

JUNE 1967 35 CENTS

# Popular Science

MONTHLY

## First Look at '68 CARS

### Secret Photos and Inside Reports



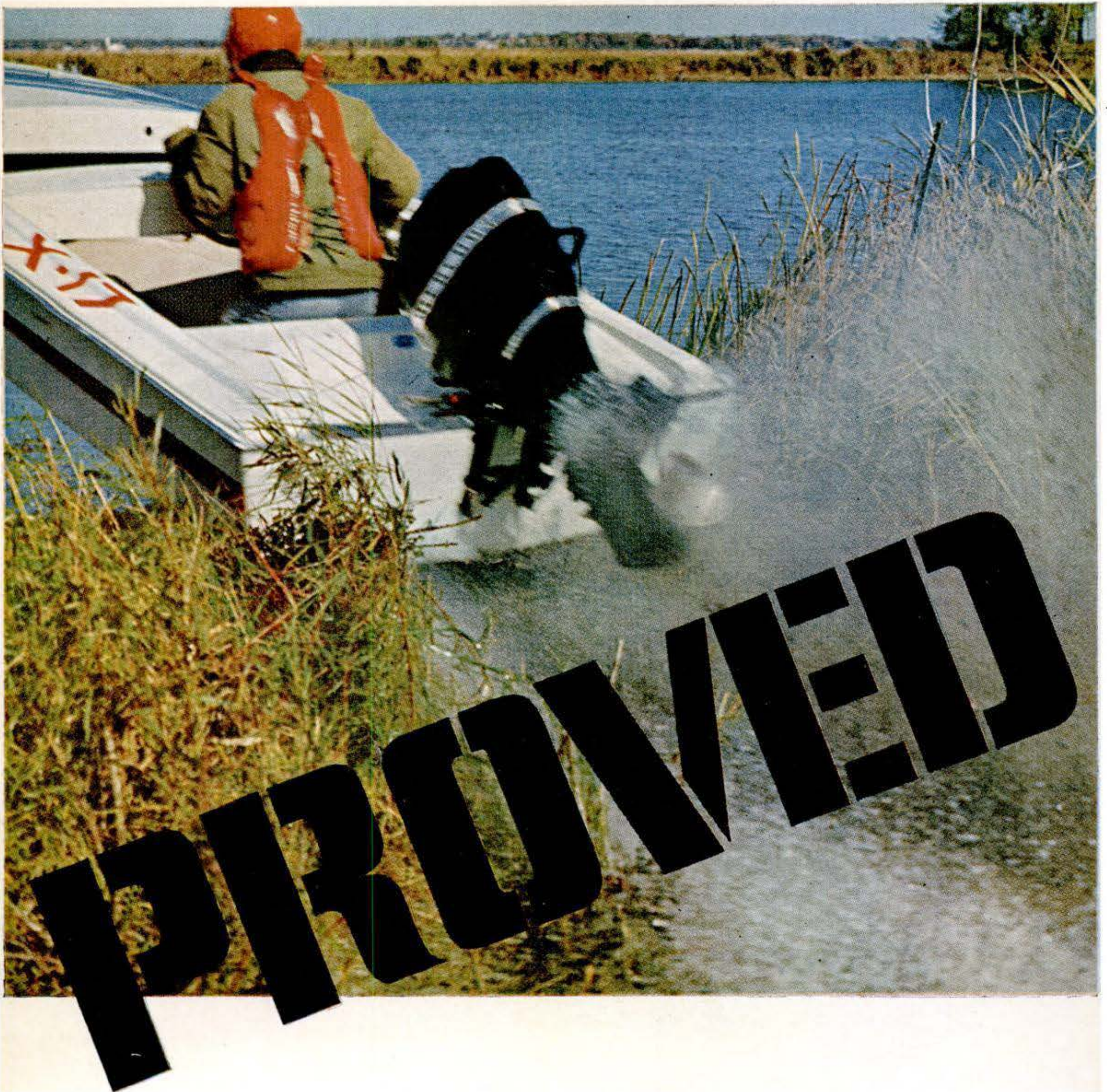
07 Rides Again in  
"You Only Live Twice"

How it works —

## JAMES BOND'S AMAZING AUTOGYRO

Science Map and Guide to the U.S.  
by LOWELL THOMAS

How the New Auto Safety  
Laws Affect YOU



The toughest test program in the outboard industry makes Mercury the most dependable outboard you can buy.

Ten years ago, Mercury developed the industry's first environmental product test program. Today, at Mercury's 4 test sites—Lake X and Sarasota, Florida, and Oshkosh and Fond du Lac, Wisconsin—both production and prototype models are put through the toughest tests Mercury engineers can devise. The object is to cram the equivalent of years of customer use into weeks of intensive tests. Mercs run day and night—wide open and at trolling speeds. They slam over logs and sandbars,

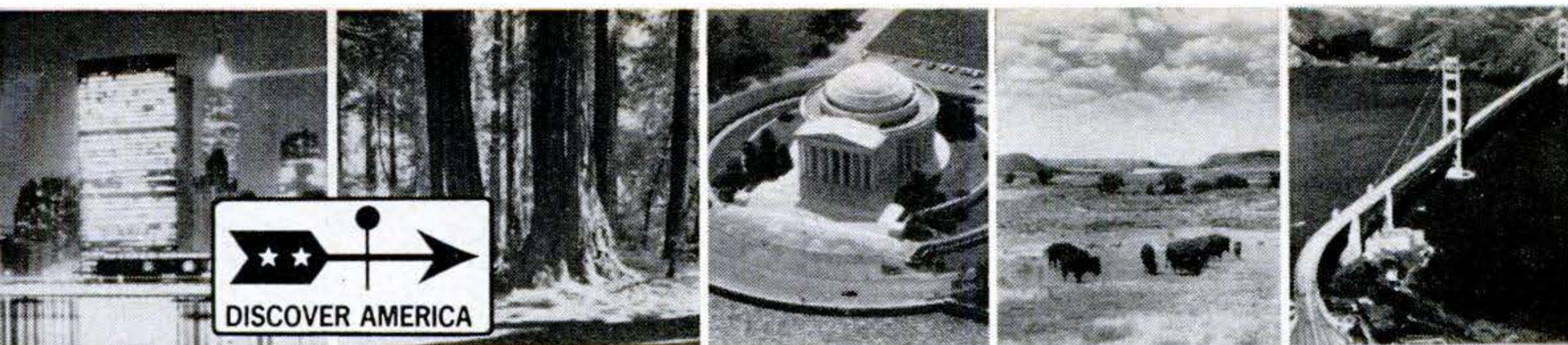
plow through weeds and silt, in driving rain and relentless sun. Tests completed, motors are torn down and results tabulated. As the product improves, tests become tougher. We're determined to build each year's Mercs safer, stronger, faster, quieter and more economical. And this unique test program helps us do it. The 1967 Mercurys are the result of 28 years of unchallenged engineering leadership, and of cumulative millions of test miles. They're *engineered to stay ahead*: 3.9, 6, 9.8, 20, 35, 50, 65, 95 and 110 HP. See your Mercury dealer—or write for '67 catalog to Dept. PS-4, Kiekhaefer Corp., Fond du Lac, Wisconsin.

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### **Science Map and Guide to the U.S. BY LOWELL THOMAS** PAGE 59

The famous commentator and explorer selects 125 places to visit in the exciting world of science and mechanics, technology, space and aviation. Complete with full-color maps.

### **James Bond's Amazing One-Man Autogyro** PAGE 66

How it works: Exclusive story of 007's flyweight fighting machine.

### **Your First Peek at the '68 Cars** PAGE 70

What's Detroit cooking up? PS brings you secret photos and inside reports.

### **What the New Auto Safety Laws Will Mean to You** PAGE 80

Will they mean higher costs? How will they affect you and your car?

### **How You Can Build a Scandinavian Flip-Top Table** PAGE 144

Swivel the top, and it converts from family dining to games. With lie-flat blueprint.

COVER PHOTO BY JAMES E. BAMA

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## COMING NEXT MONTH

Each month in PS we aim to entertain you, to keep you up to date in a dozen different fields, to add to your skills, and save you some money. We also try to throw in a couple of surprises to add zest to the time you spend with the magazine. Sounds like a big order, doesn't it? Let's see how July stacks up—

- More Late News on the '68 Cars
- The Care and Feeding of Your Muscles
- Machines That Make You Money
- An Equalizing Trailer Hitch You Can Build (complete with a lie-flat blueprint)
- Testing the New Glasspar Boats
- Photo Tips from PS Readers
- How to Open Clogged Drains—Part 2 (Another in our money-saving series on plumbing)
- What's New in Electronic Kits
- 19 Smart Tricks with a Router
- What You Can Do with Latex Paints Now
- The ABC's of Keeping Your Car in Tune
- And lots more . . . On sale June 27.

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# PS Readers Talk Back

Want to get something off your chest?  
Write "Readers Talk Back," **POPULAR SCIENCE**,  
355 Lexington Ave., New York, N.Y. 10017.

## Like the Norbye/Dunne report

I have found nothing quite as interesting or as well put together as the Norbye/Dunne reports on new cars, like the compacts—Valiant, Chevy II, and American [April]. Keep up the good work.

JONATHAN H. PALMATIER III, Lowell, Mass.

. . . The Norbye/Dunne report is the most complete test I've ever read.

STEVE D'HUYVETTER, Sunbury, Ohio.

## Testing your physics know-how

I thoroughly enjoyed Wesley S. Griswold's story on Professor Miller ["Classic Toys Test Your Physics Know-How," April]. I sometimes think even our best scientists really gain the most understanding of basic principles when they can relate complex problems simply to increase the understanding of the layman.

JOHN W. ECKLIN, Huntsville, Ala.

## How good are those health aids?

Your article "Are You Wasting Money on Worthless Health Aids" [April] shows that Dr. James L. Goddard has not kept up with the modern doctor on the advances made along the lines of nutrition. It is very amusing that Dr. Goddard claims that he is interested in people wasting their money for vitamins and minerals. People do waste money for a lot of unnecessary



items like cola drinks, cigarettes, etc. People also waste money on the wrong drugs prescribed by the wrong doctor. Why does Dr. Goddard limit his criticism on the waste of money to vitamins when there are so many ways in which people are really wasteful?

PAUL FUNDERBURG, Miami, Fla.

. . . Vitamins taken under careful supervision could mean the difference between borderline

illness and good health. Even taken blindly, they represent something for your money, which is more than you can say for the abundance of skillfully advertised foods completely devoid of any nutritive value. It is none of the government's business to establish what food supplementation should be. We all differ in our responses to drugs and chemicals, our abilities to absorb nutrition, our metabolism, blood, and other factors. If Dr. Goddard wants to rescue us from fraud, let him begin with an investigation into vitamin depletion resulting from processing, marketing methods, and incorrect cooking of foods.

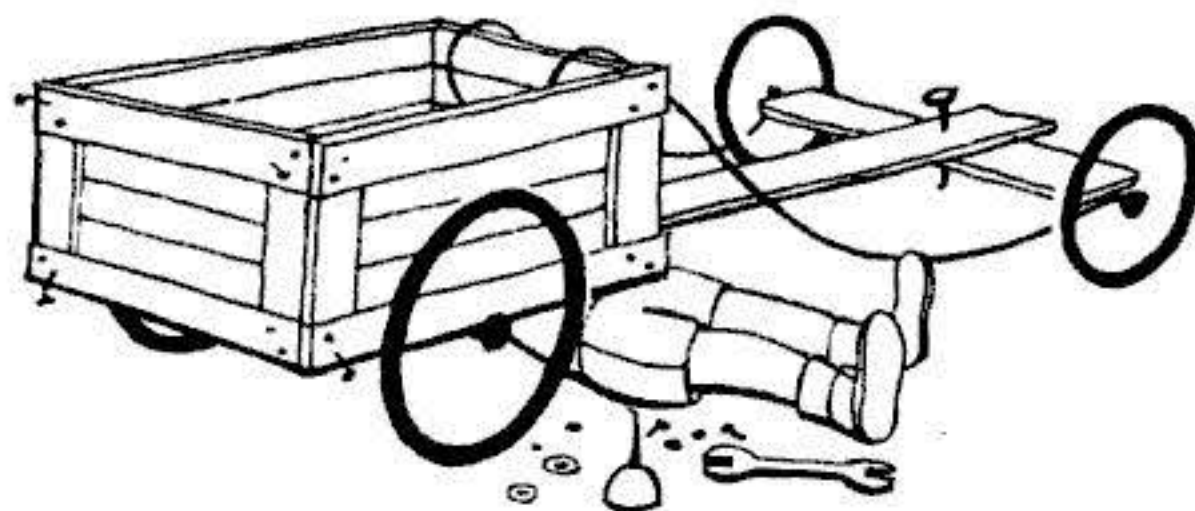
J. B. GASTERIO, Stamford, Conn.

## Young Gus Wilson

I have been reading **POPULAR SCIENCE** for many years, and as far back as I can remember I have read of Gus Wilson tackling many problems. How old is Gus, and how long has he been working as a gas-station attendant?

ED ZABRISKIE, East Paterson, N.J.

*Gus graduated from gas-station attendant over 40 years ago. He's been appearing as an expert mechanic in PS ever since, but he's re-*



*luctant to discuss his age. "Just tell them I started very young," he says.*

## Helicopters to the rescue

"How Copters Can Solve Traffic Jams" [April] reminded me of an incident several years ago in which I saw a house burn down, trapping a girl inside. If a large helicopter had been available, it might have been used to rescue her. The downwash of the blades could have caused the fire to stop burning. Meanwhile, the copter could have dropped Jacob's ladders for rescue. Helicopters also have the advantage of being able to get to a fire quickly by flying over traffic.

EDWARD A. O'DONNELL, Lakeville, N. Y.

## Rebuttal on TV gadgets

We would like to clarify statements in "Gadgets to Improve TV: Are They any Good?" by Ronald M. Benrey [Feb.] in which an RCA Model 10A170 indoor TV antenna is said to be no better than a "\$1.19 pair of rabbit ears." Benrey says that a field-strength meter indicated both antennas to be equally sensitive. This tells only part of the story. A field-strength meter measures only the amount of signal on a meter, not its quality as seen on a TV set. In

*Continued*



Medical news from America's leading society of foot doctors.

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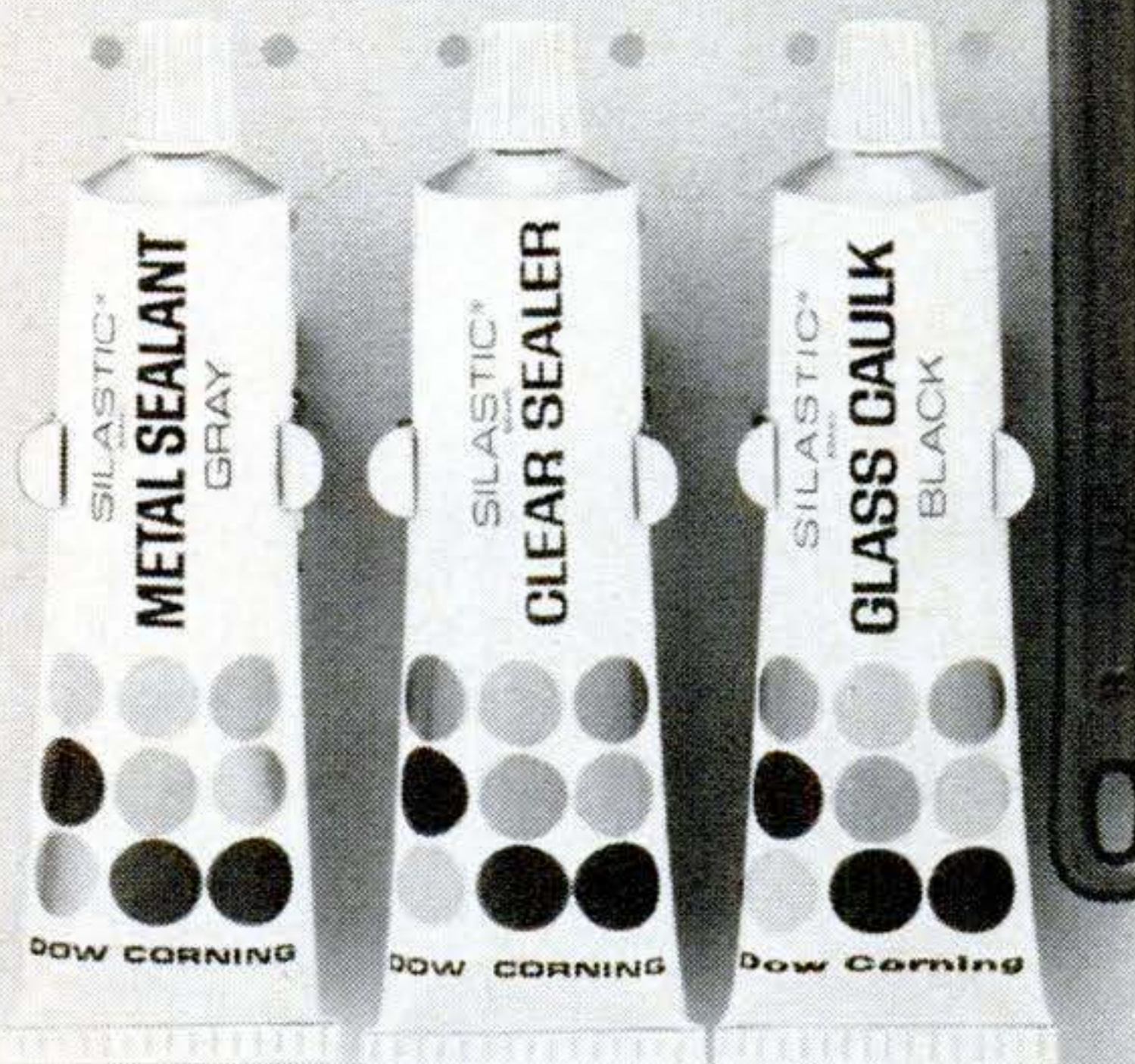
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Greensboro, N.C.

## PS Readers Talk Back

[Continued]

most locations where indoor antennas are used, signal strength is adequate. Ghosts and unwanted noise are the elements that spoil TV pictures. RCA indoor TV antennas contain unique switching circuits designed to provide maximum rejection of this type of interference. These switching circuits were developed on actual TV sets in hundreds of difficult reception locations and were not based on field-strength measurements. Take another look at the 10A170 antenna, connect it to a TV set, and examine picture quality. Our customers have, and 92.4 percent say they have improved reception using the antenna.

J. D. CALLAGHAN  
RCA, Deptford, N.J.

### Pure Oil tests called to task

You call the Union/Pure Oil Performance Trials "The World's Most Revealing Car Tests" [April]. Any statistician could tell you that the tests are worthless. Using your point system, two identical cars should rank within one or at most two points of one another. This failed to happen with many of the cars tested, casting doubt on the validity of the trials as a whole. Five of the 22 pairs of cars in your table showed inconsistent fuel-economy ratings. The worst discrepancy occurs in the case of the Olds 4-4-2, where one car got three points and the other eight points. The results can be summarized like this: Cars with big engines go faster and burn more gas than cars with little engines. Brakes on current American automobiles are unsatisfactory in a highway emergency. There is little consistent difference among the products of the various manufacturers in terms of the parameters tested.

R. D. GILLETTE, M.D., Huron, Ohio.

### Are those stereo gadgets any good?

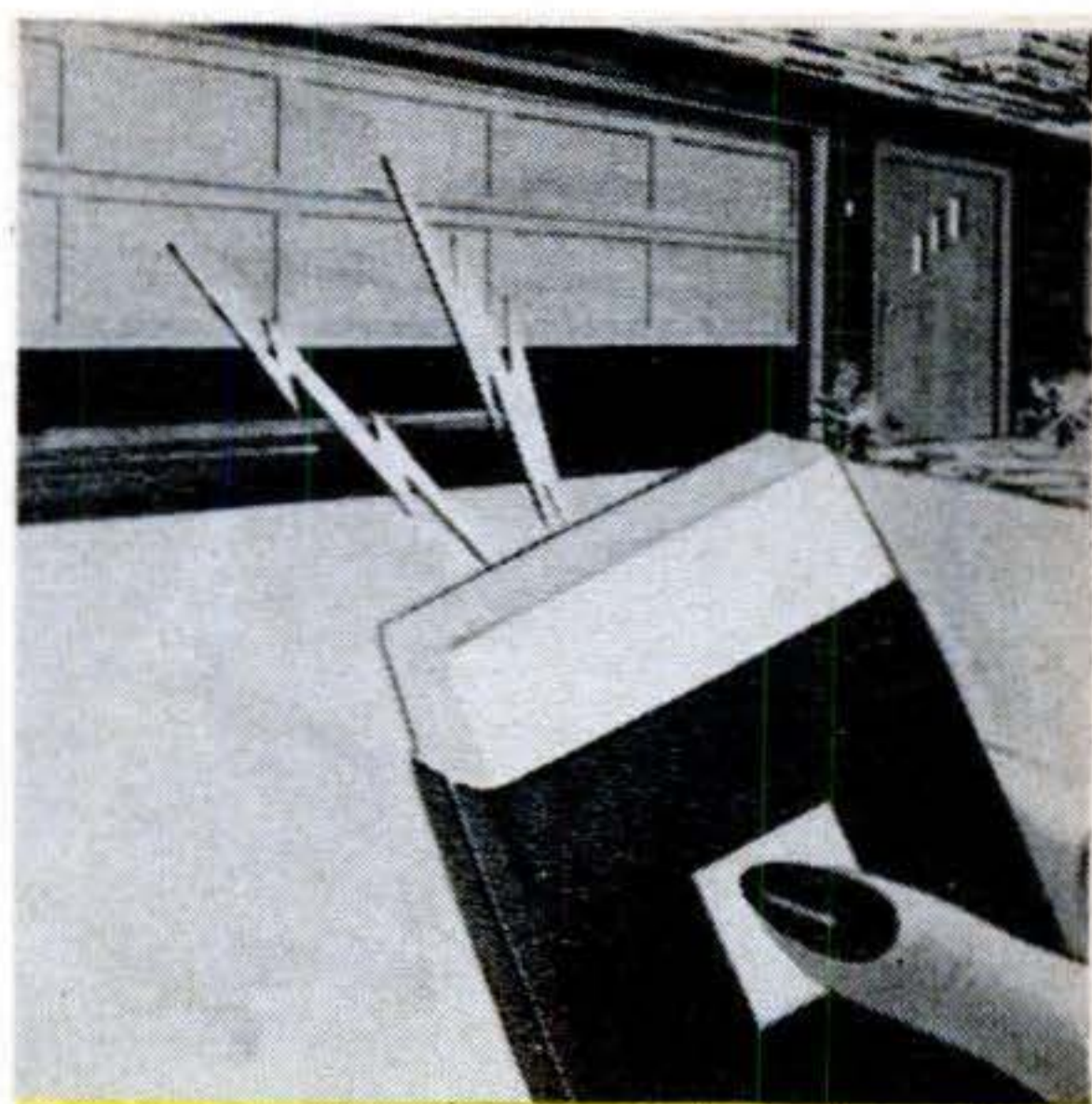
"Gadgets For Your Stereo: Are They Any Good?" [April] was much appreciated, as it showed gadgets up—in some cases—for what they really are. I take minor exception, though, to your description of the Scotch self-threading reel. I own a recorder with a combination tape-tension automatic-shutoff bar, and have found if I bring the tape in contact with the self-threading reel hub and give it a slight start in rotation, the reel works like a charm. And I'm still eliminating the threading problem.

T. C. NELSON, NYC.

### Japanese Wankel car

I certainly agree with Kenichi Yamamoto, manager of the Cosmo Wankel project that the RC engine is the engine of the future ["Japanese Wankel-Powered Car," April]. Yet here it is today in a beautiful car that puts Detroit to shame in styling and engineering. Detroit will

*Continued*



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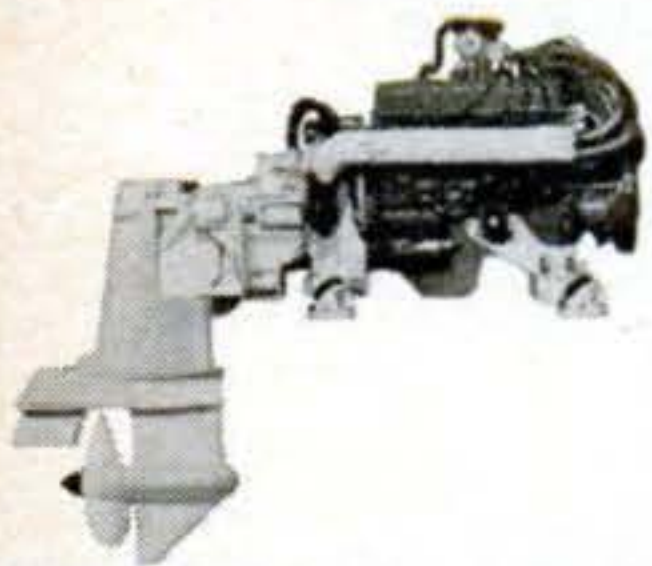
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**FASTBACK**

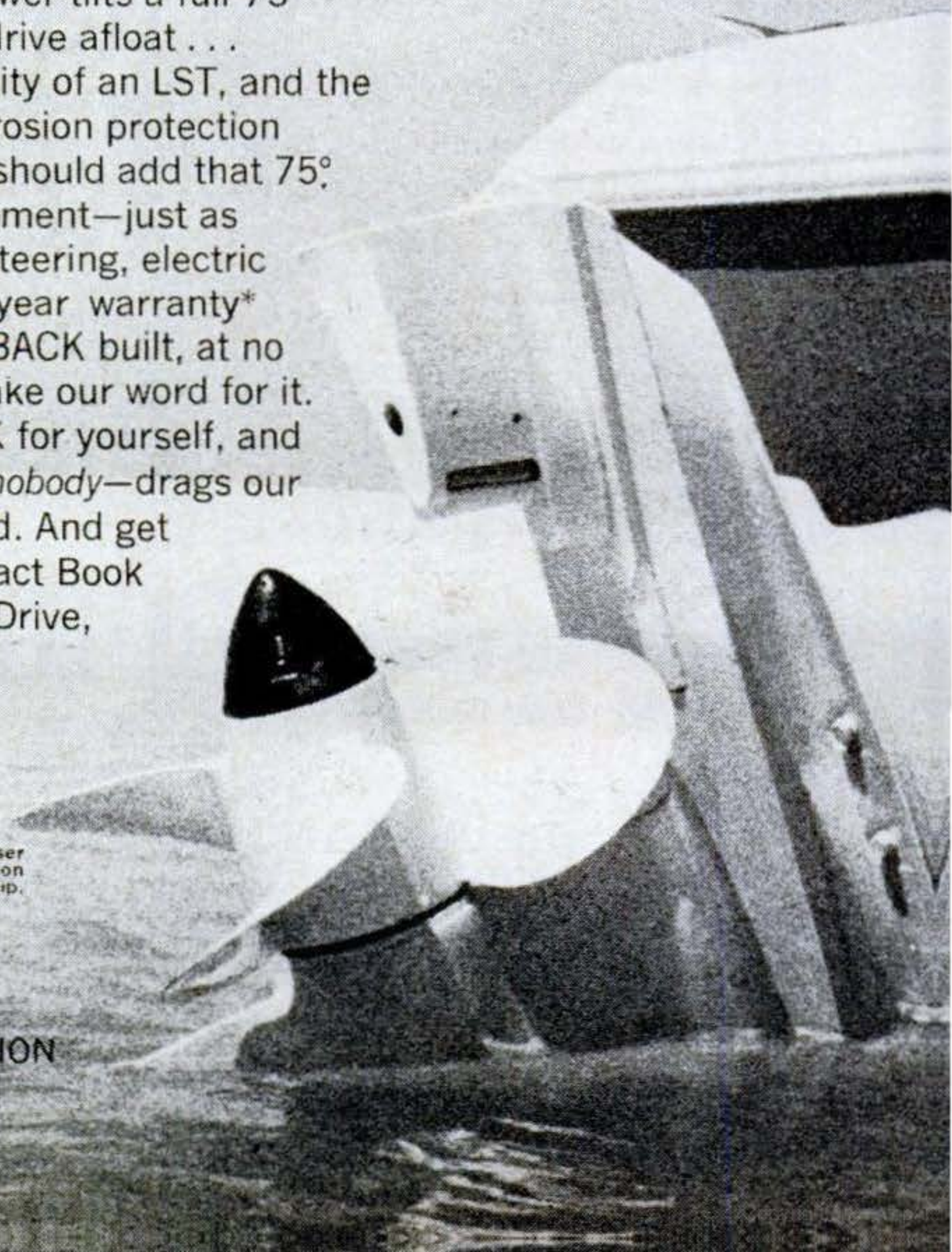


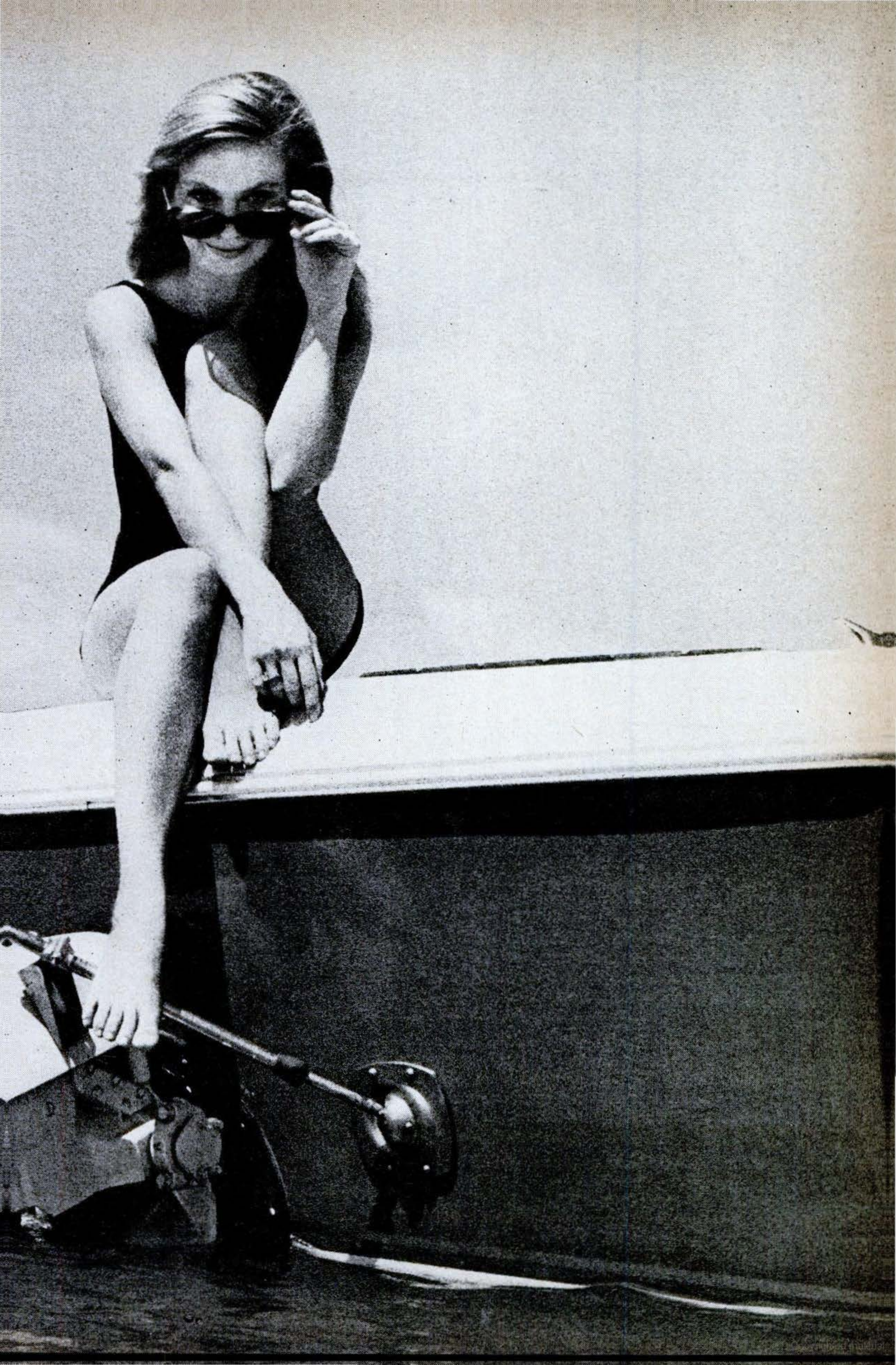
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90° port-to-starboard steering, electric power shift and full, 2-year warranty\* come with every FASTBACK built, at no extra cost. But don't take our word for it. Test-drive a FASTBACK for yourself, and see why nobody—but *nobody*—drags our honey through the mud. And get the 1967 FASTBACK Fact Book by writing: OMC Stern Drive, Galesburg, Ill.

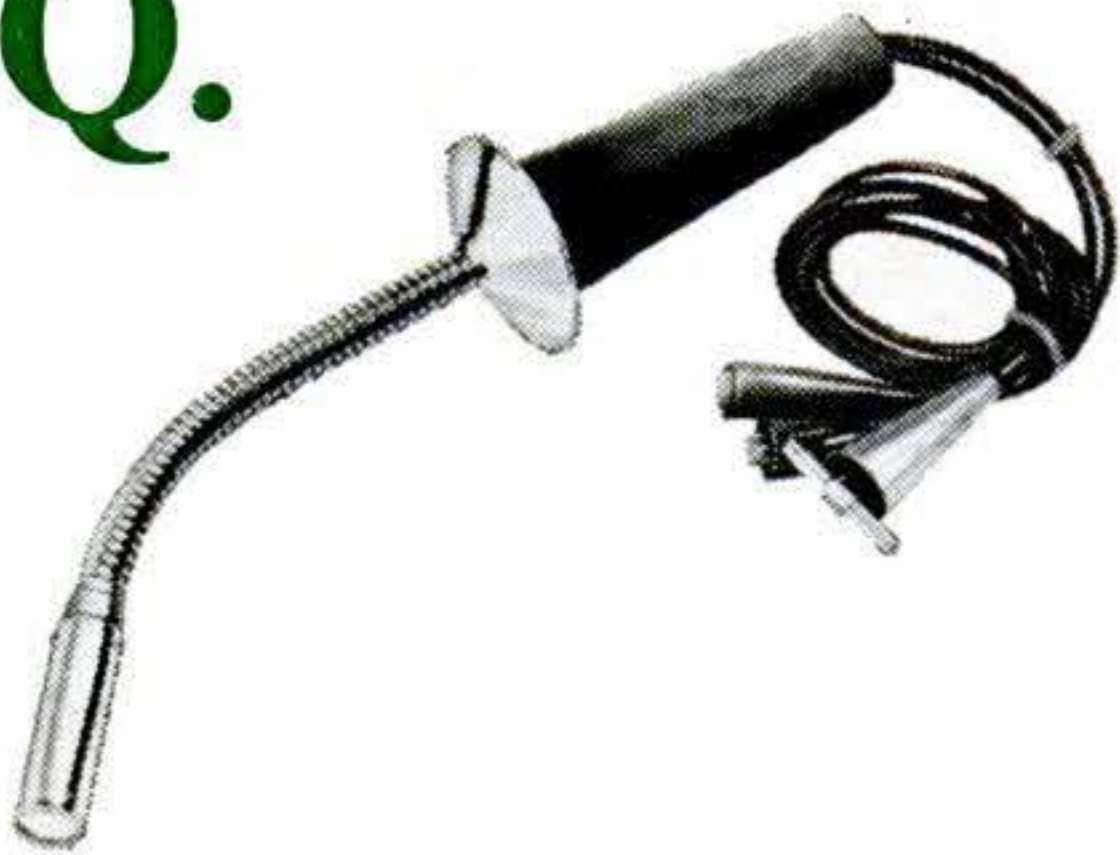
\*For 24 months after purchase, OMC Stern Drive will replace to the original purchaser of an OMC Stern Drive any part of its manufacture, which upon inspection proves to have failed in normal use due to faulty material or workmanship.

A PRODUCT OF OUTBOARD MARINE CORPORATION

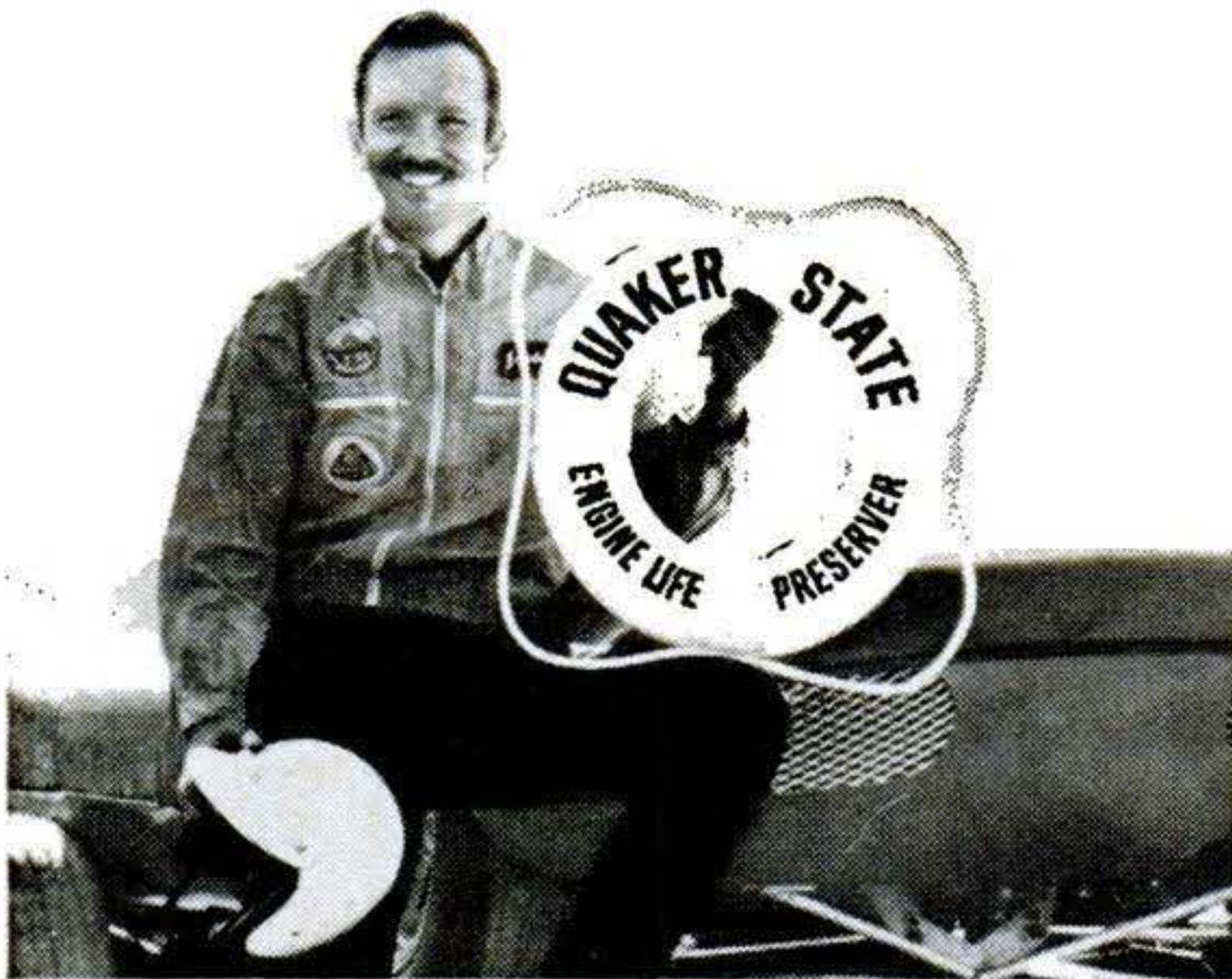




# Test your automotive I.Q.



*This light does what?*



*What does this symbol stand for?*

It's an engine timing light designed to make sure you get the engine performance you expect from your car. The life preserver is the symbol of Quaker State Motor Oil—the motor oil that keeps your car performing at its lively best. Quaker State's refined only from 100% Pure Pennsylvania Grade Crude Oil. It keeps your car on the road, out of the repair shop and saves you money. Quaker State's the best engine life preserver your money can buy.



Quaker State Oil Refining Corporation  
Oil City, Pennsylvania

## PS Readers Talk Back

[Continued]

certainly have to wake up soon and incorporate some of these progressive ideas in the near future, or it will be standing at the wayside holding the bag.

BOB DIETRICK, Baldwin, N. Y.

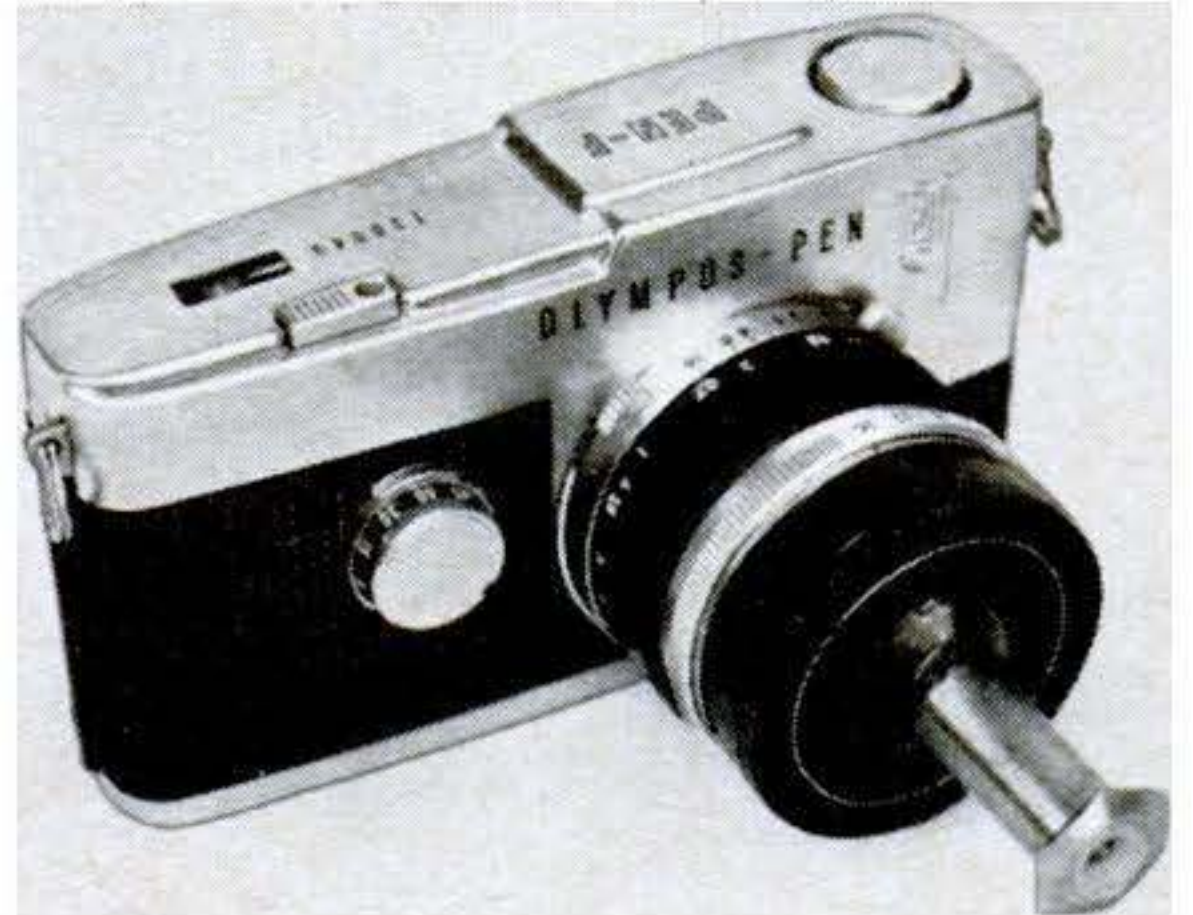
### Photo-gadget grab bag

In "Photographer's Grab Bag" [Mar.] Paul Wahl gives a rule-of-thumb formula for setting shutter speeds for outdoor exposure with any film. He said to set the shutter speed equal to 1/ASA film speed. I would like to know how to set the shutter speed equal to 1/ASA.

E. F. McCONNELL, Detroit, Mich.

*Use ASA speed as the denominator for shutter speed. For ASA 50 film, shoot at 1/50 second; for ASA 200 film, 1/200 second—or the nearest shutter speed on your camera. It's a good general guide if you don't have a light meter.*

... How did you get the poor-man's fisheye lens to work? I can't seem to get a sharp focus,



either by adjusting the camera's lens or the peephole door lens—or adjusting both together. The negatives and prints are out of focus any way I try. I use a Mamiya/Sekor, 1.8 camera. Does this matter?

D. MILLER, Morton Grove, Ill.

*The device should work with the normal lens of any camera. Try some close-ups with the lens about three inches from subject's face. The pictures aren't sharp, but they're amusing.*

### How to pull out a pull-out section

Grr! I'm so mad I could spit. Your "How to Repair Your Toilet Tank" pull-out section [April] didn't. All I got was a handful of scrap paper. Will you please put operating instruction on this type of booklet for your bumble-thumb readers.

CURTIS MASSIE, Cincinnati, Ohio.

*It's easy to do if you first fold the magazine back on itself at the section you want to yank out. Press down the center spine, tug easily—one at a time—and out they come.*

# TOM McCAHILL SAYS:

## “Good Appliance Repairmen are Scarce as Edsel Dealers!”

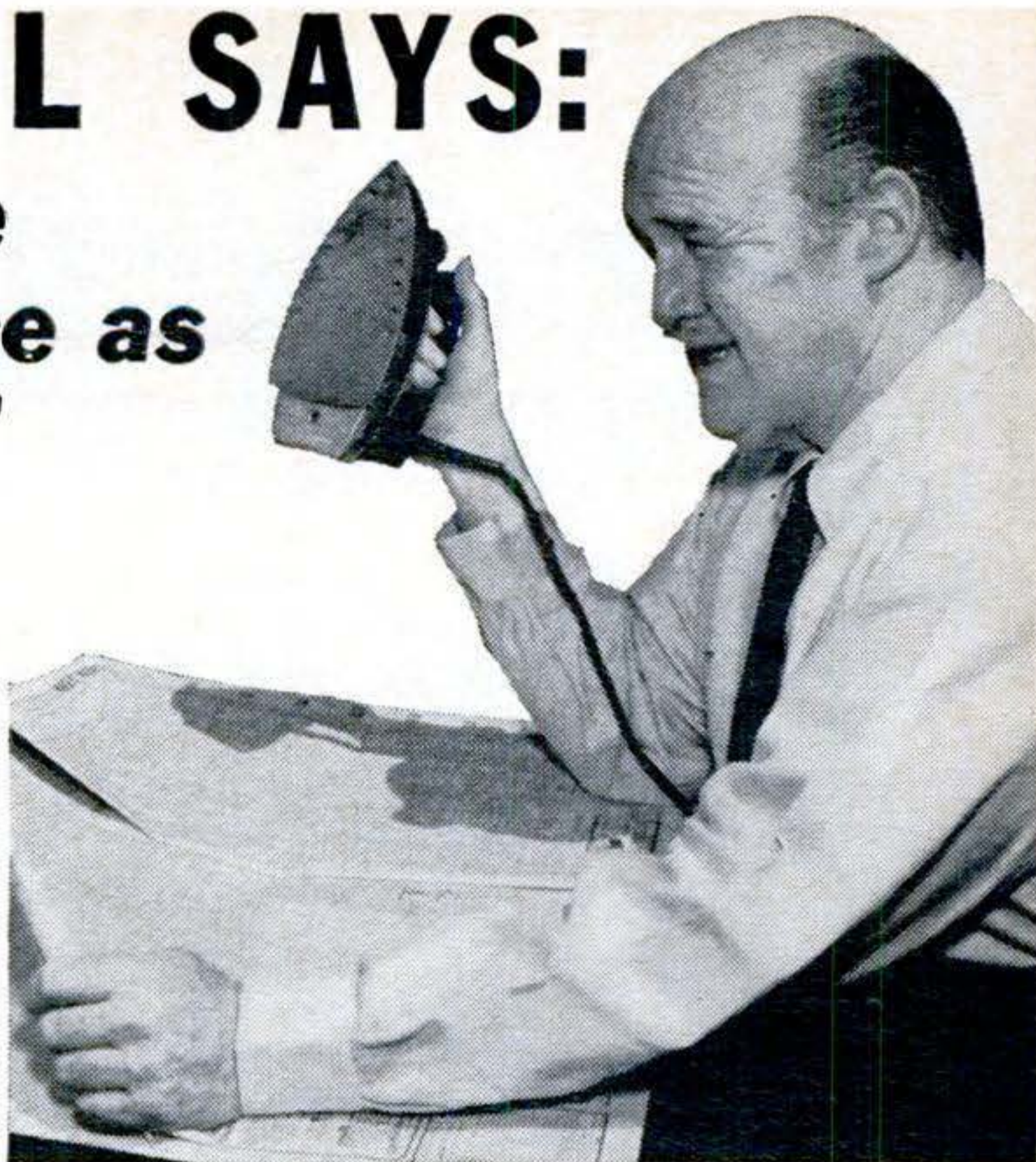
I don't think anything disturbs me as much as trying to find an appliance repairman . . . and finding out I'll have to wait my turn because he has more business than he can handle.

With over 400 million Appliances now in use, and more coming every year, there just are not enough repairmen around to take care of every Mrs. Jones who wants a broken Appliance mended in a hurry! And that's why a smart guy could really clean up in the Appliance repair field.

Some years back, almost anyone could do a fast repair on an iron or toaster with a bit of fancy tinkering. But today's complicated Appliances call for a special brand of know-how the average Joe doesn't have without training. Appliances are loaded with thermostat controls, solenoids, and special devices. Unless a repairman has a working knowledge of these parts, he won't even get to first base.

That's why I want you to take a good look at the home study course offered by the Appliance Division of the National Radio Institute. They show you all about repairing home and commercial Appliances—even farm Appliances and small gasoline engines. If you're interested, they also include a special package covering air-conditioning and refrigeration repairs. The cost is surprisingly low, and even includes a special Appliance Tester.

NRI is one of the biggest and best schools in the field, and has been around since 1914. They have a staff of 150 people in Washington, D.C., who are



equipped to guide you through the easy course with expert and personal instruction.

Take it from Tom . . . this is one of the easiest and most rewarding fields a guy can enter today. You don't need a college education, you don't even need to know the first thing about Electrical Appliances when you begin your training.

There's nothing to lose . . . except the price of a stamp on your letter or postcard. Fill out the coupon below *now*, before you turn the page. Get the full rundown on the training that can increase your spare time income or provide you with a business of your own a lot sooner than you think. In just a few short months you could be ready to take the first profitable step towards a new and rewarding career. Do it!

*Tom McCahill*

TOM McCAHILL

APPLIANCE DIVISION, NATIONAL RADIO INSTITUTE  
3939 Wisconsin Avenue, Washington, D. C. 20016

AVAILABLE UNDER NEW GI BILL.  
If you served since January 31, 1955  
or are in service, check GI line below.

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OK—I want to see for myself. Send me the free book on Professional Appliance Servicing. No salesman will call.

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Accredited Member National Home Study Council.

Check for facts on new GI Bill.

# "Say, Smokey—"

## A clinic on cars by America's most famous mechanic

Each month in POPULAR SCIENCE Smokey Yunick answers questions on cars—family cars, high-performance jobs, hot rods, and racing cars—selected from those sent in by readers. Got a problem? Ask Smokey. You'll find the address at the end of the column. Please print your name and address.



*"I've just about given up hope on a problem with my 1963 Skylark. In rainy weather, until the engine is warm, it misses and runs rough. After driving about four miles, you wouldn't know there was anything wrong with it. A tune-up, and everything else the agency has done, fails to help."*

RUTH M. FEMEYER, Norwood, Ohio.

I believe you will find the trouble to be oil or dirt and/or cracks on the spark plugs, plug wires, distributor cap, or coil top. When wet, these things short out the juice to the plugs.

*"I want to put a supercharger in my 1966 Volkswagen. Would it burn up the engine? If I drove carefully, would there be less chance of damage?"*

DAN VANDERCOOK, Newport, Mich.

If I were going to supercharge a Beetle, I'd prefer to use a turbocharger. I doubt that any type of charger would add to its life, but it would be fun until it croaked.

*"Ever since I had the engine completely overhauled in my Model A it has idled rough and loped. I have rebuilt three carburetors, installed new plugs, and put in new points, condenser, and coil. The timing is right. On retarded spark it gets rough and quits. When the engine is hot, it won't idle smoothly even with the spark advanced. A new cam didn't help, either."*

JIM CAROTHERS, Ruston, La.

Idling was no dream at best in the Model A. But they could be made to chug right along with retarded spark if everything was dead right. Check for loose distributor parts or worn distributor-drive components. The carburetor must be just right—you may need a new one. Check for too much compression. The heads may have been resurfaced 15 or 20 times by

now, each grinding raising the compression. Be sure the pistons are all the same, and the right ones for standard compression. Check the intake system for leaks and the proper gaskets.

*"My '62 Bel Air with the 283-inch engine and automatic sometimes refuses to crank when the switch is closed—I just hear a click. The battery and all wire connections are good, including the firewall plug. The coil and ignition switch have been replaced and the starter solenoid repaired. Sometimes, when the car stands for a few hours, everything works fine. Service-station mechanics have started the engine by shorting the battery terminal to the solenoid winding terminal on the face of the housing."*

MARCOS DE LA ROSA, Lamarque, Tex.

I have seen this problem end up many times at the battery terminal. Connections appear to be in good shape, but sometimes the clamps are loose or oxidized internally.

*"The travel on the brake pedal on my '66 Ford is about a quarter of its length, which is okay, but sometimes it will depress almost three-fourths to the floor before taking hold. Pumping brings it back to normal. I have had the system bled three times and a new kit installed in the master cylinder. The brakes can't be adjusted because an access hole for a tool has been eliminated on this model. Backing for automatic adjustment doesn't help to eliminate the trouble, either."*

CHARLES R. CASE, Satellite Beach, Fla.

If you have power brakes—which you did not state—have the system checked for a leak in the slave cylinder, piston cups, or residual check valve. Get the automatic adjusters checked for proper operation. Be sure you have bled all the air out of the lines. One outside



# Okay, so we failed to invent a house paint that would last forever.

# But wait 'til you see how close we came.



If you paint your house with new-formula LUCITE® you'll wait to repaint like you've never waited before.

We made it to last even longer than the original LUCITE House Paint. And the original LUCITE has held up on test houses for as long as eight years.

Another nice thing about new-formula LUCITE: the primer's already in the paint. No need to prime, even over most bare woods.

An easier job when you *do* paint.

A longer wait *between* paintings.

Longer, we think, than you dared hope for.



Better Things for Better Living . . . *through Chemistry*

JUNE 1967 | 15

## The second set is your first real choice.



### Don't boot it.

Get the Dunlop Gold Seal: the only popularly priced tire that's certified safe at 100 mph.

You won't ride at 100. But you will use the extra margin of strength and performance . . . the four full plies, wet hold, patented Safety-Shoulders, new low-profile design, and wider footprint of the Gold Seal.

All Dunlop tires meet or exceed every official specification for safe performance.

Upgrade when you replace. Dunlop quality costs no more. Find your nearest dealer in the Yellow Pages and let him prove it.

 **DUNLOP** Buffalo, N. Y.  
... means quality in golf, tennis, and tires

### "Say, Smokey—" [Continued]

possibility is that the master-cylinder piston is sticking, or a return or supply hole is plugged with dirt.

*"My 1964 Olds 88 wagon has air conditioning, power steering, power brakes, and 31,000 miles on it. I average 11½ miles per gallon in normal driving and 12½ cruising at 65 m.p.h. I am a conservative driver. Is this average mileage for this car? Can it be improved? What effect would a different ring gear and pinion make?"*

ED PAYNE, Aiken, S. C.

That mileage is on the low side. Despite your convictions about your driving habits, study them for the smoothness of your throttle and how often you hit the top end on acceleration. Run in as high a gear as you can without lugging. In flat country you could get along very well on a 3.10 or 3.18 axle. Dual exhaust helps mileage. The core of good mileage is, of course, a real tune-up by the numbers.

*"I'm well pleased with my 1966 Marlin except that it comes equipped with a 195-degree thermostat. I believe that's unnecessarily high. I would like to change to a 170-degree thermostat but have heard so many conflicting stories that I need your opinion."*

A. O. McDow, Key West, Fla.

Better stick to what Rambler says. The company is very mileage conscious, and a high water temperature goes hand in hand with low fuel consumption. I'm certain that if you put in a cooler control, you will make more trips to the gas pump.

*"My '65 Dodge 440 has a shake, shudder, and shimmy between 68 and 72 m.p.h. In many trips to the dealers they have installed new engine mounts, checked the alignment, and balanced the wheels. The dealer says I just have to learn to live with this condition. I can't get a visit from the factory regional manager."*

M. J. JONES, Richmond, Va.

This is tough to diagnose at this distance. Chrysler unit-constructed products have a tendency to amplify vibration. Keep at the dealer to have the factory service manager ride in your car—and when he outlines a cure, ask who bears the cost.

*"My '64 Fairlane V-8 with automatic transmission was hit in the rear, and the engine slid back on its mounts about an inch. The insurance adjuster and the Ford service manager insist this can cause no harm and refuse to move the engine back to its original position. What do you say?"*

CHARLES E. KNEEN, South River, N. J.

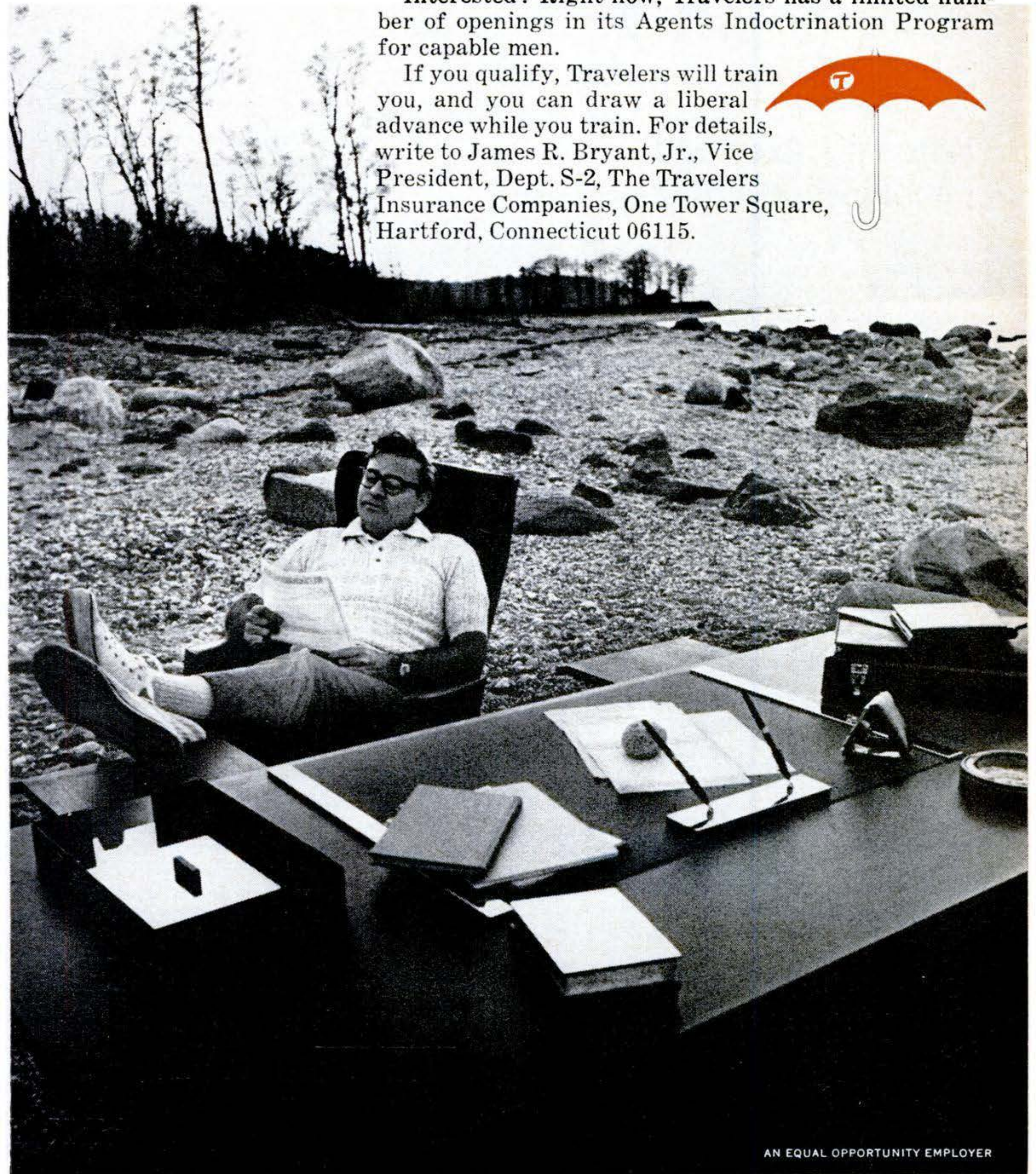
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# You're your own boss when you sell for The Travelers.

That's one advantage of being a Travelers Insurance Agent. You set your own hours and your own income potential. You collect full commissions on all business you write.

Interested? Right now, Travelers has a limited number of openings in its Agents Indoctrination Program for capable men.

If you qualify, Travelers will train you, and you can draw a liberal advance while you train. For details, write to James R. Bryant, Jr., Vice President, Dept. S-2, The Travelers Insurance Companies, One Tower Square, Hartford, Connecticut 06115.



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## Bikes cost money.



## Protecting them is still cheap.

3-IN-ONE can help keep bikes from rusting and running down. It fights rust; protects moving parts from wear; makes things last longer. You pay good money for a bike, a lawn mower, power saws, fans, etc. They're certainly worth a few cents of "insurance." Use 3-IN-ONE. Regular...electric motor oil...or this handy new spray can.

## "Say, Smokey—" [Continued]

I say baloney. Tell them to put that engine back where it belongs. Nothing about your car will be right until they do.

*"I have considerable difficulty braking from high speed in my British Humber Super Snipe despite the front disks. The rear wheels lock, and the car bounces about, giving you the feeling that there is no braking up front."*

NORMAN ENGLER, Brooklyn, N. Y.

Either get a "faster" lining—one with more friction—for the front, realizing that it will have a shorter life, or have the hydraulic-system pressure reduced in the rear. Or you could put a "slower" lining in the rear.

*"The gas mileage is lousy in my 1966 Buick Special with the 310-inch engine. We have checked points, plugs, distributor, timing, timing chain, and ended up putting on a new carburetor. An exhaust analyzer indicates the jets are correct. We still get only 15 to 16 m.p.g. on this straight-stick job."*

DALE WETZEL, Broadview, Mont.

Once again—and I've said this before—you're only going part way. Assuming your engine is tuned right, check to see that your rear-axle ratio fits your terrain. Check for air-cleaner restriction, choke adjustment, a proper distributor-advance curve, wheel alignment, dragging brakes, tire size and pressure—and your driving habits.

*"My 3/4-ton Ford four-by-four has a lot of heavy-duty equipment in it, and I'm going to put on a camper body. The fully loaded weight should be 1,900 to 2,300 pounds. I'm driving Firestone Transport six-ply 7.50-by-16 tires. New 16-inch six-plys are hard to get. Can I safely use 15-inch wheels with high-flotation tires either on or off the road? I would greatly appreciate your advice on this."*

RICHARD DE PUE, No. Hollywood, Calif.

There are 15-inch nonflotation tires and wheels available in eight-ply that will do your job safely. If you go into high-flotation tires, it won't make any difference whether you buy 15-inchers or 16-inchers—you'll have trouble finding either of them on the market. Remember that if you change to high-flotation tires, you are going to have a little trouble steering at high speeds. Finally, let me say that, availability considered, 16-inch tires would be best for your purpose.

Got a question on autos? Send it to:

"Say, Smokey—" POPULAR SCIENCE

355 Lexington Ave., New York, N.Y. 10017.

Not every question may be used. Questions cannot be answered by individual letters.

The 5-channel CB-20 "Reacter" is one of seven solid state CB transceiver brands on the market selling for less than \$100. Even if their specifications were comparable, doesn't it make



sense to buy yours from the company that has built more communications rigs by a country mile than all the others put together?



**FREE**

12 pg. brochure, "All About CB"

**hallicrafters**

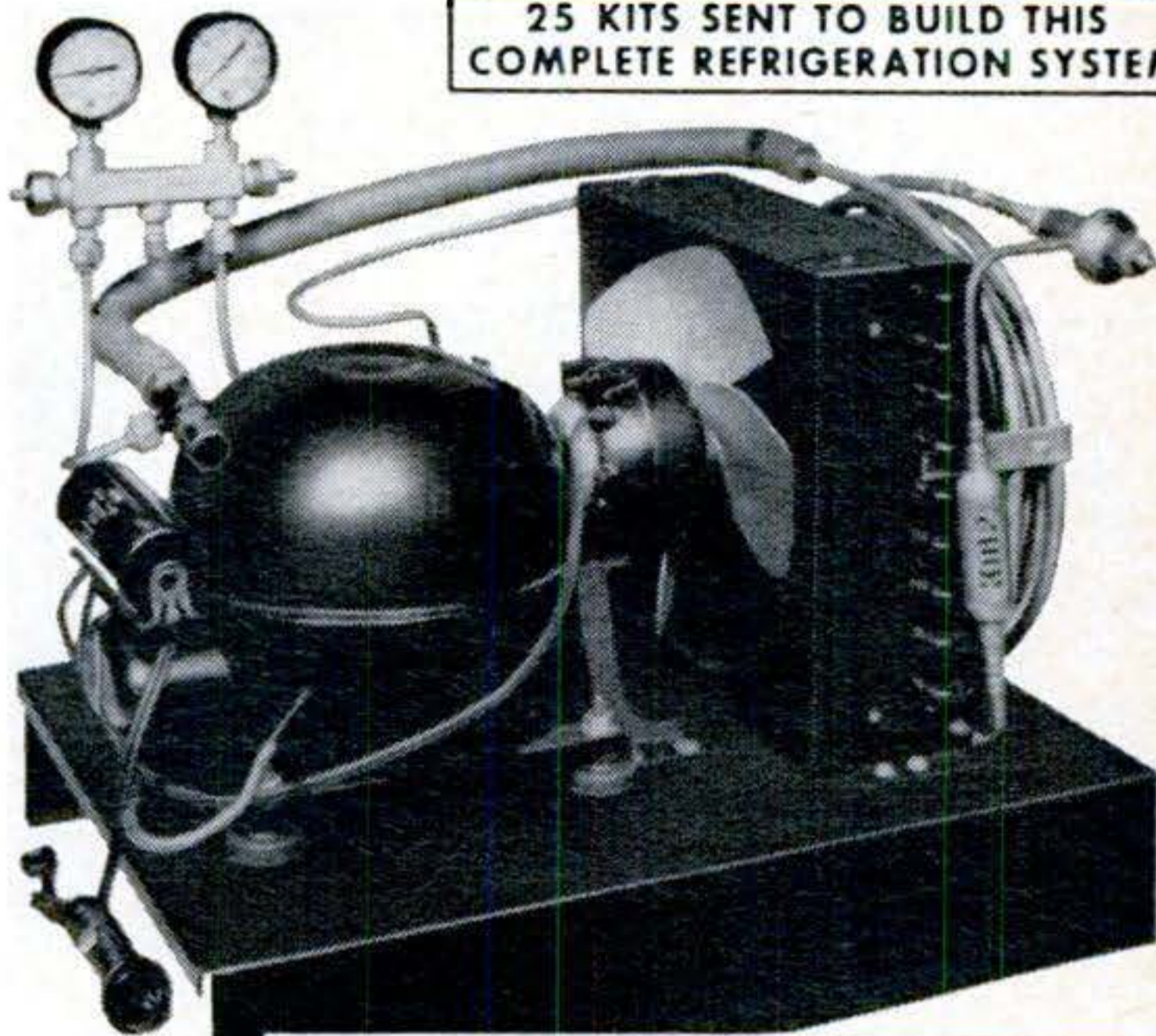
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25 KITS SENT TO BUILD THIS COMPLETE REFRIGERATION SYSTEM



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GI TRAINING**

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A better job, top pay and steady work are easily within your reach. Learn to repair and install air conditioning systems, refrigerators and freezers. Air conditioning is one of America's fastest-growing industries. Millions of autos and homes are being air-conditioned. The need for trained men is immediate and great.

**Make Home Your Training Center** — Learn by practicing. CTI sends 25 kits of tools and parts to build a complete refrigeration system — which you later convert into a refrigerator or freezer. The course is easy!

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Check for facts on GI Bill

Accredited Member National Home Study Council

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"\$642 while learning and I used the money to outfit a complete lock and key shop. Now I average \$3.25 an hour in my spare time. With the help of your instructor, anyone can master the course with ease."

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# Science Newsfront

Last-minute news  
and notes to keep you  
up-to-date

By W. STEVENSON BACON

## Emergency life support for submariners

Suppose the atmosphere in a spacecraft or a small submarine becomes contaminated? In both cases, immediate rescue would be impossible. To keep a crew of four men alive aboard Deep Quest, the deep-diving submersible that will be launched this summer, Lockheed Missiles & Space Co. has developed an unusual closed-circuit emergency life-support system. It includes face masks, regulators,



breathing bags, and a container of a carbon-dioxide-absorbing chemical, lithium hydroxide. The system detoxifies the air breathed by four men for as much as three hours—time enough for them to make a safe return from depths as great as 8,000 feet.

## Light you spray from a can

Stranded on a dark highway with a flat tire? A new invention may soon make it possible for you to quickly spray "light" from an aerosol can to warn drivers behind you. Want to write a note in the dark? Use a crayon of the same stuff—it prints in bright, illuminated letters. These are just two possible applications for "Chemical Light" developed by Du Pont and being made by Remington Arms. Known as PR-155, it is a particularly active chemical compound that oxidizes in air to produce light (chemiluminescence) for several hours—without heat or electricity. It is up to 5,000 times as bright as moonlight on a concrete highway. First uses for Chemical Light will be for coating life rafts and in emergency lighting systems.

## Flashlight batteries last 20 years

A new type of flashlight battery that lasts indefinitely (20 years or more) until you activate it with a built-in plunger will be introduced late this year. Known as a reserve-type battery, the alkaline cell will lick one of the big disadvantages of ordinary carbon-zinc cells: short shelf life. Prototypes of the reserve battery incorporate a glass vial of liquid electrolyte which, when broken as you screw down the top terminal, puts the battery to work. Developed by the Mallory Battery Co. for emergency lighting uses everywhere—homes, ships, planes, automobiles, etc.—the reserve battery should appear late this year, reasonably priced, but somewhat more expensive than ordinary batteries.

## Tornadoes happen everywhere

If you think you live in a part of the country that's immune from tornadoes, you're wrong. According to records of the Environmental Science Services Administration, only seven states escaped unscathed in 1966. Although many of the 579 storms were in the Central Plains along so-called "Tornado Alley," funnels were reported in such highly populated states as California, New York, Pennsylvania, and New Jersey. The average tornado, caused by colliding air masses of different temperatures and moisture contents, is a quarter of a mile wide at its base. Its 300-m.p.h. winds cause total destruction where it touches ground over a path of many miles.

## Flying saucers for everyone?

If you have the urge to make like a Martian, you may get your wish. This is the goal of Paul S. Moller, assistant professor of mechanical engineering at the University of California, who wants to develop low-cost (\$4,000 and up) flying saucers for personal transportation. After installing new engines in his first machine [PS, July '66], Moller recently made a series of successful test flights a few feet off the ground. With a second, eight-foot-diameter, single-engine craft, demonstrated a few weeks ago, he hopes to achieve real flying-saucer altitudes.

## 3-D movies that "jump out of screen"

One of the first really practical systems for quality 3-D movies that will literally jump out of the screen at viewers was recently described

# The Winterproofers.

## Summer's the time to use them.

Sorry. We didn't mean to interrupt your summer leisure.

But we did want to point out that some do-it-yourself jobs are easier to do in summer than in winter.

Especially those jobs that need waterproof gluing.

And since it's dry out, why not take advantage of it. With Elmer's. Elmer's makes a glue, or adhesive, for every job. Indoors or out.

Number one always goes to America's most popular home glue, Elmer's Glue-All®. Elmer's Glue-All comes in a handy squeeze bottle with a mess-free applicator top. It's a white plastic glue that dries fast and clear.

Elmer's Glue-All is great for gluing wood, paper, pottery, leather, cloth and all porous materials. (And it's great for any season of the year.)

For home construction, or repairs, use Elmer's Waterproof Glue. It's great for exterior doors, storm windows and shutters. As well as boats, outdoor furniture and sporting equipment.


For construction and furniture repairs, use Elmer's Plastic Resin. It's highly water resistant and will not stain acid woods such as oak or mahogany.

For waterproof caulking around windows, showers and tubs, use Elmer's Mystik Tub Caulk. It's also excellent for resetting tiles, sealing plaster cracks and marine work.

Elmer's Contact Cement is an adhesive you can use on both porous and non-porous surfaces. It needs little or no clamping. And you can use it to bond such materials as wood, leather, linoleum and plastics.

For construction and repairs on non-porous materials, such as glass, iron, aluminum and hard plastics, use Elmer's Epoxy Glue. It makes an especially strong waterproof bond.

And for a handy home lubricant for windows, doors and drawers that squeak, stick or bind, use Elmer's Slide-All. (Now with miracle Teflon\*). It sprays dry, is non-greasy and odorless.

Now that you know all about our glues, there's only one thing we want to remind you: It's easier to winterproof your home in the summer than it is to winterproof your home in the winter.  BORDEN CHEMICAL



\*Teflon is a DuPont registered trade mark.

# You keep the eyes of the Army from going on the blink.

It's dark. The sky, hills, road and trees are all the same color. Black. No shades of grey. Just solid black.

But the radar keeps watch. It's the Army's eyes that see in the night. A lot of men depend on it. And it depends on you. You're the expert, the radar specialist. Your job is to keep those eyes alert. You know every transistor, every circuit, every tiny component as well as you knew the plays for your high school football team.

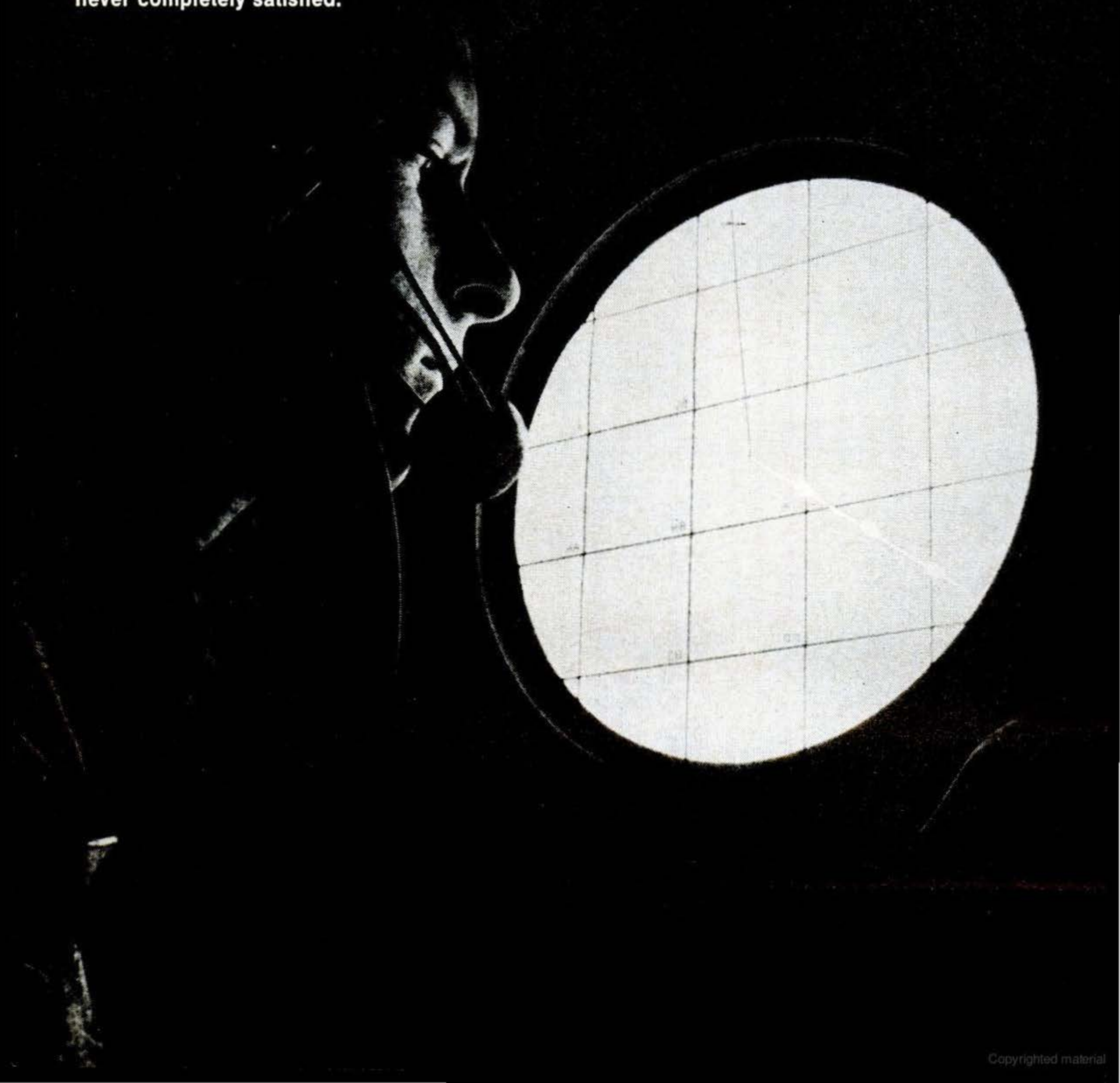
If it wasn't for the electronic training you got in the Army, you'd still be playing games—trying one job and then another, looking for a career, never completely satisfied.

But now you're set, you've got Army training behind you. It was an 8-hour-a-day, 5-day-a-week program that taught you a skill to build a career on.

And the training you selected was guaranteed in writing before you signed up. You made the right choice.

But with over 300 career opportunities to choose from, how could you go wrong?

## Army





## Science Newsfront [Continued]

by Dr. Dennis Gabor of CBS Laboratories. It would be based on a highly unusual projection screen. The screen would contain the holograms of two mirrors, one for the right eye and one for the left, superimposed on each other. It would reflect images from two projectors in a series of vertical viewing zones, each the width of normal eye spacing. Each alternate zone would carry adjacent images, one visible to the right eye and one to the left. The one problem: development of deep reflective photographic emulsions to make the hologram screen.

### New drug dissolves excess fat

If you have trouble keeping your weight down, hang on: There's hope yet. A mysterious substance that dissolves stored fat in the human body may someday be available to slim down obese people or make compulsive eaters thin. The hormone-like substance, called a lipid mobilizer, breaks down fat and moves it to the liver where it is made available to the body for energy. The mobilizer is then excreted. News of the substance comes from Dr. Eli Seifter of Yeshiva University, New York, who is experimenting with rabbits to determine if it has serious side effects. In favor of the drug: It is found in starving persons and diabetics who cannot utilize sugar and must draw on body fat.

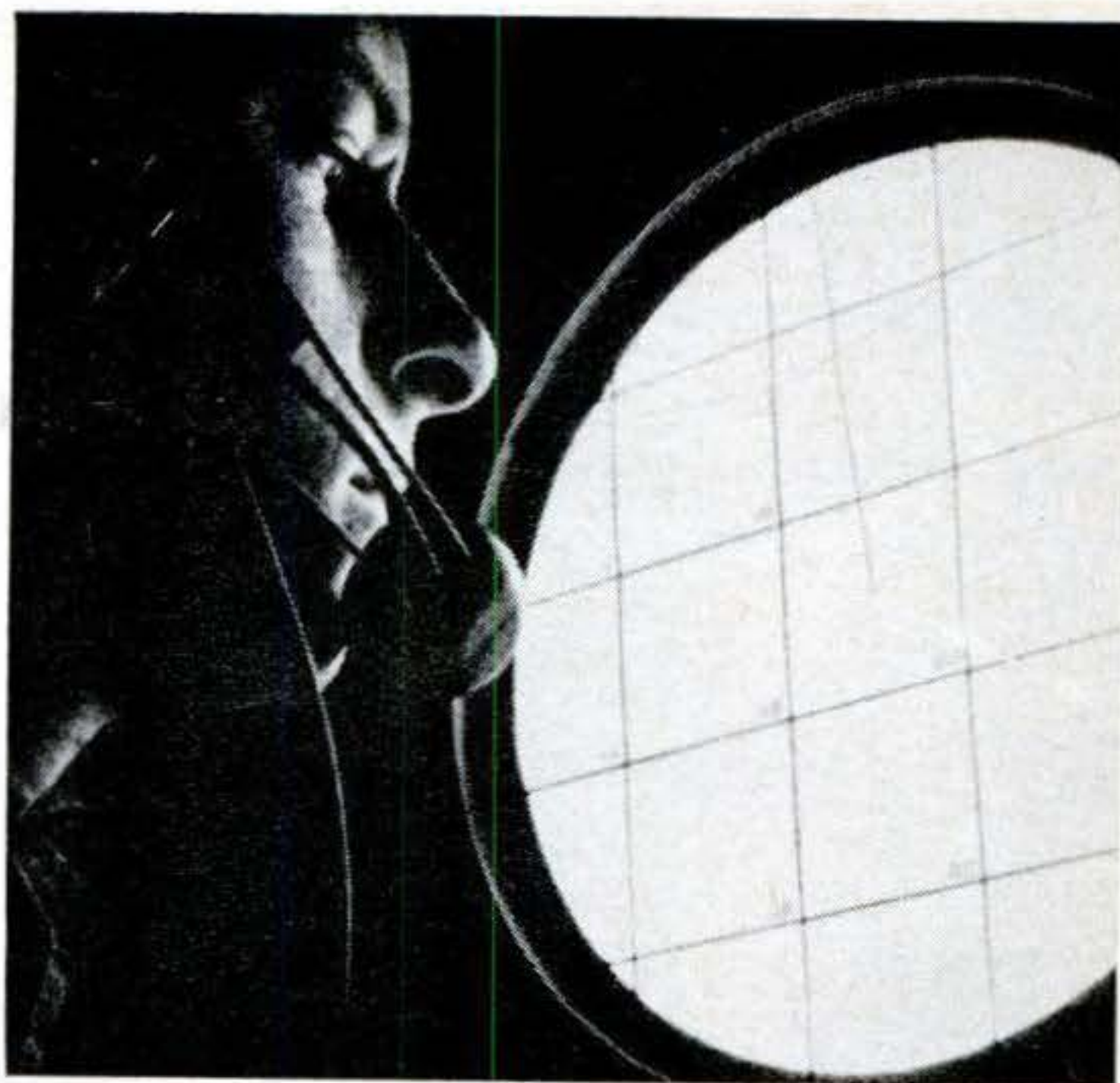
### What is the speed of light?

We'll never really know, but we're getting closer. Consistent errors in radar distance measurements on earth (radar travels at the speed of light) led a few years ago to a new value of 186,342.01 miles per second. But there may still be errors of several miles when measuring interplanetary distances. Now, in one of the most fascinating experiments ever devised, physicists at the University of Colorado, working with a laser in an abandoned gold mine, are trying to measure the speed of light to better than three parts in 100 million. Wavelength of light divided by frequency gives speed. Using a device called an interferometer, the scientists will determine at what points in a 100-foot-long vacuum tube waves of different wavelengths are precisely in step. From this, they can determine exact differences in wavelengths, frequency, and, finally, a close value for the speed of light.

### Pass the (sheet of) catsup

What will be the contents of your refrigerator in the year 2000? Rather startling, predicts Secretary of Agriculture Orville L. Freeman. There will be such things as sheets of freeze-dried catsup, gravy, and syrup, square tomatoes bred for less damage in shipping, frozen lettuce and salad mix, and steak tailor-produced for the exact fat content desired. If you can't afford steak, don't worry: You'll be able to buy a soy-

*Continued*



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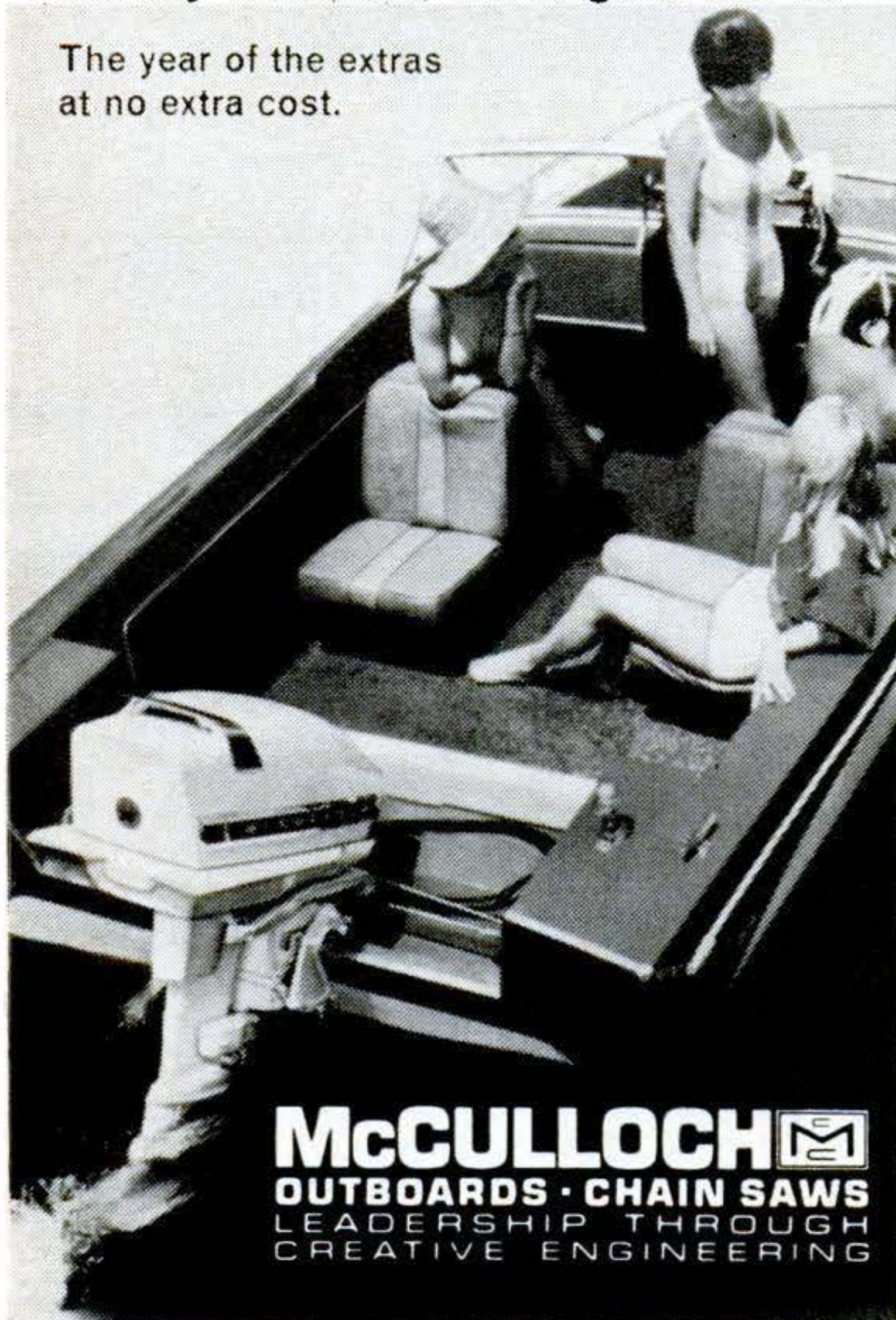
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## Science Newsfront [Continued]

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### Boats move faster in lubricated water

By adding certain chemicals to water, it may be possible to make boats, submarines, and torpedoes move faster—or, on the other hand, to move more water through a small pipeline. Researchers in this country and abroad have discovered that concentrations of less than 100 parts per million of substances such as polyethylene oxide and guar gum reduce friction between water and solid bodies by as much as 40 percent. Other applications: increased water capacity for fire hoses, irrigation pipe lines, and central-heating systems.

### Plastic-foam houses faced with aluminum

A strong, lightweight building material with excellent insulating properties can be made of rigid urethane foam sheathed on both sides with light-gauge (.032-inch) aluminum. Reason: The foamed-in-place urethane distributes the load over the entire surface of the aluminum. So strong is the new material, designed by research engineer John A. Hartsock of Olin Mathieson Chemical Corp., that an arch with a span of 22 feet sags only slightly when 350 pounds or more are suspended from its center. According to Hartsock, the arches could be placed side by side to form a lightweight, insulated building of unusual strength.

### Now it's minimotorways

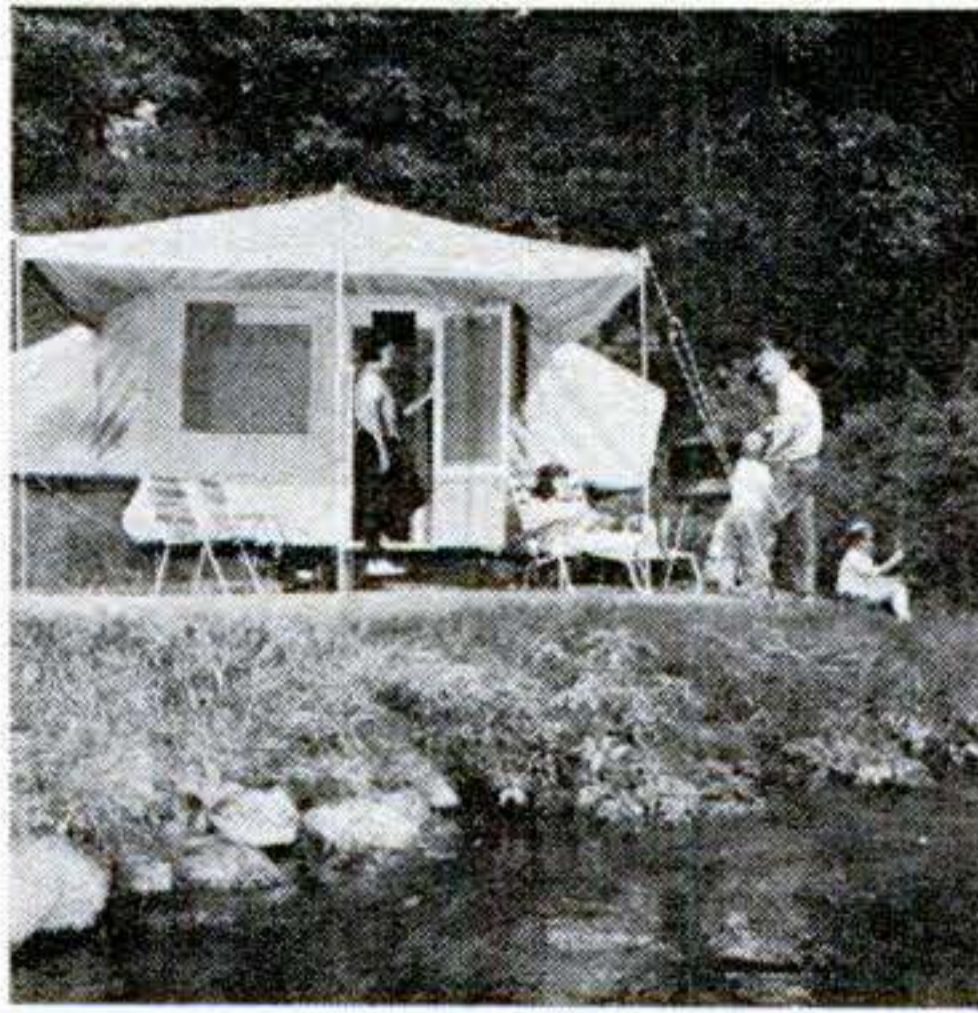
Everything is "mini" these days, including a suggestion from a British engineer to help solve the traffic problem around populated areas at low cost. F. R. Shaw of Loughborough University of Technology would build minimotorways around each town designed to handle passenger cars only. The roads would have lightweight bridges, a minimum foundation covered by a thin topping, and no hard shoulders. To keep trucks off, all vehicles would have to enter the roads through portable tunnels six feet high and six feet wide.

### Now—help for the harried bus driver

For the first time, someone has come to the aid of the world's most harried drivers: school-bus operators. Although little can be done to ward off spitballs, orange peels, and textbooks, a new invention patented by Joseph L. Ford and Richard L. Rounder of Brownsburg, Ind. promises to keep nerves intact. A pickup and transistor circuitry continuously monitor noise level. As it gets louder and louder, a light goes on at the front of the bus, a microphone switches on, and the driver addresses passengers through a speaker: "Quiet, please?" P.S.

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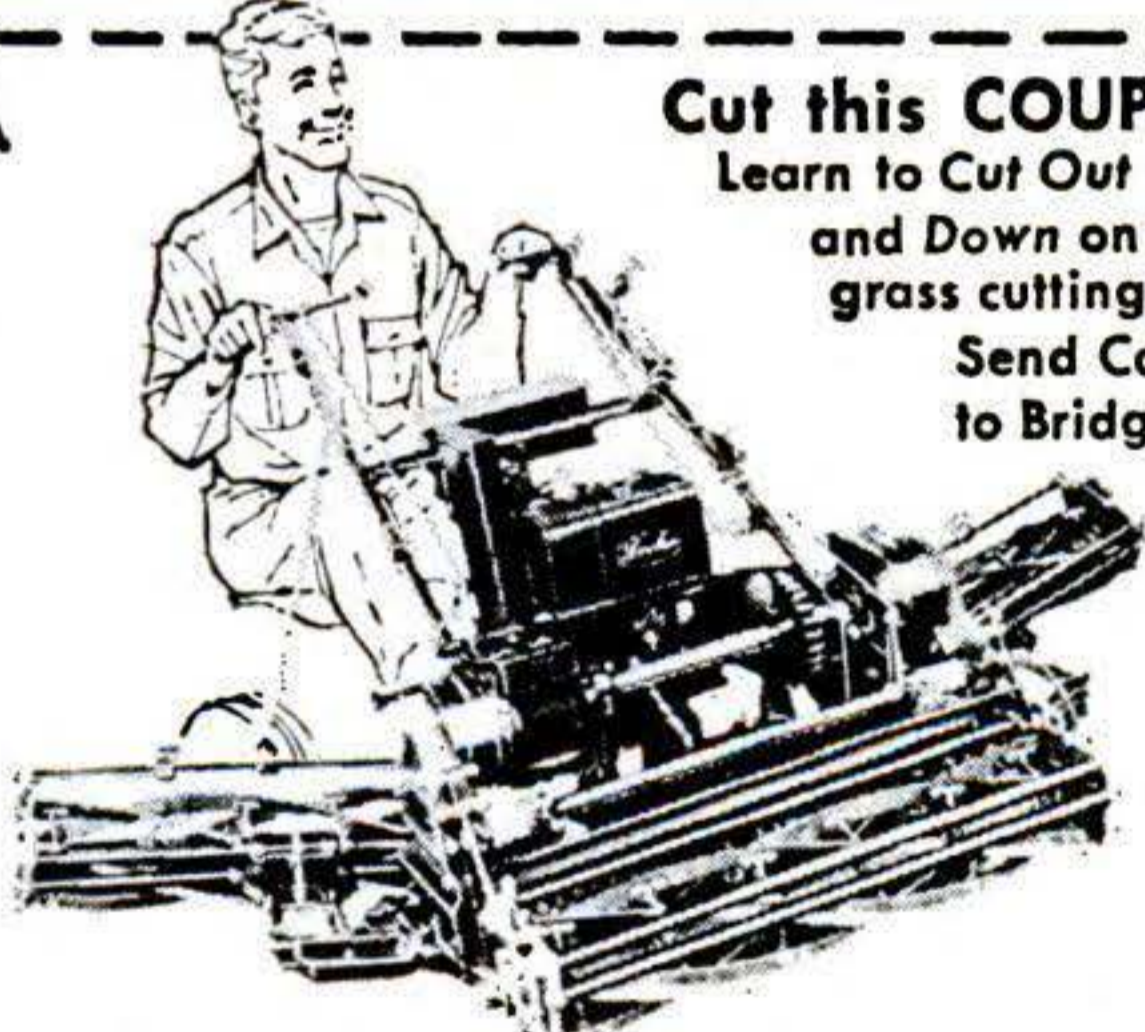
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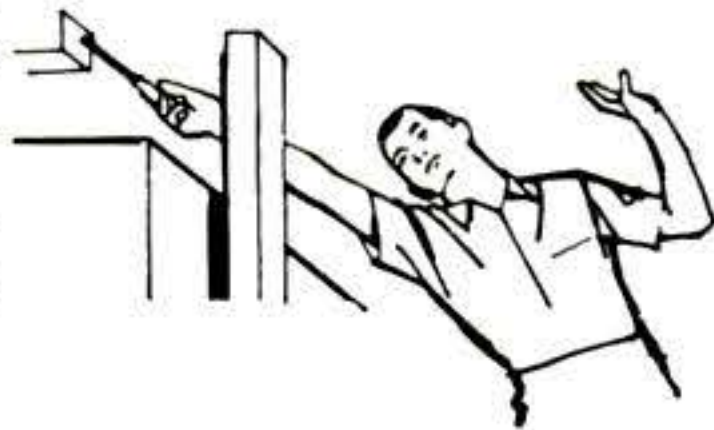
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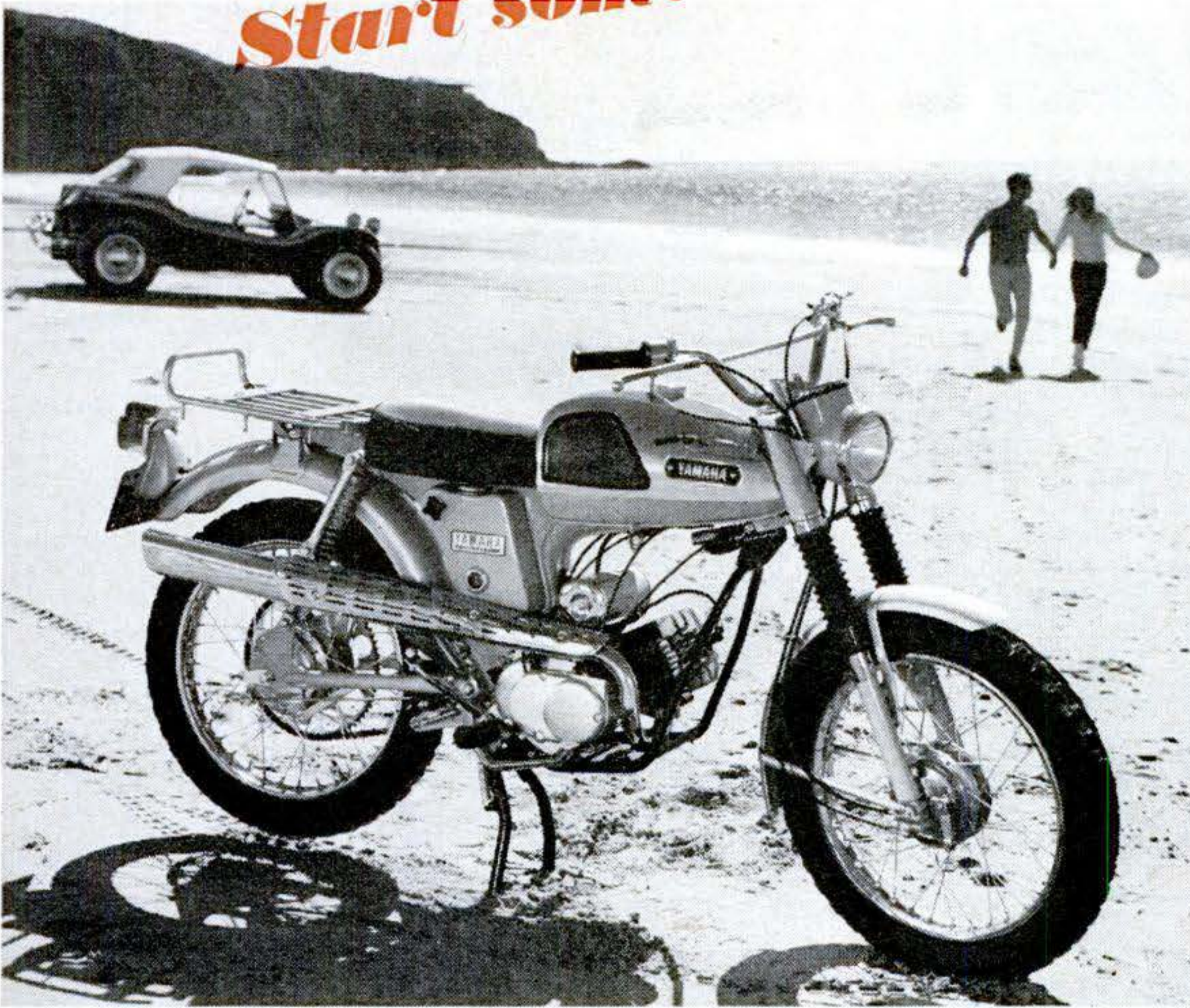


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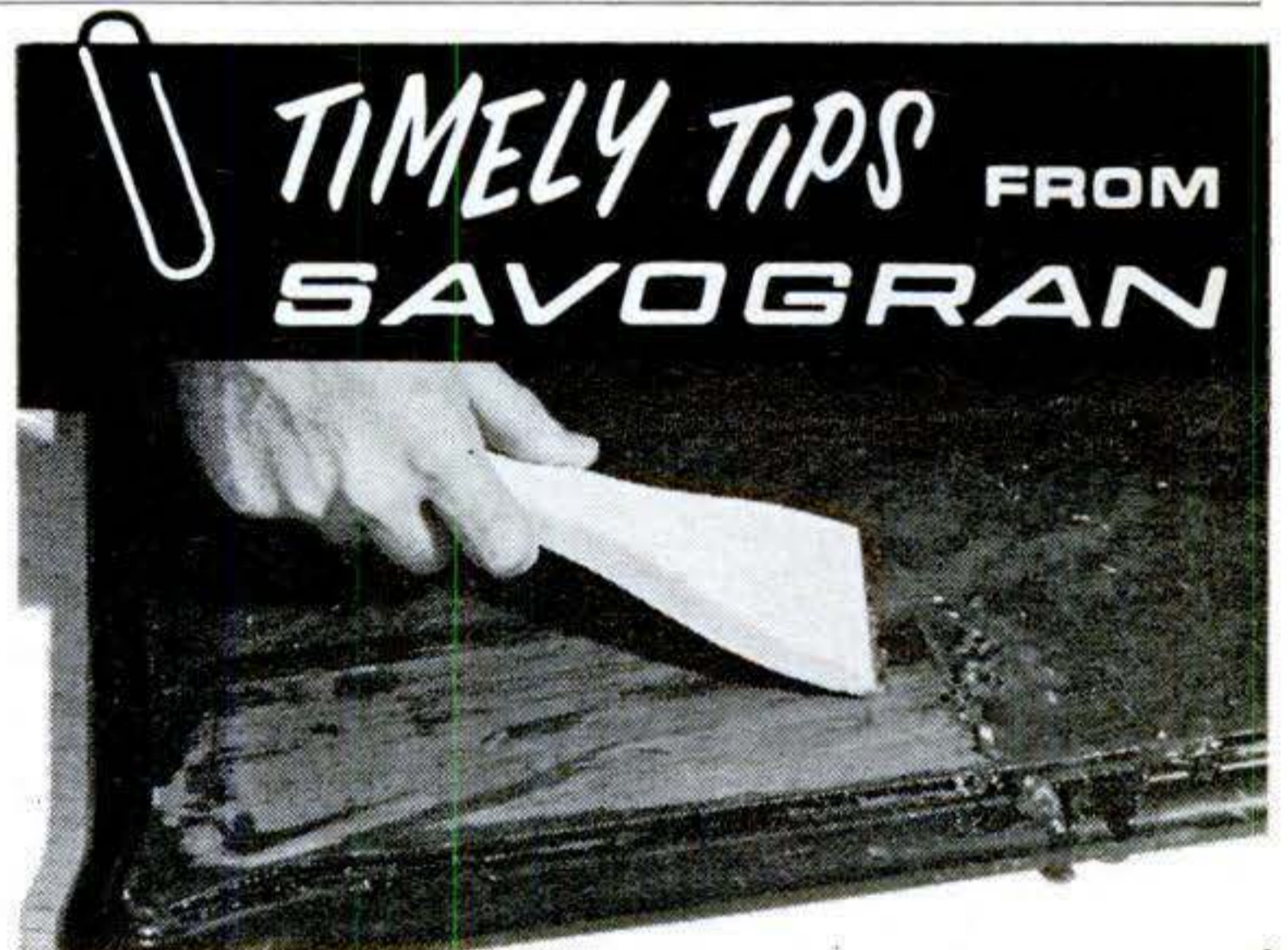
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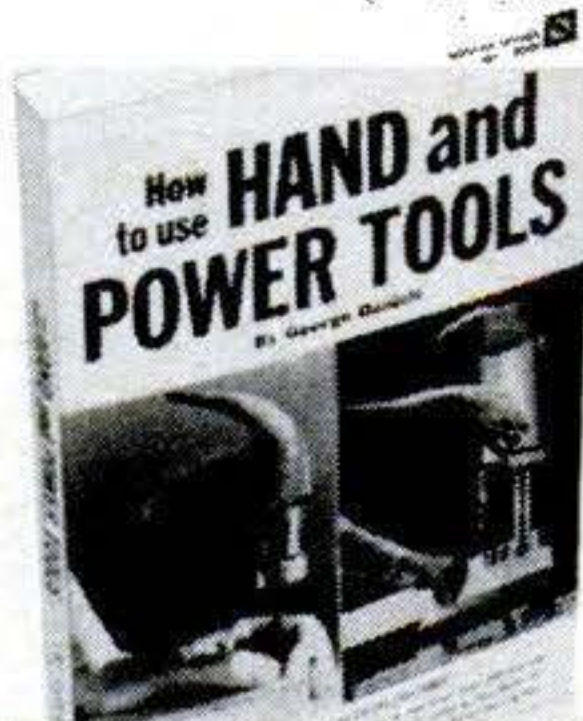
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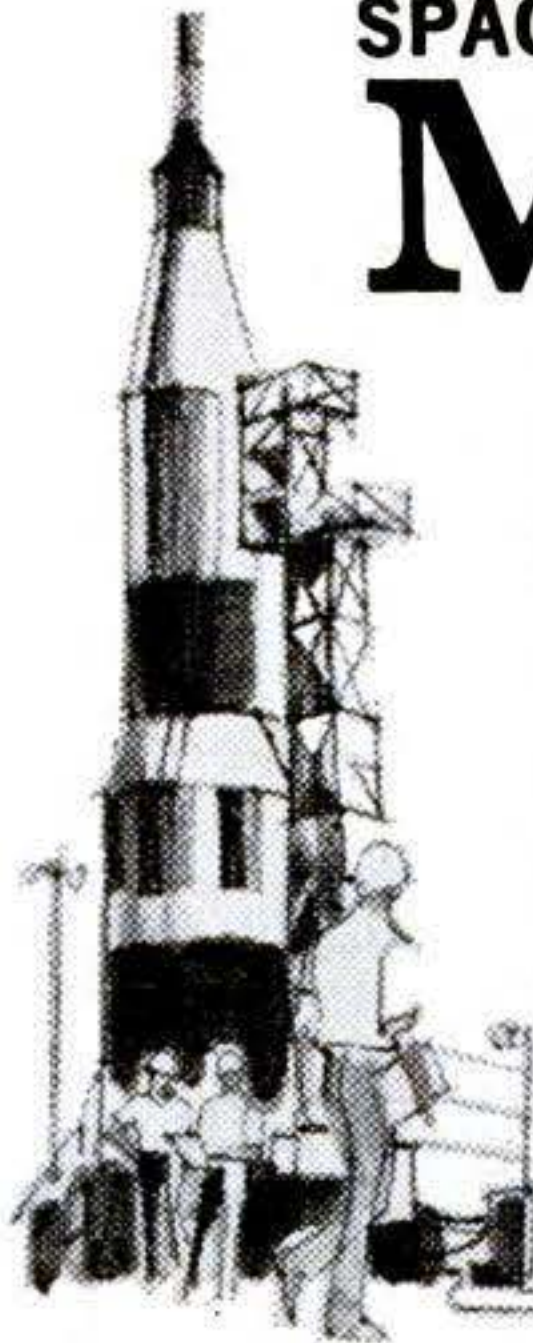
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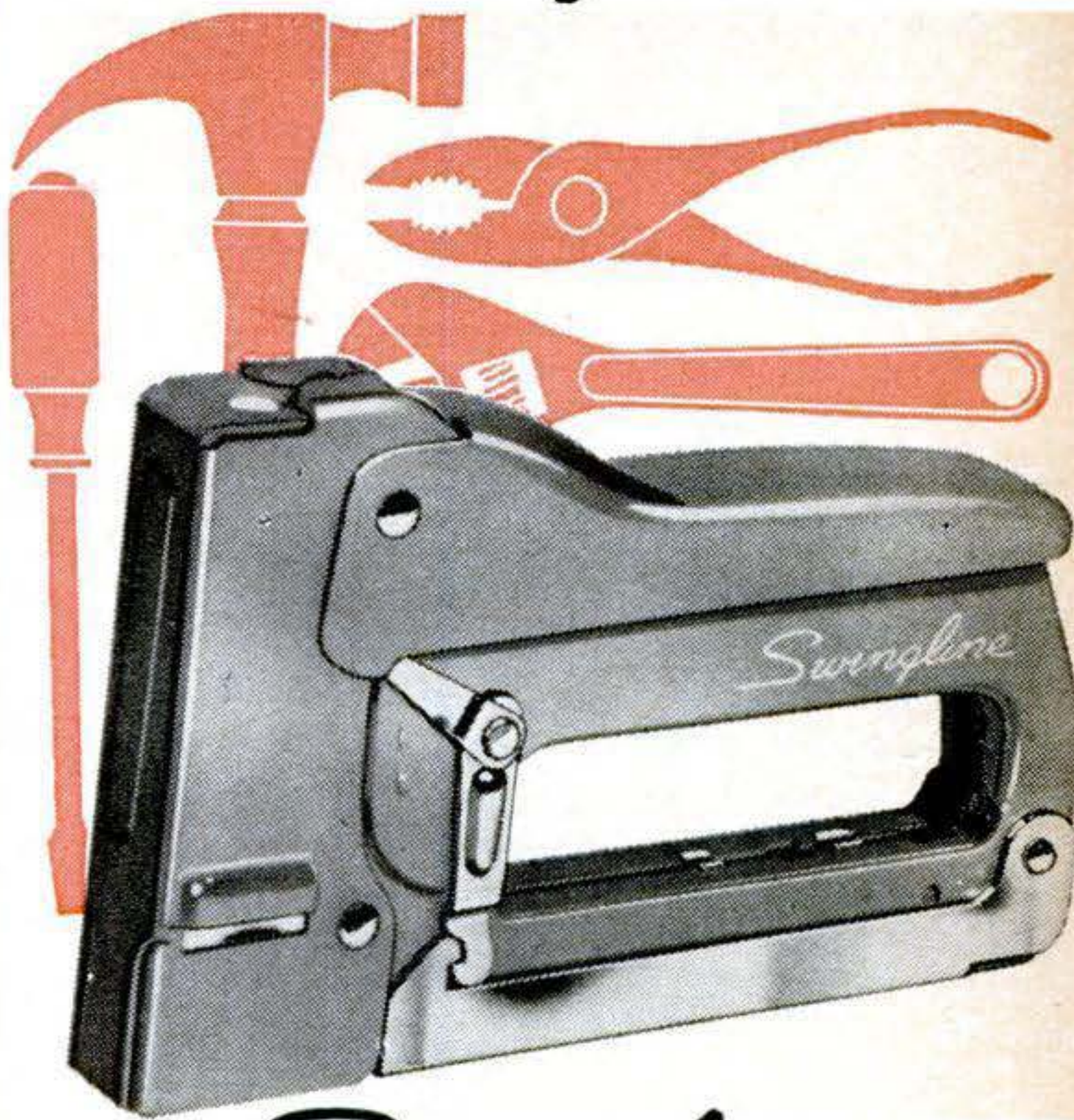
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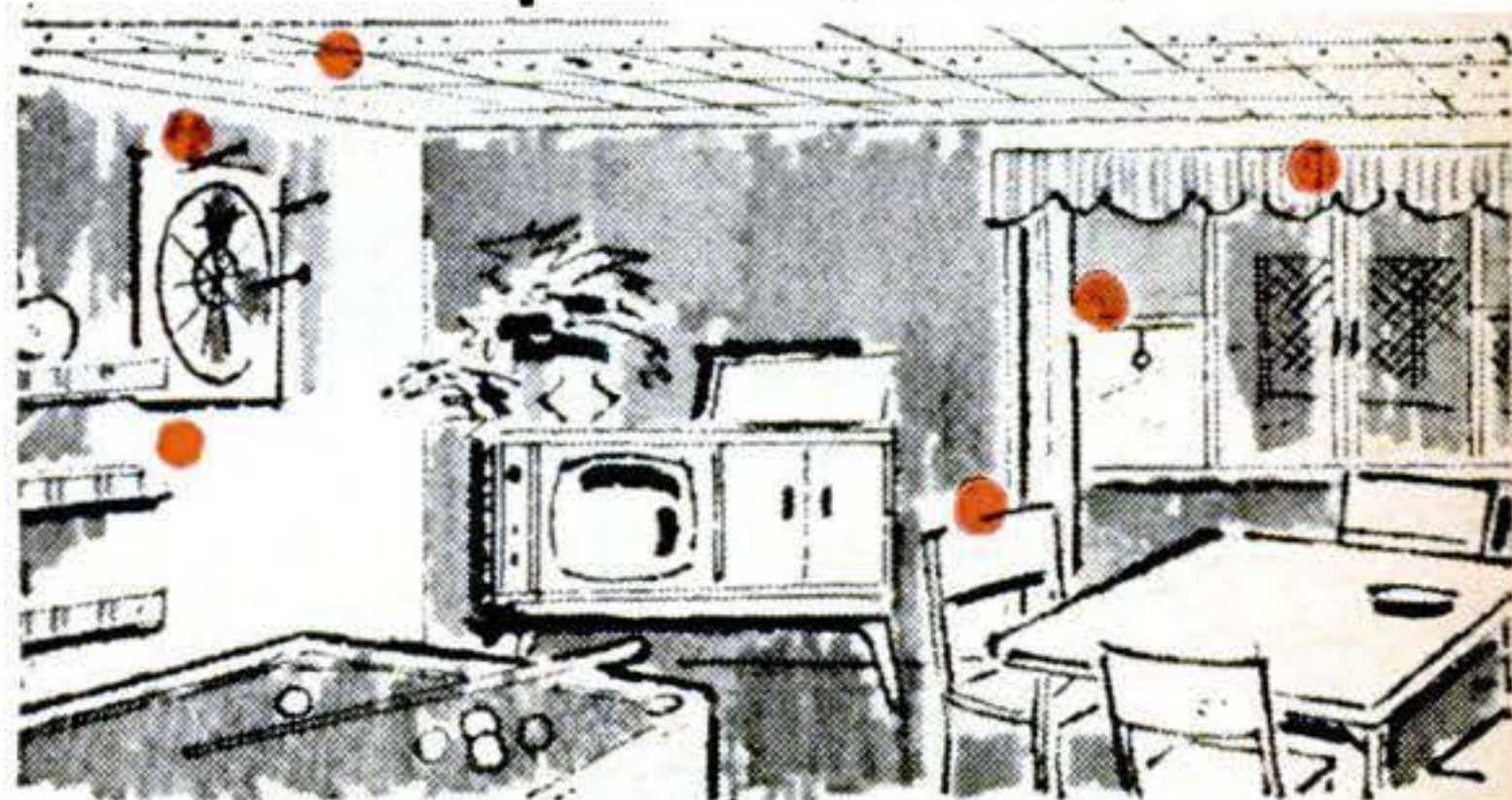
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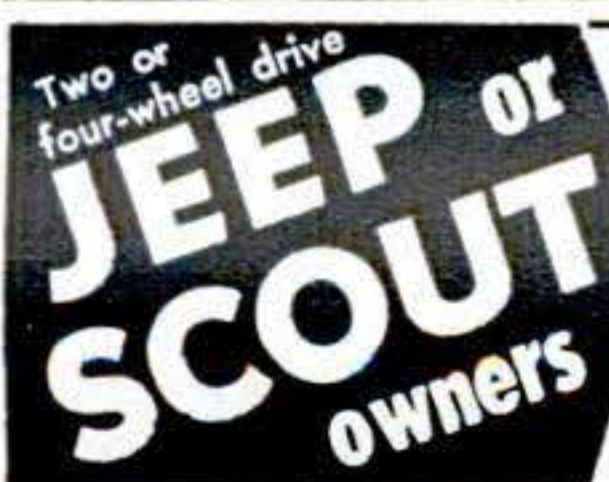
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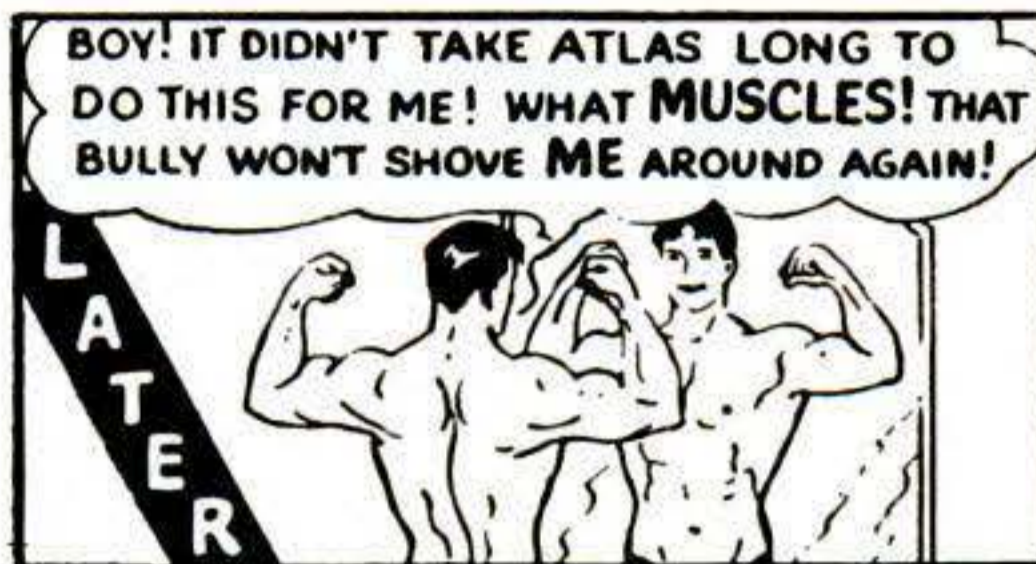
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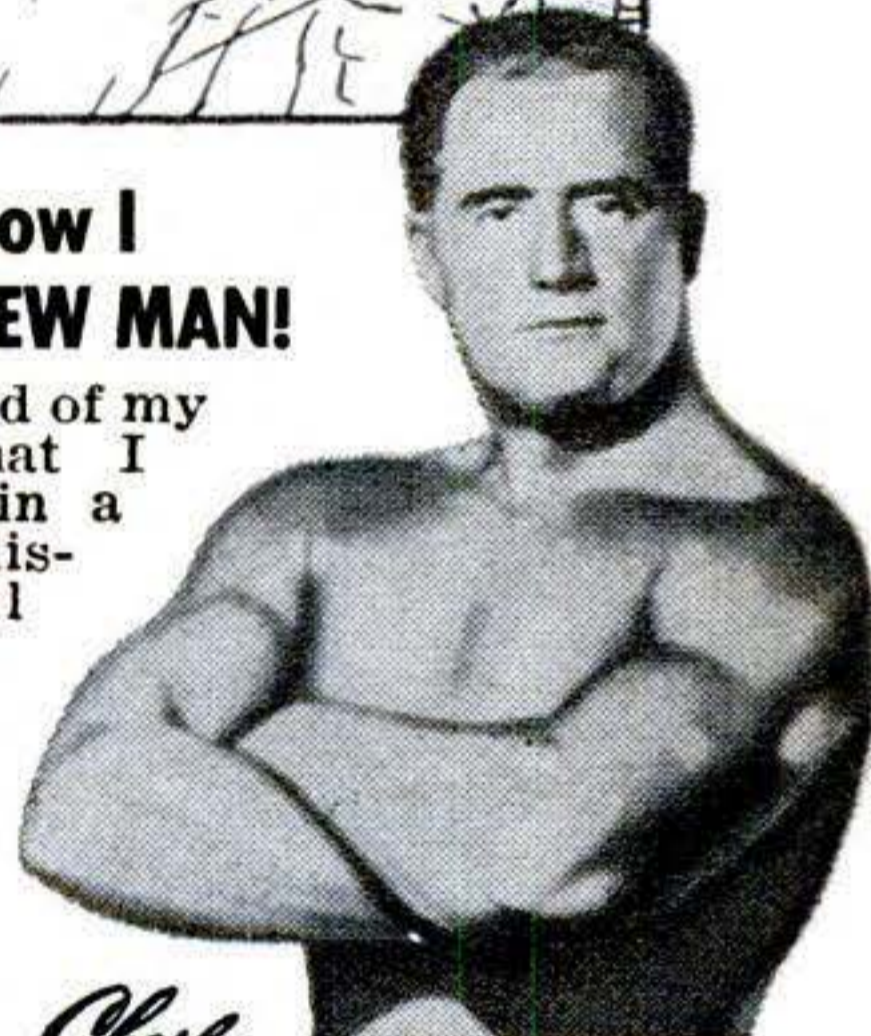
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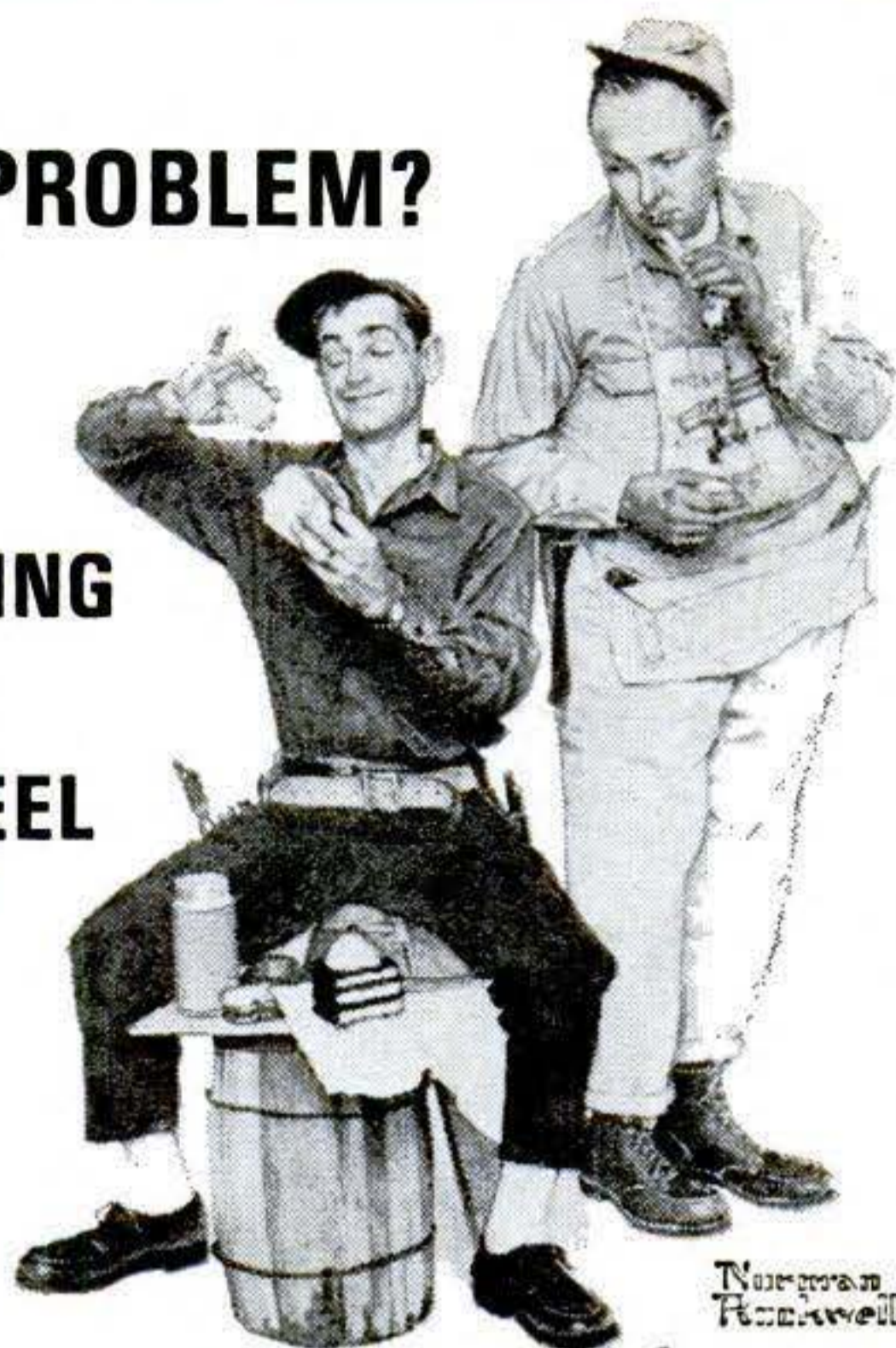
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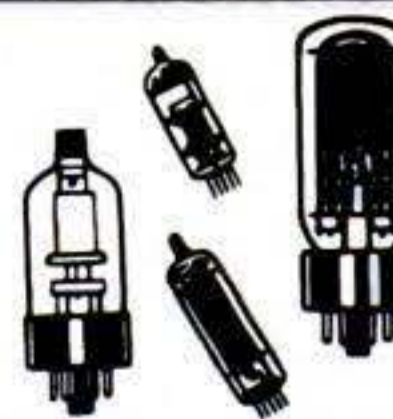
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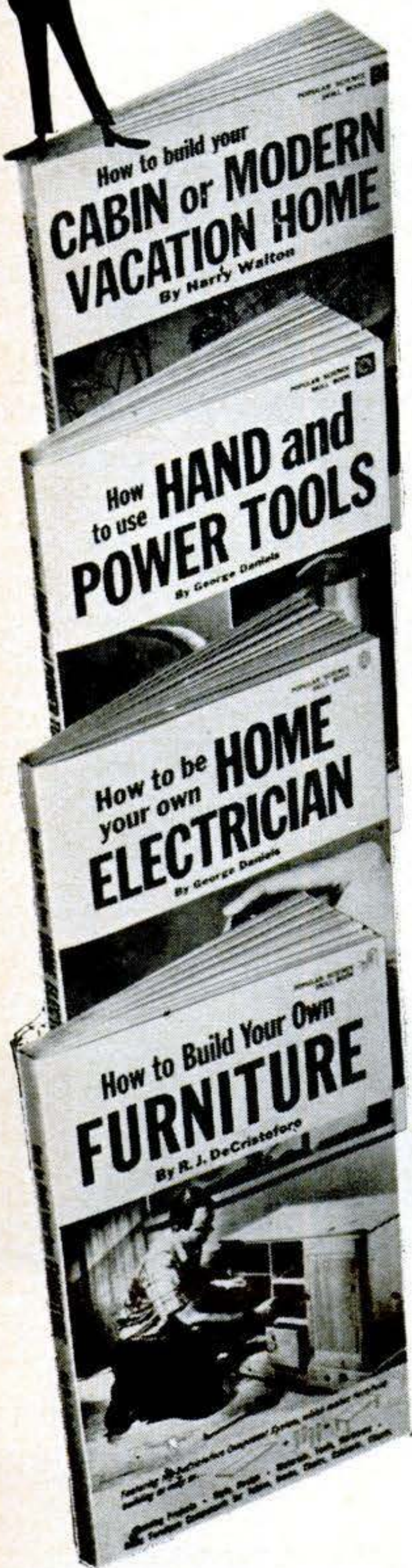
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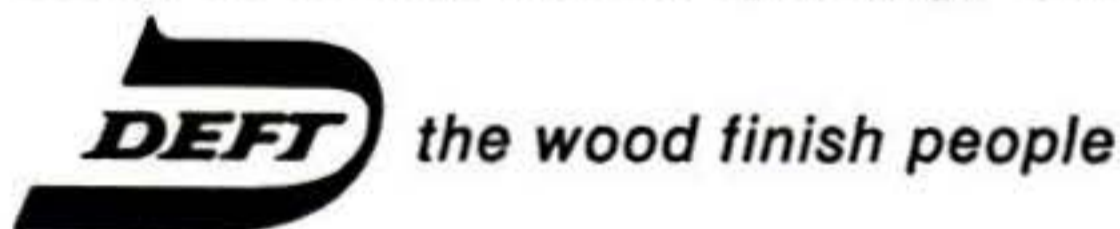
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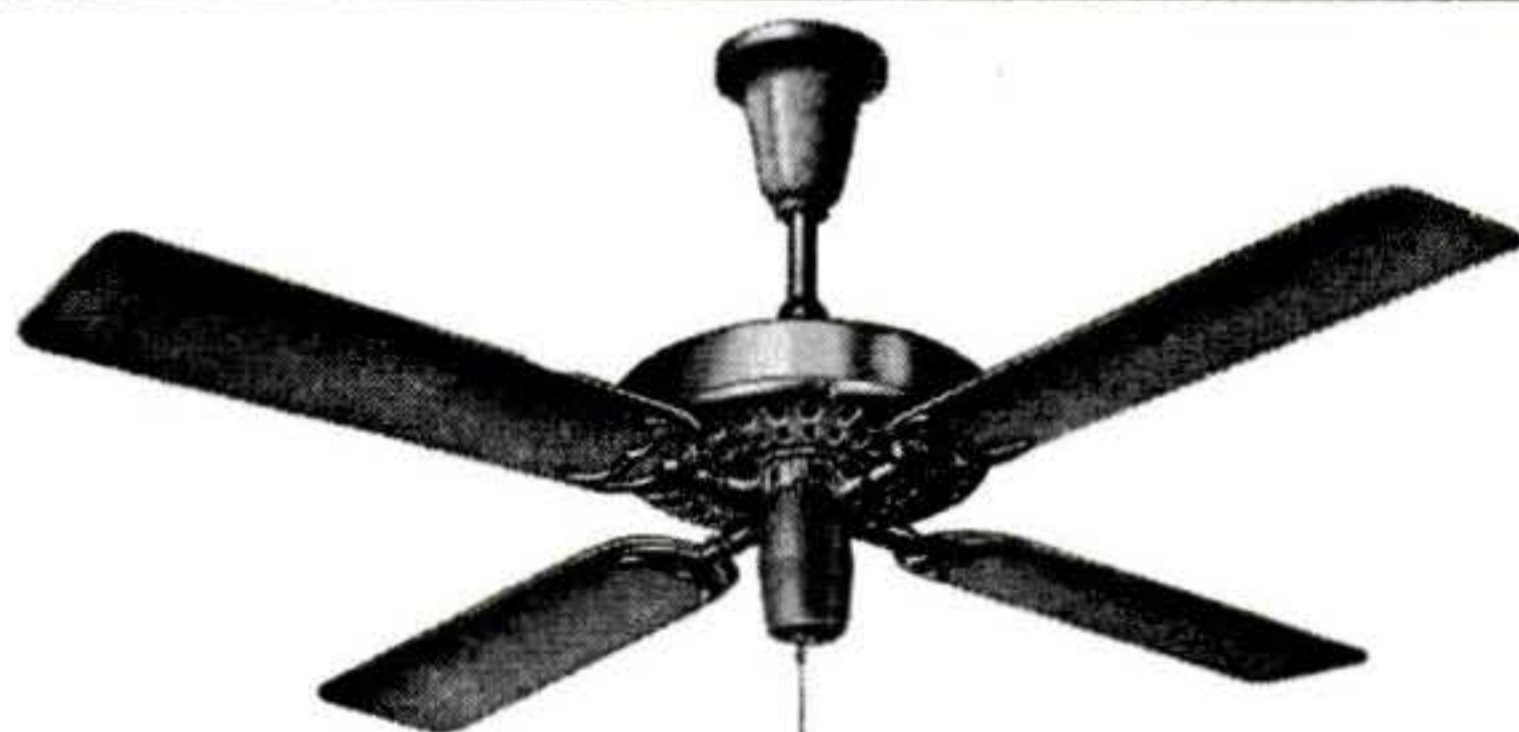
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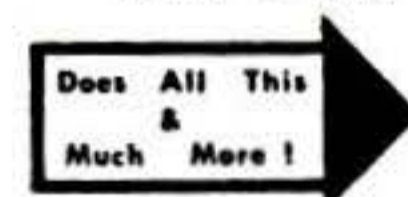


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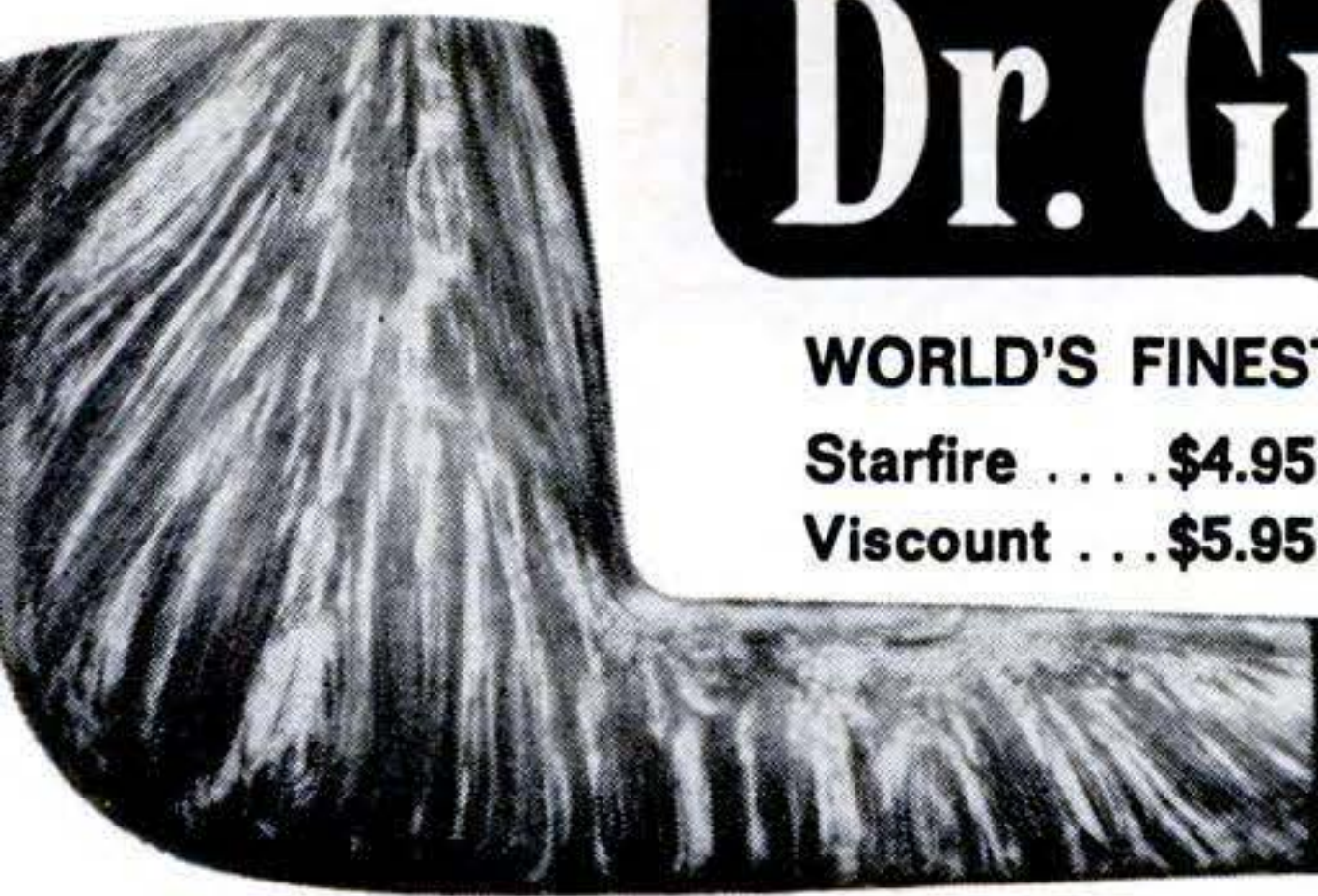
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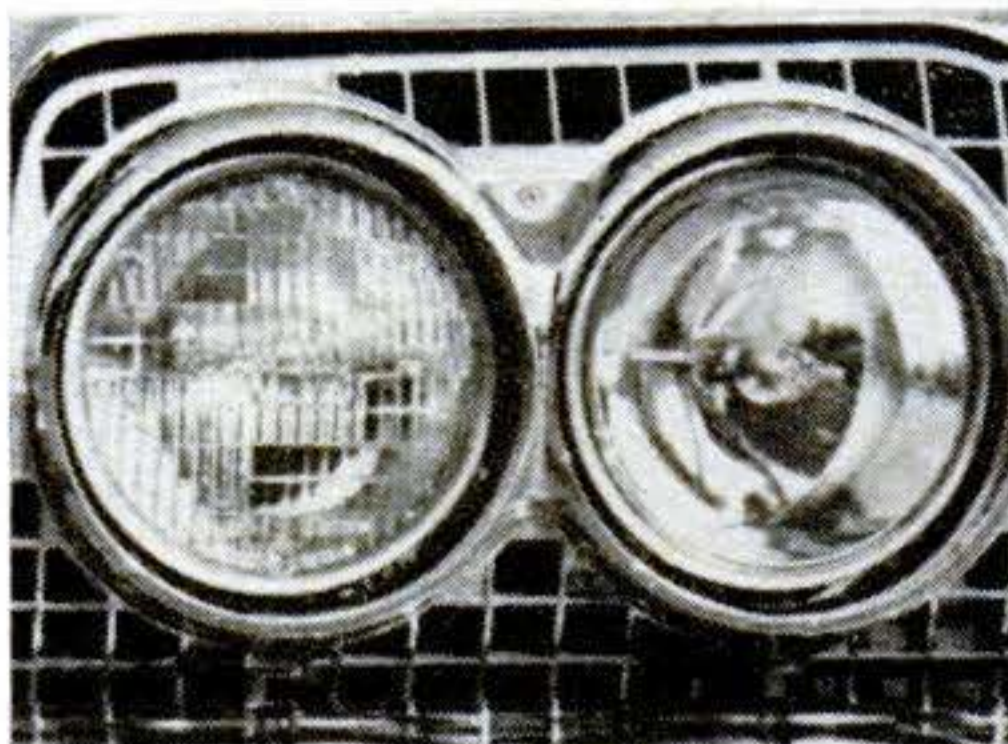
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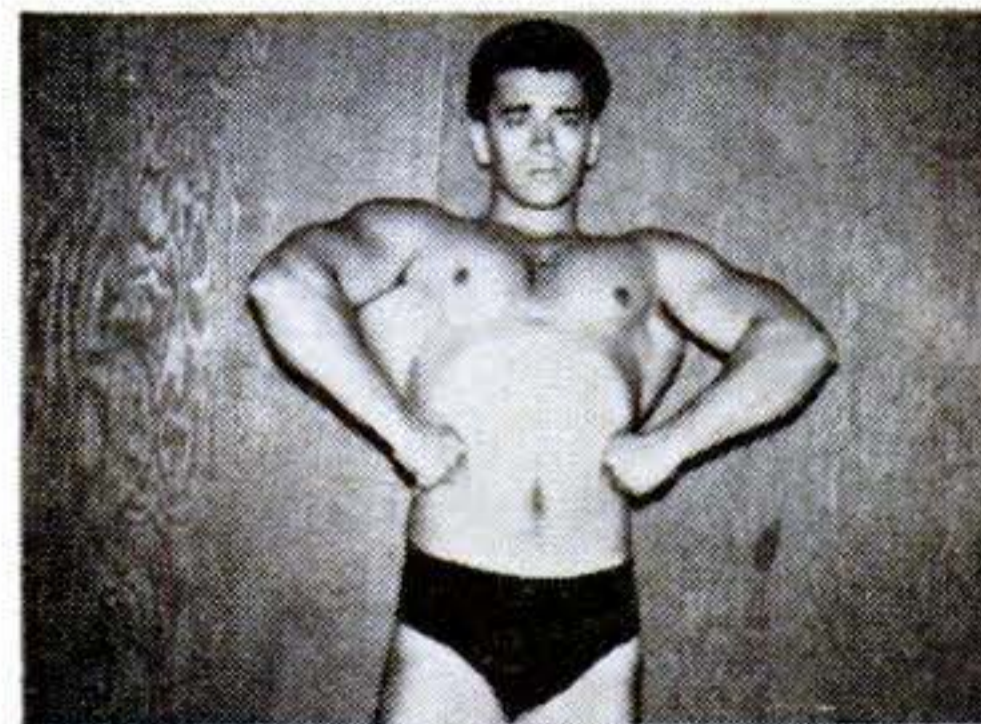
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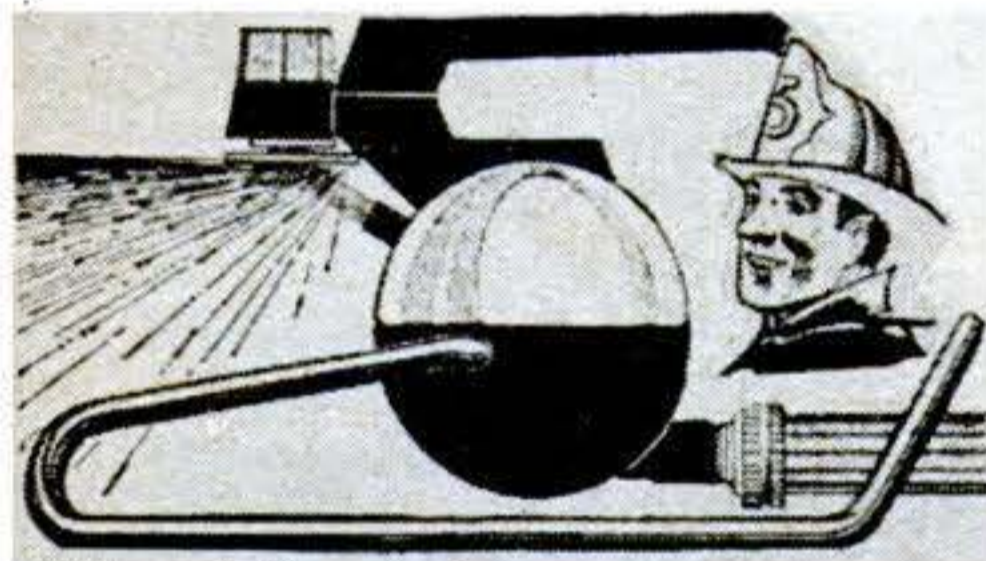
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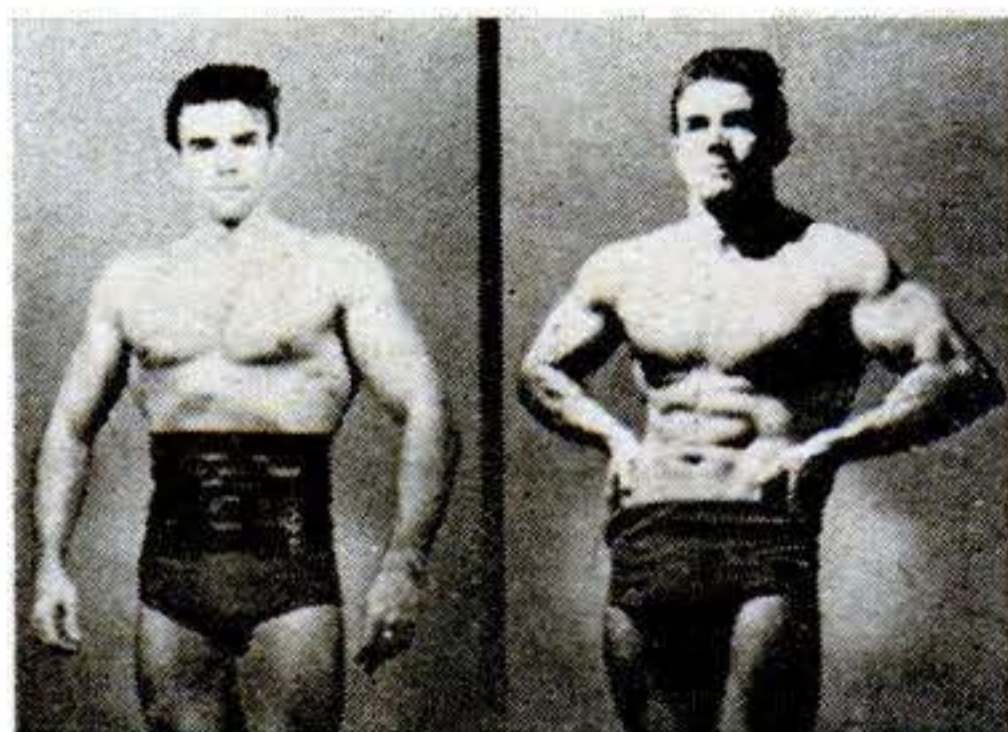
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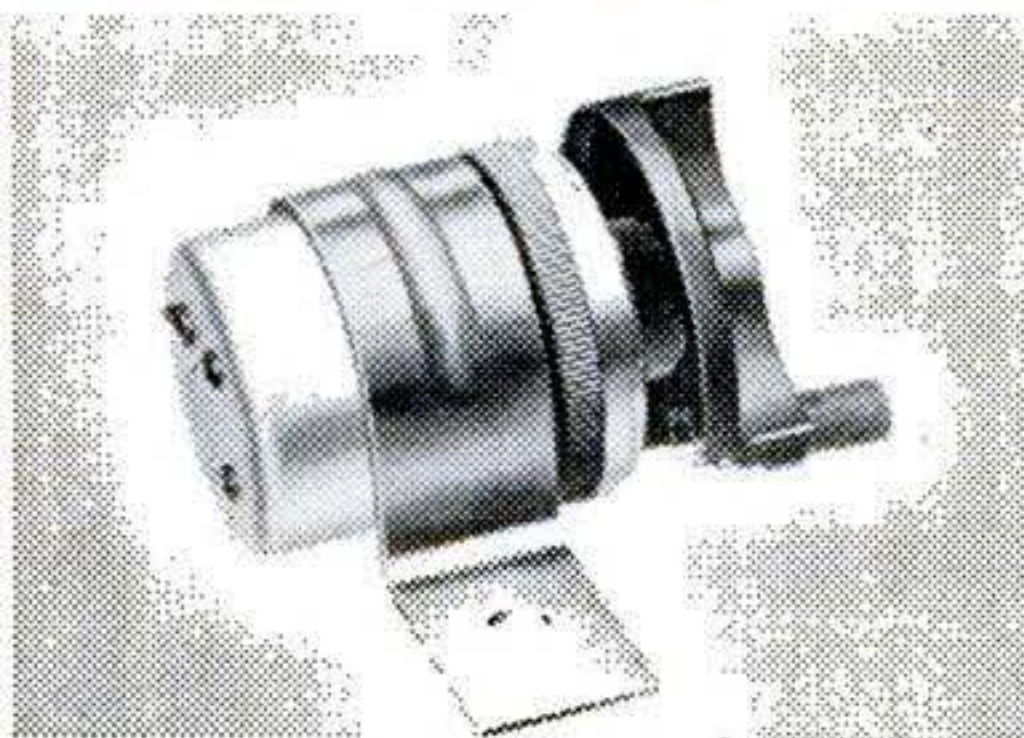


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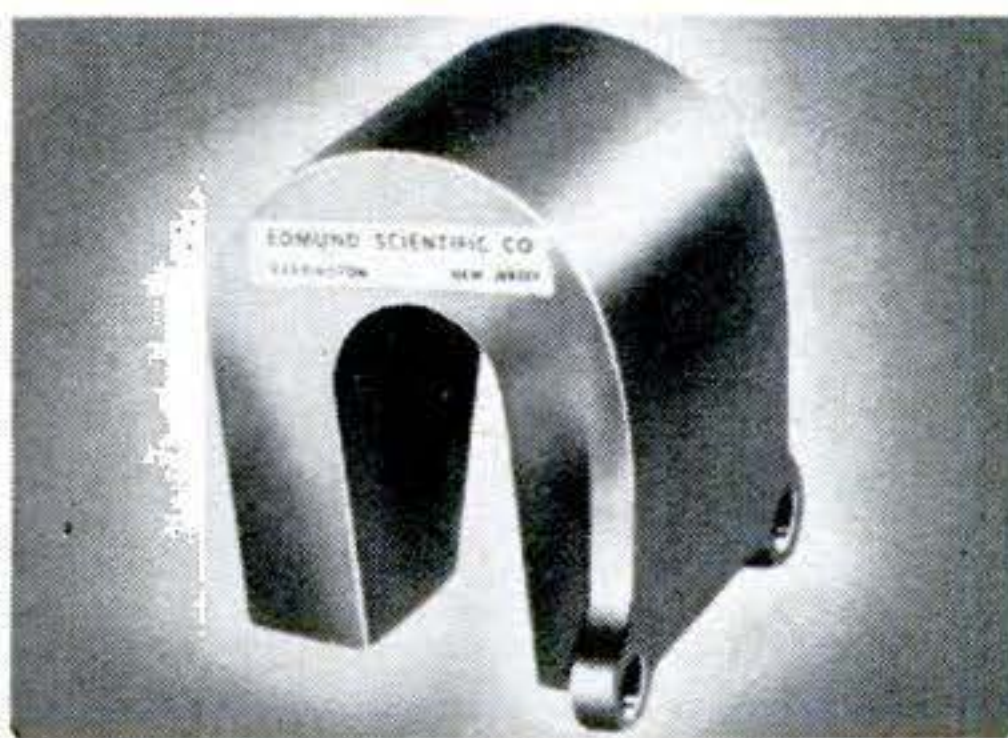
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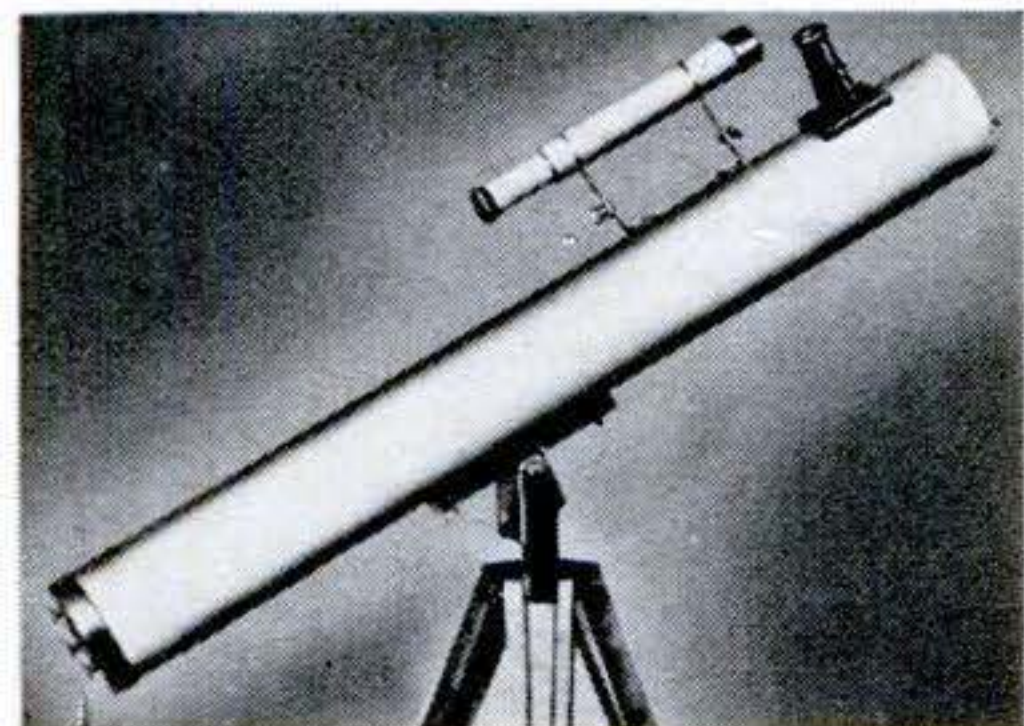
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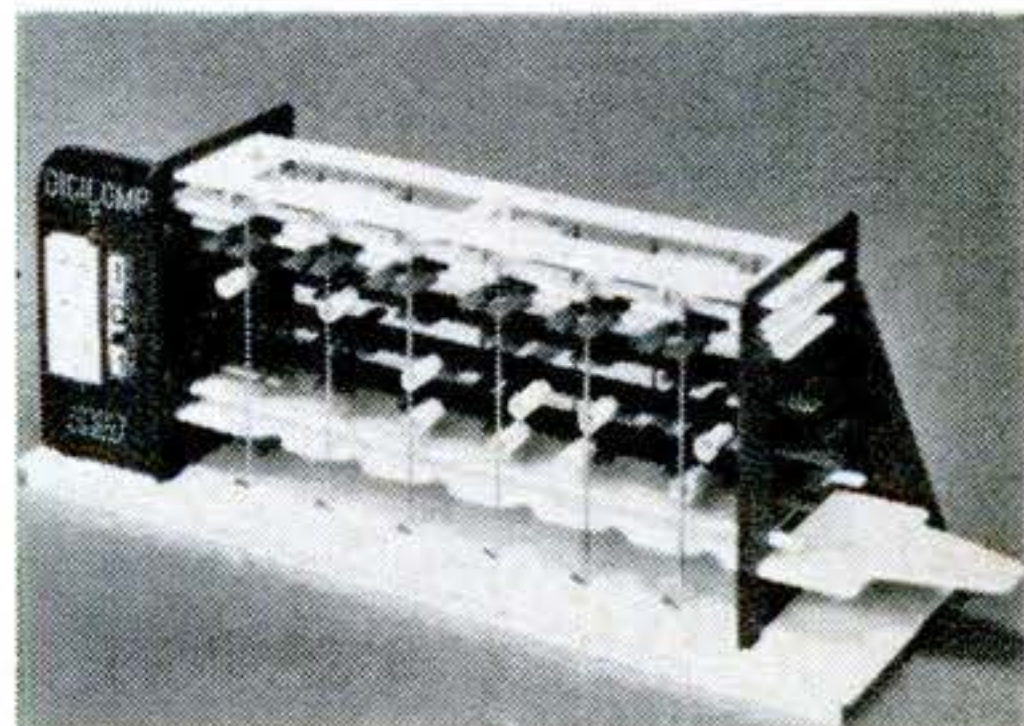
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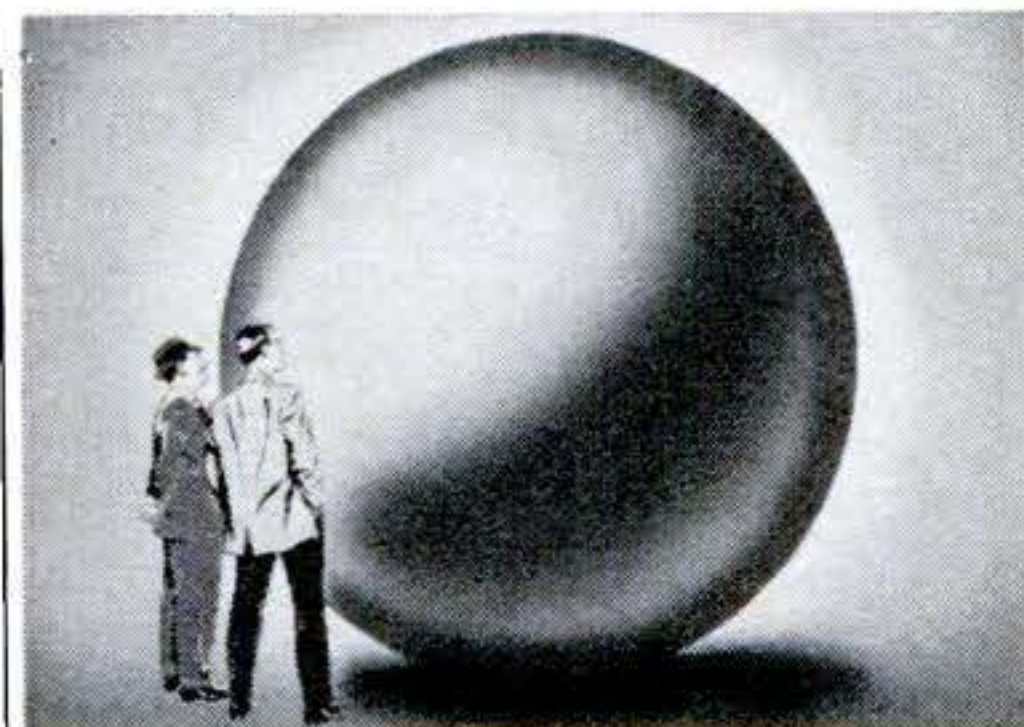
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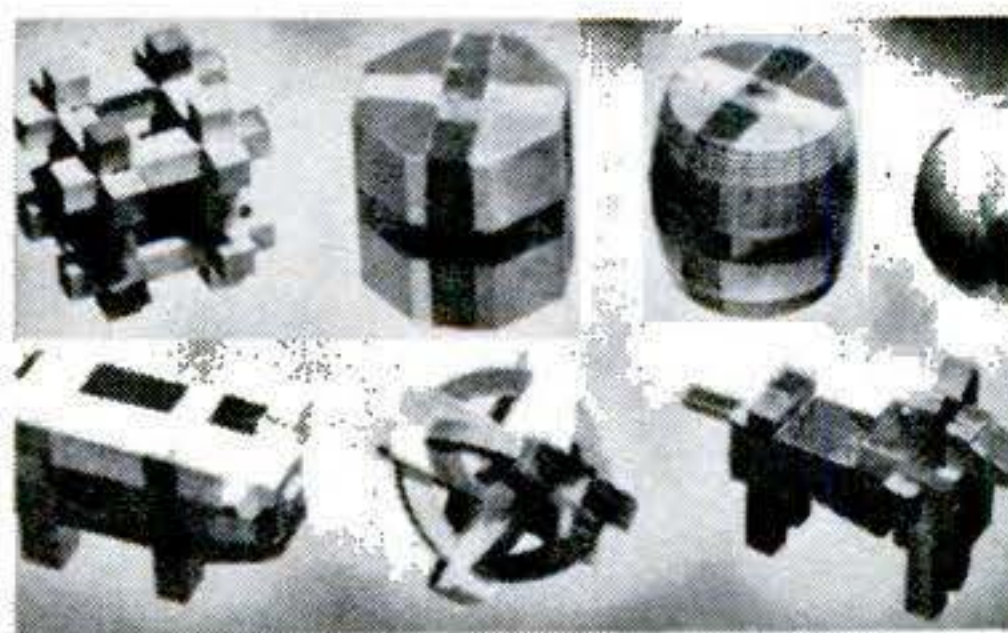
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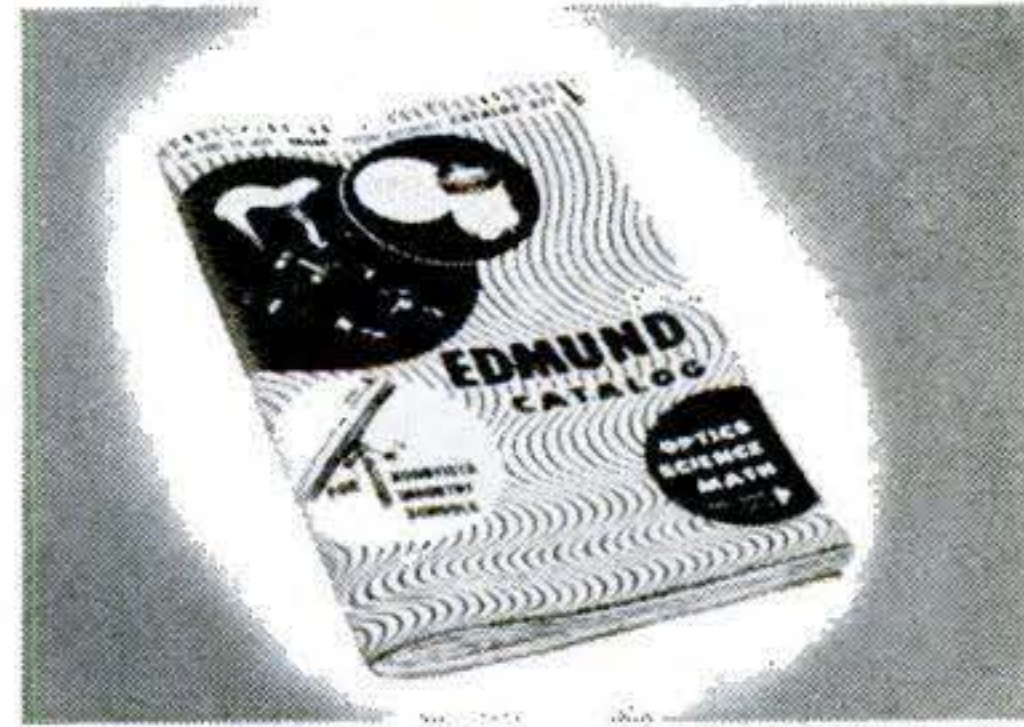
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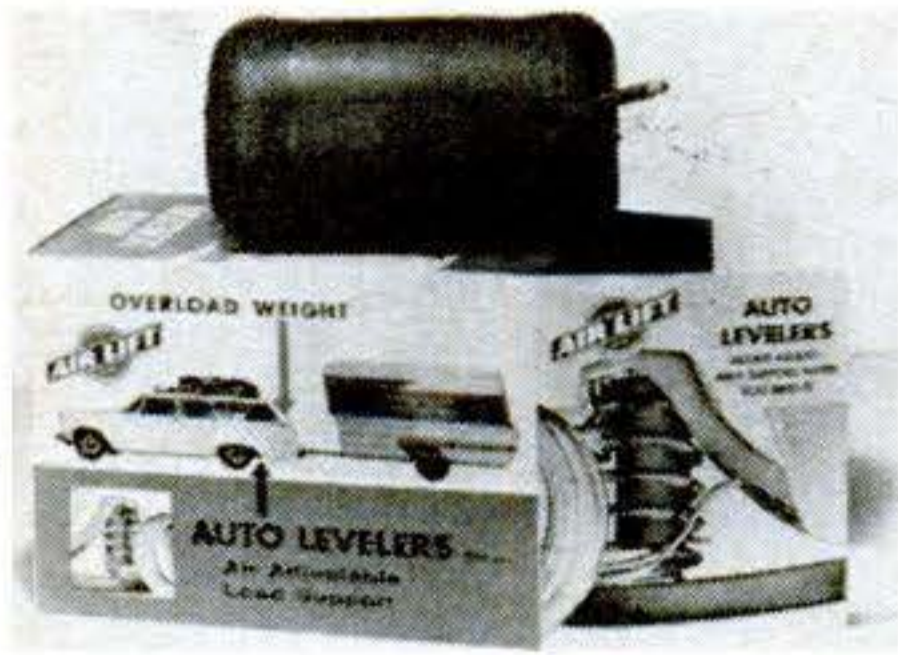
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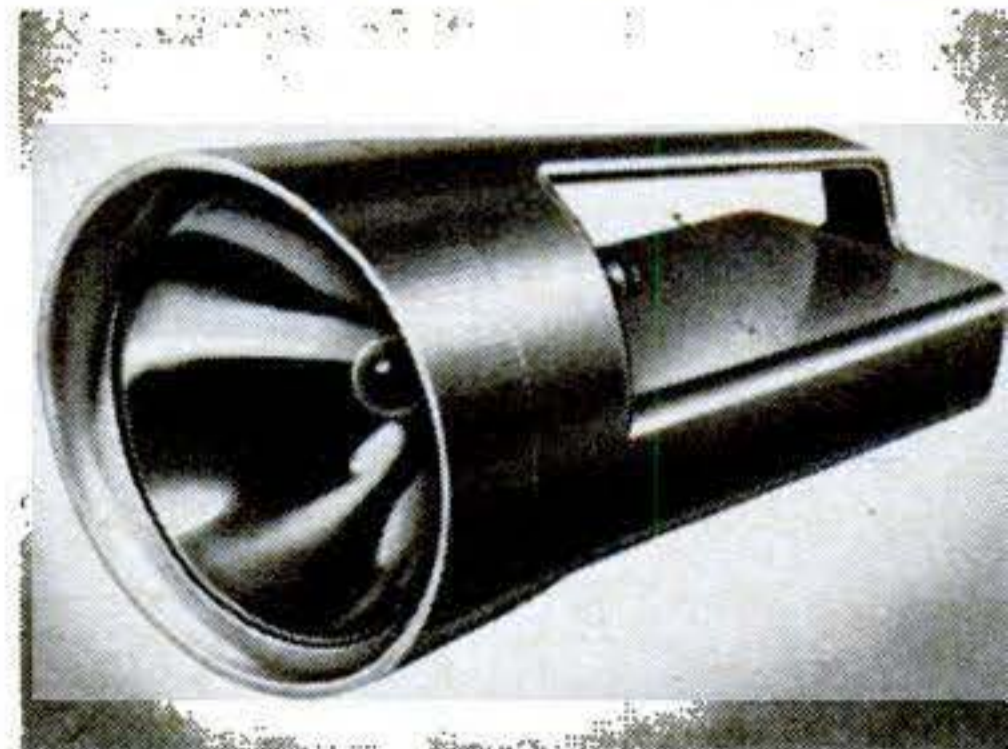
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Genuinely emblazoned from old records filed under 100,000 British & European surnames. In relief and full colour on immaculate Oak Wall Shields for mural decoration. 12"x10" . . . \$20.00; 14"x12" . . . \$28.00; 22"x18" . . . \$42.00; postpaid. Your check is returned if the Arms cannot be traced. School, Ship, Regimental Shields, Trade Marks, etc., similarly reproduced. Write Britain direct. York Insignia Ltd., Dept. PS-6, York, England.



### 80,000 CANDLEPOWER BEAM LIGHTS

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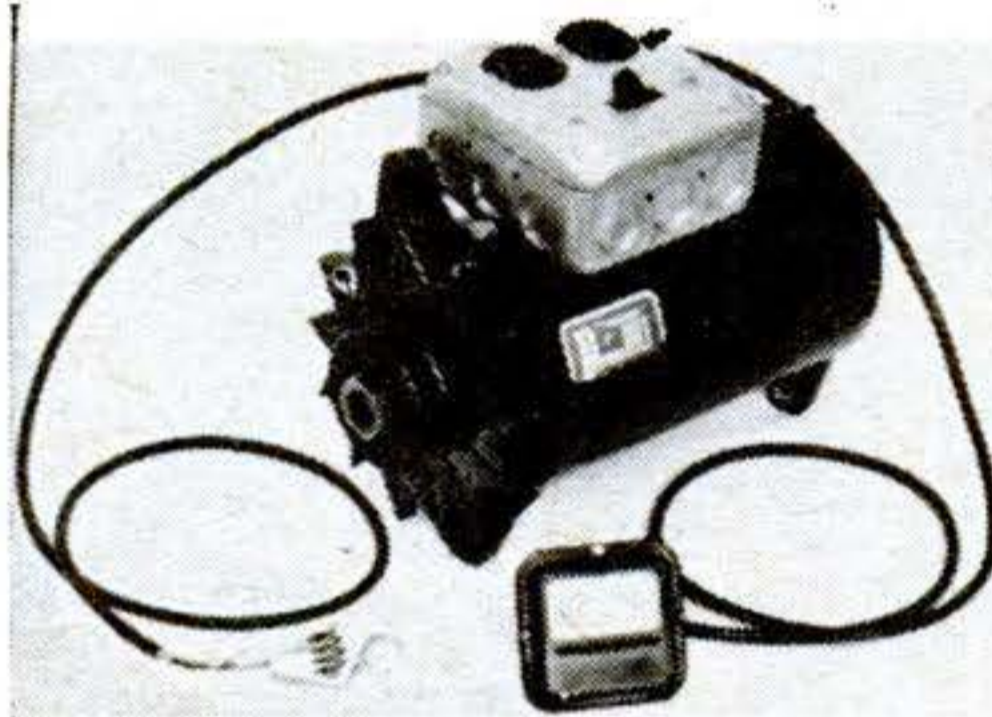


**Exclusive U.S. Patent**

**invisible  
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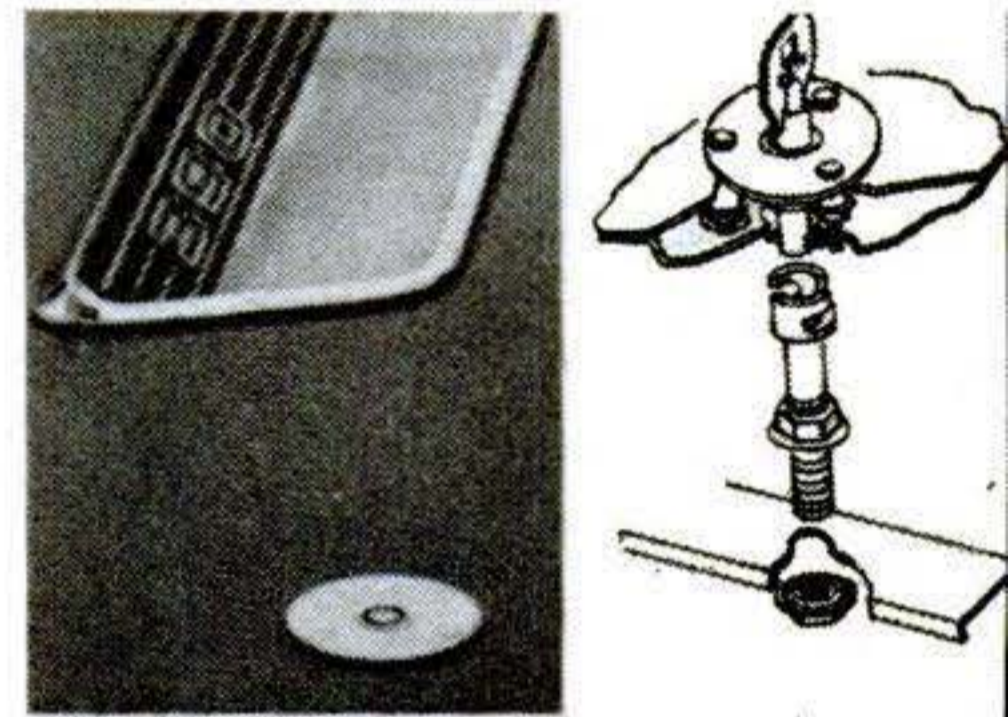
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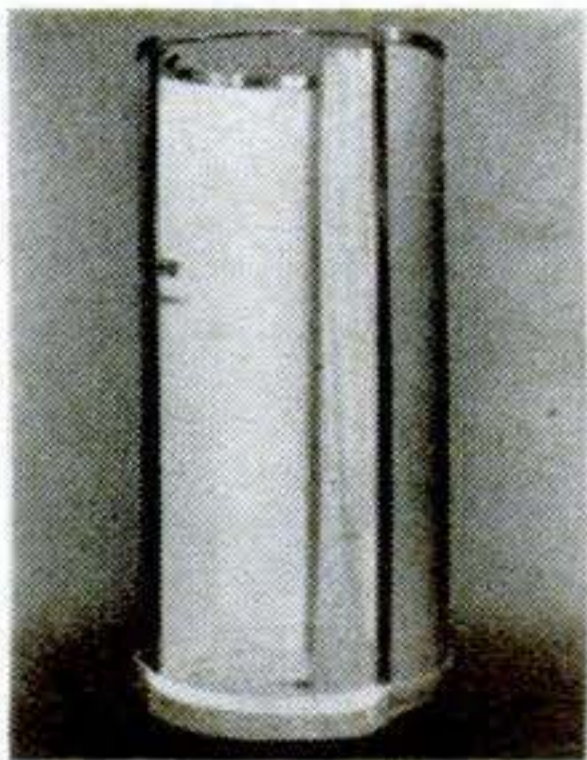
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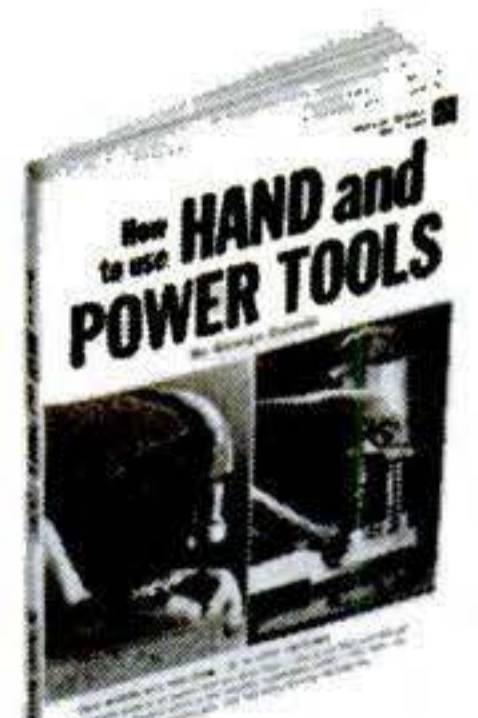
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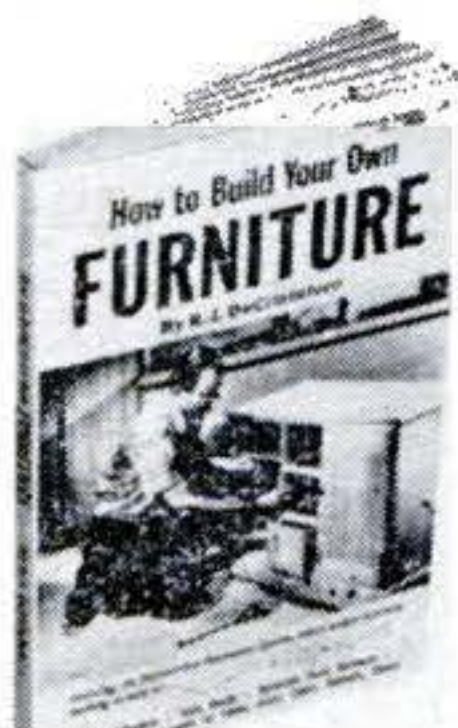
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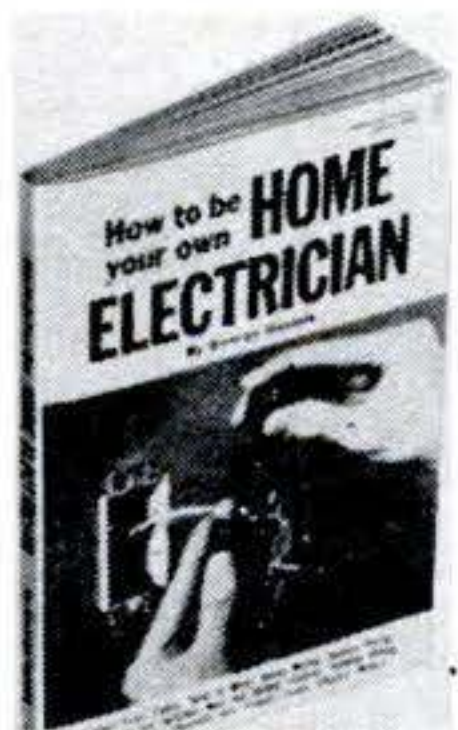
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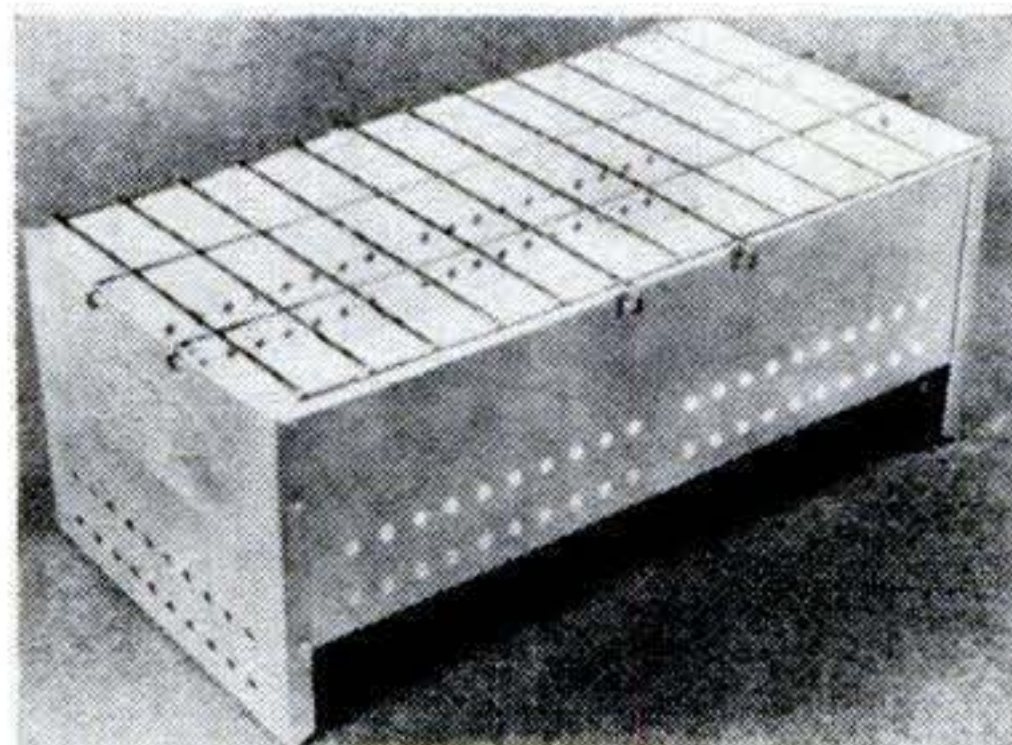
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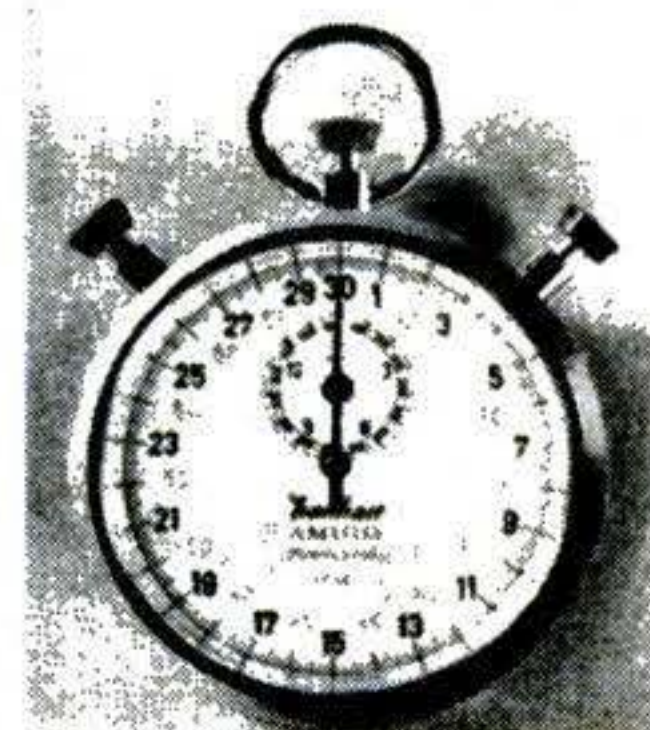
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Now you can have delicious charcoal-broiled steaks, hamburgers, frankfurters wherever you go with the low-priced "Camp Mate" Portable Charcoal Grill. It's easy to handle, easy to clean, sets up in a jiffy. Ideal for patio cookouts, picnics, hikers, campers, hunters, fishermen, travelers. Made of Bright Tin Plated Steel, measures 12 1/2" x 6 1/2" x 1" (Flat 16 oz.) Only \$3.95 ppd. U.S.A. Order from Mel-Aire Co., P. O. Box 51, McKeesport, Pa. 15132.



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Always wanted a stopwatch? Here's a fine 10th-second stopwatch at a low, low price you can afford. Antimagnetic, shock-resistant, unbreakable main spring & crystal. Large, easy-to-read dial, chromed case, easy grip edge. 3 buttons, stop-start-return. 15 minute movement. From W. Germany. Accurate, sturdy. For sports, science, industry. Only \$14.95 ppd. SATISFACTION GUARANTEED. Calif. add 4%. The Vincent Co., Dept. 10, P.O. Box 4549, Whittier, Calif. 90607.

# Detroit Report...

**FORD WILL SPEND MORE ON DEVELOPING NEW MODELS AND TOOLING** in the coming three years than ever before. For 1970, the Fairlane and Comet lines will change from unit body to separate frame, and the '70 Falcon will have the same basic body as the Fairlane. Lincoln Continental will go to separate frame and body in 1969, and a smaller Lincoln is also in the works. Mercury is planning a bigger car to compete with Olds 98 and Buick Electra 225.

**A completely restyled Mustang** is in the works for 1969—a year earlier than expected. Each body usually has a production run of three years, but Ford is planning to cut it to two years. The next Mustang will probably continue with a unit body through the 1970 models, and may get its own version of the Fairlane frame in 1971.

**An overhead-camshaft Corvair engine?** While Chevrolet says there will be a 1968 Corvair, the division is losing money on making the rear-engine, air-cooled car, and its future is uncertain. If the Corvair continues, it may get a detuned version of the Astro I engine shown in Chevrolet's latest "dream car." It's the same flat-six block with a belt-driven overhead camshaft on each bank. Output is 220 hp.

**Will overdrive come back?** Borg-Warner is developing an overdrive unit especially for automatic transmissions. The industry may be cool to the idea, however, because cars with axle ratios like 2.41:1 or even 2.28:1 can be regarded as running in permanent overdrive, while the transmission copes with all shifting duties.

**Watch for microcircuitry in new cars.** A voltage regulator with a miniature electronic circuit will appear in the '68 Lincoln, Mercury, and Thunderbird, and will be made standard on all 1969 Ford cars. GM and Chrysler are expected to have similar regulators by 1969. By 1970, experts say, new cars will have as many as 20 microcircuits. These low-cost, low-bulk electronic devices can work as inside-temperature controls; sound-volume controls for radio and tape players; fuel, oil, and water warnings; moisture sensors; and speed-limit controls.

**Car thieves will have it harder** next year. All '68 models from General Motors will have a buzzer to warn the driver when he leaves his keys in the ignition. This is the second step GM is taking to make cars theftproof. Last year the corporation quietly doubled the number of different key shapes that will work in its car locks.

**Radial-ply tires** will boom in popularity on 1968 models, but don't look for these long-tread-life designs to be standard equipment just yet. When suspensions are tuned to radial-ply tires, they'll be used in great numbers. Next on the tire horizon: the wide-oval radial-ply. Tire companies are working hard to develop this hybrid, which promises to deliver the best characteristics of both wide-oval and radial-ply designs. When it becomes available, you can throw away your snow tires. Road grip in its wide footprint will be about equal to snow-tire traction.

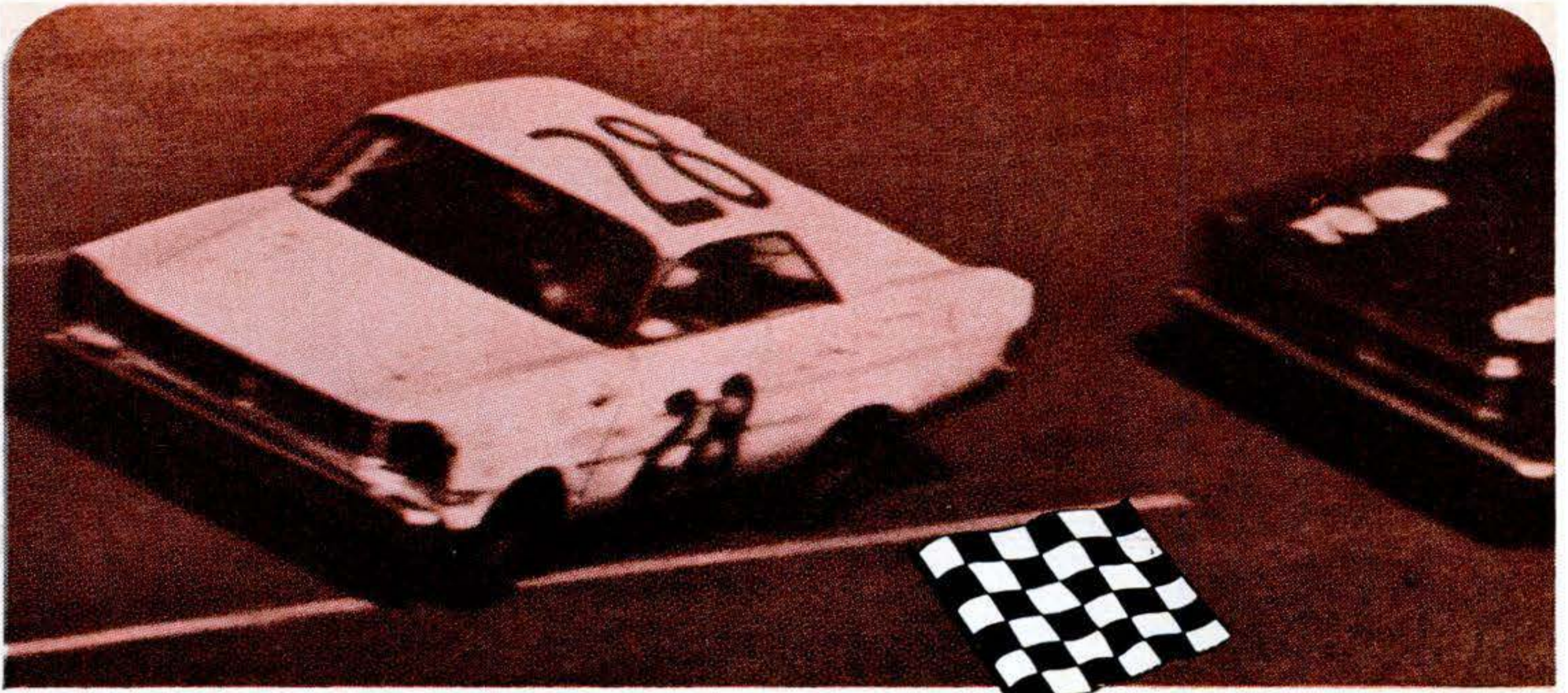
**Will the spare tire go?** Not in the near future, though new safety tires are on the way. Good-year is working on a tire that collapses to form a hard rubber rim when it goes flat. The idea is to provide rolling power until you can reach a service station. Uniroyal will also announce a hazardproof premium tire. Steel cords under the tread give the tire its puncture-resistant strength. It won't go flat when it hits road hazards like rocks, bottles, or other road debris.

**Ford's electric will go into production** only when it is fully competitive with the piston-engine car. Also, says Ford's vice-president of scientific research, in 10 years the electric vehicle will be far superior to anything that can be custom-built today. In the meantime, the piston engine will be improved and its pollutant emissions cut to practically nothing. The electric car must then stand on its own—it cannot be sold simply because of its air-pollution benefits.

**New VW shapes** may be on the way. The beetle is still selling well, but the factory is looking ahead. Volkswagen has signed a contract with Pininfarina, in Italy, for styling and engineering of new bodies. The new models may have more power, too.



Detroit Editor



**EVERY MAJOR USAC AND  
NASCAR WINNER IN '66  
USED *PERFECT CIRCLE*  
VALVE SEALS**



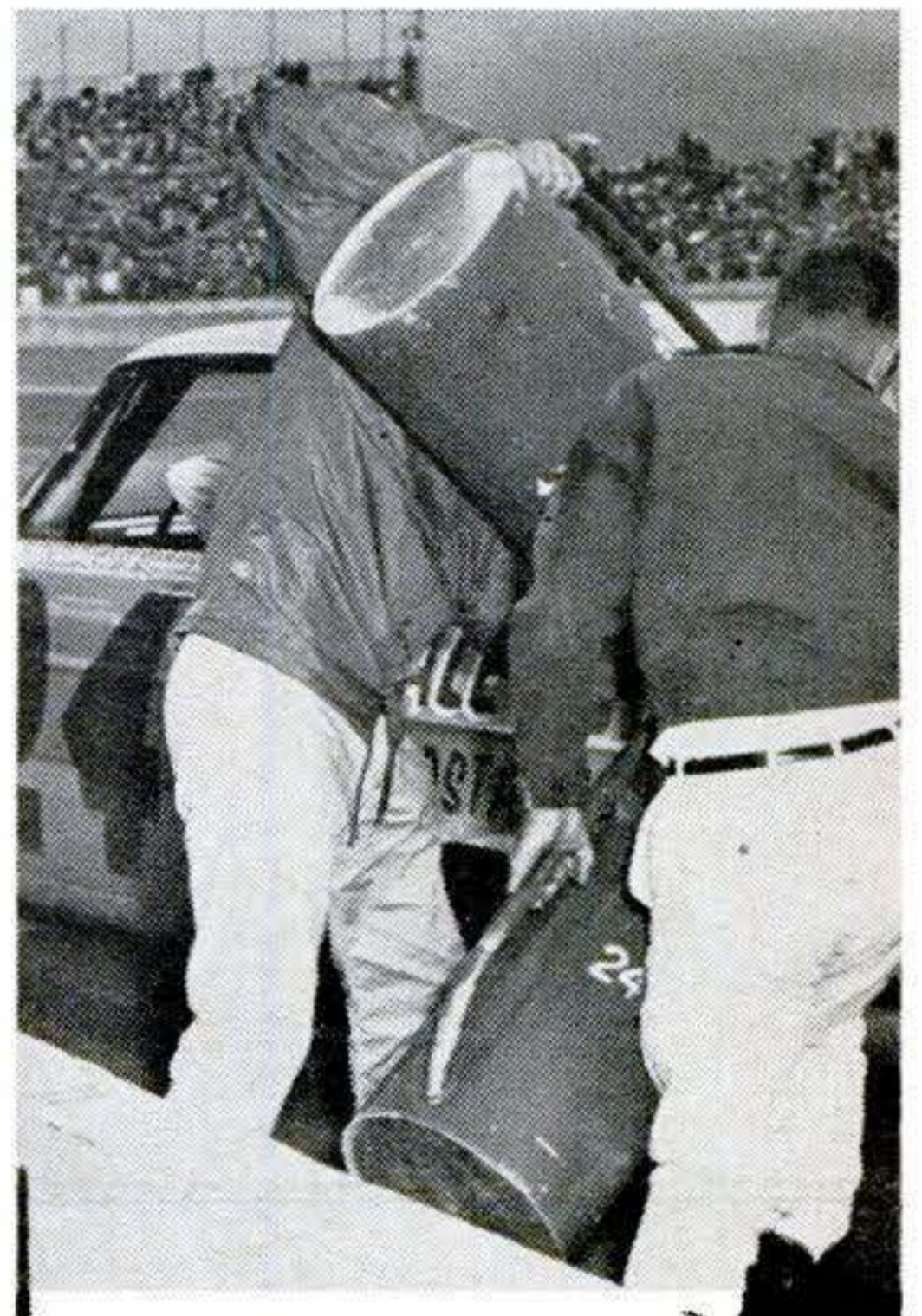
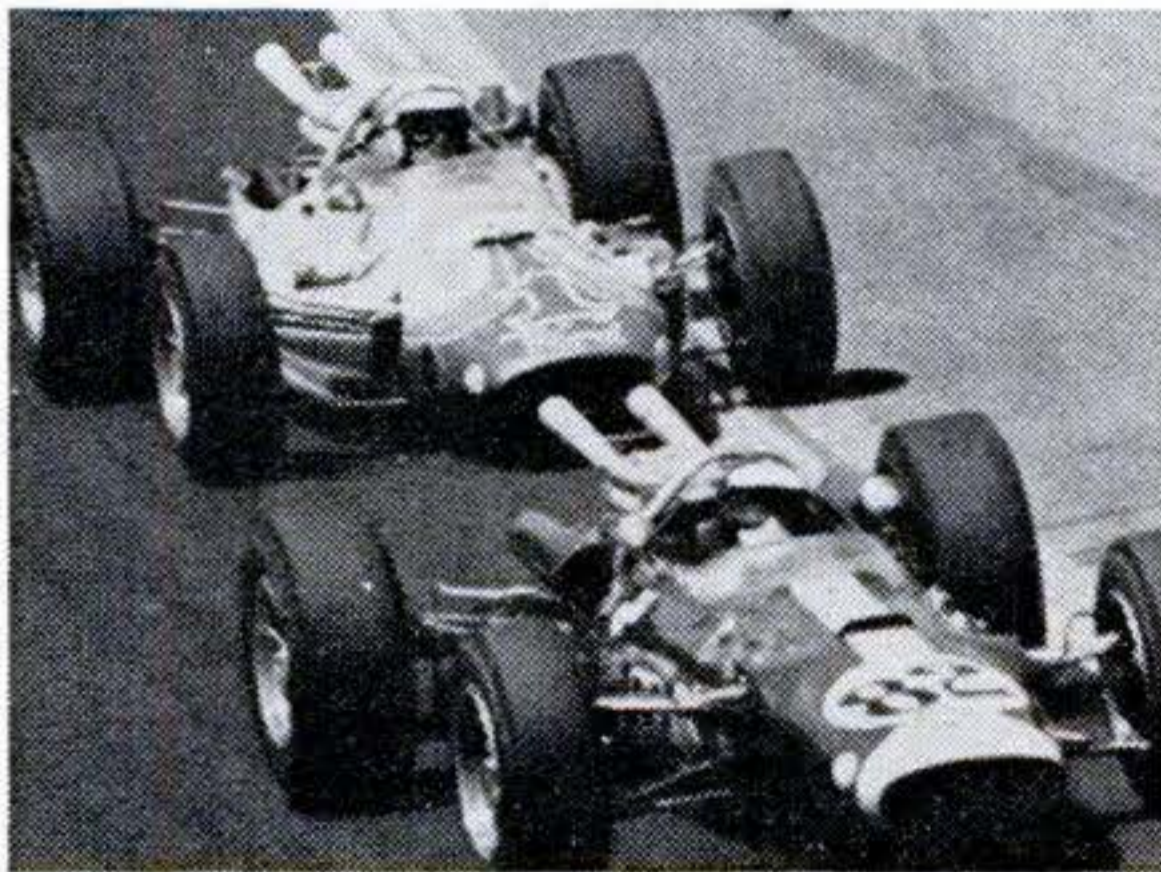
The results are in... and they prove conclusively that racing engines equipped with Perfect Circle Valve Seals have a way of crossing the finish line first. Racing drivers know that PC Valve Seals prevent performance-cutting oil loss through valve guides,

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Put one of our new V-8's in some fast-moving traffic. Acceleration on any road (flat or steep) is what these engines are built for. Both GMC V-8's are surprisingly light and compact. Yet they develop either 175 or 220 horsepower.

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or play. So we offer V-8's for sprightly  
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sands of miles of durability. And we have  
a-line that makes any job a low budget  
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as smooth as the family car. Call your GMC  
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The Truck and Coach Division of General Motors

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JUNE 1967 | 49

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Classic not only shines, but protects your car's finish like no other. Because it's loaded with carnauba wax, the hardest, most expensive wax known. Classic rubs on and dusts off effortlessly. The ingredients do the work, not you. Does a whole car — a big one — in less than an hour. Waxes right in the sun without streaking. And the protection lasts longer than any other wax. 1 lb. 2 oz. tin is \$5, good for *at least* 6 full wax jobs. Try it. If you don't think it's worth it, return the rest and you'll get your money back.

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PICTURE NEWS



### Ancient Rolls set for "retirement"

These mechanics are preparing a 36-year-old Rolls-Royce for a seven-year retirement at a Hereford, England, garage. The owner, W. H. Whitehead, is putting the Rolls in dead storage while out of England on business. The car is being packed into a specially made box after treatment of the body and engine with a special preservative. Every 10 days, the engine will be turned over. The cost for seven years' storage is, \$1,500 — the current value of the car.



### Louvers aid tunnel driver's vision

These louvers are installed at the entrance to a tunnel under the Mersey River that connects Liverpool and Birkenhead, England. Gradually reducing and increasing light intensity, they prepare drivers for entering and leaving the tunnel. The louvers are 49 ft wide and cover all four lanes.



## Homogenized Spred® House Paint is so easy... you can't call it "painting" anymore

"Spreading?" "Coating?" "Latexing?" There must be a better word for painting, now that there's a better paint:

**GLIDDEN SPRED HOUSE PAINT.**

Made with latex to take so much work, worry, time and mess out of painting.

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So why go on using precious spare time for house painting? New Spred House Paint is made for starts and stops. It dries so fast you don't worry about rain, dust or bugs. You cover wood, masonry and previously primed metal without switching paint. Cleanup is quick and easy.

You've already used Spred House Paint? And you still call it "painting?"

O.K. But isn't it the easiest painting ever?



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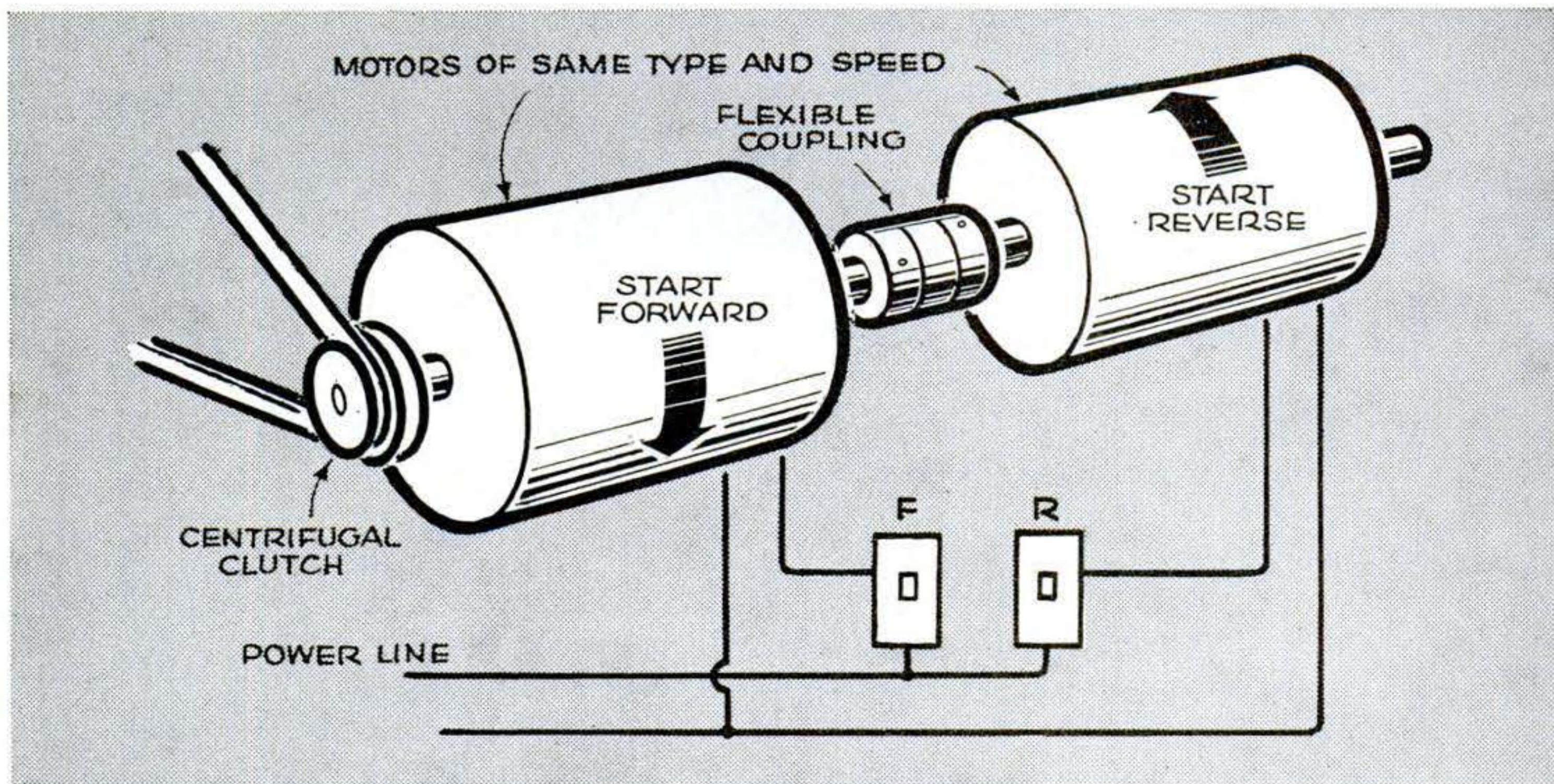
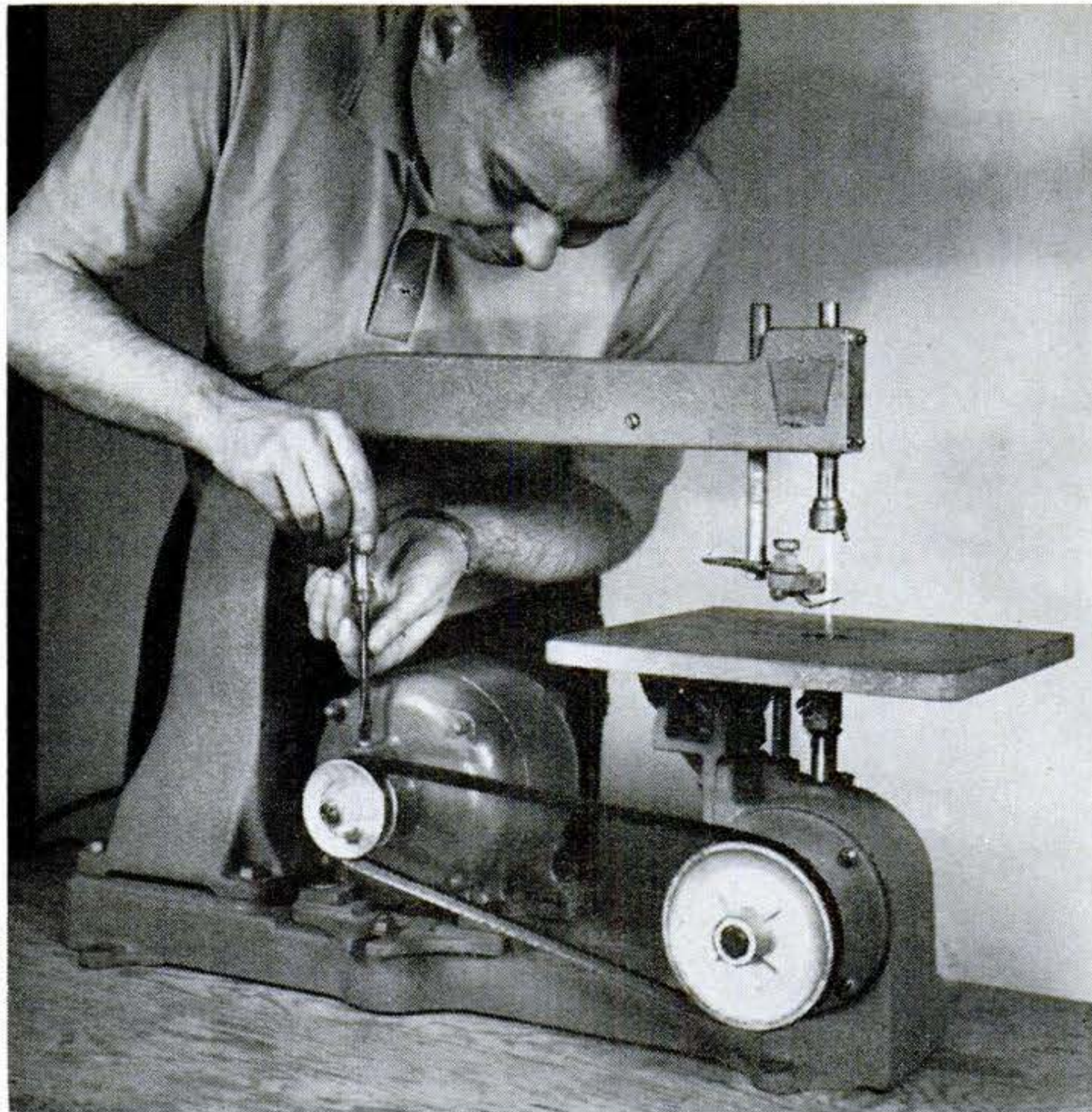
The Glidden Company • Cleveland, Ohio 44115

In Canada: The Glidden Company, Ltd.

### Get extra use from your old motors

This ½-hp. 1,725-r.p.m. motor, salvaged from a 35-year-old belt-driven oil burner has plenty of oomph to run a jigsaw. The original long shaft was cut off. The casing was cleaned and repainted, and bearing oilholes closed off with machine screws to keep out grit. Slotted motor-mounting castings on the saw allow aligning and tightening of the V belt.

J. BURROUGHS  
Tacoma, Wash.



### Motors hooked in tandem will deliver doubled power

Two electric motors of the same kind and speed can be connected to do the work of a bigger one. If one motor has a double-ended shaft they can be connected as shown. If not, they can be mounted with separate belts running on identical pulleys.

The simplest setup is one with both motors running in the same direction, a single switch controlling both motors.

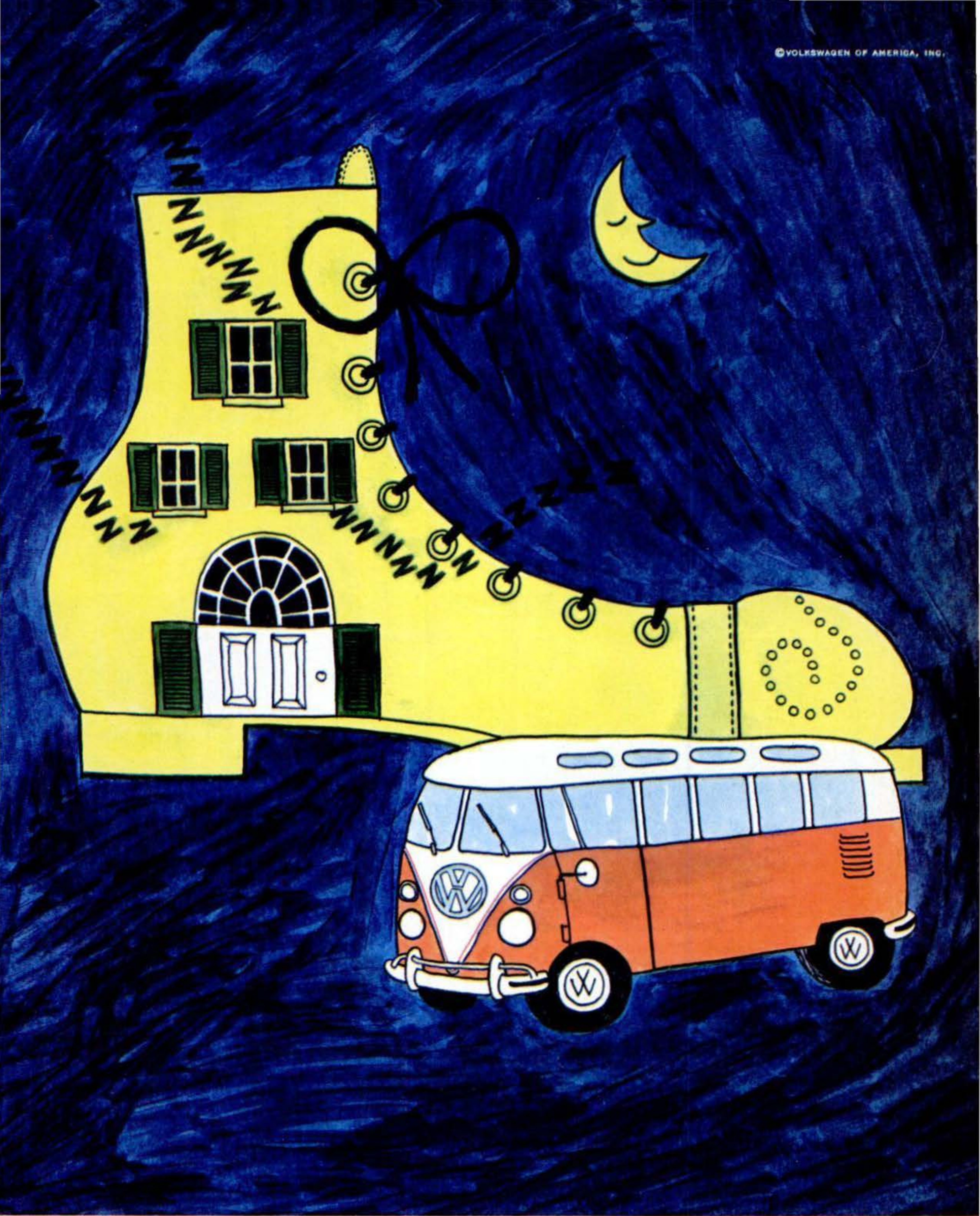
For reversible tandem drive without complicated wiring, install one motor to run against the other, and connect each to a separate switch

as shown above. Turn on one motor that runs in the desired direction, wait till it brings itself and its mate up to speed, and switch on the second. To stop, switch off both motors at once.

A split-phase motor will operate whichever way it is started. Don't switch the second motor on too soon, though, or you will ruin both motors or blow a fuse.

Whichever setup you use, if the starting load is heavy, use a clutch to protect the motors from burning out.

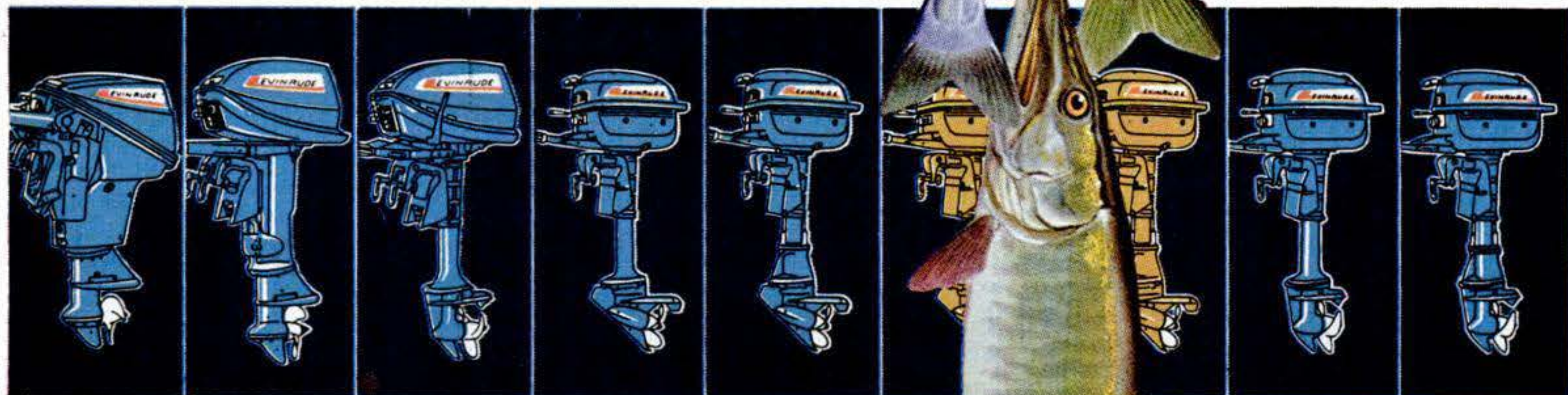
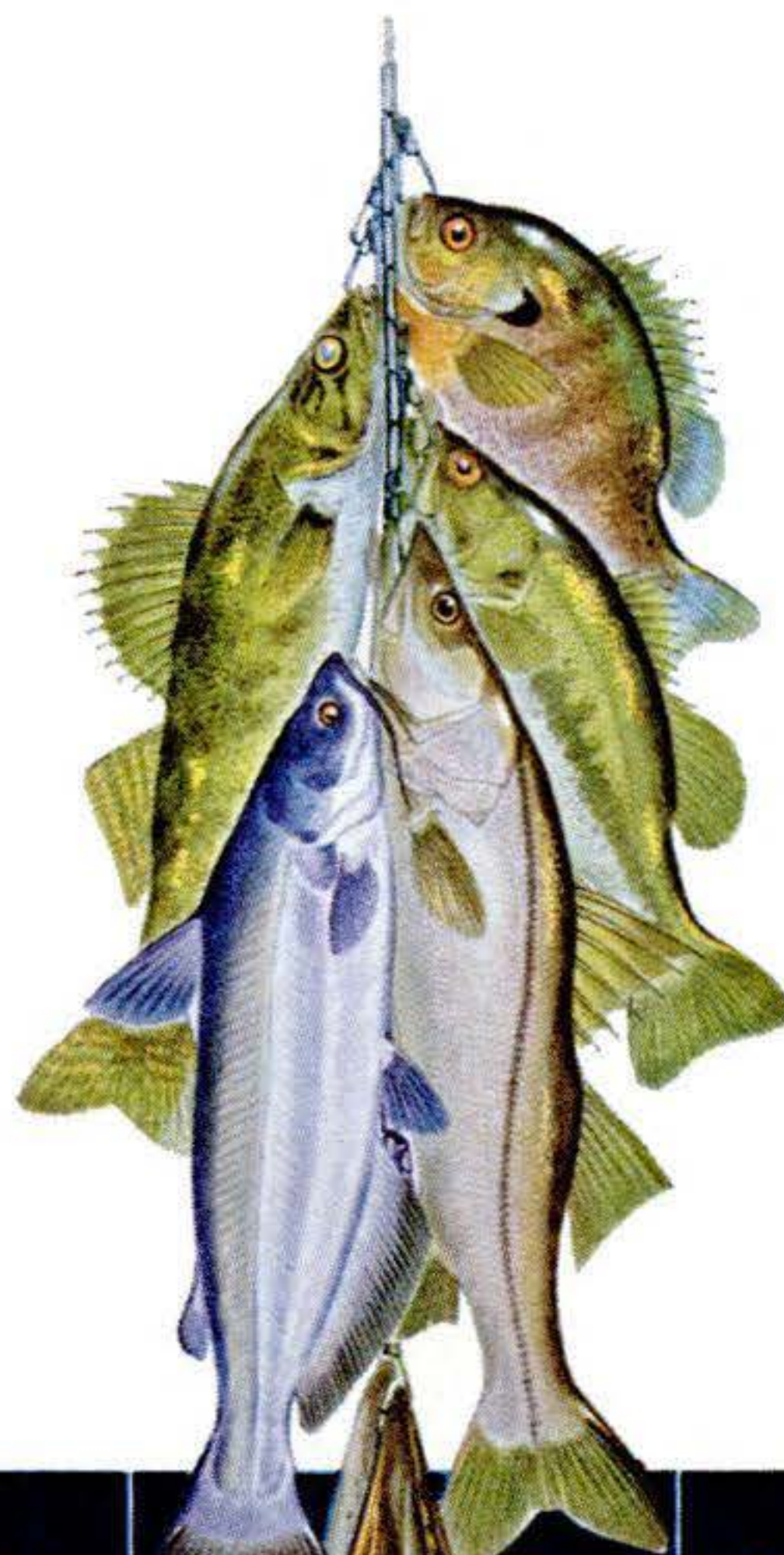
HARRY WALTON, White Plains, N.Y.



The ol' lady finally figured out what to do.  
A Volkswagen not only holds about twice as much as other station wagons,  
but it's economical to keep up, too.  
(And the people in the hat next door thought she was crazy.)



# why does Evinrude build more fishing motors than anyone else?



Because we've been building fishing motors longer than anyone else.

And over the years, we've learned that the motor that fills the stringer for a Kentucky bass fisherman isn't always the answer for the man who goes for Mississippi River catfish, or Minnesota walleye, or Wisconsin muskellunge, or Florida snook, or Georgia bream.

So we build the motor to fit the fisherman — instead of trying to do it the other way around. We build more sizes and types of fishing motors than anyone else.

*Deluxe motors* like the 6 hp Fisherman — a compact twin that's as finely balanced and beautifully machined as a jeweled watch — and almost as quiet. With full gearshift and every deluxe feature.

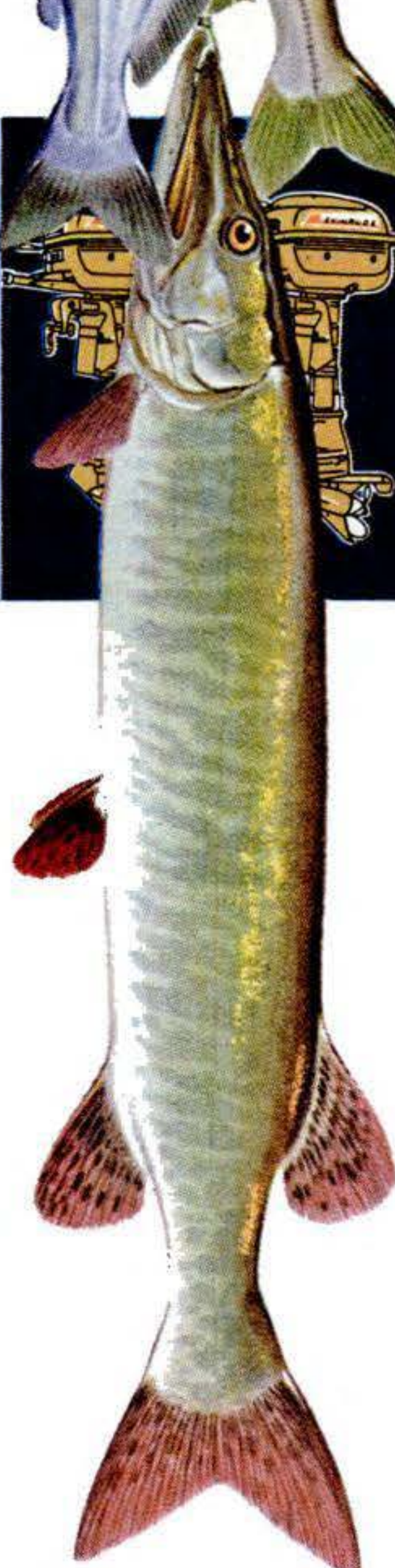
*Budget-priced motors* like the 5 hp Angler — a high thrust lightweight twin that's short on frills — but long on smoothness and quiet and precision-engineered performance.

*Go-anywhere motors* like our 3 hp twins that come in weedless (Lightwin) and high-thrust (Yachtwin) versions — in folding and conventional models — and in specially camouflaged hunting models (Ducktwin).

*Low-silhouette motors* like our sporty little 9½ hp Sportwin — most popular fishing motor ever built — now even smoother and quieter for 1967.

In the under-10 horsepower range alone — there are 9 Evinrude motors to choose from.

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first in  outboards  
Div. of Outboard Marine Corp.



### New color TV system for planes

This passenger is watching a movie on an Astrocolor screen—part of a new color-movie projection system designed for airplane viewing. Bell & Howell's Astrocolor, in use by American Airlines, permits projection of an extremely sharp image with brilliant colors by having the film make a circuit of the cabin. The film travels through a separate projector for each of the 14 screens in the plane. A movie starts at the first screen five minutes before it hits the last.



### Road roof is a bomb shelter for cars

German highway engineers built this steel roof to protect traffic from possible shrapnel hits. A U.S. Army firing range is located near the Bamberg, West Germany, road, so authorities took the precaution of building the roof to catch any stray shell splinters. The cover also keeps snow off the road in winter.



## GIANT KILLER

Enjoy the delicious flavor of Green Giant brand products, then save the cans for target shooting with America's newest, most exciting fun gun... Crosman's Powermaster 760 BB repeater rifle! A "giant killer" with power to spare! Unique, easy, short-stroke pump action! Two quick pumps for accurate indoor shooting; a few more easy pumps pack a sizzling muzzle velocity of over 500 ft. per second! Holds 180 Crosman Super BBs! Also shoots .177 cal. Super Pells,<sup>®</sup> single shot! Positive cross bolt safety! Visual loading magazine! Lifetime solid steel barrel, genuine hard wood stock, gold-tone trigger, adjustable sights! See this great new gun today at your Crosman dealer! About \$19.95.

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**Crosman/Going Great Guns**

Crosman Arms Co., Inc., Fairport, N. Y.  
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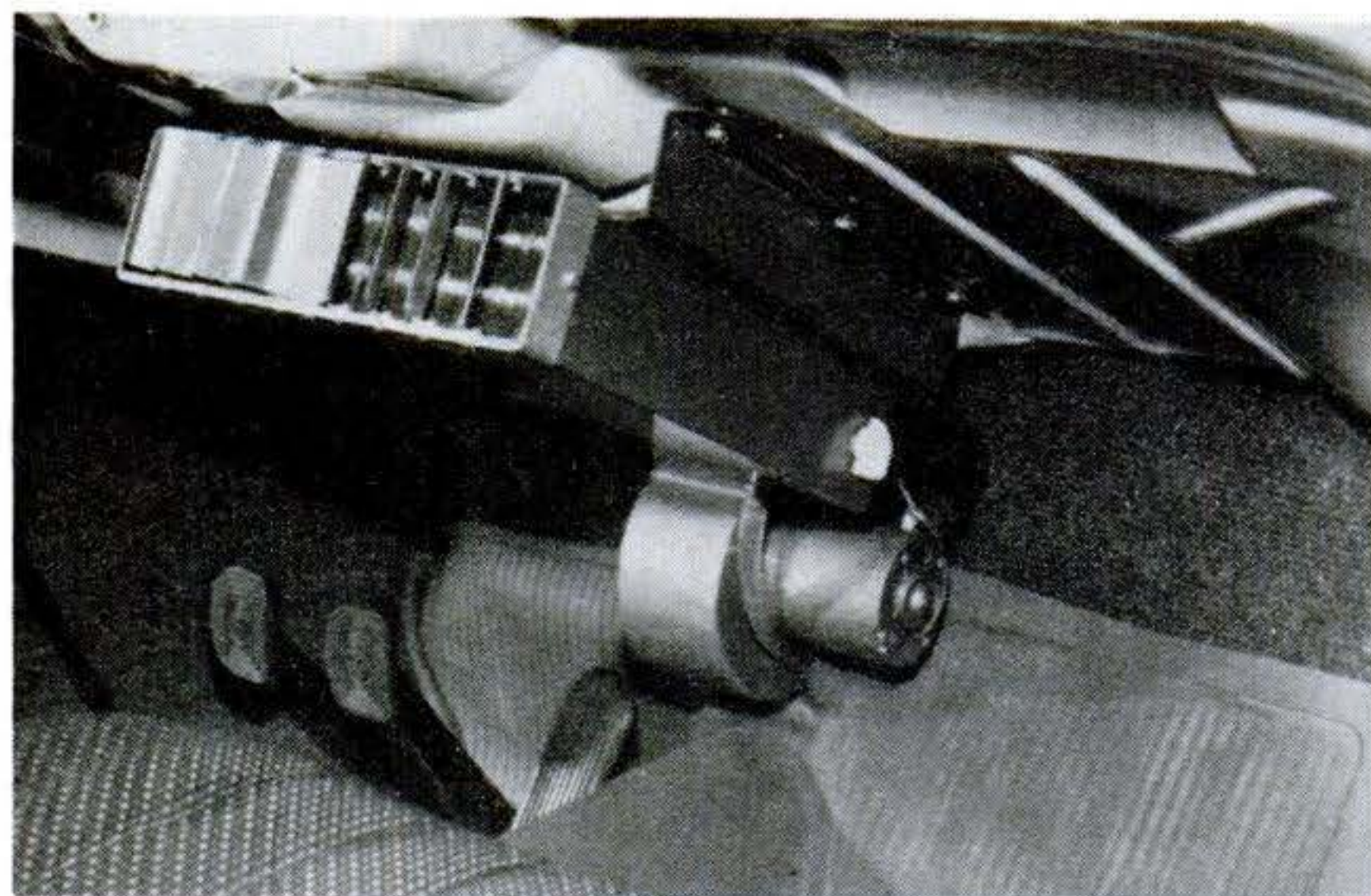
WHAT'S NEW

FOR YOUR CAR



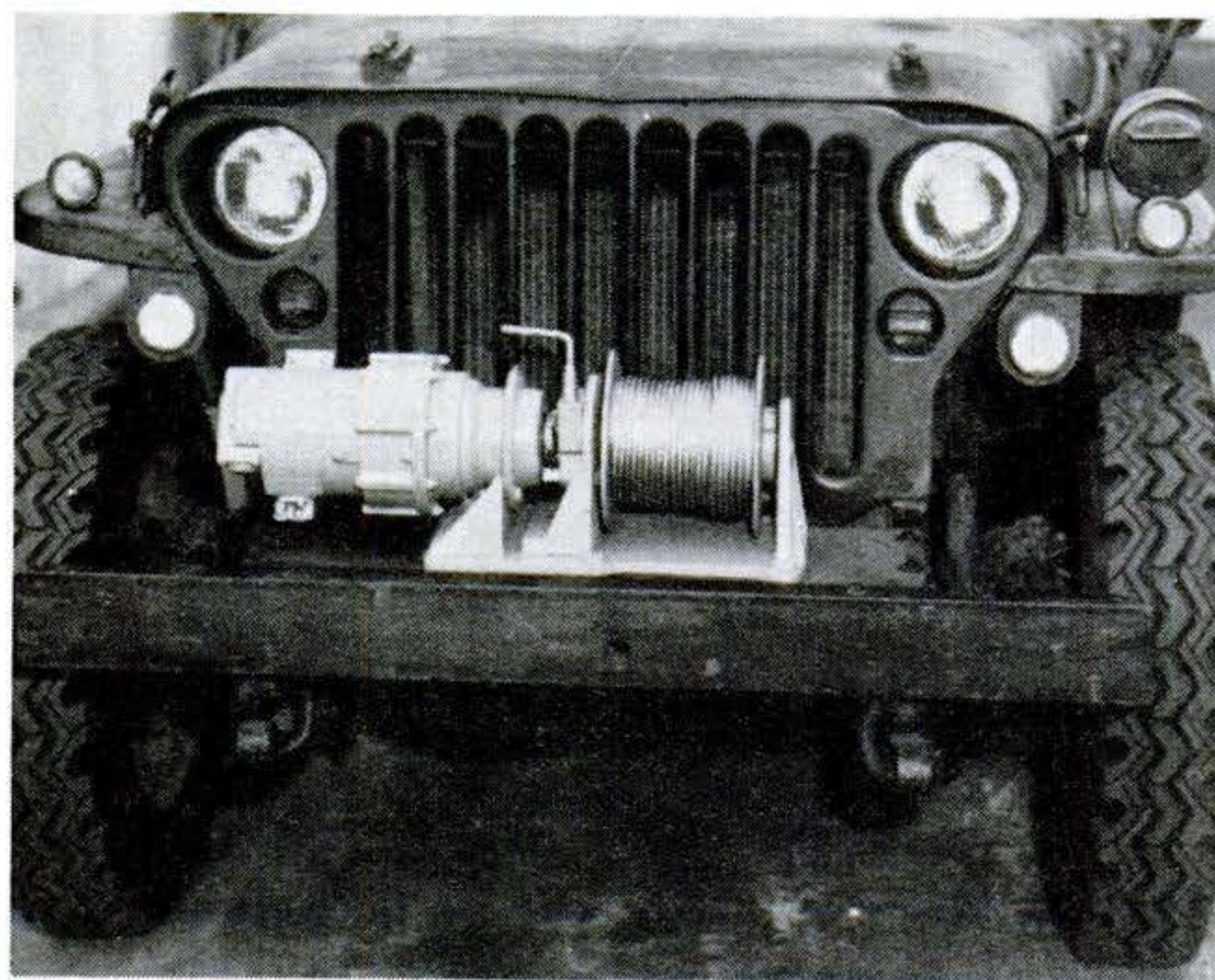
### New Sears tire has reflective whitewall for safety

Fifteen million mirror-like beads, each .002 inch in diameter, are imbedded in the two sidewall bands of this Sears, Roebuck Safety Knight tire. Result: The whitewalls show up in the light beams of other cars more than 1,000 feet away under the darkest road conditions. Sears, the first company to offer such tires, designed them to meet objectives set by the National Traffic Safety Act, which will recommend side reflectors or side illumination on all cars for the 1968 model year. Prices for the tires range from \$30 to \$39, depending on size.



### Air conditioner for small cars

The Meier-Line air conditioner weighs less than 70 pounds and steals less than 1.5 hp. at 70 m.p.h., according to the maker, Research Marketing Services, 3445 W. 8 St., Los Angeles 90005. The photo at left shows a Volkswagen installation. The unit is priced at under \$300, plus installation—which is said to take about four hours. No special tools and no body alterations are needed. The capacity of the compact air conditioner is 1½ tons. It carries a two-year warranty.



### Compact, low-cost winch

The new Titan winch has two-way free spooling, safety brake, controlled let-off, remote cab control. Drum speed is 60 r.p.m. with no load. Spool capacity is 280 feet of ¼-inch cable. Maximum pull is 3,000 pounds. \$124.50. Airborne Sales, 8501 Stellar Dr., Culver City, Calif.

### Protective coating for your car

A new Lucite-based coating, containing no wax or silicone, is said to do the work of chrome cleaners, tar removers, waxes, and rubbing compounds. Plasticon Chemicals, 38-07 Hunterspoint Ave., NYC 11101, recommends spring and fall application. Price: \$2.98 a can.





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# SCIENCE MAP and GUIDE to the U.S.

By **LOWELL THOMAS**

The famous explorer selects 125 fascinating places for Popular Science readers to visit in the wonderful worlds of science and mechanics, technology, automobiles, space and aviation

**H**igh on my list of the most fascinating sights that all of us should see today are the awesome centers of science and technology. After spending more than half a century moving hither and yon around this exciting globe, I am sure about this. And where better to see these wonders than right here in the 50 states that span our continent and reach far out to mid-Pacific and north almost to the pole?

Right here at home, on good solid earth, you can behold the wonders of space and the space age—tour a space port, look through a giant telescope, or listen in on radio signals from other planets. Or you can try your hand at manipulating the robot arm that handles radioactive materials—or go back in time to the ingenious mechanics of the early horseless carriage, even to the hand tools that our forefathers used in Colonial days.

Where to do all this? Probably not far from where you live. On the Popular Science Map of the United States, I've listed 125 outstanding attractions (by no means all there are, of course) where you can see these wonders of science, space, and technology—in fact, nearly everything that has transformed life on our planet. I've arranged these wonders in seven categories: *Aquariums and Oceanariums, Atomic Energy Installations, Aviation, Planetariums and Observatories, Science and Technology, Space Facilities, and Transportation.*

These places encompass the world's largest optical telescope atop

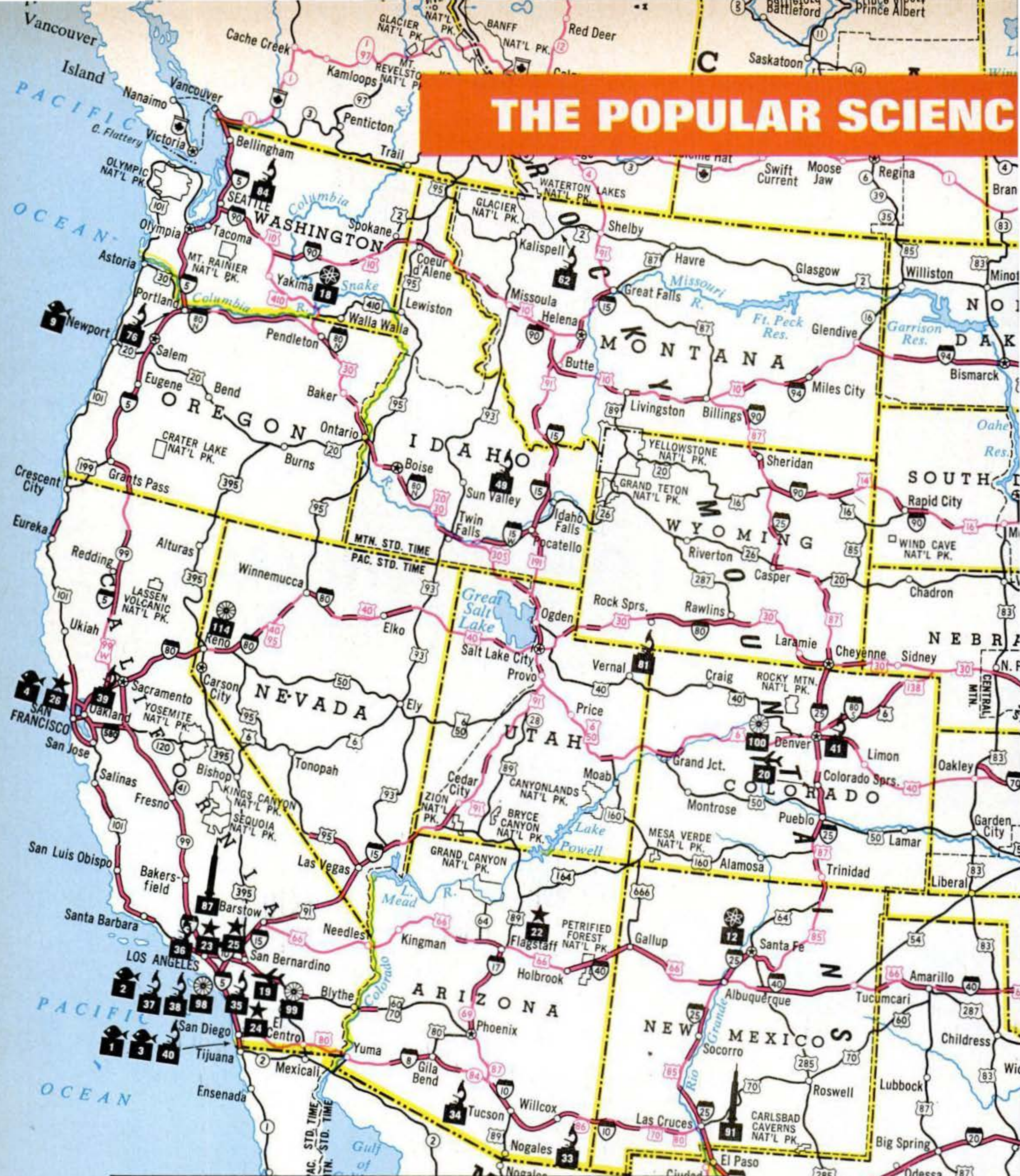
[\[Continued on page 63\]](#)



**Lowell Thomas**

Turn the page for the **POPULAR SCIENCE  
Map of the United States**



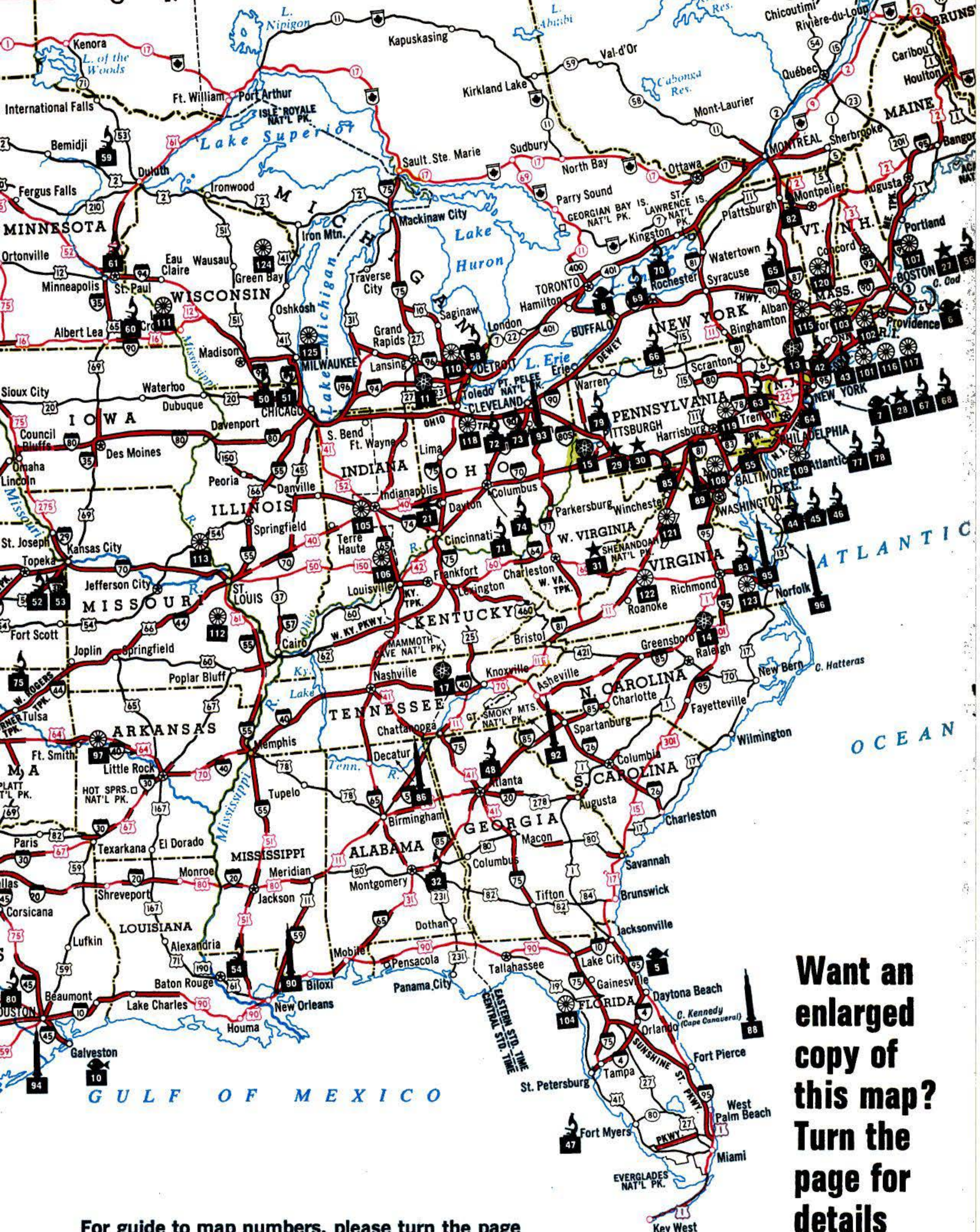


**NATIONAL PARKS**

Acadia	Maine
Big Bend	Texas
Bryce Canyon	Utah
Canyonlands	Utah
Carlsbad Caverns	New Mexico
Crater Lake	Oregon
Everglades	Florida
Glacier	Montana
Grand Canyon	Arizona
Grand Teton	Wyoming
Great Smoky Mts.	N.C.-Tenn.
Haleakala	Hawaii
Hawaii Volcanoes	Hawaii
Hot Springs	Arkansas
Isle Royale	Michigan
Kings Canyon	California
Lassen Volcanic	California
Mammoth Cave	Kentucky
Mesa Verde	Colorado
Mount McKinley	Alaska
Mount Rainier	Washington
Olympic	Washington
Petrified Forest	Arizona
Platt	Oklahoma
Rocky Mountain	Colorado
Sequoia	California
Shenandoah	Virginia
Wind Cave	S. Dakota
Yellowstone	Wyo., Mont., Idaho
Yosemite	California
Zion	Utah

-  **5 AQUARIUMS**
-  **11 ATOMIC ENERGY**
-  **21 AVIATION**
-  **31 PLANETARIUMS AND OBSERVATORIES**
-  **70 SCIENCE AND TECHNOLOGY**
-  **SPACE**
-  **106 TRANSPORTATION**

# MAP OF THE UNITED STATES



**Want an enlarged copy of this map? Turn the page for details**

**For guide to map numbers, please turn the page**

# YOUR GUIDE TO THE POPULAR SCIENCE MAP OF THE U.S.

## AQUARIUMS

1. Scripps Institution of Oceanography—La Jolla, Calif.
2. Marineland of the Pacific—Palos Verdes, Calif.
3. Sea World—San Diego, Calif.
4. Steinhart Aquarium—San Francisco, Calif.
5. Marine Studios Oceanarium—Marineland, Fla.
6. Marine Aquarium—Woods Hole, Mass.
7. New York Aquarium, Brooklyn, N. Y.
8. Aquarium of Niagara Falls—Niagara Falls, N. Y.
9. Undersea Gardens—Newport, Ore.
10. Sea-arama—Galveston, Tex.

## ATOMIC ENERGY

11. Enrico Fermi Atomic Power Plant—Newport, Mich.
12. Scientific Museum—Los Alamos, N. M.
13. Indian Point Atomic Power Plant—Buchanan, N. Y.
14. North Carolina U. Nuclear Reactor—Raleigh, N. C.
15. Shippingport Atomic Power Station, Shippingport, Pa.
16. Pathfinder Atomic Power Plant—Sioux Falls, S. D.
17. Museum of Atomic Energy—Oak Ridge, Tenn.
18. Hanford Science Center—Richland, Wash.

## AVIATION

19. Movieland of the Air—Santa Ana, Calif.
20. Air Force Academy Museum—Colo. Springs, Colo.
21. Air Force Museum—Wright Patterson AFB, Dayton, Ohio.

## PLANETARIUMS AND OBSERVATORIES

22. Lowell Observatory—Flagstaff, Ariz.
23. Griffith Observatory and Planetarium, Hollywood, Calif.
24. Mt. Palomar Observatory—Mt. Palomar, Calif.
25. Mt. Wilson Observatory—Mt. Wilson, Calif.
26. Morrison Planetarium—San Francisco, Calif.
27. Charles Hayden Planetarium, Boston, Mass.
28. Hayden Planetarium—New York City.
29. Buhl Planetarium—Pittsburgh, Pa.
30. Allegheny Observatory—Pittsburgh, Pa.
31. Nat'l. Radio Astronomy Observatory—Green Bank, W. Va.

## SCIENCE AND TECHNOLOGY

32. George Washington Carver Museum—Tuskegee, Ala.
33. U.S. Army Electronic Proving Ground Historical Museum—Fort Huachuca, Ariz.
34. Arizona-Sonora Desert Museum—Tucson, Ariz.
35. Disneyland Tomorrowland—Anaheim, Calif.
36. Griffith Park Hall of Science—Hollywood, Calif.
37. Museum of Natural History—Los Angeles, Calif.
38. Museum of Science and Industry—Los Angeles, Calif.
39. Snow Museum of Natural Science—Oakland, Calif.
40. Natural History Museum—San Diego, Calif.
41. University of Colorado Museum—Boulder, Colo.
42. American Clock and Watch Museum—Bristol, Conn.
43. Peabody Museum of Natural History—New Haven, Conn.
44. Smithsonian Institution: Arts and Industries Building, Museum of Natural History, Museum of History and Technology—Washington, D.C.
45. U.S. Botanic Garden—Washington, D.C.
46. National Bureau of Standards Labs—Washington, D.C.
47. Thomas A. Edison Laboratory—Fort Myers, Fla.
48. Museum of Science and Industry—Atlanta, Ga.
49. Craters of the Moon—Arco, Idaho
50. Museum of Science and Industry—Chicago, Ill.
51. Chicago Natural History Museum—Chicago, Ill.
52. Dyche Museum of Natural History—Lawrence, Kan.
53. Snow Entomological Museum—Lawrence, Kan.
54. LSU Museum of Natural Science—Baton Rouge, La.
55. Aberdeen Proving Ground—Aberdeen, Md.
56. Museum of Science—Boston, Mass.
57. Peabody Museum—Salem, Mass.
58. Cranbrook Science Institute—Bloomfield Hills, Mich.
59. Minnesota Museum of Mining—Chisholm, Minn.
60. Mayo Medical Museum—Rochester, Minn.

61. Arts and Sciences Center—St. Paul, Minn.
62. Museum of the Plains Indian—Browning, Mont.
63. James Forrestal Research Center—Princeton, N. J.
64. U.S. Army Signal Corps Museum—Ft. Monmouth, N. J.
65. New York State Museum—Albany, N. Y.
66. Corning Glass Center—Corning, N. Y.
67. American Museum of Natural History—New York City
68. New York Botanical Garden—Bronx, N. Y.
69. Eastman Photography Museum—Rochester, N. Y.
70. Museum of Arts & Sciences—Rochester, N. Y.
71. Museum of Natural History—Cincinnati, Ohio.
72. Health Museum—Cleveland, Ohio.
73. Museum of Natural History—Cleveland, Ohio.
74. Center of Science and Industry—Columbus, Ohio.
75. J. M. Davis Gun Collection—Claremore, Okla.
76. Museum of Science and Industry—Portland, Ore.
77. Franklin Institute—Philadelphia, Pa.
78. Academy of Natural Sciences—Philadelphia, Pa.
79. Carnegie Museum of Natural History—Pittsburgh, Pa.
80. Museum of Natural Science—Houston, Tex.
81. Dinosaur National Monument—Utah.
82. Shelburne Museum—Shelburne, Vt.
83. Colonial Williamsburg, Inc.—Williamsburg, Va.
84. Pacific Science Center—Seattle, Wash.
85. National Computer Center, U.S. Internal Revenue Service—Martinsburg, W. Va.

## SPACE

86. Space Orientation Center—Huntsville, Ala.
87. NASA Flight Research Center—Edwards, Calif.
88. John F. Kennedy Space Center—Cape Kennedy, Fla.
89. Goddard Spaceflight Center—Greenbelt, Md.
90. NASA Mississippi Test Facility—Bay St. Louis, Miss.
91. Missile Park Museum—White Sands Missile Range, N. M.
92. NASA Data Acquisition Facility—Rosman, N. C.
93. NASA Lewis Research Center—Cleveland, Ohio.
94. NASA Manned Spacecraft Center—Houston, Tex.
95. NASA Langley Research Center—Hampton, Va.
96. NASA Flight Research Center—Wallops Island, Va.

## TRANSPORTATION

97. The Museum of Automobiles—Morriston, Ark.
98. Briggs Cunningham Auto Museum—Costa Mesa, Calif.
99. Orange Empire Trolley Museum—Perris, Calif.
100. Colorado Railroad Museum—Golden, Colo.
101. Branford Trolley Museum—East Haven, Conn.
102. Mystic Seaport—Mystic, Conn.
103. Trolley Museum—Warehouse Point, Conn.
104. The Early American Museum—Silver Springs, Fla.
105. Indianapolis Speedway and Museum—Indianapolis, Ind.
106. Howard Steamboat Museum—Jeffersonville, Ind.
107. Seashore Trolley Museum—Kennebunkport, Me.
108. U.S. Naval Museum—Annapolis, Md.
109. B & O Transportation Museum—Baltimore, Md.
110. The Henry Ford Museum—Dearborn, Mich.
111. Wilkie Steamboat Museum—Winona, Minn.
112. National Museum of Transport—St. Louis, Mo.
113. Riverboat Museum—Clarksville, Mo.
114. Harrah's Automobile Collection—Reno, Nev.
115. American Museum of Fire Fighting—Hudson, N. Y.
116. Suffolk Museum and Carriage House—Stony Brook, N. Y.
117. L. I. Automotive Museum—Southampton, N. Y.
118. Crawford Auto-Aviation Museum—Cleveland, Ohio.
119. Gene Zimmerman's Antique Cars—Harrisburg, Pa.
120. Steamtown, U.S.A.—Bellows Falls, Vt.
121. Car and Carriage Caravan—Luray Caverns, Va.
122. Pettits Museum of Motoring, Natural Bridge, Va.
123. Mariners Museum—Newport News, Va.
124. National Railroad Museum—Green Bay, Wis.
125. Brooks Stevens Automotive Museum—Milwaukee, Wis.

Mt. Palomar, in California, where you can look through a 200-inch telescope. Also, the underwater wonders exhibited at Marineland of the Pacific—or if you're fortunate enough to visit Hawaii this summer, Sea-Life Park on Oahu (which, of course, doesn't show up on the map). There are the vast halls of the Smithsonian in Washington, D.C., where you can see some of the world's most famous aircraft—from Glenn Curtiss' to Charles A. Lindbergh's and on to Gemini 4, from which the late Lt. Col. Edward H. White took his walk into space, to mention but three.

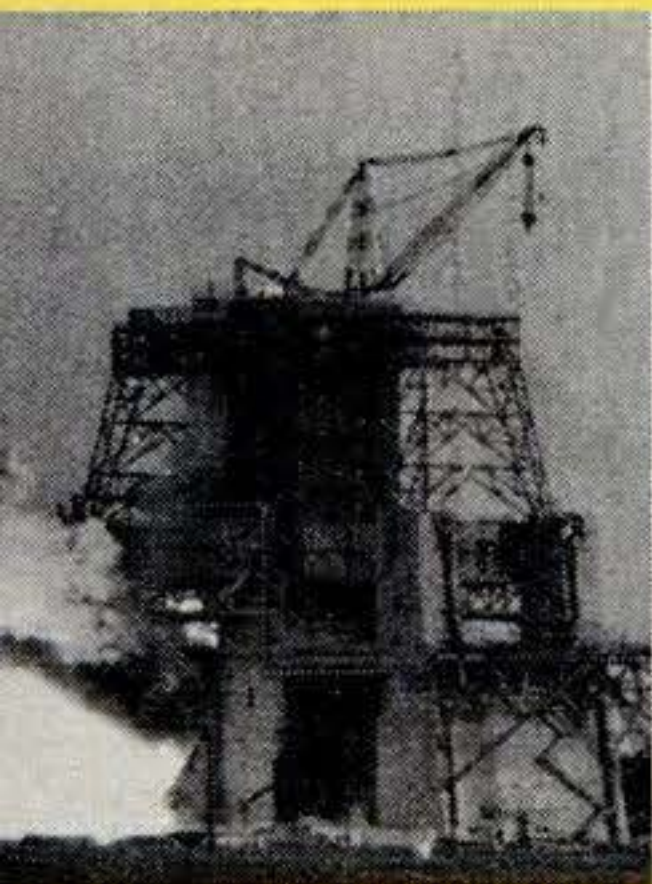
Many of these attractions are free and most of the others charge only a modest

admission fee. Let's take a closer look at some of them and suggest what you should see and do when you get there.

Suppose you start your tour with a visit to the great space port at Cape Kennedy from whose launching pads we hope to send our first explorers to the moon. There are inexpensive bus tours of this 80,000-acre site on Florida's east coast, and you will get a close-up look at most of the fantastic machinery involved in man's latest exciting adventure.

If you're out west, and you want to see where our astronauts train, head for Houston, Tex. The \$200-million, campus-like

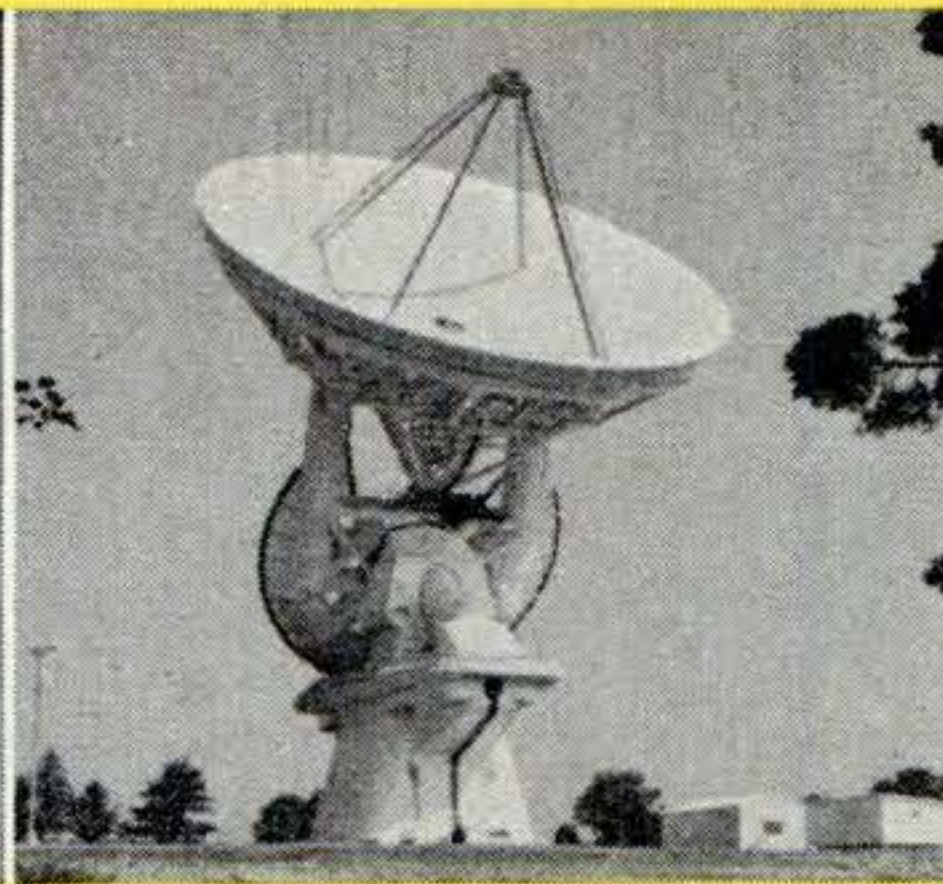
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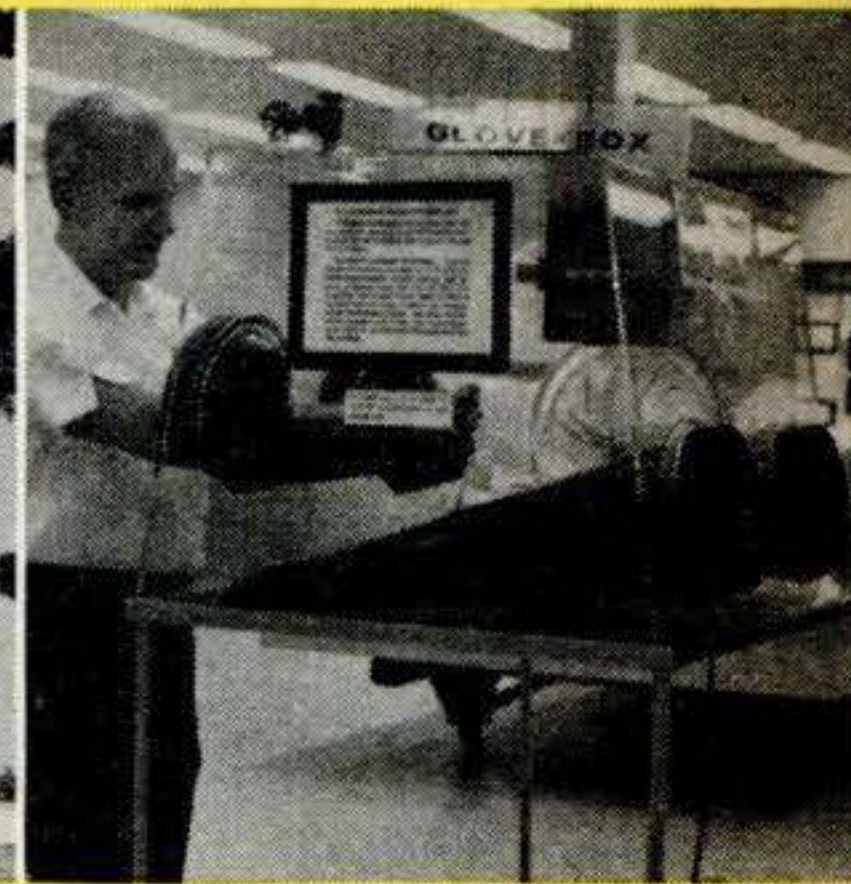
Rocket testing at NASA Mississippi Test Center



Walrus at Marineland of the Pacific



Radio telescope at Green Bank, W. Va.



Atomic exhibit at Hanford Science Center

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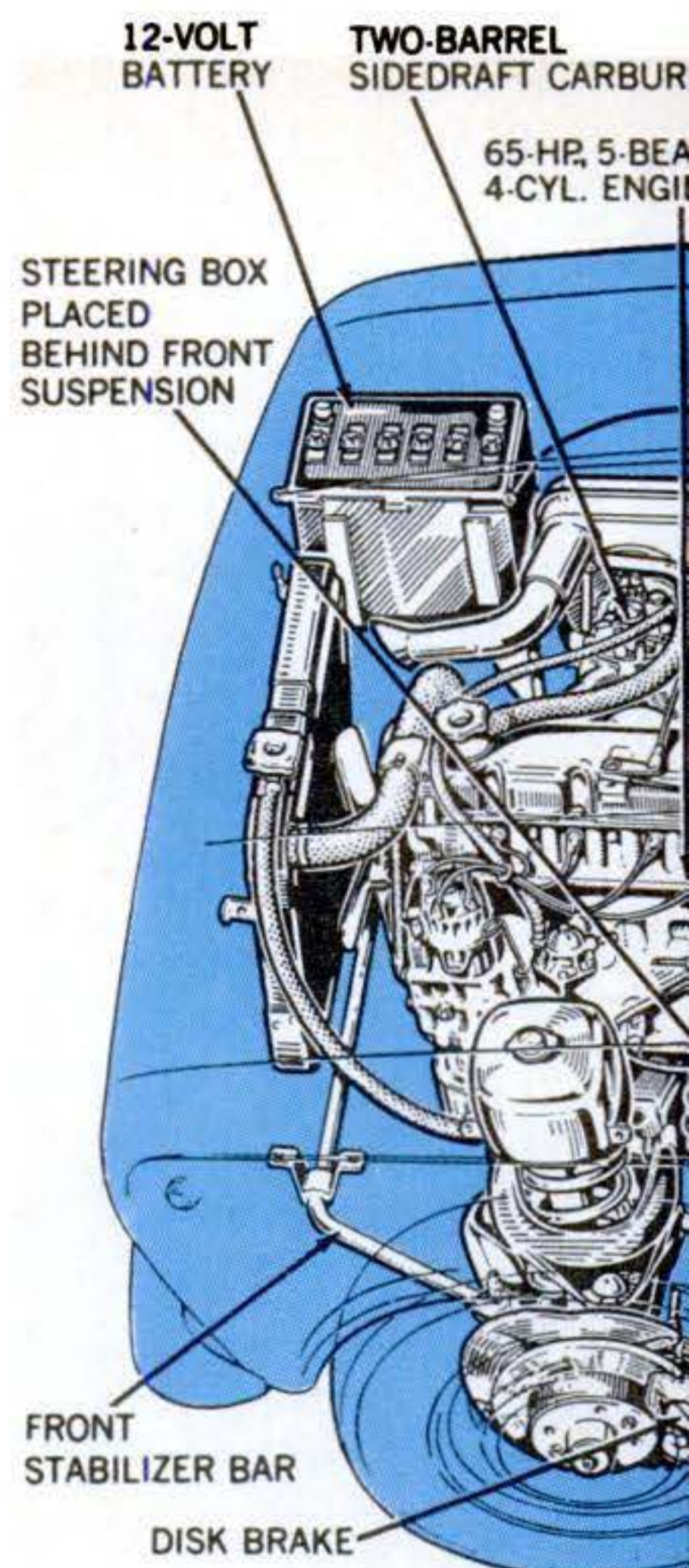
State \_\_\_\_\_ Zip \_\_\_\_\_



**Boxy lines and huge window area dominate the Fiat 124 styling.**



**It handles great at all speeds, with driver alone or car loaded.**



# FIAT 124

**By JAN P. NORBYE / PS Automotive Editor**  
PHOTOS BY BILL MORRIS

**A**t last, somebody has come up with a small car for people who hate small cars. The Fiat 124 has more leg room both front and rear than a full-size American car, and head room and hip room to match U.S. compacts. It's lower, wider, and *shorter* than the VW. The Fiat trunk holds 13.6 cubic feet of luggage.

The 124 has a top speed of 87 m.p.h. and gets from zero to 60 m.p.h. in 16 seconds (most small cars take over 20). Fuel economy varies between 27 and 32 m.p.g.

Coil springs all around give a good ride without choppiness, harshness, or shake. Visibility is excellent in all directions. Maintenance is simplified—the chassis has lifetime lubrication, and you change engine oil every 6,000 miles.

Safety? It not only meets the '68 safety laws, but goes well beyond them. It has impact-absorbing front and rear body sec-

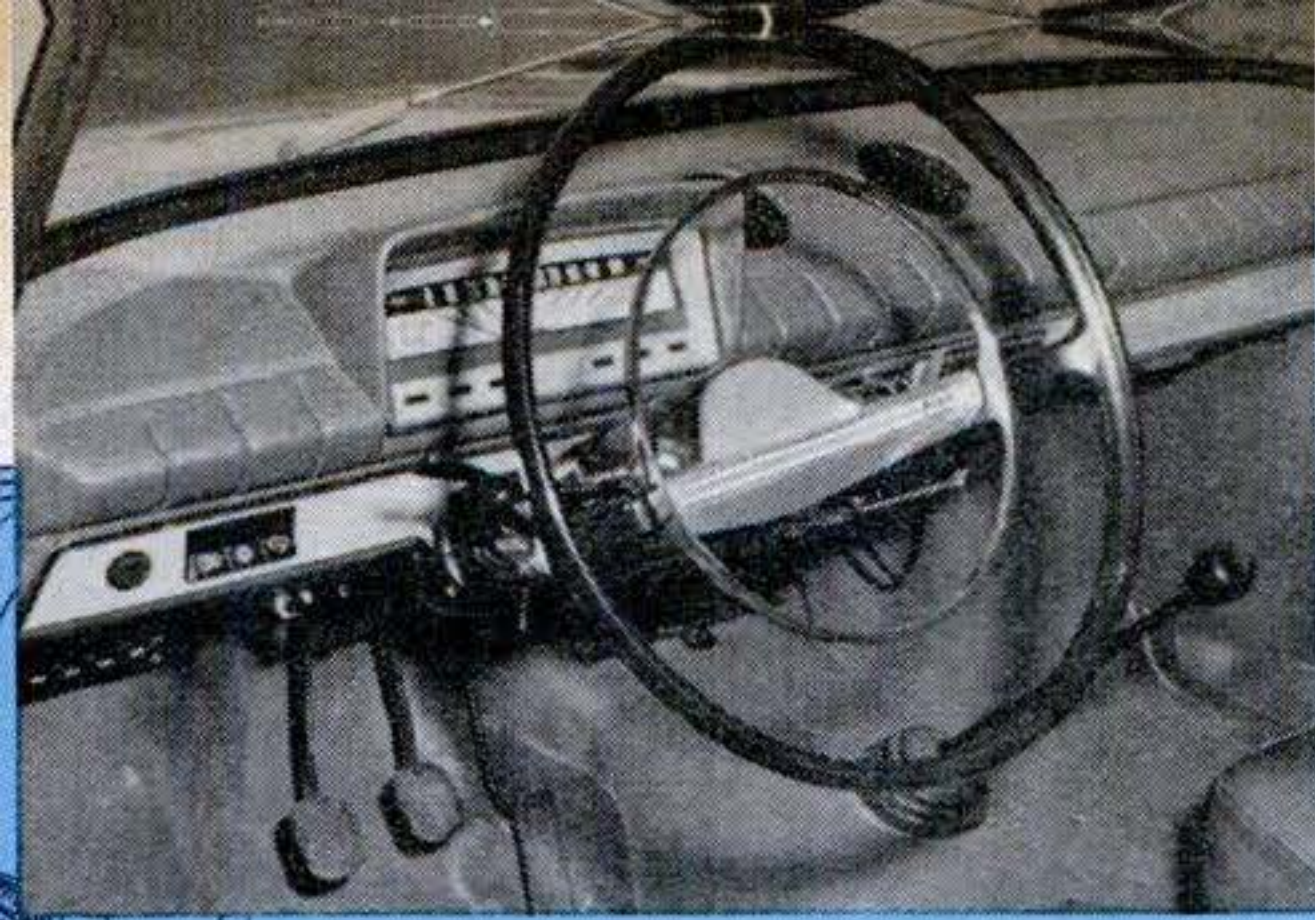
tions, safety door locks, and a fantastic brake system. Disks are used on all wheels, and a rear brake balance valve adjusts line pressure to the load on the rear wheels and keeps them from locking prematurely.

**Fun to drive.** It handles like a thoroughbred on winding country roads. It's peppy on the expressway, and agile in city traffic. Parking's a cinch, for not only do you have a clear view all around, but the car responds to all commands with precision.

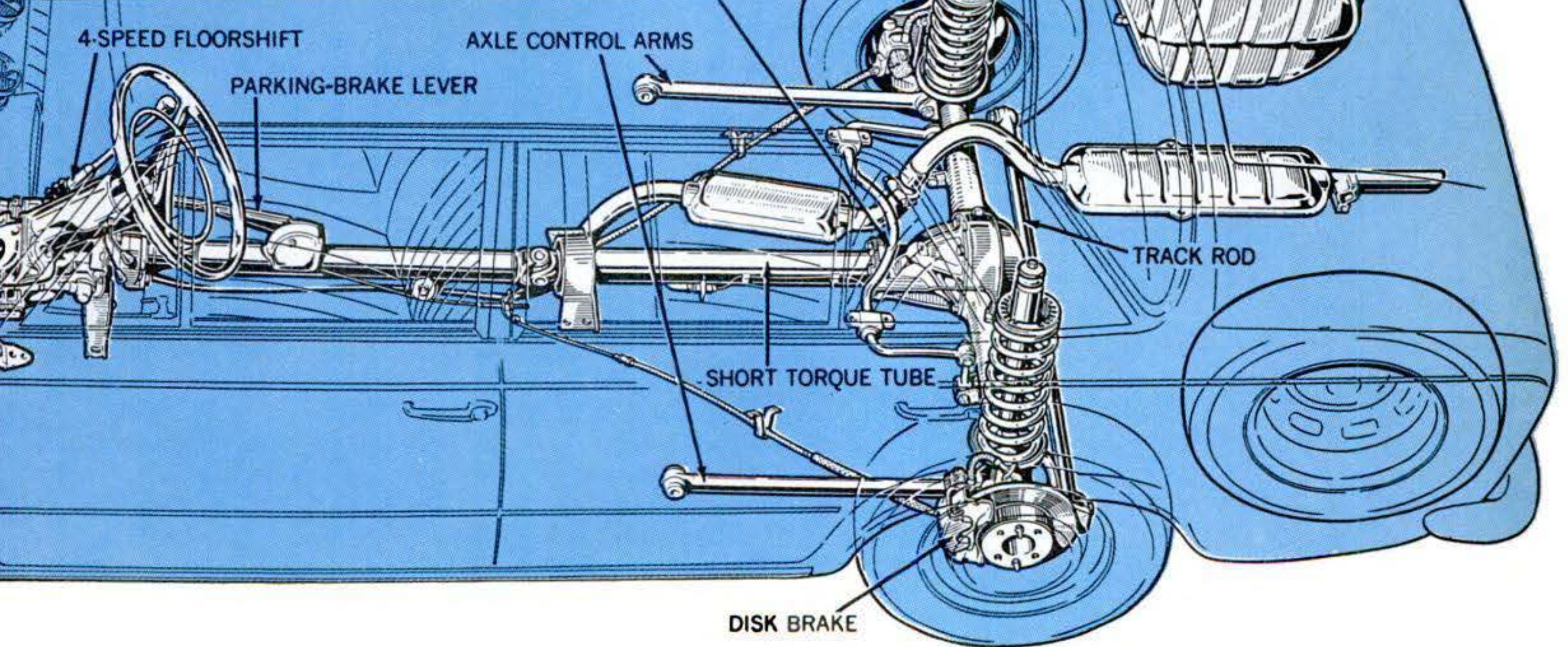
Driving the Fiat on the Bridgehampton race circuit, I broke all past records in the slalom test with an incredible 36-m.p.h. steady speed between pylons spaced at 48 feet. Earlier that day, I had made the wiggle-wobble test (high-speed lane change) on a wet track. I got it up to 55 m.p.h., equal to the best speed for the '67 Ford and Chevy in the dry [PS, Dec. '66].

**The power unit.** The 124 engine is a lightweight, robust four with high specific output. The crankshaft is carried in five main bearings, which means longer life as





Safety and simplicity are interior keynotes. Steering-wheel hub is padded, and top of dash absorbs impact.



# erky New Economy Car

well as reduced noise and vibration. Cruising at 70 m.p.h. on the highway, you know from the engine noise that you're not driving a V-8, but it's as quiet as some sixes. The exhaust note is very sporting, but not loud enough to be called noisy. Block and head are cast iron, with generously sized water jackets and passages for maximum cooling. It's a hot little engine, designed to work hard and withstand high stress levels.

The four-door sedan will soon be followed by a 124 GT coupe and a 124 roadster using a twin-cam head on the same basic engine.

We expect luxury cars to be full of engineering refinements, but settle for less in a small car. The Fiat 124 may change your outlook a little. The same thorough engineering that went into the most expensive six-cylinder Fiats was also applied to the 124. This makes it stand out from all other low-priced small cars. I have driven all of them. At \$1,800, you'll have a hard time finding a better buy in a small car than the Fiat 124.

## Facts on the Fiat 124

### DIMENSIONS (inches)

Wheelbase .....	95.3
Front track .....	52.4
Rear track .....	51.2
Length .....	158.7
Width .....	64.0
Height .....	53.7

### ENGINE

Type .....	OHV four
Displacement .....	71.5 cu. in.
Bore & Stroke .....	2.87 x 2.81 in.
Compression ratio .....	8.8:1
Carburetion .....	Single 2-bbl. Weber
Power @ r.p.m. ....	65 @ 5,600
Torque @ r.p.m. ....	69.4 @ 3,200

### CHASSIS

Clutch .....	Single dry plate
Transmission .....	4-speed, all synchro
Axle Ratio .....	4.30:1
Tire size .....	6.15 S x 13
Brakes .....	Disks front and rear
Steering ratio .....	16.4:1
Turns, lock to lock .....	2.75
Turning diameter .....	35 ft. 1 in.
Curb weight .....	1,802 lb.
Price (suggested retail) ..	\$1,798



Here's an exclusive report on the super-agent's flyweight fighting machine and how it works

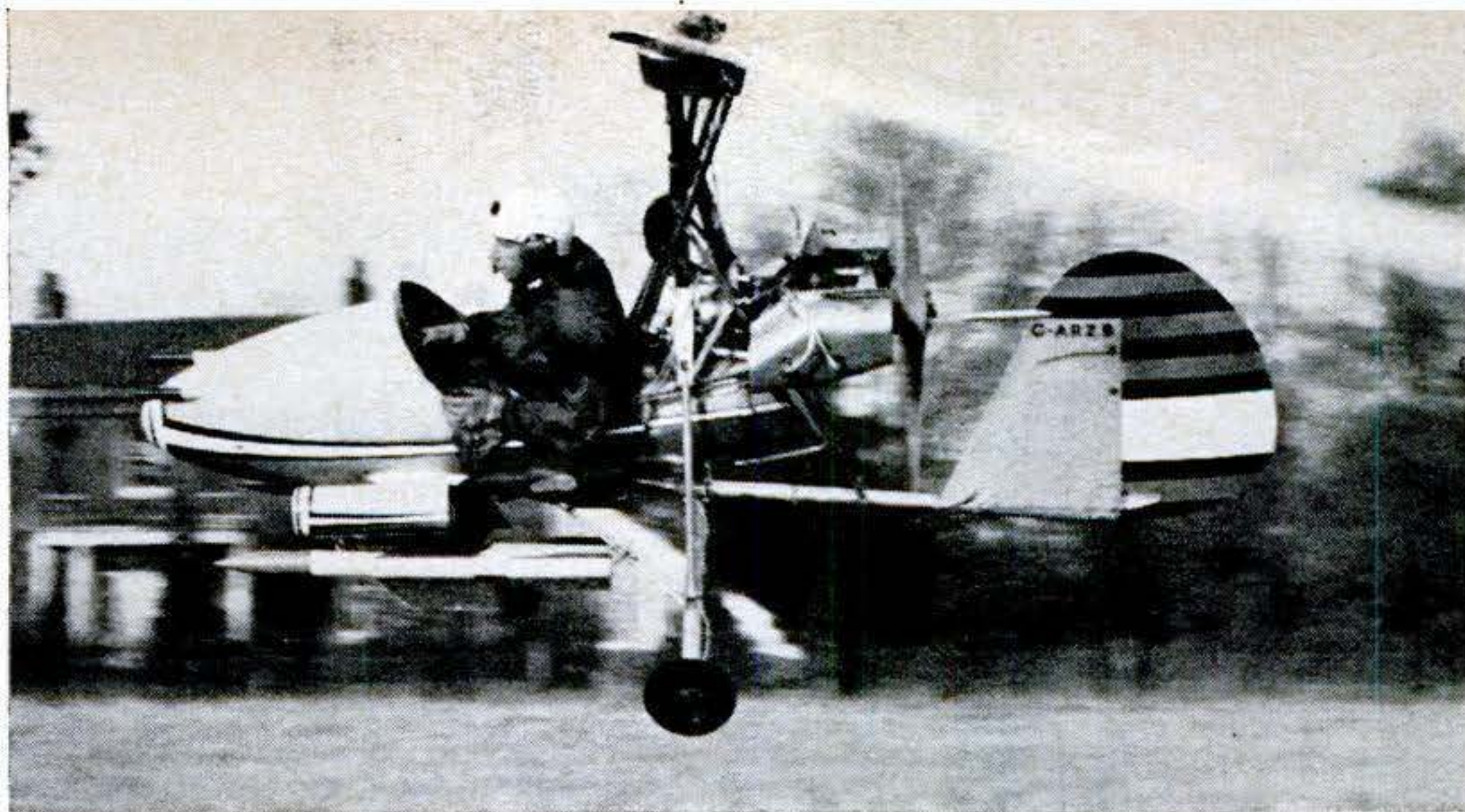
**007 RIDES AGAIN!**

# James Bond™

Actor Sean Connery (below, right) inspects Little Nellie, the tricky midget autogyro that takes on the SPECTRE air force in "You Only Live Twice." At left: Connery in cockpit, ready for action.



Wing Commander Ken Wallis pilots his tiny WA-116 autogyro in a sharp bank, his inside wheel just a few inches off the ground. The maneuverability of the midget craft is amazing. Little Nellie can make a tight turn in a 30-foot radius, banking as much as 120 degrees.



# mazing One-Man Autogyro

By DAVID SCOTT / PS European Editor

"I want Little Nellie. Most urgent!" Thus James Bond radios to the London headquarters of the British Secret Service's Q Branch. Agent 007 is in Japan on the trail of SPECTRE, in the new Bond film *You Only Live Twice*. This time the international crime syndicate, bent on world conquest, has goaded America and Russia to the brink of war by capturing their space capsules in orbit.

Each nation believes that the other is the evil marauder, and they're close to hostilities when tracking stations report that the latest missing U.S. capsule came down not in Russia but Japan. Double-O-Seven races to Tokyo to find out who is launching the interceptor rockets, and from where.

He suspects that the fiendish mob is operating from volcanic mountains in southern Japan, and reckons that Little Nellie is just right for reconnaissance. The tiny autogyro arrives—in four large suitcases containing tubes, wheels, and assorted hardware that mechanics hastily assemble.

Bond climbs in, hops into the air, and while circling the crater of a volcano is boxed in by four black SPECTRE helicopters. In the big action scene that follows, our indestructible hero darts around the menacing choppers like a hummingbird among hawks, and drops them one at a time with the exotic array of armaments thoughtfully supplied by Q Branch.

**The real thing.** No improbable gimmick conjured up by special-effects men and trick

photography, Bond's flying machine is the real thing. It's a WA-116 autogyro designed and built by Wing Commander Ken Wallis, a Royal Air Force armaments expert, now retired.

Barely 9½ feet long and weighing only 250 pounds, the little gyro can take off in 30 yards, float through the air at 14 m.p.h., speed up to 130 m.p.h. in 10 seconds, climb to 7,000 feet in seven minutes, and land in about 24 feet.

Maneuverability is amazing, with instant response to controls. The flyweight craft can far out-accelerate any helicopter, and run rings around it by turning in a tight, 30-foot radius, while banking as much as 120 degrees.

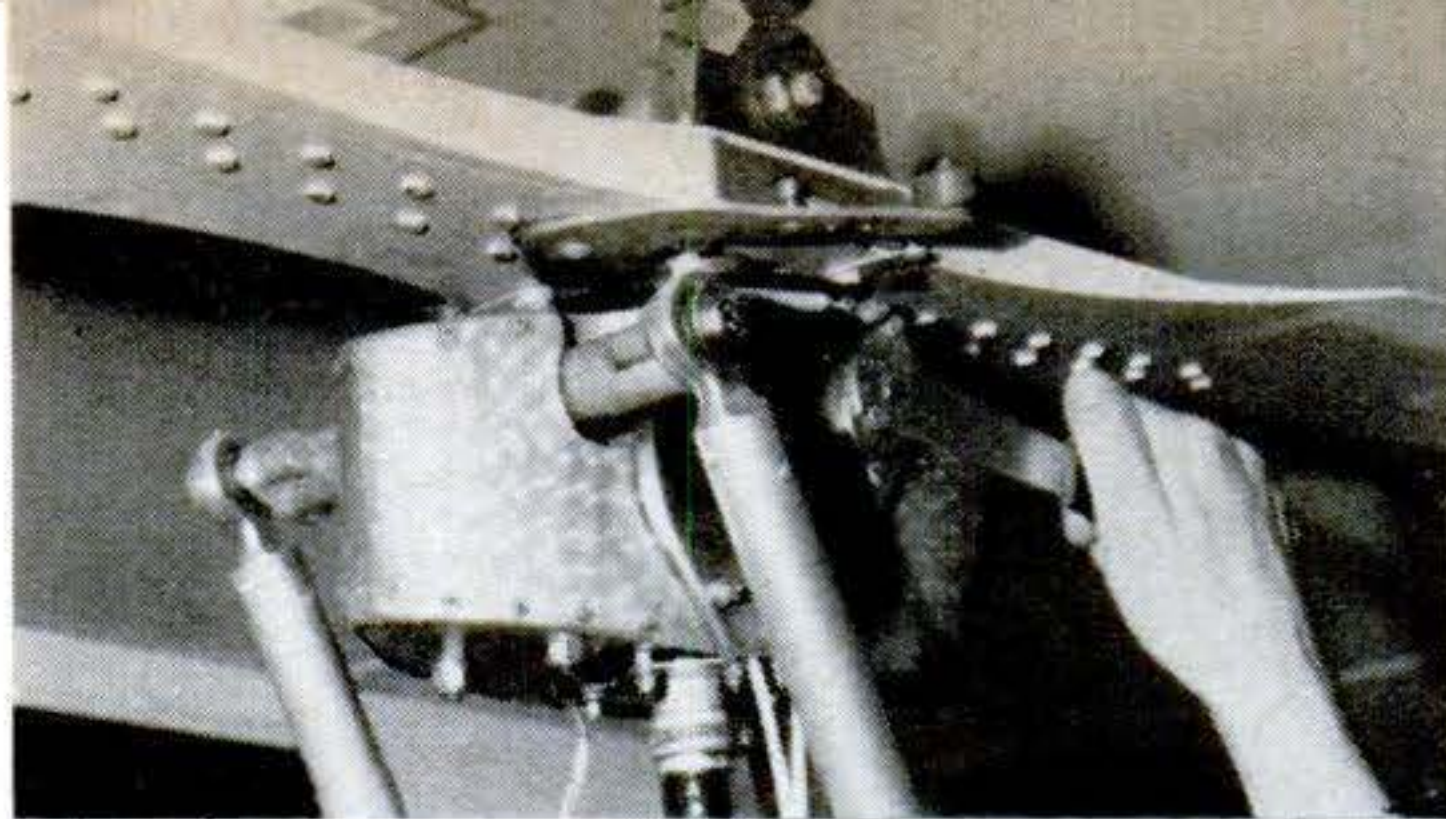
Range is 200 miles, and Wallis has been up to 13,500 feet. He calculates the ceiling at 18,000 feet, but at that altitude in an open cockpit the cold would be unbearable.

In relation to their basic weight, autogyros outclass all heavier-than-air machines as weight-lifters, and Wallis' can tote 500 pounds, twice its own weight. Exceptional power-weight ratio gives it outstanding mileage—18 m.p.g. cruising at 70 m.p.h.

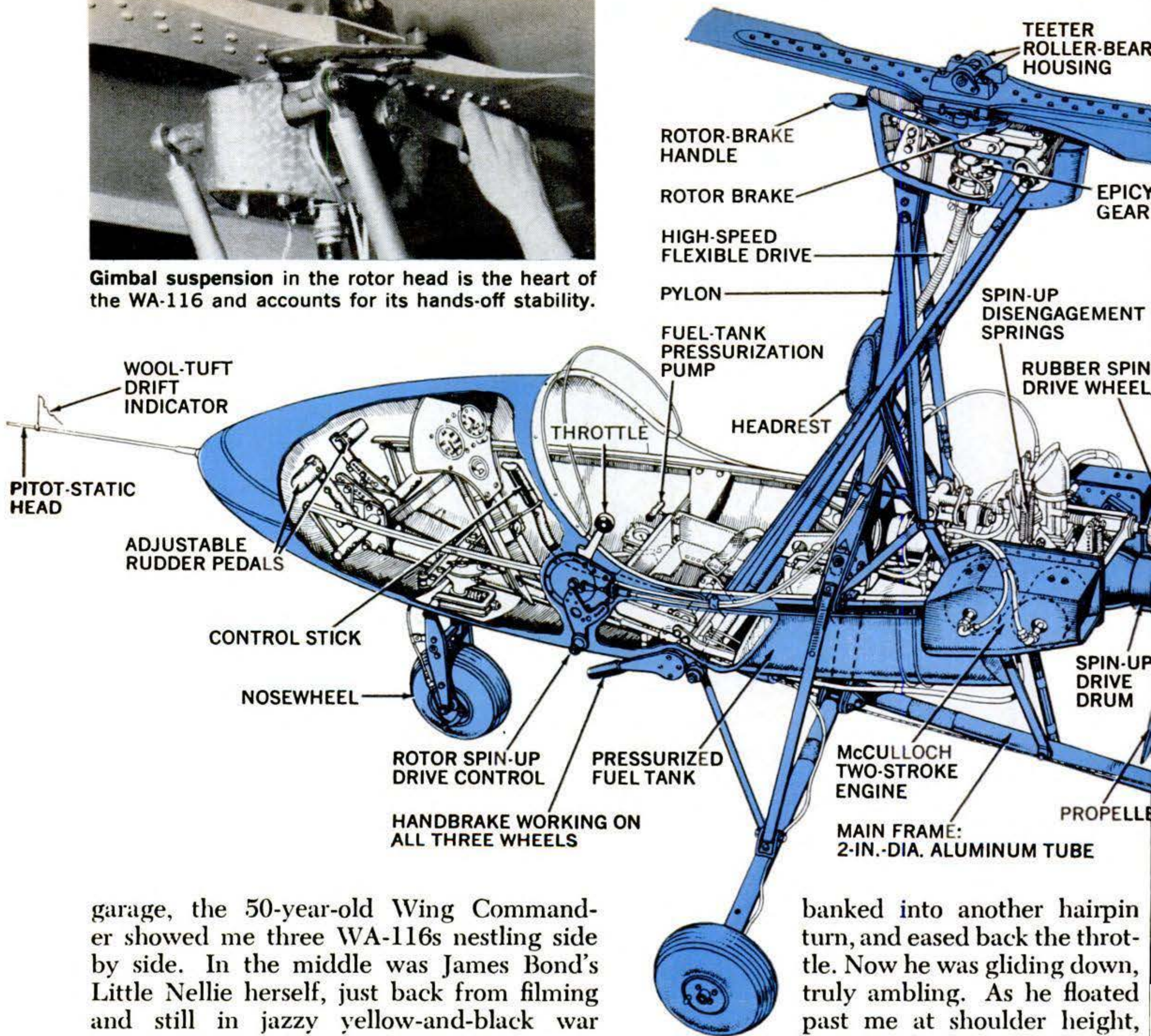
It's ultrasafe. If the engine conks out, you just let go of the controls and glide to earth with the windmilling rotor over your head acting like a parachute for a gentle touchdown.

**Flying Little Nellie.** I spent a day with Ken Wallis for a private demonstration of his remarkable baby in action. In a low-roofed "hangar" about the size of a two-car

*Continued*



Gimbal suspension in the rotor head is the heart of the WA-116 and accounts for its hands-off stability.



WOOL-TUFT  
DRIFT  
INDICATOR

PITOT-STATIC  
HEAD

ADJUSTABLE  
RUDDER PEDALS

CONTROL STICK

NOSEWHEEL

ROTOR SPIN-UP  
DRIVE CONTROL

HANDBRAKE WORKING ON  
ALL THREE WHEELS

ROTOR-BRAKE  
HANDLE

ROTOR BRAKE

HIGH-SPEED  
FLEXIBLE DRIVE

PYLON

FUEL-TANK  
PRESSURIZATION  
PUMP

HEADREST

THROTTLE

SPIN-UP  
DISENGAGEMENT  
SPRINGS

RUBBER SPIN  
DRIVE WHEEL

SPIN-UP  
DRIVE  
DRUM

McCULLOCH  
TWO-STROKE  
ENGINE

MAIN FRAME:  
2-IN.-DIA. ALUMINUM TUBE

TEETER  
ROLLER-BEAR  
HOUSING

EPICY  
GEAR

PROPELLE

garage, the 50-year-old Wing Commander showed me three WA-116s nestling side by side. In the middle was James Bond's Little Nellie herself, just back from filming and still in jazzy yellow-and-black war paint. Wallis was the stand-in for actor Sean Connery in all the flying shots.

"I'll show you how we did it," he said.

After pulling on a one-piece flying suit he grasped the brightly colored machine by the tail and pushed it to a grassy field in front of his house. He started the engine with a flip of the pusher propeller, and shoehorned himself into the cockpit. Raising one hand over his head he started the rotor turning, then engaged the engine-powered spin-up mechanism that quickly revs up the big pinwheel to takeoff speed.

Wallis opened the throttle, released the brakes, and jogged forward on the rough ground. In seconds he was airborne, climbing steeply. Openmouthed, I watched him skim the treetops, bank to vertical in a narrow U turn, then dive towards me. A few yards from where I was standing he leveled off, wheels only inches above the grass. The plane did just what it was told.

With a pull on the stick he shot skyward,

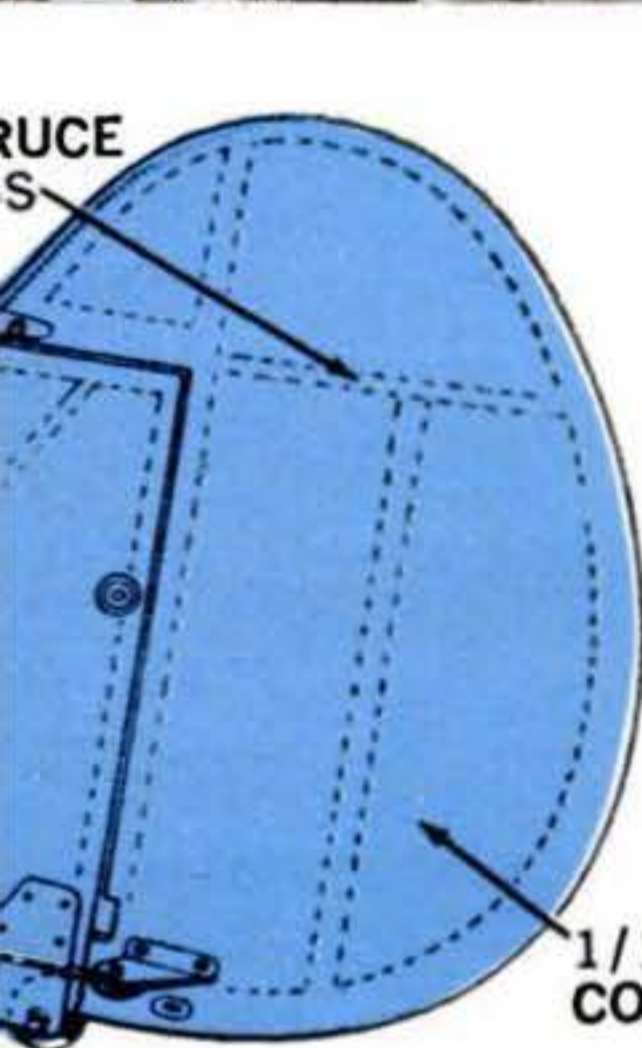
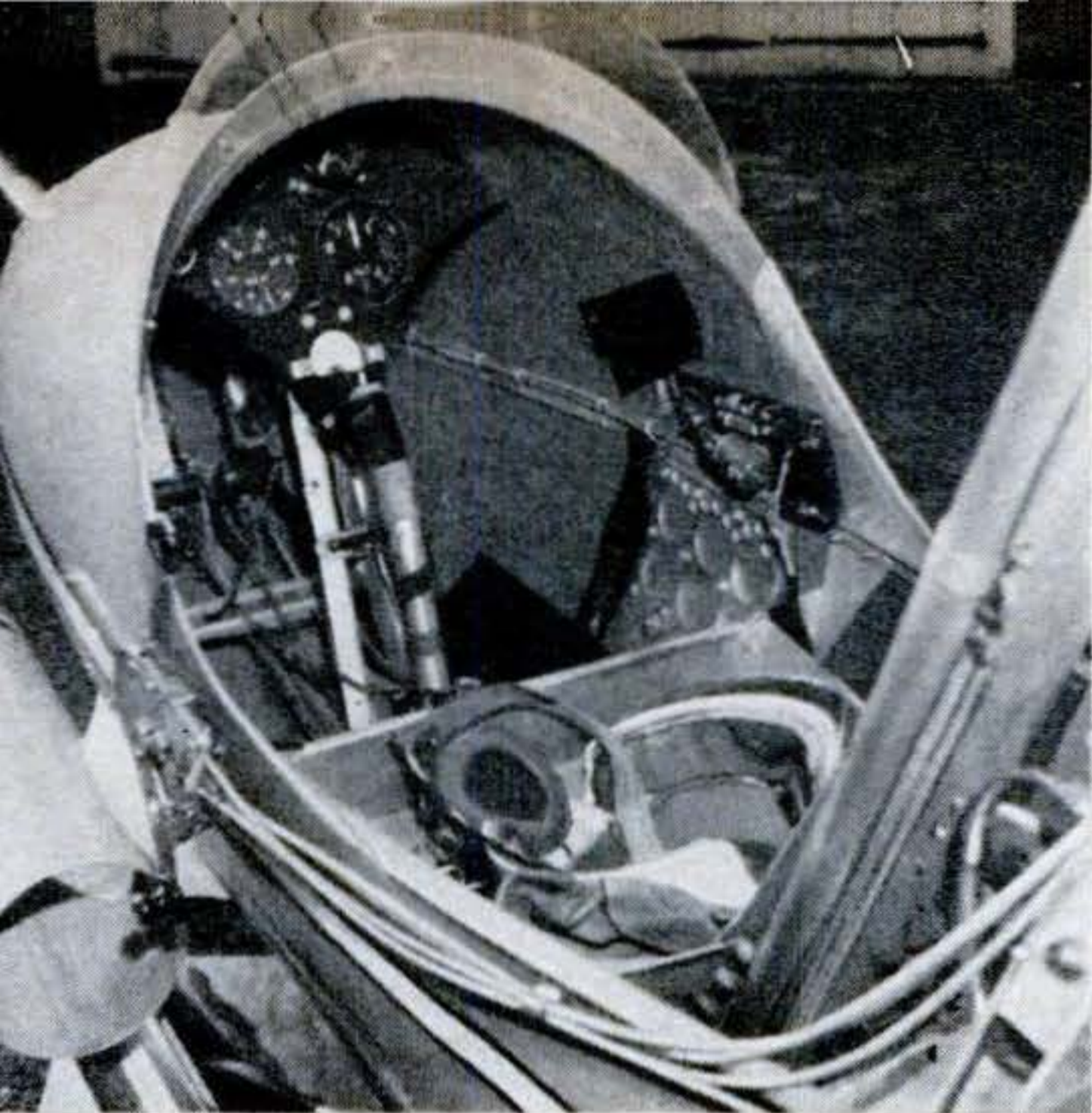
banked into another hairpin turn, and eased back the throttle. Now he was gliding down, truly ambling. As he floated past me at shoulder height, he thrust both arms out of the cockpit. "Look, no hands!" he shouted down to me, grinning.

**Nellie's clever rotor.** While the principle of the autogyro—a freewheeling, wind-driven rotor providing lift—dates back 40 years, the WA-116 is perhaps the most sophisticated and advanced design yet made. Ingenuity is centered on the rotor head, which uses an offset gimbal for controlling the teetering two-blade rotor.

Teetering corrects for the excessive lift of the advancing blade by allowing it to climb, while the retreating blade dips correspondingly for a bigger bite of air. The gimbal geometry accounts for the plane's remarkable hands-off stability, and for its "forgiving" nature if the pilot blunders.

The basic concept is found in other autogyros [*Is This Every Man's Flying Machine?* PS, Apr. '66], but Wallis has contributed significant improvements.

In the WA-116 the axes of the gimbal are



**Cozy cockpit** is cowled in fiberglass, has mechanically interlocked throttle and spin-up levers (left). Instruments consist simply of an altimeter, an air-speed indicator, a rotor tachometer, and an engine-temperature gauge. The frame of the autogyro is made of two-inch aluminum tubing.

displaced, with the roll spindle below the pitch spindle. The theory of the suspension geometry is complex, but the practical results in flight are startling.

Powered spin-up of the rotor, essential for short takeoffs, coupled with automatic torque limitation and sequenced disengagement, is another Wallis innovation. The system is cunningly simple. A metal drum on the propeller hub drives a rubber-tired roller that transmits engine power to the rotor through a flexible shaft and planetary reduction gearing.

Initial movement of a control lever elevates the little gearbox in the rotor head so that its output pinion meshes with an internal ring gear beneath the rotor spindle. Then you pull the lever home and the friction roller is thrust against the drum.

You follow this procedure with the wheel brakes on and engine idling, after hand-pushing the rotor to assist rear engagement and to avoid excessive starting drag. Ease the throttle open and in a few seconds the rotor winds up to 325 r.p.m., its maximum engine-driven speed.

Release the brakes and the gyro leaps forward. During the ground run, the rotor,

still driven from the engine but now assisted by autorotation, speeds up in the rush of air, reaching 360 r.p.m. just before takeoff. The spin-up control, mechanically interlocked with the throttle lever, flies off automatically when the prop reaches 3,700 revolutions.

**Safety features.** The rotor turns at about 400 r.p.m. in flight, more than the maximum of the gear drive at full engine power. Nothing happens if spin-up is engaged when the engine is throttled back. The risk that torque reaction from the rotor drive might affect control of the aircraft is eliminated by a free wheel in the planetary gearbox.

Teetering restrictors that limit the tilt of the rotor disk at speeds up to 200 r.p.m. are another safety feature. These simple centrifugal weights in the gimbal system prevent damage to the blades or head when taxiing over bumpy ground. There is also a hand-operated self-wrapping band brake to stop the rotor quickly after landing.

The airframe of the WA-116 is little more than a two-inch-diameter aluminum tube extending from nose to tail. It supports the pilot's seat, rotor mast, and tail assembly, and carries the undercarriage suspension arms, which are braced by struts.

The engine is a highly modified U.S. McCulloch originally designed to power drone target planes. The flat-four two-stroke delivers 72 hp. to the prop.

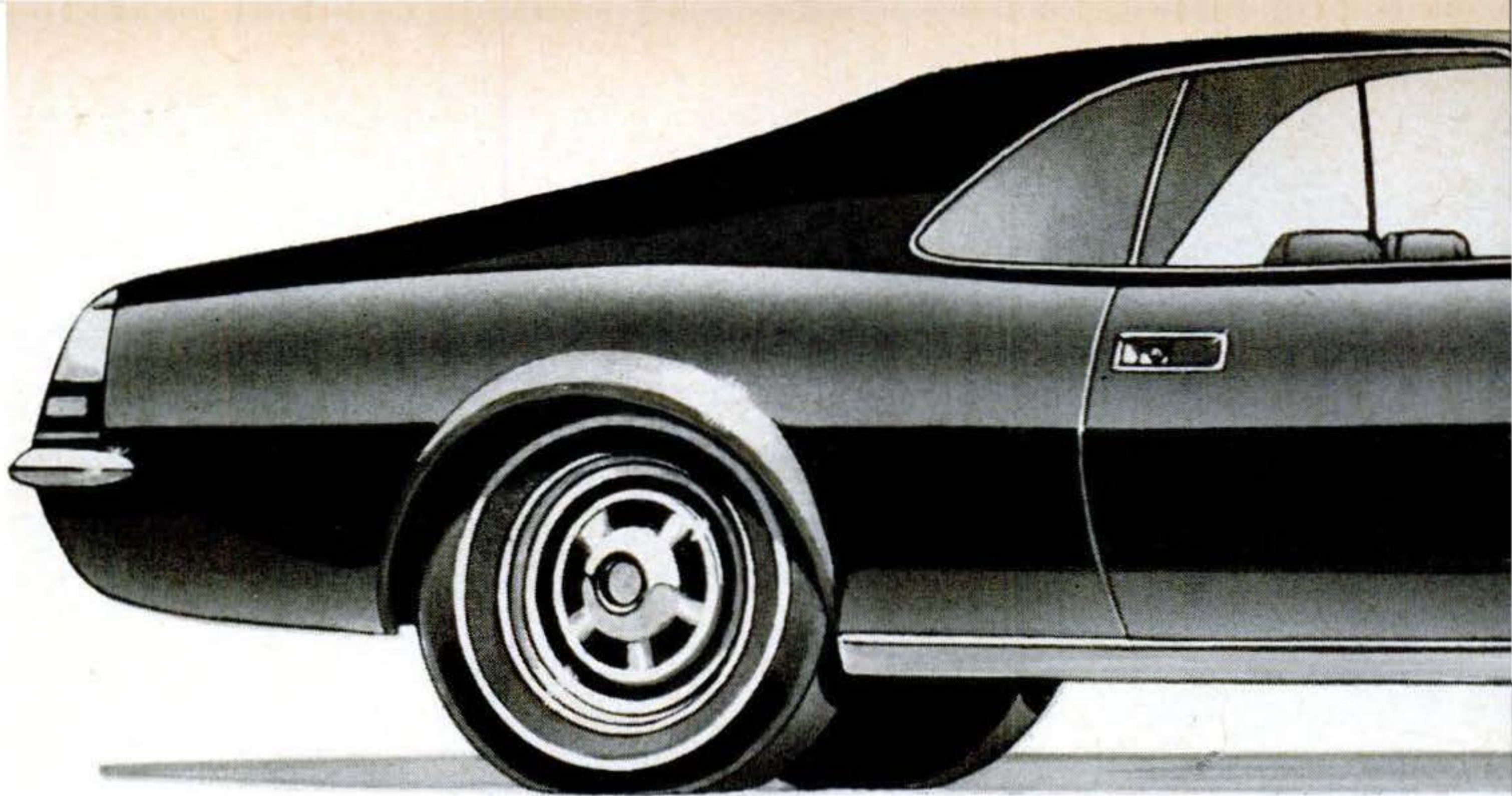
Controls are simple. A joystick between the pilot's knees tilts the rotor for pitch and roll through an under-seat two-way pivot and a pair of ball-jointed control rods to the overhead gimbal unit. Pedals operate the steerable nosewheel.

This fascinating machine is the brainchild of a man with flying in his blood. Ken Wallis' father and uncle built an all-metal monoplane in Cambridge, England, in 1909, only six years after the Wright brothers pioneered powered flight with their wood-and-wire biplane.

In 1937 he got a pilot's license, and joined the RAF at the outbreak of World War II. His interest in rotary-wing aircraft was kindled in 1957, and after four years of work with autogyros he put the WA-116 in the air.

**New hardware for 007.** Wallis' break came in May, 1966, when Eon Productions, James Bond film makers, approached him.

*[Continued on page 190]*



**Our sneaky reporter gives you:**

# Your First Peek at the '68 Cars

**What's happening? The "specialty-car" wave that began with the Mustang is still rising—and more fastbacks are coming**

**By JIM DUNNE / PS Detroit Editor**

**I**f you've been worrying about whether Detroit would be able to come through with all those required safety improvements and emission-control devices, and still come up with its annual surprise package of engineering and styling changes, relax. Detroit has not been idle in any area.

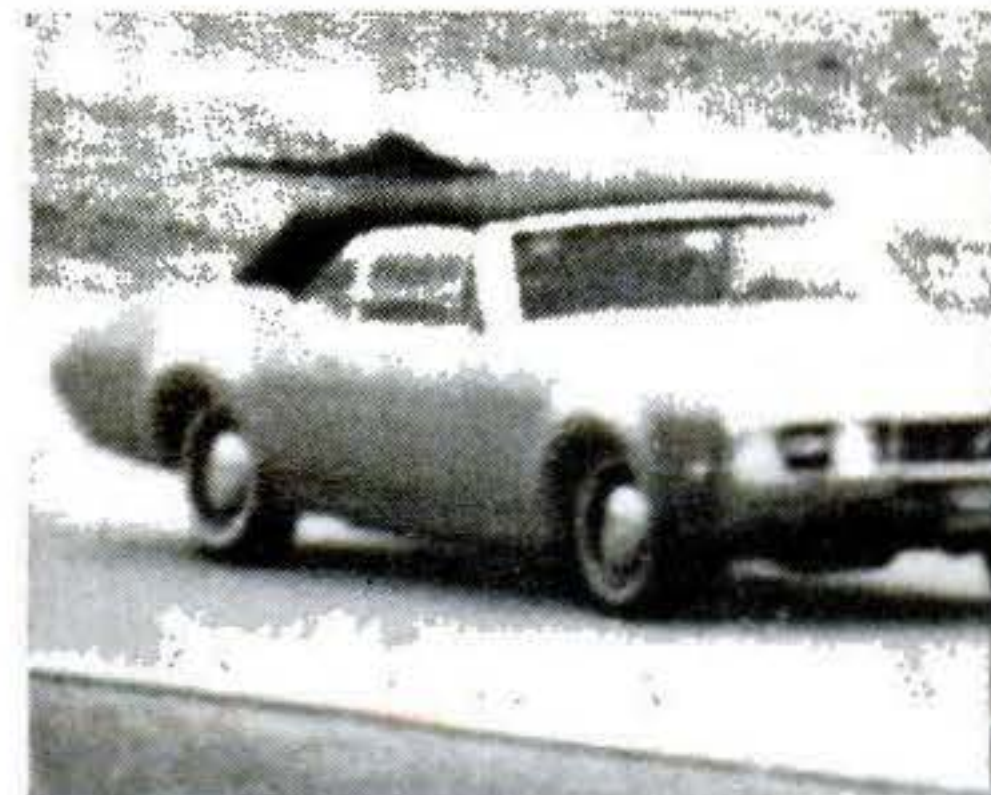
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Pontiac gets split grille with tall centerpiece, side-by-side headlights.

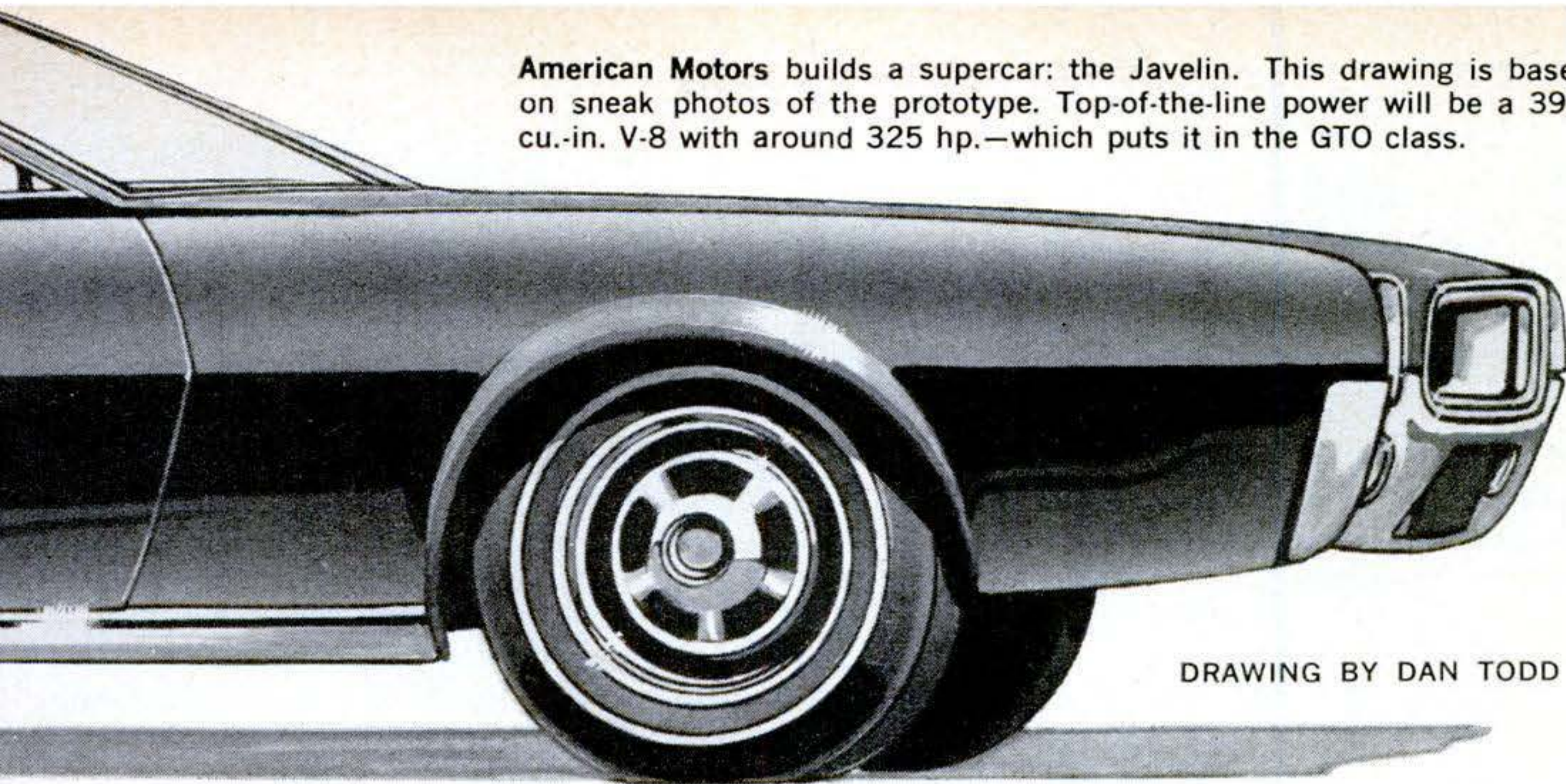


Oldsmobile 98 gets revised front end but no structural body changes.



Olds F-85 convertible has simplified front end, new bulging fender line.

American Motors builds a supercar: the Javelin. This drawing is based on sneak photos of the prototype. Top-of-the-line power will be a 395-cu.-in. V-8 with around 325 hp.—which puts it in the GTO class.



DRAWING BY DAN TODD



Chevrolet Impala gets few body changes—it even keeps the rear fender ridges of the '67 body. Grille de-

sign is new and squared off, in contrast with the wrap-around grille that extended into the fenders in '67.



Oldsmobile's 4-4-2, shortened to 112-inch wheelbase, has semi-fastback coupe body with Toronado lines.



Pontiac Tempest gets new split-grille design, inspired by bumperless Firebird. Hood has dual air scoops.

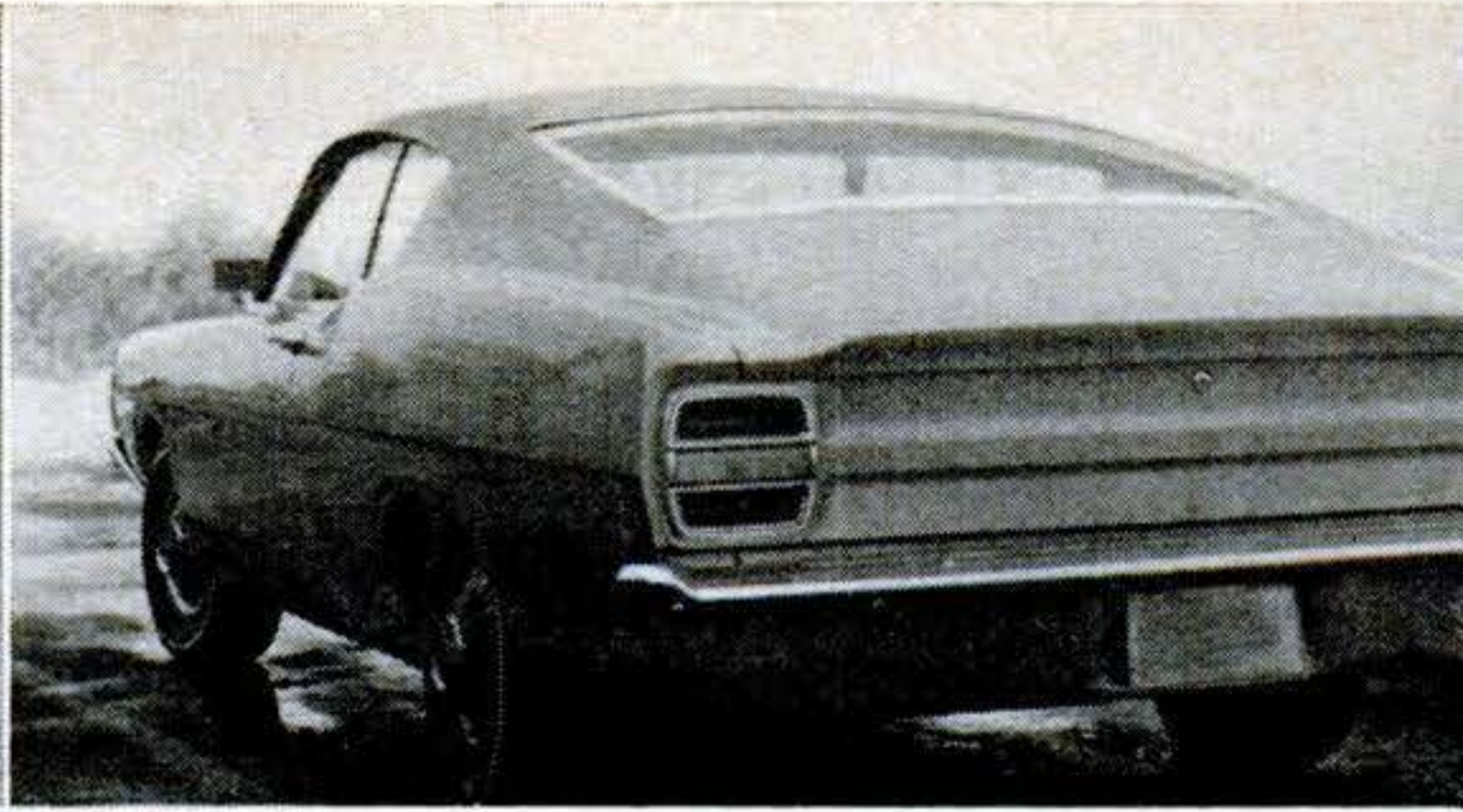


Chevrolet Concourse is new deluxe four-door hardtop on stretched chassis with 116-inch wheelbase. This

gives Chevy a top-line intermediate ahead of Ford, which started top-line trend with the full-size LTD.



**Mercury Comet gets new skin, with lines so similar to the big Mercury you can hardly tell them apart.**



**Comet and Fairlane will both have true fastback coupes with Mustang-inspired tail-end panels.**

There will be plenty to catch your eye:

- You'll find three new nameplates.
- You'll see completely reworked intermediates from the Big Three, plus facelifts on the full-size cars.
- There'll be one completely new engine family, six modified or enlarged engines.

**Three newcomers.** You can start watching in the next eight months for American Motors' Javelin and AMX, and Lincoln's Continental Mark III.

The Javelin is a 109-inch-wheelbase AM version of Ford's Mustang. It's 190 inches long, seats four, offers a full range of power up to a 325-hp. V-8, and has bucket seats and other plush touches like wall-to-wall carpeting as standard equipment. It will sell for about \$2,400.

Like most AM cars, the Javelin will have pullout outside door handles recessed in the sheet-metal surface. The chassis and suspension of this new car borrow heavily from the American line, but you'll look in vain for a trace of American in the exterior styling.

American Motors will introduce the car called the AMX later, possibly as much later as February, 1968. The AMX looks a lot like the two-seater show car of the same name, which—if you recall that job—makes it even more sexy than the Javelin. Wheelbase will be shorter than the American's 106 inches, but the car will seat four.

The Continental Mark III will have a wheelbase of about 120 inches. It will use the Thunderbird chassis with wraparound, torque-box frame. Its drive system will be conventional with a new, 462-cu.-in. V-8 furnishing power. In size and general proportions, it's an up-to-date version of the \$10,000 Mark II Continental that Lincoln built in the Fifties. Price is expected to be right up against the Eldorado—or over \$8,000

fully equipped. It looks as if Lincoln is shooting for a Mark III debut before the first of the year.

**The new intermediates.** General Motors' A body (Chevelle, Tempest, F-85, Buick Special) is completely new and comes in two sizes. A fastback, two-door hardtop is expected to have a wheelbase shrunk to 112 inches, while the four-door sedan will be stretched to 116.

Ford Fairlane and Mercury Comet get all-new sheet metal. These cars share the same unit body. Overall length of both cars is just over 200 inches, four to six longer than this year. Fairlane's grille, split horizontally across the middle, will house side-by-side headlights. Two two-door hardtop models will give you a choice of fastback or notchback. The front-door vent window will be gone.

The Chrysler Corp. intermediates are also completely restyled. In keeping with big-gun policy, the new Belvedere and Coronets will be conservative. Even the all-new Charger—without its trademark, the fastback roof—is less extreme looking than some high-volume production cars at Chrysler's competitors. Again, the main difference between Charger and Coronet will be in roof styling, with each getting its own version of a semi-fastback. The Belvedere shares the basic body of the Coronet, and will get an all-new skin, too.

**New in power.** The new engine family comes from Ford. A large-displacement lightweight V-8, it embodies all the lessons learned from the smaller 289 series. It comes in three sizes: 393, 430, and 462 cu. in. Lincoln gets the 462-cu.-in. monster. It exactly matches displacement and horsepower of this year's car. The 430 cubic inch is available for big Fords, Thunderbird, and Mercury. The baby of the family





**Fairlane** front end has side-by-side headlights. Body structure is unit-construction again as in 1967.



**Ford Falcon** strengthens split-grille theme, but continues to light roadway with single head lamps.

—393 cu. in.—becomes the main engine of the Ford line, optional on all intermediates, and on Mustang and Cougar.

Reports say the new V-8 has bigger water passages for better cooling, staggered intake and exhaust valves for better breathing, and more rounded combustion chambers for more complete burning of fuel.

And the modified or enlarged engines?

● Chrysler Corporation will have a new 340-cu.-in. V-8 that will become standard in Chryslers, big Dodges, and Chargers, and be available for Plymouths.

● American Motors has stretched its 343-cu.-in. V-8 to 395. This unit will be the new power option for Ambassadors, SSTs, and Javelins. AMC wanted to go to 401 cu. in., but found it made the walls too thin.

● Cadillac will increase its displacement from 429 to 472 cu. in.

● Pontiac will add a 448-cu.-in. V-8 to its options. This engine shares many parts with the present 428-cu.-in. engine.

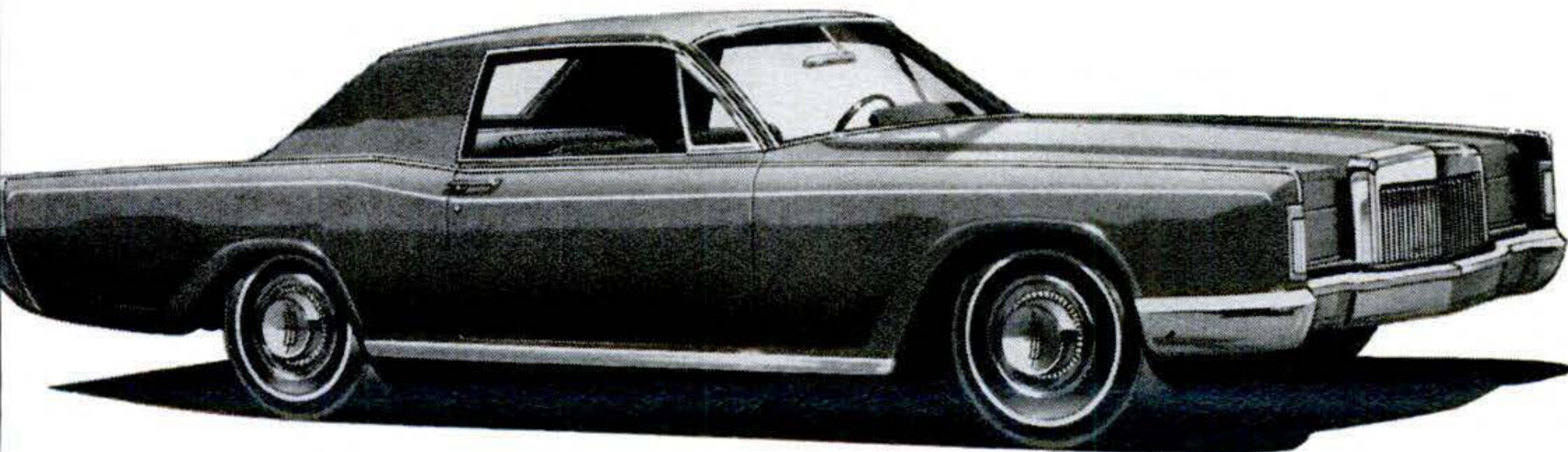
● Buick has been experimenting with enlarged versions of the 340-cu.-in. Le Sabre V-8; will probably change to 350.

● Chevrolet has suffered from a big gap between the base-model 283 cu. in. and its next size (327). Look for a 307-cu.-in. basic unit for Chevelles and Chevrolets.

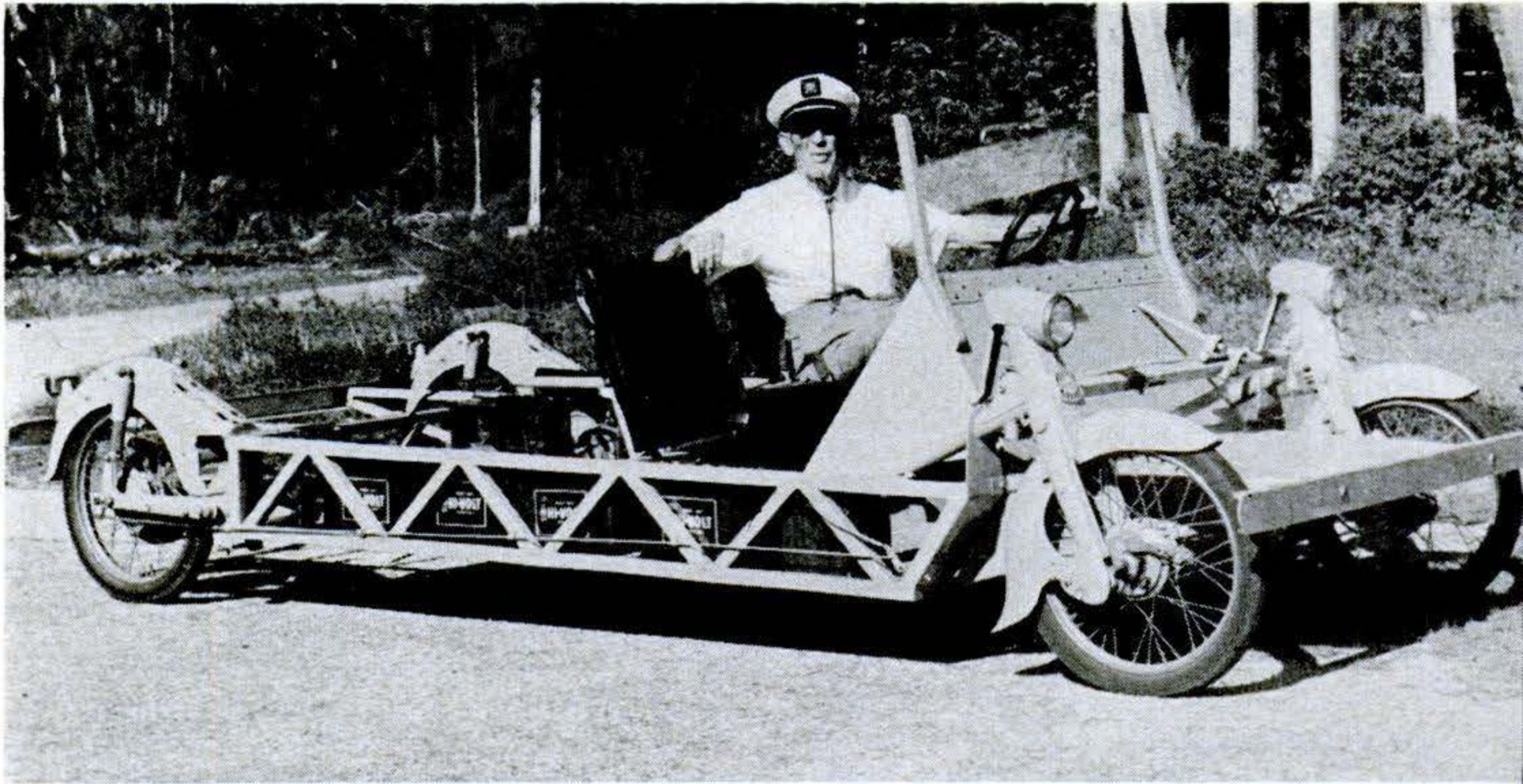
**Body hardware.** You'll be impressed by the many small changes on '68 cars. Side-marker lights—front and rear—are sprinkled throughout all the new-car lineups. Though not part of the safety law now, Detroit expects them to be mandatory by 1969. Front-door vent windows are gone from full-size Pontiacs, Oldsmobiles, Buicks, Cadillacs, the Pontiac Firebird, and Chevy Caprice. On most GM intermediates and full-size cars, the wipers are recessed under a lip at the rear edge of the hood.

Chrysler will bring out its version of the dual-action tailgate made so popular by Ford. Chrysler's has a unique provision for opening the gate from the inside. It's combined with a washer-wiper mechanism to keep the back window clear of dust, rain, and road film. You can also look for some '68 Chevy and other GM wagons to begin selling dual-action tailgates, notably the F-85 wagon (Vista Cruiser), which will be built on a 121-inch wheelbase—a change that affects Buick's Sportwagon, too.

Expect facelifts on Chevy II, Rambler Rebel and Ambassador, Thunderbird and Toronado. The Imperial, Eldorado, and Riviera will have few and very subtle changes. The four-door Toronado Riviera bodies will be delayed until the '69s. **PS**



**Lincoln Continental Mark III** (code name Mark X) will compete directly with Cadillac Eldorado.



Designer Gar Wood sits in the driver's seat of his new low-slung, electrically powered automobile.

## Gar Wood builds an experimental electric automobile

It looks like a king-size bed frame on wheels, but this experimental battery-powered chassis may be on the market, wearing a plastic body, in a year. The car was designed by Gar Wood, former champion power-boat racer of the Twenties and the Thirties.

Wood built what he calls the super-electric car for town use—trips to shopping centers, meet-

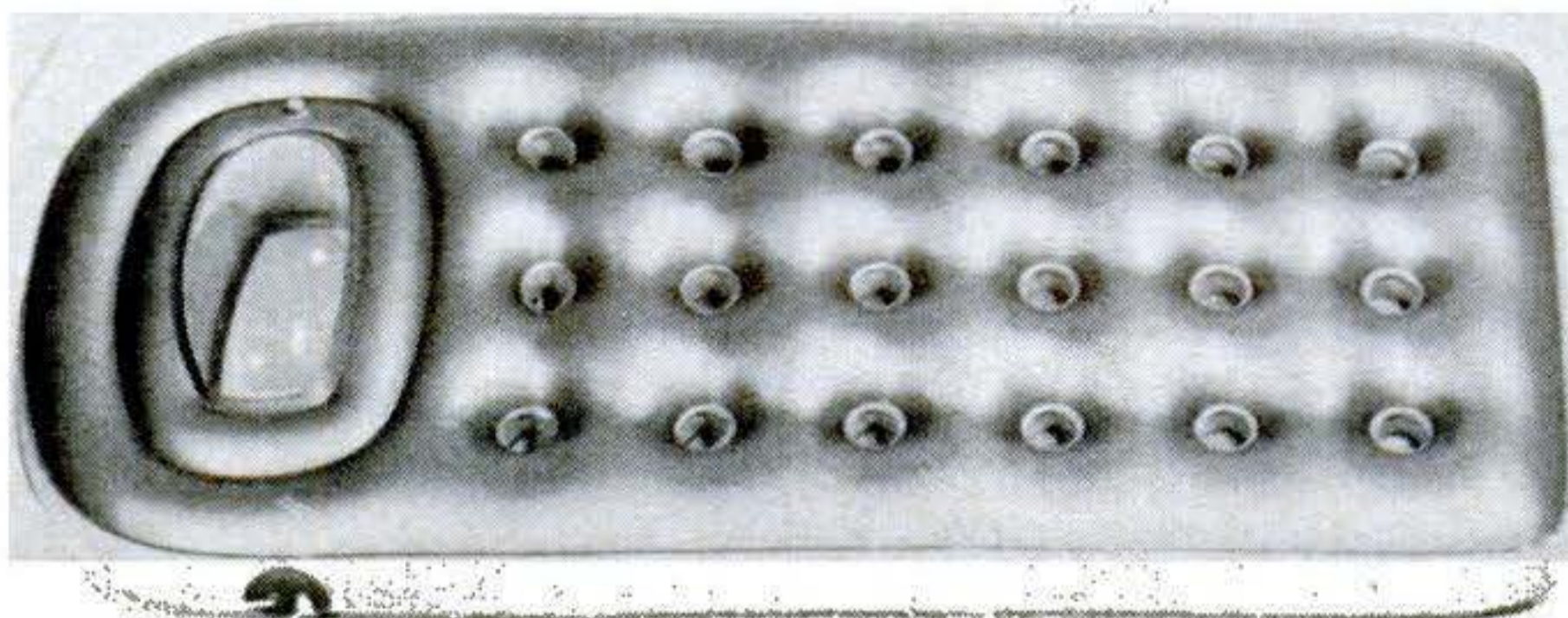
ings, movies, taxiing the kids to school. Powered by eight standard 12-volt car batteries, the Wood model A-1 gets up to 50 miles on a charge. The batteries can be recharged on house current—at 20-amp rate—in eight hours.

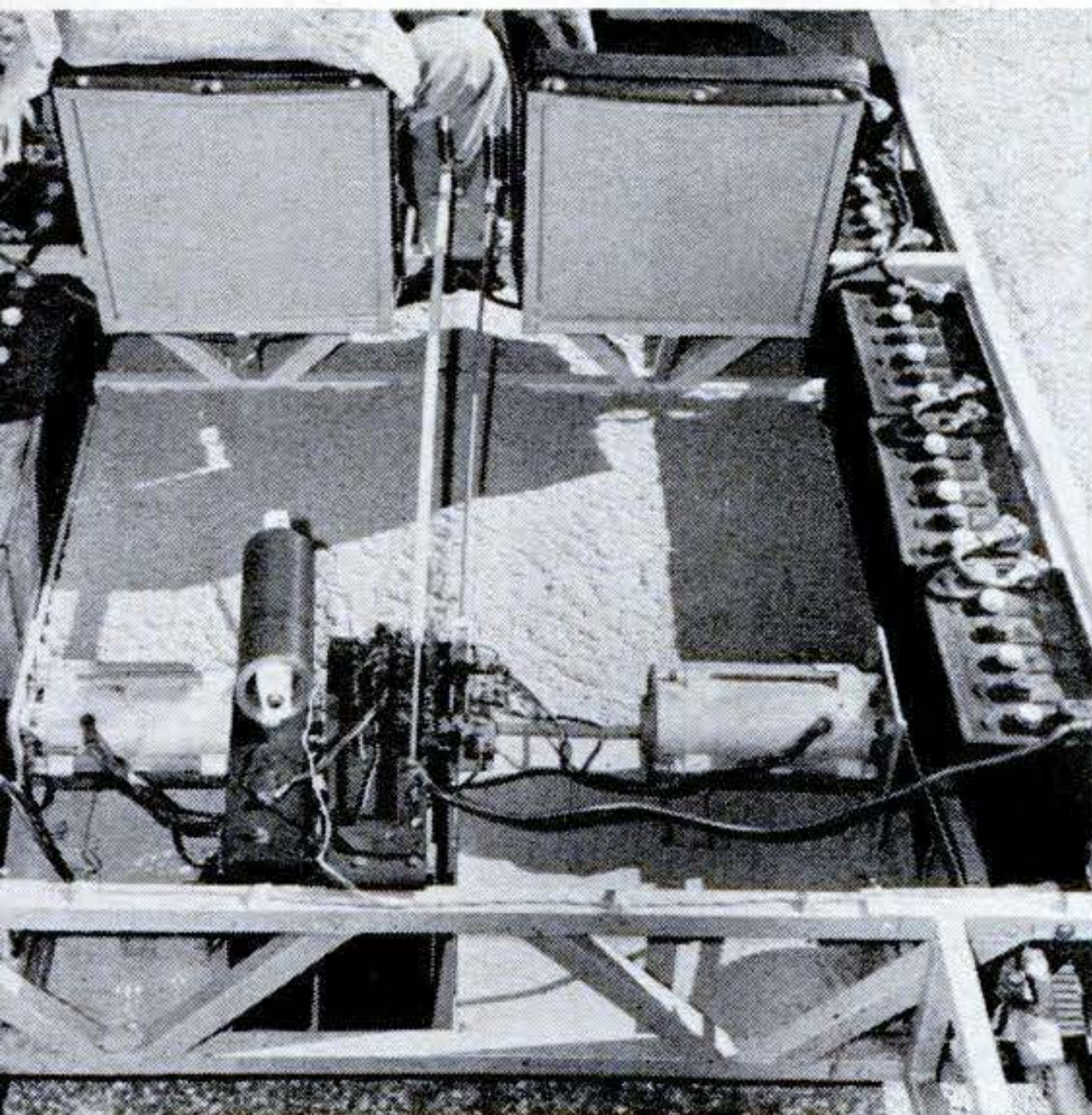
Eight batteries, four along each side of the chassis, are connected in series to power two 1.5-hp. DC motors. Each motor belt-drives a



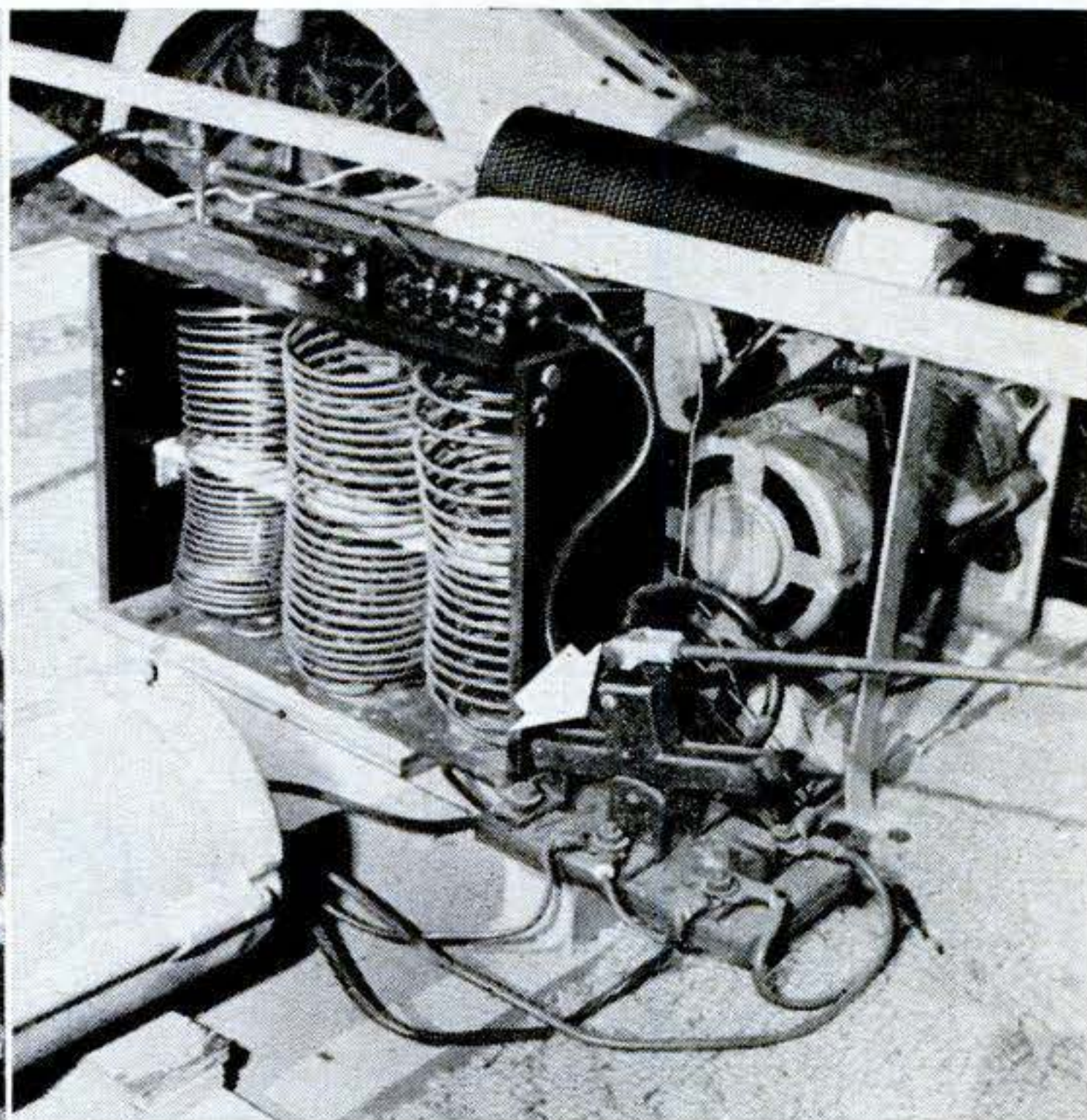
## Inflatable float has a see-through window

You can float and scan the bottom of the bay at the same time on this new air mattress made of Neoprene and vinyl. The plastic window has built-in ventilation to keep it from fogging up. This makes it handy for skin divers to use when picking diving targets, or for students observing underwater life. The float measures 60 by 26 by six inches. It is made by the Kayak Corp. of America, 7 E 38th St., NYC 10016. It's \$15





Four 12-volt car batteries line each side of the chassis. They are connected in series to two 1.5 hp. motors, which each belt-drive a rear wheel.



The Wood model A-1 has no gears or solenoids. The accelerator and forward-reverse levers (arrow) are connected by rods to the motor controls at the rear.

rear wheel. Wood hopes to replace the belt drives soon with direct gear drive.

Each 20-pound motor turns up 12,000 r.p.m. They are cooled by built-in fans. The drive ratio from motor to wheel is 18:1, which gives a 40-m.p.h. top speed. An earlier version had a 14:1 ratio for a 52-m.p.h. top speed. Wood says he will go back to the 14:1 ratio when he

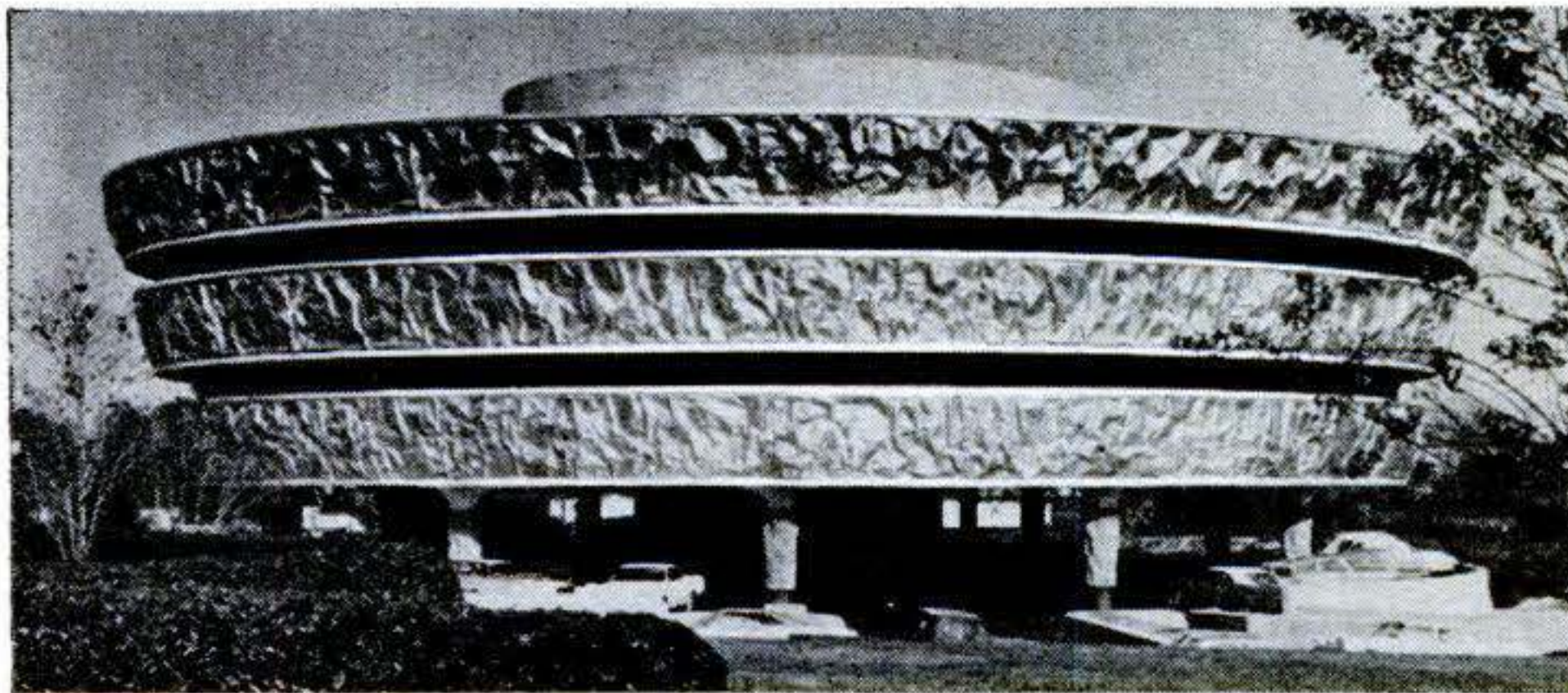
installs gear drive in the auto in place of belts.

Five resistance coils cut the voltage and amps from the batteries to the motors. As the accelerator lever is pushed forward, the coils are bypassed one by one and the car picks up speed.

How much will a super-electric cost? Wood's figures indicate a price of \$1,600 (including batteries); less with mass production.

### Saucer-shaped building

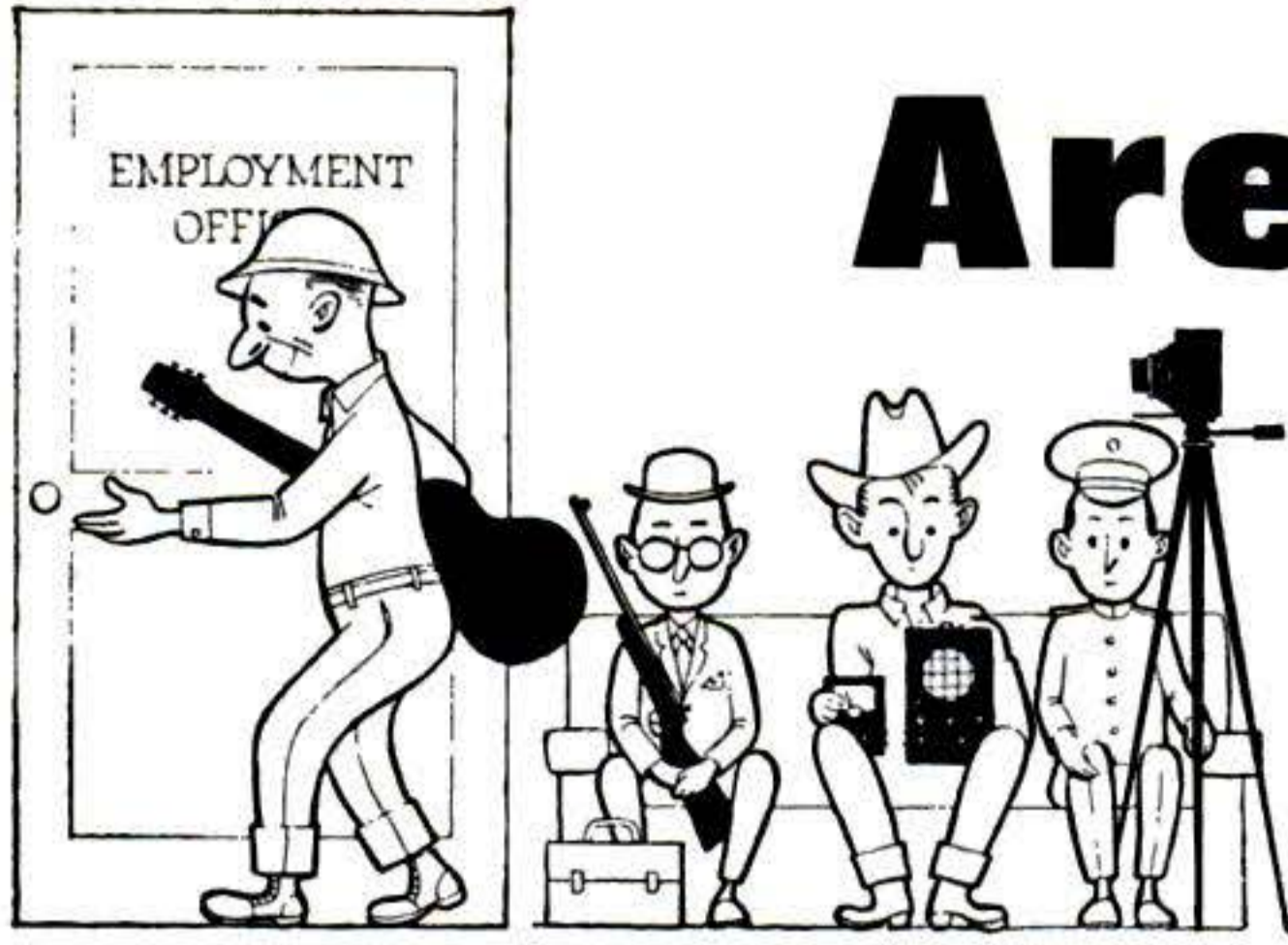
This building in Richmond, Va., has an aluminum facade that gives it the look of a vehicle from outer space. But the aluminum skin has a down-to-earth function: It permits use of continuous 700-foot strips that expand and contract, eliminating seams. The building houses Markel Service Insurance Co.



### Marcos 1600 GT bows in

The latest entry from this British sports-car specialist is a hip-high coupe with a fiberglass body. Its hopped-up Ford Cortina four-cylinder pushrod engine propels it to a top of 120 m.p.h. The 91.4-cu.-in. power plant turns out 120 hp. at 5,400 r.p.m. Foot pedals and steering column are adjustable.





# Are You Making

You'll change jobs at least five times as new jobs open up and old ones disappear. Let this well-known authority show you how to discover your real interests and talents

By **BERNARD HALDANE**, Chairman, Board of Trustees, The Foundation for Re-Employment

**Y**ou're going to have to change your vocation! U.S. Labor Department reports show that most people under 30 will change five or more times, and those over 40 are also likely to change several times.

If you are making the most of yourself—which would put you in a very rare class—you'll find the changes smooth. If you are like most people, you will resist change. In any case, you probably want a smoother ride along the road of progress. This article will give you an up-to-date system that enables you to make the most of yourself and avoid dead-end, obsolete jobs.

Behavioral scientists agree that it is the

rare man who uses more than 50 percent of his abilities most of the time—the great majority come closer to the 25-percent level. The failure of people to live up to the best that is in them was deplored by Dr. John W. Gardner when he headed the Carnegie Foundation. But he provided no formula for doing it. Our method of helping you make the most of yourself is called Achievement Pattern Analysis.

## Analyzing achievement

Nearly everyone can use the system demonstrated by such greats as Henry Ford, Wernher von Braun, and General James

## Guide to Self-Evaluation

Copyright by Bernard Haldane, The Foundation for Re-Employment

1. Sit down with an 8½-by-11 pad of paper and some sharp pencils.

2. Write this down: "An achievement is something I feel I have done well (what others might think of that experience does not count), that I have also enjoyed doing and am proud of. My achievement experiences may be associated with any part of my life—work, recreation, schooling; personal, church or community relationships; hobbies or other activities."

3. Write a couple of lines on two or more achievements for approximately each three years of your life. Write them down as they come to your mind, regardless of when they happened; remembering one will cause you to remember others. Keep on until you have about 20 examples. *It is worth taking the time.*

4. Place a check mark against the seven greatest (to you) of all your achievements.

5. Number those seven in the order of their importance to you. No. 1, the greatest of all;

No. 2, the second greatest achievement; and so on.

6. Starting with No. 1, describe in detail each of your seven greatest achievements. Say what you did, and the results that made it an achievement to you.

7. Write down your hobbies and principal nonwork activities.

8. Identify your job-career elements taking the five following steps:

A. Do the facts (as revealed in No. 6) show you are likely to have additional "great" achievements when you work more with people \_\_\_\_\_ with things \_\_\_\_\_ both equally \_\_\_\_\_?

B. Do the facts show you are likely to have "great" achievements when you work more with hands \_\_\_\_\_ with brains \_\_\_\_\_ both equally \_\_\_\_\_?

C. These 16 job elements are each related to different main areas of work. From stu

# he Most of Yourself?

Gavin. At six, Ford could repair a clock; at 10, he had a flourishing watch-and-clock repair business. At 12, he designed a forge, and supervised its construction in a school yard. At 14, he designed a dam, organized a team to find materials, and built it.

By the time he was 15, Henry Ford's achievement pattern showed ability to run a business that involved the use of moving parts, ability to design, organize, recruit employees, and supervise their work.

Interestingly, Ford worked with the *structure* of his achievement pattern, not with the name given to an achievement or accomplishment at any time. If he had said to himself, at age 10, as many admiring adults did, "you'll be a wonderful watch-maker," he might have become just that.

*If you attach yourself to a job title, and it becomes obsolete, as one third of all jobs already are becoming, you are on the way to career obsolescence.*

## Make changes work for you

What can you do about it, at your age? If a man over 60 can do something about it

with little education or skill, then you probably can. Here is what happened to a man we'll call Joe. Nearly 61, after 40 years with one company and 35 in the same job, he was let out in a general cutback of operations. He had little education, and little skill, according to his employment-office record—he operated a simple polishing drum that is now obsolete.

Two years ago his company joined the growing group of progressive ones that provide re-employment (not retraining) programs for employees dropped because of technological progress. He volunteered to participate in the program for two reasons: "First, I get time off and the company pays me. Second, I don't think you can do anything for me, but you never know."

He was asked to evaluate himself, using the steps given here. Poorly spelled, this is the essence of what he wrote: "I just fixed the broken stock on a rifle so the owner couldn't see where it was broke. I made a set of chairs and a table for a friend who liked it very much. All my friends bring me broken furniture to fix."

*Continued*

of your achievement facts, check from three to five elements you feel were tapped to produce your achievements, and therefore vital in your personal career structure.

- 1) Designing, coloring, shaping things
- 2) Calculating, keeping records
- 3) Observing, operating, inspecting
- 4) Writing, reading, speaking, teaching
- 5) Hand skills: fixing, building, assembling
- 6) Analyzing, systematizing, research
- 7) Inventing, developing, creating, imagining
- 8) Helping people, being of service
- 9) Ideas, beauty, intuition
- 10) Outdoor or travel activities
- 11) Managing or directing others
- 12) Independent work, owning or collecting things
- 13) Performing: music, acting, demonstrating
- 14) Food preparing, homemaking
- 15) Persuading, influencing others
- 16) Science, engineering

D. Each of the above 16 has two to five parts. Underscore the parts that fit you best; then list them in what you believe is their order of greatest importance.

E. Now use all the items checked in No. 8 to write a job description—your true person/vocation description. This shows the kind of work you are likely to put your heart into, and therefore be best at. (Some people find it difficult to be objective about themselves; a wise friend can review your facts and help you think them through.)

9. Examine this vocation or job description for whatever additional training or education you may need to qualify for it.

10. Never forget that you are likely to make most mistakes when you are overconfident (or tired), and are therefore careless in applying your best talents; also when you insist on being "smart," and try to make your less-than-best talents work extra hard. You are more likely to avoid making mistakes when you do things that require the application of your motivated, your will-to-do, skills and talents.

A man who gives this kind of information surely has his heart in working with furniture, making and repairing it. Yet when he was asked, "How about getting into furniture-repair work?" he replied; "How could I? I don't have any experience." He was demonstrating a common vocational sickness caused by prevailing employment-application forms—he had never been paid for his fine cabinetmaking work, could not list an employer, supervisor, or rate of pay.

But there's a happy ending. He took pictures of his workshop and the furniture he'd made, and got testimonials from those who had the furniture. He took these to the foreman of a furniture-repair shop, and said what he had been trained to say: "Can you use a man who does this kind of work?" The resulting job pays much more than he got as a polishing-drum operator.

### How real are your "excuses"?

Nearly everyone has hidden talents, or talents he can use more effectively in the interest of himself and his employer. We often curtain off opportunities to use and develop our best talents, giving self-limiting "excuses" like these:

1) My education isn't good enough (or not right) for that opportunity, so why think about it? (A purchasing agent felt that way. His Achievement Pattern Analysis revealed his heart was in working with color reproduction; he quickly became a TV color researcher, and helped to develop our present color-TV tubes. And did it without retraining or further education.

2) I don't have the work experience.

3) My boss doesn't want me to challenge him or make suggestions. I'm boxed in.

4) I need more training, and I don't have the time or money to get it.

5) My color, nationality, age, or religion are against me.

6) That kind of work can't produce the income I need.

7) I've been demoted; something must be wrong with me.

The smart thing is to ask yourself—as Ford might have—"What is right about me?" There are many things right with *you*, and if you study *them* you will find out how to make what is right happen again, and better the next time. Effectiveness of the Achievement Pattern Analysis system recently earned commendation from Presi-

dent Lyndon B. Johnson as "vital to the continued progress of a technologically advanced society."

To find the structure of your excellence, and overcome the "excuses" that could prevent your progress, here is the way to study, not your mistakes but your achievements. An achievement is simply something you feel you did well, enjoyed doing, and are proud of.

### Evaluating yourself

To get started, write down your best accomplishment of the past year; then your best accomplishment between ages 12 and 17; then your best accomplishment up to age 12. This exercise gets your memory started. Following the "Guide to Self-Evaluation" given here, work out your seven greatest achievements.

Study those seven achievements to find out what you did and which talents you used most frequently in order to make the different achievements happen.

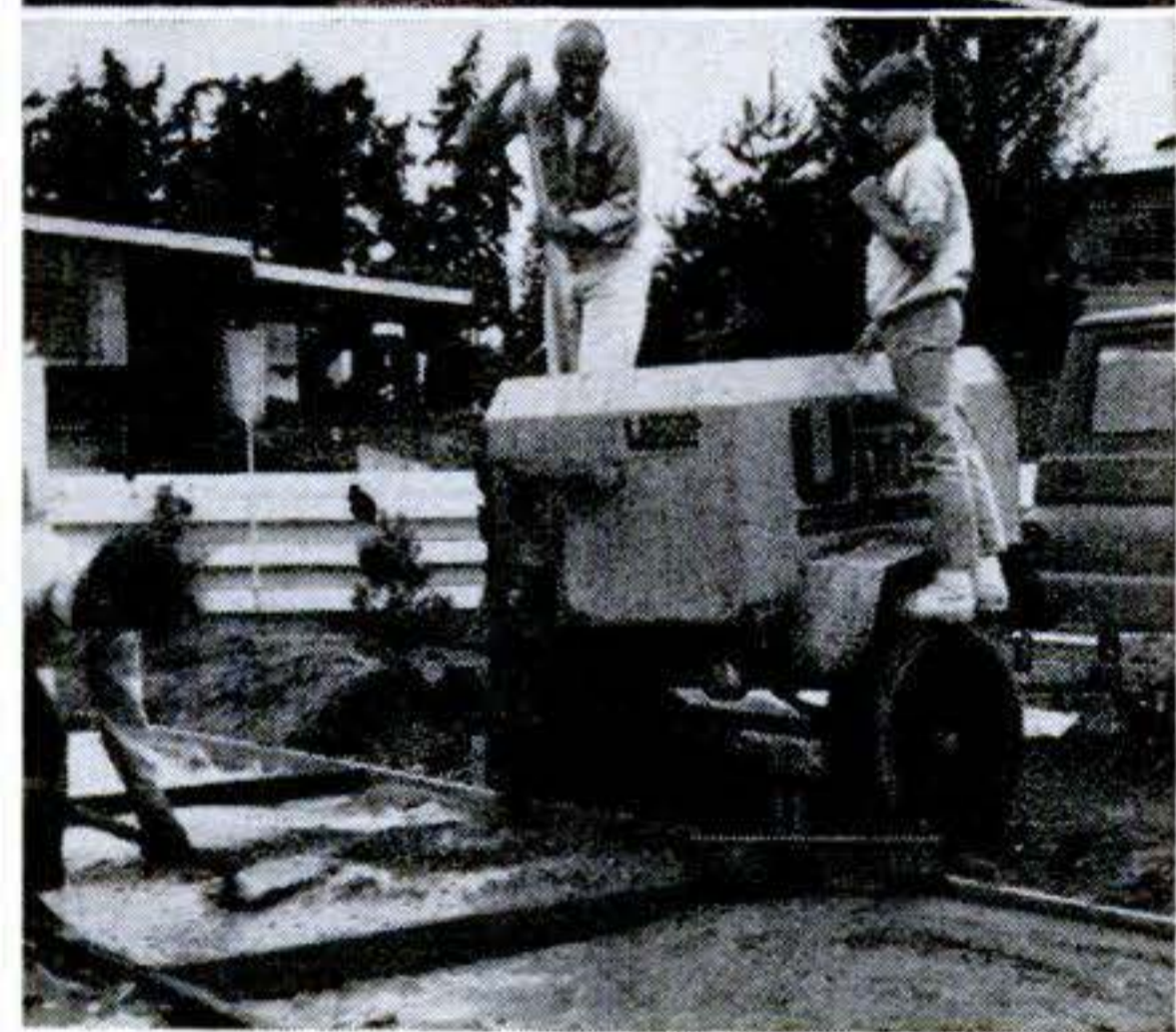
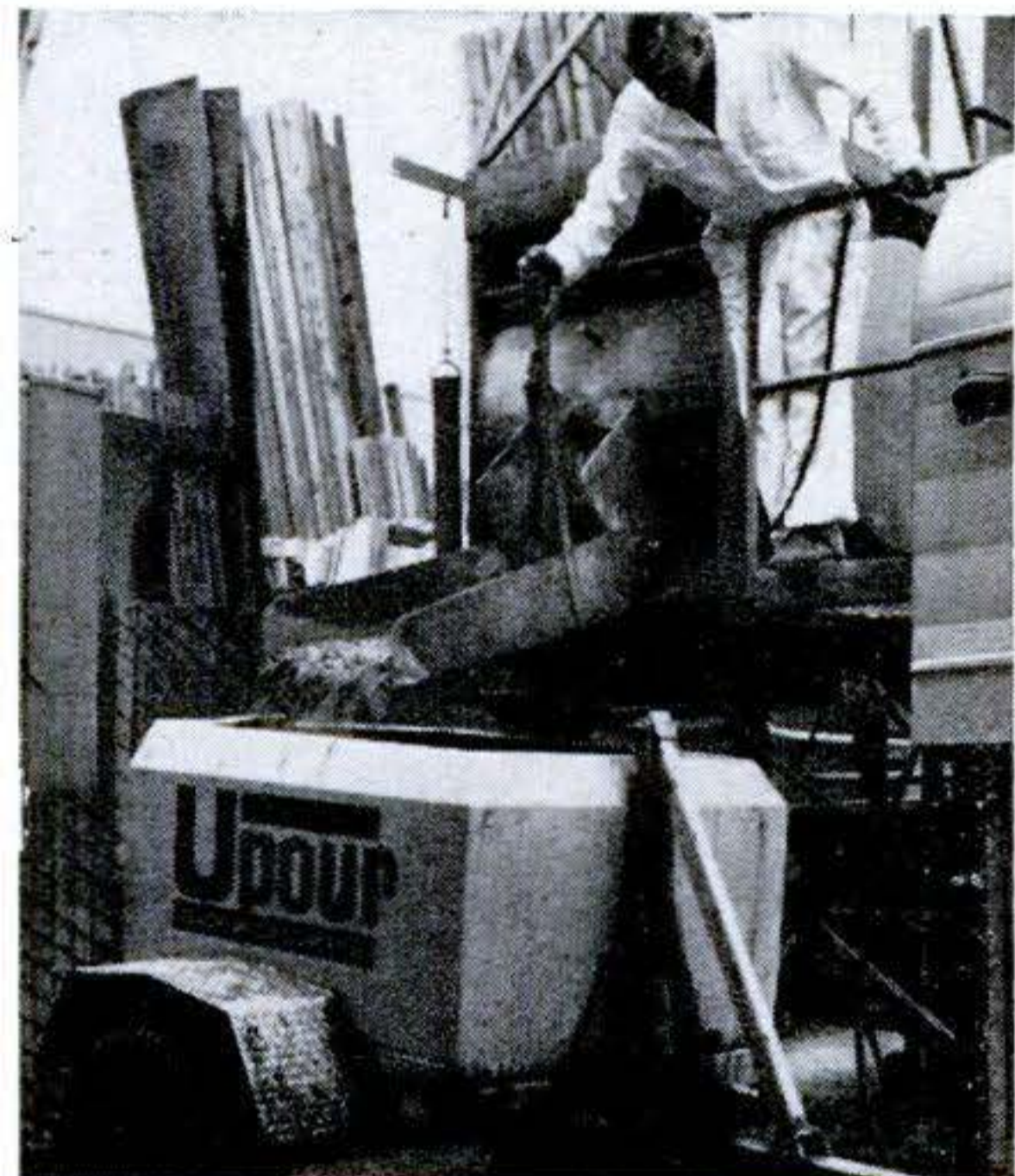
For instance, here are the six greatest achievements of a go-cart designer, a high-school dropout who was told he lacked auto-mechanic experience and education by the State Employment Service in Cumberland, Md.: "As Maintenance Officer 1st Class, supervised a crew of six servicing six-engine jets. While abroad, taught myself how to fix all foreign makes of autos; the officers always had me fix their Jaguars. Designed and built a go-cart that won a race doing over 60 m.p.h.; made it from junked parts—rebored the motor pistons, welded the frame, and rebuilt every part myself; sold it for \$350. Built two more go-carts. Learned to operate all machines in a machine shop between ages 10 and 12; helped my father, a first-class machinist, spending all my spare time with him in the shop."

Those are not hidden mechanical, designing, machine-operating, auto-related talents, but they are talents that cannot be revealed through filling out application forms used by the great majority of companies.

If you think you might not be making the most of yourself, or if you want confirmation of the excellence that is within you, study your achievements—not your mistakes. Find out what is right with you, the structure of your best. Then move ahead—building on that. PS

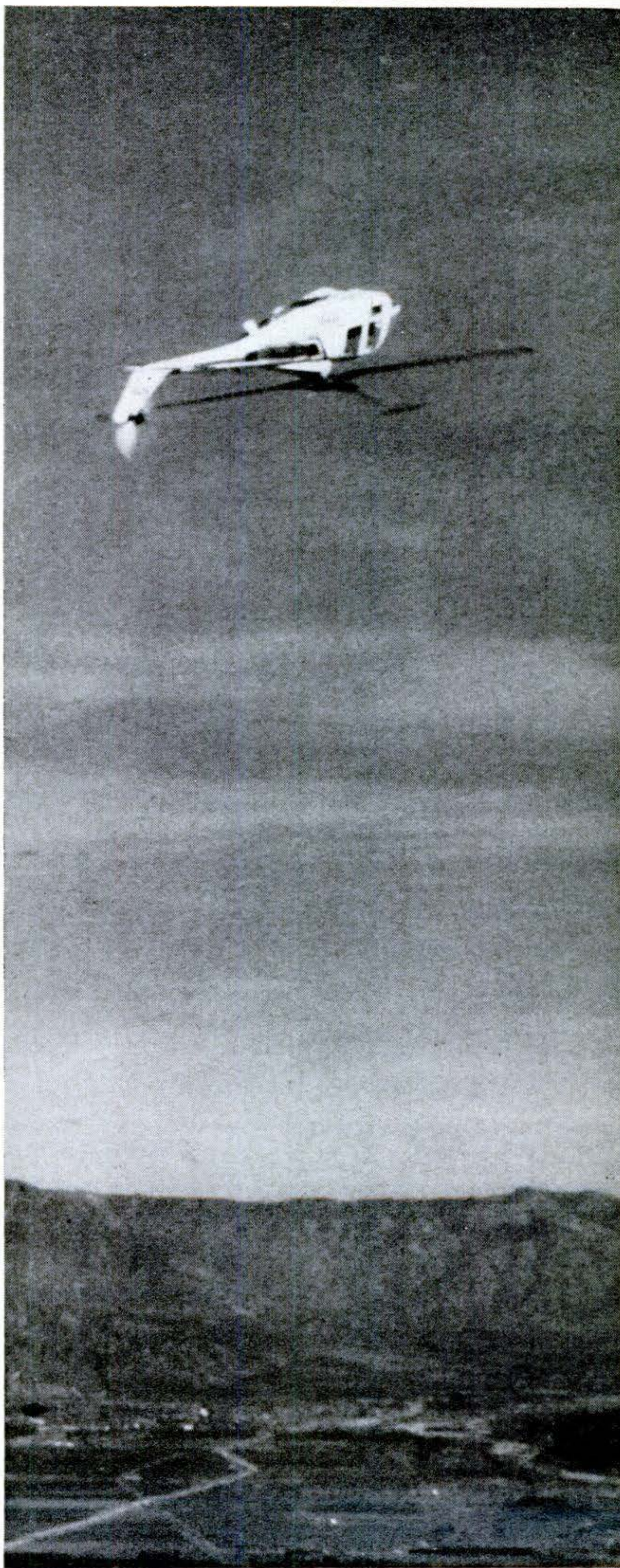
## Upside-down copter ▶

This Lockheed helicopter (right) flies upside down in a recent demonstration of acrobatic maneuvers over Oxnard, Calif. Test pilot Sam Mason put the chopper through loops, barrel rolls, vertical climbs, and dives to demonstrate outstanding flight qualities of the rigid-rotor craft. Lockheed says the copter can outmaneuver a fighter.



## Ready-mix concrete in trailers

You can now haul your own ready-mix concrete in many areas. Developed by the U-Pour Concrete Co., Portland, Ore., the system allows you to rent a trailer with a cubic-yard capacity. It is loaded with ready-mix from an overhead concrete mixer (top). An inhibitor is added to delay setting time. You drive it home and back it up to a prepared form, open the gate in back, and pour (bottom). The customer is expected to wash out the empty trailer before returning it.



# What the NEW AUTO SAFETY

Here's how the U. S. safety standards, recently passed by Congress, will affect your car and its maintenance—and your ability to get and keep your driver's license

*This special report was prepared by PS Automotive Editor Jan P. Norbye, Detroit Editor Jim Dunne, and Senior Editor Herbert Shuldiner after exclusive interviews with top executives of the new Department of Transportation and leading spokesmen for the Detroit auto makers.*

**T**he new federal traffic safety laws soon to go into effect usher in a new era of auto regulation that will eventually touch on every aspect of your driving.

The unprecedented National Traffic and Motor Vehicle Safety Act, which Congress passed last year to combat the rising toll of highway deaths and injuries, will affect:

- Your ability to get and keep a driver's license.
- The new car you buy and what you must do to maintain it.
- The roads you drive on and signs that guide you.

You will begin to see changes brought about by the new laws on all cars manufactured after next January 1. But actually most of the safety standards issued by the National Traffic Safety Agency, which was established to administer the new regula-

tions, will be incorporated into the 1968 models that start coming off the assembly lines this fall.

Many of the standards (see drawing farther on) won't be readily visible because they involve components that are out of view—minimum strength requirements for seats and seat-belt anchorages, rupture-proof fuel tanks, and collapsible steering columns.

Upper-torso restraining belts, however, which will be mandatory for the outside front-seat positions, will be one of the new items you can spot right off. You'll also notice that horn rings, windshield wipers, and control knobs will be made of satinized or brushed metal to dull their reflective qualities. Ford will use vinyl coverings on some of these components.

**Watered-down standards?** Originally there were 23 standards proposed for the '68s, but several, like rear windshield defrosters, load-rating and safety-performance minimums for tires, and headrests, have been deferred, pending further study. Some critics have blasted the National Traffic Safety Agency and its administrator, Dr. William Haddon, for dropping these fea-

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## Highlights of the proposed federal traffic safety standards

**Vehicle inspection**—States will have mandatory inspections of all motor vehicles annually, also prior to first registration and upon sale as new or used car. All vehicles involved in fatal accidents must be re-inspected.

**Driver education** — Comprehensive driver training programs to be set up for all high-school students, and for adults in need of driver education.

**Licensing**—State regulations will require physical and eyesight examinations, driving-skill tests, and examinations for knowledge of traffic laws, signs, and how to handle emergency situations. Licensed drivers to be re-examined every four years for eyesight and

periodically for driving ability. For drivers under 25, or over 65, more frequent exams.

**Traffic laws**—States must develop programs to achieve uniformity of codes and laws throughout the state. These rules must be consistent with those of other states.

**Traffic courts**—All traffic-court records will be centralized. All persons charged with hazardous violations must appear in court.

**Alcohol and highway safety**—It will be unlawful to drive when blood alcohol concentration is 0.10 percent or more.

**Highway design and construction**—States will set up safe highway-design programs, plan to minimize through traffic on local streets.



# LAWS Will Mean to You

tures and for watering down many of the other standards. The critics claim that most of the safety items have been available for the past few years, and that many more advanced safety devices have been ignored.

However, Lowell K. Bridwell, National Highway Administrator, says, "Our initial standards are as good as we could put out now, within the limits that were placed on us by the law and time. But they are a long way from what we ultimately believe should be incorporated in vehicle standards." Additional standards, he says, will be adopted for the 1969 model year.

Also influencing the government to moderate its initial standards were the problems Detroit would encounter with the lead time needed to retool in order to get its new models out on schedule. Even now it appears that the first '68s will not meet the standard that sets minimum requirements for occupant protection in interior impact (number 9 on drawing).

Detroit's Big Four have sued the government to modify the standard, claiming that they would have to stop making cars on December 31 if the regulation is not changed. The Safety Agency has refused to rescind the standard, but has initiated proceedings that may result in the adoption of a modified occupant-protection standard for the coming year.

**Performance standards.** The government standards don't specify any particular designs. They are performance standards, and the manufacturers are free to use any hardware they wish, just so long as they accomplish

*Continued*



## YOU

New federal safety laws are expected to bring more exacting testing of driver applicants with the use of simulators like this at a New Jersey test center.



## YOUR CAR

A New Jersey state inspector checks a tire and wheel. States without inspection laws will have to enact them.



## YOUR ROADS

Designs like this section of Michigan's John Lodge Expressway will become more common.

the required results. For instance, the braking standard doesn't say whether you have to use disk or drum brakes. It only specifies maximum permissible stopping distance and swerve at a given speed.

Dr. Haddon says, "We were criticized for not proposing disk brakes as a mandatory requirement. Actually, the law prohibits this. Besides, we want to avoid freezing technology."

The safety items that will be built into the '68 cars will not only make them a little safer, but, in the manufacturers' claim, also a little more expensive. Detroit auto makers agree that the extra safety belts will increase costs, which will be passed on to you. But it's a little early to estimate just how much more, if any, the other items in the safety package will cost.

Government officials dispute the need for cost rises. They say the auto companies retool for styling changes anyway, and that safety-feature costs can be absorbed at the same time.

**New cars come first.** At first only the buyers of new cars will be affected by the safety laws, but soon they will affect everyone who drives. In September, the safety agency will set preliminary standards for used cars, and these will go into effect a year later.

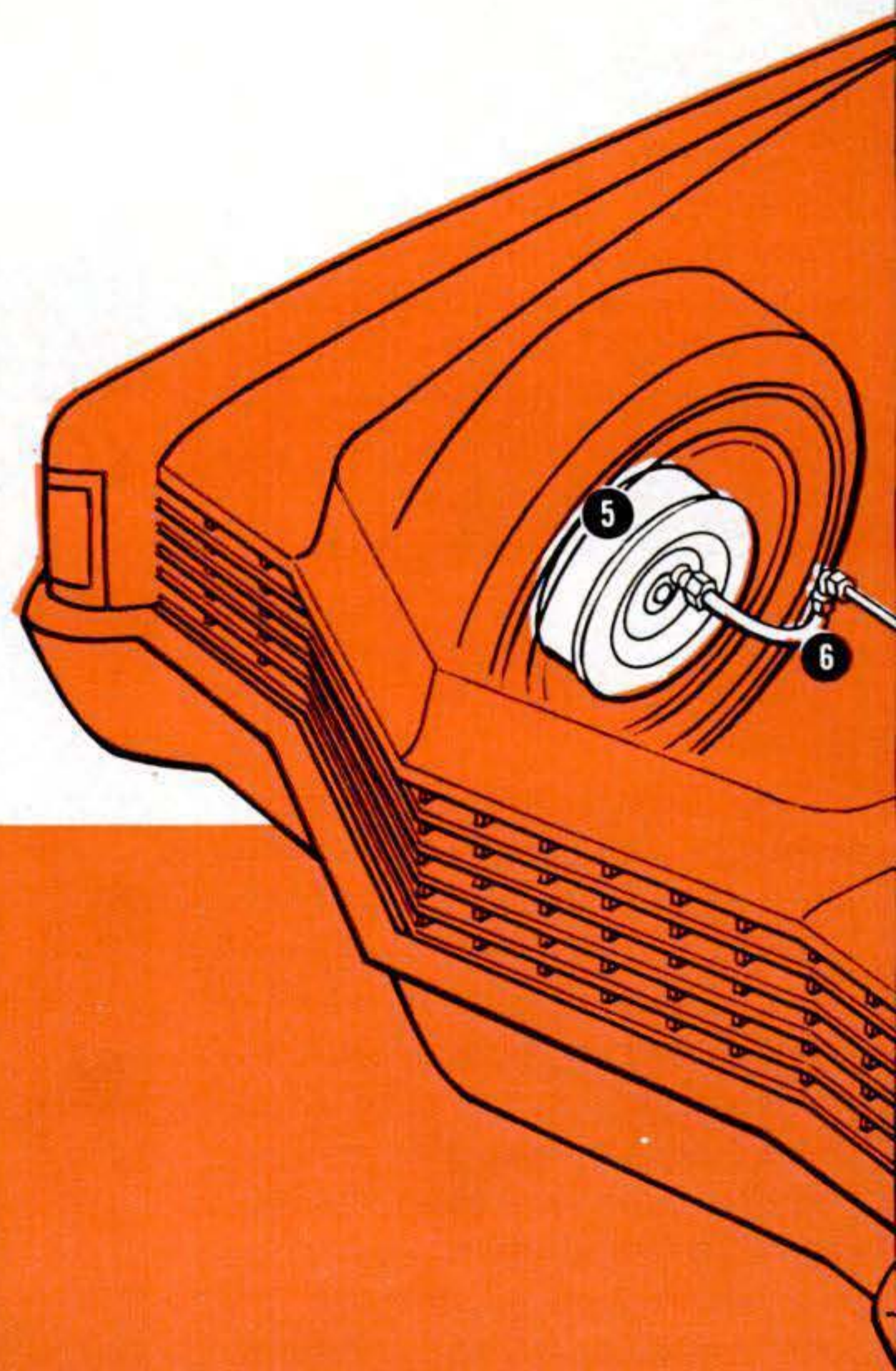
By the end of 1968, all states will have to adopt a uniform highway safety program (see text at bottom of opening page), which will cover licensing, registration, driver education, traffic records.

How will the government insure that the states enact these programs? The Federal Highway Administrator has the power to withhold up to 10 percent of all federal highway construction funds allotted to a state if it fails to enact an improved highway safety program. Will the government actually take such a drastic step?

"It's inappropriate at this stage of the game to talk about how tough you are going to be," says Bridwell. "I refuse to believe that any state is not going to enact a safety program."

But there are strong indications that the power to withhold highway-building funds will be a strong persuader for the states to come up with programs that meet the federal standards. And federal officials are hopeful that many states will not wait until the last minute before swinging into legislative action.

## New Safety Standards Adopted by the Federal Government

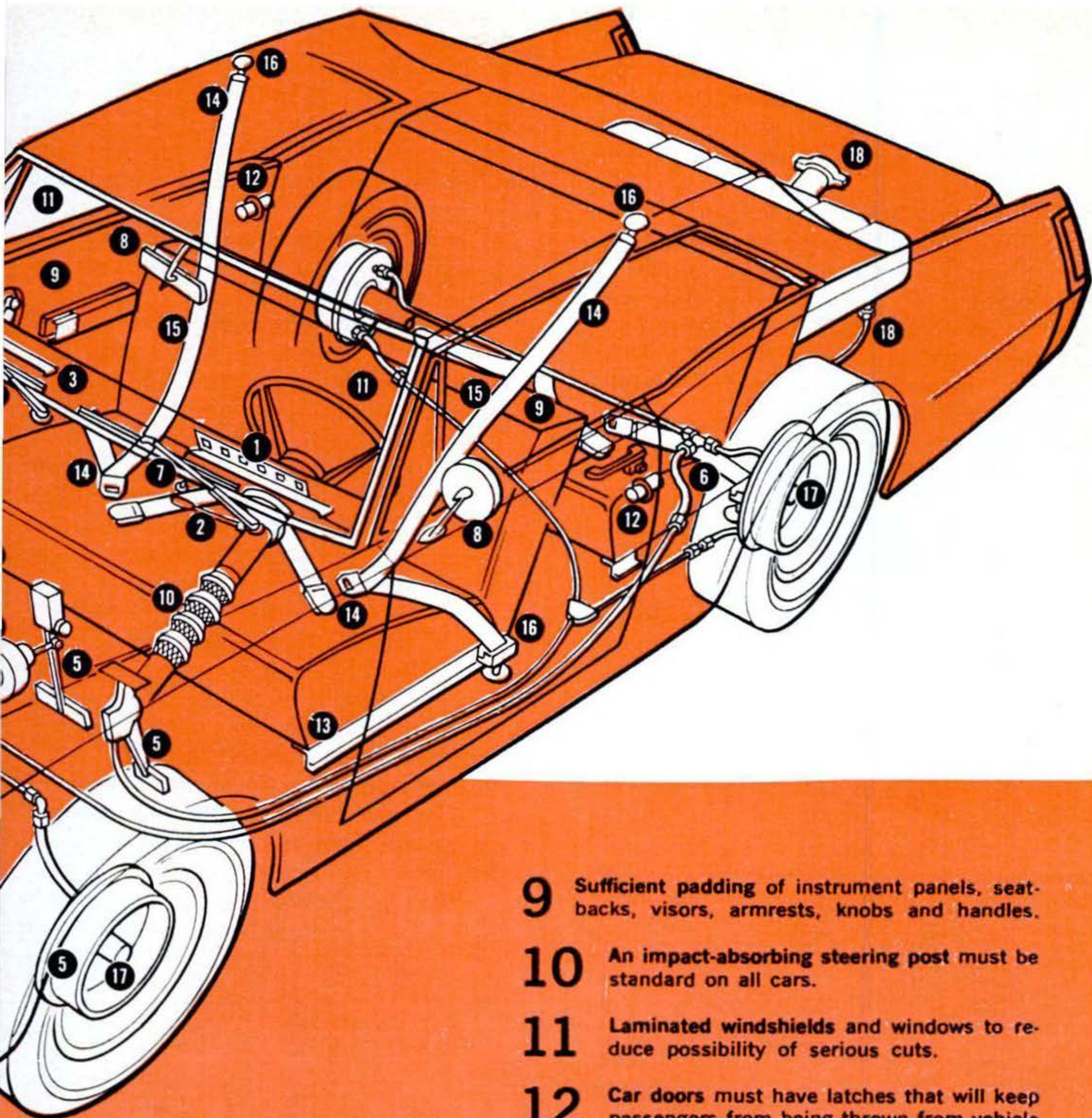


**1** Headlamps, ignition, windshield wipers, and other essential controls must be clearly labeled and within reach of drivers restrained by lap and upper-torso belts.

**2** All automatic transmission shift levers must conform to P R N D L sequence; interlock required to prevent starting car in either reverse or forward drive; and there must be engine-brake effect in one lower gear at speeds below 25 mph.

**3** Front windshield defrosters must work effectively, regardless of how cold outside temperature gets.

**4** Two-speed windshield wipers, able to sweep the windshield at least 90 times per minute, are required on all cars.



Foot brakes must stop vehicle from 80 m.p.h. within 342 feet in a 12-foot lane. Parking brake must hold on a 30-percent grade. A warning light must indicate failure of the hydraulic system. A dual brake system is required to prevent total hydraulic failure.

Hydraulic brake hoses must withstand rigorous failure tests.

Windshield-wiper arms, moldings, horn rings, other body hardware must have dull surfaces to cut reflection into driver's eyes.

Rear-view mirrors must give clear, unobstructed view of rear (second mirror on passenger side cars with narrow rear window) and be designed to break away on impact. Outside left mirror is mandatory.

**9** Sufficient padding of instrument panels, seat-backs, visors, armrests, knobs and handles.

**10** An impact-absorbing steering post must be standard on all cars.

**11** Laminated windshields and windows to reduce possibility of serious cuts.

**12** Car doors must have latches that will keep passengers from being thrown from vehicle in an accident.

**13** Seat anchorages must be strong enough to prevent their coming loose in an accident.

**14** Lap and upper-torso belts for outside front-seat positions, lap belts for other seats.

**15** Belts must meet latest requirements of National Bureau of Standards.

**16** The strength of anchorages must be compatible with belts and there must be anchorages for upper-torso restraint belts for rear out-board passengers.

**17** Spinner hubcaps and other winged wheel projections are outlawed.

**18** Fuel tanks and connecting hoses must be rupture- and leak-proof in a crash.

## It will take a lot more work—and some years—to cut the accident toll

Although the deadline is September, 1968, Bridwell says he hopes "to get the auto-inspection program going, in those states that do not have them, much sooner than that."

Dr. Robert Brenner, Haddon's deputy, says, "We are going to generate knowledge about used-car safety and encourage the development of many high-speed automated techniques that will drive the cost of inspection down."

**Better inspection equipment.** To effectively handle the volume of cars that will need inspection when stiffer regulations go into effect, federal officials propose to increase the use of X-ray and electronic diagnostic equipment. "We are going to push ahead with demonstration projects and manpower training programs," Brenner says.

What safeguards will there be for the car owner whose vehicle must be inspected at service stations that stand to make a profit by finding defects that need to be corrected? Brenner admits that the standards have no provisions for solving possible abuses by privately owned inspection stations.

The safety program will also have a great impact on what drivers have to know and what they will have to accomplish in order to drive. Bridwell says that doesn't

mean that licenses are going to be taken away from people. "But if we are any good at what we set out to do, we should be able to give greater assistance and greater training to drivers to make them better and safer drivers.

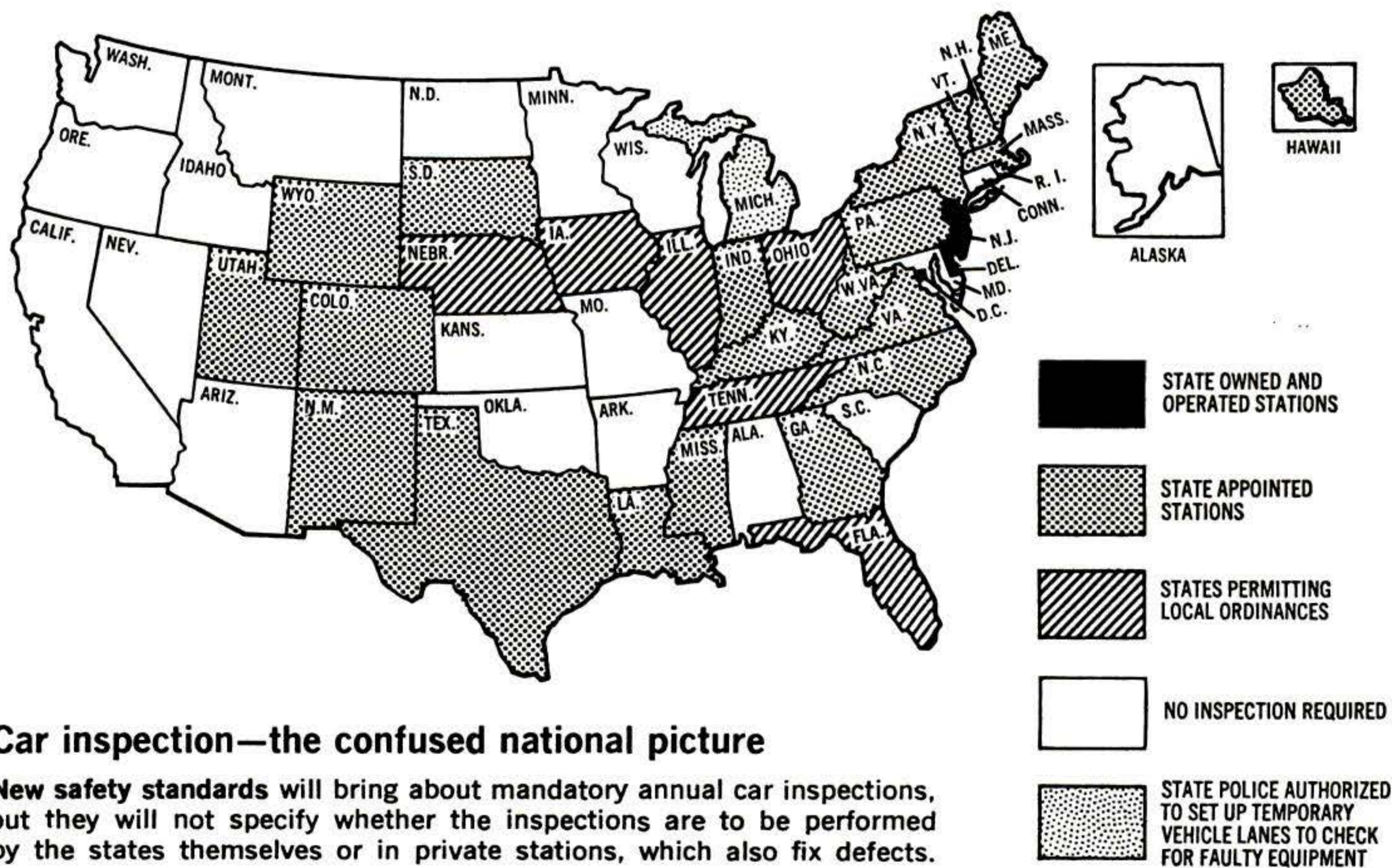
"It's up to us to set the goal or the level of proficiency that a driver-training system has to be able to accomplish," he says. "But whether this is done in private or public schools, by regular or special teachers, is up to the states."

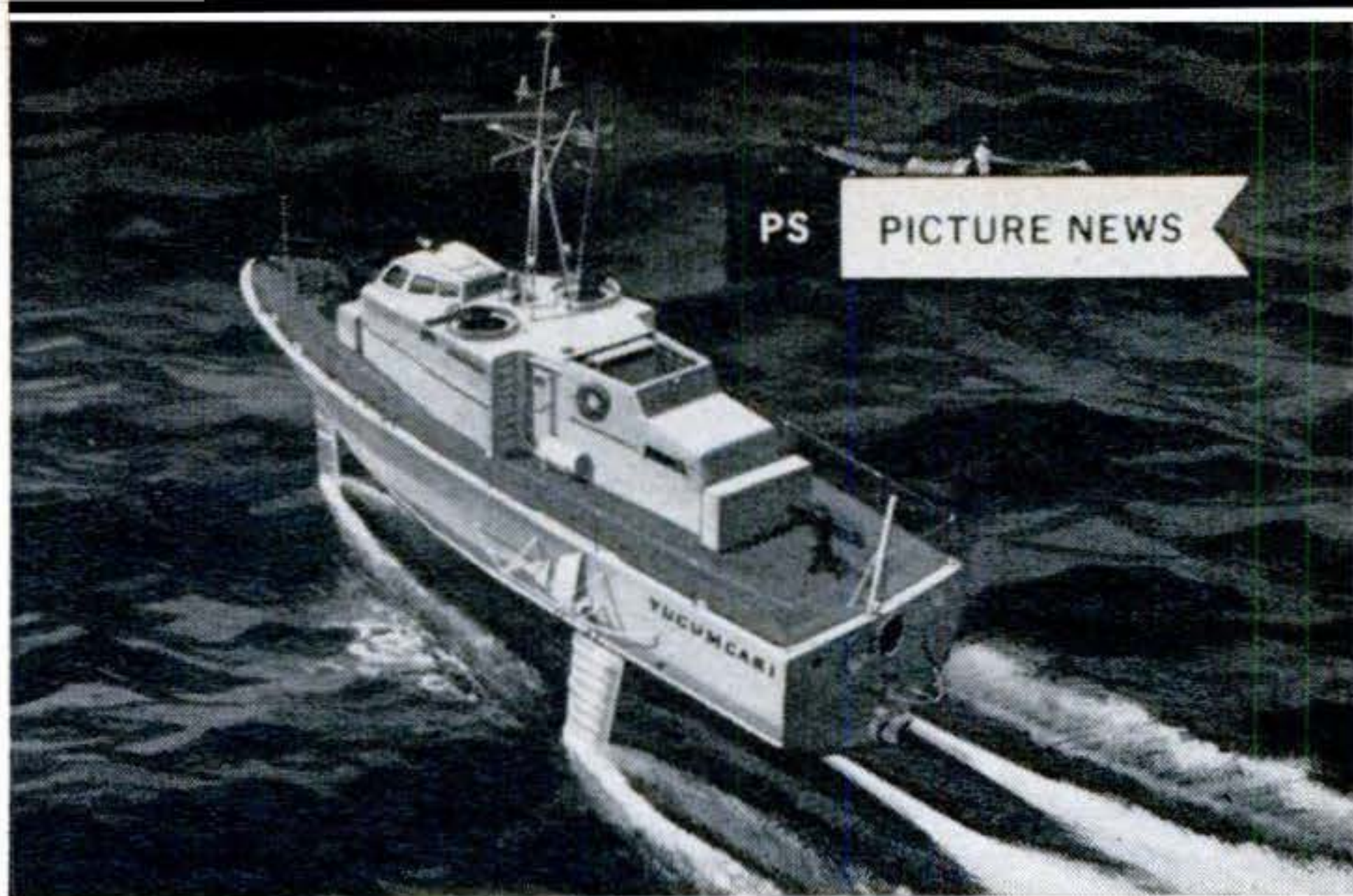
**About eyesight.** Because the standards will result in stricter licensing regulations, many people may not be happy. There are people who are now listed as legally blind who still get driver's licenses in states that don't require eye exams. Mandatory vision tests will get these drivers off the road.

Other features in the safety laws that will yield benefits to you, but more slowly, will come from federally sponsored research. The new standards require the states to collect a great deal more data relating to accidents. Computers will sort it.

"Accidents happen in classes," Bridwell says. "Intersection accidents, grade-crossing accidents, rear-end collisions, result in higher death or injury rates than others. We'd like to place the emphasis on the

*[Continued on page 195]*





**New hydrofoil boat to be launched for Navy**

Better than 45 m.p.h. is expected from this new jet-propelled hydrofoil gunboat, being built for the Navy by the Boeing Company. Water will be drawn through aft struts into a centrifugal pump and be discharged through stern nozzles above the water line. Named the Tucumcari, the 71-foot vessel is scheduled to be launched this summer.



**Giant Russian helicopter-crane hauls a bus**

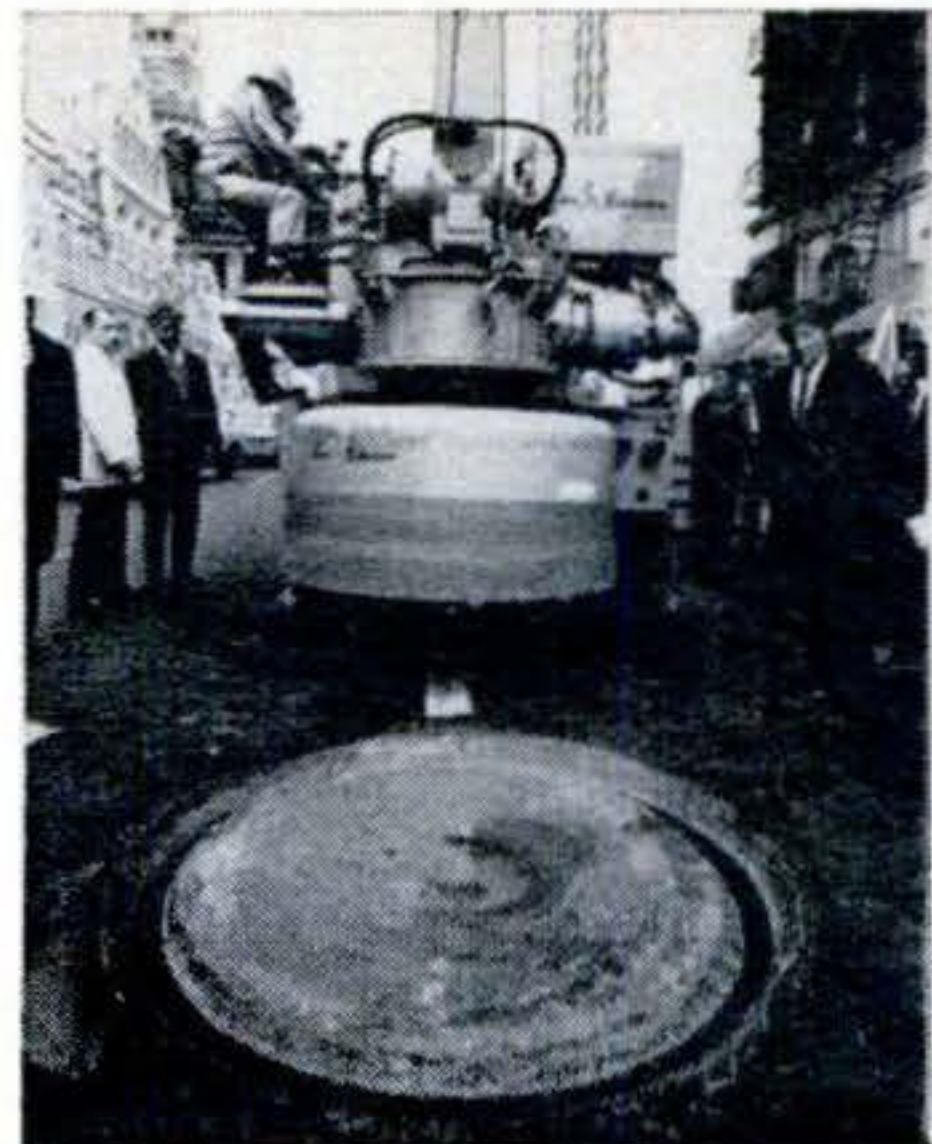
This bug-faced Russian helicopter seems to float in the air like a giant spider at a recent demonstration at Gatwick, England. The huge chopper is shown carrying a bus on a platform fitted in the undercarriage. The platform has hydraulically operated grips that can be controlled by the pilot in the cockpit or from a panel located outside the helicopter.

**THE WINNERS!**

Here are the lucky entrants who won the top prizes in the February PS Spot-the-Cars Game:

**1ST PRIZE—THE CAR plus 1,000 gallons of gasoline**  
A/1C Thomas Piscione, 485th GEEIA Squadron  
APO San Francisco

**2ND PRIZE—HEATHKIT 25-INCH COLOR TV**  
Michael Bushko, 481 Gansevoort Blvd., Staten Island, N.Y.



Pavement cutter slices out circle.



Workmen apply clamps to section.



Huge slab is easily lifted out.

**Street "cookie cutter"**

This new pavement drill may replace the nerve-racking rat-a-tat of jackhammers to open city streets for utility repairs. The Road-Bor is a bell-like cutter which has tungsten-carbide-faced teeth on the bottom. The drill rotates into the pavement while water is fed into the unit to lubricate the cutting edge and hold down dust. The truck-mounted machine can cut a slab up to five feet in diameter.



# Only One Wheel to a Customer!

How our do-anything reporter learned to ride the most baffling contraption ever devised by man: the unicycle

By ROBERT GANNON PHOTOS BY BILL TETLOW

**N**ow it had become routine. First, I balance on the unicycle, touching the wall with one hand and holding the other out for balance. Then I push off and start to pedal. The cycle swivels, zips out from under me, and smacks against the far wall as I slam to the floor.

Somehow, I was making no progress at all. My ability as a unicyclist was only slightly better now than when I had bought the thing two weeks before.

Unicycles, so I had heard, are having a sort of boom. Absurd—but clubs have sprung up across the country, Japanese imports are multiplying, U.S. bicycle manufacturers are tooling up to go into unicycle production. Even the TV Monkees ride unicycles in their weekly program opener. So, if everyone else is doing it, why shouldn't I?

My cycle, a Japanese model, cost me \$33—about average, I learned later. Shiny gold with a red-and-white seat. Very circusy. No instructions came with it. "How do I go about starting?" I asked the clerk.

"You crazy?" he said. "How should I know? You couldn't get me near one of those things. Why don't you try ski poles?"

A bad suggestion. The only ski poles in the house were bamboo, and almost immediately I fell on one and broke it.

**Lots of ways to fall.** But first let me tell you what it's like sitting on a unicycle when you don't know what you're doing. Before you try, you think it's going to feel like a bicycle, only more wobbly. It's nothing of the sort. A bicycle can fall sideways, sure. But a unicycle can fall also to the front or back, or the wheel can scoot out, or it can twirl—which it does whenever you try to push on the pedal. The only way it can't go is up. It's like trying to tap-dance on ball bearings, or balance on a revolving tightwire.

Up on the unicycle, leaning against the wall, I felt utterly helpless without a handlebar to grab. I knew the theory—always keep your body over the axle—but the practice seemed impossible. I needed something to hang onto.

I threw a rope over a rafter in the laundry room and, while hanging on the two ends for balance, launched myself. Four feet later—something of a record—I ran out of rope, let go, spun once, and shot the cycle against the far wall. That's when I first began tying a pil-

*Continued*

! Cycle slides out, leaving Gannon dangling from pulley rope.



It's easy. You find a hallway and use your fingers.



Undaunted, our hero hangs from a rope; then—wham.

Balancing pole just postpones the inevitable crash.



low to my rear. (I also tried lining my prospective route with two old mattresses, but I usually managed to fall between them.)

**Getting help.** Inspiration: I'll call the Monkees and find out how they learned.

I did. But no good. If you look closely at the opening of the show you'll see that each Monkee's unicycle has bicycle "training wheels" following behind.

Okay, then, I'll ask elsewhere. If anyone would know how to ride one of these things, I figured, it would be a unicycle maker. But in answer to my query, H. P. Snyder, president of Snyder Manufacturing Co., Little Falls, N. Y., wrote, "All we know about the unicycle business is that the consumption of same in this country seems to be growing . . . [but] we have not had enough experience with it to answer your questions intelligently."

Well, then, I'll go to the industry spokesman, the Bicycle Institute of America. But all I got from those people was a batch of newspaper clips picturing smart-alecky kids riding unicycles as if they were tricycles.

One clip showed a Bronx basketball team playing while riding, and another pictured Steve McPeak, a West Coast college junior, riding atop a unicycle 20 feet high.

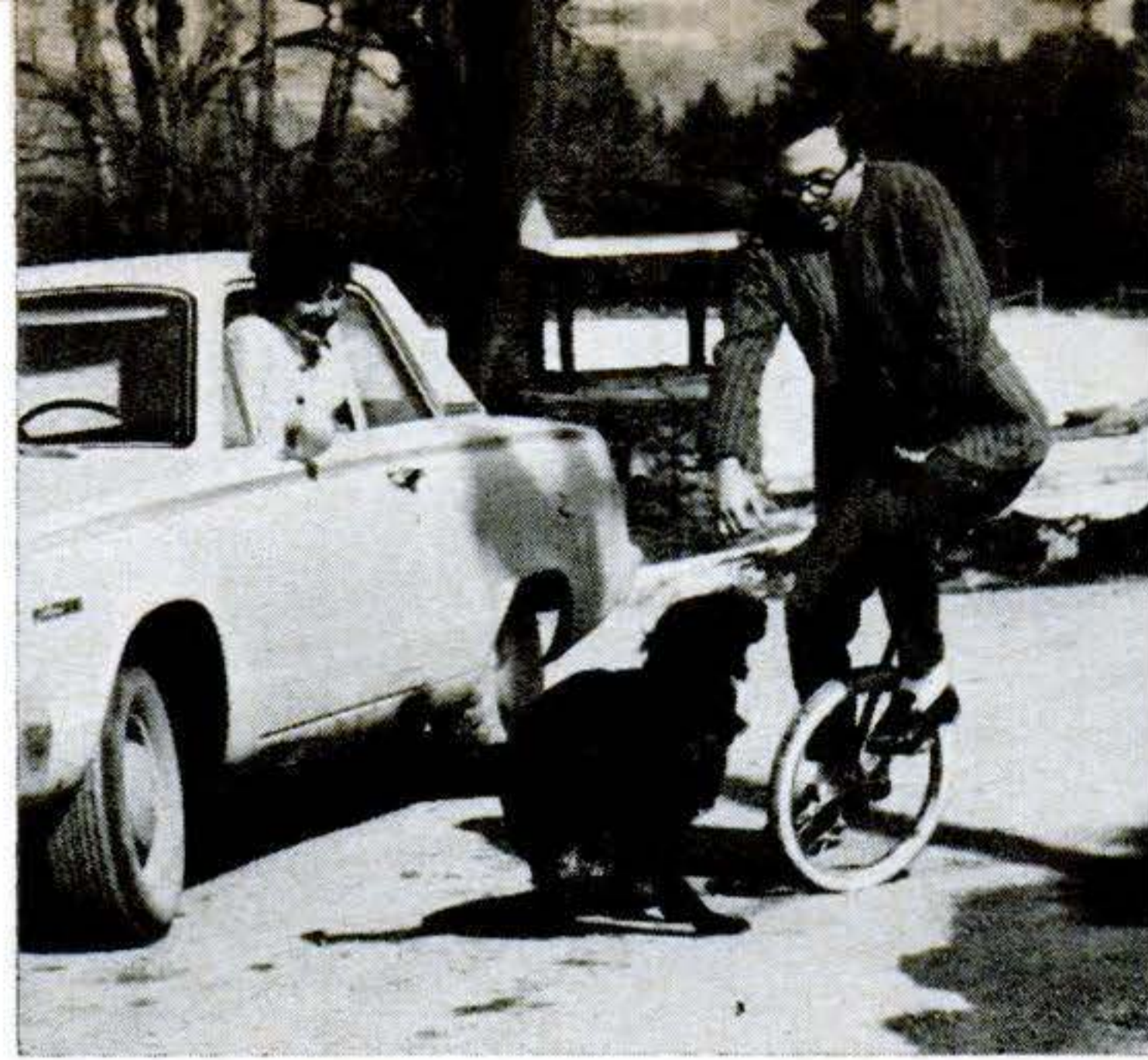
A kid named Sput McWilliams of Pound Ridge, N. Y., rides one well, so I heard. He's only nine. I telephoned him and asked if he had any suggestions for me. He thought a minute, then "Yes, I do. When you think you're going to fall, lean forward so you'll land on your hands." Yeah. Thanks.

How far can little Sput go? "Oh, I can ride miles if I want. But I don't want to often." How did he learn? "I just kept trying in the kitchen, day after day. Then my father said that if I could stay on it outside for two minutes he'd give me five dollars. I won the five."

A call to another unicycle maker—Columbia Mfg. Co of Westfield, Mass.—got Bill Leighton, the advertising manager, who said that sales were rising merrily. "But they're the devil to ride," he admitted. Does *he* ride? Of course not.

He had one great suggestion: "Somebody told us of a guy who learned riding in a swimming pool. Your body is buoyed up, and your machine, by its weight, stays down." He seemed serious.

Out in Sherman Oaks, Calif., an ex-vaudeville unicycle rider named Cycling Cy Campkin lectures high-school students on



Ignoring the stares of the curious, author practices outdoors. Problem: Dog bites him when he sets off.

the evolution of the bicycle. During his talks he rides a unicycle. He's 62. "You shouldn't have much trouble at your age," he said.

When Cycling Cy was first married, he wanted to put his wife into his act as a unicyclist, but he found she couldn't even ride a bicycle. No matter; he taught her, anyway. She still can't handle a bicycle.

"It's rare that anyone gets hurt learning," Cy told me. "When you fall off you usually land on your feet . . . [pause] . . . unless you come down on the bike, of course." Yes.

His recommendations to me: Learn to rock before you run. "Inflate the tire so it's hard, then hold on to something and rock back and forth like a pendulum." I tried it, and except for the skin I lost scraping my ankle bones against the pedal crank, found I was pretty great. Until I let go of the wall. Then zip—smack—the floor again.

**Which size?** Meantime, as the days passed, I was picking up information about unicycles themselves. They come in three sizes, I learned: too little, too big, and just right. The wheel of the small size is only a foot or so in diameter—the correct one for kids under 60 pounds to learn on. They cost about \$10. One Levittown, N. Y., bicycle shop is reported to have sold 1,100 of them just before last Christmas.

Also available is the 24-inch size—a good unit, but not for beginners. The small additional distance from the foot to the ground means that when a rider falls he has a harder time landing on his feet.

Best for adult beginners is the 20-inch.

Equally important, agree the experts, is the seat. "An ordinary bicycle seat is intolerable," says one. "The tendency of a





See that mud puddle dead ahead? Exuberant from his near success with the unicycle, author didn't.

With weeks of effort and some coaching, Gannon rides confidently. "Less work than walking," he says.

seat is to slip out backwards. A bicycle seat has a small nose, so the minute you start to pedal, it's gone." A correct seat looks something like a giant padded banana.

To identify a well-built unicycle, you look for the same things you do in a bicycle: pneumatic tire, quality frame and pedal, ball bearings, a thick axle. In a bicycle shop, a buyer should compare the unicycle with both expensive and cheap bikes. (Incidentally, though few shops stock unicycles, any can order them.)

My trouble, however, was due not to the bike, but to my approach. I figured that my biggest problem was a rather constant worry about my bones. So I stretched a half-inch rope across my recreation room, supported at the ends by massive eye screws. Along the rope ran a pulley, and hanging from the pulley: me. With the pulley rope attached to my belt, adjusted so that I wouldn't quite reach the floor, I couldn't break anything.

Wrong again. I broke the house. The third time I fell and put my full weight on the rope, the room became a caldron of dust as a huge section of plaster jerked from the wall.

**Help from the pros.** My gimmicks pretty well used up, I had only one thing left to do: get professional help. So with unicycle tossed in the back of the car, I drove to Westbury, N. Y., to the home of an ex-

circus unicycle rider named Bill Jenack. Thirty-five years ago he built one and learned to ride it in his father's barn, then ran off to join a circus.

Now a computer technician, Jenack worked his way through college as a unicyclist, today spends his off hours building cycles in his garage and teaching local kids to ride them. Trim, sandy-haired, and solid at 49, he's taught hundreds of people to ride—everyone from his son, who learned when he was four, to a 63-year-old philosopher, to a blind mathematician.

Jenack can teach most people the elements of riding in three days, he claims, working at it less than 15 minutes a day. At that point they know enough to ride along holding hands with an experienced unicyclist.

"One thing wrong with you is that your cycle seat is too low," he said, eyeing my scuffed beauty. He adjusted the seat step to the point where, when I sat down, my leg was almost, but not quite, straight. "That's so if you want to stand up and rest, you can," he explained. "You have your seat on backwards, too." He swiveled it so the longer end was forward, then adjusted it to lift the front an inch higher than the rear.

**Up from the gutter.** The best place to learn, according to Jenack, is in the gutter.

*[Continued on page 193]*

## Do you have an idea for Bob Gannon?

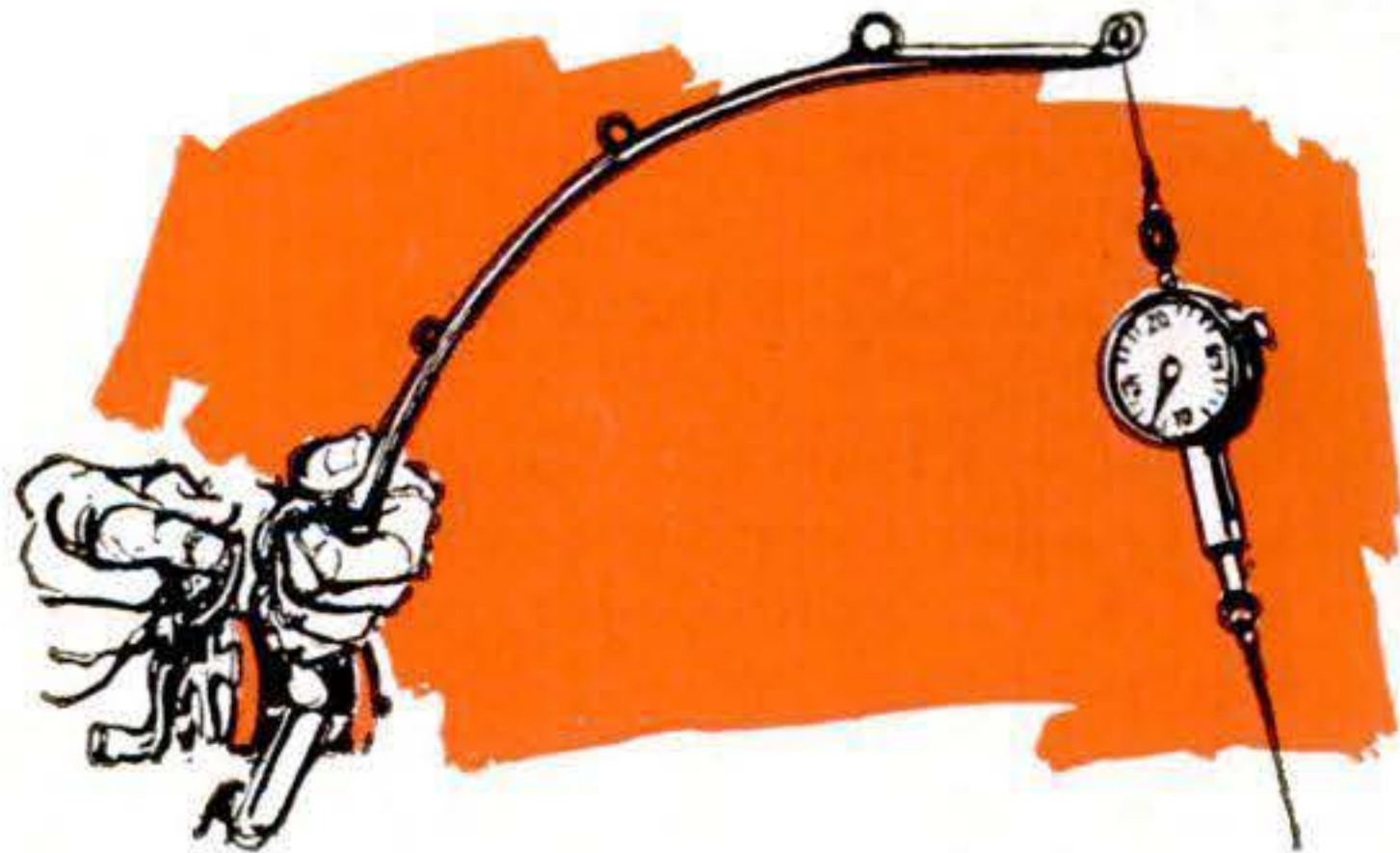
Bob Gannon, PS go-anywhere, do-anything reporter, likes to do the highly unusual. As proof, he has swallowed a camera [PS, July '65], taken a jungle-survival test [Aug. '65],

and flown in a man-carrying kite [Aug. '63]. If there's something you'd like to do but can't, or would like to see someone else do, write to Bob Gannon, Popular Science, 355 Lexington Ave., NYC 10017. All ideas will be considered, but none can be acknowledged or returned.

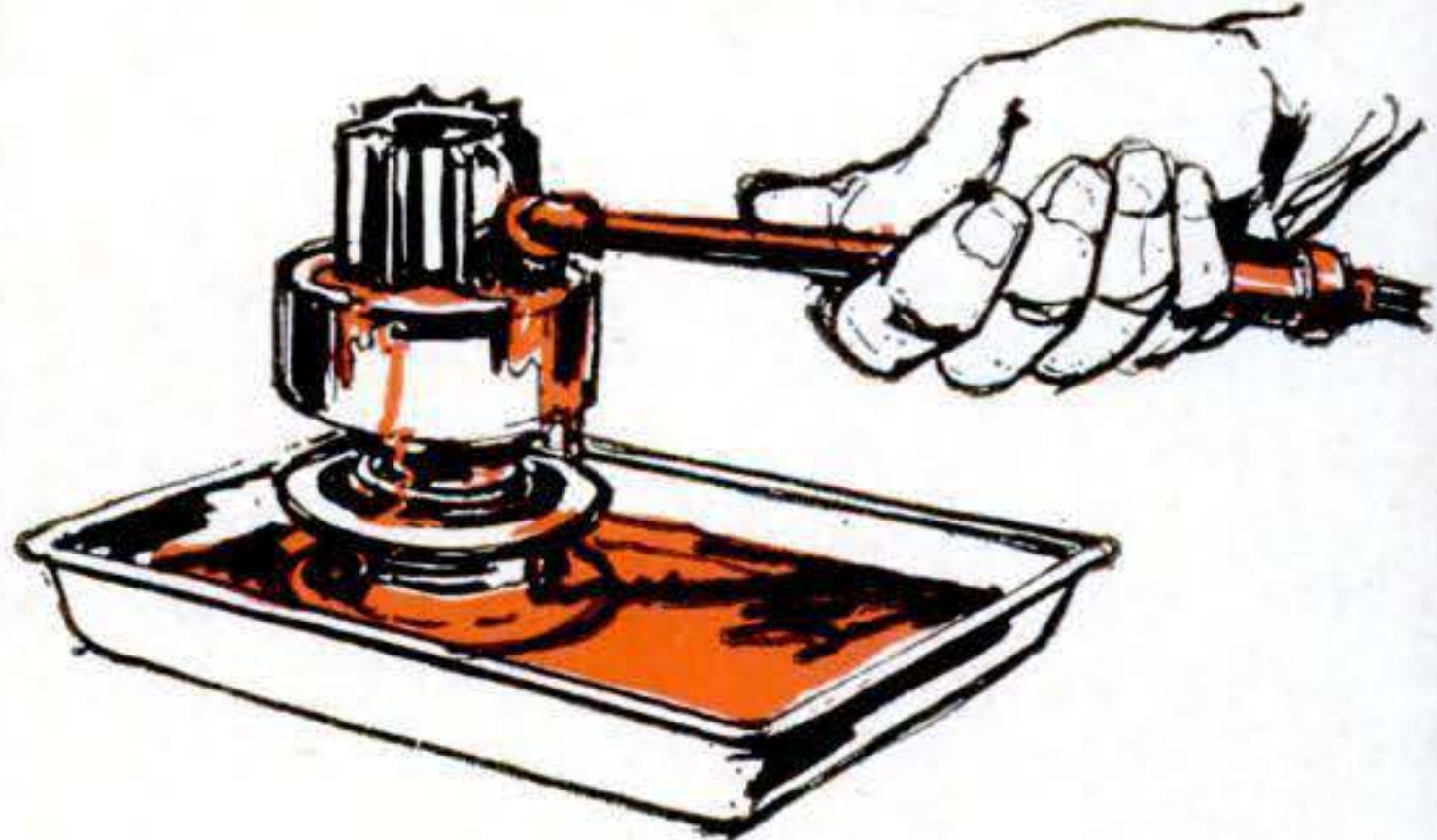
# "I'd like to see them make..."

DRAWINGS BY DANA RASMUSSEN

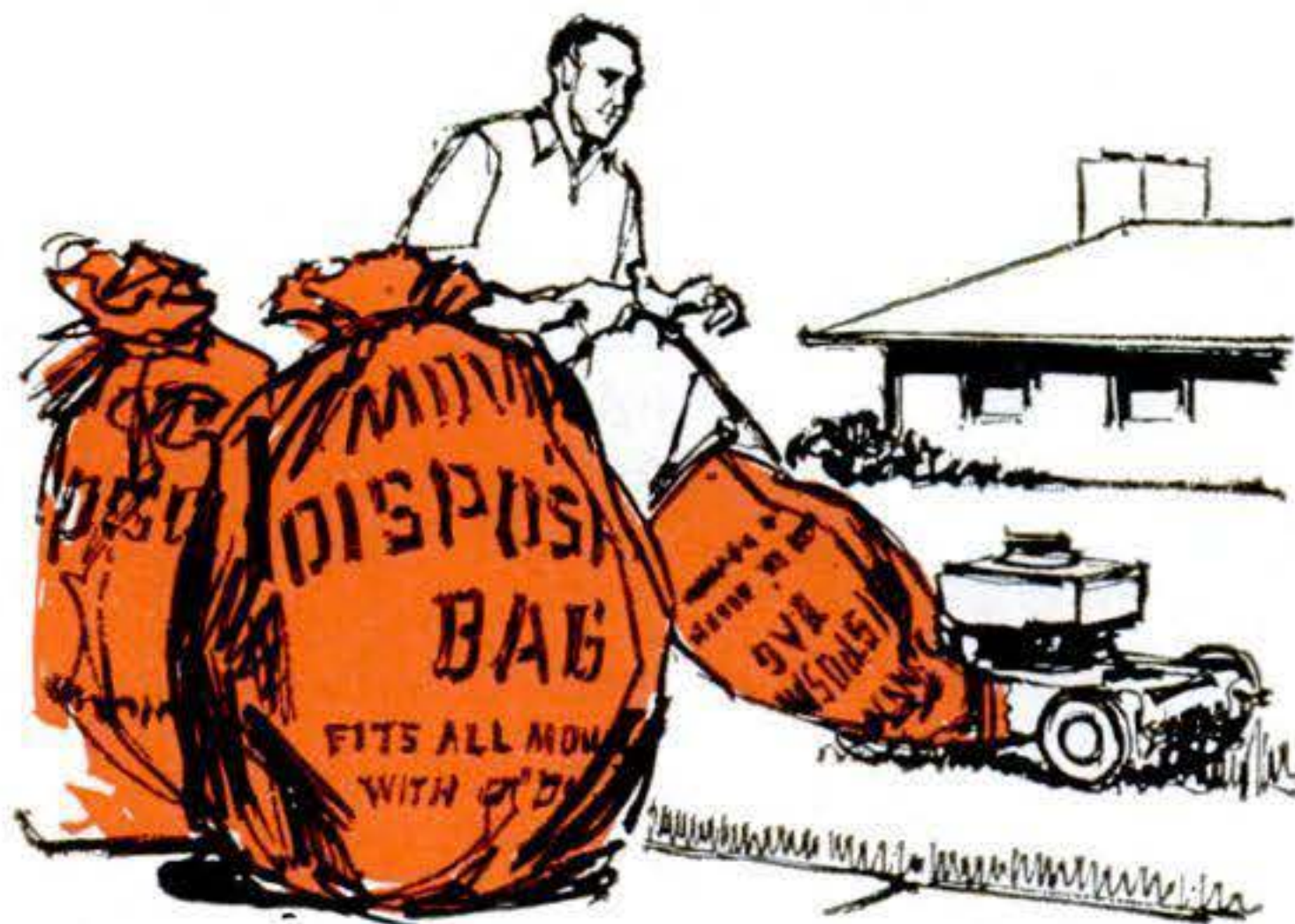
A camper's bucket with corrugated sides to serve as a scrub board. Boatmen and servicemen stuck with hand laundering would find use for it, too.—L/Cpl. G. Vidal, FPO San Francisco.



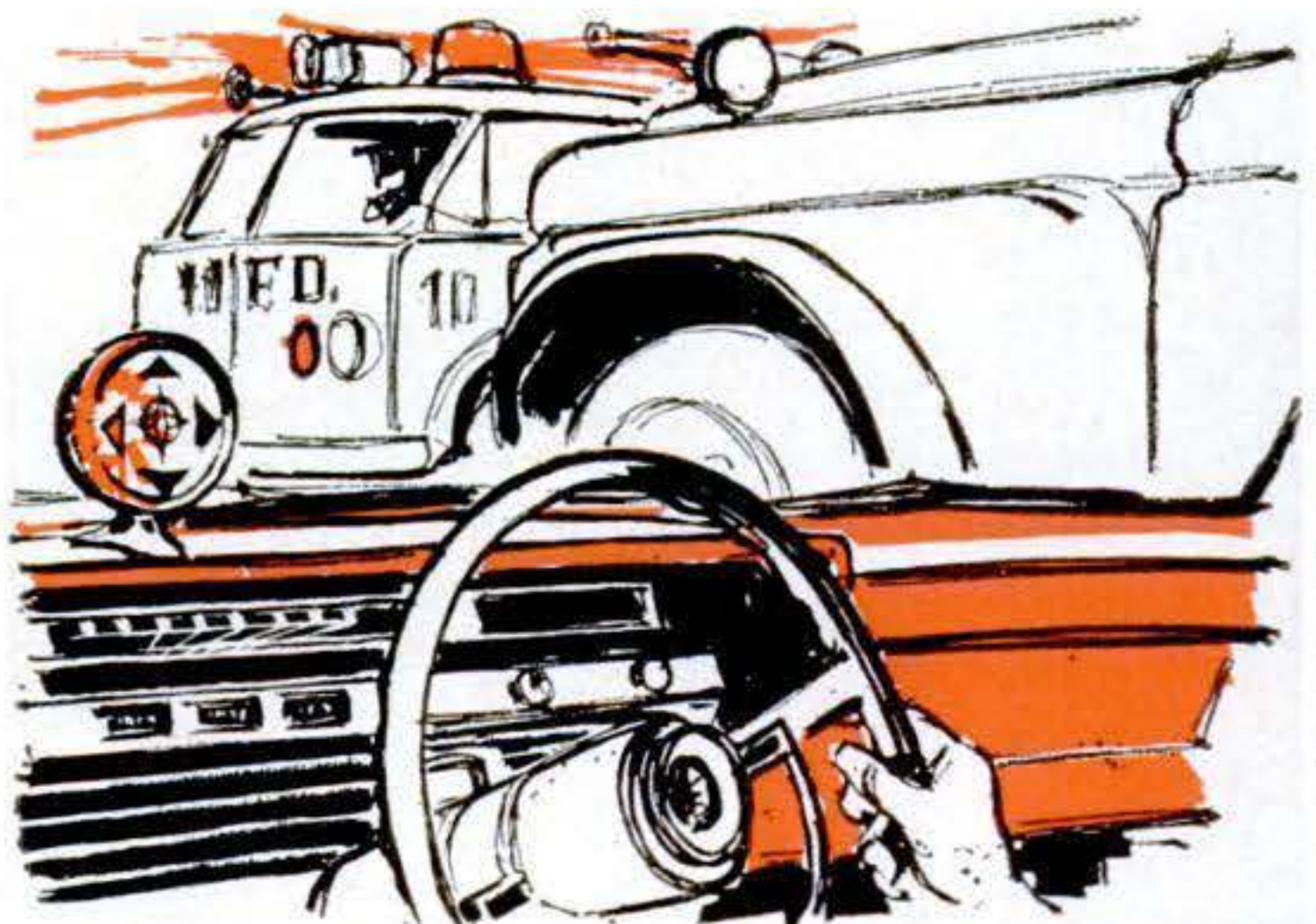
A fisherman's gauge or scale for reliably setting reel drag so your line will unwind before it can break. It would sure save a lot of fish losses.—Ronald Gaines, Quitman, Ga.



A parts-cleaning brush you'd attach to a hose to supply air, kerosene, or other solvents for cleaning carburetors, metal-stamping dies, etc.—Fred Lettino, Long Island City, N.Y.



Disposable grass-clipping bags and a clamp-on fitting for the mower's chute neck. Nobody empties vacuum-cleaner bags. Why struggle with grass clippings?—Greg Dubin, Trumbull, Conn.



A flashing signal on car dashboards to indicate to drivers the direction of travel of a siren-equipped car. Closed windows, radio, street noises, block out sound.—Richard Lesnick, NYC.

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 10017. Write your name and address clearly. Contributions cannot be acknowledged or returned.

Last month, *Popular Science* began a new series of articles intended for the car owner who knows very little about what goes on under the hood, but would like to learn. If you are that man, the series will interest you and save you money on upkeep. In this issue, we continue our primer, step by step, telling you how things work, how to maintain and adjust parts, and the tools you'll need.—The Editors

# ABCs of Keeping Your Car in Tune



## SECOND OF A SERIES:

The distributor points trigger the spark that fires the engine. Here's how you can make sure of a strong and well-timed spark

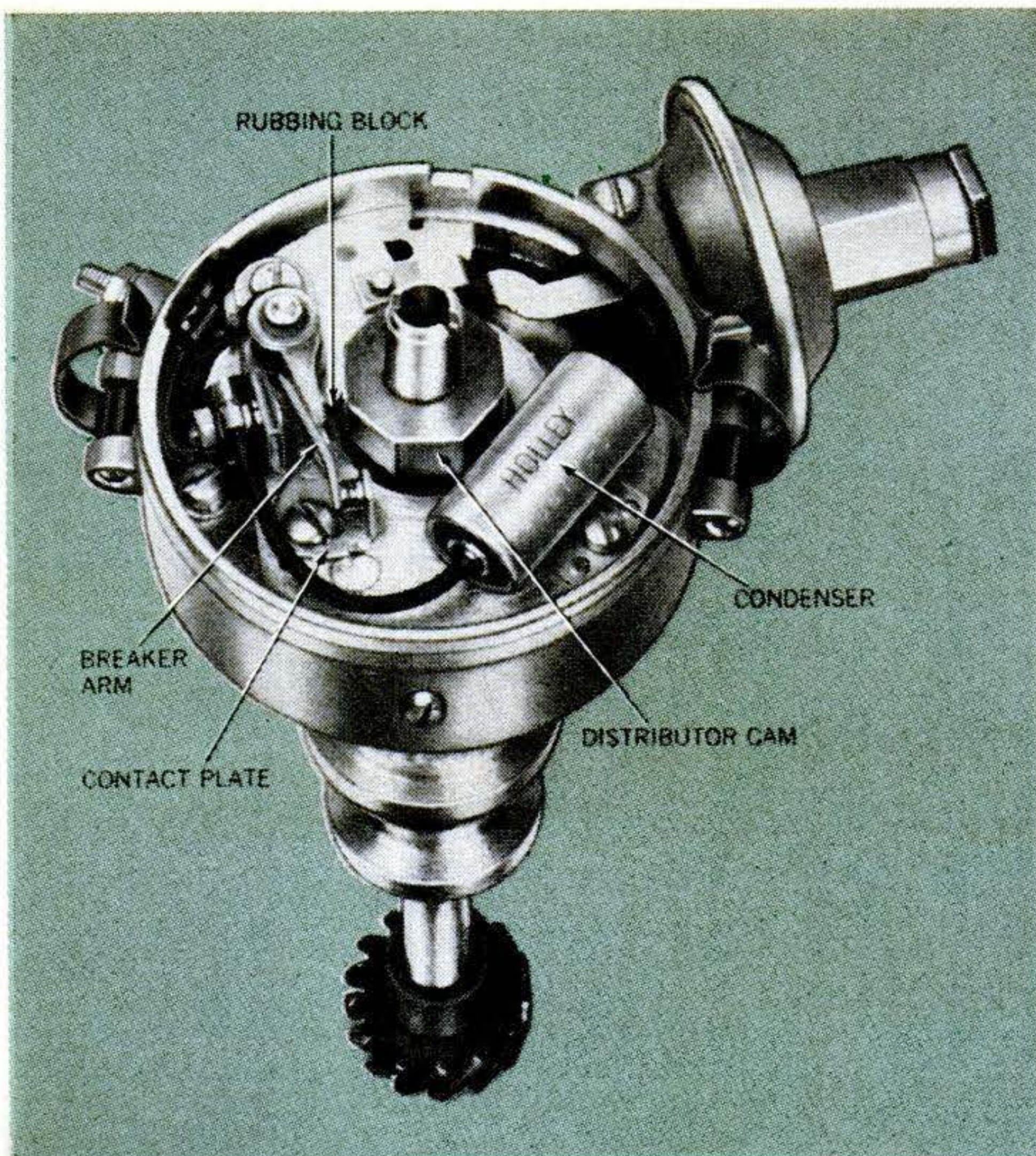
# How to Replace and Adjust Distributor Points

By HERB CARRIER

Last month I told you how to keep your spark plugs in good shape. But you also must make sure your plugs get enough voltage to produce a healthy spark at the right instant. The easy job you'll learn about this month can save you gas, give you easier starting, and assure you full power from your engine.

The critical parts involved are bits of tungsten about  $\frac{1}{8}$ " in diameter—the distrib-

*Continued*



With cap and rotor removed, the cam and breaker arm are exposed. Opposite the contact-points assembly is the condenser. The eight-lobe cam means it's for a V-8 engine. The contact points are open when the cam lobe pushes the breaker arm away; closed on the flats.

utor contact points. New replacement parts will cost you no more than \$2-3. You can put in new points with a screwdriver and long-nose pliers, but there are other tools that make the job even more rewarding, giving truly professional results.

You can expect points to wear out just as your tires do. Ordinarily, they should be replaced every 10,000 miles. You should check the adjustment after running a new point set a few hundred miles. Before I explain this operation, let me tell you about how the parts work.

**How a spark is produced.** You'll find the distributor across the engine from the carburetor on a six; on top of the engine in front of, or behind, the carburetor on a V-8. It's about the size of half a grapefruit, with a number of fat wires coming out of it.

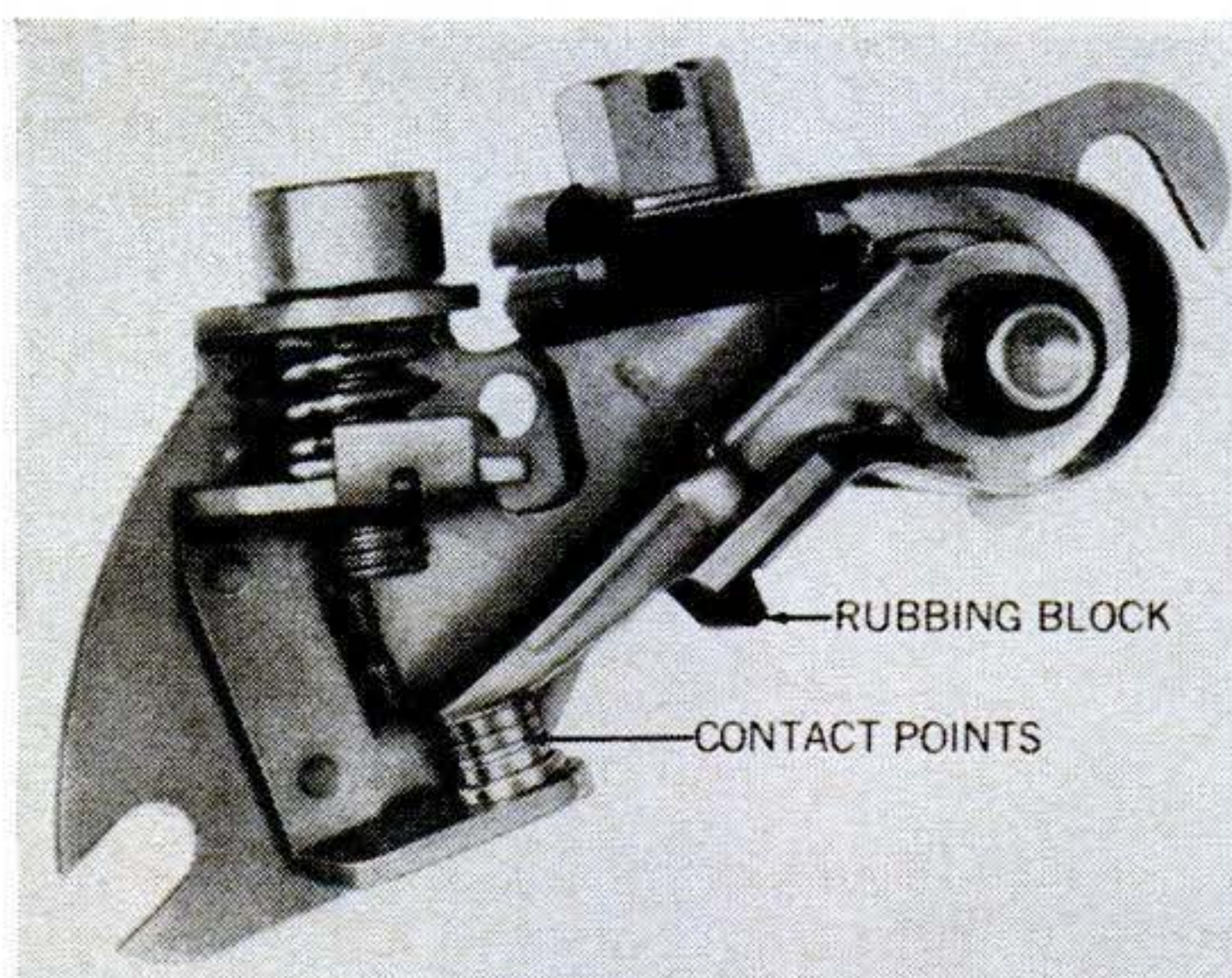
When you turn on the key, battery current flows to the ignition coil and on through the distributor points to "ground" (the engine block). The coil—about the size of a beer can—is filled with a soft iron core around which are wound two coils of wire.

When the points are closed, battery current flows through the one coil, the "primary." This input current sets up in the iron core a magnetic field that also envelops the other, "secondary," coil, which has many more turns of wire.

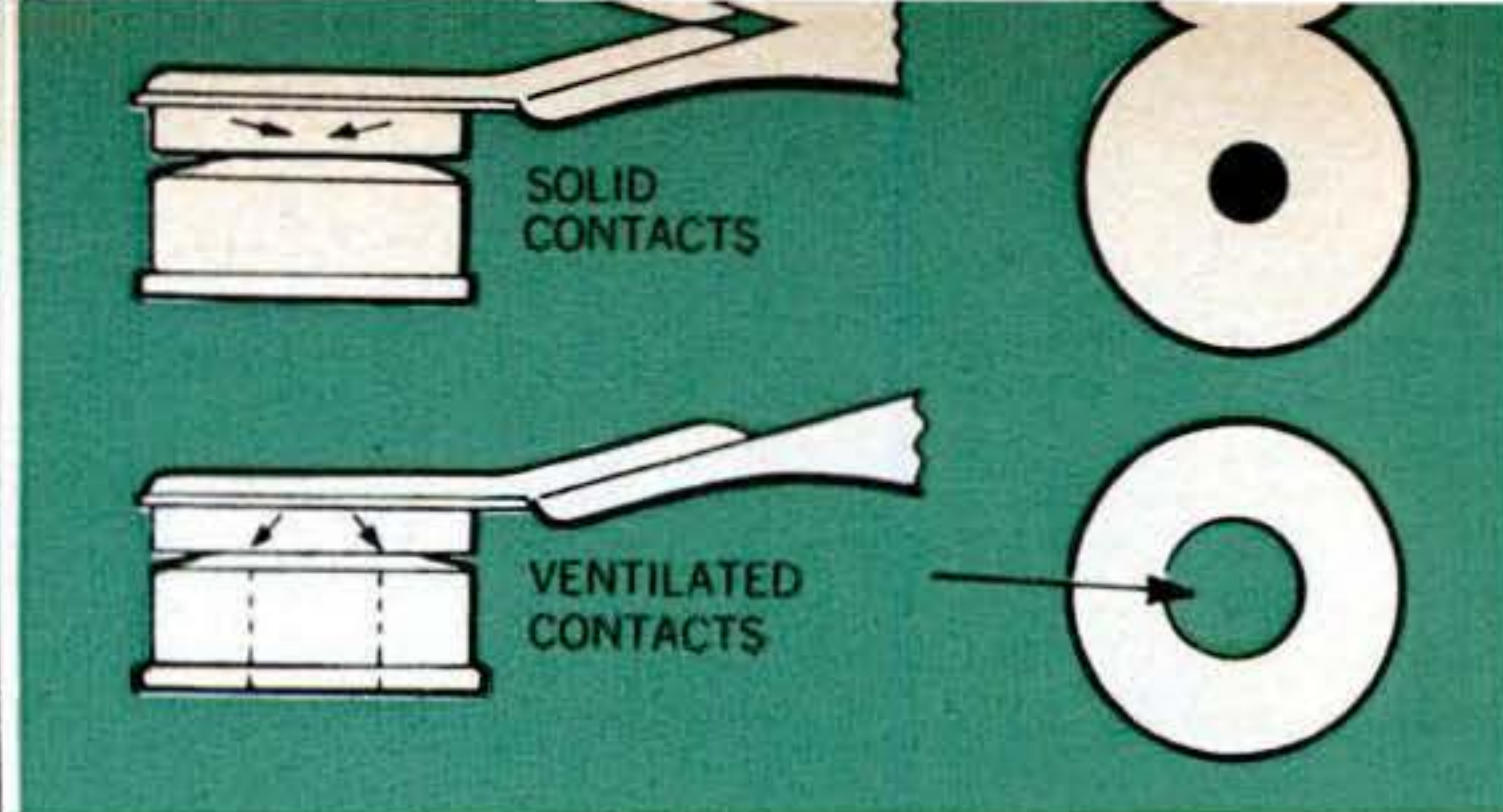
When the contact points open, the primary current is suddenly cut off, and the magnetic field collapses and induces a high-voltage current in the secondary winding. This high voltage runs through a fat, heavily insulated wire, from the center terminal on the coil to the center tower in the distributor. The rotor on top of the distributor shaft sends it to the plugs in correct firing order; the points that interrupt the low-tension current take care of timing. A cam on the rotor shaft actuates the contact arm every time a spark is needed.

**Setting to work.** One of the first things to suspect if your engine is hard to start and sluggish on acceleration

is the contact-point adjustment. This controls the maximum gap between the points when they open; in turn, this determines "dwell" (relative time the points are closed). Dwell is measured as the number of degrees through which the distributor cam



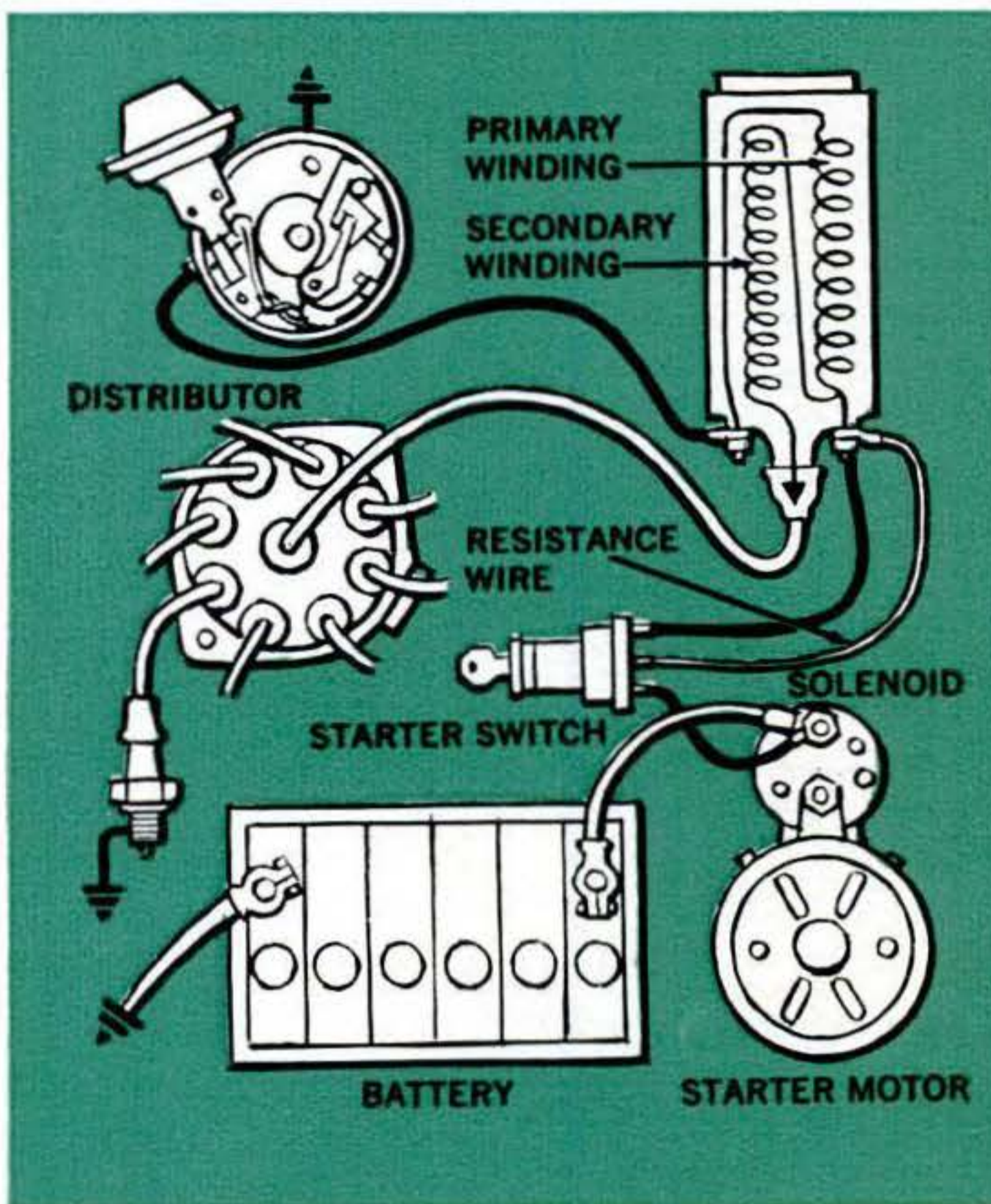
Breaker-points assembly includes breaker arm and rubbing block, breaker-arm tensioner, contact points, and breaker plate with spring and adjustment screw. Slots at ends hold assembly to base.



Breaker points in good condition are relatively smooth and ash-gray in color. They will show no pitting or burning. Good points can be cleaned and adjusted. Bad points will show discoloration, burning, and pitting, and should be replaced. Most automobile mechanics say not to file points.

Breaker points must be aligned center to center. This applies to both solid and ventilated points. The contact area must be squared off. Improper point alignment leads to premature failure of contact points. You can identify ventilated points by a vent hole drilled through the point center.

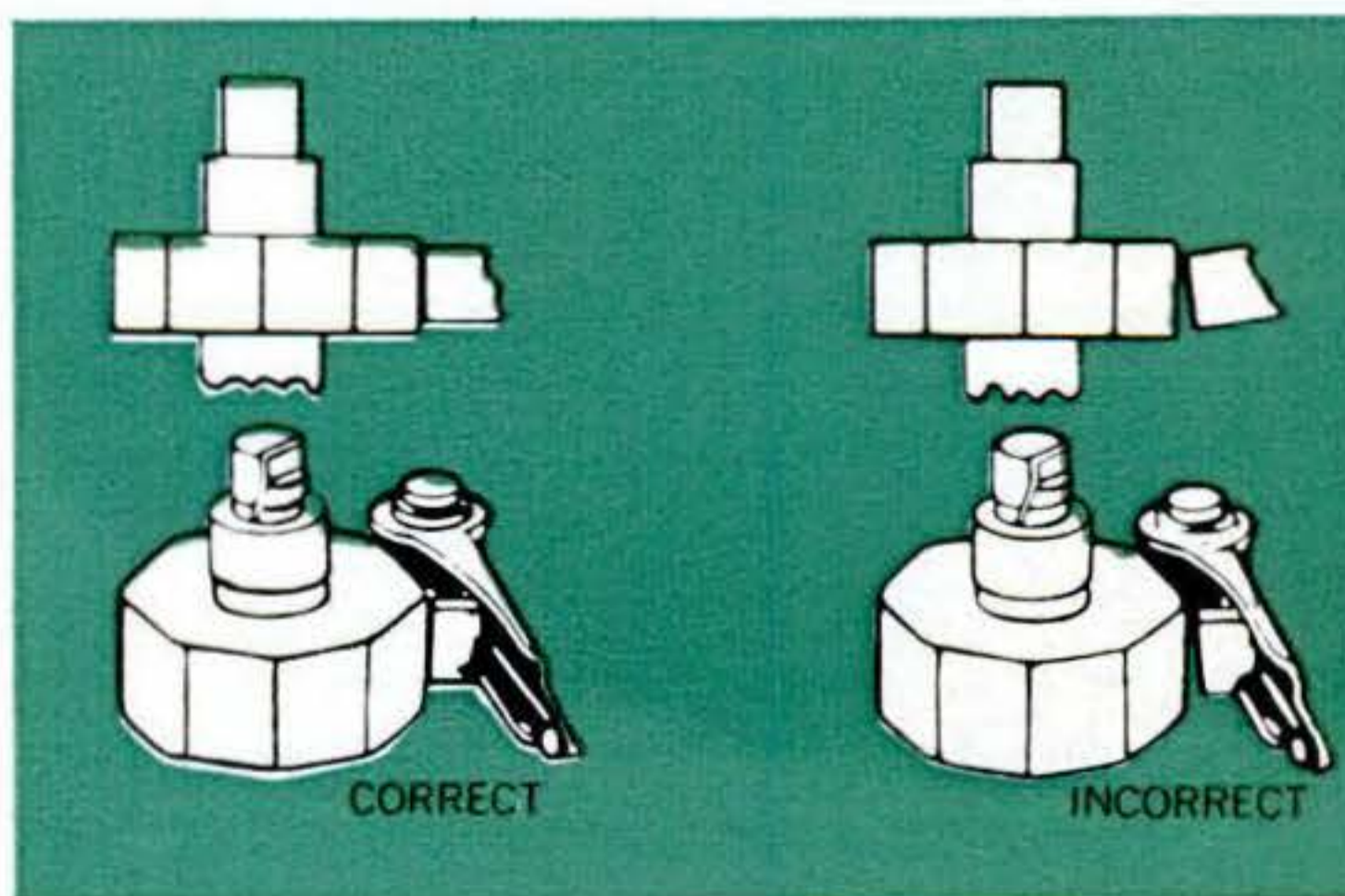
turns while the points are closed. Incorrect dwell can cause a weak spark, throw the ignition timing off, and cause the points to burn or pit prematurely. Check the manual for your car to find correct dwell and point gap.



With an inexpensive instrument, called a "dwell meter," you can check dwell without even opening the distributor. You hook up the two wires from the meter; with the engine running at idle, the meter needle will indicate degrees of dwell. If you intend to continue taking care of tune-ups yourself, this is a worthwhile investment. Prices start at about \$20.

Low-tension current flow from the battery is interrupted by contact points to set up a high-tension current in the coil. This current flows to the distributor, where the rotor sends it to the plugs.

Of course, if you find the points need adjustment, you'll have to take the top off the distributor. An exception is the Delco—it can be externally adjusted. Later on, I'll tell you how you can set the points approximately correct without a dwell meter.



**Homework on the distributor.** Before you go to work on the distributor, study how the cap is held on the body. Two methods are commonly used: spring-steel snap clips (bails) or spring-loaded J clamps. A screwdriver is all you need to remove either retainer. On the bail type, slip the screwdriver between bail and cap, and twist it to pop the bail free of the cap. On the J-clamp type, insert the screwdriver in the hole(s) at top of the cap. Position the screwdriver in the clamp slot. A push down and a half turn will free the clamp end (latch) from the distributor.

Rubbing block must contact the cam exactly square. With incorrect contact, the rubbing block will wear down rapidly until it seats completely. This will affect the breaker-point gap. A .003" wear of the block will bring the gap to .005"—making a five-degree delay in spark delivery.

Lift the cap off the distributor body with your hands. Do *not* use a hammer or screwdriver to force off the cap! It's hard plastic, easily broken, and a new one will cost you about \$4.

(When you replace the cap, *the tang and notch must be aligned properly.* Misalignment can cause a broken cap, broken dis-

Continued



To adjust point alignment, only the point on the breaker plate can be moved. Take care not to bend the breaker arm. A special tool is available for point alignment (above), but the job can also be done with a suitable pair of needle-nose pliers.



Kastar tool kit simplifies point setting, because you avoid bumping the starter. Fit a sleeve over the cam —this gives a permanent high spot. The feeler gauge adds sleeve thickness to gap setting. Kit includes Dial-A-Gap tool for Delco distributors.

tributor rotor, maybe even a blown muffler.)

Lay the cap aside carefully. *Do not remove the wires from its top.* When the cap is off, remove the rotor.

The rotor fits on the distributor shaft just above the cam. Two general types are used: screw-on and press-on. The press-on rotor is often not much bigger than your thumb. You simply pull it off the shaft. The screw-on rotor is a full circle, almost as large in diameter as the distributor body. You take out retaining screws to lift it off. *Rotor-to-shaft alignment is critical, too.* During rotor removal, note the provisions to assure proper alignment. A tang-and-notch setup is usually used on screw-ons; flats on the otherwise round surfaces of press-ons.

**The points.** With the rotor removed, the points are readily visible and accessible. Inspect the points to determine if they are fit for further service or must be replaced. Open the points carefully for close inspection. Sometimes a small mirror is handy. Good points can be cleaned and adjusted. (Since new points are so cheap, many mechanics never file the points but replace them during tune-up. If in doubt, buy new.)

Now, with the points exposed you can check adjustment in the traditional way—without a dwell meter. The trick is to get the correct dwell approximately by measuring the gap between the points when they are fully open. You'll need a feeler gauge of the correct thickness for your car (see manual). This is nothing more than a piece of metal accurately ground to the correct thickness. (In an emergency, the thickness of a paper matchbook cover is close enough for a crude adjustment.)

Turn the engine over with the starter until the rubbing block is on the high point

of the cam. This is easiest if you have someone "bump" the starter while you watch the points and rubbing block. With the gap at its maximum width, you should feel a light drag when you pass the gauge through the gap. Be sure the gauge is perfectly clean before it touches the points.

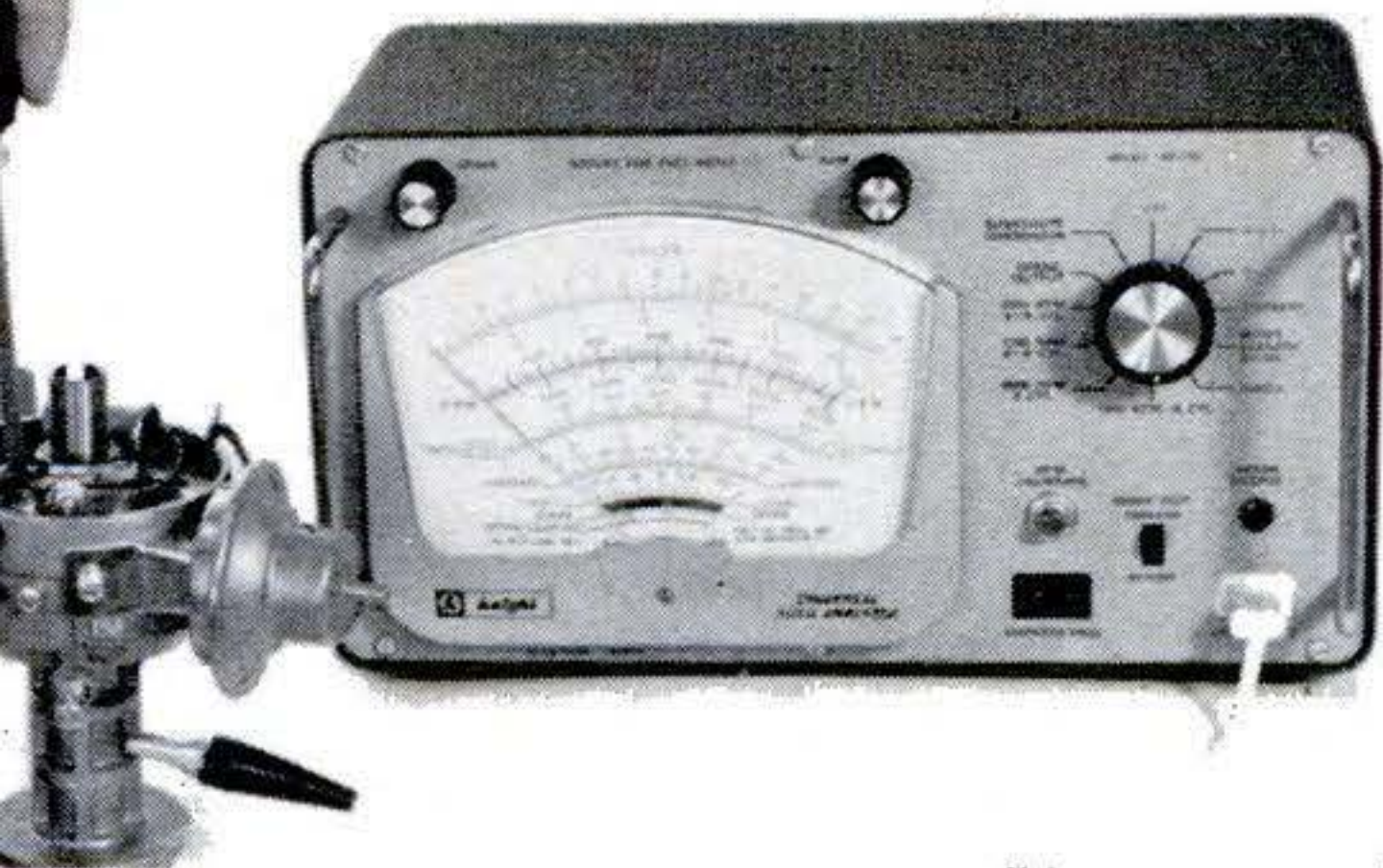
If the gauge won't fit into the gap without springing back the breaker arm, or if it passes through the gap loosely and you feel no drag, move the *stationary* point. Loosen the locking screw slightly and carefully move it in or out as required.

You can beat the frustrating business of getting the cam to stop in the right place when you bump the starter with the ingenious kit (made by Kastar, Bellport, N.Y.) shown in a photo. It also has a special tool for adjusting Delco distributors.

**Putting in new points.** Take out the two retaining screws and lift the point assembly free of the breaker plate. (On Delco distributors with screw-on rotors, *loosening* the screws is enough, because they are mounted in slots instead of holes.) Note how the points are attached to the breaker plate.

With the point assembly slightly lifted from the plate, remove the two wires from the point assembly post. One wire goes to the condenser, the other to the coil. Usually a small nut and lock washer retain the wire terminals on the point assembly post. Pull the old assembly off the post. Before you fit the new assembly, wipe the breaker plate, cam, and inside of the distributor cap with a clean, lintfree cloth. Install the terminals so that they *touch nothing* but the post, the nut, and the lockwasher.

**The condenser.** The condenser's job is to keep the points from arcing when they open and to accelerate the collapse of the



**Dwell-tach speeds up gap setting** and improves accuracy. Dwell angle is controlled by the point gap, and increases when gap is narrowed. Longer dwell delays opening, retarding the spark. If dwell is too short, the strength of the spark will be inadequate.

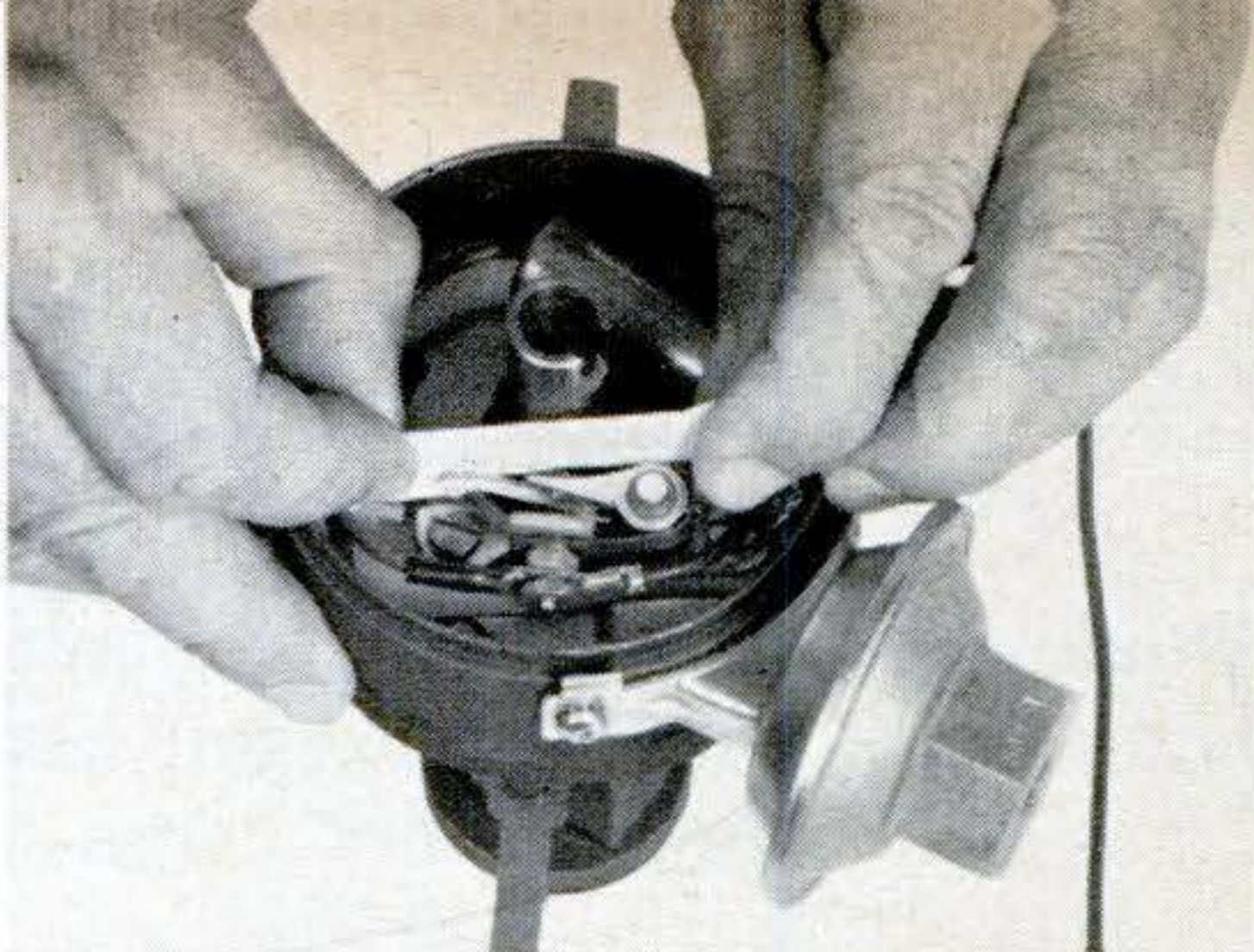
magnetic field in the coil. Many mechanics automatically replace the condenser when changing points. This is rarely necessary. Condensers seldom fail. If they do, you'll know it—your engine won't run.

When servicing the points, check the vacuum advance, too. The vacuum-advance mechanism uses intake-manifold vacuum to vary spark timing according to engine load (the centrifugal advance mechanism gives an earlier spark the faster the engine is running, and needs no checking).

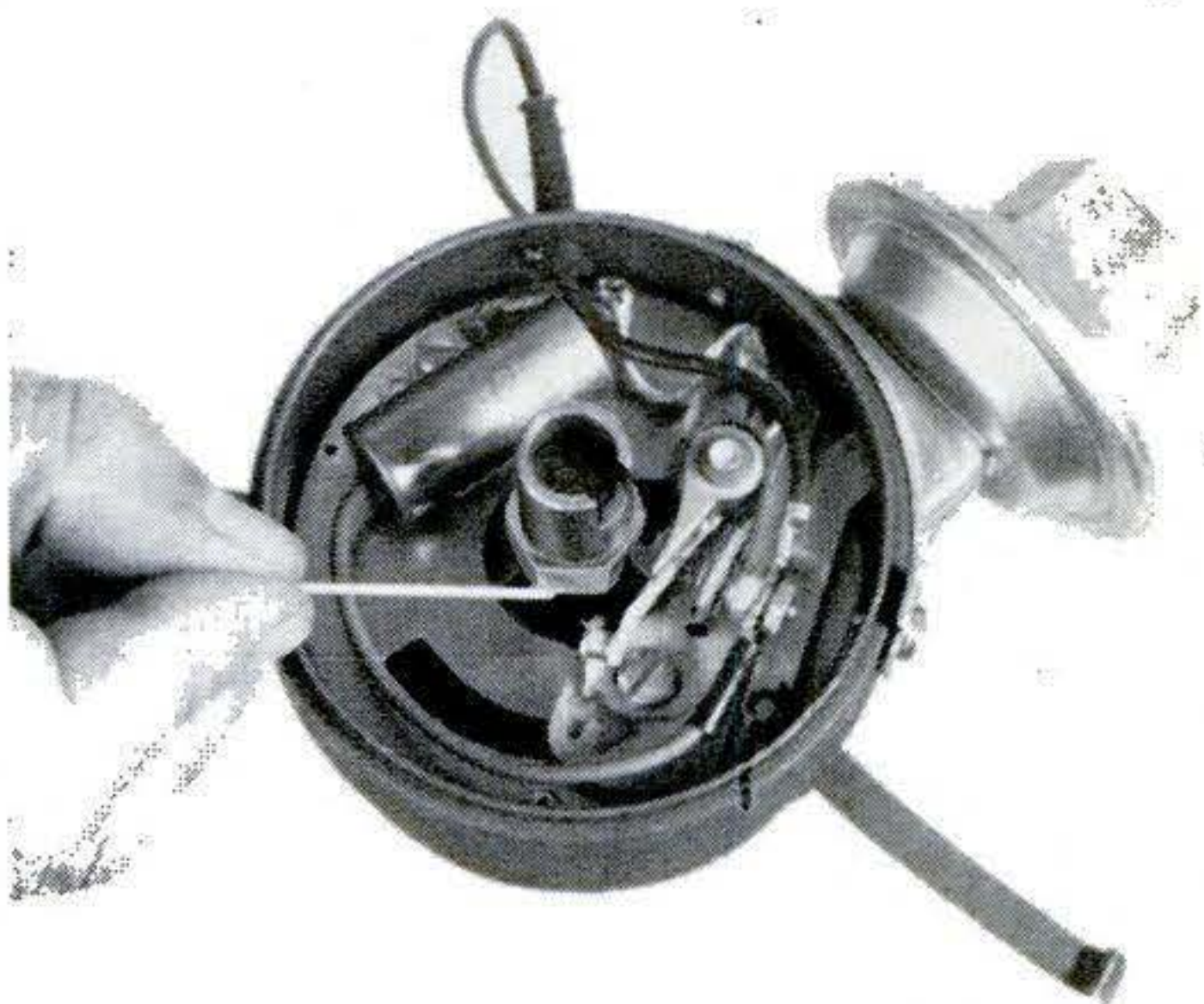
Disconnect the fitting and metal tubing from the vacuum-advance diaphragm. Rotate the distributor breaker plate toward the diaphragm as far as it will go without forcing. Hold the plate in this position, and place a finger over the hole in the diaphragm can from which the fitting was removed. Hold your finger on it tightly for an air-tight seal; then release the breaker plate. The plate should move slightly, but not return to its original position until you remove your finger from the hole. If the plate snaps back to its original position while your finger is making an air-tight seal, the diaphragm is defective.

To replace a defective diaphragm, remove the two retaining screws and the lever connection at the breaker plate. Lift out the diaphragm assembly. *A ruptured or leaking diaphragm can be a major cause of poor gasoline mileage.*

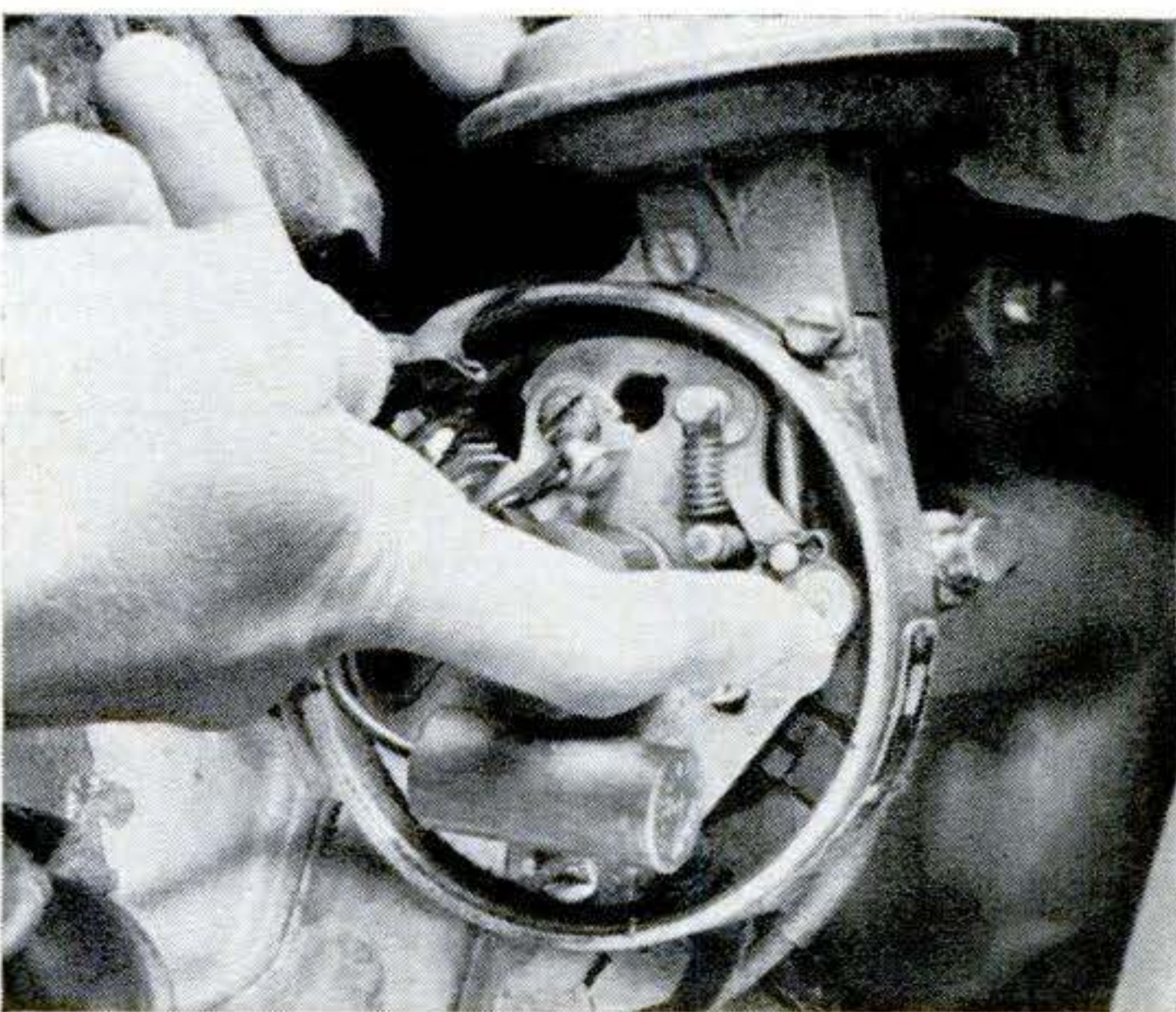
When you re-install rotor and cap, *double-check alignment!* Press each wire firmly into its cap tower. Since you have not disturbed the distributor's mounting to the engine, ignition timing should be okay. But a timing check is often advisable. Next month we'll talk about spark timing and ignition advance, and adjusting them. **PS**



**Point cleaning** is best done by passing a clean strip of cleaning tape or bond paper back and forth between the points. Insert and remove by spreading the points. Do not drag the tape or paper through the points when removing it after finishing the job.



**Lubricate the cam** after cleaning or replacing the points. Use approved lubricant only—do not use petroleum jelly or chassis grease. Quantity needed is only about the size of a match head. Over-lubrication will lead to contamination and failure of the points. Rotate cam when lubricating it.



**Check vacuum advance** after disconnecting tubing. Turn breaker plate towards diaphragm, with a finger on the hole to seal it off. Release the plate. Slight movement is okay, but it should not return.

# Beating the SPACECRAFT

Should our astronauts breathe pure oxygen, or something more like natural air? The fatal oxygen blaze in an Apollo cabin has brought a new look at the pros and cons of choosing a spacecraft atmosphere

By ALDEN P. ARMAGNAC

**W**hat should our astronauts breathe? Fire-hazardous oxygen—or a safer airlike mixture, more like what Soviet manned spacecraft have used? Should our Apollo craft's pure-oxygen system be scrapped, at whatever cost in delaying our man-to-the-moon program?

Those urgent questions were raised when a flash fire in an oxygen-filled Apollo cabin cost the lives of astronauts Grissom, White, and Chaffee, during a countdown rehearsal at Cape Kennedy last January. They were underscored only four days later when an oxygen fire in a space-simulating chamber fatally burned two men at Brooks Air Force Base, Texas.

Seeking answers, a NASA-appointed board of eight experts has just completed a

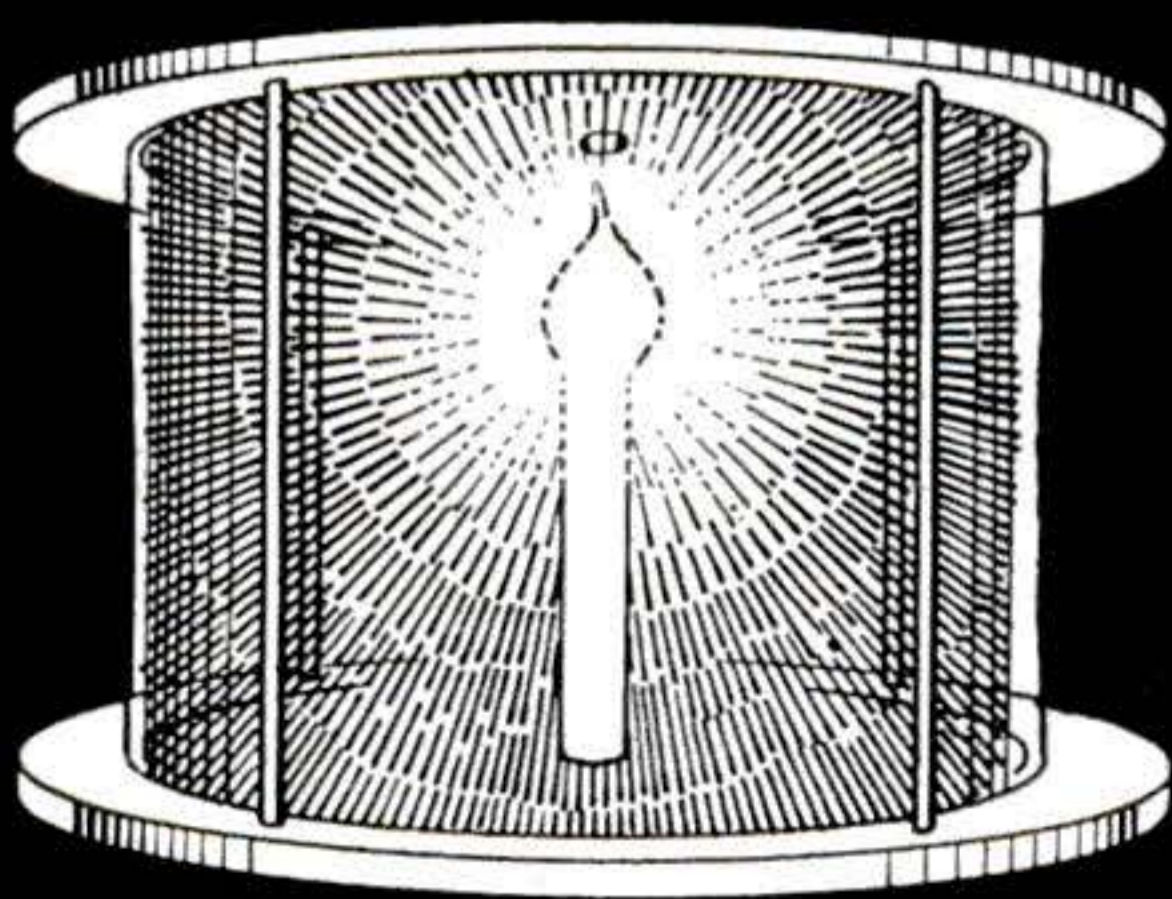
searching 10-week investigation of the Apollo tragedy—and come up with surprises.

The fire-gutted cabin, it found, had held something quite different from what the astronauts would breathe in space—and far more dangerous.

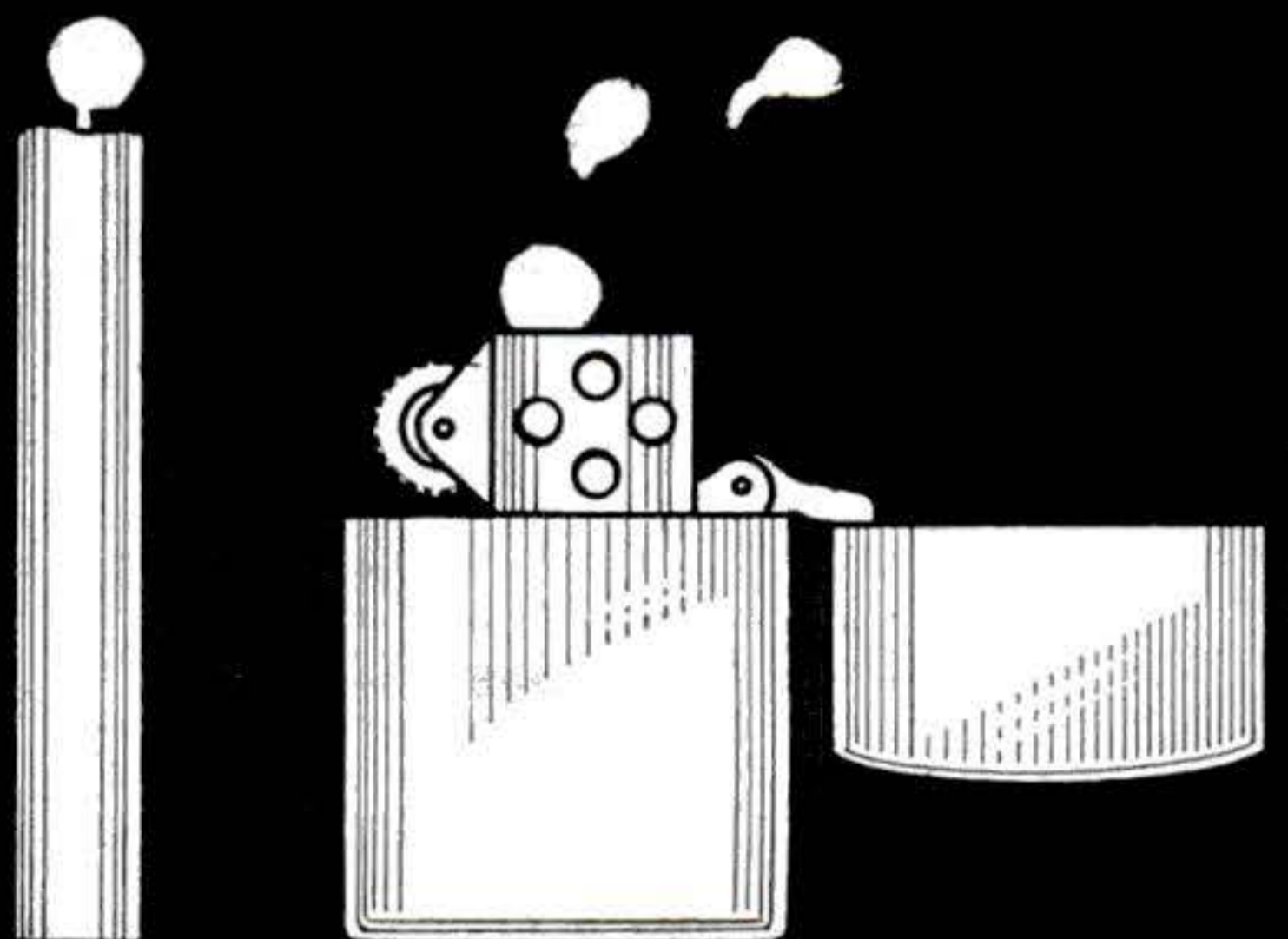
The Apollo spacecraft was to have a cabin atmosphere of pure oxygen. This was to be at a pressure of five pounds to the square inch, "absolute"—one-third of sea-level air pressure, which is 14.7 pounds per square inch. Mercury and Gemini cabins had used the same.

**A fatal difference.** Instead, at the time of the fire, the Apollo cabin held pure oxygen pressurized to 16 pounds—even more than the air outside. And oxygen at that kind of pressure—in which iron picture wire will burn like tinder—needs only a tiny spark to create an inferno.

## Experimenters study cabin-fire risks—and weird zero-gravity flames



Fire hazards of spacecraft atmospheres are gauged in Air Force test by how fast a lighted cigarette burns in chamber fed with oxygen or mixed gases at various pressures. Cigarette bursts into flame, as pictured, in pure oxygen at half-atmosphere pressure or more. Lowering pressure, or diluting oxygen with nitrogen or helium, slows burning rate.



Zero gravity may tame a fire in space—since flames won't leap upward to spread. Candle flame shrinks to small ball, liquid-fuel lighter flame to quick-dying little clouds, and gas-fuel lighter flame to round-tip shape, as shown, in weightlessness during planes' parabolic flights. Coming zero-gravity-fire tests in orbit will augment these brief ones.



# FIRE PERIL

Why was it there? Standard prelaunch procedure was to purge the astronauts' spacesuits and cabin of air, with pure oxygen. For that, the oxygen had to be a little above the pressure of ground-level air—which explains the 16 pounds. That wouldn't be for long, in an actual launch.

As the craft rocketed past two-mile height, the opening of an automatic relief valve in its wall would begin spilling the excess oxygen. Cabin pressure would gradually drop to the five-pound mark. That was all the thin wall was designed to withstand, without risk of bursting, in a vacuum. On the ground, it needed more pressure within, to help it resist being crushed by atmospheric pressure outside; the 16-pound oxygen took care of that.

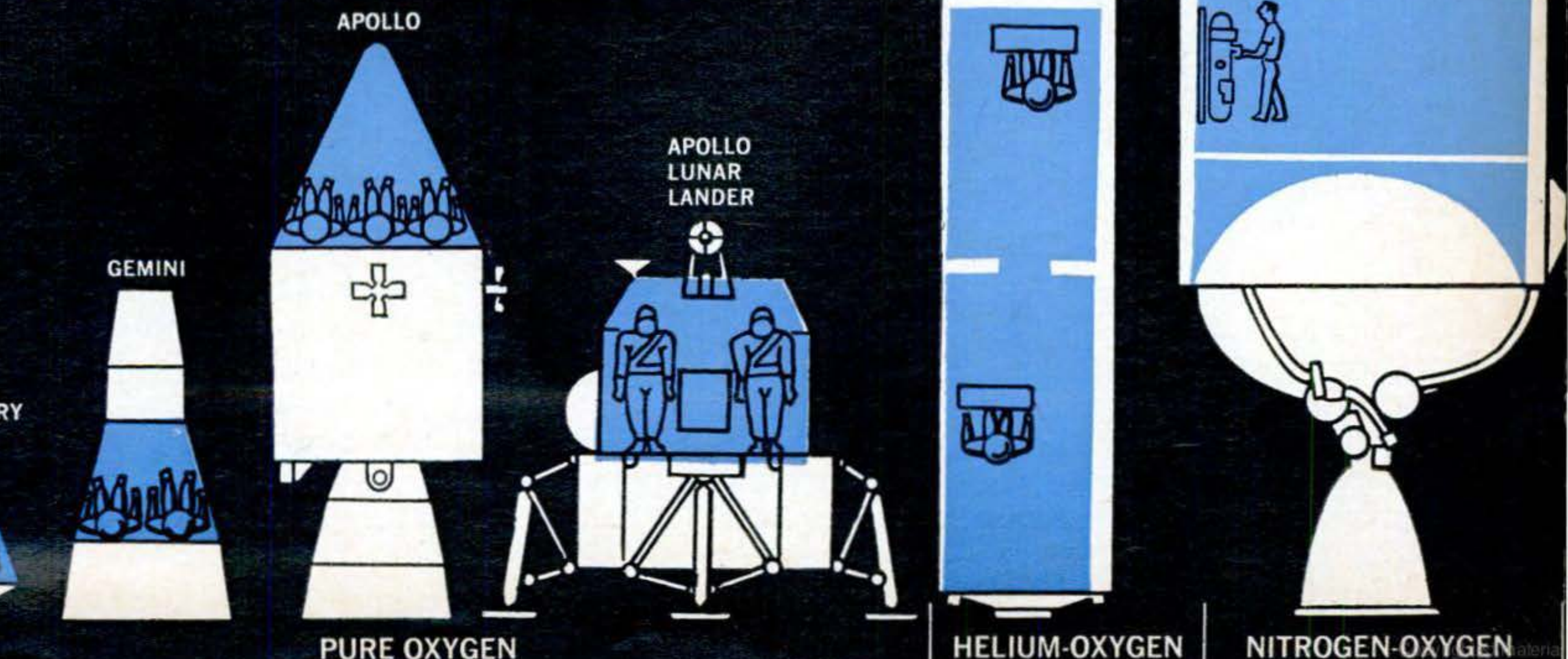
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Engineer in spacesuit tries out mock-up of airlock for NASA's coming Orbital Workshop in a spent Saturn IV-B stage—one of our first spacecraft that will have a "two-gas" atmosphere. Astronauts on 30-day missions in the two-story laboratory will breathe a mixture of nitrogen and oxygen. But it will not eliminate fire hazard—since it will be under only one-third the pressure of natural air, and so must contain a much higher concentration of oxygen than air does.



Here are the cabin atmospheres chosen for our present and coming spacecraft. Pure oxygen of one-man Mercury and two-man Gemini was again the choice for Apollo's three-man craft and two-man lunar lander. Air Force's two-man Manned Orbiting Laboratory will have helium-oxygen mixture, and NASA's three-to-six man Orbital Workshop will use nitrogen-oxygen combination. All have five-pound ( $\frac{1}{3}$  atmosphere) pressure. Living space filled with gas for breathing (colored part in each of these drawings) ranges from 50 cubic feet in the Mercury up to 10,000 cubic feet in the Orbital Workshop.



Planners admit having had a blind spot for the procedure's prelaunch fire peril. Every U.S. astronaut from Glenn to Lovell and Aldrin unwittingly risked it and survived. Then luck ran out. Apparently a short-circuited wire sparked—and we saw what the appalling consequences could be:

Within eight seconds of first being seen, the Apollo fire erupted into a near-explosion of flame. Seven seconds more and the cabin ruptured, spewing fire, as furnace-like heat raised interior pressure past 29 pounds. It took would-be rescuers five agonizing minutes to wrench open the scorching-hot hatch—and find the astronauts dead, of smoke inhalation.

Announced before the inquiry board's final report was a conclusion that put the finger on the unrecognized menace: "The Board specifically recommended that pressurized oxygen no longer be used in prelaunch operations." Whether and how its use could be avoided, NASA was studying at this writing. Some experts speculated that air or nitrogen could be substituted in the cabin, and flushed out with oxygen after lift-off, while astronauts breathed oxygen through their separate spacesuit systems. Prelaunch fire precautions as extreme as in a powder magazine seemed the only alternative.

The board called, too, for fitting Apollo with a quick-escape hatch. That might have saved the dead astronauts, whose three-layer hatch normally took them 90 seconds to open. Designers reportedly had considered and rejected an explosive-bolt hatch like Mercury's, because of technical difficulties—but ways around these were soon being seen after the Apollo disaster.

**Oxygen system cleared.** What about the low-pressure oxygen planned for Apollo in space? It could hardly be blamed for the fire, having had no part in it directly. So the board, while advising more-intensive study of two-gas systems, did not go as far as to call for changing Apollo's pure-oxygen one—which would have been a major setback to the lunar-Apollo program.

Undeniably, though, pure oxygen ranks as the most fire-hazardous of all possible cabin atmospheres, even at low five-pound pressure—the only one at which it is suited for spacecraft, since breathing higher-pressure oxygen for more than a few hours would be harmful. How risky is that?

One test, extensively used to gauge the fire hazards of various space-cabin atmos-

pheres, compares how fast things burn in them—paper, fabric, or cigarettes.

By that test, Apollo's five-pound-pressure oxygen offers three times the fire hazard of sea-level air. Sea-level air and Soviet space-men's duplicate of it are the least hazardous—short of the ideal safety of air reduced to 11-pound pressure, as at 8,000-foot altitude. (All figures in this article are for "absolute" pressure, the amount more than the zero of a vacuum.)

**Are two gases safer?** For comparison, our first two-gas systems are on the way. The Air Force's coming Manned Orbiting Laboratory will have a helium-oxygen atmosphere; NASA's planned Orbital Workshop in a spent Saturn-rocket stage, a nitrogen-oxygen mixture. Contrary to some popular belief, that will not free them from fire risk. With a total pressure of only five pounds planned, 70 percent of each mixture must be oxygen, to provide enough to breathe.

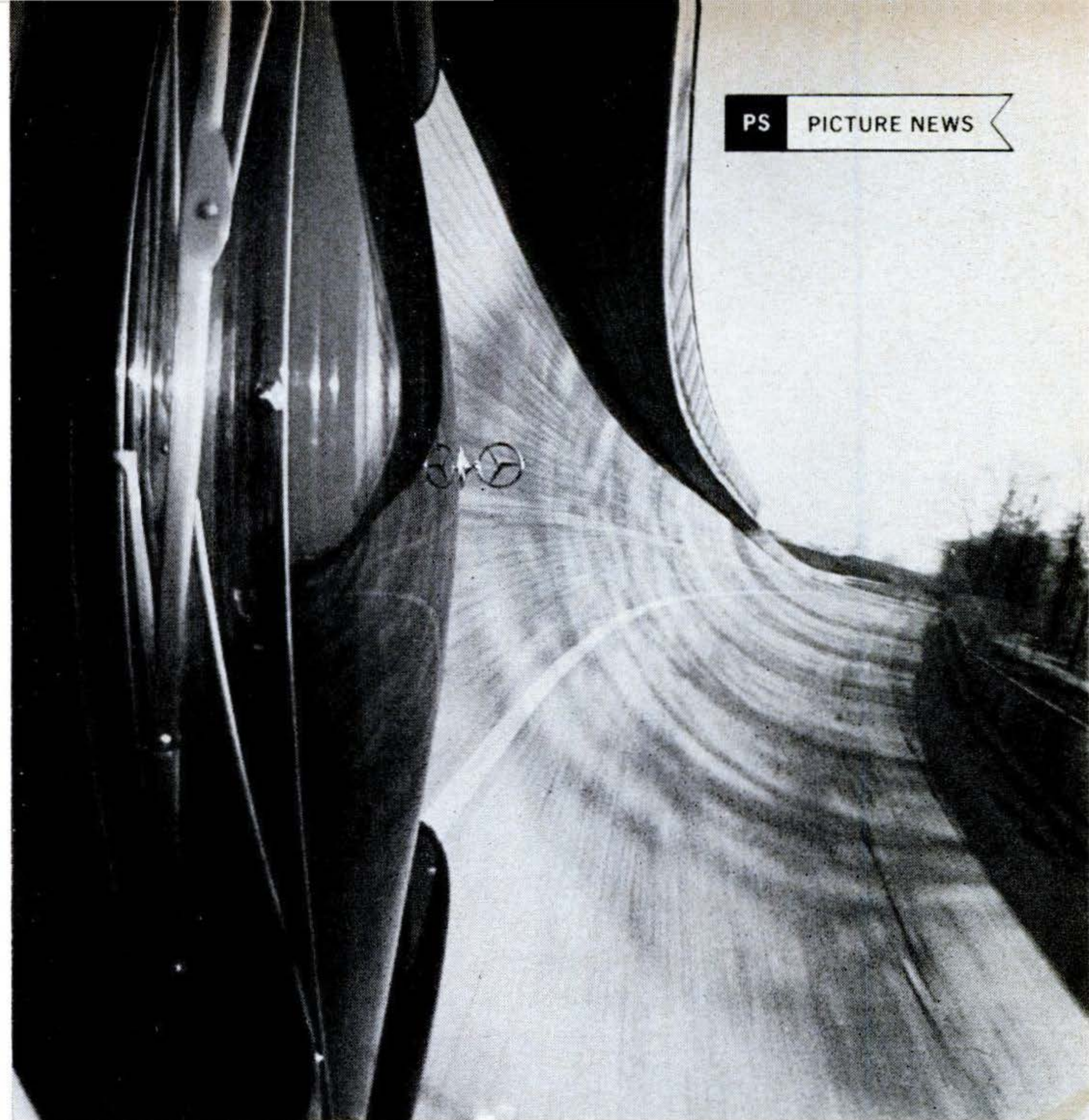
So these atmospheres will actually be about twice as fire-hazardous as air—a gain over pure oxygen but hardly a dramatic one. (They were chosen mainly to avoid possible ill effects of breathing pure oxygen for as long as the 30-day missions planned; and the labs' Gemini and Apollo earth-to-orbit ferry craft would still use pure oxygen.)

Several oxygen fires in space-cabin simulators have offered another clue to the degree of Apollo's fire hazard. The recent Texas tragedy occurred under 7.2-pound pressure. No fire in oxygen at five-pound pressure or less has been fatal. One close call, in five-pound oxygen, illustrates how *not* to fight an oxygen fire:

All you see first is an eerie little flame, half an inch long, coming from the insulation of a light-fixture wire. Make the mistake of trying to snuff it out with a towel, and the towel blazes up. It sets your clothes afire. When companions run to wrap you in an "asbestos" blanket, its organic binder ignites—and their garments take fire, too. You strip off your flaming clothes, and see the hair on your chest burning. When that actually happened in 1962 to four men at the Naval Air Center in Philadelphia, they suffered second-degree burns, but escaped and survived.

In case of fire in space, by contrast, astronauts have a built-in safeguard. By pulling a hand lever, they can open an

[\[Continued on page 212\]](#)

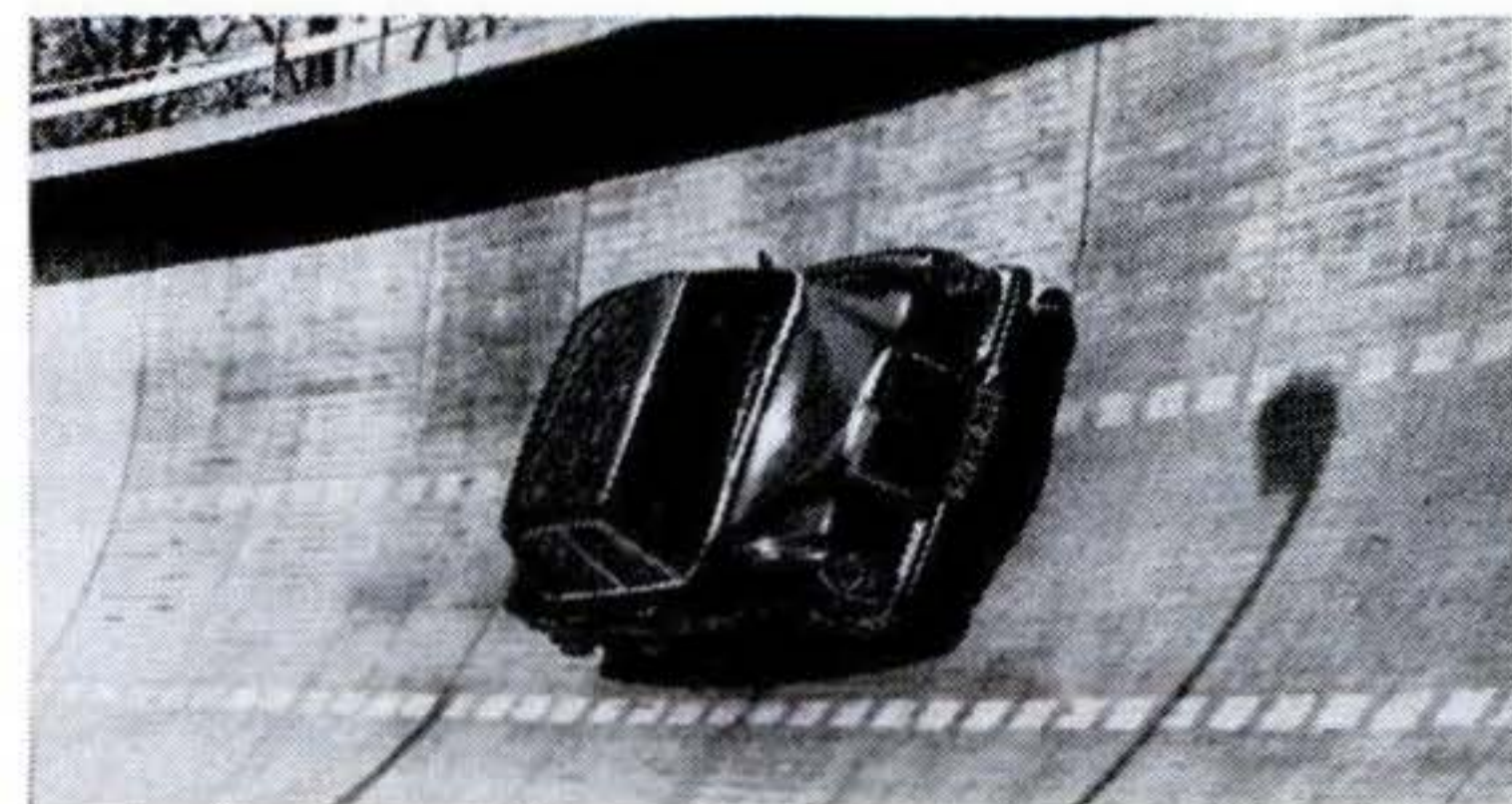


Spectacular shot was taken through windshield near end of bank at a sizzling 110 m.p.h.

## Mercedes-Benz tests new production cars on a "wall of death"

This banked turn is the newest facility on Mercedes-Benz's proving grounds outside Stuttgart, Germany. The turn radius is only 180 feet, and the curve has been taken as fast as 112 m.p.h. with this 250-S passenger car.

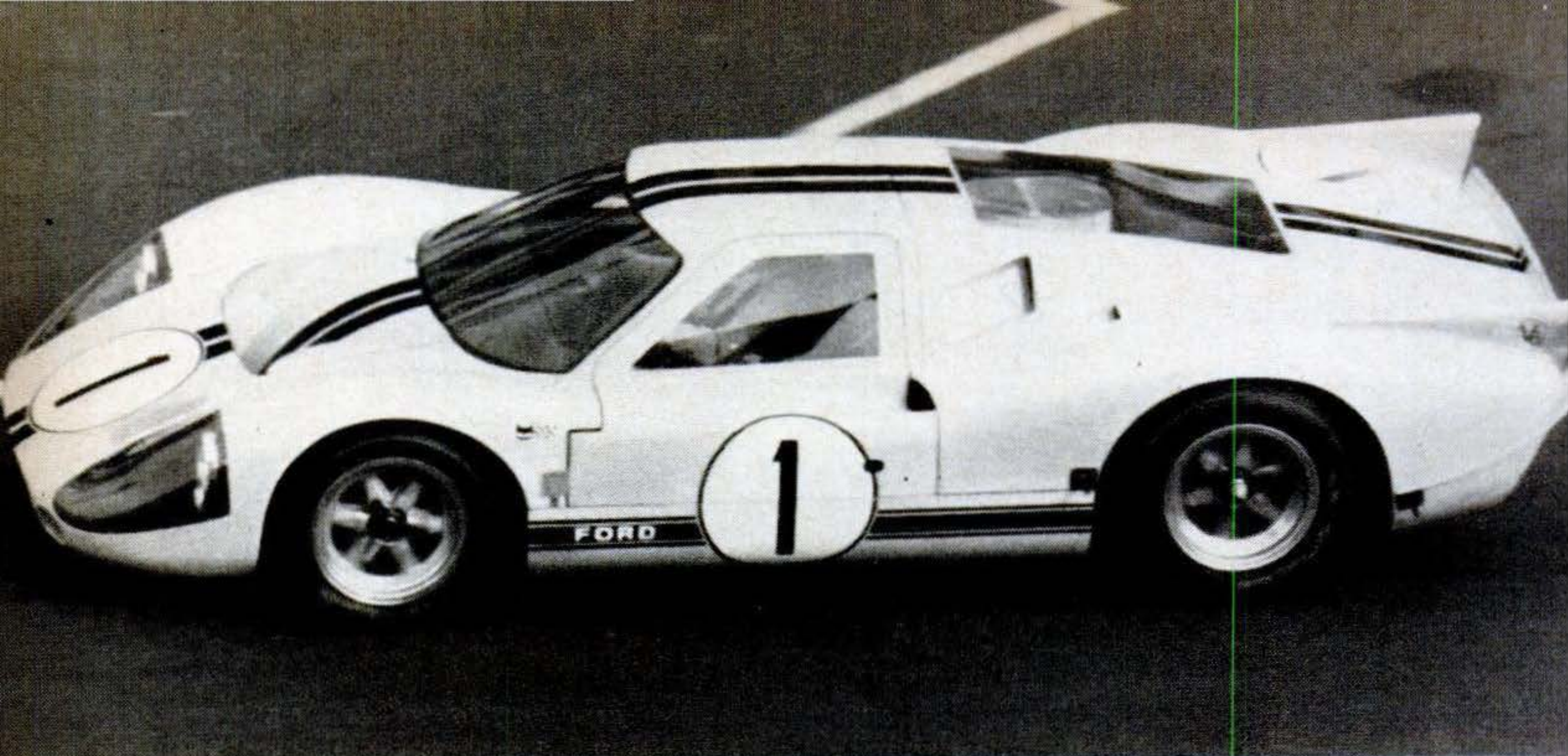
The steep bank converts centrifugal force of the high-speed run into "down" force on the car's suspension. There is little or no side force on the car as it turns, but its springs support about twice their normal load.



As the car accelerates, it will actually tend to climb up to the steepest part of the bank.



In the middle lane, the driver confidently takes his hands off the steering wheel at 87 m.p.h.



**FORD** Mark IV has 550 hp., weighs 2,300 pounds. Top speed is over 215 m.p.h.,

which it will reach at end of 3½-mile Mulsanne straight, just before slowing to a 40-m.p.h. turn.

# Can Ford Beat Ferrari Again at Le Mans?

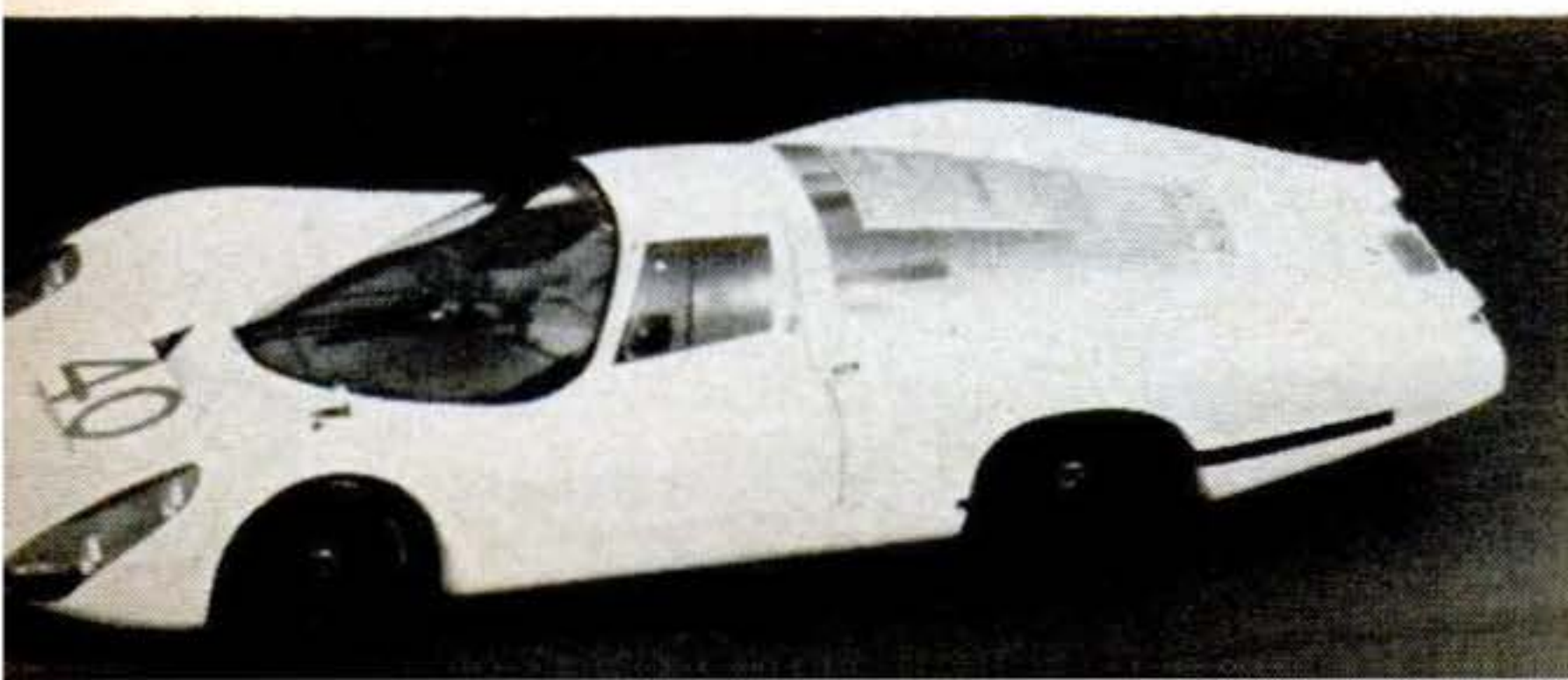
After Ford's great triumph at Le Mans a year ago, Ferrari trounced Ford at Daytona this winter. When they meet this time at Le Mans, anything can happen

By DAVID PHIPPS



Alfa Romeo Type 33 has a midship-mounted four-cam V-8 engine, tubular frame, aluminum body.

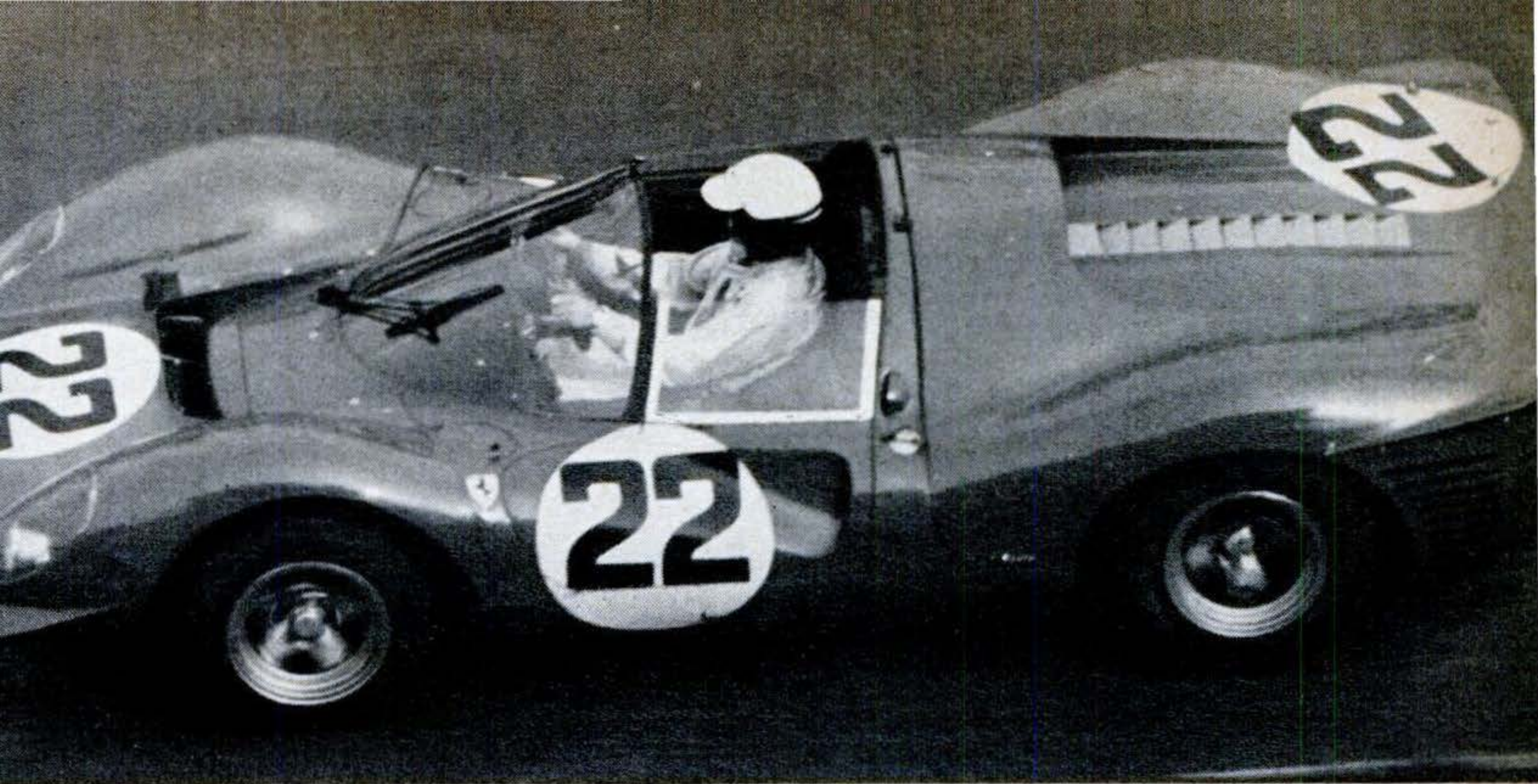
Porsche Carrera 10 has extremely long tail for lower drag. The engine is a midships air-cooled flat six.



**T**he world's toughest endurance race will take place on June 10 and 11, as 55 cars set out for a 24-hour grind on the extremely fast 8.3-mile road circuit at Le Mans, France. Ford's taste of success last year has given the company an appetite for winning, and no effort will be spared to score a repeat.

In addition to two cars of the type that won last year (Mark II), Ford is entering three new ones (Mark IV) of the type that won at Sebring two months ago. The Mark II was developed by Ford Advanced Vehicles in England; the Mark IV is strictly a Dearborn project from beginning to end. Both types have the same 427-cu.-in. push-rod OHV V-8 that Ford uses in its stock cars, but they differ greatly in chassis design and appearance.

But winning at Le Mans won't be easy



**FERRARI** Open-cockpit P4 has 465-hp. V-12 amidships, weighs 1,750 pounds. It

won't equal Ford's top speed, but it has better acceleration. Four Ferraris will run against five Fords.

for Ford this time. In practice last April, all four Ferrari drivers went faster than the lap record. The fastest one knocked a full eight seconds off the record. While Ferraris were busy demoralizing the opposition's drivers, the Ford mechanics were struggling with carburetor problems. The blue-and-white Fords never equaled the speed of the red cars from Italy.

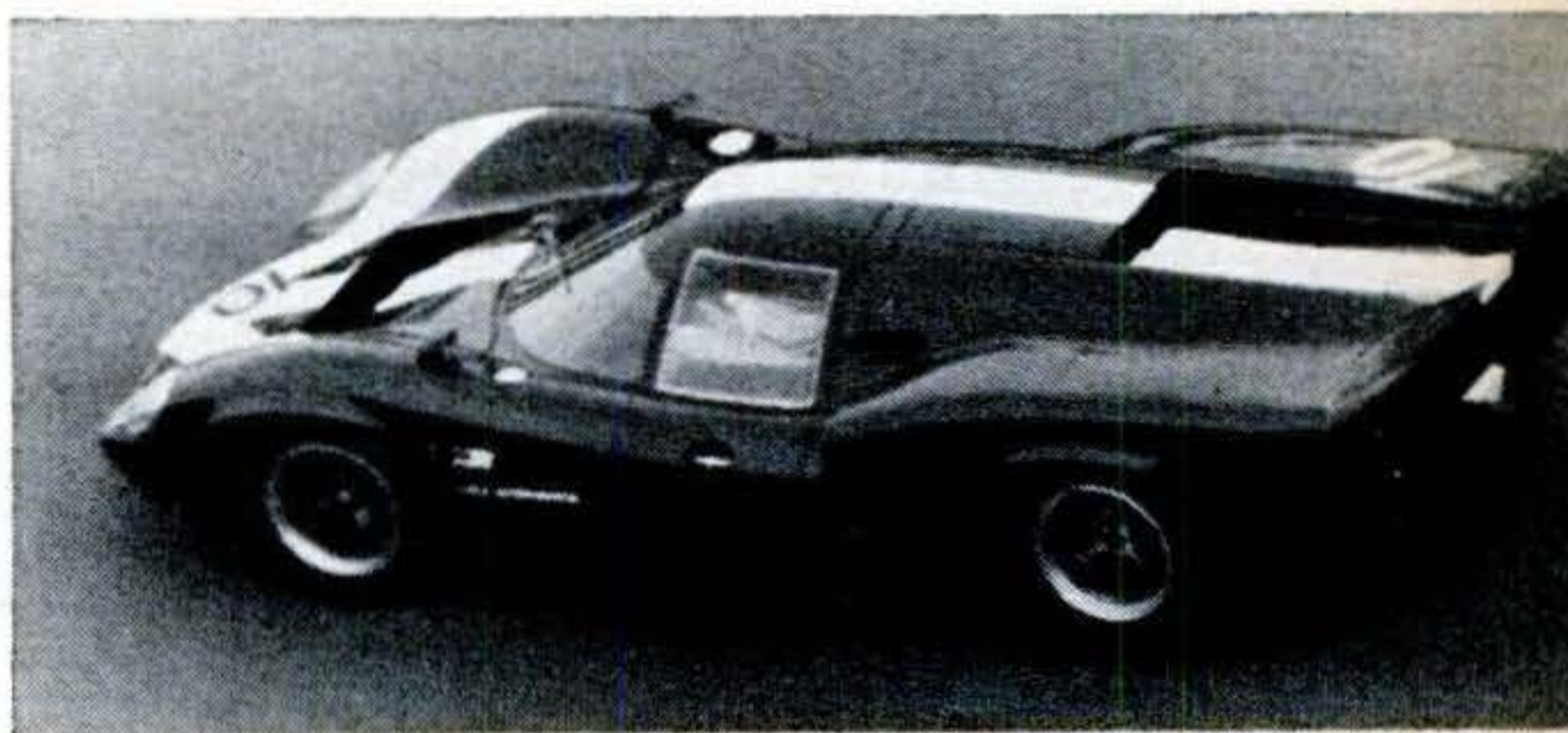
**What'll it take to win?** Cars will probably have to average over 125 m.p.h. throughout the 24 hours. No allowance is made for pit stops to refuel or change tires or make repairs. The clock keeps ticking away when the car is standing still. An average of 125 m.p.h. means covering a distance of 3,000 miles between four p.m. on Saturday and four p.m. on Sunday. Each car has two drivers; one rests in the pits while the other drives. The rules keep a driver from staying at the wheel more than eight hours in a stretch.

After the April test sessions, the new Ferraris look more like winners than the re-vamped Fords.

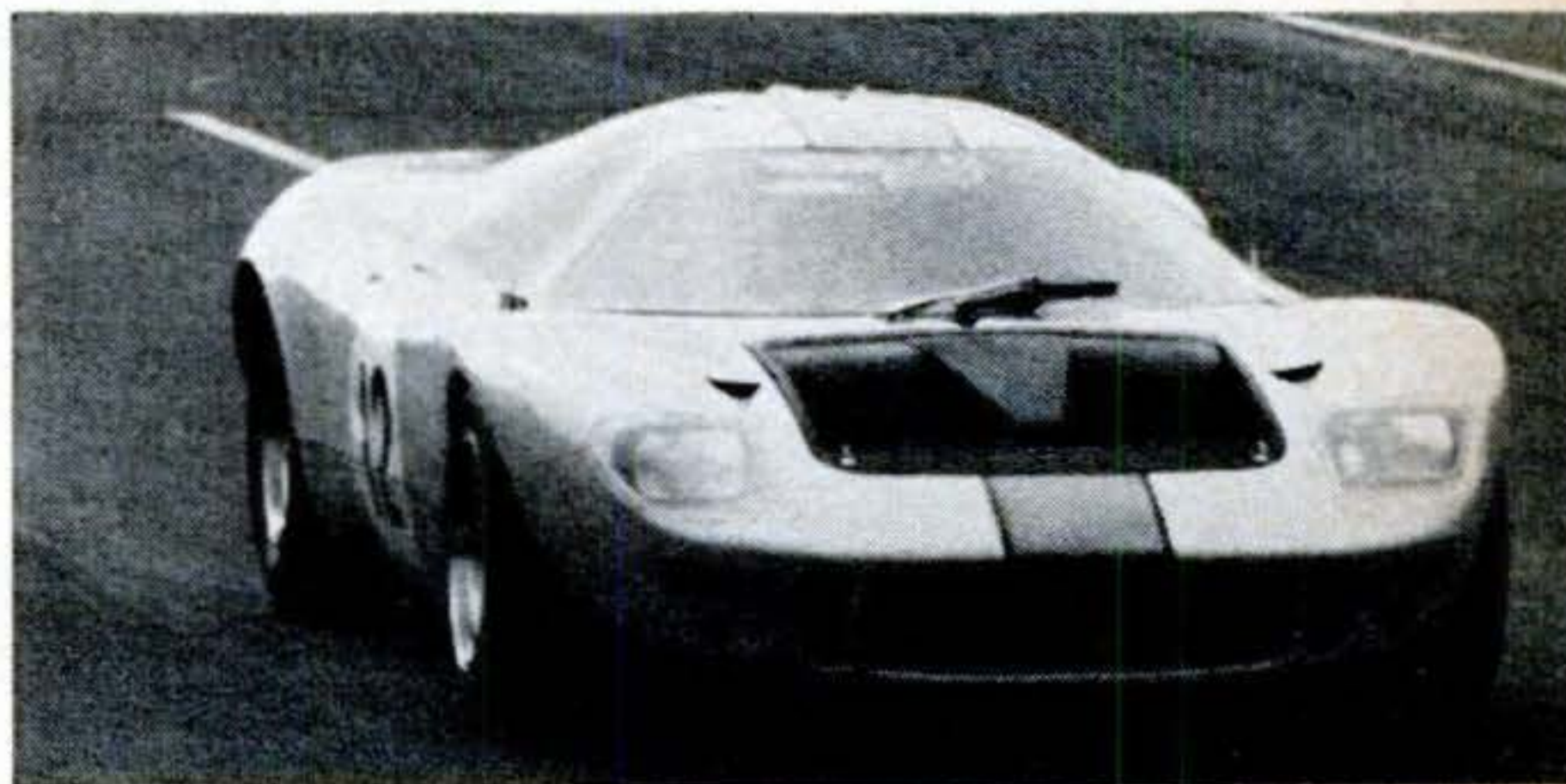
Ford has entered five cars, all with 427-cu.-in. pushrod V-8 engines. Some will be Mark IIs; some will be Mark IVs.

Ford's biggest problem is weight. The Mark II weighs around 2,600 pounds, the Mark IV over 2,300. Excess weight slows acceleration, raises fuel consumption, and adds to brake wear. The brake disks on the Ford had to be changed several times on last year's lighter cars, so Ford may be in for severe brake trouble.

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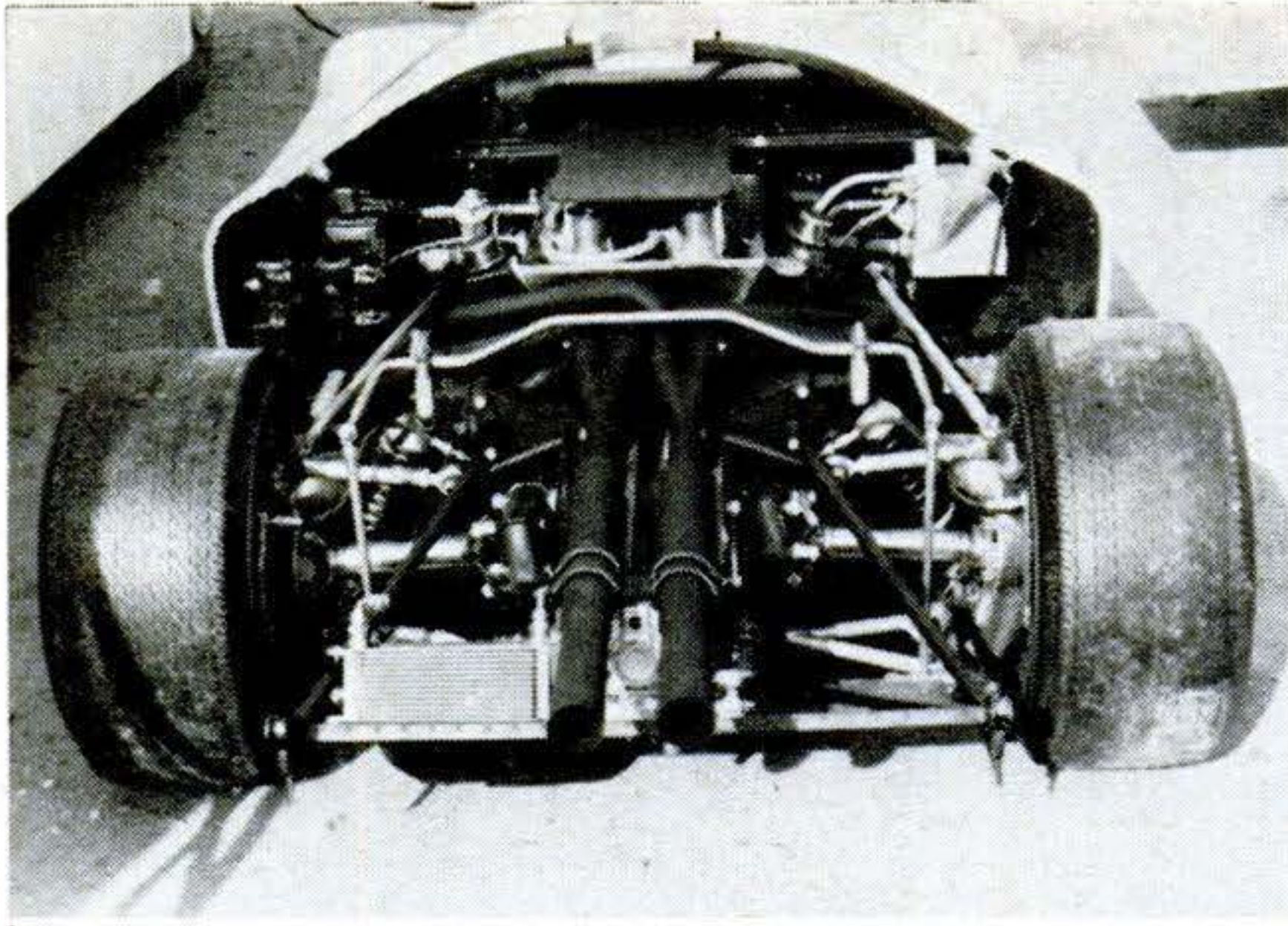
**Latest Lola** has Aston Martin V-8. It was designed by Eric Broadley, with John Surtees as chief tester.



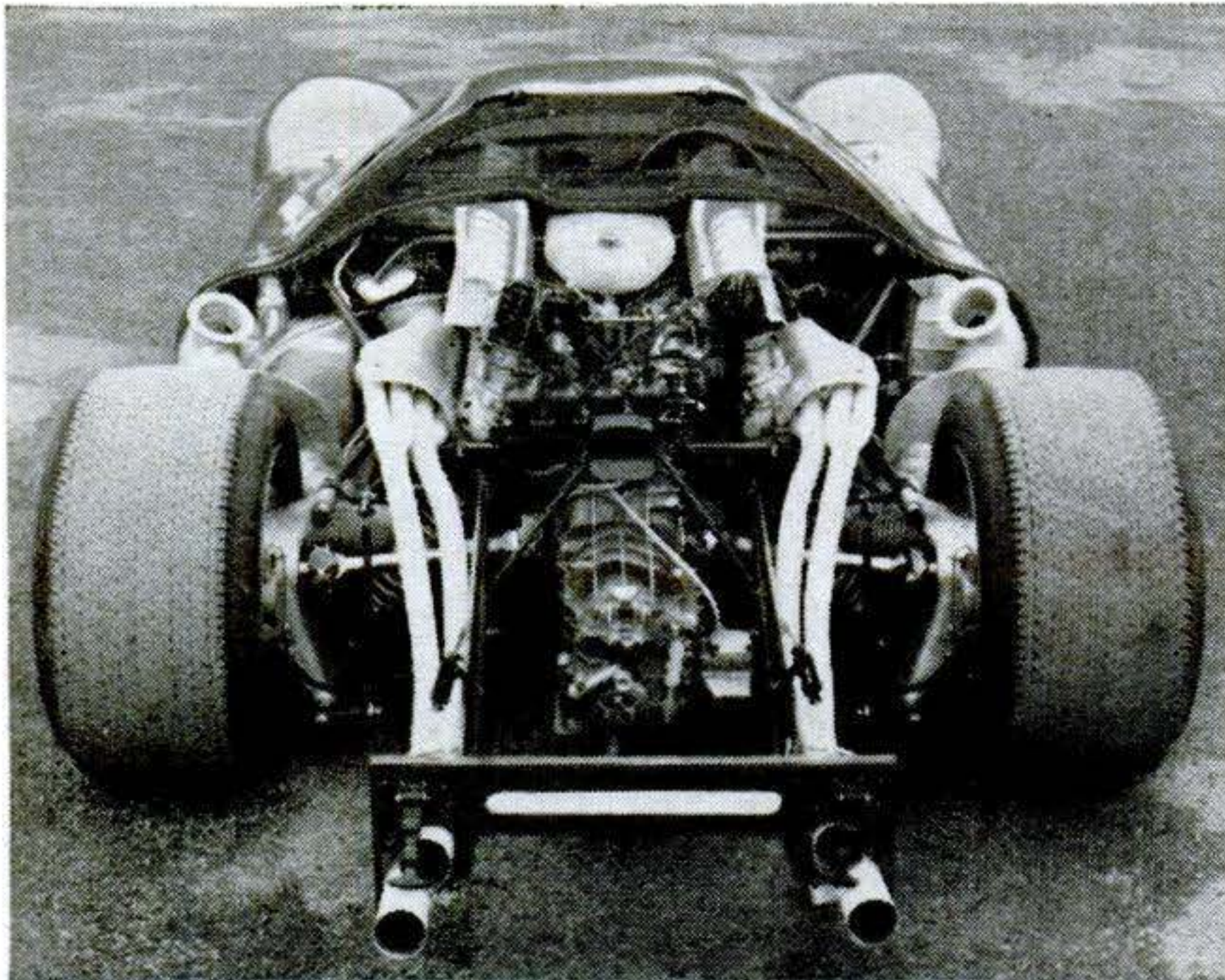
**Mirage** is the name of John Wyer's new Le Mans car. It's basically a Ford GT 40 with new bodywork.

**Matra** is France's largest maker of sports cars. This is their biggest model—powered by a Ford V-8.

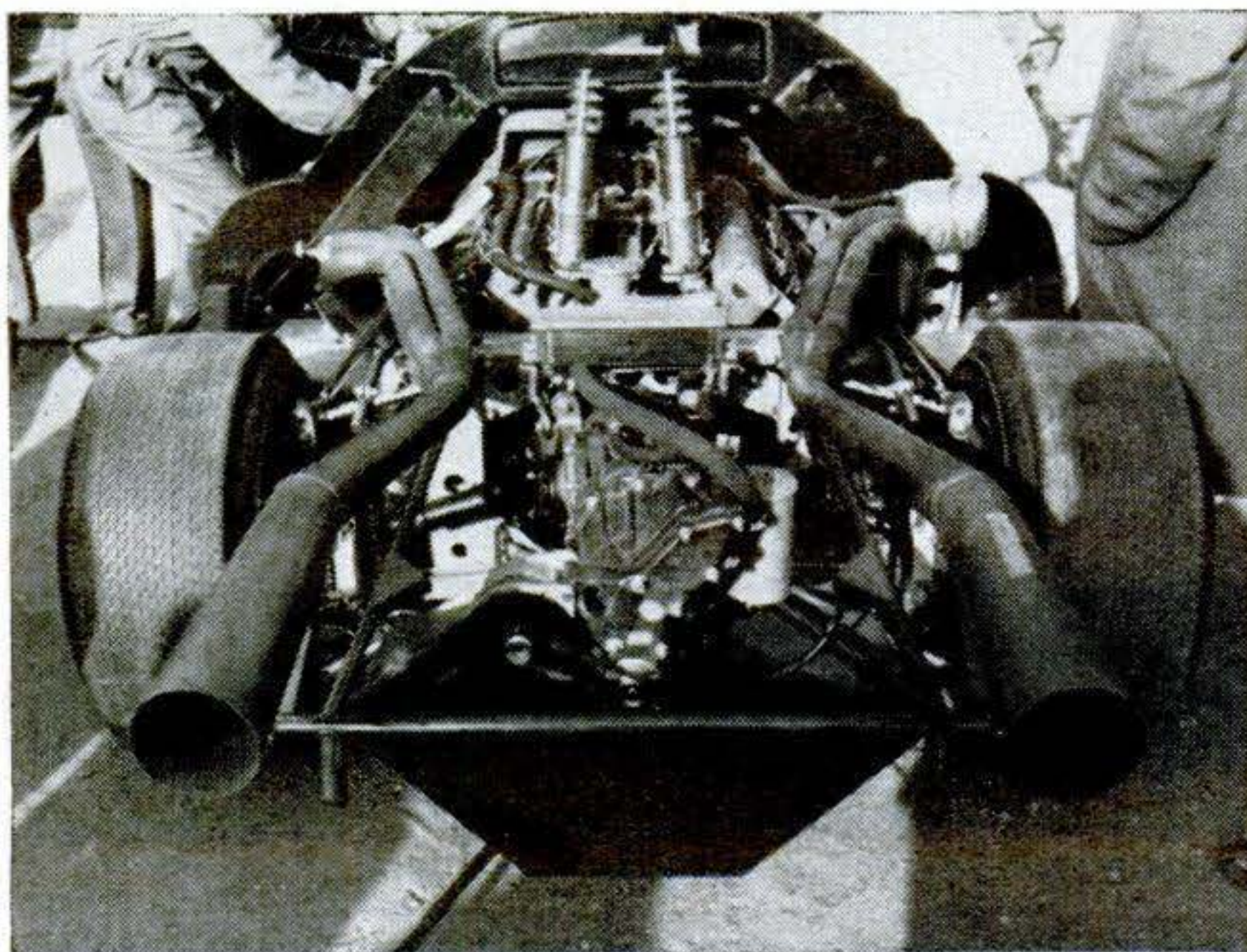




Rear view of the Mirage, with body panels removed, shows Ford engine installation, exhaust pipes, and suspension system.



Ferrari's 12 cylinders need a lot of tubing for exhaust and intake. The P4 uses fuel injection instead of carburetors.



Aston Martin engine in Lola chassis looks like tried-and-true racer but is actually brand new and needs development.

Ferrari's front line consists of three factory P4s, with 36-valve four-overhead-cam 24-plug V-12 engines of 268-cu.-in. displacement. The P4 weighs only 1,750 pounds.

The works team is backed up by five privately entered 244-cu.-in. V-12 Ferraris, but their performance is likely to be considerably poorer.

**The other contenders.** In addition to the Fords and the Ferraris, many other cars are contenders for overall victory:

- One Chaparral with a 425-cu.-in. Chevy V-8.

- Two Lola-Astons—an all-new development with an Aston Martin four-cam V-8 in a Lola chassis.

- One rebuilt Lola with a much-modified 336-cu.-in. Chevrolet V-8.

- One Bizzarrini with a stock-block 327-cu.-in. Chevrolet engine.

- Two Mirage cars built by John Wyer, powered by a 311-cu.-in. version of Ford's Fairlane V-8.

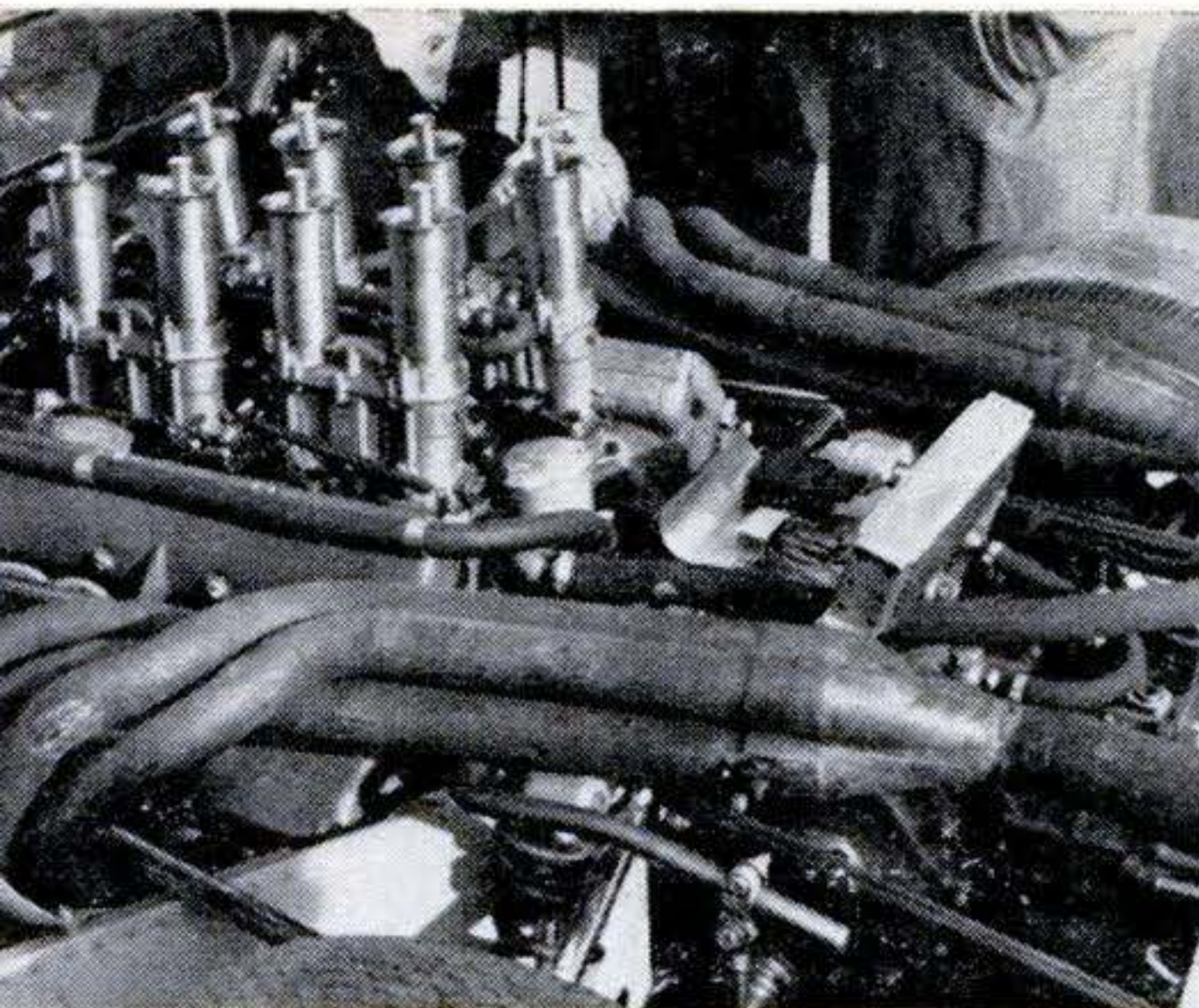
- Two 289-cu.-in. Ford GT 40s entered by Ford of France.

- One French-built Matra-Ford with the 289-cu.-in. V-8.

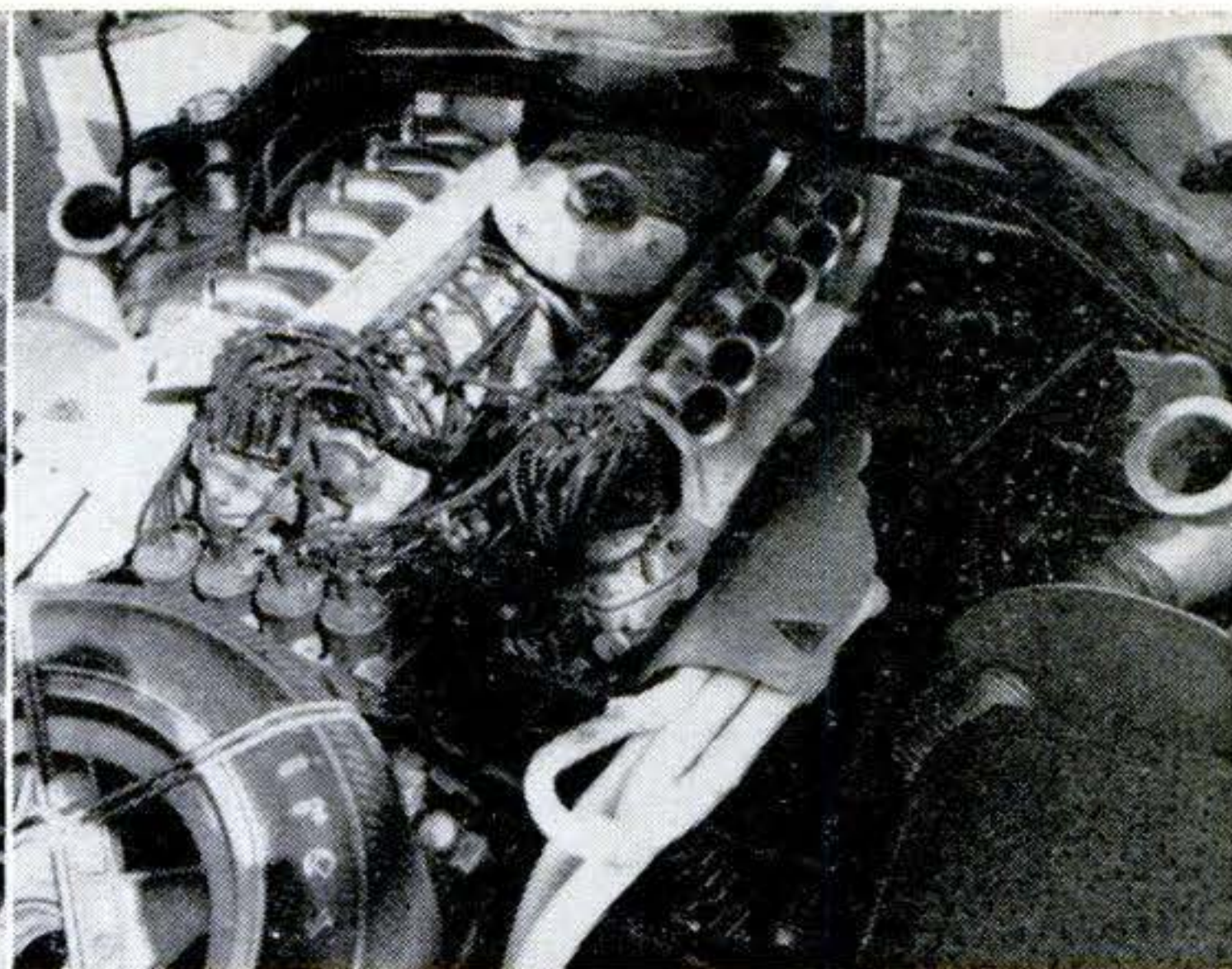
The Le Mans race has special prizes for smaller cars, based on speed vs. fuel consumption and speed vs. engine displacement. In the second echelon are some very fast cars that could finish among the leaders if enough big cars drop out with mechanical trouble.

Ferrari has three V-6 four-cam 121-cu.-in. Dino cars. Alfa Romeo has three all-new Type 33 V-8s of 122-cu.-in. displacement. Matra has three BRM V-8 engine coupes that proved speedy but fragile last year. Porsche has a team of four air-cooled flat-six 121-cu.-in. Carrera 6 cars. Similar Porsches came in fourth, fifth, sixth, and seventh overall last year.

**Chaparral—a dark horse?** The Chaparral poses two big questions: Will the Le Mans technical commissioners accept its "wing," and will it go the distance? If you say no to the latter, remember that everybody said it would never last

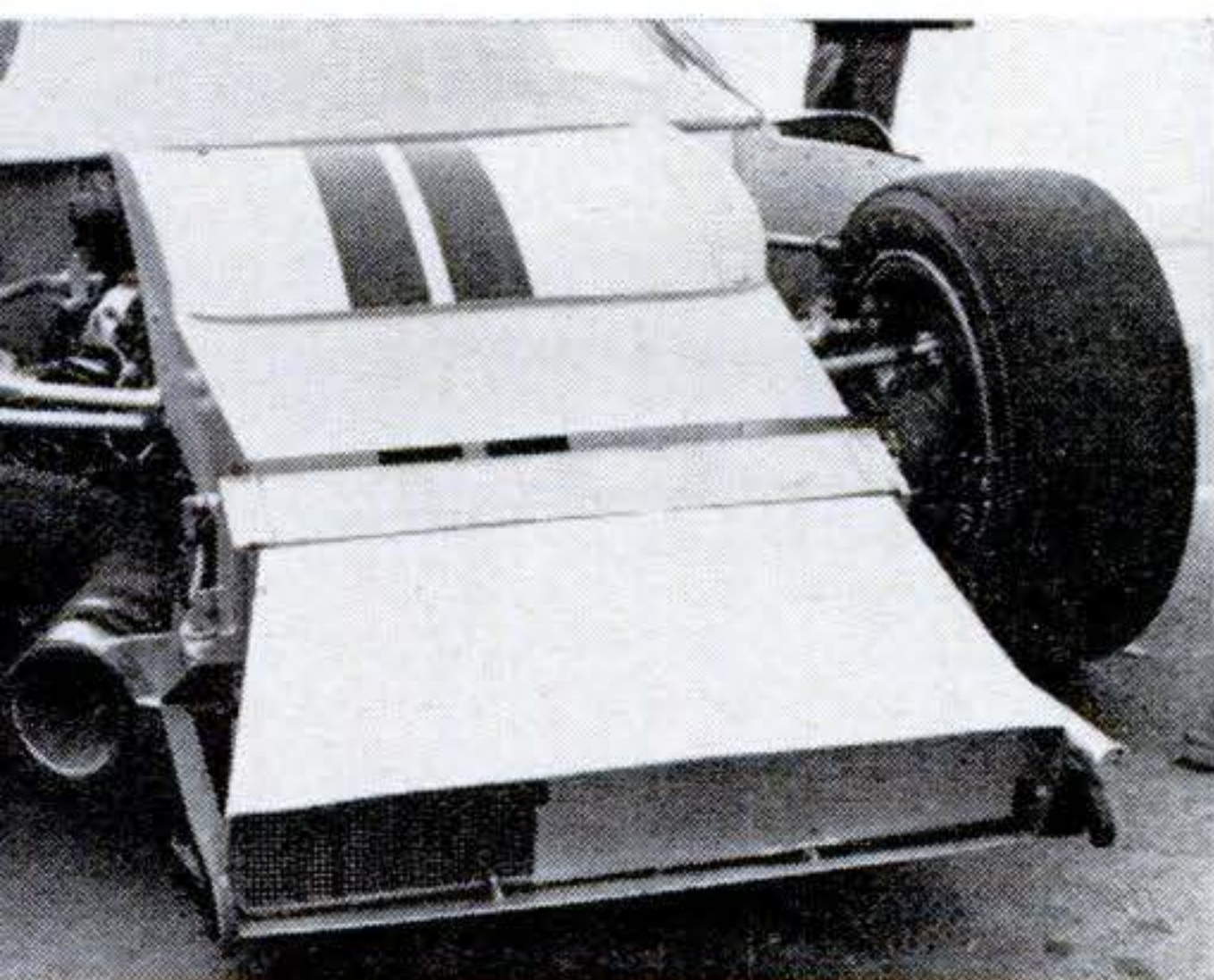


ton Martin's V-8 has short-stroke aluminum block, overhead camshafts, and Lucas fuel injection.



Ferrari P4 engine has three valves and two plugs per cylinder, two 12-tower distributors, and four coils.

000 kilometers at the Nürburgring last year. It did, and it won. The Chaparral's performance at Sebring two months ago, when it shattered the lap record before dropping out with transmission trouble, suggests that Ford should really be worried; defeat of a car full of "no-racing" General Motors parts would be a very bitter pill to swallow. Apart from the Chaparral, the strongest challengers to the Fords and Ferraris will probably be the Lolas. The Chevrolet-powered car could well be faster than the ton Martin engine-works entries, though unlikely to last the full 24 hours. The Mirage is really just a lightened Ford GT40 with a more aerodynamic body. In tests, a 19-cu.-in. Mirage lapped in three minutes, 2.2 seconds, only 2.1 seconds slower than the Mark IV; and given a trouble-free run, the 311 model need not be too far behind thirstier U.S. cousins. The same should be true of the GT40s and Matra-Ford.



ord Mark IV radiator is canted to scoop up air from low ducting. Note separate brake-cooling ducts.

The only really unknown quantity is the three-liter Alpine, which has two Renault Gordini heads on a common V-8 block. Alpine only expects 300 hp. at the most, but this should push their lightweight aerodynamic coupes along very quickly.

As always, the French Alpines and CDs dominate the smallest class. The little Alpine is a streamlined job with a Renault engine placed amidships, while the CD (initials of the designer, Charles Deutsch) has a front-drive Peugeot engine and drive train placed behind the driver. Each team has two cars, and there is an independently entered Alpine, too. The opposition in the economy-car class comes from an Austin-Healey Sprite prototype, a Costin-Nathan with a Sunbeam Imp aluminum engine, and an incredibly ugly Mini-Marcos.

**What happened to the GTs?** The 24-hour race was instituted in 1923 as a durability test for touring cars. Now the fastest racers in the world speed along the same roads at over 200 m.p.h., while the GT class is poorly supported.

Dana Chevrolet of Los Angeles will run a 427 Corvette Sting Ray, and Claude Dubois will run a Shelby Mustang 350. Scuderia Filipinetti challenges the American cars with a production-model Ferrari 275 GTB, and two French independents will run Porsche production cars. The GT cars will certainly prove less spectacular than the hot sports prototypes, but the race would doubtless be safer and contribute more to the development of regular passenger cars if the 24-hour race were restricted to GT production cars. I think speeds of 200-plus are strictly for aircraft.

PS

# Chrysler's Five-Boat

Great day! PS tests not one but five units of the 19

By JIM ROE / PS Boating Editor

**W**hat could be more fun than testing a boat in the warm waters of southern California? A chance to test five different new boats. And that's just what we had in the waters of the San Diego Cup Race course on California's beautiful Mission Bay. Five brand-new boats with Chrysler blood and Chrysler power:

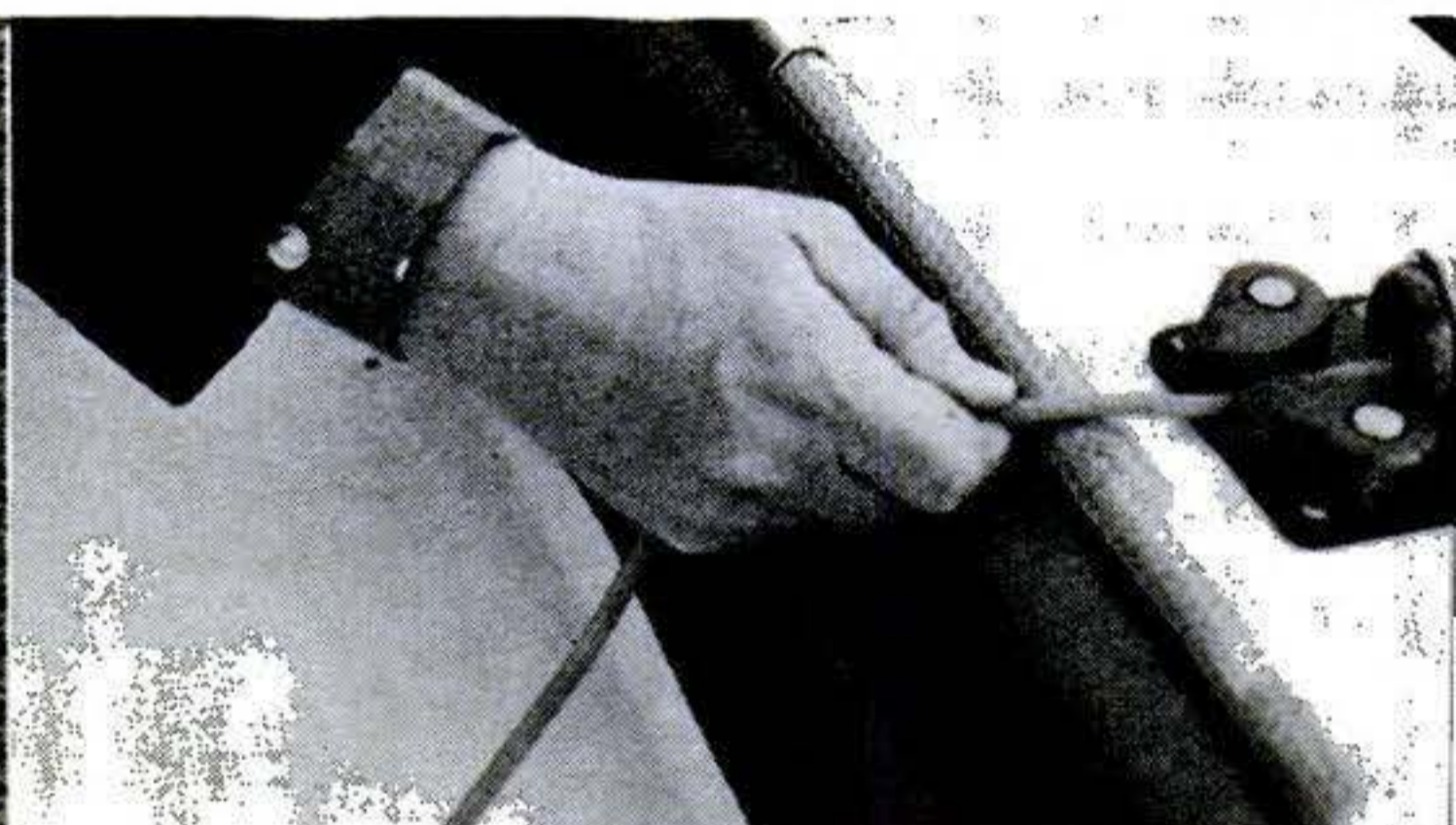
The LS-16 sailboat; the Charger 183 outboard hull powered by a new Chrysler 105-hp. outboard; the trusty Chesapeake 18-foot

hull powered with the Chrysler-Volvo 110-hp. stern drive; a 210-hp. inboard engine powering a 23-foot Uniflite cruiser; and finally a star of the new stern-drive fleet—the Courier 229 with Hydro-Vee hull design powered by a 150-hp. stern drive.

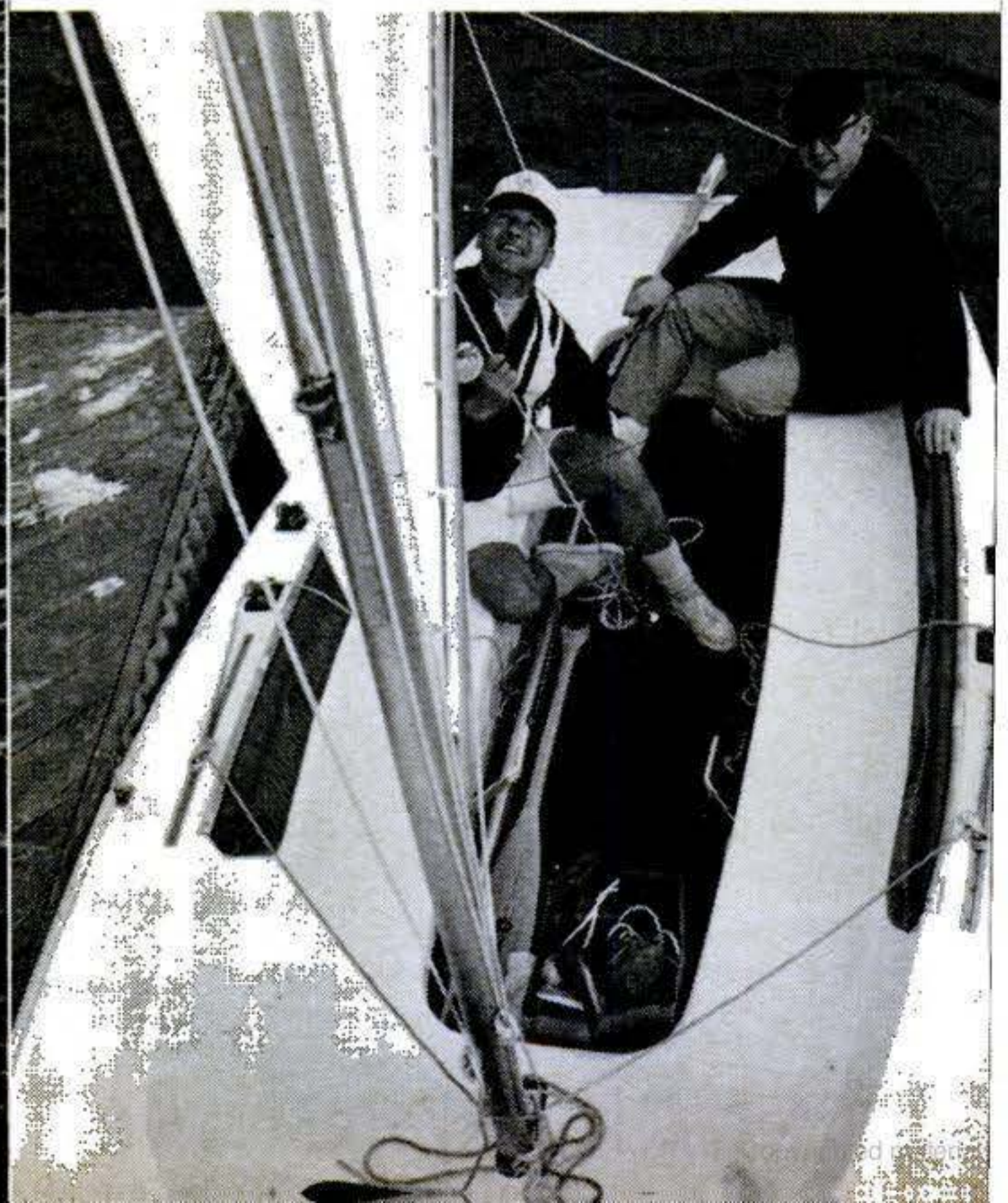
Sailing expert Dick Stratton bravely put to sea in the LS-16 with two novice sailors as his crew. Racing driver Gary Ferguson was handling sheets up forward, while I manned the tiller.

The friendly LS-16 performs well with such a pickup crew. Even on a spinnaker run she performed as though Dick had a full crew of experts aboard. The LS-16 has

*Continued*



LS-16 sailboat is a beauty under way (left) and loaded with features dear to a sailing man's heart (like cam cleat above). Below, gull's-eye view shows this 16-footer's uncluttered cockpit area. Lock-and-key bow-storage compartment is inside cover at base of aluminum mast.





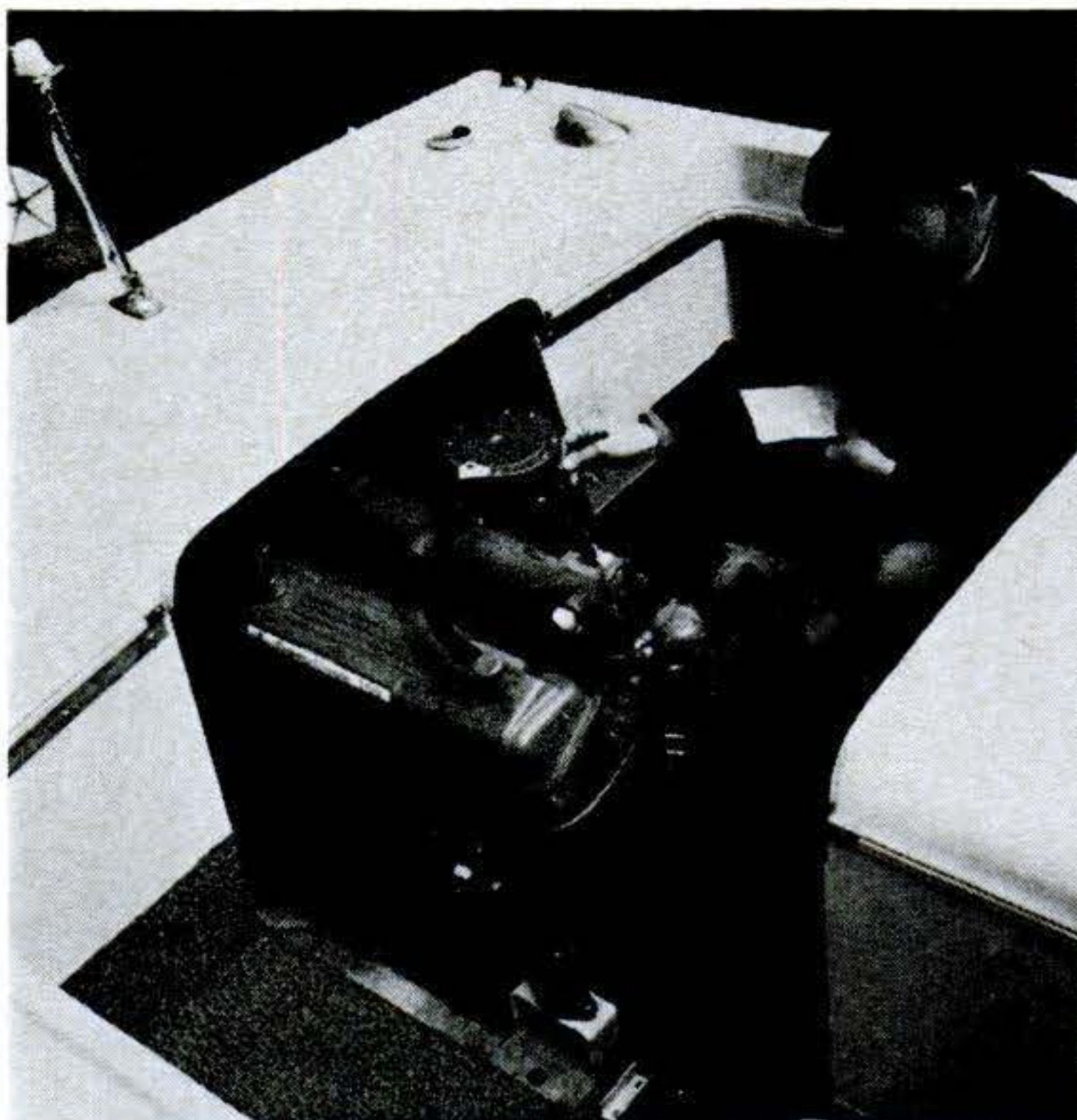
# Fleet-Fast and Fancy!

Chrysler boat fleet on sunny California's Mission Bay

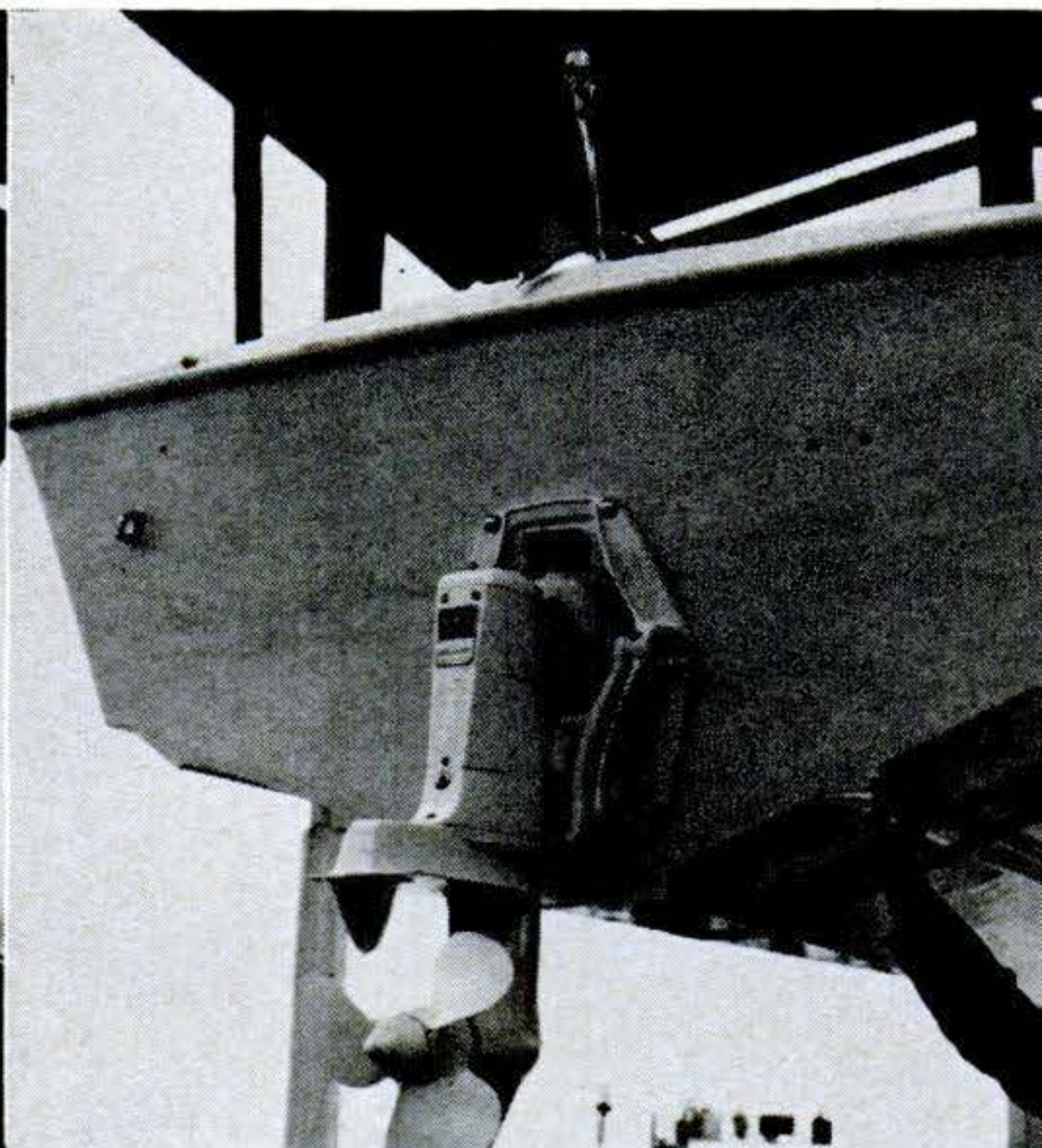


See's the fleet: At top, LS-16 sailboat, 23-foot Uniflite cruiser. In the middle, Charger 183, powered by 105-hp. outboard. At bottom left, the Courier 229 with 150-hp. stern drive. On the right, the Chesapeake, an 18-footer with Chrysler-Volvo 110-hp. stern drive.

## Here's the flashy Courier 229—both power and hull by Chrysler



Stern drive is neatly tucked under fiberglass housing. This six-cylinder overhead-valve engine weighs 765 pounds, has underwater discharge for exhaust.



Hydro-Vee hull displays its stuff on the hoist. Here at transom, it shows typical deep-V characteristics. Up forward, sponsons help give stability.

a centerline length of 16 feet, beam of 73 inches. Maximum draft with the twin powered-action aluminum bilge boards down is two feet, 10 inches. The fiberglass hull has poured-in foam flotation, as does the aluminum mast and boom. Sail area for the working mains'l and jib is 160 square feet. Spinnaker adds an extra 164 square feet.

Cockpit area is roomy and well arranged. A handy nylon hiking rail extends the full length of the cockpit.

**Exceptional maneuverability.** The design of the LS-16 (and of its smaller sister ship, the LS-13) eliminates the centerboard and its resultant cockpit-cluttering trunk. The specially designed twin pivoting bilge boards feature trunks that are molded into the fiberglass hulls under the seats. This gives the boat exceptional maneuverability. There is greater speed because using only the leeward board minimizes the drag. The LS-16 weighs only 450 pounds, yet can carry six.

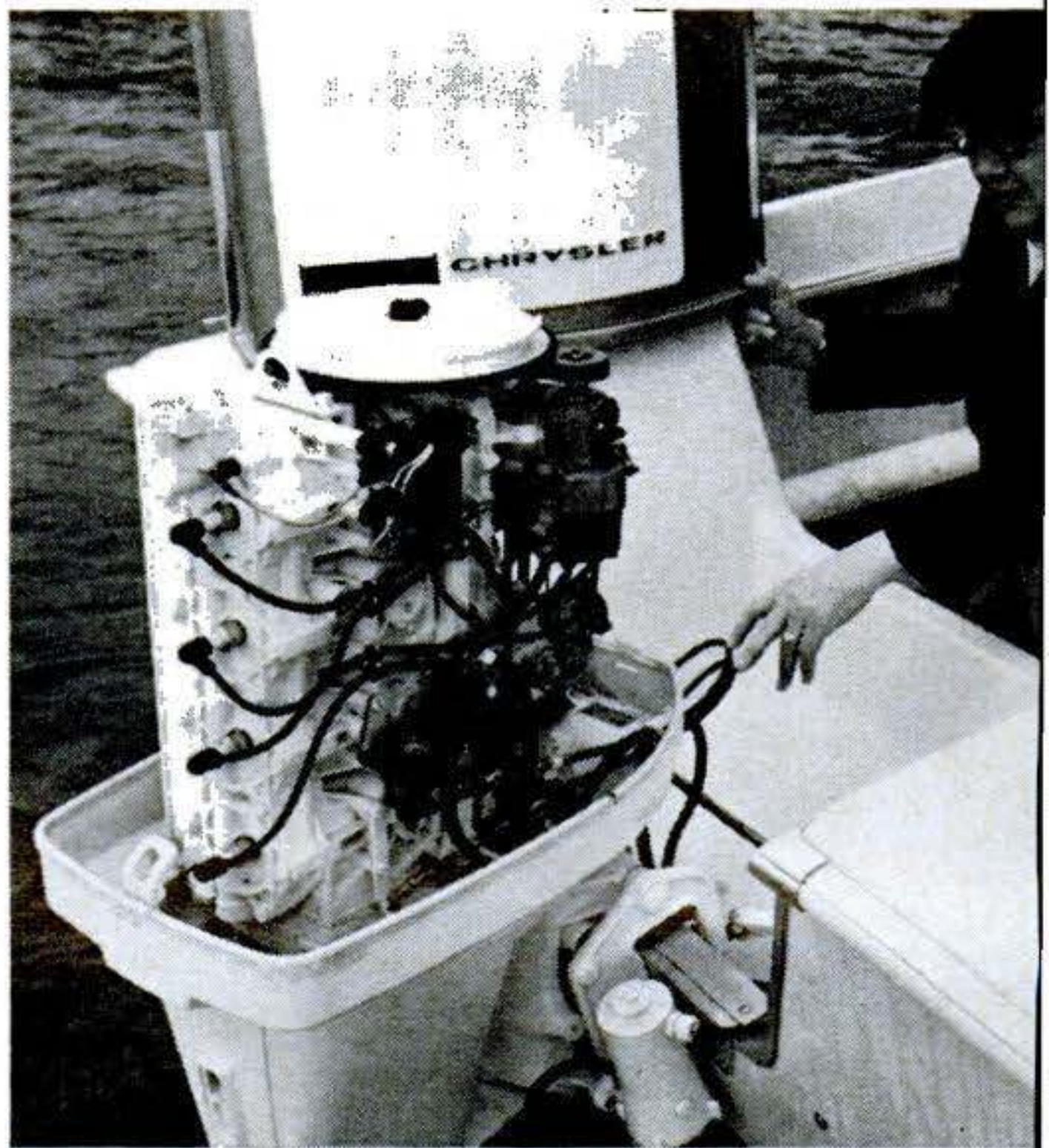
At the other end of the speed range from the LS-16 is the 16-foot Charger 183 hull, equipped with Chrysler's 105-hp. outboard. Chrysler uses a cubic-footage measurement to name its boats; thus the Charger 183 has 183 cubic feet of usable space inside the hull.

When the throttle controlling the 105-hp. outboard went forward, the Charger literally leaped out from under us. Up on plane in a moment, the boat flew along just above

the tops of waves in a fine level attitude.

Linked with the Charger Hydro-Vee hull, the 105-hp. outboard seemed an ideal big power choice. This is a big and husky motor. It has automatic electric choke, hydraulic tilt, hydraulic shock absorbers.

**Faithful Chesapeake.** This '67 version of Chrysler's husky and popular 18-foot lap



Four cylinders and 105 hp. are features of Chrysler's biggest outboard. It has a 96.55-cu.-in. piston displacement, runs on a 50:1 gasoline-oil mix.



**Courier 229 in action:** At high speeds this sturdy hull tilts very little in a turn. Walk-through windshield allows easy access to the roomy bow cockpit

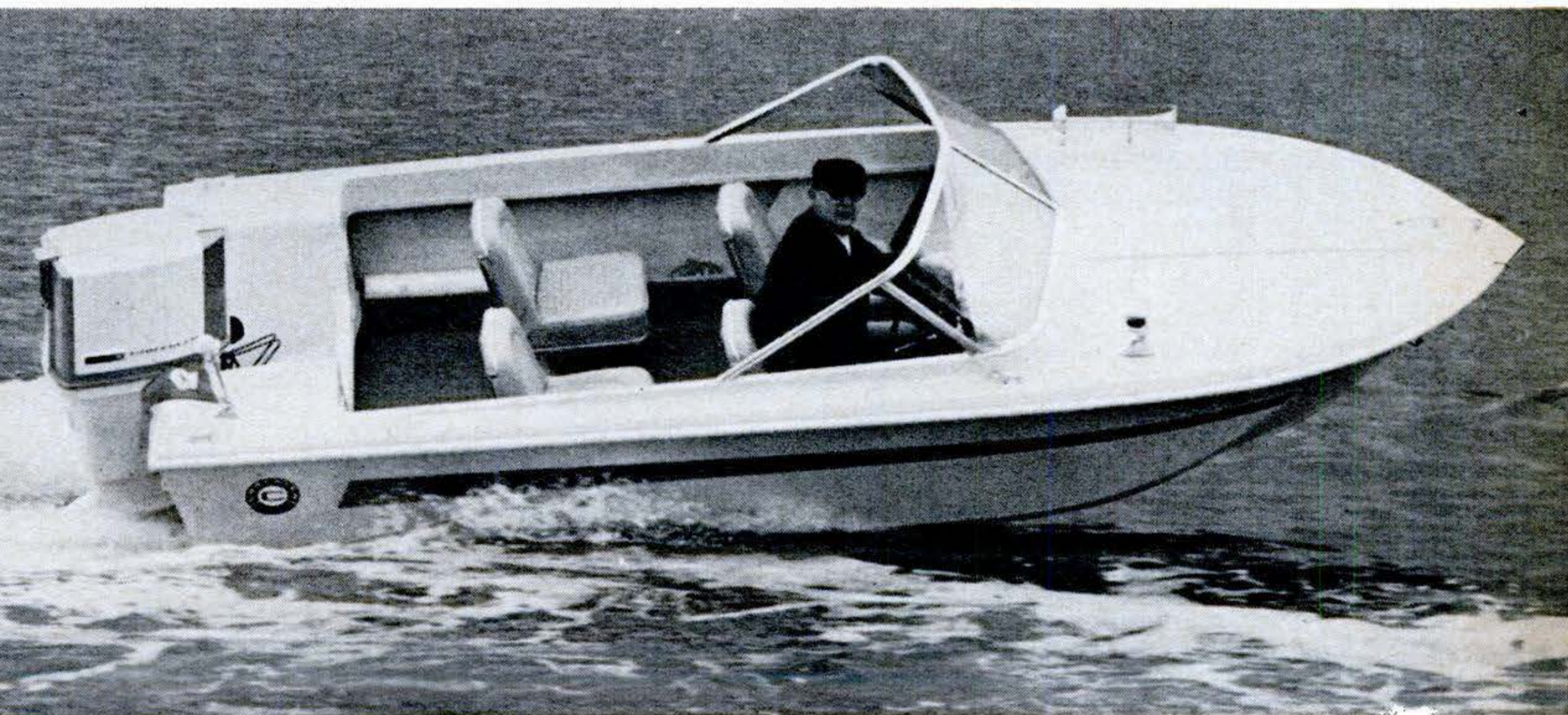
—a feature popular with boatmen these days. Even with most of our test crew aboard, the Courier gave us a pleasingly fast pickup and a level ride.

strake-style fiberglass hull was powered with a Chrysler-Volvo 110-hp. stern drive. I have operated this hull many times before, and this newest version did honor to the breed. It's a go-anywhere, do-anything craft which is at home in rough water or smooth, and seems just right for either a family outing or a group of fishermen.

The Chesapeake has a beam of 90 inches and weighs 1,040 pounds, less engines. The stern-drive version has a maximum horsepower recommendation of 120; the outboard, 130 horses.

You'll find it a handy no-nonsense craft. During most of our five-boat test, it served as a stable photo platform.

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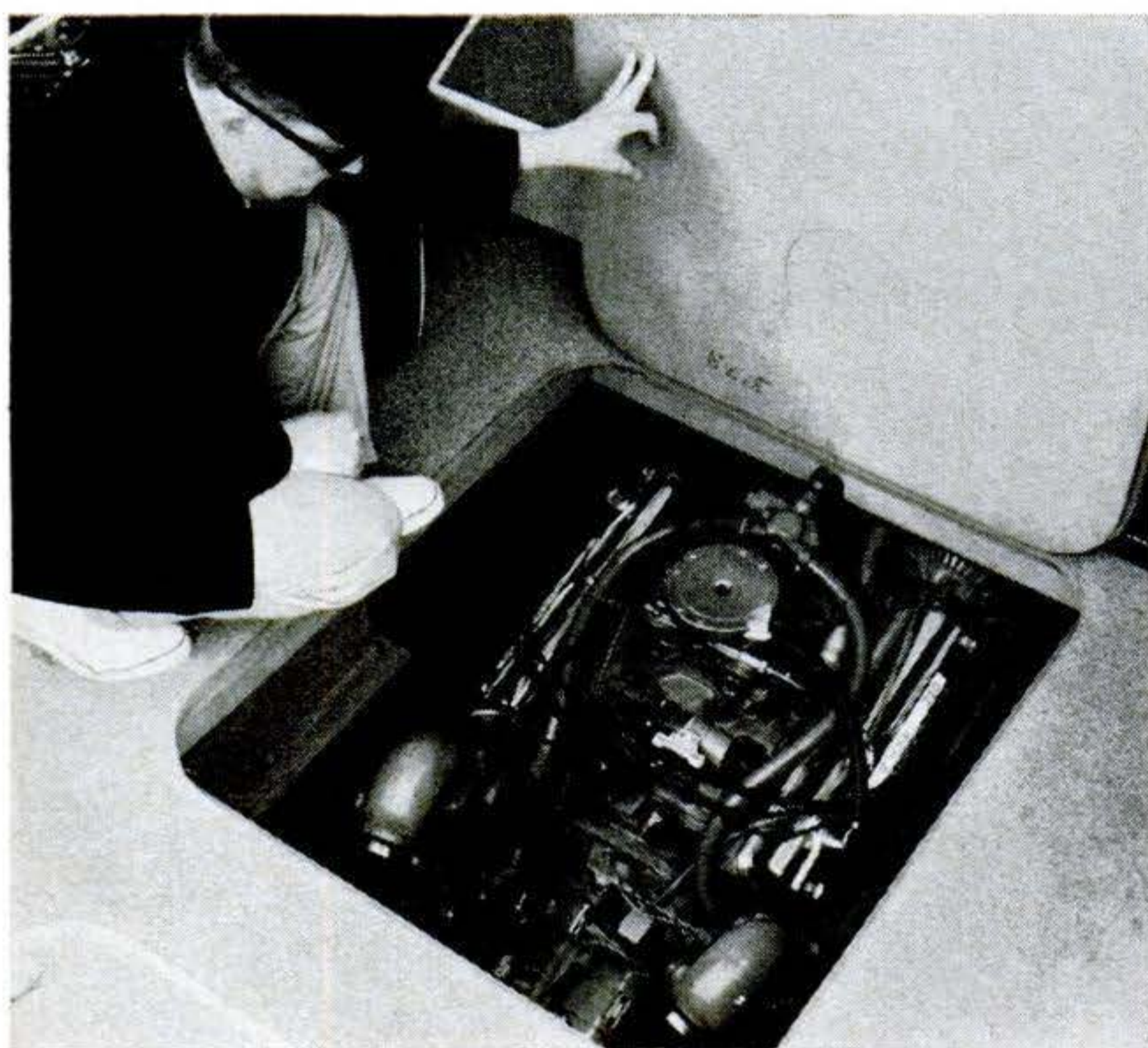


**Hot rod of the crowd,** the Charger 183 outboard, powered by the Chrysler 105-hp. motor, is a speedy performer under all conditions. This boat has the

same Hydro-Vee hull as the Courier 229—gives the same stable ride in both rough and smooth water, and takes high-speed turns in its stride.



**Uniflite fiberglass cruiser** is a 23-footer. It's a heavy boat, but the 210-hp. inboard engine gave it plenty of acceleration and a high top speed. Power during the test proved smooth at all points, from low idle through maximum r.p.m.



**Tucked below deck**, the 210-hp. inboard ticks away quietly until it is needed for a fast sprint. Cubic-inch displacement is 318. The engine has a four-barrel carburetor, burns regular-grade gasoline at a compression ratio of 8.5:1.

Long before Chrysler went out for sailboats, outboards, or even stern-drive boats, the name was well-known and respected in the inboard marine-engine field. Big Chryslers had powered many a sumptuous and gleaming yacht. Today there are 10 Chrysler inboards, ranging from 120 hp. through 335. And besides these there is a new, red-hot Chrysler 426 hemi V-8 designed for racing.

For one of our tests we chose a modest yet adequate 210-hp. engine, installed in a 23-foot fiberglass Uniflite cruiser. Though this boat is extra heavy for her length, the 210-hp. engine made her frisky as a colt. The Uniflite model has almost everything aboard for family cruising: galley, icebox, enclosed stand-up head, dinette, and comfortable bunks. Quite a load for a single engine—particularly if you expect the boat to perform something like a runabout. She gave us calm dignity or get-up-on-plane enthusiasm.

**Courier 229.** One of the real stars of the 1967 Chrysler fleet, this 229-cubic-foot hull has plenty of take-the-whole-crowd room aboard, even without the bonus of its roomy bow cockpit. Our test boat was equipped with a 150-hp. stern-drive unit, which

[\[Continued on page 187\]](#)

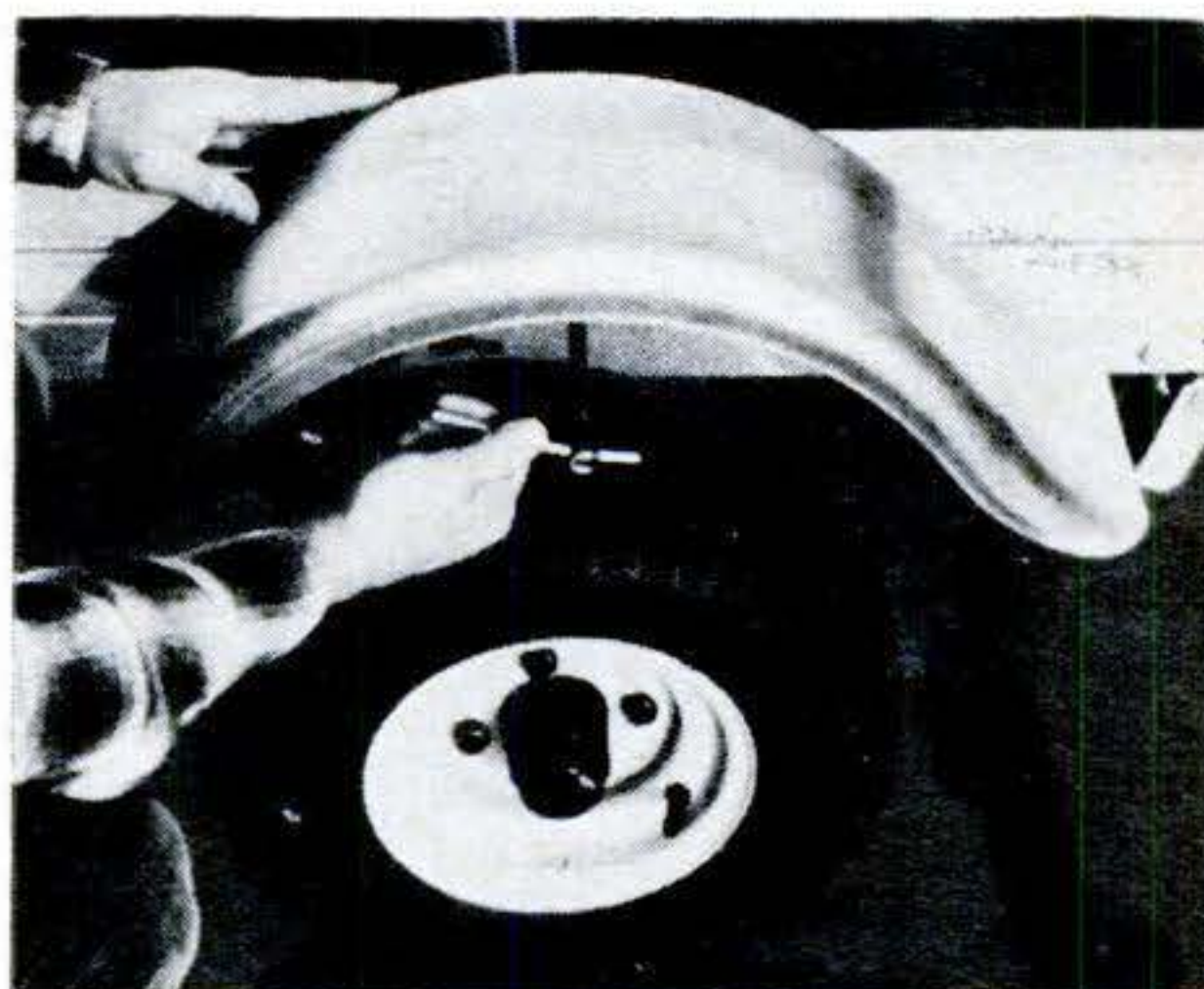
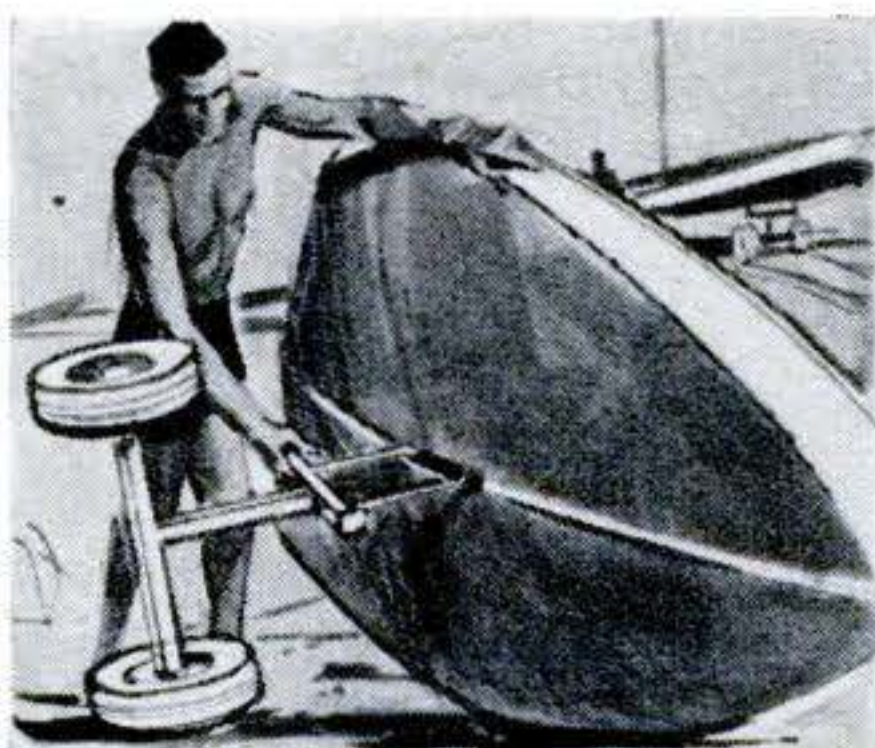
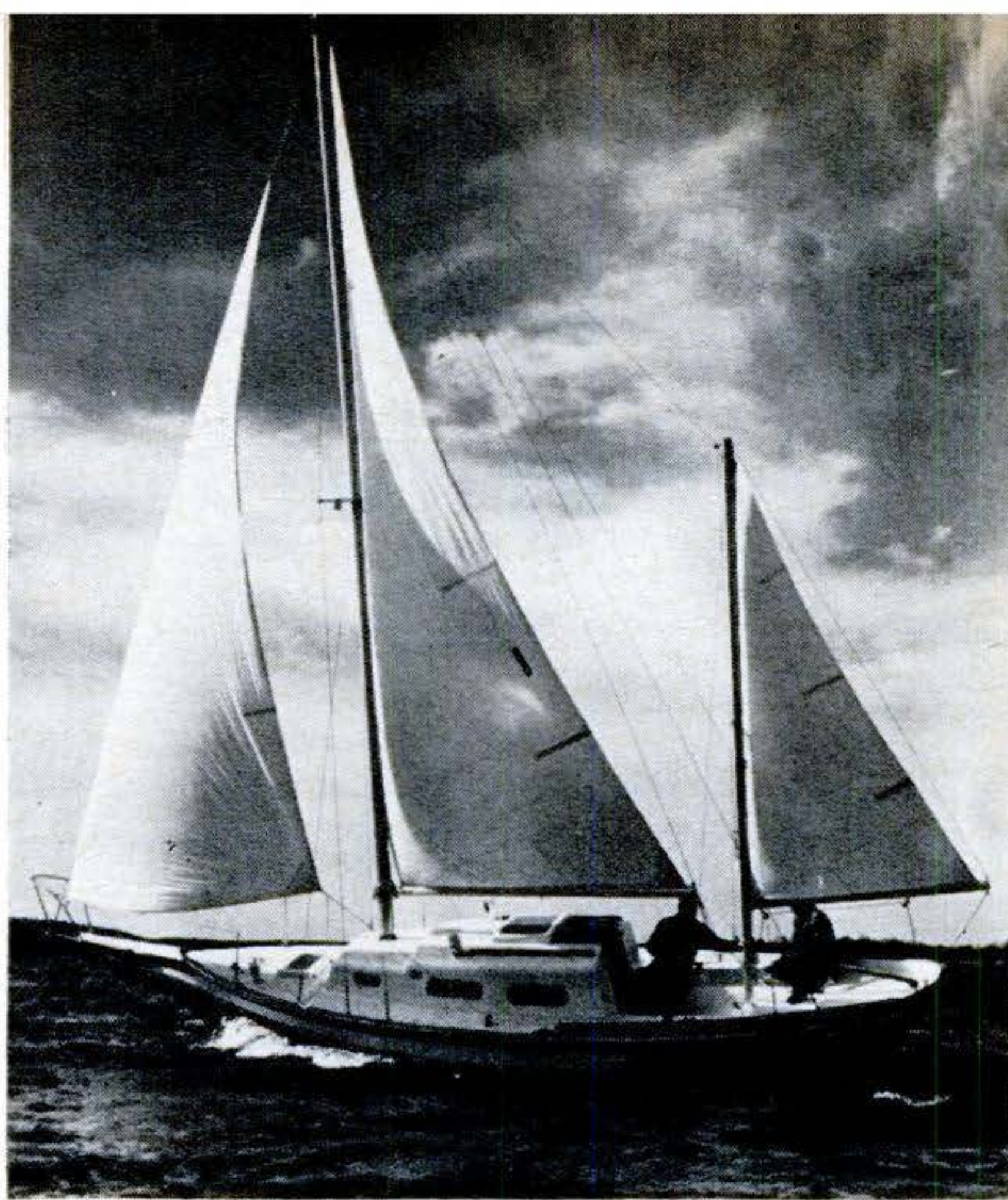


**Workhorse of the group** is the 18-foot lapstrake Chesapeake. Built of fiberglass, this hull has proven

highly successful in all types of water conditions. Power: 110-hp. Chrysler-Volvo stern drive.

### Fiberglass cruising yacht for the back-yard builder

You can buy just the hull of this 26-foot yacht and dodge the most difficult part of home boatbuilding. The complete boat costs \$8,995 but the hull alone, which you rig and fit yourself, is only \$2,995. It is made of fiberglass, with the color of your choice molded in. The hull includes deck and cabin house. Main bulkheads, chain plates, and rudder come installed. You also get blueprints and paper patterns. Either ketch or cutter rig is offered. The Privateer is made by Kenner Boat Co., Knoxville, Ark.



### Replacement boat-trailer fenders

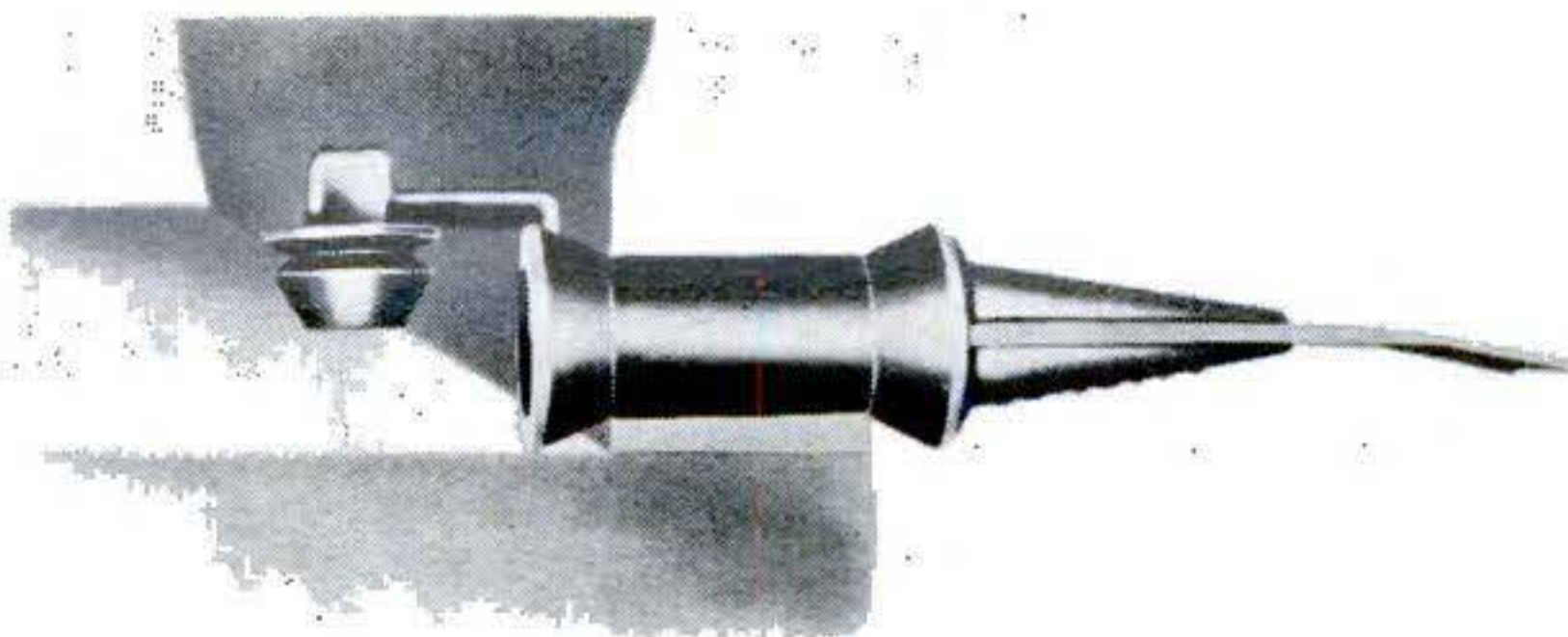
Banged-up, corroded fenders can be replaced with new ones to give your boat trailer a like-new appearance. These, made of cold-rolled steel, are easily installed, come primed, ready for spray painting. There are three sizes to fit from 4.80-by-8 to 5.30-by-12 tires. Prices are \$5.50, \$6.70, and \$8.90 a pair. Golden Rod, Hastings, Nebr., makes them.

### Dolly simplifies handling of board boats

Boats like the Sunfish and Sailfish are handy in the water, but a handful ashore. This dolly fits into the centerboard well and makes handling easy. Commercial Engineering, Houston, Tex. 77036.

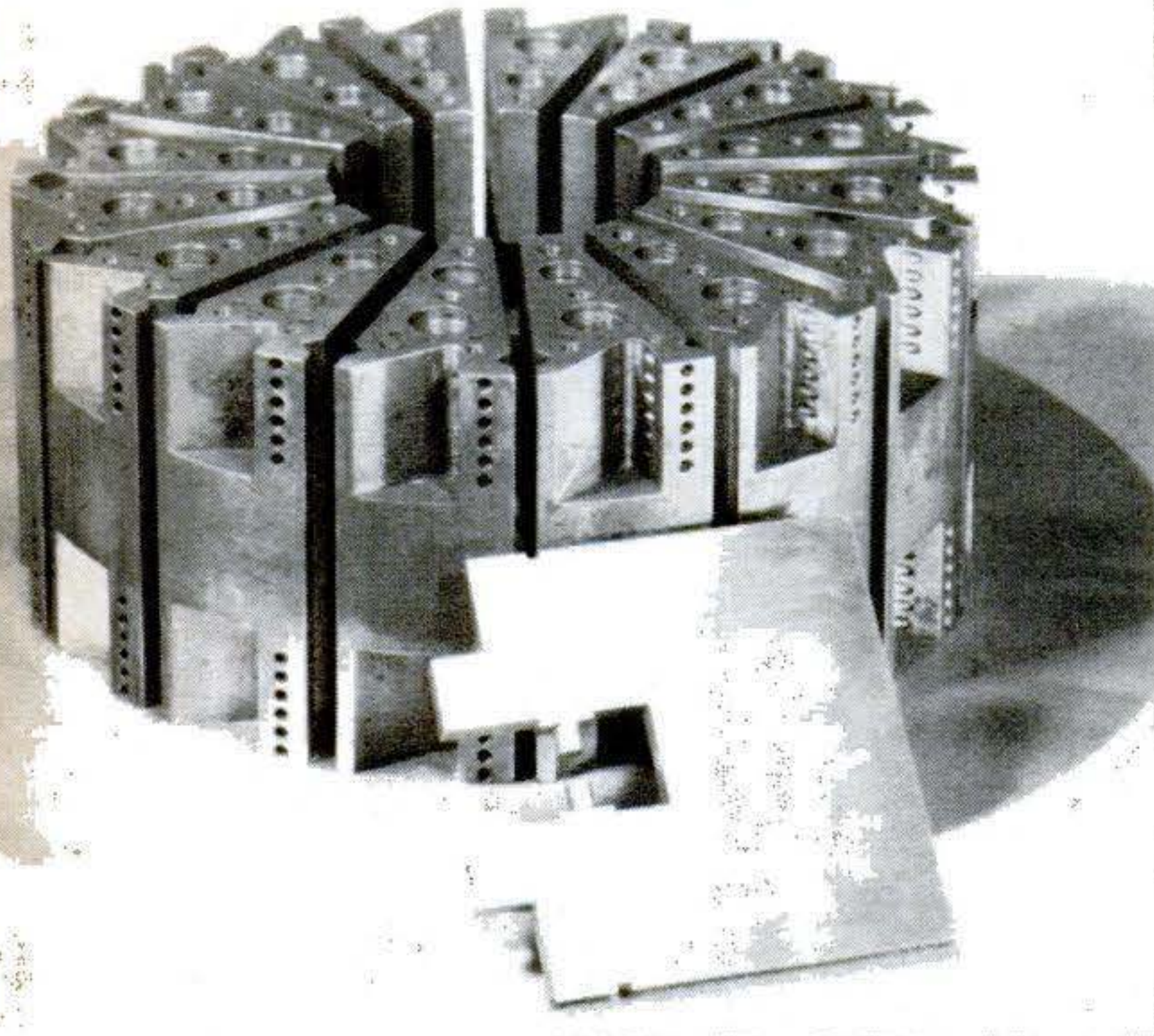
### Drain plug automatically removes bilge water while your boat is under way

This neoprene drain plug, inserted through the transom, has long, pliable lips that seal out water when the boat is at rest. When under way, accumulated bilge water surges out. The automatic device can be installed quickly and easily in most one-inch-diameter drain holes. The \$3.25 plug is made by Tempo Products Co., 6200 Cochran Rd., Cleveland, Ohio 44139.



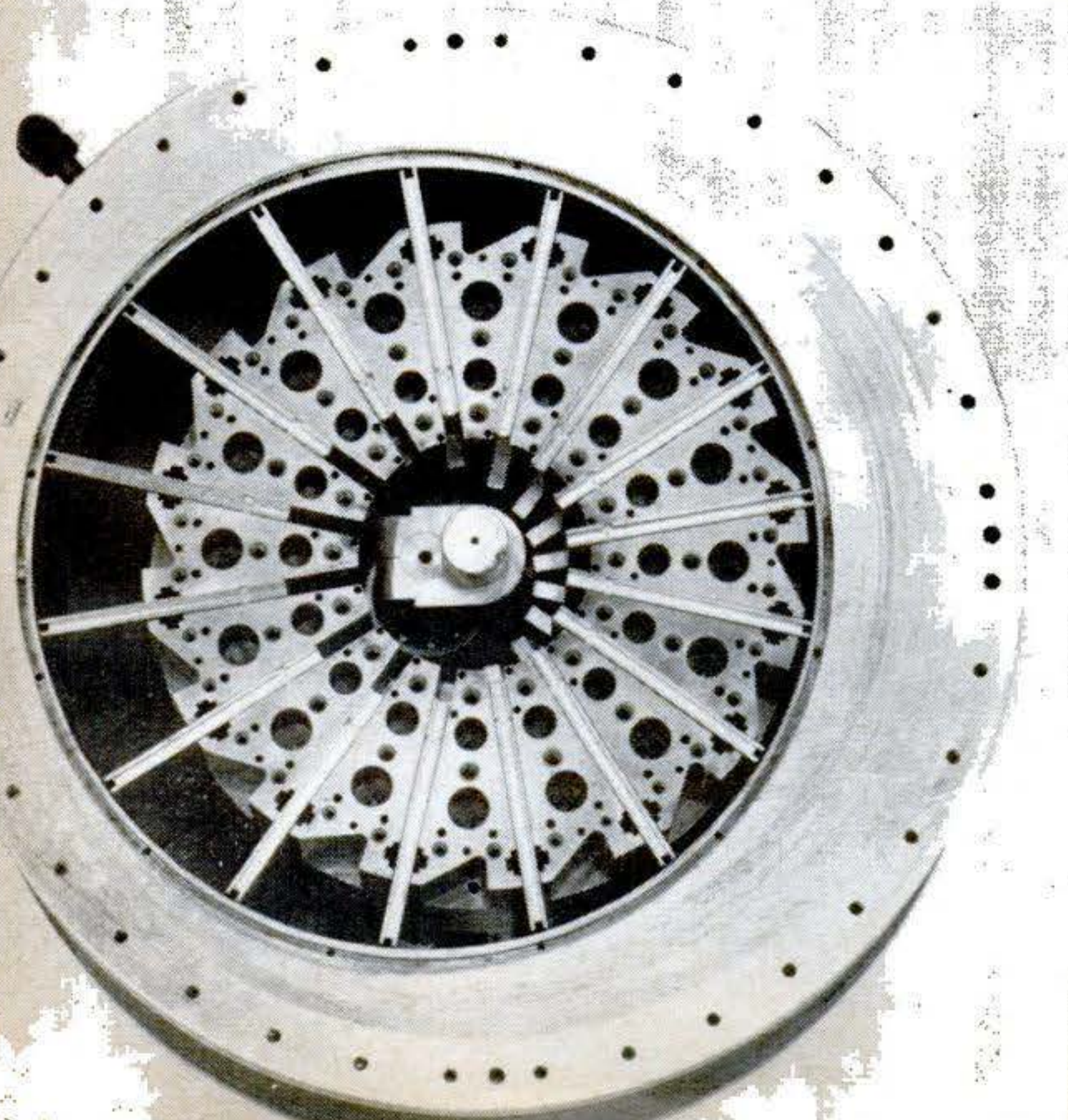
# 400 Hp. from an 80-Pound Rotary Engine

By W. STEVENSON BACON



Heavy slotted rotor carries vanes like that at front to form 16 working chambers. Note notches and holes in the circumference of the rotor; they swirl the fuel and air to mix it prior to combustion.

Something amiss here? No, rotor is mounted off-center in elliptical housing. Vanes slide out to form chambers (left) which get smaller to compress fuel (right). End plates bolt directly to rotor.



**H**ere's a screaming banshee of a rotary engine that's so light you can lift it in your arms, yet engineers claim a walloping 400 horsepower for it.

It burns gasoline or kerosene with almost equal, economical ease, consuming just 0.4 pound of fuel per horsepower per hour.

After start-up, it requires no ignition system—like a jet engine it burns continuously with its rotary vanes pulling in fuel, compressing it, and then getting a push as firing grooves touch off each charge.

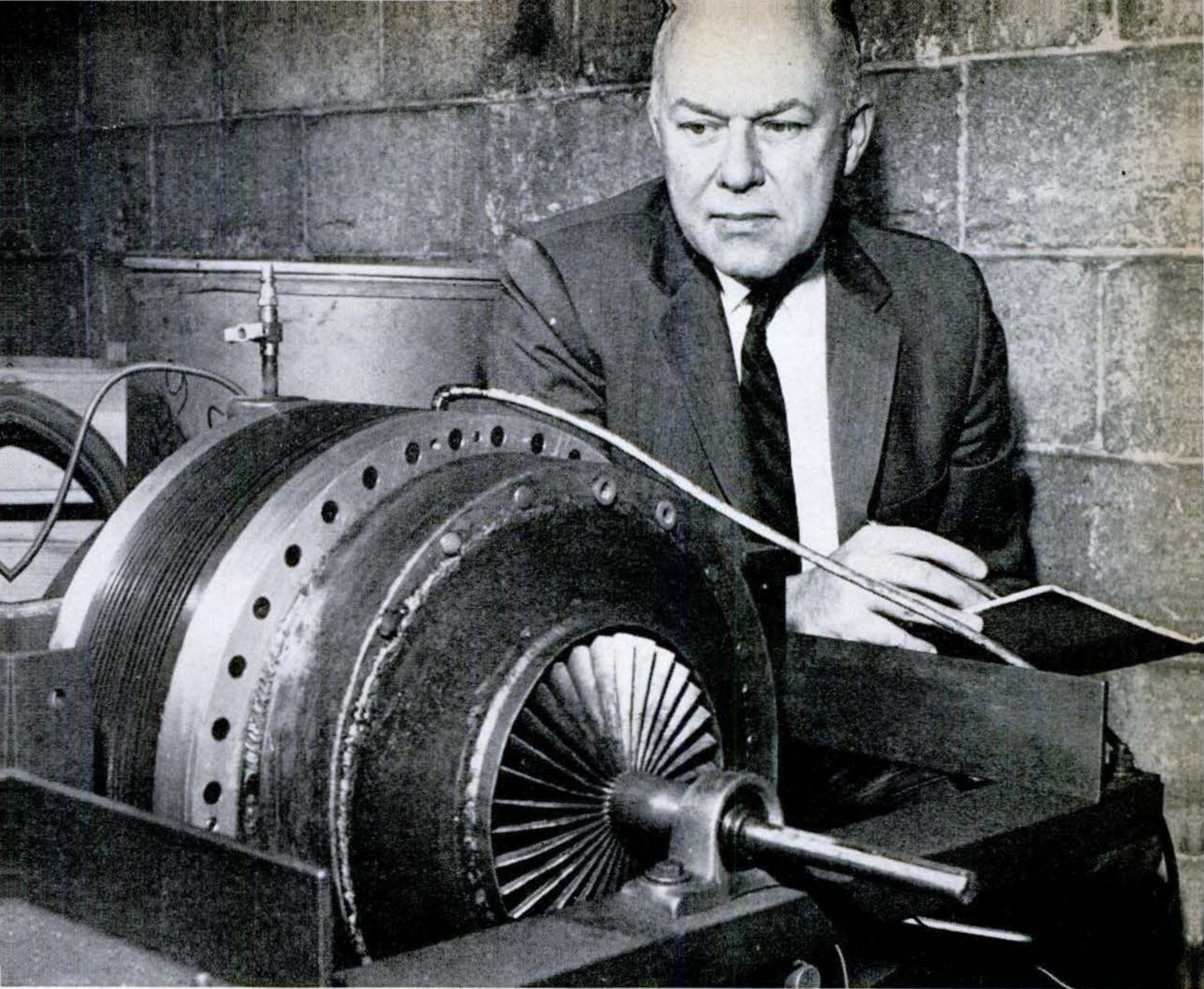
Will you ever see one of these little engines in your car? Maybe and maybe not. Like the turbine, the rotary-vane engine is basically a constant-speed engine (although it produces 400 hp. at 5,000 r.p.m., there's no torque below 1,000 r.p.m.), and would be difficult to adapt to start-and-stop automotive use.

On the other hand, there is a good chance that you'll someday power your boat, a lightplane, or personal helicopter with one. Look at the advantages: With a fabulous horsepower-to-weight ratio of 5:1 (and the developers believe that 7 or 8 to 1 may be possible), the rotary-vane engine would add a good 30 to 40 m.p.h. to the speed of a lightplane. Horsepower-to-weight ratios of current lightplane engines are less than 2:1.

How about a tiny lightweight outboard motor that's eight inches in diameter and two inches deep, yet delivers close to 200 hp.? It's possible, say engineers.

Helicopter applications are also exciting. The engine is so light it could be installed at the hub of the rotor blades—completely eliminating transmission and gearing.

For automotive use, the rotary could be doubled, with one engine functioning as a compressor to blow air into the second. When blown this way, the second engine would produce sufficient torque at low r.p.m. to make it a practical car engine.



Inventor Wallace L. Linn checks test data on his rotary-vane engine. Fan blades at the front are part

of a blower that forces fuel-air mixture into the engine to improve its performance substantially.

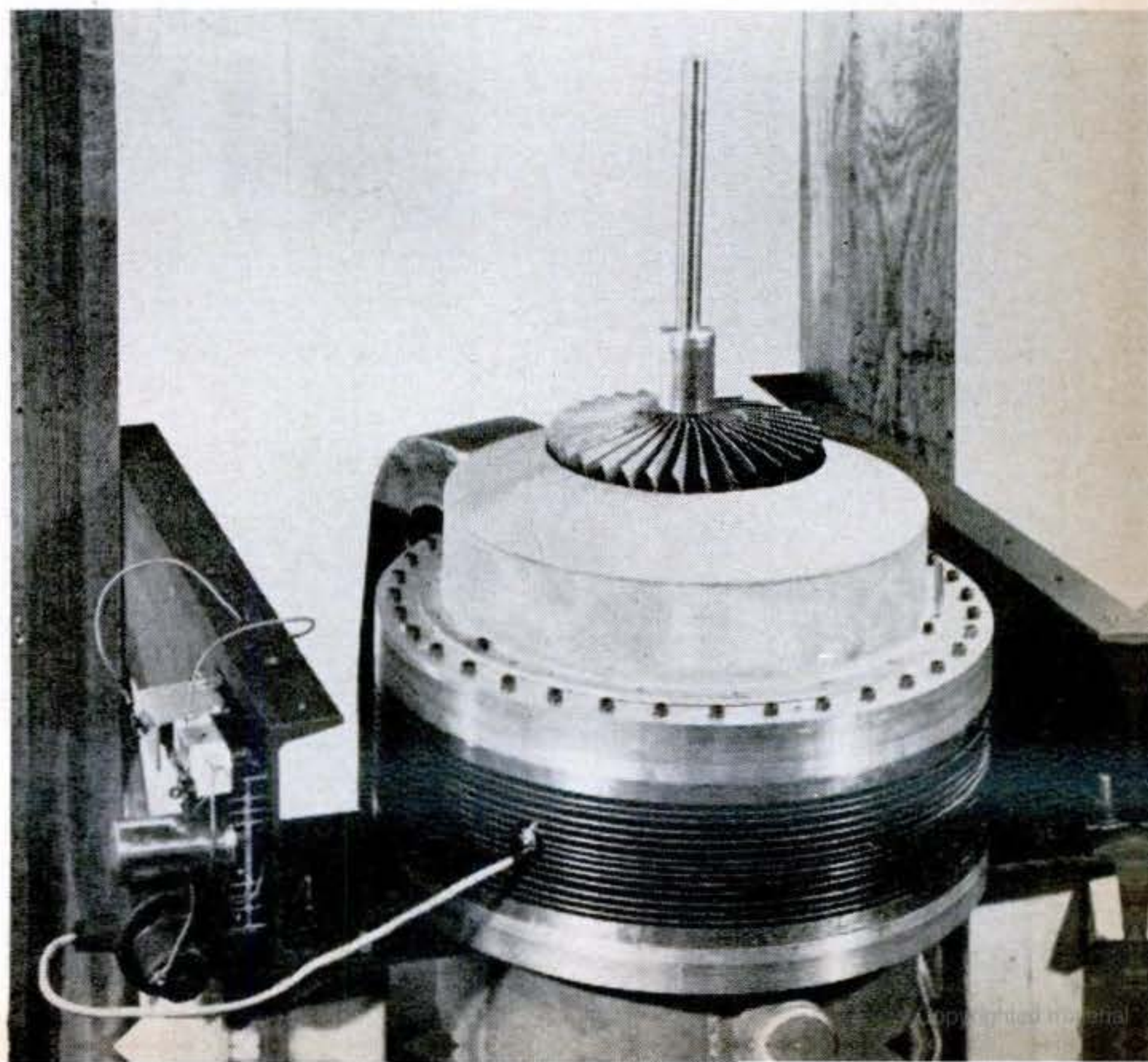
**How it happened.** The new rotary was born at P. R. Mallory & Co., long known as a manufacturer of electrical parts, batteries, and road materials. Although engines are outside Mallory's field, inventors Gianni A. Dotto and Wallace L. Linn, who were "just interested," began tinkering several years ago and built the first prototype. Under test it lost its head and promptly blew itself apart—after reaching 18,000 r.p.m.

Small electric motor brings engine to 500 r.p.m. to start; after ignition, burning is continuous. Grooves in end plates interconnect the three engine chambers to keep combustion going after it begins.

In the next model, the one shown here, the cast-iron housing was replaced by one of a copper-chromium alloy, increasing strength while cutting weight to 158 pounds. The next step will be to build an engine of aluminum: Voila! 80 pounds or less.

The engine consists of a slightly elliptical housing lined with stainless steel. A slotted motor is mounted on the offset part of a stationary overhung crankshaft. The rotor revolves around this offset axis, coming closest

[\[Continued on page 194\]](#)





People pictures, like this one taken in New York's Greenwich Village, capture special flavor of area.



Silhouette of stone archway and shadow in foreground help to frame this photo of the Parthenon.

# 16 Ways to Get Better

**Do they laugh when you sit down at your projector? Read this—and smirks may turn to smiles**

By PHIL McCAFFERTY

**W**hen you examine your vacation travel photos for the first time after returning home, do they fail to come up to the vivid scenes you saw through the viewfinder? Here's how you can make more-exciting travel pictures and use your camera to better advantage.

**1 Check your equipment.** Carefully clean the lens with lens-cleaning tissue and remove any dust from both inside and outside the camera. Lens tissue wrapped around tweezers will do a good job of getting into all the corners.

Make sure the batteries for your camera, meter, and flash gun are fresh.

If there is any reason to suspect trouble with the camera, have it checked by a qualified repairman. If it has not been checked for more than two years, this is a good idea even if the camera seems fine.

Now is the time to become familiar with any new equipment you have, and to check

out new films. Try a roll or two, at home. And don't forget to read your camera owner's manual, to refresh your memory of all your camera's features.

**2 Protect your film.** Today's films are great, but they are perishable, and color film is particularly sensitive to high humidity and high temperatures. Careless handling can result in loss of speed, fogging and changes in color balance.

Most film is packed in sealed foil/plastic containers or gasket-lidded cans. Don't touch these inner packages until you load the camera. The packaging protects against humidity.

The big thing is to keep film from becoming too warm. Makers of color film would like about 70-degree maximum.

If you're traveling by car, don't store film or loaded cameras in the trunk or glove box, or on the dash top or rear window ledges. These places get *hot*, and the latter two invite theft, too.

The latent image is even more perishable than unexposed film. Have exposed film processed as soon as possible after shooting. Prepaid mailers are a good way to handle this if you're not in one place long enough to have processing done locally. Call and make arrangements, before you go, to air mail the film to your usual processor and





**Effect of depth** is created by bridge leading off into distance. Reflections on water help any picture.



**Composition and contrast** work together in this pleasing picture. Backlighting adds to contrast.

# Travel Pictures

have him hold the photos until you get back home.

**3 Prevent equipment travel sickness.** Traveling can subject delicate photo equipment to severe conditions. Extreme temperature, humidity, rough handling, vibration, and dust, all plague equipment, and can spoil pictures. For car travel, consider an insulated food chest to protect equipment from heat, vibration, and bouncing around.

By air, sea, or train, carry the camera, and a comfortable gadget bag for acces-

sories, with you if at all possible. It's safer, and you're ready to shoot any time.

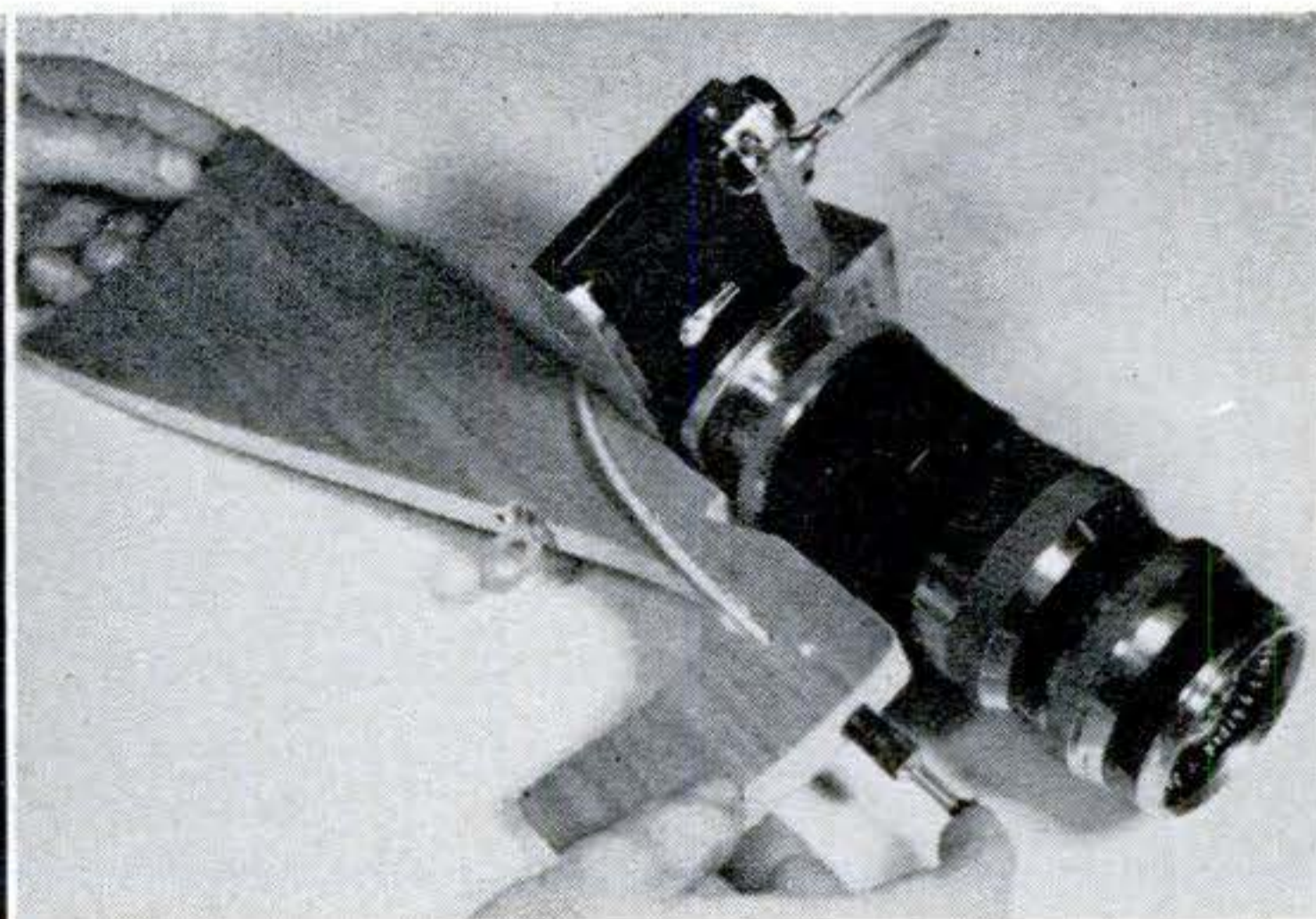
**4 Shoot fast and shoot steady.** The worst picture spoiler of all is camera shake. Here's how to beat it: In good light, without a camera support, shoot at fast speeds—never slower than 1/60 of a second, if possible. If poor light makes slow shutter speeds necessary, steady the camera on a window ledge, rock, car hood, or, best of all, a tripod. The little portable tripods are inexpensive, weigh little, fit in a gadget bag, and make fuzzy shots crisp.

*Continued*

**Extra room in the car? These photo aids are worth taking along**



**Insulated picnic chest** does double duty: It shields your cameras and film against heat, and it protects equipment against damage from car jouncing.



**Gunstock support** provides extra stability when you are shooting with unwieldy telephoto lenses. The simple design shown above is easy to duplicate.



Night photos, like this one of Amsterdam, are easy to take. Just set up your camera on a steady support—this picture was taken from the flat railing of a

bridge—and shoot. A cable release, to prevent jarring the camera, is a must on long exposures. Table on facing page offers suggested night exposures.

**5 Make composition work for you.** Here's how to improve your batting average for pleasing pictures by making the basic rules of good composition work for you:

First off, the best pictures usually have only one main subject or center of interest (take two pictures if necessary), and a picture should not be exactly centered in the frame. A bit below and to the side often works out best.

One of the simplest tricks of composition is to frame a scenic photo with branches or a tree. The branches may mask an empty sky. A tree on the side can form an attractive "L." Framing also adds a three-dimensional effect. Including a foreground is an effective way to frame distant scenics, but avoid straight-across foregrounds like fences or roads. It is desirable to "walk right into" a picture.

"C" and "S" compositions formed by a beach, a stream, or a road in the valley give variety to scenic photos.

Don't pass up a picture you want because it lacks the best composition. Beauty and interest can outweigh composition.

**6 Keep an eye out for extra effects.** Many pictures can be vastly improved if you just step back a few feet, or shoot from a different angle. Shooting through an

archway or a doorway can make a masterpiece out of an otherwise ordinary picture. Reflections from a lake or river, or from puddles or wet streets on a rainy day, add sparkle. Picture help is all around you.

**7 Use your filters.** Filters can turn uninteresting photos into outstanding ones. Here is a rundown on a few:

For black-and-white: Medium-yellow blocks blue to make clouds and light-colored buildings stand out against the sky. Deep-yellow does the same, but more so. Landscapes are dramatic, clouds stand out. Medium-red really darkens skies. Clouds become pure white.

The most popular color filter is the skylight, which "warms" and reduces bluish casts that may be present in scenics and at high altitudes. Many keep it on the camera at all times, where it also protects the lens.

The greatest of all is the polarizing filter. It works on both black-and-white and color. Polarizers suppress reflected light, making many shots excitingly rich, with dramatic skies. Furthermore, they cut reflected blueness on objects in the scene.

**8 Be optimistic about bad weather.** Lousy weather sometimes seems to follow a traveling photographer. Consider fog and

rain an opportunity for you to create striking photos.

Think shapes rather than details. Give thought to small bits of color in a scene of overall drabness. Pictures taken in the bright sun that would be postcardish are often striking when the weather is bad.

Bad weather is the time to visit gardens and floral displays. Overcast cuts shadows and seems to make flowers even more brilliant. Close-ups of flowers with raindrops are always lovely. And what about quaint harbors and colorful boats shrouded in fog?

## 9 Lick the problems of backlighting.

Backlighting and side lighting give scenic photos dramatic effect. This is especially true of backlit colored leaves. Backlight heightens land contours and textures, and gives three-dimensional effects.

Where backlighting puts important foreground detail in shadow, fill in the shadow with flash or reflector.

## 10 Shoot at night.

Night shots, particularly in color, add interest and variety to the picture record you bring home.

Be on the lookout for wet streets, colorful signs, and floodlighted buildings. Car lights also make interesting pictures. (Leave the shutter open for 10-15 seconds.) For many of these possibilities you'll want a tripod.

For spectacular pictures of skylines or high overviews of cities and harbors, double-expose like this: Pick your position at dusk, and with the camera on a tripod shoot at about half of what would be a proper exposure. Then wait until darkness sets

in and expose the same film like a night shot to pick up lights and traffic.

## 11 Think positive about sunsets.

If you're not taking sunsets, you're missing spectacular shots, whether on desert, lake, or seashore, or in the big city.

Broken clouds around at sunset? Fine, that's all you really need. If the sun sets clear, pick something of interest to silhouette against the fiery background. When you find beautiful clouds *and* an interesting silhouette, you can't fail, especially in color.

The nice thing about a sunset is that almost any exposure looks good, and pleasing shots can be taken from an hour before the sun sets until perhaps a half-hour after it sinks below the horizon.

## 12 Correct an automatic camera's mistakes.

Got a completely automatic camera, with no way of changing shutter speed or lens opening? Here are ways you can alter the exposure for special situations (bright backlighting, mountain country with lots of ultraviolet light, shooting people pictures in extra-bright conditions):

- Decrease exposure (darken your color pictures) by setting the film-speed adjustment to a higher ASA speed than that of the film.

- Increase exposure by setting the film-speed adjustment for a lower ASA speed than the film's.

- On cameras without an ASA setting—the Instamatics, for instance, where the cartridge automatically sets film speed—try

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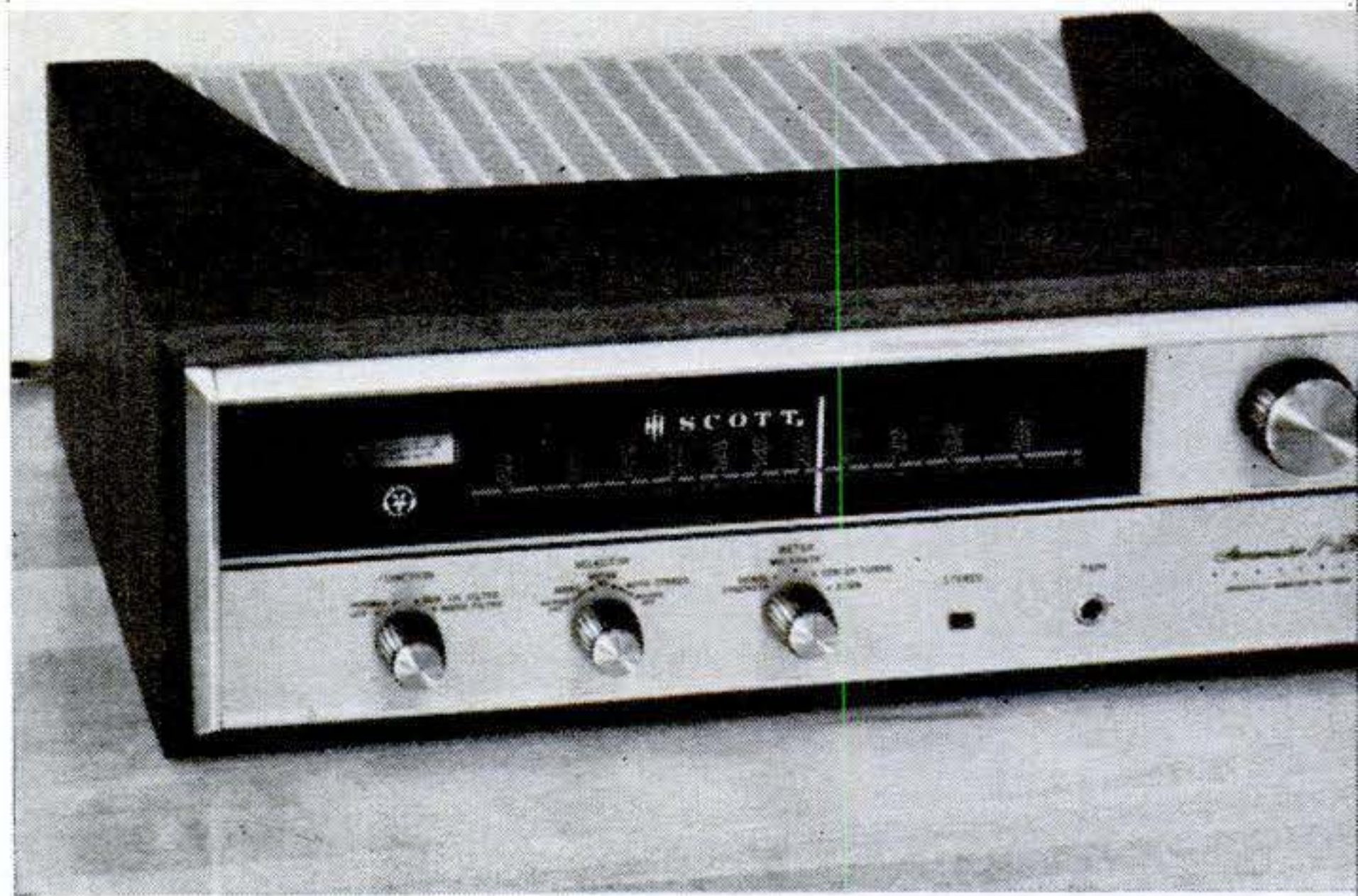
## PS GUIDE TO NIGHT SHOOTING

SCENE	EXPOSURE TIME (seconds, with lens at f/5.6)		
	Film Speed		
	ASA 25	ASA 50	ASA 100
Sunset (sun behind clouds)	1/8	1/15	1/30
Skyline (just after sunset)	1	1/2	1/4
Fairs, circuses, carnivals	1/4	1/8	1/15
Street scenes, very brightly lighted	1/2	1/4	1/8
Street scenes, brightly lighted	4	2	1
Floodlighted buildings, fountains, monuments	12	6	3
Candlelight close-ups	6	3	2
City lights from distant overlook	60	30	15

WHAT'S NEW

ELECTRONICS

## This Top-Notch FM Tuner Comes in a Kit

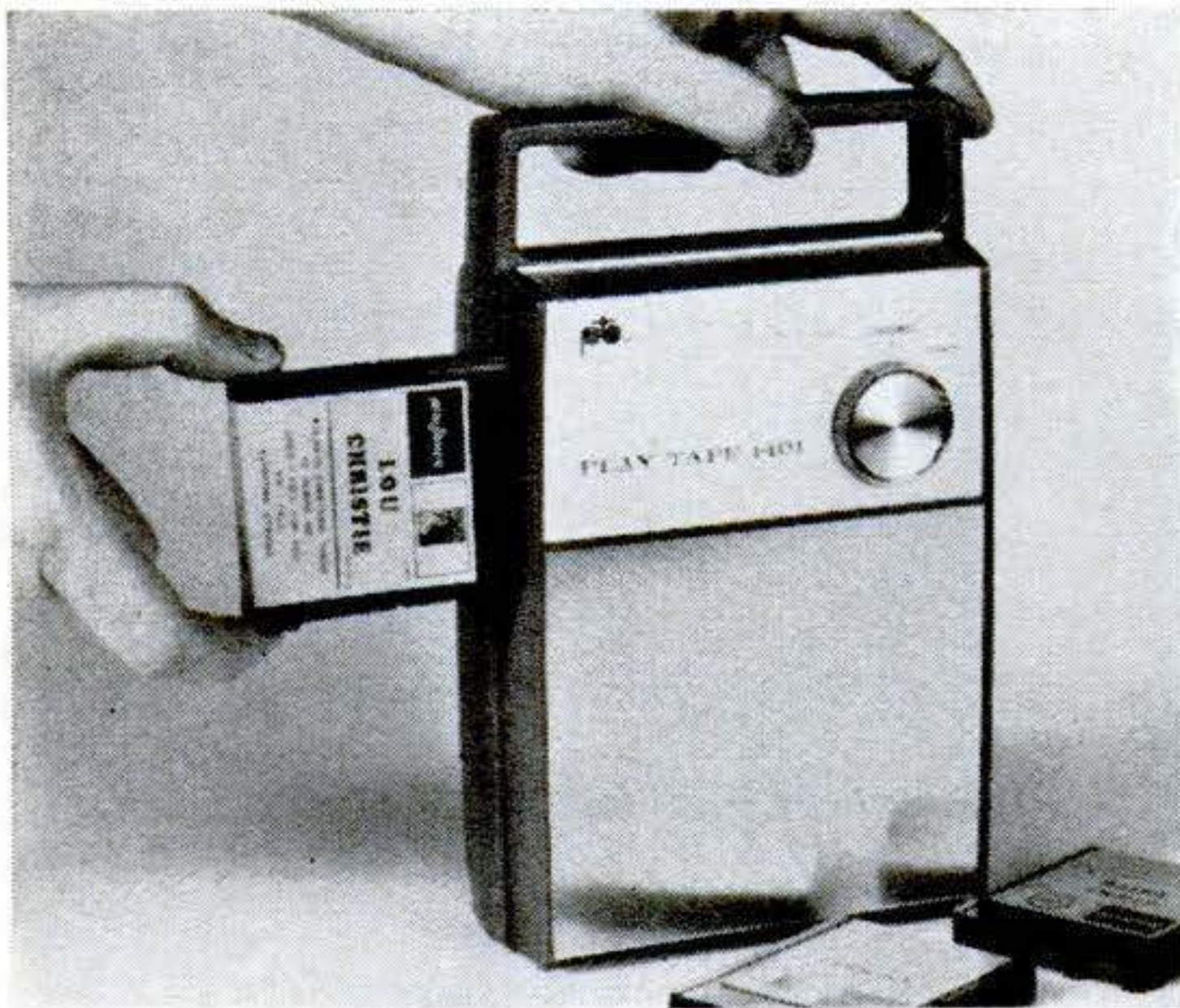


A full set of front-panel controls plus a multifunction panel meter give the LT-112-B versatility.

You've got to stretch a point to call the new Scott LT-112-B stereo FM tuner a kit: All of its printed-circuit boards as well as the critical front-end section come prewired. And you'll find most of the major components are already mounted on the chassis when you open the packing carton. It took me only eight hours to hook

everything together, and I never had the slightest doubt the tuner would work perfectly the first time I turned it on: The remaining wiring is so simple, and the excellent instruction manual is so easy to follow, that it's almost impossible to make a mistake.

Happily, the amount of money you save by



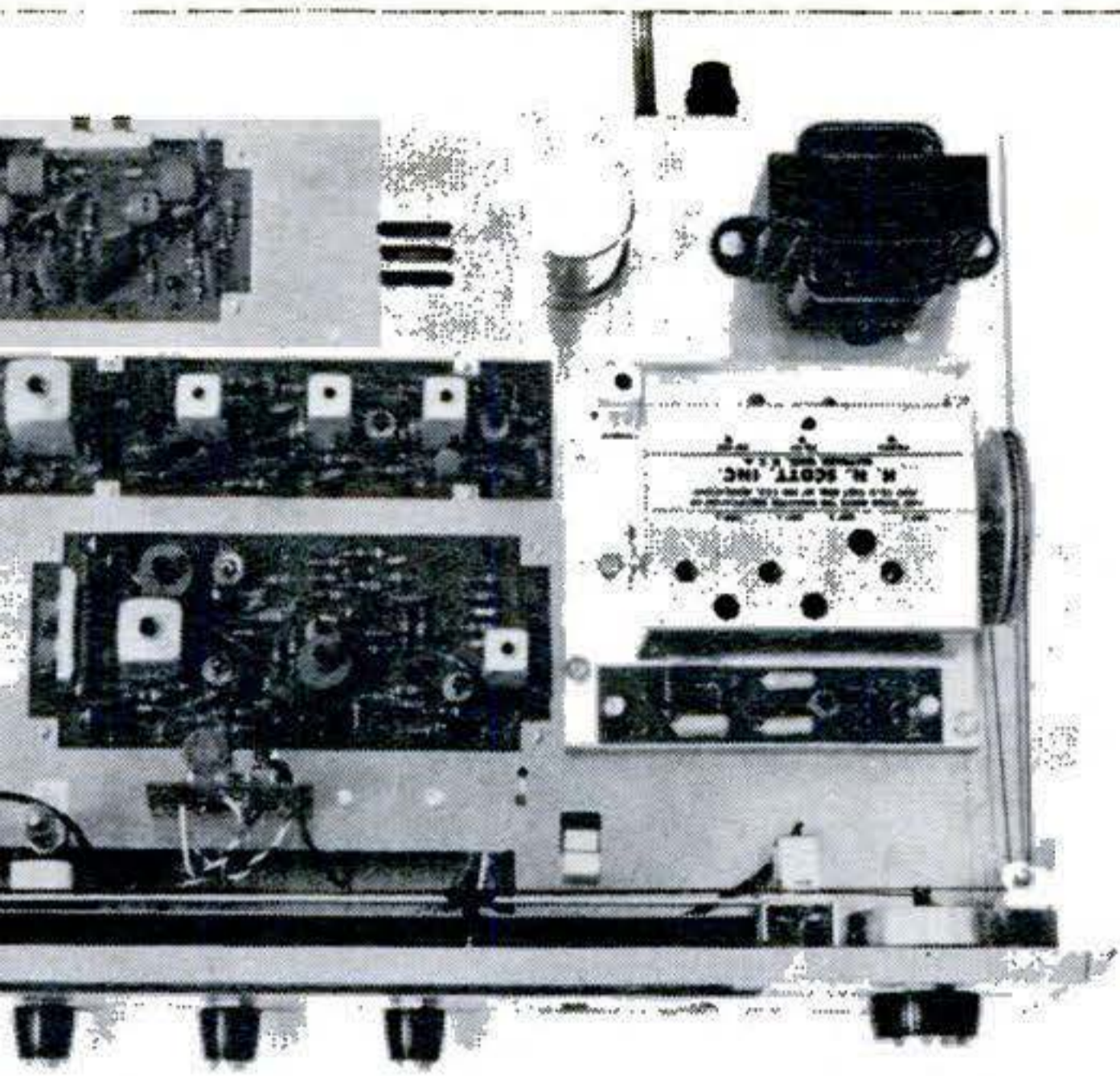
### A portable tape player for pop tunes

Until now, a blaring transistor radio has been the teen-ager's prime companion. This portable tape player will probably change all that. The battery-powered Play Tape machine accepts plug-in tape cartridges—miniature versions of the cartridges used in automobile tape machines—that are prerecorded with the latest pop hits. Each cartridge holds four selections, and costs under \$1.50; the machine costs \$30 and is on sale at most record shops.

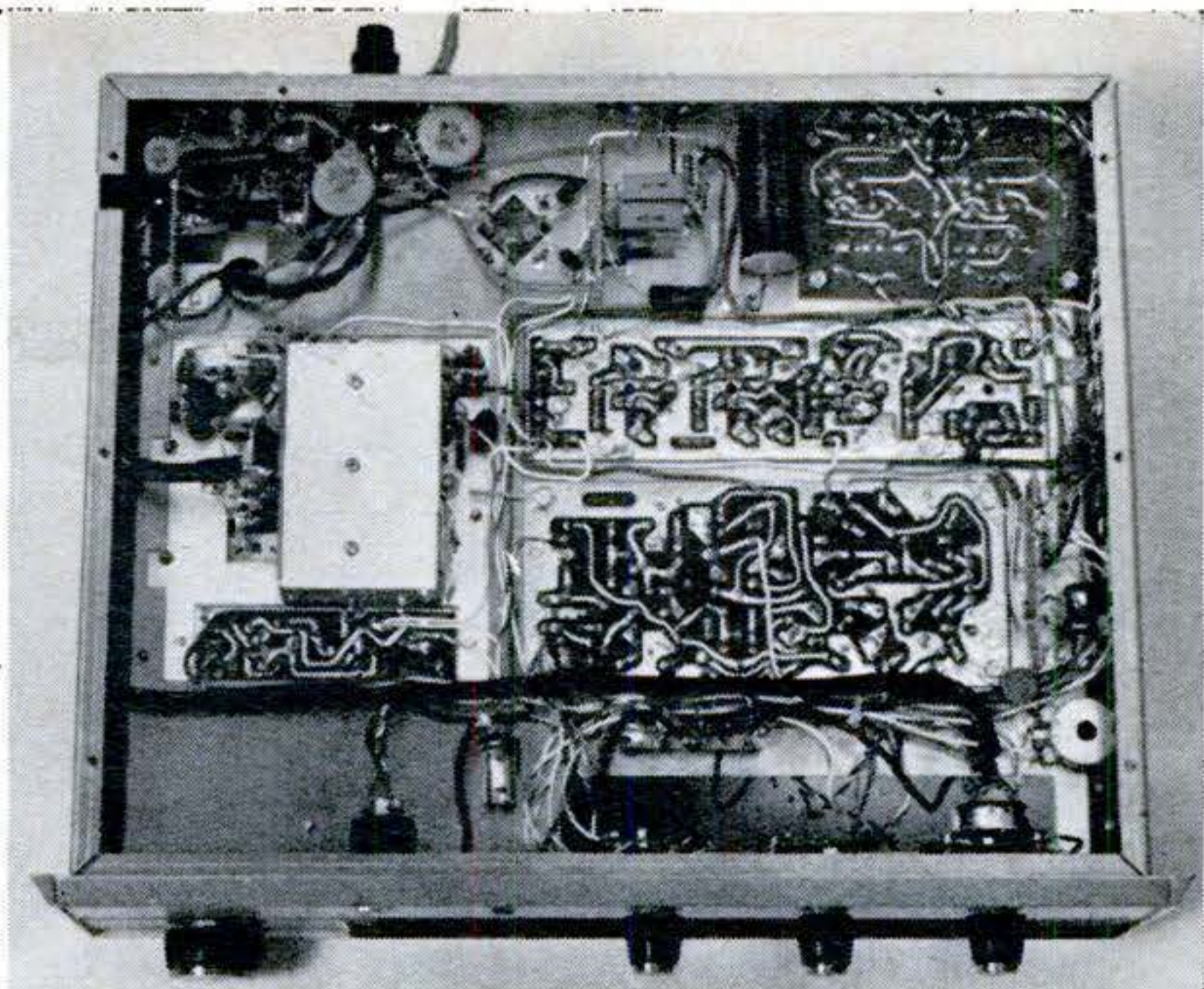


### This tiny portable is also a clock radio

GE's palm-size portable AM Micro-Radio uses a space-saving integrated circuit [PS Aug. '66] instead of a conventional transistorized chassis. Its power supply is a rechargeable nickel-cadmium battery. When you bring the radio home from the ball game, plug it into its clock charger; the set becomes a full-fledged clock radio that plays through a bigger speaker inside the clock unit, and the battery is automatically recharged. Cost: \$40.



The circuitry is fully transistorized—including three field-effect transistors in the front end.



All wiring is done underneath the chassis. Layout is exceptionally spacious, free from tight corners.

wiring the tuner yourself is quite substantial: The LT-112-B kit costs \$170 (plus \$20 for the cabinet shown above left), but it is almost a carbon copy of Scott's factory-wired \$250 LT-312-B tuner.

How does it perform? In a word, flawlessly. Stereo performance is superb, and the set's sensi-

tivity will cope with the deepest fringe-area reception conditions. The tuner has no automatic frequency control, and doesn't need one, since drift is nonexistent. I rate the LT-112-B as one of the finest FM tuners available—in or out of kit form. It's made by H. H. Scott, Inc., of Maynard, Mass.—*R. Benrey*



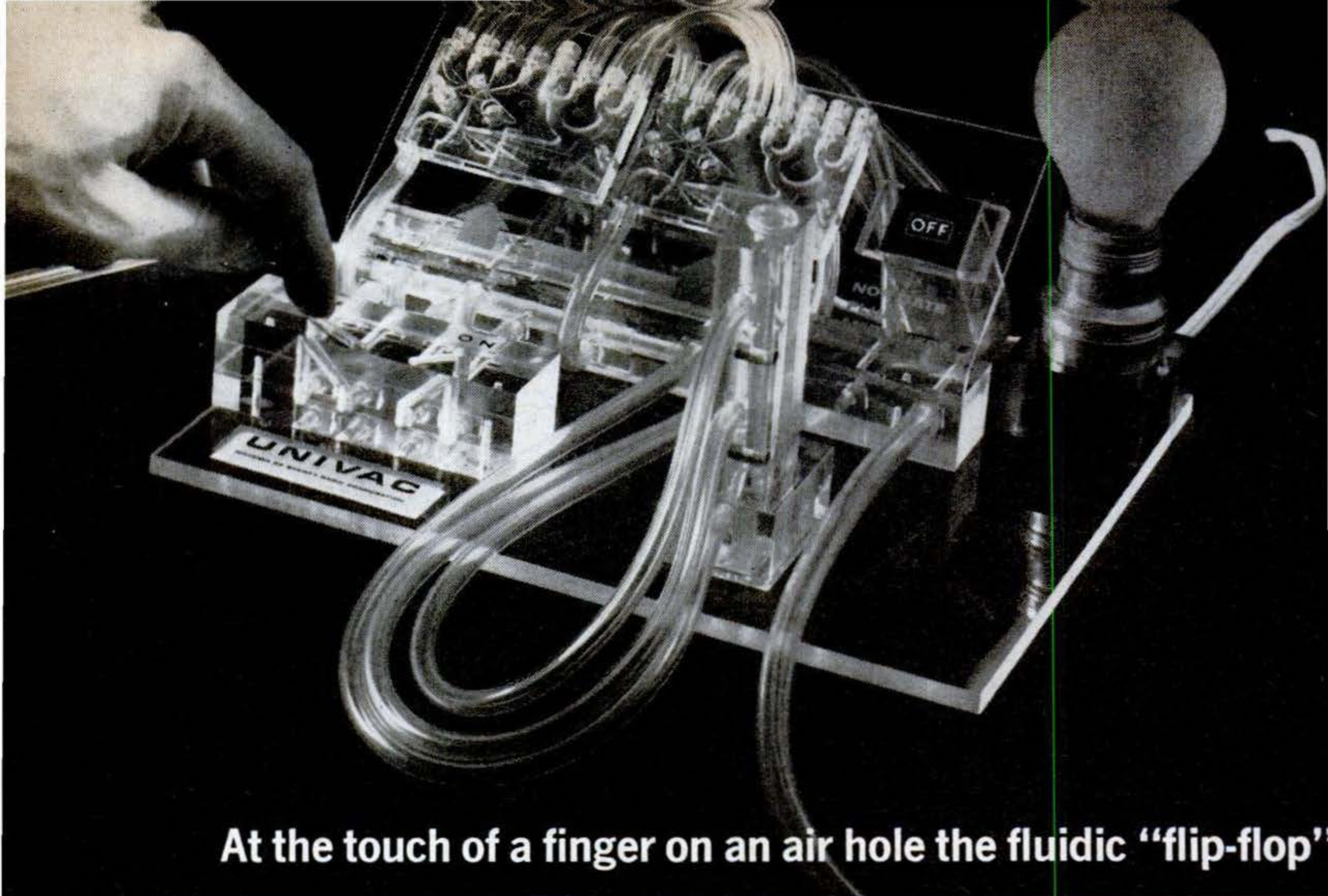
### Directional mike for home recording

The new Sonotone CDM-80 dynamic microphone has a cardioid (heart-shaped) sound pickup pattern to make it extremely directional: The mike will only "hear" sounds that strike it from the front. Thus, stray, unwanted sounds that arrive from random directions are canceled. The mike has a built-in transformer so it can be used with either high- or low-impedance recorder inputs. It costs about \$45 and is made by the Sonotone Corp., Elmsford, N.Y.



### Pop music, police bands? Take your pick

Here's a transistorized portable AM radio that doubles as a very-high-frequency (VHF) monitor receiver. It has a built-in crystal-controlled converter that adapts the set—at the touch of a button—to pick up VHF police, fire-department, weather-bureau, and similar service broadcasts. By installing different pairs of crystals, the set can be tuned to receive any two local VHF stations. The VHF Sentry costs \$40; it's made by Sonar Radio, Brooklyn, N.Y.



At the touch of a finger on an air hole the fluidic "flip-flop"

# FLUIDICS: How They've Taught

**The fledgling science of fluidic devices is about to grow up. Here's how these gadgets work, and what the new technology will mean to you**

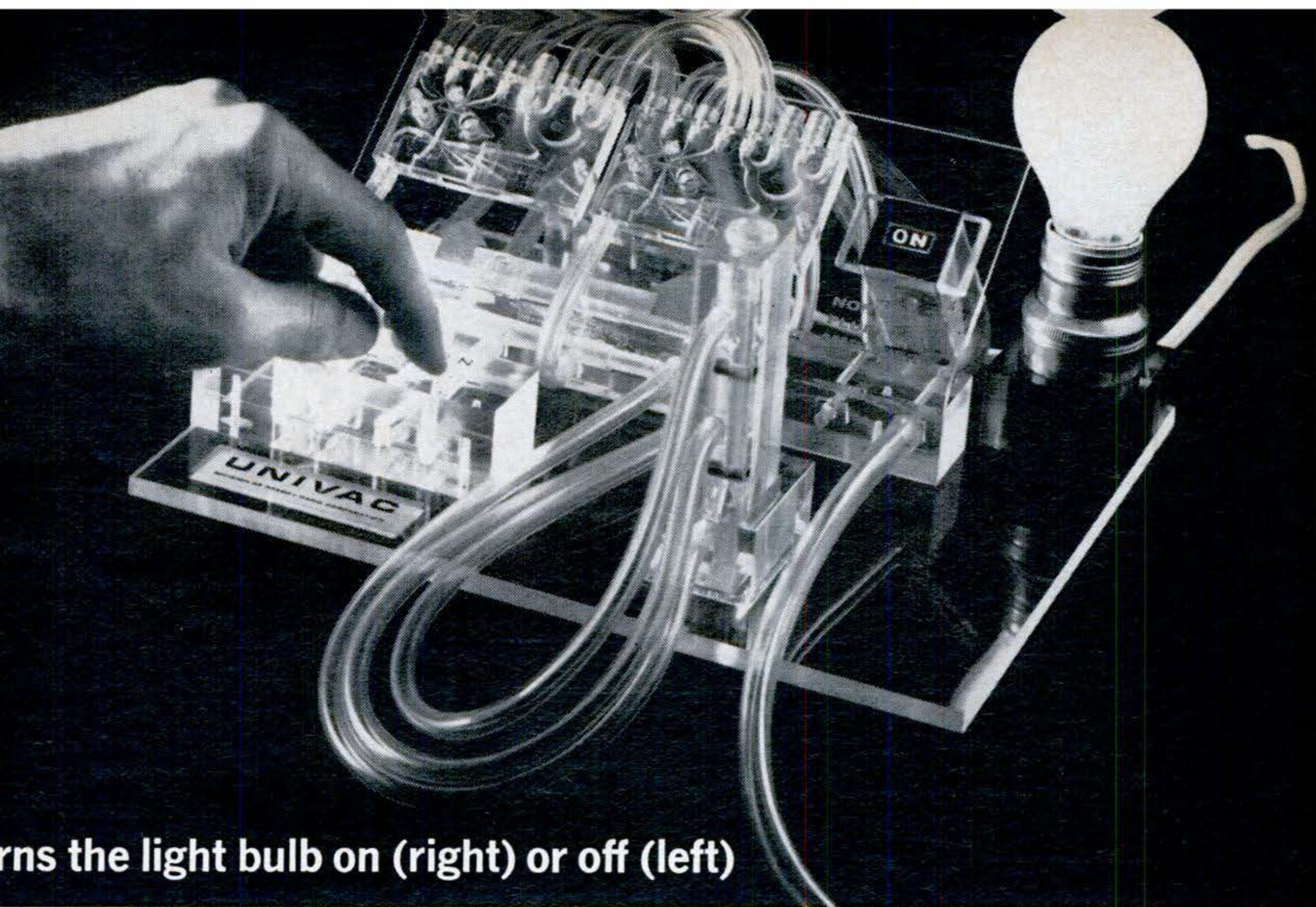
By **RONALD M. BENREY**  
*Electronics Editor*

It looks like a plumber's nightmare, and it makes noises like a sick vacuum cleaner when it's working, but the gadget at the top of this page may turn out to be one of the most important technological developments of this decade. It's called a fluidic (pronounced flew-id-ik) device, and it's the offspring of a brand-new science: fluidics—the art of guiding the flow of narrow streams of

air or other fluids. (If the idea that air is a fluid seems odd, think of this often-used definition of "fluid": a substance that takes the shape of the container it is placed in. Thus, a stream of air is as much a fluid as is oil or water.)

Chances are you'll never use a fluidic device to switch your house lights on and off, but in a year or two you'll be buying products made on assembly lines controlled by fluidic devices. Possibly, the next washing machine you buy will have a fluidic cycle controller instead of a conventional electric motor. And a fluidic device may replace the tricky mechanical linkage in the carburetor of your 1972 car. Not long after that, you may fly in an airplane whose autopilot is guided by a fluidic computer.

A fluidic device is little more than a chunk of solid material (plastic, glass, ceramic, and metal all work fine) that contains a maze of curiously shaped passages. A stream of air forced through these pas-



Turns the light bulb on (right) or off (left)

# Stream of Air to Think

Messages by a compressor or other means can be guided and varied by the action of other—lower-pressure—air streams. We'll see how and why shortly, but for now let's say that the process is roughly analogous to the way electric currents are controlled by smaller

currents inside electronic vacuum tubes, transistors, and relays.

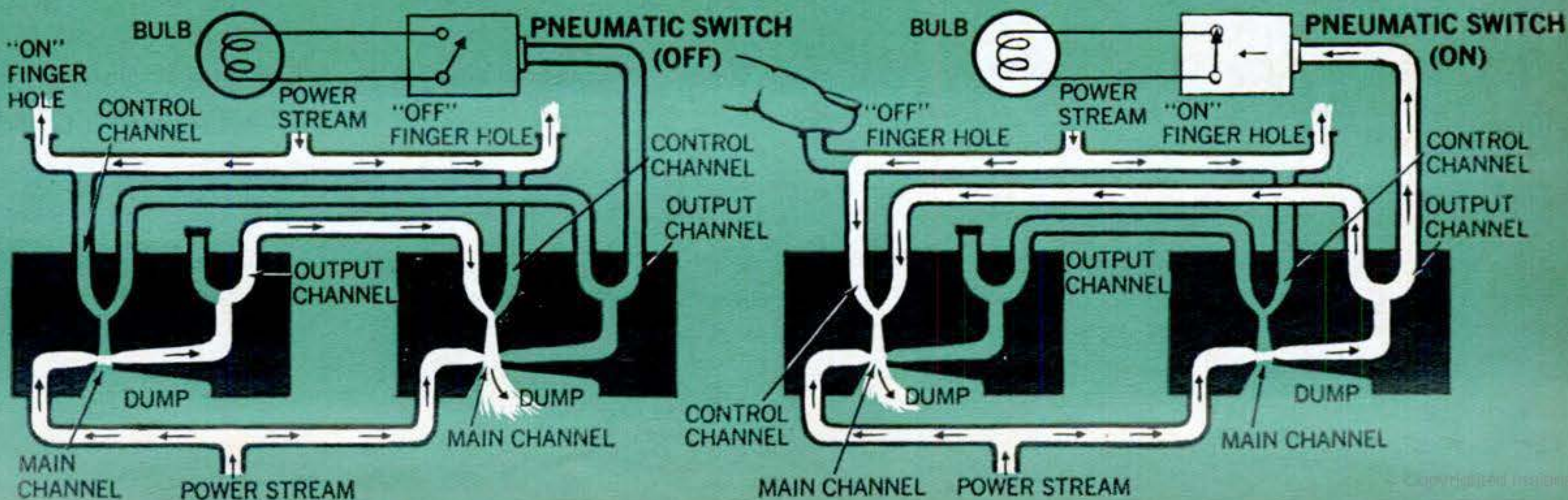
This means that a designer can build a fluidic device that actually duplicates the function of many types of electrical circuits and mechanical linkages. He can design

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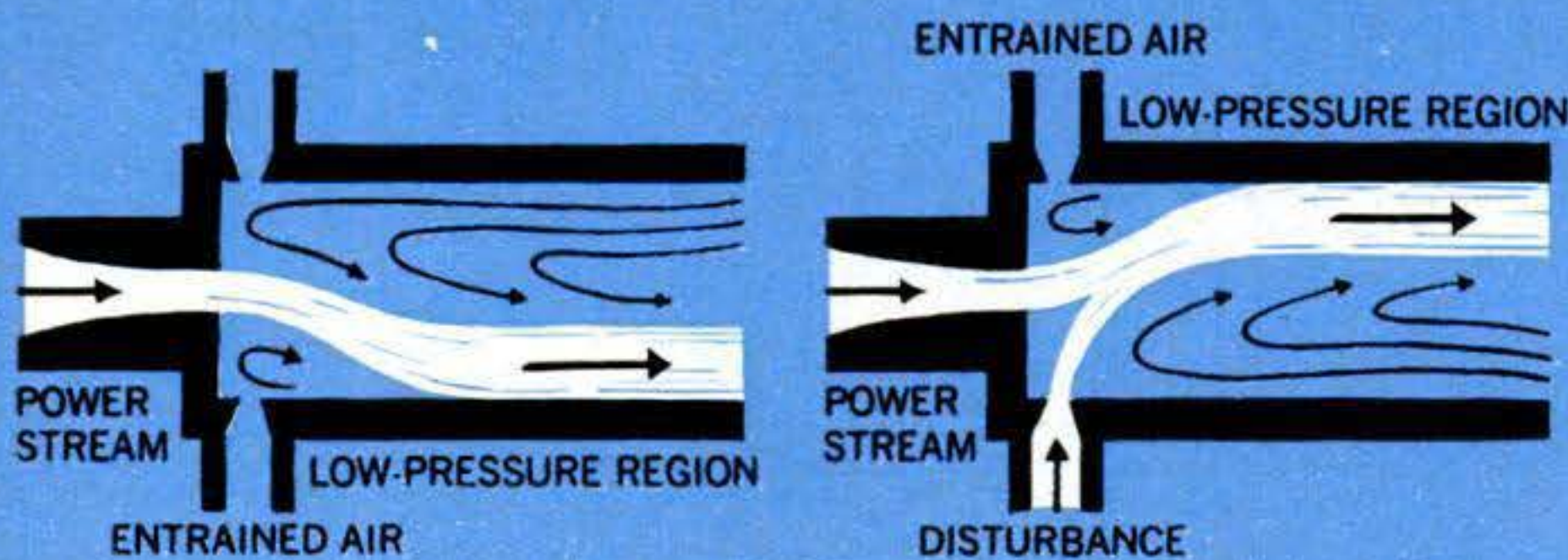
## The "light switch" works like a dog chasing its own tail

**Off:** Air flowing through the left gate's output runs into the right gate's input. Thus, the right gate's main channel stream is dumped (see text for explanation). The pneumatic light switch is "off."

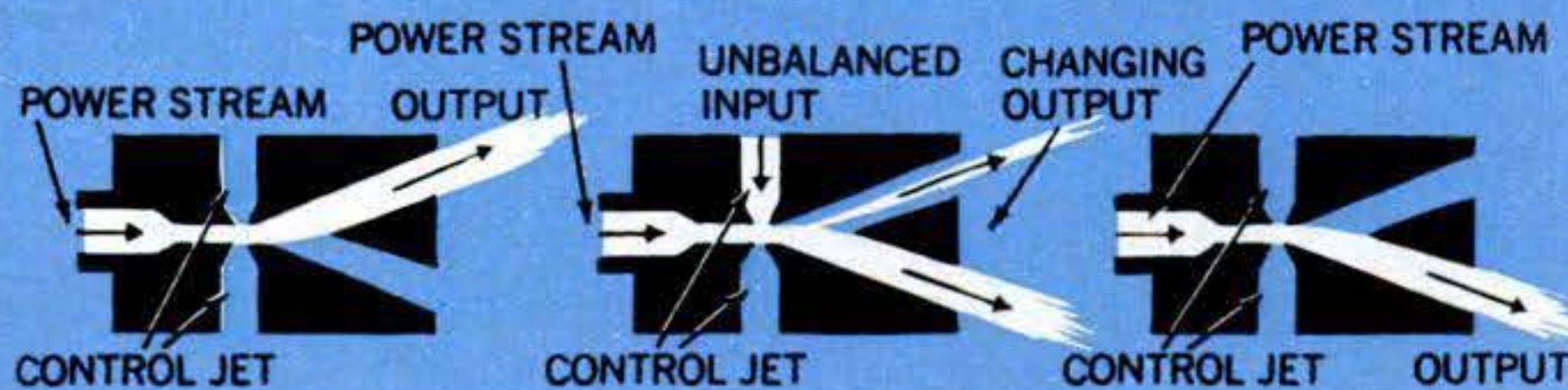
**On:** Cover the "on" hole with a finger and a burst of air is forced into left gate's input, dumping its main stream and "unlocking" right gate's output stream. The pneumatic switch turns the bulb "on."



## Here's the cause of the Coanda, or "wall-attachment" effect



## A bi-stable—or two-state—device



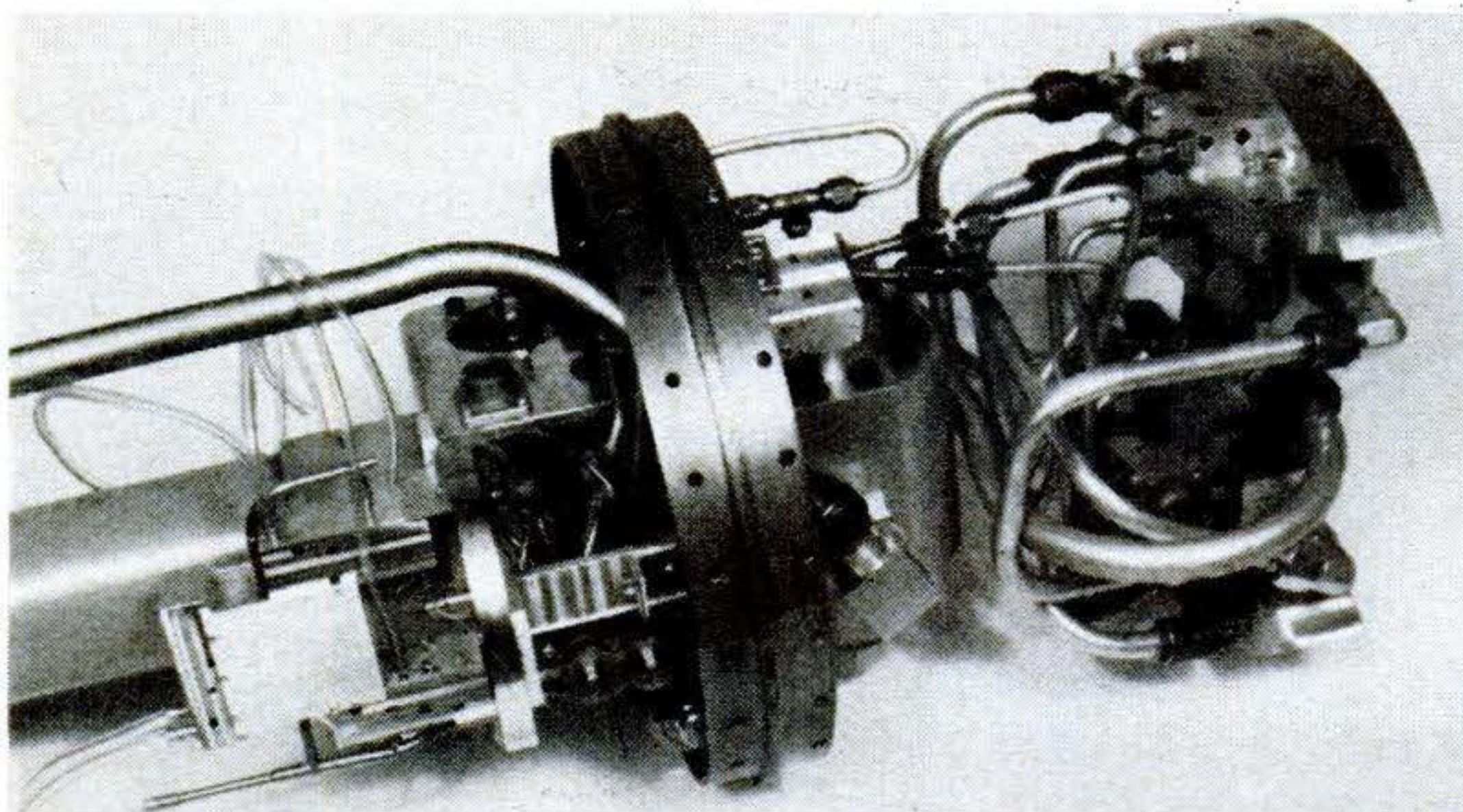
Like a toggle switch, the bi-stable device shown above has two stable operating "states"—the air stream is exiting either through the top output port or through the bottom port. The stream will remain locked in position until an input stream fed into the appropriate control jet jars it loose (see text).

amplifiers, oscillators, switches, logical (decision-making) "circuitry," computing and control devices—in short, the same types of building blocks that complex electronic systems are built of. In many ways, a fluidic circuit is strikingly similar to an equivalent electronic circuit, but instead of electricity, streams of air flow through it.

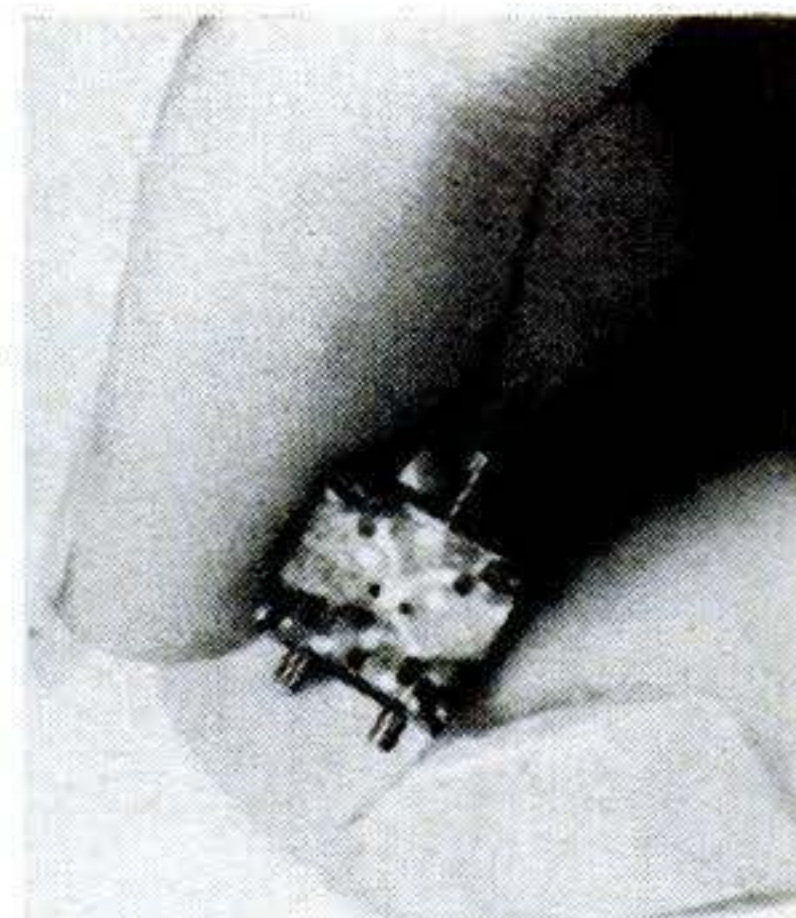
Not surprisingly, it was the search for a control system having these virtues that led to the development of the first practical fluidic devices in the late 1950s and early 1960s. The place was the U.S. Army's Harry Diamond Research Laboratories.

Among other things, this laboratory develops fusing and guidance systems for artillery shells and missiles. In these appli-

## Fluidic devices can challenge electronics in many areas



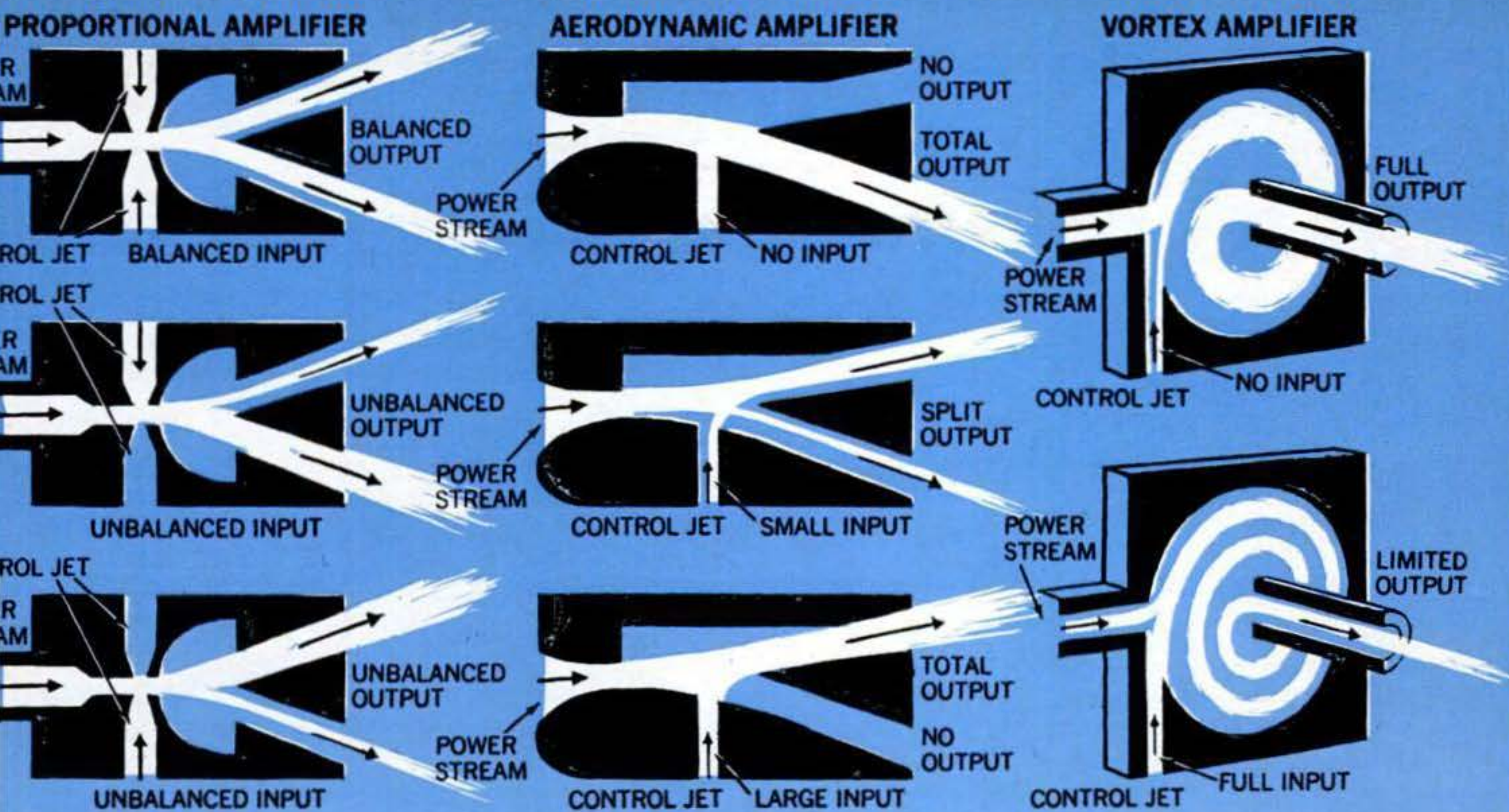
Fluidic missile-control system above was built by Honeywell for the U.S. Army's Test Instrumentation Missile. The system includes a set of reaction jets to alter the missile's flight path.



Tiny multistage fluidic amplifier (hand-held, above, right), also from Honeywell, is scarcely larger than a semiconductor microcircuit (foreground). Future fluidic devices will be even smaller.



# Fluidic amplifiers: three physical effects at work



The proportional amplifier (above, left) has a tapered main passage to prevent wall attachment in front of the power-stream splitter. The aerodynamic amplifier (above, center) guides airflow

through it by passing the power stream over a wing-like surface. The miniature "hurricane" produced inside a vortex amplifier (above, right) is particularly effective at controlling large volumes of air.

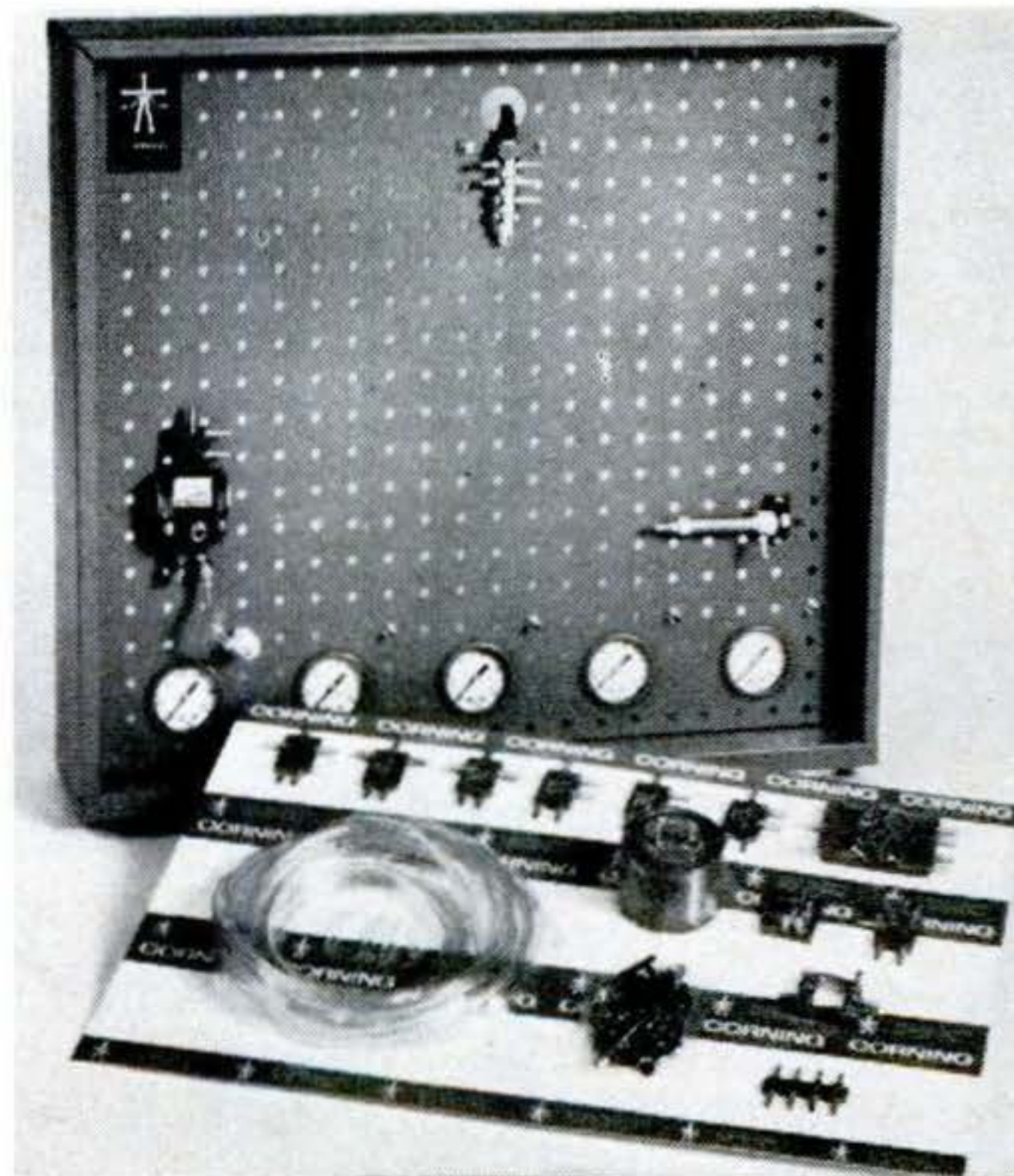
circumstances, the need for reliability is obvious, but fluidic devices have another significant advantage over electronic circuits: They can be powered by simple compressed-air storage bottles rather than by heavy batteries, or even by ram air forced into an intake port as the shell or missile flies through the air.

Actually, most fluidic devices will also work if streams of liquid are forced through them. However, air is normally used as the working fluid for several practical reasons: Air isn't messy or corrosive, the devices don't have to be sealed to prevent leaks, and a source of air is often close at hand for most industrial applications.

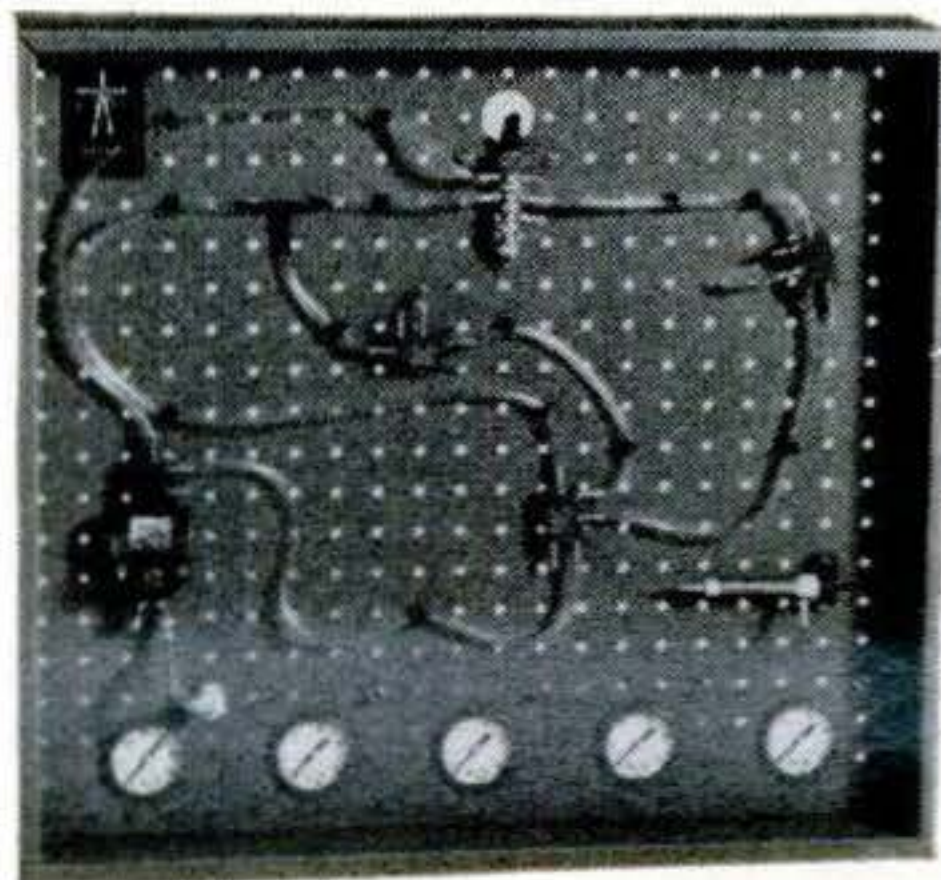
**How they work.** Two physical effects you've probably observed many times are at work in most practical fluidic devices. They are: momentum transfer and the Coanda effect. The next time you hose down your car, try these experiments:

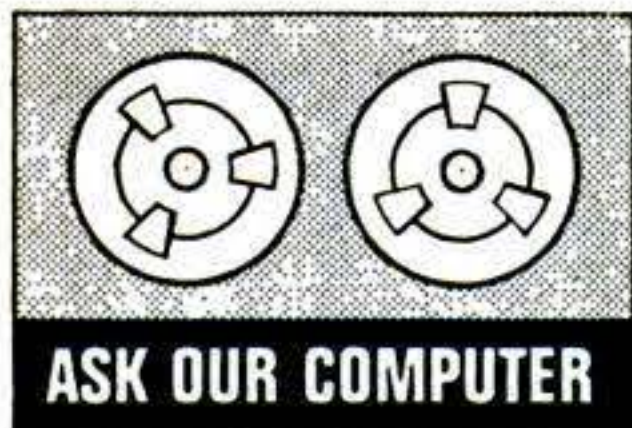
First, set your hose nozzle for a thin, powerful jet and shoot it sideways at the full-force stream coming out of another outside faucet. You'll see that the thin jet can divert the large stream through a considerable angle. This effect is called momentum transfer—as the jet and stream intersect, the jet transfers some of its momentum to the

[Continued on page 196]



Want to experiment with fluidic gadgets? The Corning Glass Works (Corning, N. Y.) has a fluidic "breadboard" kit that contains an assortment of devices and hardware to match. Outfit costs about \$350.





## Here's the June question in Popular Science's Ask-Our-Computer service



# Is Now the Best Time to Trade In Your Car?

**T**he first news about the 1968 cars is out [see page 70] and once again it's time to start thinking about the car you own. Should you keep it for another year, or would you be smarter to trade in on a new model?

If you are in the dark, why not let PS's giant electronic brain help you make a decision now? Summer is the best time to start planning, since you'll want plenty of time to shop around in advance for the best financing plans, and to take care of the minor appearance-improving repairs on your car so you'll get a top trade-in price.

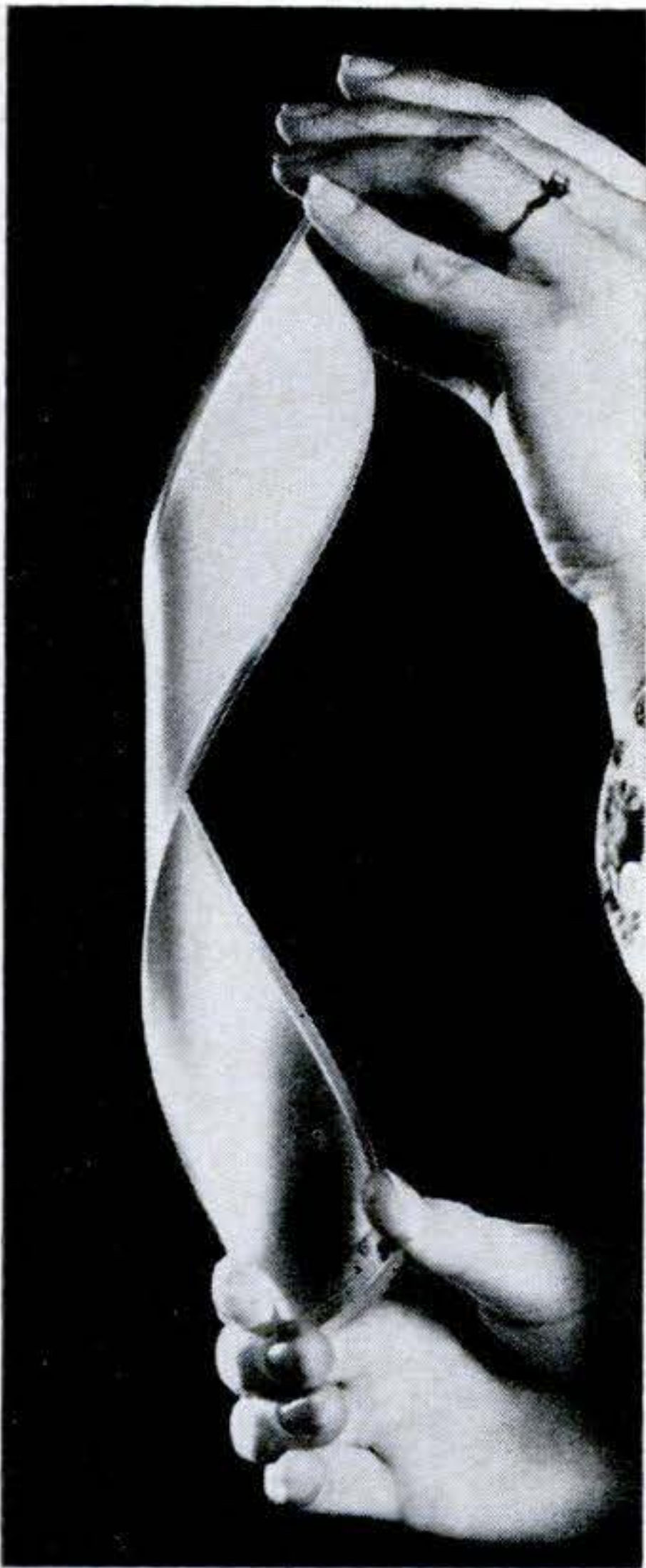
Here's how our Ask-Our-Computer service works: Just mail us a *stamped*, self-addressed envelope (legal size, please) and we'll send you a free questionnaire that asks for all the really significant information about your car—everything from its mileage to when you last had the transmission serviced. Also, there are questions about the kind of driving you do.

Return the completed questionnaire to us with a \$2 service fee, and our programmer will feed the data into the computer. "I Lived with a Computer . . . And So Will You" in our May issue explained it all.

We've written a special computer program called TRADE? that analyzes the data and estimates the cost per mile of running your present car for another year. The analysis takes into account depreciation as well as estimated maintenance. If this cost-per-mile figure is greater than the cost per mile of an equivalent new car (which our computer also estimates), then it's time to trade. The computer readout sheet you get will give you much of the solid information you need to make a wise trade/don't-trade decision. Then you can figure in the intangible factors like: How much extra is it worth to you to drive a brand-new car this fall?

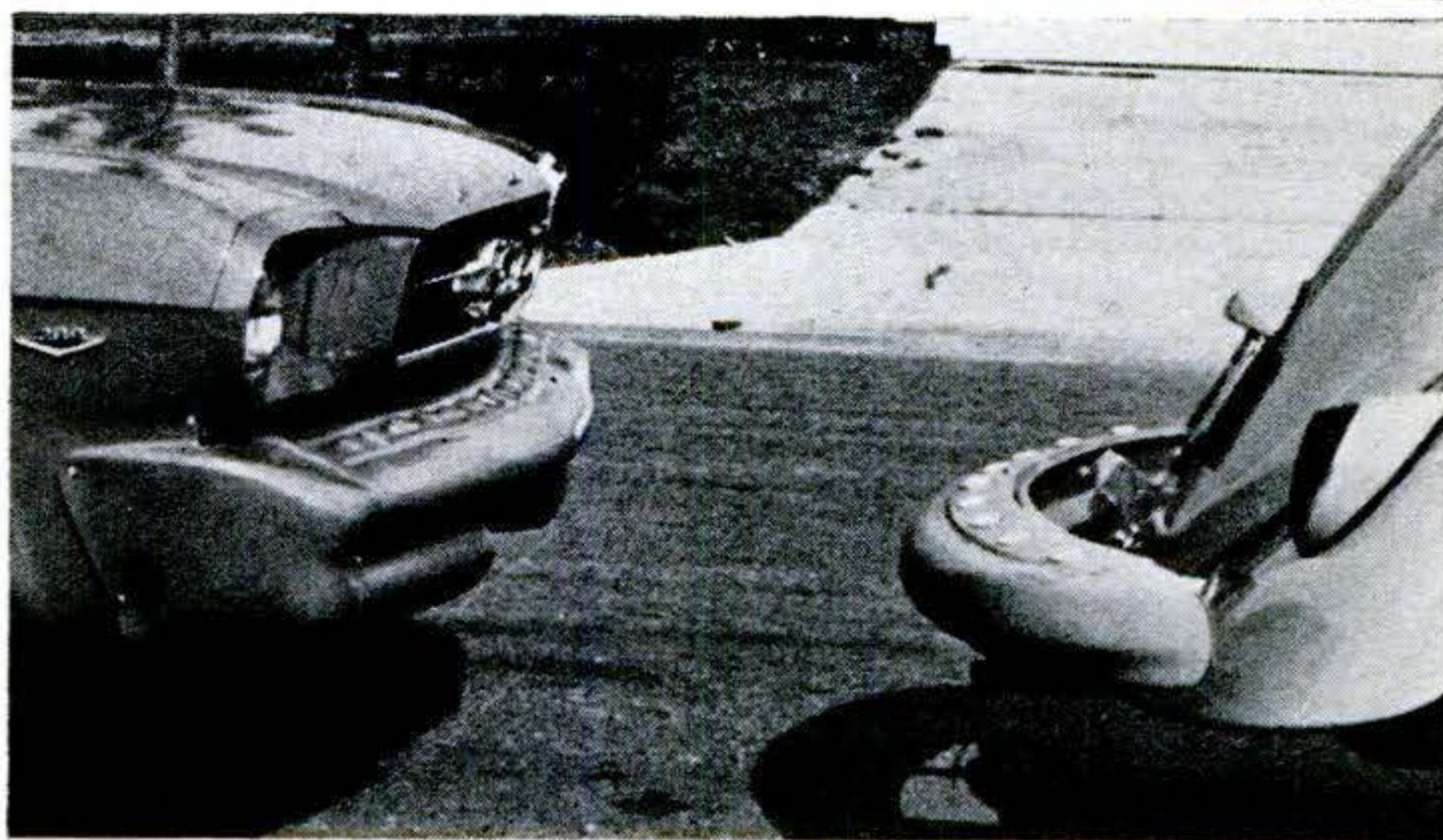
Send your stamped, self-addressed envelope to Ask-Our-Computer, Program #2, POPULAR SCIENCE, 355 Lexington Ave., NYC 10017.

Ask-Our-Computer is a brand-new service, and we'd like to tailor it exactly to your needs. If you have any ideas about a subject or problem that you feel would make a good Ask-Our-Computer program, please write them on the back of a postcard and mail to Ronald Benrey, Electronics Editor, at the above address.

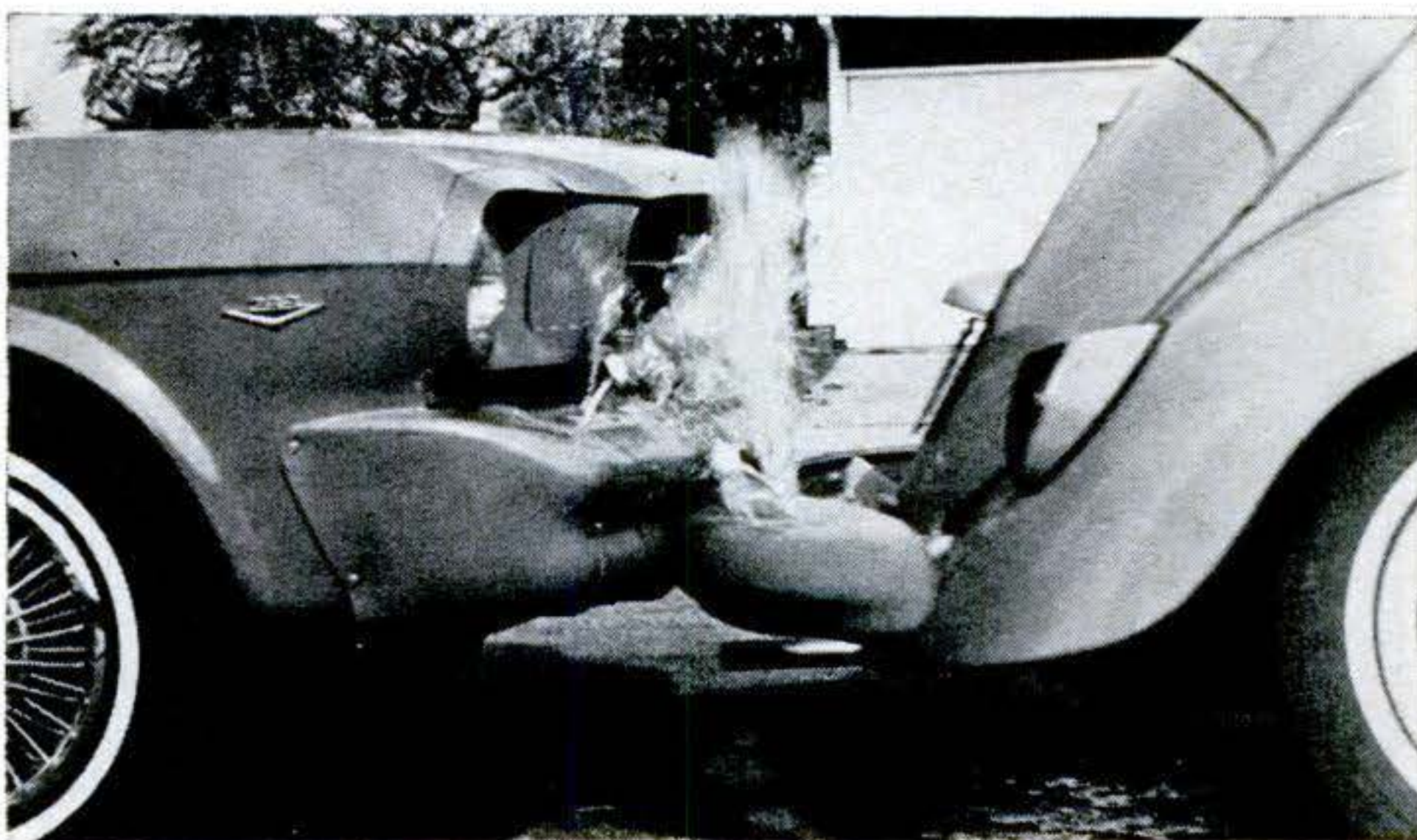


### Wafer-thin lamps are a new twist in lighting

Flexible, and thin as a dime, this electroluminescent lamp from General Electric gives off low-intensity light for illuminating cockpit and other dials, stairway railings, and advertising displays. The light emanates from crystalline powders sandwiched between the lamp's electrically conductive surfaces.



Wearing water-filled bumpers, two test cars line up—nose to tail.



Cars crash and water spouts from bumpers to reduce impact effect.

### Water-filled bumpers soften collisions

The water-cushion bumpers above, their makers say, lessen the hazards of low-speed collisions. Of metal-backed, hollow vinyl, each bumper is filled with seven or more gallons of water, depending on size. Fifteen intake holes on top are sealed with plastic plugs. When the bumper hits any object, the displaced water forces out the plugs and water squirts out, releasing energy absorbed in the crash. Rich's Mfg. Co., Box 4703, Sacramento, Calif., sells the bumpers for \$150 a pair.

### New Army river boats

The Aircats at left are racing along a Vietnam river during a training mission to test the new craft. Powered by an airplane engine, these air boats can hit speeds up to 48 m.p.h. They're operated by two-man Special Forces crews and can transport five armed infantry soldiers. A .30-caliber machine gun mounted aboard provides covering fire for the troops.

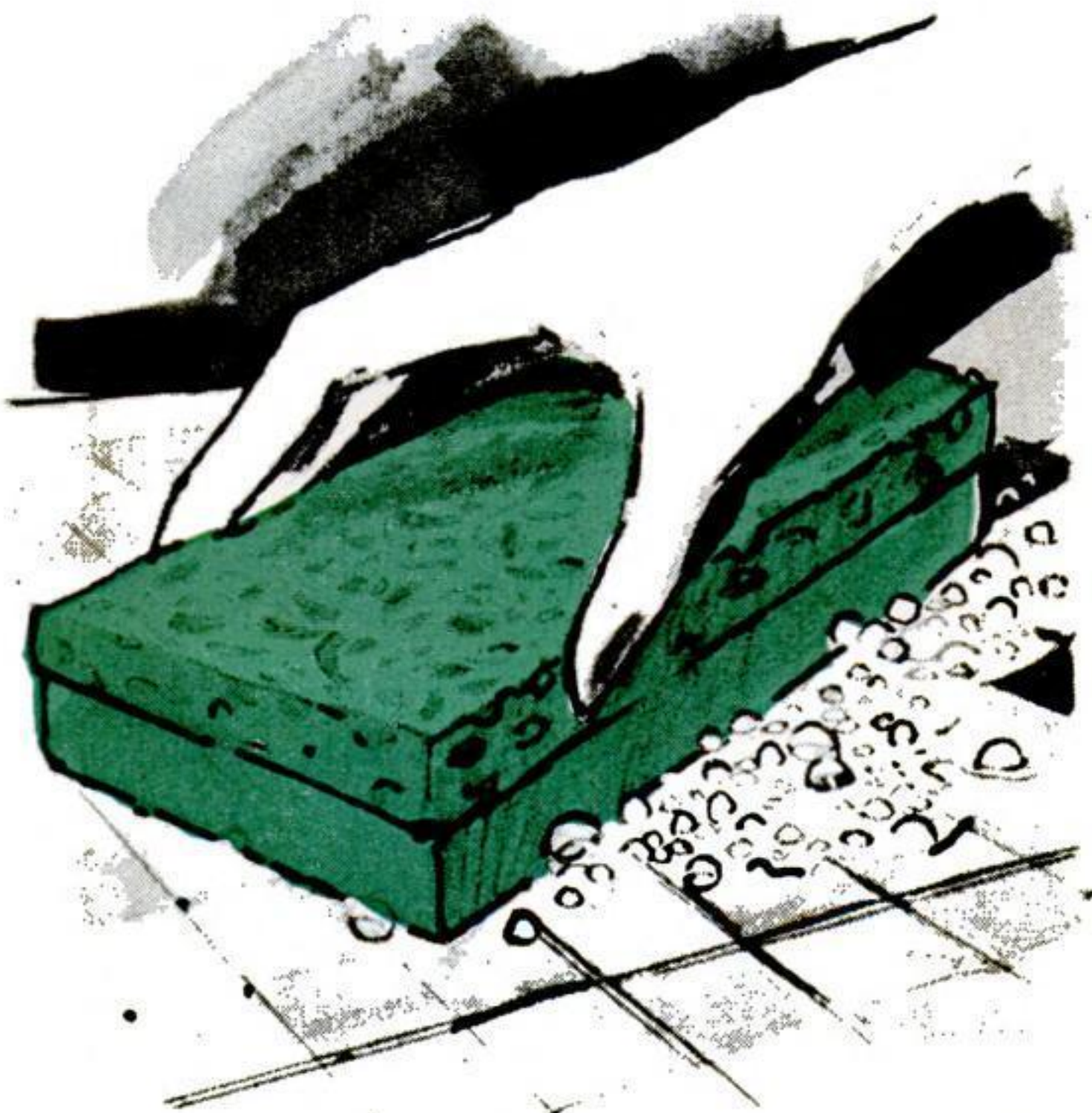




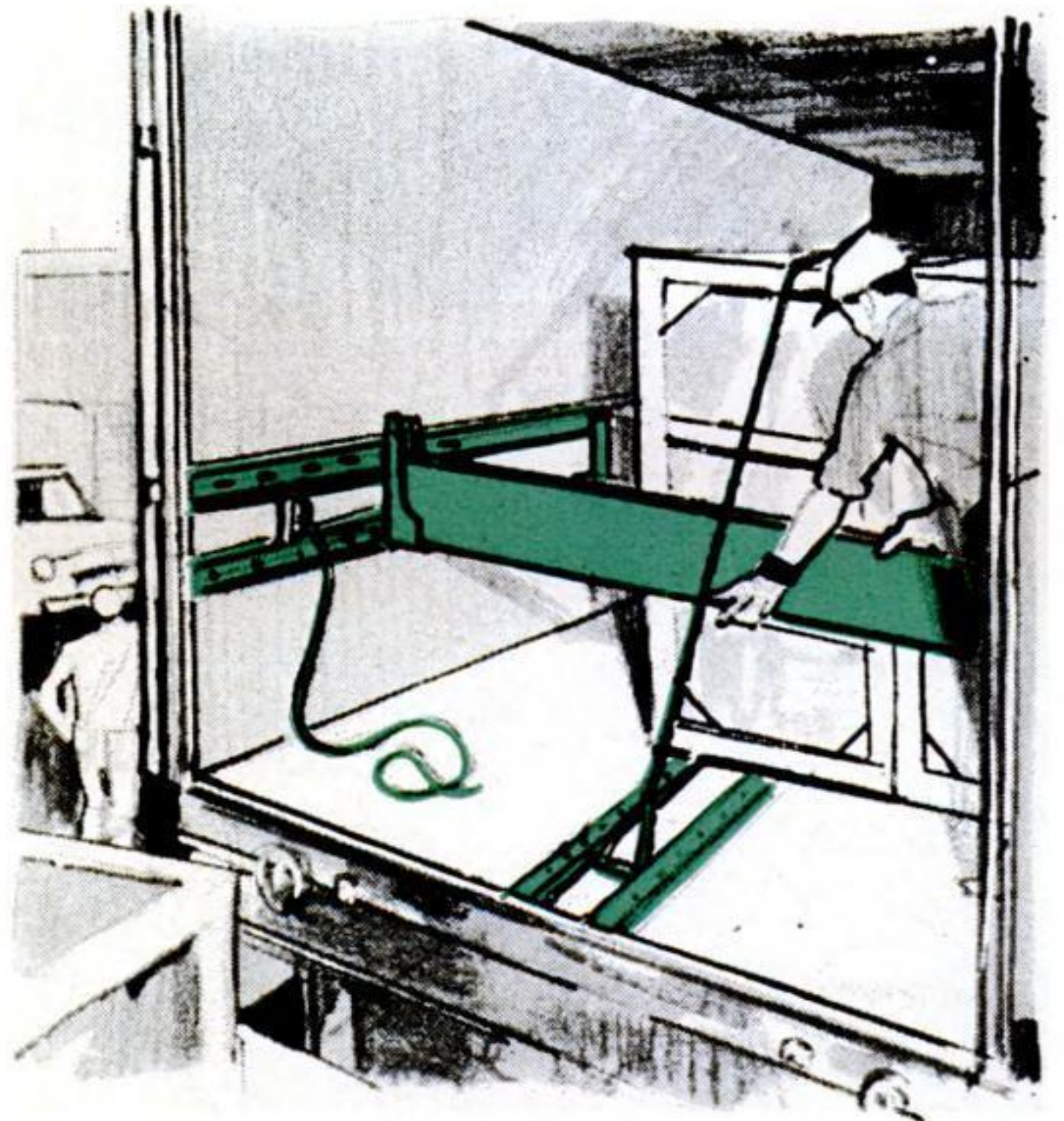
# New Ideas from the Inventors

DRAWINGS BY WILLIAM CASTIMORE

**Seesaw pumps spray.** The warming exertions of seesawing youngsters would serve also to cool them off, if they rode this recently patented rig. The teeterboard would pivot above a square-topped pyramid containing a water tank, a hose inlet, and a float valve. Up-and-down motion would operate a reciprocating pump, mounted outboard on the base, forcing water through flexible tubes to spray heads on the board.



**Soap holds its own sponge.** A plastic film coated on both sides with waterproof adhesive, according to this Colgate-Palm Olive patent, would serve as a bonding membrane between a sponge and a cake of floating soap. The easy-to-use combination would speed cleaning and scrubbing operations, and the barrier layer would keep any water trapped in the sponge from softening or wasting the piggyback soap.



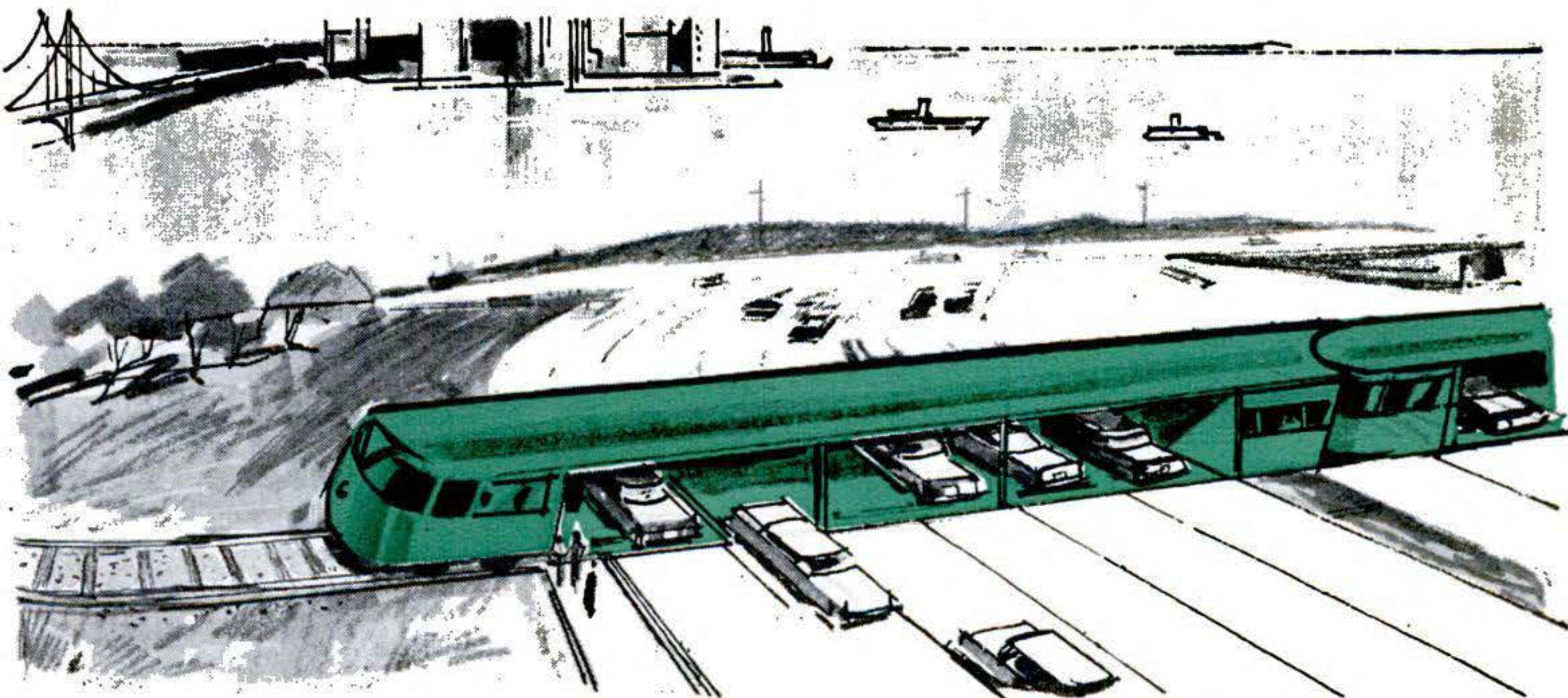
**Fence steadies truck's load.** Cargo-positioning slats that could be locked at any point along the length of a truck would steady regular or odd-shaped loads and keep heavy objects from shifting in transit. Retaining rails on the truck's sides and floor would also hold adjustable loops for rope tie-downs, to permit quick securing of cargo. The load-holding system could also be used on ships, trains, and planes.



**Socket magnet holds nut.** A magnet set into the mouth of a socket wrench would make it easy to lift out a loosened nut or start one in an otherwise hard-to-reach place. Riveted to a nonmagnetic disk, the bar-magnet insert would exert a stronger grip on the wrench than on the nut, allowing removal of the nut with a light tap. One holder would fit several wrench sizes.



**Sun hat supports dressing room.** Here's a beach towel or blanket to give you cabana privacy on beaches without dressing rooms. One end of the cylindrical enclosure, with a metal hoop for rigidity, would slip over the wide, stiffened brim of the separate sun hat. For balance, the hat could be tied under the chin like a bonnet; the covering could be tied from inside.

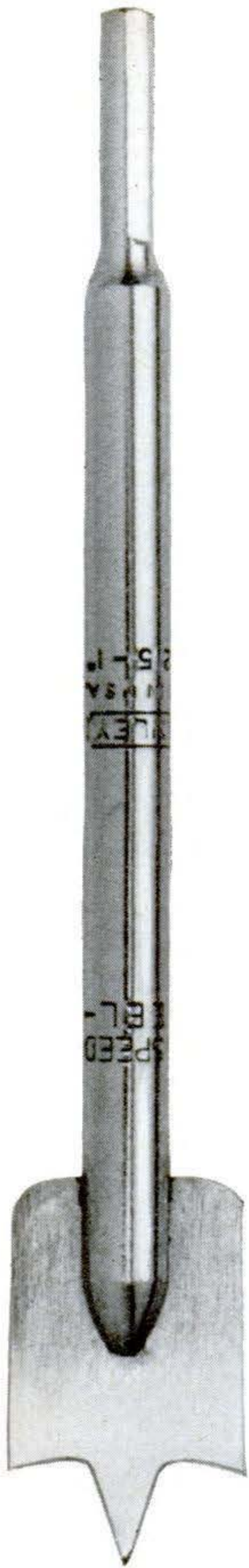


**Wide train ferries cars.** Instead of driving from one city to another, you may one day drive into one side of a high-speed train and drive out the other side at your destination. On the

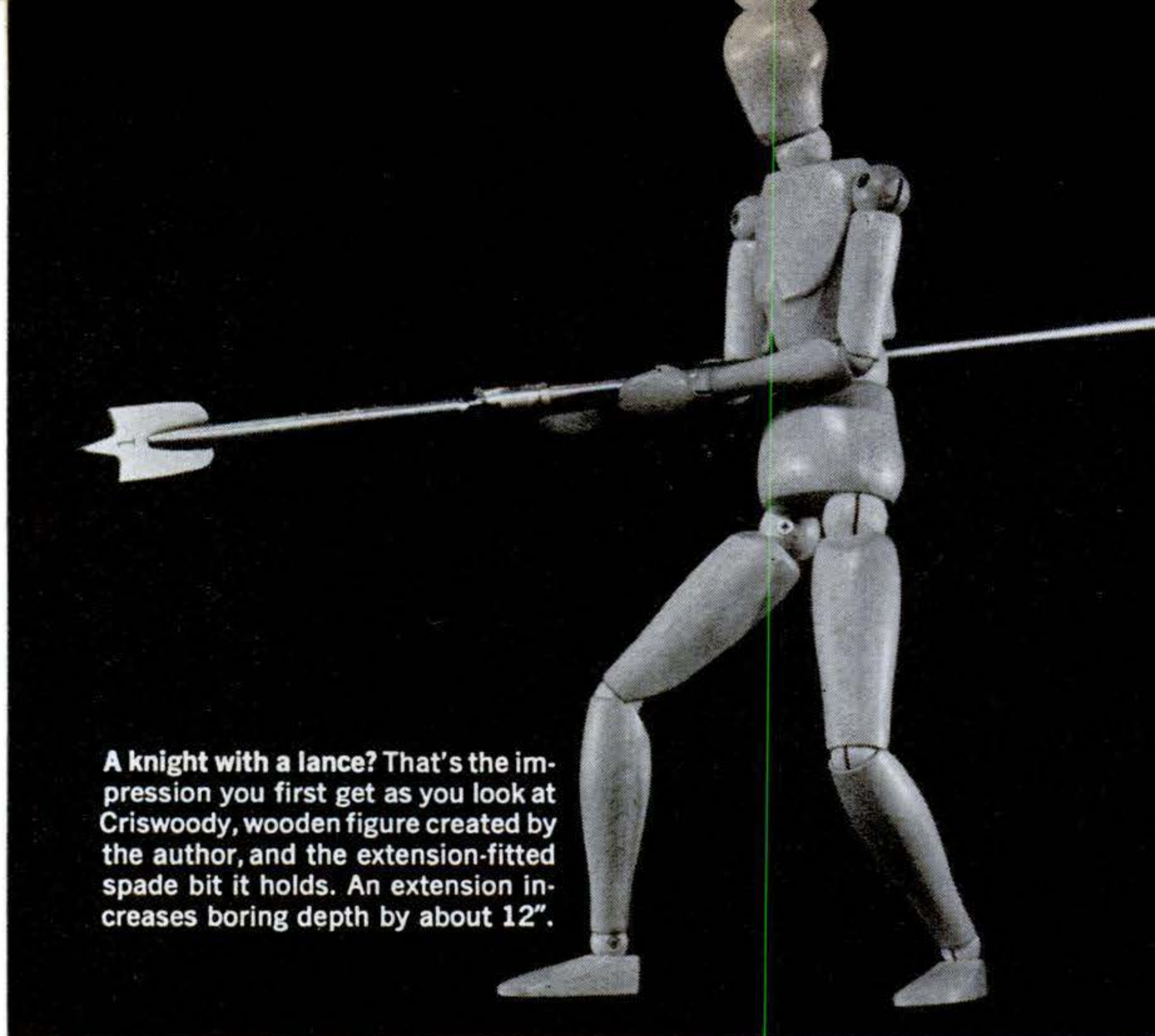
way, you'd ride in a lounge compartment. Curved ends let rail cars "nest" for lower wind drag. Wider track gauges and clearances would be needed for this high-speed intercity system.

The following patents have been issued on these inventions: Seesaw—No. 3,231,269 to R. Dalrymple, Jr., Upper Black Eddy, Pa.; Soap sponge—No. 3,293,684 to W. Tundermann, Colonia, N.J.; Load holder—No. 3,241,500 to B. and W. Simpson, Orinda and Oakland, Calif., and D. Lewis and H. Shipley, Lafayette and San Pablo, Calif.; Wrench magnet—No. 3,240,087 to T. Estes, Dal-

las; Beach shelter—No. 3,288,157 to H. Szkolny, Belmont, Mass.; Car ferry—No. 3,285,194 to D. Clejan, Chicago. Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington, D.C. 20231, at 50 cents each. To write to an inventor, if the address above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.



By R. J.  
DE CRISTOFORO



A knight with a lance? That's the impression you first get as you look at Criswoody, wooden figure created by the author, and the extension-fitted spade bit it holds. An extension increases boring depth by about 12".

## What Spade Bits Can Do for You

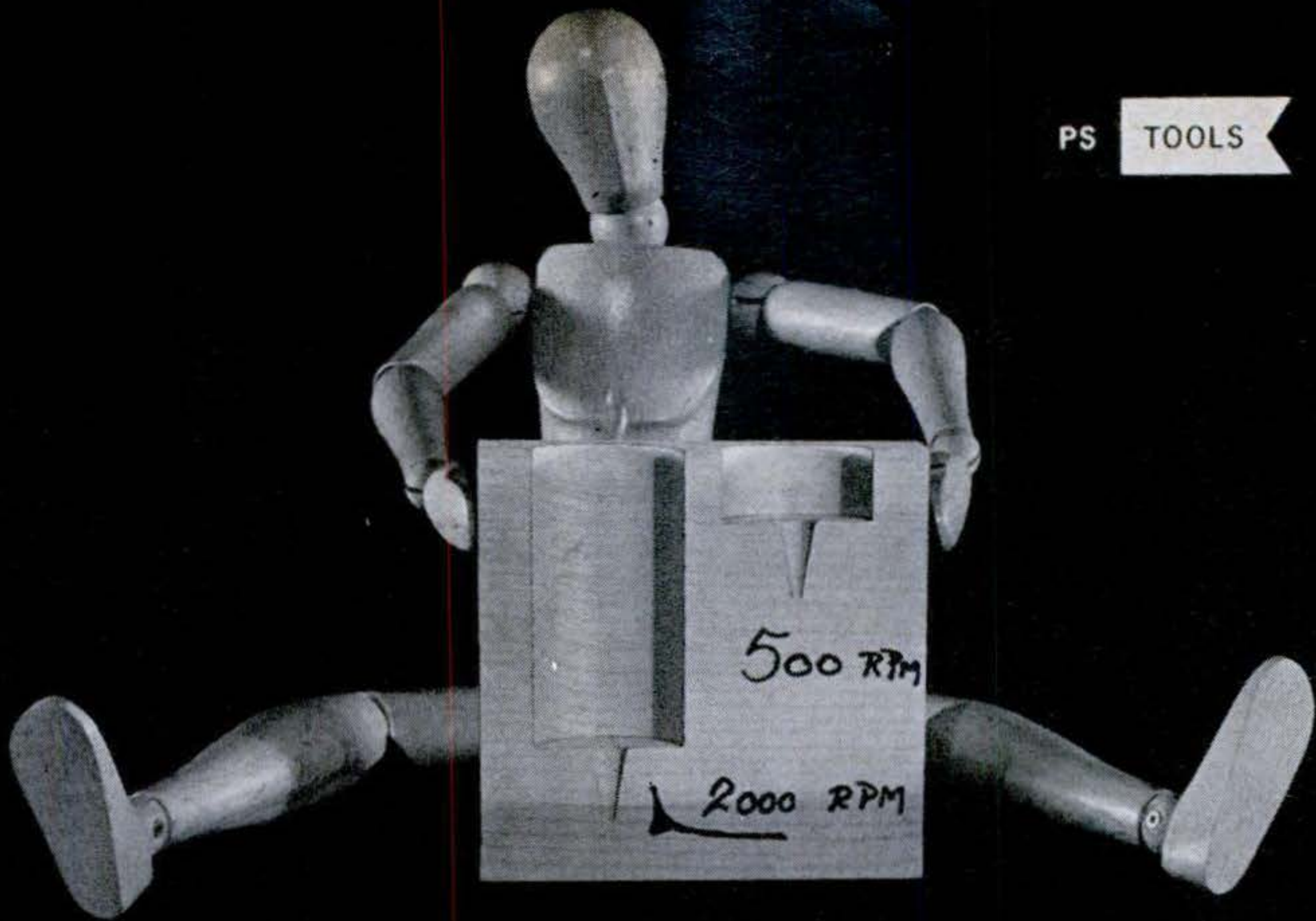
**S**pade bits do their job primarily by scraping away wood. The concept of a tool that scrapes goes far back into prehistory—to the first man who found he could shape wood to his needs by scraping it with a sharp stone. Spade bits—also sometimes called wing or flat bits—show up in various designs in hardware stores. But they are all *scraping* tools. On that basis they differ radically from augers and twist drills.

Spade bits are for use under power—either in a portable electric drill or a drill press. Although they have existed for years, they've really come into their own only with the great growth of the electric drill in the past decade or so.

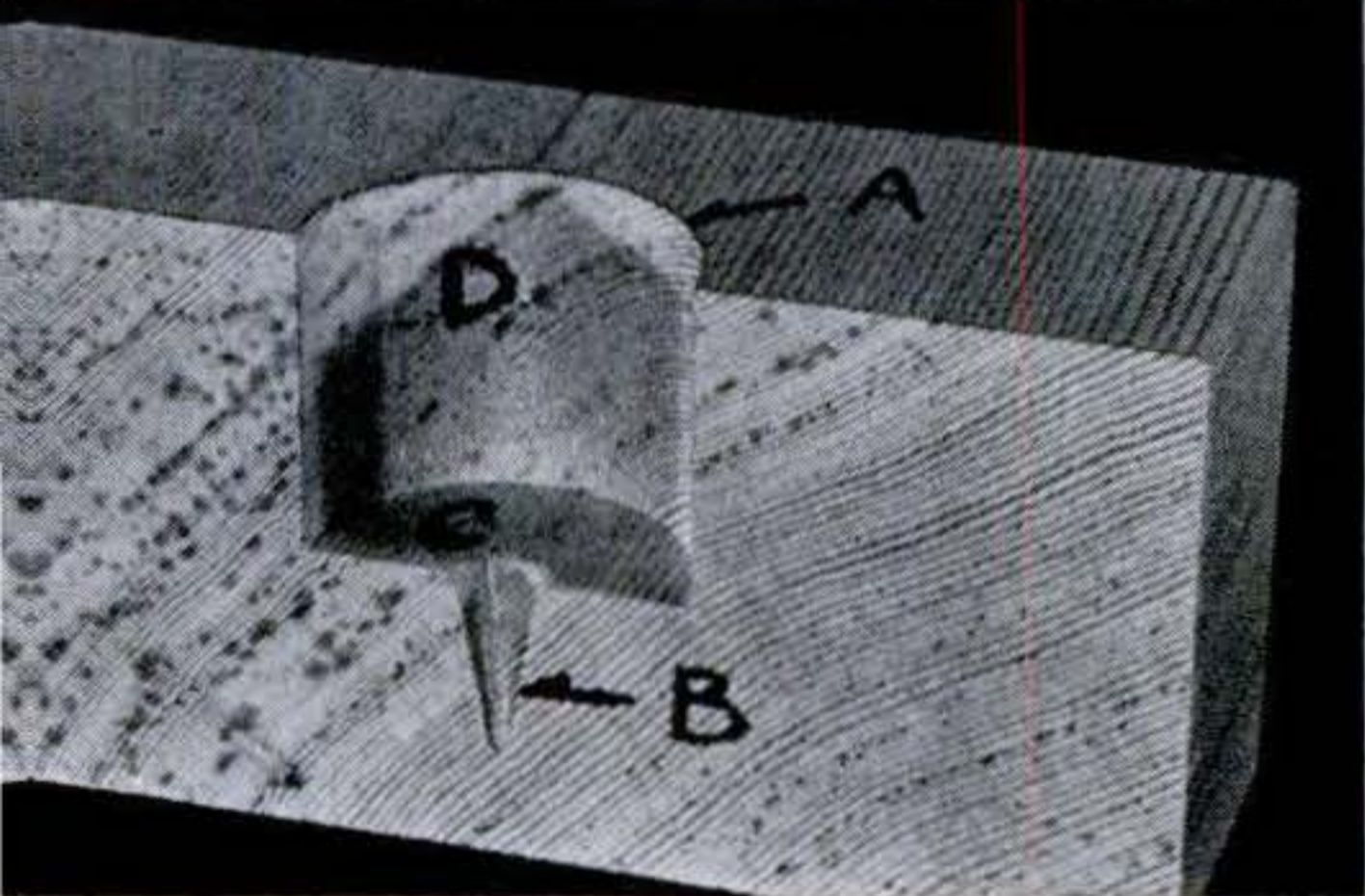
Offhand, I can't think of another bit I would care to chuck in a 1,500-2,000-r.p.m.  $\frac{1}{4}$ " drill to form a  $1\frac{1}{2}$ " hole. This seems contrary to the old rule that advises slower speeds and more power for larger holes—a rule I don't care to disregard generally. But with spade bits you do get a better job, faster, when you operate at about 1,500 r.p.m., even for large holes.

The Irwin Auger Bit Co., a major maker of tools for boring holes, has been making this point for years. To check it out to my own satisfaction, I set up a constant-load feed on a variable-speed drill press. By stopwatch timing (15 seconds) as I drilled two  $1\frac{3}{8}$ " holes—one at 500 r.p.m., the other at 2,000 r.p.m.—it was pretty obvious which speed was most

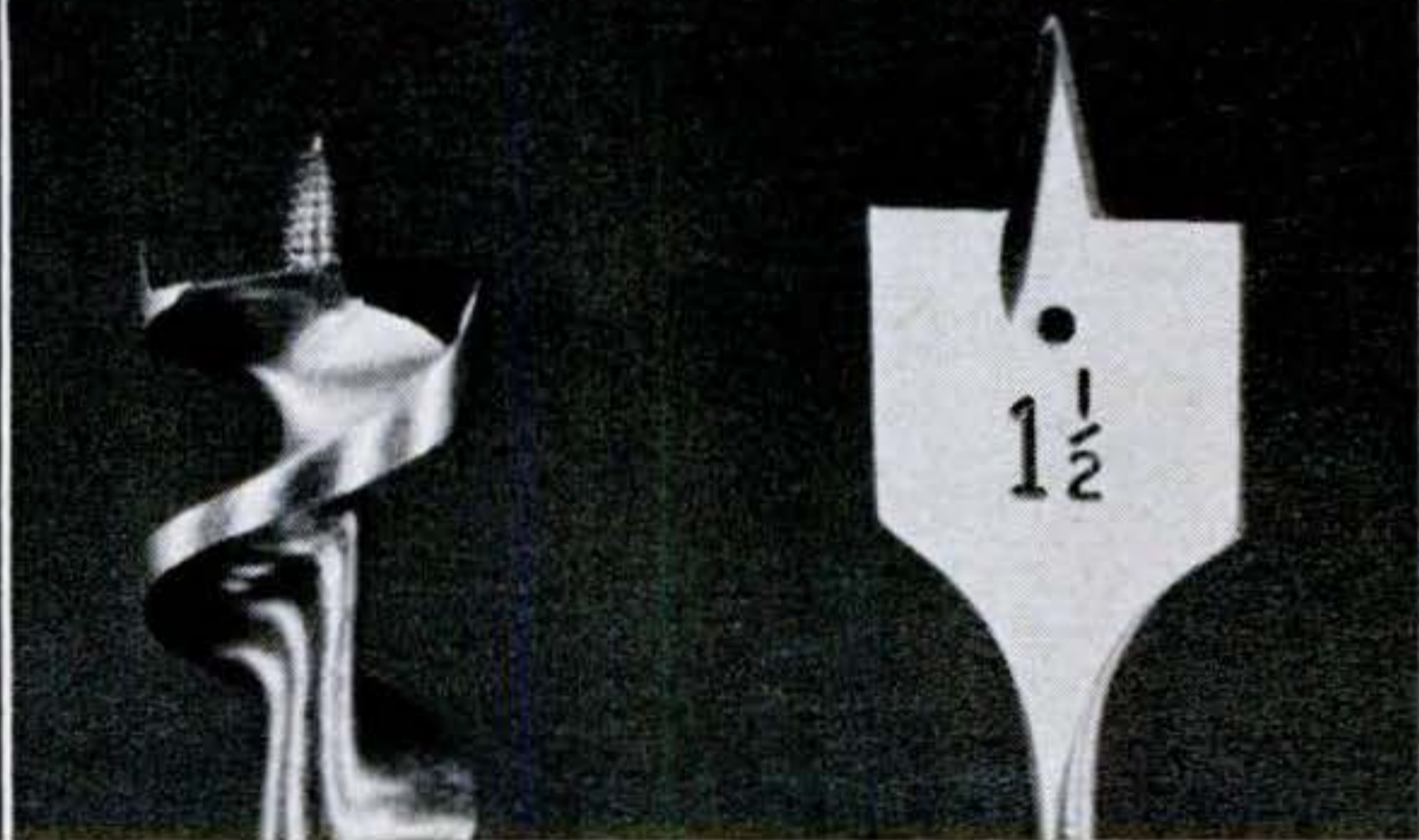
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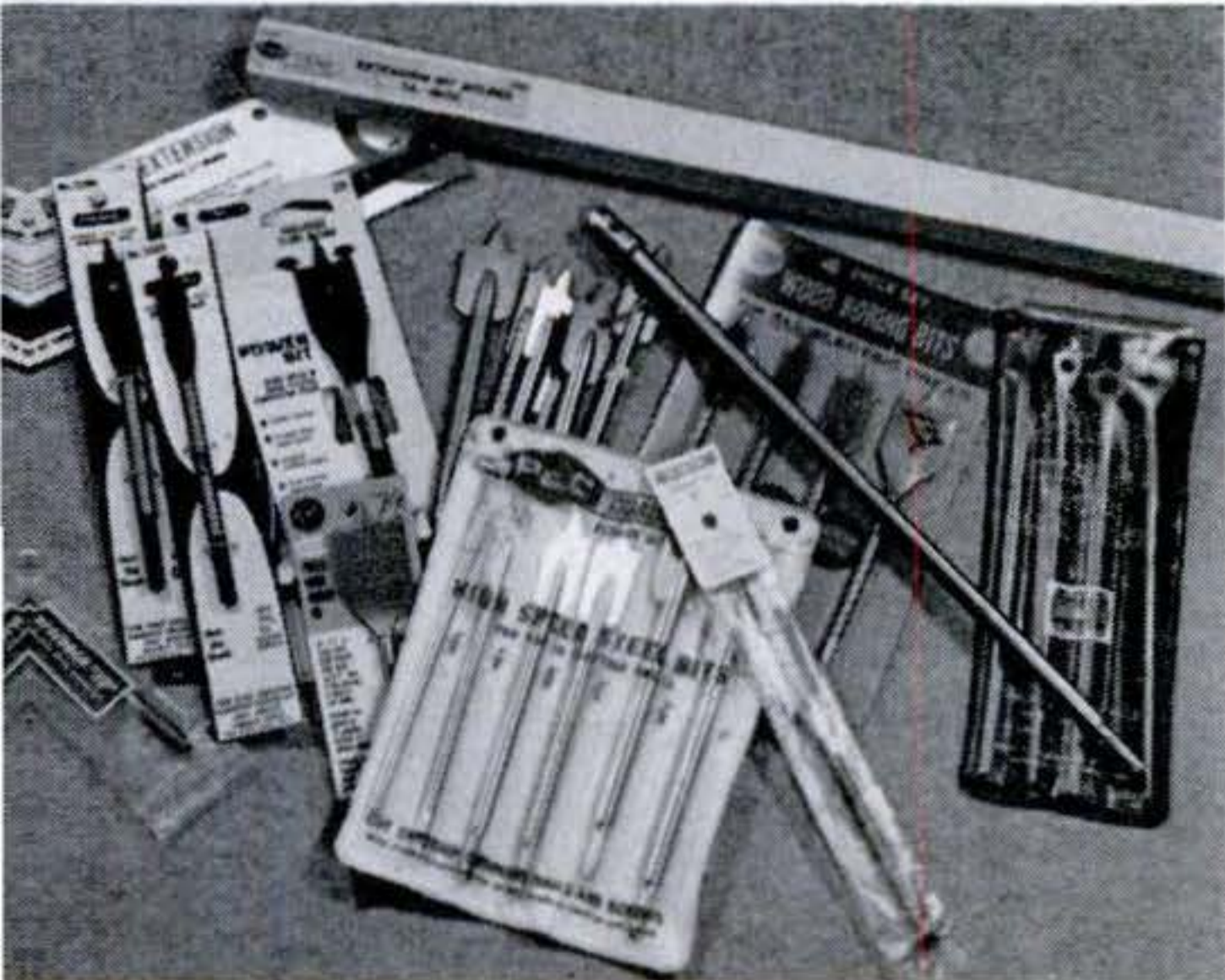
How speed pays off: Criswoody here holds a block that the author used to show how much deeper you can drill at recommended high speeds. A 1 3/8" Irwin Speedbor bit was used for 15 seconds. The 500-r.p.m. hole is only 1/8" deep, the other about 2 3/4".



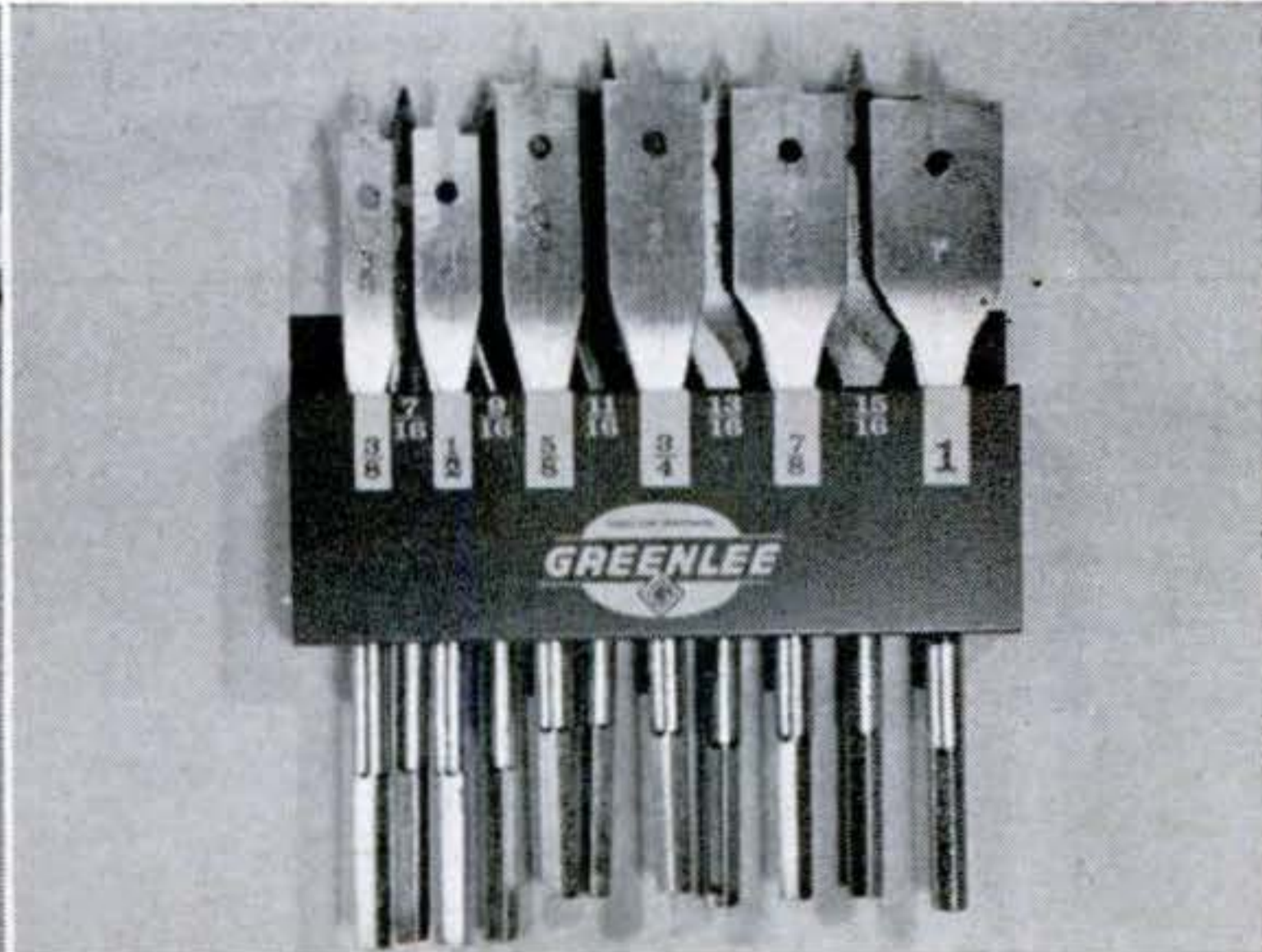
Factors that determine spade-bit quality: A, clean entrance; B, clean cutting, concentric point; C, flat or arched bottom; and D, smooth sidewalls.



Auger requires a hand brace; spade bit is designed for a power drill. The 1 3/8" auger at left sells for about \$2.90, the 1 1/2" spade bit for \$1.40.

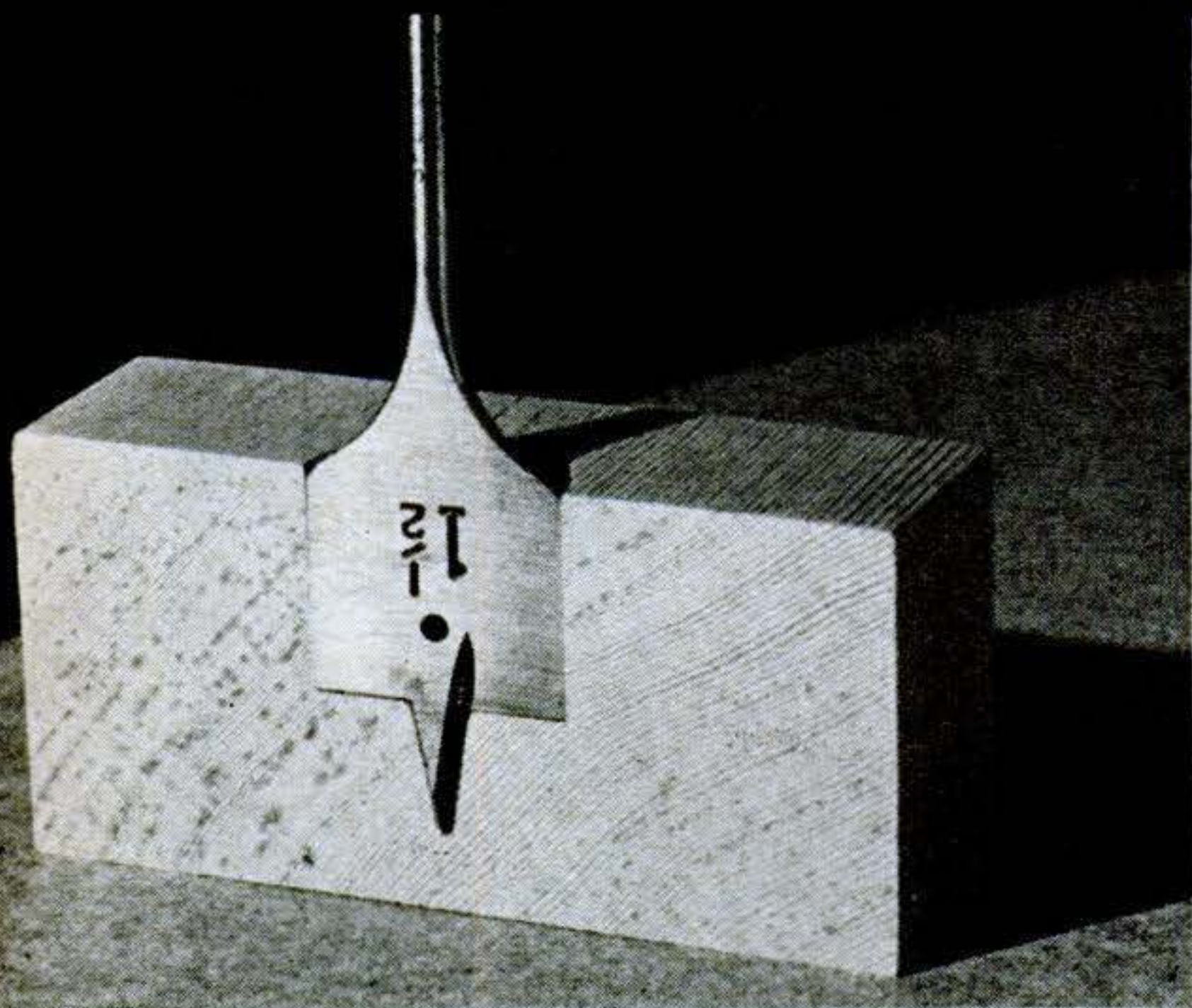


You can buy spade bits individually or in sets. Speed tests prove that buying for price alone is poor policy. The Greenlee set at right has 11 bits and includes metal



shelf for easy storage. Spade bits are easy to maintain but should be handled and stored so that damage to cutting edges is avoided.

## Major brands of spade bits that you can buy— and some of their differences



**Irwin Speedbor 88** is fast and smooth-cutting, and provides a flat-bottomed hole. Both cutting edges of the point are grooved to provide a hollow-ground design that penetrates easily into the wood.

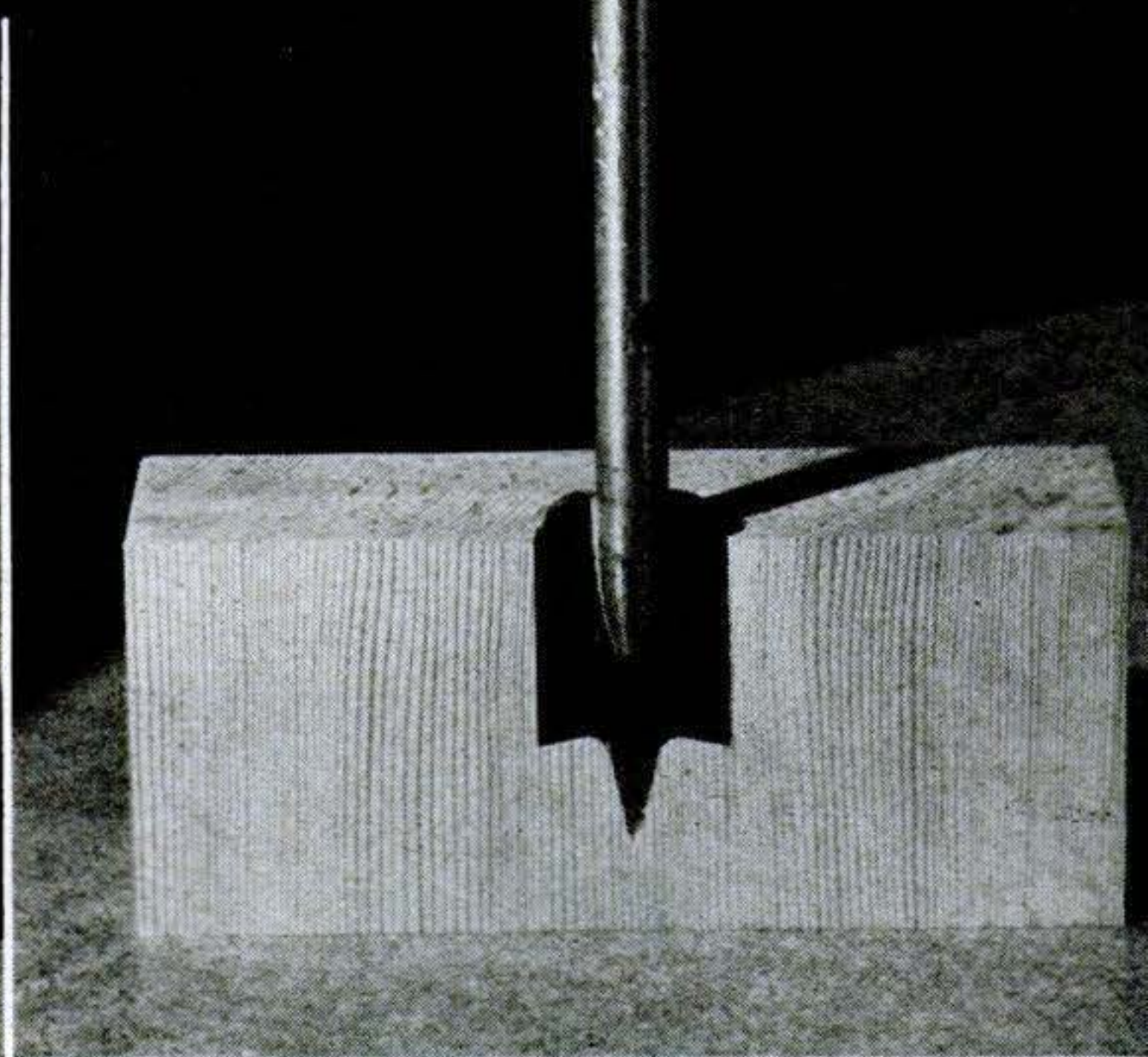
efficient. The 500-r.p.m. hole was about  $\frac{11}{16}$ " deep; the 2,000-r.p.m. hole about  $2\frac{3}{4}$ " deep!

**Why spades over augers?** To my mind this is primarily a question of whether you wish to work under power or with a hand brace. A screw-tipped auger pulls itself into the wood. You know what happens if you use an auger in a drill and it happens to grab.

Spade bits have points instead of screws, and since they are primarily scraping tools, you can easily control the cutting action in relation to the driving power. If you work correctly, there is no chance of the bit grabbing and twisting the drill from your hands or setting the work to whirling.

**What to look for.** Walk into almost any hardware store and ask for spade bits, and the owner will come up with something that may range from a set of four for less than a dollar (from the bargain-tool counter) to a single bit for a  $1\frac{1}{2}$ " hole that costs \$1.40.

As is the case so often when price is not the foremost consideration, even an amateur can make a pretty fair initial judgment by hefting the tool and taking a close look at some critical areas. Often by being persnickety you can pick the best of a lot of similar bits, even when all are from the same manufacturer. We found, in one case, heavy burrs on some cutting edges that were not present on others. In another in-



**Two-piece design** is used by P&C Tool Co. and Millers-Falls. These bits have a heavy, rigid shank. A very slight taper from bottom points of the spade to the top edge provides relief on sides of hole.

stance, the shank flats were not typical of the general quality.

Check the size range, especially when buying sets. Some sets increase in increments of  $\frac{1}{4}$ ", some  $\frac{1}{8}$ ", some  $\frac{1}{16}$ ". Depending on your needs, this can be a very important first consideration.

Check the business end for a clean finish and for sharp, relieved edges. This applies to the sides of the spade also, since quality here will mean a smoother finish in the hole.

Check the point for the same things and for its length. A long point can be a big help when it comes to drilling at an angle.

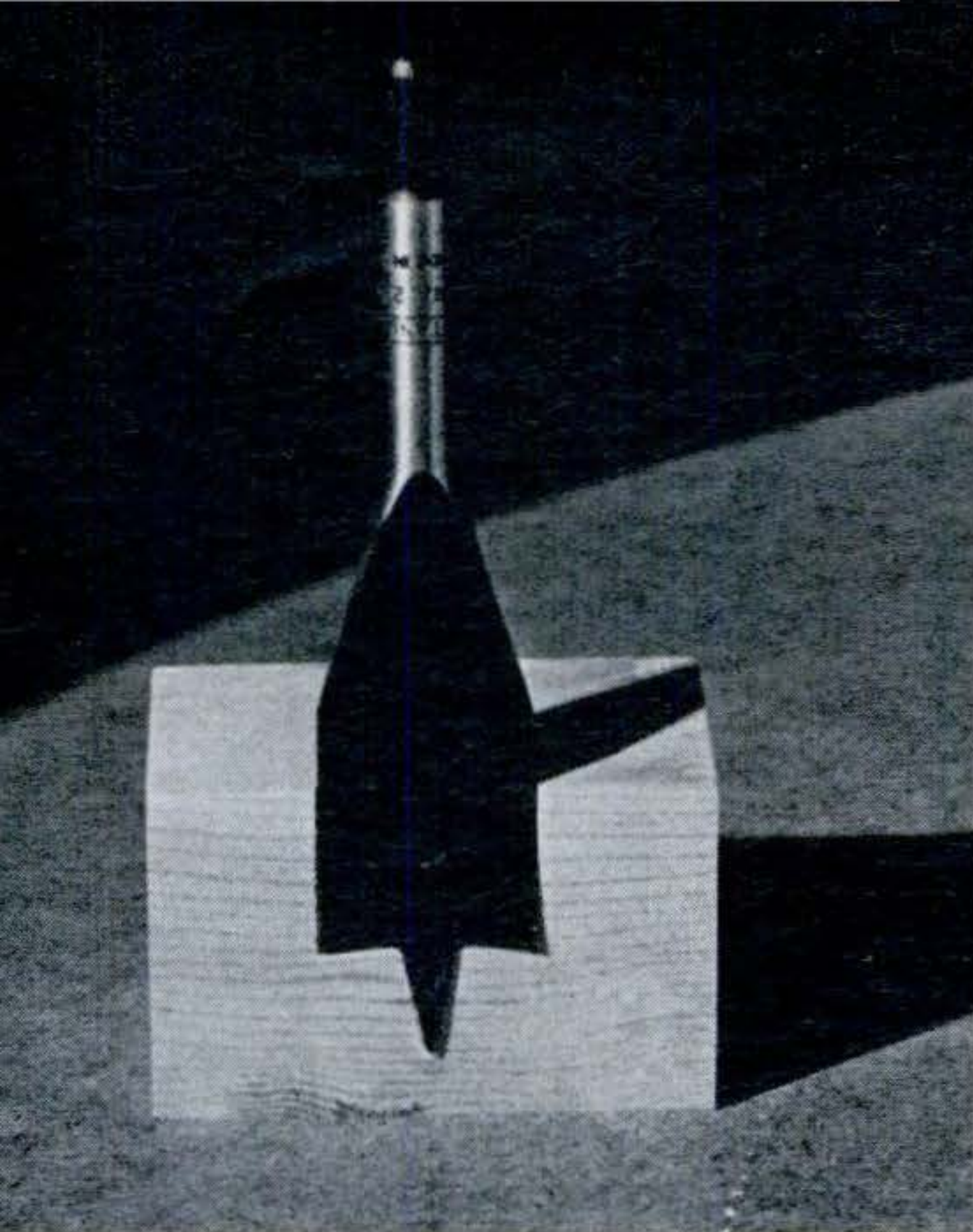
Check the shank for rigidity and the chuck end for flats. These flats mean a better chuck grip and less likelihood that the bit will spin in the chuck when working through rough stock.

Want reach? Then find out if an extension is available. Nail-cutting feature? Some spade bits are made so they won't suffer damage cutting through an occasional nail.

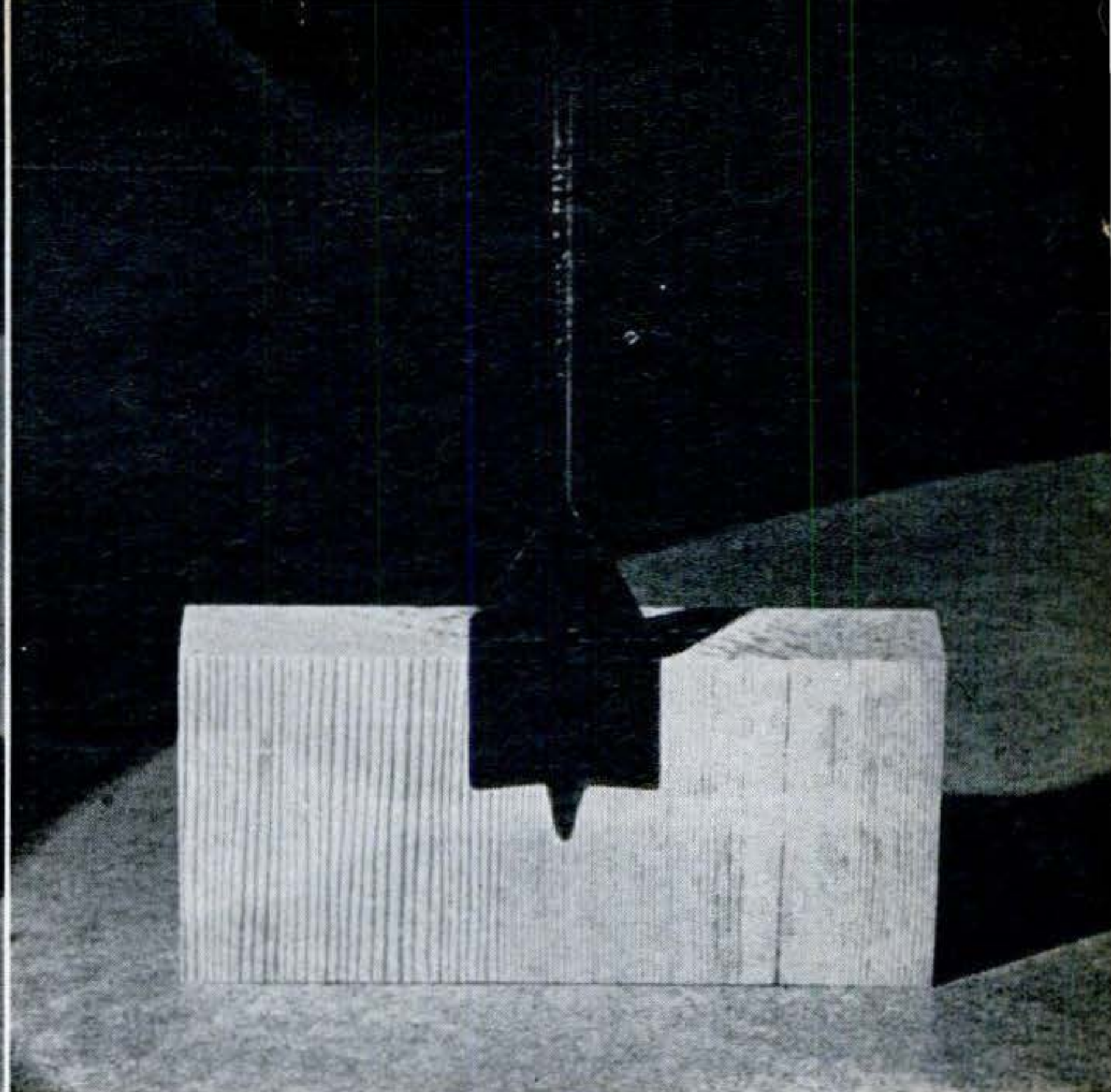
Check for concentricity. This is very important. You can do this right in the store by placing the bit so the spade end extends over the edge of a counter. Place your palm on the shank and roll the bit back and forth. If the point describes a circle, then it is not concentric. If the shank isn't true, you'll feel that, too.

You might also take a look at the pro-





Stanley power bit has flare design on cutting points of spade which, while not spurs, are designed to contact the wood first and so outline the hole for a clean entrance. Montgomery Ward bit is similar.



Highly polished Sears bit is hardened and tempered to retain cutting edge to 800 degrees. This 1 1/4" size sells for 79 cents, forms holes up to 5" deep. Design of spade bits makes them easy to sharpen.

le of the spade. This will tell you what shape the bottom of the hole will have—a consideration for flat-bottom holes.

**How to use them.** Always use a chuck key to be sure the bit is gripped tightly and the chuck jaws are seated on the flats.

Unlike fluted bits, these tools do not remove waste from the hole. Since they work with a scraping action they produce a lot of fine sawdust. On very deep holes, pause occasionally to clean out the waste so the bit will work easy and cool.

On through holes, where you want a clean break-out, be sure to back up the work with a piece of scrap stock.

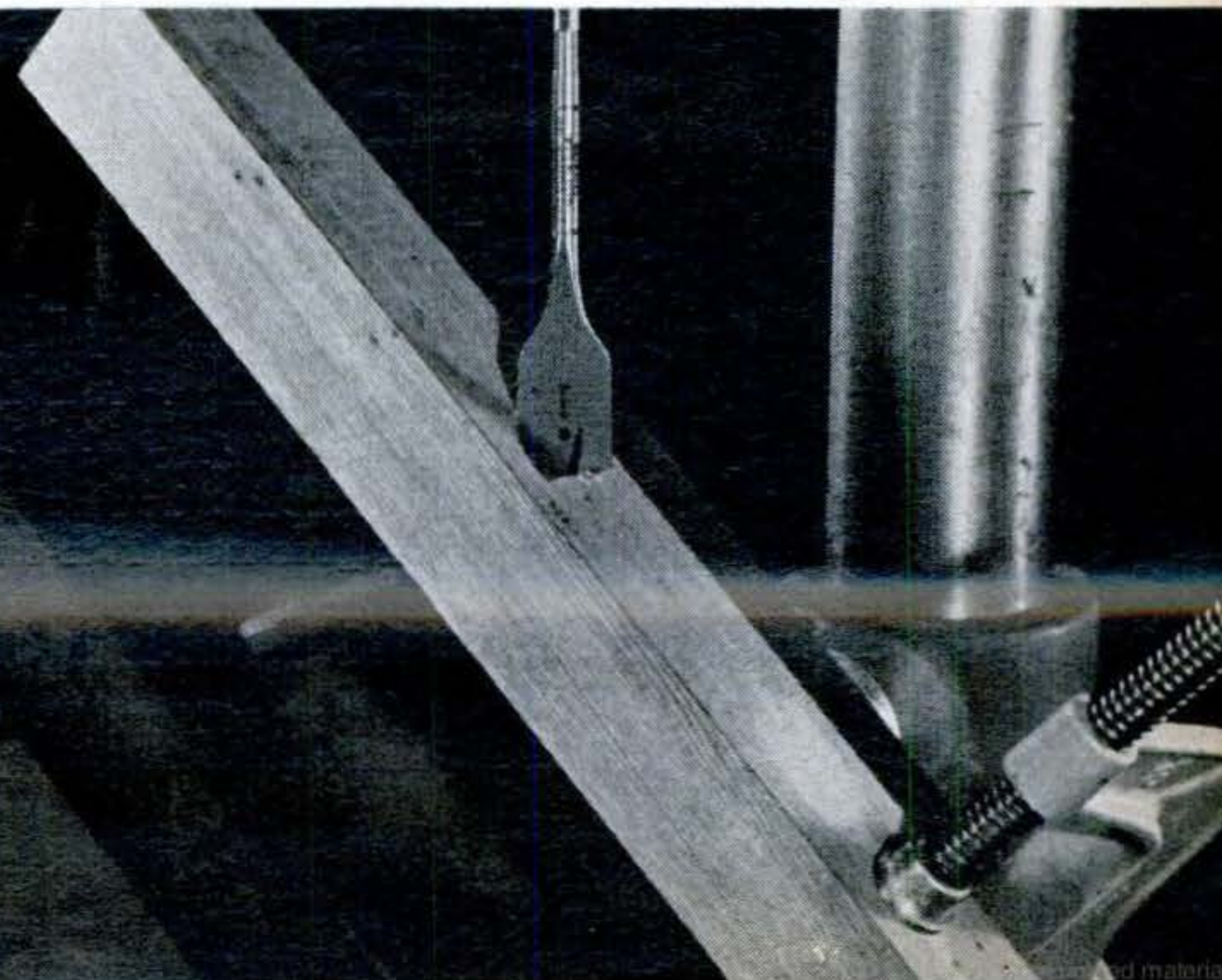
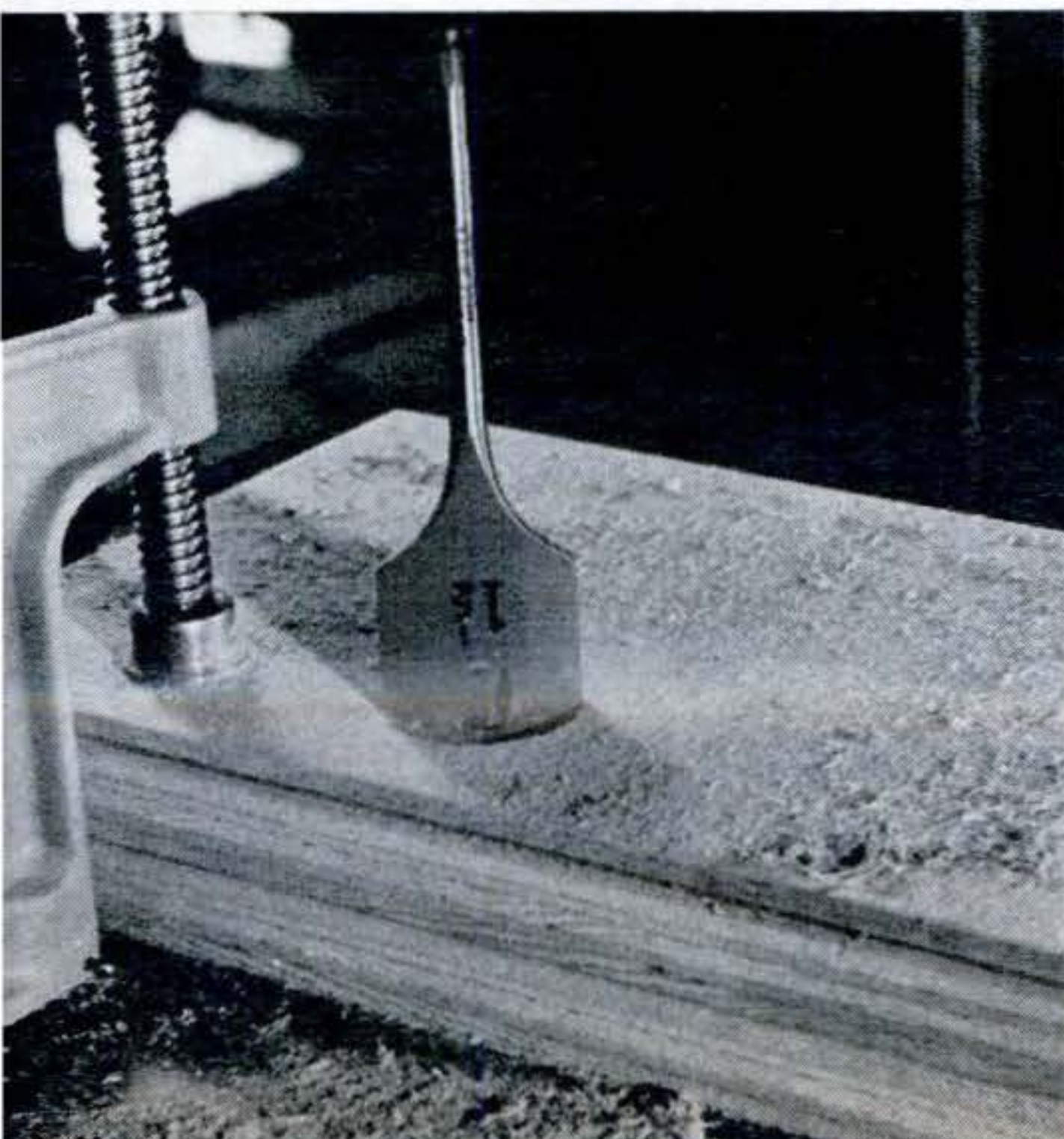
When using an extension, press the point of the bit against the work before turning on the power. In fact, it's probably a good idea to spin the tool quickly a few times until the point is firmly seated.

These tools cut fast enough when used correctly so that there is no point in forcing the feed. Forcing could result in burning the wood and/or the bit. **PS**

## Two special situations where spade bits will serve you well

Drilling holes through thin stock is feasible with spade bits, provided you use a back-up material.

Bits with long points are a big help when drilling holes at an angle since the point will enter first.





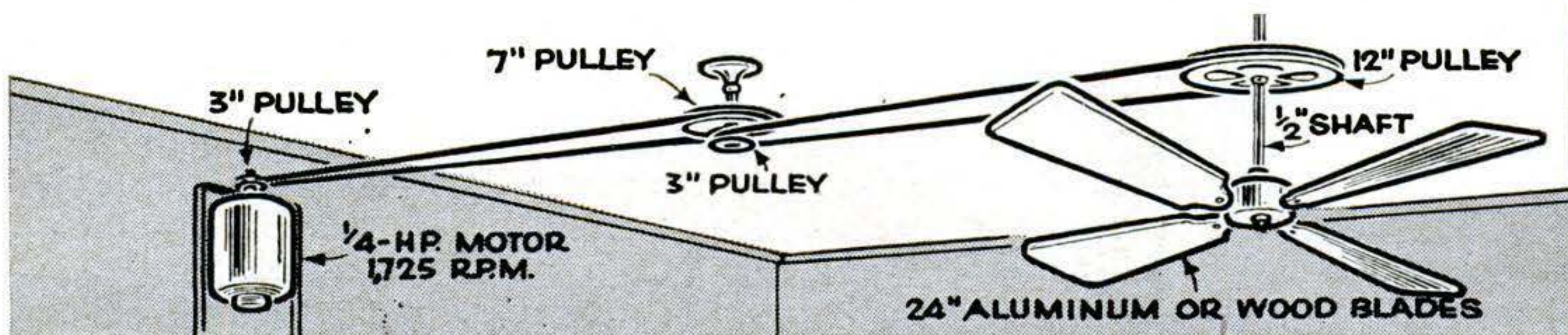
# Shop Talk

By ROBERT P. STEVENSON

## Old-fashioned wood-blade ceiling fans are now making a comeback

Before the development of modern air conditioning, big ceiling fans with slowly revolving wooden blades were a common method of stirring up cooling breezes, especially in restaurants. These fans are becoming popular again, this time for home use. That word comes from Emerson Electric Co. (8100 Florissant, St. Louis 63136), a company that has been making such fans since the Nineties. Emerson reports that customers install its new models, with 36- or 52-inch blades, in breezeways and covered patios. The fans, controlled by a two-speed switch, move large volumes of air without rumpling hair or disturbing table settings.

For convenience, you may want to buy such a fan. But you may also take a cue from Dr. A. L. Geiser of St. Paul, Minn., who writes that he and his son put together a very satisfactory one from odds and ends, locating it on the porch of their lake cottage. The Geisers started with a ¼-hp 1,725-r.p.m. rubber-mounted motor, installing it shaft-up on the porch wall. The sketch shows details of the belting and pulley system.



## New items you may want to know about for your home shop

The transparent-plastic tool pouches that reached me the other day make sense. The heavy-gauge polyethylene bags are fitted with a ¼-inch brass eyelet in one corner. The eyelet slips over a nail or a perforated hardboard fixture—and small tools, electronic parts, or other gear are stored in plain sight. A package of 18 bags sells for about \$1.40 at hardware or department stores. Peg Boy Mfg. Co., 1234 Midland Ave., St. Louis 63130 can tell you more about them . . . If you'd like to doctor a chair or other furniture with loose joints, check your hardware store for Devcon's new kit containing a tube of Grip-Wood and a hypodermic syringe. Press adhesive into the syringe, insert the needle, and depress the plunger.

## Tourist note: See the Daisy Air Gun Museum in Arkansas

All grown-up kids who used to shoot a Daisy air rifle ought to be interested in a bit of news from Rogers, Ark. That's the home town of the Daisy Company, and if you get near it on your vacation travels this summer you're invited to stop in at the recently opened Daisy International Air Gun Museum. You'll see approximately 200 guns that document the history of air guns from 17th-century Europe to the present day.

**TO REMOVE SECTION, open magazine wide at this page, rest it on table, run your thumb firmly along center fold. Then pull out the sheets gently, one at a time.**

# How to Open Clogged House Drains

Part One

By **GEORGE DANIELS** and **LOYD WEAVER**

**C**logged plumbing is one household problem you can't put aside for another day. A fixture that won't drain is useless. One that overflows can be disastrous. So it's fortunate that the fix-it job in most cases is relatively simple.

When only one fixture is affected and others drain freely, the stoppage is either in the fixture itself or in the drain line that leads from it to the main drainage artery called the "soil stack."

**Symptoms can be sneaky**, however, if several fixtures share the same drain, as bathtub and washbasin sometimes do. As the basin is higher, its contents may end up in the bathtub.

If the house drain is clogged, outflow from

all fixtures above the stoppage will usually back up into the lowest one and overflow. Typically, this means that basement laundry tubs (or floor drains) become the dumping ground and overflow point for all fixtures and toilets above them.

If the stoppage is localized, as in a washbasin or sink, try the easiest methods of clearing it, first. (Cures for the really tough stoppages—fortunately less common—will be described next month.)

**Start at the drain outlet** of the fixture if the stoppage is in a tub or washbasin. Stopper mechanisms and outlet strainers gradually collect matted hair, lint, bobby pins, soap film. You're not likely to notice this, as it develops slightly below the outlet level, and isn't readily apparent. Thus, the final seal-up can come with surprising suddenness.

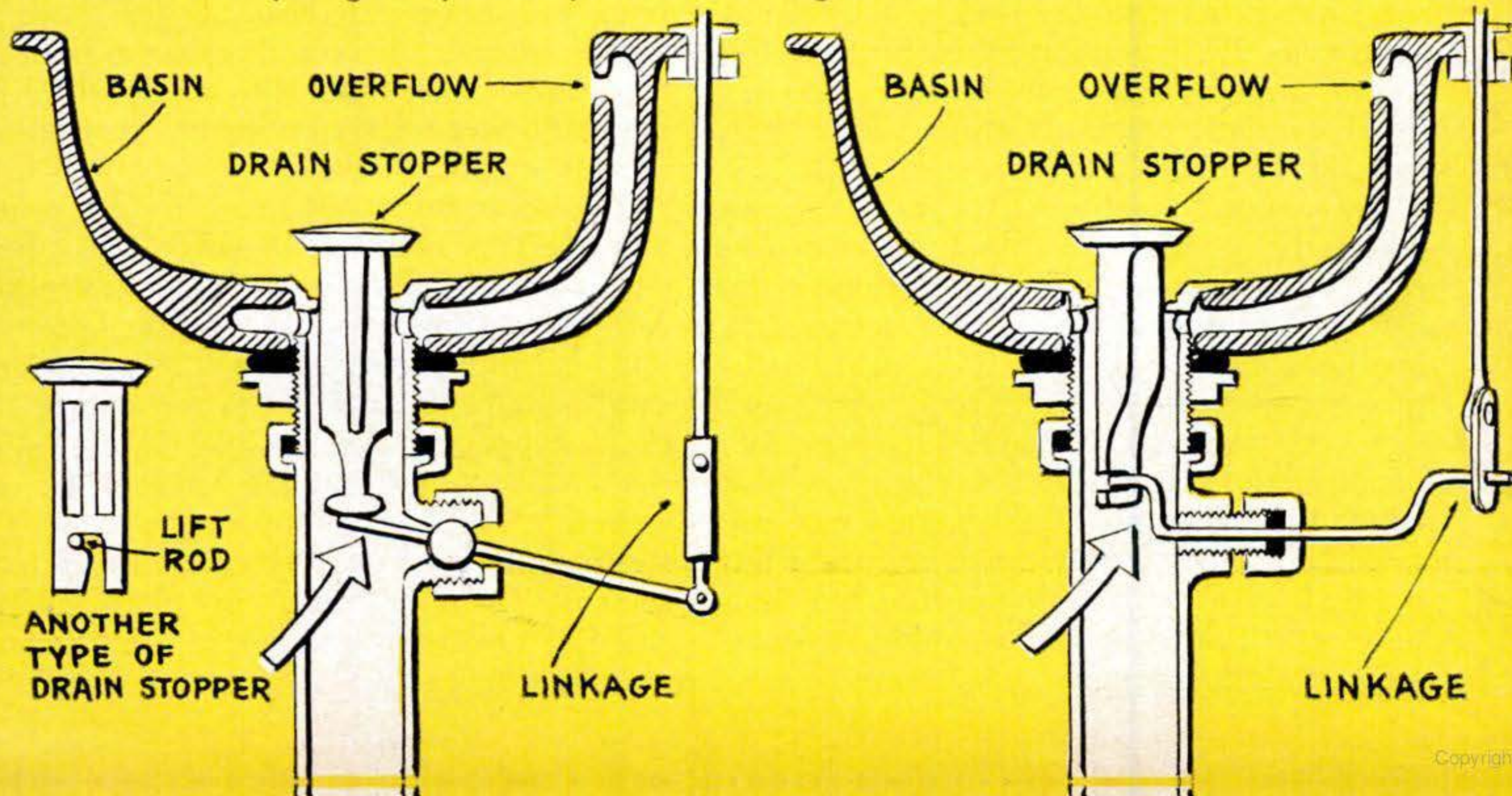
Reach down through the water and pull

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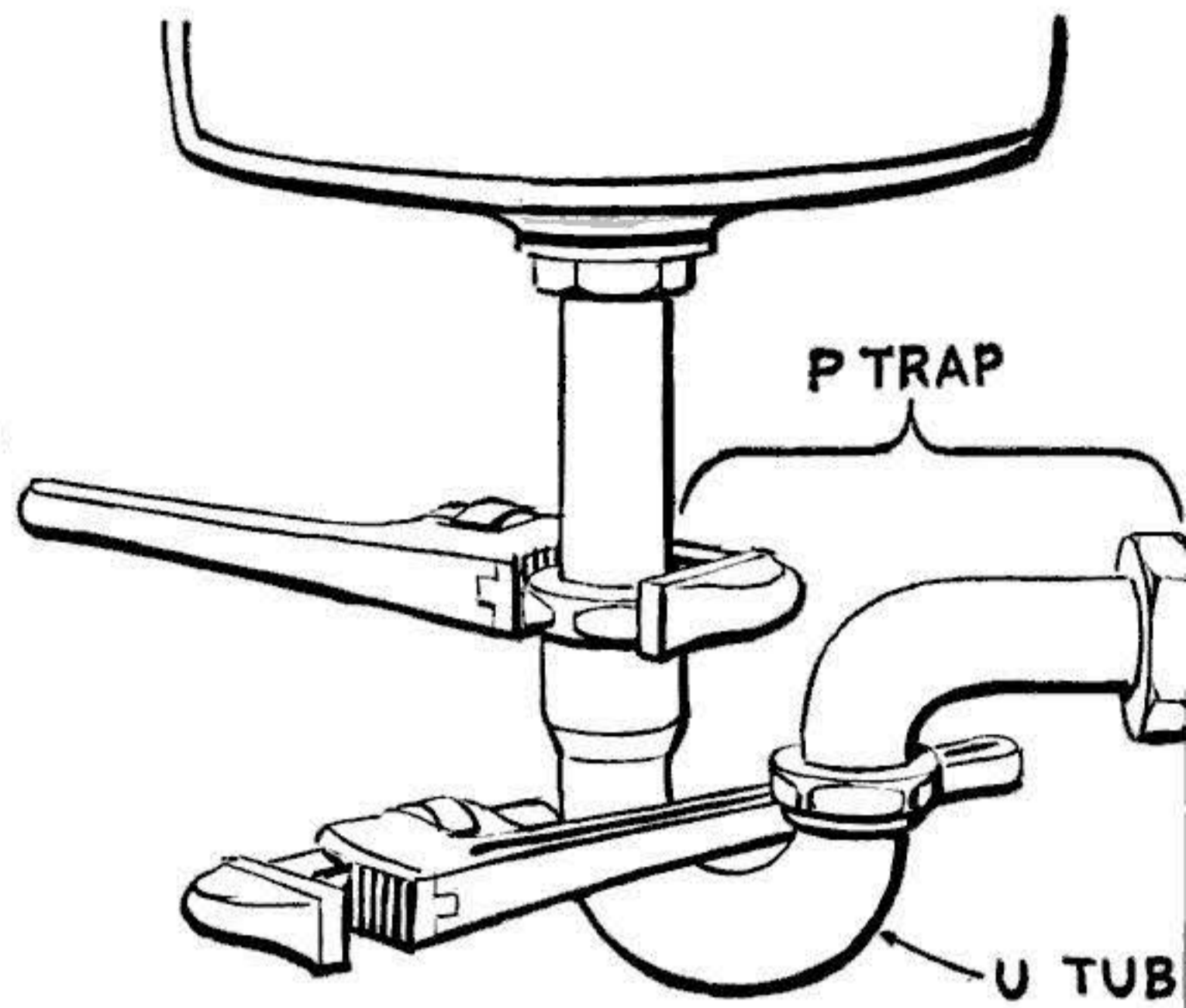
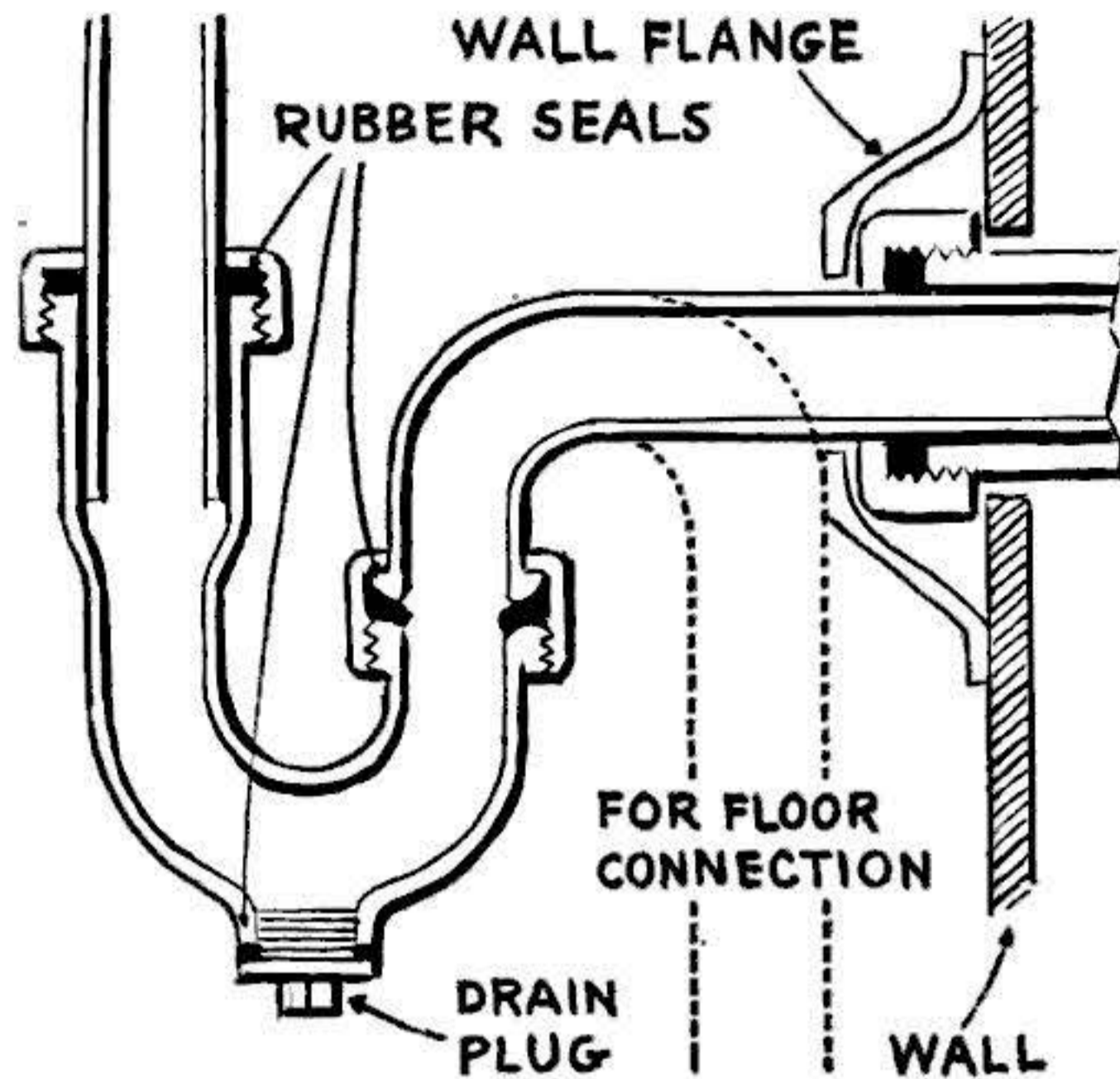
## How you can clear a blockage at a lavatory drain outlet

Modern drain stoppers like the two at left can simply be lifted out of sink opening to expose the possible

stoppage point (arrow) for cleaning. Type shown at the right, below, must be turned to remove it.



## Types of traps you may find under lavatory or kitchen sink



Traps under a fixture often are the site of a stoppage. If there's a drain plug at the bottom of the trap, remove it to get at the stoppage. Sketch at right shows how to hold the U section of a P trap with the handle of a backing wrench while loosening the upper slip nut. The trick is to keep pull of the

wrench from loosening anything except the slip nut. If tubing seems on verge of collapse before turning, free the frozen nut by holding head of one hammer (or other weight) against one side of nut while striking it sharply with another hammer on opposite side. Do this several times, at different points

out everything that feels like this kind of matted build-up. If the fixture starts to drain, let it empty. Then use long-nosed pliers, tweezers, or whatever will help you clear the outlet completely.

If the fixture has a pop-up stopper, remove it. Some simply lift out. Others must be lifted slightly and then turned to disengage them. (Look out for the edges of pop-up stoppers. Some of the older types are sharp enough to cut wet hands.)

As most kitchen sinks have stoppers that serve also as removable strainers, they're not subject to this type of trouble. But lift the stopper from a clogged sink, anyway. There's usually a fixed crisscross grid under it that can sometimes be blocked.

If removing obstructions from the outlet doesn't help, bail out as much water as you can. Then have a look at the trap under the fixture. Under sinks and lavatories these are readily accessible U-shaped fittings. Bath-tub traps are made in several forms, and may be accessible through a removable panel in the other side of the wall against which the tub sets. First-floor tub traps are sometimes located between joists of an unfinished cellar ceiling. If the tub trap can't be reached, skip the trap-cleaning step and

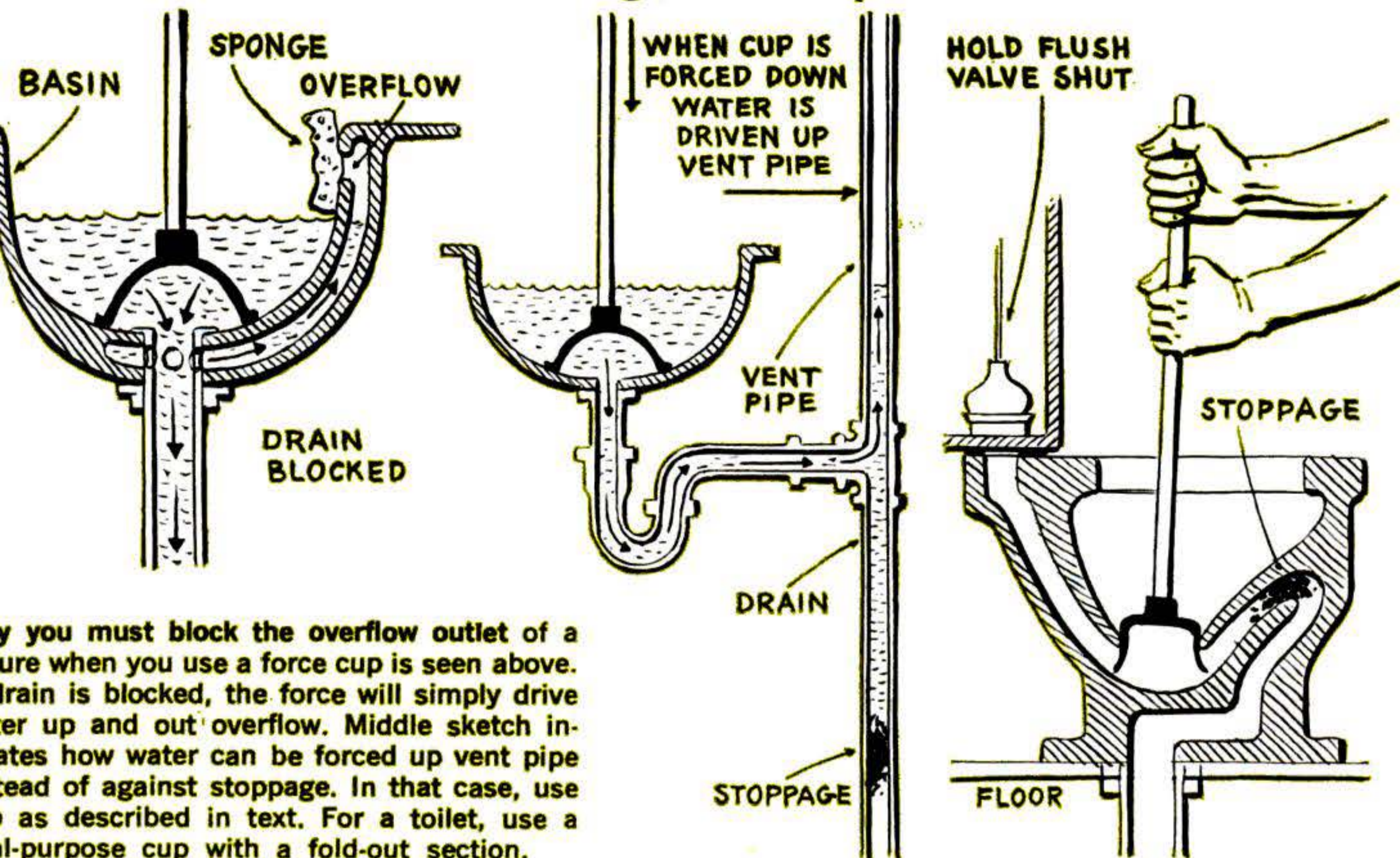
use a force cup as described later on. Or you may eventually have to use an auger.

When a sink or lavatory trap has a drain plug, place a bucket underneath and remove the plug with an adjustable wrench. If a noticeable amount of solid or stringy matter comes out, use a hook-ended wire to snag out any more you can reach. The wire can possibly work enough of an opening to put the fixture back in limited operation.

If the trap has no drain plug (likely in newer homes), your best bet is to try a plumber's force cup next. If you have to buy it, favor a big one. Prices run from 50 cents for smaller models to about \$1.50 for big multipurpose types that fit any fixture, including a toilet bowl.

**To use a force cup,** run enough water into the sink or basin to cover the rubber cup when tipped over sideways. Then you can tip it into vertical working position without trapping air inside it. You want a solid column of water from the cup to the drain stoppage. If you're working on a sink, the metal strainer-stopper should be removed. If the sink is double, close the strainer-stopper in the other side and have someone hold it firmly in place. When there's an overflow opening in a lavatory or

## Good tricks to know when using a force cup on a blocked drain



When you must block the overflow outlet of a basin when you use a force cup is seen above. If the drain is blocked, the force will simply drive water up and out the overflow. Middle sketch illustrates how water can be forced up vent pipe instead of against stoppage. In that case, use a force cup as described in text. For a toilet, use a toilet-purpose cup with a fold-out section.

For a bathtub, have a helper hold a rag wad or sponge against it.

The effect of the force cup is greatest where the fixture drain line is a single short length from fixture to soil stack. Then, with other outlets blocked, the cup exerts its main force against the obstruction.

When the fixture drain is longer, it is usually "re-vented." That is, another pipe is tapped into it near the fixture to run vertically upward through the wall to the roof or to another connection to the soil stack, above the fixture. This re-vent lets air flow freely into the drain so outflowing water isn't slowed by a partial vacuum behind it, and so it won't suck water out of the trap by pulling air through it. But when you use a force cup on this arrangement (and the stoppage is beyond the re-vent connection) part of its energy is expended driving water up the re-vent pipe.

But, if you have a sense of rhythm, an old trick may save the day. Try to time your force-cup strokes to match the natural up-and-down momentum of the water column. (It's like timing the push you give a kid on a swing.) You can tell when you have it right because the force cup seems to work more easily. Then, with the cup

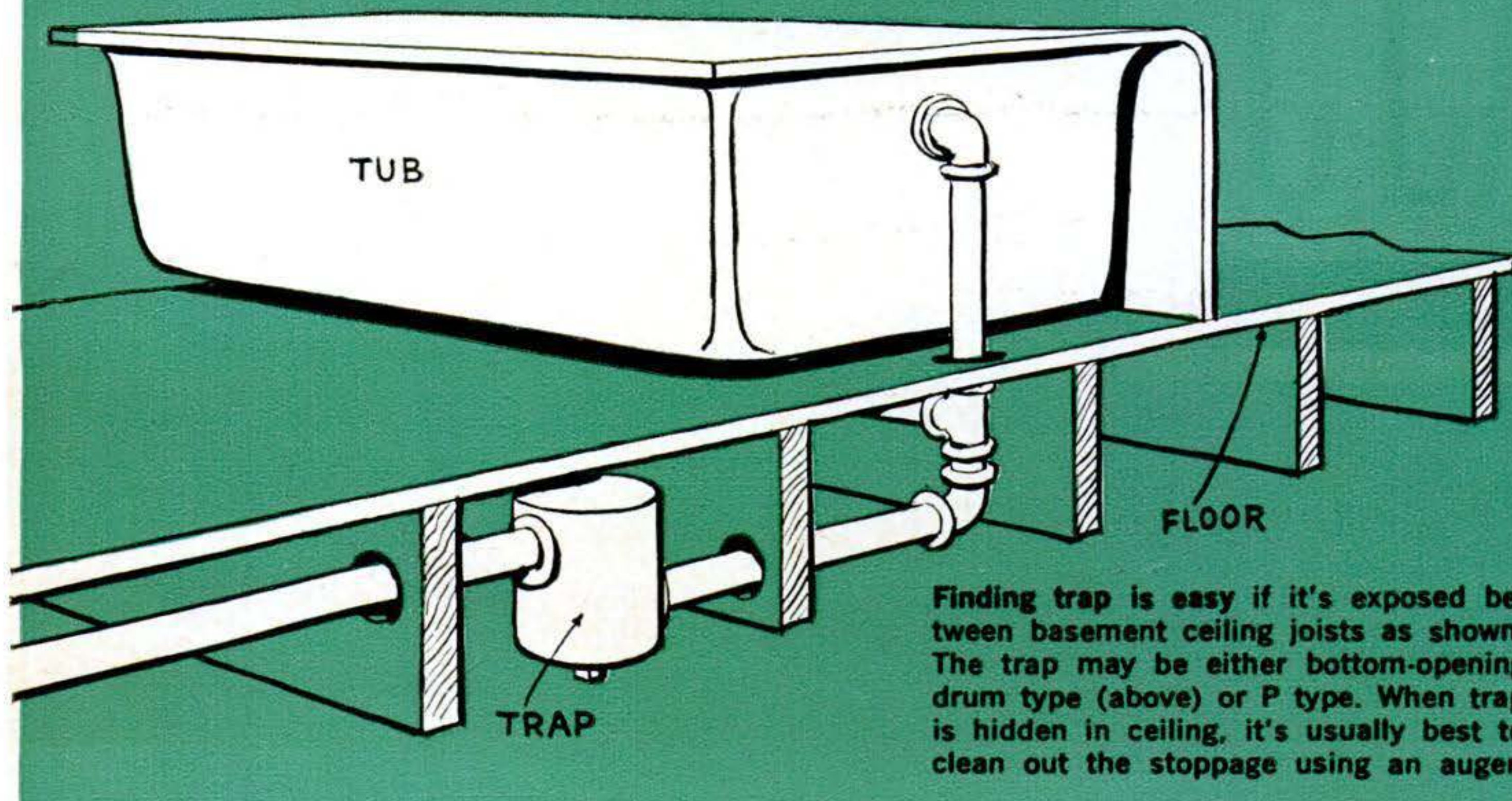
part way on its up stroke, suddenly break the rhythm and drive down hard. This bangs the water back against the descending column in the re-vent pipe, and gives a greater push against the obstruction. This may be the extra punch needed.

In any force-cup work, pull the tool forcibly from the drain outlet at intervals of half a minute or less to see if the line is clear. (The forcible pull-off also helps clear it.) If the fixture drains, even though slowly, let it empty. Then run in a gallon or two of very hot water.

If drainage remains slow a chemical drain cleaner can often complete the job of opening it up. But don't try to use a cleaner until some flow has been established. The cleaner won't work, and should never be used, in a drain that is completely clogged or filled with water. Before you try any cleaner be sure you know what's in it, what risks are involved, and what precautions to take. Improper handling of some types can actually *clog* your plumbing or cause serious physical injury.

**Of chemical cleaners,** there are several common types. The most familiar is largely sodium hydroxide (caustic soda) and aluminum particles. Mixed with the prescribed

## How you can locate the trap for a bathtub



Finding trap is easy if it's exposed between basement ceiling joists as shown. The trap may be either bottom-opening drum type (above) or P type. When trap is hidden in ceiling, it's usually best to clean out the stoppage using an auger.

amount of water, their reaction raises the temperature to boiling in a few seconds, softening or liquefying grease or fatty materials. The bubbling of the reaction also helps. Poured into the drain dry, without premixing in water, they may leave a crystalline deposit in the pipe. Repeating the process can block the pipe.

Premixing is best done in an enamelware pot with a wooden paddle, either outdoors or near an exhaust fan to avoid breathing fumes, in strict accordance with the manufacturer's instructions. But an enamelware pot may not be available. In that case, you might use an old five-gallon paint bucket or a plastic scrub pail and discard it.

A newer form of cleaner contains sulfuric acid, coupled with inhibitors to prevent it from damaging the pipe. This cleaner generates heat to soften or liquefy greasy stoppages and destroys other clogging materials (including sanitary napkins) by acid action.

**Caution! Caution!** Both of these cleaning chemicals must be handled with the utmost care. They can cause serious burns if spilled on the skin, possibly irreparable damage if spattered in the eyes. Breathing the fumes can be injurious. Also, if a drain line happens to relog while filled with the solution, as sometimes happens, the chemical must be neutralized according to the manufacturer's instructions before the trap or other drain parts can be taken apart safely. And,

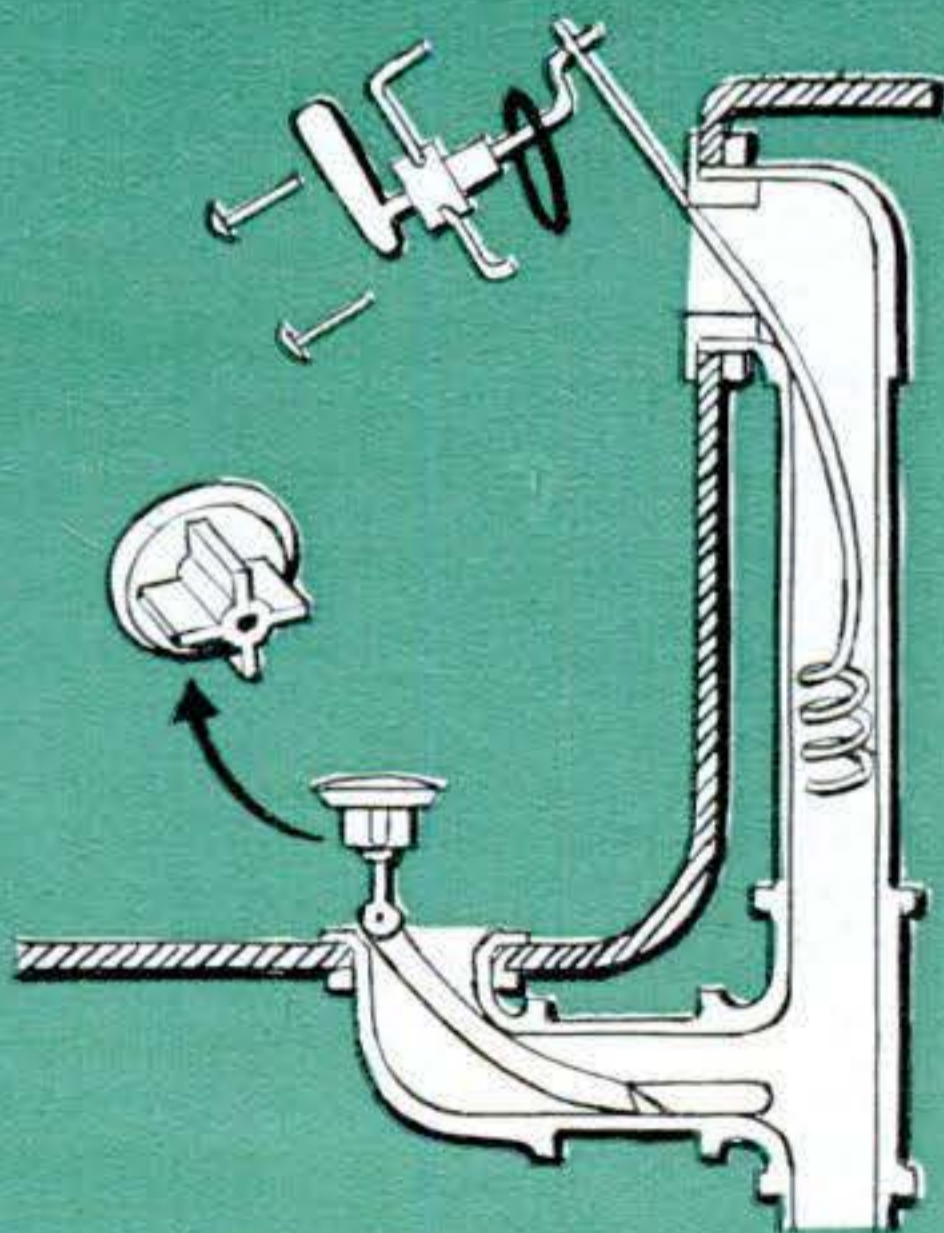
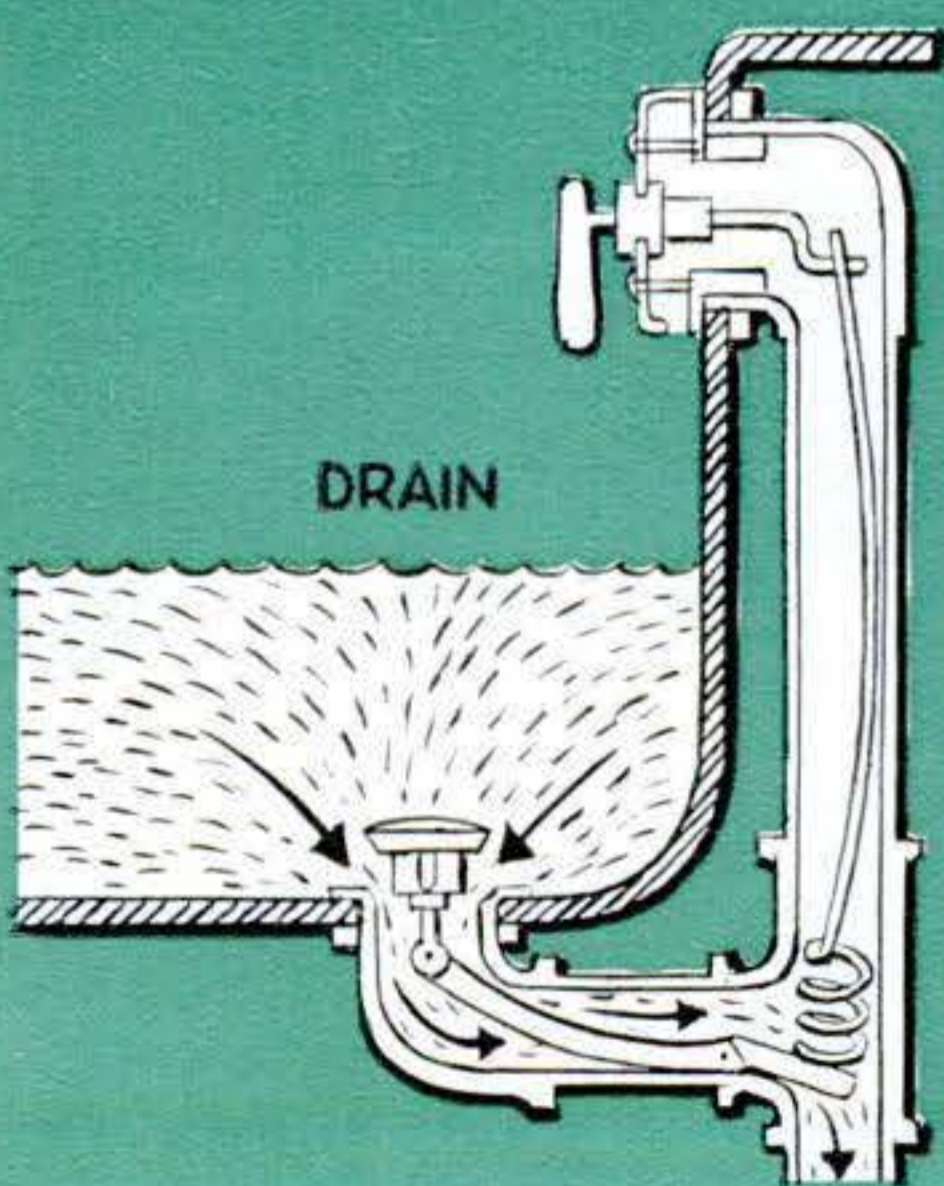
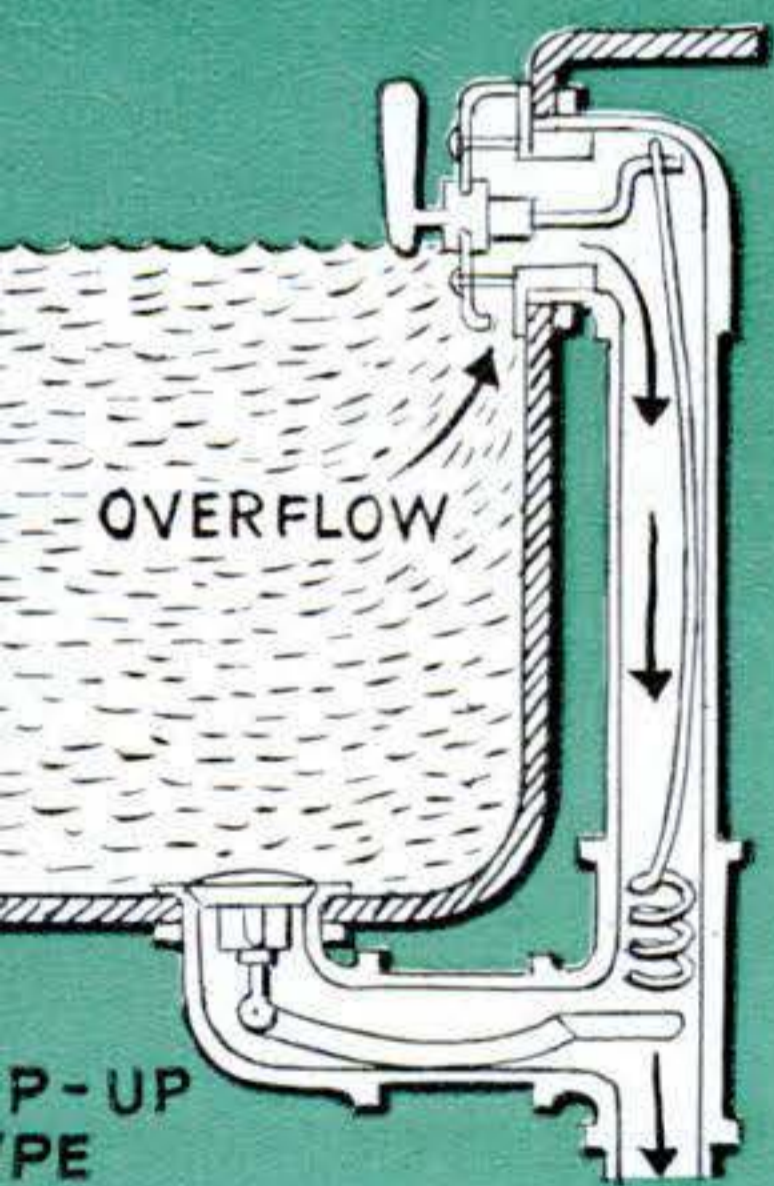
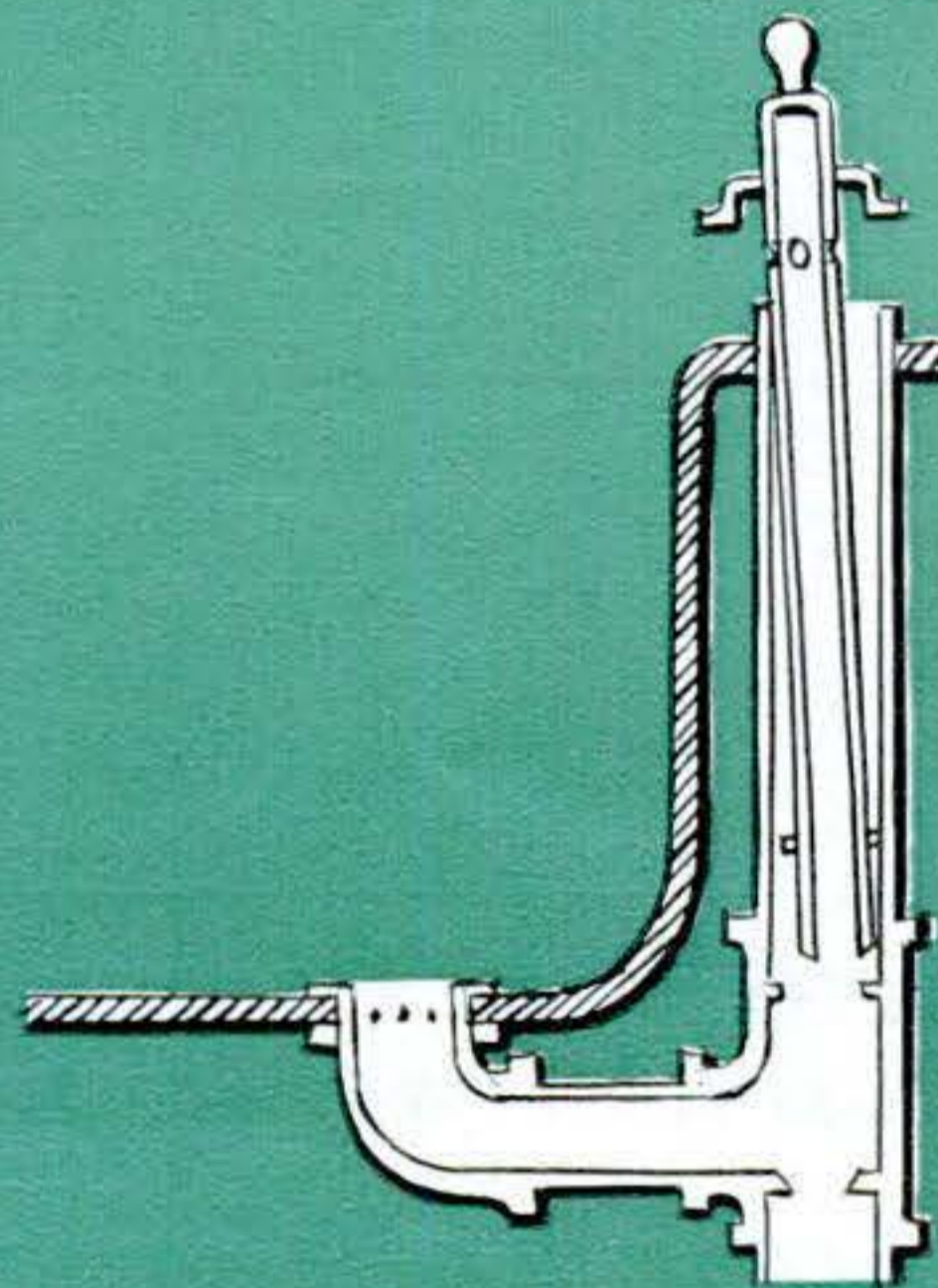
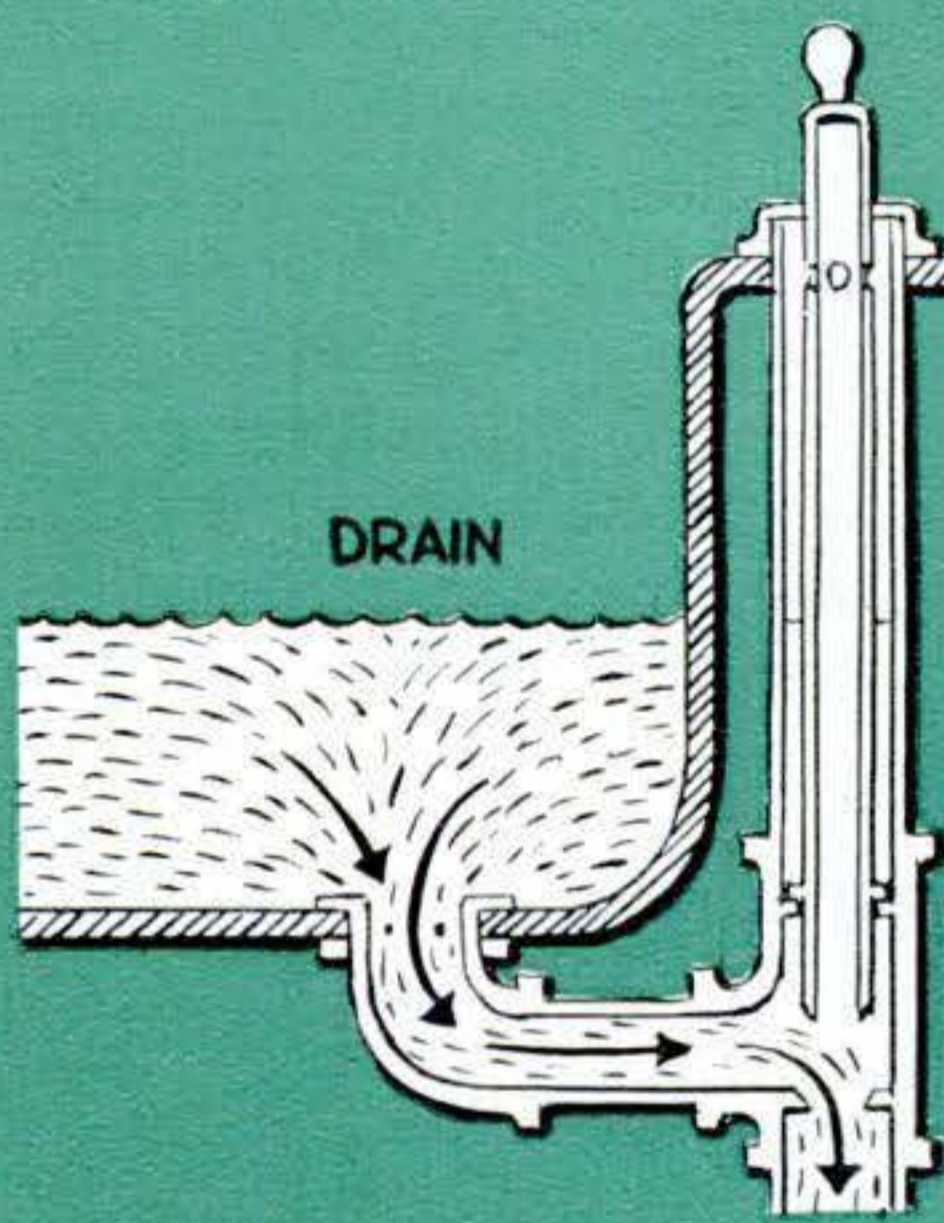
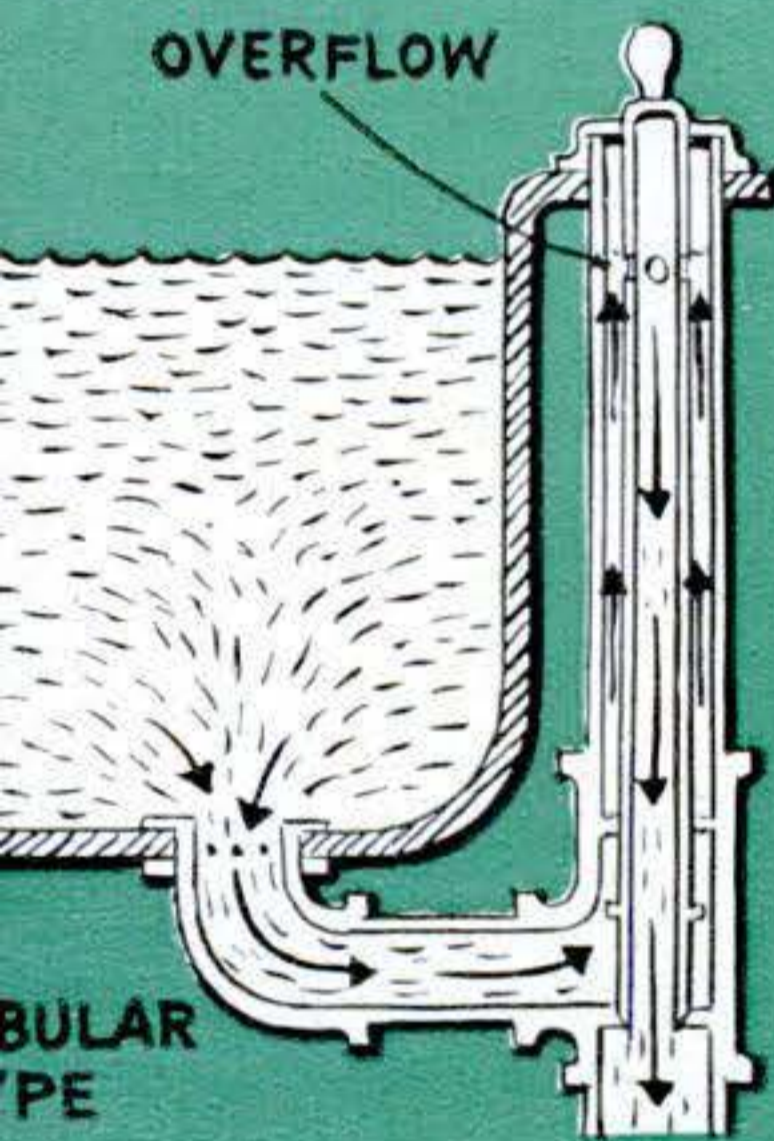
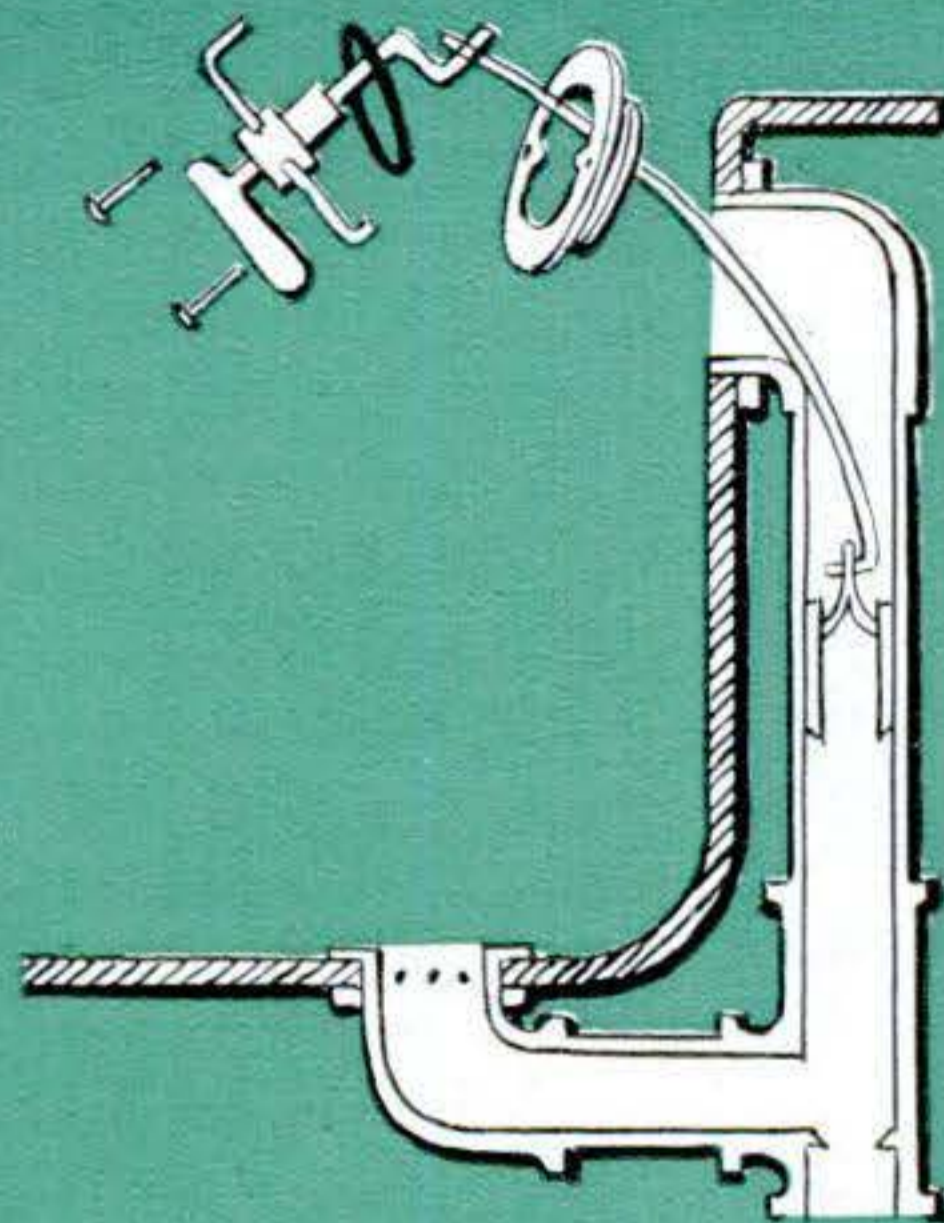
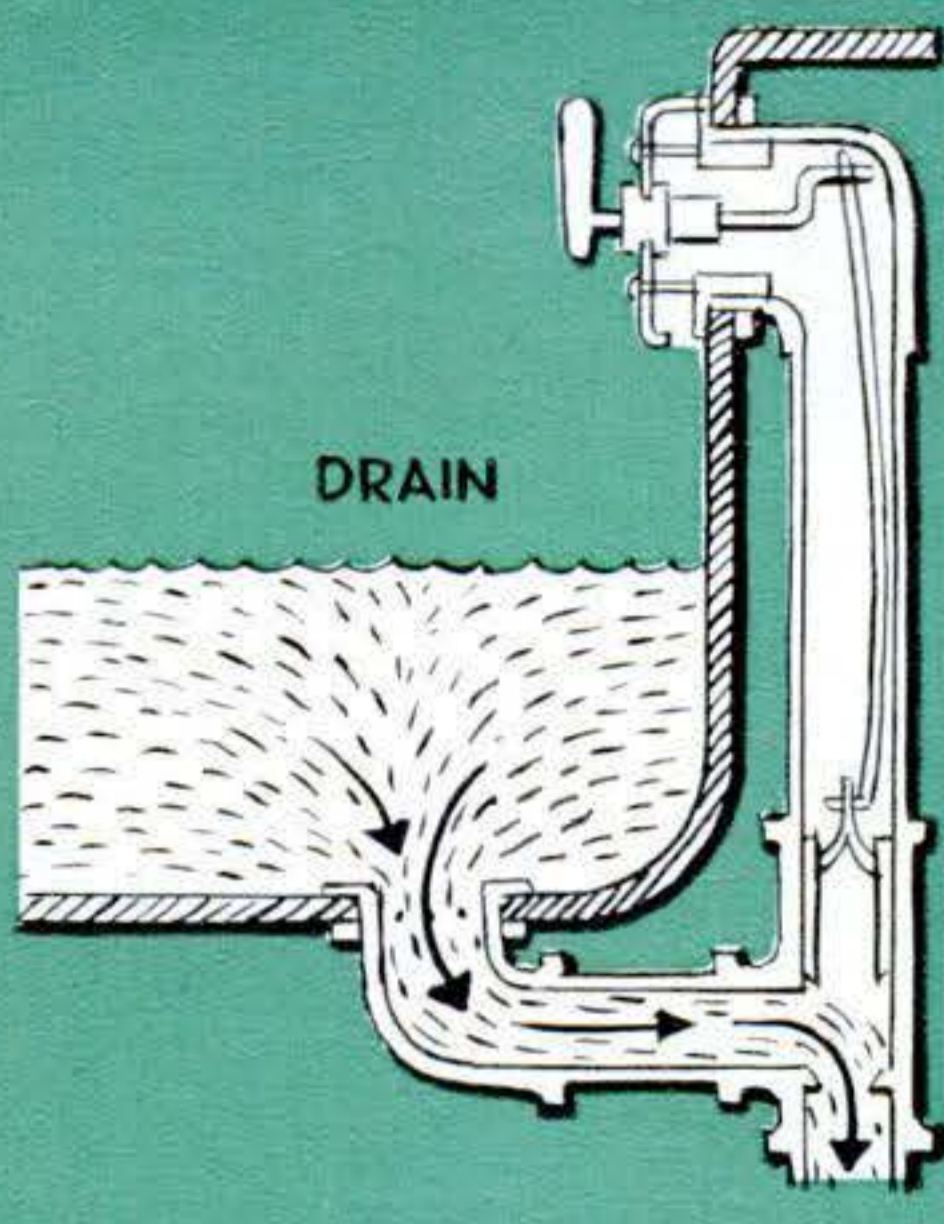
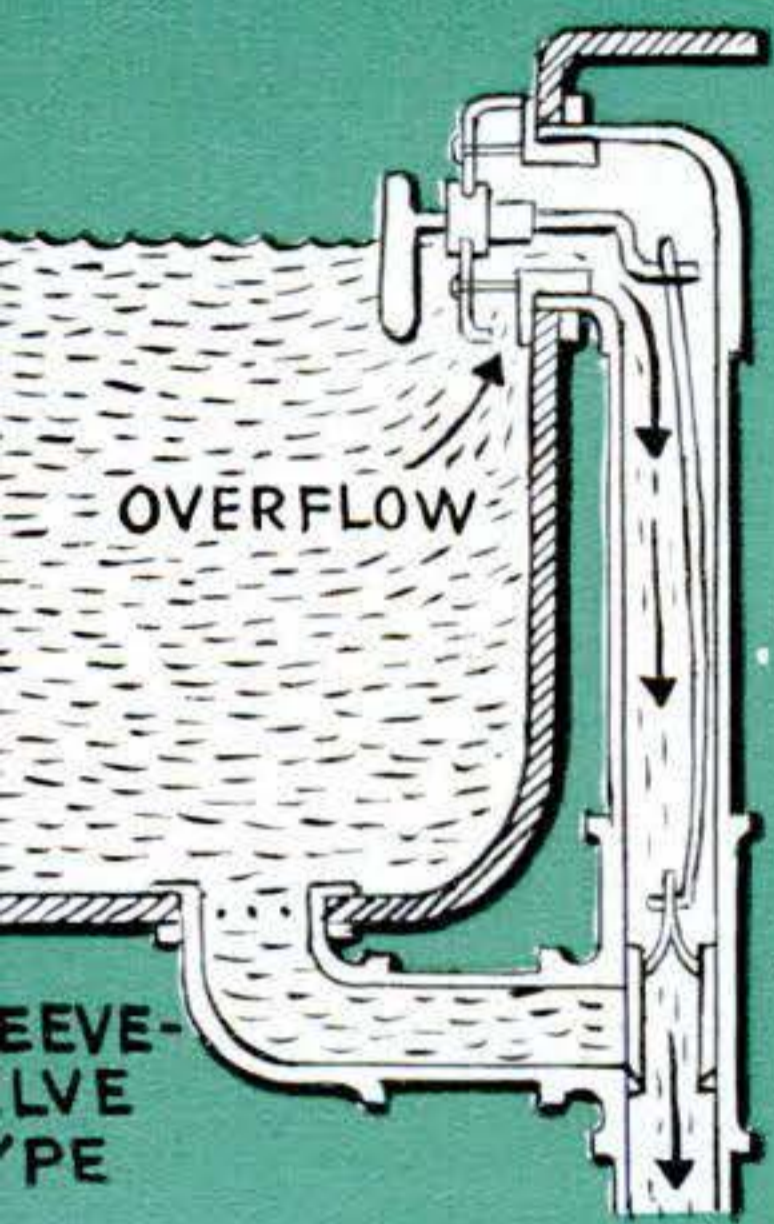
as it's difficult to be sure that neutralization has been completed, protective goggles and rubber gloves are advised for dismantling.

**Solvent-type drain cleaners**, newest additions in the field, do the job without hazards, but a little more slowly. Examples are Liquid Drano and Cloroben PT. They may take overnight to free a slow drain, but dissolved grease deposits won't recondense farther along the pipe, as can happen with acid or caustic types. Although far more powerful in their cleaning effect, they're comparable to everyday cleaning fluids and solvent paint removers from the safety standpoint. Methods of using the new solvent cleaners vary because ingredients differ.

When the force cup fails to open the drain at all, you can't use a chemical cleaner. Instead, you bail out the fixture and remove the trap. This is also the procedure if something solid like a butter knife fell into the drain. It's the only way, too, of cleaning a trap that has no drain plug and it clears the way for use of other clean-out tools we'll cover next month.

**To remove the trap**, look under the usual lavatory or sink and you'll see that its chromed U portion is connected to the other parts by a large hex nut at each end. The one at the fixture end is a "slip-joint nut," at the drain end a "union nut." Both can be disconnected by simply turning them. The pipe doesn't turn. To keep from dis-

# Three bathtub drains and how to take them apart for cleaning



ing up a bathtub drain is often a convenient getting at a plumbing stoppage. Perhaps all ed to do is claw out hair and bobby-pin con- n. Or you may want to use a force cup on the while plugging the overflow with a sponge. In

most systems, this is also a handy spot to work an auger into the system—as will be described next month. In addition to a drain generally like one of the three types shown here, your tub may have just a rubber stopper on the end of a brass chain.

torting the tubing (which may be corroded, and is thin-walled) you use a large wrench on the nut, and insert a wrench handle (through the U, as illustrated) to apply force in the opposite direction. If you haven't a second wrench, use a piece of wood instead. If your only wrench big enough for the nut is a Stillson, protect the chrome nut with stick-on tape.

**If a nut won't budge** with normal wrench effort, don't resort to brute force or you may break the trap. Instead, apply several squirts of penetrating oil where it can seep into the threads. It works fast and usually frees the nut. If it doesn't, hold a hammer against one of the flats on the hex nut, and tap the opposite one sharply with another hammer. Do this at several points around the nut.

Once the nuts are unscrewed completely, you can wiggle the U section downward to free it. After it's removed, clean it out with any suitable tool, from stiff wire to a slim screwdriver. If it's blocked by firm fatty deposits, boil it in a bucket partly filled with clean water. If you find the removed trap is clean, your stoppage is beyond it.

Replacing the trap, if all's clear, is the next step. Before doing it examine the rub-

ber washers at the connections. If they're brittle or broken, replace them with matching new ones if available. Otherwise you can substitute a few turns of any soft cotton string—or cotton wicking available from plumbing suppliers. Wrap the string or wicking so it will tighten, rather than loosen as the nut is tightened. When wet, the wrapping swells and seals the connection. If your joint leaks after the wrapping is compressed, back off the nut and use a couple more rounds of cord or wicking.

**When a toilet clogs** and the bowl overflows, remove the tank lid and pull up on the float arm and push down on the flush valve to stop the flow. Then shut off the water supply to the tank.

Look for the stoppage at the outflow opening in the base of the bowl. If there are small children in the house you may find anything from a teddy bear to a toy train at this point. If so, you can pull it out by hand, or hook it with a piece of wire.

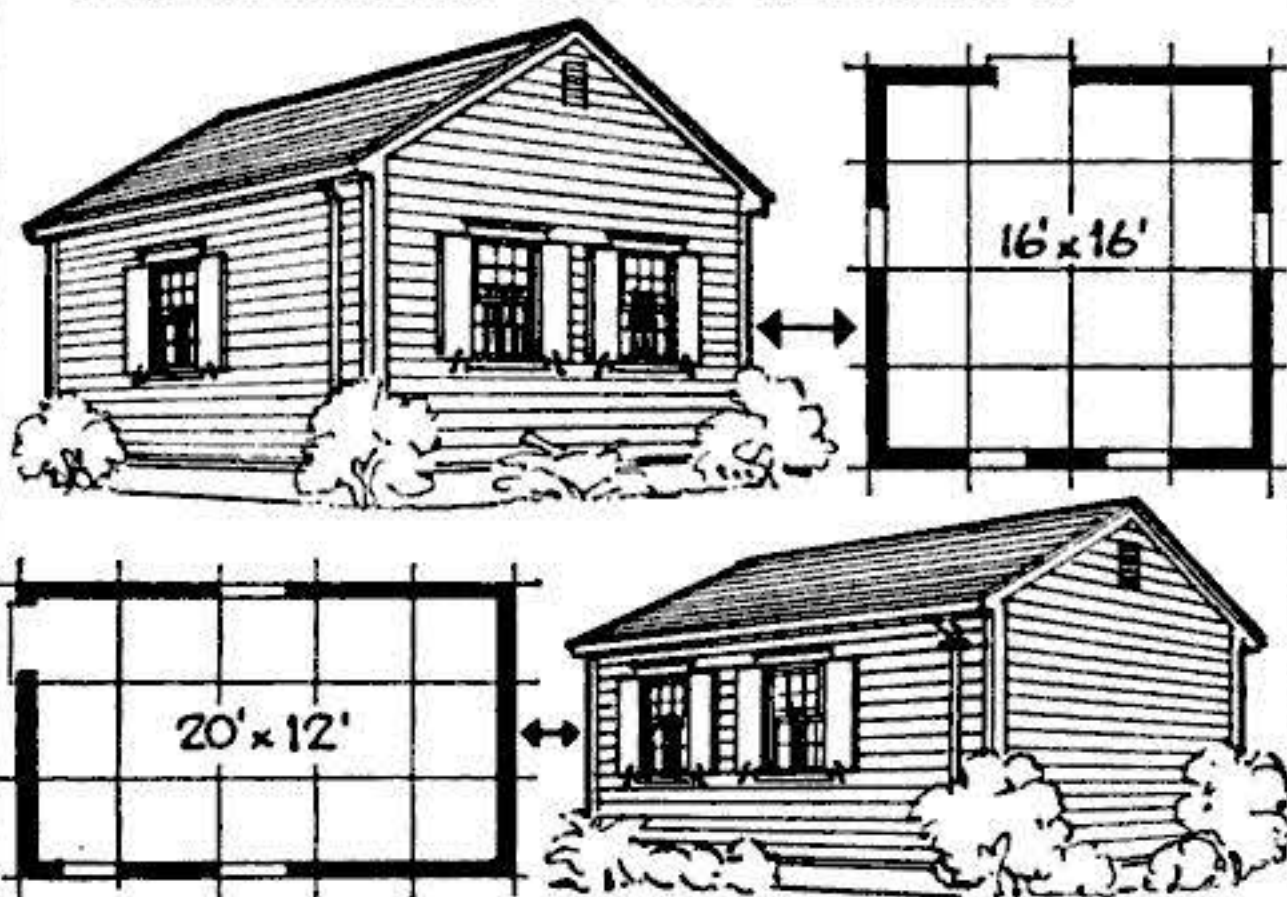
If nothing shows in the outflow opening the stoppage may be in the narrowed upper portion of the bowl's built-in trap. Unless the material is solidly impacted, there is a good chance you can remove it with an all-purpose force cup. This type has a fold-out section that wedges into the narrow portion of the bowl, just above the outflow opening. As the handle of the force cup prevents it from being tipped sharply, some air will remain in the cup, but it won't interfere with its operation. Before using it bail the bowl down to normal water level. Push the cup down slowly, then pull it up rapidly.

As the stoppage entered from the bowl it's often easier to free it by drawing it back into the bowl. Remove the cup after a few strokes to see if any pieces have been sucked back. If so, scoop them out with a piece of wire mesh or rubber gloves. You can often tell by the feel of the cup's action when the stoppage has been dislodged.

When this happens, stop immediately. If the blocking material is in the bowl, remove it. Then test the job by pouring fresh water slowly into the bowl. If the level remains normal, pour a little faster. If the bowl shows no tendency to fill above normal level all may be clear.

Try the first flushing with the tank lid off, prepared to close the inlet and flush valves manually in case there's still a partial stoppage.

## Two Basic Rooms You Can Add to a House



Need more space in your home? You can get it by adding one of the two modular rooms shown in April POPULAR SCIENCE. Scaled working drawings are available—plans for both rooms for \$5. Do the work yourself, or turn the plans over to a builder. Use them, too, to file for a permit. Fill out the coupon—and mail it with check or money order today.

### Basic Rooms Editor

Popular Science Monthly, 355 Lexington Ave., New York, N. Y. 10017

Please send me one set of blueprints for both 16'-by-16' and 12'-by-20' basic rooms. I enclose \$5 for both blueprints.

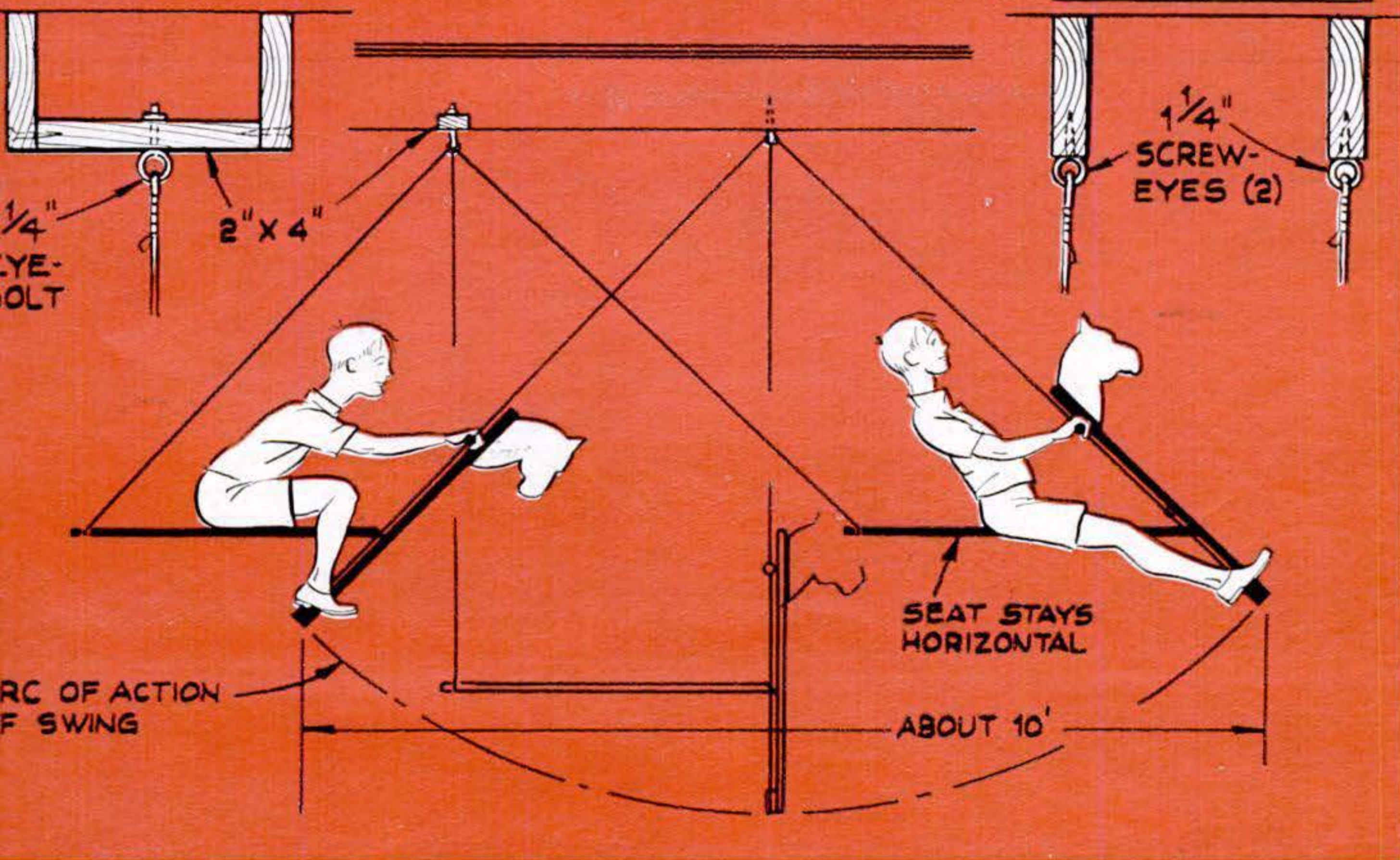
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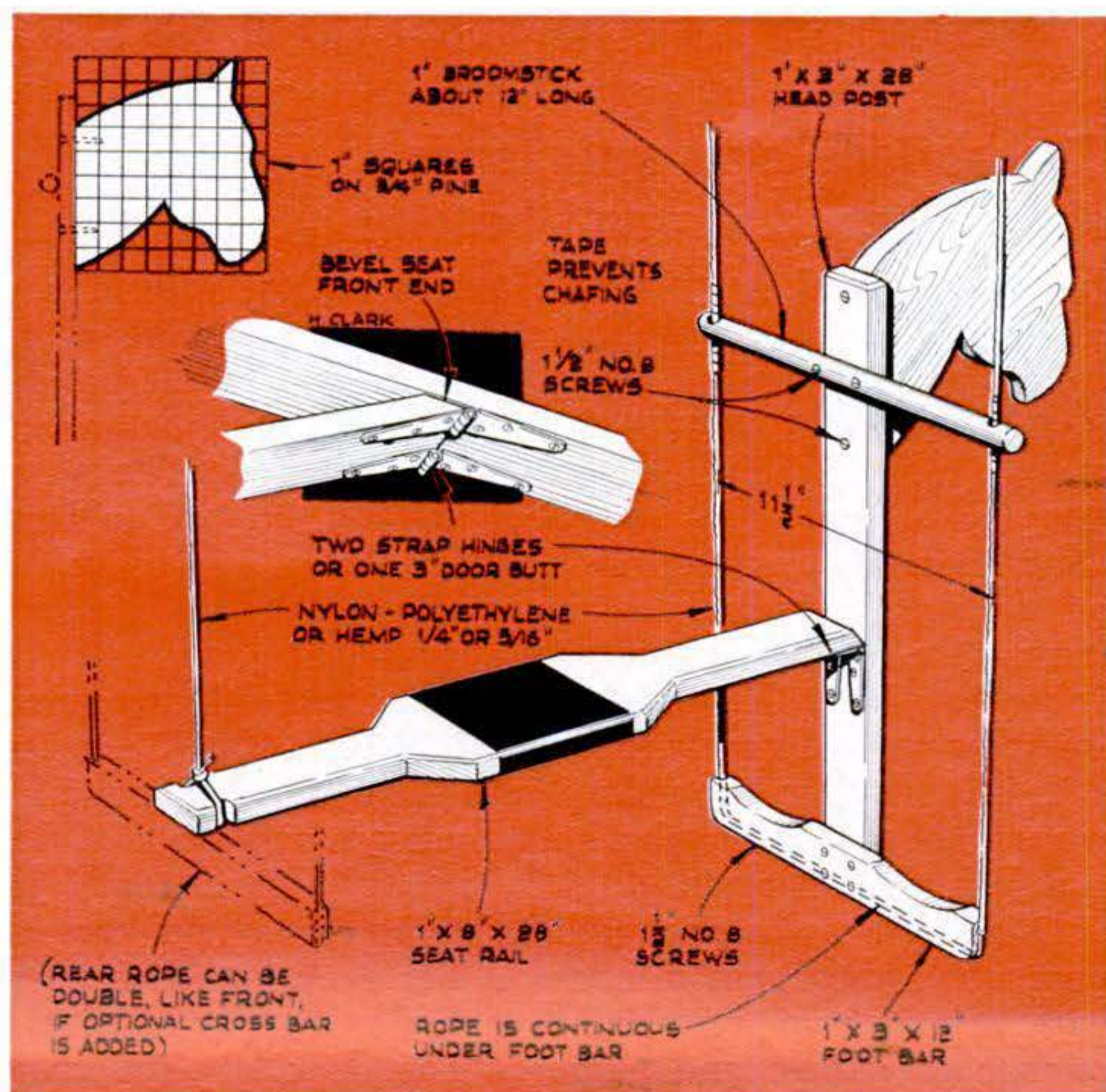




# A Swing You Can Hang in the Basement

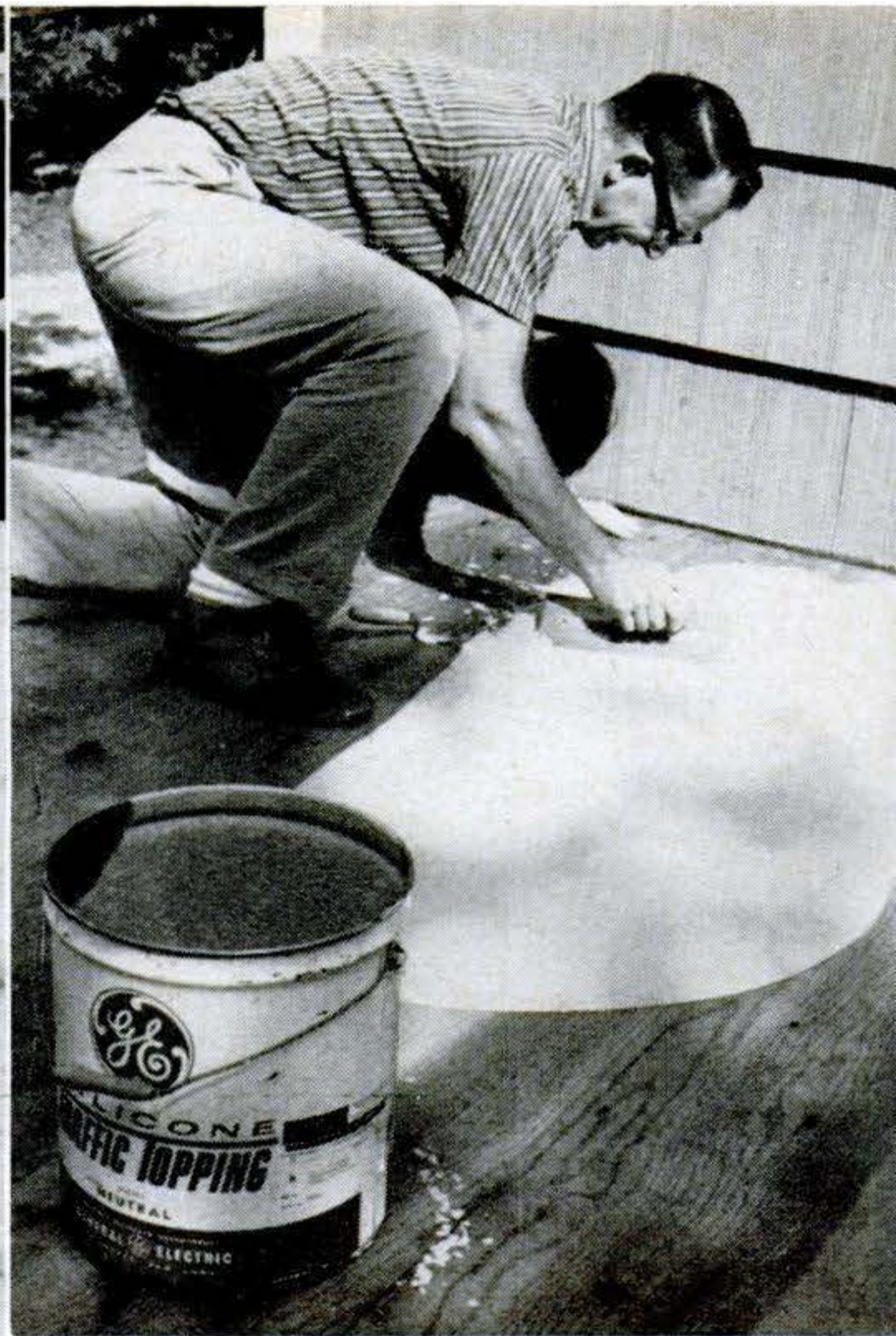
Because my swing-loving kids were frustrated—and restless—on rainy days, I built a swing indoors, down in the basement playroom. I started out by simply hanging two ropes and a seat from the ceiling joists. Then I decided to add a little life to the indoor exerciser to compensate for the lack of swinging height under a ceiling, and before I knew it, the horse swing was born.

The kids, mine and their little friends, took to the saddle like rodeo artists. It didn't take them long to learn all the tricks for an exciting aerial gallop—holding on to the handle behind the horse's head and pushing with their legs against the "stirrups." Reverse pressure on the foot



brakes their steeds. I used ordinary clothesline first, but afraid it would break

under cowboy tactics, I changed to stout hemp for greater safety.—Hank Clark.



Old mineral-paper roof was buckled and leaking, but after the new material had been troweled

## GE's New Traffic Topping

**The surface also withstands sharp heels and won't become tacky on hot summer days**

By **BERNARD W. POWELL**

**T**he house was new—to us. Telltale stains on the garage walls had suggested a leak during the rush of closing, but we didn't know how bad. Then the rains came; and we knew we had a real problem.

In solving it, we wound up with the most waterproof roof in town and a stunning new sun deck in the bargain.

Our single-car garage, with adjoining carport, abuts the house in back. A flat deck, with access from a second-floor bedroom, roofs both garage and carport. The deck is very slightly pitched away from the house, and has a railing around three sides.

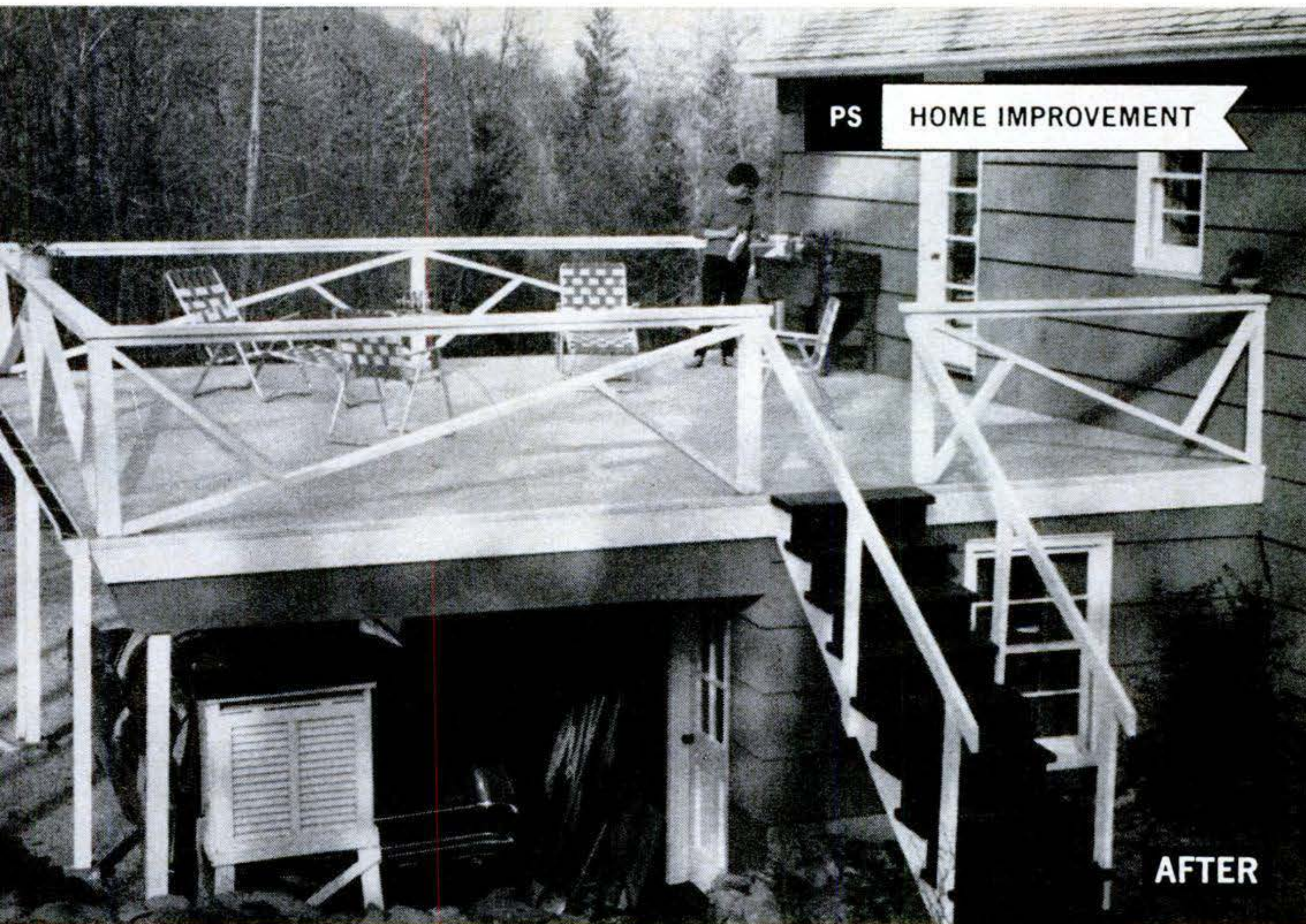
We found it covered with mineral paper buckled and cracked.

The roofer I called for an estimate made a distinction between a "regular" roof and "walk-on" roof. A regular roof is guaranteed waterproof provided no one walks on it. A walk-on roof would cost twice as much.

**The solution.** Not long before, a friend had told me about an outdoor dance floor and sun deck his yacht club had put up using a new kind of rubbery compound put on with a trowel. It was holding up well. I wondered why it wouldn't work for us.

When I ran it down, I found the rubber compound was GE's silicone Traffic Topping. GE developed it for problem spots in roads, such as bridges where expansion and contraction forces are too much for ordinary materials. The topping has recently become available to home owners.

**The cost.** Materials for my job cost approximately \$580, with about \$495 of that going for the Traffic Topping and about \$7



on, the author wound up with a leakproof surface that he can walk on without fear of damage.

# Waterproofs a Sun Deck

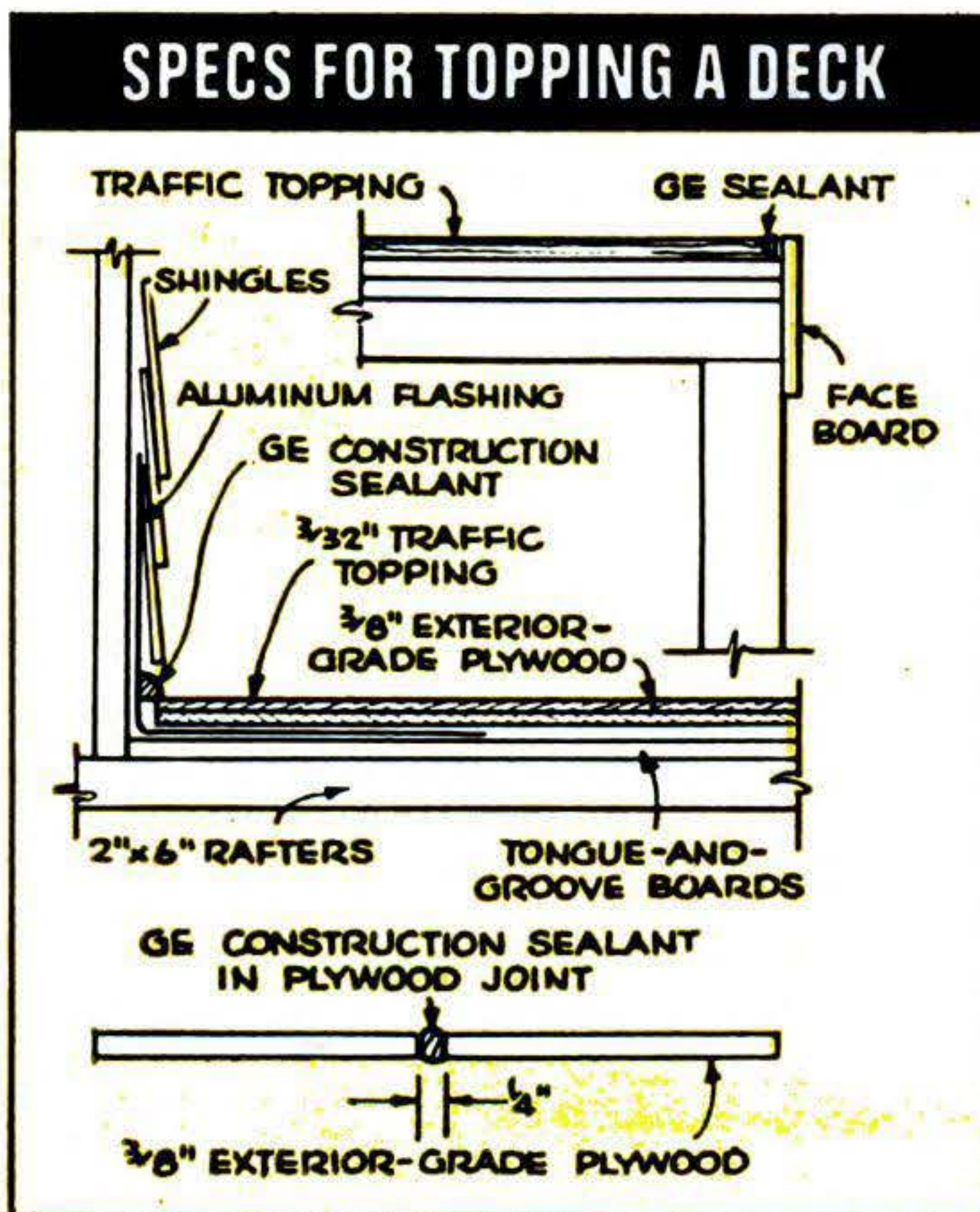
for the plywood underlayment. Thus, for my 22'-by-24' deck the cost worked out to about \$1.10 per square foot, with me supplying the labor.

This was just a few cents more than the rate per square foot a local roofer estimated it would cost me to get a walk-on roof in the ordinary way. And that walk-on had restrictions: no women in spike heels, no use on hot summer days. My new roof has no walking restrictions whatever.

Traffic Topping has a silicone-rubber base with a mixture of refined white quartz sand. It expands and contracts about 10 percent from its original dimensions as temperatures change. When you use it, you add a specified amount of liquid curing agent. It comes in four-gallon units and on a big job like a deck you mix all four gallons at once. GE says you've got a 30-minute pot life—but in actuality we found it longer.

**Preparation.** First, I stripped off all old tar paper. Fortunately, no rot had started

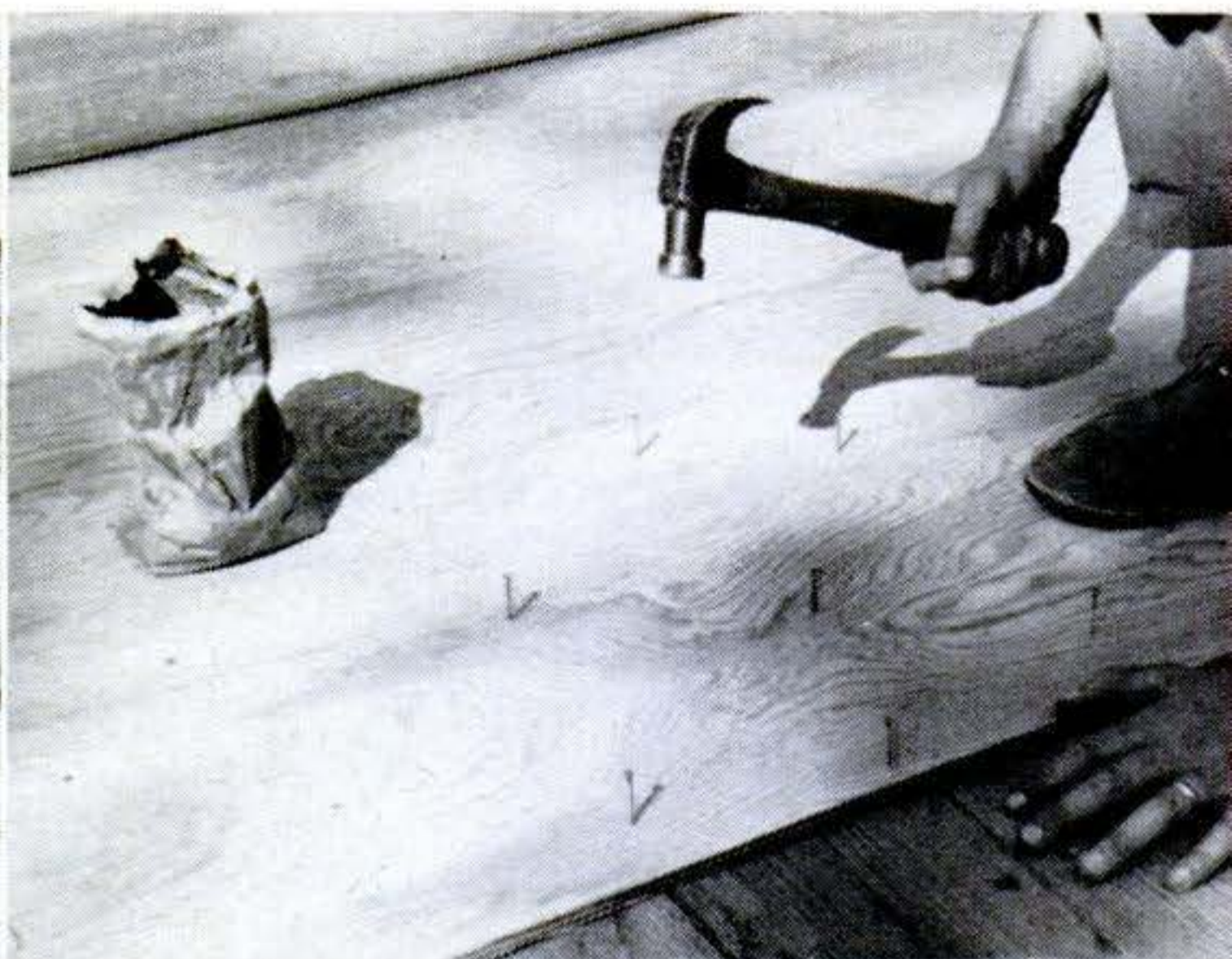
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## The right way to do it: 10 high points of applying



**1** Bead of GE Construction Sealant SE-1201 was forced up under bottom shingle above aluminum flashing after all the old roofing had been removed.



**2** Plywood underlayment was stagger-nailed to sheathing, using annular ring nails. This nailing is important to prevent later damage by nail pop-up.



**5** Bead of construction sealant was forced into the  $\frac{1}{4}$ " gaps left to offset contraction and expansion. Sealant also was applied at house wall.



**6** Primer-sealer SCP-151 was applied to deck with a paint roller on extension handle while the wood was still damp from light spraying with water hose.

and the 8" tongue-and-groove was sound. All nails were pulled or driven flush. (At this stage it was a simple matter to pull one plank and slip in insulation batts over the garage ceiling.)

With the sheathing back in place and re-nailed where loose, we then put down a plywood underlayment. Our 22'-by-24' deck took 17 sheets of 4'-by-8' exterior-grade  $\frac{3}{8}$ " fir plywood. You need exterior for the proper glue bonds in the plies; you can save a bit by getting "sanded one face only," putting the unfinished face down.

Laying the deck was routine. Sheets were notched to fit around the railing posts and then stagger-nailed with annular roofing or rosin-coated nails. (We used both—since we ran out of one and had to borrow the

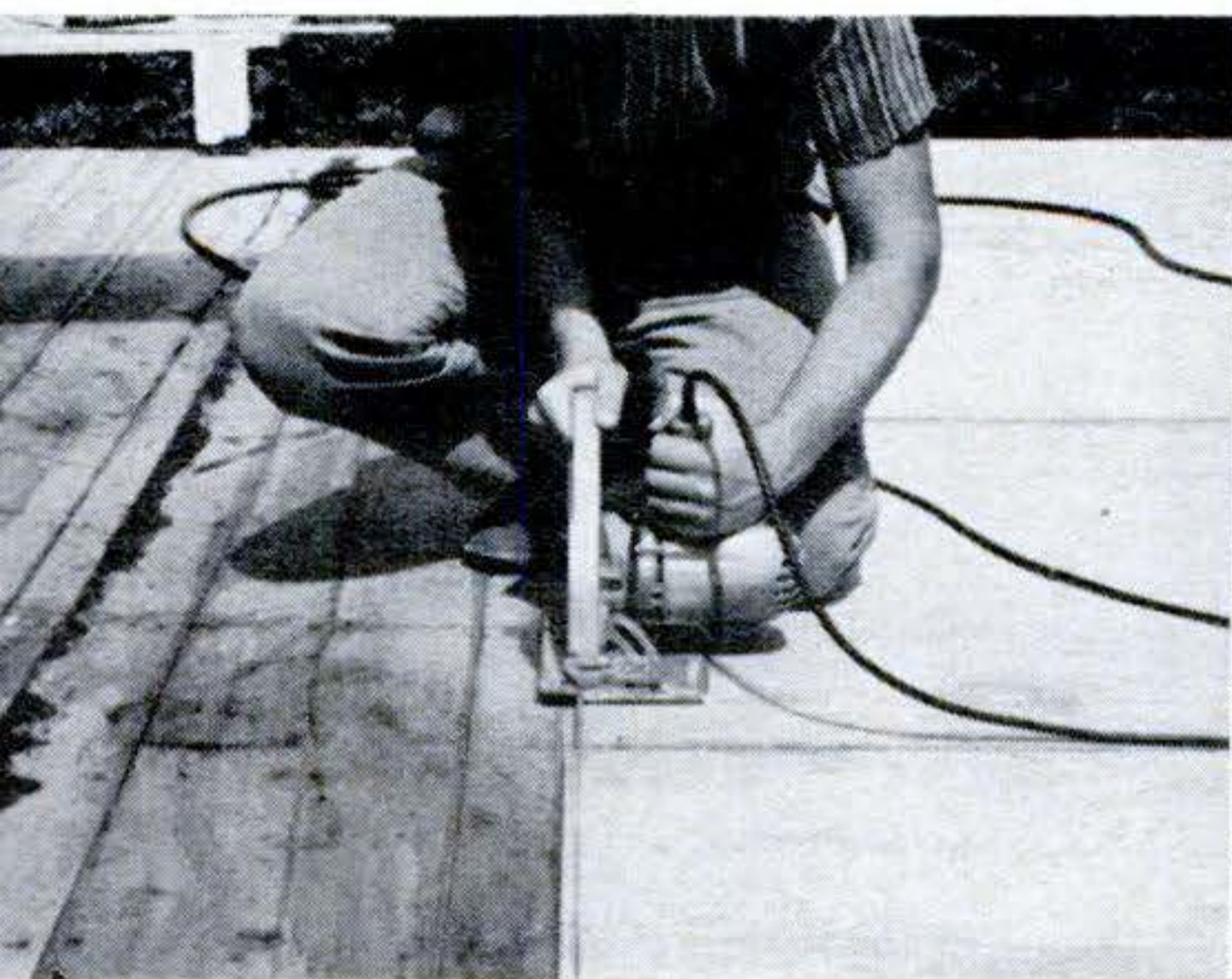
rest midway on a Sunday afternoon.) A  $\frac{1}{4}$ " gap was left between adjacent sheets. This is important. You shouldn't butt sheets since there is a slight movement in a frame structure. Our deck spanned both a heated garage and an open carport.

**Sealing.** When the plywood deck was laid, we filled the gaps with GE Silicone Construction Sealant SE-1201, using a cartridge caulking gun. This is a high-grade, rubbery caulk, translucent when dry and highly flexible and waterproof. Before caulking, we primed all seams with Traffic Topping primer SCP-151 for maximum bond. The primer takes about a half-hour to dry.

One thing to note here is that after your deck is finished, it is possible from time to

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

## at of water-sealing Traffic Topping to a sun deck



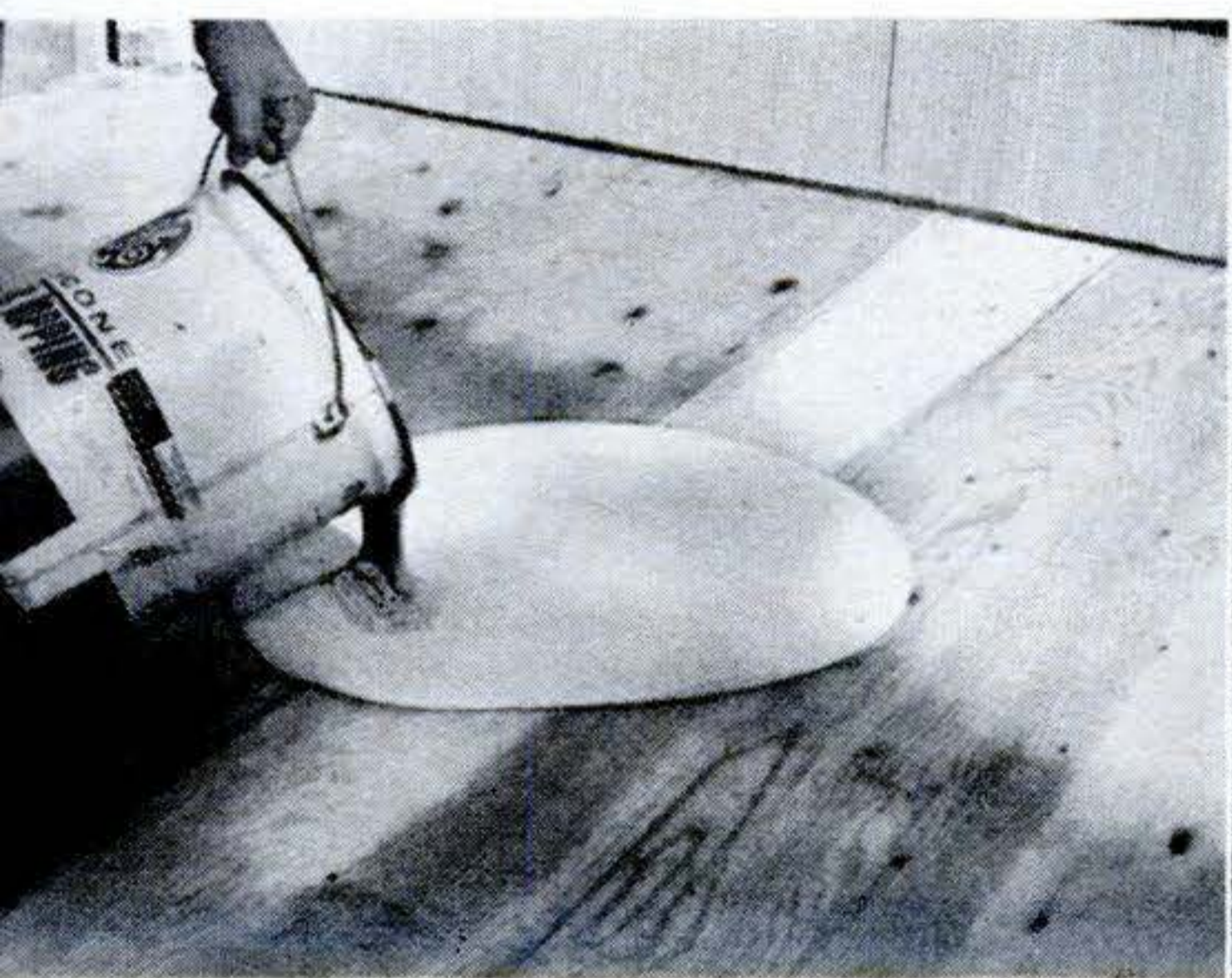
**3** To assure straight seams between plywood, portable saw can be used to trim the edges after the four-by-eight sheets have been nailed down securely.

**4** Seams were first primed with SCP-151, as above, before being caulked. Priming dries in about a half-hour. Note  $\frac{1}{4}$ " spacing between the sheets.



**7** While primer was drying—it takes about half an hour—Traffic Topping was opened and thoroughly stirred to loosen aggregate that had settled.

**8** Curing agent STM-700C was poured into mix and the whole batch stirred for several minutes. Any of the material that's not well mixed won't set up.



**9** Traffic Topping was next poured out on the deck, but not more than can be handled easily. Try just a small circle until you get the hang of it.

**10** Hold trowel at angle (between 30 and 45 degrees) and exert slight downward pressure. Use the trowel with long, sweeping strokes.

# 3 One-Evening



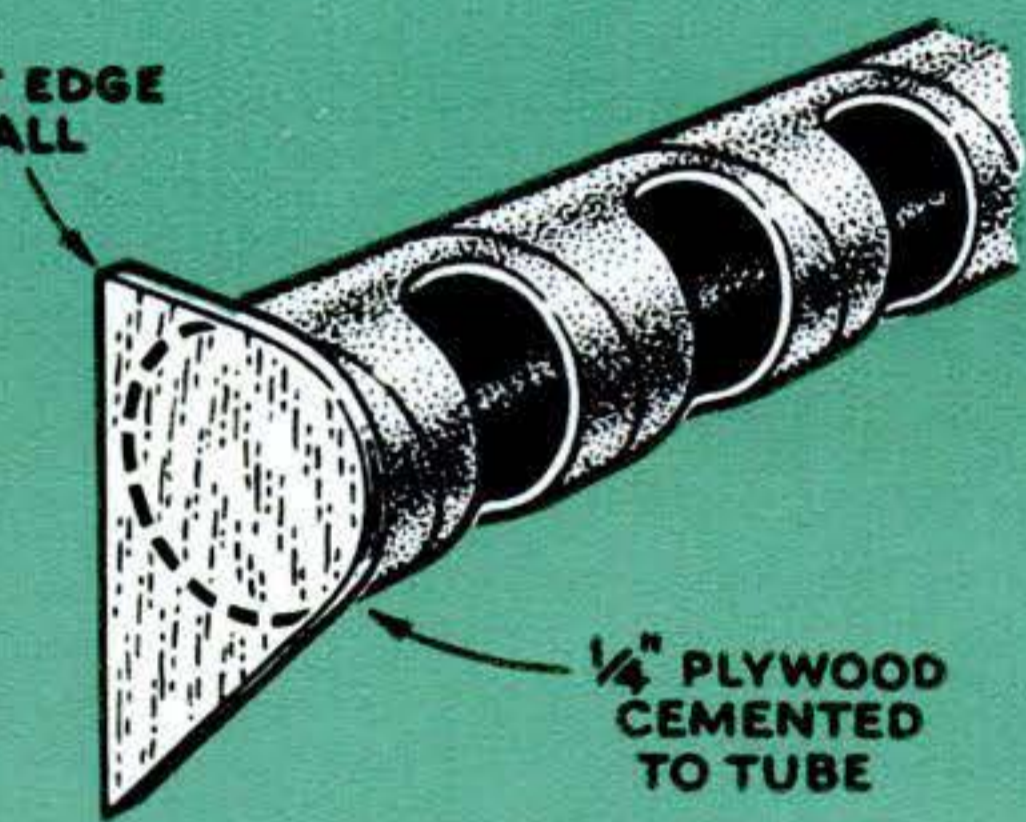
## TIN-CAN HUMIDOR

Here's a good-looking humidior you can make out of an ordinary 12-ounce tin can. Only the top should be removed. Paint the outside of the can with bronze paint. Then

apply a decal or glue on an illustration from a magazine. The lid and base are turned from  $\frac{1}{2}$ " stock. Use a decorative wood such as mahogany or walnut. Finish as you prefer: either oil or varnish. The can is secured to the base with a  $\frac{3}{8}$ " wood screw.



CEMENT EDGE  
TO WALL

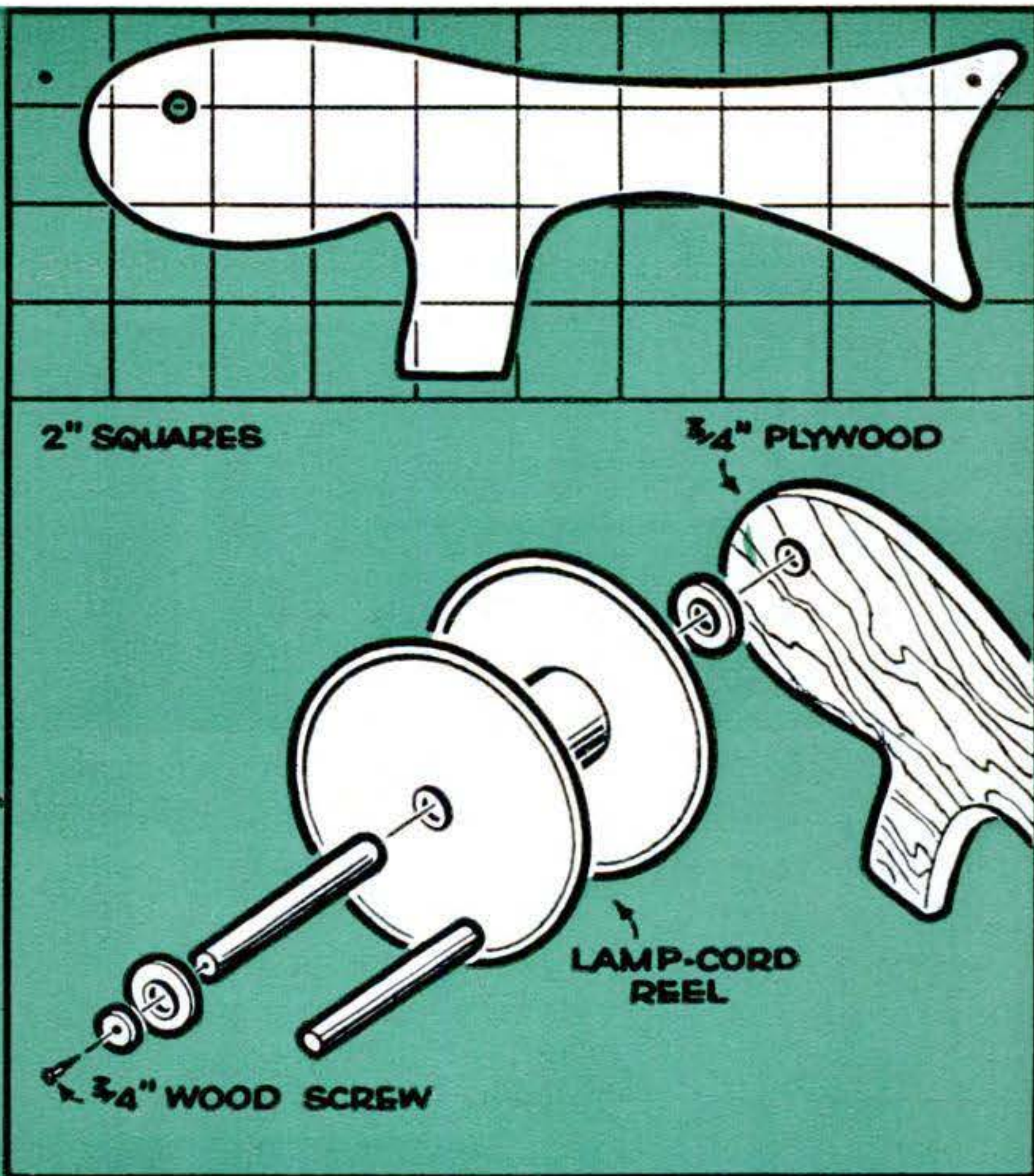


$\frac{1}{4}$ " PLYWOOD  
CEMENTED  
TO TUBE

## MAILING-TUBE GUN RACK

A piece of mailing tube, slotted as shown above and jammed into a jog in a wall, makes a quick and simple gun rack. Or the rack can be installed on a straight stretch of wall. Make supports of  $\frac{1}{4}$ " plywood and cement them to the ends of the tube and to the wall. For better appearance, paint the tube. A soft rubber mat on the floor will protect the gun butt and keep them from sliding, too.

# Projects



## GUNSTOCK KITE REEL

This handy reel keeps a youngster's kite string free of tangles and ready for use at the first sign of a breeze. The reel itself is a simple type that electric lamp cord comes on. A gunstock handle is made from plywood. Make a pattern for the gunstock by copying the drawing with the squares enlarged to 2". To assemble the reel, glue one end of the axle into a hole drilled in the handle. The reel is slipped on the axle, with washers at either side, and secured by a 1" wooden disk screwed to the outer end of the axle. The winding spool is mounted near the edge of the handle with a nail. Drill the handle before gluing to prevent splitting.



# How You Can Build

**Imported elegance converts from games to dining as fast as you can say "smorgasbord"**

By **DARRELL HUFF**

**H**ere's a handsome family-sized dining table that contracts into a compact game table that takes up only half the space.

Its style is Swedish Modern, but tables like it are in equally wide use in Denmark and Norway. It is custom-designed for any home where food is important, games are enjoyed, and space is at a premium. Custom-build it yourself and you can take pride in a furniture piece as good to look at as it is handy to use.

Remarkably, this convertible table does its act without elaborate hardware or extra leaves. The secret is a stove bolt set off-center as a swivel. This, in combination with a stop block that holds the top in desired position, makes the table as sturdy in spread-out form as when compact.

The table consists essentially of two parts: substructure and folding top. The substructure is made of four lathe-turned (or ready-made) legs bolted to four rails. The rails in turn support a platform board. Bolted to this board is the table top—two identical leaves hinged together.

A third part is a tray that fastens to the rails. Lined with green felt, it stores game accessories or place mats and table silver and napkins.

To build the table as we show it, make the wood parts shown in the blueprint on the following two pages. Hinge the two leaves on their long edges so they fold together with two faces in contact for the card-table position. Suitable are two (or preferably three) Soss Invisible No. 204 hinges. On the underside of the lower leaf, mount the pivot assembly and stop block.

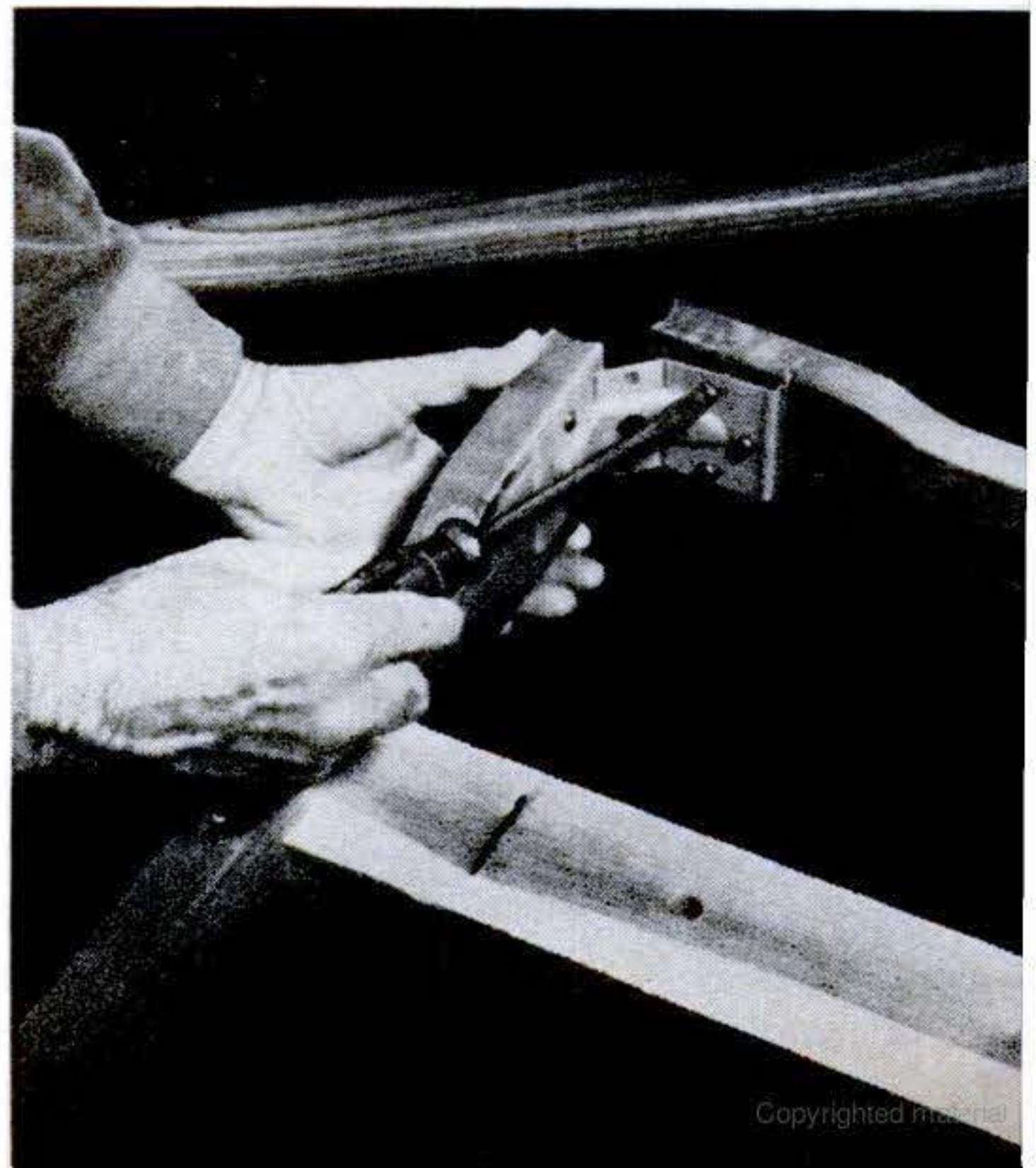
The pivot assembly consists of a  $\frac{3}{8}$ " flat-

[See blueprint on the following two pages;  
*text continued on page 192*]



The small-table version is just right for bridge or other games and for breakfast or intimate dining.

Saw kerfs across ends of rails take lips on corner braces; the braces themselves are screwed into place. Hanger bolt screws into hole drilled in leg. Place platform  $\frac{1}{8}$ " below top edges of rails.





# Scandinavian Flip-Top Table



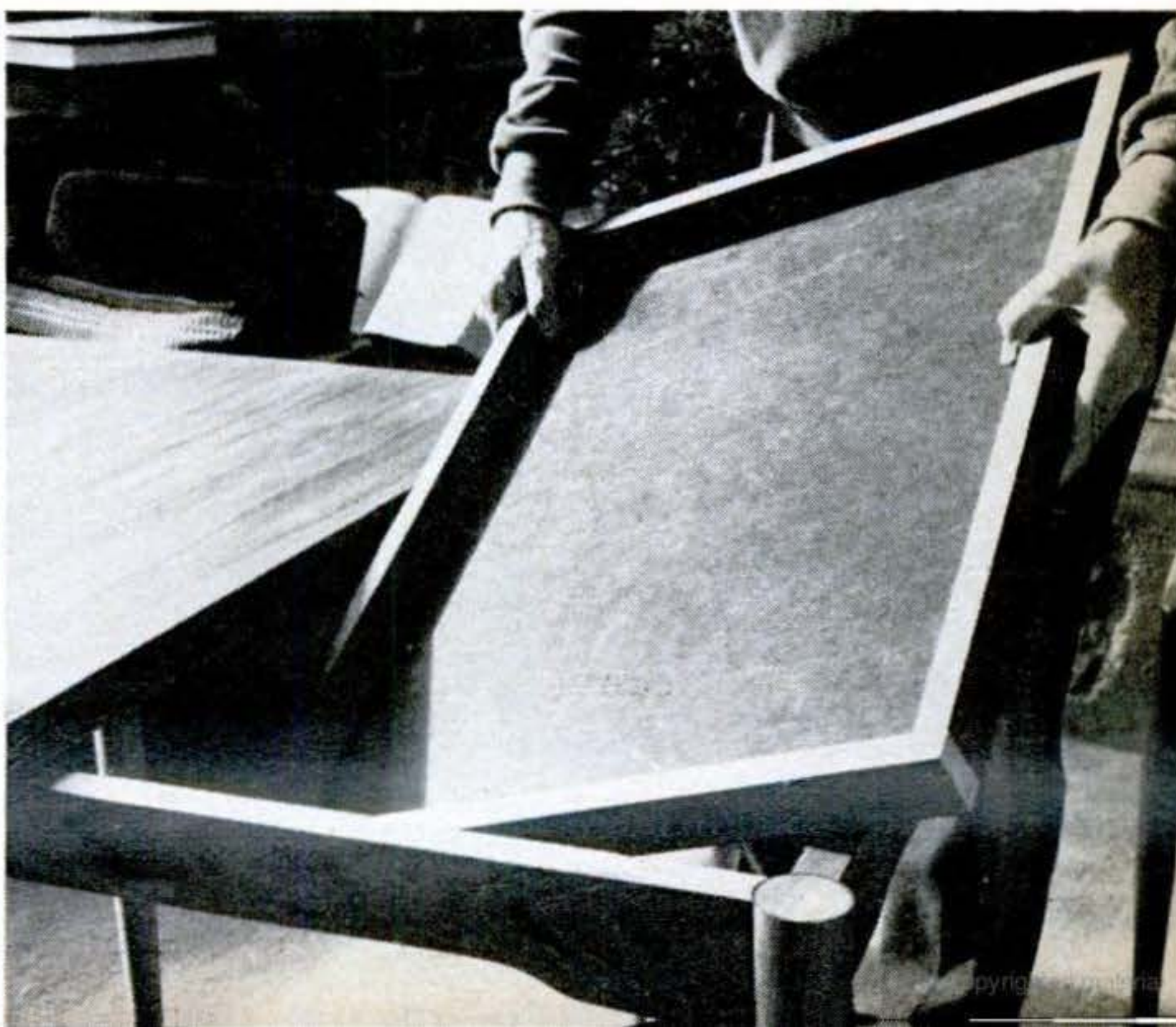
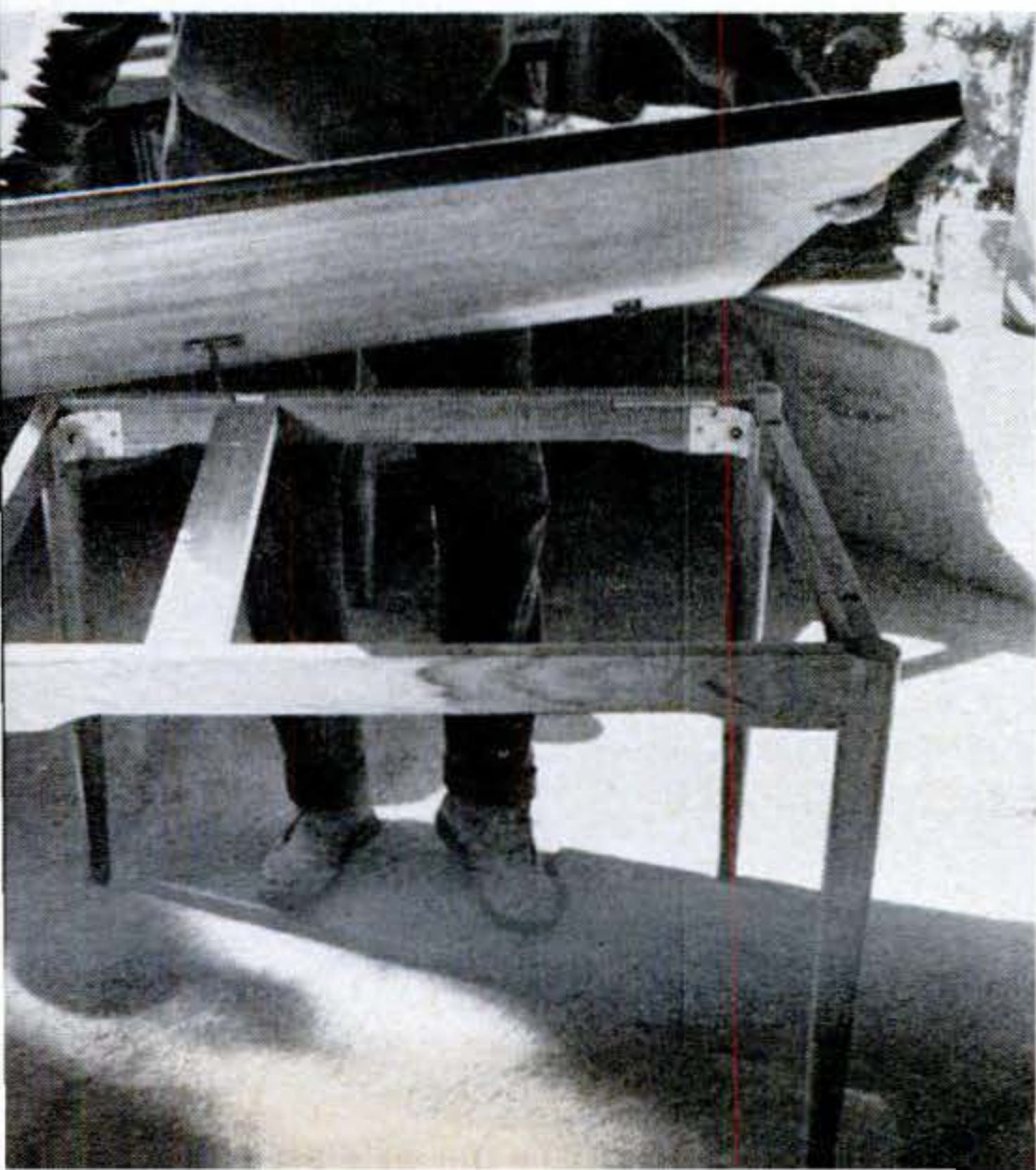
To double the table size for dining, swivel the top and unfold it, revealing a shallow storage drawer.



With the top unfolded, the table is 62" long—a size generous for four diners and ample for six.

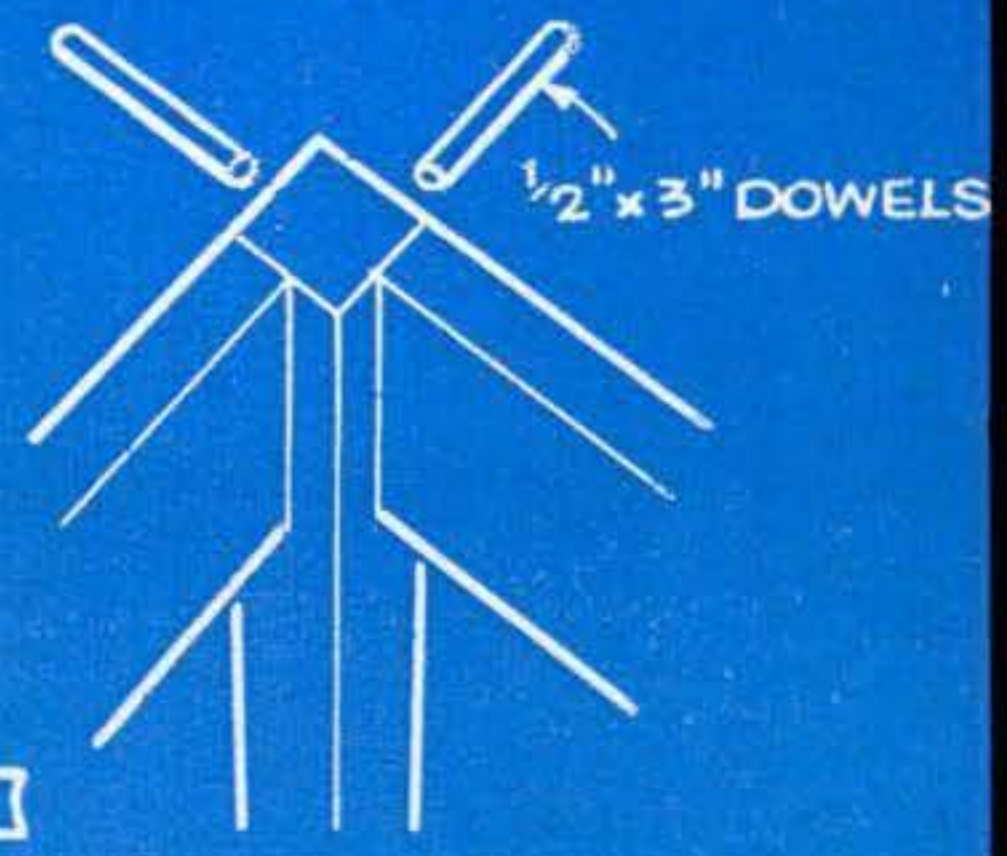
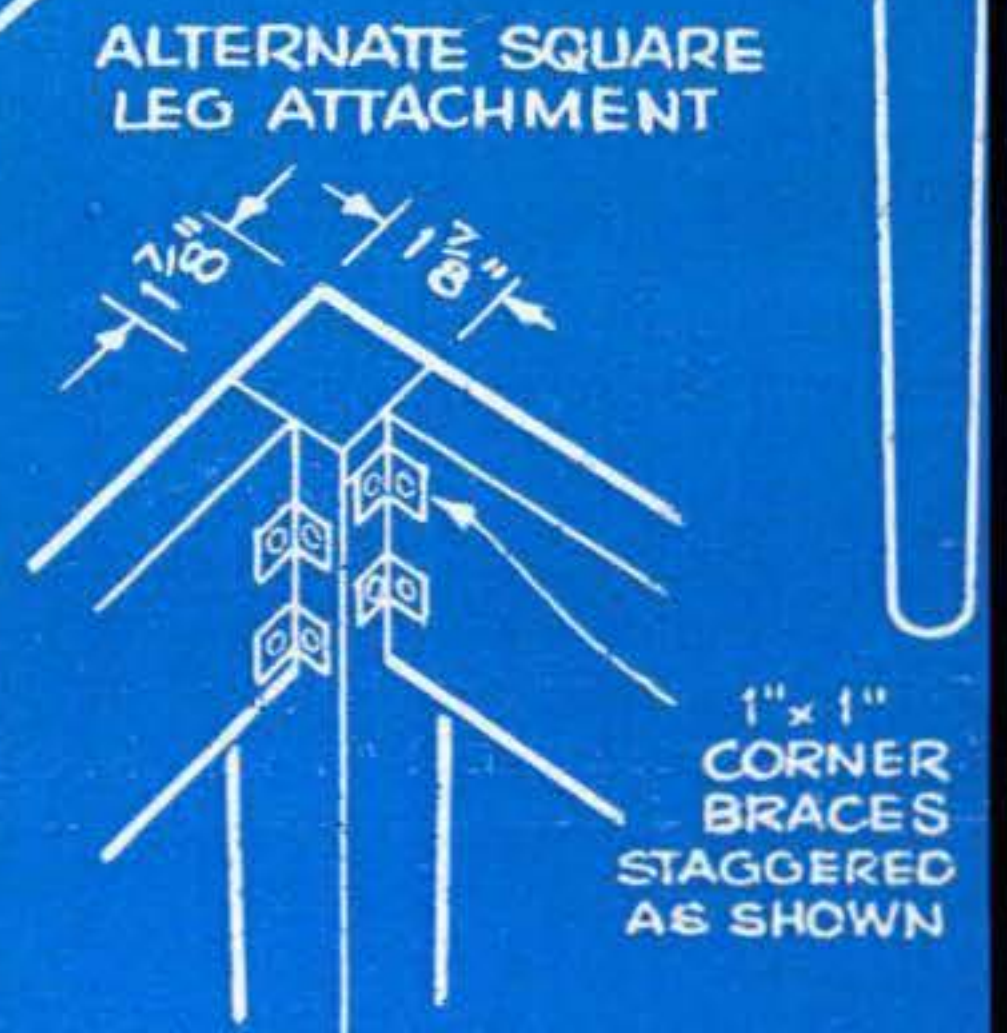
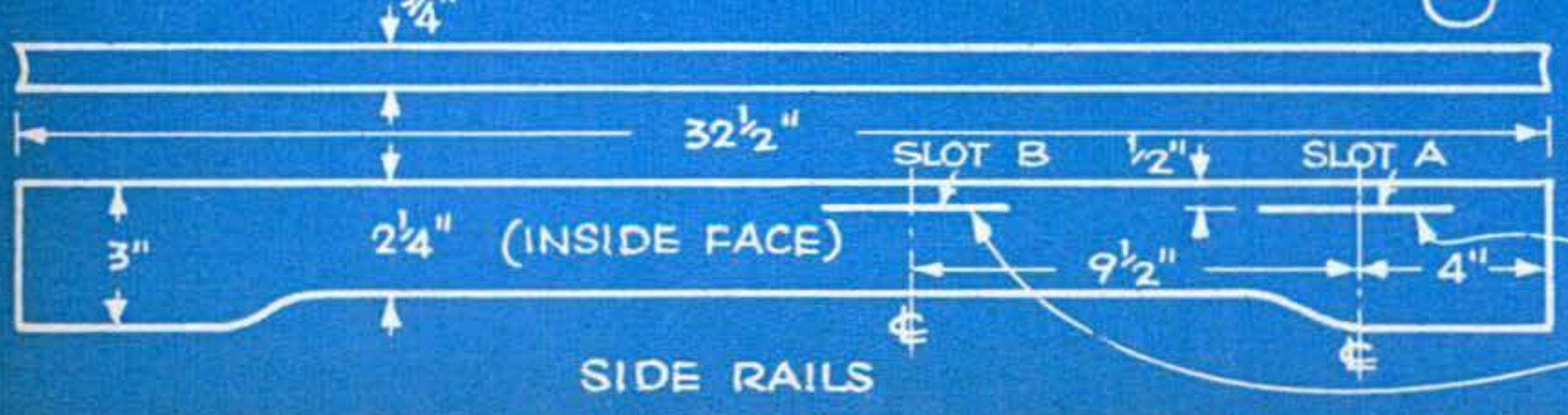
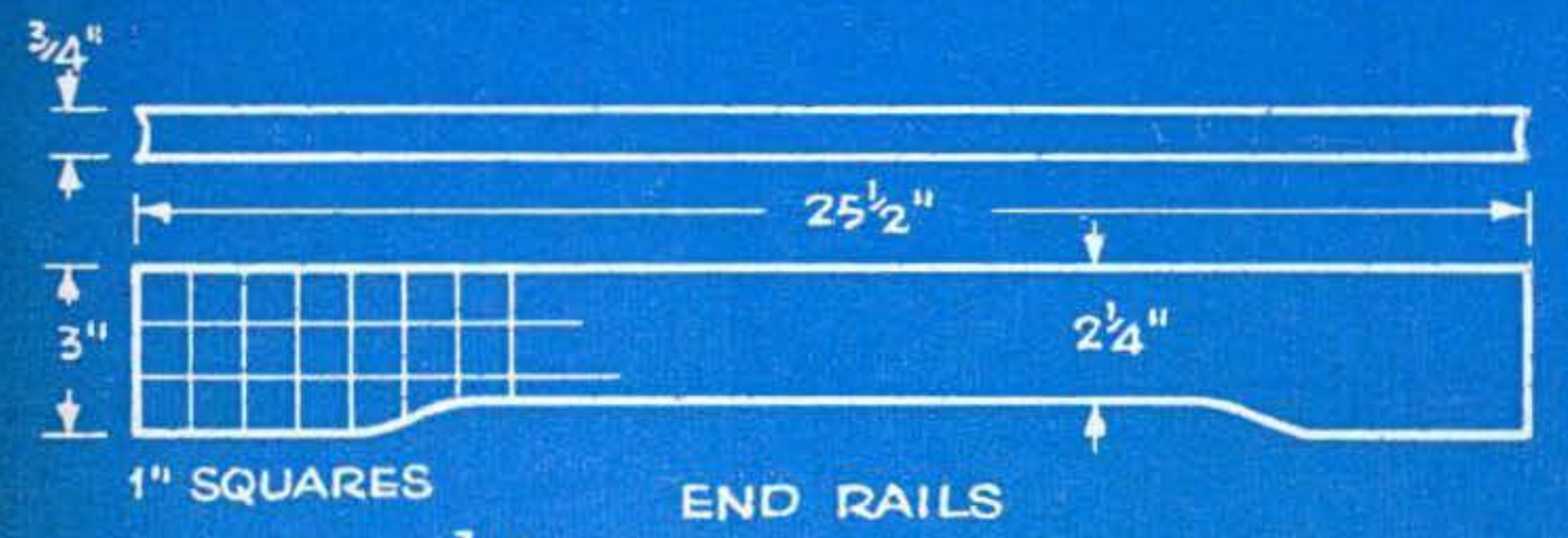
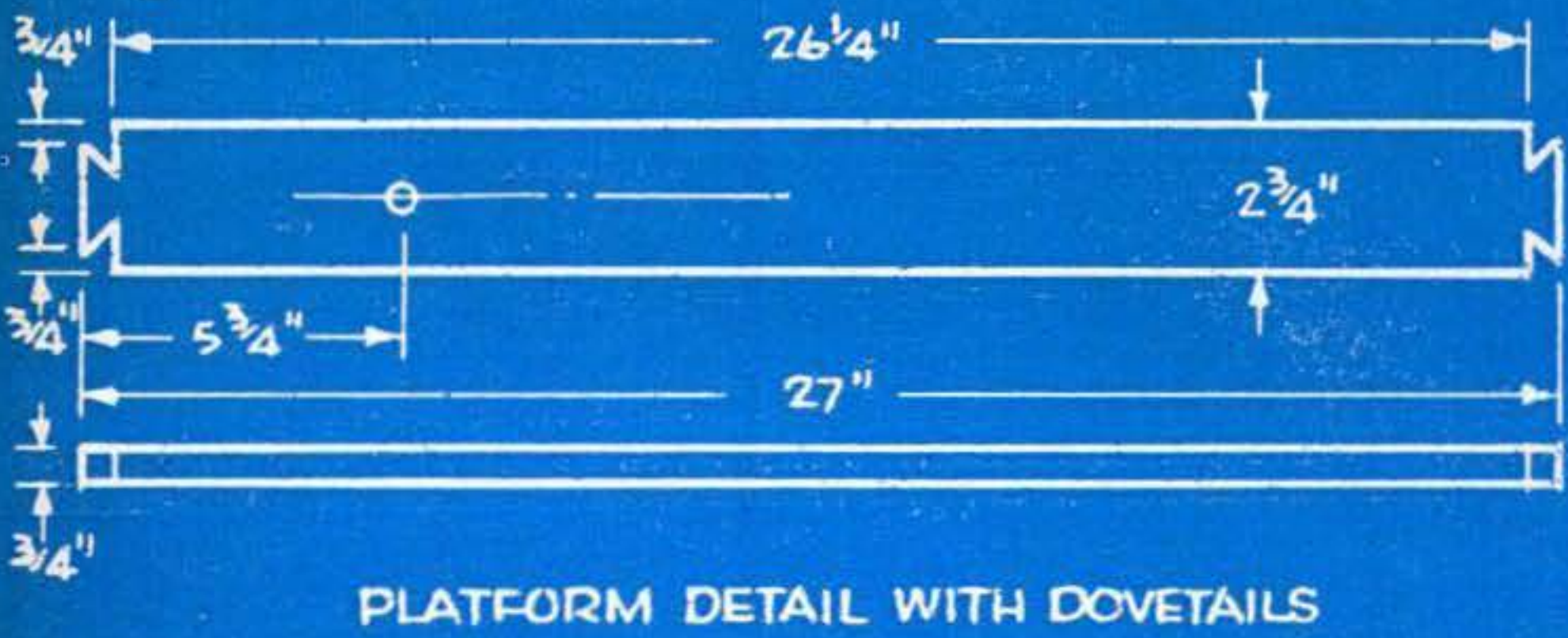
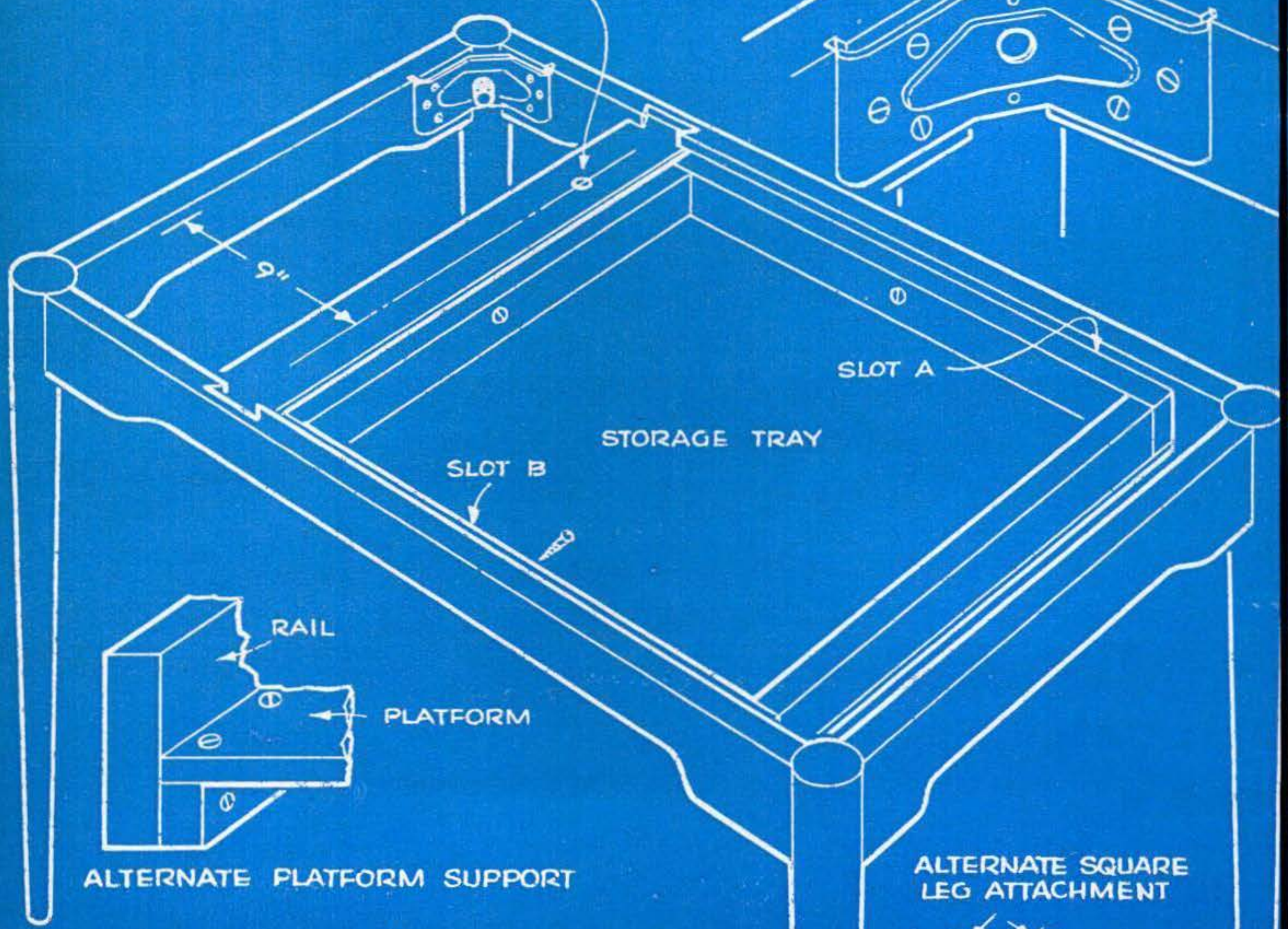
Relationship of parts is seen here—swivel plate and its  $\frac{3}{8}$ " bolt ready to go through hole in platform, stop plate near far right corner, and folded table top. Use second nut on swivel bolt as a lock nut.

Shallow storage tray is mounted with screws between the rails. Locate it so that bottom is flush with lower edge of rails. Line it with felt to hold cutlery. It's sized to take place mats without folding.



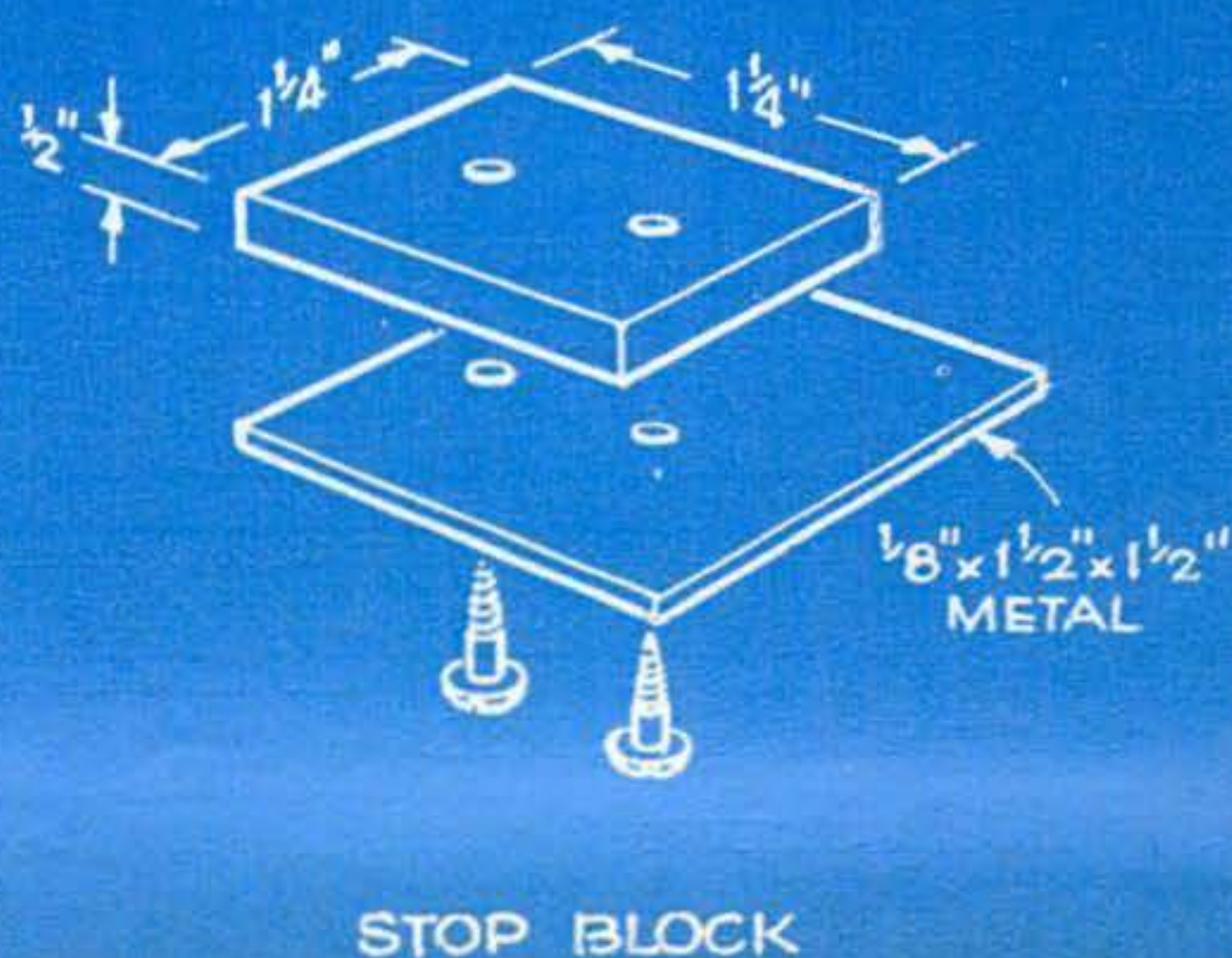
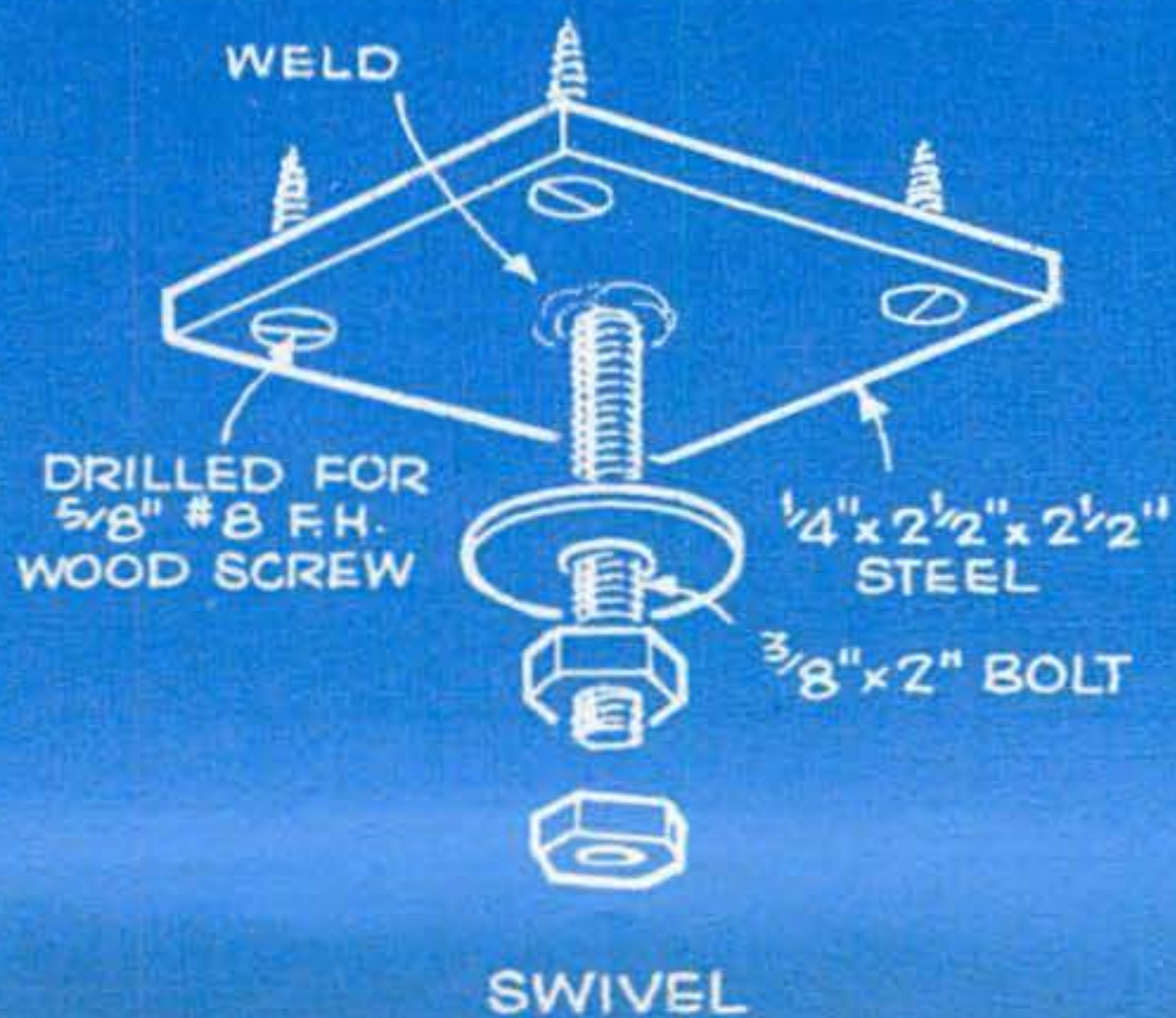
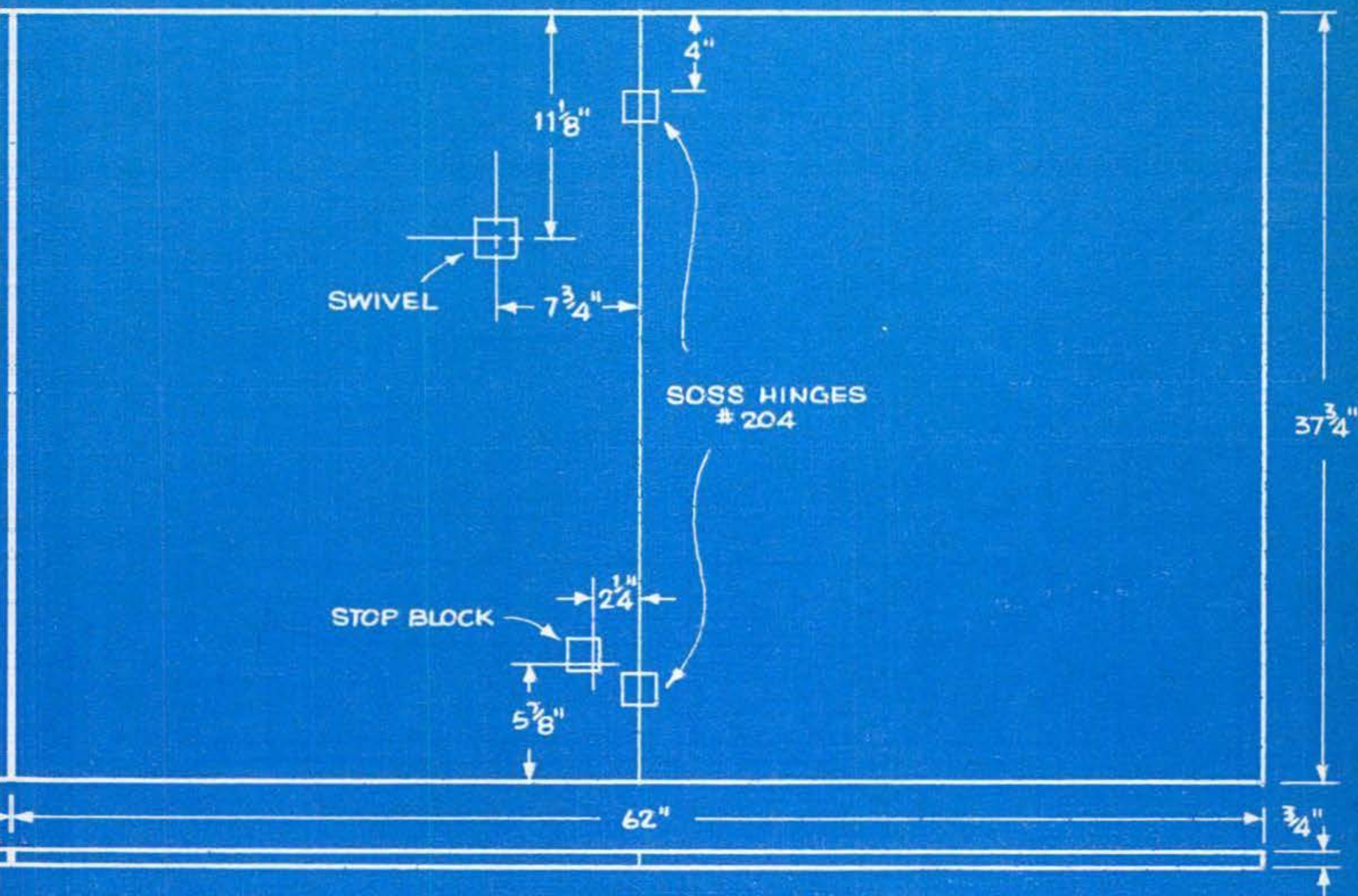
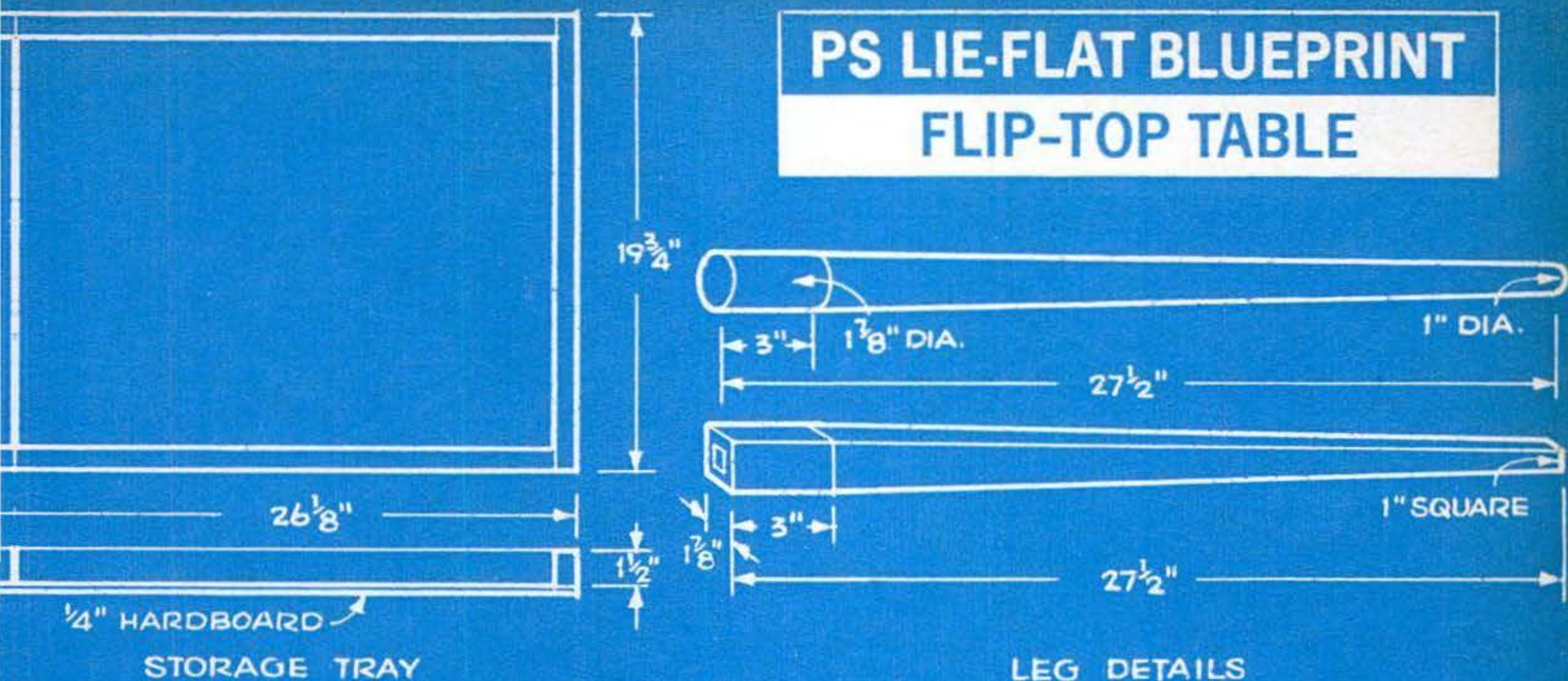
5/16" RADIUS  
 1/4" x 2 1/2" HANGER BOLT  
 5/16" RADIUS

PLATFORM WITH 3/8" HOLE FOR SWIVEL

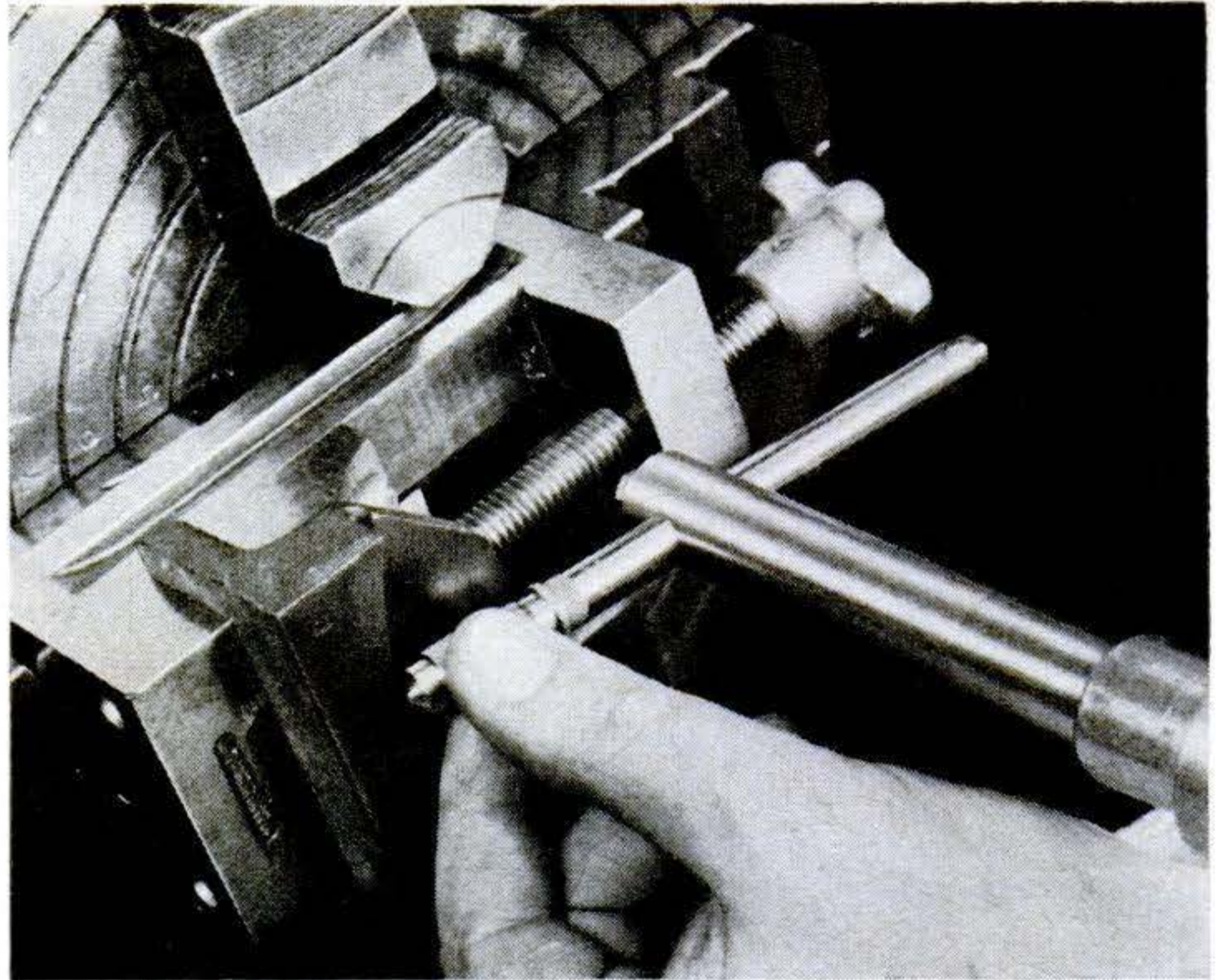
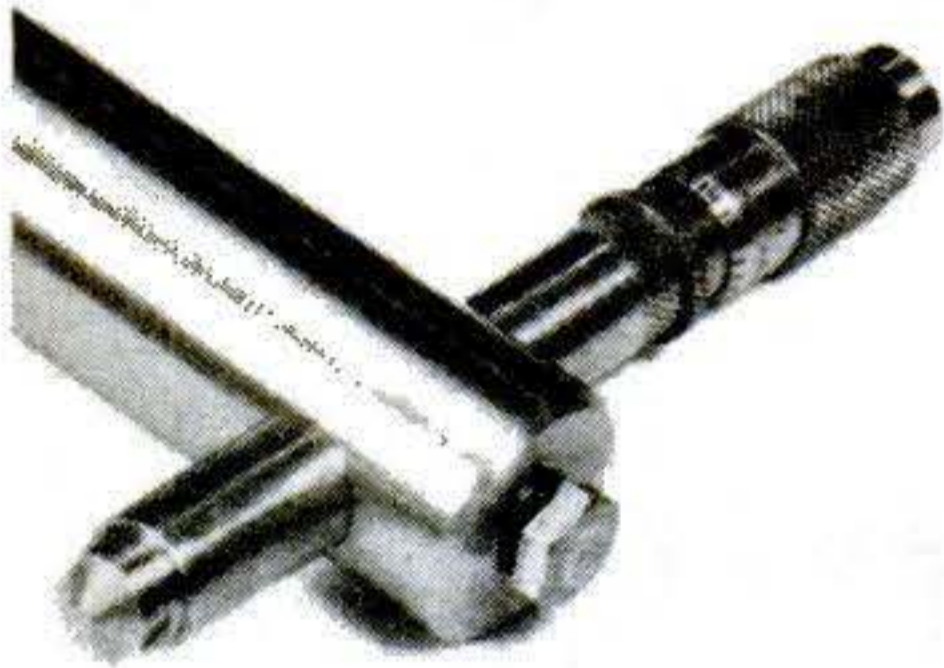


SAW KERFS 1/4" DEEP, 4" LONG

# PS LIE-FLAT BLUEPRINT FLIP-TOP TABLE



## Short Cuts for Machinists

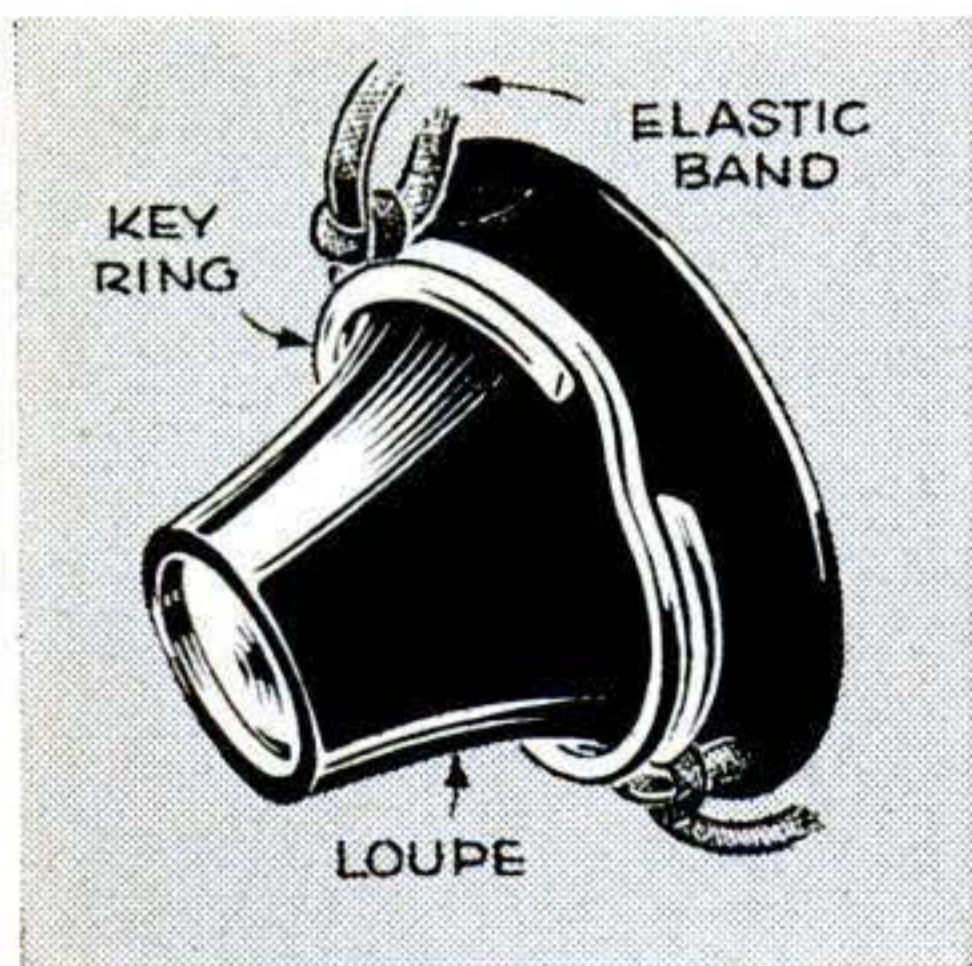


### Support bar helps you to measure the radius of lathe-turned segments

Make this support bar for an inside micrometer, and you can measure the radius of segments turned in a lathe. The bar has a Morse taper shank to fit the lathe tailstock. The tubular inside micrometer fits in a radial hole in the end of the bar and is held in place by a soft setscrew. To use it, zero the spindle at .100", then extend the micrometer contact point to get the desired

radius from the center line of the support bar. Do this by setting the bar in a V block on a surface plate and measuring the radius with a vernier height gauge. With the bar installed in the tailstock, the correct radius is reached when you read .100" on the micrometer; roughing cuts will read below that setting.

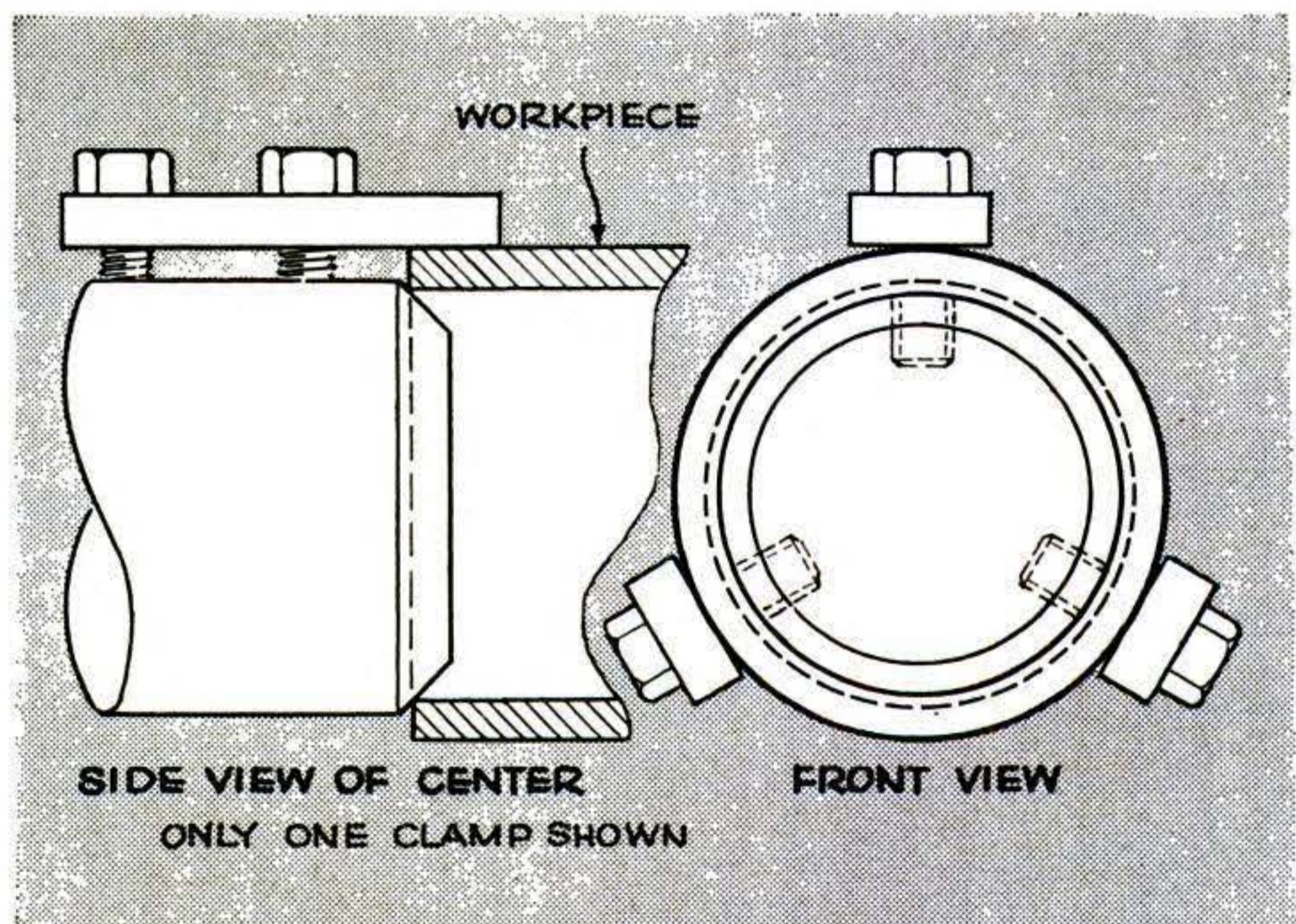
H. J. GERBER, Menomonie, Wis.



### Loupe holder frees your hands for work

If you are forced to hold your machinist's loupe to your eye with one hand because you have a hard time screwing up your face to hold it there, here's a hint that will end your problem. Tie the ends of an elastic band between the leaves of a spring-type key ring, as shown in the drawing above. Insert the loupe in the key ring; the headband will hold it to your eye.

RALPH GALLAGHER, NYC.



### Holding small thin-walled tubing between centers

If you have to turn tubing that's too small to hold between centers with a dog, here's a jig that will do the job. Turn a special center on the end of a piece of rod stock and hold the work with three clamps as shown in the drawing. Chuck the new center in the headstock and support the work on the other end with the tailstock center. This setup will hold the tubing for cuts of about 100 thousandths.

JACK GOLDMAN, Ozone Park, N.Y.

**Rent your own earthmoving equipment? Sure. More and more, earthmoving is becoming a do-it-yourself, save-big-money job**

**By CHARLES E. RHINE  
PHOTOS BY BILL MORRIS**

# How to Rent a Backhoe



**H**ave some digging to do? Do you have to put in drain tile or footings? Excavate for a swimming pool? Landscape your yard? Repair or replace a sewer or water line? Whatever the job, if it involves digging, you can save money—and have fun in the bargain—by doing it yourself. Not with a shovel and wheelbarrow, but with a backhoe—a modern earthmoving machine you can rent for about \$10 an hour and run

yourself. They're now common rental items. They can handle most digging jobs around the home. Even a big backhoe is easy to learn to operate; the rental dealer will teach you how. Lots of home owners have done it; you can, too. Here's how I know.

I heard about a couple of tool-rental outfits near Chicago that were doing a brisk business renting backhoes and other heavy

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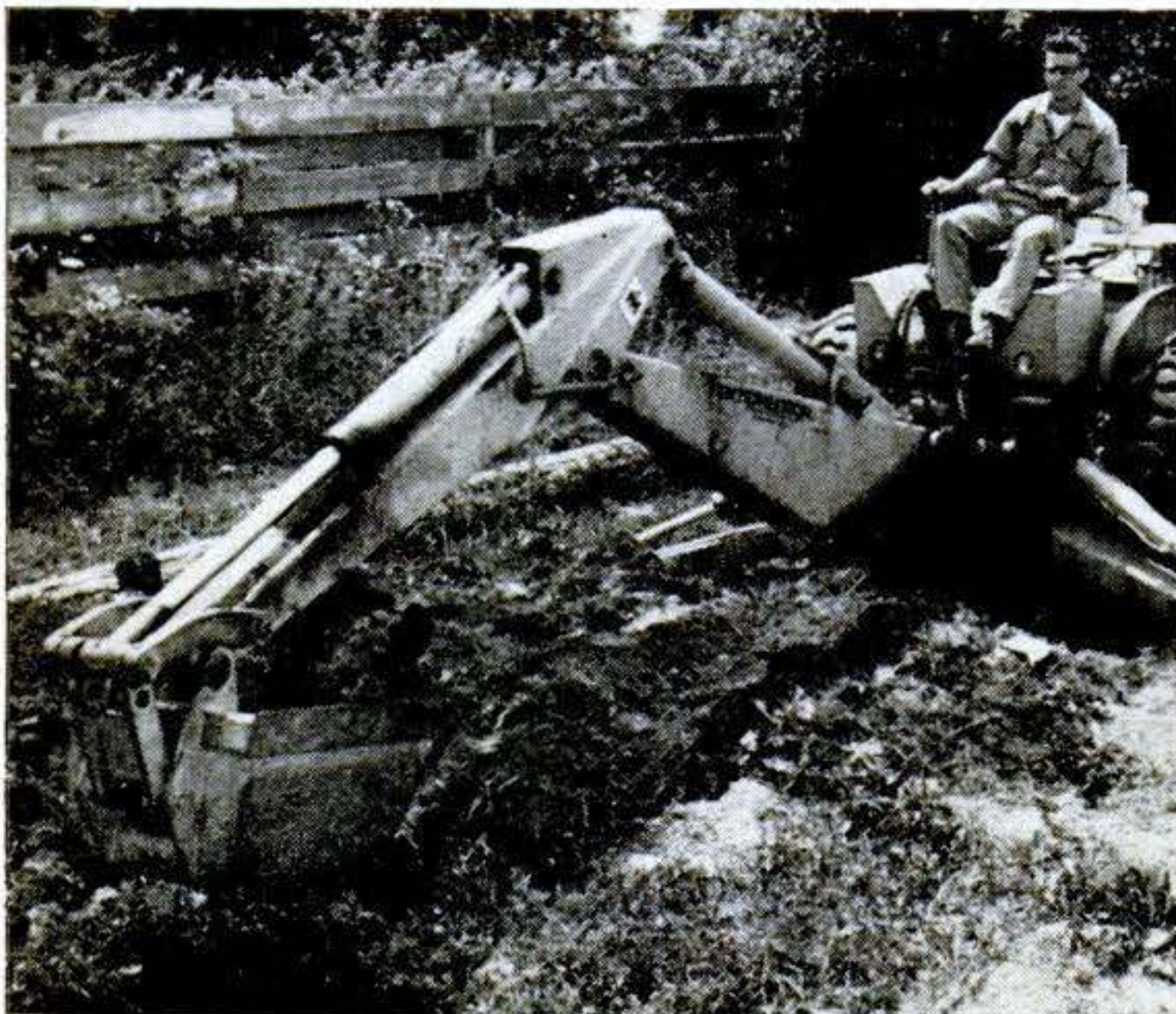


**The author learns how to run a backhoe right on the rental dealer's lot. Brief instruction and**

equipment to home owners. To find out what it was all about, I went to see them—Buttrey Trailer Service in Downers Grove, and Des Plains Rental Equipment Co. in Des Plains.

At Buttrey's I asked to be taught to run the big International backhoe on the lot. I

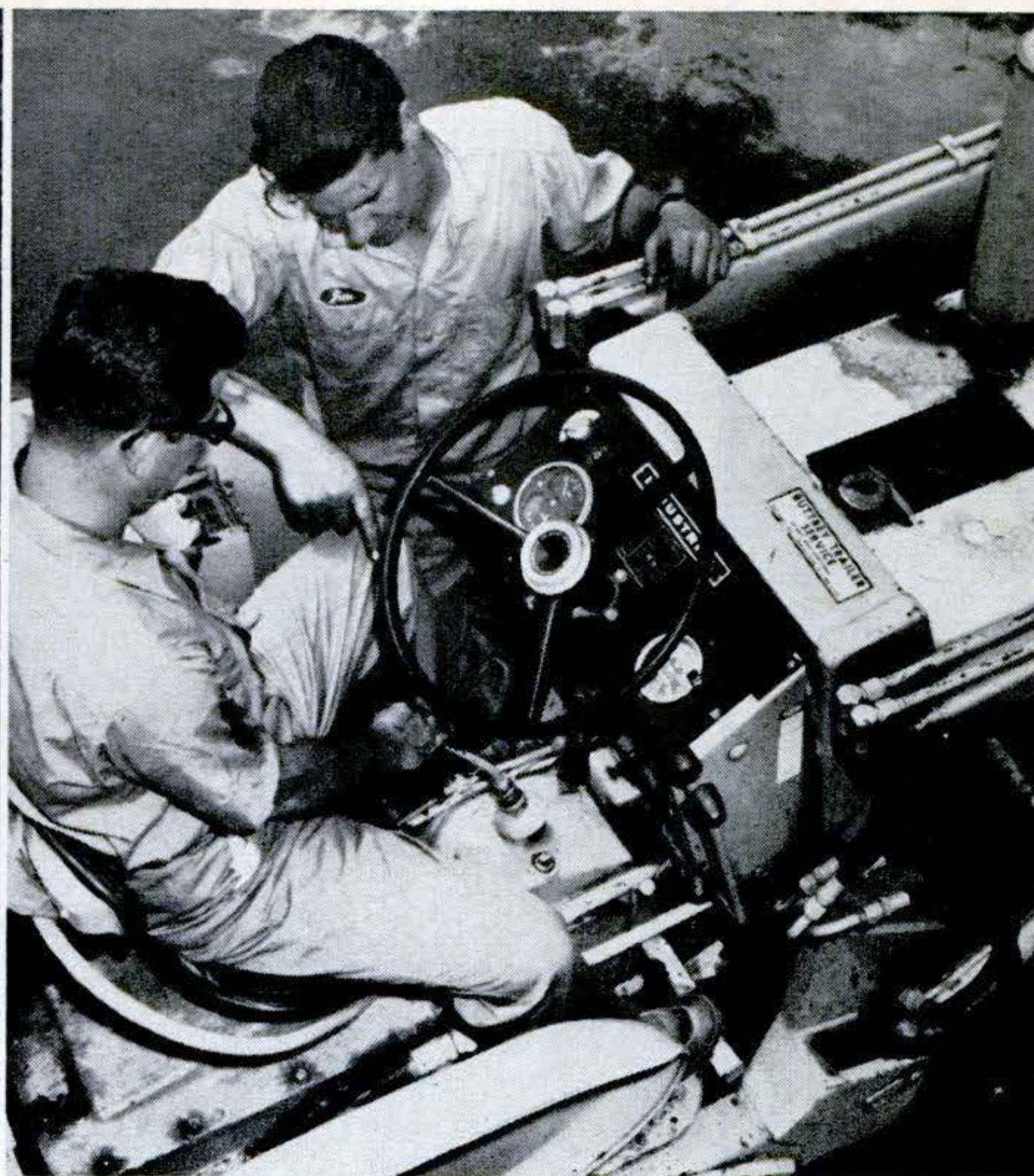
wanted to find out for myself just how easy (or hard) it was to operate. One of the company men, Jim Harrison, told me the tractor runs just like a shift-transmission car. And sure enough, there were the familiar stick shift, clutch, brake, accelerator, and steering wheel. It even had power steering



**To dig, the operator sits in the bucket seat facing the rear of the machine. Four levers (two on each side) control movements of the backhoe.**



**Backfilling and bulldozing are done with the boom bucket. You control the bucket with two levers while you drive the tractor. Power steering eases driving.**



practice digging were all that was necessary. At far right, the machine's controls can be seen.

to make driving over rough ground easy. It was no problem driving the backhoe to the digging spot.

In the seat facing the back of the machine (where you operate the backhoe) a half-dozen levers stared me in the face, and the big steel arm loomed up ahead of me.

**How you operate it.** Jim said, "Push this lever forward and the arm swings to the left; pull it back and it turns to the right." When I nudged the lever, it did just that. I found that one lever lifts the arm up and down, one moves the bucket arm in and out, and another swings the bucket for

*Continued*

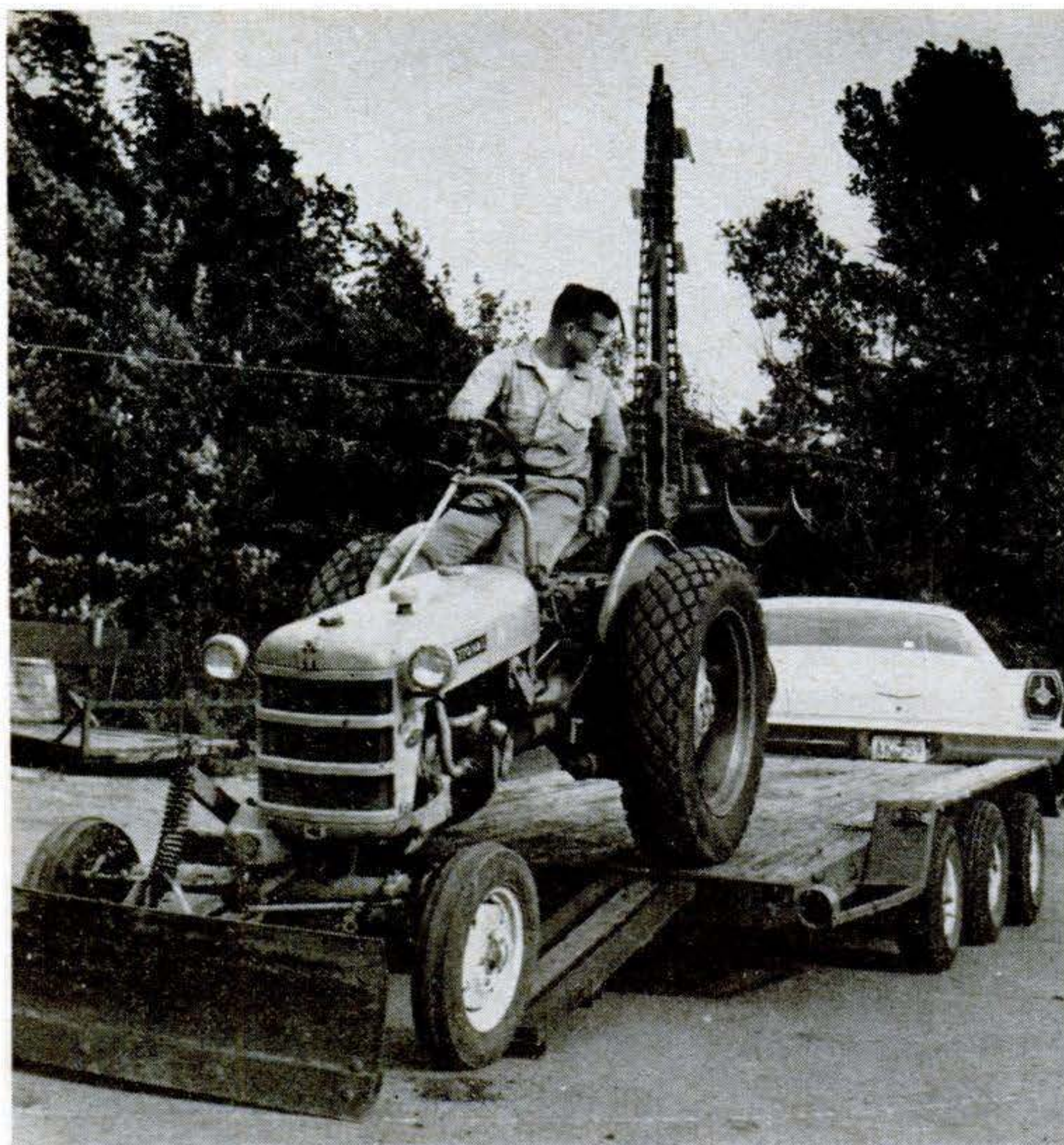


**Earthmoving jobs** are easy—you scoop up bucketfuls of dirt and dump them wherever you want to put the fill. You can landscape your yard this way.

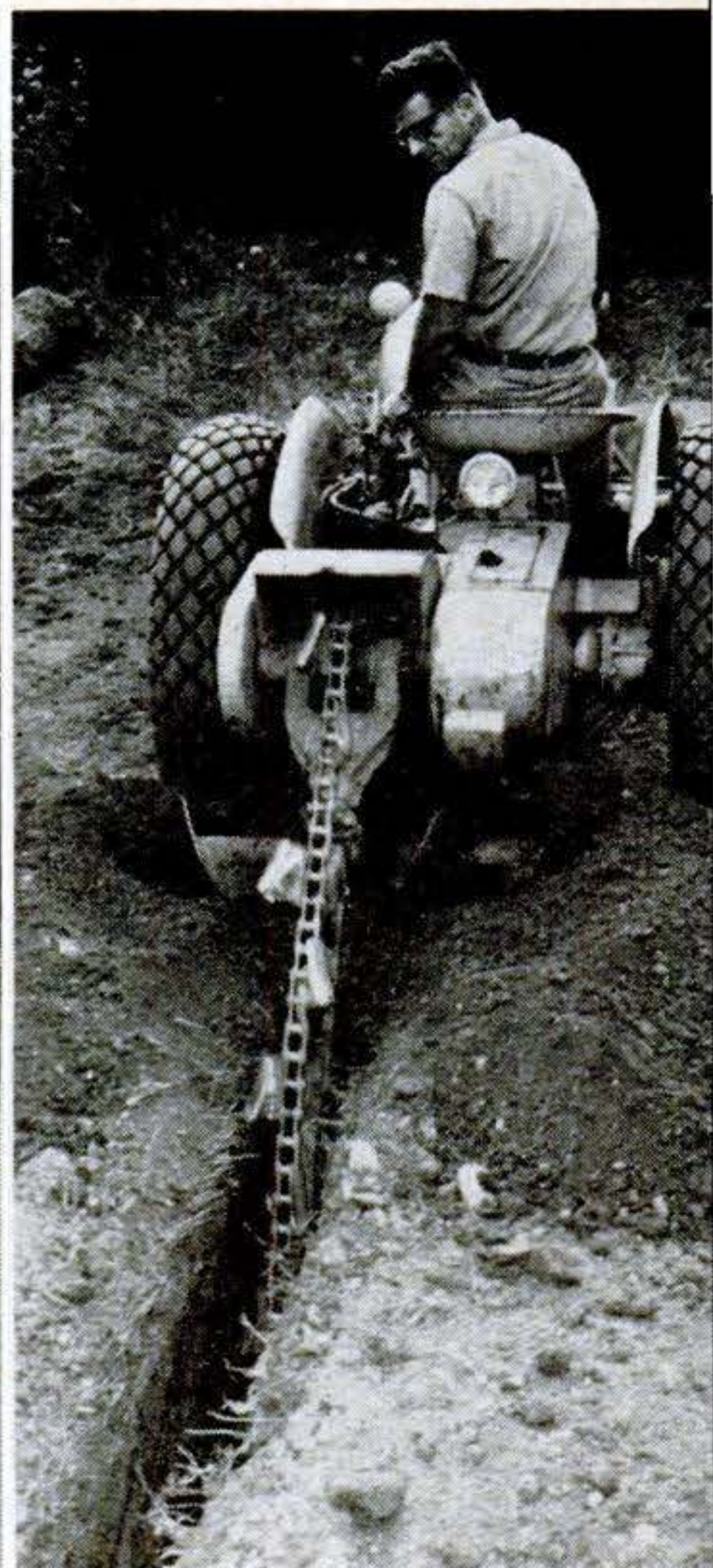


**Truck loading** goes fast with the boom bucket. When you have to remove the fill from a basement or swimming pool, you rent the dump truck, too.

The backhoe is only one type of heavy equipment for rent. Here a



A trailer you tow behind your car helps you take the equipment home and bring it back. Rental cost usually includes use of the trailer to carry it in.



Trencher mounted on a tractor makes quick work of laying pipelines or underground wires. The front blade is used for backfilling. Rent: \$7.50 an hour.

scooping and dumping. Two other levers lower the stabilizers—arms on each side that brace the machine while you dig.

I played with the controls for a few minutes, swinging the backhoe around in the air until I had memorized which movement each lever controlled. Then I started digging.

Operating one lever at a time, I slowly positioned the backhoe arm and scooped up a bucket of dirt. After carefully making several scoops, I gained enough confidence to operate two levers at once. I could swing in the arm while scooping the bucket. I could raise the arm while turning it to the side. I became so eager I nearly dug a crater.

It convinced me that if you have a little mechanical ability, you can run a backhoe and do excavating jobs around your home. You'll not only save money, but have fun at the same time.

How do you save? A lot of contractors

won't bother with some of the small jobs home owners have—the cost is often a lot more than the job is worth simply because it's small and overhead must be covered. And sometimes you have to wait until the contractor has time to fit your job in between his regular work. By doing it yourself, you can get the job done when you want it done, and you save labor costs.

**Where do you rent a backhoe?** Look in the Yellow Pages of the phone book under "Tools-Rental" or "Contractors Equipment-Rental" to find a dealer near you.

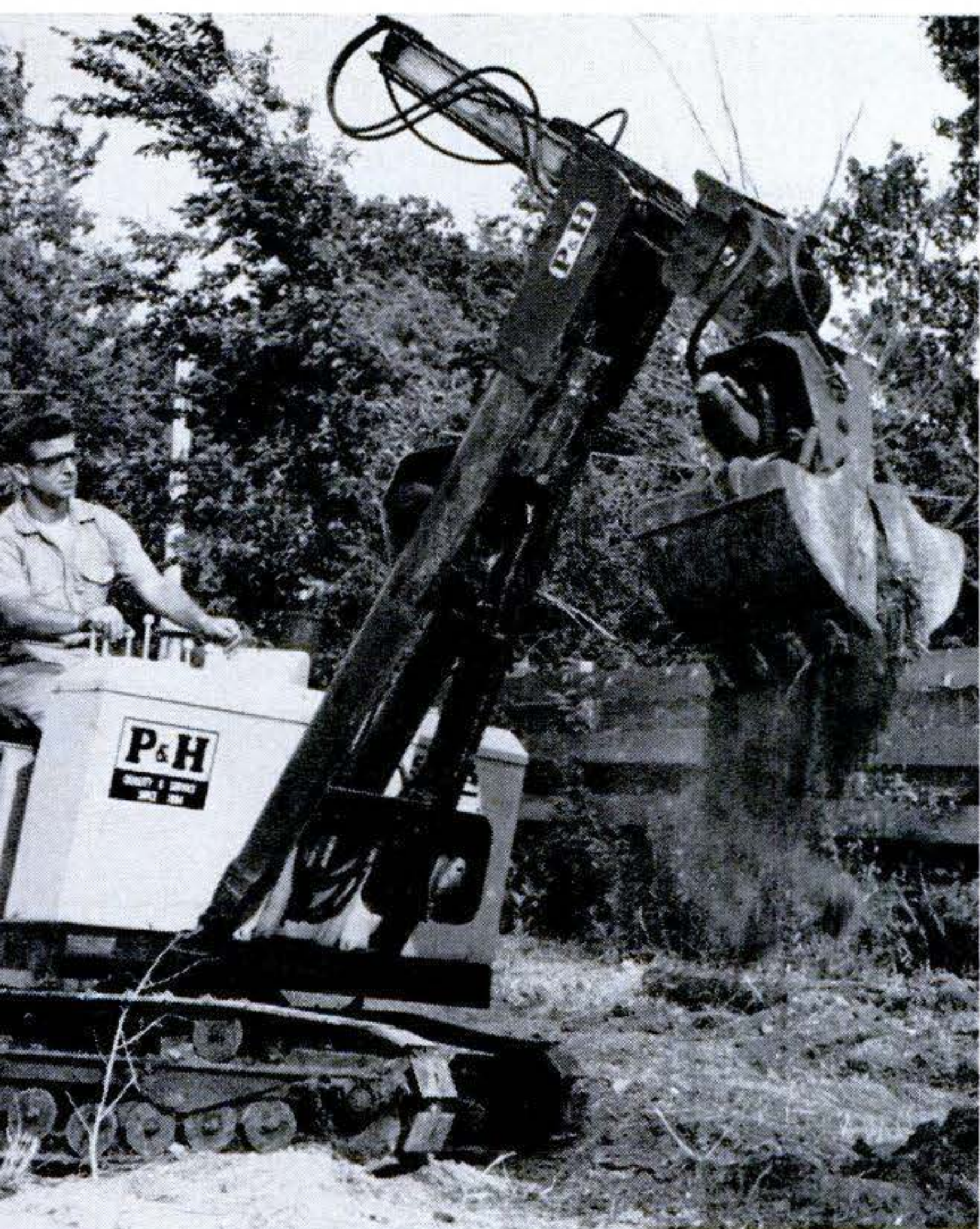
Backhoes are usually rented to contractors who need them only occasionally. But since contractors don't usually work on weekends, the rental company is happy to rent them to home owners who want to do their own digging.

But rental dealers won't give their equipment to just anyone. They have to be particular. These machines are expensive and,

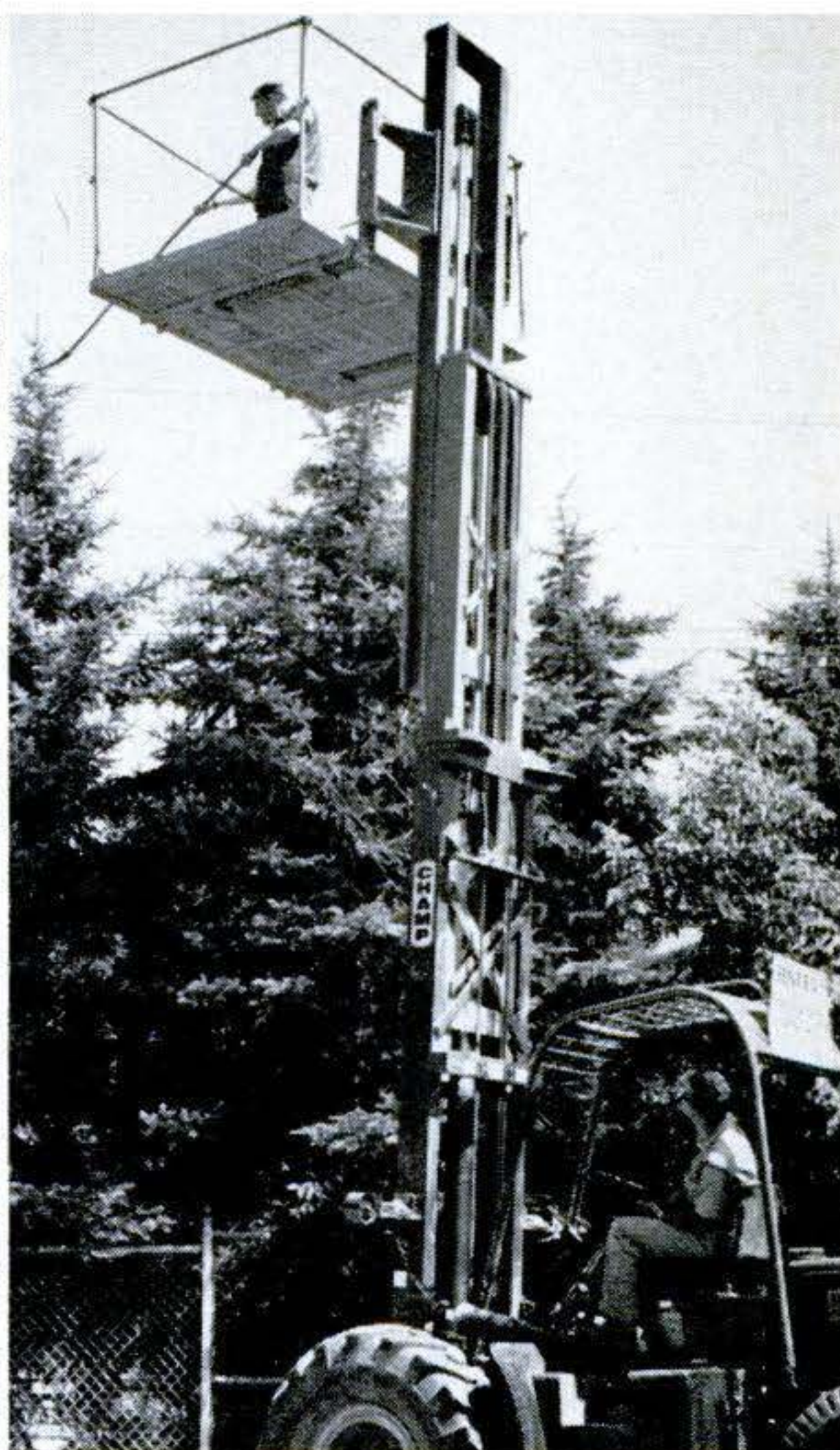
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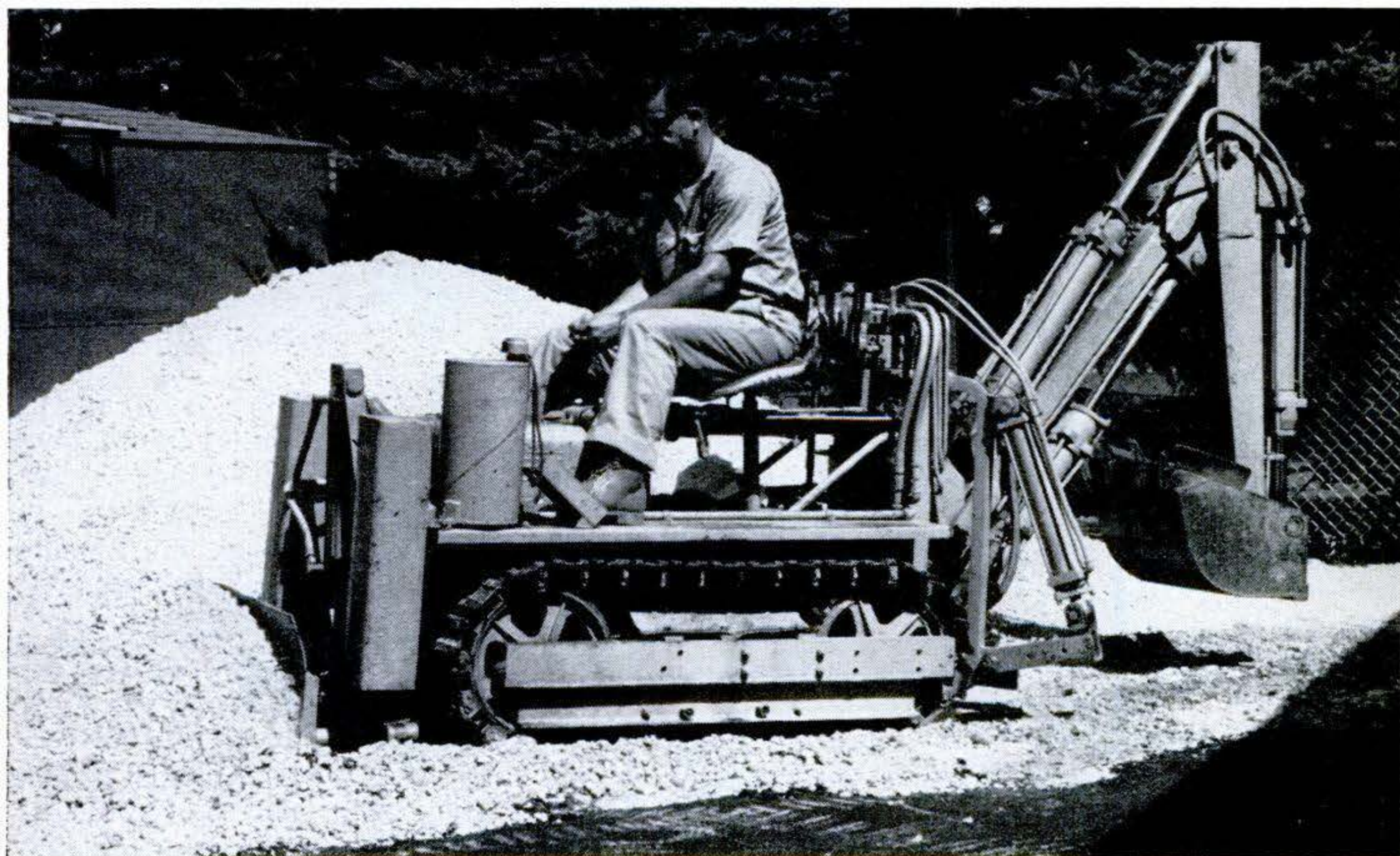
Other machines you may find useful around your home



**Clam-bucket digger on tracks rents for about \$8.50 an hour including trailer. It has the advantage of being able to dig right next to a foundation.**

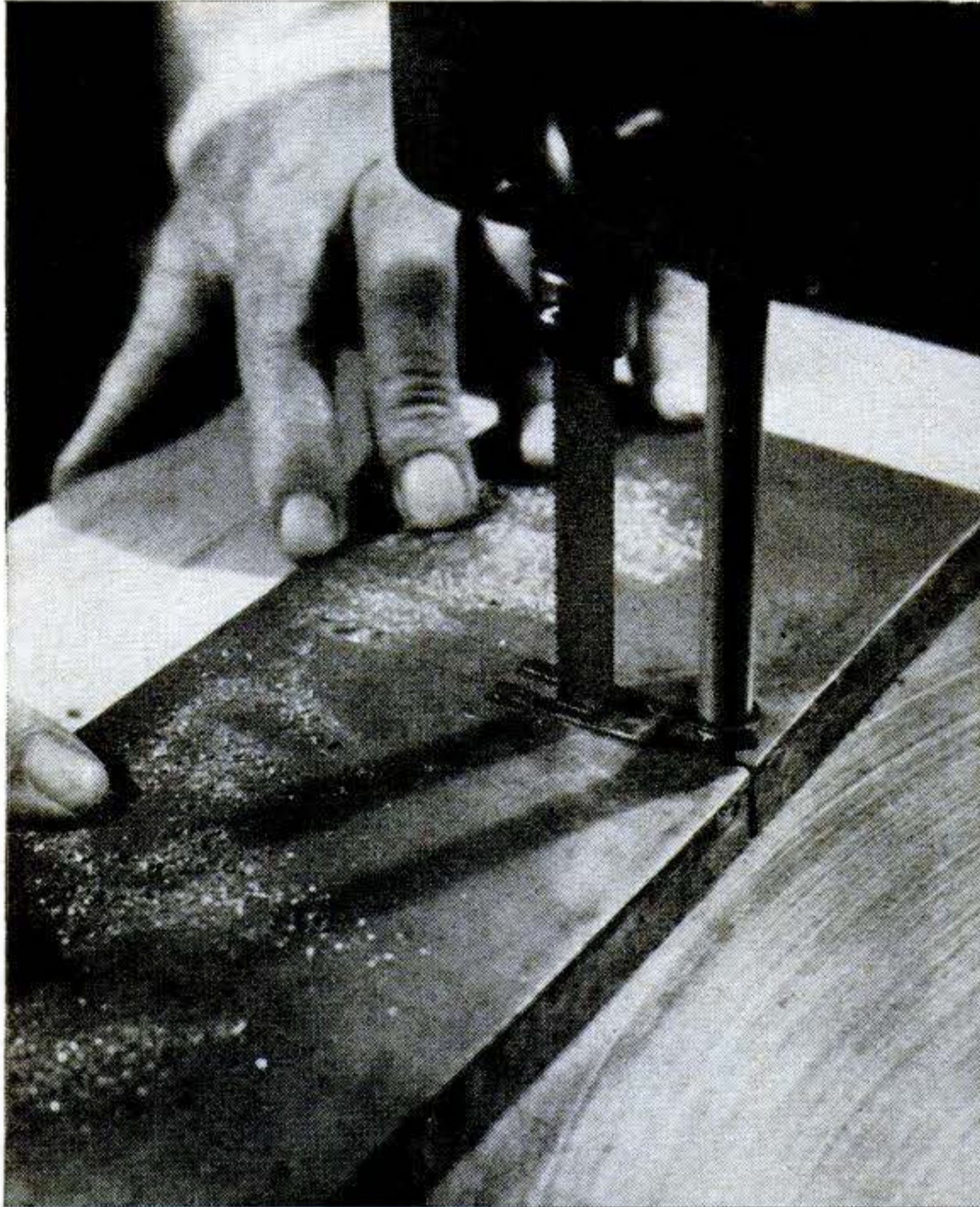


**Extension forklift puts you up in the air for tree trimming. It lifts pianos, refrigerators, and other heavy objects to a second floor. Rent: \$8 an hour.**

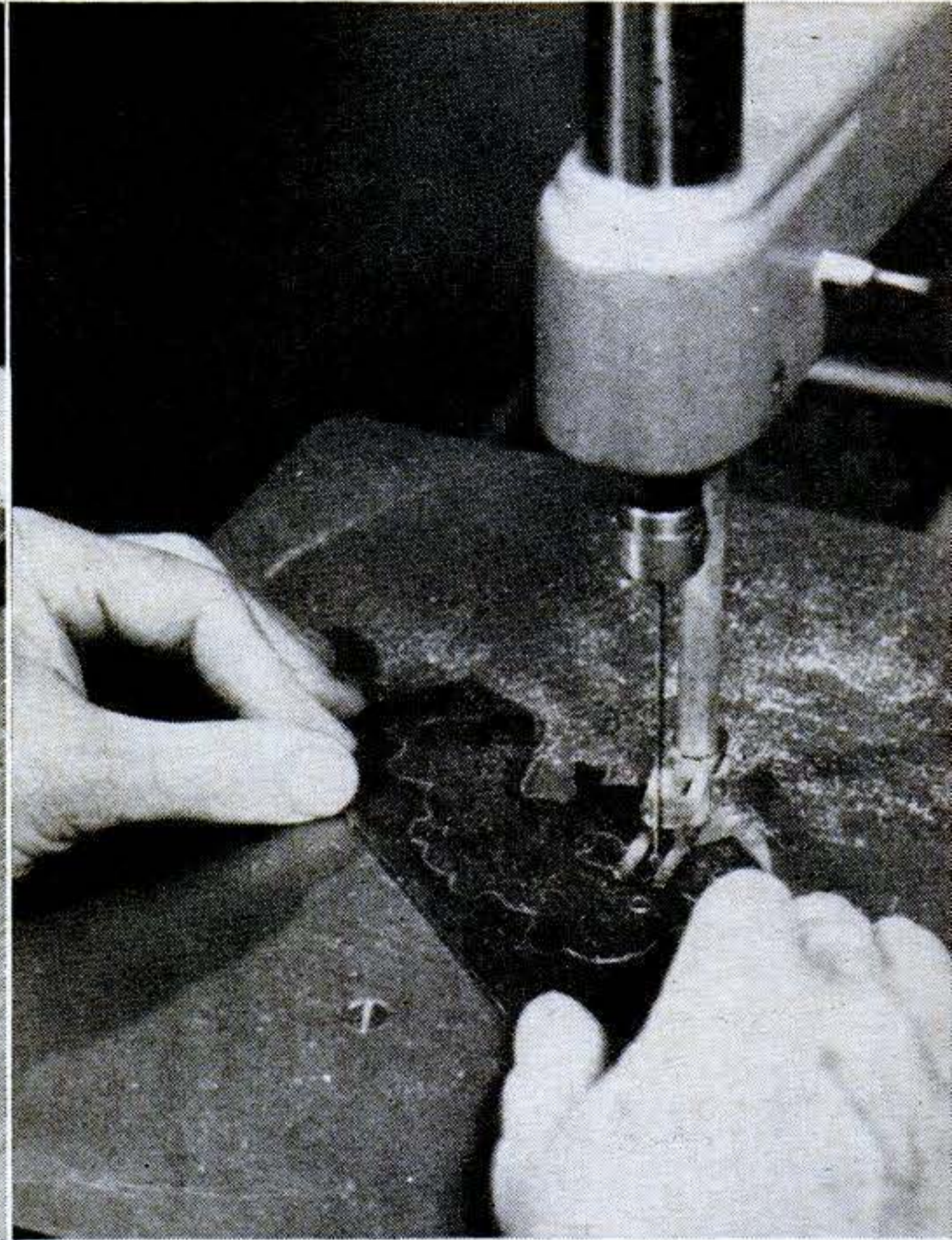


**Small bulldozer and backhoe combination rents for about \$42 a day with trailer. Shown here spreading**

**gravel on a driveway, it can also dig trenches and move earth. It can't load a truck.**



**Straight-line sawing** of metal is done with a section of hacksaw blade broken to length and ground on each end to fit the jigsaw chuck. You don't need a blade guide; blades this wide won't bend.



**Metal scrollwork** is done with a narrow blade, and with the blade guide and the table insert in place. For thin work, use blades with 32 teeth to the inch. After cutting, file or sand the edges and buff.

# METALWORKING

By **WILL THOMAS**

**D**o you think of your jigsaw only as a tool for doing scroll woodwork? If you do, you're missing out on one of the handiest metal-working tools in your shop. If a metal is soft enough to be cut with a file or hacksaw, it can be worked on your jigsaw using metal-cutting blades, files, sanding drums, and cloth buffers.

If your jigsaw can be slowed down by switching the drive belt on a multiple pulley, try to get the speed down to about 600 strokes a minute.

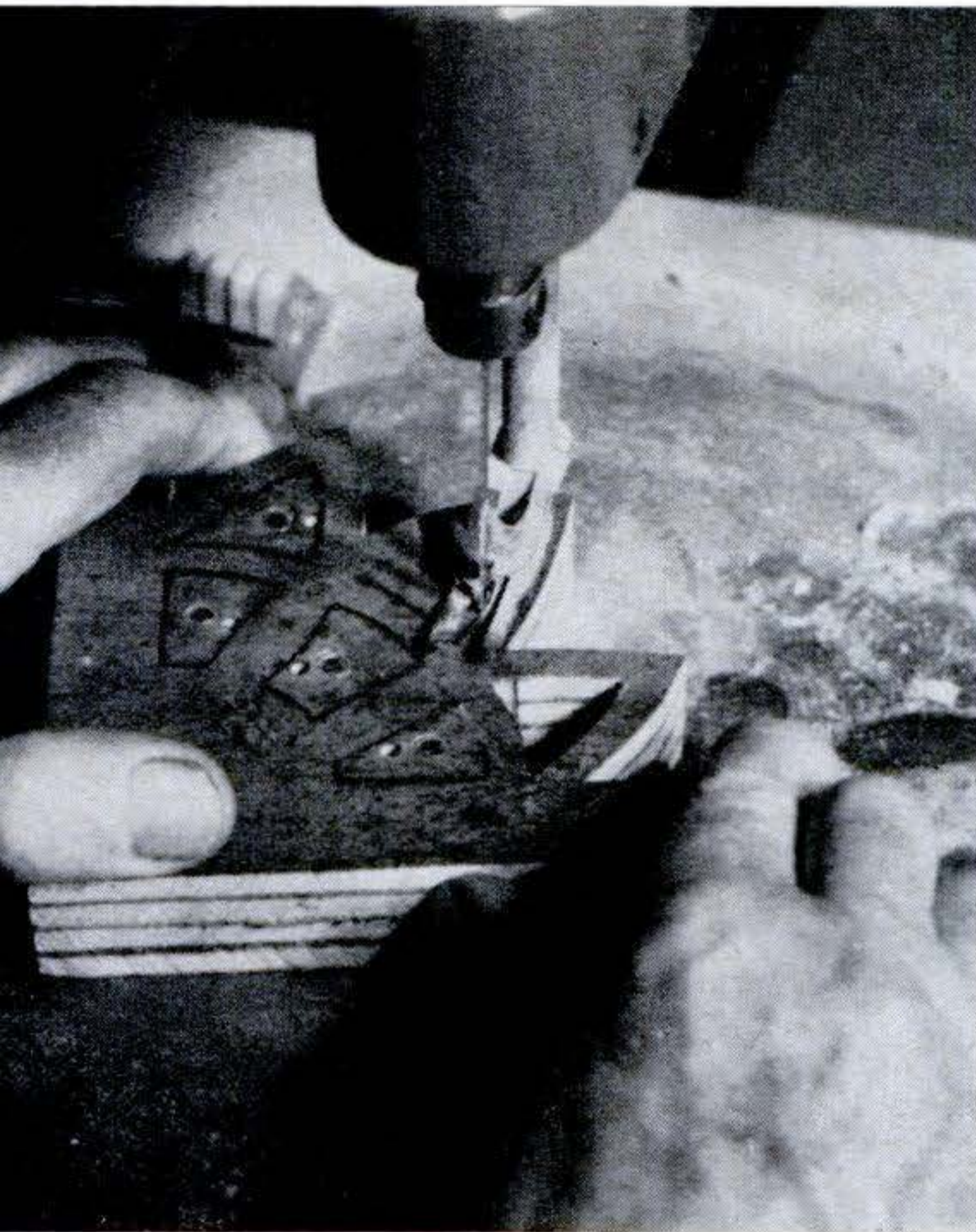
You can saw metal using regular metal-cutting blades from the hardware store. You can also use saber-saw blades. You can even make your own blades—from hacksaw blades.

**Putting teeth into metal.** For thin work (less than  $\frac{1}{8}$ " thick), use a blade with 32 teeth to the inch. The small teeth won't

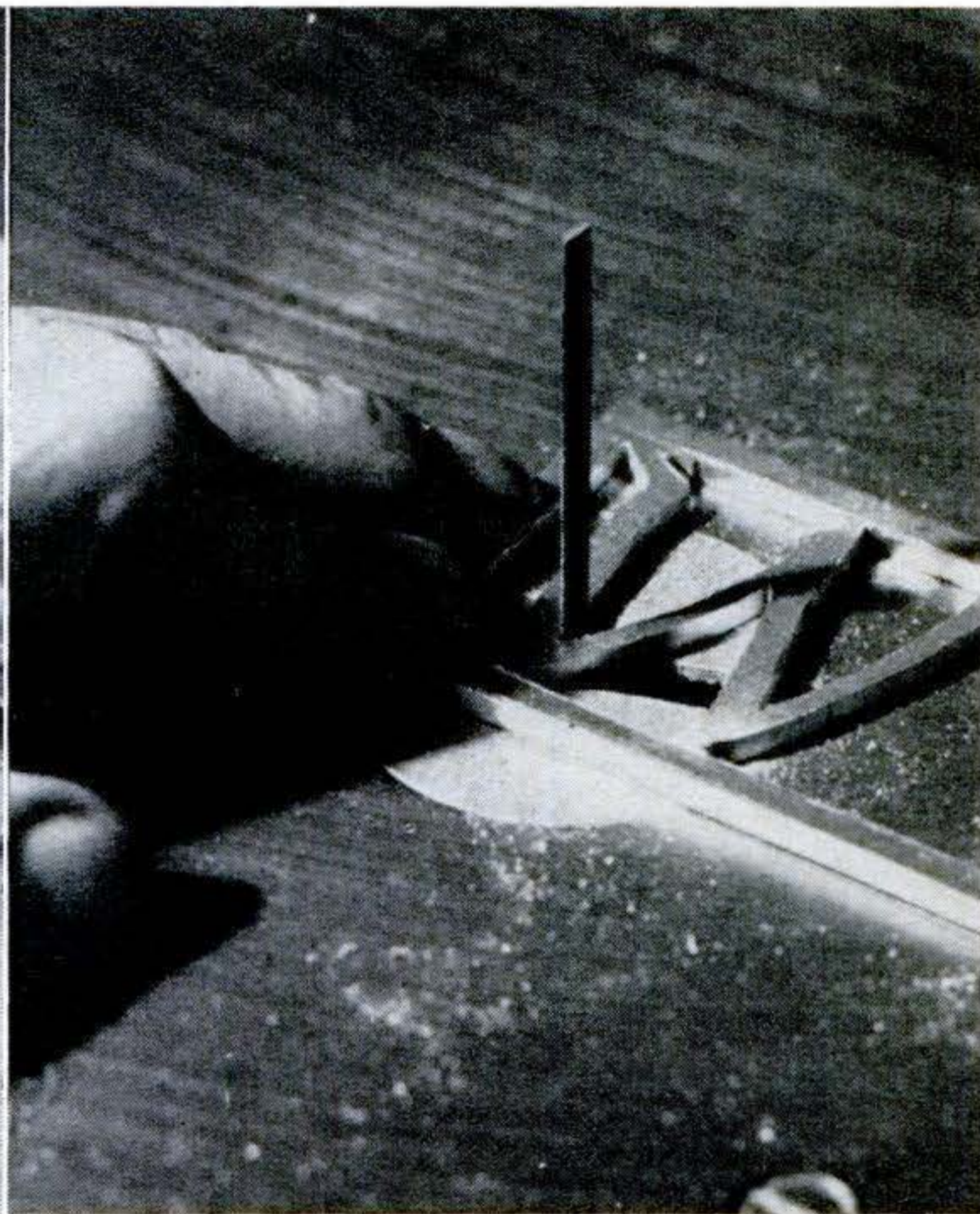
grab the work and cause excess chatter. A blade with 24 teeth to the inch cuts best on steel and pipe about  $\frac{1}{8}$ " to  $\frac{1}{4}$ " thick. For cutting hard metal thicker than  $\frac{1}{4}$ ", use an 18-tooth blade. If you cut thick, soft metal (aluminum, for instance) use a 12- or 15-tooth blade. These larger teeth won't clog up easily.

Making your own blades from hacksaw blades is easy. You break them to length and grind the ends to fit the jigsaw chuck. (A hacksaw blade breaks easily if you first score it with a small, triangular file, then place it in a vise with the score just visible above the jaws. A blow or two with a mallet will snap the blade.)

Hacksaw blades come in tooth sizes of 18, 24, and 32, and are usually made of molybdenum or tungsten steel. But because they are wide, the blades are suitable only for straight-line cutting. The narrow blades necessary for doing scrollwork in metal are available by mail order

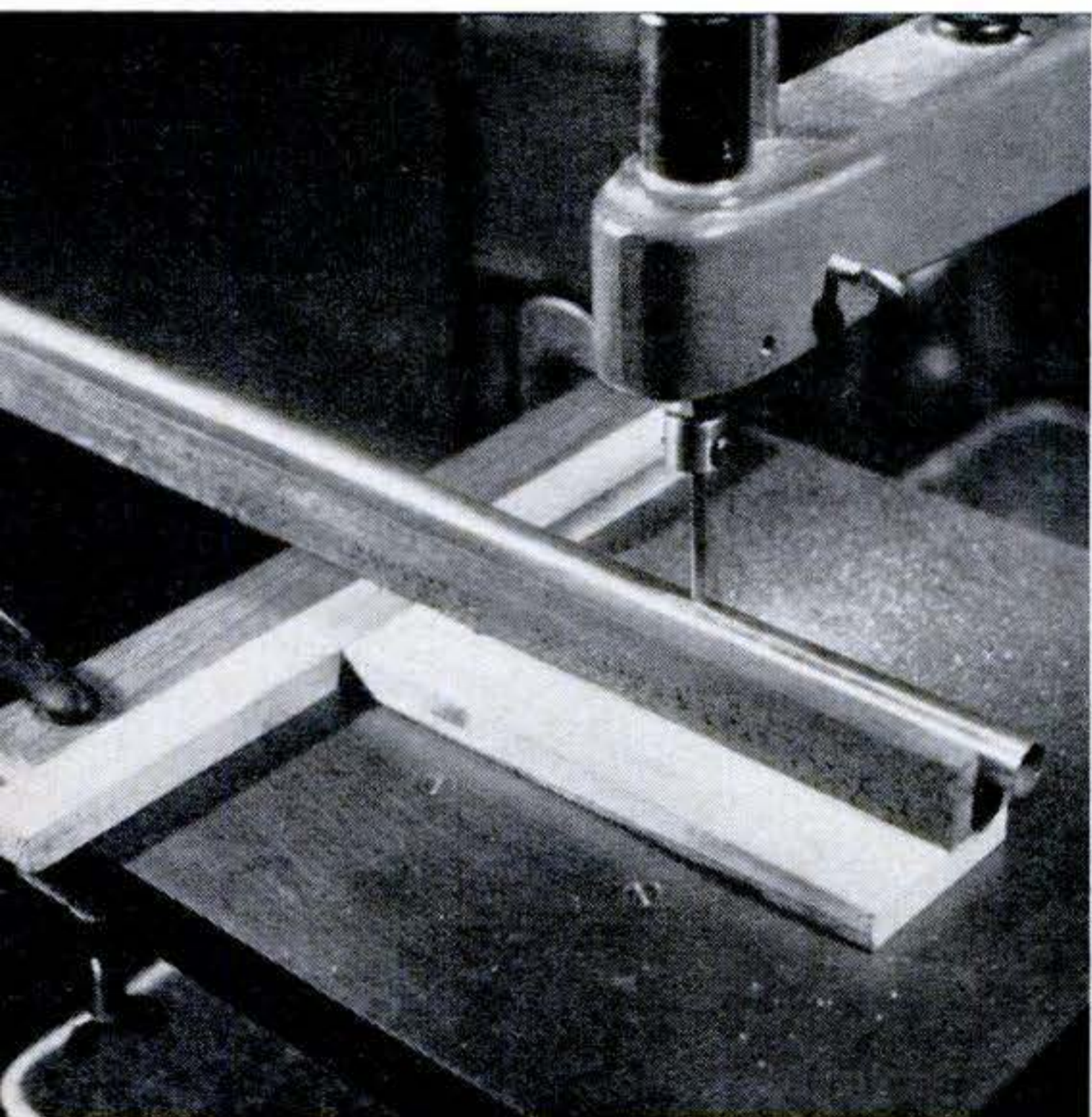


**Cutting very thin metal between layers of hardboard prevents tearing. Pattern is drawn on top piece and nails through waste areas hold stack together. A narrow 32-tooth blade is used in the saw.**

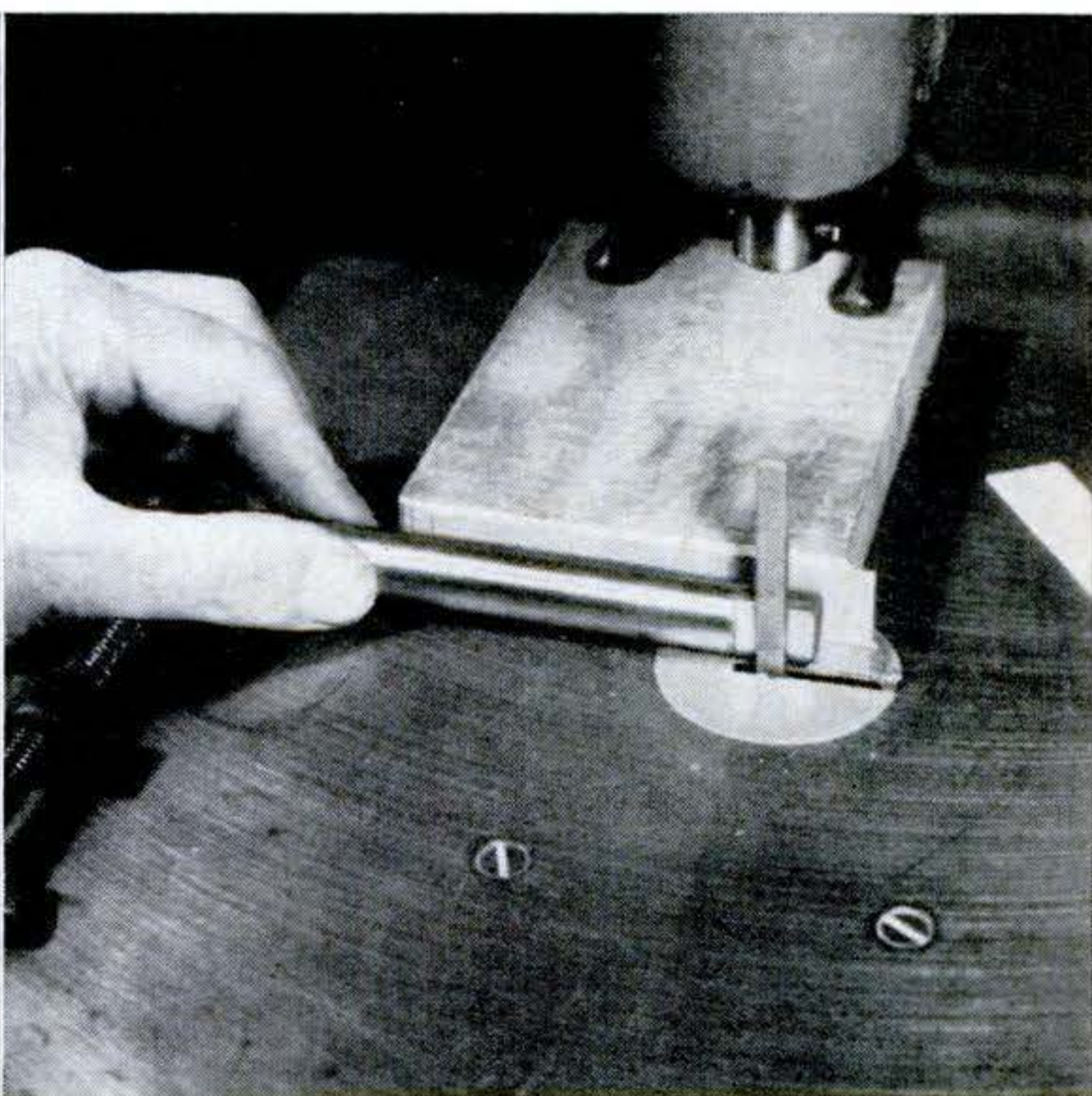


**Chuck a file in your jigsaw and you can smooth and size very intricate work. You can buy jigsaw files, or make your own by breaking a hand file to size and grinding the tang to fit the jigsaw chuck.**

## TRICKS on a Jigsaw

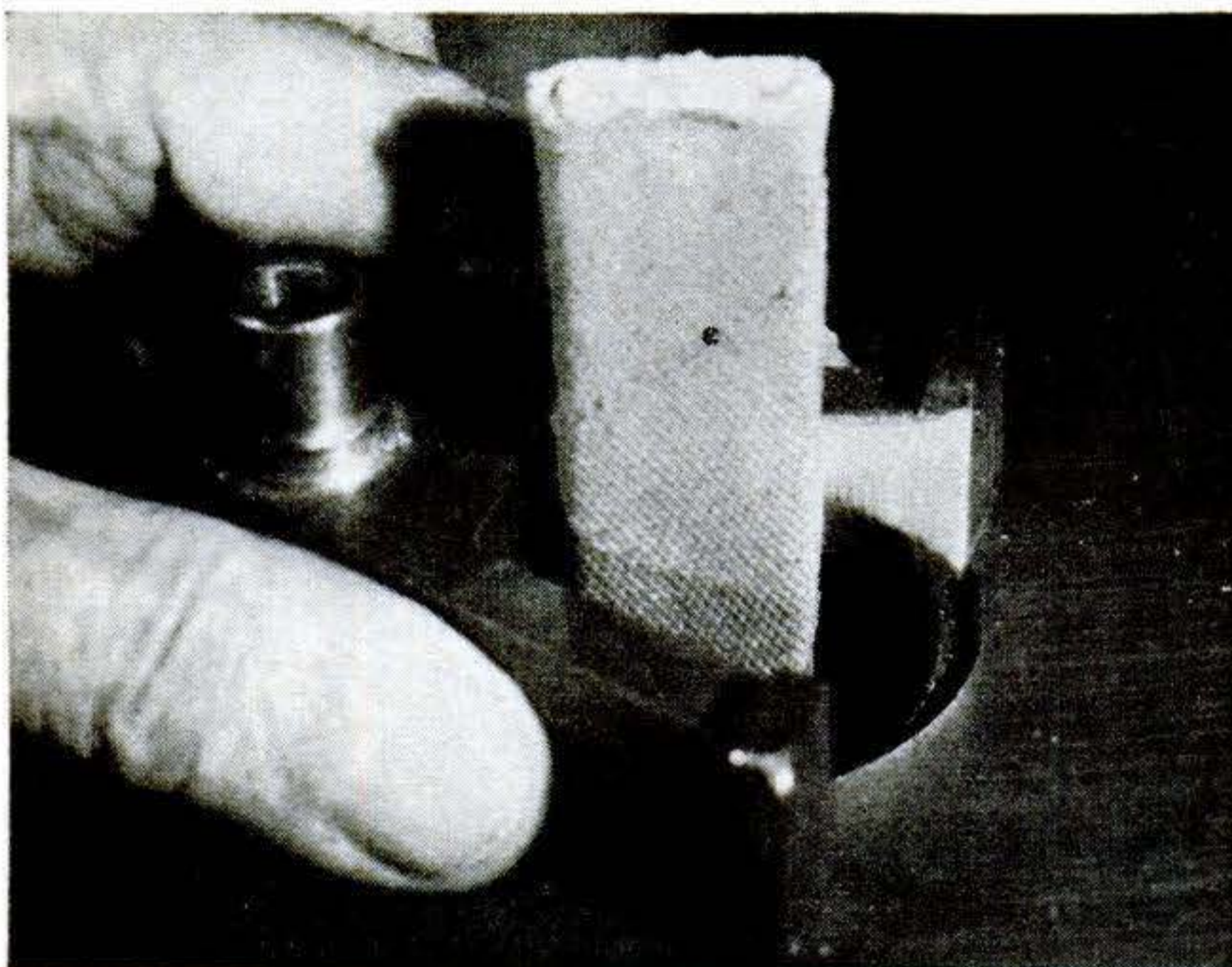


**A jig made from wood scrap helps make square cuts. A T-shaped guide, it rides against a straightedge clamped to the table parallel to the blade. A strip on top of the T holds long rods and tubes.**

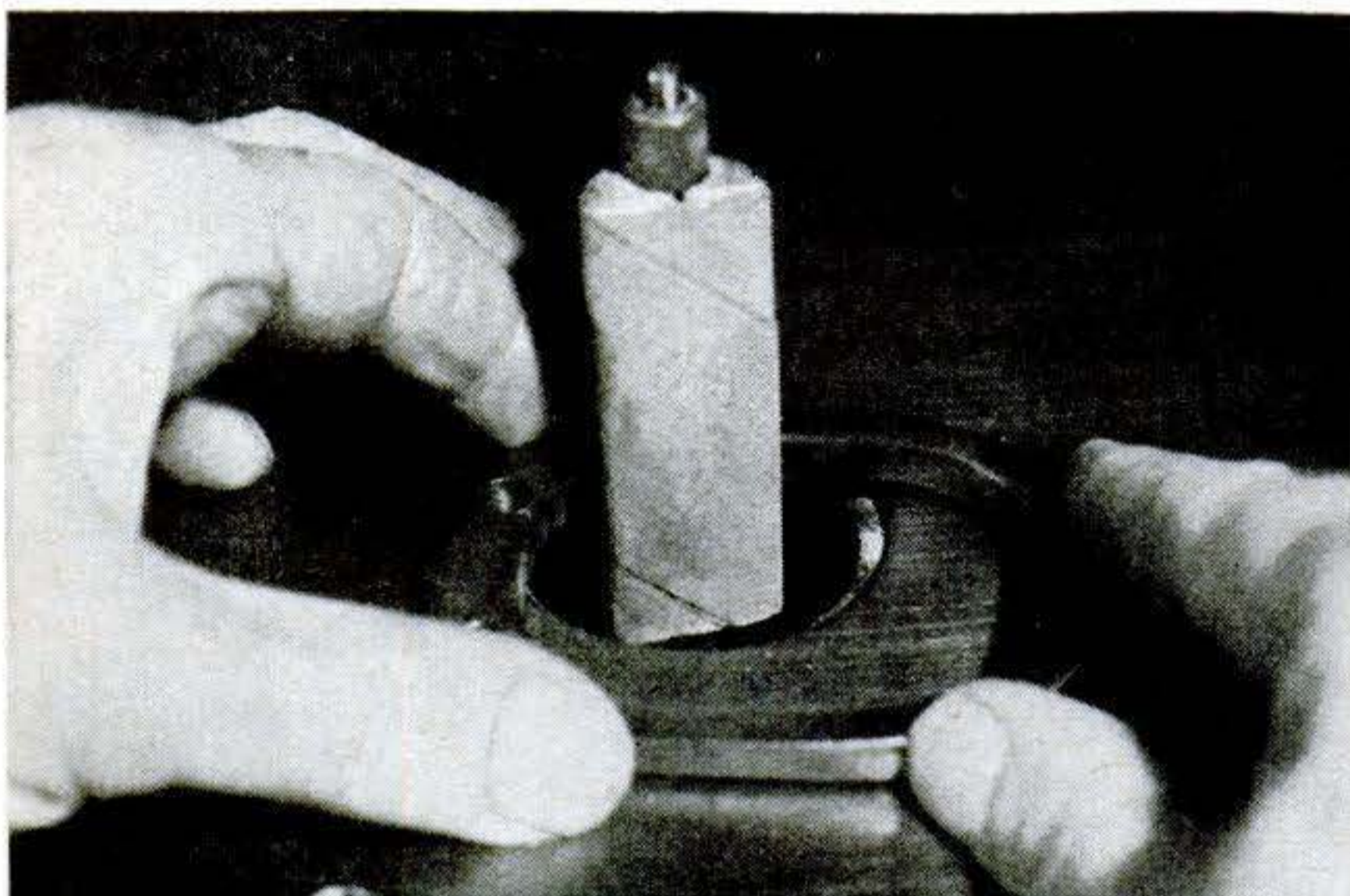


**Good filing trick puts flats on a shaft. Backing block keeps shaft parallel to file; clamp stops it from turning. Strips of thin cardboard are inserted between shaft and block after each pass.**

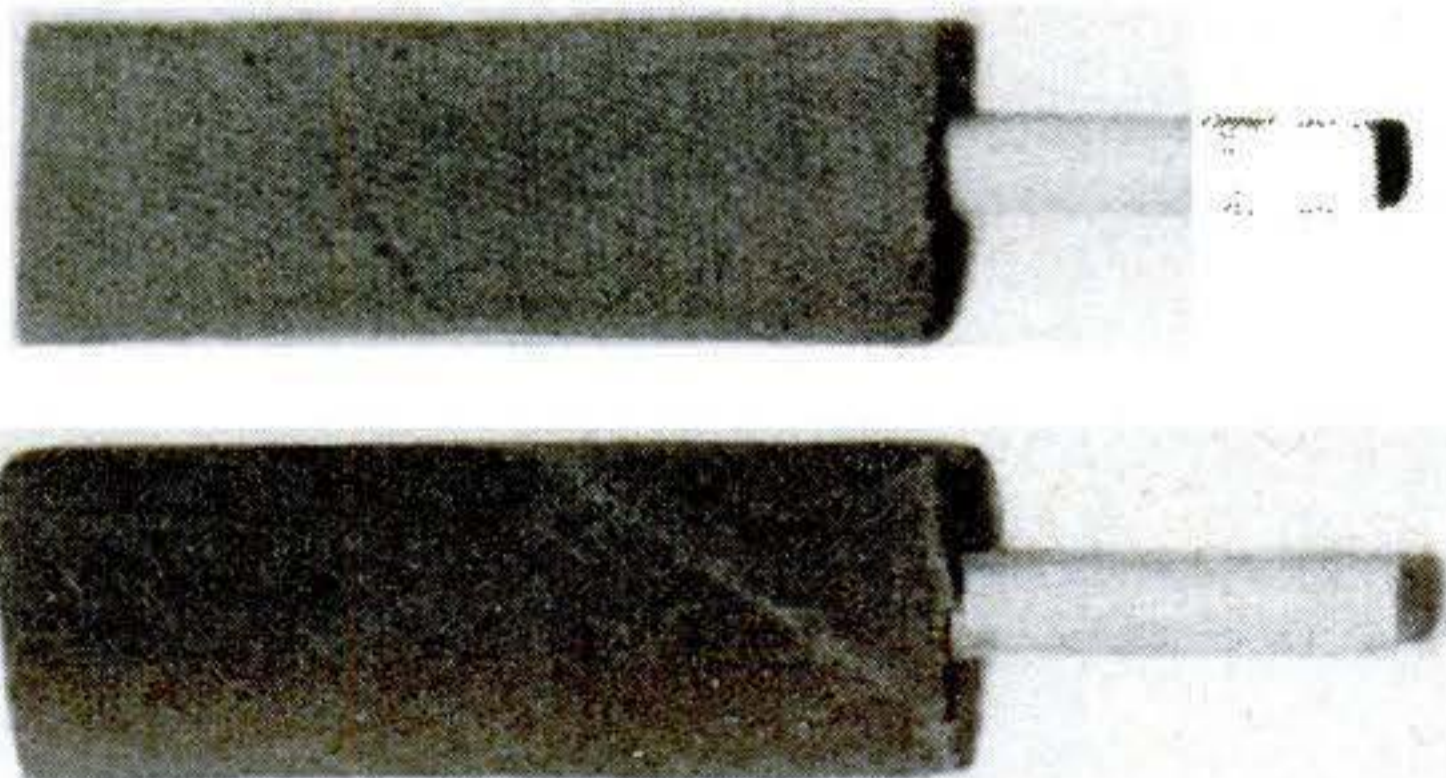
## Sanding and buffing—two jigsaw jobs for giving metal a fine finish



You can buff metal with canvas-covered wood spindles mounted in the jigsaw chuck. Apply buffing compound to the canvas, and the reciprocating motion of the spindle will give metal a high polish. It works well on plastics, too.



You can sand metal with an abrasive-cloth-covered spindle. Sanding drums made for electric drill are fine if not too large. But it's easy to make your own sanding spindles to the shape you need—cylinders, half-rounds, triangular shapes.



Homemade sander and buffer are made from lengths of hardwood dowel. Turn down one end to fit the jigsaw chuck; shape the other end to suit the job. Glue strips of abrasive cloth or canvas over it, winding them on in spirals.

and from most hardware stores. Metal-cutting saber-saw blades can also be ground to fit a jigsaw.

**Your jigsaw is a filing machine.** It's a good one, too. With a file in it, a jigsaw can do work that would otherwise require a milling machine or shaper. The same files made for industrial bench-filing machines will fit. They're made by leading file makers and sold through mill-supply outfits.

But you can make your own from regular hand files. You just break the file to length, and grind the tang to fit the jigsaw chuck.

The big advantage of files is the great variety of sizes and shapes available, and they're easily changed as needed. Some can be used with the table insert, others cannot. But you can make table inserts with openings to fit the larger files. Hold-downs usually aren't needed.

**The finish.** Even the most careful sawing or filing job can be finished further to a fine high gloss. You do it with sanders and buffers mounted in the jigsaw drive chuck. They're small cylinders (and other shapes) covered with abrasive cloth for sanding, or with canvas for use with buffing compound.

Some mill-supply outfits sell sanding and buffing tools for jigsaws. Electric-drill sanding drums work, too. But it's easy to make your own to any shape you want. Turn down one end of a hardwood dowel to fit the jigsaw chuck. Wind the other end in a spiral with strips of abrasive cloth or canvas, coated with quick-setting glue (contact cement is fine). Trim off any excess at each end. Use the tools without a table insert.

You can make holding devices that will let you do jigsaw filing to very accurate tolerances. A setup for filing flats on a shaft is shown on the previous page; other machining jobs can be done with different setups. **PS**



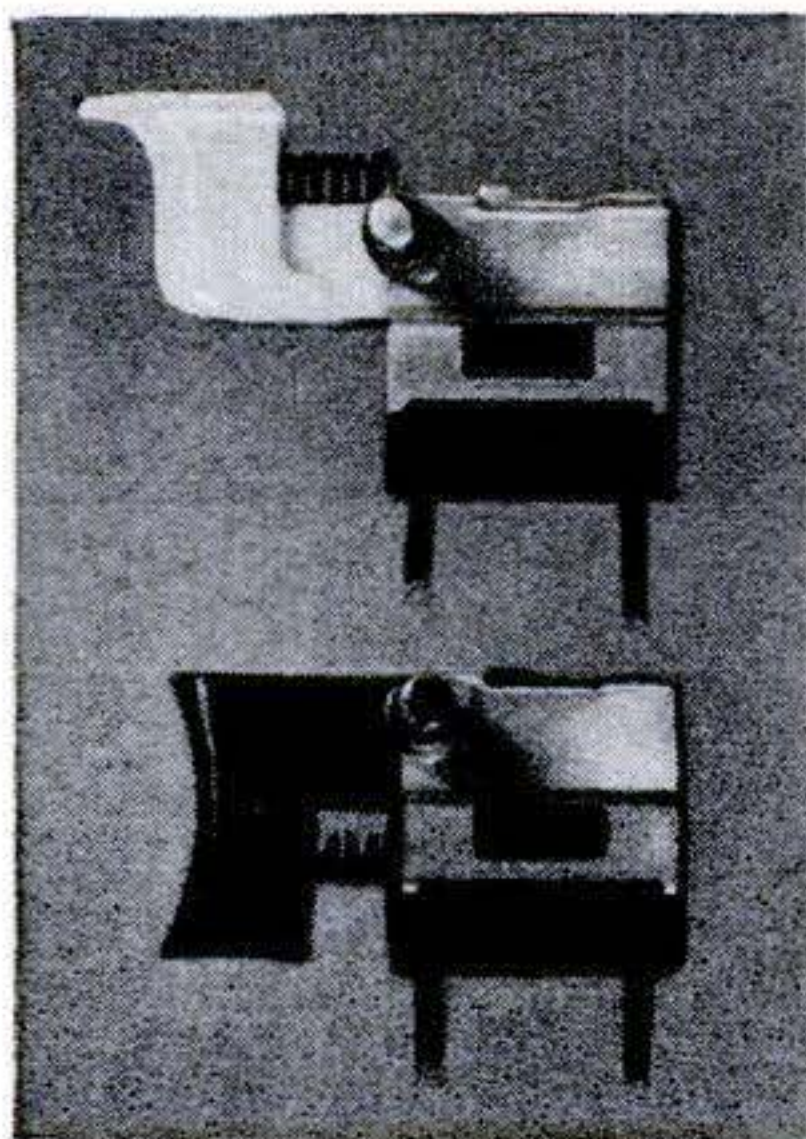
This old drill has a new trigger that you can squeeze to get any speed from 0 to full-rated r.p.m. Decal (supplied with kit) below nameplate shows it's converted.

## Now, Speed-Trigger Your Old Drill

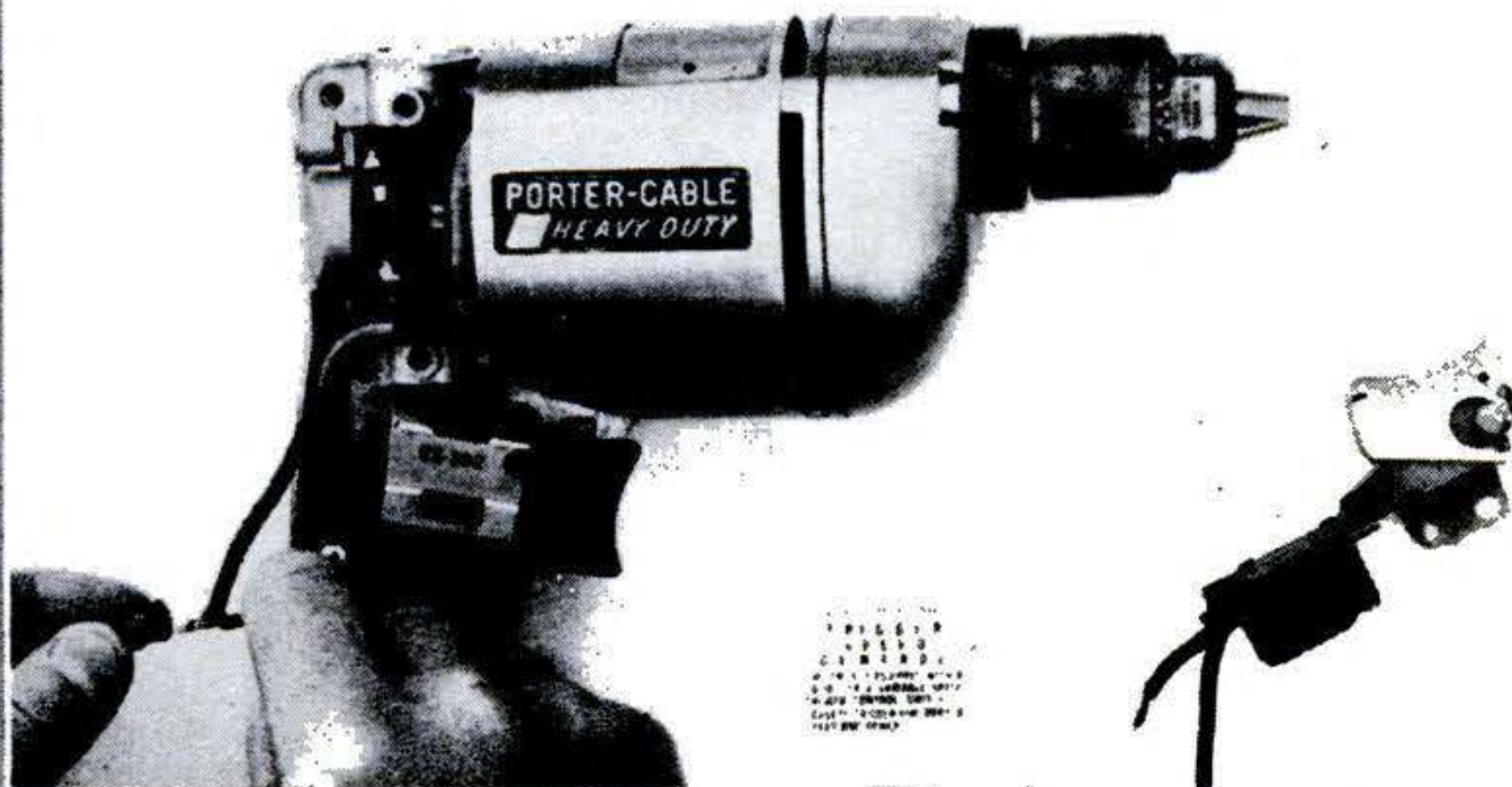
**A** new kit you can buy for only \$5.65 and install yourself in a few minutes converts most standard drills of 3.6 amps or less to trigger-controlled variable speed. With it, your old  $\frac{1}{4}$ " or  $\frac{3}{8}$ " drill has speeds from zero to full-rated r.p.m.

What you get in the kit is a silicon-controlled rectifier switch, instructions, and wire nuts for making the connections. To convert your drill, you unscrew the handle plate, remove the old switch, wire in the new trigger, and replace the handle plate. If your drill has a drop-body switch like the one shown below (at right), you'll have to file down the raised bosses inside the handle to make room for the new switch.

The kits are sold by Motors-Controls Co., Box 91, Mequon, Wis. 53092. When you order, give your drill make, model number, amp rating, and chuck capacity so they'll know which model switch to send.



Two trigger styles fit most popular  $\frac{1}{4}$ " and  $\frac{3}{8}$ " portable electric drills. Model TS-101 (at top) and Model TS-102 (at bottom) are both rated at 3.6 amps, 110 volts. Kit contains everything you need.



Installation consists merely of removing the handle cover, taking out the old switch (right), and wiring in the new variable-speed trigger using electric wire nuts as shown, or solder-and-tape joints.



With rear wheels off and a heavy trailer attached behind it, this front-wheel-drive Toronado

## Trailer Hitch That's

**This load-equalizing hitch makes for smooth driving when you tow a heavy trailer**

**T**he weight a trailer puts on your hitch can throw your car off balance, cutting traction on the front wheels for steering and stopping. With a big trailer, the tongue load may be as much as 600 to 1,100 pounds; most sedans sag excessively with a load of more than about 300 pounds. But most cars can handle two or three times this without seriously affecting driving characteristics if the trailer is attached with a load-equalizing hitch.

Hitches of this type have been around for a number of years, but a lot of people don't know about them. What one can do is dramatically demonstrated in the photo at the top of the page. It shows how an Eaz-Lift hitch shifts the tongue load to the front car axle and the trailer axle. It does it so well that the front-wheel-drive Toronado shown can be driven with its rear wheels removed. (The rear axle is wired up to prevent it from dragging.)

How does it work? Basically, the hitch acts as a bridge between the trailer frame and the car chassis. But it's a bridge that swivels on turns and flexes on bumps, yet keeps the car from sagging. The secret is

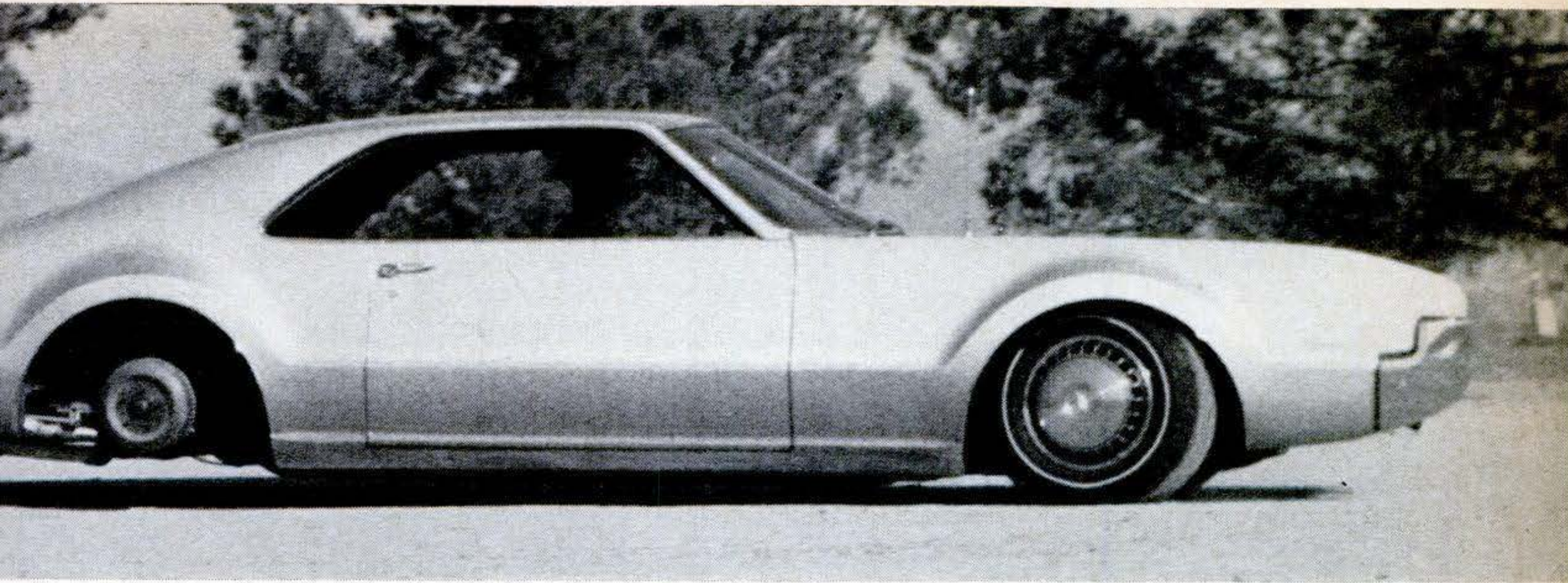
a pair of spring bars that fit into sockets on the hitch head and run back to attach to the trailer tongue.

The spring bars are cinched up and put under tension after the trailer is attached to the car. You do this by hooking the spring-bar chains on a special yoke that you raise using a tire-jack handle as a lever.

This flexing, swiveling bridge formed by the hitch essentially turns the trailer and car frames into a single chassis. The effect is to transfer about a third of the tongue load to the car's front axle and a third to the trailer axles, leaving about a third on the hitch ball. A trailer with a tongue load of 600 pounds would then exert only about 200 pounds on the rear suspension of the tow car.

Some load-equalizing hitches mount on the rear axle rather than on the frame. This type puts no load on the car's suspension system. Springs and shock absorbers take none of the trailer load; instead, all the tongue load is put on the rear wheels of the car, still leaving the car out of balance.

Several companies sell load-equalizing hitches. Prices start at around \$60 and go as high as \$150 including installation. The hitches are also stocked by most trailer-rental outfits. In next month's issue of *POPULAR SCIENCE*, we'll have blueprints that show how you can build a load-equalizing hitch for less than \$15, using torsion bars from a junked Plymouth car.

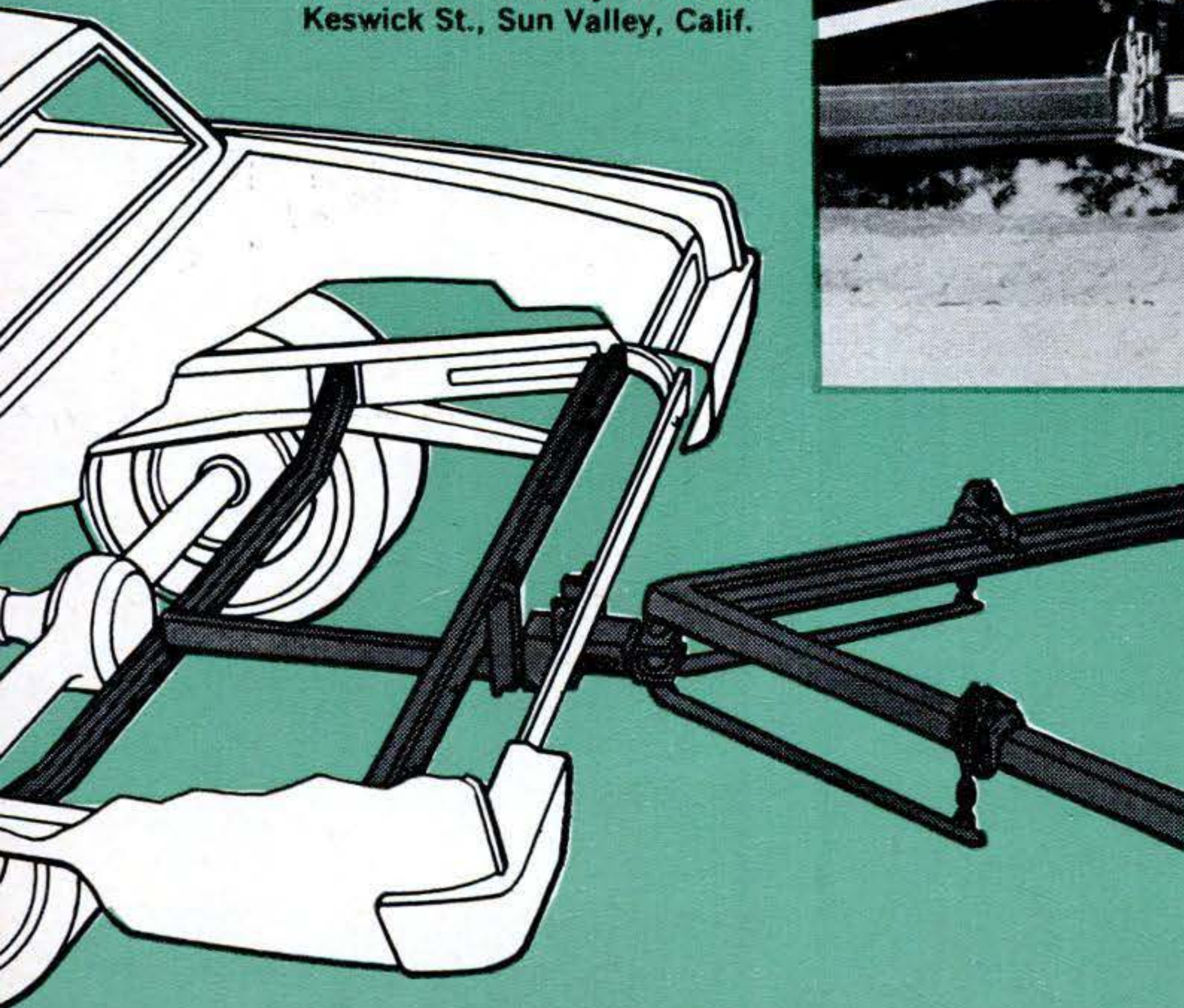
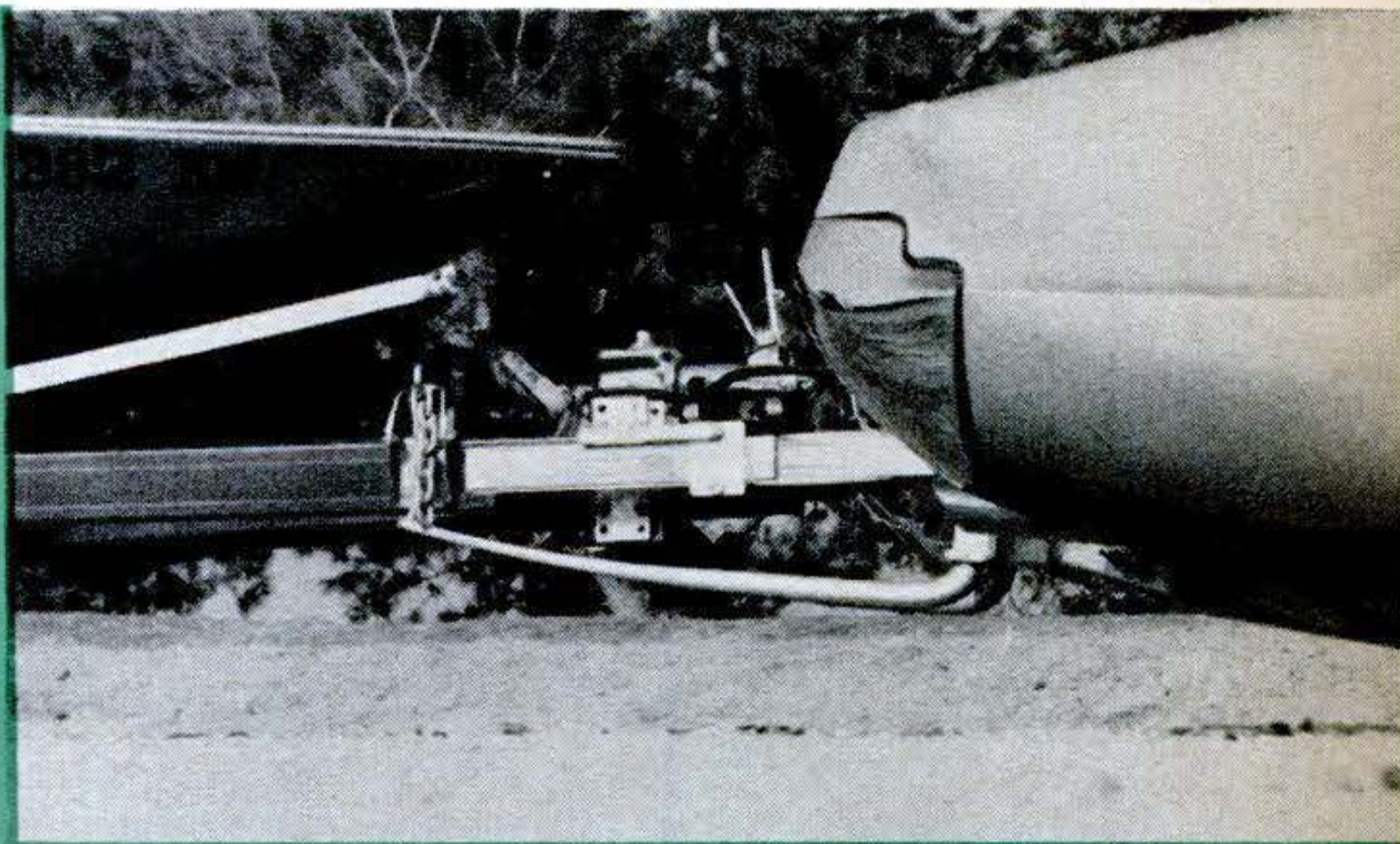


being used to demonstrate how well a load-equalizer hitch distributes the tongue load.

# Easy on a Car

By V. LEE OERTLE

Spring bars form a bridge between trailer and car chassis. The bars flex on bumps but don't let the car sag. Model shown is made by Eaz-Lift, Keswick St., Sun Valley, Calif.



## How it attaches to a car

Braces attached to car chassis carry lifting tension put on the spring bars when you cinch up the chain yokes on the trailer frame.

**How the load is shifted** Heavy tongue loads throw a car off balance, forcing down the rear and reducing traction on front wheels, as shown below, left. A load-equalizing hitch distributes load evenly on car and trailer axles as below, at right.



# How to Add a Kitchen to a Camper

By A. S. RYAN

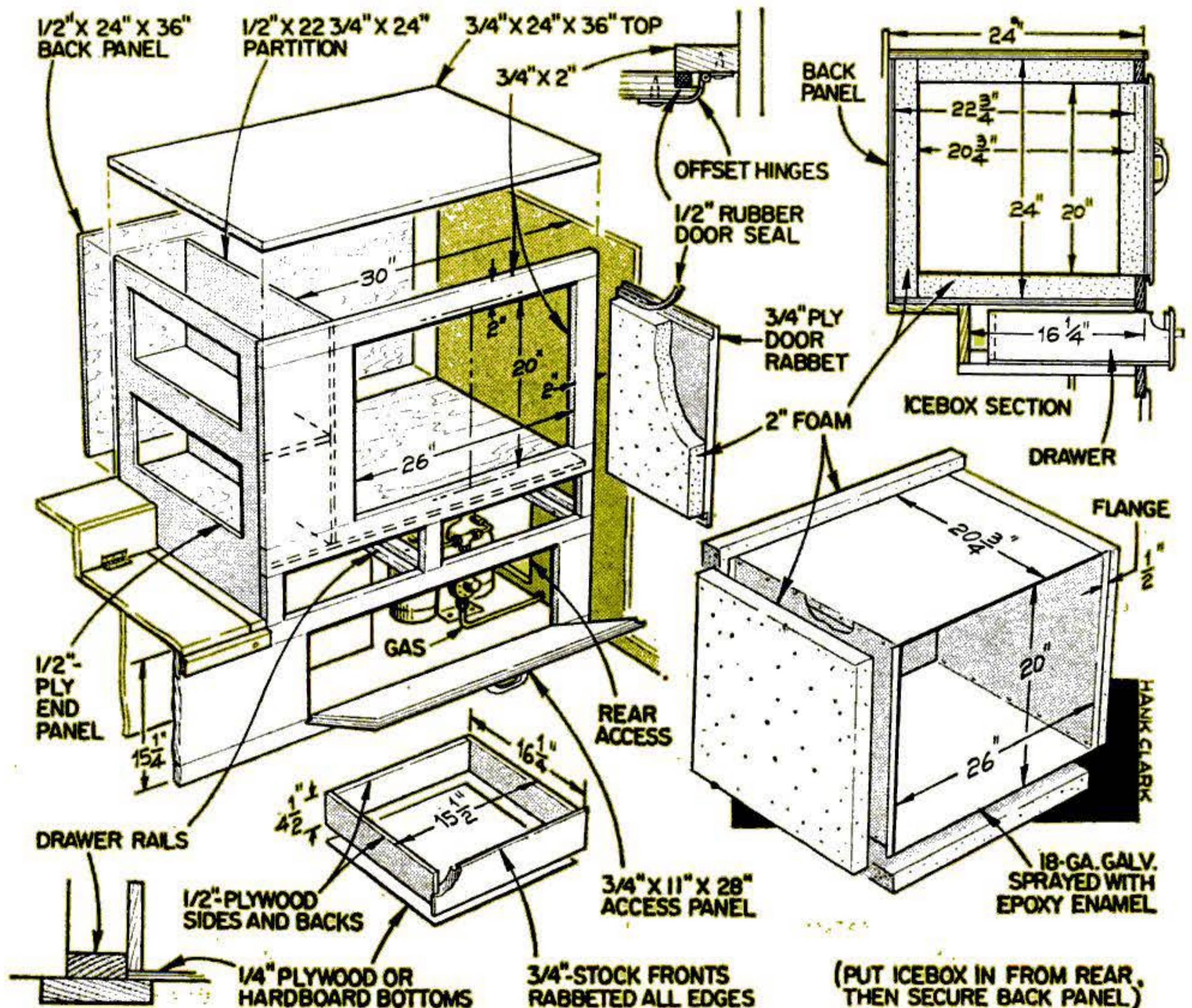
**H**ere's a kitchen that lets you have all the conveniences of home on your camping trip. It has a sink with a water supply, gas stove, icebox, storage drawers and cabinets, counter, seats, and a dining table that converts into a bunk. It fits the expandable camper shown in the blueprint last month; with minor changes, it can be made to fit almost any camper that lacks a kitchen. Everything is contained in two sections that run along each side over the wheel wells.

Before you start building, measure your truck or trailer carefully, and change the dimensions on the plans to suit. Test-fit the parts before putting them together. Assemble the cabinets with 6d nails and a good waterproof glue.

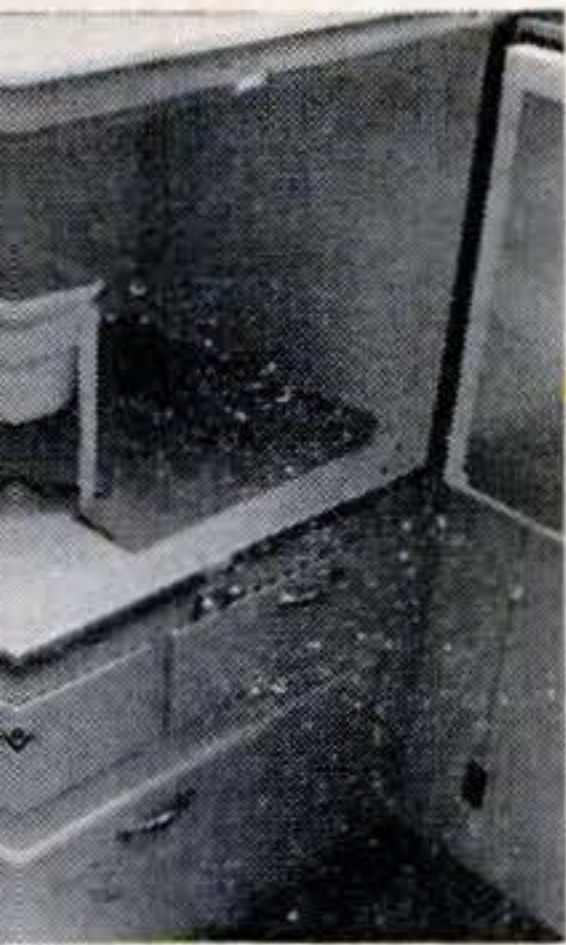
**The big pieces.** First, cut out and put together the plywood panels for the top, back, sides, and partitions of the two counter units. If the kitchen goes into a camper where the rear panels of the camper can be the ends of the two cabinets, you don't have to fit the cabinets with plywood ends. Make sure the panels are put together square.

Add the drawer runners and the shelves before attaching the front trim. Saw up the front trim from  $\frac{3}{4}$ " pine stock. An easy way to assemble these trim pieces is to lay them out on the floor and put glue on all the butt joints. Put bar clamps across the assembly. Make sure it's square; then drive corrugated fasteners into all the joints. Drive them into the side that goes to the inside of the cabinet so they won't show. When the

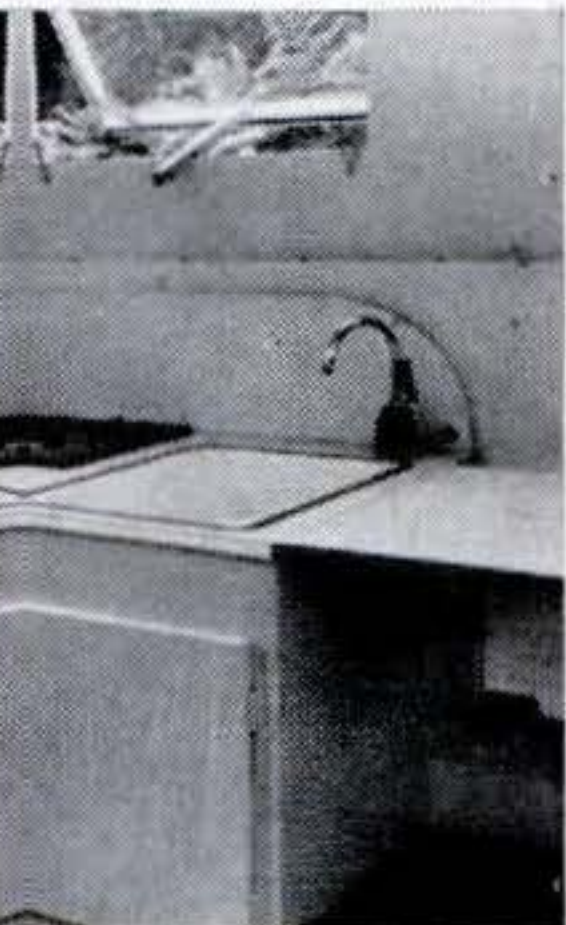
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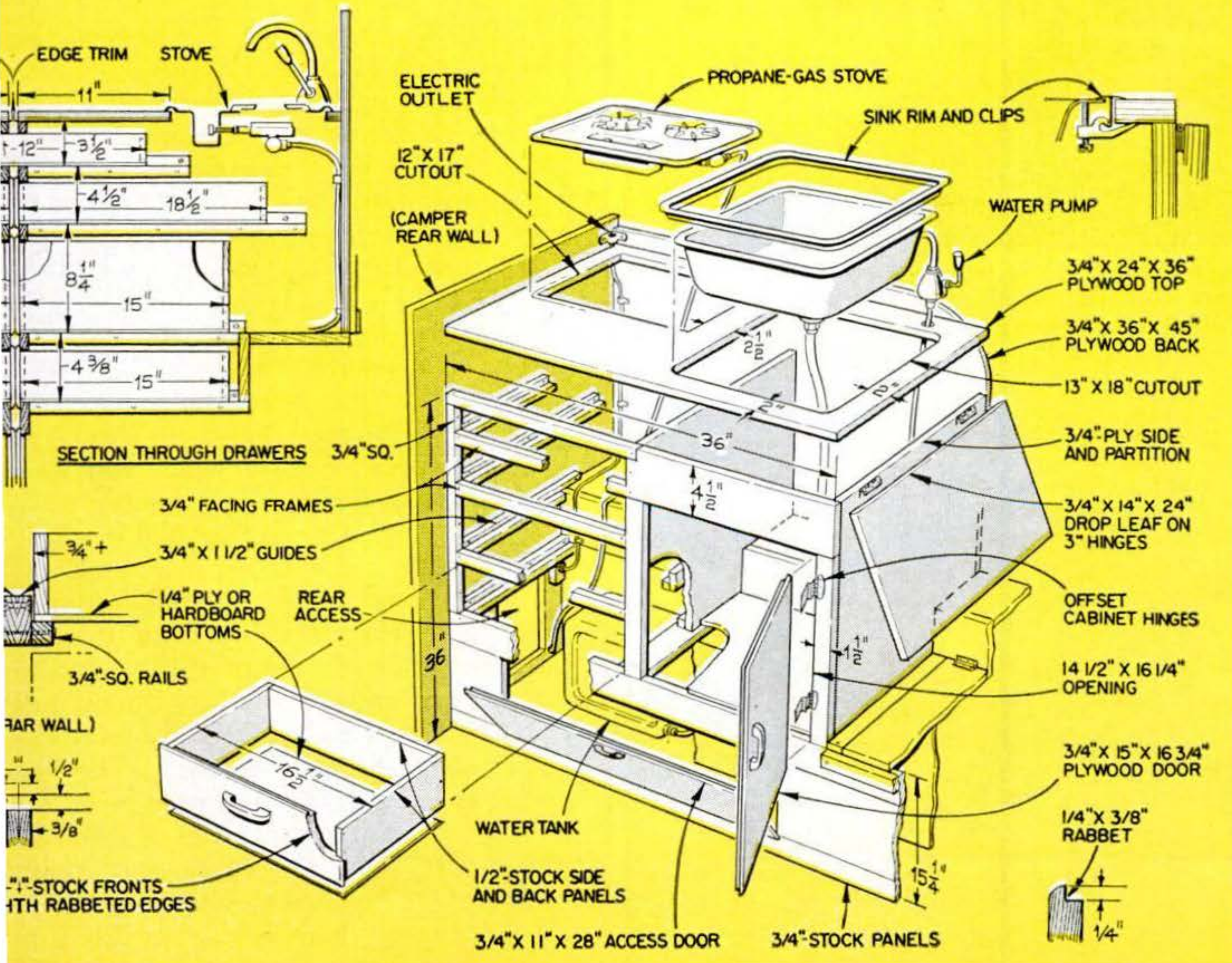
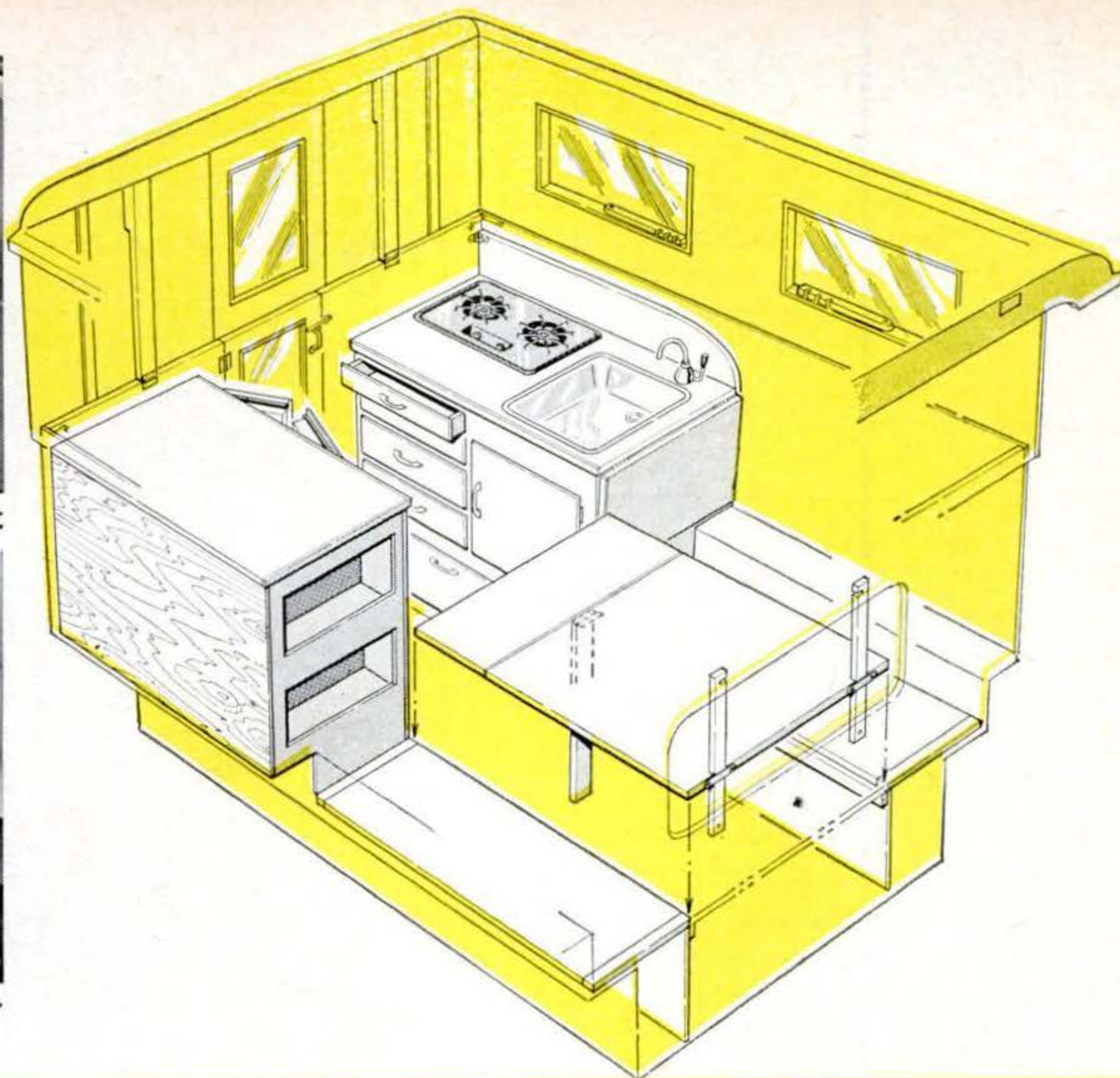




Icebox cabinet



Stove counter



glue is dry, glue-nail the trim to the front of the cabinets.

Build the drawers and doors as shown in the drawings, sizing them to fit the various openings. Put on bullet catches to keep them from opening while traveling.

Install the seats, hinging the lids and attaching one-by-two cleats to the front edge of the storage area. These hold the table in the lowered position to make a bunk.

Make the dining table of  $\frac{3}{4}$ " plywood, hinging a short section to fold up so you can get in and out of the seats on each side. The table seats four—five if one person sits on a camp stool in the aisle. The table attaches to the cab end of the camper with two swing-up brackets, and is supported on the other end with a fold-down leg.

**The icebox.** Make the icebox lining from 18-gauge galvanized steel. Coat it with epoxy enamel and assemble it with sheet-metal screws. Caulk the seams with silicone and insulate it with 2"-thick urethane-foam sheets. Insert the icebox unit through the cabinet rear before attaching the plywood back.

Mount a plastic dishpan big enough to hold a 50-pound chunk of ice inside the icebox on an angle-iron frame. Attach a hose connector in the bottom of the dishpan, and run a drain hose through a hole in the floor.

The sink is the boat-galley kind with a hand pump. Water is stored in a five-gallon plastic tank belted in the storage area beneath the sink. Store a length of plastic garden hose there, too, for filling the tank.

**The stove.** A standard two-burner stove fits in the opening in the counter top beside the sink. The gas line runs from two one-gallon propane cylinders mounted under the rear of the icebox. It runs through a hole in the camper rear panel, along the bottom edge of the panel, and in again on the stove side. Bolt a wood brace to the plywood walls to hold the cylinders in place. And be sure to keep the gas turned off at the cylinders while traveling.

See that the propane tanks and the water tank are installed back out of the way, yet easily accessible through doors in the bottom of the cabinets, or through small doors in the end of the camper, whichever is easier.

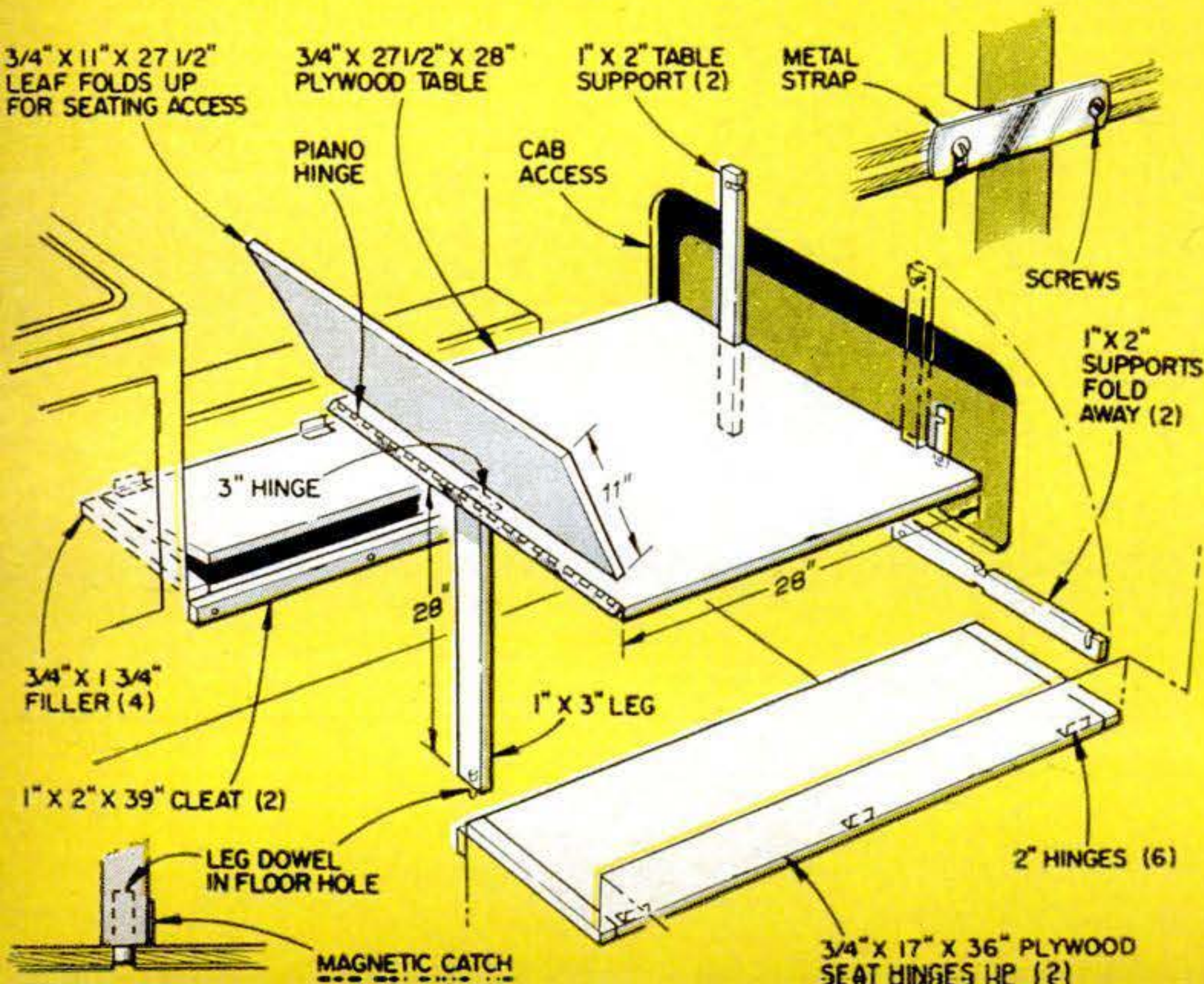
You can wire the camper so you can have lights and run appliances or tools when you stop over at campgrounds where electric hookups are available. Just mount an outdoor receptacle on the end panel of the camper. Run Romex cable from it to a couple of receptacles (one in front and one in back) mounted on the camper wall. Light sockets on extension cords can be run to hang from the camper roof.

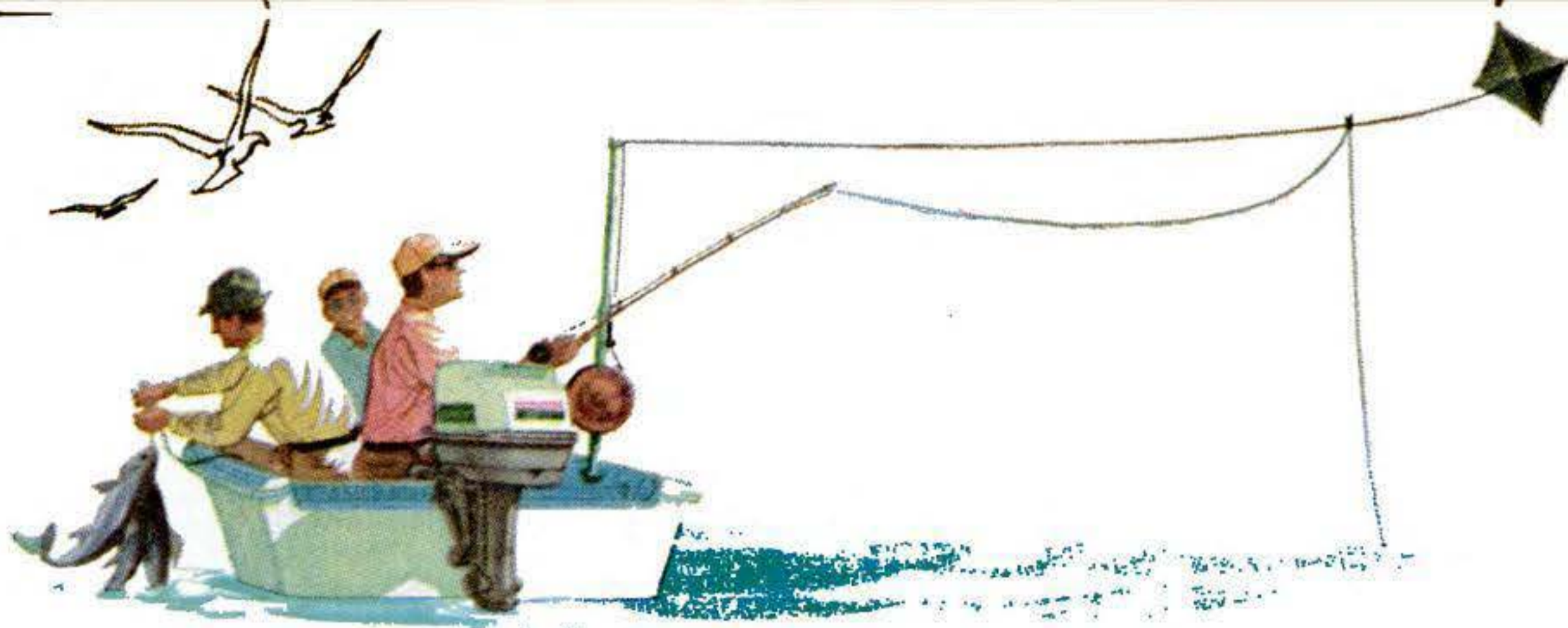
To finish your kitchen, set and putty over the nails, sand rough edges, and coat with a sandable primer. Paint all the outside surfaces with enamel.

### How to build a table that turns into a bunk



Sleeping bunk in the left photo becomes a dining table (right) when you lift up the center section. It's supported on one end by two brackets, on the other by a folding leg. In bunk position, the leg is held up by magnets.





## Way out fun...way In economy

WHEN YOU BUY A BIG JOHNSON TWIN, like the 40, you get a two-fisted machine that lends itself to flight or fishing, skiing or cruising. An outboard that creates fun very quietly. (No Sea-Horse is allowed to speak with anything but a soft voice.)

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Gus held the card against the other tailpipe. The card jerked feebly and irregularly.

## Gus Takes a Busman's

**It was a rare day off for Gus and he was out for trout—but when his pal's car started acting up, guess who got hooked?**

**By MARTIN BUNN ILLUSTRATION BY RAY QUIGLEY**

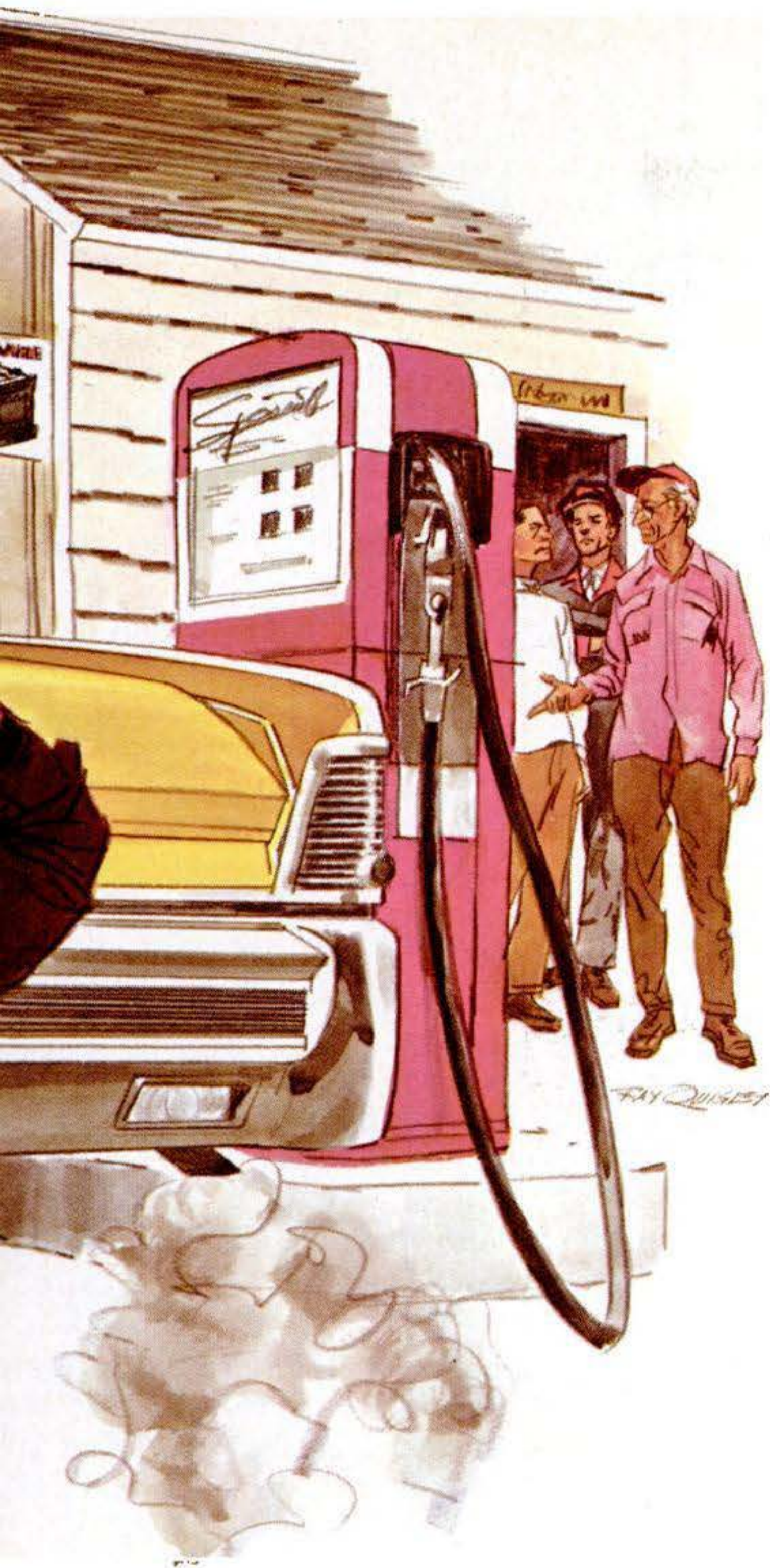
**W**ith a whisper of brakes, the big Lincoln Continental pulled up before the Model Garage, where Gus Wilson's coupe stood packed and waiting with Doc Wilder inside.

As the driver of the Lincoln blew his horn, Gus came out of the shop, grinning at the three occupants of the big car.

"Congratulations!" he said. "Eight o'clock. Fine way to start a fishing trip."

Sam White, a local used-car dealer who wore a floppy white hat and a gold-capped grin, nodded.

"Pete and Ed both overslept, but we'll still make the lake by five this afternoon. We'll even start supper," he added, "so you



# Holiday

can eat with us soon as you wheel that ice truck of yours in, say about seven.”

“Fine. I hate to cook,” confessed Gus. “You both going to ride this road locomotive?” he asked the two passengers. “I have room for one more besides Doc.”

“I’ll stay here,” said Ed Hastings from the front passenger seat.

Pete Vancourt, a lantern-jawed, black-haired younger man sprawled in the back seat, waved a hand.

“Me, too. Man, this set of wheels is solid luxury. Why fight it?”

“I’ll follow you, just to make sure your

crate keeps rolling,” retorted Gus. “You’re carrying the tent, and I don’t want to sleep on the ground.”

“It’ll be set up,” returned White, “long before you get there.”

**Throughway traffic** was already brisk this Friday morning with people off to an early weekend. He’d been lucky to get away himself, thought Gus. Three repair jobs were ready to deliver, and Stan, his assistant, could easily finish the last one this afternoon. For once, Gus wouldn’t be in for the Saturday half day.

The Continental had swept past early in the trip, amid good-natured jeers from its passengers. Gus had waved them on, holding to the legal speed of 60. White probably would beat him to the lake. Gus didn’t care. He was anticipating the quiver of his rod as a fish took the bait, the thrill of seeing a silvery form leap...

Miles sped by. Doc Wilder, his scrawny figure slumped comfortably in a manner no posture-conscious physician would have approved, suddenly awoke with a snort.

“Huh? Are we there? What’s up?”

“You woke yourself, making like a walrus coming up for air. We aren’t there.”

“Seen the other fellows?”

“They hightailed past us. Guess Sam held back till we got on this road, just for the satisfaction of scorching by.”

“Grand day,” said Wilder. “Glad I came up from Florida. Getting hot there.”

Gus grunted amiably, changed position, and settled back for the drive.

**Hathaway Lodge**, a synthetic-timbered structure adjoining a fuel-and-service complex, was the place the group had agreed to stop at for lunch. Gus was surprised to see no sign of the Lincoln, for all three men were hearty eaters who should by now be ordering dessert. Or was White so intent on being first at the lake that they’d eaten and run?

But Gus and Wilder had just been served when the three men marched in and, after a shuffling of chairs, sat down.

“Stopped for coffee?” asked Wilder.

White harrumphed, his red face sour. Vancourt opened and shut his mouth without comment. Ed Hastings yawned.

The meal was less than festive.

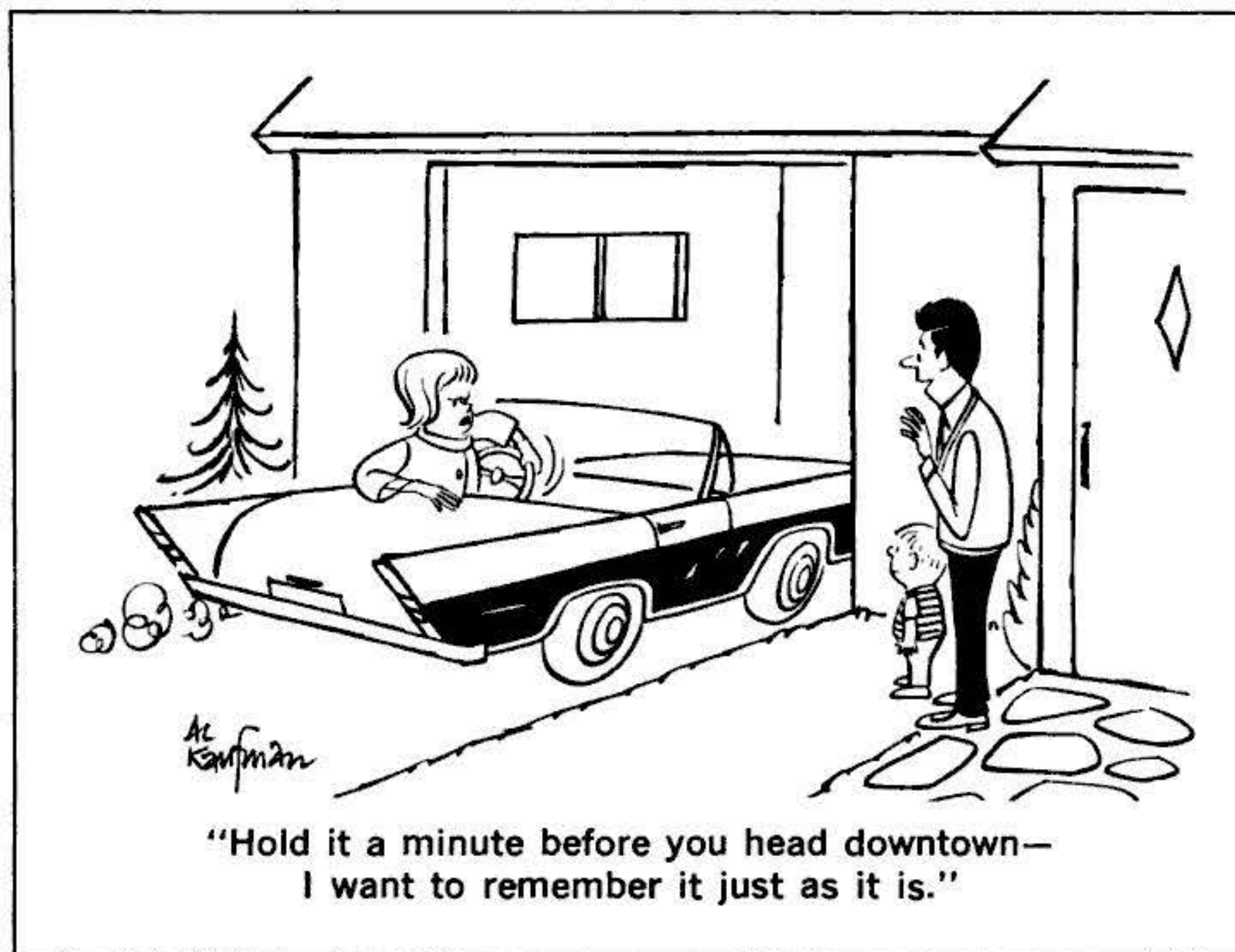
Gus pulled out first, reached 60, and waited

*Continued*

for the Lincoln to roar by. It didn't. In fact, Gus lost it in the rearview mirror twice, and eased up on the throttle. When the posted limit went up to 65, an increase to that speed left the big car far behind. Uneasy, Gus slowed again.

A big FUEL FOOD REST sign flitted by, and a moment later the Lincoln's horn blared repeatedly. In the mirror, Gus saw White making frantic off-the-road gestures. Gus pulled into the stop, and the Lincoln rolled up to a fuel pump.

"Anything wrong besides needing gas?" asked Gus, climbing out for a stretch.



Sam White glared at him.

"We stopped at a service area to look things over," he admitted.

"Car's lost all its pep," put in Vancourt. "It won't do over 60."

"And that's with the pedal down to the floor," growled White. "My mechanics are going to hear about this. Somebody goofed on the tune-up."

"But we couldn't find where," put in Hastings.

"And if that ain't enough," grumbled White, "she guzzles gas like I owned a well. What it took to get here figures out at something like six miles a gallon."

Gus whistled. Opening the hood, he looked at the automatic choke and manifold heat valve. Both were free and in normal position for a hot engine. There wasn't a trace of gas leakage. Plugs and wiring harness were almost new; the distributor cap looked flawlessly clean.

"Let's hear it," said Gus.

Having paid the attendant, White started the engine. Gus listened intently, then walked behind the car and listened some more. When White joined him, Gus was holding a bit of card against one of the twin tailpipes. It fluttered with an even rhythm. Gus moved it to the other tailpipe. The card jerked feebly and irregularly.

"What's that for?" demanded White suspiciously.

"Just a minute," said Gus. He went into the station and spoke to the attendant, then made a phone call from the office. When he came out, White was gunning the engine.

"It's two-thirty," declared Gus. "But there's a Lincoln agency in Doverville we can reach before they close at four."

"Hey, now wait. What for..."

But Gus was already in his own car. Sorely puzzled, White followed it.

**With the Lincoln on a lift,** an agency man dismantled the left-hand exhaust system. When it lay on the floor, Gus picked up what seemed to be an extra muffler and took it

to a workbench. With a hammer and chisel he opened the casing.

"A hard-head like you would never have believed me," he told White. "So look."

"Kind of corroded," muttered White.

"Uh-huh. Which loosened this piece, which was blown up against this, blocking the passage of exhaust gases to the muffler. They couldn't get through the crossover to the other muffler, because the crossover comes *after* the resonators. One bank of your V-8 engine was strangled. It couldn't get rid of exhaust gases, so it couldn't breathe in. It was hardly firing."

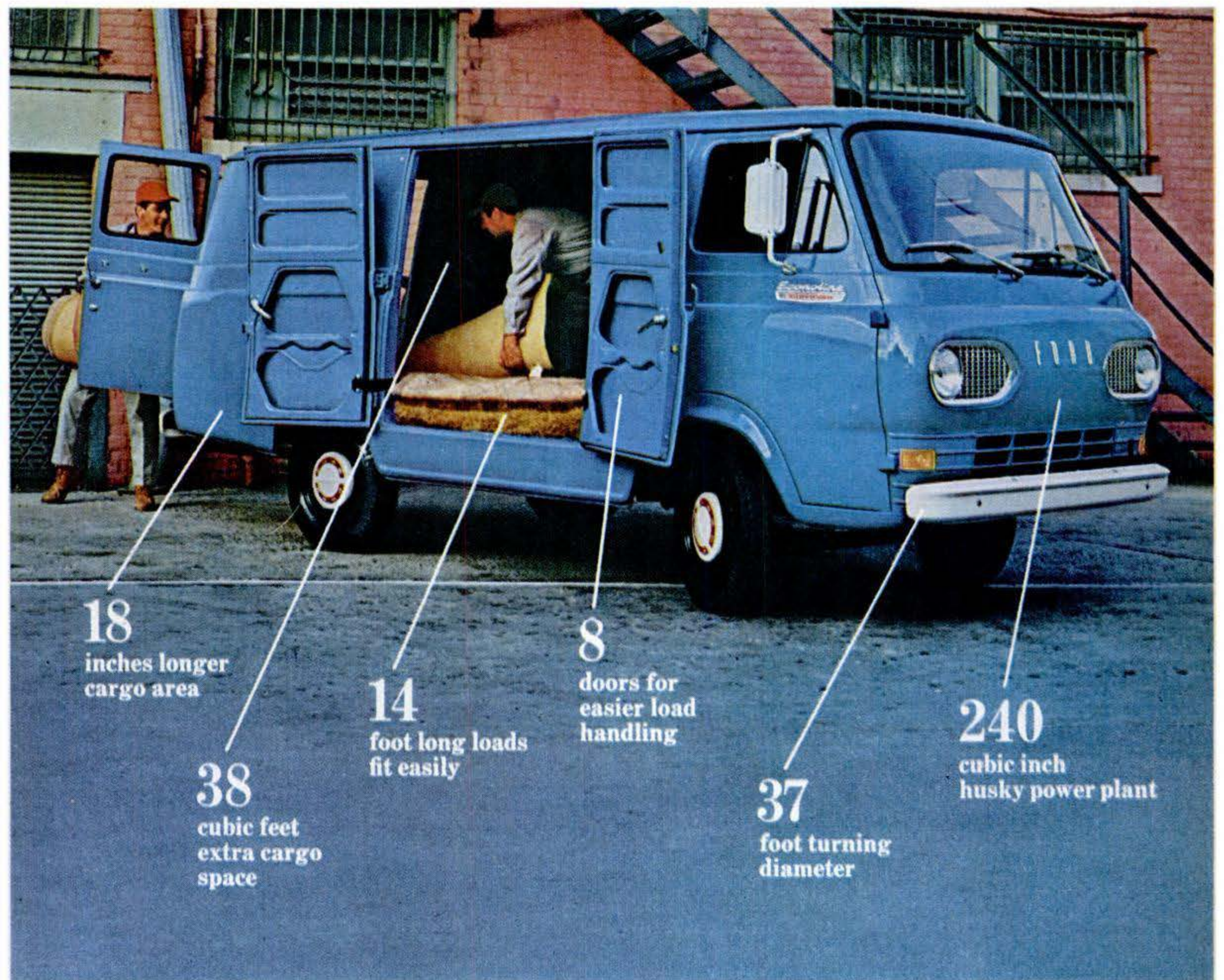
"No wonder it had no pep."

"You were driving on half an engine. At full throttle, it could only get you to 60. I kind of think," added Gus with a grin, "that plate blew soon after you highballed past me back there."

"Okay, don't rub it in. But if only half the cylinders were taking gas, how come

*Continued*

# How to win the numbers game:



**18**  
inches longer  
cargo area

**38**  
cubic feet  
extra cargo  
space

**14**  
foot long loads  
fit easily

**8**  
doors for  
easier load  
handling

**37**  
foot turning  
diameter

**240**  
cubic inch  
husky power plant

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**The right van for your job!** That's what you're sure of with a Ford Econoline that can be custom tailored to your individual requirements.

Need greater cargo capacity? Ford SuperVan offers 38 cu. ft. more. You can carry extra long, 14 foot items—*with rear doors closed.*

Need easy access? Econoline offers enough doors to stock a clubhouse locker room. Two doors up front, four amidship, and two more in the rear. Deliveries are no longer restricted to first-in—last-out loading. Routing speeds up; costs come down.

Need power? Both Ford's 170 cu.

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## FORD ECONOLINE

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IN THE SAME  
37' CIRCLE**



fuel mileage dropped into the basement?"

"You had to floor the gas to do 60, didn't you?" asked Gus. "So what happens with an automatic shift when you jam the throttle down to the floor? It downshifts to intermediate. So you were probably driving in that most the time."

White muttered some harsh words.

**Their lake stay over**, replete with a day and a half of fishing and of dining on trout and pickerel, the group pulled out Sunday afternoon. Gus again let the Continental lead, and it rapidly pulled away.

There was little traffic this far north, but it gradually thickened. Late that afternoon Gus and his passenger—Ed Hastings this time—reached the eating spot the group had agreed on. White, Vancourt, and Wilder were already seated.

"Had to wait for a table, muttered White, "or we'd have been out of here."

"You suppose he wants to get back to business so he can unload that lemon of his on some customer?" bantered Vancourt.

"It's not for sale," snapped White. "Thanks for the diagnosis, Gus. Might've burned the valves if you hadn't spotted the trouble."

Nodding, Gus studied the menu.

"Well, now, how about some nice fish?"

A chorus of groans answered him. Gus stayed behind to get gas after the Lincoln pulled out. As the attendant put back the cap, a small sports car with a young man and a pretty girl steamed in, vapor billowing from under it. The driver leaped out and gingerly took off the radiator cap. A geyser spouted.

"Okay if I take some water?" he asked.

"Help yourself," said the attendant.

The young man swiped aside a shock of hair that eluded his beret.

"I know it's no good asking, but you got a fan belt for this Triumph?"

"You just said it," said the man. "No good asking. You aren't going to get a Triumph belt anyplace on a Sunday."

"Don't I know it? Been trying for 40 miles. We're due back at Milford College tonight. That's 160 miles. With the engine boiling like this, we'll never make it. The battery was weak to begin with, and now that the generator isn't charging it'll probably go dead pretty soon."

The attendant turned away, shaking his head. Gus motioned the driver aside.

"That girl of yours," asked Gus, "does she go for the Mod look, or wear nylons?"

The young man bridled. "What's it to you?"

"Only that if you can get a stocking from her," returned Gus, "we might rig you some kind of fan belt."

The glare on the young man's face faded. He went to the Triumph and spoke quietly. Bending over, the girl presently handed him a filmy handful of fabric.

Gus took it from him and ran the stocking around the water pump, generator, and crankshaft pulleys. After making a tight knot with the driver's help, he cut off the excess. The young man filled the radiator.

When the engine was started, the improvised belt tracked perfectly.

"I've seen this work before," said Gus, closing the hood, "but not for 160 miles."

The girl laughed. "I have more nylons."

"The generator's charging, too," said the young driver. "Sure am obliged to you."

The little car roared off.

"Busy vacation you're having, aren't you?" remarked Hastings as Gus got in.

"Fellow was in a jam. But he's just learned something us oldies have known a long time." Gus winked. "Never underestimate the power of a pair of nylons." **PS**

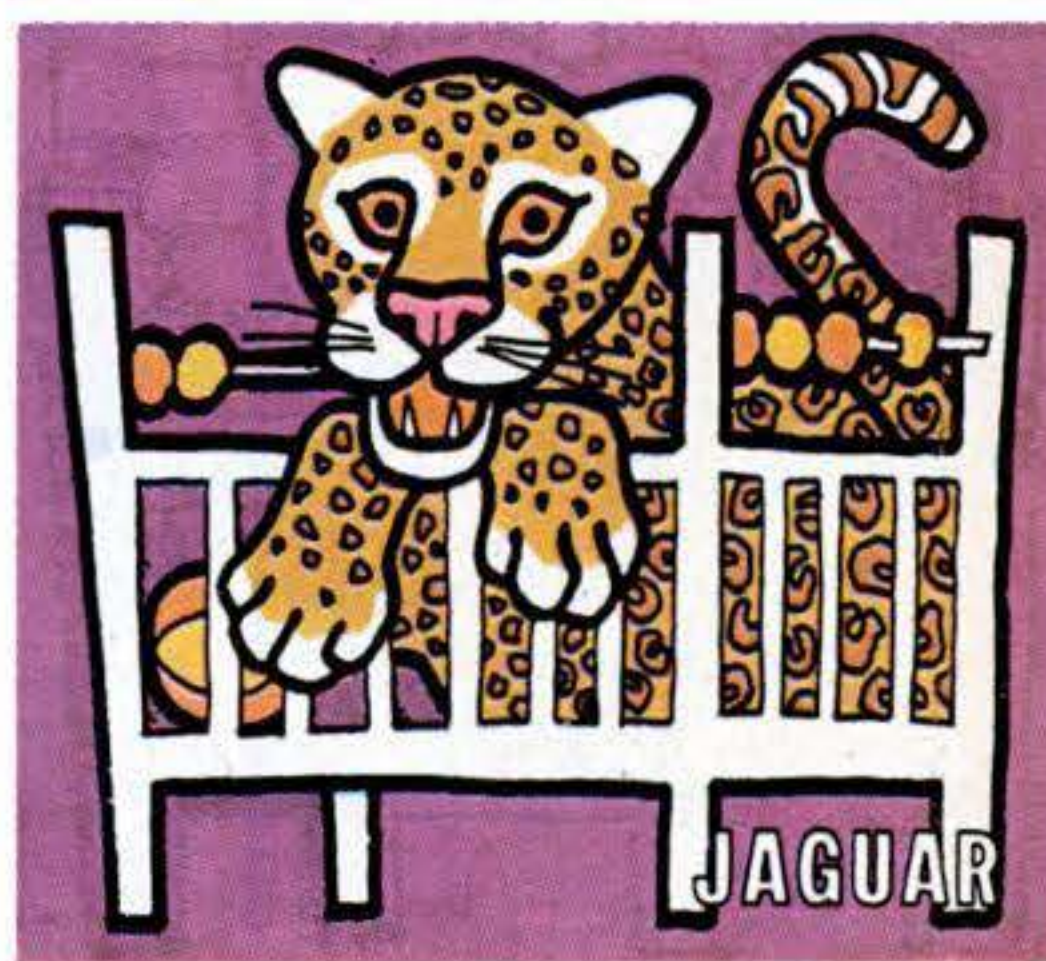
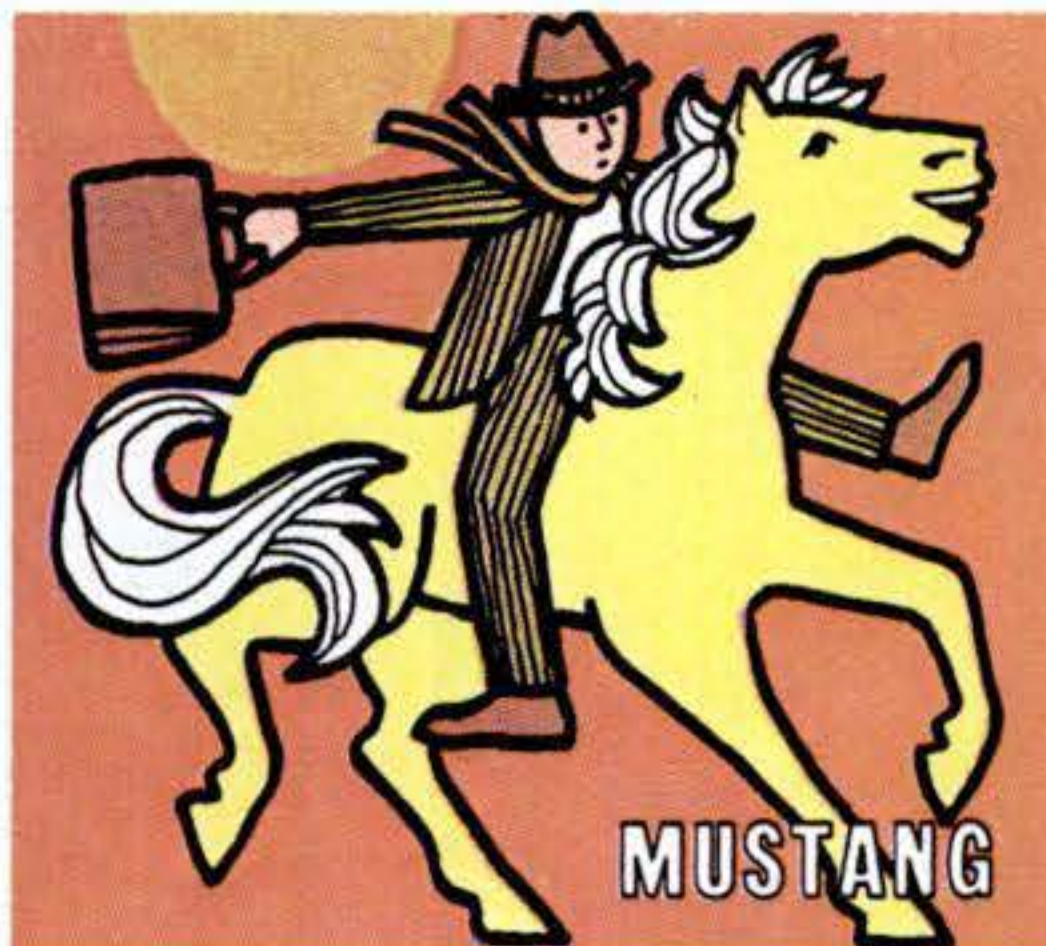
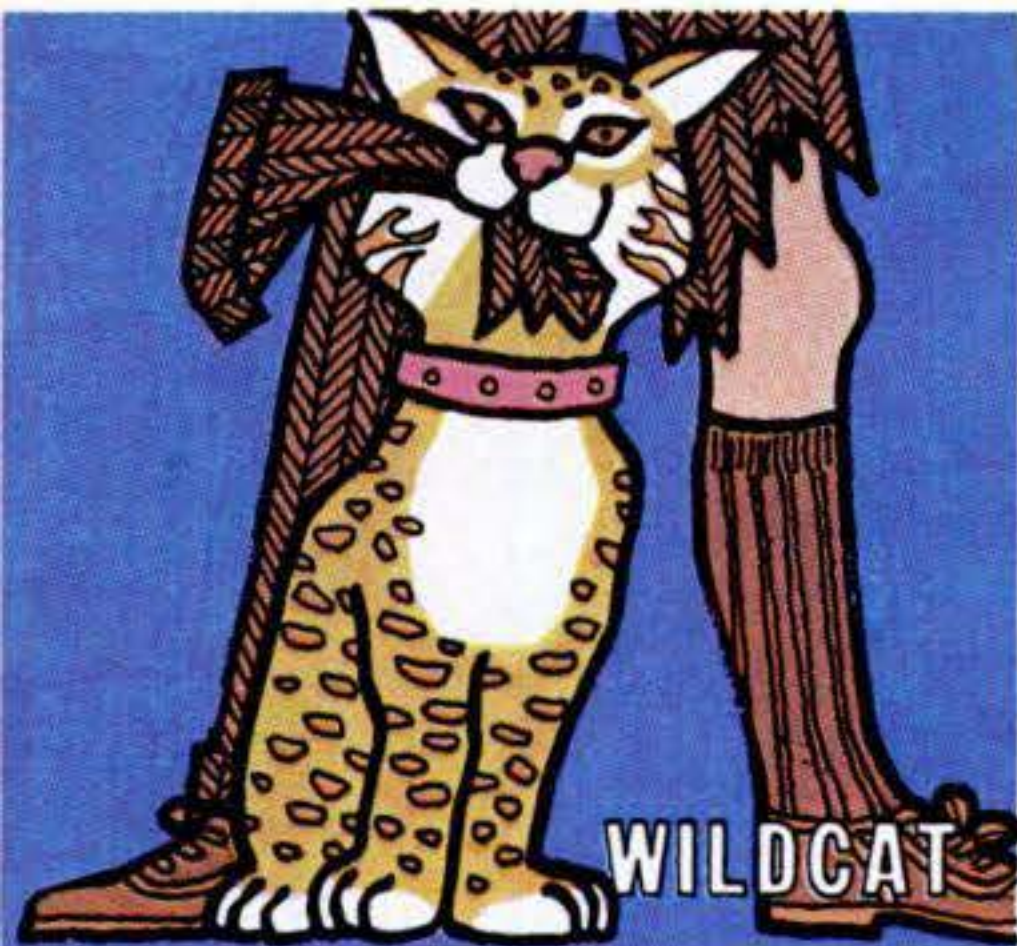


### The Imp goes fastback

The Californian is the first fastback in the Sunbeam Imp family. It has a roof line two inches lower than the standard Imp, for a 52½-inch overall height, and a sharply raked rear window. A 42-hp. overhead-cam engine with 10:1 compression ratio, at the rear of the Californian, takes it to 80 m.p.h.



# Win a Pet



or a car of the same name



BUICK WILDCAT



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RAMBLER MARLIN



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wherever they sell Du Pont Golden "7".

## 6 GRAND PRIZES.

The first sweepstakes winner has his pick of the pets. Any one of the six cars. Second winner picks from the remaining five cars. And so forth . . . down to the sixth winner who gets the car that's left. (Animal lovers may choose a real beast instead of a car.) And all you do to enter is fill in and mail a free entry blank. Get one wherever they sell Golden "7" and other Du Pont Auto Products.

## 777 OTHER PRIZES.

Besides the six grand prizes, Du Pont will give RCA 25" color TV sets to the next 15 winners. Then, 15 Harley-Davidson motor scooters. 50 Bell & Howell movie cameras and projectors. 100 AMF Renegade bicycles. 597 Thermos picnic chests. 777 winners in all. (Win a Pet sweepstakes closes June 30, 1967. Void where regulated or prohibited by law.)

Better Things for Better Living  
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## GOLDEN "7".

The motor oil additive that makes cars take off. Like a whisper. (1) Golden "7" boosts compression. (2) Gives you all the horsepower your engine has to give. (3) Helps stop oil burning. (4) Quiets the engine and valves. (5) Protects all working parts. (6) Cuts engine wear. (7) Cuts engine repair bills.

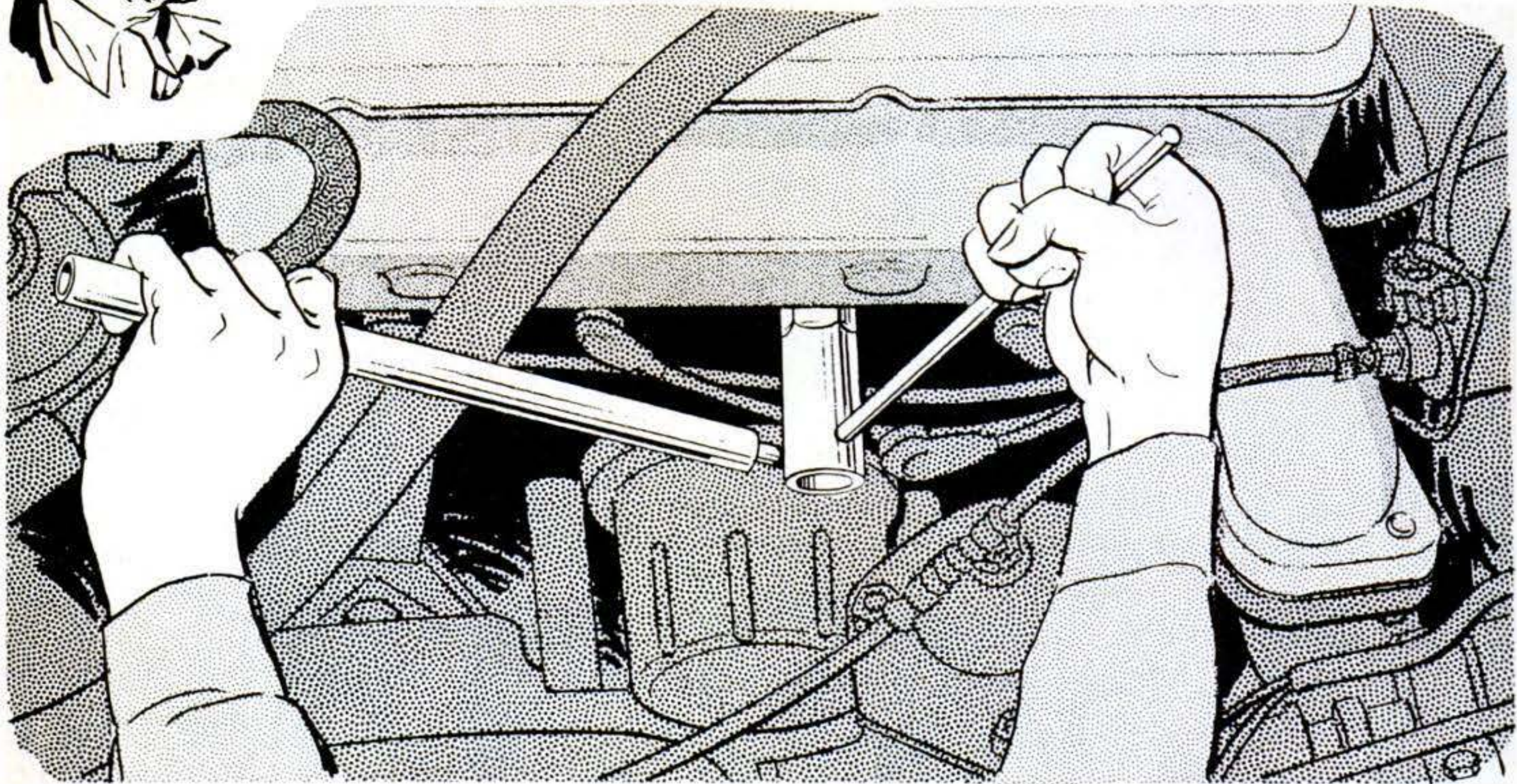


Look for these and other high-performance Du Pont No. "7" car care products.



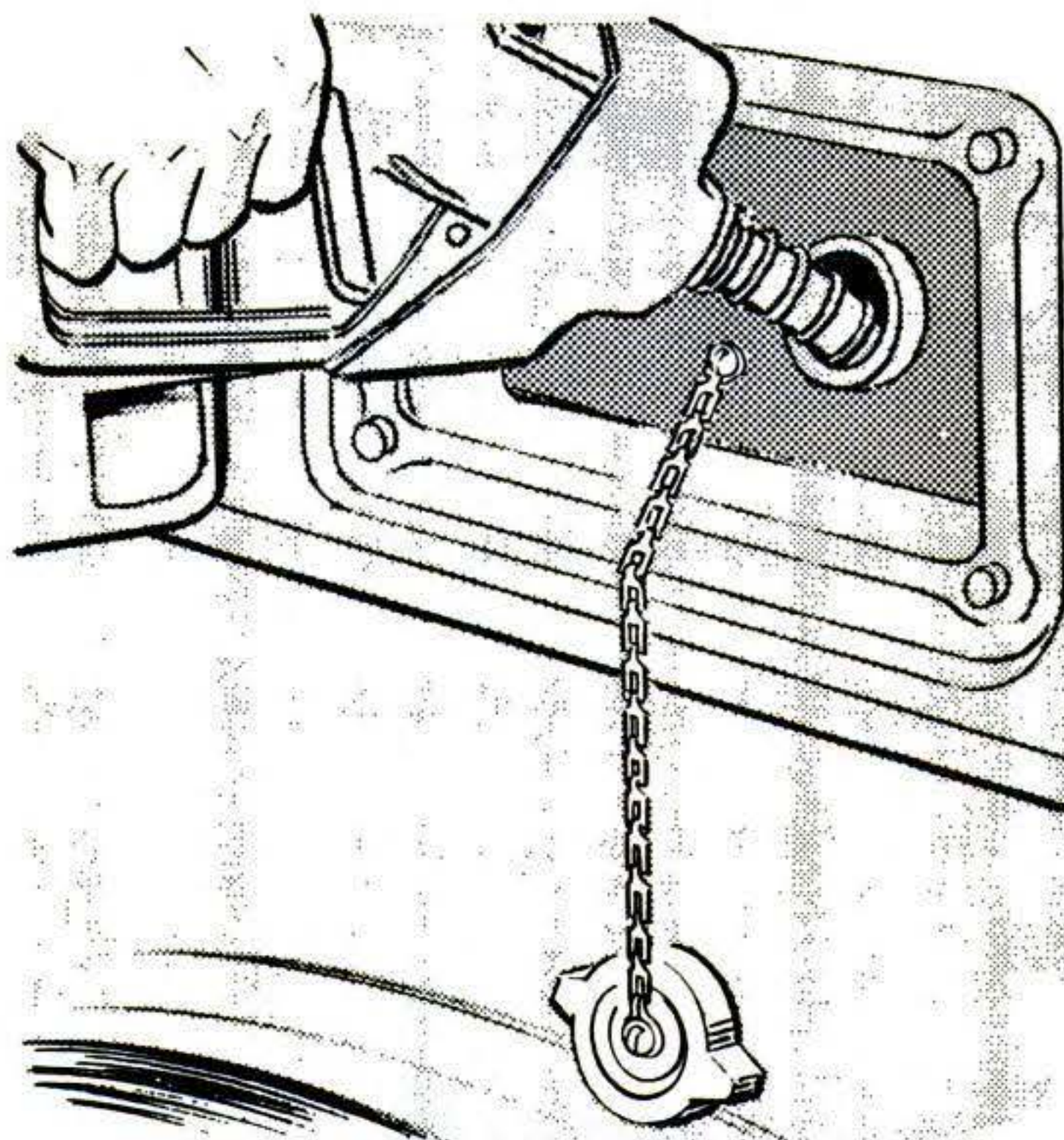
# Hints from the Model Garage

DRAWINGS BY DAN TODD

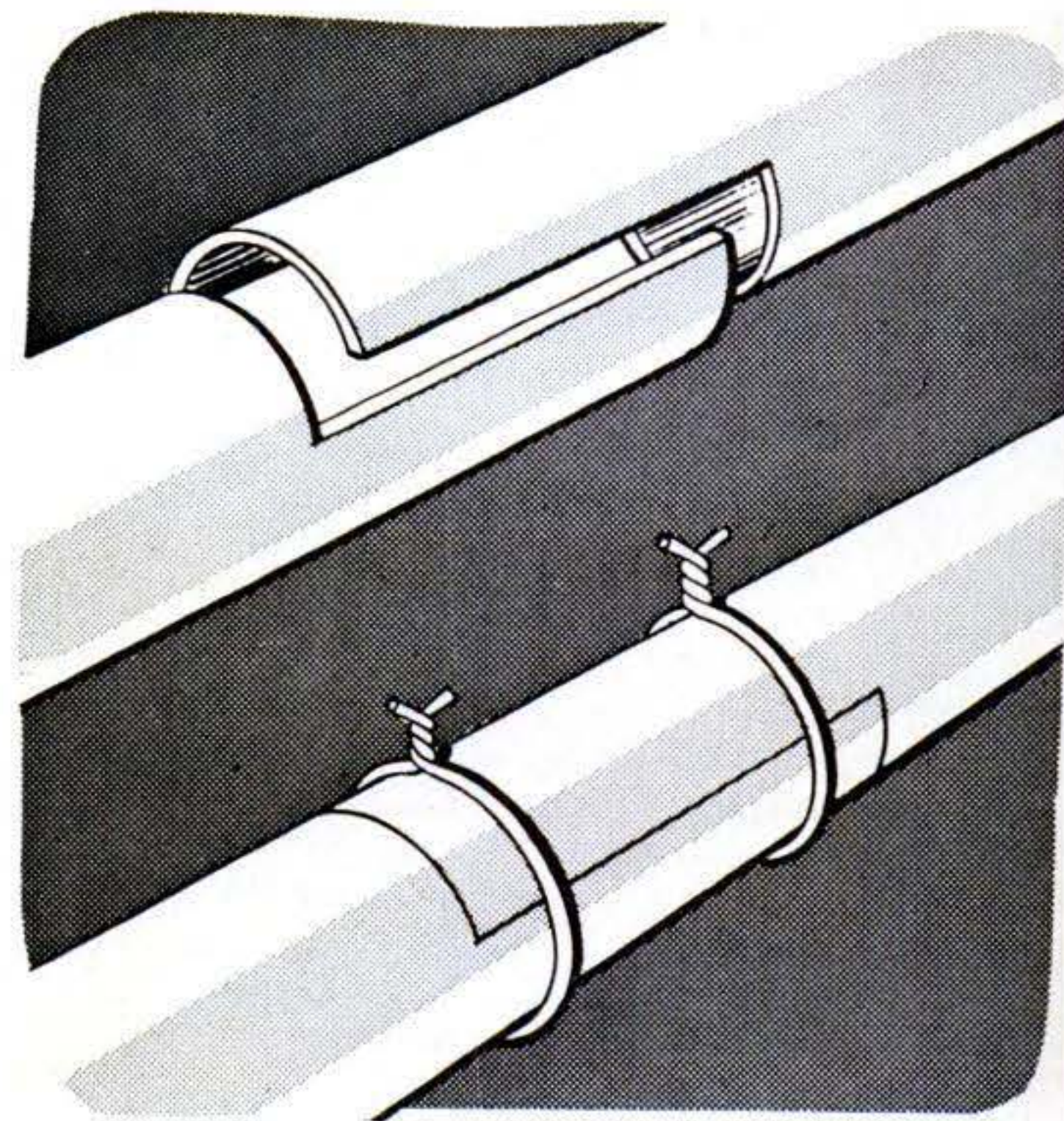


**Tight spark plugs** in awkward locations that will not come out with an ordinary plug wrench, may be loosened with a long L-shaped handle instead of the short one in an ordinary wrench. The L-shaped handle may be a suitable length of quarter-inch steel rod. The two legs of the

L provide extra leverage and let you use both hands to break stubborn plugs free. Using both hands also helps keep the socket steady on the plug. Additional leverage—and even more steadiness—can be obtained by slipping a piece of pipe over one of the legs.



**To avoid losing the cap** on your fuel filler neck, or leaving it at a gas station, hook it to a chain. Use a 10-inch length of chain and secure it to the panel around the filler neck with a self-tapping screw. The other end of the chain should be screwed or brazed to the filler cap.



**To join two lengths of fuel-line tubing** when you don't have a proper union or a flaring tool, cut an inch-deep cross sector out of each line to give a stepped joint. File the ends for a tight fit. Fasten the joint with two wire loops, solder the center portion, and remove the wires.

This 2 level house and garage were painted 4 years ago. The colors are so bright they look like they were painted last week. That's the superb color retention of Dutch Boy Latex House Paint.



A beautiful house with a beautiful paint job done in 1964. Dutch Boy Latex House Paint makes the difference—200 years of paint-making experience.



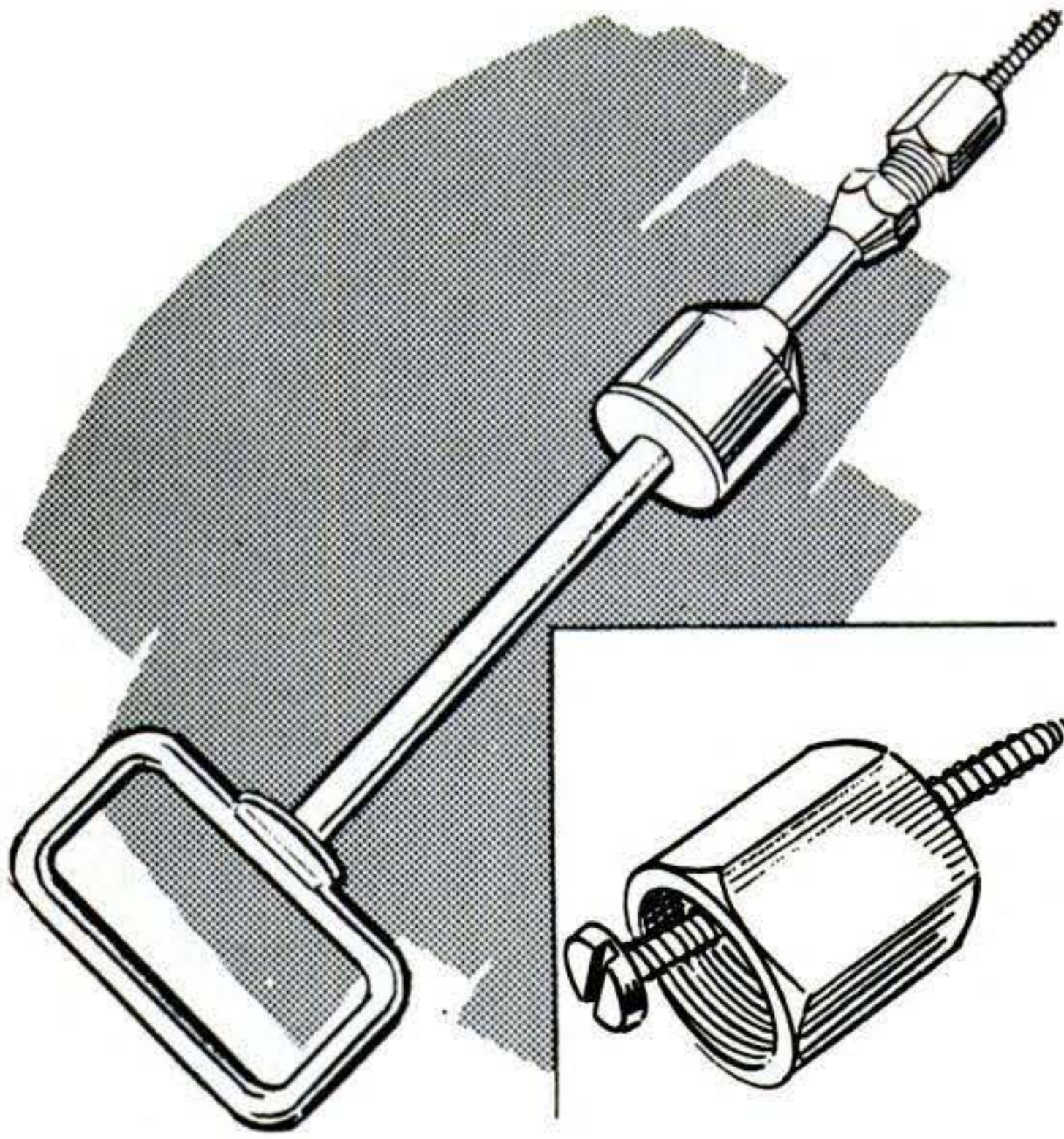
This house? Painted 6 years ago and not one sign of peeling! When used with PBL (Penetrating Bonding Liquid), Dutch Boy Latex House Paint is guaranteed against peeling from a sound previously painted surface for 5 years.



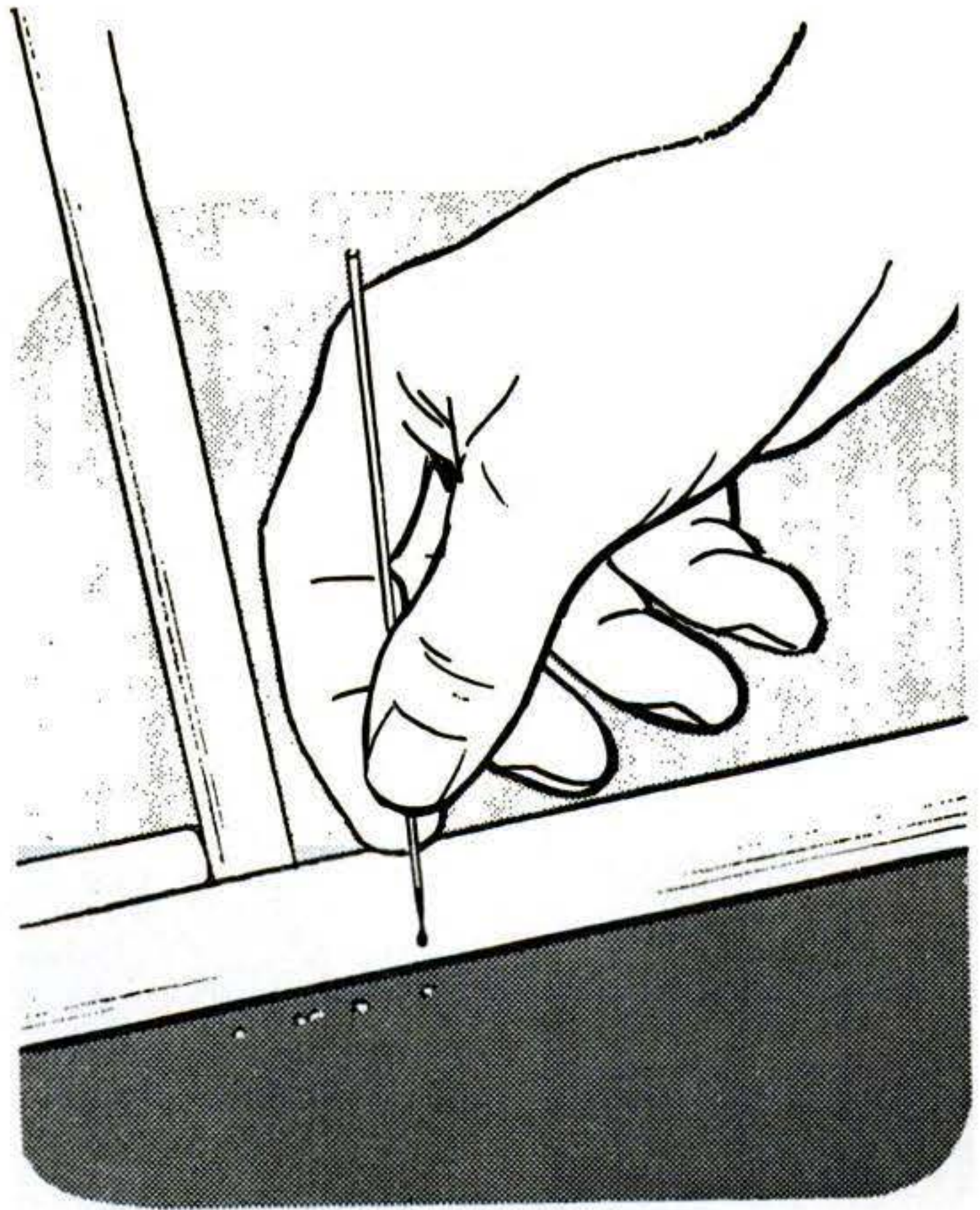
This can has it all! Exclusive formula with 100% pure acrylic latex. Plus 200 years' experience. Plus superior color retention. What more could you want from a paint?

**All Latex House Paints  
are not the same.  
Dutch Boy<sup>®</sup>  
makes the difference.**

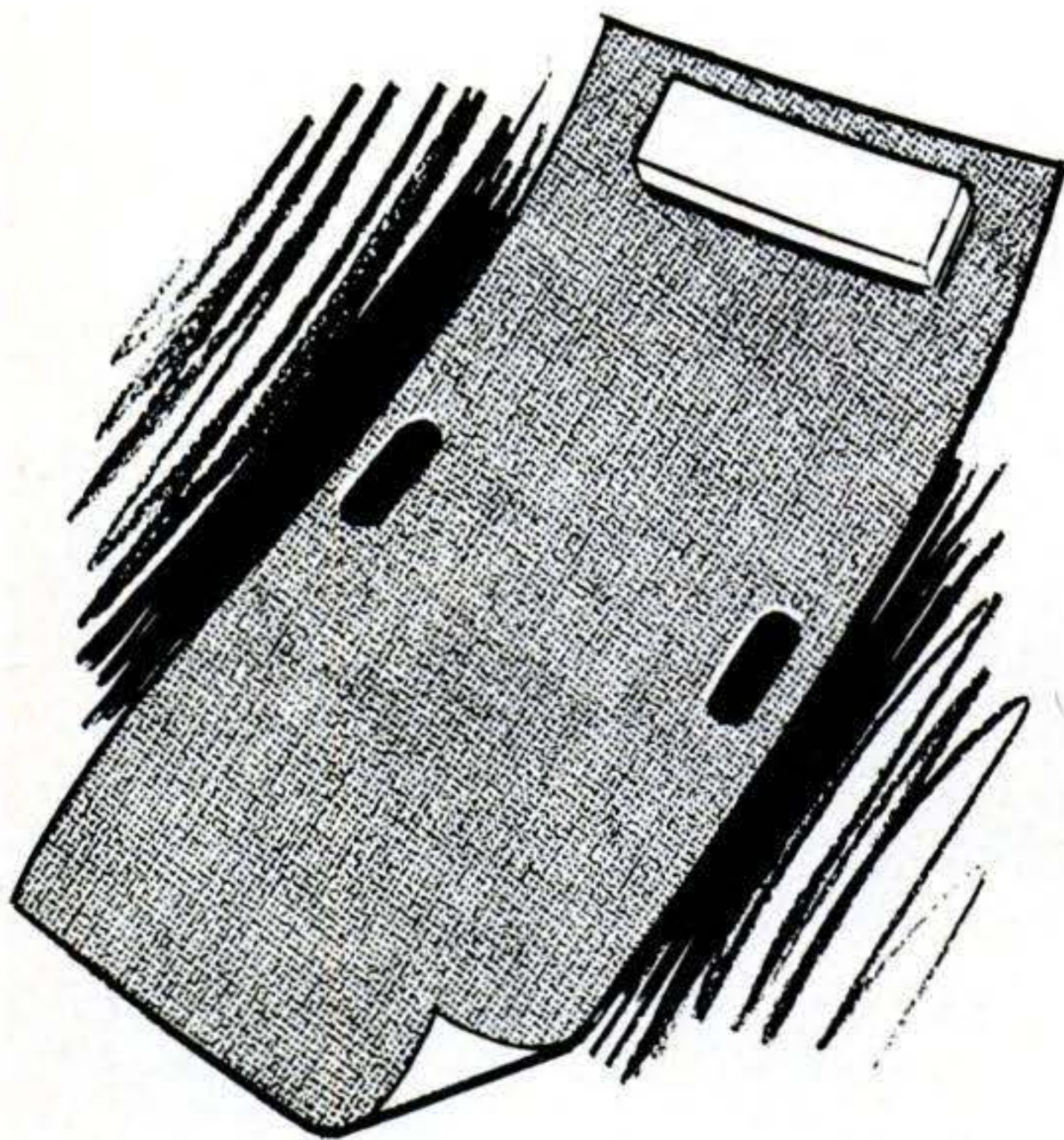
## More Hints from the Model Garage



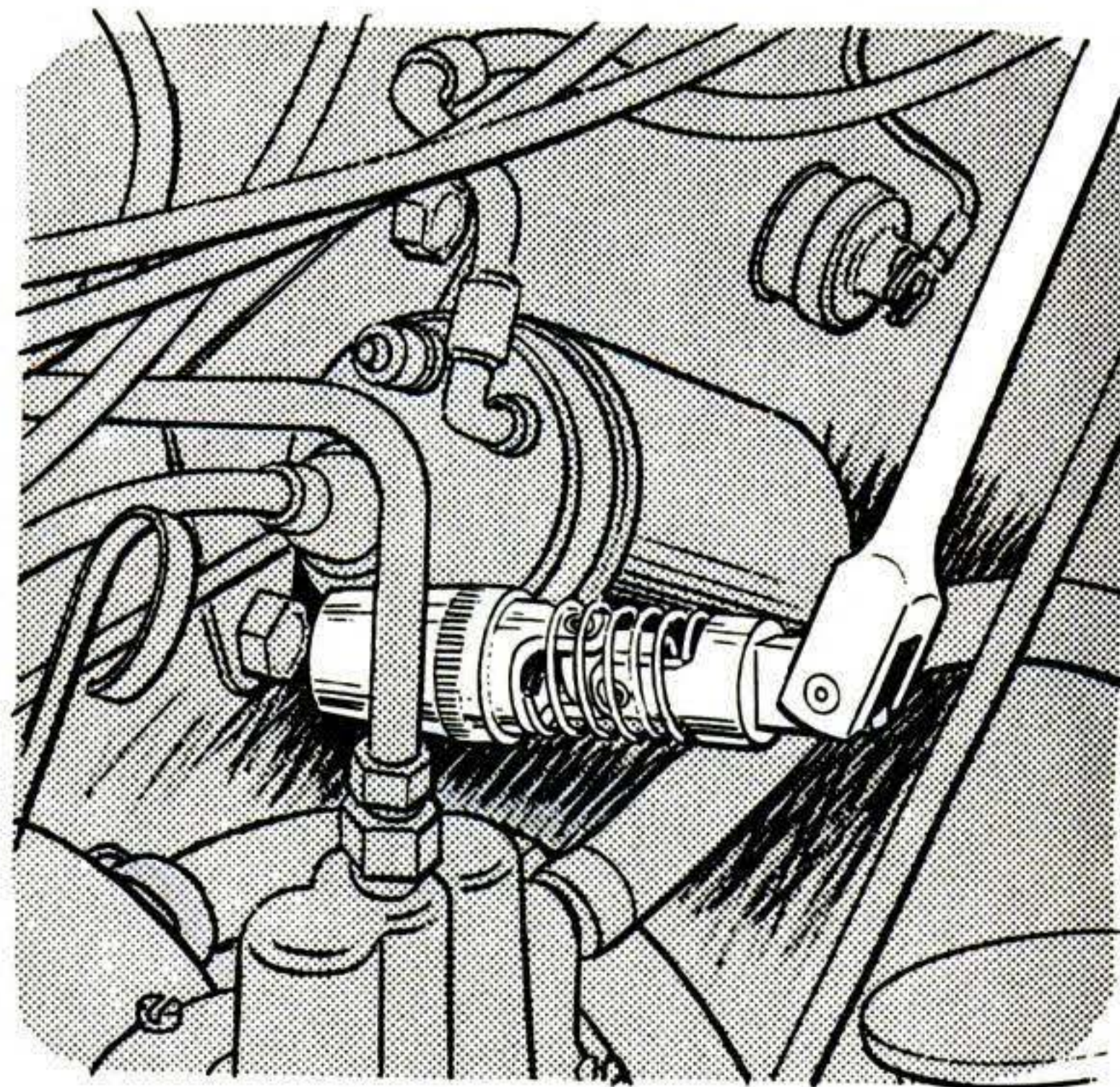
A slide hammer for pulling out dents in body metal can handle slide weights up to eight pounds with this modified tip. The screw that grips the body panel is held in a special nut with its forward end welded shut and then drilled. The nut is threaded onto the rod.



To touch up chipped paint spots use a small wire or a large sewing needle instead of a brush. Reduce the paint with thinner and dip the needle tip. Apply the tip to the chipped spot and the paint will run off and fill in without overflowing and leaving telltale runs.



Sports cars with low ground clearance often make it impossible to use a creeper board without jacking up the car. Instead, make a thin creeper of three-by-four-foot scrap heavy linoleum. Place the slick side down and cement a slab of plastic foam on top for a headrest.



To keep a universal-joint socket wrench from falling to one side in tight places, slip a coil spring around the joint. This will keep the socket straight when approaching the nut. With the socket seated on the nut, the spring won't interfere with the joint's bending action.

# Now! The lowest-priced V-8 pickup you can buy.

**Meet the new high-styled 908B** —the lowest priced V-8 pickup truck\* in the field. Only the INTERNATIONAL® 908B gives you big V-8 value in a standard size pickup at this money-saving price.

All the famous INTERNATIONAL features are standard: rugged, truck-styled chassis, heavy gauge body, stronger suspension, plus full safety package including new, easier steering. You get

INTERNATIONAL's extra comfort, too, in the 908B, with the smart 1967 styling that sets the pace in the pickup field.

Why pay more for a full-powered V-8 when you can get it in the world's finest pickup for less? Test drive the new 908B at your nearest INTERNATIONAL Dealer. He can save you more all the way, and he's ready to deliver. International Harvester Company, Chicago, Illinois 60611.

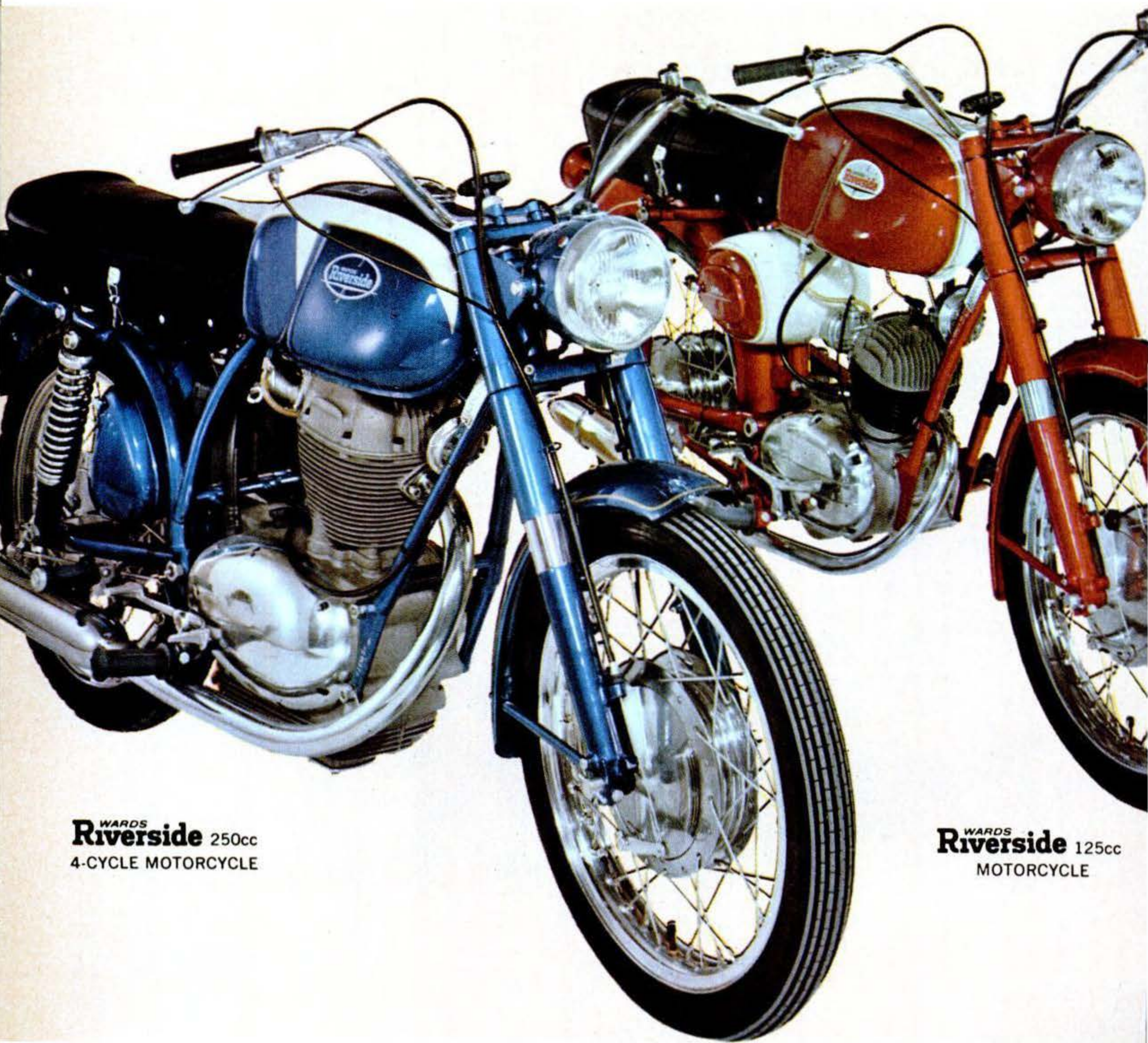
**INTERNATIONAL® TRUCKS**



Based on manufacturer's list prices for comparably equipped V-8 models, including heater and defroster. Add state and local taxes, destination and handling charges.



# Introducing the new **Riverside** cycles



**WARDS**  
**Riverside** 250cc  
4-CYCLE MOTORCYCLE

**WARDS**  
**Riverside** 125cc  
MOTORCYCLE

## Built by Benelli of Italy.

(Which means exciting, durable machines.)

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(Which means lowest prices, no money down.)

Take the Riverside 250 on the other page. It's a big 250cc, 4-cycle goer with 20 horses. You can shift through 4 speeds up to 90 m.p.h. Yet it's easy on the wallet: up to 70 m.p.g.

Standard equipment includes speedometer, sealed beam headlight, stop-tail light, electric horn, key lock, extra light bulb and spark plug, dry charge battery, 4-speed gear box, 18-inch front tire, 17-inch rear tire, dual seat, folding foot pegs—*she works.*

And you can choose from two zinging colors: black and gray or candy apple blue with white.

(For a pleasant surprise, check our low prices and easy terms.)

Speaking of low cost, take a look at the Riverside 125.

Its 125cc, 6.5 h.p., 2-cycle engine combines 68 m.p.h. speed with 119 m.p.g. thrift. And it comes with 18-inch tires and the same standard equipment as the Riverside 250.

Colors: your choice of midnight blue and gray or candy apple red and white.

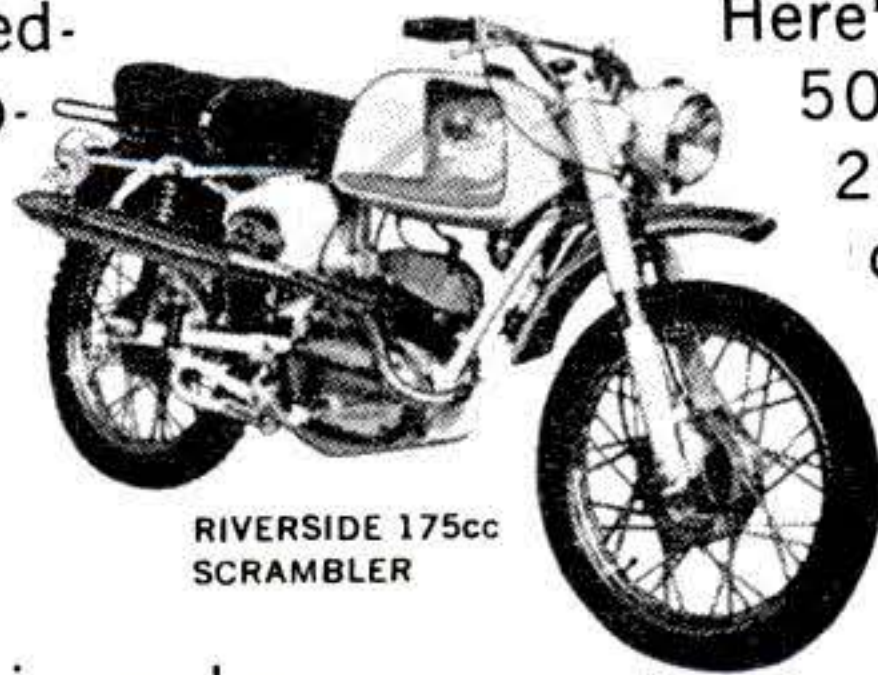
Like to scramble? The Riverside 175 chews up a 45% grade, moves out with 350 lbs. payload.

Here's the king of economy: the Riverside 50cc Sports Bike. With a 4.5 h.p. 2-cycle engine, it can really move out. Glittering silver gray enamel finish and sparkling chrome trim makes it look peppy as it is. Standard equipment includes headlight, stop-tail light, speedometer, electric horn, 18-inch tires, and a 4-speed gear box.

One more important point: for expert service all you have to do is visit any Montgomery Ward auto service station. You'll find factory-trained mechanics and a complete supply of parts at their fingertips.

So check out the new Riverside motorcycles.

At your Montgomery Ward store. Today.



RIVERSIDE 175cc  
SCRAMBLER



RIVERSIDE 50cc  
SPORTS BIKE

See the new Riverside at retail or catalog stores.

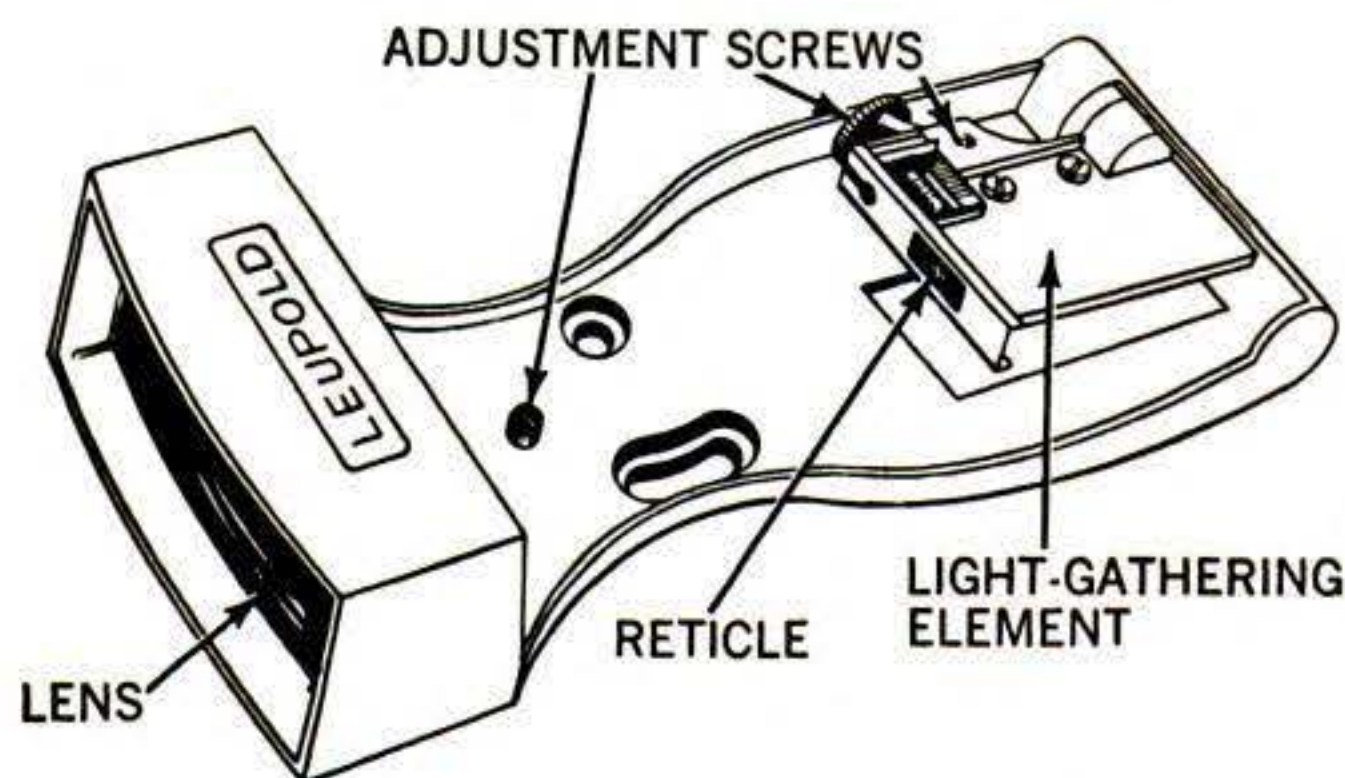
# MONTGOMERY WARD

WHAT'S NEW

FOR OUTDOORS

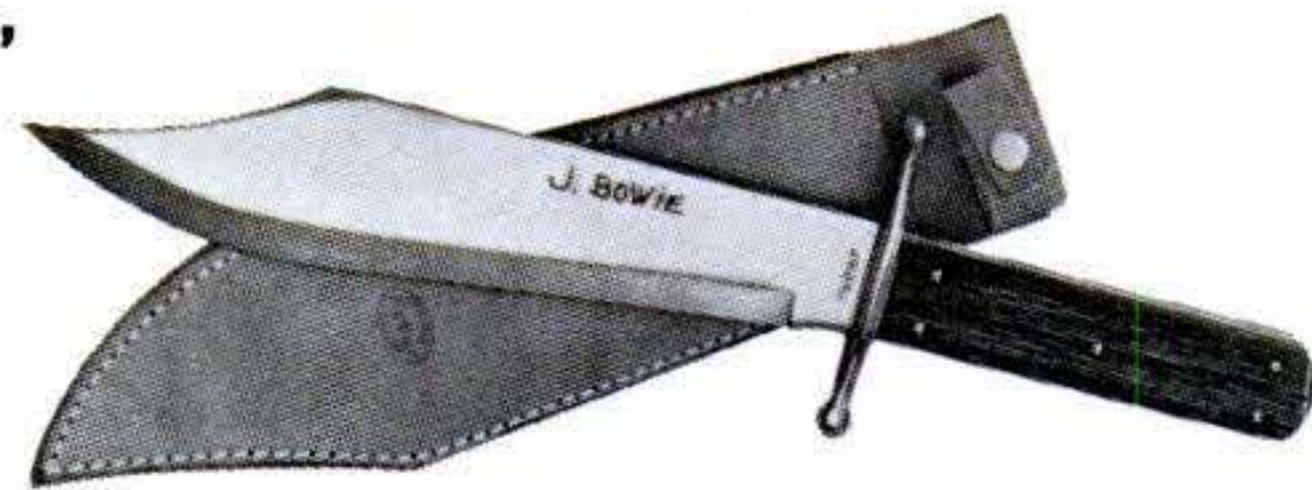
## Optical bowsight gives archers 'scope-sight accuracy

Designed exclusively for bows, the M1 optical bowsight provides archers with features previously associated only with rifle telescopic sights. A light-gathering element directs light through a reticle, or sighting pattern, forming a bright, fluorescent-orange image that seems to be superimposed on the target. Four different reticles, easily changeable in the field, are available to assist in range-finding. The maker is Leupold & Stevens Instruments, Portland, Ore. 97213.



## Today's version of Jim Bowie's "Arkansas toothpick"

That's an authentic copy (right) of the knife invented by frontiersman Jim Bowie, but with a modern advantage: Its blade is high-carbon, electric-furnace steel. The guard is bronze; the handle, impregnated mahogany. Ka-bar Cutlery, Olean, N.Y., makes it. The 13½-inch knife is \$18.



## Build your own pickup camper

You can build your own pickup camper, just like the one below, from a Viking kit. Or you can choose a kit with all the parts and equipment to build a trailer camper. Plans alone are also available for pickup campers, pickup covers, trailer campers, and bus conversions. For a catalogue (\$1, refunded with purchase) write to Viking Camper Supply, 94 Glenwood Ave., Minneapolis 55403.



## New camper comes in big economy package

Lowest in price of three 1967 Trade Winds models, the Caprice trailer provides an unusual amount of room—104 sq. ft. of living space—for \$880. Features include a mildew-resistant duck tent, torsion-bar suspended axle, vinyl-covered marine-plywood floor, and an aluminum screen door. When the camper is closed for traveling, it is sealed against weather and dust. Trade Winds Campers, Inc., Manawa, Wis. 54949.





# How to make a tom of a collins

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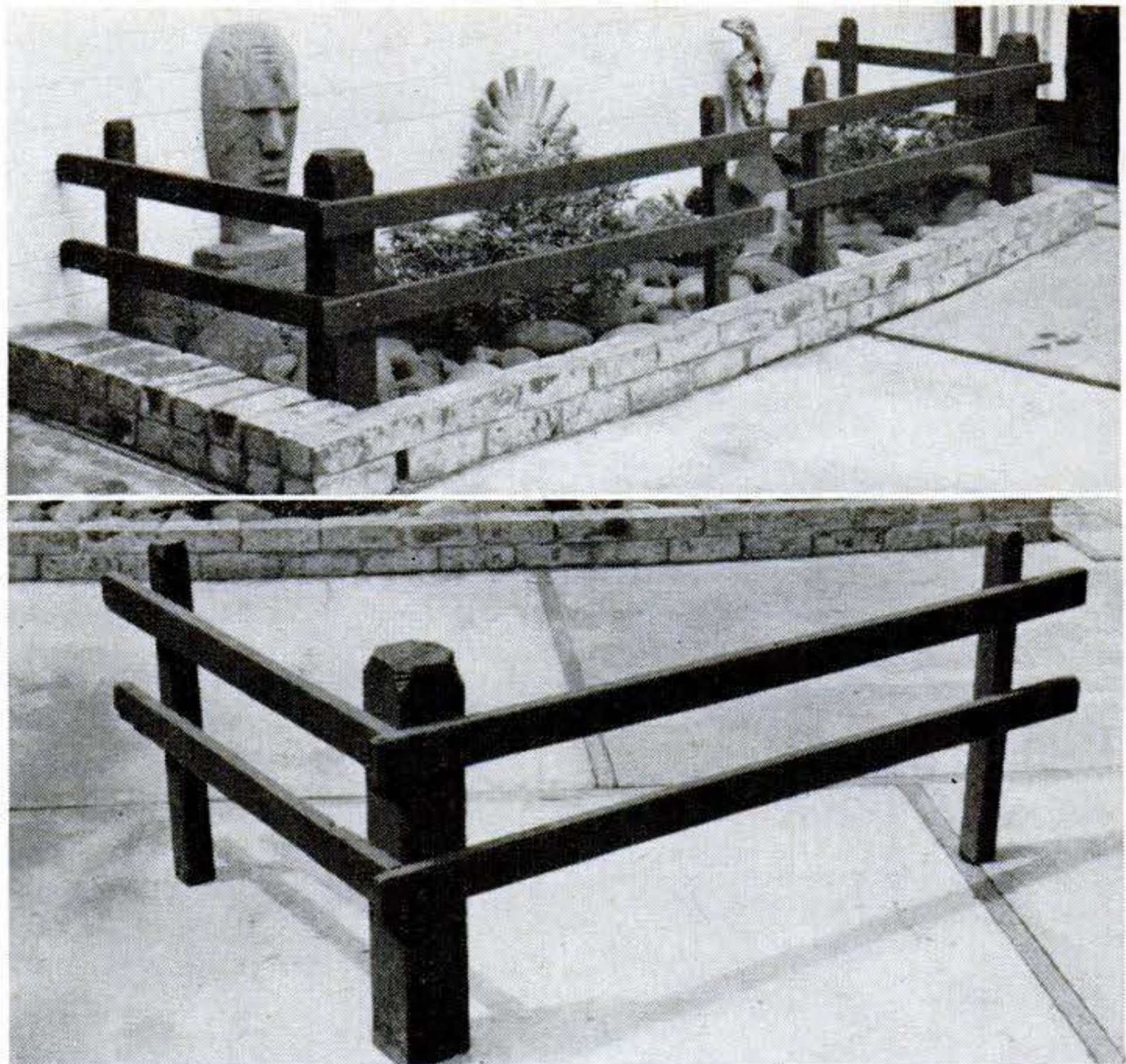
# Home-Improvement Short Cuts



## Tool lets you clean rain gutters safely

This homemade gutter-cleaning tool not only protects you from falls caused by overreaching—it reduces the number of times you have to climb up and down to move the ladder to a new spot. It's simply a garden trowel fitted with a broomstick handle held on by a wood screw.

H. BODKIN, Wyandotte, Mich.



## Fence sections lift out for easy gardening

Sturdy, portable fence sections can keep out kids and dogs, yet be moved as easily as a garden bench when you want to weed or plant. The corner posts are made of four-by-fours 2' long to give good nailing room for the 1"-by-4" rails. The end posts can be made from two-by-twos. Use galvanized nails.

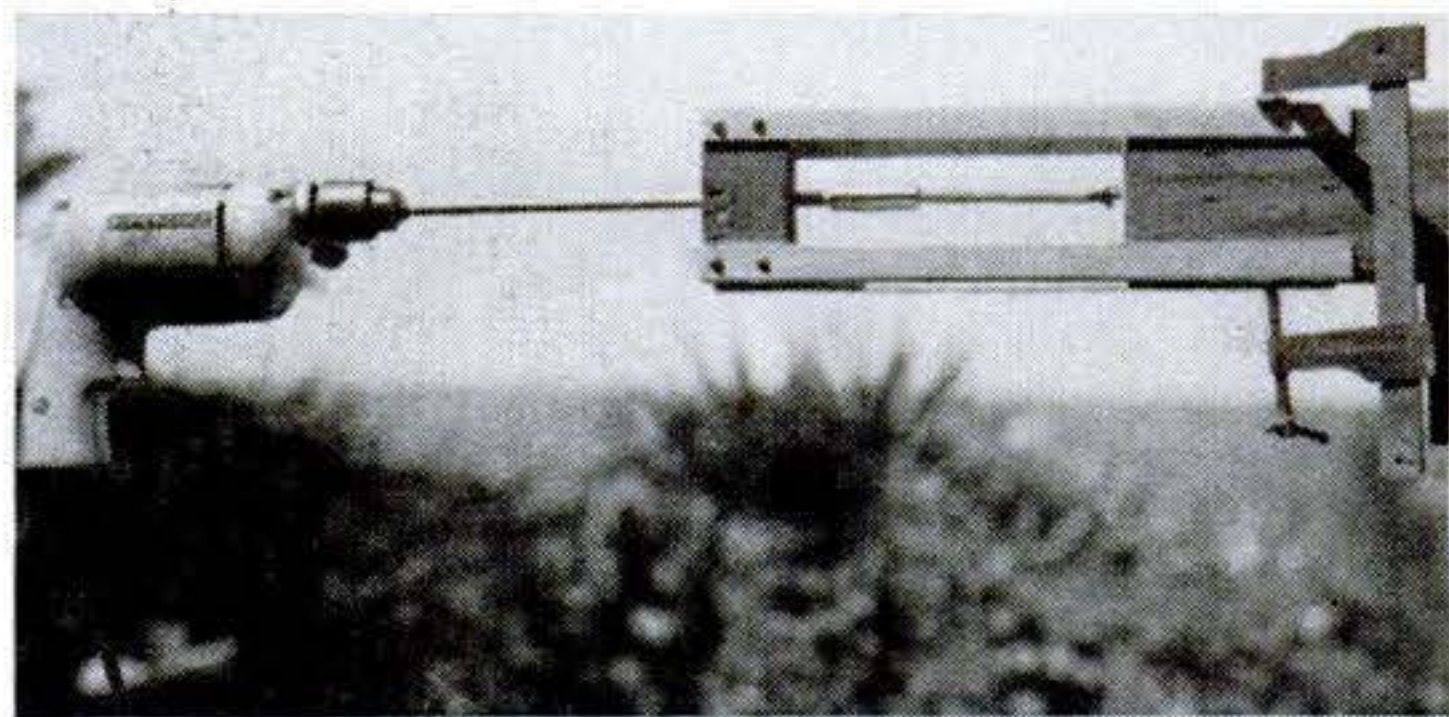
ROBERT HOPPOUGH, Chico, Calif.



## Old wood-glue trick works with epoxy

Woodworkers have long known the trick of mixing glue with sawdust to make a virtually invisible repair. The same match-and-mix idea works with a modern epoxy. When I needed to repair a slate floor, I crushed a piece of slate with a hammer, and then mixed the powder with epoxy. The repair was ready to walk on in a few minutes.

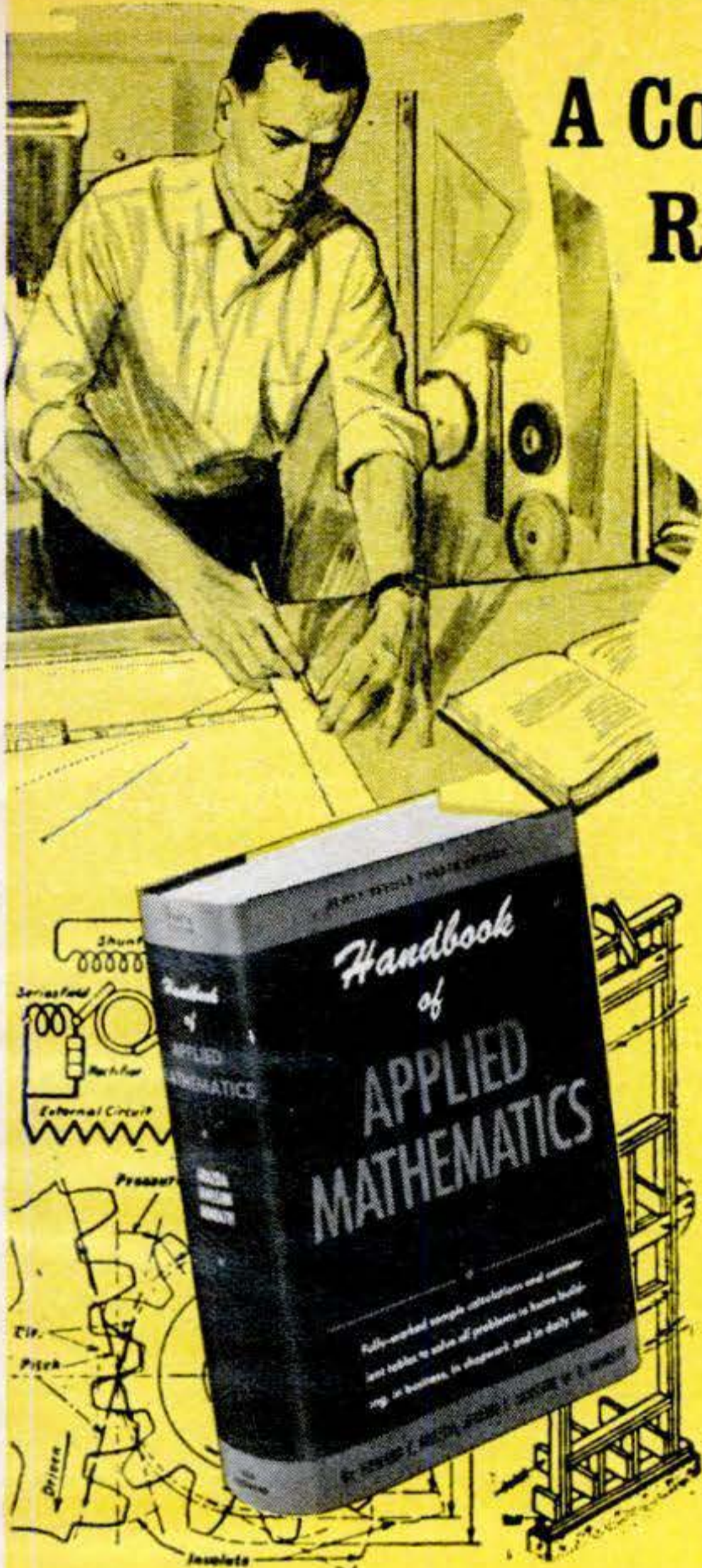
DARRELL HUFF, Carmel, Calif.



## Jig aligns end holes in fence post

When drilling the ends of four-by-four fence posts to take anchor bolts, use this jig to make the holes true. In a 2" block of four-by-four, drill a hole 1/64" larger than the drill bit to be used. (For precision, use a drill press.) Then screw a 12" length of aluminum angle to each of the blocks. Put the bit in the hole and clamp the jig to the post.

HAROLD LEWIS, Hilo, Hawaii.



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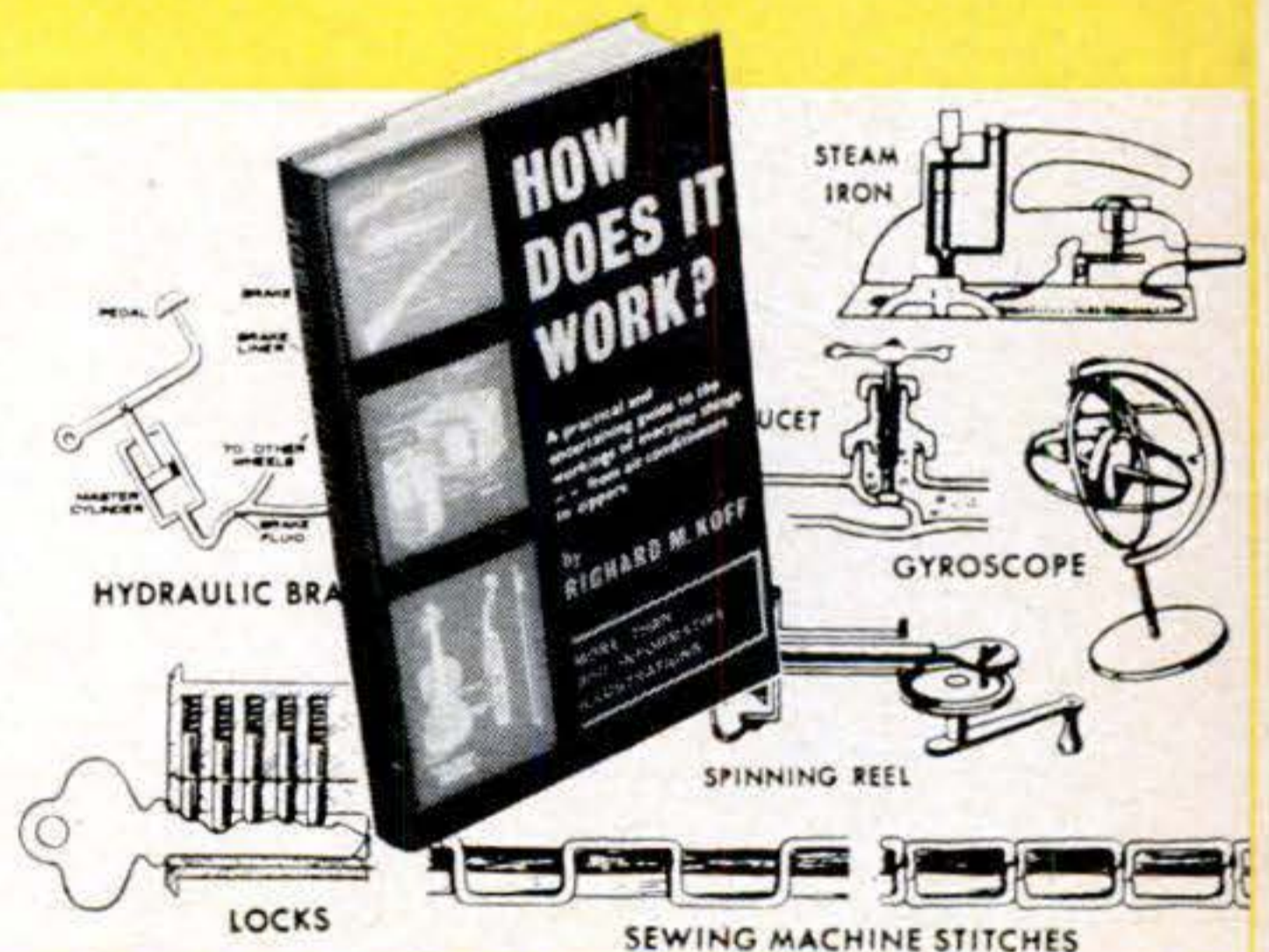
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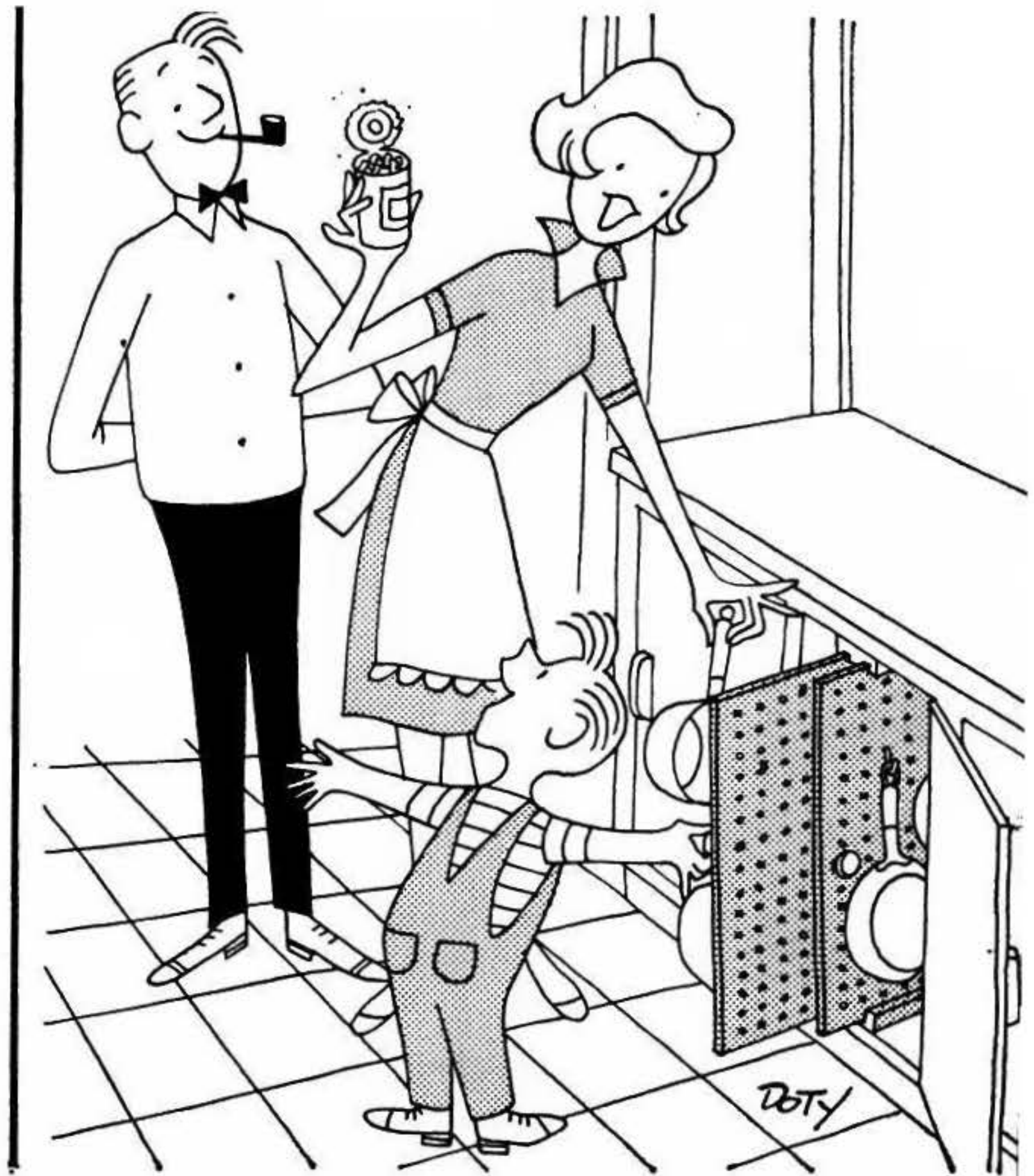
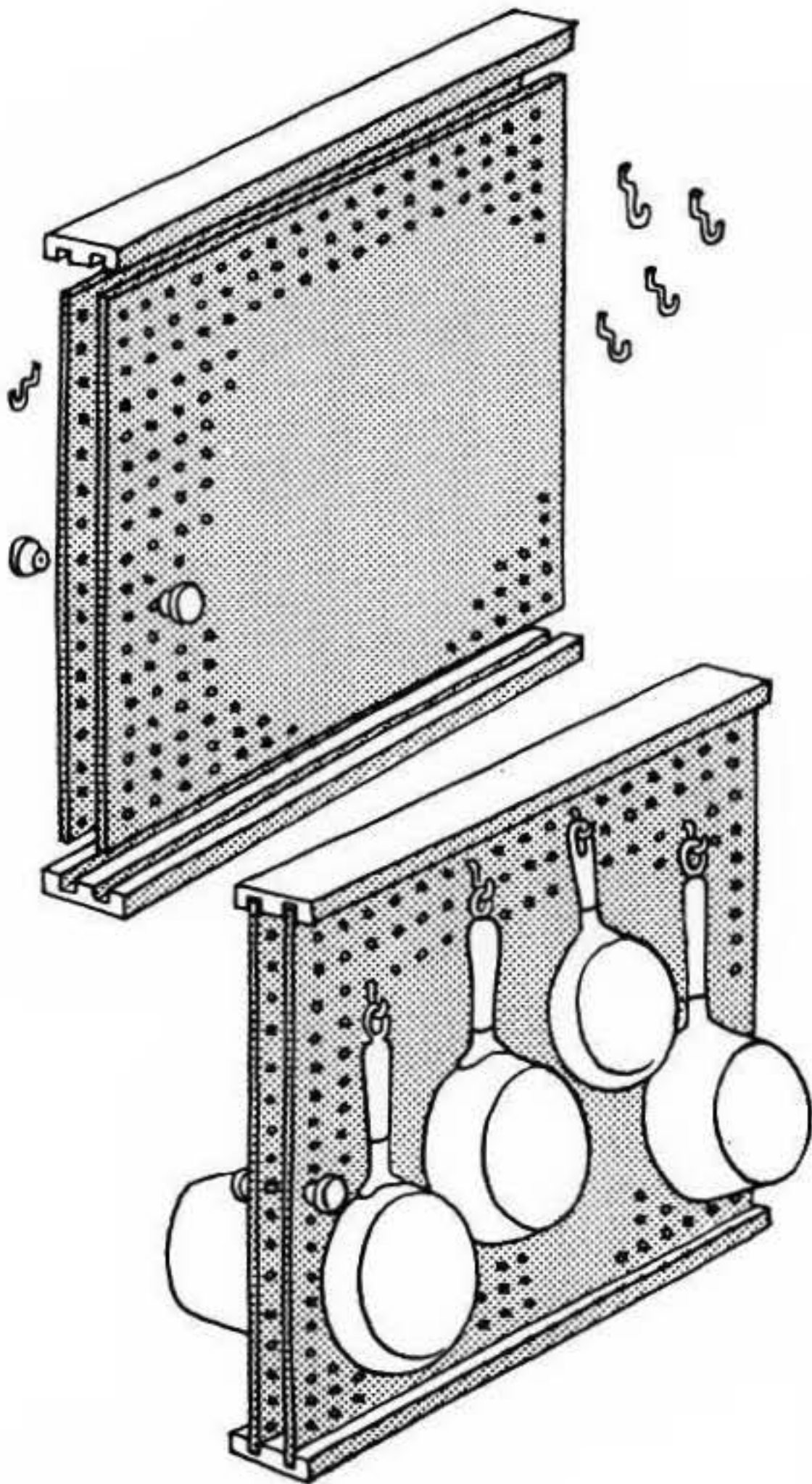
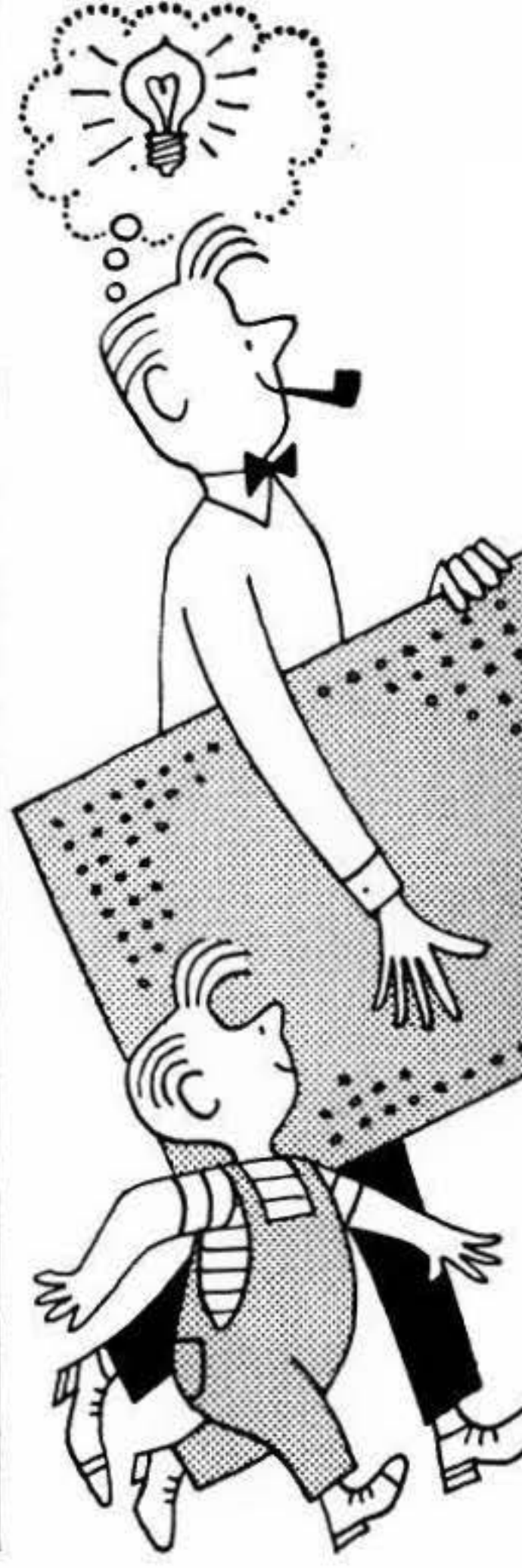
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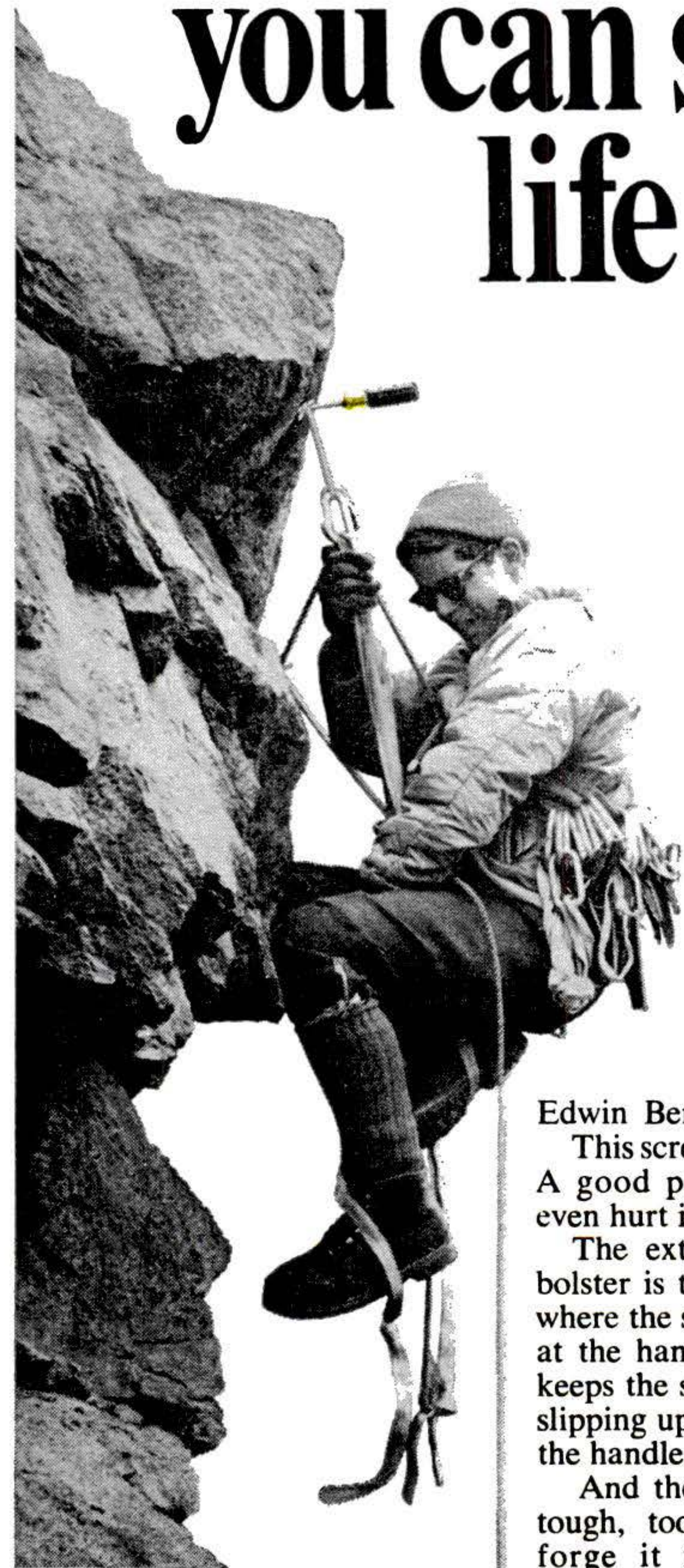
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By ROY DOTY



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Where shaft meets handle, an extra heavy-duty bolster.

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This screwdriver is tough. A good pounding won't even hurt it.

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alloy steel that's been heat-treated to really stand up. Then we plate it with chrome to prevent rusting.

Pick our screwdriver up. The full-size rubber grip handle will feel just right in your hand.

Who says they don't make tools like they used to anymore? Stanley makes tools like they used to anymore.

Stanley Tools, Division of The Stanley Works, New Britain, Connecticut.

**STANLEY**

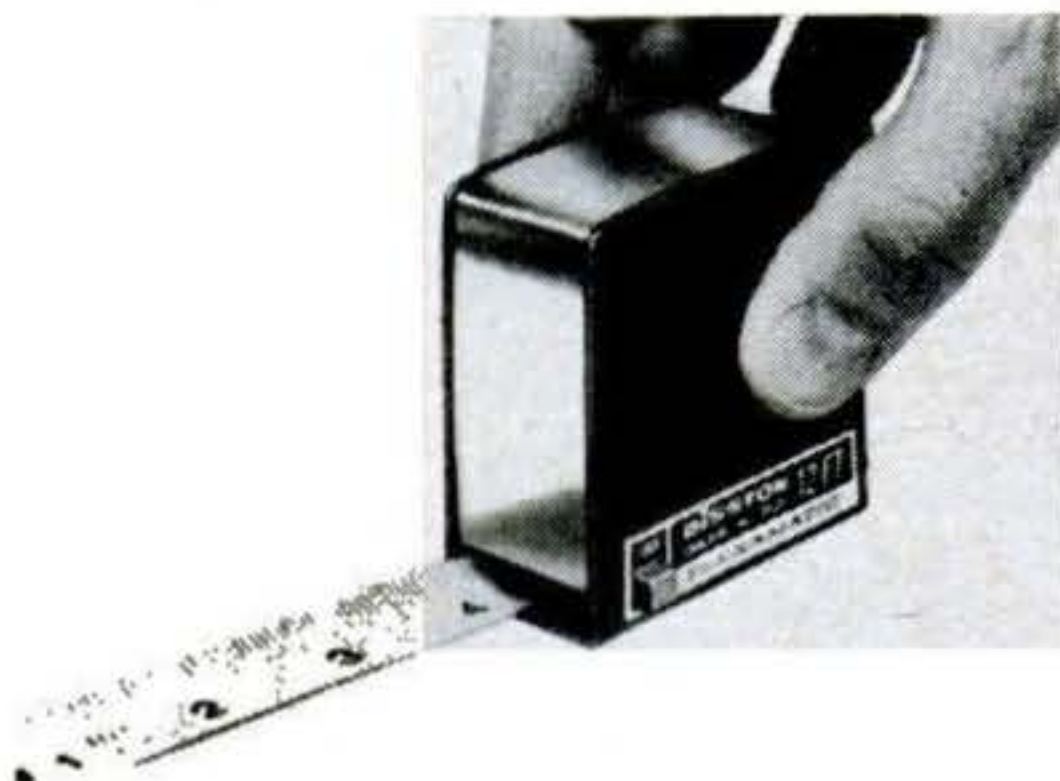
January 19, 1967: Edwin Bernbaum, a member of the expedition that first conquered the Northwest Ridge of Alaska's Mt. St. Elias, stakes his life here on a Stanley Jobmaster No. 66-668 screwdriver driven into the rock.



### Freehand saw has two speeds and seven blades for cutting either metal or wood

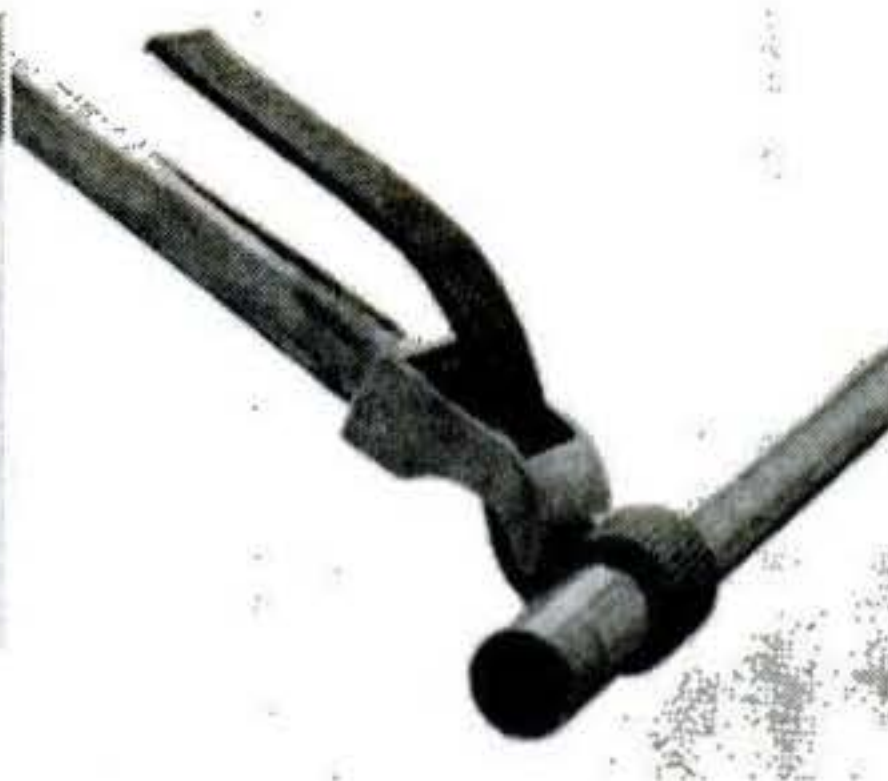
This Wen reciprocating-blade Zipp saw is electric-powered and portable. It comes with seven blades to deal with a wide range of jobs. Further versatility is provided by a high-low electronic switch. At low speed, the saw will cut steel bars, 2" pipe, copper tubing, or an auto-

mobile frame. Delicate pattern work on wood can also be done. Operating on high speed, it cuts 6" logs into firewood quickly and handles two-by-fours and hardboard efficiently as well. Plunge cuts can be made without a starting hole. The motor is  $\frac{1}{2}$  hp. Price: \$44.95.



### Squeeze-case measuring rule

The blade on this new rule from Disston retracts with just a squeeze on the nylon sides of the case. Frame is stainless steel. The Flexamatic rule weighs about  $\frac{1}{3}$  less than conventional models. The maker, H. K. Porter Co., says it is the first steel rule with a snap-open case—no screws involved. It comes in 10', 12', and 16' lengths. The rules sell for from \$2.60 to \$5.



### Lightweight strap wrench

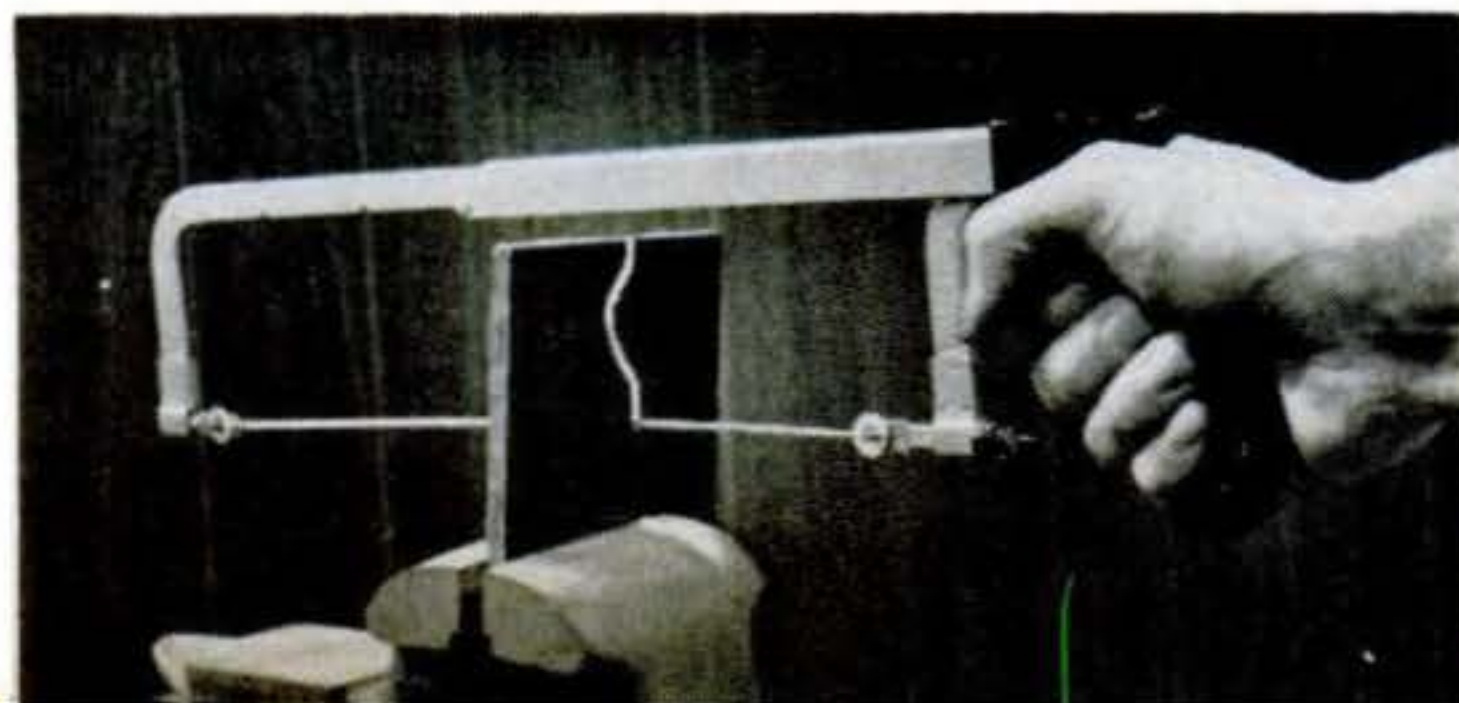
Here's an aluminum-alloy strap wrench that weighs only half as much as conventional types but exceeds government strength specifications by more than two to one, according to the manufacturer. It is designed to prevent marring on such materials as plated tubing. Contoured handles prevent oil-slick hands from sliding off.



### Ball-bearing orbital sander

A ball bearing on the driving plate of this Thor electric orbital sander makes for long trouble-free service, says the maker. It takes a 4½"-by-6½" sheet—you can cut out three from a standard 9"-by-11" sheet of abrasive paper. Price: \$14.44. The company also is making a new electric bench grinder for \$18.88. It has its own self-contained shaded-pole 3,450-r.p.m. motor.

### Used like a coping saw, rod saw does many of the jobs of a diamond saw



The tungsten-carbide cutting edges of this rod-saw blade are said to cut the hardest materials easily. The blade fits a standard 12" hacksaw frame. It's made by Dillon Tile Supply, 158 11th St., San Francisco 94103. \$2.50.



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## Science Map and Guide to the U.S.

[Continued from page 63]

Manned Spacecraft Center is open for drive-through tours. Here you'll see capsules, models, and mock-ups of the various spacecraft used since the start of our Mercury program.

NASA's Space Orientation Center at Huntsville, Ala., headed by Dr. Wernher von Braun, is the biggest space installation in the country, with more than 7,000 employees. Here you can study the evolution of rocketry, and get a background briefing on how we are going to reach the moon.

Not far away, in Bay St. Louis, Miss., you will be welcomed at the great Saturn V testing facilities, where the huge booster is being developed that will lift our moon-bound vehicles. Chances are you'll see one of the big 7.5-million-pound Saturn V boosters in place in its test stand.

For a complete change of pace, if your interests are more mundane, how about a visit to the Shelburne Museum in Vermont that houses so many of the bygone wonders of the horse-and-buggy era? Here you will see a collection that is a virtual history of how common hand tools evolved from earliest times down to our present machine age. If you have never seen a working blacksmith or wheelwright shop, you will find one here going full blast.

**Cars that made history.** Have you ever seen a Tucker Torpedo running? Probably not, since there are only about 20 to 30 of these 1947 autos left. Ah, but you will see one if you visit another great center of Americana—the Henry Ford Museum in Dearborn, Mich. The radical rear-engine car is just one of the innumerable treasures housed in this institution where you can trace 300 years of American progress in mechanical and industrial crafts. Among its many gems you will see President Franklin D. Roosevelt's Lincoln, and Ford's X-8 engine, once considered the next step beyond the Model-T's four-cylinder engine.

But the famous Ford Museum is only one of many automotive museums where you can see yesteryear's great models. If you're a car buff, a visit to Harrah's Automobile Collection in Reno, Nev., will give you a view of a 1922 Wills Ste. Claire with America's first and only single-overhead-camshaft V-8—until Ford's racing engine was introduced in 1965. And how about the 1921 Heine-Velox, built on the West

Coast, with its hydraulic brakes and enormous engine? A rare car indeed, with highly advanced engineering throughout. There's a 1929 Model J Duesenberg, too, in the Harrah collection, that is spoken of as the best in the whole world for its authenticity and quality of restoration.

While you're in the West, let's hop down to the Briggs Cunningham Automotive Museum in Costa Mesa, Calif., and take a look at the two-liter Type-166 Ferrari, the first ever imported into the U.S. You'll also be fascinated by the American Underslung, a 1911 four-cylinder, 50-hp. sports car with a frame under the axle designed to give it an unusually low center of gravity.

If you're speed-minded, a visit to the Indianapolis Speedway museum will spread out before you some of the great cars that have come in first in the big Memorial Day races. One of the most exciting of these is the Maserati that the late POPULAR SCIENCE writer and racing champion, Wilbur Shaw, drove to victory in 1939 and 1940. Its beautiful straight-eight engine and classic design will put stars in your eyes.

**Airplanes, too.** Interested in speedy airplanes rather than cars? Then hurry on to the Air Force Museum at Wright Patterson Air Force Base, Dayton, Ohio. Here you will find an awe-inspiring collection, including the actual planes used by our aerial knights from World War I days right down to recent times. There is a Jenny, of course; also a Spad, and a Curtiss Hawk P6E, one of the most beautiful planes ever built. Here too, you will find a Boeing P-26 of about the same era. Also one of the two Douglas World Cruisers in which man made the first aerial circumnavigation of the globe in 1924. Even Spitfires, Zeroes, and Messerschmitts are here.

As for the awesome power of the atom, you can watch it being tamed at places like the Hanford Science Center in Richland, Wash., where the world's first production reactors were turned out for making atomic fuel. At Hanford, you may even operate a "master-slave manipulator" like the one used to handle hot radioactive substances. But I've only begun to scratch the surface in telling you about all the unusual things you will find on our Popular Science Map of the U.S. This summer—or anytime—there is high adventure ahead for you. ■



## Chrysler's Five-Boat Fleet—Fast and Fancy!

[Continued from page 108]

ave it ample runabout speed or plenty of power to get up a multiple tow of skiers. It's also available in an outboard, where it will take up to 140 hp. The 229 is 17 feet long, with a beam of 86½ inches.

**The Hydro design.** One of the secrets of the Courier 229's performance—and of other Chrysler hulls in 1967—is the new Hydro-Free hull design. Efficient and stable, it incorporates some of the best features of both the three-point hydro and the deep-V hulls.

This combines the stability that the unlimited hydroplane racing boats get from sponsons, and the high-speed and soft-ride characteristics delivered by the ocean-racing deep-V hulls. The forward hydro-step sponsons provide stability to the modified-V hull when the boat is at rest or when it is moving at no-wake speeds. As the boat in-

creases its speed the V-shaped hull lifts in the water, and at about 20 m.p.h. the sponsons run clear. At top speed the hull's wetted surface is very small and the delta keel provides stability and holding power in turns. In high-speed turns, the inside step sponson comes in contact with the water to keep the boat relatively level and in a stable attitude. When crossing wakes or driving through heavy seas, both sponsons combine to give stability and cushion re-entry into the water. And the sponson tunnel—part of the nontrip chine—captures water as it breaks away from the step and contributes to the hydraulic cushioning effect of the hull bottom.

Five boats—each with a different personality from the others. And each gave promise of season-long boating pleasure. P.S.

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JUNE 1967 | 187

## What's New in Mowers

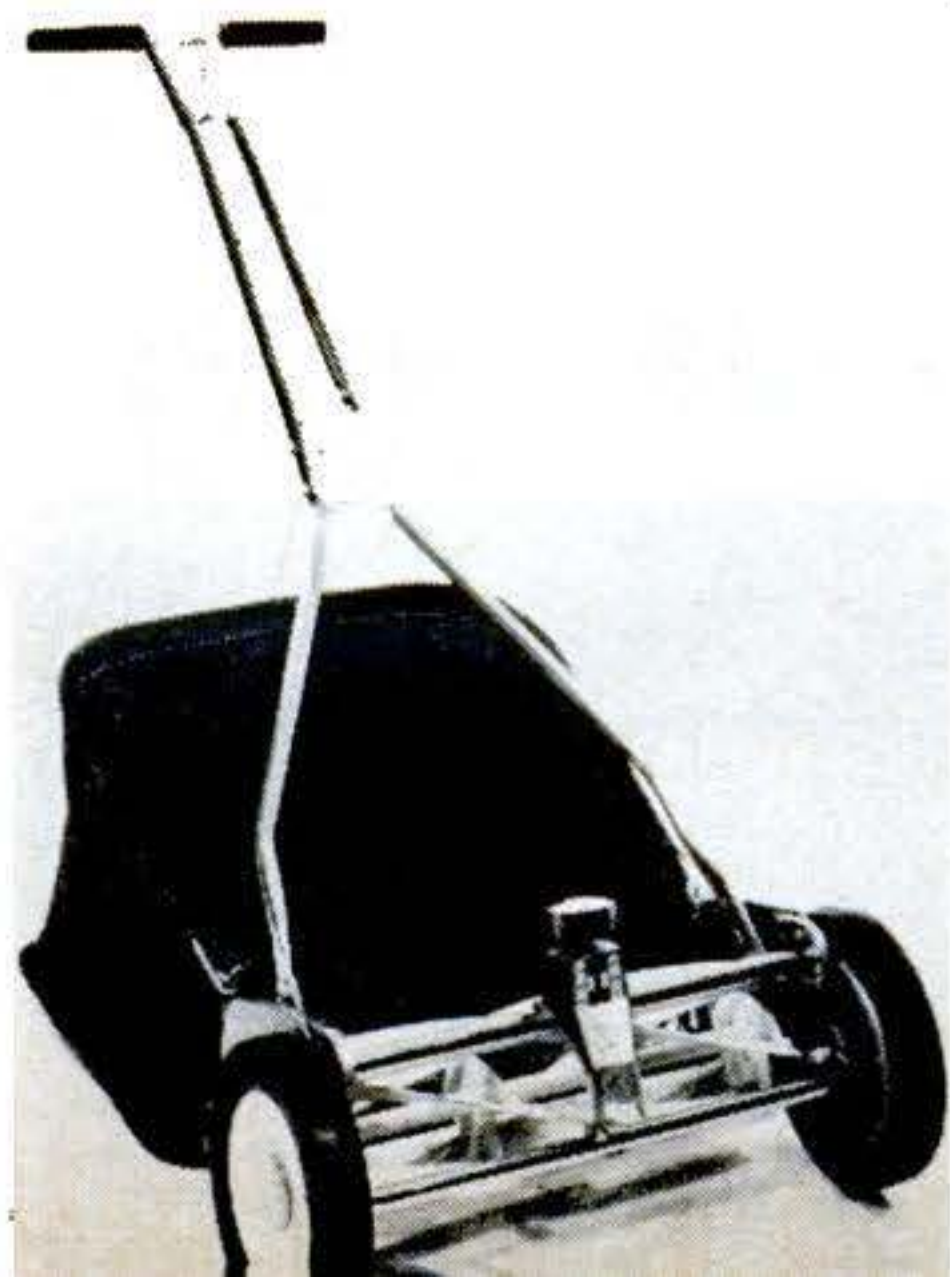


### Wheel adjustment sets mower cutting height

Just twist a plate on each front wheel and a camming arrangement adjusts the height of the cutting blade. Three settings give clearances of one, two, and three inches. The feature is found on two of Gilson's new riding mowers: the four-hp. Custom and the five-hp. Cadet.

### Hand mower has dial for adjusting cutting height

This reel-type hand mower from Sears, like the big power rider above, has an easy adjustment for cutting height. A dial selector eliminates the need for tools. Dual-frame construction maintains cutting alignment; the outside frame absorbs shocks. The Dial-Adjust sells for \$49.



### Pivoting front axle prevents lawn scalping

The front axle, frame, and mower pan pivot independently on this new Lawn Boy to prevent scalping of lawns. The seat, footrest, and all controls remain stable, while the rest of the unit follows irregular terrain. Cutting a 30-inch swath, the mower is powered by a six-horsepower Briggs & Stratton engine. An automatic clutch lets the operator shift through three speeds forward and into reverse without stopping or clutching. Cutting heights can be selected by the rider while on-the-go.

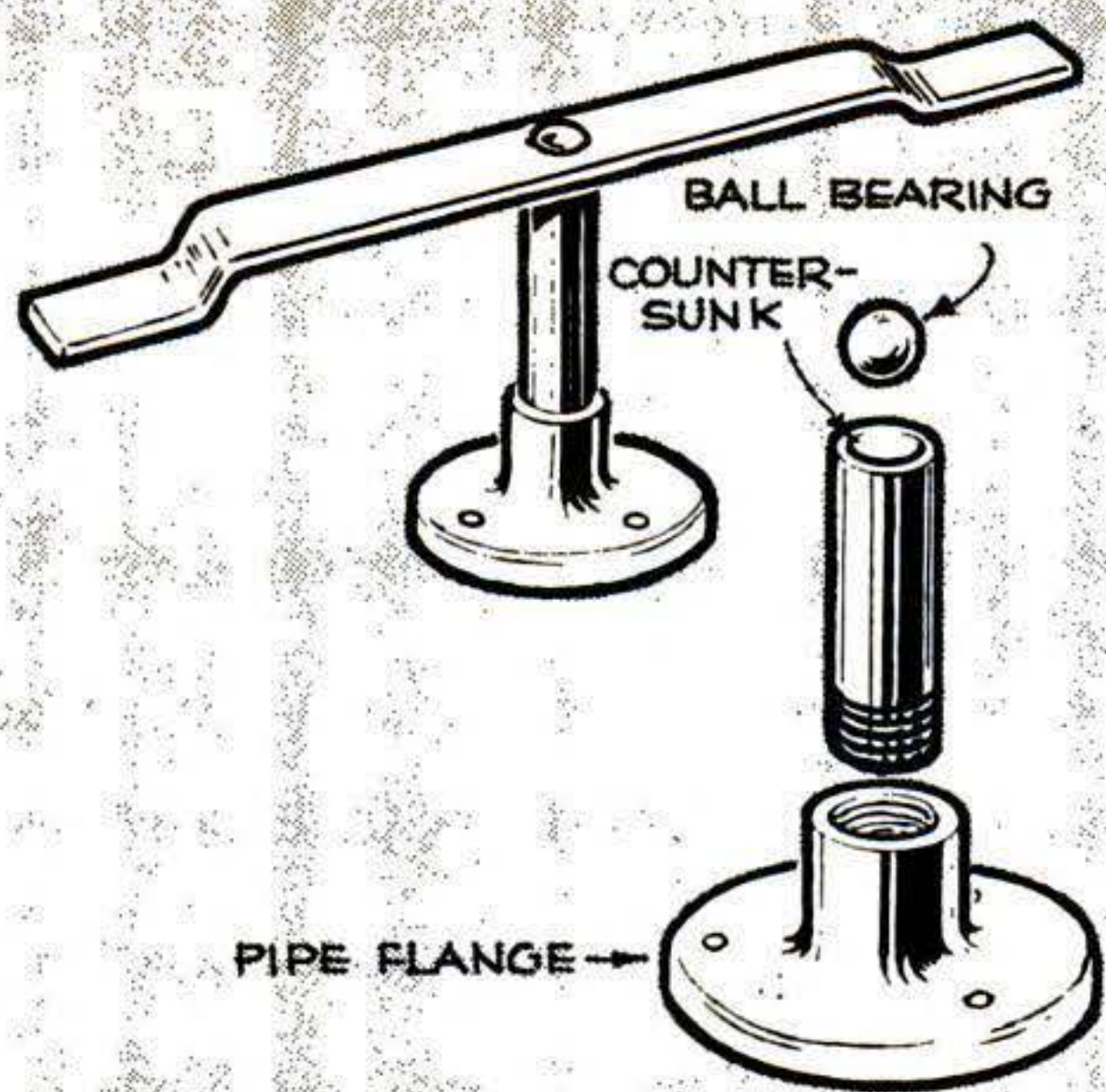
### Rider mower brakes automatically in neutral

A new 26-inch riding mower has been brought out by Hahn Eclipse. The Pow-R-Boy 200 has five speeds forward and is powered by a five-horsepower Briggs & Stratton engine. The blade may be disengaged at any time and is adjustable to five different heights. A flexing frame enables the mower to conform to lawn contour. The mower brakes automatically in neutral without creep or roll for safe parking on hills. A deluxe and standard model are offered, the standard with four speeds.



SHORT CUTS AND TIPS

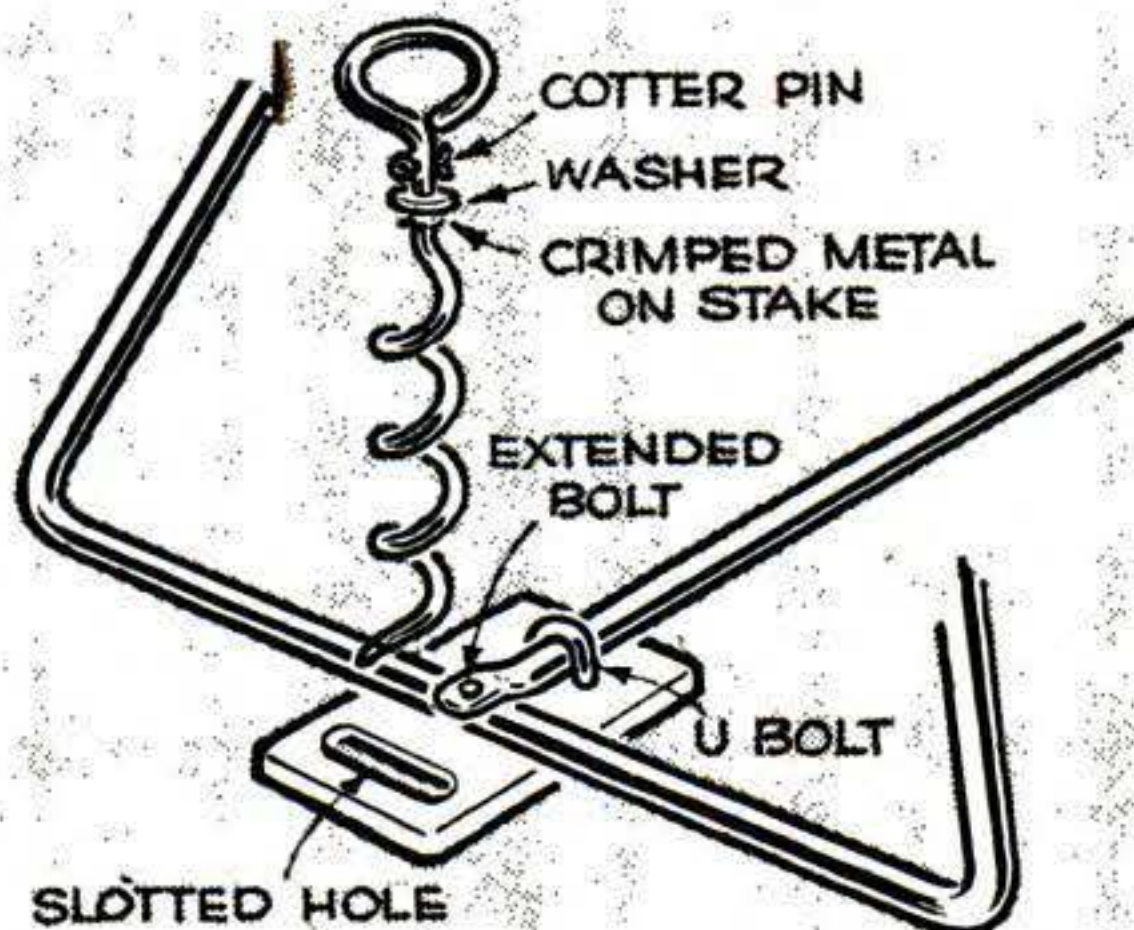
FROM PS READERS



### Make a mower-blade balancer

Balance the blade on a rotary lawn mower and it will run smoother, cut better. This balancer will test blades with any size spindle hole. The blade will center on the ball bearing. To make it, thread a 6"-long piece of pipe into a flange. Countersink the top to form a cup. Put a large ball bearing in the cup and set the blade on the ball. Grind the blade until it rests dead level.

PETER LEGON, Malden, Mass.



### A tip for making lawn mowing easier

The swing frame that we have in the backyard has to be staked down to keep it from tipping over as the youngsters swing. Staking it permanently would increase my grass-trimming job. So I use a corkscrew dog-tether stake at each end of the swing frame as shown. This makes it easy to move the frame.

JACK H. HIRRLINGER, College Park, Md.

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\*NOTE: Special mounting brackets for 1966-67 Ford, GMC, and AMC cars with smog devices \$15.00 extra.

## James Bond's Amazing One-Man Autogyro

[Continued from page 69]

Searching for fresh sensational hardware for *You Only Live Twice*, they saw 007 in a pirouetting autogyro as a box-office winner. Wallis agreed.

To heighten the drama, gag men took liberties with the autogyro. They made it portable—in the film. The assembly sequence is faked, but ingeniously.

The special-effects team started with four giant suitcases, each 38 by 12 by 24 inches, and made up the parts to fit inside.

Cleverest bit is the tubular airframe, fabricated as a collapsible “spider,” in which the double-hinged four-section keel is laid out flat and held rigid by sliding collars over the joints. Pivoted suspension arms drop down at right angles, and the central upright supports the rotor mast, which is then slipped in place.

After the mast is braced, the rotor head and control rods are added. The rotor is fitted next, each 10-foot blade in three sections joined by hinges on the leading edge and aligned by tongues and grooves on the trailing one.

The assembly sequence was shot on a set rigged out as a private garage at Pinewood Studios, near London. Beyond double doors was a painted backdrop showing a Japanese road with mountains looming in the distance.

In stalks Major Boothroyd (actor Desmond Llewelyn), Bond's Q Branch boss and provider of exotic weapons, accompanied by four mechanics carrying boxed-up Little Nellie. The men unpack the cases and fit the parts together with military precision.

For the final shots the real autogyro was substituted for the mock-up and pushed out of the garage. Filming then continued in Japan, on the actual road portrayed on the backdrop. Boothroyd explains the machine to Bond, who then spins the prop and climbs into the cockpit.

When the camera was not looking, Wallis (disguised by a duplicate of Bond's helmet and shirt) changed places with Sean Connery. 007 flips open the throttle and zooms into the Nipponese sky.

**The sky battle.** Suddenly the four SPECTRE helicopters, lethal-looking Bells, appear from nowhere and close in on him. In the eye-popping dogfight that follows, Bond demolishes the first chopper with flame-throwers on the autogyro's tail.

Parachute-dropped explosives tangle in the rotor of the next one, and it falls like a rock. The third is downed with a whoosh of rockets, and the fourth by a couple of air-to-air homing missiles.

Much of the aerial combat was filmed from behind-the-scenes helicopters. But Wallis carried cameras on the autogyro for a Bond's-eye view of the victims' violent ends. He was in constant radio contact with the airborne camera crews and his SPECTRE assailants so that the planes could be correctly positioned for each take.

No trick photography was used in the firing of the weapons, but a special-effects crew cooked up both the explosives and their impact. The flaming chatter of Bond's machine guns, for example, came from a cluster of tiny chemical charges behind the barrels that were electrically ignited in sequence by a motor-driven switch in the autogyro cockpit.

Missiles were powered by real 96-pound-thrust rocket motors, but their uncanny homing was staged with studio models. Similarly, when Bond's tailplane in close-up is peppered with enemy bullets, the line of holes is punched in a dummy rudder by a series of detonators on the hidden side.

**Other Nellie versions.** Filming completed, Ken Wallis returned to his business of designing and building autogyros. Twelve WA-116s have been built for experimental work, but this model has a Certificate of Airworthiness only for restricted use because the McCulloch engine used has not been fully tested.

Already flying is the more streamlined WA-116 Meteorite, a high-performance research aircraft, powered by a supercharged radial two-stroke engine. Next step is the slightly larger WA-117, powered by a Rolls-Royce Continental 100-hp. engine.

In the past several years Wallis has been swamped with requests from amateur enthusiasts for plans and kits. But he decided against entering the do-it-yourself business, preferring to assemble his machines under controlled conditions.

So the WA-117 as a finished product will be manufactured by Wallis and his cousin-partner at their small plant in Cambridge. It will be on the market this fall at around \$8,500. Raise the cash, and you, too, can take to the air like James Bond. PS

## 16 Ways to Get Better Travel Pictures

[Continued from page 115]

this: Partly cover the photocell window with a finger. Covering half the window increases exposure one *f* stop; three-fourths, two *f* stops.

**13 Don't forget people pictures.** Here's the secret of good people pictures: Reduce the amount of "this is Mom and the kids in front of Old Faithful, Mom's the one with Old Faithful coming out of her head" type pictures, and go three ways.

- Establish the character of a scene with a native costume, a boy cleaning a fish, a child smelling a wildflower, etc.

- Use a person to establish the scale of objects by having him stand next to a totem pole or statue, or look up toward the top of a tree or building.

- Use people to add depth and interest to scenic shots by having them walk down a tree-lined lane or wade in a lake.

**14 Get more out of your extra lenses.**

You'll want your wide-angle lens to record the vastness of large halls and to get sharp detail all the way from very close foreground to infinity.

Close-up lenses or extension tubes are vital if you want frame-filling flower shots and interesting museum details.

Telephoto lenses are great not only for meaningful photos of game and scenes you can't get close to, but for people pictures. With a long lens you can often get protrait-like shots from a distance that catch the subject off guard.

**15 Keep a notebook.** Notebooks sound burdensome. They needn't be if you keep them simple. And what a help it is when you get home and are putting together your slide show to be able to look up the name of a lake, or town, or street that you have recorded on film.

**16 Waste some film.** Bracketing exposures a little above and below what should be correct is often suggested. If you have been getting satisfactory exposures, forget it unless the situation is tricky or very important. Why not instead blow some film on experimentation and on pictures that promise humor or insight that straight scenics or people pictures can't offer? Let yourself go. PS

# If you haven't got the time, we've got the camera.

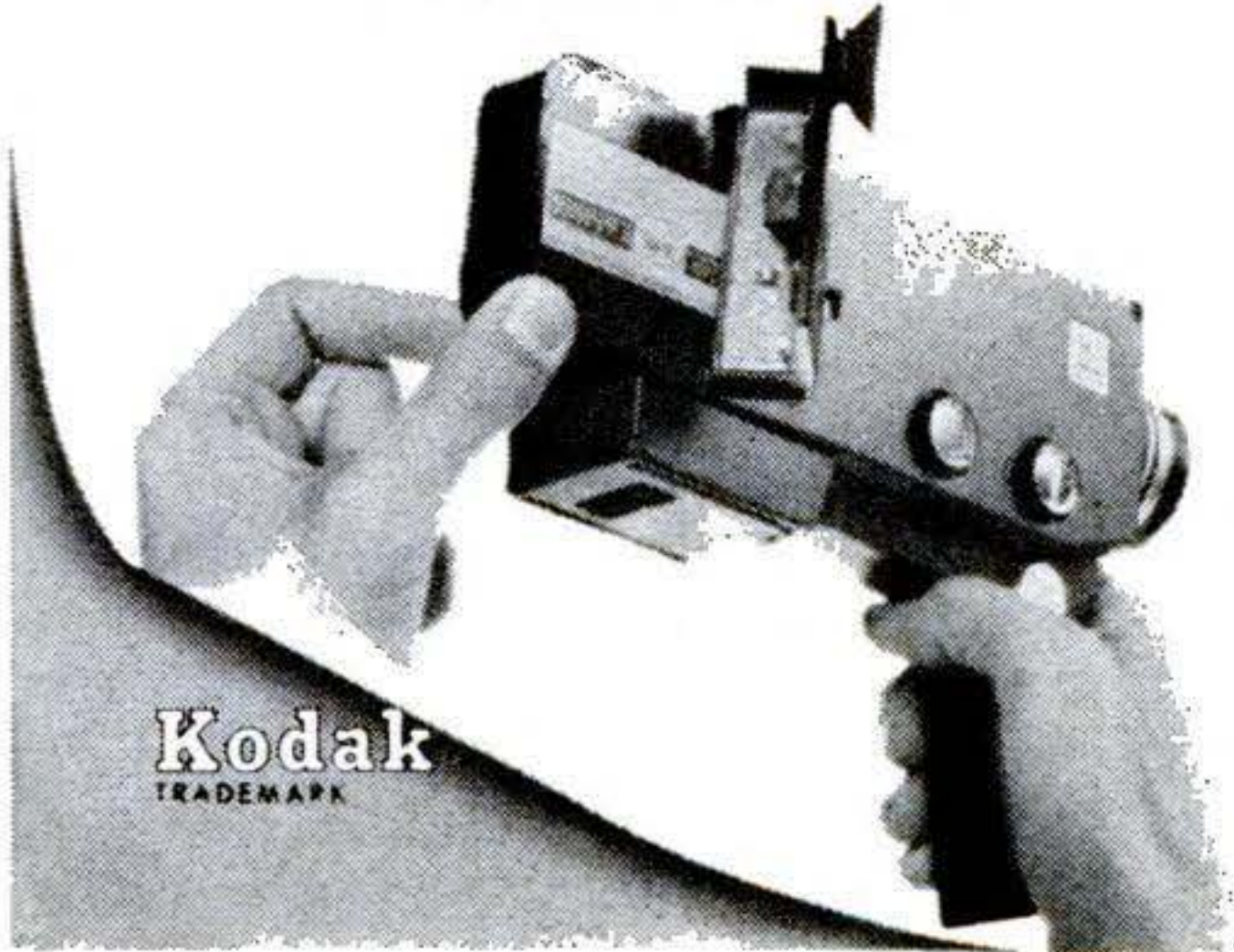


**8** Slide a film cartridge into the KODAK INSTAMATIC M8 Movie Camera and join the new wave of super 8 movie-makers. With this camera there's no fiddling at the start, no flipping at midpoint, no winding anywhere along the way.

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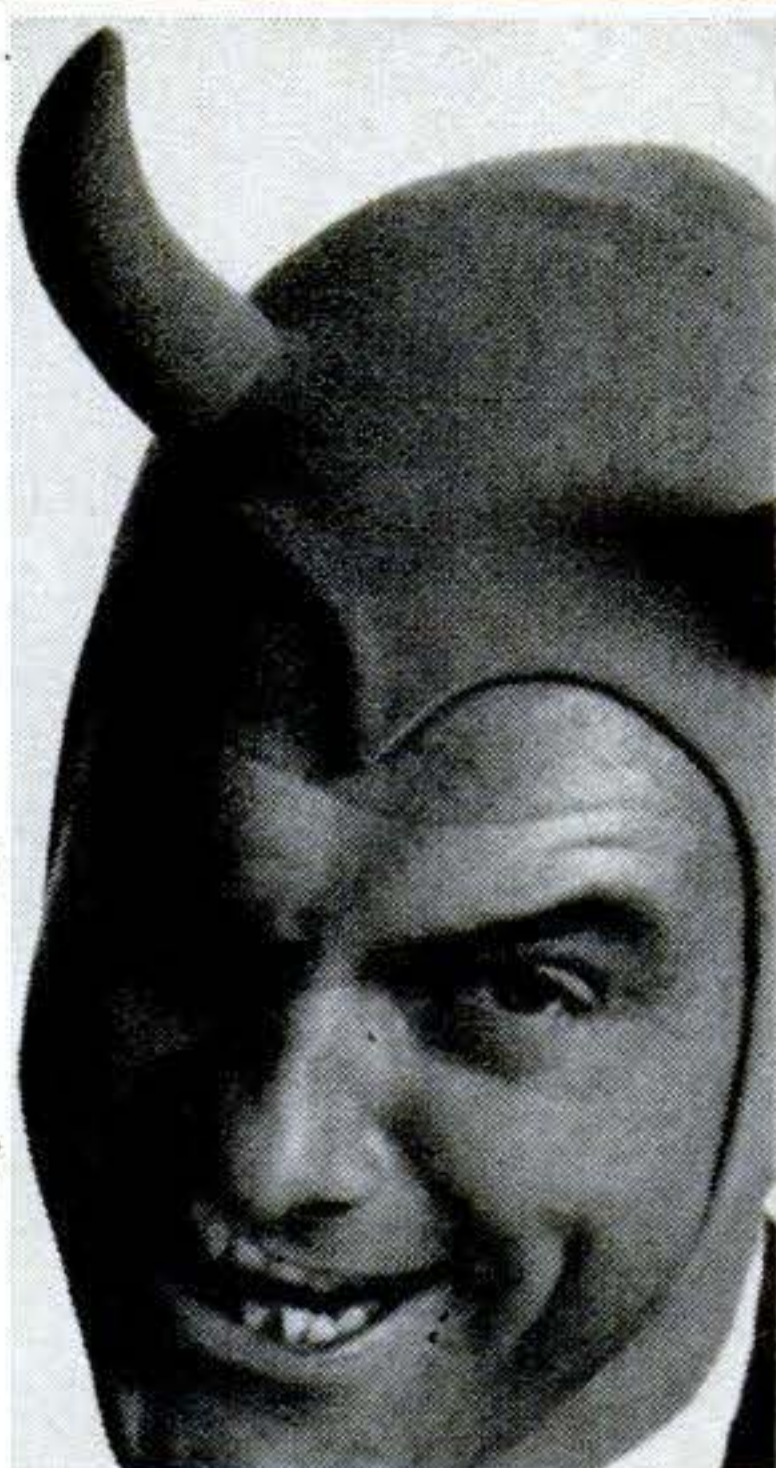
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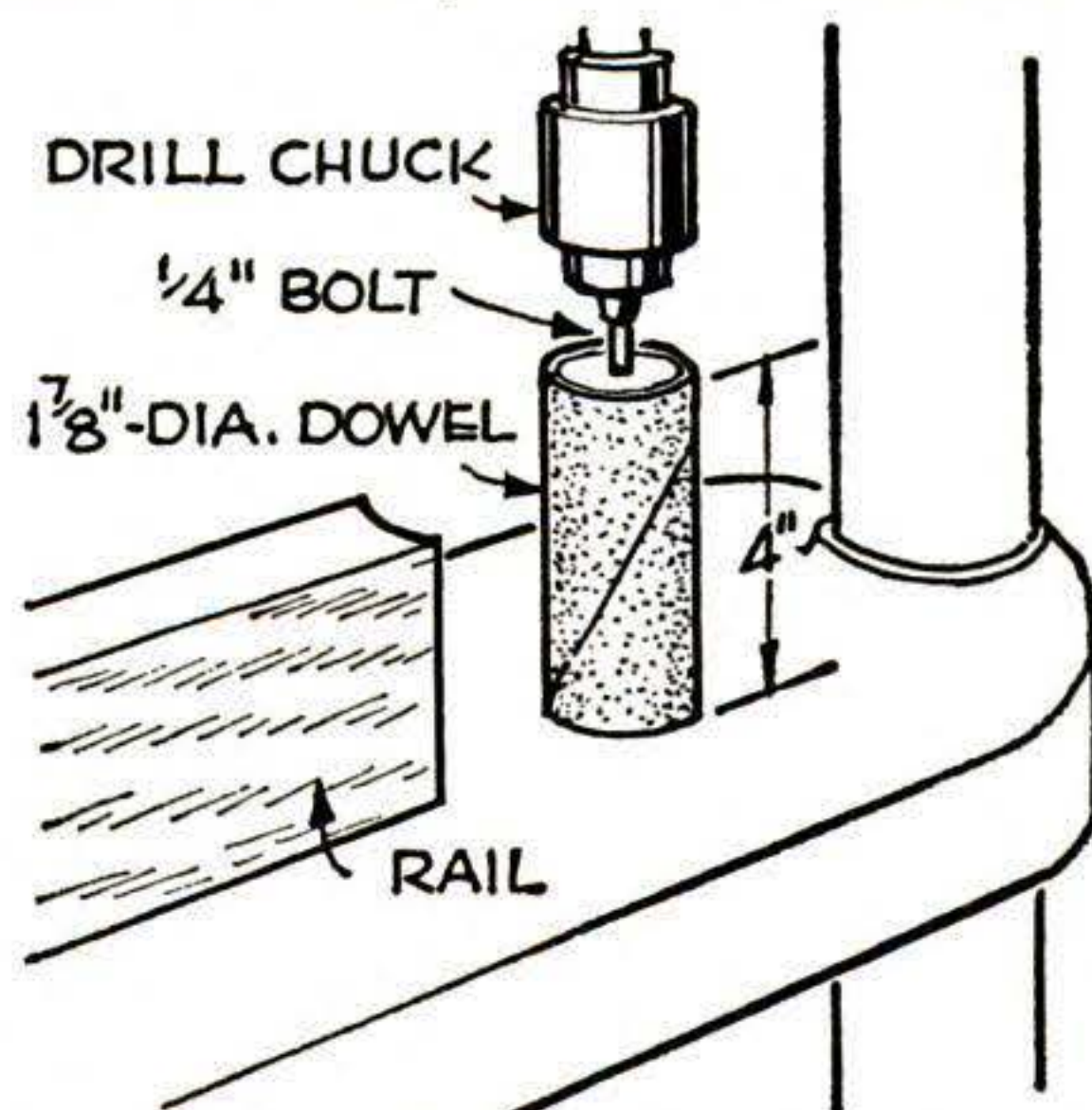
## Build a Scandinavian Flip-Top Table

[Continued from page 144]

head bolt 2" long welded to a square of  $\frac{1}{4}$ " steel, a washer, and two nuts. The stop block is positioned so the  $\frac{1}{8}$ " metal that projects on two edges presses into saw kerfs cut into the inner faces of the two long rails at the proper spots.

A set of four corner braces with hanger bolts and nuts provides a sturdy and workmanlike way to fasten legs to side rails. Corner braces 4" to 4½" overall are about right, and hanger bolts should be  $\frac{1}{4}$ " by 2½". The hanger bolts have tapered screw threads on one end to turn into a hole drilled into the legs.

If not available locally, you can order such hardware from dealers in woodworking supplies. Among them are Albert Constantine and Son, 2050 Eastchester Rd.,



A homemade drum sander makes short work of curving ends of rails to  $15/16$ " radius for snug fit with legs. Turn a 4" length of dowel to  $1\frac{7}{8}$ " diameter.

Bronx, N.Y. 10461, and Craftsman Wood Service, 2729 S. Mary St., Chicago 60608.

Assembling the parts you've made into a ready-for-use table is simple. And, of course, your table will be easy to disassemble at any time, too.

The table we show is veneered in teak. Rails are veneered over solid wood, the top over particle board to resist warping. Other versions have been produced in solid wood. Hardwood plywood could be used for the top, as could a ready-prepared particle-board top sold surfaced with plastic laminate.

To curve the rail ends, make a drum sander (sketch above). Turn a cylinder 4" long to the same diameter as the leg tops. Drill lengthwise and insert a bolt for chucking in a drill press. Glue on sandpaper. **PS**

## Only One Wheel to a Customer!

[Continued from page 89]

The cycle wheel rests against the curb, pointing into the street, with the pedal cranks at a 45-degree angle. On the first day, Jenack's ordinary student climbs on and holds hands with a person standing on each side of him. Then, sitting upright and looking straight ahead, he pushes his body forward by pressing back against the rear pedal. When he begins to tip forward, he automatically catches and balances himself by pedaling a quarter revolution or so forward, then back. A couple of times and, for the first day, that's it.

On the second day, still with two people standing alongside holding his hands, the trainee rocks for a few minutes, then pedals a full revolution, rocks again, maybe pedals back a revolution, then forward again. And so on. As the pedals revolve, the unicycle has a tendency to spin or twirl—but the people on either side stop the motion.

On the third day, as Jenack teaches riding, one or two unicyclists ride along with the pupil, holding him up more or less, hand in hand, and keeping him going in sort of a straight line. Incidentally, Jenack mounts his unit by leapfrogging onto it and touching his feet to the pedals simultaneously.

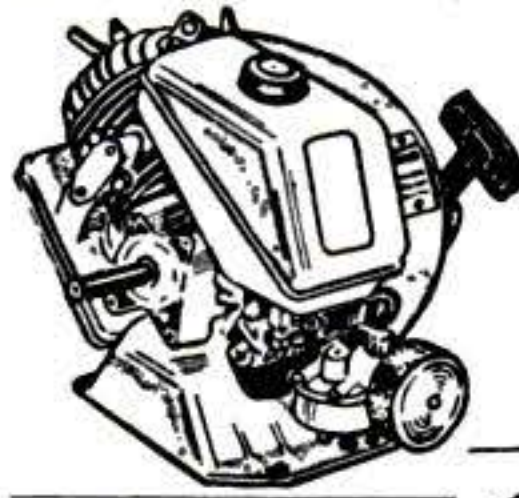
Because of my superb sense of balance and coordination and natural ability (along with the fact that I had been trying to ride for a month), Jenack glossed over the first two lessons and concentrated on the third. And you know what? It worked. Soon I found myself pedaling along with him—wobbly and apprehensive, like an old lady in high heels walking down an icy hill, but at least without the zip-splat I had learned to expect.

**Practice makes perfect.** Back home again, infused with my new-found confidence, I perfected my art, first by riding along the upstairs hallway (the walls are close enough to grab when panic strikes), then outside in the driveway, equipped with a 20-foot bamboo tightrope walker's pole.

Today, without the aid of gadgets, I pedal along quite well, learning to ignore the comments of stuffy neighbors. I wobble only a little, and wonder how learning could have been so tough. Only one trouble remains. For some reason, my dog doesn't like to see me ride, and when he catches me at it he runs over and bites me. P S

## Briggs & Stratton — Clinton New Gas Engine Sale

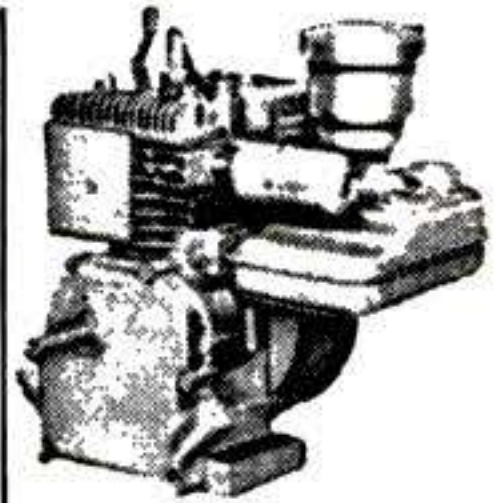
Never before and perhaps never again—this offer of brand new genuine Clinton and Briggs & Stratton engines including 1 yr. factory warranty at less than cost. Perfect power for go-carts, scooters, tractors, mowers, generators, pumps, sprayers, etc. We balled out 3 big factories who needed cash and the savings are yours while quantities last. Act fast.



Clinton 2 1/2 hp. Mdl. 500—Re-coil starter Std. 5/8 shaft w. keyway—ready to go. Reg. price \$59.50. Special (item 1002)

**\$34.95**

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6 for ....\$190.00

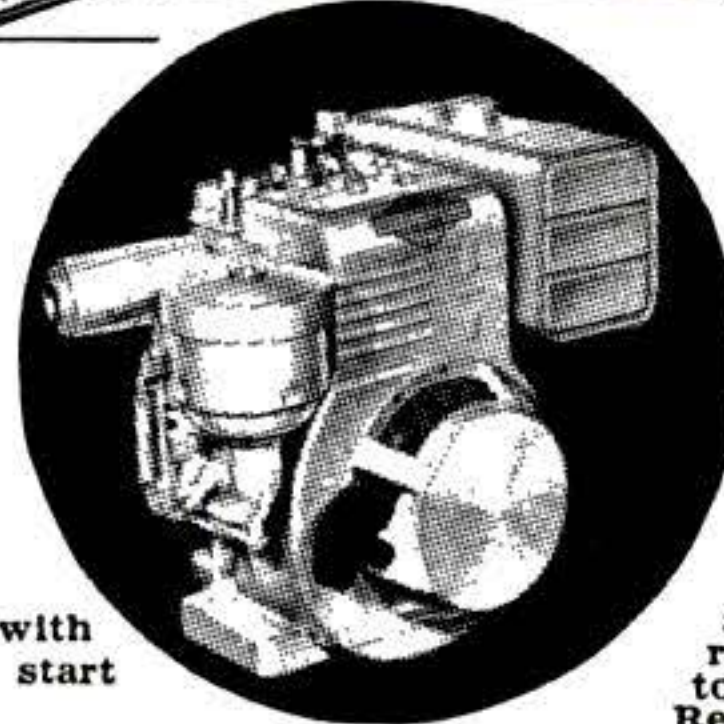


Briggs & Stratton 2 1/2 hp. Mdl. 81106 Rope start, std. 5/8 shaft w. keyway. Sturdy 4 cycle power. Reg. price \$49.80 Spec. (item 1518)

**\$34.50**

2 for ....\$67.50  
6 for ....\$199.50

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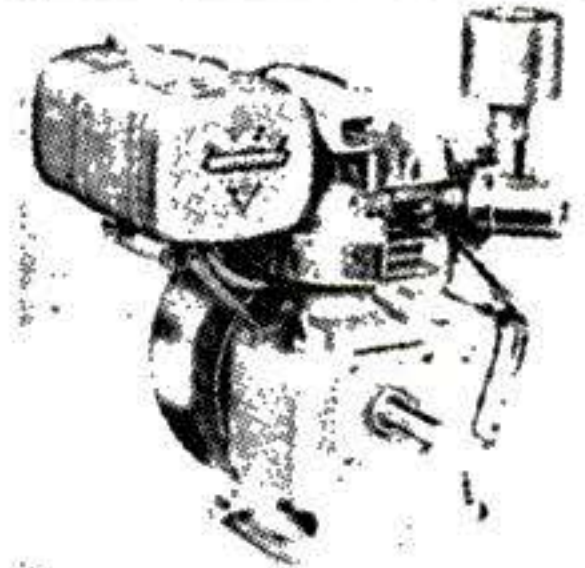
**2 3/4 h.p. Clinton—34.95**

Model 400, rugged 4 cycle model. Alum. Block, castiron cylinder Rope start 5/8" std. shaft **34.95**  
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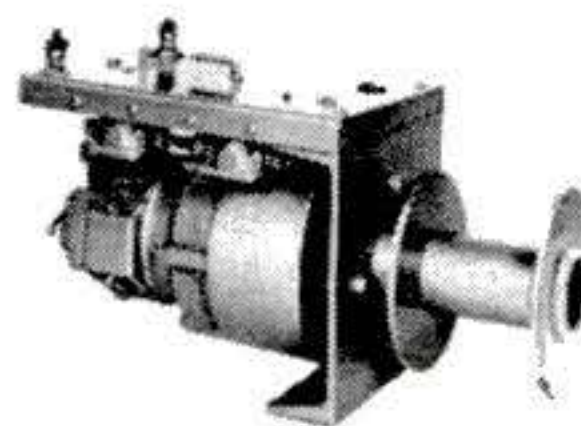


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[Continued from page 111]

to the inner wall of the housing near the 12 o'clock area and farthest away at six o'clock.

Heart of the rotary-vane engine is, naturally, its vanes. Made of steel, they fit into the slots in the rotor and travel radially an inch and a half. As the distance to the inner wall gets greater, the vanes slide out and form an effective seal against it. The vanes rule off the engine's working chambers. Thus, the prototype has 16 working chambers although more or less could be used.

Exact position of the vanes is determined by a cam mounted inside the rotor on the center axis of the crankshaft. Each vane has two bearings, which ride on dual cam tracks on either side of the cam. The vanes never get closer than 0.015 inch from the inner wall and cannot get hung up or bent.

How about seals, the problem that has plagued all rotaries including the Wankel? This is solved neatly with tiny pieces of stainless-steel tubing recessed in the tips of the vanes. They ride along in close proximity to the wall, forming an effective, completely durable seal. Although there is some gas leakage (this is one reason for the low torque at low r.p.m.), it is not a serious problem. Leakage is in the direction of rotation and ceases to be important at high speeds.

Fuel is fed to each chamber in turn through slots that go all the way through the housing and inner wall at the five-o'clock position. As each chamber continues around with its charge, it gets smaller and smaller the closer it gets to the inner wall. Maximum compression is reached at the 12-o'clock position.

One unusual feature of the engine is that the fuel ignites as decompression starts—before the one-o'clock position where the spark plug and firing grooves are located. This is said to make the engine run cooler with no substantial loss in power.

The combustion gases expand, and the exhaust at about the three-o'clock position. End plates of the engine are bolted directly to the rotor, and they too revolve on resilient cast-iron sealing rings. The output shaft of the motor is bolted to one end plate.

Although Mallory engineers are the first to admit the rotary-vane engine needs more work—it screams like a mammoth jet engine—they point out that it has unique features. Simply built, it has a minimum of parts to wear out. And it is light and efficient.



## The New Auto Safety Laws—and You

[Continued from page 84]

most serious classes and try to wipe them out one by one.

"It's our hope to develop accident-investigation teams that work in the field. These teams will not replace police investigators. Rather, they will do in-depth research on selected accidents culled from the massive new collection of data."

If the data show that one type of car gets into an abnormal number of accidents, would it be "grounded" the way federal aviation officials ground unsafe planes? Bridwell called a program of this sort for automobiles "speculative." He says the law doesn't give the government the power to "ground" cars once they are certified as meeting the safety standards. But—"we can prevent a manufacturer from making unsafe cars."

What effect will these safety laws have in reducing the number of dead and injured in highway accidents? Bridwell's grim prediction is that despite the introduction of safer cars "the number of deaths and injuries is going to go up before it comes down. To reverse this trend is going to take time."

**Part of a process.** Federal officials look upon the new laws as the start of an evolutionary process toward greater highway safety. One reason is that we now have 16 million cars on the road. If we build nine million new cars and scrap an expected five million old ones, you only improve a relatively small percentage of the total car population. The standards aren't going to show up in all cars on the road for probably a decade, officials say.

Another reason for the pessimistic outlook on lowered highway accident rates is that the vehicle is only one part of the system. And it will take a lot more time before the standards aimed at upgrading driver skills, traffic laws and controls, and the safety design of highways begin to significantly help in reducing the number and severity of accidents.

"Our goal in this," says Bridwell, "is to achieve a very substantial increase in traffic safety so that you can use your automobile safely and conveniently—pursue the normal activities of going to work and driving for leisure—with a greater degree of knowledge that you can do this safely, that no harm is going to come to you, and that you are not going to inflict harm on others." **PS**

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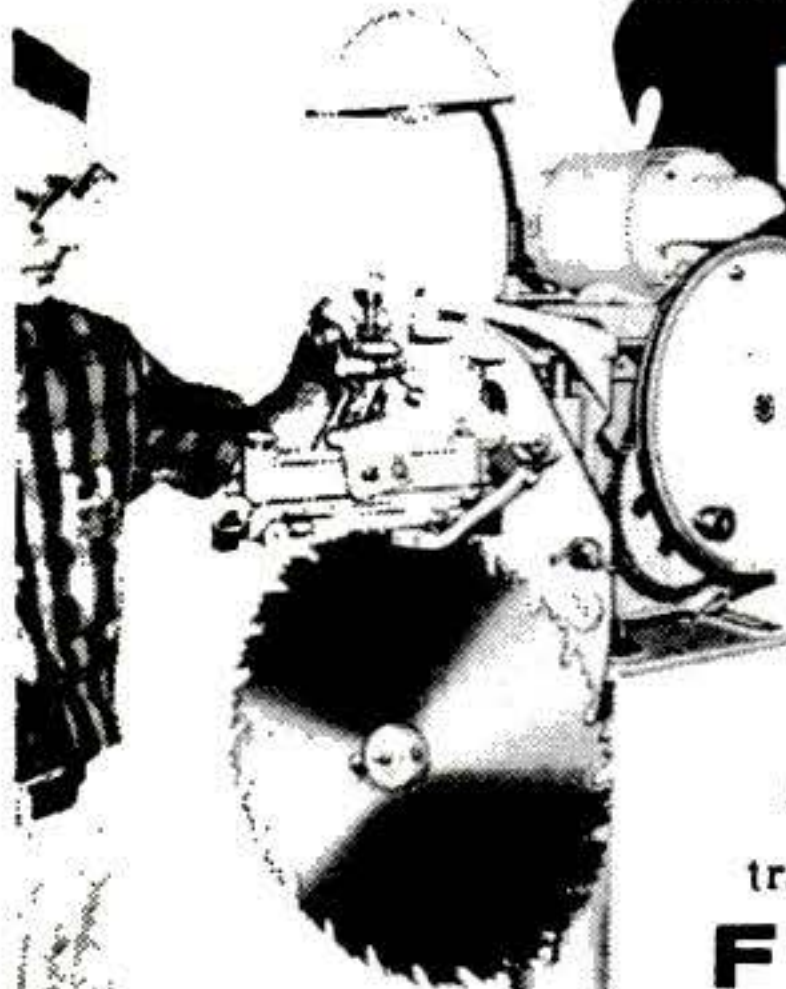
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**Fluidics: A Stream of Air That Thinks**

[Continued from page 121]

stream, and changes its direction. Two streams of air interact in exactly the same way.

Next, set the nozzle for a maximum flow and hold it about an inch from, and parallel to, the side of your car. You'll find that the stream is pulled against the car body.

This wall-attachment phenomenon was first identified in 1932 by a Rumanian scientist named Henri Coanda, and it is called either the Coanda effect or the wall-attachment effect.

The diagram at the top of page 120 explains this phenomenon in terms of a moving air stream: Any moving stream tends to entrain—or capture—part of the medium that surrounds it. In other words, the air stream or the water stream from your hose tends to pull in air from the surrounding atmosphere. However, if the stream is flowing near a wall, the act of entraining surrounding air creates a low-pressure region—a slight vacuum—between the stream and the wall. Consequently, the stream is drawn to the wall, and it attaches itself to it.

Here's how these effects are employed:

**Logic devices.** The fluidic "light switch" shown on pages 118 and 119 is made up of two fluidic gates—or decision-making switches—interconnected with plastic tubing to create a fluidic flip-flop (toggle switch).

A simplified diagram of each gate is shown at the bottom of page 119. In operation, the power stream (the main air stream) flowing through the main channel can either flow into the output channel or out through the dump opening; it all depends on whether or not there is an air stream flowing through either of the control channels. If a control jet is present, it diverts the main stream—by momentum transfer—through the dump. If not, the power stream runs through the output channel.

The device is capable of making a yes-no decision: If there is no control jet, there "yes," there is an output air stream; if there is a control jet, then "no," there is no output.

**Bi-stable—or two-state—devices.** The Coanda effect makes this type of device—another kind of flip-flop—extremely easy to design, as illustrated in the diagram on page 120. Assume that the power stream is attached to the upper wall, and thus flows completely out of the upper output port. If the air stream is fed through the

**Fluidics: A Stream of Air That Thinks**  
 upper control jet, it will (through momentum transfer) dislodge the power stream from the wall, and bend it toward the lower wall. Almost instantly, the stream will flip to the lower wall, attach itself, and exit through the lower output port. Note that it will remain locked on the bottom wall even if the control jet stream is turned off.

An air stream entering through the lower control jet will flop the power stream back to its original position.

Bi-stable devices are used to "remember" bits of data in digital computers and control systems.

**Amplifiers.** These exceptionally versatile devices (shown at the top of page 121) can be used in a variety of ways. As straight-forward amplifiers, they produce an output air stream that is a larger replica of the air streams fed into the control jets. Or they can be used as sensors in control systems: Any object that blocks the flow of air into the control jet changes the device's output. And they can be hooked up so they oscillate and produce pulsating output air streams. There are three basic amplifier types:

- **Proportional amplifier.** If the two control jet streams are equal, then the power stream splits evenly, and both output streams are equal. However, if the control jet streams are unbalanced, then momentum transfer bends the power stream and the outputs are unequal.

- **Aerodynamic amplifier.** The power stream flows over a surface shaped very much like an airplane wing, and aerodynamic effects make it tend to follow the surface's curvature. Thus, the stream exits through the lower output port. However, an air stream forced into the control jet cancels these effects and bends the power stream upwards.

- **Vortex amplifier.** In the absence of a control-jet air stream, the power stream entering the hatbox-shaped structure flows out of the axial output tube relatively unimpeded.

If an air stream is fed through the jet, however, it starts the power stream spinning like a tiny hurricane, and the output is substantially reduced.

You'll be hearing a lot more in years to come about these ultrasimple gadgets that prove that thin air—the stuff you and I breathe—can be pretty clever stuff. P 5

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## Traffic Topping Waterproofs a Sun Deck

[Continued from page 140]

time to see the seam pattern beneath the Traffic Topping. This is because you have deliberately put down wide seams with a rubbery caulk to assure flexibility. On very hot days, the caulk and plywood expand slightly, revealing the run of the seams. Therefore, if you're the fussy type, figure out beforehand how your sheets will lie (over-all pattern).

So far, an easy two weekends had been spent getting the deck ready. Now we were ready for the frosting on the cake.

**Traffic Topping.** We picked a warm, dry day in late summer. First the entire deck was very lightly dampened with a spray mist from the garden hose. Then, before it dried, Traffic Topping SCP-151 primer was applied over the entire deck, using a short-nap paint roller on an extension handle. This was dry in about an hour.

Next, the first can of Traffic Topping was prepared. Since the silica aggregate tends to settle out somewhat during storage, it is best to stir up the mix for a few minutes before adding the curing agent. This comes sealed in a plastic retainer in the can lid.

Now we mixed in the STM-700C curing agent. (Note: Many solvents in the primer and the topping are toxic. Outdoors you won't have too much problem—but if you do a garage or indoor playroom, use plenty of ventilation.)

When thoroughly mixed, the Traffic Topping was dumped out on the deck and we started troweling. A 10" mason's trowel proved just right.

The trick is to bear down on your trowel and make long, continuous sweeps as you spread the material. You're shooting for a  $\frac{3}{32}$ " layer when you're done—which isn't much. But that's all you need to do the job. You'll almost automatically get this if you bear down on your trowel and hold it at a 30- to 45-degree angle. We finished the whole job in one session to avoid join marks. However, if you do have to come back to finish it later, here's a hint: Lay down a strip of masking tape where you stop. Trowel the last of your material out across the strip. Then whip up the strip and you'll have a nice straight line.

Try to avoid going back and forth over the mix too much. Actually, it's a whole lot like troweling cement (Traffic Topping looks like a well-laid cement deck when

done). Too many passes over the same spot cause graininess.

You can roll out unwanted trowel marks using a paint roller lightly moistened with mineral spirit. Again, the secret is to press down a bit when you're rolling and not to make too many passes or use too much spirit. The mix is plastic and viscous and will self-level to some extent. It will begin to set on you in 30 to 45 minutes. Don't waste time and you'll be okay.

You can figure about 16 square feet of coverage to a gallon of Traffic Topping. When you get near the bottom of your pail, don't dump it all out on your deck. Pour the remainder in with the next can of Traffic Topping since, if there's any material that hasn't mixed with curing agent, it is mostly in the bottom of the pail.

That's about it. Keep kids and cats and dogs off your deck for about 24 hours. For finish-up, we caulked all remaining seams along the house wall and around the railing posts with more SE-1201. This gives a waterproof skin right up to and over the edge of the deck, and the backband is a drip member for any runoff.

**Results.** The deck has been highly satisfactory. It's gone through a hot summer and a cold winter without the slightest problem. The Traffic Topping is remarkably tough and resilient. Slightly grainy in texture, it is nonskid. It looks like concrete. Ours is a silver-gray color. Other colors are terra-cotta, a much darker slate gray, and a dark green. These colors are all available. Later I'm going to paint a decorative compass rose in the middle of the deck, using compatible GE silicone paints. Since much of the traffic on the deck comes up an outdoors stairway, there is ample opportunity for muddy footprints. Dirt and stains wash away readily enough; perhaps the darker-colored Traffic Toppings don't show dirt as much as our lighter deck.

And there are no more leaks! Our deck is slightly pitched. However, this new material is so waterproof that puddles can sit on it and evaporate.

The deck is a focal point for parties and fun. The garage and carport are dry at last, and gone are the potential troubles from water seeping down the interior walls. If you have a similar roof or deck, GE's new material may well be the answer. **PS**

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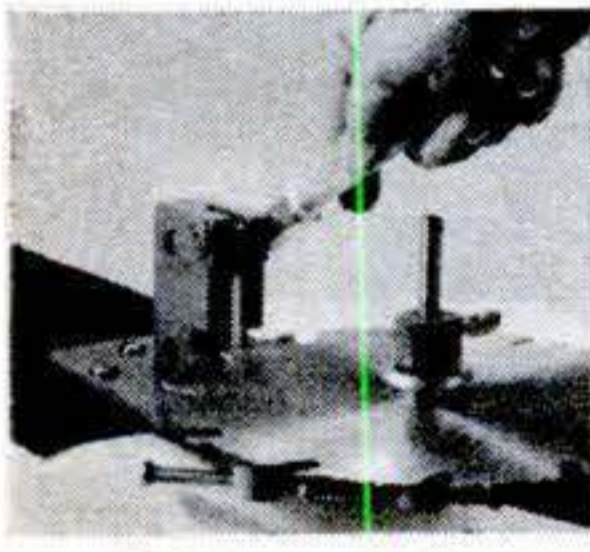
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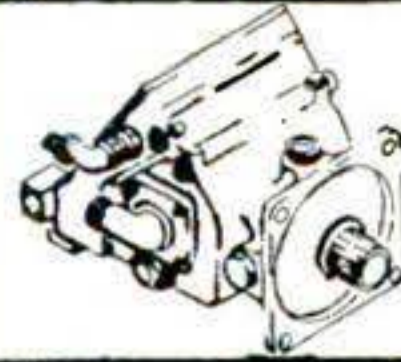
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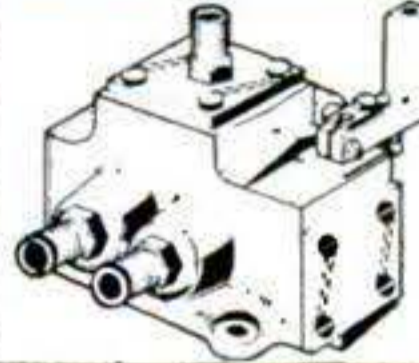
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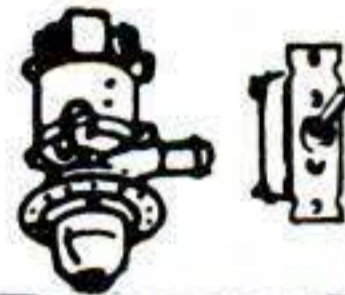


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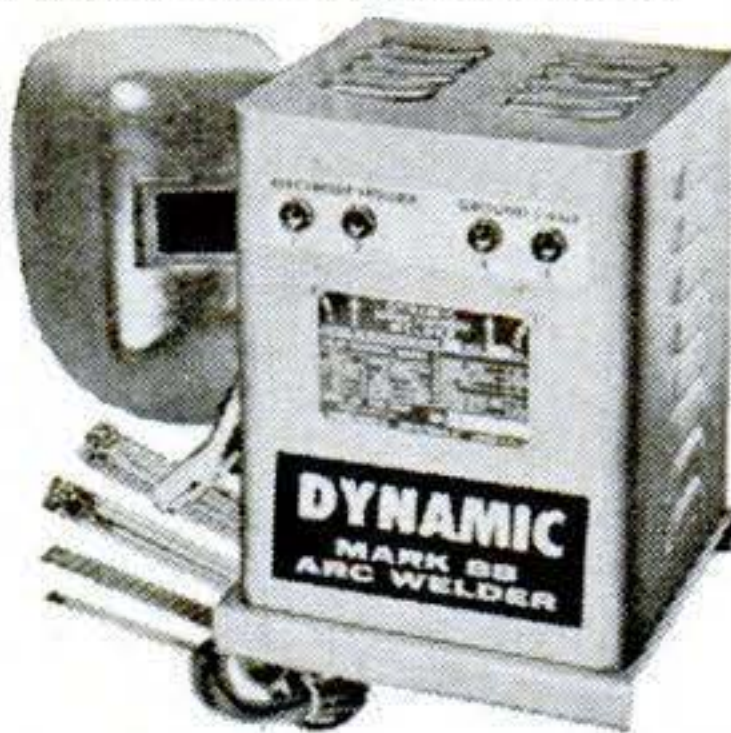
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**How to Rent a Backhoe**  
 [Continued from page 152]

they want to be sure you won't damage it. And they don't want you to hurt yourself or someone else.

Backhoes rent for \$7 to \$10 an hour or \$40 to \$60 for a 12-hour day. Rates vary with locality and machine size. You pay for time from the moment you leave the dealer's lot until you return the machine. So it's a good idea to have your work well planned and laid out before you rent.

**Laying out the job.** If you're laying pipe or drainage tile, have all the materials you need on hand. That way you can install the pipe or tile quickly, backfill, and return the machine with the least lost time.

On big jobs, like putting in a septic-tank system or a footing, do the digging and return the backhoe. After you've made your installation, rent the backhoe again to do the backfilling.

If you have fill to remove from your property, say after excavating for a basement or pool, you'll need a dump truck to haul it away. You can rent that, too. The backhoe's hydraulic loader quickly loads a truck. Getting rid of fill is usually easy.

**Before you take it home.** Make sure you know how to operate all the controls on the machine. Practice on the dealer's lot until you have them down pat. If the dealer has a patch of ground where you can dig and backfill, ask him to let you practice there. Get instruction on positioning the machine for the job you'll be doing.

Be sure everything is in good working condition. Bring to the attention of the dealer anything questionable.

Ask the dealer about insurance and liability. Read the rental agreement, and know what your responsibilities are.

Dealers will deliver and pick up the machine. They use a low-boy trailer or a tow truck. It usually costs a few dollars extra, but it's worth it if you have to take the machine a considerable distance. The smaller digging machines go on a trailer you can pull behind your car. Rental price usually includes use of the trailer.

When you get the backhoe home, if you have any operating problems or if the machine breaks down, don't try to make repairs yourself. Phone the dealer for instructions immediately. If you don't phone, you'll have to pay rental time even though you're unable to use the equipment. **PS**

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## Beating the Spacecraft Fire Peril

[Continued from page 98]

emergency vent in a spacecraft and dump the whole cabin atmosphere overboard. That will quench even an oxygen fire with the best extinguisher there is—a vacuum.

Naturally, when crewmen do that, spacesuits must protect them from the vacuum of space. If fire strikes while they're in shirtsleeves, will they have time to get spacesuits on? Studies indicate their chances are good. Oxygen itself doesn't burn; an oxygen fire must feed on things that do. So its spread will be stopped or slowed, if care has been taken to arrange "fire breaks" or gaps between any combustible objects that must be in a cabin—a safety precaution found lacking in the Apollo cabin where the astronauts died.

Finally, a crew in space may have something else working for them—zero gravity. On earth, flames leap upward, spreading a blaze. In a weightless state, where there is no convection, flames shrink into weird little balls—and a fire's spread should be retarded. That effect, suggests one expert, might be a critical factor in giving crewmen time to don suits. We'll know more about it when zero-gravity-fire experiments, like one planned for the Orbital Workshop, can be made in space.

But why haven't we done as the Russians have—and used a homelike "artificial air" having the same makeup, pressure, and fire safety as natural sea-level air?

First, weight counted. For our little Mercury, we didn't have much choice. Its Atlas booster could orbit only a two-ton craft, compared with Russia's five-ton Vostok. Weight-saving meant a cabin wall thinner than a dime and strong enough to hold only a five-pound-pressure cabin atmosphere—which, being so rarefied, would have to be highly enriched in oxygen. A pure-oxygen system was the simplest answer. Gemini, limited to half the weight of Russia's Voskhod, followed suit.

Apollo gave us a choice. Its mighty launch rockets, Saturn I-B and the soon-to-fly Saturn V, could put up a spacecraft far heavier than any Soviet one up to this writing. Yet pure oxygen was chosen again—for a number of reasons:

**The "decompression" hazard.** U.S. spacecraft designers are concerned over losing a cabin's atmosphere in space—through a breach caused by a meteoroid, a docking

accident or other collision, or spontaneous structural failure. Then the crew would have to fall back on spacesuits. And going in a hurry to a spacesuit's low pressure, from anything like normal-pressure air, would invite dire consequences from "bends"—the decompression sickness of divers, due to bubbles of nitrogen released from solution in the blood.

Our experts think this hazard, which pure oxygen avoids, rules out anything more airlike for a cabin than a half-and-half seven-pound-pressure mixture of nitrogen and oxygen—the nearest thing to natural air that they're even talking about for the future. Soviet designers seem to have ignored the risk.

**The spacesuit problem.** Space-walking, too, puts restrictions on a cabin atmosphere. In the vacuum of space, a pressurized suit balloons taut and stiff. Only with the least possible pressure in it can a man manage the effort of moving arms and legs. So our space-walking suits use oxygen at only about 3½ pounds' pressure. That is the lower limit that gives the lungs enough oxygen—and almost the minimum, too, that will keep them from collapsing. (Because risk of low-pressure lung collapse is aggravated by the *g* forces a spacecraft undergoes, five pounds is held the minimum for cabin pressure.)

So space-walking or moon-walking call for decompressing to spacesuit pressure—and again, risks bends, if done from an airlike cabin atmosphere. A Soviet space walker did do this just once, with the help of an airlock, to don a five-pound-pressure spacesuit—which must have been too stiff to allow anything more than floating on a tether as he did. Our much more "spacesuit-compatible" cabin atmosphere of five pound-pressure oxygen has permitted our extensive and practical Gemini space-walking feats—and will aid our ambitious space missions to come.

Guarding against all dangers, then, demands different and conflicting things of spacecraft atmosphere. As our experts see it, we must settle for the best we can do in reducing risk of fire, without adding to astronauts' other perils. Whatever Apollo changes NASA announces—perhaps by the time you read this—debate over the difficult trade-offs may go on for years. ■

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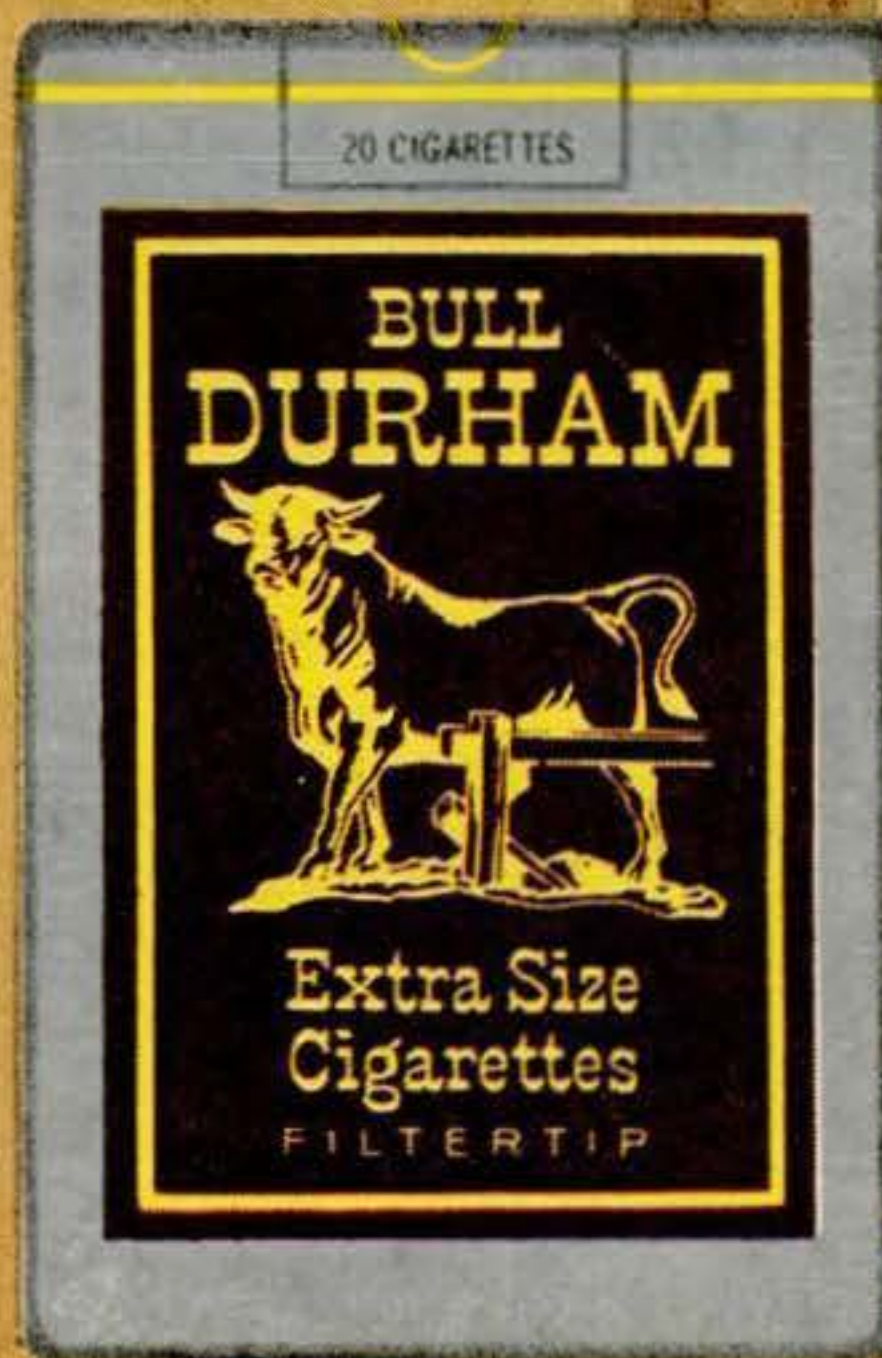


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