

FEBRUARY 1963 35 CENTS

Popular Science

Answers to Your
Space Questions by
Wernher von Braun

How to do lathework
on a table saw

Monthly



FIRST LOOK AT '63 $\frac{1}{2}$ CARS

Detroit Goes **Back to the Races**



To see how this
picture turned out,
see page 61...

NEW! All About POLAROID COLOR

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**the taste
to start with**

**LUCKY
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Handling charge—\$6²⁴*

Is this ad for people who know all about cars? our Chief Engineer asked. Good. Then tell them about Tempest's suspension. No, not the standard suspension; these guys really drive. Fill them in on Group 634. (Ever notice how engineers have a thing about numbers?)

Heavy-duty springs and shocks is what Group 634 is, and a paltry \$6.24 is what the whole shebang costs, installed right at the factory.

What it does to a Tempest just plain mortifies those poor souls resigned to wallowing along in their Mushmobiles (a Mushmobile being any non-Tempest laboring under the delusion that curves are for getting flustered in).

O! 634 (this number business is catching) is just the start of a long string of low-extra-cost sporting options

for Tempest. Like (hold your breath): a tachometer . . . high-output Delcotron a. c. generator . . . aluminum brake drums . . . heavy-duty clutch and linkage packages . . . and oversize tires, to pick at random.

Then there are engines. And what engines! The big 4 of 115, 120 or (with auto. trans. only) 140 bhp—plus, at extra cost, the 166-bhp version of the 4 and the omigosh 326-cu. in. V-8 of no less than 260 bhp. Axle ratios? A no-extra-cost range, all the way from a stump-pulling 3.90:1 to a high-fuel-economy 2.53:1. Dry your moist, trembling hands and clamp them onto a Tempest steering wheel. You're only young once.

Wide-Track Pontiac Tempest

*Manufacturer's suggested retail price for specified optional equipment (including reimbursement for Federal excise tax). State and local taxes extra. Pontiac Motor Division • General Motors Corporation

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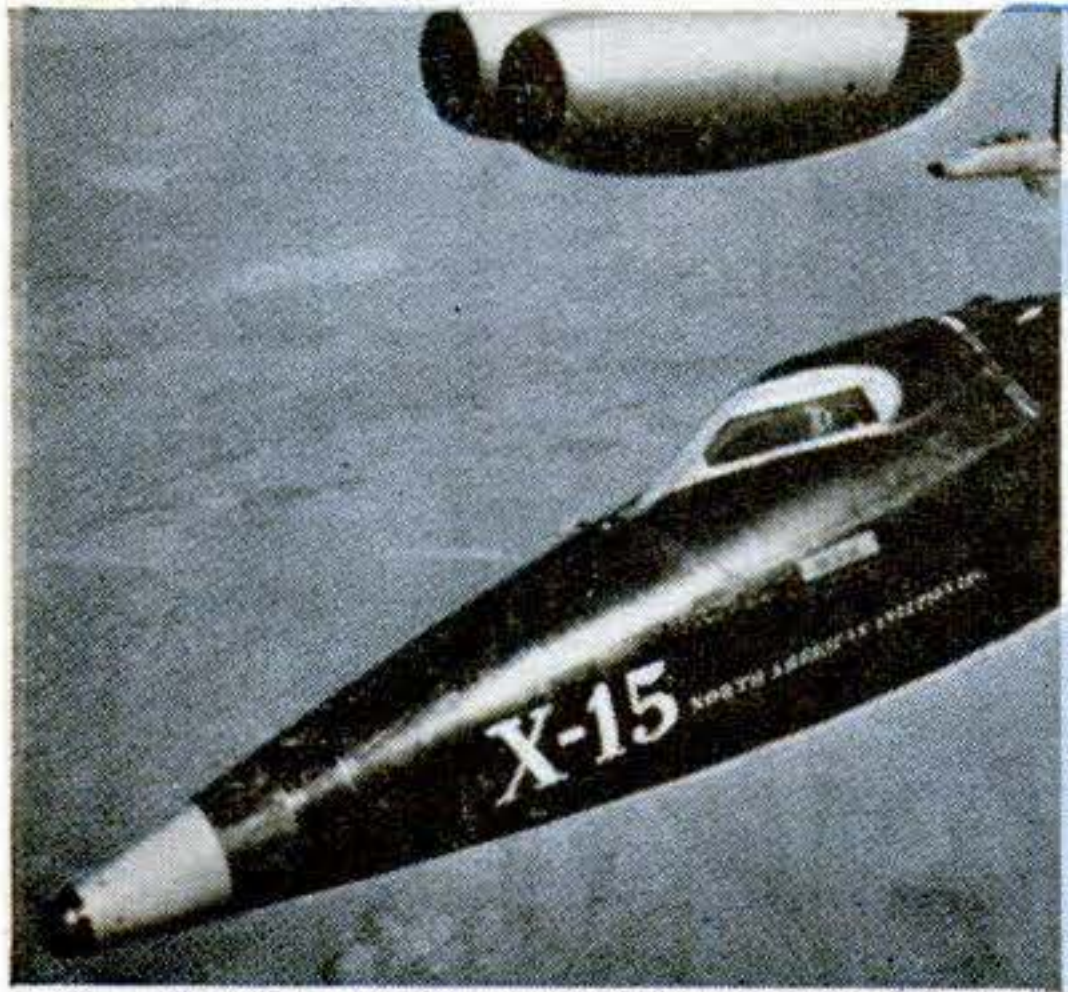
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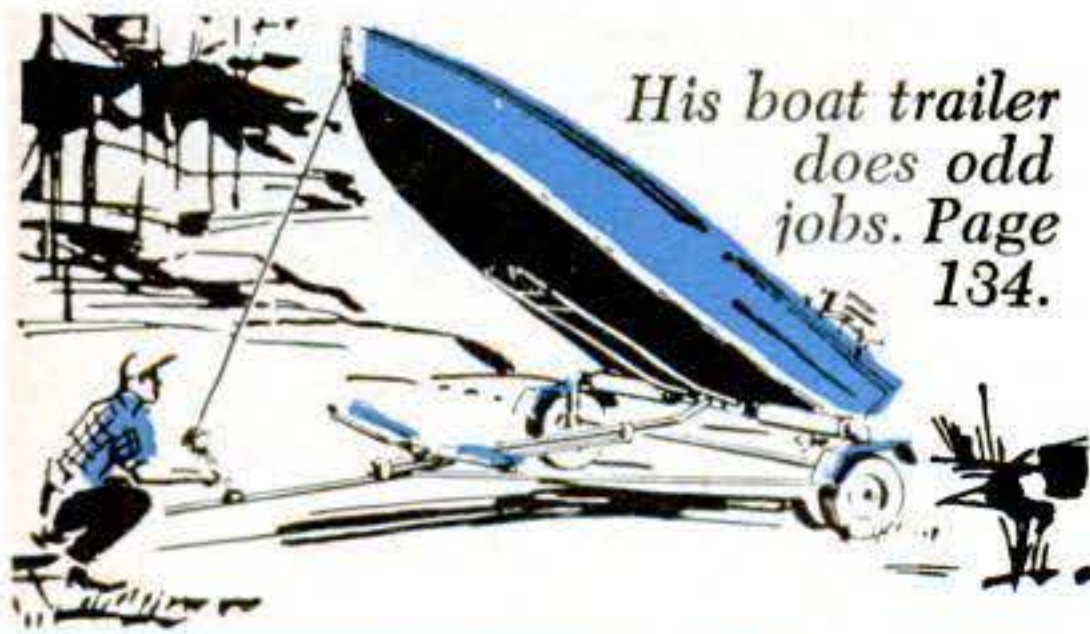
JOHN R. WHITING, Executive Vice-President and Publisher

February 1963

Cover photograph by Robert D. Borst



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in the incredible X-15. Page 78.



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Easy as pie with this jig. Page 138.

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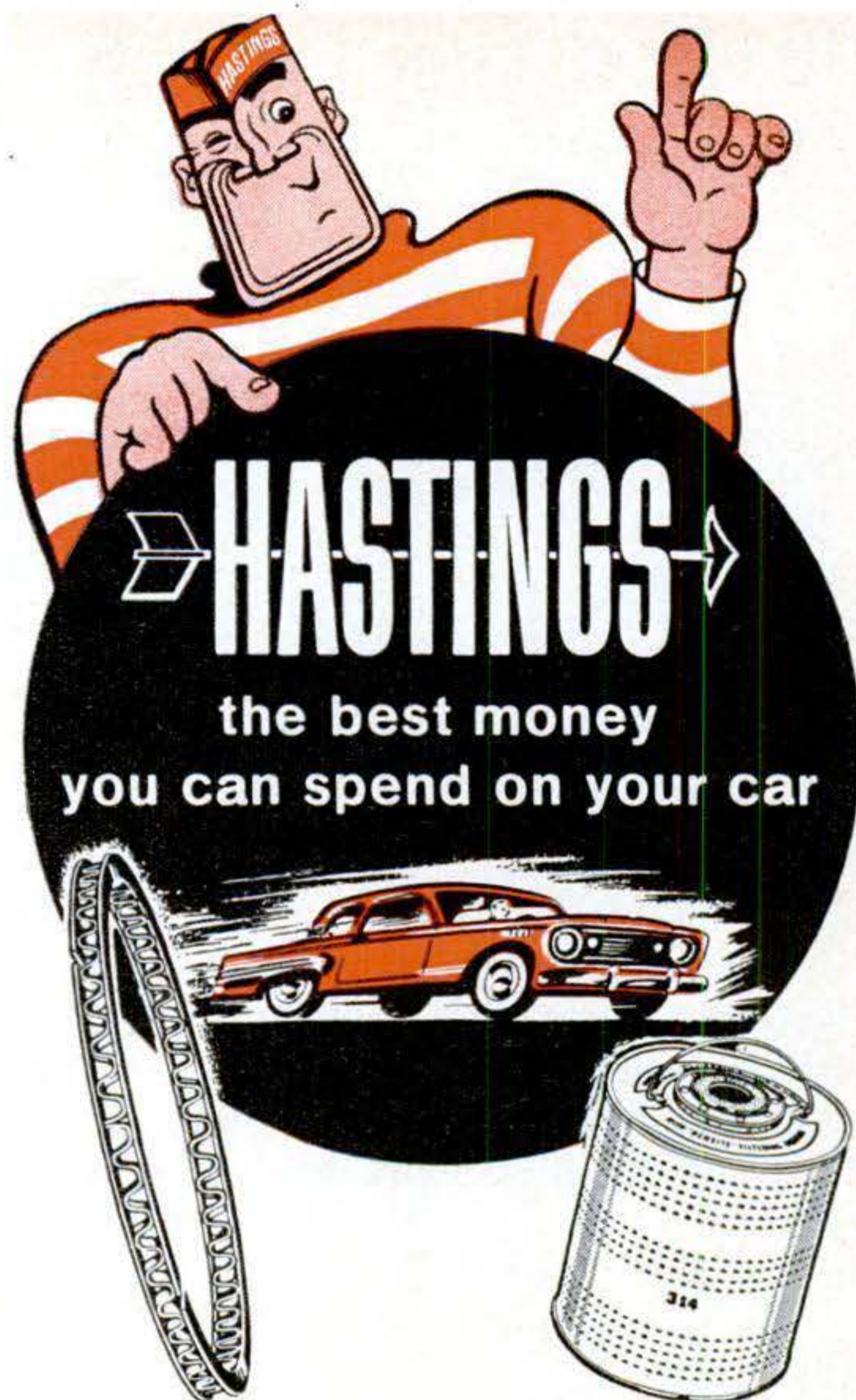
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HASTINGS PISTON RINGS

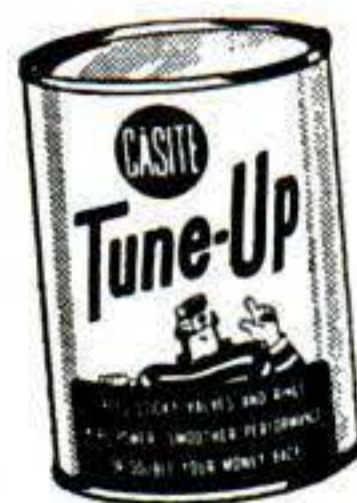
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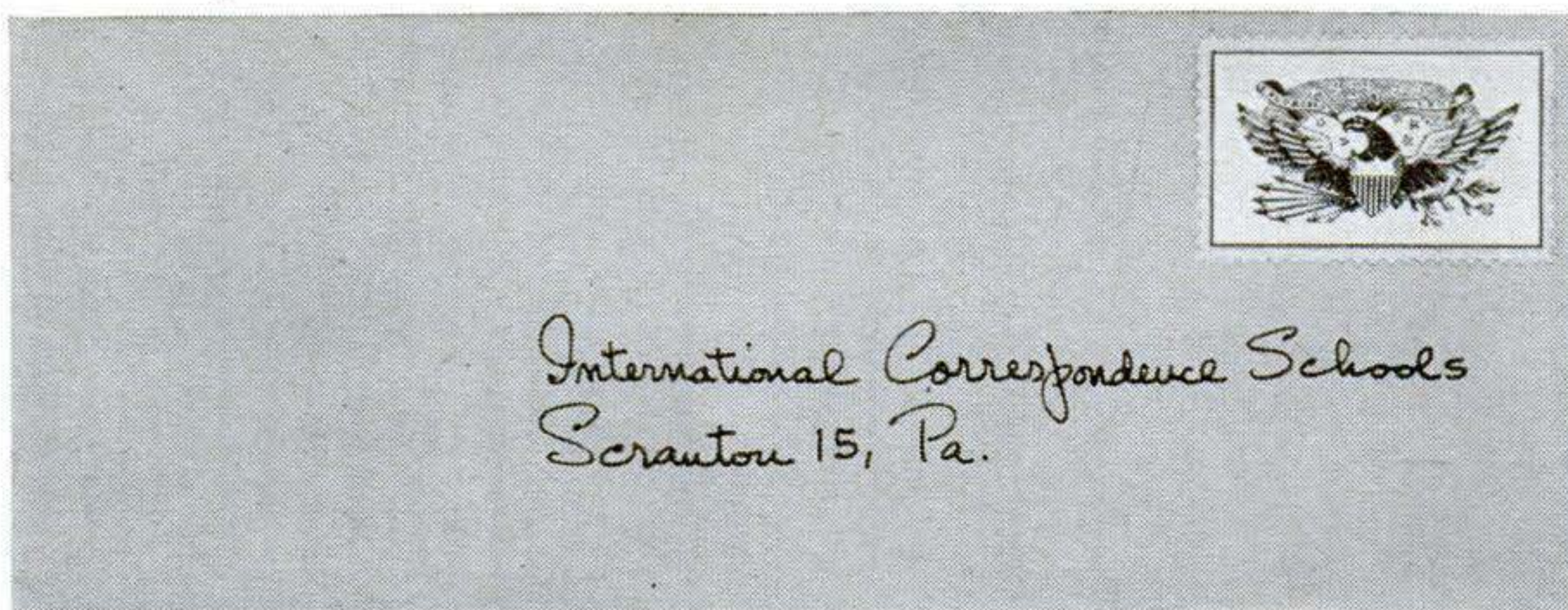
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Read these true-life success stories of people once in the same boat you may be in right now—stuck in a dull, routine job with little future. Then follow their example. Mail the coupon that helped each of them—and thousands of others—find bigger pay, a better job, lasting security and a happier life. But don't put it off another minute. Cast *your* "ballot" for future success *today!*



Thanks I. C. S. for successful career. "Your engineering course stood me in good stead throughout a rewarding government career. Without it, I could not have passed rigid Civil Service exams which qualified me for steady advancement, good pay and challenging overseas assignments!"—W. J. Eichorn, San Francisco, Cal.

Calls courses "money in the bank." "I recommend the I. C. S. method to anyone who sincerely wants to get ahead. I completed my high school education through I. C. S. and am now studying Textile Engineering. I attribute my growing income to the fact that I. C. S. made me a valued employee."—Ezra Whitmore, Hogansville, Ga.



Housewife becomes house designer. "Less than 3 years ago I became interested in home designing, and wondered if it were possible for a housewife to compete in that field. Now, scarcely a year and a half after enrolling for Architectural Drawing, I have sold plans for 58 dwellings. It's almost too good to be true!"—Valerie J. Pack, Midway City, Cal.

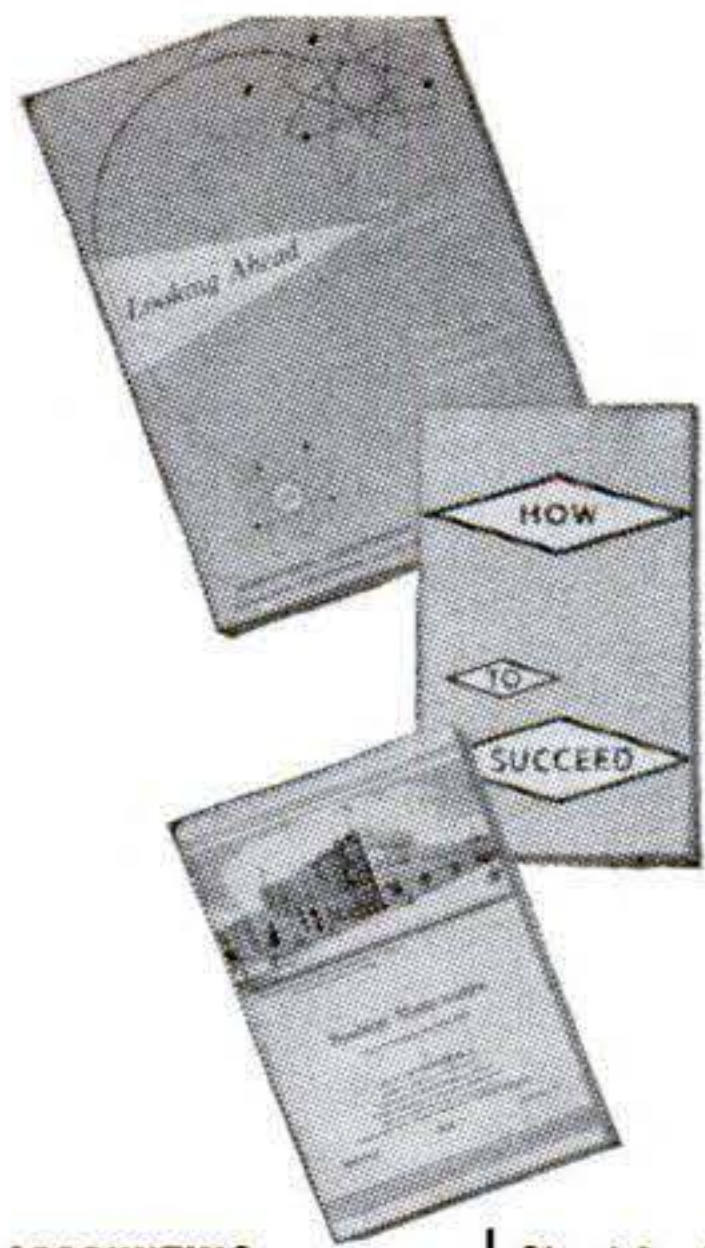
Salary doubles since enrolling. "Mailing the I. C. S. coupon changed my entire life. My salary is now just about *double* what it was when I first enrolled!"—Ernest Garrett, Shreveport, La.

Says training pays for itself. "My initial investment has been returned to me many times over—in terms of a better job, higher pay, increased satisfaction. I owe it all to I. C. S."—J. B. Stone, Norwalk, Cal.

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Mason
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Commercial Cartooning
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Figure Drawing & Painting
Magazine Illustrating
Show Card & Sign Prod'n
Show Card Writing
Sign Painting & Designing
Sketching & Painting

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Auto Engine Tune-up
Automobile
Automobile Body Rebuilding and Refinishing
Automobile Electrical Technician
Automobile Technician
Diesel Engines

Diesel-Gas Motor Vehicle Engines
Gas Engines
Internal Combustion Engines

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Aircraft Mechanic
Aviation Engine Mechanic

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Marketing
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Office Management
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Shorthand
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Chemical Engineering Unit Operation
Chemical Laboratory Technician
Elements of Nuclear Energy
General Chemistry
Industrial Analytical Chemistry
Industrial Chemistry
Professional Engineer—Chemical

PULP AND PAPER

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Pulp & Paper Engineering

Pulp & Paper Making
Pulp Making

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Construction Engineering
Highway Engineering
Mine Surveying & Mapping
Principles of Mapping
Principles of Surveying
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Railroad Engineering
Roadmaster
Sanitary Engineering
Section Foreman
Sewage Plant Operator
Structural Engineering
Surveying and Mapping
Water Works Operator

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Architectural Drafting
Drafting & Machine Design
Electrical Drafting
Electrical Engineer Drafting
Electronic Drafting
Industrial Piping Drafting
Junior Mechanical Drafting
Mechanical Drafting
Sheet Metal Drafting
Structural Drafting

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Electrical Contractor
Electrical Eng'r'g (Power Plant option—Electronic option)
Electrical Engineering Tech.
Electrical Instrument Tech.
Electric Motor Repairman
Illumination Eng'r'g Tech.
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Power-House Engineering
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Practical Lineman
Professional Engineer—Electrical
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Supervision

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Mathematics and Physics for Engineers
Mathematics and Physics for Technicians

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Industrial Instrumentation
Junior Mechanical Engineering
Mechanical Engineering
Professional Engineer—Mechanical
Quality Control
Introductory Technical Writing

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Oil Field Technology
Petroleum Production
Petroleum Prod'n Eng'r'g
Petroleum Refinery Operator
Petroleum Refining
Petroleum Technology

PLASTICS

Plastics Technician

PLUMBING, HEATING, AIR CONDITIONING

Air Conditioning
Air Conditioning with Draw'g
Air Conditioning Maintenance
Domestic Heating with Oil & Gas
Domestic Refrigeration
Heating & Air Conditioning with Drawing

Heating, Drawing & Estimat'g
Plumbing
Plumbing, Drawing & Estimating
Plumbing & Heating
Plumbing & Steamfitting
Practical Plumbing
Refrigeration
Refrigeration & Air Conditioning
Steamfitting

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Air Brake Equipment
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Diesel Engineer & Fireman
Diesel Locomotive
Diesel Machinist
Railroad Administration
Railroad Car Repairer

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Creative Salesmanship
Real Estate Salesmanship
Retail Merchandising
Retail Selling
Sales Management
Salesmanship
Salesmanship & Sales Management

SHOP PRACTICE

Boilermaking
Electric Welding
Foundry Practice
Gas and Electric Welding
Gas Welding
Heat Treatment of Metals
Industrial Metallurgy
Machine Shop Inspection
Machine Shop Practice
Machine Shop Practice & Toolmaking
Metallurgical Engineering Technology
Physical Quality Control of Metals
Practical Millwrighting
Reading Shop Blueprints
Resistance Welding Technology
Rigging
Safety Engin'r'g Technology
Sheet Metal Worker
Tool Design
Tool Engineering Technology

Toolmaking
Welding Engineering Technology

STEAM AND DIESEL POWER

Combustion Engineering
Power Plant Engineering
Stationary Building Eng'r'g
Stationary Diesel Eng'r'g
Stationary Diesel-Electric Engineering
Stationary Fireman
Stationary Steam Eng'r'g
Steam Engine Operation

TEXTILES

Carding and Spinning
Carding
Cotton Manufacturing
Cotton Warping & Weaving
Dyeing & Finishing
Hosiery and Circular Knitting
Loom Fixing
Spinning
Synthetic Fabric Manufacturing
Synthetic Throwing, Warping & Weaving
Textile Designing
Textile Engineering
Textile Mill Supervisor
Woolen Manufacturing
Worsted Manufacturing

TRAFFIC

Motor Traffic Management
Railroad Rate Clerk
Traffic Management

TV-RADIO-ELECTRONICS

Gen'l Electronics Technician
Industrial Electronics
Practical Radio-TV Eng'r'g
Radio Operating
Radio Servicing
Radio Servicing with Practical Training
Radio & TV Servicing
Radio & TV Servicing with Practical Training
Servicing Electr'n'c Devices
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Practical Telephony
Telephony and Radio Communications
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PS readers talk back



Gus to the Rescue

I had a rattle in the dash of my '59 Chevrolet for nearly a year. One garageman told me that it was the throw-out bearing in the transmission. Another man said that it would probably also need a new clutch. The clutch seemed good and I didn't have the \$40 for the bearing so I did nothing. I checked the steering column and could find nothing wrong. Then I read "Gus Tackles a Noisy Problem" [Nov.], describing a job on a '59 model.

The next day I checked the shift link, as the article suggested, and it was loose. I took an old inner tube, cut out two washers, and put the linkage clamp back together. The rattle was gone. Your article and a piece of inner tube saved me many dollars and solved my problem.

REV. C. L. DOVERSPIKE, Jersey Shore, Pa.

Praise from the Source

I am pleased about the presentation of my book *Peenemünde to Canaveral* in your December issue [p. 67]. Considering that he worked from written description only, your artist did extremely well. It was also interesting to learn that the article serves as the opening to a series on space by Dr. von Braun. You will certainly have one of the most brilliant minds in this field at your disposition.

Space travel and rocket propulsion will increasingly occupy the minds and attention of those interested or active in science and technology. Due to the inherent complexity of many of the aspects, Popular Science, as a discipline as well as a magazine, will contribute materially to the future understanding of them.

I knew your magazine back in Germany, prior to WW II. It appeared to us that the availability of this type of inexpensive technical literature combined with the love (unrestricted by Prussian bureaucracy) to tinker with automobiles and radio transmitters were giving the U.S. a decided technological advantage.

DIETER K. HUZEL, Woodland Hills, Calif.

Nothing for Nothing?

I admire the courage and enterprise of the builders and backers of the "trigible" [Nov.]. I wish them every success.

However, somebody is going to have to disillusion them about "gratis up-and-down gravity power" and "gaining speed for free." You can't get something for nothing. Any forward progress they make through the heating-and-propoising maneuver will cost them as much propane fuel (probably more) as running that fuel, instead, through their engine propulsion system.

WARNER CLEMENTS, Beverly Hills, Calif.

Circulation Goes Up

I was doing fine cutting out the problems of the "Teach-Yourself Chase" [Dec.] to paste to cardboard for future use in math work. Then I came to pages 179-180—where you had problems back-to-back. Had to get me another copy to make out. I bet you did it on purpose!

OLIN MAPES, Jacksonville, Fla.



Biggest, Guttiest Locomotive

I am sure that many of the old young men who read PS couldn't miss enjoying Henry B. Comstock's farewell salute to the mighty Mal-

CONTINUED

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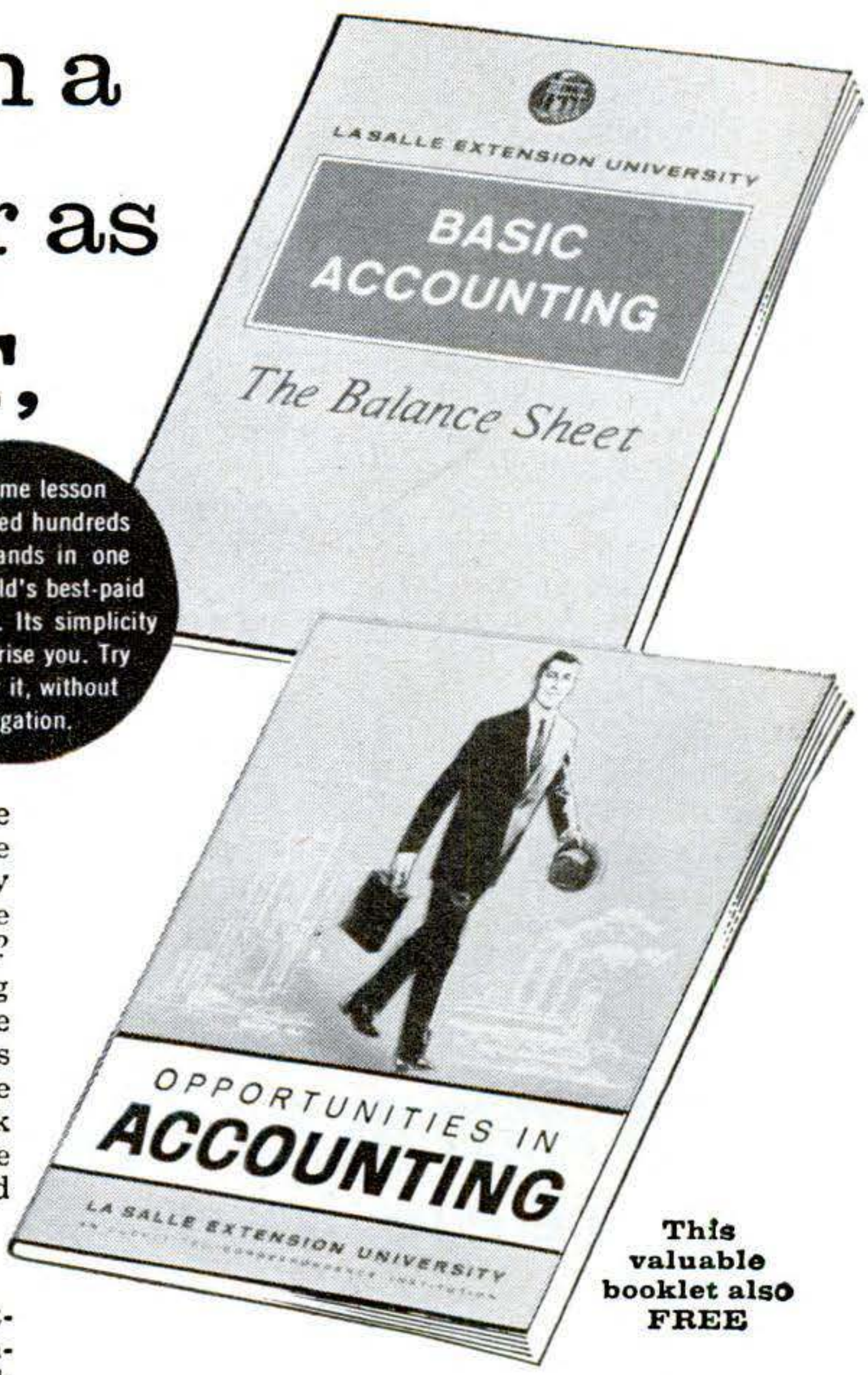
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—William T. Black, Canoga Park, Calif.

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—Rudolf Urbatis, Port Chester, N.Y.

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Name.....Age.....

Address.....County.....

City & ZoneState.....

108

lets [Dec.] detailing the part they played in American railroading. Fine sketching, too.

CHARLES WOLFE, Port Chicago, Calif.

Markovich at the Wheel

The report on the Tempest [Oct.] states that the steering is painfully slow, and that it is six turns lock-to-lock.

The '63 specs say that the steering is 4.5 turns lock-to-lock. Who is right?

I would not call 4.5 so slow.

CHARLES LYON, Philadelphia.

Memo from auto writer Alex Markovich: "G.M. says it's 4.5 turns lock-to-lock for both manual and power steering. But when I drove the thing (with manual steering) I counted six turns. In fact, I distinctly remember counting the turns several times, while the engineer sat watching, red-faced and silent. This was a prototype, not a production car. Maybe they realized the error of their ways at the last minute."

Watch That Solder!

While reading John Burroughs' article ["Electroplating in Your Own Shop," Nov.] I noticed that he was doing some soldering requiring a paste acid flux. This is poor practice for soldering electrical connections because of corrosive action.

He should use rosin-core solder, which is

made especially for soldering electric parts.

STINIUS DAHL II, Knoxboro, N.Y.

Any Carb Experts Around?

I own a 1962 Dodge Lancer with 145-hp. engine, downdraft carburetor. After the motor reaches normal heating and I park the car from 10 to 20 minutes, I have a tough time getting



it started again. Apparently no one around here can solve this hard-starting problem, although it's definitely the carburetor. Maybe one of your readers has a solution.

RAYMOND JAKABCIN, Stratford, Conn.

Getting Synchronized with History

About your articles on the '63 cars [Oct.]: Ford may have made this country's first completely synchronized three-speed transmission, but they didn't do it for 1963. An all-synchro box was standard equipment in 1938.

BUD SCHLEMMER, Enid, Okla.

Ears are red at both PS and the Ford Motor

CONTINUED

Why Johnson built 2 new reels in one

"Build a reel that offers the best of BOTH spinning and bait-casting." That's what anglers asked for, and Johnson did it . . . built the Johnson "710". Here's the reel that gives you spinning ease on the cast, bait-casting power on the retrieve. THEN, when a big one runs and you want game-taming drag, simply SHIFT the handle back a fraction of a turn. Drag takes over automatically. Run's over, you resume normal retrieve. Keep the fun of catching fish . . . and keep your catch, too.

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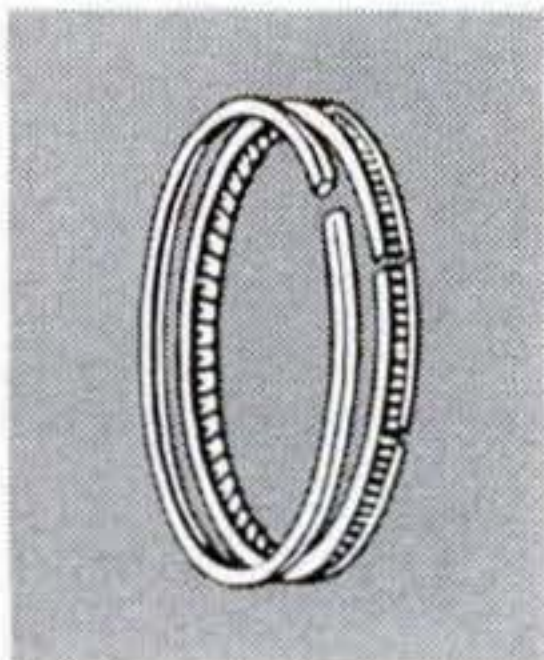
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Co. Says Ford: "Mr. Schlemmer is right. No one around here remembered this. We had to check with the automotive-history department of the Detroit City Library to make sure. The all-synchro box was abandoned a year later."

Meteorologists, Please Note

The article "Wettest Days Follow the Moon" ["March of Science," Dec.] prompted this amateur astronomer to examine why more rain should fall in the weeks following new and full moons.

Using a working model of the earth, moon, and sun, I found that in the daylight hours of these periods, the atmospheric tide (barometric pressure) declined from a maximum in early afternoon to a minimum a few hours after sunset, an interval during which maximum temperature drop also takes place (just after sunset). The cumulative effect of the temperature drop and the pressure drop could bring on rainfall more readily.

W. T. THOMAS JR., Daytona Beach, Fla.



About the Caddy

As the manufacturer of the fan clutch referred to as a "gimmicky innovation" in November ["Caddy's New Engine"] we feel you are doing an injustice to the product. If you had had the opportunity of riding an air-conditioned Cadillac without this device, we are sure you would refer to it as a very necessary apparatus to make the car a nice, quiet, smooth automobile.

T. J. WEIR, Chief Engineer
Schwitzer Corp., Indianapolis.

Testing the Galaxie

Being a dyed-in-the-wool Ford-performance enthusiast, I feel it my duty to point out that the Ford pictured ["The Ford Stable," Oct.] is not equipped with the 405-hp. engine—a mill with three two-barrel carbs. The car shown obviously has four barrels.

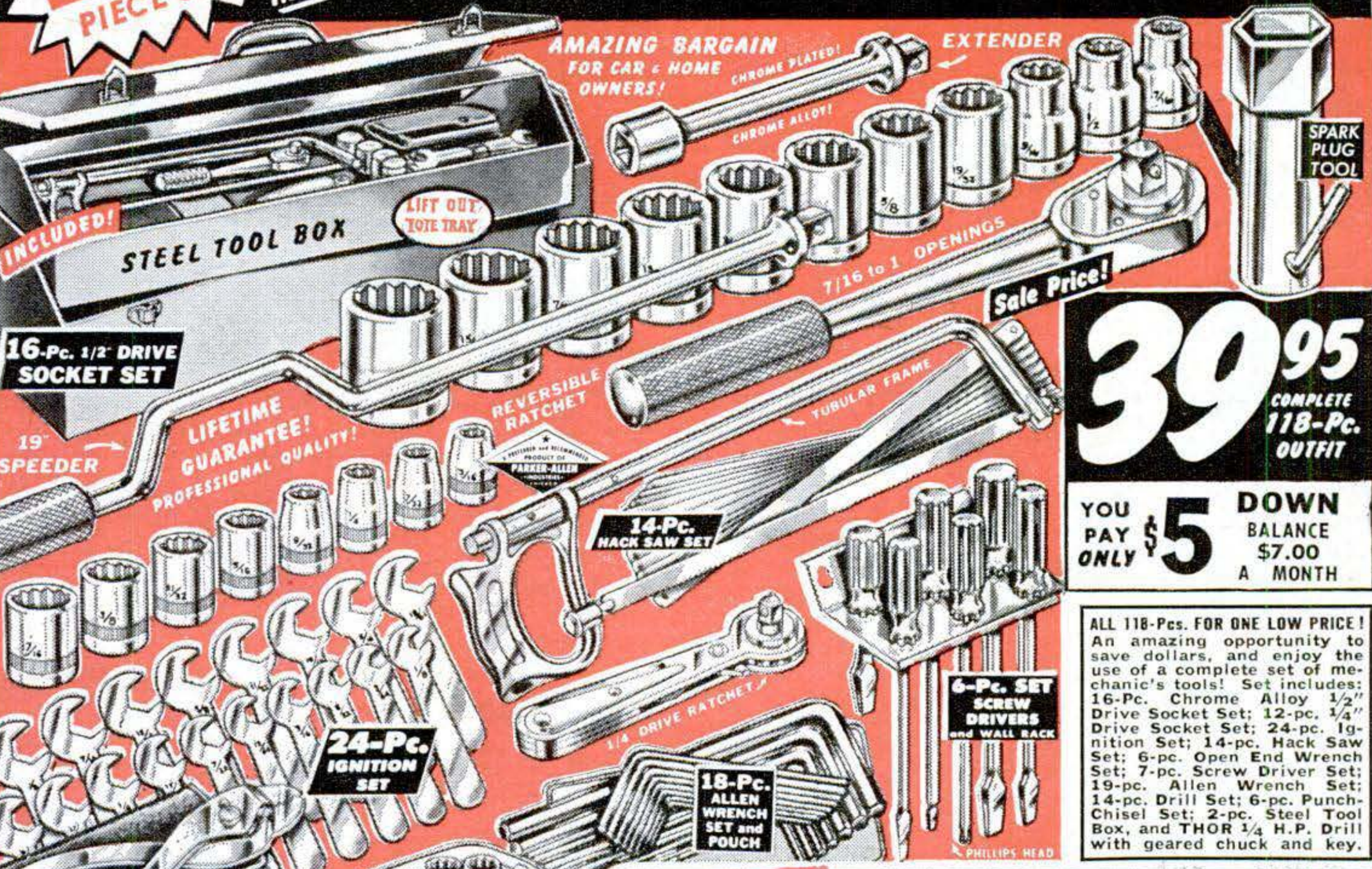
If your test drivers are going to compare the Ford 406 with other super-super stockers, please give Ford a break—peek under that air cleaner and check for three Holley two-barrels, indicating that you have 405 lusty, honest horses under the hood!

G. E. LEMMON, University City, Mo.

Right. The photo at top of page 75 doesn't show the 405-hp. engine. But the test drive reported by Alex Markovich (bottom of the page) was made in a 405-hp. job. The two stories were written by different editors.

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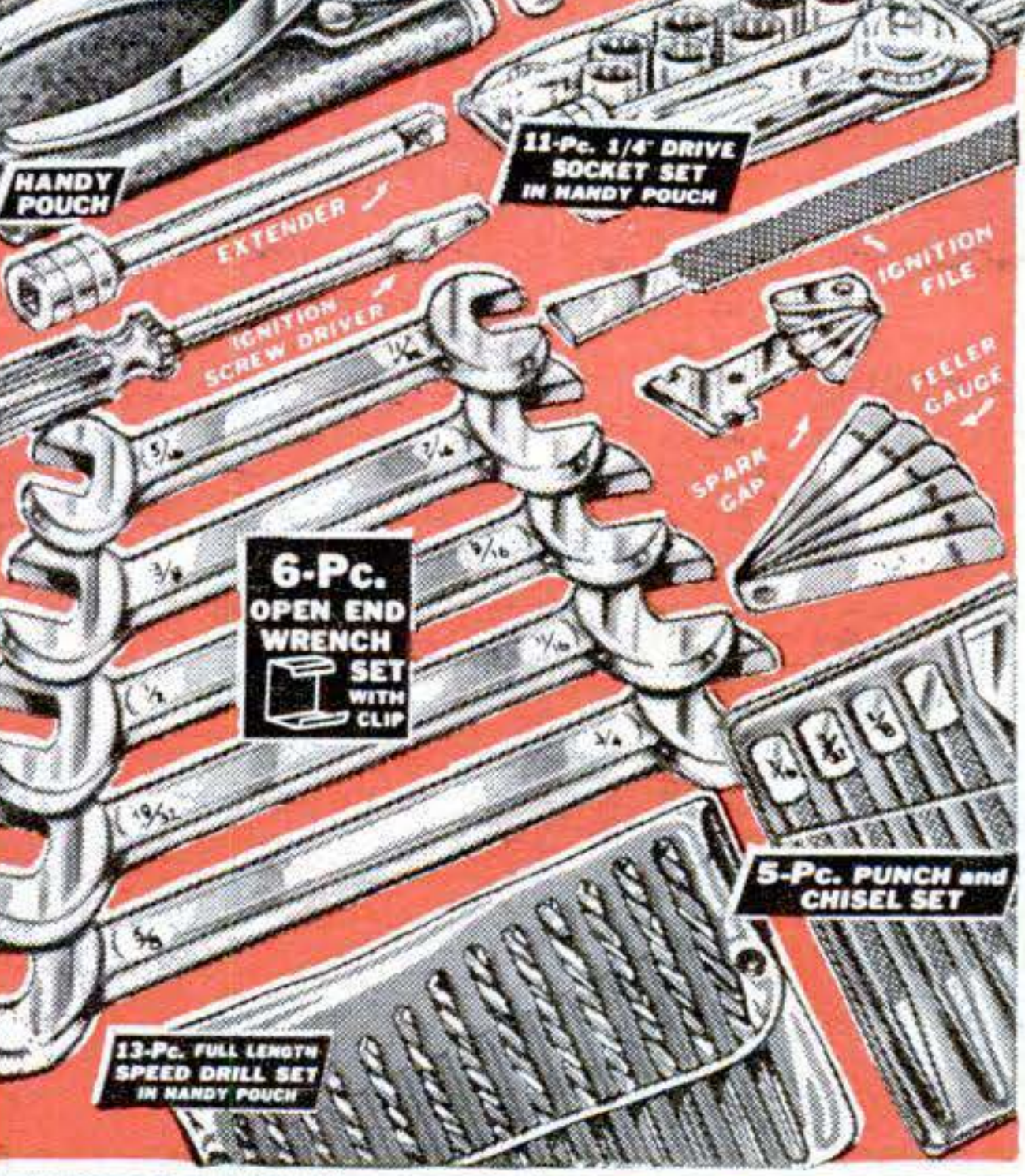
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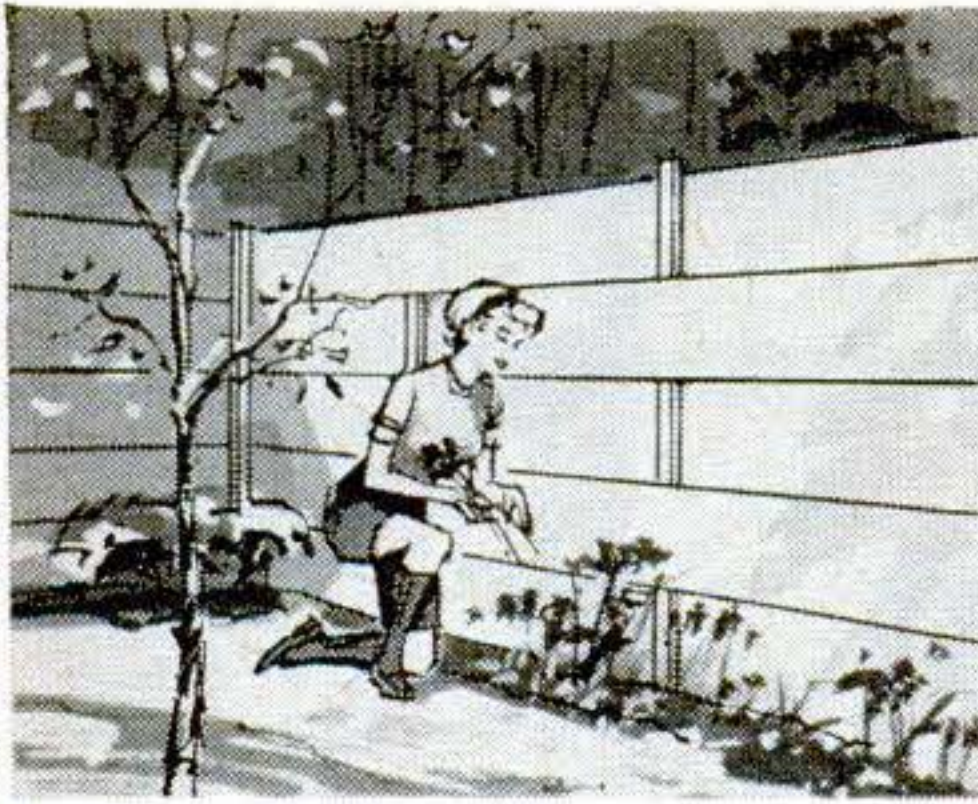
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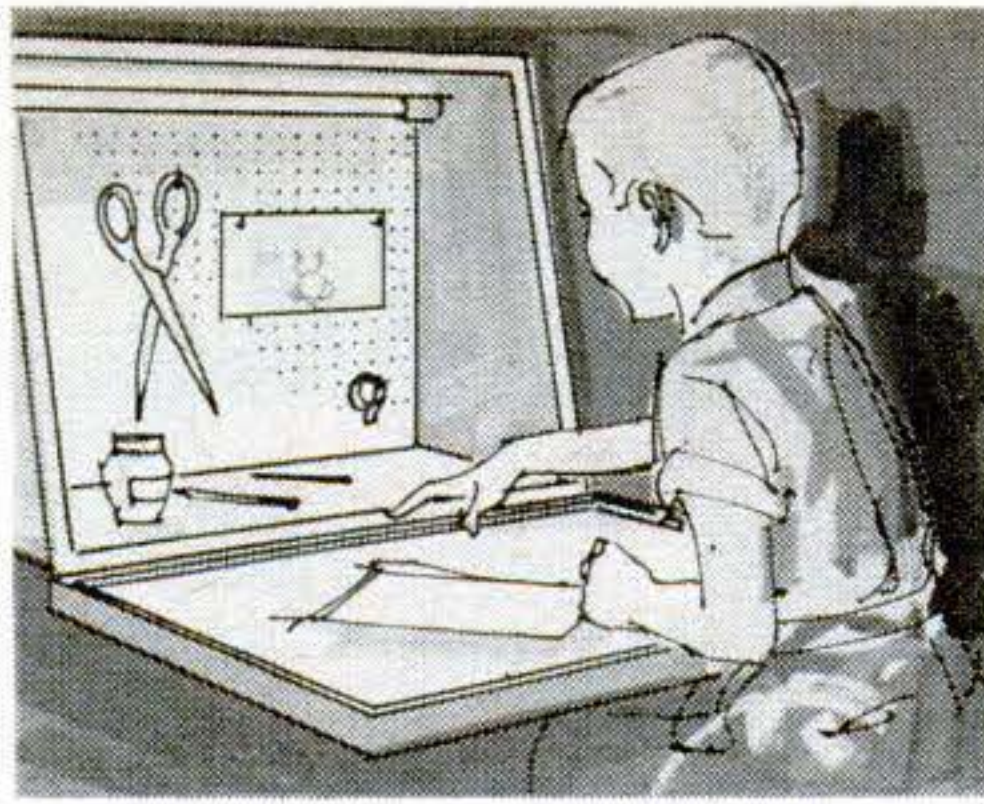
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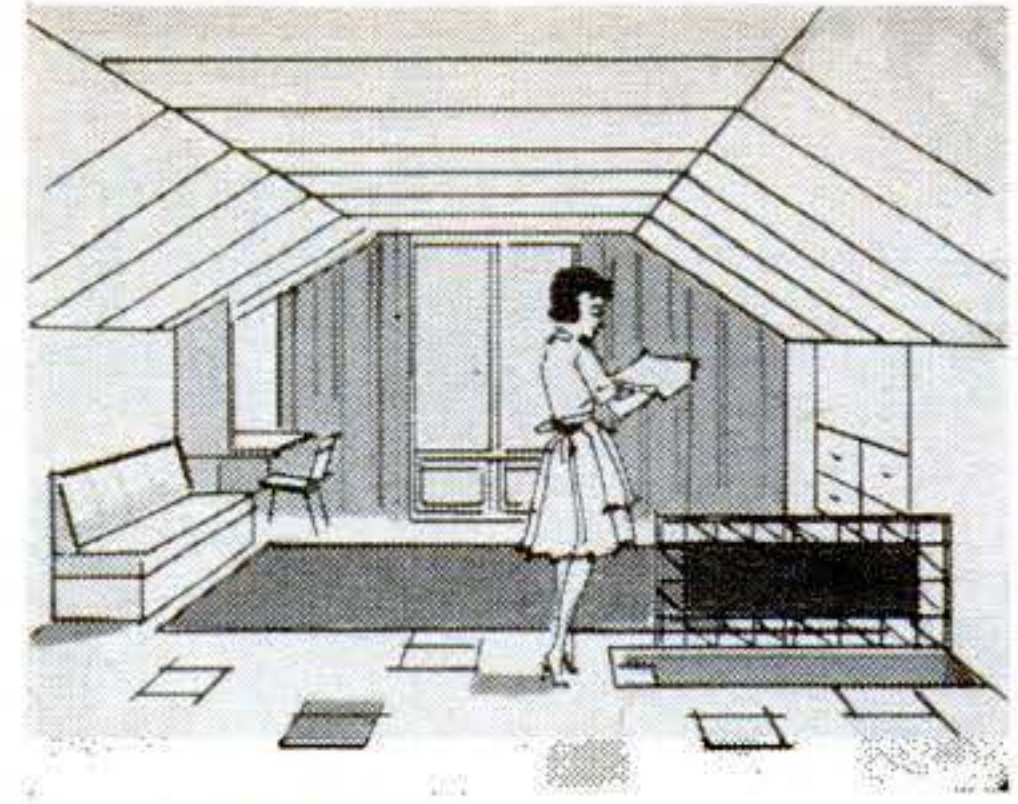
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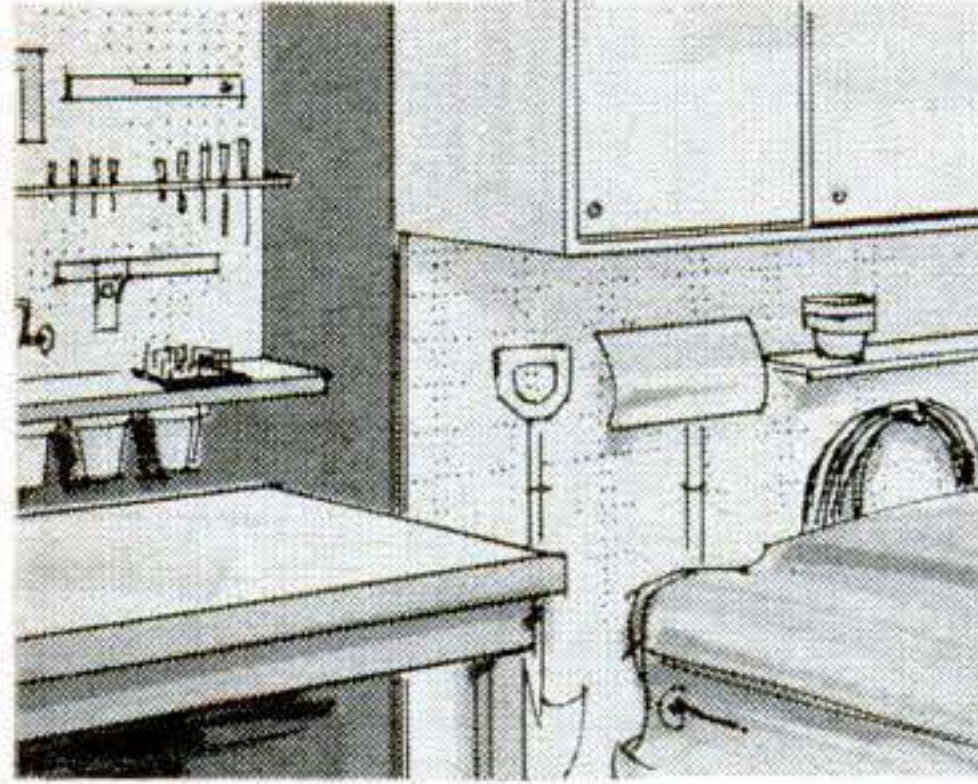
1. Fences of distinctive design



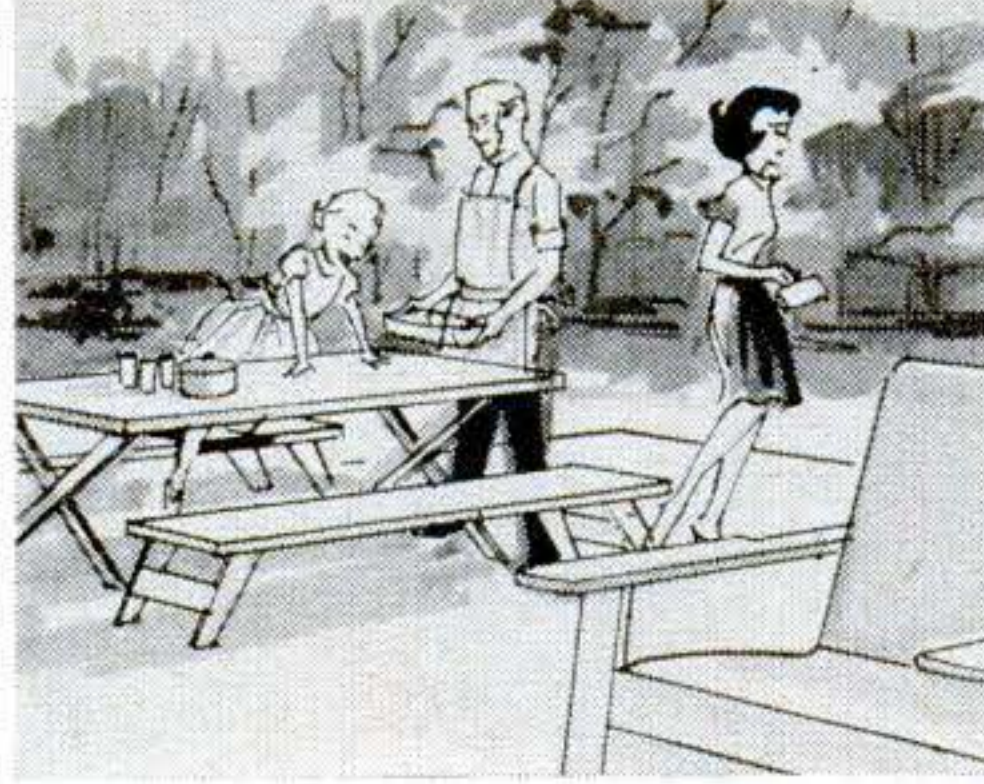
2. Wall desk with optional chalkboard front



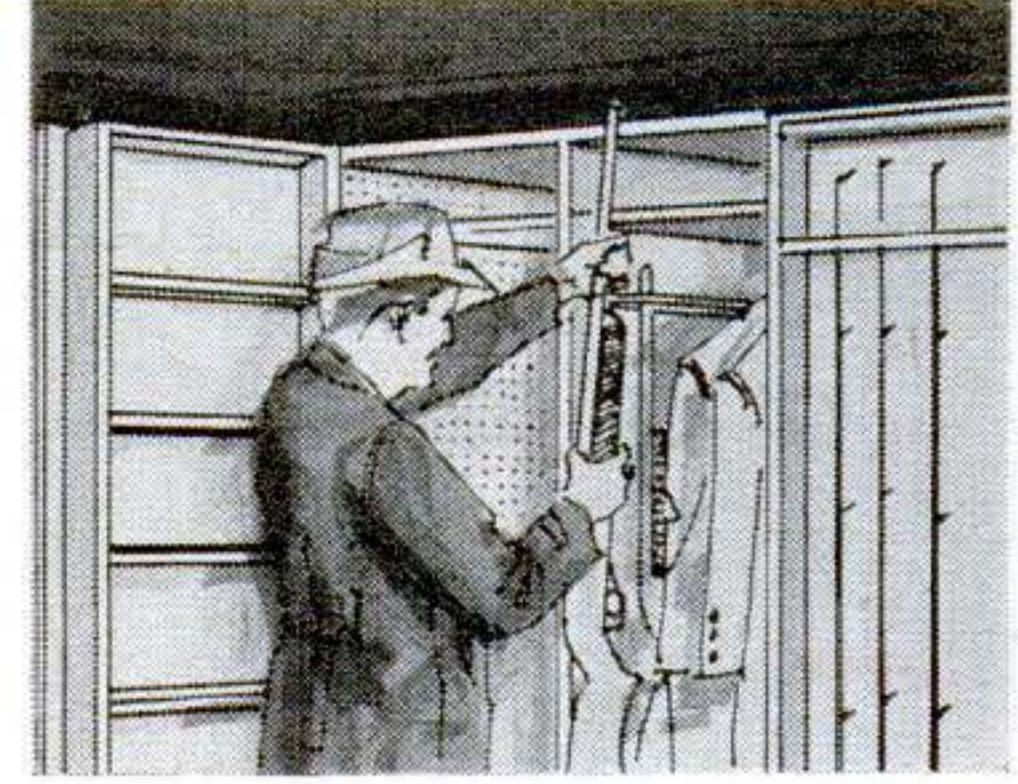
3. Remodeled attic



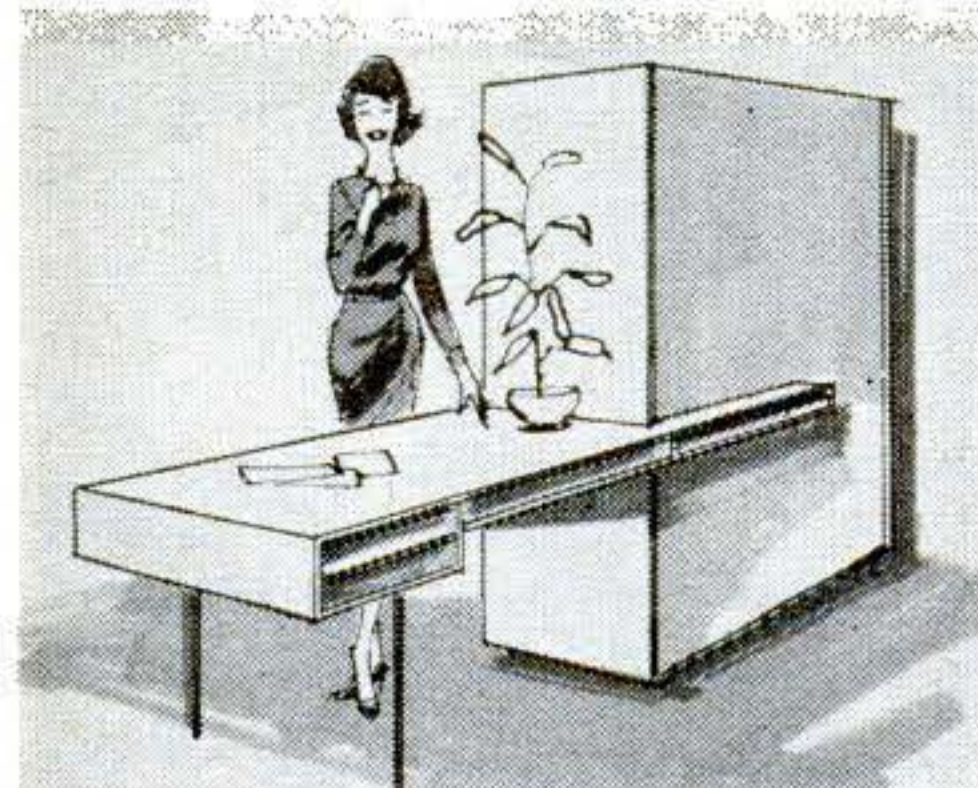
4. Garage interior remodeling



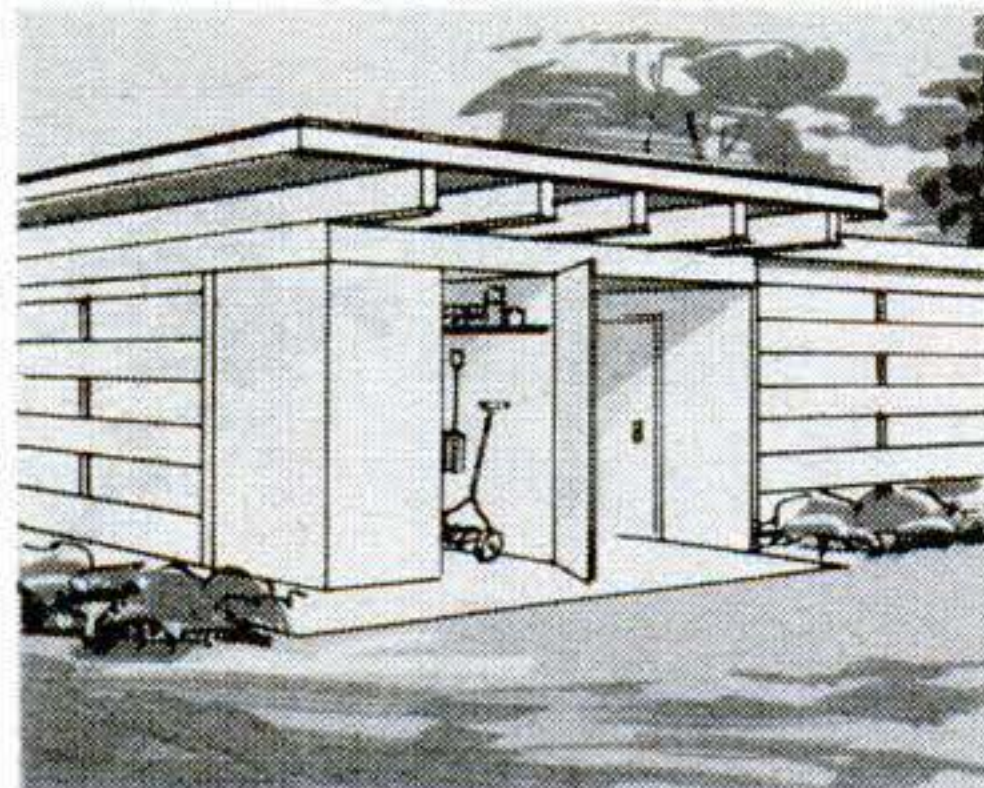
5. Picnic table and benches, lawn chair



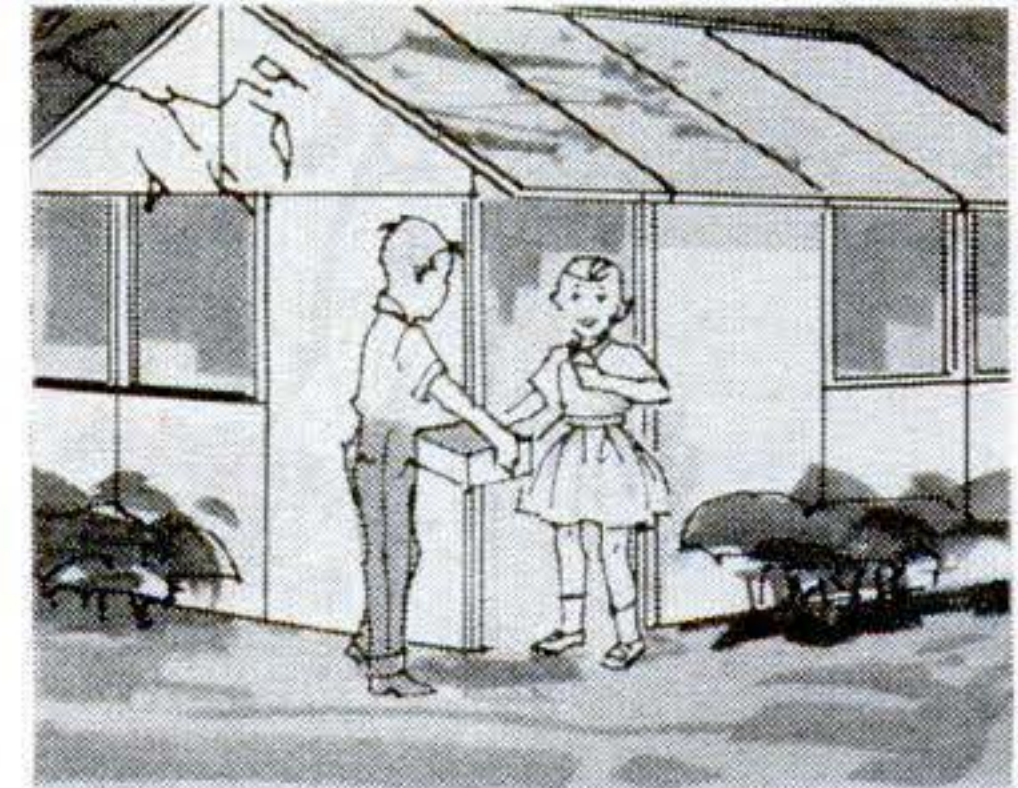
6. The sportsrobe



7. Room divider with desk and wardrobe



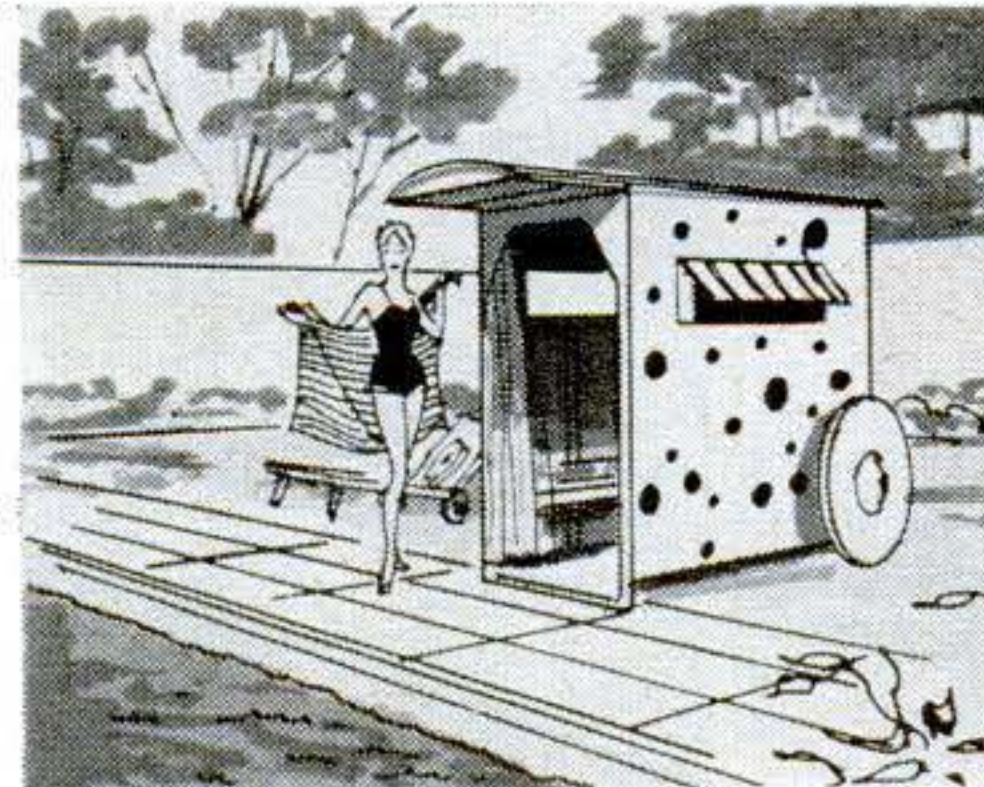
8. Woven carport wall with tool room



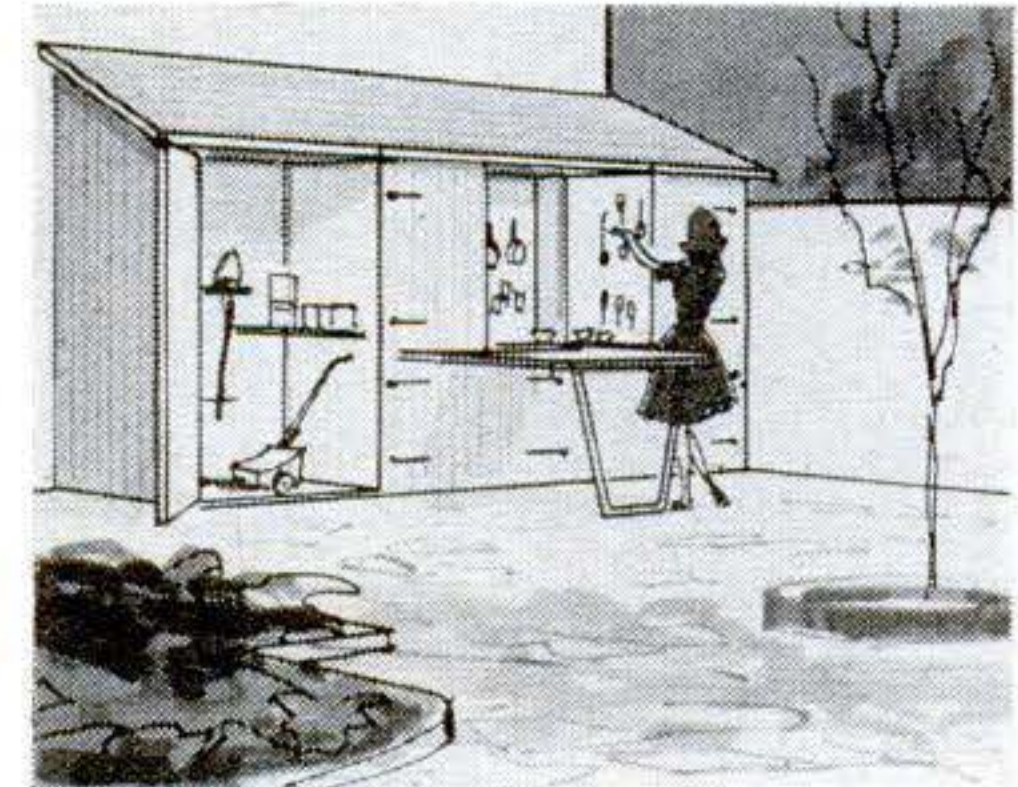
9. Playhouse plan for children



10. Home entertainment center
Family leisure hi-fi center



11. Roll-away cabana



12. Outdoor living room

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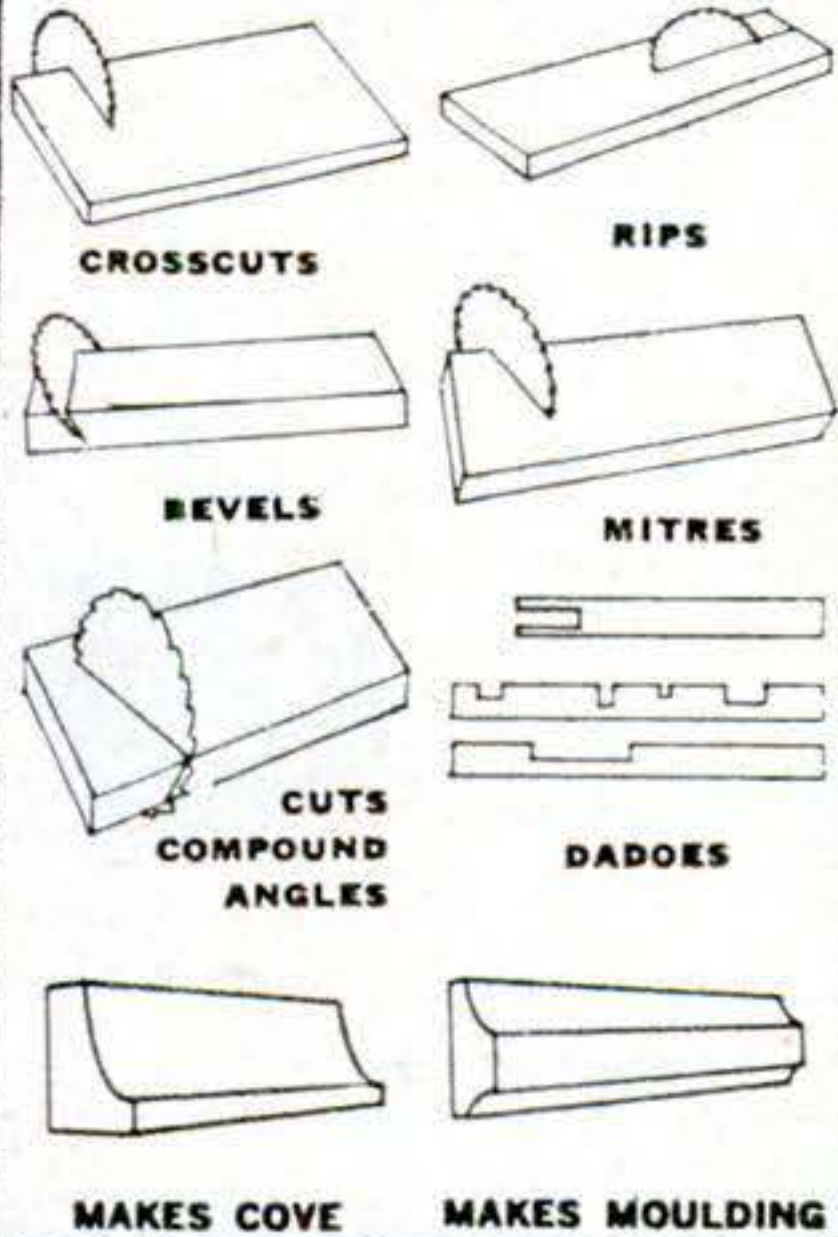
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r red	s spoon	t tree	ue use	v voice	w window
y yes	z zebra	ς daisy	wh when	ch chair	
th three	th the	sh shop	3 television	q drink	
a father	au ball	a cap	e egg	i milk	o box
u up	ω book	ω spoon	ou out	oi oi	

Some first-graders will soon be studying the strange-looking alphabet shown at left. It has 43 characters—one for each of the basic sounds in the English language—and is supposed to help children learn to read faster and better by eliminating confusion over sounds. Ordinary letters must be combined in more than 2,000 ways to represent English sounds, and some letters can stand for many different sounds. The new alphabet, called Augmented Roman, has been tried in England and is now to be tested on a few classes in New York City. It is not intended to replace the old 26-letter alphabet except in the beginning grades. Once the children learn to read, they will be shifted gradually over to the standard system.

Why the grass is green

The green grass just sits there, soaking up sunshine, sucking water from the ground, inhaling carbon dioxide from the air—and converting those simple substances into rich food. Photosynthesis is the most remarkable chemical process known, and the most puzzling. Now Dr. Melvin Calvin, a University of California chemistry professor who has devoted his career to unraveling its mysteries, thinks he is close to the ultimate secret. Photosynthesis turns out to be very remarkable indeed.

Inside the green leaf are tiny factory particles, too small to be seen except under a microscope. To work, each particle must absorb a whole package of light energy at a clip. The package for the organism is very big: 30,000 to 40,000 calories of energy. This huge load is the smallest bite the organism can take. It takes that much light energy and converts it into chemical energy without even getting warm.

By delicately measuring the change in magnetism that occurs when an electron moves in a molecule, Dr. Calvin has now shown that two separate operations are involved. One light package

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The March of Science . . . continued

knocks an electron free from a "donor" material and into a "hole"—a vacant electron position—in an "acceptor" material. A second light package picks the electron up (leaving behind a new hole) to add its energy to a new, chemically powerful compound that ultimately becomes carbohydrate food. Many intermediate steps are required, but the starting point—the fundamental change that converts light energy into chemical energy—is these down-and-up jumps of electrons.

The drifting continents

The old legend of Atlantis, the lost continent that supposedly sank into the middle of the Atlantic Ocean, dies hard. More and more scientists now believe that the myth may have some foundation in fact. For one thing, there is high if not dry land—an undersea ridge—running straight down the middle of the Atlantic Ocean. No other ocean has anything like it. Even more obvious and intriguing are the shapes of the continents of South America and Africa. The east

.....
 : Some jobs can be done better after stay- :
 : ing up all night, reports a British doctor. :
 : The lack of sleep keeps you from con- :
 : centrating too hard and getting so tense :
 : you can't work right . . . Soft urethane :
 : foam, which is popular as cushioning for :
 : easy chairs and sofas, is now replacing :
 : the springs as well. A slightly less resil- :
 : ient form of urethane is just glued into :
 : the furniture "deck." It costs less to as- :
 : semble and should last longer—no coil- :
 : tying cords to break. :
 :

coastline of South America fits almost exactly into the west coastline of Africa, as if the two had once been a single continent that split and moved apart, opening up the ocean in between.

How could such a fantastic change in the face of the earth come about? There are at least two theories:

1. Princeton's Prof. R. H. Dicke believes that all the distant matter of the universe generates a very weak force that affects the earth. This "scalar field"

If You Can't Beat 'Em

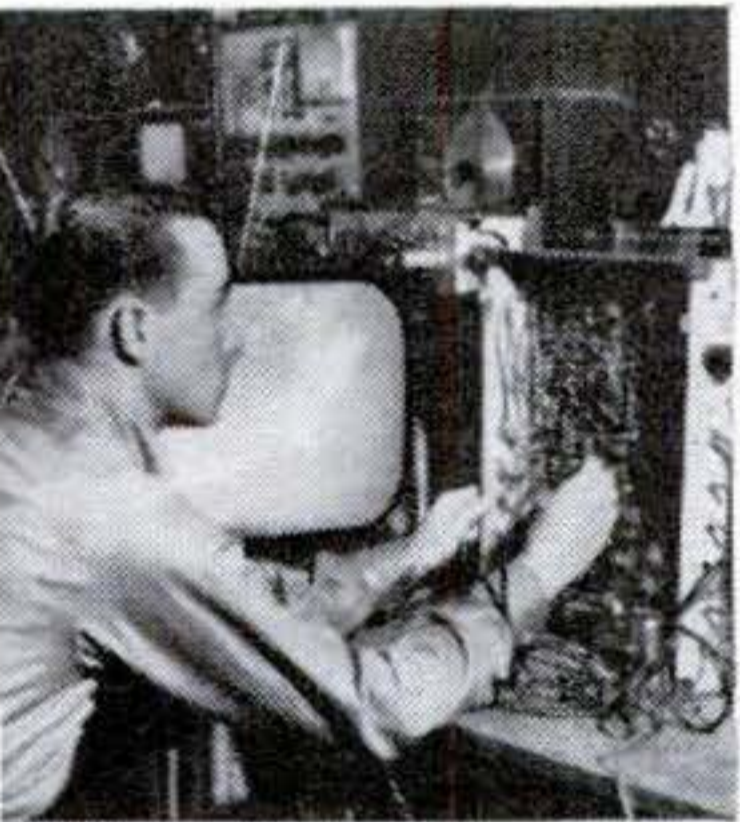


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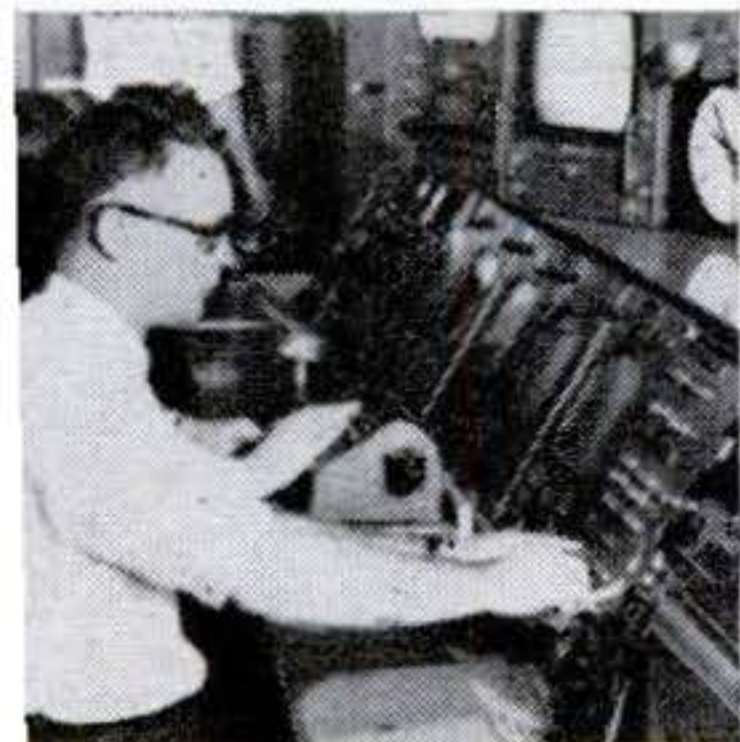


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According to the U.S. Dept. of Labor, there will be a 42% increase in professional and technical jobs, but *absolutely no increase in jobs for men who are unskilled*. That's why job counselors advise the unskilled man, "for an interesting career, get into Electronics." You *must be trained* to get ahead in the next few

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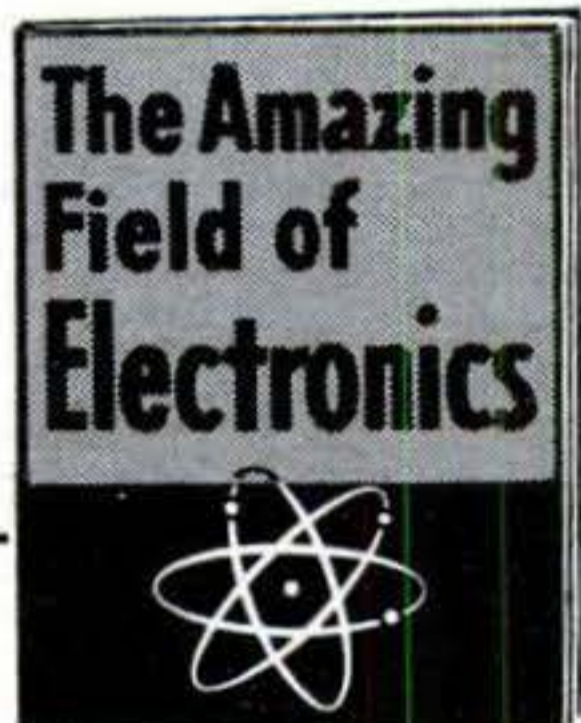
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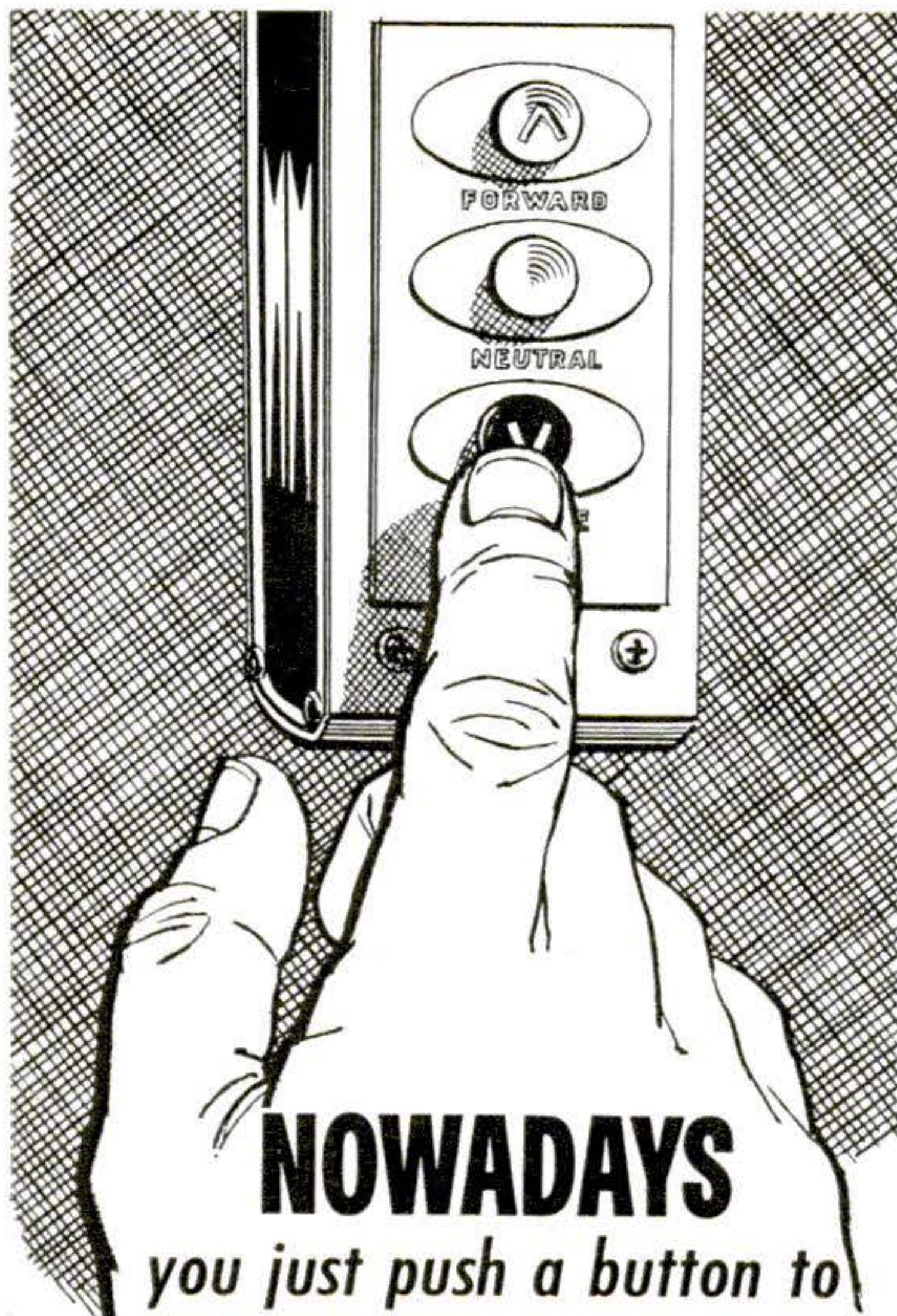
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would cause an extremely slow decrease in the gravitation that holds the earth in one piece; over millions of years, the loss in gravitation would let the earth expand, making it crack at the surface. Not many physicists believe in the scalar field. And even Professor Dicke regretfully concludes that it could not have expanded the earth fast enough to open up the Atlantic Ocean, which seems to be only about 200 million years old.

2. A number of scientists think that currents in the molten interior of the earth move the solid crust around, like rafts on a lake. The drift is very slow—about ½ inch per year—but it might have floated Africa and South America apart.

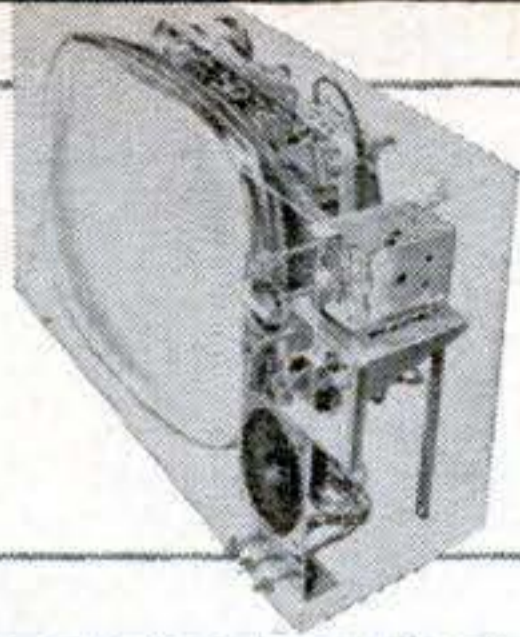
The hard evidence that can pin down the answer lies on the bottom of the sea—or under the bottom. Only in recent years, spurred by military interest in submarine warfare, have scientists begun to learn about the strange world beneath the water: submerged mountains, rivers, canyons, thick sediment beds. One of the most eminent of the oceanic explorers, Columbia's broad-shouldered, white-haired Prof. Maurice Ewing, was asked at a seminar last fall if his newest findings disprove the drifting-continent theory. Professor Ewing replied, rather ruefully, "I have the evidence now to refute *any* theory I can think up."

Machine learns to read

What may be the key to widespread use of electronic computers for all kinds of high-grade paperwork—language translation, automatic library searching, mail sorting, big-scale accounting—was demonstrated last fall by IBM. It is an experimental reader that can be taught to recognize almost any style of printing.

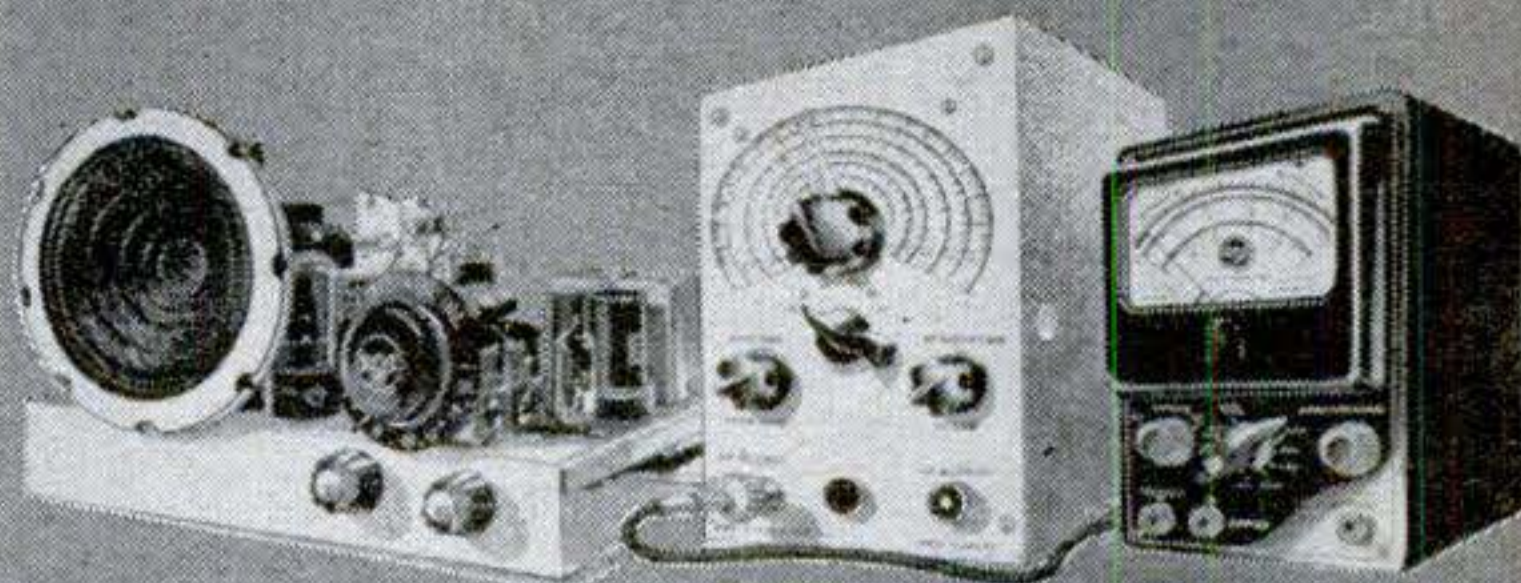
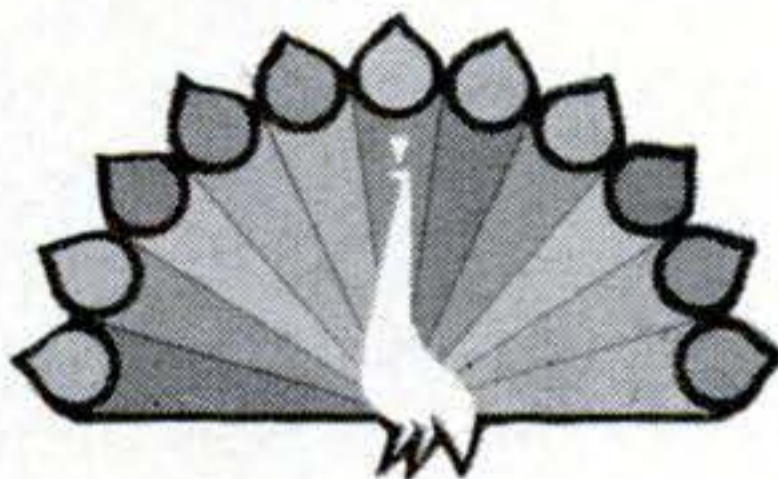
Reading is the bottleneck of much automation now. Most computers have to be fed the raw information by girls punching typewriter keys. There are some direct-reading machines, but they can decipher only a few styles of type. (The ones that banks use to read checks

CONTINUED

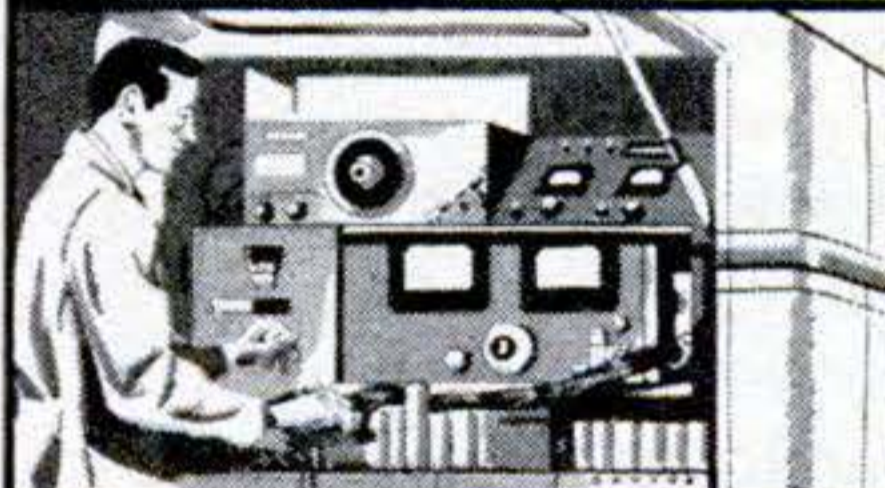


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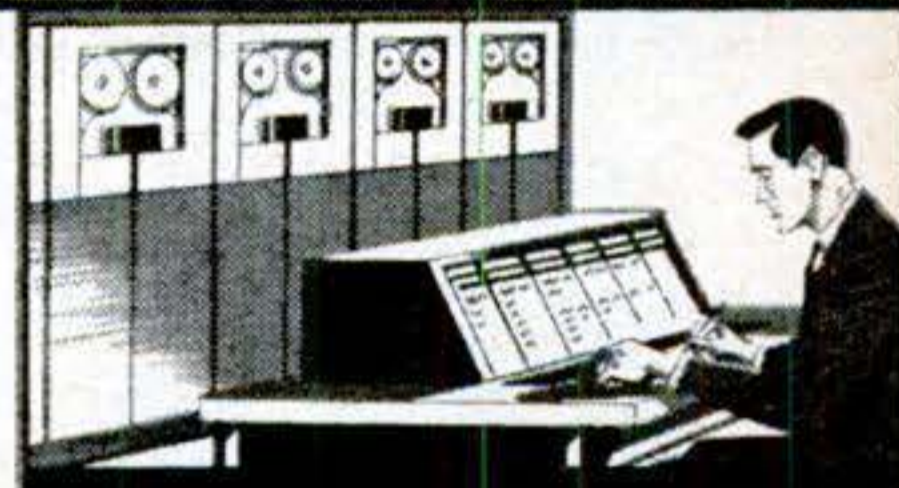


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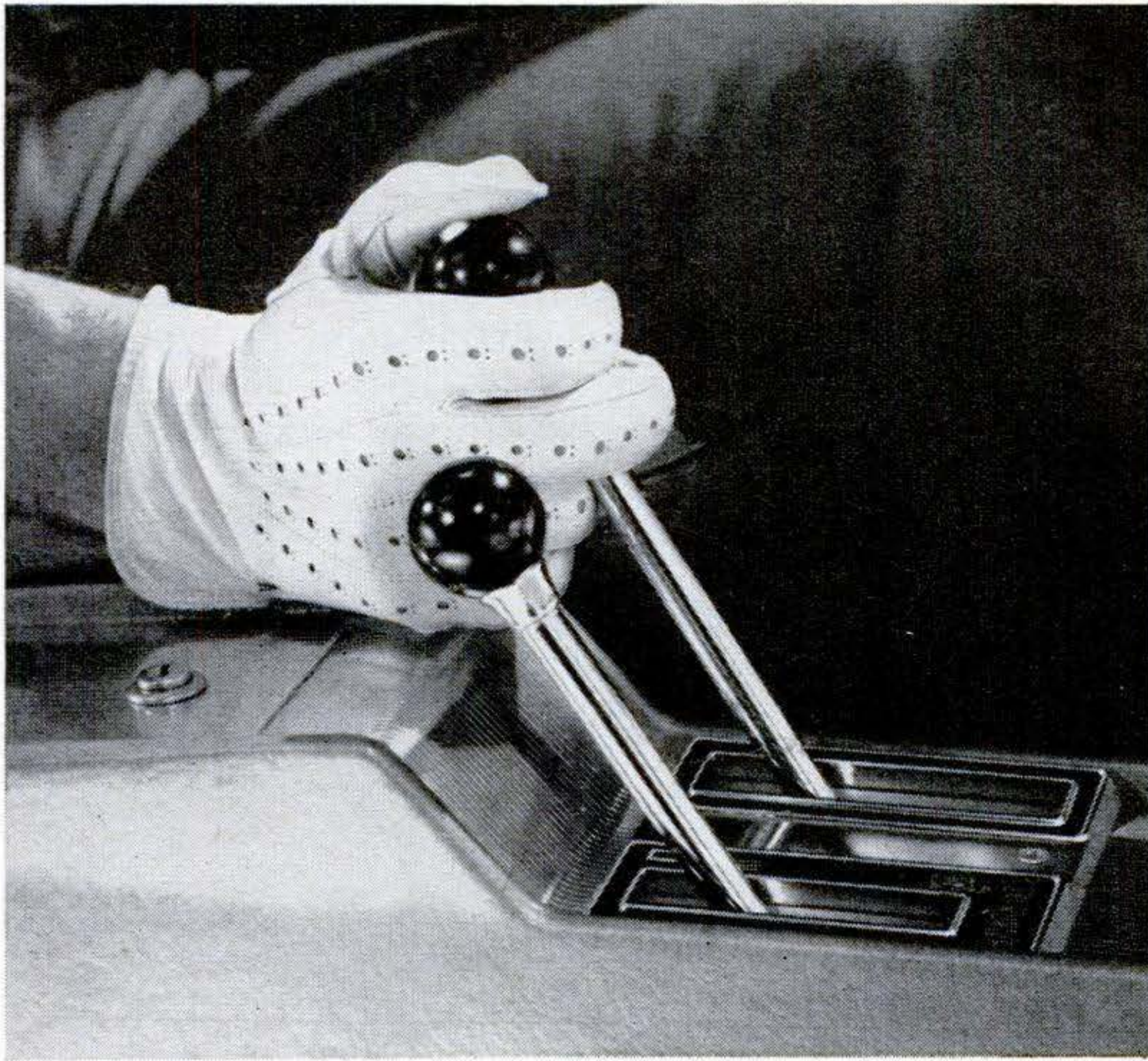
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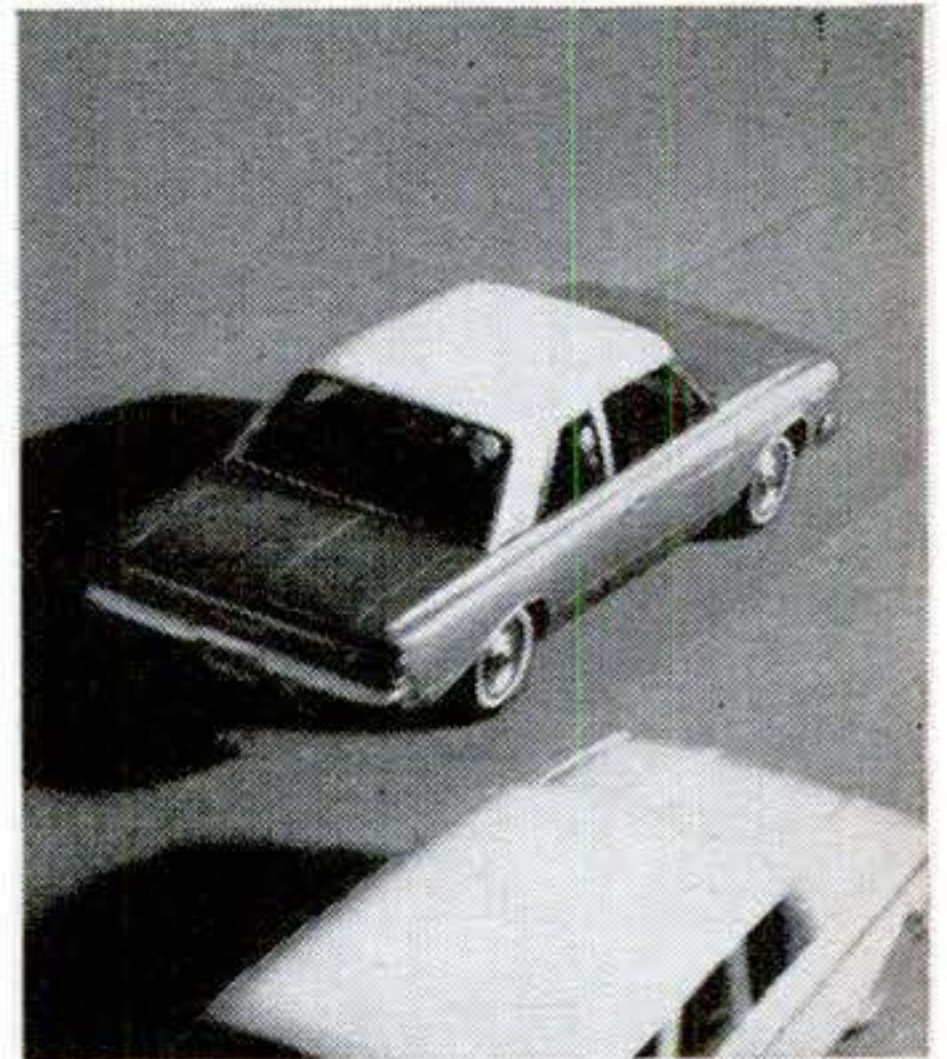
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'63 Rambler story. The new Classic 6 and Ambassador V-8 also feature all new Advanced Unit Construction—new curved glass side windows—dozens of other far-ahead features that won Rambler the '63 "Car Of The Year" award by *Motor Trend Magazine*.

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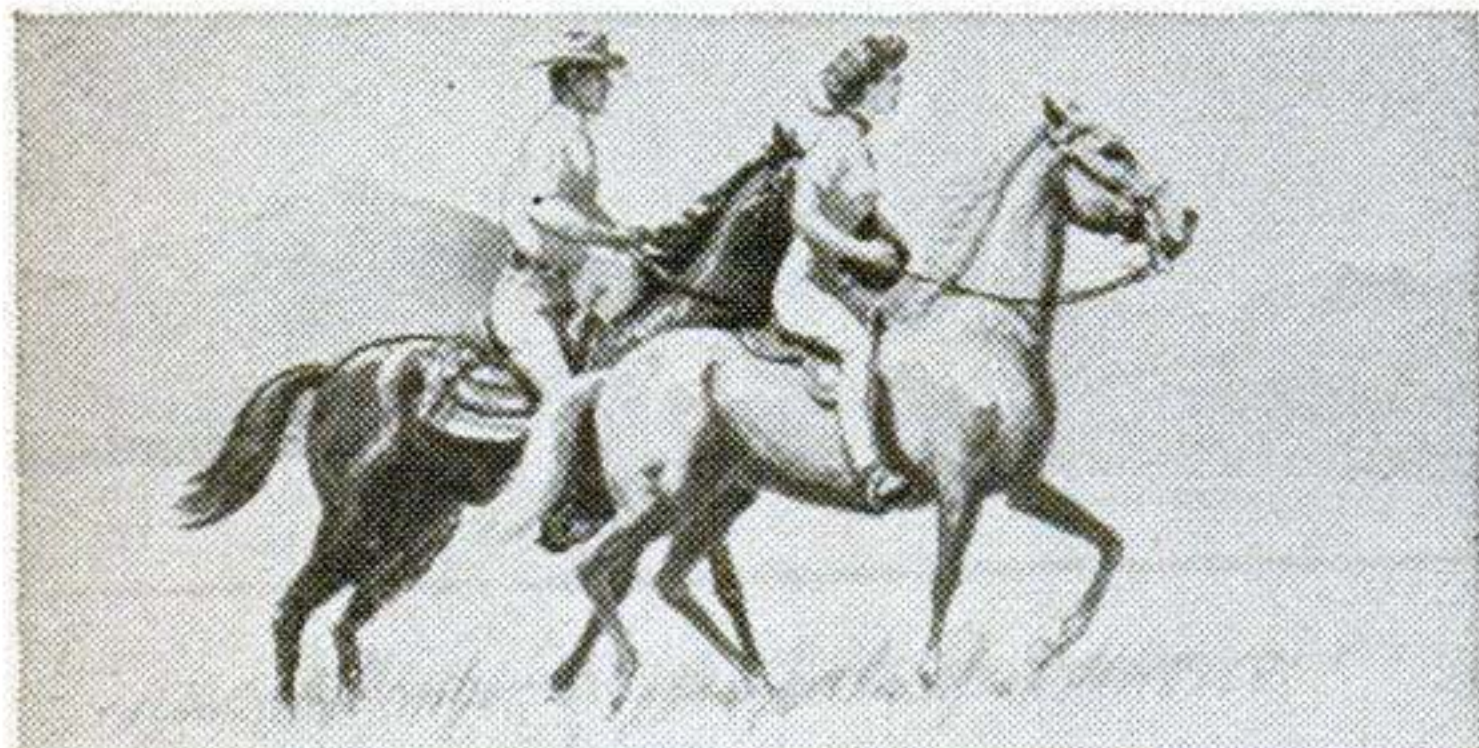
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The March of Science . . . continued

might sink and smother. New studies promise something more solid.

Stanford astronomers think the moon's surface is "cotton candy" or maybe "Cracker Jack." Their measurements of radio waves indicate that the moon is very porous to a depth of at least several yards. The material could be lightly matted filaments like cotton candy or crumbly cells like Cracker Jack.

Meanwhile Caltech scientists have been remeasuring the moon's temperature. The dark side gets colder than anyone suspected (270 degrees below zero F.) but there are a few spots that cool off surprisingly slowly. These warm spots are probably patches of solid rock—very good landing places.

Atomic rays vs. trees

You get a glimmering of what atomic war might do from this picture of the Biology Gamma Forest at Brookhaven



National Laboratory, N. Y. These dead trees are the casualties of six months' nearly continuous exposure to gamma rays from a very hot piece of radioactive cesium (on a pipe, circled in photo). Some trees can take it better than others: Pitch pine was killed by 20 roentgens per day; sedge stood up to 350 roentgens per day. Oddly enough, not all the trees were killed by gamma rays alone. Insects resist radiation better than plants, so the rate of destruction by insects goes up as tree vitality declines. ■ ■

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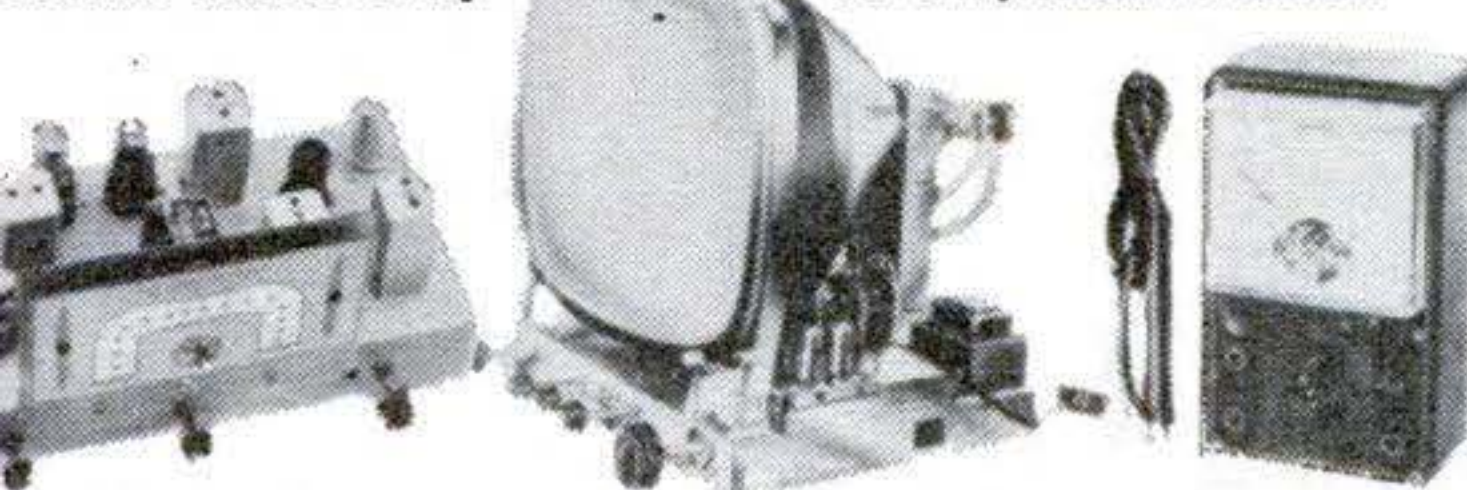
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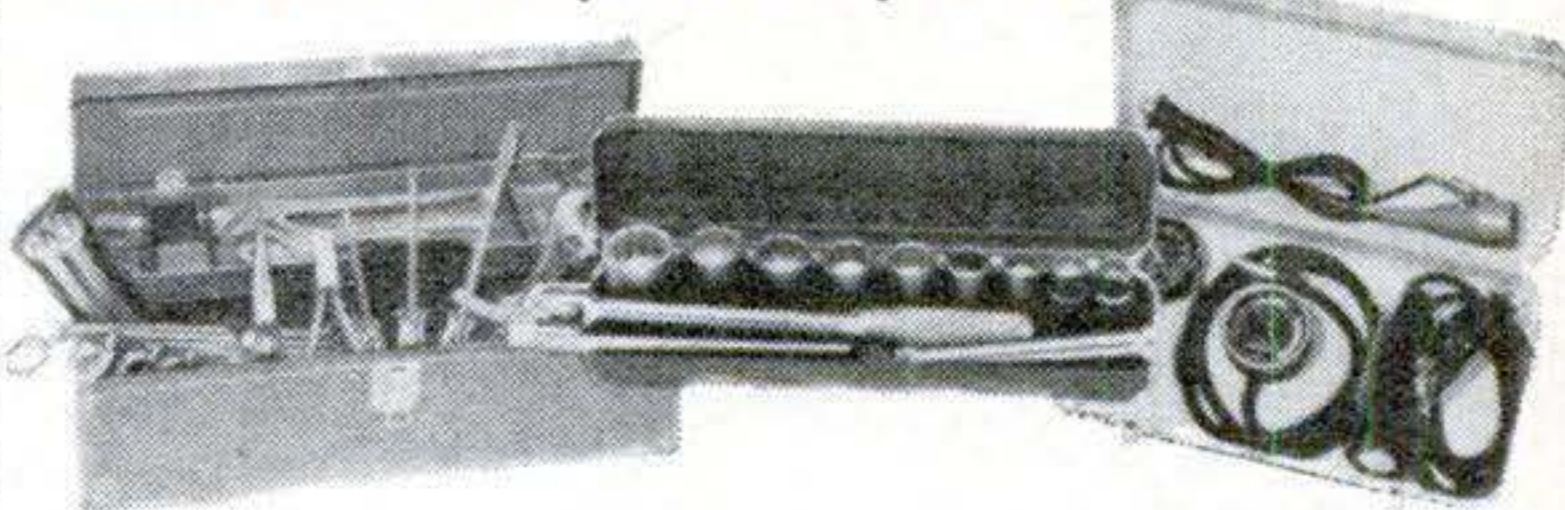
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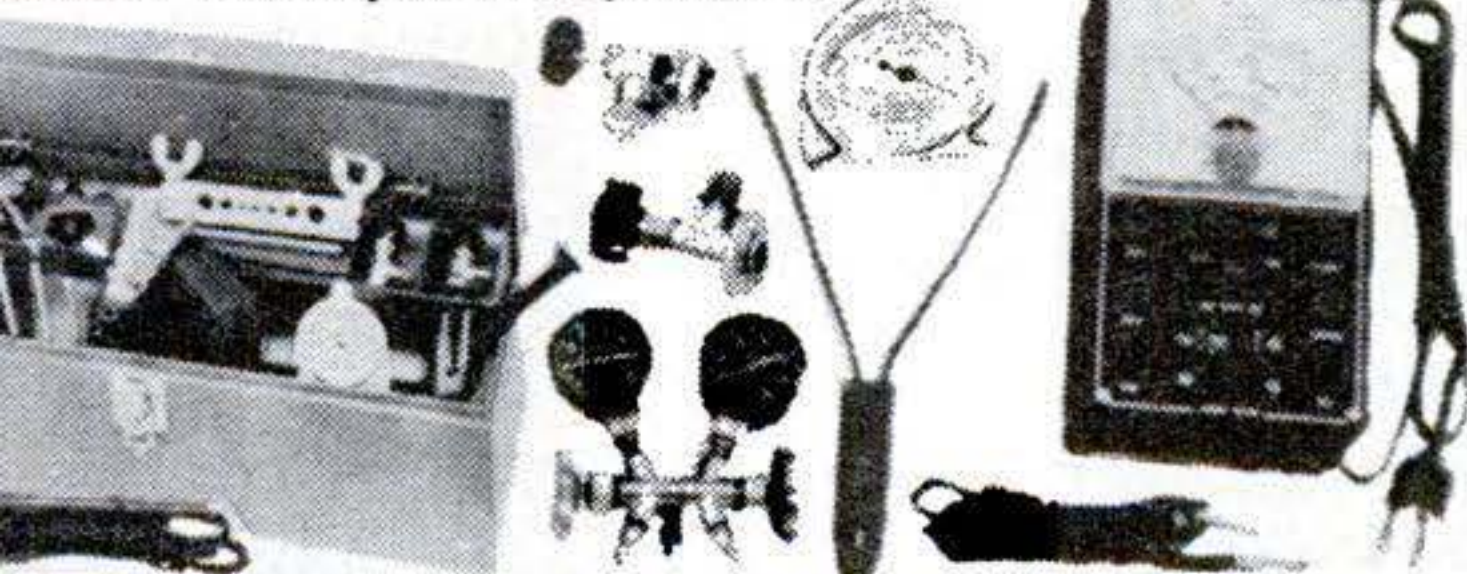


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Getting Ahead

By Dr. Lewis R. Fibel

A monthly column to help you prepare yourself for a better job

Future Scientists of America take note: The National Science Teachers Association is again conducting a program aimed at discovering and encouraging students with the potential of becoming tomorrow's leaders in science and engineering. More than 30,000 high-school students are expected to take part, performing experiments and reporting results. More than \$10,000 in scholarships and savings bonds will be awarded to entries judged best at regional and national levels. The program ("Future Scientists of America") is sponsored by Ford Motor Co.

engineers, health physicists, radiation specialists, and others. If you are interested, write the Director, Division of Personnel, A.E.C., Washington 25, D.C.

"**Careers in Science**" is a fine 15-cent investment for high-school students interested in science or its applications as a profession. The pamphlet, available from the American Association for the Advancement of Science, 1515 Massachusetts Ave. N.W., Washington 5, D.C., describes specific careers and lists over 200 publications that give fuller details.

A special training course in the application of radioisotope techniques to the field of highway engineering has been announced by the Oak Ridge Institute of Nuclear Studies (P.O. Box 117, Oak Ridge, Tenn.).

"What opportunities are available for surveyors? How much would I make?"
—R.L.S., Provo, Utah.

Surveyors usually work with engineering, architectural, or construction firms. They use transits and other instruments to measure the earth's surface. They must be able to interpret the measurements, and draft plans and maps. A prime personal requisite is a liking for outdoor work. You should be in good health, have some mathematical ability and physical dexterity.

There are over 25,000 surveyors in the U.S., with every indication of a steady demand. Minimum training needed is a technical course in high school, but most jobs require additional training of the kind you might get in the armed forces or in a technical institute. Many states require a licensing exam for surveyors.

In industry, skilled surveyors are paid three or four dollars an hour.

Schools Awarding the Largest Number of Doctorates in Engineering (in order)	Research Income Received by the College of Engineering
---	--

1. M. I. T.	\$11.5 Million
2. Illinois	7.5 Million
3. Michigan	16.0 Million
4. Purdue	1.7 Million
5. Stanford	3. + Million
6. Wisconsin	0.9 Million
7. California	3.4 Million
8. Columbia	3.5 Million
9. Carnegie Tech	2.5 Million
10. CalTech	2.3 Million

Want to do graduate work in engineering? Then you'll be interested in the list above of the 10 schools that awarded the most doctorates in engineering last year. Also interesting is the comparison of research money flowing into those schools.

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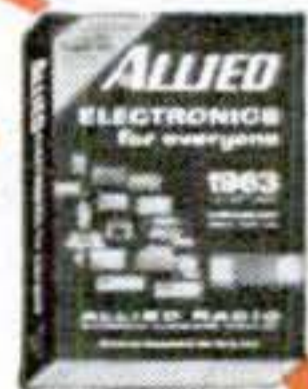
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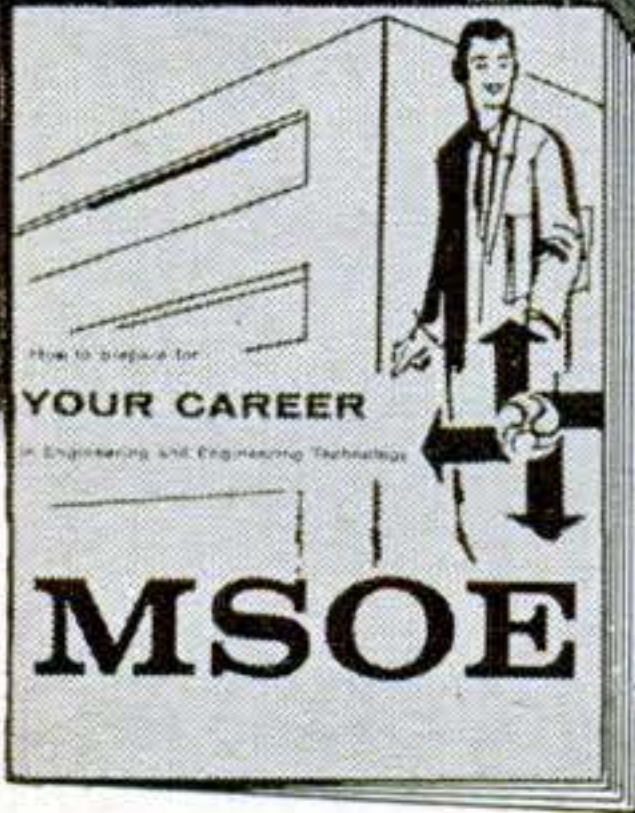
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"Where can I study electrical construction and wiring? I am a high-school graduate."—C.W., Norfolk, Neb.

Organized curriculums are offered at 16 colleges scattered throughout the country. The schools nearest you are two in Illinois: Chicago Technical Institute (2000 S. Michigan Ave., Chicago) and Joliet Junior College (East Jefferson St., Joliet).

"I like to tinker with radio and TV sets. Do you think I should select electronics as a career? Where could I study?"—L.H.P., Kings Mountain, N.C.

If you like to tinker, you have some interest in the field. But electronics is a lot more than tinkering—and a lot more than radio and TV. For success as an electronics technician, you should be confident of your ability in mathematics, science, and English. Did you do well in these subjects in high school? If so, you might consider a career in electronics, perhaps one that involves testing and maintaining the complex electronic instruments used in the space and missile industries, or in communications.

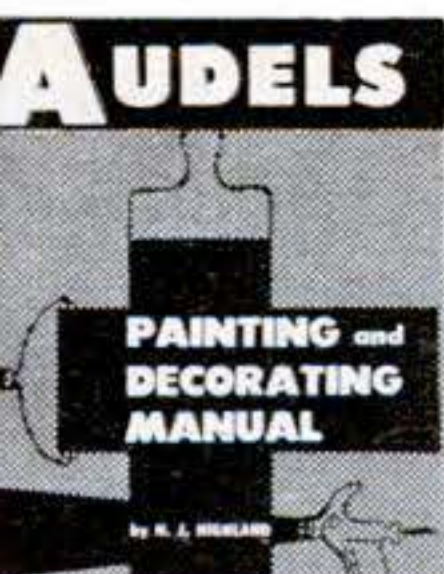
A fine two-year course in electronics is given at Charlotte College (221 N. Cecil St., Charlotte, N.C.). Tuition for North Carolina residents is \$180 a year.

Many other colleges also offer electronics, and some courses are available by correspondence.

.....
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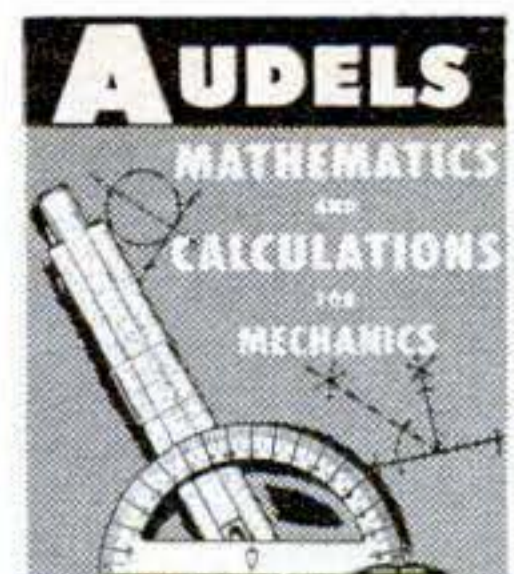
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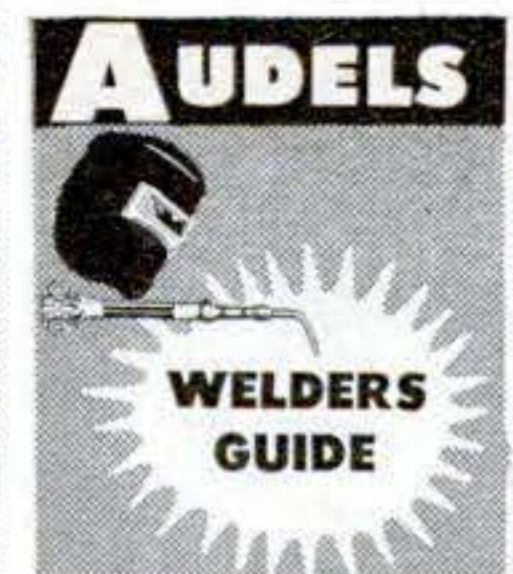
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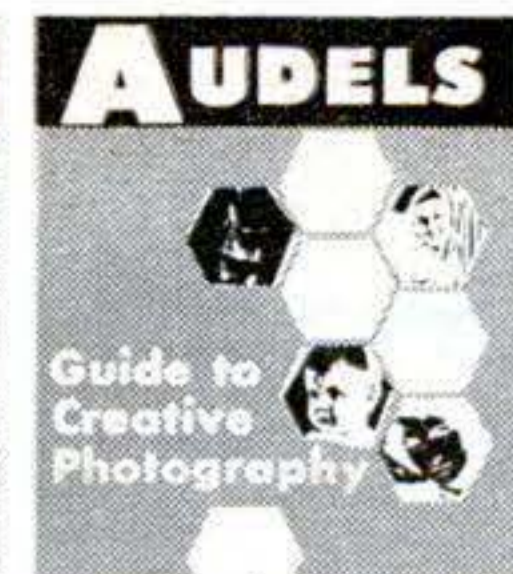
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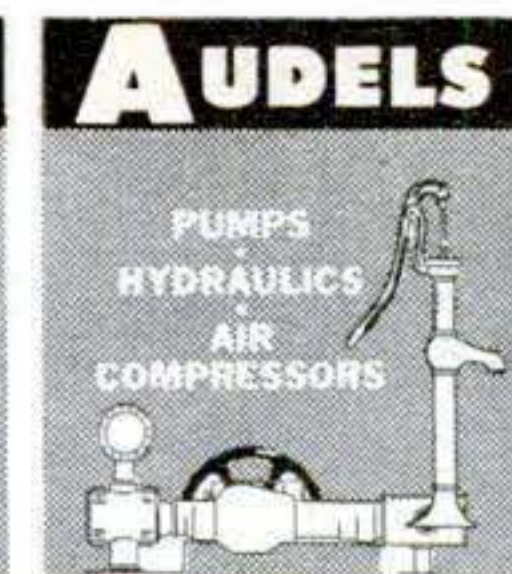
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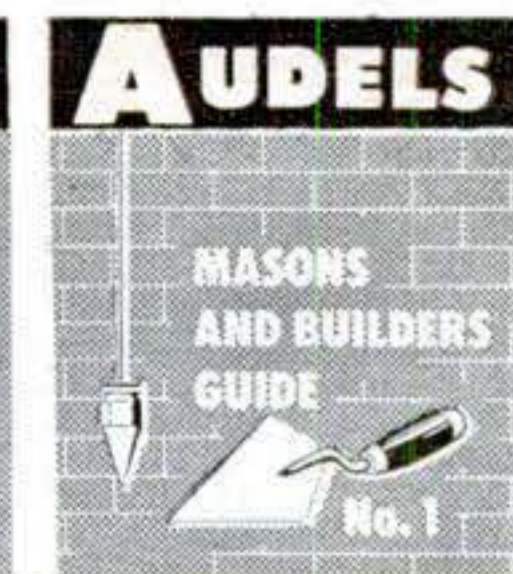
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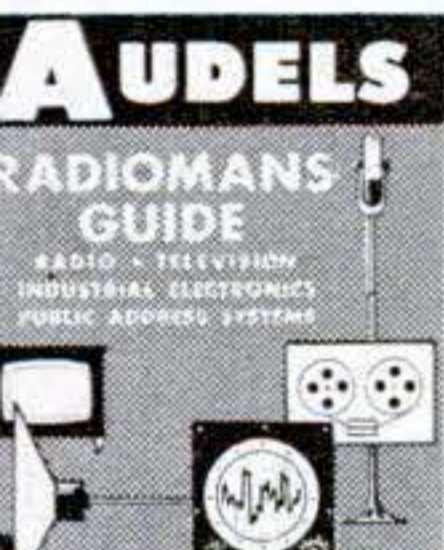
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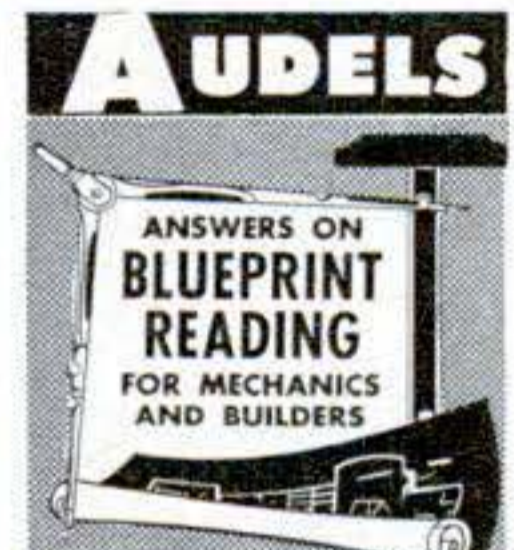
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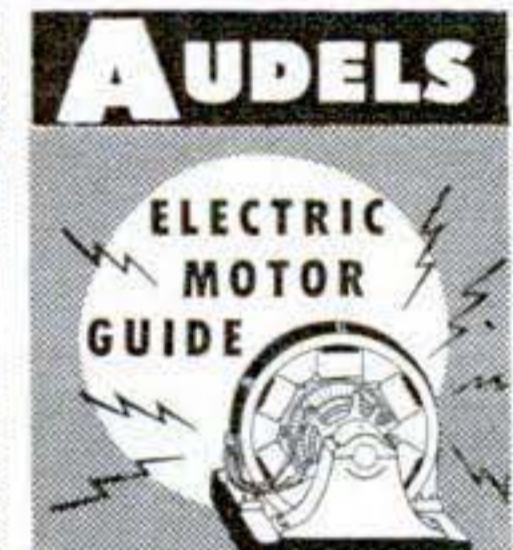
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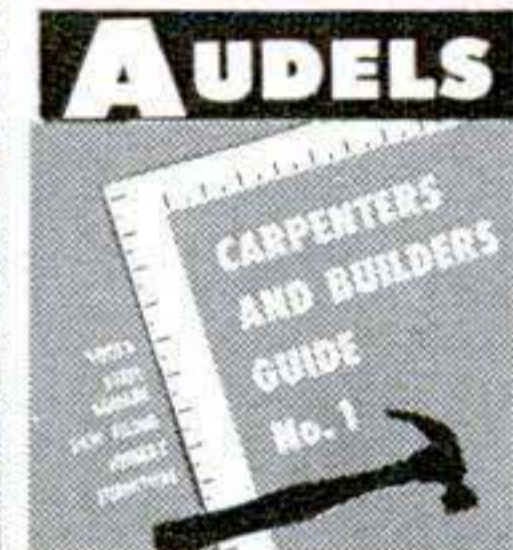
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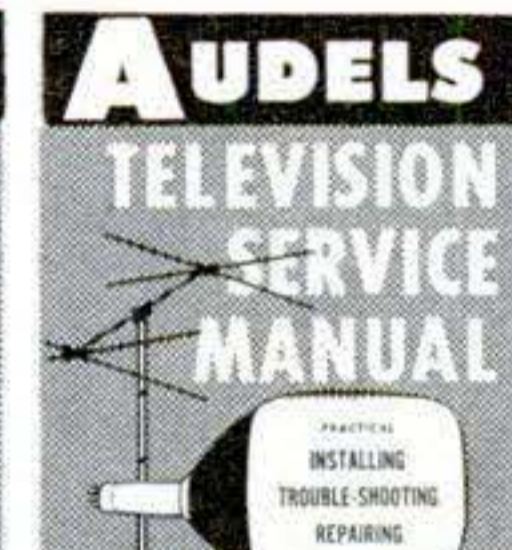
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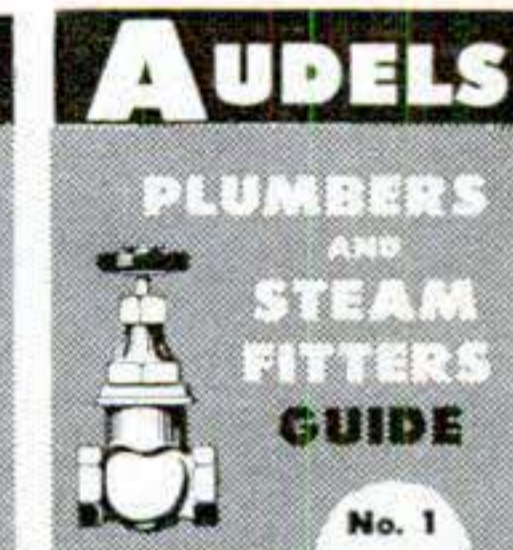
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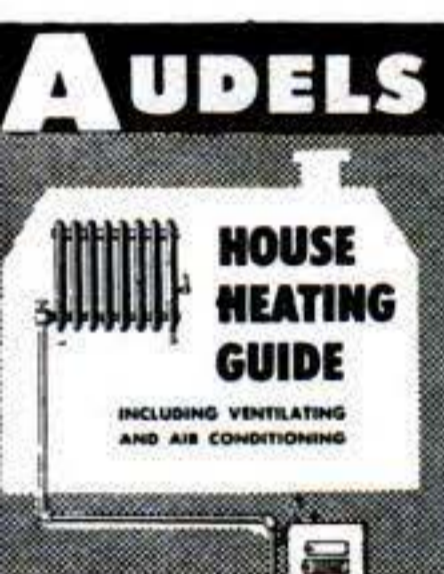
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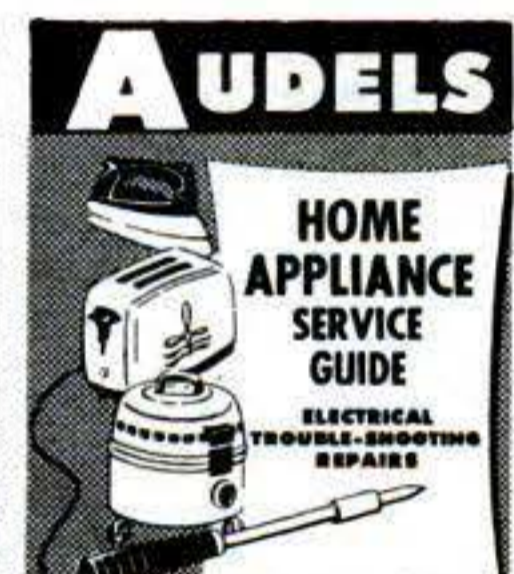
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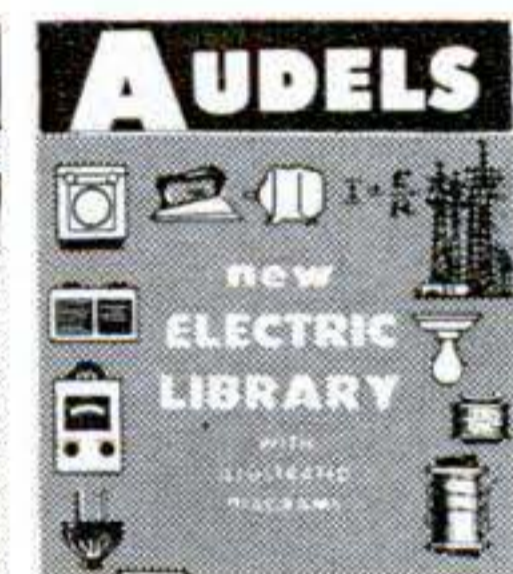
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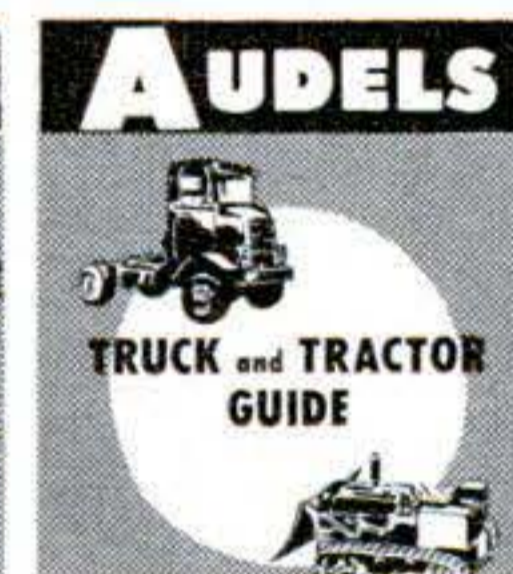
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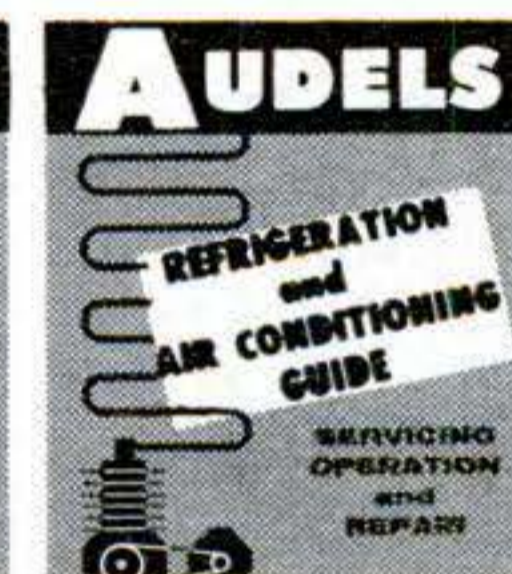
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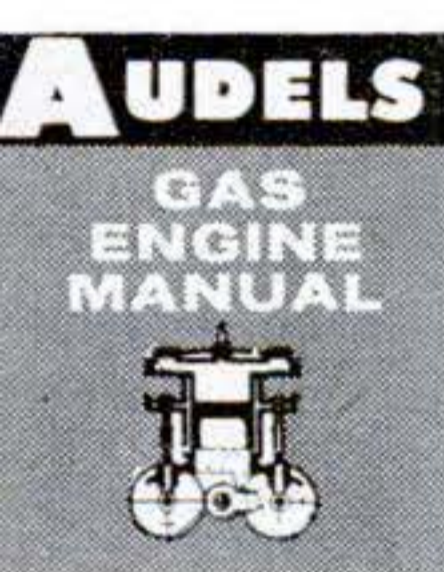
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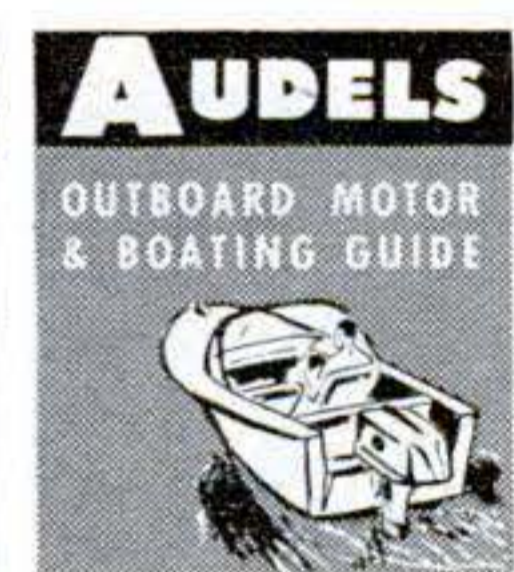
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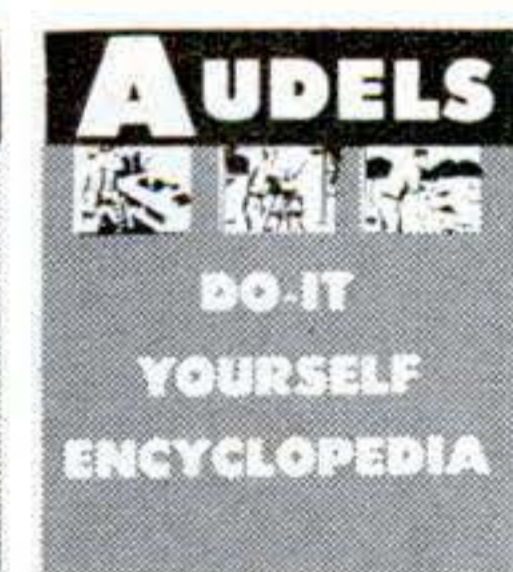
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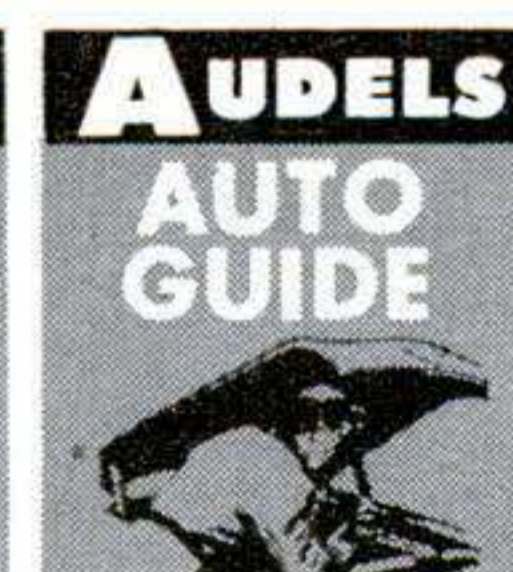
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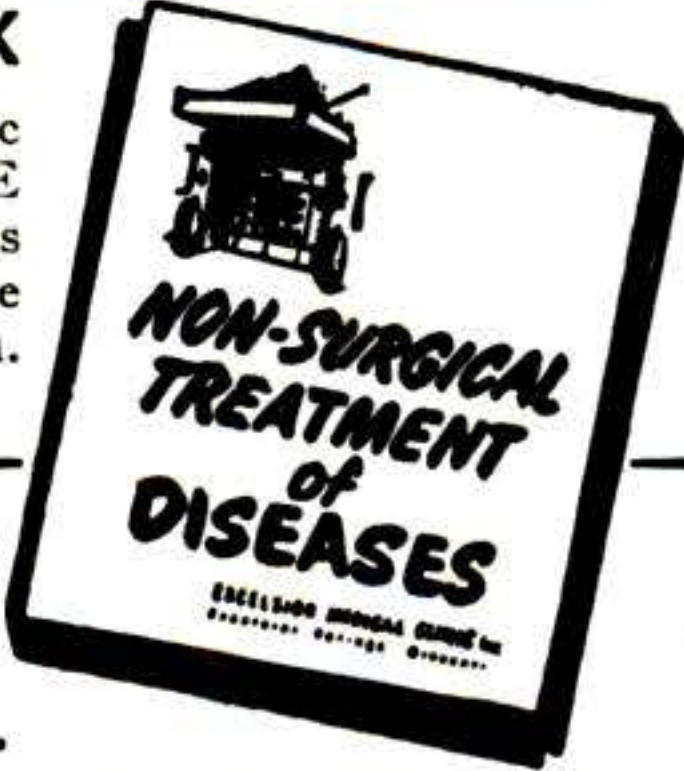
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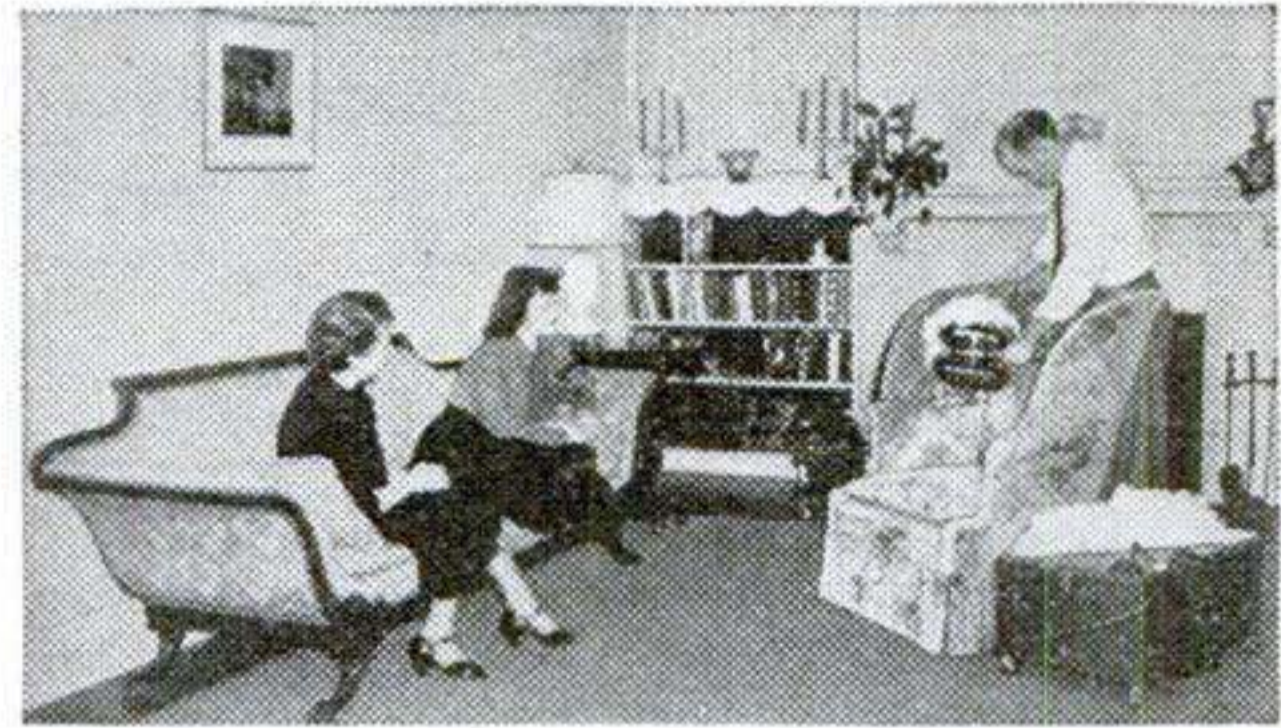


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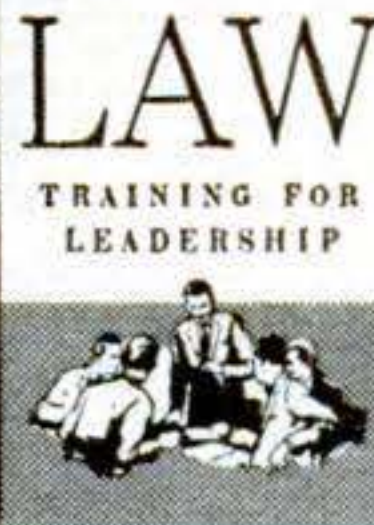


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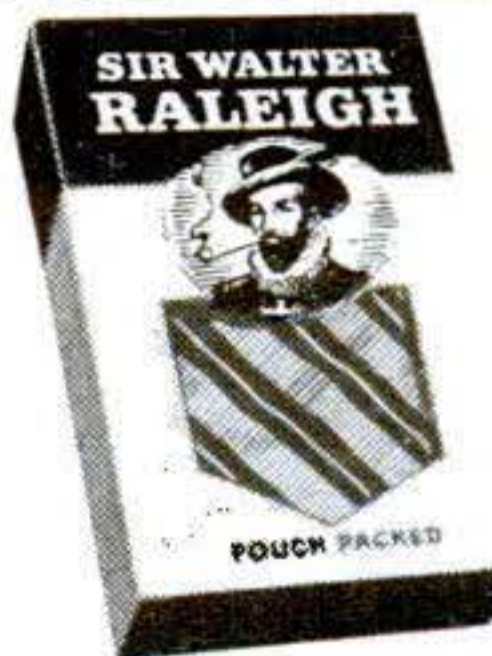
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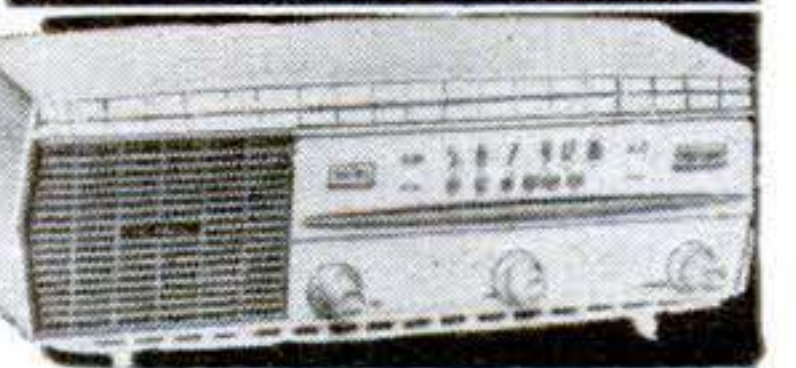


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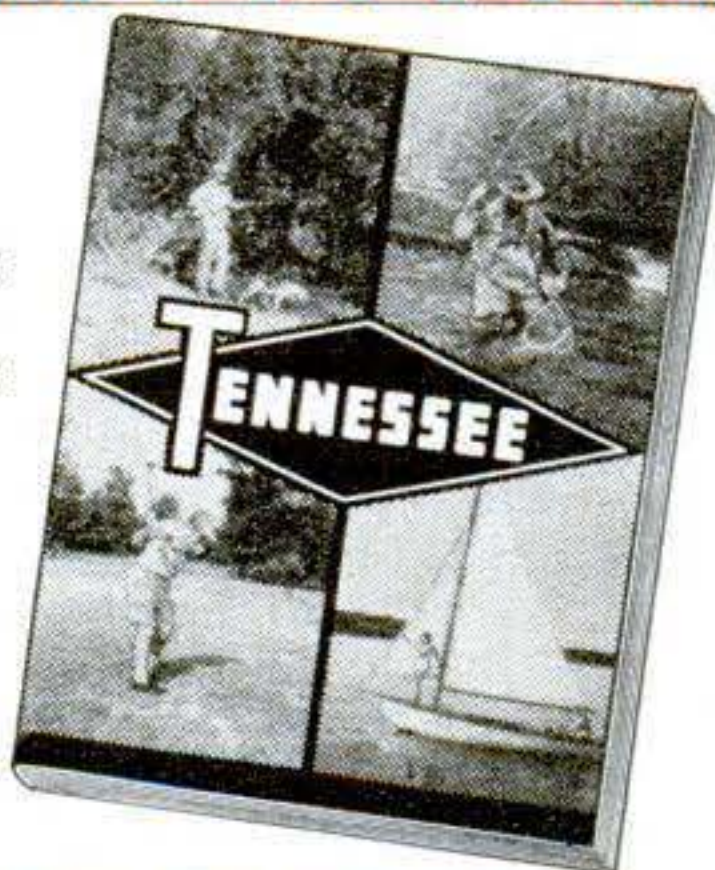
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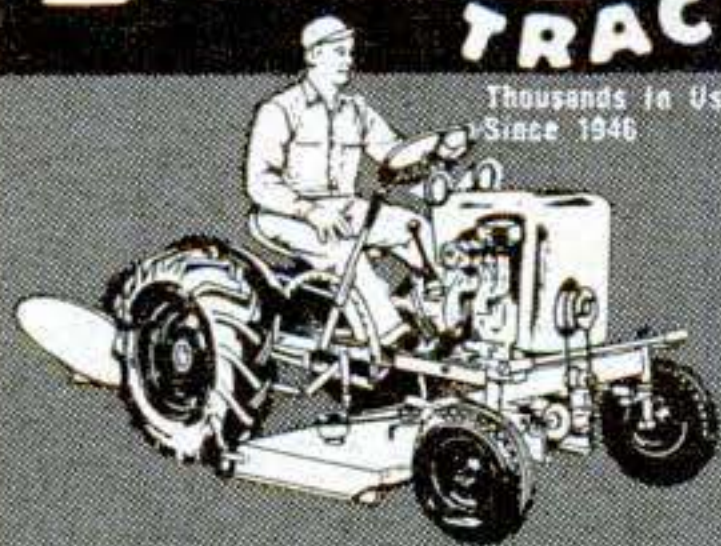
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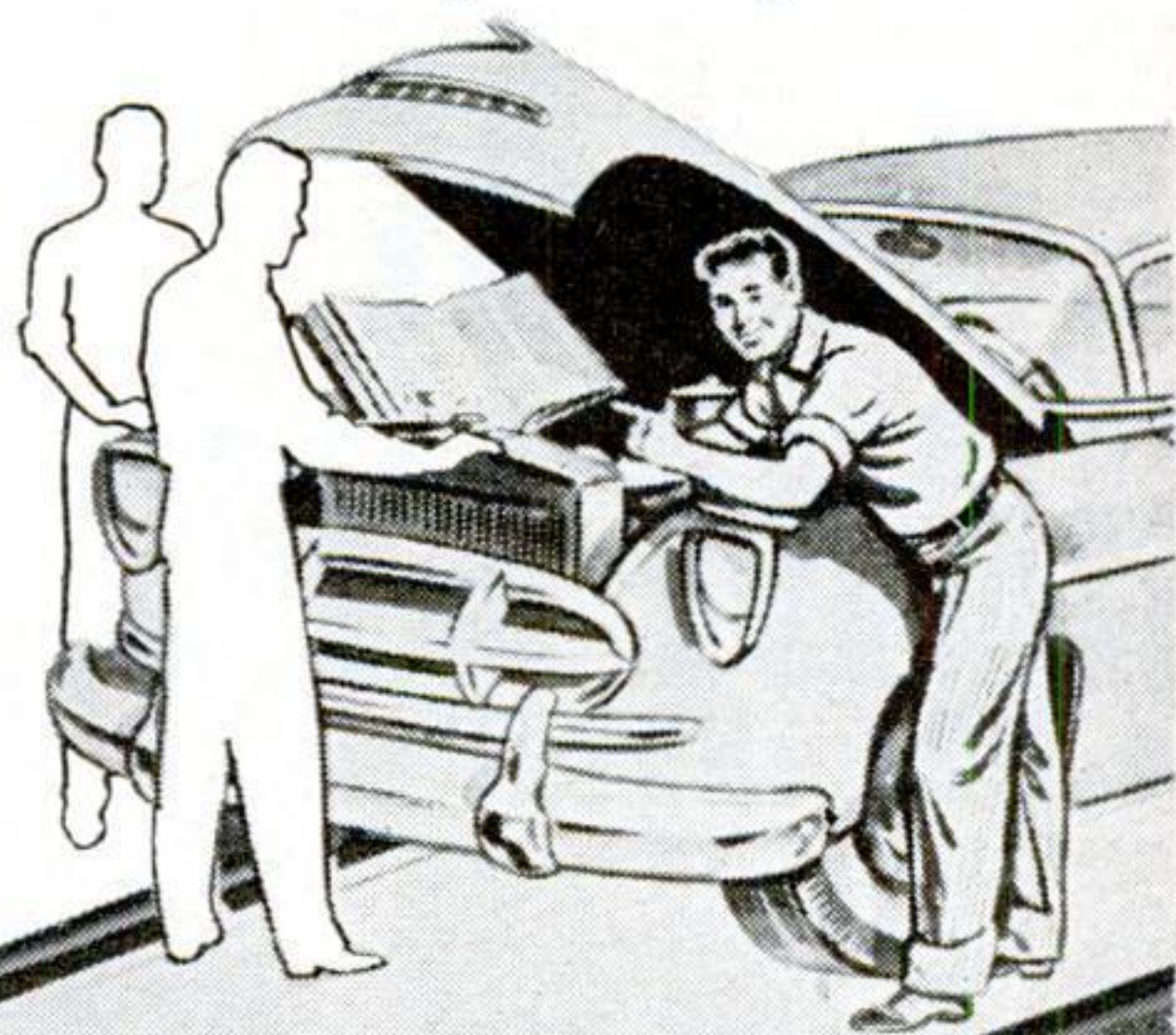
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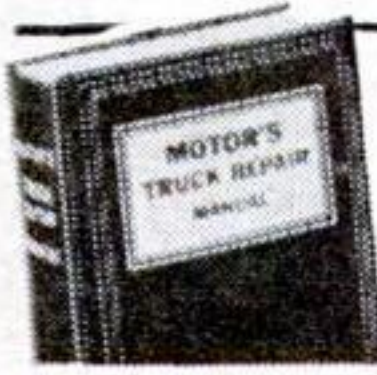
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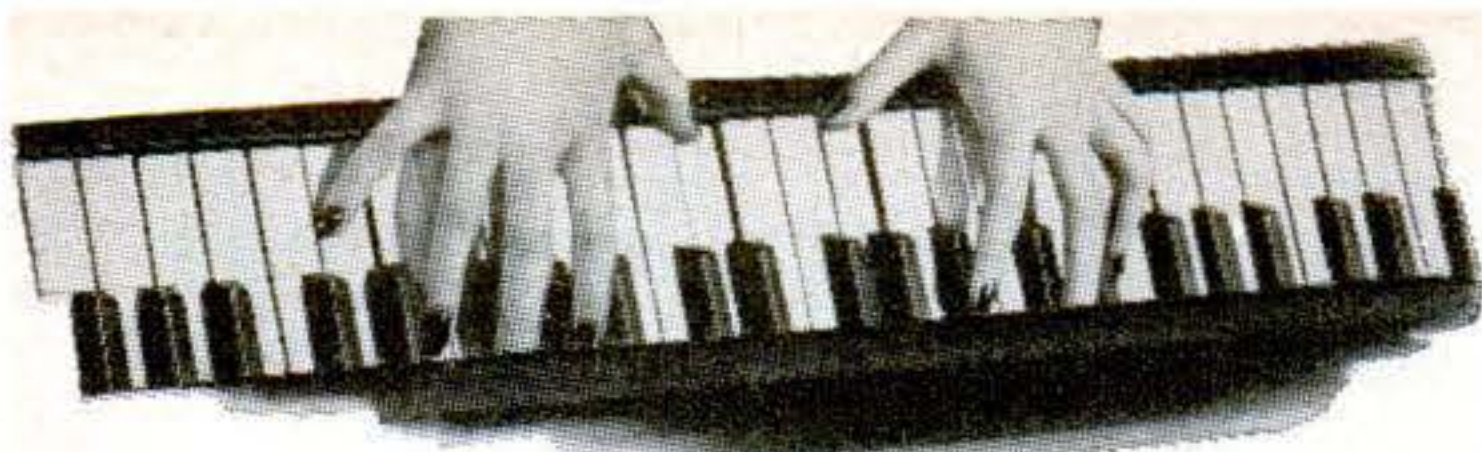
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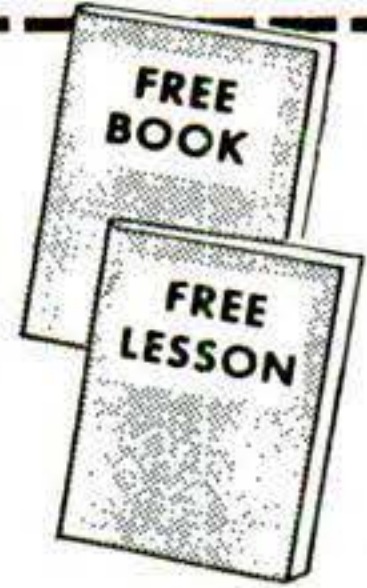
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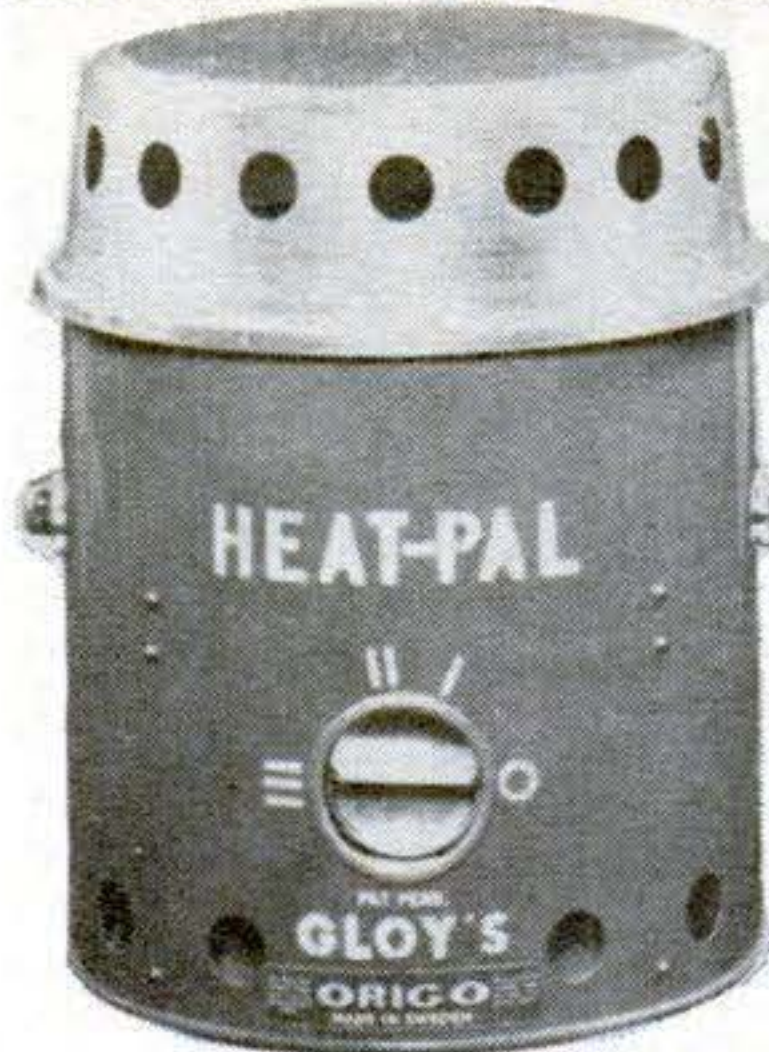
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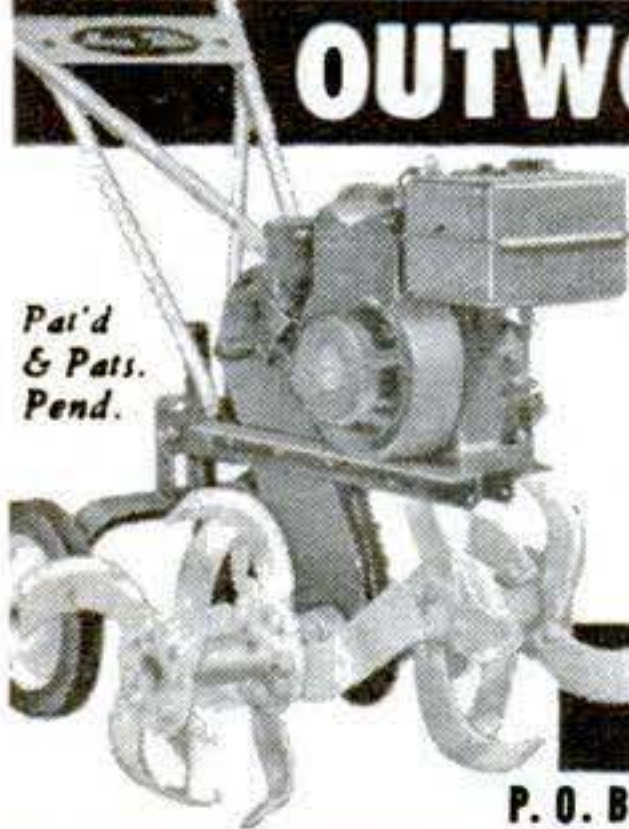


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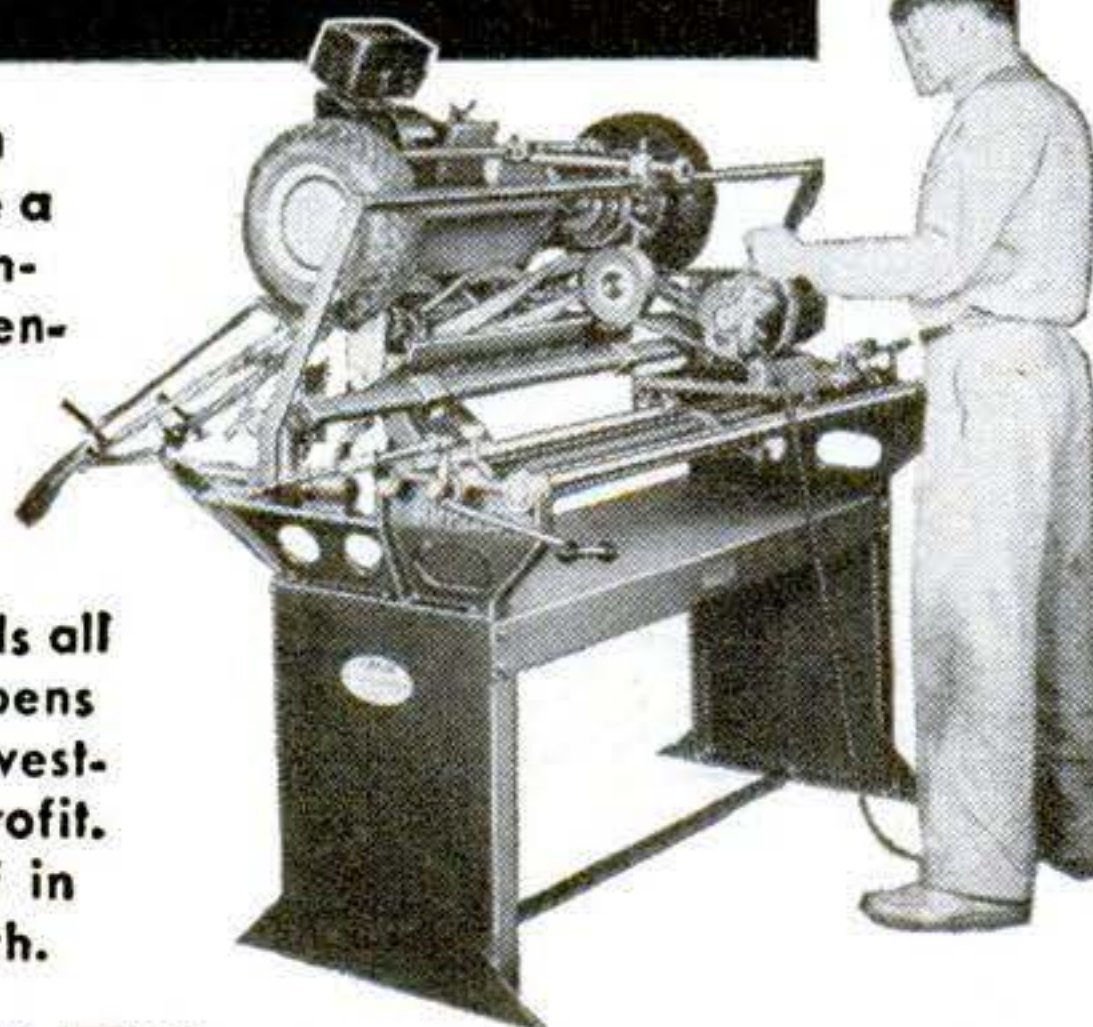
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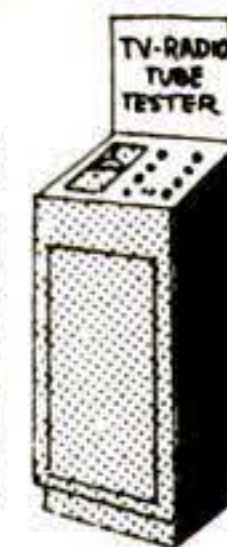
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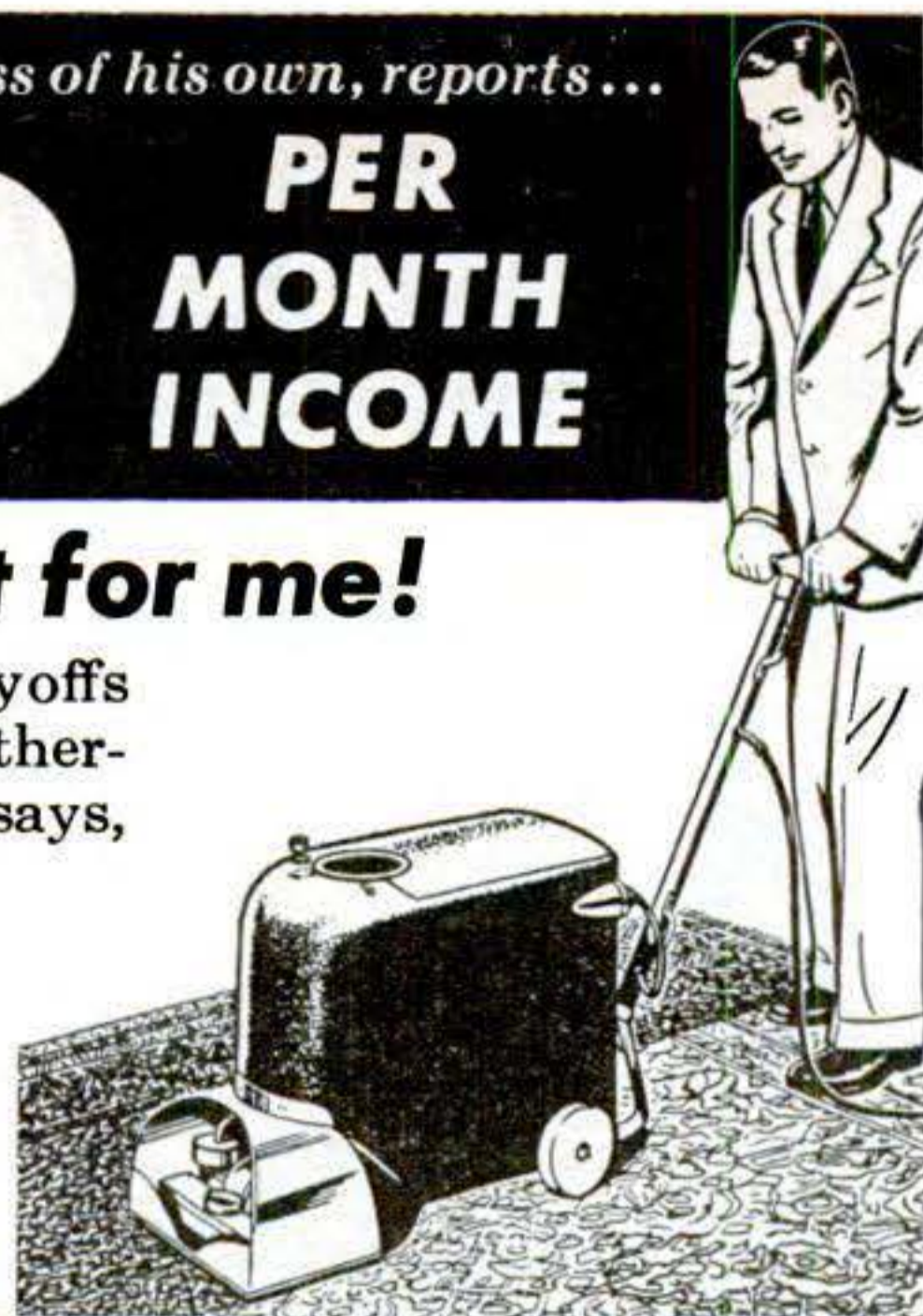
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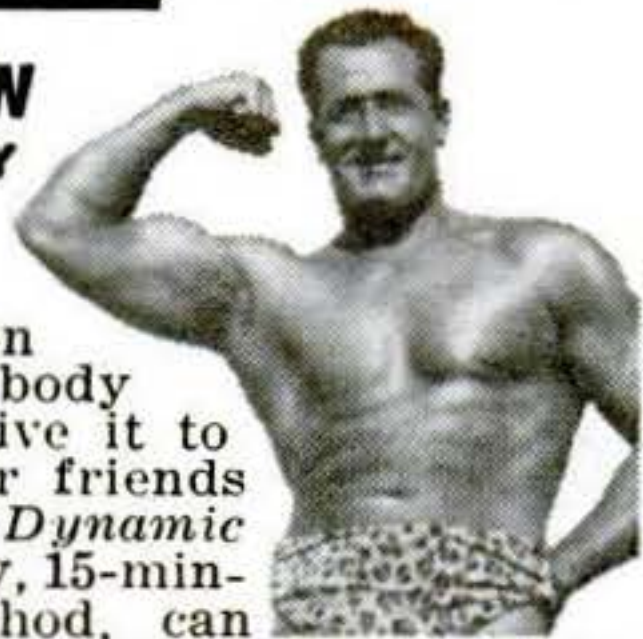
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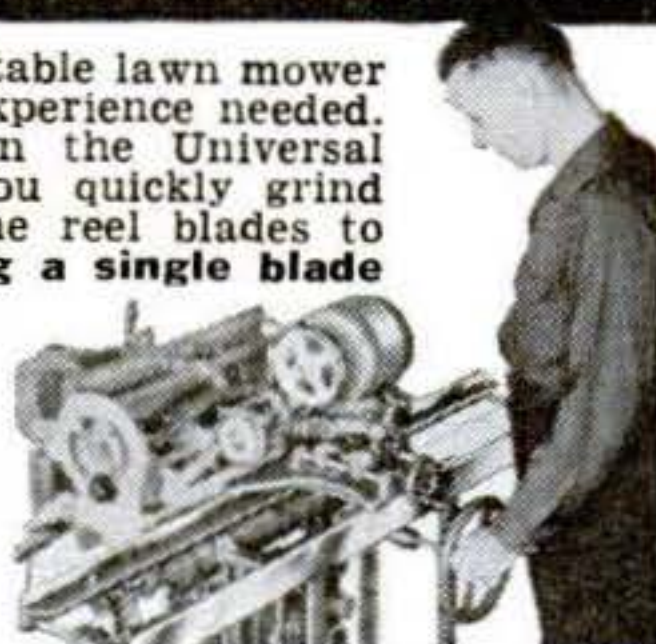
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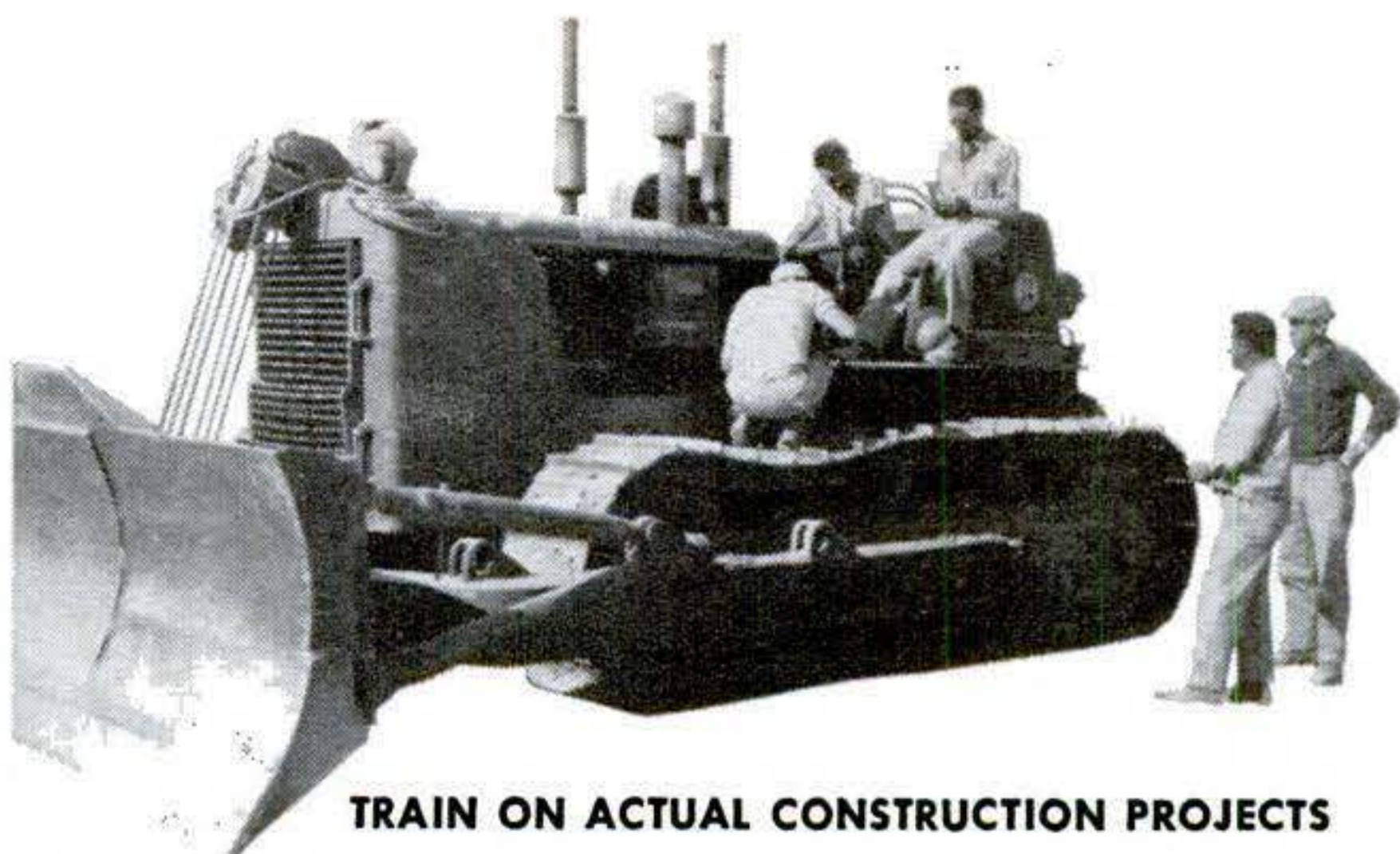
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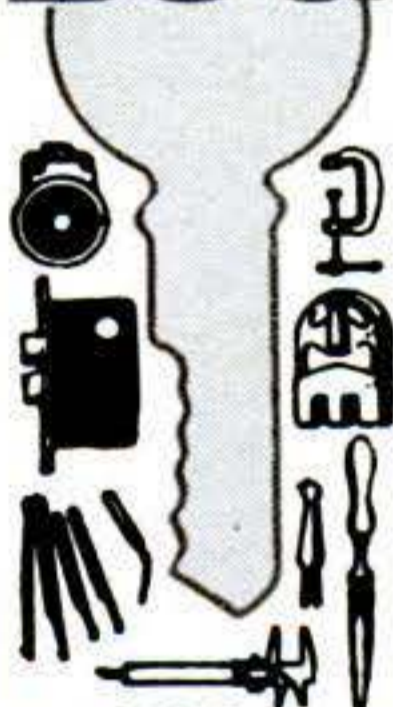
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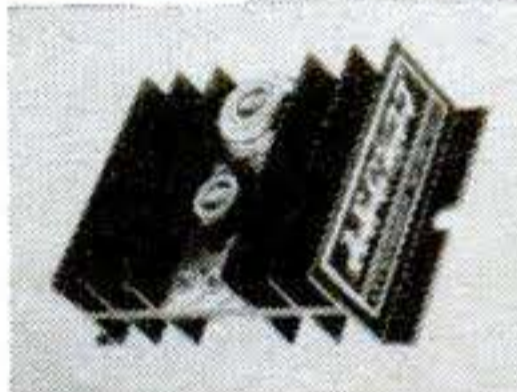
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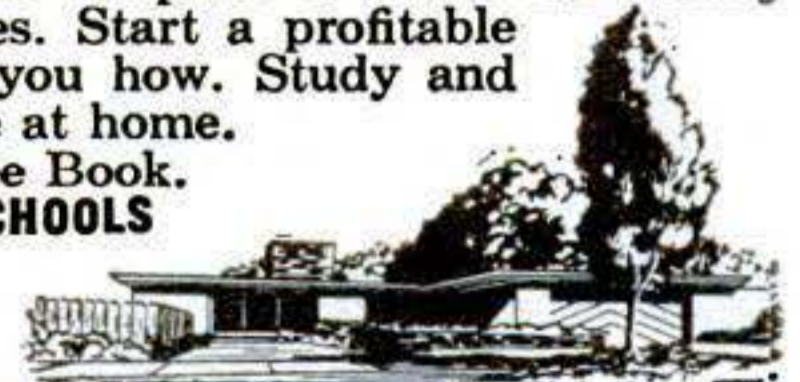
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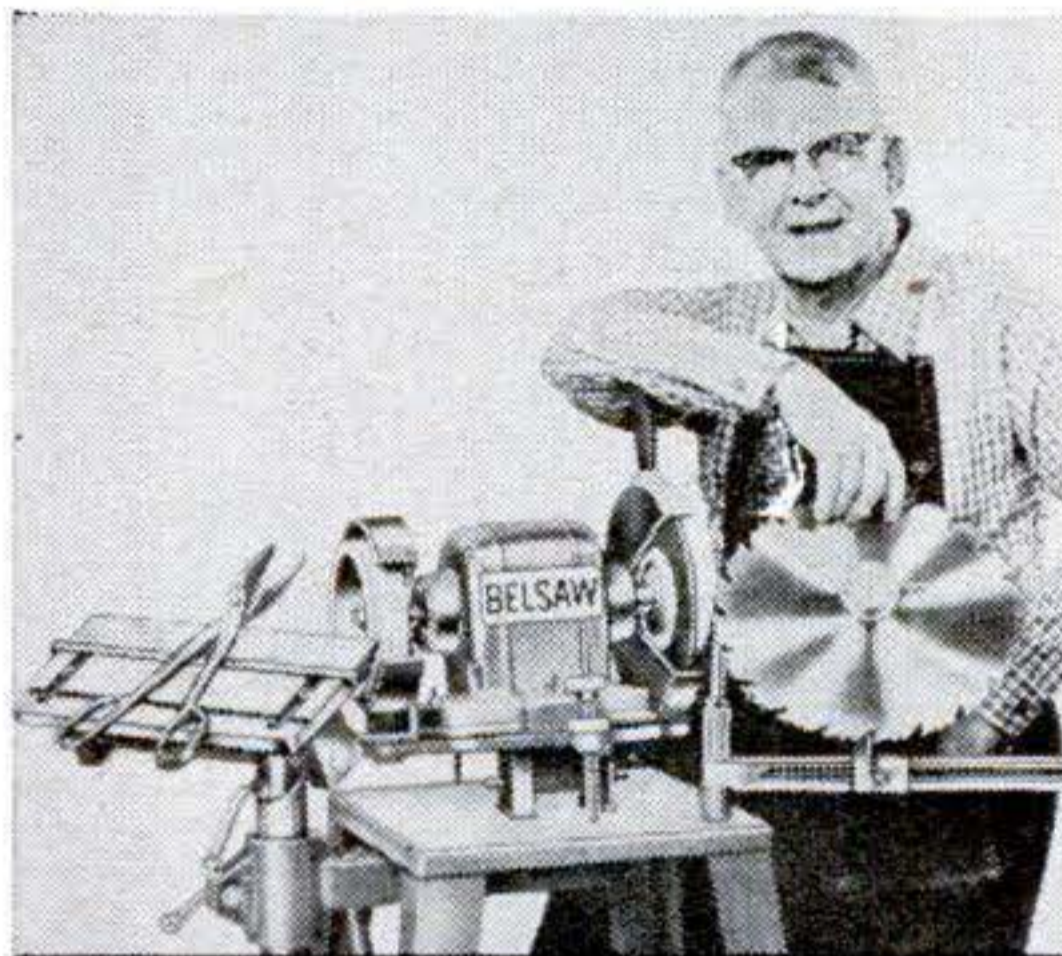


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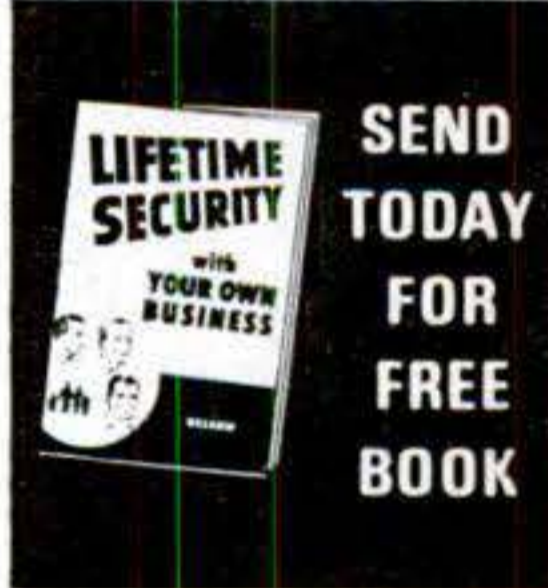
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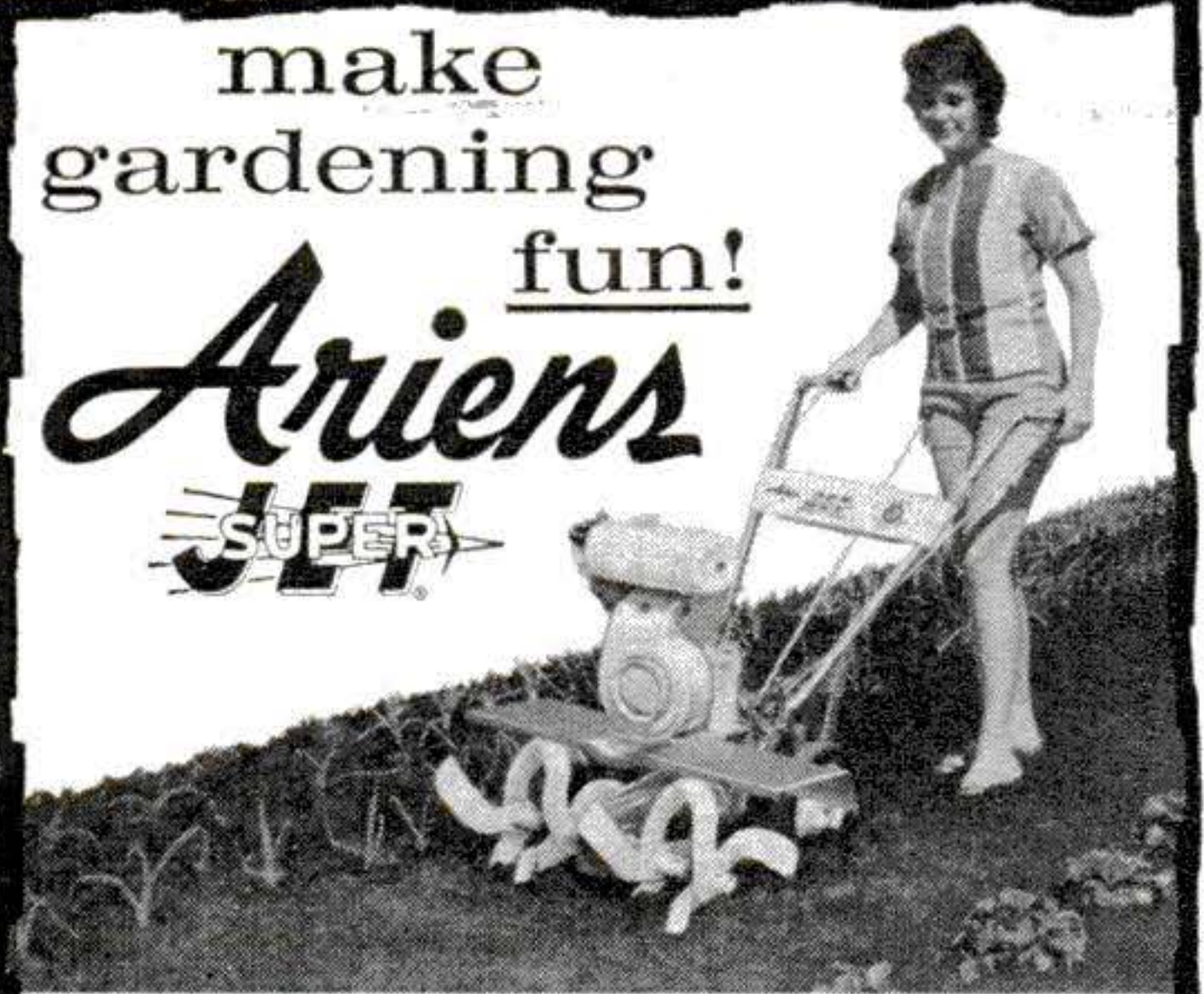
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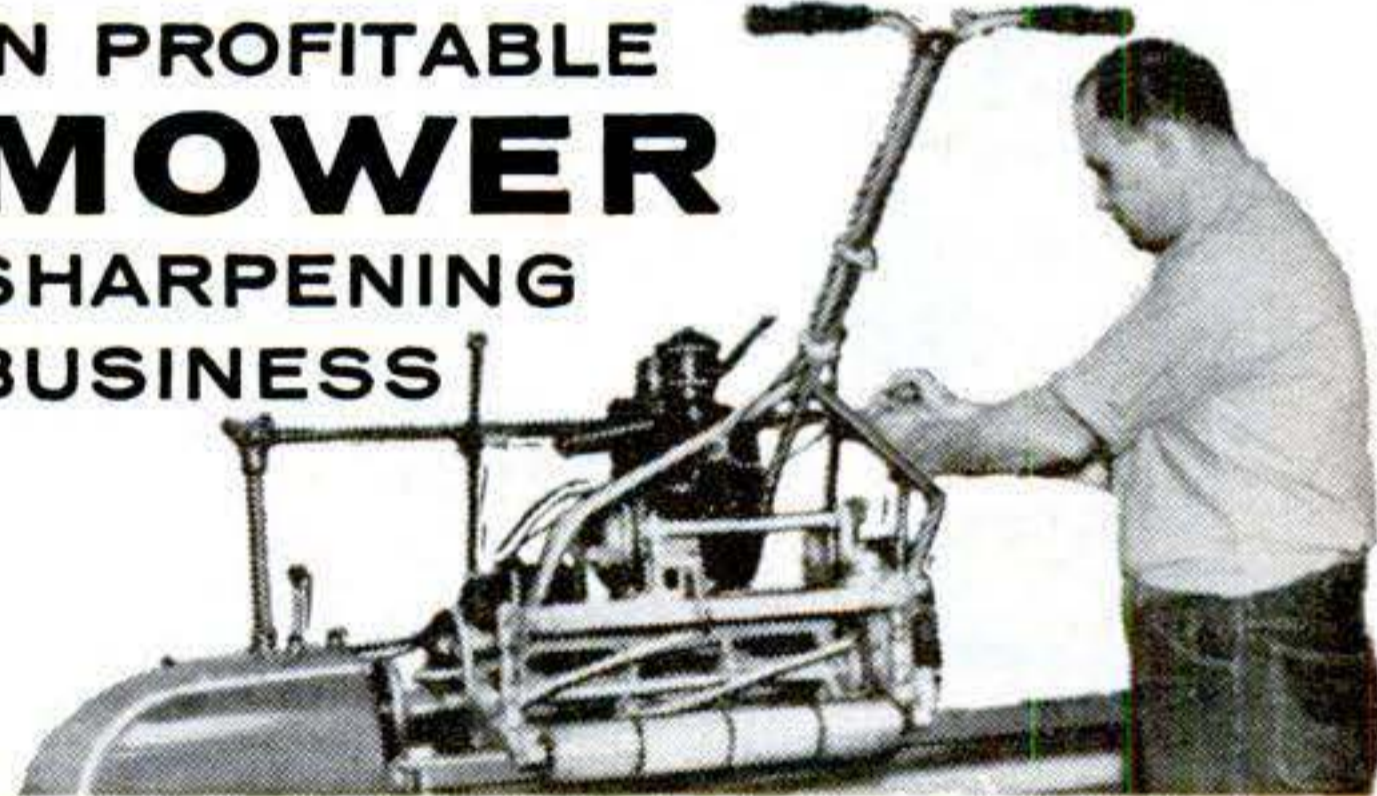
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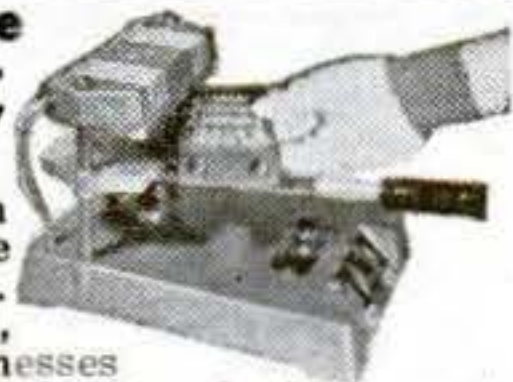
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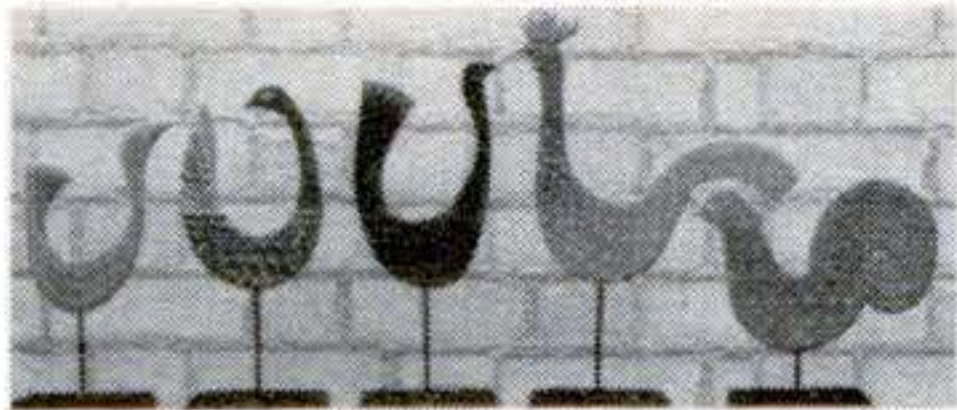
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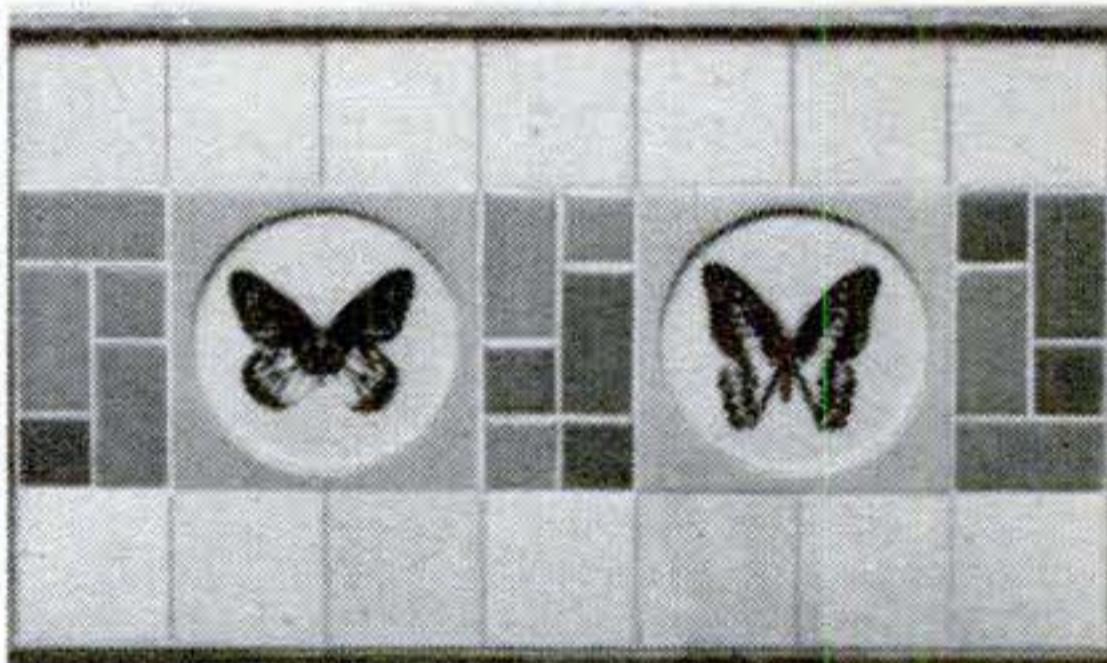
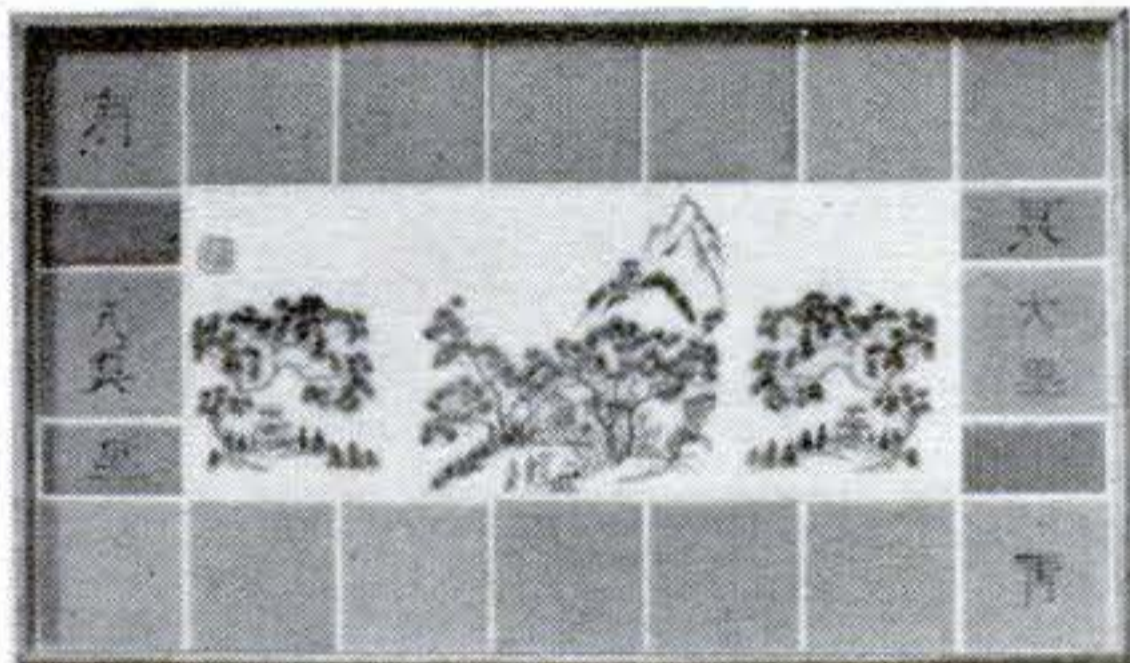


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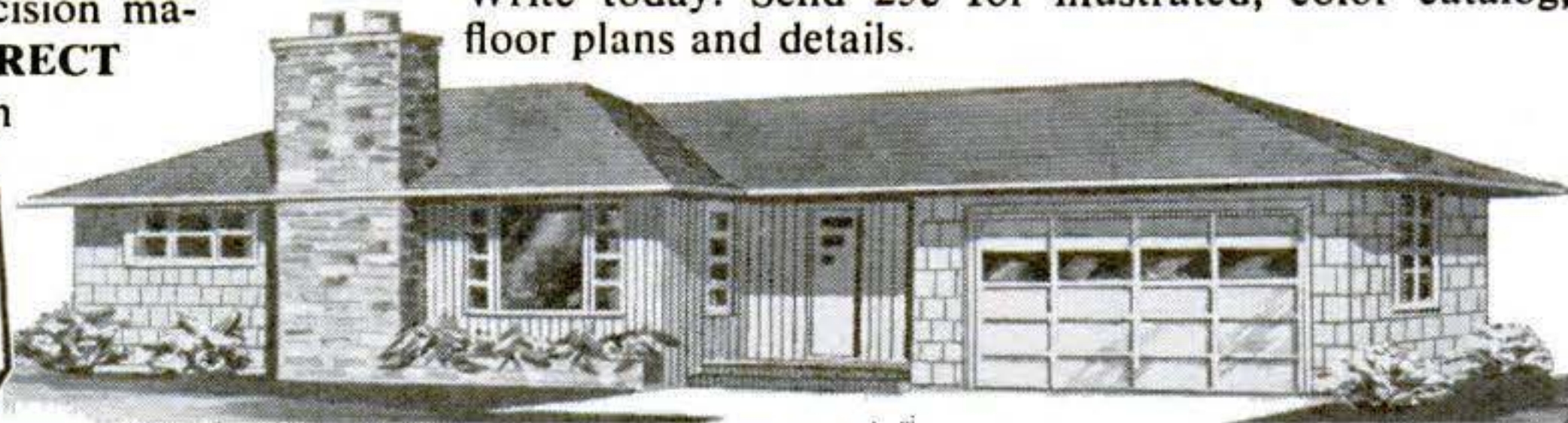
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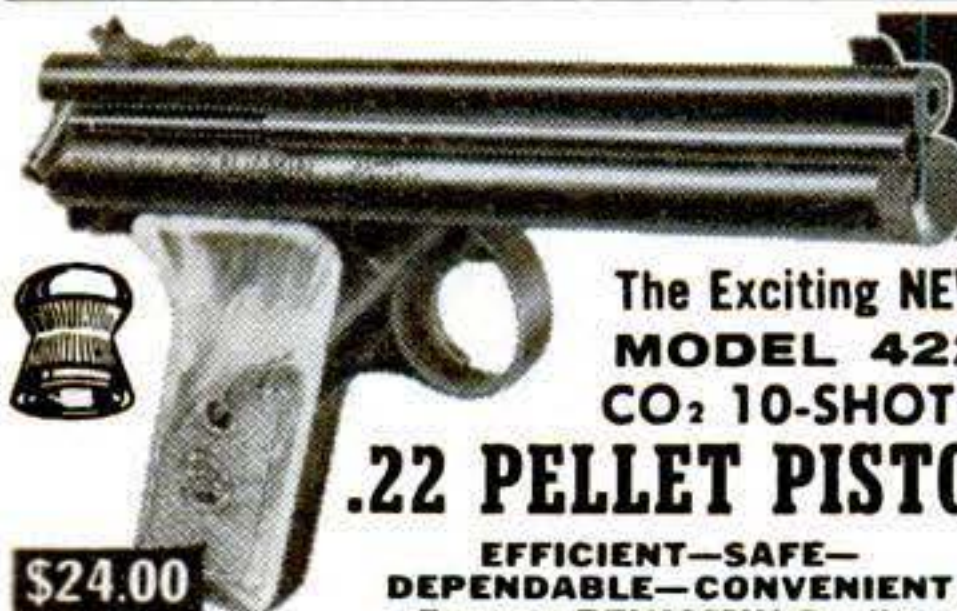


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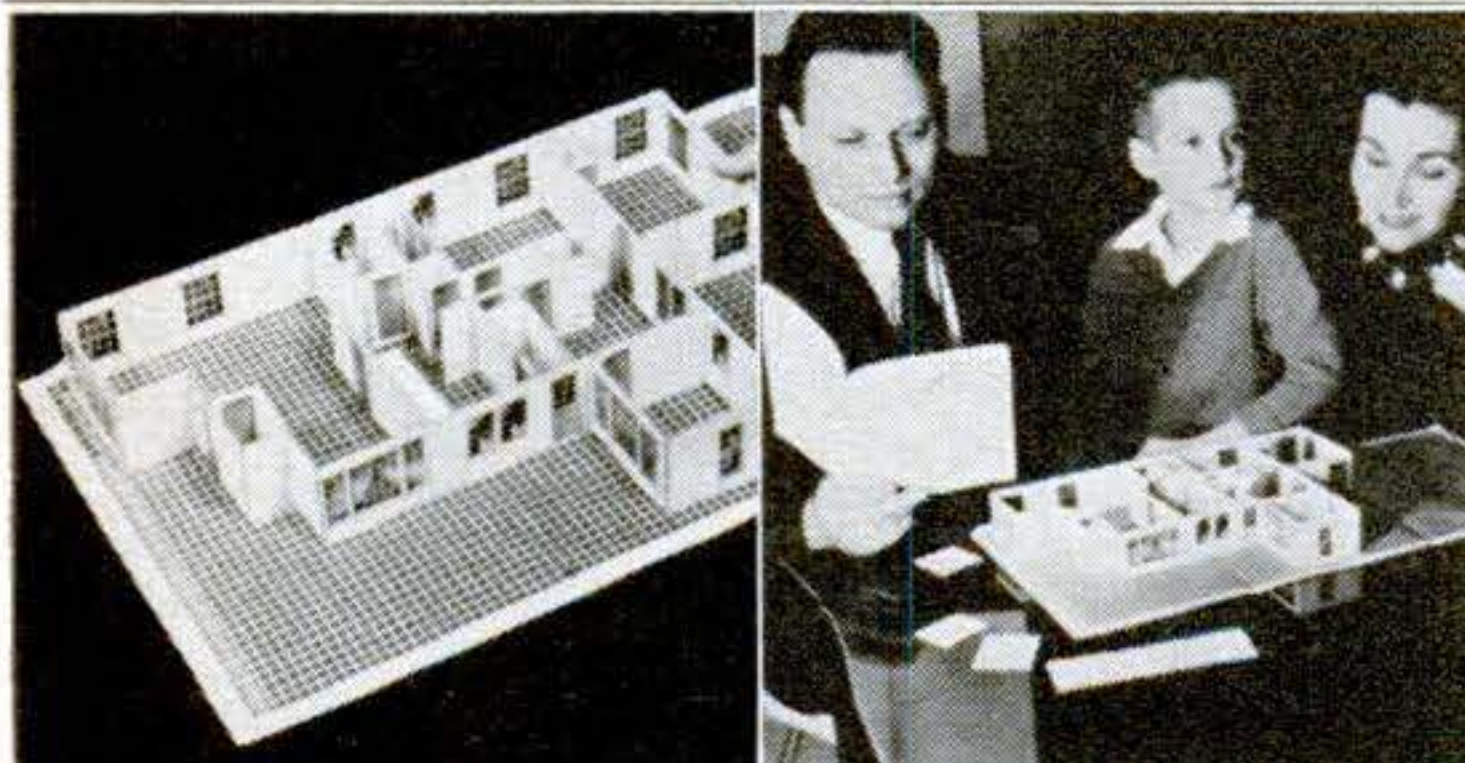
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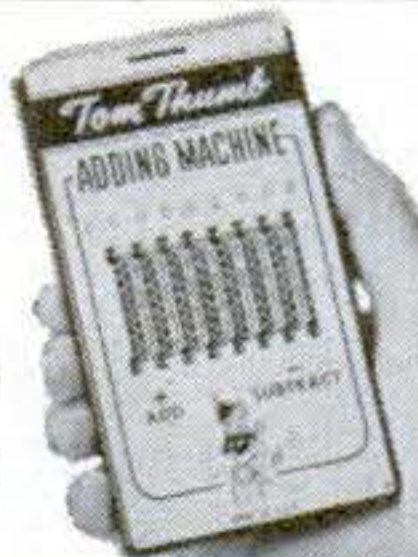
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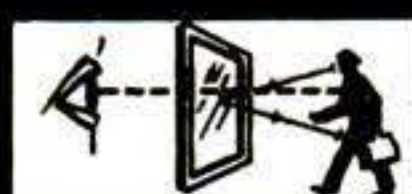
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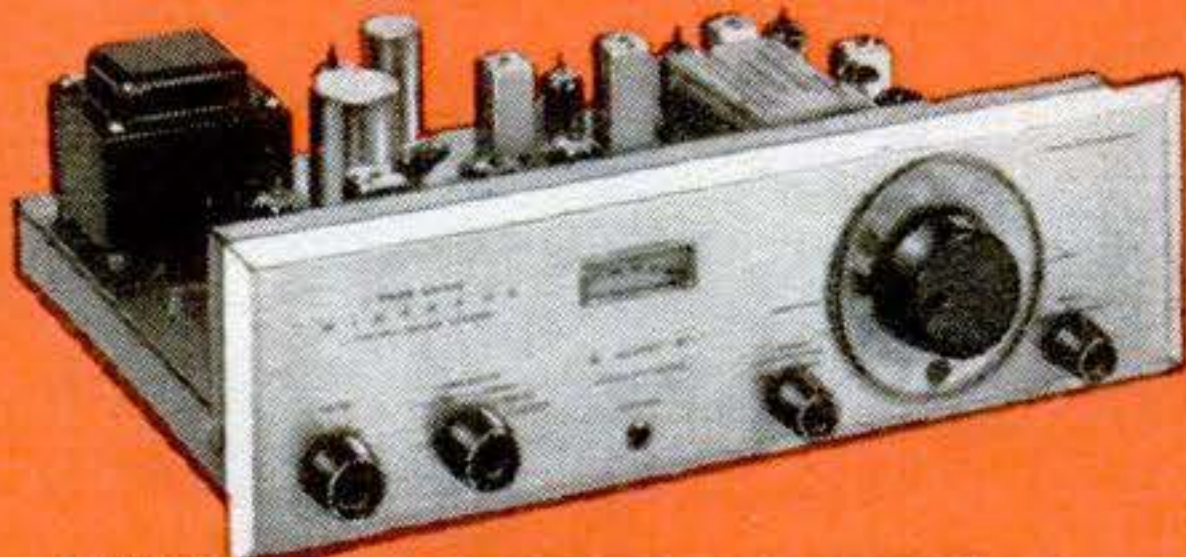
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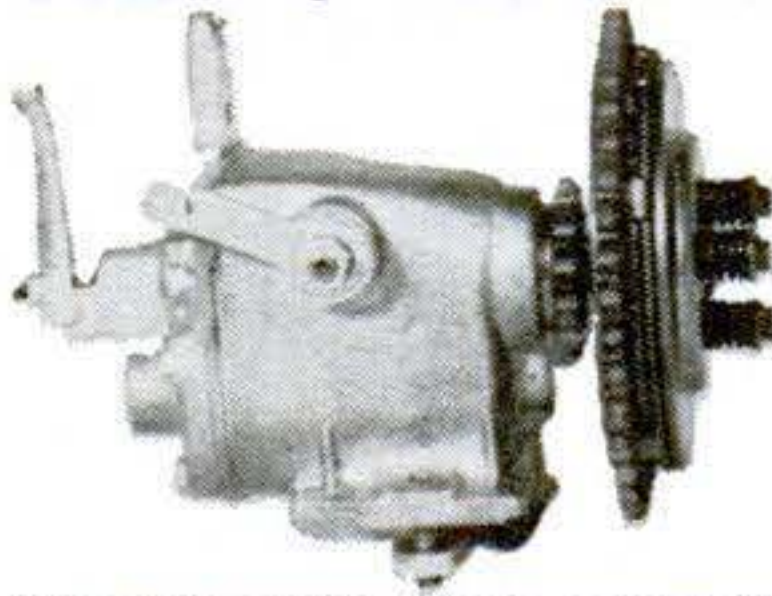
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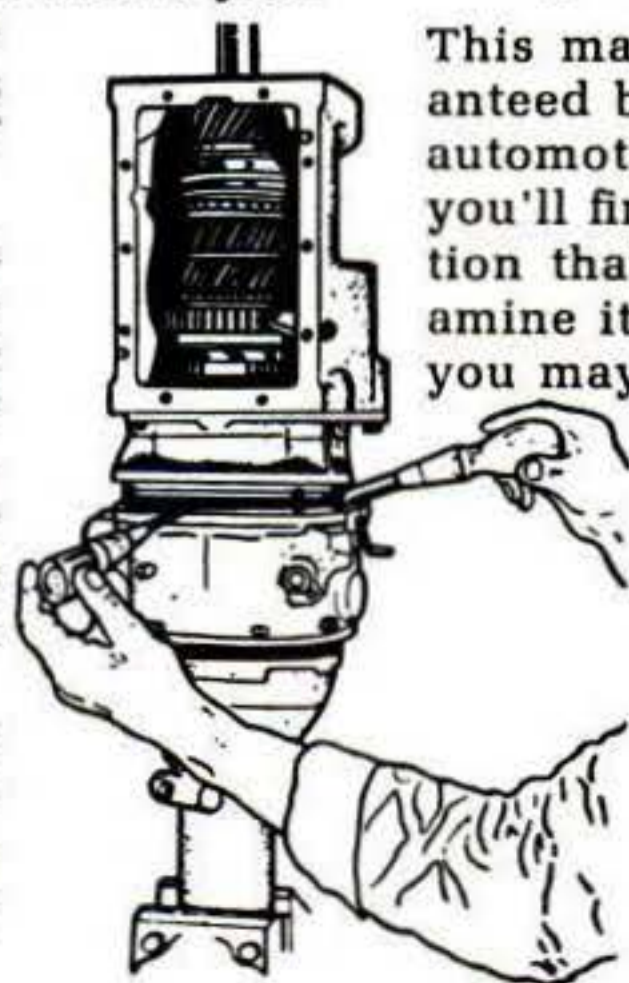
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DEALERS—AGENTS WANTED

Detroit report

By Devon Francis

Fiber-glass woes

If you have your heart set on an Avanti or a Corvette, you may have a long wait. Neither Studebaker nor Chevrolet can produce fiber-glass bodies fast enough.

At Studebaker, the shortage is so severe that the company has set up a new assembly line in South Bend.

The big problem is assembly. As one factory man said, "You can't stick a two-by-four in a fiber-glass door and spring it into shape." This is done in fabricating sheet-metal bodies. But not with fiber-glass; parts have to fit perfectly the first time.

Chevrolet's problem: The new Stingray Corvette is just too popular. A 300-400-percent increase in sales over last year is building up.

The situation is happier with individual body parts; plastics are still moving into the industry like gangbusters. At least one model of the 1964 Rambler line may have a hood made of a tough plastic already used in instrument panels and consoles.

Ford has announced fiber-glass body parts for the Galaxie—primarily for competition, when such parts are not prohibited. They include front fenders, hood, outside door panels, and deck lid. Saving, with other options: 160 pounds.

Still fighting smog

Anti-air-pollution devices may cost you still more money when you buy your next new car. Buyers of 1963 cars are already paying for positive crankcase ventilation—a device that channels blow-by gases from the crankcase back to the engine. The latest word is that California may require exhaust purifiers on all new cars by the fall of 1964. Several such devices are being tested. They should

be considerably more expensive than crankcase purifiers.

Another step planned in California is to require all used cars put up for sale to have positive crankcase ventilation by 1964.

Flexible glass

Nothing has excited Detroit engineers recently as much as that new type of glass developed by Corning. It looks just like tempered glass, but it's five times stronger. Result: The glass can bend and flex without breaking.

The new glass will simplify installation of curved side windows. The expensive and space-consuming mechanism for rolling down curved windows won't be needed, since the window can be withdrawn into a straight part of the door. Another advantage: Thinner, lighter-weight glass can be used.

Motorists in orbit

The average motorist driving along a crowded freeway is more tense and nervous than an astronaut in orbit. These were the findings of the Hughes Aircraft Co., developers of a device that electronically measures heart beat, respiration, and galvanic skin response—an accurate barometer of tension. Some traffic situations, it was found, are more frightening than blastoff from a launching pad.

The device will be worn by astronauts to record emotional condition in flight.

Better brake fluid

The new government standards for brake fluids, which become effective in March, will be tougher than the SAE standards now generally accepted by the industry.

A fluid that is to be sold in interstate commerce must meet minimum specifications for boiling and flash points, viscosity, acidity, stability at high temperatures, corrosiveness, fluidity at low temperatures, evaporation, water tolerance, compatibility, effect on rubber, and resistance to oxidation.



Cleans itself 2,000 times a minute

What Every Driver Should Know About the Spark Plug That Cleans Itself While You Drive. How does an Autolite Power Tip Spark Plug clean itself while you drive? Simple. The electrode or firing tip of a Power Tip spark plug is longer than usual. This extra length puts the firing tip deeper into your engine's combustion



chamber. The tip soaks up the heat of the exploding gasoline. Enough heat to actually burn away fouling deposits while you drive. That is how Autolite Power Tip Spark Plugs stay cleaner, longer than ordinary plugs to keep your power and mileage at their peak. Try a set and see. Autolite Power Tip, the spark plug that cleans itself while you drive.

PRODUCTS OF  MOTOR COMPANY

SPARK PLUGS • BATTERIES • SERVICE PARTS
 **AUTOLITE**
 THE NAME TO REMEMBER WHEN YOU CARE FOR YOUR CAR

1873 "In his chapter on the special expressions of animals, Mr. Darwin writes,

"The lips of young orangs and chimpanzees are protruded, sometimes to a wonderful degree, under various circumstances. They act thus, not only when slightly angered, sulky, or disappointed, but when alarmed and even when pleased. But

the degree of protrusion is not the same in all cases. The drawing represents a chimpanzee made sulky by an orange having been offered him and then taken away. A similar protrusion or pouting may be seen in sulky children."

"In his evidence before the Royal Commission on the water-supply of London, Dr. Parkes states that where the population of any town shows a considerable amount of diarrhoea, and also of typhoid fever, it would lead him to suspect the water-supply; for the health of the population seems to be very much influenced by the purity or impurity of the water consumed."

1903 "If we take those men who have most attracted the eyes and ears of the world, we have a definite group which we can analyze. We have examined six biographical dictionaries and encyclopedias—two English, two French, one German and one American—and noted the men in each who were allowed the longest articles. Then the men who appeared in at least three dictionaries were selected and, from these, the thousand who were allowed the greatest average space.

"According to this list the 10 most eminent men in order are Napoleon, Shakespeare, Mahommed, Voltaire, Bacon, Aristotle, Goethe, Caesar, Luther, and Plato."

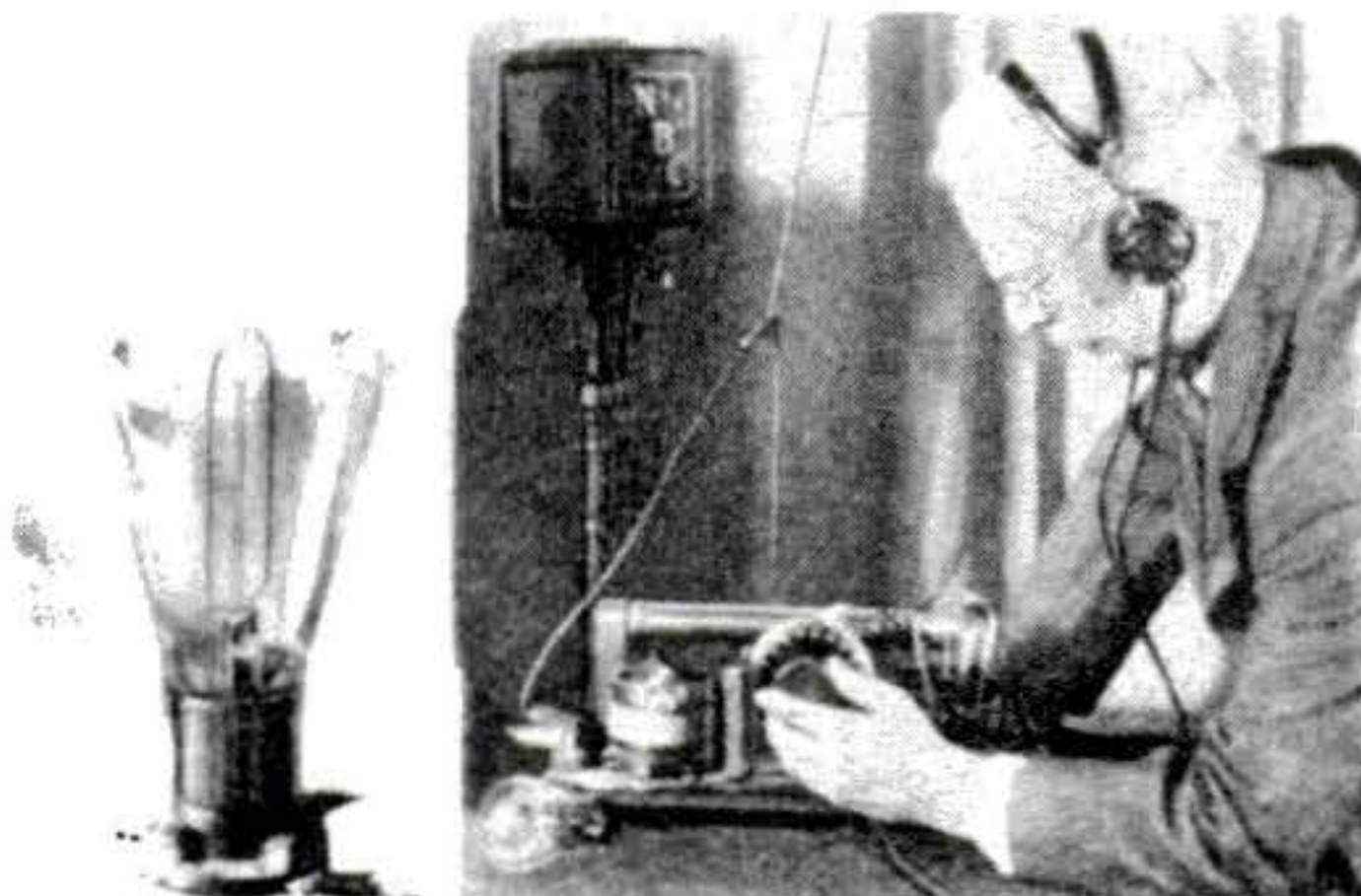
"According to the census report of 1900, there were 111,000 deaths from tuberculosis during the year 1900. This does not,

however, include the deaths in certain states in which the vital statistics are incomplete, and it is probable that there are at least 145,000 victims of the great white plague annually within the limits of the United States.

"The last census return in those states where registration was approximately correct shows that 12 percent of all deaths resulted from pulmonary tuberculosis, 8½ percent from pneumonia, 3 percent from typhoid fever, and 3 percent from diphtheria and croup."

1933 "A blast of dynamite echoed at noon recently through the Colorado River valley near Boulder City, Nev. The blast opened an epic battle between men and nature—the turning of the great river from its channel to clear the way for building Hoover Dam. Five thousand shots of dynamite choked the river channel with debris from the cliffs around the dam site. Dump trucks hurled load after load into the stubborn river to seal the barrier. At three in the morning, the men rested beneath floodlights, exhausted with their fifteen-hour fight—but it was won."

"A vacuum tube was devised by Thomas A. Edison long before wireless sets were dreamed of. Proof of its ability to pick up a modern radio program was given the other day at a New York broadcasting studio. Music was tuned in on a receiving set using a faithful copy of Edison's original tube, with a curved filament of carbonized bamboo and a plate formed of two upright wires."





Wherever toughness counts, in axles, frame or springs... count on new

'63 FORD PICKUPS

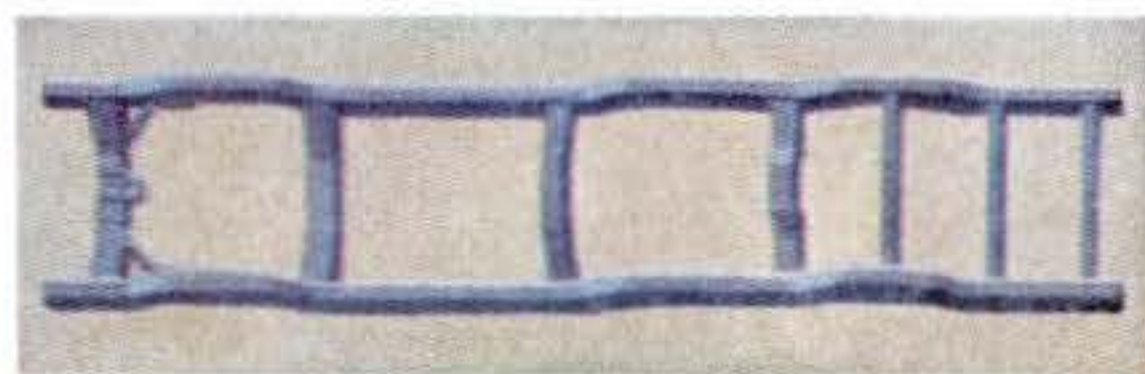
...BUILT LIKE THE BIG TRUCKS



No "Knee-Knocker." Ford doors open wide with no annoying "dog-leg" to get in your way. Custom Cab offers 23 lbs. of insulation for a quiet, relaxing ride.



Tough I-Beam Axle—the same design as big trucks! Maintains front-end stability... keeps front wheels tracking true for longer tire life!



Parallel-Rail Frame gives Ford pickups that same kind of rugged backbone that's used in the biggest trucks! See the '63 Ford pickups today!

A new Ford pickup may ride like a car, but there the likeness ends—everything else is truck-tough...*big-truck-tough!* From axle to axle, Ford builds pickups like big trucks for extra durability and reliability, and for lower operating costs!

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For
**Outstanding
Reliability &
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New 75 hp Sea-Horse
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Meet water skiing's 5-Star Admiral!

Shifts automatically, electrically! Most responsive outboard ever built!

Want blistering pick-up for skiing? Want big dig for big loads? Trust this new 75 hp Super Sea-Horse V-engine. Revolutionary new electric clutch engages automatically in a split-second . . . makes this the most responsive outboard ever built! Other features: 20-ampere alternator-generator; 5-way super-silencing; a healthy 89.5 cu. in. displacement for impressive reserve power and longer engine life. Your Johnson dealer's listed in the Yellow Pages.

See him soon. Other models to check out: the 28 hp "Convertible" and the new Johnson Compacts at 18, 10, 5½ and 3 hp. For free catalog, write: Johnson Motors, 1326 Pershing Rd., Waukegan, Ill., Division of Outboard Marine Corp.

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Exclusive Electramatic Drive

Outboarding's first truly automatic transmission. Unique directional throttle (no extra charge) controls both gas and gears. Makes driving sure, docking easy. Available at 75 and 40 hp.

Color Photos in 60 Seconds

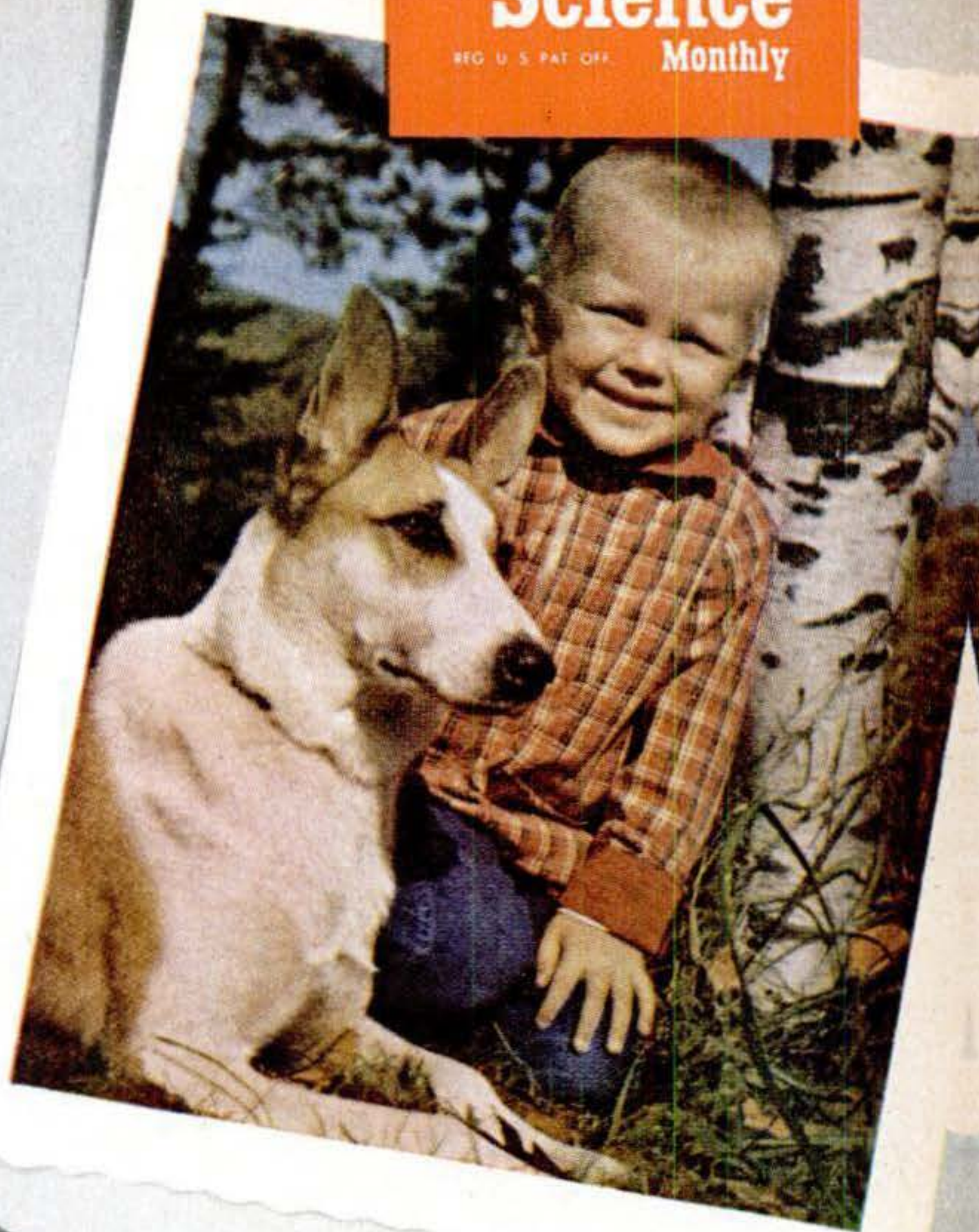
With Polaroid's amazing new film, you can shoot color pix and see finished prints almost immediately

By Bob Hering

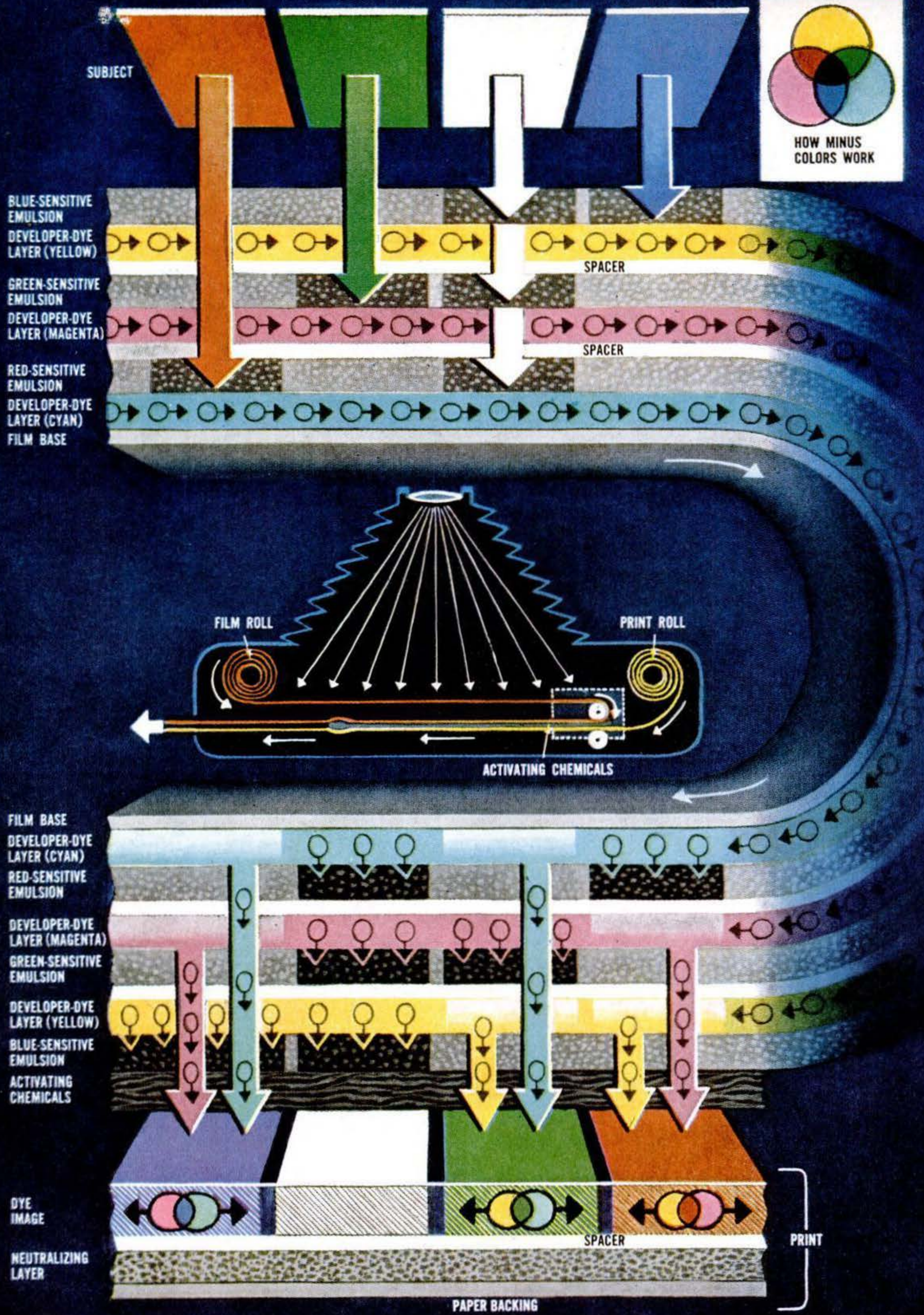
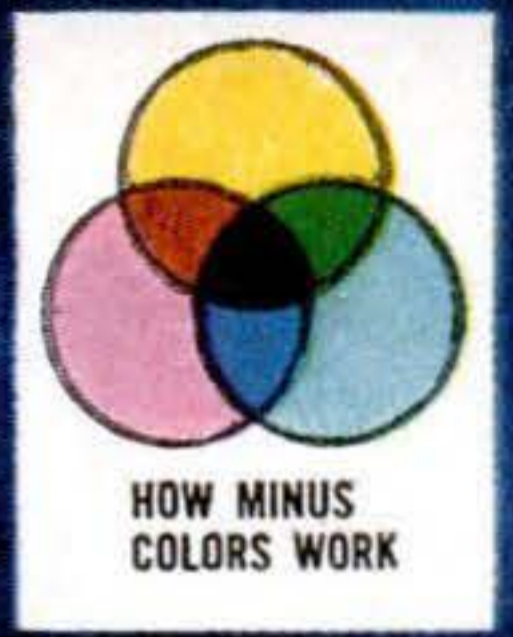
IMAGINE peeling off a finished color print just one minute after you snapped the picture. Unbelievable? We agree. Seeing your subject in a full-color print, 60 seconds after you aimed the camera, is nothing short of magic.

Just shoot the picture and pull the tab. There's a stir of migration as a whole school of linked molecules, each molecule consisting of a special dye and developer leashed together by an inactive atomic thread, begin

**TO SEE HOW THE NEW
COLOR PROCESS WORKS, TURN THE PAGE**



How Polacolor works—from exposure to finished print

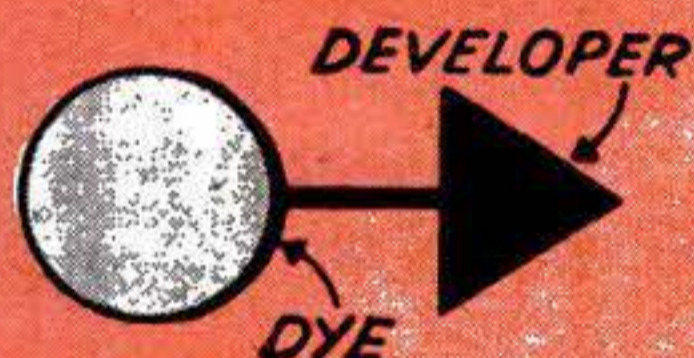


POLACOLOR, like other color films, depends on "minus colors"—yellow, magenta, cyan. Each is the complement of one of the primary colors of white light—blue, green, red; and each *subtracts* its complement from white light. Insert on facing page, at upper right, shows how overlapping minus filters produce the primary colors: Clockwise from top, yellow and cyan subtract blue and red, letting only green light through; cyan and magenta subtract red and green, leaving only blue; magenta and yellow subtract green and blue, leaving red. Black results where three filters overlap. Diagram shows what happens as shutter is clicked. Dotted rectangle over camera is area of full-page diagram.

When you snap the shutter, light from lens is filtered by color-sensitive layers. Green light passes through blue-sensitive emulsion (yellow dye layer) without affecting it, but exposes silver halide grains in green-sensitive emulsion (magenta layer). Red and blue light act similarly in their sensitive layers. White light exposes the grains in all layers.

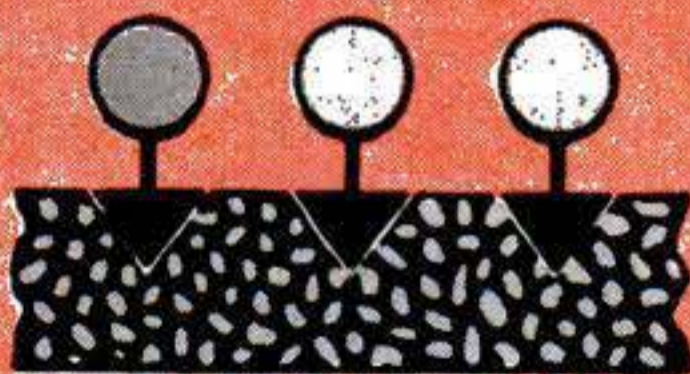


When you pull the film tab, film, print, and processing pod are pulled between a pair of metal rollers, breaking pod and spreading a thin layer of alkaline reagent between film and print. Reagent reaches all layers of film and sets linked developer-dye molecules into motion. Molecules bump into exposed grains, seeking correct ones to develop and be trapped by.



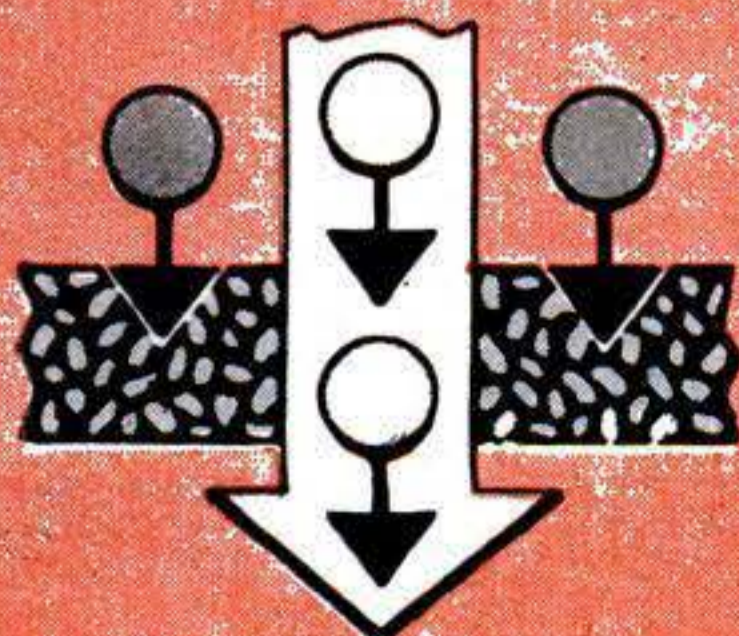
Exposed grains, for instance, in red-sensitive emulsion are developed by, and trap, the cyan developer-dye molecules.

When a developer-dye molecule meets no exposed grains, it keeps moving toward print. It can pass through layers already developed, since silver grains there have trapped as many developer-dye molecules from adjacent layers as they can hold, and will accept no more.



When you look at the picture, you see colors subtracted by the dyes in the print. Dye molecules, having migrated to receiving layer of print, are embedded as layer turns to permanent plastic. But the dyes are minus colors.

The colors you see are formed by white light bouncing off the print's white backing through the dyes' subtractive filtration. Neutralizing layer of acid molecules stops chemical action, stabilizing the colors.



nudging their way down through the negative to the print, making chemical changes as they hurry through the thin layers. Wait 60 seconds, flip open the back, and lift out a full-color print. That's Polacolor, Polaroid's new color film—so new that this report by POPULAR SCIENCE, with pictures actually taken on Polacolor, is the first to appear in any magazine.

The entire process, from exposing the negative to delivering a finished color print, takes place within the camera.

In perfecting this, Polaroid has achieved several extraordinary firsts:

- A finished color print is made outside a darkroom.
- A one-step process replaces the 20-odd steps required in most conventional color-print methods.
- Processing time is cut from 1½ hours to a minute.

Even during the early Forties when Dr. Edwin H. Land, founder of the Polaroid Corporation, was developing the basic process, he dreamed of inventing a one-step process for color. Now, after continuous research and more than 200 patents, the dream is a reality.

To use the new color film in existing Polaroid cameras, the diffusion-transfer technique, employed in the original black-and-white process, was adapted. Polacolor contains everything to make a picture: silver to record the image, a developer to process the film, and dyes to produce a color image.

Two basic requirements were set up early in the program: one, the need in the negative for a dye linked to a developer in a single molecule, so the molecule could control its own diffusion transfer from the negative to the positive; the other, the need for a color-stable positive that needed no coating or washing.

Among the early attempts to invent a one-step color film that would produce finished pictures in the camera, two processes showed promise: a "strip-emulsion" process, and one using "exhaustive color couplers."

The strip-emulsion idea involved laying down microscopic strips of emulsion.

what PS staff thought of Polacolor

“ I tried Polacolor outdoors on a gray, overcast day, with fill-in flash. The results were excellent—even in shadows, under trees, the prints were ‘natural.’ Daylight flash, indoors, mixed with normal room lighting, resulted in prints a little too warm in color, by strict standards—but for family-and-friend use, they were a delight. Processing timing and the other details of use gave no problems.—*John R. Whiting, Executive Vice-President and Publisher (former editor of “Popular Photography”).*

Polacolor is a tremendous milestone in color photography. My picture of the little boy and dog is true in color, although subtle and less exaggerated than we find in some color materials. I found the reds lacking in color saturation and leaning towards the orange side. Skin tones were excellent. Blues were a bit exaggerated. It worked well with electronic flash and flash bulbs.—*Robert D. Borst, Staff Photographer.*

The introduction of Polacolor is about the most exciting news for the amateur since the first days of Kodachrome. Blues and flesh tones are excellent. Reds are less brilliant than I would like them, but I’m sure later emulsions will improve them. Peeling off a color print in just seconds is an exciting experience.—*W. W. Morris, former Chief Photographer.*

The real treat of Polacolor is being able to see it almost immediately. It’s especially good for outdoor use in clear or slightly diffused sunlight—and that’s where most of us will be shooting it. The fact that prints won’t need coating made a big hit with me.—*Robert L. Hering, Photography Editor.*

exposed silver salts in each of the three emulsion layers to metallic silver. After re-exposure during processing, dye-coupler molecules associated with the silver grains in the positive image combine with chemicals in the color developer to form three dye images—cyan, magenta, and yellow. The amount of dye produced is proportional to the amount of silver developed. These cyan, magenta, and yellow dye images act as subtractive filters to control the amounts of red, green, and blue that you see through the transparency. The relative densities of the subtractive colors determine the intermediate colors. With this method, the dyes are created when the film is processed. Time and temperature are critical.

But Polaroid needed a process that did not involve precise time and temperature control. They also had to eliminate that second exposure, so the film could be used in Polaroid cameras. This required a new approach—and out went the exhaustive-color-coupler process.

As the work progressed, researchers developed a completely new concept based on linking—chemically—a preformed or complete dye to a developer in a single molecule. The dyes could be put in the film at manufacture instead of being created during processing, as in conventional film.

This dye-linked-to-a-developer in a single molecule is the key invention that makes Polacolor possible.

The invention was the basis for development of an extremely complex negative: In a total thickness of less than half a human hair, there are more than eight layers.

One big problem in the multilayer process was the interaction between the layers. All action in the molecules had to be completed within their appropriate layer before they reached the next layer. To keep the emulsion layers apart, researchers used gelatine spacers.

Many of the dyes tested destroyed the film’s sensitivity to light, and had to be discarded. Also, the dyes had to be bal-

[Continued on page 208]

But this proved impractical, as distinct lines showed up on the finished prints.

The exhaustive-color-coupler process held out more hope.

In conventional reversal (transparency) processes, the developer reduces the

A LITTLE red car, making big-car noises as it streaked around an oval test track in a Detroit suburb, last month ushered in the second edition of the U.S. auto industry's display of 1963 products.

Fairly bursting with the energy of its first V-8 engine, the little red car, a Falcon, was called a 1963½ model by its parent, the Ford Motor Co. So were three other Falcon models, a brace of Ford Galaxies, a Thunderbird, and a collection of Mercury Comets, Meteors, and Montereys.

With 10 models from the Chrysler Corp., either spanking new or with optional mechanical variations, it all totted up to 20 mid-season additions that have been made to the manufacturers' car lines.

They have new shapes. They wear new spangles. Fresh transmissions turn their propeller shafts. But their outstanding characteristic is the growl from their tailpipes.

The Falcon is a case in point. Introduced

CONTINUED

What's New in the 1963 1/2 Cars

By Devon Francis

Mid-season entries give you a wider choice in the new cars.

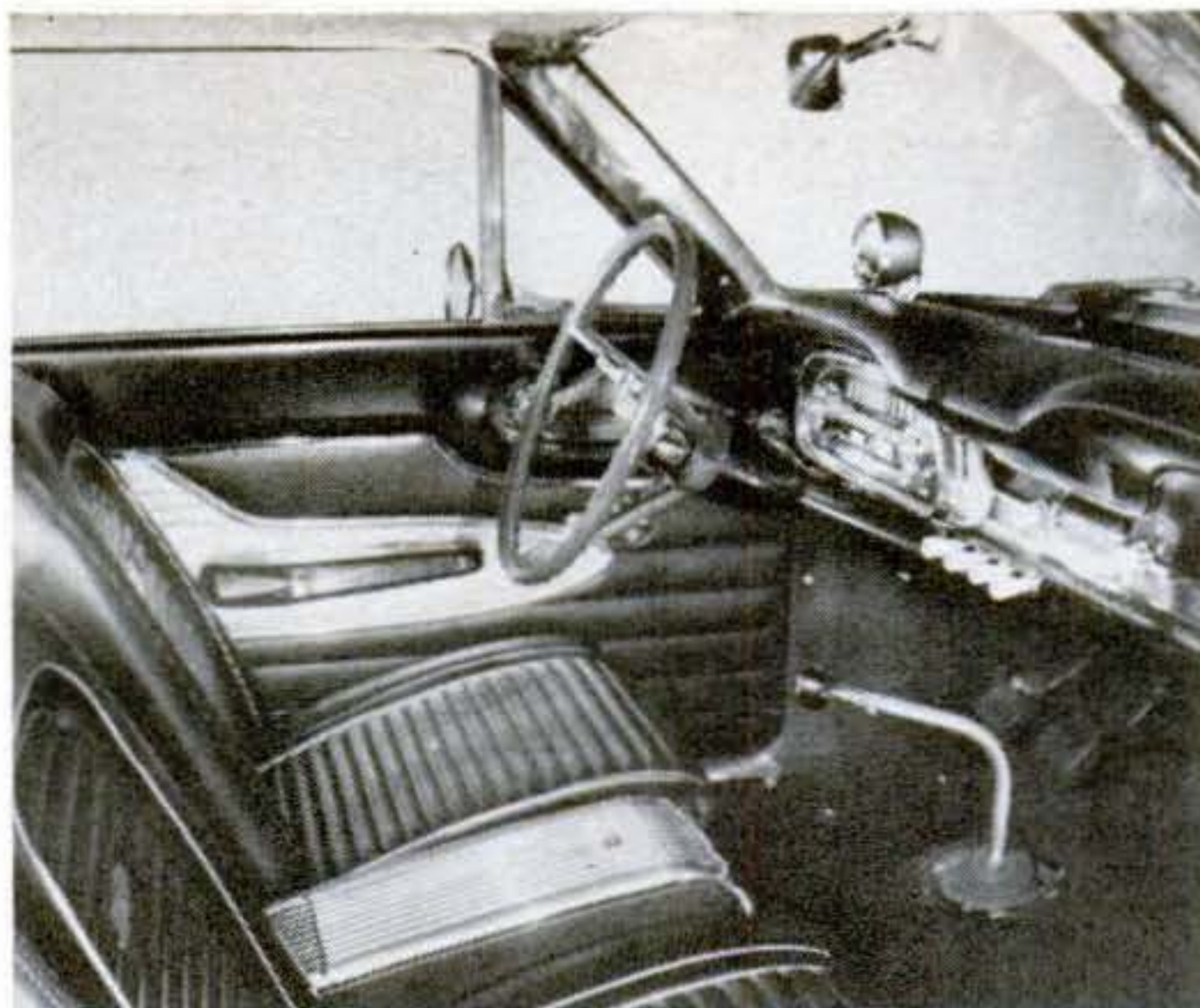
Here are highlights of what the auto makers are offering



just 3½ years ago as a car that could get 30 miles from a gallon of gas, it had a little coffee mill of an engine that produced 85 horsepower. Now here it is, with a 260-cu.-in. V-8 putting out a thundering 164 hp.

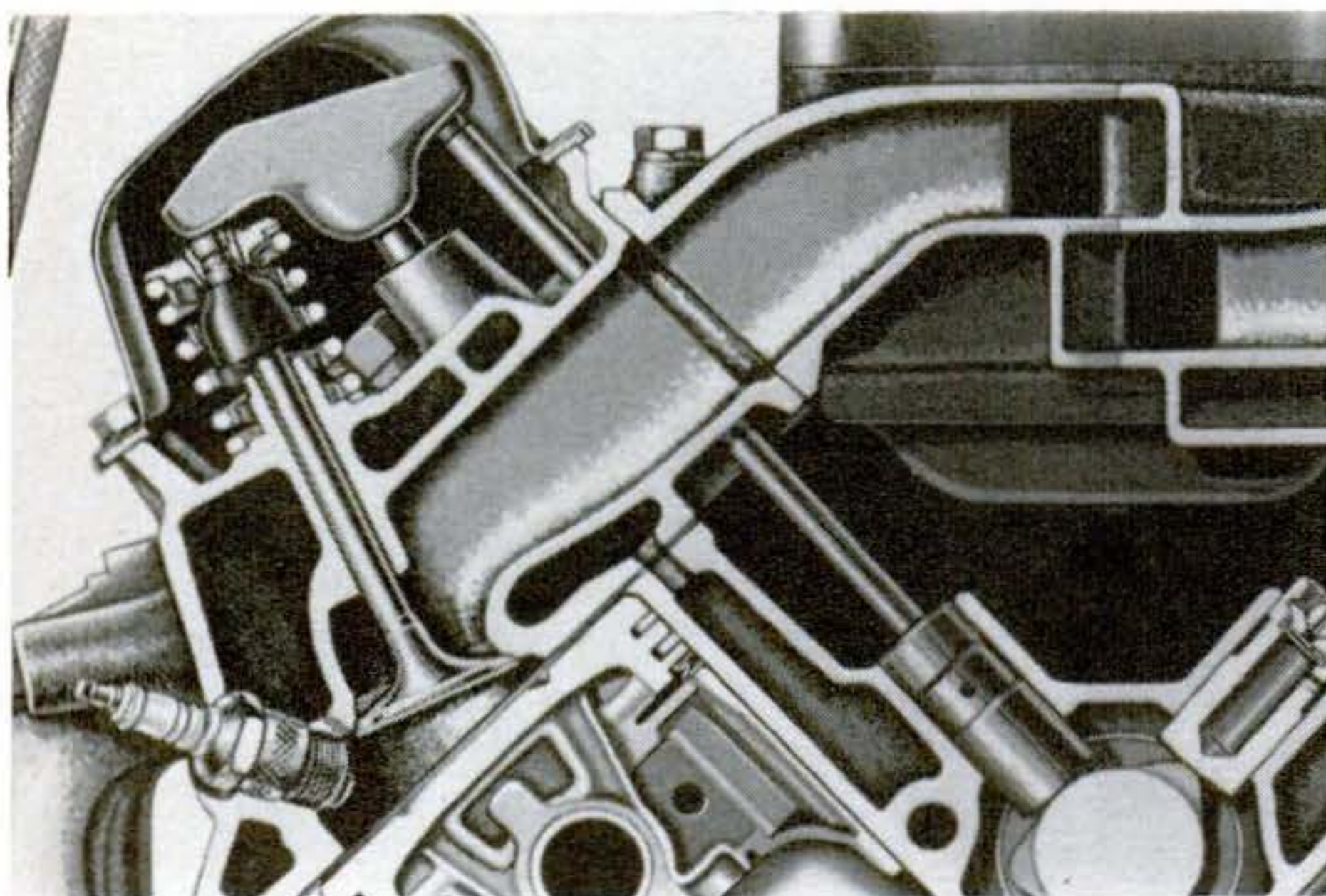
And don't be surprised if the Falcon is upgraded presently to a considerably higher horsepower—on this same engine.

I drove a 1963½ Falcon on Ford Motor's acceleration strip at the Dearborn test track. Called the Sprint, it was a hardtop with a floor-mounted, four-speed manual transmission, a stiffer body than is usually built for the Falcon, a beefed-up rear axle, heavy-duty springs,



Bucket seats, tachometer above dash, and floor-mounted, four-speed manual transmission are embellishments of new Ford Falcon Sprint.

CONTINUED



New engine, with solid valve lifters, producing 271 hp. from 289-cubic-inch displacement, is option on high-performance Ford Fairlane and Mercury Meteor. Compression ratio is 11:1.



Dodge and Plymouth offer four-speed manual shift with various engines. Ratios with Dodge's 383-inch engine are 2.2, 1.66, 1.31, 1. Optional axle ratios are 3.23 and 3.55.

Here is what the 1963½ cars have to offer you

By brands, here are the cars and new mechanical options that have appeared on showroom floors since the introduction of the '63 cars last fall:

- Two Dodge Dart convertibles in the 111-inch wheelbase series, known as the 270 and GT.

- Three Dodge 880-series models, priced lower than the Dodge Custom 880, with new grille, hood, front fenders and bumper.

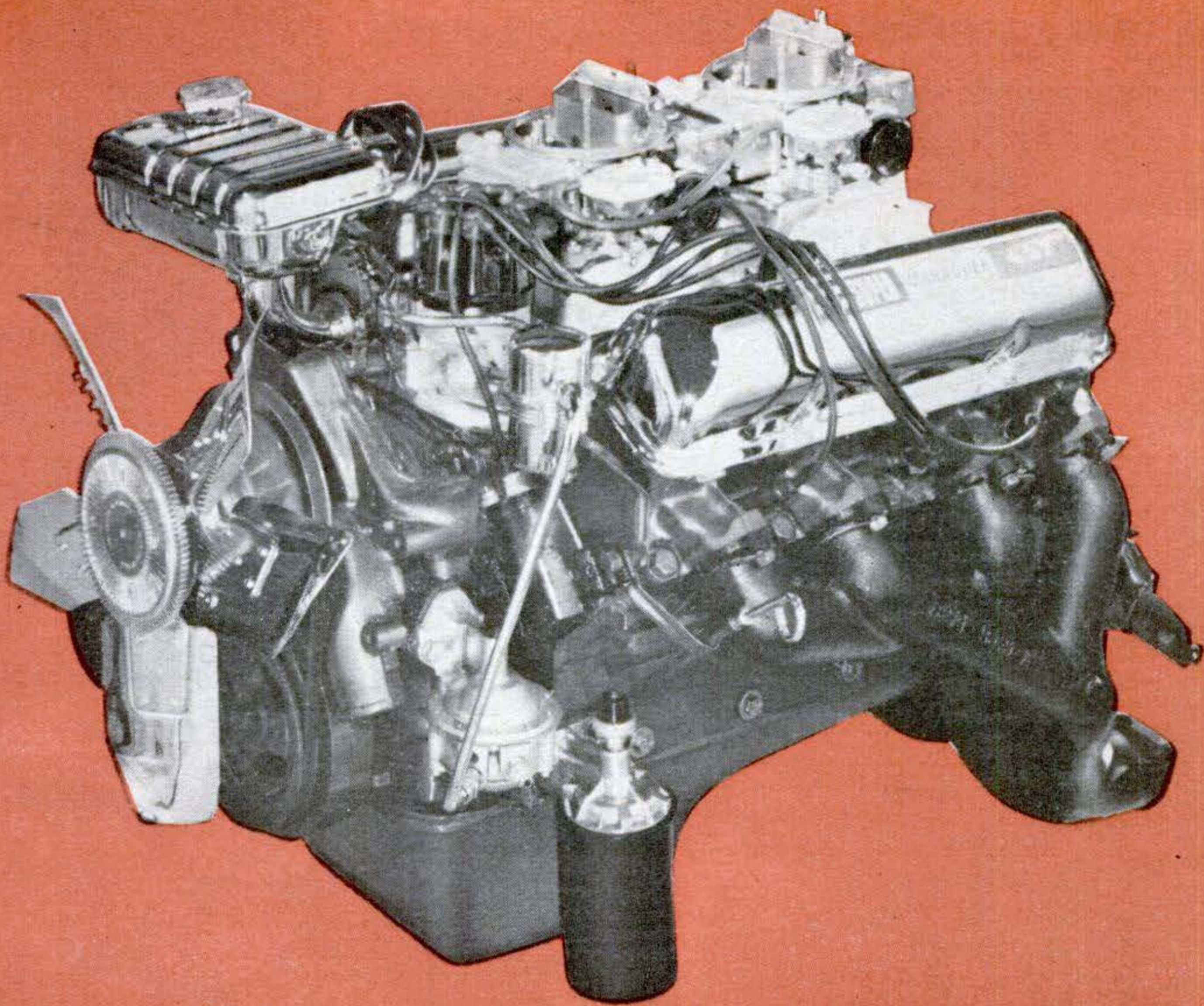
- A manual four-speed, floor-mounted transmission for Dodge's 318- and 383-inch engines in four of its "big car" series,

and for Plymouth's 318-, 361-, and 383-inch engines. This transmission will also be made available on Dodge's (and the Chrysler Corp.'s) huskiest engine, displacing 426 cubic inches.

- A Chrysler New Yorker with a landau roof.

- The Chrysler 300J, with a 413-inch, 390-hp. engine.

- A Chrysler New Yorker salon with headrests, reclining seats, autopilot, humidity control, special tires to reduce road noise, and vacuum door locks as standard equipment.



Newest and biggest Ford Motor engine displaces 427 cubic inches, produces up to 425 hp. Available in Galaxie, Merc Monterey and Marauder,

huskiest version has two four-barrel carburetors, burns superpremium fuel. Compression ratio is 11.5:1. The valve lifters are solid.

- Two Mercury Marauder two-door hardtops with "fastback" roof lines, one with bucket seats.

- Two Mercury Comet two-door hardtops with fastback roofs, one with bucket seats.

- A Mercury Monterey four-door hardtop with bucket seats.

- Two Falcon fastback hardtops, one with bucket seats.

- Two Falcon Sprint performance compacts, one a hardtop, one a convertible.

- Two Ford Galaxie fastback hardtops.

- A Thunderbird landau, designated as a limited edition.

- A 289-inch Ford Motor Co. engine,

replacing the 260- and 292-inch engines in the Galaxie. Rated at 195 horsepower, it is boosted to 271 hp. in optional, high-performance versions of the Ford Fairlane and Mercury Meteor.

- A 427-inch, 425-hp. engine for the Galaxie and full-size Mercs. This engine replaces one of 406 inches producing 405 hp. A transistorized ignition system is optional on this engine.

- Other Ford Motor cars are upgraded on power, mostly as an option, with existing engines—the Fairlane and Meteor get a six-cylinder, 200-inch, 116-hp. engine; the Falcon and Mercury Comet a 260-inch, 164-hp. V-8.

Mid-season's new cars have new shapes, wear new spangles, and growl with power



DODGE 880 HARDTOP



VALIANT CONVERTIBLE



COMET HARDTOP FASTBACK



MERCURY MARAUDER HARDTOP



PLYMOUTH FURY 4-SPEED



THUNDERBIRD LANDAU

and brakes and tires of increased size.

The speedometer correction showed a speed of 56.3 m.p.h. at an indicated 60, and 77.7 at an indicated 80.

With the accelerator on the floor, the speedometer indicated a trifle over 100 m.p.h. While the dial was marked only to 100, the car was running out of steam at 4,500 engine revolutions per minute when the needle nudged past the last graduation. What I had encountered was tappet pump-up on the hydraulic lifters—the valves refused to seat. With solid lifters—which will produce a lot of added power at 5,800 to 6,000 r.p.m.—the car no doubt will clock well beyond a true 100 m.p.h.

Here were some of the accelerations on corrected speedometer readings:

0-60 m.p.h., without getting out of third gear: 10.9 seconds.

0-80: 22.1.

30-60 with no downshift: 9.7.

30-60 with downshift to third: 7.3.

40-60: 6.9.

40-70 with no downshift: 11.1.

40-70 with downshift to third: 11.2.

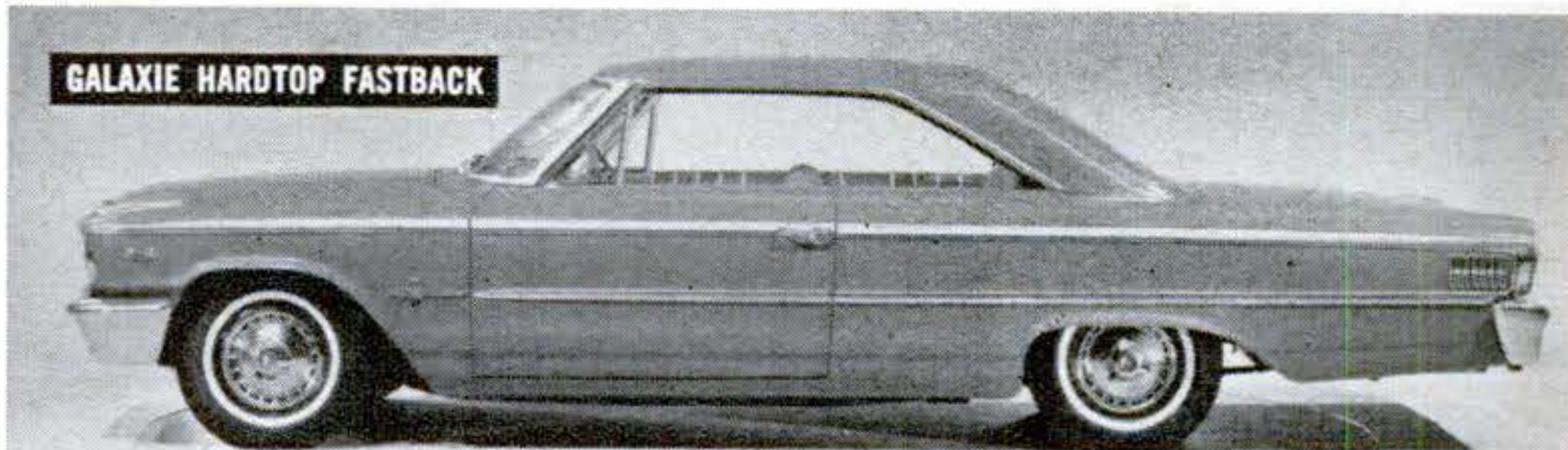
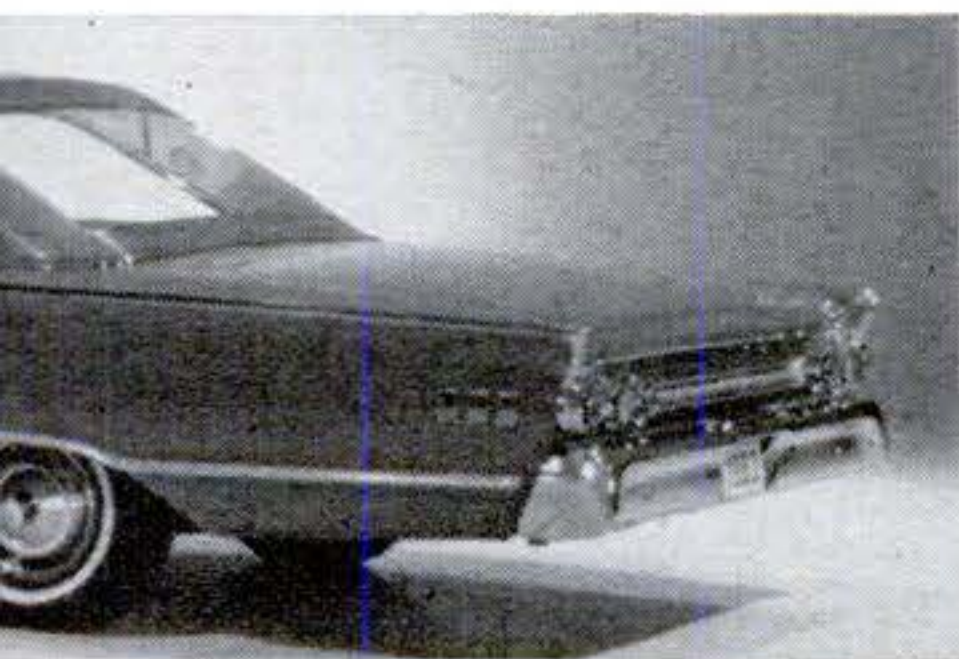
40-80: 16.5.

60-80: 10.2.

The 40-70 and 60-80 accelerations in high gear showed that the engine—with a 3.5:1 axle—had ample spunk in the higher speed ranges.

Let it be remembered that the original Falcon ate up almost 23 seconds in reaching 60 m.p.h. from a standing start, and had a top speed of around 78 m.p.h.

Despite the Sprint's stiffer springing,



its ride was not harsh. I found it quite comfortable.

Another 1963½ car with explosive horsepowers under its hood is Plymouth's four-speed Sport Fury.

Wesley S. Griswold, POPULAR SCIENCE's West Coast Editor, drove one of the first of these 330-horsepower jobs just off the production line.

"My convertible had a 383-inch engine and a 3.23 axle," he reported. "If my calculations on the speedometer correction are on the button, this car won't quit until it reaches a true 120 m.p.h.

"Here are some of my accelerations:

"0-30 m.p.h.: 3 seconds.

"0-60: 7.

"40-70, starting in second gear and going up only through third gear: 5.3.

"40-70, in fourth gear: 6.6.

"50-80, starting in second gear and going up only through third gear: 6.2.

"50-80, in fourth gear: 6.8.

"The car cornered snugly at any speed. On straightaways, in passing, it almost tugged the seat out from under me.

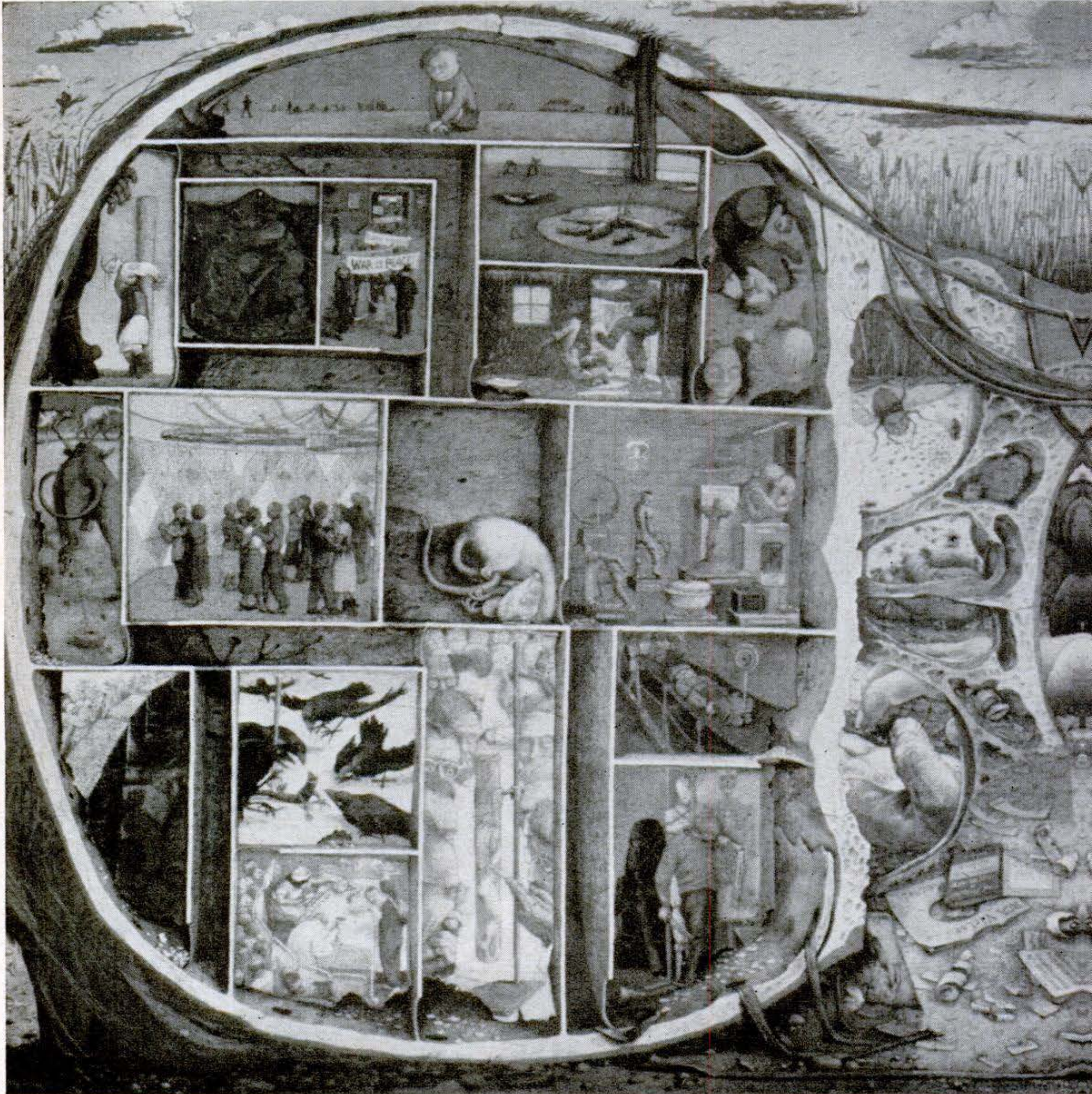
"I didn't care for the rough idle caused by the high-lift cam, but that's the penalty you pay for performance."

Finally, as a case in point with the 1963½ cars, there is that Ford Motor 427-incher. Editor Robert P. Crossley witnessed this engine drive both a Ford Galaxie and a Mercury Monterey to 160 miles an hour at Bill France's Daytona speedway.

For other news of the mid-season cars, see the accompanying pictures. ■ ■

Today's tranquilizers, energizers, and similar drugs help the sick mind. Soon they may improve the healthy

The



A schizophrenic artist paints the torment of his tortured soul

Creative people often retain their talents when mentally ill. This psychotic painter saw himself lying on his side on stony ground, his skull split open to reveal a life story in compartments that are chambers of horror. Pictured, from the

top down, are scenes of childhood cruelties, war, frustrations in love and work, and torments by his doctors. The rat in the center is the artist who, having nibbled at the bitter fragments of his life, now curls up to die.

Truth About Brain Drugs

By Joan Steen

TRANQUILIZERS work. So well, that in a decade they've become the third most frequently prescribed drug in America.

Phenobarbital, an older drug, works too for many a sleepless patient. So does Benzedrine—as the long-haul truck driver or others hard-pressed at times to stay awake can report.

But what makes such drugs work? Why do some drugs calm you down or knock you out, while others stimulate you or waft you to a painfree state of bliss?

Up to eight or nine years ago it was anybody's guess. Then came the tranquilizers. So impressed were doctors at the profound improvements—even apparent cures—of mental patients who took these drugs that they began to take a new look at all drugs that affect behavior.

Now the research is paying off. Scientists are on the verge of unraveling the strange biochemical mechanisms that underscore our behavior.

New “psychoactive” drugs have come to light with startling new effects. Some may improve your memory; others may step up your creative output; still others may stimulate a “seat of pleasure” in the brain to produce that glow of well-being called joy.

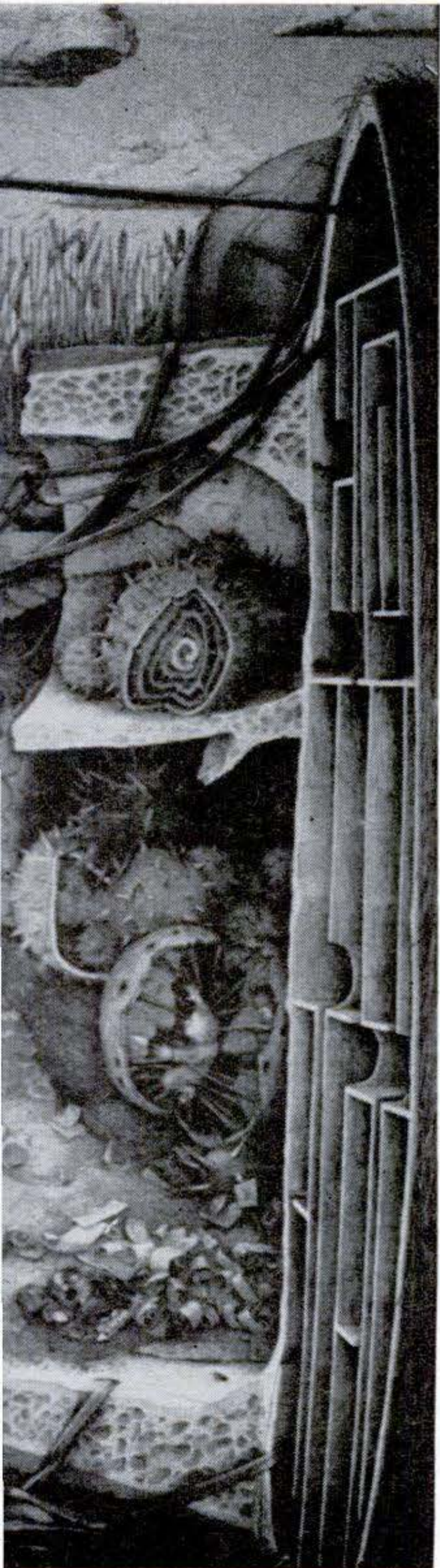
To fit these ideas in place, first consider some facts about the mind:

If you ask a physicist how he visualizes an atom he may tell you he sees a central very dense mass (the nucleus), enveloped in a cloud of energy-charged particles (electrons).

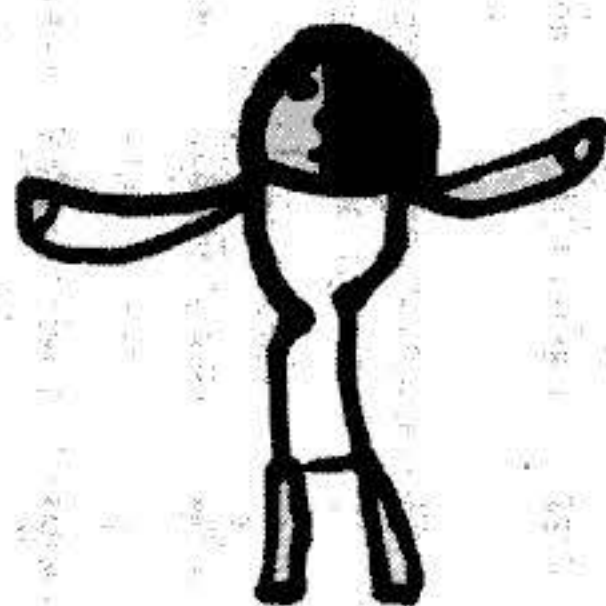
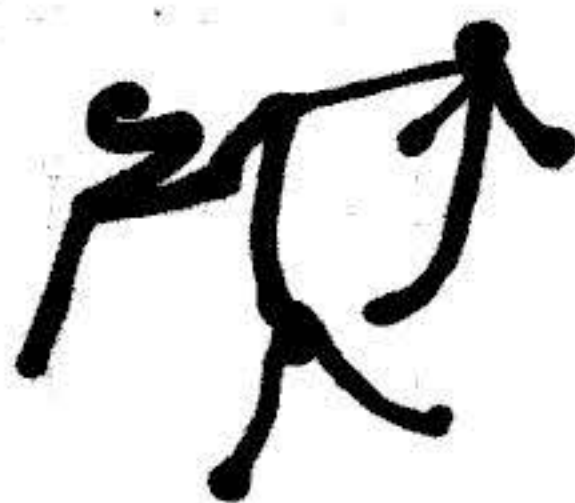
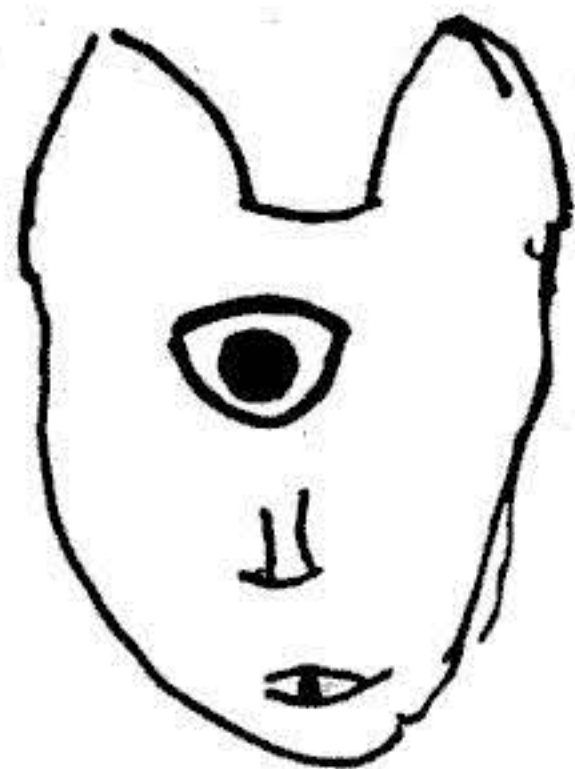
A “*bowl of jelly.*” Ask a biologist how he sees the central nervous system and you may get a remarkably similar picture. For the dense nuclear core read “brain,” that “modest bowl of pink jelly”—according to biochemist Robert S. DeRopp—which packs over 10 billion energy-charged particles in its soft, warm mass. These particles, the nerve cells, are the most extraordinary cells in the body. While the “head” of each cell is a microscopic bit of protoplasm, its

CONTINUED

71



Nightmare world of the disturbed



hairlike "tail" may trail out several feet to reach your eyes, your ears, your fingertips.

When stimulated sharply enough, the tail "fires"—clicks out an electrical impulse. But the transmission is not the same as a telephone wire carrying current at 20,000-mile-a-second rates. Nerves fire their charges more slowly, like explosive fuses. The fastest pulses travel about 300 feet a second.

If an impulse reaches the head of the nerve and has enough energy, it jumps across the tiny gap that separates it from a neighboring cell to fire it, and spark a path to the brain. There it joins forces with other impulses to light up your mind in a unique pattern that determines your behavior.

Suppose you turn the corner of a street and find yourself facing a thug coming at you with a knife. What happens? In a flash your heart starts pounding; your breath deepens; you stop digesting food. Blood leaves your body center and rushes to your muscles. The liver releases sugar and the spleen gives up blood corpuscles. Now you are equipped to get away fast—this is a "flight" reaction.

But suppose you take a stand? Anger wells up within you; your face gets red; your fists bulge; you lunge forward, prepared to put the man in his place. That's a "fight" reaction. Either way, you're experiencing fast chemical changes.

When the nerve impulses carrying the threat reached the brain they set off chain reactions. Back streamed messages to muscles and glands. There the impulses triggered the release of chemicals—hormones—to do the work.

If the major hormone released was adrenaline, you were prepared for flight; if it was noradrenaline—a close relative—you were prepared to fight. Most people react consistently one way or the other.

The adrenal hormones are just two of half a dozen major hormones stored throughout the body. It is these chemicals plus the electrical impulses that tease them into life (and later destroy them) that drugs affect.

The tranquilizers. The first "new" behavioral drug scientists studied was old outside the western world. It was Rauwolfia—derived from the roots of a plant. In India its use dates back at least 2,500 years. It was popular as a child pacifier, a reducer of blood pressure, and a drug of "rare merit" for treating nervous disorders.

All these claims were justified, the doctors discovered. They extracted and purified the roots of the plant to make reserpine—still one of the most powerful in today's sprawling collection of tranquilizers.

Generally the collection is divided into three groups:

Hallucinatory monsters are depicted in four of six drawings at left done by patients in acute mental states. The female figure was drawn by a woman in an attempt to describe her divided self. The wiggly lines below it are sketches by an anxious depressed patient.

reserpine (trade names "Serpasil," "Rau-Sed," etc.) along with other Rauwolfia derivatives; chlorpromazine ("Thorazine," "Compazine," etc.), one of a group called phenothiazines; and meprobamate ("Miltown," "Equanil") with its relatives.

The three share one property: They can reduce hallucinations, delusions, and other forms of abnormal thinking in the mentally ill, but they don't otherwise effect the cortex—the "thinking" part of the brain. They don't make you forget your troubles.

What they do seem to affect are the layers under the cortex, the older structures of man's "primitive brain." These parts are the heart of man's emotional life. Depress them and you may be able to quiet the raving maniac, soothe the anxious or the angry, take the sense of pain from the cancer patient. Stimulate them and you can rescue the suicidally depressed, excite the passive into passion, intensify the vision of the poet or the painter. The strange truth is that most drugs do both.

One way to see why this is so is to study how the brain is hooked up electrically. This is what Dr. Harold E. Himwich of the Galesburg (Ill.) State Research Hospital has done, watching the effects of drugs on two great system loops in the brain.

The brain's alarm clock. One is the reticular activating system—the RAS. When stimulated, it makes you alert. When depressed, it relaxes you, makes you drowsy.

Suppose you light a cigarette and the matchbook flames up in your hands. You get scorched slightly and drop the book. What happened? One route of incoming messages had beelined directly to the cortex and reported: *cigarette-match-flame-fire*. Another had sidetracked through the

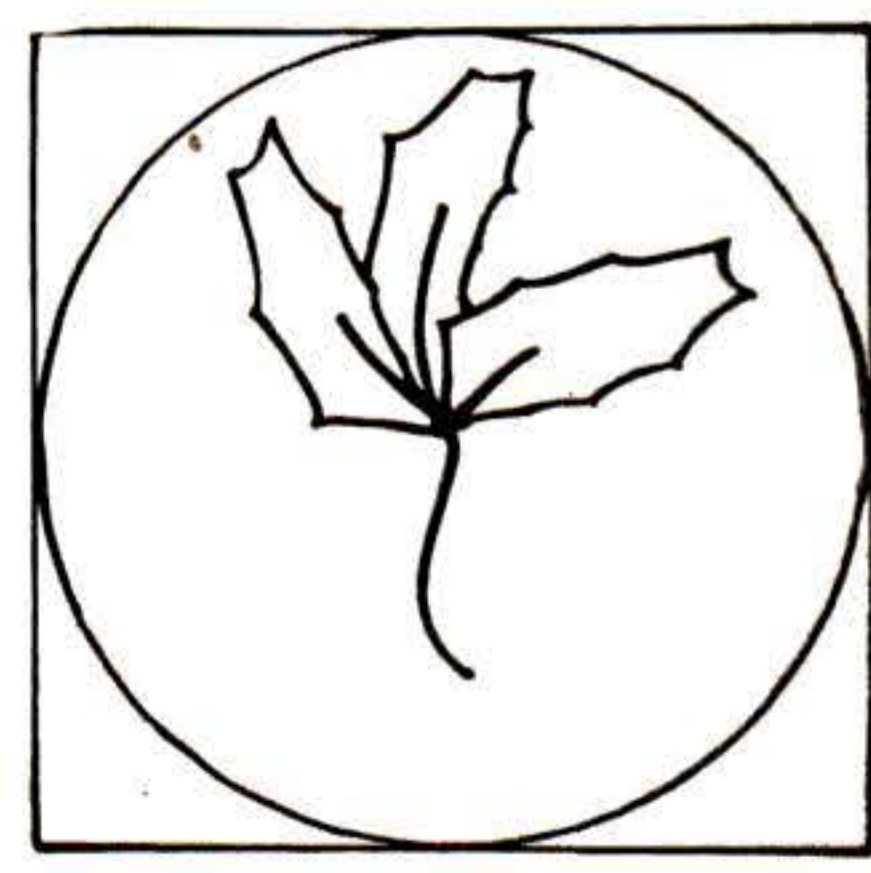
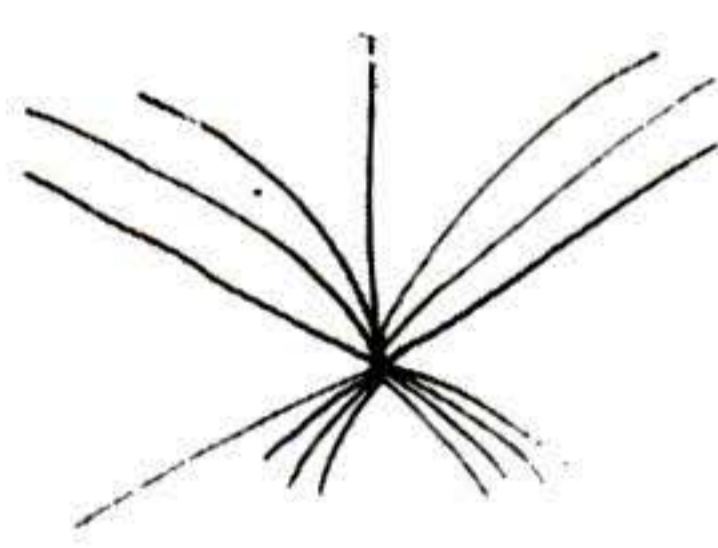
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From an evil eye to a country cottage



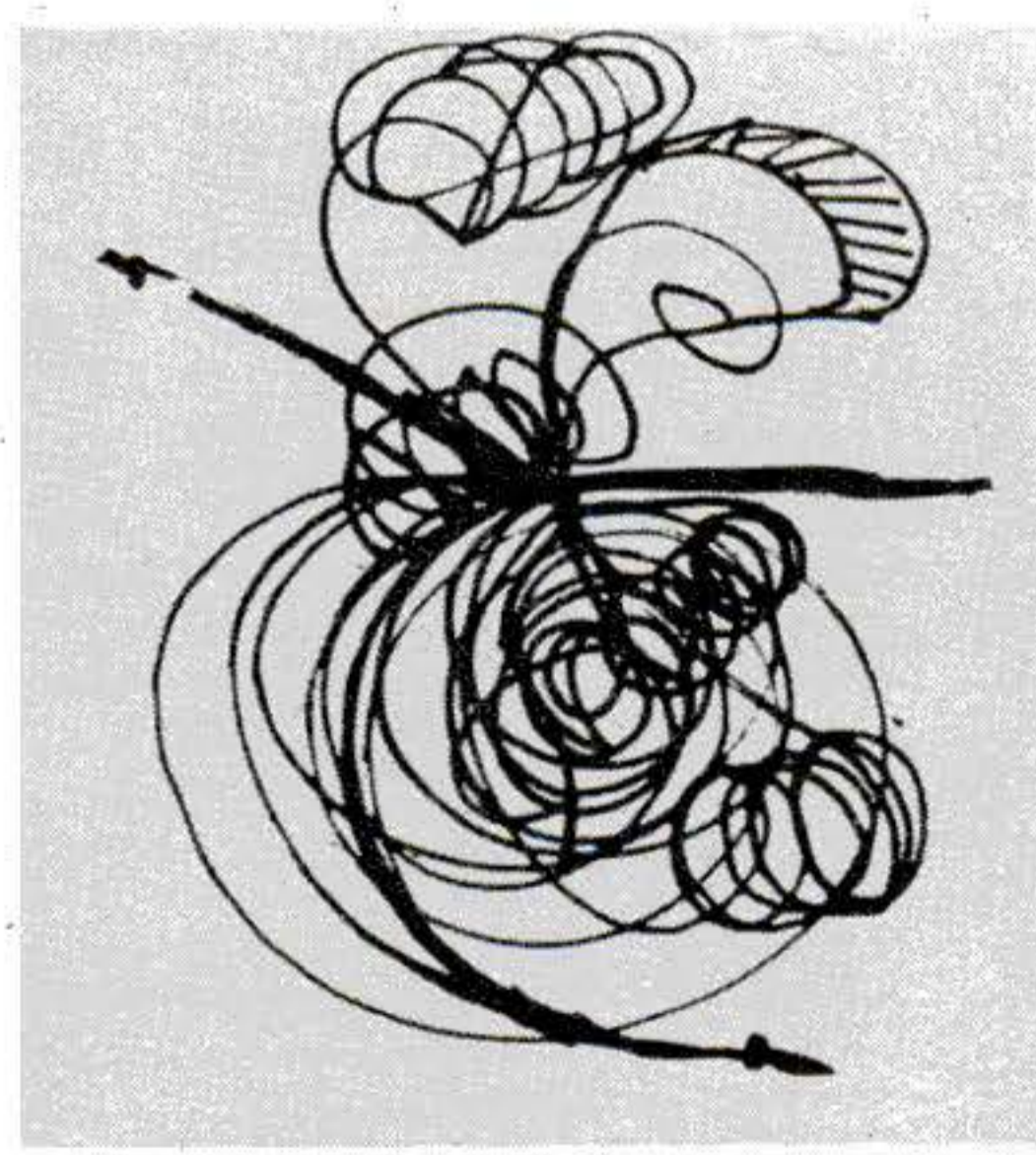
Two contrasting scenes were sketched by a woman among first to take reserpine. Drug, she said, "cut the rot" from her mind.

Sinister spider no longer threatens



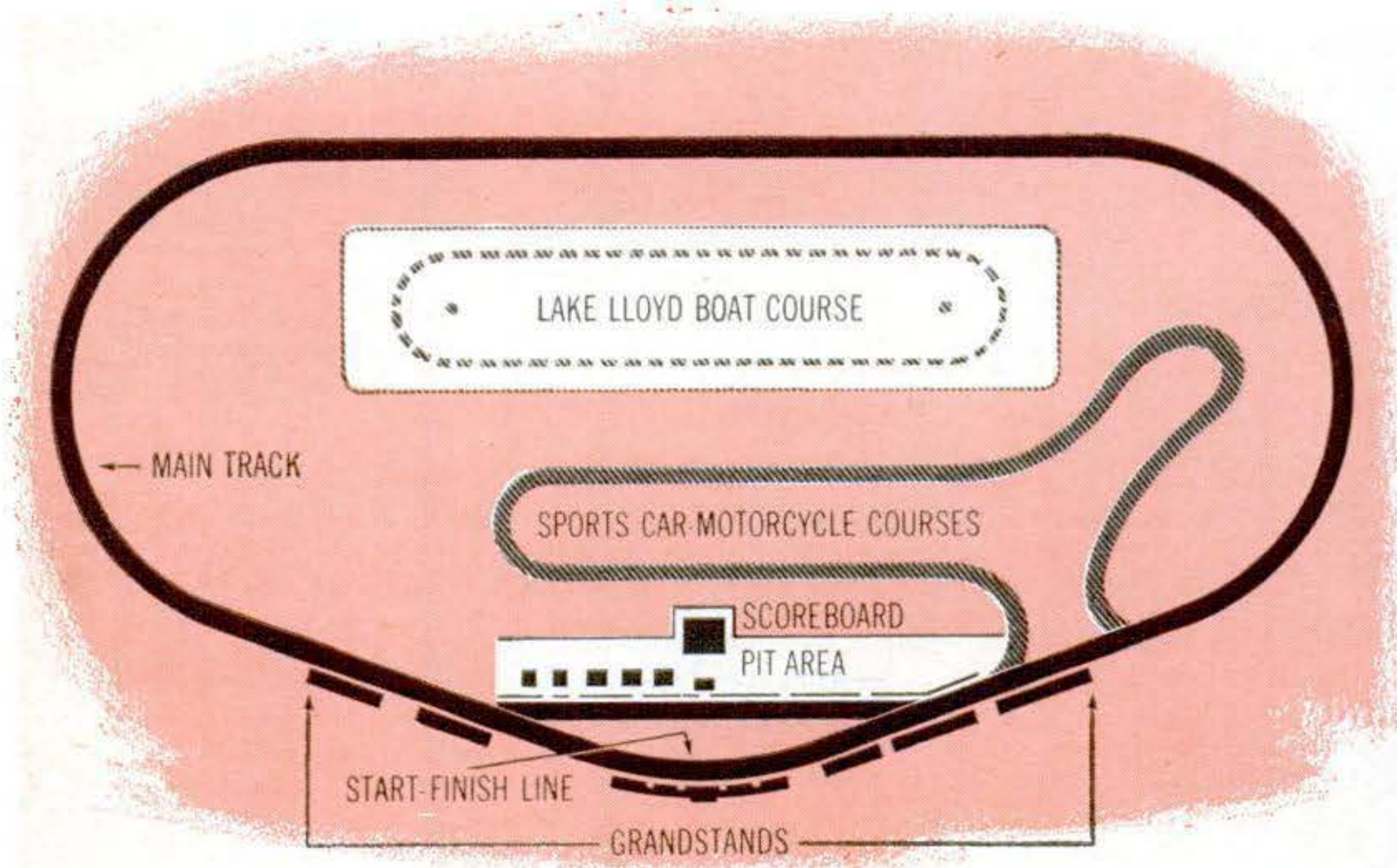
Frightened, depressed woman who sketched insect at top was treated with energizers, later pictured herself as healthy branch of holly.

From chaos to an ordered world



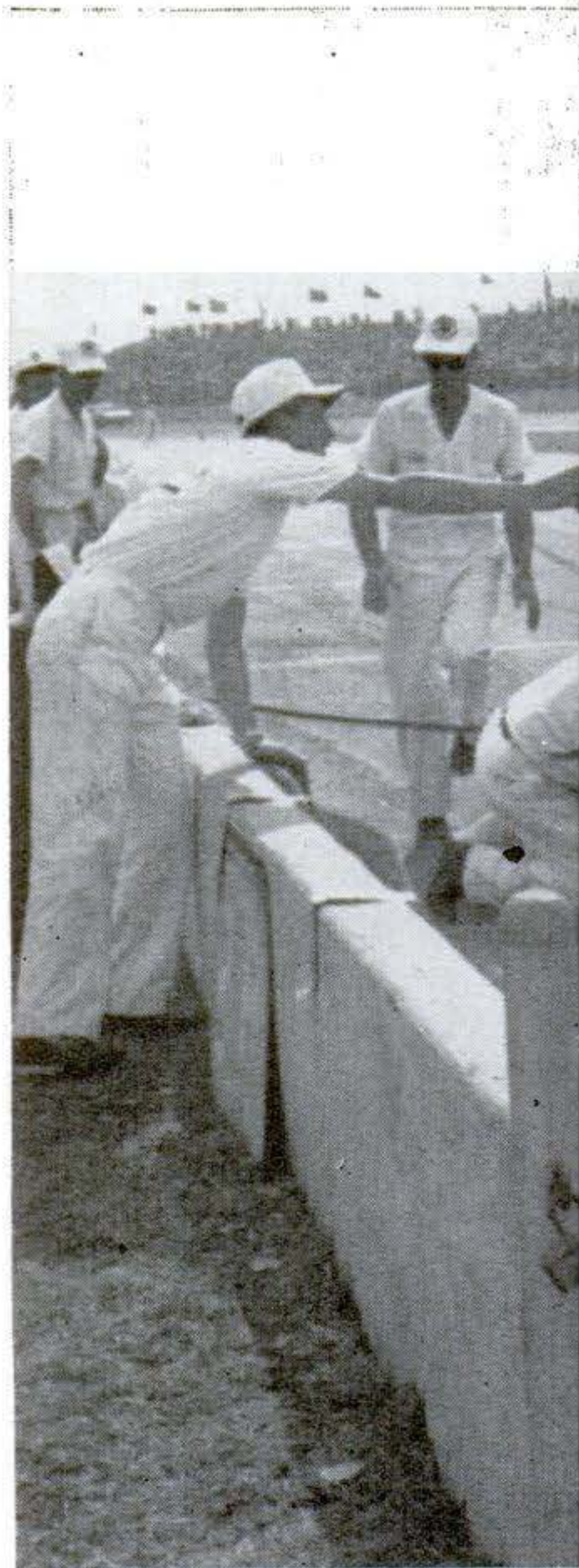
"That's me—a broken mainspring," a schizophrenic man said on completing the drawing above, at left. He worked with Walter Brown, art therapist at Rockland State Hospital, New York. Later, after therapy and tranquilizers, he produced the happy, gentle self-portrait at right.

This month at Daytona, site of the U.S. stock-car classic, sedans will average higher speeds than those in the Indianapolis 500



Daytona Speedway is world's newest, fastest, safest track. It's 2½ miles long and has turns mathematically banked. Infield is used for sports-car and motorcycle racing, the lake for boat racing.

In 200 circuits of track, drivers make four pit stops (right) for gas —cars get only five miles per gallon. Tires are changed once or twice. Picture was taken before rule limiting number of pitmen.



Detroit Goes Back



A start-of-the-race parade? No. The two cars in the rear are easing up to get a "draft" for more speed. Cars maintain an almost constant pace, slacking off only slightly on the turns.



to the Races

By Keith Vining

ON THE 24th day of this month—February—a man of considerable skill and a fair spate of nerve is going to slide behind the wheel of an automobile and, in the next 3½ hours, proceed to earn himself \$7,500 an hour. When he finishes he will be the winner of what is becoming the classic of U. S. stock-car racing—the “Daytona 500.”

That’s only part of it. He and the several dozen drivers who will race against him will split a total kitty of about \$115,000. True, it’s not much compared with the \$425,000 annually distributed among the drivers at the Indianapolis 500, but it ain’t hay.

The winner of the Daytona 500 will

earn his loot. On what is billed as the world’s fastest and safest auto-racing track, the Daytona International Speedway, the victorious driver will *average* better than 150 miles an hour. That’s 10 miles an hour faster than cars especially built for racing can do on the daddy of all American tracks, the Indianapolis Speedway.

And, mind you, that 150-plus m.p.h. will be in a stock automobile. How it differs from your family jalopy is explained later.

The track record for the Daytona 500, 152.5 m.p.h.—set by Glenn “Fireball” Roberts in a Pontiac—will be in jeopardy, as will records in several other racing

CONTINUED

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events during Daytona's Speed Week starting February 16. Behind that is a reason. Detroit—meaning the companies that make the automobiles—has returned to the racing pits.

It has been a long time since Detroit got its hands grimy at a race track—officially, that is. In 1957 the auto manufacturers formally eschewed stock-car racing. Racing drew a bad image of the family automobile in the public mind. Detroit would not even supply an innocent pace car for the Indianapolis 500.

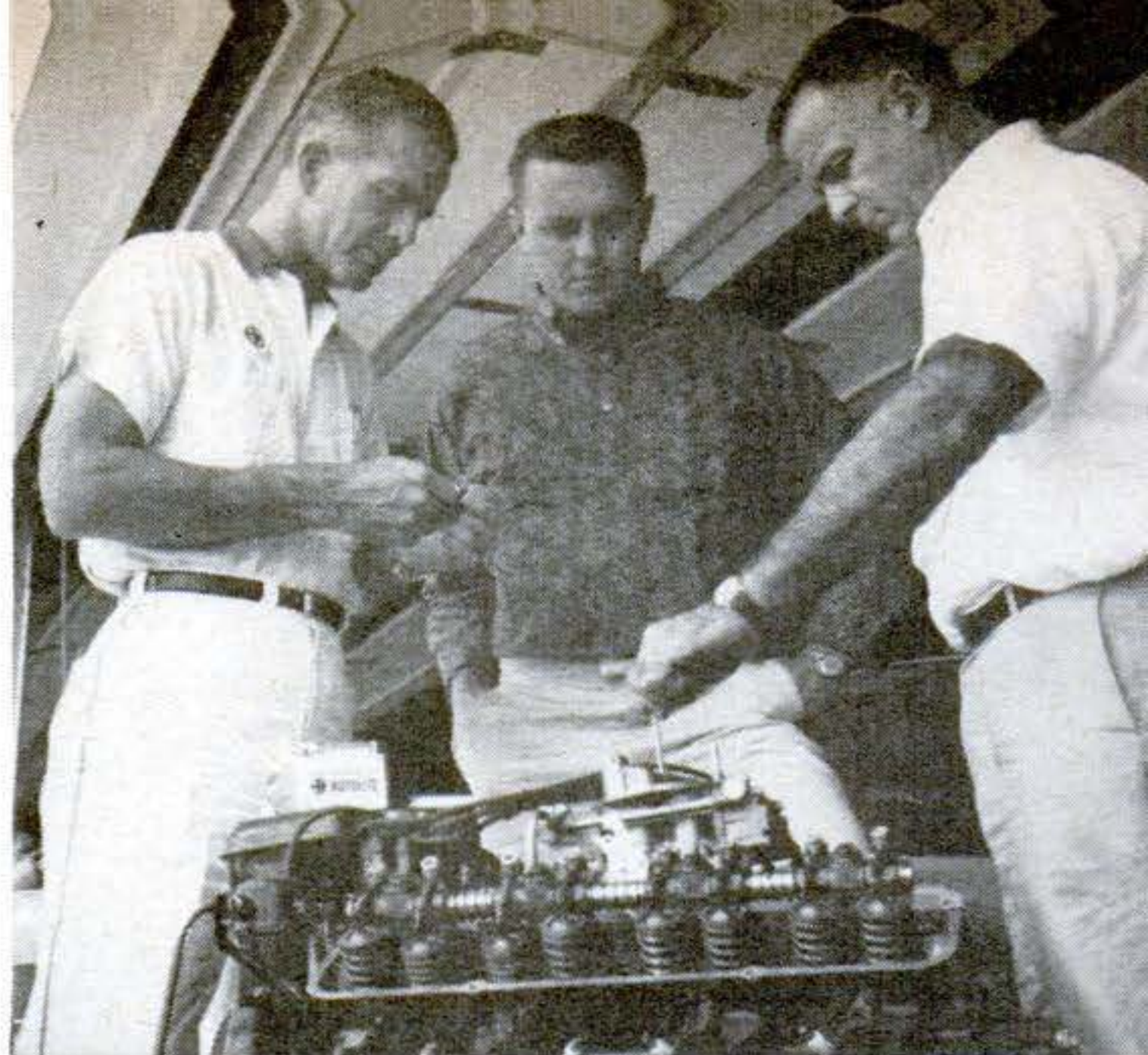
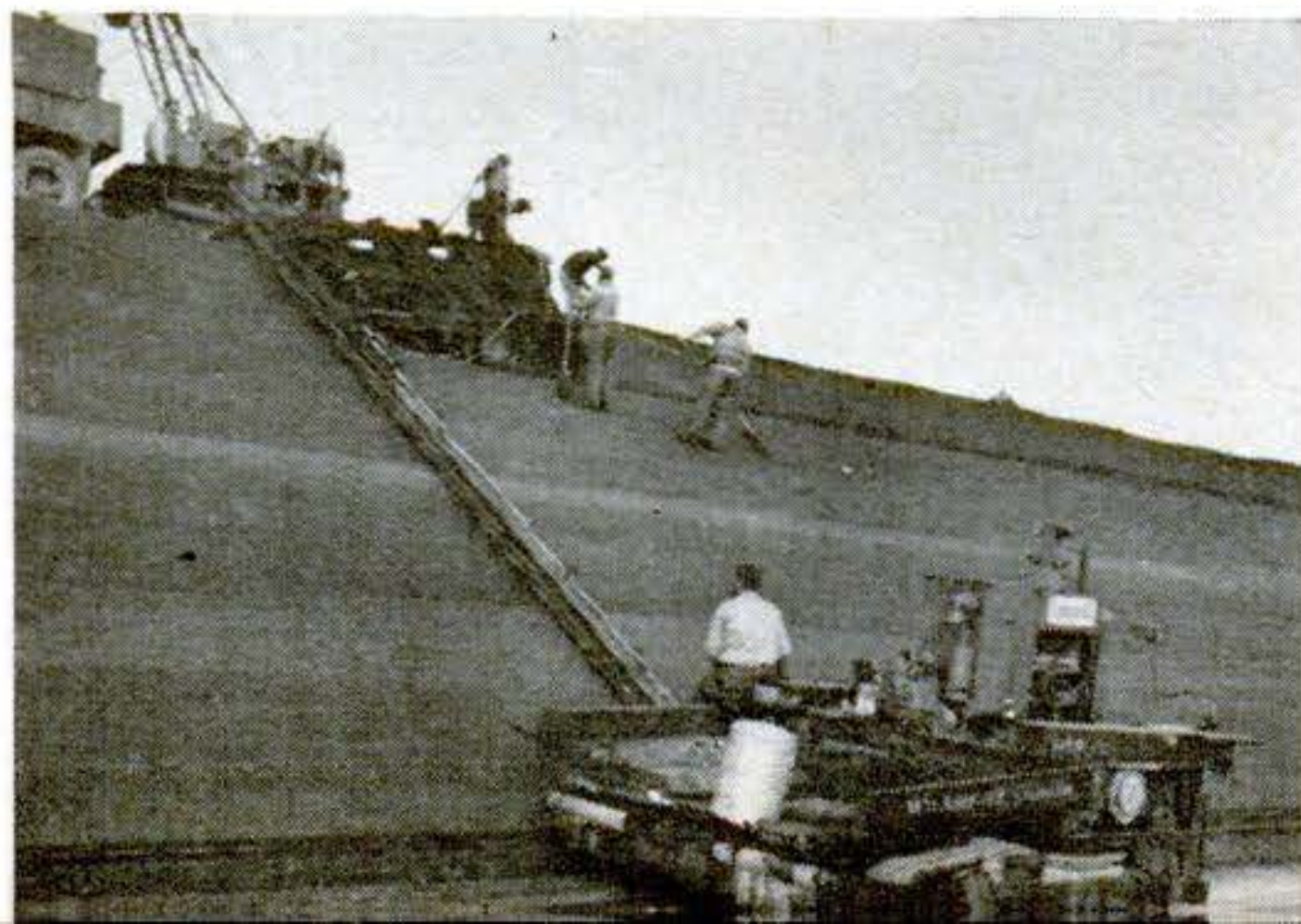
That's all changed now. Detroit is back, and the intimate association between racing victories and the sale of automobiles bearing the winners' brand names possibly has something to do with it.

Detroit's support of stock-car racing, boosting the liveliness of the competition, is for the most part covert (as, indeed, it has been ever since the industry's pious announcement of divorce from racing in 1957). But it is real. To name names, General Motors, the Ford Motor Co., and the Chrysler Corp. all turn out parts on their production lines to boost the performance of their stock cars on the race track.

As this issue of POPULAR SCIENCE goes to press, here are the cars and the quantity thereof scheduled to compete in the Daytona 500 qualifying trials preceding the big race: five Pontiacs, nine Fords, four Chevrolets, eight Mercurys, four Dodges, and five Plymouths. There will be a lot more.

[\[Continued on page 205\]](#)

Steep banks on turns forced special techniques during track construction. Rollers were suspended on cables from "cats" above in laying pavement on curves banked up to 31 degrees.



Skull session: Dan Eames of Autolite, Driver Troy Ruttman, and Bill Stroppe study a carb.

How they get a 'stock car' ready for Daytona

PREPARING a stock car for the rugged 500-mile race at Daytona this month is something like preparing a house to stand up to a hurricane.

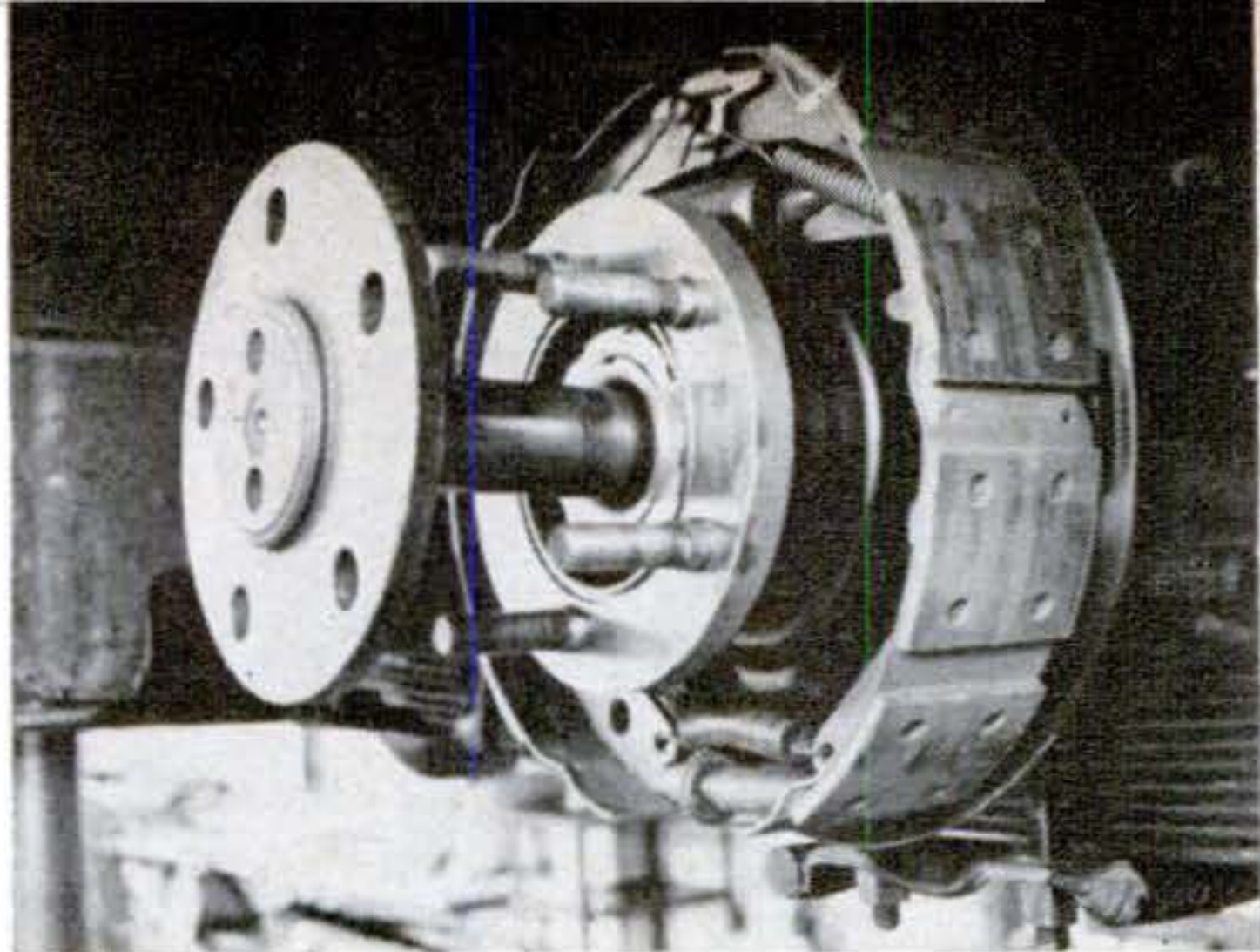
An expert recently showed me how it's done. Bill Stroppe, long known nationally for his success in setting up racing cars and managing race crews, let me see how he and his "boys" prepared six 1963 Mercury Marauders for the supreme test in Florida. He is 43, a square-faced, tanned ex-football player with blue eyes, a crew cut, and undented amiability.

The car he showed me was a two-door Merc with a 427-cu.-in. Marauder V-8 engine, rated at 410 hp. His six identical Mercurys had all come off a production line—with heavy-duty radiators, batteries, springs, shock absorbers, axles, brakes, and stabilizer (sway) bars.

To prepare the Merc, it was stripped right down to its frame, and rebuilt. The frame itself was especially notched over the rear axle, so that it could be lowered as much as the rules allow.

Every weld was rewelded, for ruggedness. All shock towers and brackets were welded on. Bolts of aircraft quality and sturdiness were put on the shackles. Nuts

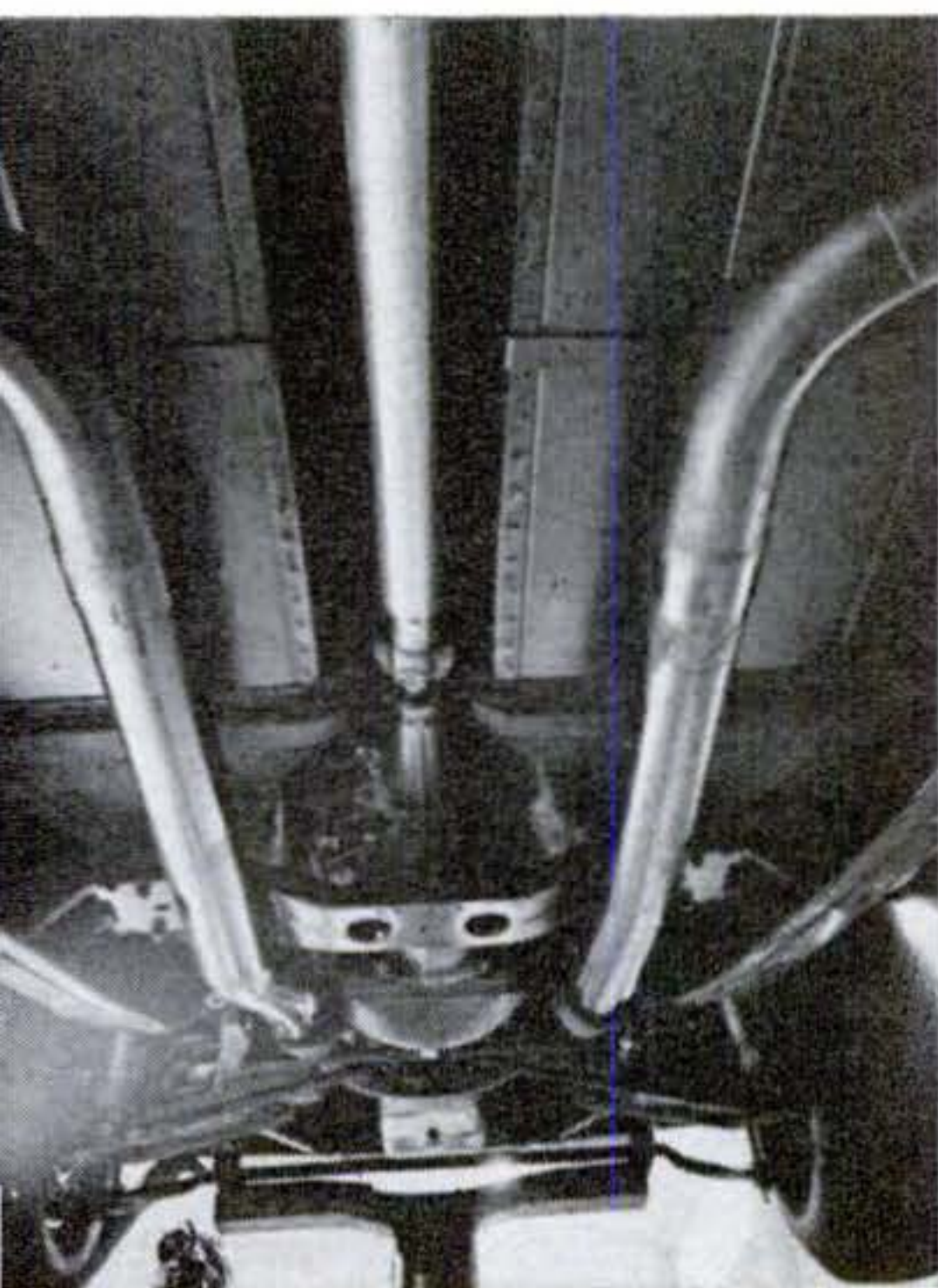
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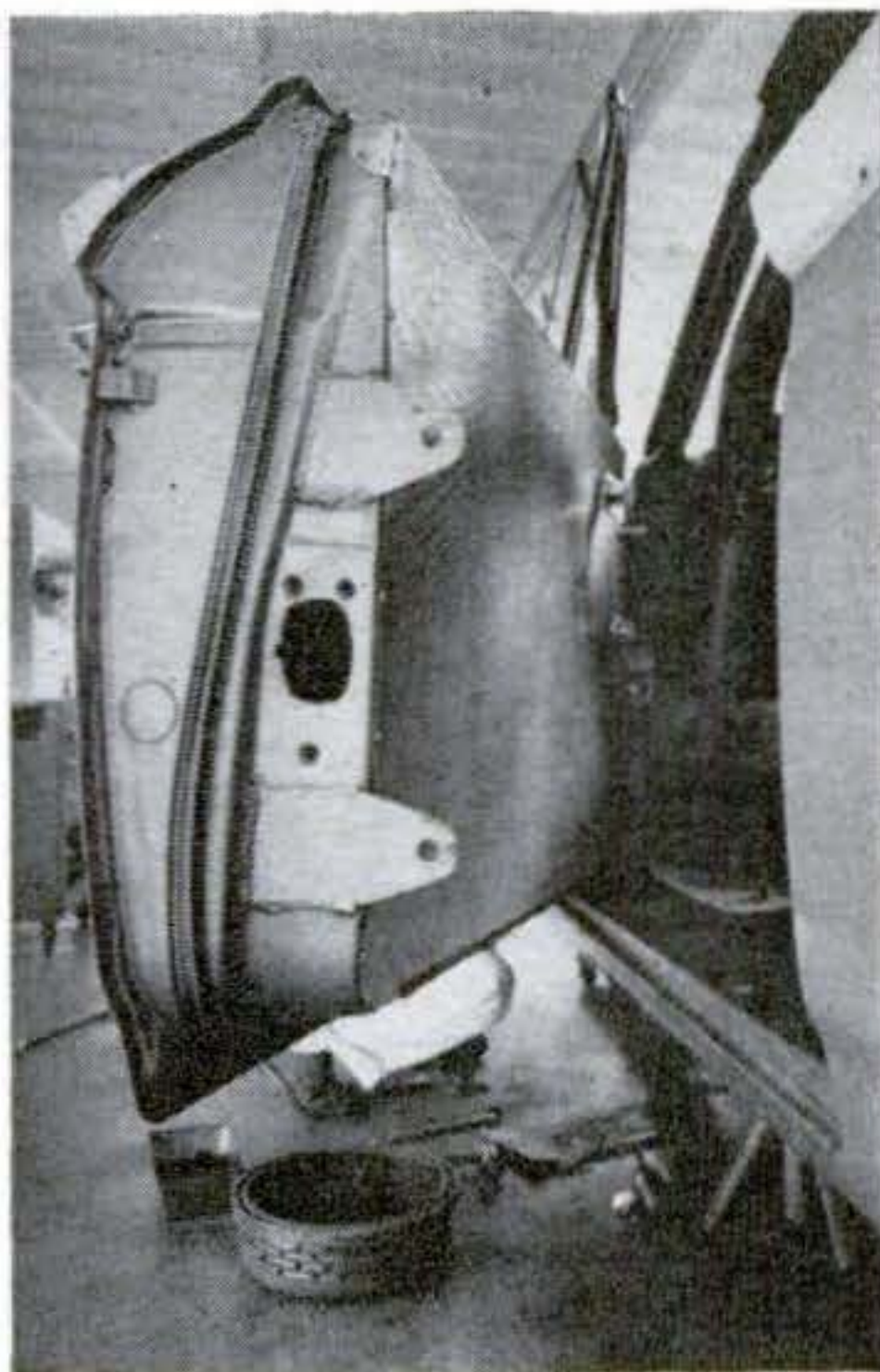
A racer's rear axle is full-floating type. For safety, the drums have special hubs to carry the bolts for beefed-up wheel spiders.



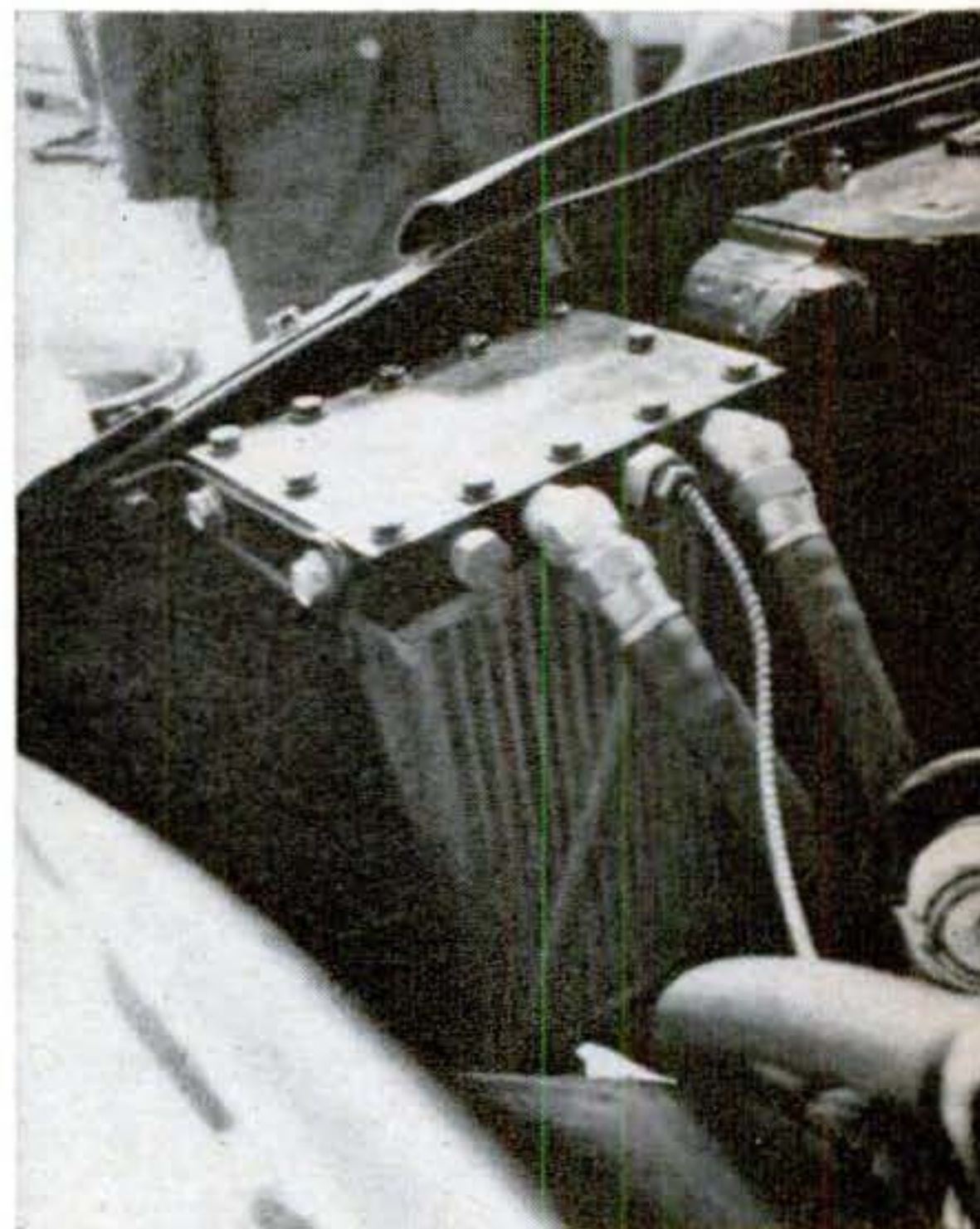
Dash has tachometer, gauges for water temperature, fuel supply and pressure, oil temperature and pressure. Toggles are for ignition.



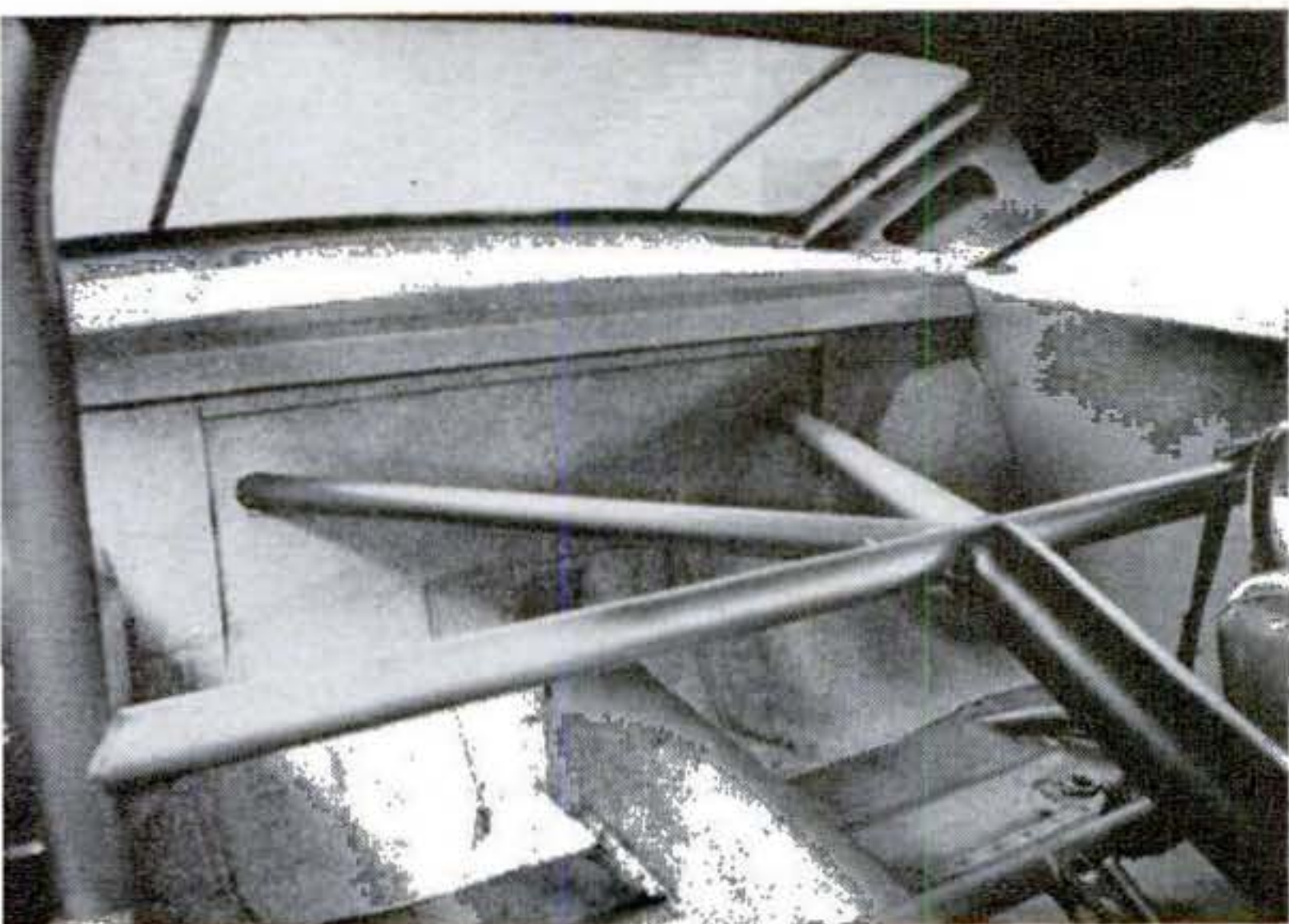
Unmuffled twin exhaust pipes are routed out sides of car, to exit behind doors. This is done to cut down on the fire hazard at fueling stops.



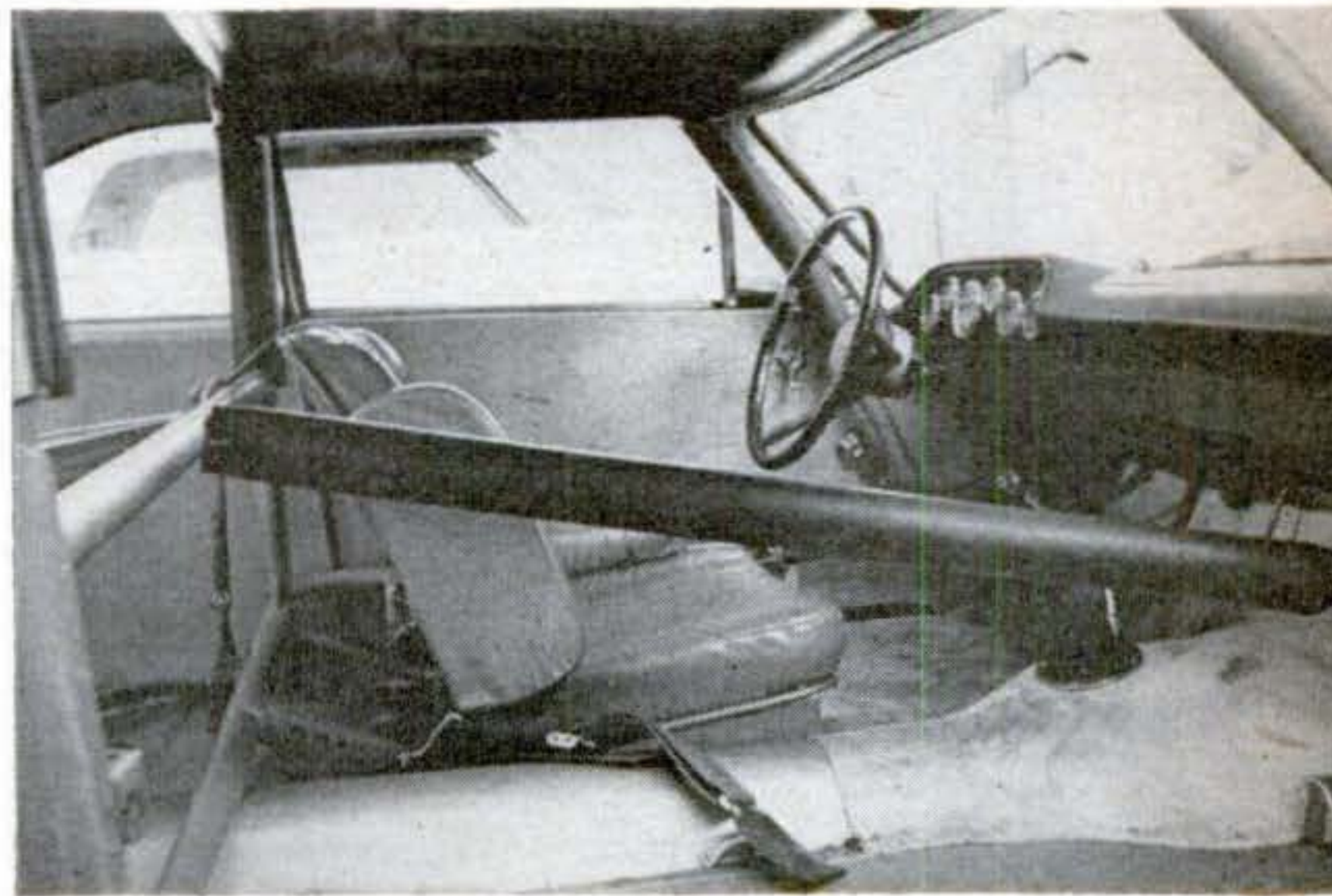
Car doors are lined with aluminum as a fire barrier, and bolted shut, then fastened to roll-bar framework. The driver crawls in through window.



Cooler is installed in left front of engine compartment to keep oil down to 190 degrees. When cars bunch up, fresh air for engine cooling is scarce.



Steel firewall stiffened with steel bars, is substituted for the usual cardboard partition between the passenger compartment and the trunk.



Same steel bars help form support for roll-bar framework, anchored to car frame. Driver's bucket seat is bolted to this framework.

Fastest, Highest, Hottest

The Incredible

By Wesley S. Griswold

STARTING a flight in the X-15 is like starting your car while falling off a cliff. The little black research plane with the ball-tipped nose and inadequate-looking wings drops like a bomb from its B-52 launch plane.

After a plunge of 500-1,500 feet, the craft—if its tremendously powerful rocket engine “gets a light”—climbs as though shot out of a cannon. It is hurled upward by nearly 600,000 hp. at full throttle—the all-out thrust of 2,000 robust automobile engines. That terrific power flashes into being with the sound of an explosion; in just a few seconds the plane is supersonic. The pilot hears no more noise from the engine, feels only the subdued vibration of its effort.

The craft barrels aloft until burnout—two minutes at most. The pilot, weightless, then crests an invisible summit in the near-vacuum of space, and the X-15 starts falling earthward, belly foremost.

In space, the plane’s “attitude” is controlled by steam jets in nose and wings (like a spaceship) but this has no effect on its ballistic trajectory. As the craft re-enters the atmosphere, its “angle of attack” becomes critical. Spearheading into the atmosphere at top speed would burn too much skin off the X-15. For frictional braking, the pilot must point the nose at an angle above his trajectory. The angle must be precise, since too much re-entry stress would tear the plane apart.

Descending from the awesome heights to which the black bird soars is a sensation the dizziest roller coaster couldn’t begin to match. During re-entry, de-

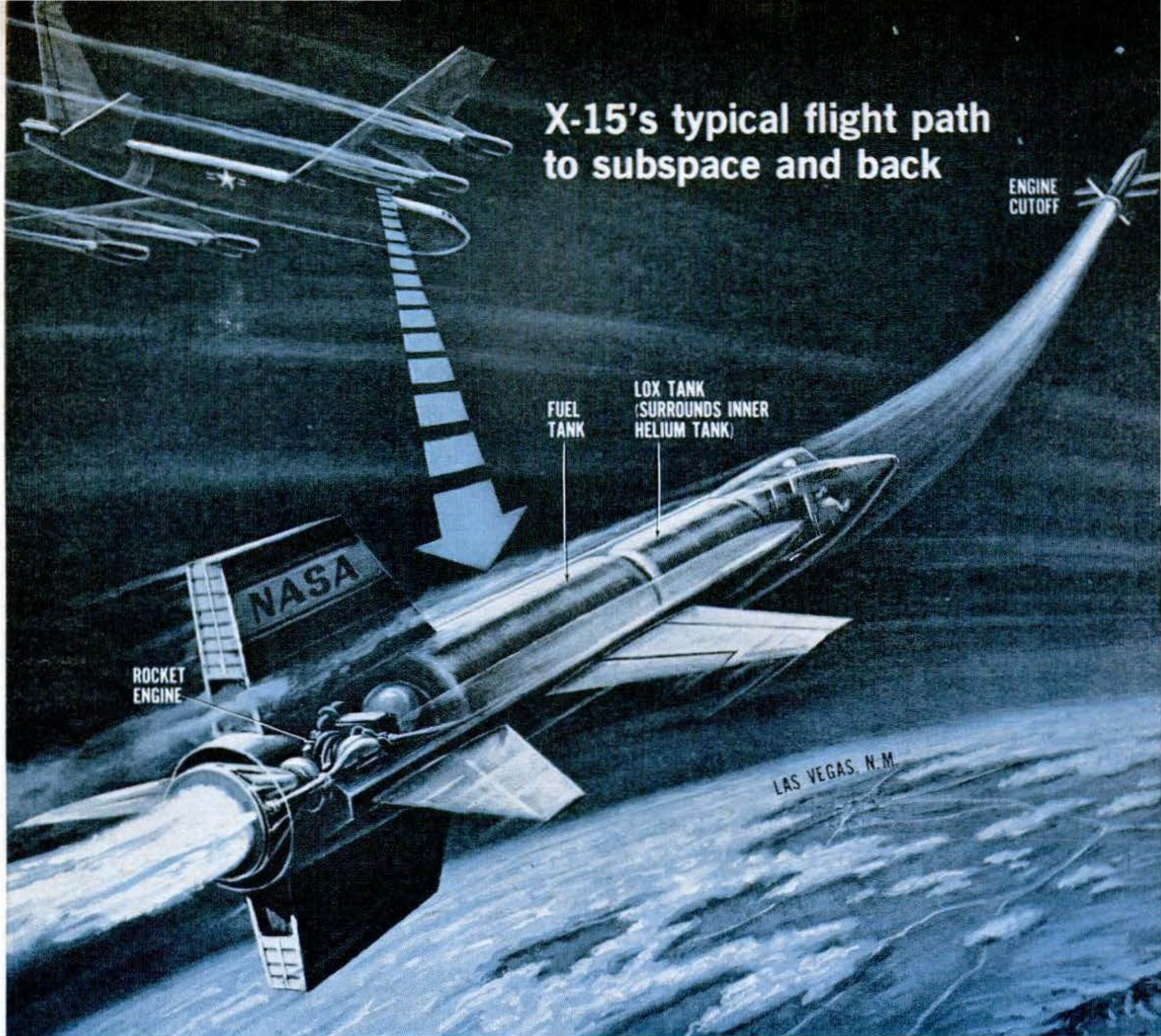


X-15

Writing history with a ball-point rocket plane, a band of test pilots is compiling know-how for the day when we'll really fly in space!



Moment of release is shown in this NASA photo as X-15 aerospace research plane falls away from wing pylon of B-52 mother plane over the Nevada desert, at 45,000 feet. Rocket's first-stage igniter is on at drop, but pilot has no engine power—he must “get a light” before heading for space. F-104 chase plane is in the distance.



X-15's typical flight path to subspace and back

ENGINE CUTOFF

ROCKET ENGINE

FUEL TANK

LOX TANK (SURROUNDS INNER HELIUM TANK)

LAS VEGAS, N.M.

After the drop of 500-1,500 feet from its B-52 launch plane, X-15's rocket engine starts, if pilot is lucky. The 600,000-hp. engine is fed 4.2 tons of fuel (liquefied ammonia gas) and 5.2 tons of LOX (liquid oxygen) from outer wraparound tanks by pressure from helium in central tank. Pilot cuts engine, after less than two-minute powered flight, at 125,000 to 140,000 feet and continues, weightless, in ballistic trajectory over

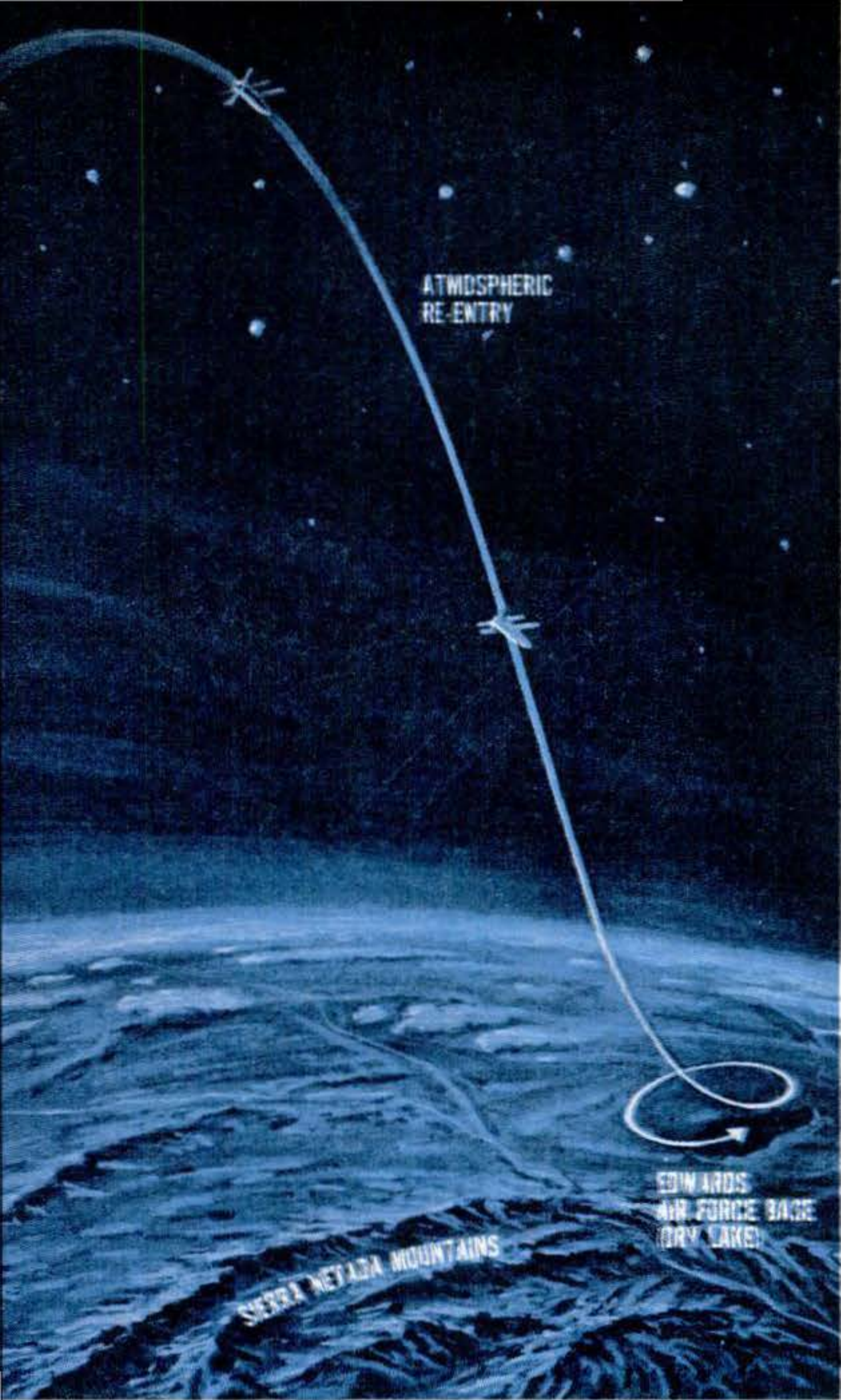
the hump at border of space. Looking across 420-mile flight range, view here is easterly toward Las Vegas, with Sierra Nevada Mountains in lower right foreground. As X-15 falls toward earth and re-enters atmosphere, ship's undersurfaces must be presented at correct angle for frictional braking. Farther down, pilot regains aerodynamic control and lands at Edwards Air Force Base in California.

celeration G-forces shove the pilot against his harness with fierce energy. He might black out or come apart inside if it weren't for the body-gripping, blood-damming air bladders that automatically inflate his pressure suit.

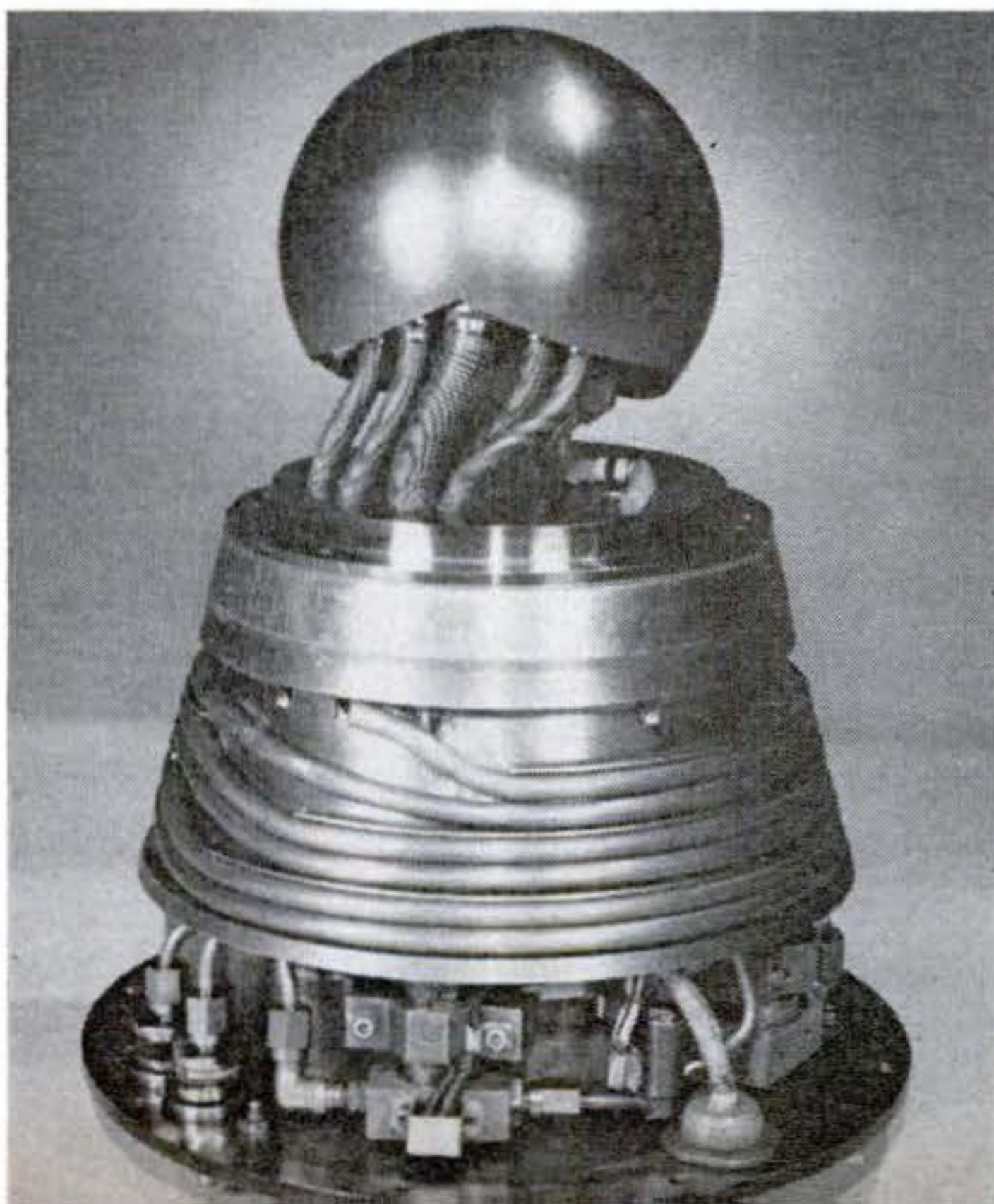
Terrific come-down. Landing the 50-foot plane-missile is like driving a car at racing speed on the bare rims of its rear wheels. The X-15's landing field is a hard-baked dry lake. It sets down on two three-foot steel skids and a pair of small nose wheels at 180-225 m.p.h., and

slides for a mile or more before it stops.

It was during such a landing that one of the three X-15s, ship No. 2, was wrecked last November 9. After dropping from the mother plane, pilot Jack McKay discovered that his engine was unable to reach full power. He shut down the engine and made an emergency landing on Mud Lake, 195 miles from home base. The nose-wheel support collapsed at the end of his landing slide, and the ship flipped over. McKay had anticipated trouble and had blown

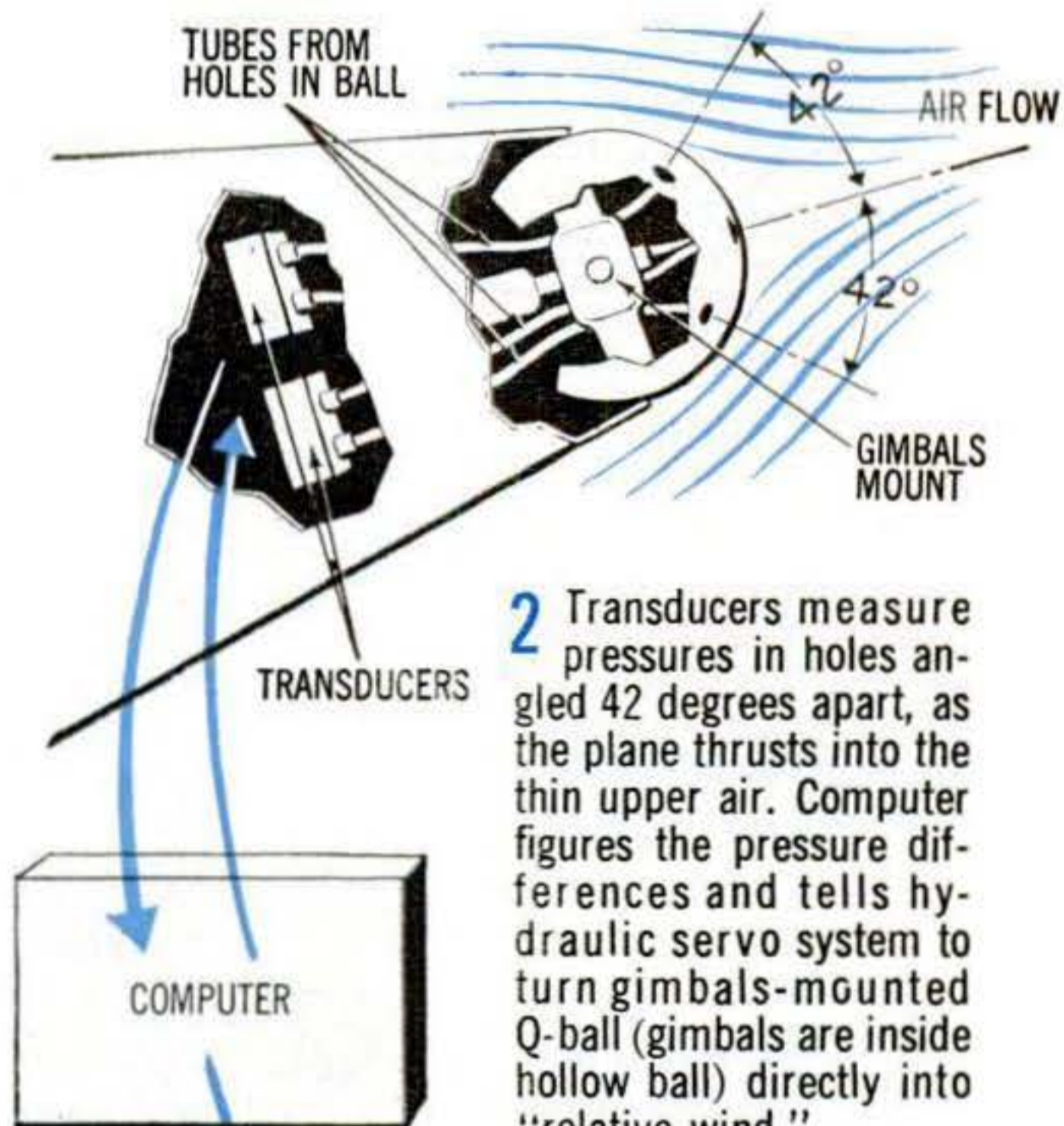


Inside Q-ball: Hollow nickel-chrome ball, cooled by liquid nitrogen, can take 4,000 degrees F. and pressures up to 2,500 lb. per sq. ft. It's made by Northrop's Nortronics division.



How X-15 is aimed for re-entry

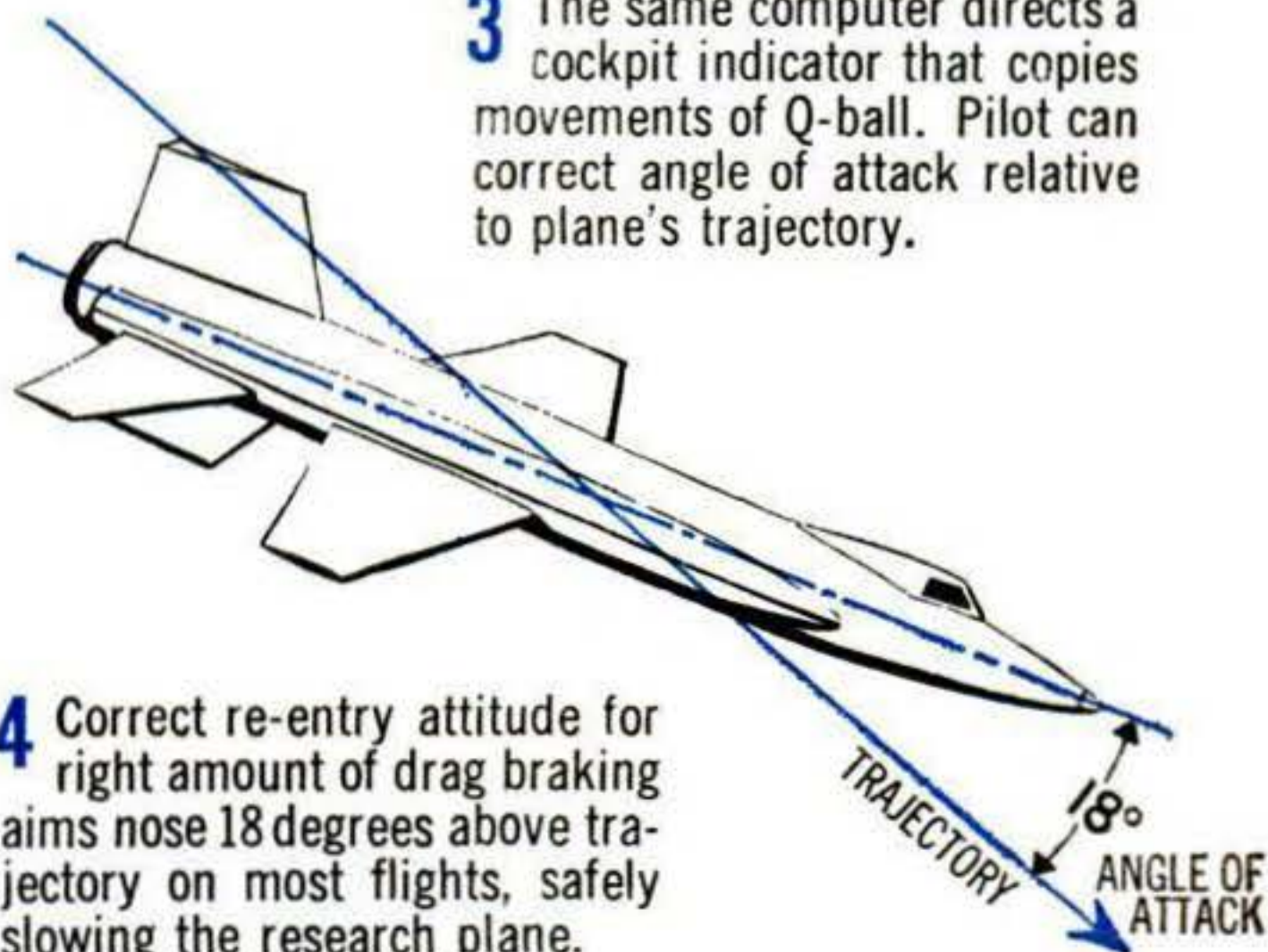
1 Q-ball, at tip of X-15's nose, and jets of steam (generated by hydrogen peroxide) from miniature rocket motors, also shown, are both needed for ship's return to earth. Q-ball senses X-15's critical "angle of attack."



2 Transducers measure pressures in holes angled 42 degrees apart, as the plane thrusts into the thin upper air. Computer figures the pressure differences and tells hydraulic servo system to turn gimbals-mounted Q-ball (gimbals are inside hollow ball) directly into "relative wind."



3 The same computer directs a cockpit indicator that copies movements of Q-ball. Pilot can correct angle of attack relative to plane's trajectory.



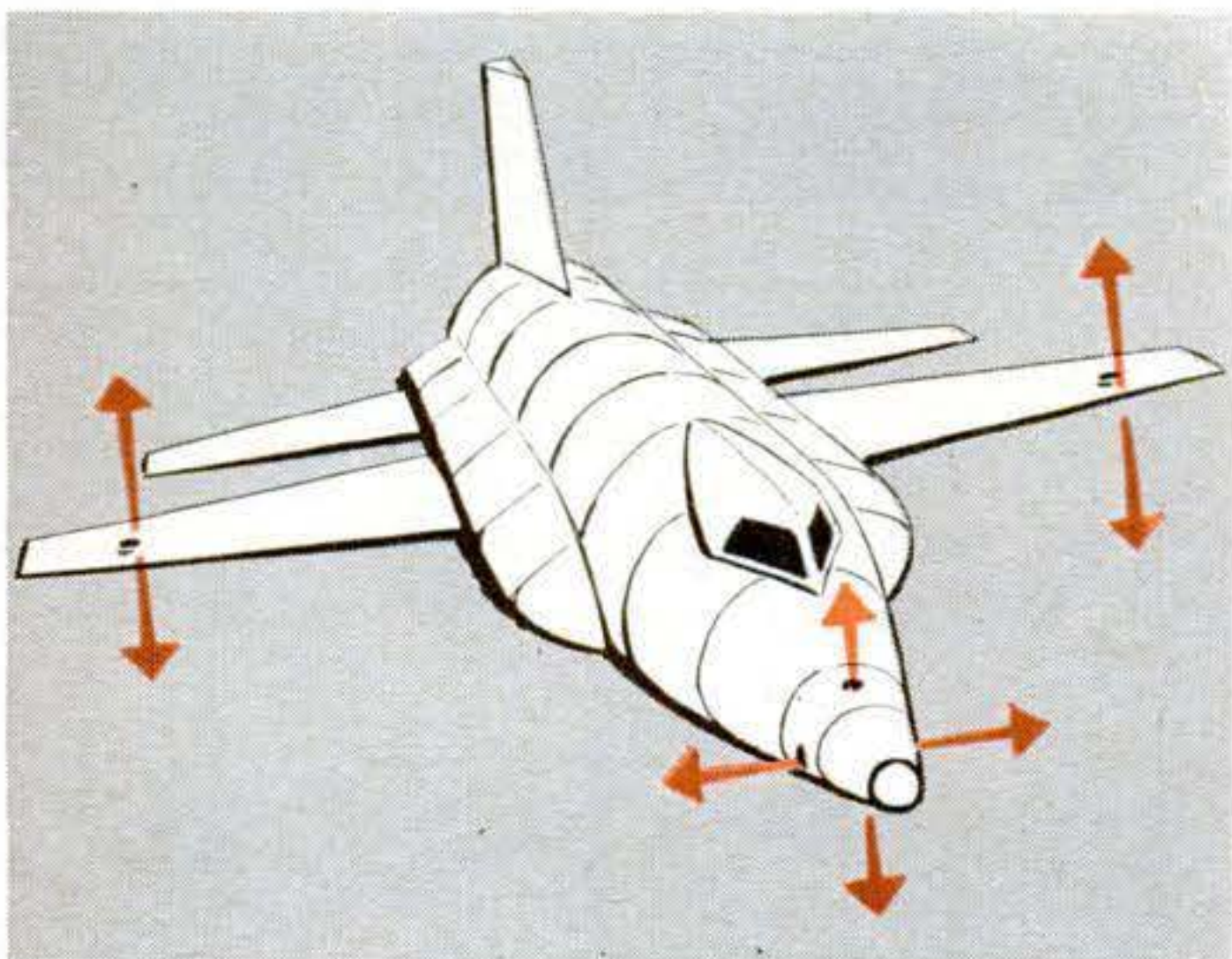
4 Correct re-entry attitude for right amount of drag braking aims nose 18 degrees above trajectory on most flights, safely slowing the research plane.



Pilot gets a choice of conventional center stick or one at his right in atmospheric flight. Both wiggle tail and wing surfaces. Side stick is used when G-forces won't let him reach center stick.



In the thin air of subspace, where aerodynamic control is lost, pilot uses steam jets, controlled by stick at his left (top center of photo). Striped handle is for emergency ejection seat.



Steam jets are used in various combinations to change plane's attitude when outside the atmosphere. Nose jets control vertical pitch and sideways yaw; wing jets control roll.

off his cockpit canopy. Rescuers eased him out in five minutes, only bruised.

When POPULAR SCIENCE first took a look at the X-15 [June, '58], we needed a crystal ball and a lot of luck to make out even its outlines. The plane wasn't finished. It was under tight security wraps. Only extravagant predictions about it were easy to come by. "This will be a steppingstone to space," said North American, its builder.

In the 4½ years since, flying out of Edwards AF Base, Calif., under a joint Air Force, Navy, and NASA program, the X-15 has repeatedly proved itself the most incredible aircraft ever built. It has set altitude and speed records far beyond the capabilities of any other known plane.

Miles-high adventures. The X-15 has already found answers to important questions about subspace that couldn't have been answered satisfactorily in any other way—answers to problems about leaving and entering the earth's atmosphere, aerodynamic heating, and the operation and control of hypersonic aircraft. The X-15 has also provided vital biomedical information for pilots of future aerospace craft, who will fly both in space and in the atmosphere.

The X-15 pioneered the use of steam jets to control a vehicle's attitude in space, and has firmly established that it is practical and preferable to have men, rather than robots, pilot spacecraft.

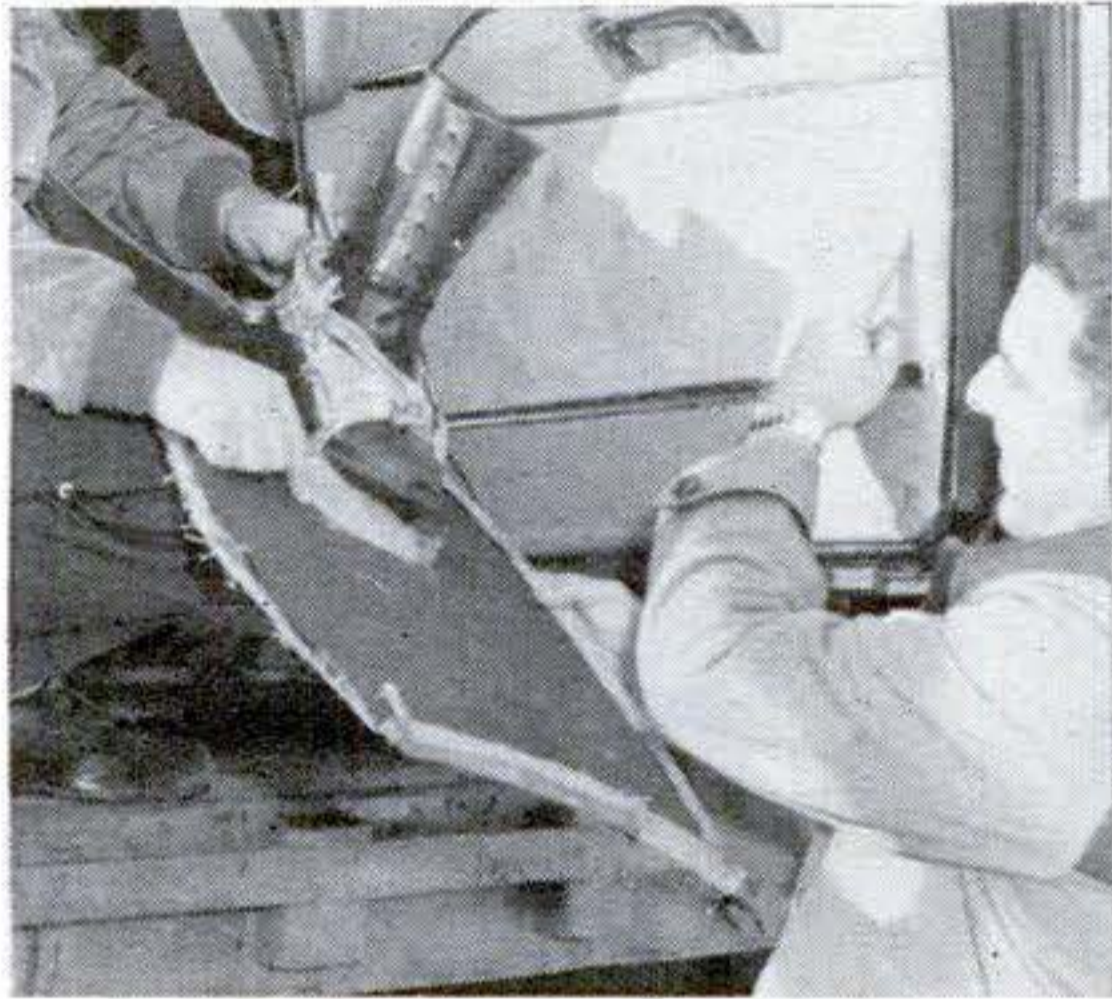
The X-15 has blazed a path from outer space to earth for the forthcoming X-20 (better known as Dyna-Soar) and other globe-girdling ships to come. The Dyna-Soar will be launched on the tip of a Titan III, go into orbit like a Mercury capsule, and then fly back to the ground like a plane—like, in fact, the X-15.

Furthermore, the X-15 has tested out special instruments and systems that are almost sure to be used on such craft.

For instance, the "Q-ball." This odd and crucial sensor is a 5½-inch hollow sphere of nickel-chromium alloy, mounted in the pointed nose. By determining "relative wind" at the plane's

[\[Continued on page 211\]](#)

Dressing up a manikin in upholstery (right), survival instructors Don Conroy and Leo Morin give demonstration to Air Force personnel. Conroy fits face mask while Morin makes warm clothing from seat upholstery.



Serviceable snowshoe is improvised from fiberboard panel cut from inside the car door. It's tied to a boot with strips ripped from the seat covers.



How to survive a blizzard using your car and your head

Stranded in a snowstorm in your car, how would you survive? Don Conroy, Air Force survival specialist at Hanscom Field, Mass., suggests you tear the car apart.

Snowshoes can be improvised from fiberboard cut from inside the doors, face masks and mukluks shaped from the ceiling lining. Seat covers can be ripped into strips for

leg and foot wrappings; upholstery padding can be made into warm boots.

Conroy has one more tip: Remove the spare to a safe distance. Fill a hubcap with gas by disconnecting the fuel line at the carburetor and pressing the starter. Dump the gas on the tire to start a long-lasting and bright signal fire.



1902 antique-car race re-enacted

A 1900 Winton with Alexander Winton Jr. at the wheel spurts ahead of a 1902 Oldsmobile driven by Keith Oderkirk in a re-enactment here of the first speed race on Florida's hard-packed sand beaches. It was part of the 60th anniversary of beach racing during Ormond Beach's annual Birth-

place of Speed Celebration. In the re-enactment the Olds won two of three half-mile sprints, but in the original race in 1902 the senior Winton's Bullet tied R. E. Olds' Pirate—at 57 m.p.h.

The following year Winton pushed the speed mark to 68 m.p.h. In 1935 at Daytona Beach, Sir Malcolm Campbell set a record of 276 m.p.h. that still stands.



Special trailer makes 4,000-pound Cubmarine easy to tow on land. Flappers on each side of bow are

Portholes all around provide clear view in every direction above or under surface. Square plate behind pilot standing in main hatch is emergency escape hatch for use when submerged.

Newest underwater craft: two-man Cubmarine

Unlike most of the tiny submarines used for skin diving, this Cubmarine will take you and a pal down without bathing trunks or skin diving equipment. It's a self-contained dry sub that descends to a depth of 225 feet. Air is supplied to the cockpit by two separate systems feeding from four

pressure cylinders. Recirculators remove carbon dioxide and add oxygen for up to eight hours. Mouthpieces are available for emergency, and there are outside fittings that can be hooked up with an escort vessel or a skindiver's air bottle.

Powered by a four-hp. motor drawing



Sporty new walk-through Scout

Two-tone bucket seats and matching two-seat rear bench mark the latest version of International Harvester's all-purpose Scout.

A partition dividing the front and rear sections has been removed and the right front seat is hinged to lean forward and provide easy access.

Removing the back seat turns the Scout into a pickup. For more space, the tailgate (with attached spare tire) lowers. Three tops are available.



diving planes. Propeller at stern is shrouded in rudder to protect it against underwater obstructions.

Instrument panel resembles a small plane's. It has compass, depth finder, pressure gauges, inclinometer, voltmeter, ammeter, and clock. Switch at left is for forward or reverse. Levers at right flood or vent Cubmarine's two sets of trim tanks.



juice from ten 12-volt marine batteries, the 18-foot boat cruises on the surface at six knots, submerged at five, and has a range of about 20 miles. It has a three-foot beam and is five feet, nine inches high from hatch to keel.

Diving planes at the bow and the rudder are maneuvered by airplane-type controls. Other equipment includes a blow-and-flood system for the main ballast tanks and trim

tanks forward and aft. Water may be interchanged in these or pumped out to sea.

The Cubmarine, built by Perry Submarine Builders, West Palm Beach, Fla., was born of an idea that came to John H. Perry Jr. during an encounter with sharks while spear-fishing. Because of that experience, the prow of its aluminum hull has two spear-gun tubes for hunting in the depths. The little boat costs \$29,600.

Three jets in tail

America's first triple-jet airliner, designed for short to medium range, is rolled out by Boeing at Renton, Wash. The 727 is powered by Pratt & Whitney JT8D turbofan engines. It will carry 70 to 114 passengers from 150 to 2,000 miles at cruising speeds of 600 m.p.h. Five airlines have ordered 87 of the new jet planes.





STRATOSCOPE II:

Sky-High and Starry-Eyed

Inflation begins as helium flows through tubes into the side of Strato II launch balloon.

Photographic assignment for a bizarre balloon-telescope: Go up 15 miles, get best shots ever of planets and stars

By Robert Gannon

ONE evening late this month or early in March, a 90-foot balloon will rise through the dusk over Texas, dangling a 340-foot plastic sausage, two parachutes, and a three-ton telescope. The whole string is as tall as a 66-story office building.

As the balloon gains altitude, the sausage casing will rip and a giant plastic bag inside it will begin to inflate, becoming a second, and even bigger, balloon. The double balloon will carry the telescope to 80,000 feet. Then astronomers on the ground will order it to get our first really good look at Mars.

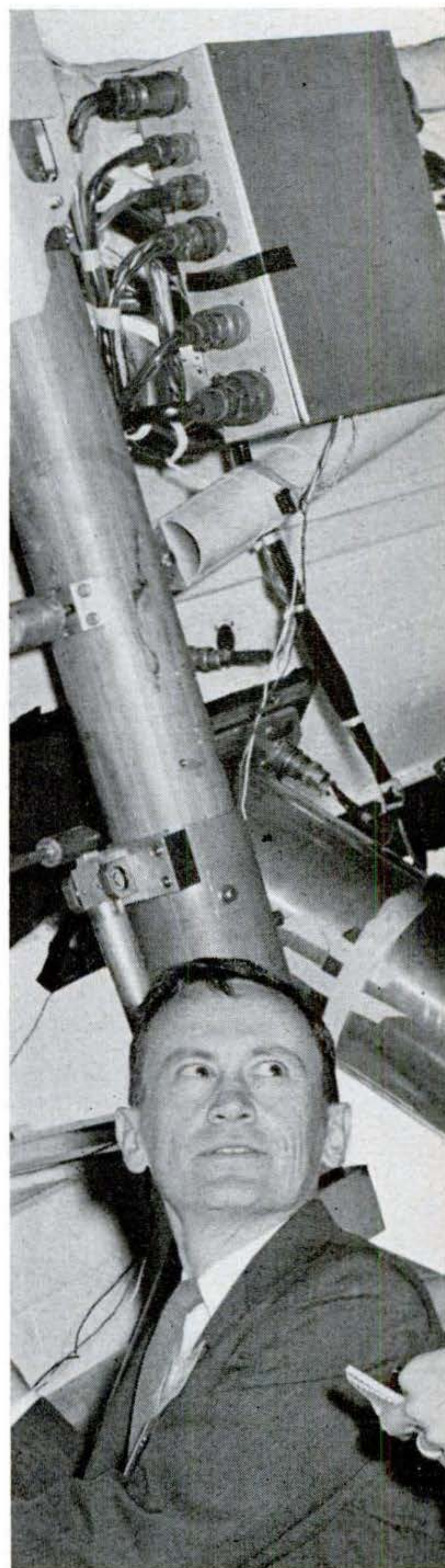
Photos of the planets and stars by Stratoscope II (as the balloon-telescope combination is called) will be the sharpest and clearest ever taken. They'll even be better than those shot through the massive 200-inch scope on California's Mount Palomar, though Strato II's magnifying mirror is only 36 inches across. The reason: The balloon telescope drifts above 96 percent of the turbulent, dusty atmosphere that limits "seeing" conditions from the ground.

A series of flights this year will answer many long-standing questions about the canals of Mars, the cloud patterns of Venus, the red spot of Jupiter, the craters of tiny Mercury.

To make best use of the good seeing up there, Strato II's telescope has the most perfect large astronomical mirror ever polished and an aiming mechanism so precise that its camera can take time exposures lasting all night.

The wasp-waisted double-balloon configuration is the product of an ingenious launching technique designed to keep the balloon from wrecking its payload by dragging it along the ground. (The scope cost \$2,500,000, and is supposed to be re-usable.) Total cost of the project to date: around \$5,000,000.

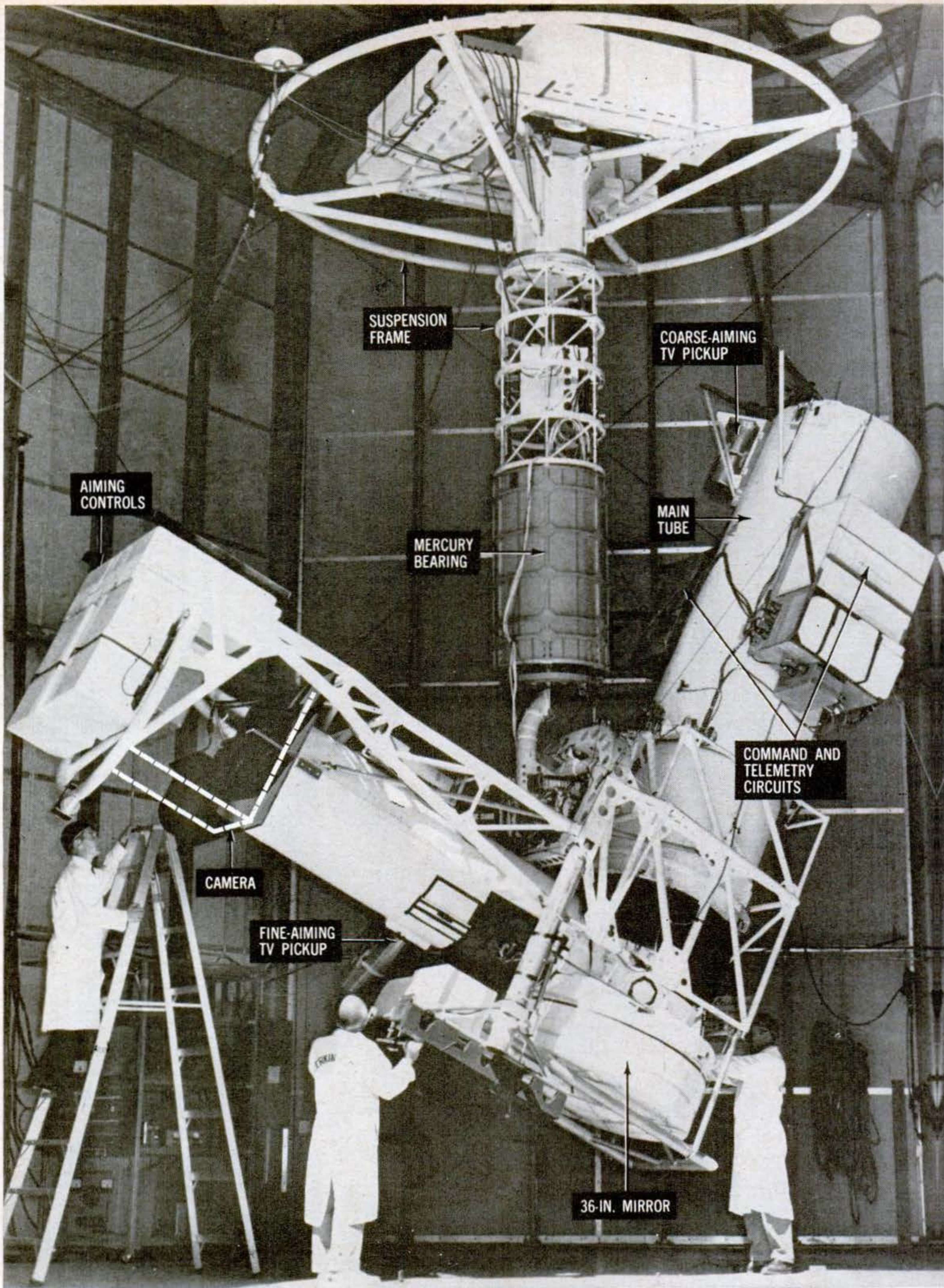
All that money came from the National Science Foundation, the Office of Naval Research, and the National Aeronautics and Space Administration. The man who talked them into putting it up, and who directs the project, is Dr. Martin Schwarzschild, internationally noted Princeton University astronomer.



Dr. Martin Schwarzschild, originator of balloon astronomy, supervises the Strato II flights. The big telescope, his brainchild, towers over him.

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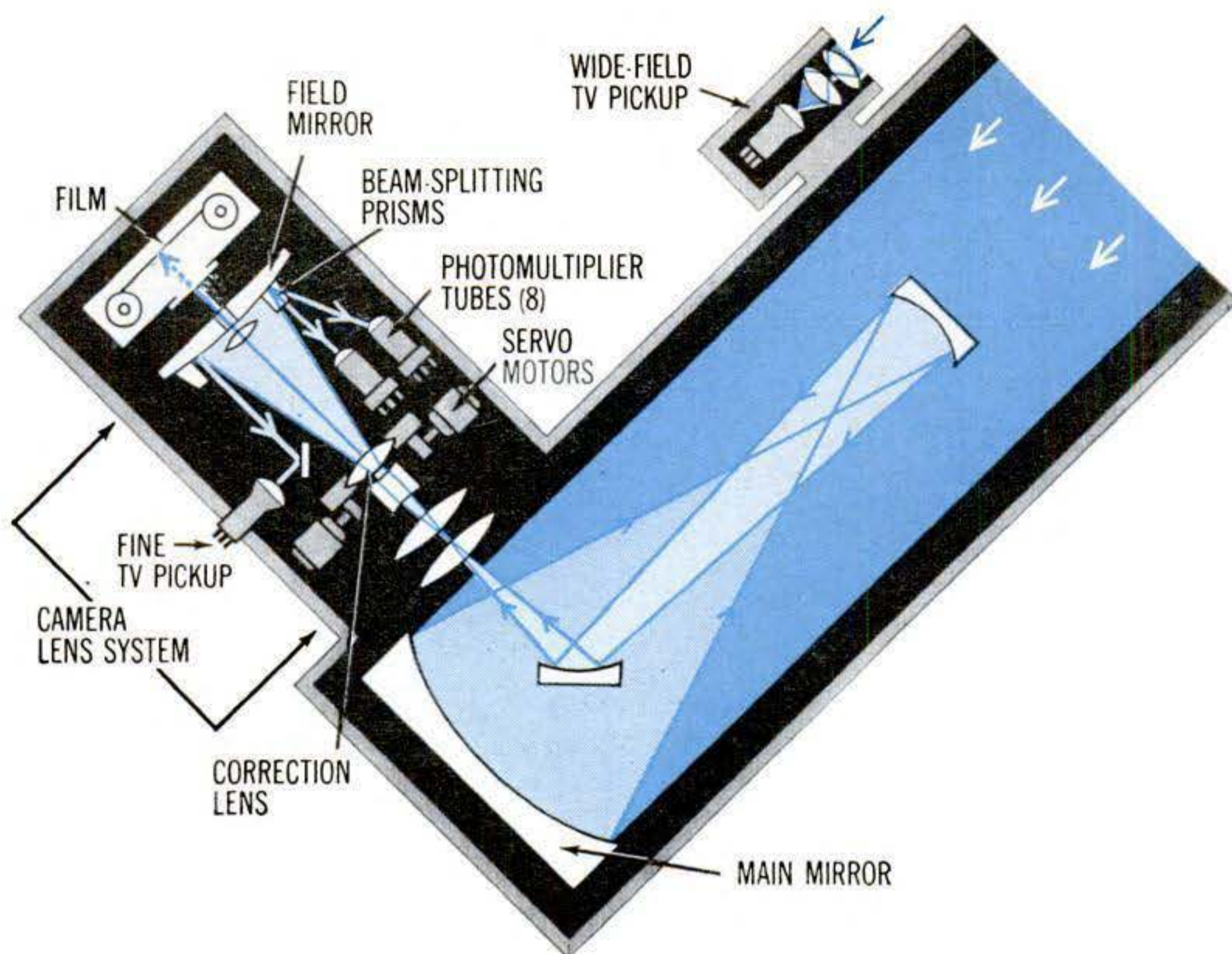
87



Payload of Stratoscope II is this three-ton telescope, built by Perkin-Elmer. Right arm is scope's 18-foot main tube, with 36-inch mirror

at bottom. Eleven-foot left arm carries controls and camera. The whole works turns gently on a huge mercury bearing in the center frame.

Simplified diagram of scope and camera. Wide-field TV pickup, upper right, is for coarse aiming. Light entering main tube, right, hits magnifying mirror, is directed by mirrors through lens system of camera, left. Camera sees center of image. Field mirror sends wider image to TV pickup, lower left, for fine aiming. Beam-splitters send images of guide stars to photomultiplier tubes that control servo motors, moving correction lens to keep image centered on the film.



The concept of hanging a telescope from a balloon had its genesis at Princeton in 1955. Dr. Schwarzschild had just returned from a six-month sun-study project at Mt. Wilson Observatory. "I wasn't very happy with the results," he told me recently. "There was too much blockage from the atmosphere. We just couldn't see the sun clearly enough—and I couldn't figure out how to solve the problem."

The key idea was provided by James A. Van Allen, now of radiation-belt fame. On a visit to Princeton, Van Allen had lunch with Schwarzschild, listened to his complaints, and gently took him to task. "You astronomers are a conservative lot," he said. "We physicists aren't. For example, for years we've been using balloons to hoist scientific instruments into the stratosphere."

Schwarzschild latched onto the suggestion, developed it, and convinced the government of the value of a balloon-borne observatory. Sponsored by three U.S. agencies, Stratoscope I, a 12-inch ground-controlled balloon-telescope designed to take pictures of the sun, was launched in 1957. It worked spectacularly, taking the sharpest photos of sun-

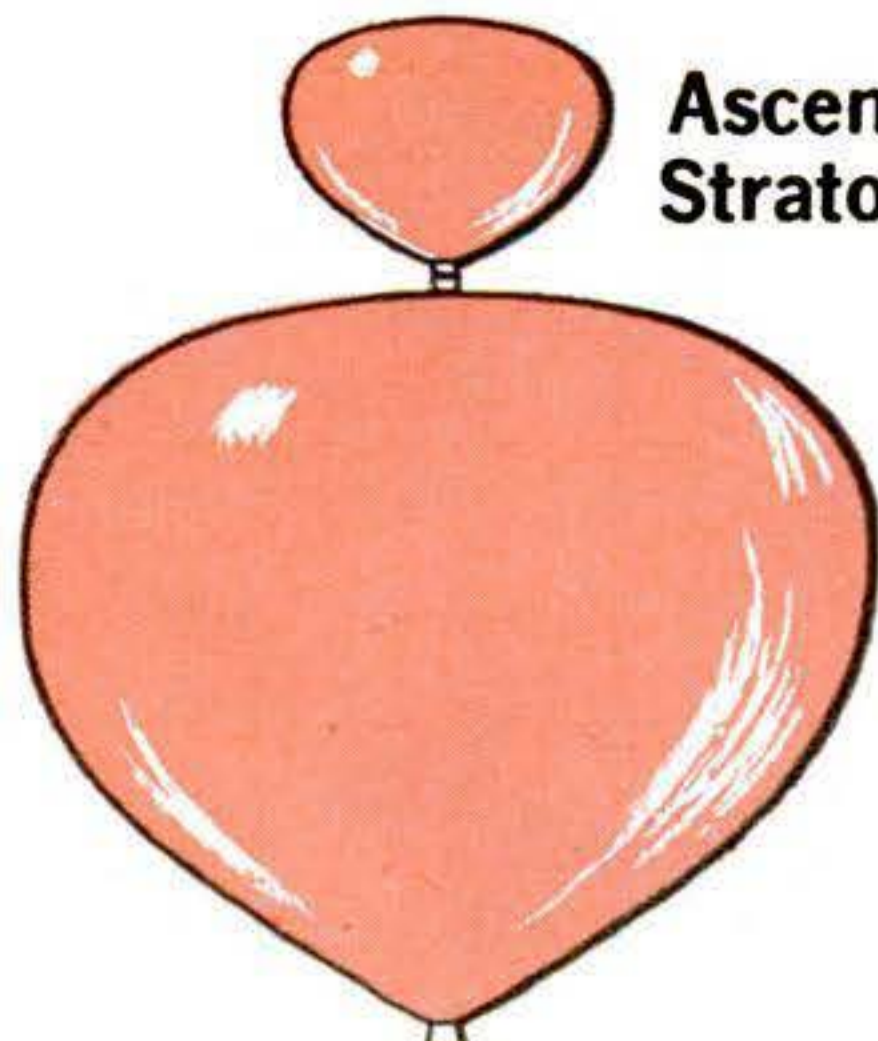
spots and the sun's boiling surface ever obtained. From this unqualified success, Stratoscope II evolved.

The telescope itself looks like a giant "L" with arms 18 feet and 11 feet long. It hangs from a vertical frame, floating on a washtub-size mercury bearing. So perfectly balanced is it that when I leaned against the structure in a test lab at the Norwalk, Conn., plant of Perkin-Elmer Corp. (designer and builder), the three-ton scope swung slowly, as easily as a barn door.

The 36-inch mirror is a masterpiece of craftsmanship. Cast by Corning Glass Works and fine-ground by Perkin-Elmer, the 400-pound quartz mirror is polished to a tolerance of one 2½-millionth of an inch, and will give an optical resolution of 1/10 second of arc. That's equivalent to an ability to distinguish between two toadstools a yard apart 1,000 miles away. Best photos ever taken by a telescope up to now have had a resolution of ⅓ second of arc—about a third as sharp as those Strato II will provide.

Heavyweight lift. The telescope, ballast system, and other paraphernalia weigh about five tons, an immense weight to be lifted by balloon. The dou-

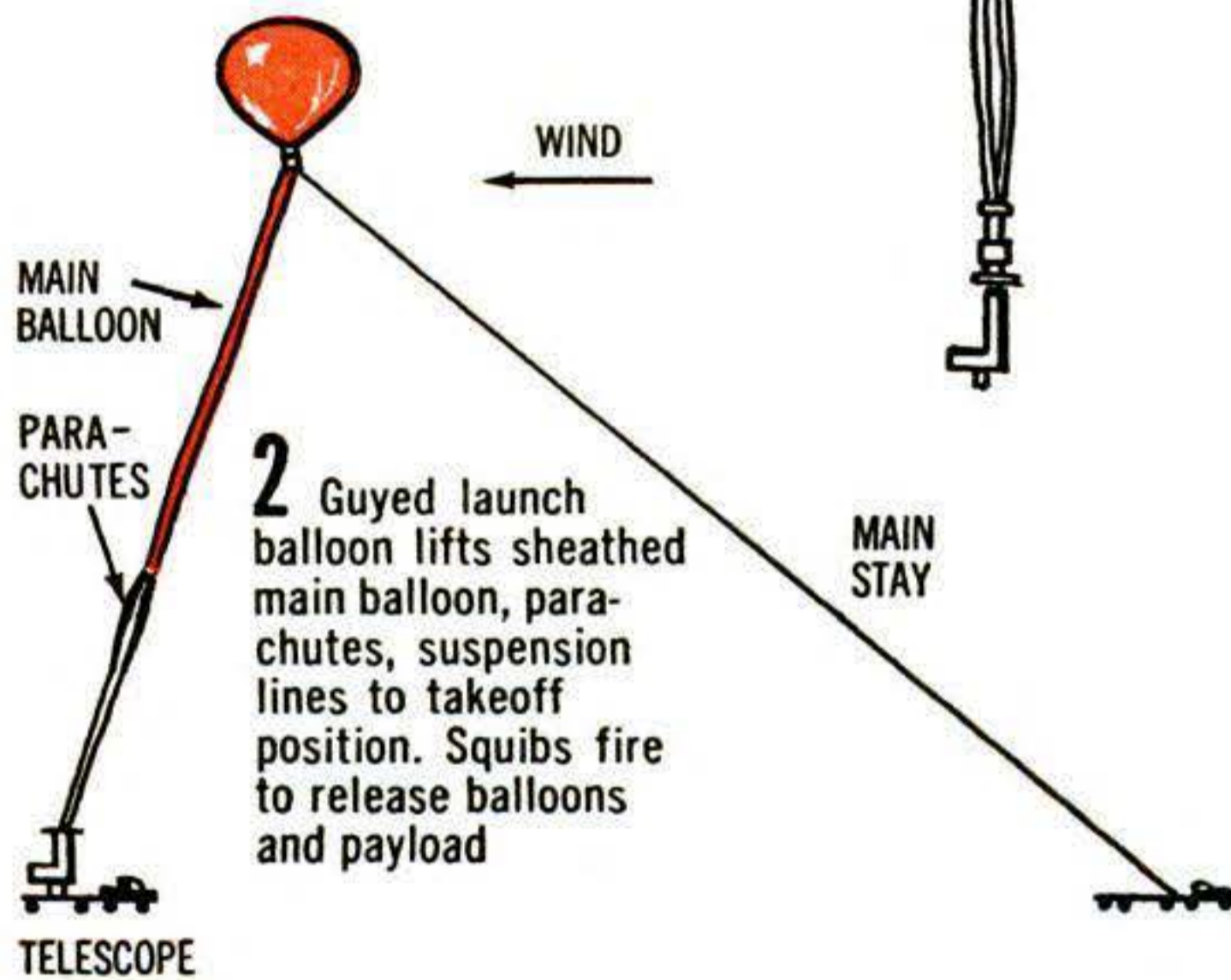
Ascent of Stratoscope II



4 At 80,000 feet, both balloons are fully inflated. Telescope swings to sighting position. Strato II drifts till dawn, is valved down

SCOPE IN SIGHTING POSITION

3 As balloon rises, helium expands into main balloon, ripping sheath



2 Guyed launch balloon lifts sheathed main balloon, parachutes, suspension lines to takeoff position. Squibs fire to release balloons and payload

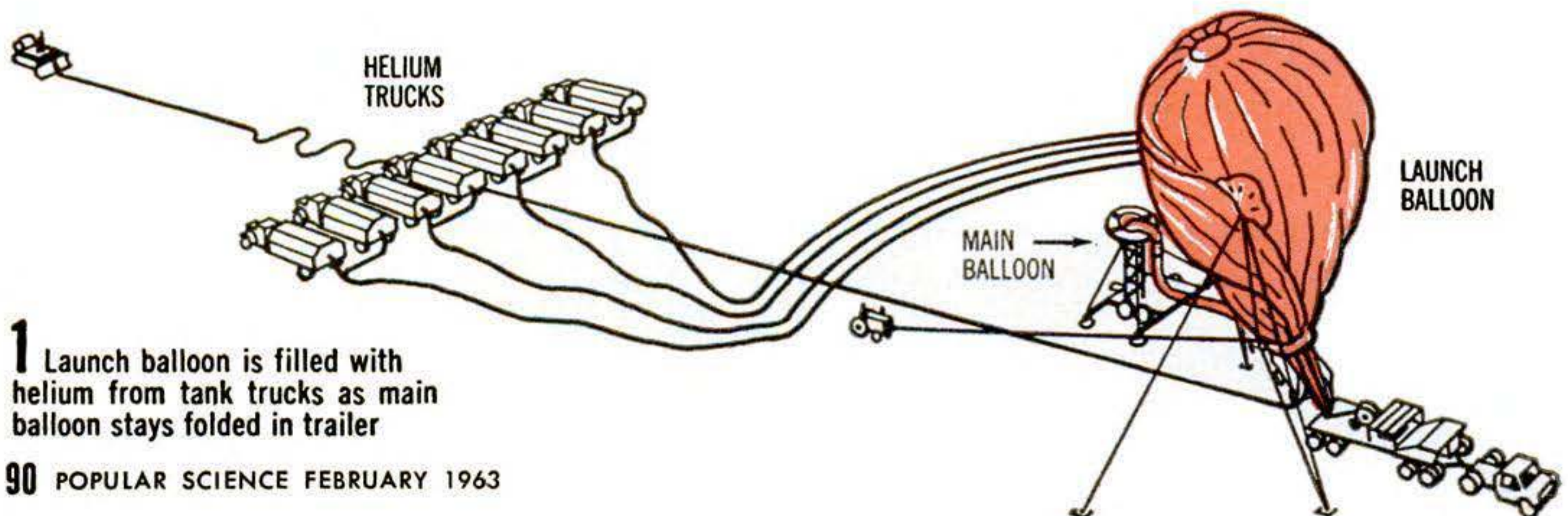
MAIN BALLOON

PARACHUTES

WIND

MAIN STAY

TELESCOPE



1 Launch balloon is filled with helium from tank trucks as main balloon stays folded in trailer

HELIUM TRUCKS

MAIN BALLOON

LAUNCH BALLOON

ble balloon alone weighs a ton and a half.

A few years ago the project would have been impossible; no balloon material was strong enough. But in 1959, the G. T. Schjeldahl Co., balloon makers of Northfield, Minn., tried mylar, a plastic some 10 times stronger than the most commonly used gas-bag material, polyethylene. To the thin mylar, Schjeldahl laminated a net of dacron threads that double the strength of the mylar. As of today, the combination can't be beat for strength and lightness.

Launching of Stratoscope II will take place at a newly completed airfield near Palestine, Tex. Called the NCAR (National Center for Atmospheric Research) Scientific Balloon Flight Station, it's the first year-round facility devoted exclusively to scientific ballooning. Vitro Laboratories of Silver Spring, Md., is responsible for Strato II flight operations.

From the air the facility looks like a giant water splash on the Texas plains, with launch aprons radiating like fingers from a short, fat silo called the Stratoport—a hangar for Strato II's scope.

Trial launch. On December 12 the apparatus made a full-scale test flight, the first from Palestine. The operation was complete in detail except that a dummy payload was used.

After a weather okay (the day was sparkling), operations began about noon. Vitro engineers wheeled the trailers carrying the two balloons out on the apron.

Though it looks like a Rube Goldberg contraption, the double-balloon system is an ingenious solution to the problem of getting Stratoscope II off the ground. Enough helium to lift the five-ton pay-

[Continued on page 194]

Uphill skiing comes easy on escalator

A rubber conveyor belt on Mount La Crosse, Wisc., serves as an escalator to carry skiers back up a steep slope after they have reached the end of the run. Builders of the Ski-A-Later call it the world's first.

Skiers just slide on, one ski slightly advanced. In just over a minute, the 300-foot rubber belt takes them up a slope with a vertical drop of 43 feet. The lift has a capacity estimated at 1,200 to 1,400 skiers an hour.



Economy car comes at high price

For only \$12,000 plus change, you can be the proud owner of a 1963 Lost Cause.

A customized Corvair, you say? You're right. All trim is removed, the top upholstered, and a tiny rear window put in. Paint is hand-rubbed British racing green. Interior is trimmed in black leather and walnut. Other specials: six chromed wire wheels (rear tires are larger, meaning two spares), tachometer, AM-FM radio, trunk straps, picnic hamper, and lap robes.

The line forms at Lost Cause Motors, Louisville, Ky. Delivery takes eight to ten months.



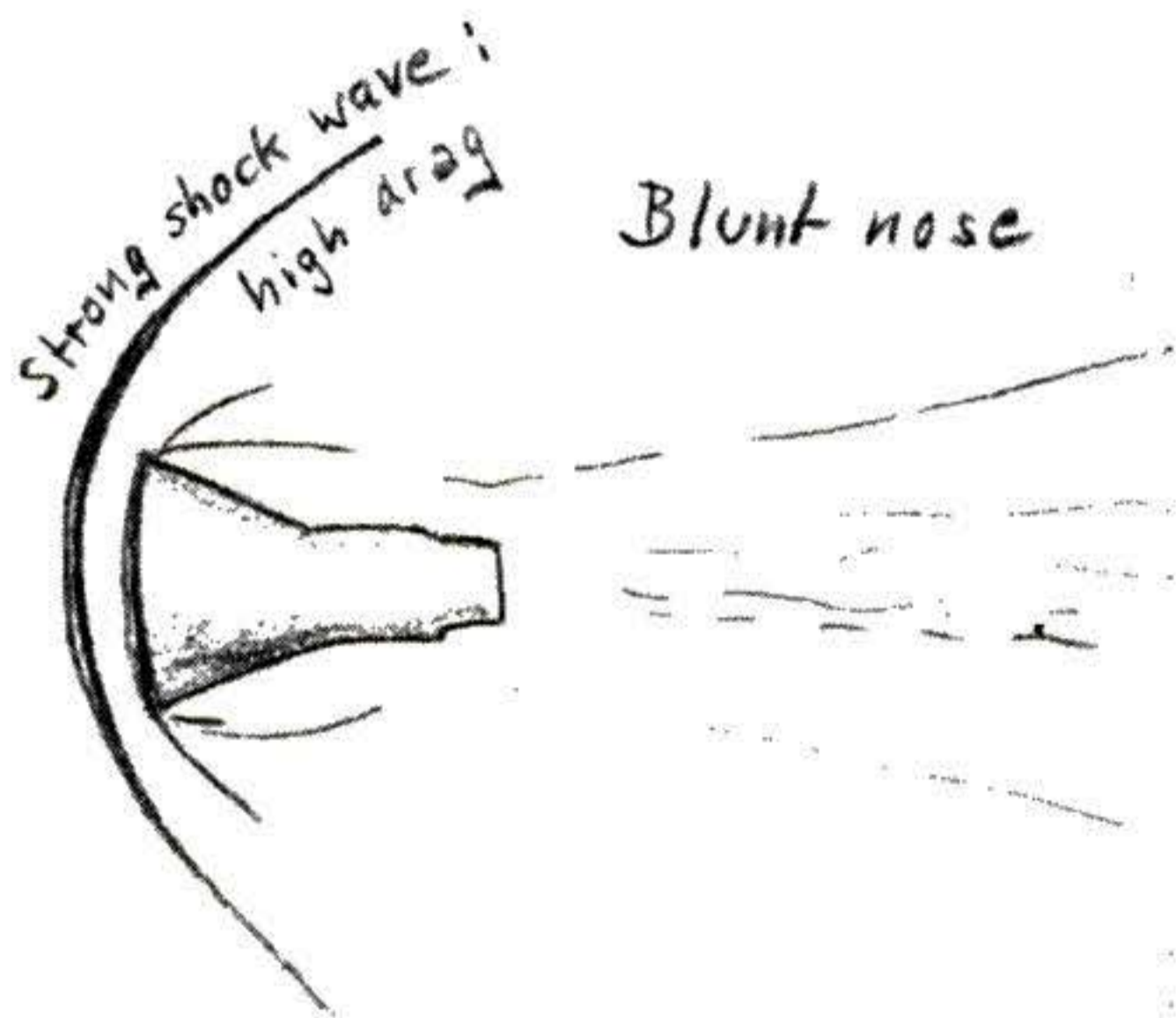
Car-shuttling train

An experimental platform train to shuttle cars through the proposed tunnel under the English Channel is demonstrated above by the French tube promoters. The 12-car train carried 40 cars 35 miles from Paris to Fontainebleau, about the length of the tunnel. The autos were not lashed down for the ride. They were unloaded at one end in two minutes, driving off over steel plates closing the gaps between cars.

More Answers to Your Questions About Space by Dr. Wernher von Braun

Q Why has the Mercury capsule a blunt nose?

A For an orbiting spacecraft to return to the earth's surface, its initial velocity must be reduced to zero. To provide the entire retardation energy with retro-rockets is unattractive; it would call for a rocket-propulsion system of about the same power and propellant consumption as the one used to carry the spacecraft into orbit in the first place. For this reason, retrorockets are employed only for the limited task of pushing the spacecraft's orbital path back into the atmosphere. The bulk of the braking action



is provided by the ensuing aerodynamic drag.

The drag is produced by air compres-

sion and air friction. Both generate heat. Suppose the kinetic energy of an iron ball, entering the atmosphere at an orbital speed of 25,600 feet per second, was completely converted into heat and all that heat was transferred back into the ball. It would never reach the ground, because there would be enough heat to melt 35 iron balls!

For successful re-entry it is therefore essential that only a small fraction of the total heat generated during aerodynamic deceleration be absorbed by the spacecraft. The most effective mechanism to carry energy away from the spacecraft and into the surrounding air is a shock wave. You may have witnessed the havoc caused to adjacent moorings by a large boat moving through a narrow channel at excessive speed. It demonstrates vividly that a very substantial portion of the boat's horsepower is carried away by the bow wave.

The blunter the bow, the stronger the wave. This is just as true for a spacecraft returning at hypersonic speeds.

We see, therefore, that the Mercury capsule has a blunt nose in order to *minimize* the heat absorbed by the spacecraft's structure, and to *maximize* the heat carried away by the shock wave.

What about supersonic aircraft?

Supersonic airplanes are needle-nosed to keep down aerodynamic drag. This is necessary when the designer has the

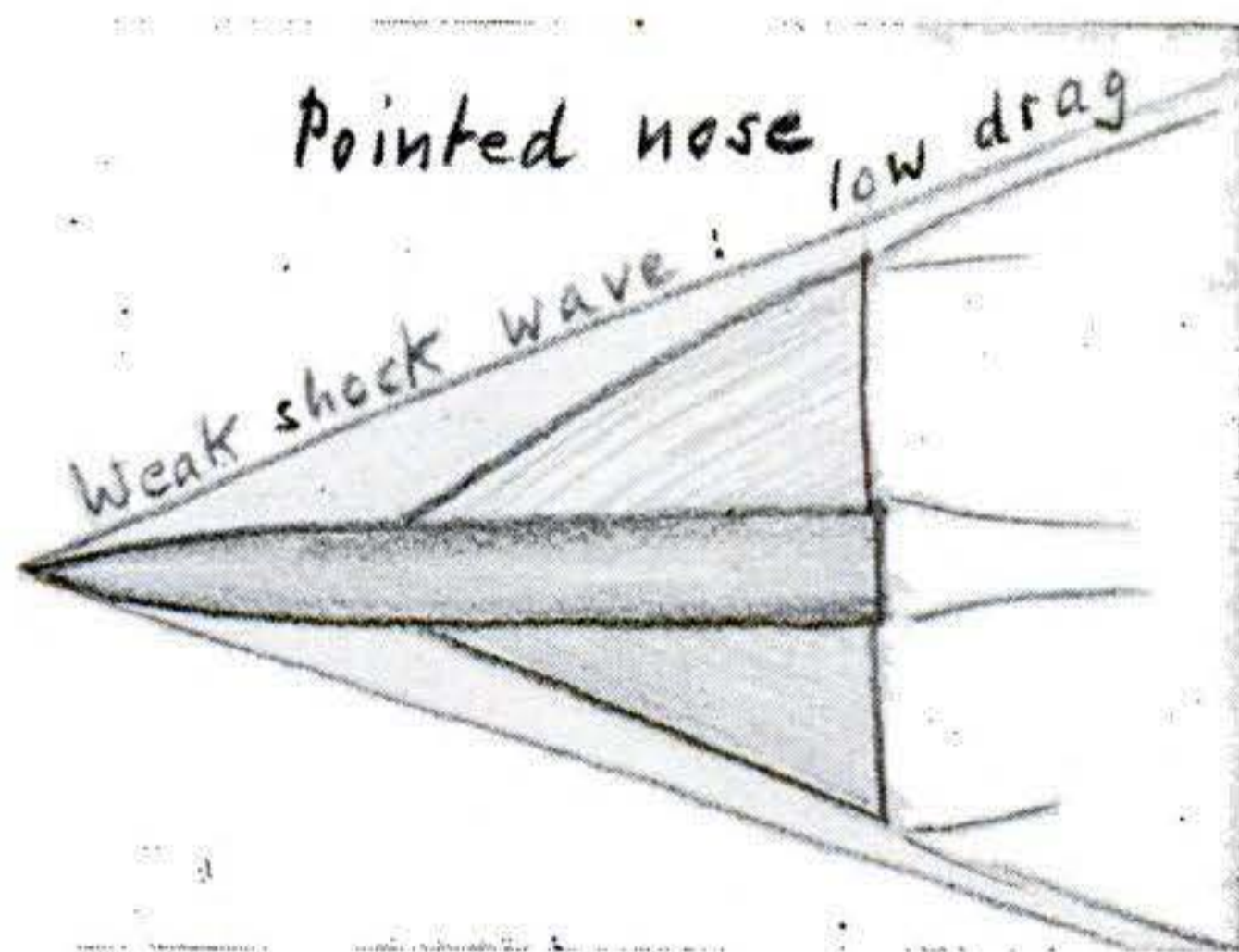
Co-chairman of a \$100-a-plate "Night of Exploration" dinner in New York, November 2, Dr. Wernher von Braun presents a scroll on behalf of the Explorers Club to Astronaut Walter M. Schirra Jr. Sharing the head table with Dr. von Braun, Director of the George C. Marshall Space Flight Center, were such notables as Sir Edmund Hillary, conqueror of Mt. Everest; General James A. Doolittle; Lowell Thomas; James E. Webb, Director of the National Aeronautics and Space Administration; and Colonel Bernt Balchen, first man to pilot a plane across both poles.



task of reaching ever-increasing speeds with the limited engine power at his disposal.

Aerodynamic heating, on the other hand, is not yet a very serious problem at the speeds of present-day supersonic aircraft, operating at Mach 2 or 3.

An orbiting spacecraft such as the Mercury capsule is boosted into space by a powerful rocket that rises vertically. Its flight path begins to level off only after it has cleared the denser layers of



the atmosphere. Here, drag reduction during the ascent becomes a minor consideration. Re-entry from orbit, however, is commenced at Mach 25! During the blazing retardation maneuver that follows, the job of keeping the heat away from the capsule, and of dissipating as much of it as possible into the surrounding atmosphere, must be our first concern.

Q *How dense is the Martian atmosphere?*

A It's pretty thin, and its physical makeup is quite different from that of the atmospheric shell that surrounds the earth.

Before we discuss it further, let us see on what observations those conclusions are based.

All of the light coming from Mars is reflected sunlight. Part of that light, before reaching our eyes, has been reflected by the Martian surface and has thus penetrated the Martian atmosphere twice—on the way down and on the way back up. The rest has been reflected by Mars' atmosphere itself and thus has never reached the ground.

Figuring pressure at surface

A careful analysis of the sunlight reflected by Mars has led astronomers to conclude that the *mass* of a column of Martian atmosphere resting upon a square inch of the planet's surface amounts to about 22 percent of that of a comparable column of air on earth. Due to the much smaller size of the Red Planet, the gravitational pull at Mars' surface is only 38 percent of one "G" (the gravity to which we are accustomed on earth). Consequently, the surface *weight* of that column of Martian air is only $.38 \times .22 = .084$ of the weight of its terrestrial counterpart.

Mars' atmosphere . . . and tying down a rocket

The atmospheric pressure at Mars' surface is the weight of that column of air. Since, on earth, sea-level pressure averages 29.92 inches of mercury, it follows that on Mars we may expect a surface atmospheric pressure of about $29.92 \times .084 = 2.5$ inches of mercury (or 85 millibars).

This is one-twelfth of the sea-level pressure on earth and about the same pressure that prevails 11 miles up in our stratosphere.

Atmosphere, though thin, goes high

However, as we rise from the Martian surface into this tenuous atmosphere, we find its pressure stratification quite different from that of the earth's air. This, again, is a direct result of Mars' feeble gravity, which simply fails to compress its atmosphere into as tight and compact a layer of gas as ours. In the earth's atmosphere we have to climb to an altitude of about 10 miles to experience a reduction of atmospheric pressure by a factor of 10—that is, from 29.92 inches to 2.992. (It is down to .299 inches at 20 miles, to .0299 at 30 miles, and so on.) In Mars' atmosphere, we would have to climb to an altitude of about 25 miles to experience a pressure drop to a tenth of the Martian surface pressure—from 2.5 inches to .25. We would have to ascend to 50 miles to get it down to .025 inches, and to 75 miles to reduce it to .0025.

This leads to an interesting conclusion: Although the surface pressure on Mars is only one-twelfth of our sea-level pressure, at altitudes above 19 miles the Martian atmosphere is actually *denser* than our own.

What astronauts can expect

This is of considerable practical importance for future voyages to Mars. Many important phenomena (aurora effects, airglow, ionization, meteorites) take place in the upper layers of a planetary atmosphere. Altitudes of clouds are directly related to the pressure stratification of the atmosphere. Generally speak-

ing, we can say that in the Martian atmosphere, atmospheric phenomena can be expected to extend to much higher altitudes.

The first astronauts to enter the Martian atmosphere for a landing will feel its decelerating effect at altitudes where back on earth they orbited with no noticeable atmospheric drag.

Q *How are large rockets prevented from taking off with inadequate thrust?*

A The rocket is tied to the launch platform by a multiple clamp-down mechanism, which is released only after there is clear evidence of adequate rocket-engine performance.

The technique of holding rockets down during thrust build-up was tried, off and on, during the early years of guided-missile development. It became standard procedure with the advent of multiengine rockets, because of the obvious hazards involved in a takeoff with one faulty or inoperative rocket engine.

In launching large multiengine rockets such as Atlas or Saturn, at least one characteristic indication of adequate engine performance (such as combustion-chamber pressure) is piped into the control room for all engines involved in the takeoff. The decision to release the clamp-down mechanism (commonly called the "tail grab") is made by the launch director on evidence that all engines are "in the green." In modern launch facilities the procedure is often automated; that is, the tail-grab signal is activated automatically when all engine read-outs are within pre-specified limits. All engines are shut off if this condition is not met within a few seconds. ■ ■

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Dr. von Braun will consider answering questions from readers of POPULAR SCIENCE in the magazine, but he cannot undertake to answer each one by mail. Letters to him should be addressed in care of POPULAR SCIENCE, 355 Lexington Ave., New York 17, N. Y.



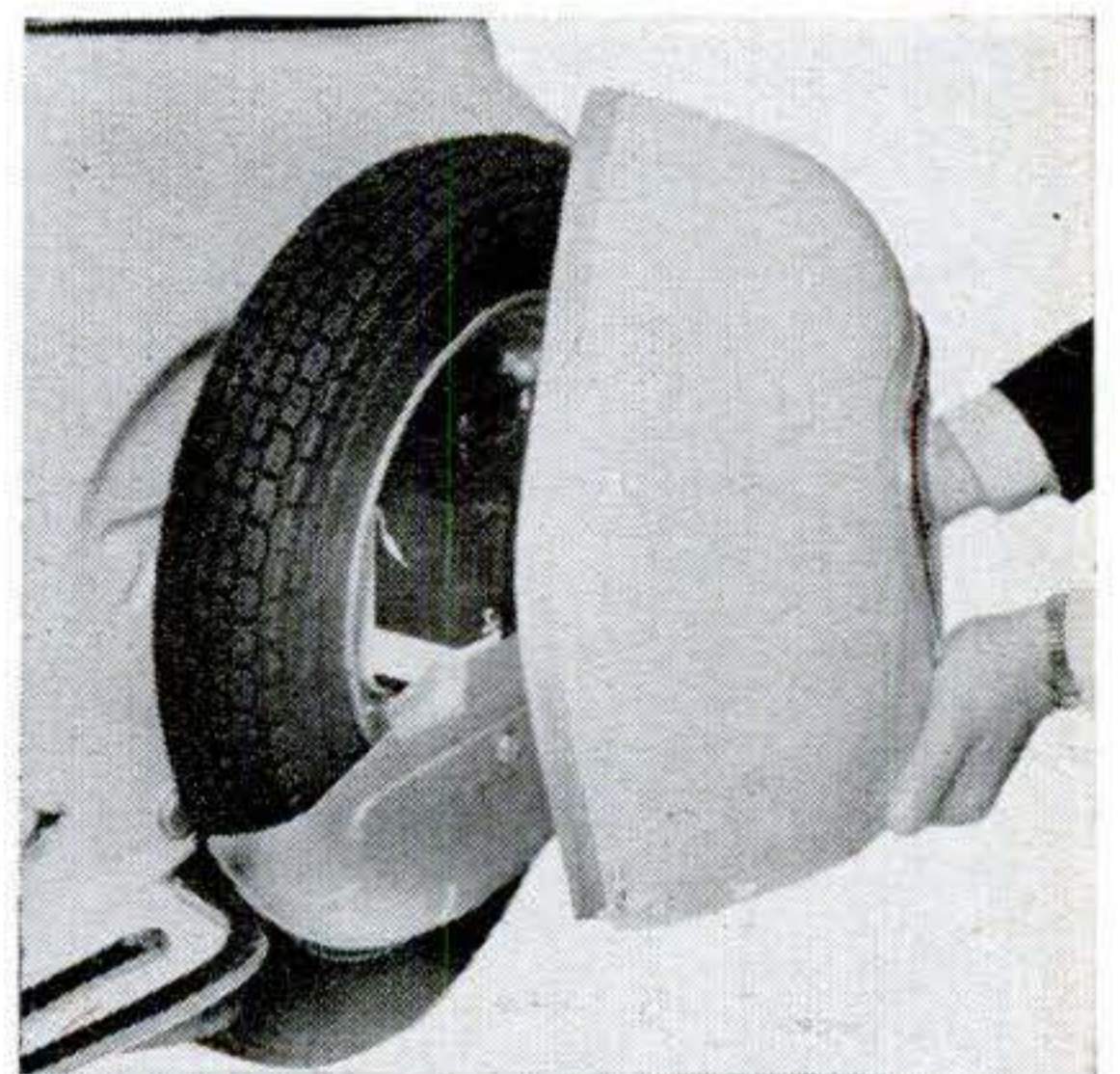
Air-terminal restaurant with a high-up view

Rising 135 feet above the \$70 million extension to Los Angeles International Airport is the parabolic Central Theme Building. At its base is a bank, a barber

shop, and a cafeteria. Seventy feet up beneath the arches is a gourmet restaurant. Sixty 11-foot-high windows give diners an unobstructed 360-degree view.



Power egg is hinged to ride up and down with wheel. Trailing link and coil spring carry the front wheel.

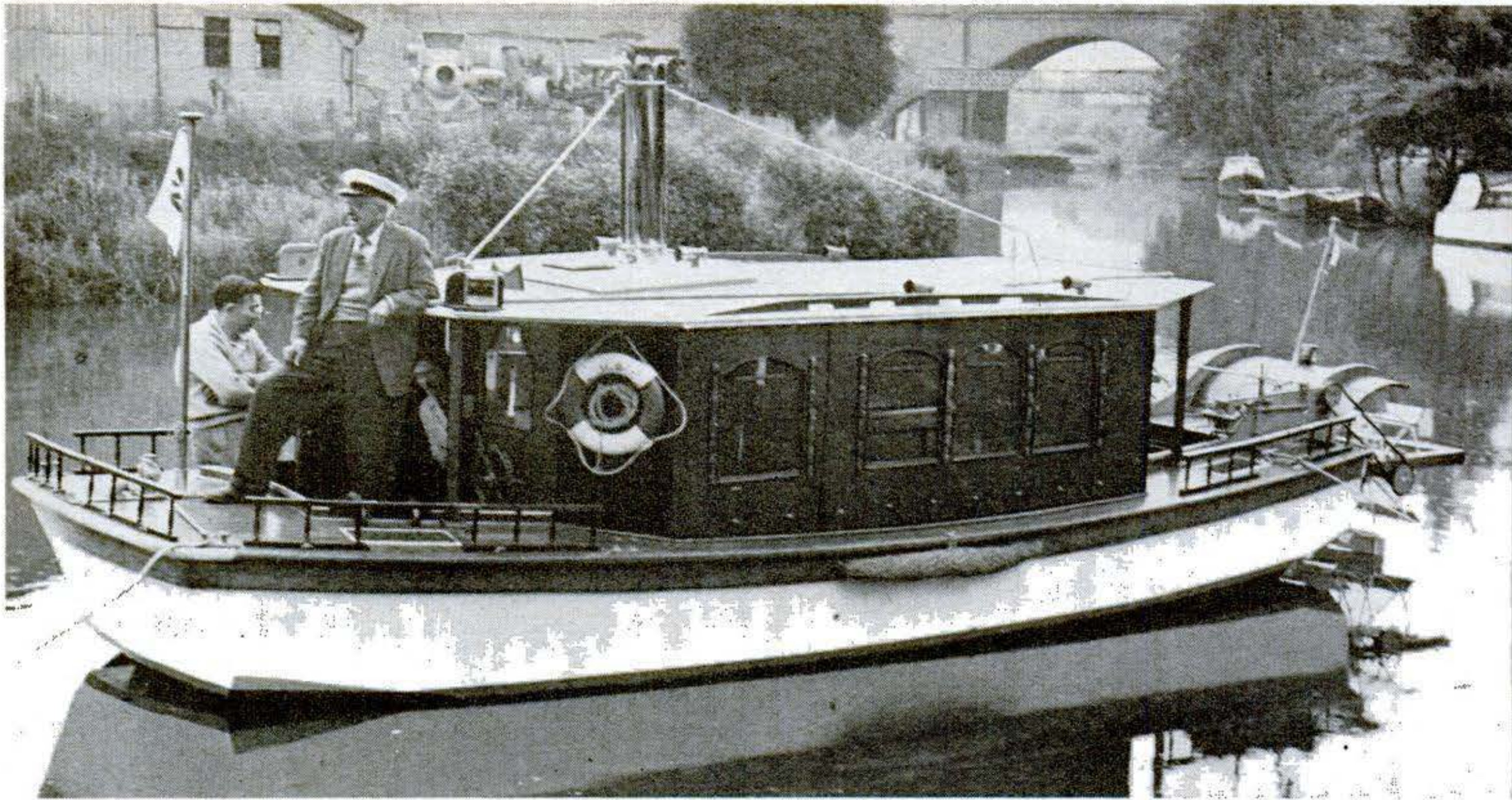


Removing cover gives access to spare, and to battery mounted snugly inside.

New Vespa hides its spare

The spare wheel on the latest Vespa scooter is housed neatly behind a detachable cowling that balances the cover for the off-

set engine on the opposite side. A lockable toolbox fits into waste space beneath the double seat and provides room for odds and ends. The new model is powered by a 9.8-cu.-in. engine giving 60-m.p.h. performance.



Cabin of Guildford Belle is topped by 30-inch copper-bronze stack rising from boiler room.

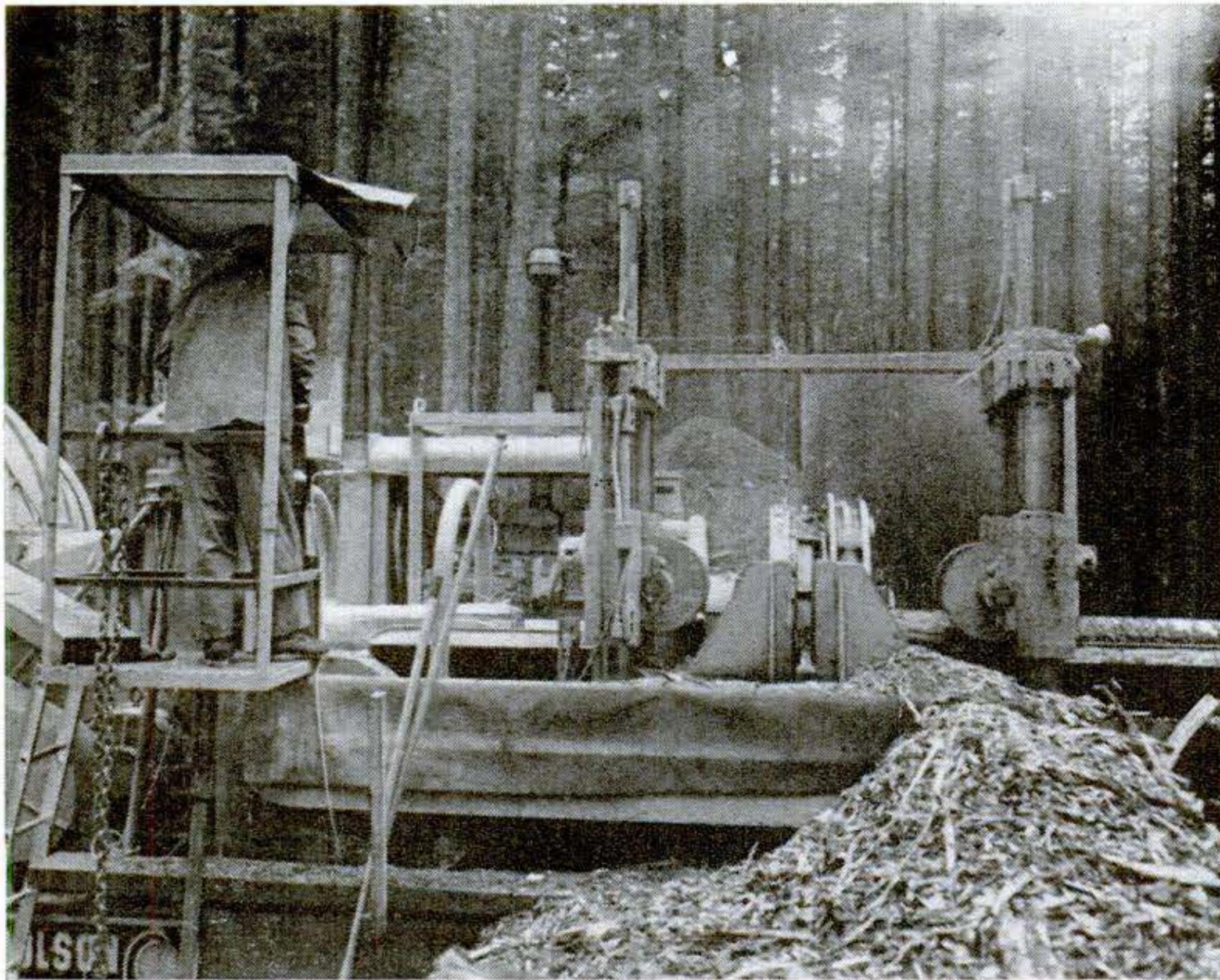
The little sternwheeler cruises at four knots while burning 11 pounds of coal an hour.

Mississippi steamboat now at home on the Thames

Scaled down to 30 feet, this British-built sternwheeler is copied from an old Mississippi river boat. Spurred by a childhood fascination, 44-year-old Fred C. Mitchell, who has a hi-fi shop in Dorking, Surrey, spent five years on the model, even visited America to study details. He did the work

himself, making the engine and hardware in his shop, leaving only the bare oak hull to a small nearby shipyard.

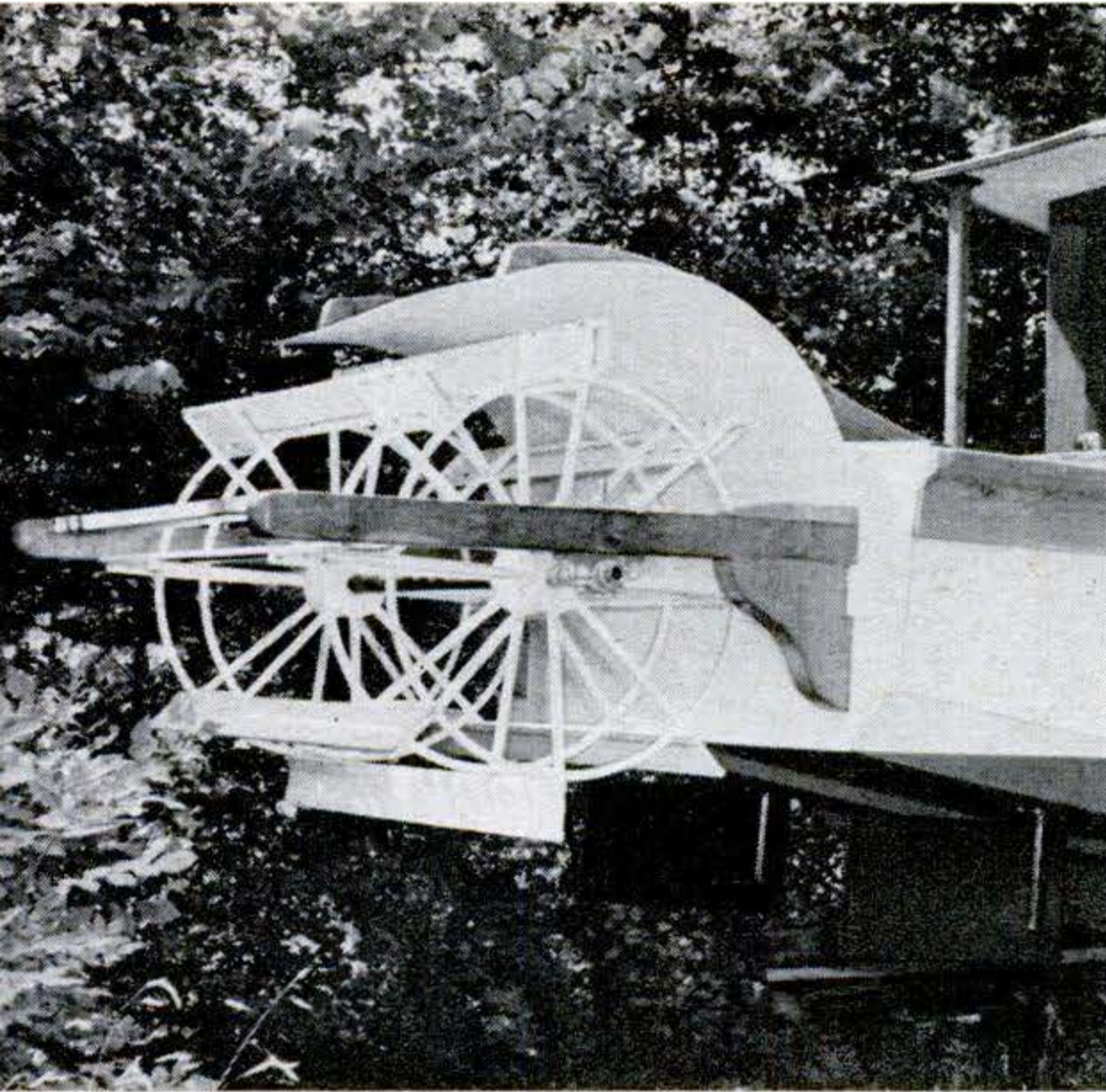
The main cabin behind an open cockpit in the squared-off bow houses the boiler room and living quarters. Twin steam engines in the aft cockpit are double-acting



Wood chopper moves in on logs

A \$130,000, 72-foot machine that barks and chips logs right in the forest is making it practical to harvest small-diameter hemlock. The experimental Utilizer is now undergoing tests by Crown Zellerbach in Oregon.

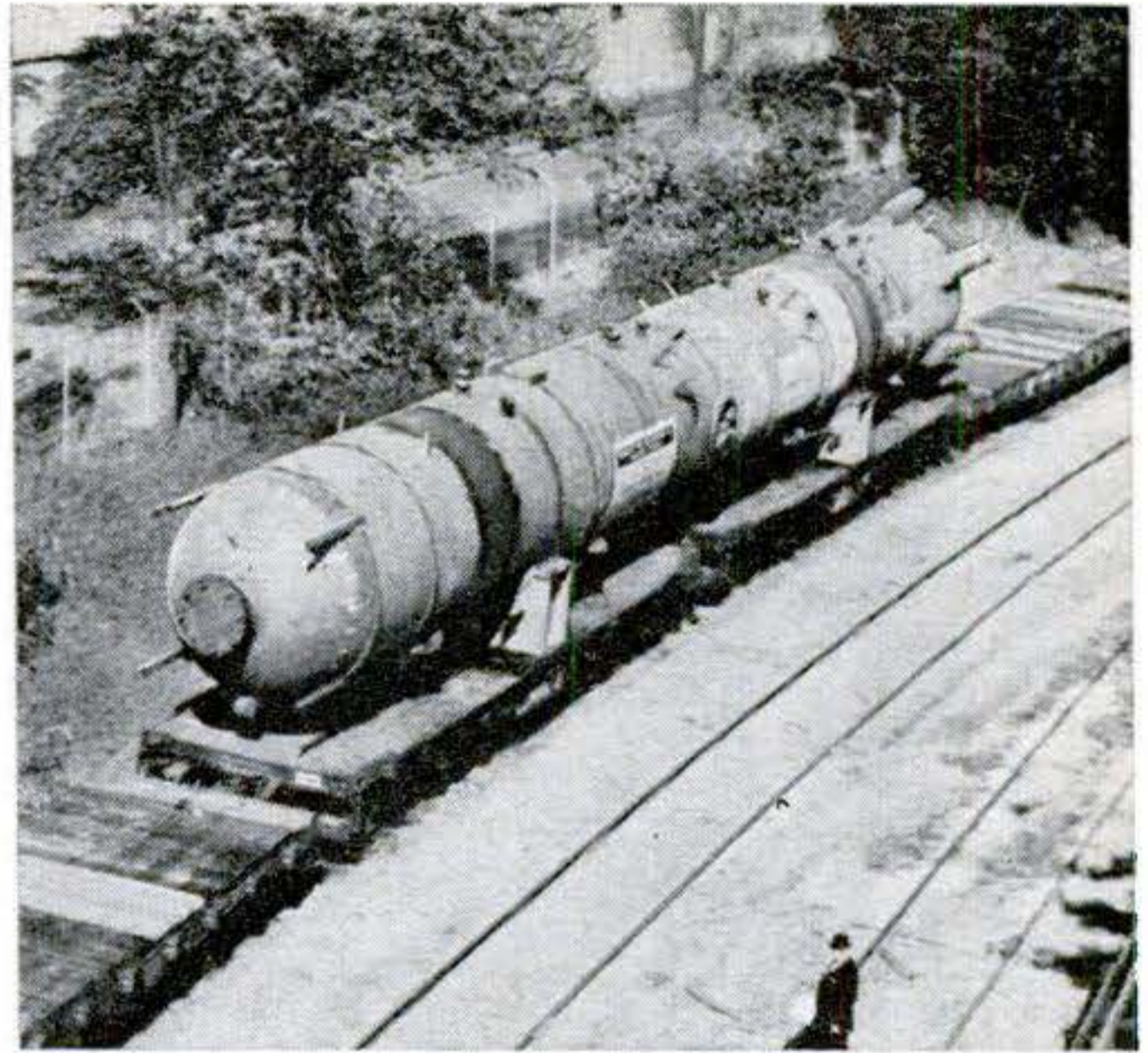
It pulls trees along a conveyor through blades that bark them and chop them into small chips for easy transportation. Power is supplied by two Cummins diesels rated at 280 and 700 hp.



Chain-driven paddle wheel is 51 inches wide. Dual rudders under the stern steer the boat.

slide-valve units with a combined output of nine hp. and a top speed of seven knots. Steam is fed from a coal-fired multitube boiler that develops a working pressure of 120 pounds, but is capable of 250.

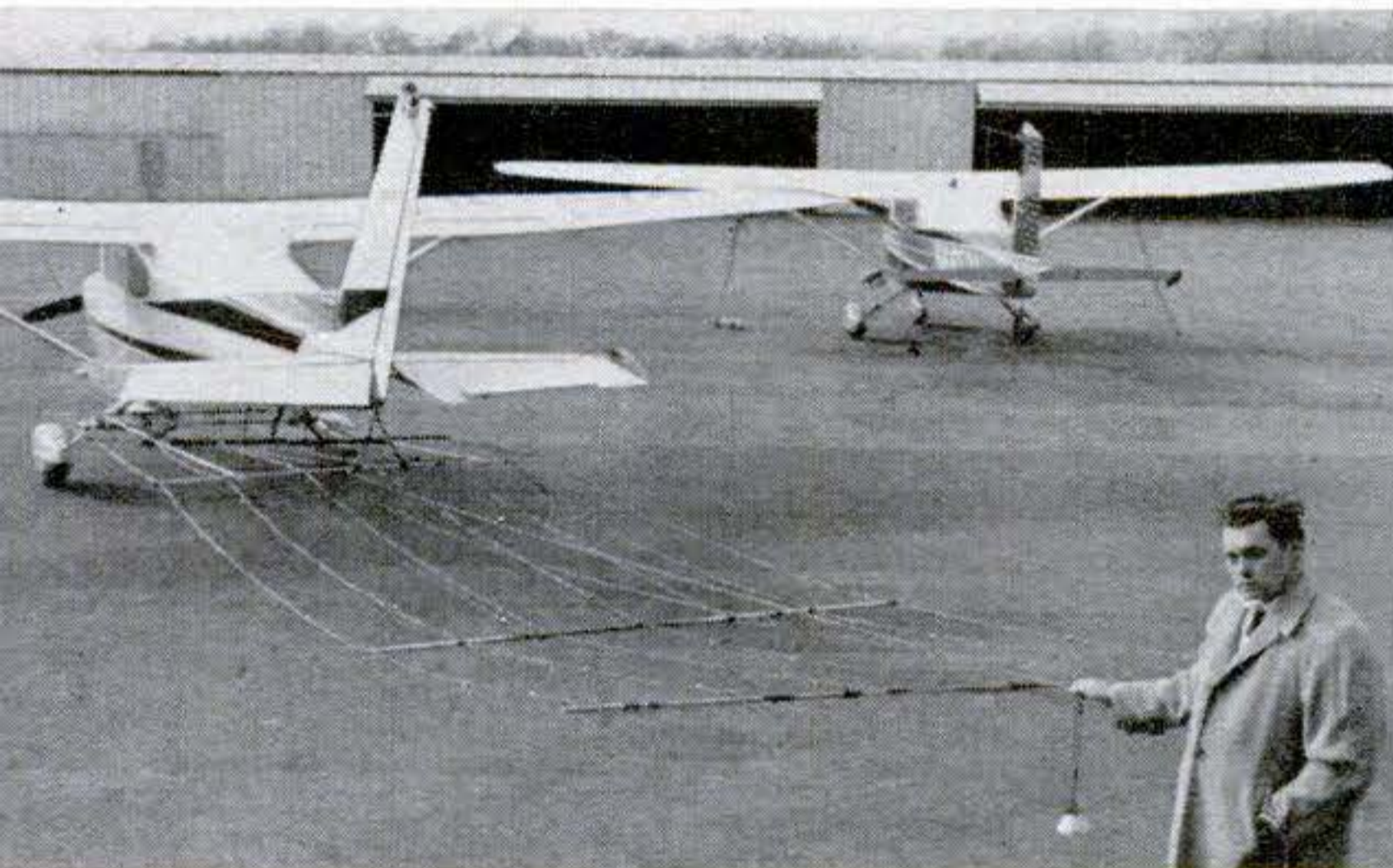
Mitchell, in true Mississippi River tradition, has christened the 5½-ton craft the Guildford Belle. He realizes his life's ambition with weekend cruises with his family on the close-by Wey and Thames.



Railroad carries record load

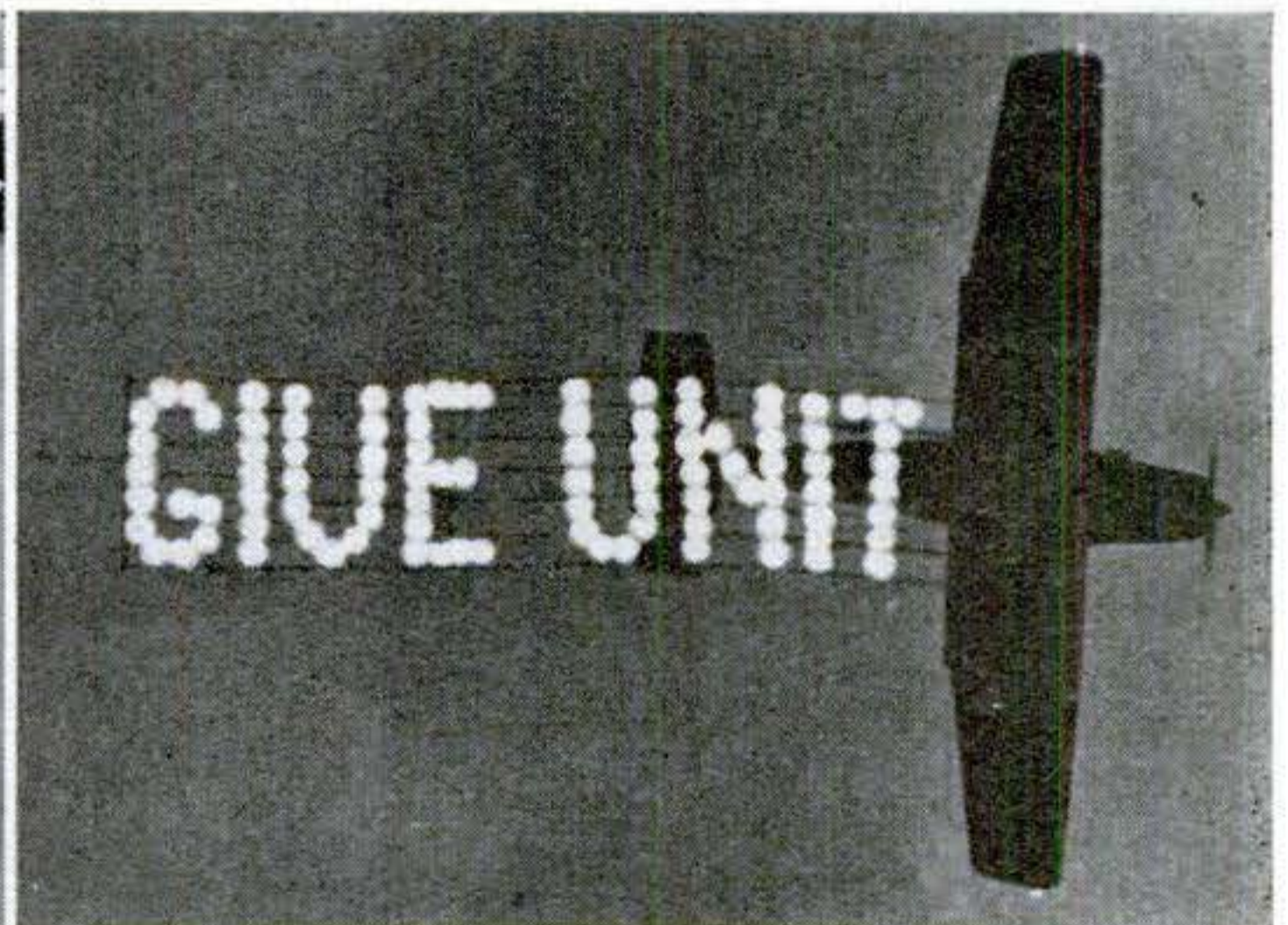
Heaviest single piece ever shipped by rail, a 500-ton pressure vessel journeyed two-thirds across the country—2,200 miles from Milwaukee, Wis., to Avon, Calif. The 98-foot vessel, one of six built by A. O. Smith Corp. for a Tidewater Oil Refinery, was carried on two flatcars designed with four trucks each, instead of the customary two, in order to even out the load.

Combined weight of the vessel, blocking, and flatcars was 1,079,200 pounds, 13,600 more than the previous record. The trip was made on the Milwaukee, Santa Fe, and Southern Pacific in three weeks, with speed held to 30 m.p.h., no passing on curves, and frequent overnight stops.



Skywriting on electric billboard

Look up after dark in the area of Kingston, Pa., and chances are you'll see a plane skywriting with electric bulbs. Like daytime skywriters, the plane shoots out messages from its tail a letter at a time—but they are in electric lights instead of smoke.

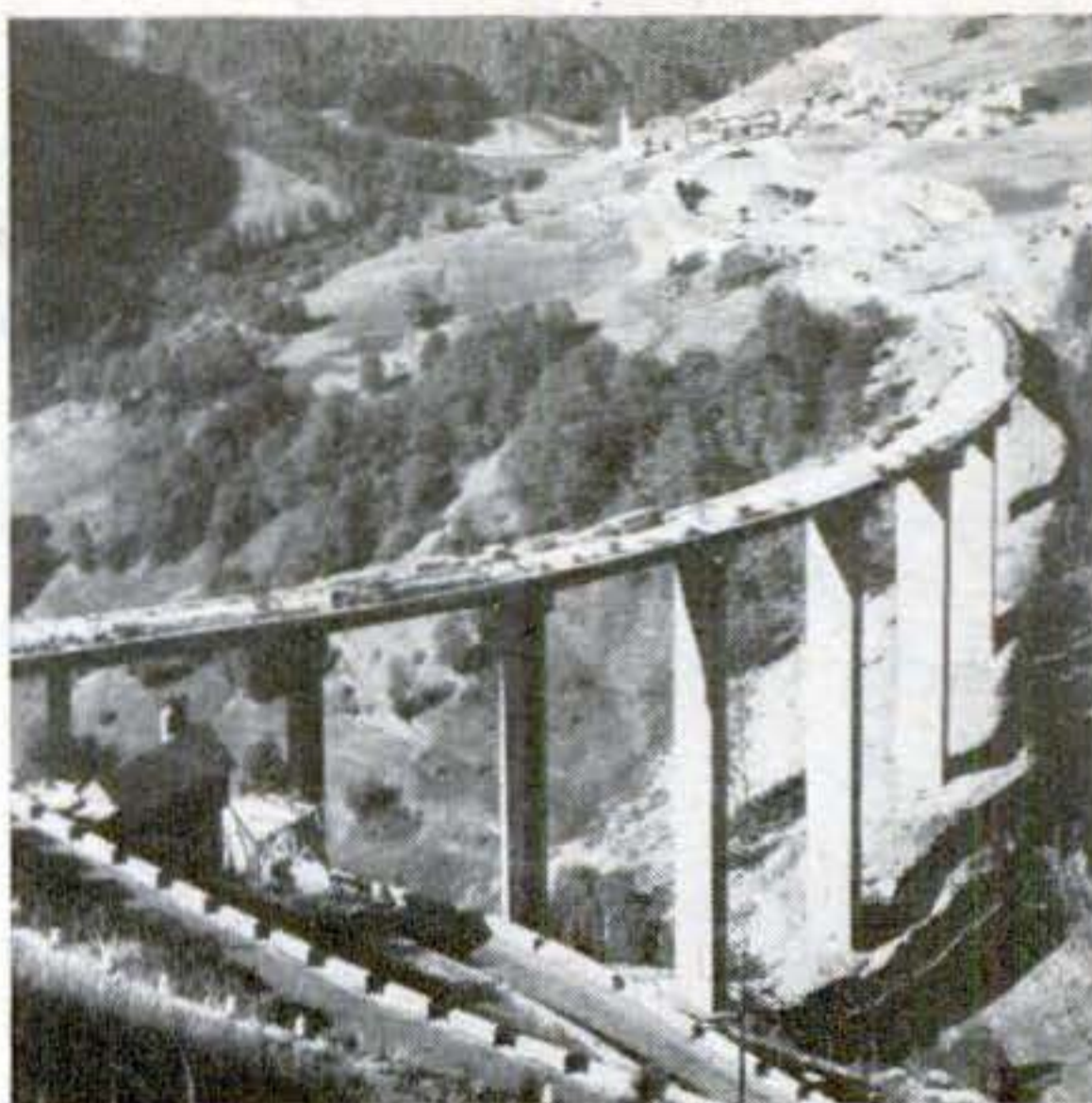


Re-View Agency's equipment consists of a trailing frame of electric wires fitted with on-off bulbs fed by the plane's 35-amp generator and working like electric billboards that spell out news bulletins or other messages letter by letter. The message being flown above is an appeal for Kingston's United Fund.

Snowplow, Go Home!



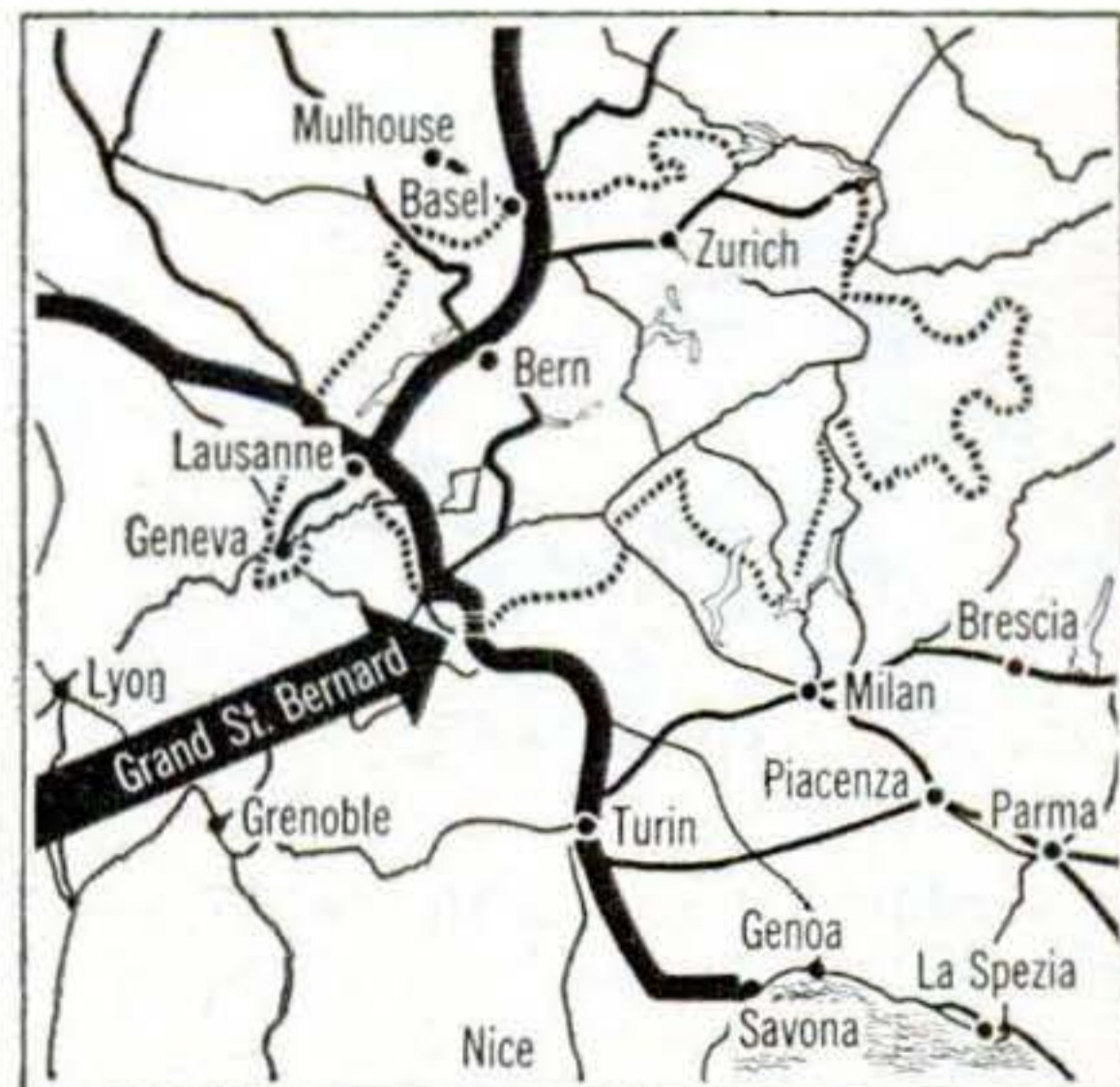
New tunnel and covered highway to keep Alpine route open all winter



Viaducts like this one span mountain valleys north of Turin. No grade on route is steeper than five percent.

OPENING late this year, an all-weather highway that bores 2,000 feet under the St. Bernard Pass will let European motorists drive from northern Europe to the Mediterranean—year 'round—without skirting the Alps. Up to now, the pass has been closed eight months of the year.

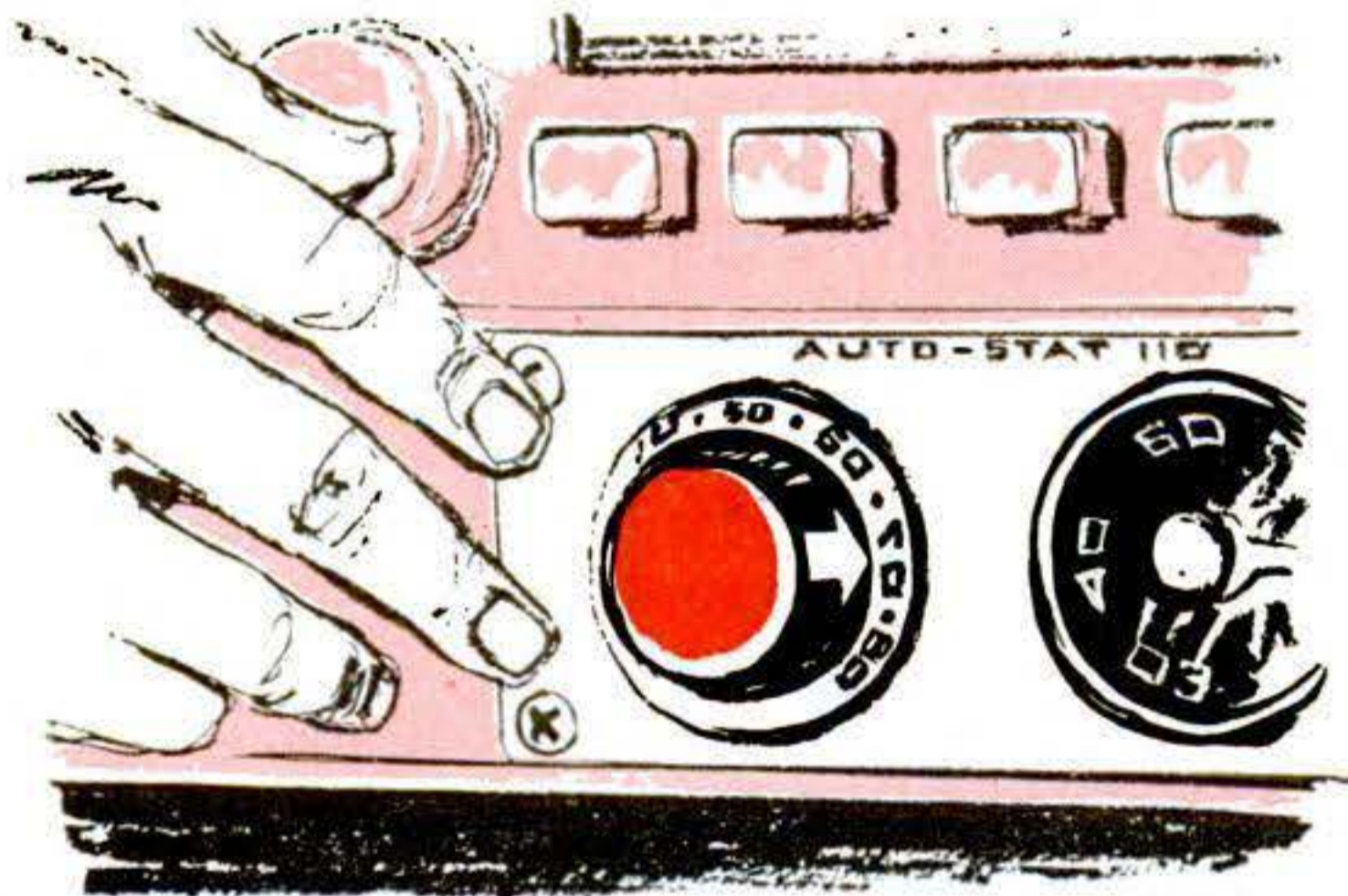
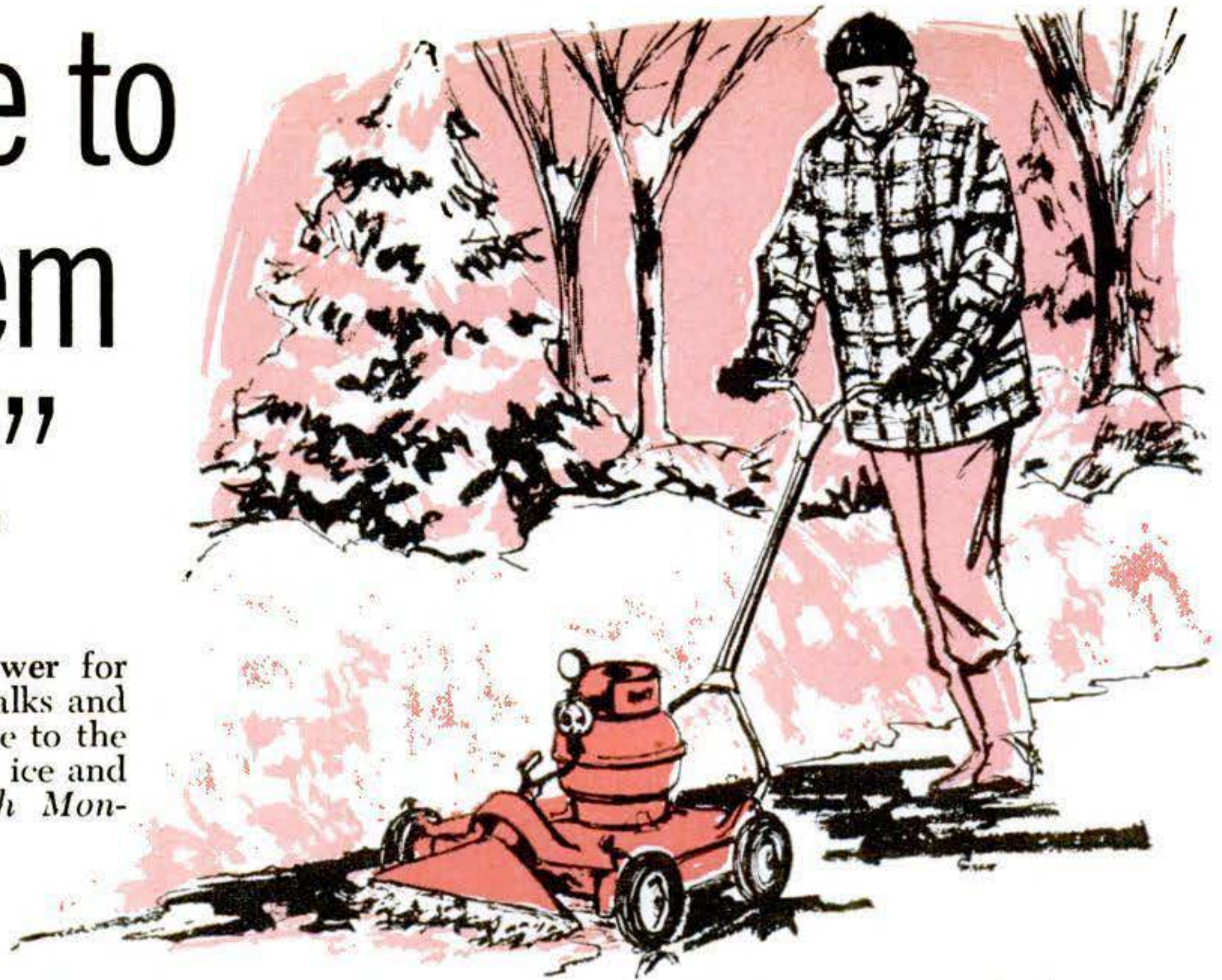
A joint Swiss-Italian project, the highway has nine miles of approach roads, kept snow-free by concrete roofing, and a 3½-mile tunnel. This is a 31-foot tube, cut through solid rock, with a two-lane roadway. Huge ducts suck in fresh air, blow out exhaust fumes.



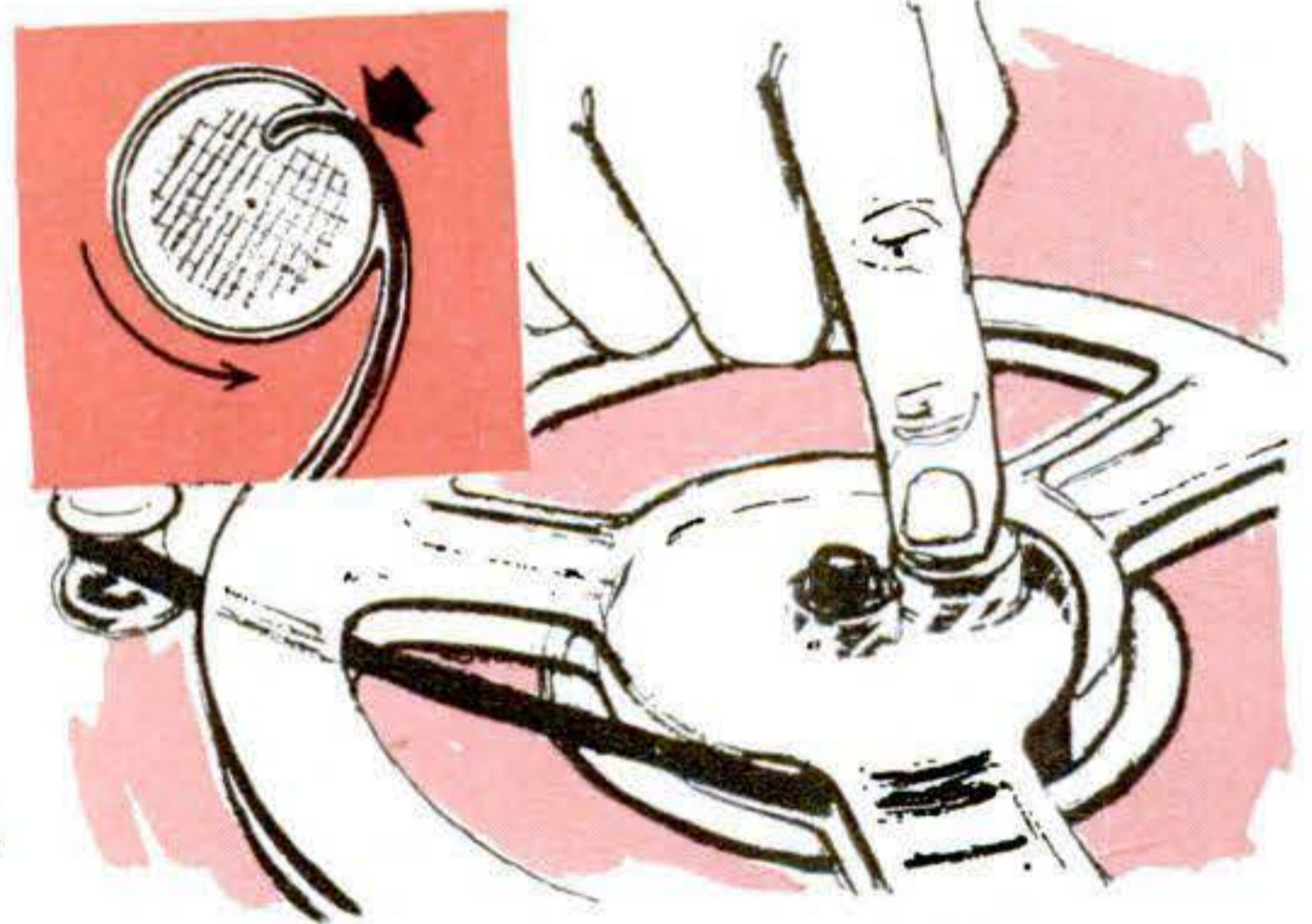
Customs and toll gates are at both ends. Drivers will pay \$1.35 to \$3.30 for cars, 40 cents for each passenger.

"I'd like to see them make..."

An oil-fired flame thrower for clearing ice from sidewalks and driveways. A flame close to the ground would melt thin ice and loosen thick ice.—*Ralph Monroe, Pontiac, Mich.*



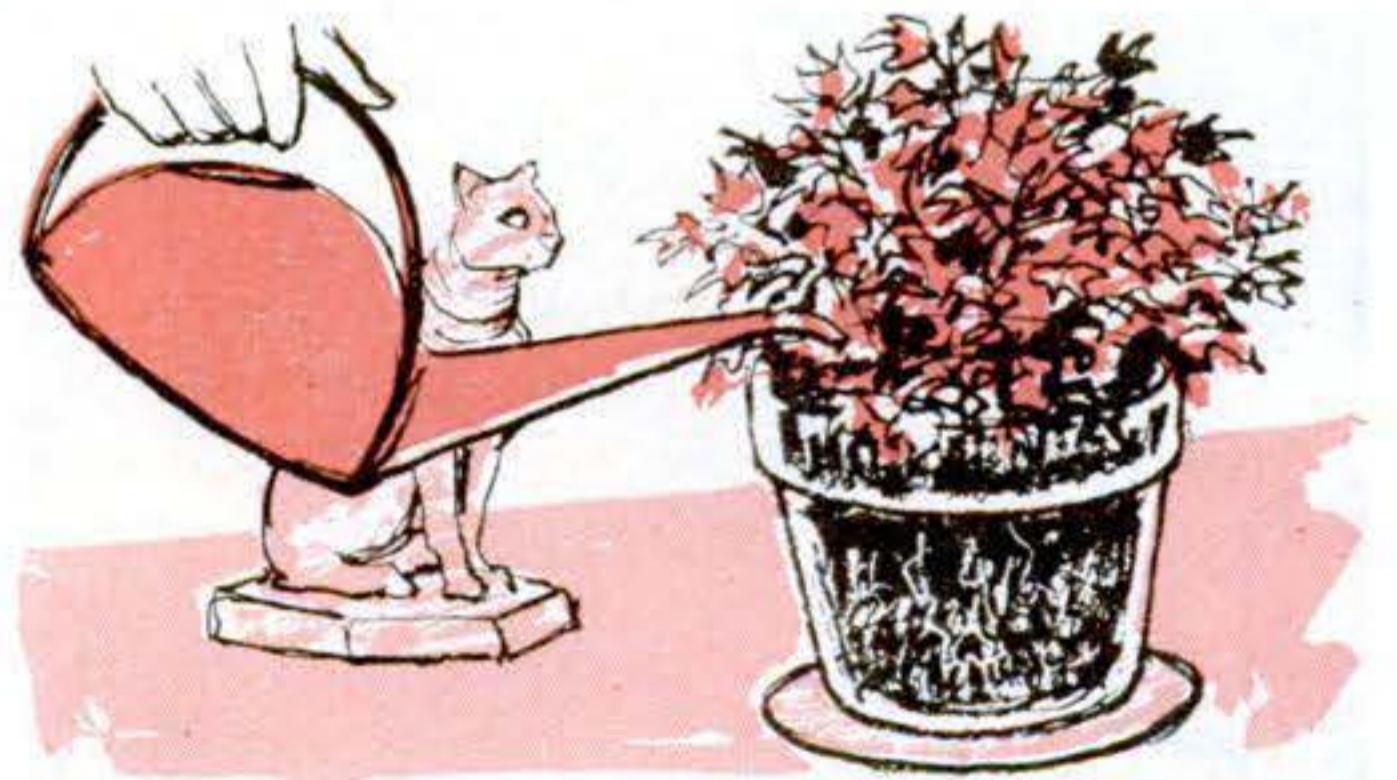
A car-heater thermostat that you could set for desired temperature. This would eliminate being baked, as well as constant need for adjustment.—*Mrs. Barbara Davis, Rome, Ga.*



Easy-to-load tape-recorder reels. They'd have a slotted plug, set in flush, that you could turn with a finger to lock in the starter end of the tape.—*David A. Odom, Puyallup, Wash.*



Snow-shedding shovels with blades coated with Teflon—the plastic used on greaseless frying pans—and a built-in hand warmer in the handle.—*H. F. Stephens, Pleasantville, N.J.*



Transparent flowerpots for house plants so you could check depth penetration when watering and even determine when roots were outgrowing the pot.—*Roger Rachow, Omaha.*

Everyone has his own pet idea of a gadget that he would like to see in general use. What's yours? We will pay \$5 for each one published. Please use Government postcards

only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 17. Write your name and address clearly. Contributions cannot be acknowledged or returned.

GIs will get firepower plus when . . .

The Sergeant Shoots Off

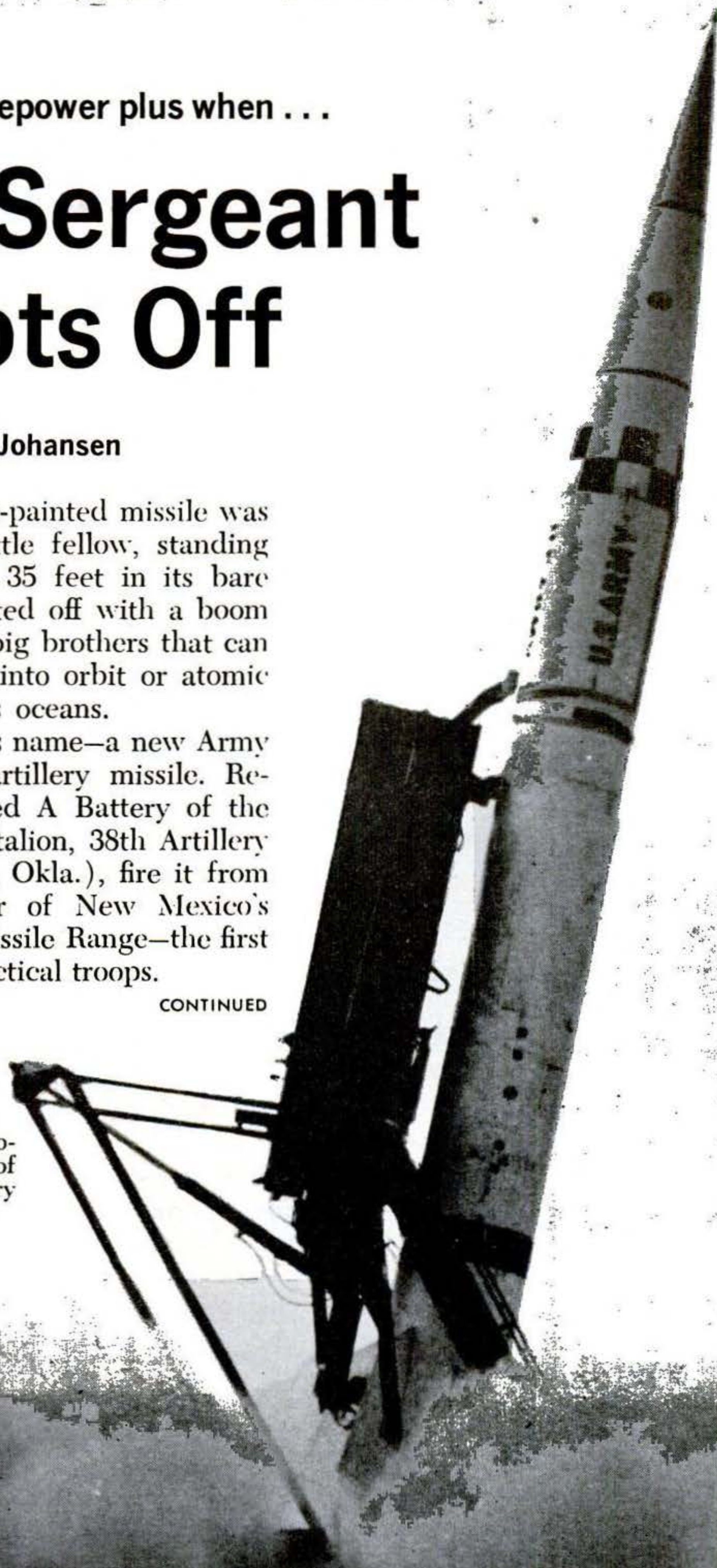
By Herbert O. Johansen

THE white-painted missile was only a little fellow, standing less than 35 feet in its bare fins—but it blasted off with a boom like that of its big brothers that can hurl astronauts into orbit or atomic warheads across oceans.

Sergeant is its name—a new Army nuclear-nosed artillery missile. Recently I watched A Battery of the 3rd Missile Battalion, 38th Artillery (from Fort Sill, Okla.), fire it from the desert floor of New Mexico's White Sands Missile Range—the first launching by tactical troops.

CONTINUED

Blastoff: Actual photo of first firing of Army's new artillery missile by troops.



"The Sergeant missile embodies the traditional traits of the tough and battle-hardened Army sergeants for whom it was named"

GIs put Sergeant together on the double-quick. Here's how six



1 Assembly begins: Launcher boom is swung out as truck carrying rocket-engine and guidance-section containers pulls alongside.



2 Rocket section is lifted out of its container by an electrohydraulic hoist, hung and locked to boom's underside by three hooks.



4 Warhead—which can be nuclear, biological, or chemical—is mated. Detonation circuit will obey preset electronic-brain signals.



5 Control fins are attached to rear of the rocket. They provide aerodynamic stability, attitude control, and some maneuverability.

A limited-war, solid-propellant battlefield weapon, the Sergeant will replace the now outdated, liquid-fueled Corporal. In the Army's missile arsenal it will take its place between the shorter-range Honest John and Lacrosse and the much-longer-range Redstone and Pershing.

At zero countdown, poised on its launcher, the Sergeant's rocket ignited with the roar of a thousand angry bulls, kicking up a huge, enveloping cloud of desert dust. Then it came into view, streaking aloft with bright-orange flame spewing from its tail. Even after rocket

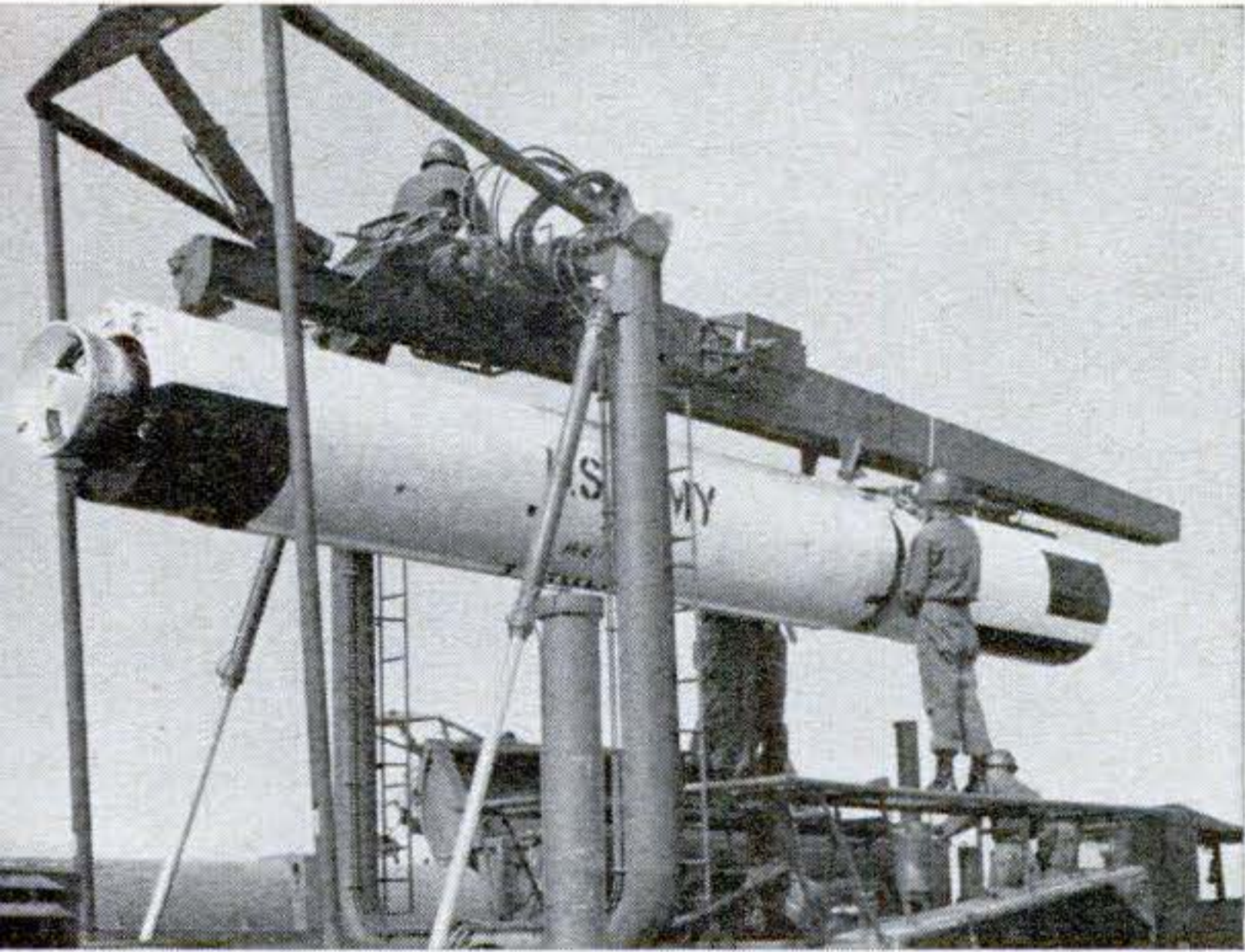
burnout seconds later, the missile could be followed by wind-whipped, squiggly vapor trails. Speeding at 2,000 miles an hour, it climbed to 28 miles—then nosed down toward a desolate tumbleweed and bunch-grass target 85 miles uprange.

There was an anxious wait for reports from an outer-range observation post. Then: "Shot good—within target area."

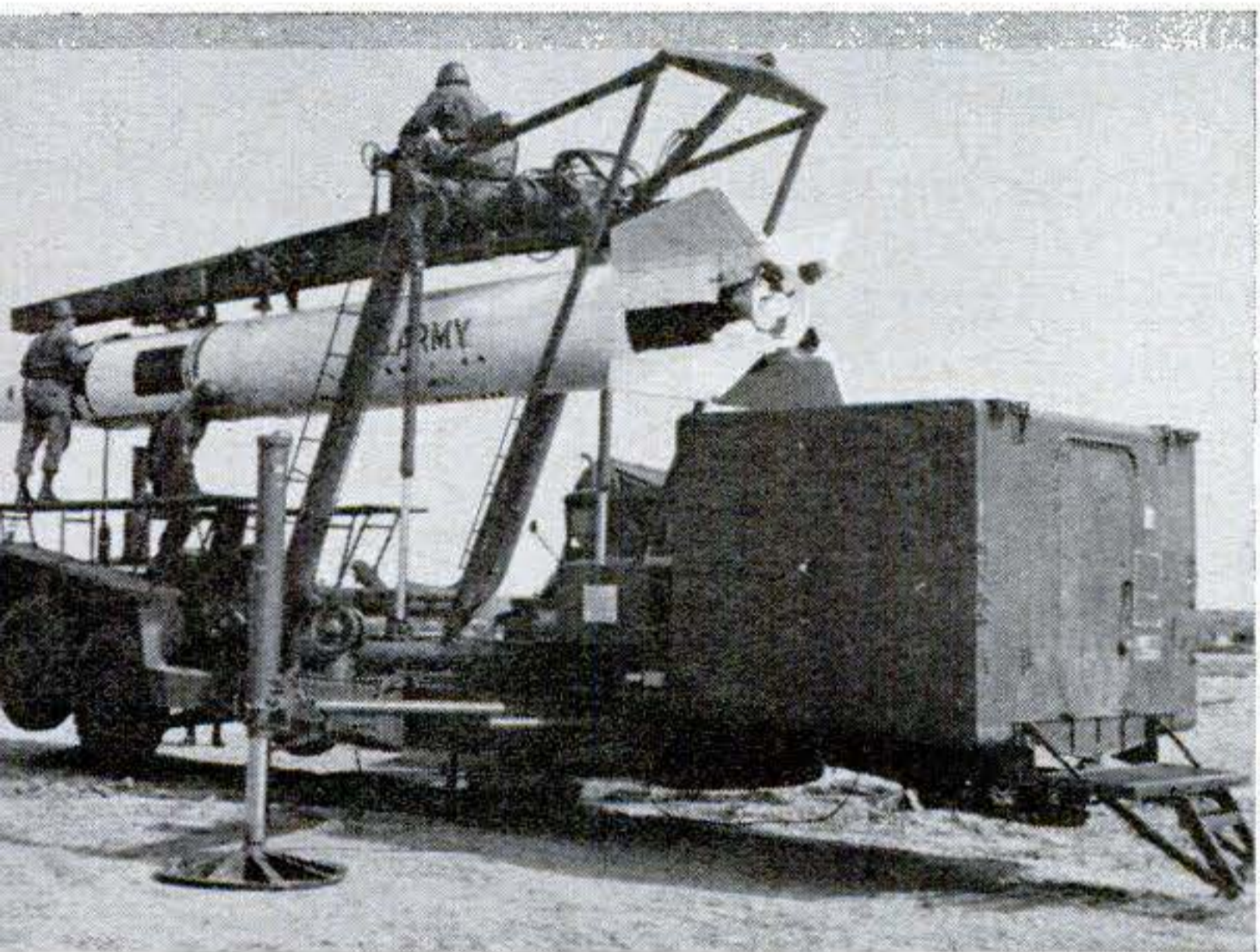
More complete data (some 70 optical and radar ground stations tracked the missile flight) followed on over-target impact: "In the pickle barrel," said a mis-

[Continued on page 202]

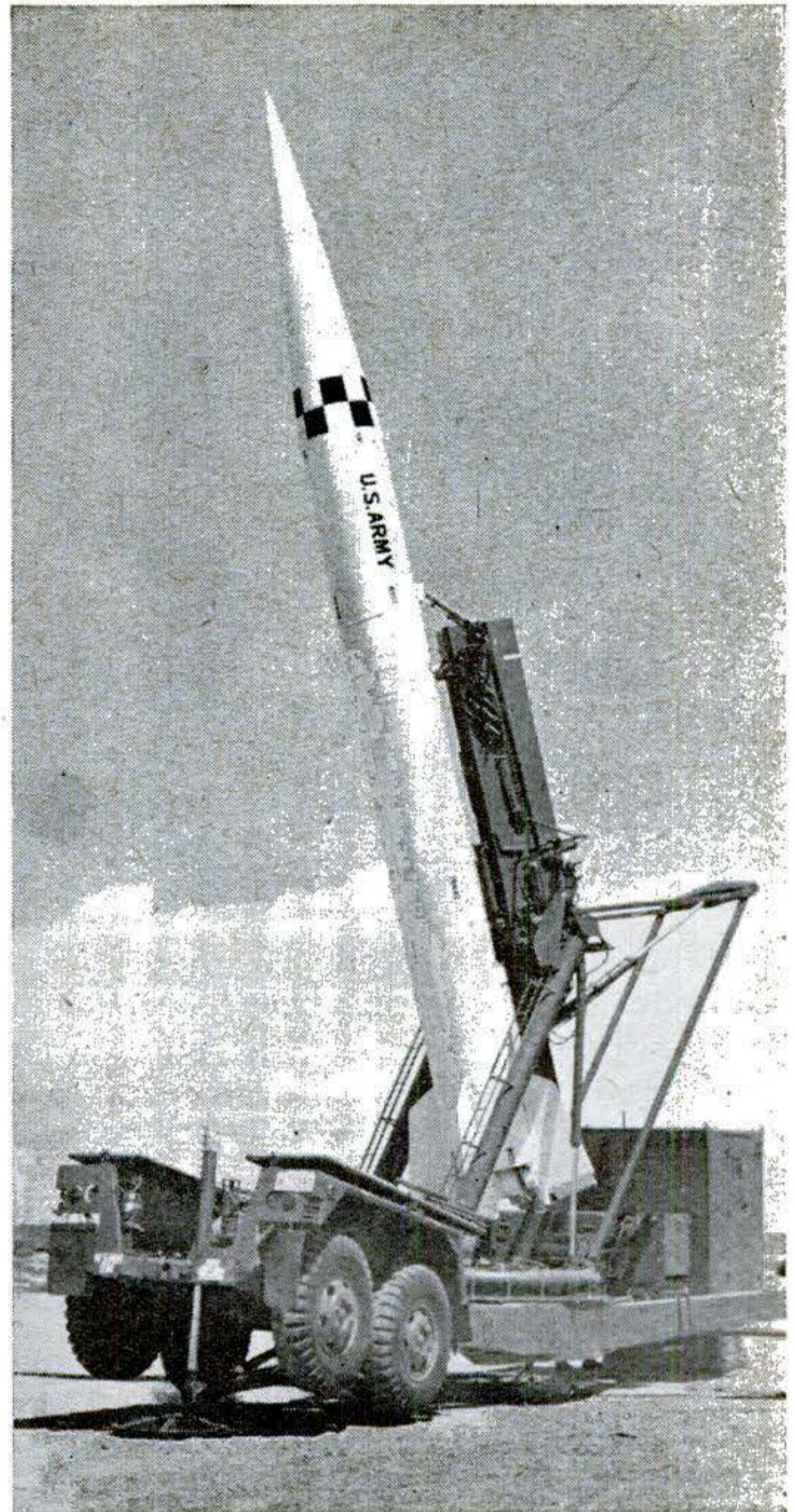
missilemen do the job in seven minutes—then “shoot and scoot”



3 Inertial-guidance unit comes next. It goes ahead of the rocket engine, and is joined to it by four quick-connect, swing-type bolts.



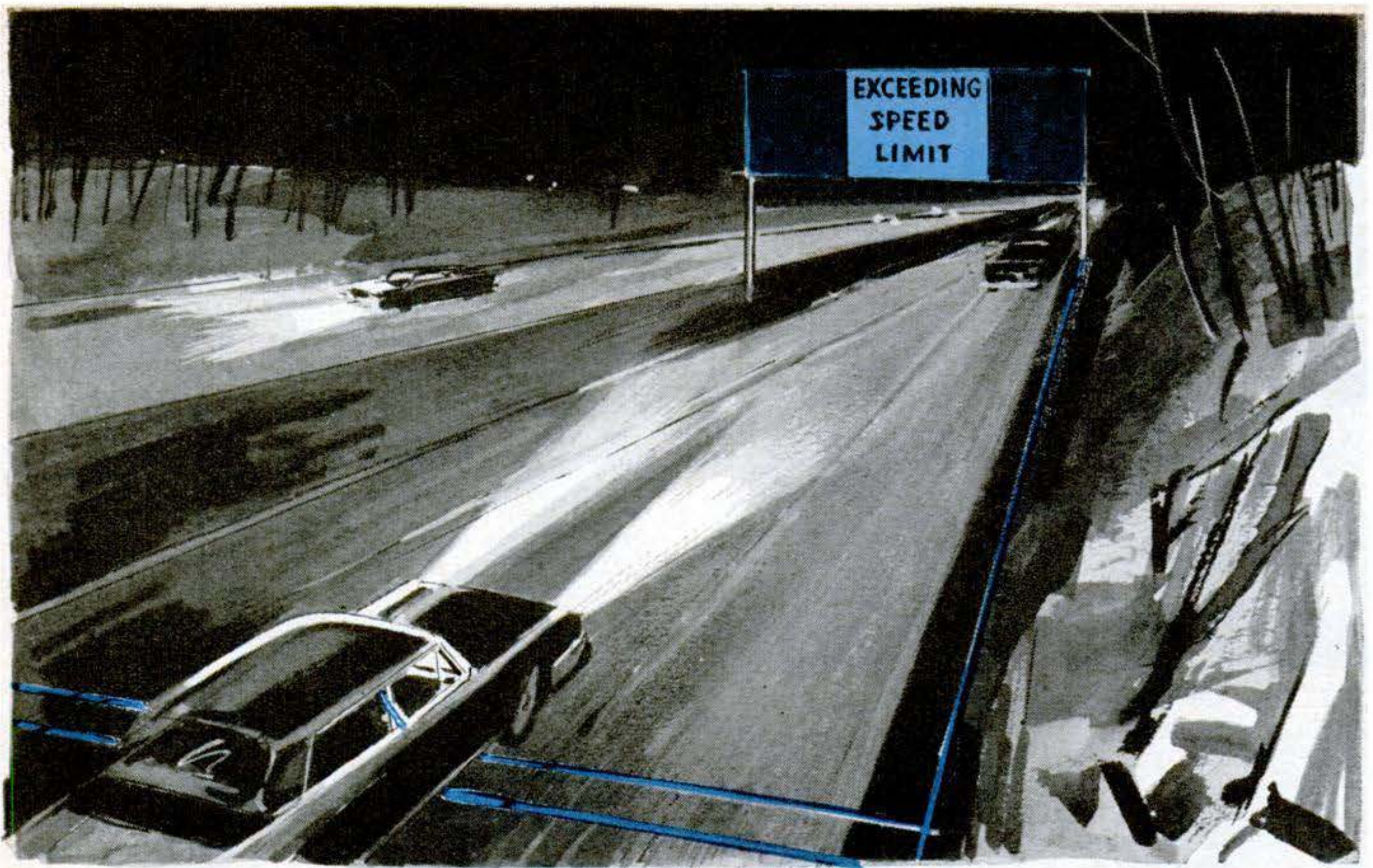
6 Missile assembly is rechecked. Because of generator noise, crew chief (on boom) uses hand signals to direct all operations.



7 Launching angle is always 75 degrees. Large cabinet at rear houses computers and circuits to program the missile's flight mission.

8 Last few minutes of Sergeant countdown is monitored from a remote-control firing pit about 250 yards away from the launcher. Manual override can stop countdown up to the last split second if the missile self-testing circuits indicate a malfunction, or on radiophone orders from a higher command.



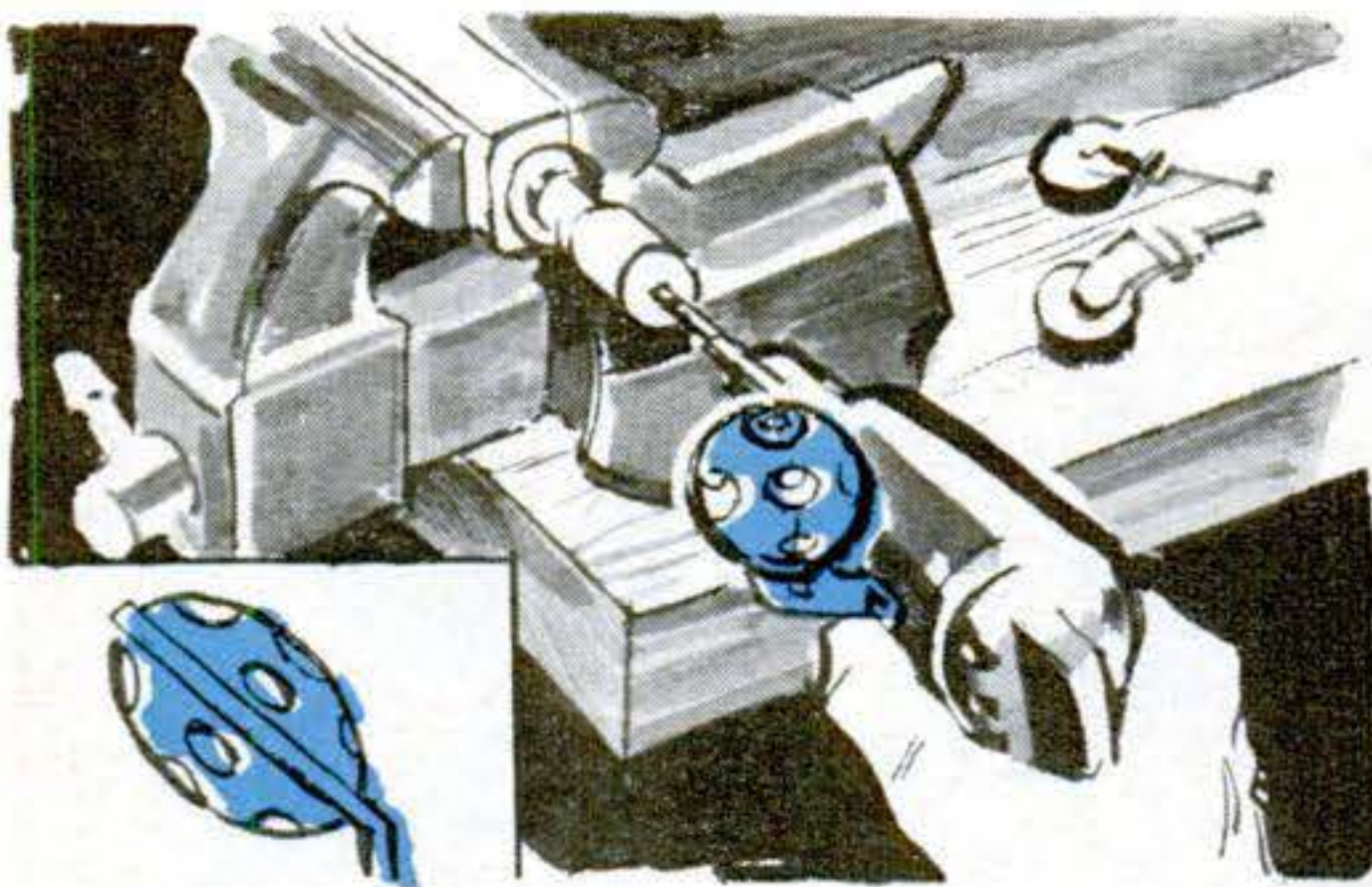


Sign lights if you speed. To alert drivers to unintentional speeding—and cops to the other kind—this recently patented sign would flash a warning ahead of a car that

was exceeding the local limit. Wheel pressure on hoses laid across the road would trigger switches in a speed calculator that would turn on the sign.

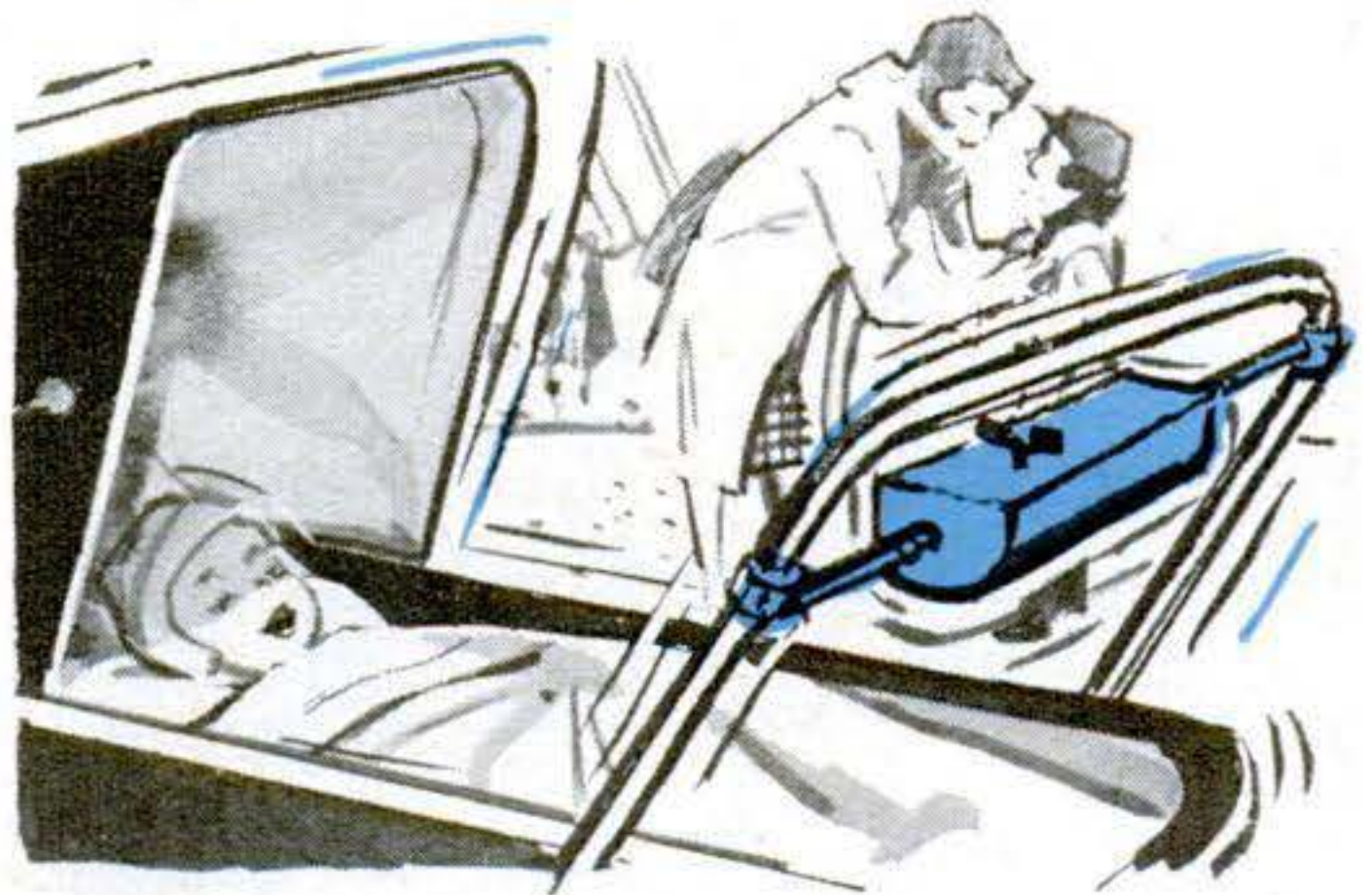
New ideas from the inventors

Bubble levels drill. Bracketed to the housing of your electric drill, the multiposition bubble level below would let you aim your drill horizontally or adjust it to several other angles. You'd hold the drill bit on a true line by keeping the bubble centered in the selected window.



The following patents have been issued on these inventions: **Speed sign**—No. 3,054,087 to Rue L. Clegg, Salt Lake City; **Drill level**—No. 3,052,036 to Raymond J. Oliver, San Jose, Calif.; **Carriage rocker**—No. 3,048,419 to Martha Fredman, Milwaukee; **Amplifier**—No. 3,042,749 to Jarl A. Johnson, Pasadena, Tex.; **Mat Light**—No. 3,017,497, to Jack L. Albright, Racine, Wis.; **Swivel**

Carriage rocker calms baby. Clamped to the arms of a carriage or crib, this vibrator might help soothe baby while mother attended to other duties. A cam driven by a spring—or electric—motor would produce vibration by shuttling a spring-loaded weight from side to side.



truck—No. 3,041,111 to Joseph W. Wyrick Jr., Little Rock, Ark.

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C., at 25 cents each. To write to an inventor, if the address given above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.



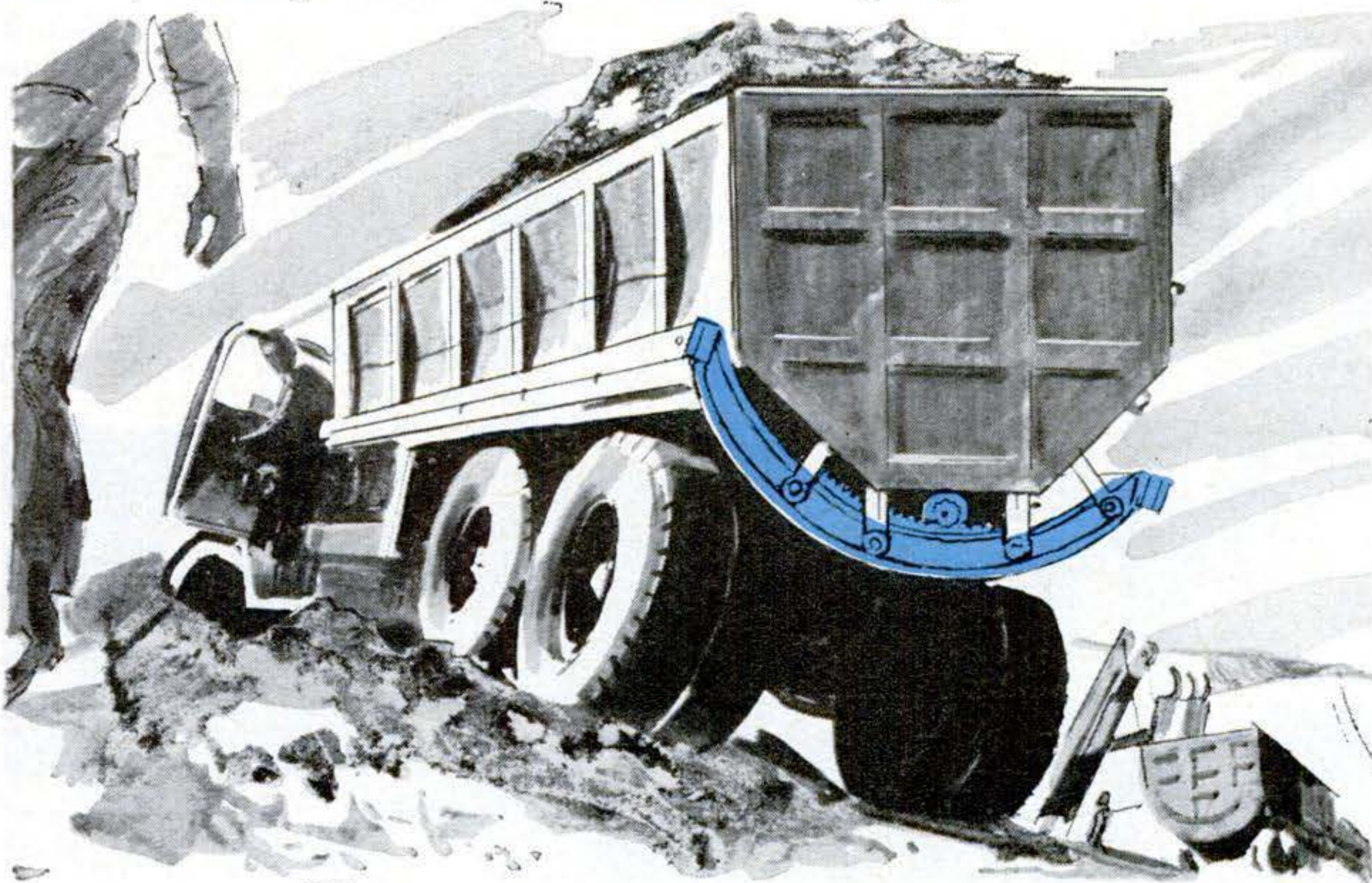
Amplifier moves with you. With this transistorized, portable, public-address amplifier hung around his neck, a coach, referee, tour guide, or even an after-dinner speaker could make himself heard while moving about freely. To free his hands, as well, he could use a strapped-in-place throat microphone connected by a standard jack.



Mat turns on night light. You wouldn't stumble in and out of bed in the dark if you had a mat like this at your bedside. You'd switch on the shaded light by stepping on the treadle as you got out of bed. When you next put your weight on the mat—getting back into bed—the treadle-operated switch would turn the light off.

Swivel truck levels load. A dump-truck operator could unload on target if his truck bed leveled the load even on tilted ground. And by holding loaded dirt or similar

loose cargo upright, this swivel-based truck body would let him carry a fuller load faster over rough ground and with less risk of spillage.





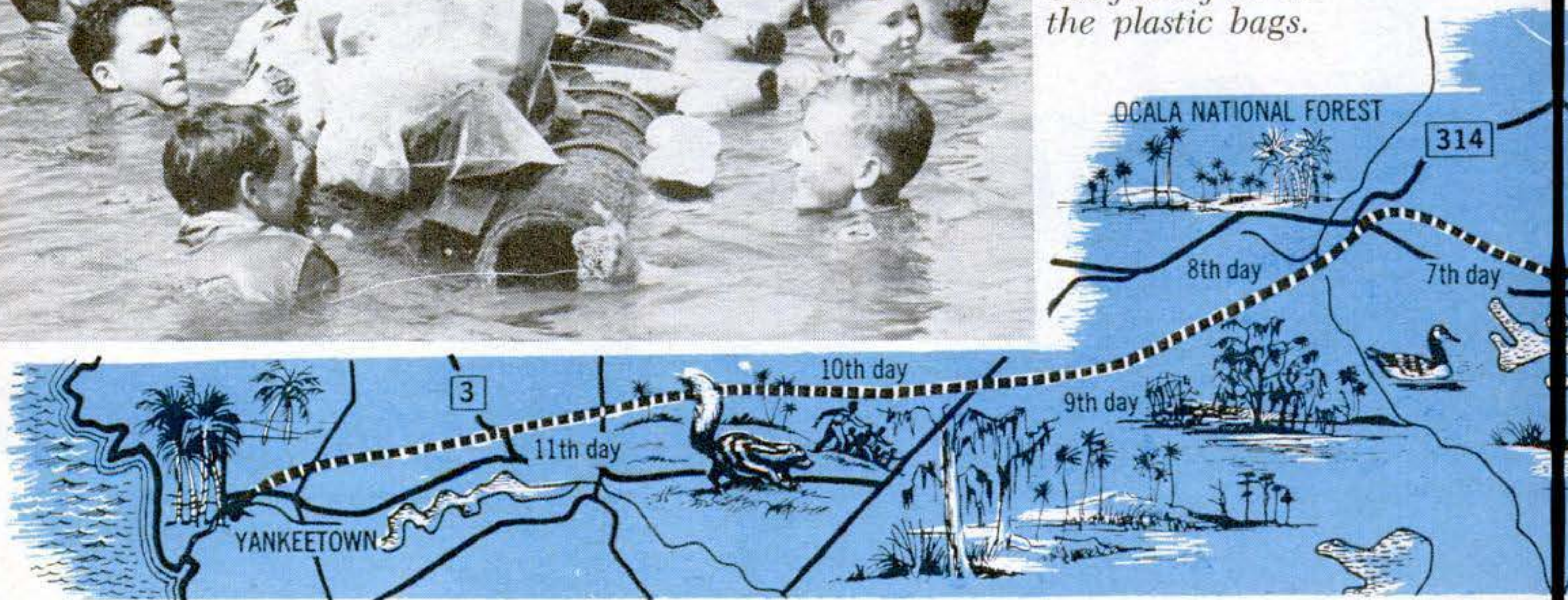
We ate a hearty breakfast and had a last sentimental dip in the Atlantic before setting

“American Kids Can Take It!”

They proved it in a hike across a Florida wilderness, living on snakes and swamp water in hundred-degree heat



We made a driftwood raft to ferry our packs across the mile-wide Halifax River. If the raft collapsed, our packs would float—buoyed by air in the plastic bags.





out across the sand dunes south of Daytona Beach. The time: 8:45 a.m., Monday, June 18.

By Ross Allen as told to Keith Vining

I'VE wrestled alligators and milked venom from more deadly snakes than I can count. I've explored the Everglades and tramped through Central and South American jungles. Yet not until last June, when I led eight boys across Florida from Daytona Beach on the Atlantic to Yankeetown on the Gulf, did I experience my toughest battle with Nature.

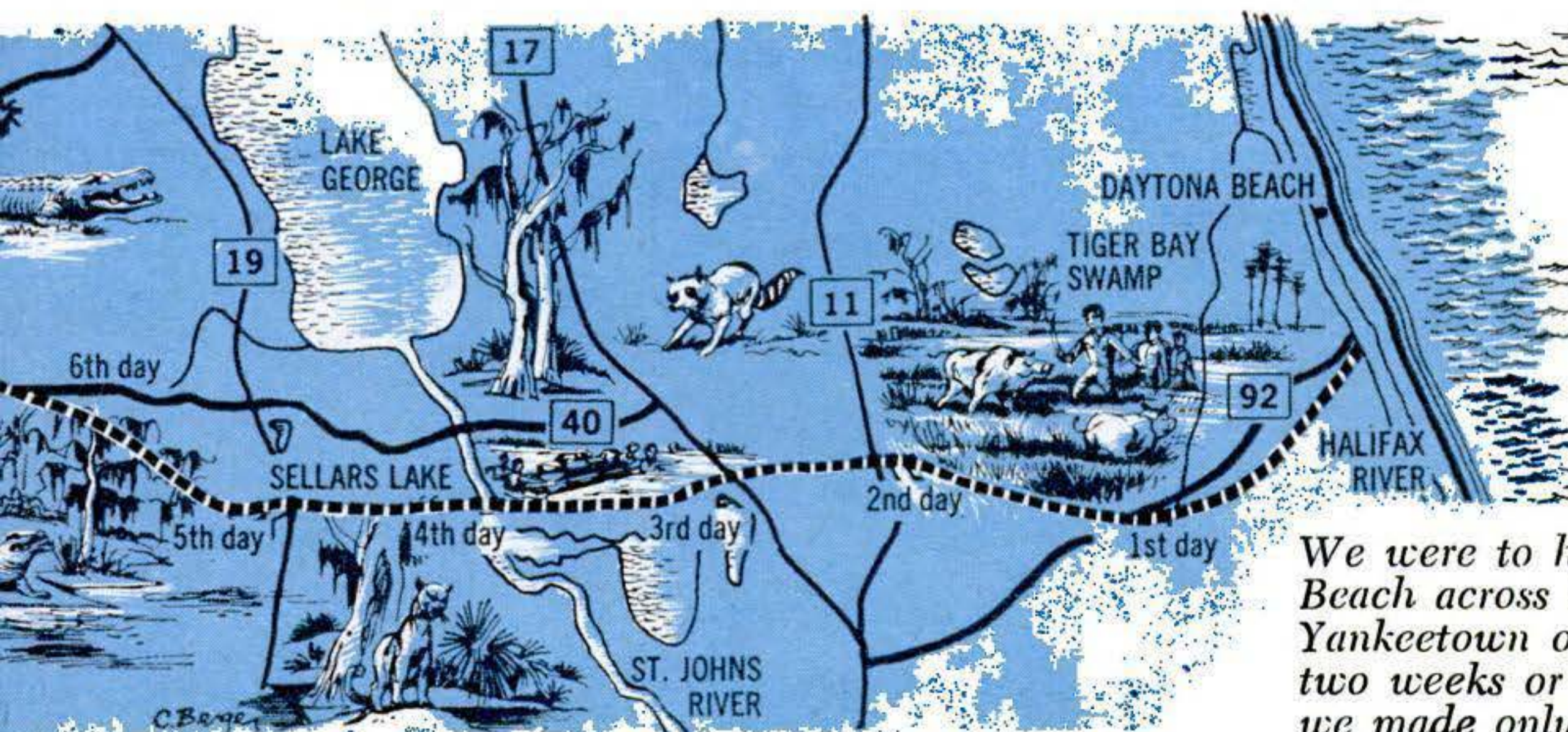
We were bogged down in uncharted swamps, maddened by insect bites, weakened from lack of food, nauseated by

swamp water. We were up to our waists in clinging, stinking mud, hacking a path through impenetrable brambles, making less than a quarter-of-a-mile-an-hour progress in 100-degree heat.

This was a survival hike. Our knapsacks contained no food—we would have to forage for that—and only a quart of water each.

We had vowed to cross the state in two weeks or less. The map distance was a little over 120 miles. But detours would add another 30.

I had dreamed of the trip for years,



There were no detailed maps, no easy trails, in the 12-day, 150-mile hike

We were to hike from Daytona Beach across Florida to Yankeetown on the Gulf—in two weeks or less. Some days we made only five miles.



The shore of the St. Johns River was all marshland, so instead of fishing or camping there we had to lash a raft together and swim the deep quarter-mile river before dark.

We were lucky in killing two young wild pigs on the second day out. Robert Rile and Bob MacKichan skinned one of them.

We often hiked and hunted at night when it was cooler. We used our miner's headlamps to capture and kill this armadillo.

SILVER SPRINGS STUDIOS



planning to train boy scouts for it. I chose eagle and explorer scouts, and the eight who finally set out with me were the elite of scores who had volunteered.

We were to live off the land, to simulate what a group might find if they were forced into the wilds. But we had an added handicap: We would have to obey all wilds-preservation and hunting laws. In addition, we would have no weapons except our hunting knives and one machete for the group.

We would be dependent on wild fruits, berries, or other plants we could find in the wilderness. For meat we would have to catch fish, frogs, reptiles, skunk, wild hog, opossum, raccoon, armadillo, and even grasshoppers. We could take only the barest essentials to sustain life in the jungle:

Salt, matches, hunting knife, spoon, pocket knife, mosquito bar, plastic bags, insect repellent, aluminum foil, antivenin kit, water-purification tablets, compass, whistle, miner's headlamp, soap, small towel, socks, underwear, handkerchiefs.

These items, plus a canteen and the haversack itself, were to weigh less than 10 pounds.

Here, from my log, are highlights of what turned out to be a nightmare journey that lasted 12 days.

First day, Monday, June 18. We waded in the Atlantic Ocean as a last sentimental gesture, and set out across the sand dunes heading due west. The time was 8:45 a.m. It took an hour to cross the land and reach the Halifax River at a point where we could find driftwood to make a raft. We lashed old logs and boards together with some garden hose we'd found, and soon had a fairly substantial raft.

We put our haversacks in plastic bags and tied them up, trapping a little air inside. If the raft broke up, the packs would float.

Wading ashore on the other side, near Port Orange, at 11:00, we wrung out our clothes, got our packs on, and at 11:45 headed for our first check point. The temperature was 91.

A couple of miles inland we ate a hasty

[\[Continued on page 198\]](#)



SILVER SPRINGS STUDIOS

Allen cuts a seed pod from a wild sunflower. The seeds were good eating.

A mild-mannered Tarzan of the Florida jungles

Ross Allen has pitted himself against nature for most of his 54 years. Now head of the Reptile Institute at Silver Springs, Fla., he has probably had more experience with snakes than anyone else in the world.

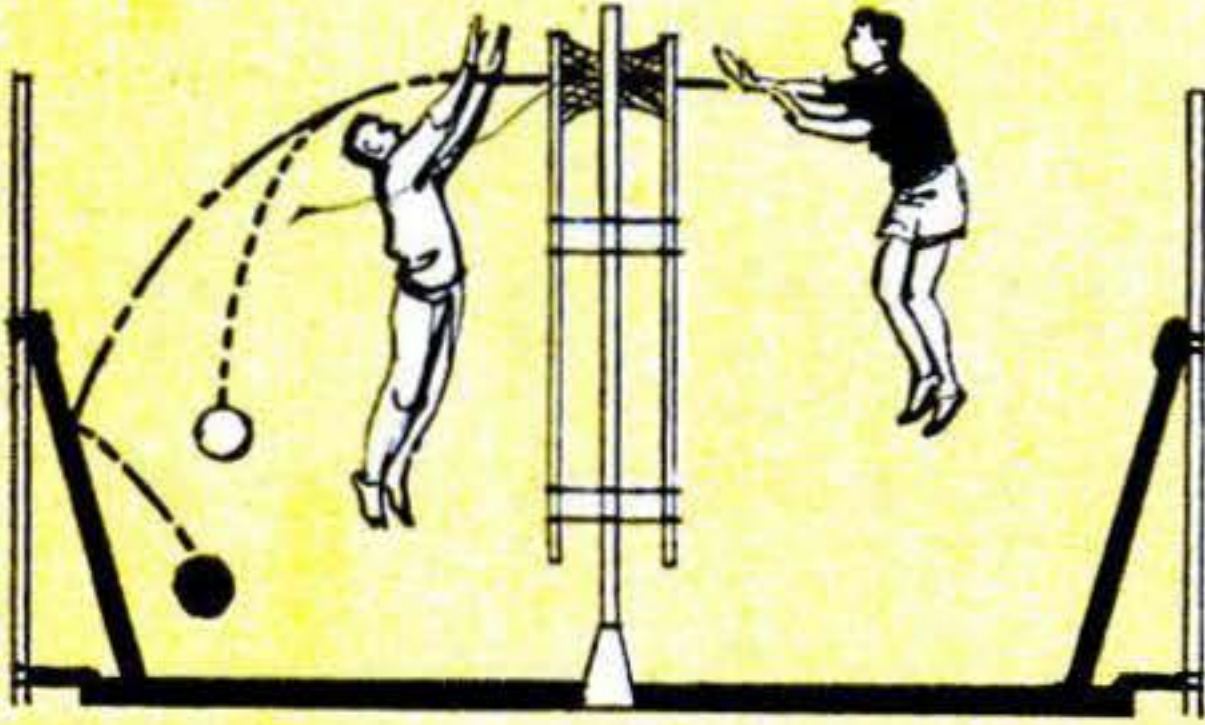
A stocky, smiling-eyed, soft-spoken man, who looks more like a small-town banker, Allen's job is raising snakes for venom. He personally milked each of the 73,960 snakes required to provide 90 percent of the antivenin used by the armed forces in World War II.

Allen's enthusiasm for nature began early. At six he was skipping classes and wandering the fields and forests. He grew up to wrestle alligators with the Seminole Indians. Somehow he also found time to gain a college degree and raise a family.

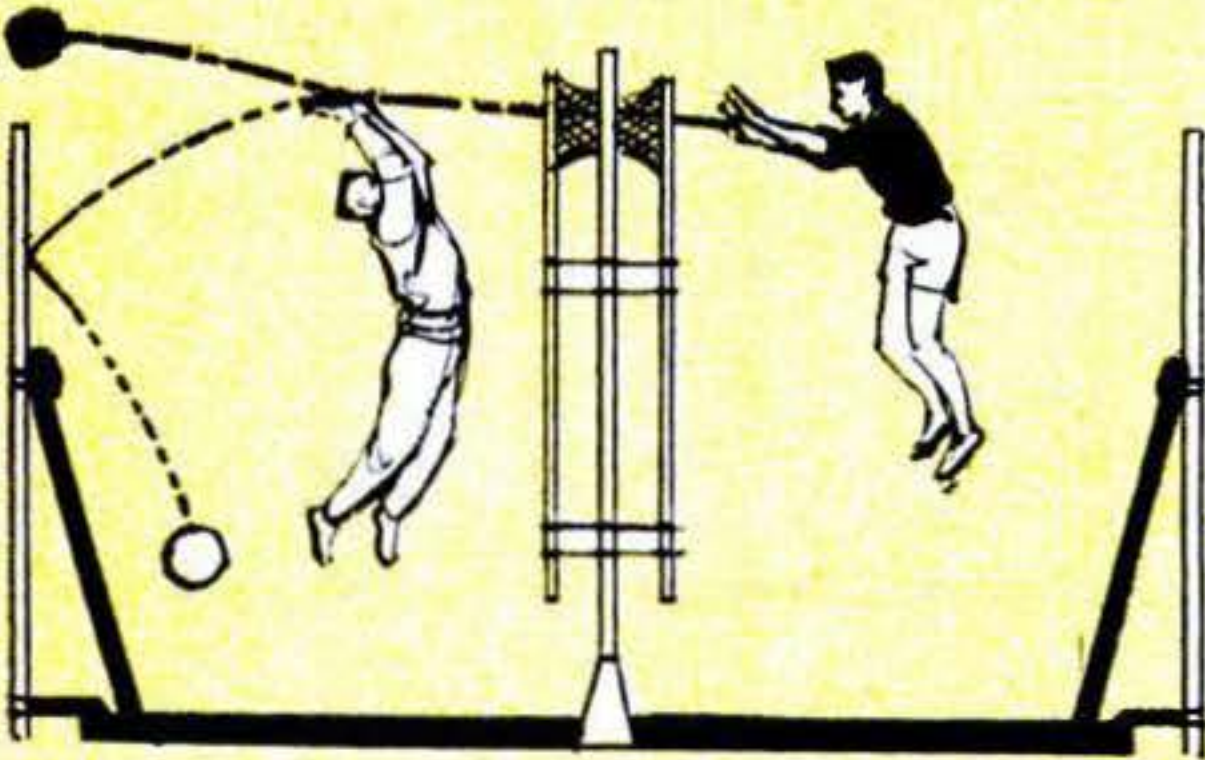
Asked his plans for the next Cross-State Survival Hike, Ross replied, "I'm planning some shorter ones—for girl scouts."

Meanwhile you can find him dressed in a white shirt, khaki pants, and moccasins—wandering through the Seminole Indian Village, the Reptile Institute, or the Anti-Venom Laboratory at Silver Springs.

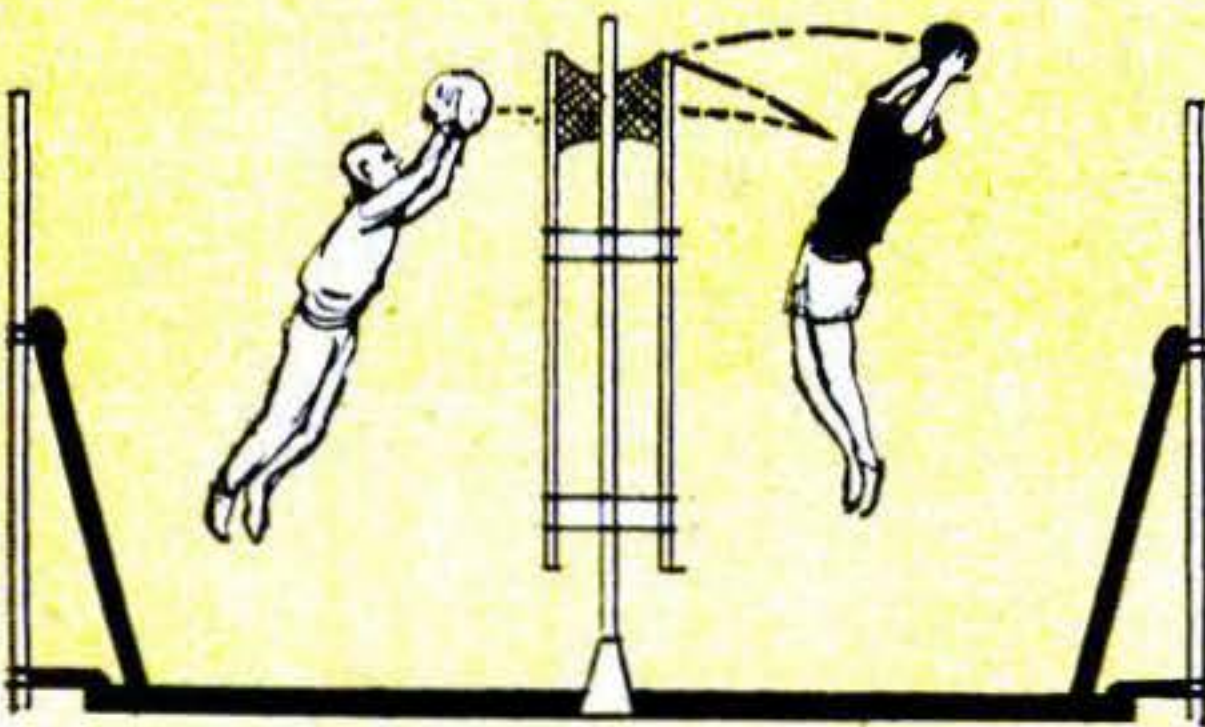
Scoring: Game is 7 points; set, 3 games in 5



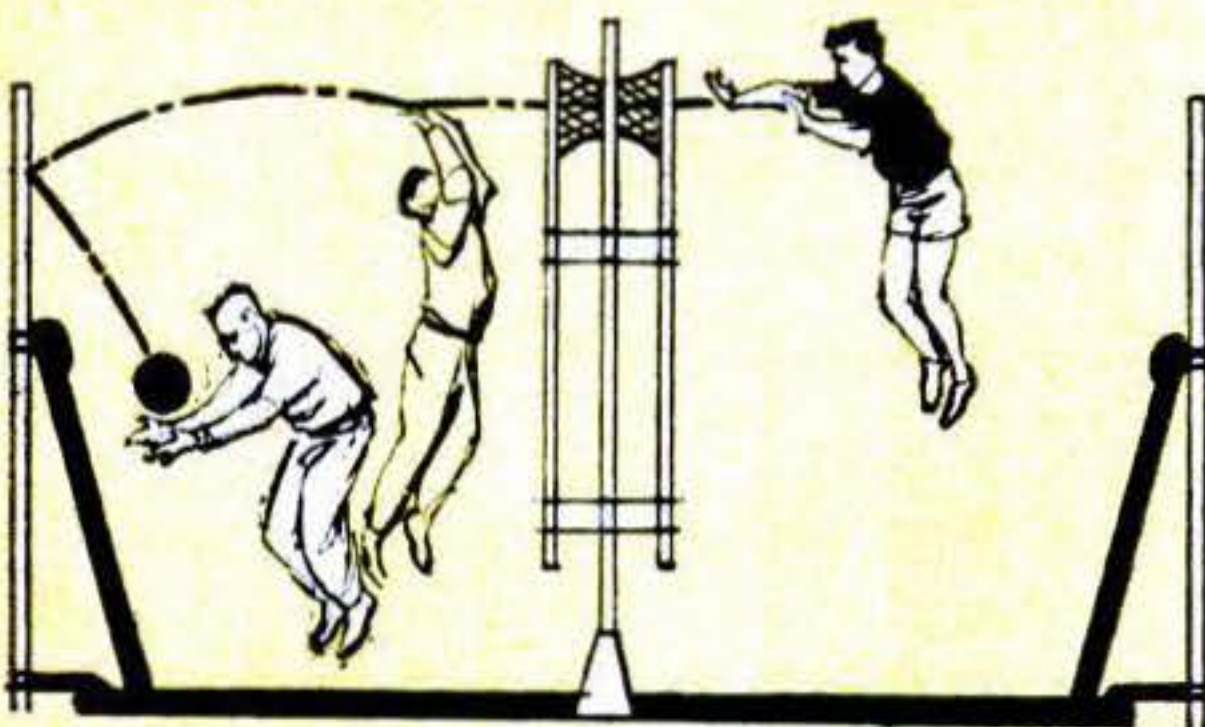
Server scores one point when he passes ball through gantry and beyond receiver, striking scoring zone on backstop or trampoline bed.



Server also scores when "butter-fingered" receiver fails to catch ball, merely deflecting it, even if it doesn't strike scoring zone.



Neither player scores if ball hits gantry, bounces back, and is caught by server, or if thrown through basket and caught by receiver.



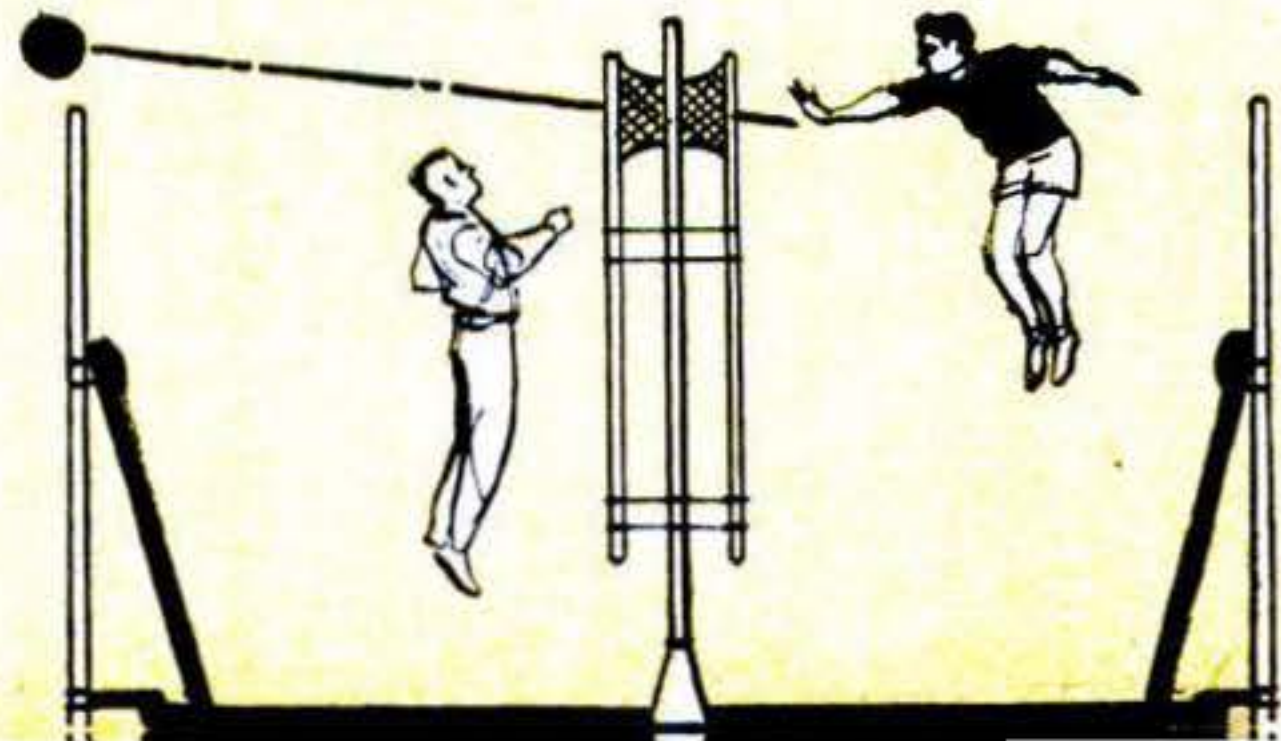
There is no score if defense tips ball but catches it before it hits bed. Touching gantry or stepping over center line is point penalty.

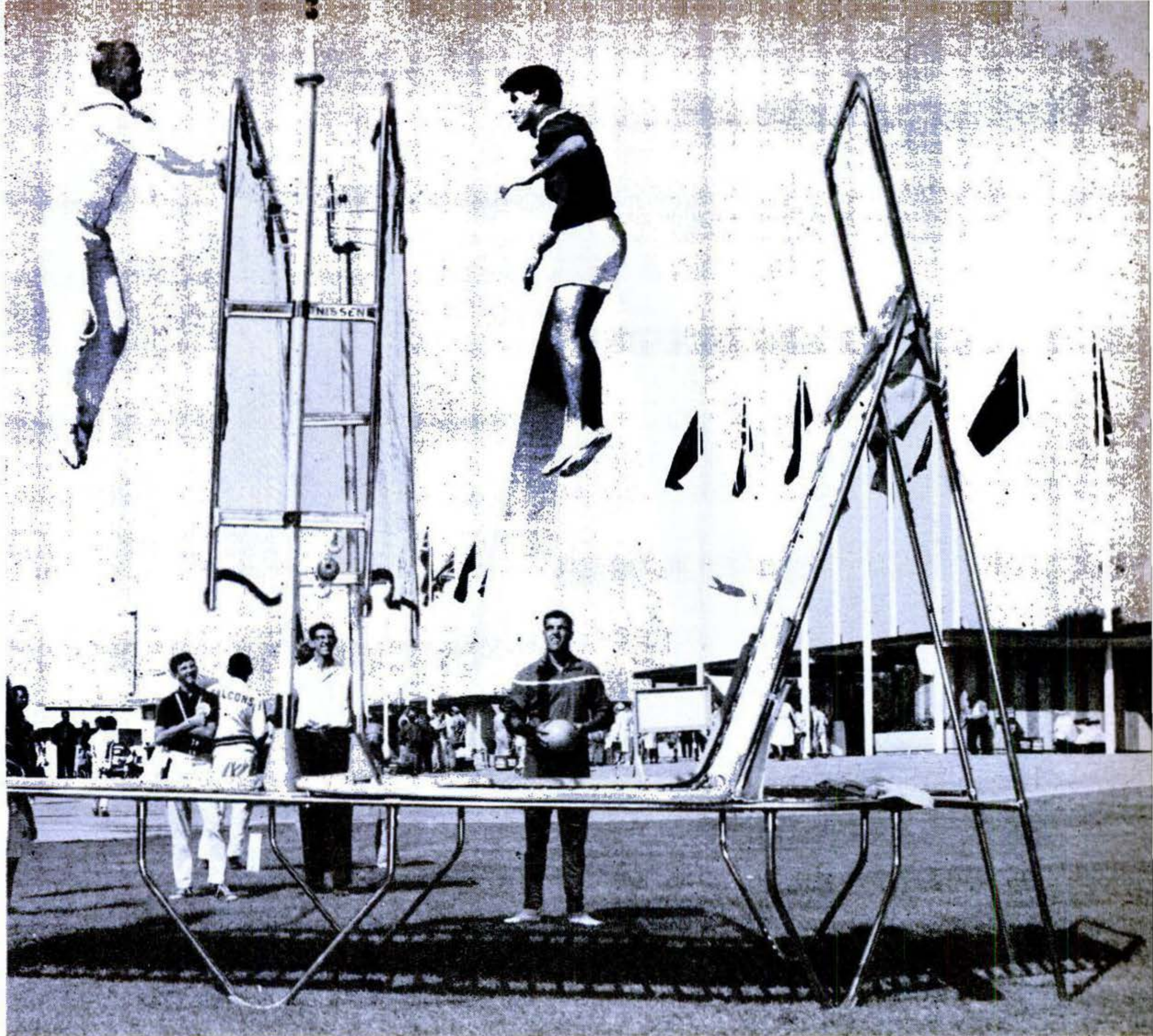


Space Ball

Nearest thing to weightlessness is this new three-dimensional game

Receiver scores point if server throws ball through gantry basket and sends it completely out of playing area, provided receiver doesn't touch it as it passes.



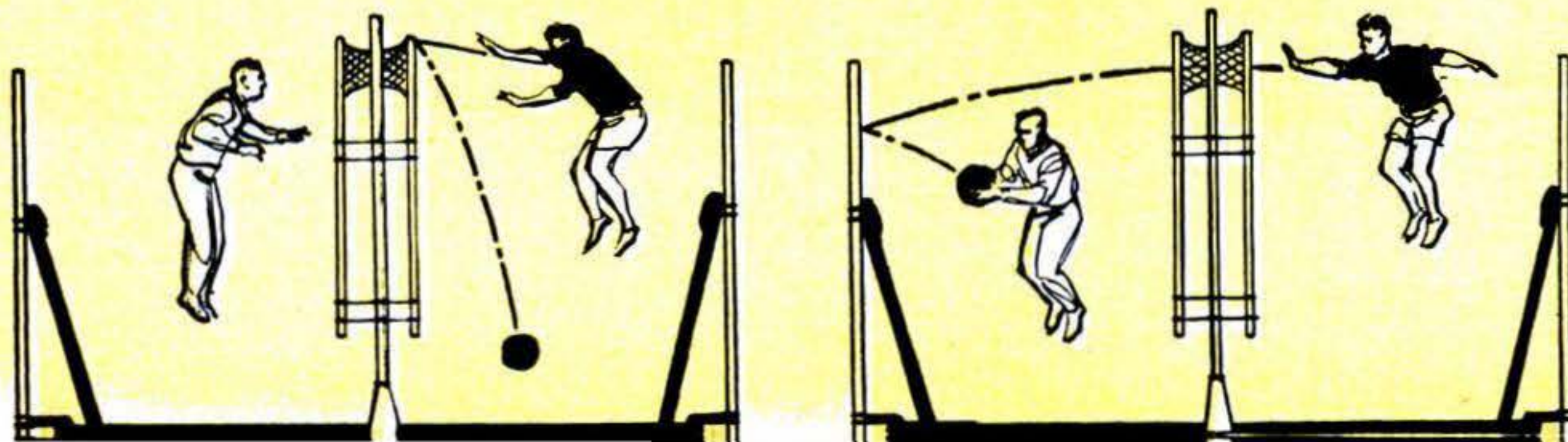


CATCHING on all over the country is this exciting gymnastic game played while contestants are weightless, or nearly weightless, while bouncing on a trampoline. It resembles volleyball but adds a third dimension of space to the length and width of the court. The ball is served through a basketlike hole

in a net-hung upright called a gantry. The skill, says the inventor, George Nissen of Cedar Rapids, Iowa, is in judging when the ball is coming through, for once a player starts his bounce he can't stop. Extra equipment needed are the gantry and two backstop nets.—*Henry and Vera Bradshaw.*

Receiver also scores if server misses basket or hits rim and ball falls to bed. If receiver reaches into basket, however, it's a foul, and server scores.

Simplest way for receiver to score is merely to catch ball on rebound when it's thrown by server outside scoring zone and bounced back into playing area.





IN CALIFORNIA one day a truck throbbed up a mountain road. As it rounded a turn, the driver saw a curious ripple of snow on the pavement. Then the snow rose like water in a flash flood and hurled the truck off the road.

The driver leaped for life and escaped. He was lucky. Not many people caught in an avalanche live to tell about it.

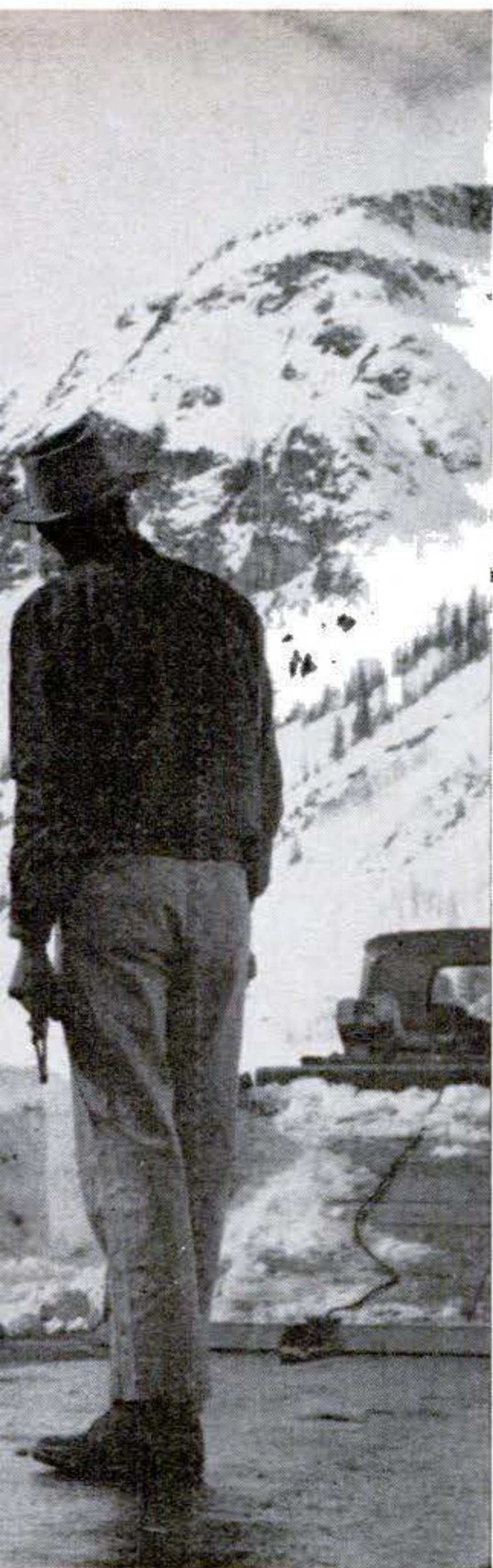
Near Seattle two climbers saw a white wave running down a mountain at incredible speed. A killing wind hit them. They tried to run but were swept to death in an avalanche. So was a dentist snowshoeing in Wyoming. So was a trucker eastbound from California on U.S. 160.

In Colorado recently a highway maintenance man on U.S. 550 felt himself

whirled over, 20 times, by a vicious wind.

"It was like a tornado lying down," he told me. Then snow buried him. "I tried to swim in it," he said. "People always do. I've found them frozen in swimming positions." He, too, was lucky. Hours later he was dug out alive, and today an avalanche is named for him: the Henry Brown.

Although there are hundreds of avalanches each winter in our high mountain states—from California to Maine—you haven't heard much about them until lately. The reason is simple: Mountain people have always avoided them like rattlesnakes. They strike over and over again in the same valleys, and their haunts, or chutes, are well known. Some have been given grim or even hateful



On U.S. 550 in the Rockies a cannon barks and a shell screams skyward as the world's most unusual highway crew goes into action

I Rode with the Avalanche Patrol

By E. D. Fales Jr.

Through field glasses, the patrol engineers watched the shell climb. After five seconds a flash lit the peak and all hell broke loose.

names, like Black Widow, Slippery Jim, and Sudden Death. The alert Colorado Highway Department now maps them. One is listed eloquently on official maps merely as the "S.O.B."

But lately millions of tourists, salesmen, and skiers have been venturing into avalanche country on growing networks of good roads. Lodges, resorts, houses, and whole towns have been built near big slides. Many people don't know their danger—as was the case in a hamlet on State Highway 82 near Twin Lakes, Colo., which was hit by an avalanche last winter.

The busiest avalanche state. As a result, all high mountain states and even the U.S. Bureau of Roads now have avalanche warning—and control—projects.

The remarkable thing is that there haven't been *more* tragedies, and in Colorado, "busiest" avalanche state of all, credit for that goes to the State Highway Department's lifesaving Avalanche Patrol.

Besides planning defensive earthworks to dam or deflect slides, the patrol keeps an eye on several hundred known chutes in every storm. It warns and guards motorists, and sometimes attacks the poised snow fields with cannons—to kill the killer slides before they can strike.

Just after the tragic Twin Lakes slide last winter, this reporter rode with the patrol in the soaring San Juan mountains of southwestern Colorado. We went gunning for an avalanche. We took along an ugly bulldog of a cannon, and in an awe-inspiring moment we got us one.

CONTINUED

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When I met the patrol I learned first that the study of avalanches has become a real science. Often they build on slippery ice formed by early winter storms. They grip the mountain at the edges—but may lie in brittle slabs unsupported in the center. Snow engineers check them visually and test them by thrusting sampling poles deep into them. By studying the sample cores in laboratories, the engineers can tell when a slide is getting ready to fall.

Many don't need such analysis. Snow blowing over mountain tops gets trapped on the lee side and comes down by the ton. Thus many lee-side avalanches load up heavily and "run" in almost every big storm—after a foot or so of fresh snow is measured on the level.

In avalanche country, keep going. Roads in many mountain states now are marked with signs that warn: DON'T STOP NEXT MILE. The word "avalanche" isn't used, for fear of frightening people unnecessarily. But I learned this from the patrol: *If you ever see such a sign in winter, don't dream of disobeying it.*

Not long ago, in one Western state, a man did. He left his wife parked in his car while he went skiing. Moments later an avalanche roared across the road. It missed the car but took him with it. He was dug out hours later, dead.

If you should ever be trapped in an avalanche while driving in a mountain state, what should you do? Patrol members say only: "It has happened to us once or twice. As a result we now always keep our windows tightly closed. If our trucks get buried, this holds a small reserve of air that may help until assistance comes."

Above all, I learned, no motorist should ever trifle with a snow slide. It may look "purty," as they say up here, but it's deadly. Once buried, in a car or out of one, a man may never dig out; the snow closes in like cement. Men have been found dead after tunneling as much as 30 feet the wrong way—*because they didn't know which way was up.*

[Continued on page 214]

Terror

ON STATE HIGHWAY 82, near Twin Lakes, I learned how cruel an avalanche can be. I got the story, standing on the mulchlike wreckage of what had been, until a few days before, a hamlet of pleasant homes. I heard it from survivors who still talked in frightened tones. Toward dark on the evening before tragedy, a well digger named General Shelton, who lived near Route 82, had paused to look up the snowy slope of Mt. Elbert, 14,431 feet high.

It had been blowing a gale, and there was talk of avalanches. But the Sheltons weren't worried—first because no slide had ever come this way, and next, because of a great boulder that towered over their house.

"If one *does* come," Shelton had told the postmaster, "that rock will split it around my house."

The mountain lay many feet deep in snow "slabs." Avalanches are often made up of slabs—some heavy as rock, overlying each other like shingles on a roof. Strange things have triggered these slabs—auto horns, shouting, thunder, sonic booms.

No one knows what triggered the slide. Trouble began toward 5:28 a.m. Far up, in the darkness before dawn, snow came down two chutes, joined, and in seconds the whole mountain seemed falling.

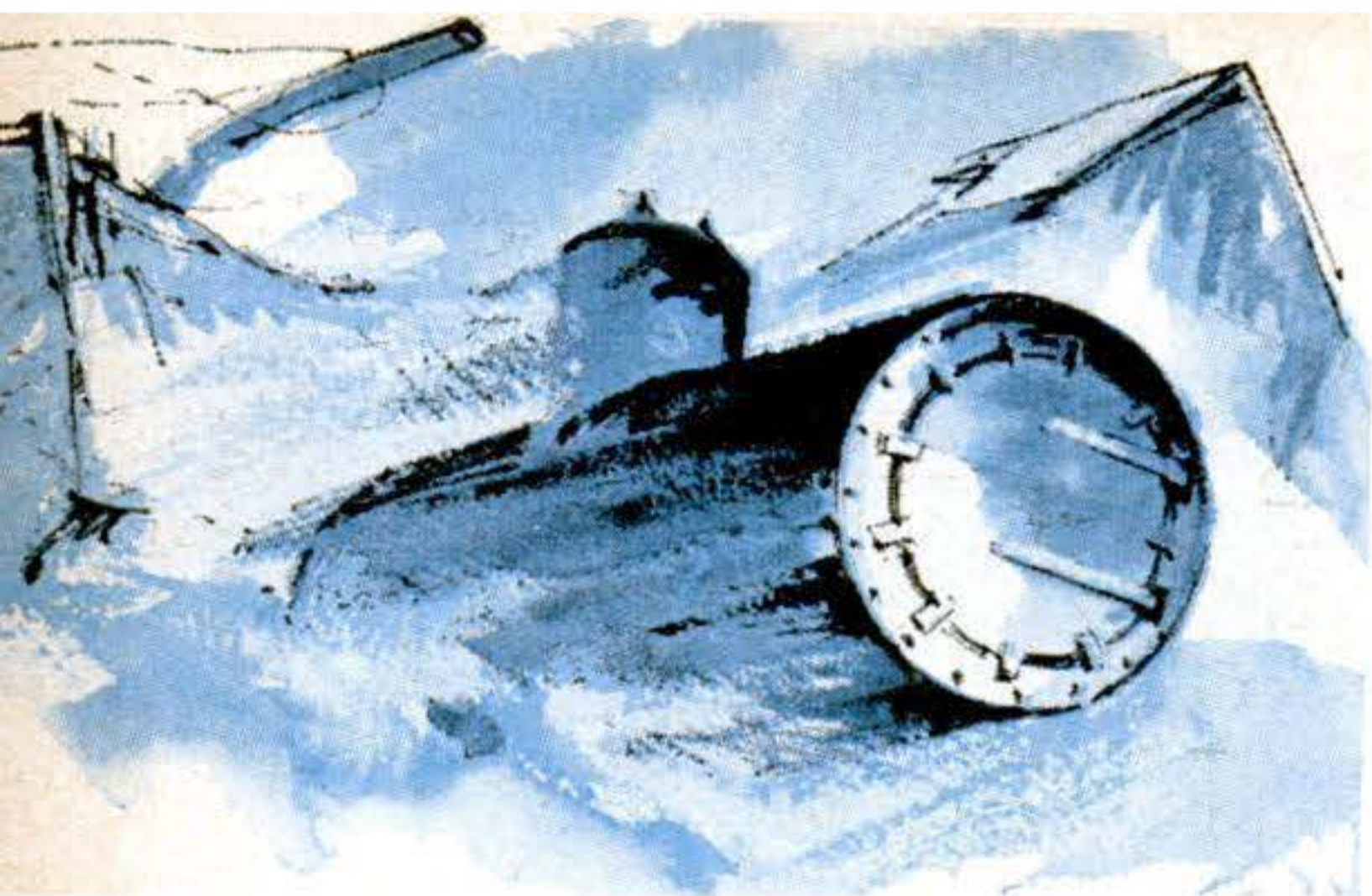
Directly in the path lay the Gordon mine, an abandoned gold digging with heavy-timbered buildings, a power plant, and a locomotive-size steam boiler. As the snow came down, the wind ahead of it pushed these off the cliff. Trees began going, and soon thousands of tons were pouring down toward the homes on Route 82, two miles below the mine. Riding the crest came the grotesque steam boiler.

Down below the avalanche, General Shelton, his wife, and three children slept secure in knowledge of that sheltering rock. Next door was his brother's house, but as fate had it, his brother and family were away. Across the road, rancher Bill Adamich and his wife were in bed. Their twin sons slept in the next room. Some distance away, Adamich's cattle dozed in his 100-foot barn.

Perhaps 150 feet from the Shelton house,

at Twin Lakes





Flung toward the town at 130 m.p.h., the mine boiler traveled two miles on the snow wave.

Nels Lindstone, 66, a builder, slept in a trailer in his back yard. He had rented his house to a family named Rowe, and they were asleep, too.

Lights were on in at least two houses. Toward 5:25 a.m., Adamich's dog, Pepe, had whined, waking his master. Deciding Pepe wanted to get out, Adamich had opened the door. It was still snowing. The dog went out into the snow and Adamich went back to bed and dozed off.

But a quarter-mile away another neighbor, Bud Davis, and his wife were wide awake. Bud was smoking and noted that the electric clock said 5:30. Suddenly the lights went off and Davis heard a roar, but only for an instant.

"It sounds like snow just fell off our roof and broke the wires," he told his wife. "I'll fix them when it's daylight." They went back to sleep.

Another neighbor, Frank Cerise, awoke at 5:30 to find his wife standing nervously at a window.

"What's the matter?" he asked.

"Oh, that awful wind started to blow again," she replied. Cerise recalled having heard, for a second or two, a hollow roar like a rising gale. Mrs. Cerise moved her collection of 40 African violets away from the window, and the Cerises went back to sleep.

Into the ravine. The avalanche, a few seconds before 5:30, entered a deep ravine a quarter-mile above Route 82. By rights it should have ended right there, for the ravine lay back of a wall of rock as high as a 30-story skyscraper.

But such was its fury that it never stopped. It fell 300 feet into the ravine on one side, crushing trees, then *climbed* 300

feet up the opposite rock wall and poured over the top. All this happened in a flash.

The slide now had attained its maximum width of nearly a quarter-mile. It was moving like a snake. Ahead raced that terrific avalanche wind; behind was a powerful vacuum. As it sloped up over the last ridge and started down, another vacuum may have been created above it.

At exactly 5:30 by the electric clocks that stopped, it hit Route 82.

Rancher Bill Adamich, just dozing off (after letting the dog out), heard an explosion, thought his furnace had blown up, and tried to jump out of bed. He never made it. His house was lifted and blown away. The acceleration was such that he slid part way out of bed.

The wind hurled the house 400 feet due south. Snow piled over it. Two closet doors and a dresser fell on Adamich and probably saved his life.

He kept calling his wife and sons. He had no way of knowing that his wife was buried eight feet beneath him, still alive but pinned as if in concrete. Nor did he know that his sons had been sucked out through the windows by the vacuum, and were dead.

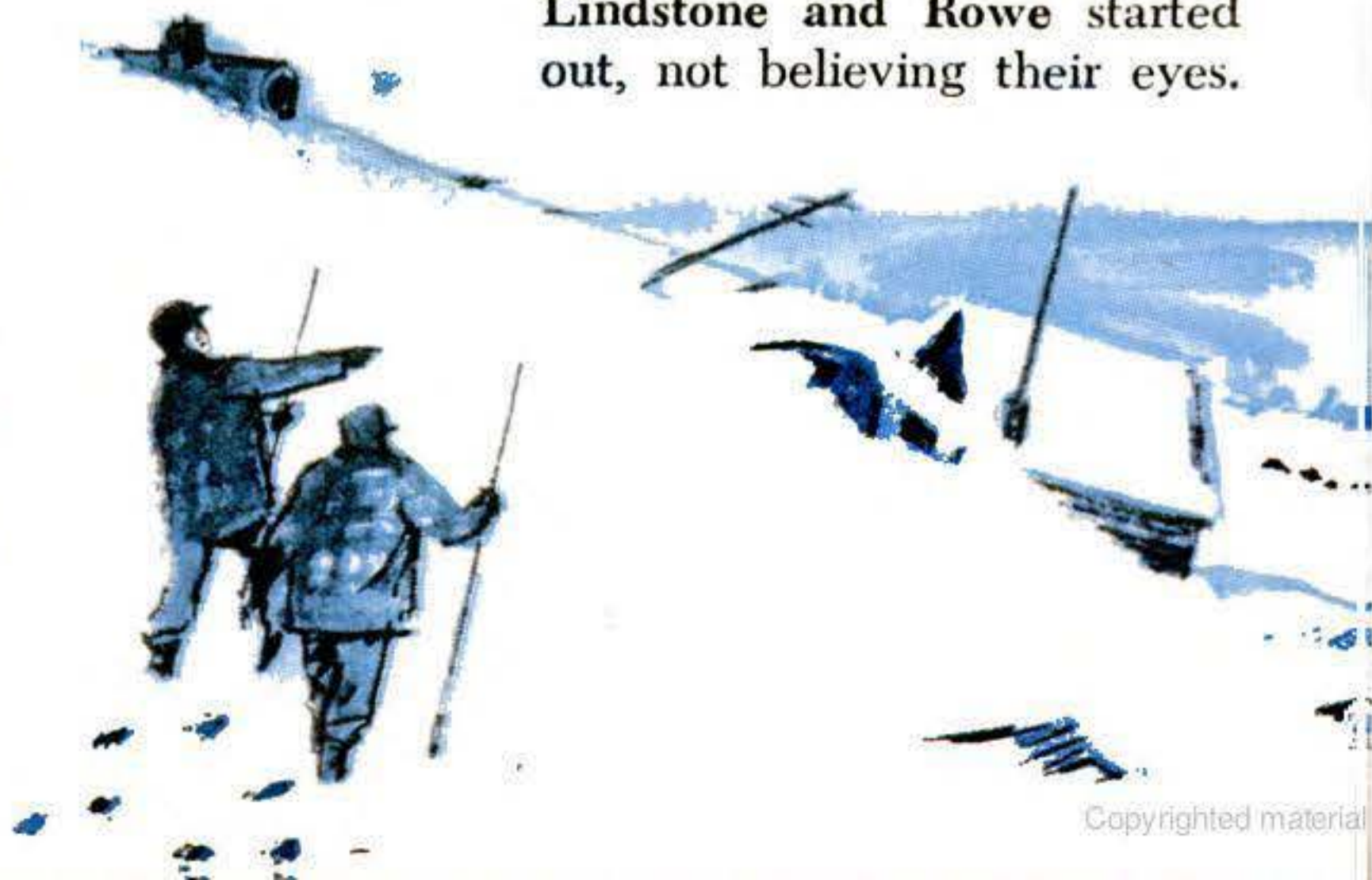
The avalanche whirled within 100 feet of Nels Lindstone's trailer but left it unharmed. Lindstone and his neighbors slept on.

When day broke, about 7:30, it was still snowing. In his trailer, Lindstone woke up, and as usual got his own breakfast. Toward 8:30 a.m. he heard someone at the door. His tenant, John Rowe, stood there, horror written on his face.

"Funny thing," says Lindstone, "he was there but he wasn't looking at me. He was staring over his shoulder. I said, 'What are you looking at, John?' He said, 'Come see for yourself.'"

Lindstone, a slow-moving man, came out into the zero morning, drawing on mackinaw and gloves. He stood with Rowe for

Lindstone and Rowe started out, not believing their eyes.



"Move!" The search patrol advanced one step in unison. Then: "Probe!" The poles were thrust deep in snow. If one hit something hard, that was wreckage; something soft would be a person, alive or dead.



long minutes, trying to believe the nightmare he saw.

A house trailer lay on top of a tilted house next door. Adamich's barn was gone, along with a garage and other buildings. There was no trace of Adamich's house or the Sheltons'. Where there had been a forest, the mountain was bare. The fallen avalanche lay like a glacier, 25 feet deep over Route 82. It had pushed far down into a meadow below.

Lindstone said to himself: "*Everything's gone—even the forest.*"

"It didn't occur to me at first that anyone could still be alive" he said. "But then we started out in the slide to look."

The alarm spreads. Some time after this, Bud Davis and his wife heard someone pounding on the door. It was Lindstone. He could hardly get the words out: "There's been an avalanche and the Sheltons and Adamiches are all gone."

Mrs. Davis raised a window shade. "Bud," she said, "for God's sake, come look."

Davis joined her. "Get some warm clothes on quick," he said. "We've got to go with them and get help."

At this time Bill Adamich, lying in snow, dressed only in sweatshirt and shorts, was waiting to freeze to death. As the snow settled, he knew he was near the top but he couldn't move. Toward 9:30 he heard a throbbing sound. "That's a plow," he thought, "but it's a long way off." He didn't know that 500 searchers already were hurrying to the scene from many miles around.

When National Ski Patrol searchers dig for bodies in avalanches they use the blunt end of long steel poles that come in four-foot sections.

They move over the surface a step at a time, elbows touching. The search leader says, "Move!" Each man advances a step. "Probe!" Each thrusts his pole deep. Again, "Move!" and "Probe!" When a pole hits something hard, that's a rock, or wreckage.

"If it hits something soft," a patrol member says, "that's a body."

Methods like this were used to seek the victims at Twin Lakes, and some searchers also hunted with long compressed-air hoses, thrusting air jets into the debris. They eventually found the Sheltons, all dead. And by 10 a.m. they located Mr. and Mrs. Adamich, both alive. It was more than an hour, however, before they were dug out, destined by some miracle to live. The pup, Pepe, lived, too.

Just how great a fury ran in that slide was revealed when the snow began to melt. Walking over the fallen avalanche above and below Route 82, I was surprised to find it matted with millions of green spruce needles torn from twigs and branches. The smell of these needles was still in the air. Hurricane winds can smash trees, but only incredible tornadic fury could have stripped an evergreen forest of needles.

A great silence. The noise must have been very great. Why, then, did no one hear it? I remembered the slide I had seen shot down on U.S. 550. The movement was so brief. The explosive edge of the Route 82 avalanche had probably shot through town in two seconds.—All sound must have been muffled by that same wall of silence we saw rise near U.S. 550—the dreaded snow fog.

One object rode out the storm—that indomitable steam boiler. I found it lying 200 feet above the highway, at a cockeyed angle, still grotesquely on top of the heap. U. S. Forestry Service experts now compute the speed of the Twin Lakes slide at 130 miles an hour—which means that the boiler had probably ridden down two miles in less than a minute.

I asked a neighbor what had happened to the great boulder above General Shelton's house.

"That's a mystery we're still trying to solve," he told me, shaking his head. "It's just gone." ■ ■

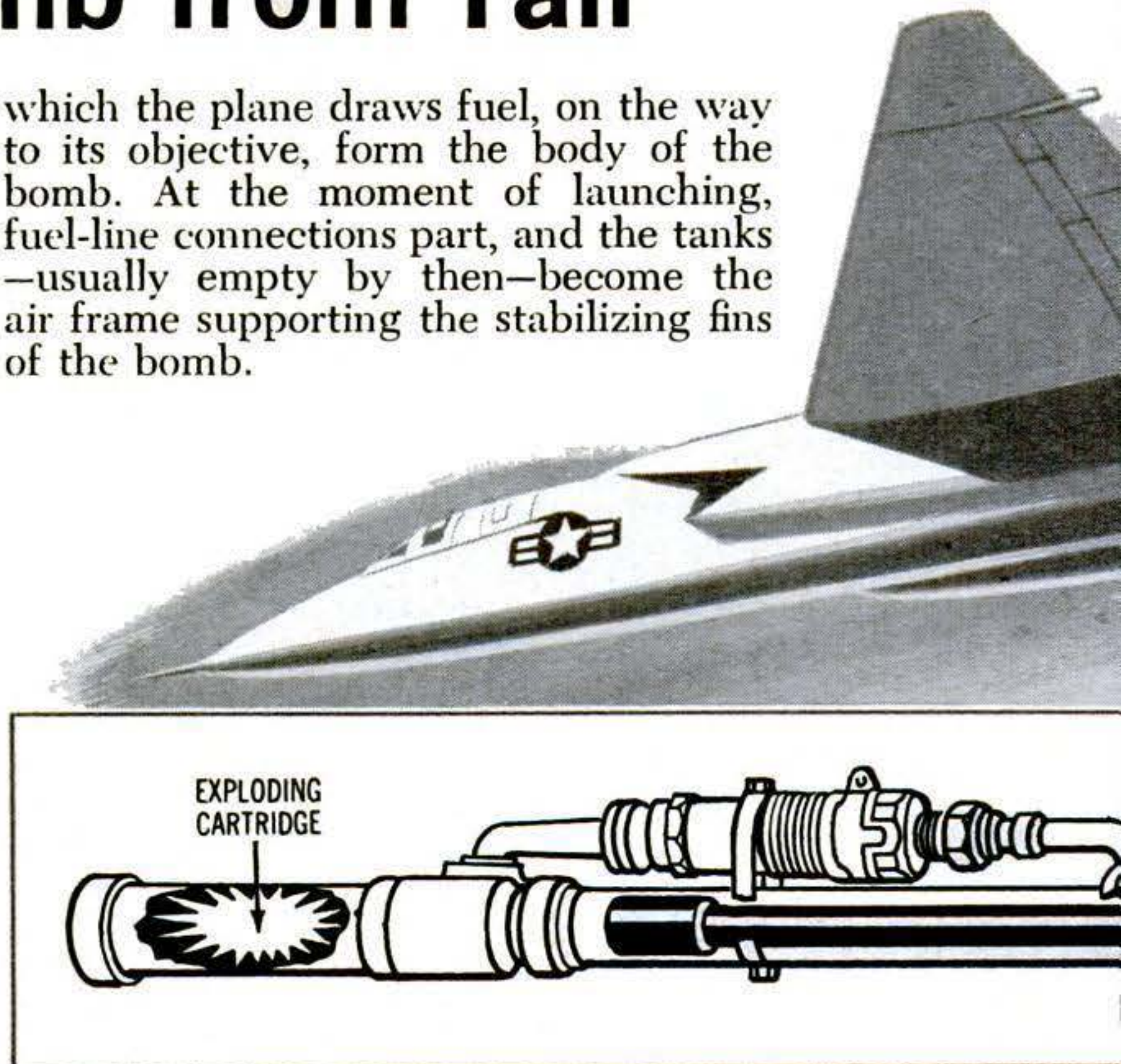
Plane Hurls Bomb from Tail

Launching a big bomb from a plane racing twice as fast as sound is quite a trick. Hit by the terrific air wash, a missile loosed from a bomb bay in the belly might flip tail-up, and collide with the plane. So the Navy's A3J Vigilante bomber, based on the nuclear carrier Enterprise, catapults its bomb from its tail. Details of how the North American Aviation-designed craft does it have just been officially cleared:

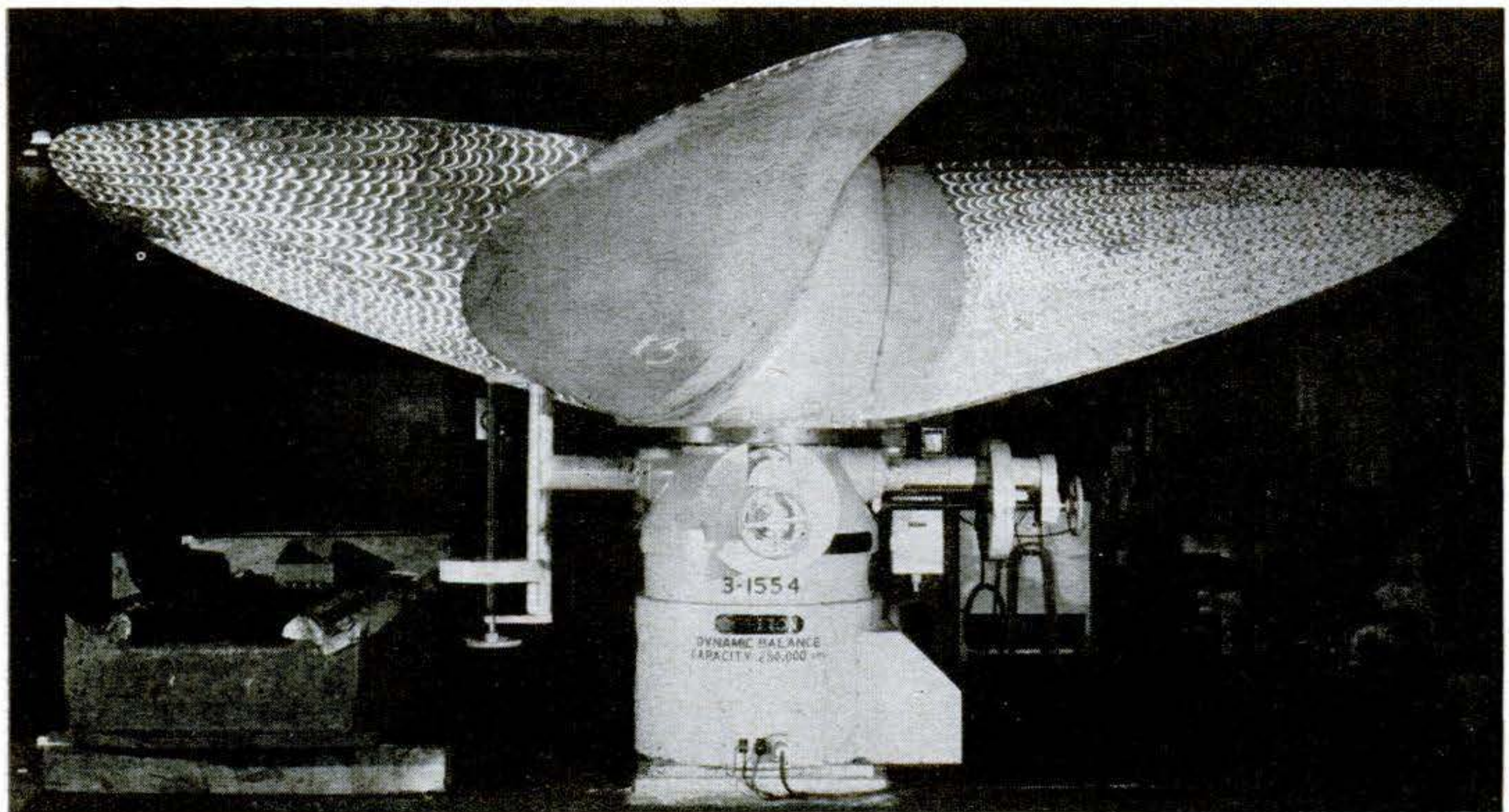
Ignition of a powder cartridge drives a piston along the barrel of a launching gun, as in plane-launching "powder catapults" of World War II. Acting as a ram, an extension of the piston propels the bomb rearward on a roller carriage, along tracks in a tunnel in the fuselage, and ejects it from a port in the tail. A tail cone, covering the port, is automatically unlatched and jettisoned as the bomb emerges.

The few uncensored details about the bomb itself, which can pack a nuclear warhead, indicate a remarkable dual-purpose design. A pair of tanks from

which the plane draws fuel, on the way to its objective, form the body of the bomb. At the moment of launching, fuel-line connections part, and the tanks—usually empty by then—become the air frame supporting the stabilizing fins of the bomb.



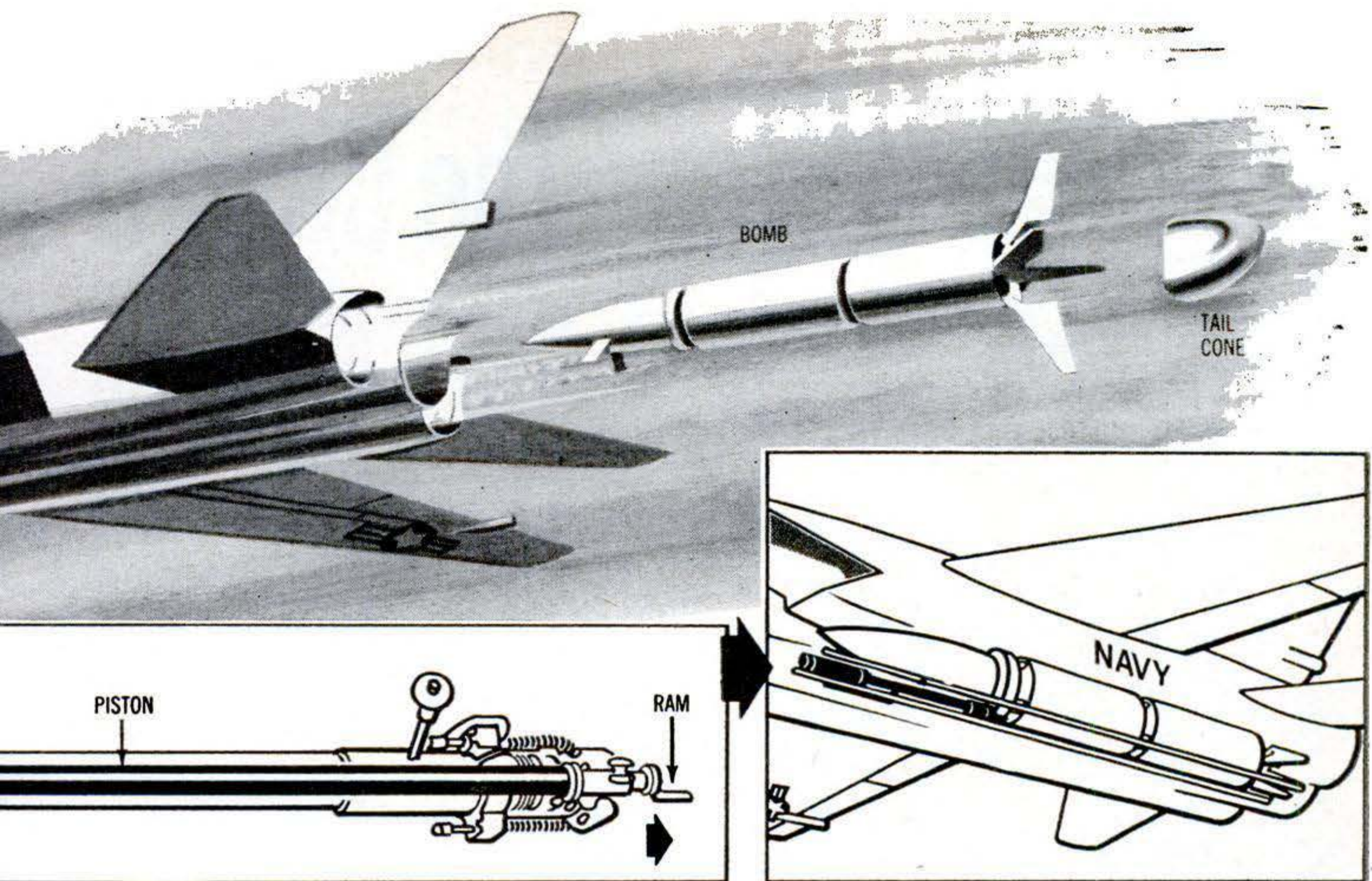
Supersonic plane ejects bomb from tail (top view) with launching gun shown just above. Explosion of powder cartridge drives piston along barrel of gun



Machine balances 125-ton prop

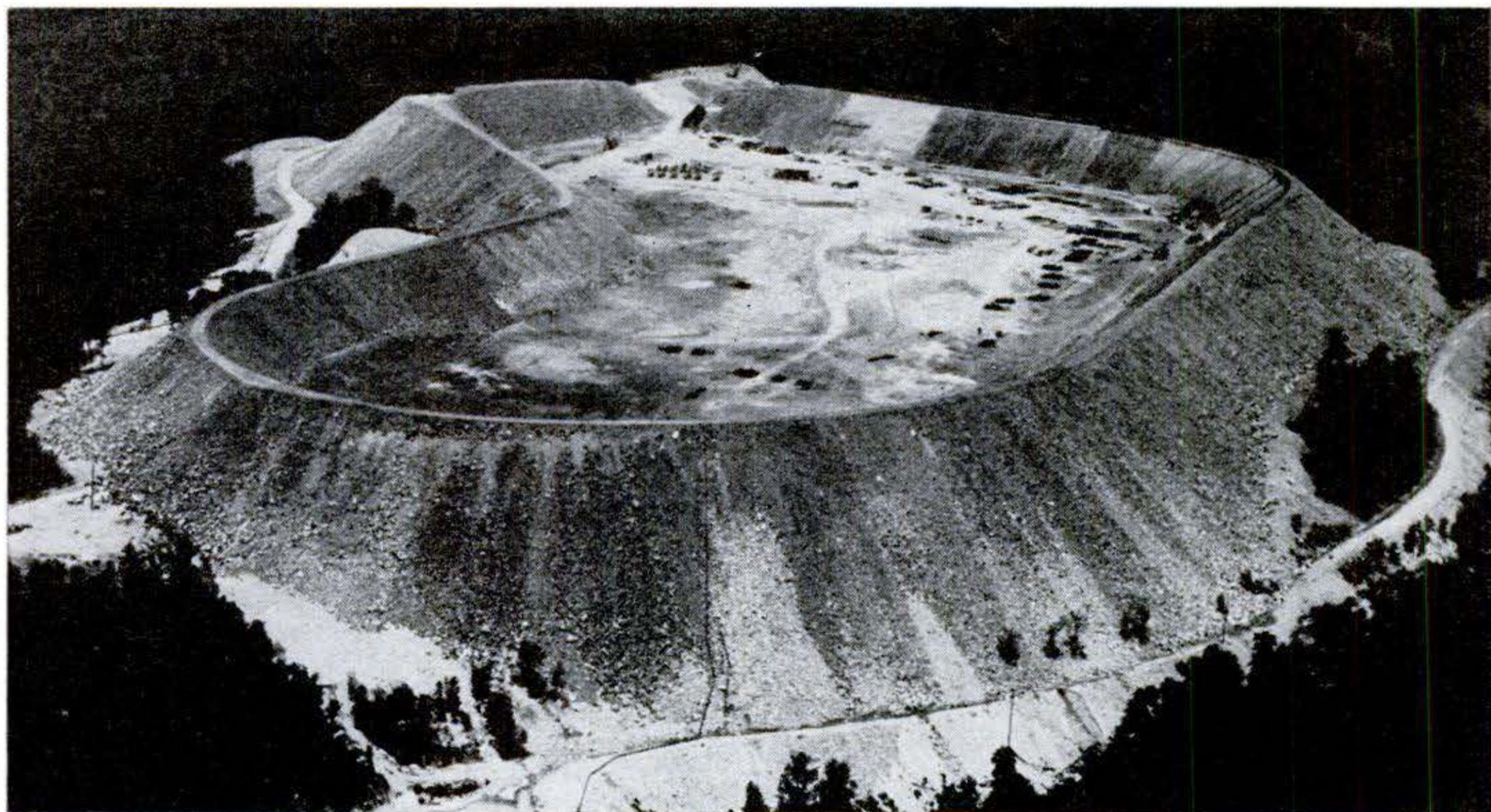
With propellers growing in size to drive the huge new tankers, Bethlehem Steel's propeller plant at Staten Island, N.Y., has installed a dynamic balance with a capacity of 250,000 pounds. The big wheel shown

on it here is a four-blade manganese-bronze propeller for a Mariner-class ship. It's 22 feet in diameter and weighs 61,000 pounds. Mounted on a vertical-axis universal joint, it's measured by strain gauges and other instruments for both static and dynamic unbalanced forces.



(toward right, in diagram). Extension of piston acts as a ram to propel bomb aft in tunnel in fuselage, where view at right shows it, and

out through port in tail. Bomb is stabilized in flight by nose and tail fins, the ones on the tail unfolding as the bomb emerges.



Mountain-top lake to generate power

This 55-acre bowl is the upper reservoir under construction at Taum Sauk, high in the Missouri Ozarks. When completed this year, it will draw water pumped from the Black River 800 feet below to provide St.

Louis with an additional 350,000 kilowatts of power. By night and on weekends, with industry shut down and electric consumption low, water will be pumped by a big reversible pump-turbine through shafts 18½ to 27 feet in diameter; in daytime it will flow back down to turn the generators.

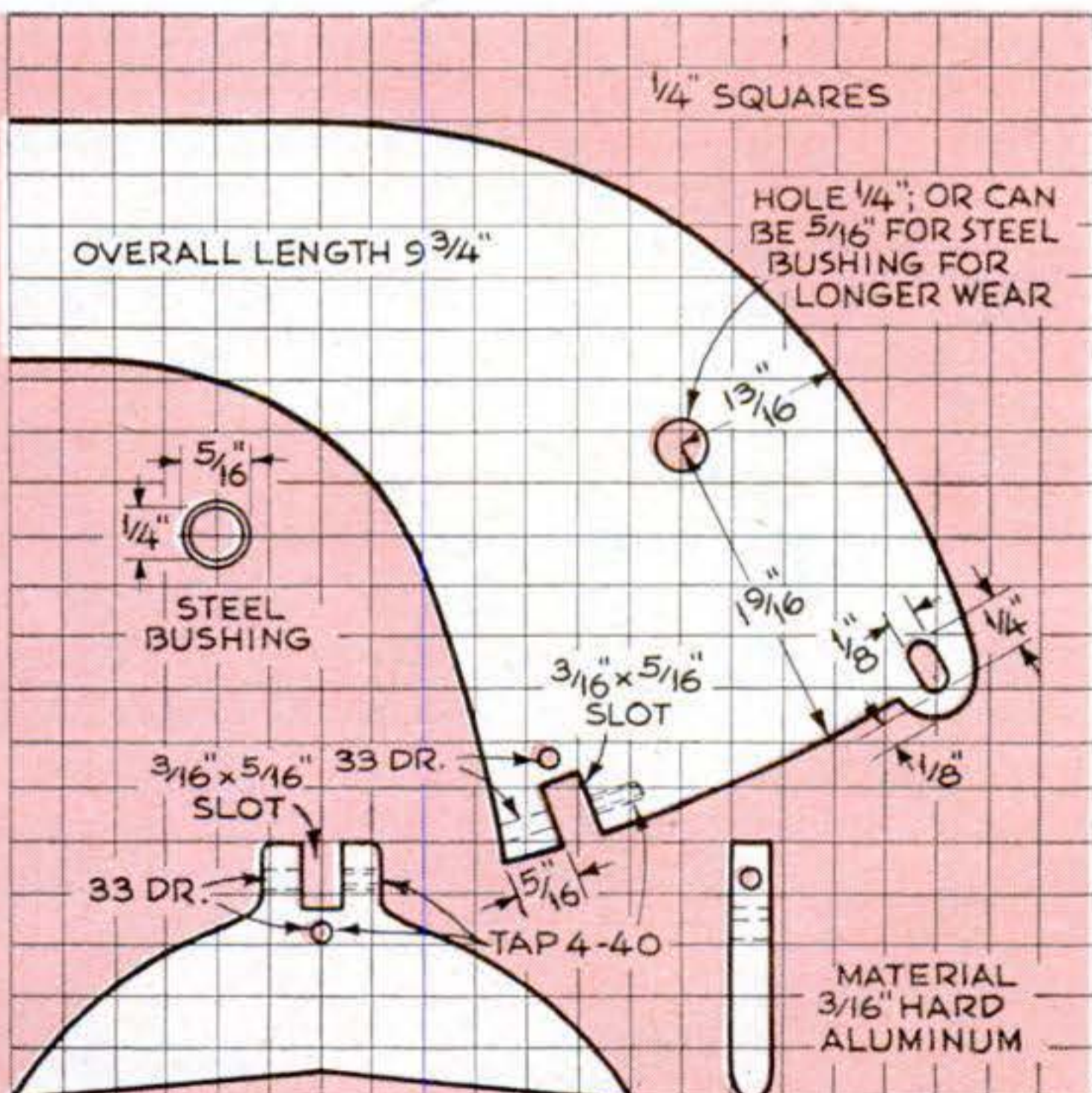
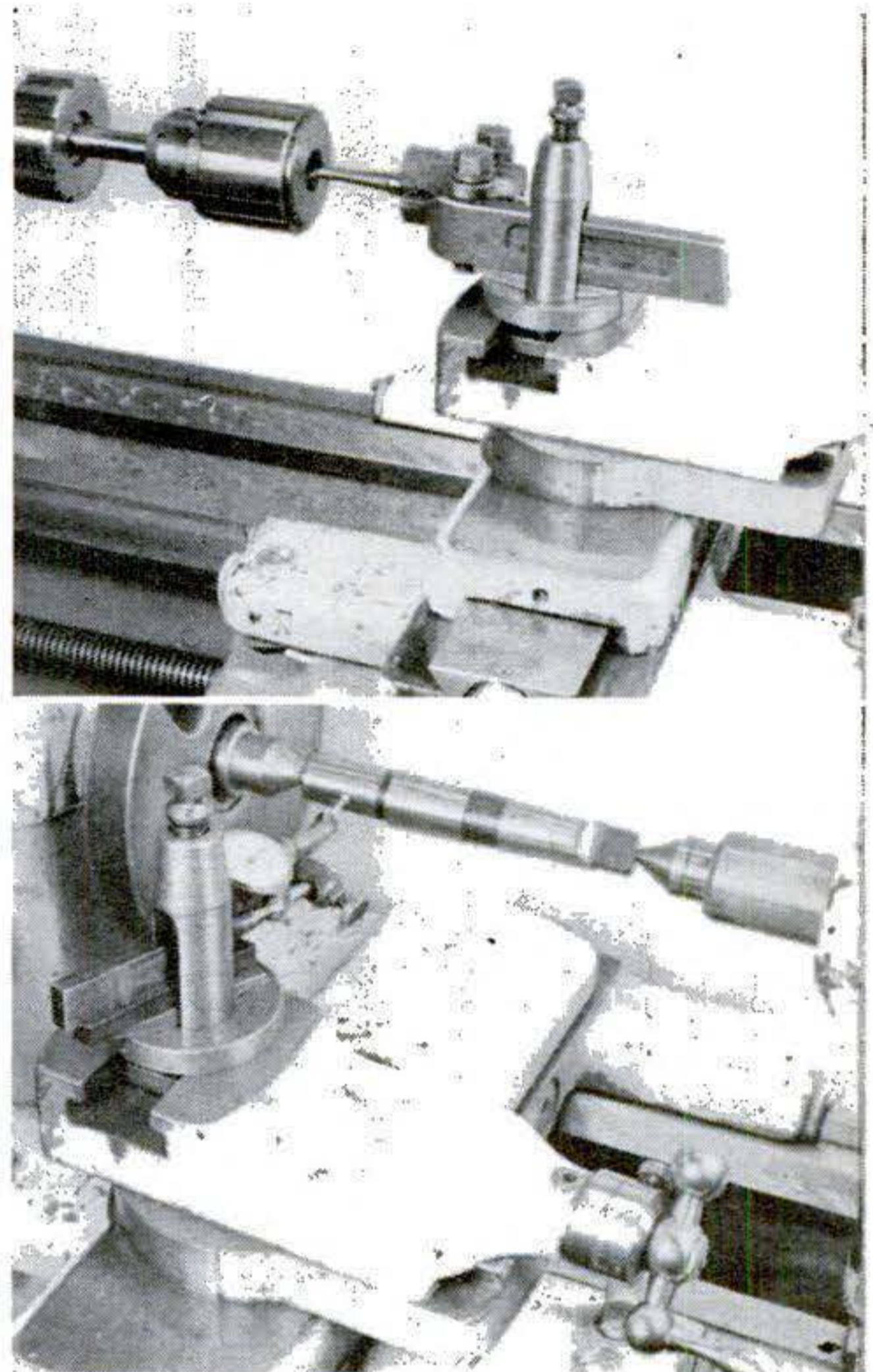
crosspiece at the other for making the break. The wheel is available at shops dealing in ceramic tile. It's a replacement for a rental cutter. Price: about \$3.

The base is $\frac{3}{4}$ " plywood covered with $\frac{1}{32}$ " steel. A flathead bolt at each corner holds steel, plywood, and supporting angle iron in a firm sandwich.

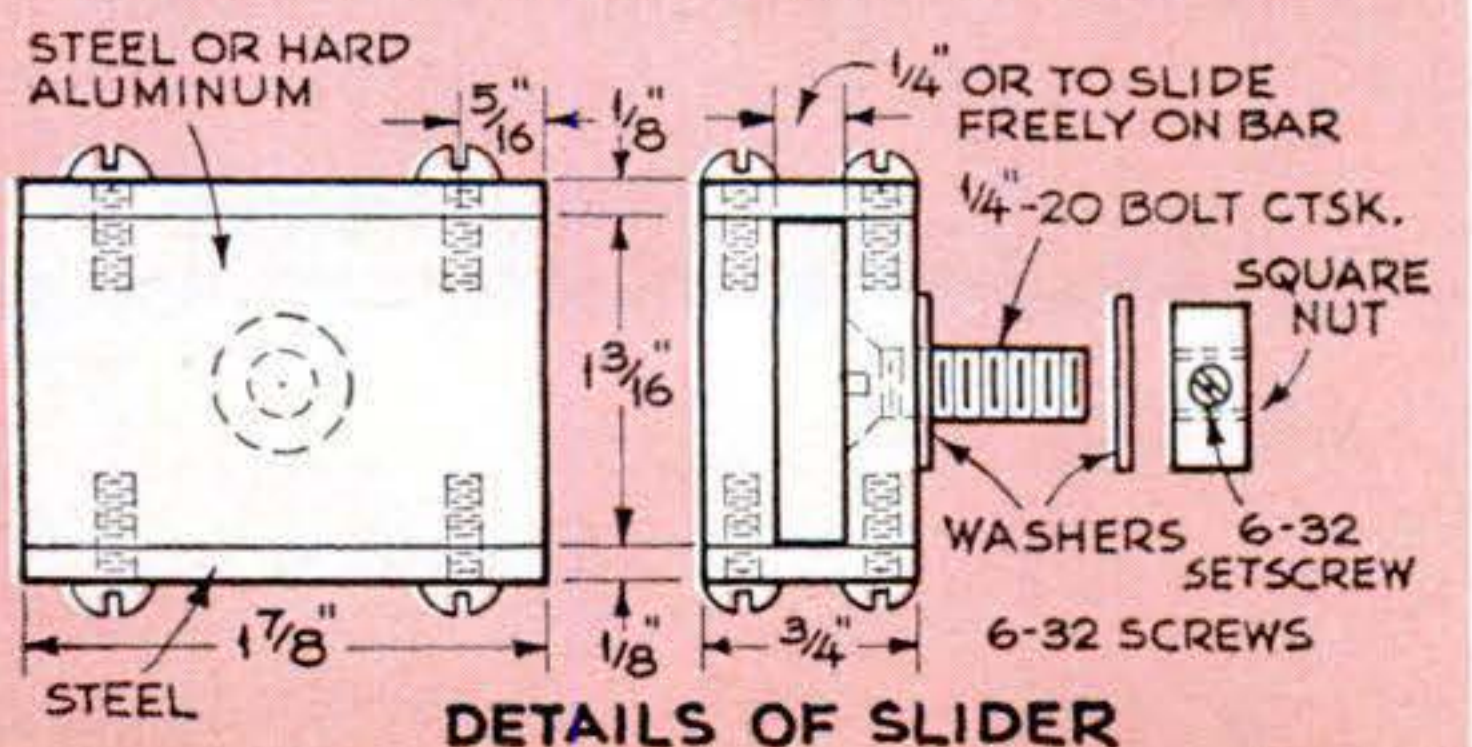
Strips of $\frac{1}{8}$ "-by-1" steel surround three edges of the base, joined by the stop bar as you see in the drawing. A hard-aluminum center blade placed square down the middle of this enclosure creates two equal recesses for the $\frac{1}{2}$ "-thick sponge rubber on which tiles rest for cutting. The rubber rises $\frac{1}{16}$ " above the center blade and edge strips. A step cut in the end of the center blade locks into a slot in the stop bar.

The handle and crosspiece are best cut with a metal-cutting bandsaw—or you can have them cut by a local machine shop. A slot in the handle provides for up-and-down adjustment of the cutter wheel for best scoring of the tile.

The slider assembly must be accurately fitted to the slider arm to move easily—but without play. Locate the two sliding-bar end supports just far enough off center so that the cutter wheel rides true on the centerline of the center blade.



DETAILS OF HANDLE AND CROSSPIECE

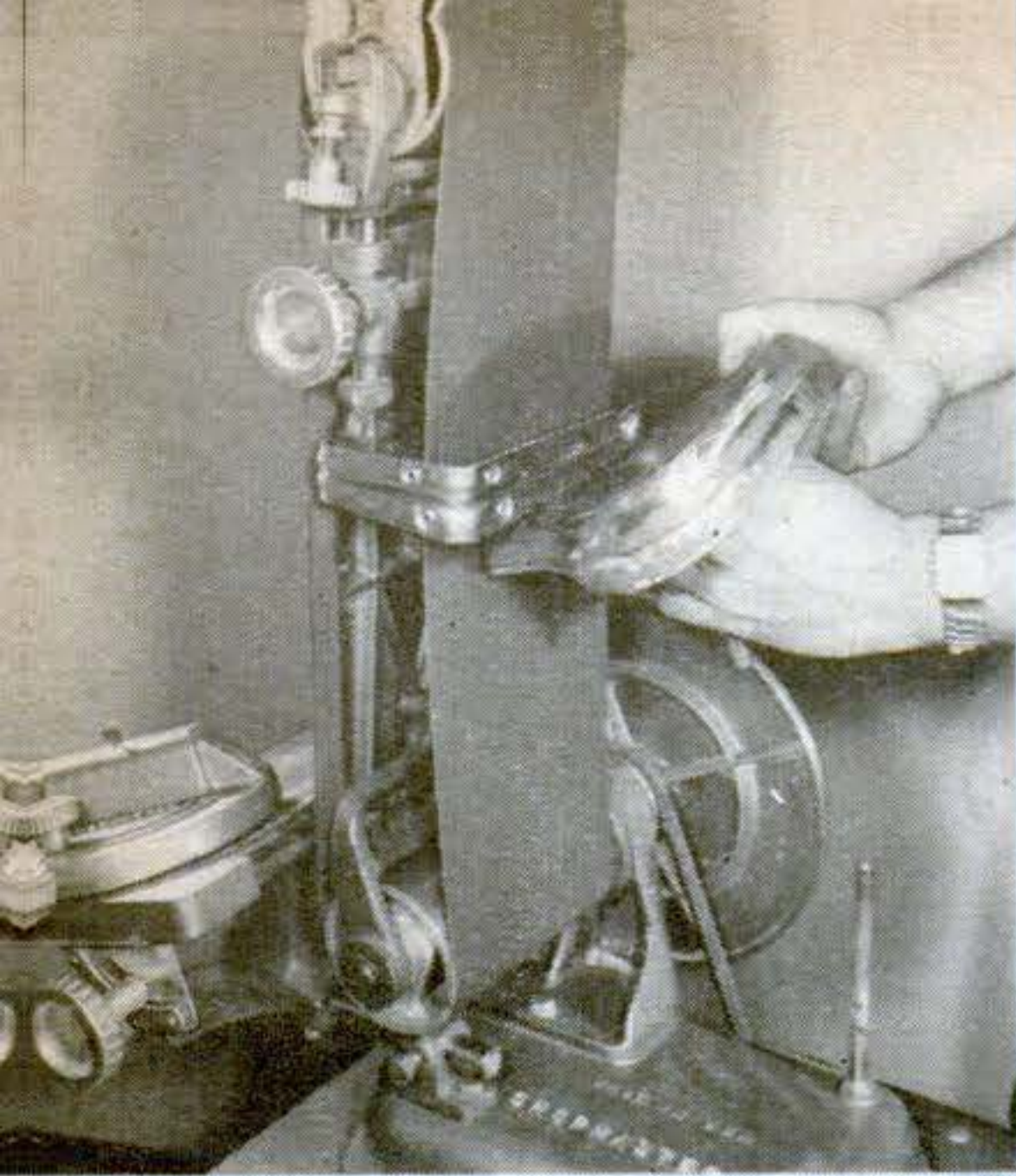


DETAILS OF SLIDER

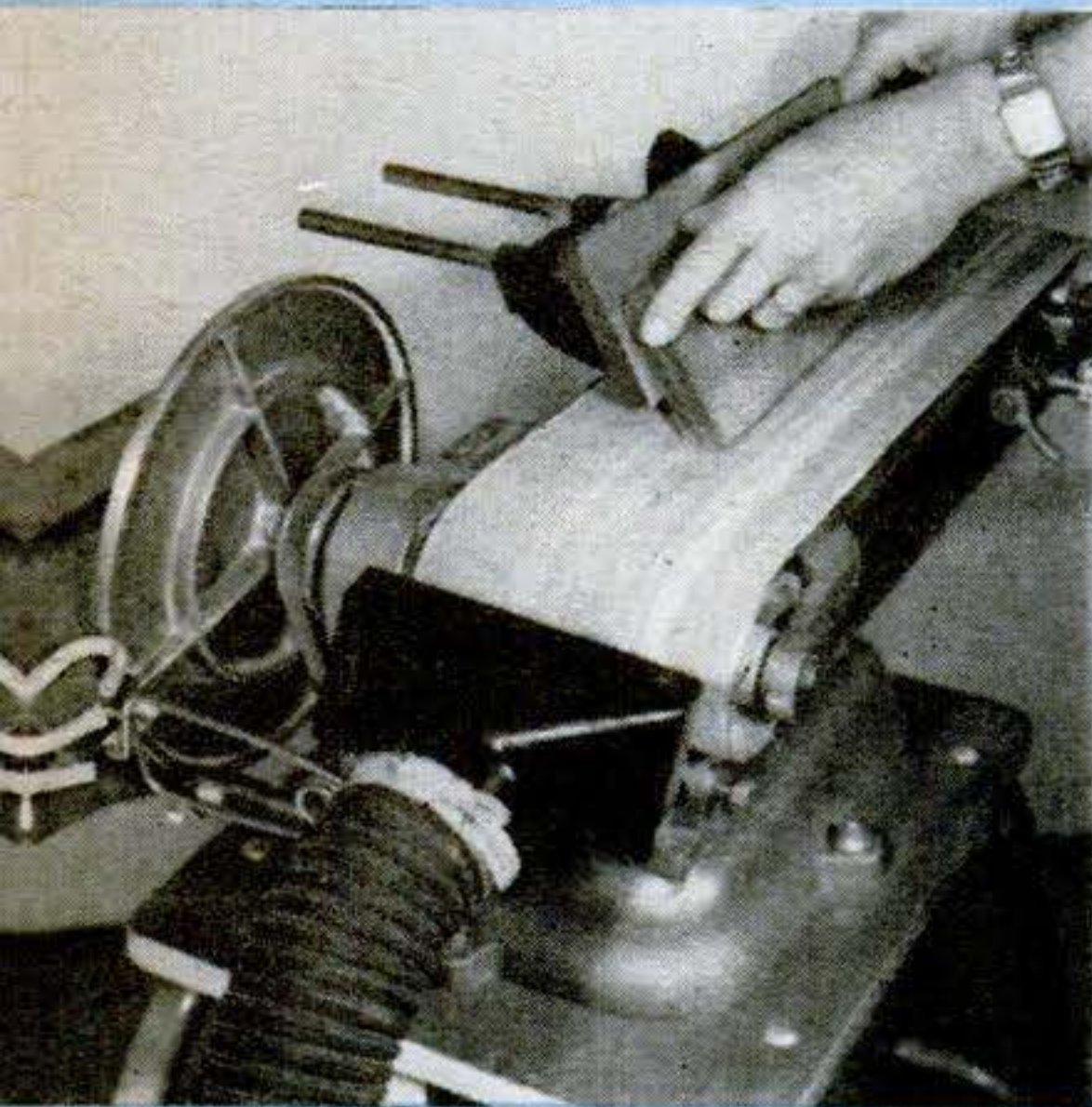
Easy way to retrue a drill chuck

Out-of-true drill chucks of the taper-socket type can be retrue, but not the way you might think. Truing the jaws themselves is difficult and requires an internal grinder. The trick, instead, is to rebores the taper socket so it compensates for the jaws and runs true even though both it and the jaws are out-of-true. The two photos above illustrate how it's done.

Mount the chuck in the lathe on a short length of drill rod. The lathe compound is then used to feed a boring tool into the chuck socket at correct taper angle. To find this angle, set up a taper-shank chuck arbor between lathe centers. With a dial indicator mounted in the compound, feed the compound along the short taper that fits in the chuck. Adjust compound on its base until indicator registers zero run-out. Indicator contact and cutting lip of the boring tool must be on exact center height. Bore out only enough so your regular arbor will still fit the new hole. —H. J. Gerber, Menomonie, Wis.



Tilt the belt up to its vertical position and you can use its slack underside for freehand shaping of curves and contours. A stop to pivot the work against can be fashioned from a strip of bent metal or a shelf bracket like the one above.



Dust problem is solved with a shop vacuum placed close to the belt or disk where it will suck up almost all sanding dust before it becomes airborne. The nozzle is held by a spring-type photo light clamp clipped to the sander's table.

For sparkling polishes, try this setup. Cement a circle of heavy felt to the disk and charge it with polishing compound. You'll be amazed at the results. Protect the highly polished faces by taping strips of felt to the table.



Belt-Disk Sander: a tool to own

This versatile machine will do many more jobs than you might suspect. Here's how one expert gets it to perform a whole shopful of tricks

By Phil McCafferty

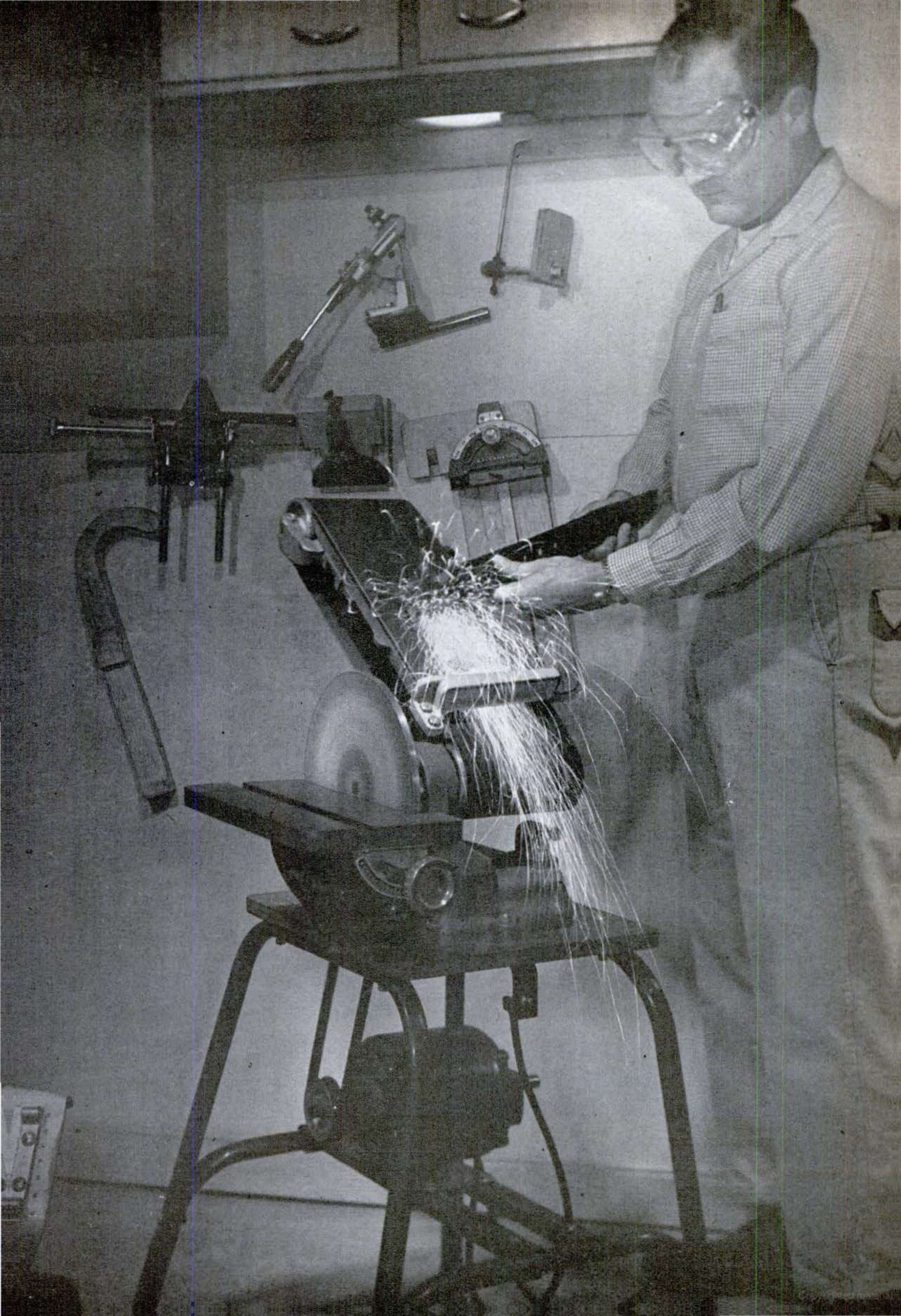
A BELT-DISK sander, combined with a few tricks and some homemade jigs, can become *the* most all-around useful tool in your shop. There's an important reason why: The belts and disks you use are *not* ordinary sandpaper. Except for a few designed solely for wood, they're made by coating heavy cloth with the same abrasives that form grinding wheels.

Between the belt and the disk, what you have, in effect, are a flexible grinder of tremendous area capable of producing all sorts of shapes in metals as well as wood, together with a rigid grinder capable of producing dead-flat surfaces on precise machining jobs. The very disks and belts used in these machines—in fact, many of the same machines themselves—are the heavy-duty work horses used in industry for such rugged jobs as sharpening carbide cutting tools and hogging large amounts of metal off rough castings.

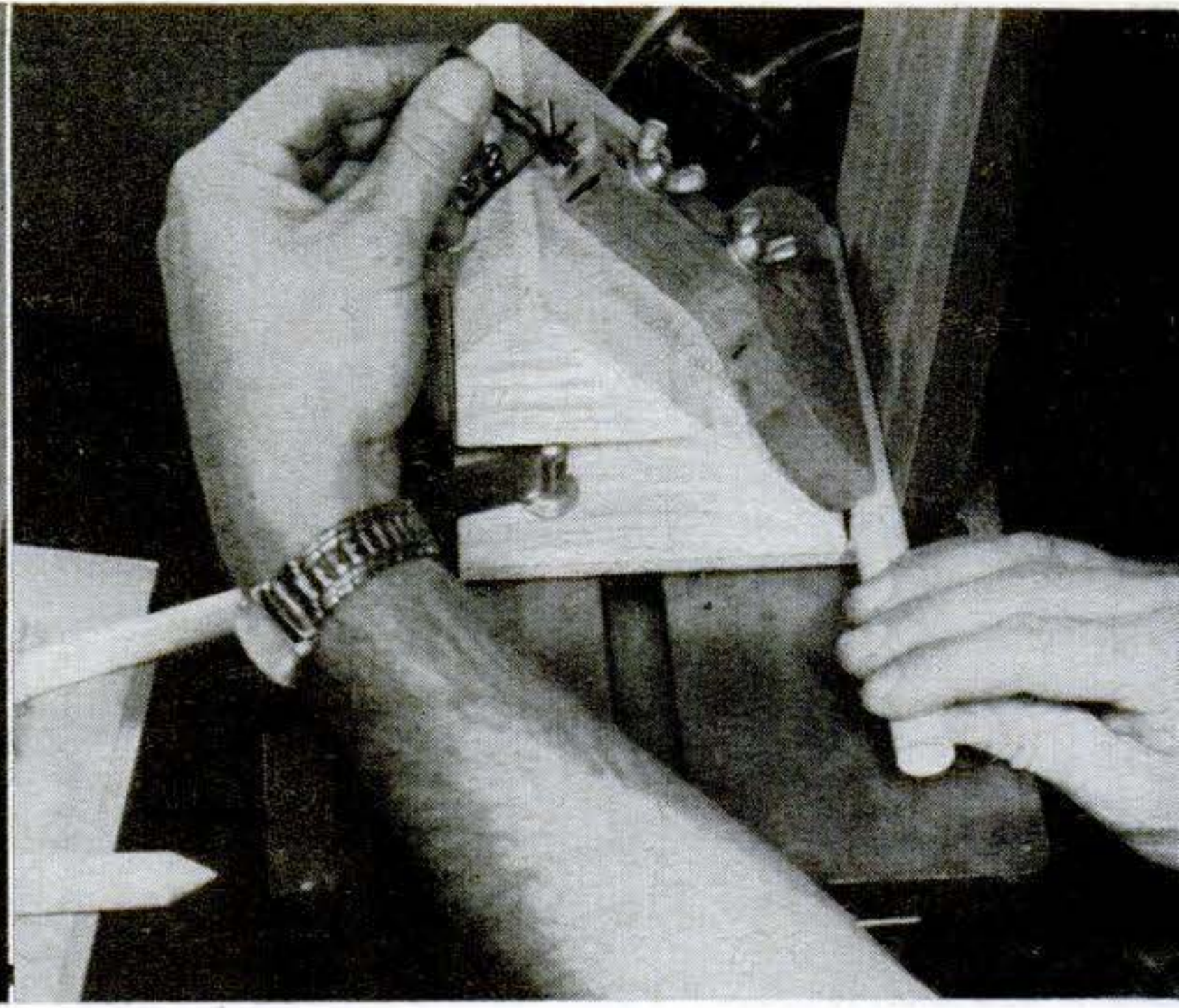
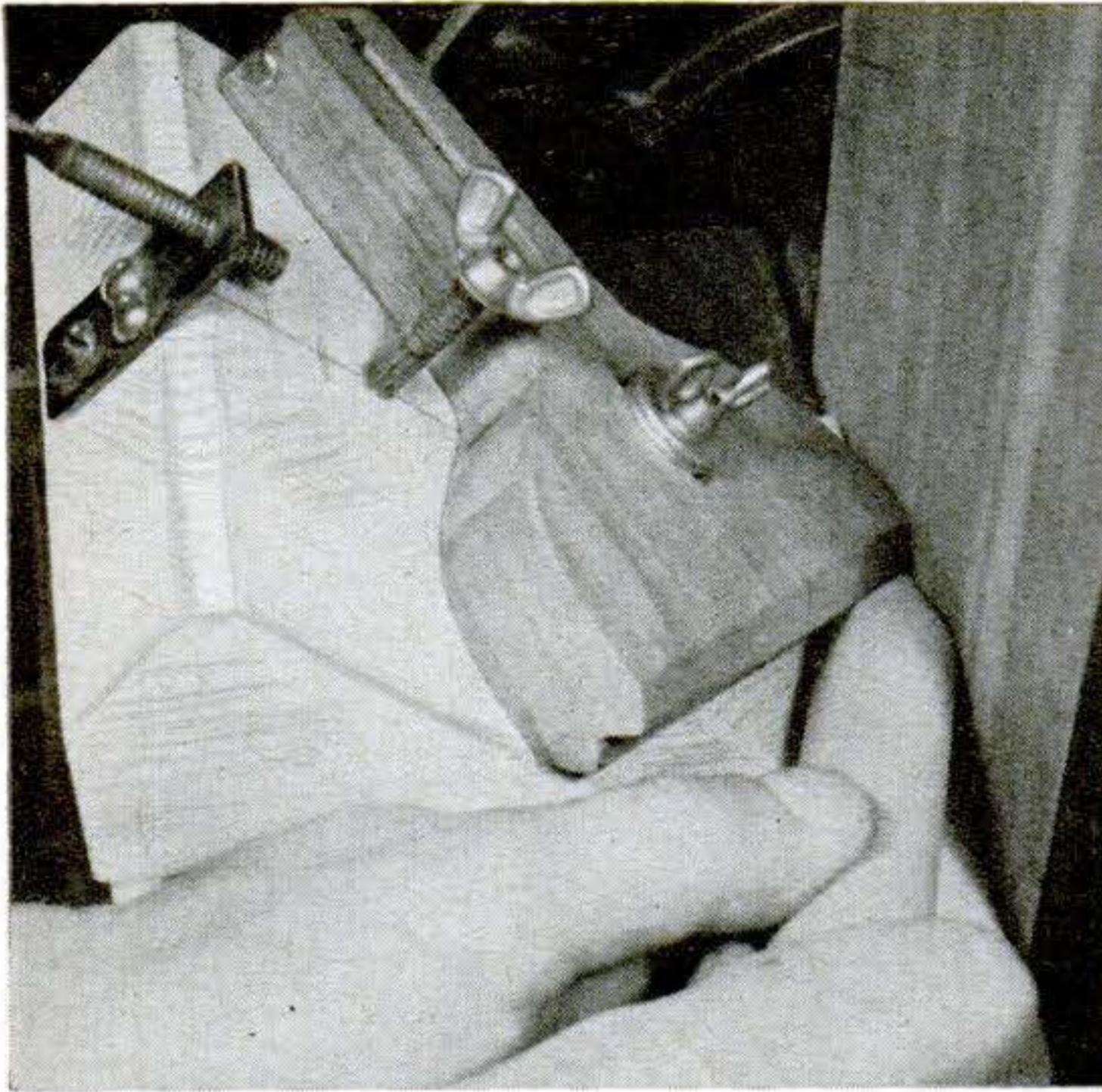
Because of their large, flat surfaces, belt-disk sanders remain true without much need for dressing. On most machines, you can single-pass grind a metal surface a foot by a foot-and-a-half. Belt-disk sanders are also safer—there's no solid wheel to shatter. And they cut much cooler because of their large exposed area. A 6"-by-48" belt, for instance, is equal to a 6"-thick grinding wheel more than 15" in diameter.

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Sparks fly as a power-mower blade is sharpened in a single pass at right—one of the many bonus jobs you can do on a belt-disk sander.



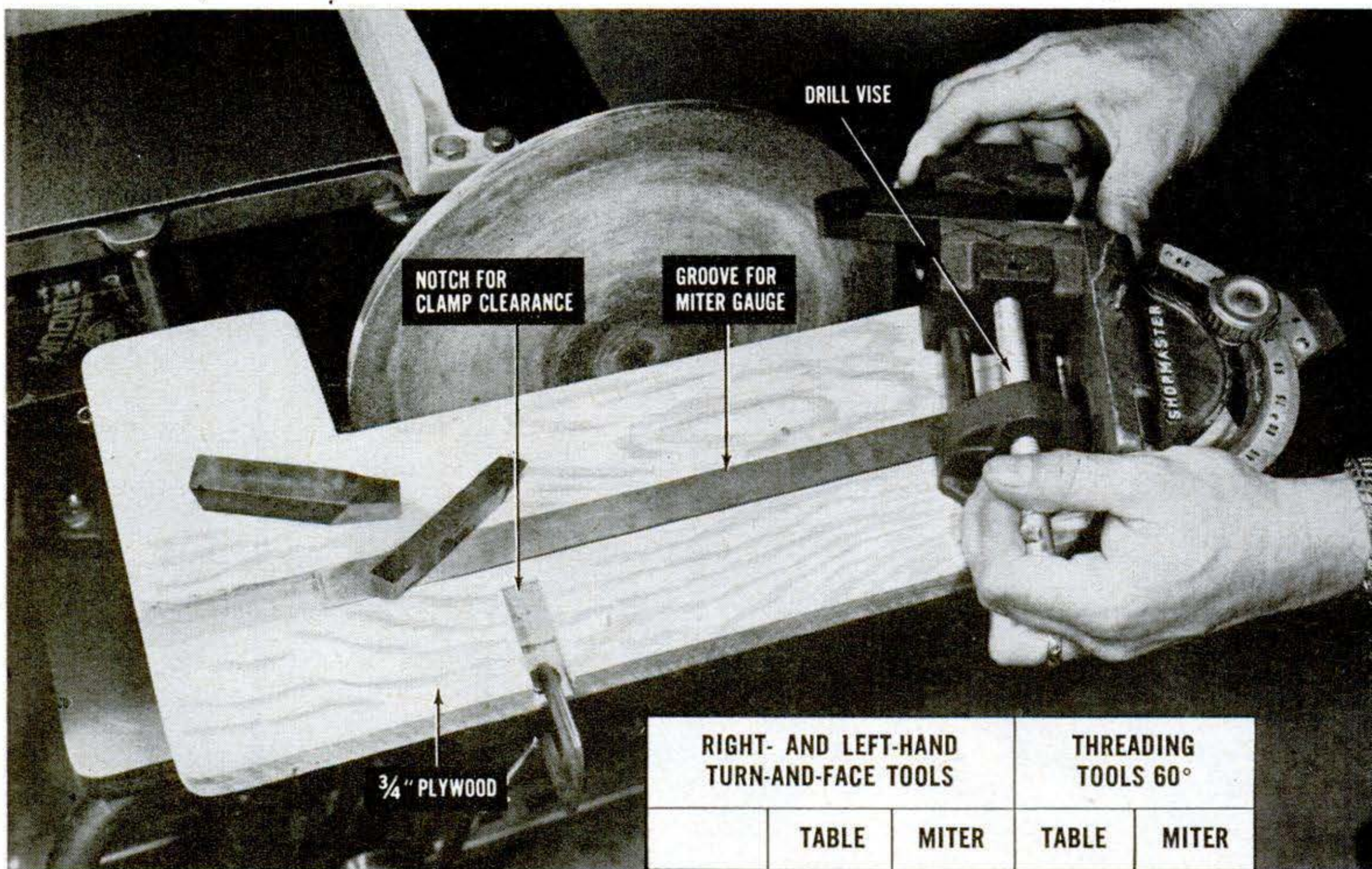
You can centerless-grind round shapes quickly and accurately with this



Want to taper dowels or neck down pins for a precise assembly fit? They're a cinch in this centerless grinding jig. For tapering, the V-grooved feed block can be locked at an angle (left). For straight grinding, it can be squared

to the belt and precision-fed with the thumb-screw (right). The jig base is made from glued-up two-by-six stock, notched as shown at far right for C clamps. The feed block should be hardwood, waxed for easy turning of the work.

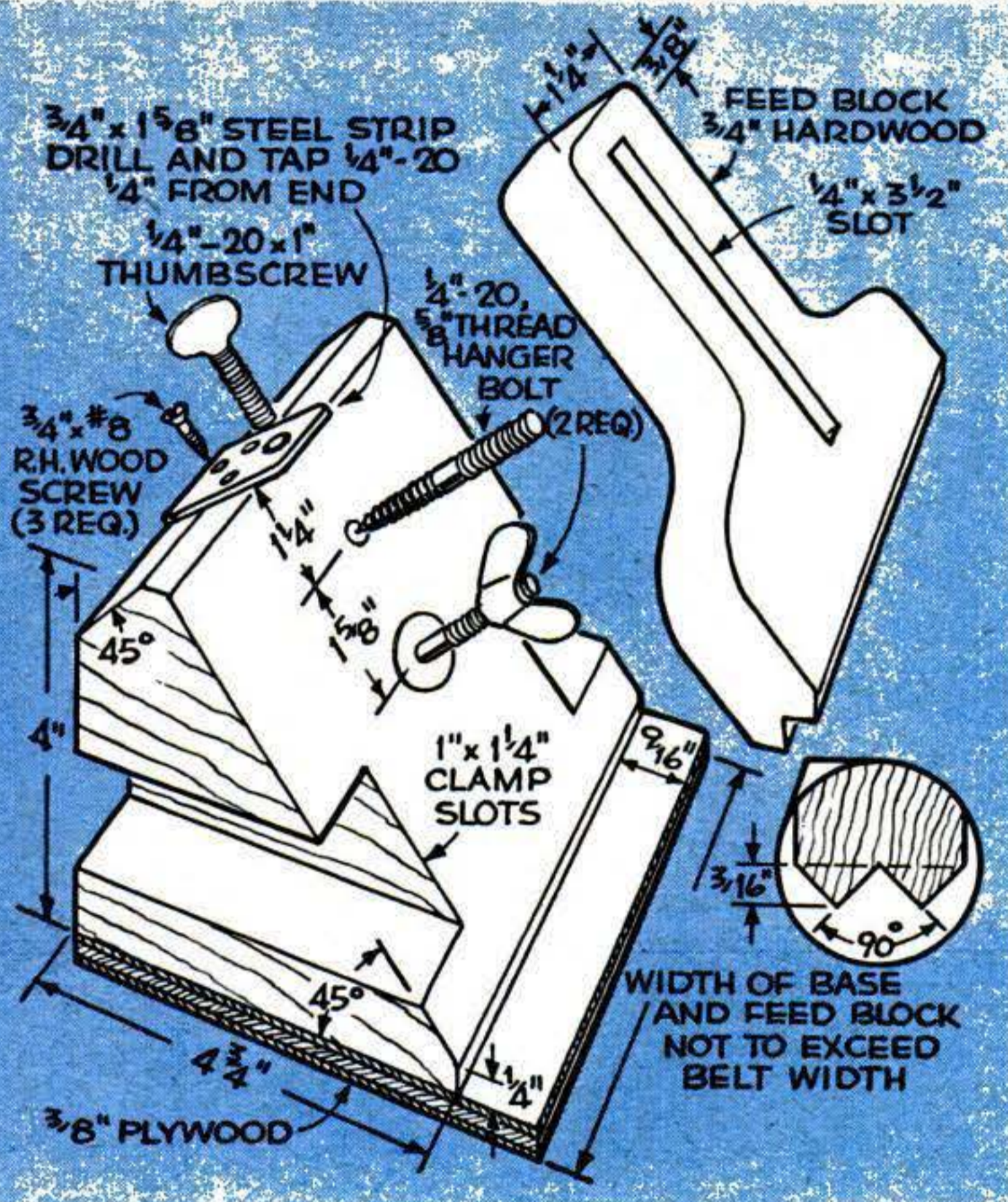
An auxiliary table turns the disk into an automatic tool sharpener



Lathe tool bits are precision-ground by setting table and miter gauge to the proper angles. Auxiliary wood table, clamped to regular table, allows miter gauge to extend beyond the disk's edge. Chart shows table and miter-gauge settings for commonly used tool bits.

	RIGHT- AND LEFT-HAND TURN-AND-FACE TOOLS		THREADING TOOLS 60°	
	TABLE	MITER	TABLE	MITER
SIDE	11°	18°	10°	30°
FRONT	11°	22°	—	—
TOP	15°	5°	5°	0°(90°)

simple jig for the belt sander

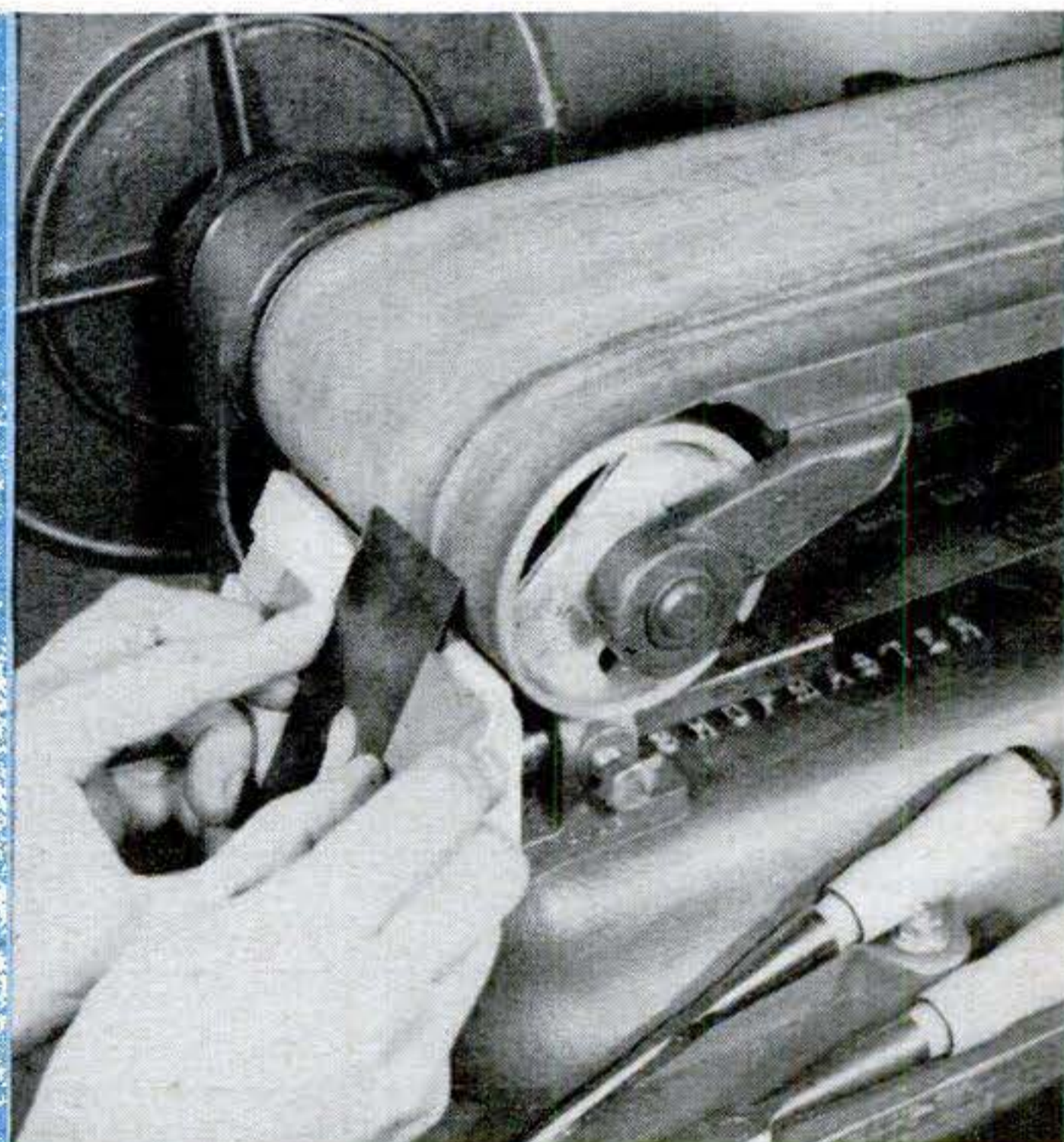
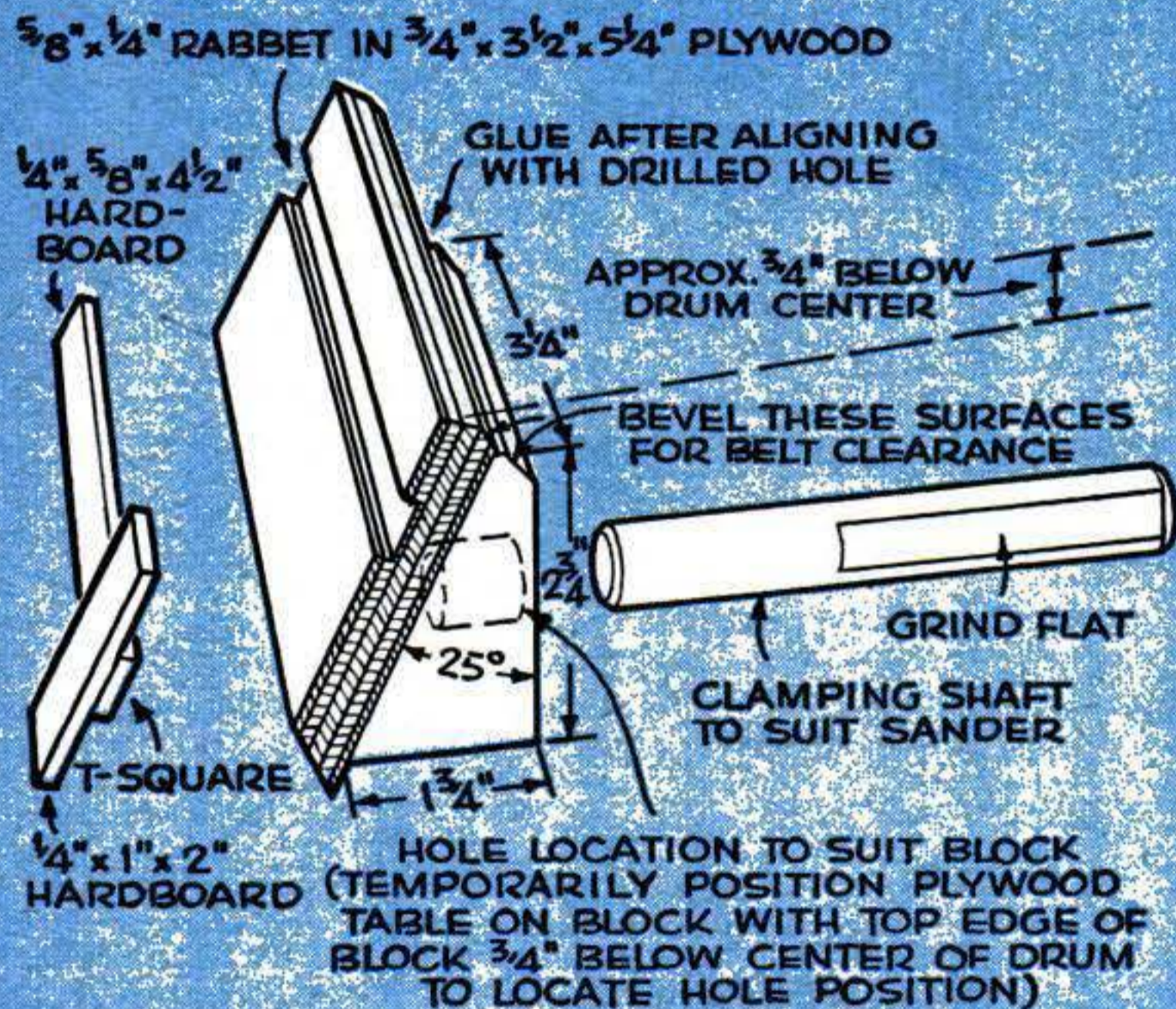


How to choose belts and disks

MATERIAL	GRIT SIZE TO USE		TYPE OF ABRASIVE
	ROUGH CUTS	FINISH CUTS	
SOFTWOOD	40-60	80-100	Garnet
HARDWOOD	50-80	120-180	Aluminum oxide
STEEL	50-80	100-180	Aluminum oxide
CAST IRON	40-60	80-150	Aluminum oxide
STEEL CUTTING TOOLS	60	150-180	Aluminum oxide
CARBIDE CUTTING TOOLS	60*	150-180	Aluminum oxide
STAINLESS STEEL	80	100-220	Aluminum oxide
ZINC, ALUMINUM, BRASS, BRONZE	36-80	120-220	Aluminum oxide or silicon carbide
GLASS, PLASTICS, MARBLE, STONE, CERAMICS, BONE	80-150	180-400	Silicon carbide

*Silicon carbide preferred for roughing.

For hollow grinding, use the belt's drum with a jig like this

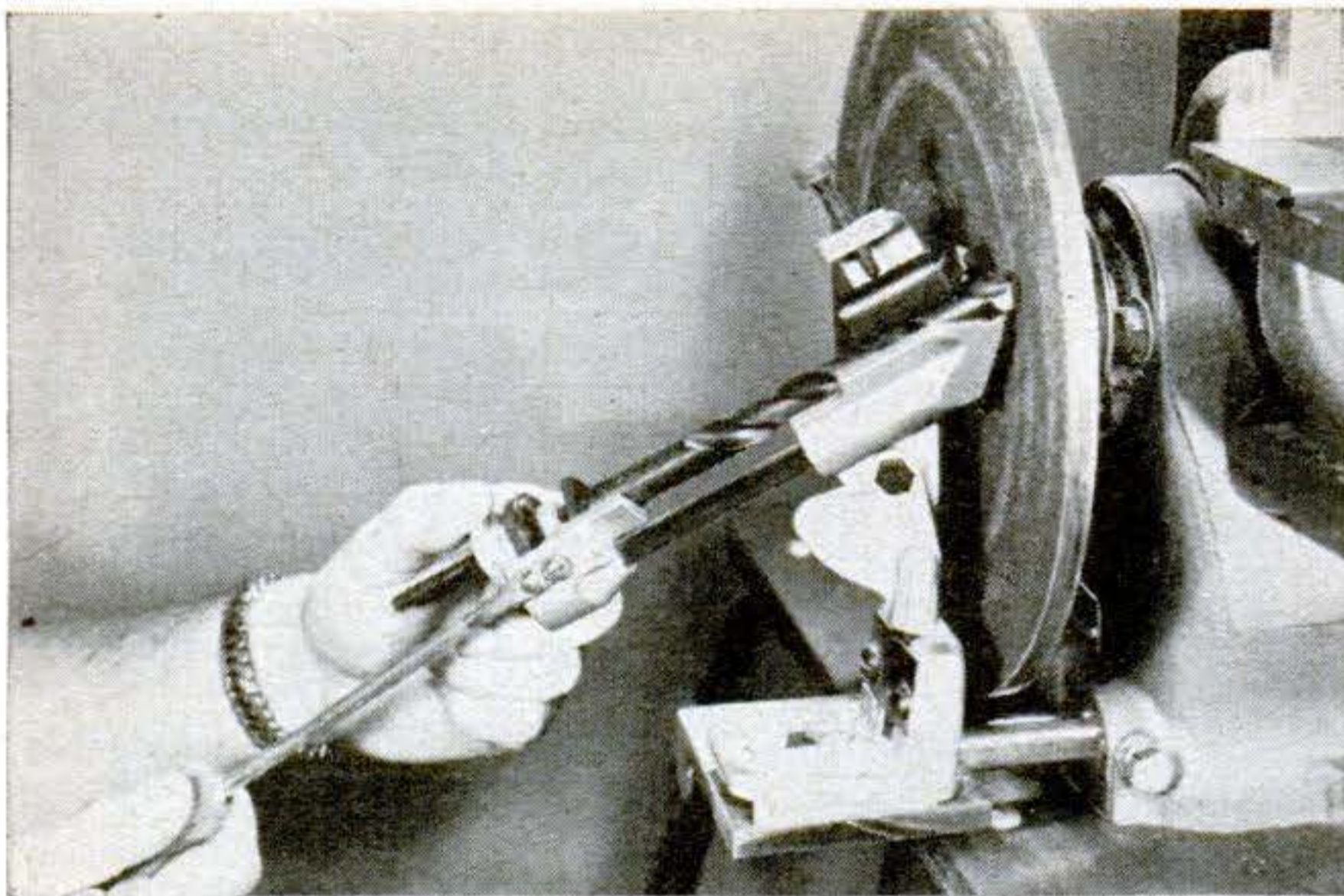


Curved belt drum is ideal for hollow-grinding plane blades and chisels. The small T square lets you slide a tool accurately across the belt for a uniform grind. The jig is held by a rod

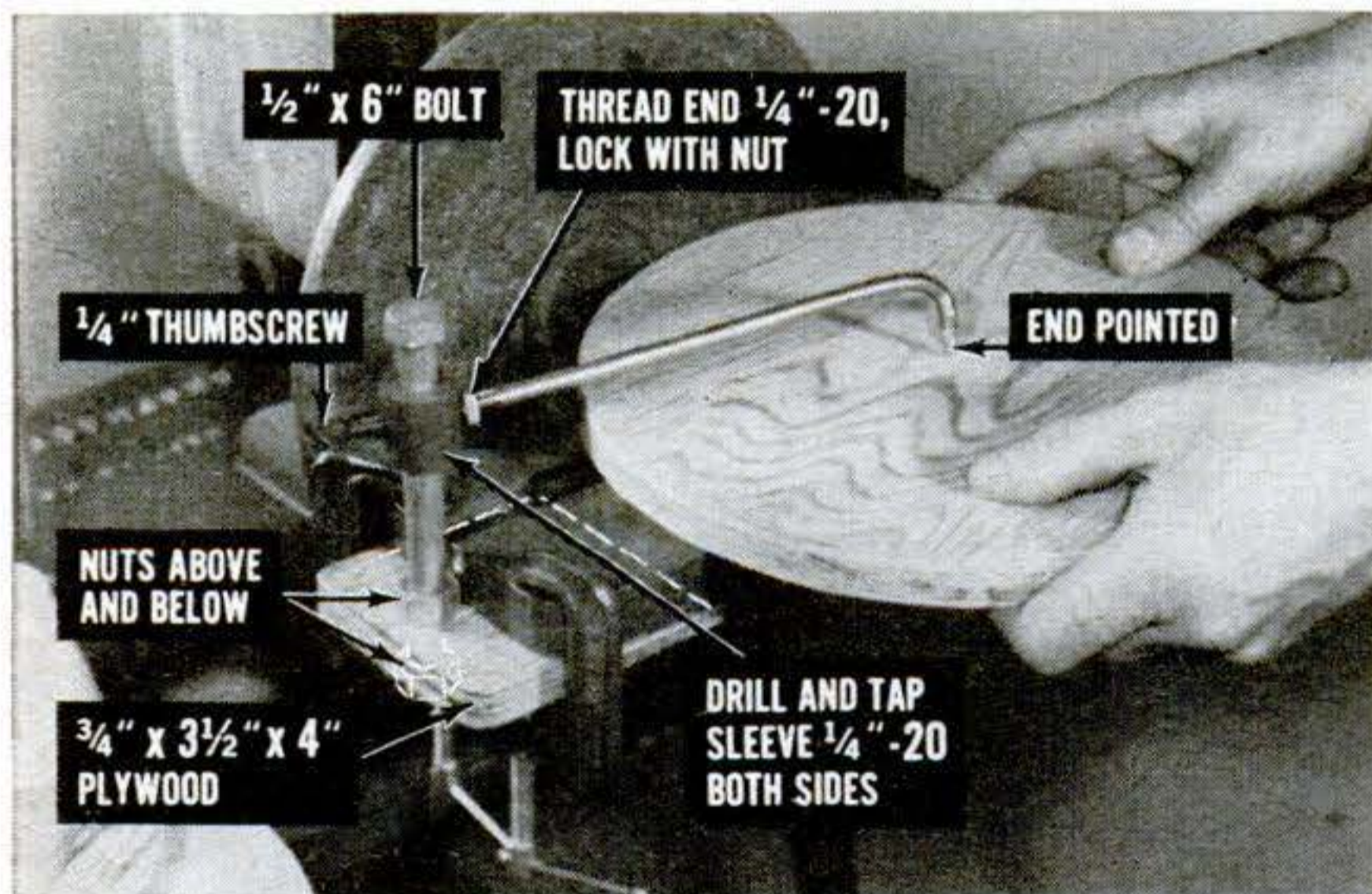
that fits in the sander's table-mounting socket. Drill the base a snug fit for the rod, then glue the rod in with epoxy, carefully propping the jig square to the belt drum during setting.

Switching jobs is faster, too. You can maintain a whole stable of different belts and disks and change from one to another in only a minute or two. Using the right abrasive for the job is the secret of both better working efficiency and longer life for your belts and disks.

When you remove a disk, transfer it immediately to a square of painted hardboard or other slick surface to keep the tacky back side dustfree and ready for quick replacement. Mark the grit size and abrasive type on the board for easy reference. Belts should be stored on large "pegs," such



Drill-sharpening jigs work better on a disk than a grinding wheel because you get a truly flat grind. Fasten the jig to a rod that fits the table-mounting socket. An old screwdriver bolted to the jig makes a handy control arm.



as sections of mailing tube. Cloth-backed abrasives come in two grades—"industrial cloth" and "industrial belt cloth." The latter is costlier but more durable.

Use these ideas:

- Try different materials on the disk. One photo here shows felt for polishing. Glue heavy canvas on the disk and charge it with lapping compound for lapping truly flat metal surfaces. Canvas without charging will burnish surfaces, too.

- When belts are ready to be thrown out, don't. Rip them into strips. They are still good for sanding intricate shapes.

- If a disk or belt becomes gummed from hardwood, salvage it by passing a discarded drill bit or high-speed tool over it to dislodge the particles.

- And, as in any grinding, wear goggles. ■ ■

Sand circular parts really round with this jig. The work pivots under sharpened point of over-arm clamped to the table. Table's tilt adjustment makes possible neat edge beveling and conical sanding.

Buyers' guide to belt-disk sanders

Make	Model	Approx. List Price (less stand and motor)	Disk Size (inches)	Belt Size (inches)	Belt Support Plate Area (sq. in.)	Tilting Table Size (inches)	Belt Drum Dia. (inches)	Bearings	Minimum Motor (hp. req.)
CRAFTSMAN (Sears, Roebuck)	99H2254L	\$57	9	6x48	105	6¼x12	3	Prelubed ball	½
DeWALT (formerly Atlas)	630	\$115	10	4x37½	47	8x15	3	Ball	½
DURO	AD3066	\$90	9	6x48	96	6½x11	3	Needle	½
	PD3066	\$140	10	6x48	99	7¼x13½	3	Sealed ball	½
POWERMATIC	30	\$133	12	6x48	87	10x16½	4½	Ball	½
POWR-KRAFT (Montgomery Ward)	84A2710	\$59	9	6x48	98	7x12	3	Oilite bronze & ball	½
SHOPMASTER	SR-1000	\$100	10	6x48	102	6x12	3	Oilite bronze	½
TOOLKRAFT	335	\$70	9	6x48	105	6¼x12	3	Oilite bronze	½
WALKER-TURNER	31-600	\$135	12	4x52½	48	9¾x16¼	5	Ball	1

A fabric called Dynel, just announced, offers a fast way of applying a tough hide to a beat-up old hull

THE boat was a battered, leaking hulk just one step from the junk heap when we took her over. As she was trailered up our drive in a heavy rain, water poured from her seams as fast as it went into the cockpits.

But in one day's working time (not including periods for resin curing) she was transformed into a dream boat, as watertight as a sealed bottle. Her new, ivory-smooth hide is one of the toughest ever developed. It never needs painting (though it takes paint beautifully) and it never needs caulking. The resale value now is at least five times the \$50 we paid for the boat.

The basis of her jiffy rejuvenation is Dynel #815 marine fabric. It's made from a fiber developed by Union Carbide Corp. from natural gas, salt, ammonia, and water.

CONTINUED



New Way to Save an Old Boat

By George Daniels





What Dynel looks like —and where to get it

Why a smooth boat-covering job is easy with Dynel is illustrated by this photo—a piece of #815 marine fabric pulled over a salad bowl. Note that it takes the curves without the slightest wrinkle.

If local boat dealers don't stock Dynel, write to Textile Fabrics Dept., Union Carbide, 270 Park Ave., NYC 17.

Half the weight of fiber-glass, it sells for about the same price. Its tensile strength of 57,000 pounds per square inch almost matches steel, yet it's so soft that artificial fur coats are made from it.

In marine form, the fabric fits every contour of a hull like a tight sweater, with plenty of give in all directions—until the resin hits it. Then it forms a tough armored hide. You use the same resins as in fiber-glassing but you use them with a new trick. You don't coat the hull with resin and lay the fabric in it. Instead, you smooth the fabric on first, staple it tight, and then roll and brush the resin through it. This way there's no rush to work the wrinkles out before the resin sets. The fabric is already taut and smooth before you even mix the resin. And the soak-through bond is so

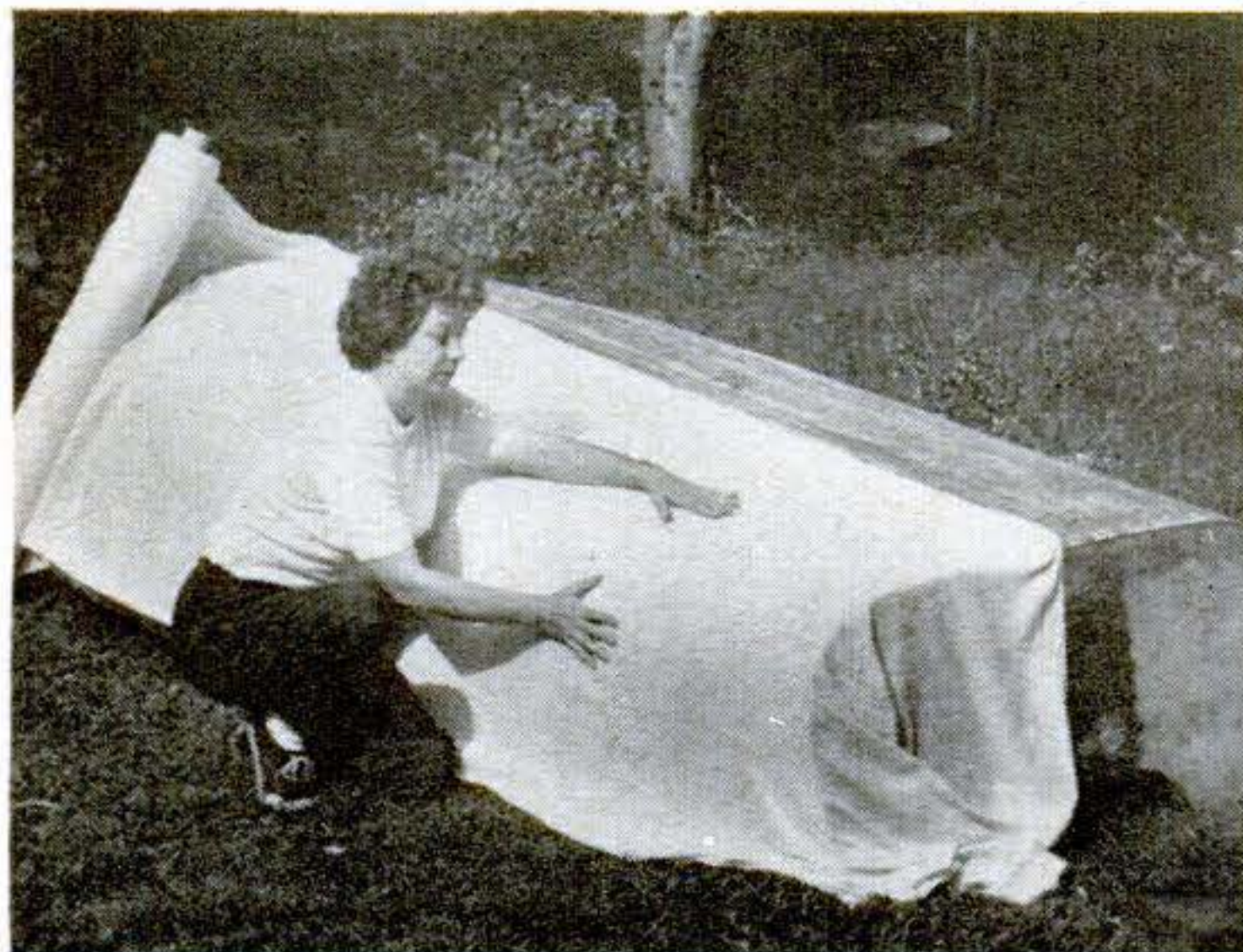
solid you can't get the fabric off without ripping a layer of wood with it.

The material you need. Measure the length of the gunwales and the distance from gunwale to gunwale under the hull at the beamiest point. Then allow an extra half-yard or so for trimming and lapping.

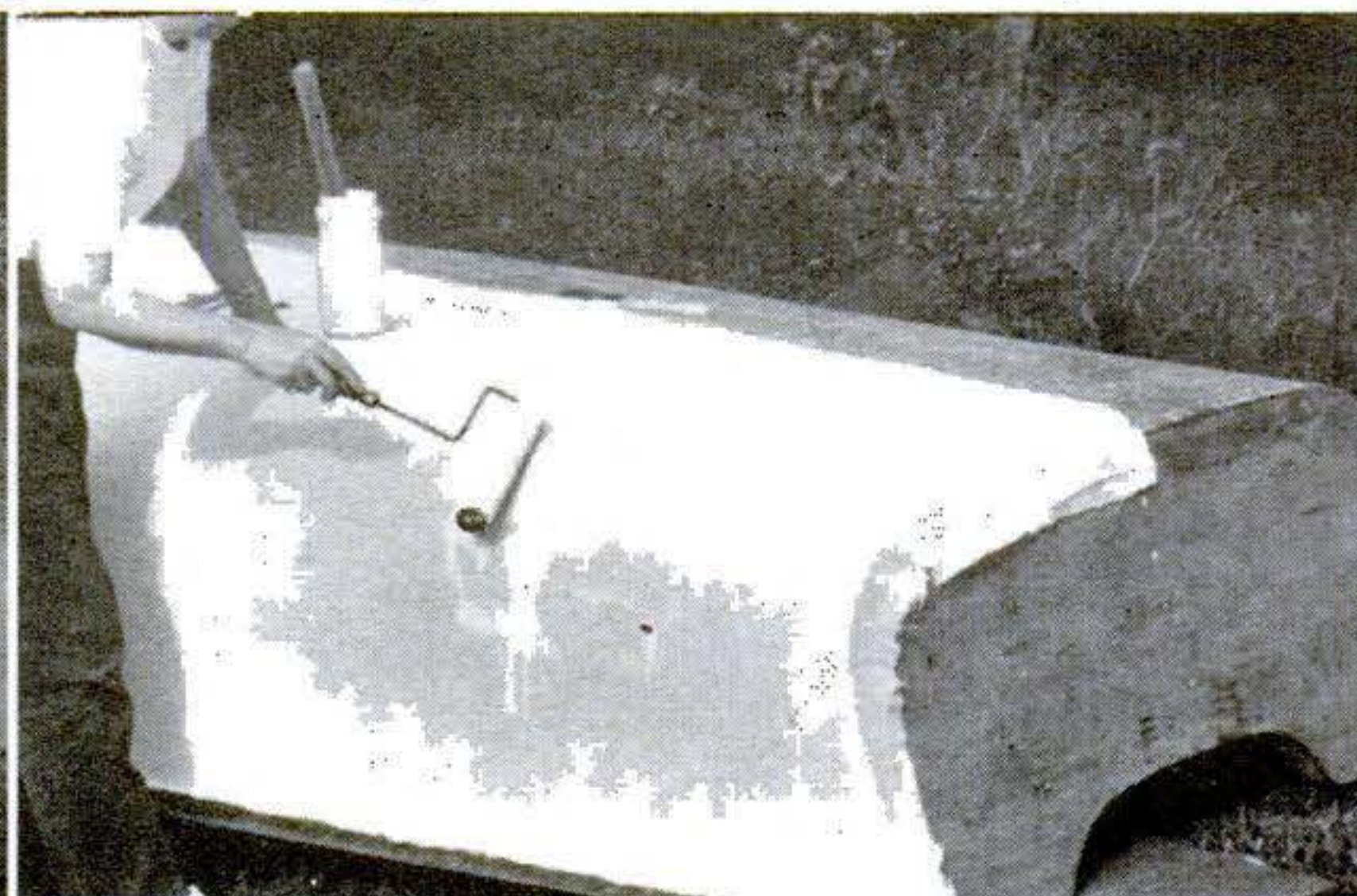
The width in #815 marine fabric is usually 4', which lets you cover small hulls with a single strip to a side. If you have to seam it, allow a 2" overlap. Figure on a quart of resin per square yard for the first soak-through coat, half as much for each of the two successive coats.

You'll also need a mohair paint roller with a couple of extra sleeves, a pair of cheap new 2" brushes, and a painter's squeegee. Unless you know you're not allergic to resin, add rubber gloves.

Applying a Dynel covering to a small boat is a job



Fabric is smoothed out over one side of the hull after spray rails, skids, all fittings—and the paint—have been removed. The fabric is then stapled in place and the excess scissored off along edges



and at ends. A soak-through resin coat is then applied, as above. This bonds the fabric to the planking. Applying this coat to the fabric surface took the author only 30 minutes.



Weathered and leaking, the boat looked hopeless when George Daniels began the restoring job.

Sand down to the bare wood with coarse, open-coat floor paper (about 3½ grit on a disk sander). This works fast and leaves the surface just rough enough for good adhesion. You can use a wax-free paint remover on outer layers of paint.

Leave the calking alone if it's hard and firm. Rake out any loose sections and replace with wood dough or a Thiokol type. Neither is affected by the resin.

Use ink to X-mark spray-rail screwholes. You can see the marks through the material after it's snug. Push finishing nails through to keep track of the holes after the resin goes on. Otherwise you'll have trouble replacing the rails.

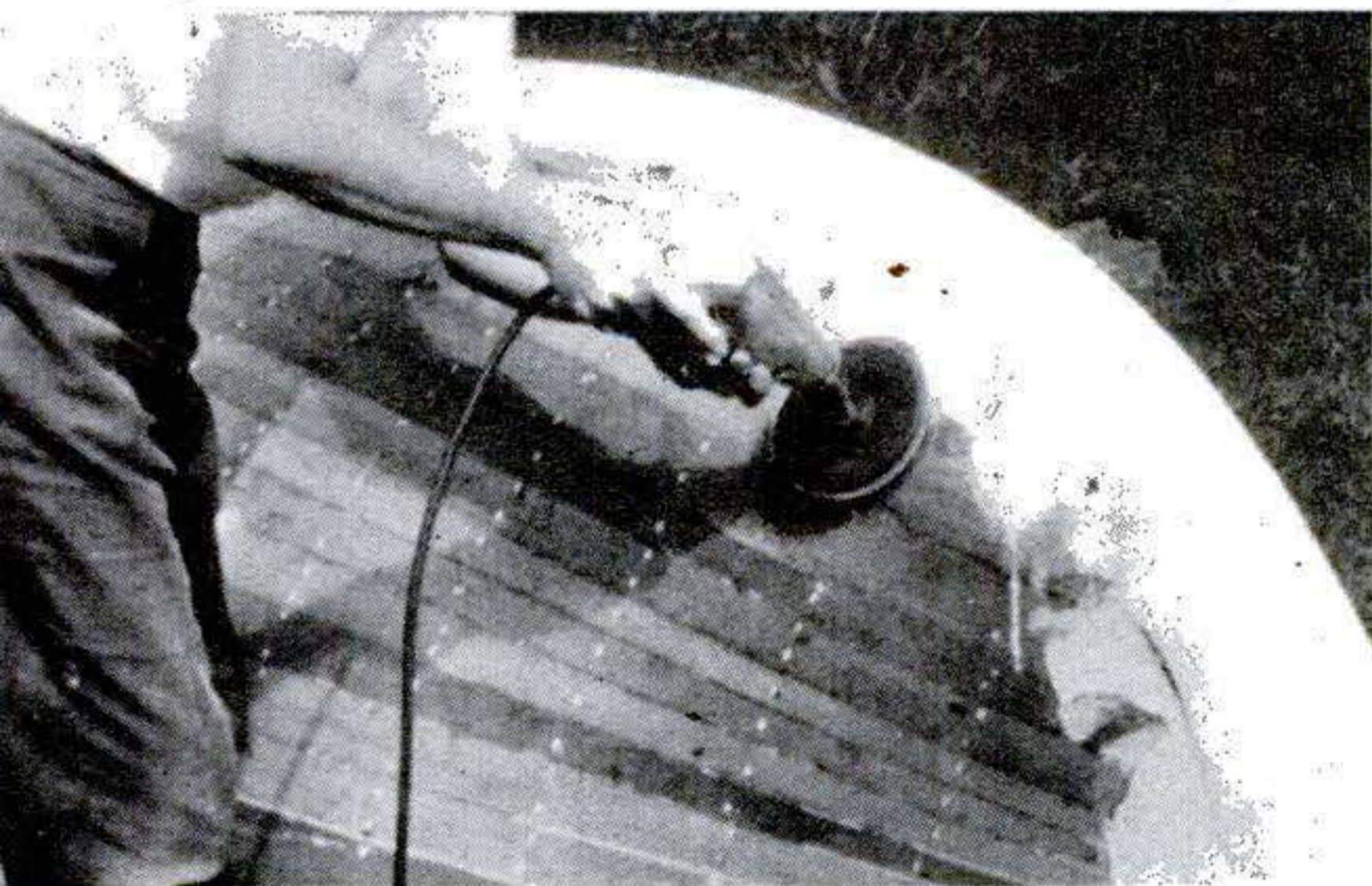
Applying the resin. This is best done out of doors. The vapor irritates some people and can be an indoor fire hazard.

You can do an entire side at a time, rolling it on generously and spreading it with brush and squeegee into corners. There's no rush. On the boat shown, the soak-through coat took only 30 minutes to a side, the following coats 25 minutes. This left plenty of margin, as the resin I used has a 45-minute (and better) working time.

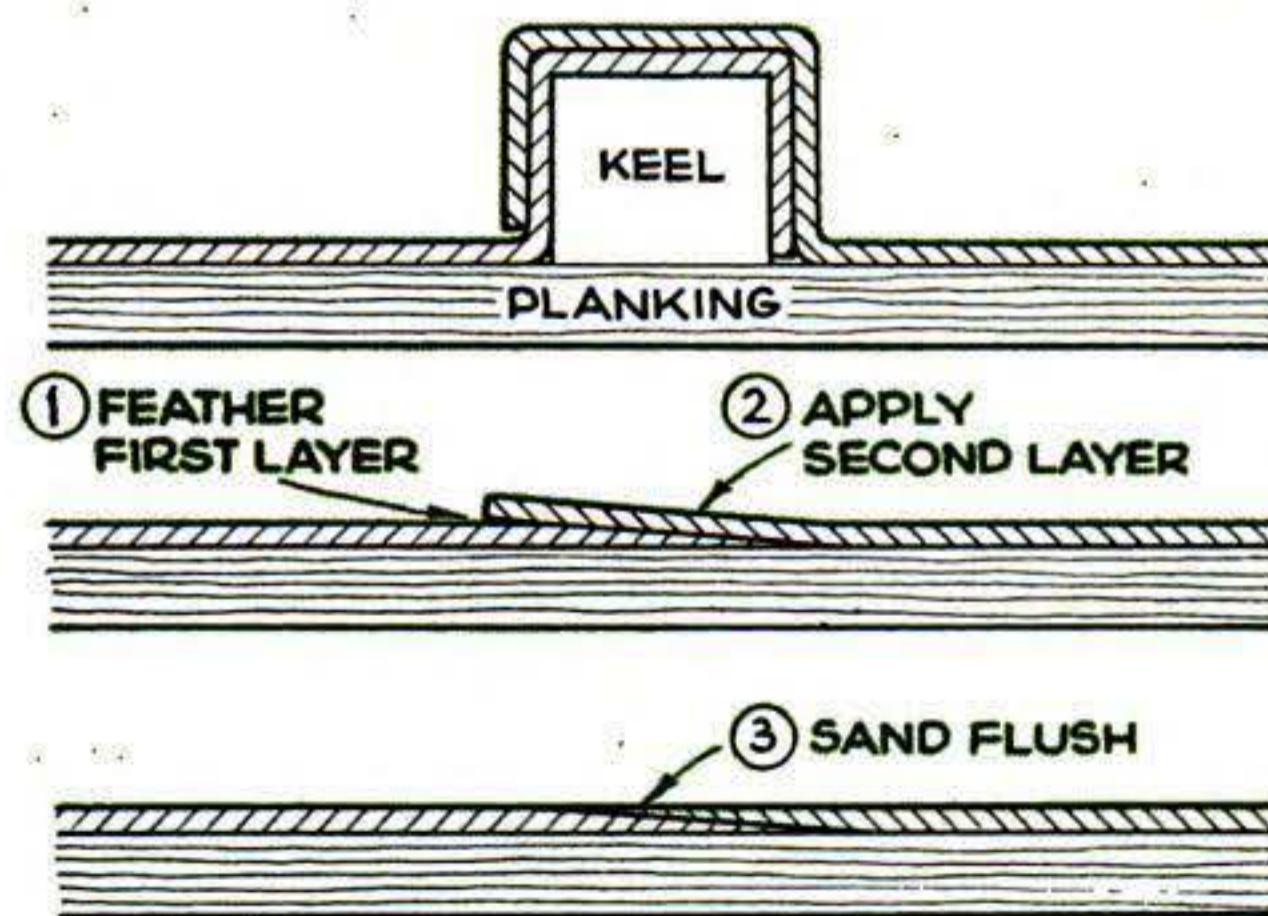
Sand between coats, but take it easy on the first coat so you don't sand through the weave. The second coat fills it in and the third one gives it a cue-ball finish. Use medium-grade paper on the sander to skim off the stiffened protruding fibers of the first coat. Sand the second coat with fine paper.

If the sanding turns up any sags in the second coat, sand them smooth. If you spot any dents that didn't show up in the

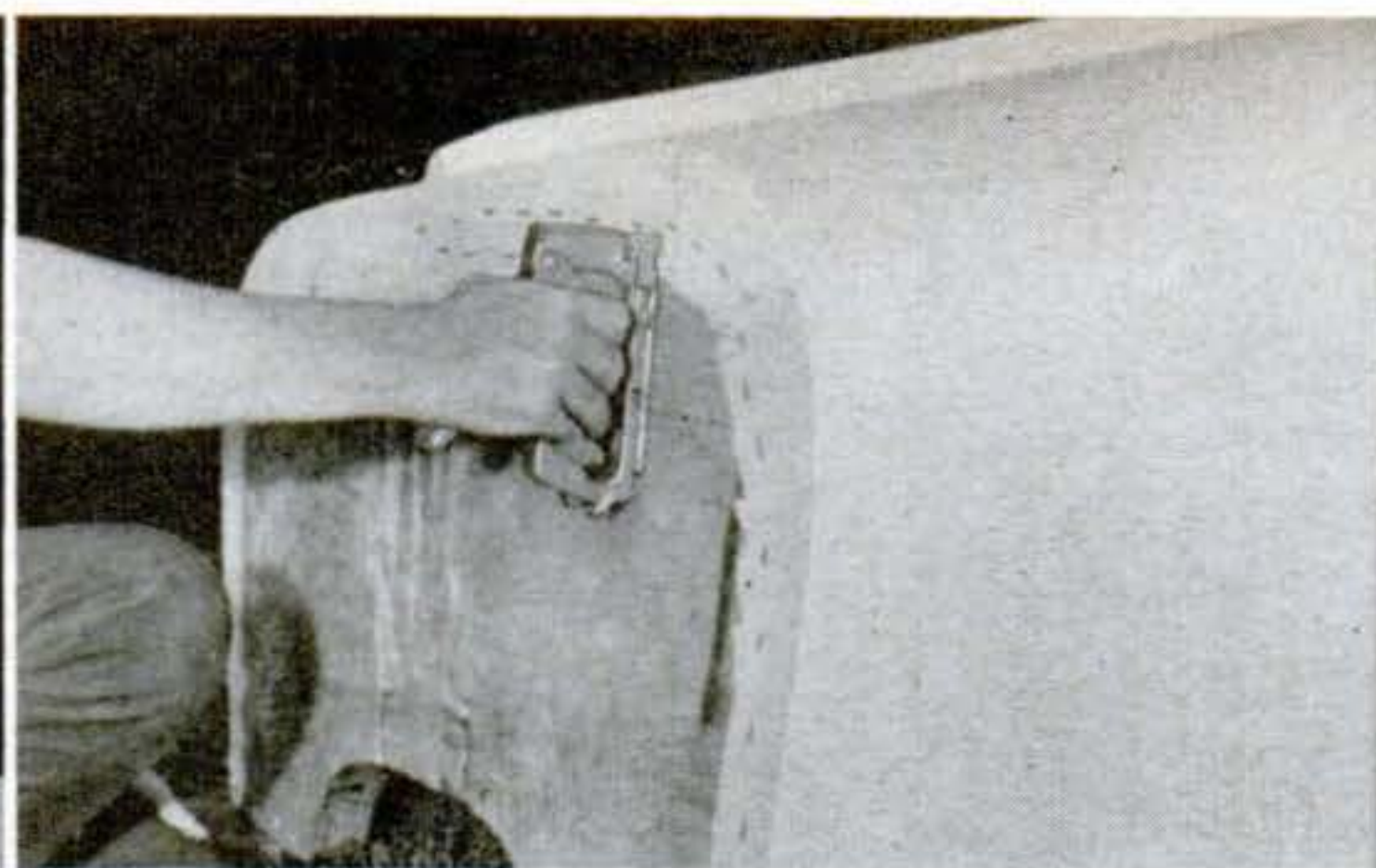
you needn't be afraid to tackle yourself



Feathering out the laps at stem and transom is required so fabric will smooth out on the second side. Latter was later lapped over the first side and also feathered out. Series of sketches above

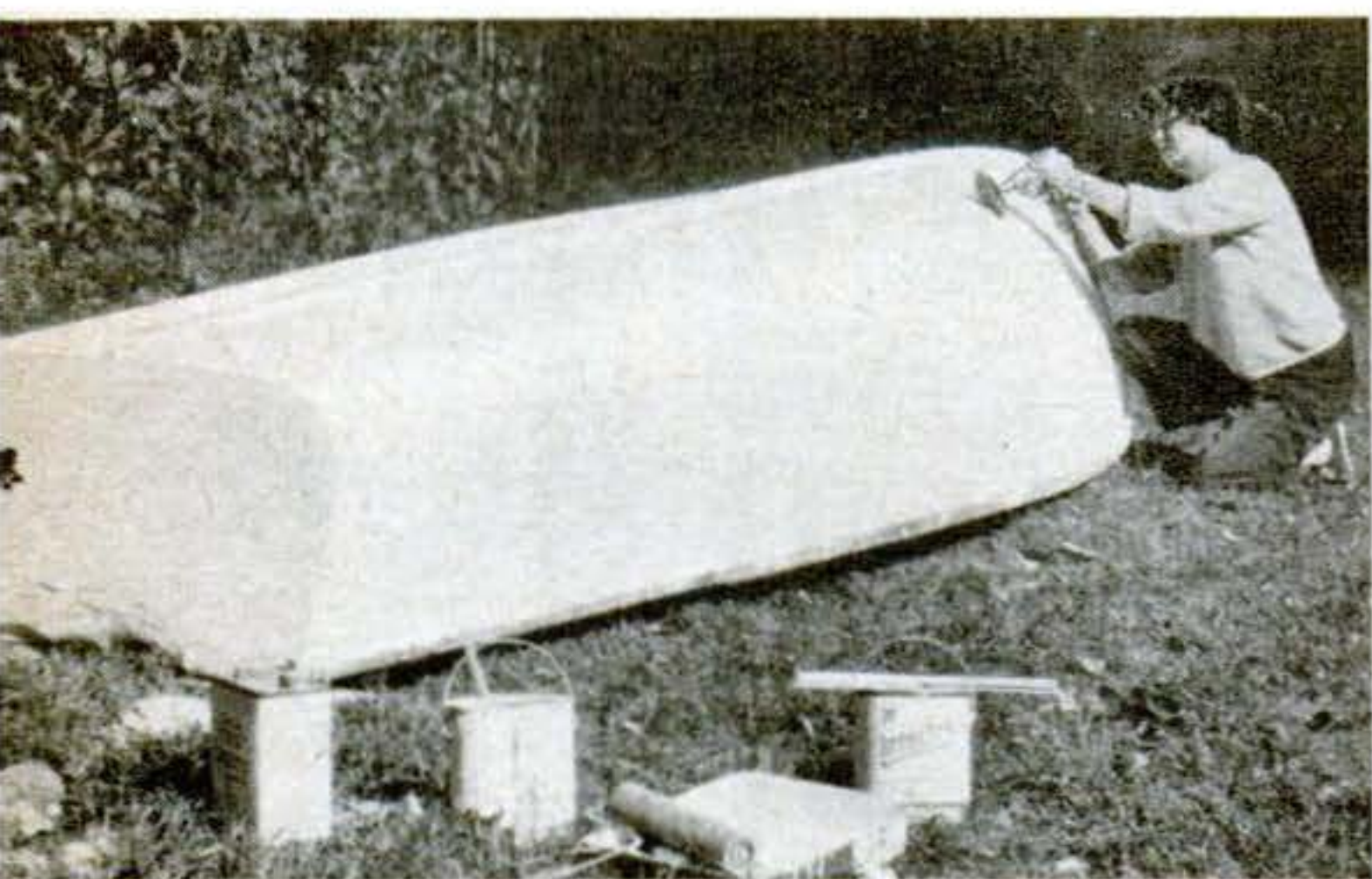


shows other lapping details. A Dynel skin often increases a boat's speed a bit because the slick surface has less surface friction. There's little gain in the final weight of the boat.



Staples hold the fabric in place until first resin coat has bonded it to the wood. They should be set closely at the stem and extra ones added if puckers appear. Use short staples and tap

them flat if they don't drive fully into hardwood. Transom staples are set in from edge slightly so edges can be feathered. Separate piece of fabric goes on the transom of the boat.



Between-coat sanding is done with a medium-grip disk after first resin coat, medium-fine after the second. Dynel fabric was applied to the decks, too, and also to the steering wheel.

wood, putty them with a little resin mixed with dry talc or portland cement. The mix sets rock-hard and never lets go.

Choose your color. Resin pigment will give you just about any built-in color you want. You can paint over it later on if you want a new color. (You fine-sand the glossy surface to give the paint a grip.)

The cost for 12 yards of Dynel to do hull and decks came to just under \$29, the resin and pigment to about \$55. Grand total: \$84. This, plus a day's work, boosted the value of the boat by at least \$200, made her stronger than she had ever been, trouble-free, and leakproof. ■ ■

Ready to go: Boat now looks modern with paint over fabric; wheel and windshield moved forward.





Winter job for a barbecue —start plants in it

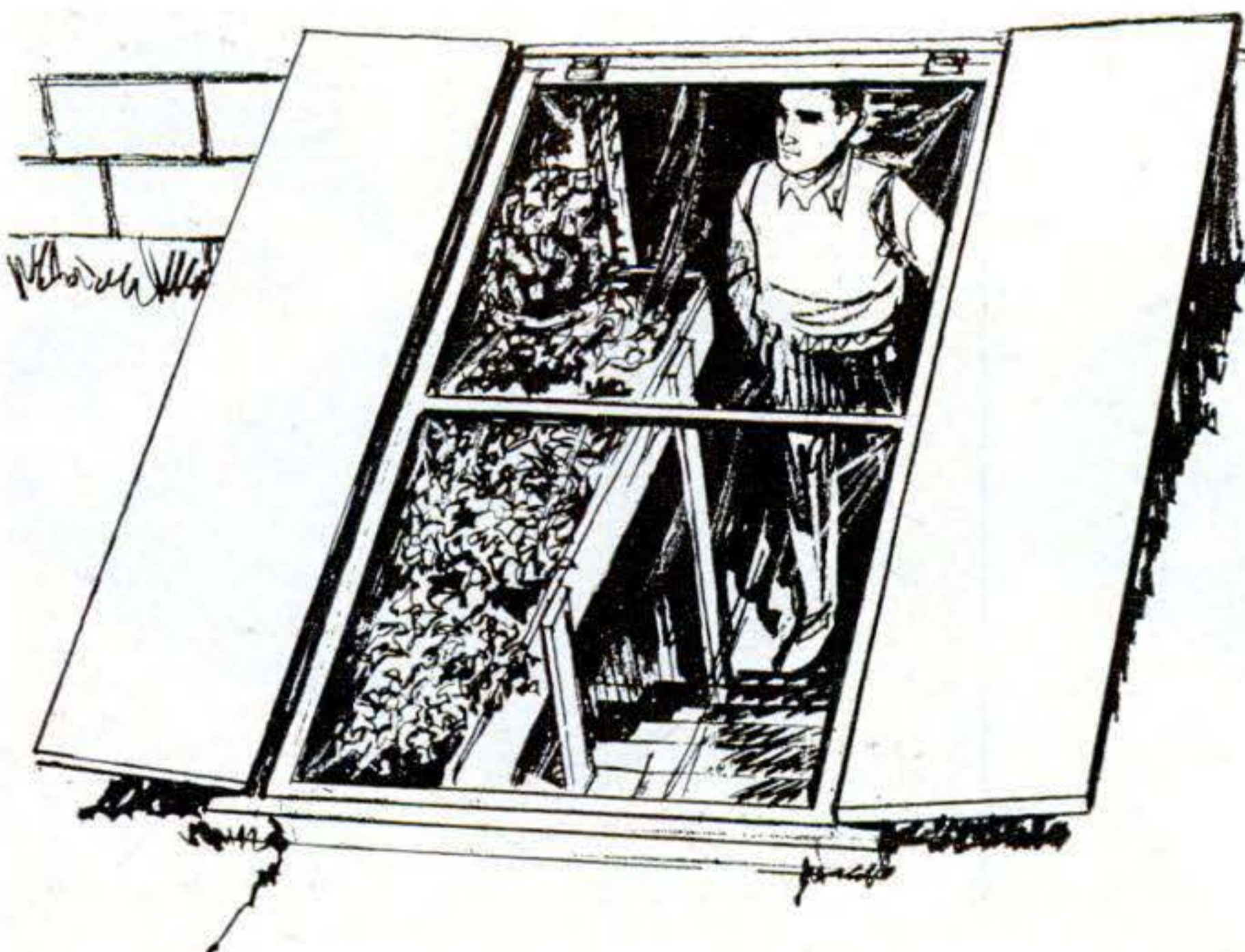
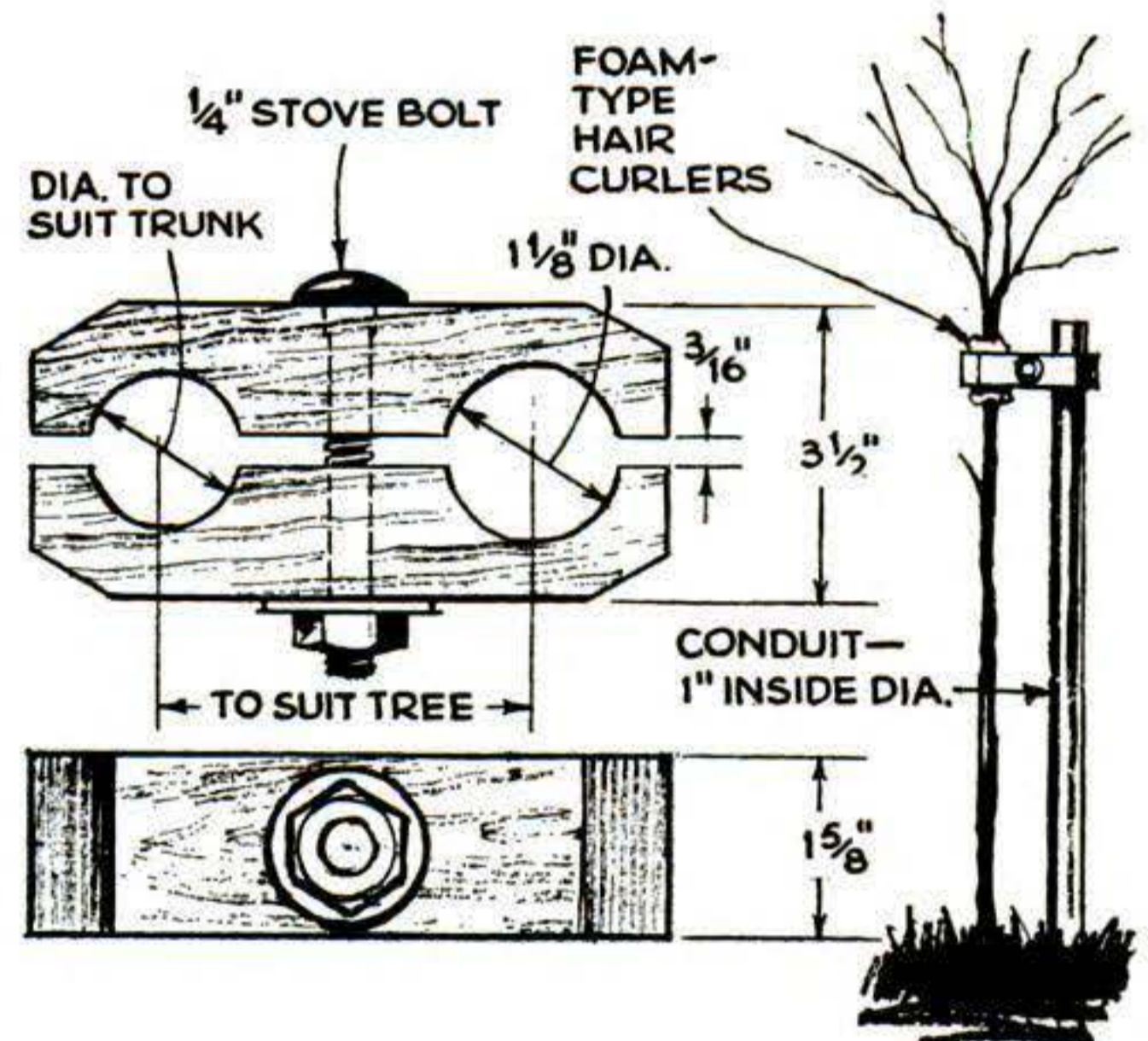
Don't let your portable barbecue gather dust until spring. Use it, as I do, as a portable greenhouse.

It lends itself well to this. You can keep it inside near a sunny window or under a light bulb on cool days, wheel it outside on favorable days. If it has a hood, leave it on for a windbreak. A translucent plastic cover draped over the hood protects seedlings.—*John Allen De Frees, Durhamville, N.Y.*

Adjustable support for a young tree

Here's a solid support that keeps the trunk of a new tree from swaying in any direction. It's made from a two-by-four cut lengthwise. A stove bolt clamps the support to a 1" conduit post in the ground.

Foam-type hair curlers are split and used as padding around the trunk. Available at drug stores, these allow air circulation, dry out quickly when wet, and are chemically inert. The support is easily adjusted as the tree or branches grow.—*H. G. Frommer, Mequon, Wis.*

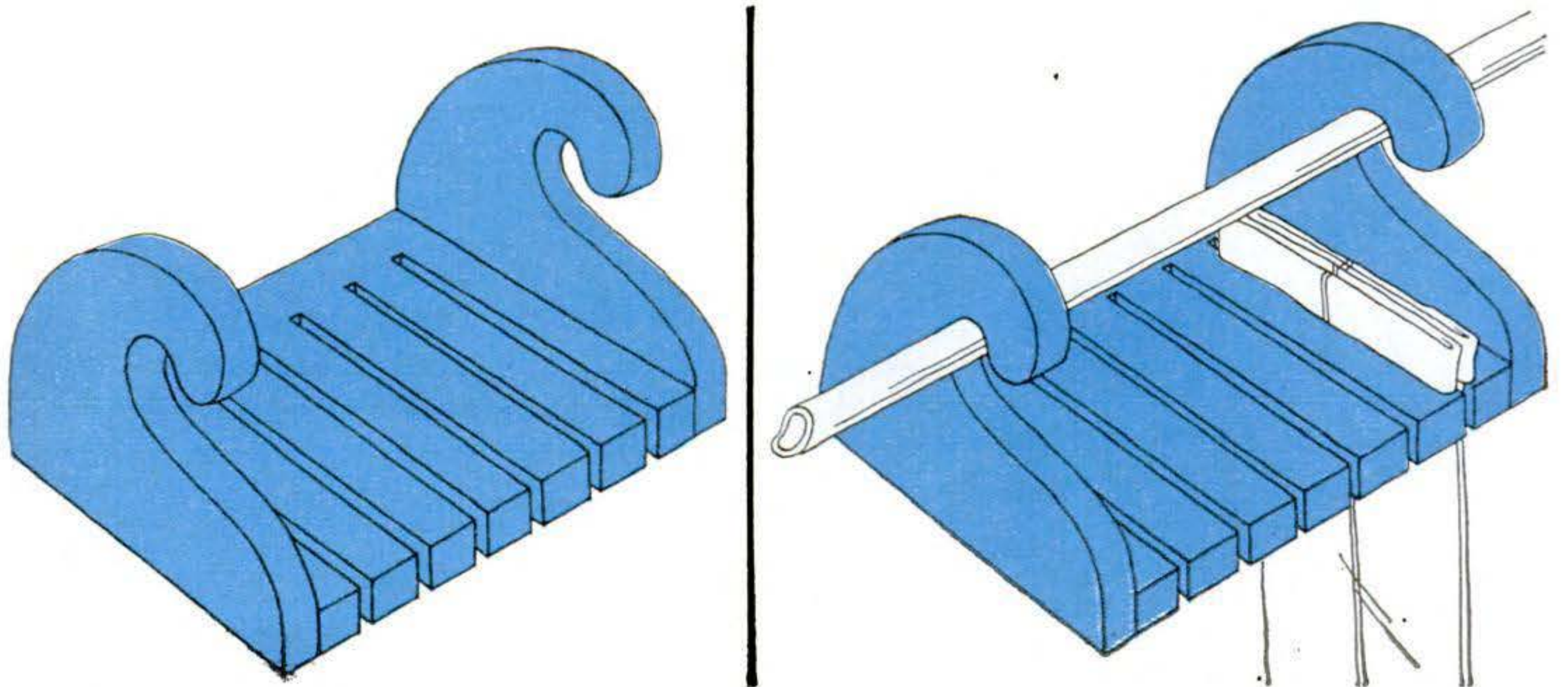
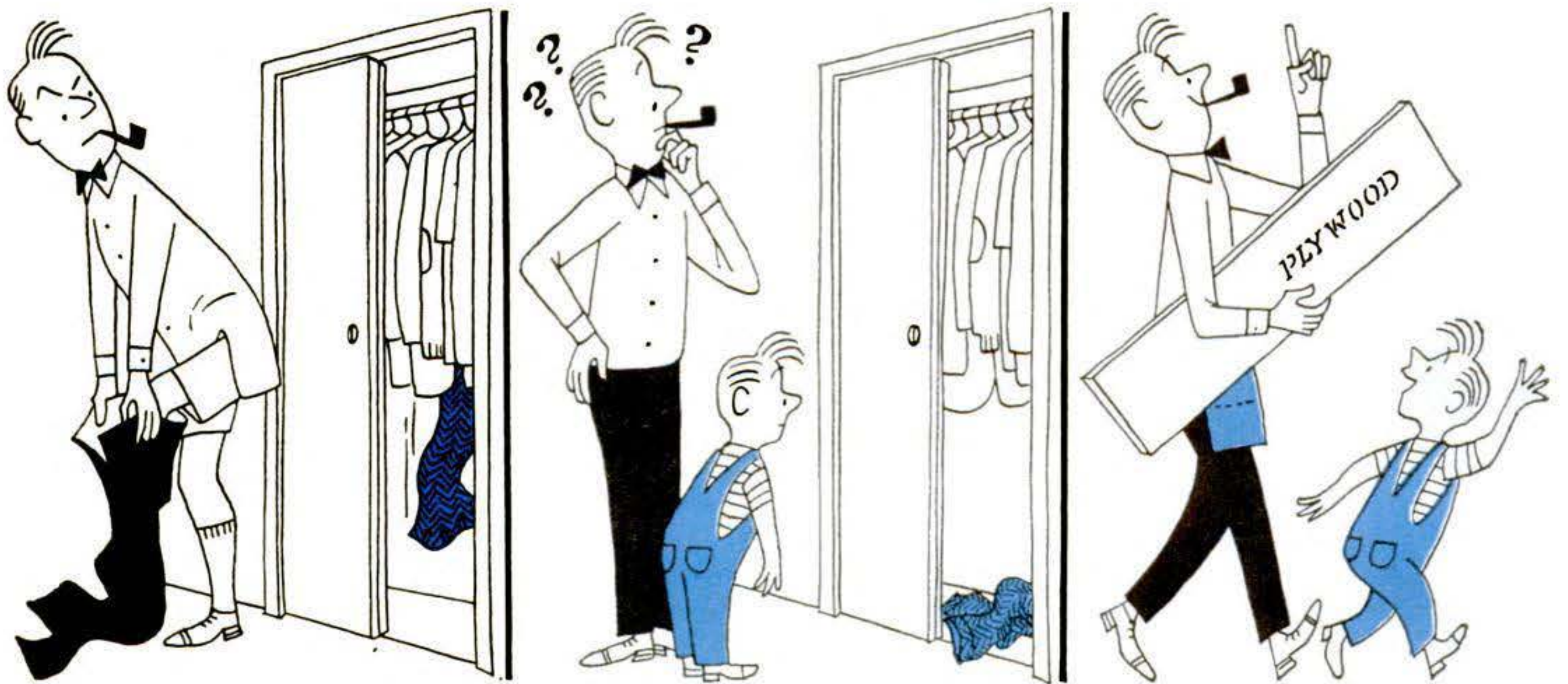


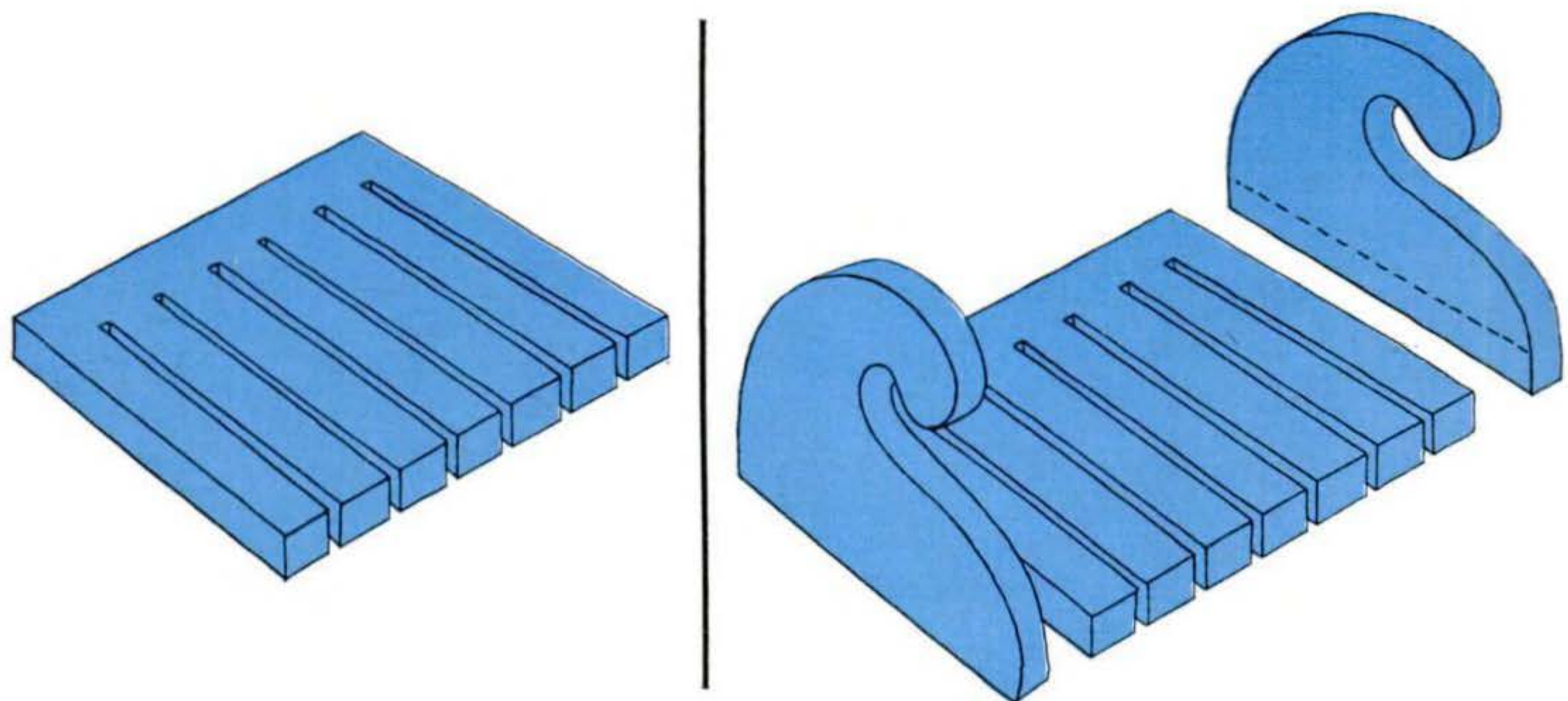
You can have a hothouse in a cellarway

We use the cellarway as a hothouse for early plants. A simple frame holds pots and flats at the wall that gets the most sun. A sash of furring strips and heavy plastic sheeting over the opening is attached with storm-window brackets so that it can be raised a bit on very warm days. The cellar furnace provides heat, and the sash is inset to permit closing the doors at night.—*Mrs. Margaret Butts, Norton, Mass.*

Wordless Workshop

By Roy Doty
and Harald Solaas





My Trailer Does More Than Haul a Boat

Looking for hot ideas in a load hauler? Toting a runabout is just one of many jobs for this rig

By Bonner I. Buller

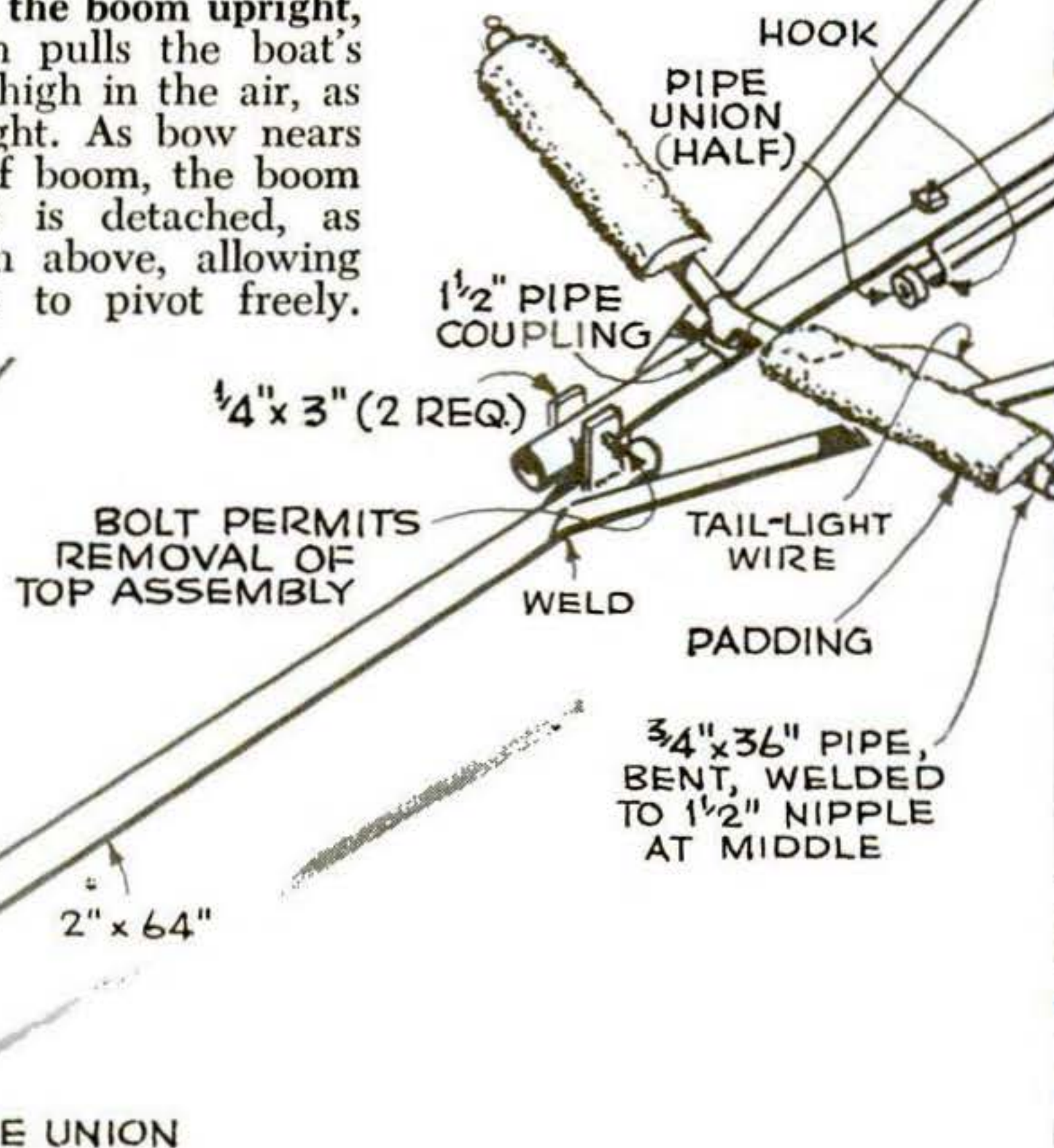
MOST trailers are built to tote one thing. Here's a job that's a self-loading boat trailer, a general-purpose yard hoist, a mobile camper, and a heavy-duty hauler all rolled into one. I designed it originally to pull our boat up the steep banks of a nearby lake, then discovered I had a versatile rig that would pay its keep all year 'round. Consider its features:

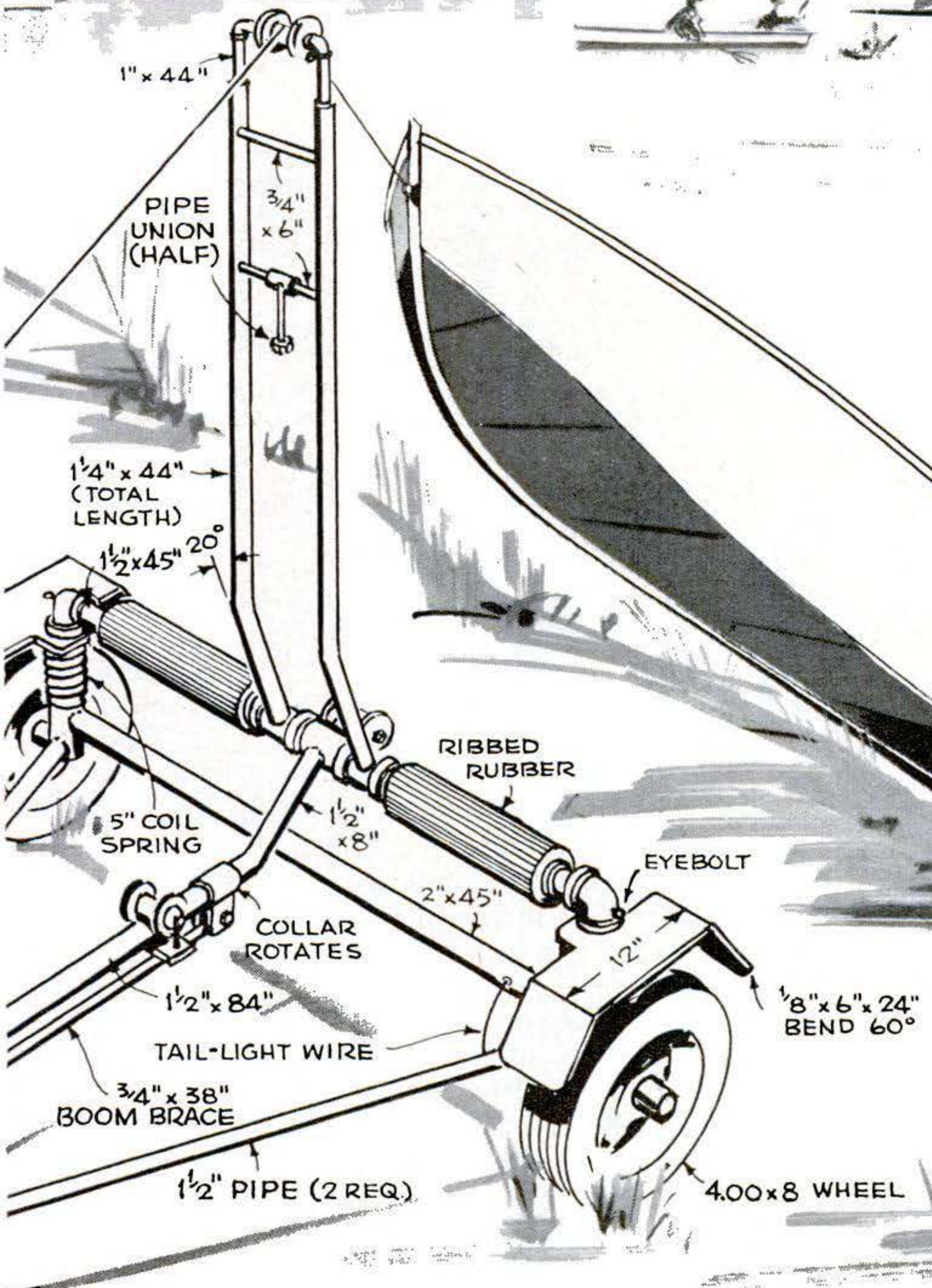
- A retractable boom at the rear, operated by a hand winch, plucks a boat or other heavy load right off the ground and sets

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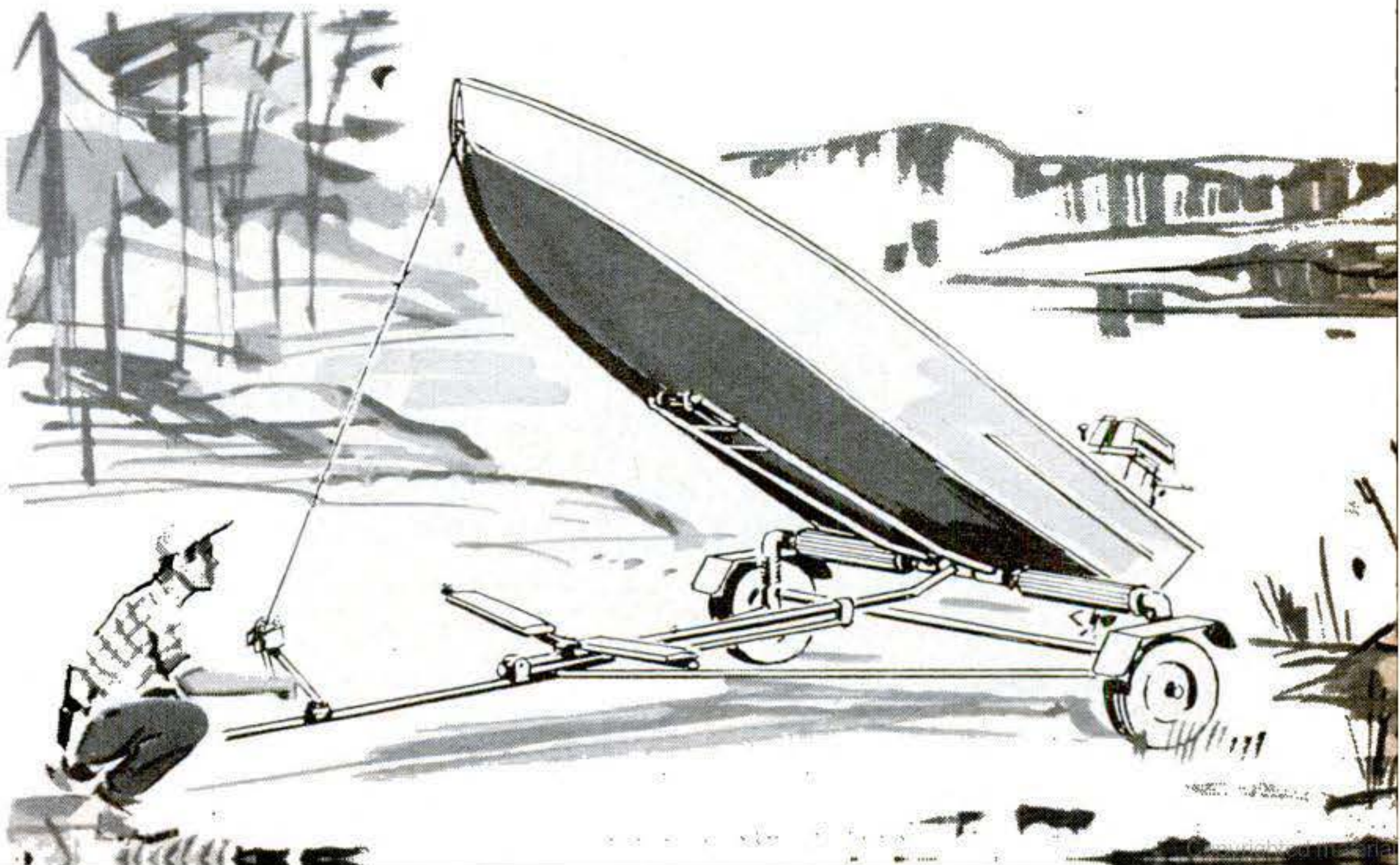


With the boom upright, winch pulls the boat's bow high in the air, as at right. As bow nears top of boom, the boom brace is detached, as shown above, allowing boom to pivot freely.





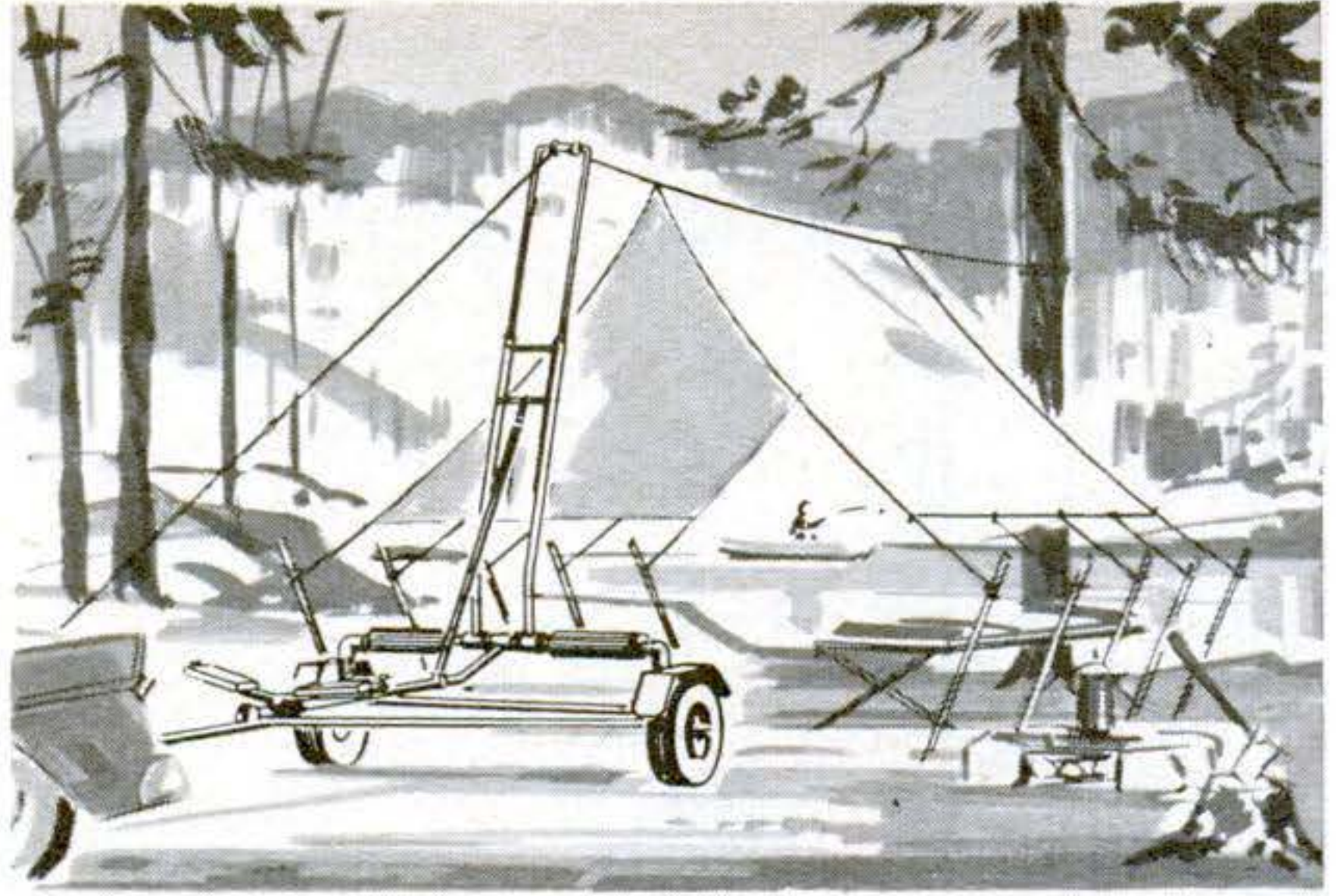
As the bow slides up and onto the boom, its weight tilts the boom downward, and the boat is plopped neatly onto the trailer bed. A few more turns of the winch draw the boat fully forward onto the front cradle, ready for a quick trailer ride home.



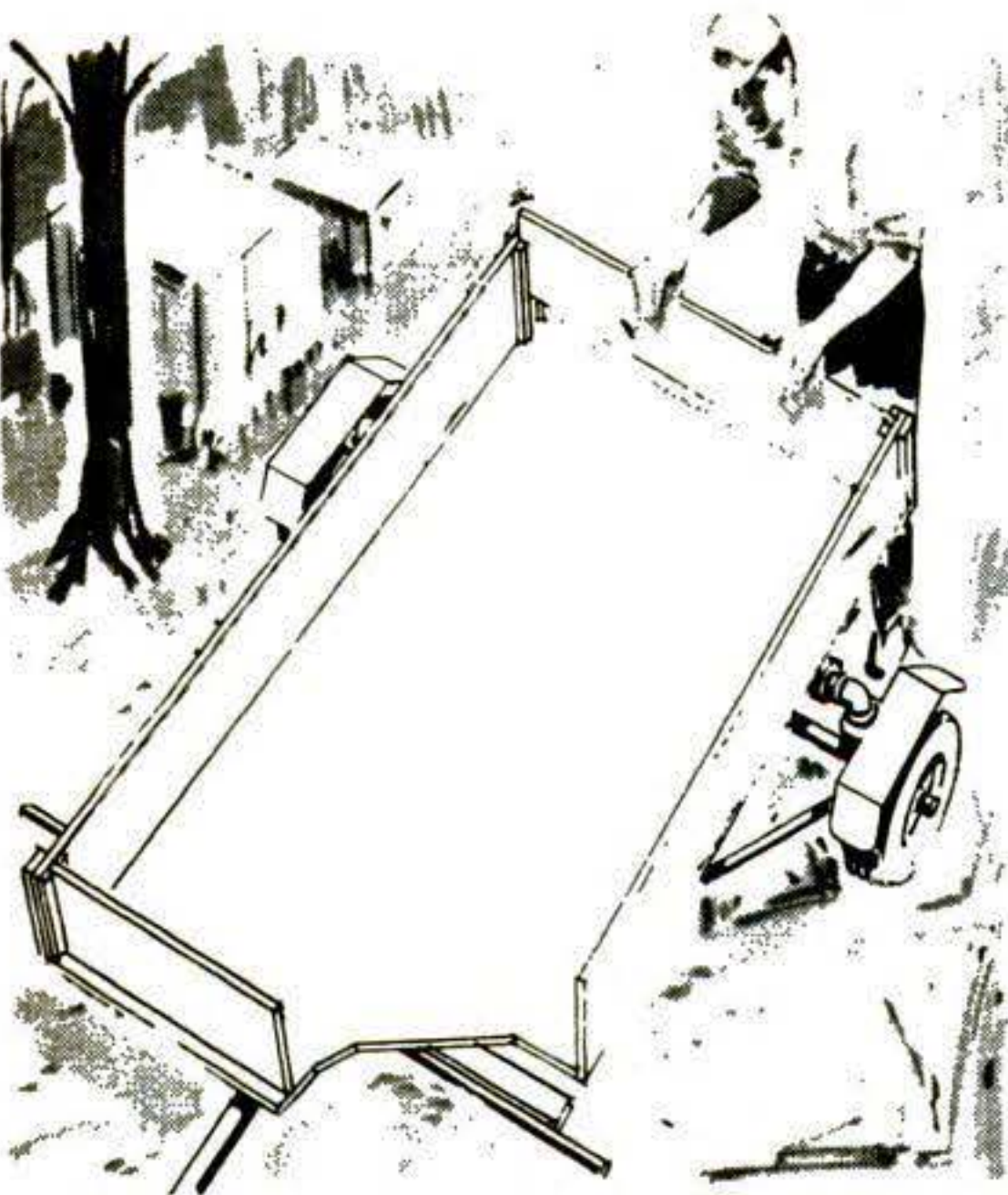
With or without a boat, this jack-of-all-jobs works the year 'round



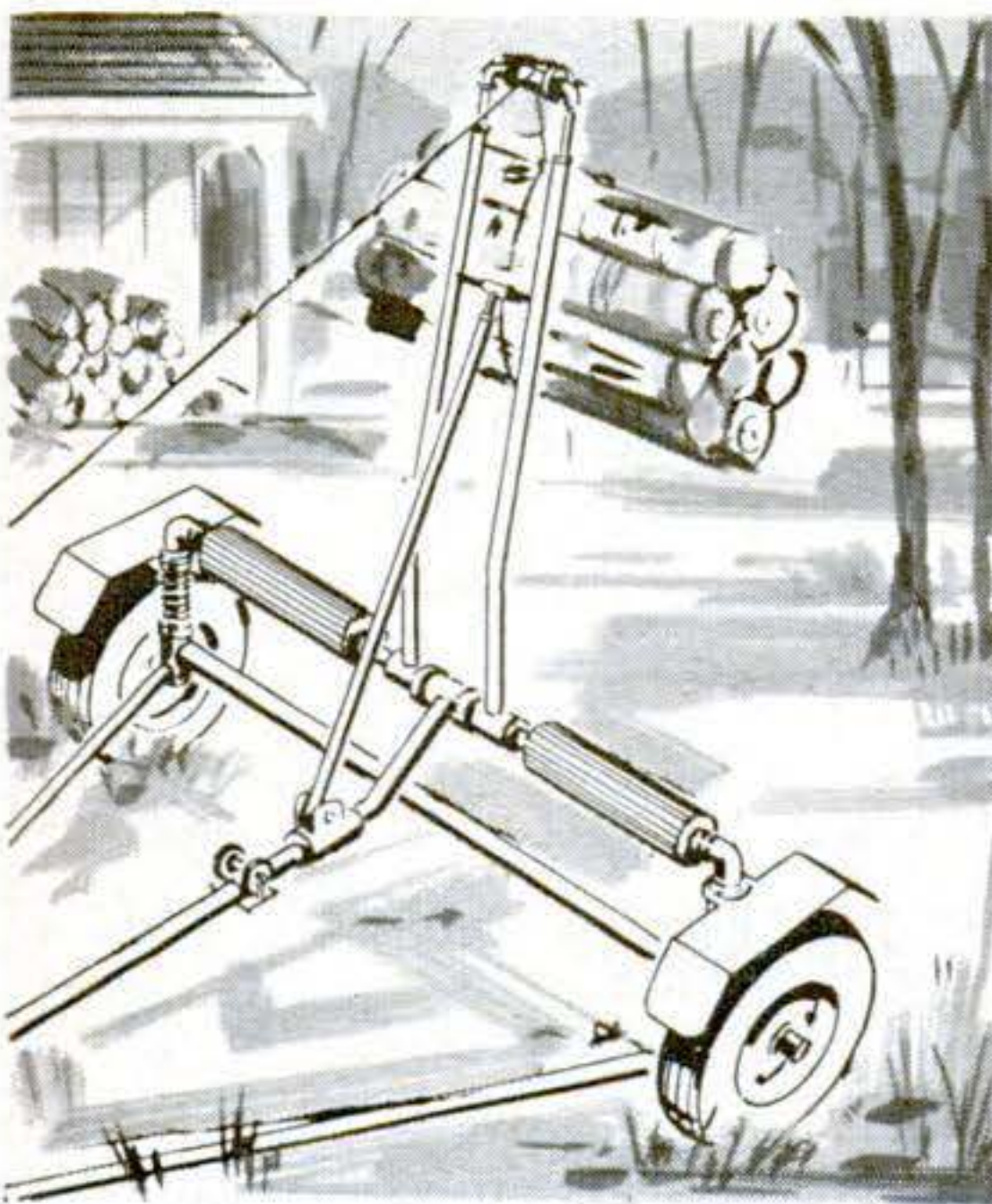
Side-winchng solves problem where you can't back trailer toward water.



Want a quick support for a tent? Just extend the boom, tie the line to a tree, and winch the tent up taut.



Lift-off box has cleats that simply fit between front and rear supports.



As a mobile hoist, trailer handles heavy lifting jobs around the yard.

it smartly on the trailer with no lifting on your part.

- Lock the boom upright and you have a fixed hoist for stacking firewood, pulling stumps, or lifting heavy machinery. You can winch a load off the ground, then just wheel it to wherever you want.

- Retract the boom and you have an unobstructed frame that can be converted to a box trailer, flat-bed hauler, or mobile camper. The front bow cradle, used when you're toting a boat, can be unscrewed and replaced with other types of supports to take almost any kind of trailer body.

- The winch mount, normally fixed, is free to swivel so it can pull in any direction. This enables you to hoist a load even where you can't park the trailer in line with it.

The cost is low because nearly all parts are common black-iron pipe, usually available secondhand for about half price. Welding is required at the joints—even those that thread together—for maximum strength. This can be done easily by a local welding shop.

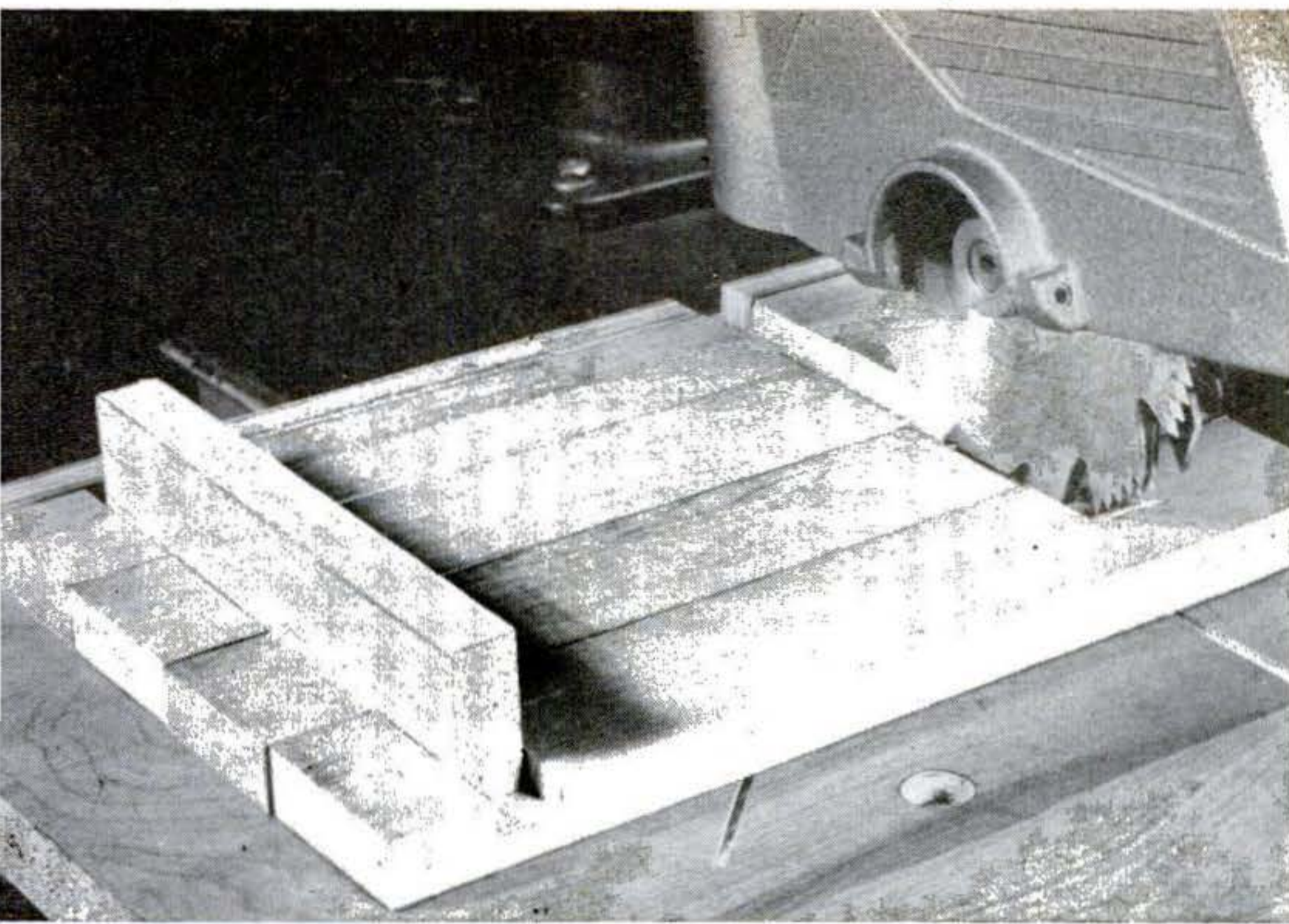
All of the sliding and pivoting joints are simply two sizes of pipe chosen to slip together as closely as possible. The boom, made of two telescoping sections of pipe, can be extended up to 8' to give you a tall derrick or pole support. The roller at the top of the boom serves a double purpose. Made of two rubber rings on a rotating pipe collar, it acts as a pulley for the winch line when the boom is raised and as an additional support for a boat hull when the boom is lowered.

The brace that holds the boom upright is connected with a standard pipe union, allowing you to attach and remove it quickly. Another pipe union is the swivel for the winch mount. One half is welded to the trailer's drawbar and the other half to the winch support. By loosening the union's collar, you

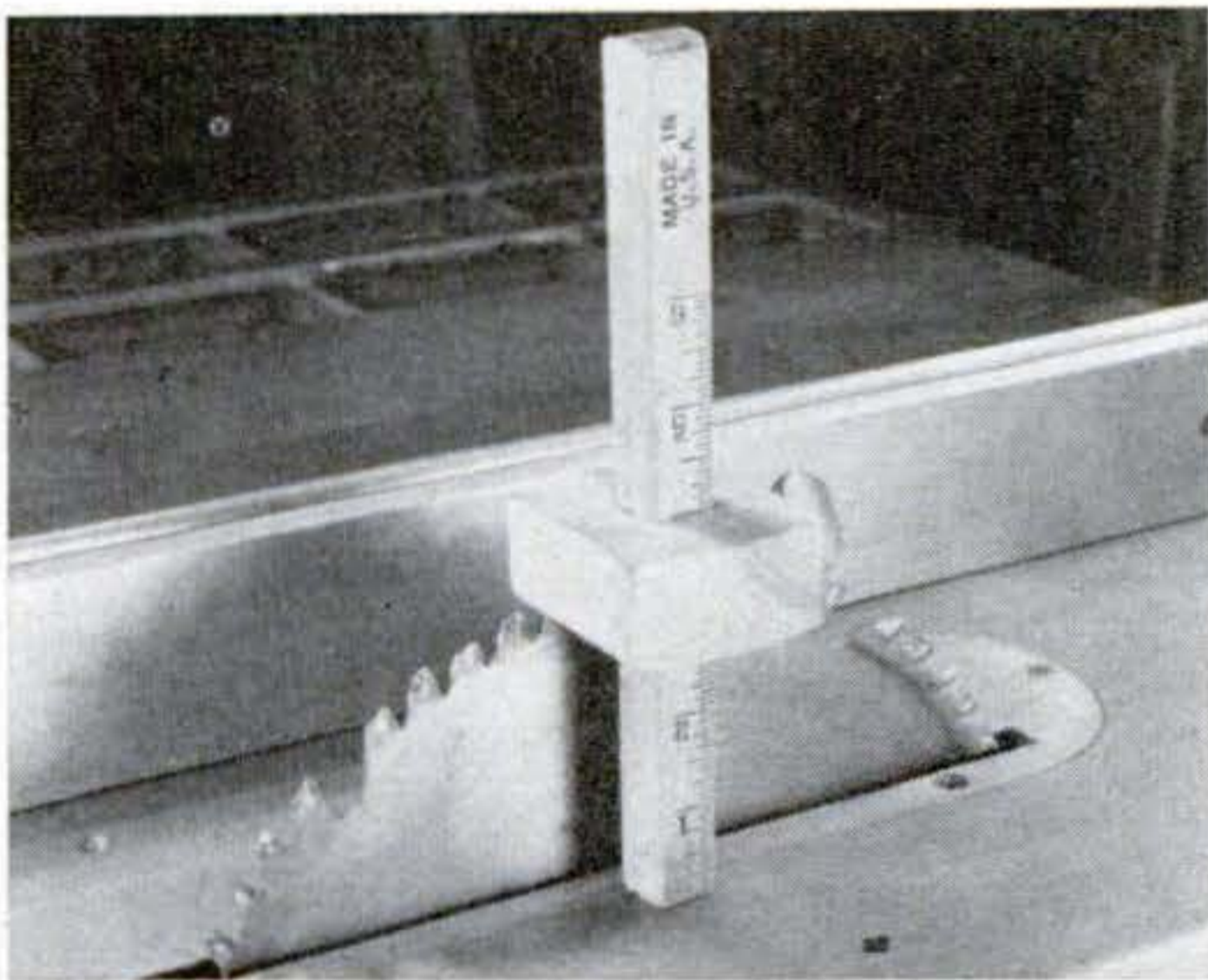
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Tips for the Home Shop

By R. J. De Cristoforo

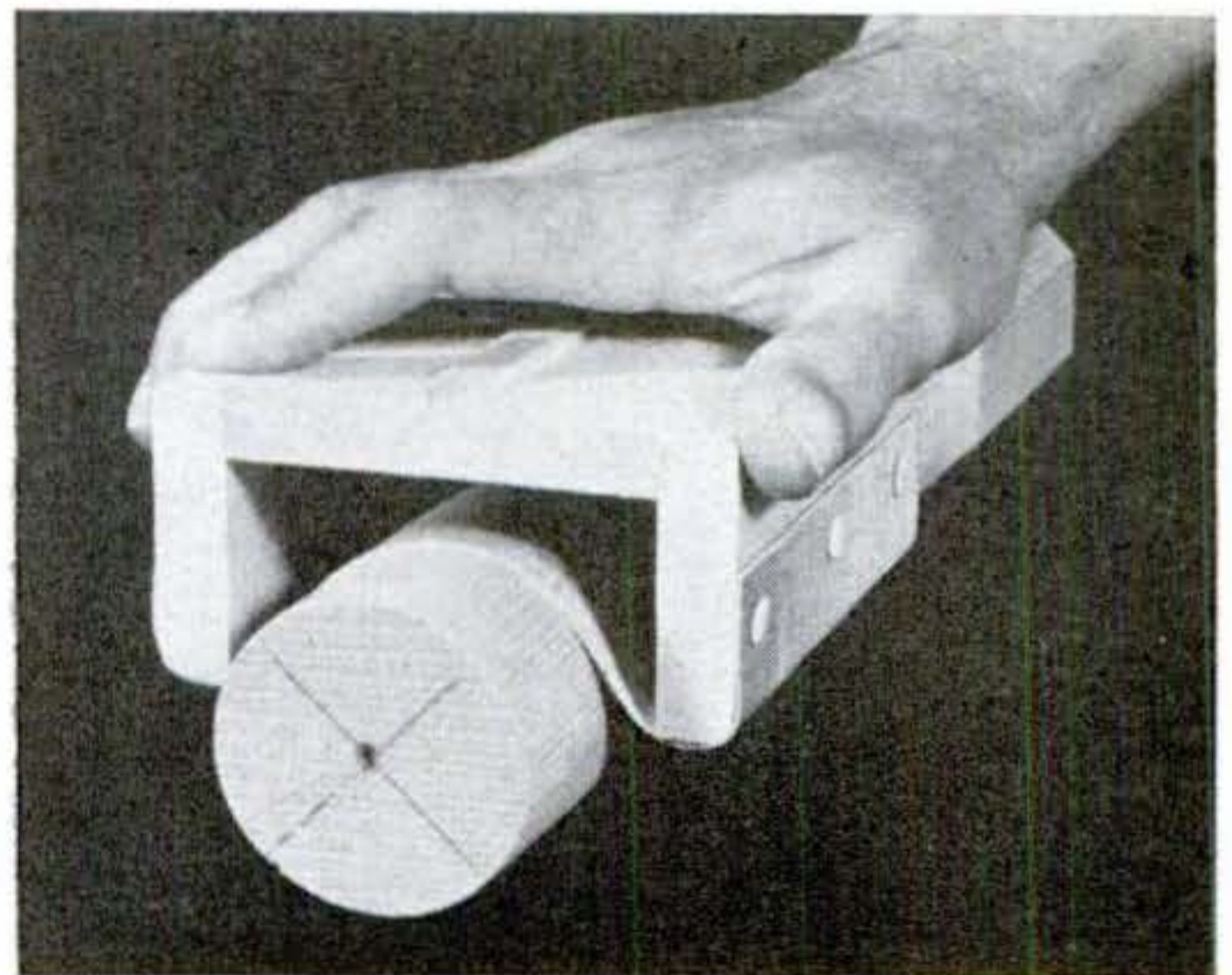
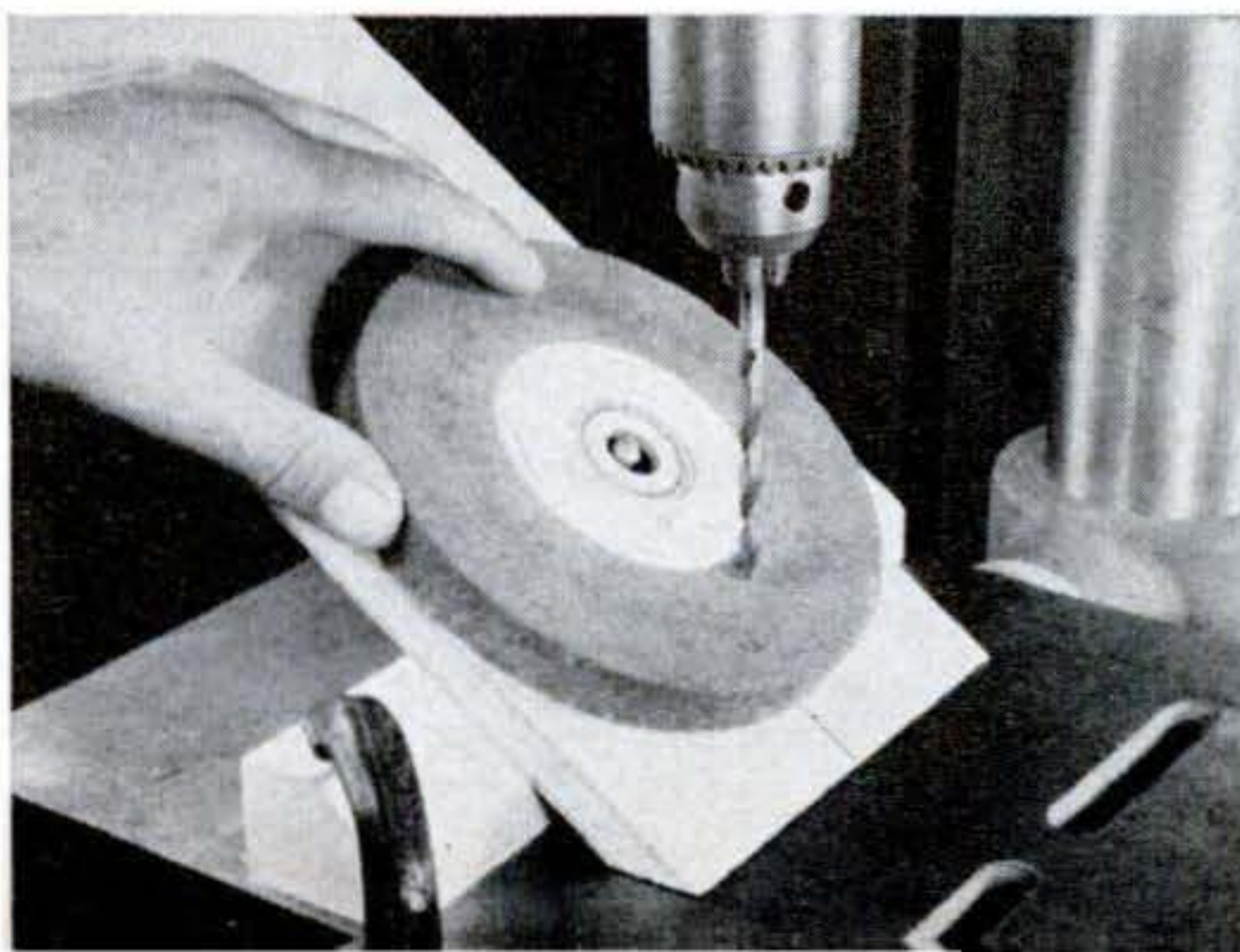


Duplicating dados on similar pieces of wood is a cinch with a radial-arm saw. Insert a snug-fitting piece of wood in the first dados. This holds the pieces together, aligning them for the following cuts, and spaces the dados equally in each piece.



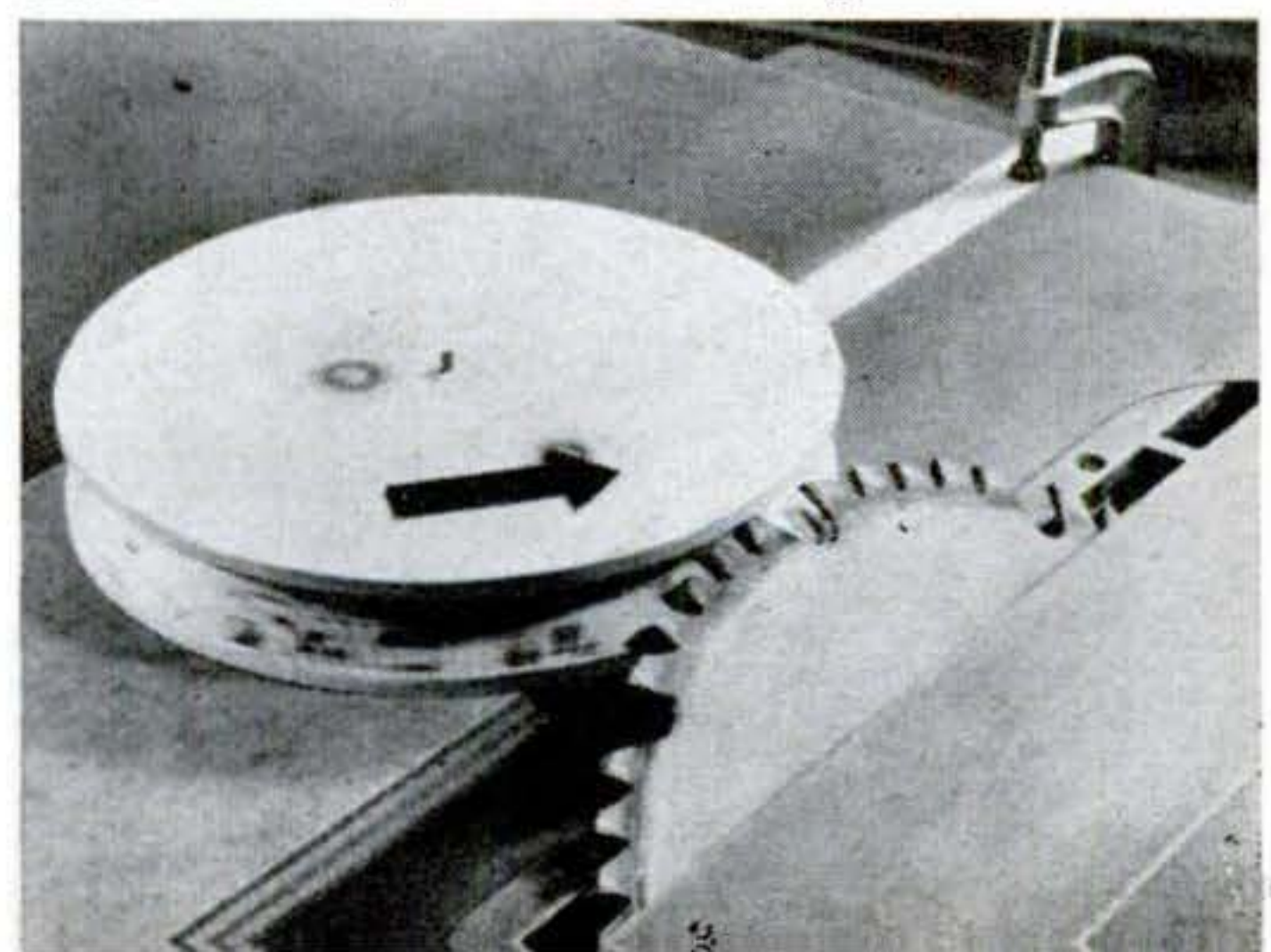
Blade projection can be measured accurately with a marking gauge modified like this one. Just remove the point and cut off the end square at the start of calibrations. The gauge also gives precise settings for a dado or molding head.

Here's a setup for sharpening drills—although you won't get a true conical grind. Turn the grinding wheel slowly as you touch the bit to it by extending the quill. A smooth stone is best. Restrict such sharpening to larger drills. Those under $\frac{1}{8}$ " tend to be too flexible.

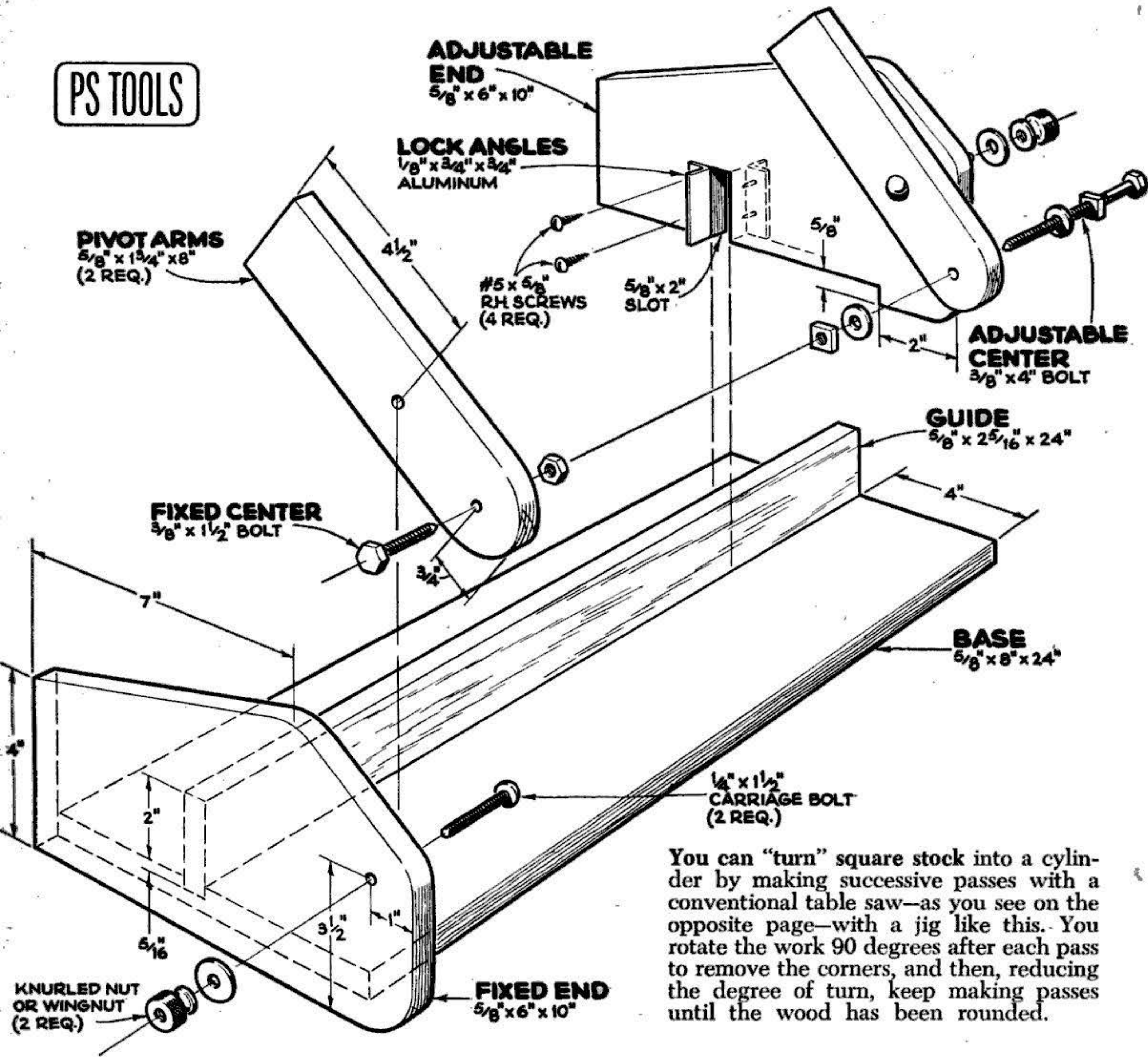


A U-shaped sanding block is ideal for smoothing cylinders and many irregular shapes since you can fit it to the work by adjusting the tautness or looseness of the paper across the block. Screw a handle on if you wish.

A V slot, a chamfer, or a bevel can be cut on the edge of a wood disk with this setup. Pivot the disk on a scrap of wood screwed to a strip that fits the table slot. Clamp the strip and rotate the disk against the angled blade. Raise blade about $\frac{1}{16}$ " after each pass.



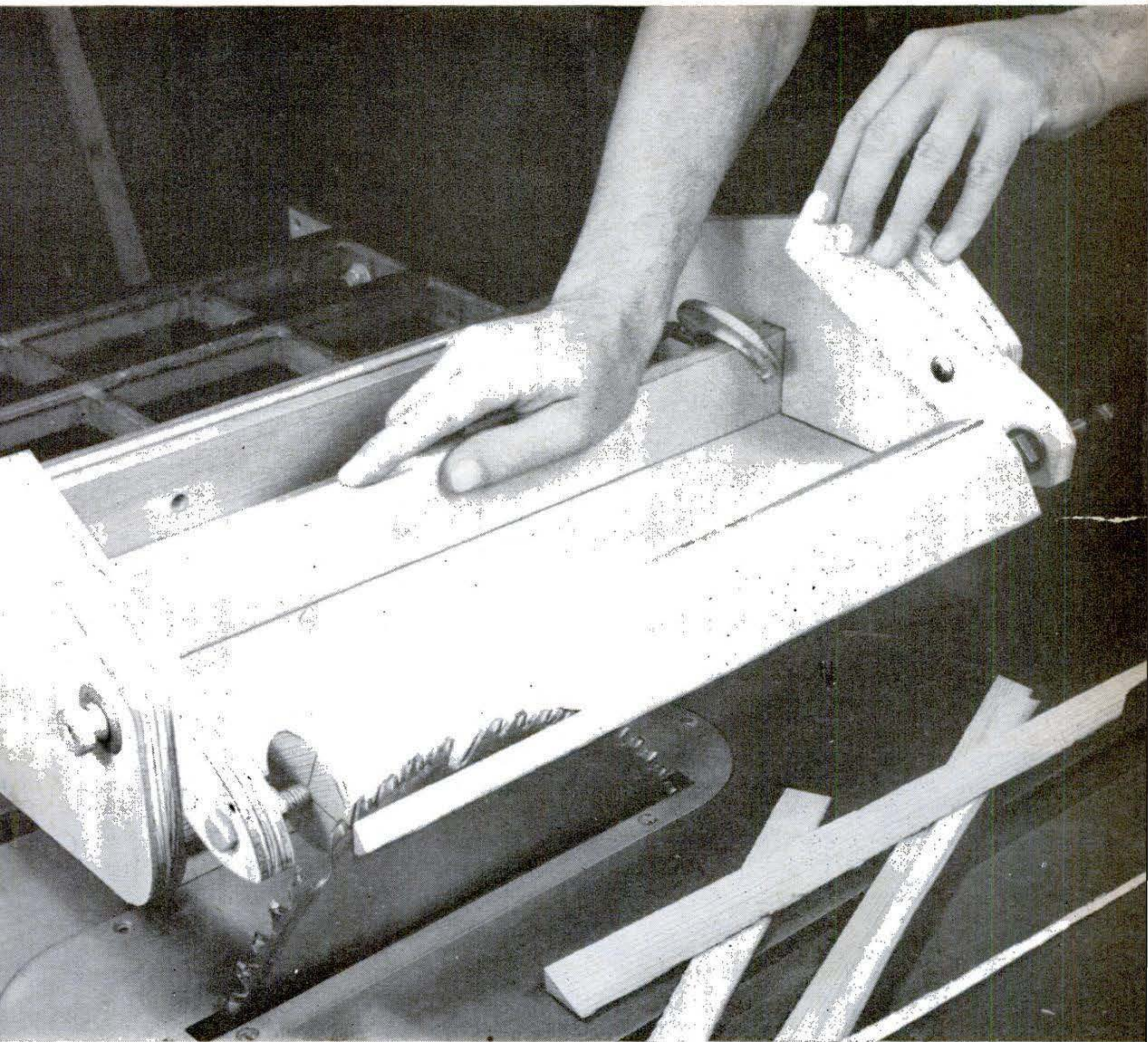
PS TOOLS



You can "turn" square stock into a cylinder by making successive passes with a conventional table saw—as you see on the opposite page—with a jig like this. You rotate the work 90 degrees after each pass to remove the corners, and then, reducing the degree of turn, keep making passes until the wood has been rounded.

How to Do Lathework on Your Table Saw

Combine an easily made wooden jig with a little know-how and you have, in effect, added a new tool to your shop at little cost



By R. J. De Cristoforo

STRANGELY enough, many intriguing lathe effects can't be accomplished on the lathe itself or by using conventional turning tools. Most longitudinal details—cuts such as reeding and fluting—require a specially mounted and powered cutter, with the lathe—if it is used at all—merely a holding device for the work.

If another tool is used, most often a jig is improvised for use on a drill press—one permitting longitudinal passes under a cutter gripped in the chuck. This is fine for fluting, not so good for reeding.

Switching the application to a table saw

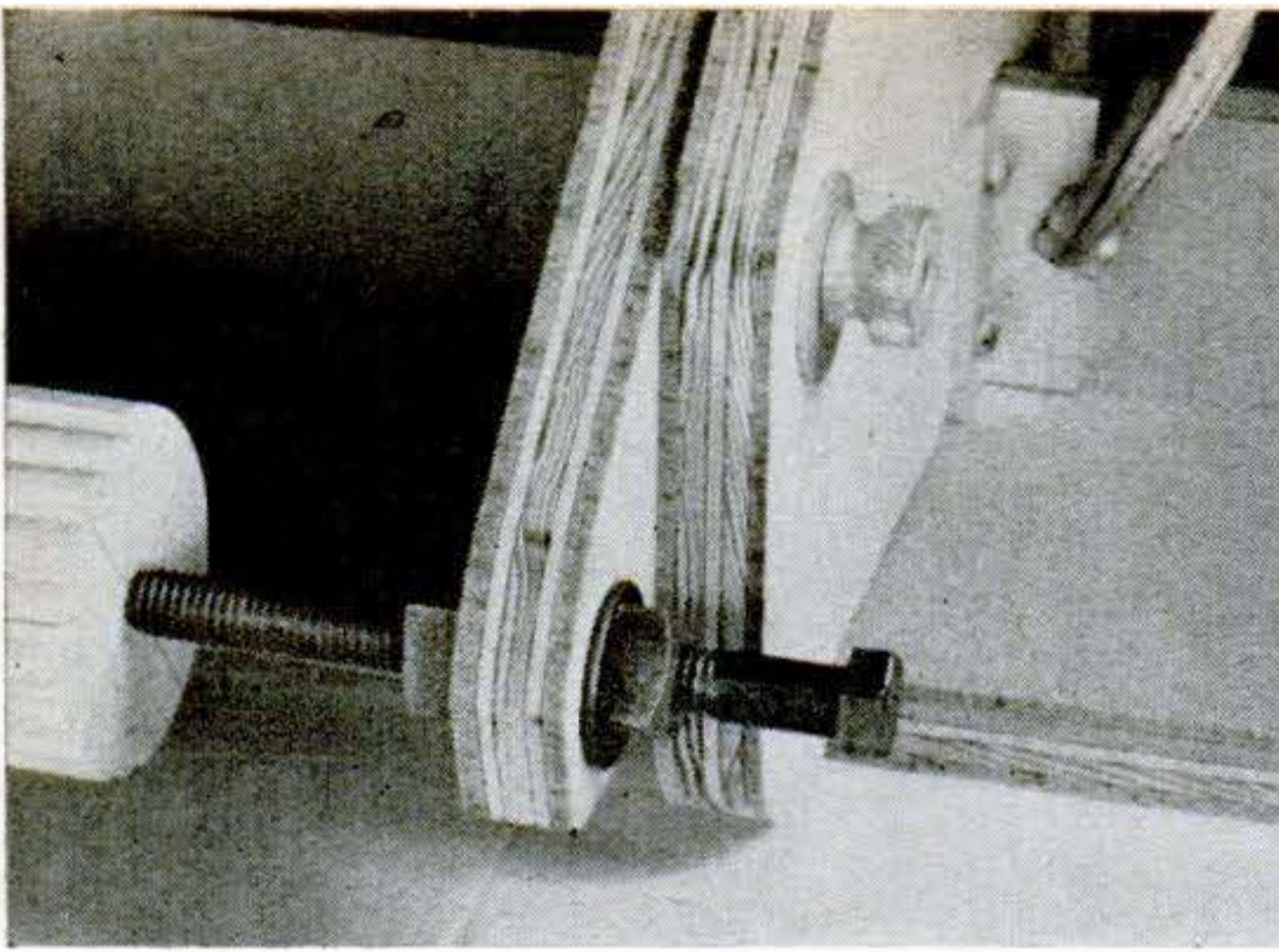
is a logical alternative. You have a built-in guide (the rip fence), a convenient depth-of-cut adjustment (raising or lowering of the arbor), and you can work with a molding head and its vast assortment of knives, or a dado, or even a saw blade.

Combine these assets with a special jig and you have a complete tool—one you can't buy. It's adjustable for work length and diameter, and has mounting centers that can operate independently.

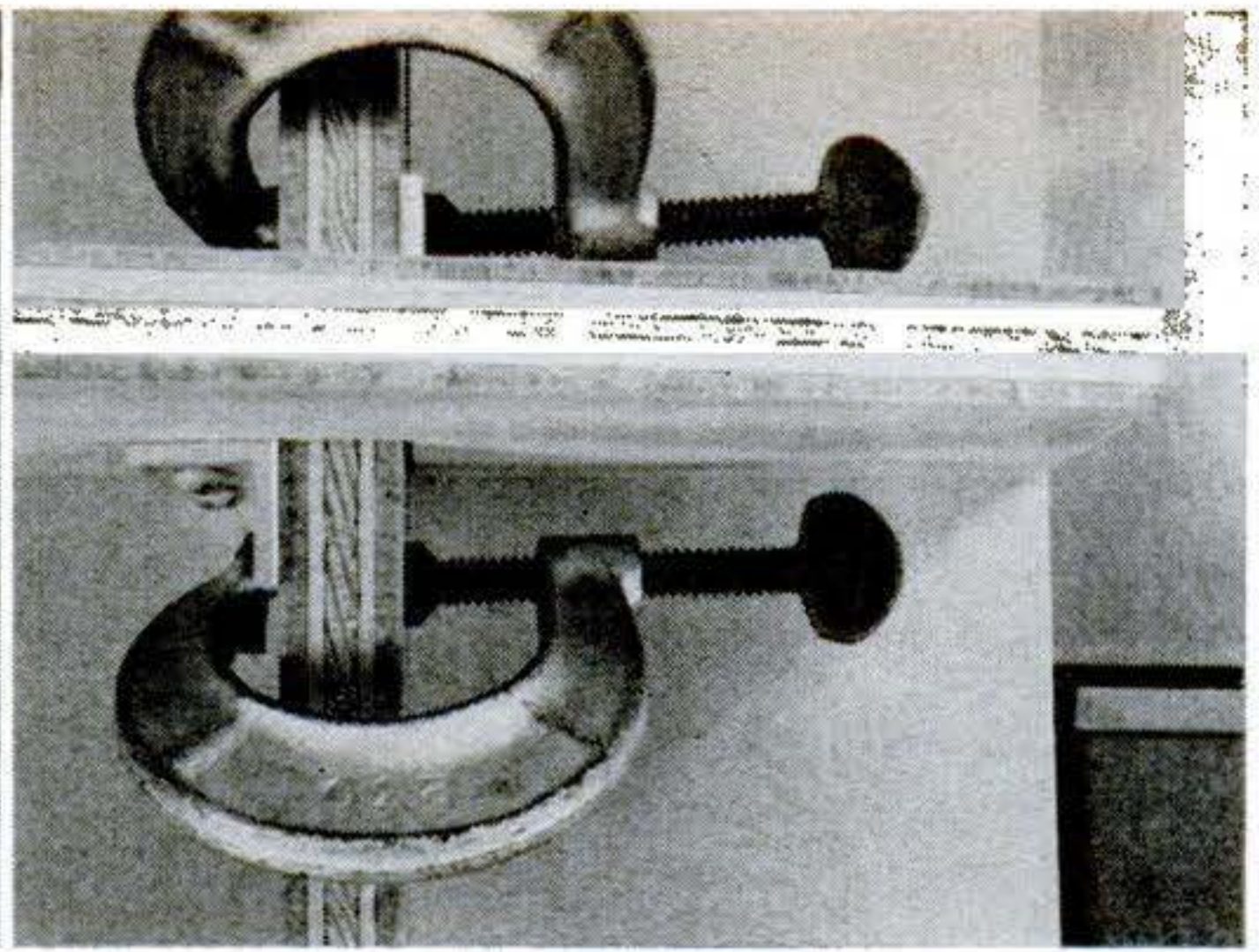
What the tool does. With the jig you can reed or flute or make any similar cut on spindles that have been shaped in the lathe, or on ready-made cylinders such as a large dowel or closet pole. In addition, using a

CONTINUED

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Adjustable center is a $\frac{3}{8}$ "-by-4" bolt pointed with grinder or file. Double nuts lock the center after it has been set to hold cylinder. The pivot arms are locked with a knurled nut or wingnut.



Lock angles are screwed to the adjustable end to bear on the guide. C clamps lock the adjustable end in approximate position and the adjustable center is used for final setting.

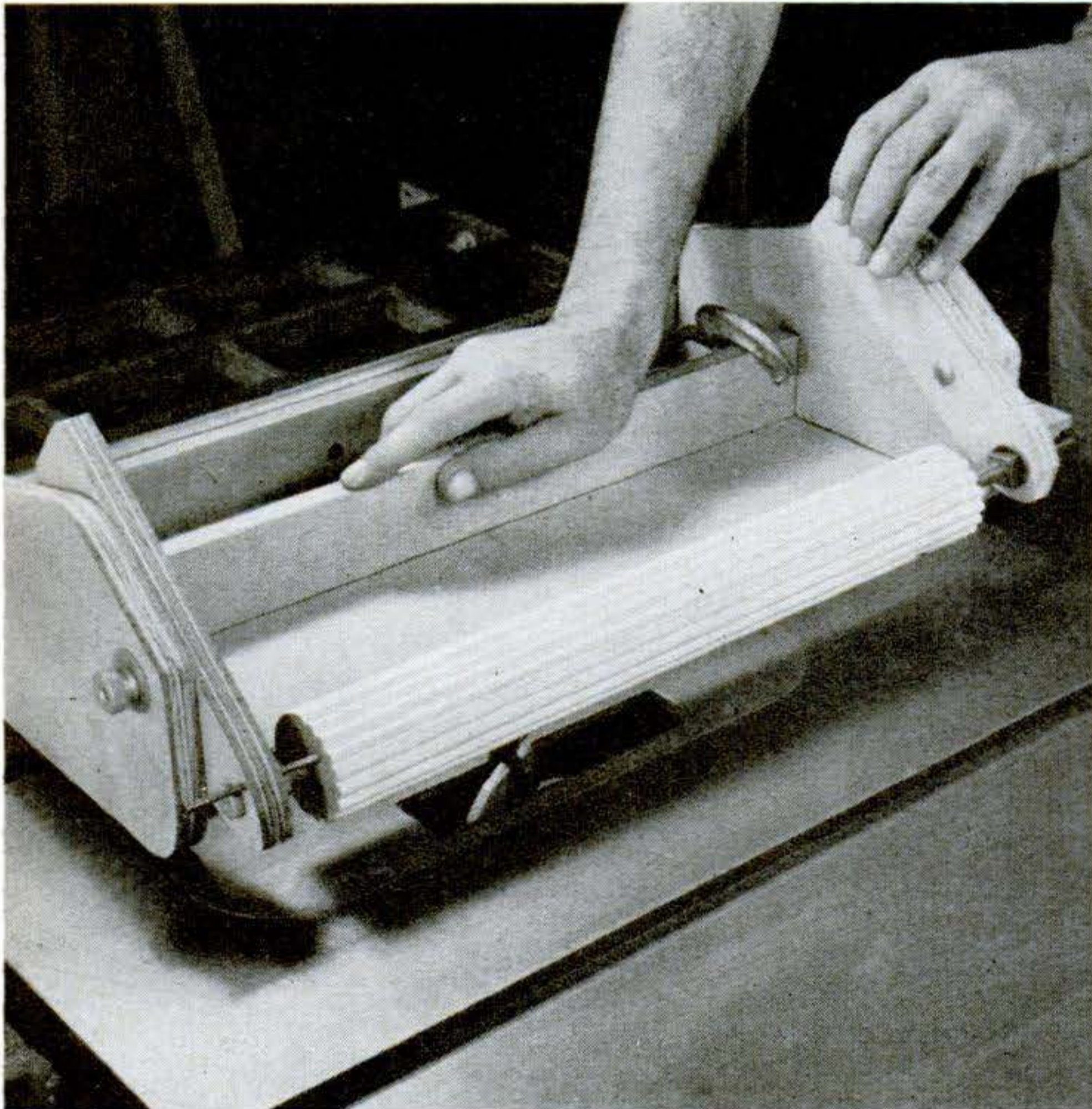
conventional saw blade, you can "turn" square stock into round and, by working with offset centers, form a tapered leg from a square blank or a round one.

You can easily slice off a section to create a "flat" on a cylinder (a good way to make shaped, half-round moldings) and you can use the jig to do coving operations on round

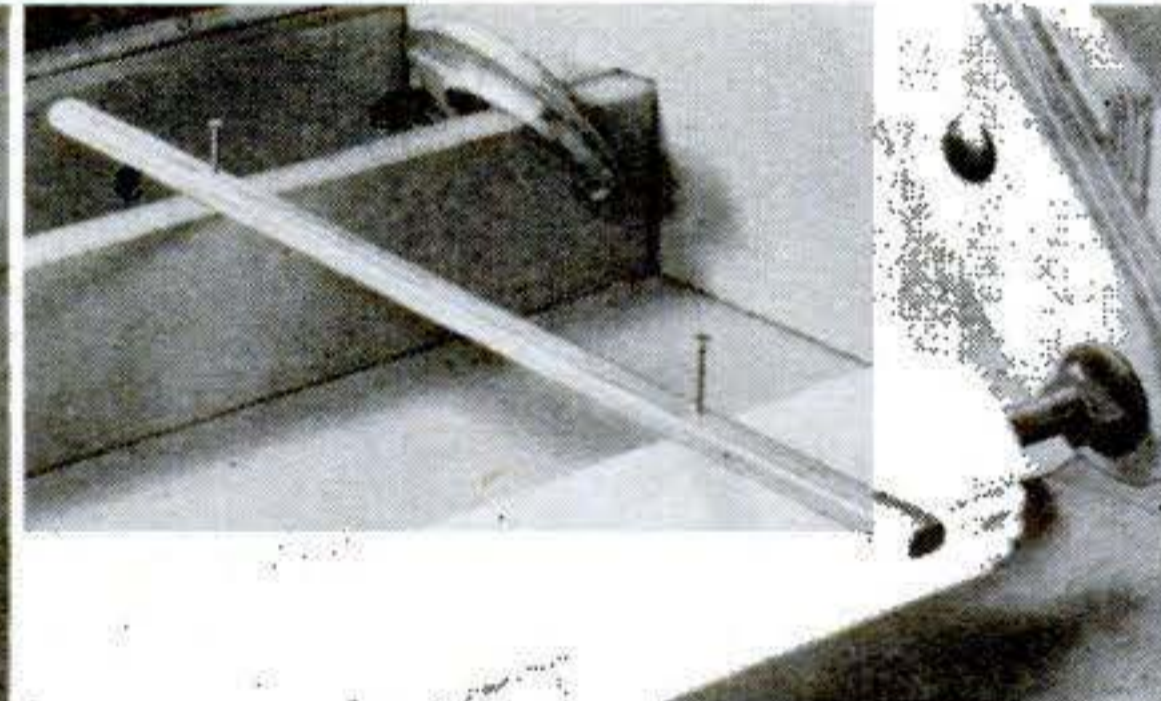
stock or on squares. Using the jig after some preliminary lathework has been done, you can create faceted effects on turnings that will impress even the most experienced power-tool woodworkers.

Making the jig. First cut the base and guide to size. Run a snug $\frac{5}{16}$ "-by- $\frac{5}{8}$ " dado the length of the base and 4" in from one

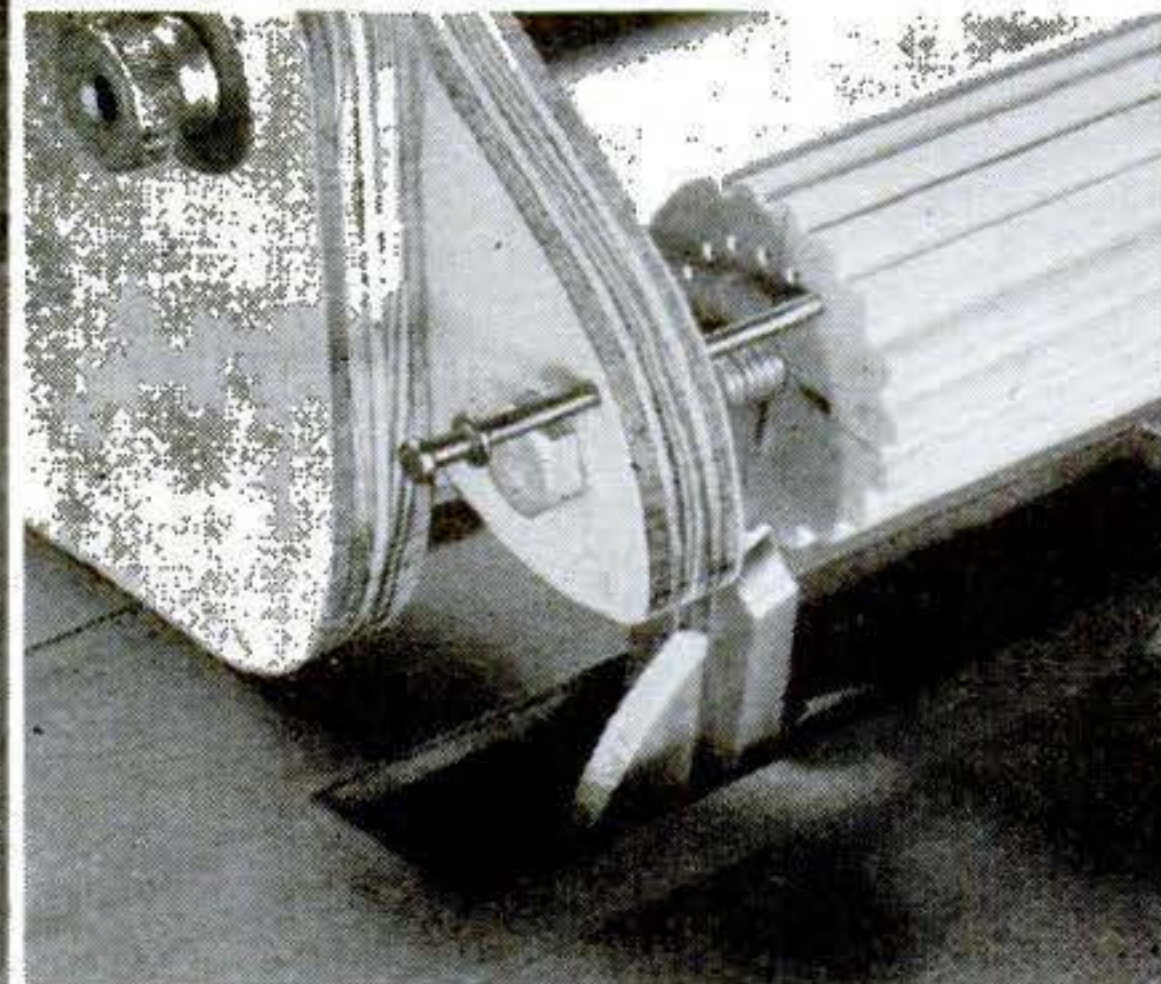
Here's how you use the jig for reeding or fluting a cylinder



Reeding and fluting, the more common "after jobs" in lathework, are a cinch with the table-saw jig. After the cylinder has been turned on a lathe, or cut on the saw as shown on previous page, you mount it as above and make passes with the saw blade.



One way of indexing the cylinder is to tack a strip of wood across the guide and the work after positioning the work.



Second indexing method is shown here—a nail through a hole in one pivot arm. A light hammer tap locks the work.

edge. Glue and nail the guide in place. Next make the ends. These are duplicates except that the adjustable one is recessed at the bottom to accommodate the base and notched to fit snugly over the guide.

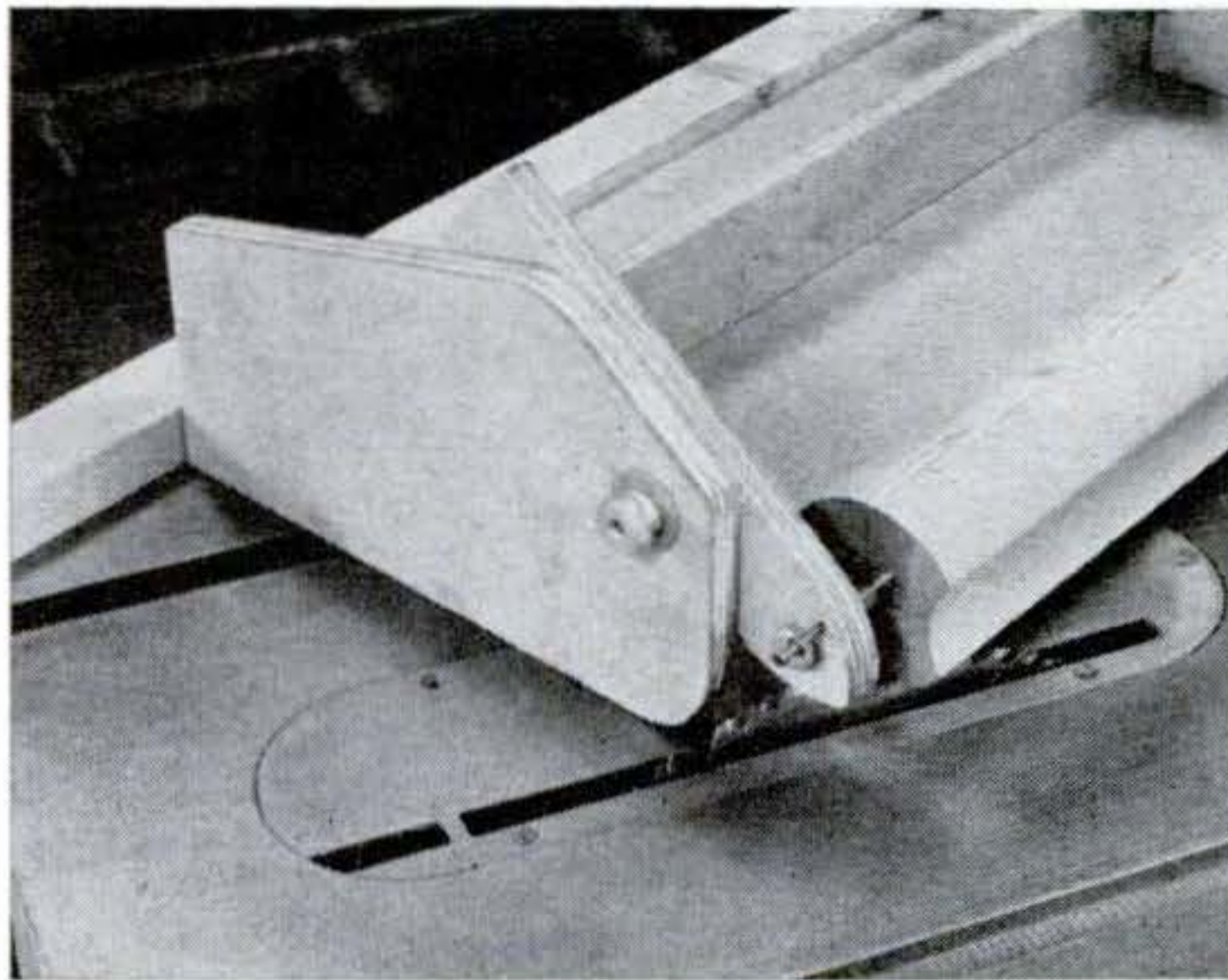
It's best to nail two pieces of wood together until you have the basic shape and have drilled the hole. Then do the recessing and notching on the adjustable end. Attach the fixed end to the base and guide with glue and nails. Cut to length the lock angles for the adjustable end and screw them to the end so that they bear on opposite sides of the guide.

The pivot arms are duplicates and must be drilled accurately. The centers are made from the bolts called for in the drawing and are pointed on a grinding wheel or by hand with a file. Be sure to use carriage bolts when attaching the pivot arms to the ends.

Use a good grade of hardwood or some hardboard-surfaced plywood to make the jig. Sand all parts carefully before assembly. Apply several coats of sealer—sanding between coats—and a heavy coating of paste wax to the underside of the base.

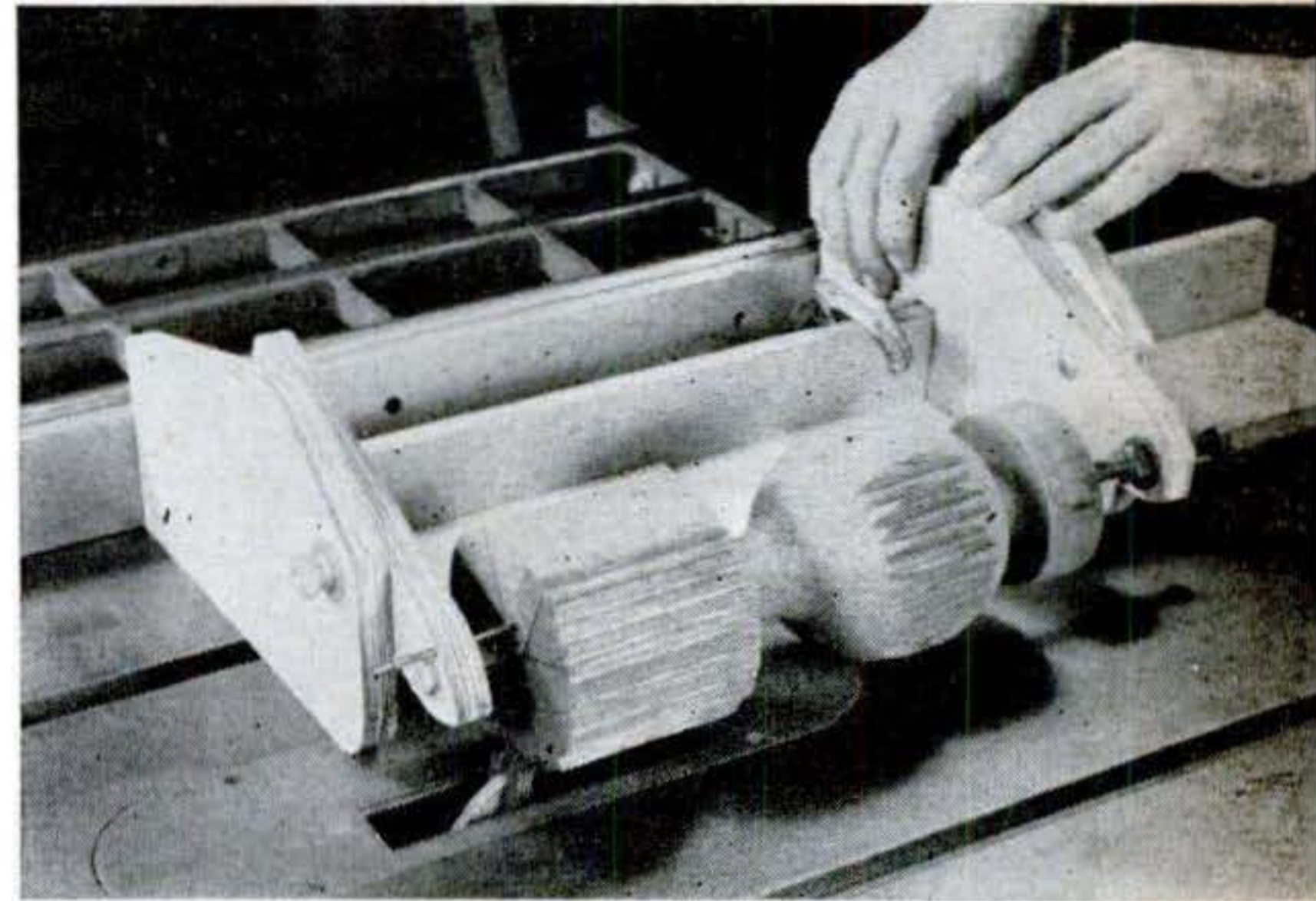
Adjusting the jig. When adjusting for work length, first set the adjustable end in an approximate position and lock it in place with small C clamps; then use the adjustable center for the final setting. Take up on the screw enough so the work will be held securely between centers.

Adjust the pivot arms for work height and lock in place, and set the rip fence so the work centerline will be directly over the cutter. Further depth-of-cut adjustment can be made by using the saw arbor. ■ ■

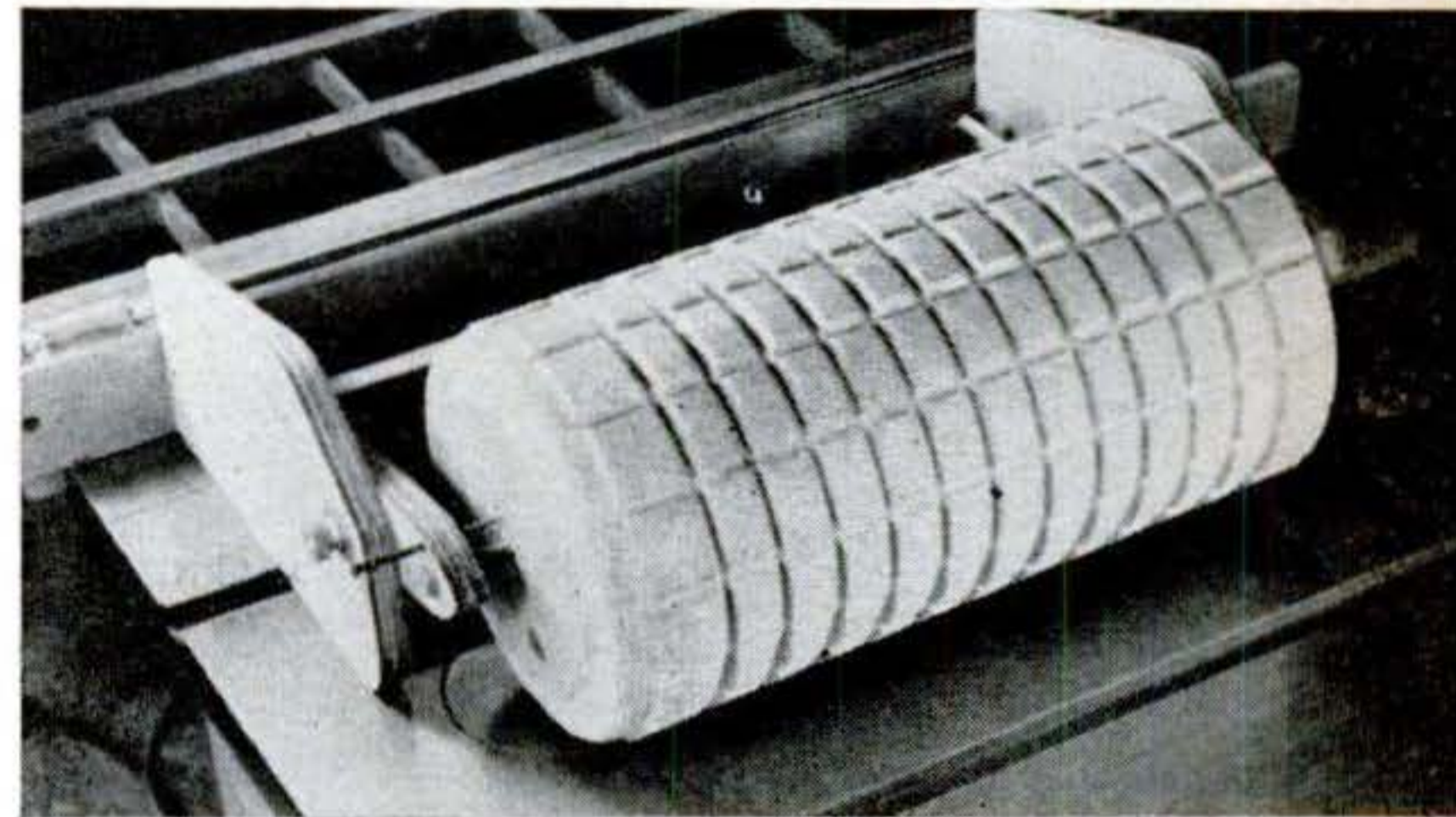


You can cove cylinders by clamping a guide strip to the table so that the work can be passed obliquely across blade. Make successive passes with blade projection increased $1/16"$.

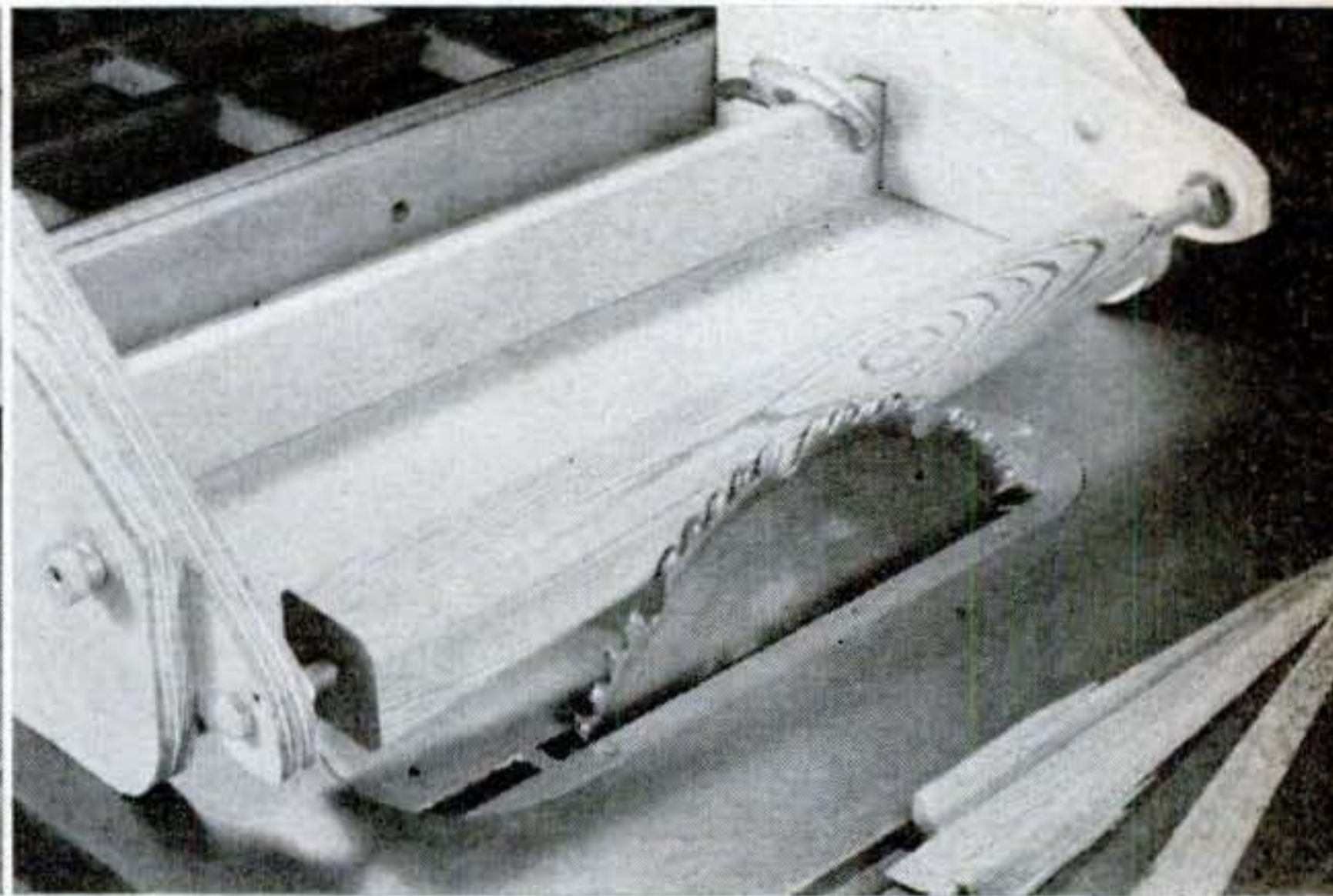
And just look at the other jobs you can do with the jig!



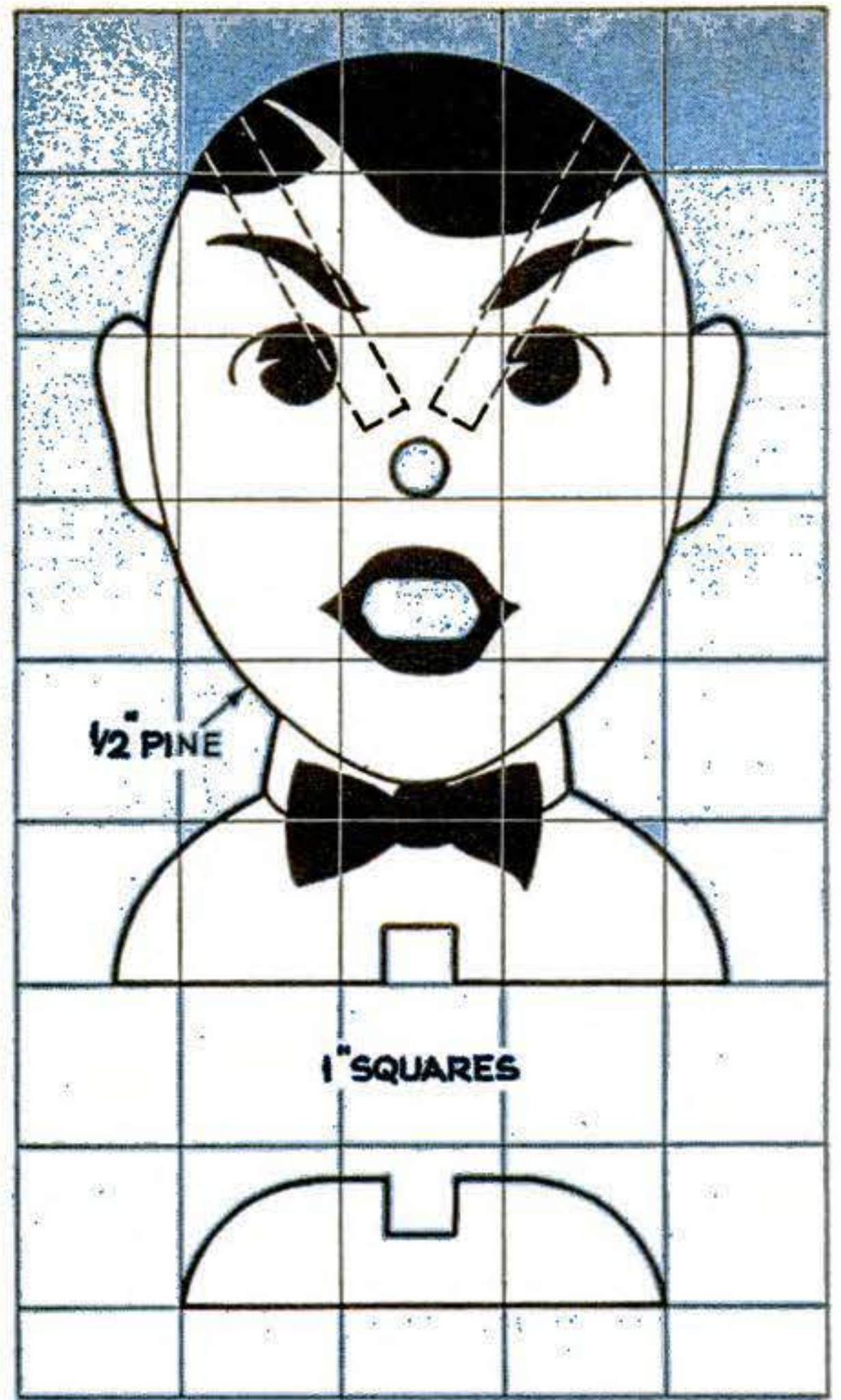
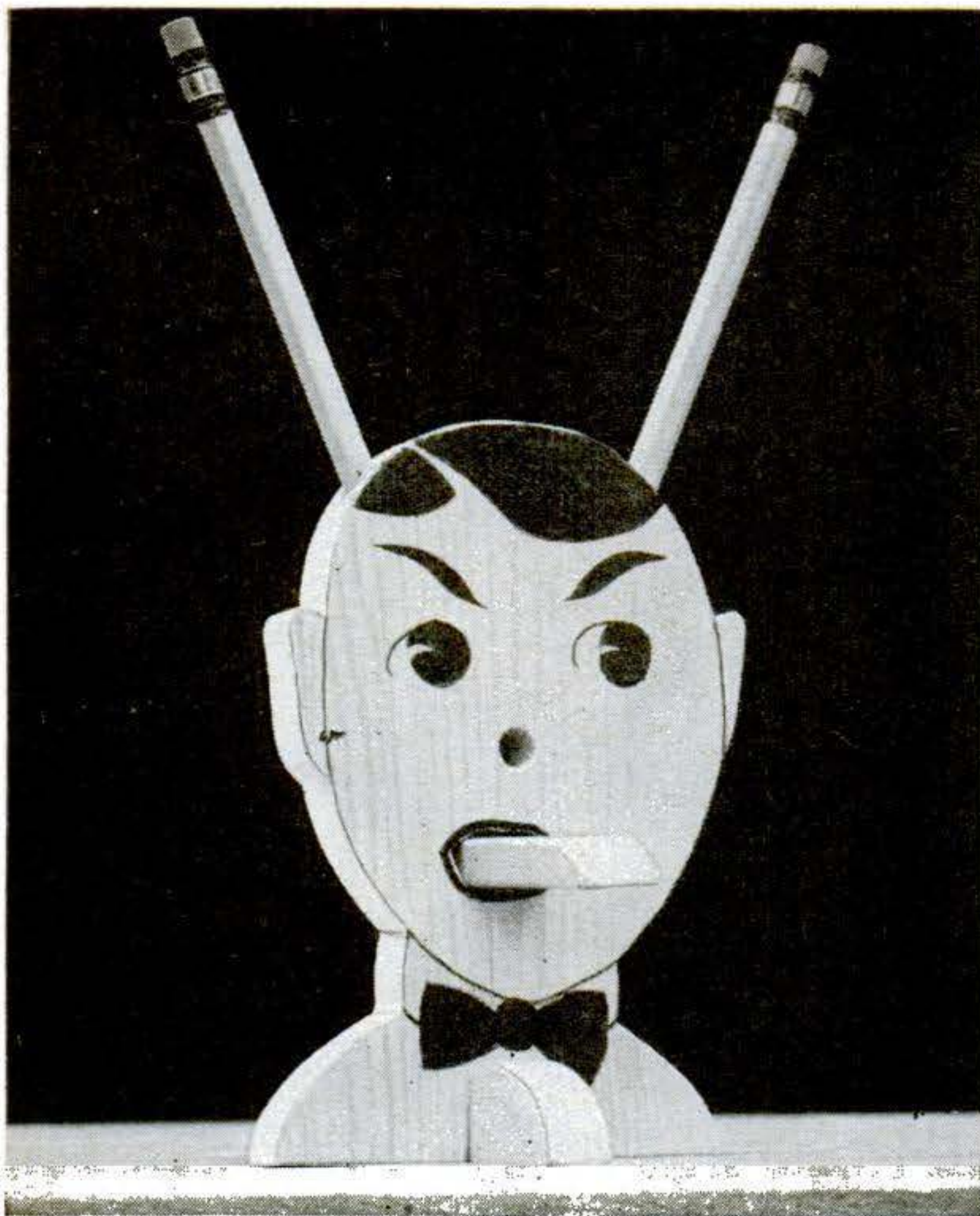
Even shaped lathework can be handled: Depth of cut is controlled by cutter projection and position of pivot arms. If your lathe has an indexing head, mark the stock before removing it.



Large diameters fit in the jig, as you see here. Faceted effect is result of small coving cuts made on the lathe followed by longitudinal cuts with the work mounted in the jig.

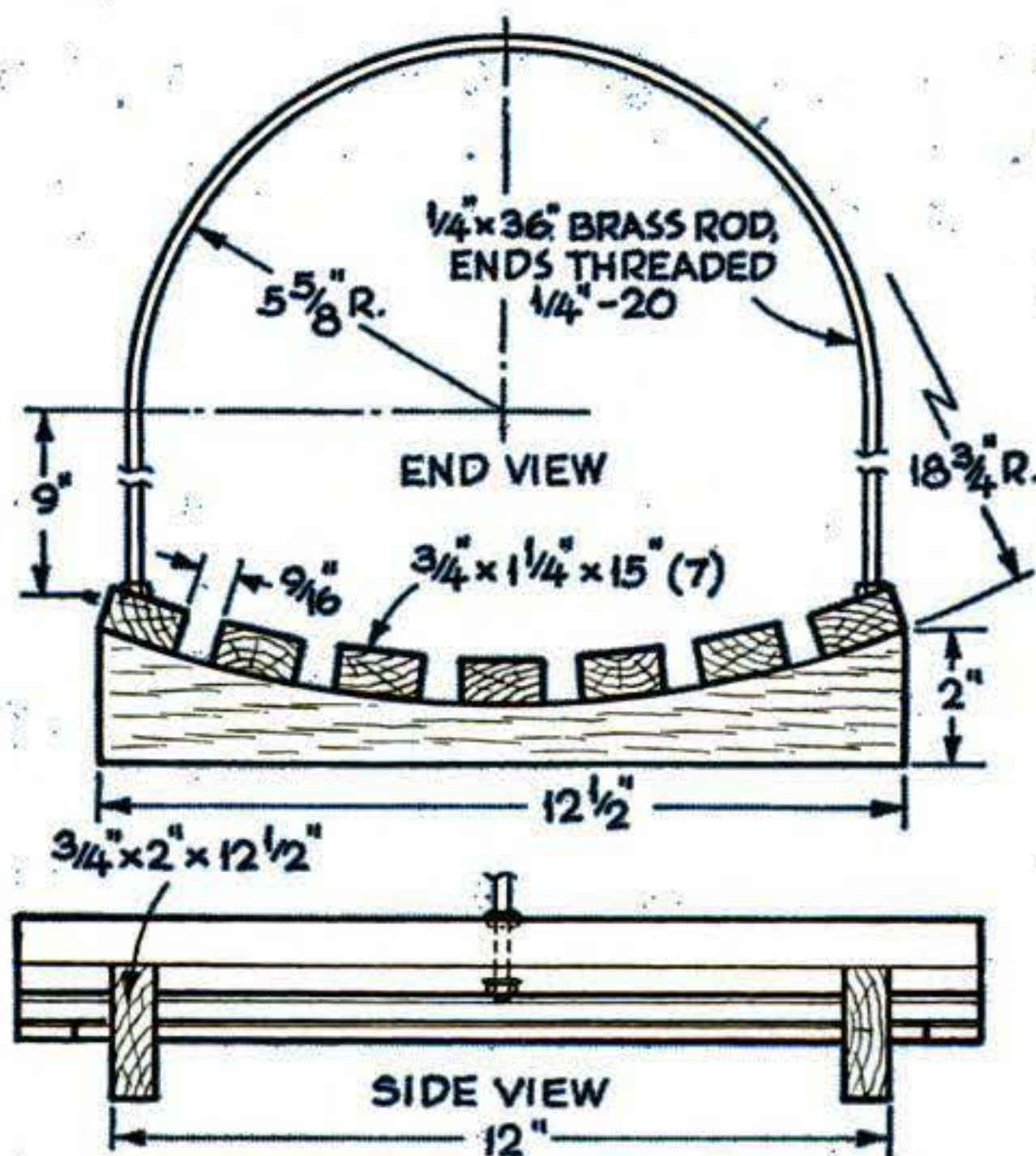
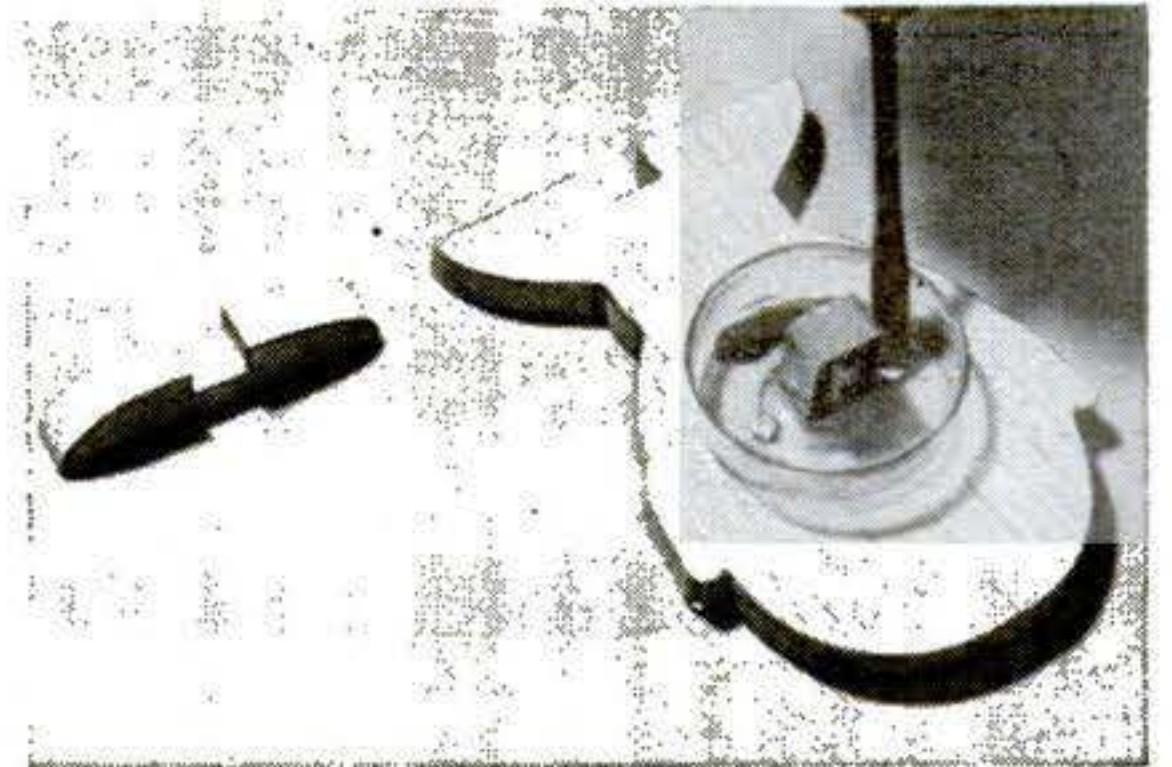


Offset the centers and you can "turn" a taper by making repeat passes with a regular saw blade. This is an ideal way to make multiple pieces for modern chair or table legs.



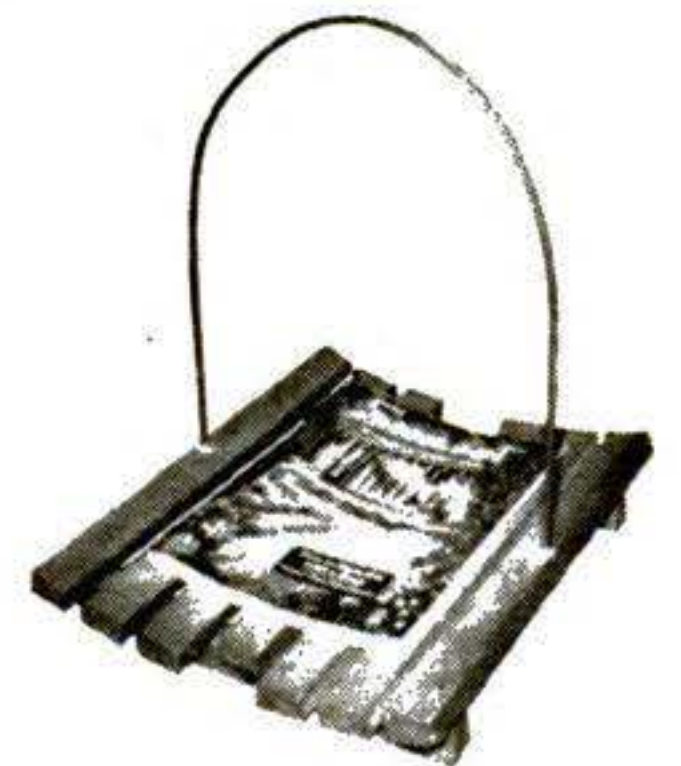
Desk set for a youngster

The devilish look of this homemade desk set ought to delight any child. It holds an eraser and two pencils or ballpoints; the nose is a pencil sharpener. Transfer the outline to a piece of pine or plywood. Before cutting the interlocking notches, make a trial cut on a piece of scrap to get width right. Screw a dime-store sharpener to the rear of the nose.—C. Sinapi, Flushing, N. Y.



Low-cost magazine rack for your home

Nominal cost and easy construction are the talking points for this magazine rack. I used pine to make mine, but anything in your scrap bin will do. The only cost may be the dollar or so for the $\frac{1}{4}$ \" brass rod with $\frac{1}{4}$ \"-20 threads cut on each end. For the sake of appearance, I preferred to cut the center slat 13\" instead of the 15\" indicated for all the others. Drill $\frac{17}{64}$ \" through the slat for the handle. Attach the slats with both glue and nails. Finish with a natural stain.—Ray Ayers, Oxnard, Calif.

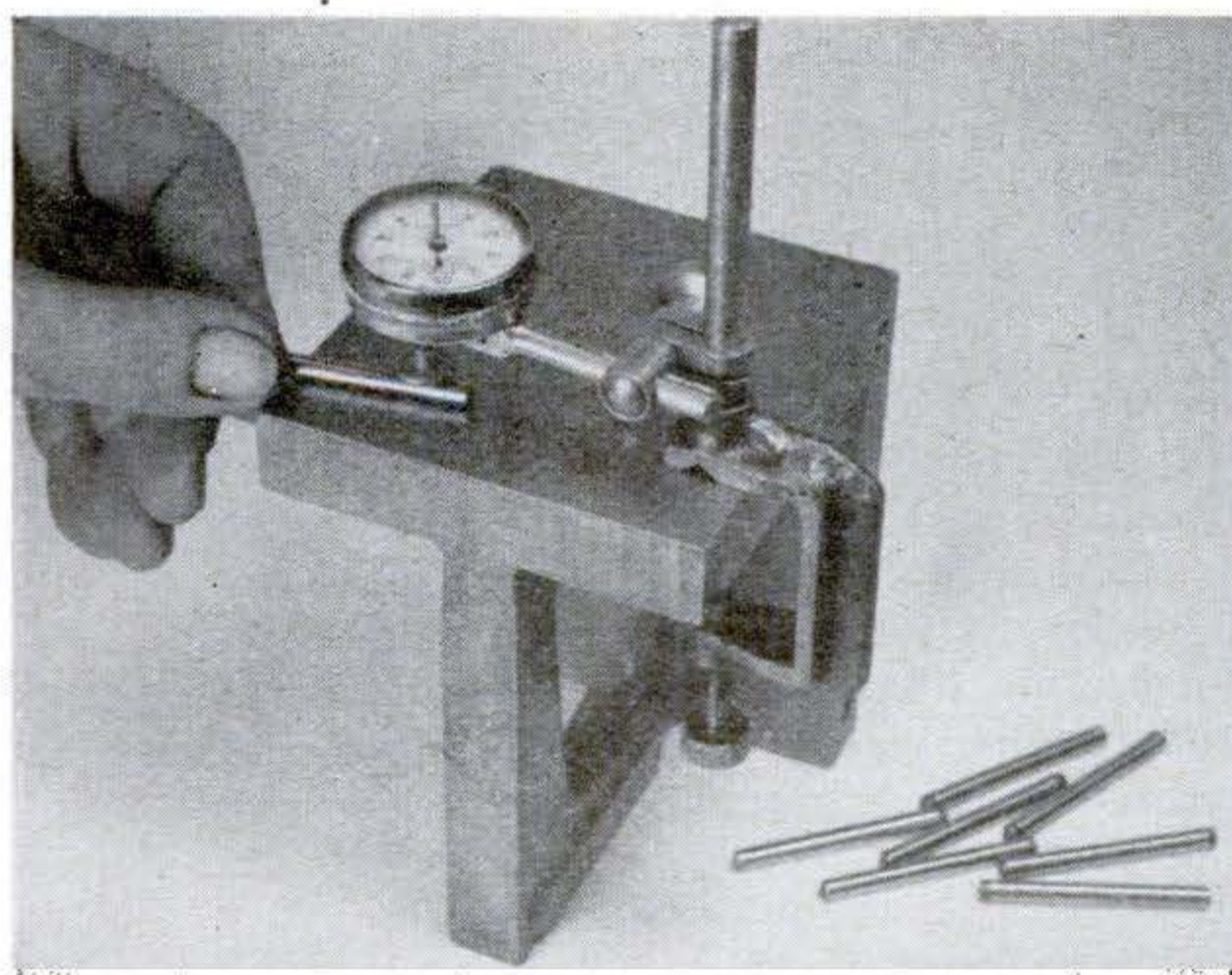
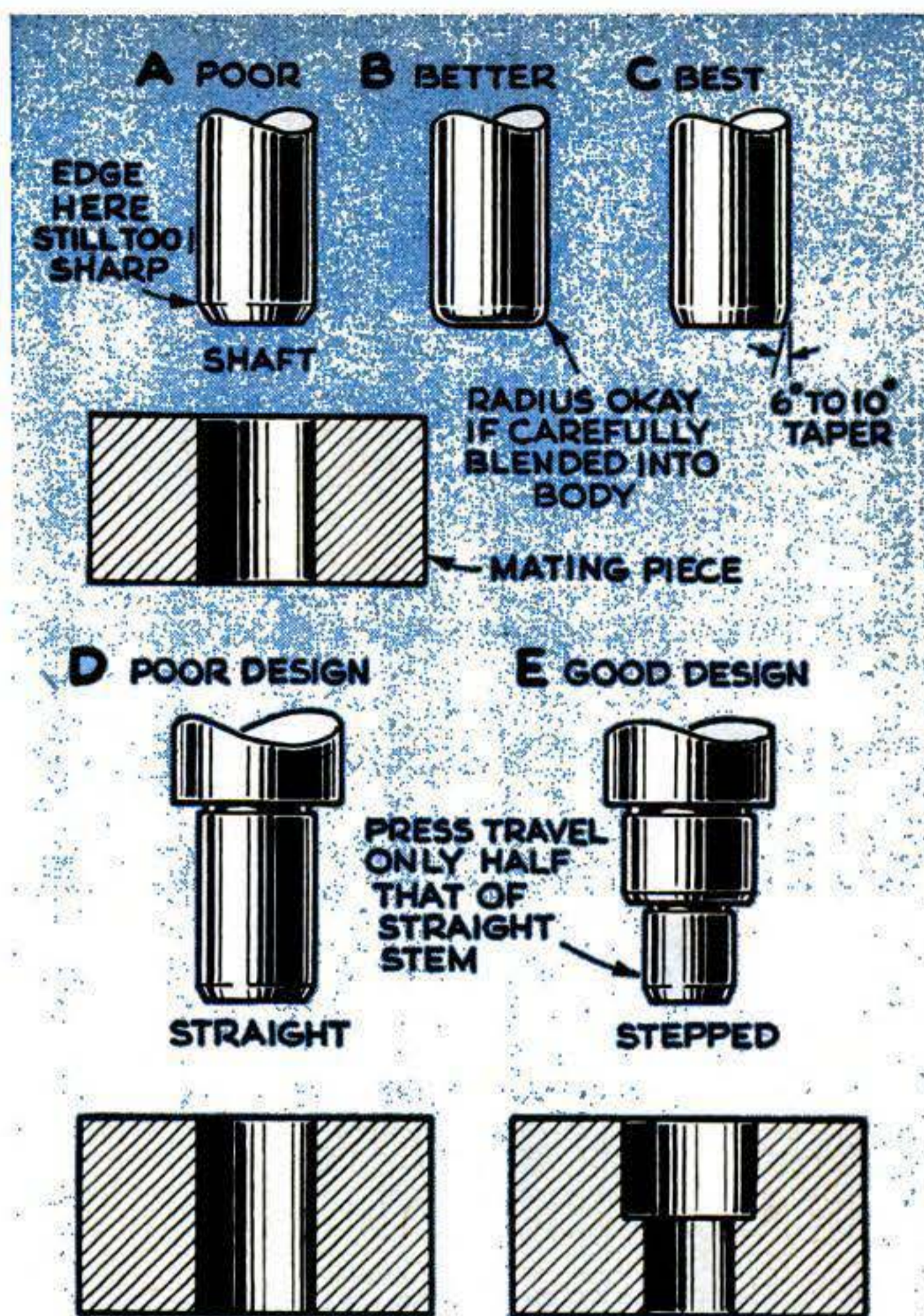


Secrets of a snug press-fit

It's the little things you do that make a successful press-fit. One common mistake is to leave the end of the male piece squared off. The sharp edge is difficult to start and will shear out the hole as it's driven through, making a loose fit.

A simple chamfer, as at A, provides little guidance for starting and may still shear the hole, especially if the piece is hardened. A radius, as at B, will usually prevent shearing, but also offers little help in alignment. A taper, as at C, is best. It gives you a good guide with no sharp edge. A length of $3/32''$ to $1/8''$ is sufficient for small stock, but increase this on larger work. Use a taper angle of 6 to 10 degrees.

On long stems, it's best to step the mating pieces, as shown at E. This way, the stem's travel is only half as far, and there is less chance of metal pickup, or galling, that often causes extreme binding before the stem is seated. A final caution: Always follow the force-fit tables in a machinist's handbook when planning the amount of oversize or interference.

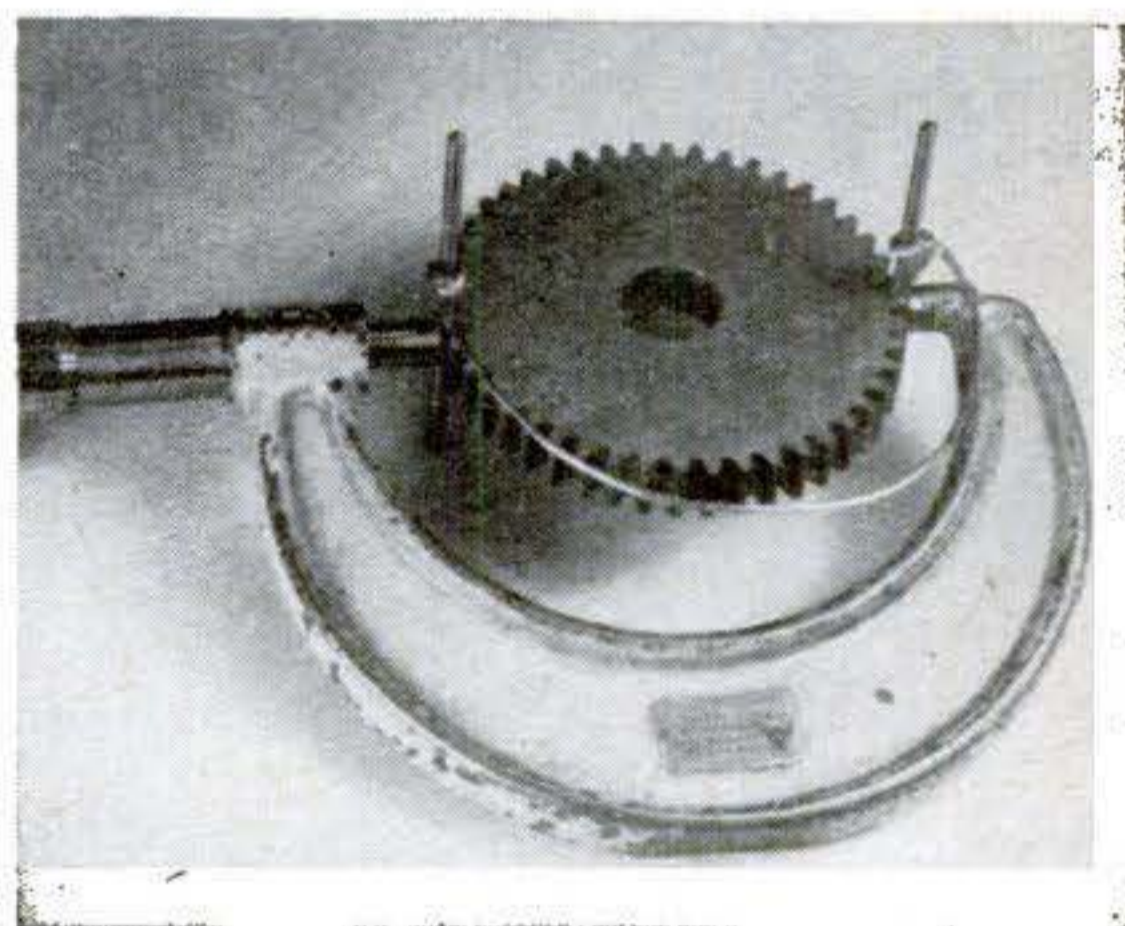


Dial indicator makes a quick inspection gauge

A dial indicator clamped to a small inspection angle plate makes a first-rate bench comparator for fast checking of small diameters. The indicator's height can be preset to provide the exact desired dimension. All you have to do is slide the work between its contact button and the plate to get an immediate reading of oversize or undersize in thousandths of an inch. The desired gap can be set with a precision gauge block or a piece of work of the correct size.

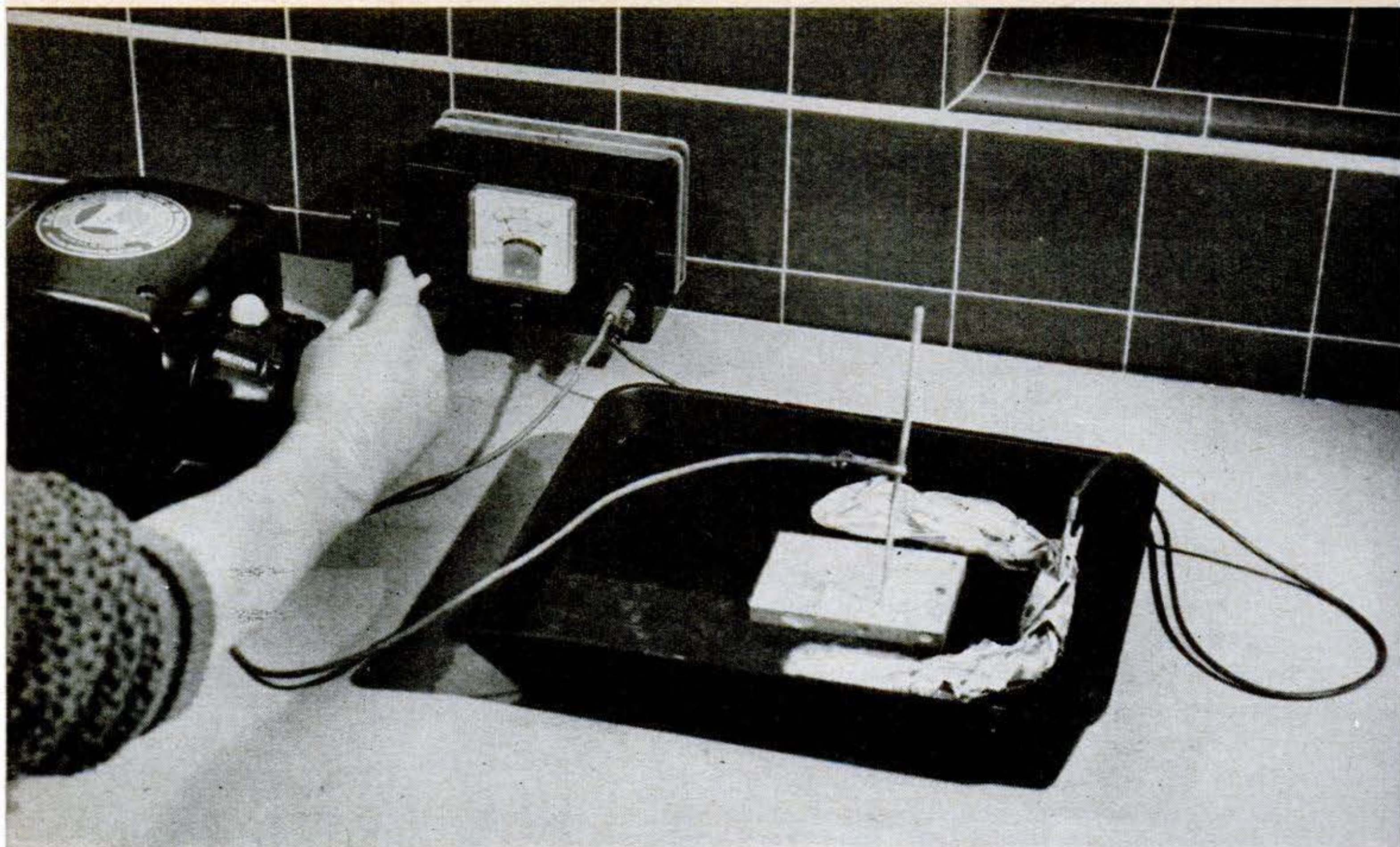
Metalworking Tips

By H. J. Gerber



Harness holds measuring wires

Measuring gear teeth with standard wire gauges is much easier if you connect the two wires on opposite sides of the gear with a simple harness of half-hard brass wire to help hold them in place. For repeated use, I usually solder the harness on, but tight loops around the wires will hold for temporary work.



PS METALWORKING

How to Anodize Aluminum

With this simple kitchen-table setup, you can reproduce those sparkling store-bought metallic finishes

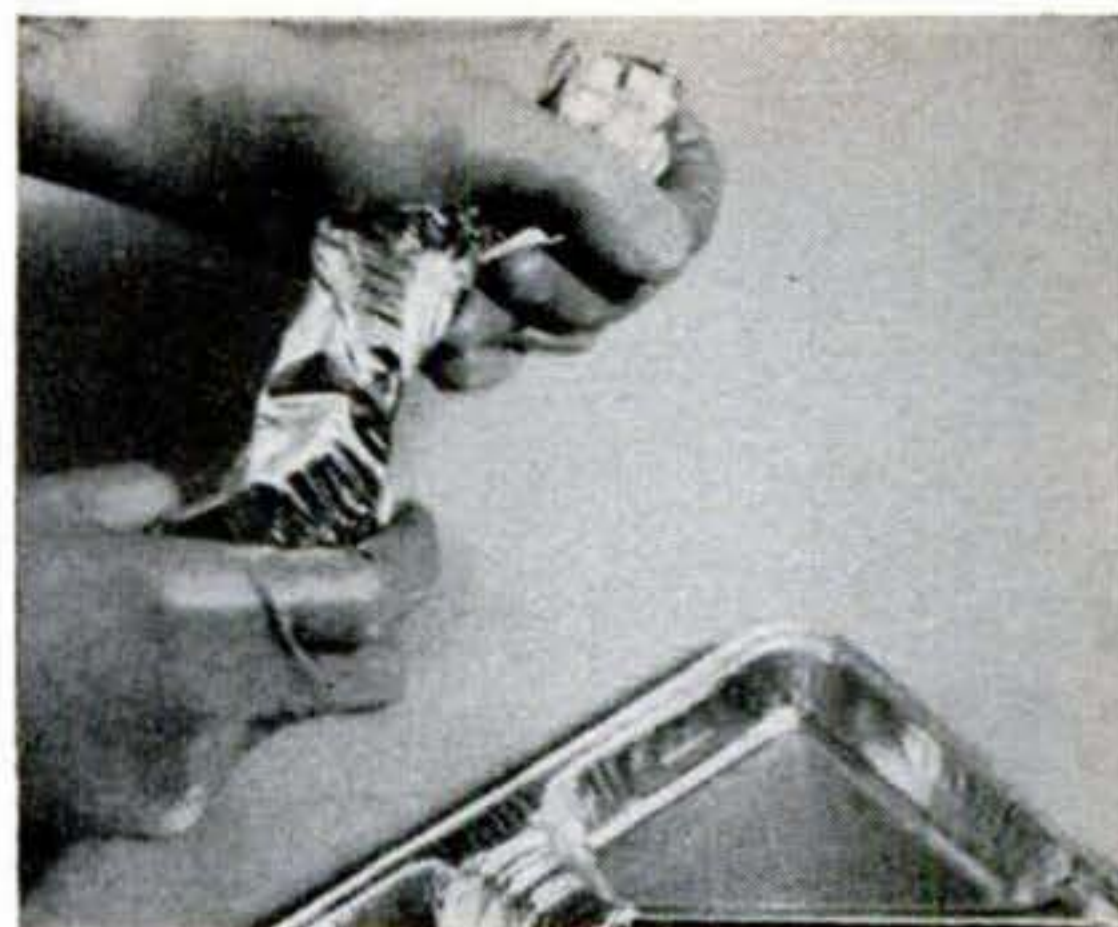
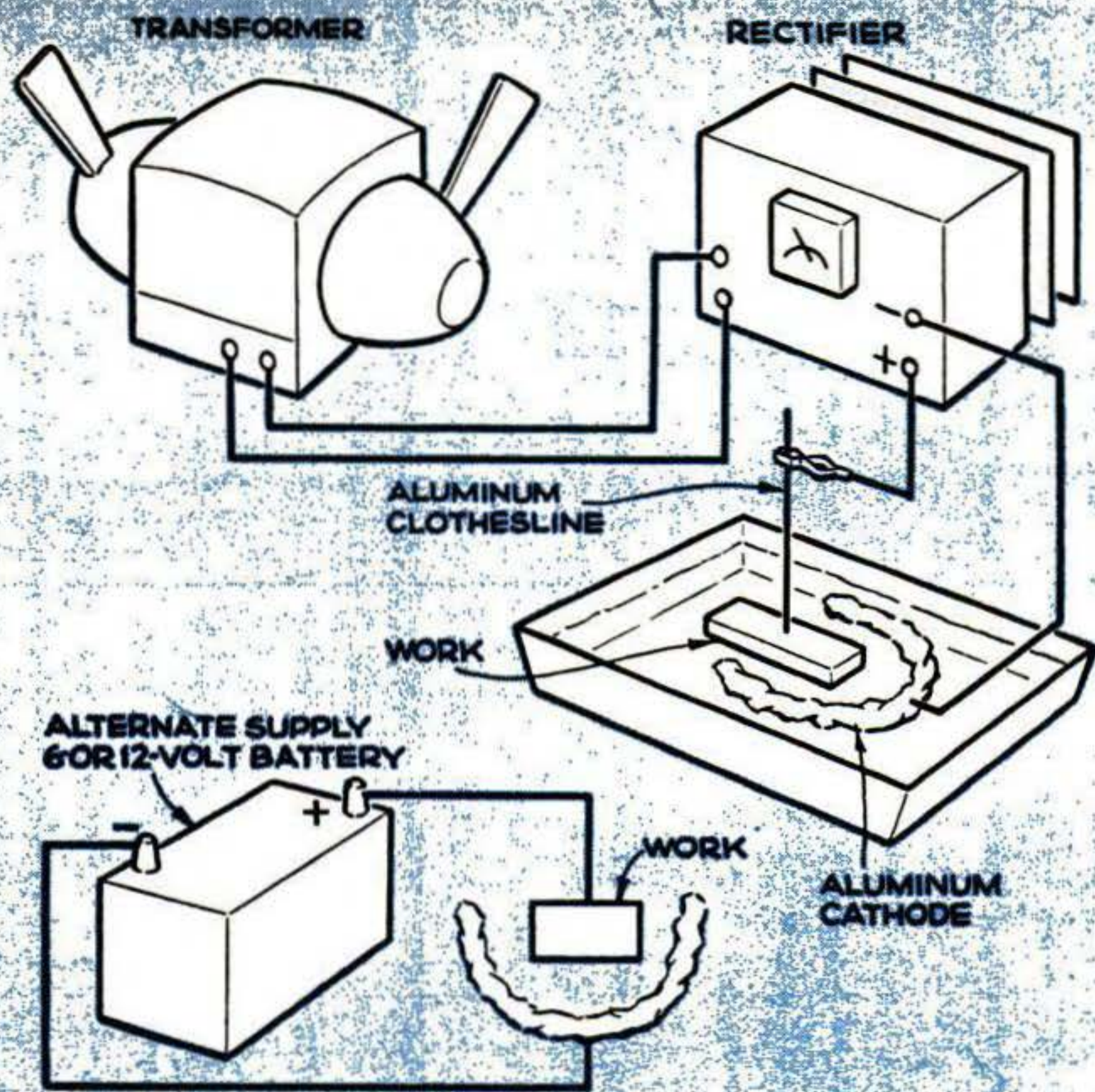
By Hank Stockert

THE deep, rich luster you've admired on manufactured aluminum articles can be duplicated right in your own basement or kitchen. The process, known as anodizing, requires only a few chemicals and a source of low-voltage direct current. You can use it to add spectacular finishes to your aluminum projects or to anodize existing articles that have no such finish. The anodized finish is attractive by itself on plain aluminum or can be made even more dazzling with colored dyes. The colors, chemically sealed into the metallic finish, can't chip or wear off as paint does.

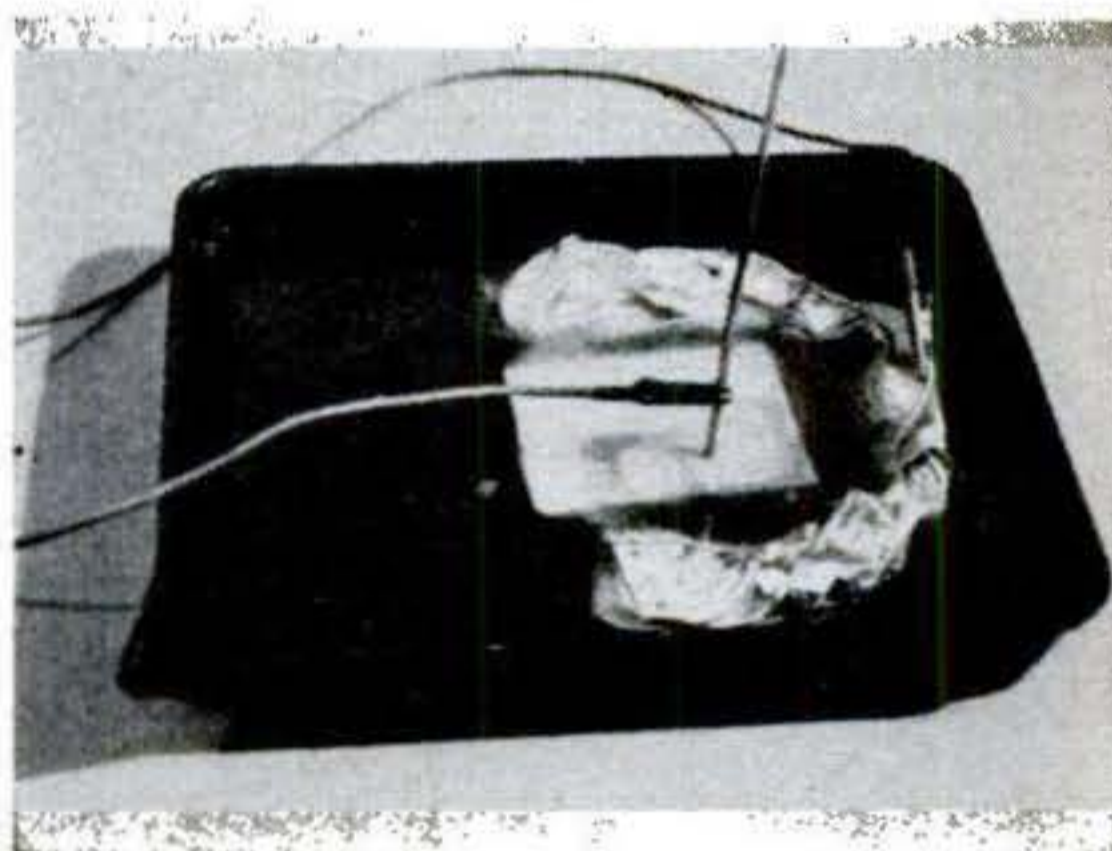
What anodizing does is convert the surface of aluminum into a form of aluminum oxide—a substance so tough that it's used in abrasive sanding papers. The aluminum is placed in an acid solution and an electric current passed through the acid. The electrolytic action releases oxygen that combines with the aluminum to form the aluminum oxide coating.

The process is similar to electroplating except that the object is connected to the anode, or *positive* post, of your power supply rather than the negative cathode as in electroplating. This is because you're modifying an existing metal instead of depositing a new metal on it.

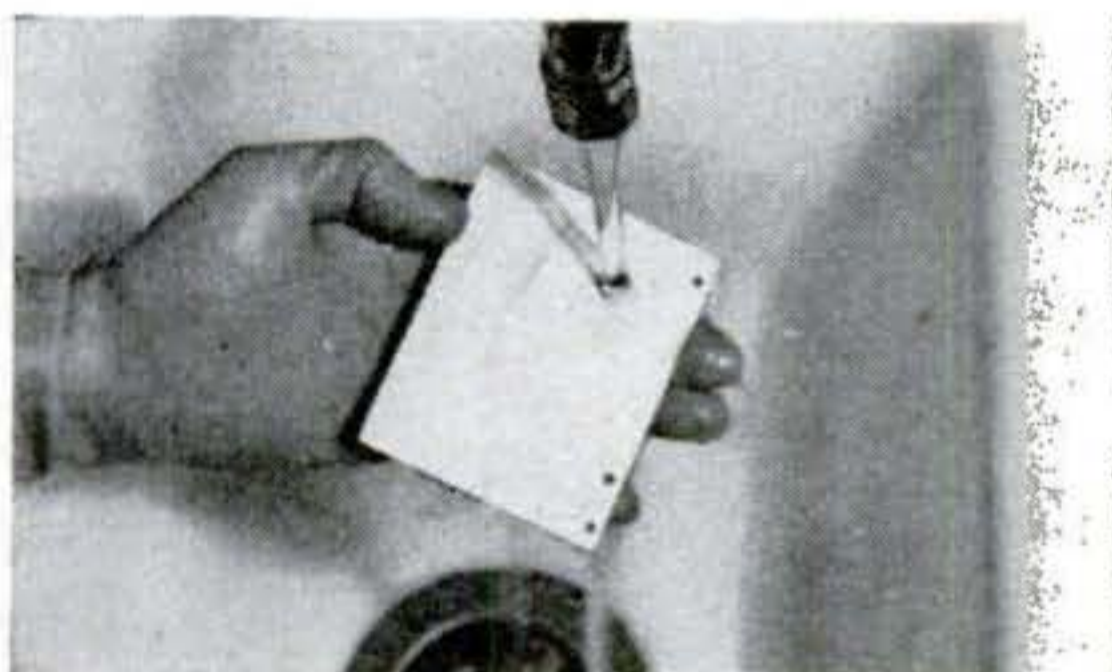
Because the aluminum oxide coating is thin, you can't expect it to hide surface defects. You'll have to remove tool marks and other imperfections before anodizing or they'll show up afterward. The coating's thinness does, however, have an advantage: It won't mask out fine detail.



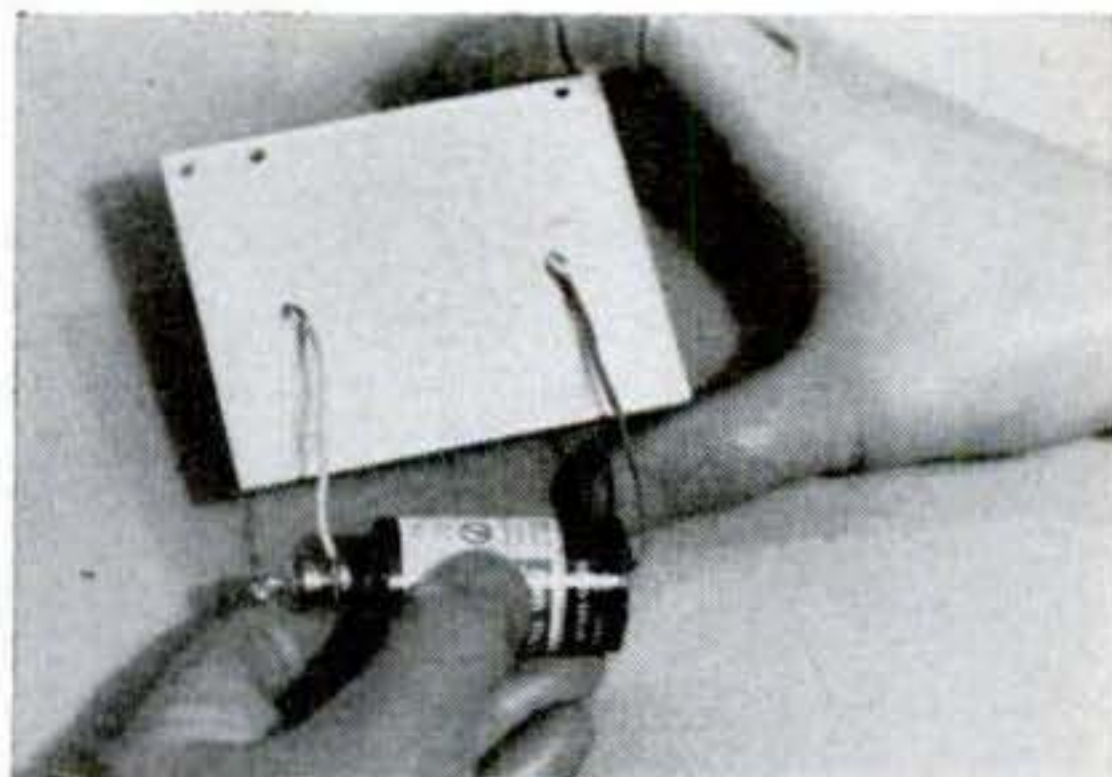
Aluminum trays from frozen dinners make an excellent cathode. Twist them into curved "sausages" and pierce holes in them to let gas escape.



Negative lead can clip directly to the cathode where it protrudes above the solution. Positive lead goes to short length of aluminum clothesline.



Rinse your work thoroughly under running water between the steps. Wearing rubber gloves is important to keep fingerprints from marring the finish.



Quick test for anodizing: Bulb soldered to a flashlight battery, with leads touching the coating, will not light if the anodizing is complete.

What you need. While the pros use many types of acid baths, all you really need is a sulfuric-acid solution of about 15 percent acid by weight. If you use commercial-grade acid, you can measure the volume of water needed to cover the work and divide this by eight to determine the volume of acid to pour in.

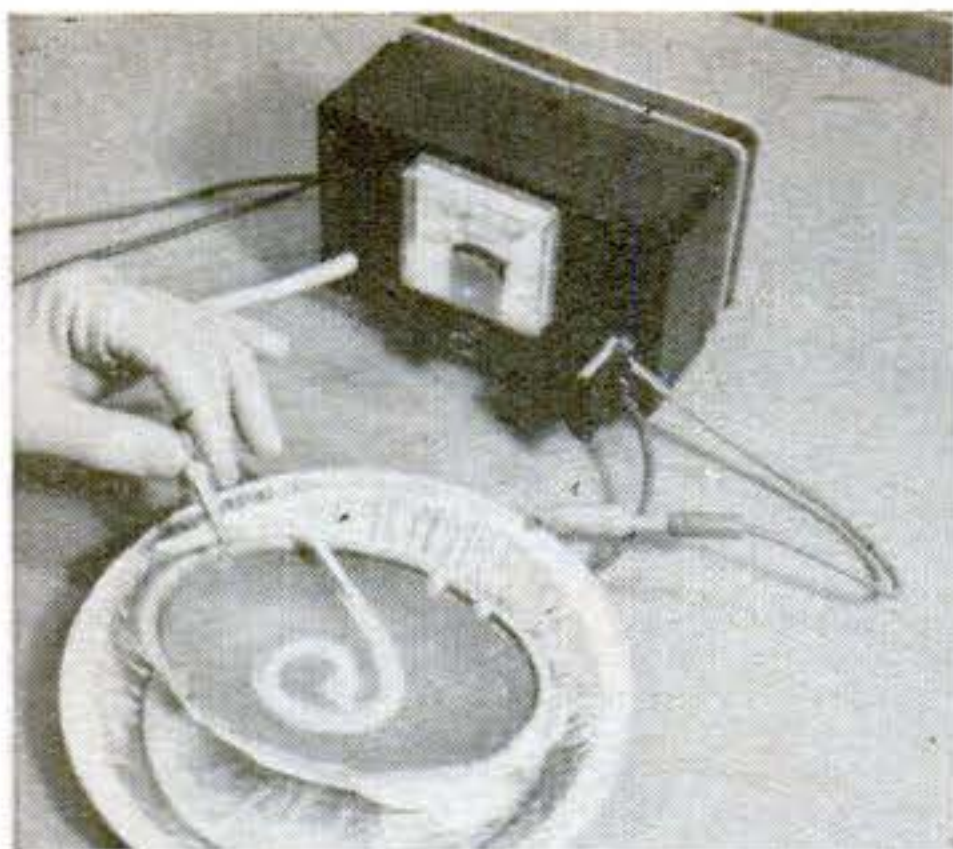
Always pour the acid slowly into water—never the other way around. (Water poured into acid boils at an explosive rate.) The resulting bath should be treated with the same respect as your car's battery acid. Many old hands recommend goggles.

You'll need a container large enough to let the acid completely cover the work. It must be nonmetallic and not affected by sulfuric acid. A plastic dishpan or photo tray are useful. For large objects, a glass fish tank is a good bet.

Your power supply can be anything that delivers low-voltage DC. Voltage and current requirements aren't critical. A battery charger such as the one shown in *POPULAR SCIENCE* in May, 1962 (page 160), is easy to use. A DC power pack for model trains or an AC train transformer combined with a rectifier will also work fine. You can even use a car battery.

The terminals of most power supplies are clearly marked positive and negative so you can be sure of connecting your work to the positive side. If you should use one that isn't marked, try it with the wires hooked up one way; if no anodizing results, reverse the connections.

Setting up the rig. Everything that enters the anodizing bath must be aluminum: the work with a



"Inside-out" setup lets you coat only inside of bowls like this ash tray. Fill bowl with acid and drop cathode into it.



Black shoe dye, unlike other dyes, can be swabbed on cold. Let dry overnight, suspend over boiling water for an hour.



Finished ash tray, dyed black on the inside, provides a striking contrast with plain aluminum outside.

wire leading to it and the cathode and its wire. Aluminum clothesline is an excellent conductor. Hook the work on the line and change its position a few times during anodizing to insure an even coat.

The aluminum cathode should have a surface area greater than the work. Crumple up one or two aluminum TV-dinner trays and form them, if possible, into a U shape to fit around the work. (Anodizing goes a little faster if the cathode surrounds the work.) If the cathode projects above the solution, you can clip the negative power-supply lead directly to it at that point. If it doesn't, twist the crumpled trays around a length of aluminum clothesline. A rubber band will keep the trays touching the line as they are eaten away.

Before immersing the object in the bath, clean it thoroughly with acetone or lacquer thinner. Use rubber gloves whenever handling it. When you turn on the current, you'll notice that there are more bubbles coming from the aluminum foil than from your project. This is normal. Let the process work for about 30 minutes. The acid solution will heat up but should not reach boiling, or you're overloading your power supply.

How to tell if it's good. You can use one of the properties of an anodized film to tell you when the process is complete. A sound film acts as an electrical insulator.

Use a low-resistance ohmmeter or a flashlight battery and bulb in series with a pair of rounded-tip test probes. Remove the work, rinse it in warm water, and allow it to dry. Sample the surface in several spots with your test probes to see if any current flows across the film. Try corners and areas that were farthest from the cathode. A high resistance reading (or an

unlit bulb) means your job is done. Otherwise, continue anodizing for a while.

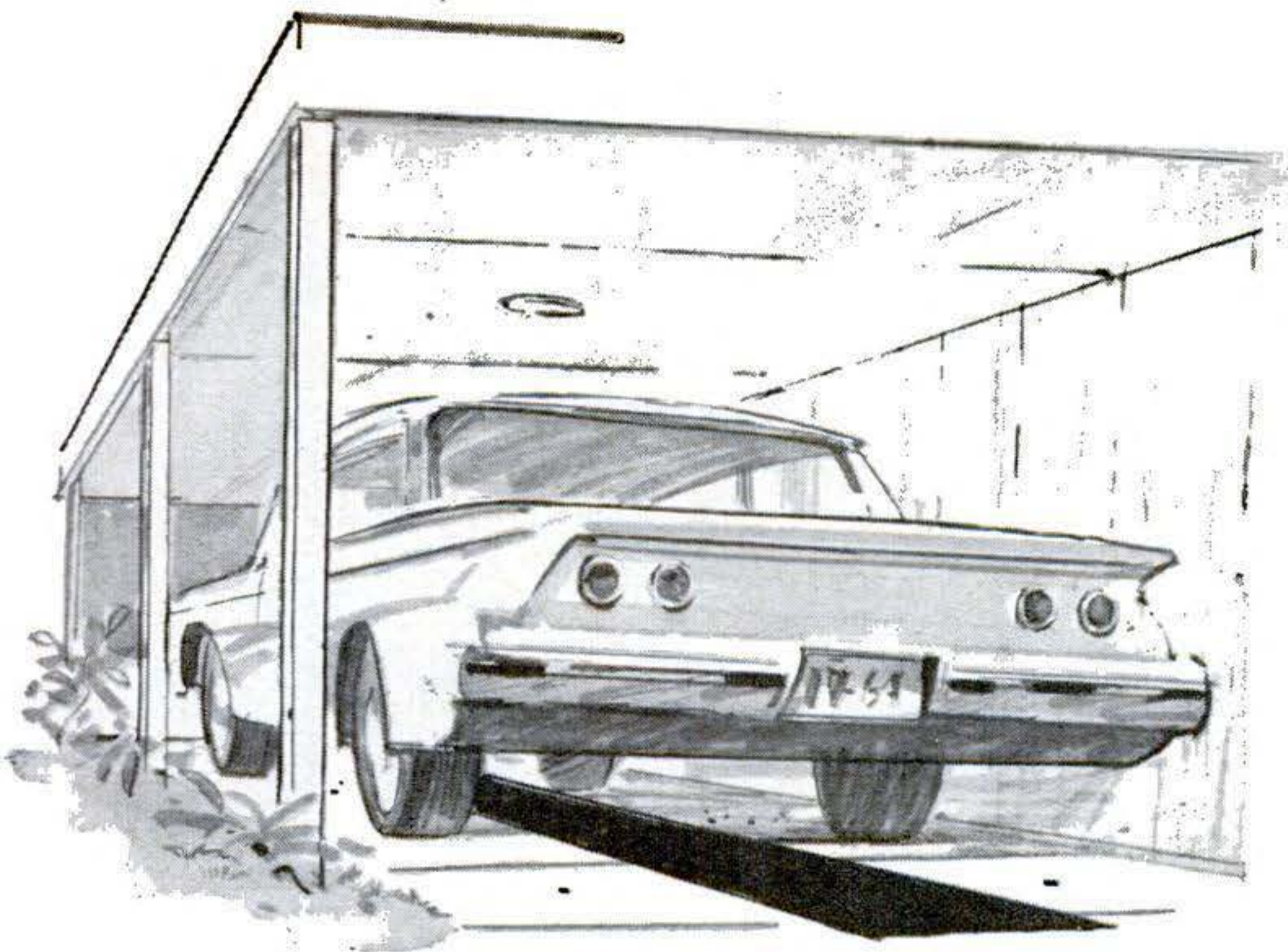
Adding the color. After the work has been carefully rinsed in cool water, it may be dropped into a boiling dye solution. Boil until you get the tint you desire. Maximum color will probably be reached in about one hour.

Time was when you could use household dyes, but manufacturers have been adding various fabric and water conditioners that make them risky for anodizing. The pros use coal-tar dyes. These can be obtained at chemical-supply houses and can generally be ordered through drug stores. You can also try common household materials such as black liquid shoe dye (which gives a beautifully deep black), colored inks, and food colorings. Where possible, it's best to color a few anodized test scraps first to see what you're going to get.

Sealing in the color. When you boiled your aluminum in the dye, you filled the pores of the aluminum oxide with dye. To keep the dye inside permanently, you need to seal the pores.

Take the freshly dyed and rinsed work and dunk it for about 15 minutes in a boiling solution of two ounces of nickel acetate to a quart of water. Follow this with a rinse and then transfer the project into boiling water for about 45 minutes to seal the surface. A final buffing will bring the coating to a deep luster. You can finish off with a light waxing.

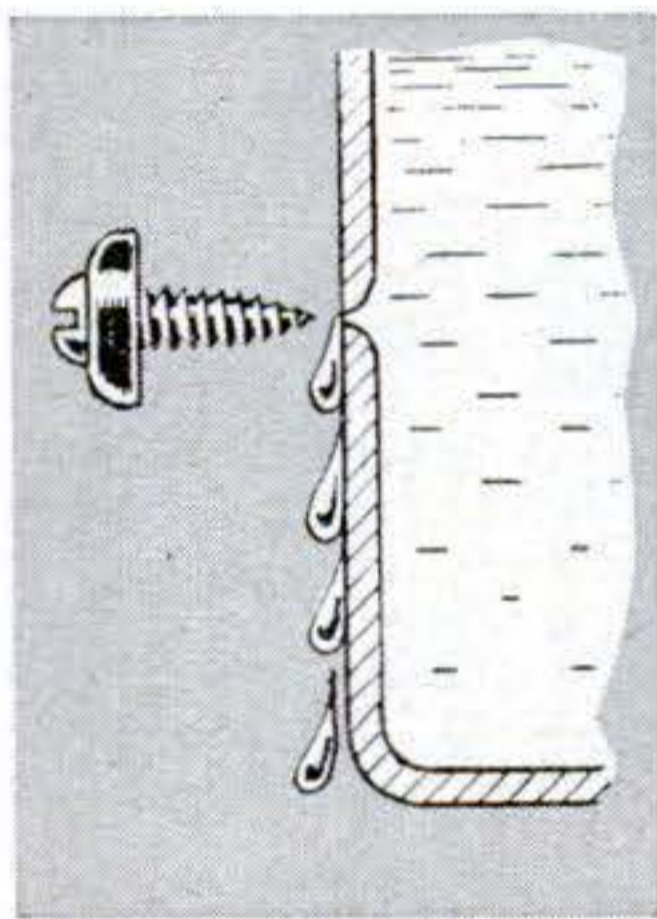
If you're after a prominent matte finish, you can etch the aluminum before anodizing. Immerse it in a solution of six to eight ounces of household lye to a gallon of water. Check it now and then and remove and rinse it when it reaches the desired surface texture. ■ ■



Camouflage trick hides oil drips from his car

The pans and mats used to catch dripping car oil are just as ugly as the oil itself, especially in an open car port. I solved the problem by painting a 2'-wide black stripe down the center of the floor. It hides the drips, looks trim, even helps me park accurately.—*Stephen N. Stresnic, Ft. Lauderdale, Fla.*

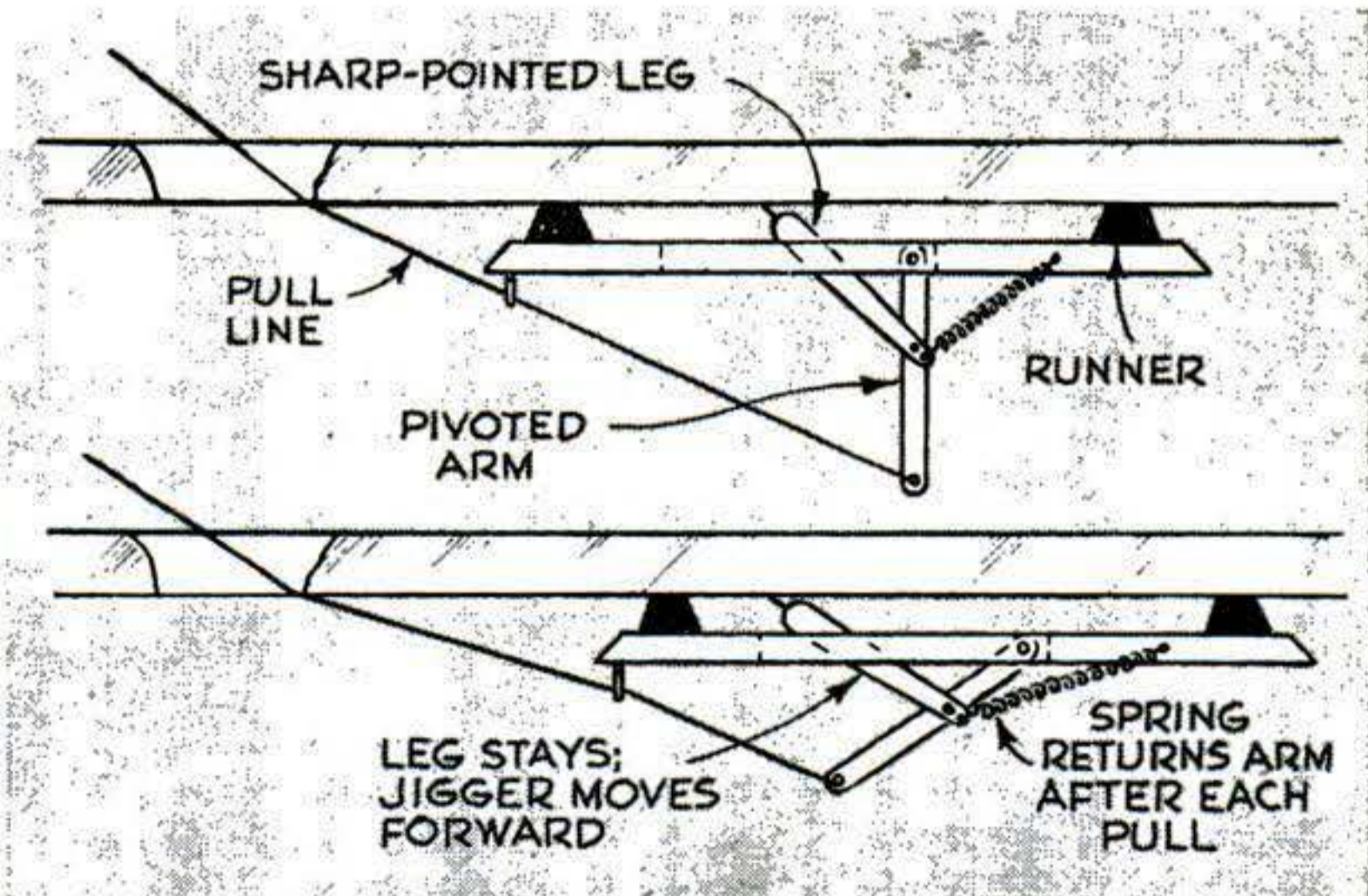
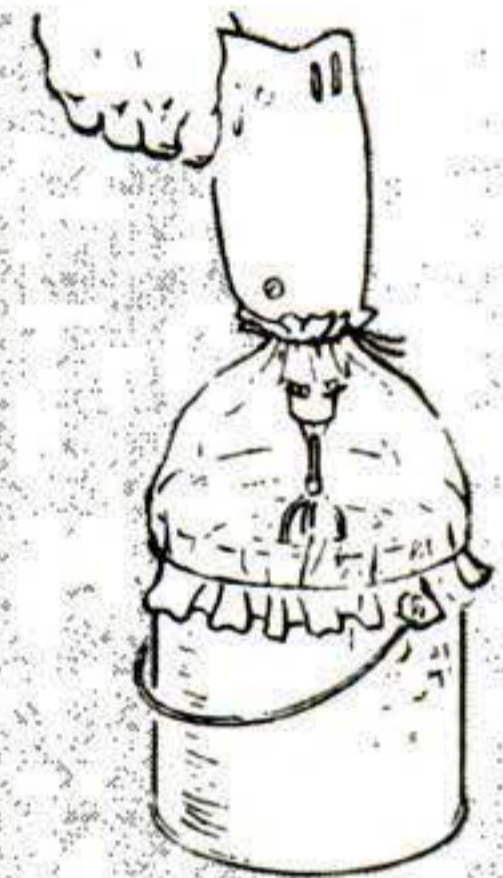
Quick repair for a leaky water tank



A faucet washer and a self-tapping screw make a handy plug for small corrosion leaks that develop in hot-water tanks. And catching the holes while they're small saves installing regular plugs later.—*A. Weber, Edmonton, Alberta.*

Spray shield for a power paint mixer

A paint mixer used in an electric drill sometimes slings paint all over the place if you aren't careful. A hood made from a plastic food bag will catch spatters. Tie the bag around the paint can and the drill.—*Ernest Guerra Jr., San Antonio.*



How to net fish under the ice

Ice fishermen everywhere could use an ingenious device developed in Canada for stretching a fish net under ice. Called a prairie jigger, it's a slotted plank 7½' long with metal tabs for runners and a lever-

actuated leg that jabs into the ice as shown at left. The jigger is inserted through a hole with a line tied to the lever. Each tug on the lever causes the leg to push the plank ahead, pulling the net behind it. The jigger can scoot along at a rate of 100' a minute—and that's no fish story.

Four Special Jobs for a Saber Saw

Attachments give you extra value from this useful tool

By Walter E. Burton

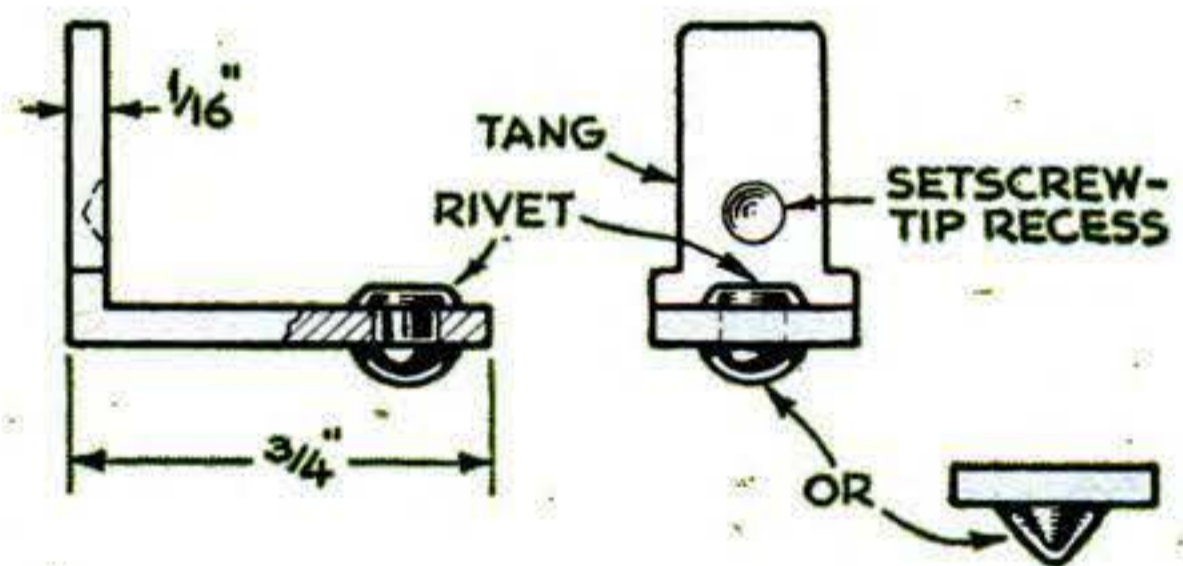


2 peening metal

A HAMMERLIKE tool made from $1/16$ " steel produces a "hammered" finish on soft aluminum, zinc, etc. The photos at right show how it was used topeen a design on a square of 0.007" sheet brass, softened by heating to dull redness and cooling in water.

A shallow recess was drilled in the tang to receive the end of one of the two opposed setscrews in the chuck. The round head of a $3/8$ " iron rivet in the projecting part of the hammer acts as a peen. For prolonged service, this head could be case-hardened.

The slipper-plate opening of the saw



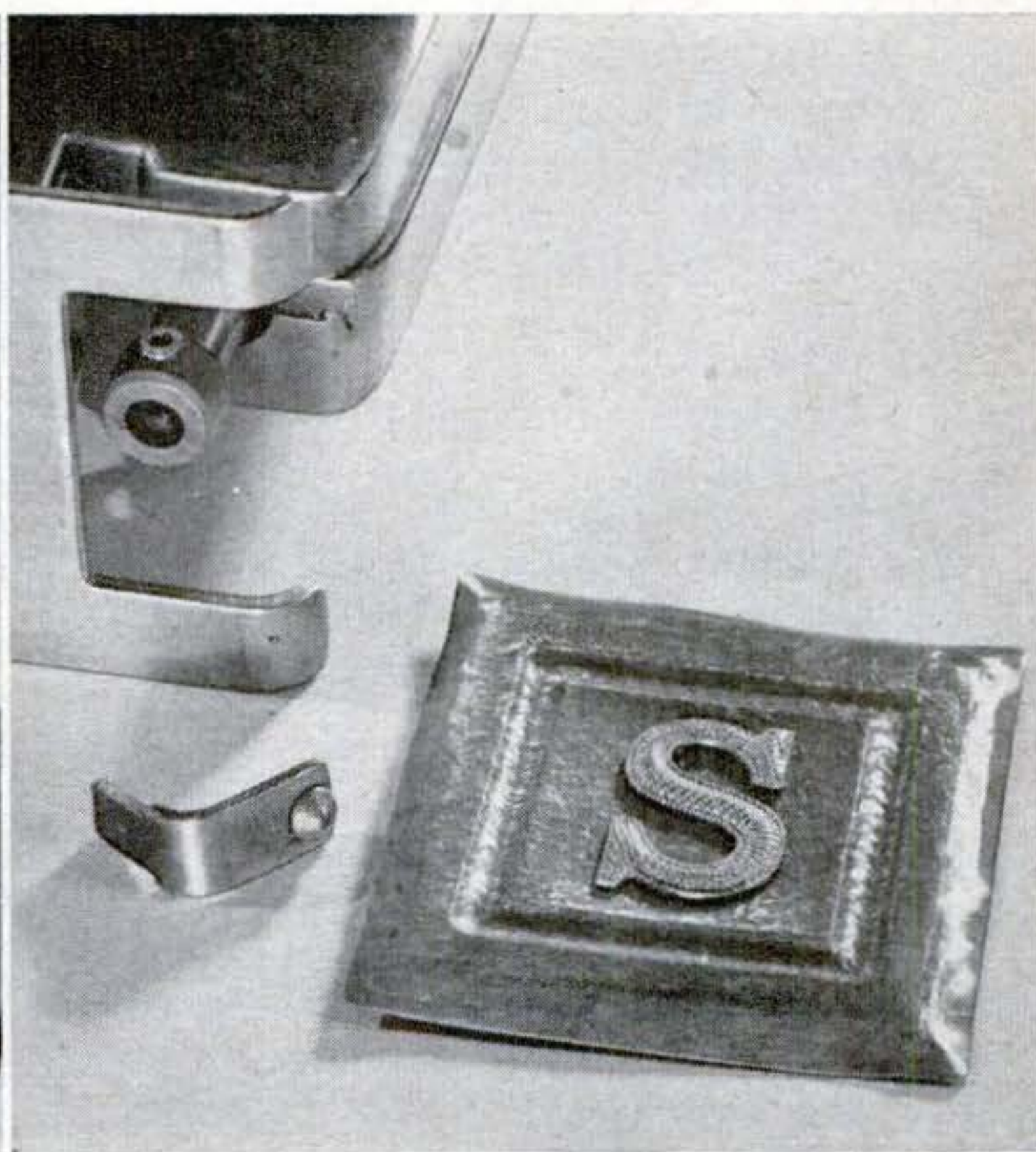
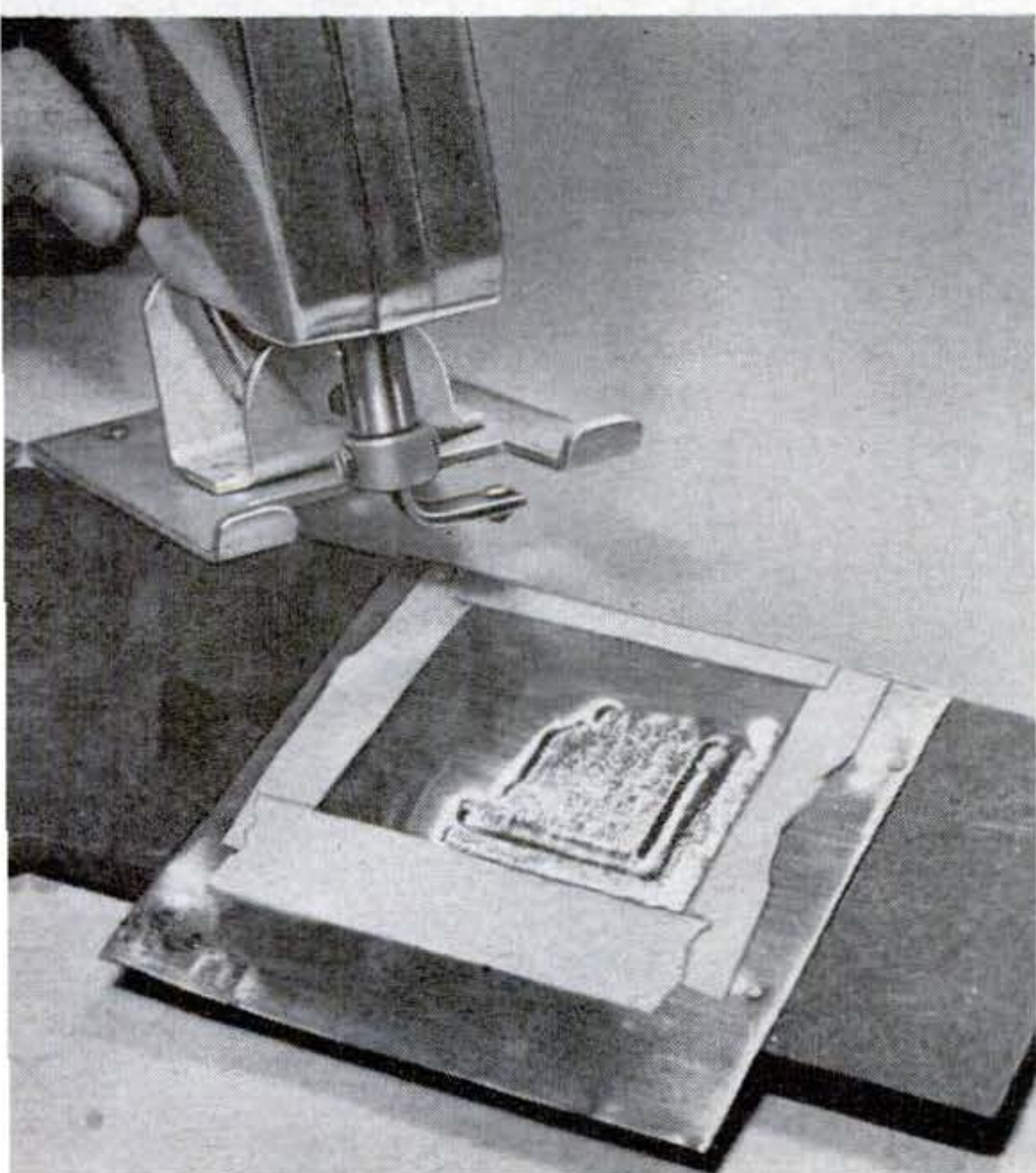
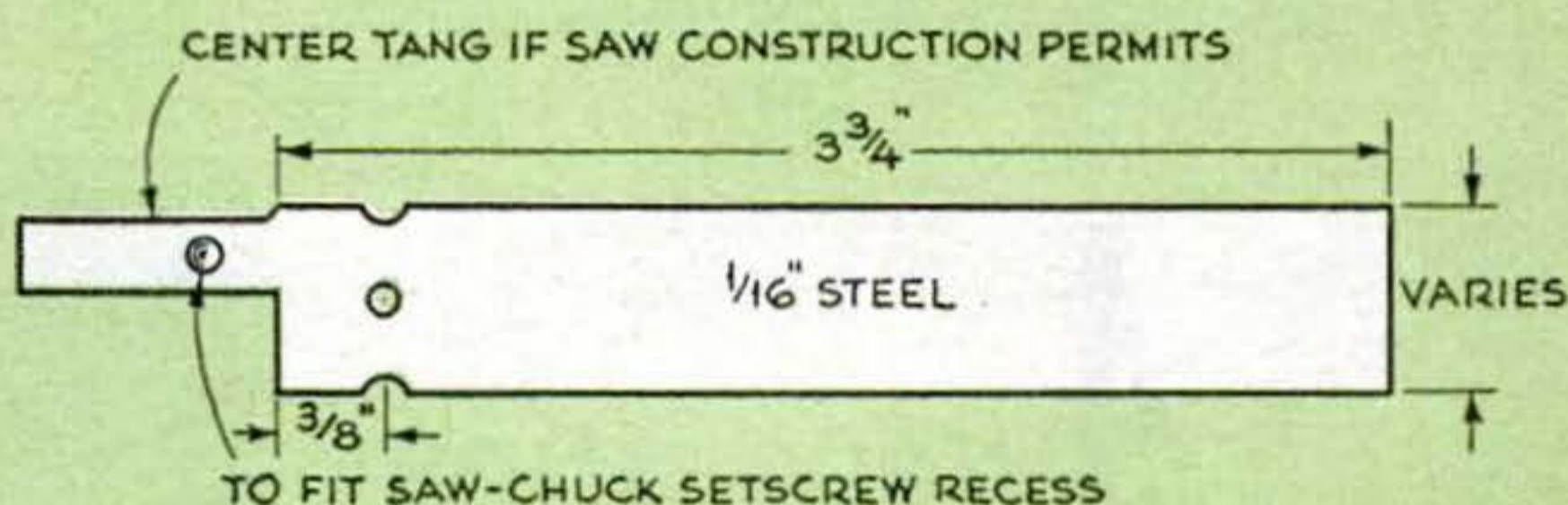
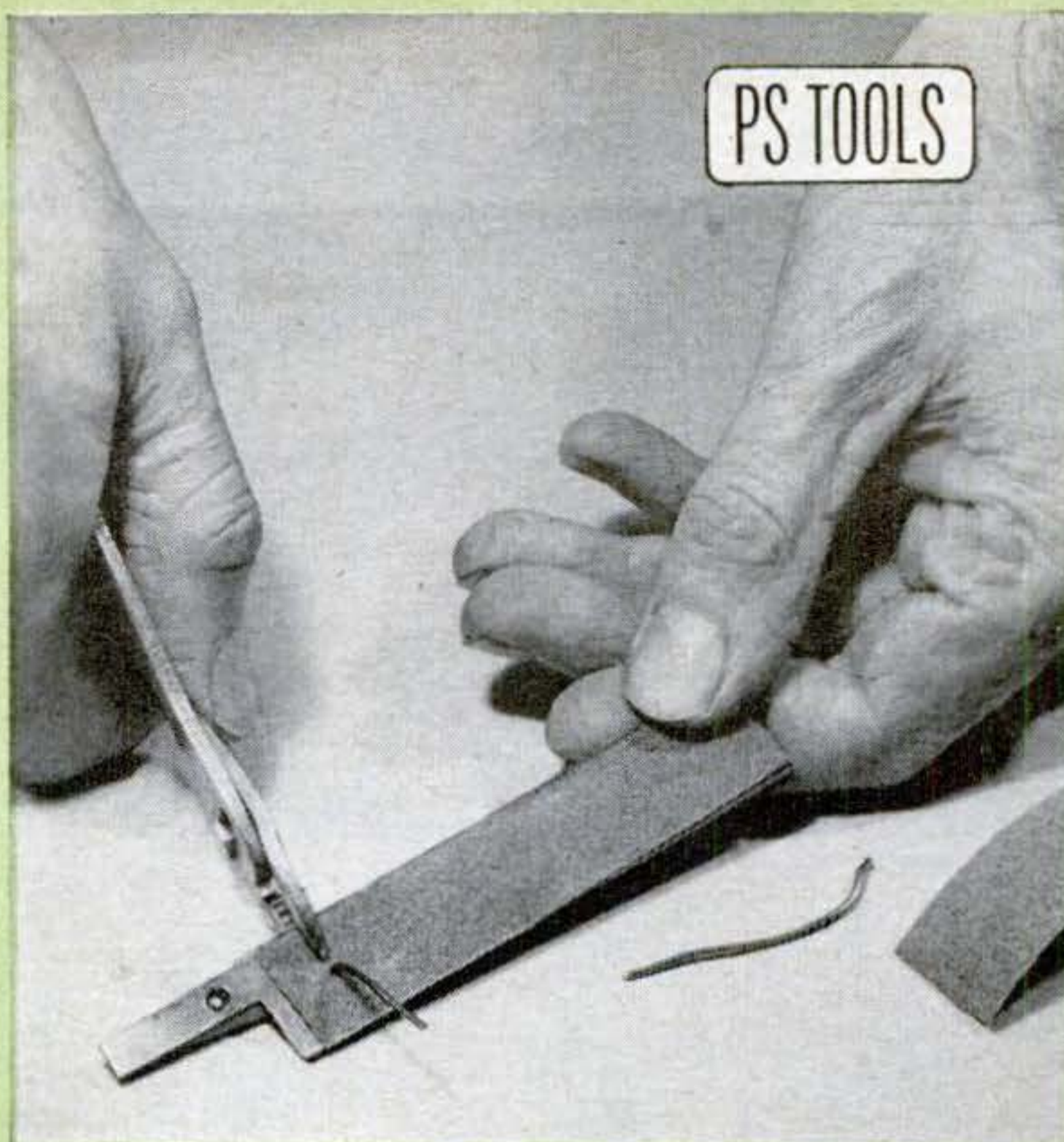
used lets the hammer extend about $3/4$ " to one side of the chuck. This gives some resiliency. Because the rivet head projects a bit beyond the plate in the down position, the plate is held slightly above the work.

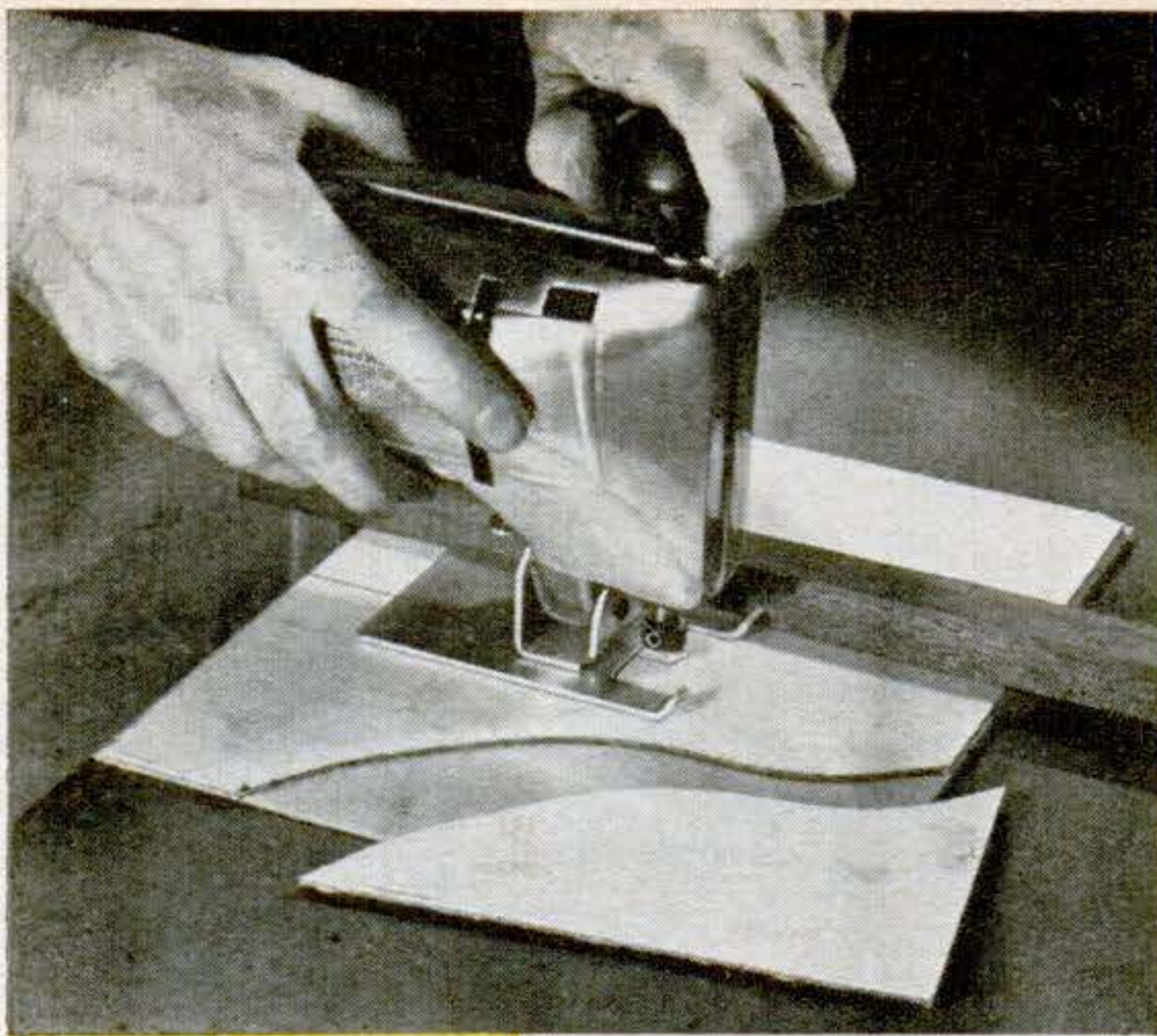
In the photos, the saber-saw hammer was used to force metal into a groove routed in hardboard backing. The metal later was stiffened by applying Plastic Steel to the back.

1 sanding and polishing

A VERY useful attachment for special sanding jobs was made by wrapping abrasive cloth around a piece of $1/16''$ steel shaped as shown. The tang is off center to clear the slipper plate. Notches and the hole near the tang accommodate soft iron or copper wire that laces the abrasive to the blade. A strip of abrasive is cut to the width of the sanding blade and twice its length, exclusive of the tang.

In using the sander to smooth the slots of a wood grille, as shown in the photo at left, it's best to insert the bar before starting the saw—or its end may mar the wood. Work with little or no pressure, the abrasive surface just touching the wood.

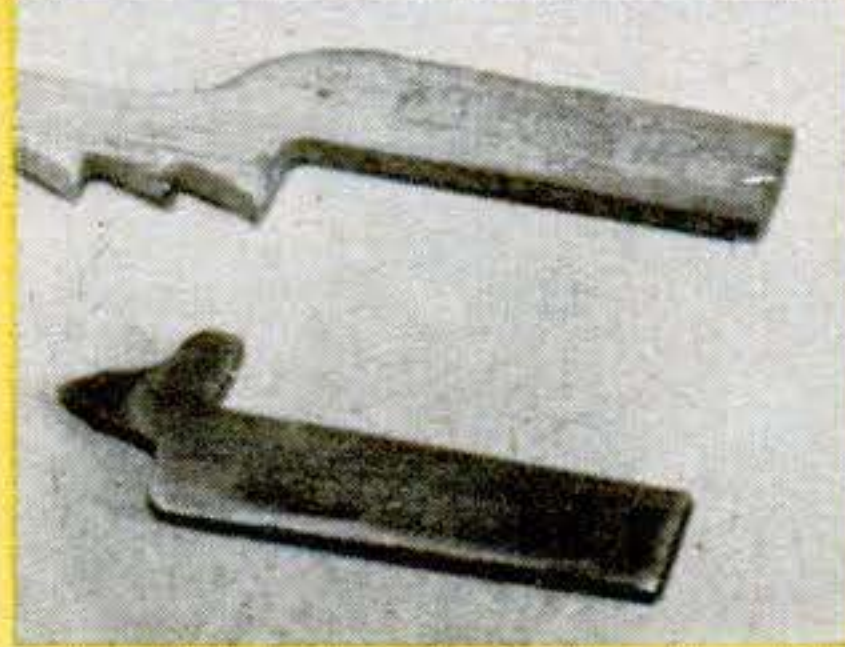
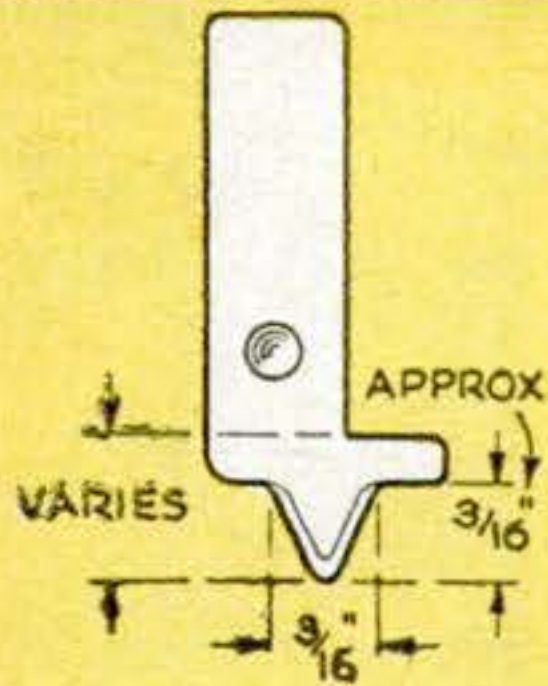




3 cutting linoleum and cardboard

A SPEAR-POINT chisel ground from a worn saw blade makes clean cuts in linoleum, cardboard, and other thin, soft materials. The cutting point was positioned so its maximum projection below the slipper plate is about $1/16''$. The cutter edges at the point were beveled equally on both sides.

Material to be cut is placed on a soft surface such as cardboard. The saw is guided by sight for making irregular cuts (top photo at left), by a clamped board for straight ones. Angle cuts can be made by tilting the slipper plate, and circular cuts are a cinch to handle if your saber saw is equipped with a circle-cutting attachment.

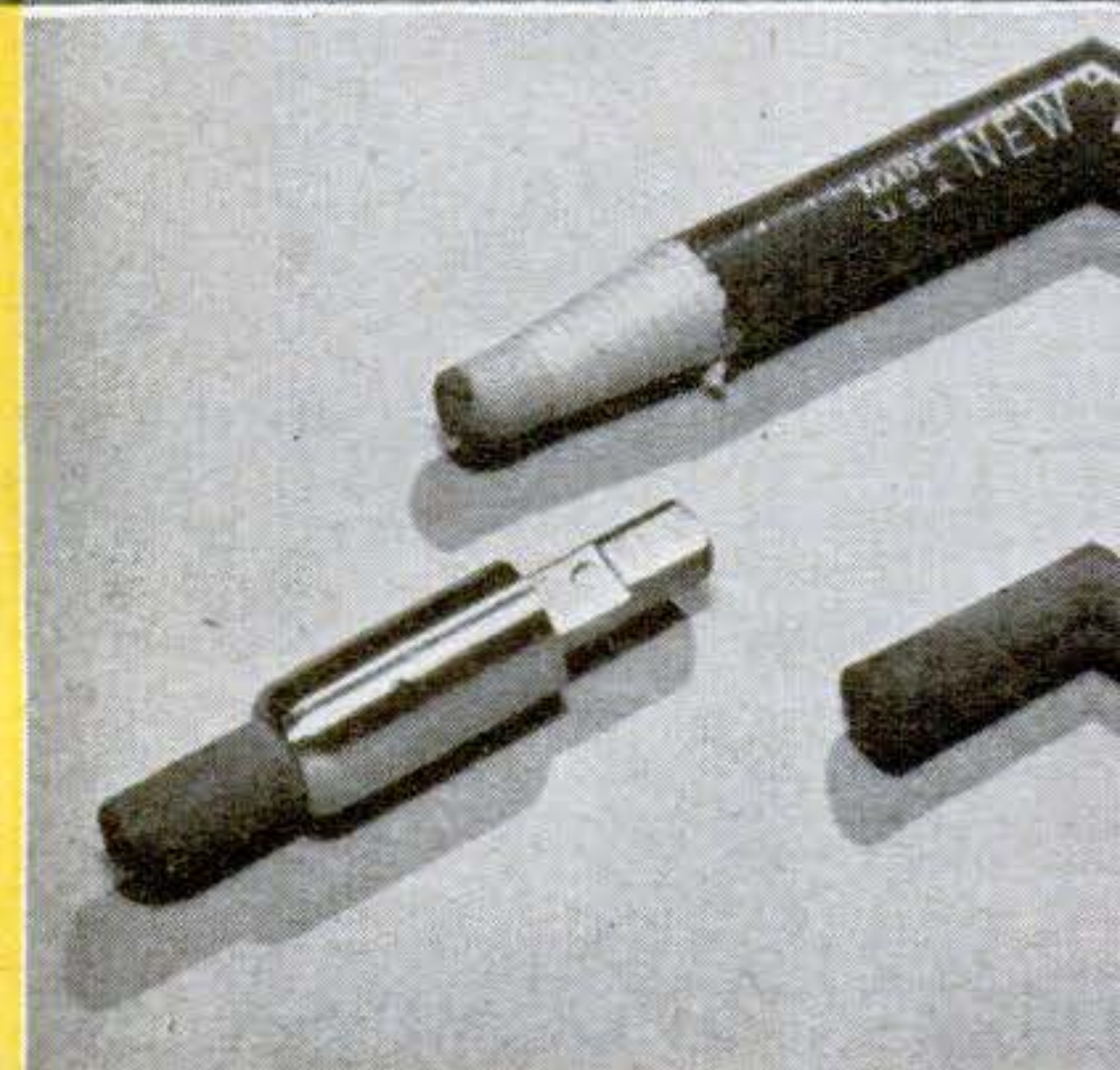
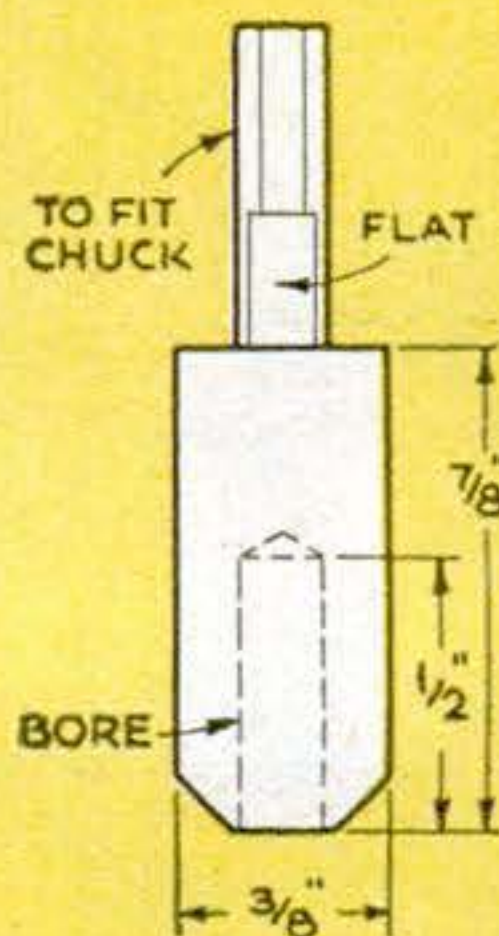
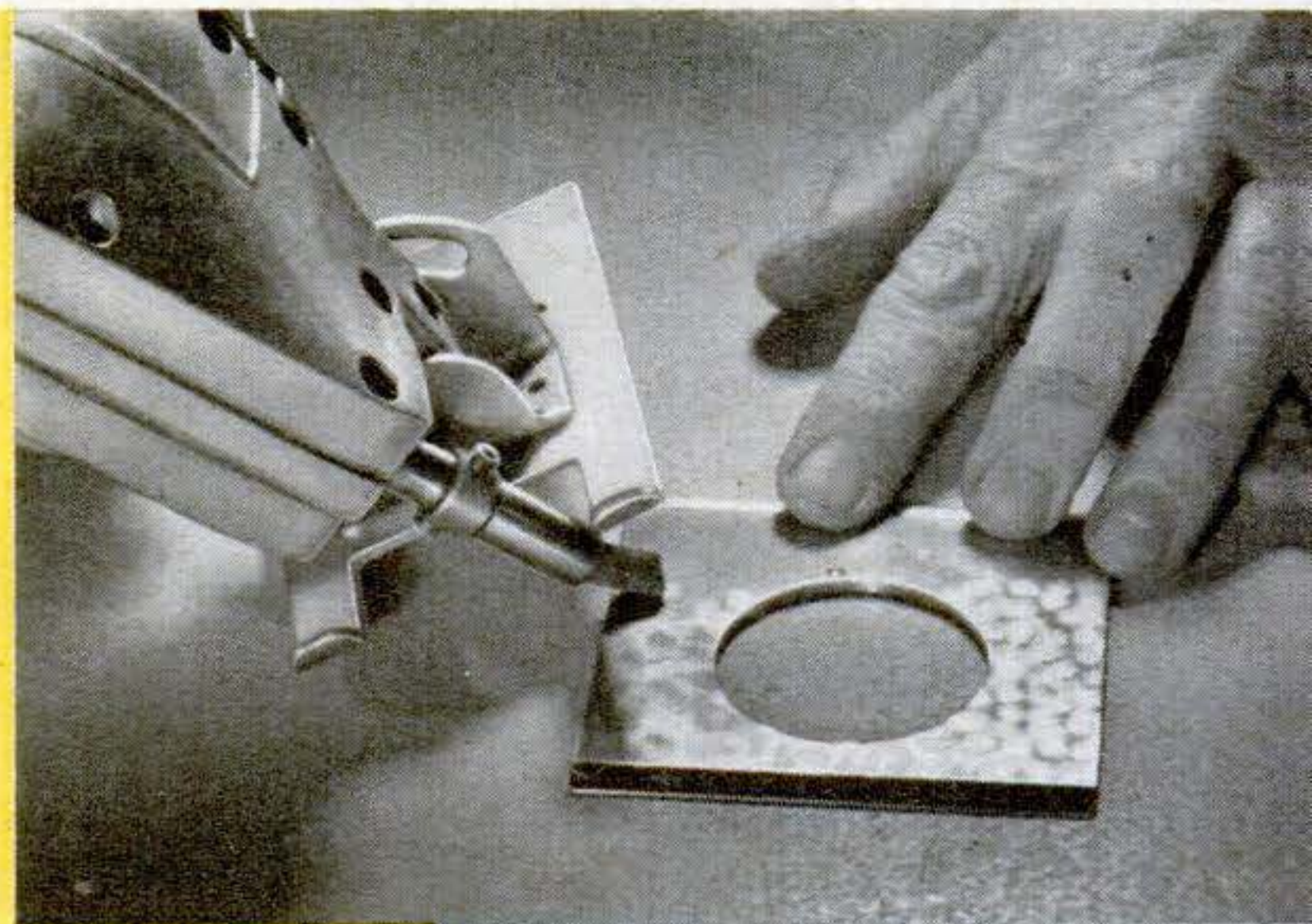


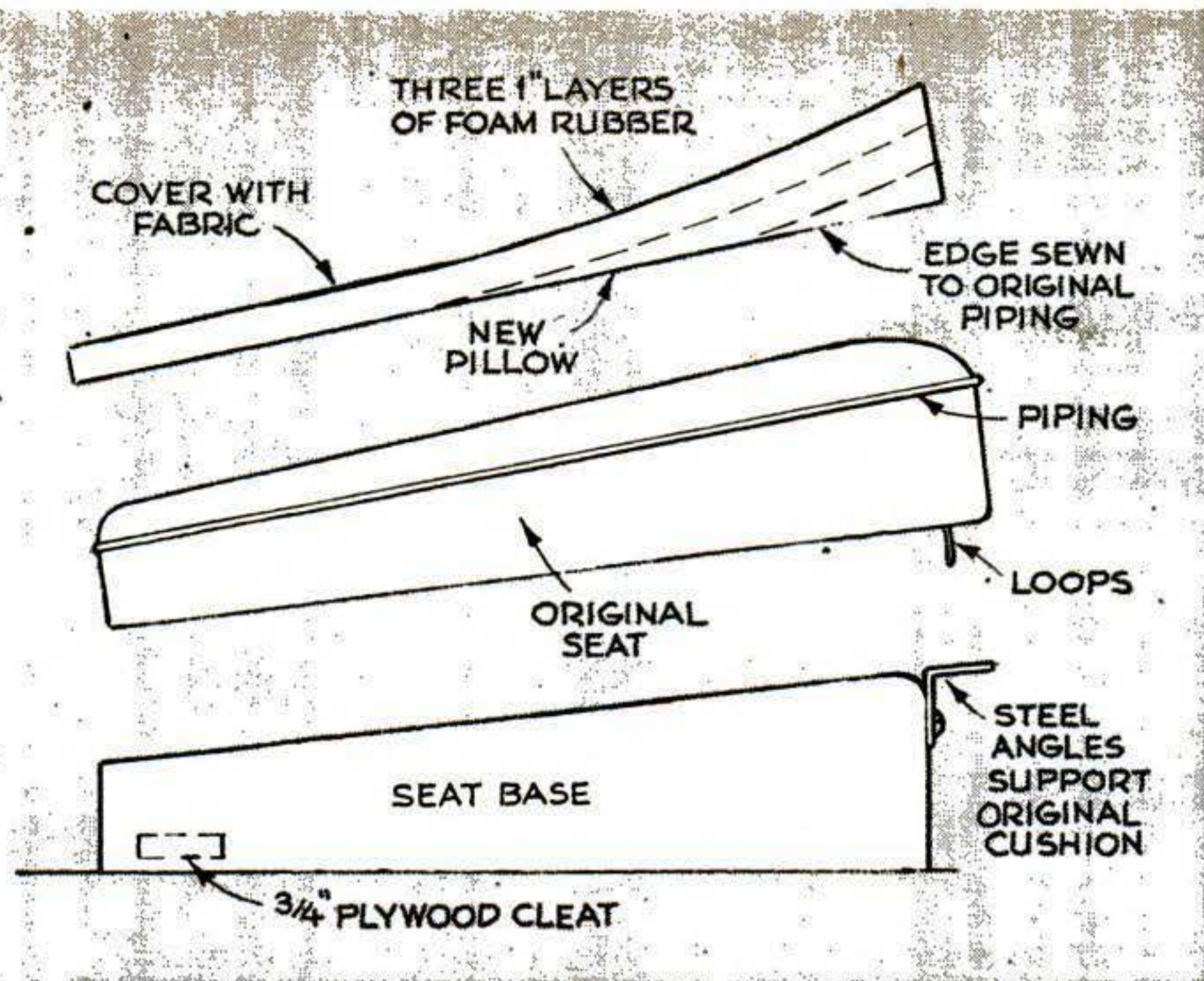
4 decorating metal

A ROUND pencil eraser held in a special chuck is the thing for this. An ink eraser has the greatest abrasive action. The saw is held so that the eraser tip strikes the work at about 45 degrees. The tip ultimately wears to a bevel.

The photo (upper right) shows the tool being used to develop a polished design on an aluminum camera lens-board. Spots were abraded at various angles so light is reflected from different directions, creating a changeable pattern.

The tool is also handy for polishing rounded contours, such as rivet heads, or removing tarnish from a hammered brass bowl. Another use—as an eraser: removing pencil marks from wood surfaces. ■ ■

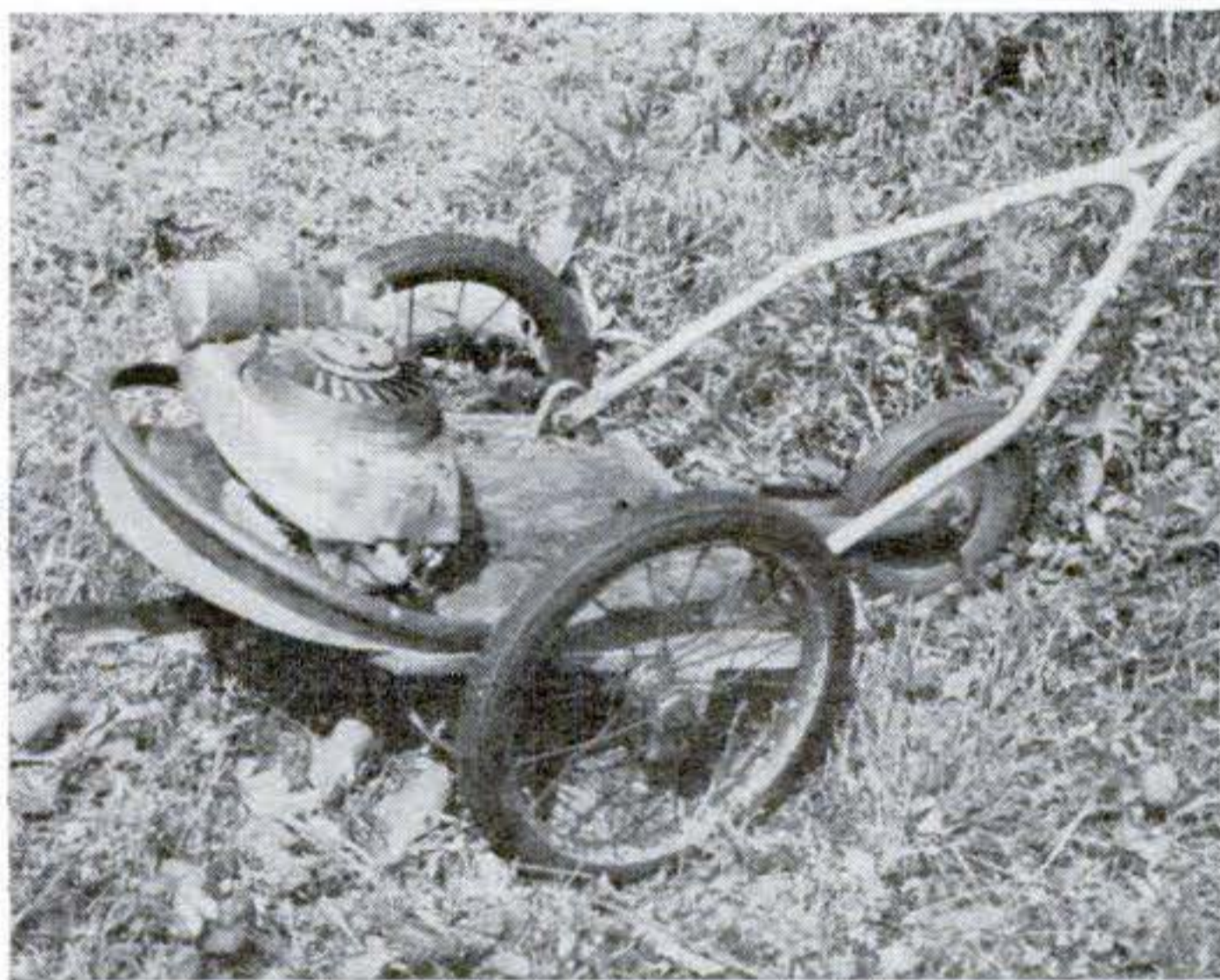




Adding comfort to a car's rear seat

You can increase rear-seat comfort in many cars by moving the seat forward and making it higher to give you more leg support. Two angle brackets bolted to the front of the seat base will let you move

the original cushion 2" forward. A new cushion made of foam rubber and upholstery fabric can then be placed on top. It should be thick in front and taper toward the rear. Sew its lower edge to the piping on the original cushion for a trim appearance. —Edward N. Horr, Hickory, N.C.



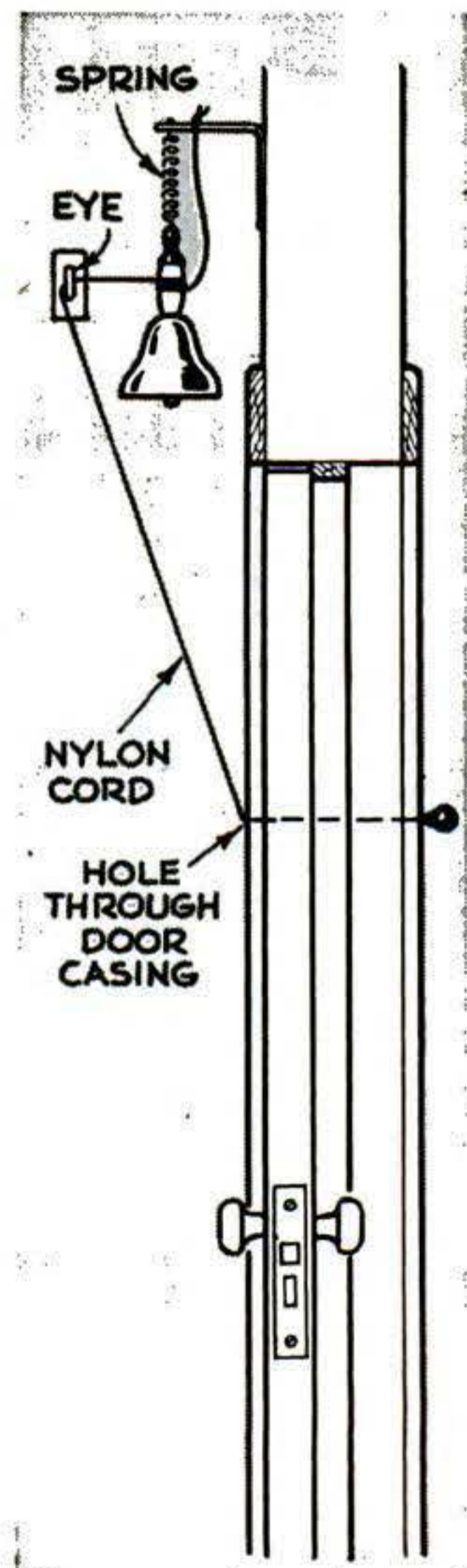
Old mowers never die—they cut weeds

When the housing on my 10-year-old power mower finally fell apart, I was left with a still-good engine and handle. So I mounted them on a plywood base, added bike wheels, and the result is a rugged weed and brush cutter that slices saplings up to 3/4". Because the blade is exposed in front, I use the rig only when no one else is around. A two-by-four shields the blade in back. The big wheels roll easily over rough ground and hold the blade high to clear rocks. A small third wheel is held at the rear in an old tricycle fork. —Thomas M. Martin, Bedford, Va.

School bell now announces callers

We needed an especially loud doorbell, so I worked up this rig for an old school bell I found. I hung the bell on a spring held by a wall bracket near the door. Then I ran a line loosely from the bracket to the bell's handle and from there through an eye on the wall and out a small hole in the door casing, with a knob tied on the end.

The slightest tug on the knob jounces the bell enough to be heard anywhere in the house. A loose line between bell and bracket lets the bell move, but keeps it from being pulled too far down on the spring. —John Calder, Laurel, Md.



How to Choose the Right Mike

Five basically different types of construction are used to convert sound waves into electrical signals

By Lewis A. Harlow

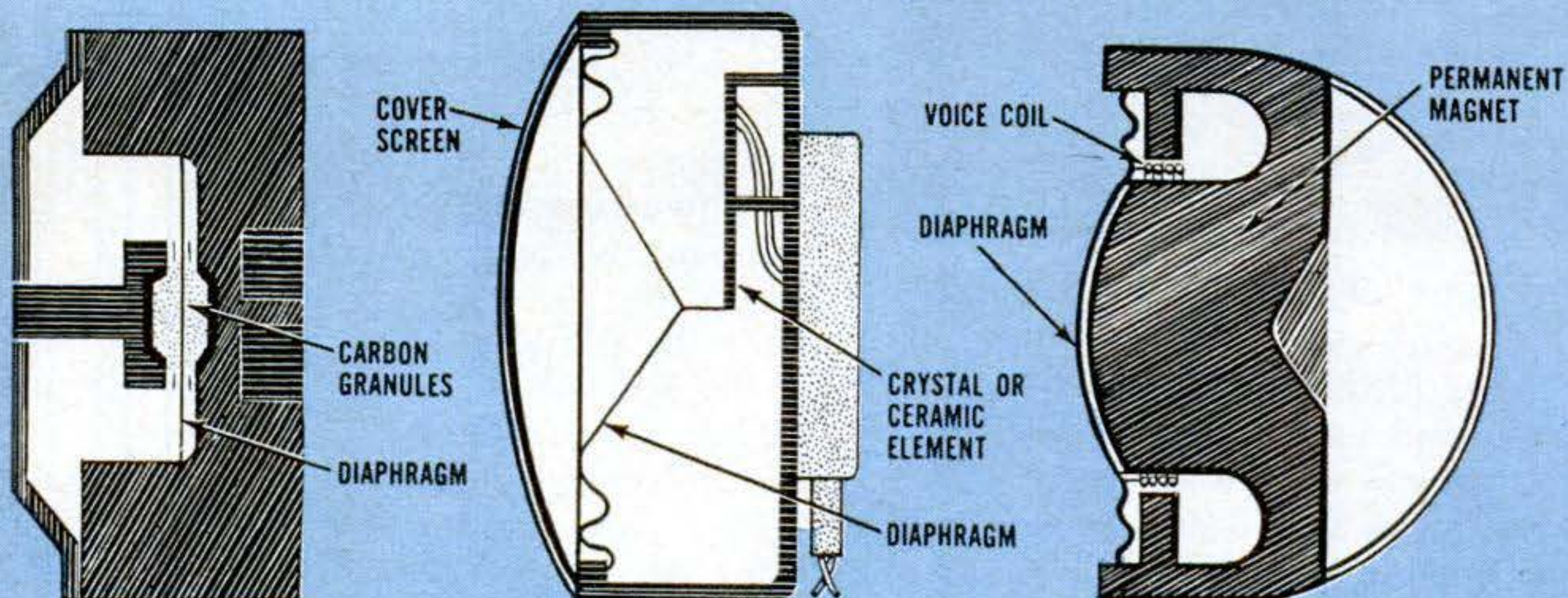
THE quickest way to improve your home-grown tape recordings is to invest in a better microphone. Most home tape recorders are capable of better performance than the mikes that come with them. But shopping for a mike can be an expensive, as well as a frustrating, experience if you're hazy about the difference in types and the meaning of the specs.

The carbon mike is the oldest of microphones. The one in your telephone is the most

sensitive of all designs. The frequency response of the carbon mike is narrow, 400 to 4,000 cycles—excellent for speech intelligibility but hopelessly inadequate for the 30-15,000-cycle music spectrum. Carbon mikes are used in noisy communications sites by the military, by taxicabs, in plane cockpits, and occasionally by sports announcers. The newest models are in palm-fitting cases acoustically designed to accept speech from an inch or less away and to reject noise from greater distances.

The crystal mike holds second place for

Five different kinds of microphones—how they work



Carbon mike varies current (usually from a battery) through it when sound vibrates diaphragm, putting alternating pressure on carbon granules.

Crystal mike generates an electrical signal when piezoelectric crystal is flexed by diaphragm. Ceramic mike is similar, but uses man-made element.

Dynamic mike generates an electrical signal when a coil attached to the diaphragm moves in the field of a permanent magnet. Principle: Current flows in a conductor when it cuts across magnetic lines of force.

wide usage. In a simple plastic "box" (for protection and not for acoustic improvement), you can buy a crystal mike for \$5 or less. Or you can pay \$25 or more, and get (1) cardioidism, (2) acoustic design of the case to minimize the crystal's limitations of frequency response, and (3) an adequately long cable of good quality.

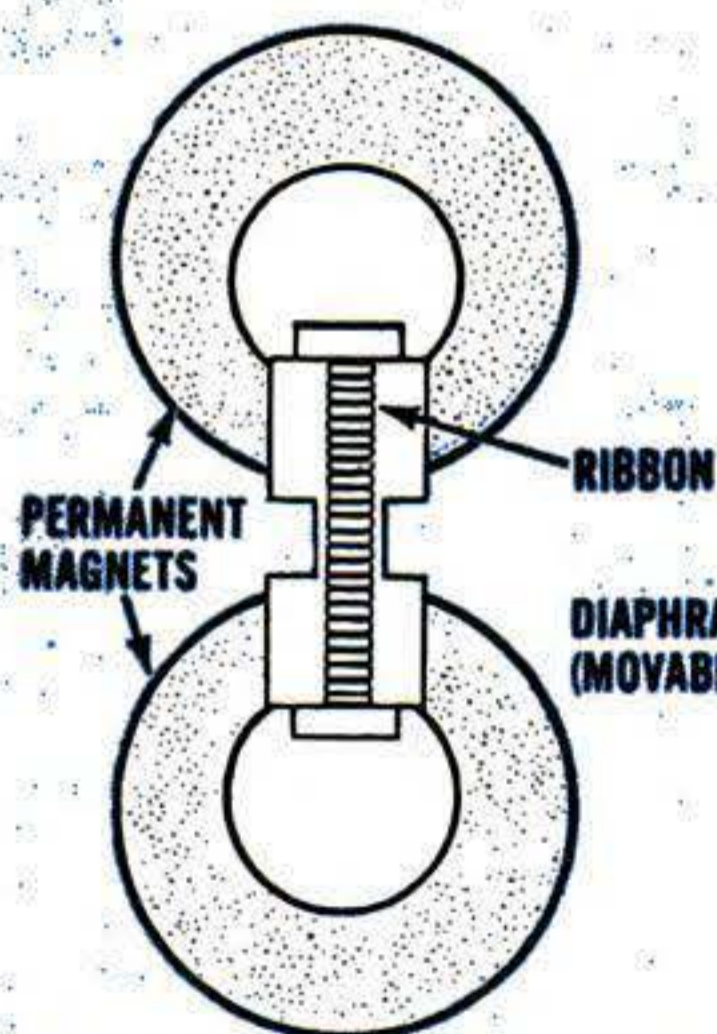
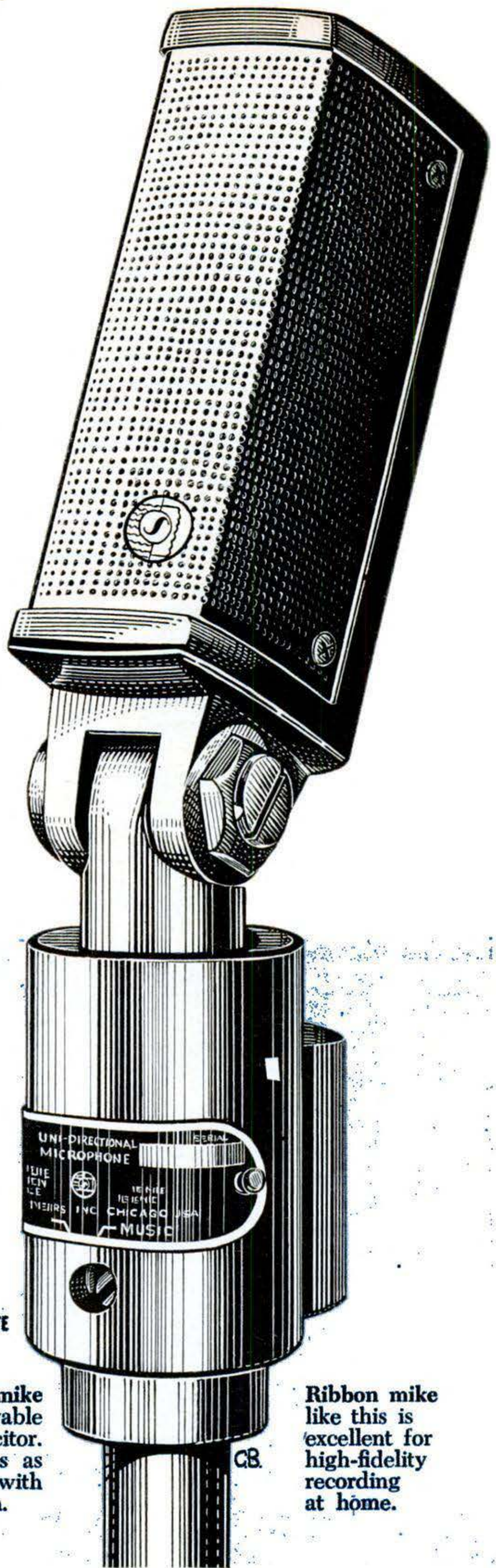
In its approach to the highs of hi-fi, a crystal quits at about 10,000 cycles—5,000 short of ideal. The bottom limit is about 50 cycles, lower than most home speakers will reproduce cleanly. Between these limits you get peaks and valleys, louds and softs.

There is another crystal weakness, too. Its twisting sandwich of Rochelle salt is damaged by both high temperatures and high humidity—130 degrees F. is absolutely fatal. Crystal mikes have a sensitivity of about minus 55 to minus 50 decibels (db.).

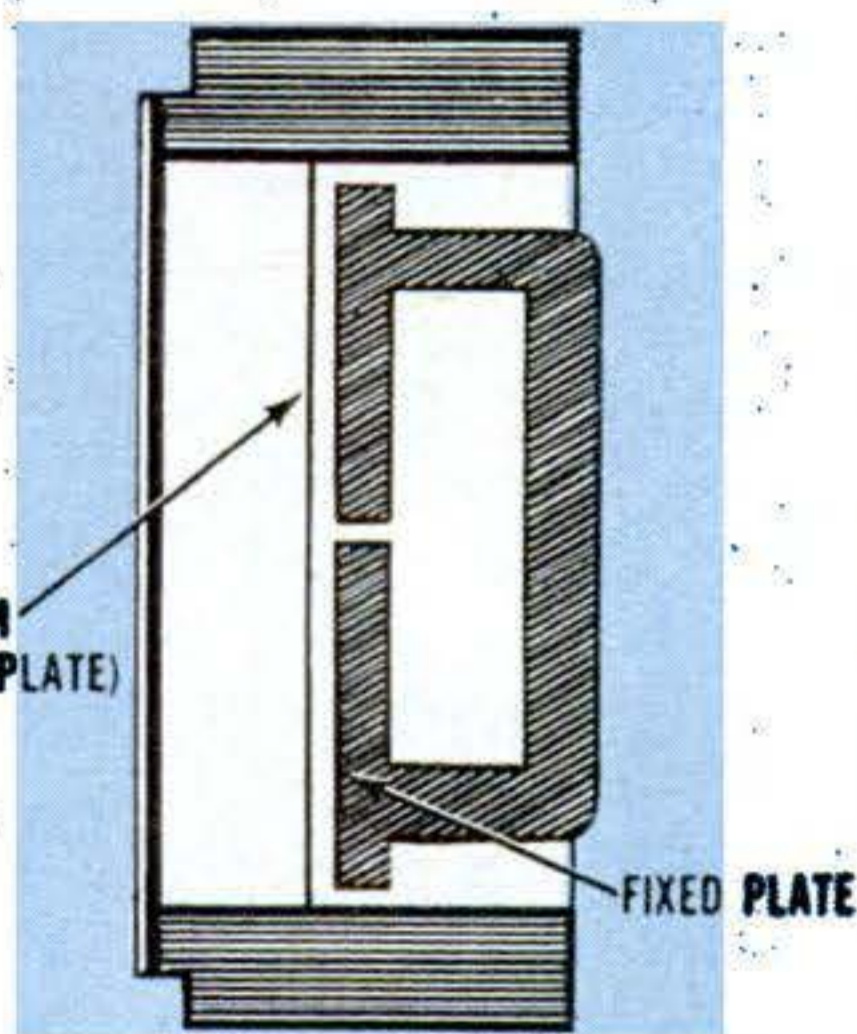
The ceramic mike is like the crystal electrically, but the oscillating sandwich is a ceramic, not a natural crystal, and this avoids the temperature problem. A ceramic averages about two db. less sensitivity than a crystal, and its frequency response is almost as wide—and about as ragged. Ceramics compete only with lower-priced crystals. You don't find "better" ceramics.

The dynamic mike bridges the price gap between the better crystals and the present "ultimates," the capacitor and the ribbon types. The mechanical principle of the

CONTINUED



Ribbon mike works on same basic principle as dynamic, but uses a thin metal ribbon, moving in field of magnet, as diaphragm and conductor.



Capacitor (condenser) mike uses diaphragm as movable plate of variable capacitor. Voltage to plates varies as capacitance changes with movement of diaphragm.

Ribbon mike like this is excellent for high-fidelity recording at home.

CB.

Microphone terms— what they mean

Cardioidism. A characteristic of certain microphones indicating a heart-shaped, directional pickup pattern.

Diaphragm. The flexible membrane in a microphone, which vibrates under the physical impact of sound waves.

Frequency response. The range of sound vibrations—lowest to highest—to which a microphone responds with approximately uniform electrical output.

Impedance. The total opposition a circuit offers to the flow of alternating current. It is measured in ohms.

Omni-directionalism. A characteristic of a microphone indicating sensitivity to sounds coming from all directions.

Pressure type. A microphone in which electrical output corresponds to the instantaneous sound pressure. The back of the diaphragm is enclosed.

Velocity type. Unlike the pressure type, this mike is open all around. Electrical output corresponds to instantaneous particle velocity of the sound wave.

Sensitivity. Electrical output for a specified sound pressure. Usually given in minus decibels (db.). The larger the number, the lower the output.

dynamic permits a frequency response all the way up to the hi-fi top of 15,000 c.p.s. This response is quite uniform, and it can be further smoothed by acoustic design of the case. You can pay \$200 for a dynamic mike, or you can buy one of the recent imports for \$10. The most popular dynamics sell for about \$50, and this is the range to consider if you want an improvement over one of the better crystals.

The magnetic mike is a mechanical switch on the dynamic. Originally developed for heavy-duty military applications, this design competes with the carbon rather than the dynamic. Magnetic prices are modest, and cases are minimal. Frequency response is fair, and sensitivity is average.

The ribbon mike has a frequency response almost ideally uniform over the entire hi-fi spectrum. It is a velocity mike. The inherent freedom of ribbon movement makes it quite susceptible to wind pressure. It is not for outdoor use.

The capacitor (or condenser), all things considered, is today's best microphone. It is the laboratory choice for precise sound measurements, and its flat frequency response rates it with the ribbon for best music reproduction. It is better than the ribbon outdoors, and it will stand rougher handling. Shortcomings? A few. It is expensive to build. It is an "active" mike, requiring an external power supply. It is extremely insensitive, requiring an extra amplifier of its own (often located in the base of the microphone itself).

In addition to type names, here is what you'll need to know to make sense out of the fine print in catalogue descriptions:

- **Impedance.** There will be a choice of "high" or "low," and you want high, because your recorder has a high impedance input. This impedance match is important.

- **Accessories.** You do *not* want to pay for on-off switching at the mike—or dual-impedance switching—or any other kind of switching. You *do* want your mike to come equipped with good cable 15-20 feet long, and you *do* want it to have a mounting socket with the standard $\frac{1}{8}$ -by-27 thread for the great convenience of mounting the mike on a standard table stand or an adjustable floor stand.

- **Cardioidism.** For home use, you are not interested; but the generous size of the cardioid provides room for other desirable acoustic features. Choose it rather than the fashionable pencil mike for this reason.

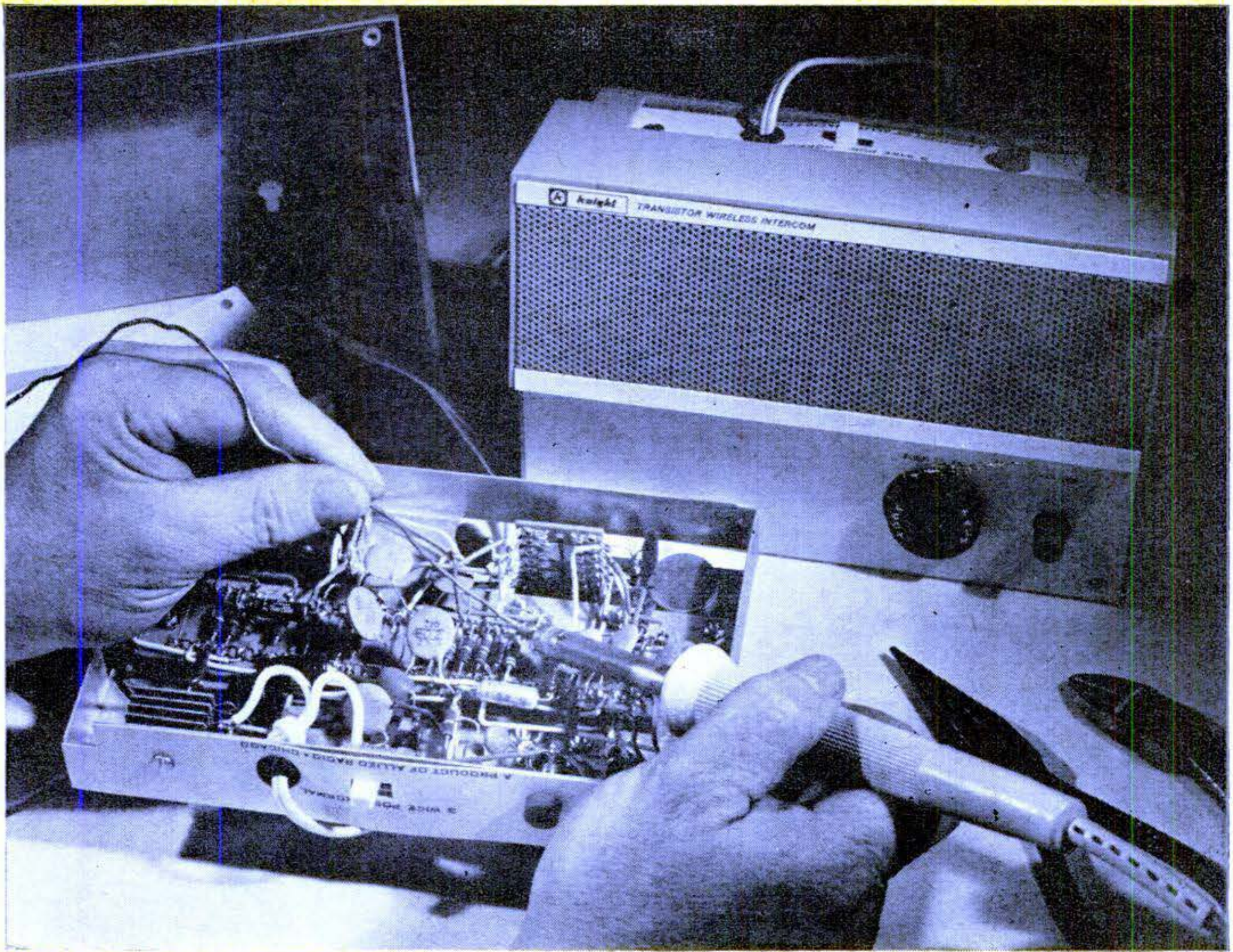
- **Sensitivity.** Not important. Your volume control is far more than adequate to handle any rating between -55 db. and -48 db., the range listed in the catalogues.

- **Frequency response.** If yours is a super tape recorder with a "highs" rating of 15,000 c.p.s., you need a microphone to match. If your recorder cuts off at 10,000 or below, as many do, a mike investment in higher frequencies is wasted.

- **Type and price.** The best buy under \$30 is a good crystal, a big old-fashioned cardioid if you can find one, with standard mounting thread and 15 to 20 feet of good cable. If your budget will stand \$50, there are several excellent cardioid dynamics to choose among. ■ ■

This \$39.95 intercom kit lets your voice ride the AC wires to any outlet in the house

PS ELECTRONICS



Back Talk from Your House Wiring

By Charles Tepfer

THERE'S a new kind of intercom that uses no special wiring, can be left on indefinitely, and may be moved any time to any place (where there's an electric outlet) for instant two-way talk. The first week I had it, I used it:

- To keep in touch with my wife in the house while I worked outside.
- As an outdoor telephone ringer.
- As a baby sitter while I visited with the next-door neighbors.
- As a sickroom attendant for my youngster in his upstairs room.
- For temporary use at my front door while I was in the darkroom.

CONTINUED

155

All this I did with only two all-transistor, wireless intercom units that I bought from Allied Radio Corp. in Chicago. These are Knight kits which I assembled in 13½ hours. Total cost: \$39.95.

The system is called "wired wireless" because it needs no wiring of its own—you plug it into the *house* wiring, which carries the message and supplies operating current.

Conventional intercoms need separate wires to carry the message from one unit to the other. Once installed, the wires and the intercoms stay put. They can't be picked up and used elsewhere unless the wires are moved or a set of new wires installed. Scattering many remotes all over the house might be the answer, but this would call for lots of wire stringing and lots of money.

In a wireless intercom system, all units are masters—each can originate calls to and talk with any other unit. Each can be anywhere it is needed at any time. All-transistorized units draw so little current that they are left on continuously—you never miss a call.

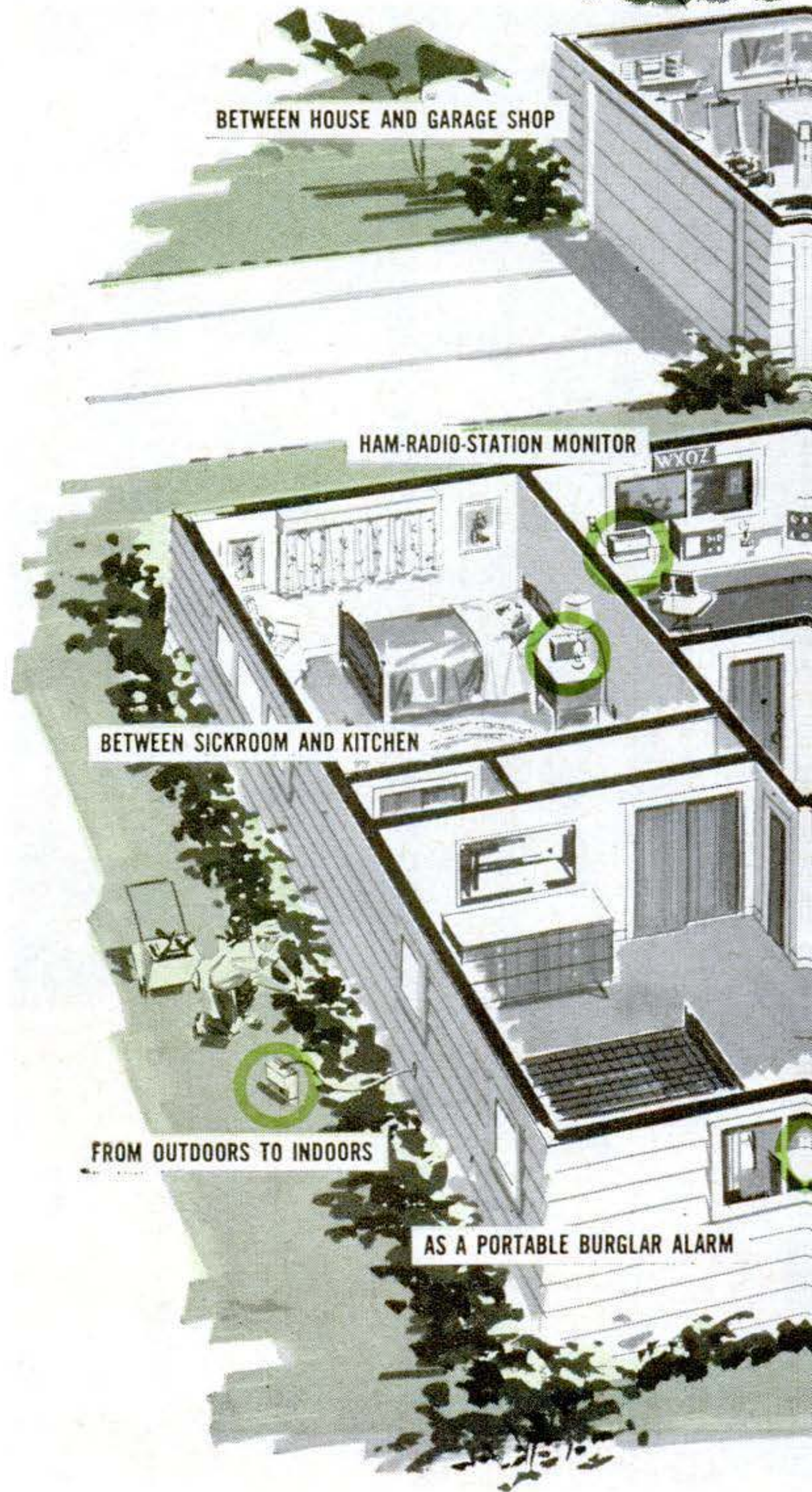
The only real limitation of these intercoms is that they must all be connected to the power line on the same side of the pole transformer. This is no problem when they are used within the house or from a house to its outbuildings. Between houses, however, there may be a power-line transformer. The number of houses served by a single transformer varies from neighborhood to neighborhood. To use the intercoms between houses, check first to make sure there is no pole transformer between.

How it works. All four transistors in the intercom are used for both receiving and transmitting. A push-to-talk switch, with a spring return, rearranges the circuits for each function.

With the switch down, talking into the microphone-speaker produces an audio signal that goes through the preamplifier and amplifier. The boosted signal then enters the line-coupling coil where it mixes with and changes the wave shape of a 200,000-cycle carrier signal generated by the radio-frequency oscillator. This mixed, or modulated, signal travels through the house power line to the other intercom unit where the switch is in the up position.

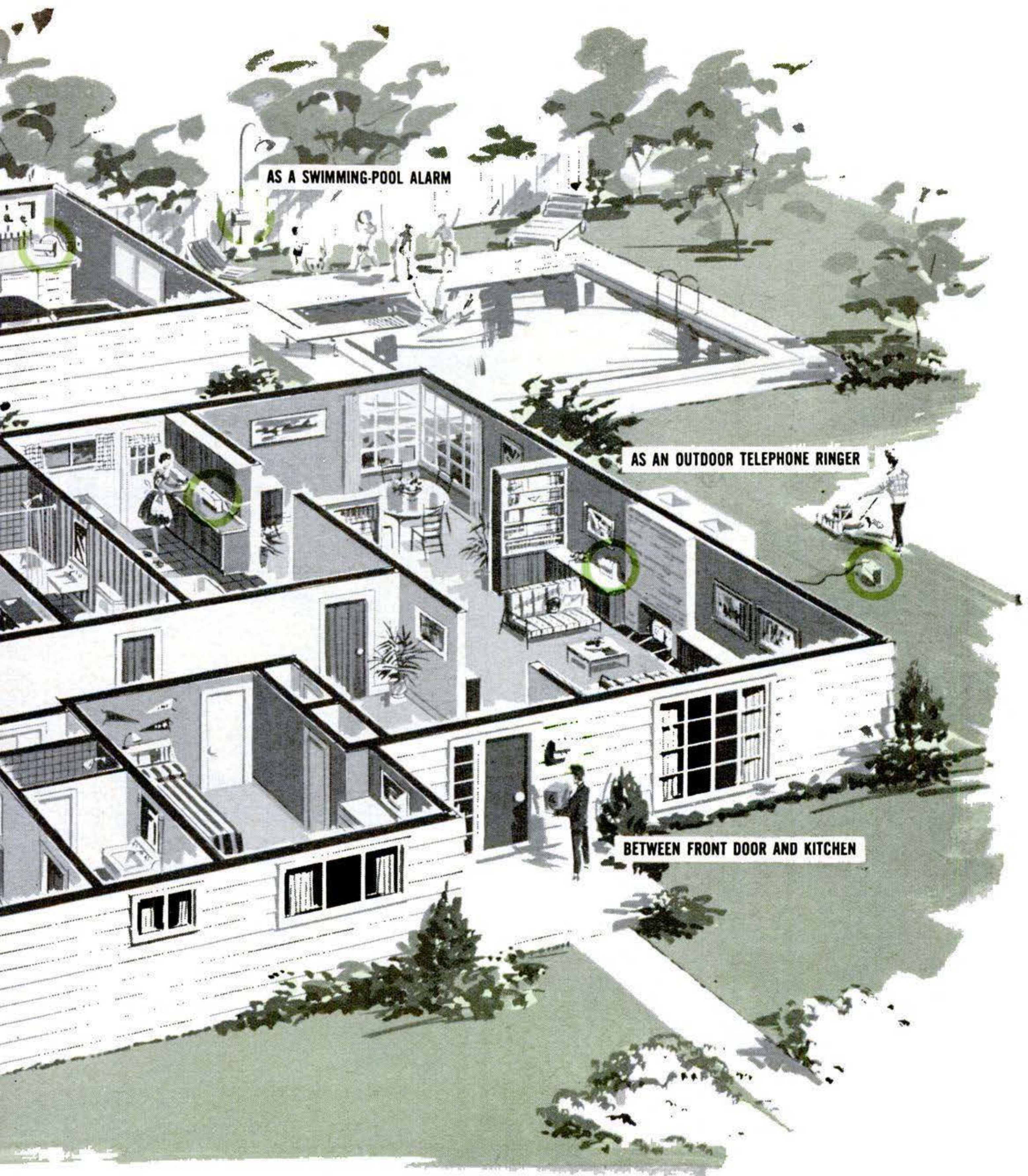
When the signal enters the receiving unit via the power plug, it goes first to the r.f. amplifier where it is boosted, and then to the diode crystal demodulator where the audio is peeled off the r.f. carrier. The

How to use "wired wireless" intercoms to save time, temper, and money



audio signal is then fed to the transistor amplifiers and into the speaker.

The AC is blocked off from the signal circuits by two capacitors. (The r.f. signal has so little current that it doesn't bother the power line at all.) Any interference that might get through to the signal circuits from the line is suppressed by the



AS A SWIMMING-POOL ALARM

AS AN OUTDOOR TELEPHONE RINGER

BETWEEN FRONT DOOR AND KITCHEN

intercom's "squench." The squench transistor (on transmit it serves as a microphone preamplifier) acts as a gate, turning the audio amplifiers on for audio signals and off for interference.

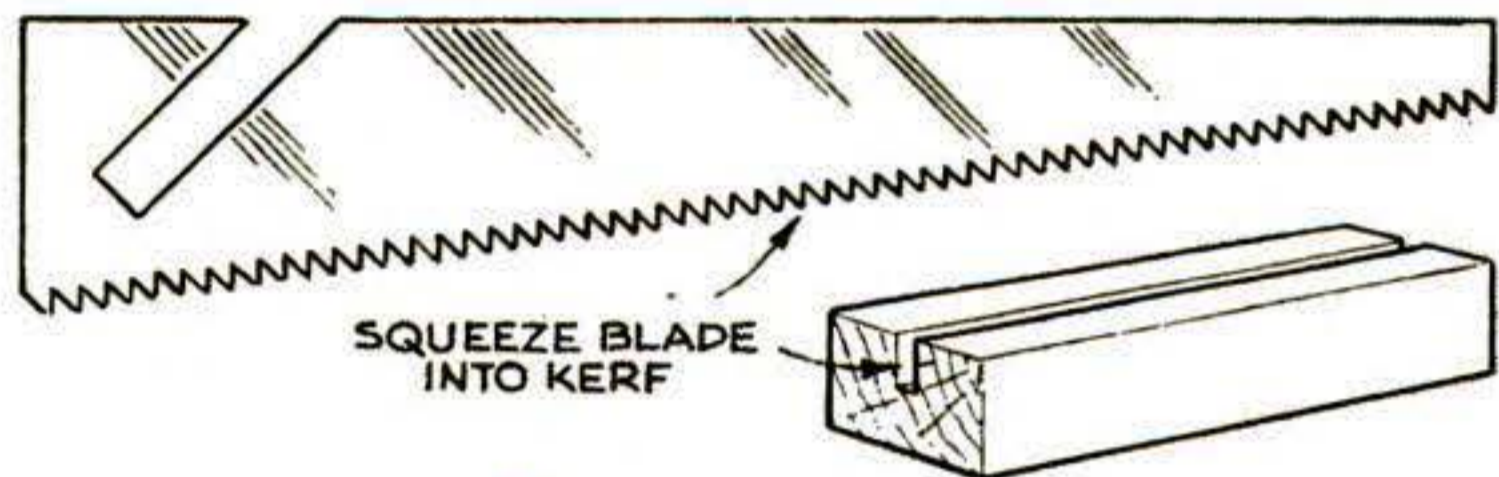
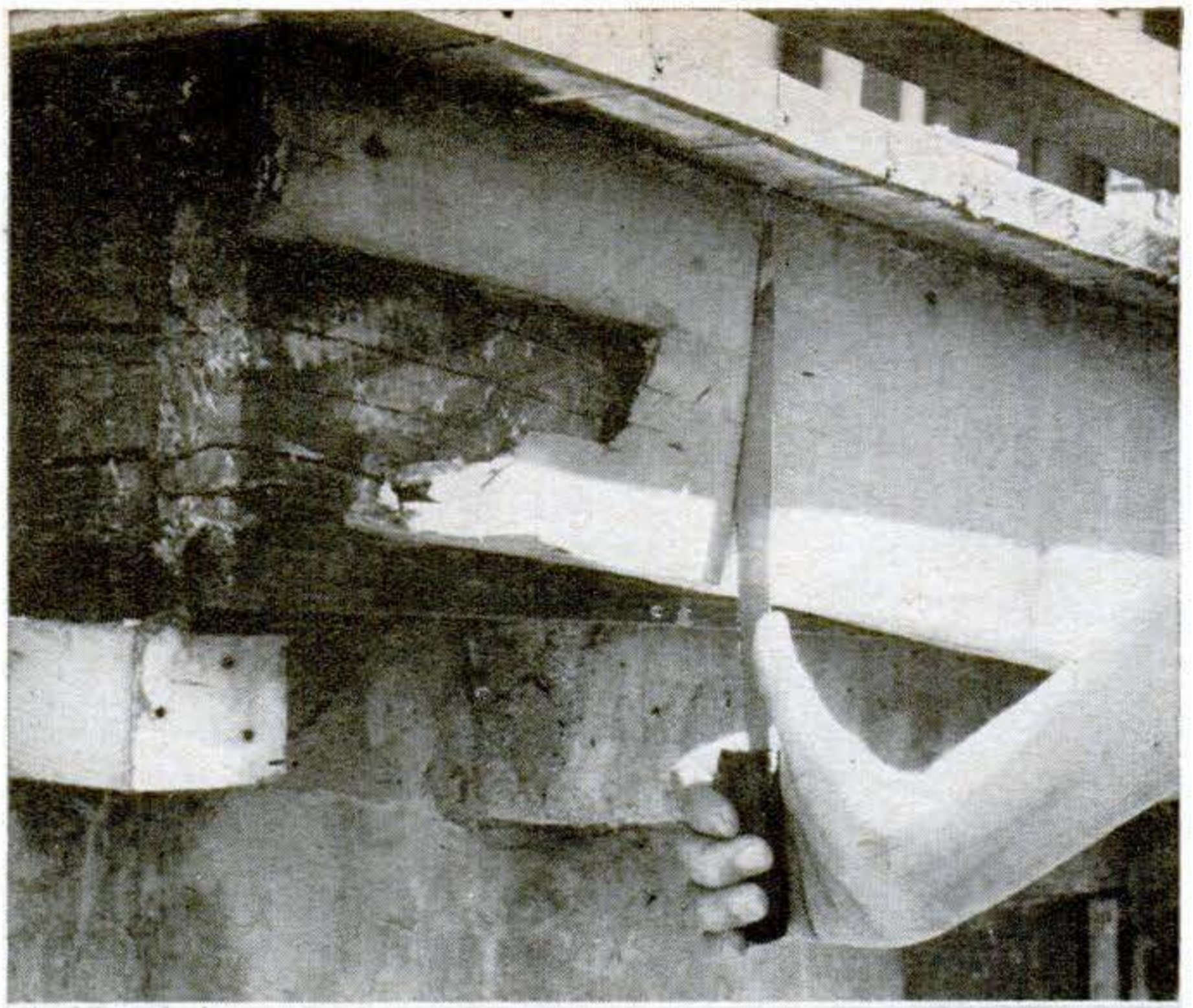
When a signal with audio information enters the intercom, a portion of the detected audio is fed to the squench transistor,

making it a conductor. The voltage it conducts goes to the audio amplifier, setting it up to pass and amplify the audio coming through. Interference signals that contain no audio cannot trip the squench into conduction. The squench circuit is adjusted initially to ignore any relatively constant interference signals that may contain audio. ■ ■

Pull saw cuts right up to an obstruction

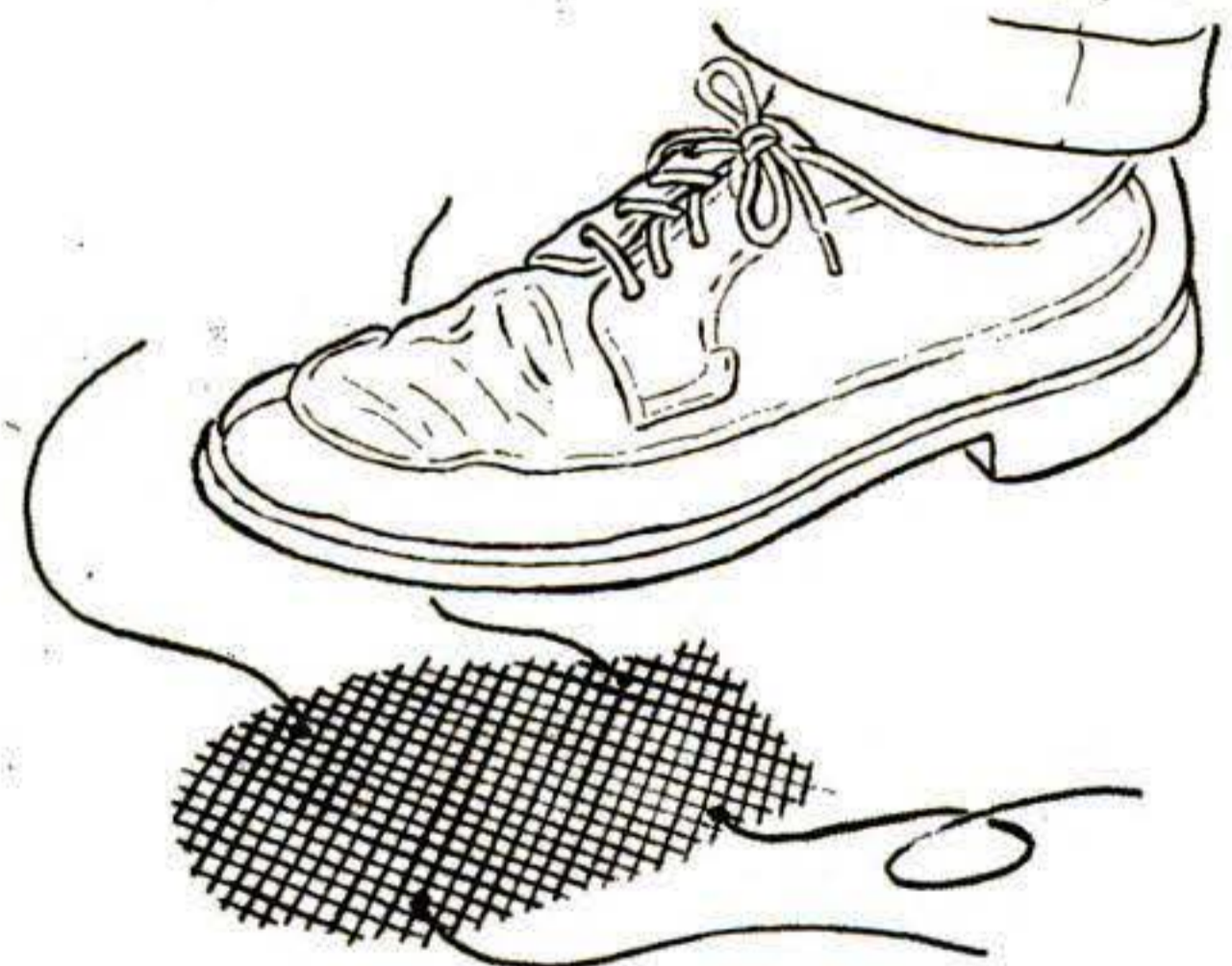
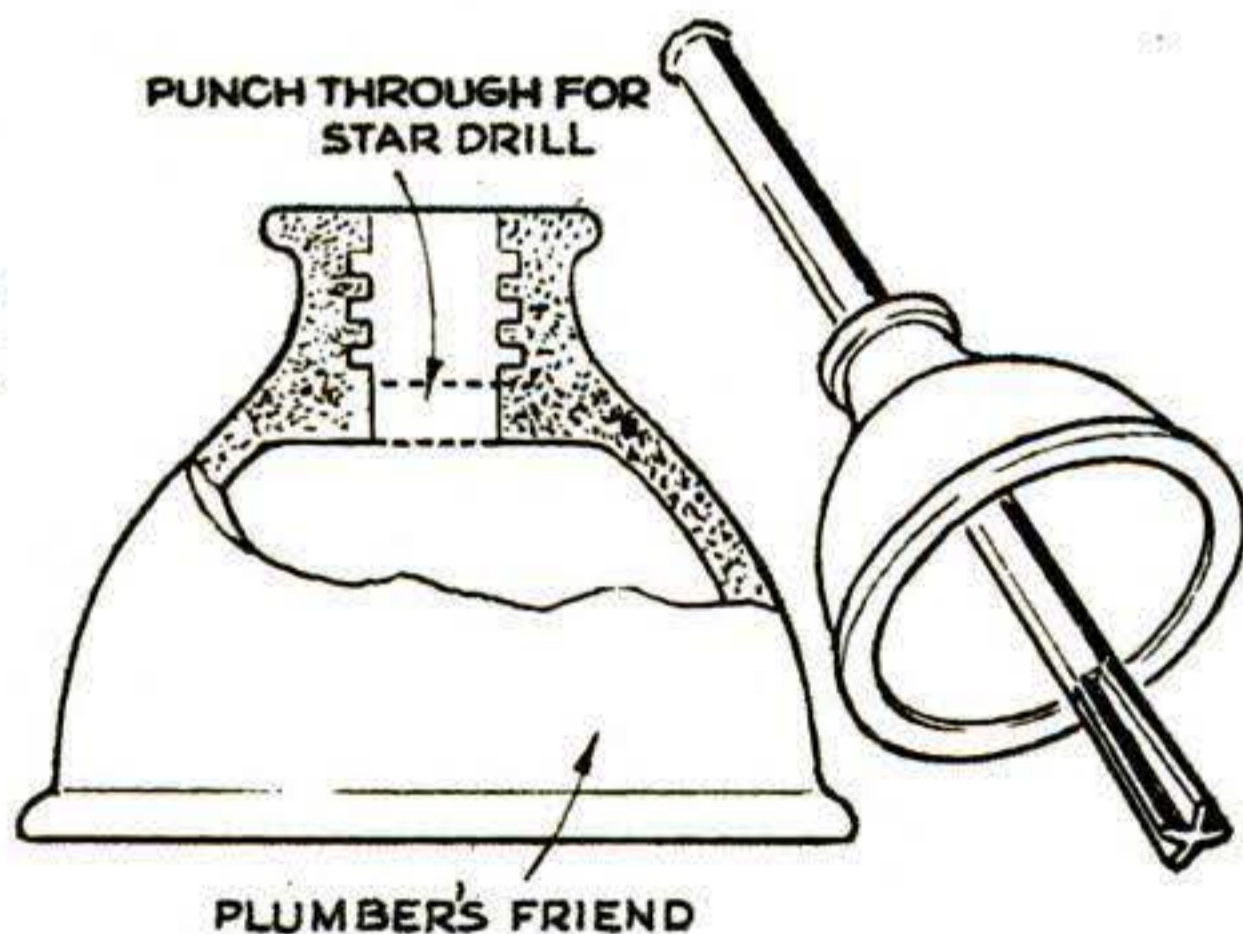
Repairs and remodeling may call for sawing a piece where another piece stops the blade at the end of the cut (as in cutting away rotted porch trim shown in the photo). A pull saw does a cleaner, quicker job than an ordinary one because it can cut up to the corner, removing sawdust from the kerf.

I made my saw from an interchangeable keyhole-saw blade. I placed the small end of the blade in a piece of slotted wood, squeezed in a vise to sink the teeth in the wood, wrapped the handle with tape. — *Harry Walton, White Plains, N.Y.*



▶▶▶ Why worry about keeping a variety of clamps on hand? I make my own to suit the job, large or small, using two bolts through two strips of wood for each one.— *George L. Broomhall, Utica, N.Y.*

▶▶▶ To locate interior wall studs behind plasterboard, I place a flashlight against the wall and shine it parallel to the wall face. This shows up the fill over nailheads.— *D. E. Young, Somerville, N.J.*



Toilet plunger shields star drill

A rubber plunger from a "plumber's helper" serves nicely as a shield to guard eyes from flying chips when you use a star drill. I heat a metal rod red and burn a hole through the rubber for the drill.— *F. P. Faltersack, San Jose, Calif.*

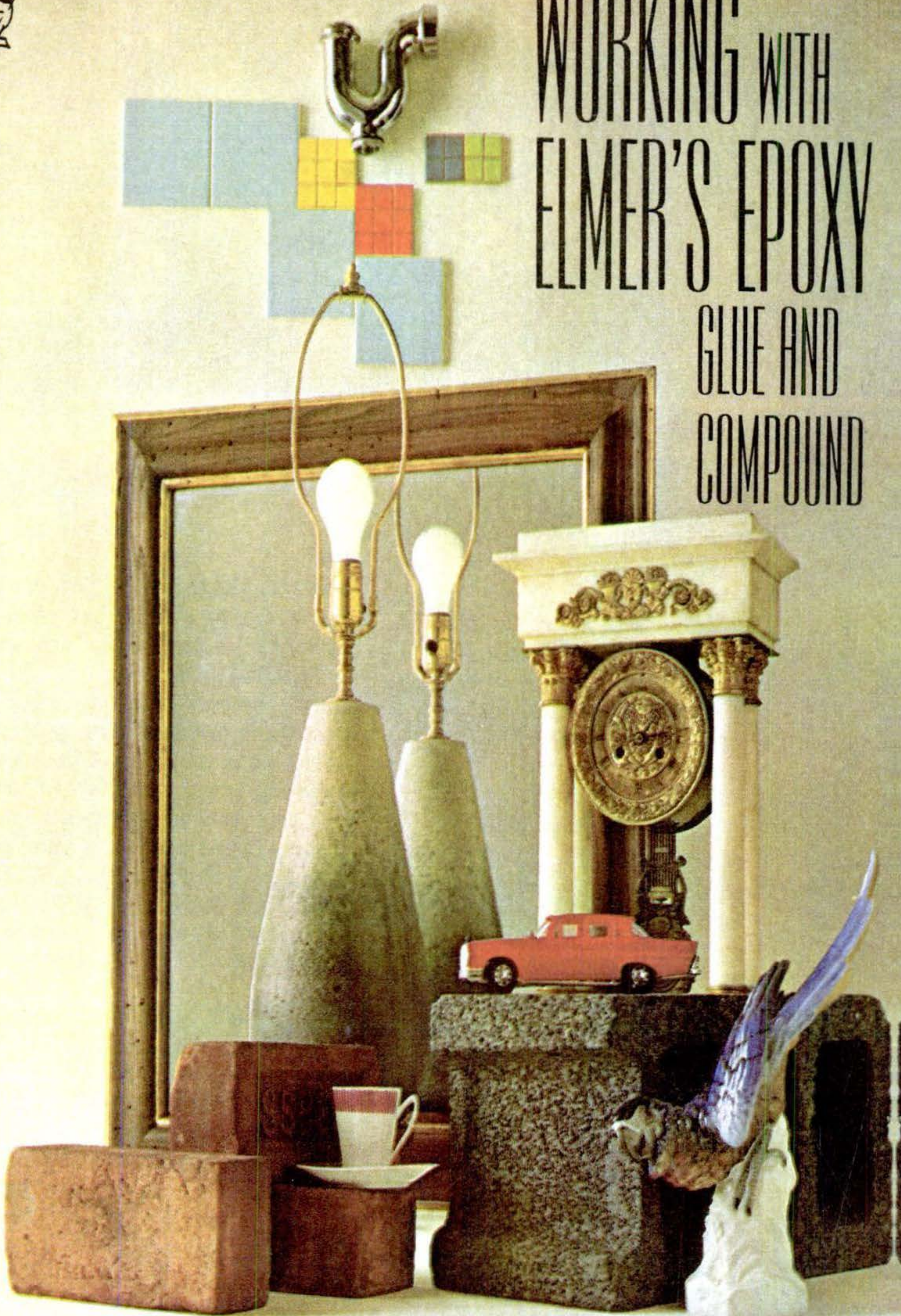
Snow soles prevent winter falls

For secure footing on ice or snow, you can make yourself a pair of tie-ons. Step down on a scrap of expanded-steel lathing and trace around your shoe from toe to instep. Cut out and tie on with leather thongs.— *J. H. Matthews, St. Louis.*



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WORKING WITH ELMER'S EPOXY GLUE AND COMPOUND



ELMER'S twin teams make "impossible" jobs easy

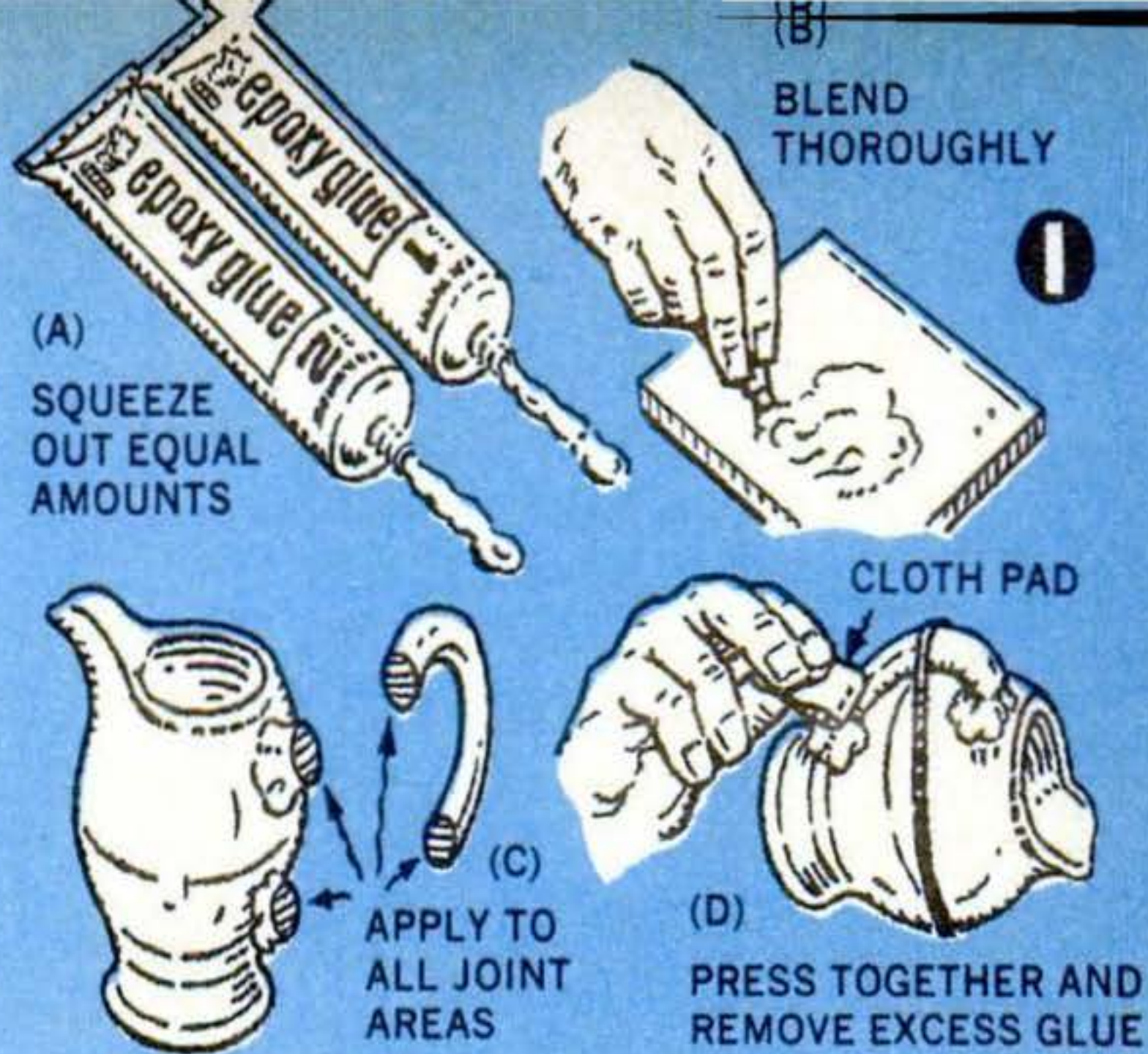
WHETHER you're a home handyman, mechanic, or craftsman, both ELMER'S Epoxy Glue and ELMER'S Epoxy Metal Compound belong in your workshop. Here's why:

ELMER'S EPOXY GLUE is the wonder adhesive that sticks practically anything to anything. The joints this waterproof and nearly transparent glue produce are so strong that stresses of up to a ton per square inch won't part them.

ELMER'S EPOXY METAL COMPOUND is a blend of the same adhesive and minute particles of aluminum. The result is a full-bodied formulation ideal for bonding irregular surfaces, and for filling, sealing, patching, and filleting. When ELMER'S Epoxy Metal Compound hardens, it's so dense you can machine, file, sand, drill, and tap it.

WHY TWO CONTAINERS? Ordinary glues and metallic fillers contain an evaporative solvent. ELMER'S Epoxies do not. Just before use, you mix equal parts of two components—one a chemical hardener. With nonevaporative curing, ELMER'S Epoxies offer three dividends—superstrength joints without clamping, a metallic compound free from any shrinkage, and no storage waste.

THERE you have them—two remarkable ELMER'S products, each an easy-does-it answer to formerly tough and impossible construction and repair jobs.



Bonding with

WHEN TO USE IT. While ELMER'S Epoxy Glue is the most versatile adhesive ever developed, it is not offered as a replacement for ELMER'S six other top-grade glues and cements (see back cover). Use Epoxy glue, primarily, to join heretofore ungluable and difficult materials. That goes for steel, iron, aluminum, bronze and brass—for concrete, brick, and tile—glass, porcelain, china, and crockery—leather and most hard plastics (phenolic and polystyrene). ELMER'S Epoxy Glue is the right choice, too, for superstrength wood joints involving small contact areas—like broken furniture legs.

HOW TO MIX AND APPLY. ELMER'S Epoxy Glue comes in two tubes, both numbered and color-coded, along with their caps, for easy identification. Tube 1 (orange) contains the resin, tube 2 (blue) the hardener. Squeeze equally long ribbons of the components side by side on a scrap of glass or other disposable palette. Then blend thoroughly, either with one of the tube-cap

WIRE JOINTS



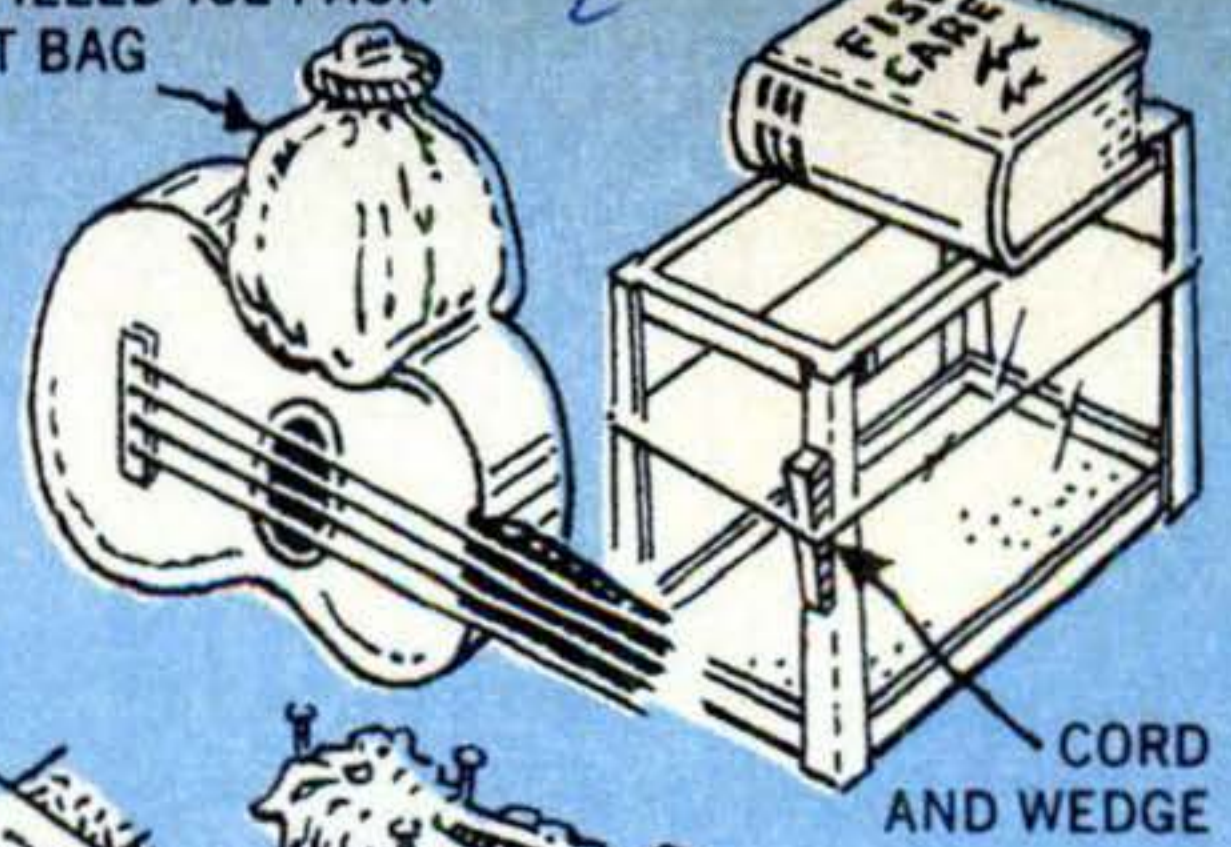
WEAK STRONG STRONGER



RUBBER SUCTION CUP

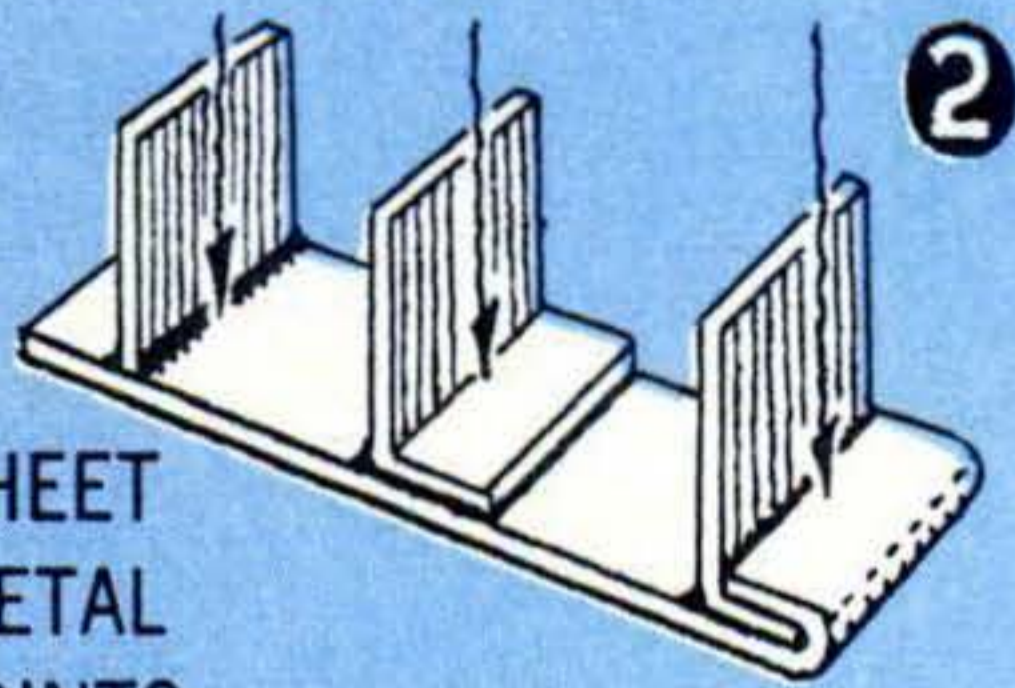
RUBBER BAND

REFILED EMPTY ICE DUCK
WATER-FILLED ICE PACK
OR SHOT BAG



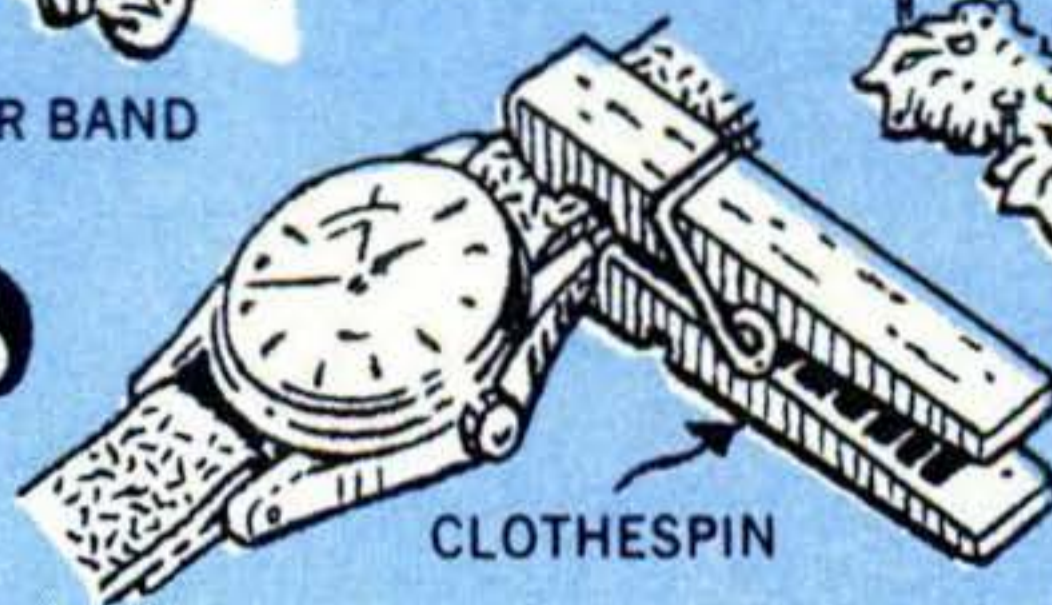
CORD AND WEDGE

SHEET METAL JOINTS

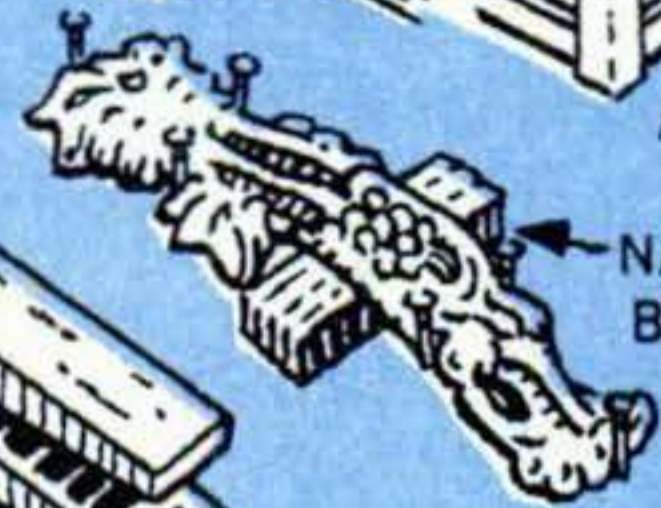


2

3



CLOTHESPIN



NAILS AND BLOCKING

HOLD-DOWNS

ELMER'S Epoxy Glue

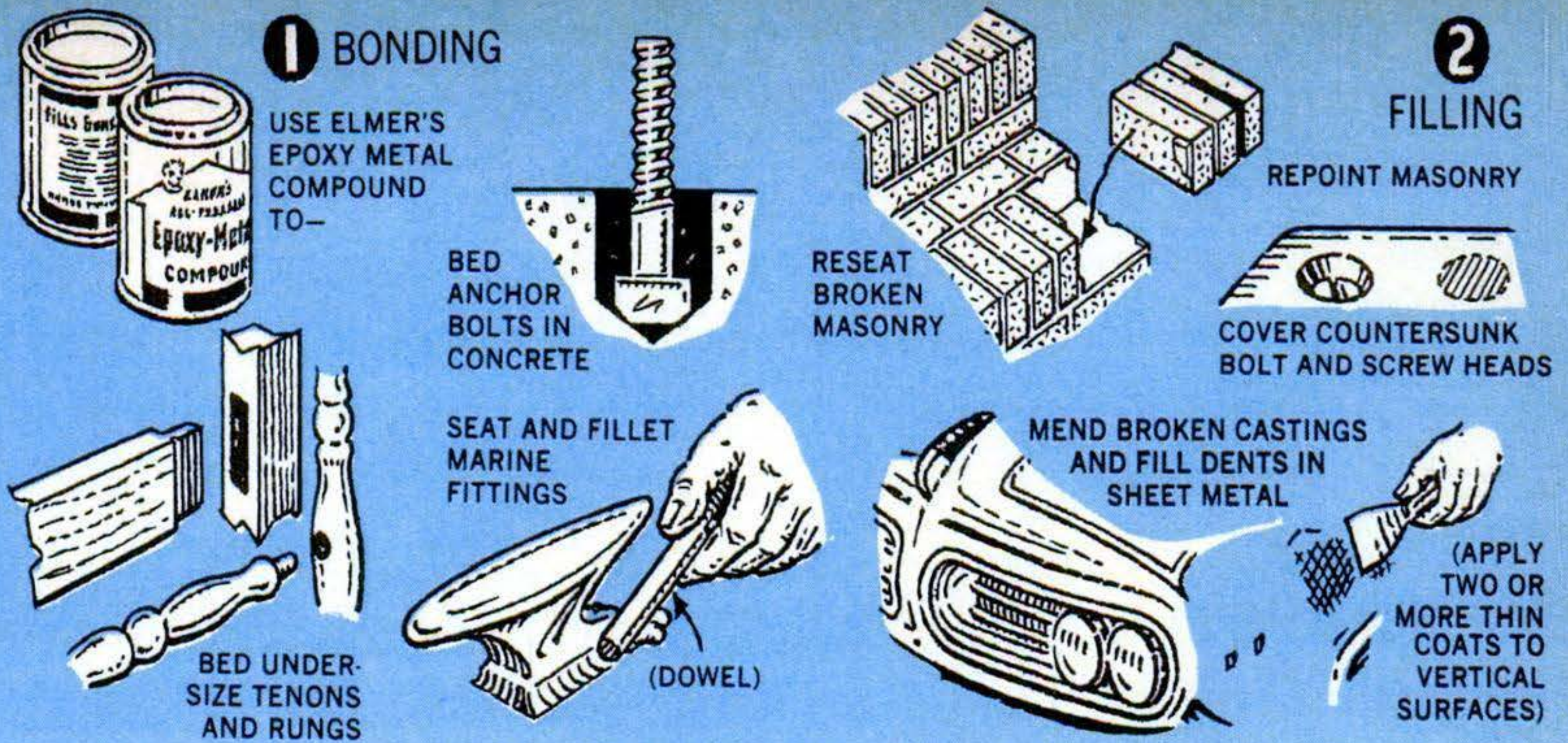
applicators or an old knife. Apply to both faces of the joint immediately after mixing. Work areas should be clean and, in the case of nonporous materials, roughened with a file or sandpaper. Press the parts together and wipe off squeeze-out (drawing 1). With new projects, remember that the greater the gluing area, the stronger the bond (drawing 2). Where possible, provide a mechanical interlock.

HOLD-DOWNS. While there's no need for pressure clamping, parts must not be allowed to shift while the adhesive is setting. Suggested hold-downs are shown in drawing 3. Don't let excess glue run onto them. Where required, shield hold-downs from the work with wax paper to prevent unwanted bonding.

THERMAL SETTING. At room temperatures (60° to 72°), ELMER'S Epoxy Glue sets in about two hours and cures overnight. To reduce setting time to as little as 20 min-

utes, and curing time proportionately, subject joints to moderate heat. Use an infrared lamp placed approximately 16 inches from the work. Or where project size permits, preheat a well-insulated kitchen oven to 150 degrees and place the work inside. Heat-cured bonds will be ready for use in 90 minutes.

DURABILITY. Properly prepared and cured, joints made with ELMER'S Epoxy Glue last practically forever. These tough-as-nails bonds have excellent freeze-thaw stability, withstand boiling water, and are resistant to most dilute acids and alkalis. Thermal curing of this revolutionary adhesive produces somewhat stronger bonds than those made at normal room temperatures. Where maximum resistance to heat is more important than top strength and flexibility (as in the case of chinaware, crockery, and glass exposed to scalding water and steam), use a blend of two parts resin to one part hardener.



The many uses of ELMER'S Epoxy

LOOKING for a heavy, superstrength adhesive to bed anchor bolts in concrete? A superior "cold solder" to fill a dent in an automobile fender? Or a rugged sealer to plug a hole in a car radiator or a gutter? For these and scores of other uses around the home and garage, ELMER'S Epoxy Metal Compound is tops.

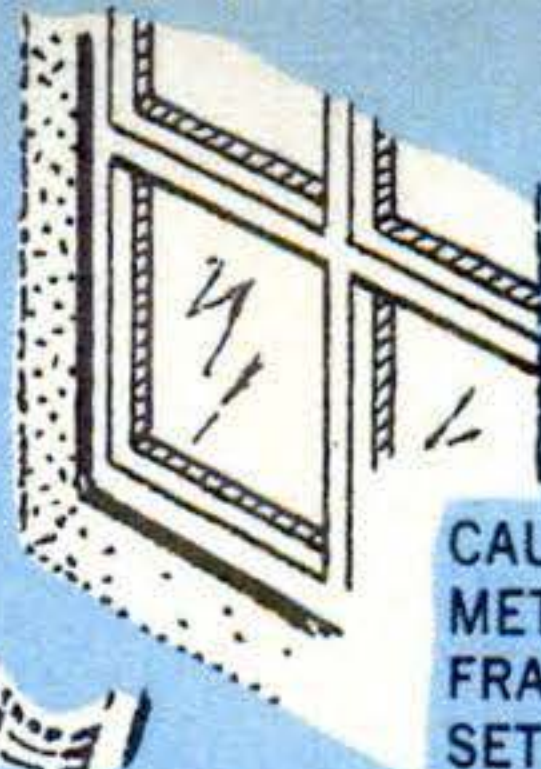
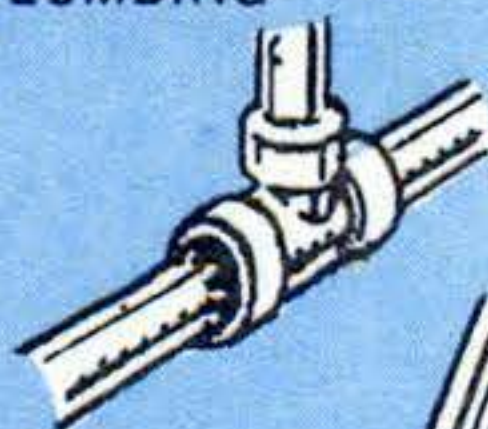
MIXING. Observe the same general rules recommended for ELMER'S Epoxy Glue. However, you're now dealing with two putty-like components packed in twin cans. *Product 1* is the metal-filled resin—gray in color. Ivory-colored *Product 2* is the hardener. Blend equal amounts in an old china bowl or other disposable container, and apply at once with a putty knife or similar spreading tool. Clean the applying tools immediately after use with denatured alcohol, lacquer thinner, or acetone.

BONDING. Trowel enough compound on both joint surfaces to prevent voids when parts are pressed together. Wipe off squeeze-out, unless you wish to run a fillet around the edges of a bond for additional strength. In that case, apply a bead of ELMER'S Epoxy Metal Compound, and press it to final form with a dowel or other shaping tool (drawing 1).

CAULKING. Use ELMER'S Epoxy Metal Compound for permanent, waterproof seals between metal windows and door frames and masonry walls. Apply and shape the way just described for filleting. Epoxy Metal Compound is *not* recommended for exterior wood-to-wood, wood-to-metal, or wood-to-masonry caulking. There you need an elastic sealer to compensate for unequal expansion and contraction.

3 SEALING

STOP LEAKS IN RADIATORS AND PLUMBING



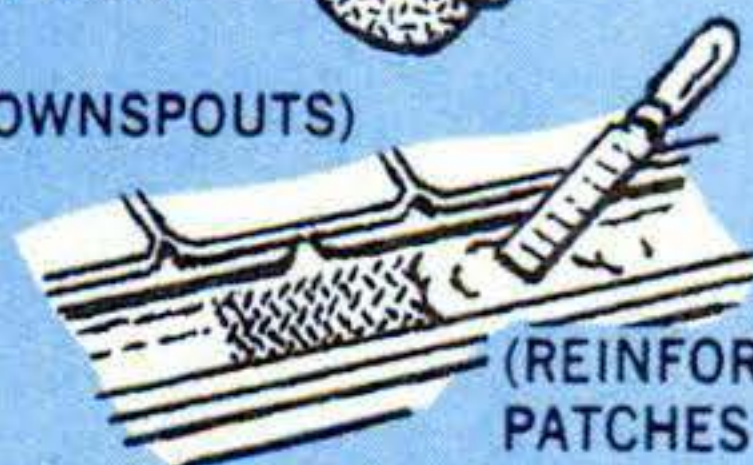
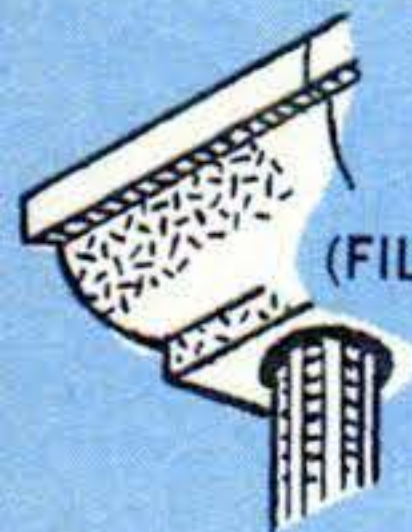
CAULK METAL FRAMES SET IN MASONRY

REPAIR GUTTERING



(METAL-TO-METAL PATCHES)

(FILLET DOWNSPOUTS)



(REINFORCE PATCHES IN WOOD WITH SCREENING)

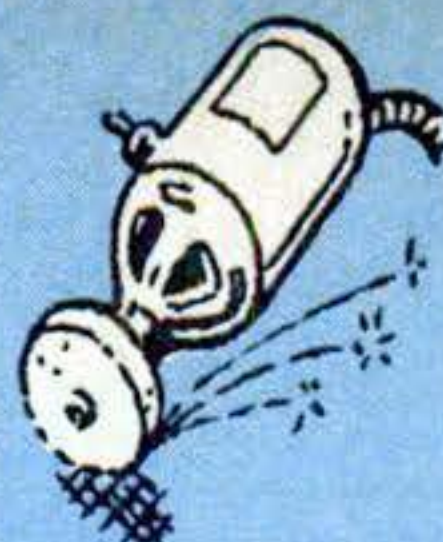
4 SURFACING

FILE ELMER'S EPOXY METAL COMPOUND



SAND IT

EVEN GRIND IT



5 TAPPING

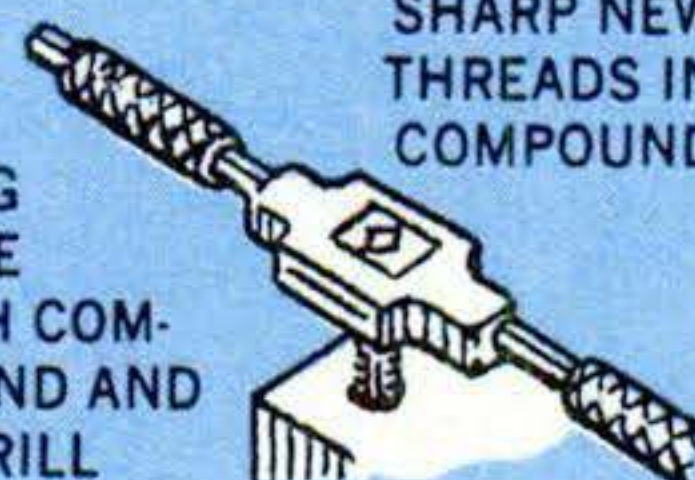
(A) ROUT OUT STRIPPED THREADS WITH OVER-SIZE BIT



(B) PLUG HOLE WITH COMPOUND AND REDRILL FOR TAPPING



(C) CUT STRONG, SHARP NEW THREADS IN COMPOUND



Metal Compound

FILLING. To build out a dent in sheet metal work, apply only enough compound to bring the surface slightly higher than surrounding areas for dress-up filing or sanding after the material cures. That's one of the advantages of ELMER'S Epoxy Metal Compound—there's no appreciable shrinkage to allow for with guesswork overfilling. On vertical surfaces, unusual nonslumping characteristics let you apply heavy filler coats. But don't expect the impossible. If dents are deep, lay on several coats, letting one harden before adding another (drawing 2).

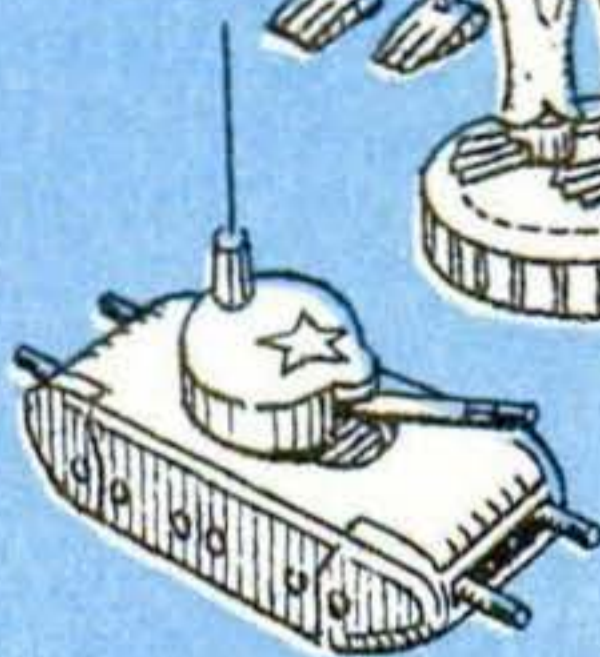
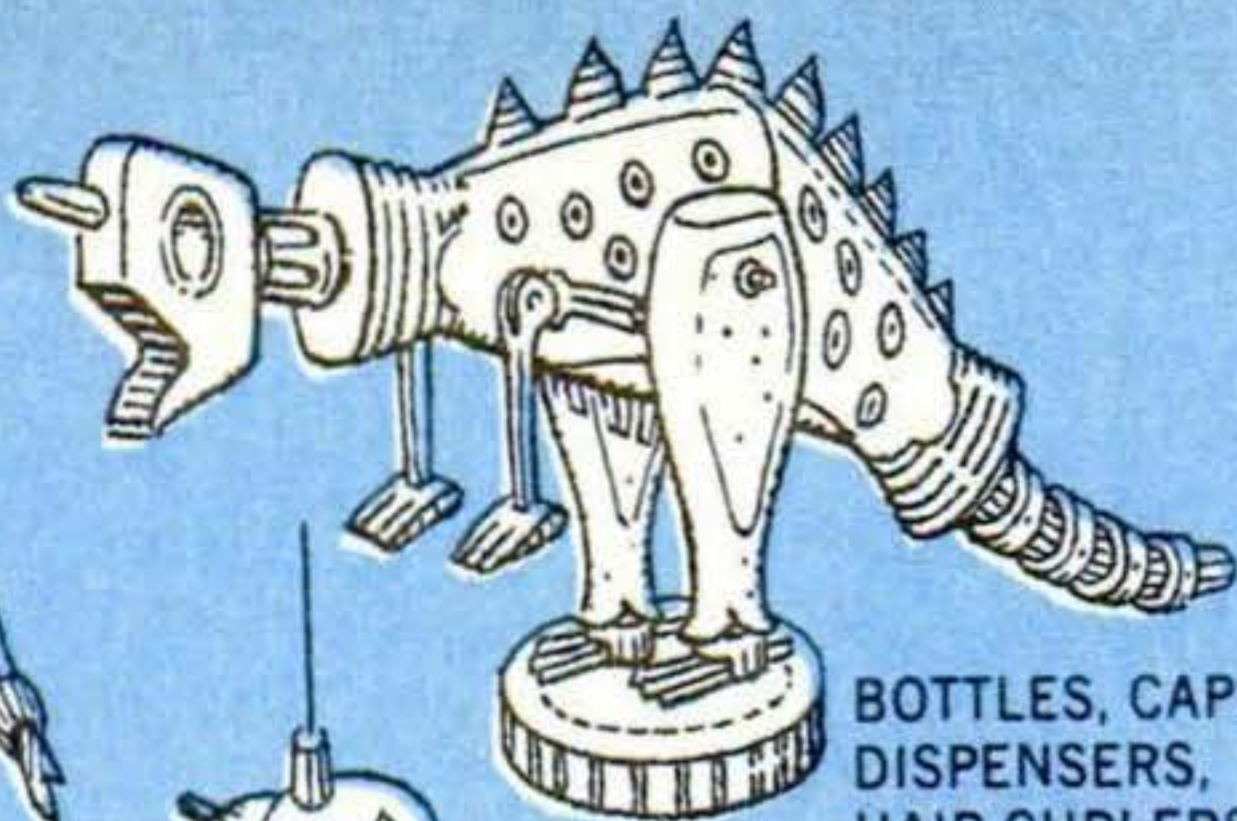
SEALING. A small hole in a car radiator or leak in a pipe joint needs only a dab of ELMER'S Epoxy Metal Compound for a permanent seal (drain out water first, to insure a dry and pressure-free work area). Where you're dealing with rust-outs in metal gutters, apply patches of the same metal,

bedding them in compound and feathering edges smooth. With wood gutters, cut back to solid stock, bridge the gap with wire mesh screening and cover with ELMER'S Epoxy Metal Compound (drawing 3).

SURFACING. After ELMER'S Epoxy Metal Compound hardens, bring it to surface—contour with either woodworking or metal-shaping tools and abrasives (drawing 4). Painting is no problem. Enamels, lacquers, and water-soluble paints can be applied without special priming.

MACHINING. Where stripped threads in a bolt-hole no longer offer a grip for bolts and studs, bore the hole to larger diameter and fill with ELMER'S Epoxy Metal Compound. After curing, drill an undersized hole through the center of the plug, tap—and you're back in business (drawing 5). Machining characteristics like this make ELMER'S Epoxy Metal Compound a favorite of professional mechanics and pattern-makers. They work it just like conventional metals—even with latheing and milling.

TOYS FROM PLASTIC DISCARDS

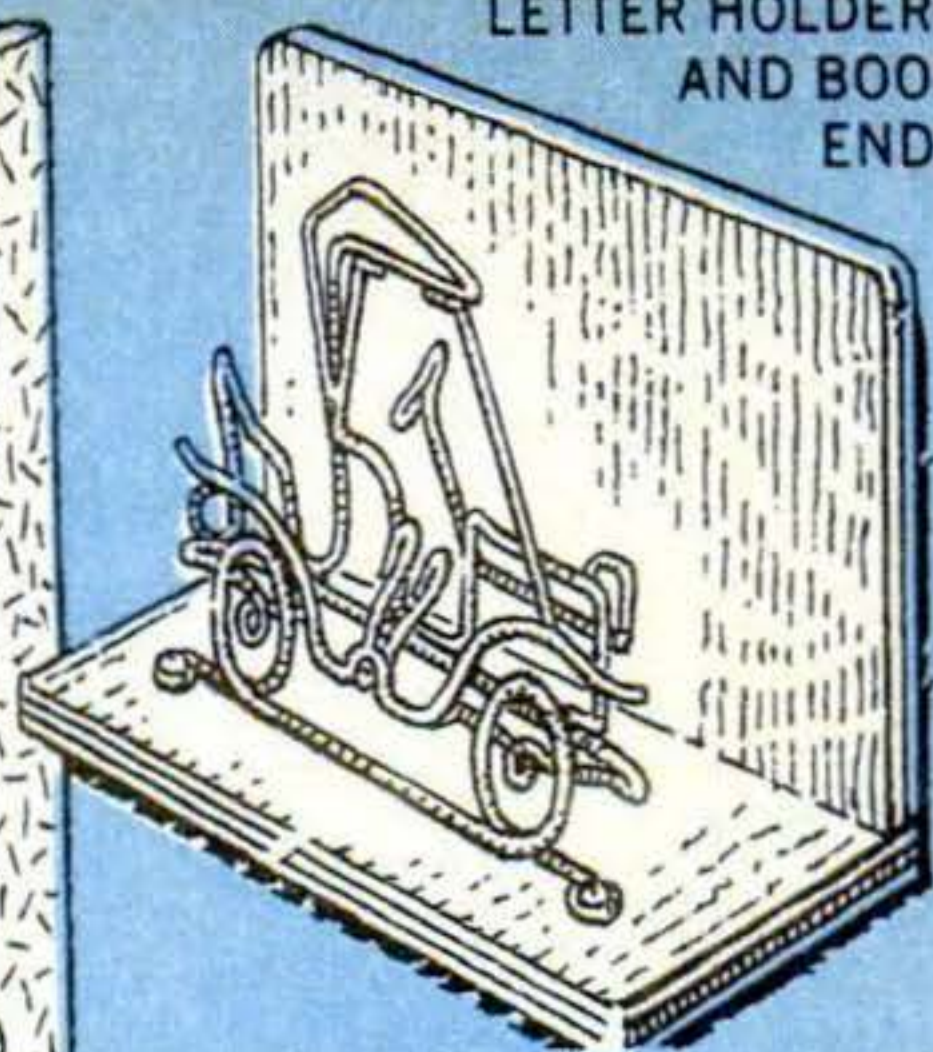


BOTTLES, CAPS,
DISPENSERS,
HAIR-CURLERS,
COMBS, PENS, ETC.

PLAQUES



LETTER HOLDERS AND BOOK ENDS

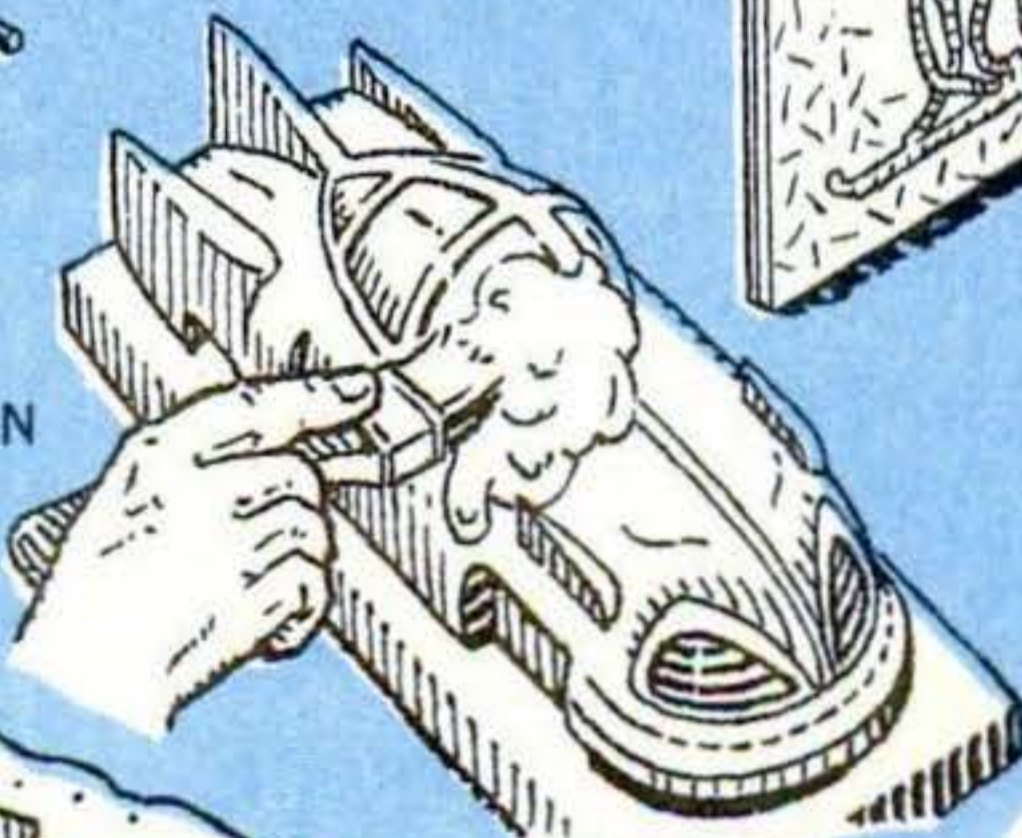


WIRE SCULPTURE

MODELING



(A)
COAT
PATTERN
WITH
LIQUID
LATEX



CASTING



(B) TROWEL
COMPOUND
INTO LATEX
MOLD

METALIZED CARDBOARD CUTOUTS

FIGURINES
AND
MOBILES



(C)
PEEL
MOLD FROM
HARDENED
CASTING



Arts and crafts

TOYS AND MODELS. Here, ELMER'S Epoxy Glue is the answer to metal-to-metal, and metal-to-wood bonds. Use it, too, to assemble plastic construction kits. The additional time you'll spend rewards you with far stronger joints than those made with conventional model cements, and eliminates the possibility of distorting or dissolving finely molded details. Another tip: By teaming ELMER'S Epoxy Glue with old plastic

utensils, and containers and caps of the kind everyone throws away by the hundreds each year, you can create distinctive toys and models that will delight any youngster and be real conversation pieces.

WIRE SCULPTURE. This fast-growing hobby no longer calls for skill with a soldering iron, gun, or torch. All you need to turn out novel wall plaques, letter holders, and trivets, are a few lengths of coathanger wire, softened by heating cherry-red on a stove burner, a pair of pliers, and easy-to-use ELMER'S Epoxy Glue.

MODELING. Top-flight sculptors have already recognized in ELMER'S Epoxy Metal Compound a new and exciting art medium. Applied over wire and mosquito-netting forms or "armatures," the non-slumping material can be molded into busts and figurines by building up successive layers and forming them with clay-working tools as they begin to set. After final hardening, the metal compound lends itself to further shaping with a hand grinder, and may be brought to a smooth finish with sanding and buffing.

CASTING. Medallions and small metal-like parts for costume jewelry and models are easily cast in large numbers using ELMER'S Epoxy Metal Compound poured into latex molds. Art stores carry liquid latex, a heavy-bodied fluid that is brushed over patterns in successive layers. These harden and build up into thick elastic molds. After prying out the pattern, give the cavity a light coating of oil or cold cream. Then fill it with ELMER'S Epoxy Metal Compound. If necessary to release trapped air, joggle the mold and puncture the compound from the back with a straightened paper clip or toothpick. After it hardens you'll have a faithful reproduction of the pattern.

METALLIC "PLATING." Figurines, mobiles and ornaments, cut from cardboard and assembled with ELMER'S Glue-ALL, may be given the effect of antique bronze castings by coating them with ELMER'S Epoxy Metal Compound and adding shallow relief with a stylus or other pointed tool. Dimple with a wire brush to simulate pitting left by sand molds. When the compound cures, paint with spatter coats of green, flat-black, and bronze enamel.

ELMER'S 7 rules for epoxies

1. CLEAN AND ROUGHEN WORK SURFACES. Remove dirt, oil, paint, metal plating, rust, or other foreign or loose matter from areas to be joined or covered. In addition, roughen nonporous surfaces.

2. IMMOBILIZE PARTS TO BE BONDED. Use hold-downs, where necessary, to keep parts aligned while epoxies set.

3. MIX SMALL BATCHES. Because epoxies start to harden quickly, mix no more than you can use in from 20 to 30 minutes. For big jobs mix successive batches. With ELMER'S Epoxy Metal Compound, usable time can be increased by blending components in a container placed in ice water.

4. WATCH THE THERMOMETER. Use epoxies at temperatures no lower than 60°. If you apply heat to speed hardening, temperatures should not exceed 150°.

5. KEEP UNUSED EPOXY COMPOUNDS APART. Avoid interchanging caps and, when dipping components of epoxy metal compound from their cans, use a separate utensil for each. Otherwise a portion of one component transferred to the other will cause hardening in the container.

6. REMOVE EPOXIES FROM HANDS AT ONCE; they can be irritating. Wipe off with nail polish remover or denatured alcohol. Then wash with soap and water.

7. KEEP OUT OF CHILDREN'S REACH. Store on a high shelf or in a cabinet.

WORKING WITH ELMER'S EPOXIES
 THE BORDEN CHEMICAL COMPANY, A DIVISION OF THE BORDEN COMPANY, NEW YORK 17, N. Y.



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CERAMICS	MARBLE
CHINA	ALUMINUM
BRICK	PORCELAIN
MOST PLASTICS	

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Epoxy-Metal
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fills - bonds - repairs

METAL, MOST HARD
 PLASTICS, TILE,
 CONCRETE, BRICK,
 MARBLE, CERAMICS,
 WOOD, GLASS

BONDS STRONGER THAN NER

what's new

.....BOATING



Three-Point Hull in New Models

These slick 17-footers are two of the newest models in the OMC 17 line of out-drive three-point hulls introduced a year ago. Outboard Marine's Seasport (left) is powered by an 88-hp. V-488, a new light-weight, compact, two-cycle engine, and is

designed for fishing, camping, skiing, or skindiving. The 176-hp. twin-engined job at right is a Dual Deluxe capable of speeds of more than 40 m.p.h. The Seasport is listed at \$2,995, the Dual Deluxe at \$4,250, both f.o.b. Waukegan, Ill.



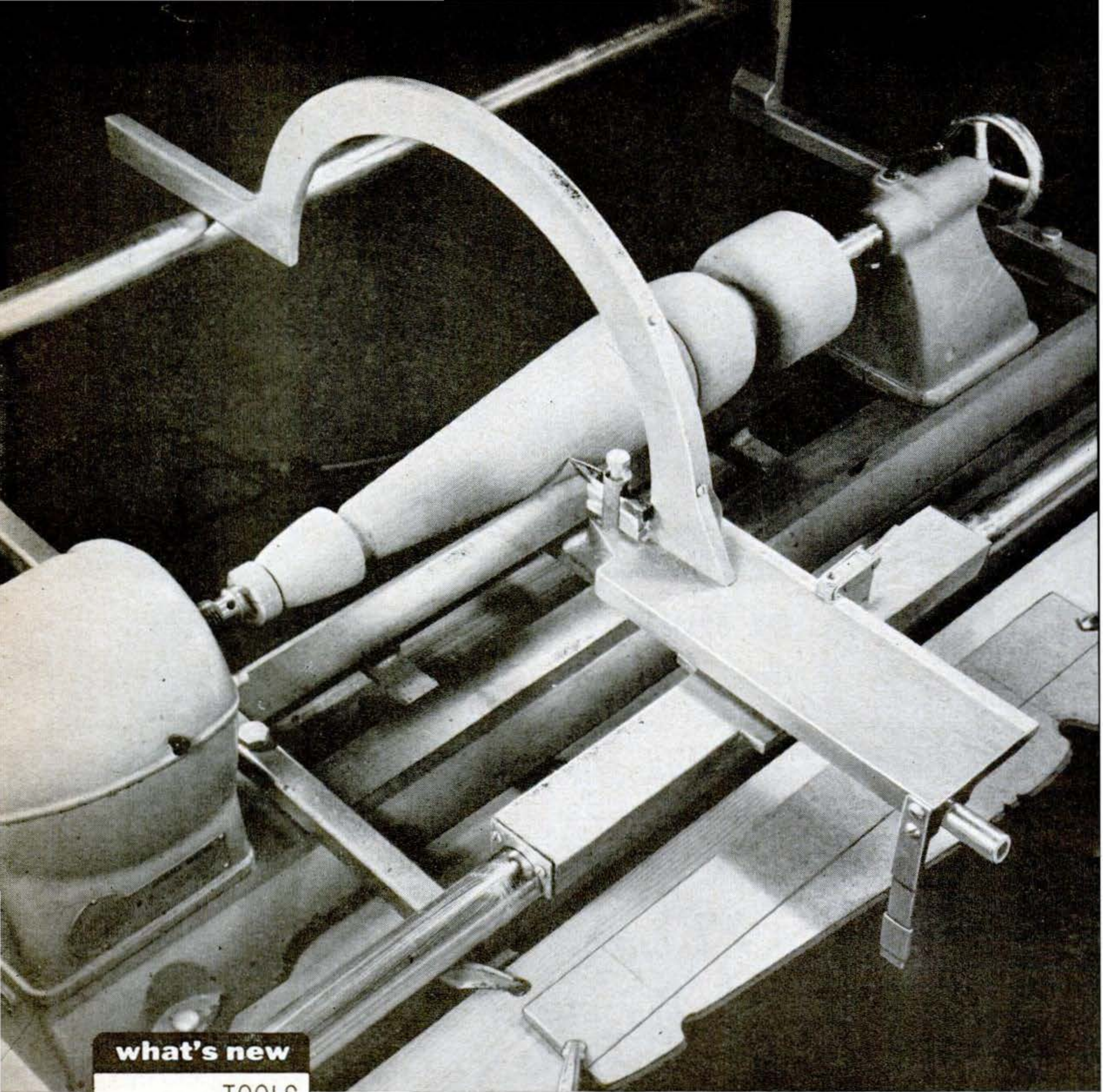
Laminated sails need no stitching

Latest in sailmaking is laminated seams with no stitching. Ratsey & Laphorn, City Island, NYC, does it by butt-jointing the edges of dacron panels, fastening with colored synthetic tape on both sides, then impregnating with a bonding agent. Seams reduce friction, make for smoother air flow.

Install-it-yourself marine radiophone

The 12-volt radiophone below has a 25-watt transmitter and an eight-transistor receiver with three-microvolt sensitivity on marine bands, 20 on broadcast. At Heath Co., Benton Harbor, Mich., \$189.95.





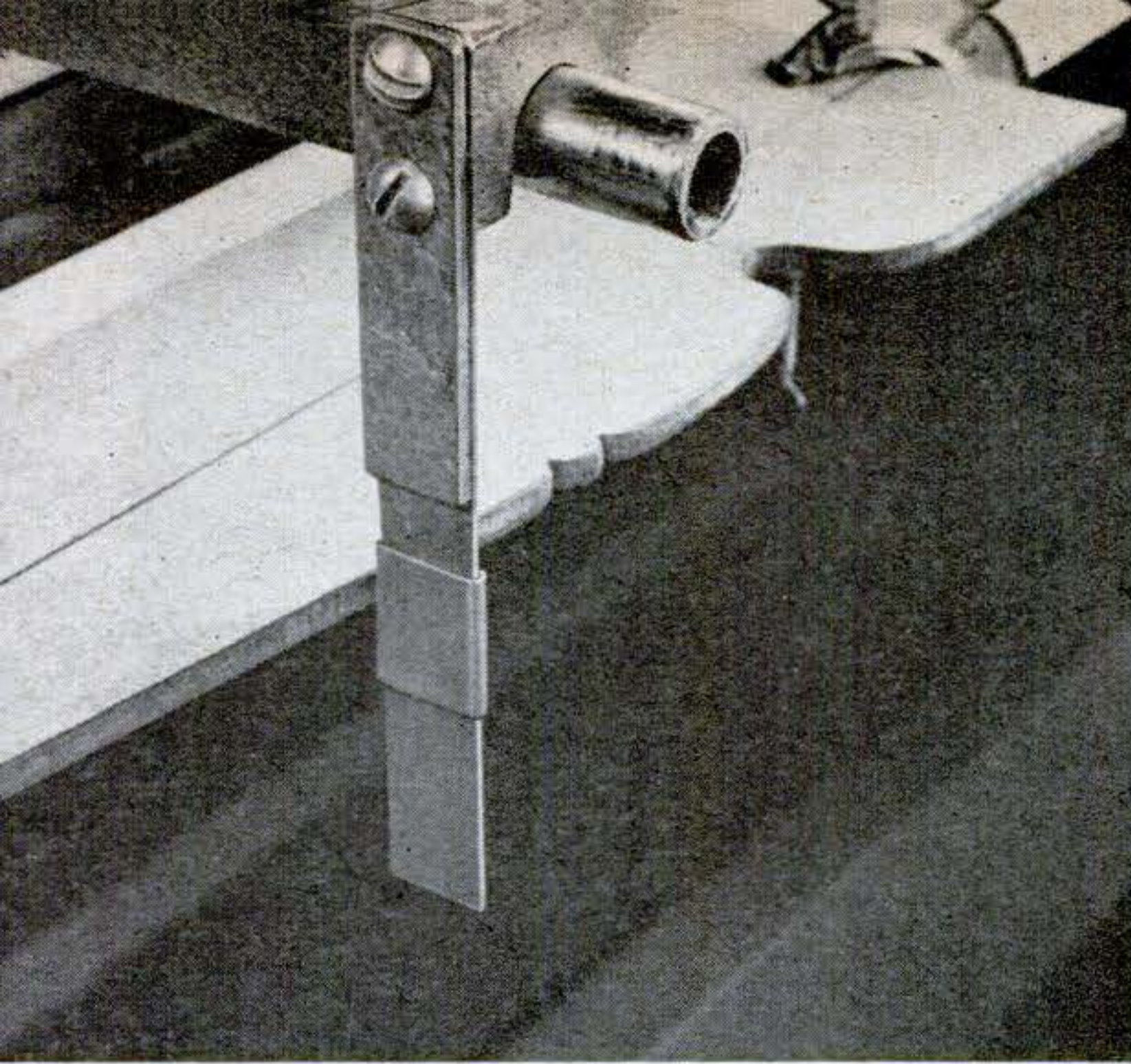
what's new

.....TOOLS

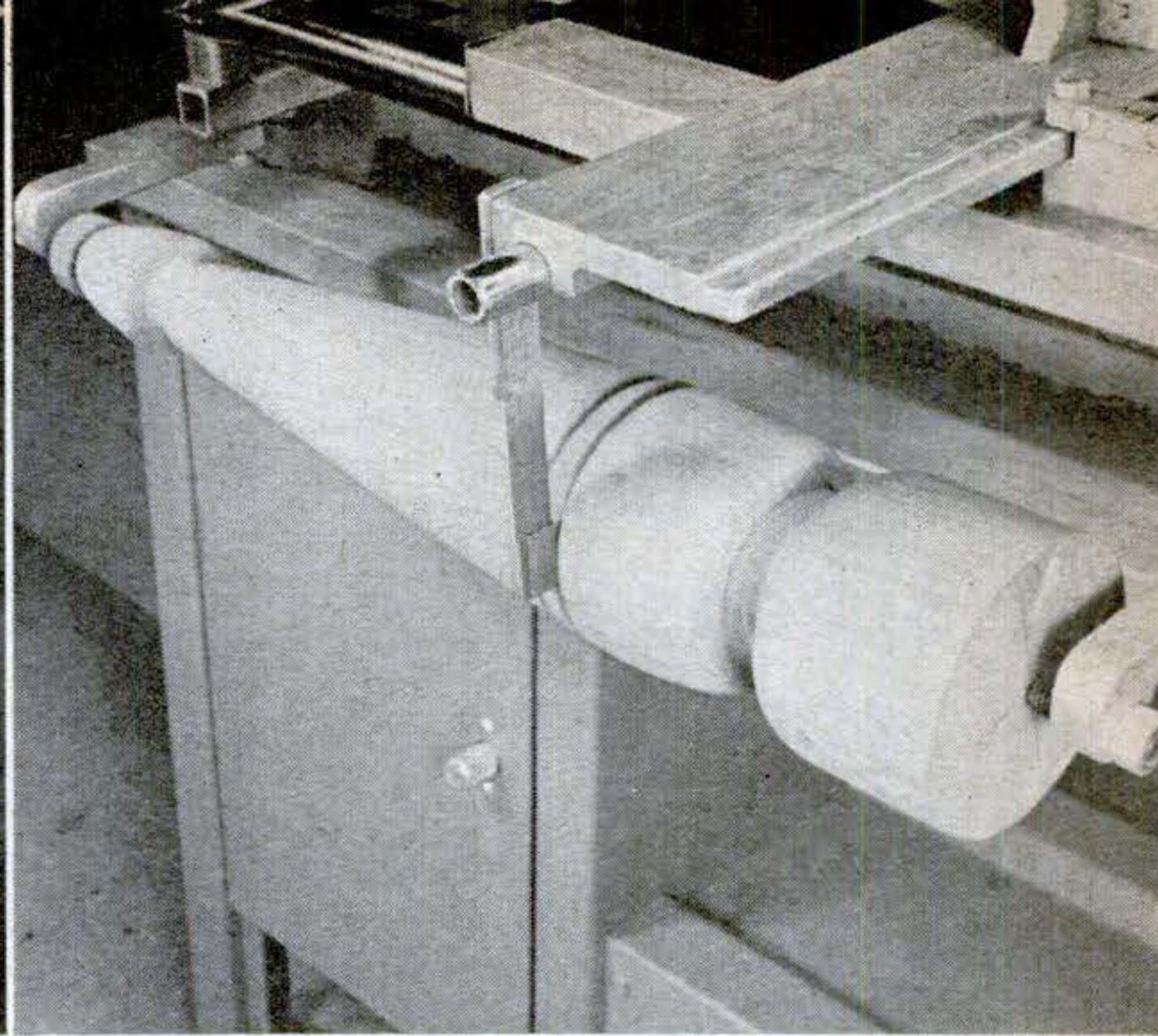
Now... Automatic Turning for Your Lathe

By R. J. De Cristoforo

THERE'S only one thing better than being able to turn out beautiful shapes on a lathe—and that's being able to do it automatically. This new lathe duplicator, called the Giz, allows you to do just that. Insert a profile template of the shape you want turned at the front of the lathe, and a cutter bit mounted on a sliding car-



How it works: A steel feeler guide rides along edge of the pattern, moving the carriage in and out. The cutting bit, mounted on the carriage, duplicates the pattern in the spinning work.



Turned shapes can be copied in the same way as a flat template. A sleeve on the feeler lets you rough-cut the work slightly oversize. For final trimming, the sleeve is slid out of the way.

riage faithfully follows the shape, producing an exact three-dimensional copy in the lathe.

The duplicator, designed especially for home shops, is one of the slickest we've seen short of the big, costly types used in industry. It automatically reproduces any shape that can be turned by conventional methods and takes the sweat out of trying to follow a template freehand with trial-and-error cuts.

The truth is, we found the Giz so versatile that, once you've mounted one on your lathe, you can throw away the conventional toolrest and chisels—you just don't need them. When you're not duplicating a pattern, the attachment can be used just as easily and accurately for freehand turning.

The carriage that holds the cutter moves

in two directions—sideways along two tubular rails fastened to the lathe, and in and out to vary the depth of cut. A feeler guide attached to the carriage rides along your template, forcing the cutter to move in an identical path.

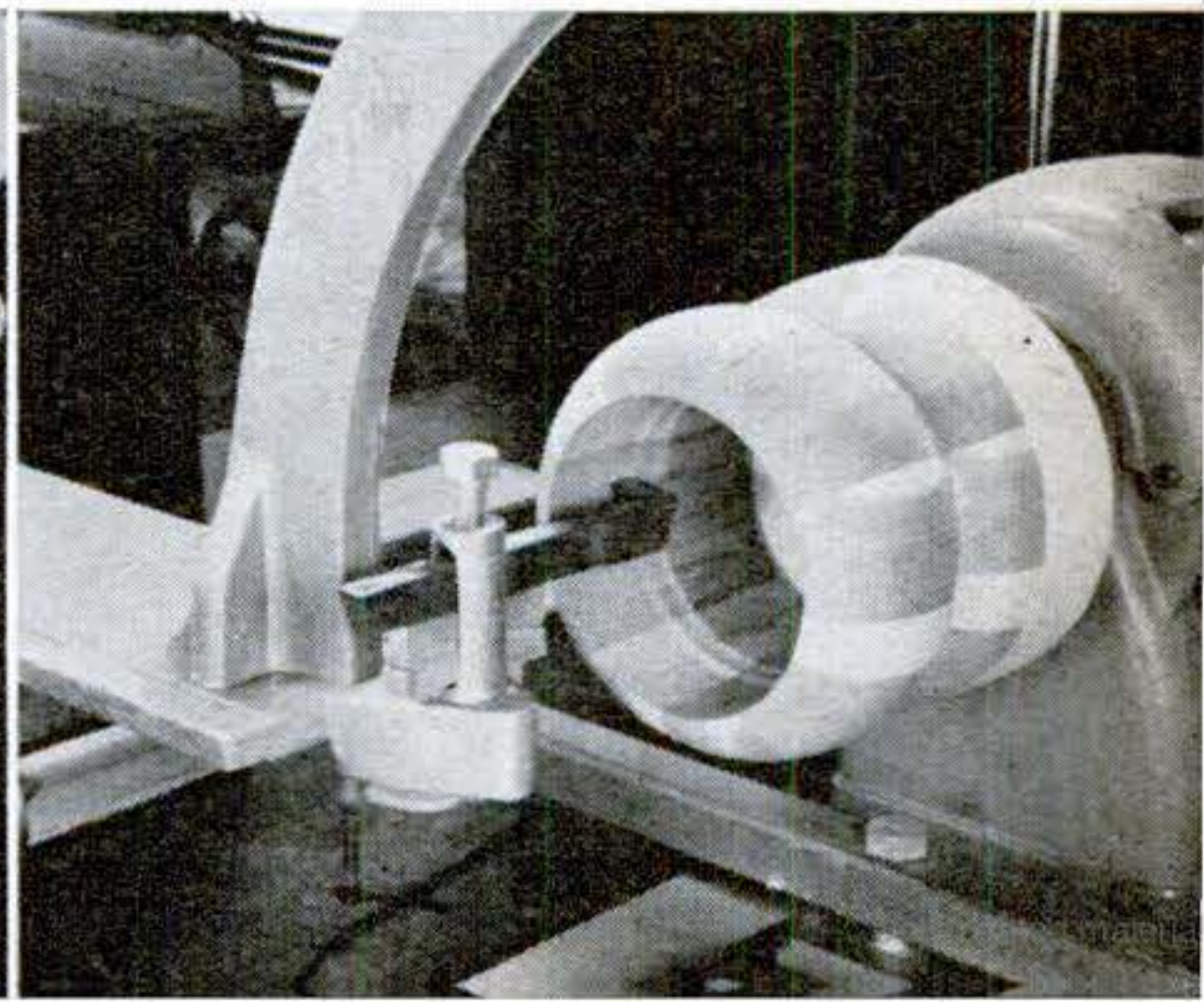
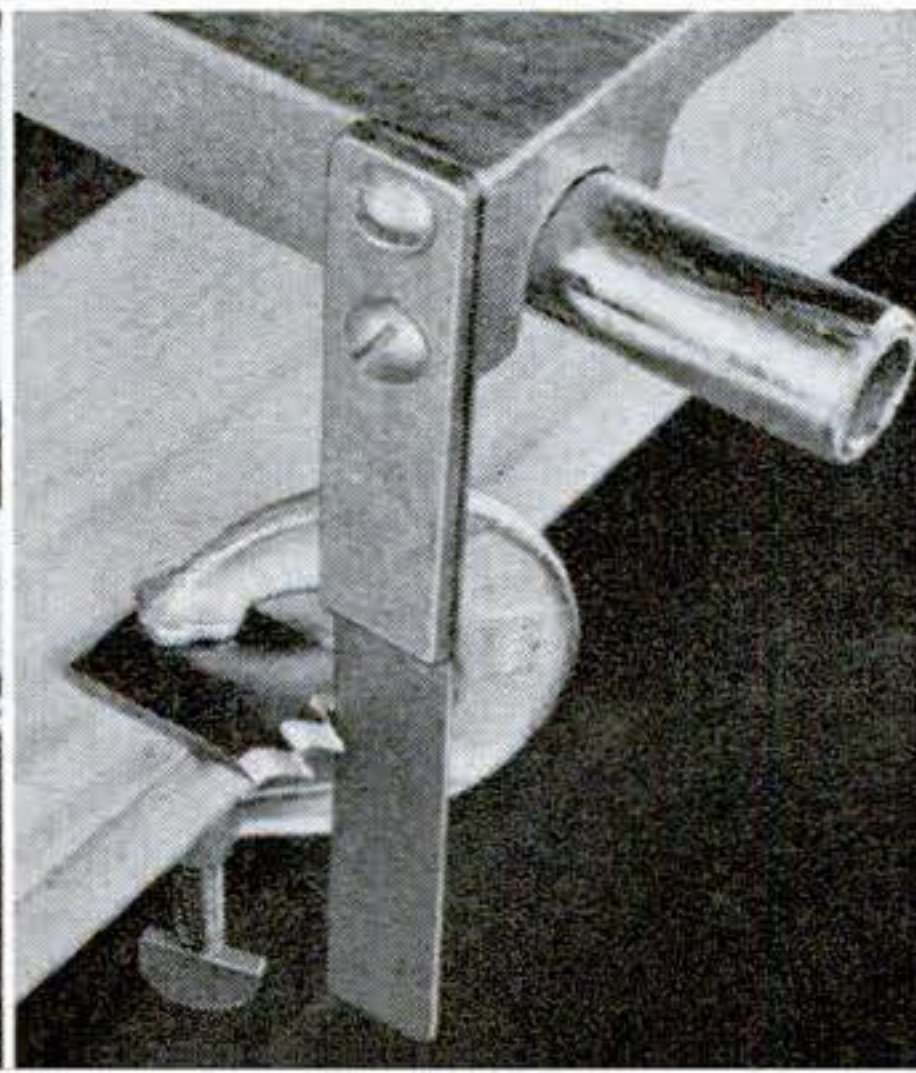
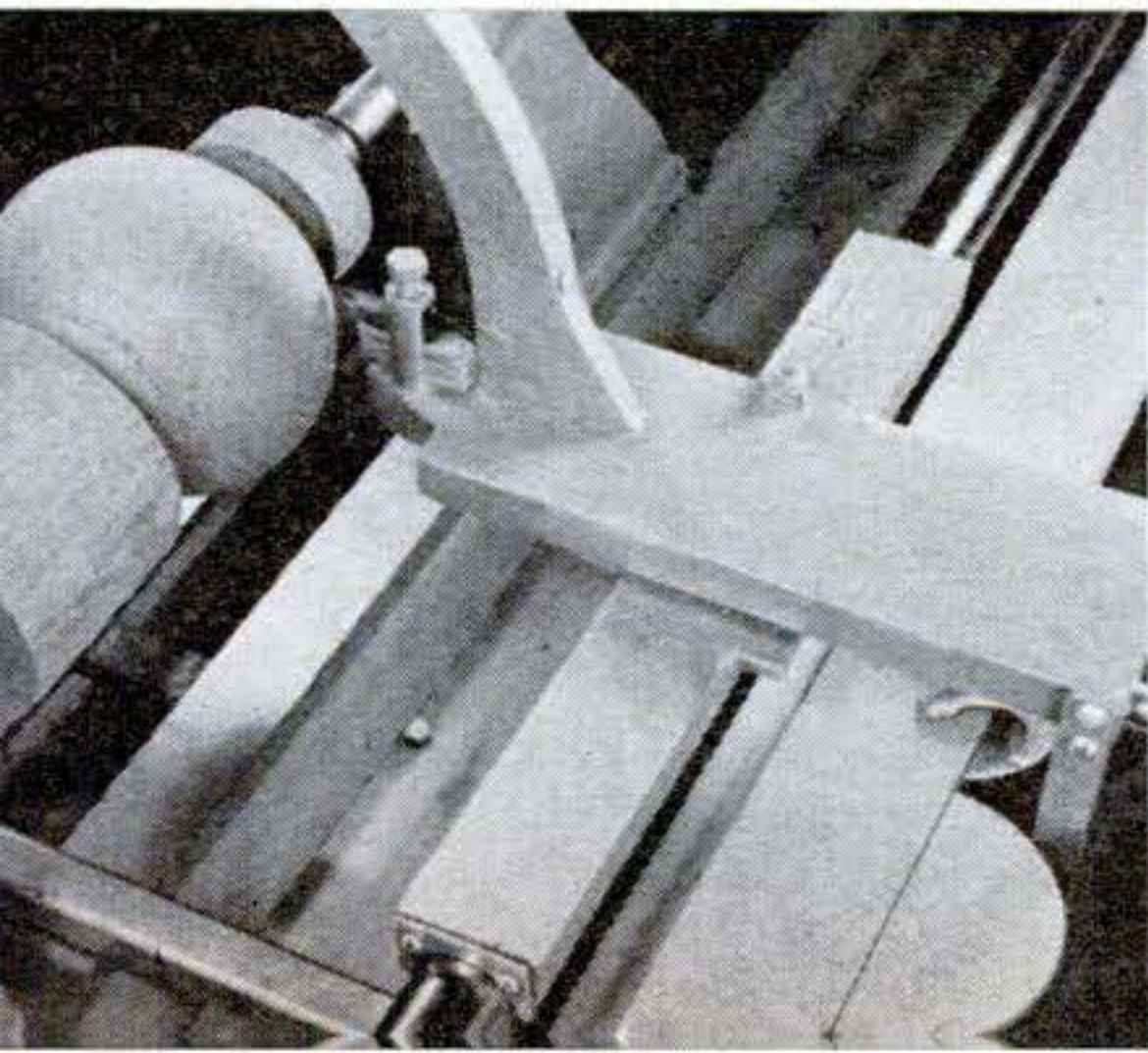
The standard cutter, which looks like a sharply pointed machine bit, is slim enough to reproduce even highly detailed patterns. For straight cuts and faceplate turning, other cutters are available.

The two-way motion of the carriage seems a little strange at first, we found, but is not at all difficult to control once you get used to it. The Giz is not a cheap accessory—it sells for about \$125—but you'll find that its remarkable abilities are well worth the investment. The Model 201 shown is made by Gizco, Whittier, Calif.

Perfect ball shapes, normally a tricky lathe job, are easy with this half-round template cut from hardboard. Work is rough-shaped first without the feeler touching the template.

Molding knives make handy templates for intricate detail work. Here, a fluting cutter is used to produce symmetrical rings. Note how the feeler follows even fine contours.

For faceplate turning, tool holder is turned 90 degrees in the carriage. A special right-angle feeler guide is sold as an accessory, as are extra-long cutting bits like this one.



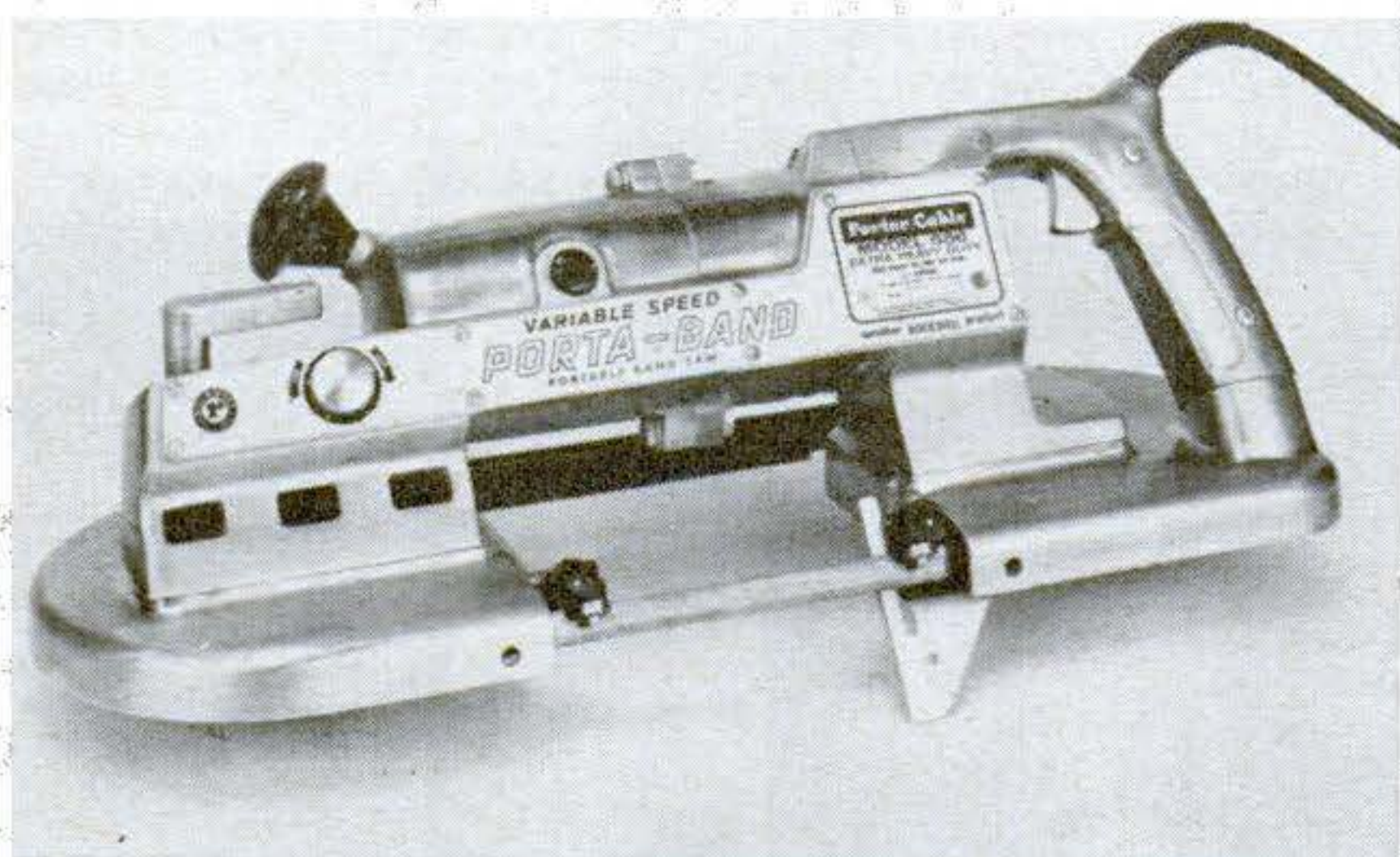
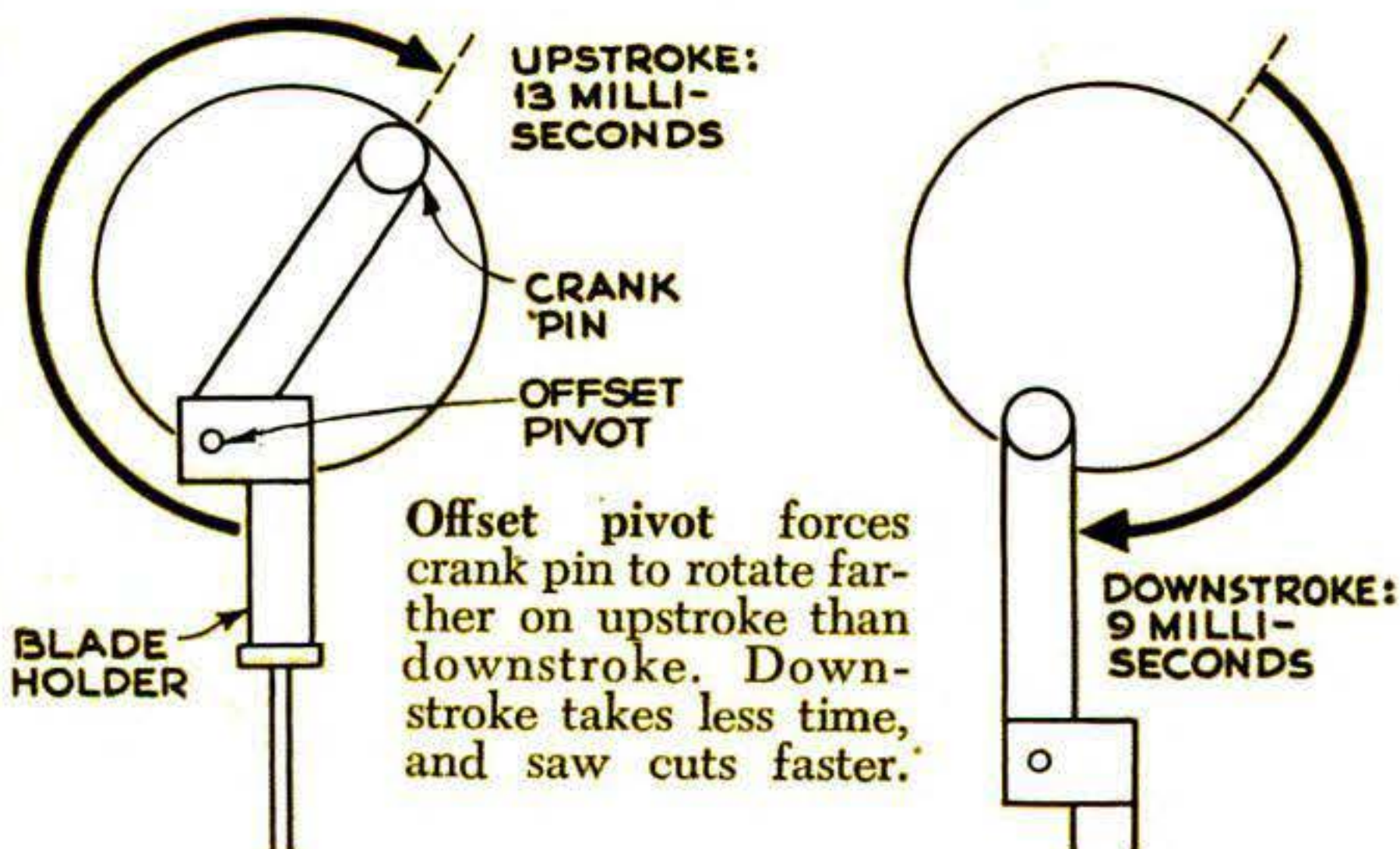
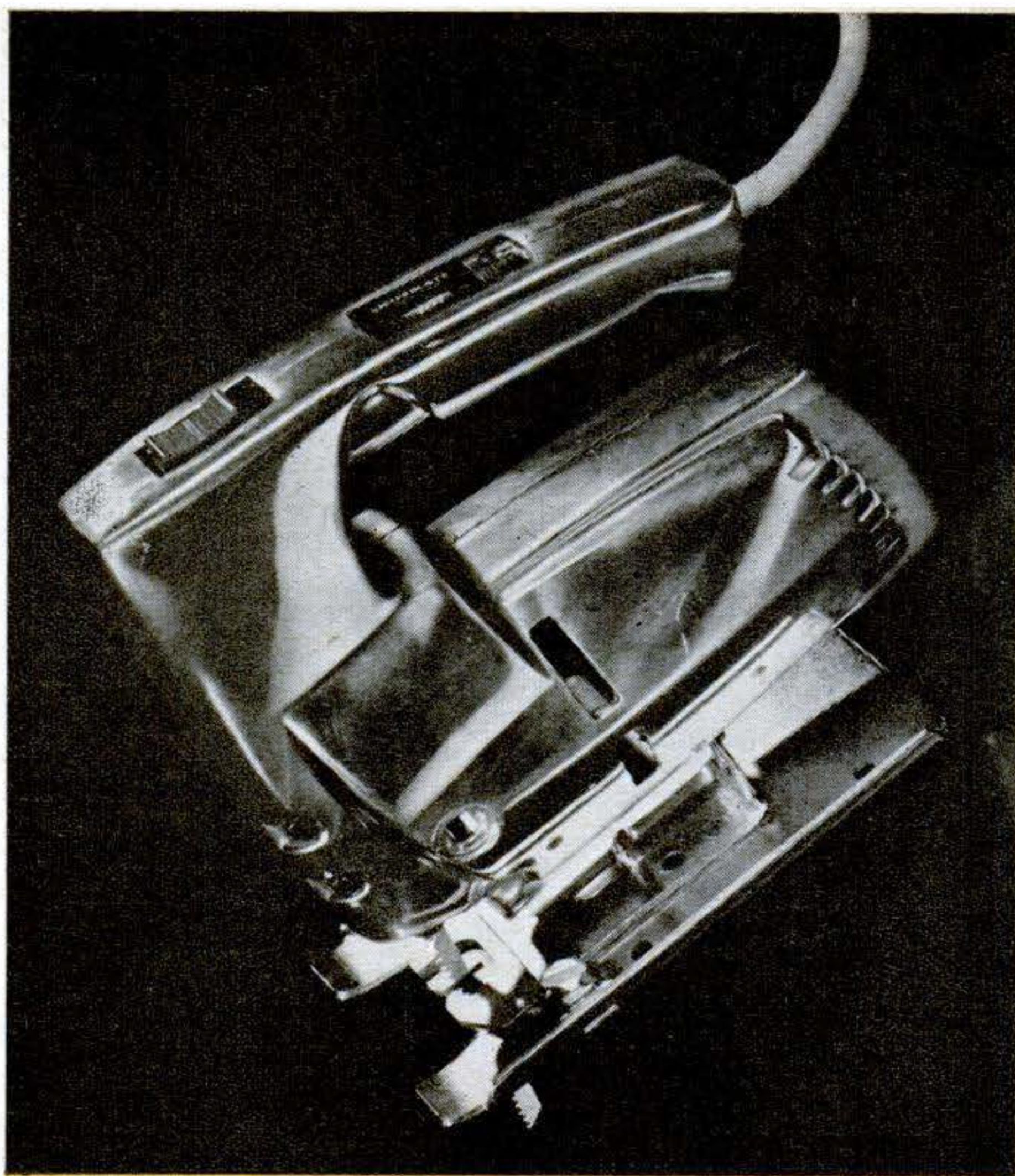
what's new

.....TOOLS

Trick Drive Speeds Up Saber Saw

How do you make a saber saw cut faster without increasing blade speed beyond the efficient point? This Shopmate turns the trick by speeding up its noncutting downstroke, then *slowing down* its cutting upstroke to normal speed.

This is done by an offset pivot on the blade holder that forces the crank pin to move farther on the cutting stroke than on the return stroke. Result: Total cut-and-return time is shortened several milliseconds, enabling the saw to make nearly 20 percent more cutting strokes a minute without traveling any faster than normal. The saw also has a removable blade guide (shown in photo) that keeps thin, delicate blades from twisting on scroll cuts. About \$25, Portable Electric Tools, 1200 E. State St., Geneva, Ill.

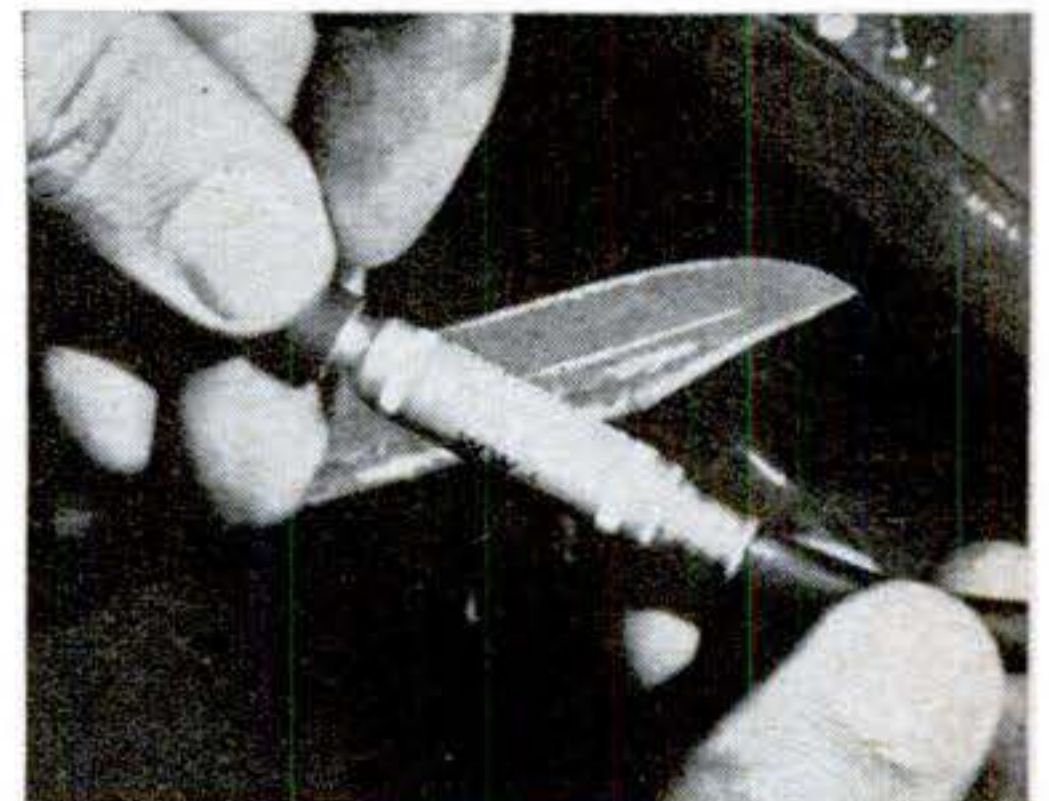


New dial-your-speed bandsaw

Twirl a knob on this Porter-Cable portable bandsaw and you can dial any blade speed from 80 to 250 surface feet per minute to handle wood or metal. The variable-speed drive uses a new silicon-controlled rectifier [PS, Dec. '62] that gives full power at any speed. The Porta-Band saw weighs only 16½ pounds. About \$298, Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh.

what's new

.....for your CAR



Filter Keeps Windshield Washers Squirting

Windshield washers won't clog if you install this 75-cent filter. The device is connected to the water hose, where it is said to trap dirt and sediment before they reach

the tiny washer spray jets. The filters, made by Fram, Providence, R.I., are available at service stations, can be installed in a few minutes without special tools.

Gun melts ice and snow on windshield

Instant defrosting of windshield and windows is claimed with this \$7.95 Safco Quickee defroster gun. It plugs into the cigarette-lighter socket. A blast of hot air from the nozzle melts snow and ice within 30 seconds, says A.G. Busch & Co., 6138 Northwest Highway, Chicago.

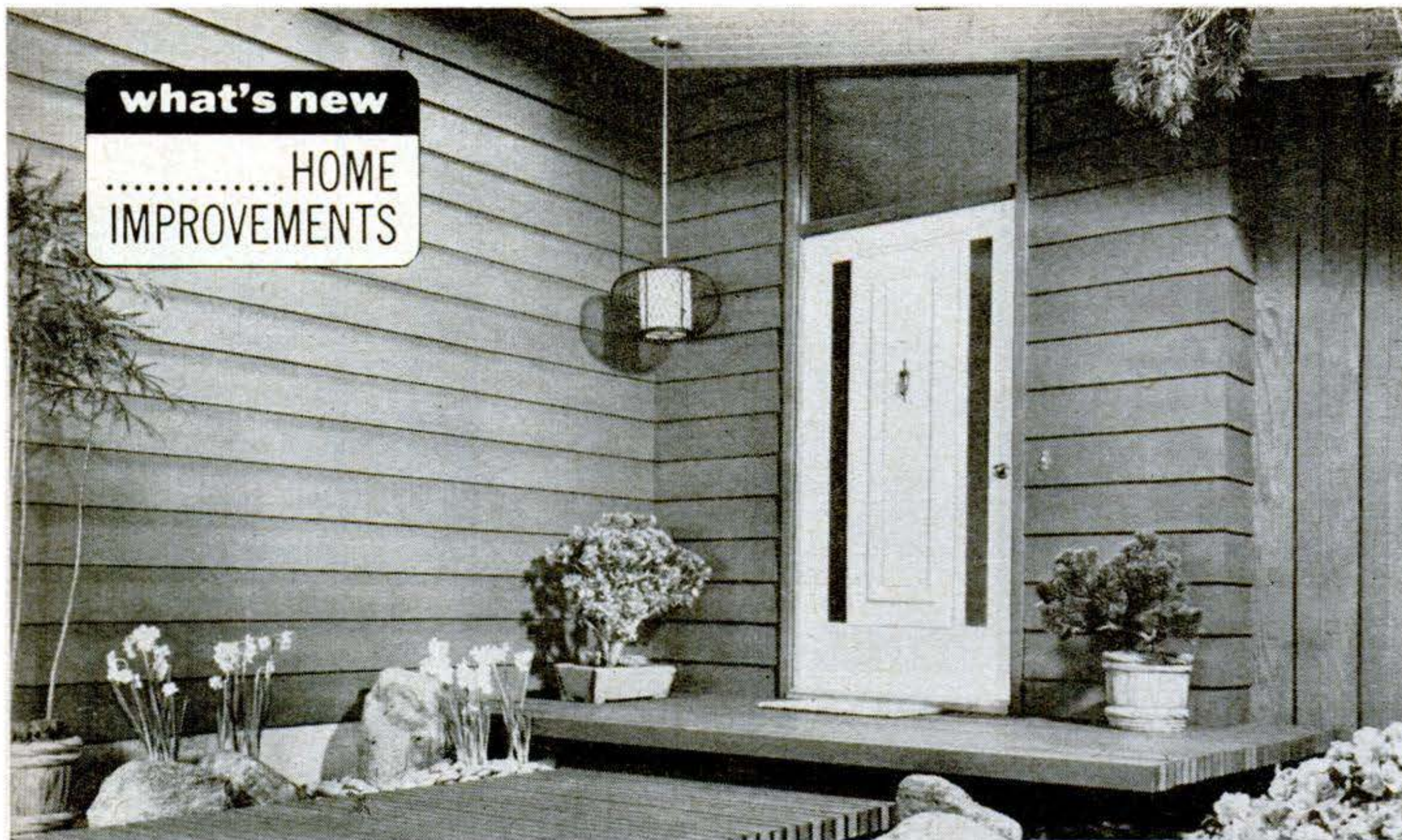
▶▶▶A booster heater for foreign cars is available from Sears, Roebuck and Co. The 6,000-BTU unit supplements existing heaters that are inadequate for U.S. winters. In very small imported cars it can even serve as the only heater. It fits the Dauphine, MGA, Simca, Volvo, Triumph, and others. About \$25, with all fittings and directions.



Kiddy harness holds tots in place

This nylon harness protects children when you have to stop suddenly, yet allows them to sit, stand, or sleep. The Kiddie

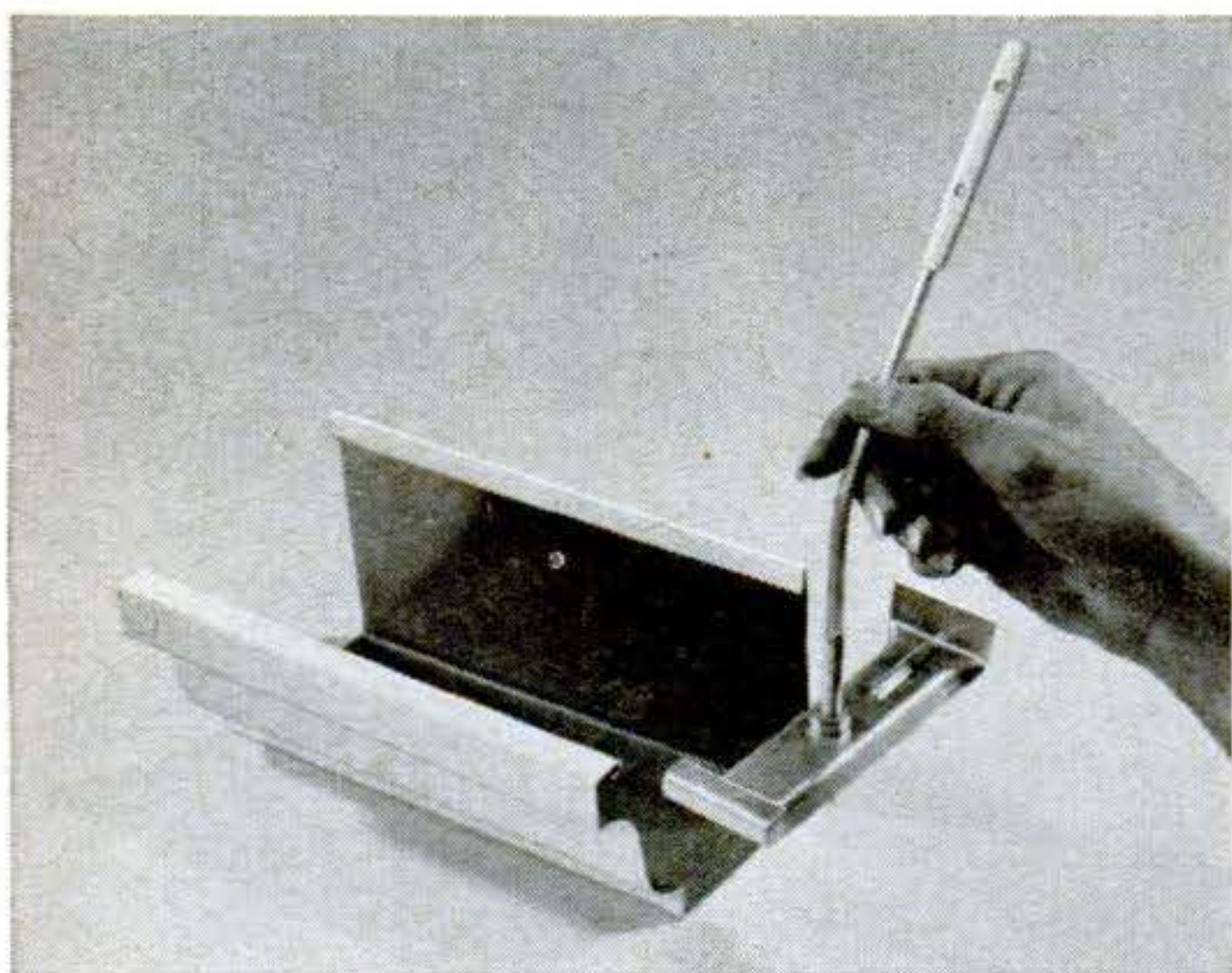
Keeper is made from seat-belt webbing and steel hardware. Waist-belt buckle, says the maker, is hard for a child to open; adults can unlatch it easily. \$6.95. Munro Mfg. Co., P.O. Box 5295, Pasadena, Calif.



Distinctive Entrance Door at Budget Price

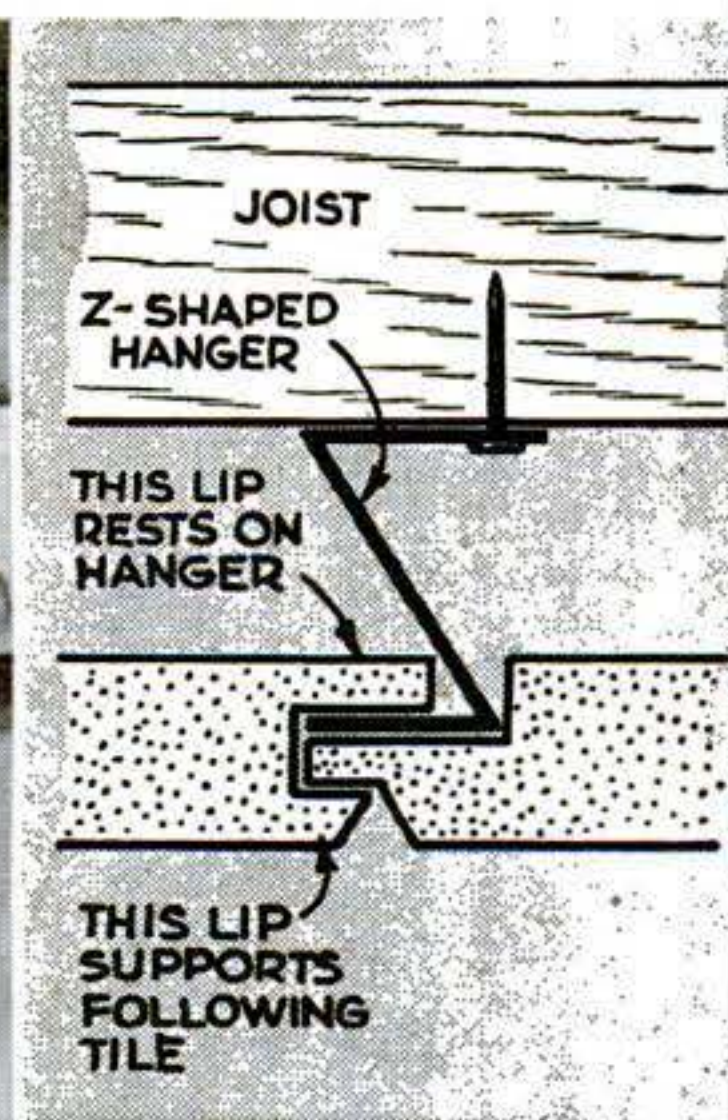
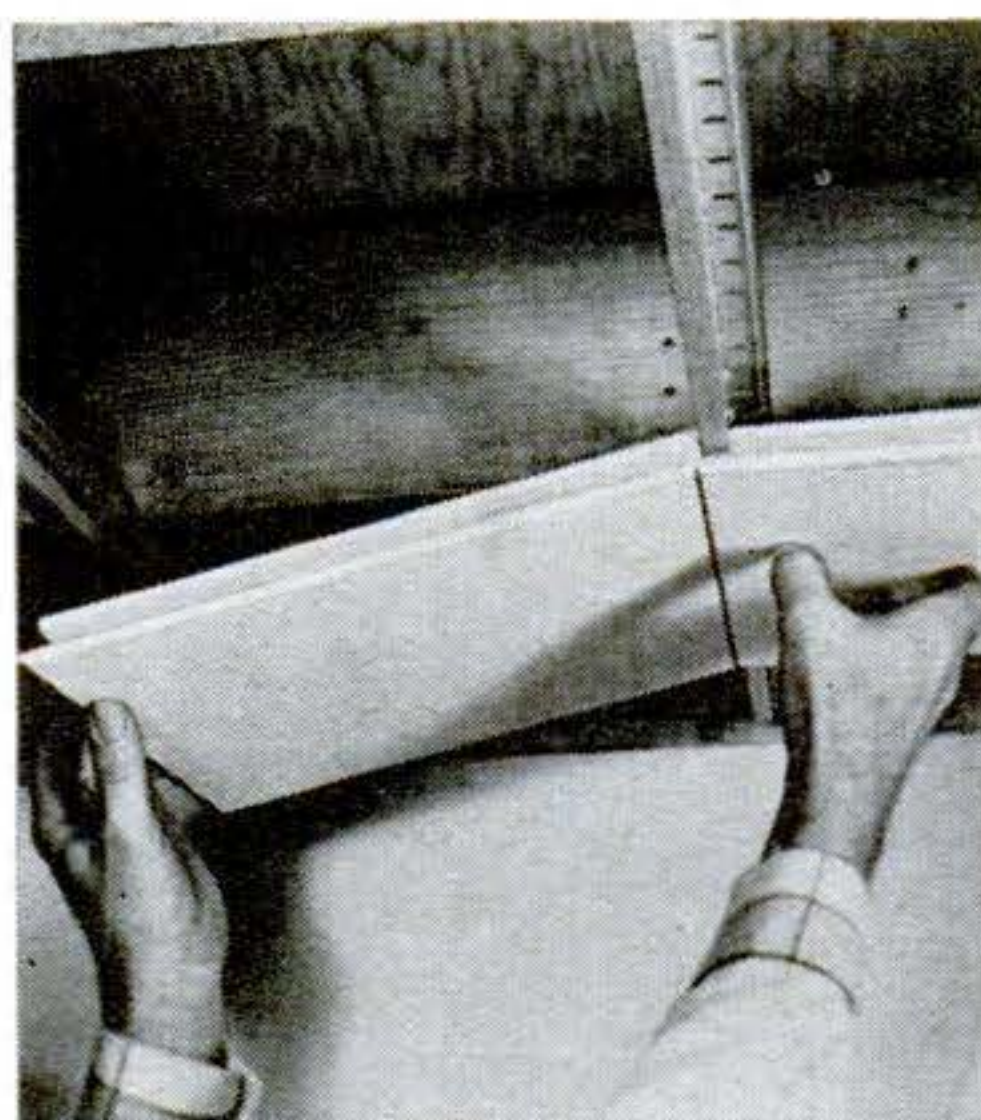
This paneled door is designed to give the entrance of your home an expensive custom look at moderate cost. You get a choice of four styles of panels that go with any kind of architecture, and they may be changed

at any time without having to buy an entirely new door. Walter Dorwin Teague designed the door for the Simpson Timber Co., Seattle. It's made in four widths, is 1½ inches thick, and sells for around \$34.



Gutter hanger has center suspension

A new type of hanger that gets around obstructions at the edge of a roof has been developed by Alcoa for use with its aluminum gutters. An aluminum plate that locks under the crimped edges is suspended from the center (instead of one end) by a rod you can bend to fit the roof's slope. Plate and rod are held together by two nuts. Hangers are available at Alcoa gutter dealers at less than 50 cents each.



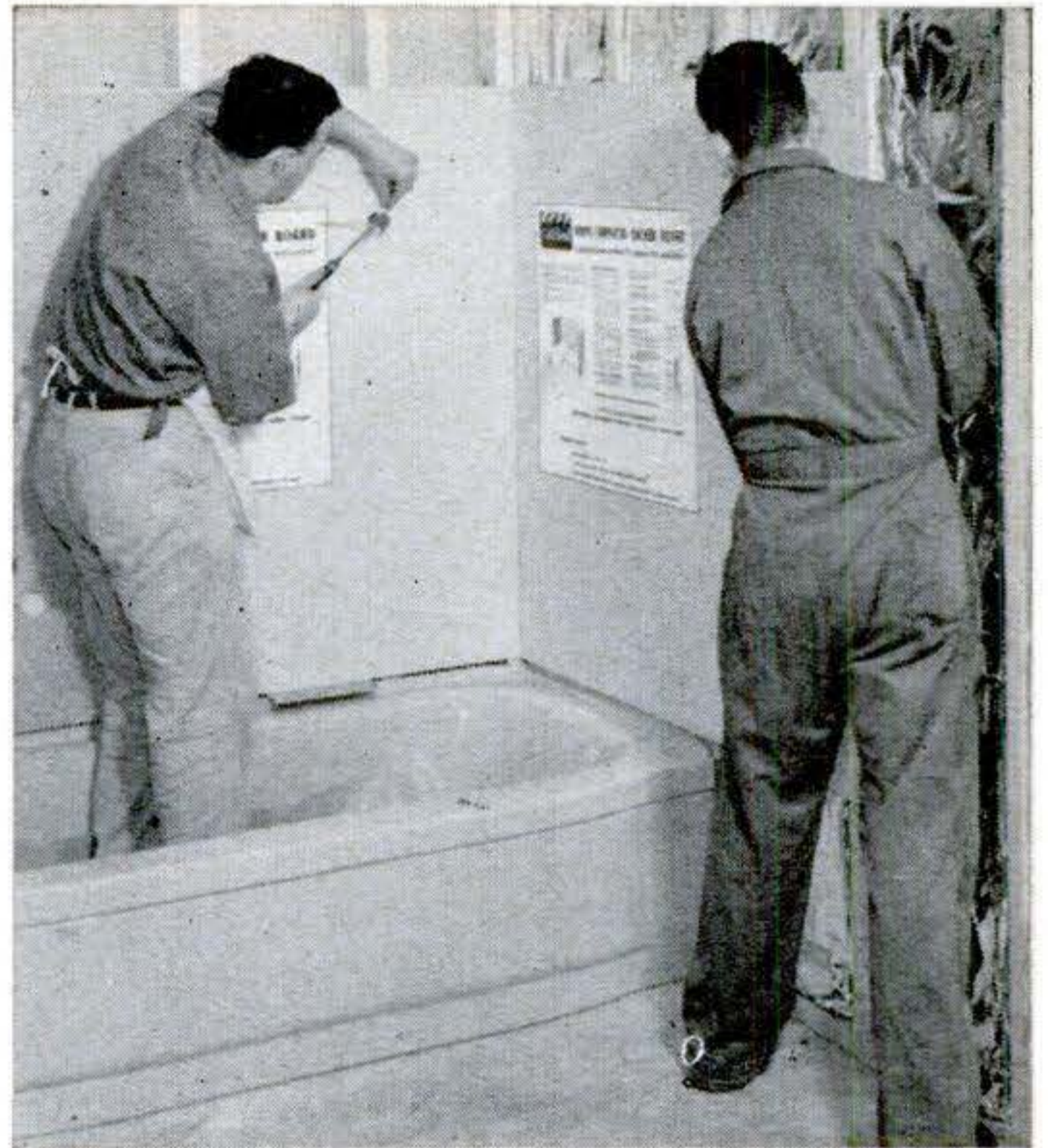
Z-shaped furring supports ceiling tiles

Once you nail this metal furring to the joists, it's a simple matter to lock tongue-and-groove tile boards into place. The easiest way to achieve professional alignment is to hang the tiles row by row, nailing on the next furring strip after each row is hung. Insulite Fastile furring is 5 cents per foot. The company also makes molding edge strips for 10½ cents a foot and plastic cove molding for 6½ cents.



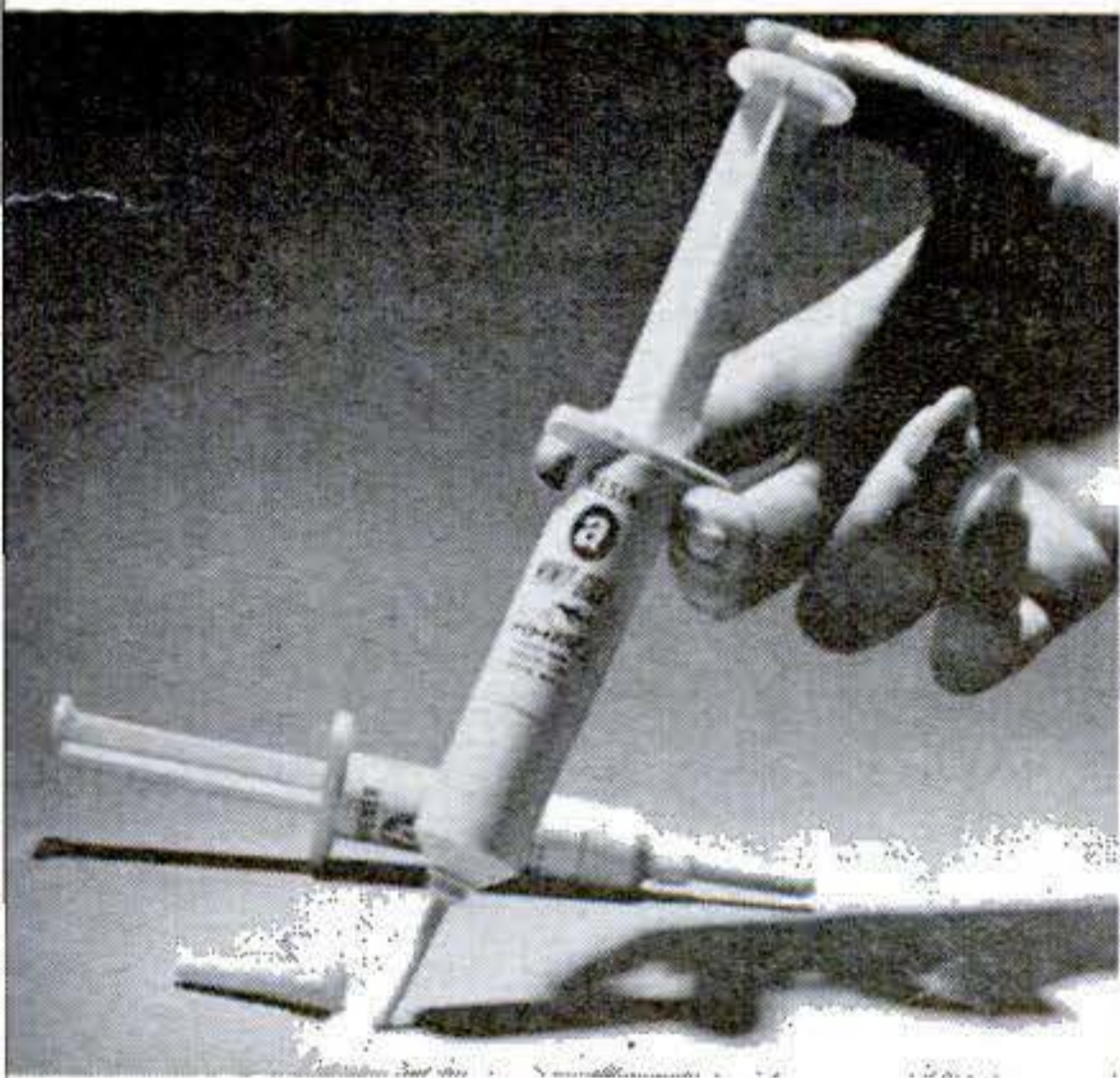
Crack cement has vinyl finish

Six chemicals in a concrete-repair mix, including vinyl compounds, give it extra bonding strength and make it go farther. Used in cracks in basement walls, driveways, patios, and the like, it dries to a hard vinyl finish. Aqua-Dri comes in 10- and 40-pound bags at \$2.25 and \$7.70 from Silcoa Products, 51 E. 42nd St., NYC.



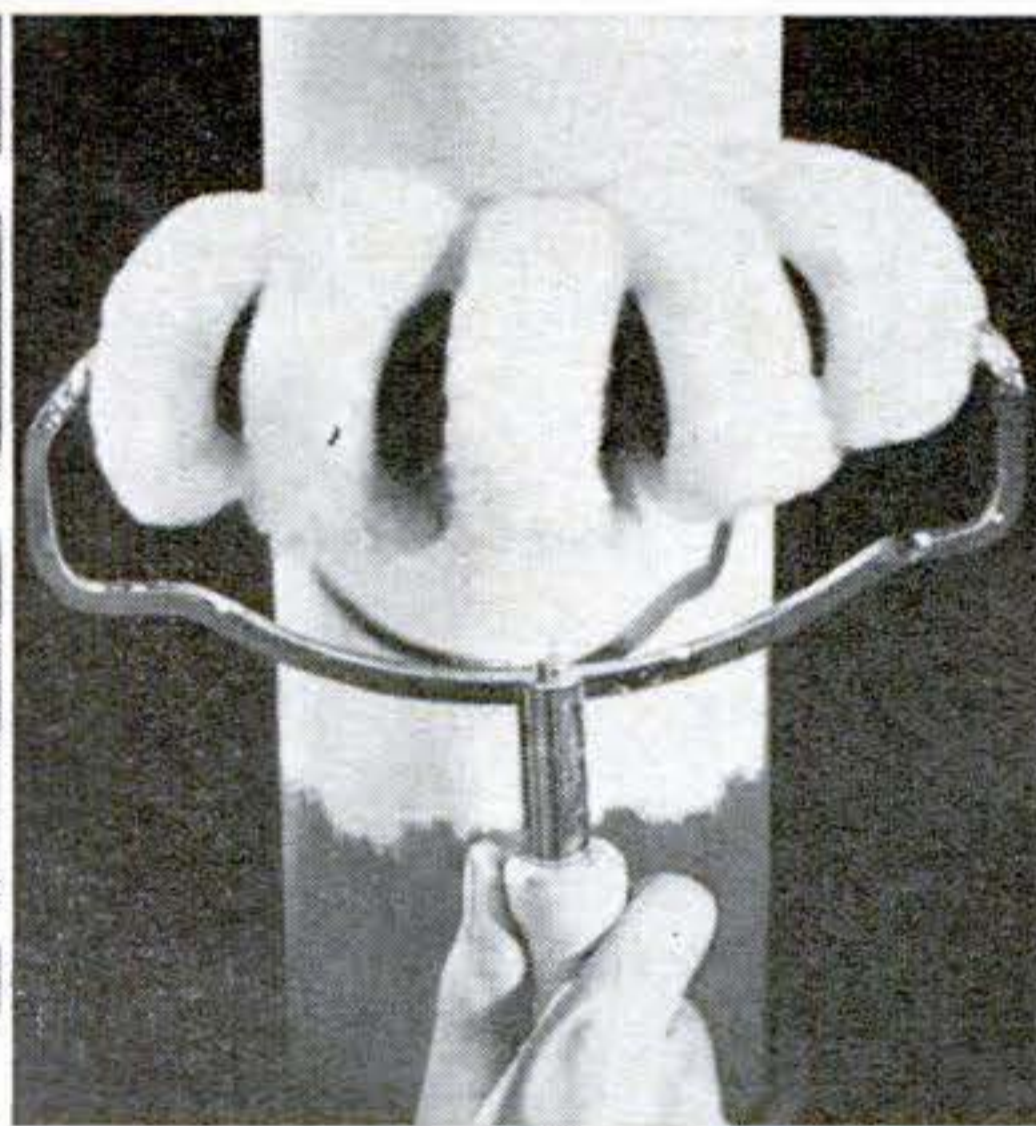
Vinyl-surfaced gypsum board

Waterproofing for the shower area around a tub is built into this backer board for wall tiles. It's National Gypsum's vinyl-surfaced Gold Bond. You install it in the same way as the rest of the drywall and do no other waterproofing. It costs \$7.50 to \$8.50 for a 4'-by-8' panel, enough to take care of a tub enclosure.



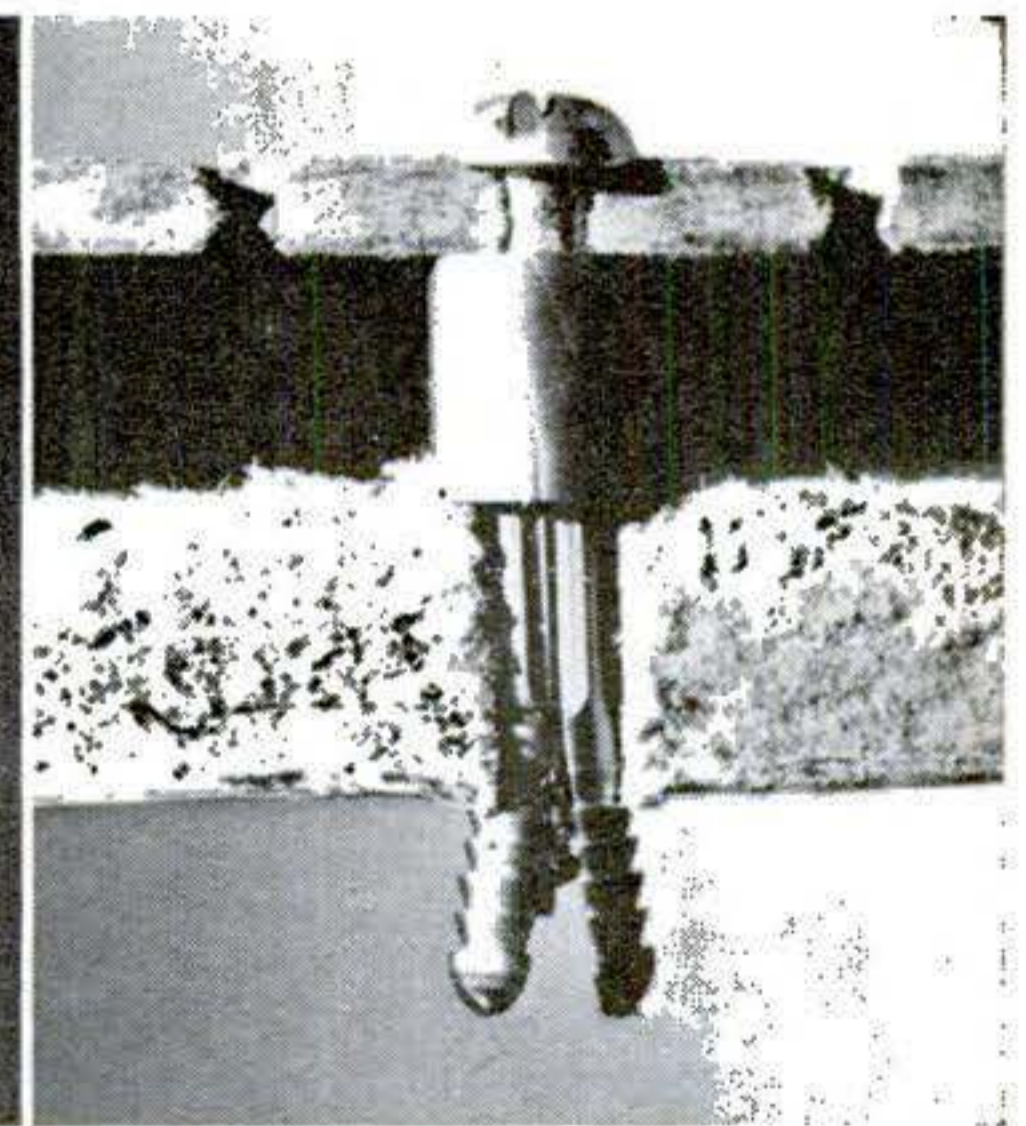
Hypos measure shots of epoxy and hardener

Separate syringes measure out epoxy and hardener in correct ratio. A special hardener formula cures the mix in one minute, says Harvey Home Products Corp., 549-A Tremont St., Boston. With plastic syringes, Minit-Grip costs 98 cents.



Jointed paint roller wraps around pipes

This flexible paint roller made of five separate wheels will fit almost any contour you need to paint, line up flat for reloading. The sleeves of Dynel fiber are washable. EZ Paint Corp., Milwaukee, lists the five-wheeler at \$8.30, handles extra.



Spacers on wall anchors mount perforated board

An expandable anchor for plaster or plasterboard walls has a $\frac{3}{8}$ " bushing already in place to space perforated hardboard so you can insert hangers. It's molded in one piece of Tenite plastic by Jordan Industries, Miami. Four, with screws: 25 cents.



what's new

...ELECTRONICS



Hinged cover on 70-watt transistorized stereo amplifier drops to expose secondary controls—tape monitor, loudness, phase, and input-level adjustments. This gives maximum flexibility yet simplifies panel for casual operation.

to music in less than three seconds.

Do transistor amplifiers actually sound better? Some might argue, but I'm convinced. The Heath AA-21 I put together is an exceptionally clean amplifier. It's hard to put your finger on just what the difference is, but there *is* a different sound. The music has greater transparency—it sounds less like hi-fi, more like music.

It's a good thing the AA-21 has a sound worth working for, because as a kit it had two drawbacks: It's a big construction job, and it's relatively expensive (\$134.95; factory-assembled, \$219.95).

Most stereo-amplifier kits in the same power range can be built in 15 hours or so. The AA-21 took 26. Four printed-circuit boards, which went together quickly, and six modules helped speed construction. The most tedious job was preparing the shielded cables. Almost 30 shielded leads are used. At each end of each cable, the outer insulation must be stripped, the shielding braid carefully peeled back and formed into a pigtail, and the inner conductor stripped.

This might not be the best kit for a novice but, if you're determined, you can complete the AA-21 successfully even if your previous electrical experience has been limited to, say, changing light bulbs.
—C. P. Gilmore.

New transistor stereo amp kit

TRANSISTORS are the hottest thing in electronics because equipment built with them can be small and light. It's surprising, then, that Heath's entry in the transistorized stereo hi-fi amplifier sweepstakes—the new AA-21, a deluxe 35-watt-per-channel unit—is about the same size as conventional tube units of similar ratings, and weighs only slightly less.

Why use transistors at all, then? The answer seems to be that most high-fidelity manufacturers believe that transistors promise better sound than the best vacuum-tube circuits. And transistors don't wear out as tubes do. A transistor amplifier should sound as good in five years as it does new.

Another bonus: No warmup is needed. Flip on the switch and you're listening

How to pick the right glue for every job

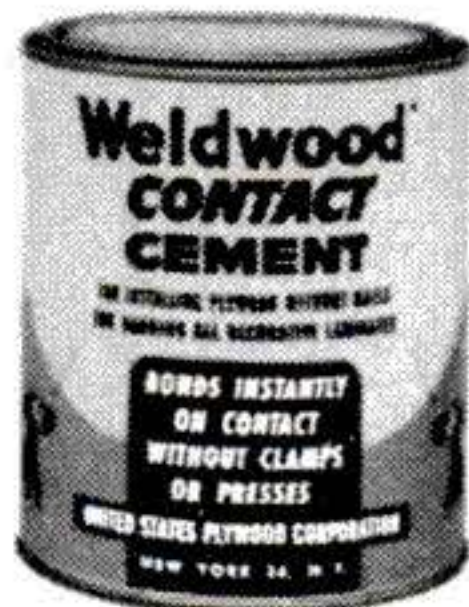
WELDWOOD ADHESIVES	APPLICATION																
	HOUSEHOLD REPAIRS china, glass, metals, plastics, porcelain		INTERIOR WOOD CABINETS, BUILT- INS, FURNITURE		INSTALLING PLYWOOD WALL PANELS		PLASTIC LAMINATES TO PLYWOOD OR PARTICLE BOARD	CONCRETE TO CONCRETE, WOOD, MASONRY	PAPER TO PAPER, FABRIC, CARDBOARD	CANVAS OR FELT TO WOOD	CORK TO WOOD	HARD- BOARD TO WOOD	BOATS (WOOD)	LEATHER TO LEATHER, WOOD	METAL TO METAL, WOOD, MASONRY	CHINA TO CHINA, GLASS	EXTERIOR WOOD OUTDOOR FURNITURE, SPORTS EQUIPMENT, WOOD TO WOOD, CORK, CANVAS
	LIGHT DUTY	HEAVY DUTY	LIGHT ASSEMBLY	HEAVY ASSEMBLY	WITH NAILS	WITH OUT NAILS											
Weldwood® EPOXY GLUE		✓					✓							✓	✓		
Weldwood® CONTACT CEMENT	✓				✓	✓								✓			
Weldwood® PRESTO-SET GLUE			✓						✓	✓	✓						
Weldwood® PLASTIC-RESIN GLUE				✓	✓						✓						
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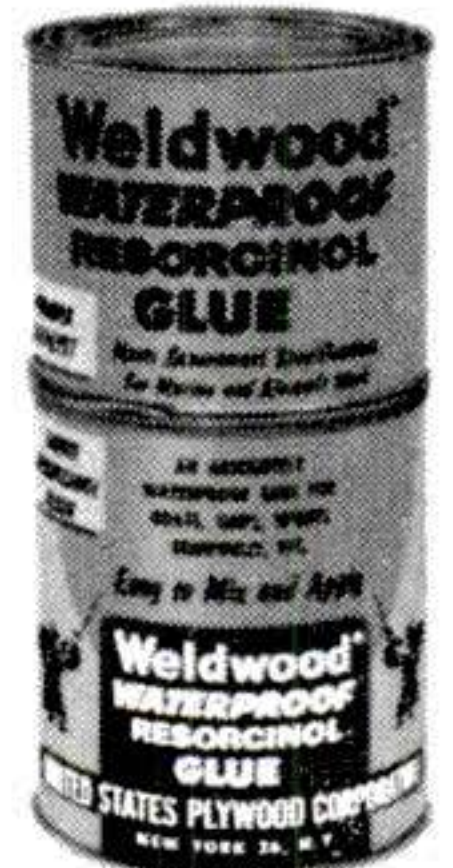
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eagerness to get up and claw water when you lean on the throttle. (The fabulous OMC 17 Dual Deluxe has TWO of these sweethearts — each with its own running system — for a sizzling 176 horsepower!)

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Opposite: OMC 17 Dual Deluxe. A. OMC 17 Deluxe. B. OMC 17 Seasport. C. OMC 17 Custom.



OMC BOATS

see your OMC dealer now... or write for free brochure!

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Waukegan, Illinois. In Canada: Peterborough, Ontario. Patents pending!



OMC 17 Deluxe, First Award Winner, Marine Interior Design Competition, Sponsored by American Institute of Interior Designers and Popular Boating.

Chevrolet has all kinds of horsepower for '63!

140

Power plant number one: A new 230-cubic-inch six-cylinder with seven main bearings for smoothness and power that'll make you think you're driving a V8. It's approximately 23% lighter, nearly three inches lower in overall height, two inches less in length.

HP

195

Power plant number two: Our old friend and yours, the 283-cubic-inch Chevrolet V8, with new cylinder heads and a higher compression ratio for better traffic performance, better highway performance, and better fuel economy in the bargain.

HP

340

Power plant number three:* A brand-new version of the Chevrolet 409. It has a moderate cam, hydraulic lifters, a compression ratio of 10 to 1, a four-barrel carburetor, and can be ordered with Powerglide.* It tailors the 409 to the pace of everyday commuting.

HP

400

Power plant number four:* Basically the same as the 409-cubic-inch V8 that delivered 380 horsepower last year, but now with a new higher lift special camshaft and free-flow manifolding that boosts volumetric efficiency and brings the horsepower up to 400.

HP

425

Power plant number five:* The King! The most powerful engine in the Chevrolet lineup. It's like the 400-horsepower 409, but it has *two* four-barrels and bags of torque. It comes with either the three- or the four-speed* stick. It could be described as stimulating.

HP

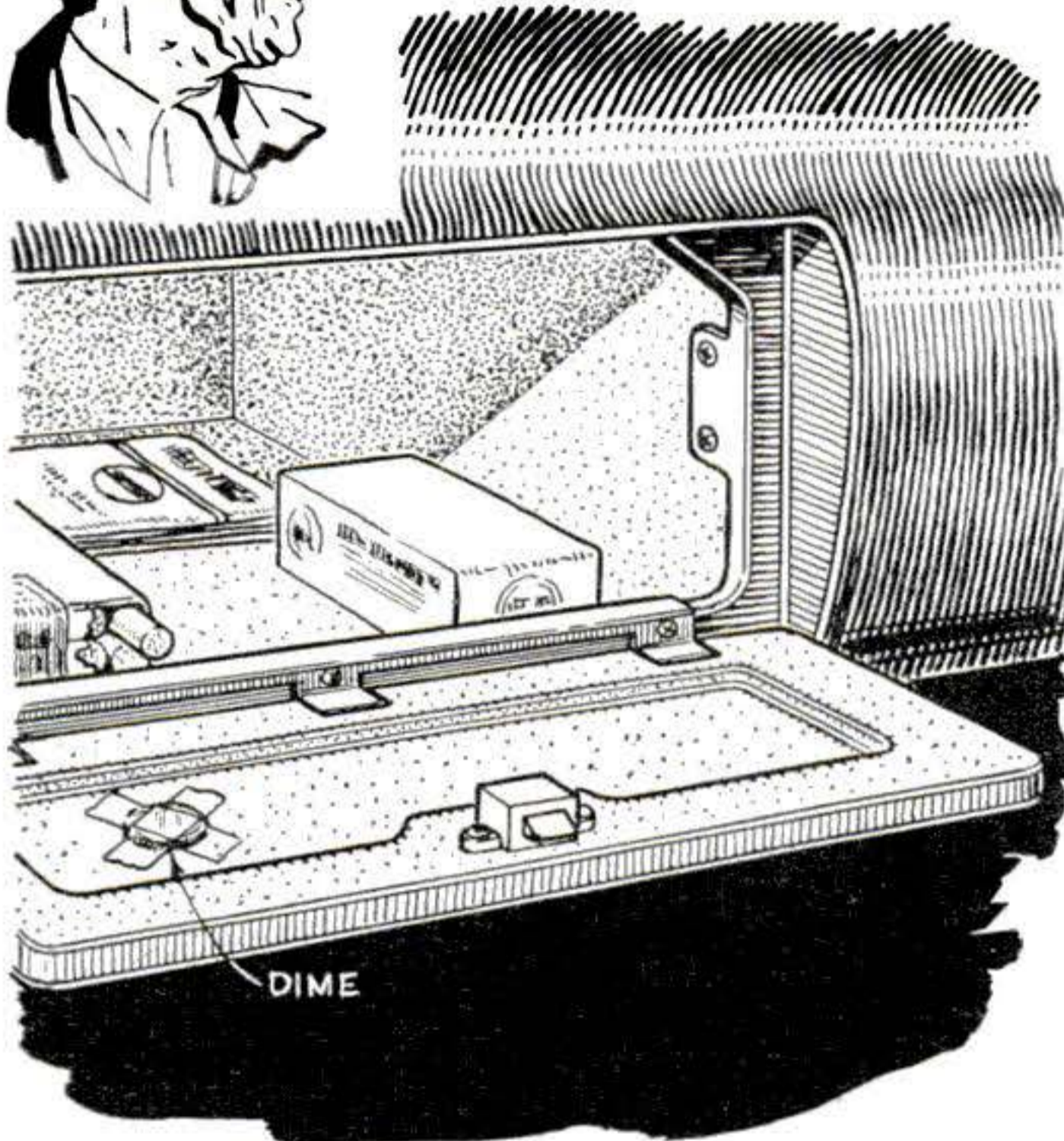


The optional 327 V8s with 250 and 300 hp, respectively, are also available, but are unchanged from 1962. . . . Chevrolet Division of General Motors, Detroit 2, Mich.

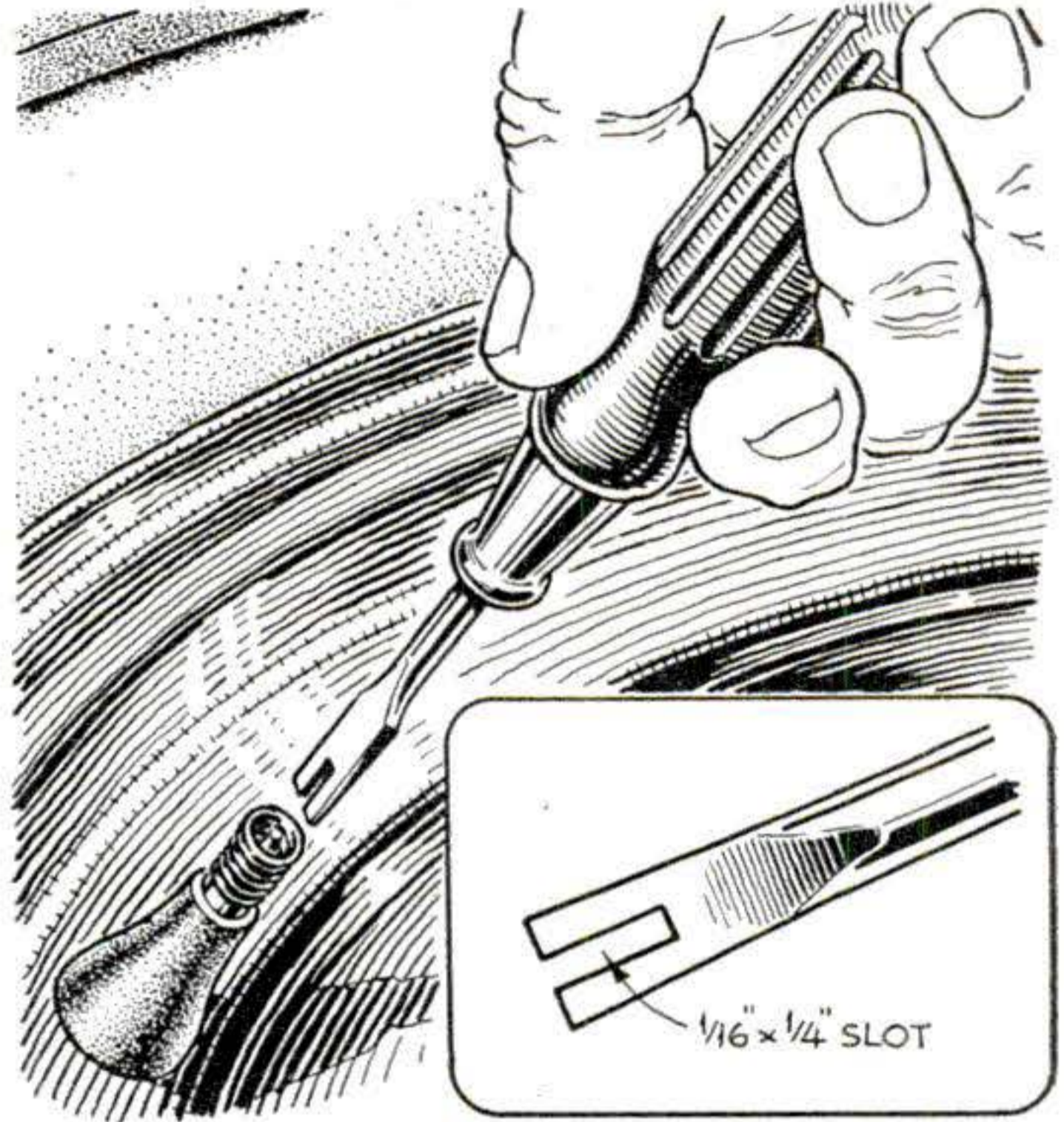
**Optional at extra cost.*



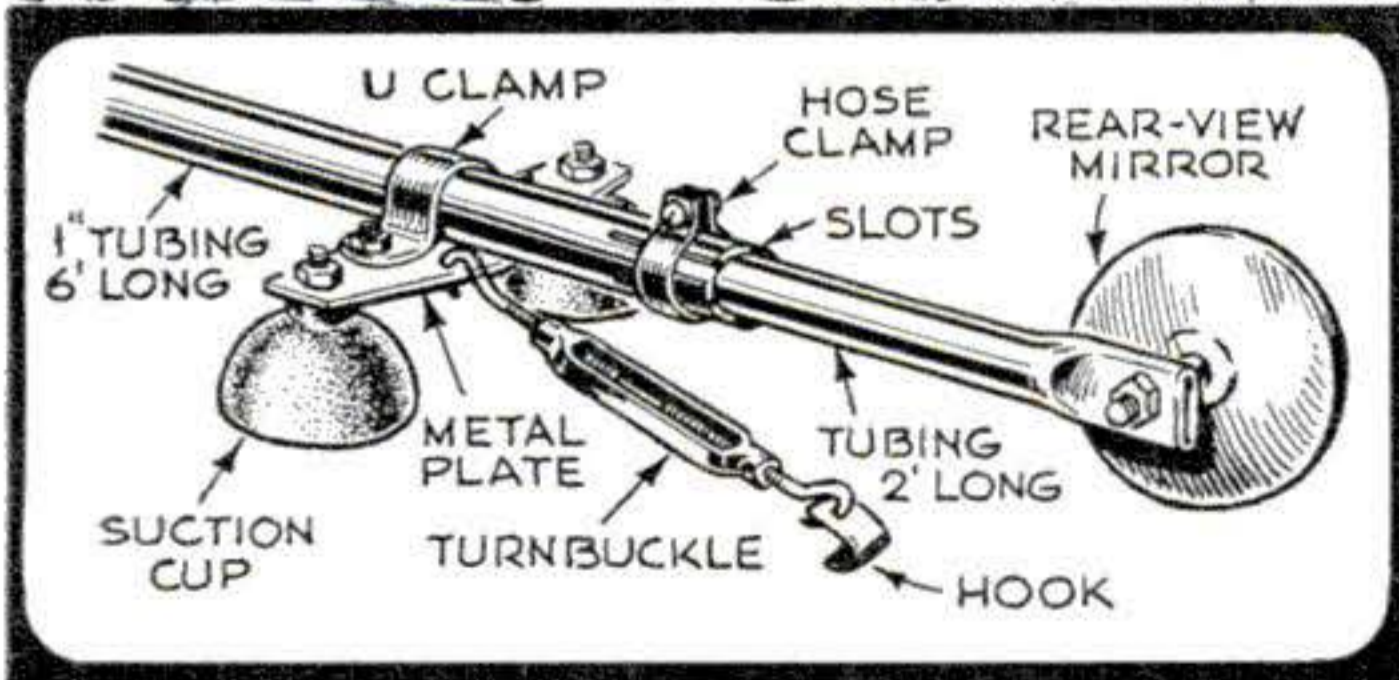
Hints from the Model Garage



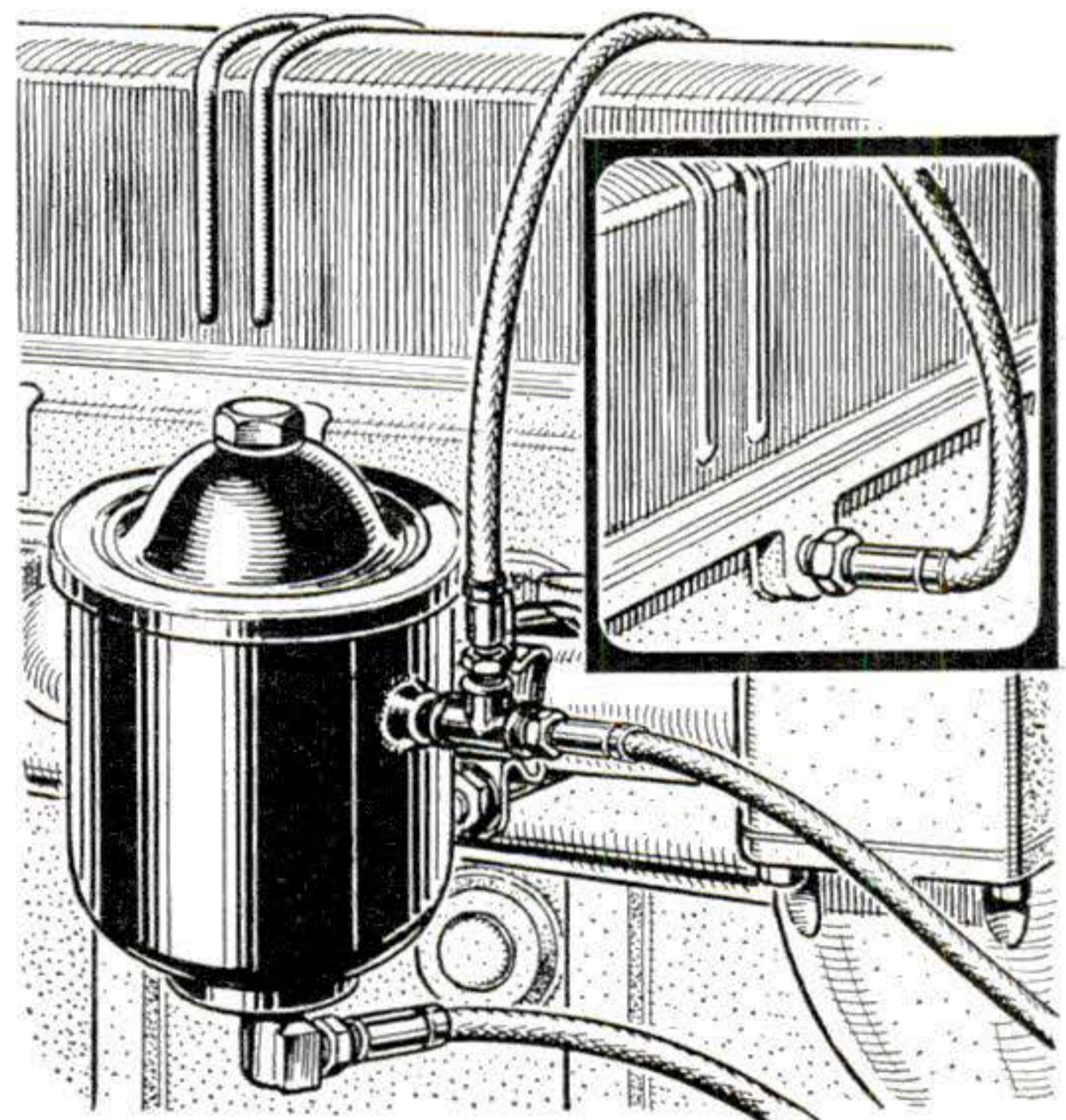
A dime taped to the glove-compartment lid could be the most important piece of emergency equipment you have. A phone call from a roadside booth can quickly summon an ambulance for an accident victim or a mechanic if your car should break down.



Removing the valve stem from a tire is an easy job with this homemade valve tool. Cut a $\frac{1}{16}$ " slot in the tip of a thin-bladed screwdriver with a hacksaw and file. You may have to grind down the edges of the blade so it will fit inside the valve.

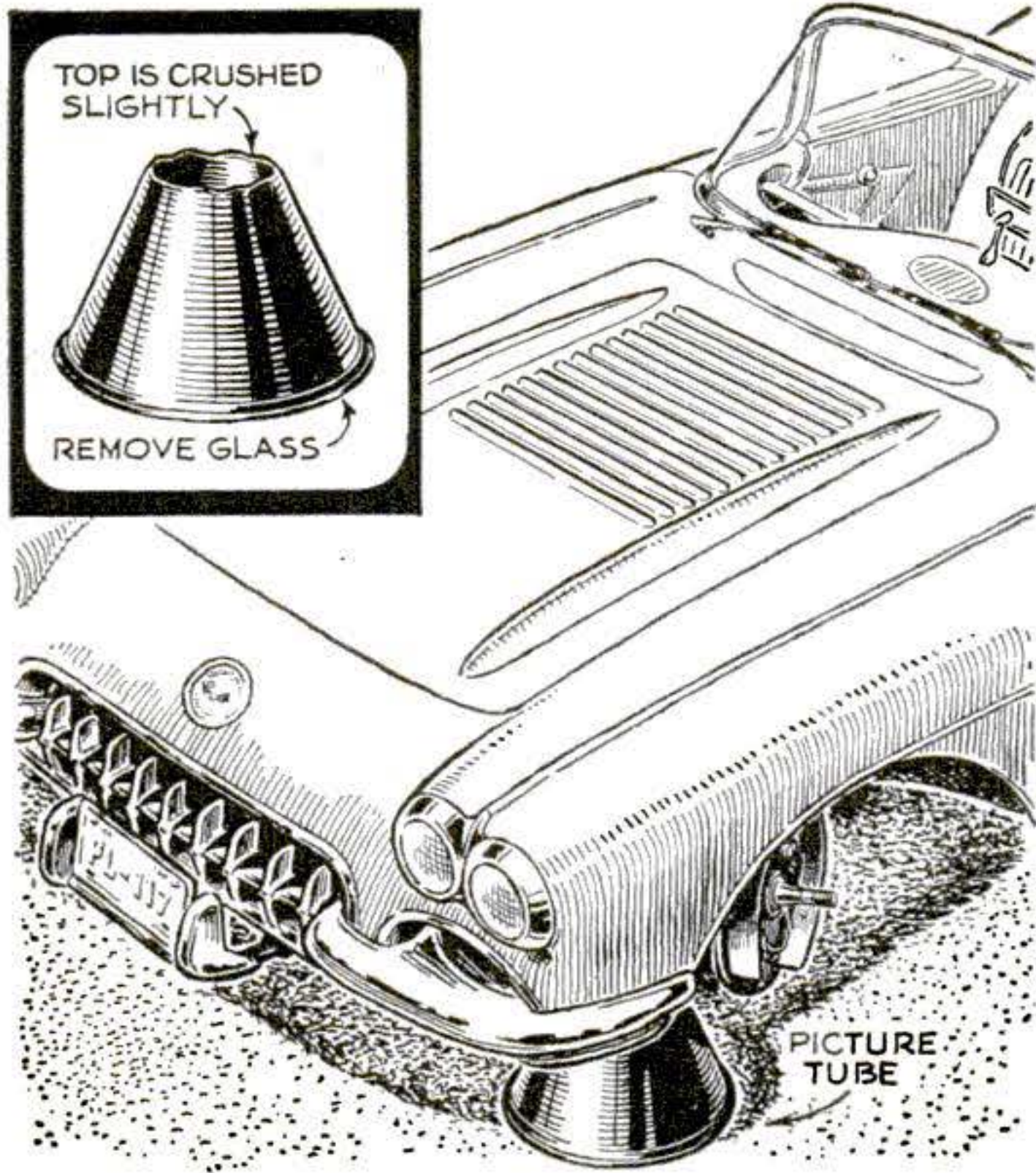


Extend these mirrors when towing a trailer and push them in when the trailer is unhitched. Accessory mirrors are attached to 2' aluminum tubes that telescope into a 6'-long, 1"-diameter tube with slotted ends. Clamps hold the extensions tight.

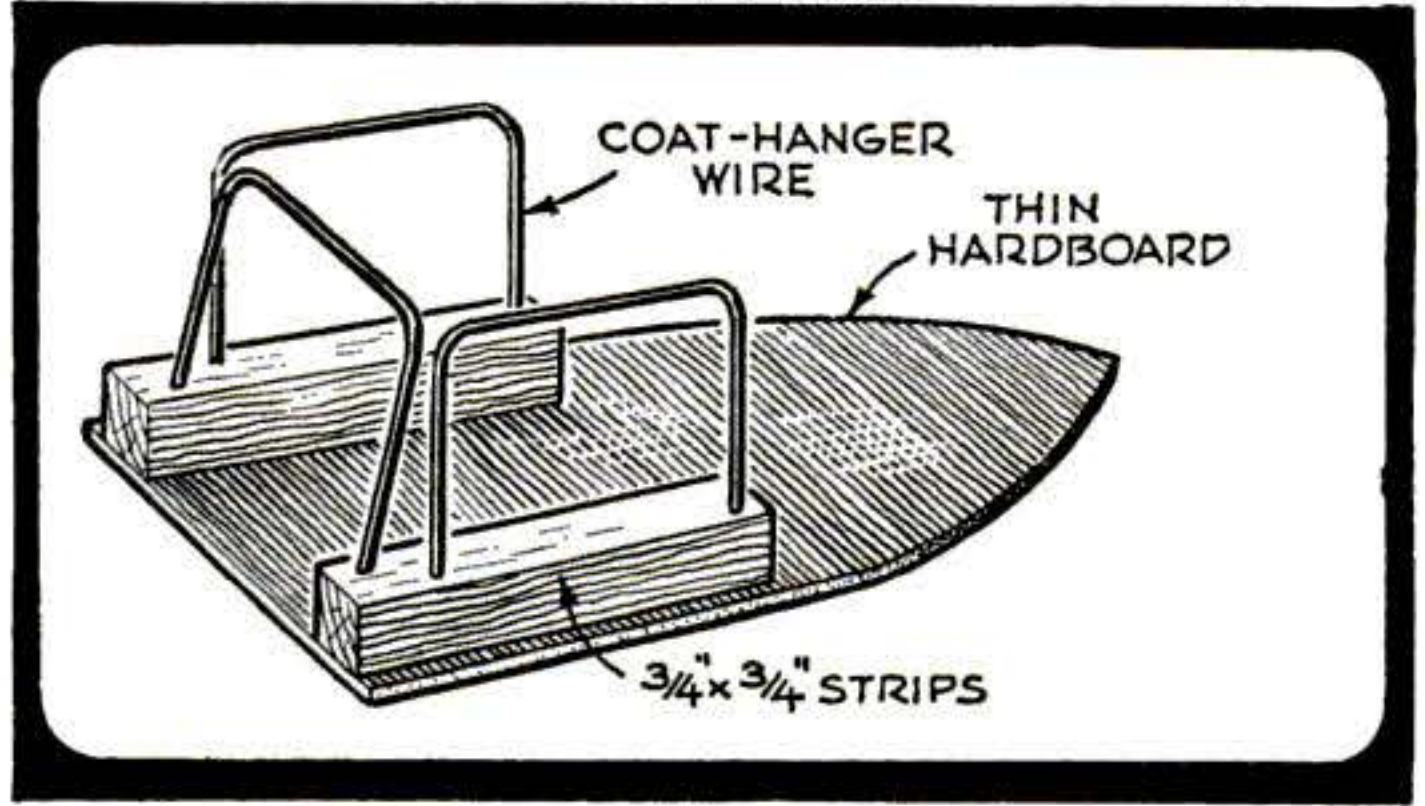
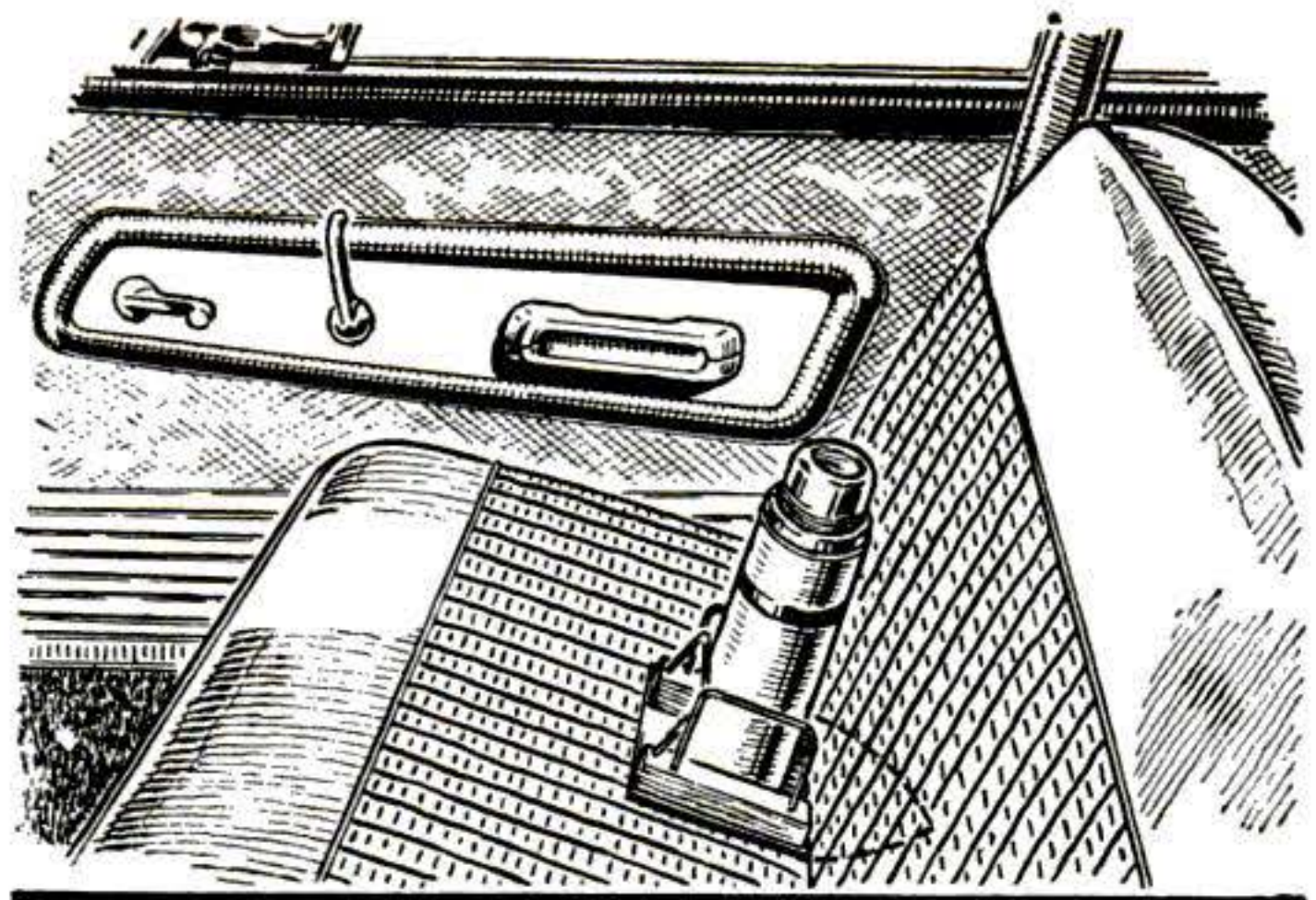


Fouled rocker-arm oil lines are common on certain sixes. Easy fix: Install a tee fitting on the oil-filter outlet. Then run a flex line from the tee to the clean-out hole on the right side of the block to feed oil directly from the filter to the rocker arms.

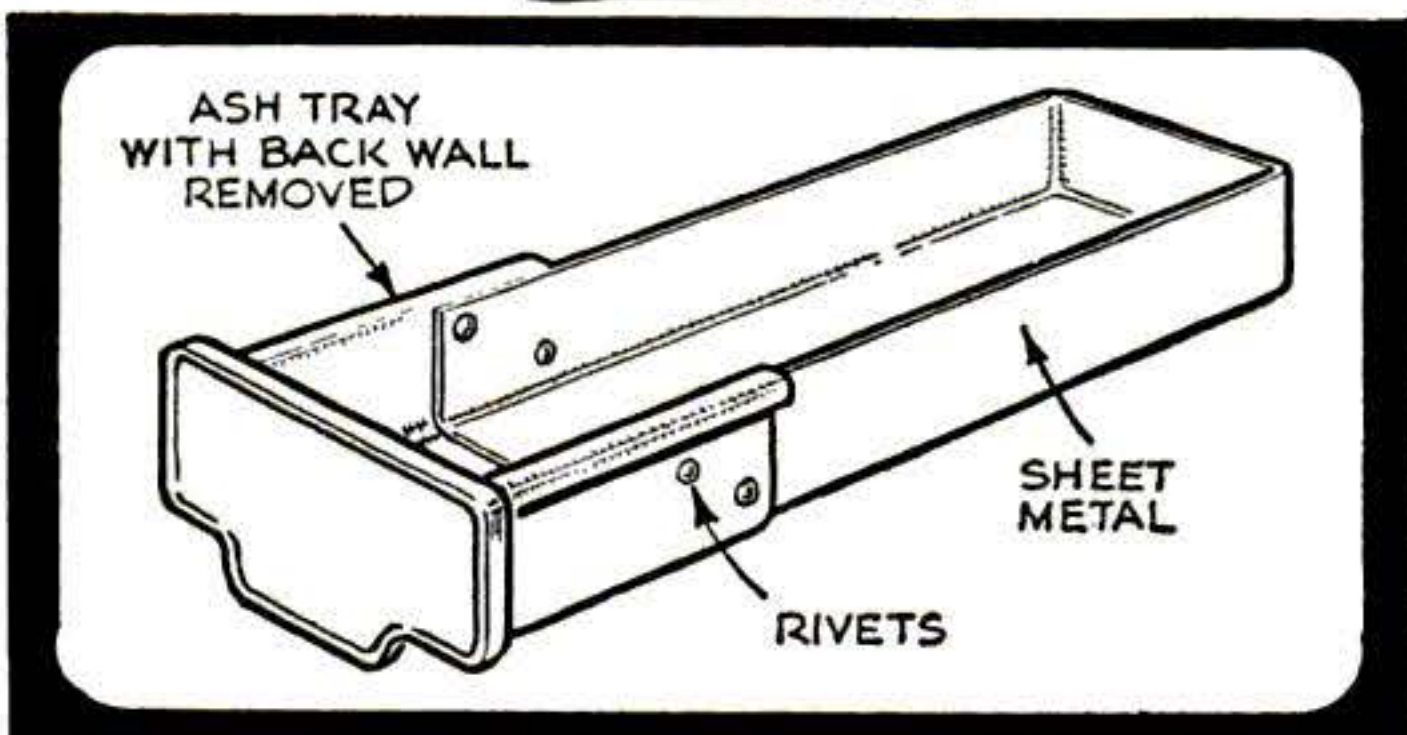
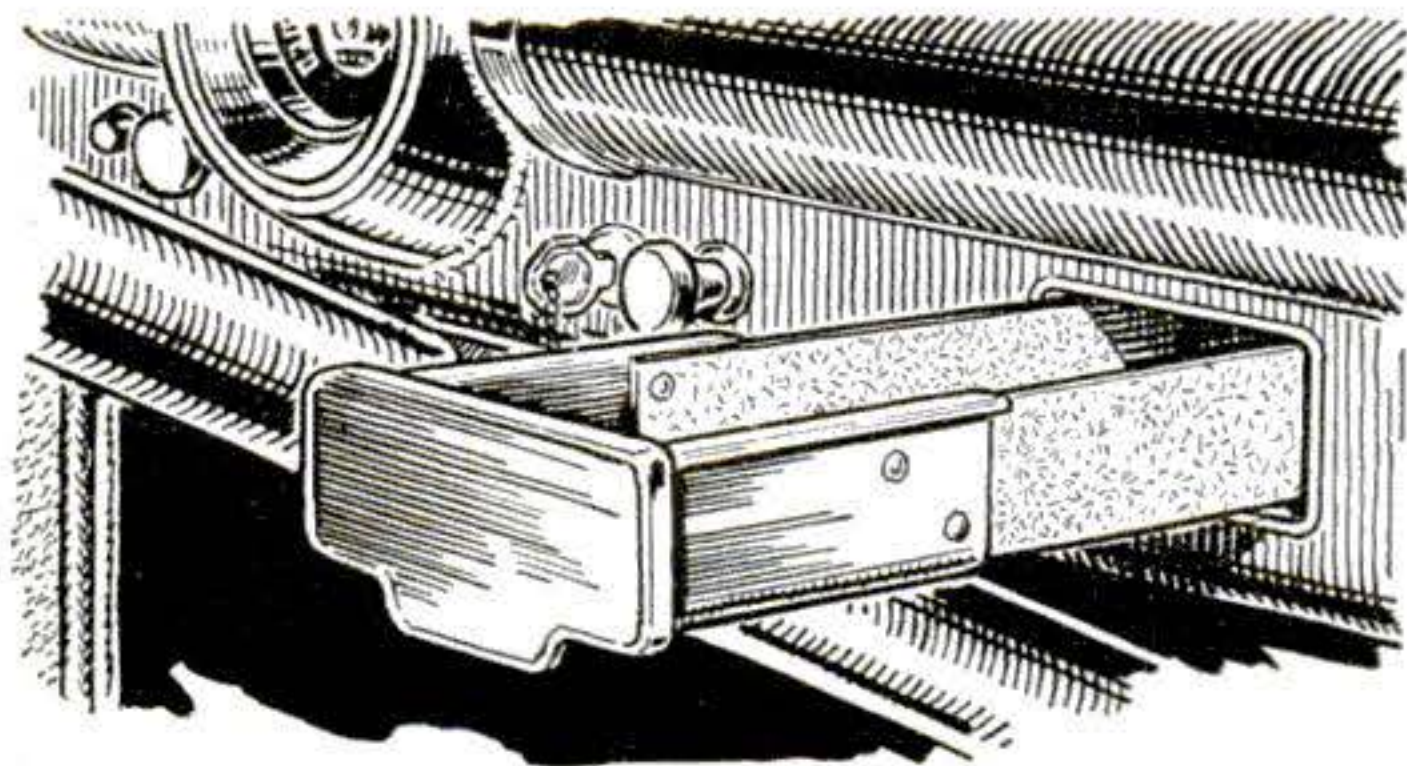
More Hints from the Model Garage



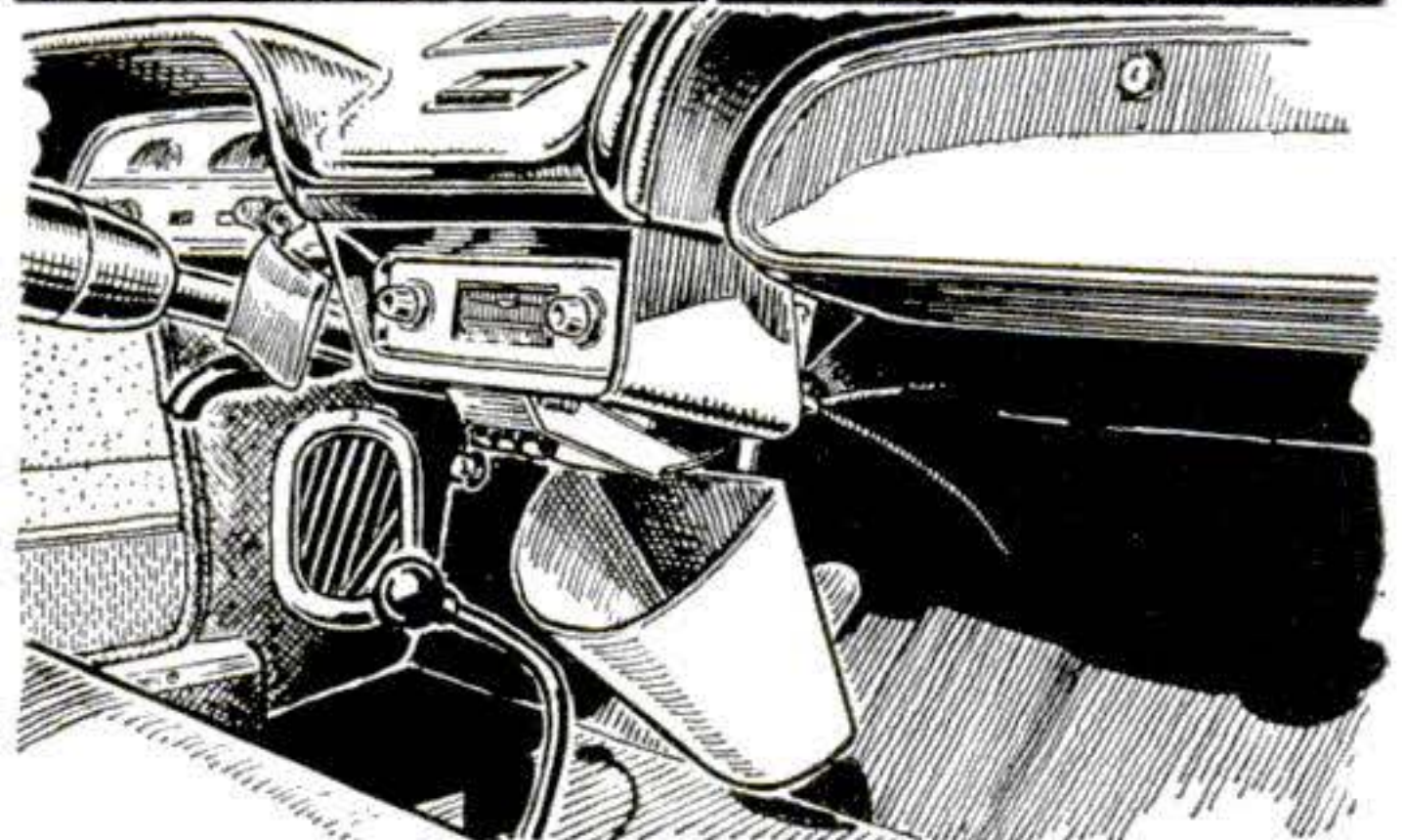
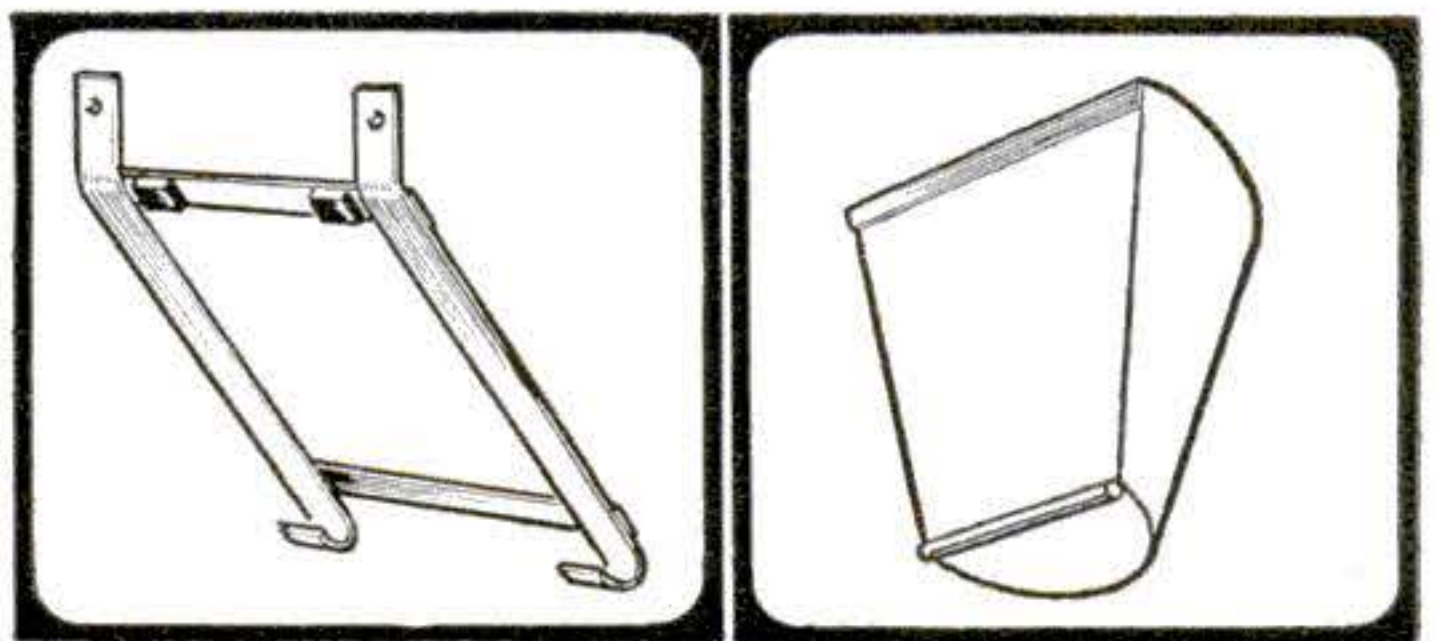
An inexpensive axle and frame stand can be had from your TV repairman; just ask him for a burned-out picture tube. Have the glass removed (let him do this). The top of the metal cone will crush slightly in use; this keeps the car from slipping off.



A wire holder for your thermos bottle will keep it from tipping when you turn or stop quickly. Cut the flatiron-shaped base from hardboard. Tack and glue wood strips to it and drill them to accept coat-hanger wire. The base slips under the front seat back.



Use your pull-out ash tray as a storage box if you're a nonsmoker. Remove the back wall and extend the length of the tray with sheet metal. You will then have a handy storage compartment for a pencil, pen, comb, tire gauge, and other small items.

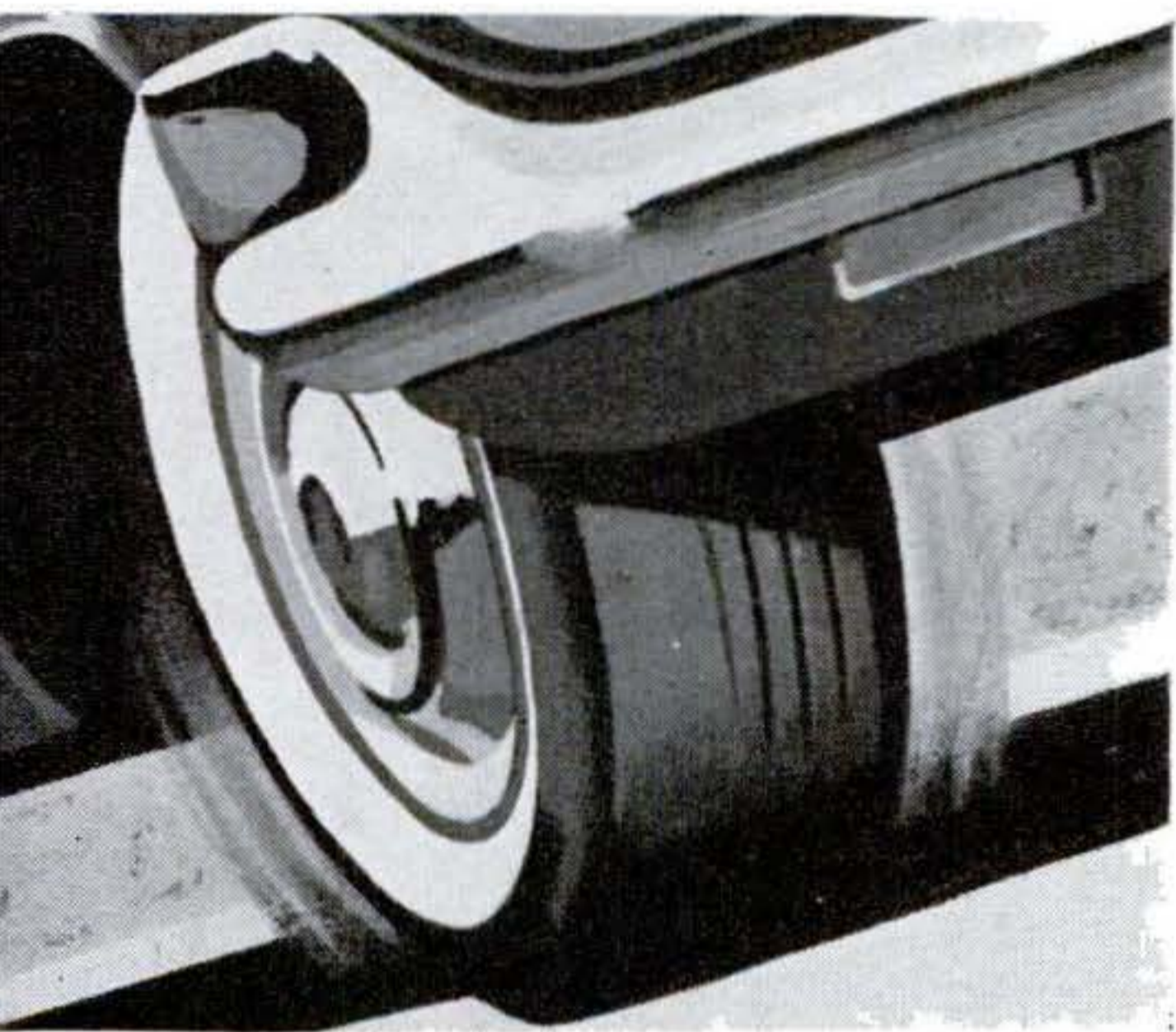


Install a litter basket in your Corvair under the radio. A cross-braced bracket hangs on screws in back of the radio. A 1/4" dowel glued to the bottom of the basket fits curved bracket ends. Two magnets on the bracket hold a metal strip at top.

Monroe **FRONT** and **REAR** Load-Leveler®

stabilizing units

END THESE HIDDEN DRIVING DANGERS



FRONT-END SAG? Sagging springs throw wheels out of line, cause shimmy, fast tire wear, loss of car control. Front Load-Leveler stabilizing units end these hidden dangers and make your car ride like new.



TAIL DRAG? Even with loaded trunk and rear seat passengers, car remains on safe, stable keel with rear Load-Leveler stabilizing units. Swaying on curves and bottoming on bumps is ended.



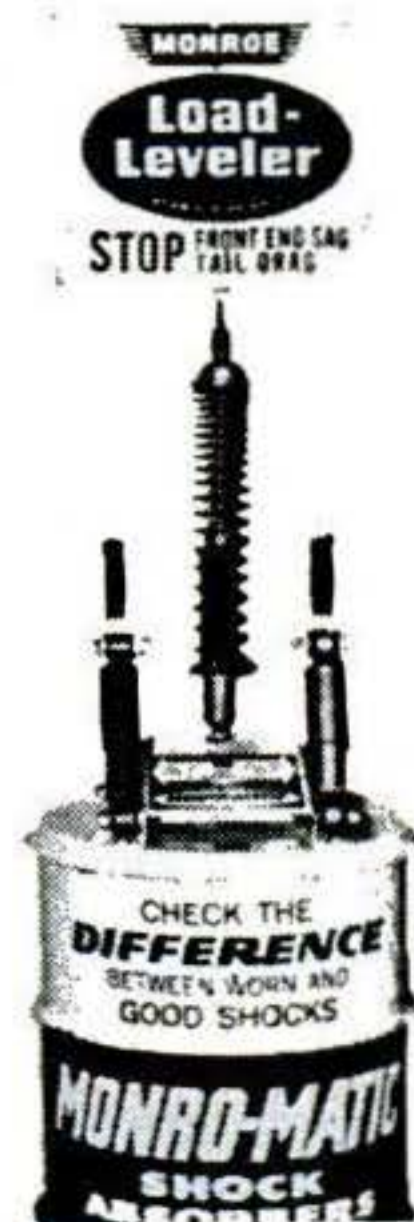
Your car's suspension system is an often unsuspected source of danger when shock absorbers wear out or are put to heavier use than they're designed for. Eliminate this danger—and enjoy a more comfortable ride—with Monroe rear Load-Levelers and the New Monroe front Load-Leveler stabilizing units.

Have Monroe Load-Levelers installed today where you have your car serviced. Look for the yellow and blue Monroe demonstrator barrel.



World's largest maker of ride control products including Monro-Matic® shock absorbers

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Gus Tackles a Wee Bit o' Scotch

By Martin Bunn

A FOOTSTEP brought Stan out from under the Model Garage's lube rack.

"Might I see your-rr boss, laddie?"

The speaker was a stubby man in a checked jacket; he had knobby features underlined by a large reddish mustache.

"He's out," said Stan. "Can I help?"

"Might be. My car's outside. It runs, but it does have a wee ailment. What d'ye charge for a small job?"

"Can't tell until I check," said Stan. "Just what's wrong with it?"

"If I knew that, I wouldnae be askin'," returned the other. "The motor is sweet as butter, but it don't have the gumption it did. I thought ye could tell me what to do, for a wee fee."

"Well, drive it in, Mr. . . ."

"I'm Bruce Duncan, laddie."

"Drive it in, Mr. Duncan. No charge for checking, and I'll give you a price if it looks like much work."

Surprisingly, the car that rolled in a minute later was a late model, which must have set its owner back a fair sum even if bought used. It idled silkily as Duncan got out. Stan opened the hood and gunned the engine briefly.

His practiced ears caught a reluctance and a hint of roughness that suggested the spark was retarded. He made sure that the vacuum-advance line was intact. Then he shut off the engine, got out the shop's timing light, and loosened the distributor-cap clips.

"Wait, mon! It cannae be there."

"I want to check ignition timing," explained Stan. "It's routine to make sure the points are set right."

"And rr-right they are, ye may be sure, for I set them myself."

Stan shrugged. "Okay." He replaced the clips, pulled off the vacuum-advance

tubing, and hooked the timing light to plug number one. "Start it up."

Duncan did so. In the flash of the light Stan watched the timing mark on the harmonic balancer.

"See that?" asked Stan as Duncan came around. "The spark is about two degrees late at idling speed."

"Cannae ye make a small adjustment?"

Stan killed the engine. "I could reset the distributor, but that might be starting at the wrong end. I should check the point gap first. You say you set the points?"

"Aye, and right on the button. I'm a machinist. When the blueprint says half a thousandth, I can split it to a hair. My car book says the gap should be from 19 to 22 thousandths, so of cour-rrse I set it at 19."

Stan grinned inwardly as he lifted the distributor cap. He nudged the engine around to stop the breaker arm on a high point of the cam, then inspected the points. They were serviceable.

"Want to check the gap again?" he asked. "If it's still 19 thousandths, I won't charge you a thing."


The reddish mustache seemed to bristle as Duncan produced a thickness gauge from his pocket. He leaned over and checked the point gap, grunted in disbelief and checked it again.

"You're right, lad, it's down to 17," he confessed, straightening up. "Who'd have thought I could go so far off?"

"You didn't," said Stan. "The only mistake was setting them at 19 thou."

"But the book says so, lad."

"That's minimum for points that have bedded down. But when you install new ones, you want to set them on the high side of the tolerance range. Then, after this fiber rubbing block wears itself in against the cam, you'll still be inside the tolerance range. If you set the gap at the minimum, cam wear can leave the gap too small."



"Weel, now, if ye could fix them, I might be money ahead," mused Duncan.

Duncan's forehead became a corduroy of wrinkles. "Makes sense. I'll know better next time. Now what'll you charge to re-time the ignition?"

"Just resetting the point gap may do it," said Stan. He increased it by three thousandths. "When the gap is too small, this contact I'm adjusting holds the breaker arm a hair too far off the cam. So the lobe has to swing a little farther before it breaks the points. By then the piston has moved along, too—and your spark is late. A gap four thousandths too small shifts ignition timing four or five degrees."

He buttoned up the distributor and re-started the engine. In the flash of the timing light, the mark appeared about two degrees ahead of its previous position. Stan hooked up the vacuum-advance line and gunned the engine. The timing mark advanced obediently. Duncan pursed his lips as he dug deep to bring out his wallet.

"I think that does it." Stan disconnected the light and closed the hood. "That thickness gauge you used, by the way, is okay only if the points are clean and flat. If they're pitted, it can give you a wrong gap, because it hits only the high spots." He

made out a small bill, which Duncan promptly paid.

"A rr-reasonable price. I've a mind to give you some more business. What'll it cost me for three sets of points?"

"Three sets?" asked Stan in amazement. "But your own are still okay."

"For the noo," said Duncan glumly. "But I'm sure to be needing new ones soon."

"We'd have to order three sets," said Stan. "Maybe Mr. Wilson will give you a discount on them. Come back in an hour, if you can."

"I'll do that, and thank ye."

Gus Wilson was in no amiable mood when he returned some time later. He lugged a small, heavy package from his car and set it with a thud on the workbench.

"That the new motor for our valve refacer, Gus?" asked Stan.

"Yes, but they've changed the motor base," growled Gus. "Won't fit our old model until I tap four new holes. While I do that, you can take the valves out of the Anderson car."

Gus detached the burnt-out motor, set the new one in place, and punch-marked

the hole locations. Electric drill in hand, he hunted around the bench.

"Seen that hand-soap can I keep around here, Stan?" he called.

Stan emerged briefly from under the hood of Bill Anderson's car. "Think so, but I can't remember exactly." The sound of an entering car made him turn about. "There's a Mr. Duncan to see you."

Gus grunted and set the drill on one of the marks. Pausing occasionally to squirt cutting oil on the bit, he allowed it to bite through. Then he laid the drill aside and turned to the chunky little Scotsman.

"I'm Gus Wilson. You want to see me?"

"As I told your-rr young man, I want to buy three sets of ignition points for you car."

"Going on a trip?" asked Gus.

"No, but my car burns them fast."

"How fast?" asked Gus.

Duncan scratched his mustache. "In a few weeks. I put in this set two weeks ago. I suppose it's that power-rrful engine does it."

Gus shook his head. "It shouldn't. I can think of a couple of things that might, though." He got out a specifications list.

"Weel, now, if ye could fix them, I might

CONTINUED

The dodge that saved the day



"Put that special order on tonight's express plane," the boss said as he left, "and you'll get not only overtime, but a bonus. It's urgent."

Sam and I finished wiring the complex electronic unit; then he nailed a crate together while I ran the final checks. I disconnected the soldering iron, read him the serial number to fill in on the invoice, and put the thing in its box.

"Ten fifty-two," he said with relief, laying aside the carbon copy and sealing the invoice into an envelope. "Nail it up, paint on the name and address, and we're off."

"Eighteen minutes left, and 12 miles to

the airport," I said. "It's going to be close. Where's the paint?"

Then I remembered that the old can had been thrown out. We hadn't a drop of paint in the lab, nor any time to hunt elsewhere, let alone buy any at this hour. There went our bonus money.

"We have no crayon, chalk, or even grease," I said. "And this hard drafting pencil barely writes on the wood."

"And ever since one of our labels came off a box," Sam said, "that agent has been a stickler for having big, fat letters painted right on the wood. Pencil won't do. He'd keep us arguing while the plane took off. Plug the soldering iron in again."

I did, but shook my head. "It'll take all night to burn that name and address in with this pen-size iron."

"I'm not going to," Sam retorted. "It'll be marked in nice, thick, dark-blue letters in just a minute."

Turn page upside down for the answer.

Answer: Sam laid the carbon paper from the invoice sheets face down on the wood. Then he drew the letters on the back of the carbon with the flat face of the warm iron. Wax and carbon color were melted into the wood fibers, making broad, indelible letters that stood out boldly enough to satisfy the most pernickety freight agent.

WILDCAT!



Anatomy of a WILDCAT! External characteristics . . . sleek, sure-footed, muscular—325-hp strong. Three distinct types—convertible, 2-dr. sport coupe, 4-dr. hardtop. Internal structure . . . V-8, 401 cu. in. Wildcat engine. 10.25:1 compression ratio. 4-bbl. downdraft carburetor. Automatic Turbine Drive transmission. 12" brakes—finned aluminum up front. Temperament . . . terribly impatient in captivity. Thrives best on the open road (tracks arrow-straight, and corners like a cat). Habitat . . . wherever you see a Buick dealer's sign.

Buick Motor Division also presents: Buick Special Skylark/LeSabre Electra 225/Riviera

WILDCAT BY BUICK!

be money ahead even after I pay for your wor-rrk," mused Duncan.

"And save yourself some trouble besides," agreed Gus. "Let's just take a quick look-see."

List in hand, he went to the car and opened the distributor. The condenser was of the listed capacity. A clip on the resistance wire leading to the coil identified it as the proper one for the car.

Gus got out a voltmeter and connected its leads across the coil's battery terminal and ground. Then he propped the meter up so that he could see it from the driver's side of the car.

Carefully he turned the ignition key past "on" toward "start," but just short of actuating the starter. The meter needle surged to 12 volts. He let the key snap back to "on." The needle twitched, then held at 12 volts.

Gus repeated the test as Duncan leaned close, watching.

"There's your trouble," said Gus.

"I dinnae understand."

"Modern 12-volt ignition systems use full battery voltage at starting, to insure a hot spark while the starter is drawing current," explained Gus. "But when the engine fires and you let go of the key, a different contact routes current to the coil through a ballast resistor or a resistance wire. That drops the voltage to half. Half the voltage gives enough spark and saves the points and your budget.

"Your switch is hanging up on the start side, putting 12 volts on the primary circuit all the time the engine is running. That overloads the points, so they burn fast. The meter proves it. That needle in my meter should drop back from 12 volts to 6."

"Can ye nae fix the switch?"

"They're tough to take apart and almost impossible to put together again. It'll cost you less to put in a new one."

"Aweel," said Duncan. "If it's an economy, let's do it."

"Soon as Stan can go get one," promised Gus. "It's just down the street."

Having dispatched Stan on the errand, Gus returned to the workbench. Oilcan in hand, he went on drilling the holes in the refacing machine.

"Ye've helped me with a good tip or two," said Duncan. "Mind if I return the favor?"

"'Course not," said Gus, mystified. "Always glad to learn something new."

"It's unhandy and time-wasting to squirt oil by hand for drilling and tapping. I've long made a habit of keeping a can of grease drippin's on hand—bacon fat or the like. You dip the tap or drill in it and go on with the wor-rrk. The heat o' friction melts the fat slow, givin' the tool lubrication as good as a third hand. Best of all, it dinnae cost you a cent. The drippin's are free."

"A mighty good idea. Sure wish I had some now," said Gus sincerely.

When Stan returned with the switch, Gus installed it himself, then repeated the meter test. The indicated voltage dropped as soon as the ignition key was released to running position.

"*Say, Gus,*" said Stan as the Scotsman drove out. "Now I remember. I put that hand-soap can in the washroom. Isn't that where you want it?"

"Won't do us any good there," grunted Gus. He went to the lavatory and got the can back. Whistling, he placed it on the bench and began to fit a tap in the tap wrench.

Stan brought a set of valves over to be refaced. "That the can you been wanting? Why do you keep it around? What's in it, anyway?"

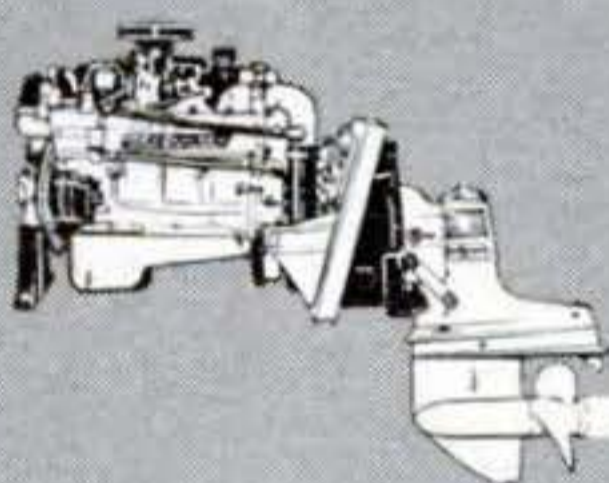
Gus took off the lid and plunged the tap into the white stuff inside.

"Bacon fat," he said. "Beats anything for drilling and tapping steel. Best of all, it dinnae cost you a cent." ■ ■

Gus is in a book now. Twenty-five of the best Model Garage stories from the pages of POPULAR SCIENCE are collected in a new paperback. You may find old favorites you'd like to reread, or even some you missed. The book is a fine gift for friends not acquainted with Gus, or youngsters

eager to learn more about automobiles. You can get *Gus Wilson's Model Garage* (40 cents) at local paperback bookshops or from Berkley Publishing Corp., 15 East 26 St., N.Y.C. (Add 10 cents for wrapping and shipping.) Please do not send orders for the book to POPULAR SCIENCE.

Here's a



success story:

In less than one year of actual production, over 110 boat manufacturers have switched to MerCruiser Stern Drive Power Packages as original equipment.

What more can we say?

*110, 140, 190, 225, and 310 hp gasoline
39 and 100 hp diesel*



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STERN DRIVE POWER PACKAGES

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SHOP TALK

By Sheldon M. Gallager



Now it's car advice from the South Pole, yet

Just received word from one of our deep-south readers, Lt. Dave Flanagan, who's aboard the Coast Guard icebreaker Eastwind busily breaking up ice in—guess where?—warm and sunny McMurdo Sound, Antarctica. Although he has no use for a car jack where he is, he passes along this reminder to motorists back home: "Old-timers complain about bumper jacks, but they sure can be versatile in an emergency. If a mashed fender jams against a tire, just brace the jack against the wheel hub or a lug nut and jack the fender away. You'll save a towing charge. The jack will even reseal a dislocated engine."

If you're looking for it, they've got it

Constantine's, a long-time favorite of craftsmen, has just announced its biggest catalogue to date, a beauty: 132 pages of rare woods, patterns, tools, and woodworking tips. You can get a copy by sending 25 cents to the company at 2050 Eastchester Rd., New York 61, N. Y. . . The Cabot people now have a glare-reducing green paint designed especially for Ping-pong tables . . . So many readers asked about a more attractive enclosure for the Gough hi-fi speaker [PS, Nov. '61] that the company has decided to offer restyled plans for \$2, or a new cabinet itself assembled or in kit form. More information can be obtained from Gough & Co., Box 254, San Carlos, Calif.

BENT
COAT-HANGER
WIRE



More solutions to an often-solved problem

The paint that stubbornly collects in a paint-can rim is one of the most common household nuisances. To prove it, our mailbag always contains at least one or two solutions to this exasperating problem. Here's our pick of some of the most interesting: William Surridge of Philadelphia suggests bending coat-hanger wire into a U shape and suspending it in the can, as at upper left. Scraping your brush against this instead of the can edge keeps paint out of the rim . . . Arthur Tanner of Poughkeepsie, N. Y., saves old lids and cuts semicircular openings in them, as at lower left, to seal the rim and provide a scraper for the brush . . . Other favorites: "Make nailholes in the groove and they'll let the paint drip back into the can" . . . "Cover the rim with foil or plastic food wrap and when you're finished, just peel it off—along with the drips" . . . "Force twine into the groove. It will keep the paint out and can be removed to replace the lid." Any other pet ideas?

Assignment: make our cars more rust-resistant



**Result: '63 Ford-built cars are
better protected against rust
than ever before**

To tackle this assignment, Ford Motor Company engineers turned to zinc. Galvanized, or zinc-clad, steel is noted for its resistance to corrosion. It presented special problems, however, in automotive applications. It was hard to weld, difficult to paint.

Our engineers solved the welding problem. They found a process which eliminates the crystalline pattern on galvanized steel and produces a surface that will accept a high-quality paint job.

Now zinc is married to steel and used for vital underbody parts and rocker panels of Ford-built cars. The zinc coating forms a tough barrier to corrosive moisture—and if corrosion attacks, the zinc sacrifices itself through galvanic action, saving the steel.

Other avenues explored in the fight against rust also brought results: special zinc-rich primers to protect critical lower body areas, aluminized and stainless steels to extend muffler life, quality baked-enamel finishes that are more durable (and look better).

Added rust protection marks another step forward in Ford Motor Company's quest for total quality—and brings you cars that last longer, need less care and keep their value better.

*Salt-water bath is one of tests
used to check rust protection
built into Ford-built cars.*

**FORD • MERCURY • THUNDERBIRD
LINCOLN CONTINENTAL**



MOTOR COMPANY

**WHERE ENGINEERING LEADERSHIP
BRINGS YOU BETTER-BUILT CARS**

The Truth About Brain Drugs

[Continued from page 73]

parts of the RAS and said *fire-burn-hurt*. You tensed your muscles, said "Ouch," and dropped the book.

In other words, one pathway gave you the news; the other let you feel it.

Now suppose a drug depresses the RAS but not the cortex. The facts still get through, but the feelings—the emotional pain and suffering—are diminished. This is one of the ways chlorpromazine acts.

But neither reserpine nor meprobamate do this. Reserpine in fact *stimulates* part of the RAS. How do they work, then?

That's where the second great system loop comes in—the Papez circuit. Here the link of emotion and thought starts in a set of odd-shaped parts at the forward base of the brain called the rhinencephalon—literally man's "smell brain."

Impulses travel from the rhinencephalon to the cortex by way of a part called the thalamus and, under it, the hypothalamus.

The hypothalamus—the size of a Ping-pong ball—at the base of the brain may be the key piece in the whole jigsaw puzzle of behavior. It coordinates all the breath-blood-muscular responses to flight or fight emergencies. It regulates hunger and sex needs (animals will forego mating for the delights of direct stimulation of the hypothalamus). And it also programs the output of the pituitary gland—the pump that primes the flow of many hormones.

The strong tranquilizers, reserpine and chlorpromazine, depress the hypothalamus. Meprobamate, much milder, leaves the hypothalamus alone, but checks the thalamus and rhinencephalon instead. The result is that you calm down.

Now you would assume that the strong tranquilizers would also perform this fine muscle-relaxing trick. They don't. In fact they stimulate the rhinencephalon—so that the strong doses used in treating mental patients sometimes produce muscular tremors.

Ups and downs. Such perversity is not all built into the drug and comes as no surprise to specialists. The truth is, the brain starts out as a split personality. Half of it wants to soup you up; half wants to put on the brakes. All motor activity results from a balancing of these opposing forces. And both opposing kinds of nerves or hormones may be mixed up in the same substructure. So to say that a drug "depresses the hypothalamus" may mean that it takes pres-



Lifelike water color at top was painted by a normal artist. After taking LSD she couldn't paint solid objects but managed the flowers—pretty but vague in weightless, unreal world.

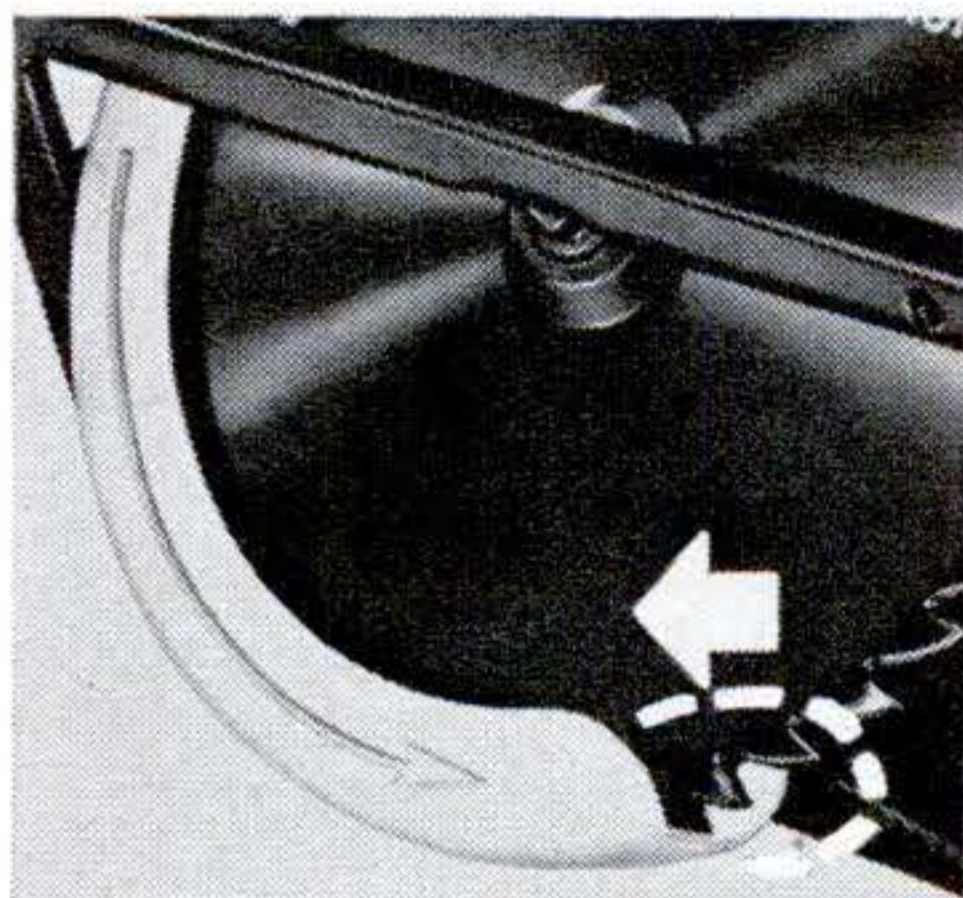
sure off the gas pedal only—like chlorpromazine. Or it may mean that it does that but also steps on the brakes—like reserpine. (It stimulates nerves that want to dilate blood vessels, lower heart rate.) Or it may mean that the drug takes the load off both systems—which is how the barbiturates act:

Phenobarbital, Nembutal, and their like generally depress the brain's activity, spreading their effect to the cortex so that finally you knock off conscious thinking altogether and sleep.

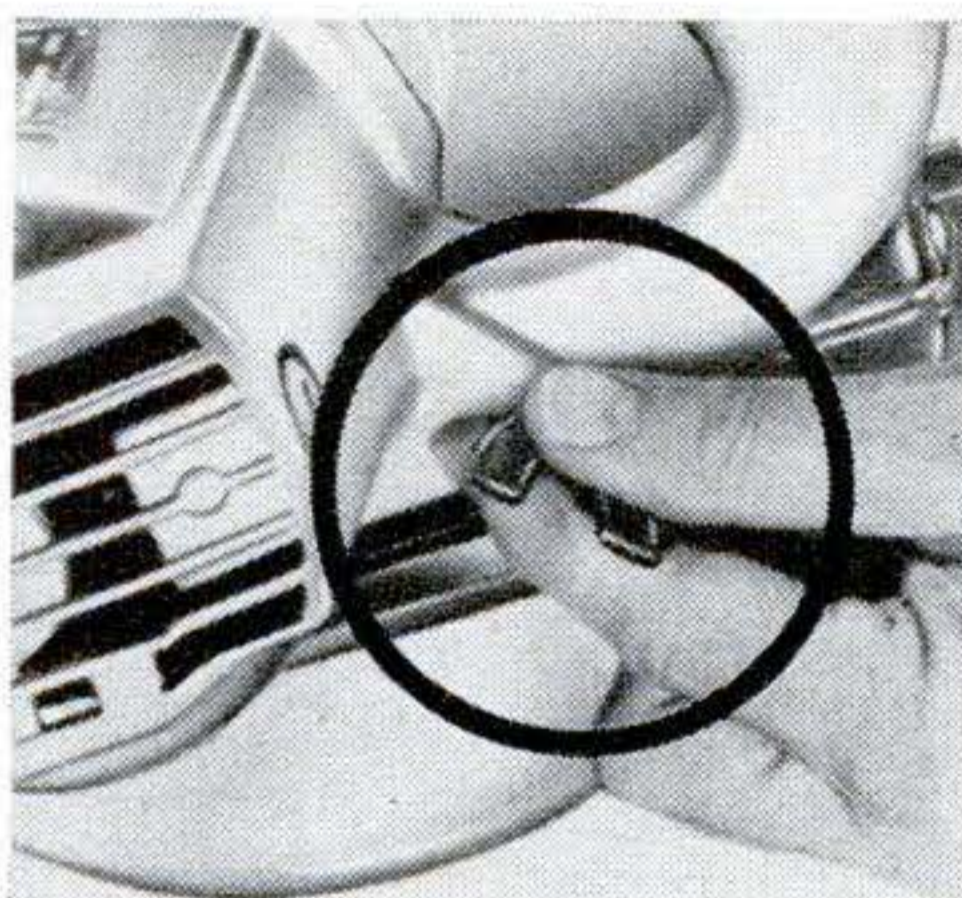
But suppose you don't want to sleep? At the opposite pole from tranquilizers and sedatives are the "psychic energizers."

Dr. Nathan S. Kline, Director of Research at New York's Rockland State Hospital, describes the work of these drugs as "fill-

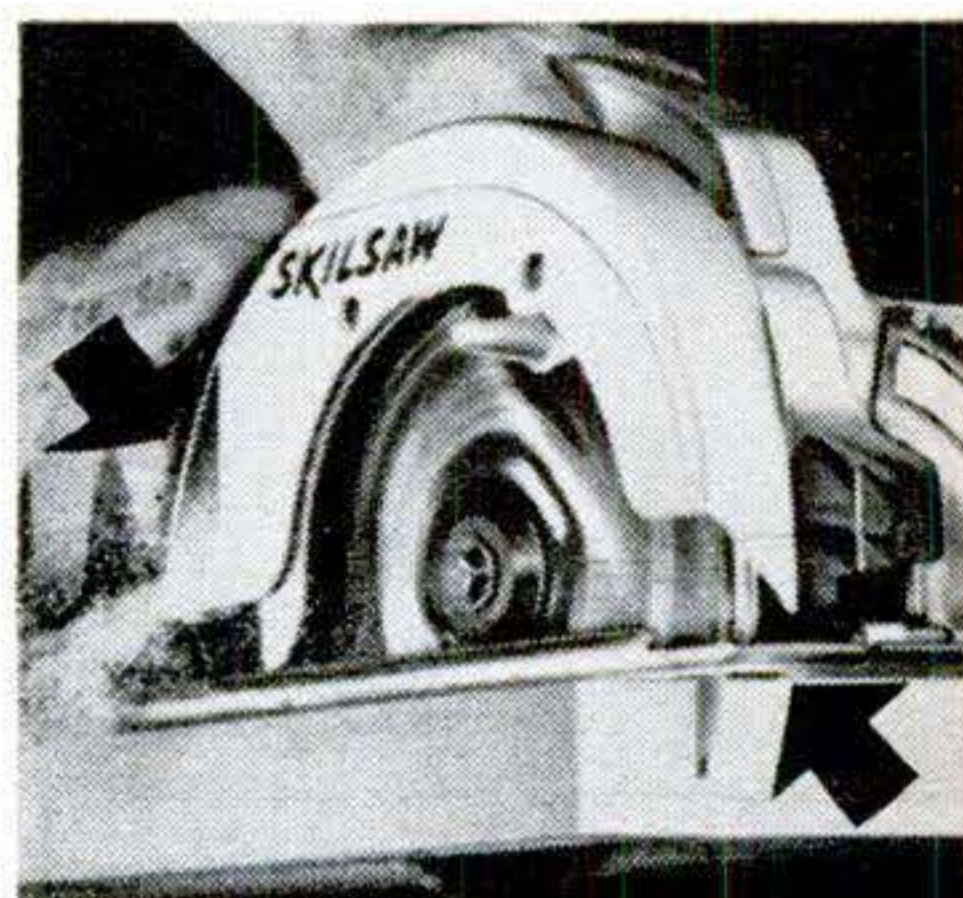
6 REASONS WHY SKILSAW POWER SAWS OUTSELL EVERY OTHER MAKE!



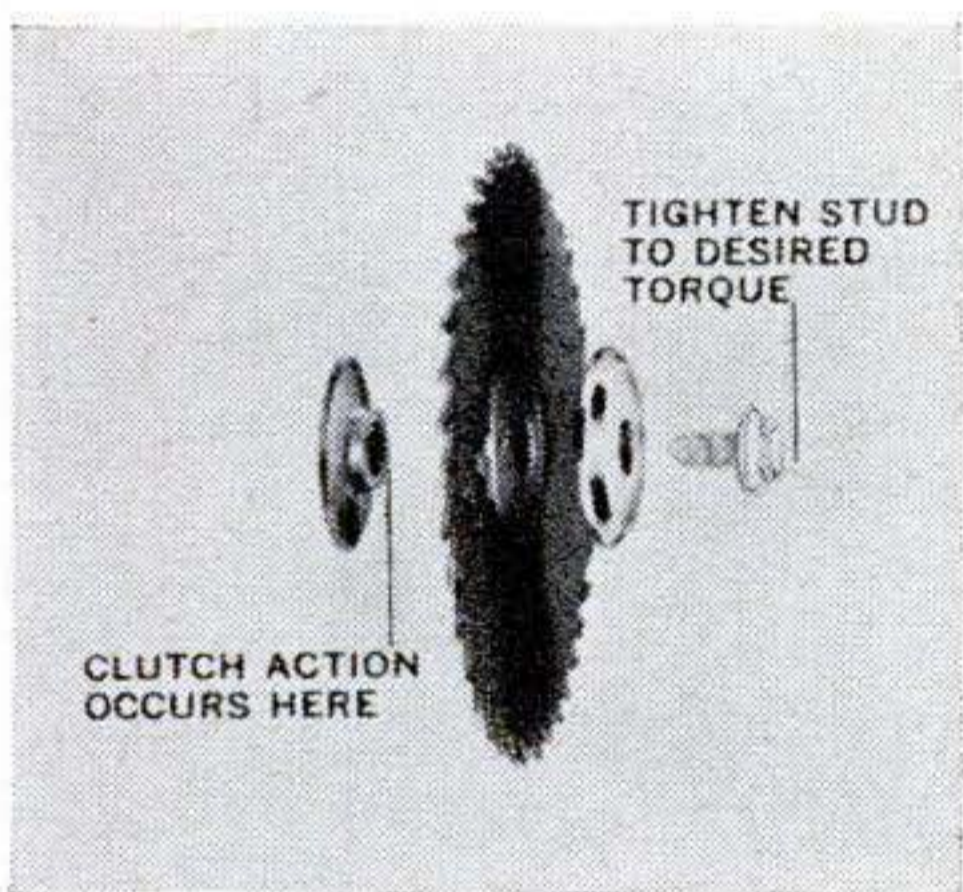
Bind-free lower guard—Retracts automatically when saw base is tilted, thus allowing bind-free starts—even on compound miter cuts.



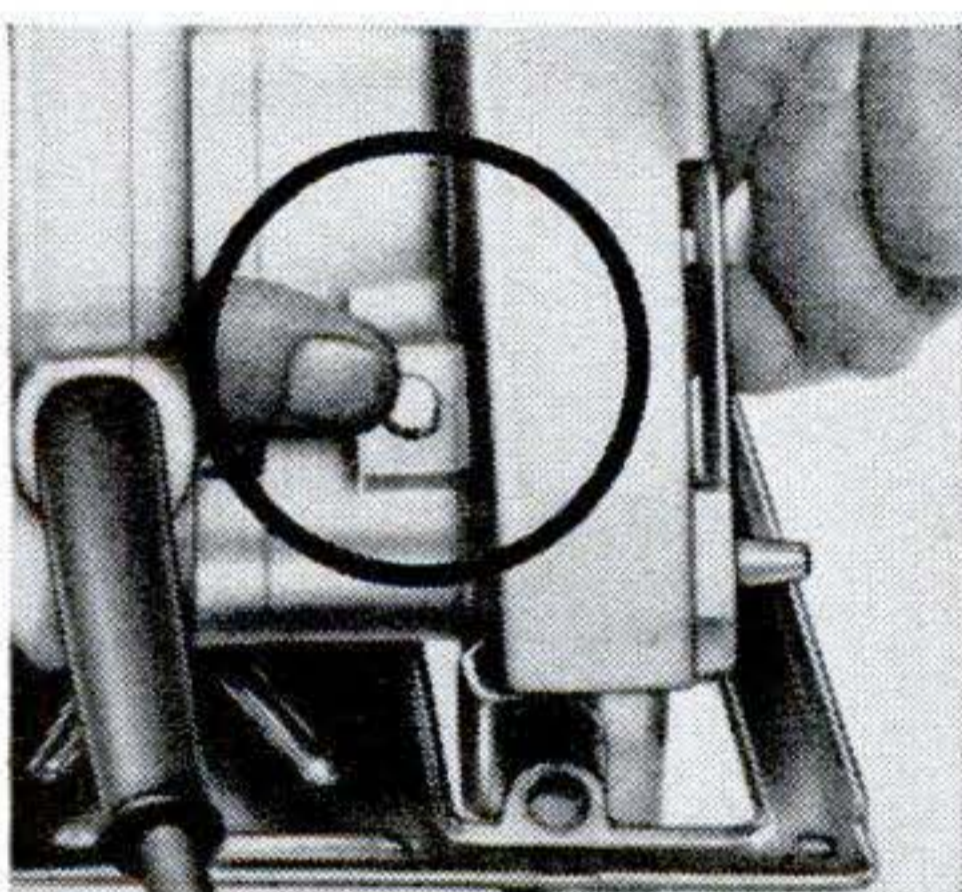
Easy-to-set depth control—Conveniently located for easy one hand adjustment. Control locks the saw firmly and quickly at any desired cutting depth.



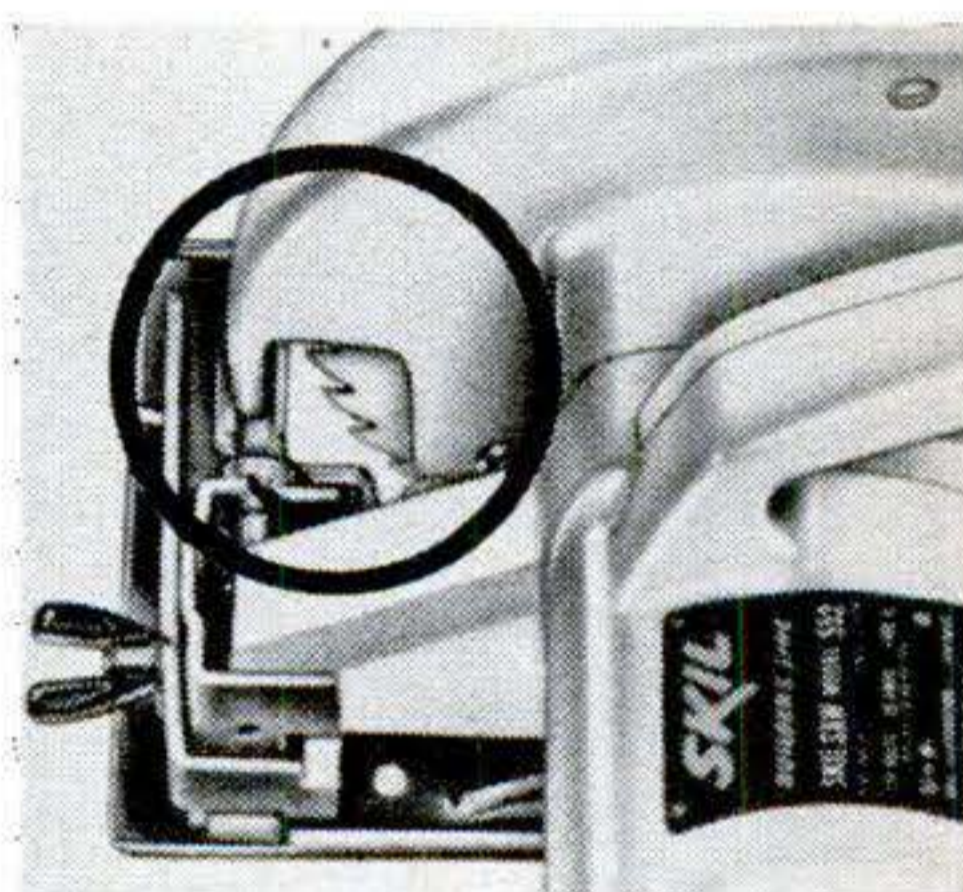
Exclusive sawdust ejection—Special air stream ejection system directs sawdust down to floor, away from the operator; blows it off the line of cut.



Vari-Torque safety clutch—Disengages blade if it binds or jams. Protects gears and other parts from damage, prevents saw kick-back.



Exclusive Blade Lock* (Patented Feature) For fast, easy blade changes. Push-button engages and locks blade shaft for greater user safety.



Full-View Blade—Upper blade guard designed to allow clear view of blade all through the cut for absolute precision and accuracy.



Skilsaw Model 536—World's largest-selling 6½" saw. Makes 45° bevels in 2" lumber, has super burnout protected motor. Other models up to 8¼".

There are many more features, too! Like super burnout protected motors on *all* models, and full ball-bearing construction on heavy-duty models.

Because Skil never compromises on quality, no other saw offers all these features to make every cutting job easier and faster.

Skilsaw Power Saws are made in both deluxe and heavy-duty models with full range of blade sizes from 5½" to 8¼". See them at your nearby lumber and hardware store.

Prices start under \$30—slightly higher in Canada.

SKIL
POWER TOOLS

* available on heavy-duty models only

The Truth About Brain Drugs

ing the pump"—giving you what it takes to make you sharp and fast-working without fatigue setting in. This is very different from the amphetamine (Benzedrine) school of "psychic stimulants" where the effect is one-shot: You're supercharged for a few hours but then you hit bottom. The pump operating at peak performance has poured out all the juices—the adrenal hormones—and now it's empty.

Block that kick. The energizers ("Nardil," "Niamid," "Marplan," "Parnate," etc.), in contrast to the stimulants, seem to work by blocking the action of a chemical the body sends out to destroy these hormones after they have been released. Hence they can continue their alerting work.

When energizers are used on patients suffering acute melancholia, the results are astonishingly good.

When used on "normal" people, they are harder to predict, but they may be a clue to "mind-improving" drugs. Dr. Kline took energizers for a brief period and found he could work harder, longer, and with greater imagination. He slept less but was not tired. (His dreams, he added, distinctly improved.)

Others found their moods deepened, so that if they started out feeling low the drugs plunged them into deeper gloom.

This could be because the chemical balance in the normal person's brain is more nearly in line. A potent drug could throw it out. But in the abnormal person this is not so. Studies of violent patients in mental hospitals show suspiciously large amounts of adrenal hormones and several others.

Proteins, too, may figure in the picture. A number of research groups have extracted certain ones from the blood of disturbed patients. These, when injected in normal adults or in animals, seem to produce schizophrenic symptoms.

Other specialists prefer to look for differences between the normal and the abnormal inside the brain itself. Dr. William Sacks of Rockland State Hospital has experimented with glucose injections. His results suggest that less glucose—the blood sugar that is the brain's major fuel—is burned in the brains of ill patients. This could mean that some of the atoms are being used elsewhere in the brain, or that, in their unused state, they may sour into poisons that cause insanity.

Such a "stale" form of adrenaline can

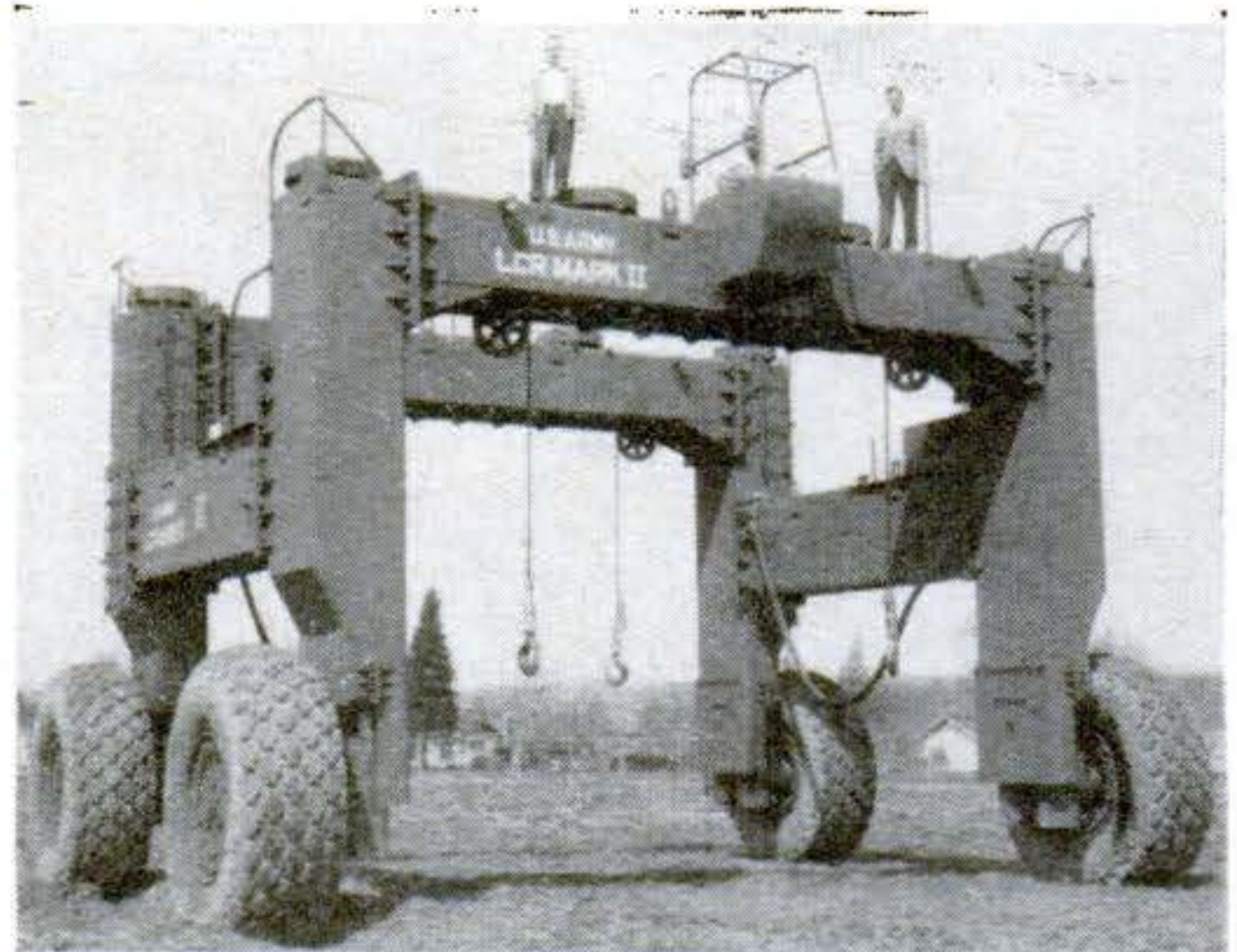
do this. So can the most impressive of the newer man-made drugs: lysergic acid diethylamide 25. Impressive because in infinitesimal amounts (1/700,000,000 of a man's body weight) it can make normal people mad—temporarily.

A true derangement takes place under LSD. The walls of the room may seem to melt and move in and the person may feel disembodied and floating. Sights and sounds are intensified so that dazzling patterns are seen and the sound of a typewriter becomes an infernal machine.

Yet when LSD has been given to neurotic patients—especially ones driven by obsessions or compulsions—it has helped in a remarkable way: It has restored memory. The long-lost childhood incident that may be the crucial clue to illness suddenly springs to mind.

Apparently LSD and other potent "hallucinogens" strike the brain universally, but hit especially hard the cortex area with its memory-storing temporal lobes.

If scientists could figure out precisely how all the mind-affecting drugs act, if they could determine whether the drugs behave strictly chemically or also electrically (either by dampening the energy level throughout the nervous system or by acting as "circuit breakers" in parts of it), they would have a weapon infinitely more powerful than any produced in space-age labs. At stake is the possibility of man, at last, controlling himself. ■ ■



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Sky-High and Starry-Eyed

[Continued from page 90]

load to altitude fills a balloon 90 feet tall and 75 feet in diameter at ground level. But as the balloon rises and atmospheric pressure lessens, the expanding helium would need a much larger gas bag. Such a big balloon would be mostly empty at launch and would billow like a spinnaker—and might bump the telescope along the ground at takeoff. By using two balloons, the bigger one encased in a plastic sleeve at first, the area exposed to the wind is reduced.

It was no secret when inflation began—you could hear it for a mile around. Helium from high-pressure tanks screeched through four waist-thick tubes into the side of the launch balloon. Each tube was held steady by two men wearing insulated gloves to guard against frostbite (helium being no exception to the rule that there's a sharp temperature drop when any compressed gas expands to atmospheric pressure). As the gas squealed in, the balloon stirred, bulged, and crackled as folds in the plastic snapped open.

Fully inflated, the launch balloon was allowed to rise slowly as guy wires were winched out. Beneath it, the sheathed main balloon, parachutes, and suspension lines were pulled up. The payload was still anchored to the ground.

Cutting it loose. Held down by cables, the apparatus stretched higher than the Washington Monument. Then, sounding like light pistol shots high in the evening air, small explosive squibs were fired electrically. One cut the main stay, allowing it to float down 500 feet by means of a tiny parachute. Another one started a seam ripping in the main balloon's sleeve. A third squib released the payload hold-down cables.

As twilight neared, the giant mobile slowly rose into the night. A truck, hauling a helicopter, began to follow below.

As the gas bag rose into thinner air, the helium inside it expanded. At about 6,000 feet, the launch balloon was filled to its limit, and slowly the gas squeezed through a three-foot collar into the main balloon. The 340-foot sheath split open, letting the main balloon inflate.

Ideal speed for the balloon's rise is 800 feet per minute. To insure that it ascended at the right speed, a radio plane circling below it monitored altitude signals tele-

metered from the scope. If it rose too slowly, the plane sent a signal for ballast to drop. Too fast, and a signal opened a valve in the top, letting out gas.

All night the balloon and its dummy payload floated eastward over the southern U.S. It was a successful test, but things went wrong at the end of the flight.

At dawn, a signal was sent to valve the apparatus down, but the balloon didn't respond. A little later, an automatic timer carried on board triggered the exhaust valve, and the balloon came to earth near Krotz Springs, La. Now the ballast—steel powder held in an electromagnetic hopper—spilled accidentally and the balloon rose again, but only to 14,000 feet, since much of its gas had been valved off.

The balloon drifted across the Gulf of Mexico and Florida, then out over the Atlantic. Approaching heavily traveled air lanes, it became a navigational hazard. Navy jets finally shot it down about 100 miles off the coast.

An embarrassment to the Strato II team, to be sure—but other test flights have landed successfully. The malfunction was not considered a serious one.

That flight was the last of five telescopeless trials, preludes to the main event scheduled for this month or next.


Let's see what that will be like—when Strato II carries real instruments and its 36-inch telescope instead of a dummy payload. Launch, tracking, and balloon control will be identical. The big difference, this time, will be an antenna-circled trailer some 200 miles from Palestine—at the flight's expected halfway point.


In the trailer will be two astronomers, a telemetry engineer, an RCA TV engineer, and a navigator—all anxiously waiting for the scope to reach altitude. Project director Schwarzschild won't be there yet. He'll be driving furiously from Palestine after supervising the takeoff.


As Strato II nears its ultimate altitude of 80,000 feet, technicians in the trailer will begin to monitor the radio equipment. Transmitters in the telescope can report data over 64 different channels. From the ground, 40 channels will be open for sending more than 100 kinds of instructions, controlling everything from focus to fine aiming.



By this time Schwarzschild will have

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Sky-High and Starry-Eyed

arrived at the control trailer. As soon as the scope reaches height, a signal will be sent to it, and motors will tilt it from an upright L to a V position, with the long arm pointing upward through only three percent of the carbon dioxide and 1/10 of one percent of the water vapor that are present in the earth's atmosphere.

The men will crowd around the TV set; on the screen the stars will appear, as seen through a small telescope strapped to the side of the big one.

What will they see? The sighting scope takes in a field about 10 degrees wide—roughly the area blocked by a coffee can held at arm's length. The answer will come when telemetered attitude and compass readings are coordinated against a star map. Then the telescope will be swiveled to point at a preselected spot in the night sky.

Once the image is centered in the coarse scope, the TV view will be switched to the camera inside the big scope, a pickup so sensitive it can focus on stars of the twelfth magnitude (the naked eye does well to see sixth-magnitude stars).

Now comes locking in. Gadgets for this operation were devilishly tough to design, because the telescope's aim must not shift more than six millionths of a degree per hour, even though the scope is swaying.

Instead of locking on the object to be photographed, the aiming system is set to fasten its attention on two guidepost stars, one on each side of the subject. Reason: Most of the bodies to be examined, particularly planets and nebulae, are just too big; objects for fixation must be points, not disks.

Two sets of servo motors will keep the telescope pointed. One set will move the whole scope. For the delicate movements needed for fine aiming, small motors inside the tube will gently wobble one of the lenses in the telescope's folded light path.

Through the night, as the observations take place, the truck driver will be jockeying around the countryside on back roads with the helicopter in tow, trying to second-guess wind directions so as to be underneath the balloon when dawn arrives.

At daybreak, the telescope will be valved down to about 5,000 feet and held there until the copter can lift off and catch up with it. Now the copter will take over

control and valve the balloon down to 200 feet or so, where it will drift until it's over a good landing site. Releasing more gas, then, will lower the load to the ground (the parachutes are for emergency use only). Hopefully, the scope will bump softly enough to be used many times over, perhaps for years. Data from one night's work will be enough to keep the researchers busy for months interpreting it.

The first flight of Stratoscope II will be for infrared studies of Mars. Measurements by sensitive equipment may detect water and organic molecules on the planet—clues to the existence of life there. It must come soon, for Mars, due to its proximity to Earth, will be in a "window" only until the end of March.

The following flight—and the first to take photos—is slated for August, with flights planned every four months thereafter. What do the scientists hope to find? Here are a few questions to which Strato II may supply answers:

- Venus, our sister planet, is continually veiled in clouds. Are these composed of water droplets, ice crystals, dust? Or what? Perhaps Strato II will be able to tell. It may even reveal the surface through gaps in the cloud cover.

- Jupiter, largest of the planets, may or may not be made up largely of gases. Nobody knows. And what is the 30,000-mile-long "red spot" hovering over its surface?

- Saturn's rings are probably composed of billions of particles. What are they? How close together are they? How large are the pieces?

- "Dark companions" of stars may not actually be dark—it's just that nobody's been able to see them yet. We know *something* is there, shown by the gravitational effect (a wobble) on their visible companions.

- Many nebulae, including the Great Nebula in Orion, are startlingly similar to our own Milky Way. The cores of nebulae are particularly interesting to astronomers, for here is where new stars probably are being formed. Strato II may resolve them into something more than blobs of light.

Most exciting of all is the possibility—when light amplifiers are later added—of seeing planetary systems of other stars.

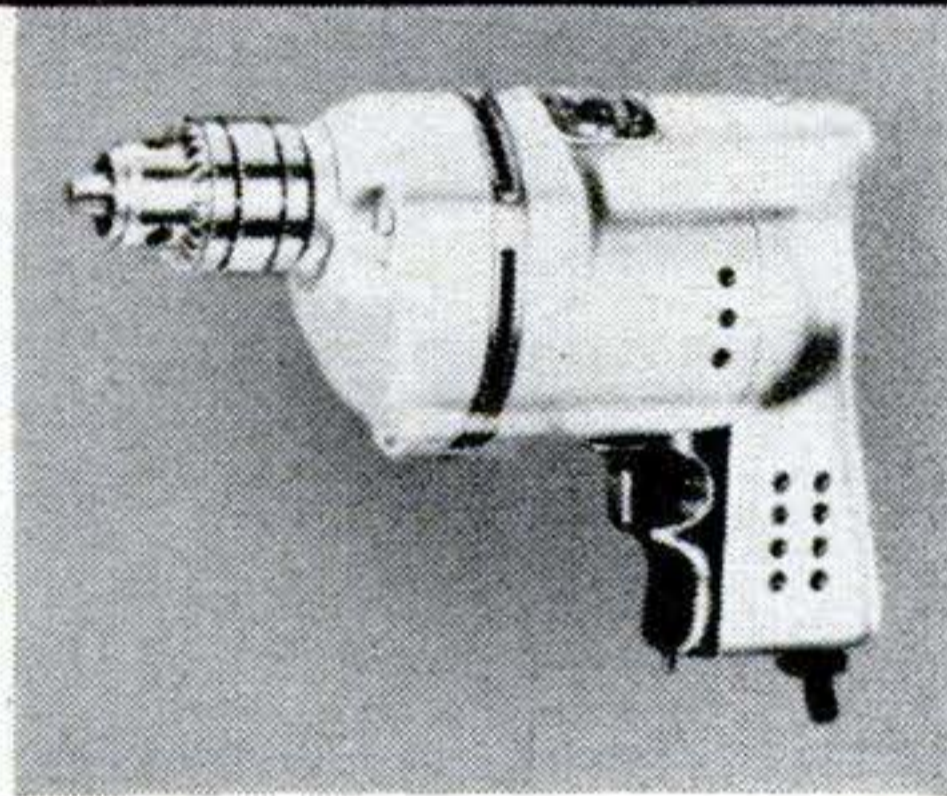
It used to be said that good astronomers go to the moon when they die. The seeing there is excellent. Stratoscope II makes *that* trip unnecessary. ■ ■

1/4" 3/8" 1/2" AND UP!

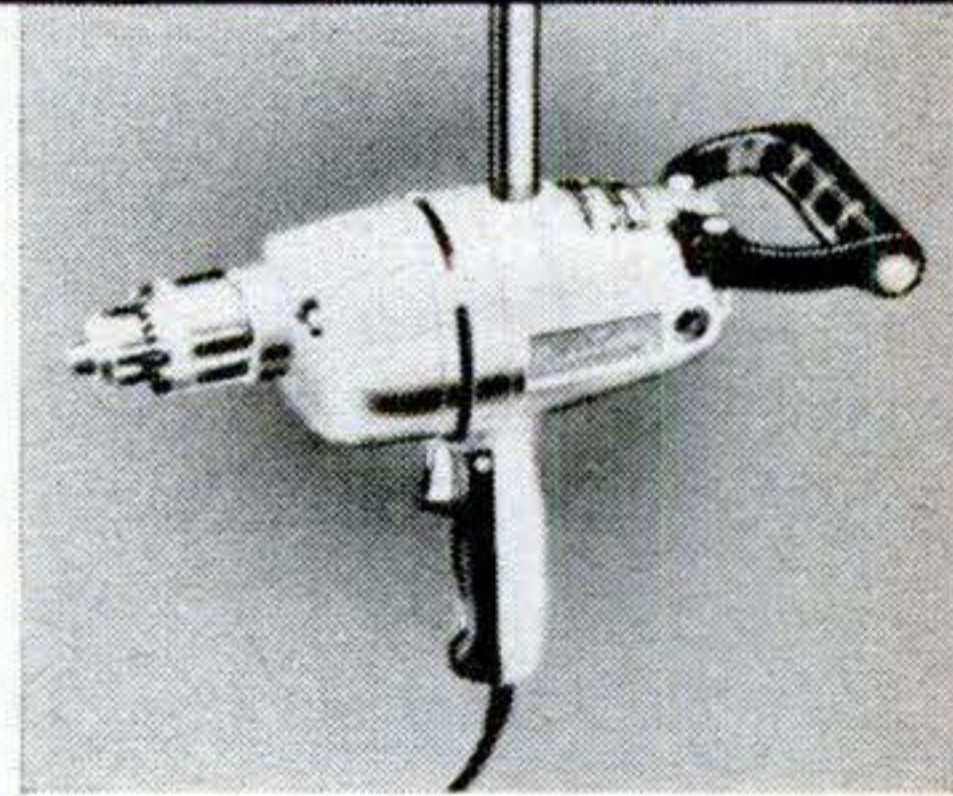
**CHUCK SIZE? YOU NAME IT!
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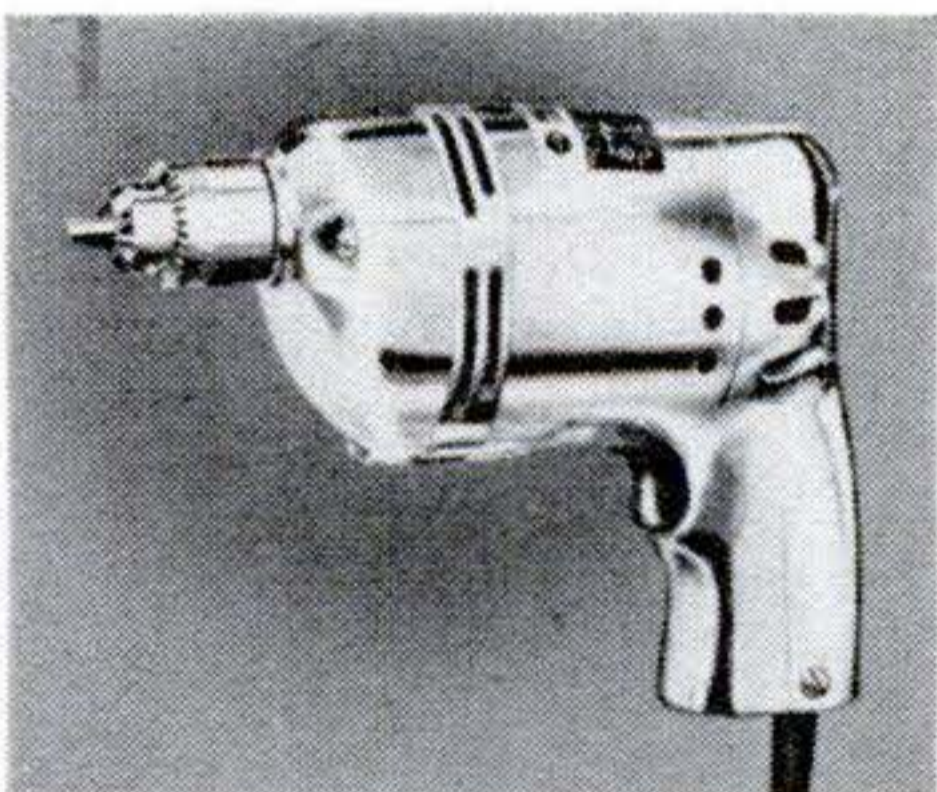
If you're a price man, get a load of this new **U-100 1/4" Utility Drill**. Check the tag. Impossible? No. Go ahead and buy—it's for real! Handles all B&D attachments. Full year free service warranty (except commercial applications).



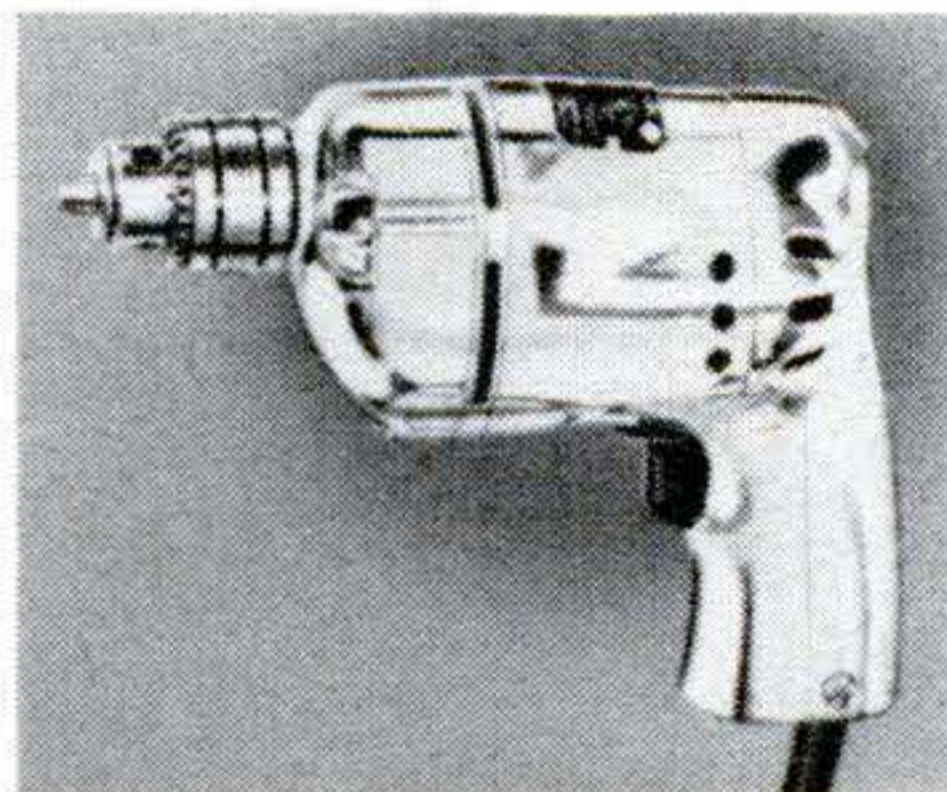
This is no "warmed over" 1/4" drill. It's a 3/8" drill that's 3/8" through and through. The **U-120 3/8" Utility Drill** has double reduction gears for extra power—a totally superior tool for the price. Up to 3/8" holes in steel; 3/4" in wood; 1/2" in masonry.



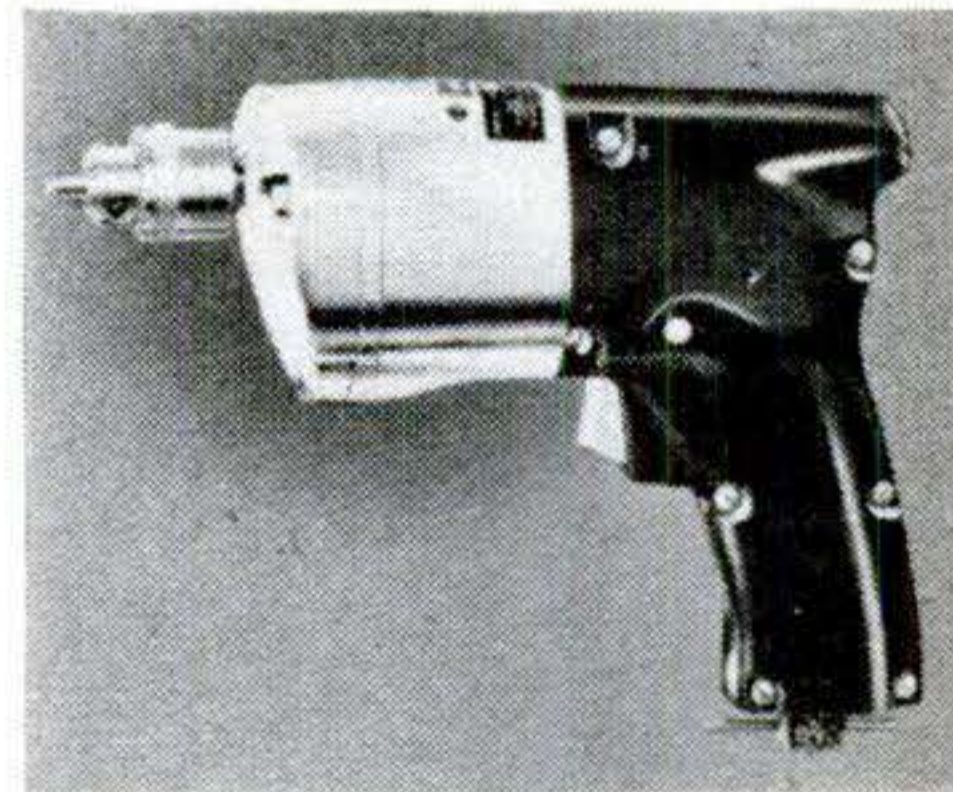
Bigger jobs? Heavier construction, maintenance, repairs? Get next to this **U-226 1/2" Deluxe Drill**—and get something that's tough enough to take the punishment and dish it out. Greatest 1/2" drill buy—for economy, capacity.



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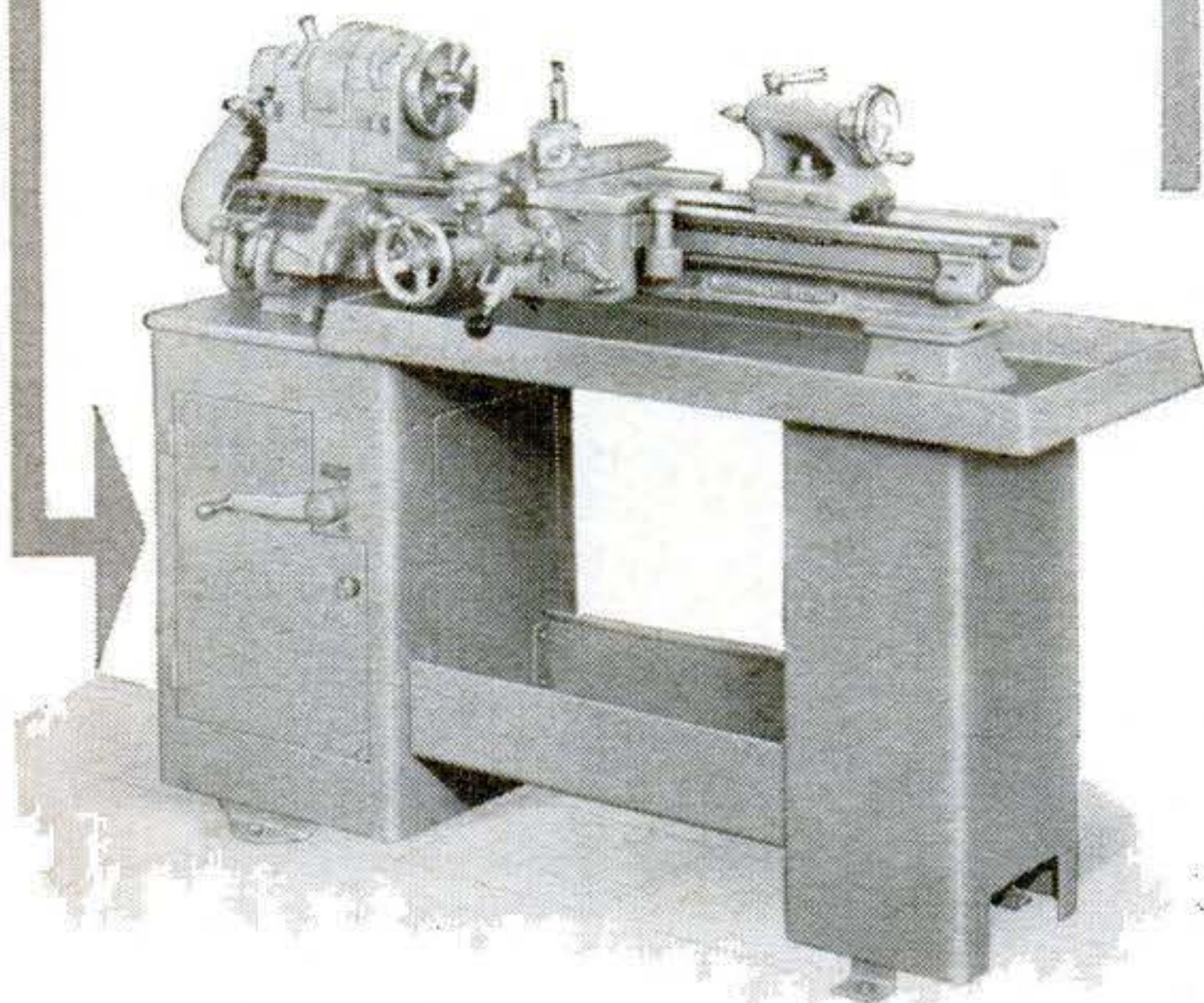


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"American Kids Can Take It!"

[Continued from page 109]

lunch of cattails, saw grass, wild cherries, roasted yucca pods and stems, and drank pine-needle tea.

When we reached our check point, near U.S. 92 and Interstate 4, it was 6:30. We had traveled 11½ miles—but only 9 on the map. We had had to bypass a large swamp. On the way we had caught a small banded water snake. Divided nine ways, it was all we had to eat as we were too tired to hunt. We slept on beds of Spanish moss.

Second day, June 19. We got up at 5:15. Since there was nothing to eat in this barren country, we set out at once.

Water got alarmingly scarce. What we found was bitter-tasting, coming from brownish pools in an occasional cypress swamp. We skirted one huge swamp just before noon. We looked for gopher tortoise, ripe berries—anything—but food just wasn't there.

At two in the afternoon we stumbled out on the banks of a drainage canal. We were way off course and weak from lack of food and good water. The canal water was no help. The heat was unbearable. The temperature must have topped 100.

"Let's rest until it gets a little cooler," I said, and led the way to some small trees along the bank. I had just dozed off when somebody shook my arm.

"Ross, what's that?"

Awake at once, I could hear heavy bodies crashing through the low scrub. Then the grunting. "Wild hogs!" I said.

Just then two razorback sows with half-grown litters came out on the opposite bank.

"Cut off the little ones!" I yelled. We all jumped in the water. The sows squealed and tried to lead the small pigs back. I threw the machete and struck one. Buddy Nye threw himself on it.

"I've got it, I've got it!" he called, stabbing the squirming animal.

As I ran toward him, grabbing the machete again, I saw the mother about to charge Buddy from the back. Men have been killed by enraged wild sows. I yelled and ran faster.

"American Kids Can Take It!"

But Buddy calls

ear the sow or my
t have been a yard
re and slammed her
e turned, confused,
egan belaboring her
while the young pig
ddy scrambled off.
d to see how the others
and spotted Dick Fowl-
n in the canal. From his
ally cutting the water, I
another pig.

We were so grateful for the meat—our first solid food in two days—that we skinned both pigs on the spot and cooked them on spits over an open fire.

We set out again, following a small fire trail west for a mile or so until it branched south and disappeared into a "bayhead" swamp. Bayheads are branches of larger swamps—nasty sinks of deep, gooey mud, lined with sweet-bay trees and cypresses draped with sphagnum moss. Heavily thorned smilax and blackberry vines weave through them. As the vines were

too thick to be pushed aside, we plunged in, Buddy and I taking turns hacking a path with the machete.

Instead of tapering off, the bayhead became thicker. The mosquitoes were fierce. We sweated the repellent off as fast as we applied it. Several of the boys were ill, probably from bad water.

It was nearly dark when we found a dirt road leading north; it dead-ended into a swamp. We backtracked and found a small trail that took us west to another north-south road. This took us to an old timber trail leading west.

We finally came out on a dirt road that led us to our check point on Highway 11 at 2:30 in the morning. We quenched our thirst with some dried-out oranges we'd found. Then we crawled under our mosquito nets and slept on the ground, having walked, waded, and crawled 17 miles.

Third day, June 20. We ate the rest of our oranges and pork for breakfast, then bathed in a small lake. To avoid the heat, we waited until late afternoon to resume



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"American Kids Can Take It!"

our hike. Hunting would be better at night, too. We could use our headlamps to hunt armadillo.

We made 9½ map miles that day, though we walked 15. The country was desolate. Our only food: one pygmy rattlesnake and a cottonmouth; our only drink: the juice of a few dried-up oranges until we made camp by a creek.

Fourth day, June 21. We came to the St. Johns River in midafternoon, but since the approaches were all swamps we had no chance to fish or camp. So, plowing our way through hyacinths, we collected a few fence rails trapped among them, and swam the river, our packs riding a makeshift raft.

Only five miles that day; we were starved and exhausted. Many of us were ill. Some of the boys found a few old lines and rusty hooks along the shore and went fishing while the rest of us made camp. They caught 16 small fish which we cooked on a piece of aluminum foil along with a snake. The night was miserable. Mosquitoes and midges were so bad that if you brushed against the net you'd be bitten a dozen times before you could draw away.

Fifth day, June 22. Our hike doctor came by to check on us this morning. He found several of the boys sick from the tannic acid in the water we'd drunk. He gave them anti-acid pills. We caught and ate about 40 small fish.

By midafternoon we were strong enough to continue our hike. On the way to Sellars Lake in Marion County we found a bountiful supply of huckleberries. We camped at the lake, though we'd made only 6½ miles. After dark we caught a few frogs, some fish, and a coral snake. What with food and clear water, we had a good night.

Sixth to tenth days, June 23-27. The next few days were good. The land was higher and cooler, the woods more open. Food was plentiful. We plotted our course so we were always within hiking distance of a lake.

On the sixth day we came to Ocala National Forest and hiked 12 miles through

it, heading for Half Moon Lake. We kept 100 or 200 yards apart, on our own food. After 1½ or 2 hours we were on our feet in the air for 15 minutes, in part by the chirps of cricket. We reached the lake at midnight. But being good, we pressed on to the edge of Highway 314 and made camp at two in the morning. We had killed two armadillos on the way.

And so it went. The next few days we feasted on huckleberries, blackberries, morning-glory root (it tastes like potatoes when roasted), and cabbage-palm heart; wild pig, armadillo, gopher tortoise, frog, fish, and even roasted grasshoppers. We were lean and fit. But I knew things couldn't stay that way.

On the morning of the tenth day we decided to start out early, rest at noon, and then do our usual evening stint. About seven a.m. Bobby Rile spotted a skunk and we ran to surround it.

"This is the way to catch a skunk so he won't spray musk on you," I said, hauling him up by the tail. I had heard that if you hold a skunk that way he can't use the musk gland which lies at the base of the tail.

Apparently the skunk hadn't heard this. He climbed his own body, grabbed his hind legs with his front paws, and let me have it right in the eyes. He caught Dick Fowler, too, and generously sprayed everyone's clothes.

The boys reacted at once—some dumped their canteens of water into Dick's eyes and mine; others killed the skunk. A lotion wash fixed up our eyes.

When the skunk was skinned, we went upwind to cook it; the meat was delicious. But we washed our clothes and bathed repeatedly for the rest of the trip.

In two more days we came into Yankeetown, end of the trail.

We had learned a lot—that man can survive in the worst kind of country with teamwork and planning. I had learned, too, that American kids can take it! They are rugged and knowledgeable. An enemy would have a hard time stamping out their fine spirit. ■ ■

VOYAGER

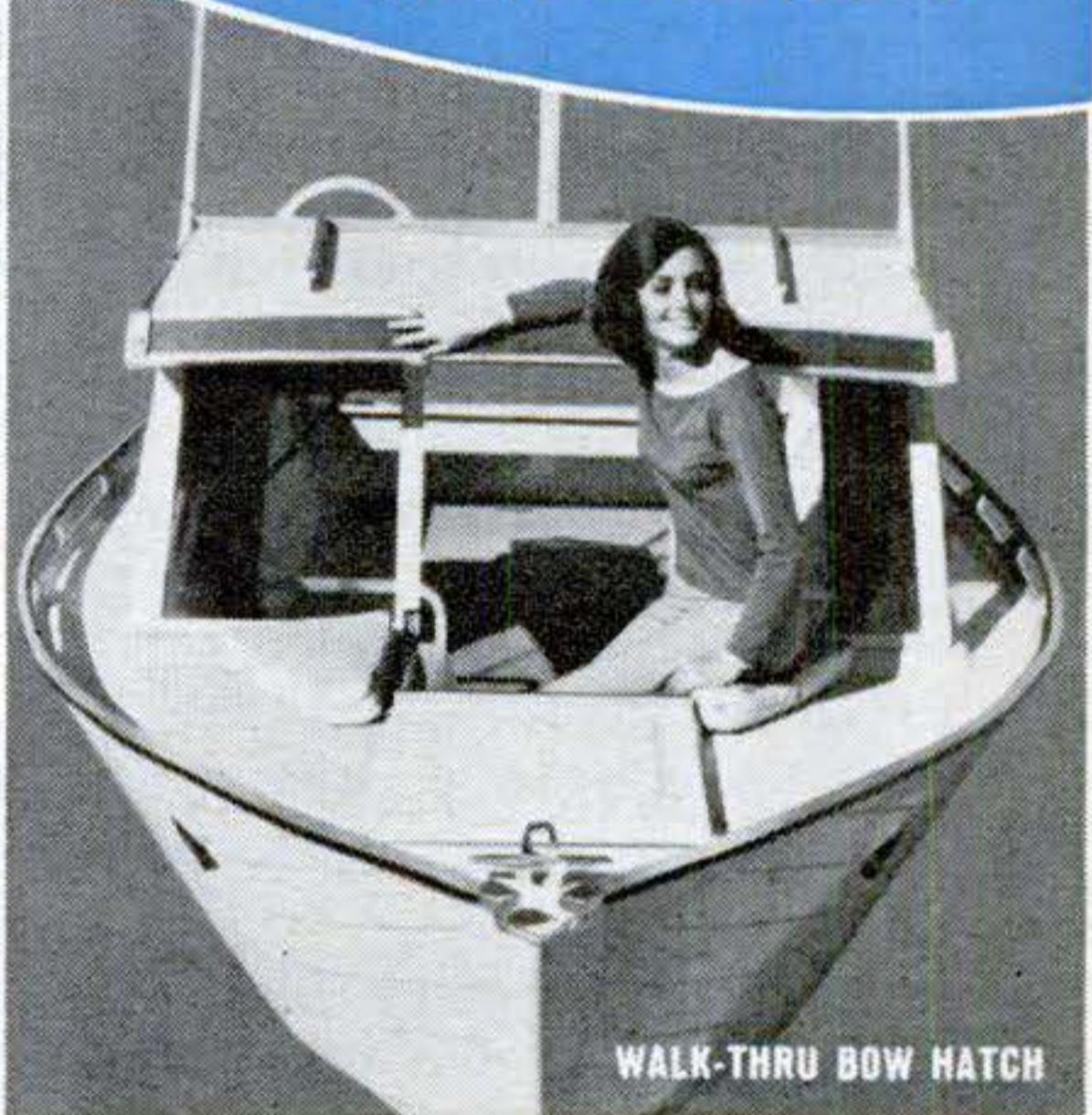


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Other developments are less obvious but just as important. The artful marriage of strength and beauty through precision lapstraking and hydropress metal forming. The marine-archi-

tect designed hulls, with extra "lift" for smoother planing from Lone Star engineered lift rails.

Take it from us, these are the best boats ever built — otherwise we couldn't guarantee them for a lifetime.* Or challenge the entire marine industry by standing pat on a policy of no year-to-year changes just for the sake of change.

Your Lone Star Dealer is so excited about the new models that he is now offering a 4 band (AM, Marine, 2 Short Wave) 9-transistor marine radio free with purchase or down payment of the new 16 ft. Medallion or 18 ft. Voyager (above). Details at any Lone Star Dealer displaying transistor radio offer. Visit your Dealer now . . . offer ends Feb. 28, 1963.

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202 POPULAR SCIENCE FEBRUARY 1963

The Sergeant Shoots Off

[Continued from page 102]

sile-artillery officer on reading the report.

The Sergeant had made its debut as an operational Army weapon that will be combat-ready with U.S. troops in Europe this year. Designed for atomic attack, the missile also can carry a biological or chemical warhead—but not conventional high explosives.

The Sergeant and the Corporal (which has been with troops since 1955) are both nuclear-delivery weapons and both have about the same range—30 to 85 miles. What, then, makes the second-generation Sergeant so much better? Let's look.

Solid-propellant rocket. This high-energy, quick-reacting fuel is easy to handle and gets the missile off in a hurry; transportation over even the most rugged terrain doesn't bother it; and inherent stability makes possible long-term storage of fueled rockets without deterioration—ready to fire. That is not the case with the liquid fuels used in the Corporal.

Mobility. All components and vehicles of the Sergeant Missile System can be hauled in Air Force C-130 Hercules cargo planes. Overland travel, even across rough, off-road areas, requires no special vehicles. The Corporal, more cumbersome and complex, does not have this flexibility of movement—or the fast, self-contained launch ability.

Ready, aim, fire. The erector-launcher gets its own power from two gas-turbine generators. It mounts a swinging boom for assembling the missile sections on the launcher—rocket, guidance unit, warhead. Attached to the rear is an electronics-packed, computer-brained firing station. Once a Sergeant's mission data has been programmed into its circuits, the countdown to blastoff is automatic, and self-testing for malfunctions.

At X minus 3 minutes, the launching team scrambles out of the blast area; two men take cover in a sandbagged firing pit 250 yards away.

At X minus 85 seconds, the missile is raised five degrees. Five seconds later, the launcher slews around to target-aiming azimuth and elevates to 75 degrees. The countdown continues automatically to "fire." Unless it receives a manual override from the pit, the five-ton Sergeant, boosted by 45,000 pounds of thrust, is on its way—sure, swift, self-guided.

The Sergeant Shoots Off

The Sergeant is not choosy about a launching site; any fairly level clearing about 60 feet across will do.

Assembly time: seven minutes for a crew of six. A "rocket safe" plug is pulled and replaced with a firing plug. Then comes the countdown. With the bird launched, the missile battery and its vehicles can be off the site and on the road in less than the 90 seconds it takes the Sergeant to reach its target. "Shoot and scoot," they call it.

Inertial guidance. Gyros, a computer, and a battery-power source are the heart, brains, and muscle of the Sergeant's guidance system. In flight the missile needs no commands from outside to take it unerringly to target. It carries its own orders, and in flight continuously compares what it is doing with what it was told to do. If trajectory or attitude varies from the preset pattern, the gyros sense it and initiate course corrections. (The three tiny gyros are so sensitive that if it took the second hand on a watch four years instead of 60 seconds to make a sweep, they could detect that incredibly slow motion.)

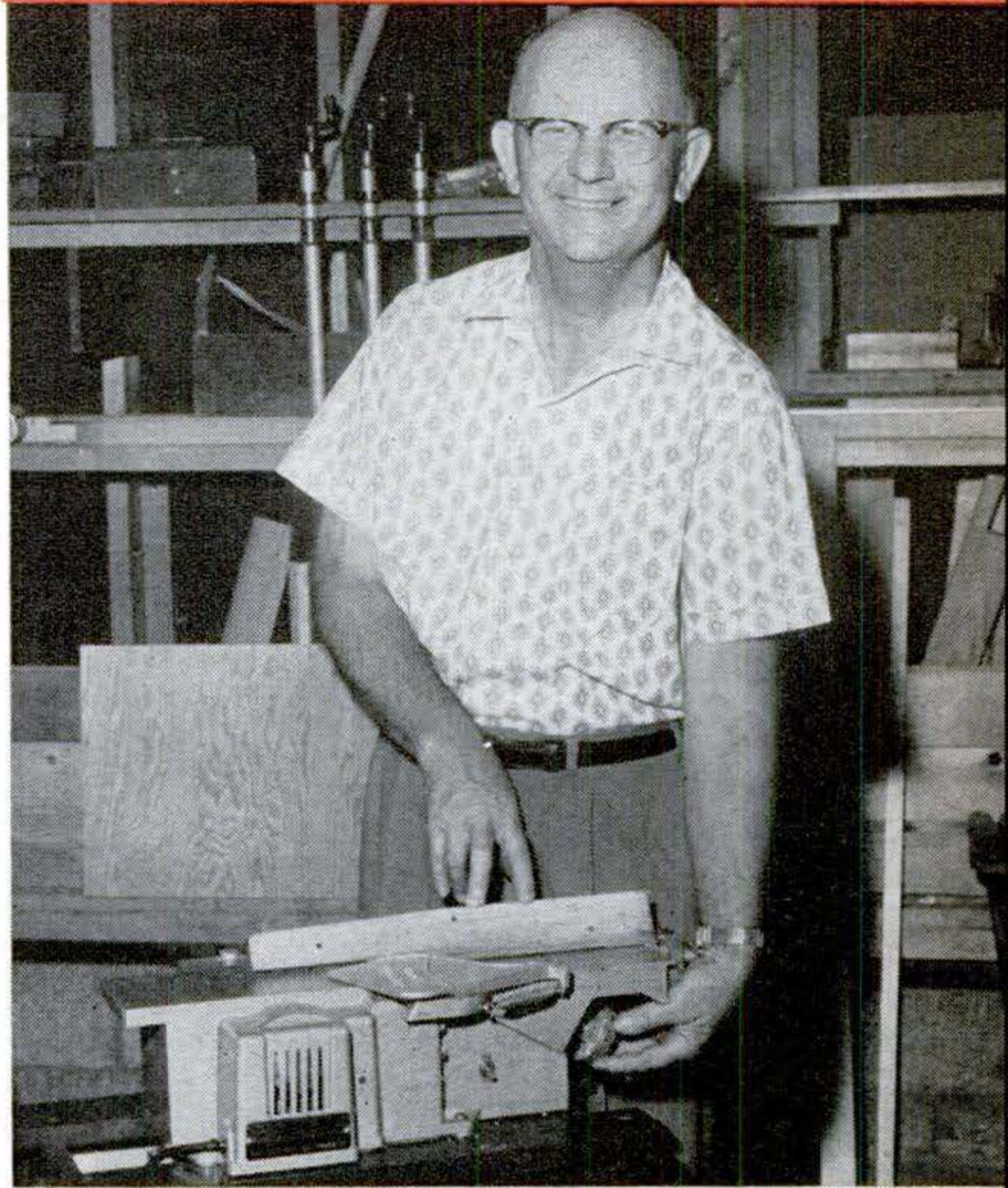
Range is pinpointed during flight by automatic aerodynamic drag brakes, rods that are periodically extended and retracted from the body of the guidance section to vary speed.

Foolproof in flight. We know of nothing that the enemy can do to disable the Sergeant's guidance system in flight or divert the missile from its course, except by a direct hit from ground fire. And that would take some doing, what with the bird's supersonic speed and the surprise it is capable of.

The Sergeant, like most Army sergeants, didn't make it the easy way. It took seven years and half a billion dollars for the weapon to make the grade from laboratory to launching. Research was begun in 1955 by the California Institute of Technology's Jet Propulsion Laboratory. In 1959, the Sperry Gyroscope Co. took over as prime contractor. A special company was formed—Sperry Utah—to build the missile and its operational system.

In the Sergeant, the Army has the second-generation artillery missile it wanted—a powerful atomic weapon ready to back up the GI on the battlefields of the limited and brush-fire wars that may well threaten us for many years to come. ■ ■

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Getting a "Stock Car" Ready for Daytona

[Continued from page 76]

and bolts were safety-wired when possible.

The car's front suspension and springs were beefed up. Upper and lower suspension arms were boxed and gusseted for reinforcement.

Because the right side of the car takes the severest loads on the turns (the race is run counterclockwise), the right front spring was given almost three times the spring rate that it has in your car. The heavy-duty shocks were set more firmly on the right side of the car. Front shocks were remounted outside the coil springs, rather than inside as usual.

The rear-axle housing was reinforced by strap steel welded to the bottom of it.

The heavy-duty brakes were given sintered-metal linings instead of the standard kind. The hotter these brakes get, the better they hold. Brake drums and back plates were peppered with drilled holes to let in as much cooling air as possible.

The deep-dish steering wheel, with horn ring removed, was wrapped with several layers of rubberized tape. A two-inch-thick circular pad of sponge rubber covered the center.

The car's windshield was reinforced with three steel clamps to keep it from popping out. Two-inch-wide vertical strips of stainless steel were fastened over the rear window for the same purpose.

Hood and trunk lid were specially clamped down to keep them from flying open or being wrenched off.

To minimize the risk of driving over broken glass or having windows shattered by hurtling fragments of metal, all car lights, hubcaps, and body trim were removed.

The car's front-wheel wells were enlarged to make room for the big tires—8.00-8.20-by-15s.

The engine was "blueprinted": taken apart, and every part checked to make sure it exactly met all Mercury specifications. Gear ratios are each team's secret.

"How does it feel to drive one of these Mercs after you're through rebuilding it?" I inquired.

Stroppe gestured at Troy Ruttman, the 1952 winner of the Indianapolis 500.

"This baby," said Ruttman, slapping the tail of the Mercury we had been inspecting, "handles at 160 like a sedan going along a city street."—Wesley S. Griswold.

Detroit Goes Back to the Races

[Continued from page 76]

A qualifying speed of more than 160 m.p.h.—160!—for two laps, totaling five miles, no doubt will be necessary.

It's no mystery why auto racing has become the second biggest spectator sport in the U.S. (the first: horse racing), and why Daytona (where, and at adjacent Ormond Beach, speed records were set and smashed on the beach sands for a half-century) has become the Mecca of its stock-car phase. The man in the grandstand can imagine himself behind the wheel of one of the machines streaking around the track. After all, it's only a souped-up stock car.

Everybody becomes a buff. The happily unredeemed fan in the stands can tell you second by second what each crewman will do as a car rolls into the pits for service.

The pit crews' performance is as stylized as that of a ballet company. Waste movement is a crime. Fuel is in individual cans, and only one can is permitted at a time over the protective wall intervening between the storage area and the pit proper. That cuts down the fire hazard.

A car coasts in. The crew chief leaps the wall with a can of gas in one hand and a wrench in the other. As he passes the right rear wheel he starts a wheel nut. On his heels is his number two man who goes at the wheel while the chief pours gas. Man number three attacks a front wheel as other crewmen pass over replacement tires.

After the tires comes the windshield and rear glass wipe, with swabs on long handles thrust at the car from behind the wall. That's necessary because only six men besides the driver are allowed in the pit proper at one time. A cooling drink—on a handle—is thrust at the driver.

The tank's full. The wheels are changed. The engine comes to life like a machine gun.

Time in the pit: less than a minute, despite the lack of a conventional racer's knock-off hubs.

The buff knows all the driver's tricks on the track. Ever hear of "drafting"? That's getting a free ride. Snuggle up close behind a car in front of you, and the vacuum in his wake helps you. Oddly enough, both cars pick up speed. The one in front seems to shed some of its wind drag.

Know how to make a turn? Most drivers "feather" their engines—ease off on the accelerator—to "breathe" them.

CONTINUED



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Detroit Goes Back to the Races

Know about superstitions? You'd better if you're going to race. Green is a bad-luck color. Nobody knows why. Peanuts are taboo. That notion originated in the days when the pits were under the grandstand and spectators let shells dribble down to get into the intake pipes. Getting your picture taken before a race is bad luck, too.

Stock-car racing rules are rigid. Some samples:

No engine can be of more than 428 cubic inches of piston displacement. A car can have only one carburetor, and that of no more than four barrels. (More carburetion will literally run a car out of track—it will go too fast.) A gas tank can hold no more than 22 gallons.

Body panels of anything but steel are ruled out as unsafe. Each car must weigh no less than its showroom counterpart. Actually, it weighs from 200 to 300 pounds more because so many of the components are beefed up. All door latches and hinges must be fixed to prevent their flying open in accidents.

Body clearances must be 12 inches on the right, 9 inches on the left. (The cars are all lopsided because centrifugal force slams down that right side on the turns.) Exhaust pipes must clear the pavement by four inches, oil pans by five.

I asked Norris Friel, technical director of the National Association for Stock Car Auto Racing (NASCAR), the supreme governing body for the sport, about that.

"Supposing," he explained, "a car blows a tire. It goes into a long skid. The oil pan drags and breaks. Whoosh! the guy behind skids."

"What about the hoods?" I asked. "Why the extra latch-downs?"

"Hoods used to buckle in the middle, where there wasn't a catch, from high speed and minor sideswipes," he said. "So now we require a center catch."

Occasionally a car owner—shush, must we admit dishonesty?—will try to put something over, winking at the rules. So Friel has 10 men inspecting the cars, two of them unidentified gumshoes.

"Aren't you afraid to admit that these spies circulate among the pits?" I asked.

"No," he said. "We want the drivers and crews to know that we've got an eye on them. Keeps 'em honest."

It all makes sense. One result has been that the Daytona International Speedway is

pretty safe. In four seasons there has not been a fatality. Injuries have been few.

This was a dream of the track's founder, Bill France, high priest of U.S. stock-car racing.

For racing, the beaches had had their day. The encroachment of hotels and motels had made driving on them hazardous. Moreover, the wind had to be just right to smooth the sand, and races had to be run when the tide was out.

In the planning stage the track was a mathematician's dream—or nightmare, depending on how much trigonometry you've had. Classified as a tri-oval, the 2½-mile asphalt roadway includes a 3,400-foot back straightaway, two end turns (each 2,700 feet around), and a straightaway in front of the grandstands dented by two shallow turns in the center.

The turns are beautifully banked. They should be—it took 18,000 separate calculations to shape their slopes for various speeds. If you're in the proper lane at the proper speed, you can take your hands off the wheel at up to 110 miles an hour. The car will track by itself.

The big names in stock-car racing will be back this month at Daytona. To the true buff, they are as familiar as the famous bangtail pilots. The Daytona counterparts of the Bill Hartacks and Manuel Ycazas are Banjo Matthews, Glenn Roberts, Dave Pearson, Dick Petty, and Junior Johnson.

Big names in the standard race-car field, including those who compete at Indianapolis, compete at Daytona, too: Rodger Ward (he won the Indianapolis 500 last year), Troy Ruttman, Parnelli Jones, Paul Goldsmith, Len Sutton, and A. J. Foyt.

Yes, Detroit has gone back to the races. In Daytona the inspectors, looking over a rig, only ask, "Is this part in the manufacturer's catalogue?"

If it is, it's "stock." And Detroit makes sure that anything that will give a car more speed is in the catalogue. ■ ■

.....

Other Daytona Speed Week Events

Feb. 16—American Challenge Cup race for grand touring and sports cars.

17—Daytona Continental three-hour grand-touring and sports-car race.

22—Two 100-mile NASCAR Grand National Circuit races.

23—National Championship NASCAR 250-mile Modified Sportsman race; 25-mile consolation.



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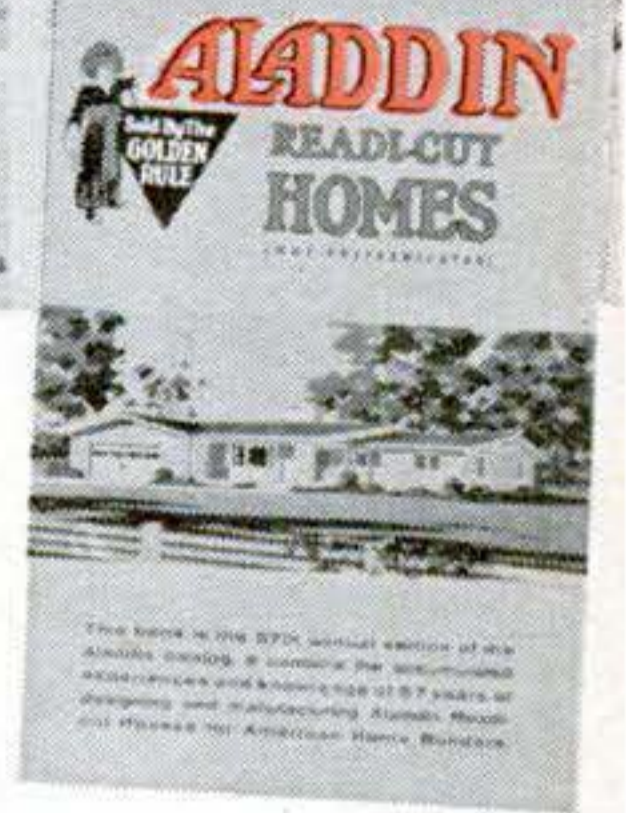
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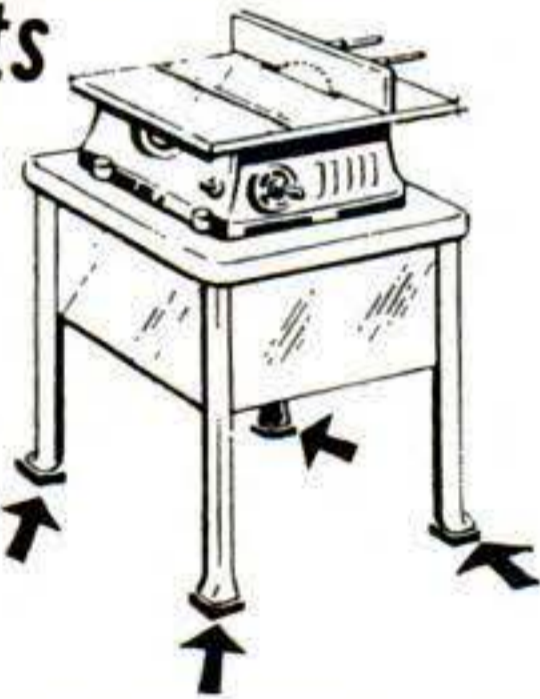
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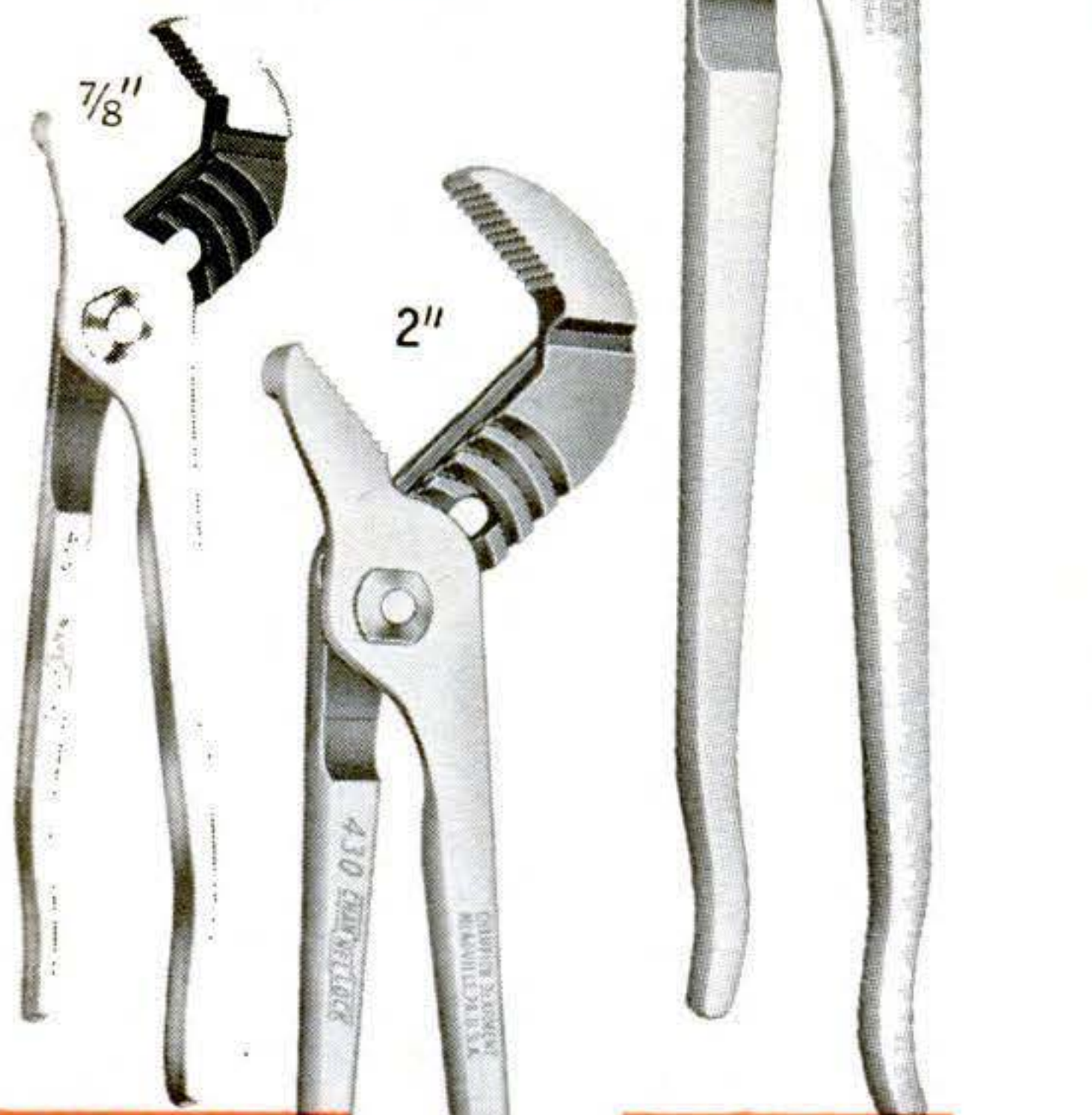
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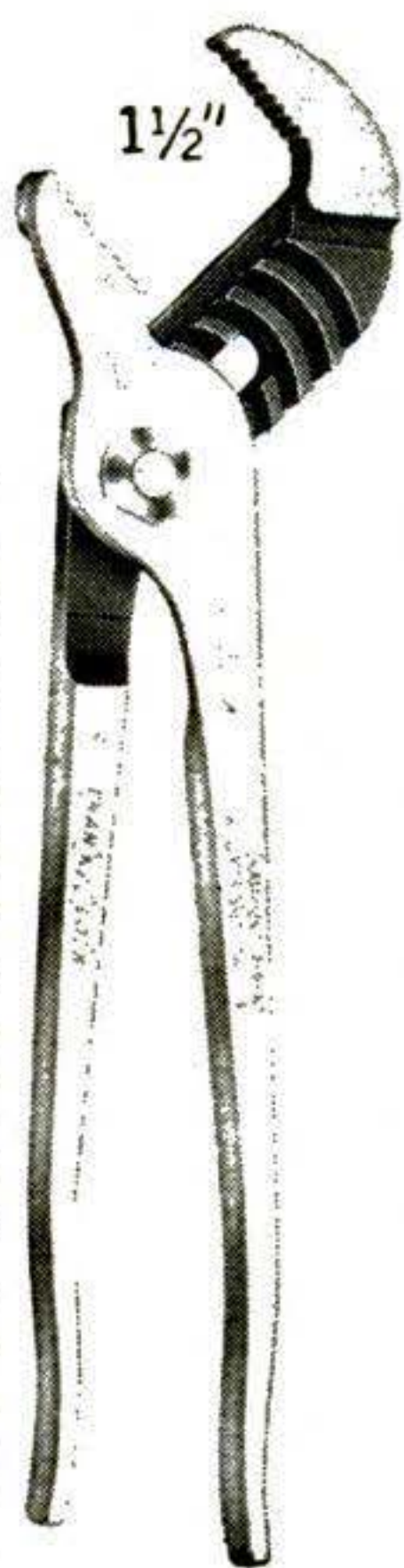
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Color Photos in 60 Seconds

[Continued from page 64]

anced to reach full development simultaneously. Chemists would create a molecule linking a developer and a dye only to discover, say, that its solubility characteristics failed to match that of the dye molecules in the other emulsion layers.

Stability of the dyes, of course, is important. The linked molecule makes it possible for Polaroid to place the dyes in the film at manufacture, insuring stability in the negative and permanency in the finished print. The linked molecule also increases the number of dyes that can be used. As part of that linked molecule, the developer controls how much dye stays in the negative and how much reaches the positive.

Who will make the film? After Polaroid had developed the process, they approached the Eastman Kodak Co. and asked them to adapt the process to Eastman's established manufacturing methods. Eastman now manufactures the color-negative material, while Polaroid manufactures the print material and the processing pods.

The first prints from the new color film required coating within seconds after developing. Reason: The developer portion oxidized in the air and affected the dyes. Polaroid beat this by putting a new receiving layer on the print. Now your print has a brilliant, permanent plastic surface.

How true are the colors? A certain amount of color distortion appears in all processes. This is true of Polacolor, too. It produces good color prints—but no miracles.

When you compare it with other color processes, keep in mind what it accomplishes: permanent, finished prints that are ready to be viewed almost immediately. It fills the same place in color that Polaroid's other films do in black and white.

The real test comes when you peel off the print and start comparing it with the scene before you. No other film has to meet such a rigid test. For the first time, you can compare the colors in the scene directly with the colors in the print—and do it immediately after taking the picture.

Do all the colors reproduce exactly? Of course not. Nor will you see a print made on any present color material that looks exactly like the subject. But move back, so to speak, and look at the print.

The skin tones. Usually these are warm and flattering when taken in full sunlight—sometimes even warmer than you may like.

Color Photos in 60 Seconds

Taken under diffused light with the proper filter, the skin tones appear normal. Indoors, using blue flash for illumination, skin tones seem rather yellowish, though these probably are rendered with greater accuracy than the skin tones recorded outdoors.

Warm, saturated colors, such as fire-truck reds, appear somewhat subdued (diluted with white) in the prints.

The blacks and grays? Compare these with the subject and you find them rich and true, with little color contamination.

The colder, saturated colors—blues and greens—reproduce darker than those you see in the subject. Pictures made on sunny days, of course, show better color saturation than those made on overcast days by diffused light. But even in clear, bright sunlight, Polacolor prints have a pleasing subdued appearance—there's no exaggeration in the strong colors.

What particularly impressed us was the excellent rendition of delicate pastels and fine details, which hold up well even in the shadow areas.

We did notice that colors tended to shift more from print to print than they would under precise laboratory time-and-temperature controls. Most of our tests, however, were made on films that still required coating. Any loss of time before coating affected the print quality. Now that coating has been eliminated, print quality should be more consistent.

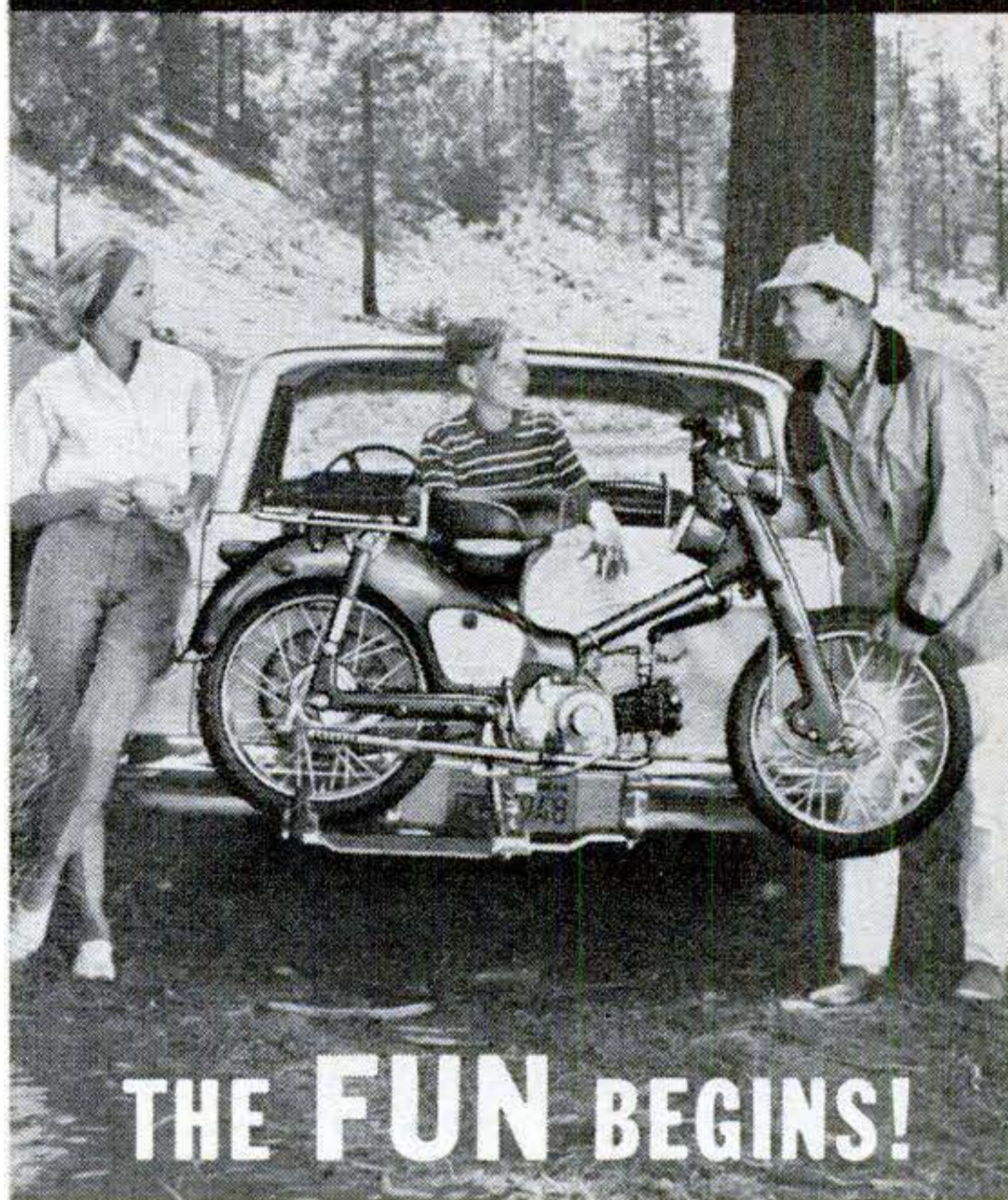
Development will usually vary from one to 1½ minutes, depending on temperature. Just keep in mind that it is the temperature of the camera, not the temperature of the atmosphere, that counts. When we pulled one picture in a quarter-minute under normal developing time, our test chart, instead of photographing neutral gray, showed pink overtones. Overdeveloped, the picture showed blue overtones.

Temperature tips. If camera temperature is 45 to 60 degrees, for instance, you let the film process for 1½ minutes. Warmer camera temperatures shorten the time. At 80 and above you give it less than a minute. It is possible to use Polacolor below 45 degrees, but results will be more consistent if the camera temperature is kept above freezing.

If you were to use the film at zero, for instance, processing time would be about 10 minutes or more, and results would be undependable.

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Color Photos in 60 Seconds

Exposure meters should be set at ASA 50, except when the temperature is 80 or above. Then set the meter at ASA 100, thus reducing exposure by one stop.

While you may only occasionally shoot extremely short or long exposures, Polacolor, like other films, works efficiently only within a specific range of shutter speeds. Polacolor's working exposure range is from 1/1,000 to 1/10 of a second. Over 1/10, there is a loss of speed and an increase in yellow densities (due to reciprocity failure). To compensate for the color shift, a blue filter is recommended.

What about color balance? Polacolor is balanced for daylight only. Use blue flash bulbs or electronic flash for fill light and as sole sources of illumination. When using photofloods as a light source, correction filters are necessary.

Exposure latitude? Typical of the reversal processes, Polacolor film has a relatively short scale. For satisfactory results, you can go only about a half-stop over or under the recommended exposure and still obtain an acceptable print.

Can you use the new film in your present Polaroid camera? It's a qualified yes. Certain modifications are needed on a few models. But only models 80, 80A, and 80B require factory conversions to use the new film.

The Polacolor negative base is much tougher than the Polaroid black-and-white film base. Unless you own a camera with notched teeth, you'll find it difficult to tear off the negative tabs. But an inexpensive accessory cutter bar is available that does the job easily.

Polaroid will offer a copy and enlargement service similar to that for black and white.

Price of the new film? Following a Polaroid policy, dealers set their own prices. At present we can only give you a rough idea: It should sell between \$4 and \$5 for a six-exposure roll. It will be available in Type 48 (3 1/4" by 4 1/4") and Type 38 (2 1/2" by 3 1/4") roll film in daylight type only.

At present, you may not find the film in your local stores, since it's being introduced gradually, starting with seven or eight of the southern states. But by summer it will be available throughout the country.

Polacolor will make a big hit with anyone interested in seeing his color shots immediately. And who isn't? ■ ■

nose, it helps the pilot find and hold the critical angle of attack for re-entry, which determines whether the X-15 will come home safely or burn up and tear apart on the way down.

An adaptation of the Q-ball is thought certain to be mounted in the nose of the Dyna-Soar glider, which will depart and return through the earth's atmosphere much faster than the X-15 does.

Dyna-Soar seems certain, too, to use the marvelous "adaptive control system" that the X-15 has flight-tested. The ACS has been installed in the No. 3 ship alone. Its electronic brain senses rapid changes in flight conditions that the pilot's own brain can't grasp fast enough. It then decides whether the craft should be steered and angled by steam jets, aerodynamic controls, or a mixture of both.

The system, in effect, ties the X-15's three control sticks together, and the plane responds to whichever one the pilot can most easily reach.

Pilots of the X-15 have discovered a lot of important and useful facts about how to get out into space and back into our atmosphere. And they've done it with a surprisingly small number of bruises.

The few mishaps of the X-15's highly dramatic career have all ended without catastrophe. Several times the artificial atmospheric pressure of the cockpit has leaked away and pilots have been saved from death by their automatically inflating pressure suits. Twice, extremes of temperature cracked one side of the craft's windshield. Maj. Bob White, the pilot on both occasions, had to land "blind in one eye" (figuratively speaking), but he made it.

There have been several emergency landings on Mud Lake—where X-15 No. 2 cracked up. Standard procedure in such emergencies is to jettison fuel before landing. The No. 2 ship also blew up during an early engine test on the ground, with no one in it at the time, and had to be rebuilt.

Through the window in space. Beginning in April, X-15 No. 1 is expected to start taking ultraviolet pictures of stars. Special cameras have been installed in a bay behind the cockpit. When the plane reaches the top on one of its dazzling arcs of flight, high above the ozone that obscures ultraviolet light for earthbound cameras and telescopes, metal eyelids flush with the X-15's

CONTINUED

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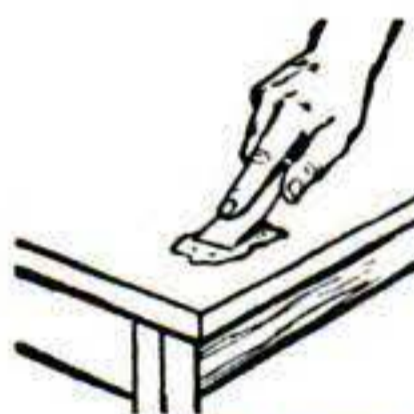
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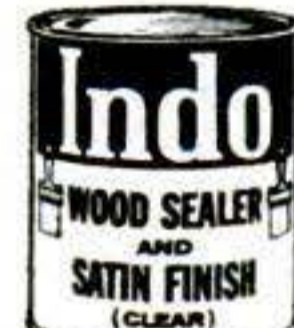
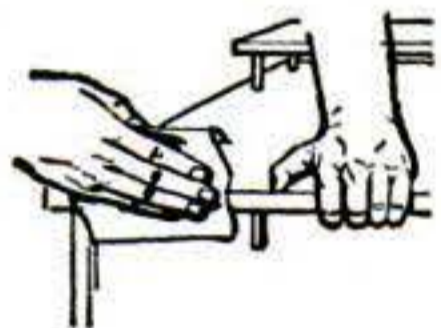
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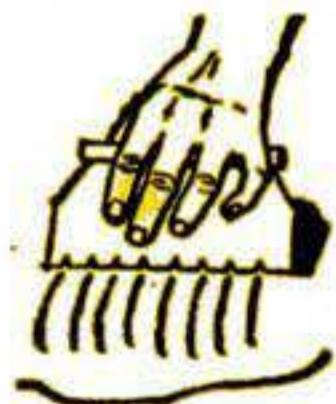
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The Incredible X-15

skin will slide open. The pilot will aim his craft to accommodate the cameras, and unique astronomical photography should result.

Studies of the light spectrum of the earth's horizon as seen from the edge of outer space are scheduled. The horizon looks flat from normal airplane height. When one is homeward bound from space, however, the full roundness of our globe, with its bright halo of refracted sunlight, is all too apparent: Finding the horizon then is too difficult for human eyes. In-bound spacecraft must have special instruments to do the job. Securing data for their development will be one of the X-15's new missions.

The X-15 has been called "the basic trainer of the Space Age," and for good reason. Rockets have taught us a little about the territory between the top limit of conventional aircraft flight and the bottom limit of satellite travel, but rocket launchings are like dipping a toe in the ocean of space. X-15 flights are like going in for a swim.

We're not alone in our admiration for the X-15. Top U. S. space officials have expressed equal enthusiasm. For example, Dr. Hugh Dryden, Deputy Administrator of NASA, has said: "Some of us have been a little regretful that the exploits of the X-15 have not received . . . widespread recognition. . . . From a technological point of view, the X-15 development may be a lot more significant in the long run than the Mercury capsule."

The Men Who Set X-15's Flight Records

Seven quiet, dedicated men calling themselves research pilots—actually, they're college-bred engineers who fly for a living—have put the X-15 through the most spectacular paces in the history of flight.

The first to experience X-15 flight was Scott Crossfield, North American test pilot. He made sure the bird met basic expectations before it was turned over to the Air Force-Navy-NASA joint research program.

After him came three military officers and three civilians. The Navy's Comdr. Forrest Petersen has since been called away to squadron duties. NASA's Neil Armstrong has become an astronaut. Only four pilots are now active in the X-15 program.

One of them, amiable Joe Walker, 42, drove the X-15 on its *fastest flight*, on

June 27, 1962. He hit 4,105 m.p.h. (68.4 miles per minute) in ship No. 1.

Another—cool, precise Maj. Bob White, 38—piloted the space plane on its *highest flight*, July 17, 1962. He flew X-15 No. 3 to 314,750 feet (59.6 miles), setting the world's altitude record for aircraft. Going over 50 miles high put him officially in the astronaut class. (Actually, the X-15 could climb to 142 miles if allowed to, but its pilot would never be able to glide back to a safe landing from there.)

Soft-spoken Jack McKay, 40, made the craft's *hottest flight* on June 29, 1962, using X-15 No. 2, now disabled. He set the ship at such an angle as it belly-flopped home from the border of space that its leading edges heated to 1,250 degrees F. and glowed like embers. As the plane's nickel-chromium skin expanded and contracted from extremes of heat and cold, "it sounded as if sledge hammers were pounding the sides," McKay reported. (The skin has joints that permit up to an inch of expansion.)

The fourth X-15 pilot, Maj. Bob Rushworth, 38, and McKay have deliberately risked serious control problems by flying without the bottom fin of the ship's unique vertical stabilizer. (The plane seemed better off without it.) And they have flicked off the automatic roll-and-yaw damping system to see if the craft could be controlled manually in its most perilous passages. (It could.)

These men have done such things with as little flourish as they would exhibit in making supermarket runs for their comparably calm wives. There is not the faintest aura of hot-shot pilot about any of them. They are family men to a rather extravagant degree, the four being the fathers of a total of 15 children. Their hobbies are simple and homely—golf, hiking, camping, mountain-climbing, fishing, hunting.

Despite the ever-present danger of their work, they've never had a serious accident.

Yet, in flying far higher and faster and hotter than men have ever traveled in aircraft before, they haven't merely been proving that it could be done.

"We're not in the business of setting records," declares Paul Bikle, head of NASA's X-15 research program and a champion glider pilot. "We just happen to be doing experiments in the speed and altitude ranges where the records are." ■ ■

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● Item #533. Marvelous low speed geared-down ball bearing motor which can be run either direction from remote control.
● Built-in limit switches will stop rotation any point. Use to control gas throttles, open doors, many other servo uses. Rotates 3 RPM on 12-v DC. Takes only 1 amp or less. Size 5"x4 1/2"x3". Wt. 2 lbs. Govt. cost \$45. SALE



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● Item #204. New Govt. Fine for boats, sump, etc. Timken bearings. 1 1/2" intake and discharge ports. 3/4" shaft. Size 12"x10"x18". Wt. 32 lbs. Cost Govt. \$97.50. SALE

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● ITEM #322. Govt. DC hoist with push-button switch, 20' control cable.
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● Item #716. Std. phone, same used on all phone systems. Use as extension to main phone and on private systems. Directions furnished. Wt. 8 lbs. Govt. Cost \$25.00. SALE



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SPECIAL OF THE MONTH!

LABORATORY AC to DC RECTIFIER

● Item #2253. Compact Army Rectifier that is excellent commercial or home laboratory unit. Converts 115-v 60-c AC 25-190-v DC or AC at 250 m.a.
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● Item #329. Govt. surplus. New 6-piece hi-strength galvanized flexible tow and lift cables. Fine item for farmers, contractors, etc.
● Consists of 5', 10', 20', 30', 60' and 100' 5/16" stranded cable with thimble eye and clevis. Wt. packed 55 lbs. Govt. cost over \$50. SALE



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● Item #2146. Expensive mechanical-drive electric output system. Consists of G.E. precision AC generator driven by engine, motor, etc.
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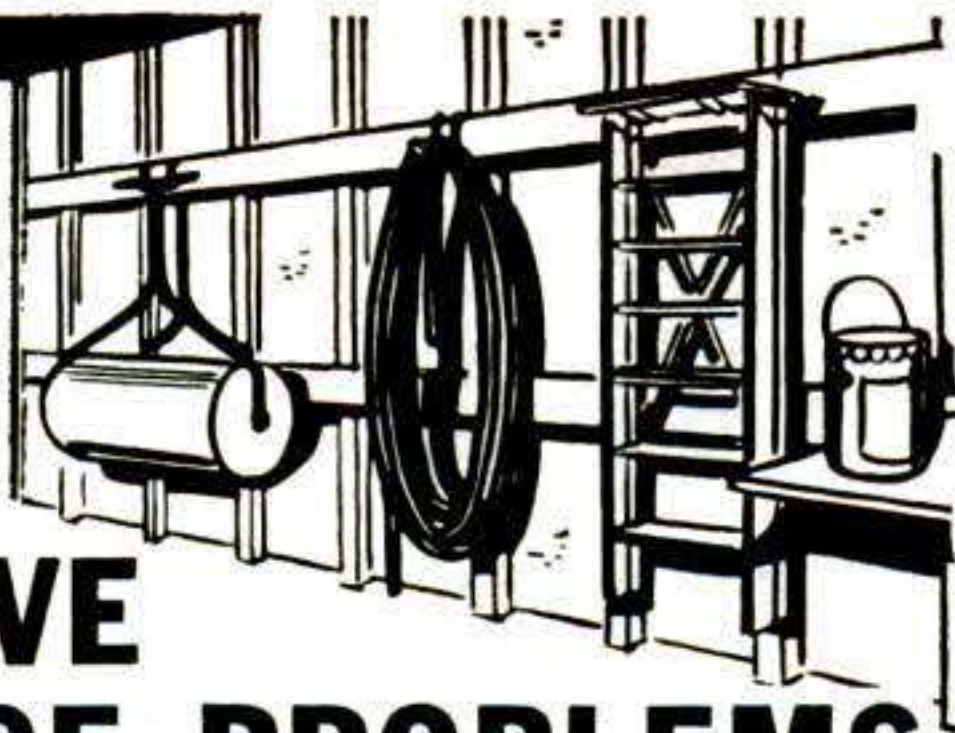
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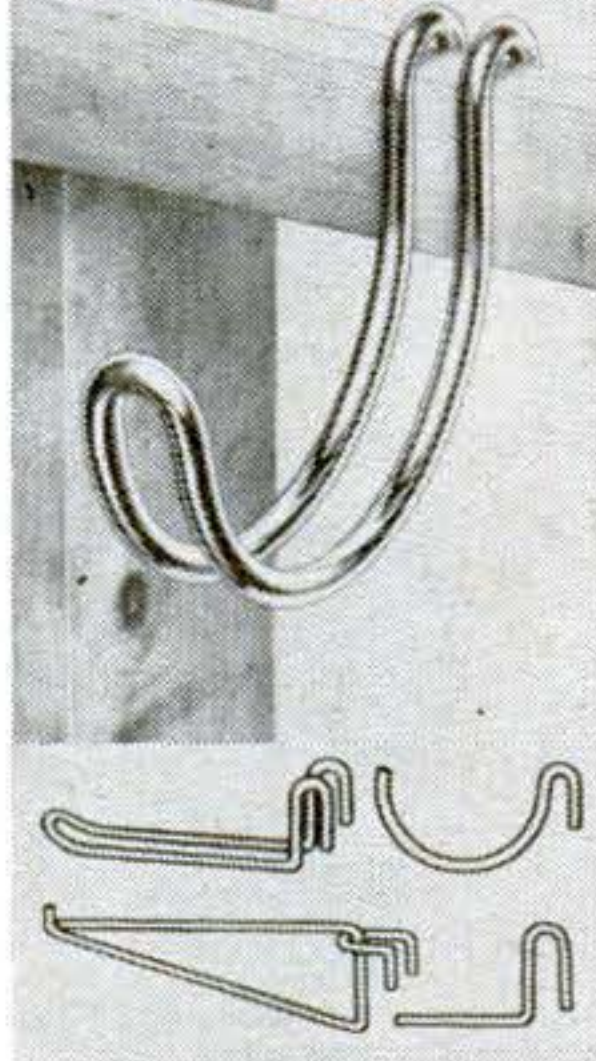
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I Rode with the Avalanche Patrol

[Continued from page 114]

Henry Brown, when buried by the avalanche named after him, couldn't tell which way to dig. "Luckily, I'd raised my arms over my face," he told me. "I could move them just enough to dig a trifle. But first I made small snowballs and tried to drop them on my face. When they went the other way—up—I knew I was lying about 30 degrees from upside down, so I began digging toward my feet." Few people are ever able to dig however, for their arms are pinned hard.

A man caught in an avalanche may never know he is moving at all. "The snow just opened up and began drawing me down in," said a National Ski Patrol member I talked to. "Nothing was moving—until I looked across to the forest on the other side which was silently going uphill." Luckily this slide was a short one and other Ski Patrol members soon located their man by following a bright yellow nylon cord tied to his waist.

There had been days of storm when I reached Silverton. Over 30 avalanches had fallen or been shot down without loss of life, thanks to the patrol.

Then one sunny morning at breakfast word came that high winds were again loading snow into several slides above U.S. 550.

We didn't wait, for the highway is used by school buses. We set up our cannon right in Silverton, butting it hard against the wheel of a highway truck. One of the menacing slides was the Jennie Parker, which once knocked a busload of tourists over a cliff.

Major Willard Croonenberghs, a highway engineer and reserve artillery officer, yanked the lanyard. The gun barked, a high-explosive shell screamed, and we saw a bright orange burst on a peak 12,000 feet above sea level. The Jennie shivered, but didn't come down.

"That will settle her—compact her—for a few days, however," said Major Sid Foster, another engineer, also a reserve artilleryman. "Now let's shoot the old S.O.B."

We began climbing lonely Red Mountain—a convoy of two plow-equipped trucks and two state cars with the cannon on a trailer behind a third truck. The patrol closed the road to traffic and, from a high switchback, began lobbing shells at the

I Rode with the Avalanche Patrol

S.O.B. This ornery slide was stubborn and refused to budge—yet. Then we hurled shells across a great valley to the monster Horseshoe slide on Red Mountain, and “settled” this one for a while. When a slide settles, it moves like a man in his sleep, choosing a more comfortable spot. The snow packs down and takes a tighter grip on the mountain.

Toward noon, we looked high up to the north and saw the Mineral Bridge slide. We could see snow blowing over the mountain and falling on the slope.

“That one,” said Orville Francis, district engineer, “looks ready for trouble.”

All this time the patrol had two trucks guarding the road. One, two miles down, had stopped traffic. The other was a half-mile above us on a switchback.

Another shot. Maj. Foster, hatless, practically standing on his head, bore-sighted the cannon—a 75mm mountain howitzer of the sort used by the U.S. Army in Italy in World War II. I looked up the bore and saw only blue sky.

“We shoot high,” Foster said. “Shooting an avalanche is like shooting a tiger. To kill, you must hit just right. We shoot for something called the fracture line. That’s like shooting for the shoulder.”

The Mineral Bridge is a big slide and it was poised above us. It is named for a bridge it likes to bury without warning. We could see its usual track toward the bridge because there were no trees left—just snow. A patrol man searched the area with binoculars for ski or snowshoe tracks to be sure no one was in the mountains.

“Now,” said Foster, “gimme that ammo.”

A handler passed the two-foot-long shell. The crew stood with mouths open and ears covered. We took a last look for cars. Then Foster yanked the lanyard. The howitzer roared and jumped.

The recoil hissed, the concussion blasted snow against our legs. From behind the gun you could see the shell disappearing like a big black baseball headed out of the ball park. The shell’s scream melted in a growing roar as each mountain threw back the blast.

Four seconds . . . then the snowy peak was lighted by an orange flash. The shell had arched and come down below the top. More seconds . . . and the boom of our high explosive came down to us. The snow field shook, moved, and stopped.

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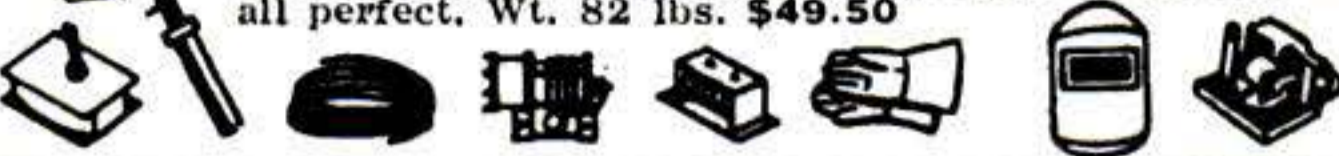


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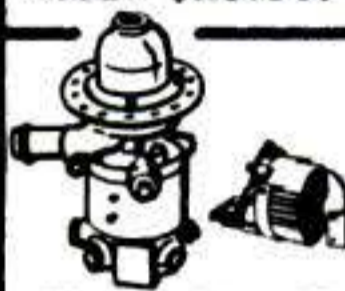
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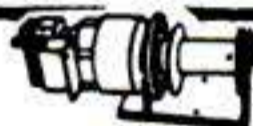
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MODEL E. Same as above less outrigger support and extra heavy base. Spool cap. 70' of 1/4" cable. Cap. 2000 lbs., \$52.50



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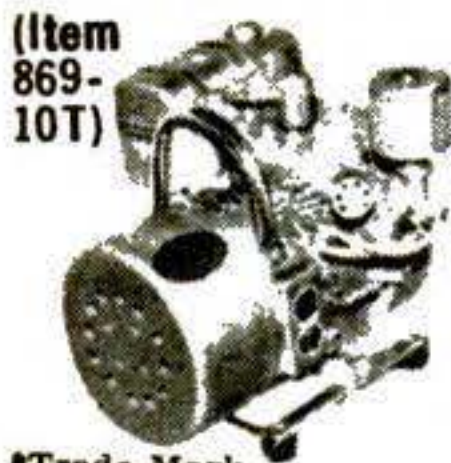
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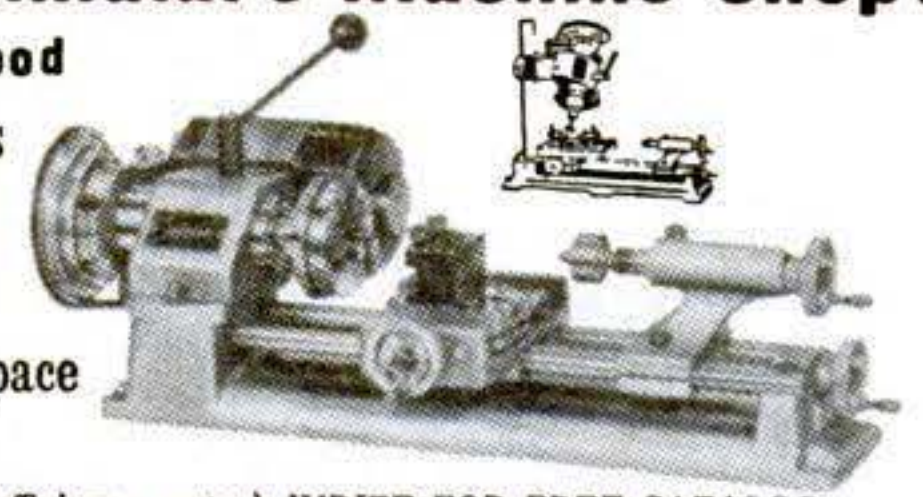
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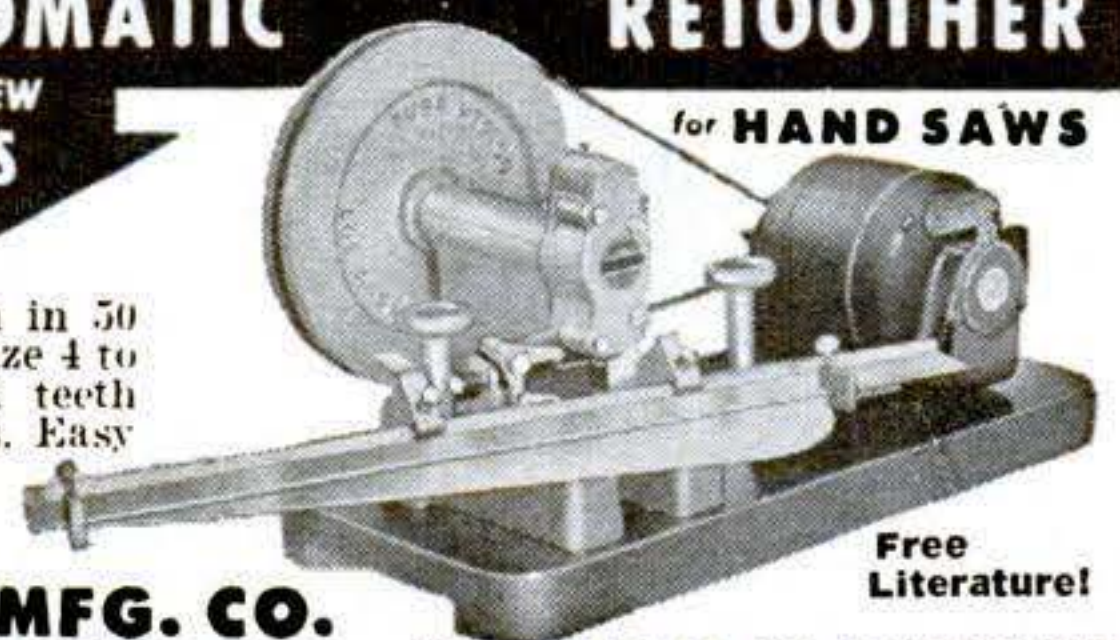
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I Rode with the Avalanche Patrol

"Too low," said Foster. "I'm going up five degrees. We've got to get this fellow down."

Wrong-way slide. The second shell hit just below a dark ridge. Again the mountains roared. We waited, tense, as blue smoke drifted from the gun. Then someone called:

"She's starting!"

Cracks like angry black lightning flickered through the snow—the fatal wound. The snow stirred heavily. A vast white shiver ran down, and in a wink the whole great slope was unlatched.

Foster said, blowing on his hands: "That gun was damn cold." He was interrupted by a shout:

"She's coming, but she's coming the wrong way!"

For some reason, the slide had jumped its usual track. It was coming toward us and would dump into a valley a half-mile below. It was heading not for the bridge but for an area farther west of the bridge and much closer to us.

An avalanche wind of great force, pushed by snow, raced ahead, breaking trees before the snow swallowed them. We saw bending trunks and thrashing branches. Then there was a sharp explosion, as if someone had fired a rifle. Down in a forest below, the first giant spruce tree had snapped like a matchstick.

After this there was complete and sudden silence. In the strange quiet, the avalanche came galloping on in bounding waves. Leaping high, it swallowed the forest. Dozens of trees must have snapped, but we heard no sound, for the avalanche now was moving behind a towering wall of silence. We could see that wall: a cottony snow fog that rose swiftly several hundred feet and hung, muffling all sound. Snow fogs are made of millions of crushed snowflakes. Men have suffocated in them, just as they have been killed by concussion, without ever being touched by an avalanche.

Within seconds, it was all over, although a bounding, wavelike motion continued to run through the snow fog. The patrol reopened U.S. 550 and we went on hunting more slides.

It would be days before the Mineral Bridge avalanche could again threaten U.S. 550. And it had been a rare and beautiful sight. ■ ■

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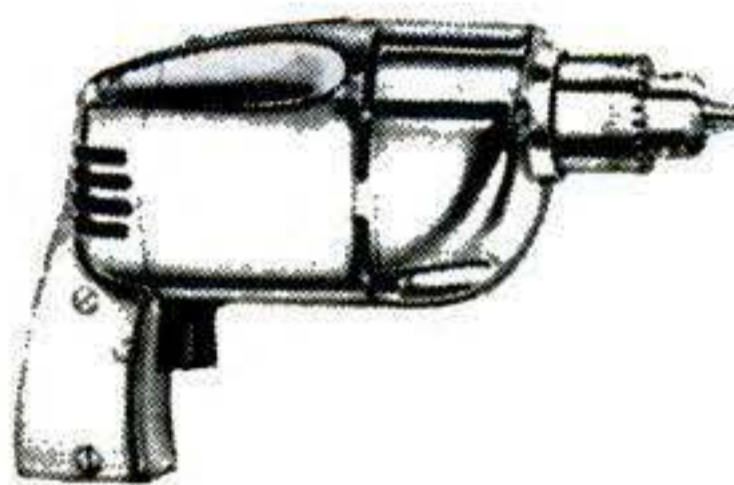
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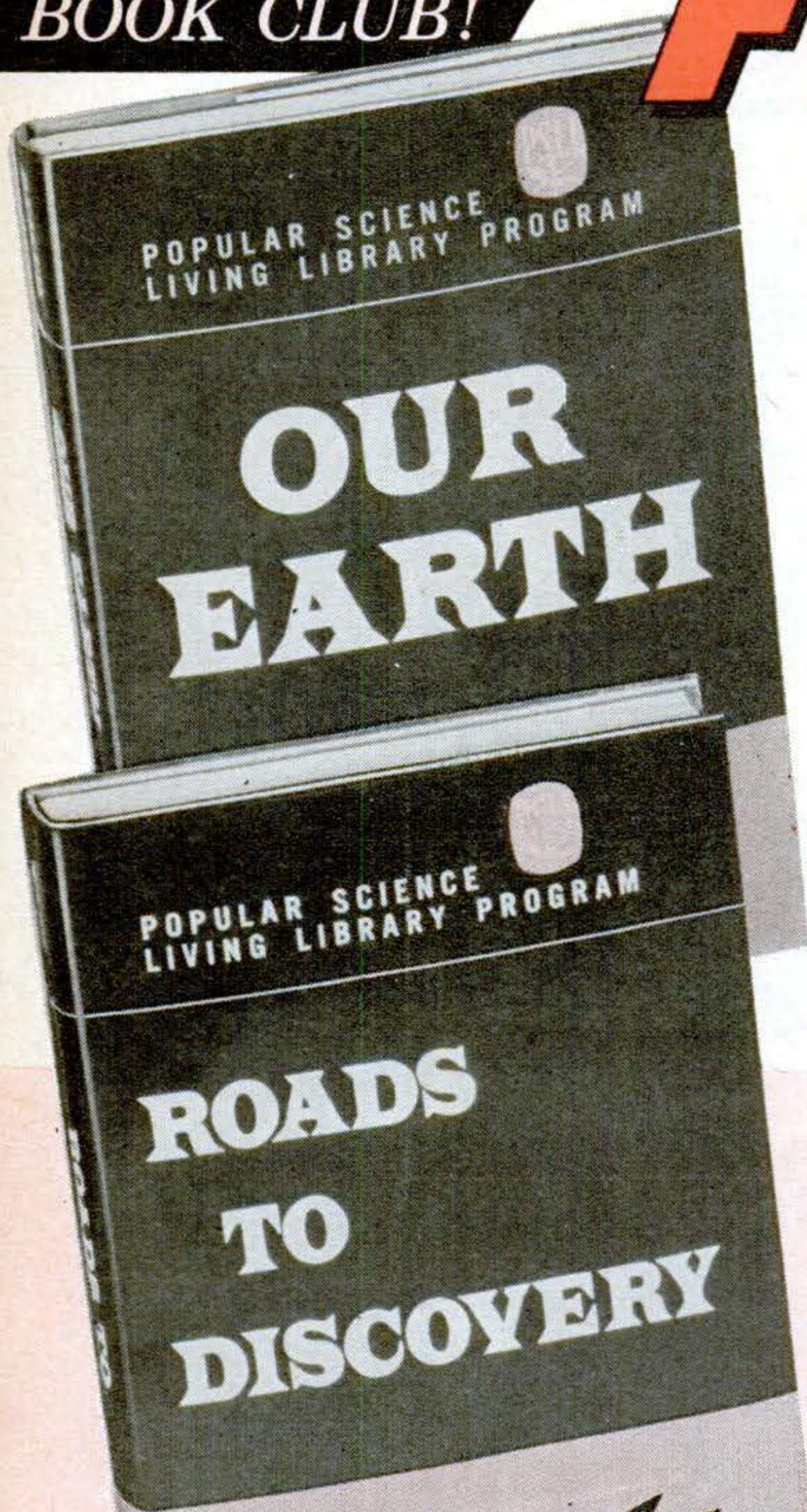
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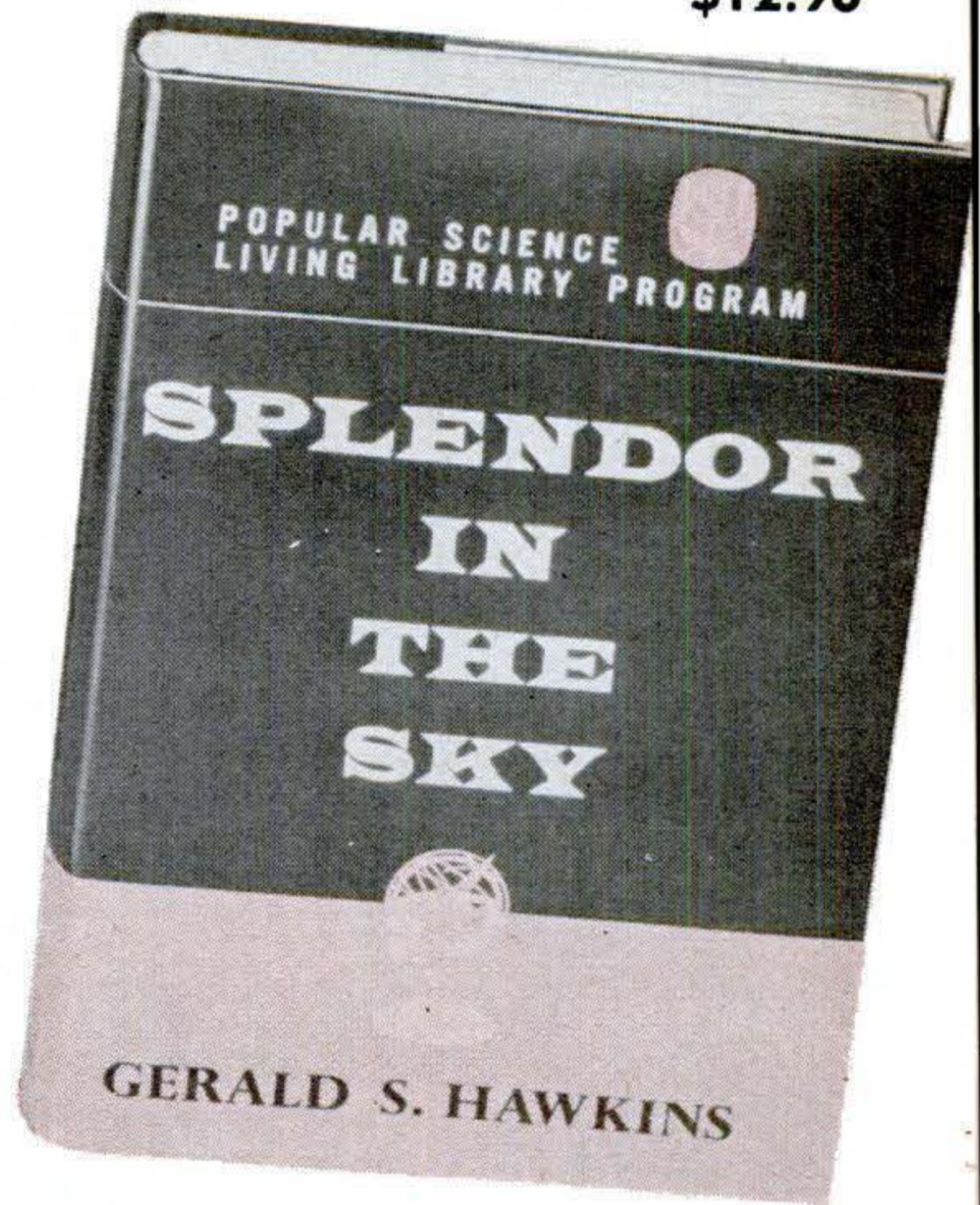
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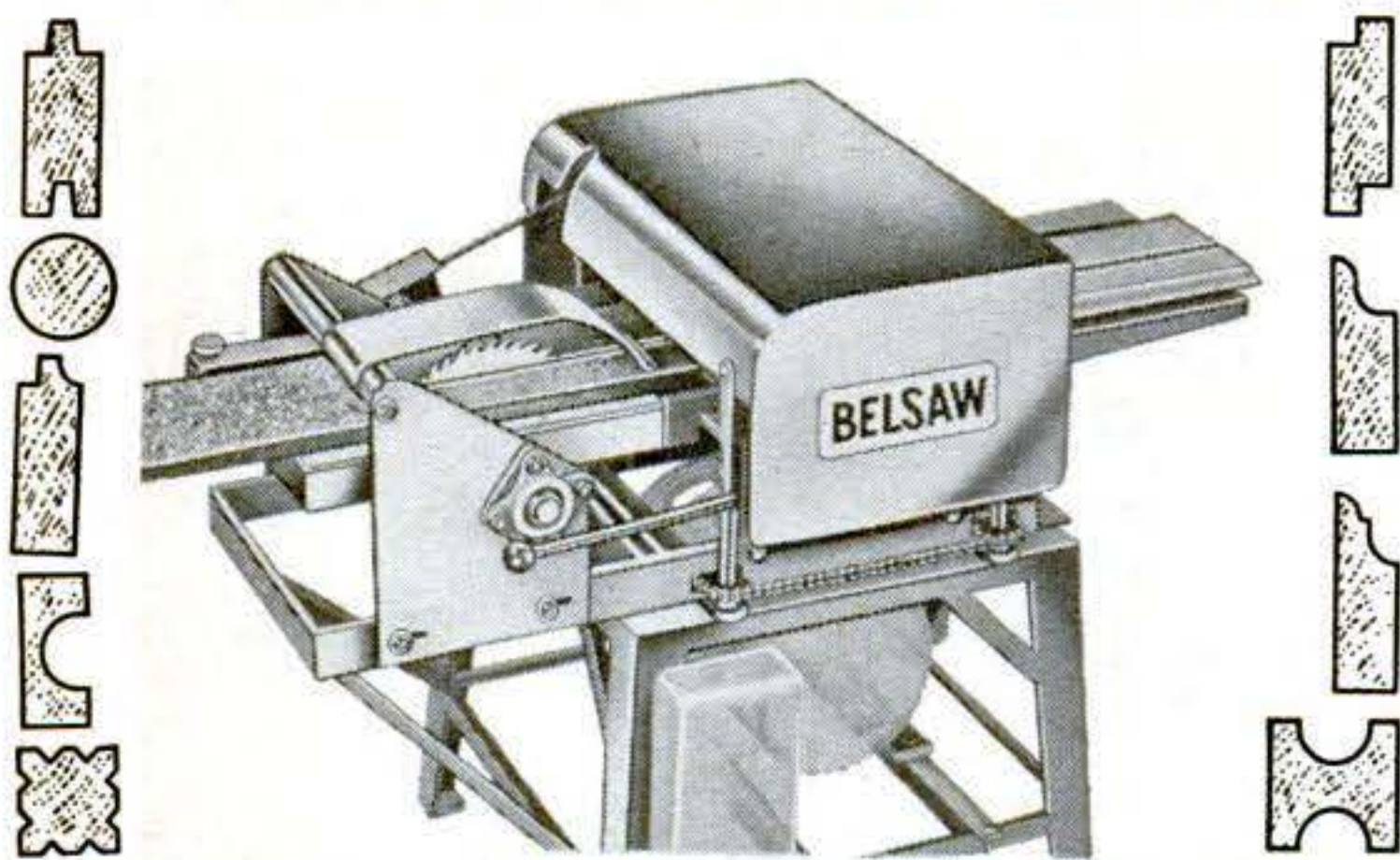
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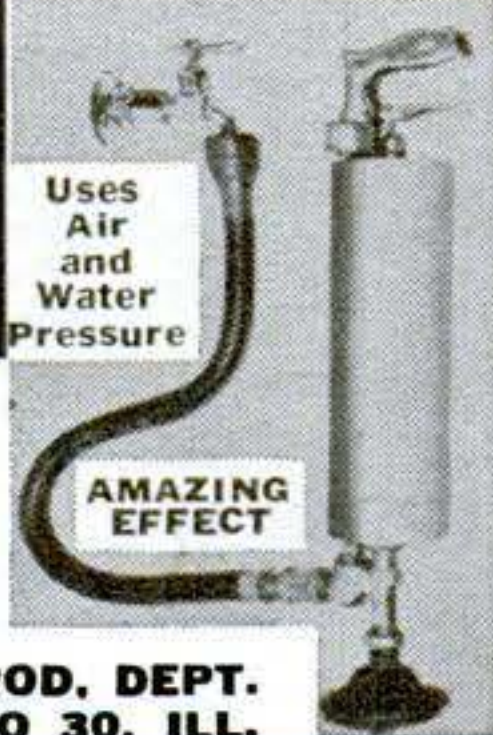
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My Trailer Does More Than Haul a Boat

[Continued from page 136]

can swing the winch to any position and then lock it tight. An ordinary threaded joint would loosen up as you swiveled the winch.

The removable bow cradle just screws into a regular pipe coupling welded to the drawbar since it doesn't have to swivel. Thread a flat support into the same coupling and you have the basis for a box or flatbed trailer. The body needn't even be bolted on. Just arrange cleats on the underside so they wedge between the front and rear trailer supports.

Coil-spring suspension, too. The rear-load-supporting crossbar floats. Its ends form sockets that simply slip over smaller diameter pipes projecting upward from the wheel mounts. In fact, the entire assembly—crossbar, boom, and bow cradle—can be lifted off if you want to mount a platform directly on the lower frame for low-to-the-ground loading.

Small coil springs inserted between the crossbar's floating joints give the trailer a soft ride. The coils are two 5" lengths cut from a standard automobile overload spring about 2 1/2" in diameter.

The secret of the small wheels lies in the trailer's design—it throws a good share of the load forward onto the hitch. Because the wheels don't have to support the full weight, you can use the less expensive 4.00-by-8 type made for motor scooters. They should have ball bearings and at least a 1" bore.

The only tricky part is aligning the wheels when mounting the axles. It's easiest to remove the tires and work with a square and straightedge against the rims. They should toe in slightly for proper tracking. Since the wheels turn on their own bearings, the axles are simply short lengths of 1" solid steel rod welded rigidly into the lower pipe frame.

The mudguards are welded to the upper telescoping cross member so they float right along with it. The rollers used to slide a load onto the trailer are sections of free-turning pipe wrapped with strips of rubber for padding. Two short sections of similar pipe are also slipped over the rear cross member and are welded to the ends of the boom. These serve as collars to let the boom pivot. The boom brace, when not in use, folds down and under the trailer's frame so it's out of the way. Its free end is held in a hook.

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RECORDS—Stereo, Monaural. Big Discounts. Noelsson, Box 211, New York 5, N. Y.

36 RADIO, TELEVISION, ELECTRONICS, HI-FI

FIX Your Own TV, Save 80%! Send for Free Illustrated Chart showing how! We'll include Giant Electronics Catalog. Zalytron, 461 Jericho Tpke., Mineola, N. Y.

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BEGINNER'S Crystal-transistor Giant catalog. Laboratories, 1131-T Valota, Redwood City, California.

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NEW Coin Locator! Free literature. Howe, 811-A Kansas, Atchison, Kansas.

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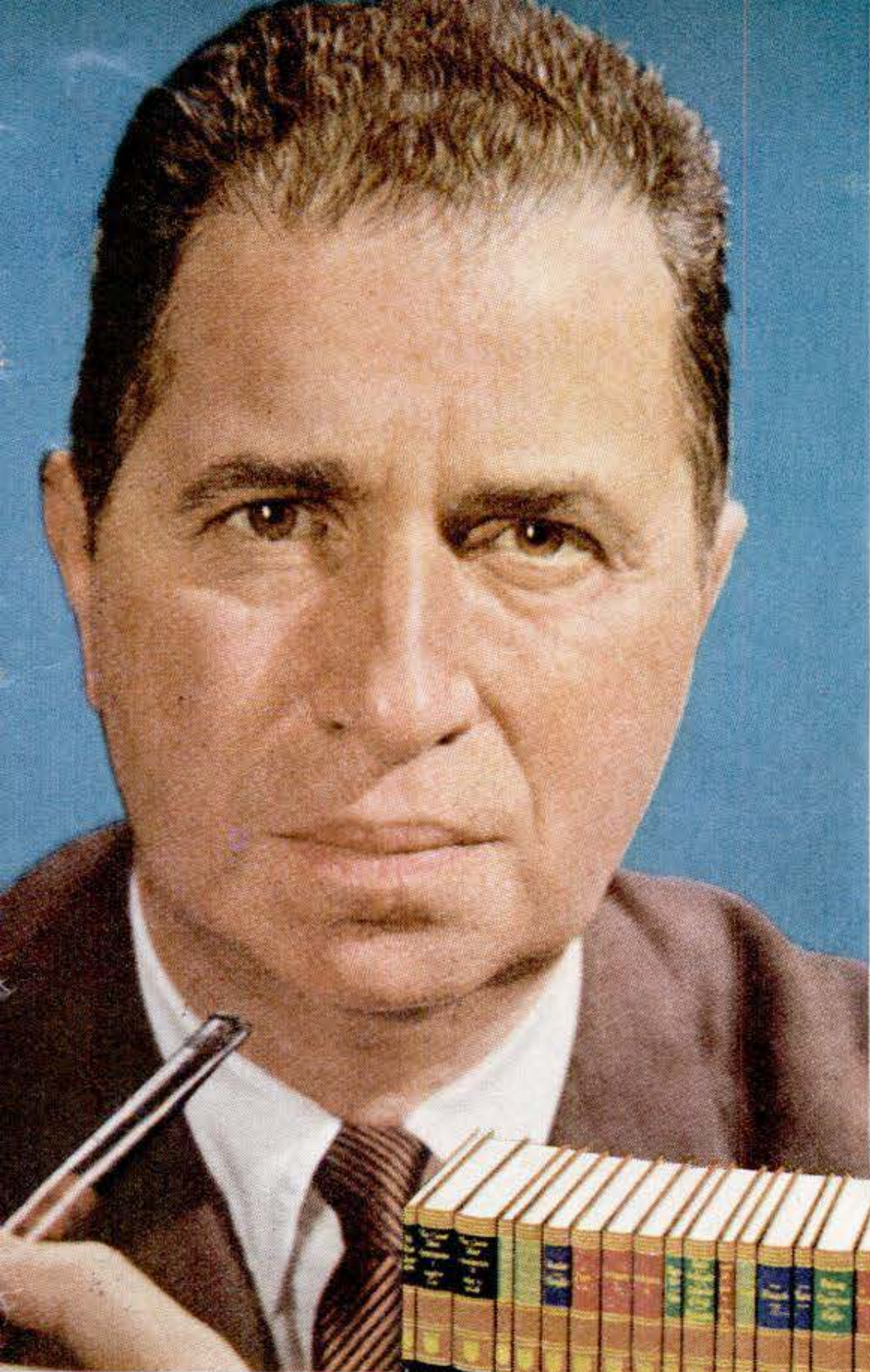
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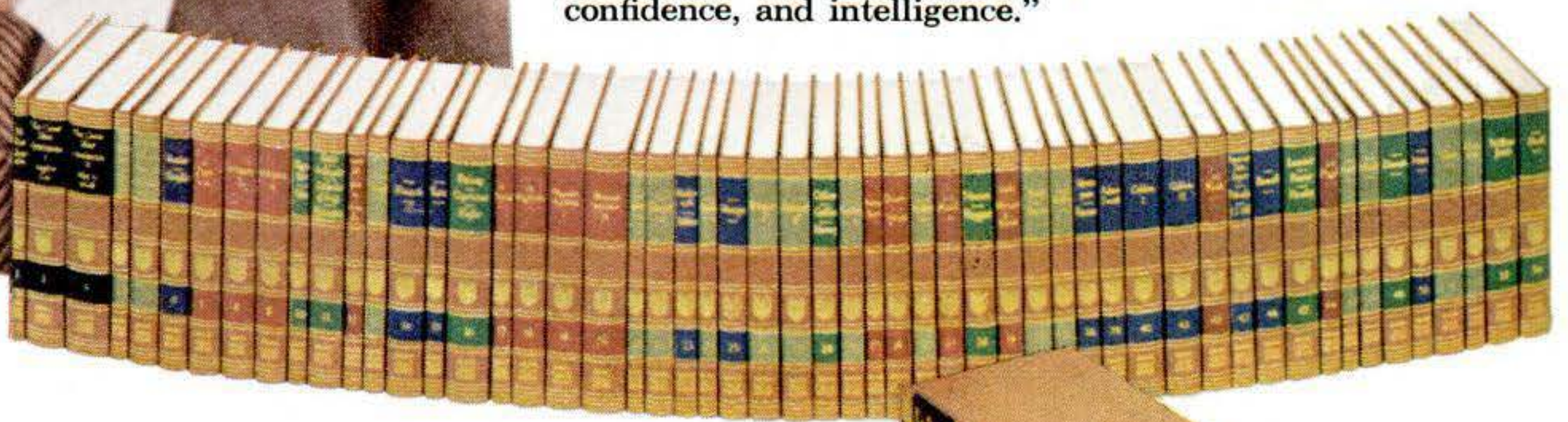
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Editor of the SYNTOPICON

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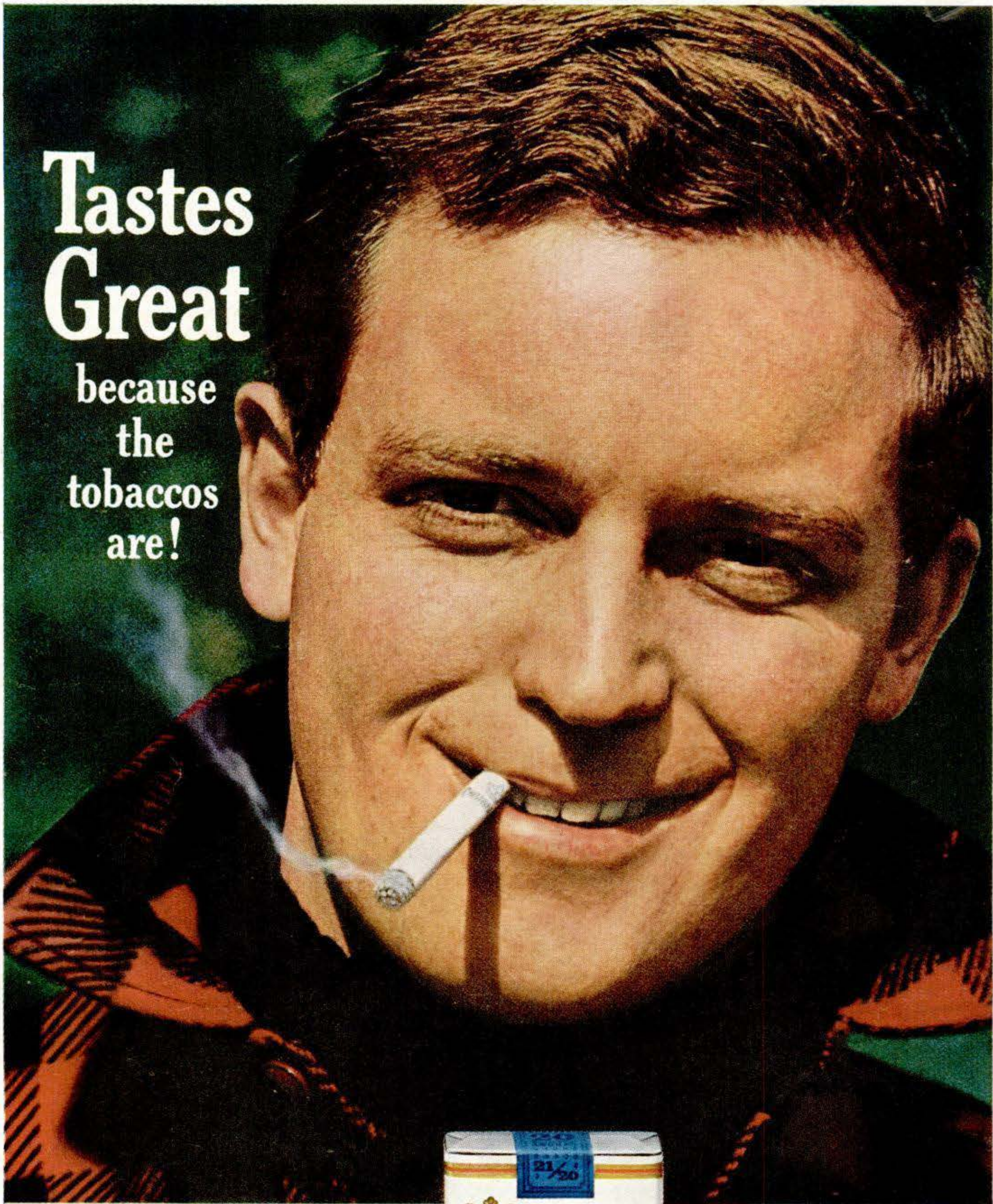
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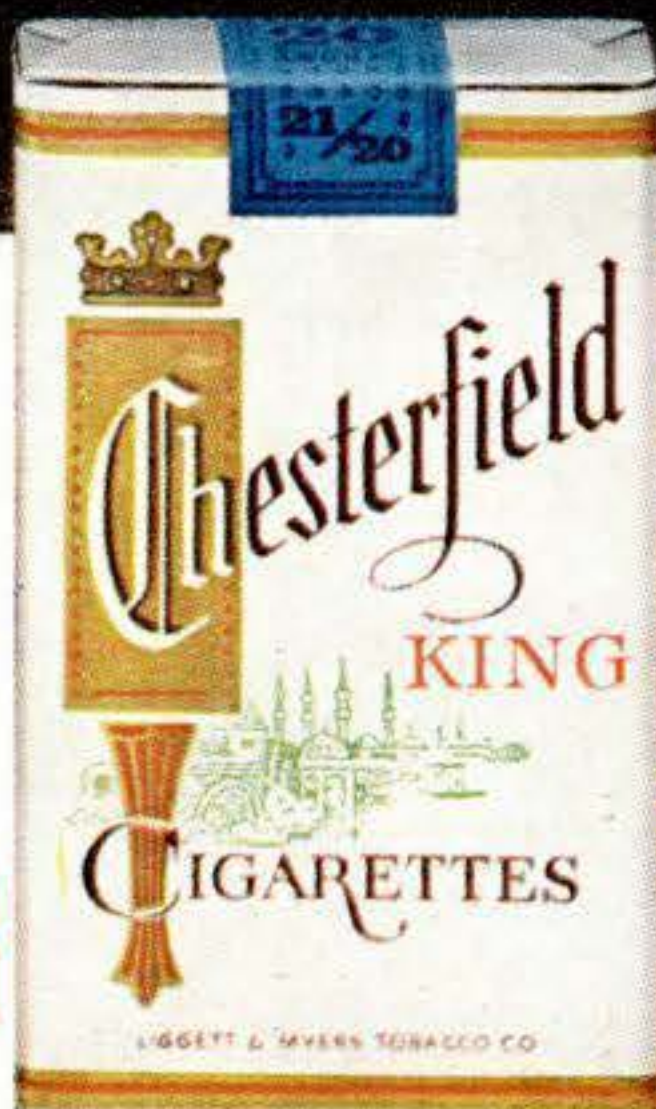
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