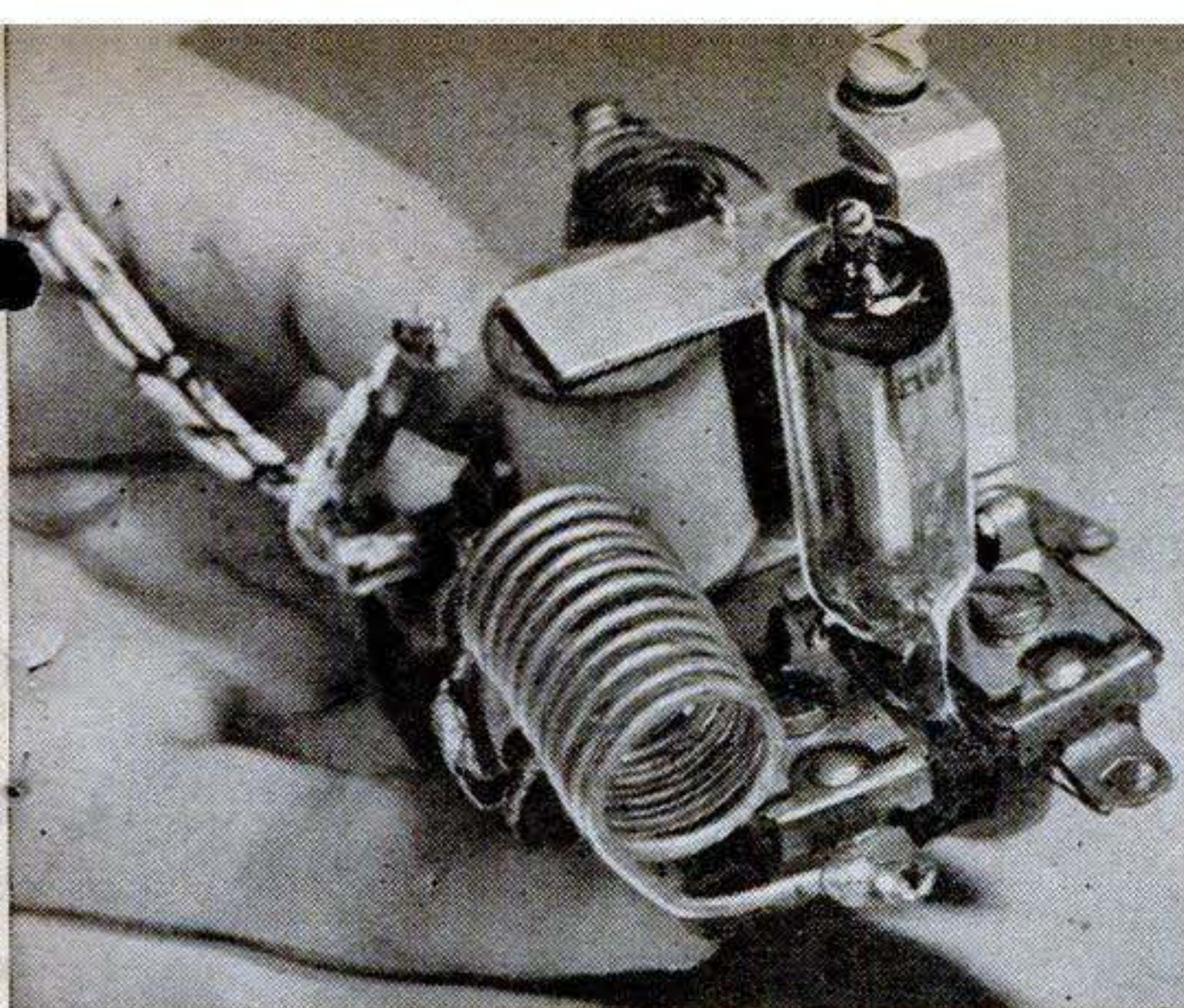
Another common arrangement uses separate transmitters and receivers for each channel of control. Receivers can still be very simple, and the method permits the simultaneous operation of different controls. The duplication of receivers involves less extra weight than might be expected, since they can use a common power supply. However, there is a practical limit of about five control channels, for closer spacing across the amateur band is likely to cause accidental interaction of the receivers.

This problem doesn't occur in a third control system, which uses a single receiver to obtain multichannel control. Here a selector, essentially a rubber-band-powered rotary switch, is placed in the plane to hook up any one of eight individual control circuits. Keyed by transmitter pulses, a ratchet wheel moves to the desired position where a wiper arm closes the circuit. While it is passing by intermediate contacts, their circuits are kept from functioning by a time-delay device, either thermostatic or electronic, which requires that the wiper arm remain on the contact for a second or two before the control circuit is activated. A telephone dial is some-

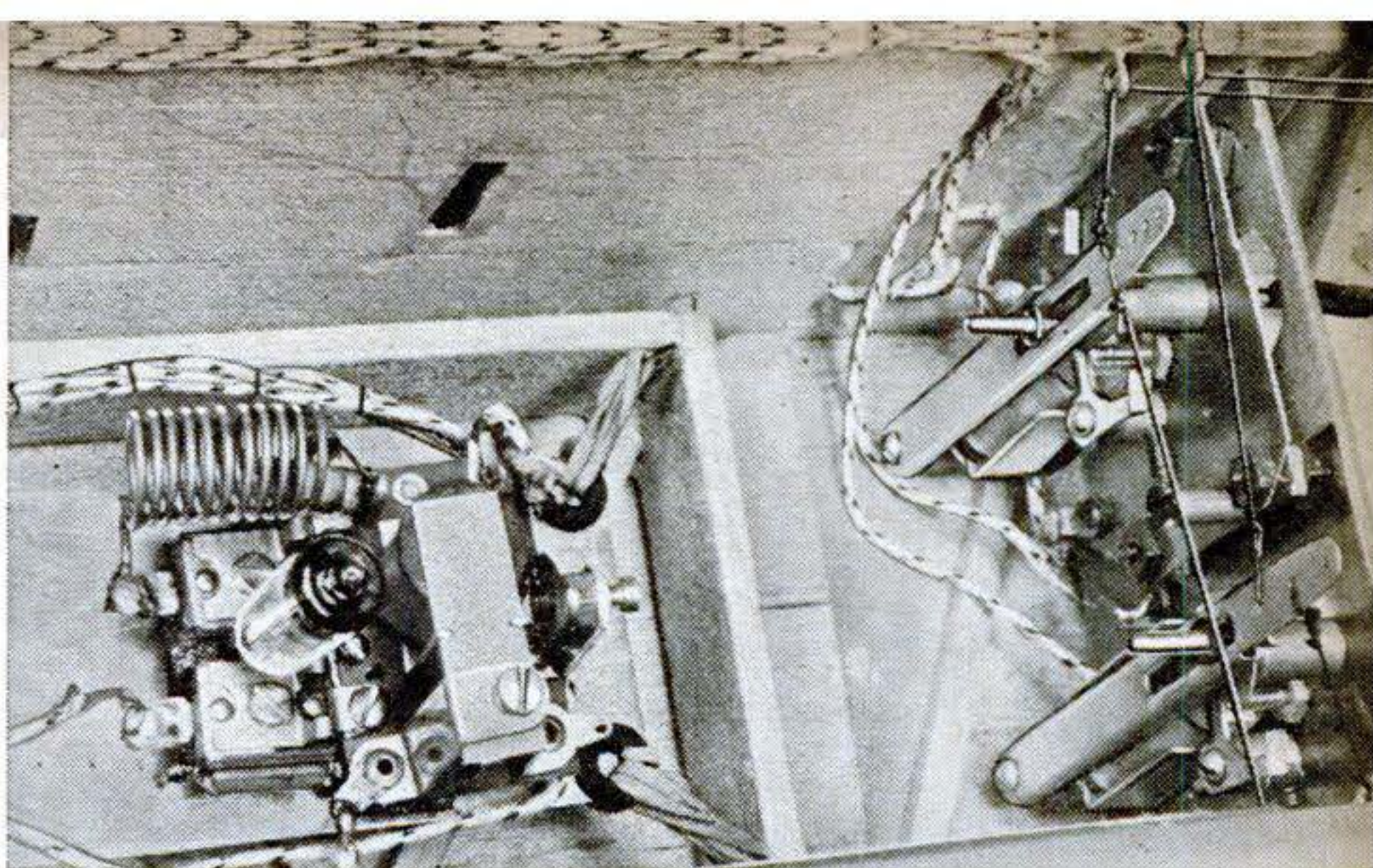
times used to key the transmitter, for it provides accurately spaced and numbered impulses.

A variant method dispenses with the time-delay device, replacing it with a second transmitter and receiver. The relay of the latter is wired into the common lead of all control circuits. The phone dial and its transmitter are then used to send out the pulses that will "set up" the required control circuit, while the second transmitter sends the "execute" signal.

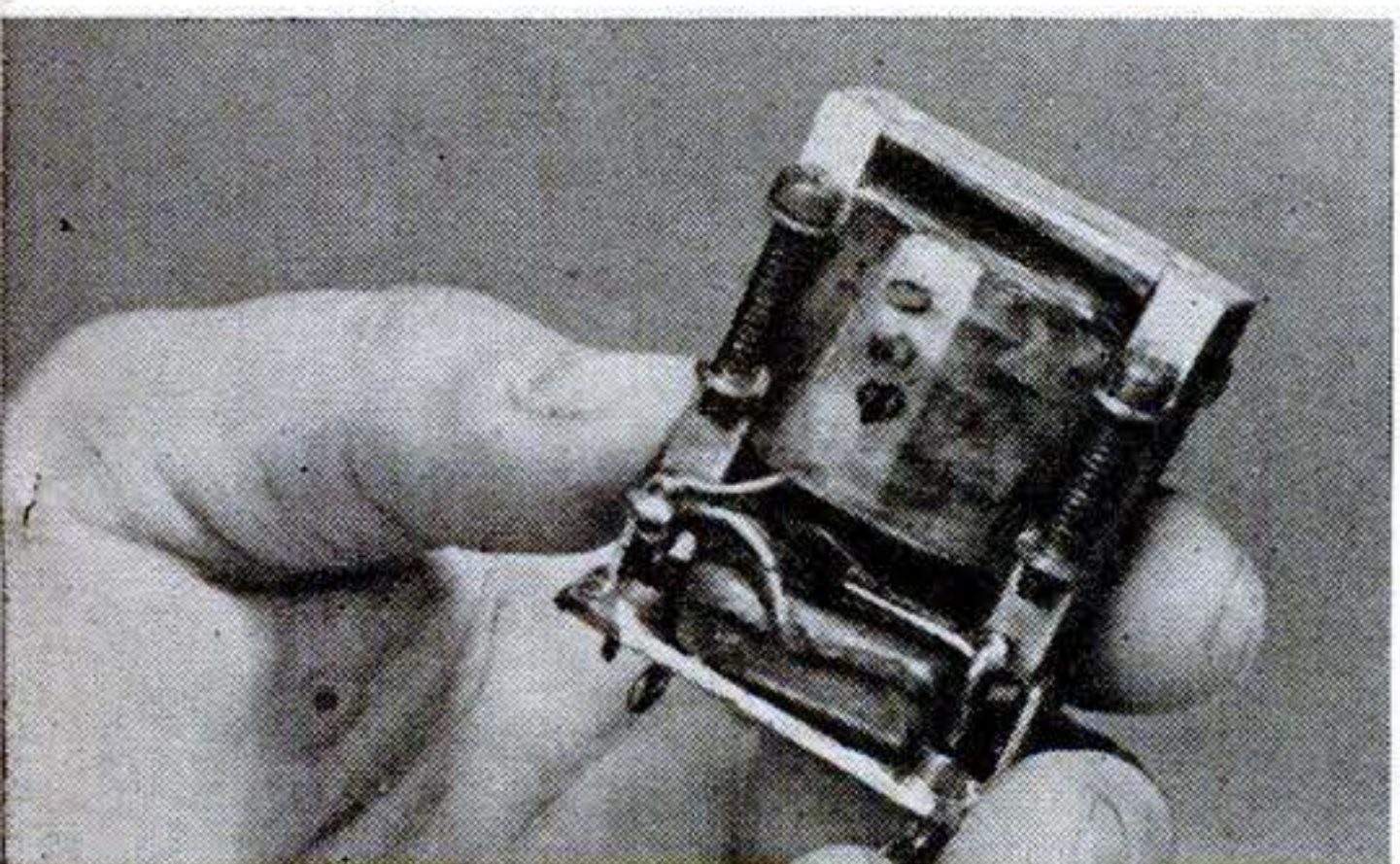
Maximum control is secured by the transmission of different audio tones, between which the receiver differentiates by tuned band-pass filters. This method was adopted by the armed forces for radio-controlled target planes, and is the basic one used with full-sized drones. Familiarly known as the "beep" system, it permits the use of 10 or more channels. The receiver is generally a superregenerative one having conventional "peanut" tubes and one or more audio stages to amplify the "beeps." Fed to a bank of filters, the audio tone builds up through resonant action enough voltage in the proper filter to trigger a relay tube and operate its associated control. While the "beep" system gives a large number of channels, disadvantages from the amateur's viewpoint include greater complexity and weight.



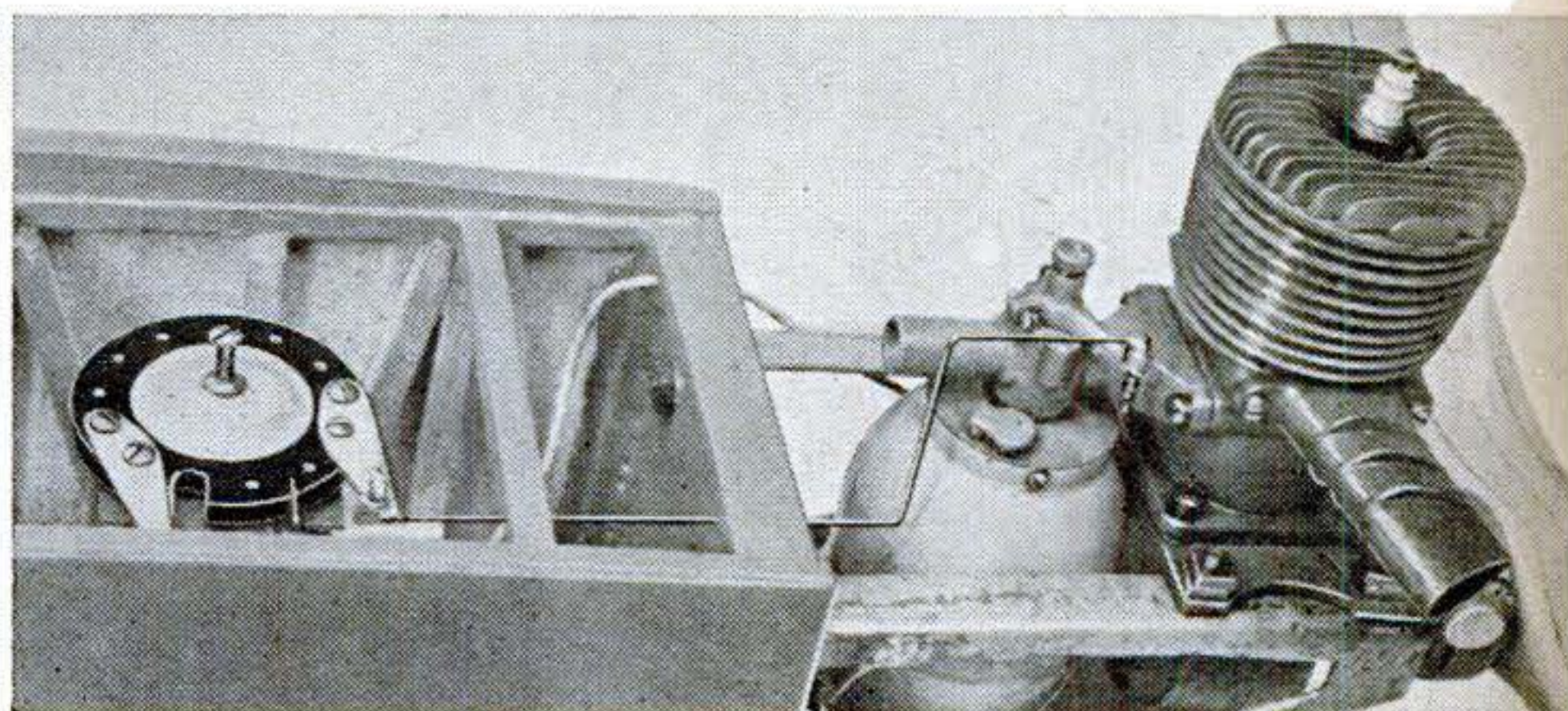
This radio receiver weighs only 3.5 oz. complete with a plate relay. A flashlight cell lights the filament; a hearing-aid battery is the B supply.



Here is one of the three receivers in place in the plane. Note the rubber-band chassis support. Shown also are escapements for the rudder and elevators.



An audio band-pass filter of the type employed in the "beep" control system. It consists of a choke coil, a condenser, and a resistor, made as a unit.



The throttle of this 3/4-hp. gas engine is moved by a wire linking it with the geared electric motor at the left to give speeds from idling to wide open.

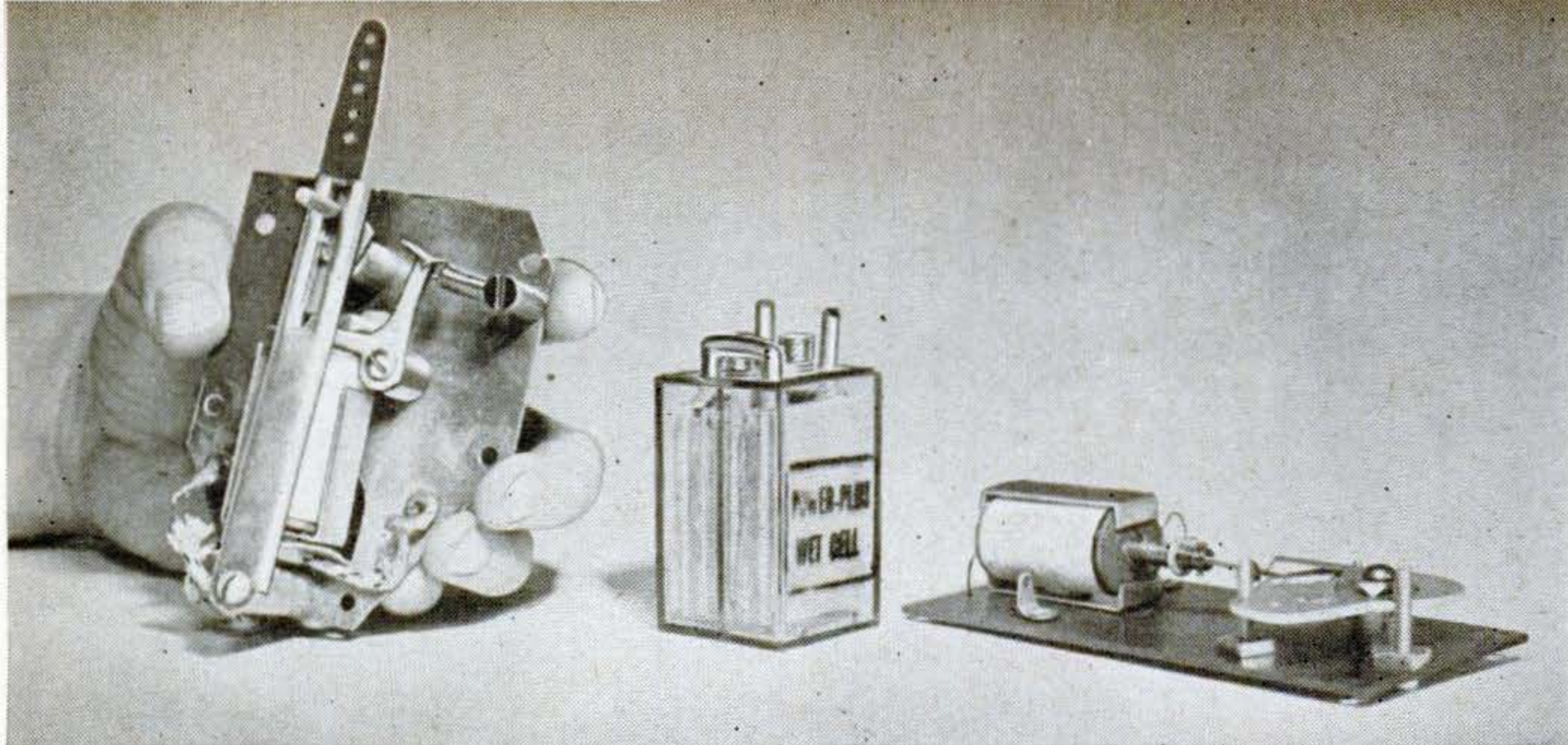
The mechanisms that actually move the controls on signal from the receiver are a vital part of any control system. For operating the rudder and elevator, escapements that control the release of energy stored in twisted rubber strands are commonly used. A ratchet wheel is prevented from turning by a double pawl; when the pawl is depressed by an electromagnet, the ratchet wheel is allowed to turn through a fraction of a revolution. This moves a linked lever to which the controls are attached by thread, fishline, or wire. Some escapements are so small they can be mounted directly inside the rudder or elevator. Two pen-light cells supply the needed current.

A typical application is an escapement having a four-position ratchet disk applied to rudder control. Assuming that the plane is traveling with rudder neutral, one pulse will apply left rudder, the second pulse neutral rudder, the third pulse right rudder, and the fourth back to neutral. Thus it can be

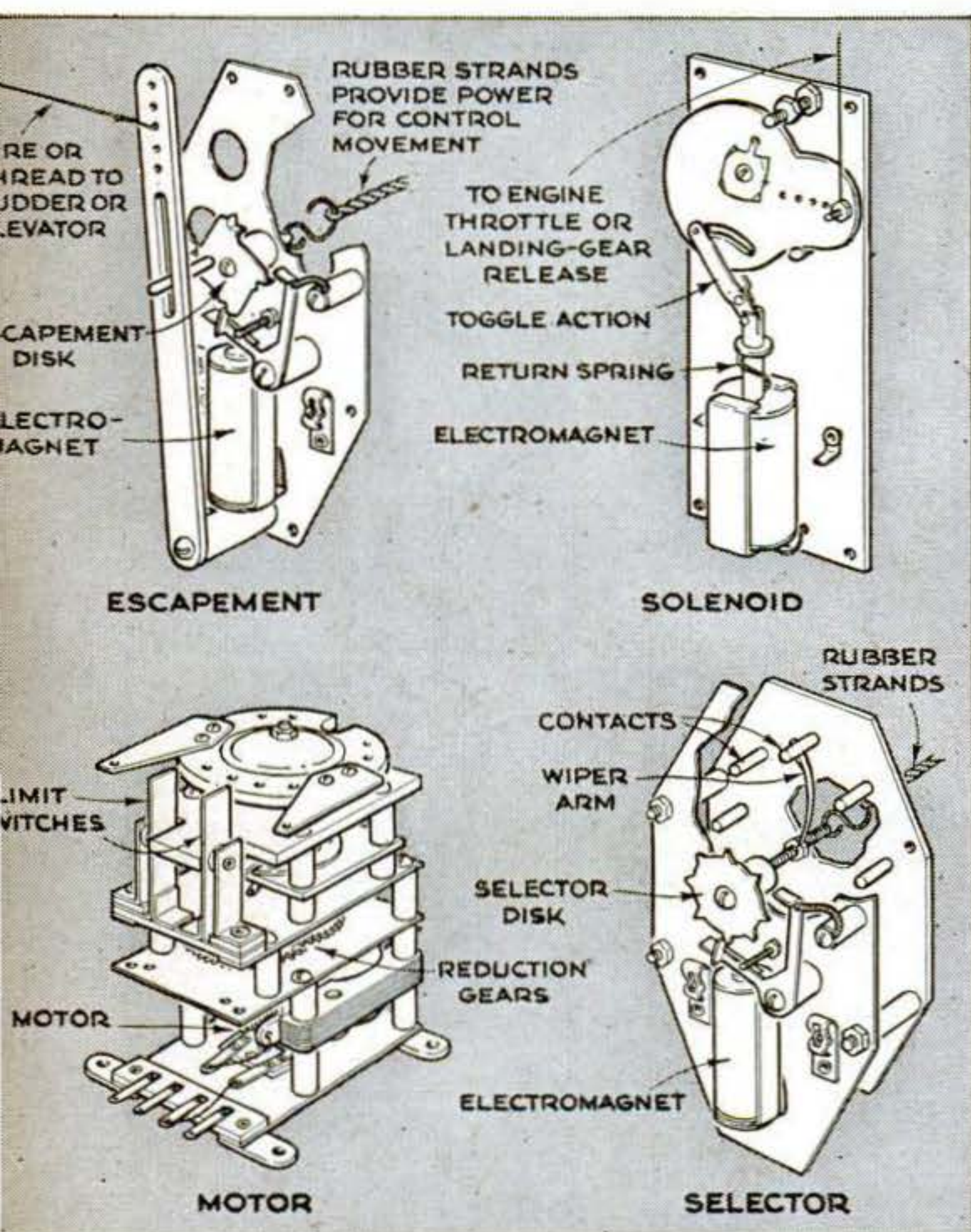
seen that it may be necessary to pass through the cycle to get a desired position. This isn't a serious drawback, since the operation can be performed rapidly. A more serious disadvantage is the lack of graduated control; the model has either left or right rudder or none.

Reversible DC motors weighing as little as 5 oz. are sometimes used for such specialized jobs as steering nose wheels or adjusting engine-throttle position. Adjustable travel-limiting switches stop rotation of a geared-down disk (to which cables or push rods are attached) at the end of a predetermined arc, and a separate centralizing circuit returns the motor to a neutral position either automatically or on receipt of a centralizing signal. Toggle-action solenoids are often used for onetime jobs such as lowering landing gear or flaps, releasing a parachute or bomb, or cutting the motor.

One promising new system independently developed by several experimenters makes



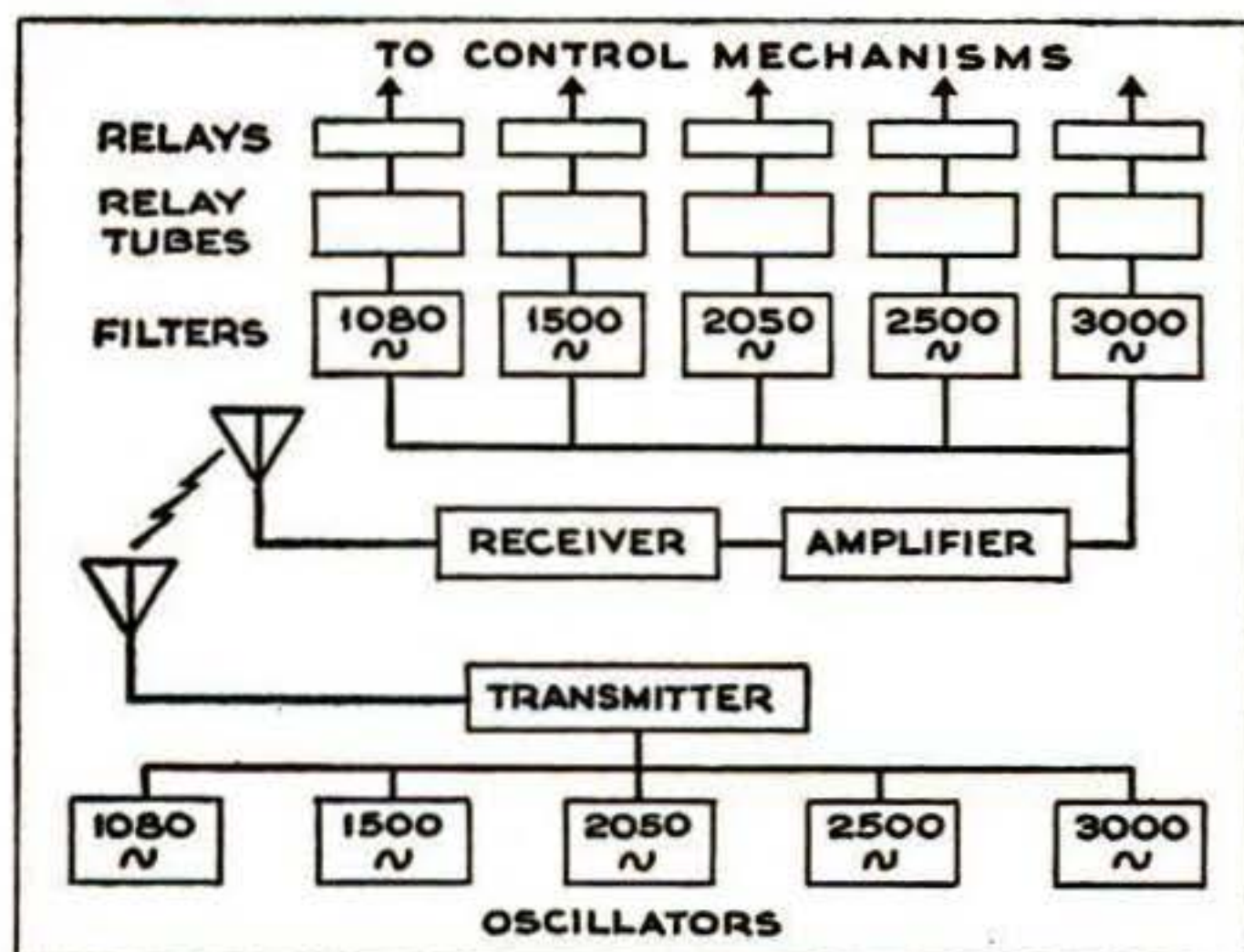
An escapement, a 4.4-volt battery, and a solenoid that locks in or out without taking constant current.



Adapted from RCH

Here are three actuating mechanisms and a selector switch. Some escapements are self-neutralizing, returning to center as soon as the relay is opened.

use of compact little actuators in which a rotor can be moved to and held at any position within almost 180 deg. An electromagnet opposing a permanent magnet is fed transmitter-controlled pulses, the rapidity of which determines the effective pull of the electromagnet and hence the position of the rotor. Thus the rudder or elevator respond in degree as well as direction.



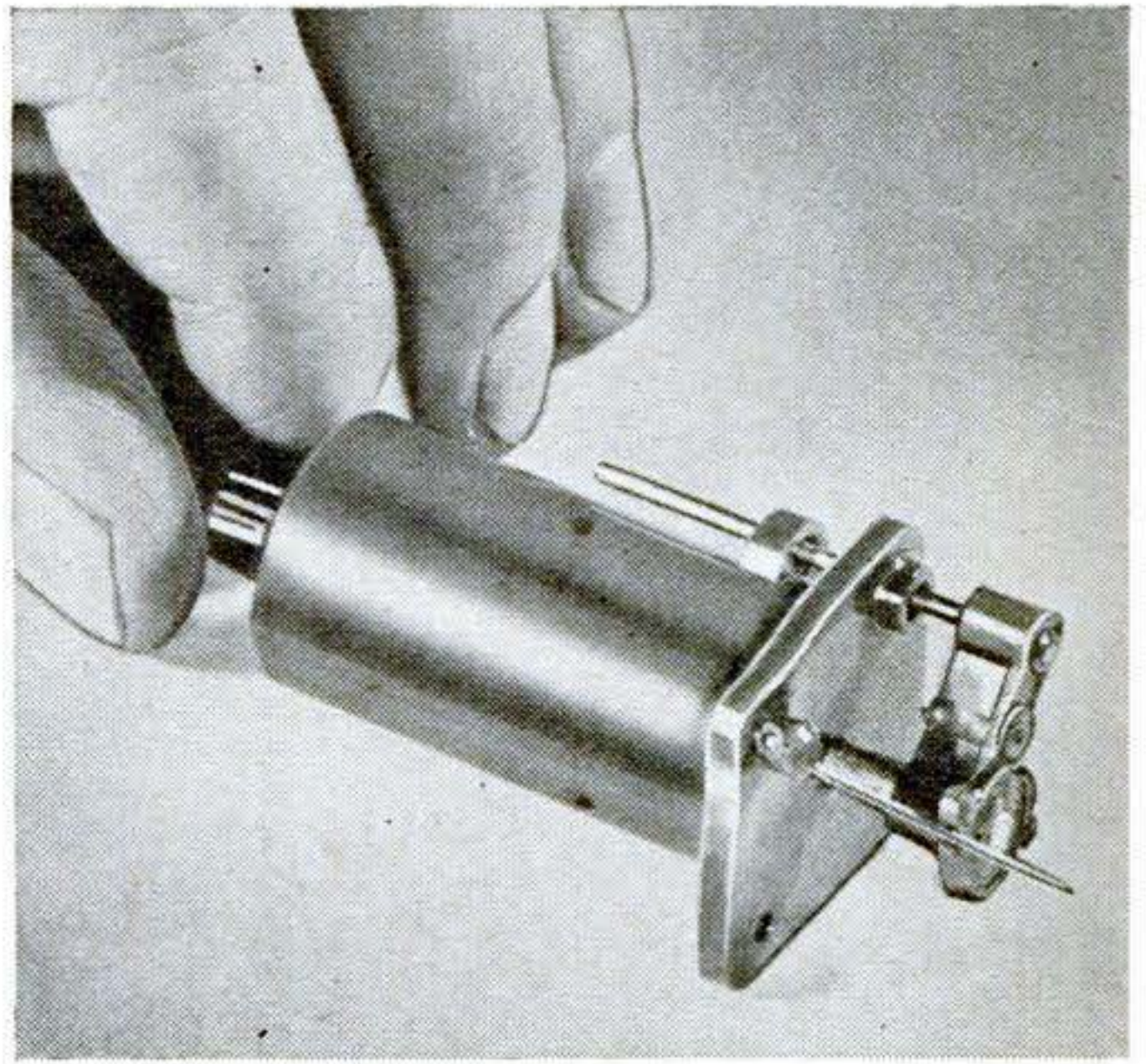
This block diagram shows the "beep" system, favored by the armed forces. Though providing many channels, it's not light enough for small models.

Radio control has its headaches and heartaches. Until the grounding pilot earns his wings, a crash can easily occur. Even if the novice pilot can train his unruly reflexes to change when the plane changes direction (left rudder when the plane is flying toward you produces the same effect as right rudder when it is flying away from you), plenty of other things can go wrong. Outflying the transmitter range casts the plane adrift on the not-always-tender mercies of free flight. An overwound escapement may jump two places, or a transmitter failure can leave the plane locked in a fatal dive. Piloting a plane with dwindling fuel supply upwind to a landing field can be a nerve-wracking affair. To the radio-control experimenter, though, near and actual crashes are not serious discouragement; instead, they're incentives to build better craft and fly them more skillfully and with greater precision.

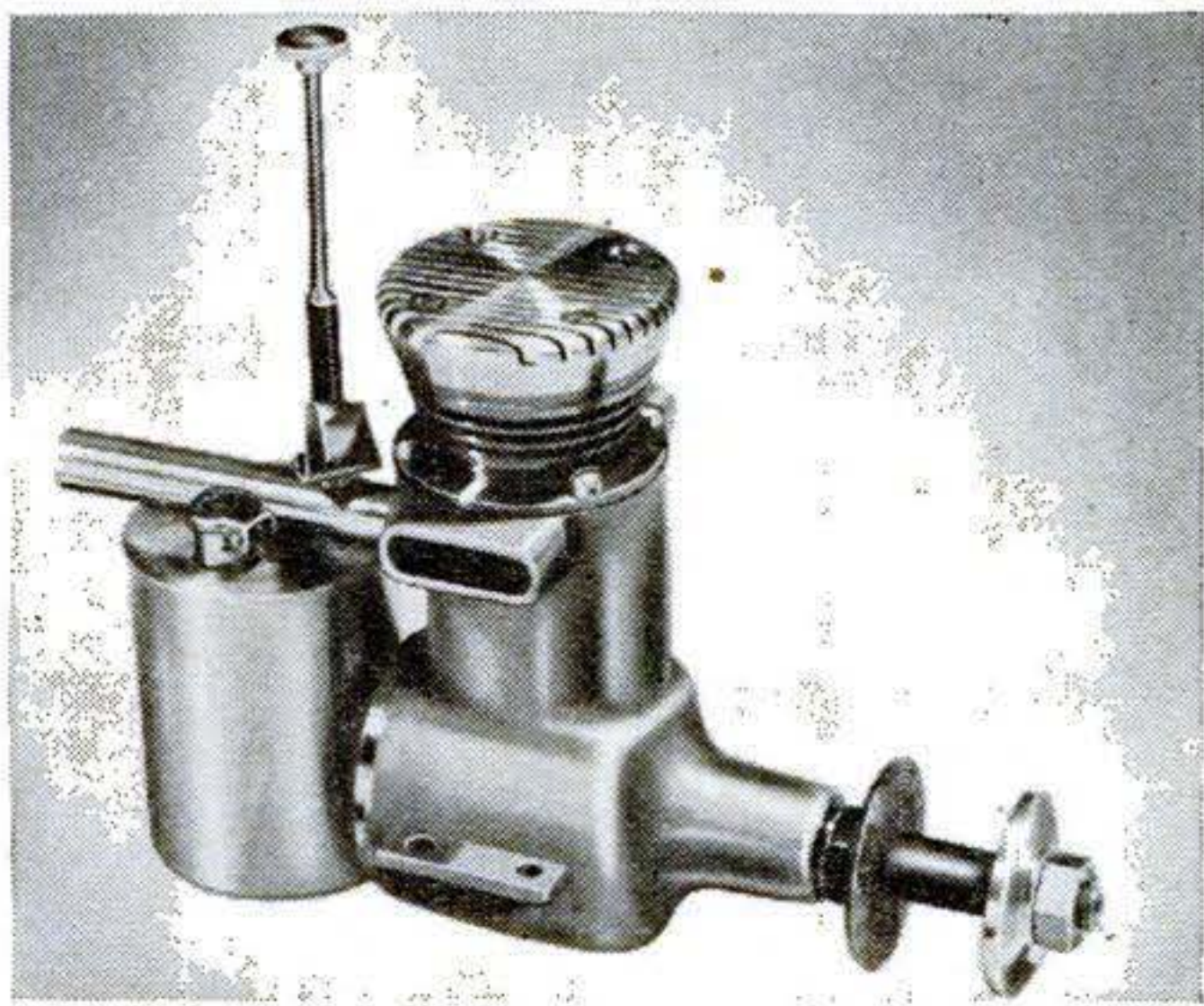
HOBBY SHOPPING



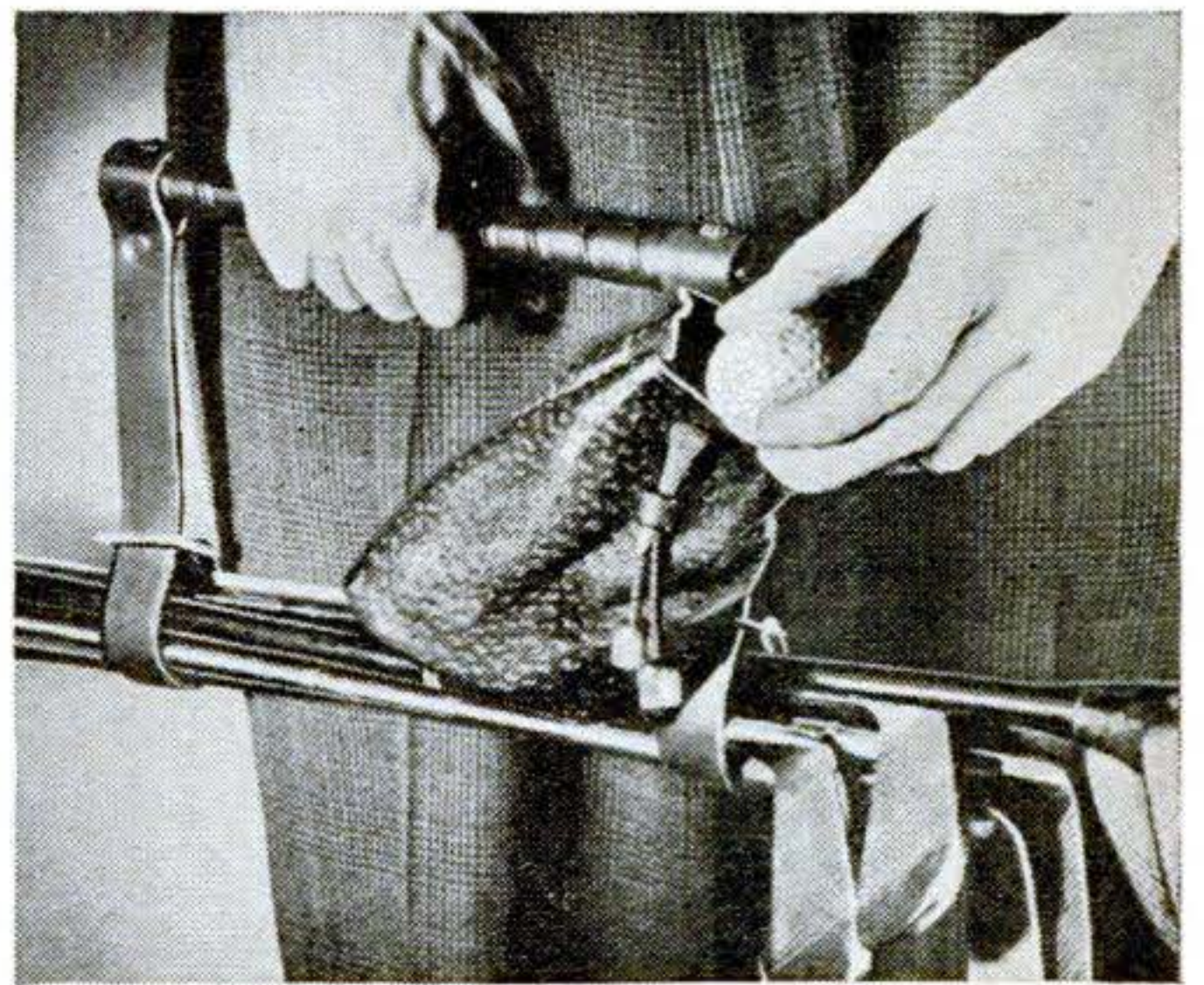
Bucket Serves Live Bait. A double-walled container made of fibreglas changes water constantly to keep a supply of live minnows floating within a fisherman's reach. The new bucket, made by the Motor Tool Manufacturing Co., of Detroit, is rot-proof and can't tip or sink.



Miniature Timer. Adapted from a Navy developed device used to release radar decoys, this small plastic timer is being made by Hillcrest Mfg. Co., of Los Angeles, for gas-powered model planes. Duration is adjustable up to 10 min. It weighs less than 1 oz. and is only 2" long.



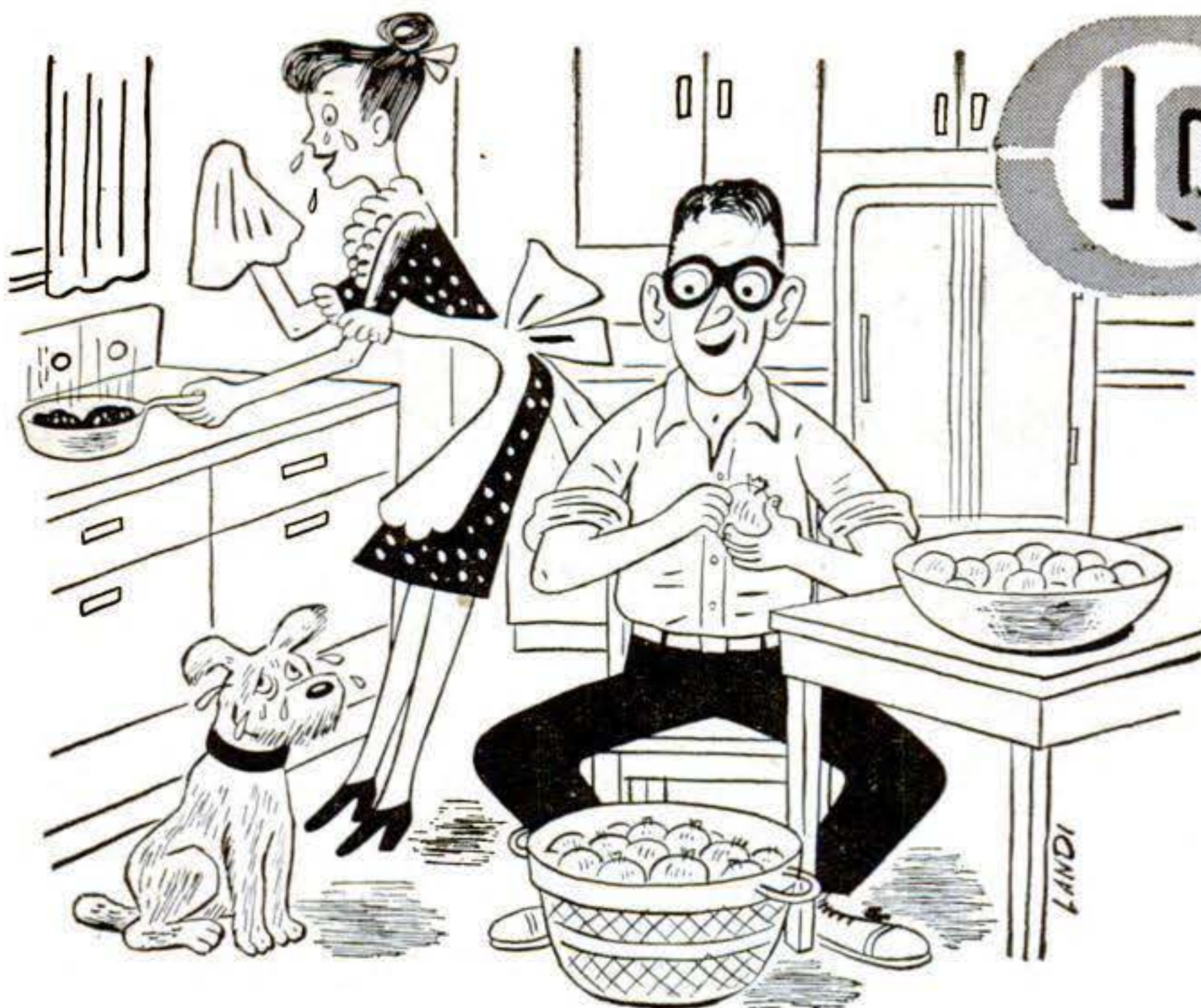
Diesel Drives Models. A Class C noninjection diesel engine of .450 cu. in. displacement has been announced by Engineering Development Company, of Del Mar, Calif. It features easy starting and has a large fuel tank which makes it especially suitable for control-line flying. Since ignition is by compression heat, it requires no batteries or spark plug. Moving parts are hardened, and crankshaft and piston are ground to tolerances of .0001". The price is \$18.50.



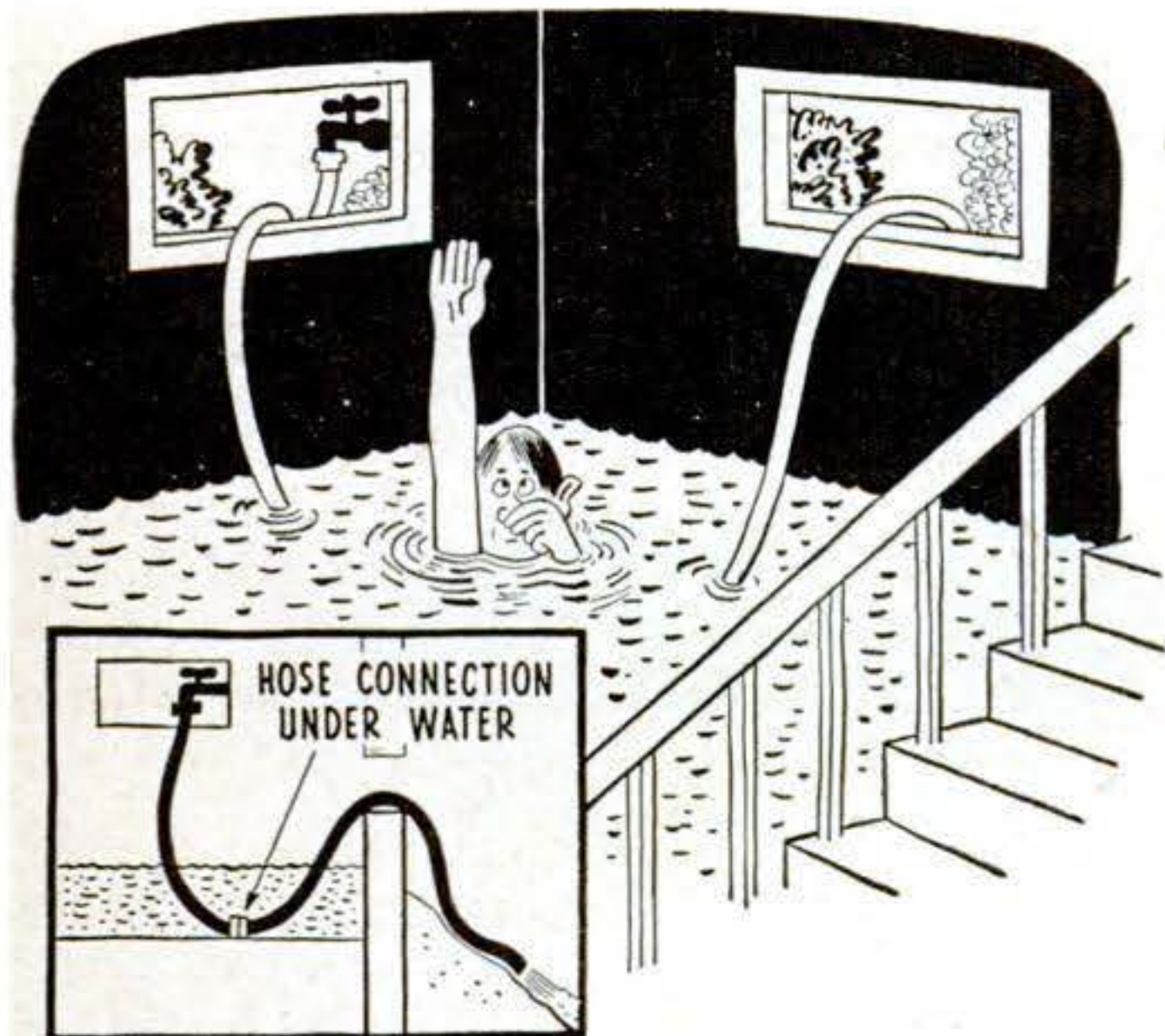
Golf-Club Carrier. Four ounces plus the weight of the clubs is all that a modern golfer will have to tote around the course. From the Duncan-Morris Co., of Akron, comes word of the Go-Lite, a club carrier that consists of a handle and two leather loops. The weight of the clubs tightens the straps and prevents slipping. Lifting an aluminum tube that lies parallel to the handle loosens the loops. A small pouch is attached for carrying balls and tees. Two models are priced at \$2.50 and \$3.50.

IQ

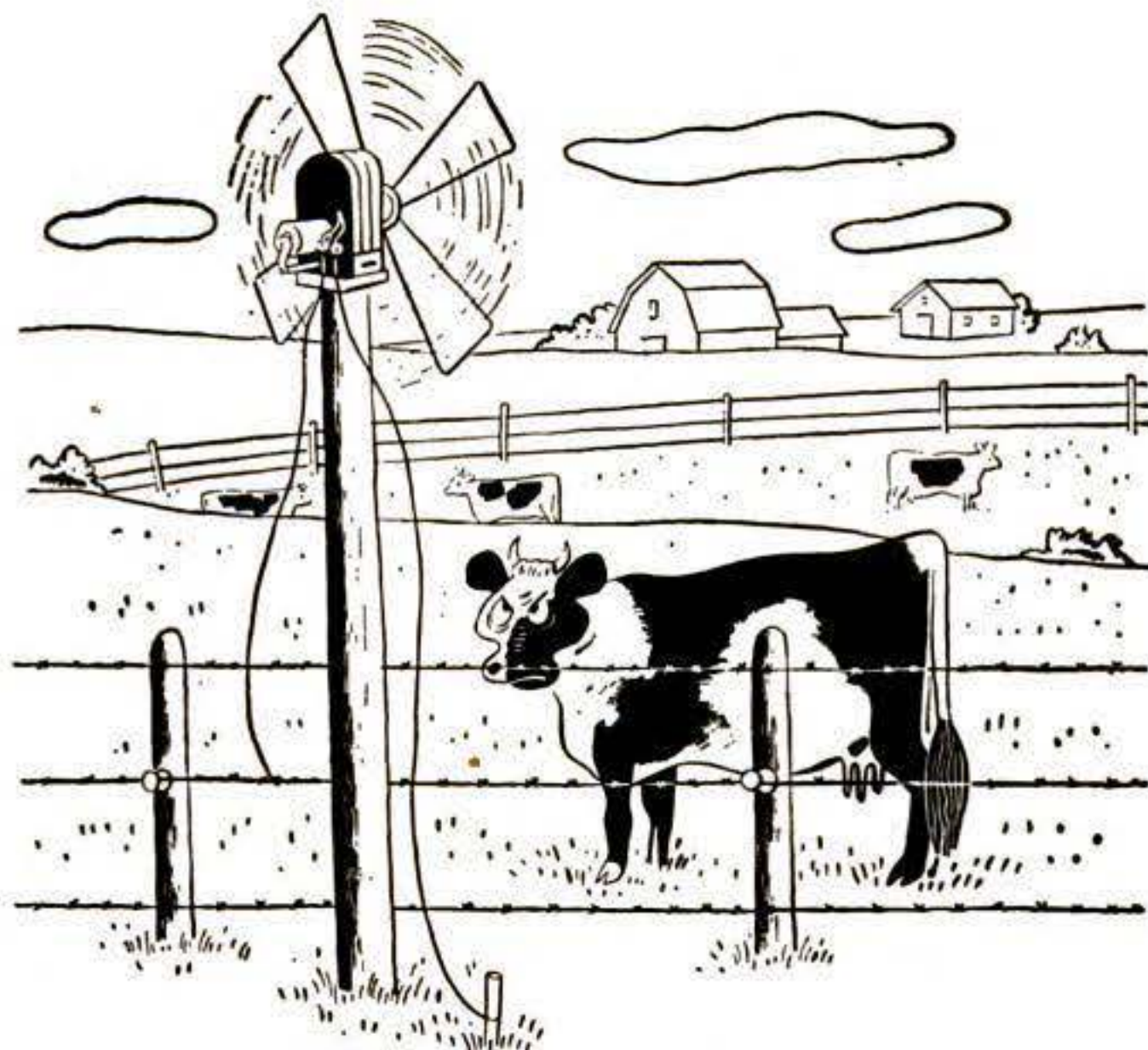
**WHAT'S YOUR
INGENUITY QUOTIENT?**



Weep No More, My Lady. You can sing, not cry for your supper—even when it involves cutting up onions to go with a skilletful of hamburgers. I can slice through a bushel of Bermudas without shedding a tear since I bought myself a pair of underwater goggles. Their closely fitted watertight rims keep the tear-jerking fumes from my eyes.—ELMER MELAND.



I Was All Wet when a cloudburst hit my cellar. Running a hose from the floor to lower ground outdoors, I attached a second hose from a tap to fill the first with water. Disconnecting the two under water started a cellar-emptying siphon.—W. PATTESON.

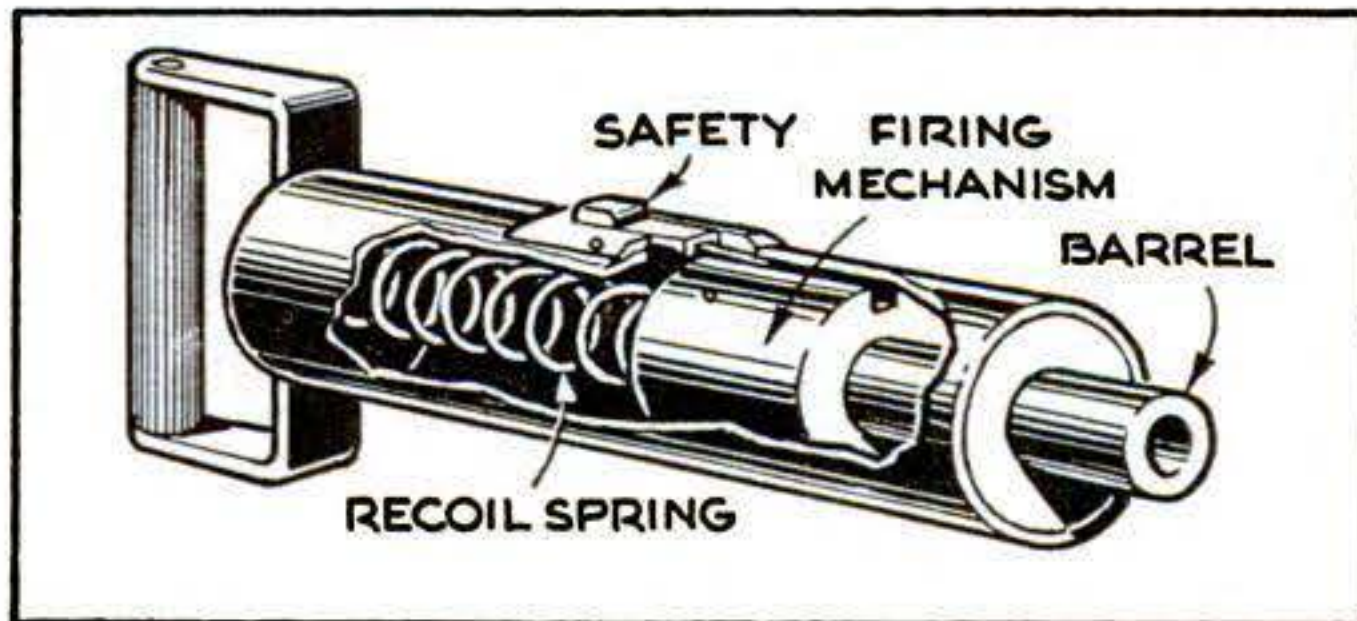
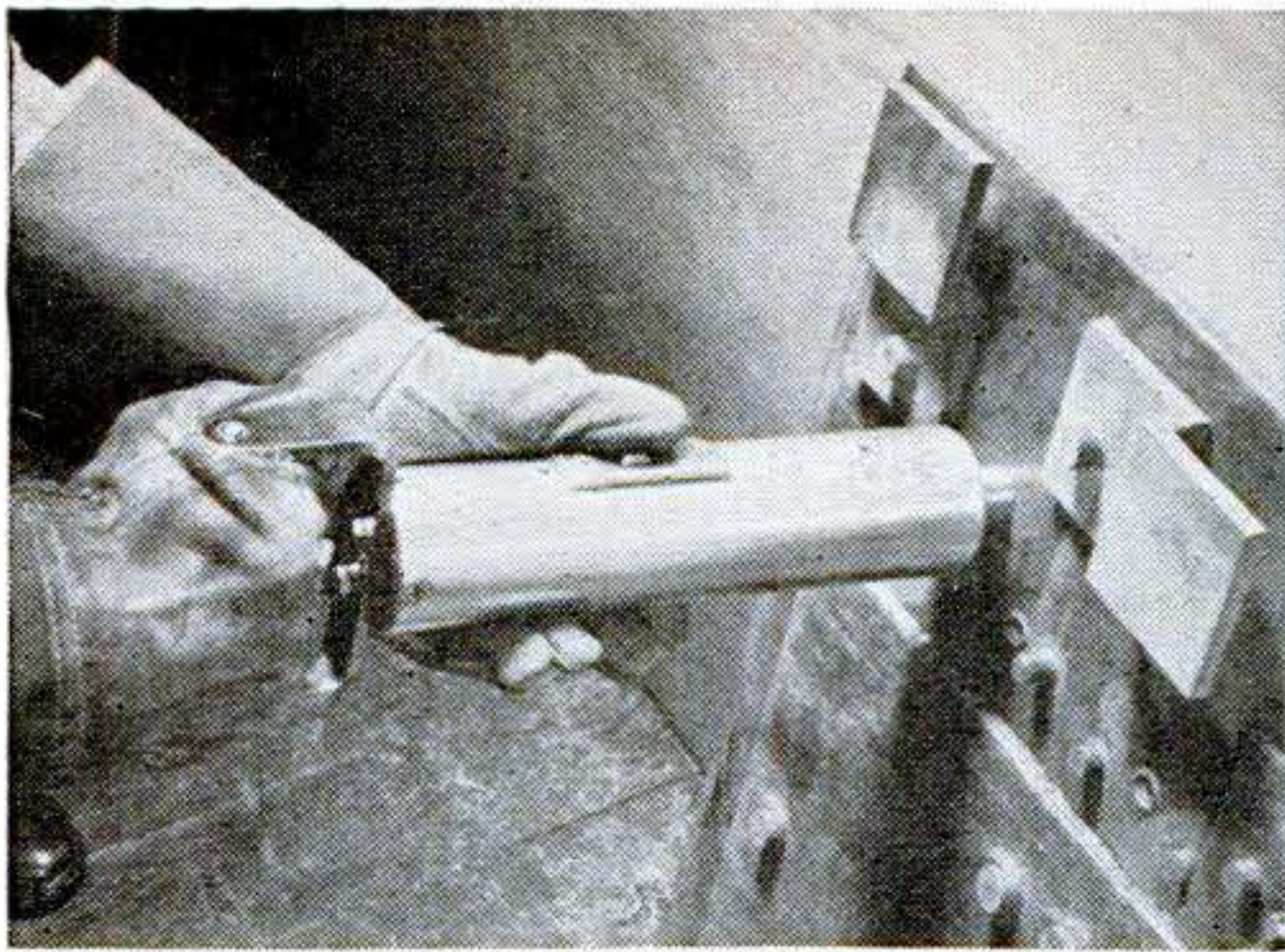


Our Fence Was a Pushover for cattle who wanted to stray. But they stay home since we hooked an old magneto to a homemade windmill. So far Bossy hasn't learned the fence isn't hot when the wind dies.—LAURICE DELAURANT.

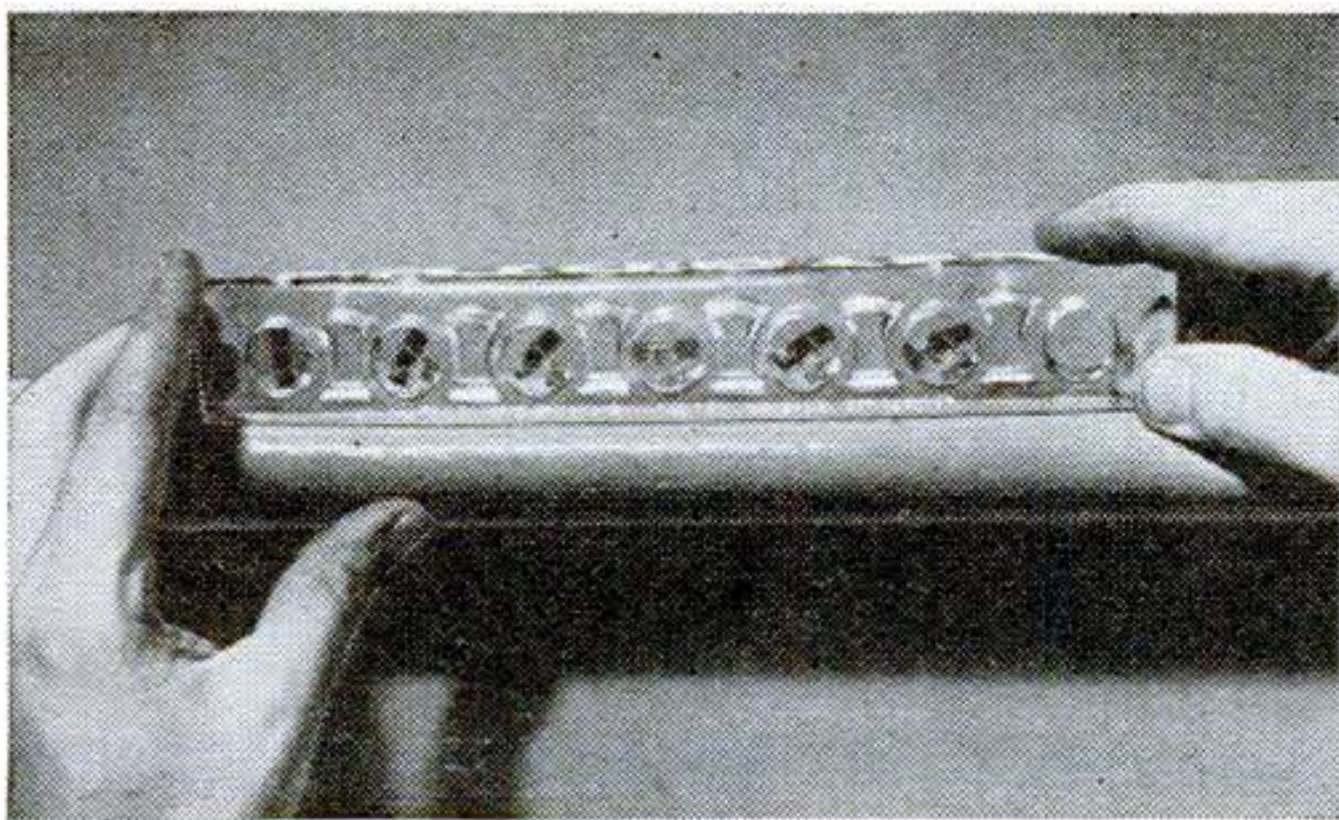


No Matter Where We Roam, our fish get fed by long-distance phone. A spoon tied to the clapper gives out vitamins when I call home.—A. CUNNINGHAM.

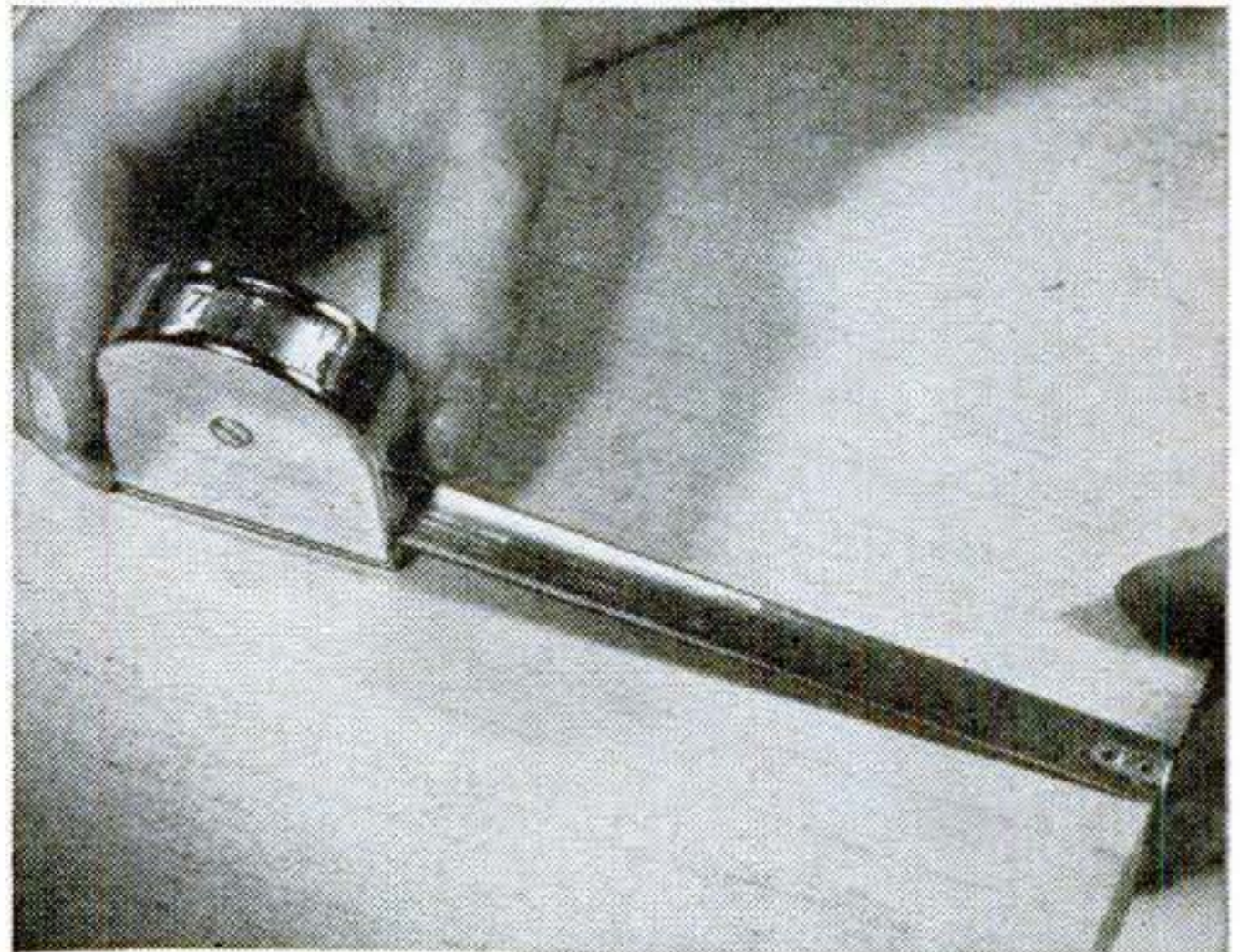
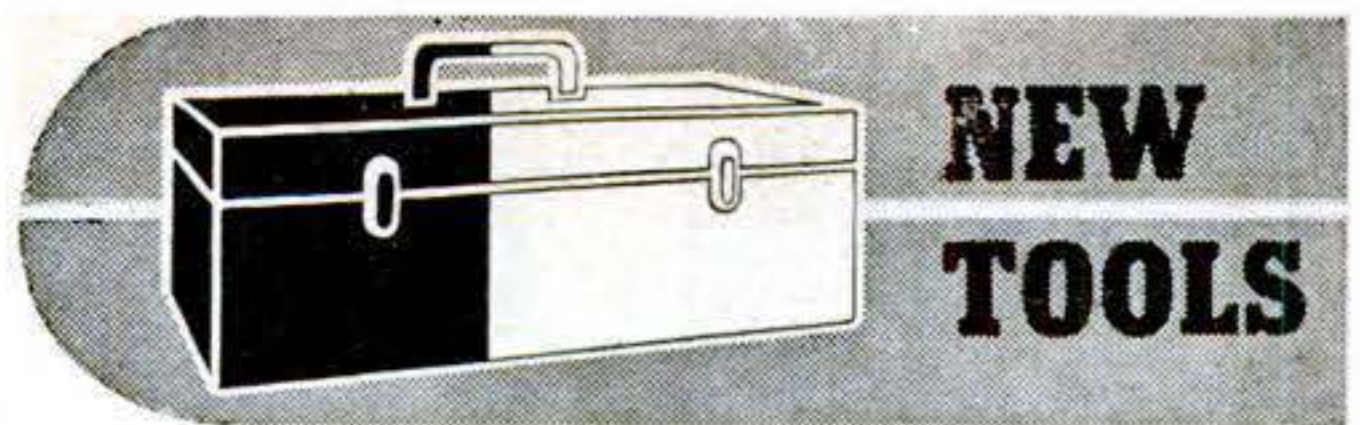
Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky — if it works.



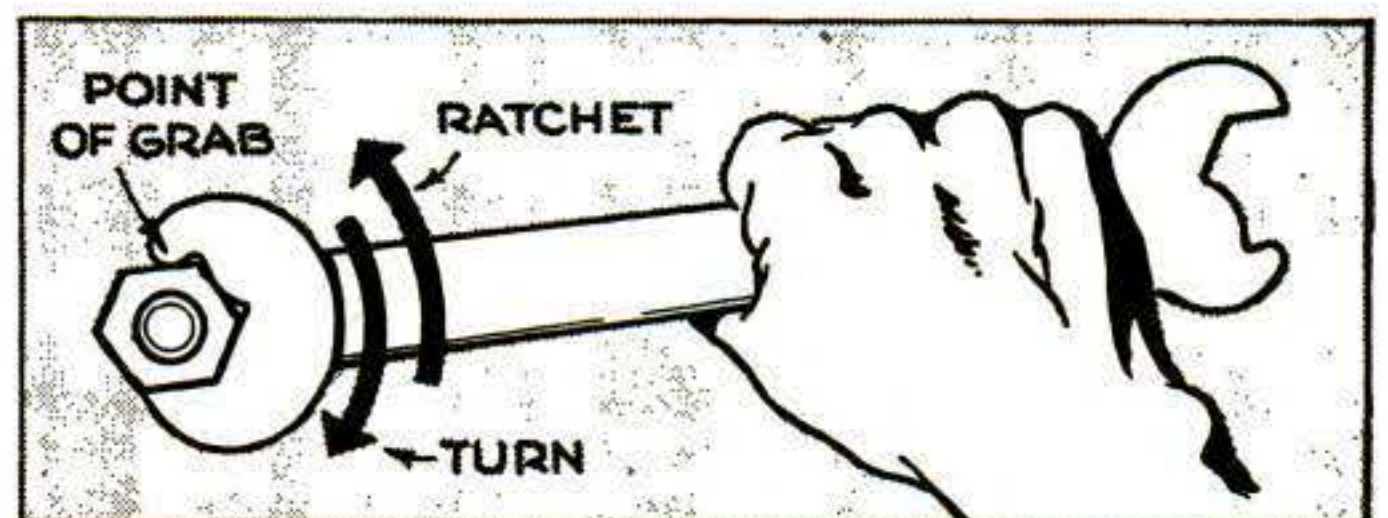
Rivet Gun Uses Explosive. A powerful hand-held rivet gun manufactured by Meco, Inc., of Portland, Ore., is capable of delivering 150,000-lb. blows, pinning $\frac{3}{8}$ " steel plates together or punching deep holes into concrete. When the operator releases a safety, places the tool against the work, and pushes, a special explosive encased in a small pistol cartridge is fired, driving in the rivet or stud or punching a circular hole. The guns are made in several sizes, weighing from 7 to 19 lb.



Level Indicates Six Angles. Molded from clear plastic, a pocket-size spirit level produced by Lawco Plastic Products Company, of Chicago, and Sobenite, Inc., of South Bend, Ind., contains indicators for six angles— $22\frac{1}{2}$, 30, 45, 60, 90, and 180 deg. To simplify identification, the value of each angle is molded into the plastic and fluids of different colors are used in the indicators for the various angles.



Tape Rule Scribes Work. With this rule, a measurement can be quickly read under a hairline on the plastic dial. Since the dial figure includes the width of the chrome case, no computation is necessary to get inside measurements. Built into the far edge of the case is a scriber that recedes inside a protective shoe when not in use. An oil-saturated wiping pad in the case keeps the nickel-plated tape in good condition. It is made by the Dart Manufacturing Co., Mason, Mich.



Wrench Is Self-Ratcheting. Embodying a new design, an open-end wrench made by the Eazon Tool Company, of St. Paul, Minn., works like a ratchet on either hexagon or square nuts, making it unnecessary to pull off the wrench at every turn.

Because of the inner shape of the head, the wrench grips hexagon nuts at three points of contact instead of two, but slides smoothly back for each new purchase. Manufactured in all standard sizes, the wrench is said to do everything an ordinary open-end wrench can do, and to be particularly effective in restricted spots.

Carving Plastic Inside Out

A ROSE, seemingly frozen at the height of its bloom and embedded in a crystal-clear block of plastic, can add breathtaking detail to your next craftwork project. Goldfish immobile in a piece of ice, butterflies that never light, and birds forever in flight can lend decorative drama to your work. Internal carving in plexiglas or other acrylic plastic breathes an air of reality that is downright startling—yet what you look at isn't actually there.

Anyone who has drilled clear plastic knows the hole at once becomes a milky, opaque cylinder, apparently more solid than the transparent substance around it. Internal carving takes advantage of this. With suitable drills, a cavity is formed the shape of the object represented. Color is added by dyeing the internal surfaces. The result is, to all appearances, a three-dimensional object embedded in plastic.

Other properties of the plastic heighten the effect. The carving is visible from all four sides as well as the top. As may be seen in the full-color illustrations on page 113, the design is reflected and multiplied by angles and facets. Edge lighting can be employed with startling results.

Although this article will deal with techniques rather than specific projects, the possibilities are tremendous. A spray can be carved in the lid of a jewel box. With a suitable base a carved block becomes a book end. Two pieces clamped back to back may form a lamp standard. A daisy $\frac{3}{8}$ " in diam-

eter may enhance an earring or lapel pin.

You'll need a high-speed hand grinder or a flexible-shaft tool with at least three bits (those shown in the photo below). Two, a ball or spherical cutter, and a cylinder cutter or end mill, are standard. A spiral drill can be purchased from hobby supply stores or by mail. Or you can make one from a $\frac{3}{32}$ " or $\frac{1}{8}$ " high-speed twist drill (carbon-steel drills dull rapidly).

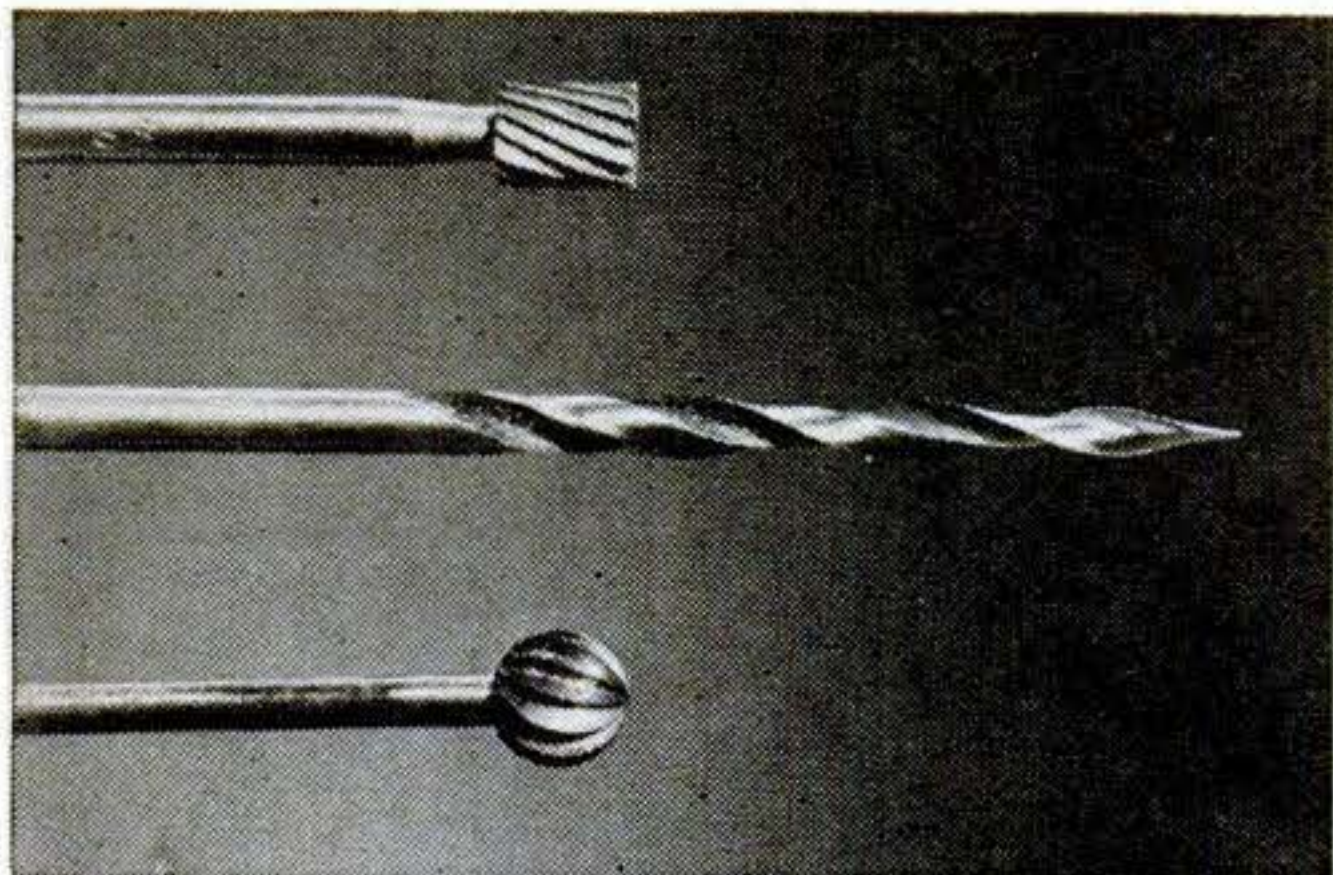
Chuck the drill in the grinder or hand-piece and hold it in motion against an ordinary grinding wheel so as to form a long, sharp taper. Be careful not to burn the steel, especially at the tip. Don't grind out the flutes; they should continue right to the tip. The pointed end should have sharp, chisel-like edges. Try it in plastic; it should not have to be forced in. You can use a miniature abrasive wheel in the hand grinder to touch up the cutting edge and to back off the metal behind it to provide clearance for free cutting.

Properly ground, the drill should pierce freely without being pushed, and should cut sideways almost as readily as straight ahead. Never use any but the gentlest pressure—let the drill do the work and the cutting proceed at its own pace. Be careful never to let the drill break through the top surface; aside from spoiling the work, this may jam the tool and break the drill or flexible shaft.

Safety first is a must, too. These drills are *sharp*; keep fingers off the plastic not only ahead of them, but also alongside portions where they may break through. Especially in shallow stock, the cut has a way of creeping out of the work.

Besides the tools, you'll need some thick plastic (at least $\frac{3}{4}$ " for the daisy shown in the step-by-step photos, and preferably thicker). Work can be done in thinner stock after practice. Always sand and polish the edges of the block before you begin carving; not only will you do better work, but you'll be less likely to poke the drill out accidentally. Masking paper is removed, of course.

Cold-dip dyes, consisting of dyes in an acetone and water solution, are commercially available. You can experiment, though,



All projects shown here and in color on page 113 can be made with three bits. Top, $\frac{3}{16}$ " end mill; center, spiral drill ground from an ordinary $\frac{1}{8}$ " high-speed bit; bottom, $\frac{1}{4}$ " ball cutter.



As natural as though frozen in a block of ice, this daisy is carved in plastic and dyed natural colors.

with tempera colors, nail polish, and even iodine and mercurochrome.

The photos on these pages show the carving of a daisy, a good project for the beginner. Make the center with the ball cutter, working from the back of the piece; that is, look directly at the tool just as in carving wood. After the center has been dyed and is dry, the work is turned over and the carving done from underneath, the spiral drill being observed through the block. Each petal is made by inserting the drill to form one tip, then withdrawing it slightly, working it sidewise at the same time, and again advancing it to form the double tip. Petals are started from the side of the center cavity, as in a real daisy. Leaves are carved both ways from their center ribs.

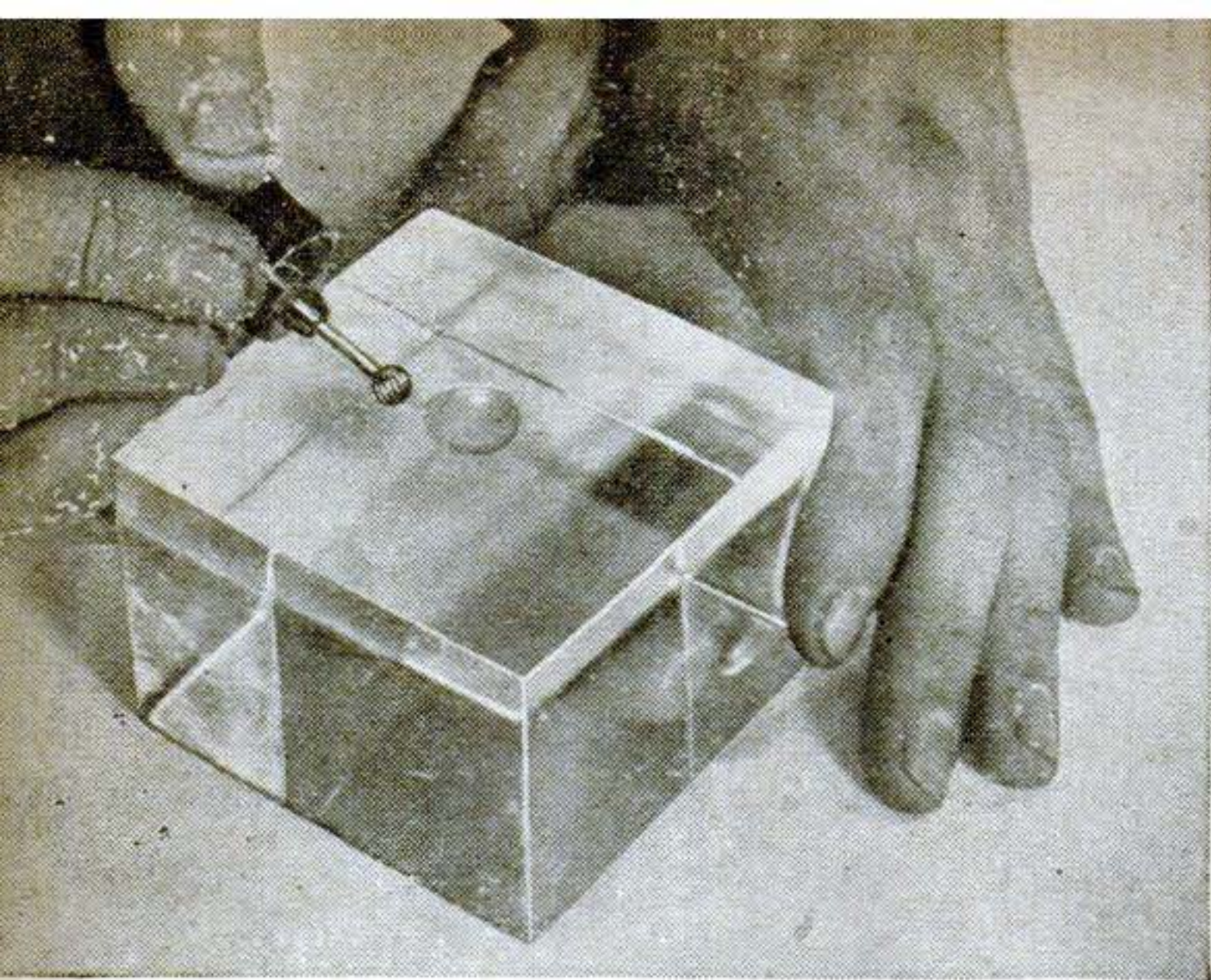
Roses are more difficult. Polish the faces of a block at least 1" thick. The piece is then held in the left hand, the drill is inserted at 90 deg. to the face, and a hole is drilled about $\frac{3}{4}$ " deep. As you reach the full depth, turn the point in a small tight circle, just enough so the end of the hole appears from the front as a rounded tip.

All the cuts will now revolve around this center hole, and the drill will be inserted at its opening for all succeeding cuts, though

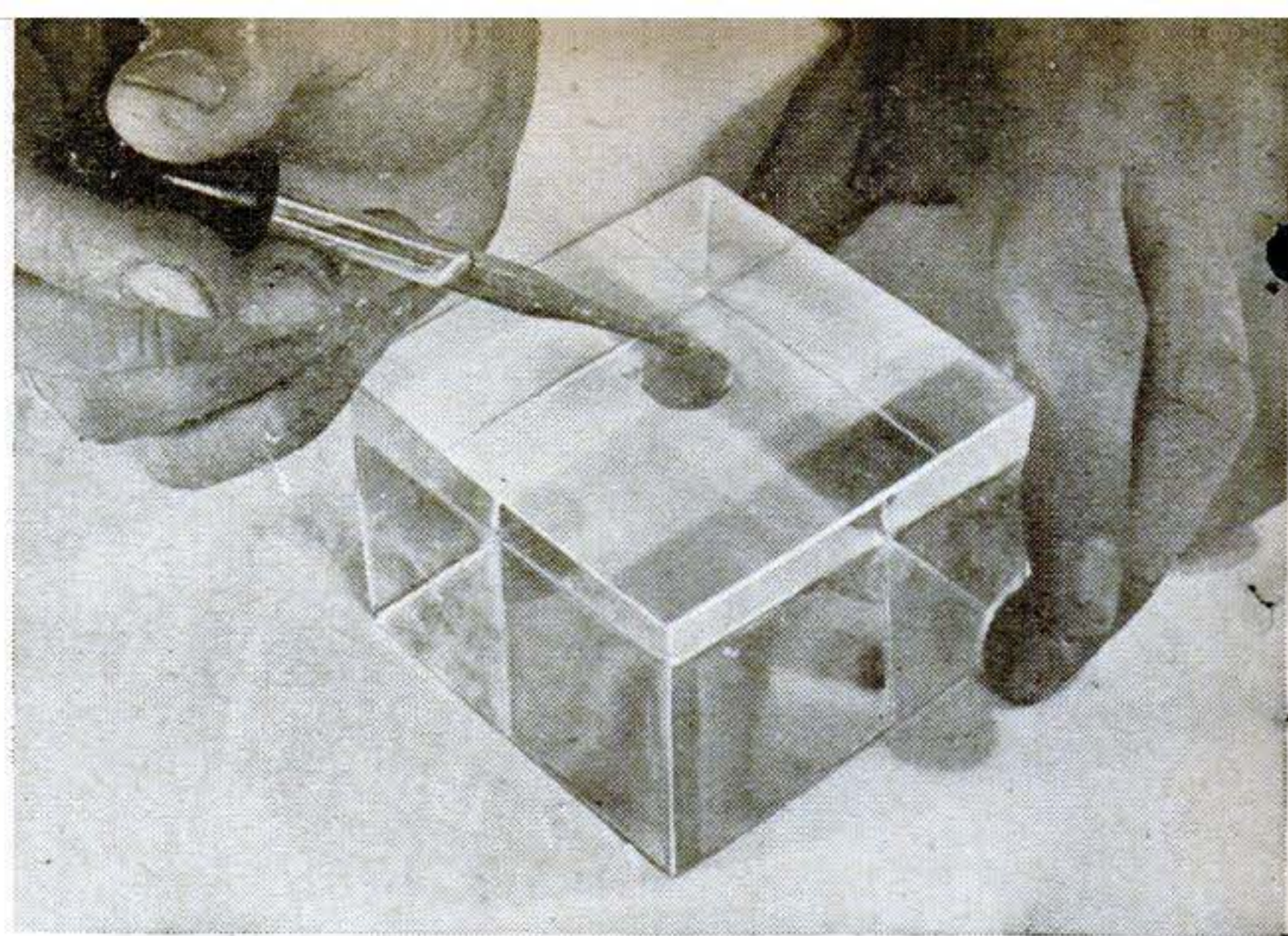
at different angles. The first cut is made by inserting the drill so that its point will be about $\frac{1}{16}$ " from the center hole when it is $\frac{3}{8}$ " deep. After the drill point reaches full depth, it is swung a quarter circle, as in Fig. 1, page 164, for line A. As the right hand twists the drill to the left towards the body, the left hand can also twist the piece against the drill. A second cut is made at the same angle as the first, and overlaps it a bit. The drill is then swung a third time, overlapping the second cut. Overlapping gives the petals a natural folded appearance. The fourth cut (*D* in Fig. 2) overlaps both the first and third cuts, forming a closed circle of four folded petals.

For the next layer of petals, the first cut, *E*, is made at a wider angle. The point of the drill when it reaches about halfway into the piece is about $\frac{1}{16}$ " from the nearest petal of the first layer. Again each cut overlaps the previous cut, and a fourth, which is not shown in the drawing, would overlap *E* and *G* to close the circle.

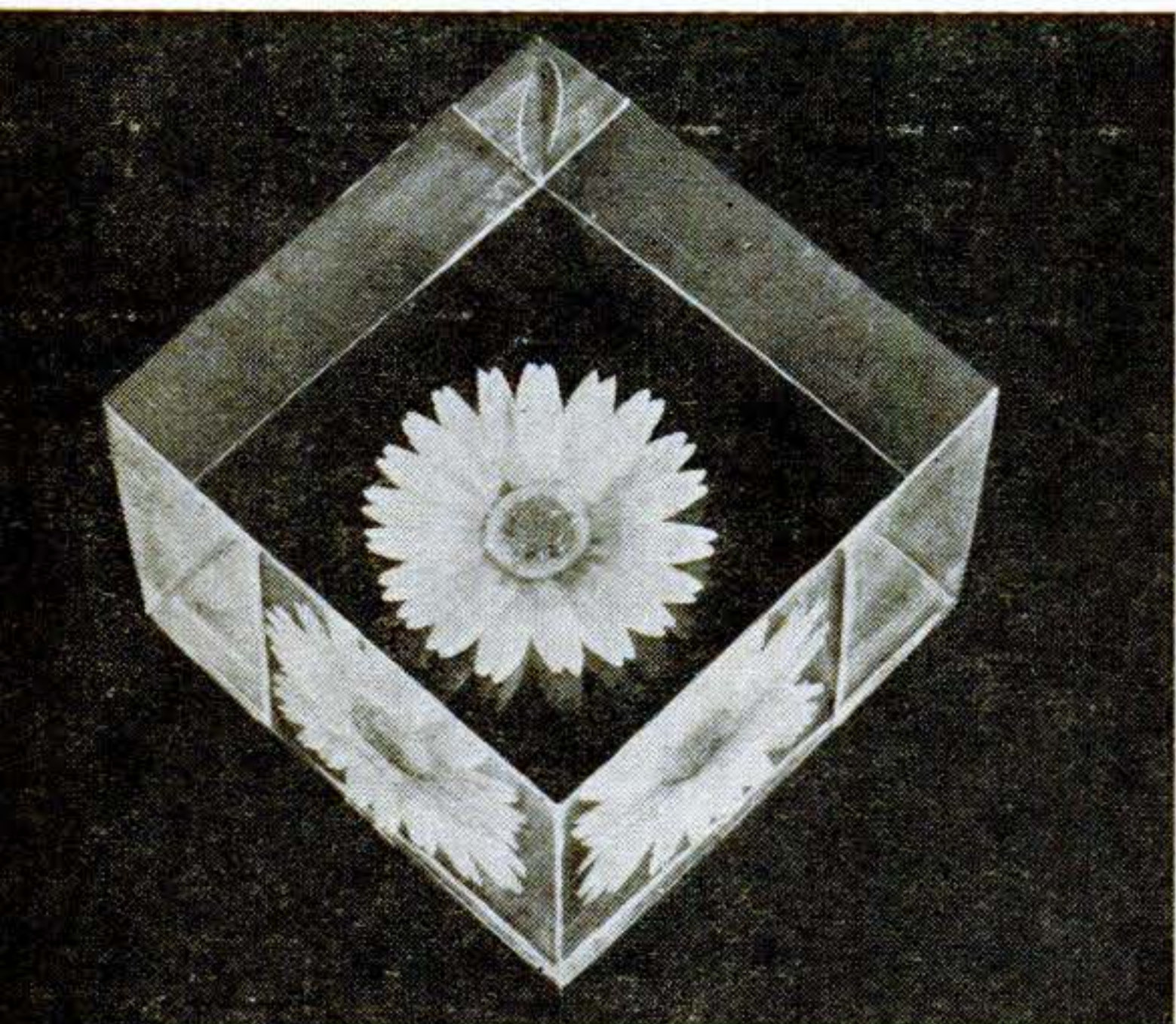
If space warrants, a third and looser layer may be made at a still wider angle. It should not penetrate as deeply. You can work the drill about to give these outer petals both an irregular edge and a wavy contour. Some ends may even be folded



1 These photos show how Robert Barry, of Rohm & Haas Company, makers of plexiglas, carves a daisy. The ball cutter first forms a cavity $\frac{1}{2}$ " in diameter and $\frac{1}{4}$ " deep to make the center.



2 Yellow cold-dip dye is next applied inside the center. A few drops will do; the time the dye works governs the depth of color. When the tone is right, the surplus is poured out.



5 Petals are evenly spaced freehand. Instead of being left plain, the daisy center can be textured by pin-point touches of the drill for the result shown in color on page 161.



6 Leaves are made with the drill angle somewhat greater than for the petals. Forward thrusts cut the points. Starting at the centerline, one side is completed first and then the other.

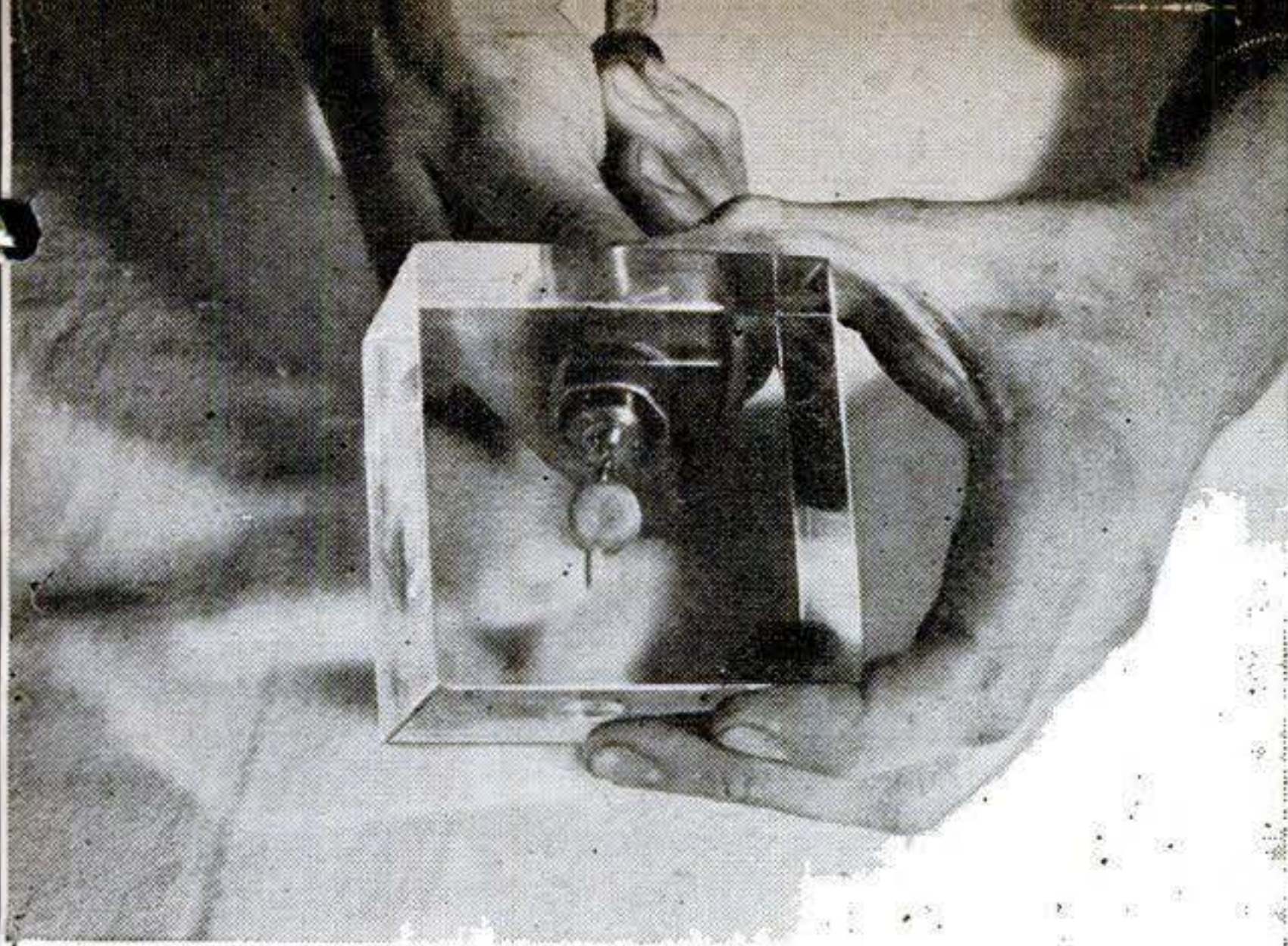
back. Where needed, the drill can be re-inserted to push out a bit more and round off the petal ends.

In carving goldfish, hollow the body first with the ball cutter, working with the piece upside down. Carve bulges for the eye and mouth. Then turn the piece back over and with the tapered drill make the fins the same way as the petals in flowers. The drill is inserted at the edge of the body and a wide sweep made with the drill point. Watch the shank carefully so as not to widen the point of entrance excessively.

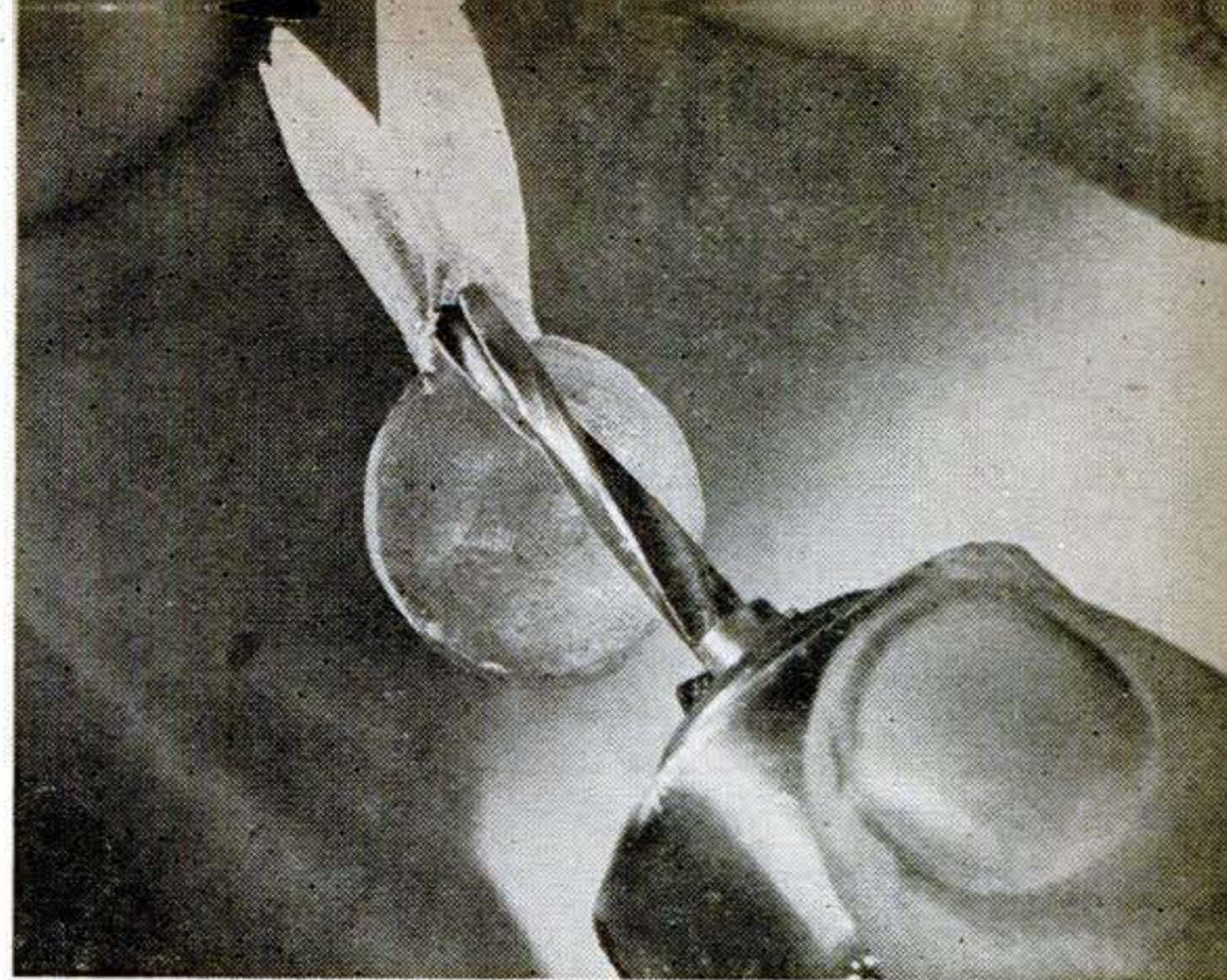
Loose chips and shavings must be thoroughly cleaned out with a needle or pin

before dyeing to avoid dark spots. Insert just a few drops of dye with a small brush or an eyedropper. After a few seconds the dye is rinsed out in water. The longer it is left before rinsing, the deeper the color will be. A velvetlike finish can be obtained by dropping in a little aluminum, bronze, or gold dust before the dye is applied.

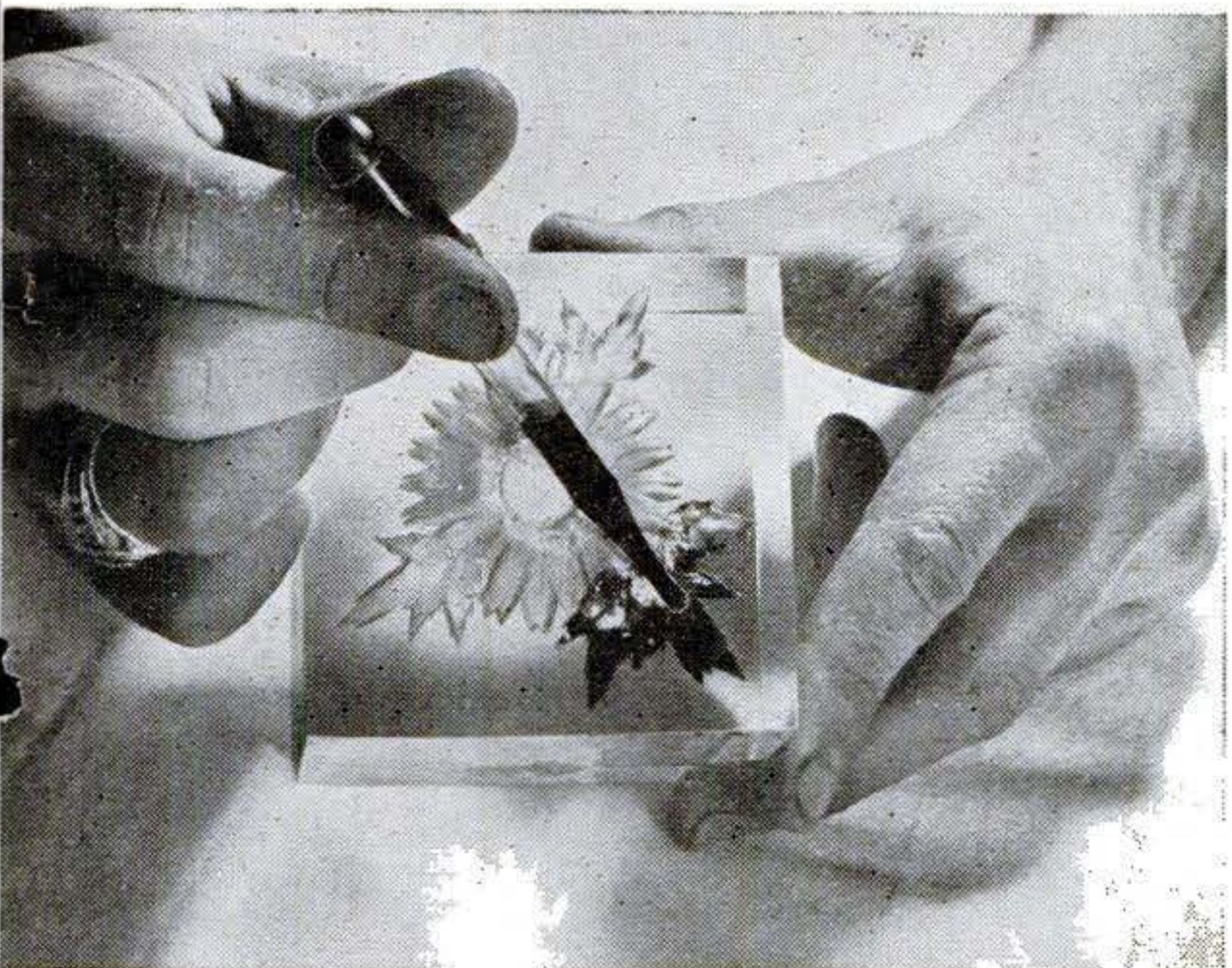
The opening in the back can be filled with plaster of Paris or dental plaster. The latter gives a hard white finish, but has to be used quickly as it hardens rapidly. This irregular white spot can be covered in jewelry by cementing over it a cup from an earring or thumbtack. Be sure the cup is



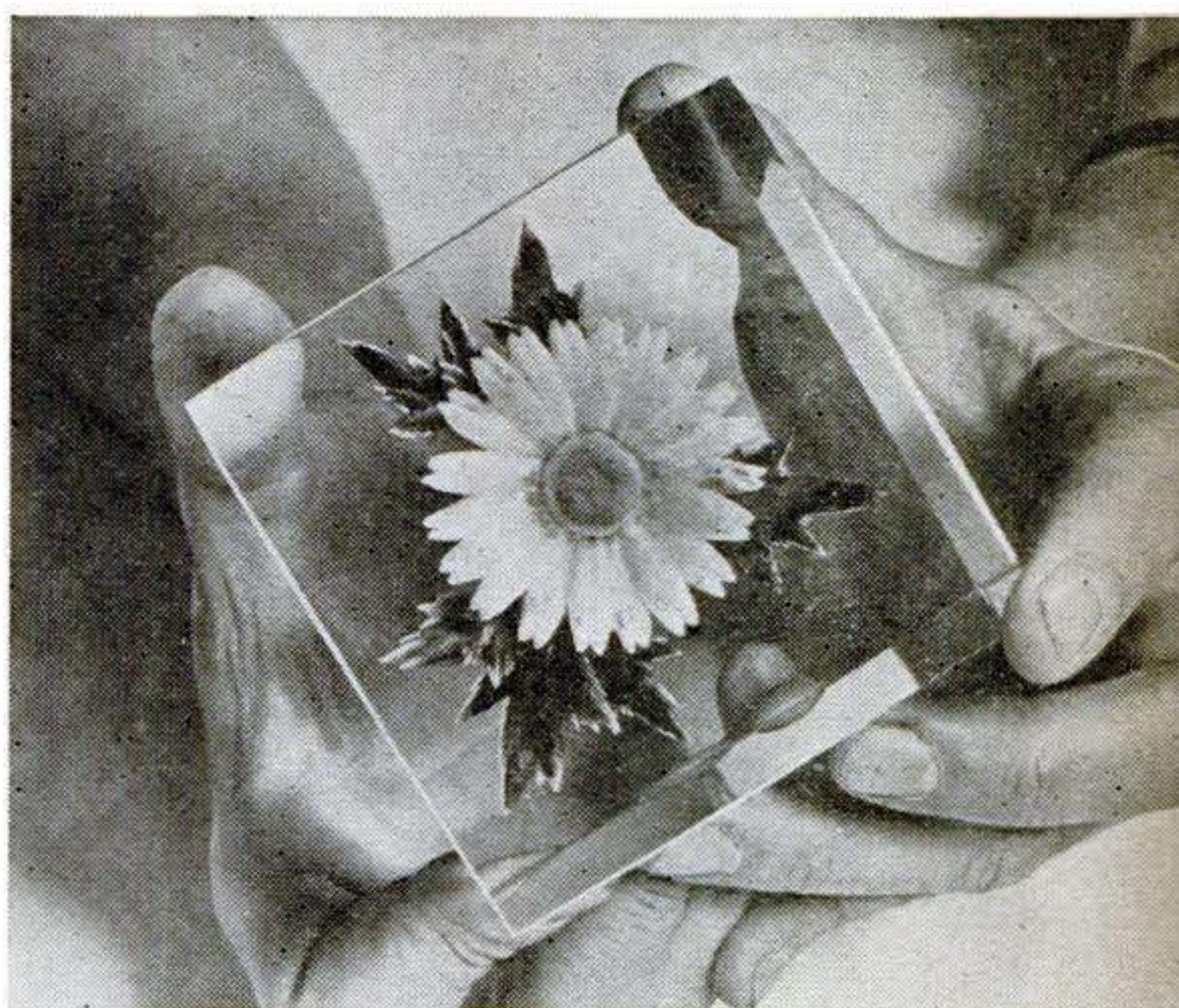
3 With the work turned over and watched through the top, the spiral drill comes into play. It is inserted in the edge of the cavity and held at as flat an angle as possible (about 25 deg.).



4 Here one petal is finished and a second begun. The drill is inserted, withdrawn with slight pressure to one side to round the end, and then advanced again to form a notched petal tip.



7 Leaf groups are tinted by dropping in dye. A tone gradation is possible if dye is applied first at the tips and works longer there. Petals can be dyed or, as here, left a frosty white.



8 The finished daisy, with yellow center, white petals, and green leaves. Seen from any edge, the carving has lifelike, three-dimensional depth. The cavity beneath may be filled or covered.

of smaller diameter than the flower so it will not show when viewed from the front. Larger pieces can be backed with metal covered with a sheet of opaque plastic, or cemented to any surface that will set off the design.

In making earrings, if you get an earring screw with a peg in the cup, you can fill the cup with the plaster also. Insert the peg in the plaster in the hole, wait a few seconds till it starts to harden, wipe off the excess plaster forced out from under the cup, and you will have a perfect bond.

When carving leaves, don't be afraid to work the drill about to form wrinkled edges,

overlaps, and other realistic details. You can form two or more layers of leaves, one above the other. Occasionally try carving a leaf at right angles to the others so it will be seen end-on through the top of the block. Such variations will help you create forms that look as lifelike from the edges as from the top. Buds and the smaller flowers may also be carved at various angles.

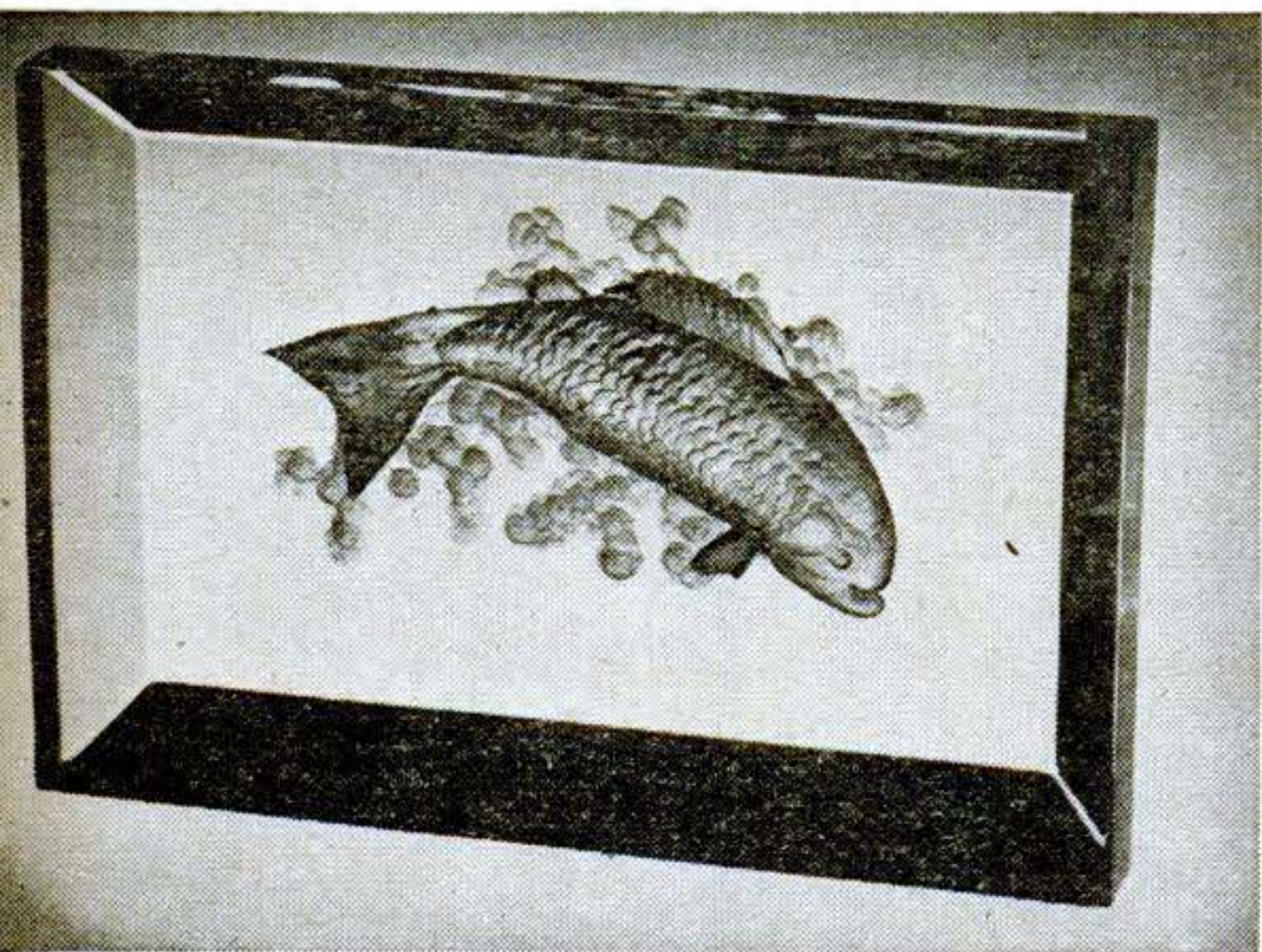
Don't overlook surface carving for less emphatic elements that serve as backgrounds to deep-cut motifs. Ferns, grasses, and seaweed are suitable subjects. Other flower forms, ranging from forget-me-nots to thistles, are only variations of the same

techniques. You can get patterns from illustrations in seed and bulb catalogs.

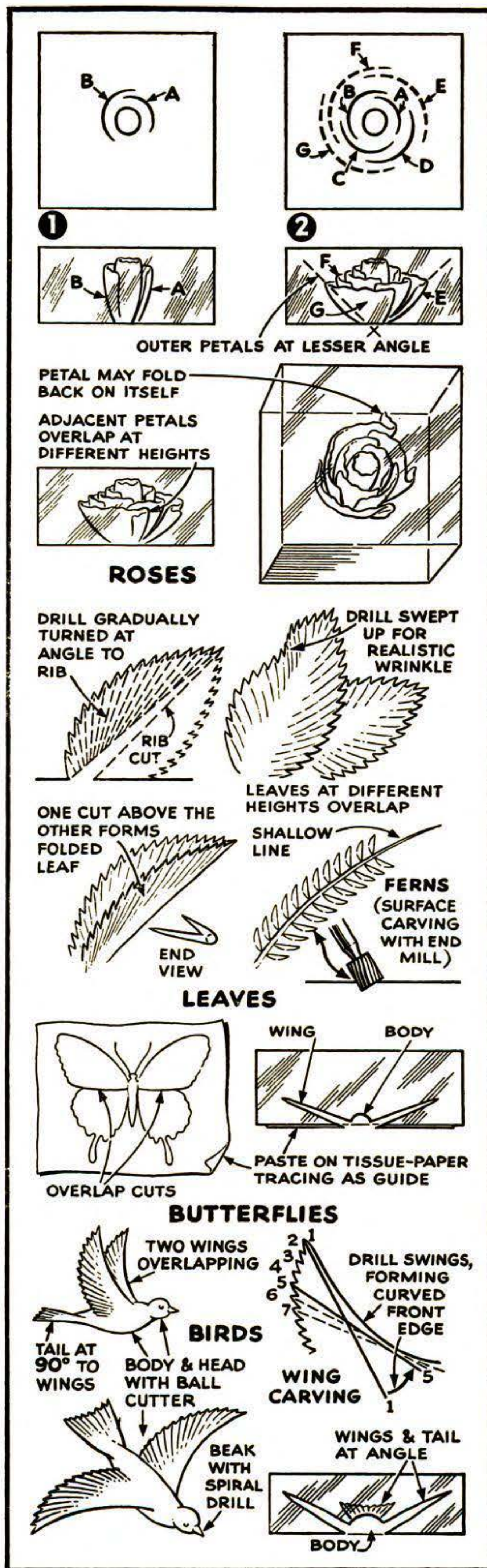
Butterflies involve symmetrical carving, and it is best to make an outline drawing of the wing on tracing paper and attach this to the underside of the plastic with water-soluble glue (don't use model-airplane or household cement, which may dissolve the plastic). Insert the spiral drill along the front line of the wing, starting about 1/16" away from the centerline. Watch the shank of the drill as closely as the tip, so that you don't cut across the body centerline; the drill will readily chew away too much there if you let it. Half the wing can be cut in a higher plane to overlap the other.

Take special pains, following the pattern closely, to get both wings the same. Then turn the work over and, with the spiral drill held as flat as possible, touch it at the centerline to form the tapering body. You can, of course, add wing spots, patterns, antennae, and so forth.

Birds are begun with a ball-carved body and head. The beak is made with a touch of the spiral drill, and wings are similar to petals except that the forward edge may curve. To form this curve with the spiral drill, make the first thrust to the wing tip with the entering point at the wing root some distance back of the edge. Withdraw and swing the drill slightly before advancing it to form the first feather edge or point. The drill thus lies tangent to an arc that forms the curve.—HARRY WALTON.



Like the daisy center, the body of this fish is made with the ball cutter. Scales are added with touches of one side of the end mill at an angle, and a bulge forms the eye. The spiral drill is used for the fins and tail, which sweep upward at 45 deg. Bubbles are the work of the ball tool.



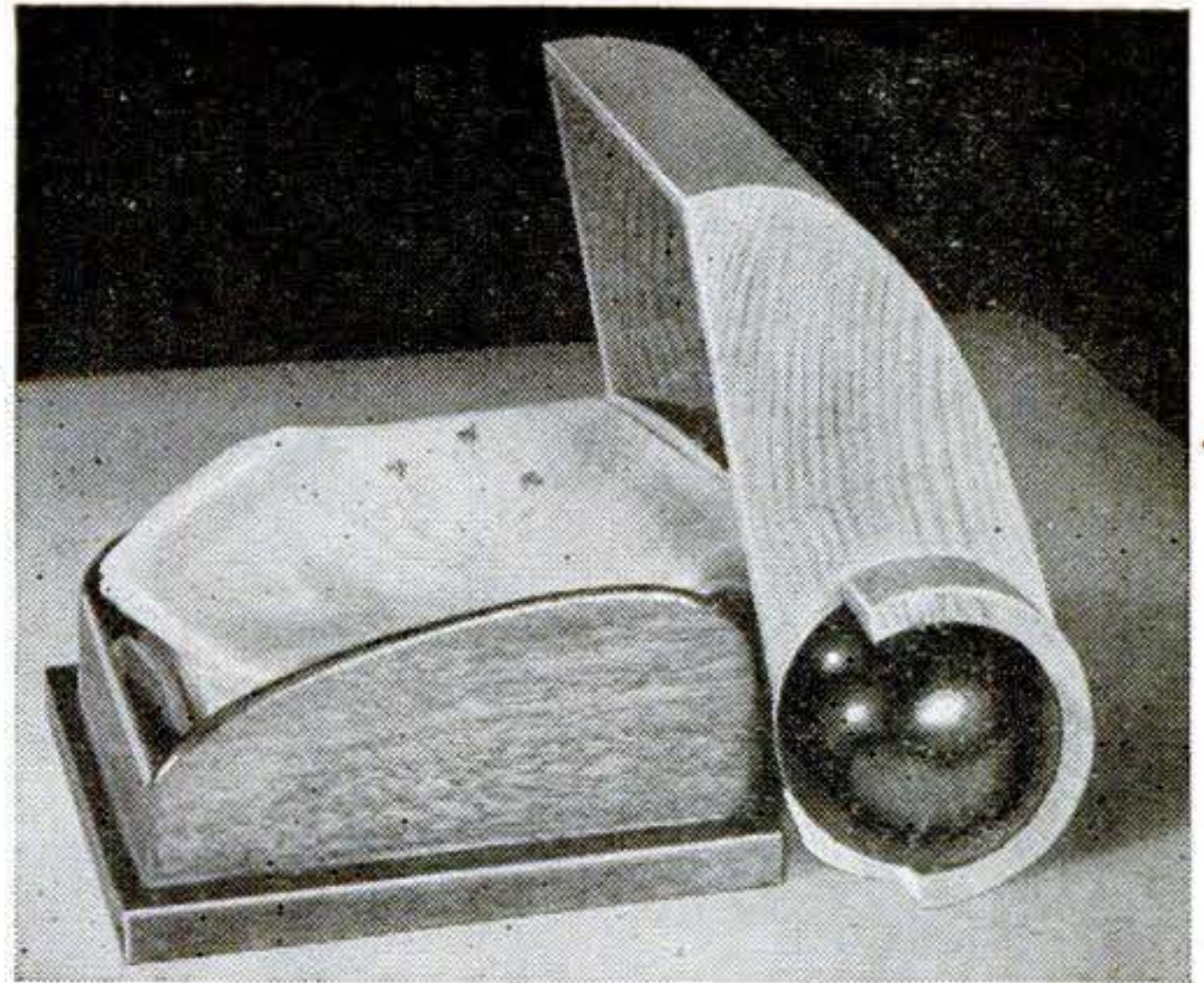
Kerchief Box Contrasts Wood Tones

WORKING with a maple turning and odd bits of walnut or mahogany, you can make a modern handkerchief box in a single evening.

Bandsaw the maple to form a T-shaped blank for the lid, and scribe 3" circles on the end of the projections as a guide for rounding the back. A pivot jig used with the sanding disk will speed shaping. It consists of two uprights spaced to receive the T-blank and nailed to a baseboard. The blank is pivoted on nails driven through the uprights and centered in the circles. Hold the jig against the sander table and swing the blank up and down until it is rounded. Make a template for the curve at the front, rough with a chisel, and shape on the sander.

An auger bit with the square shank and part of the screw point removed is a handy drill-press tool for hollowing the lid. Set the depth stop for $\frac{1}{4}$ " above the table and bore holes close together. Finish with a chisel, a twist drill in the corners, and a rotary file, if available, for smoothing.

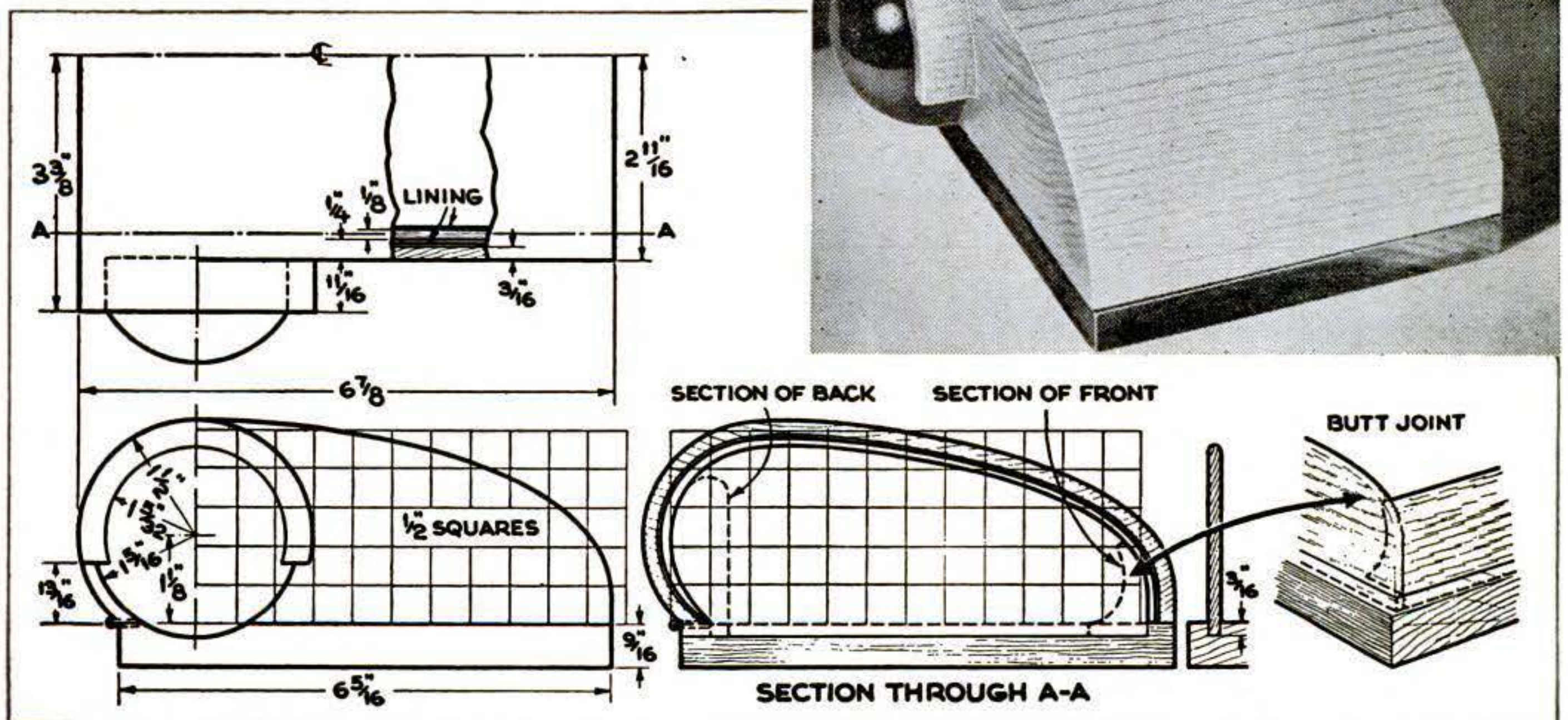
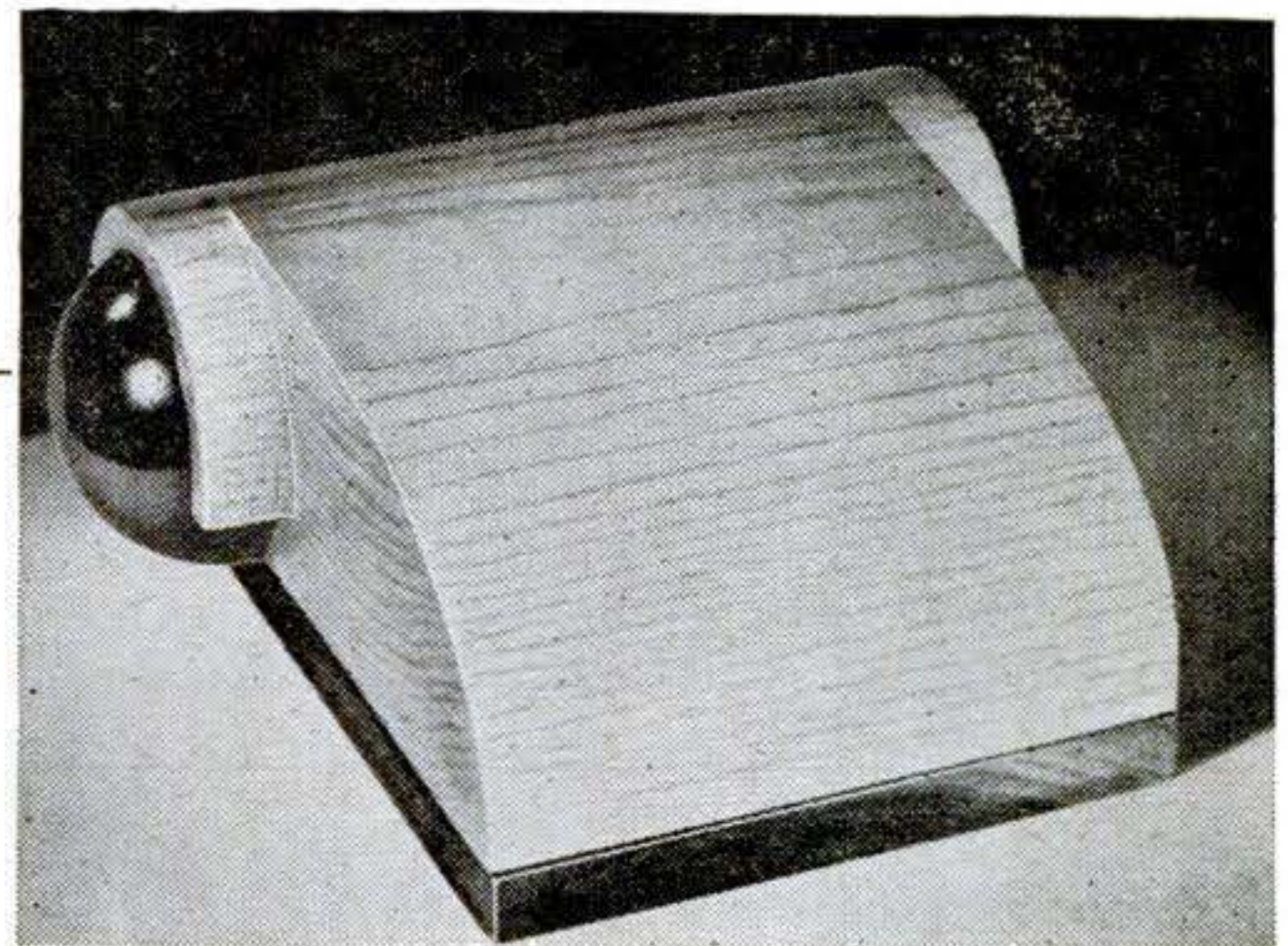
Make the base somewhat oversize and trim flush with the lid after hinging. Rout out grooves to receive the four sides, which are simply butted at the corners, and assemble with glue. The ornamental balls are turned hemispheres. Recess the lid for them with a circle cutter, finishing with a router bit. Use small brass hinges.—E. M. LOVE.

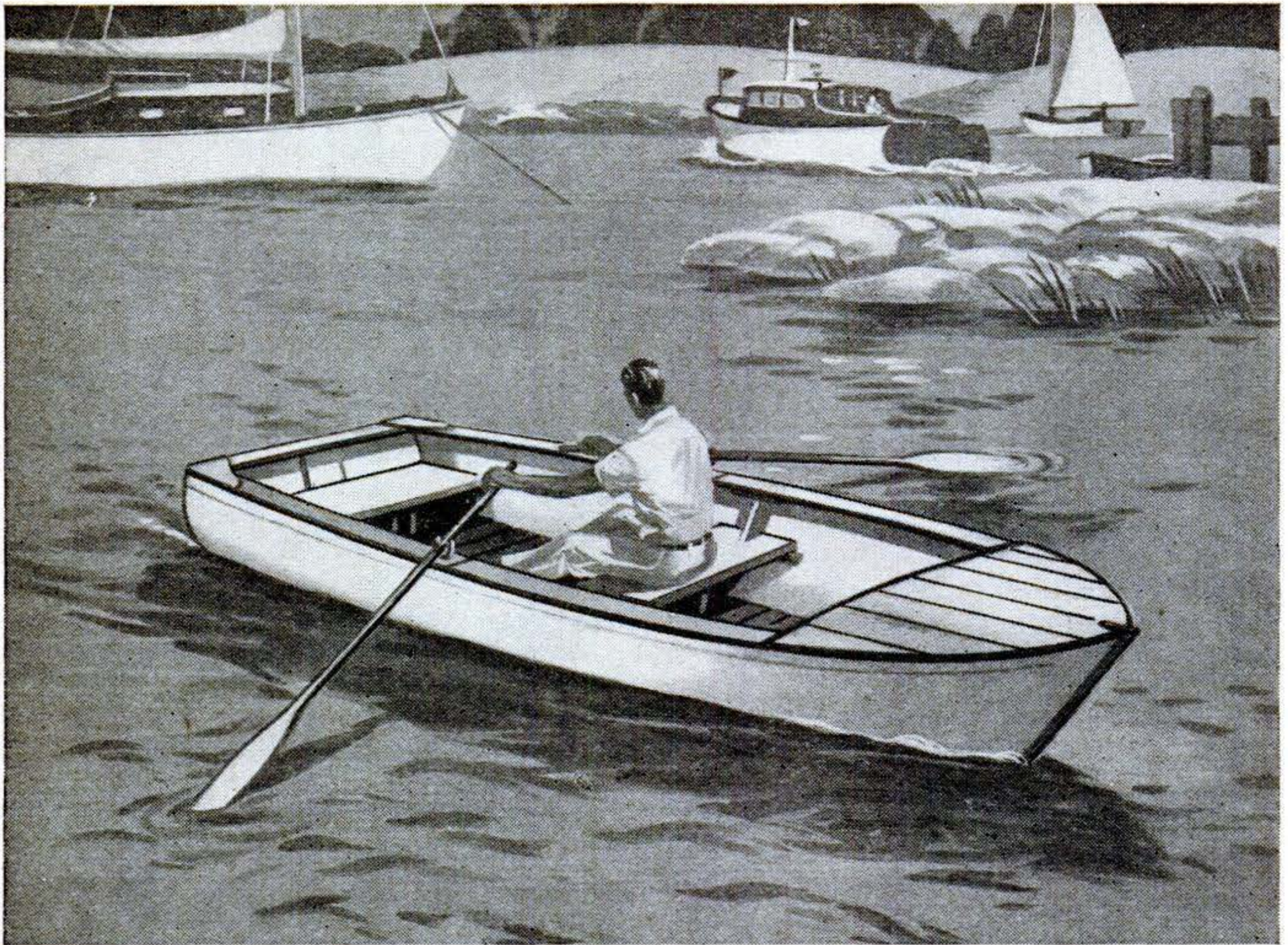


Though small, this box will hold close to a dozen men's handkerchiefs and a larger supply of women's.



Rounding the back on a pivot jig. The lid blank is swung on two nails. Shape the front freehand.





Good lines make this boat easy to handle. Its hull is a single sheet of surplus aluminum alloy.

Snip Yourself a Boat from Dural

Here's a durable, lightweight dinghy you can make with tin snips and a few other common hand tools.

By John D. Noble

THIS is one type of homemade boat that calls for neither laborious planking procedures nor the tricky fitting of plywood panels. The skin of this dinghy is a single sheet of .051" aluminum alloy, widely available in surplus outlets at present. Construction time is surprisingly short, and the cost is well below that of comparable boats built in the conventional manner.

While boatbuilding experience isn't needed to produce a shipshape job, you will want to exercise the careful attention to layout and forming that's essential to all good

sheet-metal work. Tools will be no problem; you can get by with little more than a pair of good tin snips, a hand drill, prick punch, hammer, saw, plane, screwdriver, and small wrench.

Obtain a 5' by 12' sheet of 61SO alloy about .051" thick for the shell and standard 1" lumber (13/16" net) for the framing. Use air-dried hardwood, if you can get it, to minimize the risk of warping. All screws, bolts, and fittings should preferably be brass; failing this, get hot-dipped galvanized hardware. Steer clear of cadmium-plated parts.

Clear out enough floor space to take the sheet with ample working clearance, cover the floor with enough opened newspapers to make a protective pad, and roll out the dural. Lay out the centerline and sufficient 6" squares for scribing the curves shown in Fig. 2. Locate and prick-punch all holes, but don't drill any until you have carefully

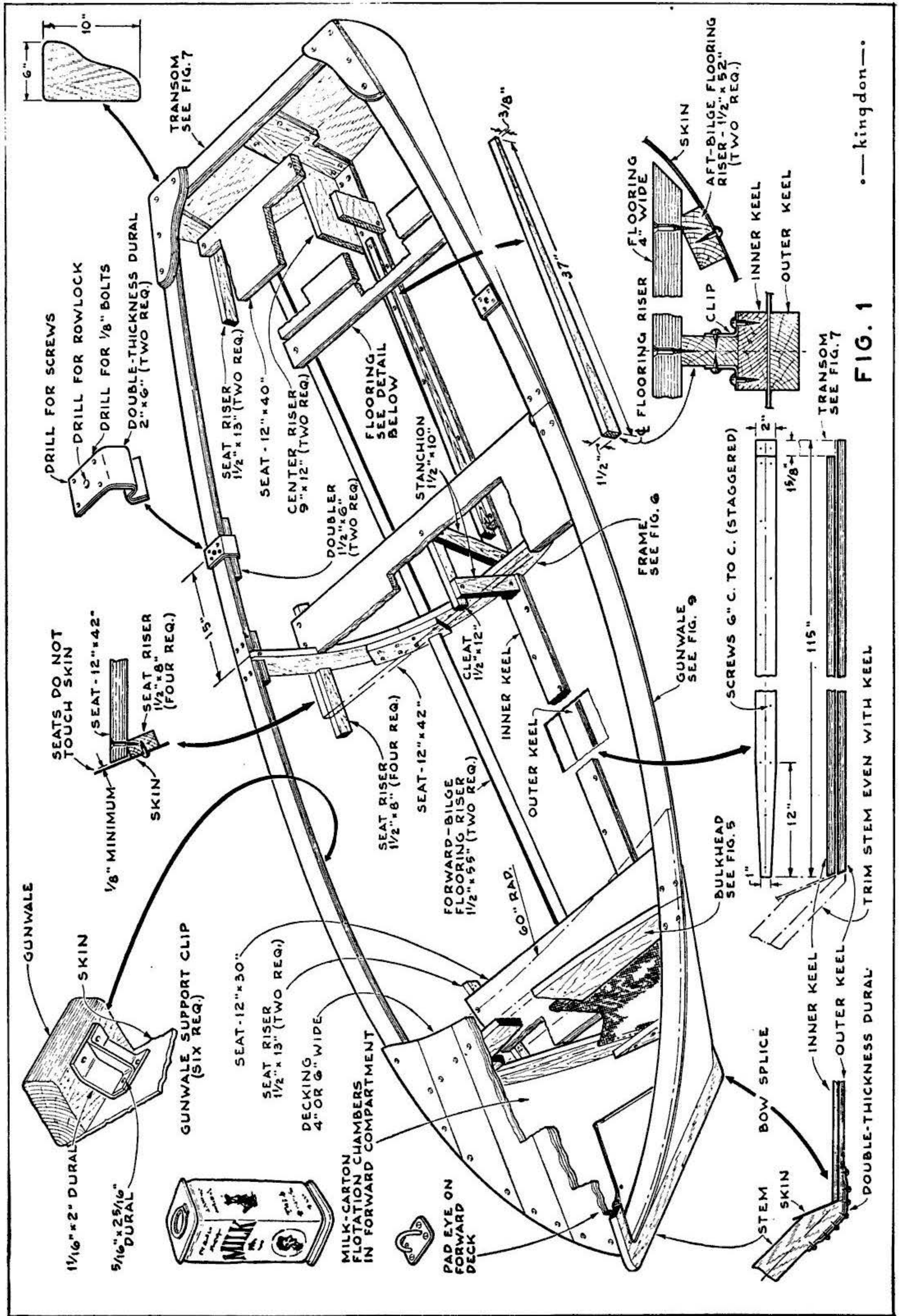


FIG. 1

—kingdon—

crosschecked the locations. Then drill them and cut the curves.

A bending jig for shaping the bow is shown in Fig. 3. Place the dural sheet on a couple of sawhorses, bolt it in the jig, and bend by turning the crank slowly until the metal is brought to approximate shape. Remove the jig and bolt the two forward points together temporarily. Don't attempt further forming at this time.

Saw out, sand, and insert the stem in the fold of the dural bow, as in Fig. 4, holding it in place with a bolt, two screws, and washers. Dip the bolts, screws, and washers in roofing cement or a similar sealing compound just before insertion. Excess can be removed with alcohol. Make sure also that both keels are coated with the sealer where they come in contact with the dural, and coat as well the attaching screws.

Figures 5, 6, and 7 show the construction of the bulkhead, frame, and transom. All must be symmetrical about a vertical centerline. The transom sealing strip, which may be felt, roofing paper, or several thicknesses of cloth, should be saturated with sealing compound. Place the transom on the keel, pull the skin up, and fasten temporarily at top with one screw on each side. Then place and secure the frame and bulkhead the same way, as in Fig. 8. The bulkhead may need to be leaned slightly forward or aft to allow the skin to form a graceful contour. Reinforce the frame with a temporary batten. Then screw the skin to the bulkhead and frame, driving the screws 4" apart, and to the transom, setting the screws 2" on centers. These screws, of course, should also be dipped in sealer before driving. The transom has an outboard-motor mount.

A method of laying out and cutting the gunwales from three hardwood strips for

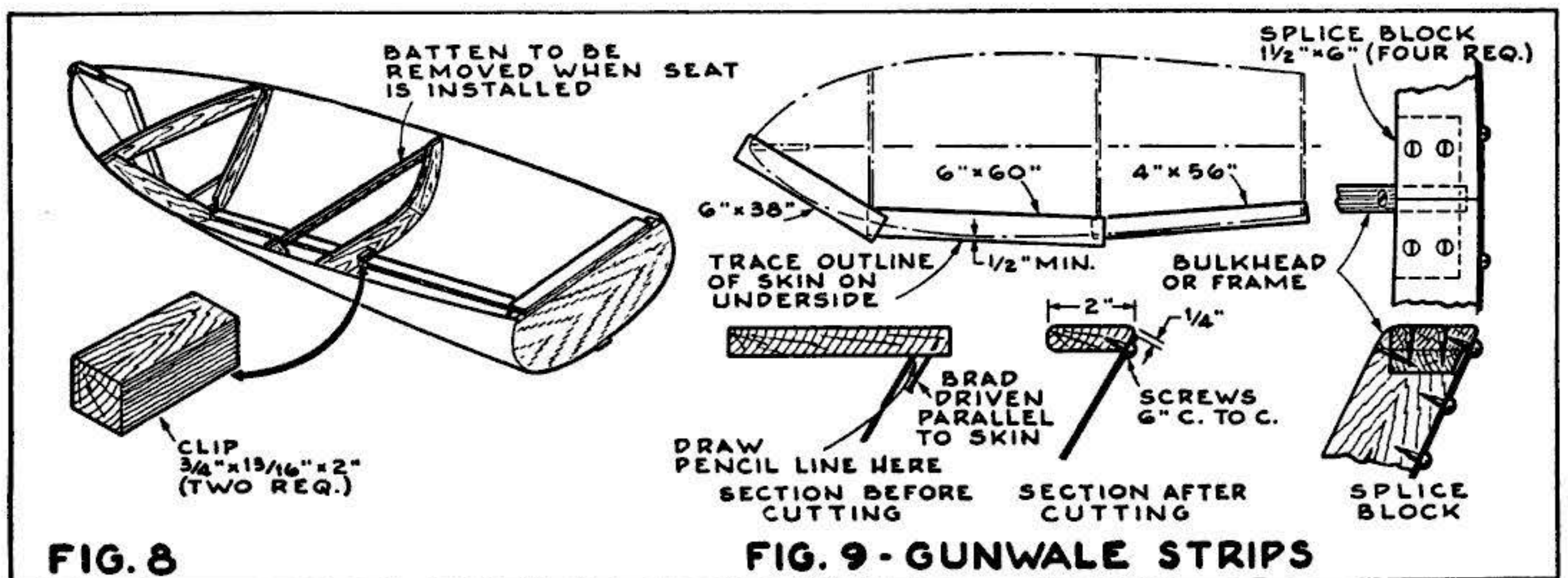
each side is shown in Fig. 9. Brads driven in at intervals parallel to the skin will indicate the cutting angle for the saw. Splice blocks are used under the joints to stiffen them. Space screws about 6" apart.

The seats and their supporting parts are next installed, as in Fig. 1, which also shows the construction and installation of the floor and its supports. The center support strip may need to be planed down slightly to allow the flooring to rest on all three points of support. No center support is required forward of the center seat. All wood parts below should be cleaned and varnished before the flooring is installed. Varnish each floor board as it is put in, and allow 1/2" space between boards.

Sand, clean, and varnish all the remaining wood parts, and varnish also all metal parts within the area forward of the bulkhead. Before installing the forward deck, utilize the space under it as a buoyancy chamber, filling it with empty paraffined-cardboard milk cartons. Rinse the cartons thoroughly and seal the lids closed. If still more buoyancy is desired, the space below the transom seat may be closed off and used likewise.

Install the decking next, allowing the after ends of the deck boards to extend 6" beyond the bulkhead. Scribe an arc of 60" radius along the after edge of the deck, and cut along the scribed line with a compass saw. Sand all edges, and varnish the exposed surface (the underside of the boards should be varnished before installation). Cut, varnish, and screw on the two gusset plates at the stern. If 1/4" waterproof plywood is available for the deck and gusset plates, considerable weight will be saved.

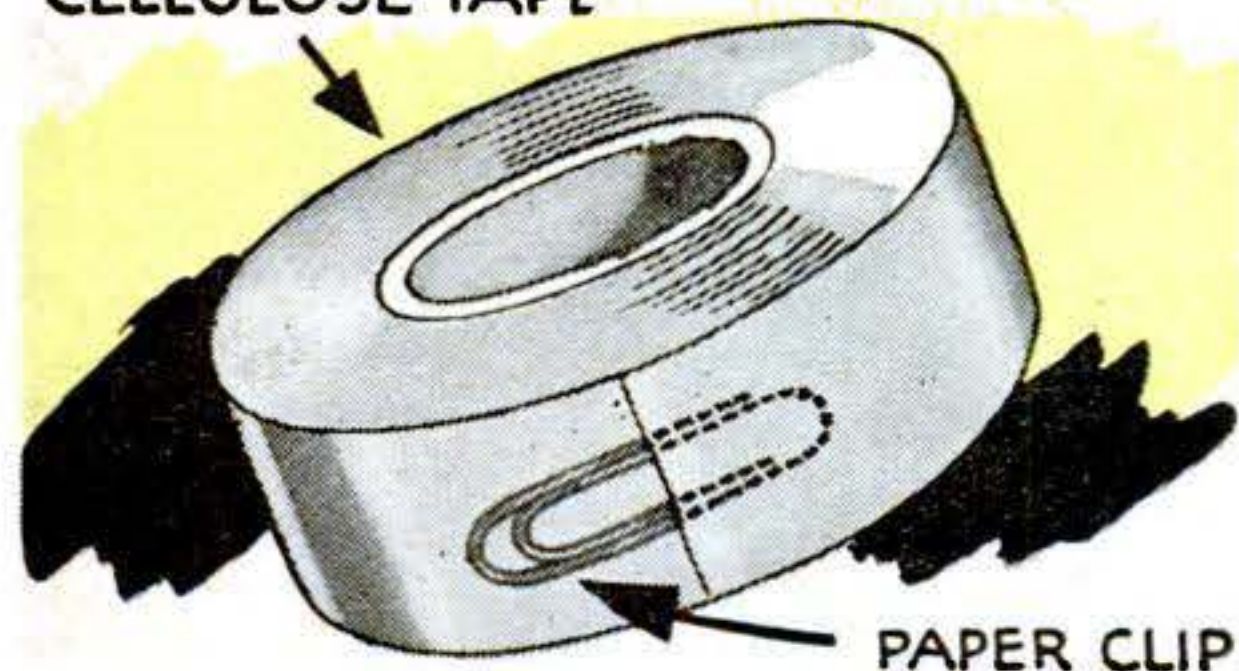
No finish is needed on the duralumin, though it may be enameled if a color is preferred. END



KEEPING the HOME SHIPSHAPE

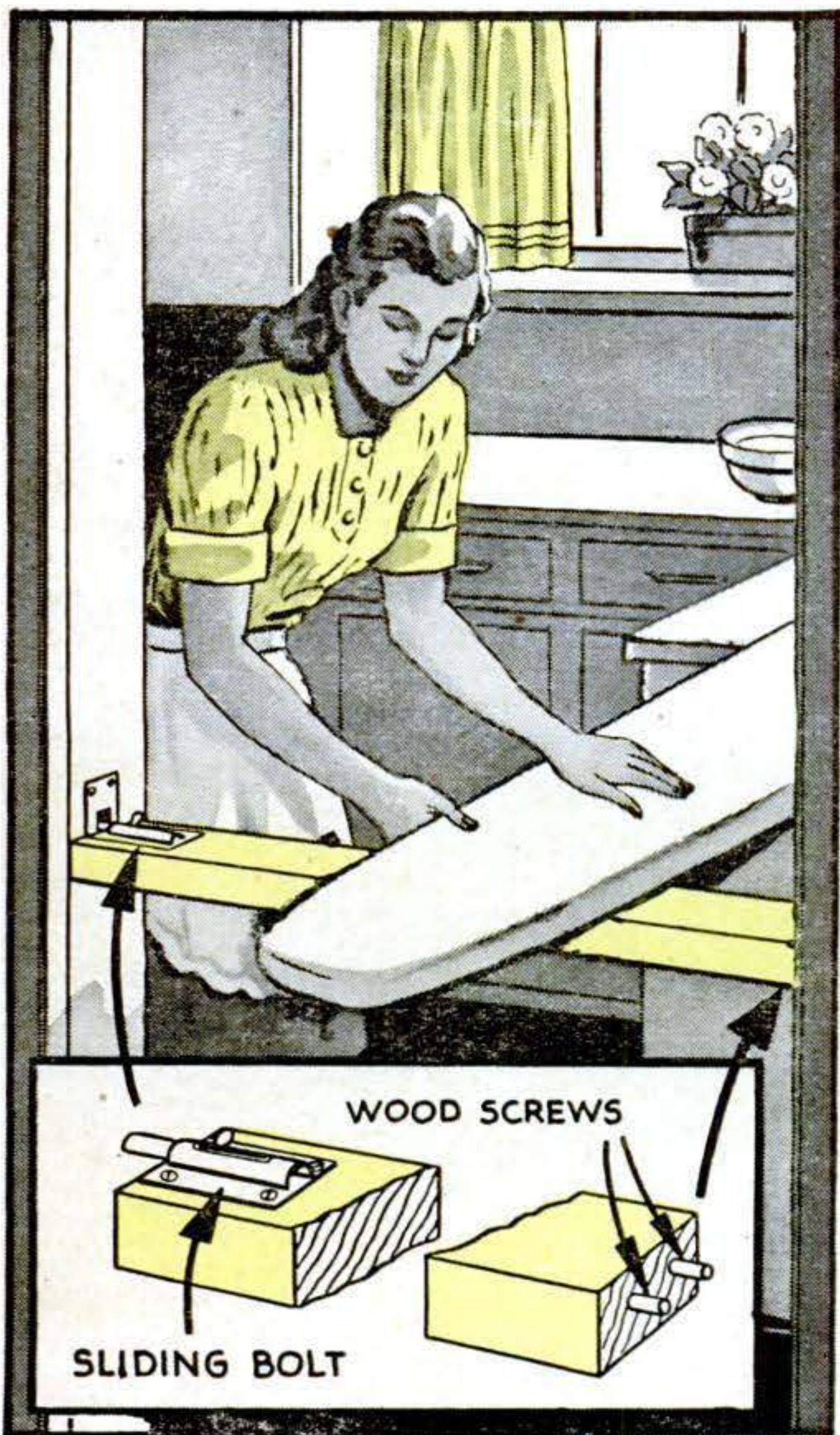


CELLULOSE TAPE



PAPER CLIP

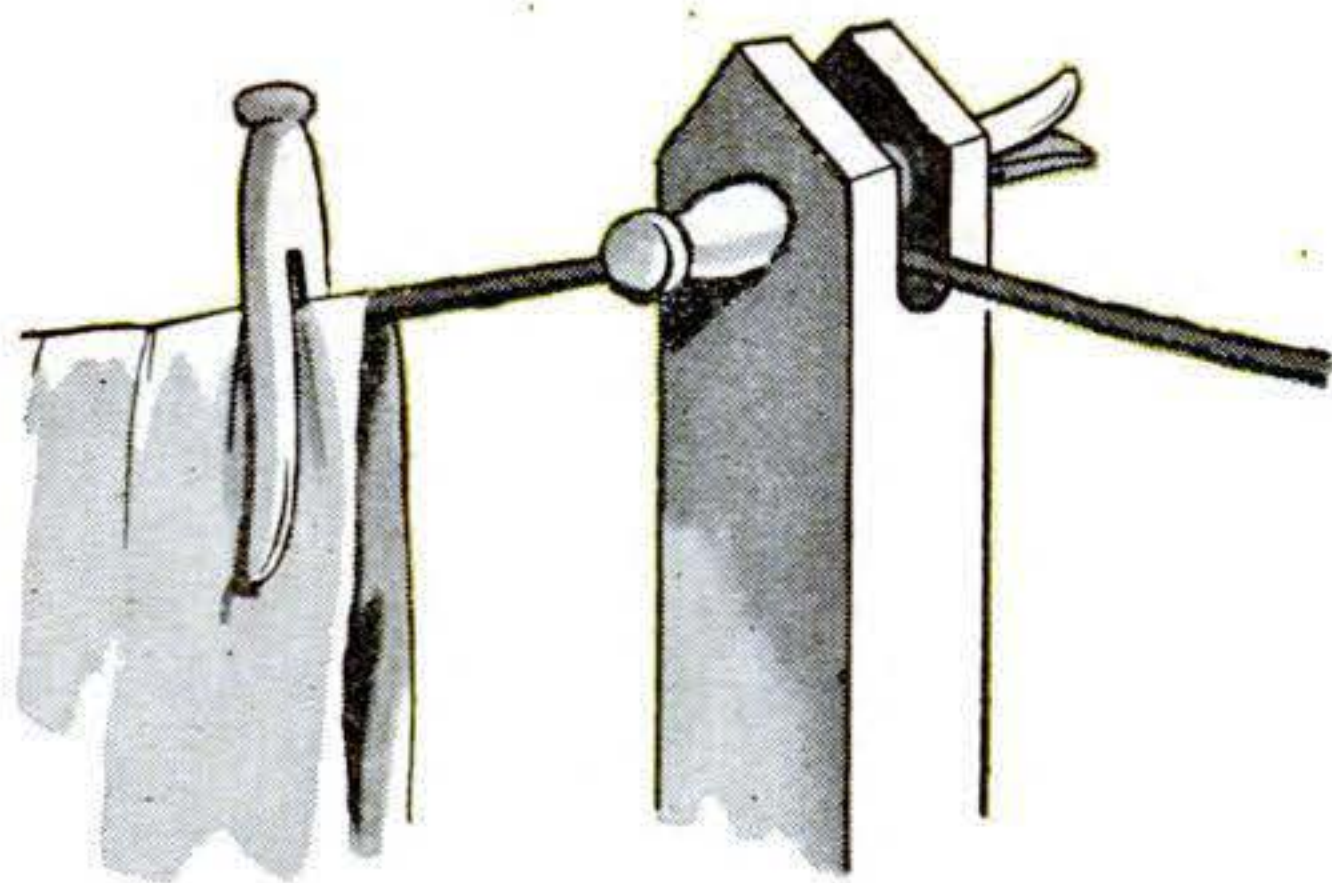
An ordinary paper clip makes an excellent starter for cellulose or masking tape not used in a dispenser. Insert part of the clip under the end and press the tape tightly back on the roll. Lift the protruding part of the clip to start the tape.



WOOD SCREWS

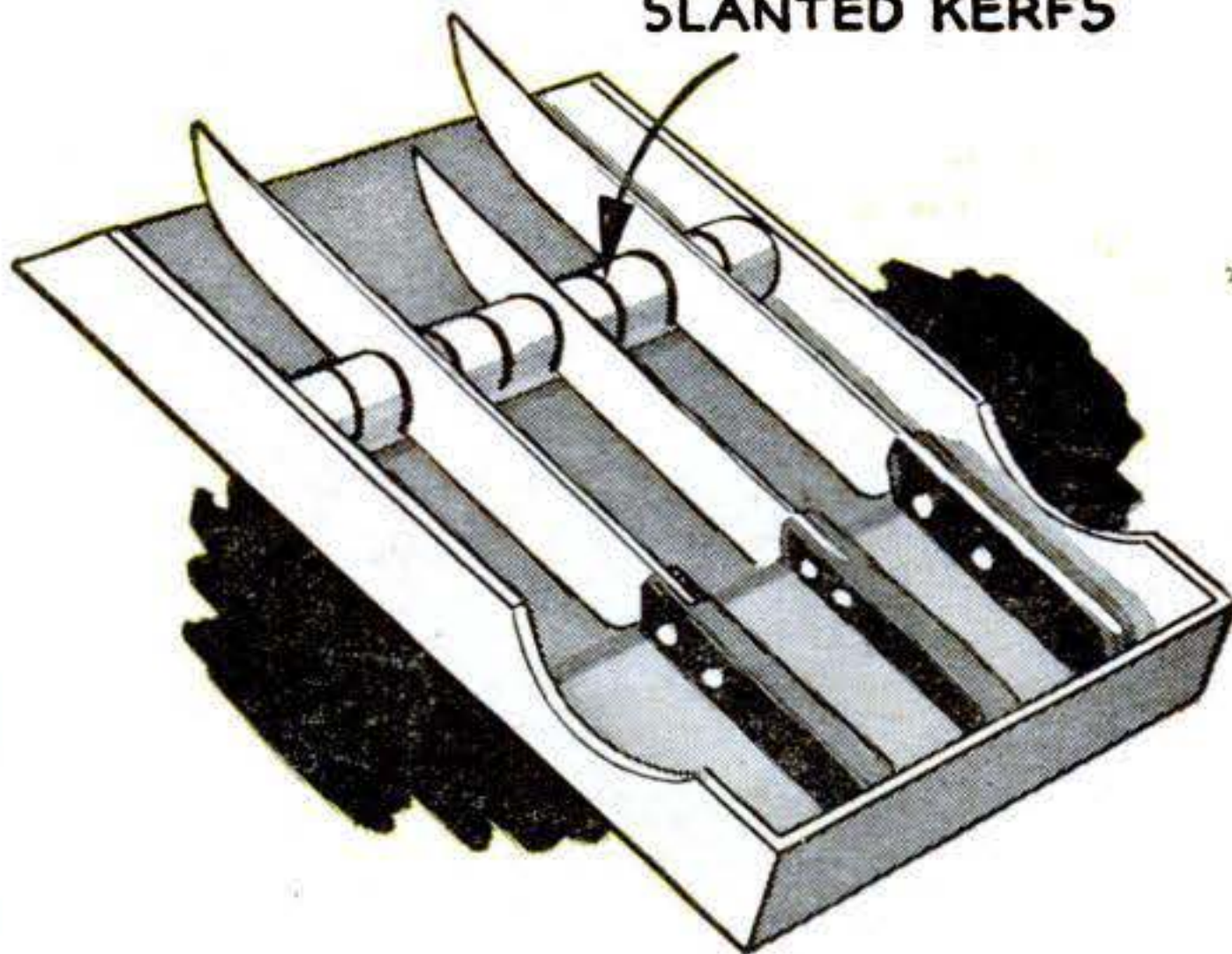
SLIDING BOLT

Need space for your ironing board? Perhaps you can make use of the distance from kitchen door to work table. Screws with heads cut off act as dowels at one end of a two-by-four crosspiece, and a sliding bolt does the job at the other. Small wooden blocks on the underside of the board keep it from sliding.

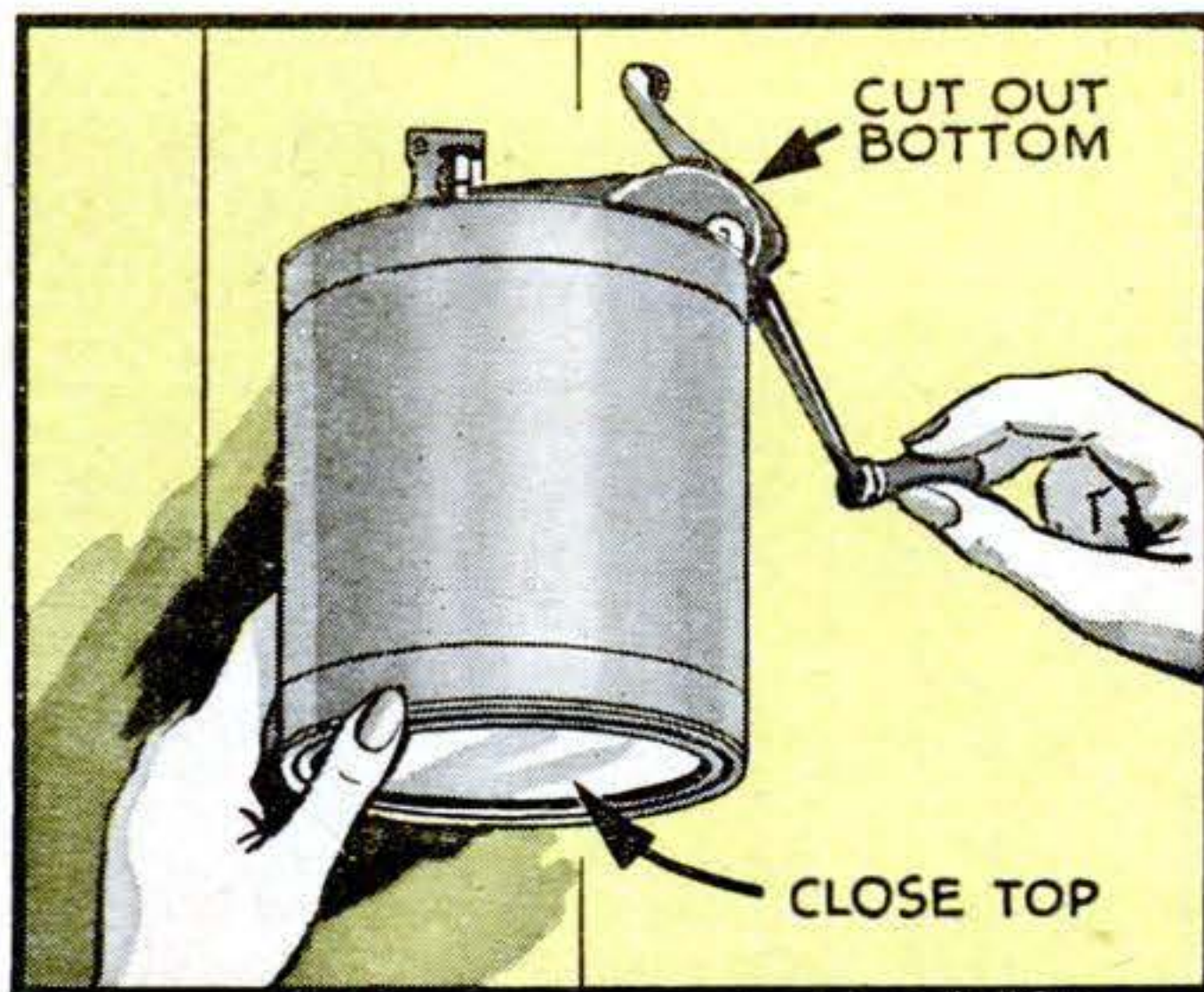


To keep your clothesline from blowing out of the notch of a clothes pole, drill $\frac{1}{2}$ " holes across the pole as shown. Press in a split-type clothespin.

1" DOWEL WITH SLANTED KERFS



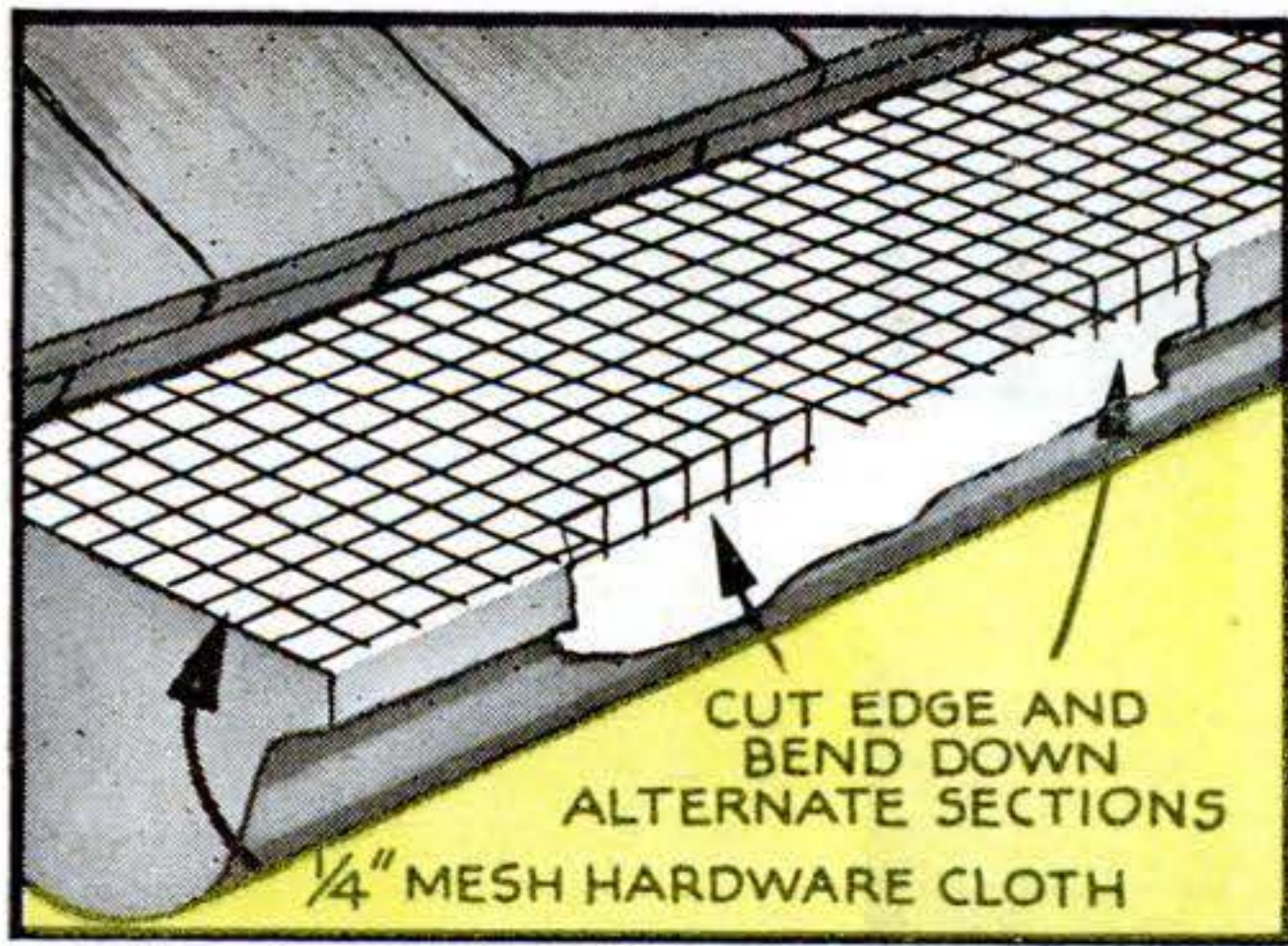
Kitchen knives will stay sharp longer if they do not rub against each other in your knife box or drawer. Saw kerfs in a hardwood dowel located as shown will keep the blades separated and upright.



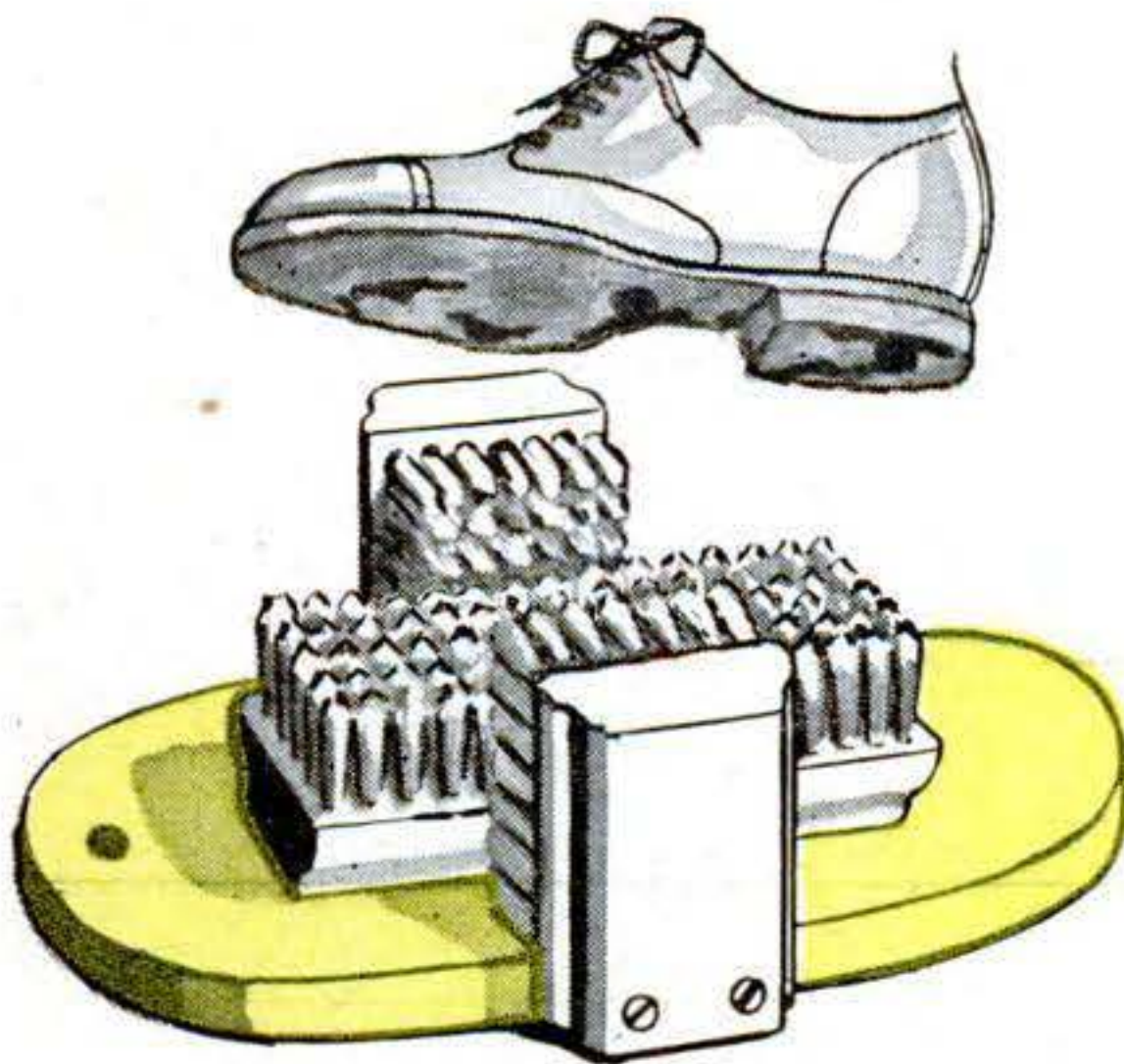
CUT OUT BOTTOM

CLOSE TOP

Cans with pry-out lids, such as are used for baby foods and many similar products, are hard to empty completely. If the metal rim on top keeps you from getting your full money's worth, press in the top, turn over the can, and cut out the bottom with one of the newer type of clean-cutting can openers.

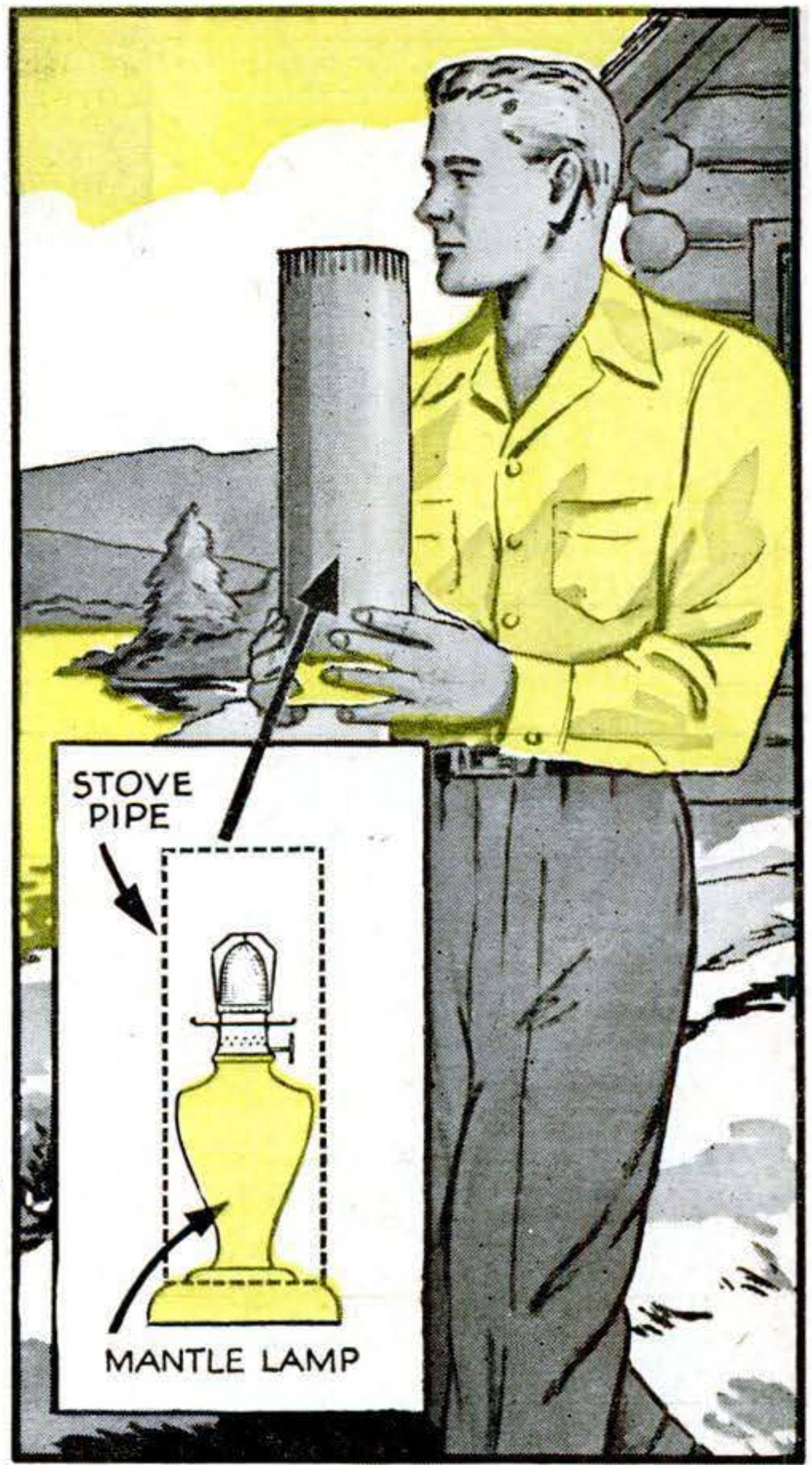


Falling leaves won't clog your rain gutters if you make wire-mesh covers. Cutting and bending alternate sections of the wire insures a nonslip fit.

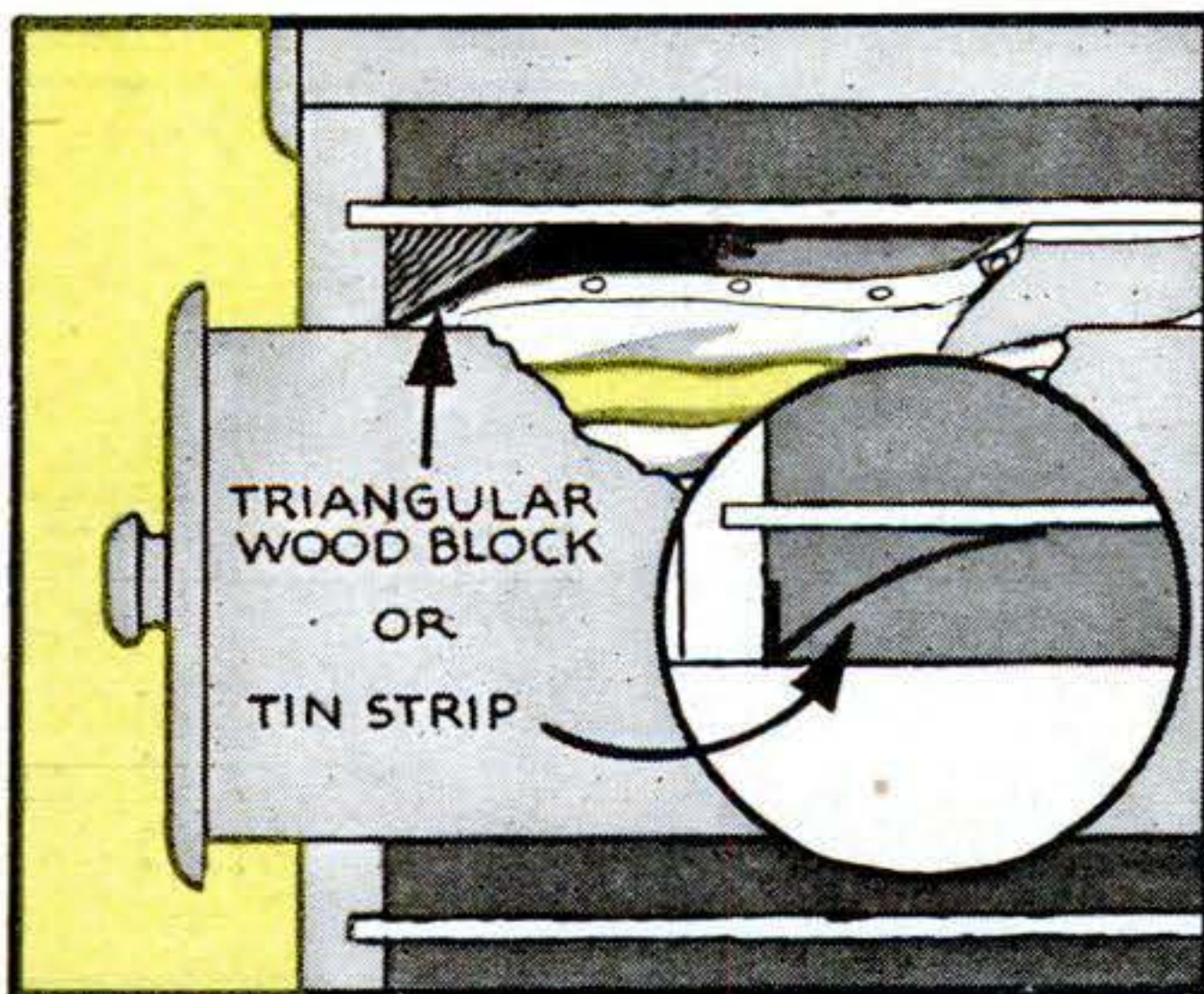


1/2 BRUSH ON EACH SIDE

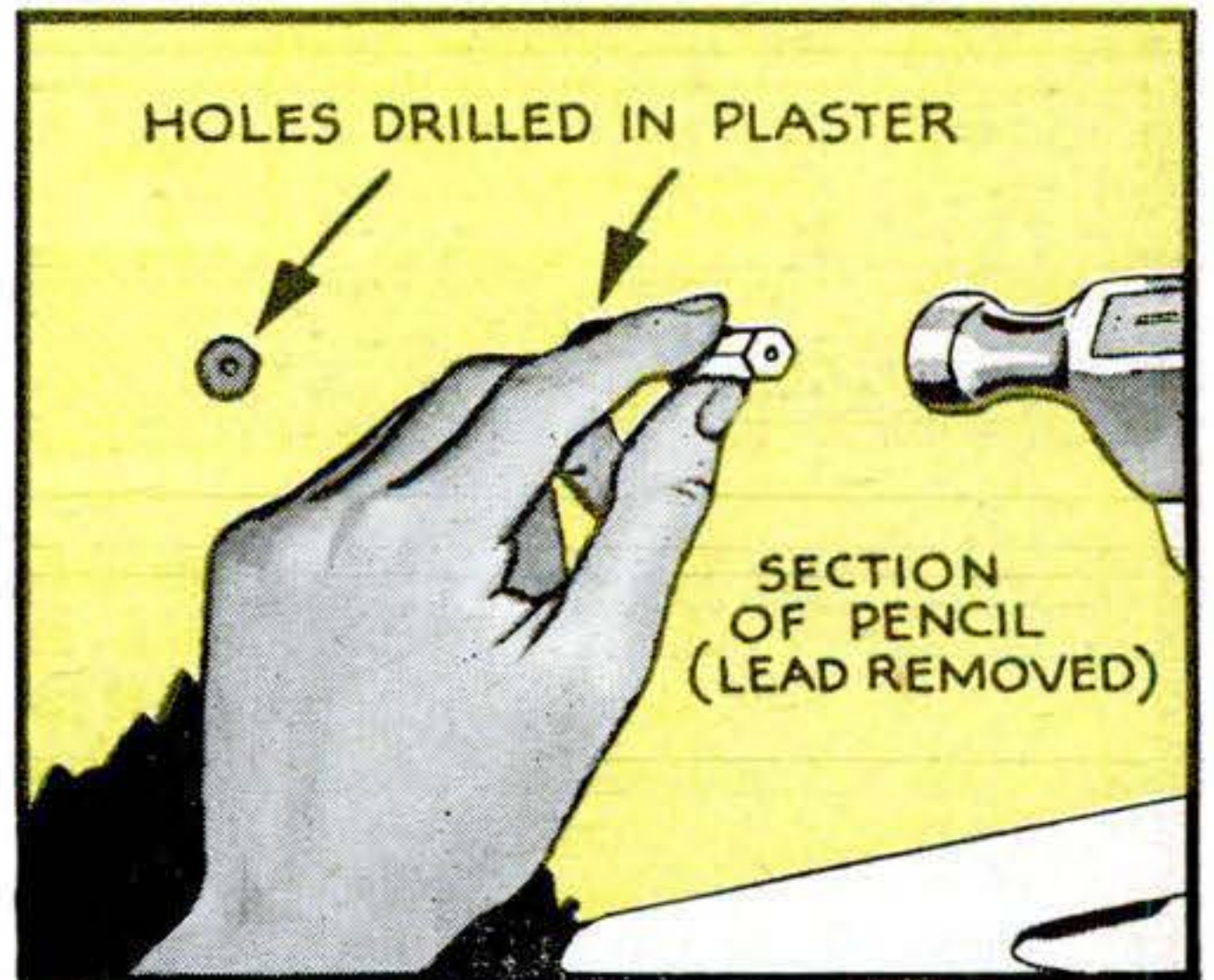
With this shoe cleaner placed near the door your visitors will find it easy to wipe their feet before entering. Two old scrub brushes are used. Saw one in half and mount the three pieces on a base.



Even with the chimney in place, the fragile mantle in a kerosene mantle lamp will often be damaged if you must transport it between buildings. A length of stovepipe will help protect it from the wind.

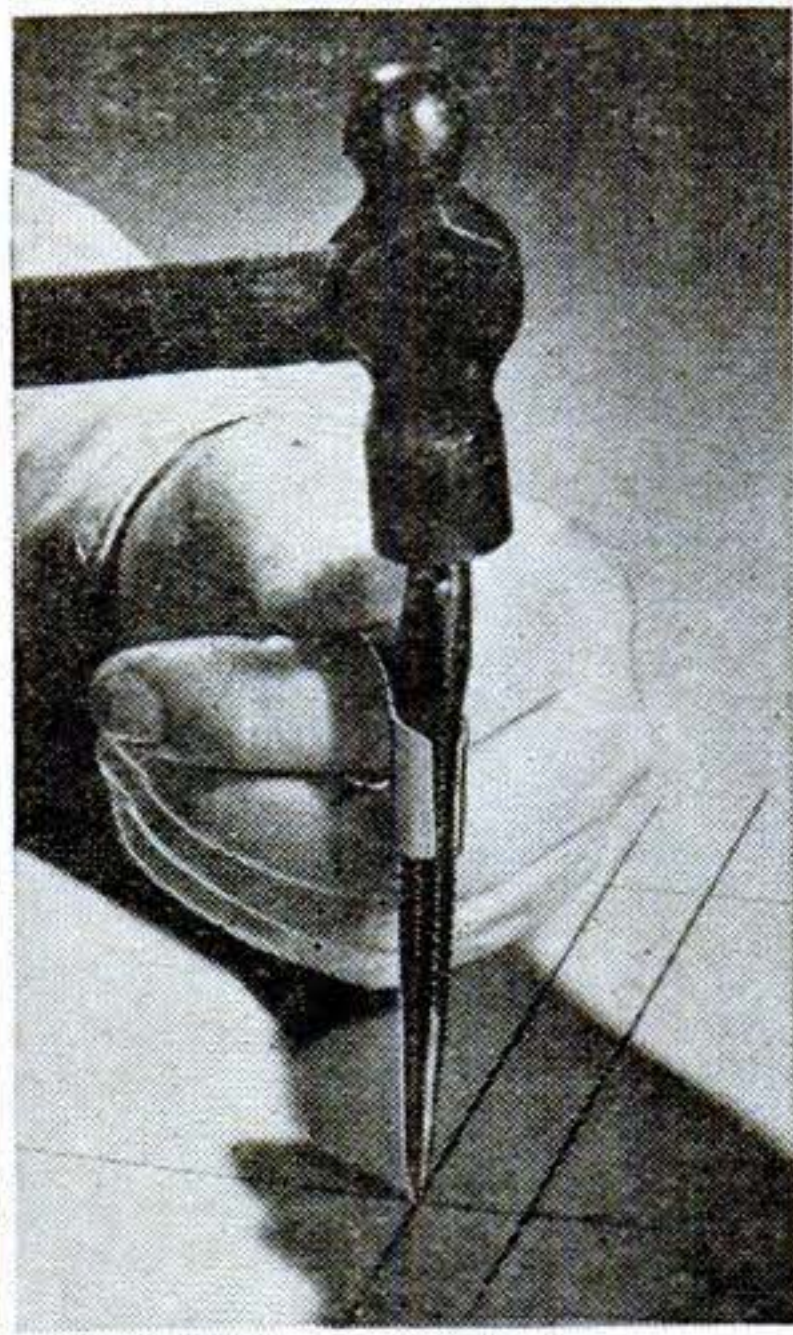
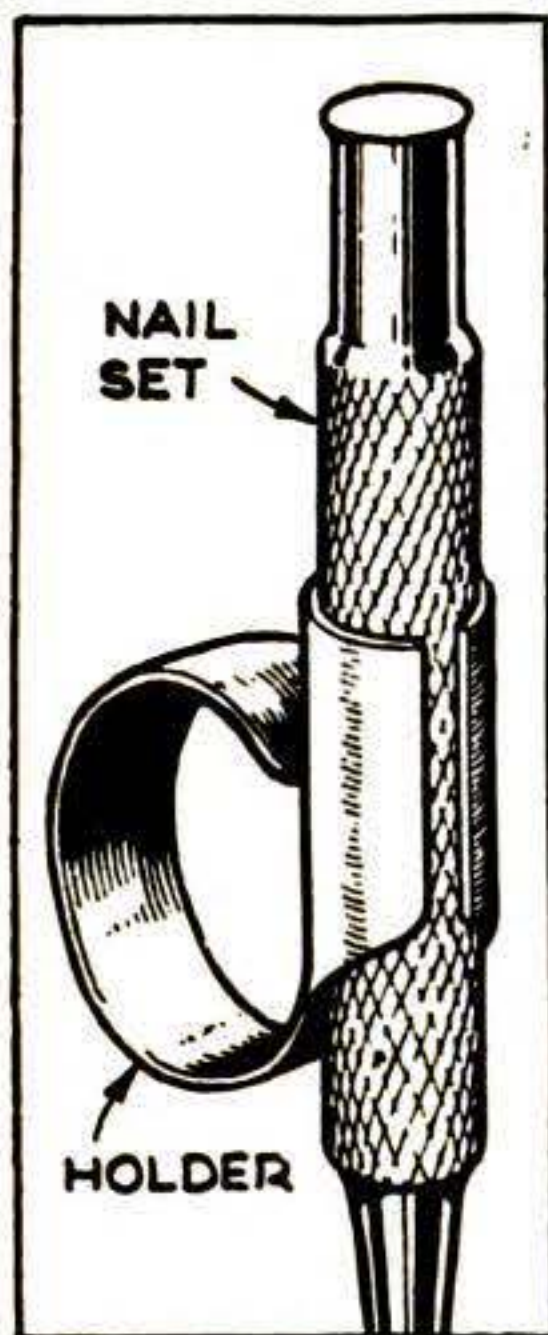


Desk and dresser drawers often become so crowded that items on top press up and catch against the inside of the rail. When this happens it is difficult to open the drawer without wrinkling some of its contents. A wood block or tin strip fastened as shown will slide the high objects down and clear.

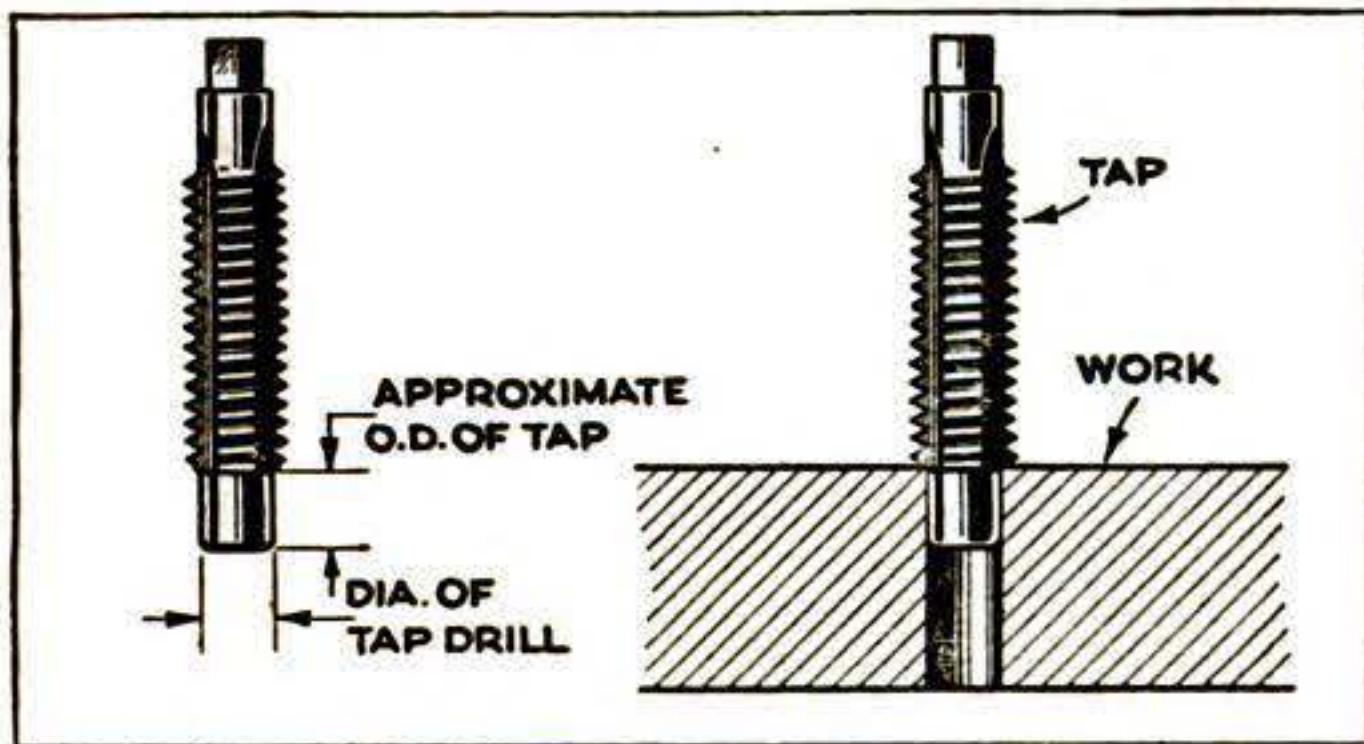


Ordinary hexagonal lead pencils can be used in a pinch as expansion plugs when you have to locate wood screws in a plaster wall. Cut a pencil into 3/4" sections and push the lead out. Drill the wall a snug fit for the pencil lengths. Then drive in the screws, which will split and expand the wood.

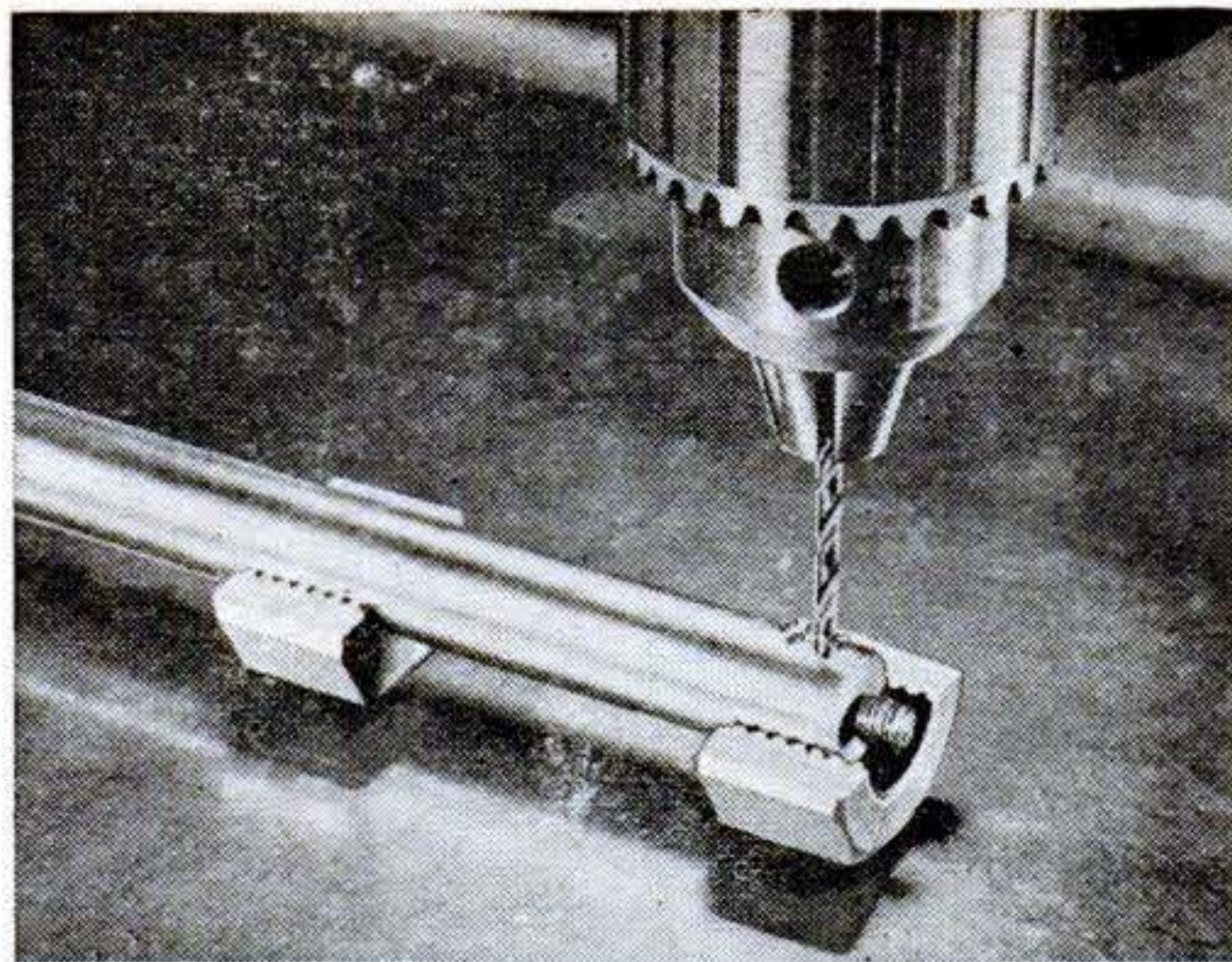
NEW SHOP IDEAS



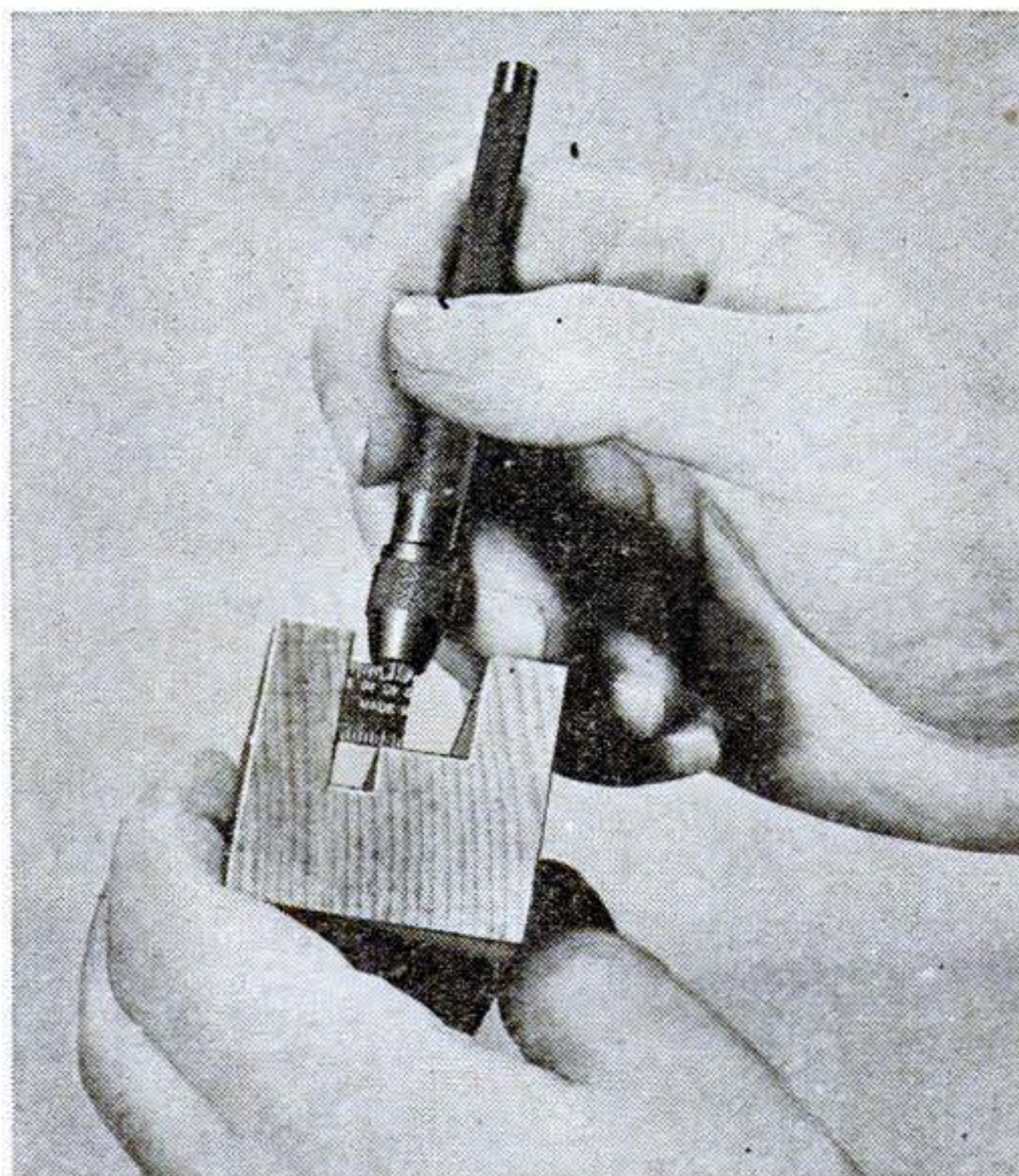
Punch Holder. When you have a large number of nails to set, or must prick-punch many layout points, you'll work faster and more accurately with this punch holder. It's merely a strip of sheet metal with a broadened end, this end curved around the punch while the narrower part of the strip is shaped for the fingers.—J. A. WALKER.



Pilot Tap. The end of a tap ground to the diameter of the tap drill will start threads straight in the work. The pilot must of course be concentric with the tap body, so it should be formed with a tool-post grinder while the tap is mounted between lathe centers. Back off the first threads with a hand grinder to get a starting thread. Worn taps prepared in this fashion may be used for starting threads to be finished with new taps. A set of pilots in the common sizes is a shop asset.—THEODORE KANAKOS.

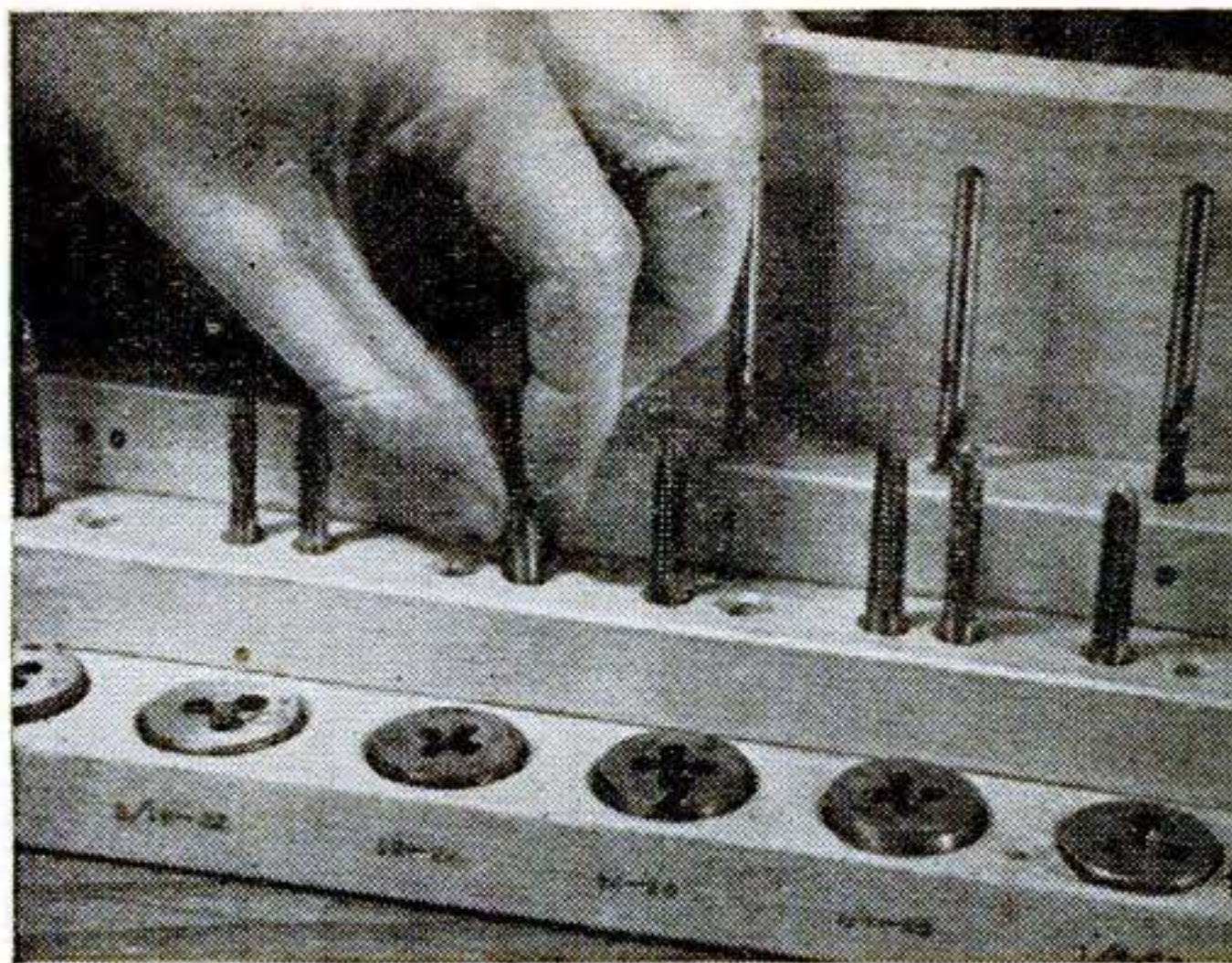


Improvising V-Blocks. If, when drilling small round stock, you need a V-block in a hurry, get a hex nut the work will just slip into, and cut it in two. The threads in the nut will tend to hold the work. For cross drilling threaded work, use a nut with a thread that matches that of the work as closely as possible.—C. W. WOODSON.

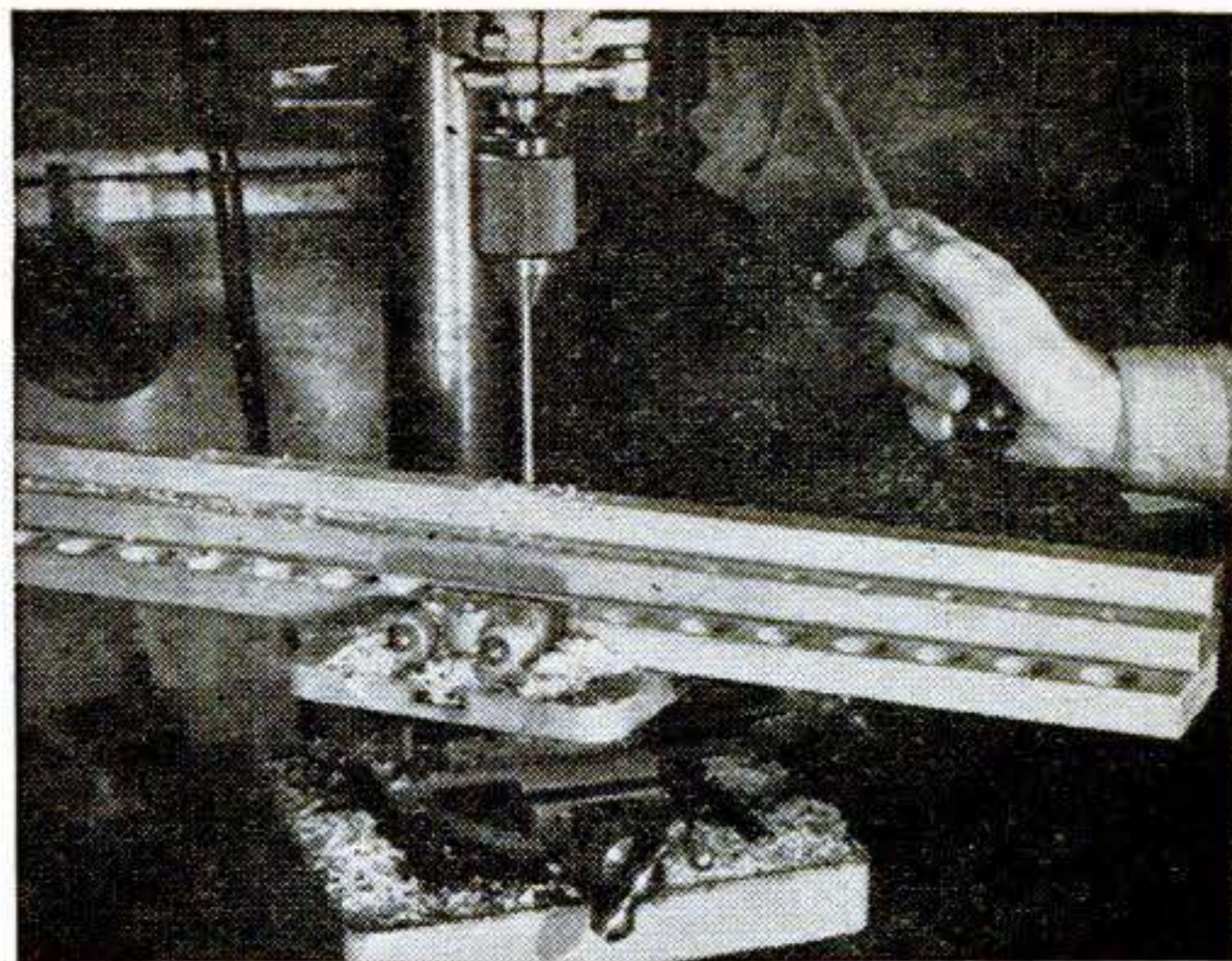


For Inside Measurements. That battered old steel rule in the bottom of your tool box can be converted into a handy set of short rules for measuring inside recesses or other hard-to-reach places.

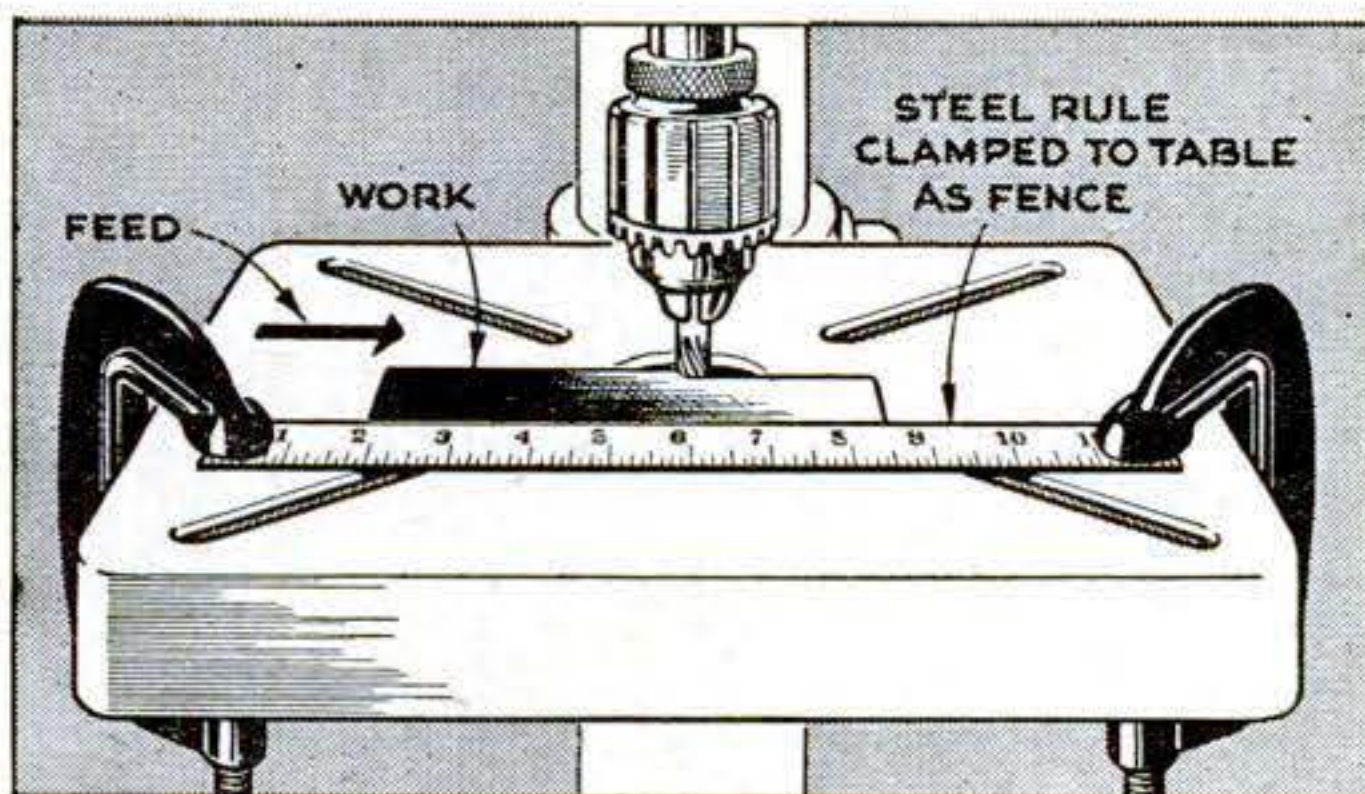
Break the rule into several different sizes and discard kinked and rusted portions. Select pieces that are slightly oversize and carefully grind the metal down to the dimension lines. To get down into a recess, grip the rule with a pair of locking tweezers or a small pin vise.



Tap-and-Die Rack. Here's a shop fixture that reduces to its simplest form the problem of selecting the right die, tap, or tap drill for any job. A few strips of lumber of varying width are nailed together in steps as shown. The widest piece, at the bottom, is bored for the dies; holes should be shallower than the dies so that enough metal



projects for an easy grip. On the next step drill holes for the shanks of matching taps. Make two holes if both plug and bottoming taps are used. The top strip is for the tap drills. A backing piece, high enough to protect the projecting drills, is also recommended unless the rack is fastened to a wall.—WALTER E. BURTON.

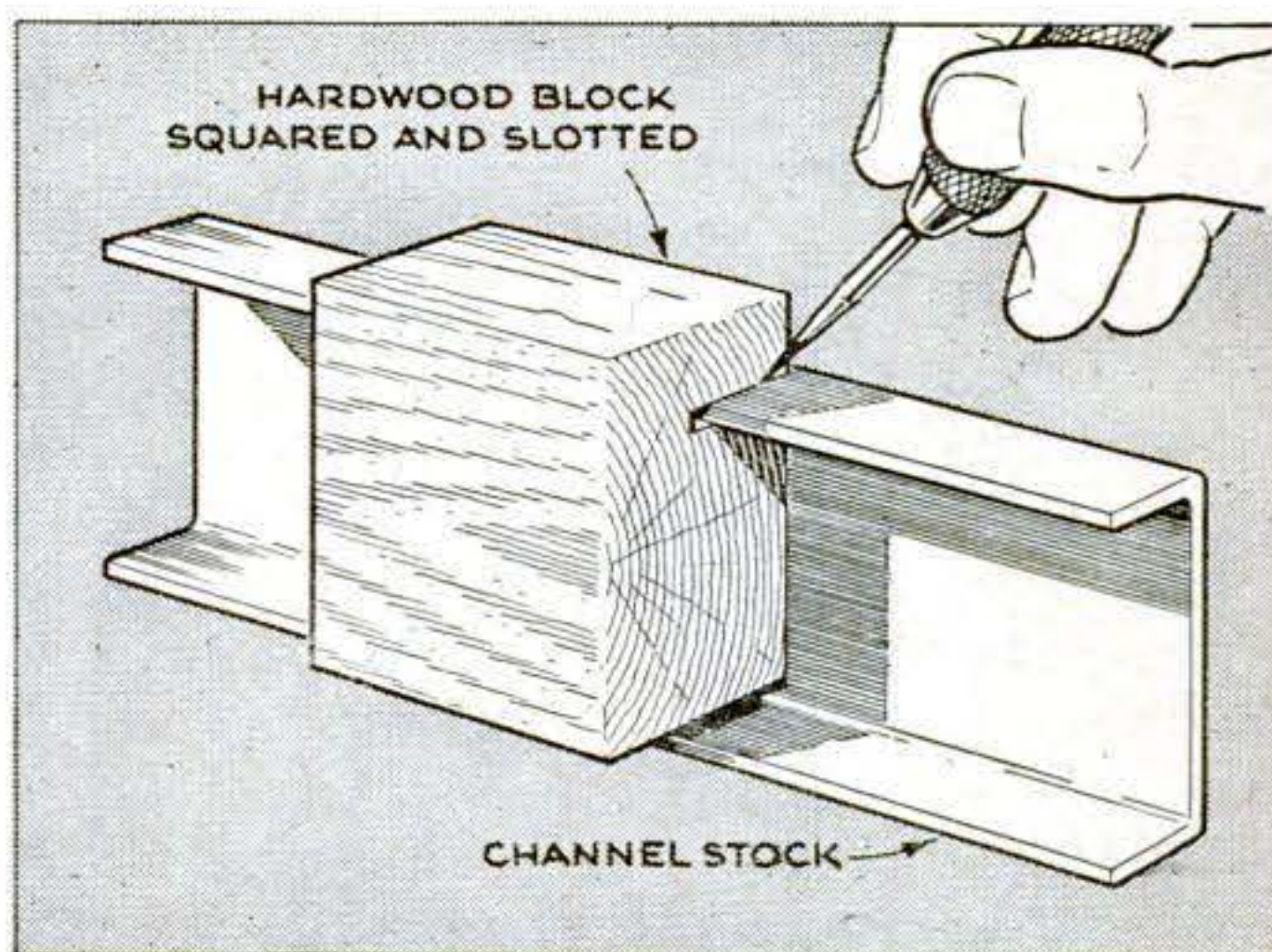


Putting Old Reamers to Work.

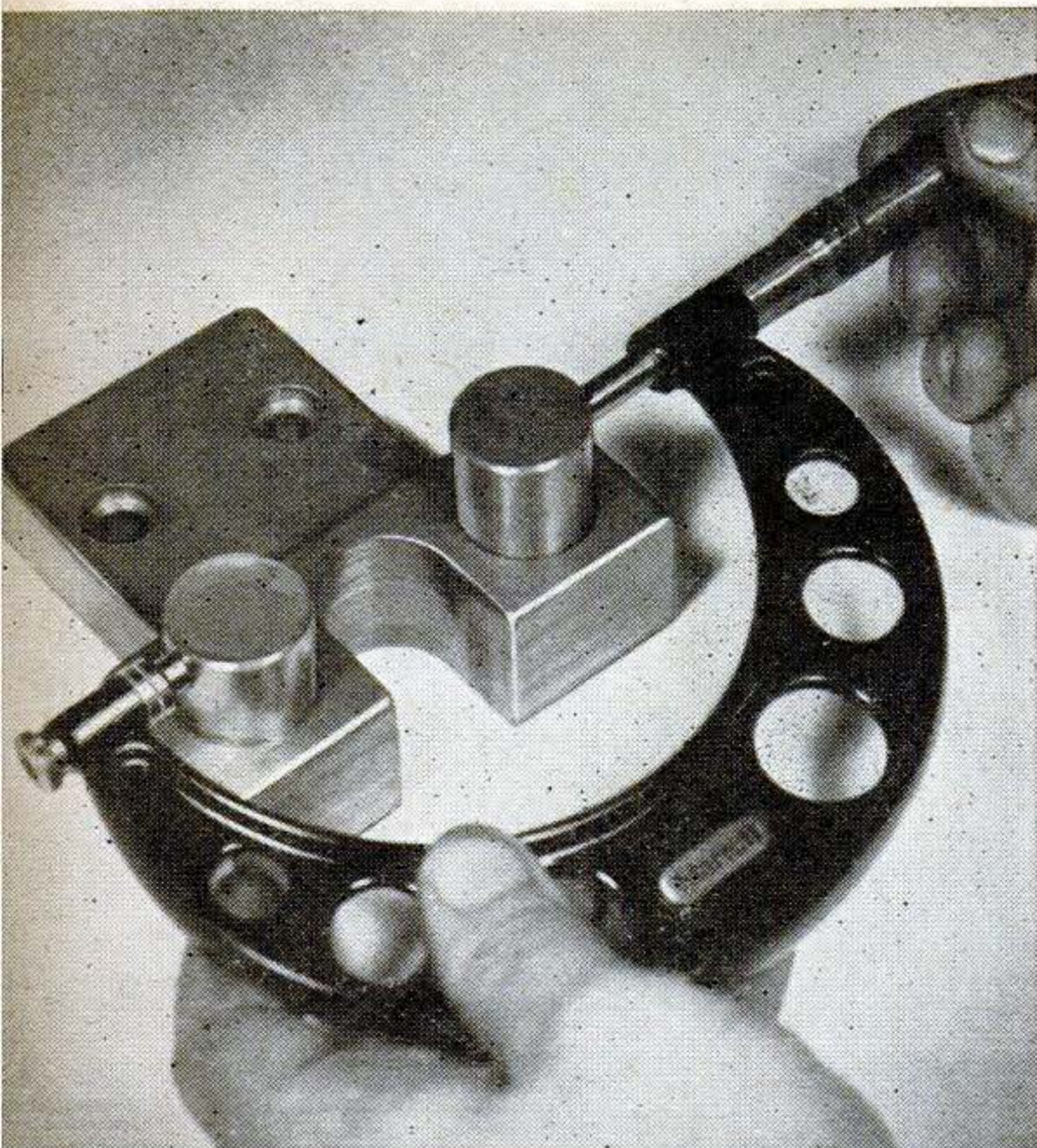
If you've ever tried to file a long strip of thin metal without producing the high and low spots that almost always show up in hand filing, you'll appreciate this use for worn-out spiral-flute reamers. The tool may be made of any reamer worn undersize, preferably one that is $\frac{3}{8}$ " or more in diameter. If a cut-off wheel is available, cut it to a length of about 3"—roughly half shank and half fluting.

To dress a strip of brass, aluminum, or other soft sheet metal, clamp a fence to the drill-press table so that the cutter will remove about $\frac{1}{32}$ ". With the reamer chucked short in the drill, feed the metal along the fence against rotation, using the lowest spindle speed. The finished piece will require only a touch of an abrasive cloth to remove the remaining tool marks. Work close to the chuck to minimize chatter, but vary the cutter position for extended runs.—HERBERT PFISTER.

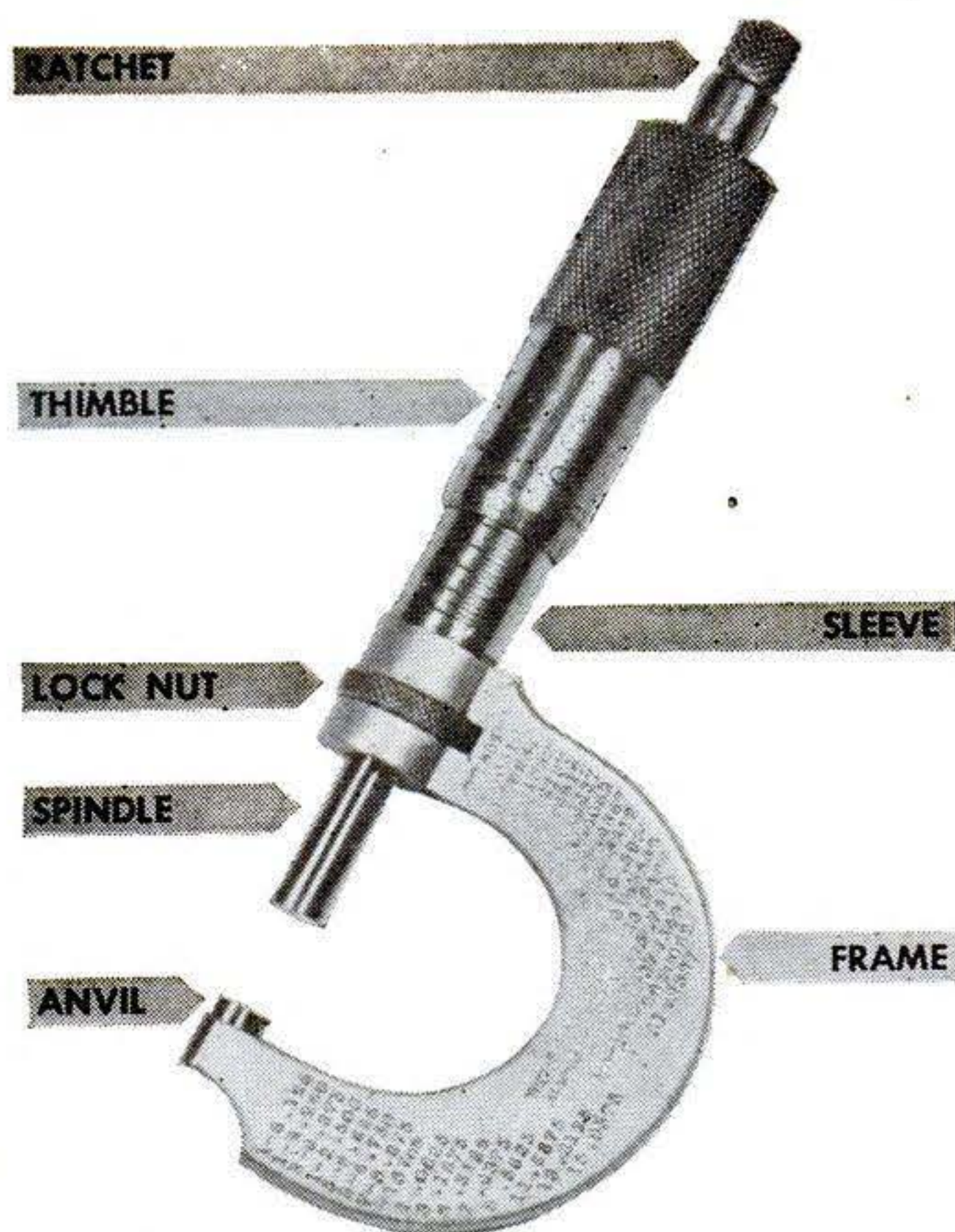
Cutting Oil. When you have pork for dinner, ask your wife to save the fat that drains off. This lard base is a top-notch lubricant for all metal-cutting operations. Reaming, threading, and cutting are made smoother, and require less power than with ordinary oils. The fat will harden, but just brush it on and let the friction of the operation melt it.—JOHN A. BLAKER.



Block Transfers Measurements. When carrying measurements from one surface to another, as, for example, around a piece of angle or channel stock, a block of wood will help you to transfer the lines quickly and with great accuracy. The block, made of hardwood, should be carefully squared and slotted. Make up one for each type of stock used.



Work measured on the bench. The left hand holds the micrometer, and the right turns the thimble.



A typical 1" micrometer with ratchet. Readings are taken from graduations on the sleeve and thimble.

Keep Your Micrometer on Its Toes

By J. C. Magee

QUITE accurate measurements, to plus or minus .0002", are possible with a standard micrometer if it is handled intelligently and treated with care. Being a precision instrument, a micrometer—or micrometer calipers, to use the full name—won't tolerate abuse. Even if you use yours only rarely, you'll find it worth while to exercise all the caution necessary to keep its accuracy unimpeachable.

Many makes are now equipped with a ratchet—essentially a tiny spring clutch—by which the thimble is turned against the work. This ratchet slips when the spindle is in contact, so that only optimum pressure, controlled by the ratchet spring, can be applied to the screw. Comparatively few experienced machinists use the ratchet, most preferring their developed sense of "feel."

If you use a micrometer only occasionally, you may prefer to stick to the ratchet nevertheless. So long as you are consistent, you'll

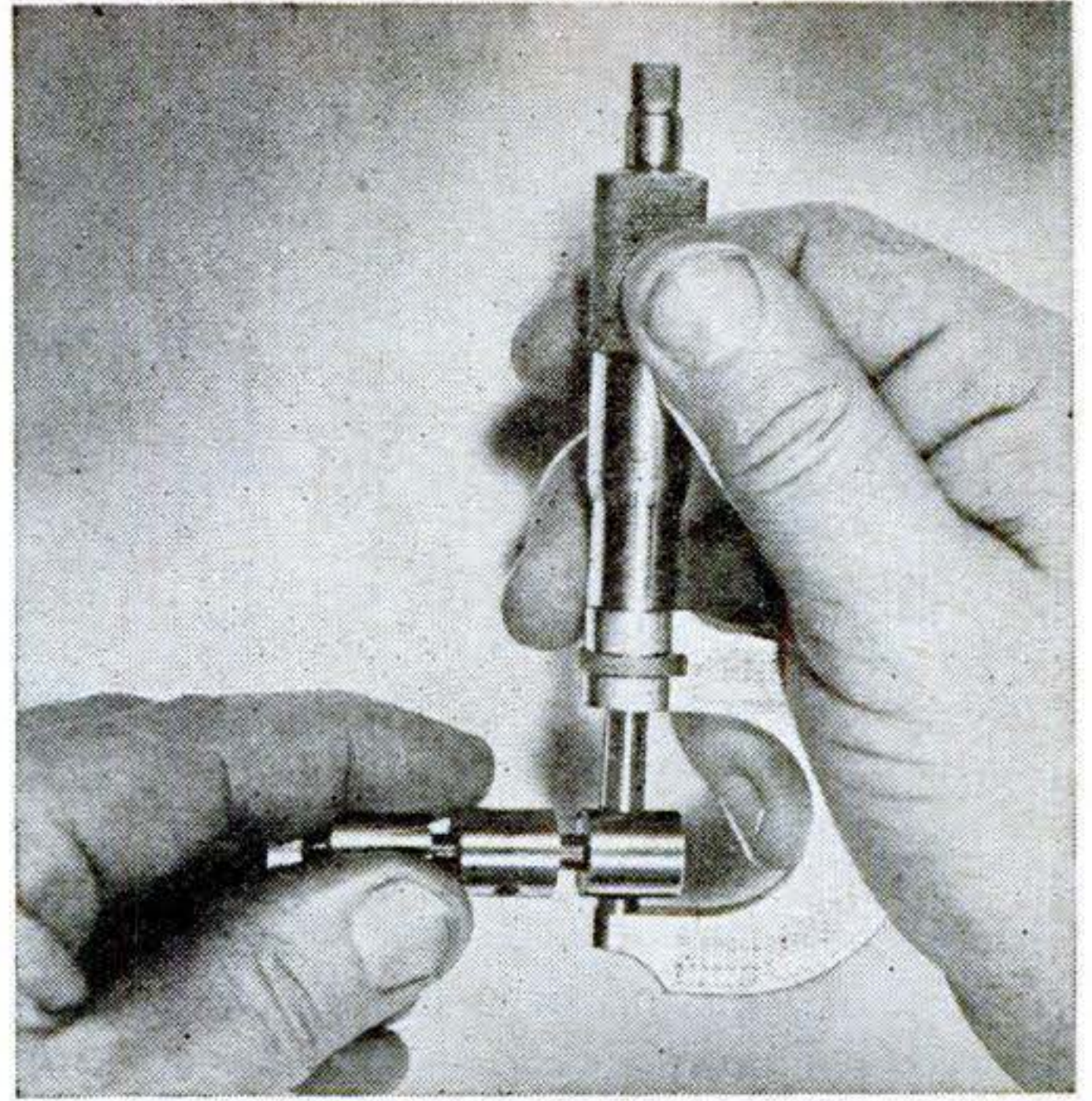
probably get accurate readings. It isn't wise, of course, to shift from ratchet to feel and back again, especially when measuring parts of the same assembly.

The old-timer's sense of feel can be attained only through practice, and naturally it remains reliable only through constant use. Probably the surest way to get the practice is by continued measuring of objects of standard size, such as accurate plug gauges, gauge blocks, or the check gauge usually furnished with the micrometer. Make each setting entirely by feel, without looking at the reading, and then check the results. If your readings are on the plus side, the pressure applied is too light; if on the minus side, it is too great. If they vary from plus to minus, more practice is indicated. Consistently correct ones will mean you've mastered micrometer feel. It's always vital, of course, that the micrometer frame be held at right angles to the surfaces in contact with anvil and spindle.

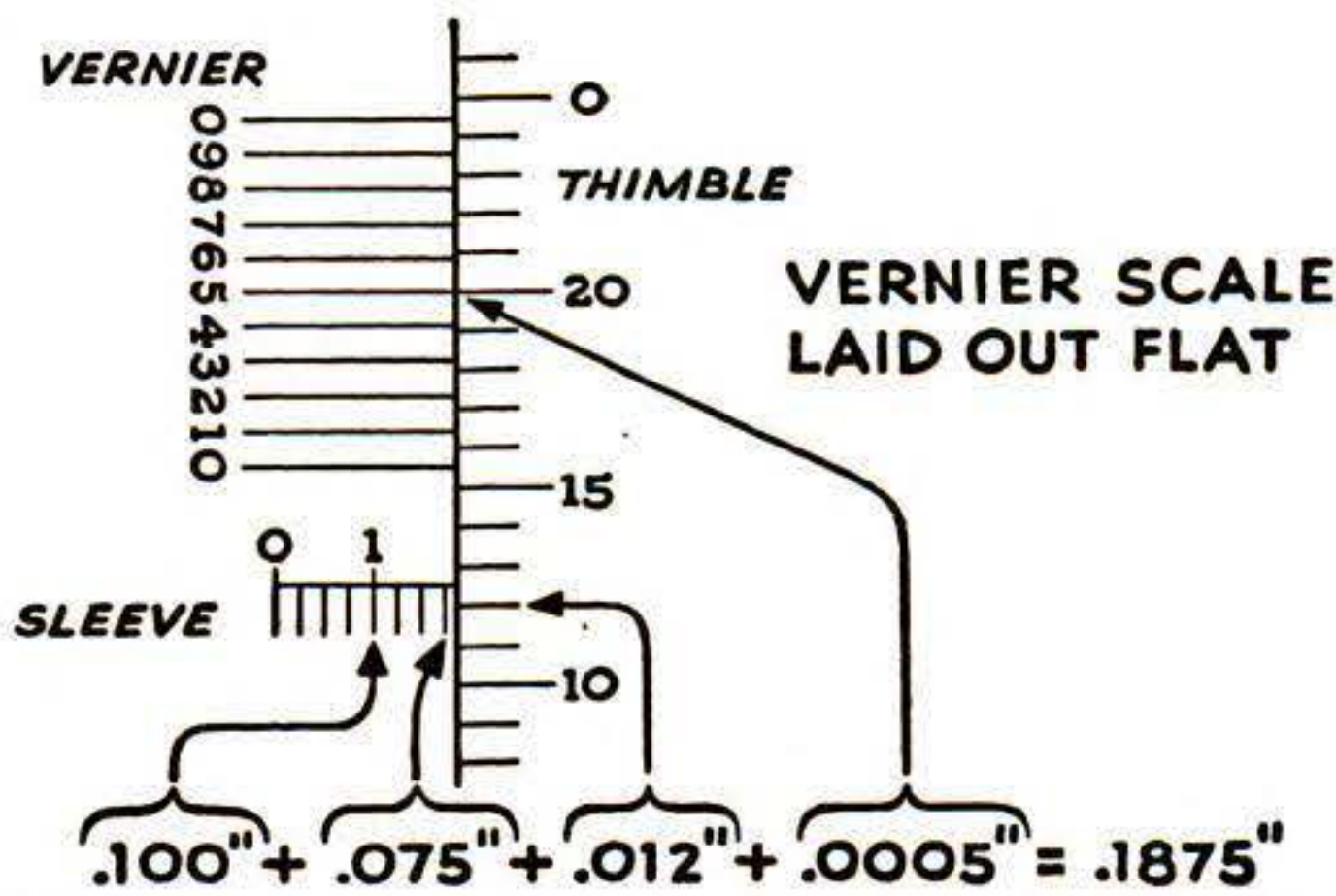
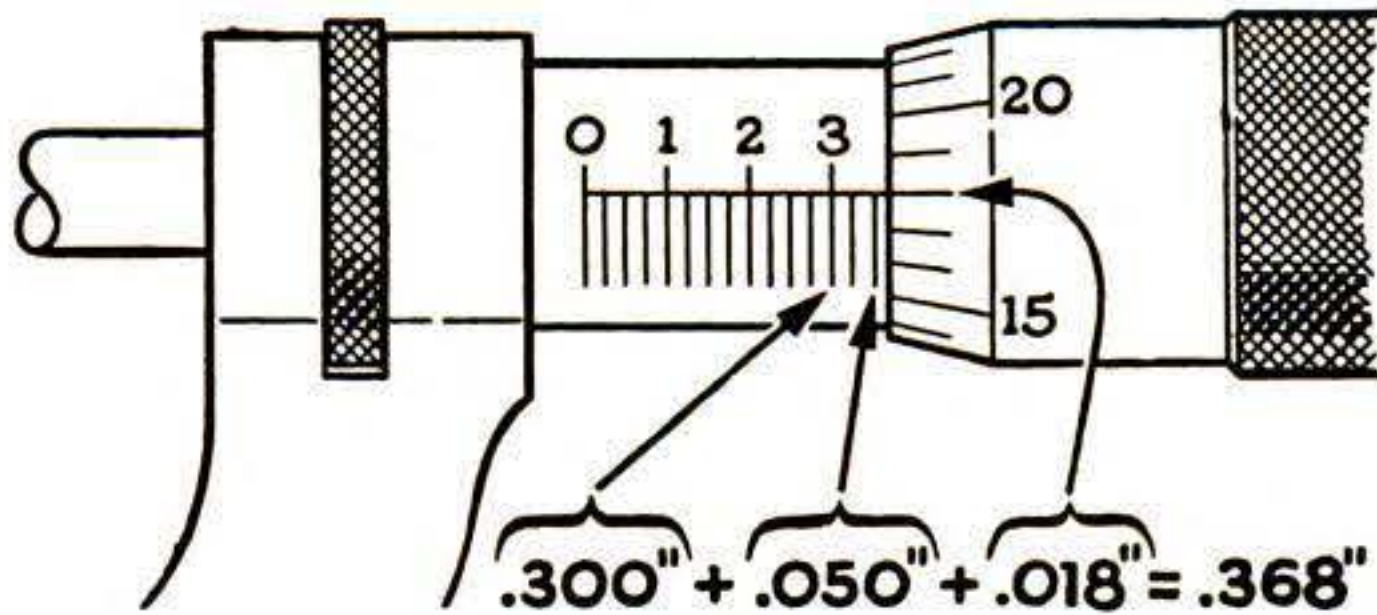
The micrometer should, of course, be set



To adjust for accurate readings, the spindle is touched to the anvil and the sleeve turned by a spanner wrench until the zero lines match.

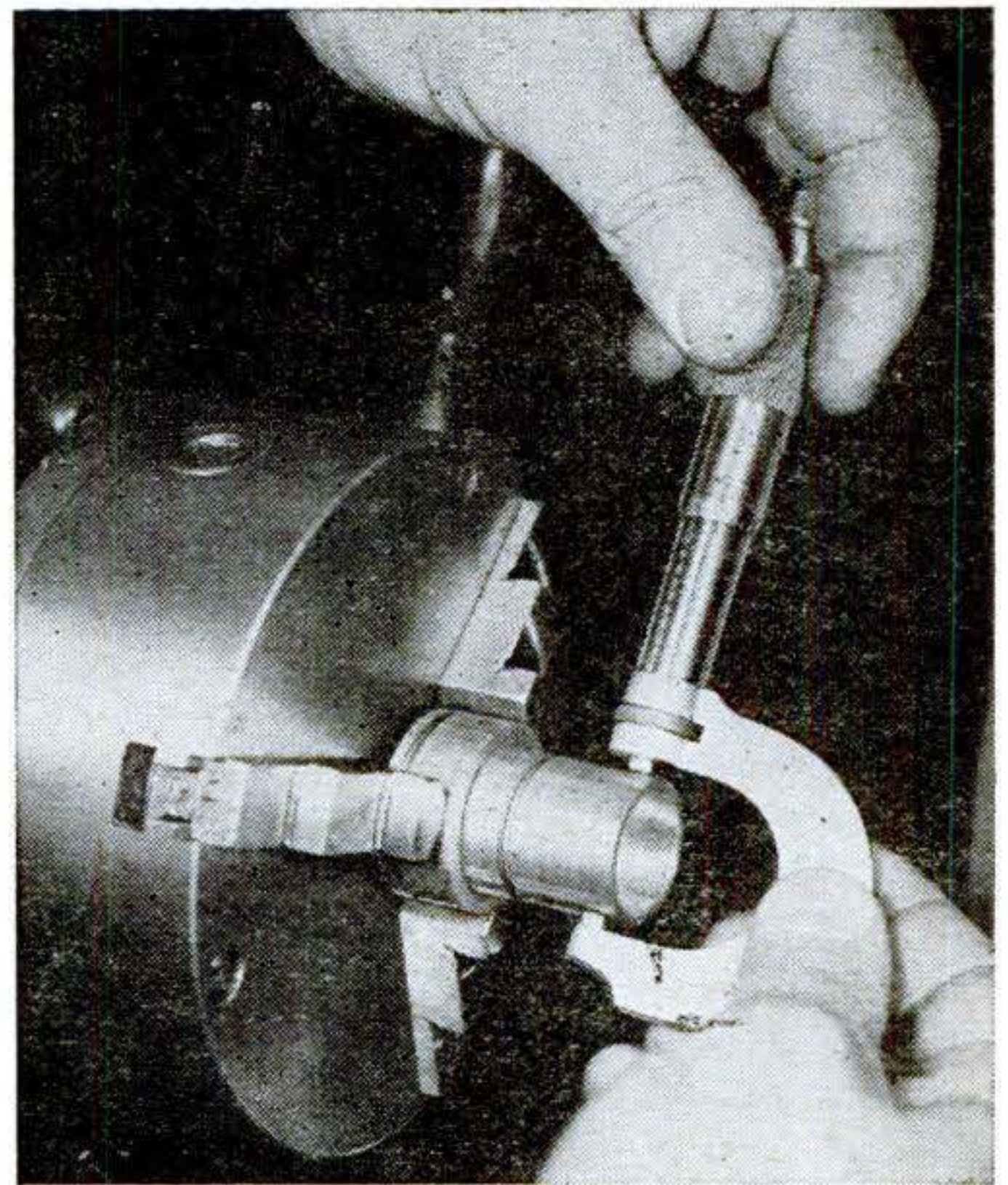


Small work is held in the left hand when possible and the micrometer in the right. Press the frame against the palm while setting the spindle.



How to read a mike. Experienced users mentally divide thimble markings to read between as close as .0002". Vernier scales (below) do it for you.

accurately at zero; that is, when the spindle touches the anvil a zero reading should be indicated. Adjustment varies somewhat, but on most micrometers it is done with a small spanner wrench furnished with the instrument. Clean all dirt from the measuring faces and bring them together carefully with the same pressure used in measuring work; then insert the wrench in the small



Measuring lathework. The micrometer is held in the right hand and the thimble turned by the left. Of course the lathe must be fully stopped.

hole in the sleeve and turn the sleeve until the zero lines on it and the thimble match exactly. To check the result, close the spindle by feel a few times.

A compensating nut on the end of the sleeve can also be adjusted with this spanner wrench to take up wear in the micrometer thread, but extreme care must be used to avoid damage. Turn the nut just enough

to remove all play and still maintain a smooth running fit in the spindle. The thimble must be taken off before the adjustment is made.

Small work should be held in one hand and the micrometer in the other with the frame pressed to the palm by the third finger, as in a photograph. Round work should be measured squarely across a diameter and in several places. After one reading, rotate it slowly with the micrometer slightly open, and close again for the next reading. Hold the micrometer square to the axis.

On lathework, leave the micrometer in place while the reading is being made, to eliminate all possibility of the spindle slipping. The frame is held in the right hand and the thimble turned with the thumb and first two fingers of the left. Never hold the micrometer close to the work while the lathe is coasting to a stop.

The lock nut, for locking the spindle at a given reading, should be used cautiously. Occasionally it comes in handy, but long-continued use at one setting wears the anvil and spindle unevenly. For production repeat work, fixed gauges are preferable. However, if your micrometer anvil and spindle surfaces do wear, you can return the instrument to the manufacturer for repair. If you feel equal to doing the job yourself, a micrometer lapping kit can be purchased that will include instructions.

If treated with care, your micrometer will give accurate service for years. Wipe it occasionally with a clean, oily rag to prevent rusting from perspiration. If you carry it in coveralls or a shop apron, keep it in a swing pocket so it won't fall on the floor when you bend over. It will pay to keep the instrument in a clean felt-lined box

when not in use rather than let it lie around on the bench with tools.

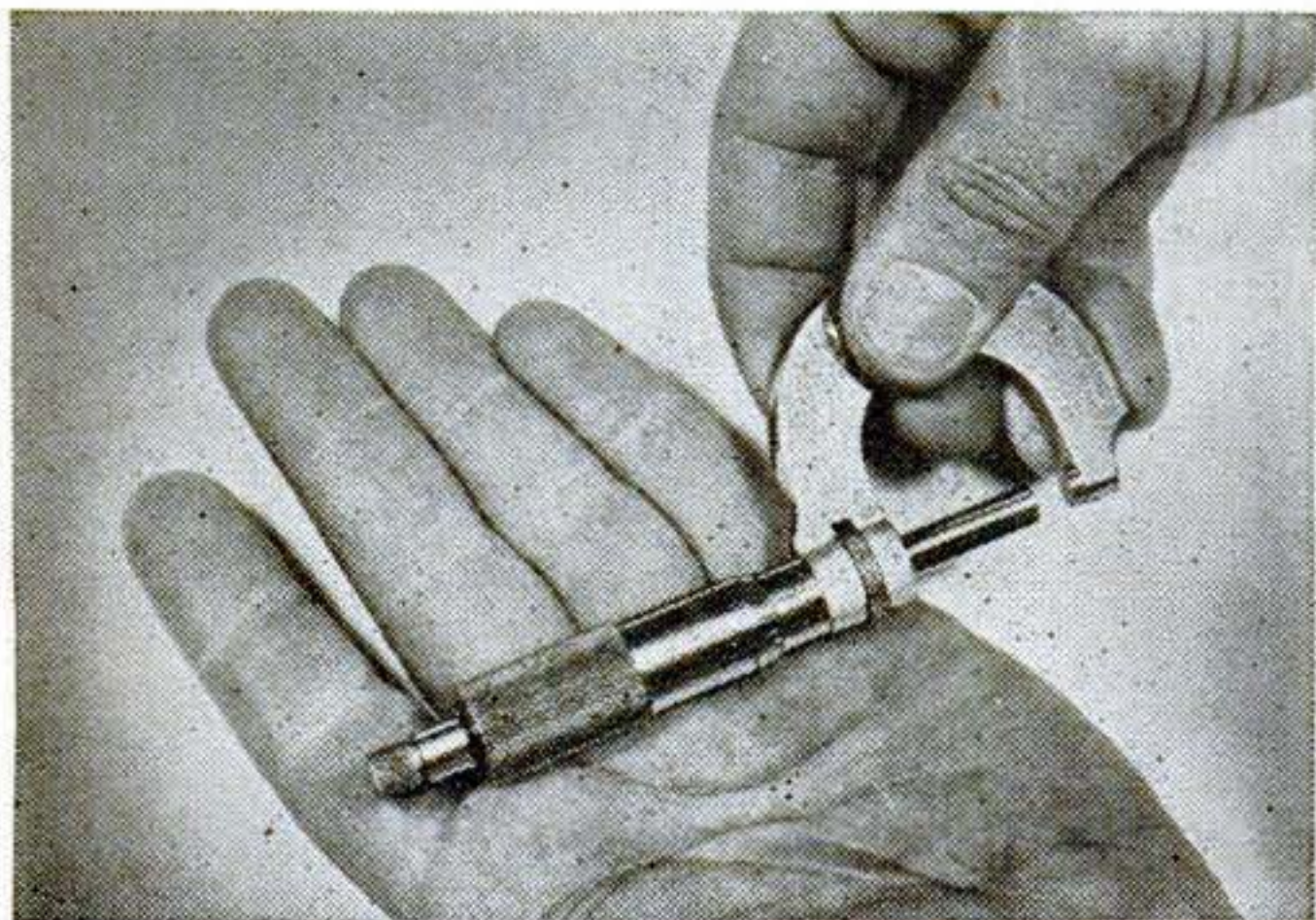
When you are in a hurry, don't hold your micrometer by the thimble and swing the frame around to open or close it. The thimble can be quickly turned by running it across the palm of one hand, which also gives it support. Never jam the spindle against the anvil or the work. When the micrometer is put away leave at least $\frac{1}{8}$ " opening between the anvil and spindle.

If you want to mark your micrometer for identification, it's best to have your name engraved or written with an electric pencil. Stamping it on the frame may cause distortion.

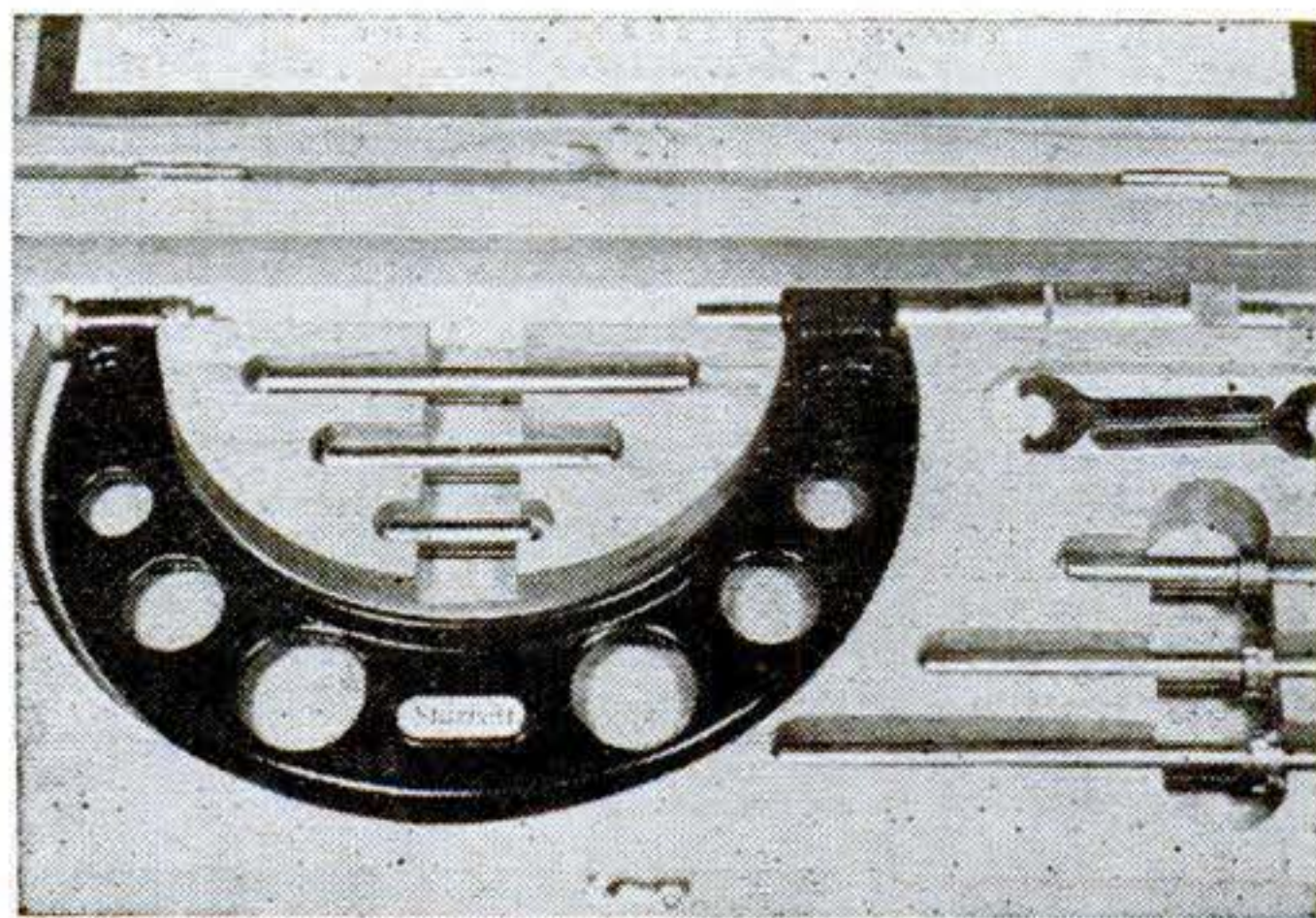
Micrometers come in standard sizes designated by the largest opening, such as 1" 2", 3", and so on. Usually only the last inch is measured in thousandths. A combination micrometer with interchangeable anvils is shown at right below. It will measure from zero to 4".

Learning to read a micrometer is fairly simple. The screw has 40 threads to the inch, so one revolution moves the spindle $\frac{1}{40}$ " or .025". On the sleeve there are 40 divisions, each representing one turn of the spindle, or .025". Every fourth division is marked, meaning .100", .200", .300", and so on. The thimble has 25 divisions, each a twenty-fifth of a revolution, or .001". In addition, it is possible to interpolate between marks on the thimble to obtain readings in ten thousandths.

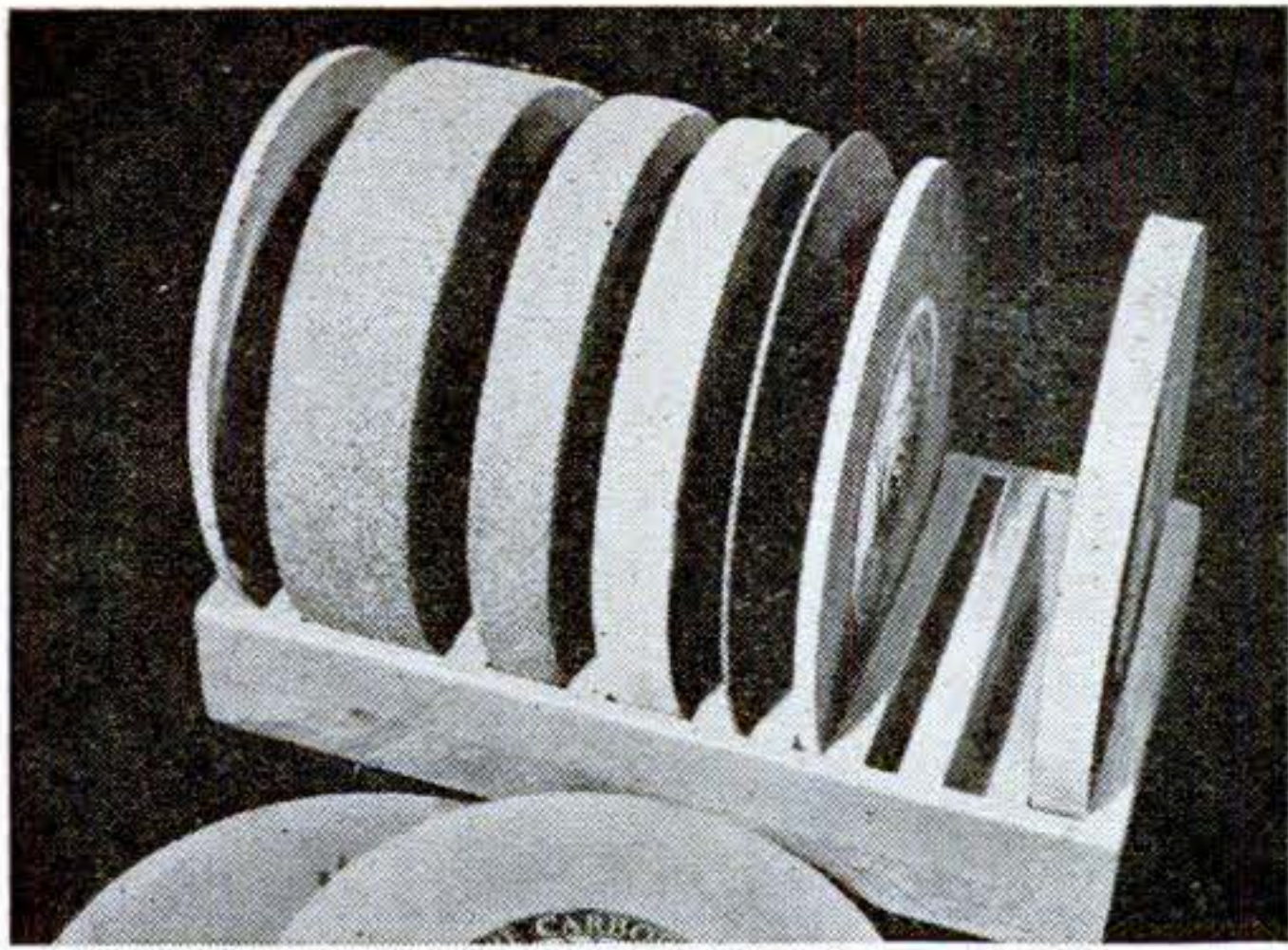
Some micrometers also have a vernier scale. When no graduations on the thimble line up with the line on the sleeve, the line on the vernier scale that coincides with any line on the thimble is read to take the measurement to the fourth decimal place. END



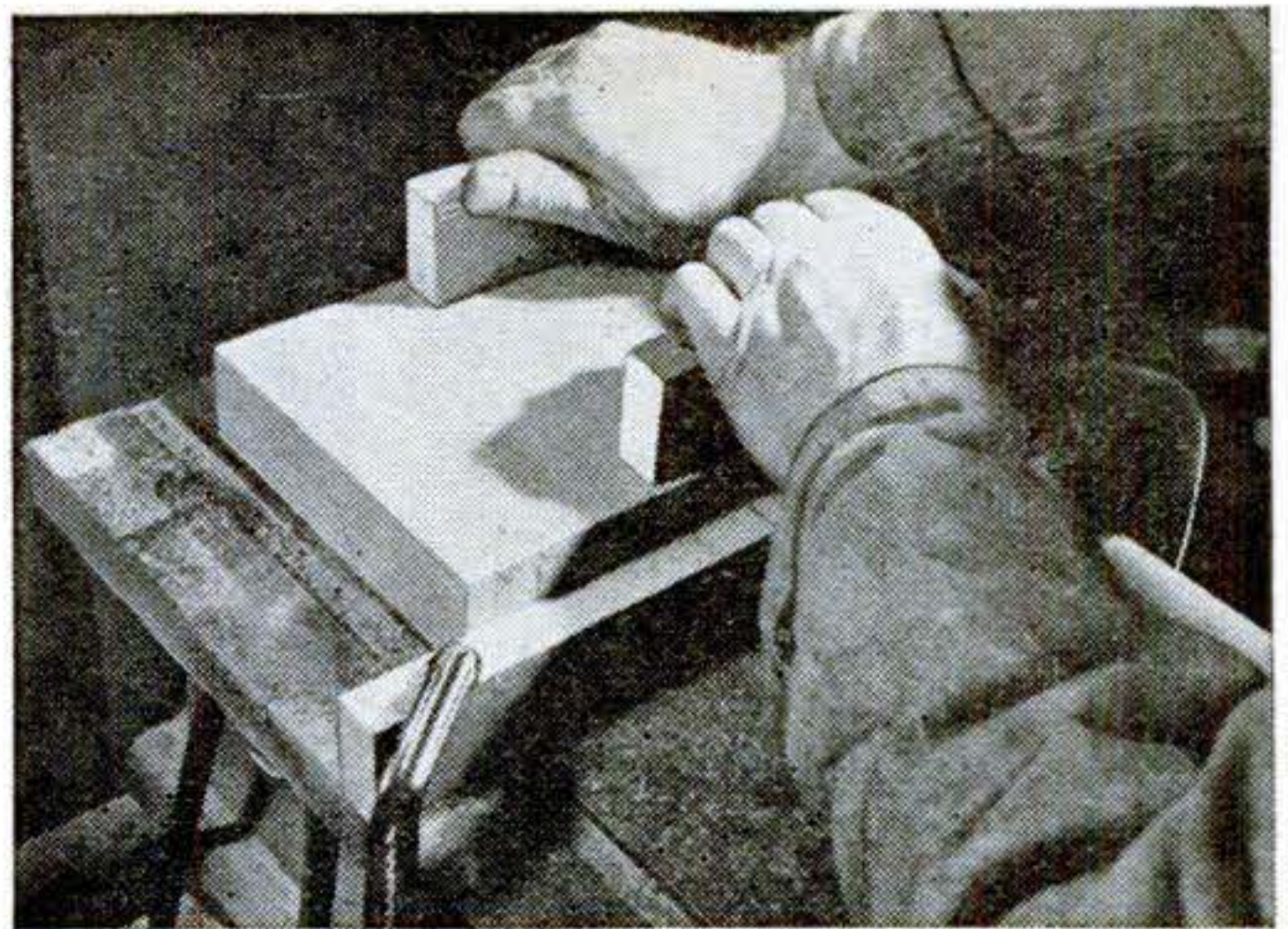
Rolling the thimble on the palm of the hand will open or close a micrometer quickly without danger of damaging the delicate threads.



Extra anvils for this 4" combination micrometer bring small work up to the spindle. Only the last inch of any measurement is read in thousandths.



Wheels of various widths are held upright in the slots, with clearance between for grasping them.



The slots are cut quickly by lowering the block onto the saw by means of two temporary handles.

Grinding-Wheel Rack Is Sawed from Solid Block

THIS concave-slotted stand for a set of grinding wheels can be made in part of an evening by a method as unusual as the project is practical. You will need a saw blade of the same diameter as your grinding wheels. Select a suitable hardwood block, or glue it up from two thicknesses, and square to the required dimensions, having the grain along the grooves to be cut.

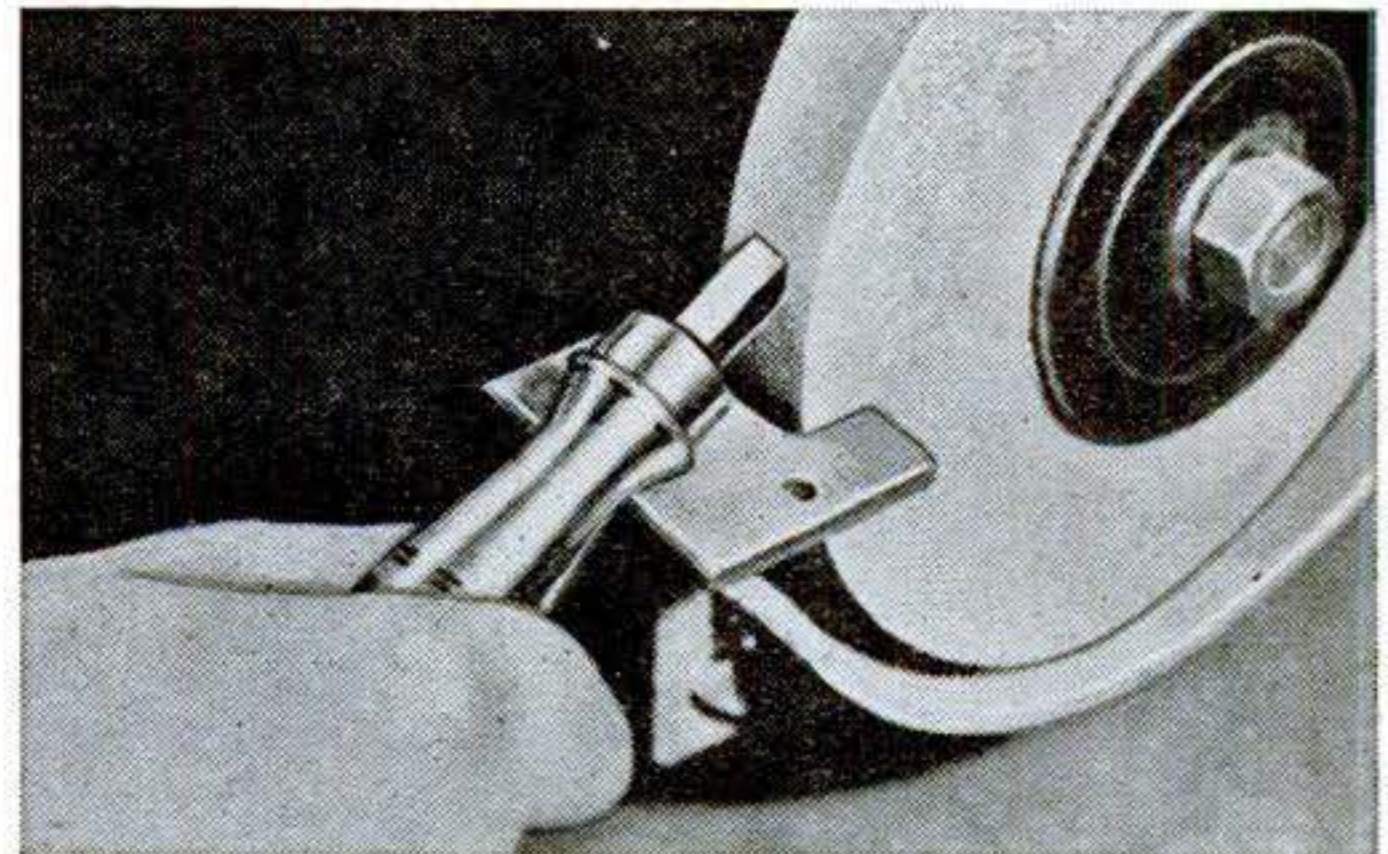
Lay out the slots on the end grain, leaving finger width between, and screw temporary

handles to the bottom at the end-grain edges. Clamp a fence to the table at right angles to the blade and $7/16$ " from the blade edge when the table is set for a $1\frac{1}{2}$ " cut. Lay a straightedge along the blade and mark the fence for blade width.

Now lower the block on the saw, using the layout lines as a guide. Make outside cuts first; then clear out between. Sand and finish. Add rubber feet at the corners to prevent slipping.—WILL THOMAS.



Grooves turned on the handle improve the grip. The same result can be obtained with a knurling tool.



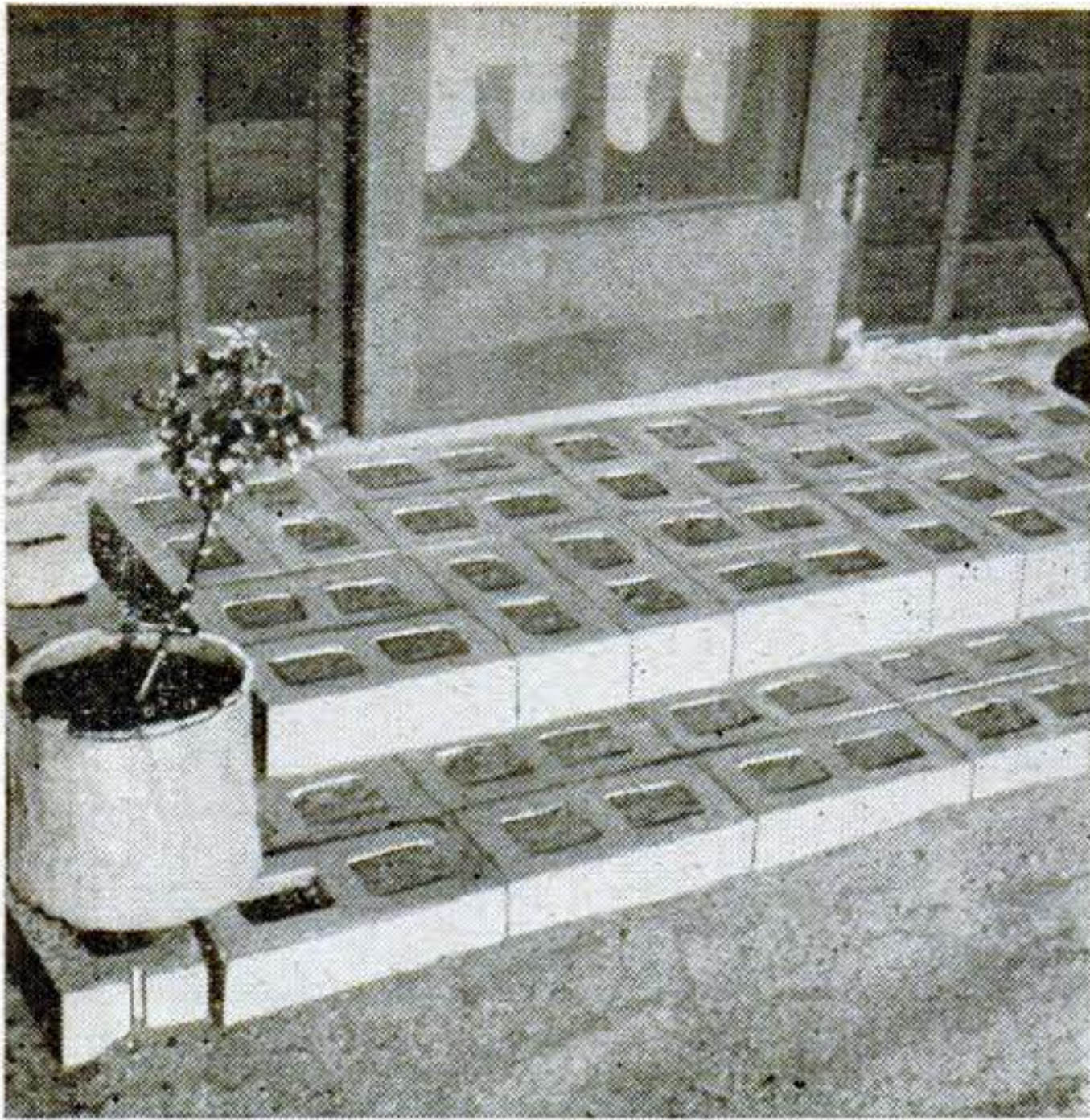
Supported on the rest, the holder steadies the bit and keeps the fingers safe from burns and scrapes.

Lathe-Bit Grinding Holder Protects Fingers

BITS used in a lathe tool holder are often awkward to sharpen on a grinding wheel when their shanks become short. However, with a handle turned from scrap brass or steel, they can be ground easily and more accurately, and at the same time the fingers will be at a safe distance.

The holder shown was turned to $\frac{3}{4}$ " at its greatest diameter and cut off at a length of $4\frac{1}{4}$ ", but the dimensions should suit the hand of the user. After shaping, a square hole was

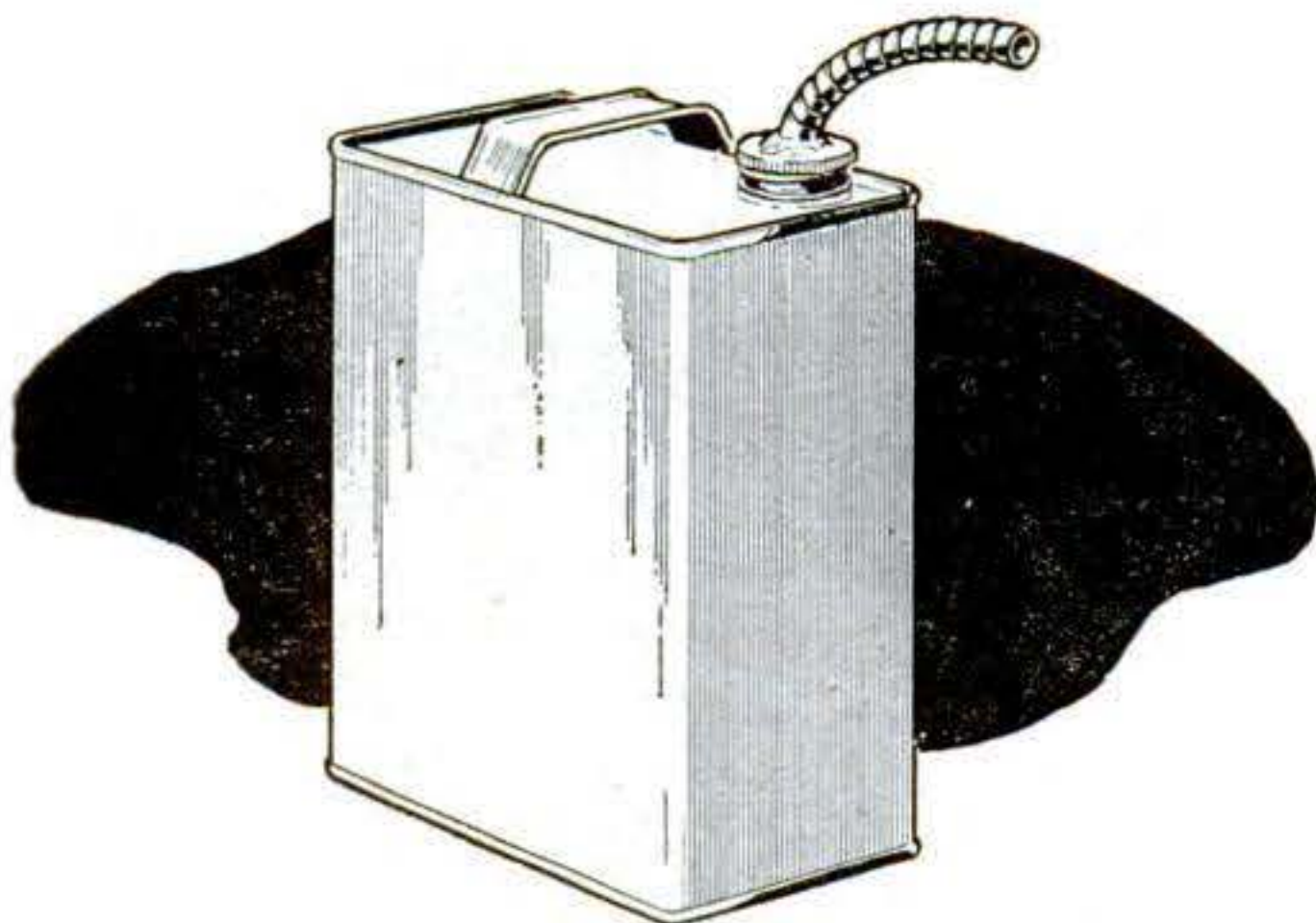
put in the end to take the bits. Since a set-screw will hold the bits, a round hole will suffice, but a square one is much neater and is easy to make, especially in brass. A simple method is to scribe a $\frac{1}{4}$ " square on the tool end and centerpunch it at the corners and middle. The corners are first drilled to required depth with a $1/16$ " or other small drill, and then the center is drilled $\frac{1}{4}$ " to the same depth. Squaring with a small file completes the job.



Hollow Tiles Make Doorsteps

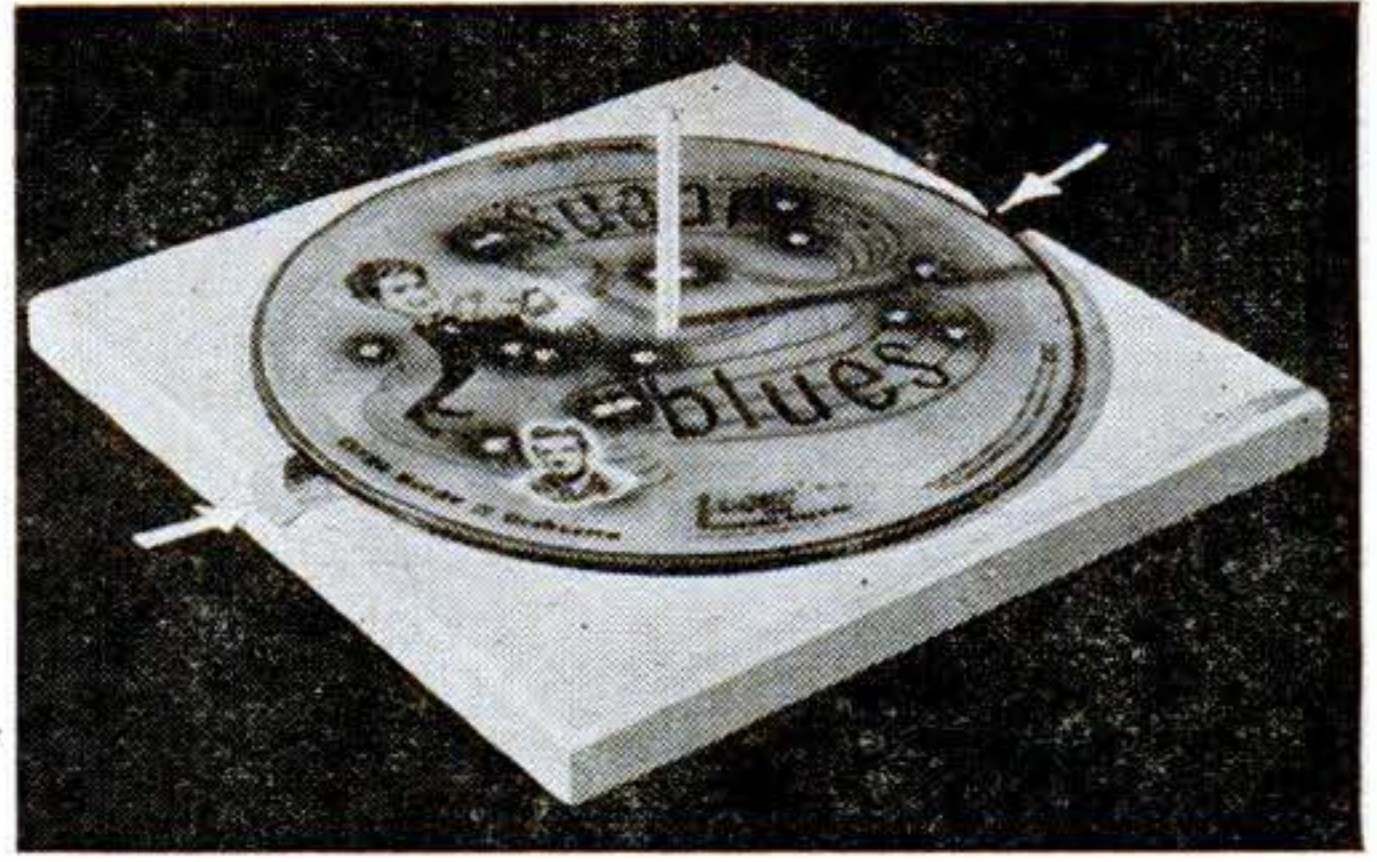
FILLED with cement to which dry color has been added, hollow tiles can be used for mosaic-type doorsteps and even terraces. Lay the tiles just as you would bricks or stones, placing the hole ends up and applying mortar between to provide firmness. Then fill with the colored cement, using either all one color or two or more colors in a definite design arrangement.

Various colors for cement can be obtained as dry powders. Mix in with the dry cement before adding water.—BOB DOWNER.



BX Shield Forms Can Spout

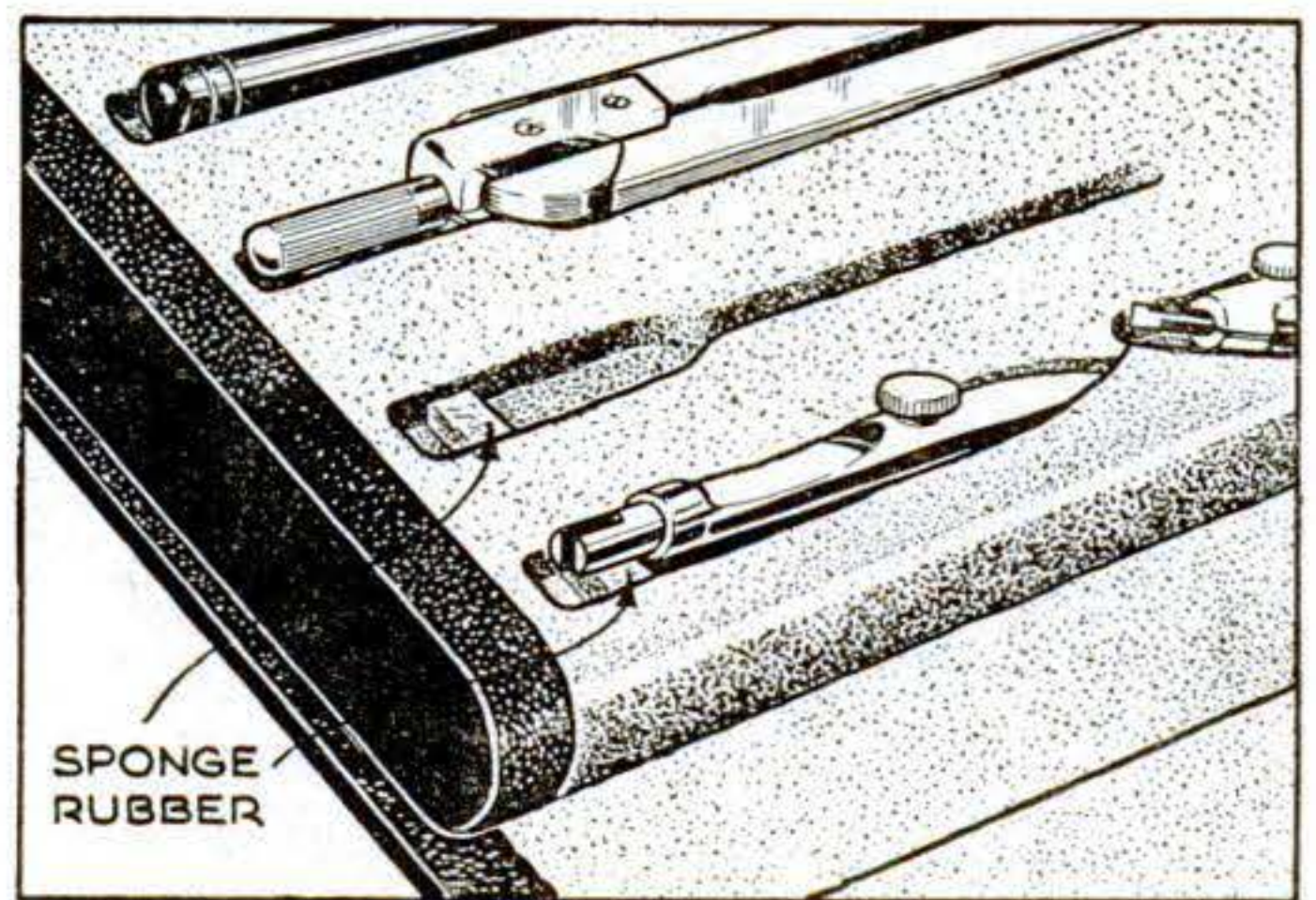
CONTAINERS, such as 1-gal. cans, are sometimes more convenient to use if equipped with a flexible spout. A 9" or 12" length of the armor from BX cable is ideal for the purpose. Remove the cover from the can opening, cut a hole of the required size in it, and solder or braze the shielding in the hole.—DONALD REISER.



Holder Contains Complete Set of Records Used in Program

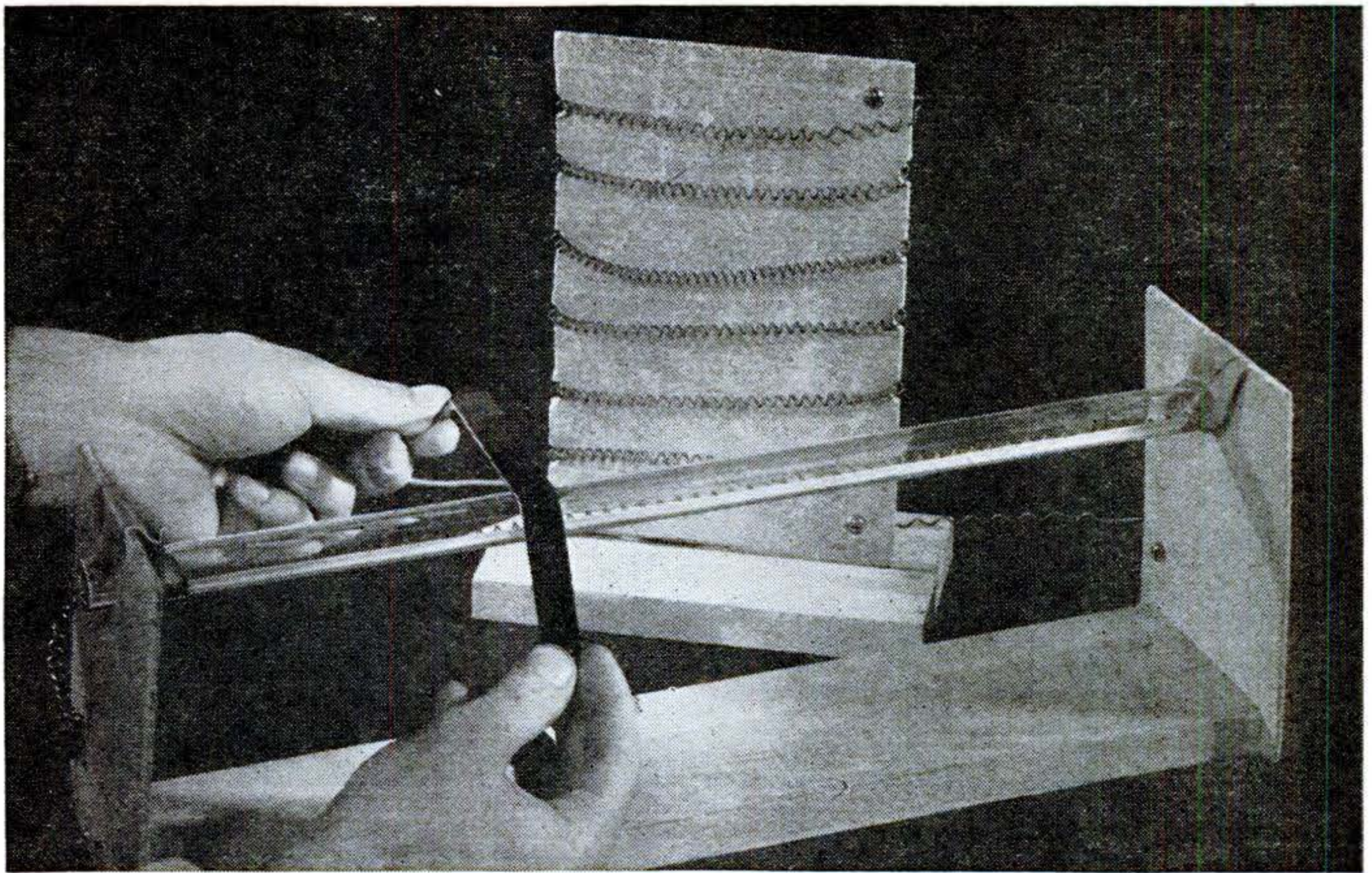
TIME can be saved when guests arrive to hear your latest records if the playing program is arranged beforehand. An ideal holder from which the records can be taken in the order they are to be played is merely a square board with a dowel inserted in the center. For a neat job, the edges of the board may be chamfered, and for an additional refinement, the board can be painted and felt glued on the bottom to protect the table surface on which it is set. The arrows show finger holes on two sides that permit you to take off a whole set of records at one time if they are to be transferred to an automatic record changer.

Glue in the dowel permanently, or leave it removable for storage of one or several of the holders.—LARRY MORRIS, JR.



Drawing Instruments Pop Up

SPONGE rubber glued into the individual instrument compartments will provide you with a handy pop-up carrying case. The handle of each drawing instrument will spring partly out of its depressed compartment as soon as the lid is raised, making removal possible without the necessity of prying with fingernails.—THOMAS TRAIL.

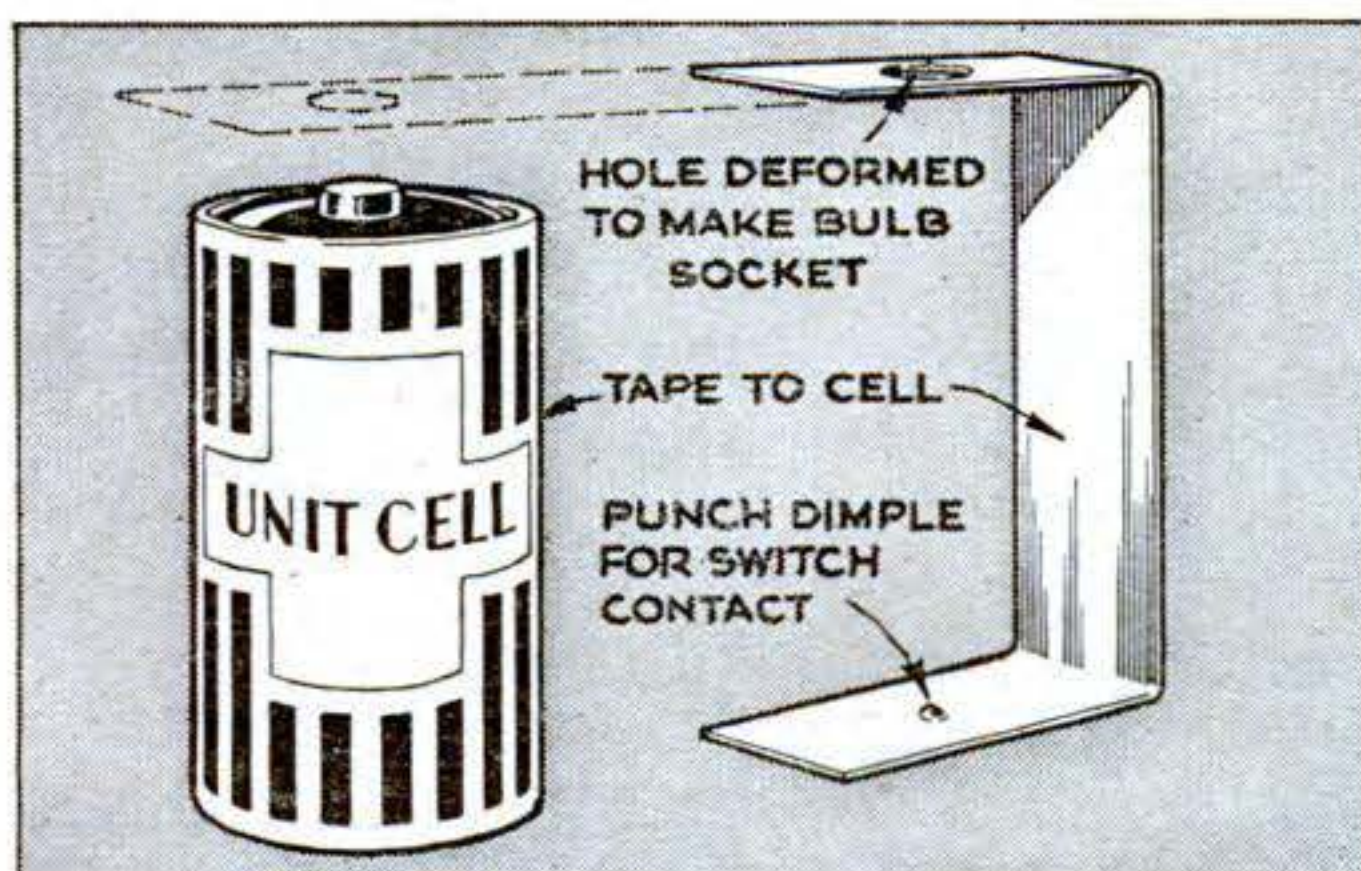


Spot Heater Makes Jig Unnecessary in Bending Plastic

WHEN heat is applied only to that part of a strip of plastic that is to be bent, forming jigs won't be necessary for many projects. This spot heater, operating on household current, is a heat-resistant glass tube, such as a boiler water gauge, through which is inserted a length of coiled nichrome wire. It is mounted in holes in two upright asbestos sheets. Additional wire, connected

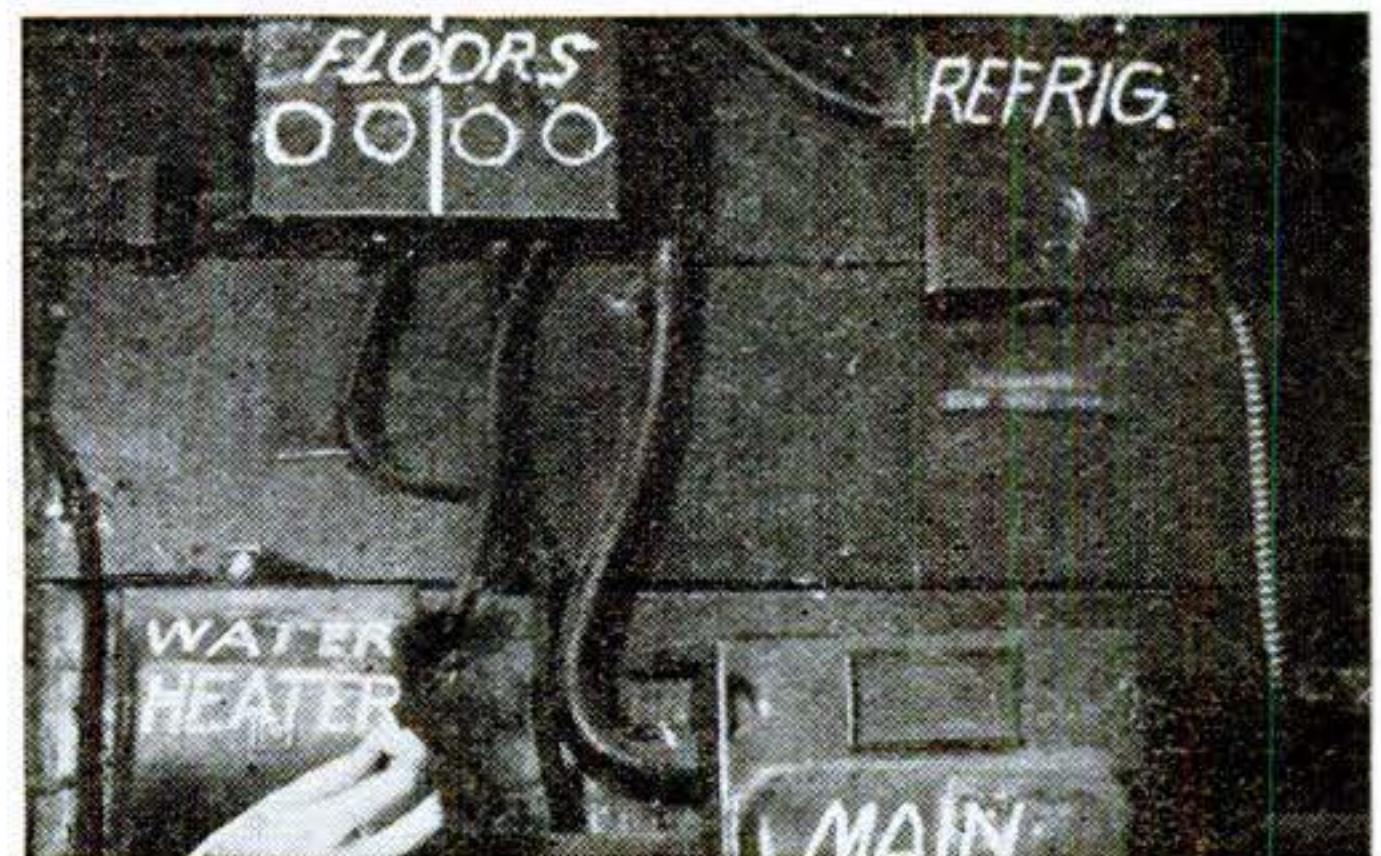
in series, is wrapped on a third asbestos board set in a grooved base. Stretch the coiled wire in the tube to reduce the heat, which should not cause the wire to glow. The best surface heat is 400 to 600 deg.

At 550 deg. 1/16" plastic can be softened for bending in 37 seconds. Plastic 1/4" or thicker should be heated first on one side and then the other.—ELI S. EISENHARD.



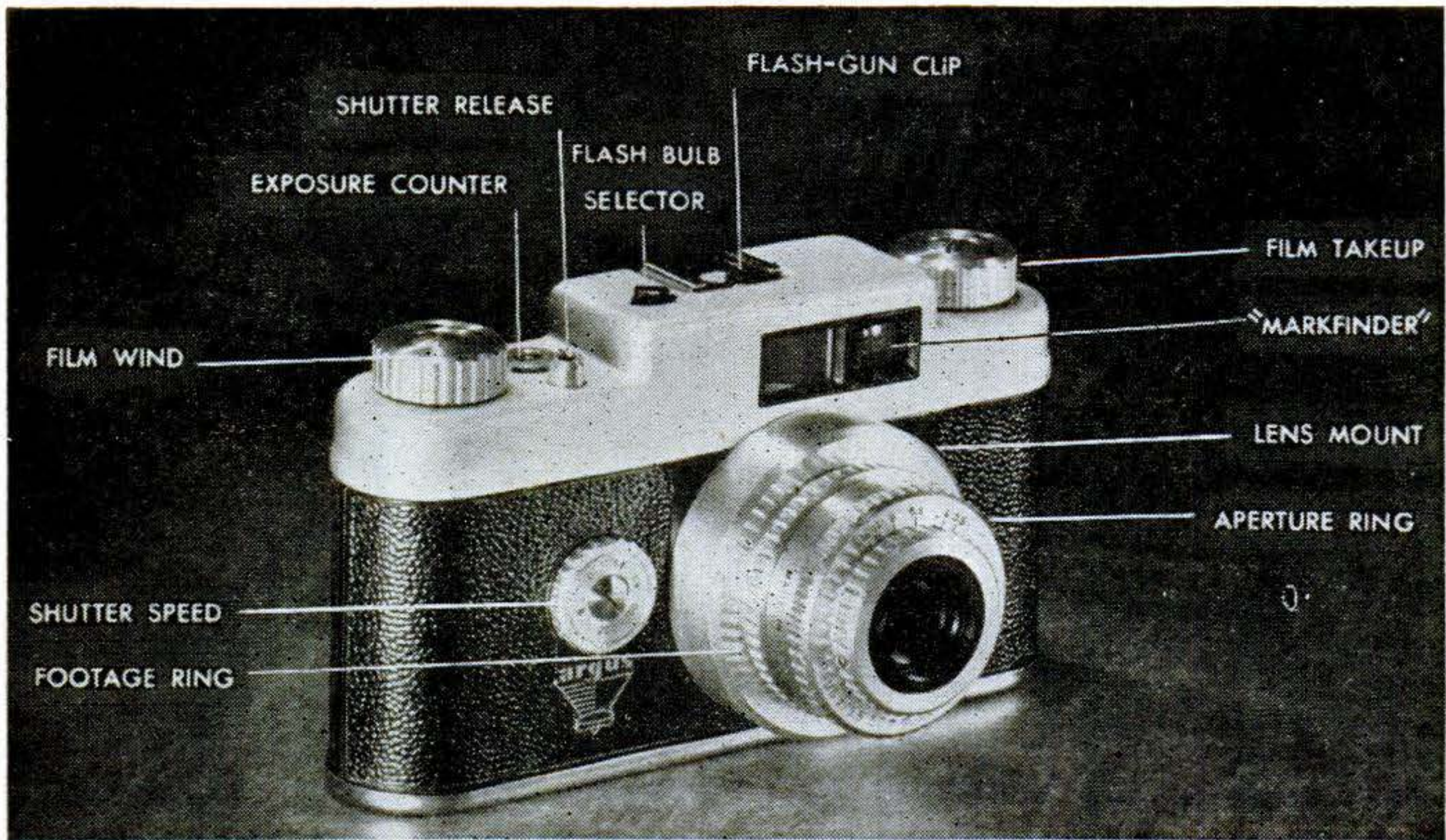
Bent Metal Forms Flashlight

OLD flashlight cells, too weak for regular duty, make handy emergency lamps or instructive toys for youngsters. Drill the hole for the bulb undersize and distort with pliers to form a threadlike socket. Tape the cell on to make contact with the bulb, and press the dimple or stand the cell on end to put on the light.—MILES KUCKUK.



Identifying Fuse Boxes

MARKING the fuse boxes in a home to identify the circuits they control will save a lot of time spent in hunting when a fuse blows. Ordinary white chalk serves, but white paint lasts longer. Check the circuits first by having someone note those affected as the fuses are unscrewed or switches in the boxes opened one by one.—H. LEEPER.



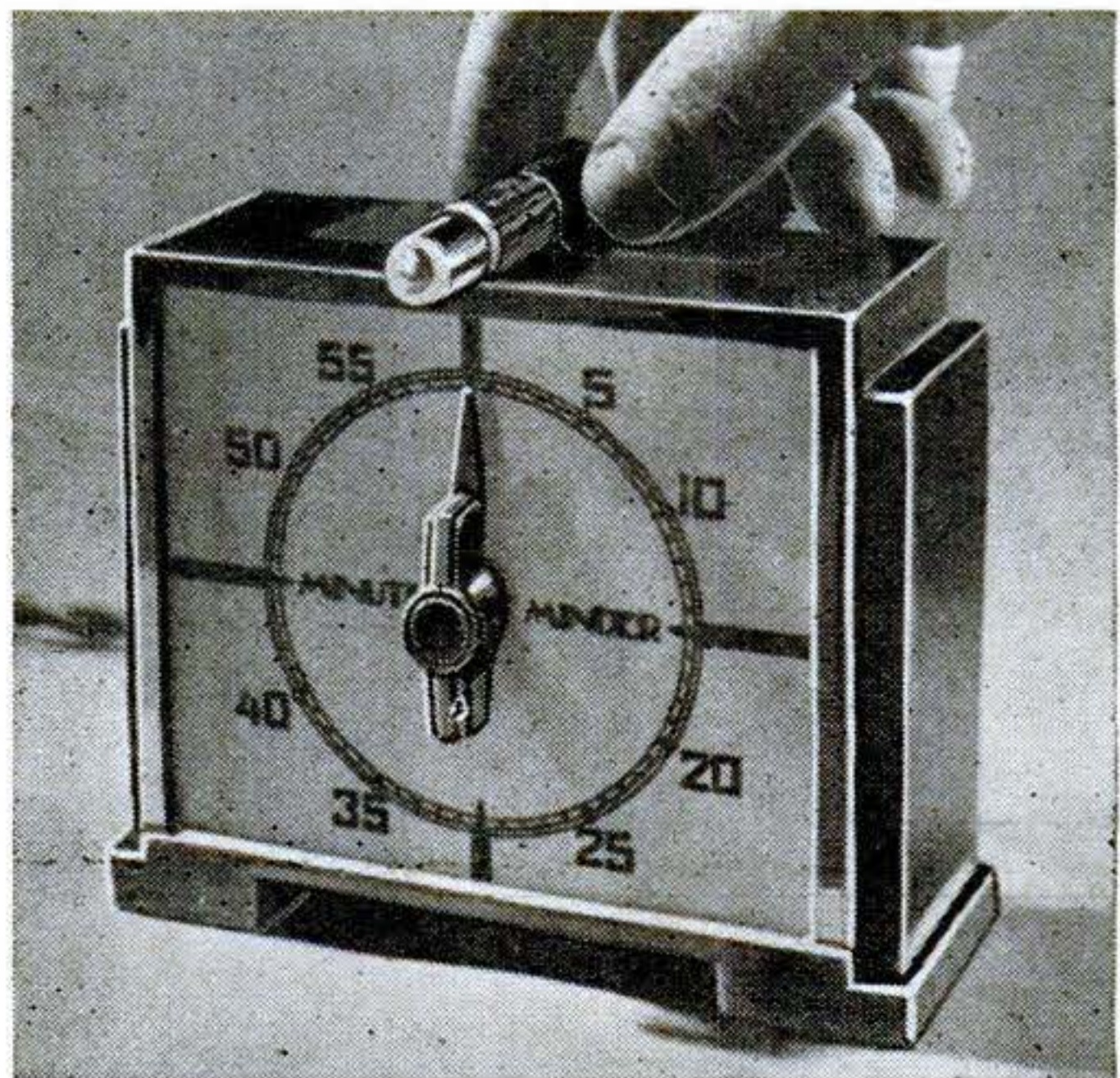
View Finder Marks Center.

Illuminated cross hairs, called by the maker a "markfinder," incorporate the principles of aircraft gunnery in the view finder of the new 35-mm. Argus. The device enables the photographer to spot the center of his picture immediately. It is particularly suitable

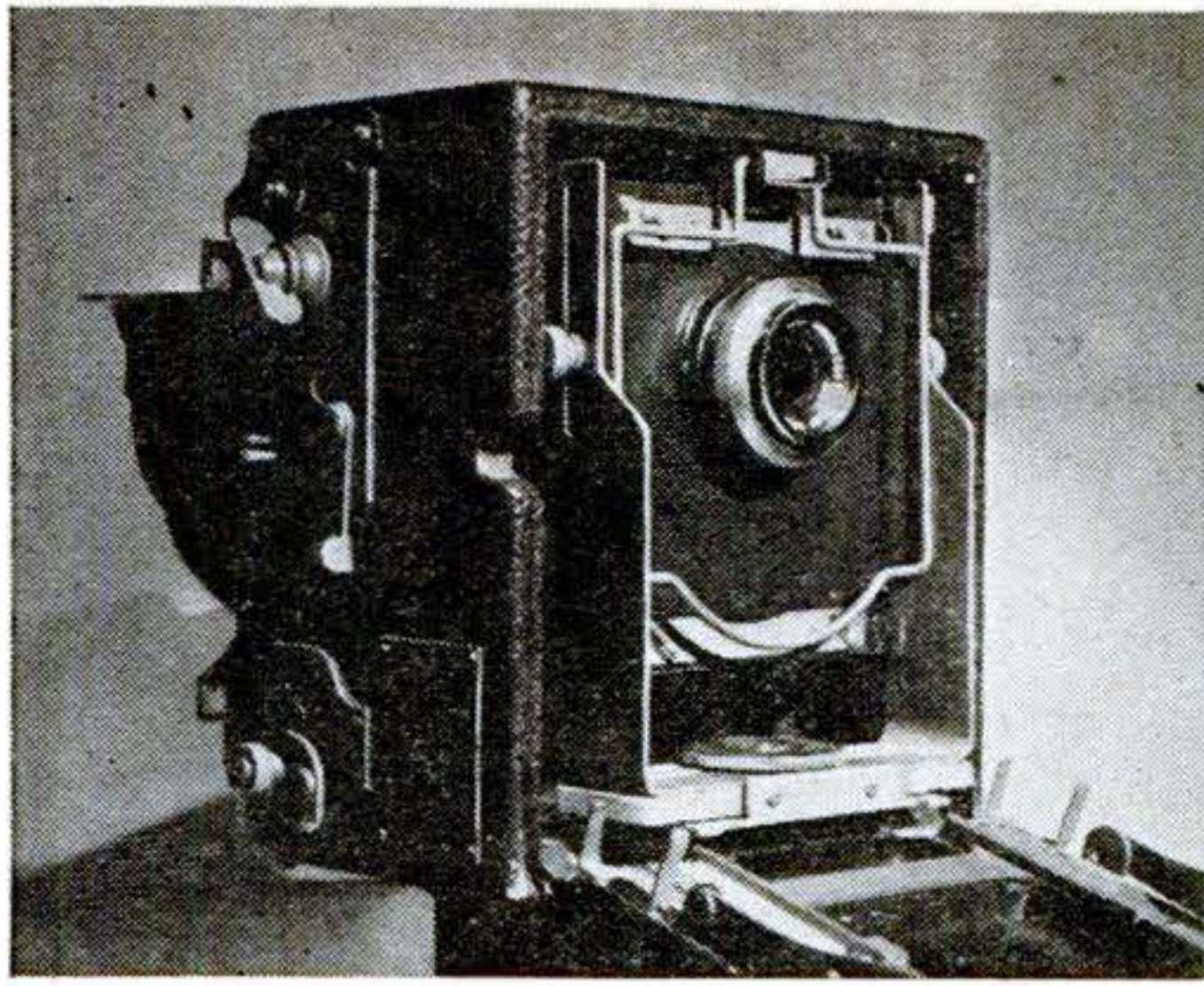
for action shots, where the cross marks can pick up and follow a moving object to help stop action. Three lenses, two mirrors, and a reticle plate are used in the finder. The camera has also a behind-the-lens shutter that permits removal of the lens without exposing the film.



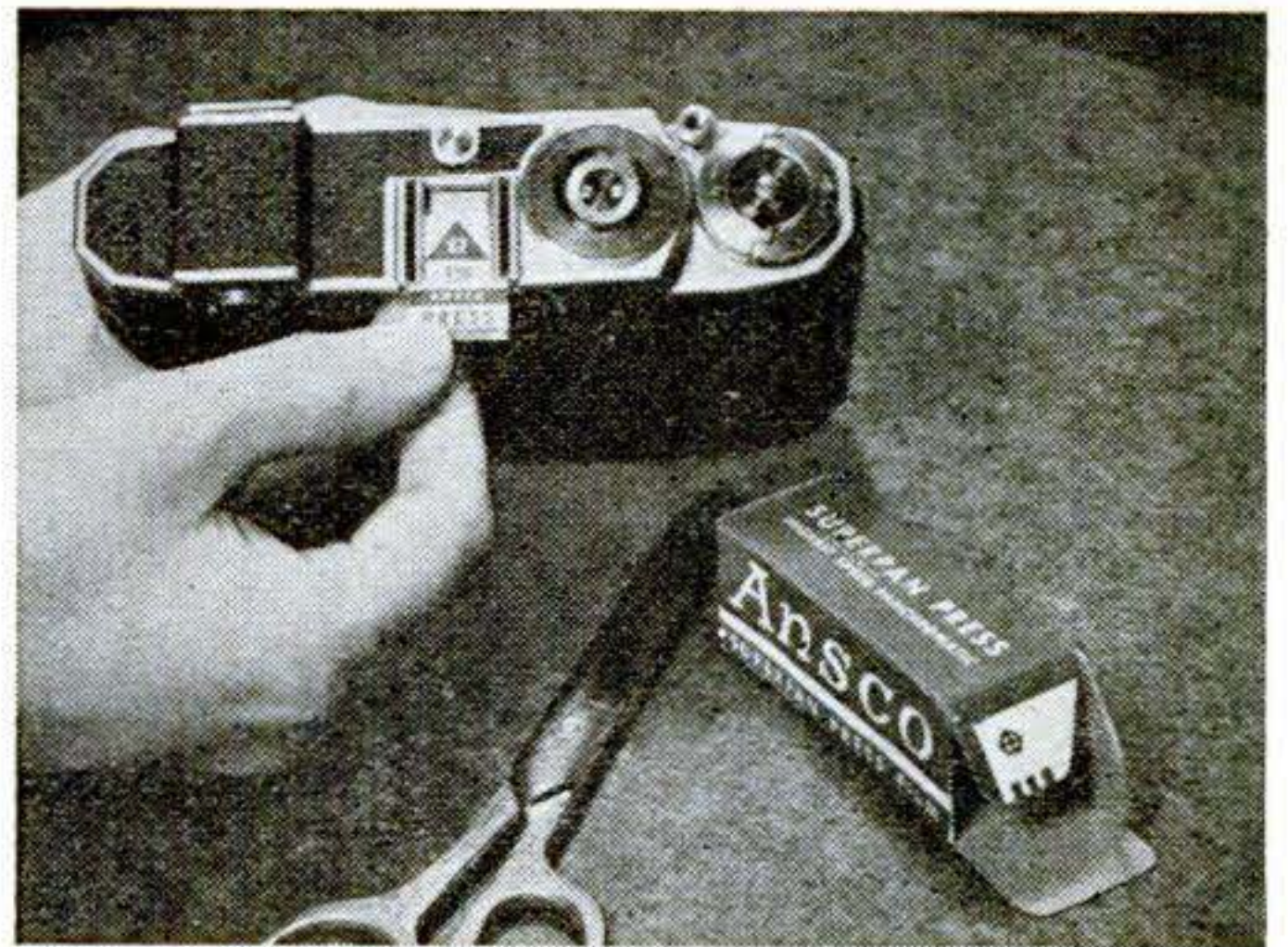
Three-in-One Photo Funnel. A novel plastic combination funnel made by Eastman for pouring liquids into either large- or small-mouth bottles is intended to be a timesaver in the darkroom lab. The funnel is in two sections that can be used separately or fitted together with the spout of one in the bowl of the other.



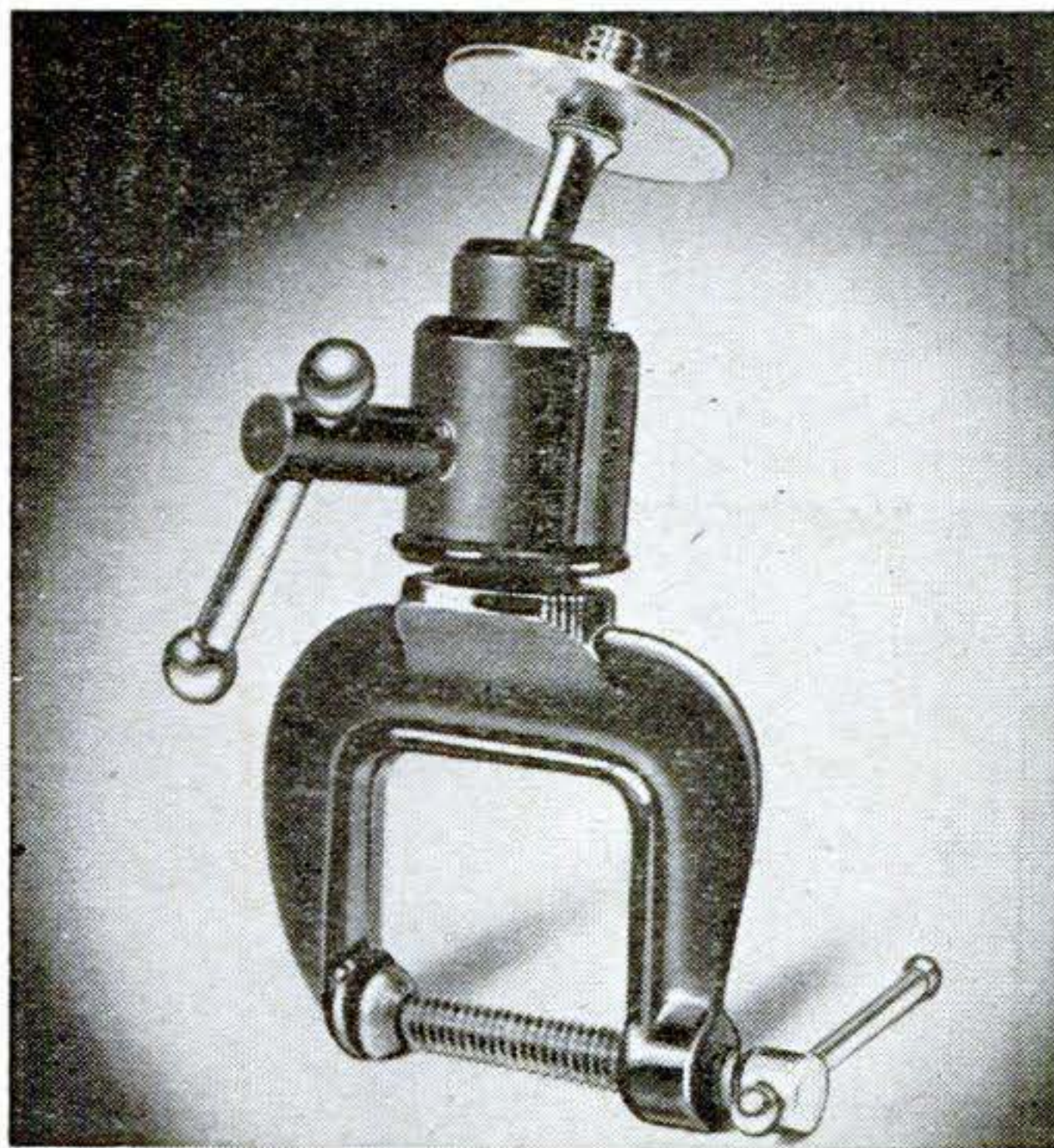
Illuminating Your Timer. Attached to the top of a darkroom timer with masking tape, a small neon circuit tester will make the dial visible in its soft, red glow. The dim light is not bright enough to fog even panchromatic film if screened to avoid direct rays. Neon testing lamps can be plugged into 115-volt house current.



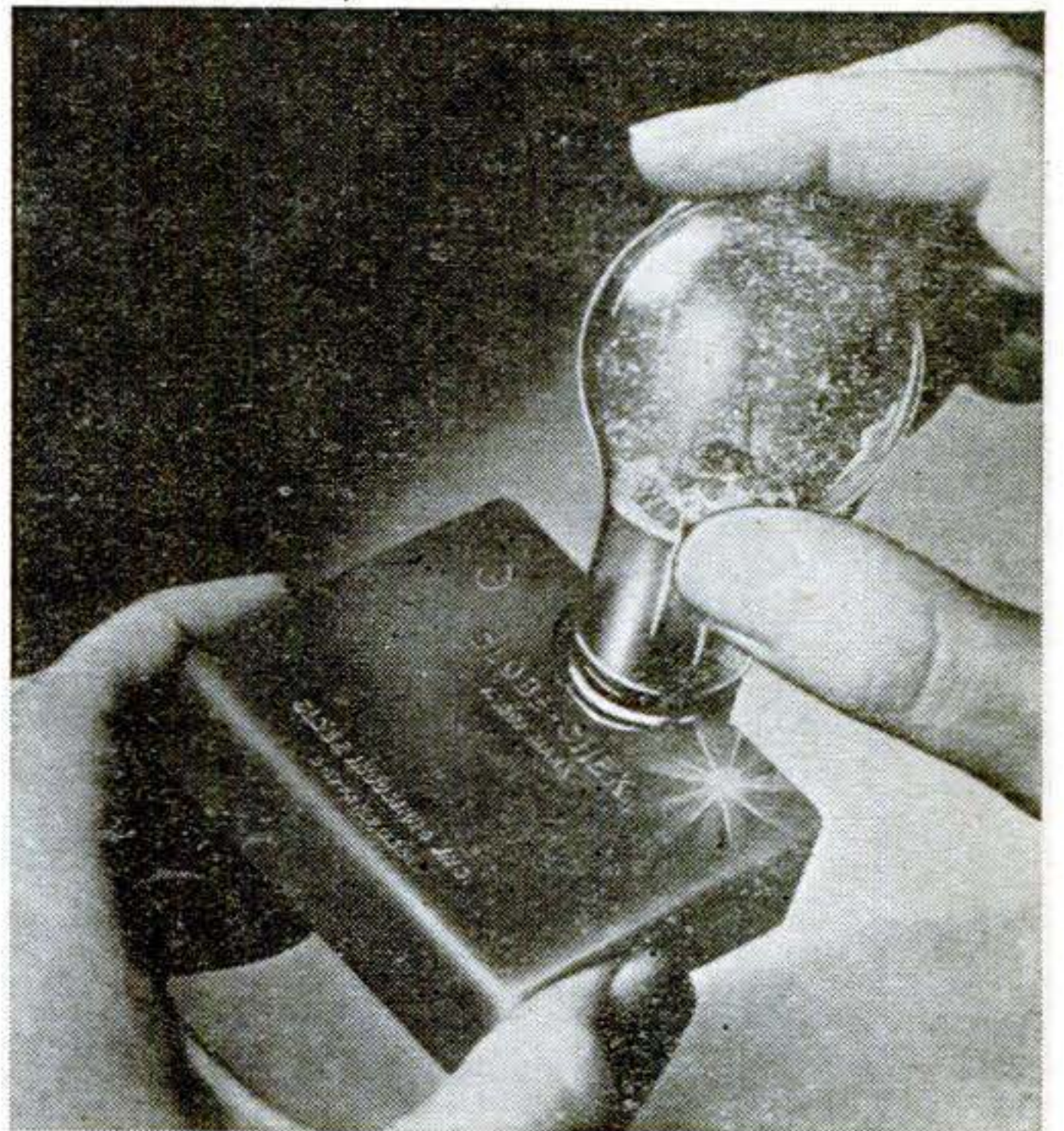
Eccentric Lens Mount. You can double the vertical and horizontal adjustment range of a lens used on a removable lens board by mounting it off center. This is especially advantageous with wide-angle objectives that are used at short extensions. To permit centering for normal work, the lens should be mounted off center the same distance the lens front can be raised. With lenses of longer focal length, take care to see that the bellows will not cut off any of the image.—ALVIN J. BRAULT.



Visual Film Reminder. When several types of film are used, markings cut from the ends of film packages and slipped in the accessory clip will show with what kind the camera is loaded. Tape will hold such a tag to a camera having no clip.



Clamp-On Camera Support. A $\frac{1}{4}$ "-20 tripod screw brazed to the frame of a small C-clamp provides a lightweight support that is easy to carry when a tripod would be inconvenient. The camera may be attached directly, but framing and composing is easier if a tilt-top tripod head is screwed on first.—RICHARD C. THOMPSON.



Flash-Bulb Tester. A pilot lamp in a pocket-size flash-bulb tester lights up when a good bulb is inserted, thus eliminating the danger of missing a shot because of a dud bulb. The tester is operated by a battery. It will test any flash bulb, including both bayonet-base midget and standard screw-base types.

Darkroom Doctoring Saves Photo Paper

By Robert Wortham

RATHER than discard enlargements that just miss being satisfactory because of some error in the making, why not remedy the defect by employing redevelopment or reduction? While these procedures do not replace burning in or dodging, one of them frequently offers an alternative or supplementary means of control to bring a print up to snuff. Properly used, they will keep a lot of projection paper from the wastebasket.

In many instances where an area of a print has a washed-out appearance because of overexposure in a part of the negative, local redevelopment will produce a more pleasing tonal range than if the area is burned in during enlarging. Until discovering redevelopment, I had always relied upon burning in to correct this fault, but more often than not several sheets of paper were wasted before I had a good print.

With redevelopment, the worker has complete control of tone and gradation at all times, and progress of the development can be observed and halted when a good print has been produced. Moreover, small areas

that may be difficult to burn in lend themselves well to spot redevelopment.

The requirements for redeveloping are simple. In addition to the customary trays, set up a fourth near your safelight. If you intend to use local control, leave the tray empty and place a small graduate of redeveloping solution near by. Ordinarily, this solution may consist of 1 part stock developer and 3 parts water, but if your regular developer is faster than 90 sec. when diluted 1 to 2, make the solution 1 to 4.

If you are working with a negative that has a washed-out area or one where there is little detail, as in a cloud portion, expose the print for the best overall tone and place it in the regular developer for the specified time. Then, after 20 sec. in the short stop, place the print in the empty tray and begin the intensification.

Small areas can be intensified by applying the solution with a small brush or the fingers. Work it into the emulsion with a circular motion, dipping often into the graduate for fresh developer. The image should come up rather slowly, allowing ample time for inspection. The more briskly the print is



Overexposed under the enlarger, this print came up too dark in some areas and much desirable detail was lost. Instead of discarding such prints . . .



. . . Save them by using a reducer. Here is the same print after it has been reduced. Details are now seen in the leaves and the girl's face is lighter.



Redevelopment of a washed-out area saved this print from the wastebasket. Compare it with the one below.

rubbed with the fingers, the faster the image will intensify, for heat generated by the friction speeds up the developing process. This is a trick long used by commercial finishers to bring up a thin area.

When a large area requires treatment, it is better to place the solution in the tray and dip in the part of the print that you want to strengthen, holding it at an angle so none of the solution reaches the fully developed part. Keep the print in motion to assure even gradation of tone with no sharp breaks.

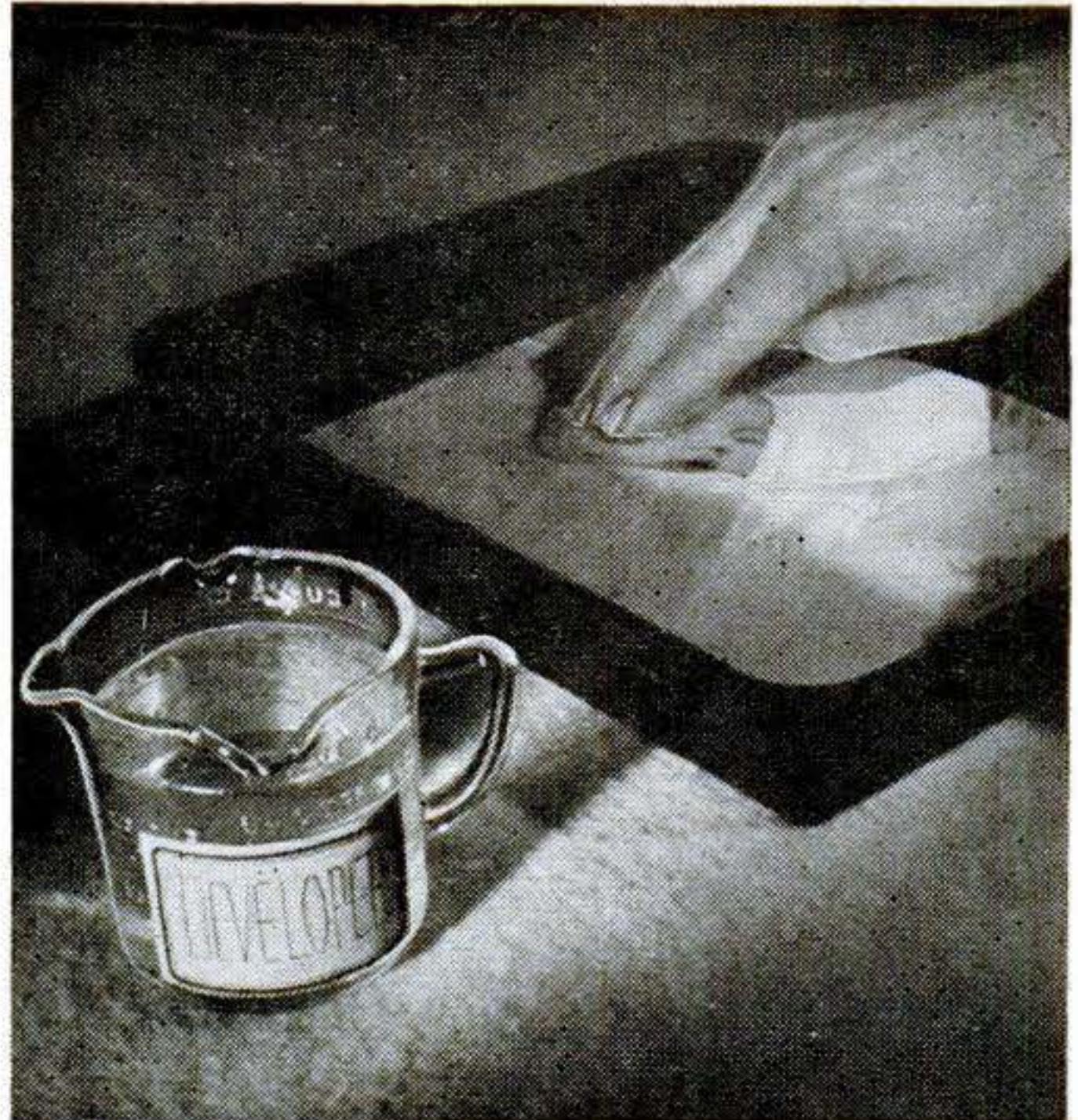
Reduction, the direct opposite of redevelopment, also will save many prints. It is particularly useful in the case of prints that have been overexposed under the enlarger. Many amateurs pull such prints before complete development has taken place, but this practice results in a muddy photo. A better method is to leave the print in the developer for the full period, fix and wash it, and then place it in a tray of reducer. Main-



When taken from the original developer, the print lacked detail in the upper lefthand corner. After passing through the stop bath, the print was held under a safelight and diluted developing solution was worked into the light area with the fingers.



A brush gives you better control when very small areas are to be reduced. Reducing solutions may be made from such household bleaches as Clorox.



For local redevelopment, dip your fingers into the solution and rub the area with a circular motion. Heat generated by friction speeds up the process.

tain the reducing solution at about 68 deg.

Many commercial reducers are available, but you can make your own from one of the household bleaches sold under such names as Clorox, Hypro, Purex, etc. Stir $\frac{1}{4}$ oz. of the bleach into 32 oz. of water. This "soup" should reduce a fairly dark print in about 15 min. It may be best, however, to check its speed on a few test strips before trying a

print, since the various brands of bleach differ in strength.

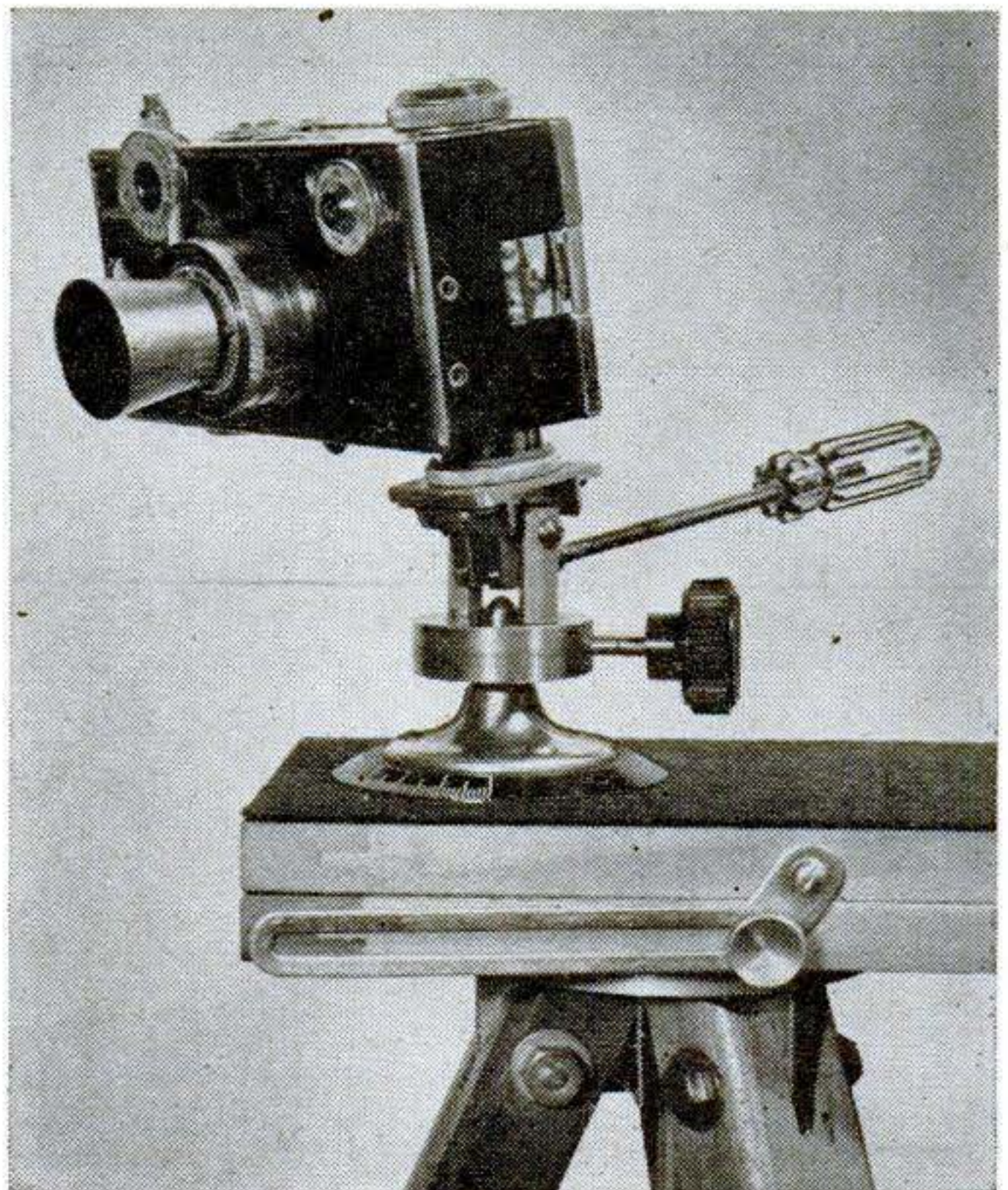
As in redeveloping, you can use the reducer for spot control of small areas or you can immerse part or all of the print. In local reduction, I often use a No. 1 spotting brush, for this makes it easier to restrict the reducer to the desired area. After reducing a print, fix and wash it again. END.

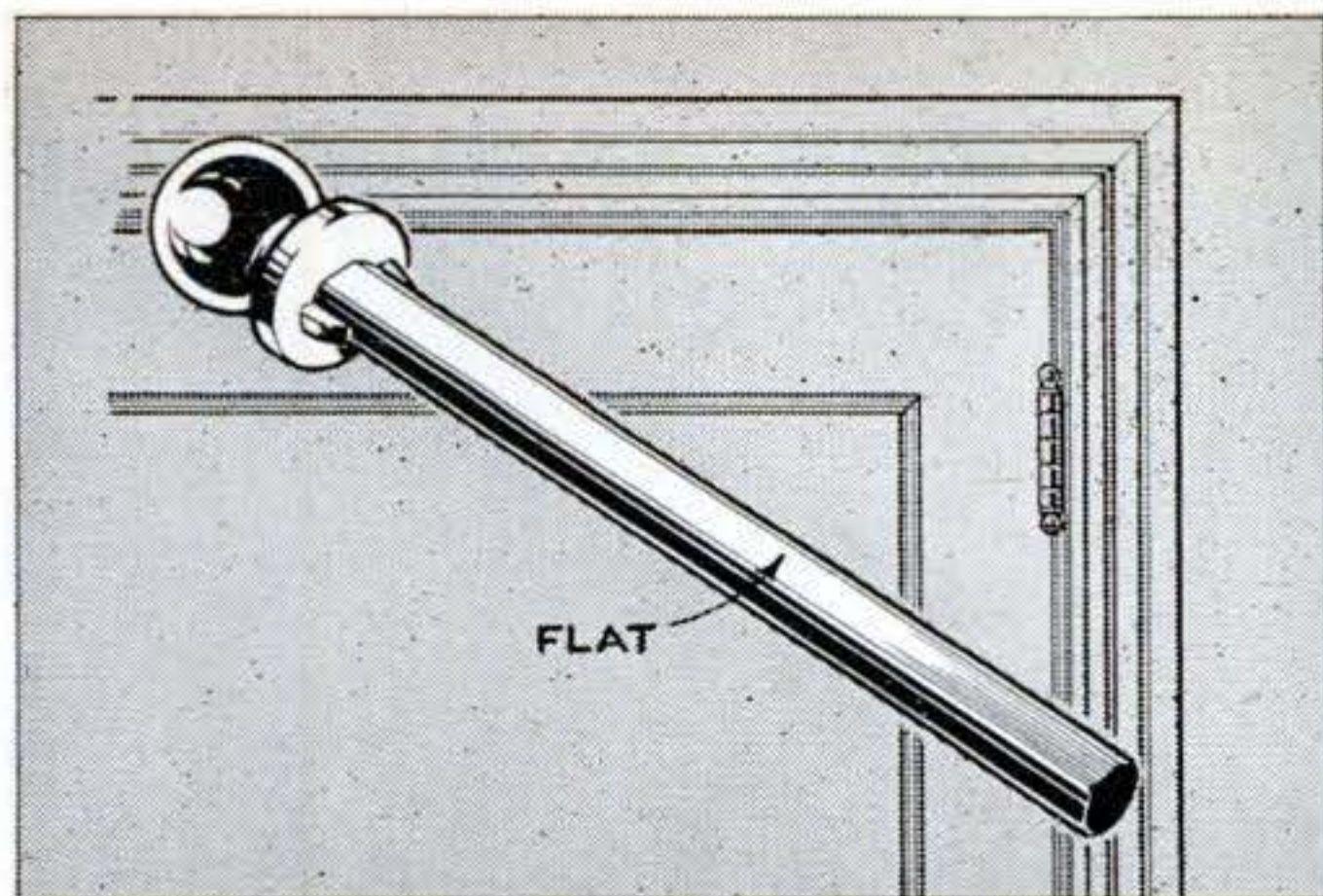
Radio Parts Used in Building Pan-Tilt Head

SCRAP parts from an old radio provided most of the material for this pan-tilt head. The entire cost was a dime spent for a screwdriver that serves as the handle.

The base is an old bakelite dial with a brass flange. This flange was threaded $\frac{1}{4}$ "-20 underneath for the tripod screw. Resting on the $\frac{1}{4}$ " vertical shaft that serves as the panning axis is a pulley taken from a radio condenser shaft, its setscrew replaced with a rheostat shaft and knob as a locking device. Two binding posts of $\frac{5}{16}$ " hexagonal brass attached vertically to the pulley support the horizontal shaft.

For the top assembly, a camera-mount screw was fitted in a brass plate. Under this, two angle pieces were bolted parallel to the axis and two small blocks were soldered between. After its end was cut off, the screwdriver was threaded to function as a set-screw against a horizontal shaft that gives the tilting action.—LEONARD J. BOGERT.





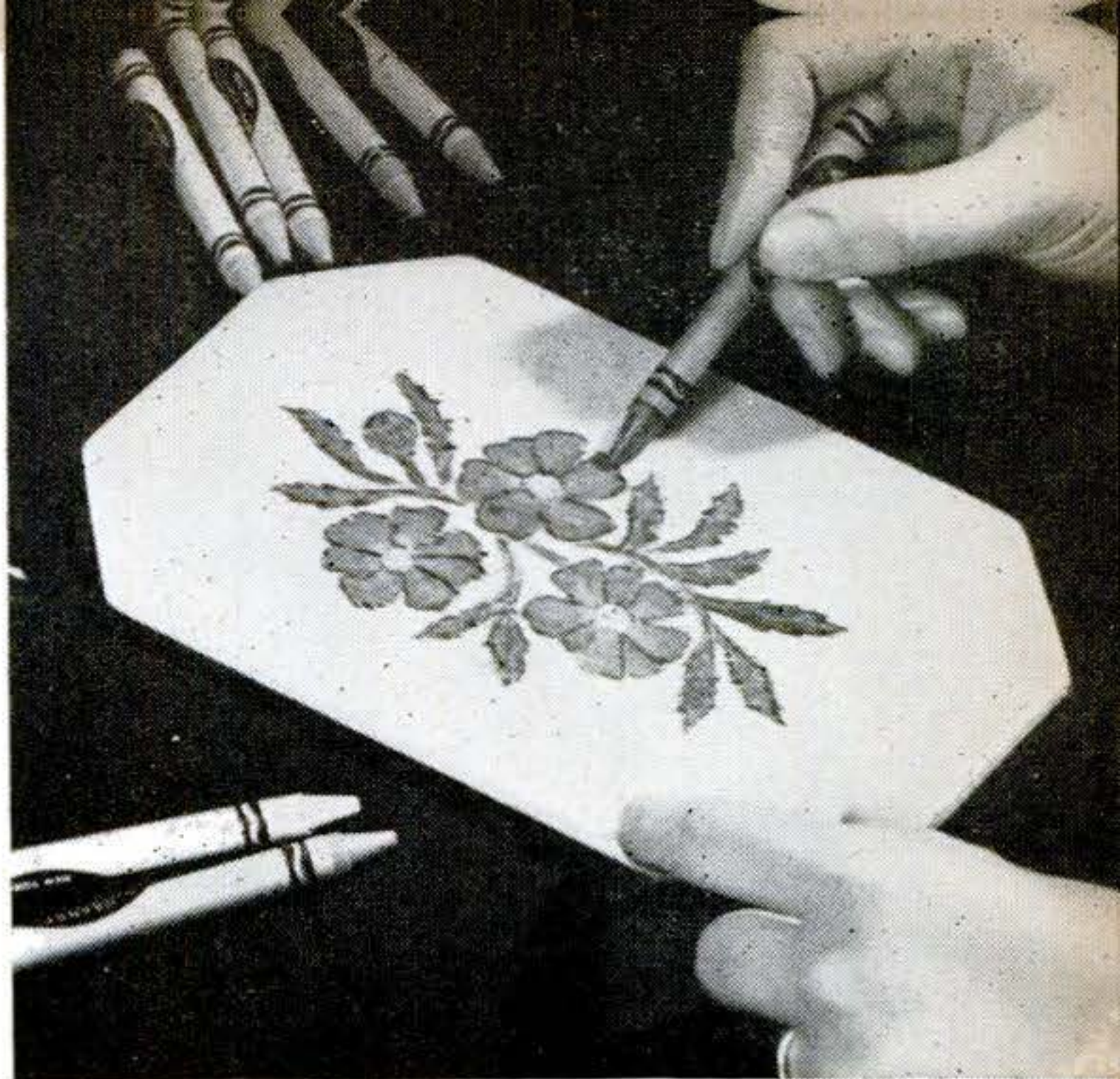
Flat Stops Squeak in Hinge

WHEN there is no clearance between a hinge pin and socket, a door sometimes squeaks even when properly oiled. File a flat on such a pin for its entire length, and then replace it in the hinge. The flat not only conducts oil all the way down the hinge but also retains a small reserve to lessen the need for frequent oiling.

Jar Rings Identify Plants



GARDEN plants that require special foods, insecticides, or the like can be identified by rubber jar rings. Place the rings over them as they show above ground and let them grow on through the opening.—T. NICHOLS.



Wax Crayons Burned in Wood

PERMANENT colored decorations are possible in wood with common wax crayons and an electric burning pencil. The outline is drawn on the wood freehand or traced with carbon paper and then burned in with the electric pencil. Color with crayons and melt the wax colors into the wood with the burning pencil for results such as that shown in full color on page 112. For large surfaces a flatiron can be used.

A burning pencil with a narrow, flat point works best, but a rounded point can also be used satisfactorily. For softer effects, the burned outline may be omitted.

The same method can be employed for decorating leather.—RALPH S. WILKES.

TINTING INTERIOR WHITE, II

[PAINTING]

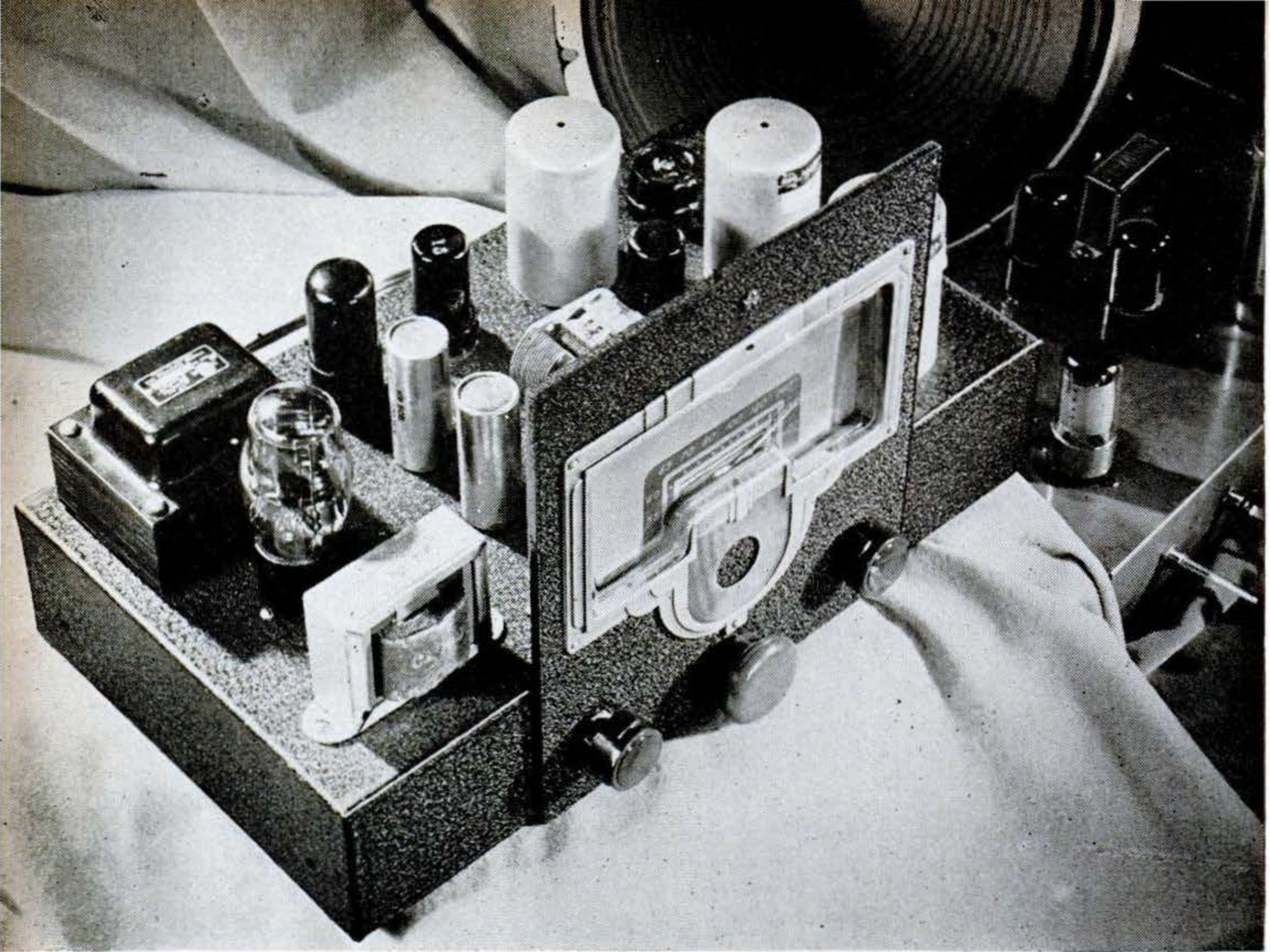
Yellows: Tint with *chrome yellow light* and a small amount of *raw sienna*. *Venetian red* and a trace of *lampblack* may be used with the *yellow* for tint variations.

Pinks: For a light rose, add equal amounts of *raw sienna* and *Venetian red*. For medium rose, use 3 parts *raw sienna* to 1 part *Venetian red*. For peach, use *chrome yellow orange* with traces of *Venetian red* and *lampblack*.

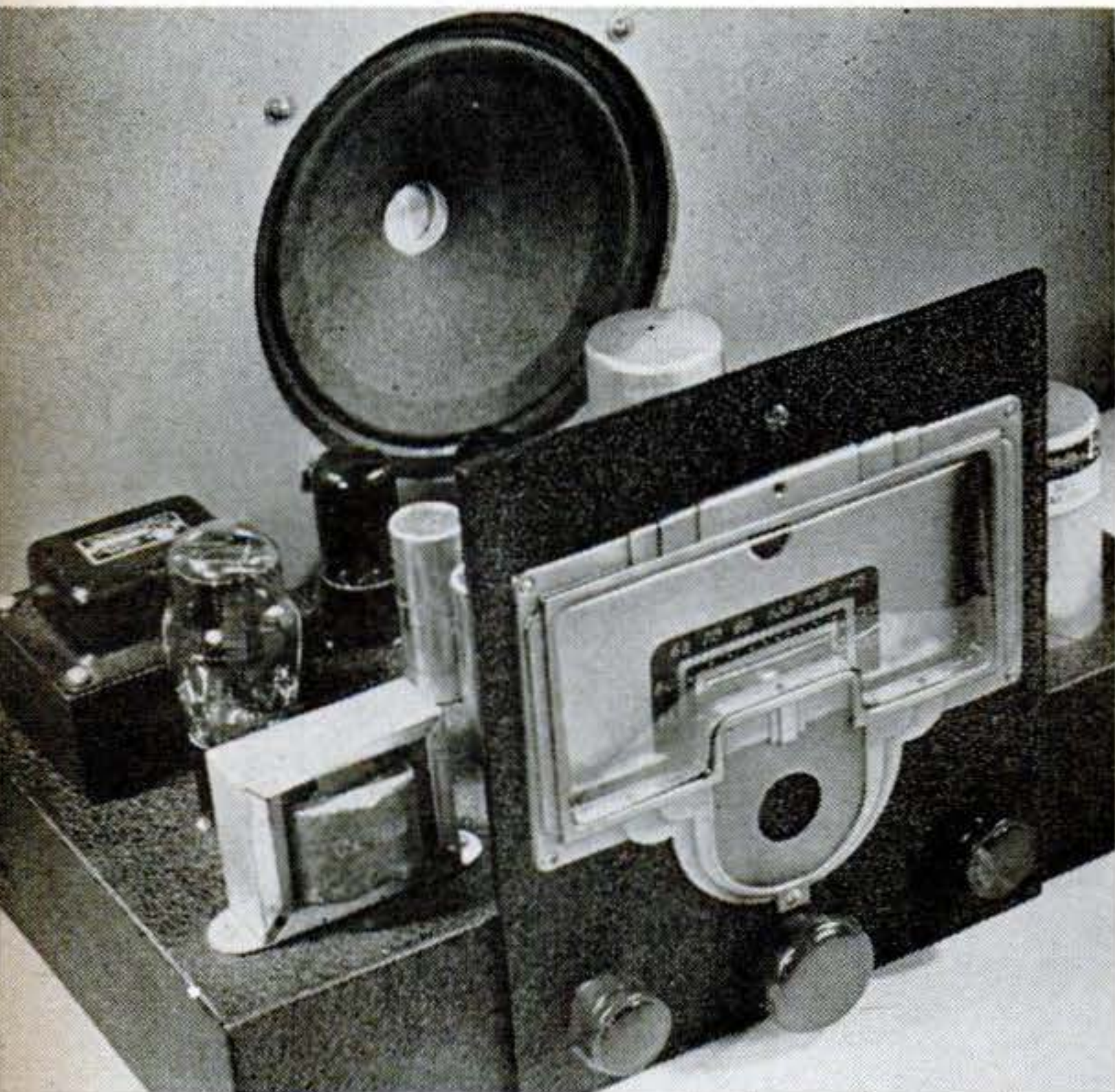
Orchids: For a salmon, add 3 parts *chrome yellow orange*, 2 parts *Red Lake*, and a trace of *Indian red*. For coral, add 3 parts *Venetian red* and 1 part *Red Lake*. Lavender can be obtained by adding *Red Lake*, and this is turned into lilac by using a bit of *ultramarine blue*. It becomes orchid if the *Red Lake* and *ultramarine* are used in proportions of 3 to 2 with a trace of *Indian red*.

NOTE: Start with a flat or interior semigloss or gloss white of the quantity needed for the job, and stir it thoroughly. Then mix small amounts of each oil color with a little turpentine to fluid consistency. Add oil colors, a little at a time, to the white, stirring thoroughly after each addition. Be wary of using too much color; tones are easily darkened, but they cannot be made lighter without waste.

POPULAR SCIENCE MONTHLY SHOP DATA



The versatile tuner-receiver. In the background is PSM's hi-fi amplifier, which will be described next month.



Working into a single dynamic speaker, the tuner becomes a complete, better-than-average receiver. It separates stations sharply, has ample room volume, and its fidelity and tone are excellent.

PSM photos by HUBERT LUCKETT

LIST OF PARTS

- R1: 10,000-ohm volume control.
 - R2: 750-ohm, 1-watt carbon.
 - R3: 15,000-ohm, 2-watt carbon.
 - R4: 5,000-ohm, 2-watt carbon.
 - R5: 10,000-ohm, 10-watt wire-wound.
 - R6: 20,000-ohm, 2-watt carbon.
 - R7, R11: 150,000-ohm, 2-watt carbon.
 - R8: 240,000-ohm, 2-watt carbon.
 - R9: 350,000-ohm tone control, with switch, S3.
 - R10: 40,000-ohm, 2-watt carbon.
 - R12: 2,000-ohm, 10-watt wire-wound.
 - R13: 125,000-ohm, 1-watt carbon.
 - R14: 1-meg., 1-watt carbon.
 - C1, C4, C16: .25-mfd., 600-volt paper.
 - C2a, b, c: Three-gang, 365-mmf. tuning condenser.
 - C3, C10: .1-mfd., 600-volt paper.
 - C5, C6, C7: .0001-mfd. mica.
 - C8, C11, C12: .02-mfd., 600-volt paper.
 - C9: 8-mfd., 450-volt dry-electrolytic.
 - C13, C14, C15: 8-mfd., 450-volt can-type electrolytic.
 - L1, L2, L3: Matched set shielded TRF coils, powdered-iron core.
 - L4: 2.5-mh., air-core RF plate choke.
 - L5: 15-h., 75-ma. filter choke, 400 ohms DC res.
 - T1: 90-ma. power transformer, 350 volts each side of centertap, 6.3-volt filament, 5-volt rectifier windings.
 - S1: DPDT toggle.
 - S2: SPDT toggle.
 - S3: SPST switch on R9.
- Electrodynamic speaker with output trans. and 1,500-ohm field coil; tubes, sockets, dial, misc. hardware.

Tune In on High Fidelity

This TRF unit can be used with an amplifier or as a self-sufficient high-quality radio receiver.

By Edward Blanton

SOUND systems, like chains, are only as good as their weakest parts. Here is a really strong beginning for that high-quality, high-fidelity system you've been planning to build—a tuner or receiver that will give you perfect, undistorted reception of every note sent out on the air by your local broadcasting stations. The set pictured at the left is a complete radio receiver. Used alone, it will give excellent frequency coverage and ample room volume. It may also be used with an amplifier as part of a more powerful and elaborate setup. Next month PSM will publish a design for an amplifier that will do full justice to the pure sound of this tuner.

But before you start, note the phrase "local broadcasting stations." A tuned radio frequency (TRF) circuit such as is employed here allows the full signal to come through to the detector stage. It does not have the tendency of the superheterodyne to clip the side bands of broadcast signals, often eliminating the high-frequency response. The disadvantage of TRF is that it lacks the ability to pull in and sharply separate distant stations. What this adds up to is simply that this tuner is recommended for those who live in or near metropolitan areas and who do most of their listening to nearby transmitters. For remote, rural listeners, a superhet tuner will prove more advantageous. However, if the stations are close by, you needn't worry about the selectivity of this set. Its three tuned circuits give plenty of separation between stations even in radio-crowded areas.

Primary and secondary windings of the antenna and RF coils are inductively coupled, and, in addition, the windings of the two RF coils are coupled through small-capacity condensers built into the units. This construction allows a flat band of

frequencies to pass through to the detector stage. All coils are shielded.

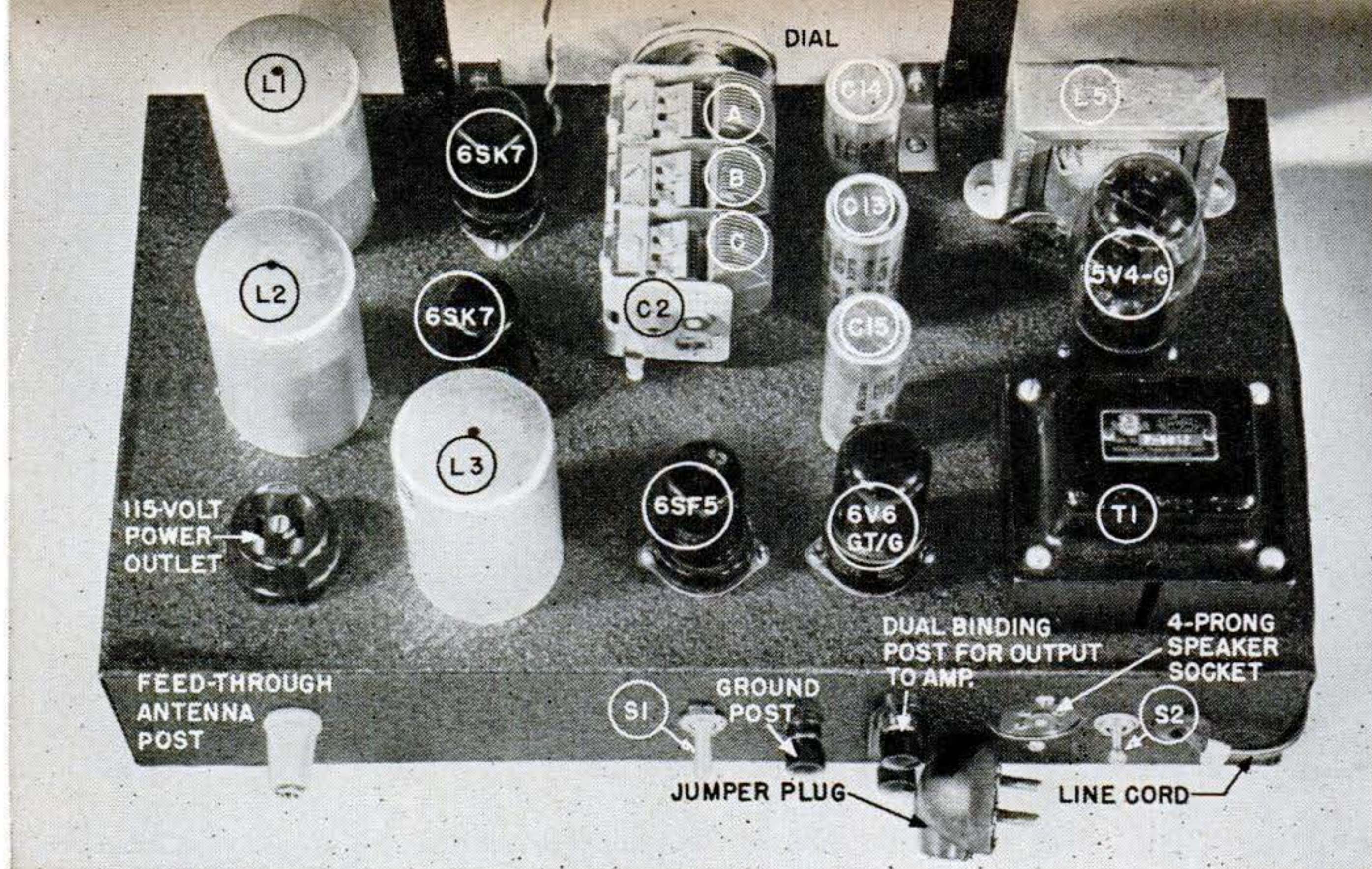
To do justice to the full-frequency response, an infinite-impedance detector circuit is employed. As can be seen in the diagram, the output from the 6SF5 detector is taken from the cathode rather than the plate of the tube. This design, better known as a cathode follower, requires no plate bypass condensers, which usually dampen the high notes; linearity of such a detector is straight from the lowest to the highest tones.

But again, the increase in fidelity is not achieved without cost. While a cathode follower passes a signal faithfully, it adds nothing to its strength, and another stage of amplification is therefore needed. This stage is built around the 6V6-GT.

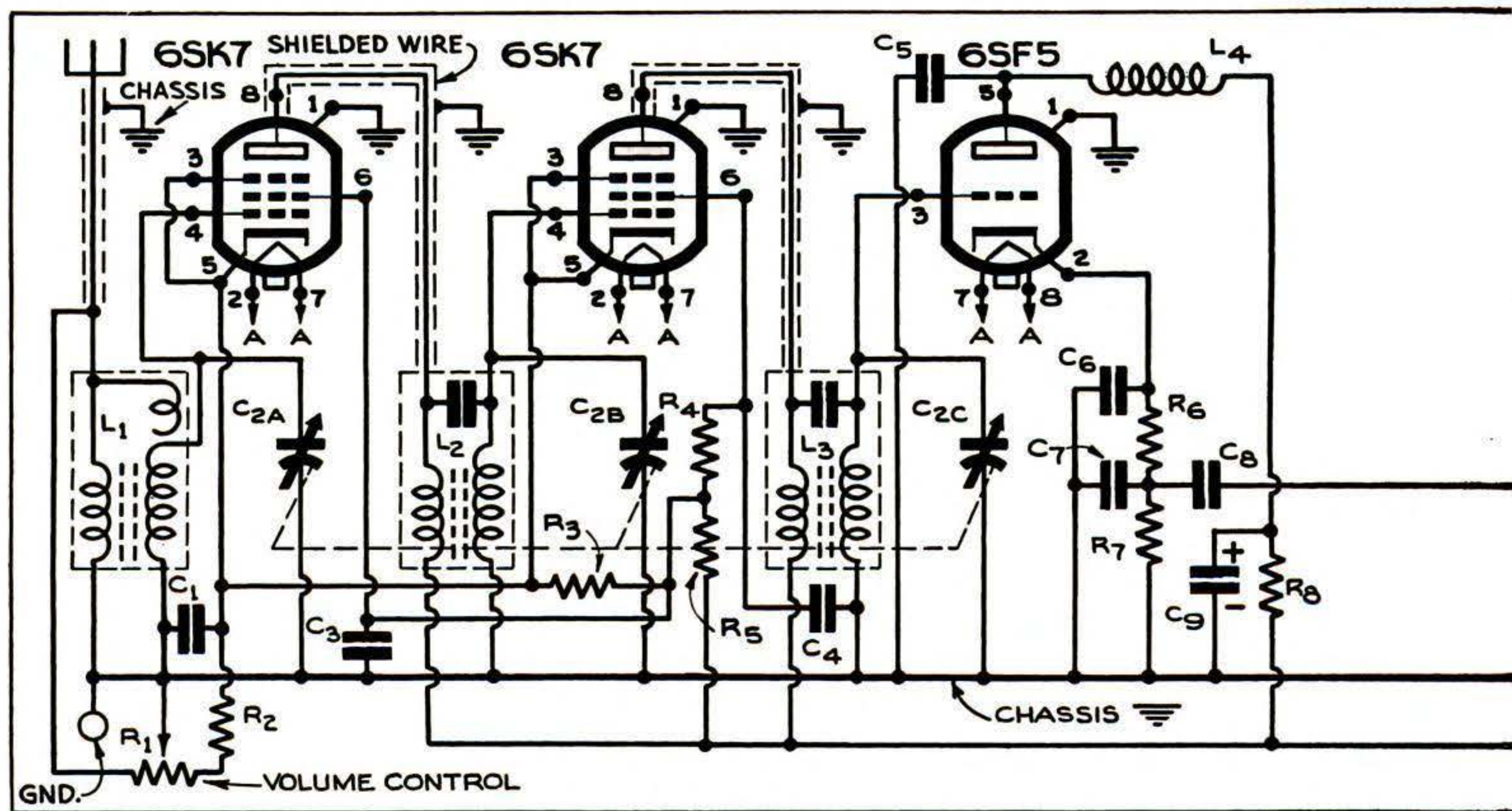
When the set is connected as an independent receiver, the 6V6 acts as a pentode. Flicking two switches changes the unit to a tuner and modifies the tube connections to those of a triode. This reduces the output, all of which is not now needed, and which might overload the amplifier. As a receiver, provision is made for the use of a dynamic speaker with a 1,500-ohm field. In order to change over to tuner position, it is necessary to make contact across the field-coil terminals and also to achieve a compensating voltage drop. This is accomplished by R12 and S2 when the latter is in position B. Still another change is needed: when the set is used as a receiver, two terminals of the four-prong speaker socket are connected to the output transformer of the dynamic speaker. As a tuner the set feeds directly into an amplifier, so the transformer terminals must be shorted to complete the circuit. The shorting connection is made by a jumper plug (indicated by the broken lines in the socket diagram) in which the corresponding prongs have been wired together.

In order to keep the unit self-sufficient, separate power supply and filter systems are employed in this tuner and the forthcoming amplifier. This results in slightly higher parts cost but makes the units completely independent for all future uses.

Layout isn't critical, but you will note



Top view of the chassis. Jumper plug replaces the dynamic-speaker plug when the set is used as a tuner.

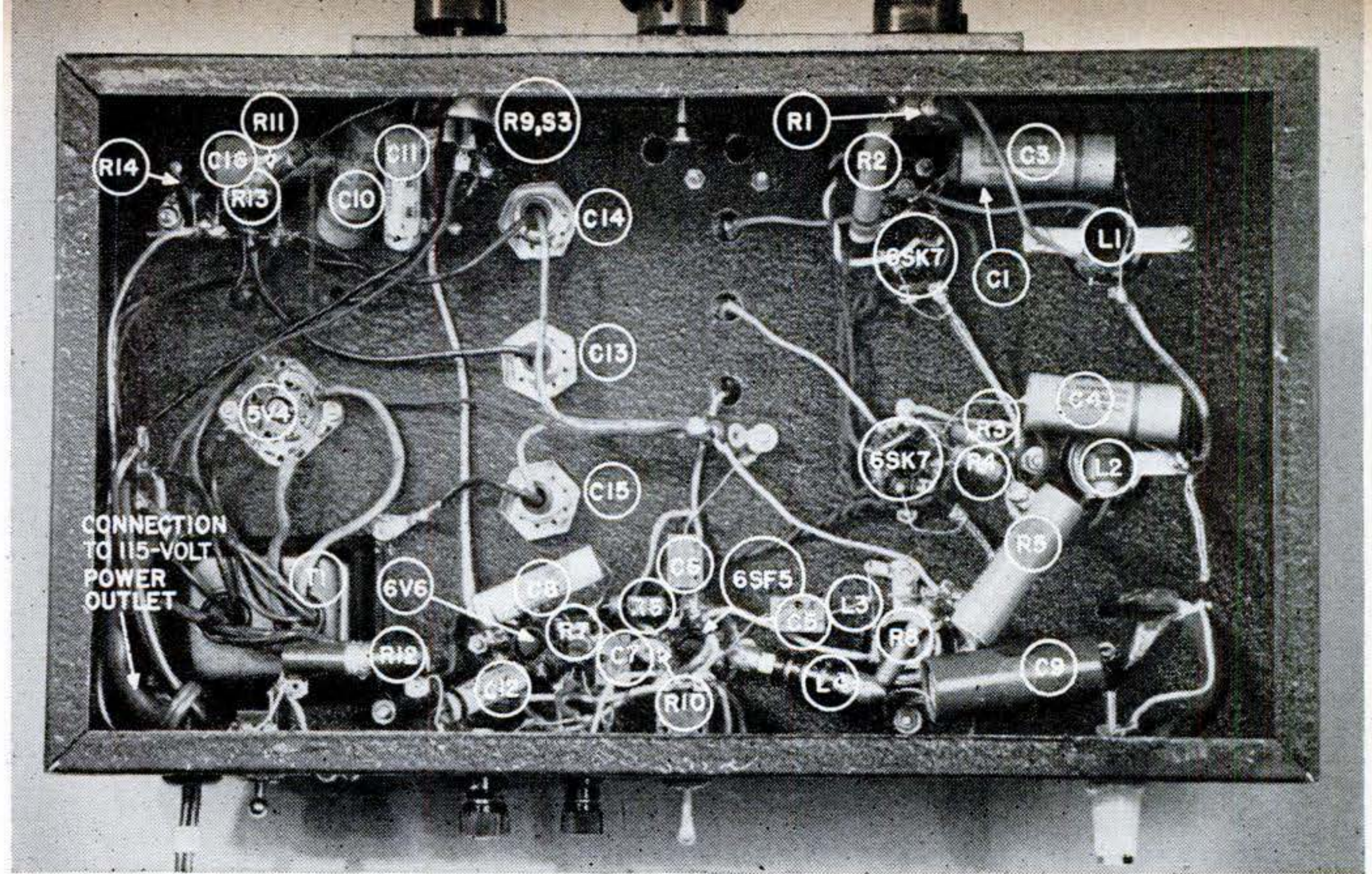


in the photographs that the three basic sets of components—RF, power supply, and detector-audio—are grouped and placed at maximum distance from each other. Especially in a circuit of this sort where detection and amplification give such faithful reproduction of the signal that passes the RF stages, it is important that stray pickups be held to a minimum. In addition to spacing, therefore, shielded conductors are used

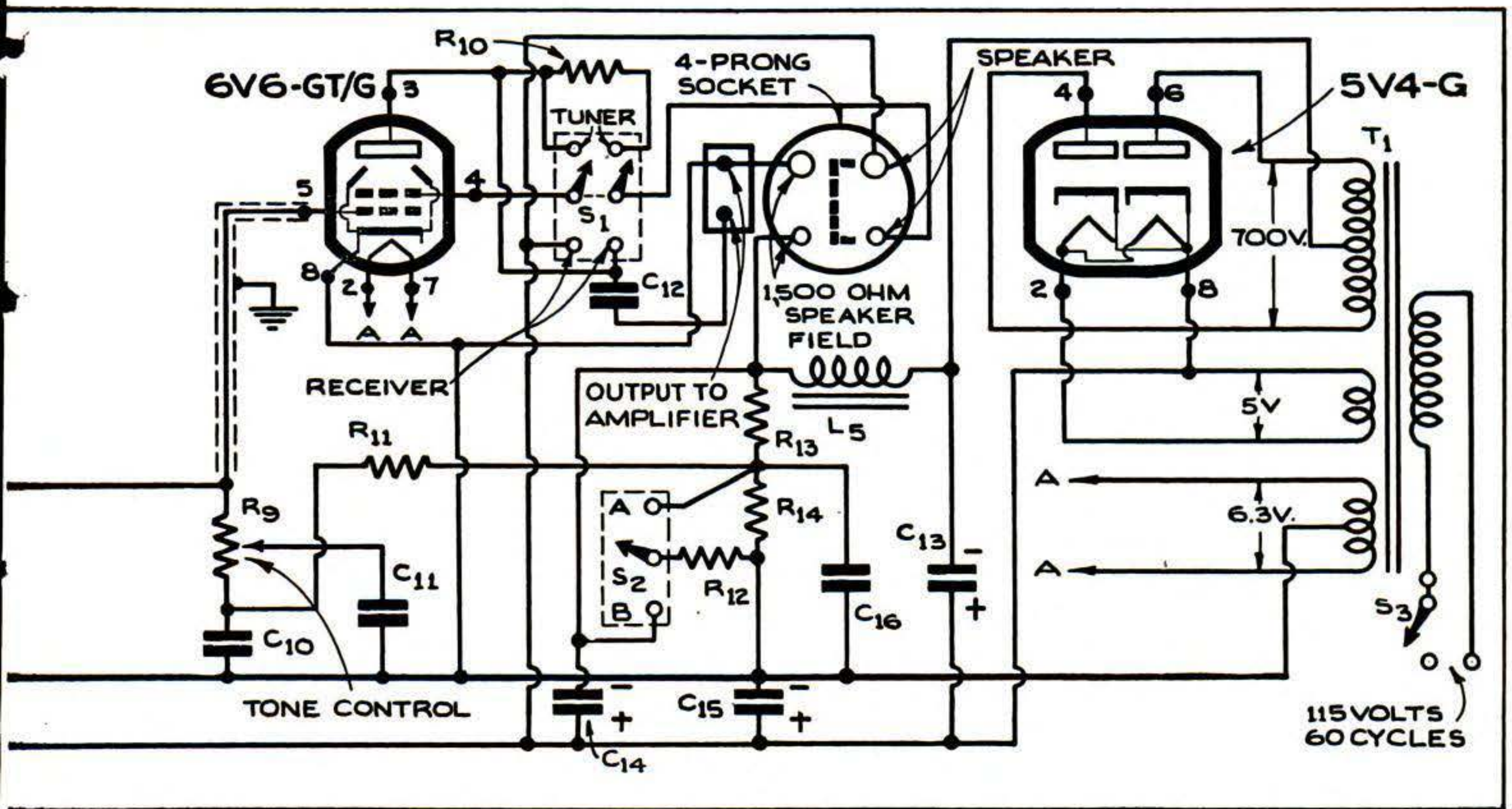
in the antenna lead and in the plate connections of both 6SK7 tubes as well as in the grid lead of the 6V6.

To use the set as a receiver, plug in a dynamic speaker having a 1,500-ohm field coil, turn S1 to the position marked "receiver," and S2 to position A. Connect an outside antenna to the insulated jack, and ground the chassis to a water pipe.

Should you want the set to feed an am-



Parts placement isn't critical, but try to keep space between components that might cause interference.



plifier, reverse the positions of both S1 and S2 and replace the speaker plug with the jumper described above. Run a single-conductor cable with a braided external shield from the binding posts to the input connections of the amplifier. The braided shield of the cable, of course, goes to the grounded terminals at tuner and amplifier.

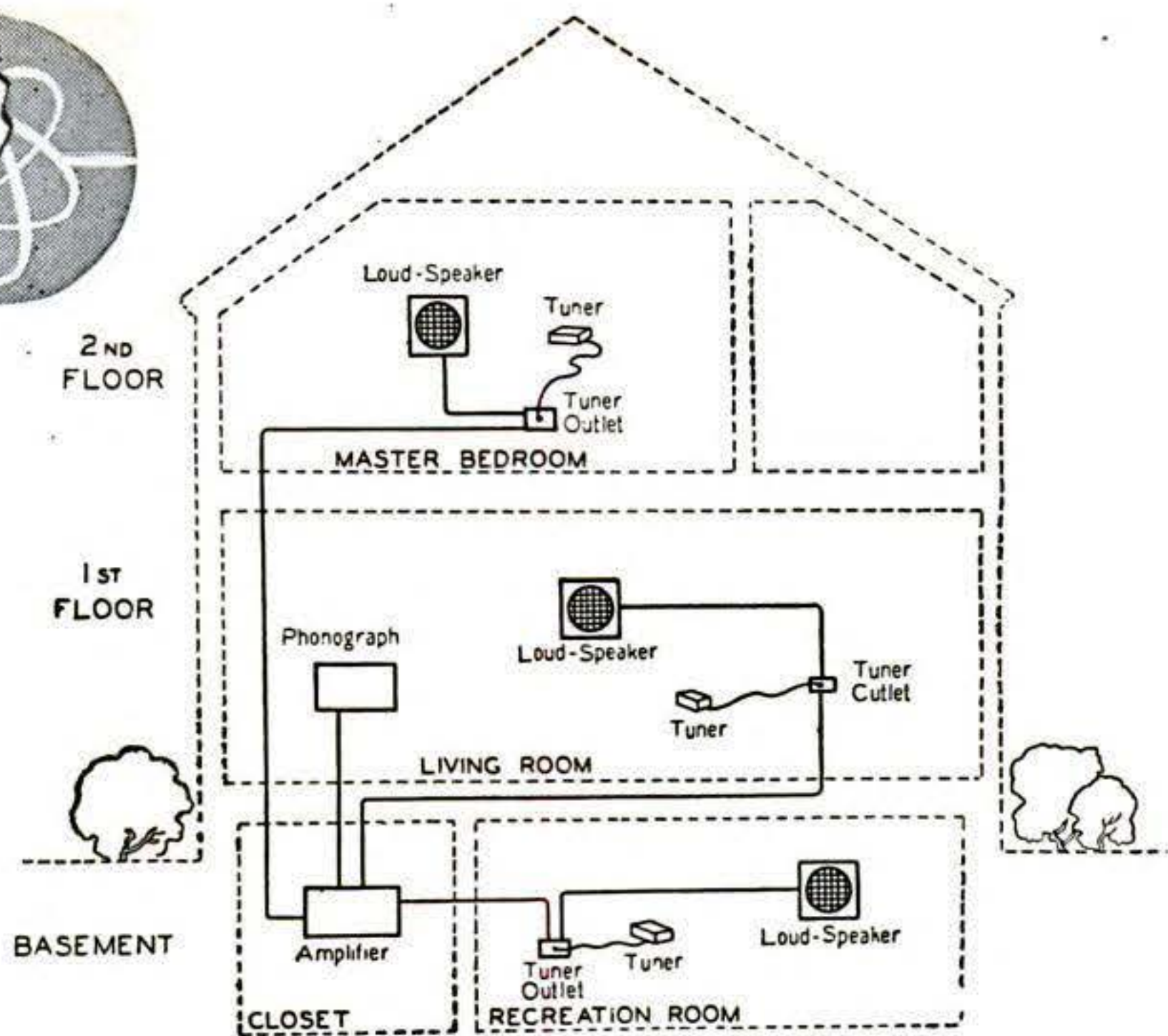
A parallel line from the 115-volt supply is brought out to a separate socket on the

chassis. By connecting it at a point beyond S3, in parallel with the transformer primary, S3 will then serve as a master switch. An amplifier may be plugged into this socket and turned on or off by the switch mounted on the tone control of the tuner. This arrangement will facilitate housing of the multiple units in a cabinet, since all controls on the amplifier can then be preset and left in fixed positions. END



Houses Wired for Sound.

Builders of new homes can solve the problem of selecting appropriate radios and phonographs by having these units built right into the structure. The installation pictured at the right was engineered by Reeves Sound Studios, New York, and consists of a single amplifier and record player and as many built-in loudspeakers as required. A portable tuner can be plugged into one of the several outlets provided, and programs may be heard over any or all speakers.



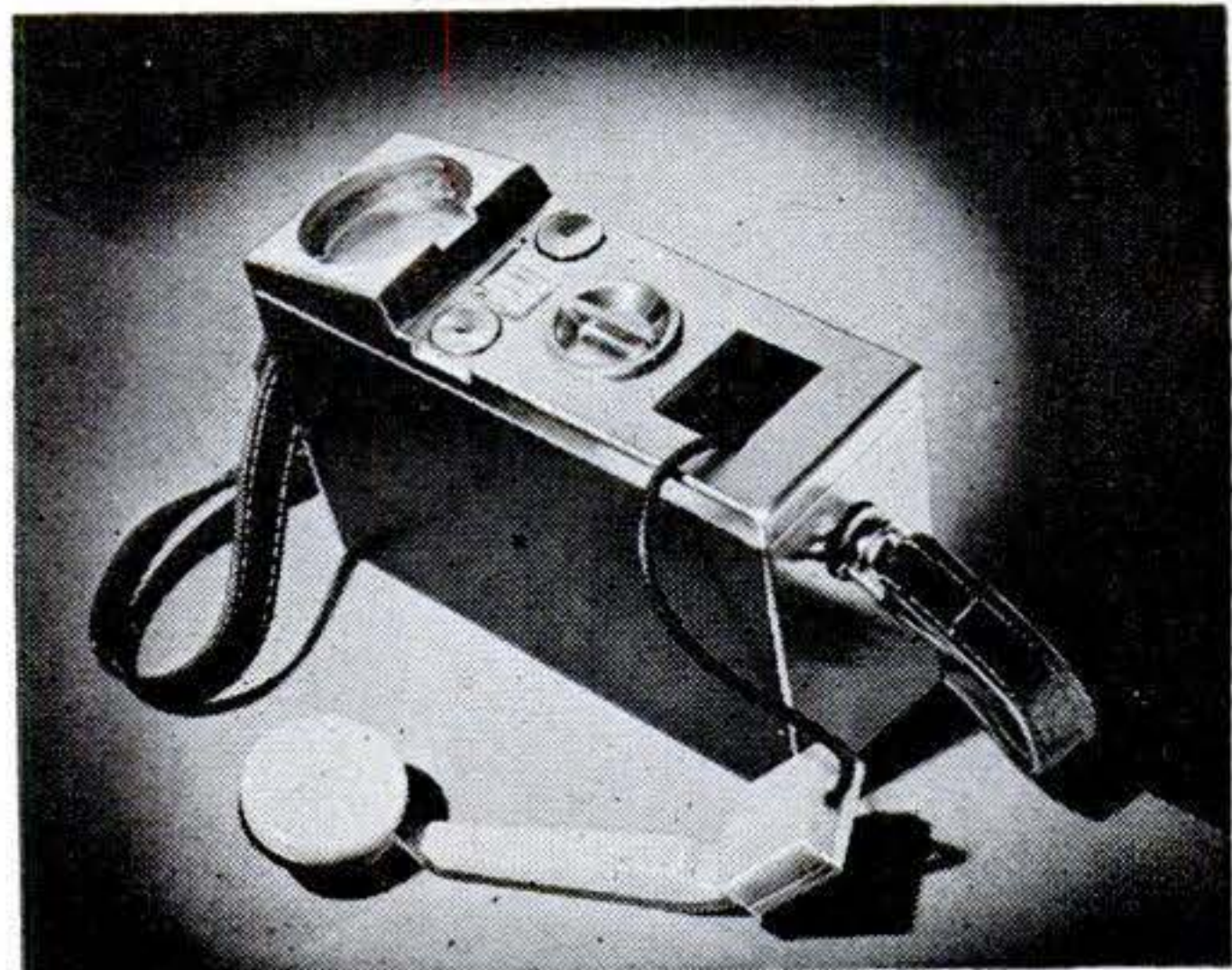
Either recordings or radio programs selected by a plug-in tuner may be amplified and sent to any speaker in the house.



Pocket-Size Ohmmeter. To provide radio, electrical, and auto repairmen with an instrument for making quick preliminary tests, chiefly as a basis for estimating repair costs, Sylvania has announced a 0-to-10,000-ohm meter housed in a pencil-like case. It uses a standard penlight cell.

Snap-In Socket.

A low-loss, high-insulating tube socket made by American Phenolic Corporation has only to be pressed into a pre-punched chassis hole to be automatically held without springs or screws.

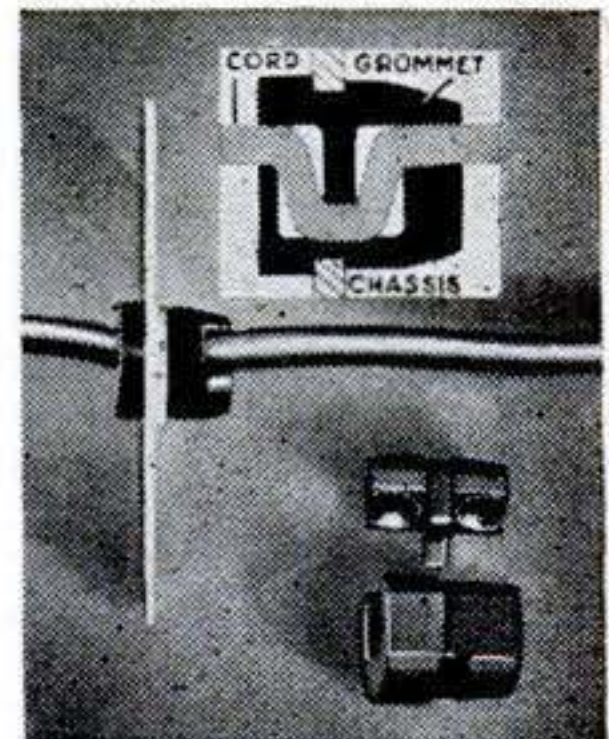


Handie Talkies Coming Up.

Among the new items scheduled for commercial production is the two-way portable shown above. The 4-lb. communicator has a range of approximately seven miles. Hallcrafters engineered the set; exterior design is by Raymond Loewy Associates.

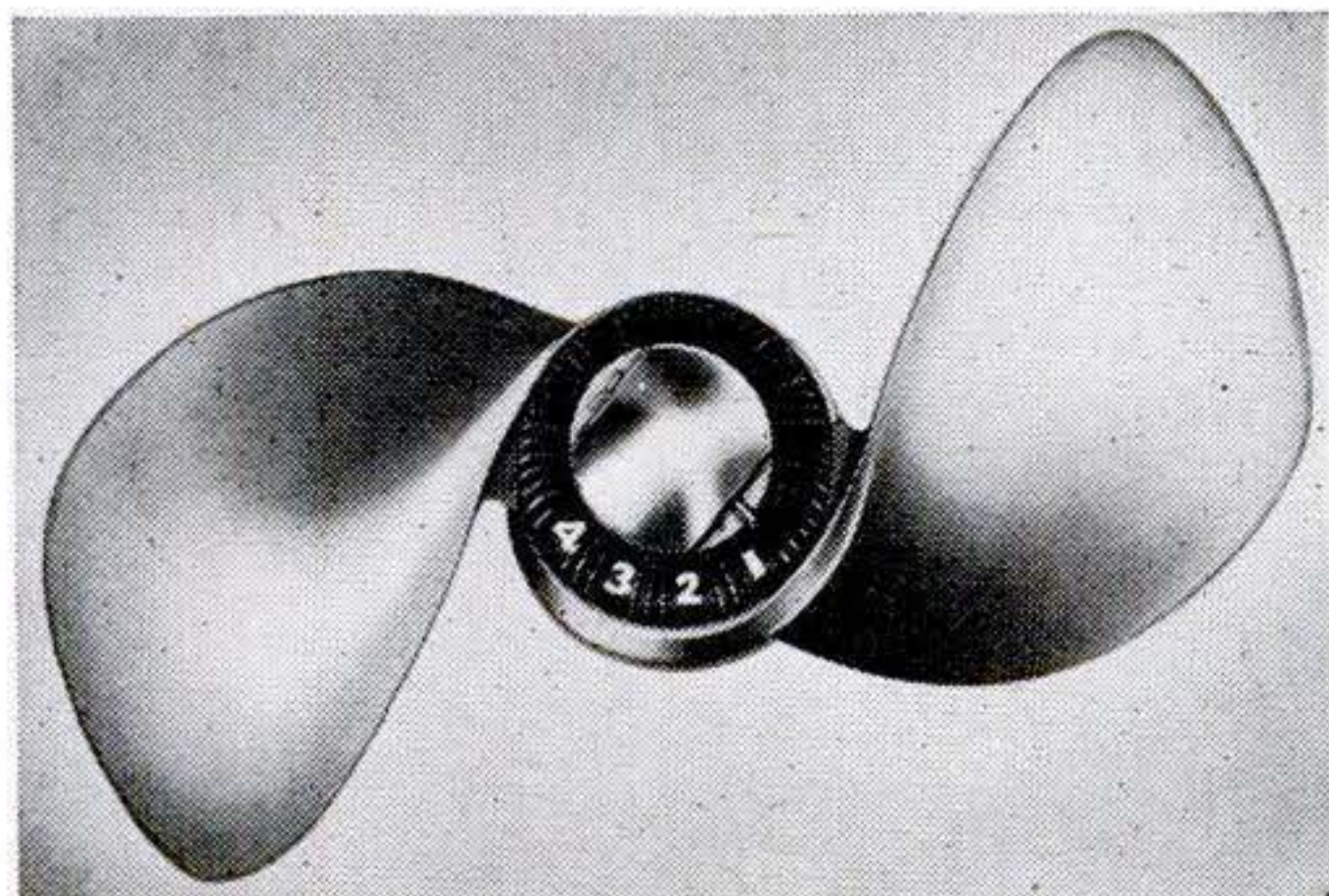
Nylon Grommet.

This newly developed strain-relief bushing locks a cord securely as it passes through a metal chassis. External stresses can't be transferred to the electrical contacts on the other side of the grommet.



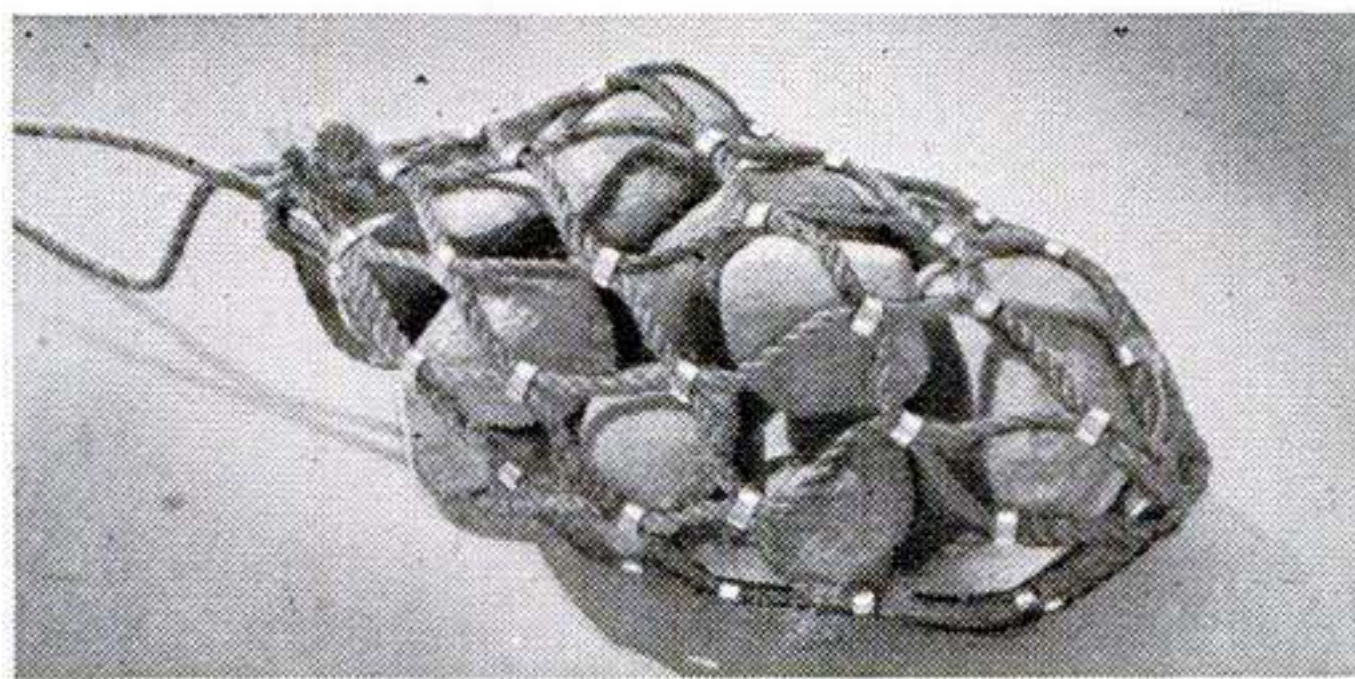
No Calking Needed.

Small plastic boats made by the Winner Manufacturing Co., of Trenton, N. J., are said to have double the impact strength of craft of conventional construction. Compound curves at the bow improve the appearance and increase the speed. Since the hull is molded as one piece, there are no seams to require seasonal calking. Color is molded in. The boats are made in three lengths—10', 12', and 14'. The latter can do 40 m.p.h. with a big outboard.



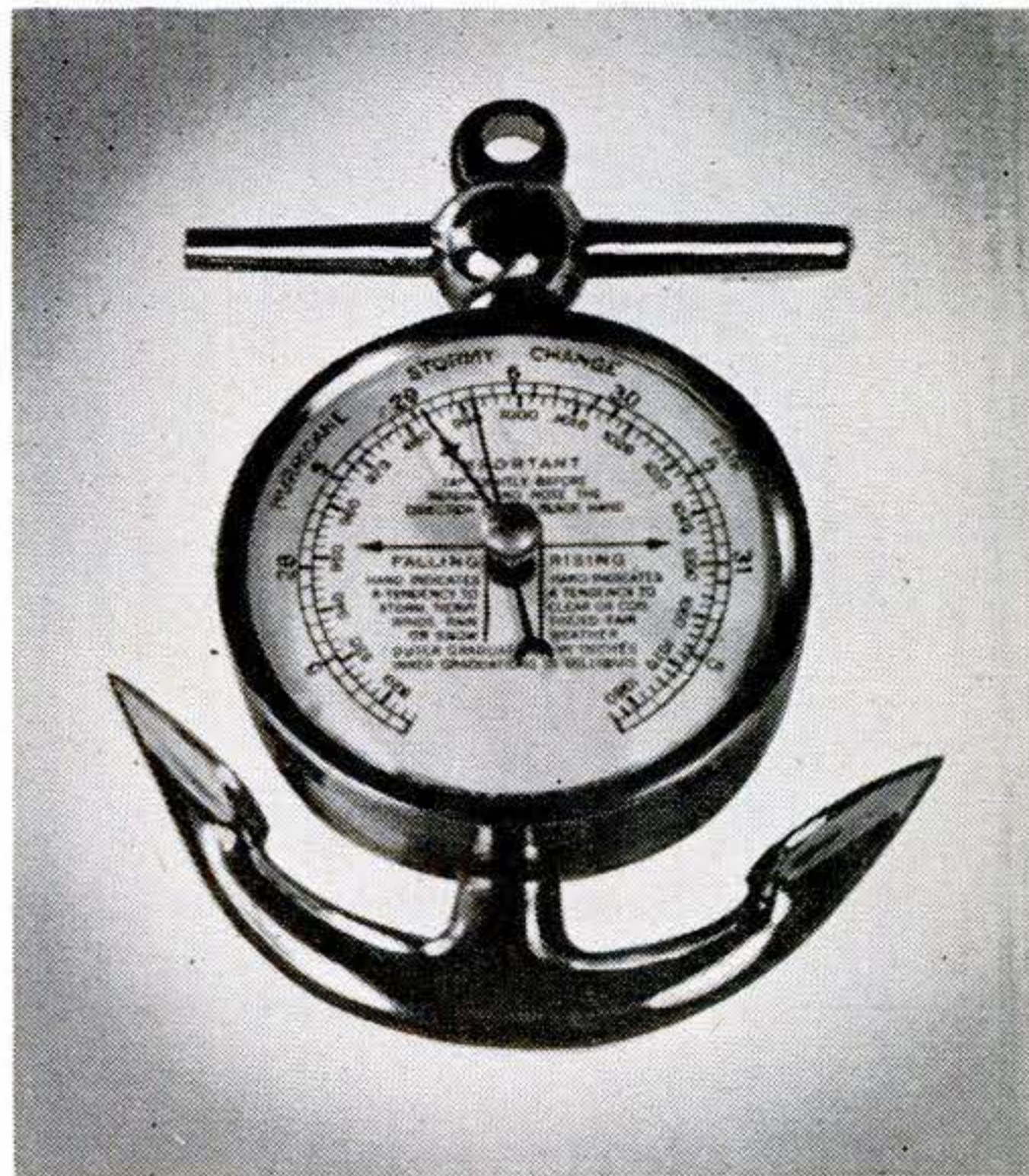
Propeller Has Variable Pitch.

A new outboard-motor propeller introduced by the Paul Bunyan Bait Company, of Minneapolis, can be quickly adjusted to any one of four settings to provide that best suited for the boat and load. Models are available to fit most outboards.



Anchor Is Also a Cooler. Made of sisal and easily folded for carrying, a bag produced by Alcraft, Inc., of Bronxville, N. Y., is intended to serve two purposes. It may be loaded with stones as an anchor for small boats, or bottles and canned goods may be placed in it and lowered into the water to cool. It holds 25 lb. of stones.

FOR BOATS AND BOATING



Barometer in Anchor Design.

Intended for either desk or wall use, this barometer has a simplified dial to make it easier to read the instrument and interpret its indications. As in other barometers, one hand serves as a reference for the deviation of the other to show whether pressure is rising or falling. For desk use, the anchor stock at the top of the dial is swiveled around 90 deg. to support the barometer at an angle. For wall use, it is turned parallel to the instrument, as above.



Gravity turns the overshoot wheel. Water-carrying buckets on one side overbalance the empty ones opposite.

Building an Overshot Wheel

Besides furnishing power, it brings an old-time air to its surroundings. Here are plans for a 5' wheel.

Part Five

By C. D. Bassett

OFTEN seen beside a picturesque rural mill, an overshoot water wheel possesses two excellent characteristics—considerable mechanical efficiency and easy maintenance. Many have remained in service for decades, and now lend a nostalgic charm to their surroundings.

Operated by gravity, the overshoot wheel derives its name from the manner in which water enters the buckets set around its

periphery. Pouring from a flume above the wheel, the water shoots into buckets on the down-moving side, overbalancing the empty ones opposite and keeping the wheel in slow rotation.

Since such a wheel may be located near but not actually in the stream, it offers endless landscaping possibilities for a country home where a stream with sufficient flow is available. If a site on dry ground is chosen, the foundation may be constructed dry and the water led to the wheel and a tailrace excavated. With very little effort, the scene may be turned into an attractive garden spot, the wheel becoming both a landscaping feature and a source of power.

It should be noted, however, that an overshoot wheel is practical only for a small-capacity output. How much power it will

produce depends upon the weight of water the buckets hold and its radius, or lever arm. Expressed in another way, the output depends upon the weight of water transported and the height, or head, through which it falls while in the buckets. For maximum efficiency, the wheel must use the weight of the water through as much of the head as possible. Therefore, the buckets should not spill or sling water until very near tail water.

Power Increases with Width

Although of simple construction, an over-shot wheel is cumbersome in size. For this reason, before attempting to build one be certain you have the facilities to move and lift it into place when completed. Also allow yourself plenty of working floor space. It must be understood, too, that such a wheel is a sizable project and requires a lot of material and time. Extreme care in cutting and assembling the parts is not essential, however, because the wheel, operating at slow speed, need not be accurately balanced.

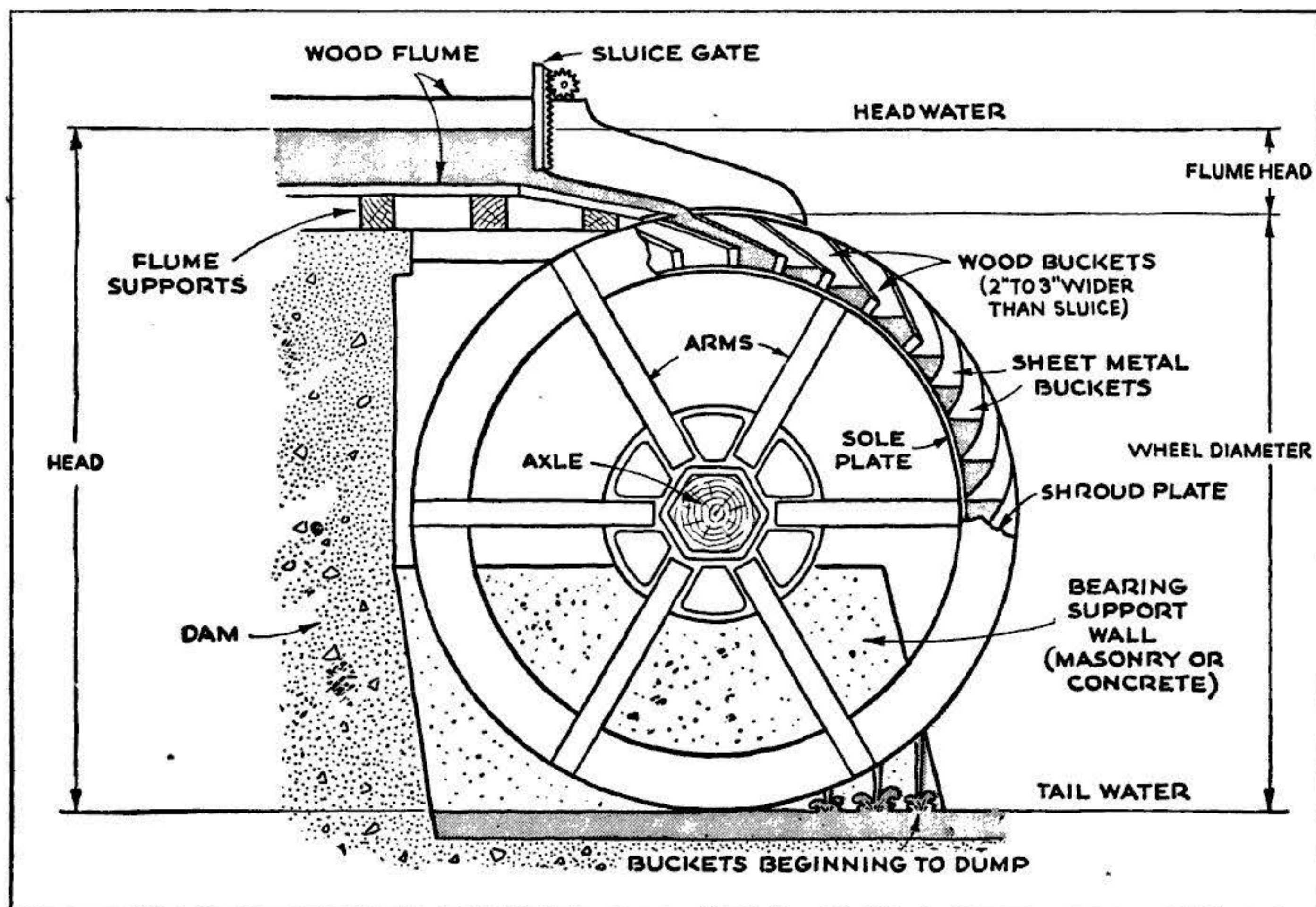
Accompanying this article are drawings that illustrate the construction of a small wheel suitable for a water head of 6' 3". The wheel itself has a diameter of 5', leaving a flume head of 15" to propel the water

into the buckets. As shown in the table at the bottom of page 195, you may build the wheel to give a power output ranging from ½ hp. to 1 hp. at 10 r.p.m. All dimensions remain the same except the width, the horsepower increasing as this is increased. For ½ hp., the wheel should be 15 31/32" wide. For 1 hp., it should be 31 29/32". Before deciding on the wheel size, you'll want to make a survey of the power available in the stream (PSM, April and May '47).

Virtually all large wheels are built with wood or steel arms, as in the drawing below, and have a shroud plate only around the outer edge, but you may find it simpler and more satisfactory to build the drum-type wheel described here. In this case, each shroud plate is a disk of ½" sheet steel. Each disk is braced by a ½" sheet steel sole plate to which it is continuously welded, by the buckets, by one of the two large diameter ¼" steel hub flanges to which it also is continuously welded, and by the long hub itself.

Large Sheet Required

If preferred, the shroud plates may be made of wood. If so, care should be taken to bolt them securely to the hub flanges. Bushings pressed into the wood for the bolts



For highest efficiency, the buckets must carry their load almost to tail water before beginning to spill.

will give the wheel a longer life expectancy.

Sheet steel for the disks may be ordered direct from several large steel companies in case your local supply house is unable to furnish it. Ordinarily, such steel comes in standard 48" widths, so you may have to weld together two or more sheets to get the required 5' diameter, using either a butt weld or a backing plate. This will produce some distortion or ripple, as will the welding on of the numerous clips required. So long as distortion is local, however, and the main lines of wheel and shaft remain true, this will do no harm.

• After the sheet has been prepared, scribe a 5' circle on it and cut it with the cutting flame of a gas welding torch. With ordinary care, this method should give sufficient accuracy. Vent and drainage holes should be drilled as indicated around each disk to lessen corrosion within the drum.

Good Buckets Important

The buckets are the most important element of the wheel. To give maximum efficiency, they must be formed so that the water enters smoothly at the top of their travel and remains in them until just before they reach the bottom. For this reason, the bucket form indicated on the facing page should be followed faithfully. Either sheet metal or wood is an acceptable material, but metal is better suited to cold climates, since wood is damaged when absorbed water freezes. Because the buckets are subject to wear from the water and sediment that it carries along, you may want to install them so they can be easily replaced.

In laying out and making wooden buckets, follow these steps:

Using a common center, strike off two arcs, one with a 21½" radius and the other with a 2' 6" radius. Then draw a radius line intersecting these arcs.

From the point where the radius crosses the inner arc, measure 2¾" farther along the line and mark the point *E*.

From the point where the radius crosses the outer arc, draw a chord 10½" long and from the new point where this intersects the outer arc draw a line to point *E*. You now have the inner trace of the bucket.

Take a piece of the bucket stock and lay it along the upper edge of this inner trace and draw a line representing the thickness of the stock. Repeat this along the outer edge of the inner trace, and you have a cross section through the bucket. Cut your stock

accordingly, making the length equal to *B* in the table of dimensions.

Steel Buckets Require Jig

Steel buckets are only slightly more difficult if you follow these steps:

Using a common center, strike off two arcs on a piece of plywood, one with a 21½" radius and the other with a 2' 6" radius.

Draw a radius line and then a tangent to the inner arc, making it vertical to the radius. From the point of tangency, measure 5" along the tangent. Mark this point.

Using this mark as a center, strike off an arc with a 5" radius. This is part of the inner trace of the bucket.

At the point where the original radius line (Step 2) crosses the outer arc, draw a chord 10½" long, and at point *F* where this chord intersects the outer arc draw a new radius line. Also at point *F* measure off 15 deg. below the new radius and draw line *FG* 11½" long.

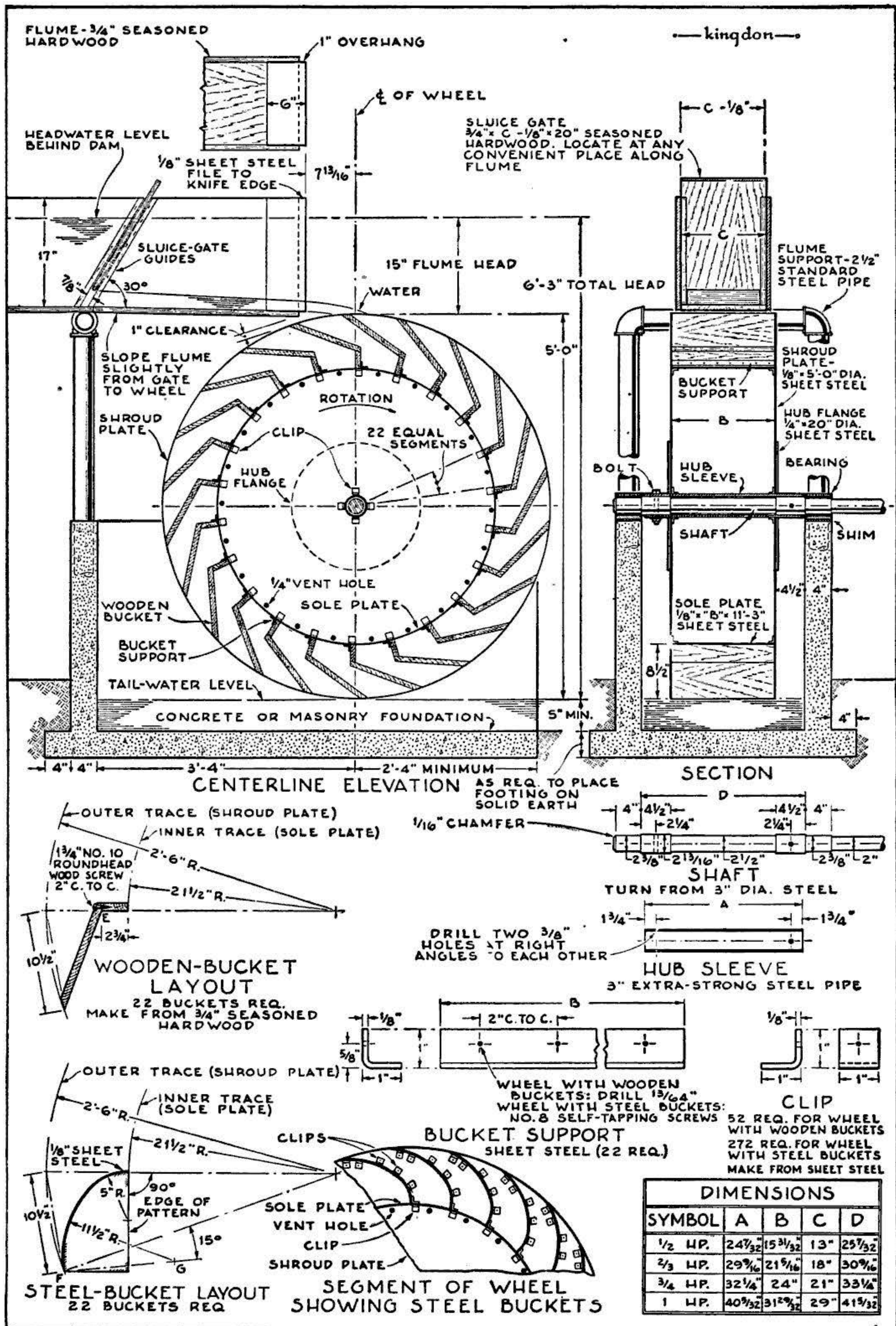
Then, using *G* as a center, strike an arc with a 11½" radius. This forms the rest of the inner trace of the bucket.

Cut the plywood along this line and along the lines that form a quarter ellipse. Using this as a pattern, cut several more quarter ellipses from scrap. Nail these to stretchers to make a bending jig around which the buckets may be formed.

Weld Wheel Parts

Welding of the various parts of the wheel produces an exceptionally strong construction. After getting together or making all the required parts, begin the assembly by welding four clips to each end of the hub sleeve. Then weld the required number of clips to the shroud plates for the sole plate, and weld the shroud plates to the clips on the hub sleeve. After welding both hub flanges to the shroud plates and the sleeve with a continuous weld, attach the sole plate to the clips on the shroud plates with No. 8 self-tapping screws. Also weld the sole plate to the shroud plates with a continuous weld, and the bucket-support angles to the sole plate.

Attach wooden buckets to the supports with ¾" No. 10 roundhead wood screws, and then drill holes 2" from center to center through the shroud plates for 1¾" No. 10 roundhead wood screws. If you use steel buckets, rivet or screw 10 clips to each side of each bucket and attach the buckets to the angles with No. 8 self-tapping screws. Then



Increasing the width of the wheel will boost its horsepower output. All other dimensions remain the same.

drill holes through the shroud plates in the way of the clips for the same type of screws.

Lubricate Bearings Well

Using locknuts and washers, fasten the hub sleeve to the shaft with two $\frac{3}{8}$ " by $4\frac{1}{2}$ " bolts, placed at right angles to each other. Two bearing mountings having $2\frac{3}{8}$ " renewable liners with shoulders should be bolted to the foundation. Place shims about $\frac{1}{4}$ " thick under the bearings.

Standard bearing mountings, variously called pedestals or blocks, may be bought complete with wick oiler or cup oil reservoir and with built-in self-aligning features. Standard bronze bearing metal liners or inserts likewise may be bought from any machine component supplier. Babbitt liners are equally satisfactory.

Although the wheel turns slowly, it is heavy and will be running almost constantly, so good lubrication of the bearings is essential. To this end, care should be taken to insure that the bearing liners are finished to the correct fit. Porous inserts or inserts containing graphite are excellent for this application, but may cost more than regular bearing inserts.

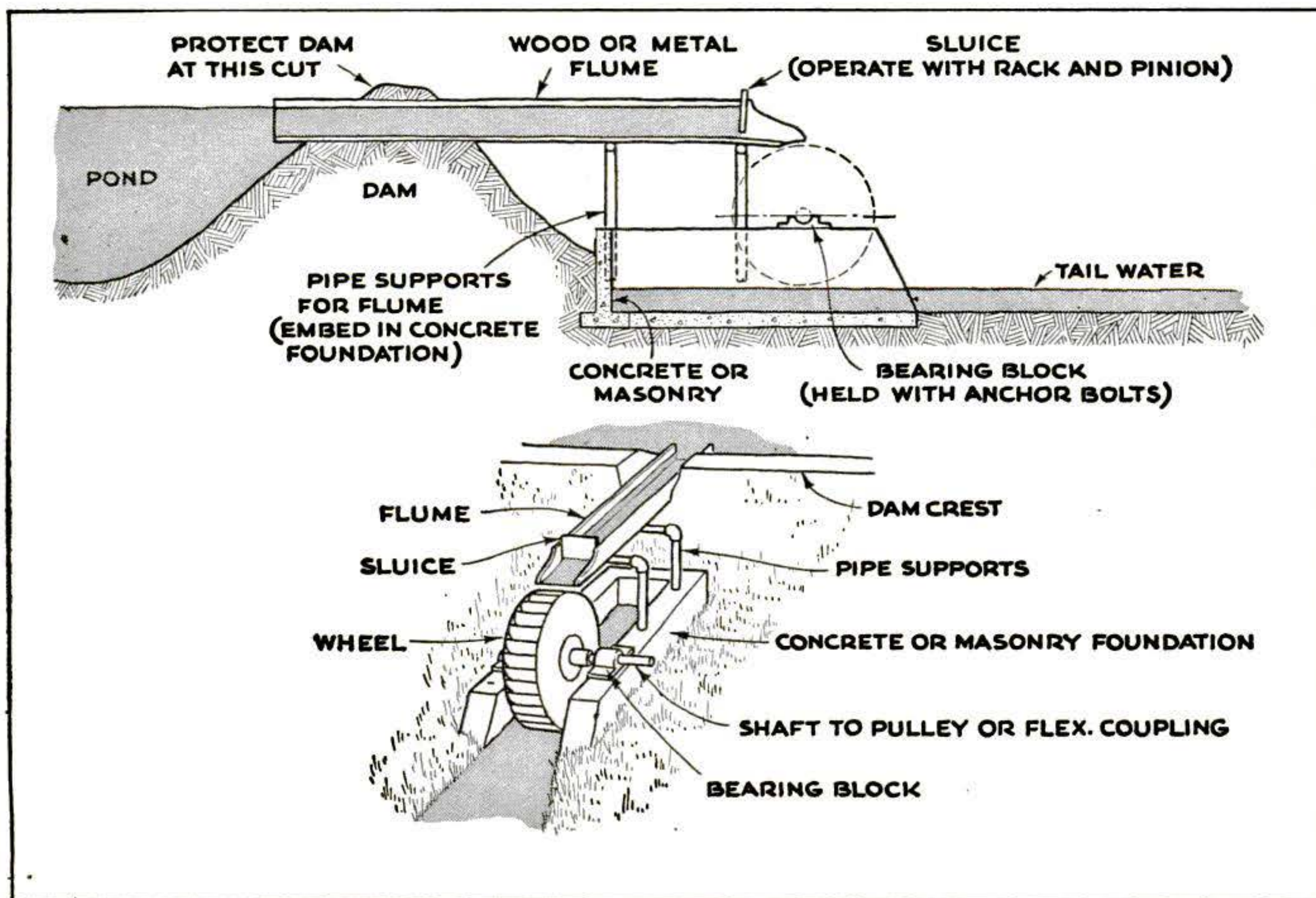
It is important that the foundation be carried deep enough so that water falling from

the buckets will not undermine it. Avoid a long flume if possible, in order to keep the construction as simple as possible. Strengthen it along its entire length with an exterior frame and support it well from dam to wheel with pipe uprights.

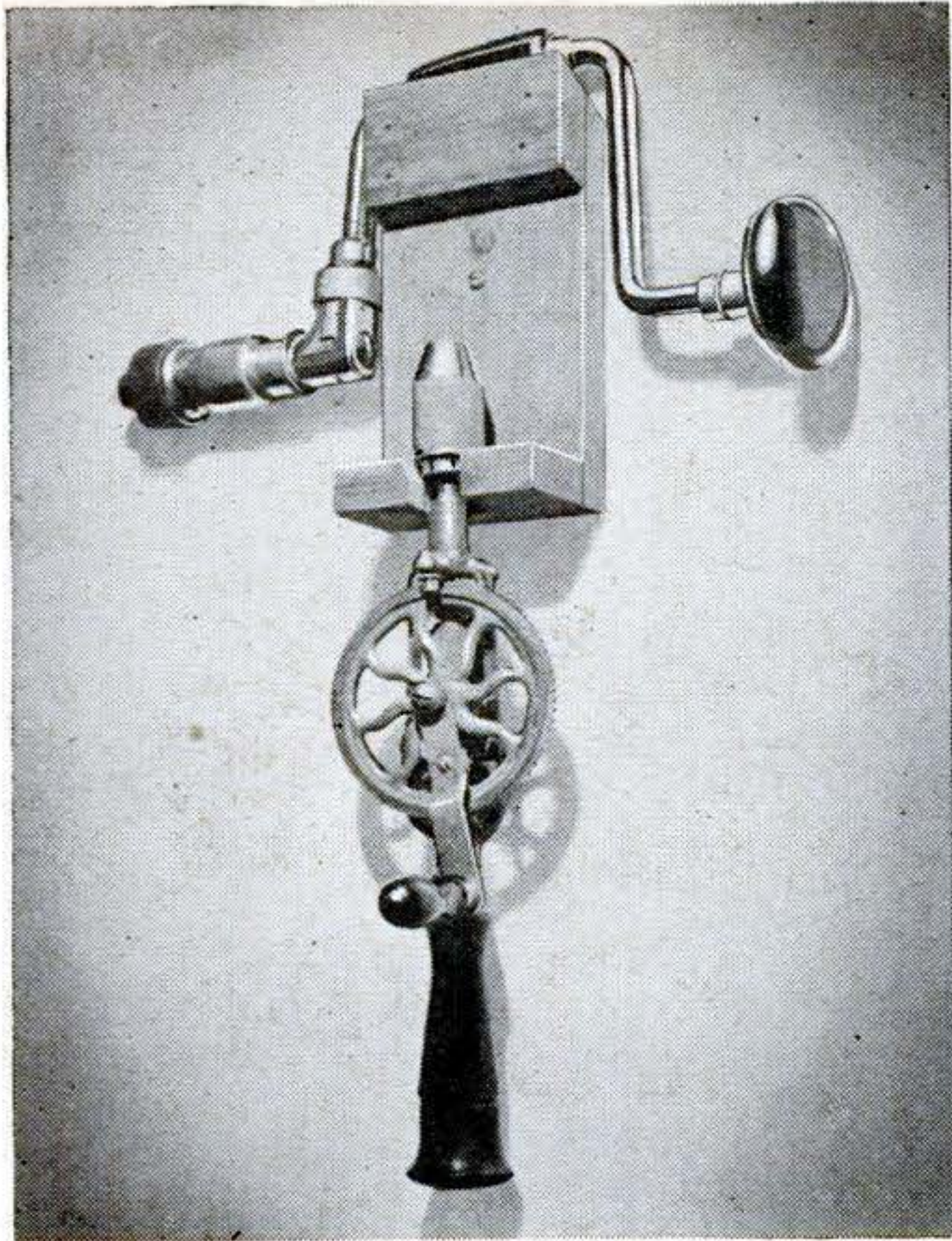
Sluice Governs Wheel

The sluice gate may be located at any convenient place along the flume. Since it is the governing mechanism of the wheel, its installation should be anything but slipshod. If it is installed at an angle as on page 195, water pressure will keep it at any desired position. If installed vertically, some mechanism, such as a rack and pinion, should be provided to keep it in place.

Adjust the sluice so that the buckets will run one-quarter full. This will give a wheel speed of 10 r.p.m. If the buckets are allowed to run more than one-quarter full, the efficiency of the wheel will drop for two reasons. Because of the increased speed, centrifugal force will throw water from the buckets. They also will begin to spill before approaching tail water. Although this practice does waste water, it may be profitably employed during a freshet to increase the power output, for at such times the excess water would be wasted anyway. **END**

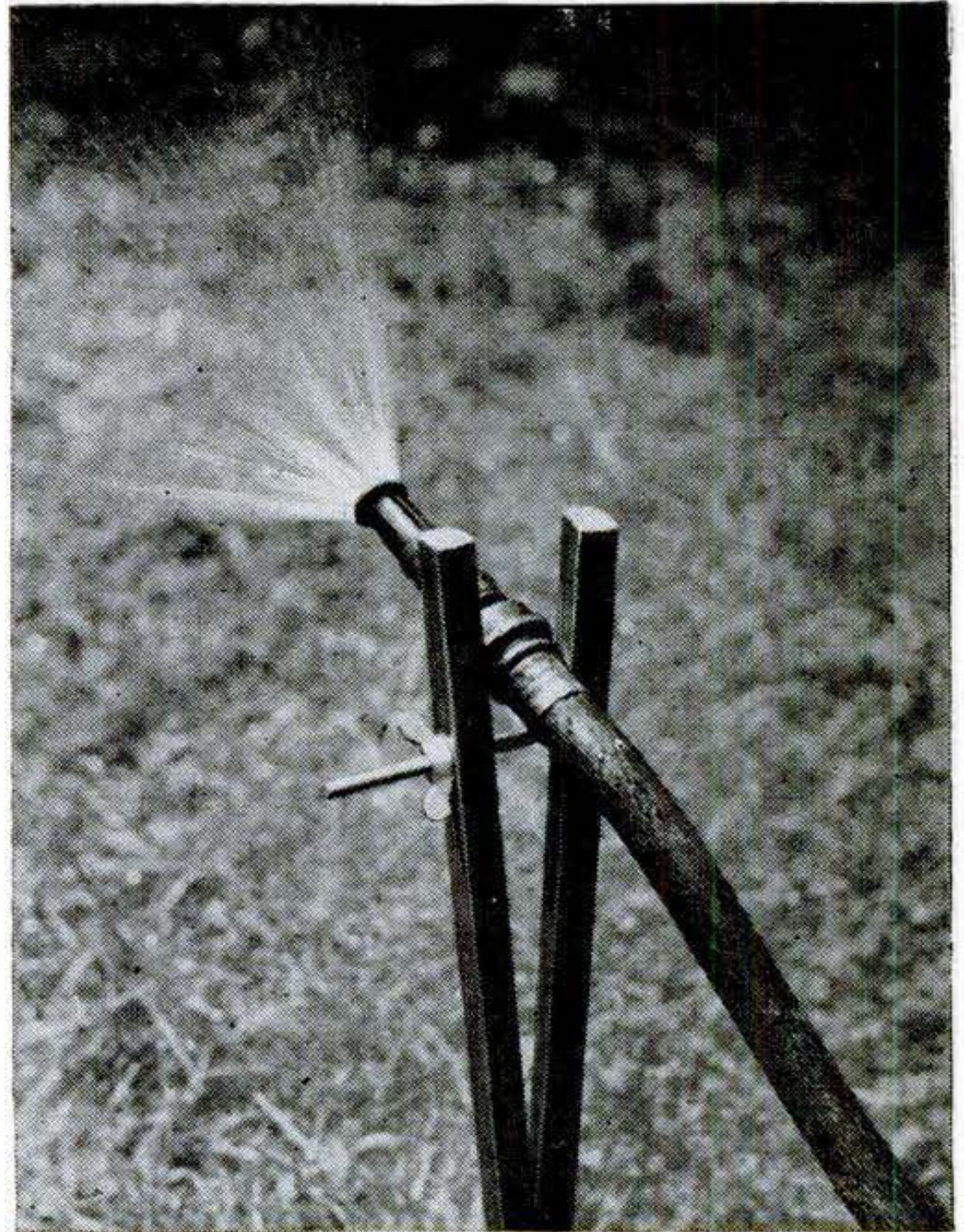


As the headwater rises or falls, the sluice gate may be adjusted to meter the correct flow to the wheel.



Rack Holds Boring Tools

YOUR brace can be kept near your hand drill in a rack like that shown above. Bevel both the backplate and block toward the wall so the brace can't fall off. If you have both a breast drill and a hand drill, the lower rack may be notched on the sides instead of the front in order to accommodate them.—JAMES A. RICHARDS.



Wing Nut Clamps Hose Stand

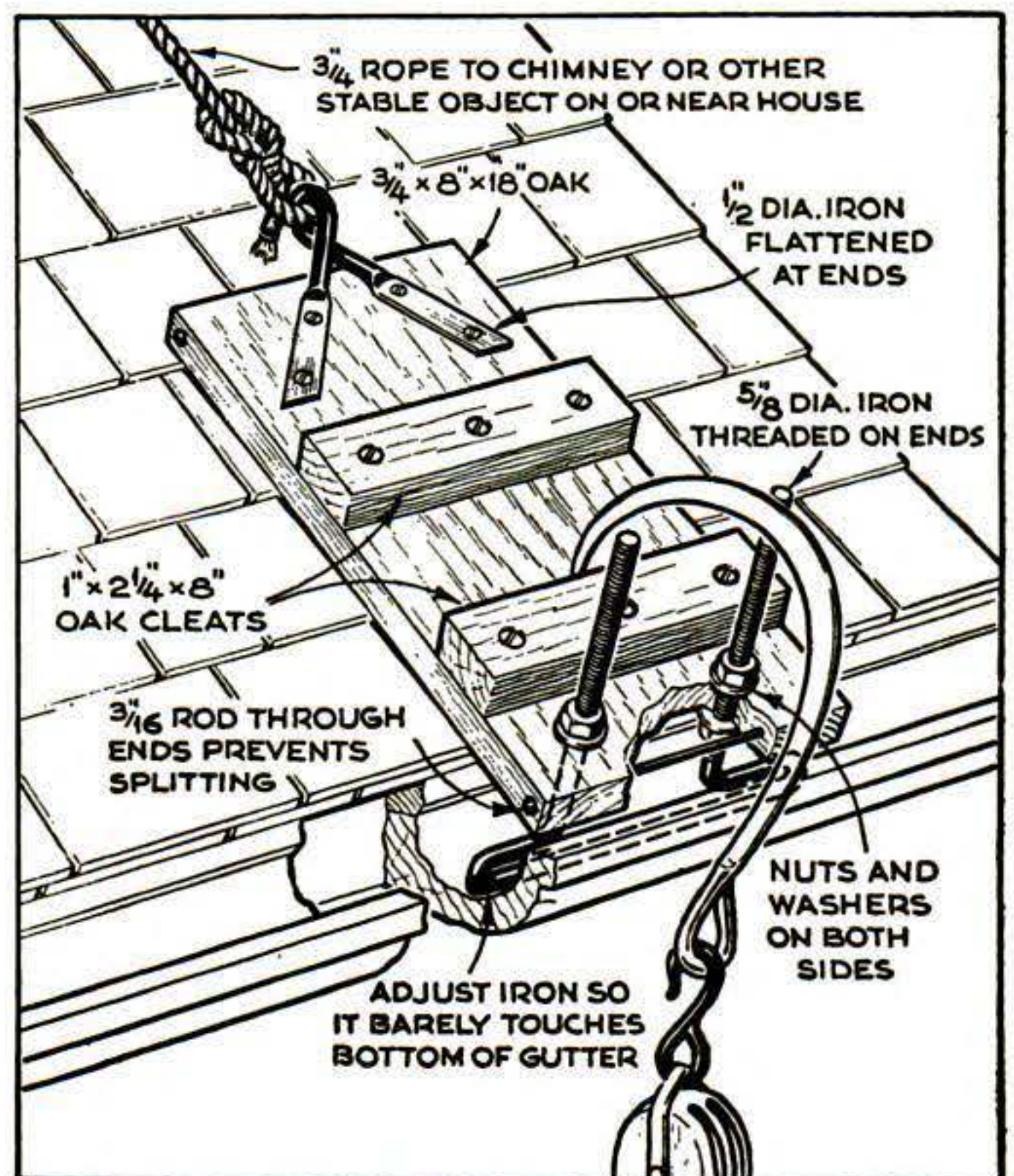
THIS Y-shaped stand made from two unequal lengths of 1" by 1" stock will hold a garden hose for spraying. A bolt equipped with a wing nut is inserted for a clamp about 3" from the end. Bevel the bottom of the short piece and screw or bolt it firmly to the long one. Push the long end into the ground up to the crotch.—HAROLD EPSTEIN.

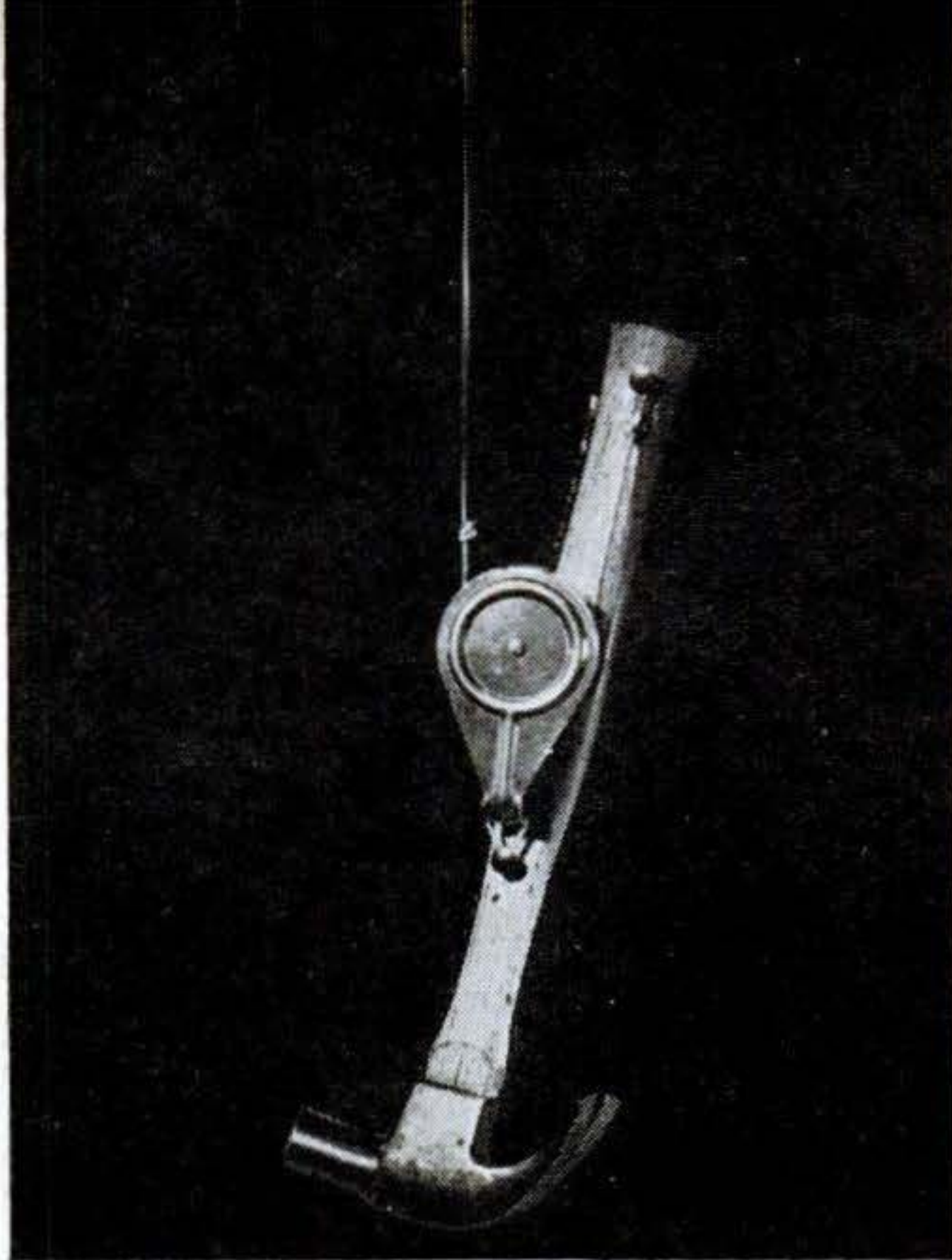
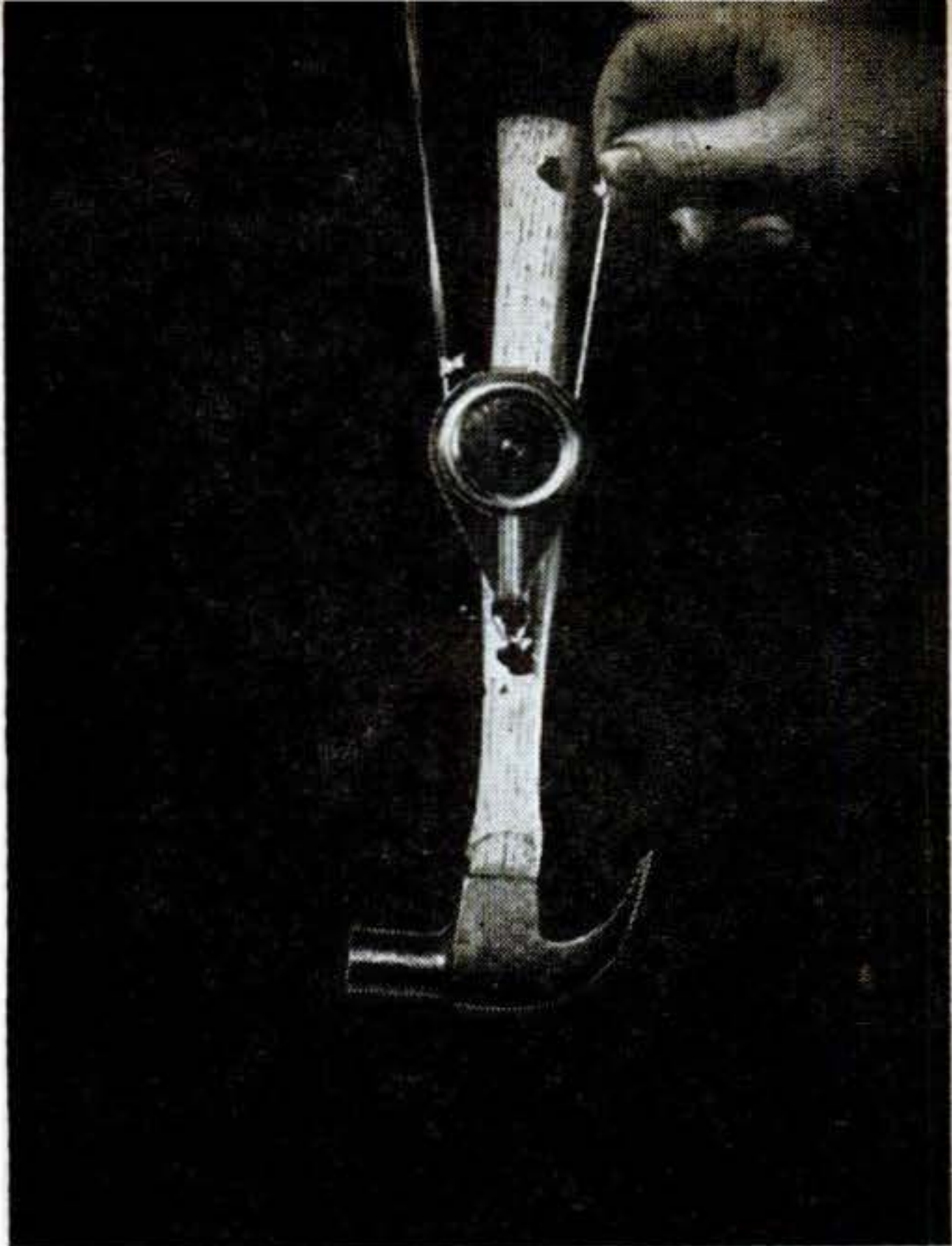
Cleated Roof Board Anchors Hook Supporting Scaffold

ONE way to support a scaffold from the sloping side of a roof is with cleated oak boards tied fast to a chimney or some other solid projection on or near the roof. The one shown has a bent U-shaped iron in the end that fits lightly against the inside of the gutter to prevent slipping when weight is shifted on the scaffold.

Threaded ends on the "U" with nuts and washers on both sides of the board provide a means of adjustment so none of the weight of the stage will be put on the gutter. Unless you have means of forging iron, it may be necessary to have a blacksmith bend the side curves in this piece and also shape the iron to which the anchor rope is tied.

Drill crosswise through both ends of the main board and drive rods through to prevent splitting.—HAROLD R. TERPENY.

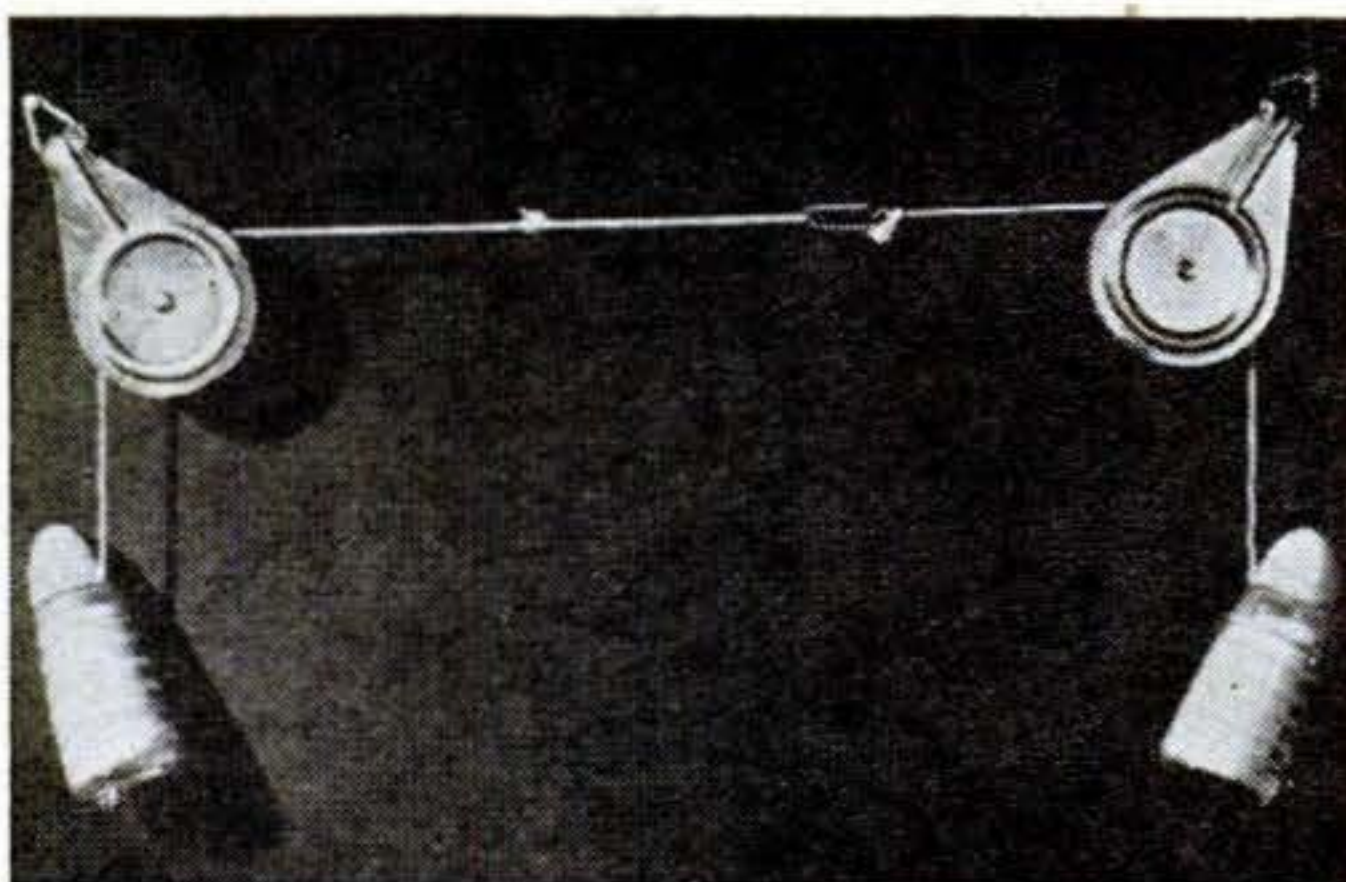
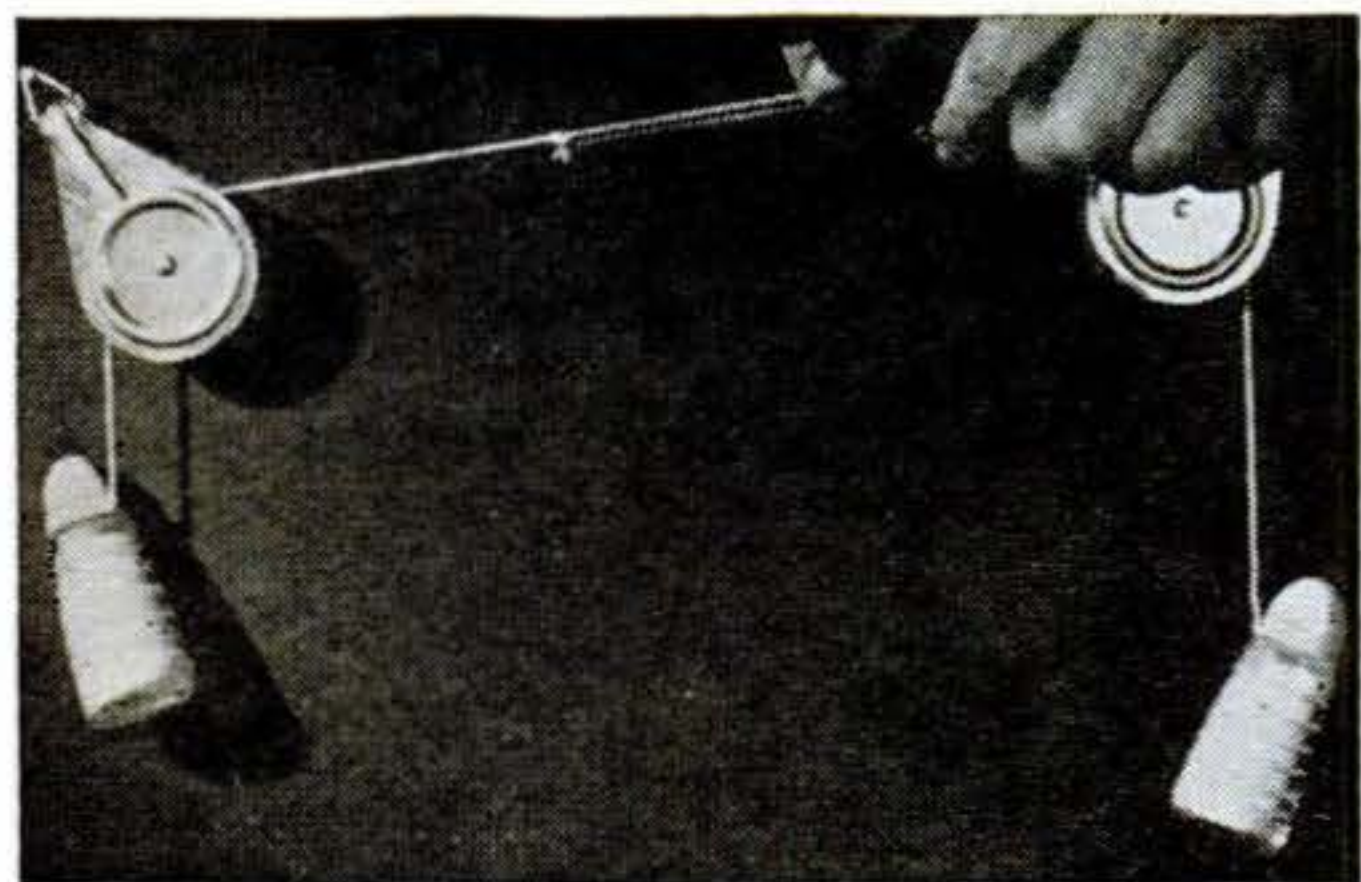




Sharing the Weight. With a pulley and thumbtack on the handle of a hammer, you can demonstrate the mechanical advantage a pulley gives. Attach a rubber band to a nail in a wall, tie a cord to it, pass the cord over the pulley, and hold the end even

with the tack (left above). But hook the cord to the thumbtack, and the rubber band stretches far more. This is because half the weight was supported by your hand in the first case. Rubber bands give clues to mechanical laws by making stresses visible.

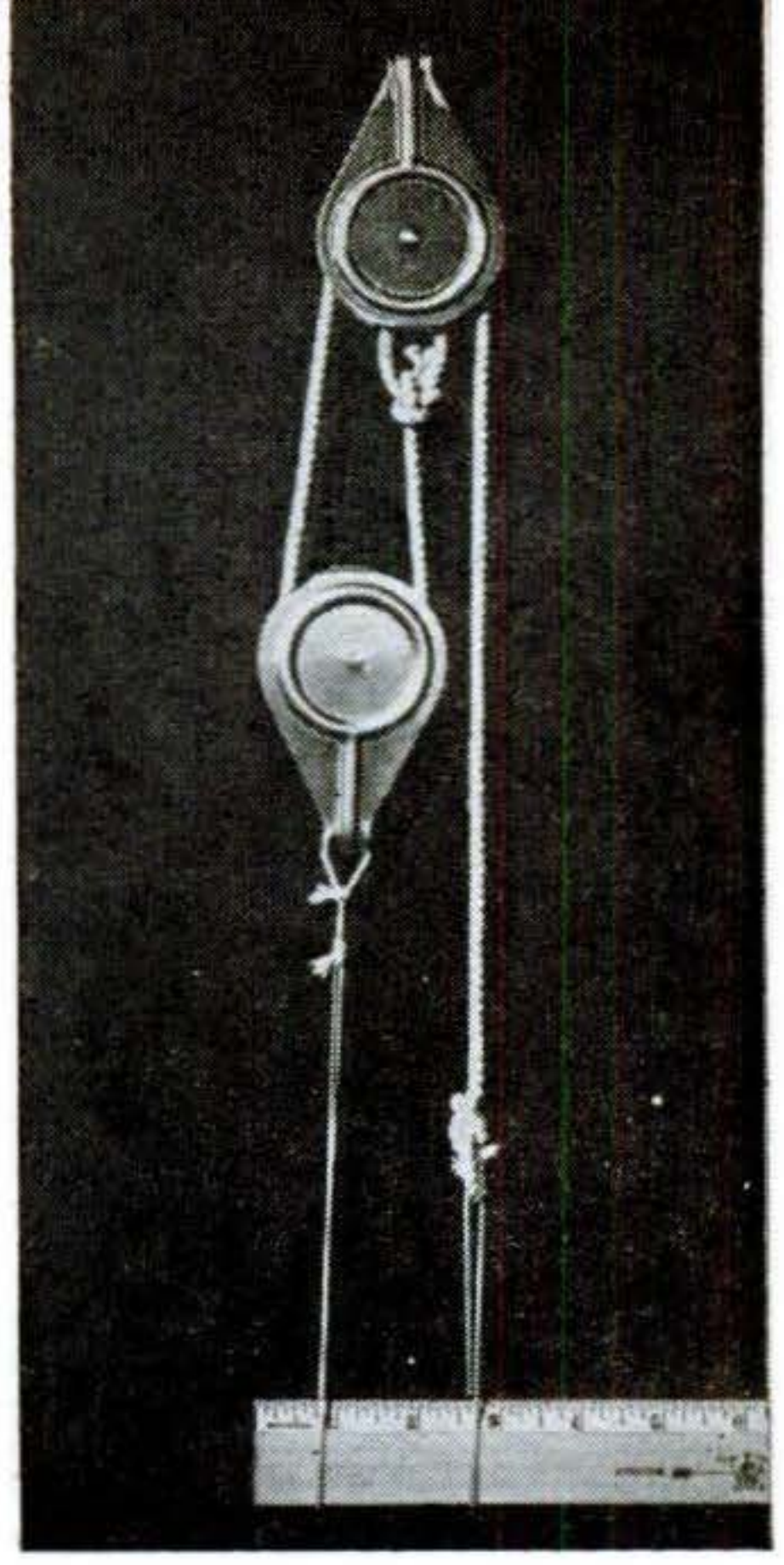
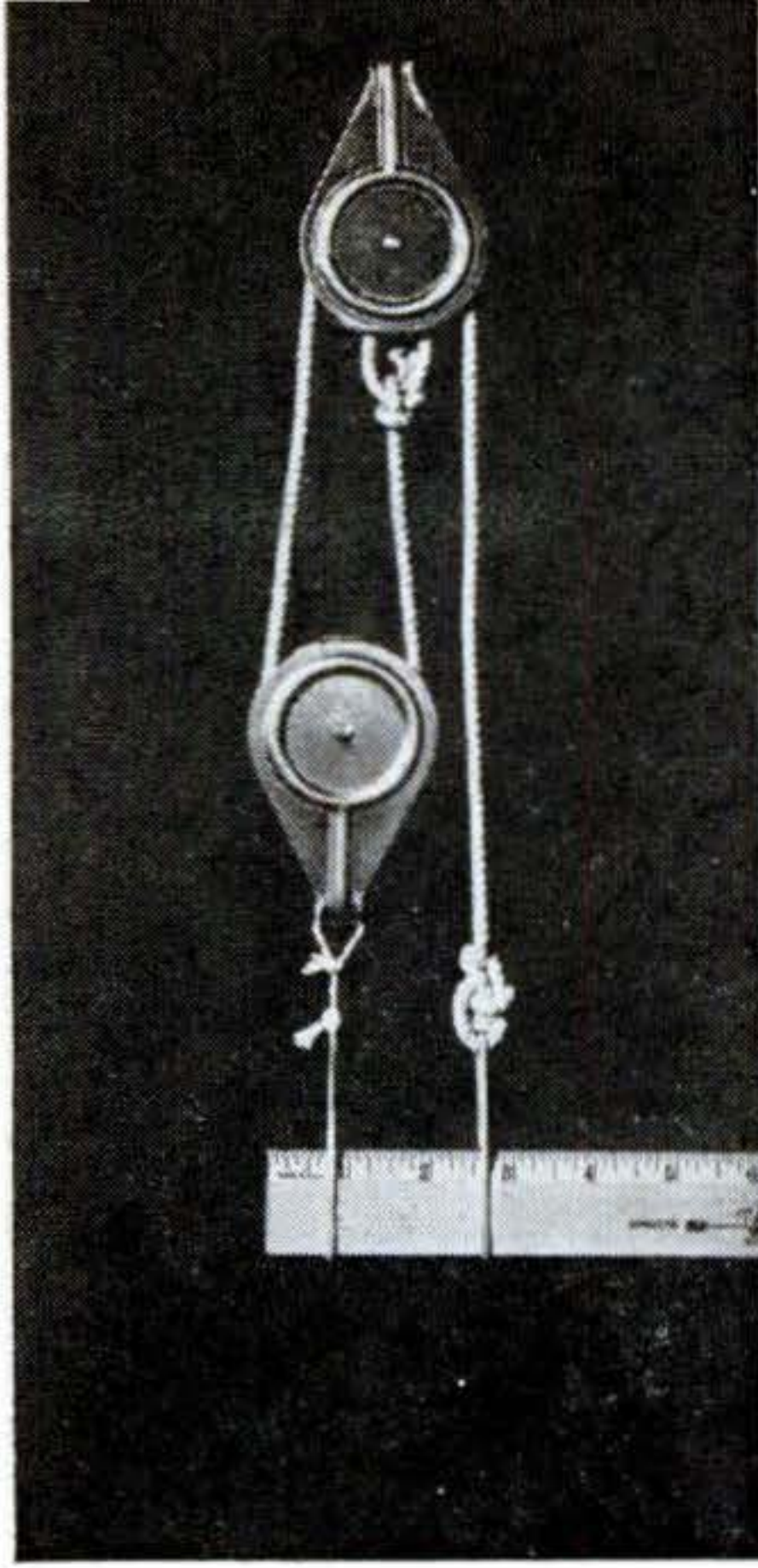
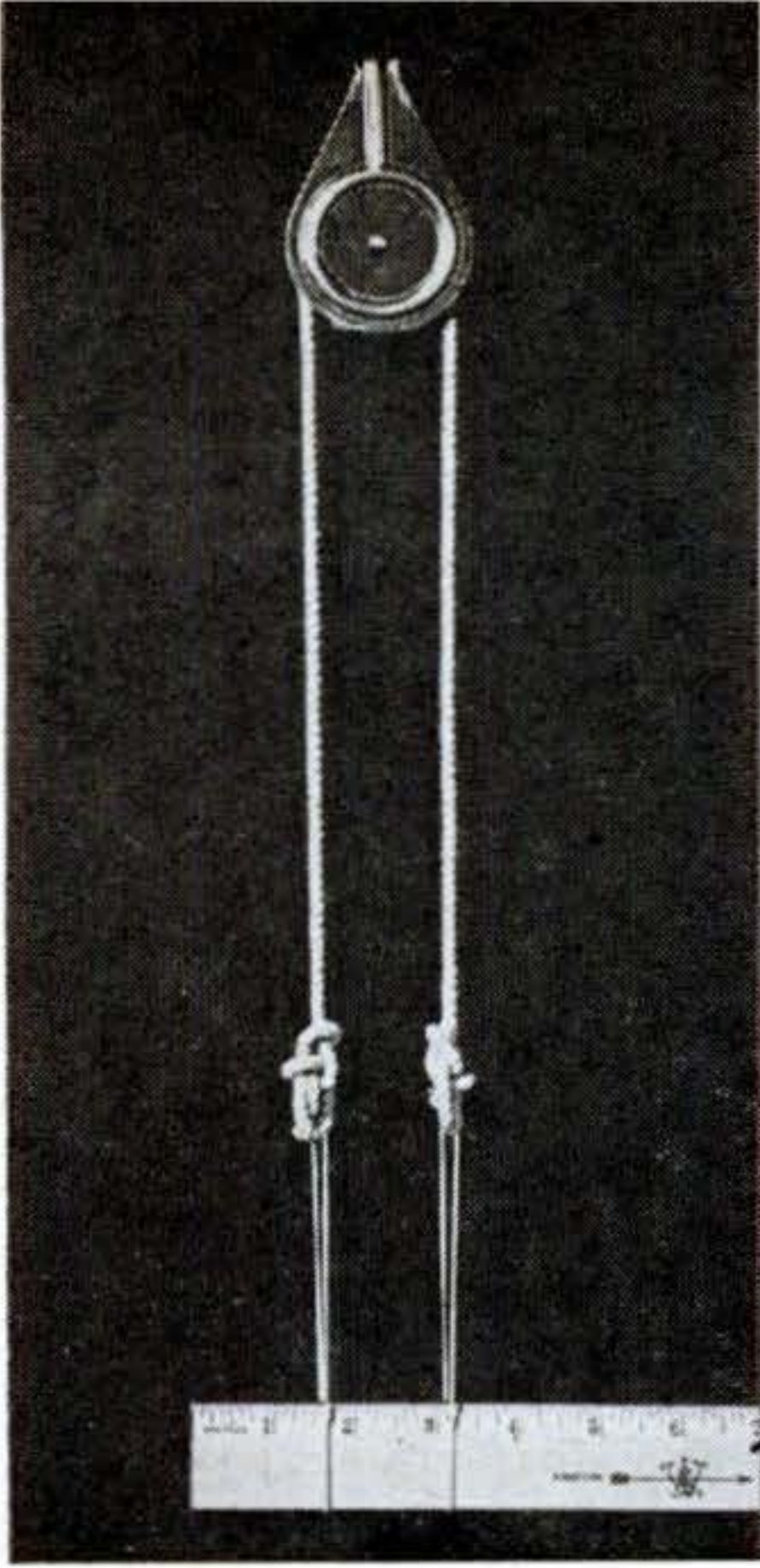
Rubber-Band Models



Tug-of-War Paradox. Do two teams exert more force on a rope than one team would alone? Try it with a rubber band and two cords tied to it and passed over pulleys. Hold one end of the band and note its stretch under the weight of a saltcellar tied to the cord. Now tie on a second saltcellar and let its weight pull against the

first. The stretch will remain the same because the second saltcellar merely replaces the pull of your hand.

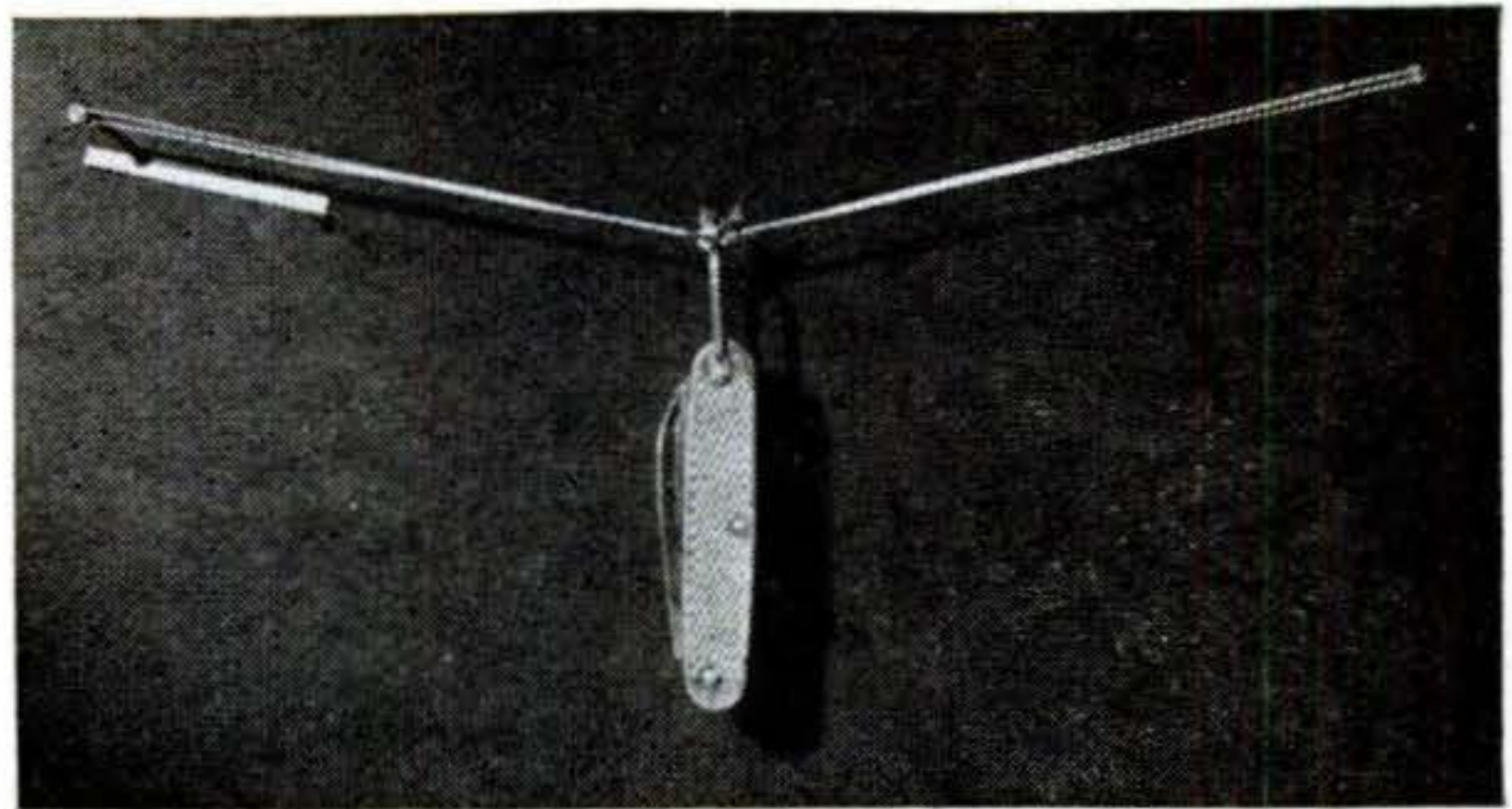
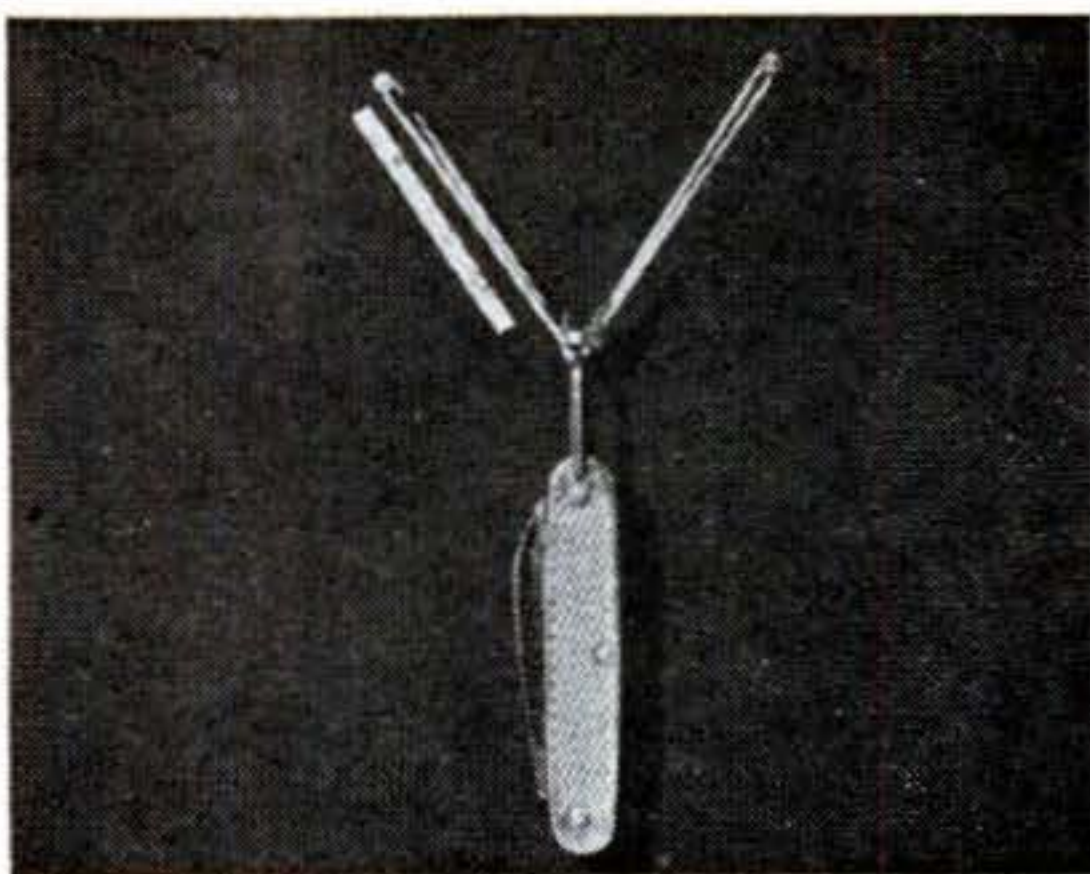
While demonstrations with rubber bands show at a glance which forces are greater than others, the stretch of rubber is too erratic to indicate the exact amount of the forces exerted.



Principle of Pulleys. Attach two matched rubber bands to the ends of a cord passed over a single pulley and exert force on them with a ruler. They will stretch the same amount. Rig a second pulley into the setup, as at center above. When no force is

exerted on the ruler, there will be no stress on the bands, and consequently they will be of equal length. But pull down as at the right, and the force exerted by the movable pulley will be greater. Such a system is said to have a mechanical advantage of two.

Show Laws of Mechanics



Suspension Engineering. When is a bridge safe? Tie two matched and equal bands together and fasten a light weight at their juncture. Cut a strip of paper to the unstretched length of one band. If you hold the bands so that they are vertical and parallel, the weight will hardly stretch them at all, but if, as at left above, you spread

them at a small angle, the stretch increases perceptibly. If the bands are spread so they approach a straight line with each other, right, the same weight produces a vastly greater stretch. In back-yard hammocks or great steel suspension bridges the same principle applies: the more the suspending cords droop, the less strain there is on them.



MINIATURE OIL REFINERY MAKES GASOLINE. Mineral oil is broken down like petroleum in this home-lab cracking plant consisting of two test tubes and a Bunsen burner. The wing-tip flame spreader heats both the oil and steel wool packed loosely in the neck of the test tube at left, driving off gas and gasoline into the tube at right. Vapors escaping from the jet in the side neck will burn with a bright flame when ignited. Crude oil is at present our most important source of hydrocarbons, containing as it comes from the ground several dozen—most of them liquids, but some gases and solids.

Chemists Build with Hydrocarbons

By **Kenneth M. Swezey**

FEW of us may recognize hydrocarbons by their technical names, but they are really the most familiar, plentiful, and useful of organic chemical compounds. As the chief constituents of coal, petroleum, and natural gas, they supply nearly all the fuel used for heat and power. Like molecular blocks, they form the starting point for synthesizing dyes, drugs, explosives, plastics, nylon, synthetic rubber, and other modern marvels of the chemical laboratory.

As the name suggests, hydrocarbons are composed of hydrogen and carbon. Because of the ability of carbon atoms to link up with other carbon atoms to form chains, rings, and more complex molecular structures, hundreds of different hydrocarbon compounds are known. A few of the simpler ones can be experimented with your home lab.

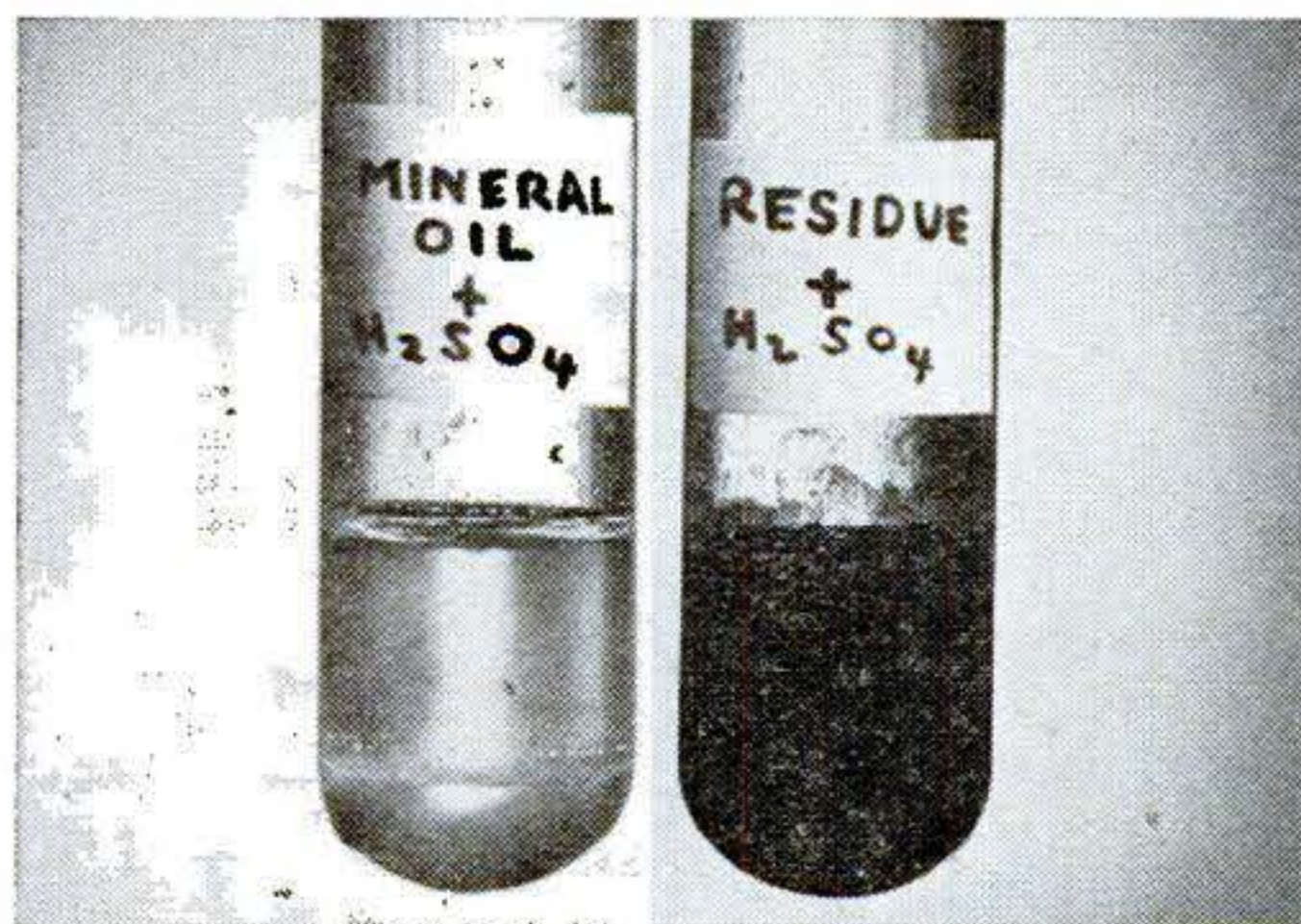
Hydrocarbons fall into several distinct series, the chief of which is called the *paraffin series* because many of its components are in paraffin. The simplest member of this series is the gas *methane*, which consists of

one carbon atom surrounded by four hydrogen atoms. Then next comes another gas, *ethane*, consisting of two atoms of carbon and six of hydrogen. In this regular order—always increasing by one carbon atom and two hydrogen atoms—the series continues until finally we find giant molecules of 60 carbon and 122 hydrogen atoms.

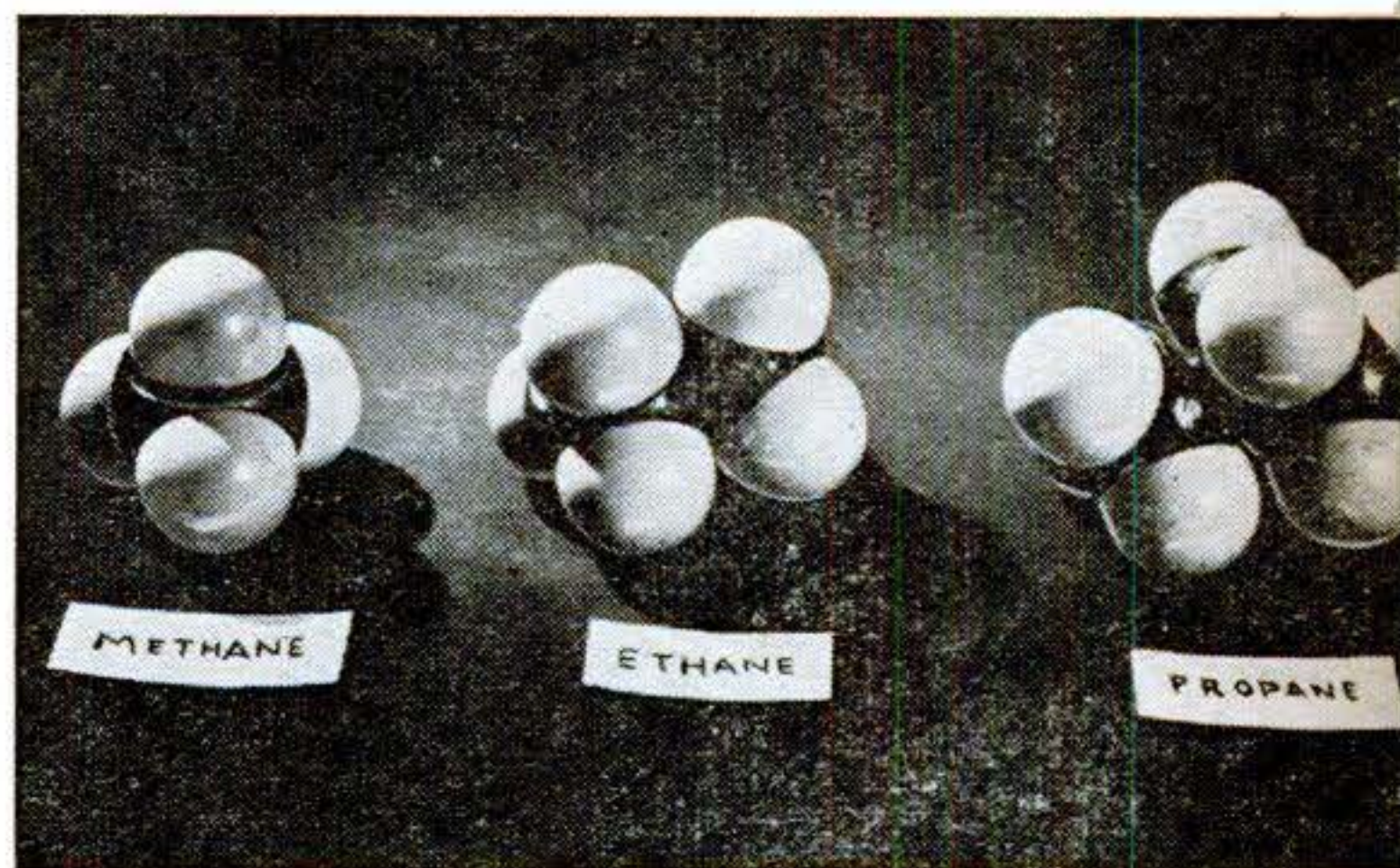
Physical characteristics change uniformly as molecular size increases. The first four members of the series are gases; the next four are components in variable degree of gasoline; then follow kerosene, heating oil, Diesel oil, and finally heavy lubricating oils, grease, and paraffin wax.

When crude oil, or petroleum, which contains dozens of hydrocarbons, is heated to about 300 deg. C. and passed as hot oil and vapor into the bottom of a high "fractionating" tower, gas and gasoline are drawn off from the upper part of the tower and naphtha, kerosene, gas oil, and heavy oil from progressively warmer lower sections.

New techniques enable chemists to link light gas molecules in the series to make heavier liquids as well as to "crack" heavier members to make lighter ones. Gasoline is



SATURATED HYDROCARBONS. Chemically inert, molecules of mineral oil and related hydrocarbons hold all the hydrogen atoms they can, but cracked molecules are deficient in hydrogen. Sulphuric acid has no effect on mineral oil, but reacts with the residue from cracking and turns it brown.



PROGRESSIVE SERIES. Saturated hydrocarbons belong to the paraffin series. The members start with molecules containing one carbon atom and four hydrogen atoms, and progress in regular order by always adding one carbon and two hydrogen atoms. The lightest are gases, the heaviest solids.

produced by both building up small molecules and breaking down big ones.

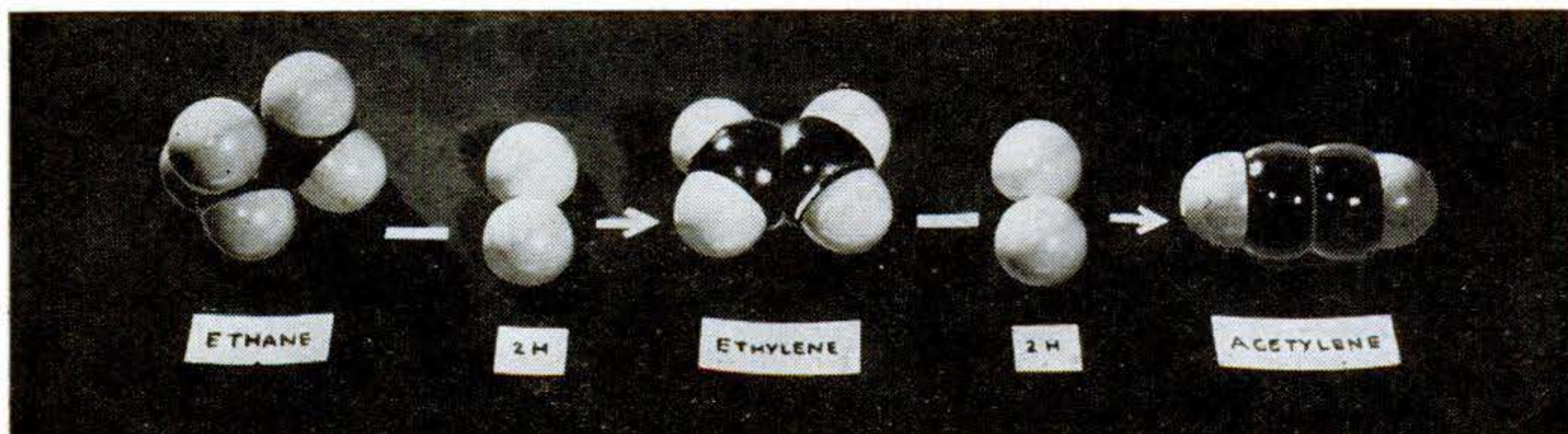
Though crude oil is generally cracked in industry by the use of heat, pressure, and catalysts, you can demonstrate cracking by the use of heat alone. The apparatus is shown in the photo on page 200. Pour 5 ml. of mineral oil in the test tube at left and fill the upper part with loosely packed steel wool. Through a one-hole cork stopper (the heat and oil will destroy rubber) run a bent glass tube and extend the tube through another one-hole stopper to within 1" of the bottom of the side-necked test tube shown at right. Draw another glass tube into a jet and attach it to the side neck with a short rubber coupling. The wing-tip flame spreader of the Bunsen burner heats both the oil and the steel wool above it.

Start heating gently, and increase the

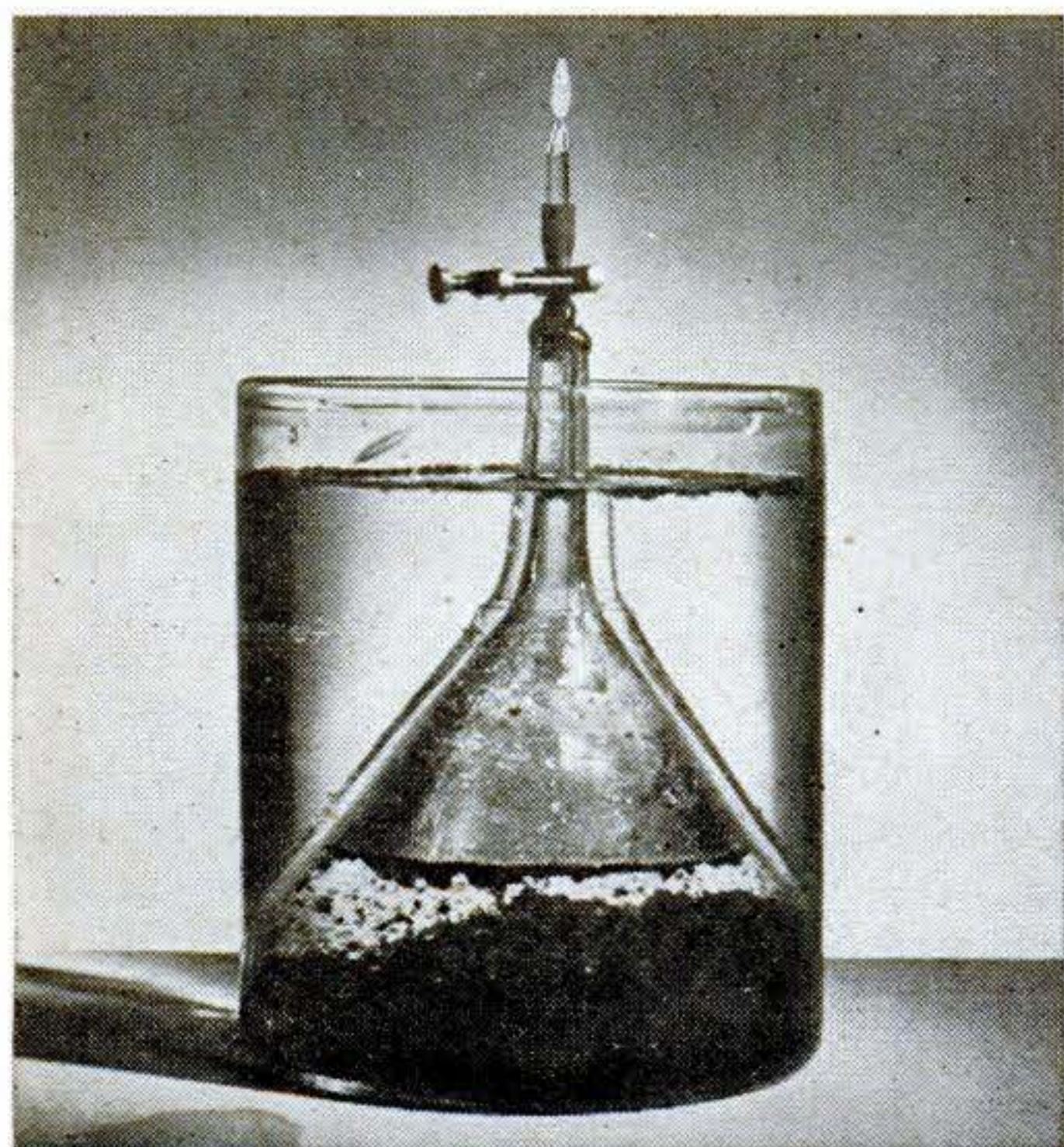
heat gradually. When the oil boils, white fumes will pour into the side-necked tube, some streaming from the jet. In passing through the hot steel wool, some of the molecules of the oil vapor are cracked, or broken down, into smaller molecules much as they are in commercial gasoline cracking plants. A match applied to the jet ignites the mixture of gas, gasoline, and other vapors, and they burn with a brilliant flame.

Hydrocarbons of the paraffin series are colorless and show little or no reaction with most reagents. In fact, the name paraffin comes from the Latin *parum*, "little," and *affinis*, "akin." Shake some pure mineral oil with an equal amount of concentrated sulphuric acid, and there will be no discoloration or other sign of reaction.

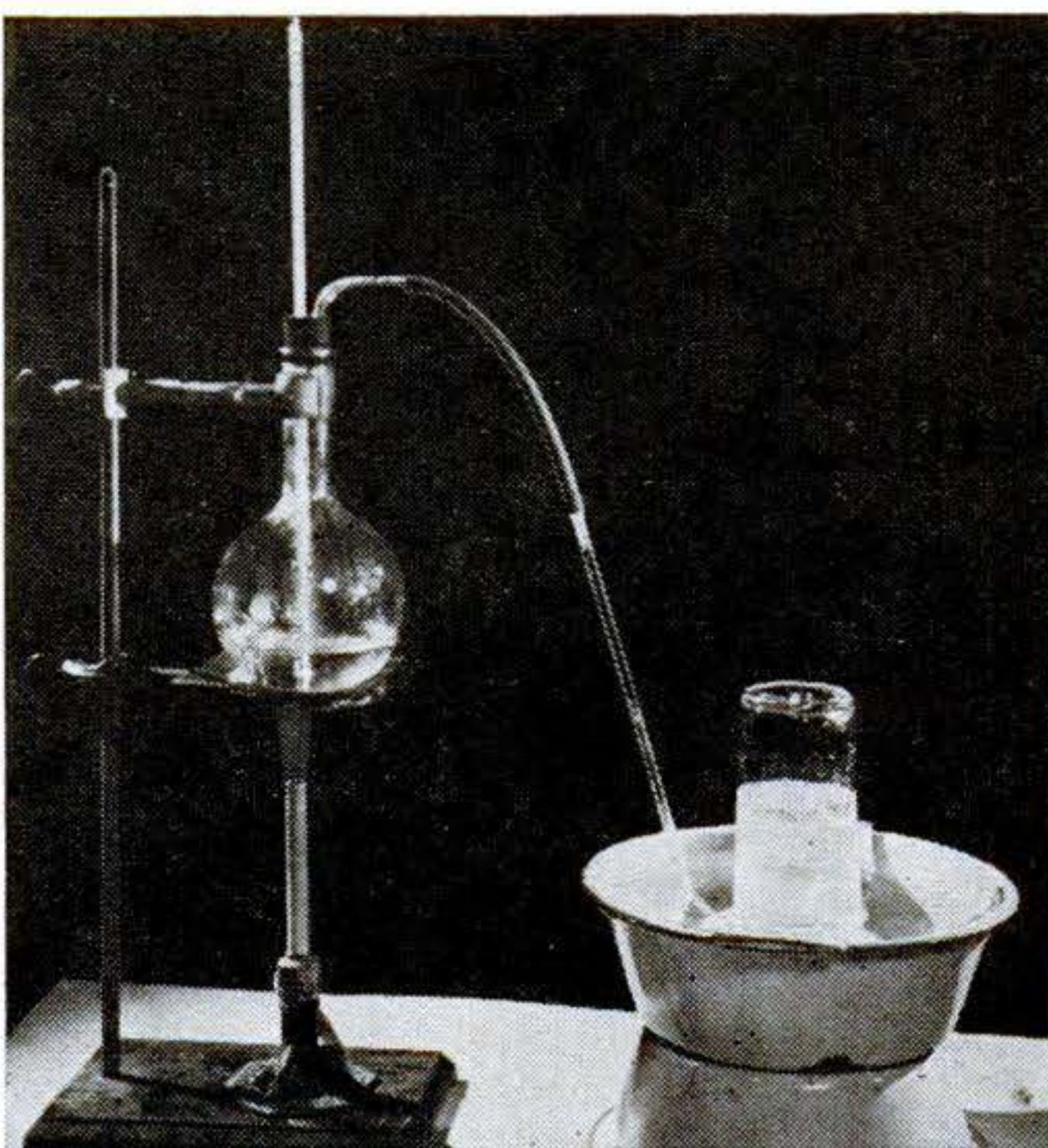
One reason for this inertness is that all possible places at which other atoms can



One method of forming unsaturated hydrocarbon compounds is by breaking off hydrogen atoms from saturated hydrocarbons. Ethylene can be made by taking two from ethane, acetylene by subtracting four.



METHANE COMES FROM COAL. That this gas is given off spontaneously can be shown by covering powdered coal with water. Methane collects in the funnel after several days and can be burned.



ETHYLENE IN THE HOME LAB. Ethyl alcohol mixed with concentrated sulphuric acid and heated gives off ethylene. The gas can be collected by displacing water in an upturned tumbler.

combine with the carbon atoms are already occupied by hydrogen atoms. Because of this, members of the paraffin series are known as "saturated" hydrocarbons. When a paraffin hydrocarbon is broken down by cracking, however, there are not enough hydrogen atoms available to fill all the places on the two resulting molecules. One of these, no longer a member of the series, becomes an *olefin*, a type of "unsaturated" hydrocarbon.

Some of these olefins condense in the bottom of the side-necked test tube when the mineral oil is cracked. When a little of this residue, or condensate, is shaken with concentrated sulphuric acid, the unsaturated olefins react immediately with the acid and become dark brown.

Methane is sometimes called "marsh gas" because it is the gas formed by decaying vegetable matter in marshes and stagnant pools. It also issues from coal seams and, mixed with air, has been the cause of mine explosions. Most important is its occurrence as the chief constituent of natural gas.

To show how methane is given off slowly and spontaneously by coal, heap a large handful of finely pulverized coal in the bottom of a large can or jar of water and place an inverted glass funnel over the coal. Attach a glass jet to the end of the funnel by means of a short length of rubber tubing. Prepare the apparatus by sucking

up water to fill the funnel tube, and close off the rubber with a pinchcock. After several days, the methane gas will rise from the coal and drive some of the water from the funnel. Open the pinchcock and ignite the gas. It will burn with a hot, pale flame.

Unsaturated hydrocarbons are obtained also by breaking off hydrogen atoms from members of the paraffin series. The gas, ethylene, C_2H_4 , comes from taking hydrogen from ethane, C_2H_6 . Ethylene helps make illuminating gas luminous, helps to ripen fruit, and is an anesthetic and a reducing agent in chemical synthesis. It can be made by heating ethyl alcohol with sulphuric acid.

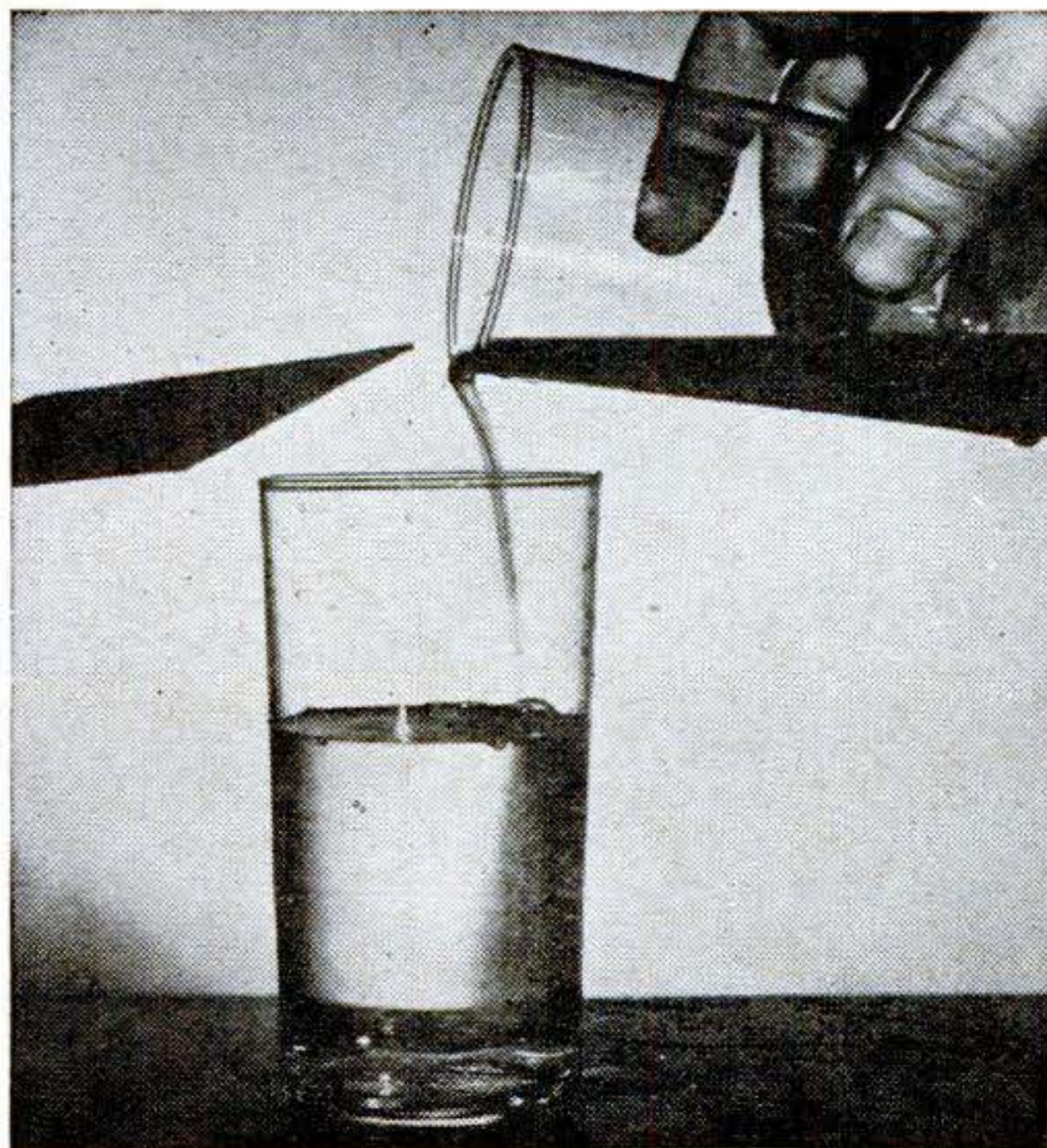
Pour into a 500-ml. flask 20 ml. of 95-per cent ethyl alcohol (denatured alcohol will do) and 50 ml. of concentrated sulphuric acid. Add 10 grams of powdered pumice or anhydrous aluminum sulphate to help the reaction. Shake thoroughly, and then support the flask on an asbestos-center wire gauze. Close with a two-hole stopper having a thermometer in one hole and a bent delivery tube in the other. Heat to 155 deg. C. and, after the air has been displaced, collect several jars of gas by upward displacement of water. Pour a weak solution of potassium permanganate, acidified with a drop of sulphuric acid, into a jar of ethylene, and the reducing gas will rob the rose-colored solution of oxygen and turn it colorless.

The still less saturated gas acetylene, C_2H_2 , is produced when four atoms of hydrogen are broken off a molecule of ethane or two hydrogen atoms off an ethylene molecule. This is the gas commonly made for lamp use by decomposing calcium carbide with water, and sold in cylinders as the fuel for oxyacetylene torches.

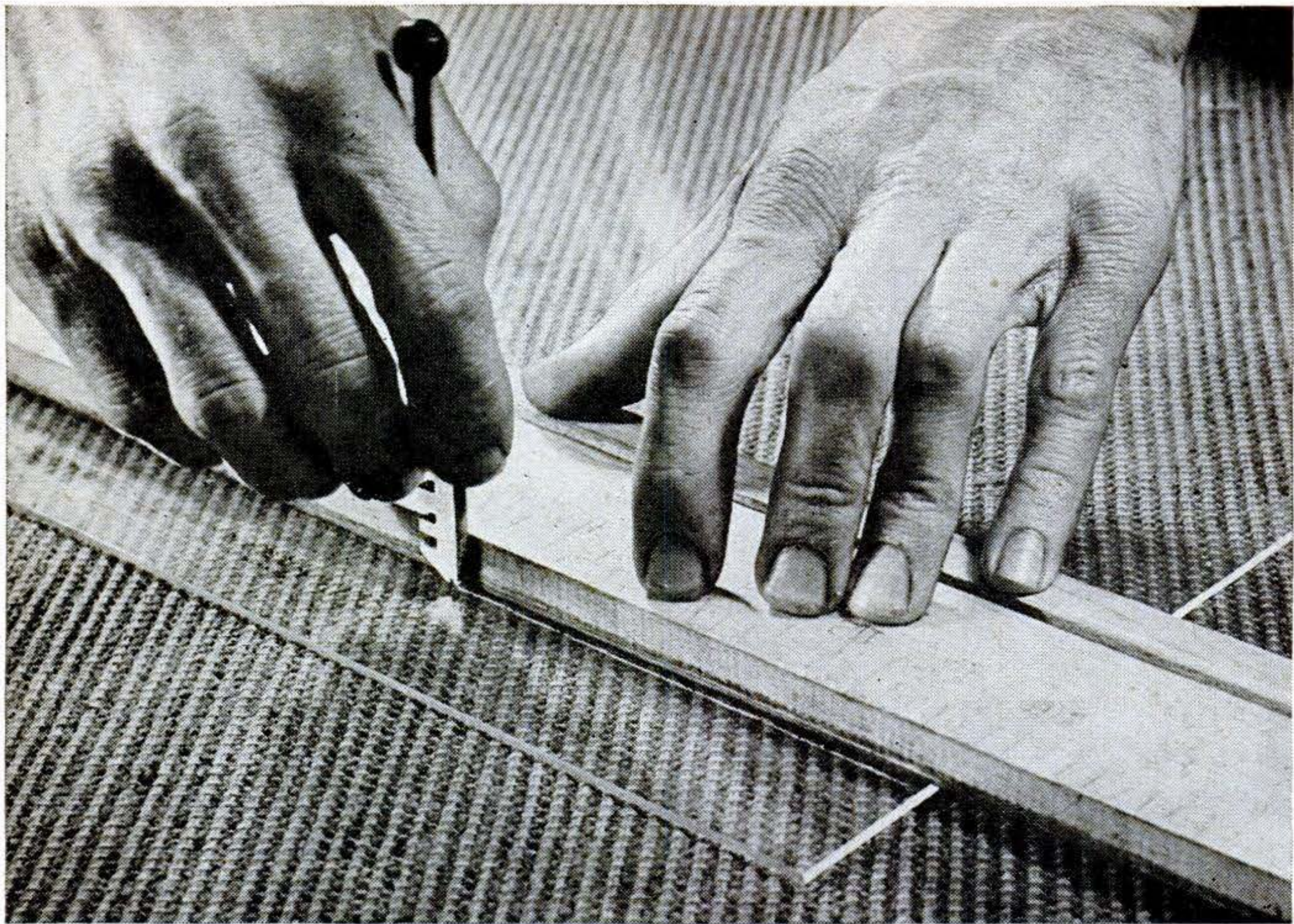
Since the two carbon atoms are able to hold four more of some other element, the gas enters actively into many chemical reactions. This can be shown by generating it in the presence of chlorine, or gas from $\frac{1}{2}$ " of sodium hypochlorite solution (household chlorine bleach) in the bottom of a large beaker. Add a little hydrochloric acid to release the chlorine and cover the beaker loosely with cardboard.

After several minutes, remove the cardboard and sprinkle a little calcium carbide into the solution. Bubbles of acetylene will break through the surface, and as each mixes with the chlorine it reacts violently and bursts into flame.

END



REDUCING ACTION OF ETHYLENE. Rose-colored potassium permanganate is reduced, or robbed of oxygen, when poured into a glass of ethylene gas. The reaction turns it colorless.



Carpeting under the glass will keep it from slipping. Score with a single firm stroke of the cutter.

How to Glaze a Window

ONE of the cheapest tools to buy is a glass cutter; in use, it can be one of the most expensive. Everyone has occasion at some time to replace broken glass in sash, French doors, and picture frames. You needn't have any trouble doing a workman-like job if you follow a few rules and acquire the simple knack necessary.

To replace a broken pane, remove all the old glass, including slivers clinging to the putty. It is best to wear gloves for this to avoid cutting your hands. Then take out all the old putty with a chisel. If it is too hard, a hot soldering iron will sometimes soften it. Examine the sash corners, and if they appear weak strengthen them with small metal angle braces. Measure for the glass, allowing $1/16''$ to $1/8''$ total clearance.

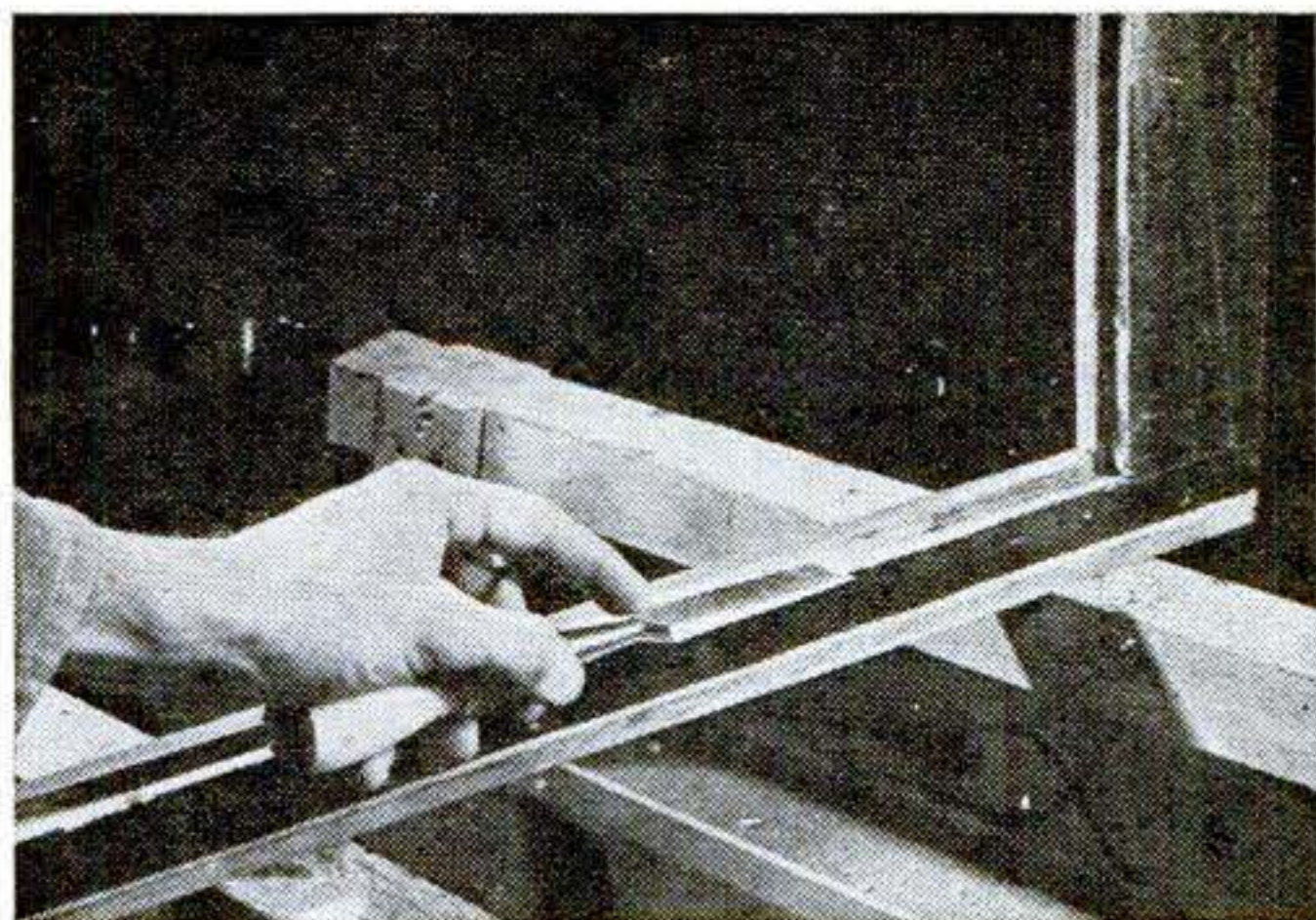
A glass cutter must be sharp. Dip it in turpentine and try it on a scrap piece of glass from the old pane. The new glass must be dry and not cold. Lay it flat on an even, firm surface. Professionals put carpeting under it to keep it from slipping. An uneven surface may cause the glass to crack under

the cutter. Use a pad of newspapers if you have no carpeting. Chalk the underside of the straightedge to prevent slipping.

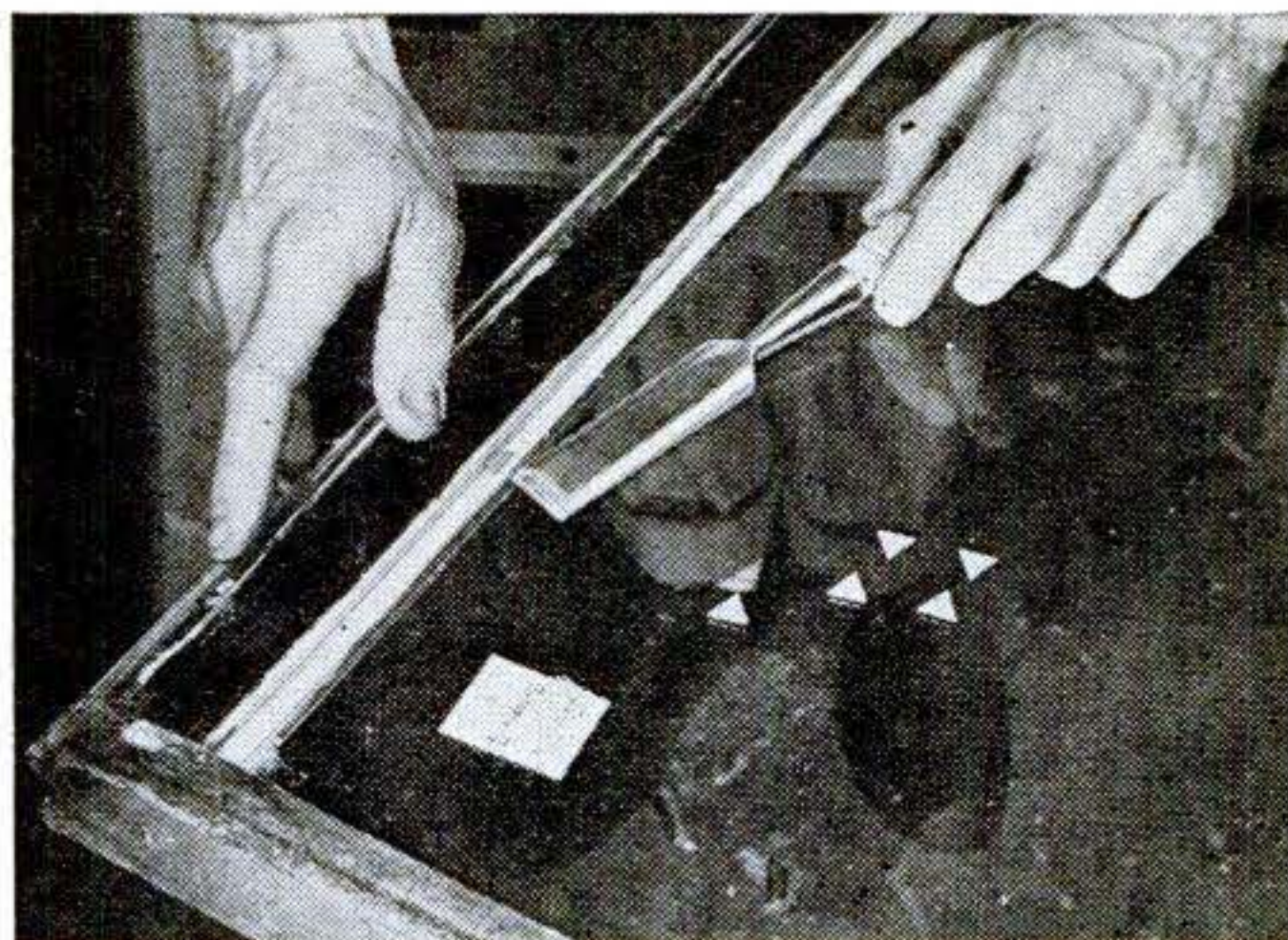
Dip the cutter again and take one even stroke, beginning about $1/16''$ from one edge. Never go over a scored line; it ruins a wheel. If the cutter skips, recut the blank spaces without going over the previous cuts.

Place the scored line directly over the edge of the bench with the waste over the edge, and break with a quick snap. Try the glass in the sash and, if it is a little large, undercut the rabbet with a chisel. Don't try to trim the glass.

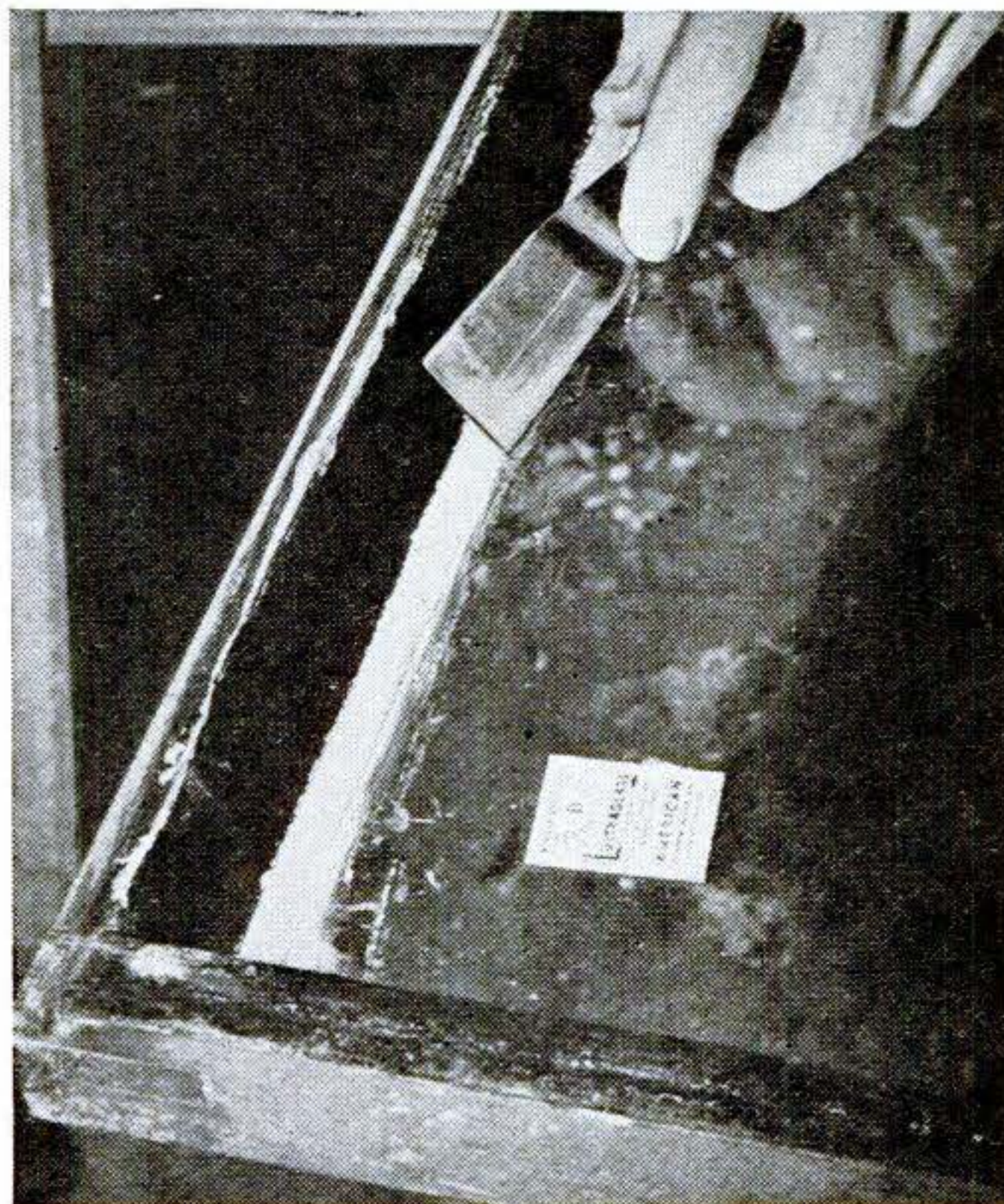
Prime the rabbet with paint so it won't absorb the oil from the putty. Then make a bed of putty and lay the glass in it. Tap in two glazier's points on each side fairly near the corners but not evenly spaced, and add more putty, beveling with a putty knife. Use only a good grade of putty containing one part white lead, four parts whiting, and linseed oil, or make your own. Outside paint may be substituted for the lead and oil.—DEXTER W. ALLIS.



Remove hardened old putty by running a chisel lengthwise and parallel to the rabbet. If glass is too big, undercut the rabbet in the same way.

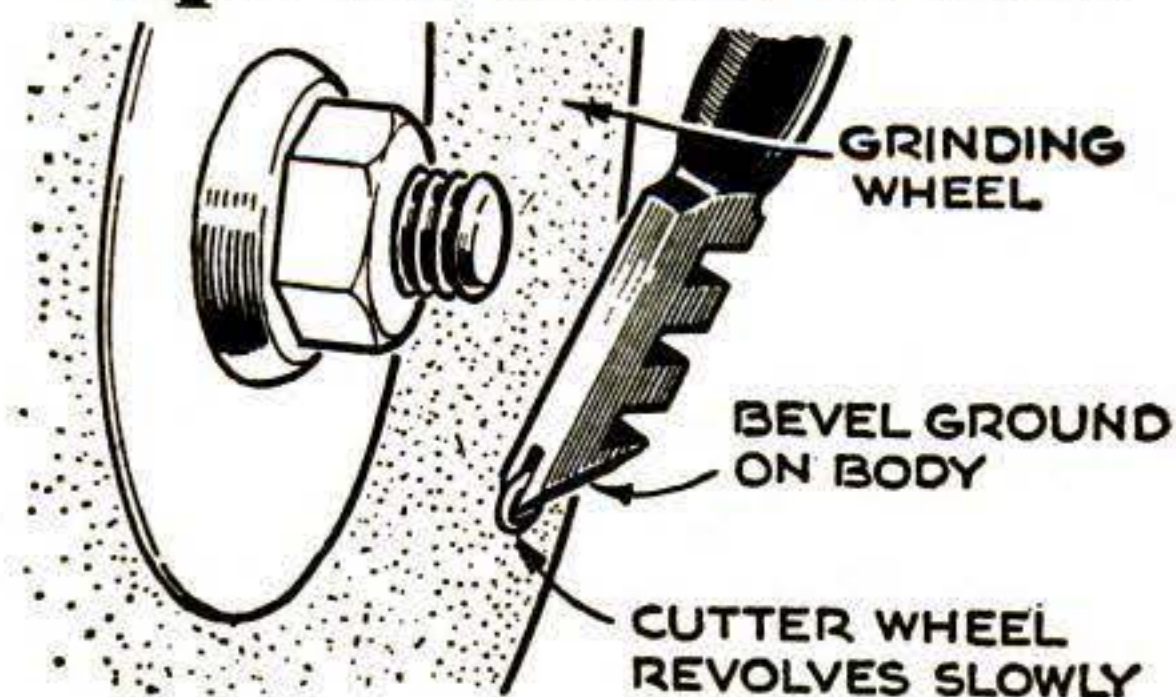


Tap in glazier's points with the edge of a chisel held flat. Don't put them too tight against the glass. Space them unevenly at the corners.



Smooth off and bevel with a putty knife, keeping the edge of the putty back even with the rabbet. Scrape the pane clean after the putty hardens.

Tips on Glass Work

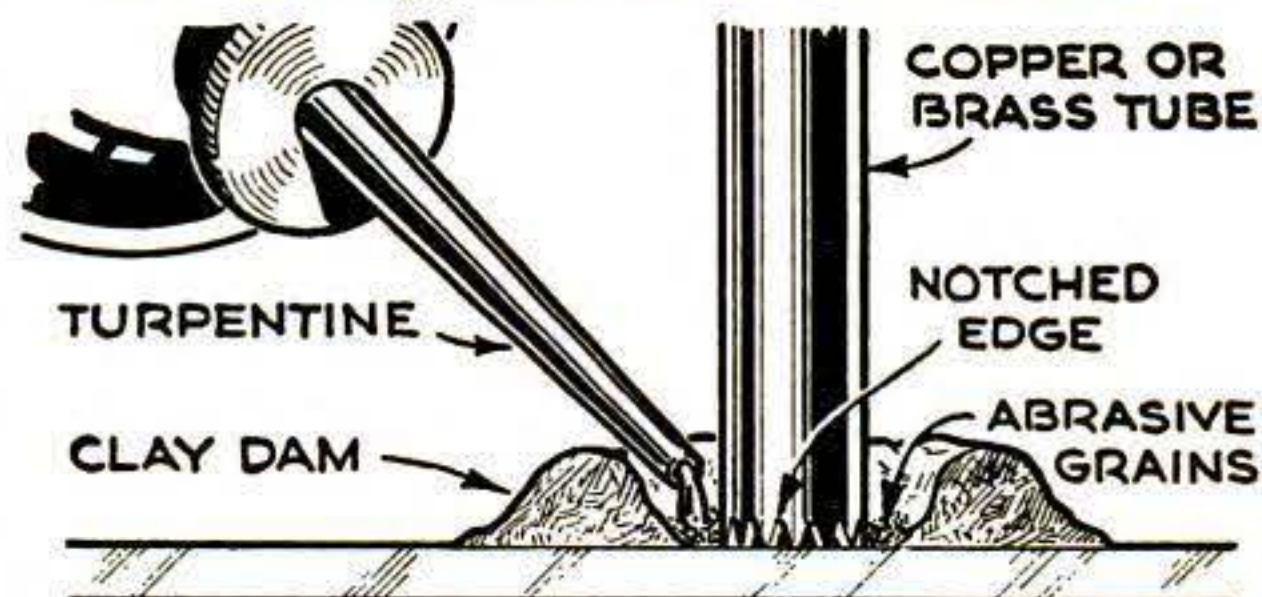


Sharpening a Cutter

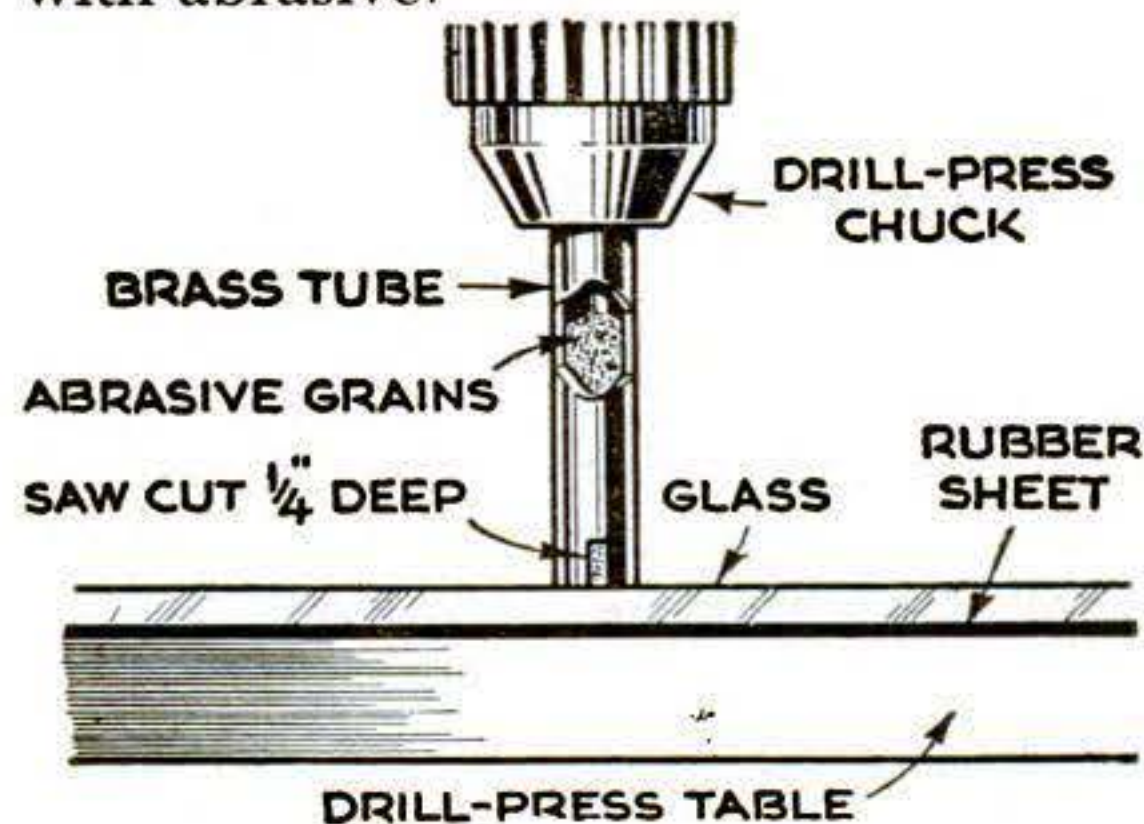
GLASS cutters must have a keen wheel to be of any service. A dull one can be sharpened easily on a fine-grain emery wheel.

Grind off a bit of the holder so the cutter wheel will touch the stone. Hold the cutter at an angle that permits the wheel to turn slowly as it is ground.

Drilling Holes in Glass



COPPER or brass tubing chucked in the drill press is effective in drilling glass. File notches in the end. Use a rubber cushion under the glass and build a clay dam on it to retain turpentine and grains of carborundum or emery. Start drilling with light pressure. When half through, drill from the other side to finish. Another way, below, is to use a tube with a saw cut across one end. Fill the tube 2" deep with abrasive.

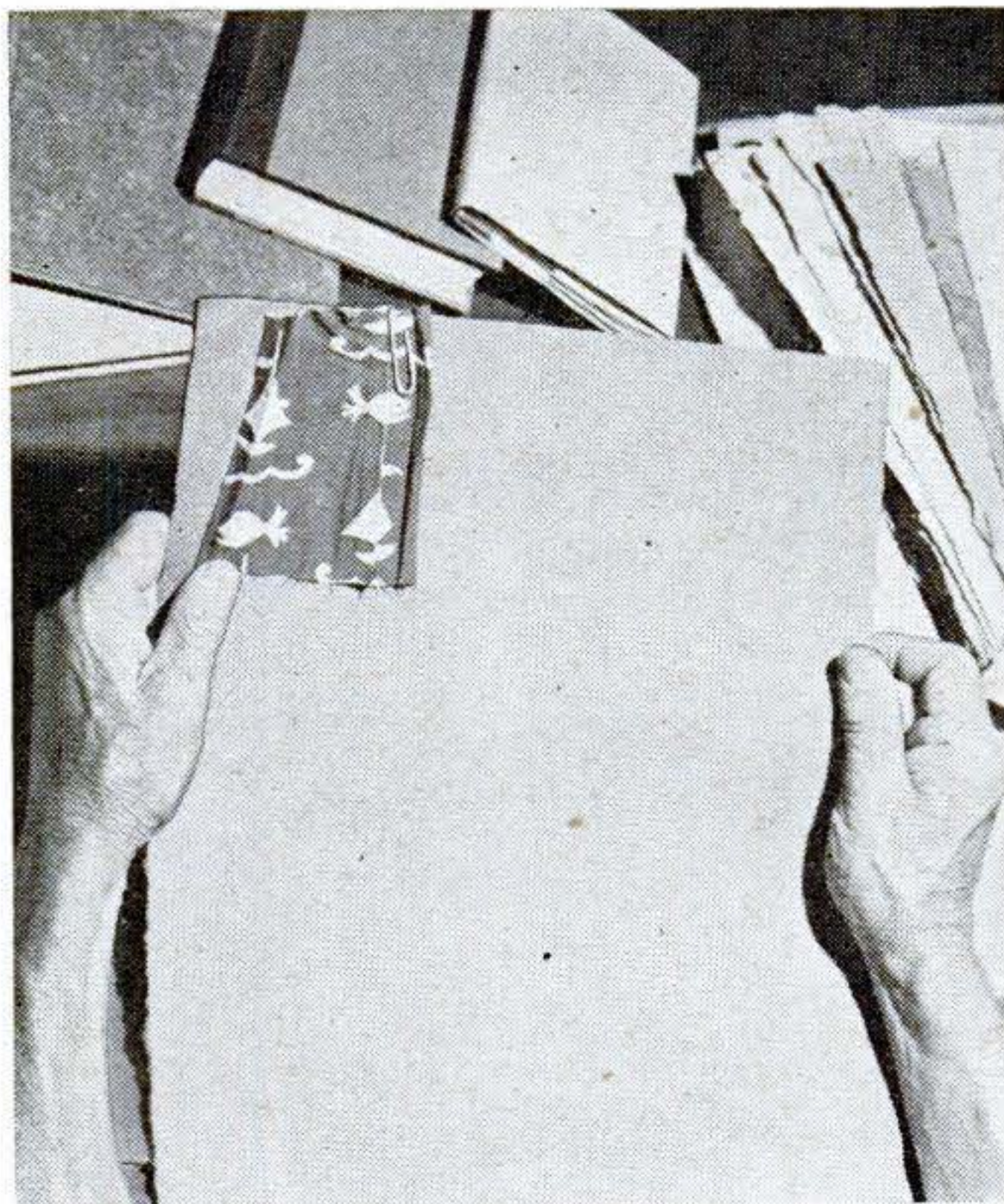


He'd Give His Shirt

AS LONG as he can find an old shirt, some worn-out pajamas, or a ragged linen sheet or two, Harrison Elliott is never bothered by paper shortages. He makes his own—and especially fine paper, too. Close friends like nothing better than to receive a box of his paper as a gift.

The process Elliott employs originated in China about the year 105 A.D. and was the only method in use until the invention of paper machines in 1798. Elliott has been learning about this ancient craft for more than 15 years; he spends all his spare time at it. His one-man mill is in the New York office building where, during the day, he is advertising director for a paper company. How he makes paper is shown on this and the facing page. Though the product he turns out is of high quality, the process is too expensive to be of commercial value.

Elliott has made paper for the Duchess of Windsor bearing her own special watermark. But mostly his hobby pleases him for the craftsman's thrill of achieving fine color and texture effects from old rags.



Some of Harrison Elliott's fine papers. The sheet being displayed was made of pulp from cloth like the attached sample and takes its color from the dye in the cloth. Interesting colors are obtained from fabrics used in his spare-time paper mill.

Photos by Joseph Kostin and J. F. Mangi



Thin films of pulp are formed one at a time on a wire-mesh hand mold dipped into the vat. Excess water drains through the fine mesh, and the sheet of paper begins to appear. The process is slow, but the result is gratifying. A continuous sieve replaces the hand mold in commercial practice.



Further drying is done by couching. The deckle, or frame, is removed from the mold, and the sheet of pulp is transferred from the wire cloth to a felt blanket by placing the screen face down on the pad and then taking it up. Here a pulp sheet is inspected and smoothed out on the felt.

to Make Fine Paper



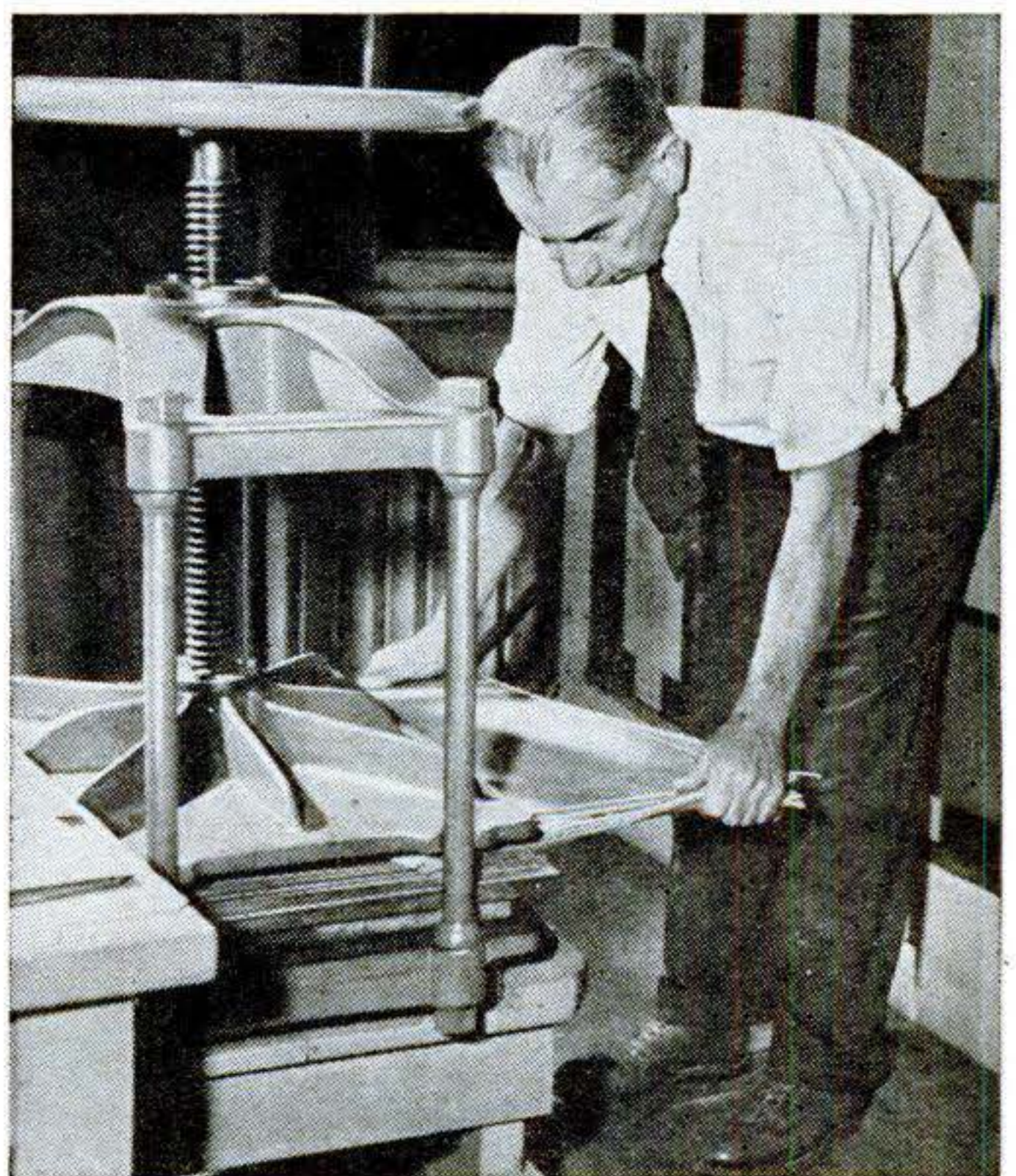
Only the best of materials can be used in making the finest papers. Here Elliott reduces a shirt to shreds as the first step in preparing pulp. Worn-out clothing provides an endless source of materials, but it must be of excellent grade.



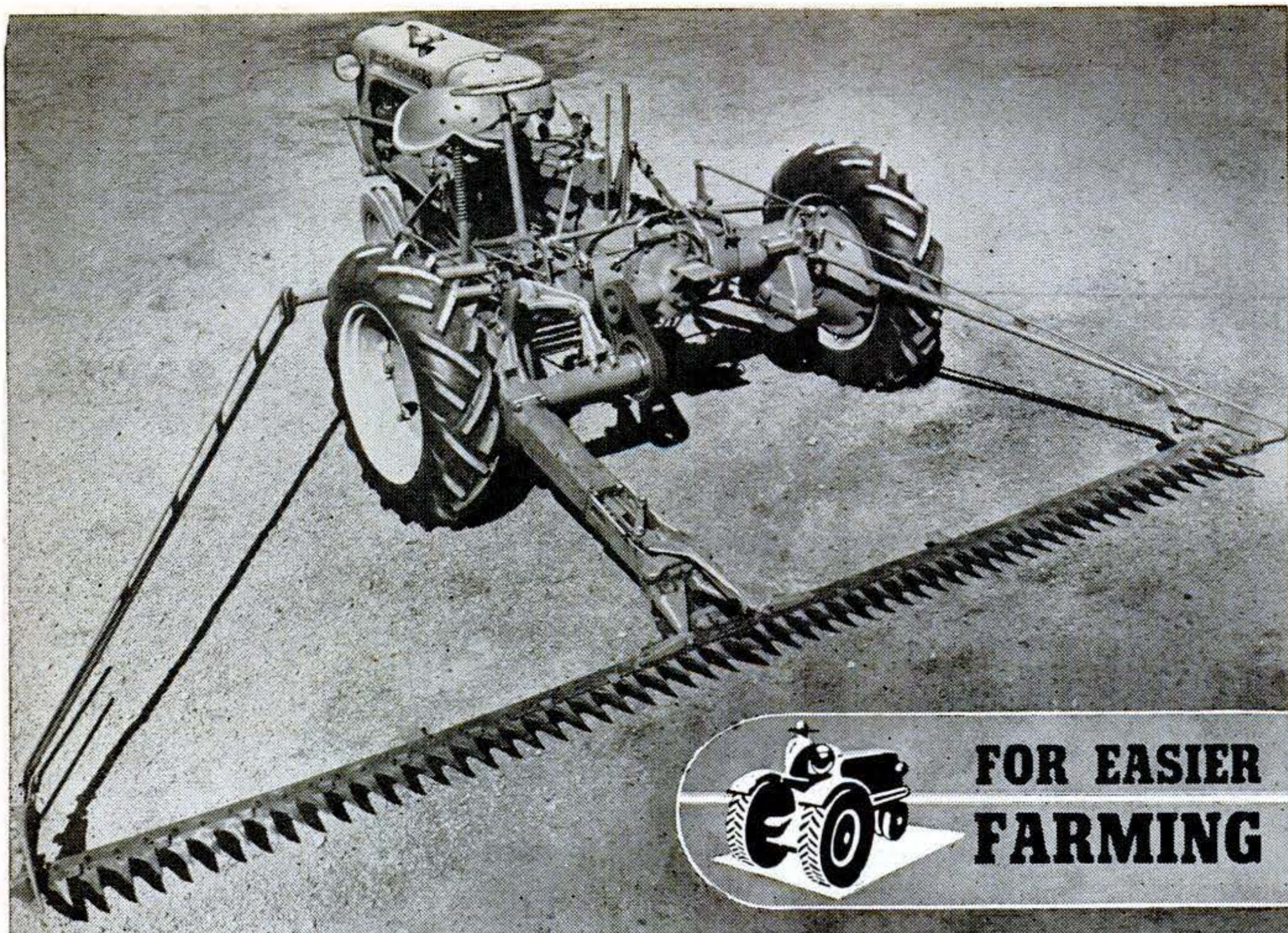
Nothing but rags and water go into the vat where they are converted into a liquid, fibrous mass by the blades of a motor-driven beater. The process is watched carefully so the pulp will be mixed to exactly the correct consistency.



Several layers of felt blankets, each containing its sheet of damp paper, are placed between heavy plates and prepared for the press. The blankets absorb the last remaining traces of moisture, and the sheets of paper will come out perfectly dry and in finished form ready for use.



This is the last step in papermaking. The paper and blankets sandwiched between the zinc plates are put in a hand press and pressure is applied. The amount of pressure brought to bear by turning down the screw governs the finish gloss. Texture and watermarks show in the final product.



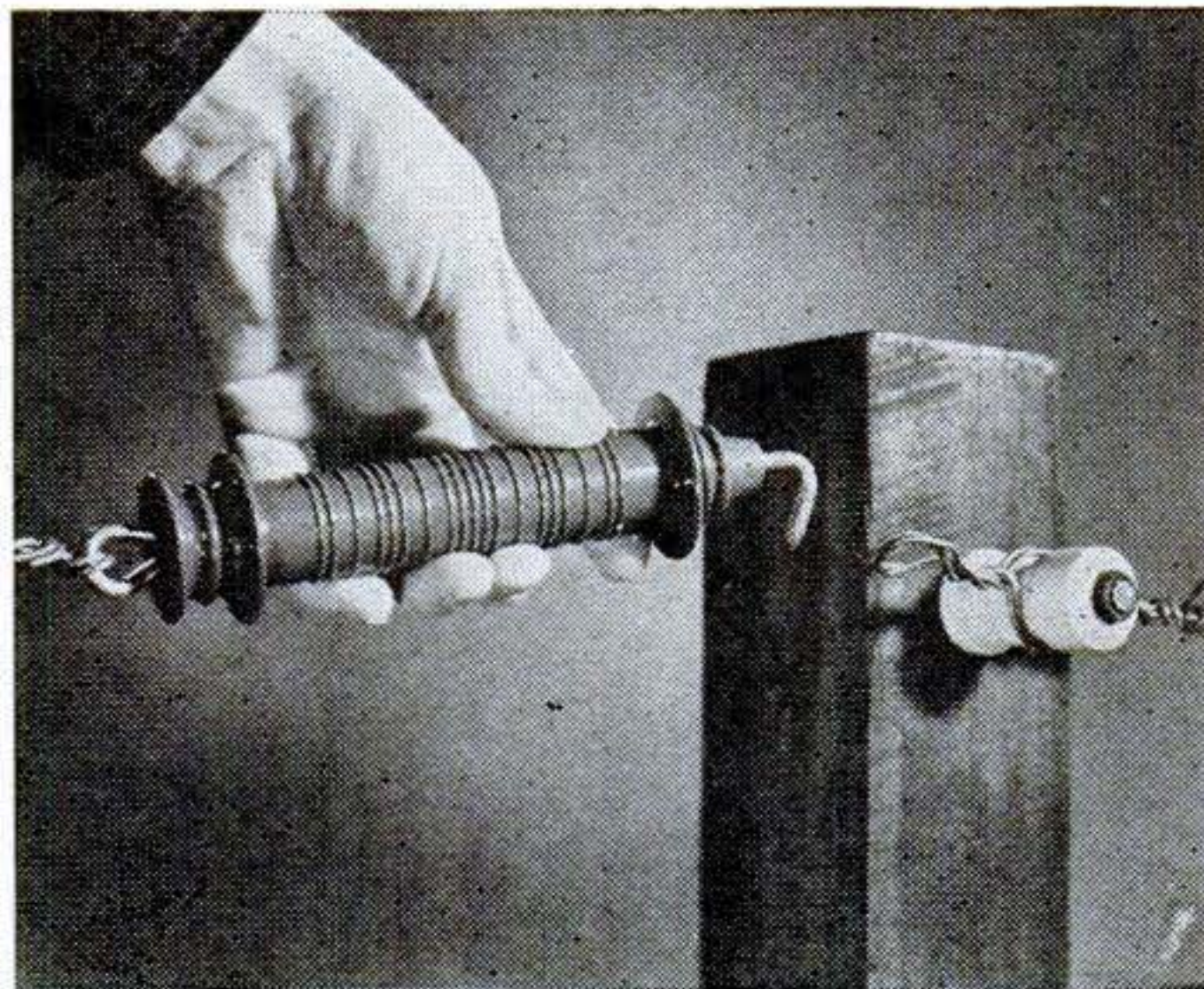
**FOR EASIER
FARMING**

All Hay and 14' Wide. That's what this new tractor mower, the Twin Seven, cuts with its double-width floating cutting bar. Made in two parts, the bar is said to follow the terrain as evenly as a single one.

It is detachable for road transport. The mower is mounted on the rear of a tractor, which is run backward, the operator having full view of the work. The Mountain Mfg. Co., of Murray, Utah, makes it.



Pumps Grease from Pail. This pressure lubricator is designed for using light or viscous lubricants direct from a 25-lb. can. It punctures the top close to the rim and is ready for use with the tightening of a setscrew. Up to 5,000-lb. pressure is possible. The manufacturer is the Aro Equipment Corporation, of Bryan, Ohio.



Gate for Electric Fence. A handle for opening the gate of an electric fence with safety is made of Tenite. It has a metal spring to maintain current contact with the fence when the gate is closed. The handle is shockproof in wet weather. It is made by Accessories Manufacturing Co., Inc., of Kansas City.



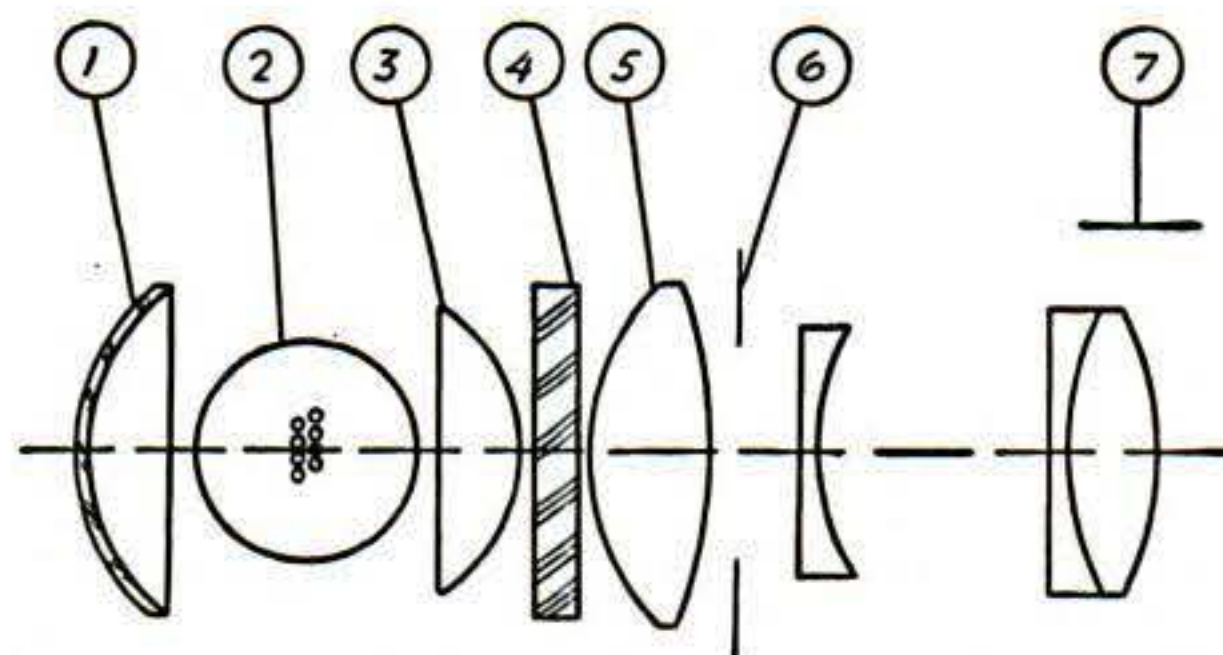
Announcing the new 1000-watt
Kodaslide Projector
Master Model
 for home or auditorium

This handsome, compact instrument delivers more light to your home screen than was ever before possible with any 2 x 2-inch slide projector . . . brings out shades and shadow detail you never dreamed existed.

Fast Lenses and Powerful Lamps . . . snap a vivid image onto the screen even in a room only half-dark. That's a great help, at your club, school, or church. The crisp image shines bright throughout, no dingy corners or hot-spot center.

Entire Optical System Lumenized . . . condensers and projection lenses are Lumenized (hard-coated) to supply maximum light. A new type of heat-absorbing glass blocks 85% of the heat . . . and it's one solid piece, which leaves no black streaks on the image.

Five superb Kodak Projection Lenses . . . For theatres and auditoriums, a powerful 11-inch $f/3.7$ Kodak Projection Ektar; for club, church, or school, two $7\frac{1}{2}$ -inch lenses—the $f/2.3$ Ektar or $f/4$ Ektanon; for home shows, two 5-inch lenses—the $f/2.3$ Ektar or $f/3.5$ Ektanon.



Optical System of Kodaslide Projector, Master Model
 (1) Spherical Reflector, (2) Projection Lamp—300 to 1000 watts, (3) Rear Condenser Lens, (4) Heat-Absorbing Glass, (5) Front Condenser Lens, (6) Aperture for Transparency, (7) Kodak Projection Ektar or Ektanon Lens (relative position depends upon choice of lens).

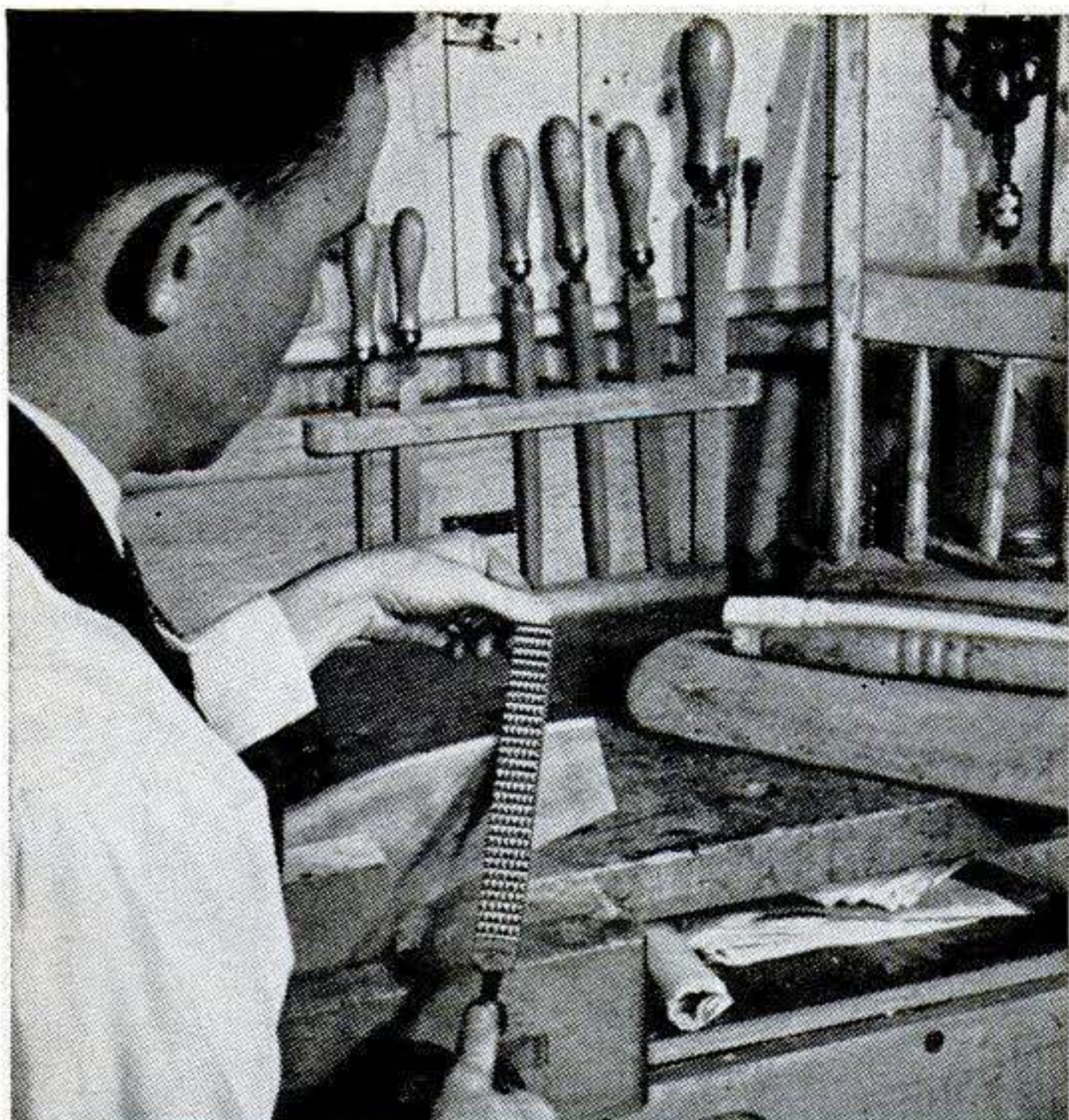
Keeps Kodachrome Transparencies Cool . . . a quiet turbine-type fan in the base forces cool air *three ways*—to the lamp, to the condenser system, and to both sides of the slide.

Descriptive, full-color folder free at your Kodak dealer's . . . EASTMAN KODAK COMPANY, ROCHESTER 4, N. Y.



KODASLIDE PROJECTOR,
Master Model, is supplied
 with a carrying case. Price,
 from \$181 to \$295, depend-
 ing upon lens selected.

Kodak



there's always a **JOB FOR FILES**

A new back is needed for a plank-bottom chair . . . a drawer or a door sticks . . . there's a saw to be sharpened or a home-appliance part to be fitted—jobs like these are always cropping up around the house. Then, too, there's "the other kind" of jobs: those done for the sheer satisfaction of creating—like building a working model . . . finishing up a workshop project . . . making toys and games for the kids.

Yes, there's always a job for files. That's why it's a good idea to keep a popular assortment of Nicholson or Black Diamond files on hand. Then, for both hobbying and repairing, you can be sure of choosing and using *The right file for the job*. Your hardware dealer has them—or can get them—in cuts, shapes and sizes to meet your every need.

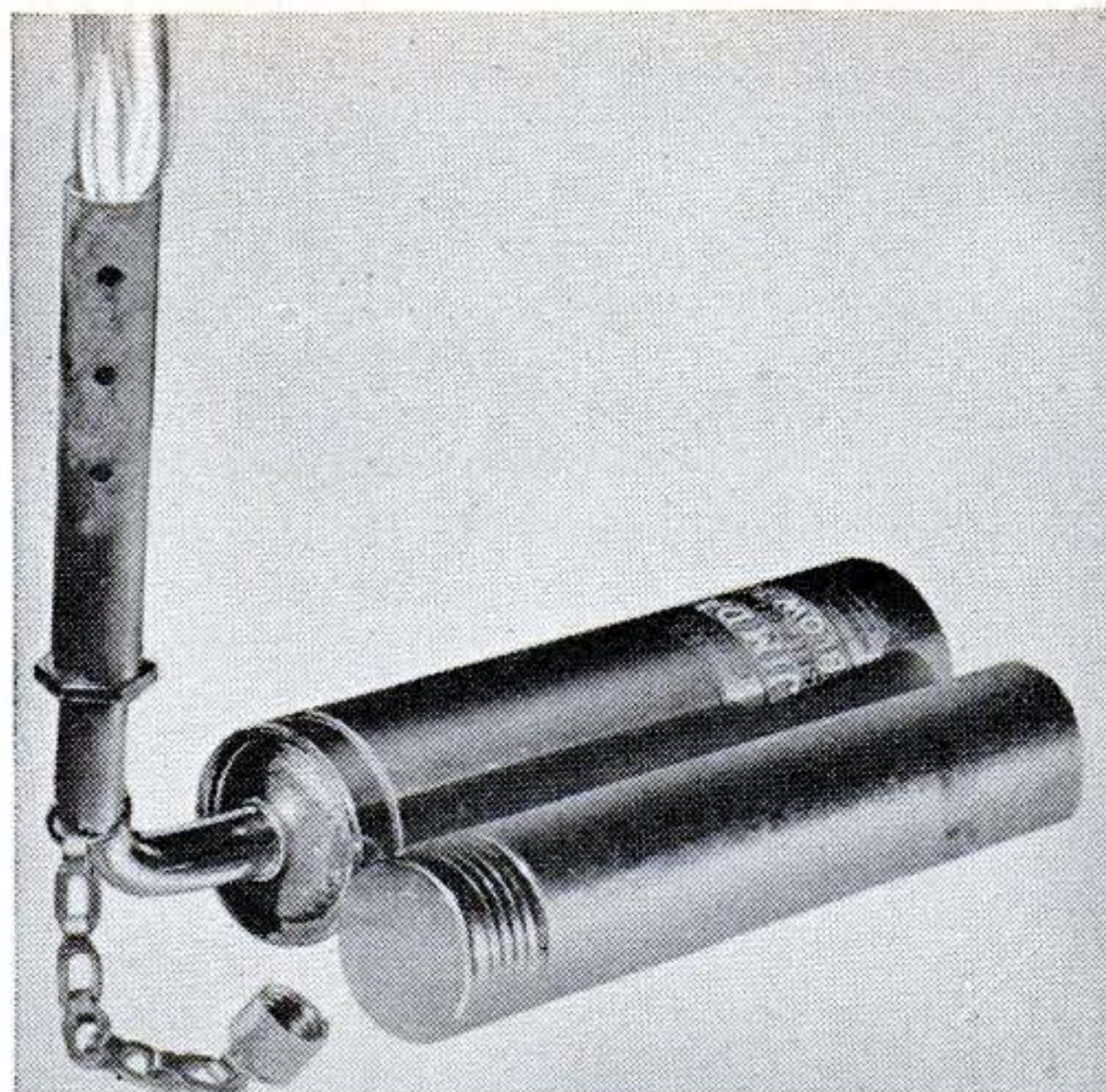
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NICHOLSON
FILES FOR EVERY PURPOSE



Torch Cooks for Campers

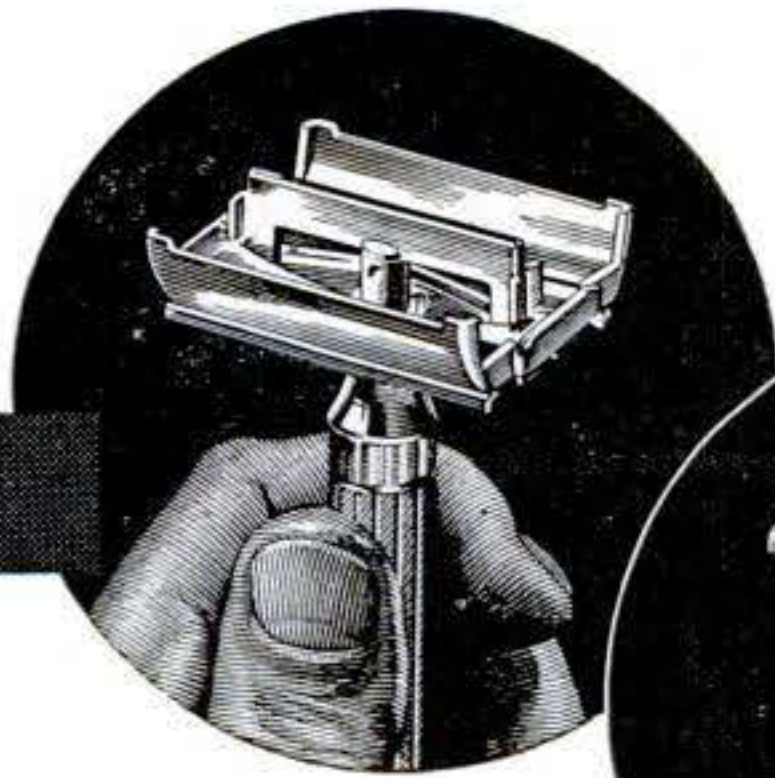
OUTDOORSMEN will find this alcohol-type combination blowtorch-cookstove, with adjustable nozzle, handy for camping trips. Placed flat, as shown in photo, it is ready to cook for two hours. Manufactured by Modern Metal Products Co., of Cambridge, Mass., the torch develops 2,200°, is non-explosive and fits into a pocket.



Fangs Are Plastic

THESE realistic gaping jaws are actually only plastic bridgework. Made for stuffed animals by C. M. Moore Co., of Kansas City, Mo., the teeth and jaws are better than natural ones, which tend to discolor, lose their luster and drop out.

Twist...It's Open

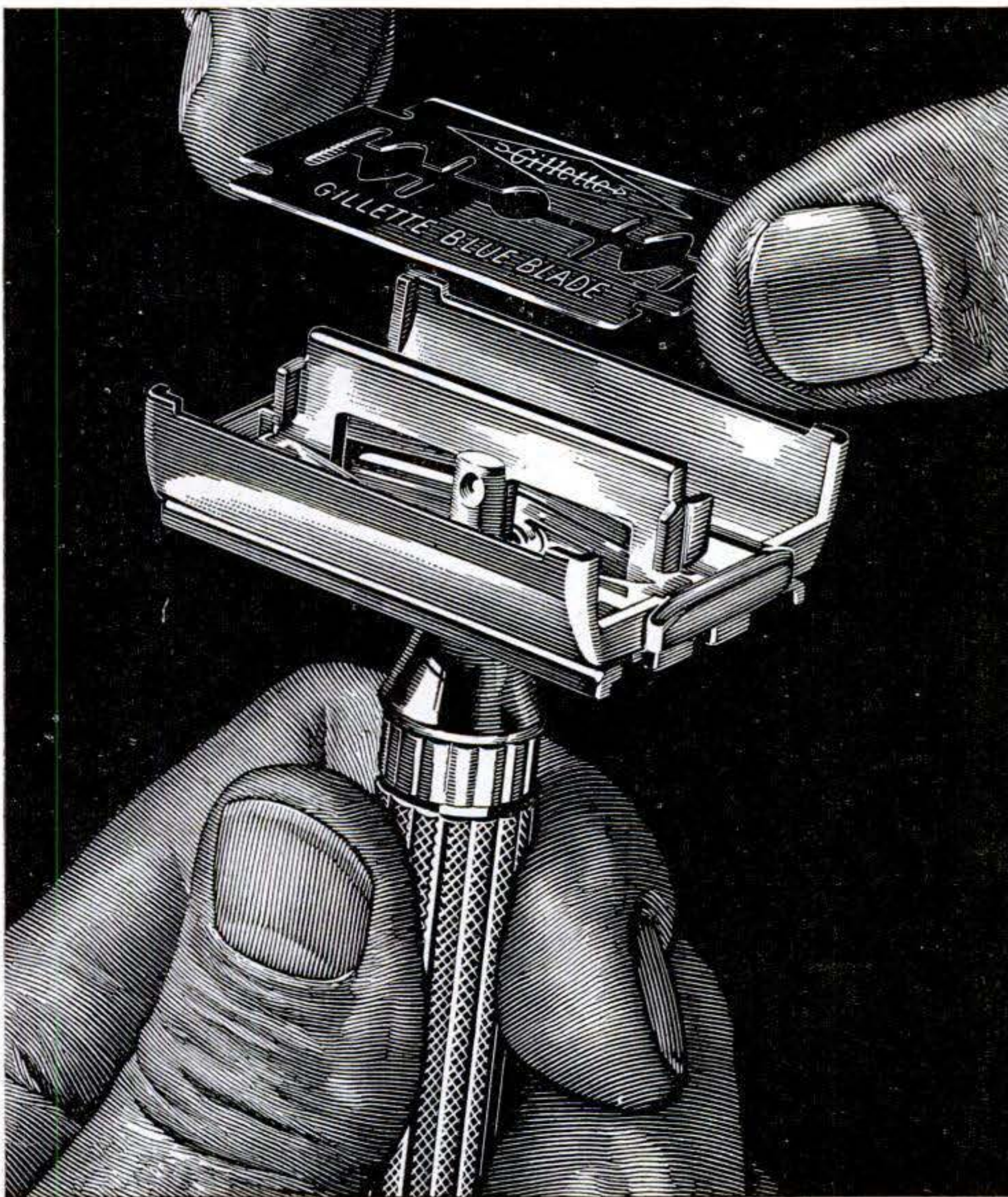


Twist...It's Closed



See how quick and easy shaving can be... with the modern

Gillette One-Piece Razor



YOU get utmost shaving comfort and convenience with a Gillette One-Piece Razor. There's nothing to take apart or put together. Blade changing's a cinch. Twist . . . the razor opens. Twist again . . . your blade's locked in position. To clean, just loosen the holder, rinse, shake.

Enjoy the quickest, easiest shaves you ever had. Ask for the superb Gillette Aristocrat One-Piece Razor or the Gillette Milord.

Gillette Safety Razor Co., Boston 6, Mass.

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Gillette Aristocrat One-Piece Razor, 10 Gillette Blue Blades \$3⁷⁹



Gillette Milord One-Piece Razor, 5 Gillette Blue Blades \$2⁵⁰

look^{SHARP!} feel^{SHARP!} be^{SHARP!} use Gillette Blue Blades WITH THE SHARPEST EDGES EVER HONED

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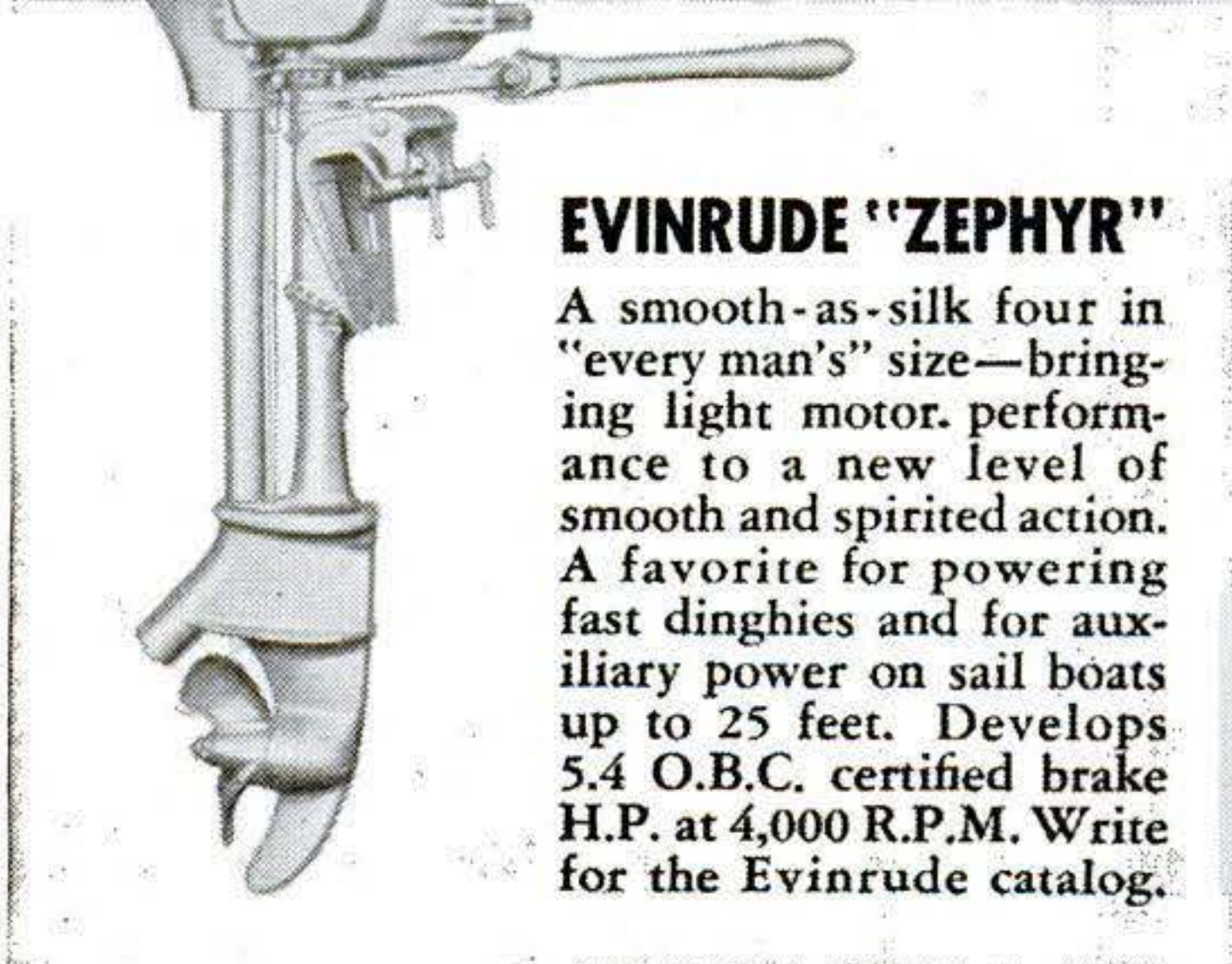
ZEPHYR



LIGHTFOUR



SPRINT



EVINRUDE "ZEPHYR"

A smooth-as-silk four in "every man's" size—bringing light motor performance to a new level of smooth and spirited action. A favorite for powering fast dinghies and for auxiliary power on sail boats up to 25 feet. Develops 5.4 O.B.C. certified brake H.P. at 4,000 R.P.M. Write for the Evinrude catalog.

There's a "Four" for YOU—

—just right in size, power, performance . . . in Evinrude's complete line of 3 thrilling four-cylinder models!

If you want a motor developing 5 horsepower or more — why not enjoy the *extra* smoothness — the *extra* thrill of performance — *that are yours with an Evinrude "four"?*

There's nothing like them — for any boat, or any kind of service! No other type of outboard motor to match their velvety surge of power, their responsiveness and flashing get away!

See your Evinrude dealer — look for his name under "Outboard Motors" in your classified telephone directory. Catalog of the complete Evinrude line of 7 models sent on request. Write for it today—address, EVINRUDE MOTORS, 5606 North 27th Street, Milwaukee 9, Wis.

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IT'S A
GRAND FEELING.
TO BUILD A
MINIATURE HOUSE



IT'S A GRAND FEELING, TOO,
WHEN YOUR CAR IS
CUSHIONED WITH MARFAK
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THAT CUSHIONY FEELING LASTS LONGER WITH MARFAK!

It's a grand feeling to work at your hobby . . . the same grand feeling you get from your smooth riding, *Marfak* lubricated car.

A smooth riding car means *Marfak* is doing its job . . . and it sticks to the job for a thousand miles and more. *Marfak* is scientifically designed to cling to bearing surfaces, to resist wash-out, jar-out and squeeze-out. Now is the time to see your Texaco Man and say: "*Marfak*, Please!"



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TEXACO DEALERS IN ALL 48 STATES



Tune in: TEXACO STAR THEATER presents the TONY MARTIN show every Sunday night. See newspaper for time and station

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NOW TRY Dustless SWEEPING



**Reduce Germ Laden Dust
Eliminate Sweeping Compound**

Dustless brushes used with Arbitrin sweeping fluid eliminate up to 97% of germ laden dust and reduce sweeping costs 20%. Arbitrin fluid, poured into a metal reservoir in the brush back, filters through the tufts and keeps dust down as you sweep. Dustless brushes are used in thousands of schools, factories, offices, stores, and institutions. There is a Dustless brush to fit your needs. Write for sizes, styles and prices today.

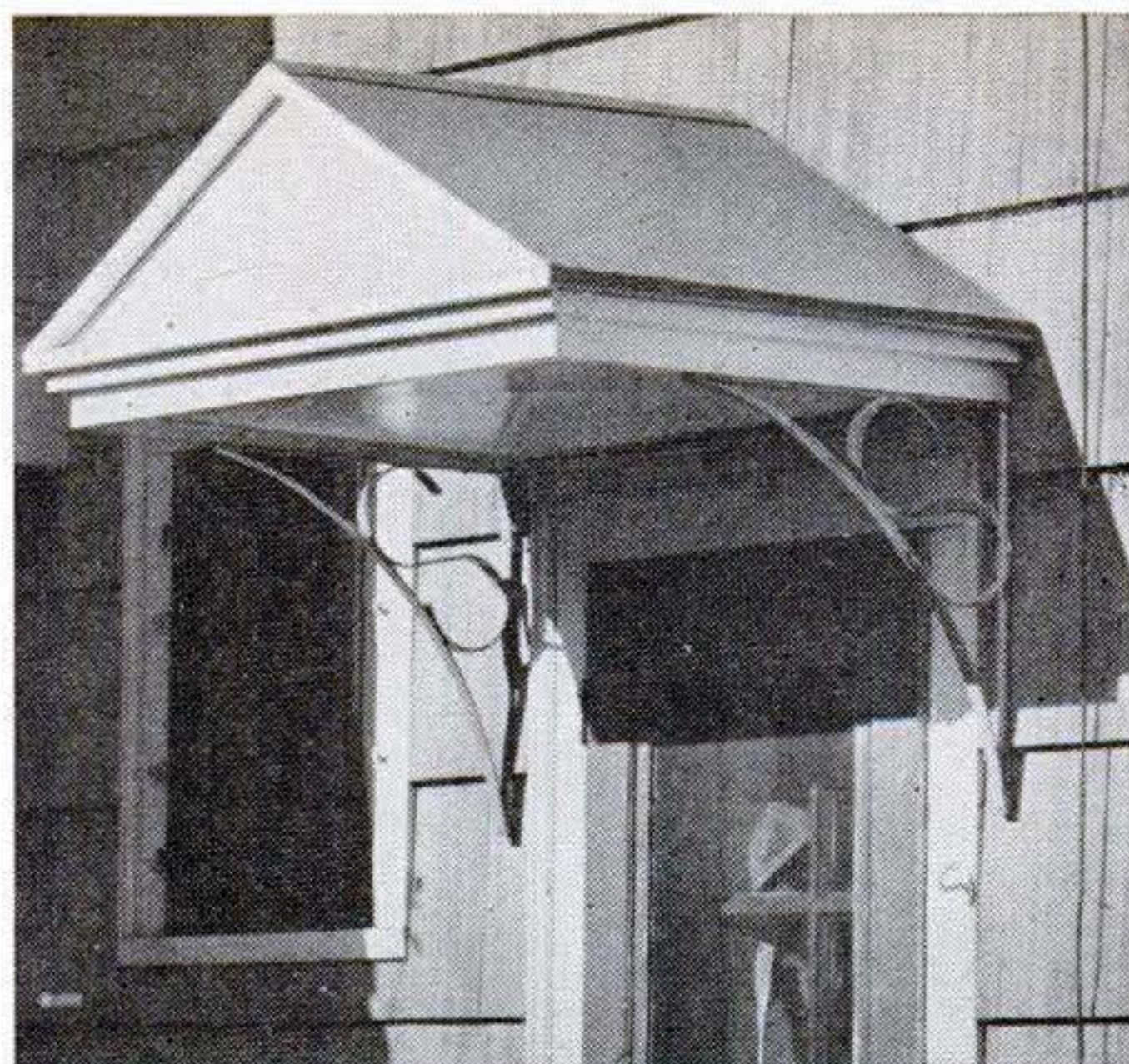


Milwaukee Dustless Brush Co.
530 N. 22nd St., Milwaukee 3, Wis.
Please send complete facts about Dustless Brushes.

Name _____

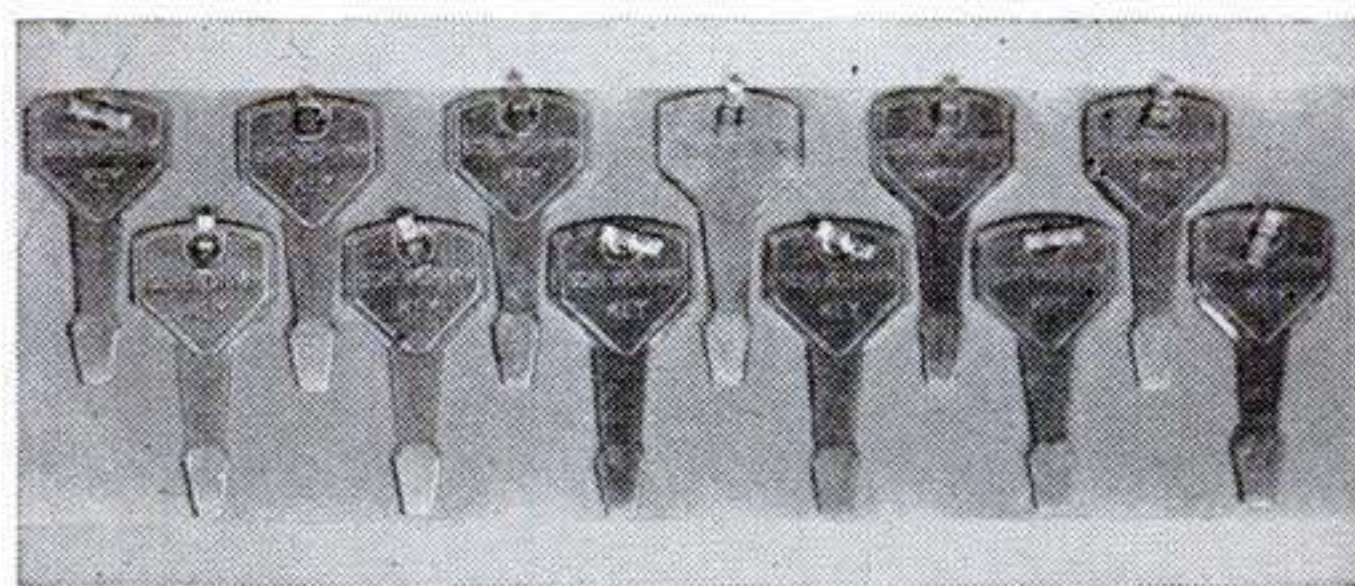
Street Address _____

City, State _____




Canopy Is Ready-Made

INSTALLED in a few minutes over any outside door, a prefabricated canopy that offers shelter from rain and snow has been introduced by the Tel-O-Post Co., Akron, Ohio. Ornamental brackets support the aluminum structure, finished in white with green top.



Key-Ring Screwdriver

SHAPED like a key and carried on a key ring, the pocket screwdriver displayed above always is at hand for use around the home. The Screwdriver Key Co., Hollywood, Calif., distributes the tool.



Model Builders Attention!

	V	V-2	V-3
Hex	1/2"	3/8"	5/16"
Thread	3/8"-24	1/4"-32	1/4"-32
Thread Length	7/32	7/32	5/32
Weight, Grams	8	3 1/2	2 1/2

Actual Size V-Plug

Champion Spark Plugs for model gas engines give the same dependable performance as regular Champions. Champion Ceramic insulation—Sillment sealed. Alloy needlepoint electrodes for easy starting. One piece construction.

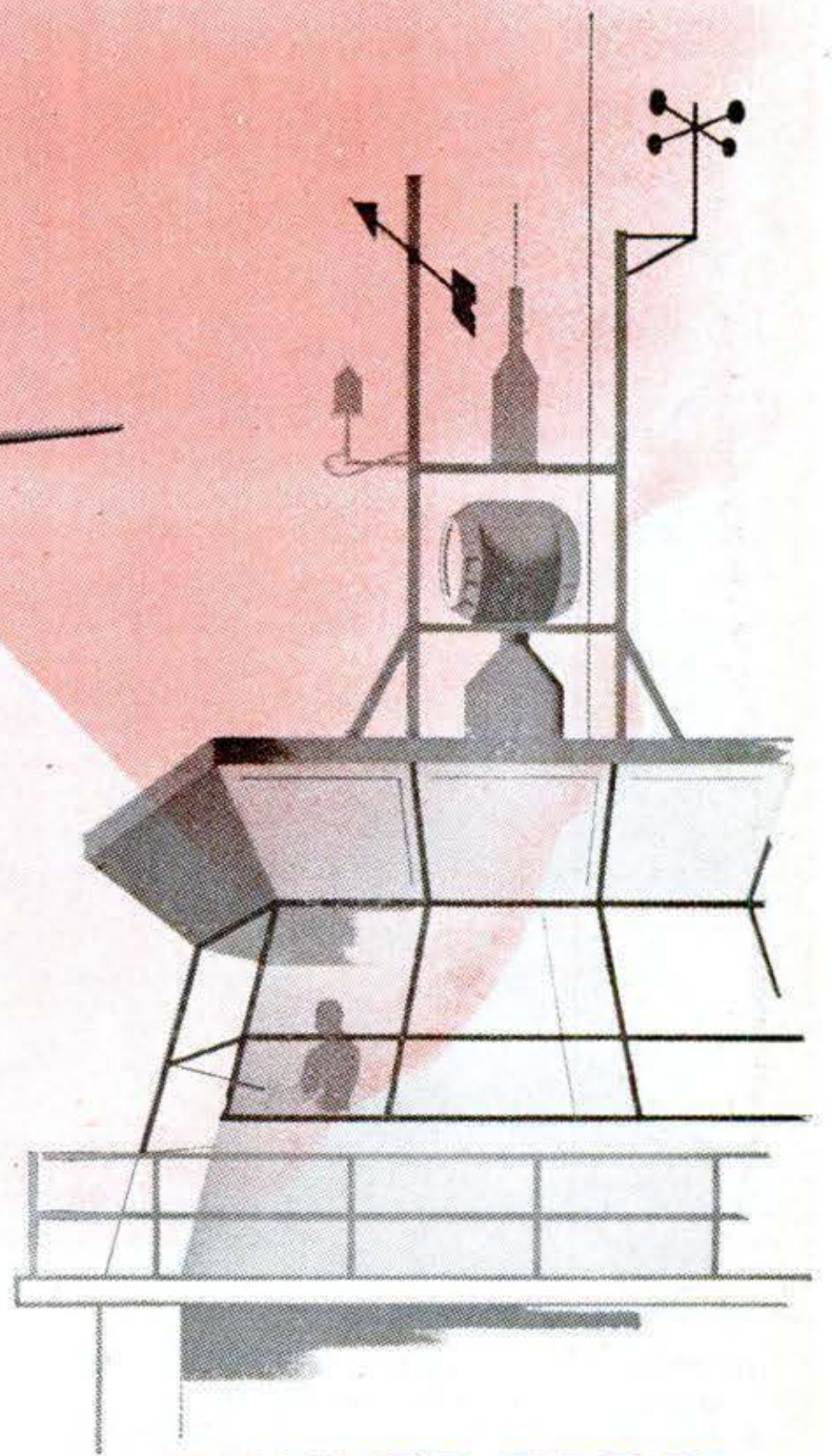
CHAMPION

SPARK PLUG COMPANY • TOLEDO 1, OHIO

Dependable

CHAMPION

AMERICA'S FAVORITE SPARK PLUG



AIR TRAVEL IS A HIGHLY ORGANIZED AND STABLE BUSINESS . . . To handle increased traffic, no other form of public transportation has had to expand its facilities so rapidly. Last year more passengers were carried more miles than ever before, with the finest safety record in airline history—one that compares favorably with any other form of public transportation. The use of dependable Champion Spark Plugs by most airlines is a vote of confidence you should consider when buying spark plugs for your car. Specify *Champion* for better performance—it's America's favorite spark plug. Champion Spark Plug Company, Toledo 1, Ohio.

FOLLOW THE EXPERTS

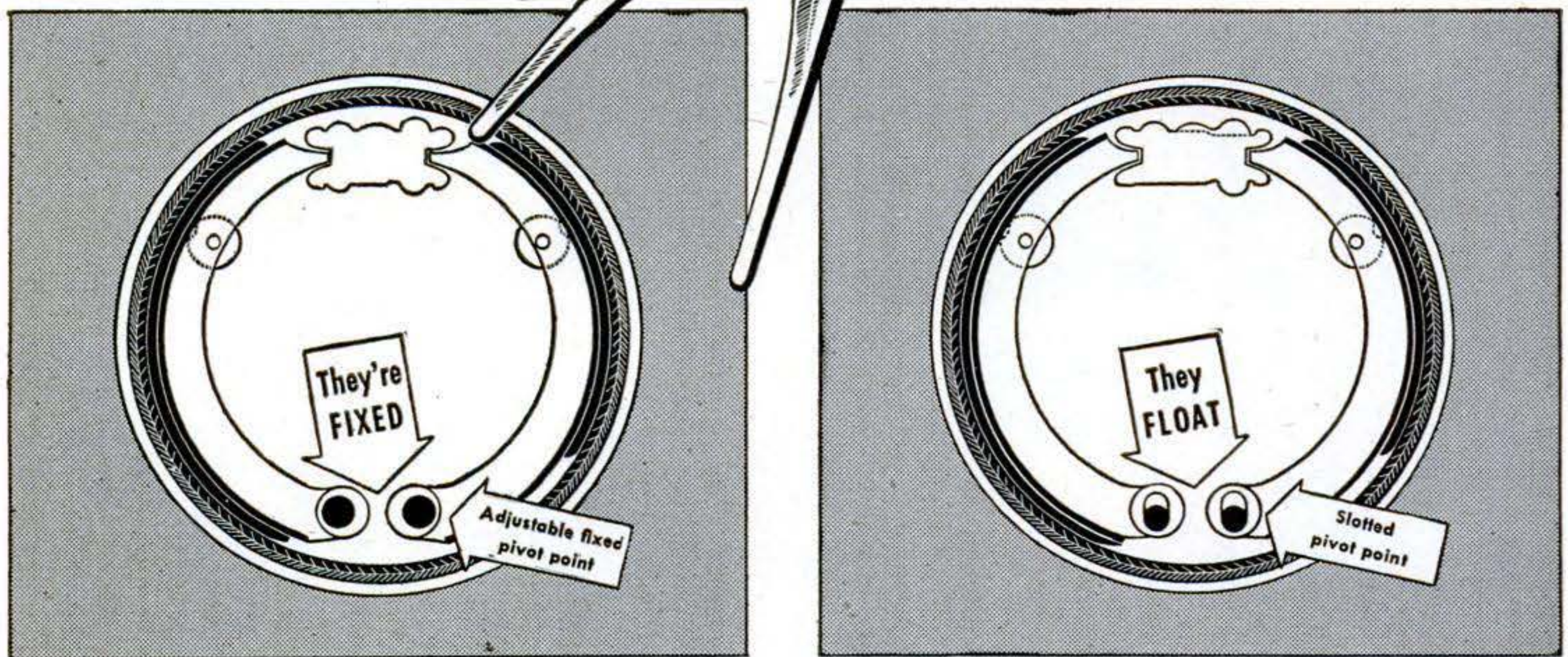
**DEMAND NEW DEPENDABLE
CHAMPIONS FOR YOUR CAR**

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

AUGUST 1947 215

How Ford brakes eliminate

"Nutcracker Squeeze"



Old-type brakes use a nutcracker-type pivot. They have adjustable pivot points using eccentric anchor bolts on the bottom pivots, and a spread at the top. To eliminate the uneven contacts of such a pivot, Ford has developed a completely new type of hydraulic brake.

New type Ford brakes are *self-centering*. This design allows the brake shoes to *float* into complete contact with the drums for evenly distributed contact pressures and increased braking efficiency with 15% softer pedal action. And they're oversized for greater safety.



They're "King-size" Ford oversized hydraulic brakes have 162 square inches of lining area, 264 square inches of drum area—the largest in their price class. This gives you braking areas greater in relation to car weight than even some of the heavier, higher-priced cars. 12-inch cast iron brake drums mean greater safety.

They're Self-centering

Ford's new floating shoe design, with fixed anchor and slotted brake-shoe pivot, centers the brakes against the drum for full-lining contact. This gives brakes even, long life . . . easier, less frequent adjustment.

They're Long-lasting

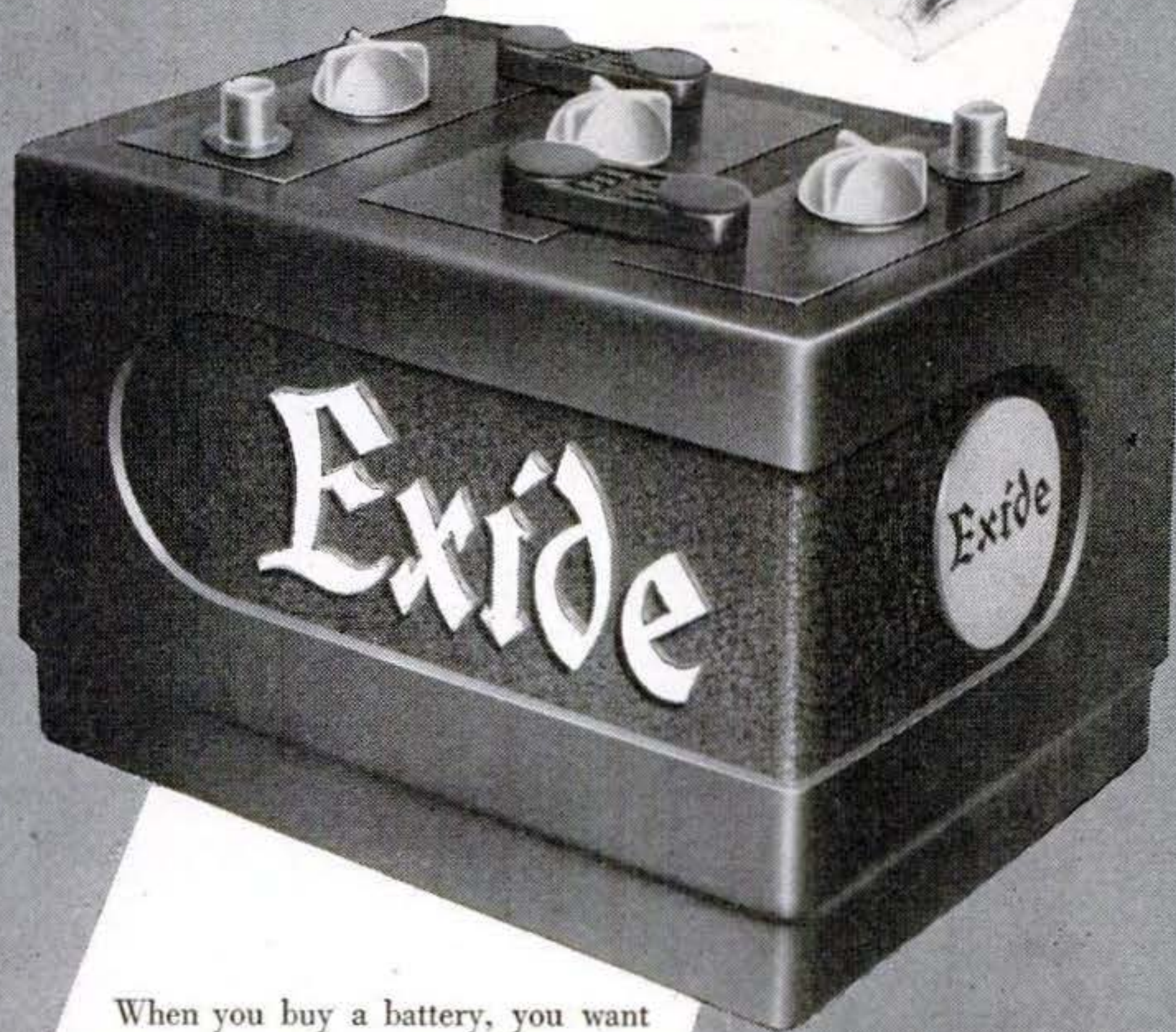
Hydraulics . . . Ford brakes get their longer life not only from their self-centering feature, but also from the long-lasting cast iron brake drums. *With features like these, no wonder "Ford's Out Front" for safety.*

There's a **Ford** in your future





WHEN IT'S AN **Exide** . . . YOU START



When you buy a battery, you want to be sure it will start your car . . . today, tomorrow, this winter. You might be tempted to get a cheaper battery, hoping it will last as long as you keep your car. But remember—*just one starting failure* can be far more costly than the little extra you pay for an Exide Battery that you know you can depend upon.

Play safe. Buy starting assurance. When it's an Exide . . . you start!

Depend on your Exide dealer for good products, good service

THE ELECTRIC STORAGE BATTERY COMPANY • Philadelphia 32

Exide Batteries of Canada, Limited, Toronto

USE AC's FOR
**UTMOST
 RELIABILITY**

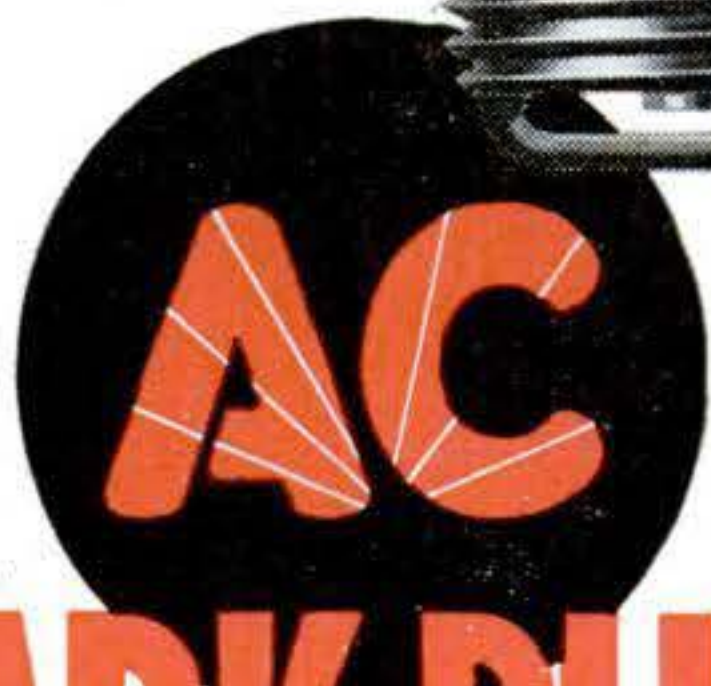
"The mail must go through"—and does, with the help of today's AC's in thousands of mail cars and trucks. You can enjoy utmost reliability in spark plug performance by having your spark plugs checked to be sure they are right for today's driving and fuels.



Look for this sign



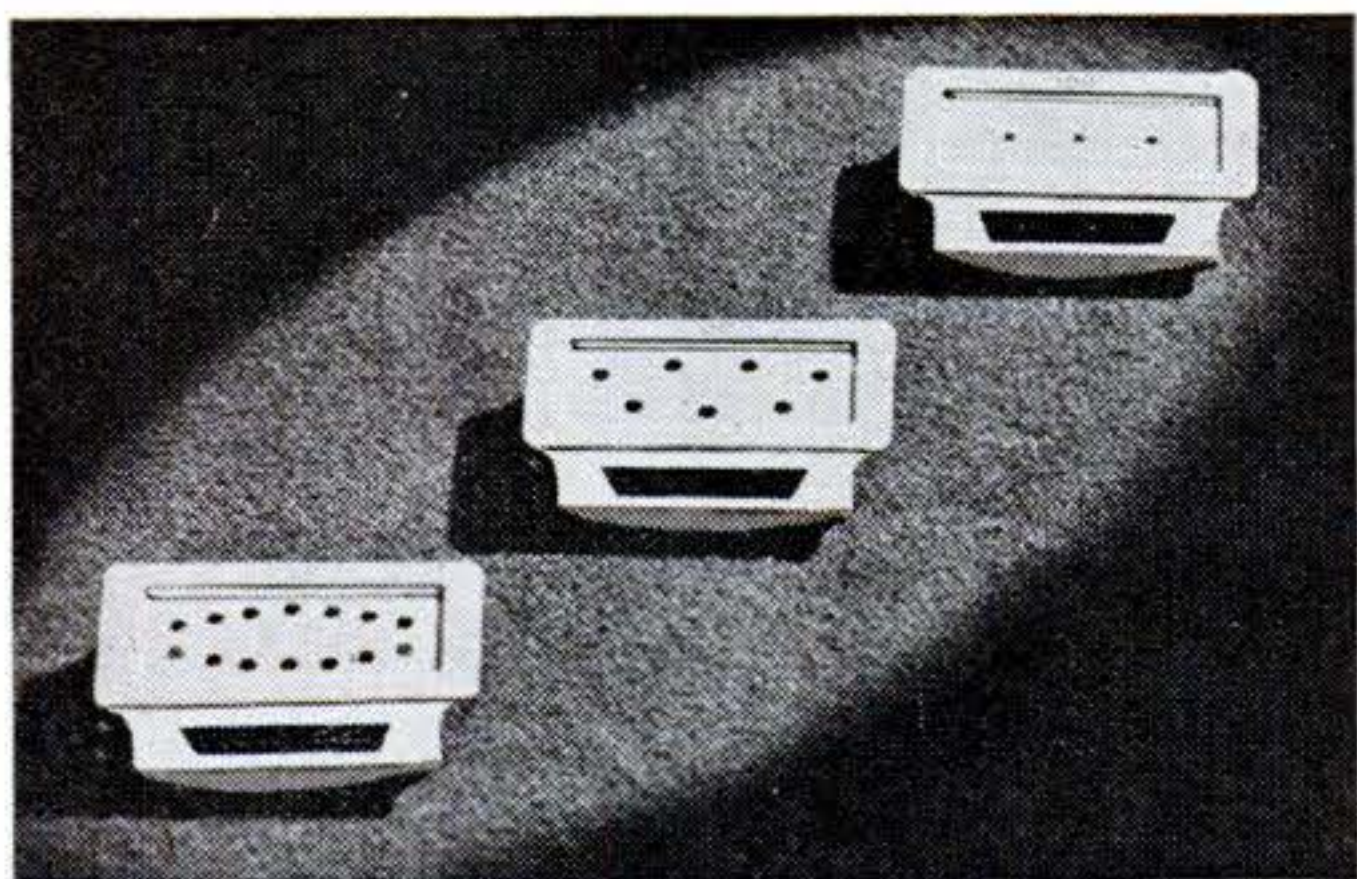
Spark Plugs cleaned and adjusted "By the AC Method" may save as much gas as 1 gallon in 10



SPARK PLUGS

AC SPARK PLUG DIVISION - GENERAL MOTORS CORPORATION

218 POPULAR SCIENCE



Gauging Bright Lights

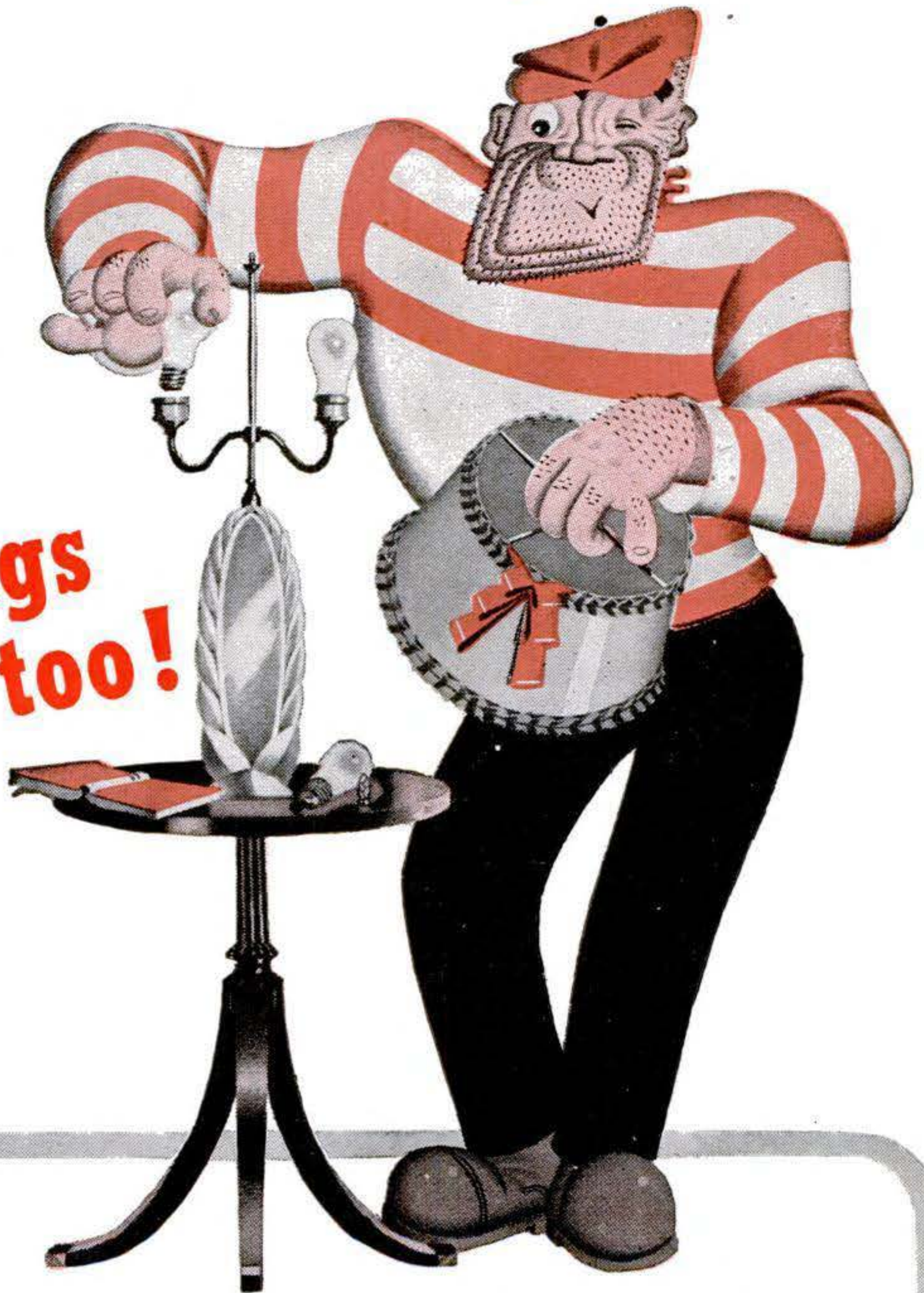
WITH these little "multipliers" you can vastly increase the upward range of a GE exposure meter. Clipped to the meter after the hood has been removed, they use the "incident light" method of measuring exposures. The three available sizes, shown above, measure illumination intensity up to 700, 1,400 and 7,000 foot-candles.



Vibration Aids Shave

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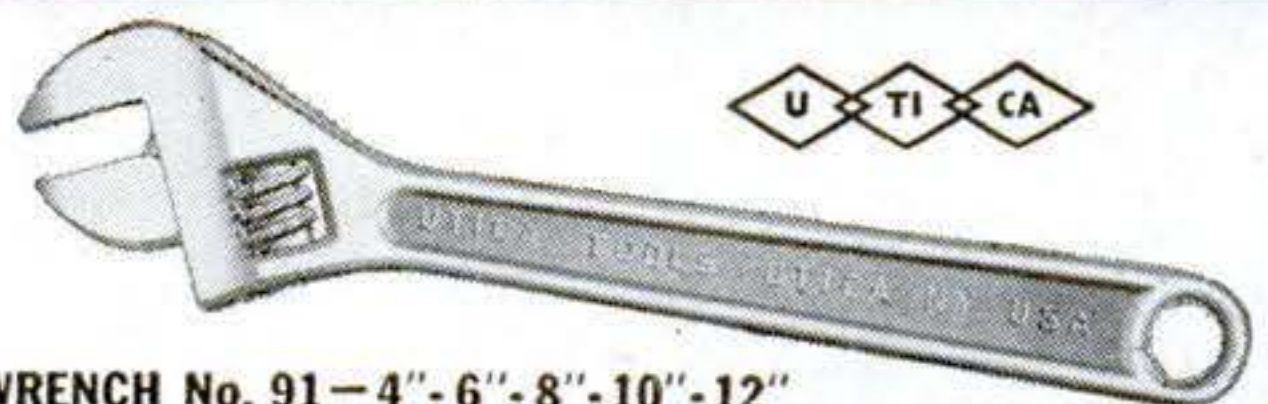
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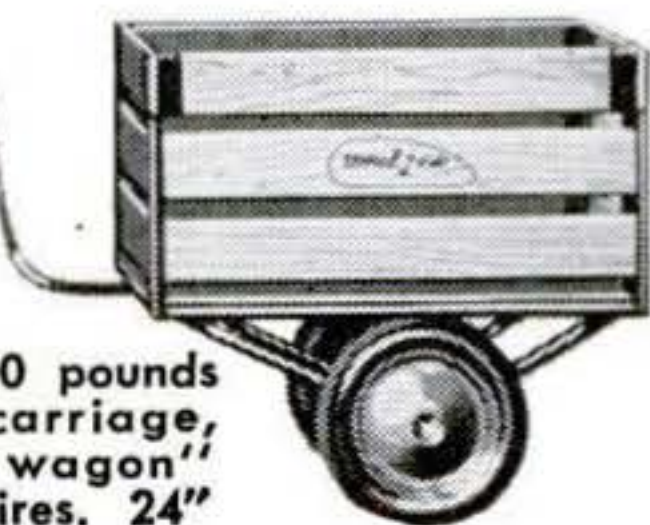
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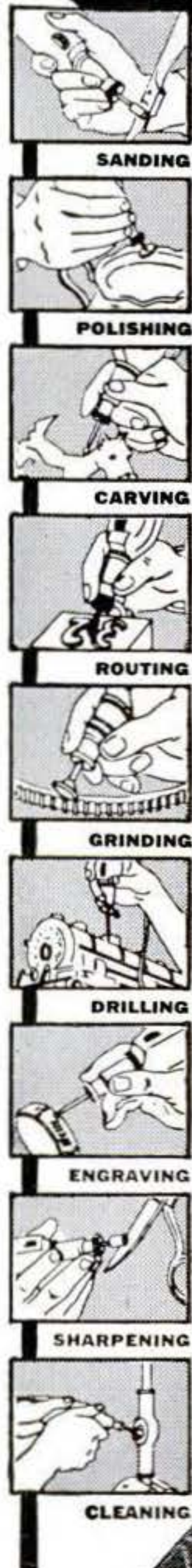
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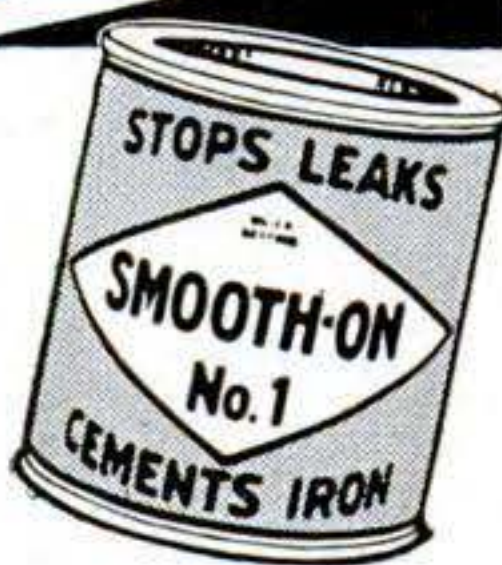
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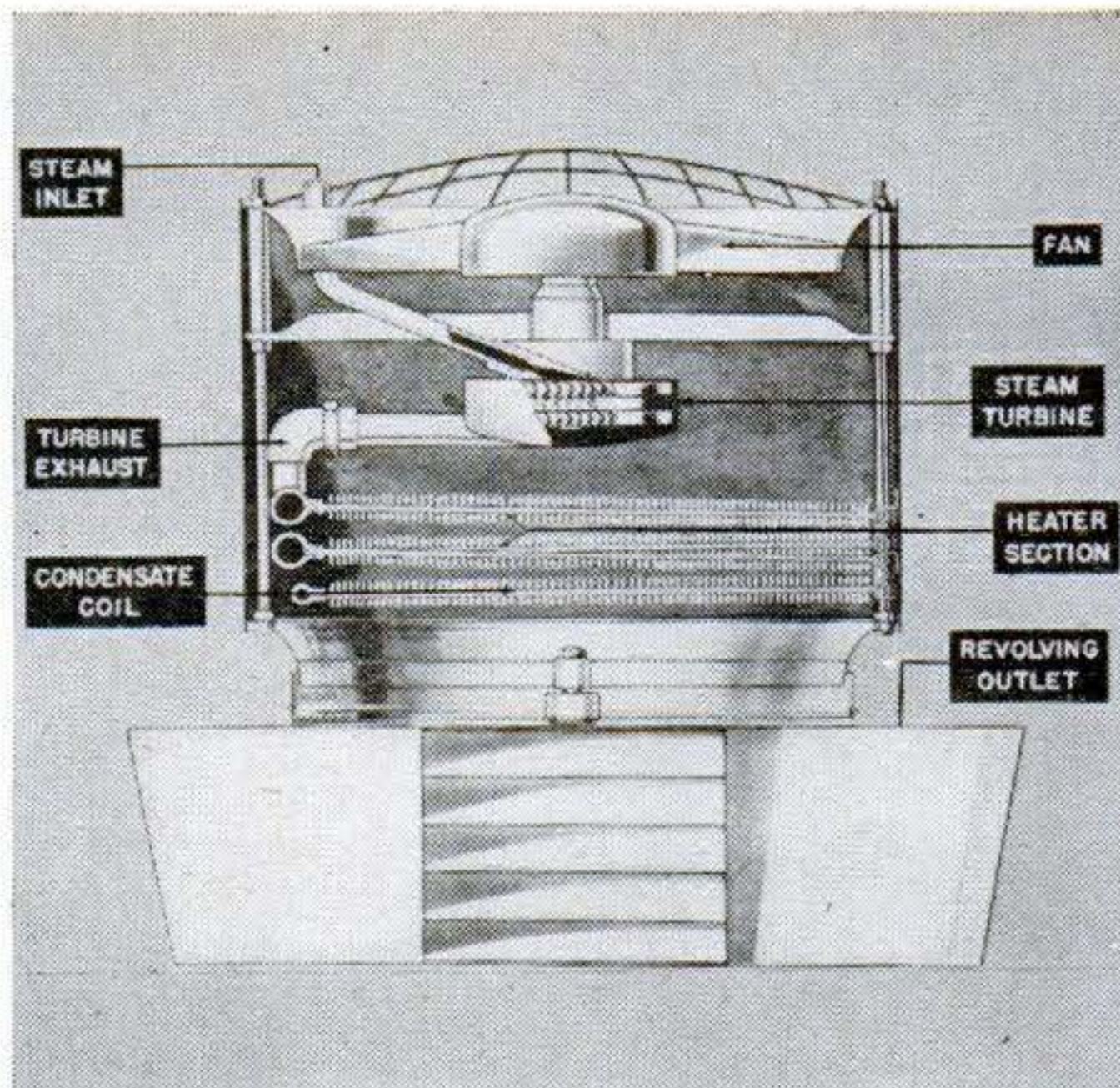
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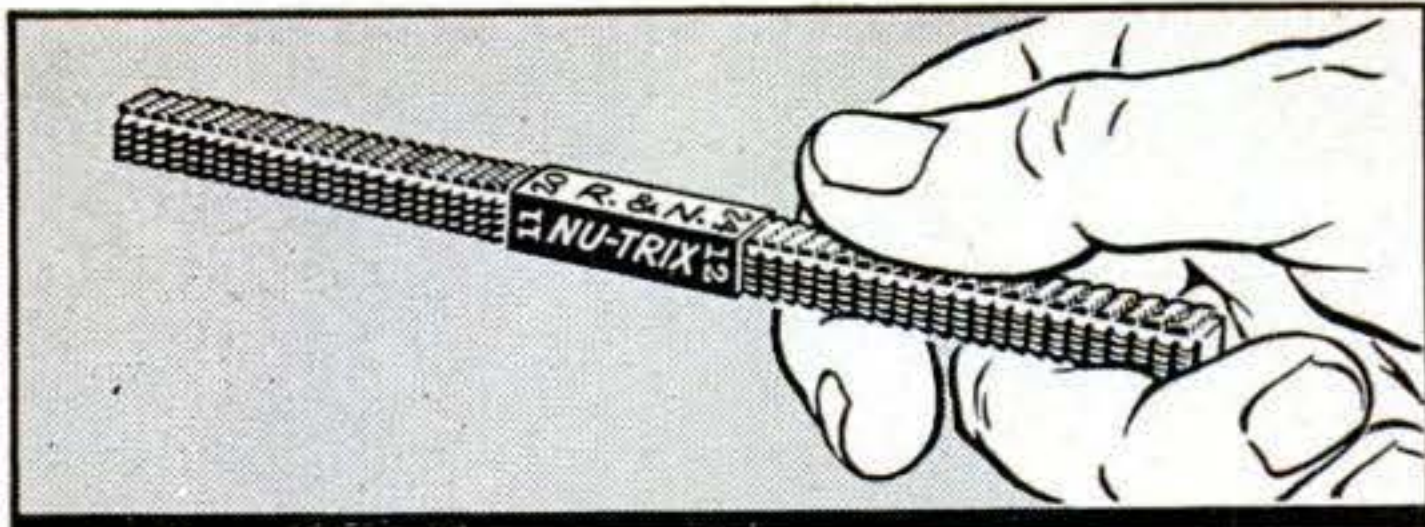


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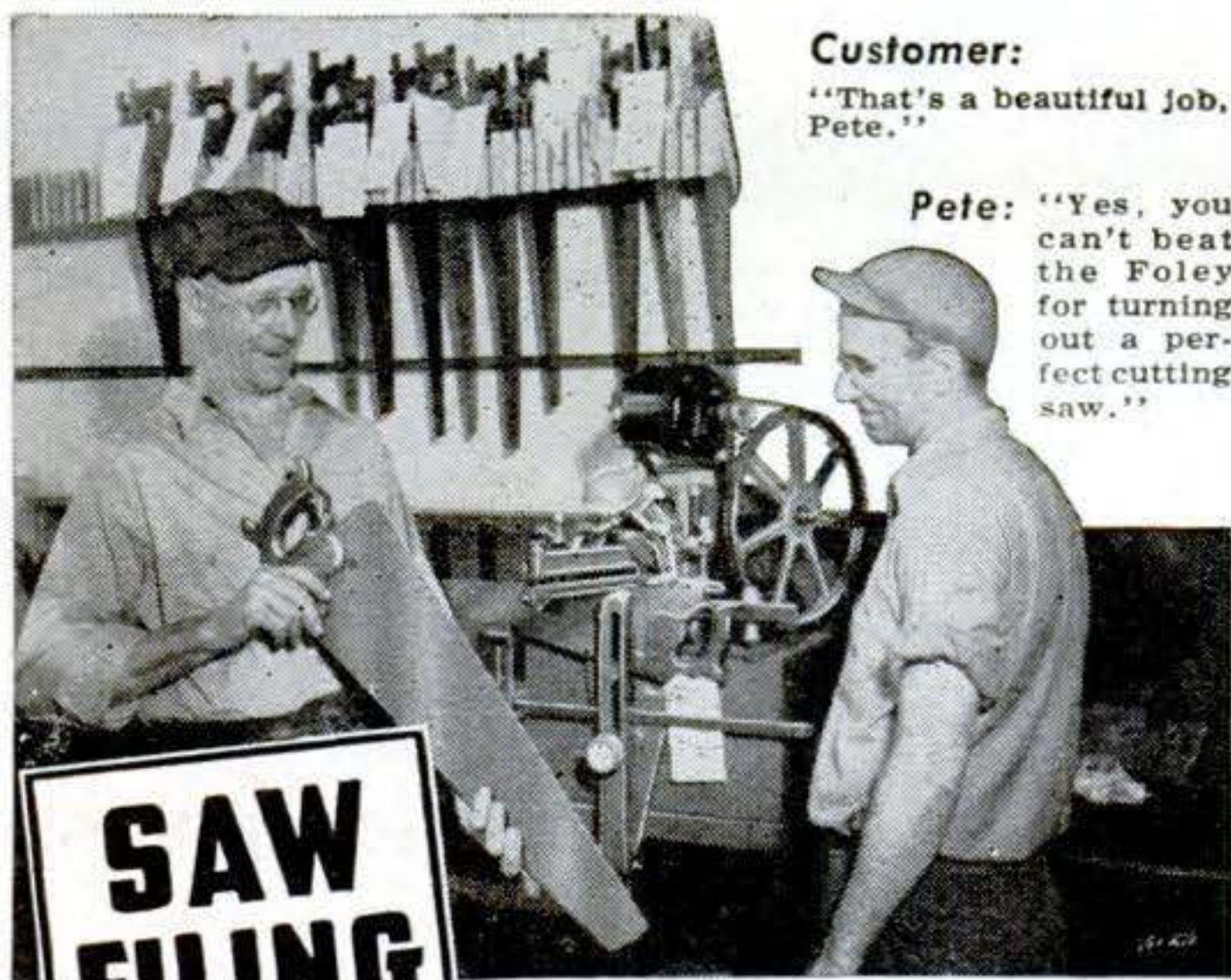
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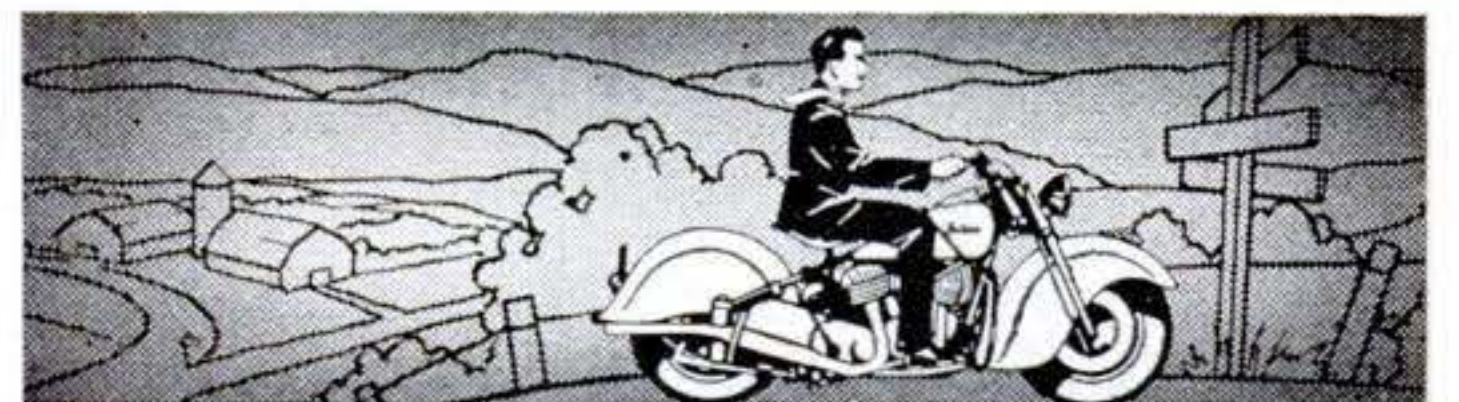
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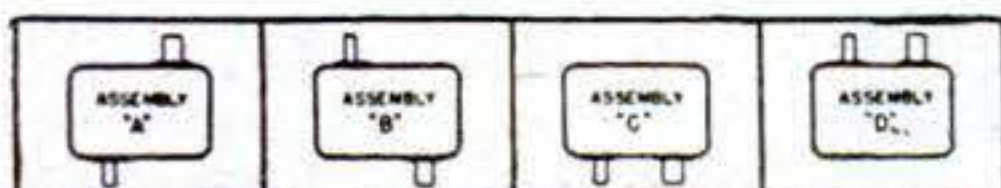
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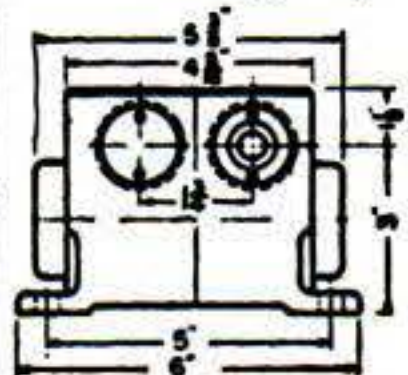
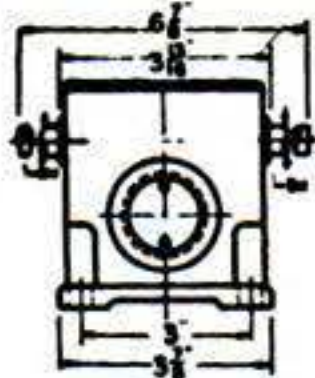


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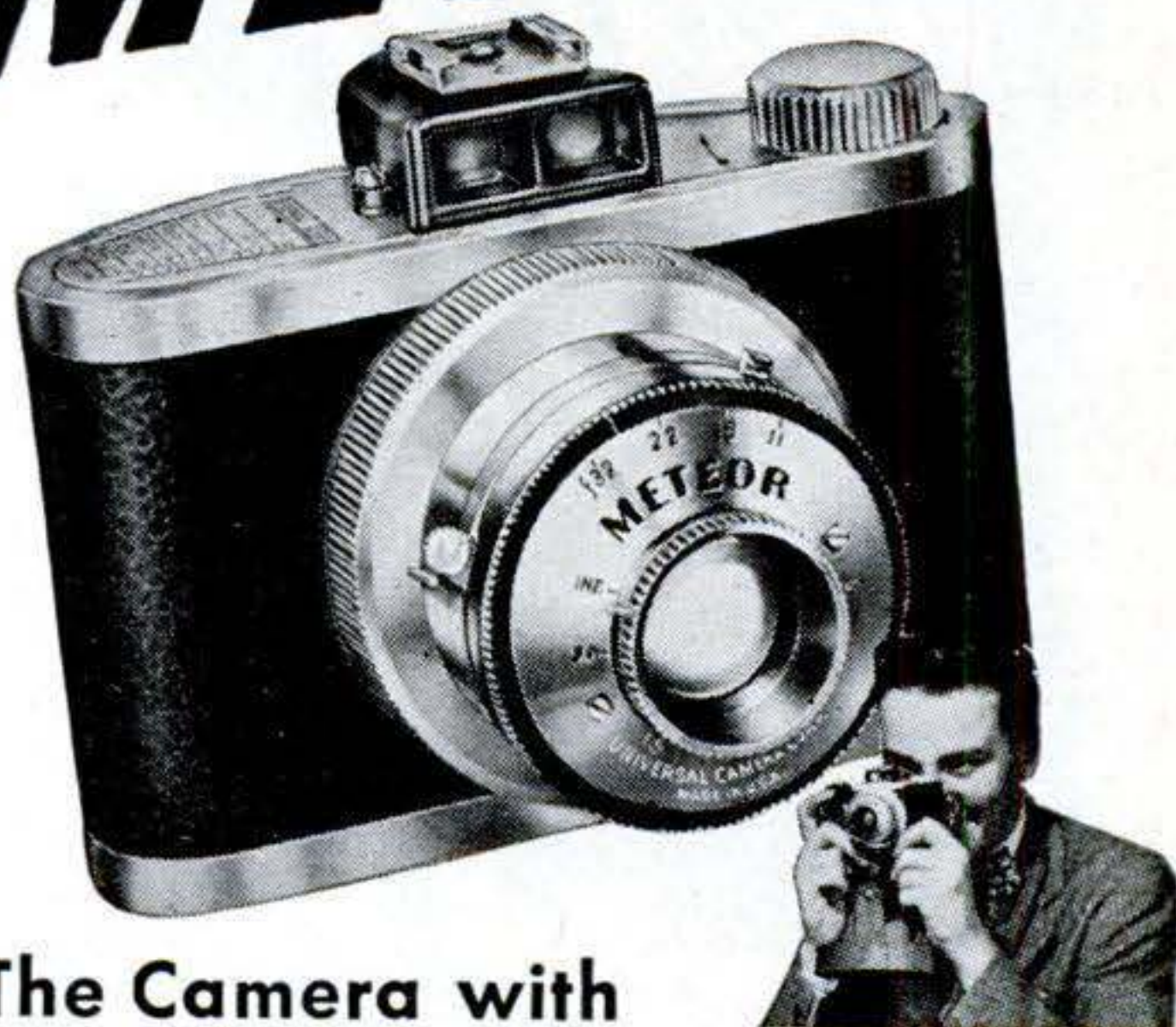


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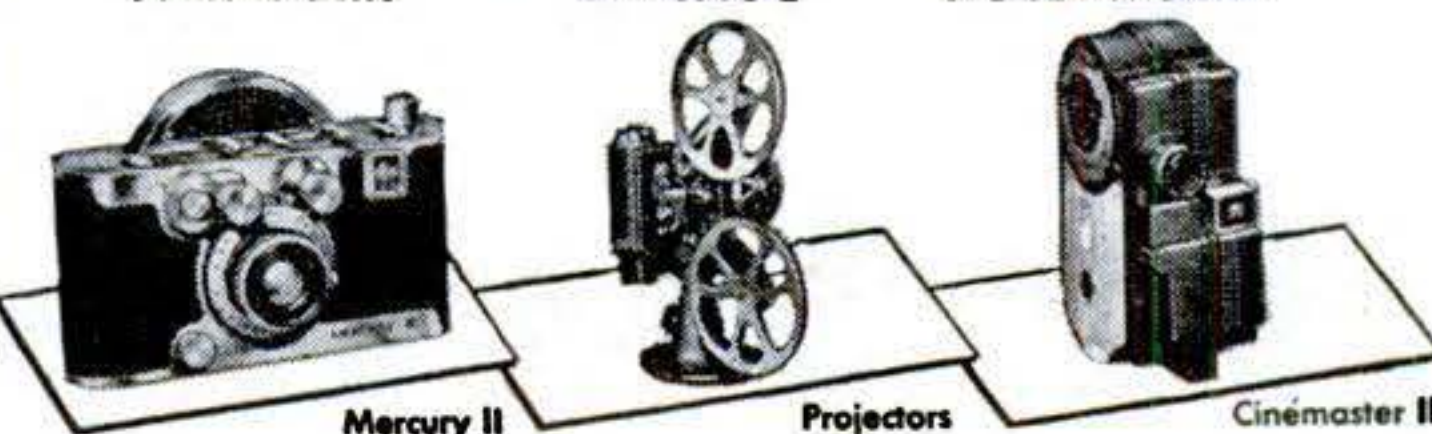
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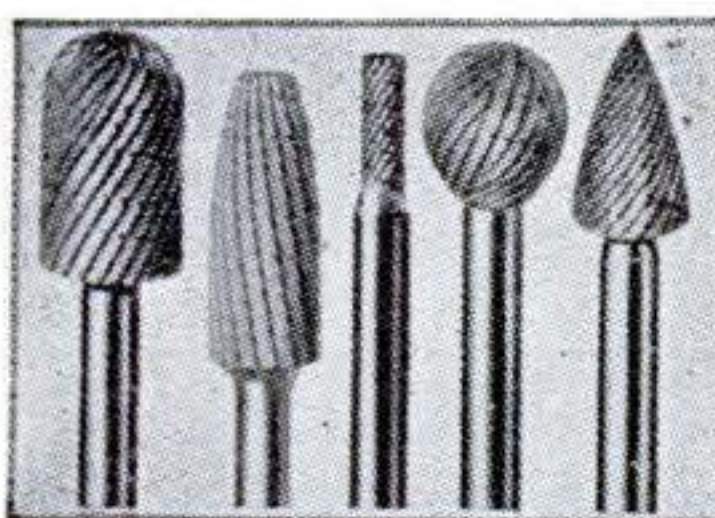
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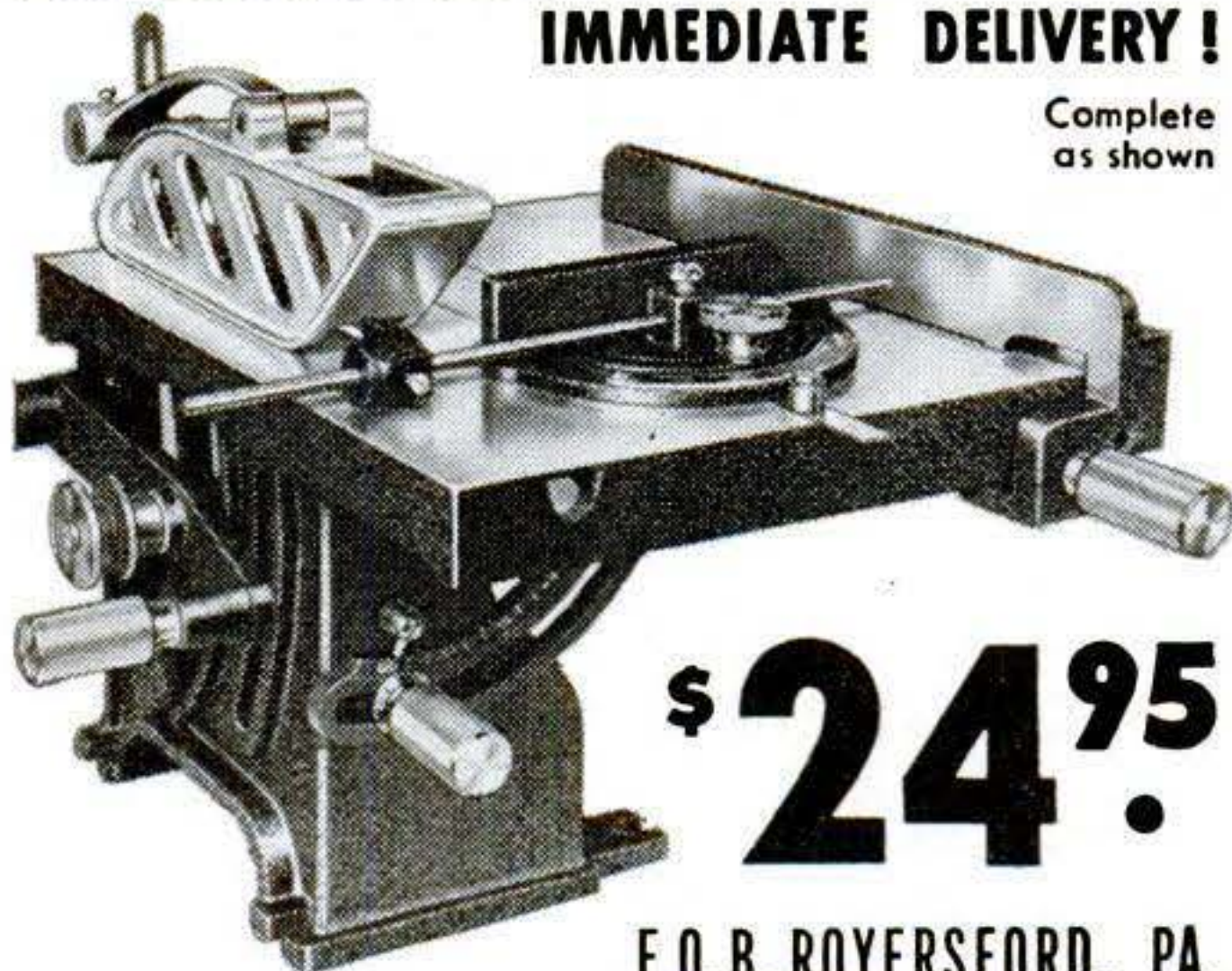
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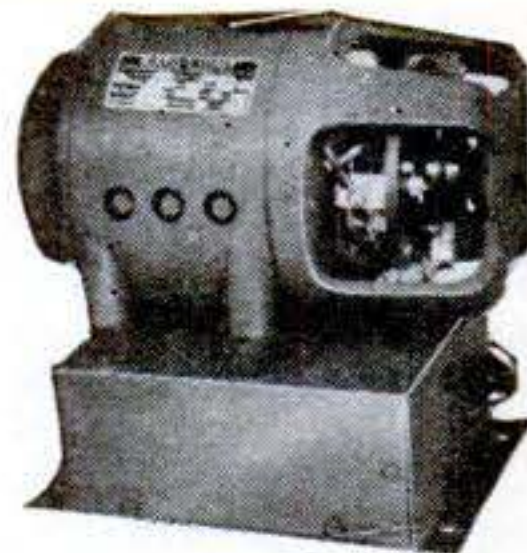
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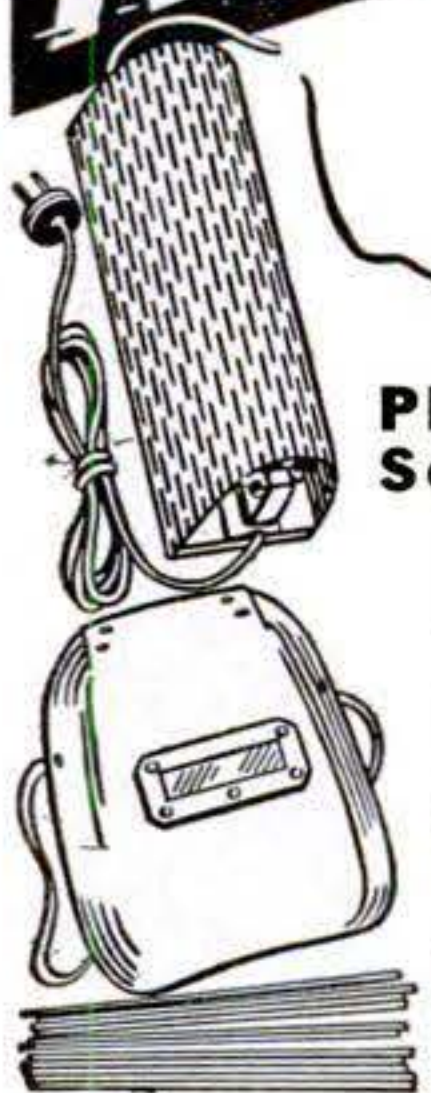
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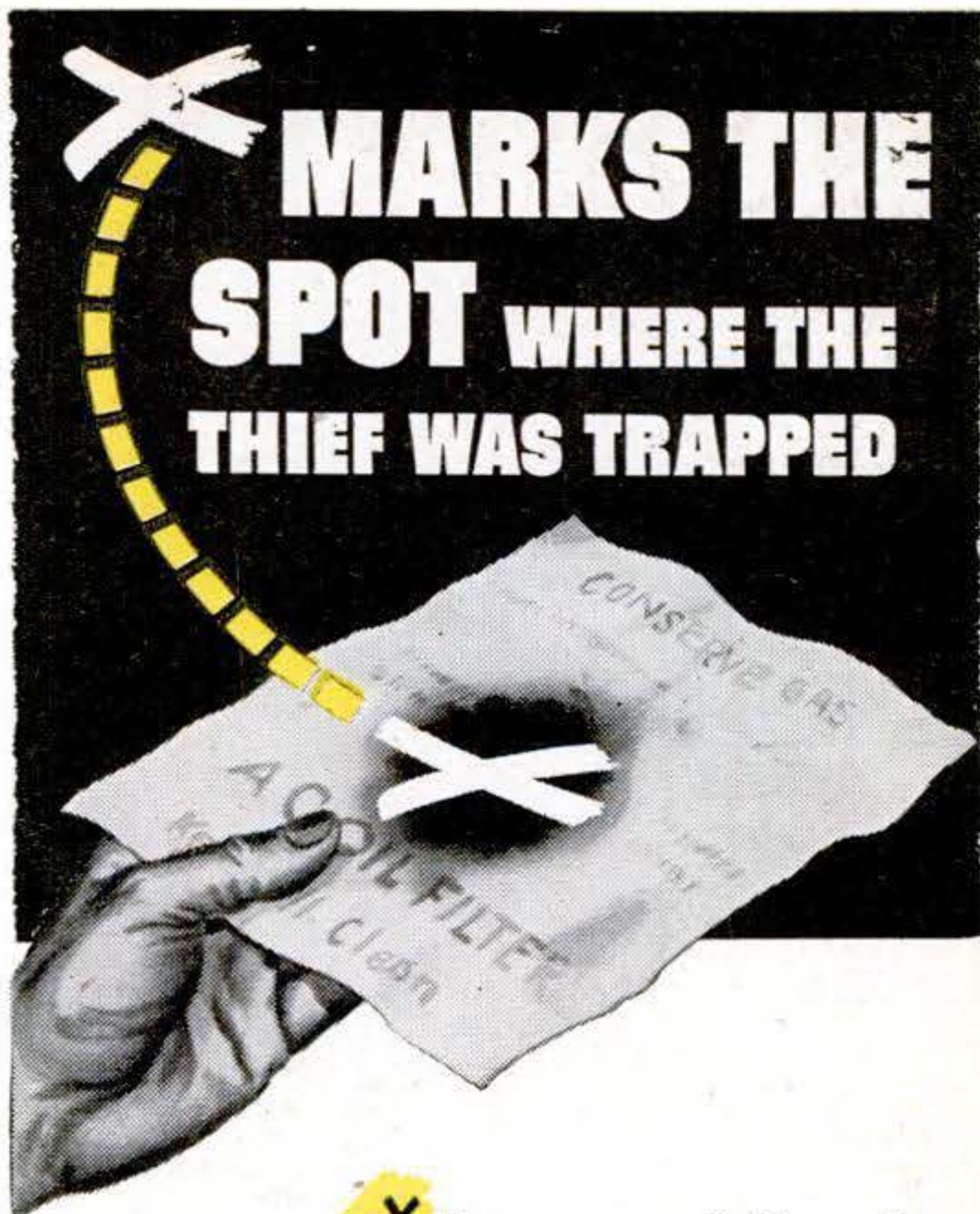
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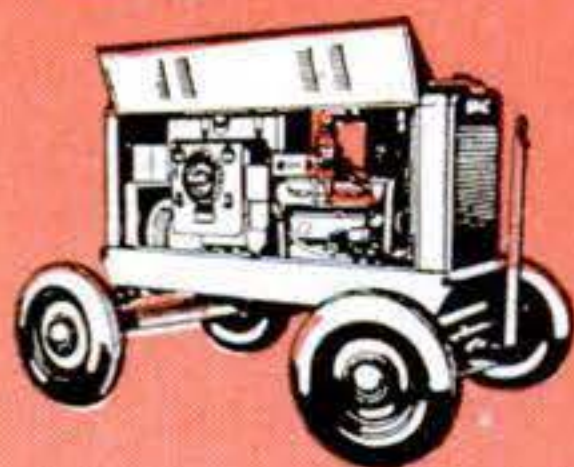
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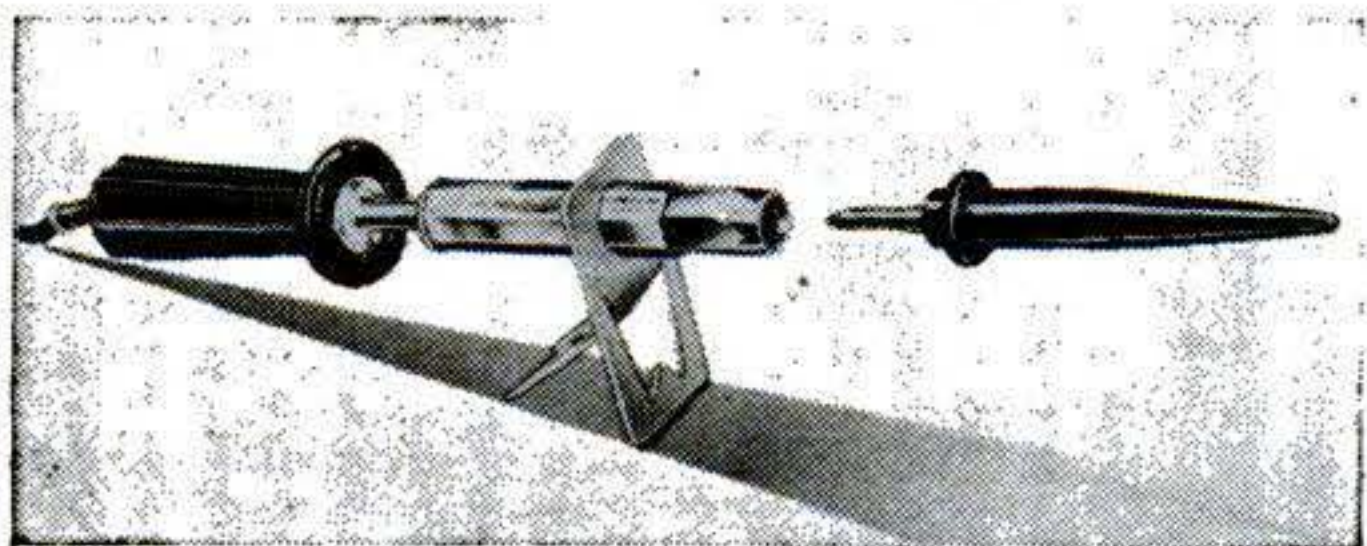
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Spray for Weed-Killers

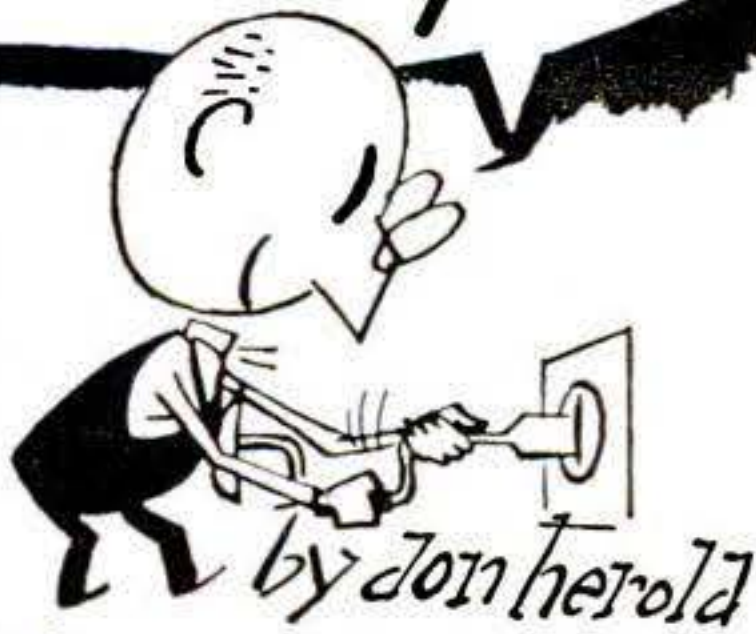
FASTENED to a rubber-socketed screw cap that fits any gallon jug, two plastic tubes and a spray head form a handy device for administering weed-killing mixtures to dandelions, thistles and similar vegetable pests. The sprayer, which has a shut-off valve on the cap, is made by Ray-Craft, Inc., for Sherwin-Williams, both of Cleveland.



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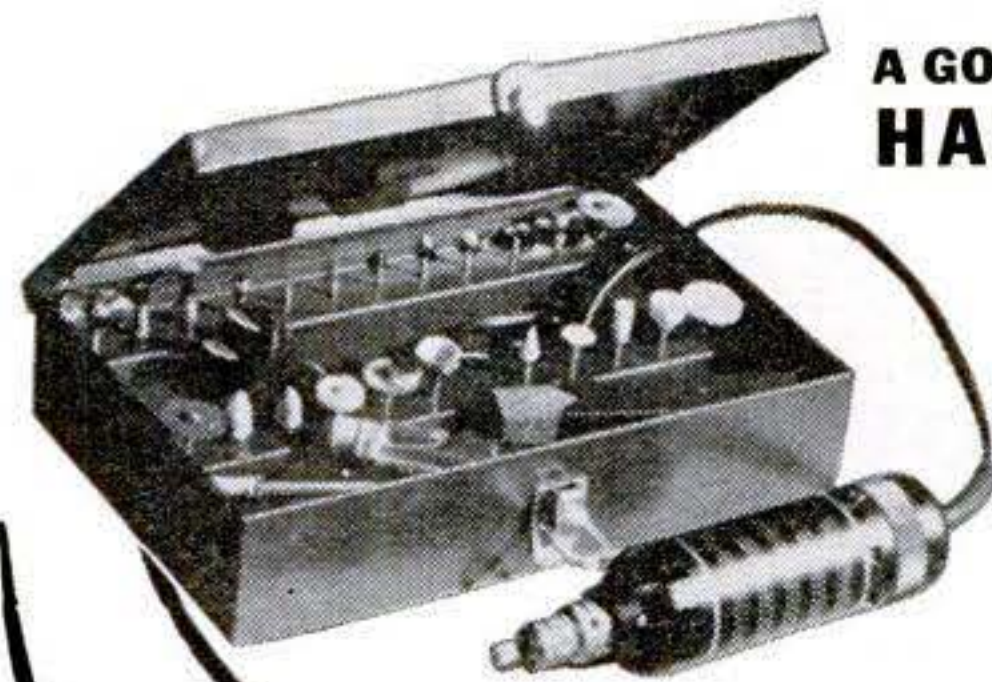
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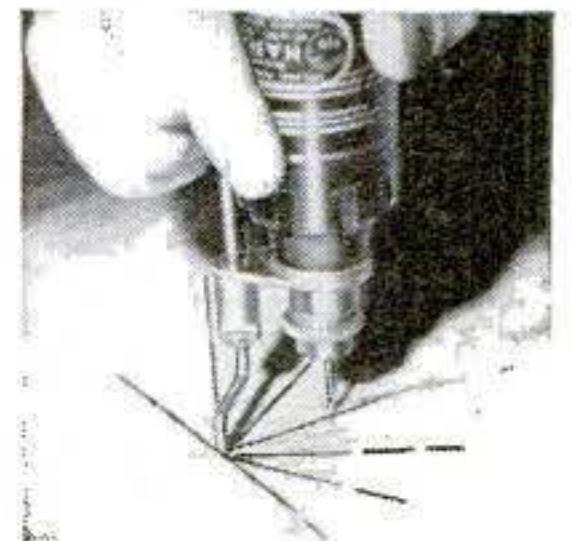
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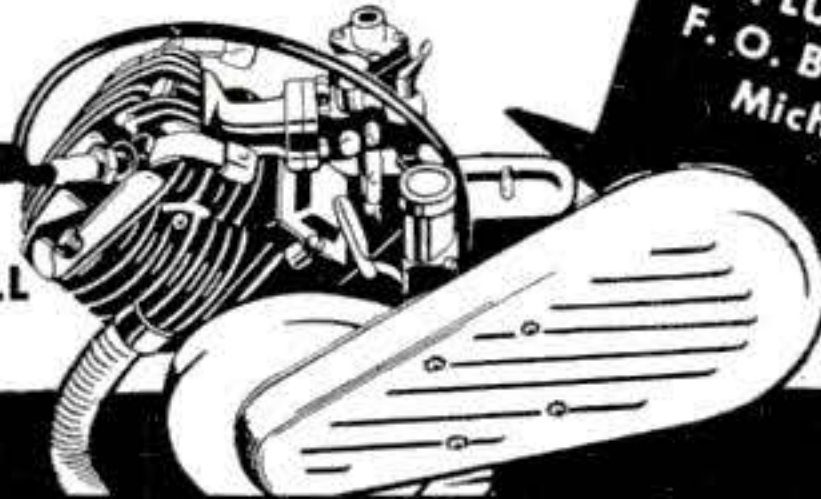
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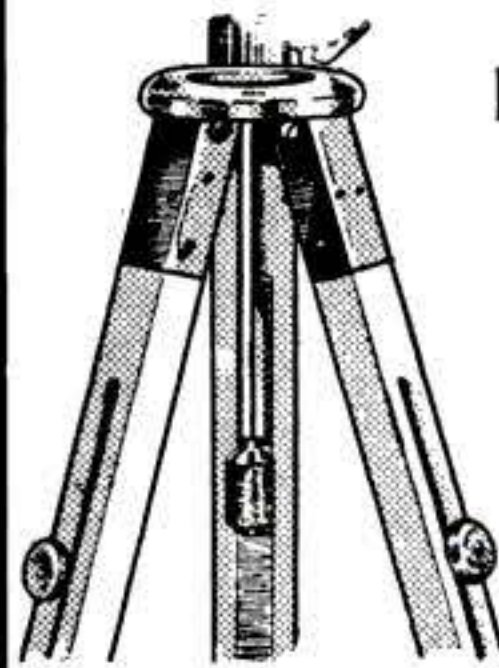
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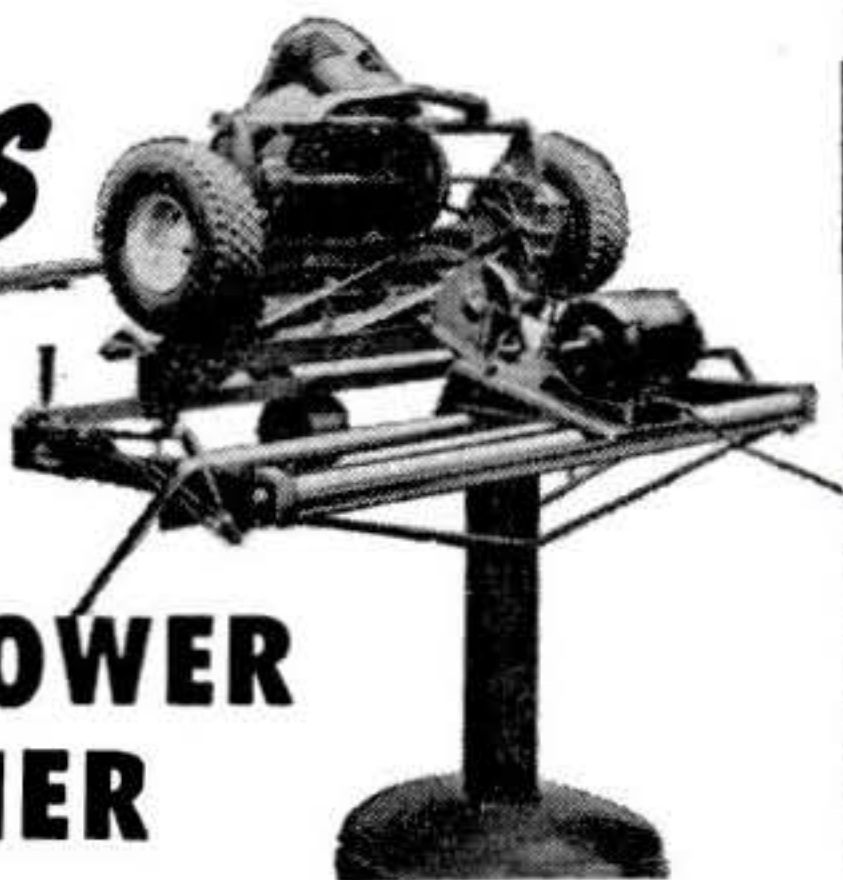
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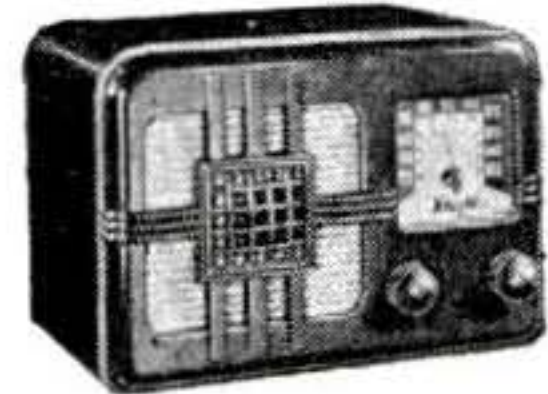


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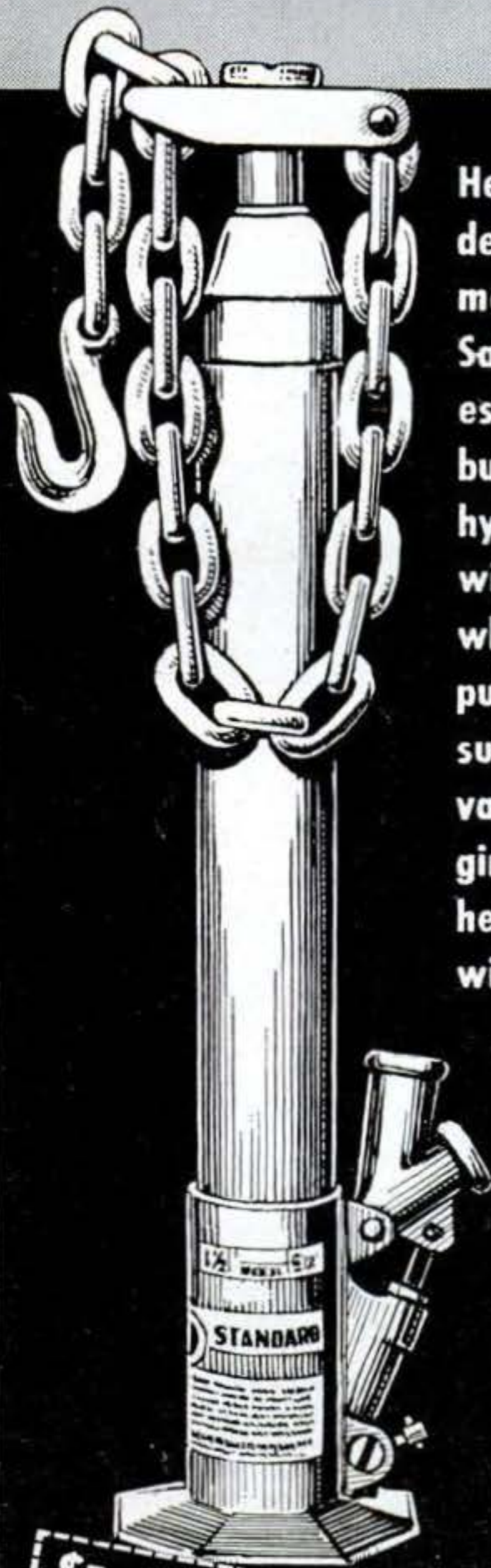
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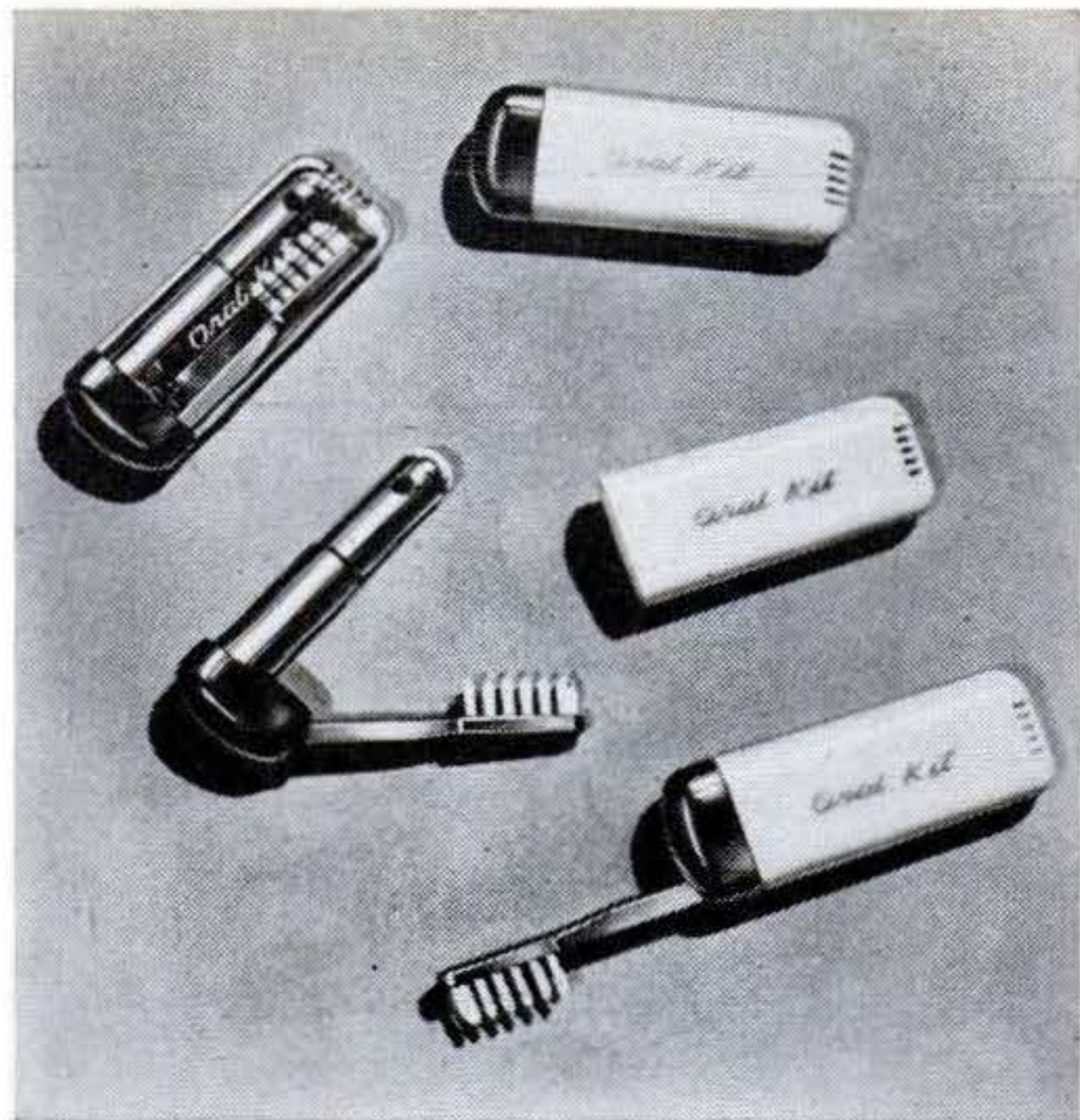
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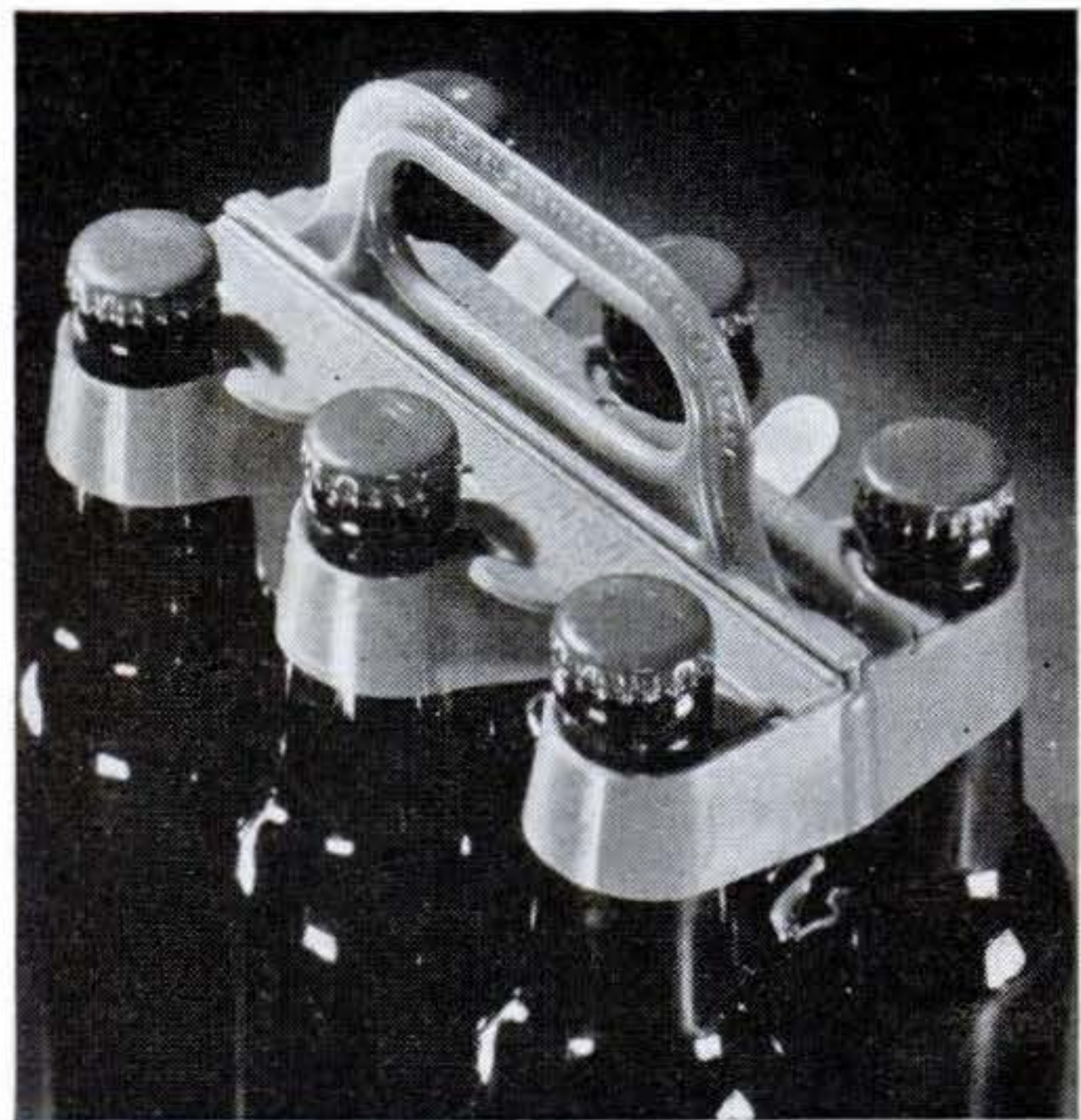
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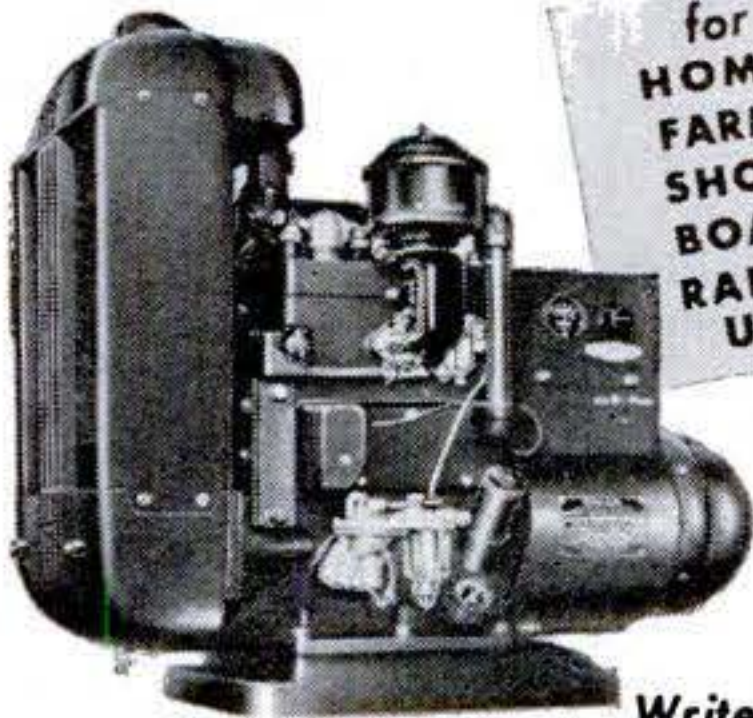


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"Humph," I snort.

"Why the gloom, sour-puss?" she asks. "Indigestion?"

"No," I shoot back. "It's just I'm thinkin' if you don't reline those brakes, you may *really* look like an angel."

"Oh," she says casually, "I can still stop can't I?"

"Not quick enough or easy enough," I reply.

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"Whoa," she laughs, "that's enough. Reline 'er with Grizzly, Joe, and I'll drive relaxed!"

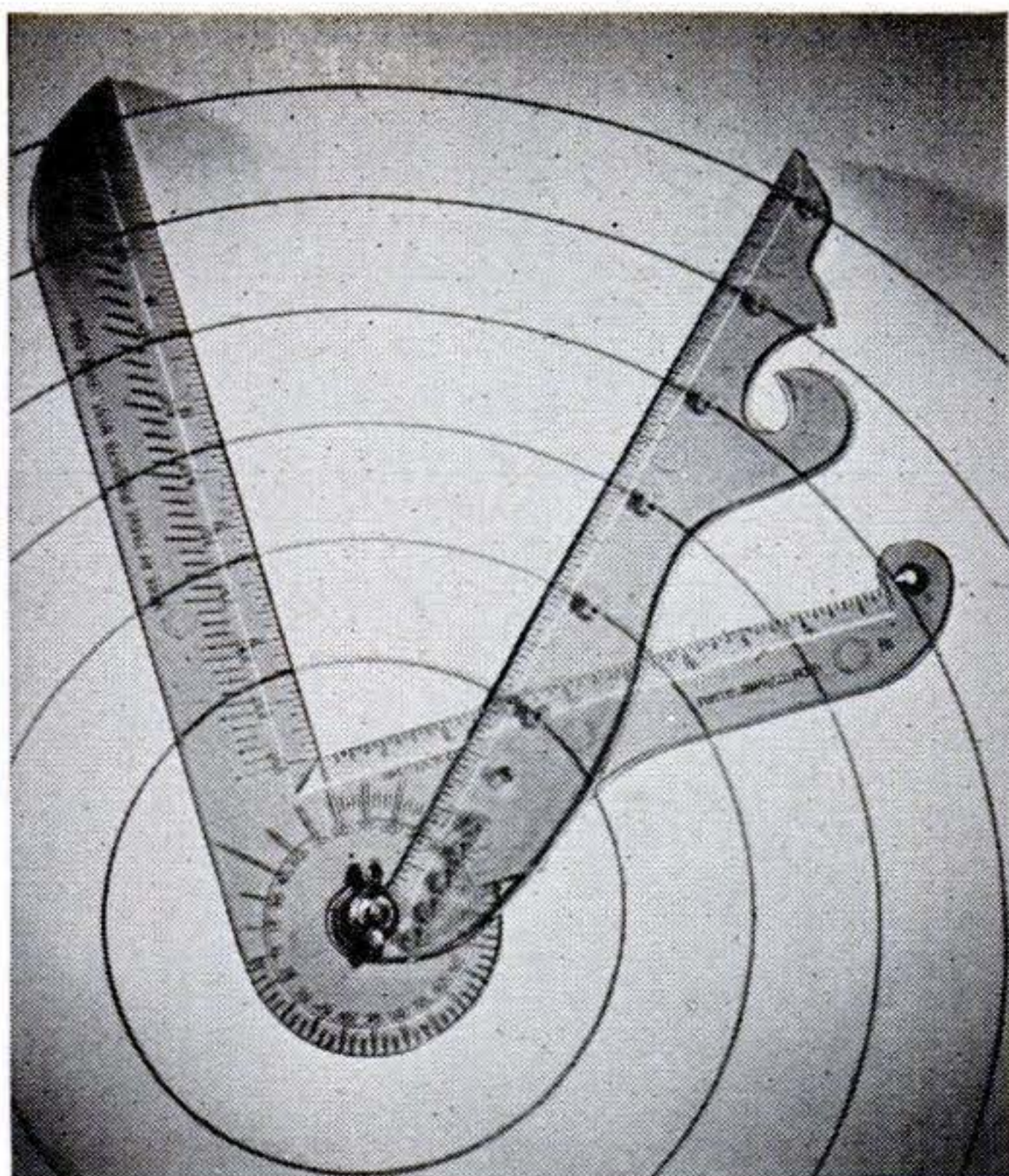


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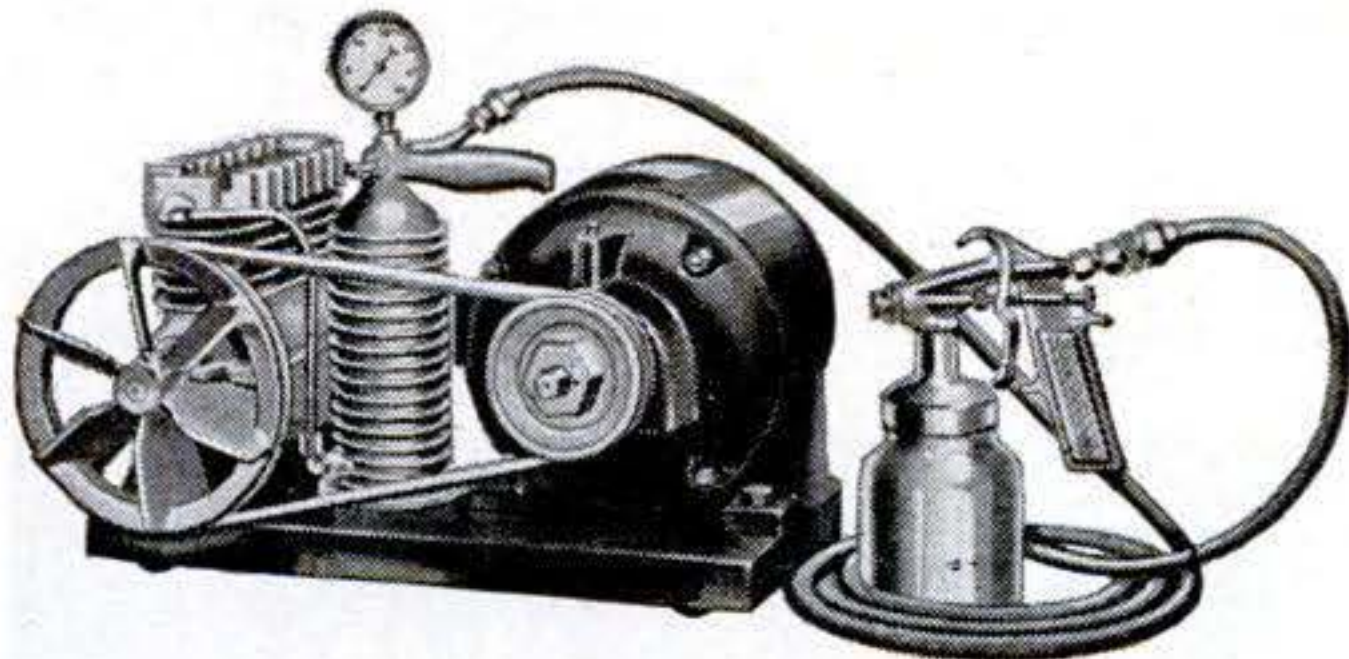


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DEvised primarily as an aid to stamp collectors, a recent product of the Micro-Lite Co., of New York, has an adjustable magnifying glass on the barrel of a five-inch flashlight. The glass slides up and down the barrel for focusing, and a ball-and-socket joint permits quick angular adjustment. Besides helping to spot marks or breaks in stamps, the light is useful in examining many other small items.

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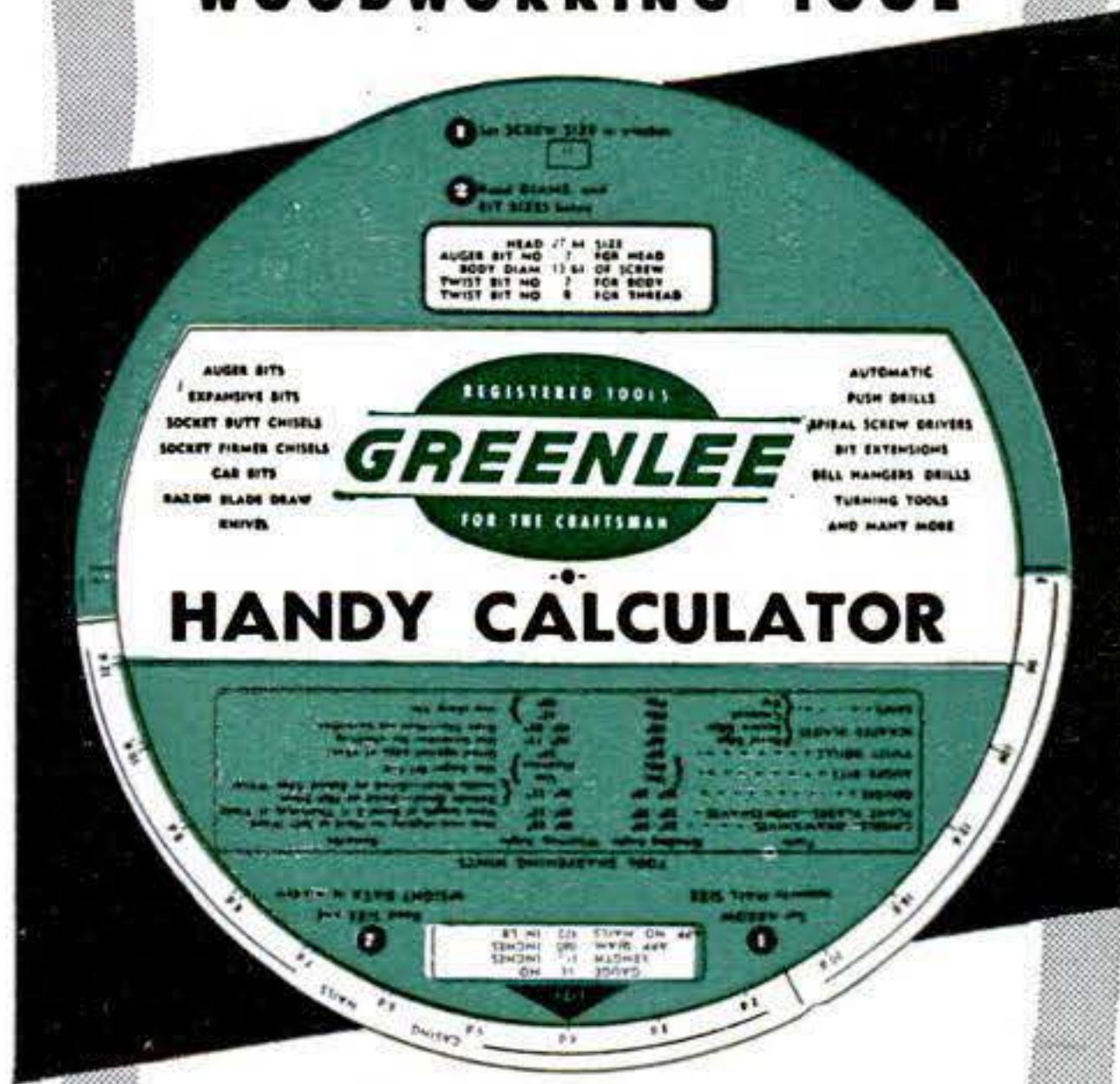
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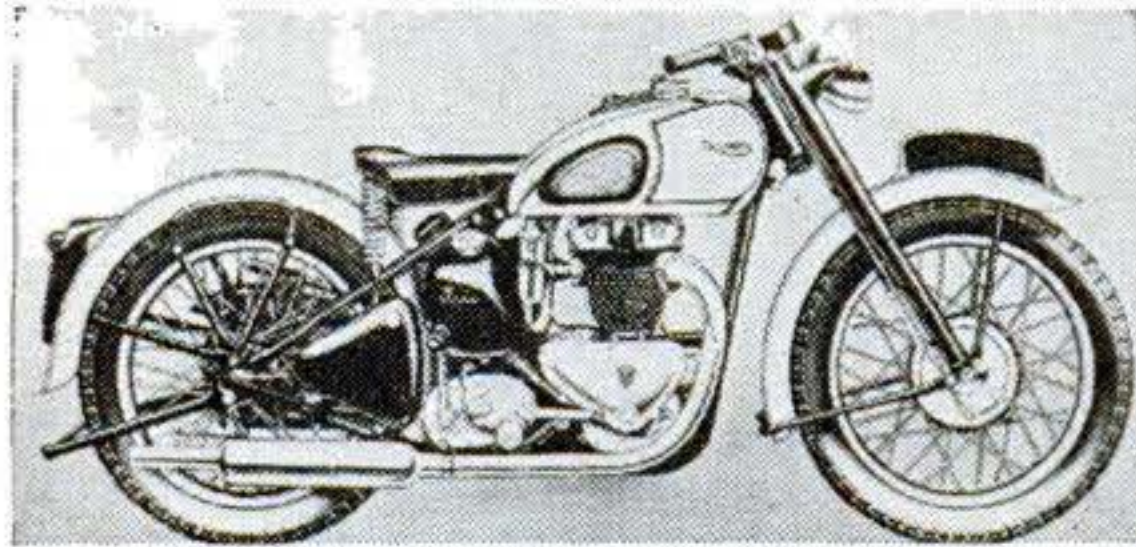
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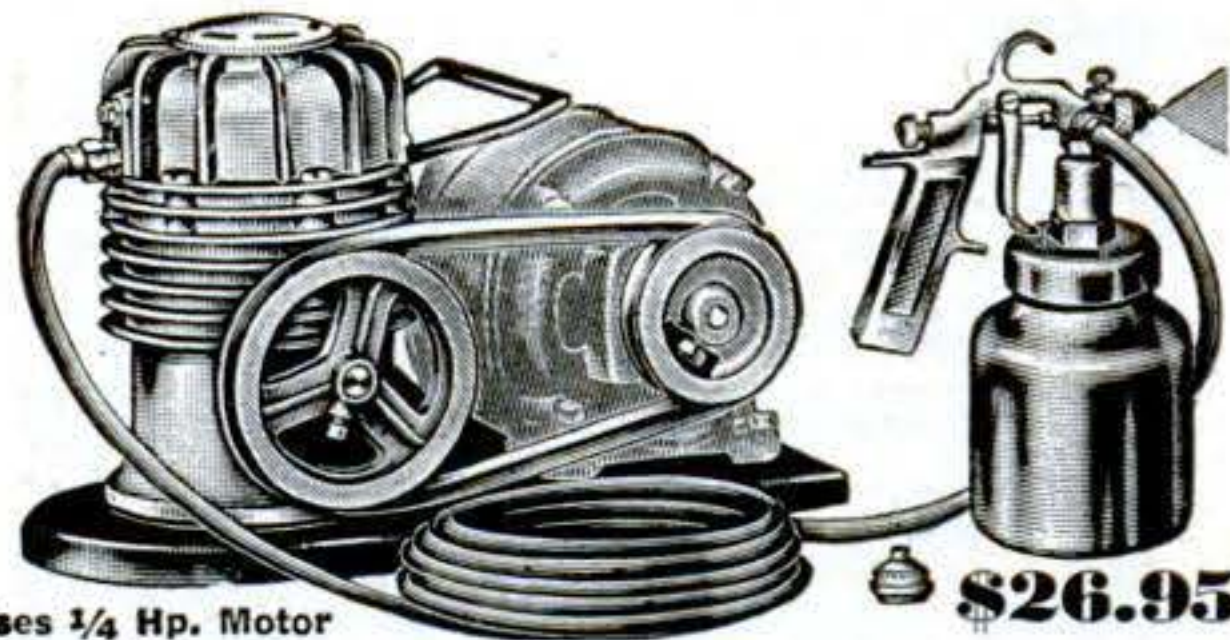
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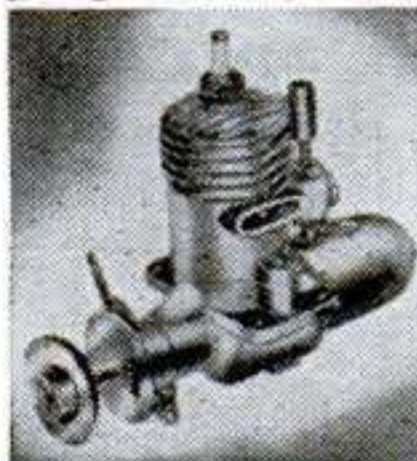
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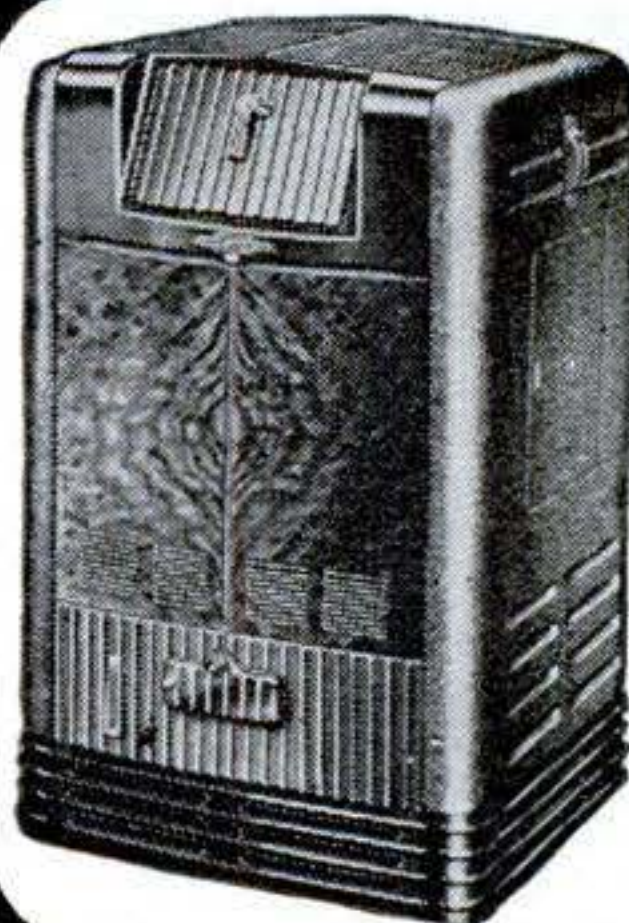
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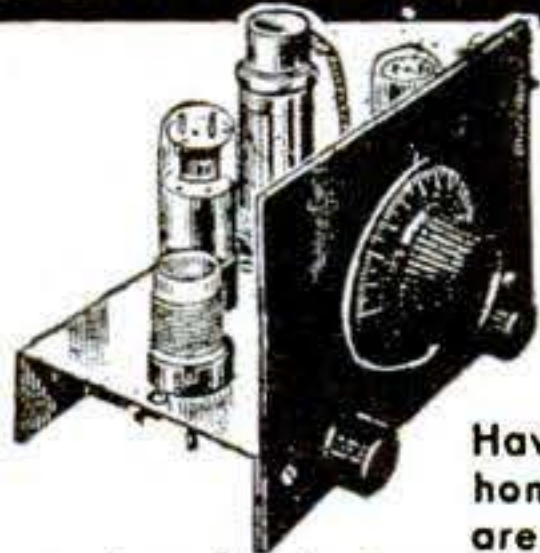
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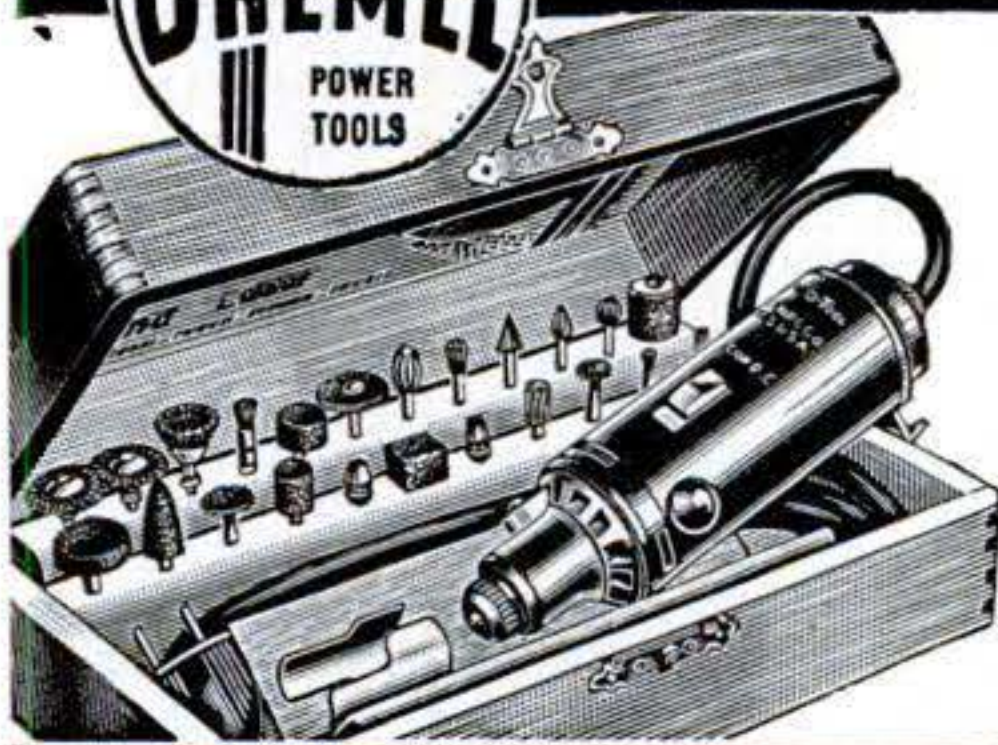


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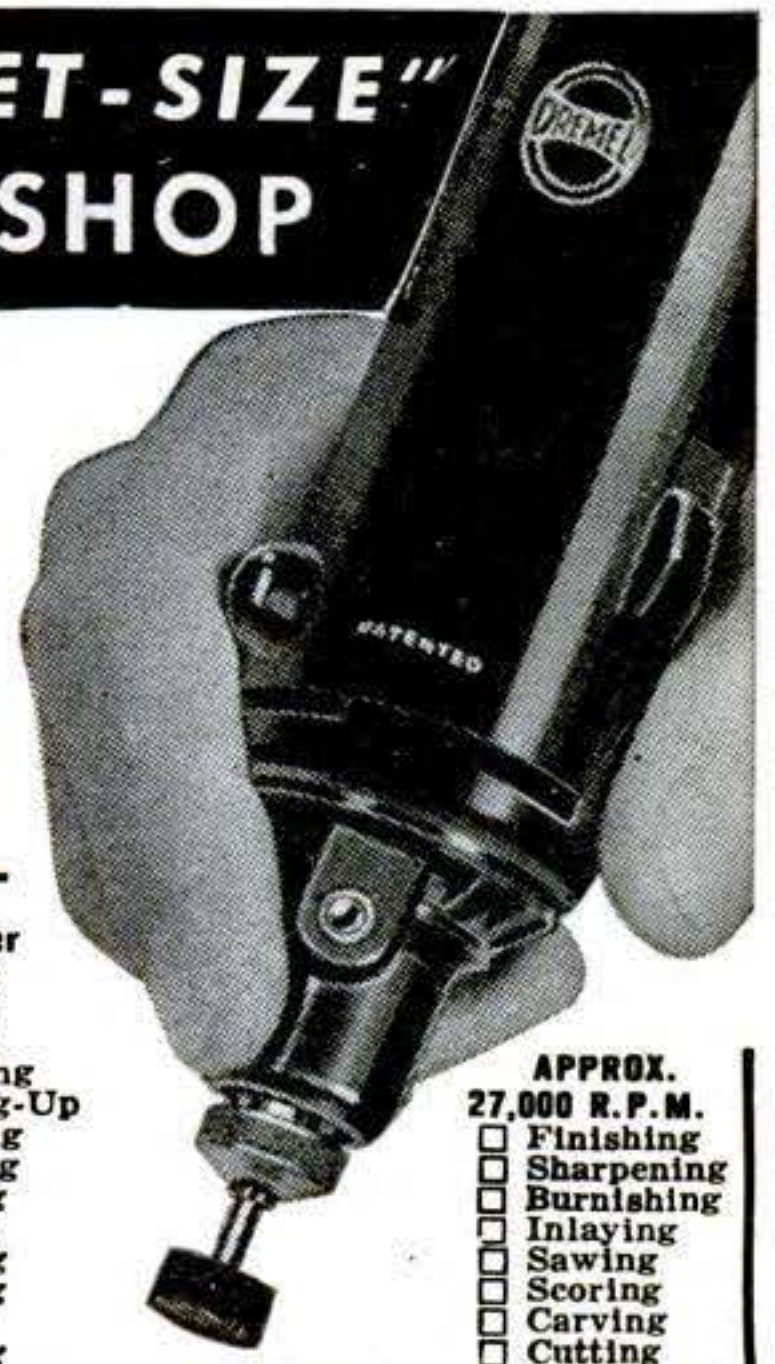
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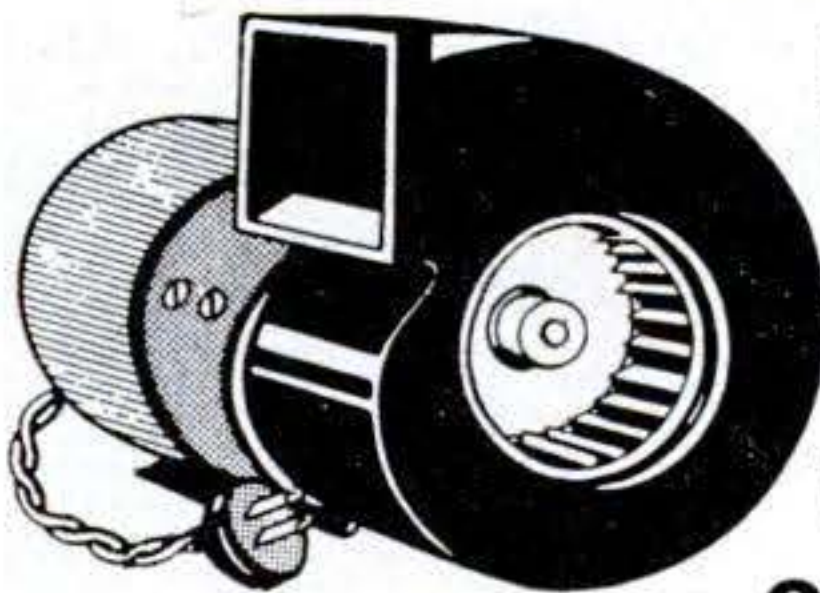
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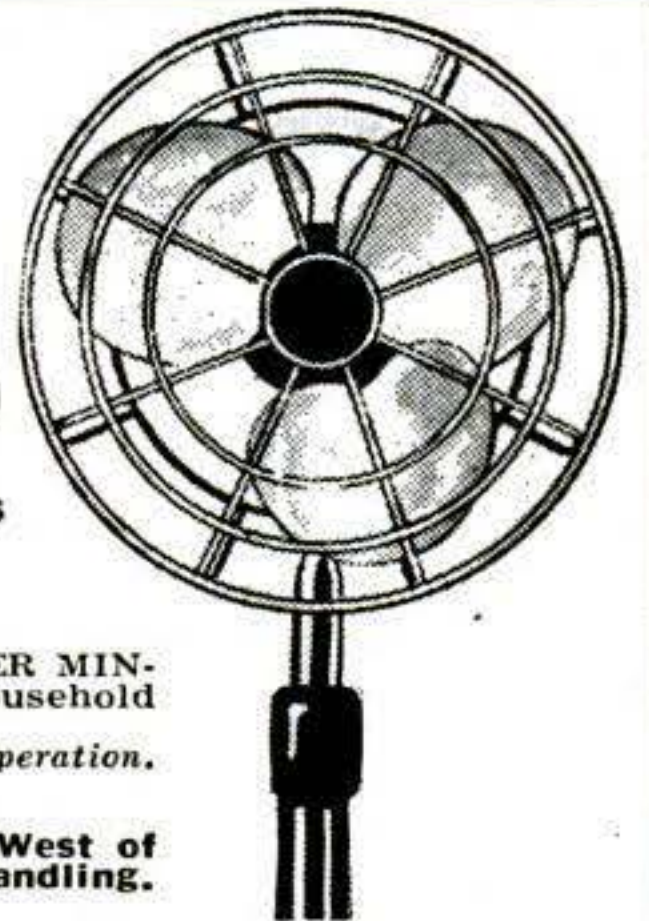
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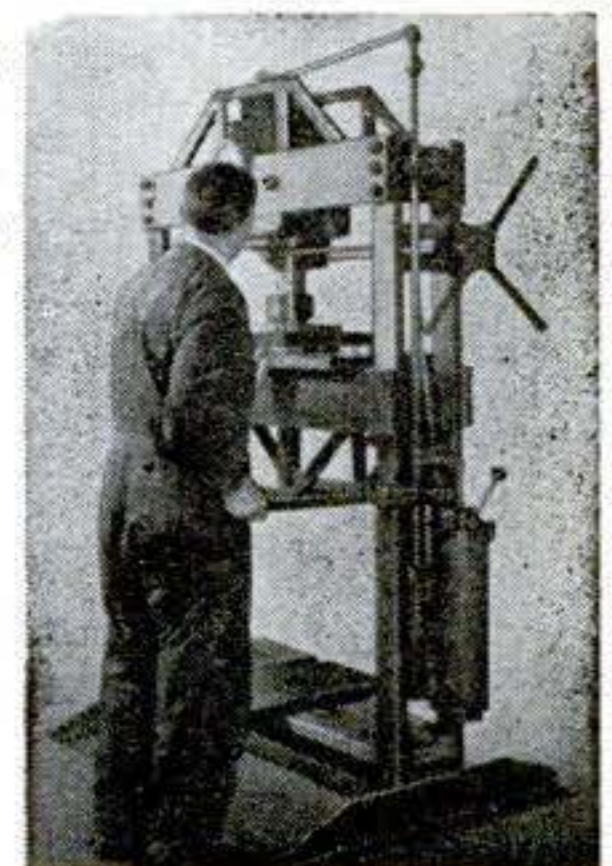
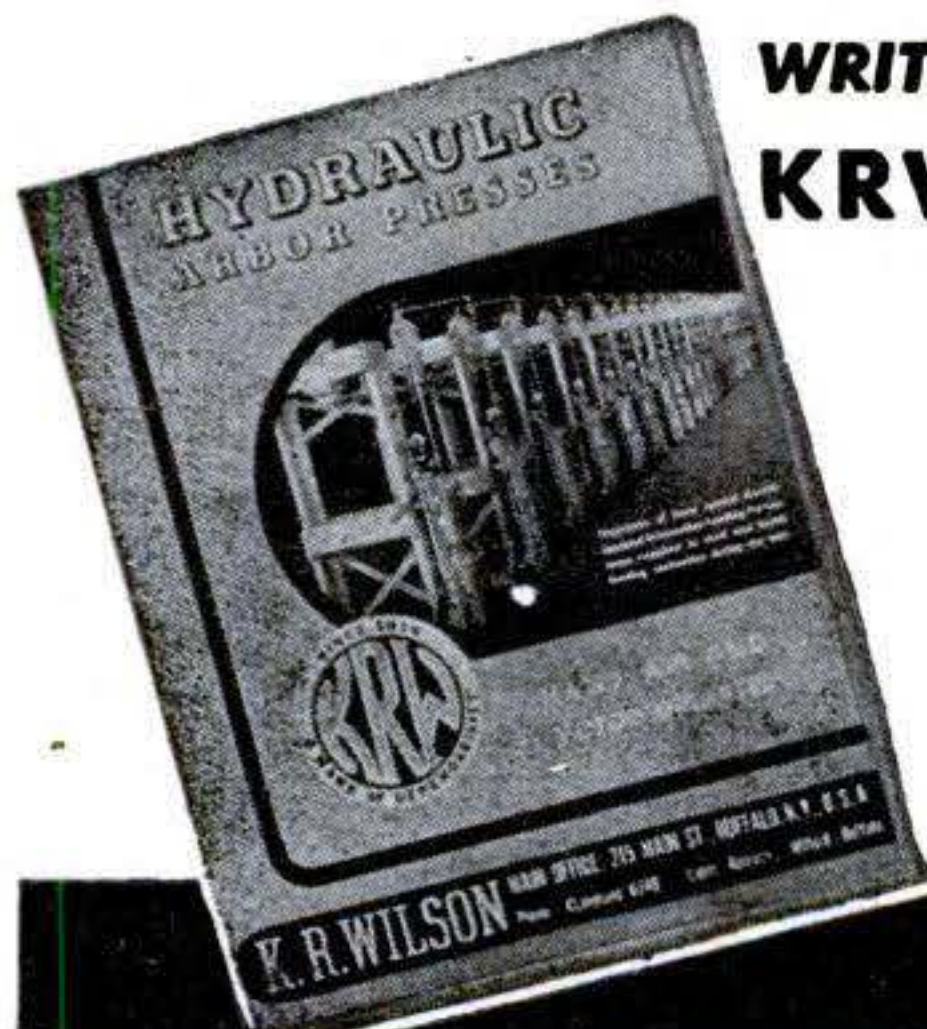


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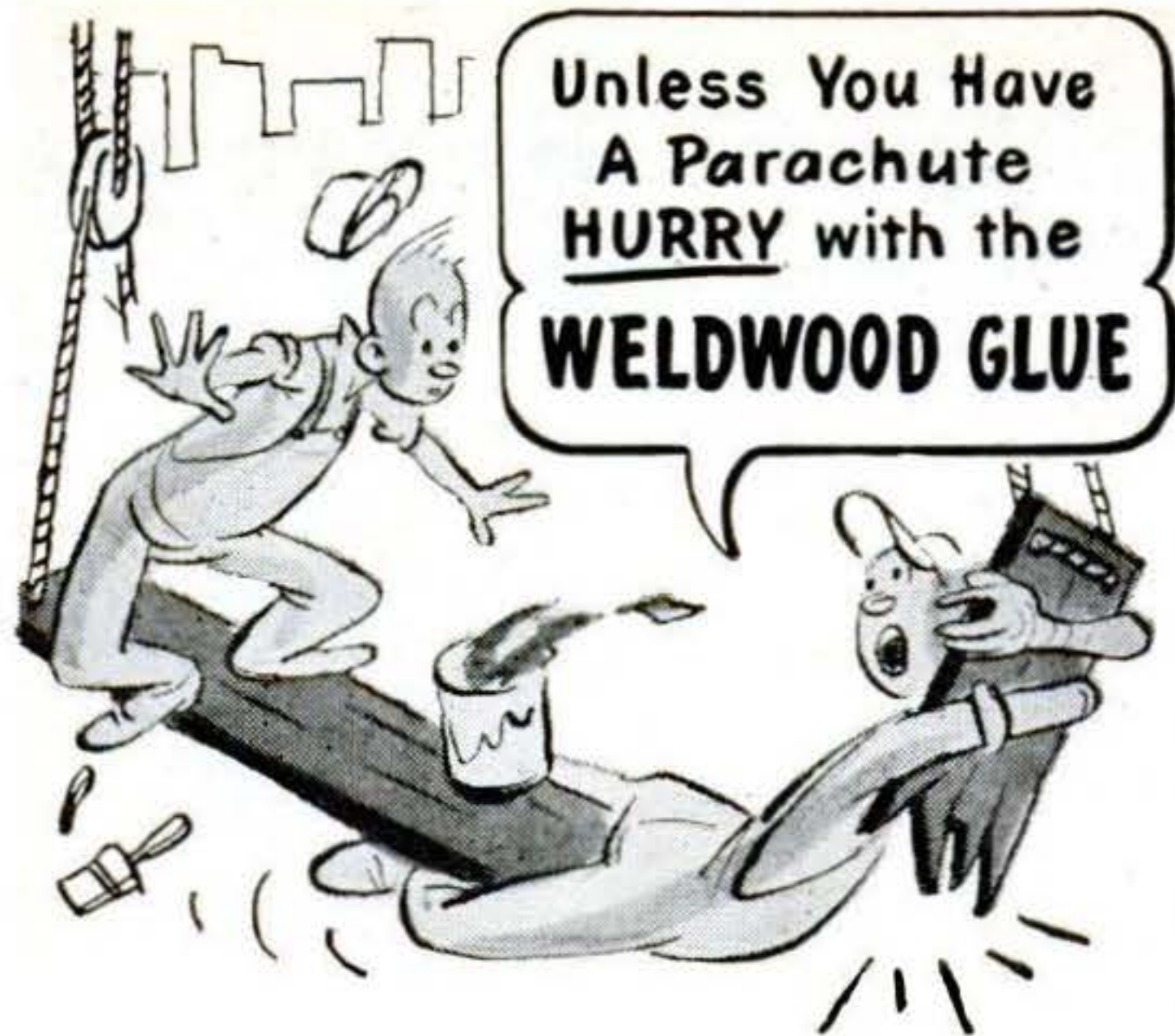
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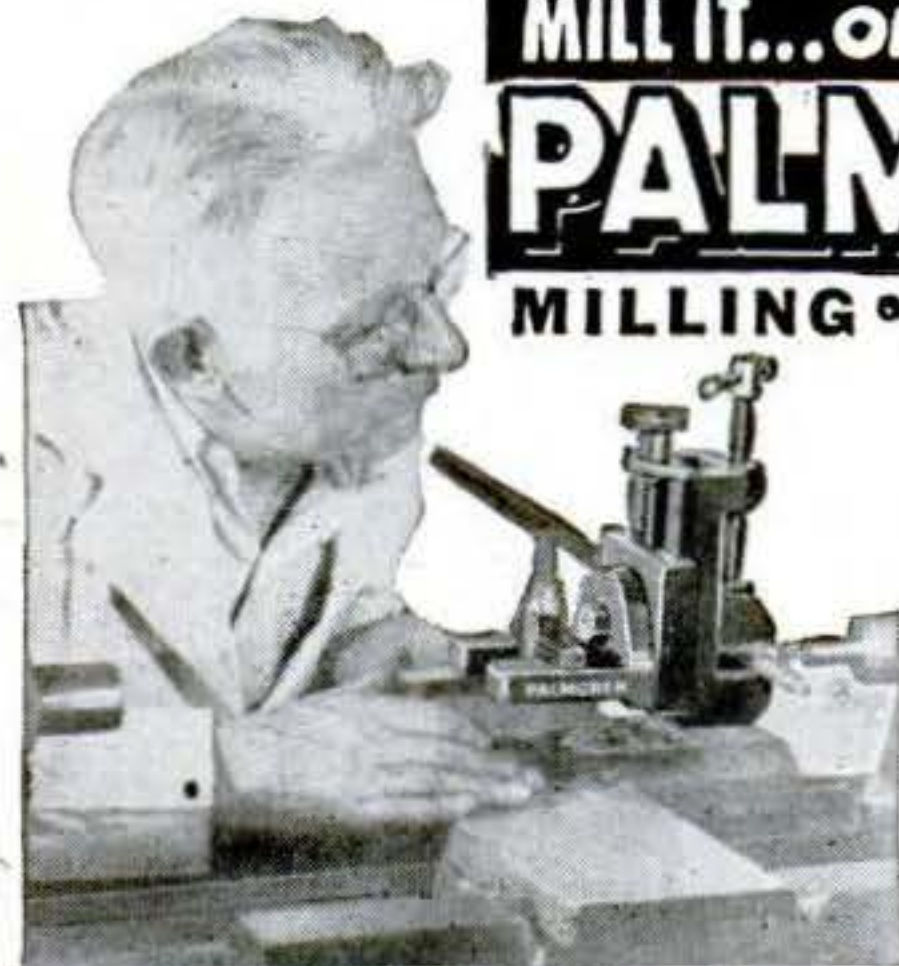


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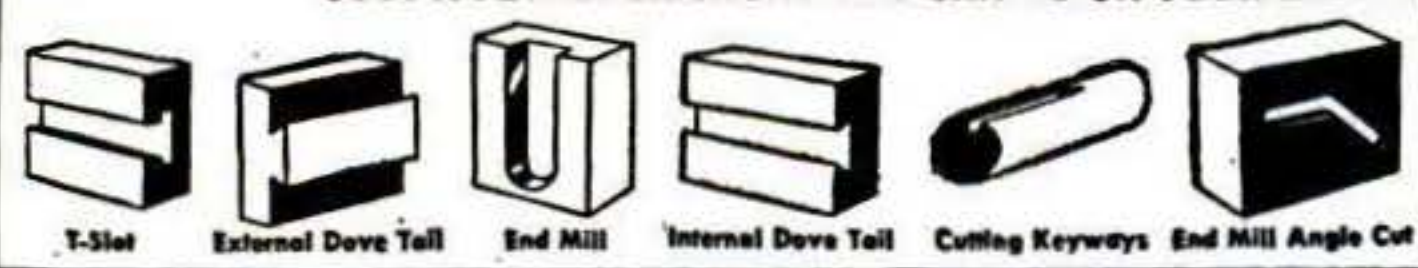
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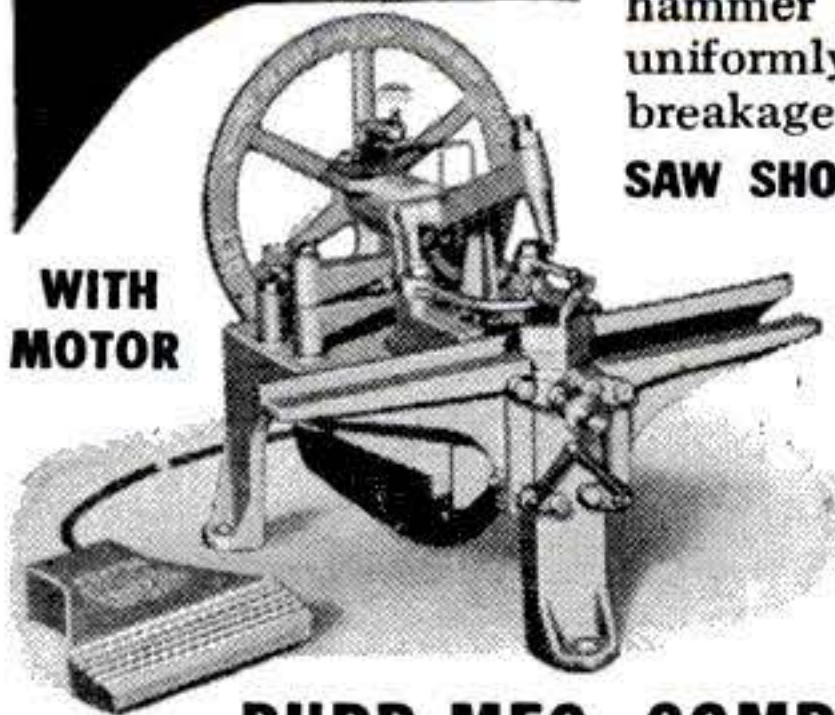
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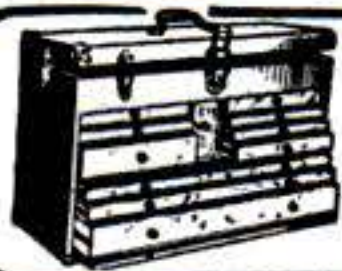
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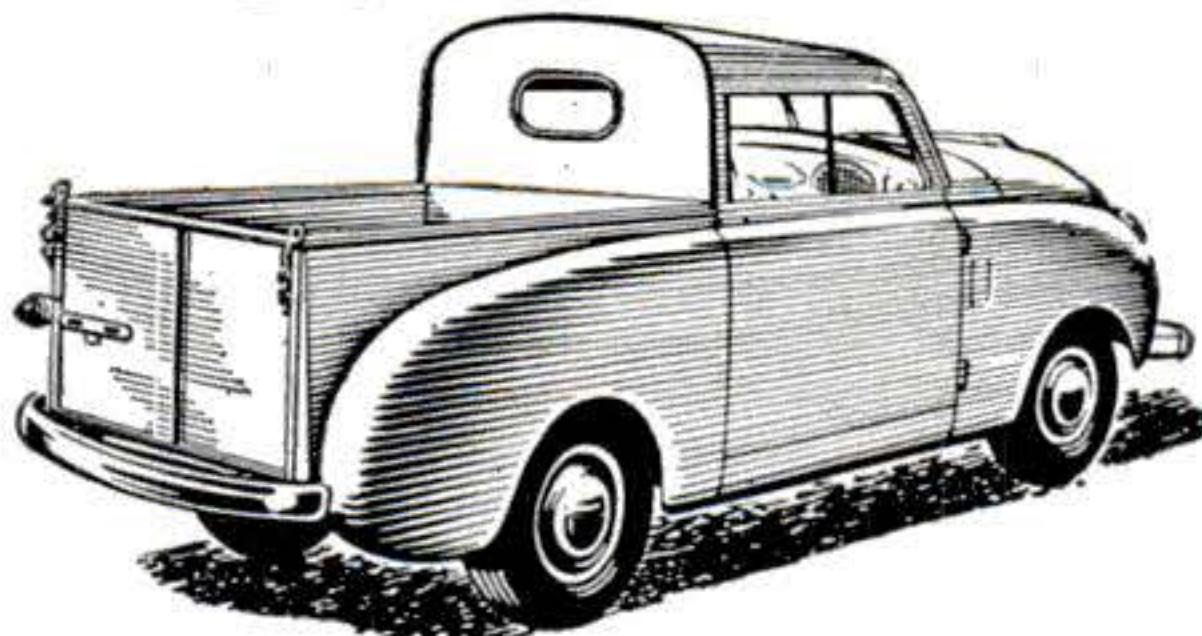
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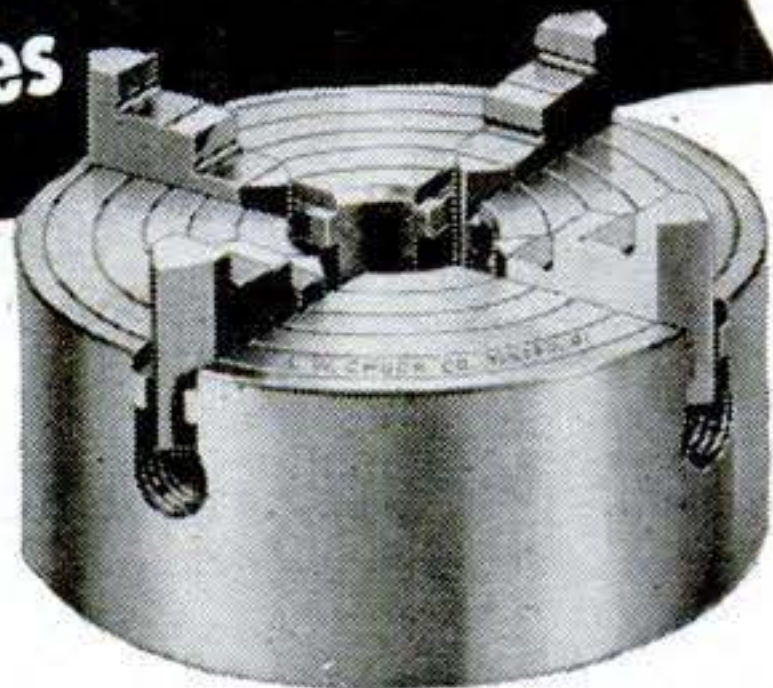
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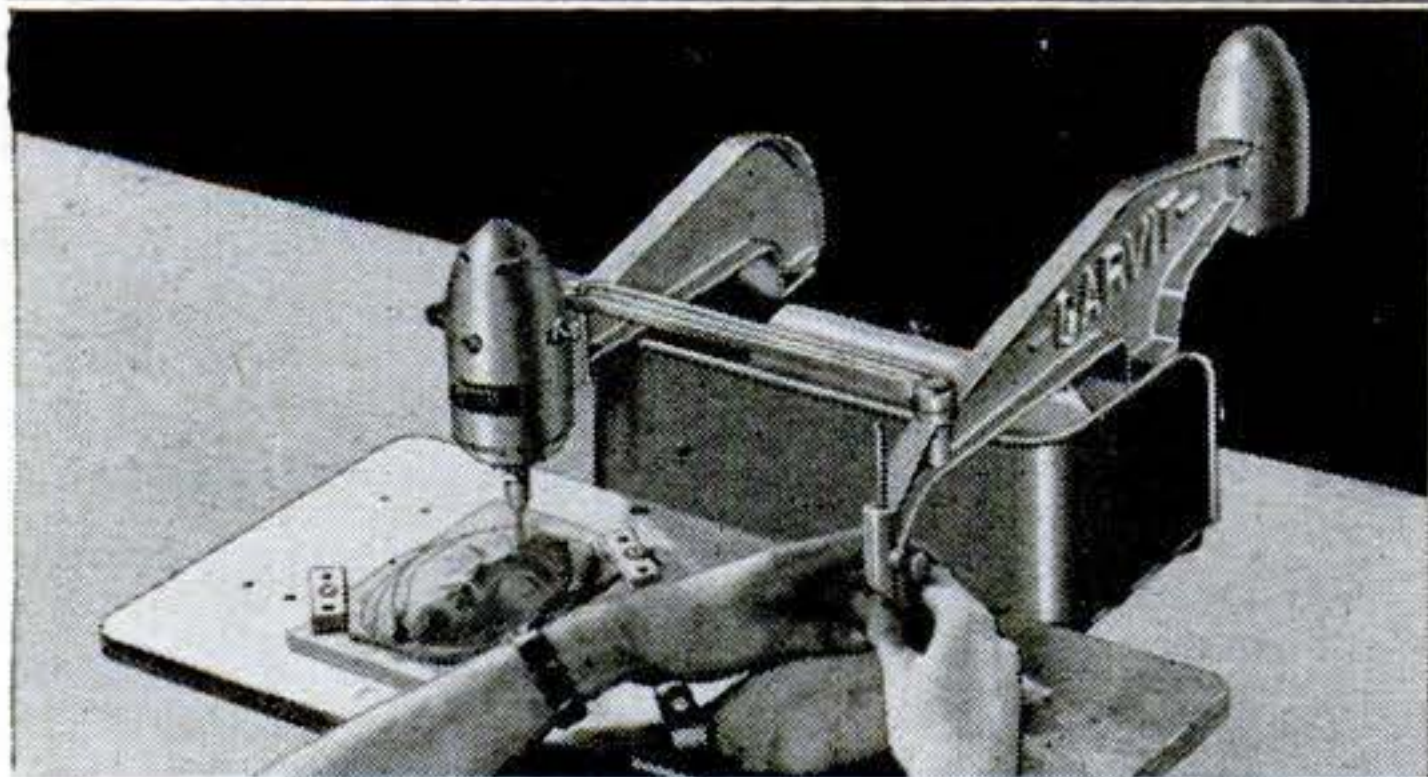
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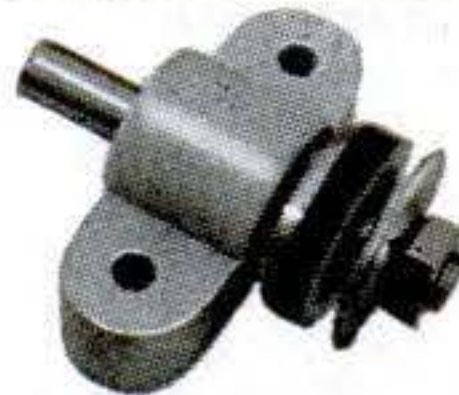
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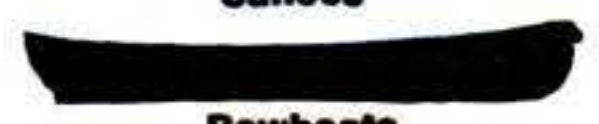
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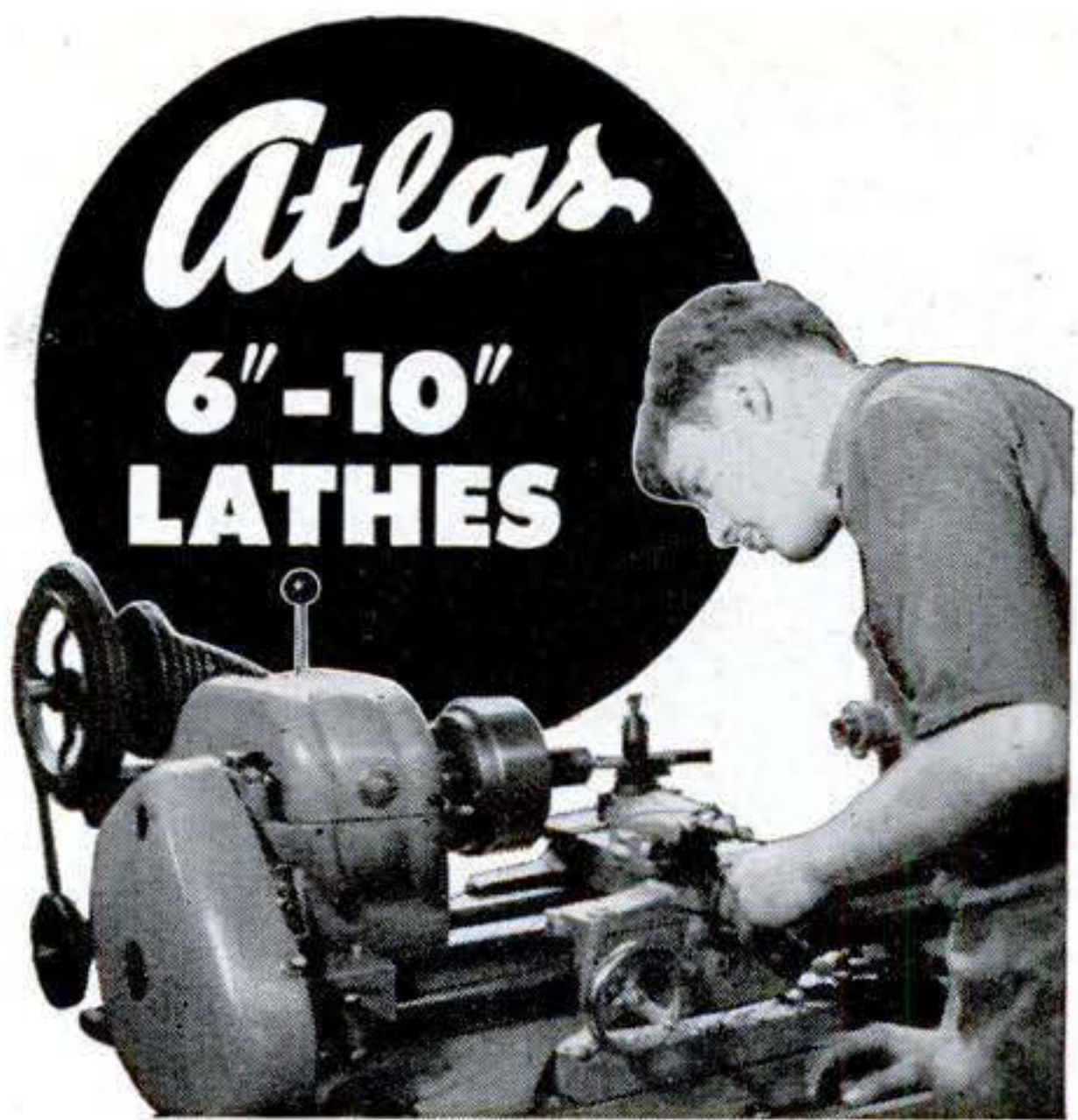
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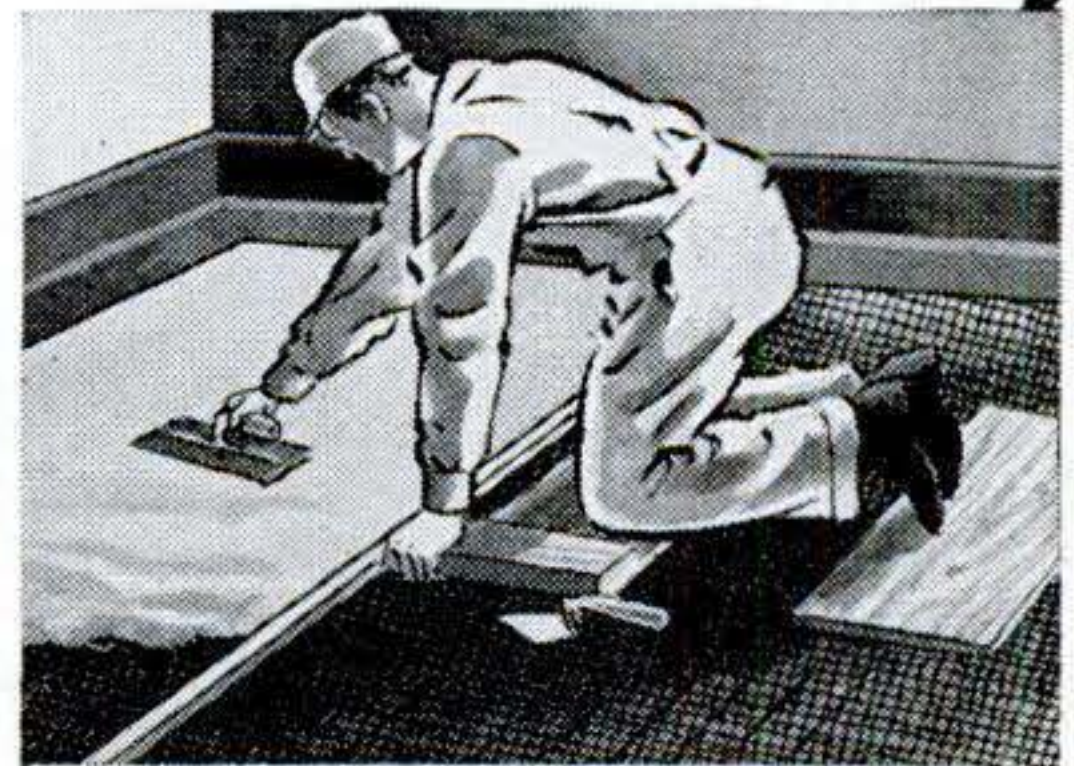
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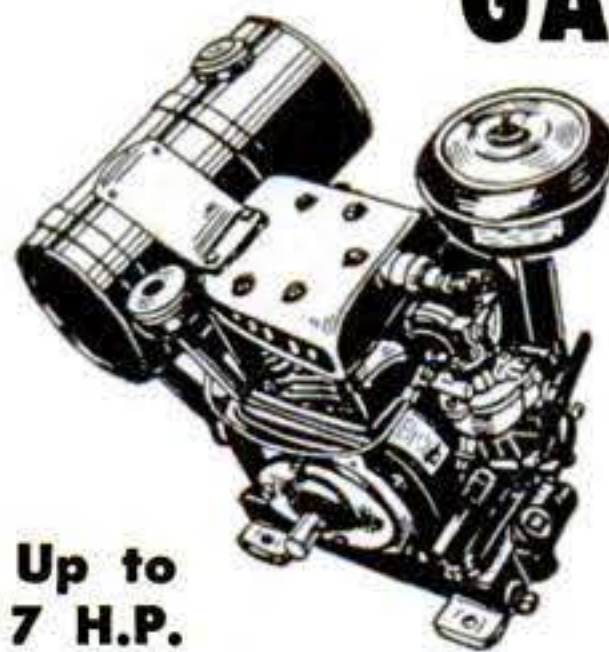


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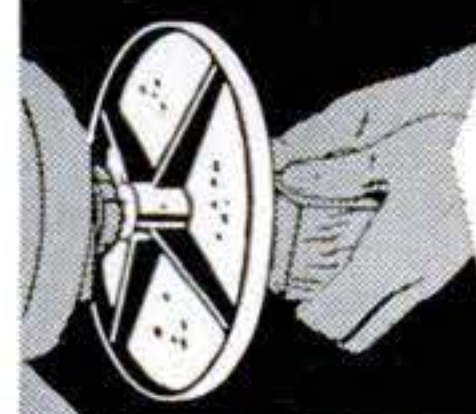


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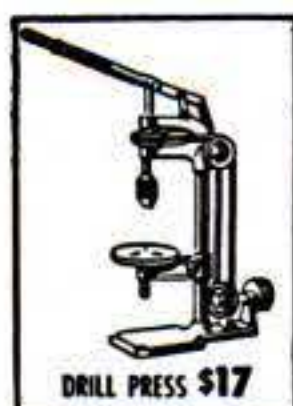
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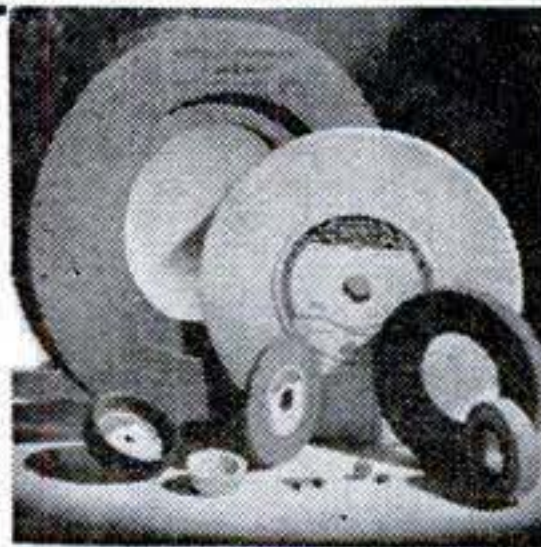
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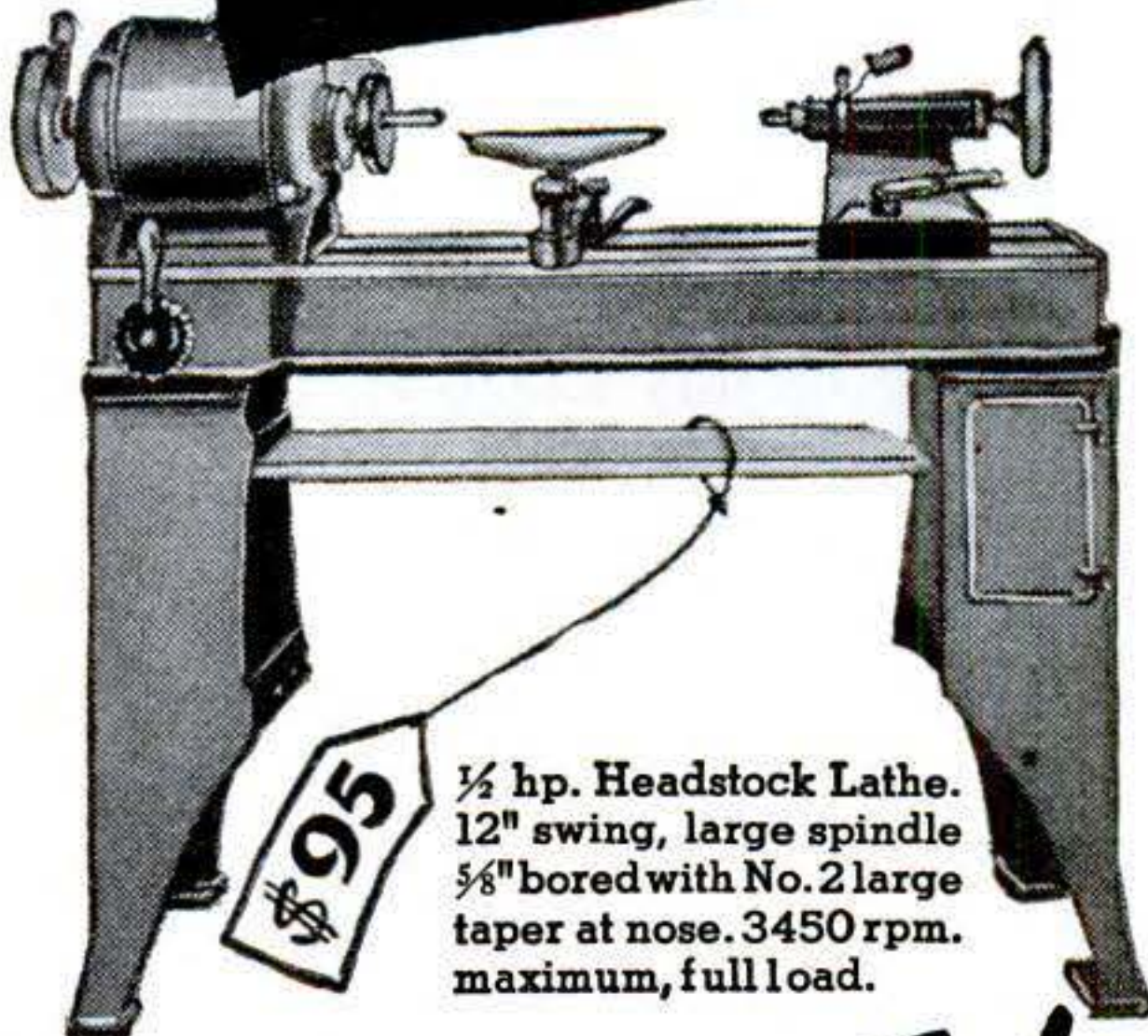
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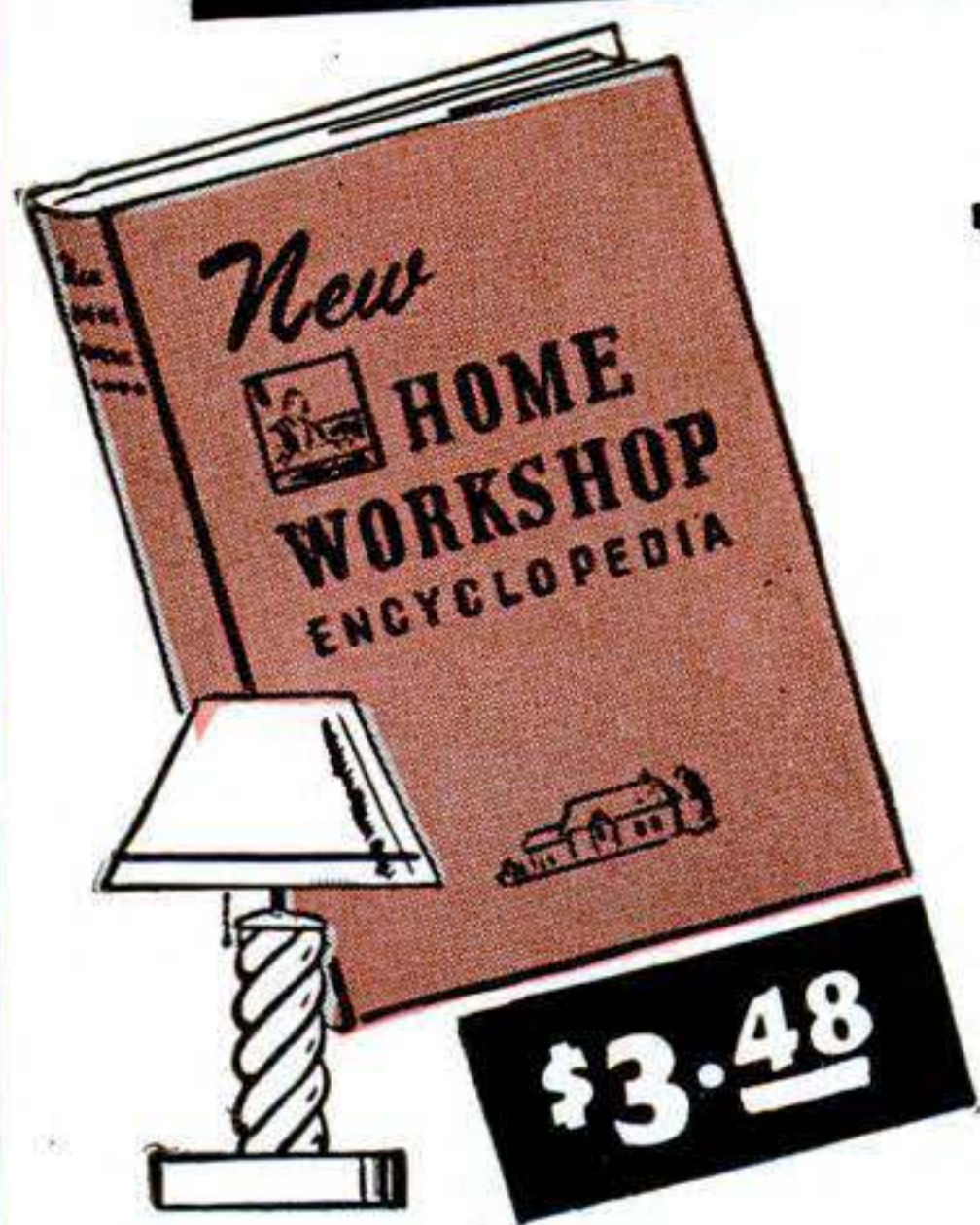
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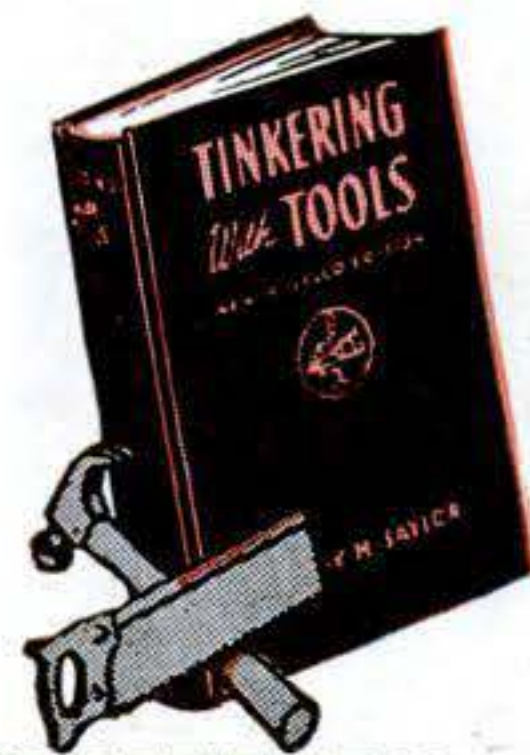
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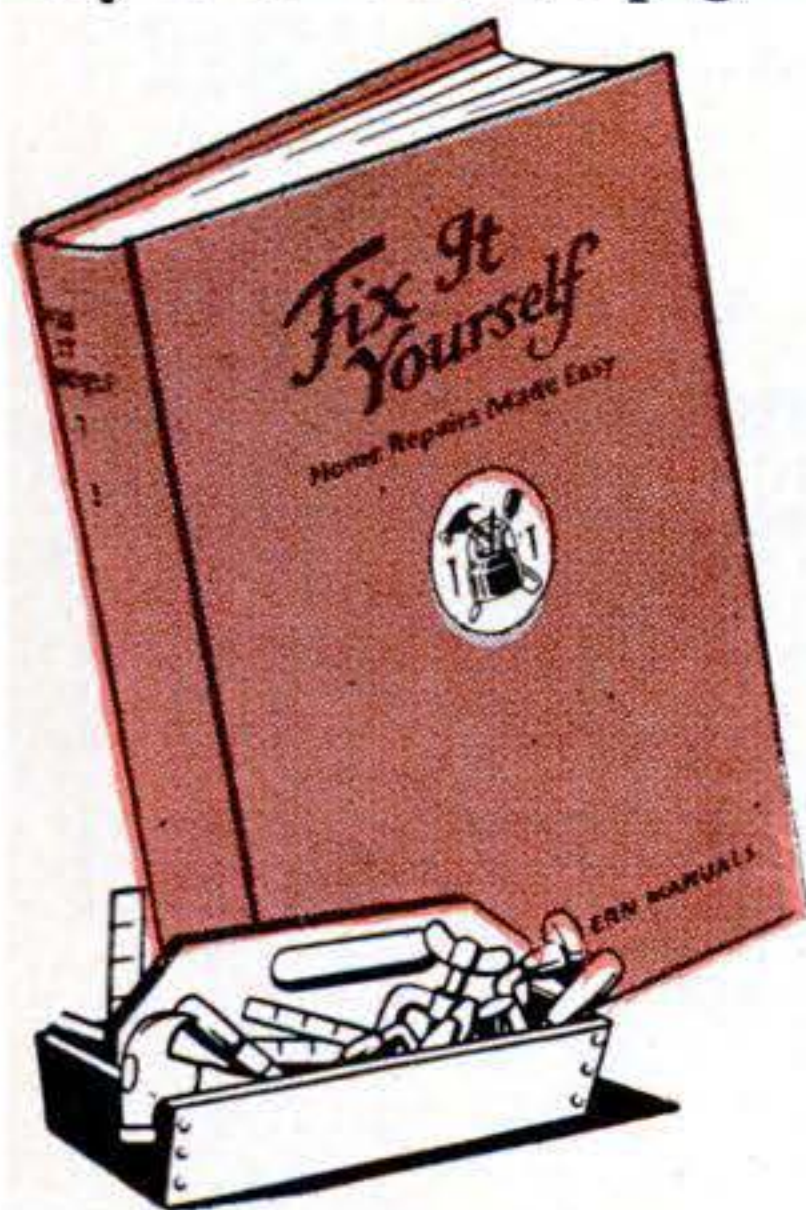
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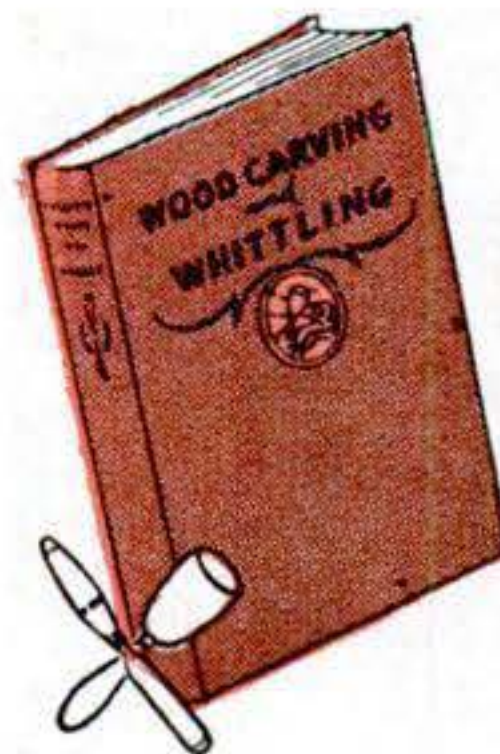
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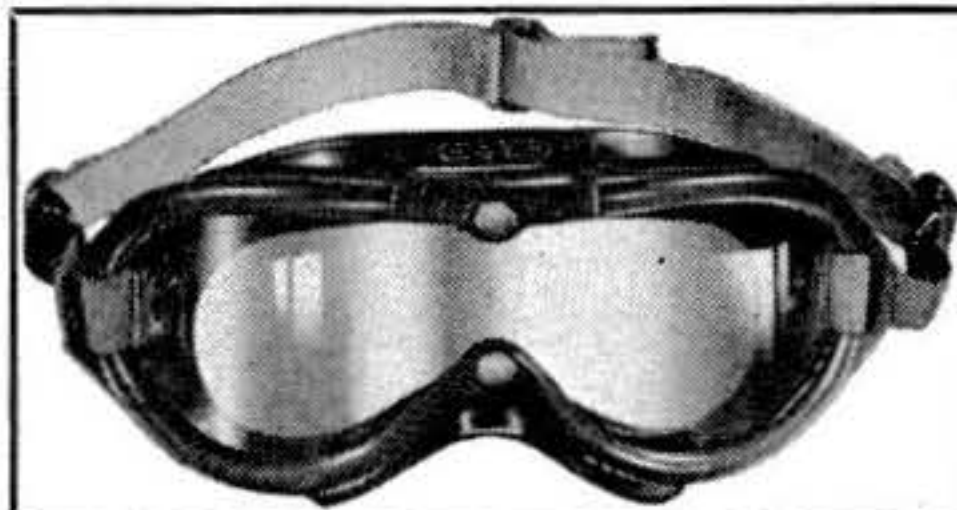
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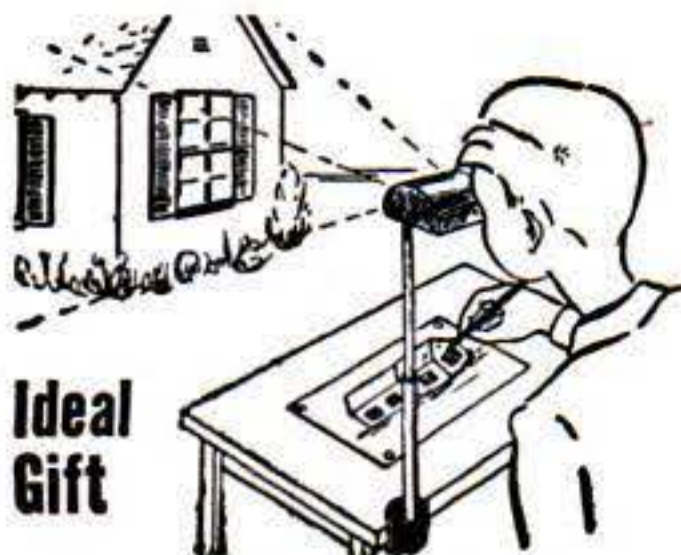
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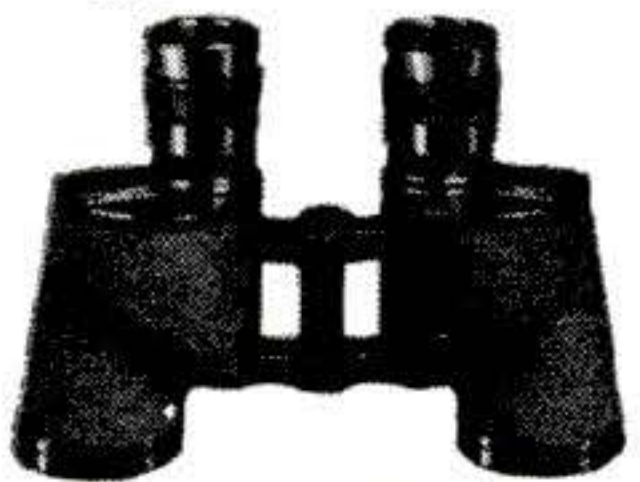
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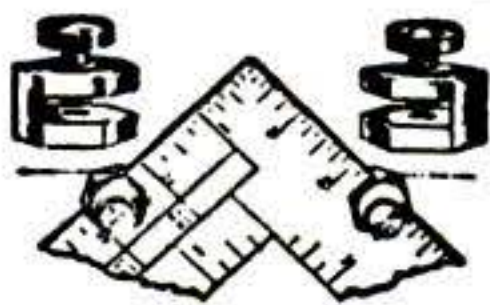
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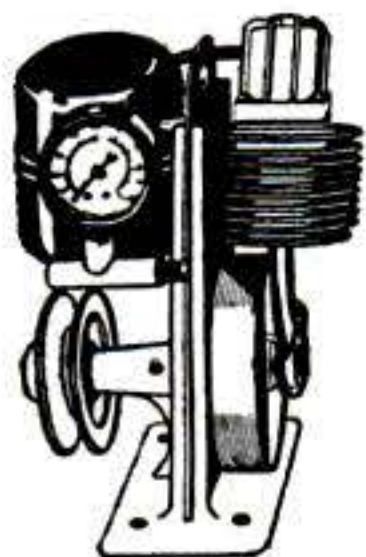
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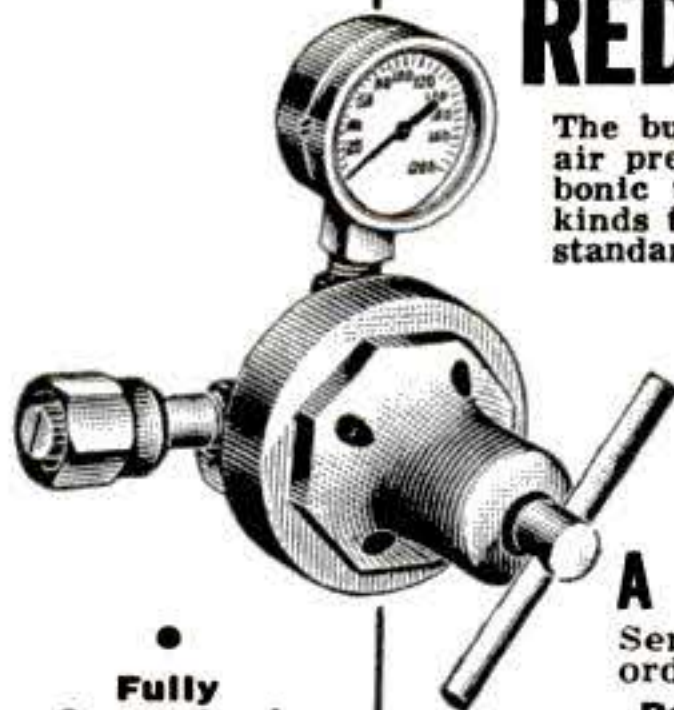
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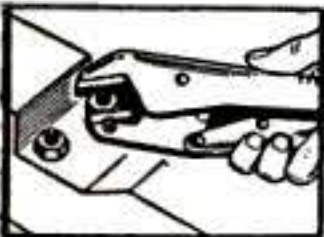
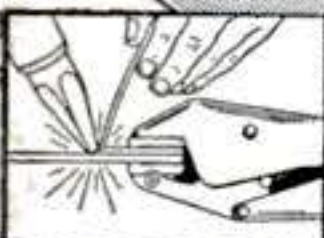
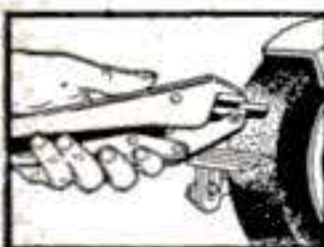
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• Ready sawed blanks of clear, soft pine, all ready to whittle. Complete, illustrated, easy-to-follow instructions for whittling and painting. Box of 3 diff. 4 inch Miniature Decoy Ducks, \$1.20. Box of 3 diff. 4 inch Hopi Cachina Dolls, 60c.

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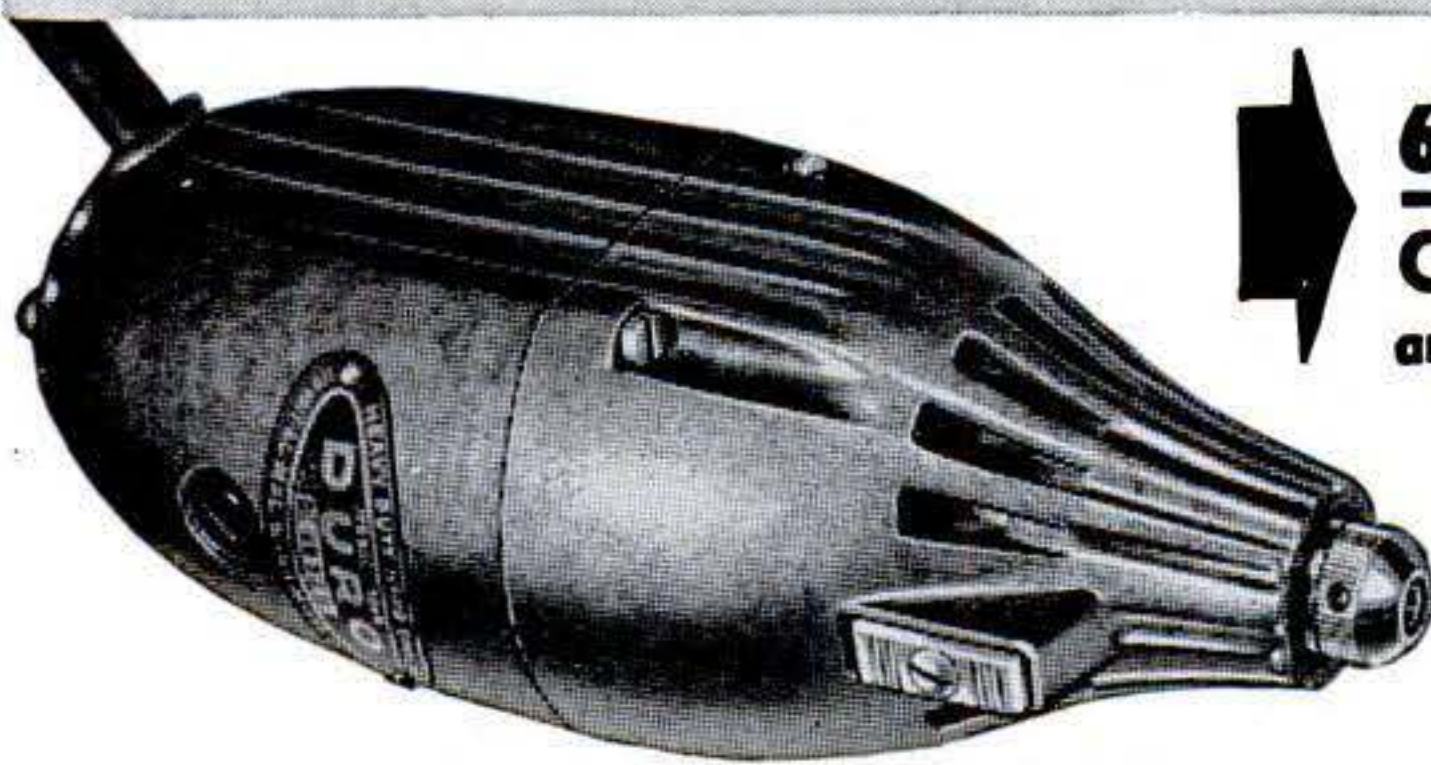
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Here is the greatest value in power tools ever offered to the American craftsman. Consider this: You get a Power-driven Drill Press, Lathe, Shaper, Router, Bench Grinder, Hand Grinder—complete with AC-DC motor, all ready to operate—with a compact accessories kit containing 50 sanding, grinding, drilling, polishing accessories—all for only \$69.50.

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TO:

Reader

FROM:

Editor

Thinking in Pictures

A BIG part of *Popular Science Monthly* is what you see before you read a word. I mean the pictures: the four to five hundred photographs, diagrams, plans and sketches in any issue.

Pictures are not just illustrations in PSM. They work hard. Often they tell a whole story. Sometimes they tell that part of the story which explains how something works, leaving to the text the history of the device, or process, and what it means.

Most of the pictures in PSM are made by our own photographers and artists, or are assigned to outside artists who have special knowledge of the subject. Working drawings call for special care; all PSM readers seem to be experts!

Some of the things PSM artists are called on to picture don't even exist. Then they have to imagine what a rocket would have to look like in order to do what it is supposed to do. Stewart Rouse did his pencil-thinking so well in his cutaway drawing of the Wac Corporal (PSM, May '46) that it differed little from the official pictures which were released months later.

Take the cover of this issue: Polar Prowl Cars have not yet been built, but those illustrated are no idle doodlings. Fred Sparks, who represented PSM on the Antarctic expedition last winter, saw their crude beginnings and their great possibilities. Art Director Samuels went to Washington to confer with those planning just such vehicles. Artist Ray Pioch used all this background to make the dream visible and practicable.

* * *

Every PSM editor has to be picture-minded, but after all of us have stopped talking, somebody has to make some pretty definite marks on paper. That somebody is the Art Editor—Howard Jensen.

Jensen is a soft-spoken individual who covers temperament with a conservative

manner and a double-breasted business suit. He went to art school in Seattle and New York. He designed stage sets for a small stock company, did typography for the glossy pages in the Sears Roebuck catalogue, worked in advertising agencies.



HOWARD JENSEN

His first job in magazines was on *Picture*, one of the earliest experiments in picture magazines. He was art director of *Parade* when that magazine was started. He worked on *Look* and was art editor of the book division. Two of the books he designed won places in the "Fifty Books of the Year" for 1945 and 1946—*One Nation* and *Look at America*.

Jensen calls PSM "a documentary magazine." I had never thought of it before, but that is exactly the difference between PSM and the other big general magazines. PSM is more like *The House on 92nd Street*, or *Boomerang*, than the typical glamorous productions of Hollywood. PSM deals in facts rather than fiction—even good old Gus is a documentary character.

As Art Editor, Jensen's job is to picture the facts, to give you a magazine which is easy to see and easy to read. I hope you have *not* noticed the recent changes in PSM's headlines and captions. Because the toughest task of the Art Editor is to create an arrangement of words-and-pictures-on-paper so clear and unobtrusive that the ideas shine right through.





My druggist
took a
prescription
from me!

ED'S MY DRUGGIST... a good one, too! And since I've been his Doctor of Motors for years, I could talk to him like a Dutch uncle.

"Look, Ed," I said, "you're happy with the way your car runs now, but you have only had part of my prescription."

Then I told him what I'd done. Ground the valves, replaced the gaskets, installed a set of Perfect Circle Piston Rings to stop her oil pumping—and a lot of other things she'd needed for a long time.

"If you want to *keep* your car in tip-top shape," I said, "Here's the rest of my prescription—just bring it in regularly for periodic checkups. Then I can correct little troubles before they become big ones—and save you a lot of worry and money."

Ed said he would follow that suggestion and that it sounded like a good prescription for every car owner. He's right, too!

R_x FOR CAR OWNERS: When piston rings are needed, get Perfect Circles, available at any automotive repair shop. Your mechanic—your Doctor of Motors—recommends them. Perfect Circle Corporation, Hagerstown, Ind. The Perfect Circle Company, Ltd., Toronto, Ont.

Your Doctor of Motors
restores power... saves gas
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**PERFECT
CIRCLE** PISTON
RINGS



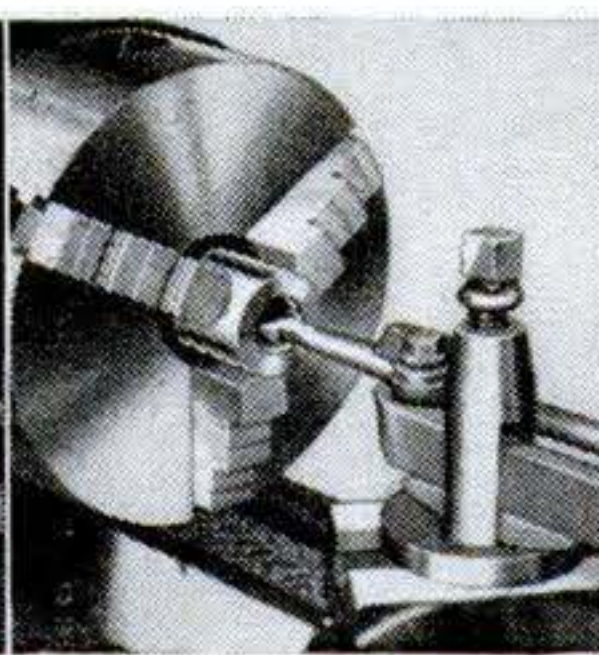
SOUTH BEND LATHE

The Basic Shop Tool

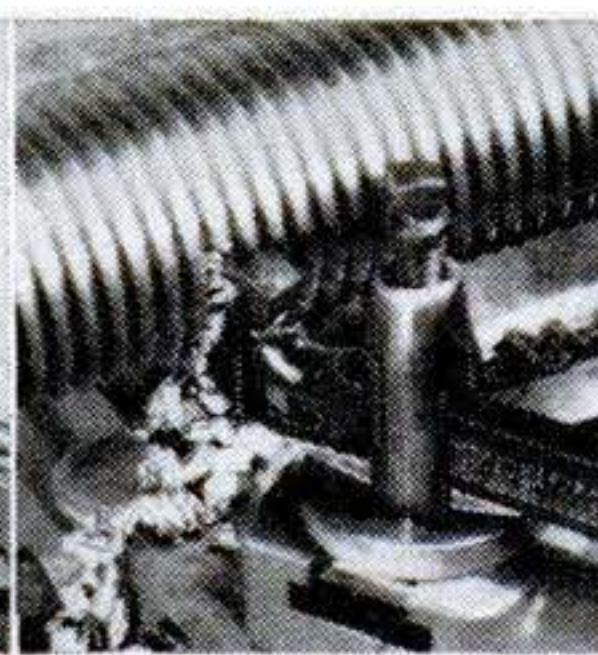
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OF THE MANY
OPERATIONS
YOU
CAN PERFORM



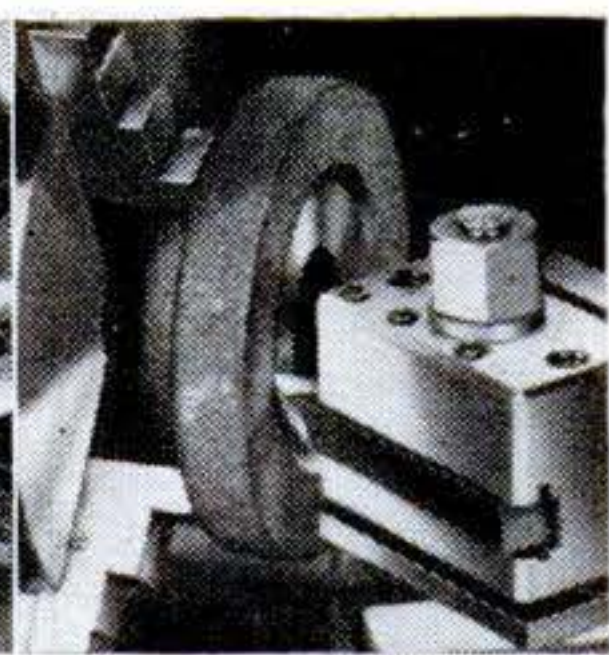
TURNING



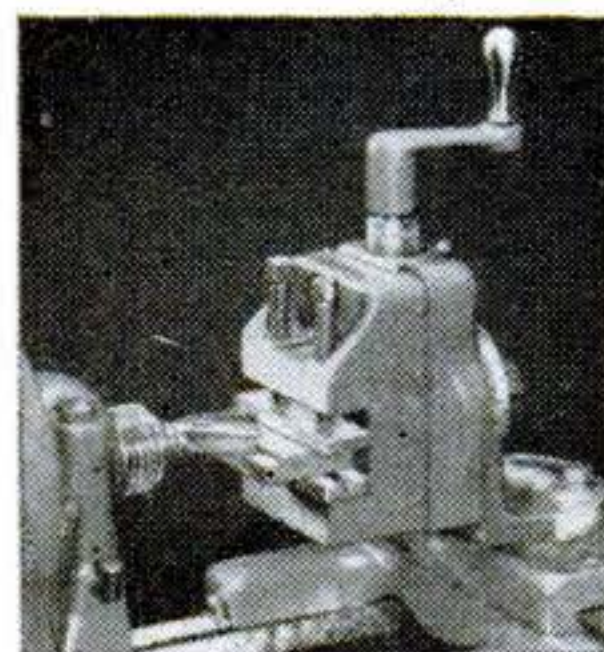
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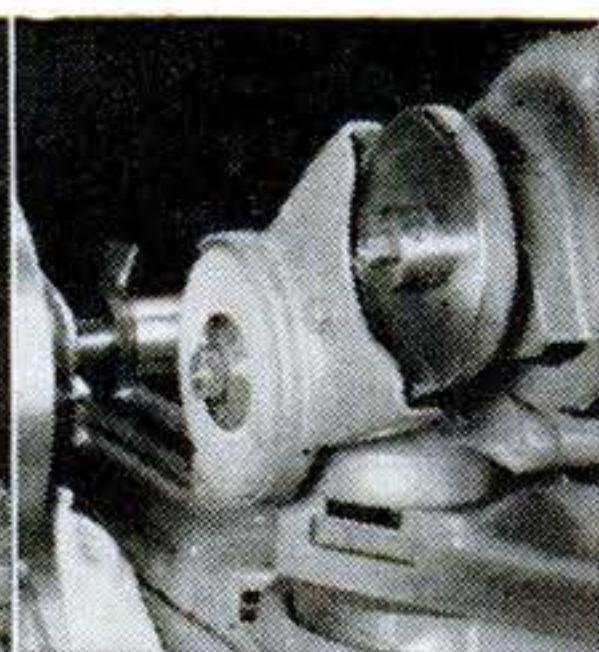
THREADING



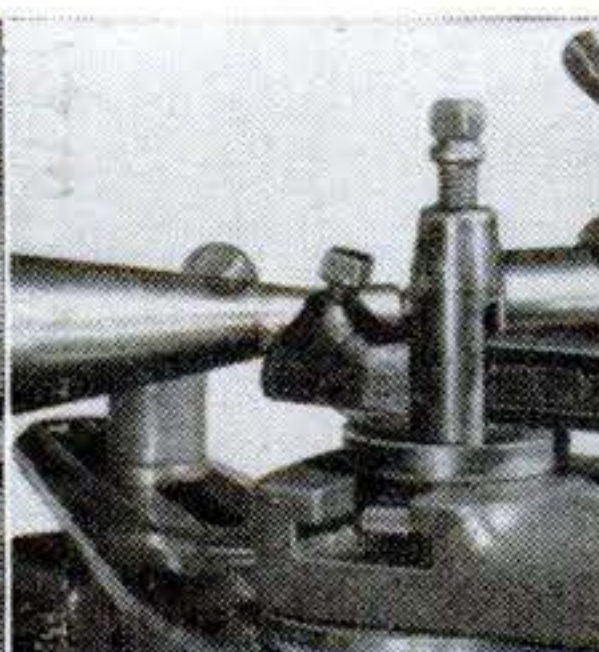
FACING



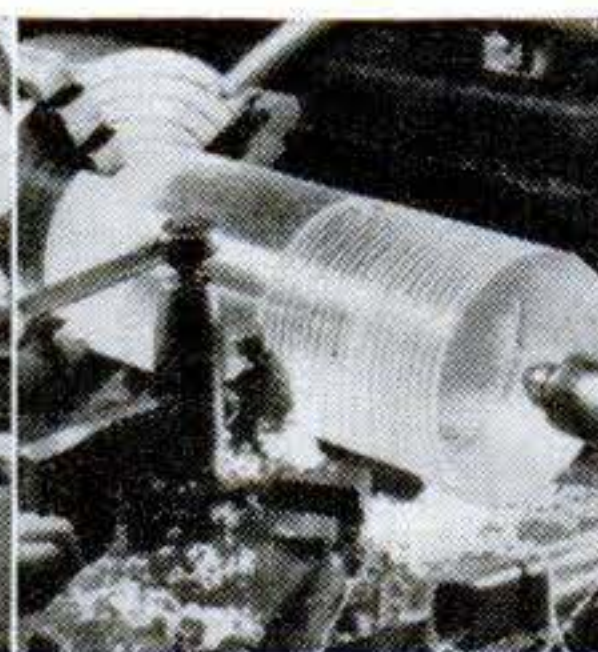
MILLING



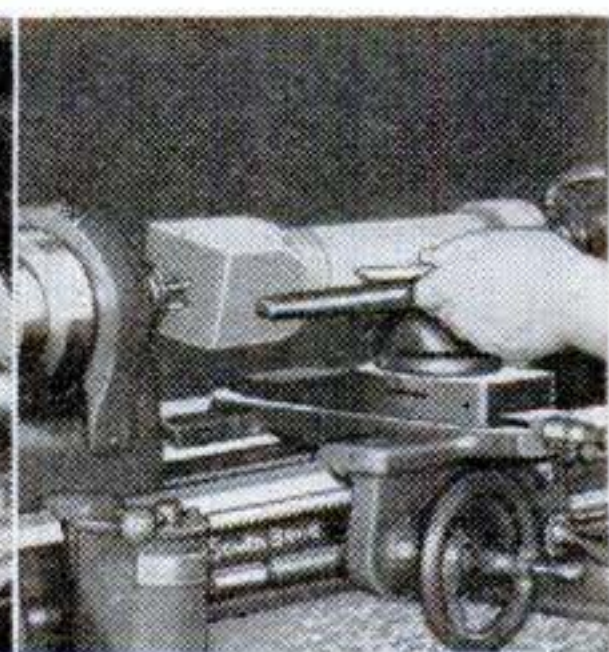
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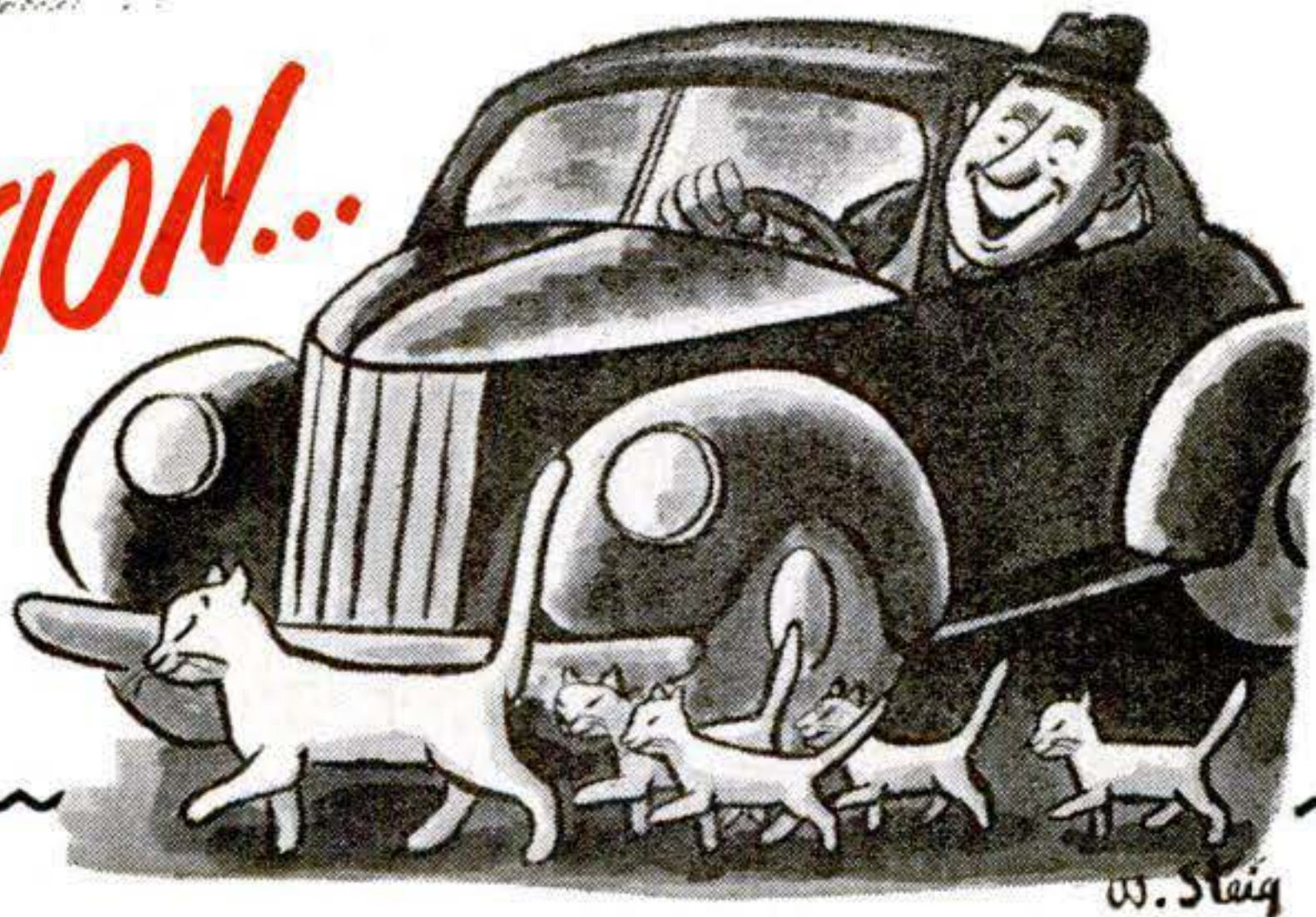
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...THROUGH CHEMISTRY

**EXPERIENCE IS THE
BEST TEACHER!**



*Walter
Ader*

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IN CIGARETTES TOO!
I LEARNED FROM
EXPERIENCE THAT
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More people are smoking **CAMELS** than ever before!

With millions of smokers who have tried and compared, Camels are the "choice of experience"!

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The results speak for themselves. More people are smoking Camels than ever before! But, no matter how great the demand:

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According to a recent Nationwide survey:

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When 113,597 doctors from coast to coast were asked by three independent research organizations to name the cigarette they smoked, more doctors named Camel than any other brand!

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WILL TELL YOU...**

T for Taste...
T for Throat...

That's your proving ground for any cigarette. See if Camels don't suit your "T-Zone" to a "T"



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