

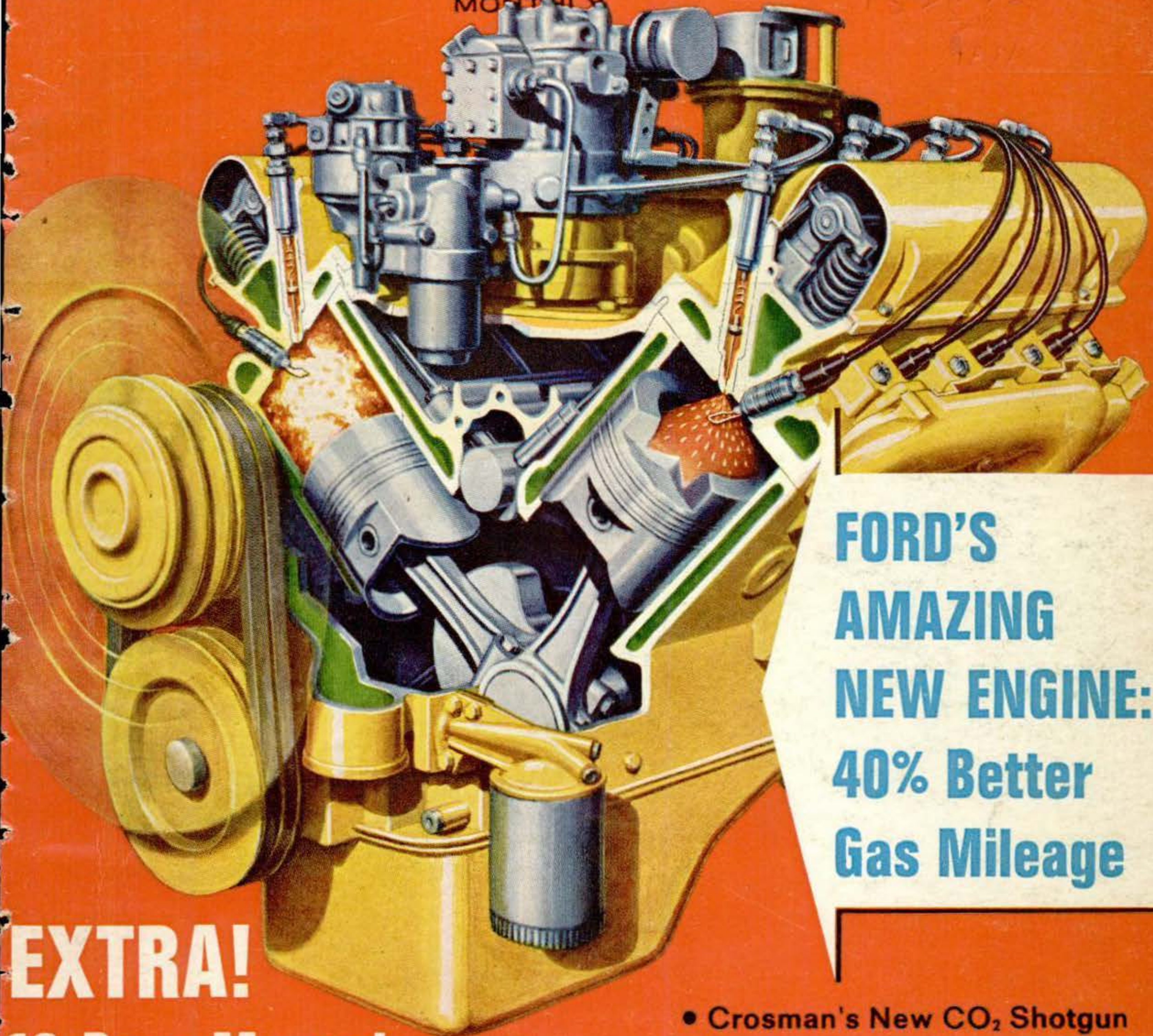
JULY 1968 50 CENTS

# Popular Science

## '69 CARS

Secret Photos and  
New Design Details

MONTHLY



**FORD'S  
AMAZING  
NEW ENGINE:  
40% Better  
Gas Mileage**

**EXTRA!**  
**16-Page Manual:  
CARE AND REPAIR OF YOUR  
POWER LAWN MOWER**

- Crosman's New CO<sub>2</sub> Shotgun
- Test Report on Eight Gas-Saving Gadgets
- Tricks Treasure Hunters Use
- How I Remodel My Own Home  
By ED McMAHON

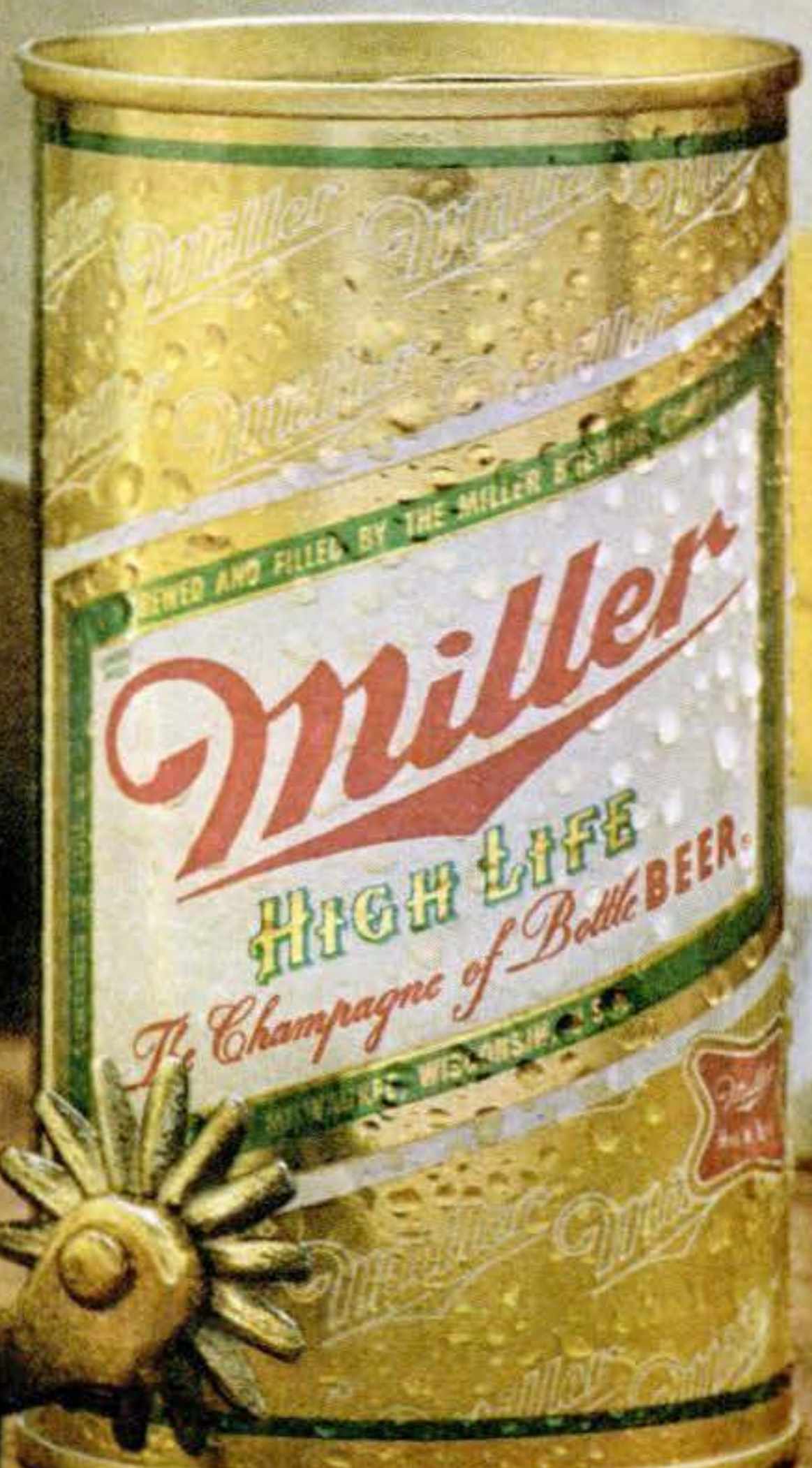
**Coast to Coast by Car in Under 45 Hours—Norbye/Dunne Break Record**





# Miller makes it right!

For raw-boned, he-man excitement . . . nothing beats a real Western rodeo. It's at times like these . . . after the riders and ropers have thrilled the crowd . . . that Miller Makes It Right. That's when the hearty, robust flavor of Miller High Life really scores. Try it . . . on tap, in bottles or the gleaming golden can . . . always right!





# How Renault scrimps on gas without scrimping on car.

The average price of a gallon of gas in Europe is 68¢. And since the price never has been very reasonable, we have always been faced with a very unreasonable task: Design automobiles, comfortable automobiles, which merely sip at gasoline.

The Renault 10 can sip at the rate of 35 miles a gallon.

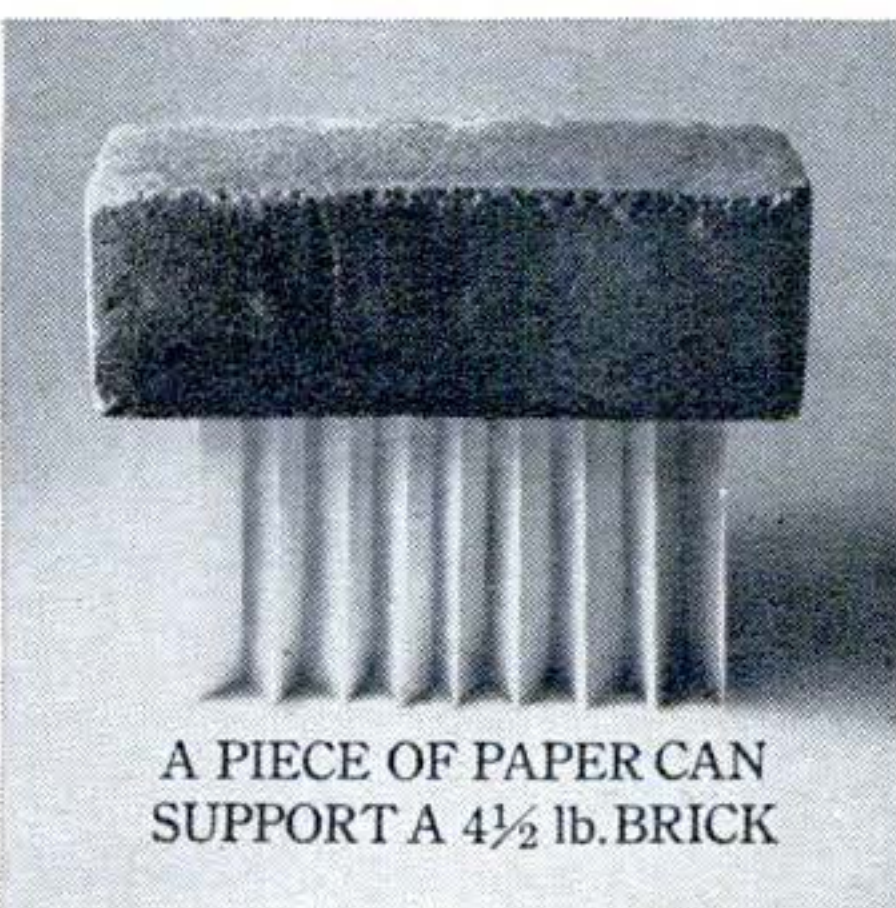
One of the chief reasons for this remarkable mileage is the Renault 10's engine. Quite simply, if you don't waste power, you don't waste gas. Which isn't all that simple.

In practice, it meant developing a new casting technique to get a more compact engine block. By keeping the block size down, we keep the car size down, which keeps the gas consumption down.

It meant anchoring the crankshaft with 5 main bearings (as much as most V-8's) to cut vibrations down to an irreducible

minimum. No vibration, no power waste, no gas waste.

The next bit of gas-saving isn't easy to explain. See that brick sitting on that pleated paper?



A PIECE OF PAPER CAN SUPPORT A 4½ lb. BRICK

Without those pleats, the same paper would never even support another piece of paper. That, in



principle, is the kind of extra wrinkle we design into the steel structure of the Renault 10. It

allows us to increase strength and rigidity without increasing sheer dead weight. And by not increasing dead weight, again, we don't increase gas consumption.

Sealed liquid cooling. Every engine uses gas most efficiently at a particular temperature. And there is no better way to maintain this optimum temperature than with liquid cooling. Therefore: liquid cooling. Which also means we don't have a big, oversized fan stealing power (and gas) from the engine.

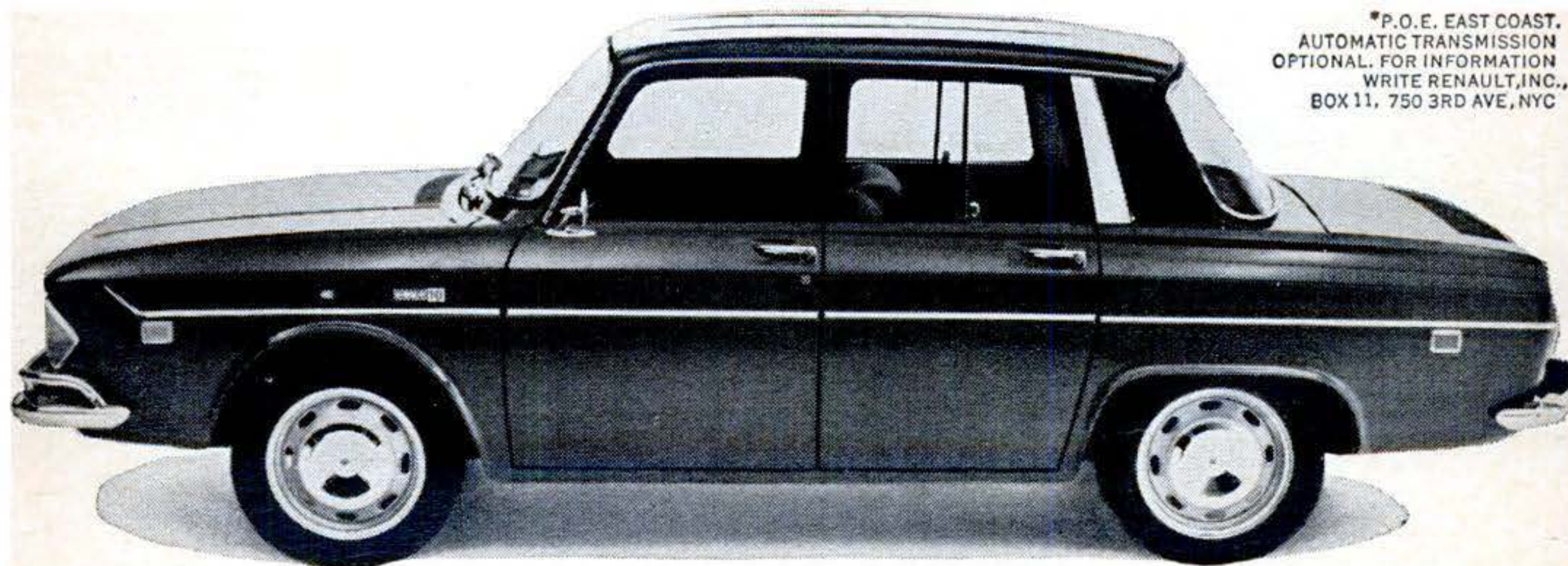
As you can see, to scrimp on gas we've had to be rather lavish on engineering. Over the last 10 years, in fact, Renault has averaged a new patent every 3 days.

Now, with your permission, a little documentation on how little scrimping there is on car. Included in the \$1,745\* price: Seats that have been compared with the seats in a Rolls-Royce. And which convert into twin beds. 11 cubic feet of trunk. Top speed, 85. Self-adjusting 4-wheel disc brakes. 4-wheel independent suspension. 4 doors. 4 speed synchromesh transmission.

If there's any scrimping on the Renault 10 at all, it's on the gas tank. It only holds ten gallons. (About 350 miles worth.)

**RENAULT** 

\*P.O.E. EAST COAST.  
AUTOMATIC TRANSMISSION  
OPTIONAL. FOR INFORMATION  
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BOX 11, 750 3RD AVE, NYC



The Renault 10



**HIGHLIGHTS OF THIS ISSUE:**

**Coast to Coast by Car in Under 45 Hours** PAGE 37

Travel with Norbye and Dunne on their record-breaking trip across the country.

**Ford's Stratified-Charge Engine** PAGE 44

Forty-percent better gas mileage, no choke, smogfree exhaust, low maintenance costs—is this the Ford engine in your future?

**Hot News on Detroit's '69 Models** PAGE 56

Safety is the name of the game for '69—and here are three major developments.

**I Remodel to Personalize My Home By ED McMAHON** PAGE 60

The popular TV personality tells how he is customizing his recently purchased house.

**Crosman Introduces First CO<sub>2</sub> Shotgun** PAGE 136

Here's a double-barreled surprise for sportsmen: a CO<sub>2</sub> shotgun—part of a low-cost skeet outfit—and a superaccurate, uniform-trajectory CO<sub>2</sub> rifle.

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**EXTRA! 16-Page Save-It Manual:**

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Men with wide-ranging interests will find a wide range of entertaining and useful articles in August PS. Such as:

- Startling New Facts About Lightning
- Last-Minute News on the '69 Cars
- Food Poisoning: How You Can Avoid It
- The Boom in Private Flying
- Sneak Preview of the '69 Pontiac Grand Prix
- The Magic Box That Plays a Game
- Erle Stanley Gardner: The Wonderful World of Four-Wheel Drive
- 16-page PS Extra: What You Should Know About Auto Insurance

### HOW TO:

- Build Indoor/Outdoor Furniture (blueprint)
- Choose and Use Bricks
- Build Your Own Ski Kite
- Use Epoxy Glue The Right Way
- Become an Expert Driver for Water Skiers

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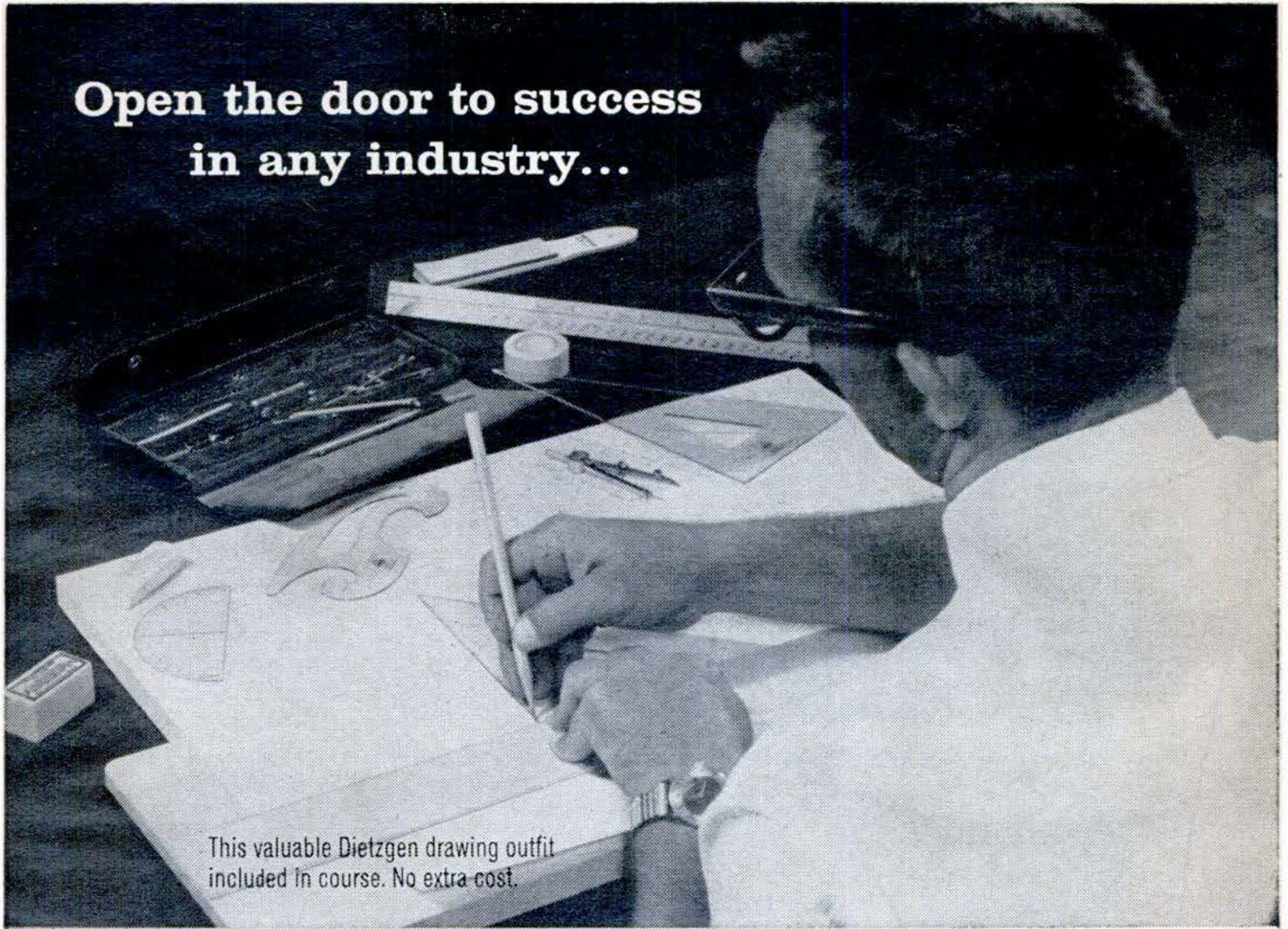
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915



### The marijuana problem

Robert Gannon's article, "The Truth About Pot" [May], was one of the best I have ever read on the subject. I think our present problem of "acid heads," "speed freaks," and "smack heads" stems from the fact that pot is illegal. Marijuana has been linked with the more powerful drugs because it is pushed by the Mafia, which controls the more powerful drug market also. Legalization of pot would cut the Mafia out of a great deal of income and take pot away from its association with more dangerous drugs.

ROBERT STEWART, Aberdeen, S. D.

... Why does PS feel bound to present a story about marijuana? Marijuana is not popular, regardless of what *Life* or PS says—and certainly not science. You have done tremendous harm by publishing this article. You can be assured you have started many teen-agers down the "grass" path with this irresponsible reporting.

CLAUDE L. STRATTON, Lakewood, Colo.

... I was very impressed by two articles in the May issue—"The Truth About Pot" and "The Codebreakers." You have rendered the country and mankind a tremendous service with these articles. Every thinking person should have the chance to read them.

HOWARD C. SMITH, Orange, Calif.

... I wish to protest the article on pot. Most of the "experts" on pot referred to in the article are medical doctors. It is a fact that the rate of drug addiction among doctors is about 30 times higher than in any other profession. If, as the article says, "smoking pot doesn't hurt driving too much," how about a Norbye/Dunne report on testing a car while puffing on pot . . . under medical supervision to make it legal, of course. Why haven't the many people who have written on pot gone to the real experts on the subject, who can be found on Skid Row, or in any mental institution.

JIM CARBERRY, Placerville, Calif.

### More on tires for your car

... Thank you for your excellent feature "Tires for Your Car" [Apr.]. You say in

the article that lowest tire wear occurs on superhighways, presumably at cruising speeds of 70 m.p.h. or more. I had been led to believe that high speed made for higher tire wear, all other things being equal.

CLARENCE LE BLANC, Sackville, Can.

*All other things being equal, higher speed does wear tires out faster. But slow and uneven speeds characteristic of driving in cities—with lots of stopping and starting—wear out tires quicker than driving at steady high speeds on superhighways.*

### Likes togetherness on the water

Sometimes being independent is dangerous. An unmanned hull like the one in "Build a Towboat for Solo Skiing" [May] can't do much to save your life, if you get hurt.

L. A. LAYCOCK, Vero Beach, Fla.

... The solo skiing towboat looks like an ideal craft. But wouldn't it be better to have an electric starter and an inboard kart engine? This would give you better visibility and the rudder would be more responsive to the inboard than an outboard engine.

W. E. HOSCH, Jackson, Miss.



### Dream selections a nightmare

R. M. Benrey's dream stereo system ["The Stereo System I Wish I Owned," May] is a nightmare to me. Who dreams of a one-source system? I don't. Certainly an FM tuner should have been included, and possibly a good tape deck. Sweet dreams, Mr. Benrey.

ROBERT F. GERARD, Carlstadt, N. J.

### You have an exception

I take exception to Smokey's response regarding Leon Zalenski's non-stop electric windshield wipers [May]. Some, if not all, wiper-motor units have a continuous (key-on) power supply and cam, or otherwise a periodically operated switch to park the blades correctly when switched off. A defect in this switch could certainly cause continuous operation.

WESLEY J. ELDRED, Fletcher, Vt.

### Bridging an information gap

May's "Readers Talk Back" has an answer to a letter from Richard L. Blausen

*Continued*



# TOM McCAHILL SAYS:

## ***“There’s COLD CASH In Repairing These Things!”***



Each time a buddy of mine moans about the lousy repair job he got on his refrigerator or toaster or washing machine, I'm reminded of the fact that a good Appliance repairman is a mighty rare breed these days.

This neighbor of mine had refrigerator trouble just last month, and needed some speedy repair service. After phoning half a dozen repairmen who were booked solid for days, he finally had to settle for a bum job from a guy who had no business calling himself an Appliance repairman. This brings me to an important point. No one who wants to earn money in Appliance repair needs to learn by trial and error. There's a great, low-cost home study plan on the market that covers every type of Appliance repair in detail. The course was prepared by the Appliance Division of the National Radio Institute, one of the biggest and best schools in the field. Thousands of guys like yourself have studied with NRI, and many of them have more than paid for the low tuition fee within their first couple months servicing Electric Appliances.

If you want to make money (and who doesn't) in a field that's crying for good talent, make certain you send for a free NRI catalog. Get the details on the well-illustrated lessons that teach you how to repair home, farm and commercial Appliances, and small gasoline engines. You'll be amazed at how little the training costs. And you'll even get a professional Appliance Tester without extra cost.

NRI has been in the home study field since 1914, and they have a staff of 150 experts in Washington, D.C., who guide you through the course with more personal attention than you'd find in some classrooms. If you're really out to learn, they can furnish a

special course in air-conditioning and refrigeration repair, too.

Even if you've never tried to put a toaster in working order, even if your schooling never went beyond the tenth grade, I'm as certain as my name is McCahill that you can make money in the Appliance repair field with the help of this NRI course.

Do yourself a favor right now. Send off the coupon below and NRI will send you a free catalog. If you don't like the looks of this material, you can forget the entire deal, and you'll be out only one postage stamp. But remember, the Appliance repair field needs qualified men *now*. And you can qualify with NRI training.

*Tom McCahill*

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Bond Street burns slow because it has a combination of plugs and flakes, for smooth and steady burning. If you're not in too much of a hurry, go to Bond Street. And taste what you've been missing.



## PS Readers Talk Back

[Continued]

of St. Marys, W. Va., that the only eyebar suspension bridge remaining in the U.S. is located in St. Marys. There are three that cross the Allegheny in downtown Pittsburgh.

H. H. FRITS, Pittsburgh, Pa.

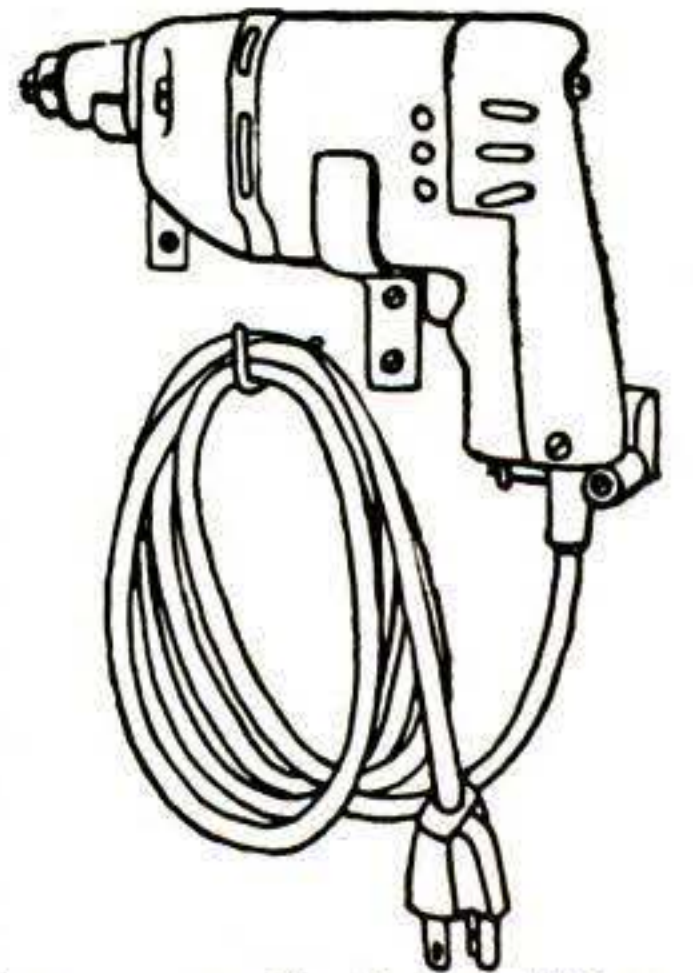
*The Pittsburgh bridges are eyebar suspension bridges, but not "like" the St. Marys bridge in size.*

### Short cut bugs him

One of your "Short Cuts and Tips" [Jan.] shows a way to keep your portable drill plugged in and ready to go. It has been bugging me ever since. Keeping any power tool plugged in and ready for use is not good practice, at least not in my shop.

And keeping a drill in a vertical position for an extended period invites lubricant seepage along the output shaft and over the chuck. I use a cradle rack for my drill and the power cord is coiled up and out of the way.

W. G. SCARBOROUGH, Lakewood, Ohio.



### About antifreeze in summer

In "Why Your Car Needs Antifreeze in Summer" [May], you say that a 44-percent glycol solution at 15 p.s.i. has a boiling point of 264 degrees F. versus 248 degrees F. for plain water, which is true. Unfortunately, you neglected the importance of heat transfer. Glycol antifreeze has a considerably lower heat capacity and is thereby less efficient in cooling an engine in summer than water.

Therefore, any car radiator filled with pure water would have approximately 20 percent more cooling capacity than one filled with antifreeze. Although the boiling point of water would be lower than antifreeze, it would be more desirable for summer driving.

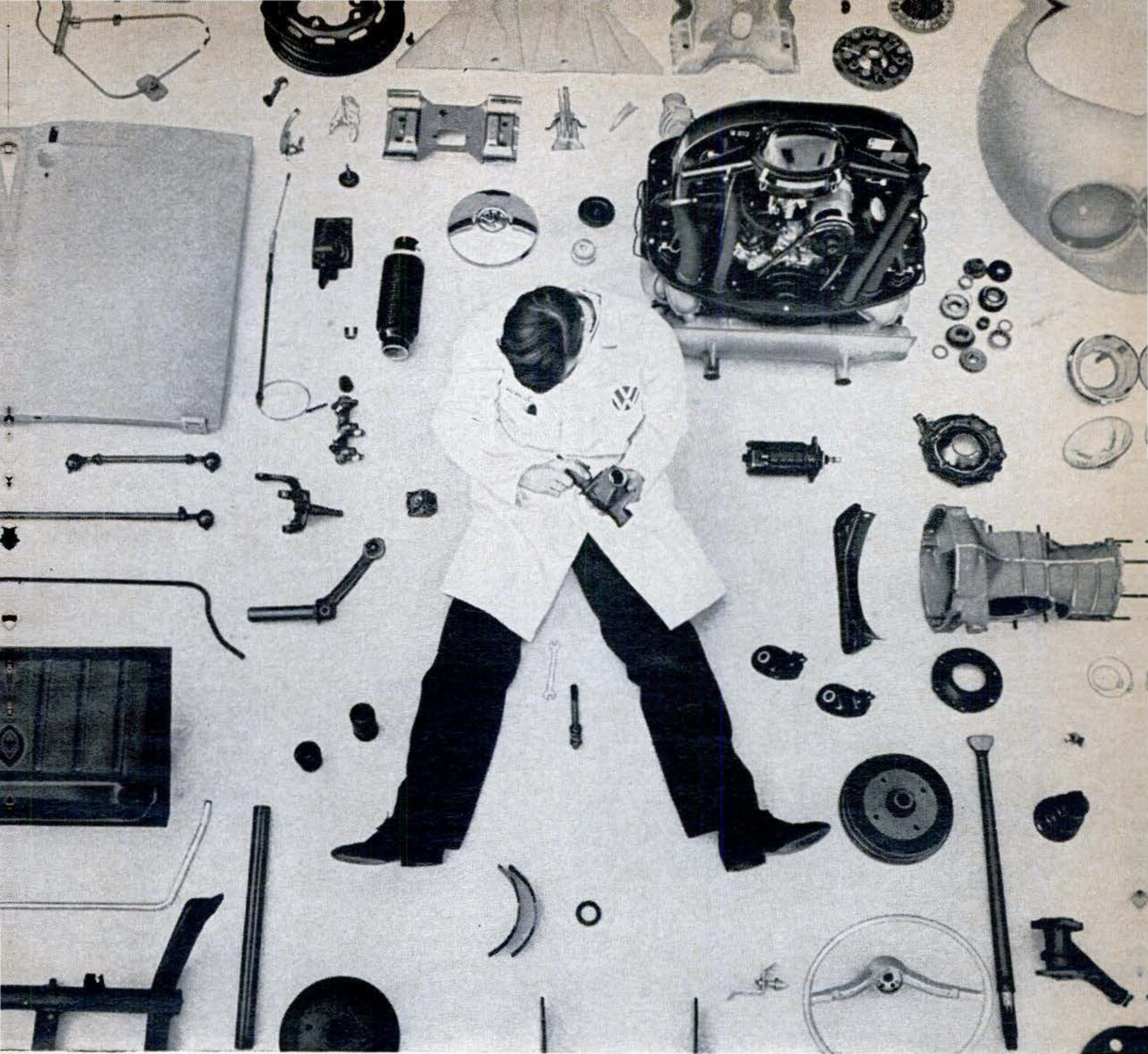
J. D. LAUBER, Schenectady, N.Y.

... Some cars need antifreeze in summer—cars with air conditioning, or those that have no inhibitor or water-pump lubricant. But generally no engine needs antifreeze [in summer]. Here's why:

Water has a specific heat of one BTU per pound per degree F., compared to about .7 for a 44-percent ethylene-glycol-water mixture. This sample calculation shows how

*Continued*





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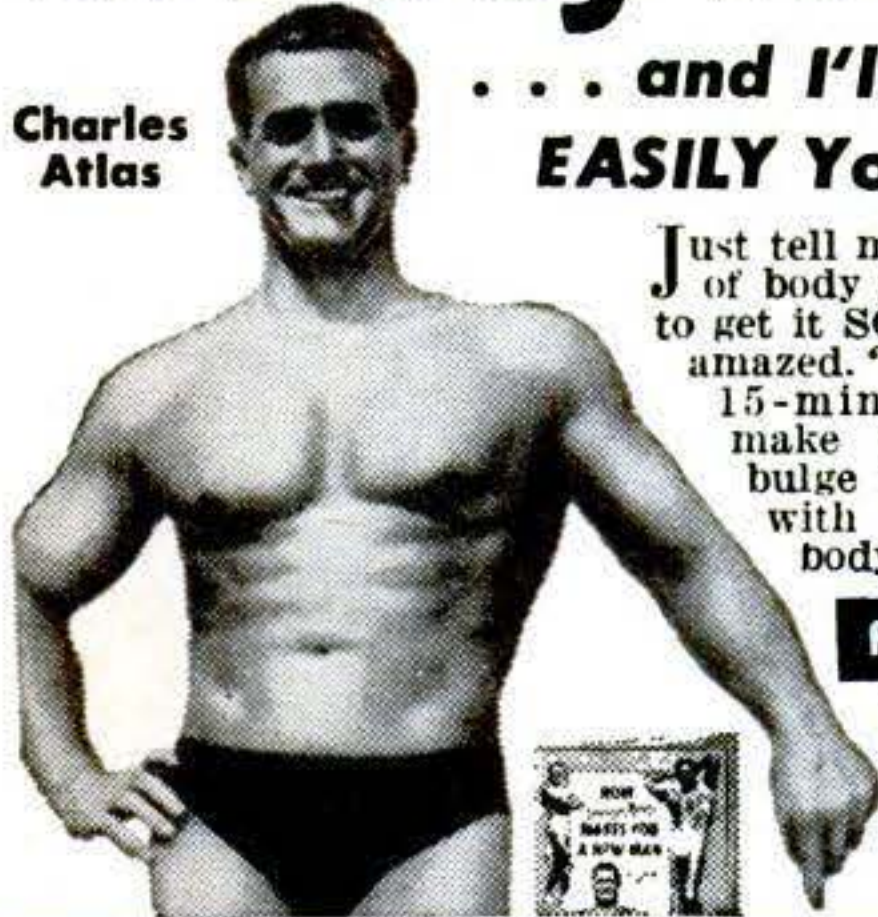
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|  | <input type="checkbox"/> Better Sleep, More Energy |

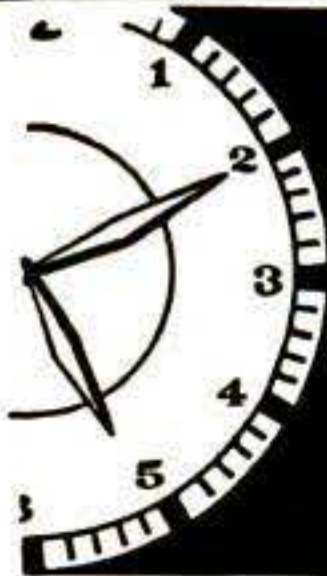
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## PS Readers Talk Back

[Continued]

much heat is removed from the engine per pound of coolant circulated:

$Q$  = heat removed, BTU/lb.

$T_{2a}$  = boiling temperature of antifreeze at 15 p.s.i.

$T_{2w}$  = boiling temperature of water at 15 p.s.i.

$C_{vw}$  = specific heat of water

$C_{va}$  = specific heat of antifreeze

$T_1$  = assumed temperature of coolant entering engine = 100 degrees F.

For antifreeze:

$$Q_a = C_{va} (T_{2a} - T_1)$$

$$Q_a = .7 (264 - 100) = 115 \text{ BTU/lb of antifreeze circulated}$$

For water:

$$Q_w = C_{vw} (T_{2w} - T_1)$$

$$Q_w = 1 (248 - 100) = 148 \text{ BTU/lb of water circulated}$$

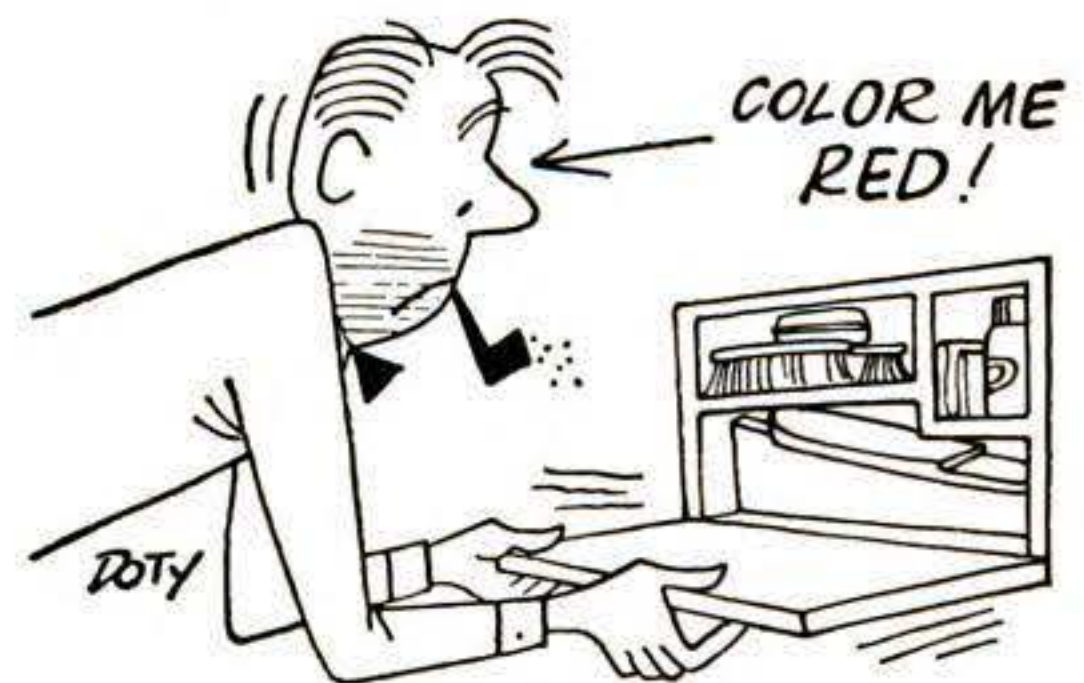
Therefore, water will remove approximately 22 percent more heat per pound of coolant circulated before boiling. Did you ever hear of anyone ever using antifreeze in a racing car?

You probably will not print this.

DAVID C. SALYER, Christiansburg, Va.

Your thermodynamic theory is correct as far as it goes, but if the water boils at 248 degrees, the pressure cap will be opened by the excessive pressure and you could boil away your coolant without the warning light coming on. The point of the story is not which coolant is more efficient in removing heat, but that the whole cooling system in a modern passenger car is designed around using an ethylene-glycol antifreeze solution.

We're speechless over WW error



Your "Wordless Workshop" in April showed an idea for a shoe-polishing cabinet. The hinges were put on wrong. The door would never close all the way if you fastened them on the inside as shown.

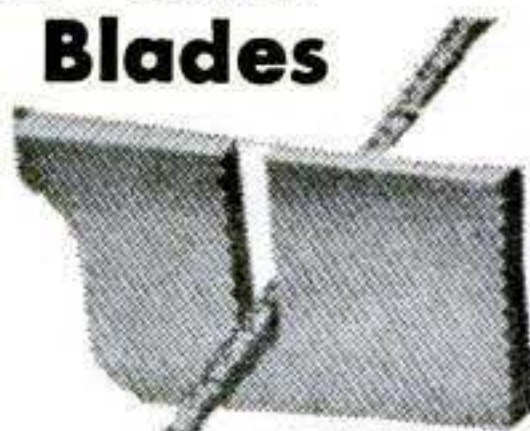
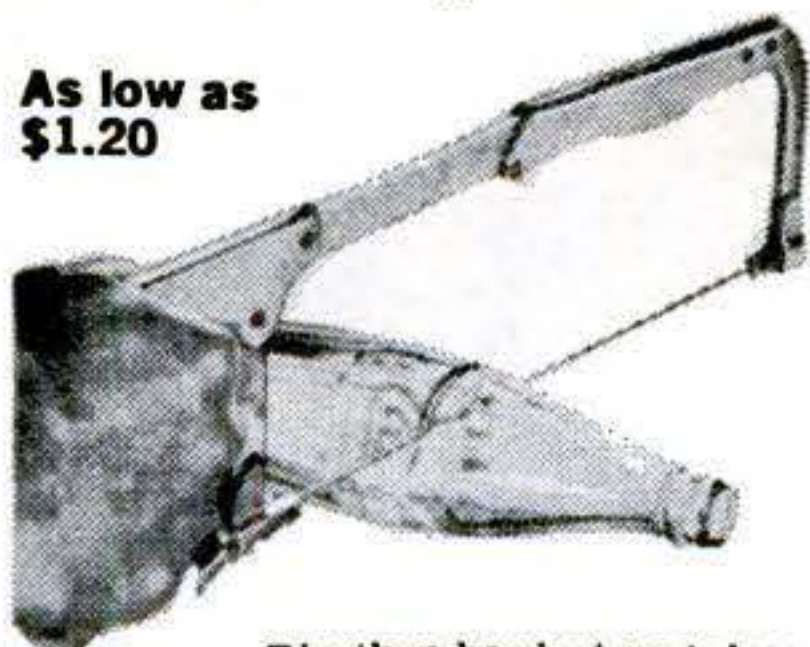
THOMAS D. WHITEMAN, Seaford, N.Y.

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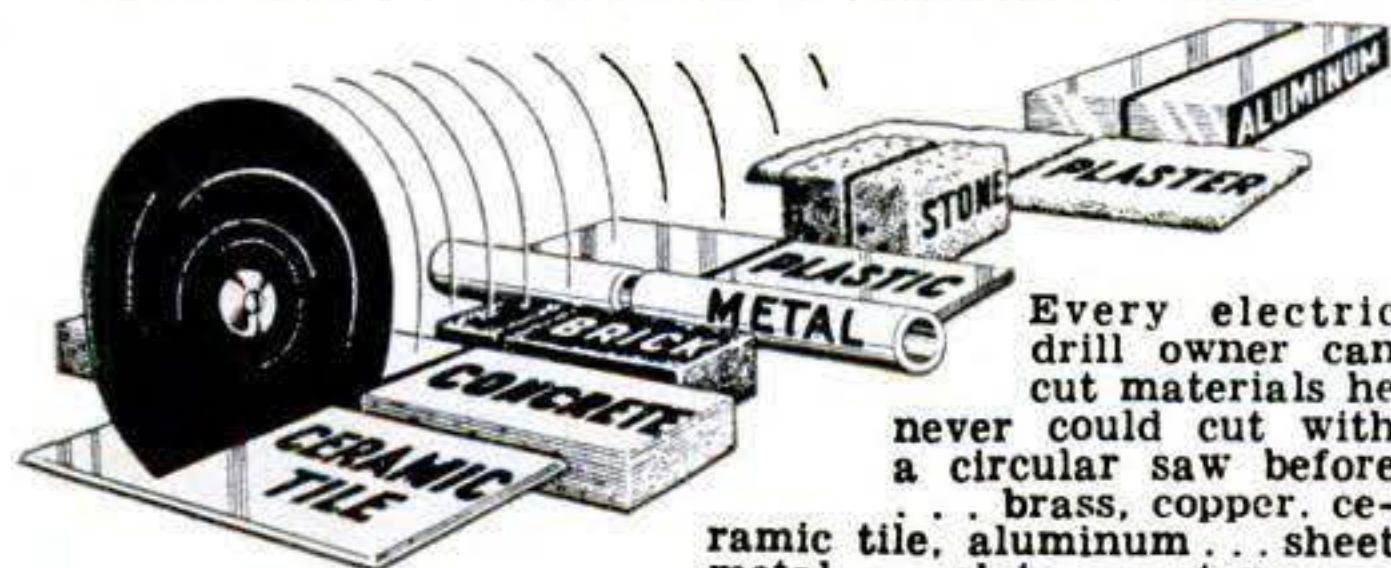


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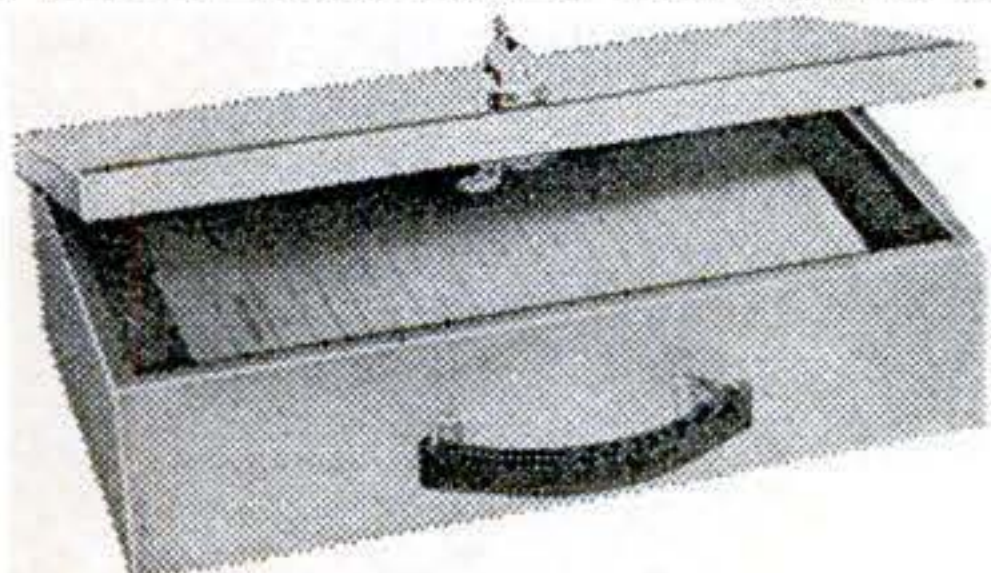


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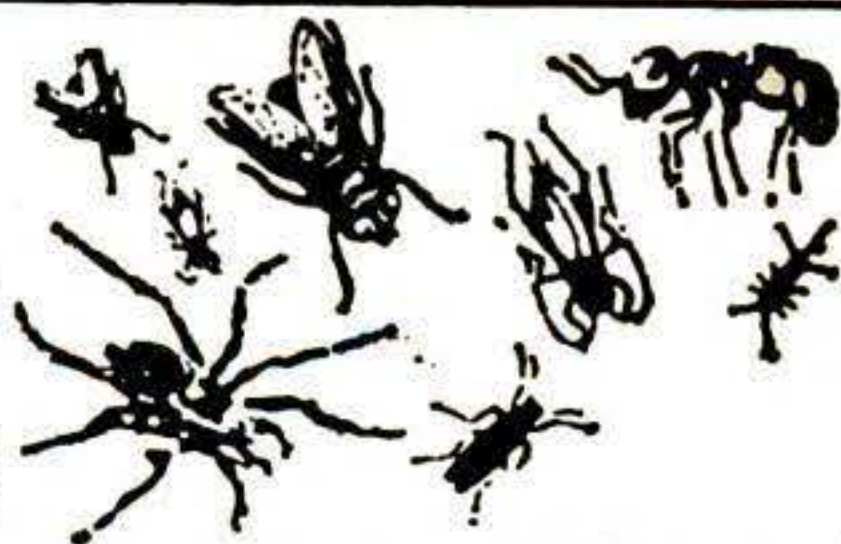
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# “Say, Smokey—”

## 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.



Smokey, a licensed pilot, sits at the controls of his personal helicopter.

.....

*“A few days ago a car stalled on the tracks at a railroad crossing and was smashed by a slow-moving train. After the driver and passengers had jumped to safety. Isn't it possible to move a car a few feet—enough to clear RR tracks—forward or backward by shifting into low or reverse and actuating the starter motor?”*

PETER KULKA, Bellevue, Ohio.

Yes, it's possible—providing you have a good battery, manual transmission, car paid for, and a lot of nerve. But my advice is that you keep your car fully insured and, if you are caught this way and want to live to be an old man, jump out immediately and run!

*“I bought a new '67 Valiant V-8 with manual transmission. My only gripe is a vibration that comes on at 65 m.p.h. and fades away at 75. The dealer replaced a bent wheel rim, but that didn't help. I've checked for wheel balance and out-of-round tires. The dealer now takes the attitude that 'all cars vibrate at a certain speed.' True?”*

MIKE DALY, San Francisco.

No—all cars do not vibrate. But all those that have any of the things listed below do vibrate: bent axles, out-of-round or bent drive shaft, U joints not installed properly or lined up for plane, engine or clutch or torque converter out of balance, engine mounts loose or faulty. I believe if you find out just why you were delivered a car with a bent rear wheel, you'll find the vibration more quickly.

*“I have a 1965 Pontiac GTO with power brakes. The brakes have never been ade-*

*quate since the car was new, but I've learned to live with it because they say there is no cure. At speeds above 60 you can push the pedal with both feet with little effect, though there's a good solid pedal. Everything in the braking system is normal, and I have over 25,000 miles on the original linings. Is there a high-friction lining available that might give better braking?”*

GEORGE A. GARABEDIAN, Philadelphia.

Whoever said there is no cure for those brakes is certainly no brake man, and has never heard of such good brake linings as Grey Rock and some others. You can get real good brakes on that car, though even the best will fade in real tough going. Talk to the best brake man in your locality.

*“The dipstick on my '66 Chevy indicates that it needs oil every time I pull into the filling station. A friend told me that if I would give the stick a one-quarter turn, then pull it out, it would give a 'true' reading. The local dealer confirmed this, but could give no explanation. Is this okay, or does it hurt the engine?”*

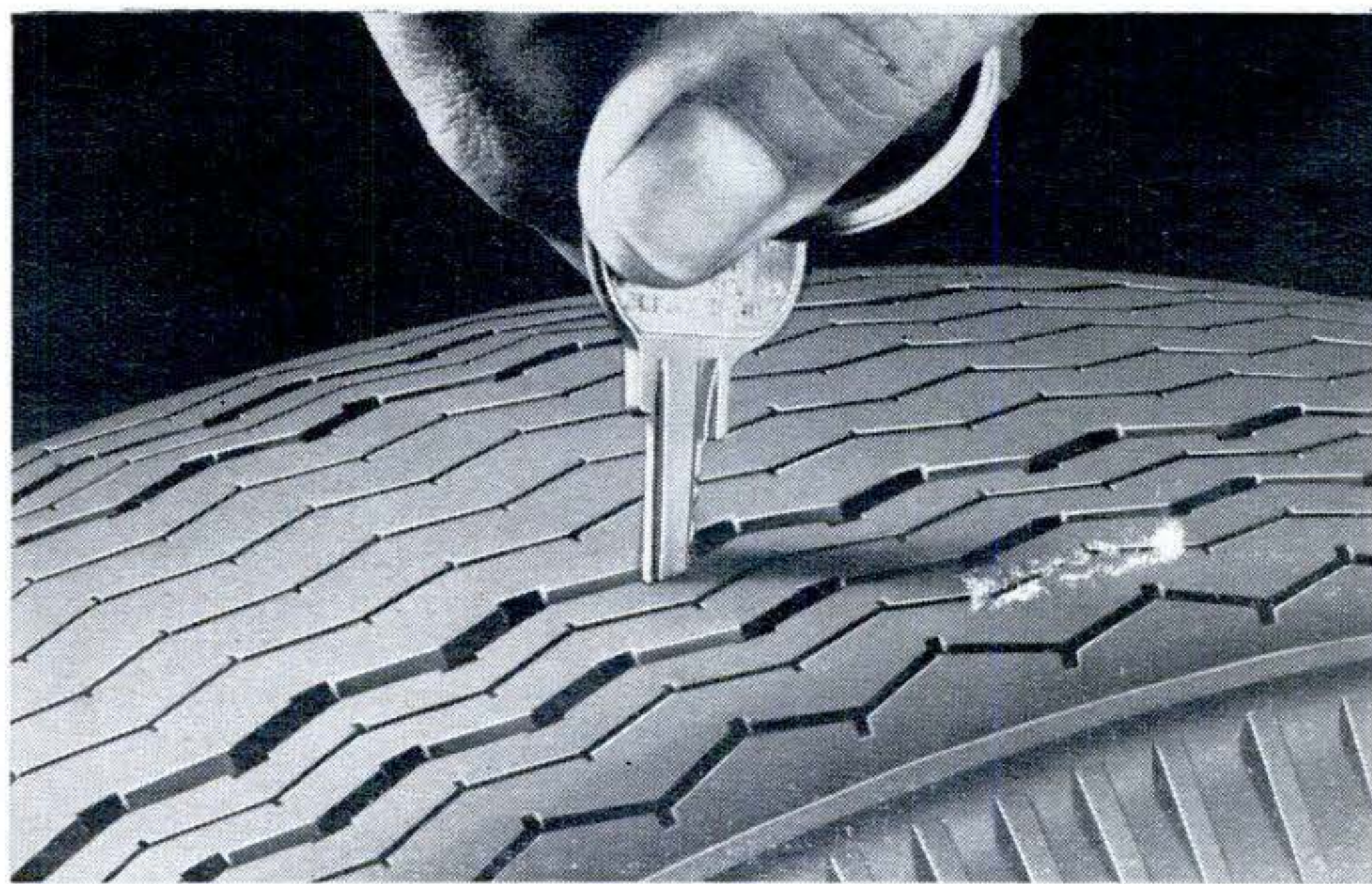
JAY BARNES, Jackson, Tenn.

Don't overfill it with oil—that *does* have some harmful effects. The only thing I can tell you, on getting a true reading, is to check the dipstick level right after an oil change. The mark it hits then is the right level. When you pull that stick out of that little tube, it is very easy to wipe away some of the reading. At all times, when you check the oil level, you should wait about five minutes after the engine is stopped to let the oil run down into the sump—something a lot of people forget to remember.





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**"Say, Smokey—"**

[Continued]

*"Our 1961 Comet 6 has had starter trouble ever since we bought it about two years ago. A newly rebuilt starter will only last two or three months before it goes bad. I burned out five in one year. They perform perfectly when I first put them on, then begin getting weak, as though the battery was run down. I have checked and rechecked battery, cables—including proper length—and starter solenoids. The flywheel starter gear is in fine shape. What to do?"*

NORMAN FIGG, Ellettsville, Ind.

This sounds like a low-voltage problem. Have the battery and voltage regulator thoroughly checked. Also, run an instrument check on the starter-motor draw, both on cold and hot engine. Too low voltage will murder a starter in nothing flat.

*"I am at my wits' end. My 1964 Plymouth Sport Fury 318 with added-on Mark IV air conditioning is plagued by a vibration in the 65-75-m.p.h. range. Monroe load levelers, alignment jobs, balancing, and tire changes do not help."*

GERT RUDIGER, Philadelphia.

The first thing to do is to unhook that A/C and see if the vibration continues. If it does not, then you know where your trouble lies. If the vibration is still there, then you are up against one of the disadvantages of unit construction, and there isn't much you can do. Vibrations that might never be felt in a car with a separate frame are amplified throughout a one-piece body-and-frame unit.

*"The specifications for my 1968 Dodge with 318-inch engine and Cleaner Air System call for an ignition setting of 2½ degrees A.T.C. for automatic transmission. Why this setting when the same engine in Canada is set for 10 degrees B.T.C.? What will happen if I advance this timing until I get a ping, or, as it is often called, power-tune it?"*

HOWARD E. REUSS, Havertown, Pa.

The timing is retarded to get air pollution down, and there is not much sense in arguing with it. Supposedly, after you get rolling, timing goes up to normal for good performance.

*"On my 1961 Meteor, gas shoots out of the carburetor clear up against the hood, even after installing a new carb. I also ground the valves, installed piston rings and*

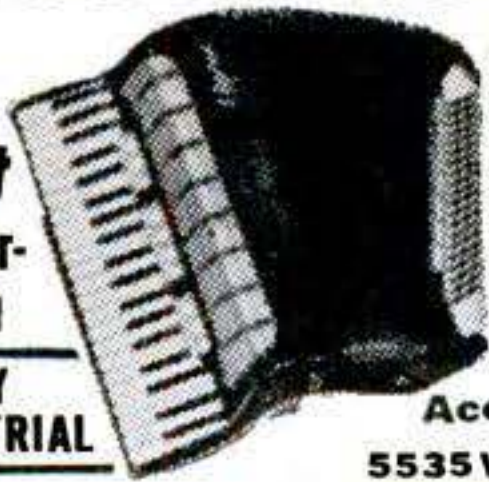
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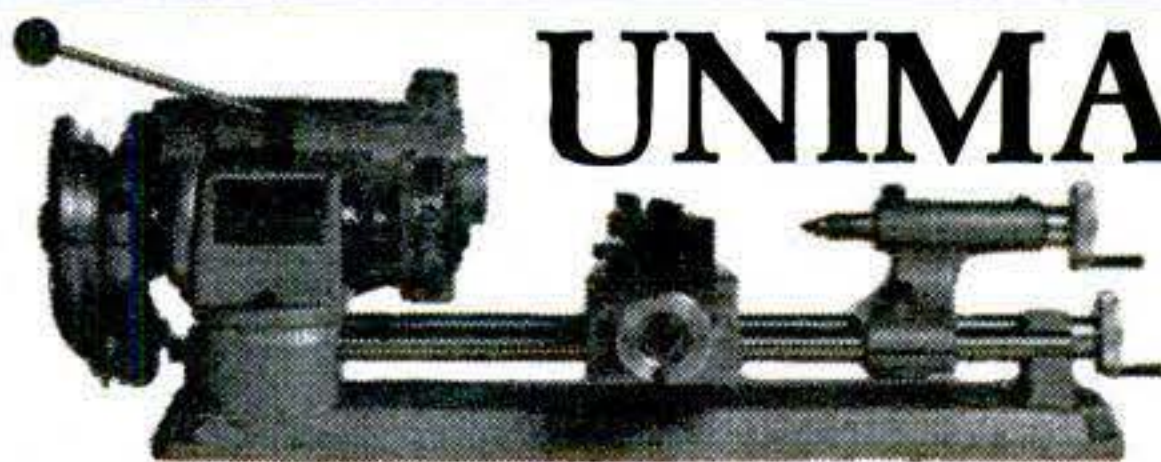
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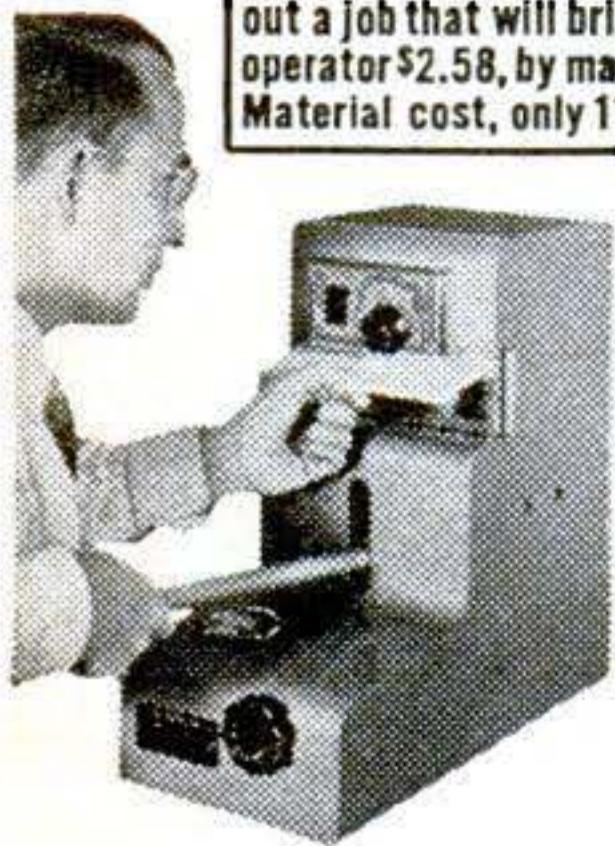
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## "Say, Smokey—"

[Continued]

all new gaskets, and the timing seems good. There just isn't any vacuum in the carburetor, the gas doesn't want to go down into the manifold. What's the cause?"

G. DERIKX, Cottam, Ont.

Valve-timing and/or head-gasket check-outs should uncover just where you goofed in your work.

"My '67 Chevy 396 with a 4 MV Rochester carburetor has a flat spot when I begin to accelerate. I think it's just where the secondary vents begin to open. If I hold the throttle in that one spot the engine holds back. On full throttle it's fine, and I can maintain any speed. I have tried a complete tune-up and set the carb to factory specs, with no improvement. Where do I go from here?"

A. DOMURET, Travis AFB, Calif.

If you are going to be all that fussy, throw the Rochester away and get the other manifold and Holley carb Chevrolet sells for that engine and your troubles should be all over. I doubt if you can get the deal you are now using to do much better.

"Our 1966 Econoline Six leaks gasoline. The dealer put in a new carb, but this didn't help. Gas pours out heavily when cranking, making it impossible to start."

DON CODER, Latrobe, Pa.

The most usual causes for this problem are: high fuel pressure, bad needle and seat, improperly adjusted float. Sometimes heat from the manifold will expand fuel until the valves won't control it. This last can be remedied with an asbestos shield between the manifold and carburetor to deflect the heat. The other causes can easily be eliminated by a professional mechanic.

"At race tracks I note that engines are revved up repeatedly as soon as they are started. Is this proper? Is it the way I should warm up my engine?"

REID R. NIELSON, Oxford, Ohio.

No! What you didn't see at the tracks was how we warmed up the engines, water, and oil, electrically or otherwise, to about 200 degrees F. before firing them up.

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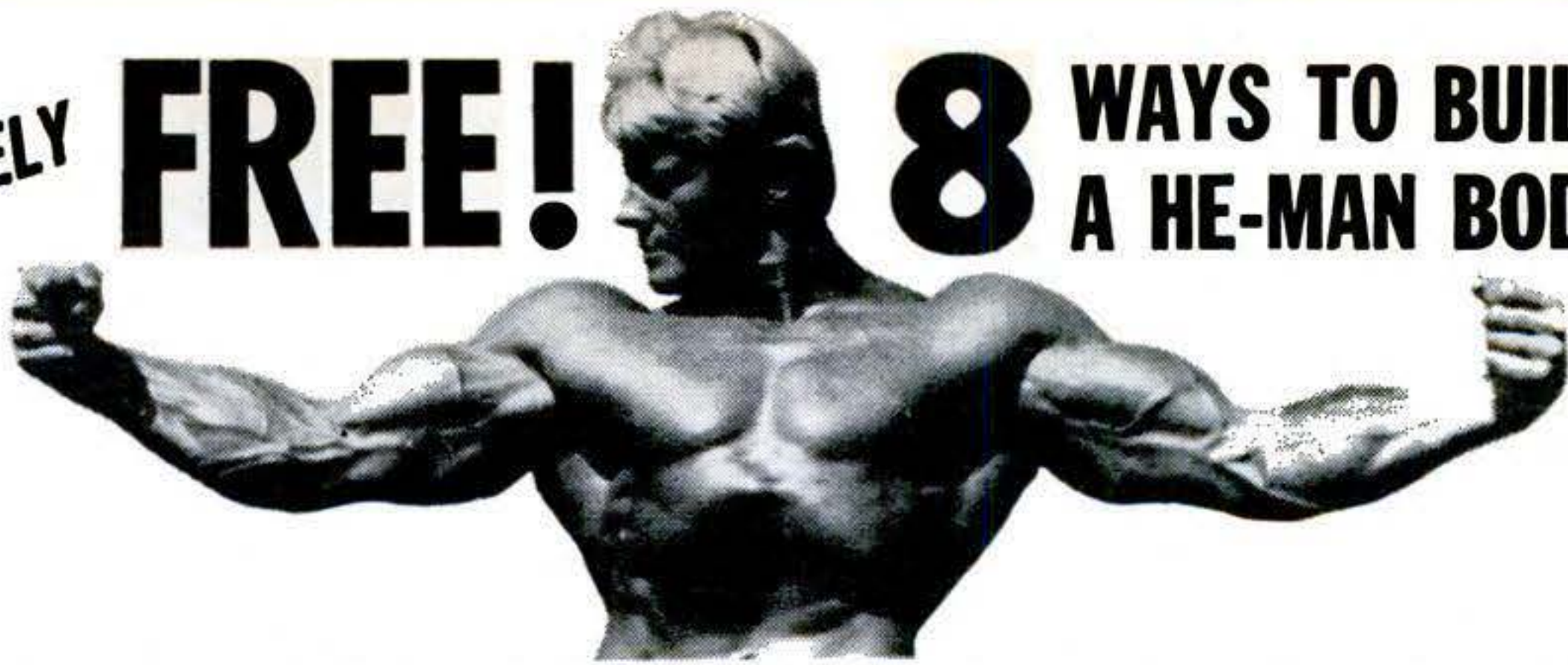
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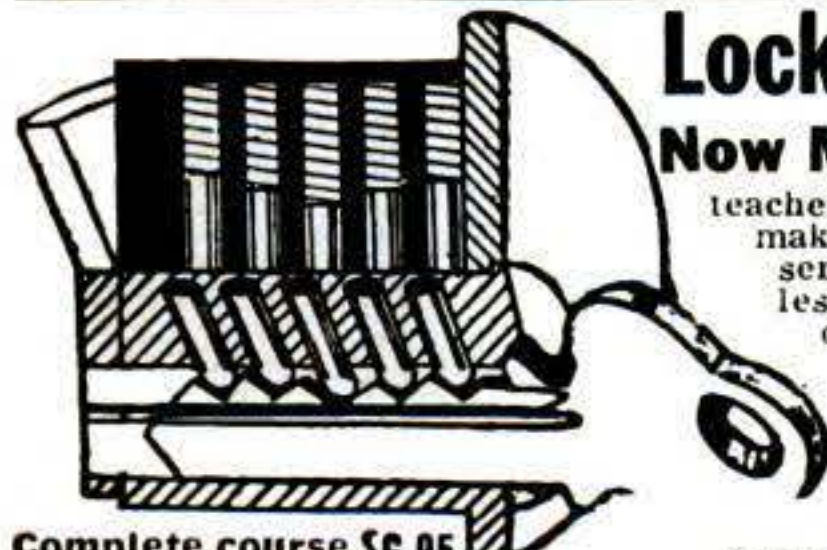


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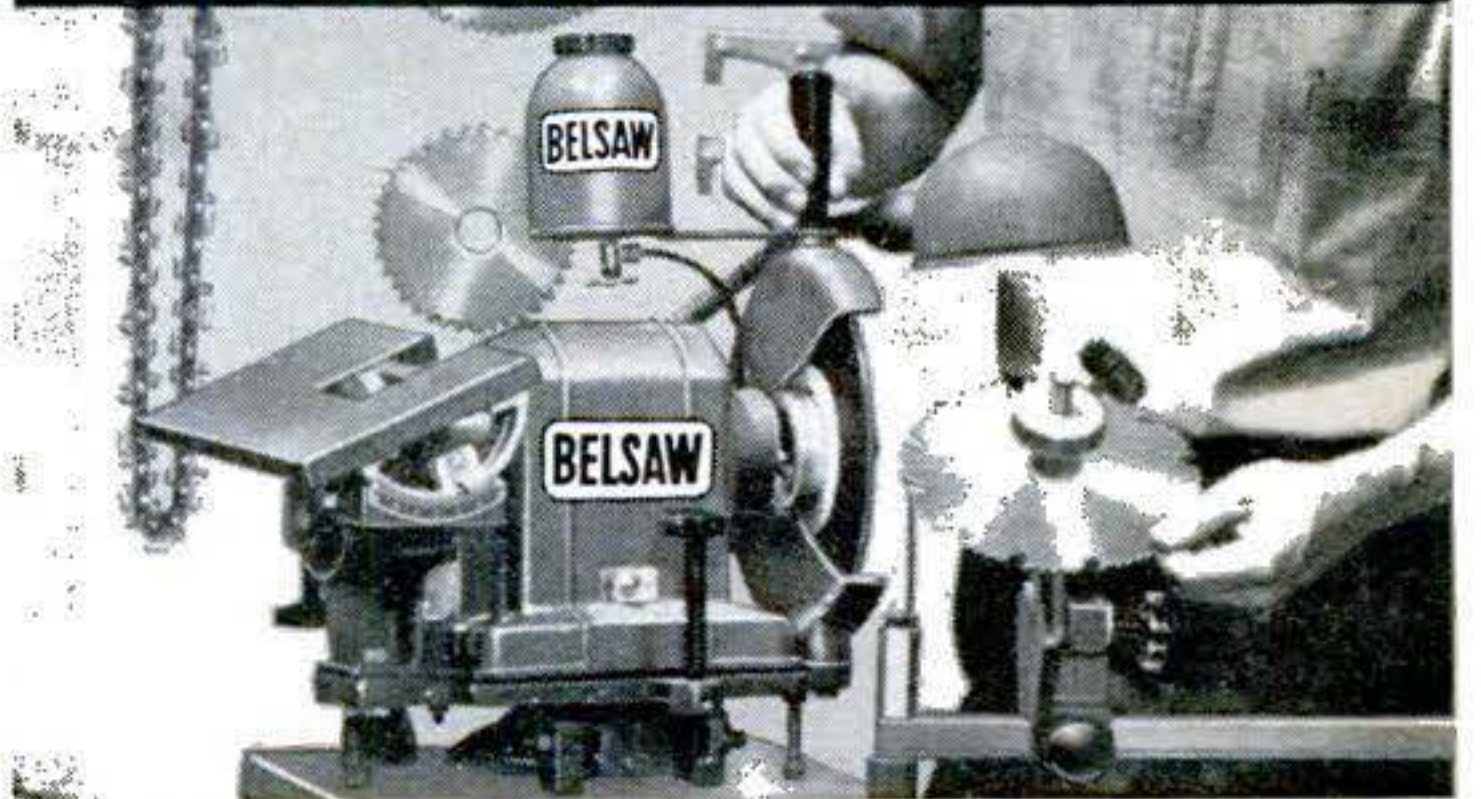
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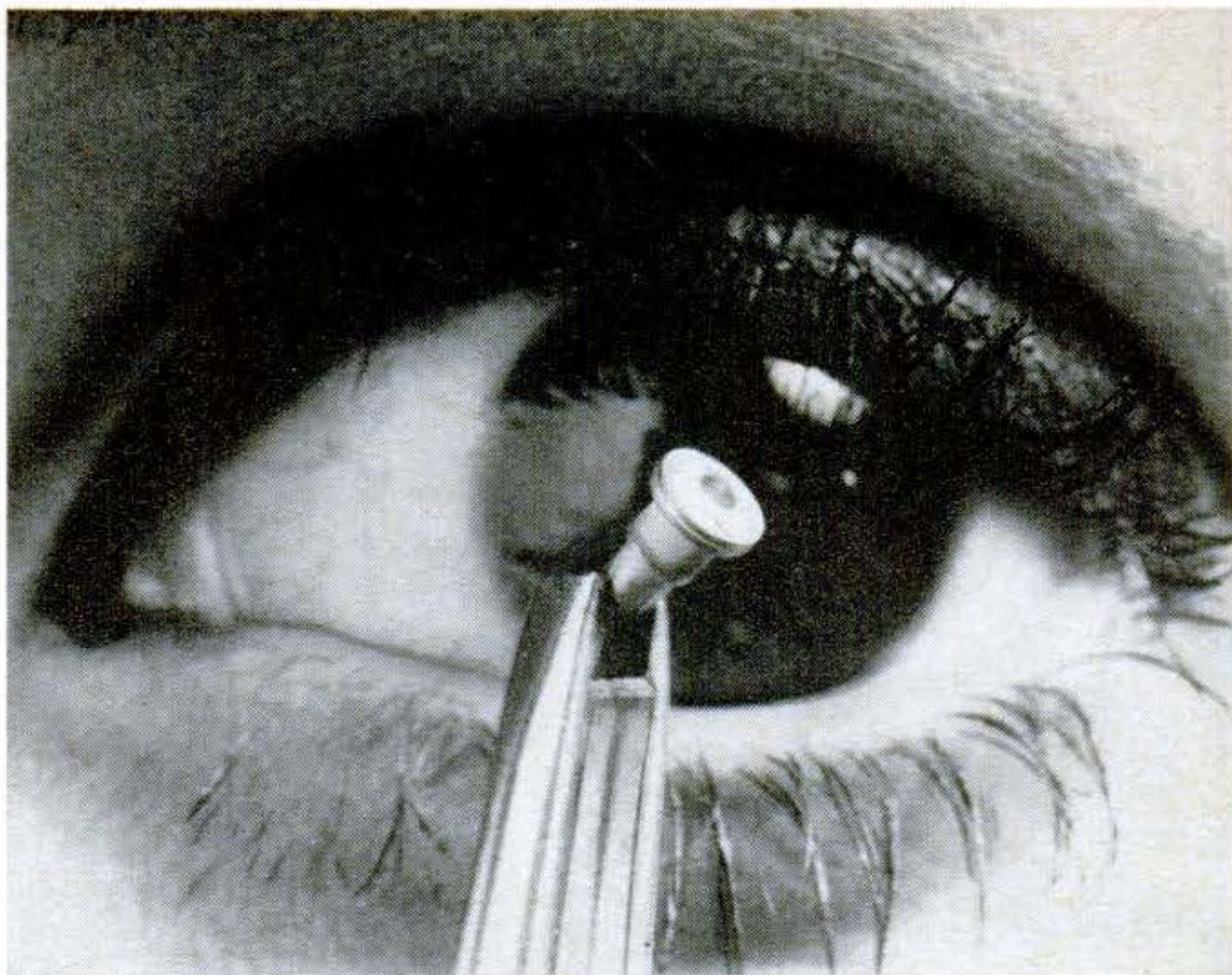


# Science Newsfront

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

By W. STEVENSON BACON

This electronic eyeball is designed to pick pictures and sound off a modulated laser beam, and may help revolutionize communications. One laser beam could carry almost all TV and radio channels now in existence. Lacking have been practical devices to detect the signals and separate them. This light-sensitive semiconductor de-



tor developed by Texas Instruments does the job. Known as an avalanche device, it's 200 times more sensitive than previous laser detectors and has an enormous bandwidth.

**Why does traffic move the way it does?** If you've ever pondered this (and who hasn't?) here's help: Traffic acts like a fluid—water or gas—and can be explained in part by the laws of fluid dynamics. In reducing traffic to equations, Dr. Robert Herman of GM assumes that a solitary driver does as he wishes. As the road gets crowded, however, traffic begins to move in a gelled state, with drivers forced to flow in a fluid stream. The consequences: All drivers try to maintain the same speed, disregarding distance from the car ahead. If one slows, the change can be absorbed *if* other drivers react quickly. Even slightly delayed reactions result in a wave-like transfer of instability—and tail-end collisions.

**By the year 2000 your wrist watch** will be powered by strategically located radio transmitters. And synchronizing signals will insure that it keeps perfect time. These predictions come from Harry B. Aronson of The Waltham Watch Co., who also foresees watches that will contain voice and vision communications devices. Miniaturized integrated circuits will ultimately make the Dick Tracy watches practical.

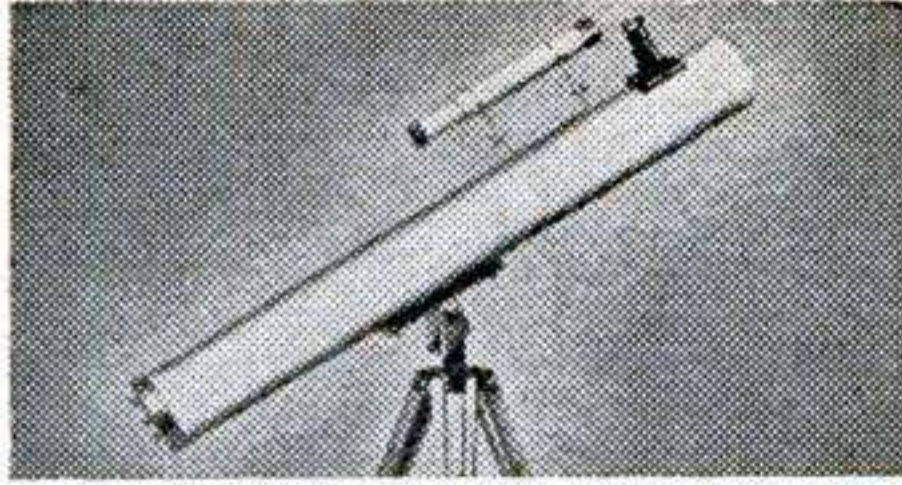
**Those "like-riding-on-a-cloud" TV commercials** are not all fiction, as race-car drivers have long known. High air velocity can make a car hard to handle at speed and even lift it off the ground. Although wind-tunnel tests of cars should solve the problem, they

don't. Now, University of Illinois engineers have found out why and built a wind tunnel that does. In the usual tunnel, air is blown over a car model on a floor. The air near the floor moves slowly in a boundary layer. Out on the road, both air and road move at the same speed relative to the car. Air speed is up, since there's no boundary layer. In the new tunnel a fast-moving belt simulates real road conditions. The tunnel is expected to solve problems such as those Ford had with its hard-to-handle GT40 a few years ago.

**An amazing clue** to the exact structure of the earth may have been found. It tells where to look for deposits of heavy metals, makes possible world earthquake predictions, and explains how earthquakes, mountains, valleys, and volcanoes occur. The theory is the work of George E. Rouse, geochemist at the Colorado School of Mines. He discovered that major earthquake belts lie on circles crossing the surface of the globe. Another dramatic finding: These belts correspond directly to the earth's magnetic field, gravitational variations, and major mineral deposits. Some 16 of the belts link all major seismic features. Rouse believes the belts are reflections of what the heavy iron core of the earth is doing: Interplanetary magnetic fields cause it to try to rotate on a slightly different pole than the rest of the globe, disrupting the surface and causing irregularities as well as violent disruptions.

*Continued*

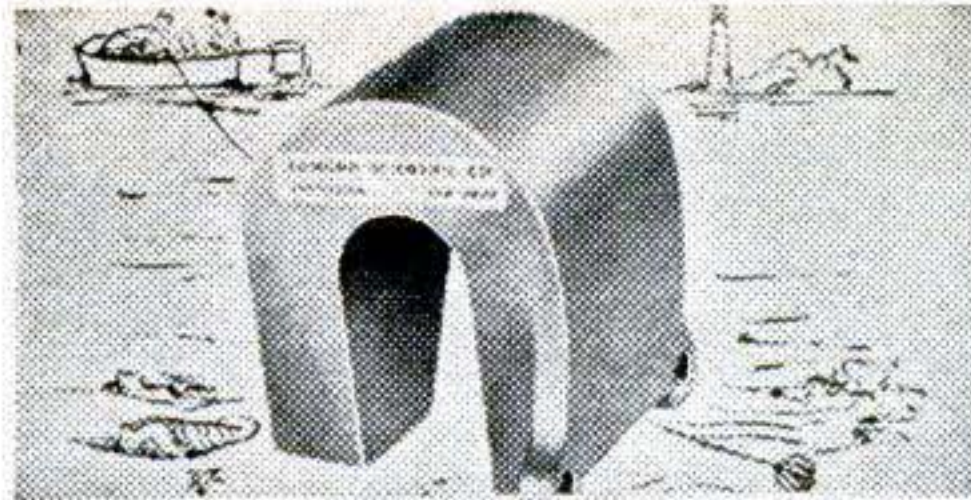




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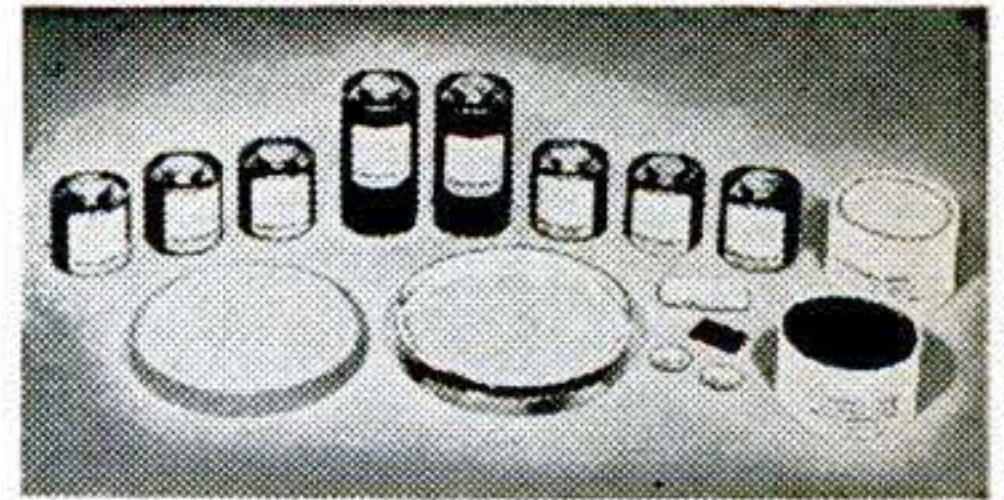
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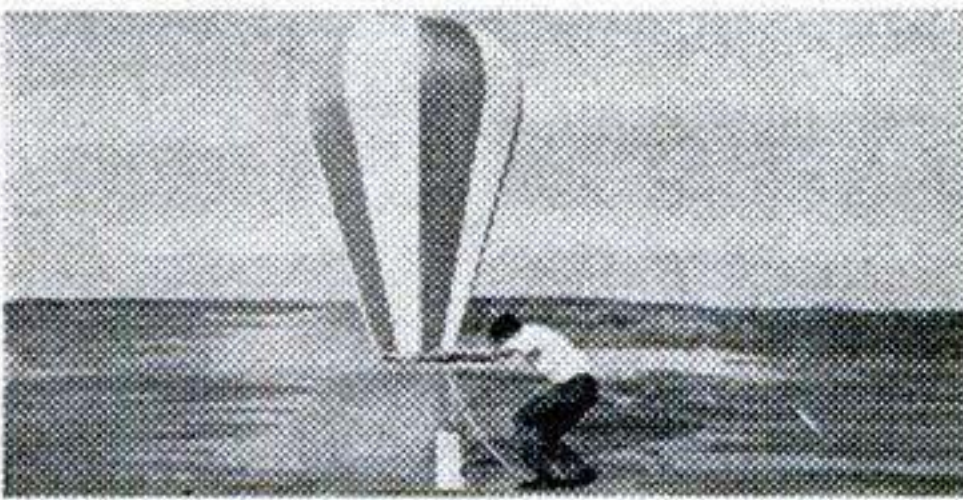


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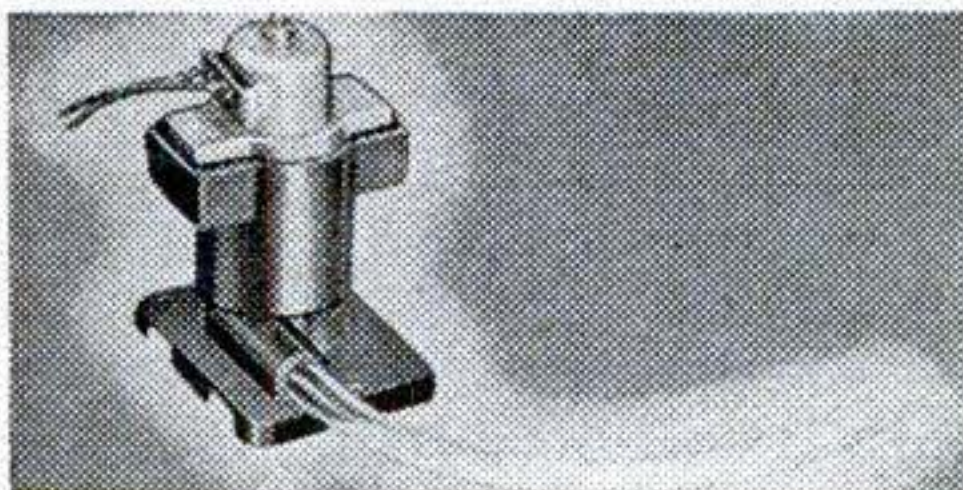
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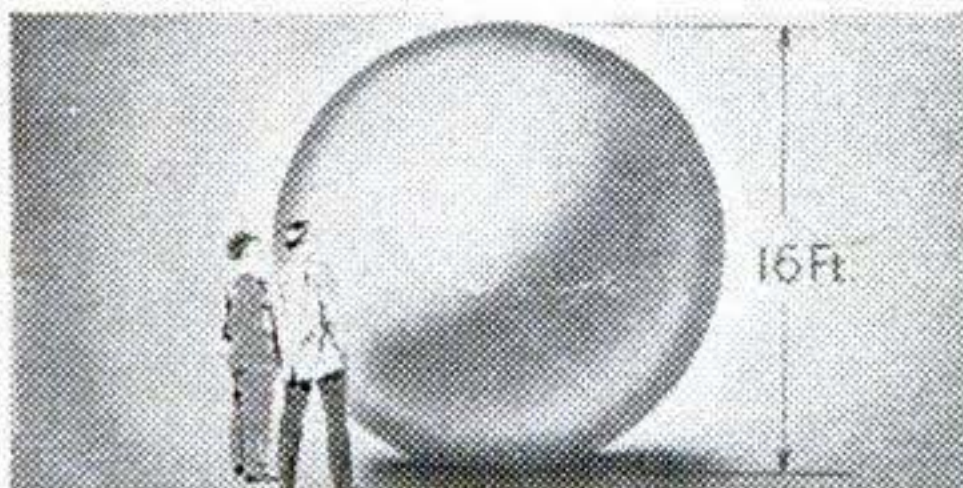
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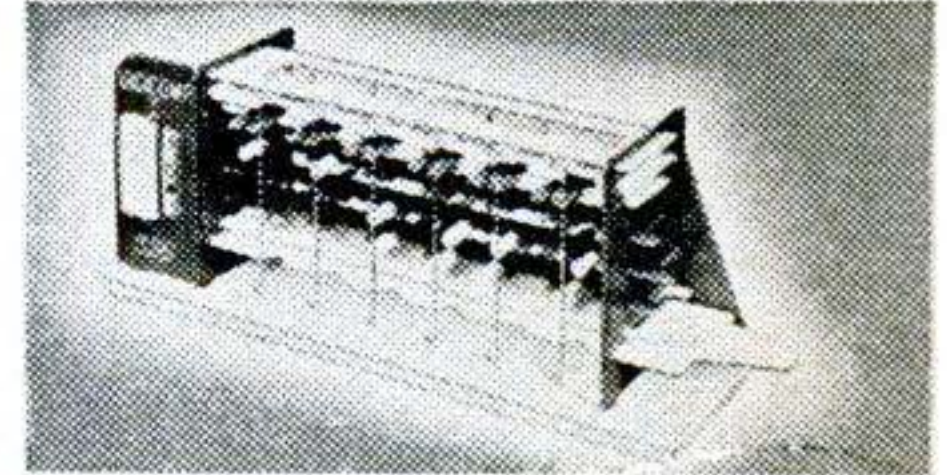
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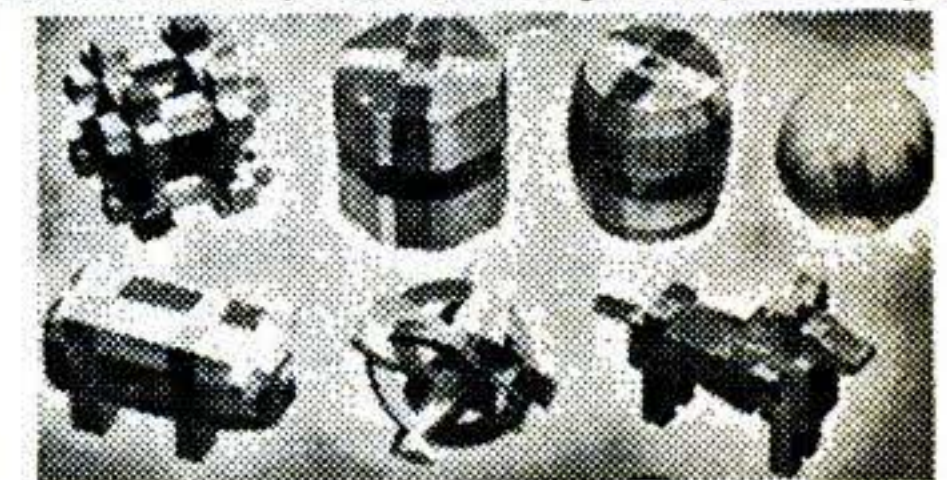


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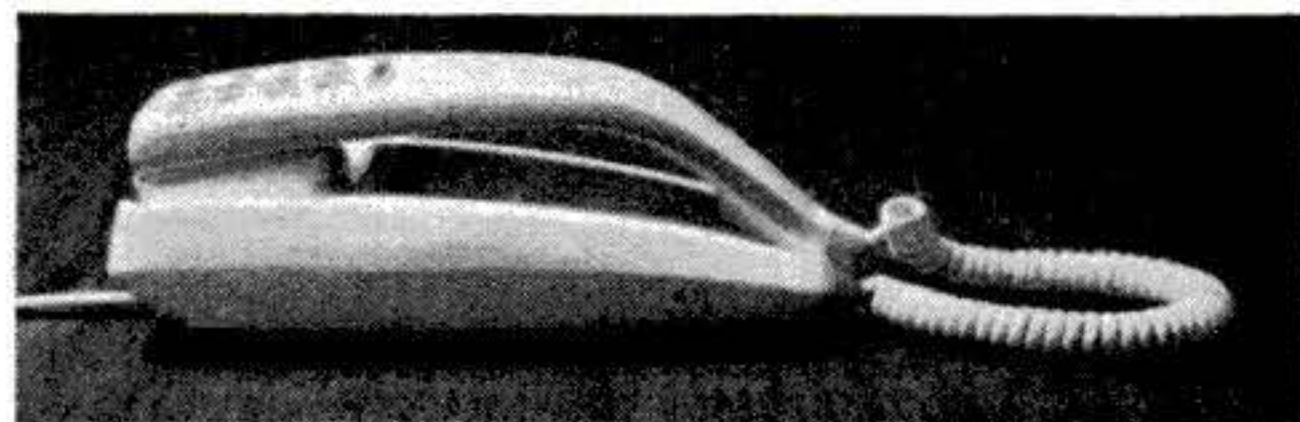
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## Science Newsfront

[Continued]

**Is the electric motor obsolete?** Researchers at Ohio State, who have just developed a way to change electrical to mechanical power with an efficiency of 97½ percent, are beginning to wonder. Their energy converter uses a piezoelectric disk to change the fixed AC output of a generator into sonic energy. A horn-shaped device amplifies the vibrations. In one application, Dr. Robert C. McMaster and Charles C. Libby have built a riveting machine. Weighing 50 pounds, it does with many tiny blows a job that would require a very heavy riveter capable of a single 20,000-pound blow.

**A small, light electronic telephone** (see photo) will offer users better reproduction of speech, be easier and more comfortable to use, and take up less space. The new phone,



recently demonstrated by Bell Labs, has buttons for Touch-Tone dialing behind the earpiece, yet the handset weighs only half as much as today's phones. It uses integrated circuits to maintain voice volume and fidelity, and has an electronic tone generator in place of the harsh electric bells used in present telephones.

**If you want to know how a brain works,** study it with another. That's the theory of Dr. Gary Galbraith of the University of Southern California, who is literally wiring volunteers up to an IBM 360 to study brain waves. The computer analyzes the signals and then transmits a signal of its own, which the subject sees on an oscilloscope. Hoped-for result of this man-computer interaction is more information on the brain-wave interactions that make a person most receptive to learning—and how the human capacity for knowledge can be increased.

**TV views of a jet's interior and exterior** are available to the pilot on his weather radar screen with a new RCA development. Basic job of the system is to pick up weather conditions up to 300 miles ahead. But with the flip of a switch, the pilot can monitor various parts of the plane via TV. Small cameras mounted outside show the landing gear, in relation to the runway, and other critical areas of the plane. Cameras inside show passenger compartments. The new radar-



## Science Newsfront

[Continued]

TV system, the AVQ-30, is said to have twice the range and many more times the reliability of previous units. The first of the new sets will be installed in Pan American Boeing 747 Superjets scheduled to go into operation late next year.

Pole-vault records will fall at the October Olympics if vaulters heed the results of a computer study recently done by Charles J. Dillman and Dr. Richard C. Nelson of Penn State. By making better use of the energy stored in the fiberglass pole, vaulters could add a foot and a half to their best jumps. Data based on the performance of four athletes showed they should control their approach in such a way as to bend the pole to give the greatest upward boost. The vaulter should then ride the pole while adding more energy by pulling upward with his arms. The best vaulter in the study could add at least 18 inches to his top height of 15 feet, say the researchers.

A man-made bacterium cell that "lives" in a computer has become the pet of Dr. Roger Weinberg of the University of Michigan. The cell thrives on milk, sugar, and kindness. If maltreated, it gets sick and dies—all by mathematical formula. The pet cell is simulated, of course, but it's revealing a great deal about life processes. To "create" the cell, thousands of facts were integrated into an IBM 7090 computer. Once "created," the cell, modeled after E. coli found in man's intestinal tract, began to function. It does well on a mathematical diet of sugar, nitrogen, and mineral salts, and gets meat and milk as a special treat. The researcher is using the cell to test and refine current biological theories.

Quark hunting—a game physicists play—is pretty much like snipe hunting, says the man who thought it up. He's Dr. Murray Gell-Mann of the California Institute of Technology. "Quark" is his name for the hypothetical building blocks of the elementary particles in the atom's nucleus. The only catch is that they probably don't exist. The search for quarks has been a bust to date, with researchers looking for them in cosmic rays, with atomic accelerators, and by grinding up oysters. This last was on the theory that since most things with curious chemical behavior in the ocean are eaten by oysters, quarks should show up there. They haven't. Congressmen have even asked if quarks could be used to make a bomb. Gell-Mann says he's tired of the whole thing and they don't exist. **PS**

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# Detroit Report...

A NEW CAR TO REPLACE THE RAMBLER AMERICAN IS ON THE WAY. It will come out as a 1970 model, and will be a stylish, low-slung car of import-sedan size. It is said to have a very modern look, with considerable influence from the Cavalier show car of 1966. The new car may drop the Rambler name. It represents AMC's boldest move to get into the import-car market since the \$200 price cut last year. The basic price of the new car is expected to be something under \$2,000.

**Dodge's new J-car**, the sporty compact slated for '70 introduction, will be an upgraded version of the all-new '70 Barracuda. This will maintain the product spread that has always separated Dodge and Plymouth. The wheelbase is one example of how this works. The Barracuda will stay at 108 inches, but the J-car will have a 111-inch wheelbase.

**General Motors has a long-range plan** to cut down the number of different bodies built by Fisher. As a first step in this program, all the big specialty cars (Toronado, Riviera, Eldorado) will be built with the new G body, which goes into production for the new Pontiac Grand Prix this fall. This means dropping the E body. The G body shares the back half of the A body (used for Chevelle, Tempest, etc.) and can therefore be built at lower cost than the former low-volume E body.

**Watch for a Camaro station wagon.** Chevy is not alone in planning sporty-car wagons, as a Javelin wagon is on the drawing board, too. Such wagons will be built more for fun than for utility. One proposal for the Camaro wagon has the standard Camaro body from front bumper to rear quarter window. From there back, the car has a station-wagon roof. This design is a four-passenger wagon with front bucket seats as standard. It has a tailgate, and a cargo area big enough to hold ski or water-sports equipment.

**Ford's small car** (code name: Delta), designed to compete with VW and Opel, will be a scaled-down Falcon. The word around Detroit is that the new compact will completely replace the Falcon early next summer—and may even carry the Falcon name. Wheelbase is 103 inches and curb weight is less than 2,450 pounds. Only a two-door unit body is planned. It follows Mustang styling trends, with a short deck.

**New Chrysler Corp. engines** are designed to be non-smog-making rather than break new grounds in performance or economy. There are two new V-8s, a 444- and a 480-cu.-in. unit, that will replace the present Chrysler and Imperial engines. A new 265-cu.-in. six with single overhead camshaft will replace the current 225 slant-six now used in Plymouths, Dodges, and Dodge trucks.

**Does racing help develop safer family cars?** If you don't think so, some of Detroit's '69 models may change your mind. Roll cages patterned after the special body reinforcements used in racing stock cars will be part of your standard family sedan within two years. Combined with the side protection offered in the full-size '69 GM cars, passengers will then have all-around collision protection. As part of this trend, GM is now planning to discontinue hardtops in most of its best-selling lines. A roll bar built into the center door post, with stiffeners in the roof structure and across the top of the windshield, will form a nondeformable cage for the driver and all passengers.

**A midships-engine sports car** is again being talked about in Detroit. There is strong evidence that such a car will be produced within the next 18 months. Ford and Chevrolet are working on racing-type prototypes right now. Ford's car is based on the Mach II show car, a two-seater with the mechanical components of the Ford GT. The Chevy is a small metal-bodied car that is planned for sale at about \$1,000 less than the fiberglass-bodied Corvette. If it is brought on the market in the next 18 months, what will happen to the Corvette? Or is the new car intended as a replacement for the Corvette?



Detroit Editor



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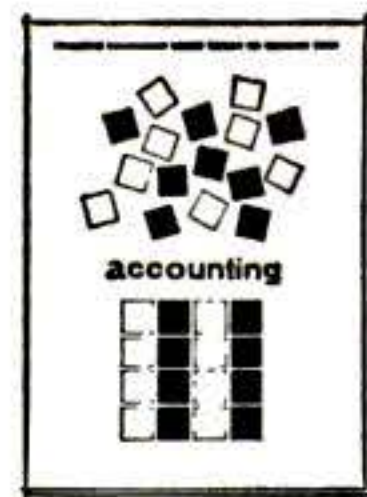
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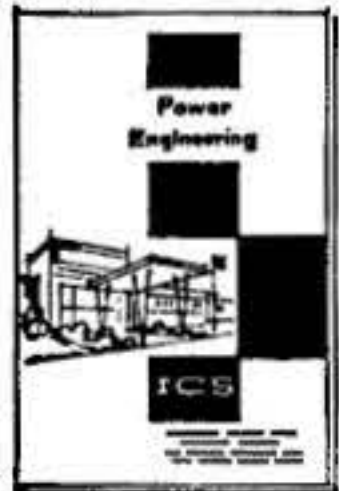




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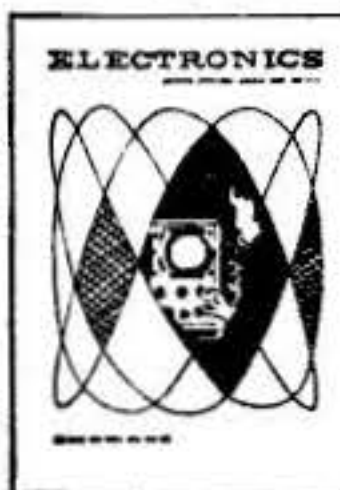
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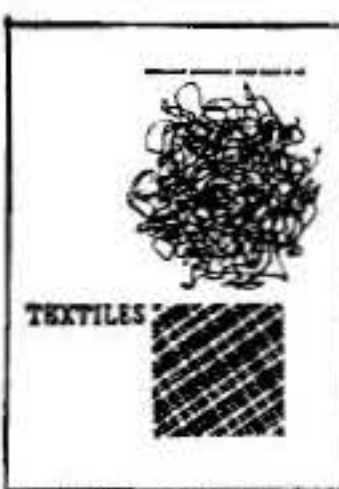


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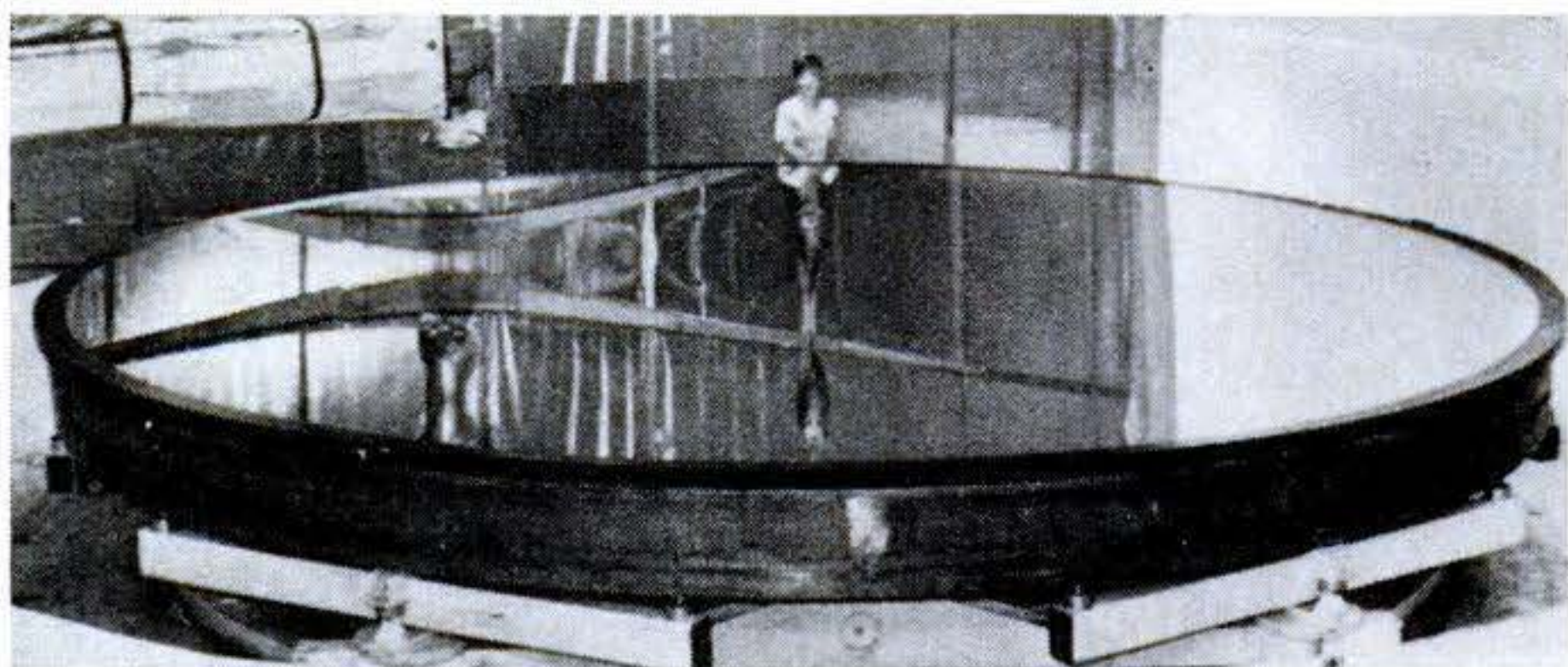






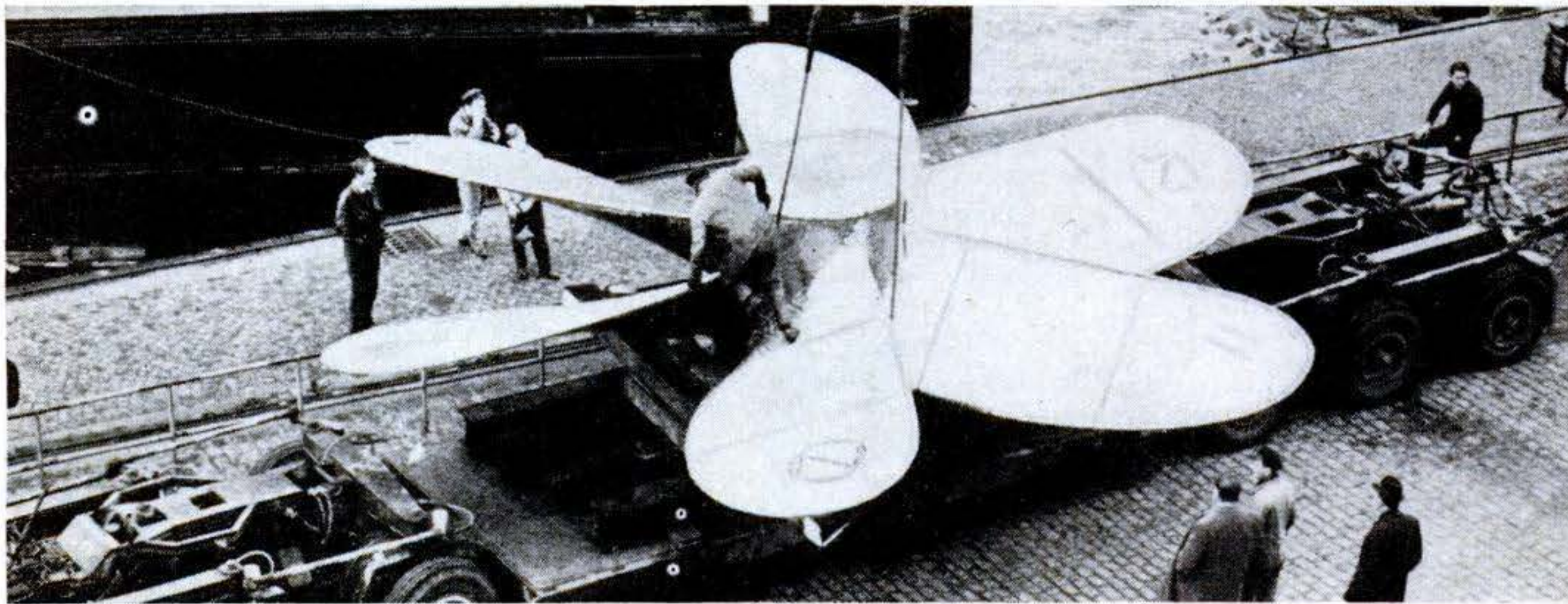
**THE BIGGEST HELICOPTER:** Looking for the biggest of anything? Okay, we've got four items. The biggest—and fastest—heli-

copter scheduled for the U. S. Air Force is this Sikorsky. Weight, 21 tons; speed, 195 m.p.h.



**THE BIGGEST OPTICAL MIRROR** is 23 feet in diameter and will be used for space research at Pasadena's Jet Propulsion Laboratory.

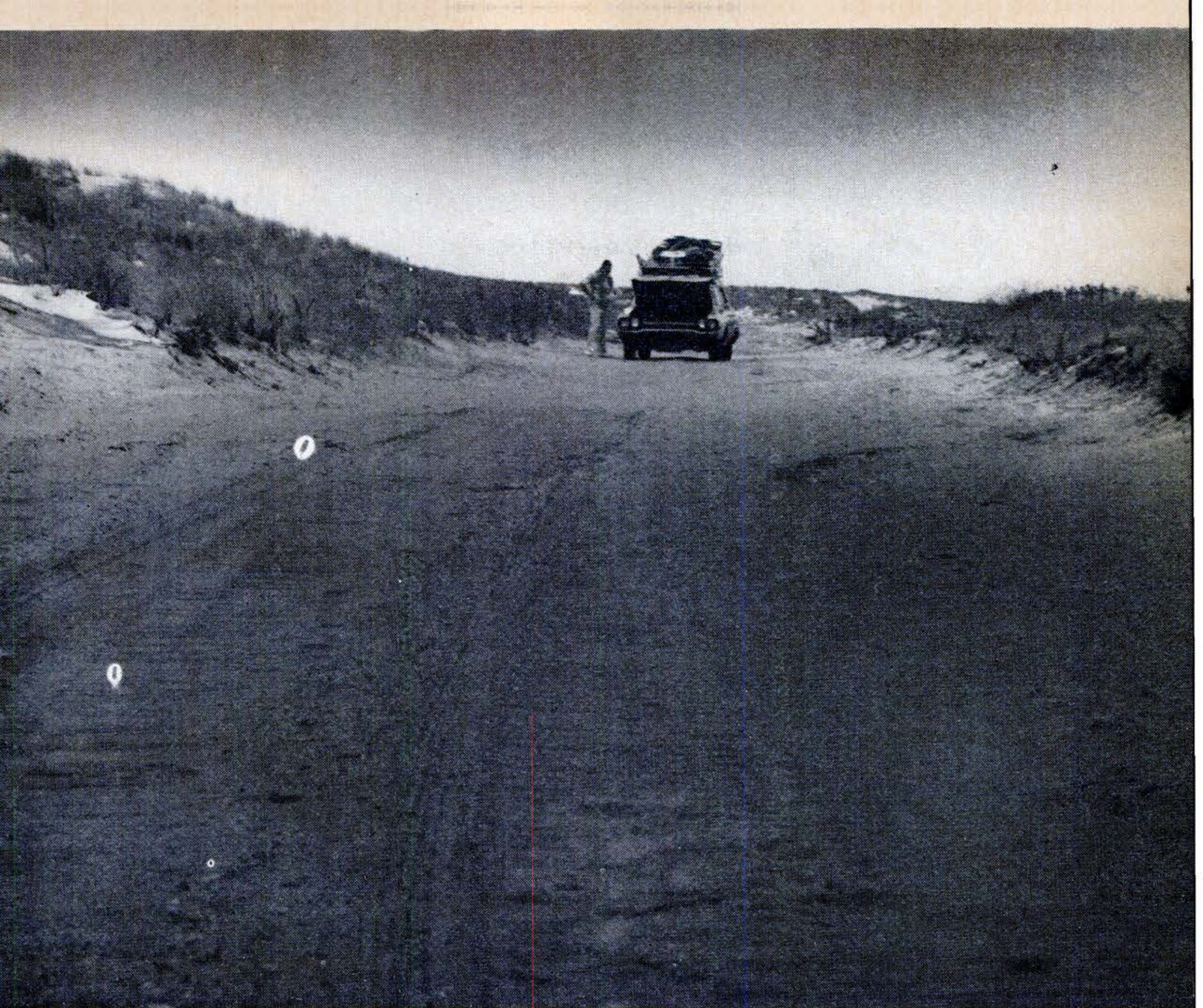
**THE BIGGEST GLASS OF BEER** (left) is served at an inn near Leeds, England. It holds more than 25 pints, costs \$4.20 to fill up.



**THE BIGGEST PROPELLER** in the world weighs 55 tons and has a diameter of 29 feet. It's for a 190,000-ton tanker being built

in a German shipyard for European service. The ship's draft will be too great for New York harbor.





## Now don't you wish you had the DieHard?

**(America's most powerful car battery of its size by 35%.)**

It's too dark for smoke signals and his scouts are much too young. He thought of everything except a new battery and now a new battery would solve everything.

Especially the new Sears DieHard.

You see, the DieHard is America's most powerful car battery. Its white polypropylene case is thinner yet stronger than the old black rubber battery case. That means there's more room inside for bigger plates and more acid. And 35% more usable starting power than any other battery of its size. Another thing. You can check your water level at a glance. The new see-through case sees to that.

The DieHard is so strong and durable, Sears guarantees it for

five years. And when Sears guarantees, Sears guarantees. So check and see if your tire tread's down. That's a good sign your battery can be going too.

There are over 2500 other good signs. They're all on the front of Sears, Roebuck and Co. stores, the only place you can buy the DieHard. If you're saving your cash for a vacation, Charge It on your Sears



Revolving Charge.

You won't save anything by waiting. Because the DieHard will probably outlast your car.

Like that other camping group says: Be prepared.

**The Sears 5-year guarantee:** "Free replacement within 90 days of purchase if battery proves defective. After 90 days we replace the battery, if defective, and charge you only for the period of ownership, based on the regular price less trade-in at the time of return, prorated over number of months of guarantee."

The DieHard. Sold only at Sears. \$29.95 with trade-in.

**Sears**

**ALLSTATE**  
You can't do better than Sears.

The DieHard is so new it's available in Groups 24 and 22F only. These sizes fit all Chevrolets from '57 on, all Buick Specials and Skylarks

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# Blue Flame for the Jet Set

This new type of spark plug lets you look inside your engine for a check on carburetor adjustment

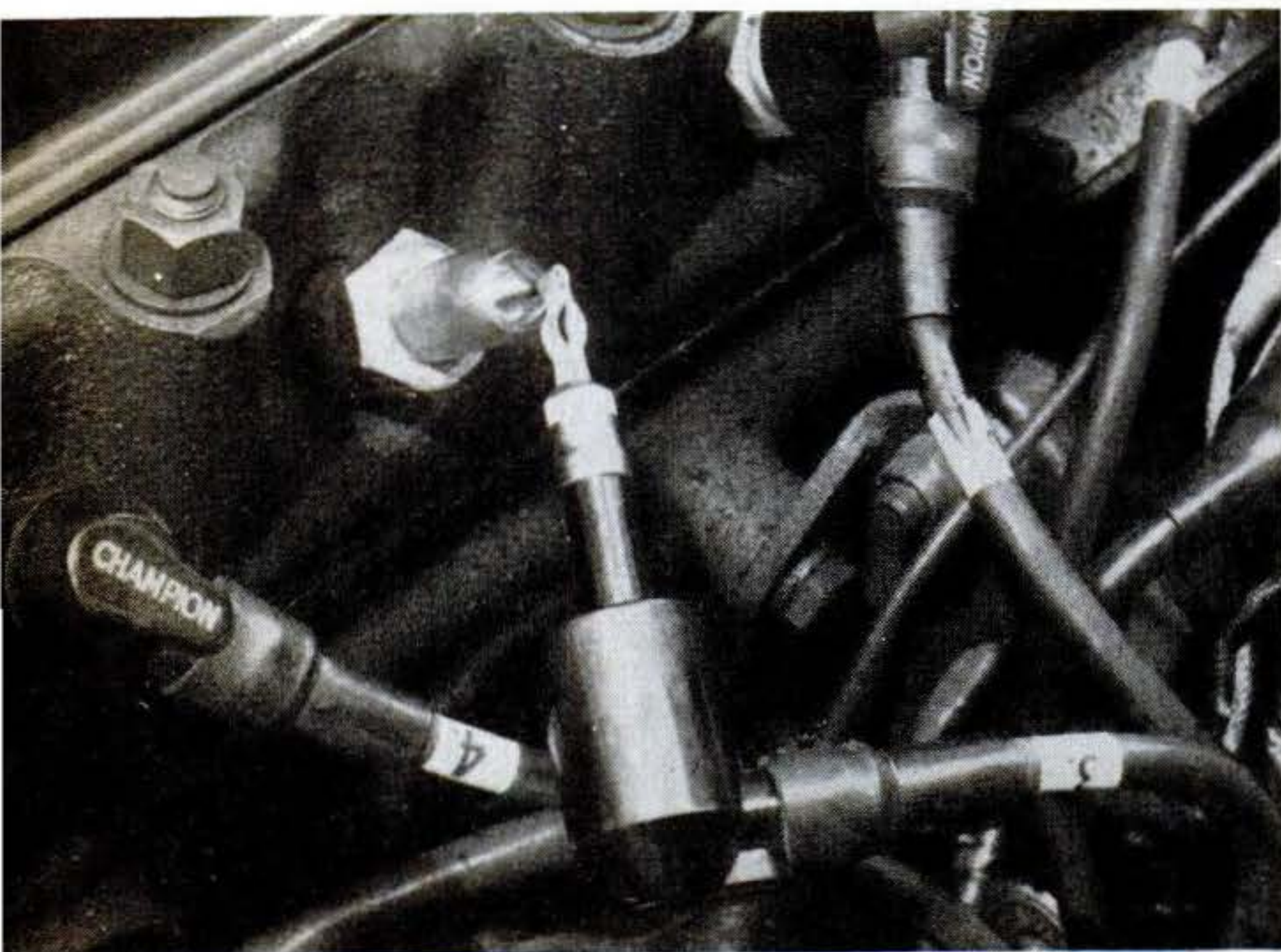
By DAVID SCOTT  
PS European Editor

The new British-made Colortune plug is a window into the cylinder that lets you witness the combustion. Just take out one spark plug, insert the new plug, start the engine, and turn the carburetor mixture screw for the correct flame color.

An orange glow in the hollow transparent insulator means an over-rich setting that wastes gas and speeds carbon buildup. Pale blue shows a weak mixture, causing overheating and burned valves. The optimum is a deep blue flame. To get it, you turn the adjuster until you reach orange, then back off until blue appears. When the correct idle setting has been obtained, speed up the engine to about 2,000 r.p.m. If the flame color changes, the main jets may be off and should possibly be replaced. More likely, the trouble is elsewhere. Orange could mean a clogged air cleaner or stuck choke. Pale blue could mean an air leak or gummed-up air passages. In any event, the Colortune plug tells you something is wrong and usually gives you an indication of where to look. The plug comes in a kit with all instructions. It will be on sale in the U.S. next year.

In the meantime, you can buy one of these new plugs direct from Colortune, 46 Fairfield Rd., London, E.3, England, for \$15.

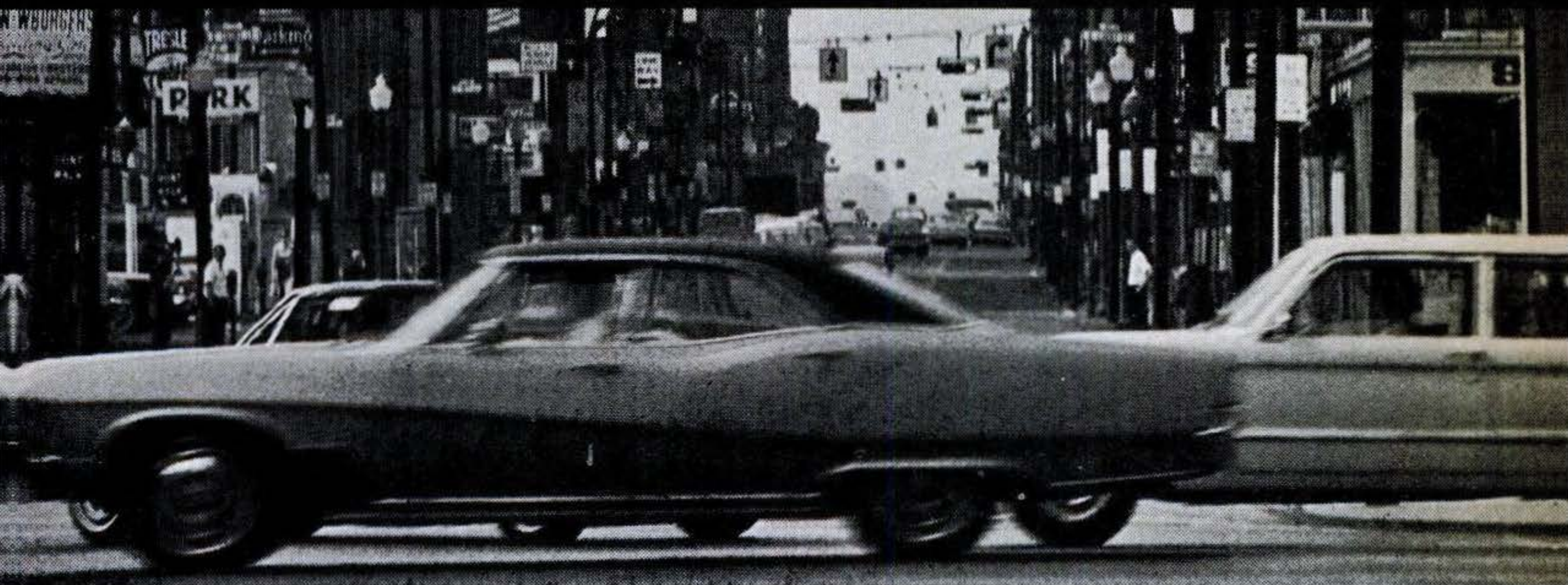
Colortune comes in a compact kit, which includes an instruction booklet. Among other items in the package are spacer ring, ignition-wire adapter, cleaning fluid.



Replacing one of the spark plugs, the glass-domed plug (center) gives you a window to see what is going on in the combustion chamber. It clues you in to trouble.



# The Everyday Endurance Run



There are times when normal driving can be tough on your car's engine. With moments of stress equalled only in competitive racing. Moments that cause excessive engine wear. That's why your car needs the full-time extra protection built into Valvoline—the motor oil that's race proved to meet the rigors of everyday driving. Every can of Valvoline contains the power, performance, and protection know-how distilled from millions of miles of racing. Take the wear and tear out of your engine's toughest moments. Ask for Valvoline.



Race proved for your car





## PERFECTION IN A PIPE

KIRSTEN'S exclusive radiator stem helps cool the smoke before it reaches your mouth... traps impurities... lets you easily remove excess moisture. Imported aged Mediterranean briar bowl. Hand-finished vulcanite bit. Truly a quality pipe that reflects the pride of old-world pipe makers. Order your KIRSTEN today.

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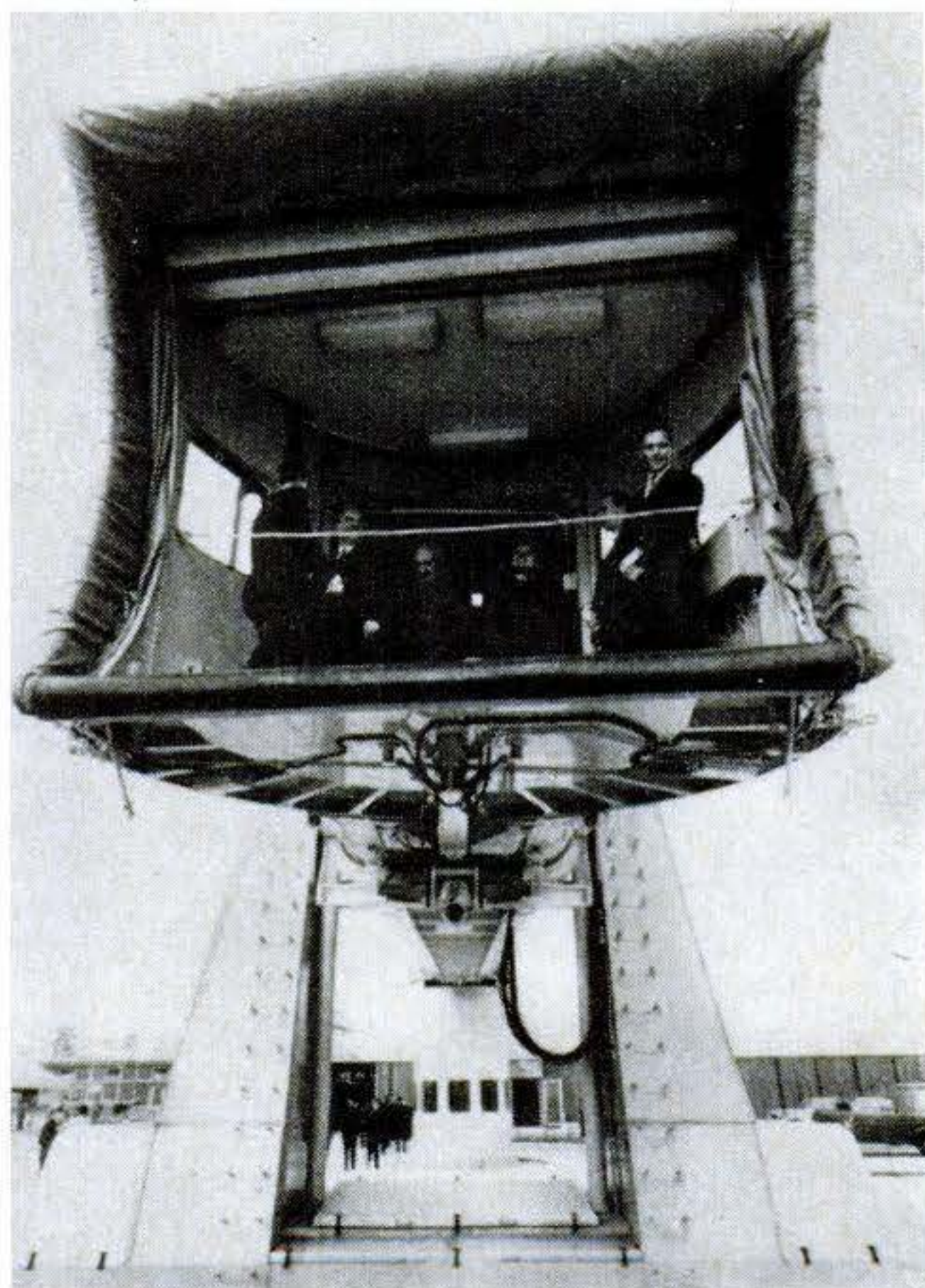
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Pros and novices alike call the Bensen Gyrocopter "the greatest thrill in flying." It's the most popular build-it-yourself aircraft — costs no more to operate than a car. Holds world records in speed, distance, altitude. Wheels and floats interchangeable for extra fun. Build with ordinary hobbyshop tools. Copter flying instructions come with construction plans. Kits and parts available. Make your first move now — send \$3 for 3-View Drawings, specs, photo.

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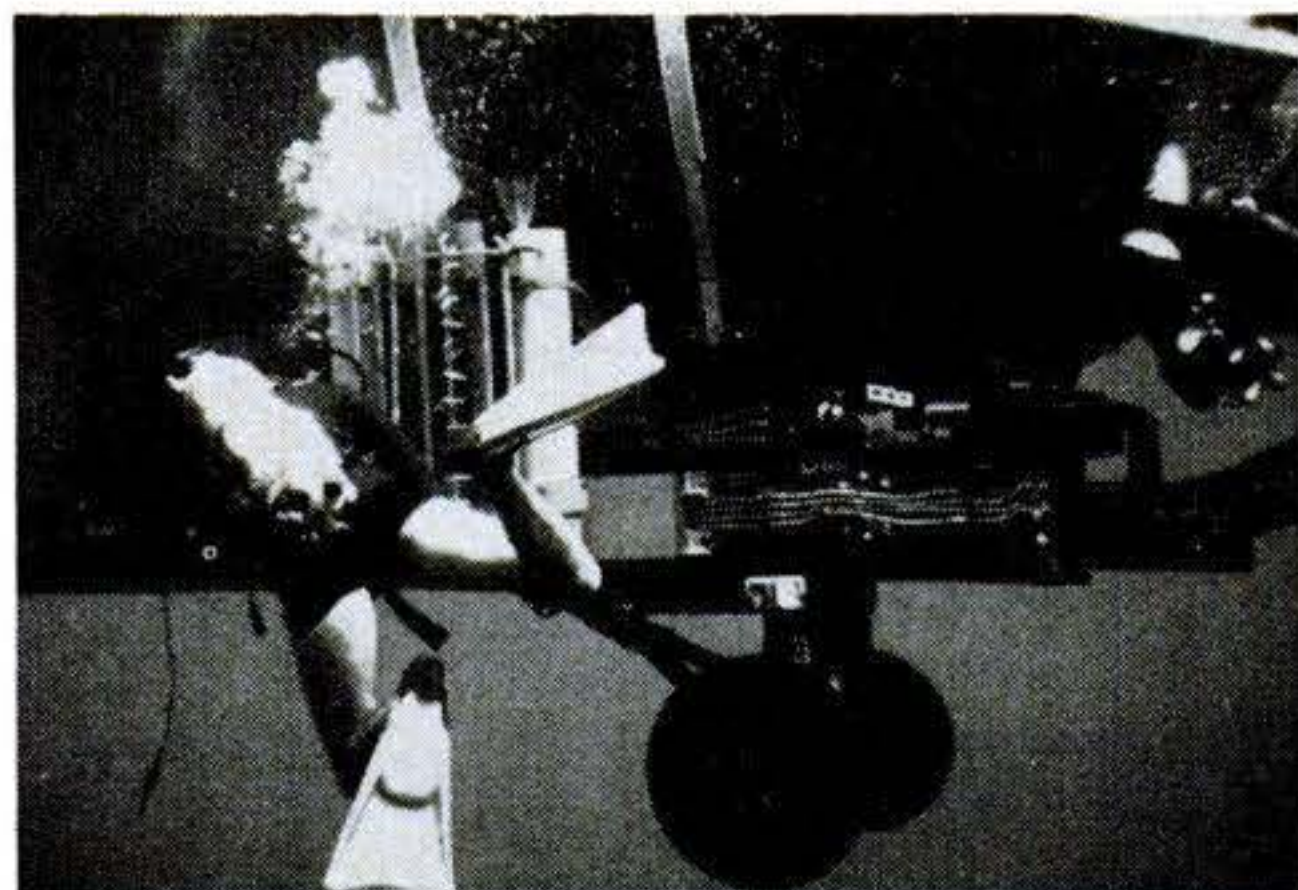
NAME \_\_\_\_\_

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## Plane ramp has l-o-n-g reach

At Frankfurt airport, passengers stand on a moving ramp that can extend 190 feet out to waiting planes. The ramp also can be moved in a 220-degree arc from passenger terminal to an airplane in the loading area. The new gangway was installed to service heavy air traffic between Frankfurt and Hamburg.



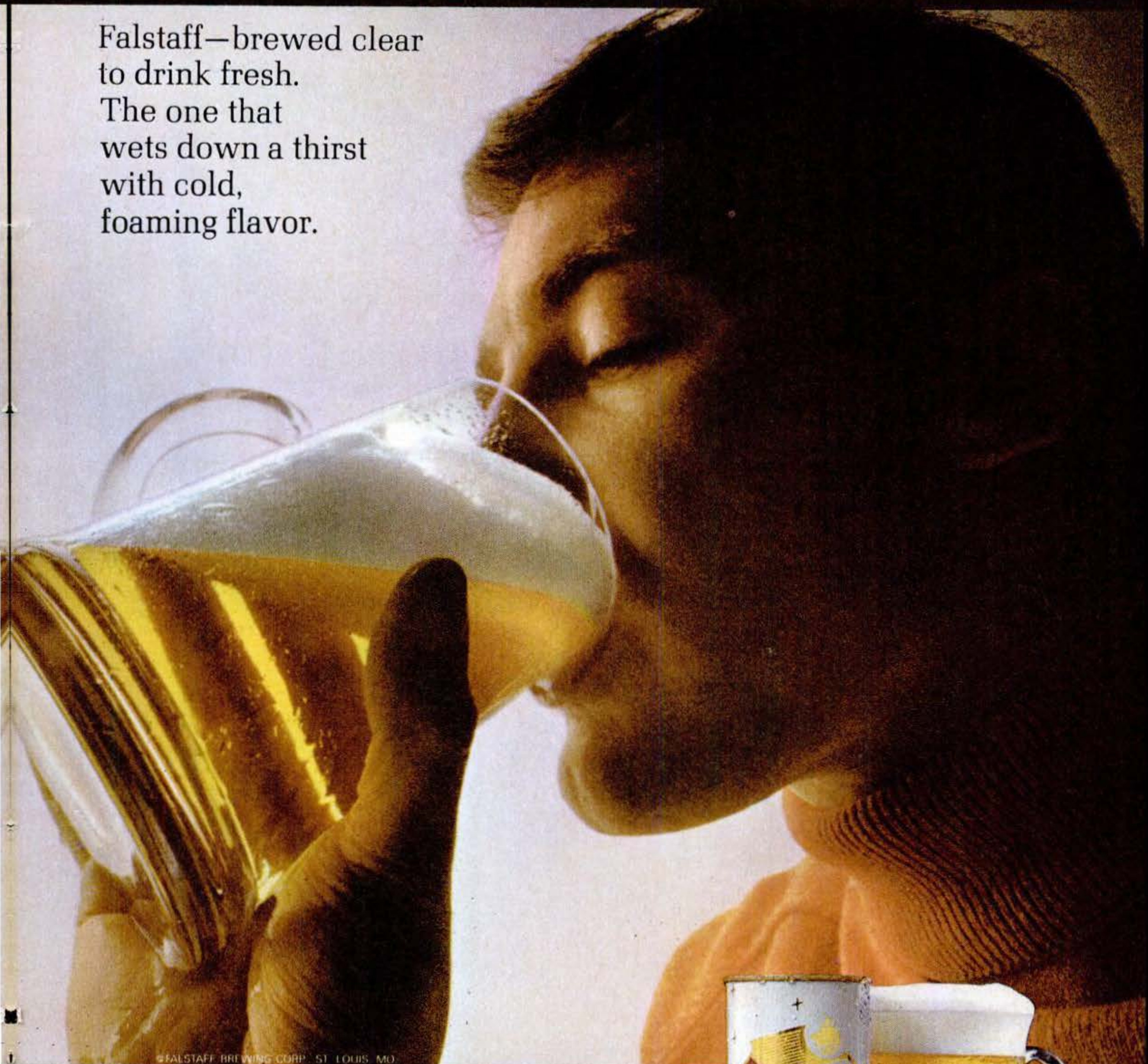
## Airplane tires take a dive

These 10-ply tires, built for use on DC-3 tail wheels, are now wheeling one of our deepest-diving subs across the ocean bottom. Three of the Goodyear tires—two forward and one aft—are on wheel assemblies bolted to the Aluminaut's bottom. The tires are filled with water to avoid pressure problems.



# the thirst slaker

Falstaff—brewed clear  
to drink fresh.  
The one that  
wets down a thirst  
with cold,  
foaming flavor.



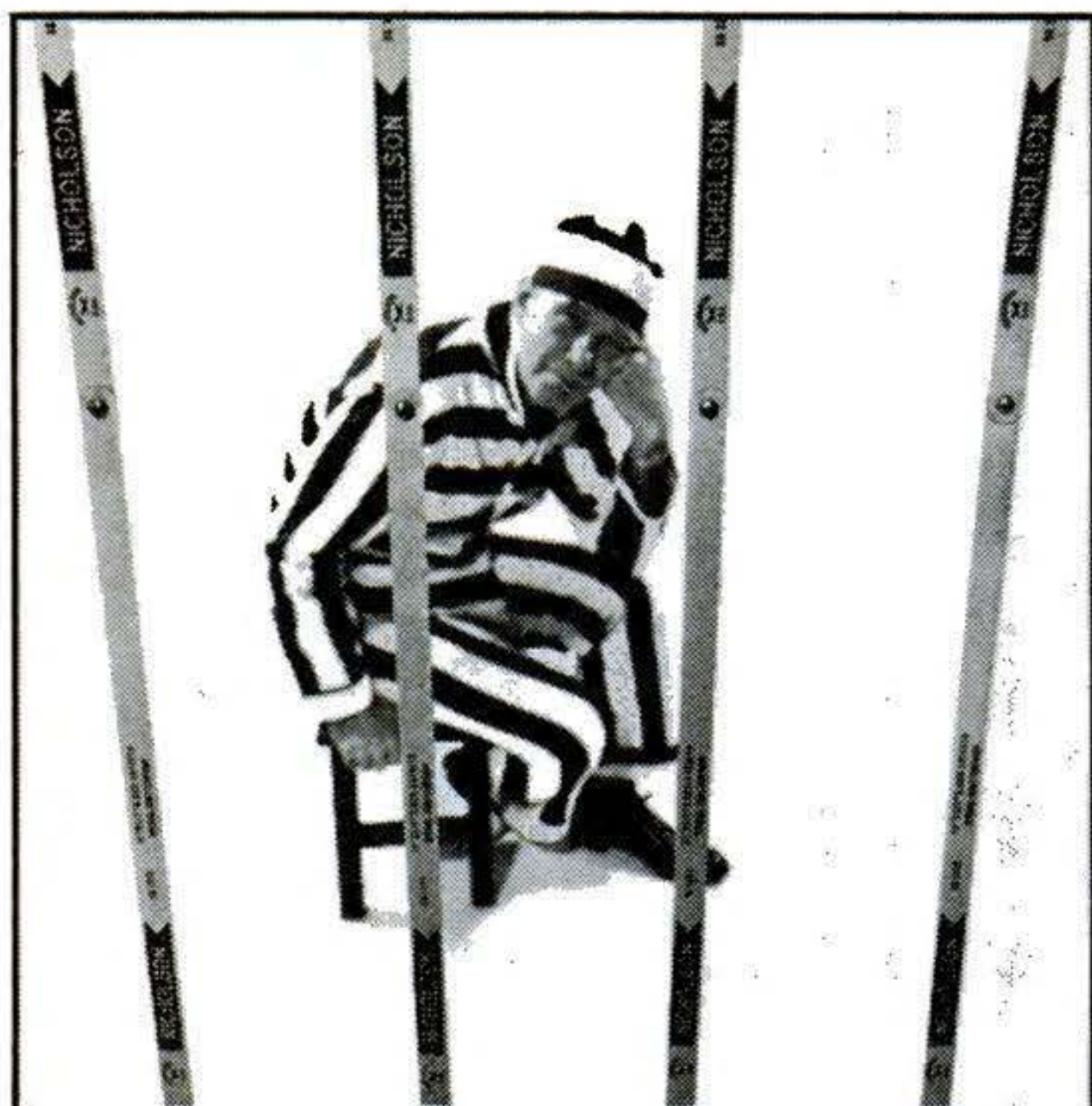
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## Some people can't buy our hacksaw blades at any price.

But you don't have that problem. Your hardware dealer has plenty of sharp, long-lasting Nicholson hacks for you.

They come in six varieties—with flexible or hardened blades, armed with teeth that bite through any kind of metal.

Get a supply soon—and escape from dull, tedious metal cutting.

There's never a dull moment with

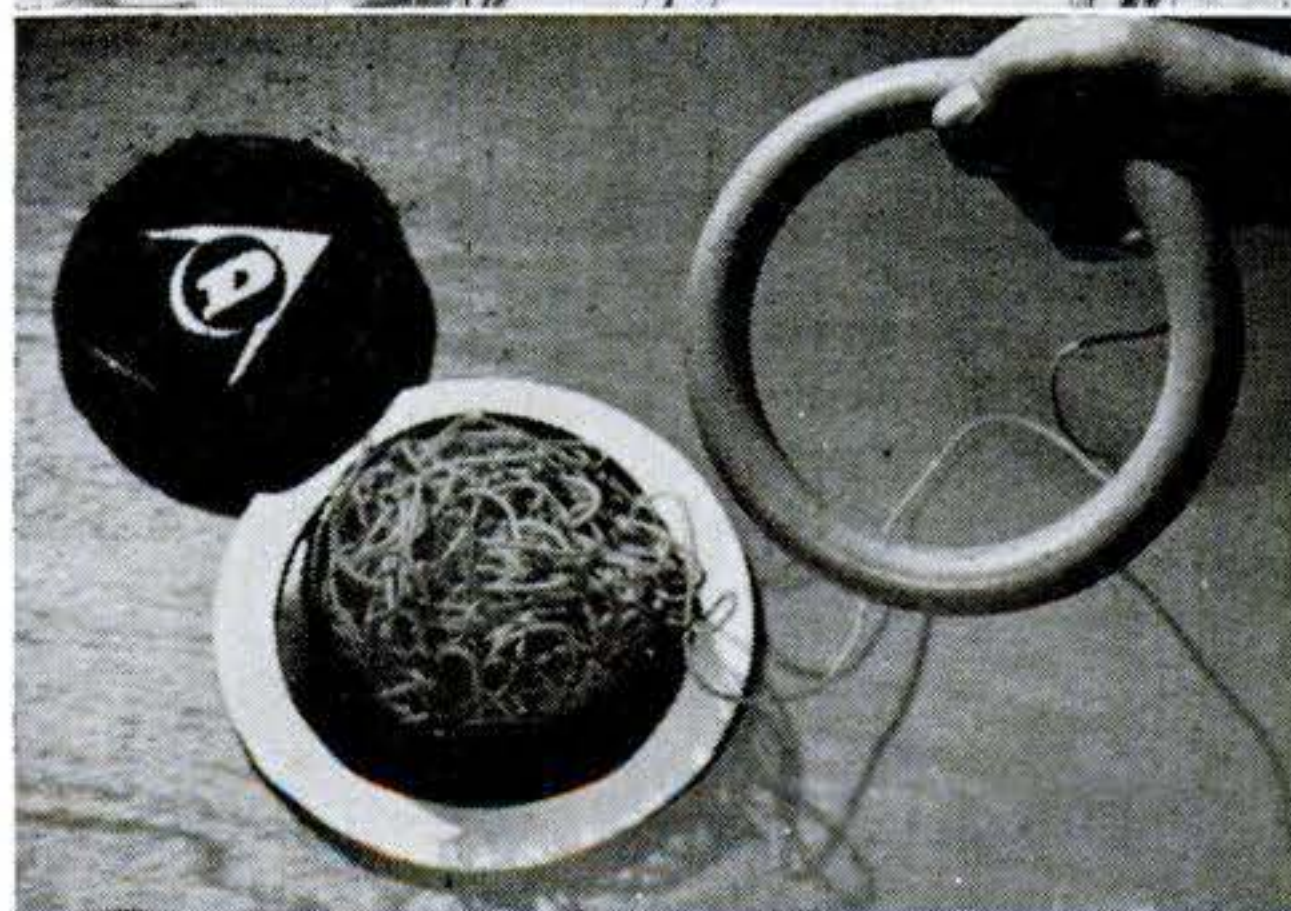
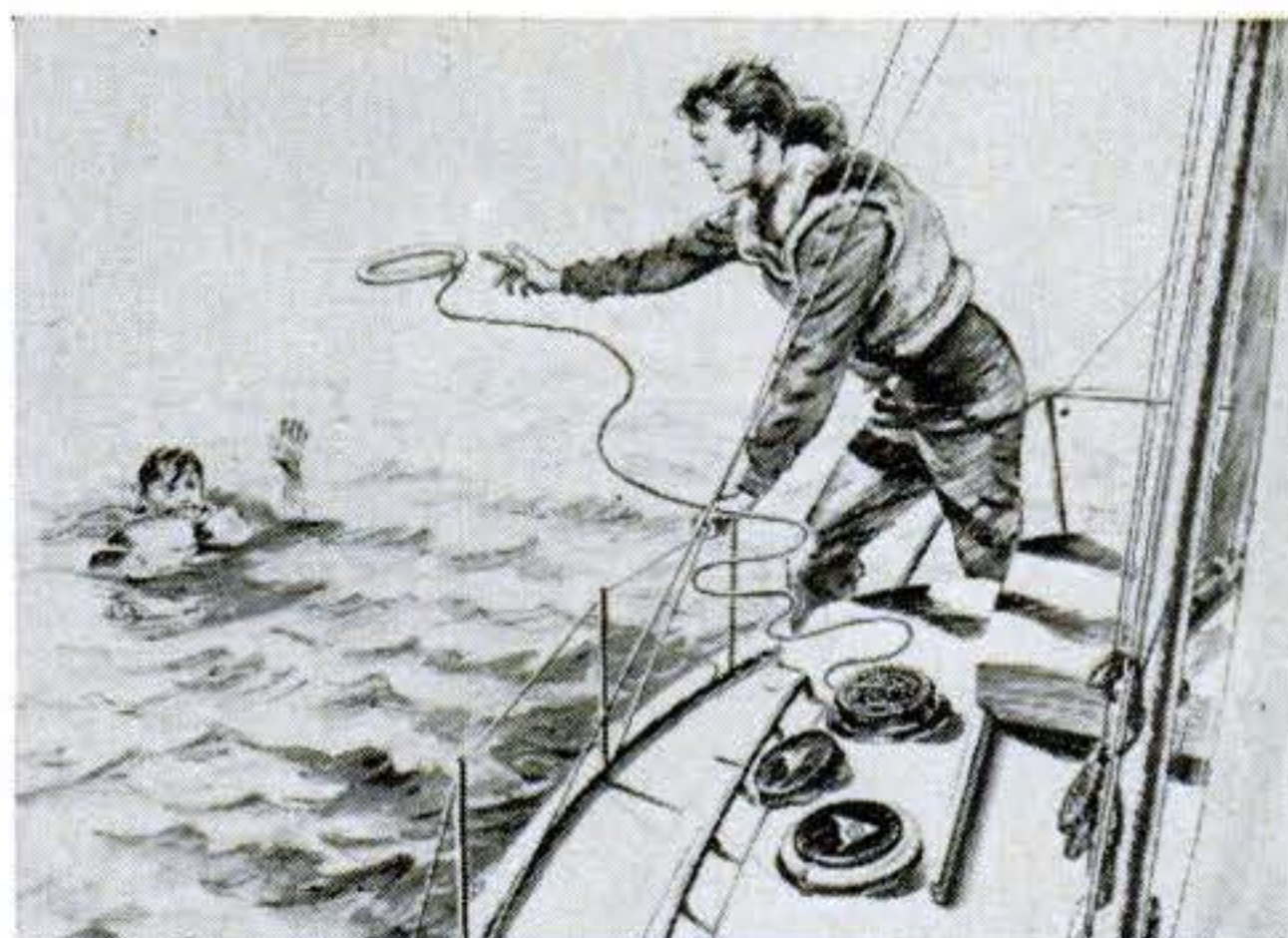
# Nicholson

Nicholson File Co., Providence, R. I.



PS

PICTURE NEWS



### Tiny life preserver is easy to aim

This English-made eight-inch rubber ring can be hurled far out to haul in a person who has fallen overboard. It's attached to a 60-foot buoyant plastic line, which is held in a container screwed to the boat deck. The ring is so light that it won't hurt even if it scores a direct hit on the person it's pitched at.



### Plane gets a nosey front

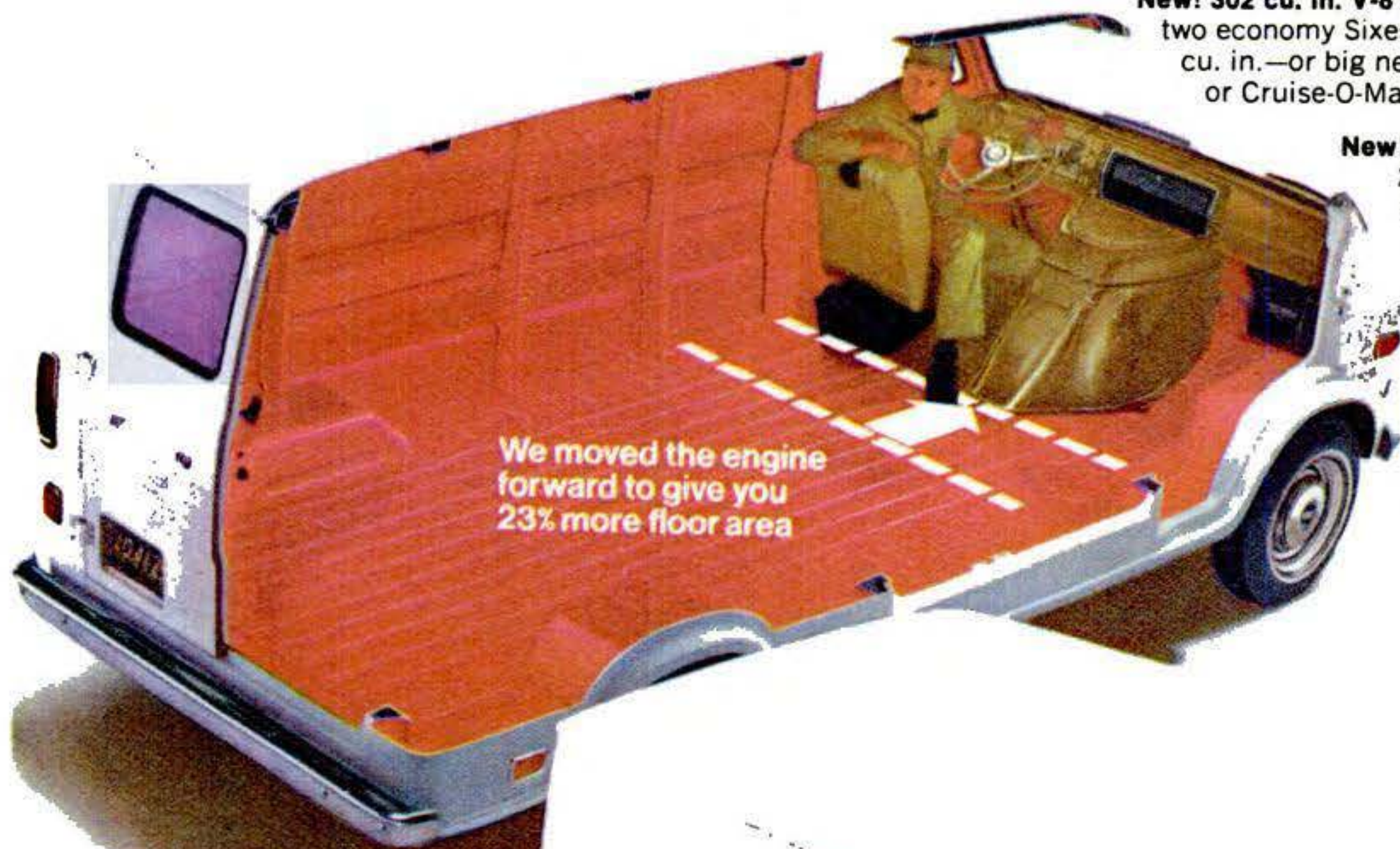
A Lockheed C-141 StarLifter was outfitted with this oversize nose radome to check out electronic gear for the new C-5 Galaxy, world's largest plane, which will get a similar unit. The C-141's radome is half the size of one that will go on the C-5 to house radar, compass equipment, and sophisticated navigation gear.

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# WE TOOK THE ENGINE OUT OF THE LOADSPACE

(IT STARTED A WHOLE CHAIN OF BETTER IDEAS)



We moved the engine forward to give you 23% more floor area

**New! 302 cu. in. V-8 available.** Choice of two economy Sixes—170 cu. in. or 240 cu. in.—or big new Ford 302 V-8. Manual or Cruise-O-Matic transmissions.

**New! Engine clear of loadspace.** Engine's shifted 22 inches forward, completely out of load area. New "sandwich" insulation in cover blocks heat and noise.

**New! Driver "walk-thru."** Step back into the cargo area from the driver's seat. You no longer have to walk around the van and open side doors to reach forward part of load.

**New! Biggest load-space.** 23% more clear floor area than in other vans. Ford Vans now offer over 8½ ft. load length; Super-Vans over 10 ft.

**New! Payloads up to 3540 lbs.** Only Ford offers three series to choose from... 600 lbs. more top payload than other vans!



**New! Long-wheelbase stability.** Forward location of front axles stretches wheelbases to 105.5" for Van, 123.5" for SuperVan. Helps make Econolines the steadiest vans on the road.

**New! Wide-stance handling ease.** New 7-inches-wider track for new stability. Quicker, easier maneuverability, too!

## ALL-NEW FORD ECONOLINE VANS

So many better ideas they make all other vans obsolete.

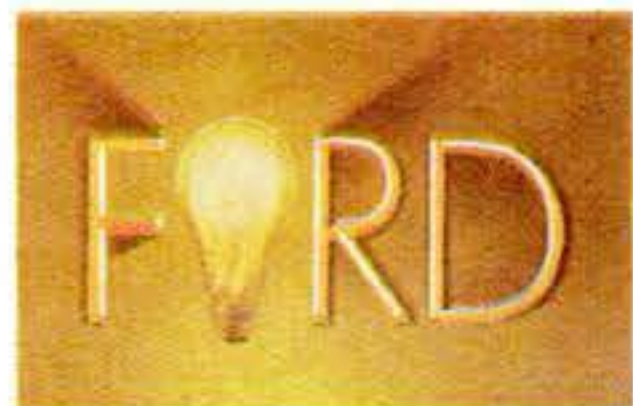
Moving the engine forward began it all. Load length increased. Clear floor area became 23% greater than in other vans. And with the engine out of the way, the driver gained new access to the rear load area; engine servicing became possible from outside the van. Next, we boosted payloads—up to 3540 lbs. And when we added Twin-I-Beam front suspension for easy ride, plus an optional 302 cu. in. V-8 for powerful performance, the sum of Ford's better ideas was a better van... all around!



**New! Twin-I-Beam ride.** The front suspension made famous in Ford pickups... two front axles for strength and stability, coil springs for easy ride.



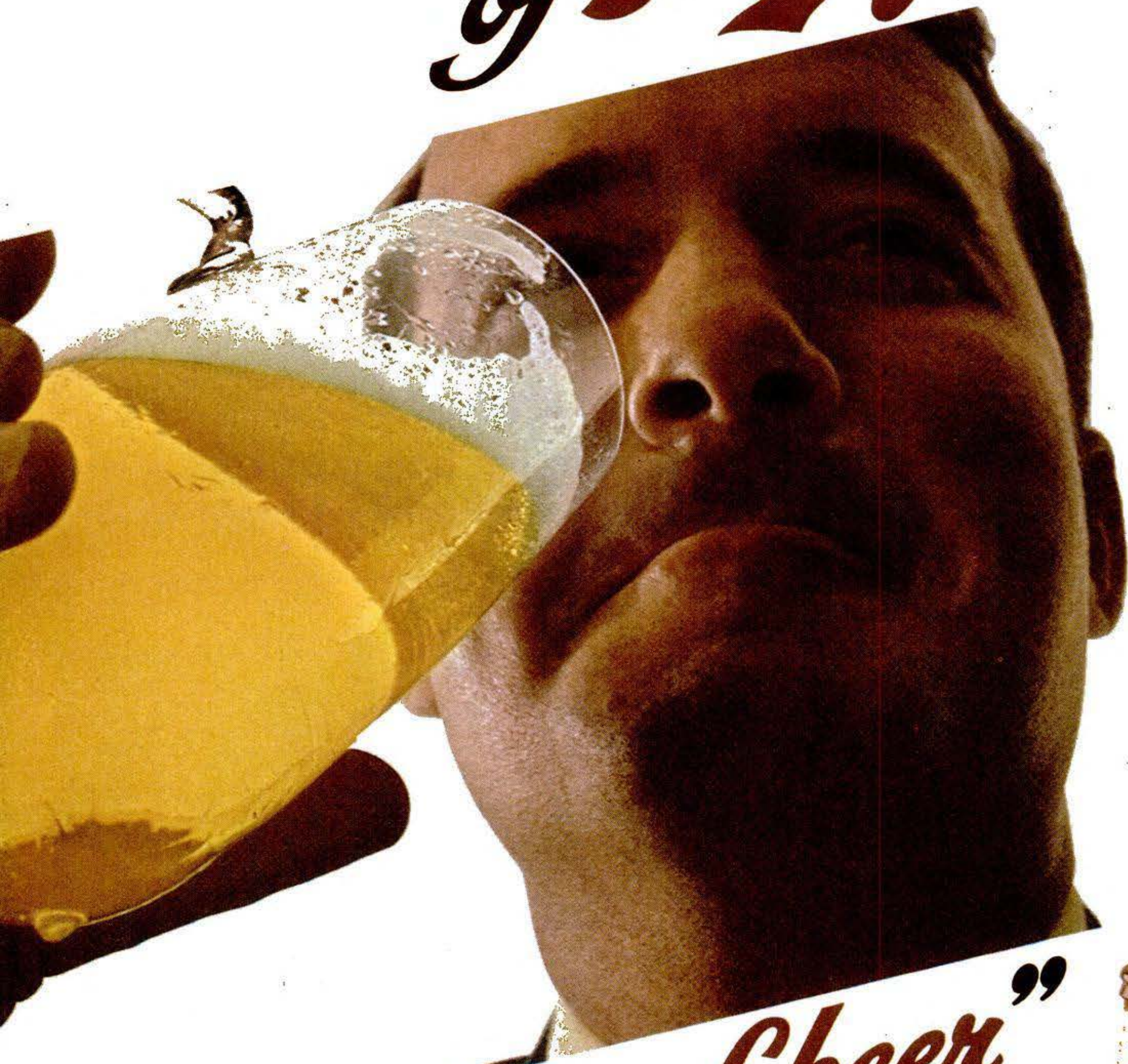
**New! Outside service center.** Just lift the chest-high hood to check oil, water, battery, voltage regulator, brake master cylinder and more. Everything is easy to reach.



...has a better idea!



*"When you're out  
of Schlitz,*



*you're out of beer"*

Quality never comes easy. Schlitz is most carefully brewed for smoothness, gusto, and aroma, without "beer bite." This is pure beer. This is Schlitz. The beer that made Milwaukee famous.

© 1968 Jos. Schlitz Brewing Co., Milwaukee and other great cities.



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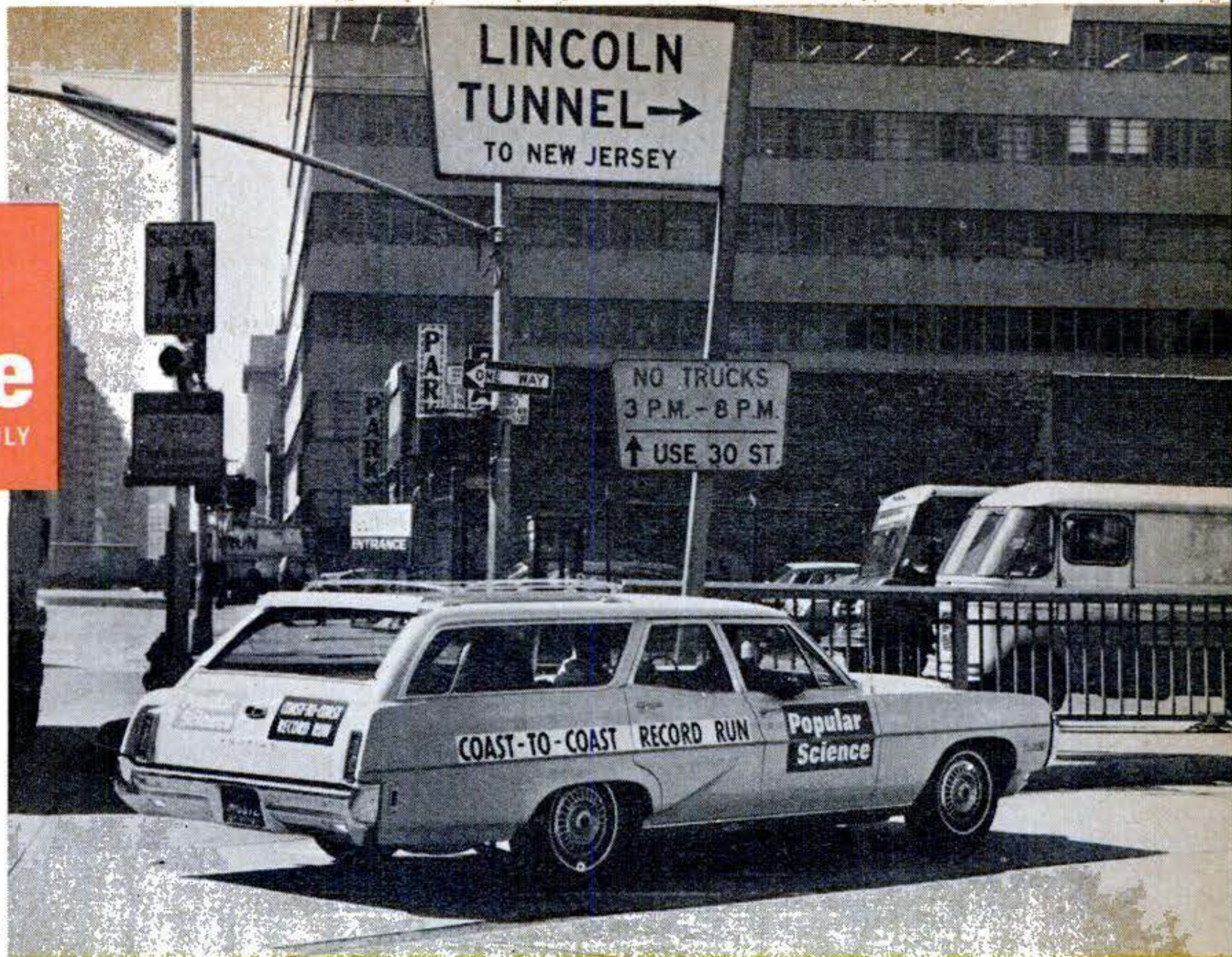


# Popular Science

REG. U.S. PAT. OFF.

MONTHLY

Poised for takeoff, Norbye and Dunne watch the last seconds tick by before punching the stopwatch and stepping on the gas.



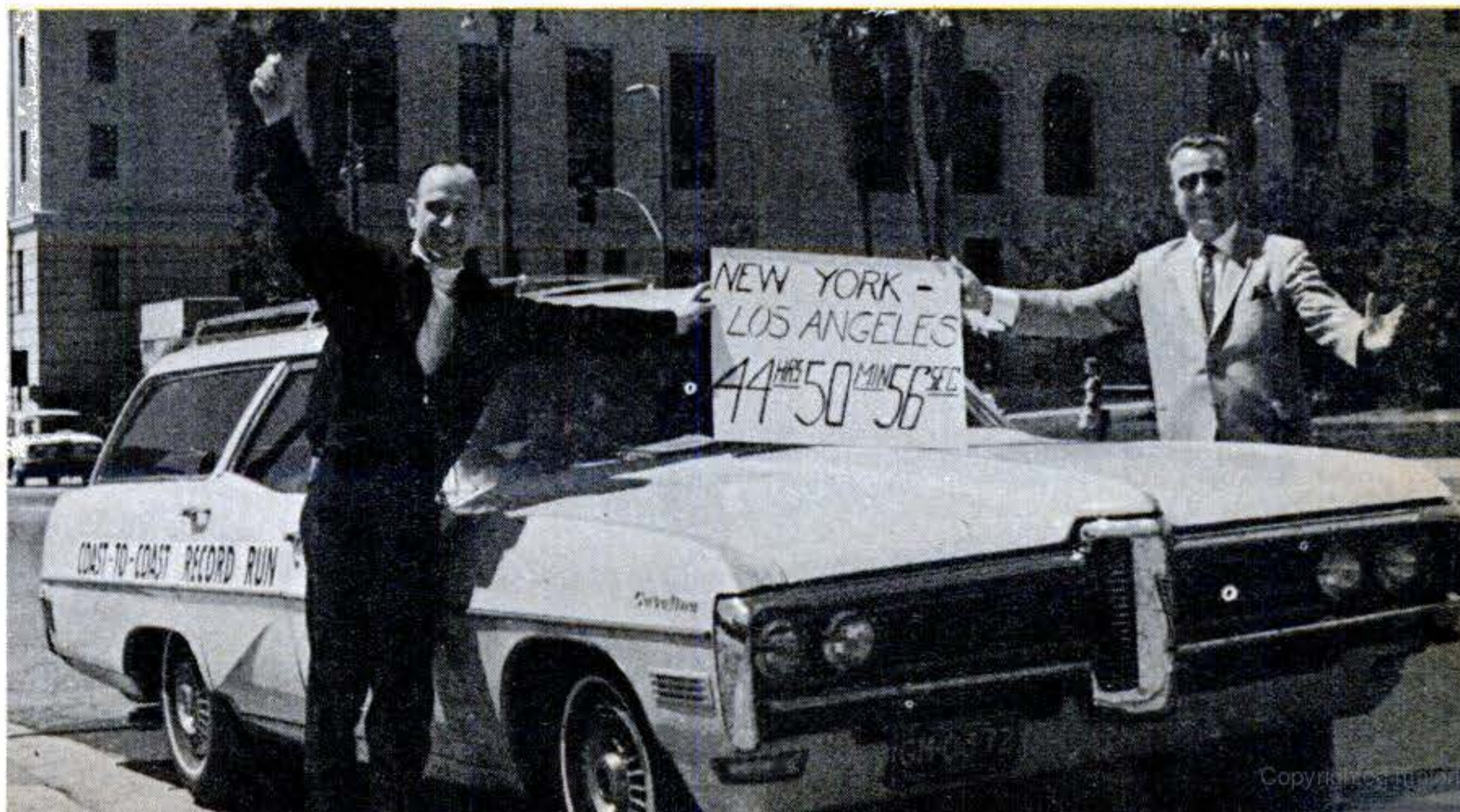
## Coast-to-Coast by Car in Under 45 Hours!

We set a new transcontinental record with a Pontiac Catalina wagon at an average speed of 64.26 m.p.h. and a gas mileage of 15.84 miles per gallon

By JAN P. NORBYE / PS Automotive Editor  
and JIM DUNNE / PS Detroit Editor

The big New York City cop was friendly and he smiled as he spoke; yet his words had us frozen. Leaning his elbow against the window of our Pontiac wagon, he said: "My cousin did it in 45 hours in an old Plymouth." Just like that. With a casual remark, he practically wiped out all our thorough planning to break Stanley Rosenthal's

*Continued*

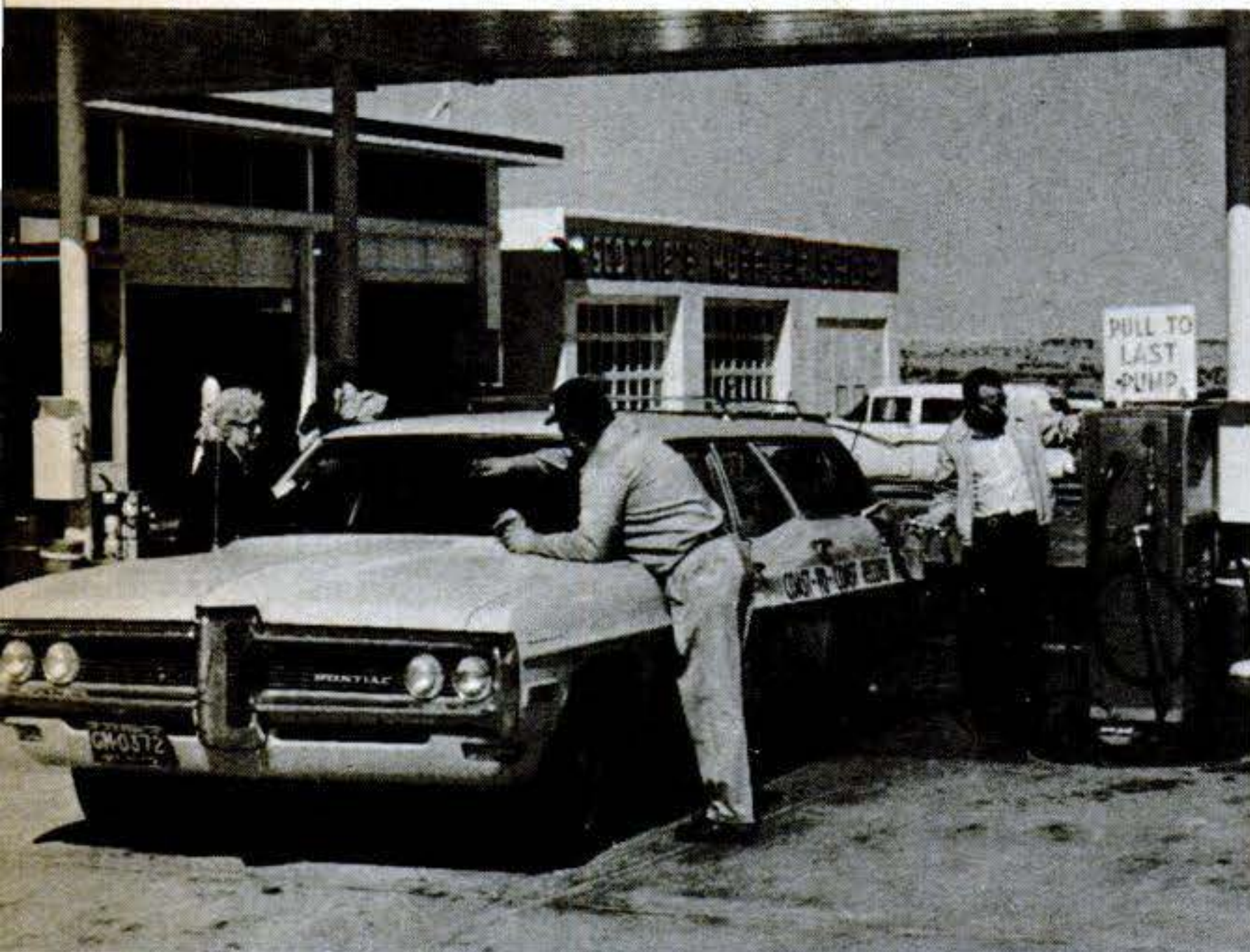


Proud and happy after their arrival in Los Angeles, Dunne (left) and Norbye pose in front of City Hall with a hastily painted sign.



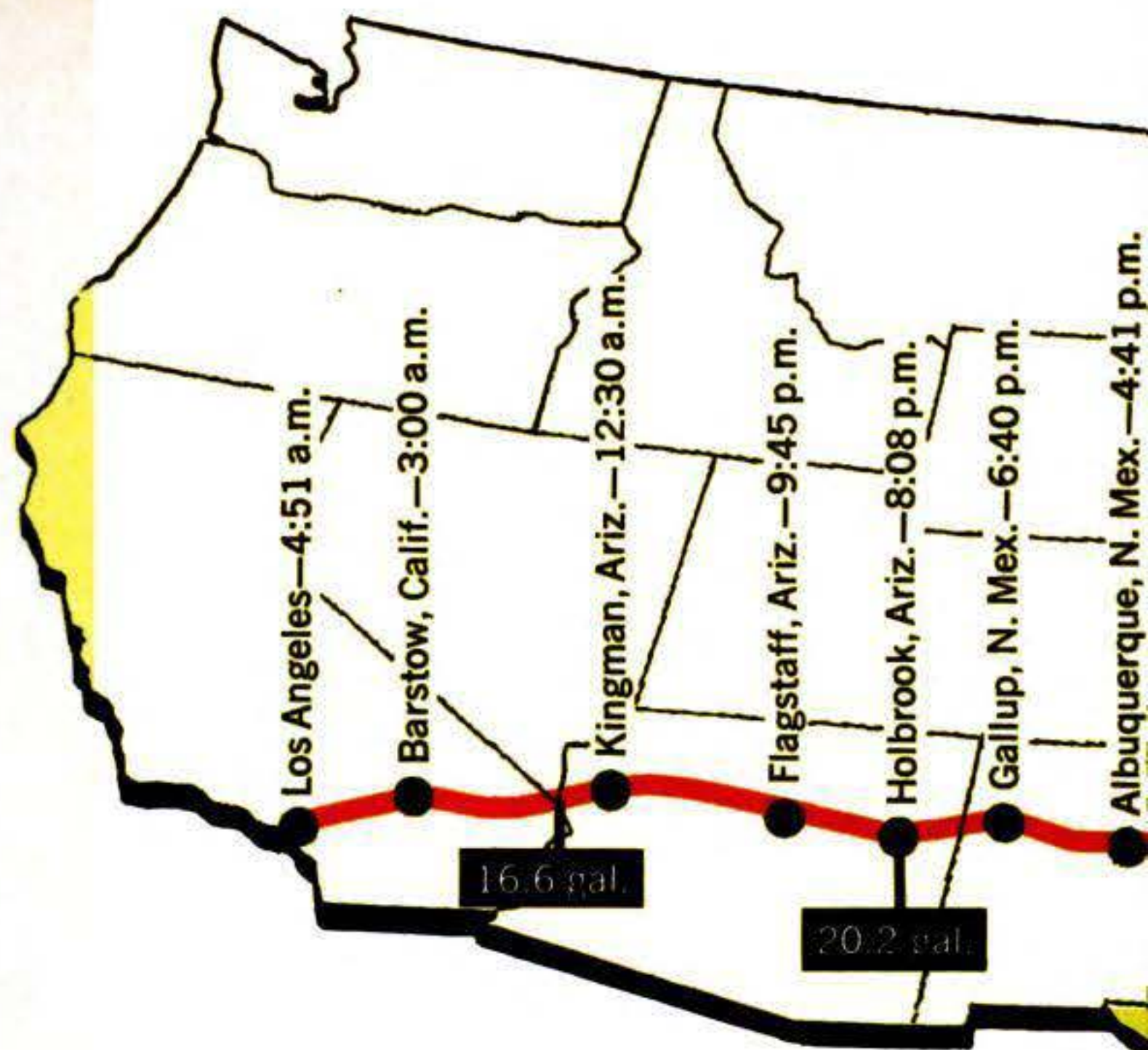


New York Patrolman Robert Ragonese signed an attestation of our exact departure time, after telling us his cousin had made the trip in 45 hours.



Norbye pumped gas in Sayre, Okla., while the service-station owner and his wife frantically cleaned our windshield. Next stop was Santa Rosa, N.M.

Running on the streets of Los Angeles, below, our unfaltering Pontiac had really earned the right to carry its "Coast-to-Coast Record Run" signs.



## "We were ahead of schedule before we left the N.J. Turnpike"

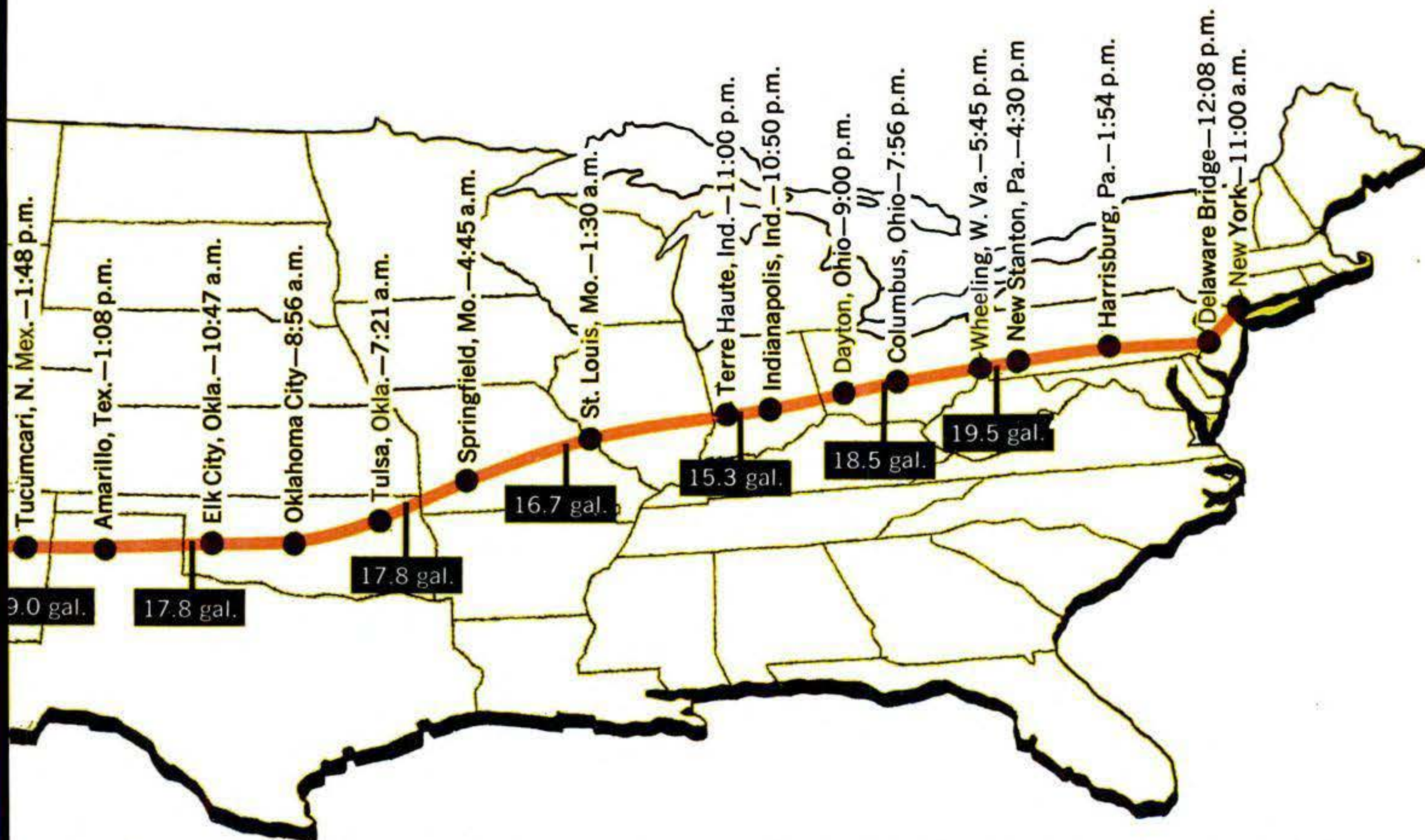
The route we followed was recommended by the AAA and we never strayed from it. The map above shows the time we reached each of the key cities on the way and where we stopped for gasoline. Hours

five-year-old record of 48 hours, nine minutes, 54 seconds in a Sunbeam. We were aiming for 47 hours—or a little better. But 45 hours? We could never do it—the rules laid down for us insisted that we observe all speed limits. Should we give up before we started?

No, we *had* to try. Setting a record was only one of the reasons for making this run. True, a new record would be the best way for us to stir up extra interest in the President's Travel America program. But we also wanted to check on the Interstate Highways program and make a report on what kind of driving you'll encounter when you take your next vacation trip.

Next, we wanted to demonstrate the high-speed reliability of a modern, standard Detroit car. Why did we pick Pontiac? For several reasons. First, we have been impressed by the Pontiac test cars we have used, and we enjoy driving them. Second, Pontiac builds one of the roomiest wagons in existence—and space and comfort are very important for a trip of almost two full days and nights. Third, we were convinced that the "longest" axle ratio would give us the best gas economy—and therefore the least number of fuel stops. Nobody is as brave about gearing





are given in local time for each city. We used 181.2 gallons of gasoline at a cost of \$71.29, averaging 15.84 miles per gallon. We bought gasoline without discrimination as to brand, using leaded as well as

nonleaded fuels. The gas gauge was inaccurate, but Pontiac had told us that when the warning light for "low fuel" began to blink, we could still travel 45 miles at 70 m.p.h. before running completely dry.

as Pontiac. The Catalina comes with a 2.42:1 axle for the 290-hp. 400-cubic-inch V-8 we picked. And we wanted a big engine for rapid acceleration every time the speed limit went up.

Well, we did it in 44 hours, 50 minutes, 56 seconds, from the Lincoln Tunnel entrance in Manhattan to the Los Angeles city limit sign on the San Bernardino Freeway.

**Planning the trip.** From the AAA we got the most direct route (2,871 miles). We followed their recommendations without deviation. By good fortune, we never made a wrong turn, even though signs in some areas are lacking and in others occasionally misleading.

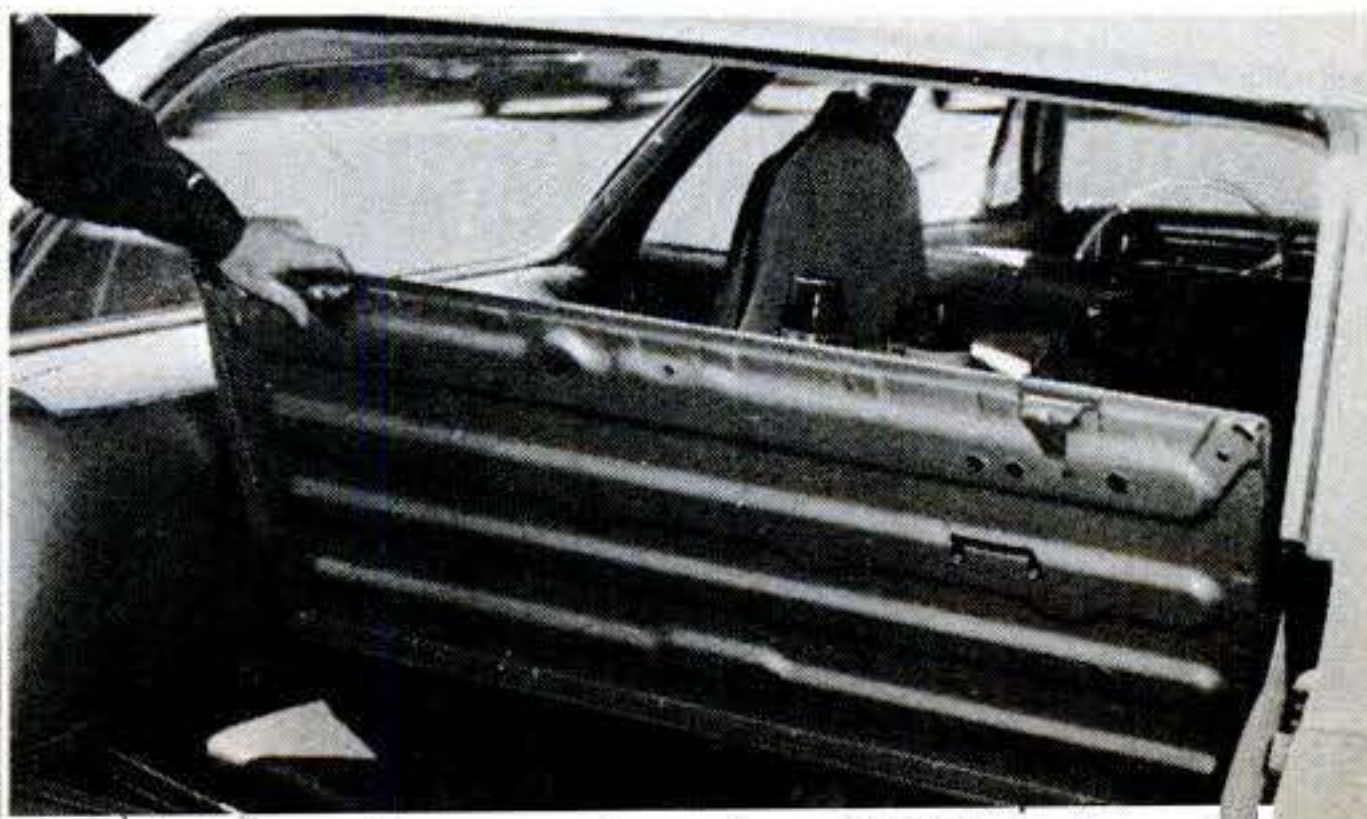
We worked out a minute-by-minute plan so we could tell at any moment whether we were falling behind schedule. We based the whole plan on getting to Los Angeles ahead of the morning rush hour. Arriving no later than seven a.m. after 47 hours on the road meant leaving New York at 11 a.m. two days earlier. Everything else just fell into place. We added a little extra time to get through Wheeling, W. Va., because we had suffered bad delays there in past years. We set aside some extra time for Albuquerque, N. M., because we would be there in the afternoon rush hour. And so on.

**No sight-seeing.** We put the pressure on

*[Continued on page 178]*

An inflatable mattress and a padded sleeping bag occupied the right-hand side of the cargo area, with our food supply stored in cartons on the left.

Our two lightweight suitcases went under the floor, one on top of the other, next to the three five-gallon jerricans that held our emergency gasoline.







Cole Palen puts his 1918 Spad (foreground) through its paces over Old Rhinebeck Aerodrome. The ship

in the background is a 1916 Sopwith Pup. Aerodrome houses world's finest collection of antique aircraft.

Spad, a sturdy, flat-winged pursuit ship, was designed to kill in a fast, diving rush. Powered by a V-type 200-hp. engine, it does over 130 m.p.h. and is excellent in climbing. "Spad" stands for the plane's maker: Société Pour Aviation et Ses Dérivés.

Sopwith Pup uses an 80-hp. rotary engine — underpowered but very easy to fly. Its speed is about 112 m.p.h. It was designed in 1915-16 to combat the Fokker Eindecker, arrived too late, and saw action, instead, against the Albatros. This plane is a copy.





# BRING ON THE RED BARON: Wire-and-Fabric Wonders of World War I Fly Again

**Contact!** Spin the prop and it's up and away in our Sopwith Camel to do battle with the Flying Circus. Restored to glory, these 50-year-old fighter planes take to the skies again

By ANTHONY WHITTIER

PS PHOTOS BY ORLANDO GUERRA

**Y**ou circle the tiny grass field, its previous assignment to feed cows. Get your wind direction from the wind sock on one of the hangars. A vicious side-slip and you're down, rolling along the bumpy pasture. Taxi up and park between a Spad and a Nieuport.

St. Omer, France, 1917? No — Rhinebeck, N. Y., 1968. This is Cole Palen's Old Rhinebeck Aerodrome, a reproduction of a World War I airfield.

Palen, an enthusiastic collector and restorer of vintage aircraft, got his start a few years ago when the Department of Defense closed down Roosevelt Field on Long Island. Among the surplus property was an old Spad.

After checking inside the wings for mice and testing the engine, he took off and flew down the field at a height of one yard. Convinced that the plane was airworthy, he went up to about 2,500 feet and just

*Continued*

**Fokker Triplane**, a triumph of design and the most famous plane of the war, was linked with the name of Baron von Richthofen who made it famous. Powered by a 110-hp. rotary, it does about 125 m.p.h. and has a ceiling of 20,000 feet.



Nieuport 28 is a high-performance airplane, best suited for dogfighting. Its 160-hp. rotary engine gives it a top speed of about 130 m.p.h. Some 300 of the French ships were bought by the U.S. (note the Hat-in-the-Ring emblem).

Fokker D-7 was Germany's greatest single-seater fighter plane, does about 130 m.p.h. powered by a 185-hp. engine. Compared to other World War I planes, it has excellent performance at high altitudes, recovers well from dives. It's easy to handle.





## Careful repair and rebuilding keep these colorful antique planes up in the air over Old Rhinebeck



Pilot adjusts valve clearance and oils valve stems of 180-hp. Mercedes engine that powers this antique Fokker D-7. The engine is original. Simple and reliable, it can be kept in condition with no more than a screwdriver and an adjustable wrench.



1910 Bleriot shows the state of the art prior to World War I. Although Louis Bleriot flew one like it across the English Channel in 1909, the antique shown seldom flies higher than 20 feet, or more than a mile or two. It's powered by a 25-hp. engine.

Visitor to Old Rhinebeck Aerodrome examines tail surfaces of Palen's Spad. Palen rebuilds and repairs old planes like a paleontologist, gluing (with epoxy) shattered parts, cutting new ones where he finds it necessary.

played around. The only bad feature: The Spad tends to ground-loop on landing and spins like a top—due to the fact that the rudder isn't big enough for control at low speeds.

Palen figures he'll ground-loop in one out of three landings and dig in a wing-tip in one out of 10.

Now his collection of antique aircraft, one of the finest in the world, numbers 15. He has a Fokker D-7 and a Sopwith Snipe as well as the Spad. A Sopwith Camel is in the works. Also on the field are a Fokker Triplane replica and a Sopwith Pup. Other planes include a Demoiselle, two 1909 Bleriot, and a number of later planes.

One of the questions Palen is asked most often concerns the danger of flying antique planes. The answer is that he, and other fellow hobbyists, put their faith in careful craftsmanship.

"True, the engines are cranky," says Palen, "but that's because they're primitive designs. You'd be surprised how easy it is to get original engines, brand-new, in their original crates. They always made more engines than planes and something is always turning up in a corner of an old warehouse.

"People write me if they discover old parts or planes in somebody's barn. I found my D-7 hanging from the ceiling of a general store in Rhode Island. The owner was tired of the thing taking up







Lineup shows variety of planes available for air shows, which are staged on the second and last Sundays of each month, May through October.

Pilots dress in authentic uniforms, stage dogfights and aerial maneuvers. As planes require much maintenance, only about six fly at one time.

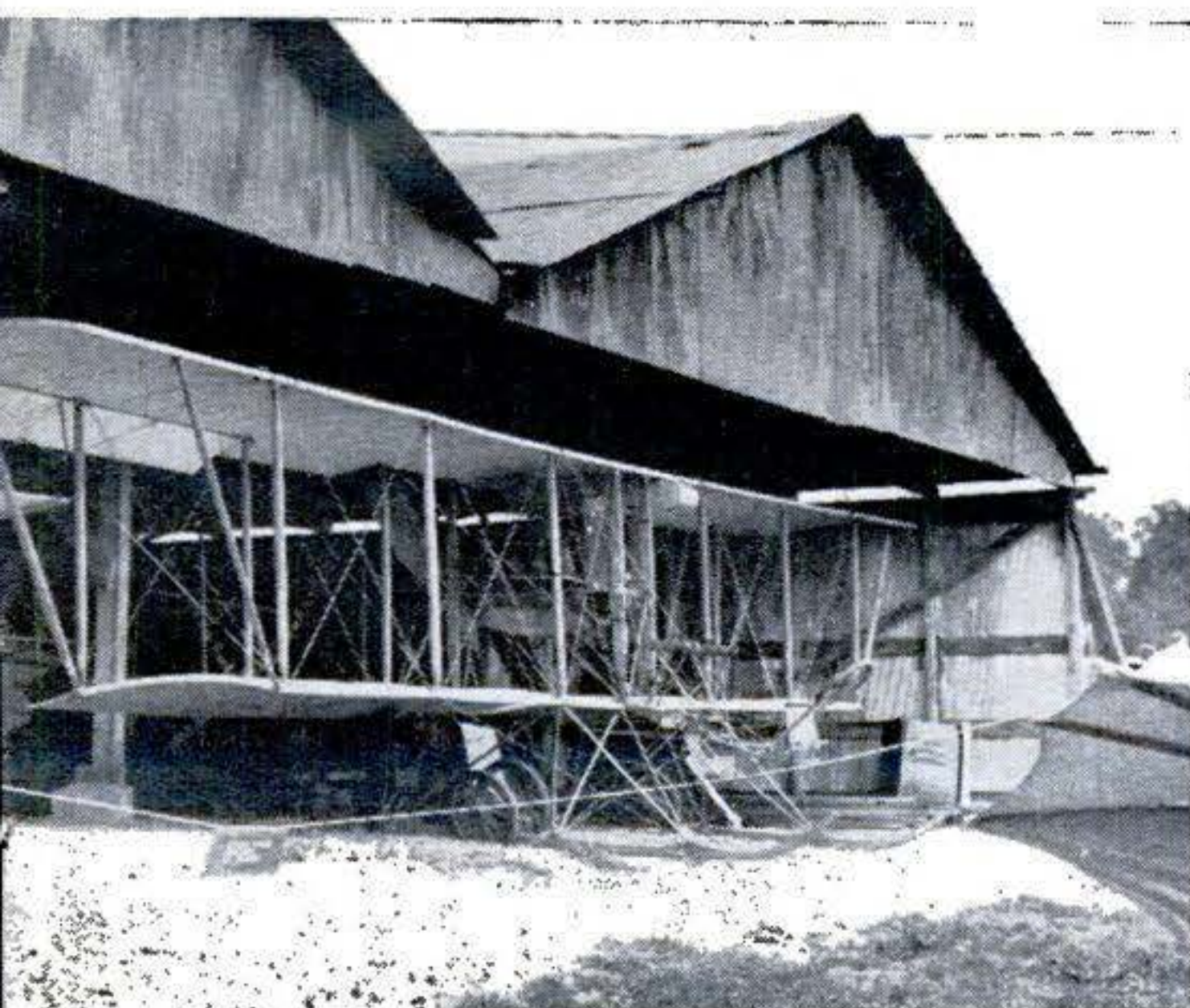
space and gave it to me as a present.”

Visitors to the Old Rhinebeck Aerodrome are treated to a dashing air show, complete with dogfight, on certain Sundays. Machine guns look and sound like the real thing, but all they fire is a mixture of acetylene gas and oxygen. The combatants include, of course, the Red Baron in his Fokker Triplane and a Britisher in a Sopwith Pup.

Although his first “combat pilots” wore no parachutes, Palen and his airmen have

—for the first time this year—decided to wear slim backpack chutes even though they don’t feel that the planes are that dangerous.

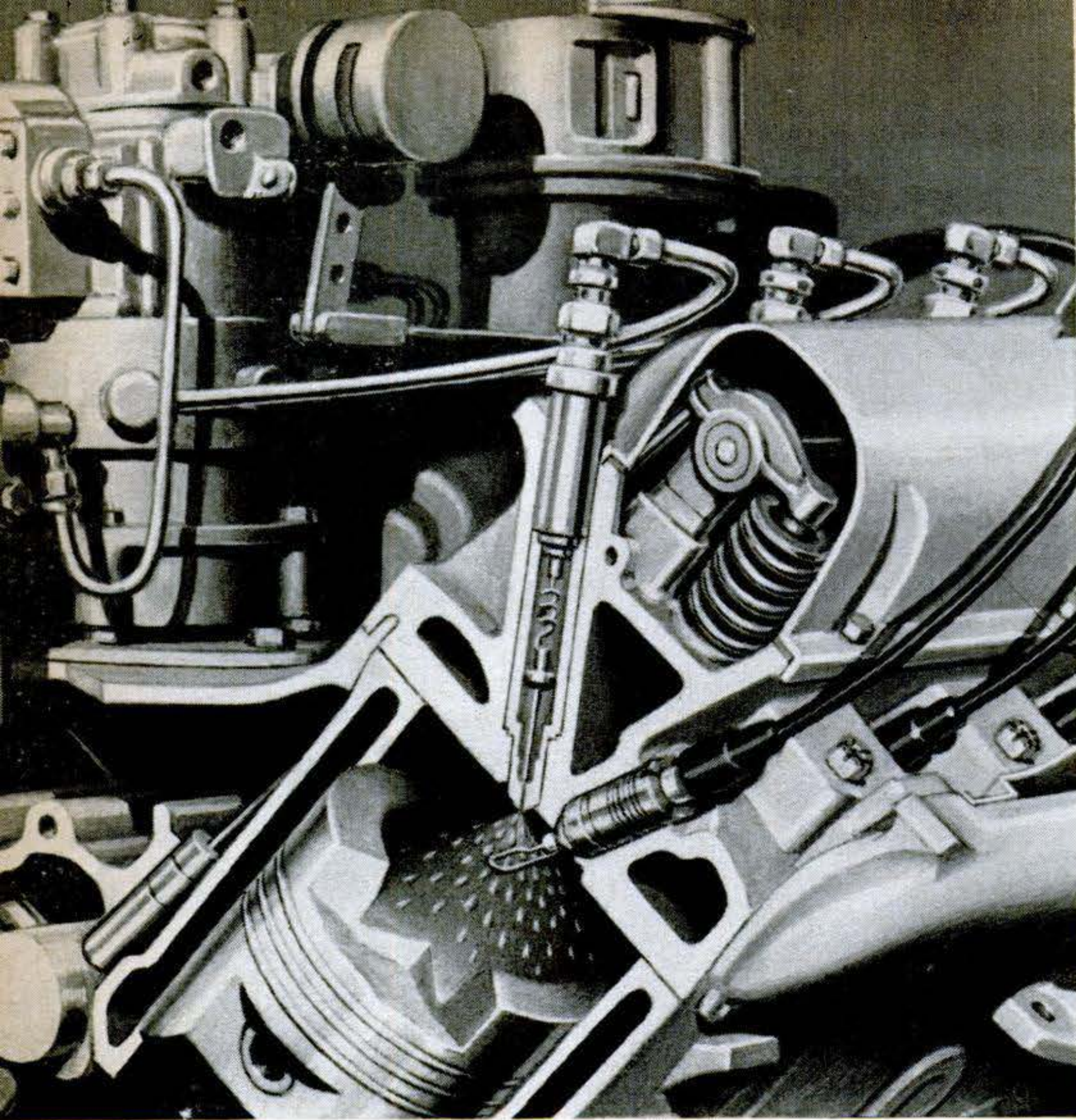
“If your engine quits, you’re going fairly slowly by the time you get to the ground,” says Palen. “We wrapped three planes into a ball last year but no one got hurt. I don’t care about the planes as long as nothing happens to the pilots. All it takes is time and money to put the planes back in operation.” **PS**



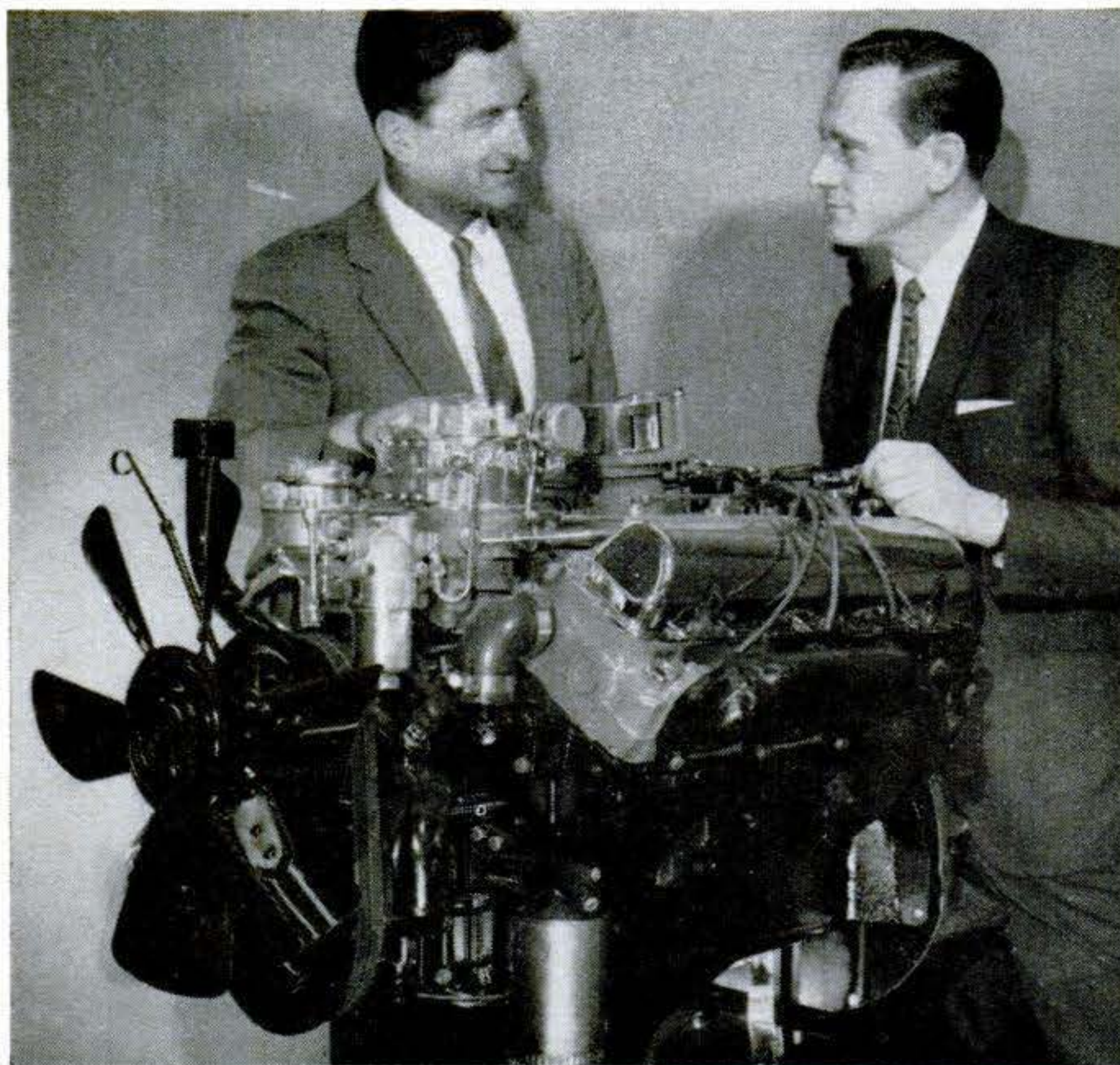
Thomas Flyer (left) is one of 12 manufactured in 1912. It goes almost 50 m.p.h. (powered by a 90-hp. Curtiss OX-5 engine), and Palen has flown it as high as 3,000 feet and as far as 100 miles. One of these planes set the world’s endurance record when it was first made. Below is another view of the Fokker Triplane. Machine-gun fire is as realistic as the planes during the bimonthly dogfights.







Fuel charge is stratified (sprayed) from the injector jet nozzle, and mixed with the fresh air trapped in the cylinder. The bowl in the piston's crown is shaped to control turbulence as the piston moves upward in the cylinder and the air is compressed.



The two engineers who developed Ford's FCP engine are Aladar Simko (left) and Irving Bishop. They've been engaged on this project since 1960, and it may still take years before it reaches production.

Piston at left is standard on pre-'66 430-cu-in. Lincoln engine with combustion chamber recessed in cylinder head. FCP-engine piston (right) contains combustion chamber, and allows a flush head.

# FORD'S promises

Some Ford in your future may give you all the benefits of this new combustion process

By JIM DUNNE / PS Detroit Editor

**F**ord Motor Company's revolutionary new FCP (Ford Combustion Process) engine is a spectacular leap forward in power-plant design, a first-order achievement that dwarfs the customary refinements in gasoline-powered engines. That's a mouthful to say of one engine, but it's all true. In tests it delivered 132 more miles on one tank of gas! I drove a Lincoln with the FCP and can testify firsthand to its performance and economy. But more about that later. Here's what Ford claims for the FCP:





# Stratified-Charge Engine

## 40% better fuel mileage

- No need for a choke, even in sub-zero weather.
- Smogfree exhaust without the aid of air pumps and catalytic mufflers.
- Same power as a comparable carbureted engine.
- Burns regular fuel with an increased compression ratio in an engine designed for premium gas.
- Same block, crankshaft, bearings, connecting rods, camshafts, and related parts as the standard car engine.
- Promises lower maintenance costs.

Let's take a close look at the mileage claims for the engine. In a business that considers mileage improvements of three or four percent the best you can expect with a new engine design, Ford's m.p.g. data are astounding.

Ford engineers, under the direction of Irving N. Bishop and Aladar Simko of Ford's Product Research Office, mileage-tested a 430-cu.-in. V-8 engine in a 1965 Lincoln Continental. Economy runs were recorded at steady 30, 40, 60, and 70 m.p.h. Then duplicate tests were run in the same type of car powered by the FCP-adapted engine.

**Miles per gallon.** When results of the

two tests were compared, it was found that the FCP car, driven at 40 m.p.h., showed a 34-percent improvement over the standard engine. That figures out to 5.5 extra miles of driving per gallon of gasoline, or 132 more miles per tankful in the Lincoln with its 24-gallon fuel tank.

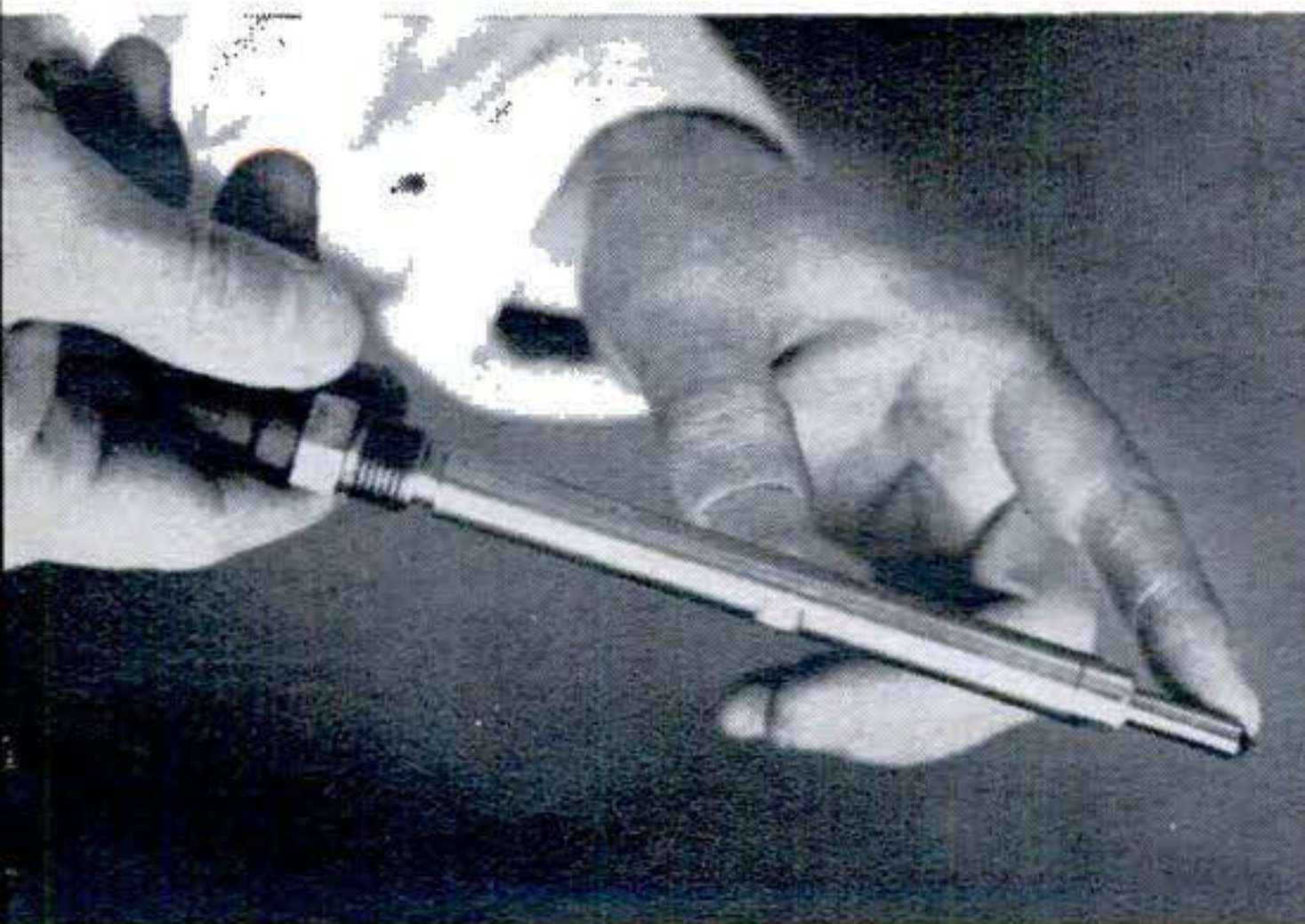
Mileage gains at the other speeds were almost as spectacular, and prove that the advantage of FCP over the standard engine was no fluke.

Even more important, the slide-rule boys found that economy gains in everyday city and highway driving were equal to or better than the laboratory results. With normal development, a 40-percent fuel saving seems as good as guaranteed.

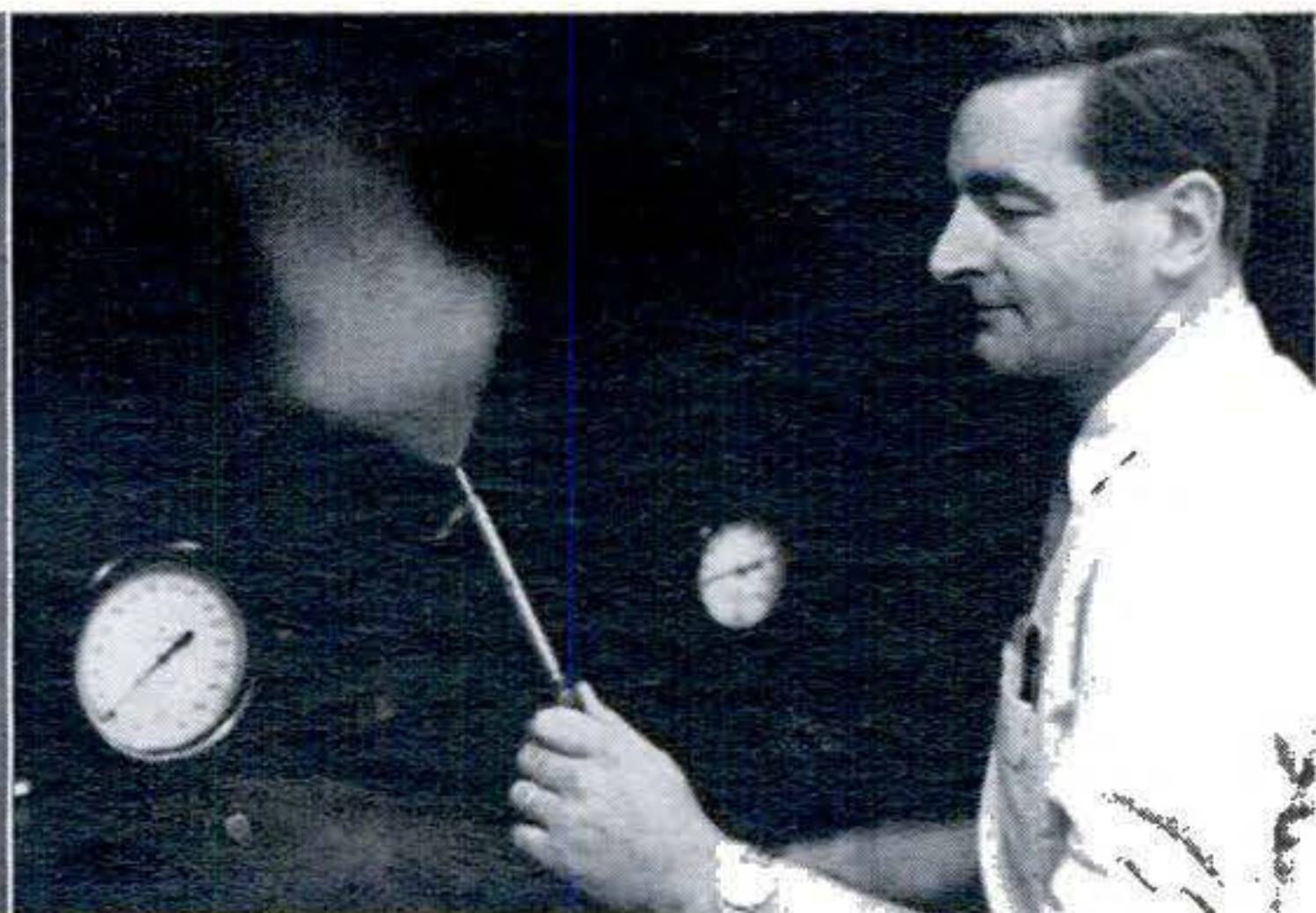
Key to all these advances is FCP, Ford's version of the stratified-charge engine, a combustion-chamber design that is decades old, but has never before been refined to near-optimum efficiency. It is a simple design, little changed from the way the British scientist H. R. Ricardo first described it in an automotive journal back in 1922.

**How it works.** Gasoline is sprayed by fuel injectors into a specially shaped

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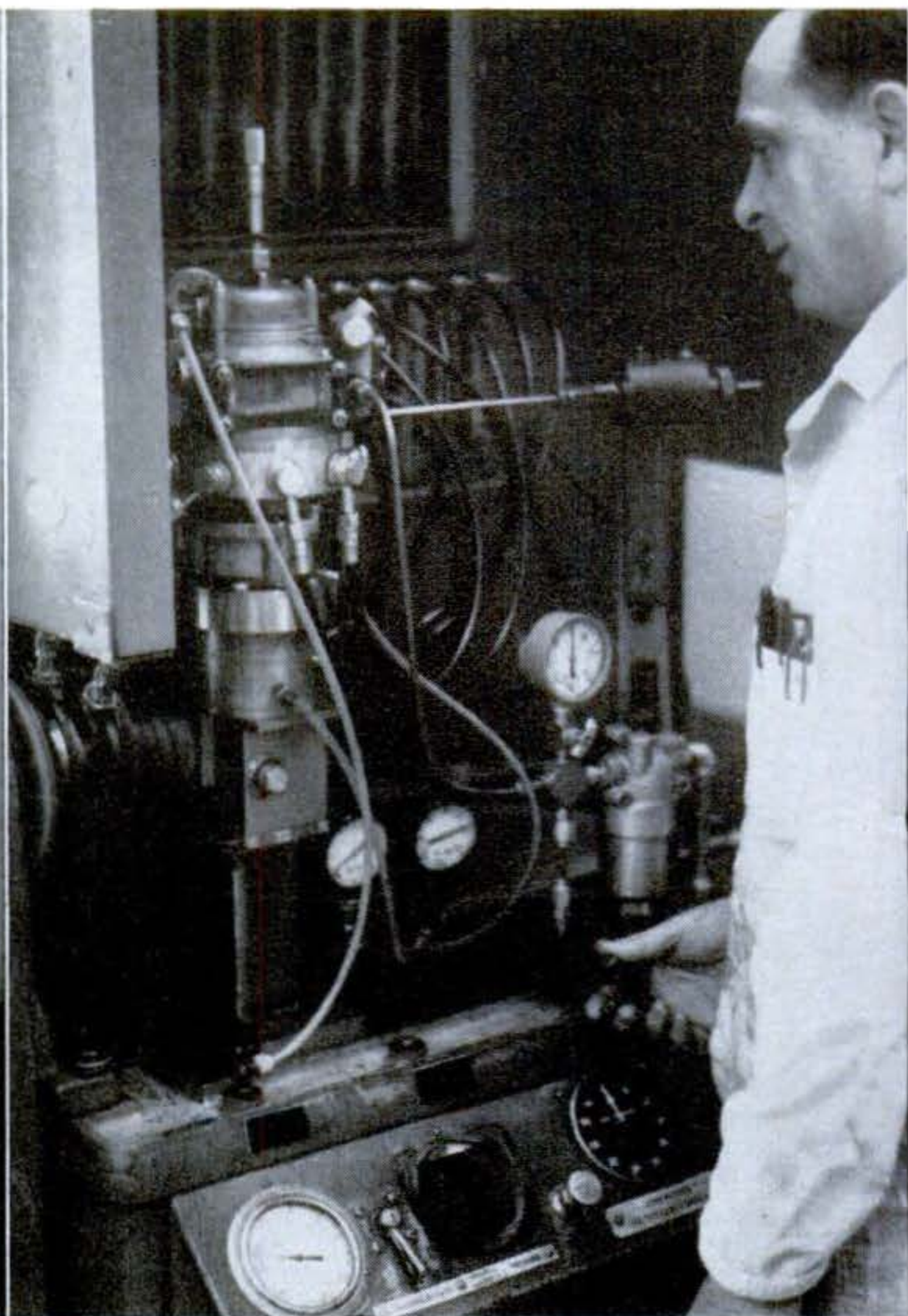
**FCP injector** is a high-precision unit. It contains a rotator set for the spherical valve on the tip (left forefinger above) that produces the spray. The injector body also incorporates a filter.



**The spray** takes a conical shape, forcing its way against the air in the cylinder and drawing in air, from the low-pressure area behind the injector tip, to participate in the mixing process.

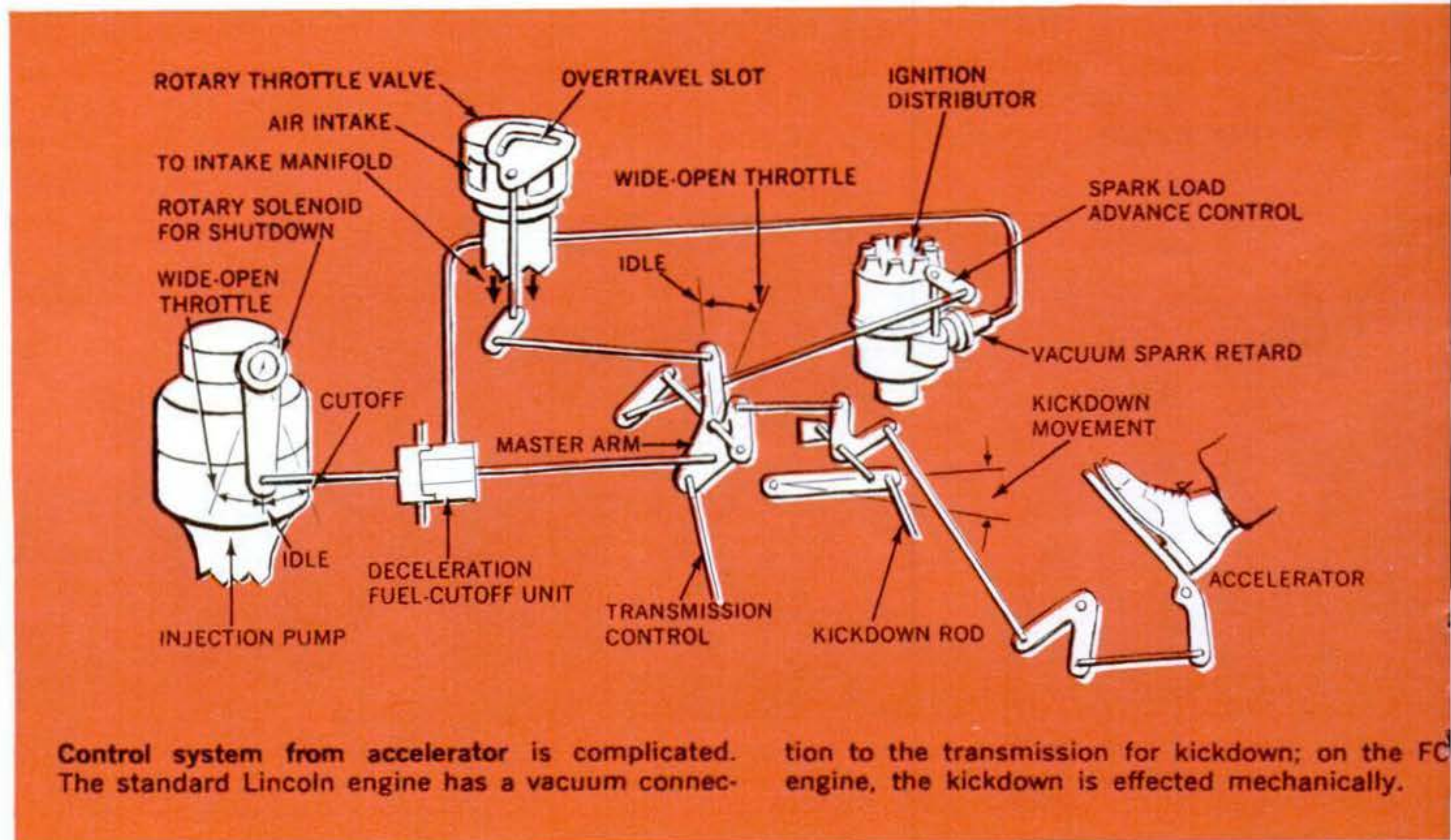


The Ford FCP engine needs no choke even in the coldest weather, never



Injection pump is of relatively simple design with a separate plunger for each injector—operated by a swashplate—and a central metering shaft.

On the test stand, an injection pump is checked out to make sure it delivers accurate injection pressure. Maximum pressure is approximately 1,000 p.s.i.



Control system from accelerator is complicated. The standard Lincoln engine has a vacuum connec-

tion to the transmission for kickdown; on the FC engine, the kickdown is effected mechanically.



## uffers from stumbling on acceleration or from fuel starvation on turns

combustion chamber. The injectors are similar to those used in diesel engines. Inside the combustion chamber, the gasoline spray mixes with fresh air drawn in through a standard intake valve. The air-fuel mixture is ignited by a specially designed spark plug with an elongated electrode. The whole procedure operates on the standard four-stroke cycle.

What makes FCP so efficient can be summed up in two words: precision burning. That's what stratified-charge combustion is all about: getting the fuel to mix with air in exact proportions; getting the mixture to the exact spot where it will burn best; burning the mixture at the exact instant when it will do the most good.

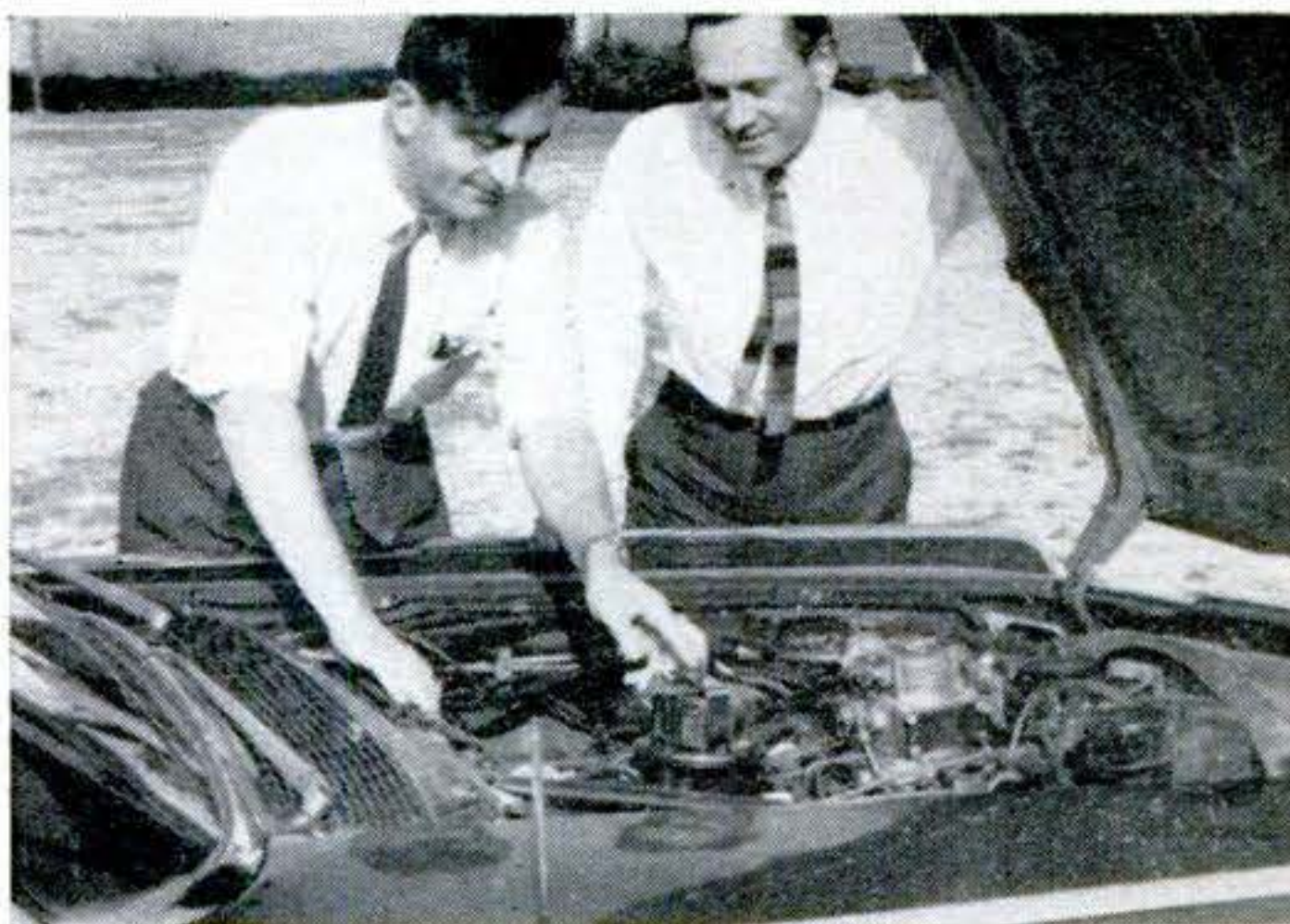
Ford engineers took this old principle, applied modern scientific techniques, and—after 10 years of trial-and-error development—came up with an engine that works nearly as well on the road as it promises to do on paper.

While most of the basic experiments were performed on a single-cylinder engine, all the fuel-mixing and burning discoveries were readily adapted to a Lincoln 430-cu.-in. V-8, the base automobile engine chosen for the tests.

**Unique in its parts.** The FCP engine needs a number of parts not found on the common carbureted engine. They are fuel injectors, spark plugs of a special design, a fuel pump and metering system, a second fuel pump in the fuel tank, transistorized ignition, and separate load- and speed-sensing devices that control fuel flow and ignition. If you mounted these on a standard engine, you could remove the carburetor, distributor, regular spark plugs, fuel pump, fuel filter. In addition, a number of important design changes in the cylinder head, intake valves, and pistons would have to be made for it to work.

It was discovered very early in the development of FCP that the pushrods, intake port, and injector should be on one side of the engine, with the exhaust port and spark plug sharing the other. This keeps exhaust heat away from the injector and still permits sufficient water cooling of the spark plug.

Experiments showed that the spark-



At a steady 70 m.p.h., FCP engine gave 32.5 percent better fuel economy than standard 430. After tests, Ford engineers Simko and Bishop smile down fondly at their beautifully behaving baby.



Spark gap has remarkably large surface area and requires plugs of special metals: Iconel base with a gold-palladium tip. Gap erosion is negligible and any tiny surface cracks are considered harmless.

plug gap should be at or near the centerline of the cylinder bore, some 0.3 to 0.6 inch below the cylinder-head face. This filled the three requirements of the spark-plug gap in a stratified-charge engine: The spark gap must be inside the mixture cloud for combustion at all load and speed conditions; turbulence level in the vicinity of the gap should be low to prevent flameout; the mixture at the gap should be readily ignitable.

What Bishop and Simko ended up with is a spark plug with a long electrode to reach the precise burning location in the combustion chamber. To make sure that the electrode is installed properly, a guide pin on the plug fits into a slot in the cylinder head. This holds the plug in position while a hold-down nut locks it in the cylinder head.

The fuel injector is an adaptation of a diesel injector. Its installation angle,

*Continued*



## In vehicles that idle a lot, fuel use is cut by more than half

spray angle, opening pressure, and injection duration were problems that were worked out after long hours of testing. One problem-solving example is the selection of injector-opening pressure. The best operation was obtained with injector pressure between 350 and 400 p.s.i. Below 250, fuel economy and emission control suffer, and no gains can be shown with settings above 500 p.s.i.

On the experimental engine, the standard intake port and combustion chamber were altered to fit into the system. The intake-port opening is smaller, though air flow is the same as with a standard engine since there is no restriction from a carburetor. After extensive experimenting, a 58-percent double-cone-cup combustion chamber was formed in the top of the piston. This design proved to be the best compromise for lowering combustion harshness and increasing fuel economy.

**Spark and injection timing.** These two critical engine functions had to be worked out to take best advantage of the stratified-charge process. Since the general pattern of spark-ignition engines also holds true for FCP engines, spark timing is advanced as a function of speed. Injection timing is tailored around the spark-timing characteristic.

At low speed and light load, the injection duration overlaps the spark timing. As the load increases, spray penetration increases and the mixture cloud must be larger. To allow for evaporation time of this larger mixture, injection timing is slowly advanced with increasing delivery. With a 26:1 air-fuel ratio, the need for long evaporation time becomes pro-

nounced and the injection timing is rapidly advanced above this load.

Although the Ford FCP engine is on test in a passenger car, the company claims it is primarily designed for commercial-vehicle use, especially in delivery vans that stop for long periods with the engine idling. Under such conditions, the FCP engine uses less than half the fuel of a carbureted engine.

Ford has a contract from the military to develop an FCP engine for the Mutt (M-151) military truck, the modern successor to the World War II Jeep. The Army's prime interest is the fuel-saving characteristic of the engine, a vital factor in an operation where 70 percent of the goods transported are fuels.

In addition to the breakthrough in fuel economy we've talked about, the FCP engine needs no choke since the fuel mixture is always correct, no matter what the outside temperature. In tests, starts were made at 20 degrees below zero F.

When driving the car, you notice the smooth delivery of fuel to the engine—no stumbling on acceleration, no fuel starvation on turns. This is all traceable to the fuel injection.

**The starting procedure.** Though unique, starting is uncomplicated. You simply hold the accelerator to the floor when turning the key. This takes the fuel-ignition system out of the "idle" mode and puts it in the "power" mode.

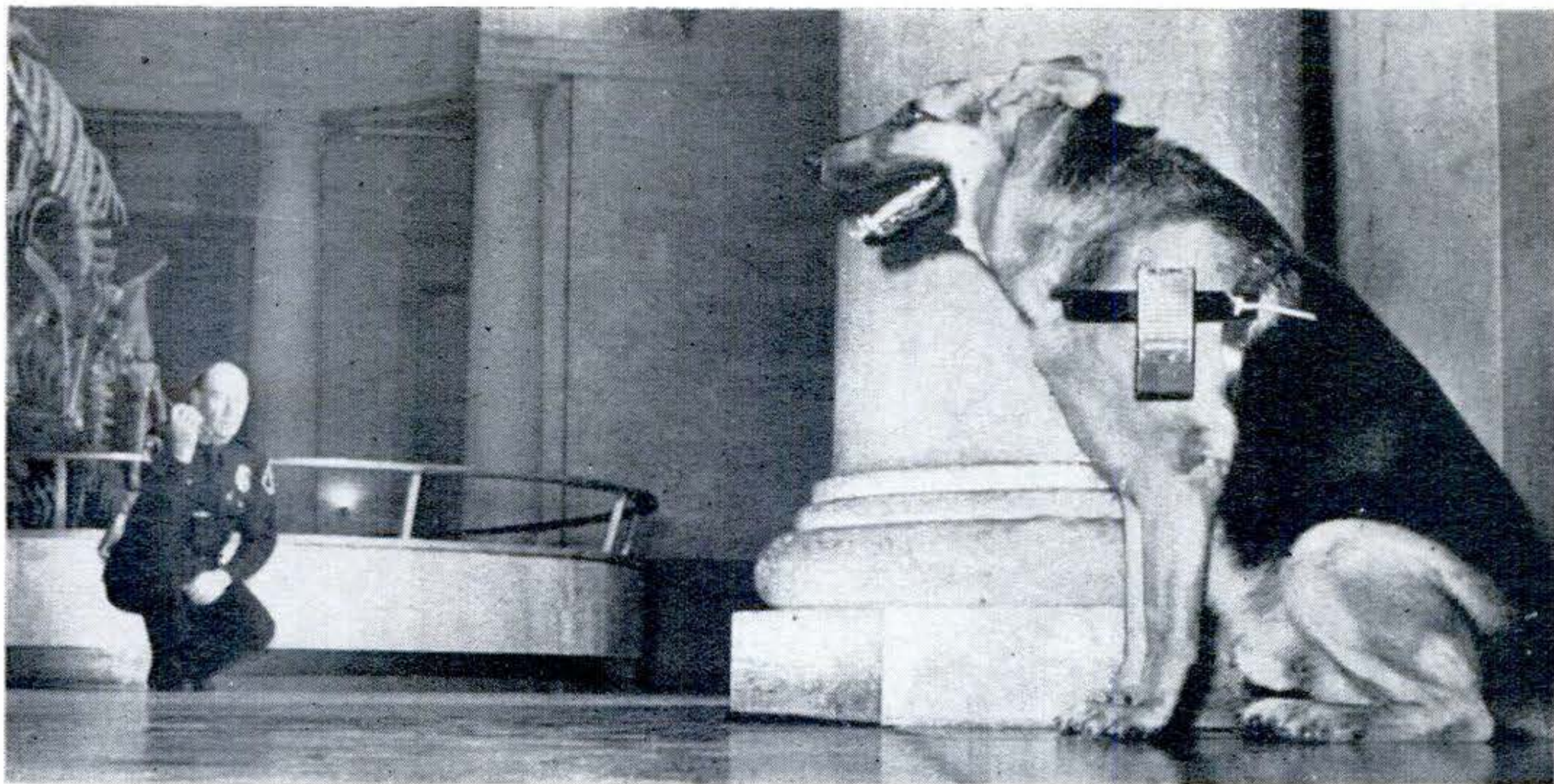
Power output of the test Lincoln was not up to par with the standard Lincoln. But developer Simko assured me that the results of dynamometer testing, which duplicated standard-engine performance,

*[Continued on page 176]*

The Mutt military vehicle at right will be powered by a four-cylinder FCP engine now being designed under a contract with the U.S. Army Tank Automotive Command. Ford will build two such engines and install one of them in a Mutt this year. Continued pressure from the military could speed development of FCP engines so they would be ripe for production in three years. Otherwise, it may take as long as seven years to develop.







### Watchdog is radio-controlled

The German shepherd watchdog (above) gets a radio command from a night guard at the Los Angeles County Museum. The dog

has been patrolling the five-story museum in 12-hour shifts for many years, but was only recently outfitted with a walkie-talkie, slung from his shoulder harness, to give guards greater control over him in emergencies.



### Bike has a five-speed stick shift

AMF's Avenger makes cycling easier with its new five-speed transmission. Sprocketed derailleur gear is easily changed by moving the stick shift, which is mounted on the frame. The slick-looking high-riser bike has a 24-inch elongated wheelbase and hand-operated front and rear caliper brakes. The price of the bicycle is about \$60.



### New minibike has plenty of oomph

Here's an exuberant little rig for transportation or just plain kidding around—the Wren Deluxe. It has a 2½-hp., four-cycle Tecumseh engine that can propel the bike up to 25 m.p.h. The machine weighs 69 pounds and is 46 inches long. It has a foot-operated aluminum cam-action brake and twist-grip hand throttle. Price: \$140.



# TORNADOES: **Death**



**N**o other storm on our planet can match the intense destructive fury of a tornado. So great are the forces in nature's wind-in-a-whirlpool that it would take about 1,000 years of electric power at the rate it is now consumed in the United States to equal the roiling energy contained in one giant twister.

Can we ever tame such colossal forces?

- Dr. Tetsuya Fujita, University of Chicago meteorologist, is confident that this summer, by reliance on laser radar and far-seeing satellites, we can. Provided with continuing photographic coverage of changing weather systems, our tornado warning system has been vastly improved. Prevention of twisters or dispersal of already-formed ones will be a realizable goal.

- At the Catholic University of America, Dr. Chieh-Chien Chang is building a tornado machine that will produce winds of more than 100 m.p.h. It promises to reveal vital information about low pressure in the eyes and the high-velocity winds in the funnels of deadly tornadoes.

- At the U.S. Weather Bureau's Geophysical Fluid Dynamics Laboratory, meteorologists, with the aid of a giant computer, STRETCH, are simulating the atmosphere of the earth. Approximating a day of weather requires 10 hours and a billion computer operations. As yet, mathematical forecasts stray from reality, but the goal seems closer: near-flawless prediction.



# Does the Twist

Last year 837 tornadoes in 42 states killed 117 people and caused millions in damage. Here's how science plans to fight the incredible energy of these storms

By THORN BACON

tion of what the weather will be in a day or a week.

- At the National Severe Storms Laboratory, technicians are measuring and sampling storms with radar, lightning sensors, barometers, rainfall gauges, and airplanes, all to the end of listing the weather factors—more than 50—present when tornadoes strike.

- Exciting news about tornadoes comes from Dr. Bernard Vonnegut of New York State University and from the New Mexico Institute of Mining and Technology. Thunderstorms and the twisters they spawn will be bombed with a chemical similar to the freon that cools your refrigerator. The object is to suppress the activity of violent electrical discharges in the mushroom of clouds atop a tornado.

- Another method to untwist a twister involves using rockets containing thou-

sands of tiny nylon filaments covered with a conducting material. Exploded in the whirling center of a tornado, the material would short out the giant electrical fuse that gives a tornado awesome power and movement.

Each year in the U.S.—which is the world's chief battleground for twisters—rampaging tornado winds kill more than 100 people and roll up property damage in excess of \$25 million.

Just a few weeks ago, shrieking tornadoes—40 in all—ripped across the Midwest and South, killing at least 72, injuring hundreds, and leaving thousands homeless. A total of 11 states suffered millions of dollars in damage.

**The "why" of tornadoes.** Despite a half-century of recorded storm destruction, only in the last 10 years has science invented the sophisticated tools to plot the

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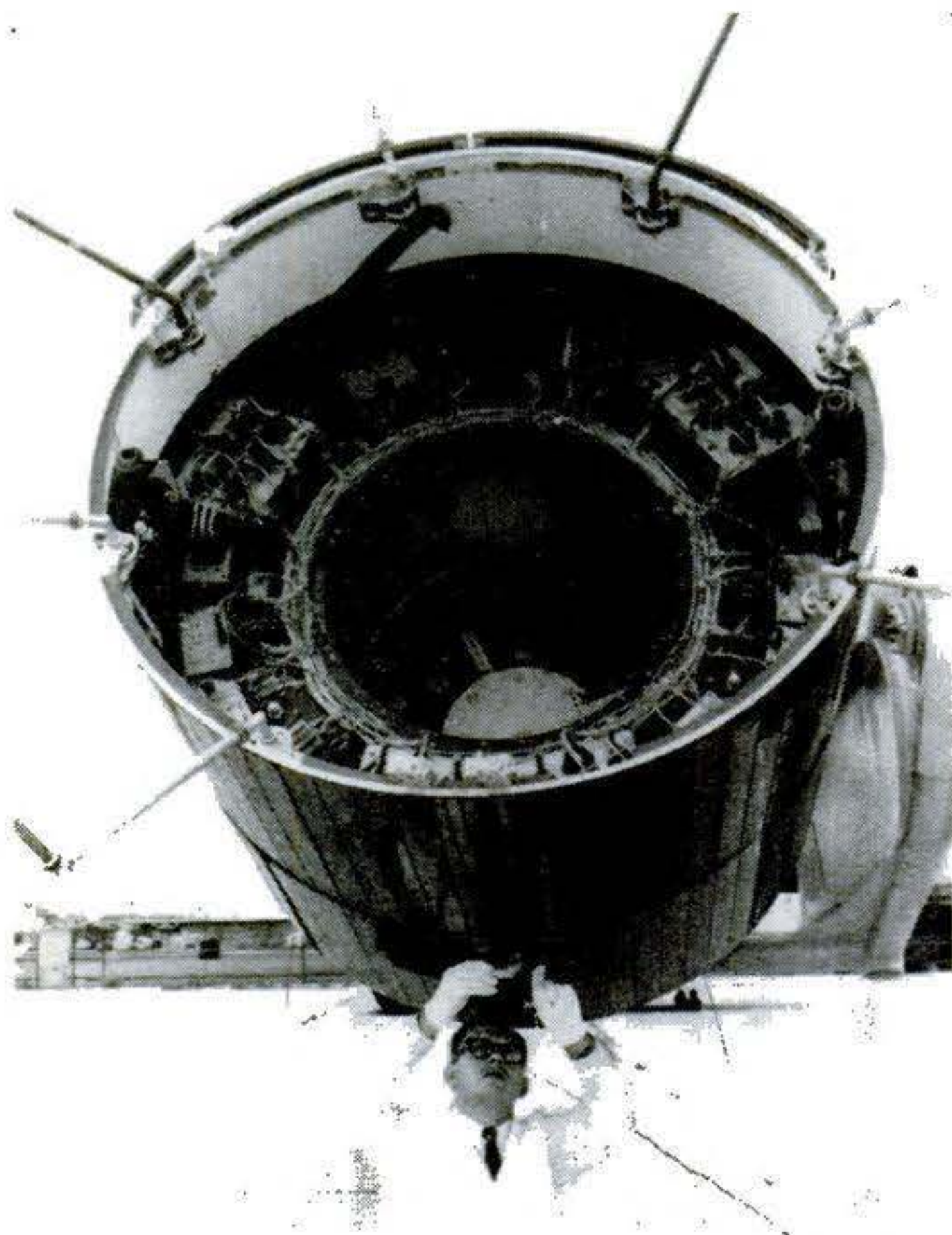
**Deadly funnel** of a tornado (opposite page) travels across Dallas, leaving a path of death and destruction. This 1957 storm wrecked 800 homes, caused nearly 200 casualties. A 1965 twister sandwiched vehicles at right in Tampa.

JULY 1968

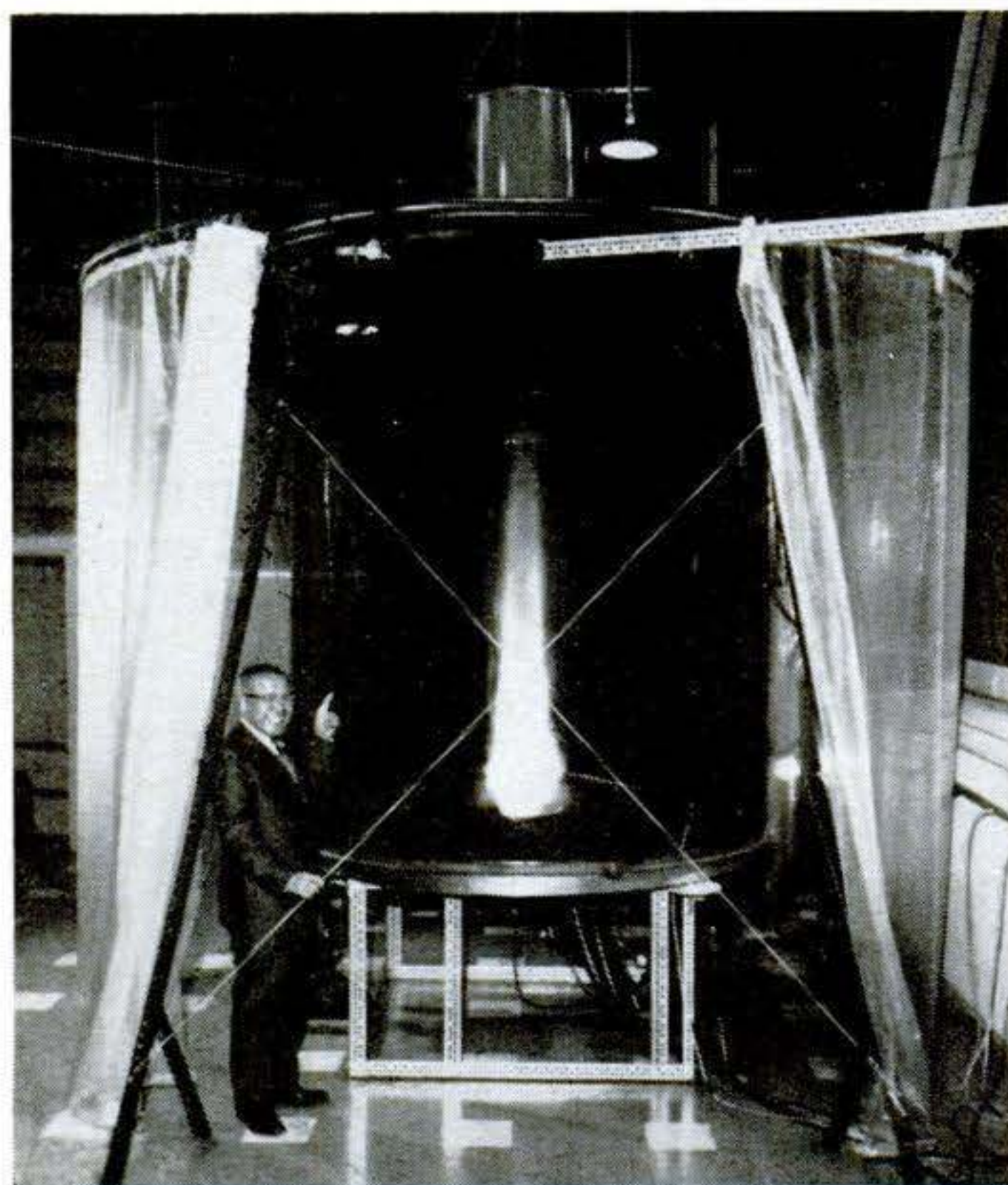




## A tornado is a mammoth chimney with a racing flow of superhot air



For focusing in on tornadoes, NASA's ATS-C synchronous satellite, is capable of photographing, in color, weather patterns over the northern hemisphere. Scientists prepare movies from photos, taken every 15 minutes, to spot tornado-breeding situations from cloud motions before tornadoes develop.



Tornadoes are created in the laboratory by the machine shown above, built by Dr. Chang. As its six-foot cage rotates at six r.p.m., it whips up a tornado-like vortex spinning at 1,600 r.p.m.

life cycle of a tornado. While there are still many questions to be answered—and argument rages among meteorologists about the concoction of weather that makes a tornado—many weather observers believe a tornado is actually a chimney with a racing flow of superhot air that stirs an eggbeater at the bottom.

Tornadoes usually occur in severe thunderstorms. The chimney is created by electricity in the thunderstorm which produces huge energy discharges in the form of lightning. Dr. Vonnegut calculates that the energy contained in a moderate lightning stroke is great enough to heat a tube of air 30 feet across and 10,000 feet high to the boiling point of water.

Repeated lightning strokes down the chimney cause a drastic drop in the inside air pressure. The air outside the chimney rushes in at the bottom to replace hot air being drawn upward into the towering thunderhead, and a terrible rotating vacuum is formed at ground level. It sucks up almost everything in its noisy, whirling path.

How a tornado achieves forward momentum is explained by Dr. Charles Moore, physicist at the New Mexico Institute of Mining and Technology. It comes, he says, from the velocity of winds pushing the clouds and the vertical stream of roaring air attached to them.

Moore reports that a TV truck pacing a Scottsbluff, Nebr., twister along a road parallel to the storm's direction gave some startling facts about the whirl speed of tornadoes. By using the speed of the truck as a basis, the twister was calculated to be spinning at a velocity approaching the speed of sound.

Some idea of the updraft velocity inside a large tornado may be gauged from the report of Edward M. Brooks, a trained observer. He reported seeing a twister in June, 1938, at Abilene, Tex., create a cumulonimbus cloud that shot up 35,000 feet in 60 seconds—a speed of more than 400 miles an hour.

**Fire storms.** Bombing raids on Germany during World War II, Moore says, sometimes set off dreaded fire storms that illustrate the principle of heating that gives tornadoes such colossal energy.





**Boiling cloud formations** like these, called mammatus, spell tornado weather to those who know the

signs. Knowledge of what causes tornadoes, plus satellite photos, has greatly improved warning times.

A fire whirlwind occurred in Hamburg on July 27, 1943. There had been a heat wave and the night was sultry. A rain of explosives turned sultriness into violent heat. As a result of the sudden linking of several fires, a great chimney of superhot air was formed with temperatures ranging probably as high as 1,850 degrees. Surrounding fresh air was sucked in, causing forced ventilation. In typical tornado fashion, writhing funnels snaked down from an artificially created cumulus cloud and snapped large trees, tossing them about like flaming matches. Thousands of people suffocated in bomb shelters as ground-level oxygen was consumed in the holocaust of heat and flames.

The weather brew that spawns natural tornadoes generally occurs when warm air, collecting moisture from the Gulf of Mexico, collides with a cold-air front in "Tornado Alley"—the Great Plains area which has recorded the greatest damage from twisters.

Tornadoes are formed when the rising warm air is transformed into charged ice particles in a cloud. The exact process by which clouds become electrified as great thunderstorms is not precisely known. But it is known that nature can transform the low-grade steam of a thunderstorm into smaller concentrations of high-grade

energy—energy equivalent to a temperature of 63,000 degrees. This is roughly six times hotter than the surface of the sun.

Once the confluence of air currents sets the stage for the onset of rain and lightning, tornadoes can develop as a result of lightning making a rip in the atmosphere, creating the long tube of hot air that stretches from agitated clouds to the ground.

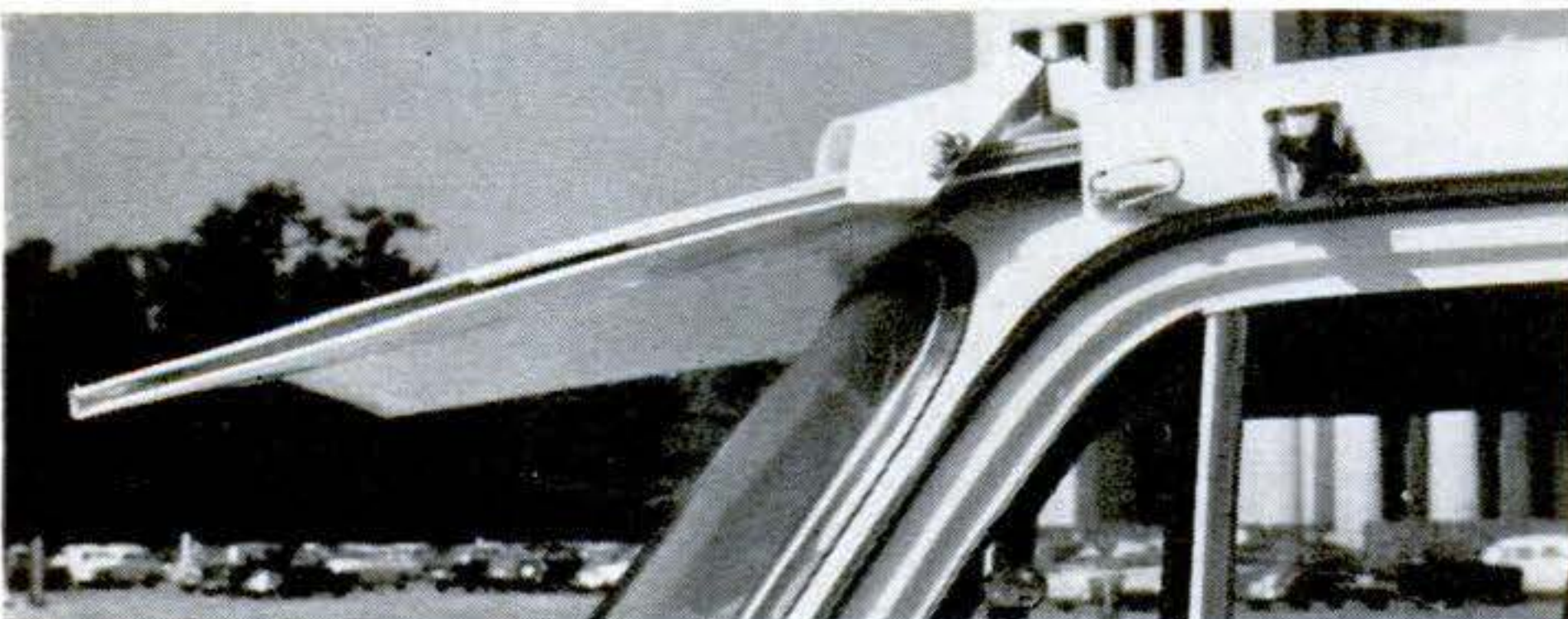
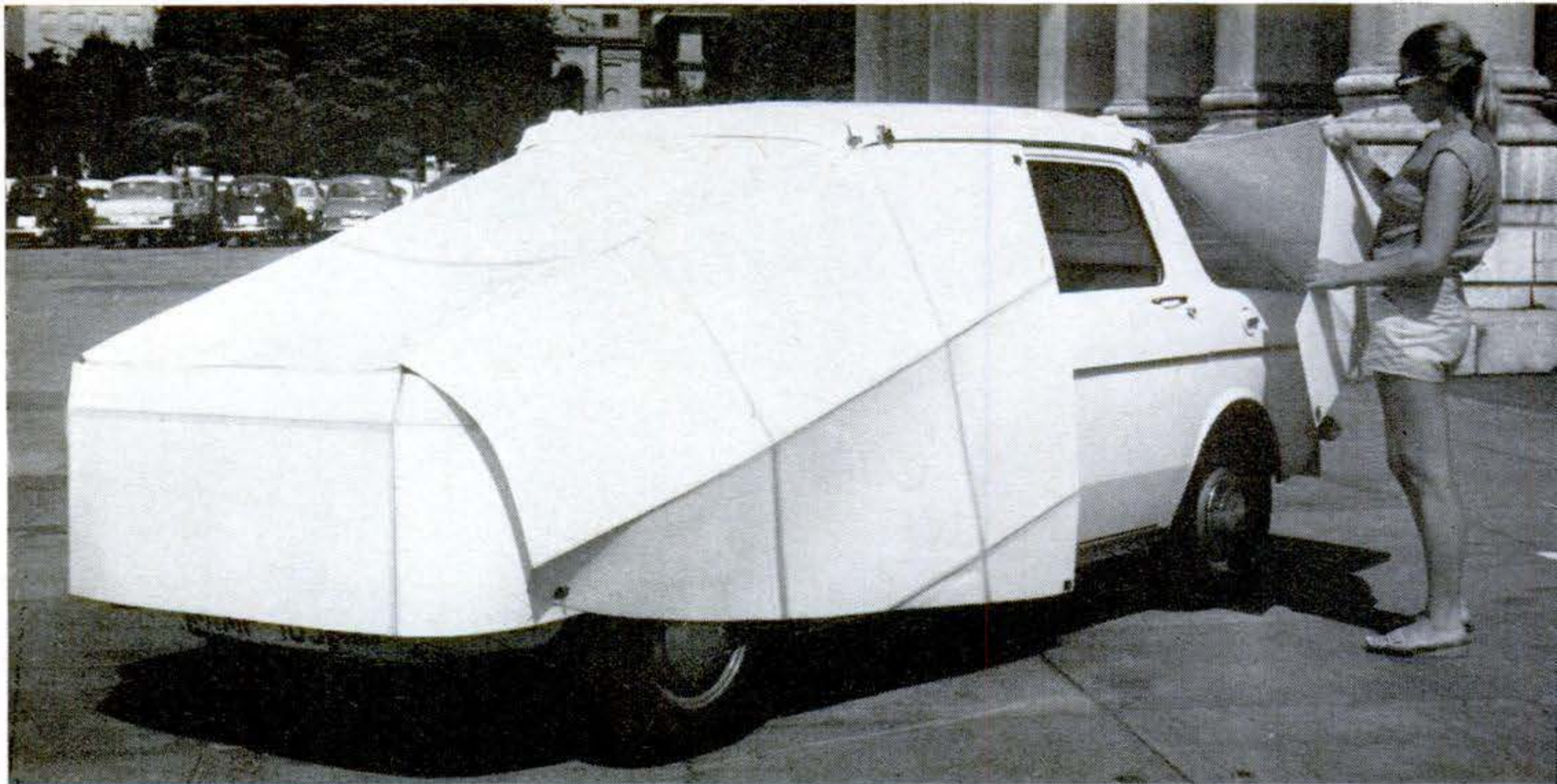
**Eyewitness reports.** Many persons lucky enough to have survived the terrifying experience of looking into a tornado have verified scientific conclusions that a twister derives its power from immense discharges of lightning. Eyewitnesses have described the eerie glow near the bottom of the funnel or a burning cloud floating in the weaving axis.

The incredible power of the gigantic spark plug inside a tornado staggers the imagination. Professor Marx Brook, of the New Mexico Institute of Mining and Technology, measured the electrical currents accompanying a twister that struck briefly near the Tulsa, Okla., Geophysical Observatory of the Jersey Production Research Corp. on May 27, 1962. His report:

"The electrical power level in a tornado

[\[Continued on page 186\]](#)



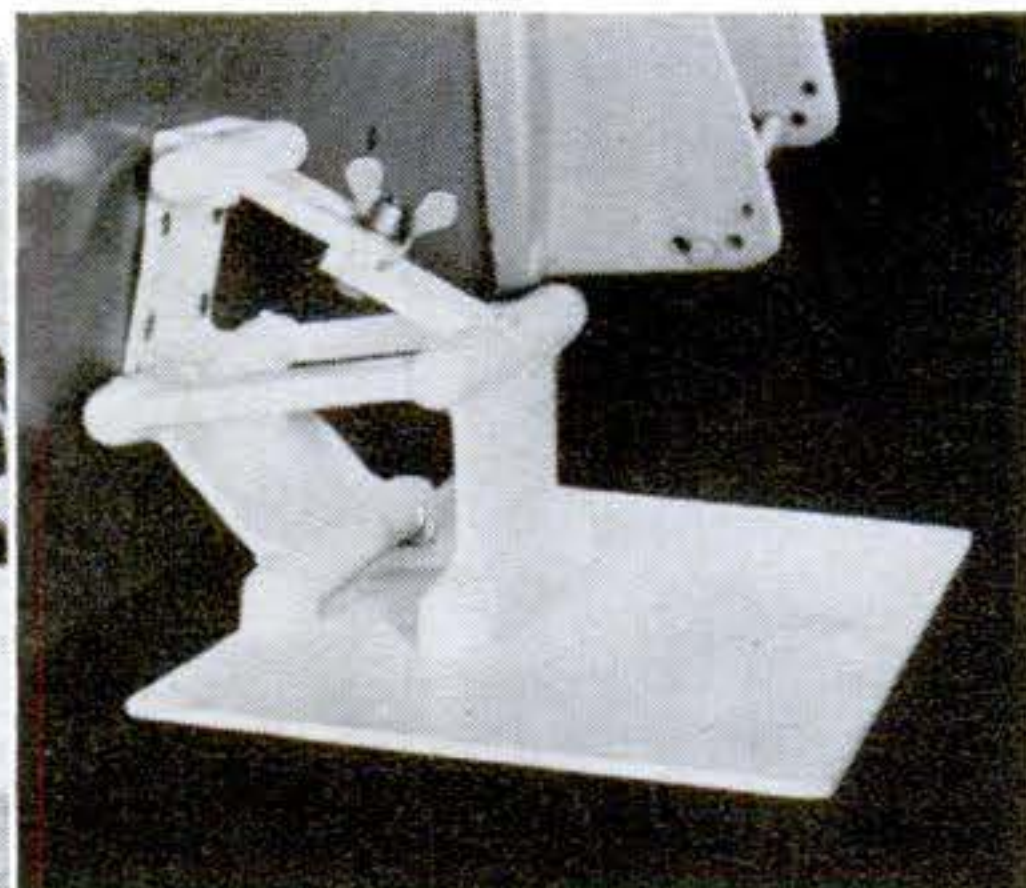


**Armadillo garage** stacks inside inch-high false roof. It's 34 polyester sheets, taped together, that slide out of front and rear of plastic housing and drape over the car. The near-rigid envelope protects car against dust and prying eyes as well as sun and snow. When stowed, the assembly is fully enclosed by its endpieces.—IWW GmbH, 805 Freising, Landshuterstrasse 13, Germany.

## Bright ideas from the **INTERNATIONAL INVENTORS**

Here's a sampling of the more than 1,000 bright ideas from 18 European countries, North Africa, Israel, South Africa, and the U.S. that were displayed at the recent 17th

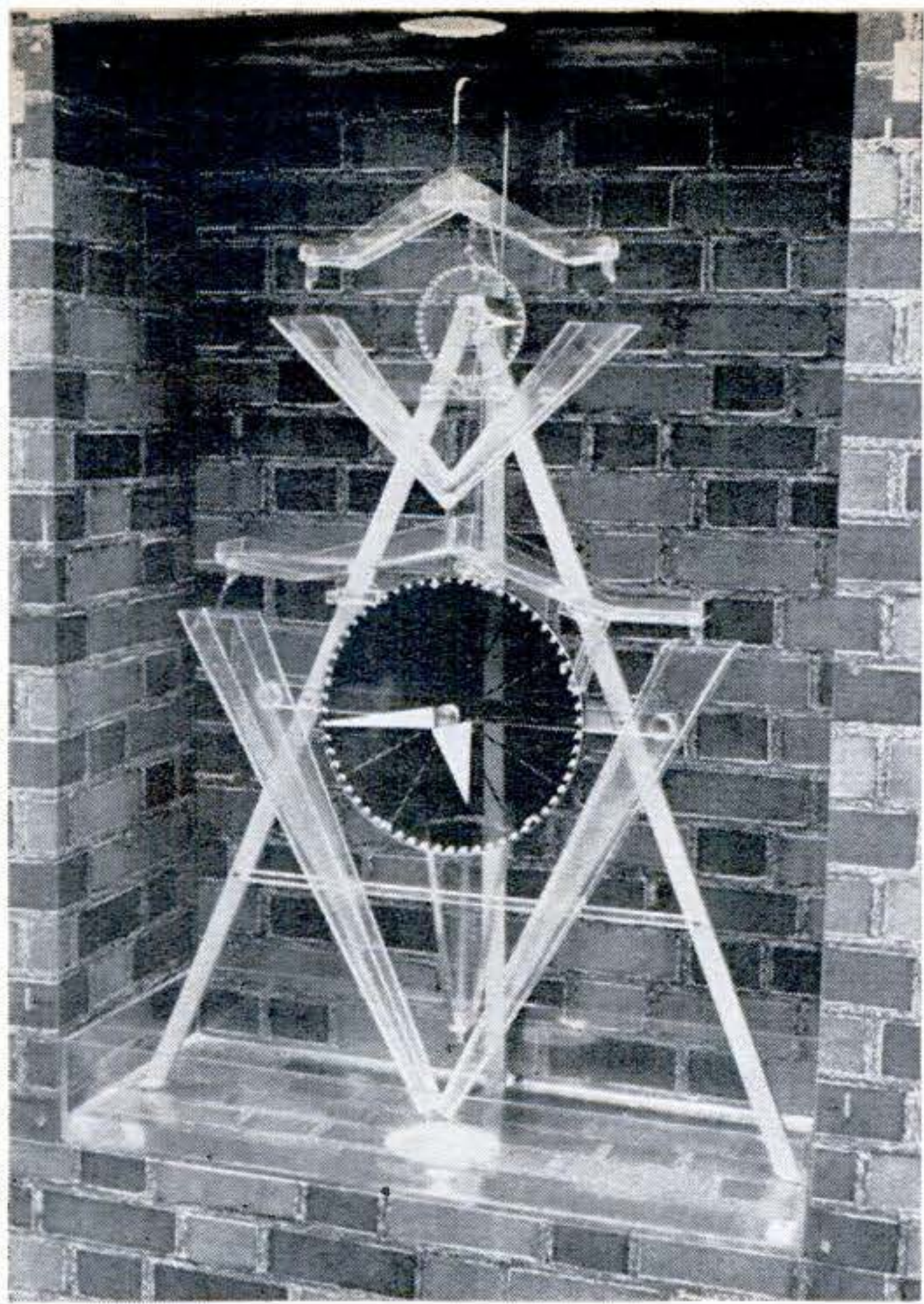
annual Inventors Exhibition in Brussels, Belgium. Over two-thirds were from individual hopefuls, hatched in home workshops. The rest were produced by small commercial



**Swinging trim-tab plates** bolted to transom on either side of prop automatically pivot downward under load, lifting stern so boat planes at low speeds. Four-hinge linkage reacts to the upward pressure wave at low speed and tilts down. As the boat levels

and increases speed, the plate trails flat to cut drag. Trim tab also corrects for passenger movement. Made of anodized-aluminum alloy in 14-, 18-, and 22-inch lengths, all 10 inches wide.—Novavia Export, Kronhusgatan 4, Gothenburg C, Sweden.

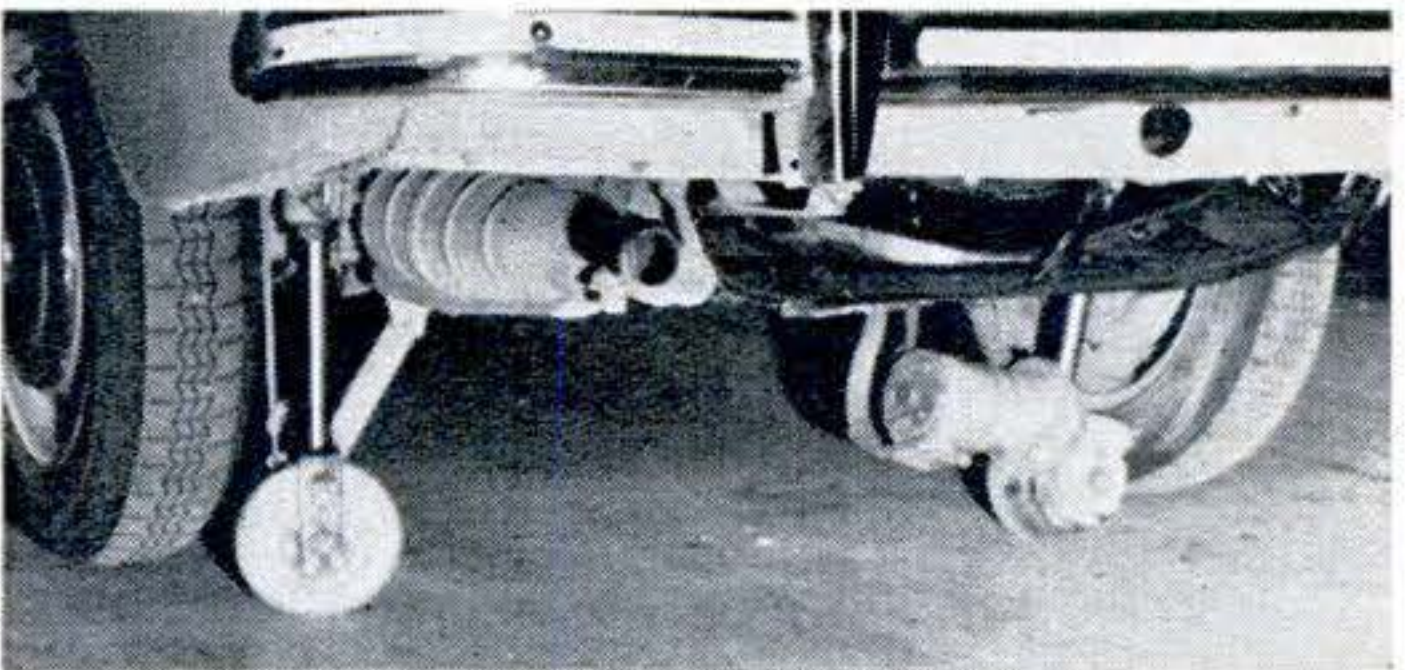




**Hydro-pendulum clock**, updated version of the age-old water clock, is accurate to four seconds a day. Water dribbled from a pipe on top falls through a series of rocking troughs that kick a pendulum into oscillation. The swing advances the second hand on its ratchet wheel, while the lowest rocking trough turns the interlocked transparent minute wheel and the hour wheel behind. Water is recirculated by an electric pump at a noncritical rate.—Hans A. Kuhn, Erlenwek 14, 3052 Zollikofen, Switzerland.



**Clamp-on towbar** keeps the tow at a fixed distance, eliminates jerking on starting and over-run on braking. Clips at each end hook onto bumper, are tensioned by a wingnut. Ball joints seating against the contact plate permit movement in all directions.—A. Classen, 437 Marl i. W., Bergstr. 10, Germany.



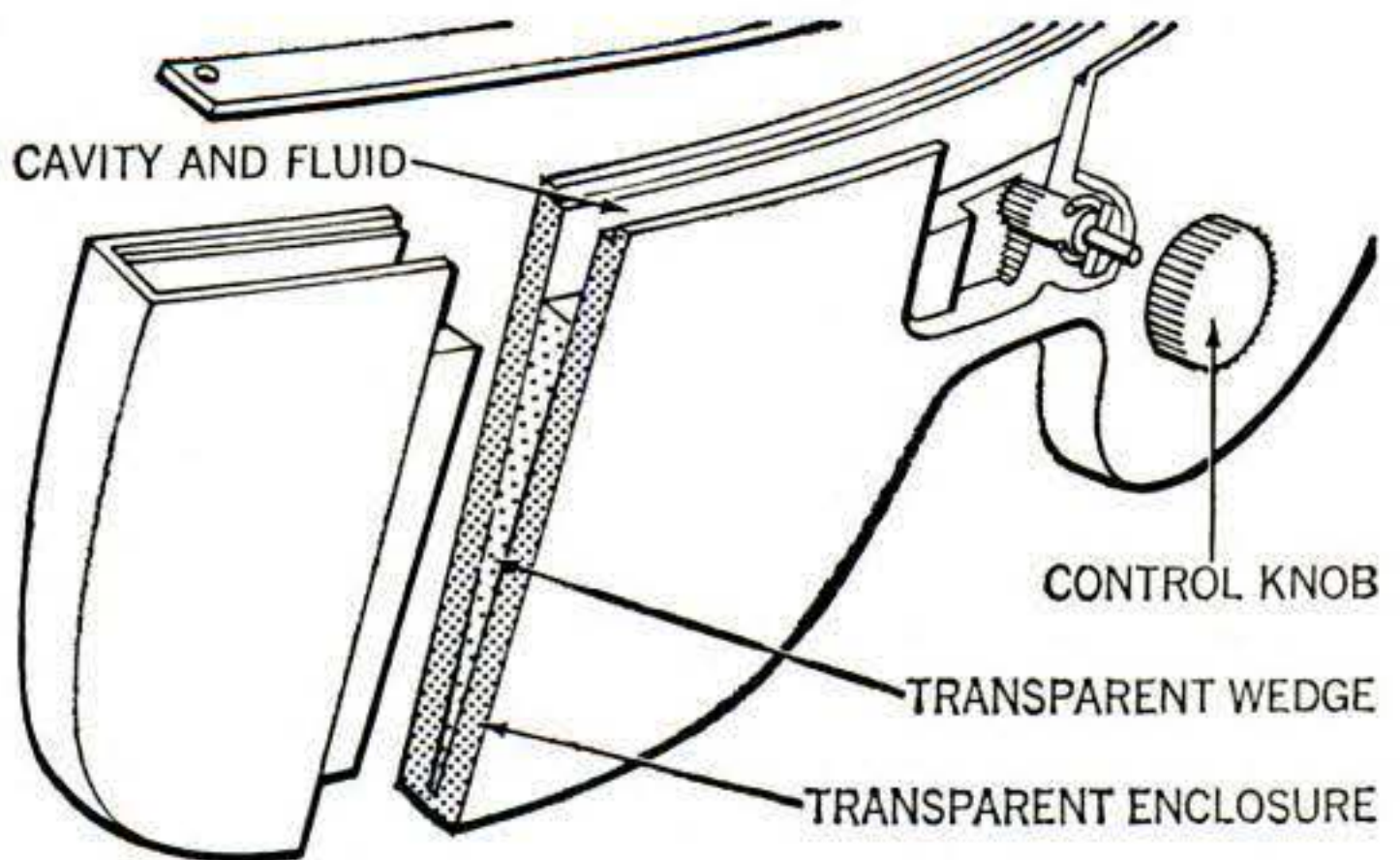
**Retractable undercarriage** rolls car tail crabwise into a tight parking space. The car is jacked up by the small wheels lowered by hydraulic cylinders powered by an engine-driven oil pump. A reversible electric motor then drives one wheel for the parking action.—Jose Guerrero, Olleria 12, Ronda, Spain.

## EXHIBITION

firms showing new products for the first time. Some hit the jackpot; the business tally came to some \$2 million in direct sales and licensing agreements.

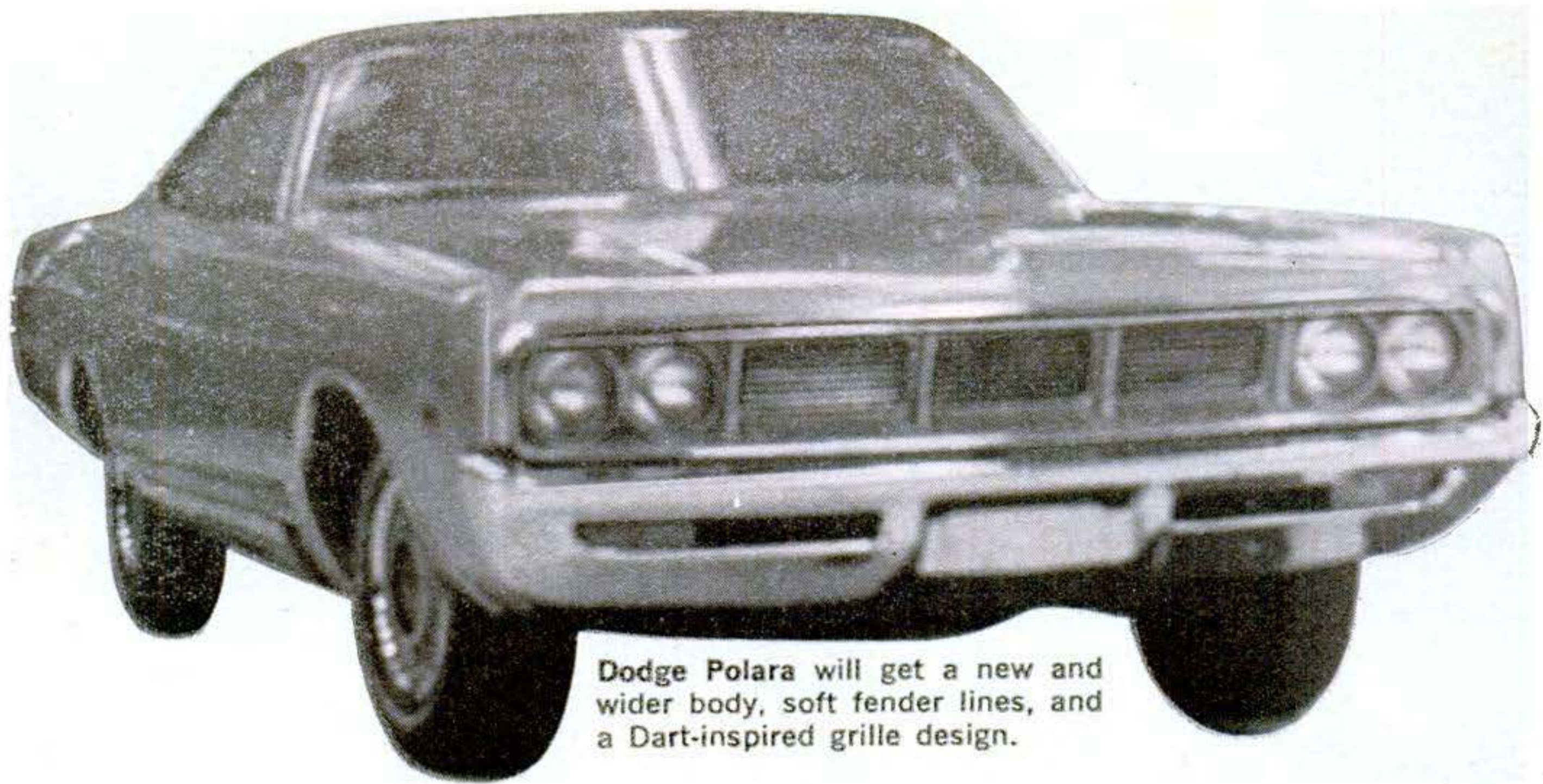


**Variable-tint goggles** change from clear to dark with twist of a knob. Sealed assembly has two outer sheets of glass with tapered inner faces. A wedge of glass, inside, seats against them. When the wedge is raised by turning knob, colored fluid from



the reservoir is forced down into the gaps as thin films. The thickness of the films—and lens darkness—is adjustable. The idea can be applied to windshields and house windows.—Luis R. Aparicio, Av. Jose Antonio 57, Madrid 13, Spain.





Dodge Polara will get a new and wider body, soft fender lines, and a Dart-inspired grille design.

# Hot News on Detroit's '69 MODELS

Big styling changes may be dwarfed by three important new developments in safety

By Carl BARNETT, Staff Editor, *POPULAR SCIENCE*

It's a year in which the auto industry is expected to make major styling changes. The '69 models will be the most dramatic yet, with new front ends, grilles, and body lines. But the real story is in the safety advances that will overshadow all other engineering and styling news in the '69 models. They are:

1. A new side-impact system, which will be standard on all new cars.

2. A new front-end structure, which will be standard on all new cars.



Pontiac Firebird will get this completely new front end while continuing the same basic body.



Oldsmobile 98 remains basically unchanged, but a new grille design will strengthen its identity.





**Lincoln Continental** gets minor facelift, avoiding direct competition with the new Mark III.



**Cougar grille** acquires big-car appearance with concealed dual headlights nearest the outer edges.



**Oldsmobile F-85** gets a new and more easily identifiable grille, continues short two-door body.



**Imperial** finally gets a modern look, with sleek rounded lines, clean grille, hideaway headlights.

all three features. These approaches to driving safety are new on American cars, and the designs involve major changes in construction and performance.

GM's side-collision protection is described as a "chain" of steel running the length of each side of the vehicle. It stops another car from climbing the doorsill and pushing into the passenger compartment in an accident. It also

helps a struck car to bounce away from the full force of another car.

High-strength, low-weight steel beams welded to the inside of the doors form a box section of great rigidity. The beams are eight inches high by two deep. In drawings the beams look like guardrails you see on highways. They are placed horizontally, 10 inches above the doorsill and are supported on each end by the door pillars. GM says the added

*Continued*



**Buick LeSabre** looks really new, with flared wheel openings and a grille that is greatly simplified.



**Pontiac Grand Prix** starts a new trend in GM styling, with a Mercedes-like grille design.



weight of the beams and related reinforcement adds up to about 49 pounds.

Ford, and possibly General Motors, will have antiskid braking systems on certain low-volume models.

In the Ford system, only the rear wheels will have antiskid. The complete system is made up of three principal parts: speed sensors in each rear wheel, a brake-pressure actuating unit, and a miniature computer. The system anticipates a rear-wheel lockup by sensing the too-fast slowdown of the wheels when the brakes are applied. It then releases the pressure on the rear brakes to allow the wheels to turn for a fraction of a second without brakes. Then brake pressure is automatically applied once again. This sequence of matching wheel speed to car speed is repeated until the car stops.

Ford's system allows the rear wheels to revolve 15 to 20 percent slower than the speed of the car normally would call for before releasing brake pressure.

Antiskid will give the driver a 10 percent shorter stopping distance on slippery pavement. On dry pavement, it will match the distance of a four-wheel lock-up stop.

We told you about Ford's controlled-crush front end in last month's PS.

But safety is not the only subject of interest in the 1969s. Since last month, we have uncovered additional confidential data:

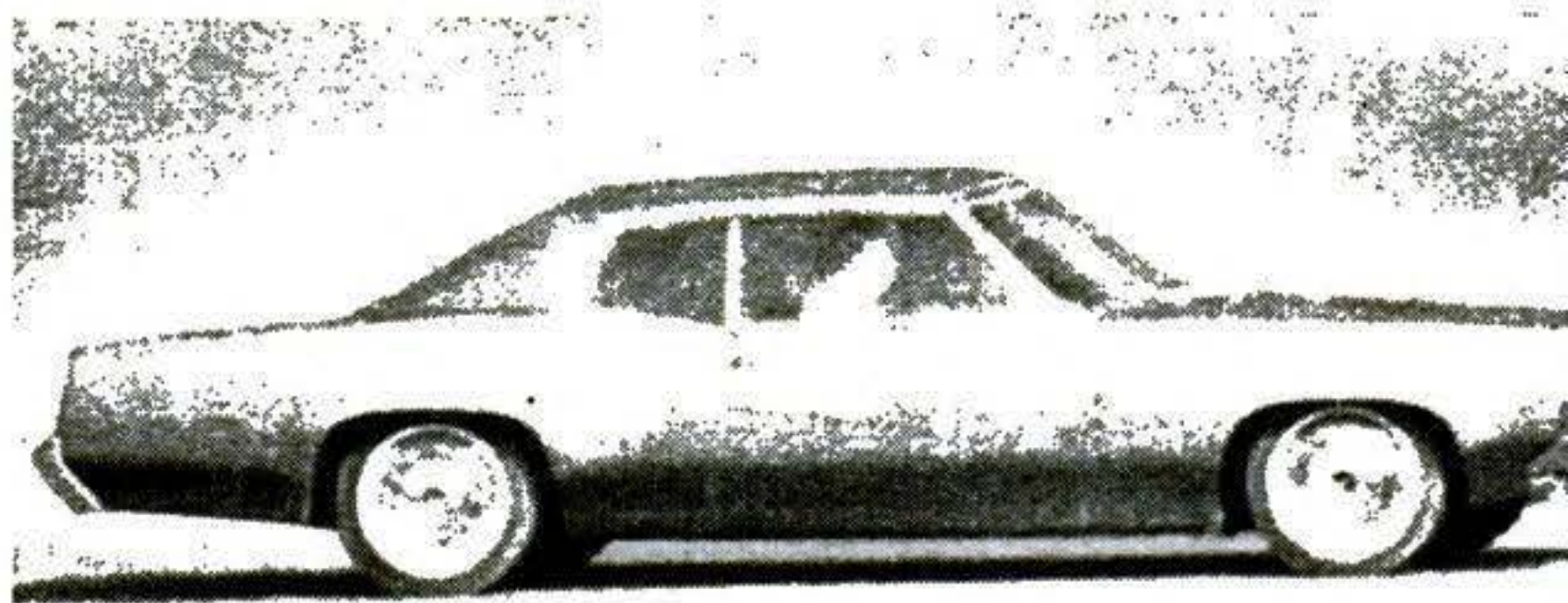
**Ford.** Mustang will give special names



**Ambassador** by American Motors is once again a new car. Vent windows will go, hood is longer, and wheelbase is four inches longer.



**Ford Mustang** fastback, shown in the flesh, looks exactly like the drawings we published in our April issue.



**Oldsmobile Delmont 88** shows new outer skin, bigger glass area, more interior room. The grille is all new.

to two new series in its lineup, a luxury-loaded two-door formal hardtop—the Grande; a 2-plus-2 fastback—Mach II.

In the big Ford you will see a number of small but interesting construction changes. Ford has what it calls "semi-hidden" windshield wipers. They do not recess under the hood as on GM cars, but are formed to blend in with the stainless-steel trim around the windshield. A new design on the big 1969 wagons makes it possible to open the tailgate without first rolling down the back window. This, along with new plastic fuel tanks, will be standard on big Mercury wagons, too.

On the Galaxie, instruments and controls are placed right in front of the driver on a curved panel that "wraps around" the driver's line of vision. It is called "Captain's Chair" instrumentation. The radio is placed to the left of the speedometer, and must be operated by the driver's left hand.

**General Motors.** The company will reduce the number of body styles, too.





**Mercury Marauder** fender lines betray Pontiac inspiration. Note air extractor on rear fender.



**Mercury Monterey** gets longer wheelbase, sleeker proportions, stylish grille, clean side panels.



**Cougar** adds a convertible body for next year. Note the Buick-like accent line in the side panels.



**Chevrolet** keeps the same overall size but looks bigger. Fenders have new torpedo-line bulges.

For '69, you'll see two-door sedans dropped from some lines, mainly the intermediates. In all, GM hopes to cut its body offerings by 15 percent next year. On the other hand, look for standardization of disk brakes on higher-priced models like Cadillac, Olds 98, Toronado, and on high-performance cars like the Firebird 400.

Firebird and Camaro will get a one-inch-longer wheelbase and all-new body skin. Firebird will have a combination chrome-rubber bumper, with the chrome part surrounding the air-intake opening while rubber extensions, painted the same color as the sheet metal, frame the headlights. Pontiac's Bonneville will have rubber bumpers front and rear.

Side vent windows are dropped for all General Motors cars above intermediate size. Chevrolet's two-speed transmission is slated only for six-cylinder engine installation, while all V-8 automatics will have the Turbo-Hydramatic.

**Chrysler.** All 1969 Chrysler Corp. wagons will have two-way tailgates and the wash-and-wipe window-cleaner system. Chrysler's hidden windshield-wiper layout is an exact duplicate of the GM design; the back lip of the hood comes all

the way to the windshield, and the wipers are hidden underneath. The wiper arms are painted black to eliminate irritating sunglare.

A new system of air conditioning, with outlets in the package tray under the rear window, is designed to provide even cooling in both front and rear.

Most changed of the Chrysler lineup is the Imperial. Its grille is a prime example of how extensive the change has been—it is made up of 64 different parts. The hidden headlights are fixed in place. Just the covering, which forms part of the grille, moves when the lights have been turned on.

**American Motors.** Most significant news from AM is the fact that, for the first time, the company is jumping wholeheartedly into the full-size-car market. Ambassador, with its new 122-inch wheelbase, will leapfrog Chevrolet, Plymouth, and Ford to become the longest-wheelbase car in the low-price standard group. Hidden windshield wipers and ventless side glass are added. The company will drop some low-volume models, and concentrate on selling its products in precisely defined, high-volume segments of the market.

PS



# I Remodel to Personalize My Home

By ED McMAHON

The noted TV personality tells why—and how—he's customizing his recently purchased house

**W**hen you're blessed—or cursed (I'm never sure which)—with a master plumber for a grandfather, it's hard to look at a bathroom without itching to improve it. The old man's influence drew all my uncles and cousins into the same trade, and I'm sure I'd be there, too, if it weren't for the maverick strain that prompted my father to run away with a minstrel show.

As a consequence, I've been kept hopping in my attempts to follow two paths of footsteps. Like my father, I've become an interlocuter of sorts, with one foot firmly planted in show business. But like the rest of my family, I'm fascinated with the mechanics of house construction.

Which is why I'm never content to buy a house and leave it as I find it. When I shop houses, I evaluate their potential for change. I don't feel I've made my family a home until I've remodeled a house to suit our own personal needs.

I've been the route several times, and am now finishing up our latest home—a 45-year-old three-story in Bronxville, N.Y., to which POPULAR SCIENCE sent a photographer for these pictures.

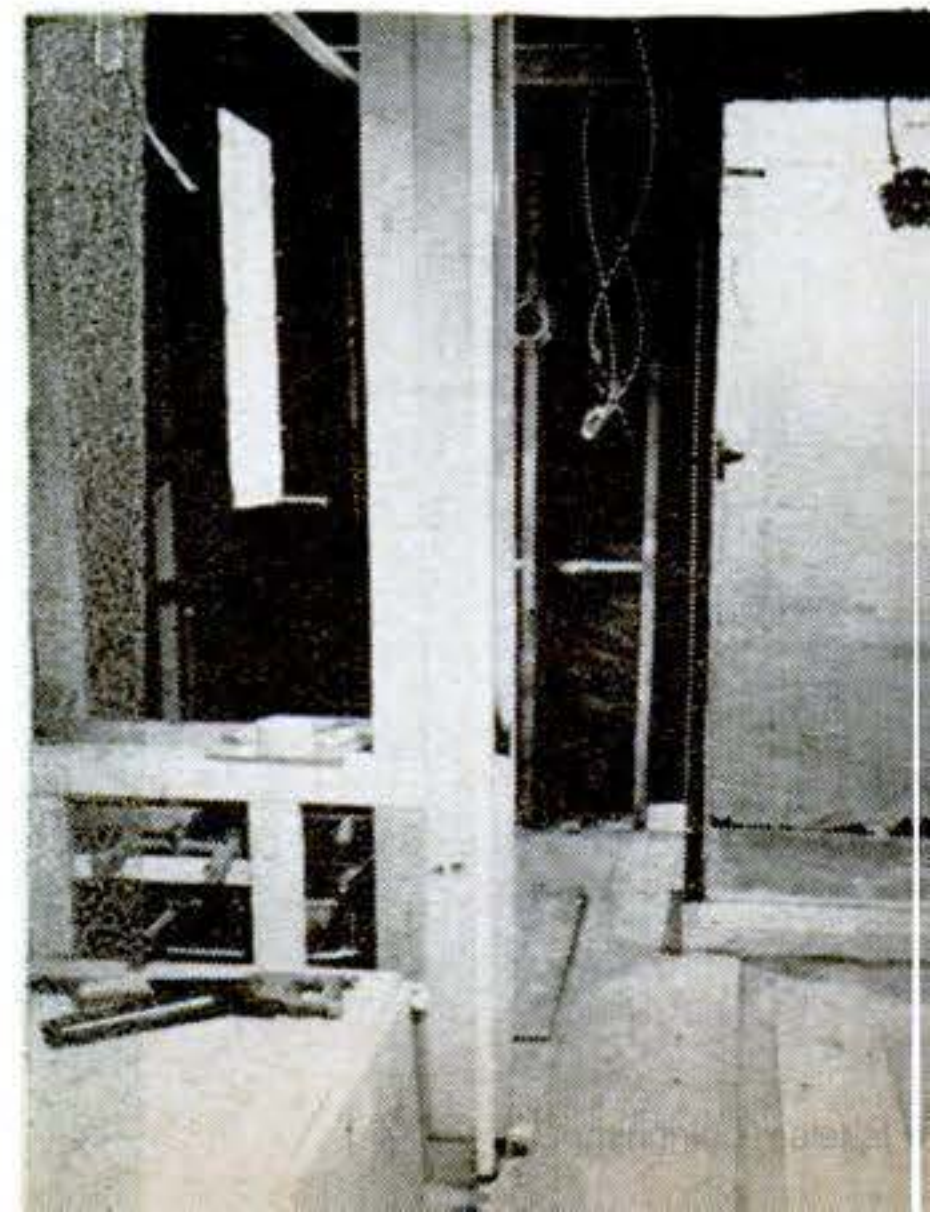
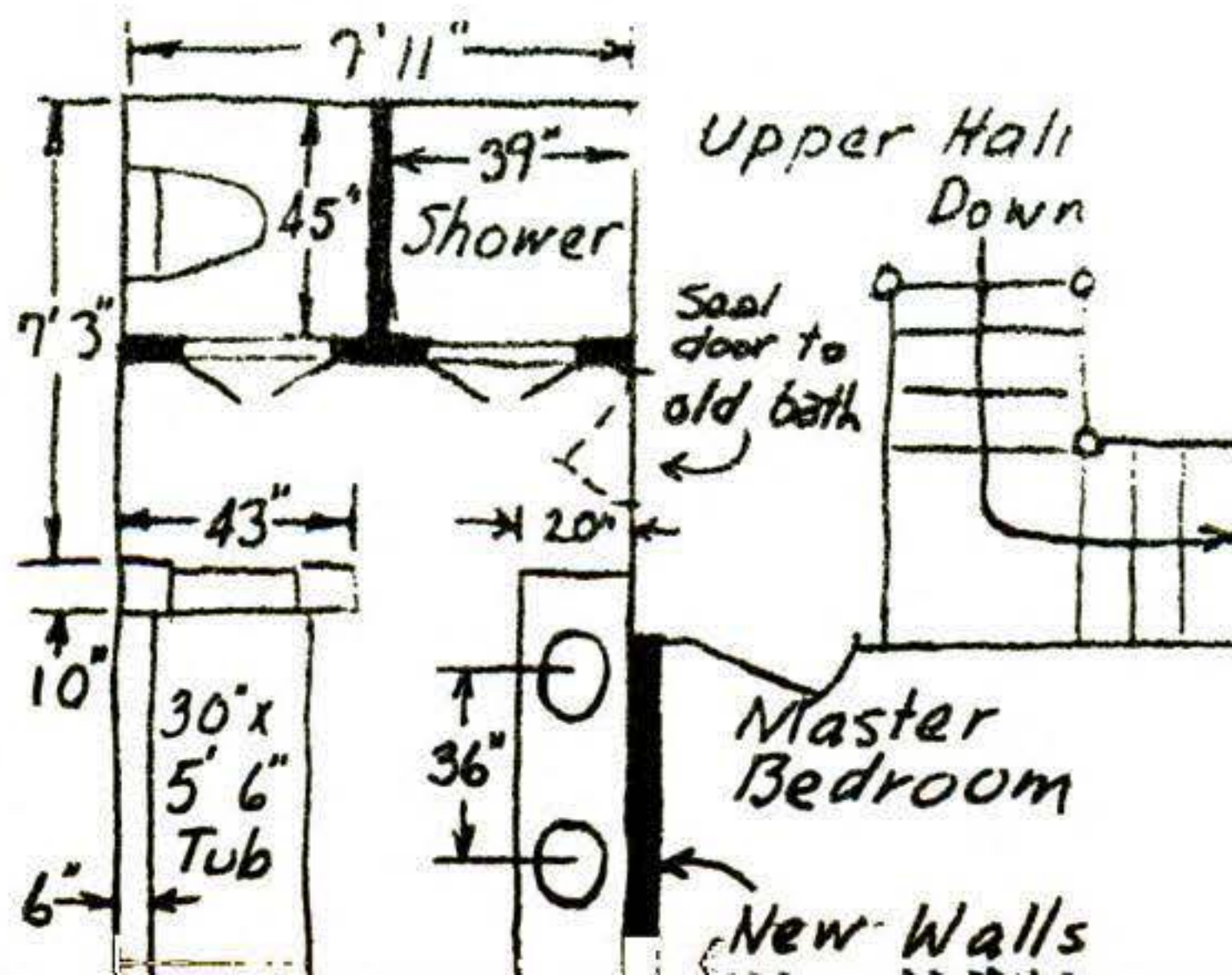
**Commuting problem.** You might ask why I don't just build from scratch. Aside from the fact that you get less house for the money that way ("They don't build 'em like they used to" is more than an idle cliché), it's not easy to find a desirable plot within practical commuting distance of most major cities, and I've got to be able to hop to NBC's studios in Manhattan on short notice.

Besides, remodeling is a challenge. You can set your own pace, and (if you're willing to put up with a few rough edges)

*Continued*

## Master bedroom needed own bath

Upstairs bedroom was of generous size, but its bathroom was a one-at-a-time affair "down the hall." McMahon decided to sacrifice corner of the bedroom (center photo, right) and knock down wall between a closet and old bath. New space measures nearly eight by 14 feet. First photo shows bath from entry door with framing completed; left photo is same view



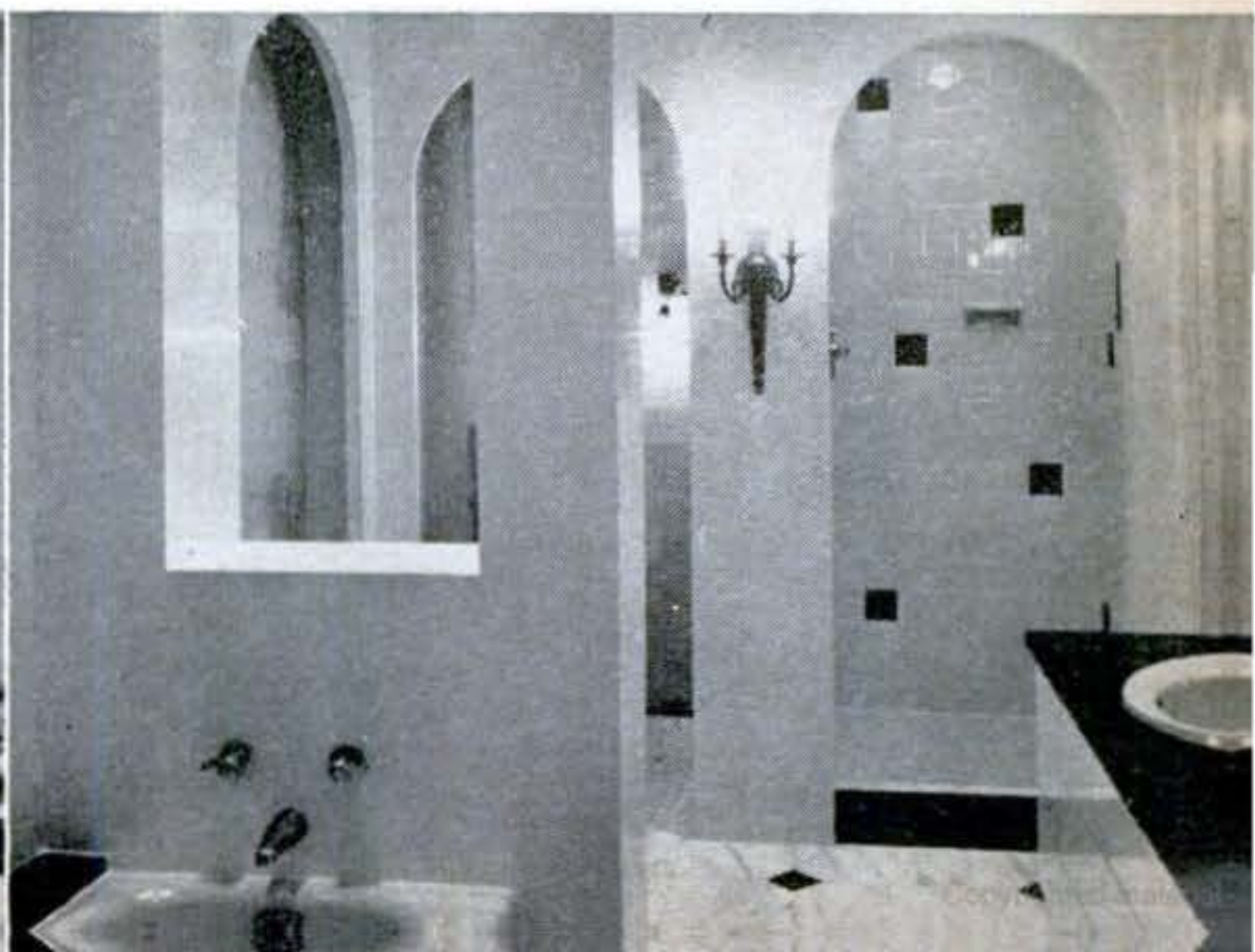
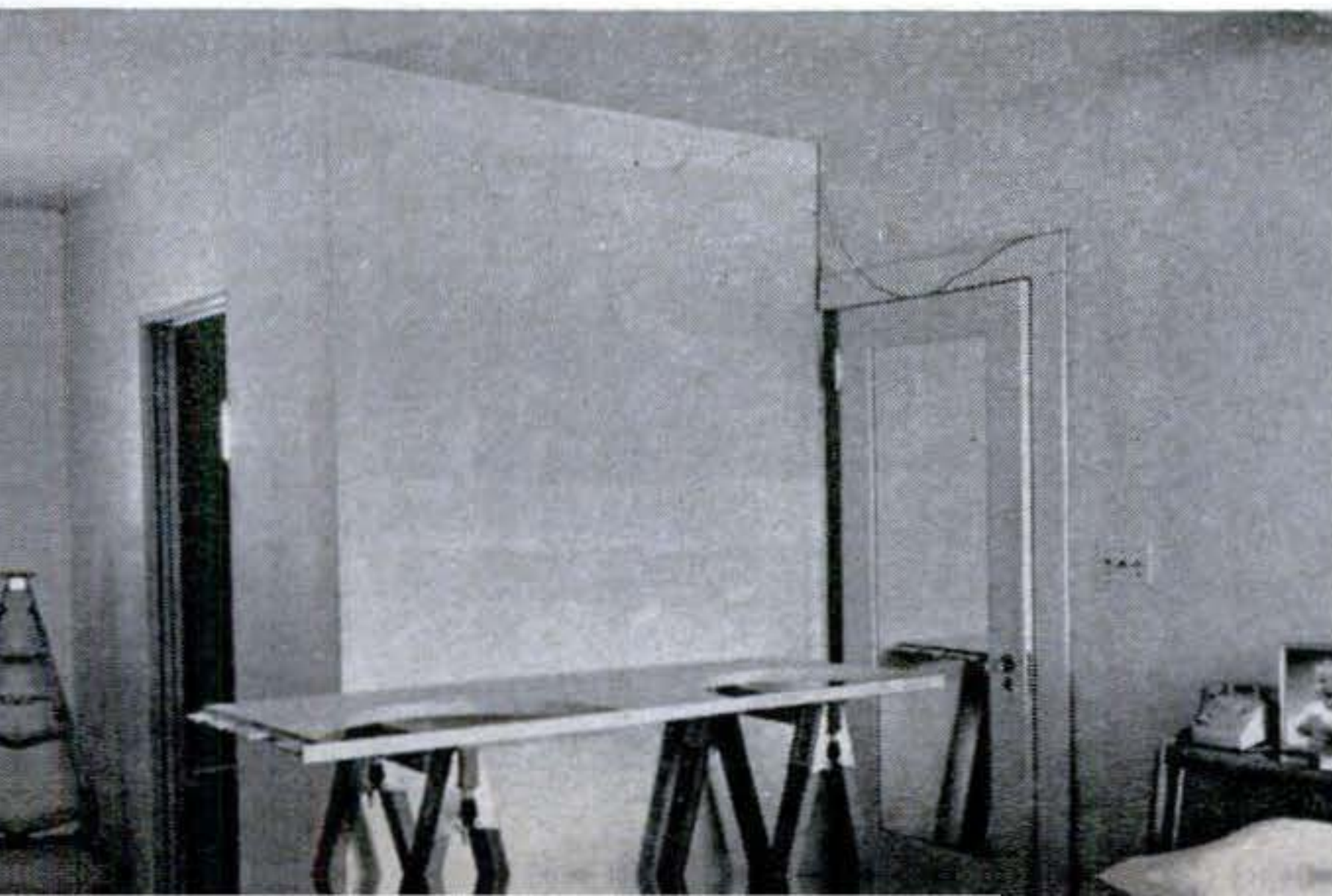




House in Bronxville, a residential suburb north of Manhattan, was built in 1923 and needed much interior remodeling. Living room is at left, master bedroom above it.



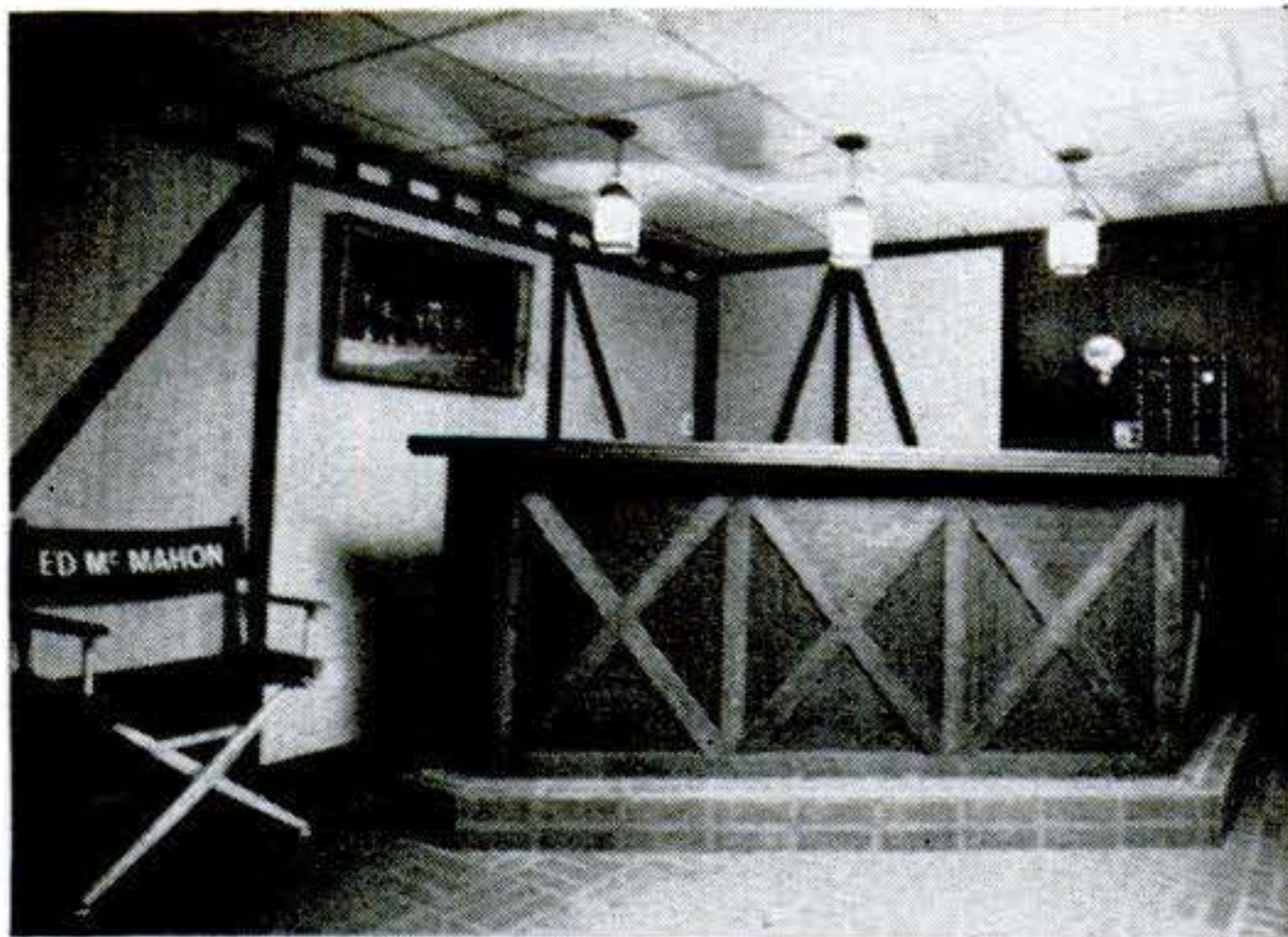
Close touch with work is maintained by Ed McMahon despite busy television schedule. As glamour bathroom for master bedroom is framed out, Ed checks with carpenter Marvin Wunsch on floor plan they drew up (reproduced below, left). At right, he puts boyhood knowledge to work in discussing tub hookup with plumber Jay Carroll.







Rustic contrast is supplied by textured hardboard panels and walnut-stained pine battens filed and gouged for hand-hewn effect. Lally column is sheathed with similarly treated one-by-eights.



Brick-patterned vinyl tile is carried up foot-rest bar platform. Face of bar is walnut hardboard panel cut in triangles to turn grain into square pattern. Joints are covered by battens to match wall beams.



Social corner features octagonal poker table with custom-fitted top that lets it double for refreshments. Top is walnut hardboard with one-by-four pine lip stained to match. Note corner "window."

## A former owner's bomb shelter

enjoy your home while you work on it. And even if you lack the time or skills to do the job yourself, you can involve yourself in both the planning and the execution by working closely with your contractor, carpenter, or plumber. It helps, of course, if you talk their language, and I've always been grateful for my experience at running pipe, installing paneling and electrical outlets, and tackling major home improvements such as laying a flagstone patio or adding a dormer window.

**Planning is what counts.** As professional demands claim more and more of my time, I find I must—often with real reluctance—turn most actual handwork over to others; but I've been careful not to lose contact with the jobs under way. And I've devoted what time I still have to planning each project, exchanging ideas with the workmen, and sketching out solutions that will customize the house.

Without such involvement, I can't see much point in ripping up an existing house. Just as the house you buy represents someone else's ideas of what a home should be, any changes you make won't reflect your own personality if the only role you play is that of check signer.

Unless you offer specific guidance from the first, you'll end up having to live with your carpenter's decisions—which will probably be based on how he's done previous jobs. What he does for you will be about as personalized as those showcase rooms that result when people turn their homes over to an interior decorator. Such rooms look as if they've been lifted straight out of a women's magazine, and the only personal taste they reflect is that of the decorator.

I'm not saying you shouldn't be open to expert suggestion. In planning sessions with my carpenter and plumber, I always welcome their opinions—but not until I've a fair idea of what I want. The master bath we've just finished is a case in point. Even before we'd set the final size, my wife and I plowed through dozens of magazines and product brochures. We finally found what we wanted in a color booklet published by Eljer Plumbingware. One of the photographs showed a handsome green-and-white bath with



## the basement made way for an elegant rathskeller bar

Roman arches. I sat down with graph paper to sketch out a scale floor plan to adapt this arrangement to the space we could spare.

My plumber and I determined how to place the fixtures to tie in with existing lines—which resulted in a layout exactly reversed from the Eljer brochure. With my carpenter, I worked out a template for the arches (it's shown, across saw-horses, in a photo on a previous page). These arches are marine plywood faced with Formica. Hinged doors on the two rear alcoves permit simultaneous use of facilities without loss of privacy.

We've slept with plaster dust and confusion for a month or so, but the results are well worth it.

**Finishing the basement.** Another big challenge the house offered was the basement. Previous owners had left it unfinished—except for the woman who'd installed a massive bomb shelter back in the '50s. Once this was ripped out, I could have simply paneled the area, done the floor and ceiling with standard materials, and left it at that. But why? For very little extra money, we could create something all our own—a needed entertainment center for our teen-agers, and a room I could make good use of for those late-night planning sessions that are part of any telecaster's life.

A rustic rathskeller motif promised a festive air. So my carpenter and I put our heads together. I had to talk him into a simulated window effect I wanted in

the focal corner. We achieved it with yellow plastic panels in a bottle-glass pattern, framed out so we could mount fluorescent fixtures vertically on the wall behind. It takes the curse of the cave off this underground setting.

I also wanted our freezer and water heater readily accessible but completely concealed. Our solution was to frame around them so we could carry our panel-and-batten wall treatment past them, providing bifold doors of the same material as shown (top, facing page).

The carpenter contributed many details. Diamond-matching the walnut-grained panels across the front of the bar was his idea. And he had to convince me to let him "hand-hew" all the battens. What sounded like a costly, time-consuming chore actually went very quickly. We just "killed" all the corners with uneven filing and nicked the faces up a little with a gouge.

**How it works.** If you can't do the job yourself, you've got to be even *surer* of what you want before you start. You probably won't be around to figure out every detail as the work goes on. But if you and your contracted help understand the aims of the job from the start, it becomes a cooperative effort.

And if your experience is anything like mine, you'll find them grateful to be working with someone who knows what he wants—and who wants something personalized enough to offer them a change from their routine. **PS**

**Living-room bookshelves** were custom-designed to fill wall, with focus on portrait of McMahon's son Jeffrey. False drawers behind center chair are slides for turntable and tape deck, wired to stereo speakers in base cabinets at either end. Plywood valance and half-round moldings glued to doors add final touch.







A technician dusts revolver for latent prints, then . . .



places Polaroid CU-5 camera over gun, and . . .

## Speed print kit makes permanent fingerprint record in 15 seconds

By producing photographs in seconds of the scene of a crime, the close-up camera used by the police technician above already helped to break up a burglary ring. The Polaroid CU-5 has a built-in electronic flash; a power pack with a 510-volt battery.



## Gyrocopter flies on VW engine power

This new model of the tiny Bensen gyrocopter flies with an air-cooled Volkswagen engine. It can be built from a kit at a cost of less than \$1,000, including engine. The 64-hp. VW engine it uses gets about 30 m.p.g. The Bensen B-8V gyrocopter has a range of 150 miles, cruises at 50 m.p.h., and can churn up a top speed of 65 m.p.h.





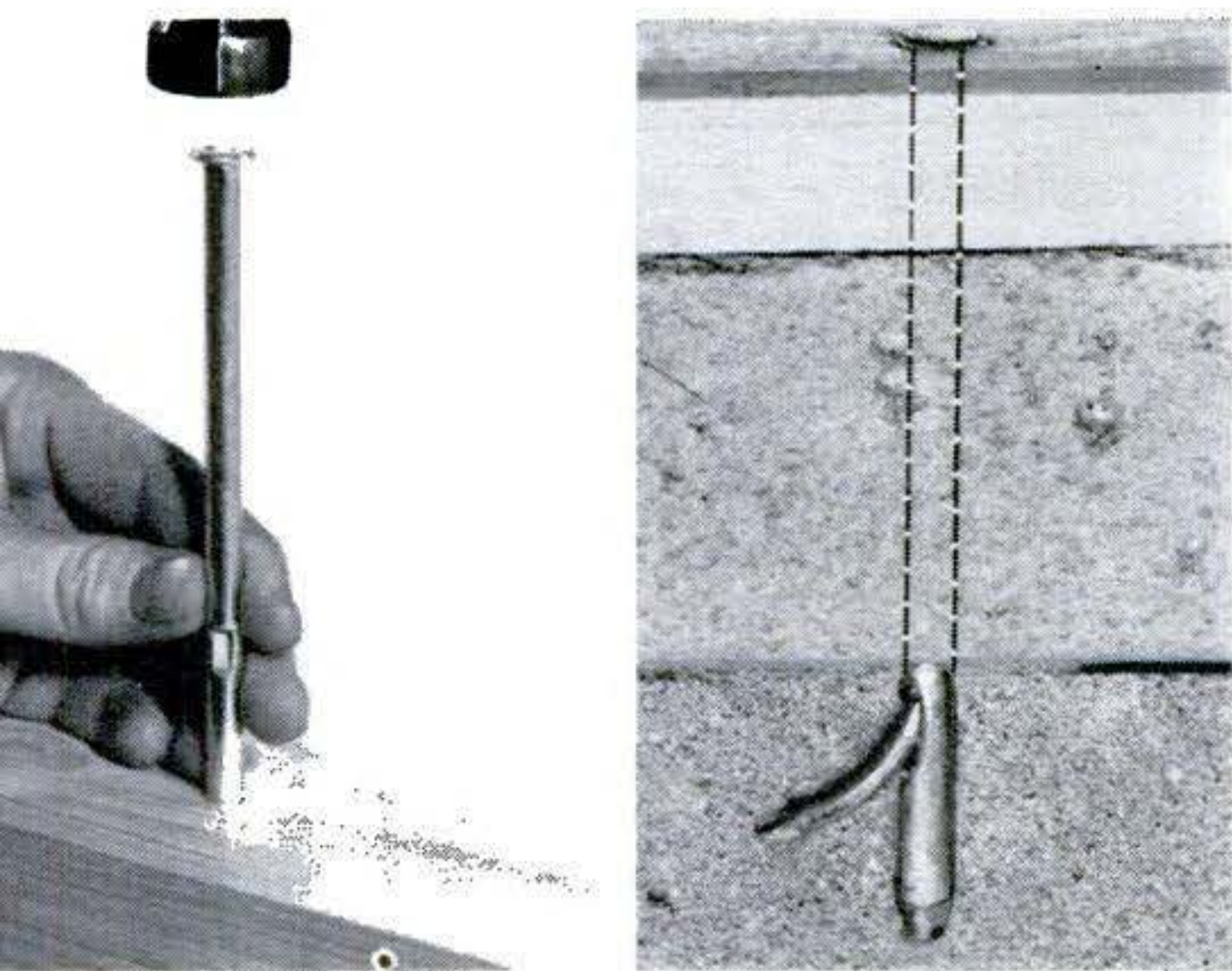
Permanent record is made of print in seconds.

gives 1,000 high-illumination flashes. Shutter speed is 1/60 second; an  $f/45$  lens opening gives great depth of field. A spacing frame clips to the camera face to eliminate focusing. The camera is in use by Miami (Fla.) and New York City police.



### GM steering column goes to war

GIs in Vietnam ride down a river in a Navy Armored Troop Carrier (photo), the seats of which are supported by the outer jackets of GM's collapsible steering post. The jacket helps cushion the shock of mine explosions. Each seat and platform has eight.



### New two-piece nail grips hard

This Swedish-made nail is designed for attaching door frames, battens, banisters, and the like. You first pound in the outer tube section (left), then drive a wire nail through the tube, which has a ramp near the bottom that steers the point out sideways into the adjacent material. No drilling is needed to get the Hema-nail through concrete blocks.

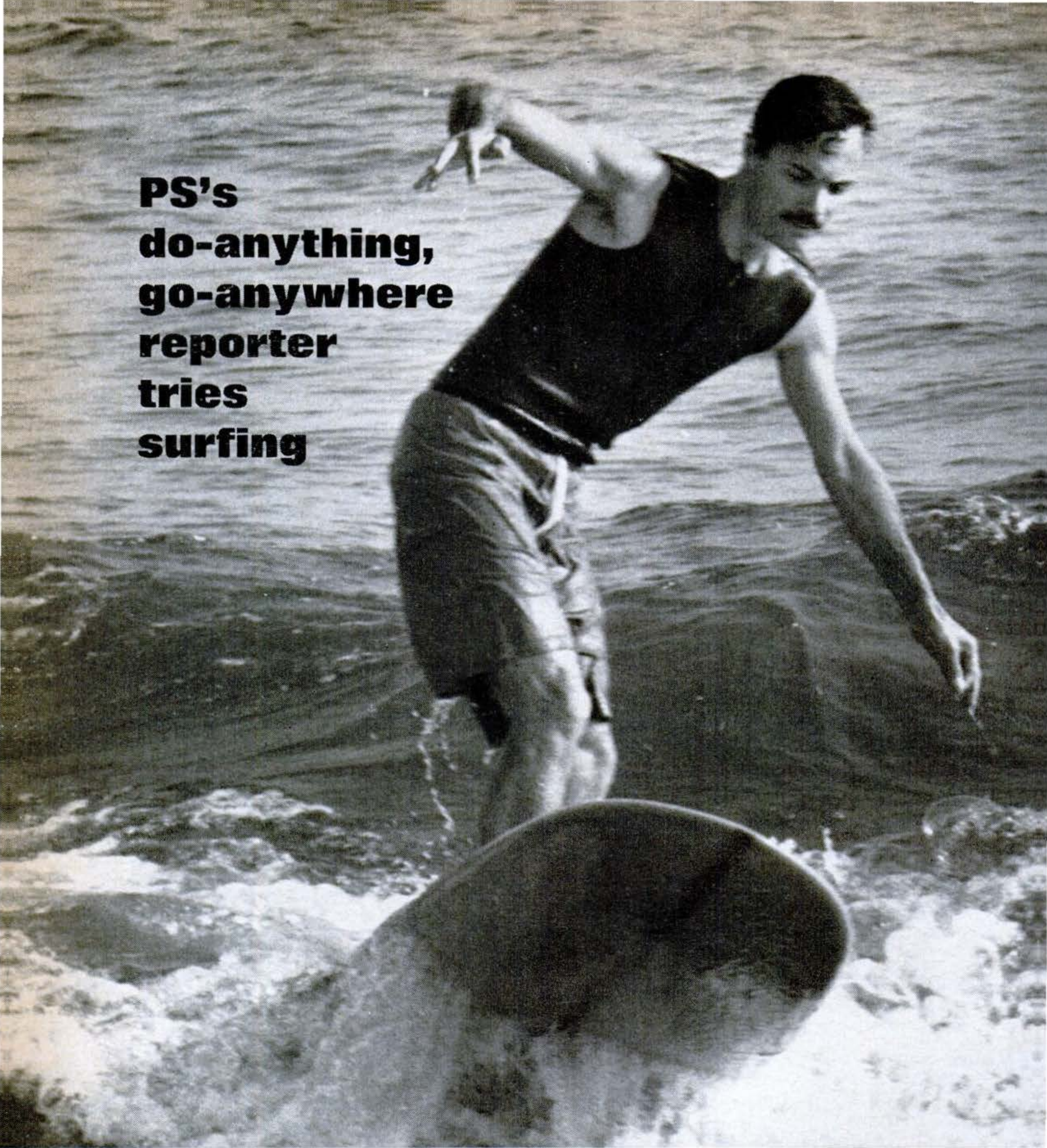


### Powered surfboard makes it easy

A jet engine on this surfboard takes you out on the water without paddling, so you can coast in with the waves. Made by Alpha Jet Industries, Anaheim, Calif., the board is 12 feet long and can hit 10 m.p.h. on its two-cycle engine. The jet-propulsion system eliminates need for a propeller, which could be dangerous to a surfer.



**PS's  
do-anything,  
go-anywhere  
reporter  
tries  
surfing**



PHOTOS BY BILL TETLOW

In wet-suit vest and baggies, Gannon gets ready by rubbing his board with slip-resistant paraffin.

With lightweight board on his head, author leads surfers to the beach in search of the perfect wave...







Precarious technique of the author (left). How pros do it, photo above.

# Riding High in Search of the Perfect Wave

A fish-eye view of the thrilling, punishing,  
and maddening sport that turns the beach set on

By ROBERT GANNON

**Y**ou see surfers in the movies or on TV and they're having a lot of fun, right? Everyone's laughing, awash with joy, alive with pure pleasure, with the wonderfulness of it all.

It's a put-on. Those aren't grins. They're grimaces. They're leers of pain—from backs still stinging from that last spill, shoulders smarting from being ground into the sand, unbearably sore board-rubbed knees and insteps, and most

of all, from the teeth-chattering cold.

I know. Because though I'm not what surfers call a hot-dogger, I have graduated from gremmie class to ho-daddyness.

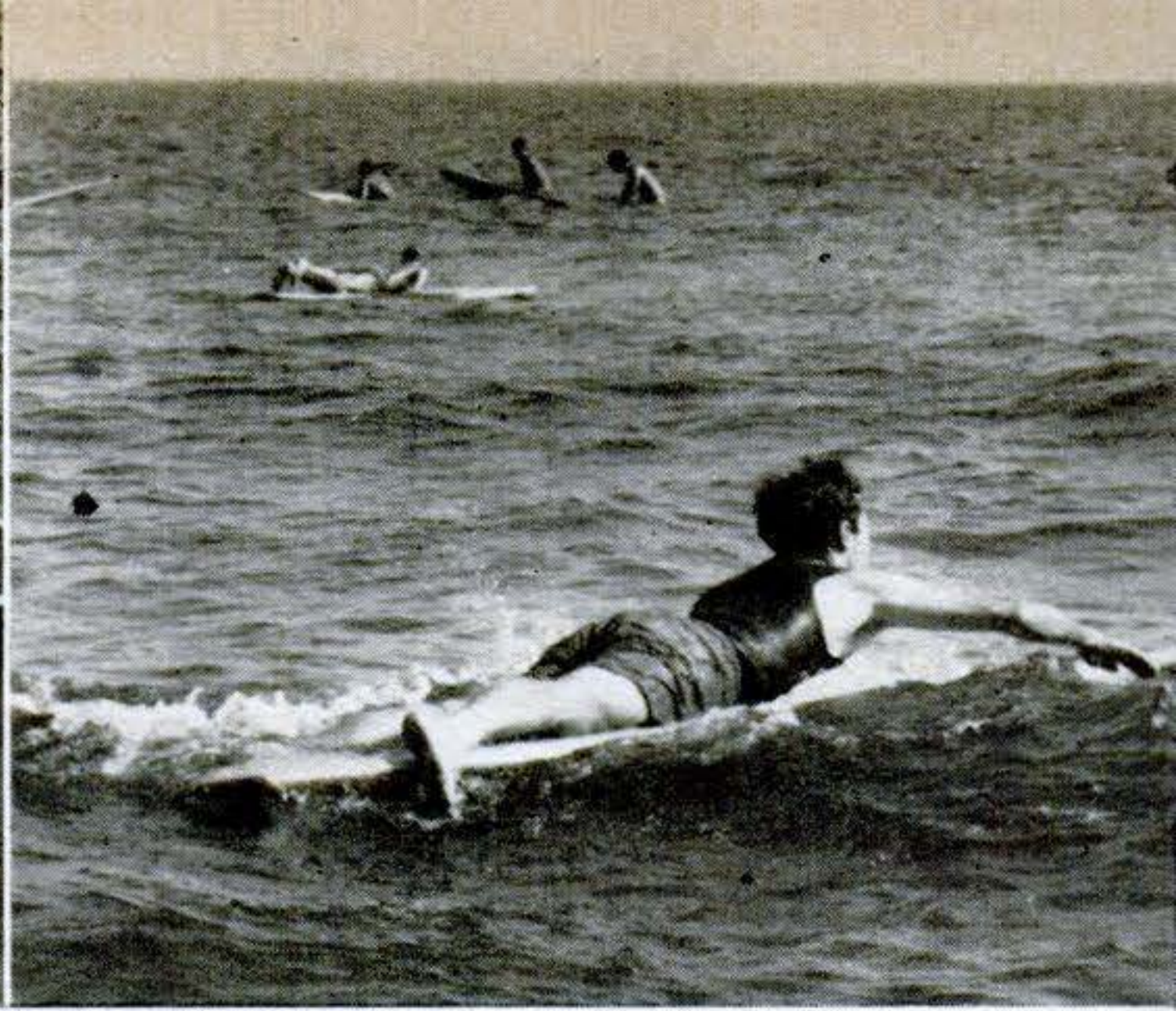
What happened is that I figured I was missing something. If wobbling atop a seagoing ironing board can turn you on, then it's for me, I thought. Groovey. And then there are all those chicks hanging around...

*Continued*





Our neophyte surfer found that paddling out where the waves are is the toughest part of the sport.



Practicing prone paddling in calm water prepares Bob Gannon for rough going that lies ahead.

Everyone else seemed to be surfing. "Here on the West Coast we have more than one million active surfers," estimates Mike Sagar, executive director of the U. S. Surfing Assn. "And on the East Coast there's just a shade less than that." California has so many surfers now that municipalities are going all out to eliminate them.

"A few years ago in Orange County, where I live, there were 25 different surfing spots available any time of the day," says Sagar, who has been surfing for 14 years. "Now I can think of exactly four spots, and two of them are restricted as to hours, and the others charge to get in."

In Miami, Joe Marci, partner in Surfboard House, says that "four years ago there weren't four surfboards. Today there's hardly standing room. One day this area had 31 boards *stolen*."

**Joining the surfers.** For my debut I went to the mecca of East Coast surf-dom: Gilgo Beach, on New York's Long Island. In nearby Farmingdale, John Hannon runs Hannon Surfboards, the oldest quality board producer in the East.

Surfboards in various stages of completion lined the walls of his shop, and there was enough acetone, fiberglass, and resin in the air to make it vibrate. A half-dozen young men—each sunburned a golden umber—smoothed and "glassed" boards. The place looked industrious. But anytime someone comes in and announces that the surf's up, in five minutes the shop is deserted.

The surf wasn't up that morning, but the place emptied anyway. The prospect of gaining another convert was all the excuse needed. And soon I found myself

zinging out toward the beach, nine-foot surfboards nestled atop the car just like they're supposed to.

On the way my mentors tried to prepare me. "When you get out there sliding down a wave," said one, "you'll suddenly know this is *it*; it's just you and the ocean."

"Yeah," said another. "You get a good wave and it's just the best thing that ever happened to you."

Added a third: "Man, the whole sea vibrates. Sometimes I get so stoked from it all I just go blah and flop off the board."

Okay, I was ready.

My instructor, a sunbaked 19-year-old named Paul Cowan, outlined the theory. "It's simple," he said. "You paddle out beyond the breakers and sit astride the board, waiting for a wave of the right size and shape. When it comes, you paddle toward shore until the swell begins to lift up and push you forward. Then, at just the right moment, you stand up, and by shifting your weight and moving your feet, direct the board down the slope, keeping with the wave. It's simple," he repeated.

**Taking the plunge.** So, outfitted in a \$30 rubber wet suit (to me, Long Island water is always frigid) and a pair of garish, knee-length semipantaloons called "baggies," I was ready to groove.

In the water your first problem is to get out beyond the waves. You paddle out either stretched prone or kneeling.

Stretched out, you're arched so you can see where you're going, working your arms in unison, breaststroking. Soon your arms feel like dropping off at your aching shoulder muscles.





A fine wave comes along, and Gannon scrambles madly to gain an upright position for riding it.



Riding the perfect wave had a far from perfect ending, as shown in photo above. This causes bruises.

Even worse is the kneeling position. Here, besides paddling, you're balancing atop the wobbly, 22-inch-wide board. It's exhausting. And then there's all that climbing back again each time you fall off the thing.

When the waves are huge, the trick to get through them is to flip the board over and hang like a sloth until the wave passes. (I wasn't very good at it.)

**Waiting for that wave.** Out there finally, you sit with the board facing shore, and you keep looking over your shoulder for *the* wave, and soon your neck begins to cramp. Then out 100 feet or so a swell grows. "Ah, nuts," you say to yourself, because the wave looks as if it will be a good one, and you'll have to try to ride in. Because that's what you're out here for, isn't it?

So you still your shivering, pull yourself to a kneeling position on your now sore-pulsing knees and ankles, and pump those weary shoulder muscles for speed.

Suddenly you feel the rear of the board rise, and around you, just at the edge of your peripheral vision, the swell appears with maybe just a ripple of white. You start sliding down the hill. Quickly you swing your feet between your arms and stand up in the typical surfer's crouch. You're up!—and one, two, three you're down.

"Hot stuff," you think as the saltwater squirts through your nasal membranes. The wash grinds your face into the bottom and loosens your fillings. But at least *that* time you didn't get zonked by the board.

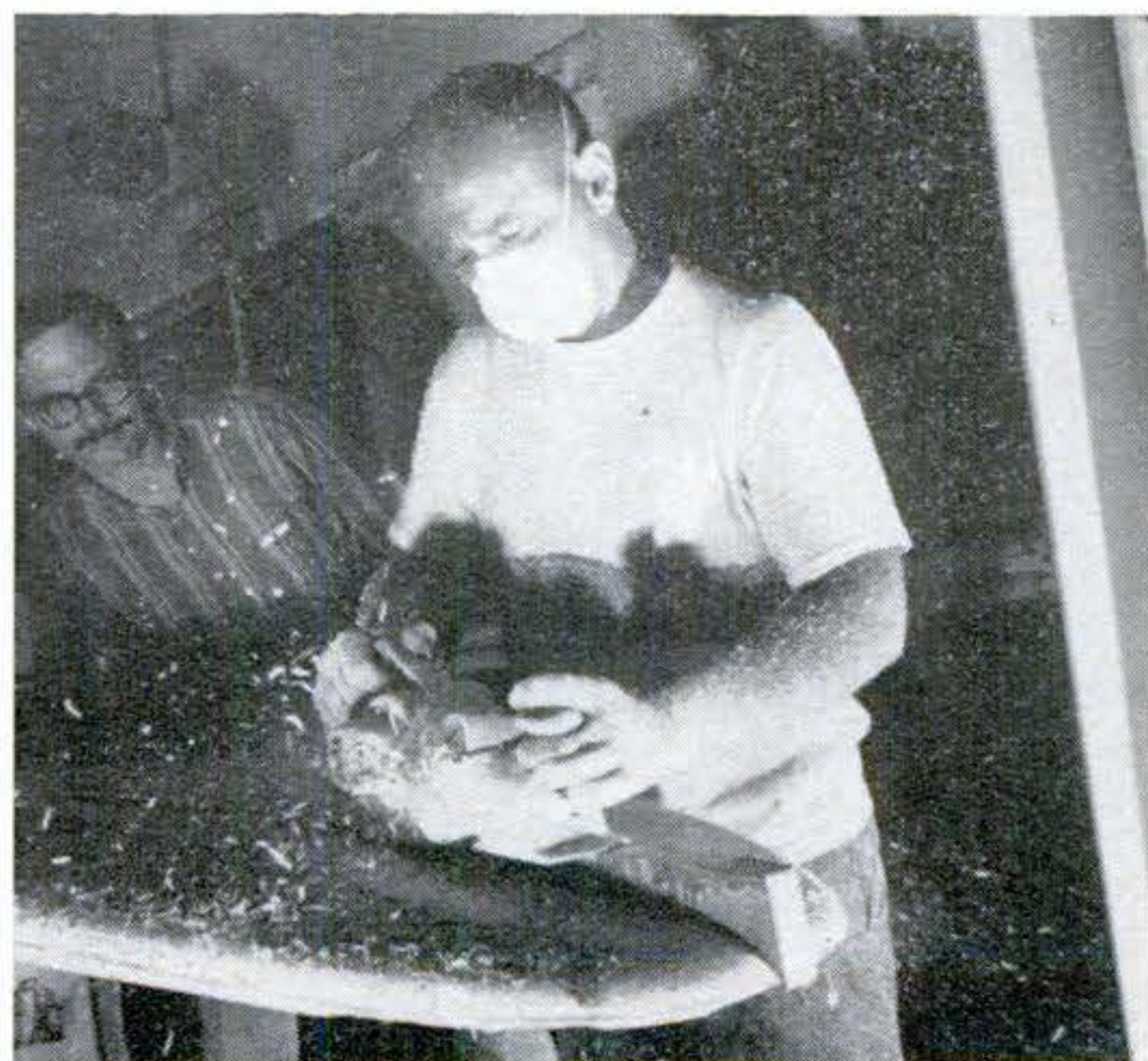
You rub the stinging water from your eyes, find the board, and paddle out again.

By the end of that first day I was so tired that when I finally came staggering in I kept getting knocked down by one-foot wavelets. I dropped my board and just stood there with my arms hanging. But I knew I wasn't paralyzed; I was shaking too much from the cold. Paul took one end of my board; I couldn't carry it all myself.

Back at the car everyone else was saying how great the surf was, how jazzed they were.

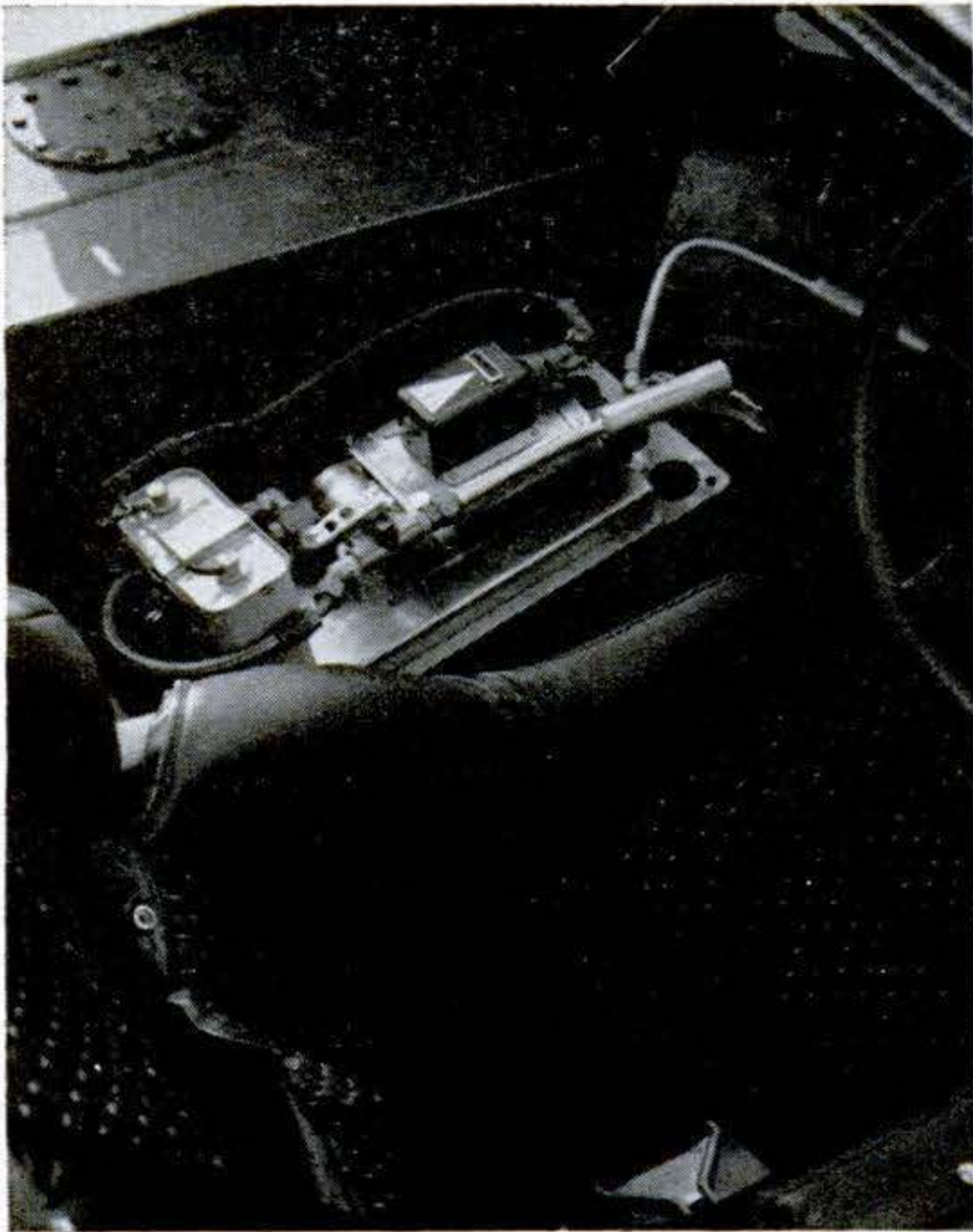
**Making a surfboard.** On my next trip to Jack Hannon's shop, I watched a board being made—a \$175 model that was being turned out by Bruno Huber, one of the East Coast's top board shapers. With an air-filtering mask strapped to his face, he started with a fat slab of plastic foam

[\[Continued on page 170\]](#)



Special Hannon surfboard is being roughed out by Bruno Huber. He uses a power plane before hand-finishing. Completing a board takes eight hours.

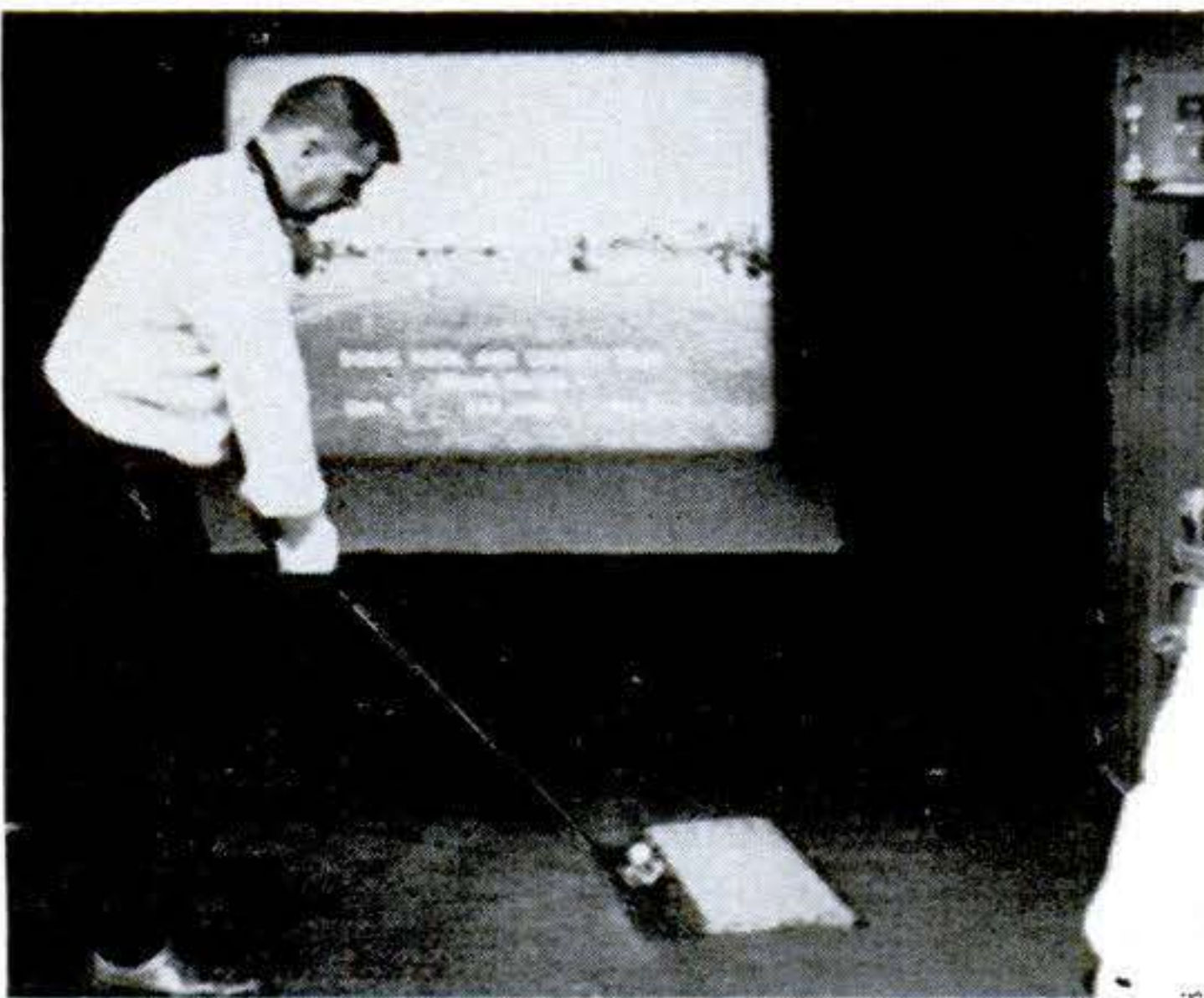




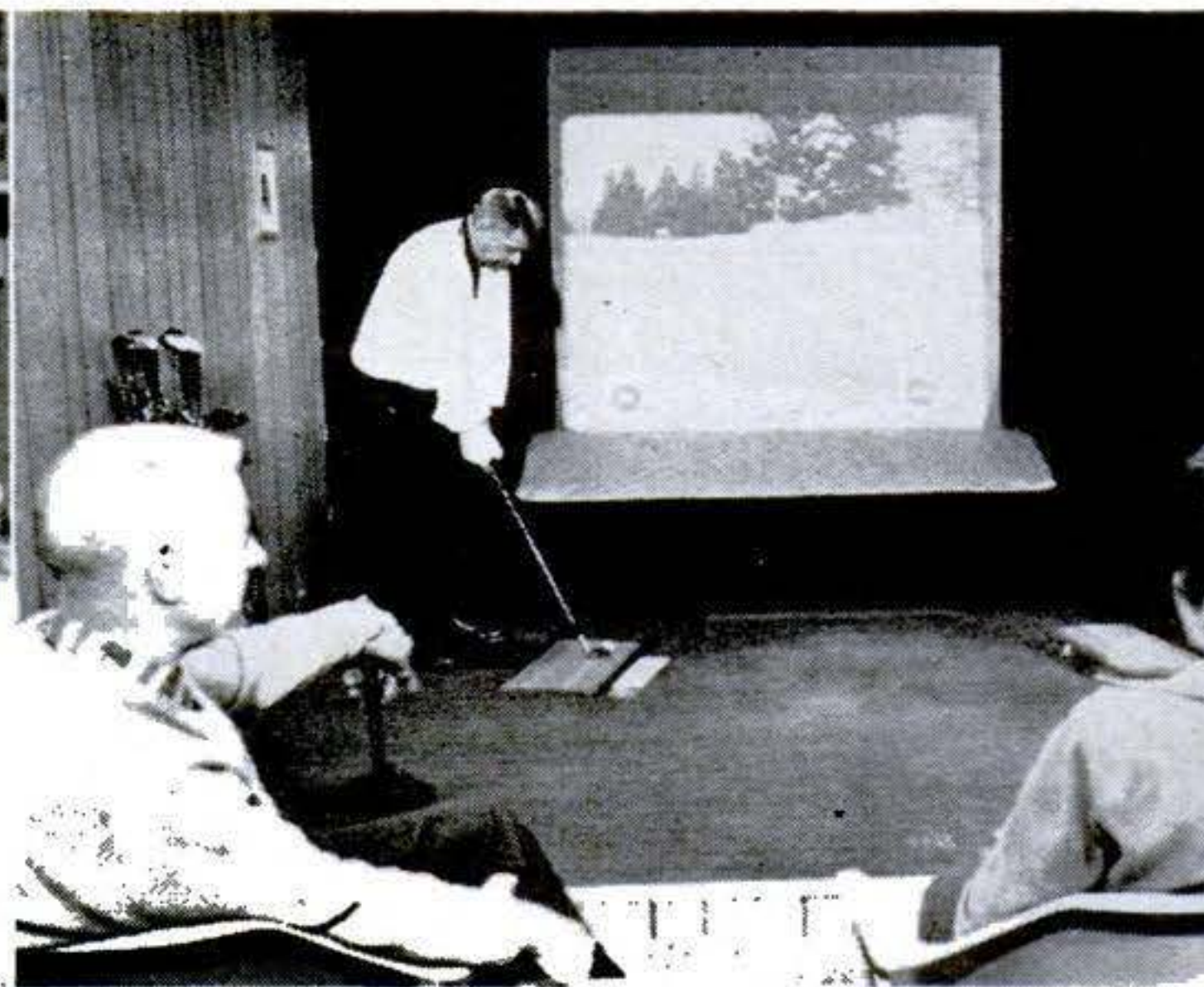
## Speedy new system for extinguishing fires in racing cars

A racing driver's greatest hazard—the cockpit fire—can now be detected and extinguished in less than a second with this compact automatic device (above, left). The lifesaving extinguisher is similar to one every

airliner carries to fight engine fires. It optically detects a fire and sends an electrical signal to a control box, which triggers a stream of DuPont's Freon FE 1301 fire-extinguishing chemical, as seen at right.



**Golfer tees off** on Golfomat course. His drive into the screen is electronically timed by computer.

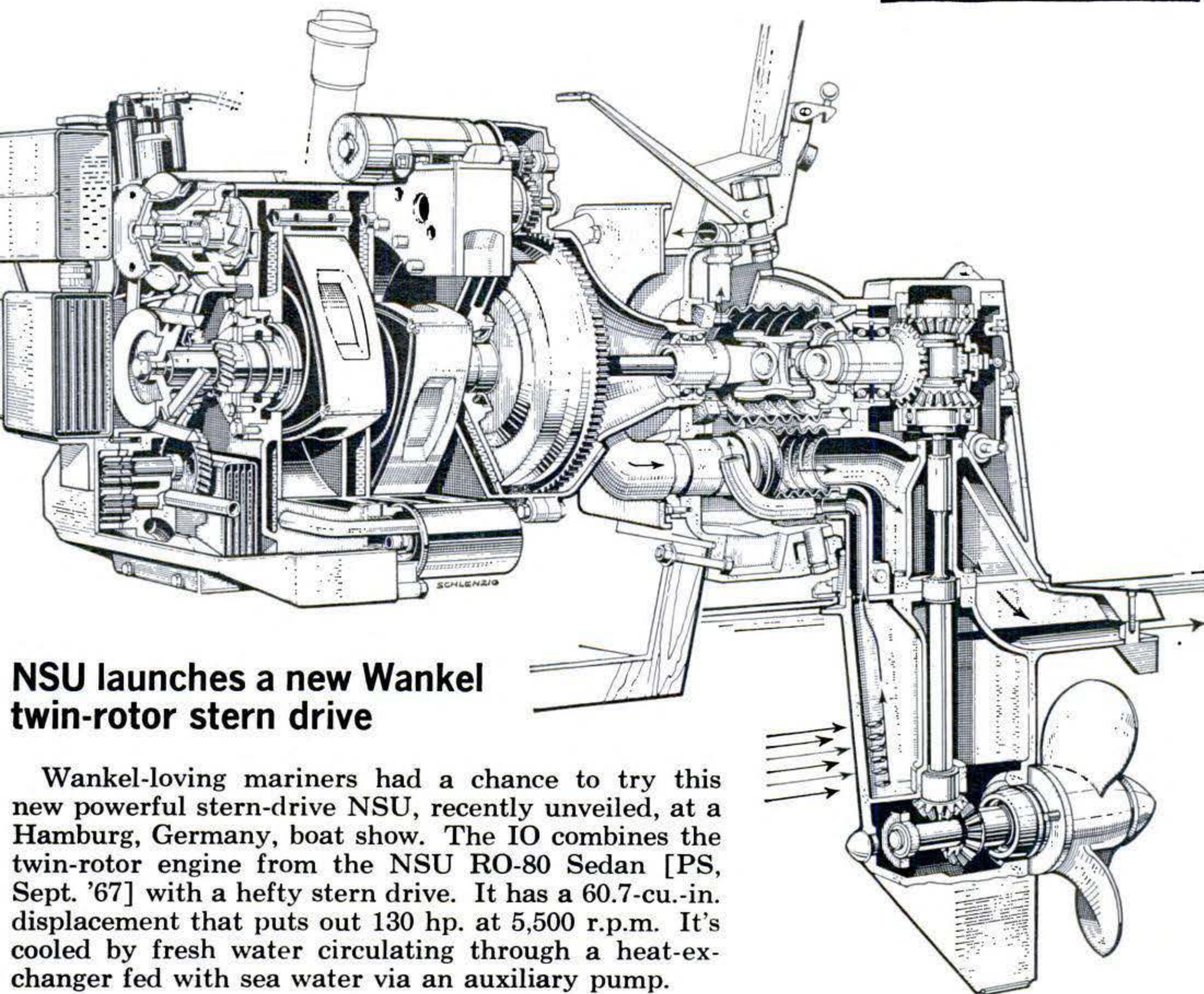


**Computer tells golfer** where ball landed so that he can line up his second shot to the green.

## Golfers now play champ courses in their own living rooms

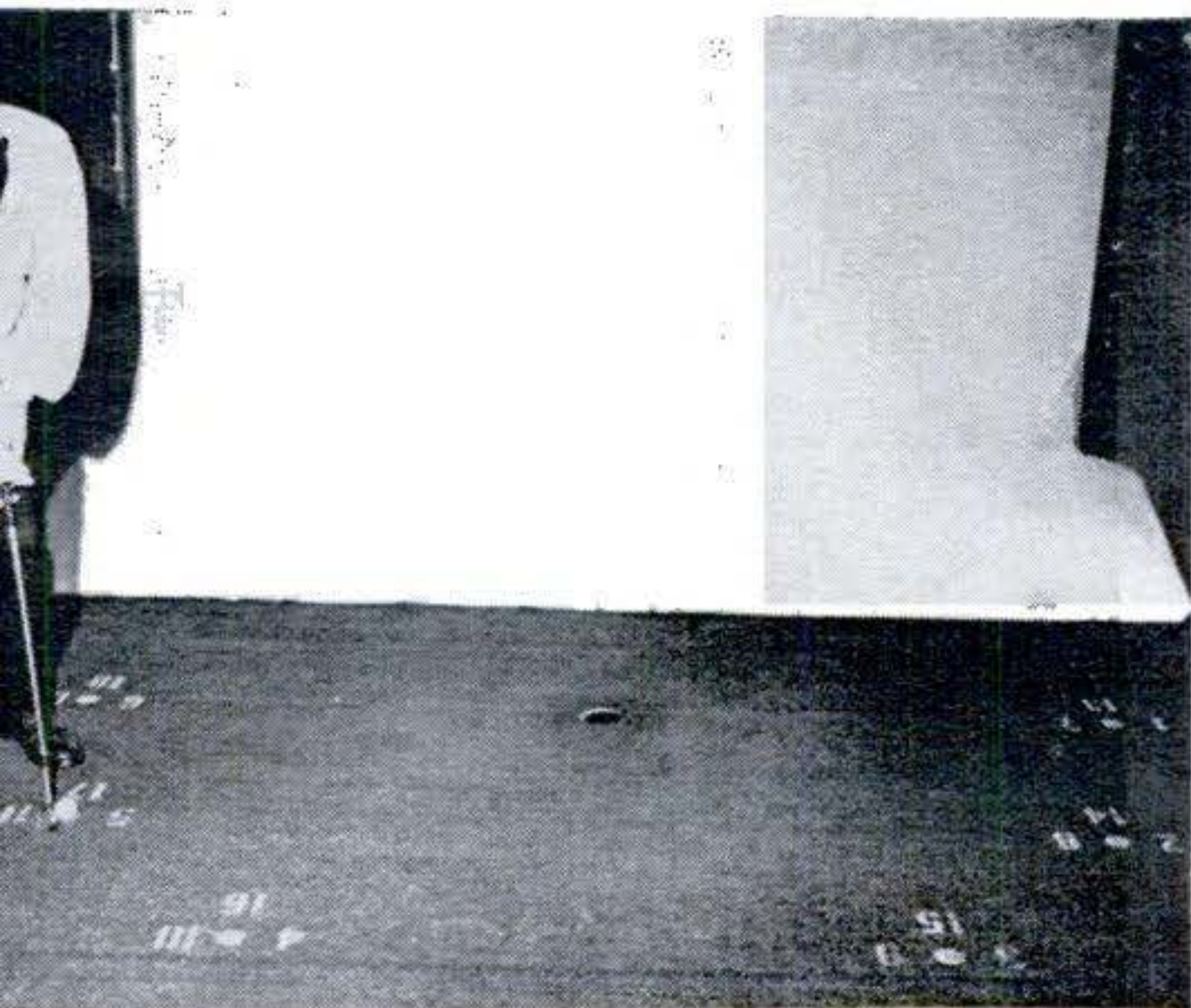
You can play 18 holes on some of the most famous golf courses in the country indoors—without walking—thanks to the ingenious Golfomat game which uses color slides and electronics to simulate real conditions. The





## NSU launches a new Wankel twin-rotor stern drive

Wankel-loving mariners had a chance to try this new powerful stern-drive NSU, recently unveiled, at a Hamburg, Germany, boat show. The IO combines the twin-rotor engine from the NSU RO-80 Sedan [PS, Sept. '67] with a hefty stern drive. It has a 60.7-cu.-in. displacement that puts out 130 hp. at 5,500 r.p.m. It's cooled by fresh water circulating through a heat-exchanger fed with sea water via an auxiliary pump.



When golfer reaches "green," projector shuts off; he putts from distance marked on artificial grass.

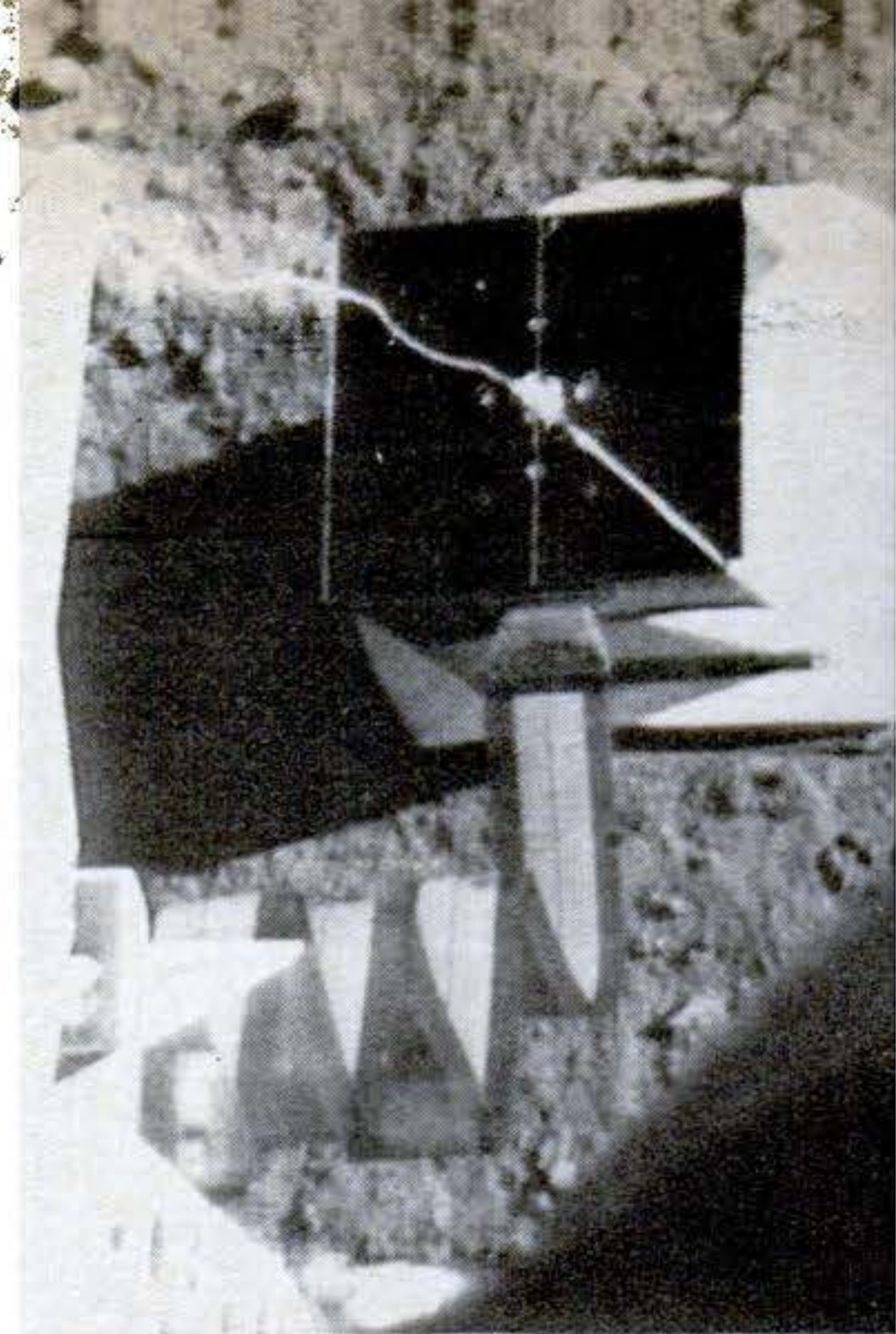
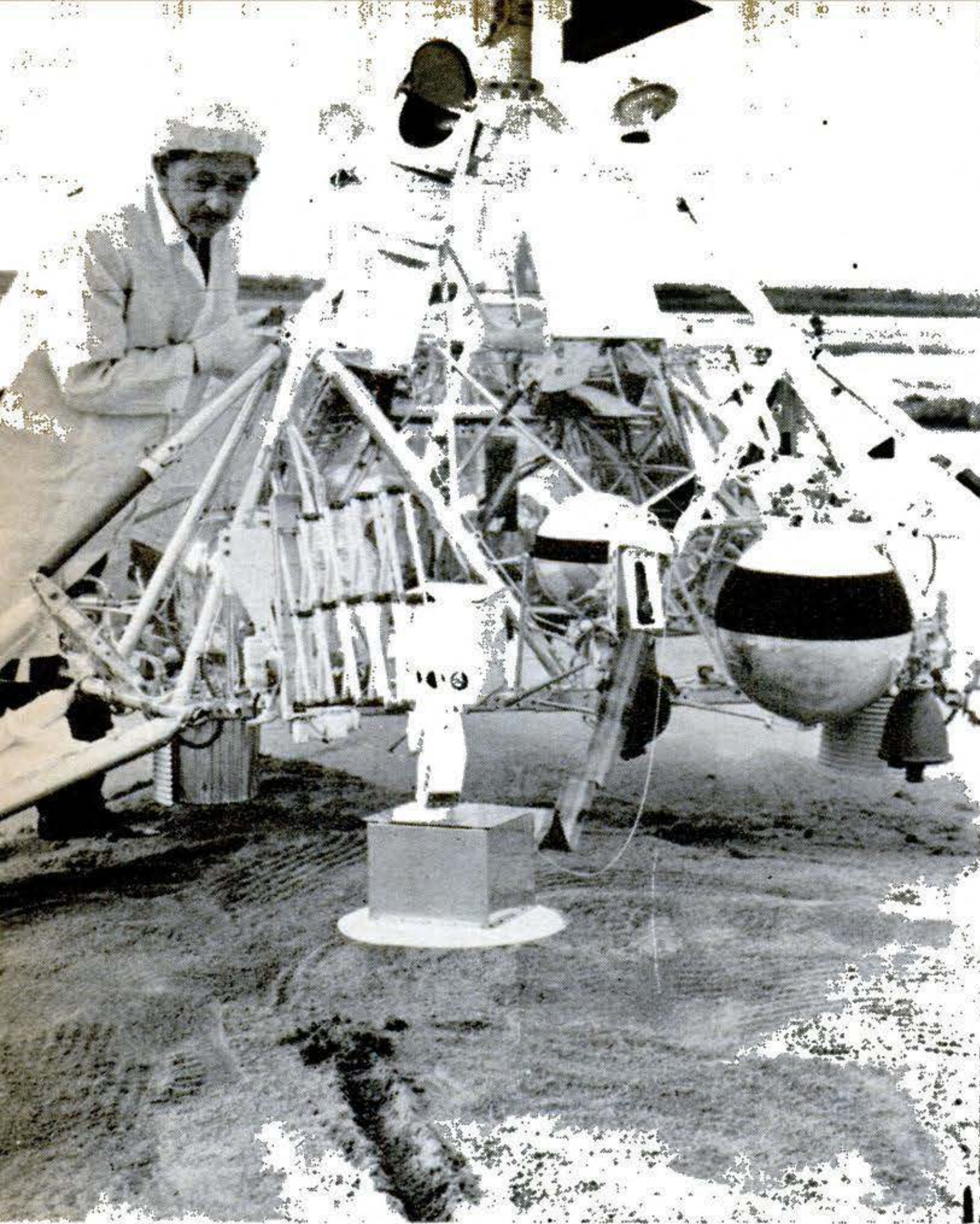
links are projected on a screen. Then you tee off and drive the ball against the screen. The ball's flight time from tee to screen is measured electronically and the distance of the drive computed.



## New vessel dredges up a mess of clams

Florida marine biologists are using this hydraulic dredge in an attempt to boost harvesting of edible clams in coastal waters. Jets stir up the bottom, allowing material to be scooped up. More jets force solid objects, like clams, onto a moving conveyor belt. The clams come off the belt all cleaned and ready to go to market.





The first chemical analysis on another heavenly body is made by Surveyor V's nuclear "chem kit," seen lowered on nylon string to surface of moon in Sea of Tranquility. A ribbonlike cable feeds power to the instrument and brings back its data to be radioed to earth.

In preflight trial at Pasadena with a test-model duplicate of Surveyor VII, excavating tool picks up "chem kit" by knob at its top to place it over a trench dug by tool (bottom of photo). Surveyor VII was the first and only one of the seven to be equipped with both of these devices.

# Spacecraft Tell Wha

**By Dr. Wernher von Braun**

Director of NASA's George C. Marshall Space Flight Center, Huntsville, Ala.

**W**hen our seventh and final Surveyor perched on the moon near the great crater Tycho and radioed back what it found, early this year, it capped a series of history-making feats by NASA's tripod-shaped spacecraft.

Five Surveyors of the seven launched successfully soft-landed on the moon. Surveyors I, III, V, and VI fulfilled the program's primary aim—testing sites in the moon's flat mares, or "seas," for coming Apollo manned landings.

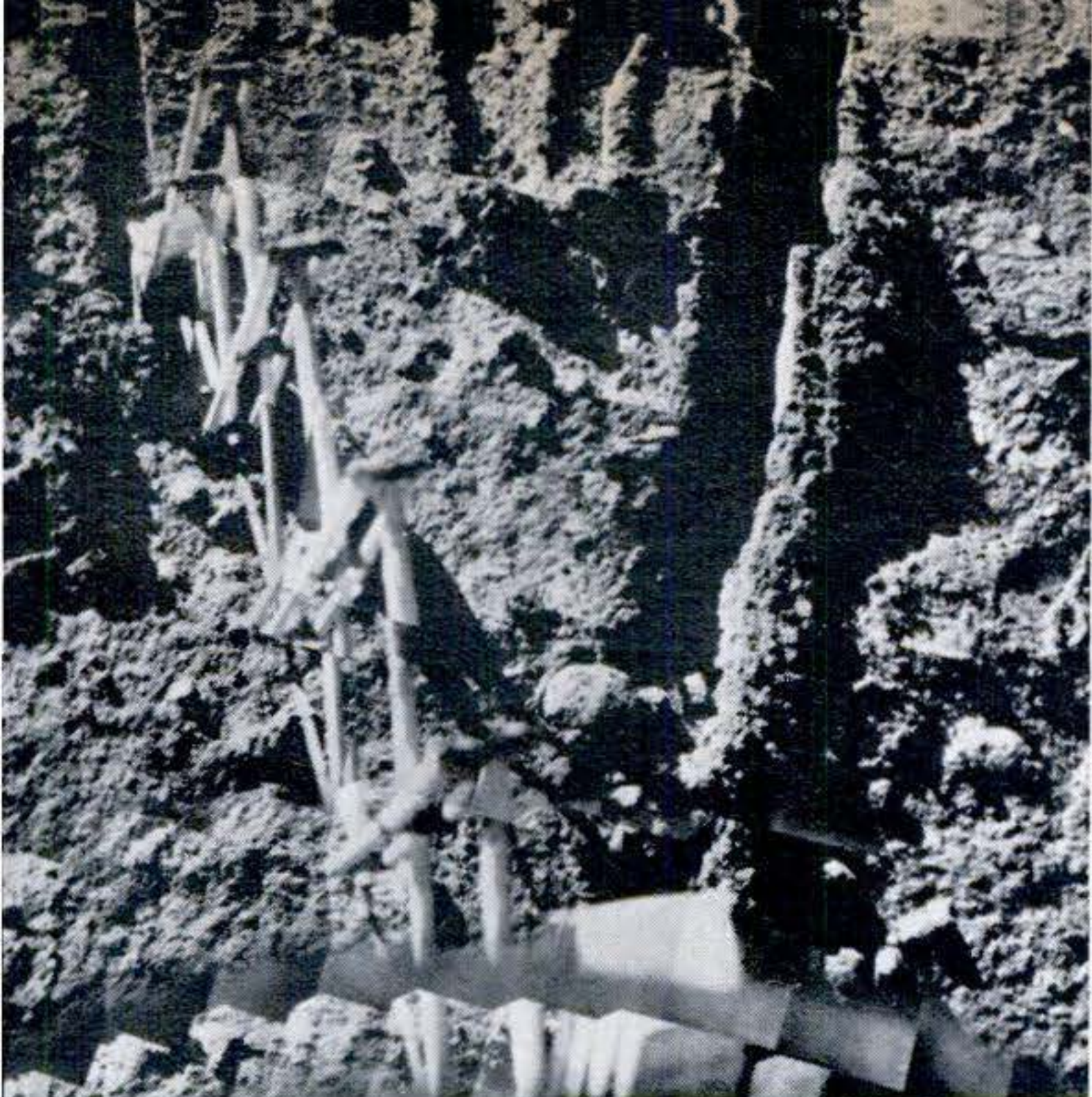
Little excavating tools on Surveyors

III and VII scooped up lunar soil, weighed it, and dug trenches in the moon's surface. "Chem kits" in cube-shaped gold boxes, lowered to the ground by Surveyors V, VI, and VII, told what lunar soil and rocks were made of. Magnificent TV pictures, sent back by all five successful Surveyors, revealed still more about the lunar surface.

Only now are geologists ready to interpret this wealth of fascinating new information. Here is what the Surveyors find the moon's surface is really like:

**What the Surveyors tell.** Walking on the moon will be a bit like treading on wet sand. You will leave footprints, but you will not sink. Wheeled vehicles will leave tracks but will not get mired. And the rocket exhaust from a landing Lunar





Surveyor VII's excavating tool starts digging a new trench, after scooping out the one to right of it, on highlands of moon near Tycho crater. Operator pushing buttons at Goldstone console, 240,000 miles away, controls motions. After making these trenches, versatile tool placed chemistry set on pile of dug-up soil, to get a subsurface analysis.



Cross on this striking Lunar Orbiter photo of great 56-mile-wide Tycho crater shows nearby landing place of Surveyor VII. It could visit this scientifically intriguing region of moon because earlier Surveyors had completed program's primary task of checking prospective Apollo landing sites in flat mares near lunar equator. (All photos from NASA.)

**Wielding chem kits and digging trenches by 240,000-mile remote control from earth, soft-landed Surveyors reveal what lunar surface's rocks and soil are really like**

# the Moon Is Made of

Module will not blast a deep crater.

Early in our Apollo program there had been grave concern whether a spacecraft landing on the moon might be swallowed up in a deep layer of dust. Some scientists thought the moon's surface, unprotected by an atmosphere from relentless bombardment by micrometeorites over millions of years, might have been turned into a powdery sort of quicksand. Photos televised by our crash-landed Rangers before impact, such as a picture of a loose rock resting on the lunar surface, gave the first strong evidence to the contrary [PS, Nov. '64]. Now the Surveyors have put an end to the "quicksand" bugaboo—both by surviving a landing, and by actually measuring the properties of the lunar soil.

At four widely separated sites, on the level mares selected for our first Apollo landings, the Surveyors find soil of amazing uniformity—giving confidence that our astronauts will not touch down on traitorous and unpredictable terrain.

**Facts and figures.** Typical soil of a mare consists of very fine particles of about 1/1,000-inch diameter, interspersed with coarser ones and rocks. The fine particles have a definite tendency to stick together, in a kind of cold-welding process that occurs in the absence of an atmosphere. (Some particles even clung to Surveyors' metal parts when thrown hard against them.)

As measured by the Surveyors, the uppermost layer's bearing strength can

*Continued*





If Apollo astronauts could land on made-to-order ground, says Dr. von Braun, our specifications would come close to what Surveyors have found on surface of moon.

be put this way: Suppose you gently set down on the moon's surface a full beer can—five square inches in area and weighing a pound on earth, but only  $\frac{1}{6}$  of a pound on the moon. It would sink in only about  $\frac{1}{10}$  of an inch. (If its moon weight were a pound, it would settle about a quarter of an inch.)

Bearing strength of the lunar surface, like that of snow, increases with depth. The moon's soil would be compacted to a depth of about an inch by a load of three moon pounds (18 earth pounds) placed on a half-dollar (one square inch). The same coin would sink in about two inches deep under a load of eight moon pounds (48 earth pounds).

How did the Surveyors tell us so? One way was with their feet. A strain gauge reported the force, often upward of 1,000 pounds, with which each of a Surveyor's three legs struck the lunar surface. Subsequent TV views showed the depth of the footpad's impression in the ground.

**Digging tools tested soil.** The little excavating machines on Surveyors III and VII contributed bearing-strength measurements, and others of interest.

Called a surface sampler, each electric-powered tool had a toy-size scoop of six-cubic-inch capacity, with a movable door. Mounted on a lazy-tongs arm within view of a Surveyor's TV camera, the scoop could be raised or lowered, swung through nearly a third of a full circle, and extended to five-foot reach. It could be pressed downward, or dropped from 40-inch height, to gauge the soil's strength by the impression made—and drawn back toward the craft to dig a trench, with the flow of current showing the effort required.

Some 240,000 miles away, the tool's operator sat at a console of the Goldstone tracking station in California, pushing buttons that actuated the device's four electric motors. The scoop responded with enough vigor to dig a trench two inches wide, 30 inches long, and seven

inches deep—modest in size but, a proud Surveyor-team member pointed out, "the greatest excavation ever dug by man anywhere, except on earth."

The versatile tool could weigh a scoopful of soil, too, by indicating the amount of current needed to elevate it.

One cubic foot of the porous material forming the uppermost layer of the lunar surface weighs about 50 earth pounds, the Surveyors report. As little as two inches beneath the surface, it weighs about twice that much, or 100 earth pounds. This is about the density of normal dry sand.

What is the moon's surface made of—rock and soil like the earth's, or minerals new and strange to us? First answers have come from a device amounting to a miniature chemistry set, called an alpha scattering instrument, carried on the last three Surveyors.

The five-pound kit occupied a six-inch cubical box with polished gold-plated walls to reflect away lunar heat, and a wide white skirt to support the open bottom. On command, a Surveyor lowered it on a nylon string about 30 inches to the ground. Radioactive curium in the box bombarded the lunar surface with alpha particles, able to penetrate just the top  $\frac{1}{1,000}$  of an inch of soil.

Some particles bounced back and detectors smaller than a dime measured their energies—which gave a telltale indication of the kind and approximate amounts of various chemical elements in the small sample examined.

**Analyzing the moon.** History was made by the first on-the-spot chemical analysis of another celestial body, last September, when Surveyor V lowered this instrument to the surface of the moon. Just as in earth rocks, the report came back, the most abundant elements were oxygen (58 percent of all atoms) and silicon (19 percent). Smaller amounts were measured of aluminum, calcium, magnesium, iron, and sodium.

From these preliminary and tentative figures, and the assumption that the oxygen is tied to other elements in oxides, NASA scientists calculated the likely proportions of chemical compounds present. The result identified the lunar material as earth-like basalt—similar to the volcanic

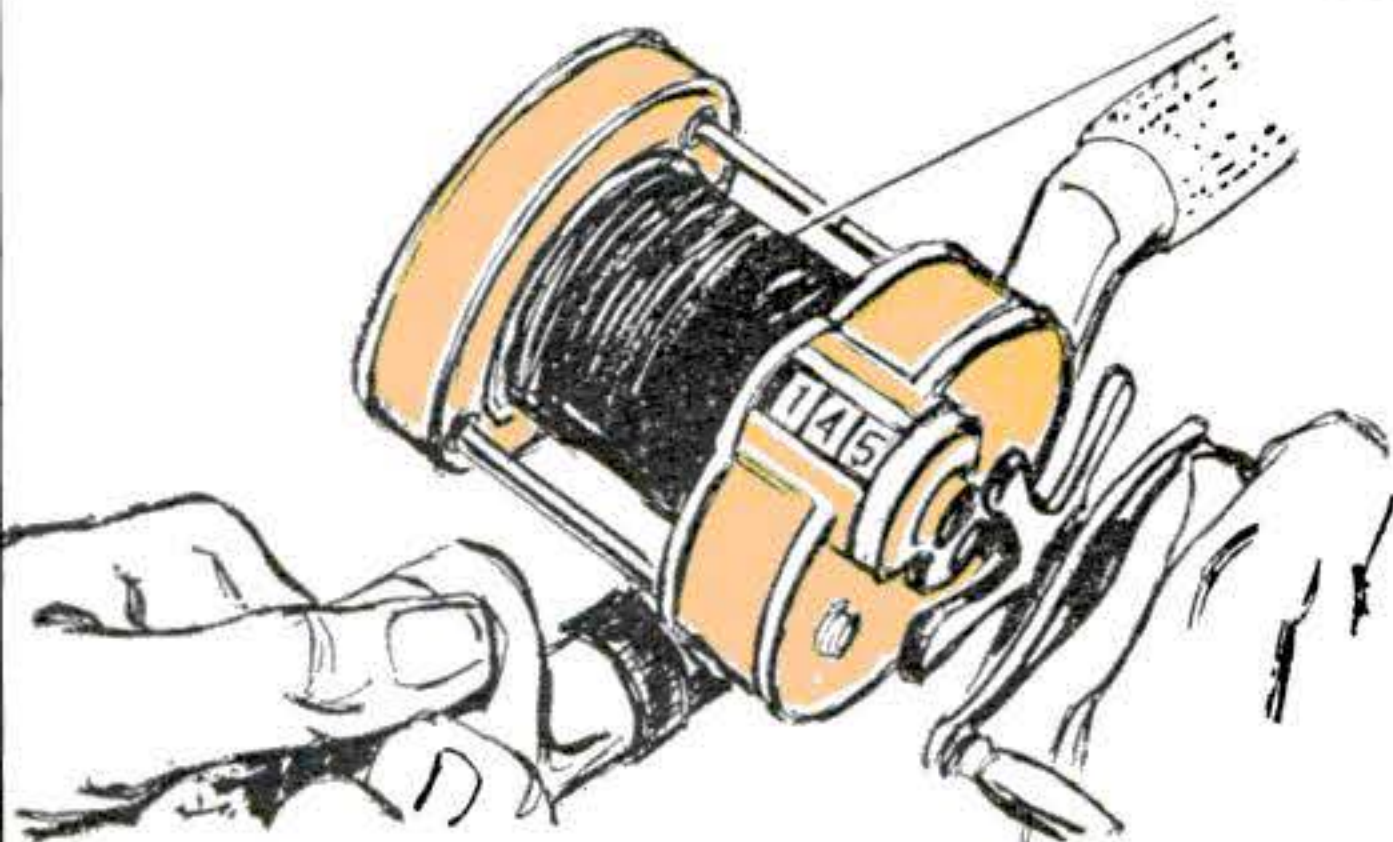
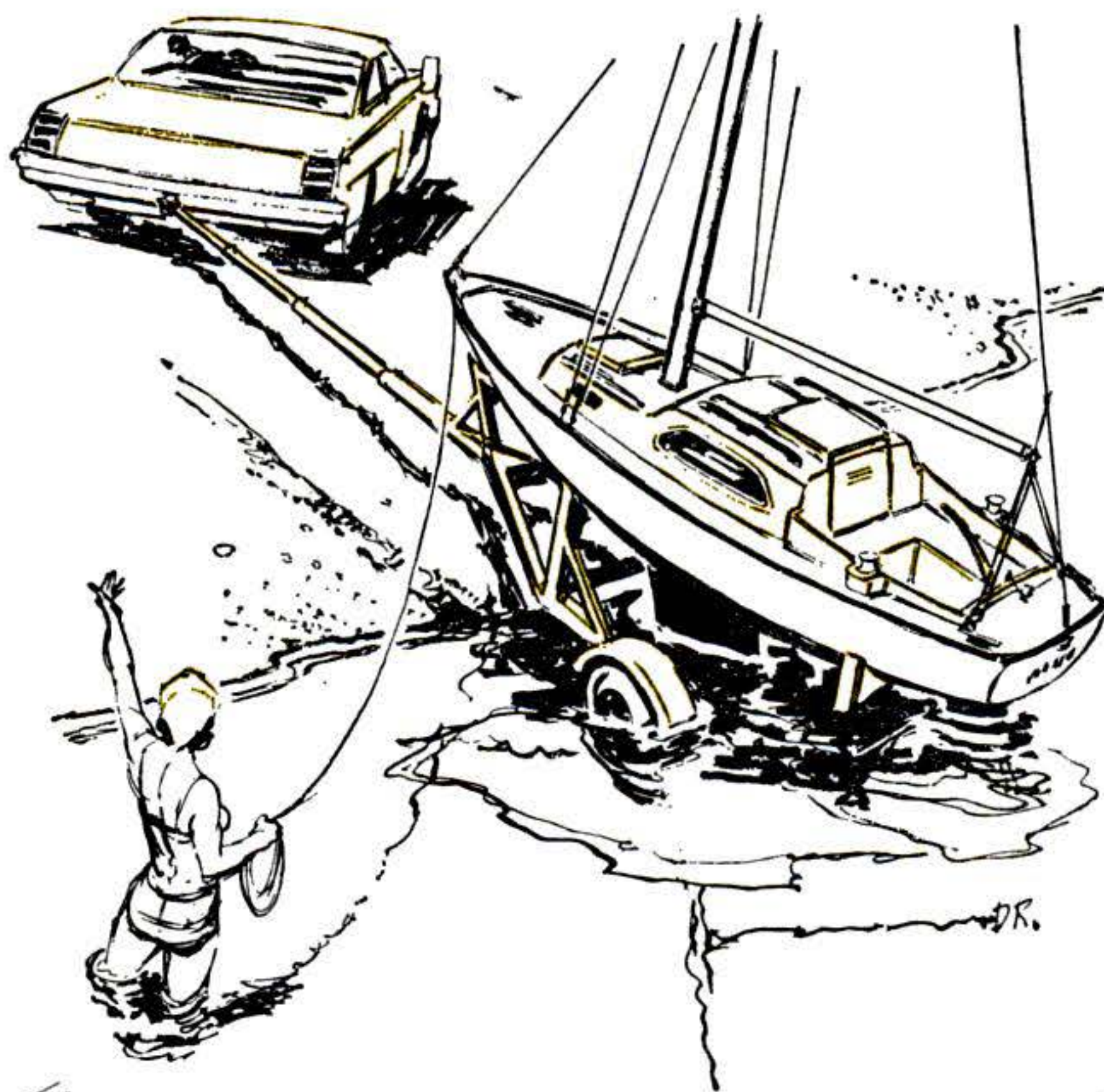
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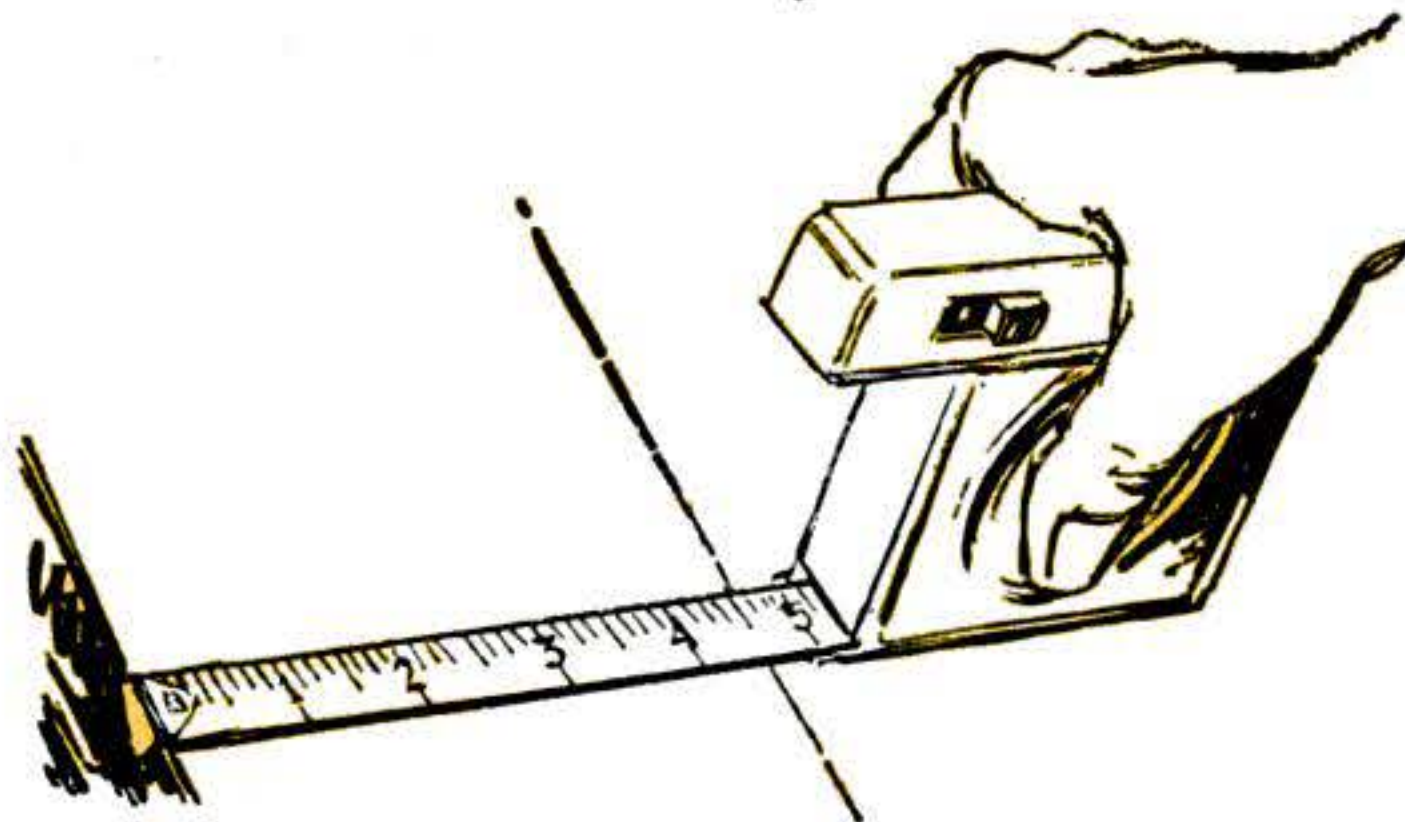
# I'd like to see them make..."

DRAWINGS BY DANA RASMUSSEN

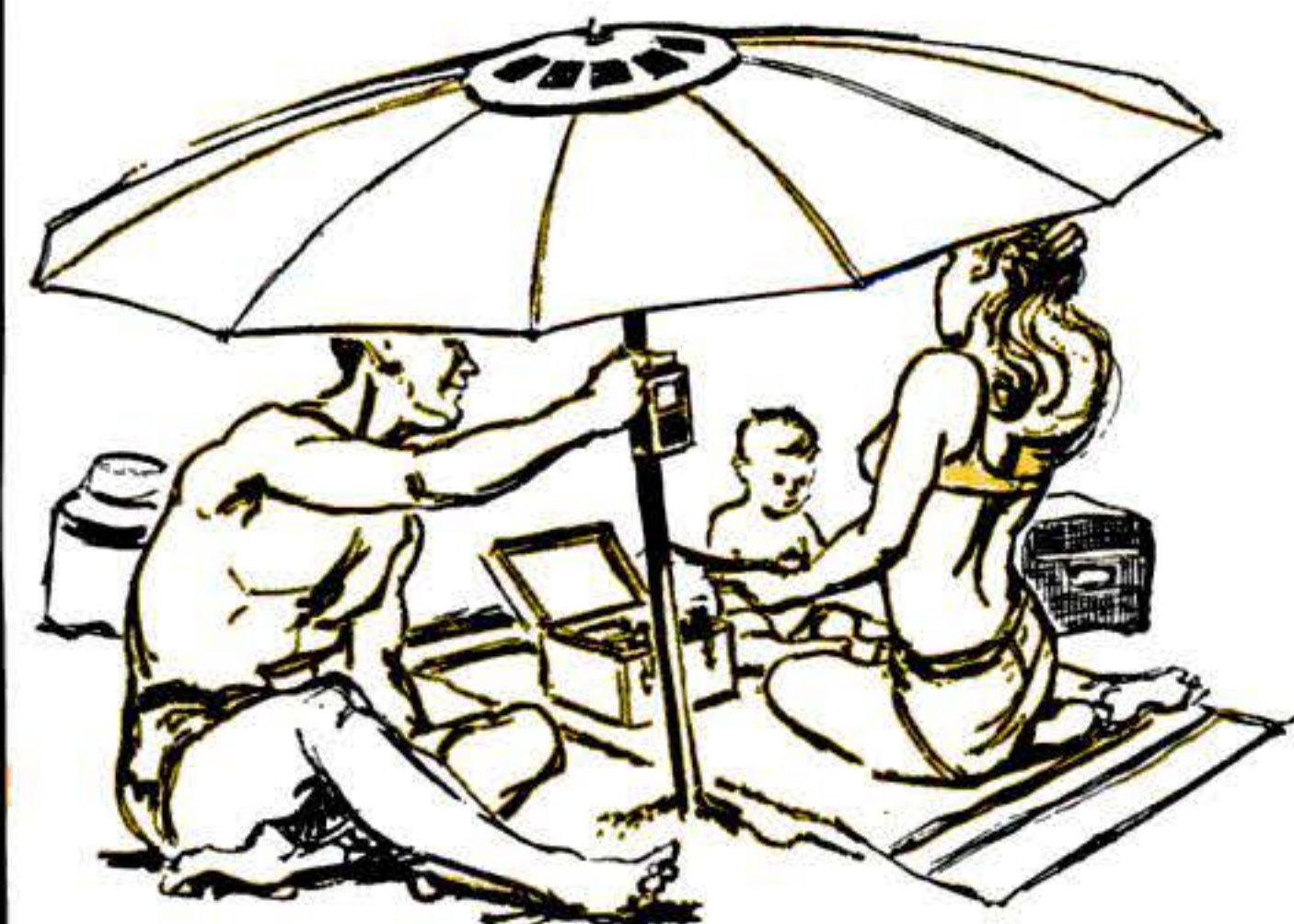
**Telescoping hitching tube** on boat trailers. You'd park, then launch or load your boat without getting the car wet.—*Russell Crittenden, Menlo Park, Calif.*



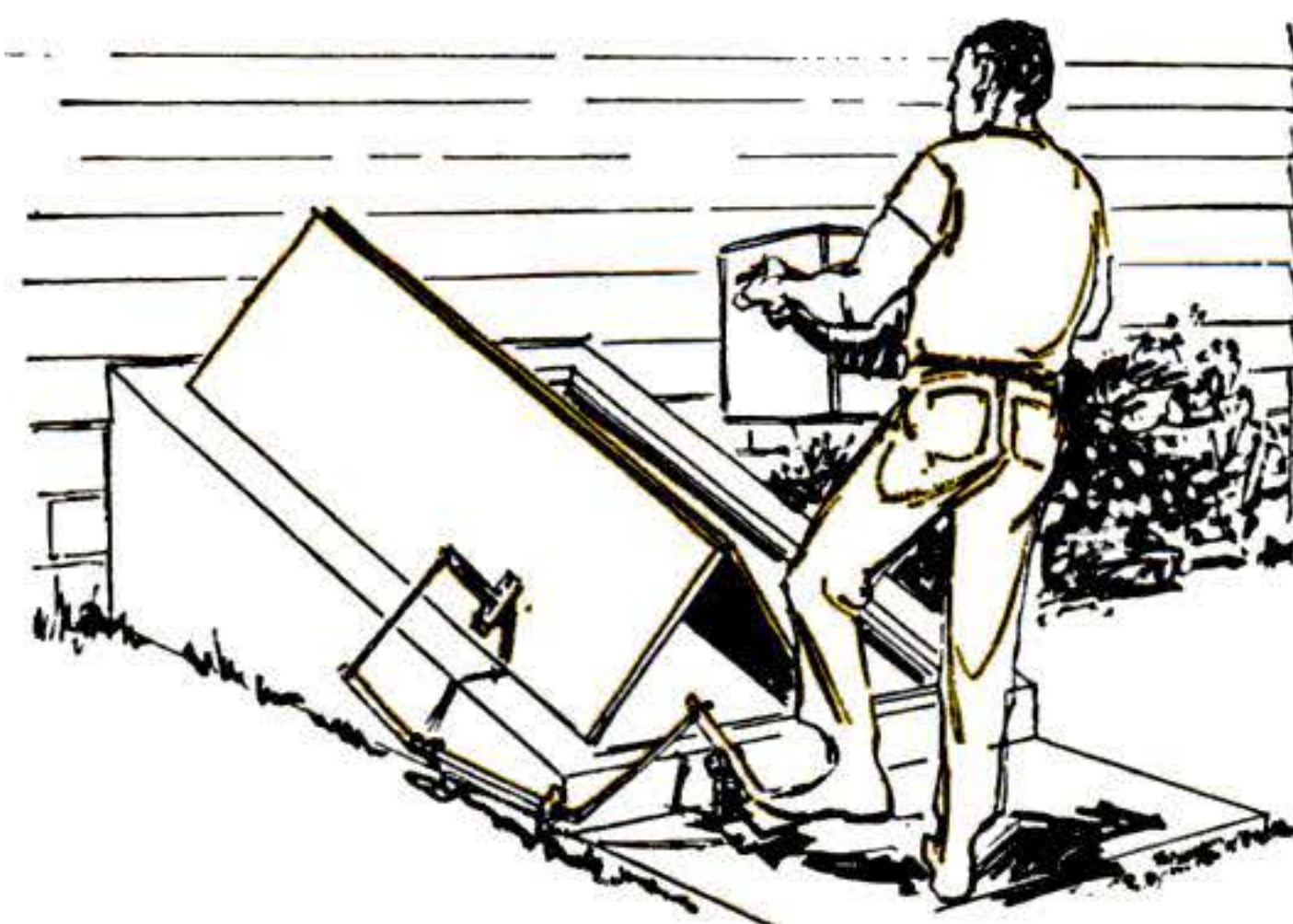
**Gauges on reels** for trolling or deep-sea fishing. They'd indicate the length of line let out and eliminate need for a marked line.—*D. N. Myers, Neffsville, Pa.*



**Illuminated tape rules** to prevent errors in reading. A piggyback flashlight would light up markings when you're working in poorly lighted areas.—*Fred Lettino, NYC.*



**A solar-battery radio** with power cells built into the top of a beach umbrella. Why keep running down batteries with all that sun around?—*David Gangel, Akron.*



**A pedal-operated opener** for unlocked cellar doors. When working outside, with arms full, you'd step on the pedal to raise the flaps.—*Norman Gramchuk, Port Alberni, Can.*

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—Ernest V. Heyn, Editor-in-Chief



Datsun's PL-510 had exceptional traction on the sand at Bridgehampton, due mainly to its independent rear suspension. Note that the wheels hang straight down with practically no camber. Only the front-drive Austin had better traction in loose sand.



## Small Cars that Really Go—

**These subcompacts fill a need that—except for the Rambler American—Detroit has ignored**

By **JAN P. NORBYE**/PS Automotive Editor  
and **JIM DUNNE**/PS Detroit Editor

**T**ired of driving through city and suburban streets with an empty car more than six feet wide? Had enough of parking an 18-foot-long vehicle in a 20-foot gap? Many people are, and they're turning to small cars with price tags around \$2,000 that have the power to tackle highway traffic with a full load.

One such car is the Rambler American—and it has pretty stiff competition from foreign cars, especially from Japan. Toyota sold 32,996 cars here in '67, Datsun 33,908. The Sunbeam Arrow is the latest Anglo-American coproduction, following Chrysler's take-over of control of Rootes.

When the \$1,998 MG 1100 was replaced by the \$1,845 Austin America, we kept it in this test, though by price it now belongs with the Kadett, Cortina, and Fiat [PS June].

We had several surprises—some good, some bad. For instance, we'll tell you

- Why the car with the biggest engine was not best on acceleration.
- Which car surprised us by its smooth off-the-road ride.

**Toyota Corona** (left) comes nose to nose with the Austin America. Datsun's PL-510 (upper left) and the Sunbeam Arrow (right) complete the quartet of \$2,000 cars. All are four-door except the Austin. The Japanese cars have dual headlights.







PHOTOS BY BILL MORRIS

# THE \$2,000 IMPORTS

- Why the Austin has such fantastic handling precision.
- Which car struck us as lacking in quality.
- What the Japanese designers forgot about rear-seat passengers.

## BRAKES

This test shows a car's ability to stop quickly, in a straight line, after repeated use of the brakes (as in stop-and-go highway traffic). Ten stops from 60 m.p.h. at one-minute intervals with half-g (16 feet per second per

**Toyota proved disappointing** in the braking test, taking over 200 feet to stop from 60 m.p.h. after warm-up. It had all the typical faults of hot drum brakes, with grab, single-wheel locking, and fade.

second) deceleration are followed by a final stop for maximum deceleration (minimum braking distance) from 60 m.p.h. in a 12-foot lane without wheel locking.

Results	Distance	Pedal Pressure
Austin	162 ft., 3 in.	100 lb.
Datsun	172 ft., 8 in.	80 lb.
Sunbeam	153 ft., 3 in.	105 lb.
Toyota	208 ft.	120 lb.

The Toyota's drum brakes were a disappointment. Not only was it difficult to stop the car, but the brakes were erratic

*Continued*

**Sunbeam was best** in the brake test, with a stopping distance of 153 feet three inches from 60 m.p.h. Pedal pressure was moderate (no power assist); front-wheel disks suffered no deterioration.





when hot and the car slewed left and right before coming to a standstill.

## ACCELERATION

The 0-60-m.p.h. test is intended to show a car's ability to reach cruising speed from standstill. The 0-80 test shows its high-speed power reserve. The 25-70-m.p.h. test simulates a highway merging situation or passing on a two-lane road.

Results	0-60	0-80	25-70
Austin	32.2 sec.		42.2 sec.
Datsun	21.4	42.0	20.5
Sunbeam	24.2	51.0	28.0
Toyota	22.6	46.9	26.7

The Toyota, with the biggest engine, was only second best, mainly because of its two-speed automatic. The Datsun proved quickest because it has an extremely willing overhead-camshaft engine and a three-speed automatic. The Austin, with less than 78 cubes, was outclassed. By the same strict standards we set for the VW last month, we cannot recommend it for turnpike driving. It has absolutely no power reserve at turnpike speed.

## LANE CHANGE

This test shows a car's ability to make an emergency maneuver at cruising speed. The right lane is blocked at a given point. The left lane is blocked 120 feet beyond. Each car



In lane change, Toyota had some body roll during this high-speed handling test, but felt completely stable. It was the best-balanced car and needed no steering corrections following move into new lane.

makes the two lane changes in succession, and the test is repeated until safe maximum speed is established.

Results: Austin 57 m.p.h., Datsun 60 m.p.h., Sunbeam 56 m.p.h., Toyota 55 m.p.h.

The Austin was uncannily surefooted in this test. Front-wheel drive and low engine weight combined with quick rack-and-pinion steering gave it clearly superior handling precision. With the Austin, it was possible to straighten out after passing the first barrier and then make a separate turn to avoid the second. With all other cars, you never stop turning the wheel but go from left to right in one move. The Toyota had some body roll but felt just as stable as the very flat-riding Sunbeam. The Datsun proved the fastest, although strong understeer caused the front wheels to lose sidebite and rub off speed.

## MANEUVERING

This test shows a car's ability to negotiate narrow, winding roads or heavy city traffic with sharp corners, stopped buses, and double-parked trucks. The car is driven as fast as possible on a snake course through pylons spaced at 48 feet.

Results: Austin 30 m.p.h.; Datsun 30 m.p.h.; Sunbeam 30 m.p.h.; Toyota 32.

In this low-speed traffic weave, the Datsun was limited by a combination of understeer and slow steering response; the Sunbeam by lifting of the inside rear



Sunbeam stayed flat, like a sports car, in all the test maneuvers. In an extreme situation, the driver can provoke oversteer to aim the little car in the right direction ahead of the actual lane change.



wider and wider on the turns. The Toyota proved perfectly balanced and was limited only by tire sidebite on all four wheels.

## FUEL ECONOMY

Because of the automatic transmissions, we were prepared for heavier gas consumption, and we were not surprised at the Sunbeam's 19.5 m.p.g. or the Datsun's 19.8 m.p.g. But the Toyota proved easier on the gas than expected, with 21.4 m.p.g., and the Austin was thirstier than expected, with 20.4 m.p.g.

## COMFORT, CONVENIENCE, FINISH

What sort of value do you get for your \$2,000? These cars are four-seaters, though five can squeeze in. Interiors are generally very well finished, and floors are fully carpeted. All have good heaters and flow-through ventilation (except the Austin). All have generously sized mirrors, inside and out. The simple instrument panels are patterned on modern U.S. designs, but there is no illumination of small controls for night-time use. All have hand-operated parking brakes. Each car has some flaws and some advantages that we'll describe in detail.

These cars also contain some ideas that may prove better than Detroit's, such as a dimmer switch wired to the turn-signal lever, and push-on, push-off radio and heater switches. However, we

found some of their ideas far from ideal, such as a horn button at the end of the turn-signal stalk.

## BEST FEATURES

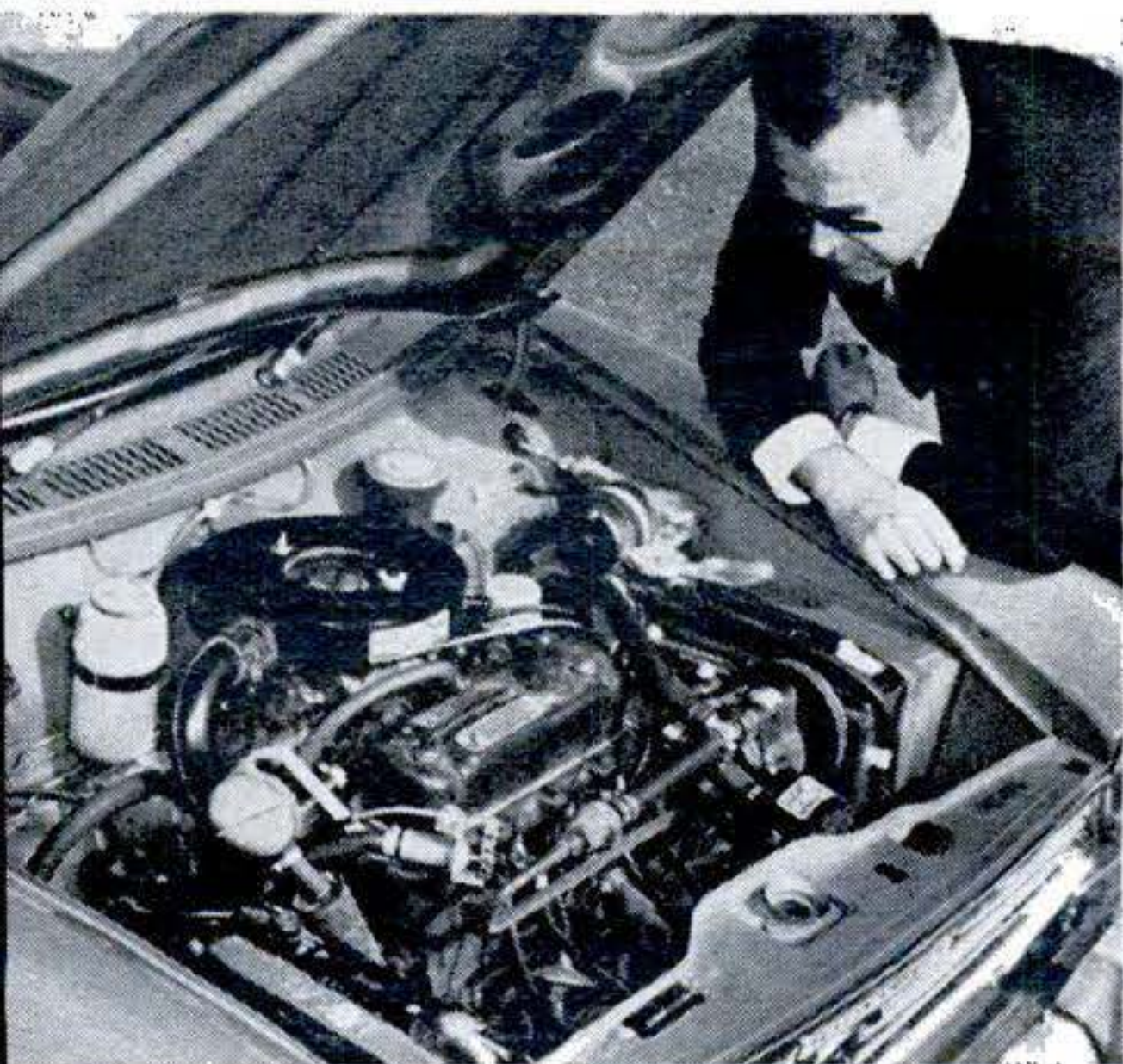
The Austin's best feature is its front-wheel drive, giving it not only superior handling precision but also better traction in the wet (and in loose sand). It also impressed us with its outstanding back-seat room.

We loved the combined inside door handles and locks. They resemble the Chrysler type, but with a locking mechanism that lets you tell at a glance whether the door is locked or not.

The Datsun, with its all-coil suspension, gave an excellent big-car ride, on good roads or bad, with a full load or driver alone. The high-grade ride is emphasized by a tight, solid body, low road noise, and an almost total absence of wind noise. It's the only car in this group without vent windows on the front doors, which gives it superior forward and side visibility.

Front seats are well designed, generously padded, and obviously expensive (but have no recliner mechanism). The seat texture is a weavelike vinyl designed to keep passengers cool over long distances. The instrument panel has been designed with full regard for crash safety, and small controls are sensibly grouped and within easy reach. Wiper arms carry

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Austin engine is placed across the chassis in the nose of the car, and drives the front wheels via a four-speed automatic transmission housed in the crankcase. This layout saves a lot of space.

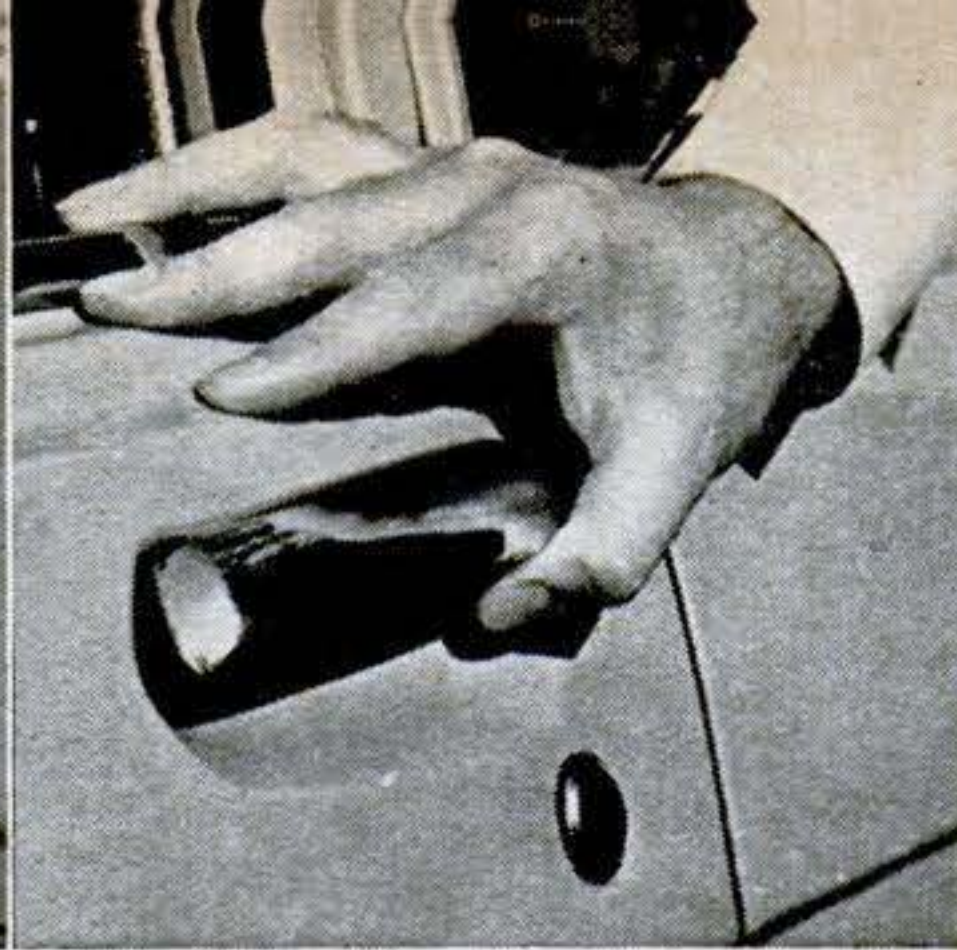


Single-overhead-camshaft engine is the first thing you notice when you open the Datsun's hood. Service accessibility was good but not outstanding. Norbye's left hand holds the distributor cap.





Locking lid for gas filler is a standard and good feature on the Datsun. The ignition key opens it, but the trunk-and-glovebox key won't.



Smooth-edged tilt-up door handles on the Datsun were easy to operate, and they look smart, too. They do not add to car width.



Squareback styling on the Austin America has been combined with a reasonably large trunk. Spare wheel, gas tank are under floor.

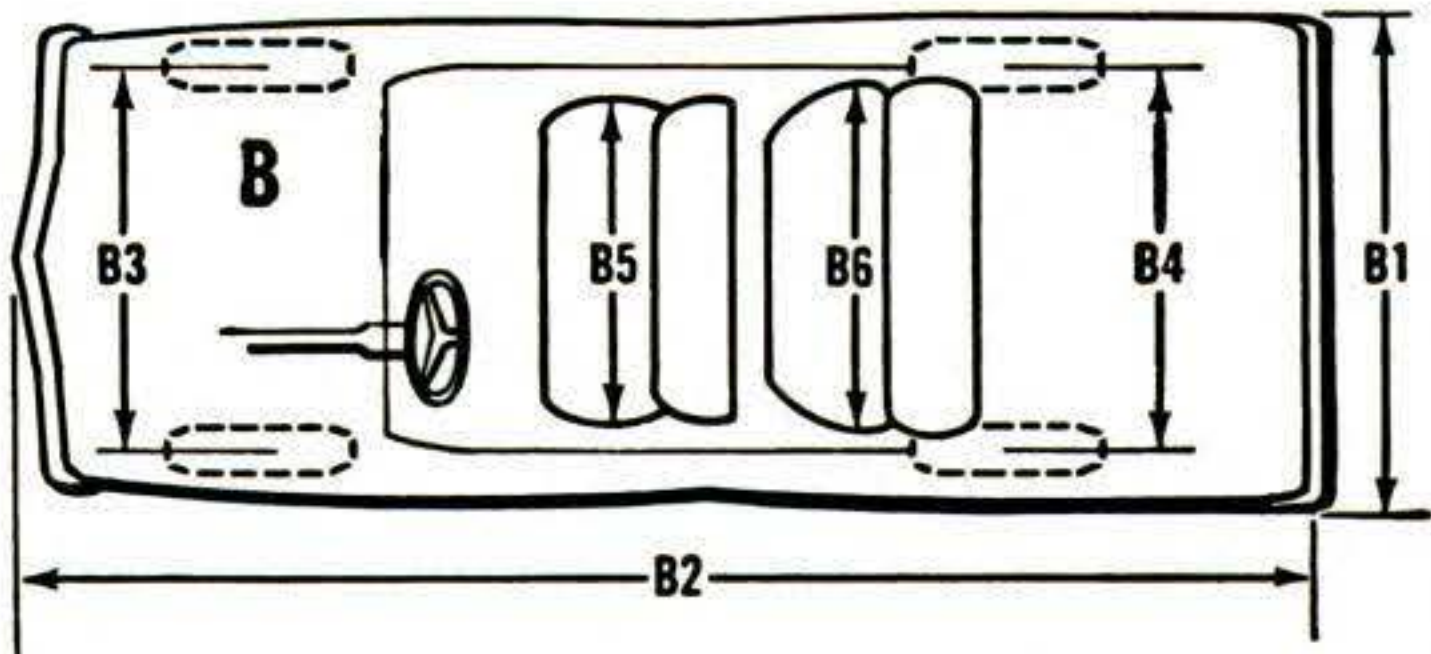
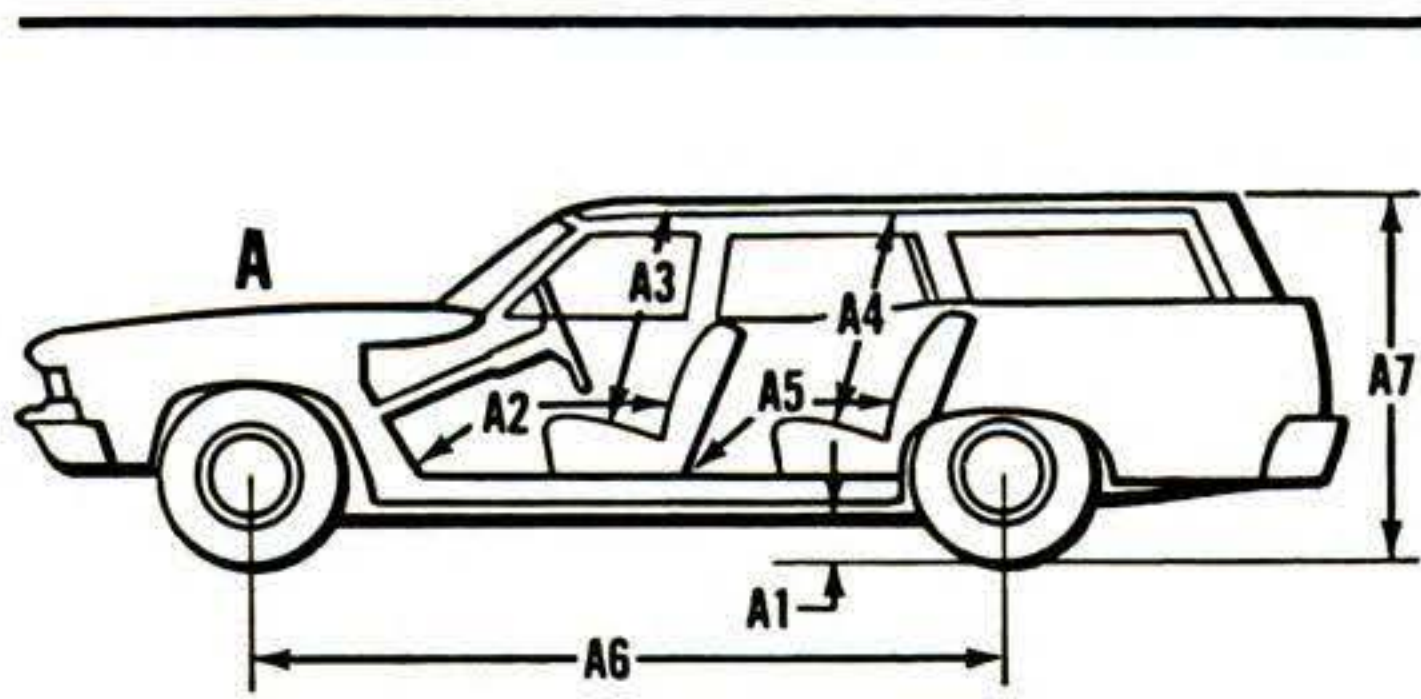
an airfoil to keep them on the windshield at high speeds. The outside door handles offer remarkable ease of operation and look smart.

The Sunbeam has truly modern design and excellent space utilization. The pleasant interior is well laid out, with large glass areas and bright colors. It's the only car in the group with reclining front seats. Its under-hood accessibility

is outstanding. The spare-wheel position is eminently practical (see photo).

The Sunbeam handles like a sports car, with a flat and somewhat stiff ride. It proved faster around Bridgehampton race circuit than the more powerful Japanese cars because of its superior road-holding.

While the ventilation system in the Japanese cars is dependent on vehicle



DIMENSIONS (inches)	AUSTIN America	DATSUN PL-510	SUNBEAM Arrow	TOYOTA Corona
A1 Ground clearance	6	6.9	6.7	7.1
A2 Front leg room (max.)	42	43.5	42	42
A3 Front head room	37.2	36	36.8	37.5
A4 Rear head room	33.7	33.3	33.6	33.5
A5 Rear leg room (min.)	40	36	35	38
A6 Wheelbase	93.5	95.3	98.5	95.3
A7 Overall height	53	55.1	56	55.9
B1 Overall width	60.4	61.4	63.5	61
B2 Overall length	146.7	162.2	169.5	162.4
B3 Front track	51.5	50.4	52	50
B4 Rear track	50.9	50.4	52	50
B5 Front hip room	47.5	50.6	47.8	46.5
B6 Rear hip room	50.5	50	48.7	49

SPECIFICATIONS	AUSTIN America	DATSUN PL-510	SUNBEAM Arrow	TOYOTA Corona
Engine type	OHV 4-in-line	SOHC 4-in-line	OHV 4-in-line	OHV 4-in-line
Bore & stroke	2.78 x 3.20 in.	3.30 x 2.90 in.	3.21 x 3.25 in.	3.46 x 3.07 in.
Displacement	77.9 cu. in.	97.3 cu. in.	105.2 cu. in.	115.7 cu. in.
Compression ratio	8.8:1	8.5:1	8.4:1	8.0:1
Power @ r.p.m.	58 @ 5,250	96 @ 5,600	73 @ 4,900	90 @ 4,600
Torque @ r.p.m.	69 @ 3,000	99.8 @ 3,600	99 @ 2,700	110 @ 2,600
Driving wheels	Front	Rear	Rear	Rear
Axle ratio	3.76:1	3.70:1	3.89:1	3.70:1
Transmission	4-speed BMC automatic	3-speed B-W automatic	3-speed B-W automatic	2-speed Toyoglide
Tires	Dunlop	Bridgestone	Goodyear	Dunlop
Tire size	5.95-12	5.60-13	5.60-13	6.00-13
Turning diameter	36.9 ft.	31.4 ft.	33.5 ft.	32.5 ft.
Turns, lock to lock	3.5	3.2	3.3	3
Brakes	Disk/drum	Disk/drum	Disk/drum	All drum
Front springs	Hydrolastic struts	Coil	Coil	Coil
Rear springs	Hydrolastic struts	Coil	Leaf	Leaf
Curb weight	1,932 lb.	2,117 lb.	2,195 lb.	2,360 lb.
Basic price	\$1,845	\$1,996	\$2,086	\$1,870
Price as tested	\$1,845	\$2,161	\$2,251	\$2,035





Sunbeam trunk has about 13 cubic feet of useful space, and the spare-wheel mounting is ingenious. You need not touch your luggage to get the tire out, and a quick-release clamp holds it in place.

For speed for air flow, the Sunbeam's fresh-air intake is led through the fan duct, so you can get a stream of fresh air even when the car is standing still.

The Toyota stands out for the tough-car feeling it gives you as soon as you ride in it. The body never utters a sound, even at 30 m.p.h. on rough terrain. Its boulevard ride off the road was a revelation, and its handling on bad roads set it apart from the other cars. On the highway, also, it's a remarkably quiet family sedan. The interior is particularly well finished, with extras like a socket for an optional inspection lamp, a reset-button odometer, and assist handles above the doors. In addition to the roomy glove box, there's a wide shelf below the instrument panel.

## WORST FEATURES

Austin's cockpit layout is by far the worst feature. The steering wheel is almost flat, as in a bus, and is set askew to the chassis center line. The pedals are offset to the right, with the steering column coming down left of the brake pedal, almost precluding left-foot braking. The floor-mounted transmission selector is less than knee-high, and you have to look down to see which position you have selected. At night, gear identification is impossible except by ear or by shifting up to Drive and counting the notches back again. Front seats are small and give the driver very poor thigh support.

Other drawbacks include a loud hum from the engine/transmission unit at highway speeds. Rear windows crack open at the rear edge, do not roll down. The only body style is a two-door sedan. Instrument panel and heater controls are designed without regard for crash pro-

[\[Continued on page 189\]](#)



Austin cockpit was not satisfactory. Note short transmission selector on floor, and small size of brake pedal (which is mounted well over to the right).

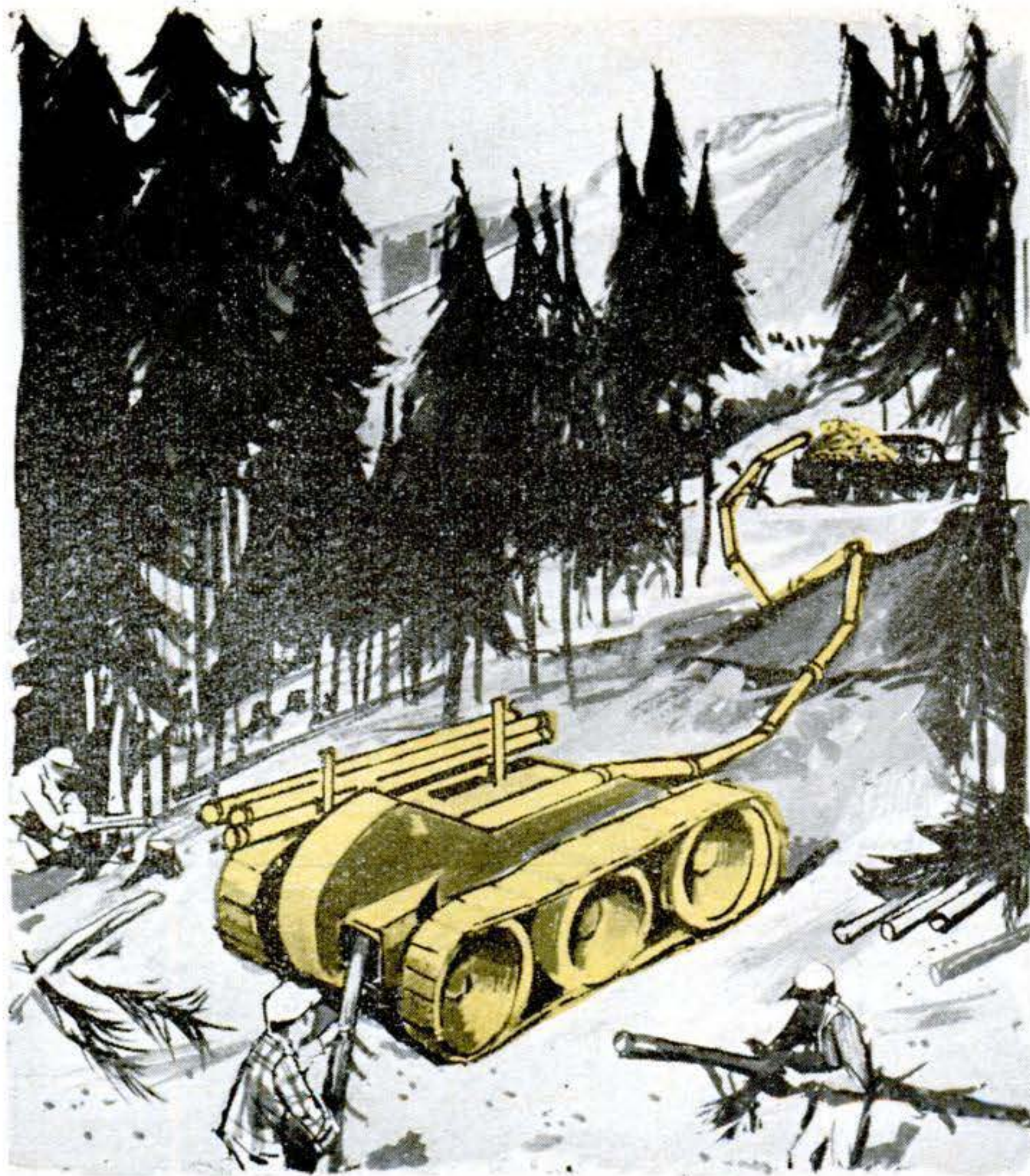


Seating comfort and space in the back of the Austin was amazing. With the center armrest folded back, the seat is wide enough for three persons.



Sunbeam alone had reclining front seats, adjustable by a handle at base of backrest. We liked the generous window areas and bright colors inside this car.

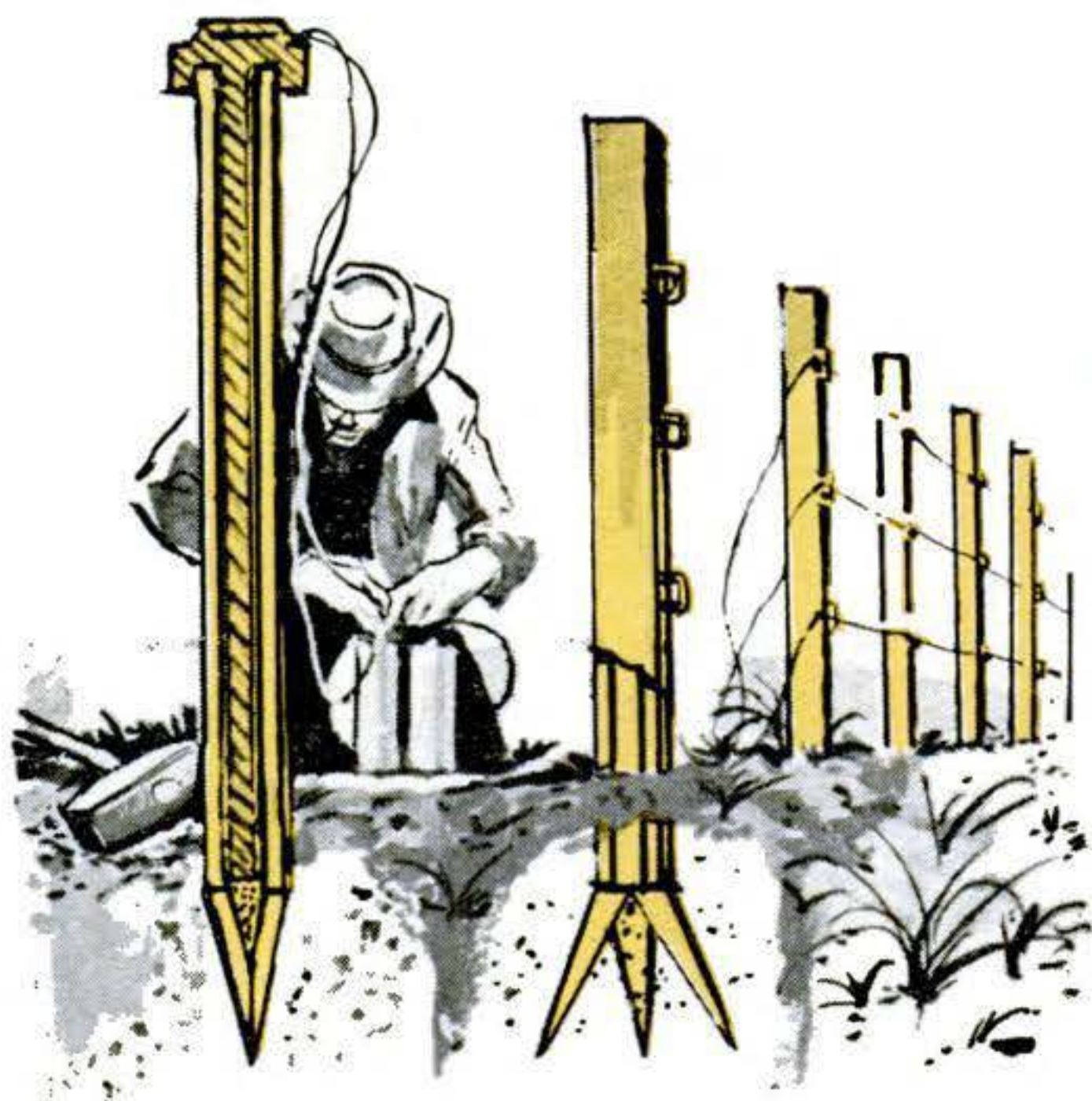




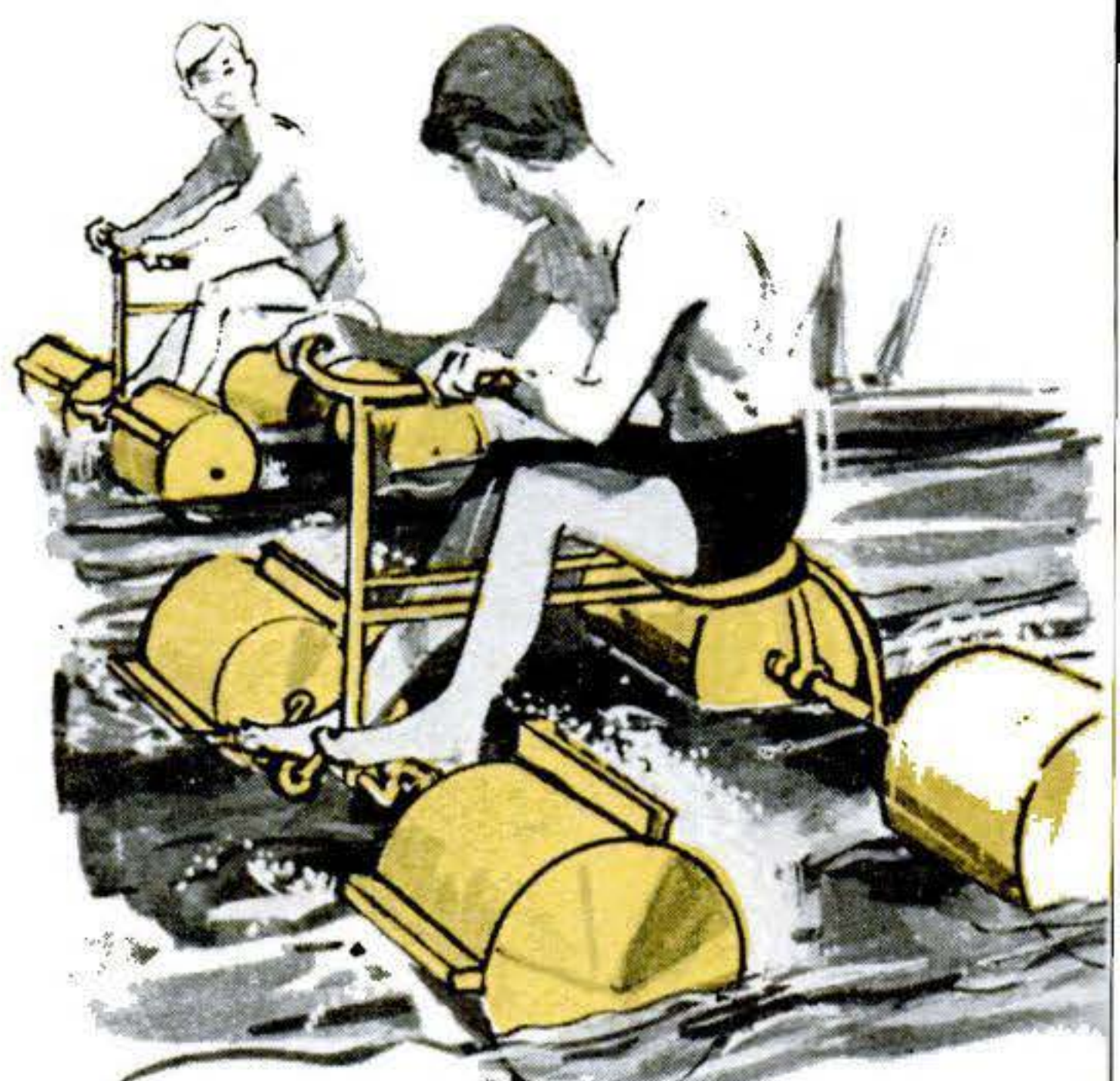
# New Ideas from the Inventors

DRAWINGS BY WILLIAM CASTIMOR

**Logger chips and pipes wood.** Small trees could be utilized more economically, according to this recent patent, by reducing them to chips deep in a forest and piping the chips to a pickup point near a road or waterway. The engine of this self-powered tractor would drive both chipper and blower. Pipe sections would be added as the chipper moved deeper into a tree stand. Chips are valuable for composition board or paper.

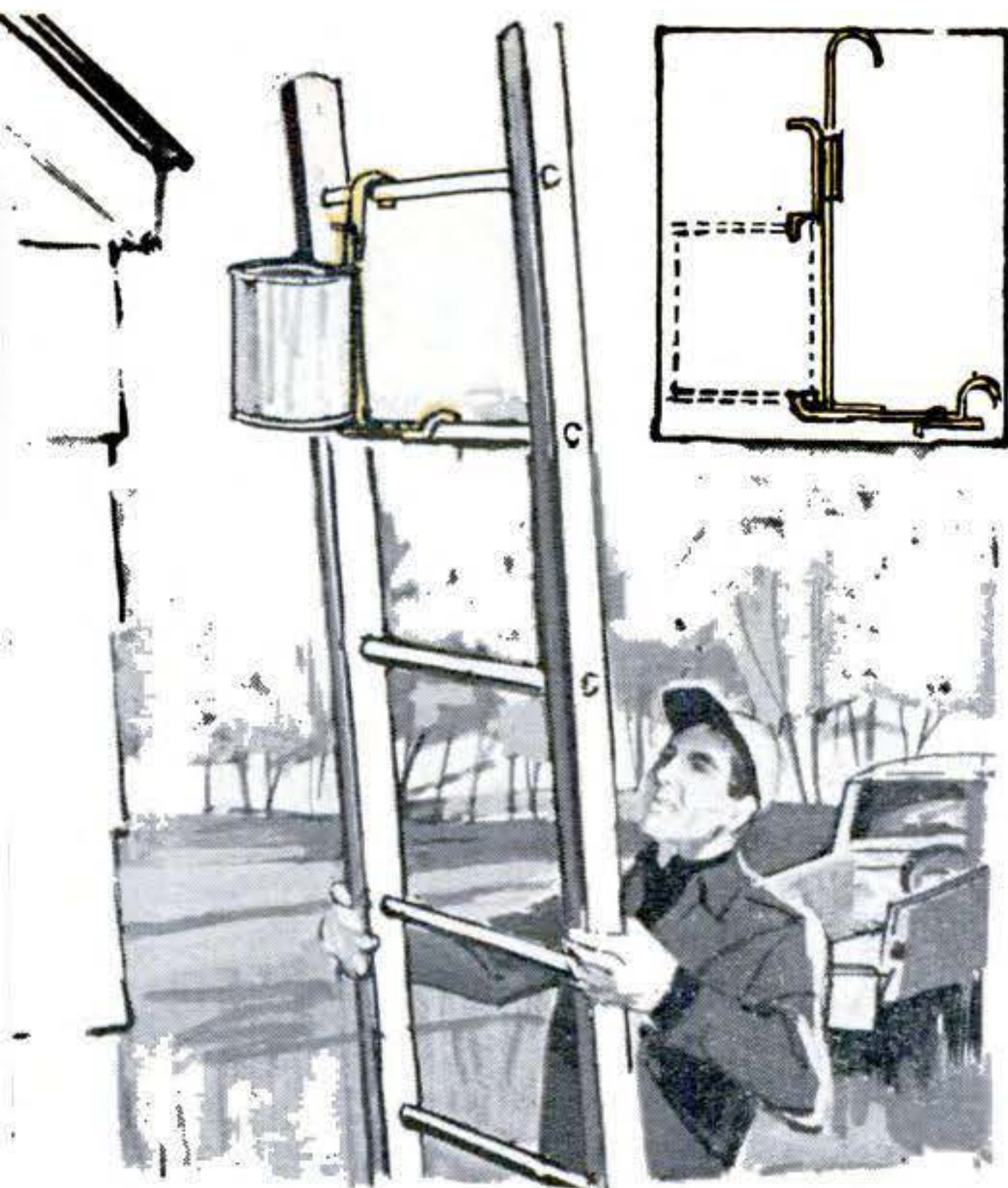


**Explosive charge anchors fence post.** Detonating a small charge in the tapered end of this hollow post would spread and anchor the points in the hardest ground. To avoid buckling the thin walls of the post while sledging it into place, a solid rod and cap would be inserted. These would be removed so the charge could be dropped in, then replaced to confine the blast.



**Cycle pedals on water.** Watertight metal or plastic drums fitted to a tricycle frame would keep this water vehicle afloat and navigable in either shallow or deep water. Fins on the front drums would propel the cycle—forward or backward—when the rider pumped the pedals. The wide stance of the buoyant drums would make the tricycle stable and sufficiently safe for use by children.

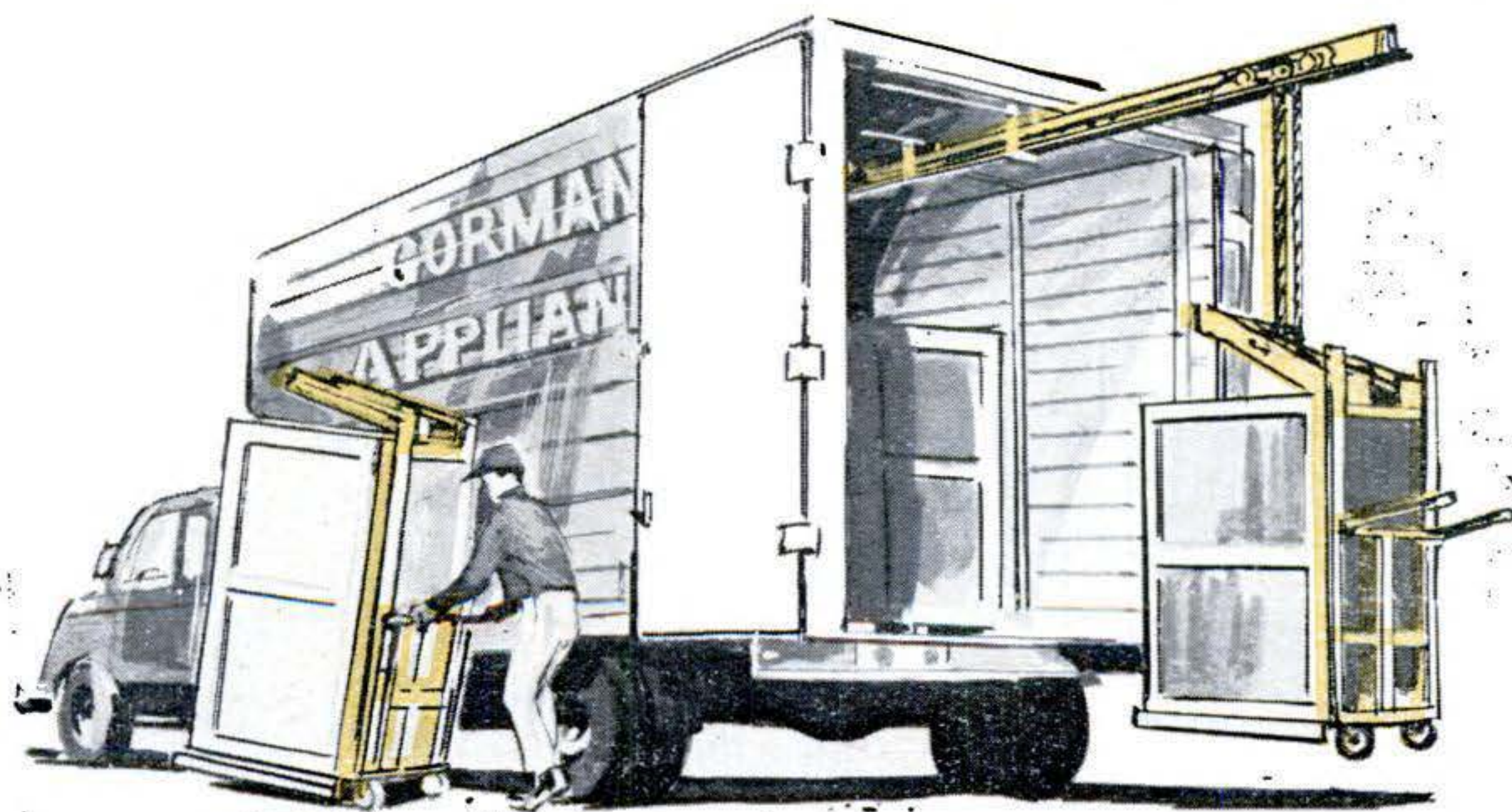




**Ladder bracket grips paint can.** You wouldn't have to move a paint can before moving a ladder if it were held to the rungs with this nonslip, nonslop bracket. Sliding arms would grip two rungs as well as the top and bottom rims of the can. The bracket would hold pails as well as bail-less cans, and could be moved rung to rung without disengaging the can.



**Heated dipper scoops ice cream smoothly.** Mild heat applied to the aluminum bowl of this plug-in ice-cream dipper would make it easy to scoop hard-frozen ice cream and would keep it from sticking to the scoop. A thermostat would let the exposed metal get warm, but not dangerously hot, and insulators would keep the handle cool to the touch.



**Truck rail loads cargo and carrier.** Suspended from a slide-out conveyor rail, this fork-base and truck could be used to load, shift, raise, or lower palletted cargo. An overhead arm

would steady the load while it was being lowered or moved in or out of the van. With cables detached, you could wheel away the hand truck and its cargo in the usual way.

The following patents have been issued on these inventions: **Tree chipper**—No. 3,356,116 to P. G. Brundell and K. E. A. Jonsson, Gavle, Sweden; **Post anchor**—No. 3,305,985 to H. T. Dean, Williamsport, Md.; **Water vehicle**—No. 3,249,084 to T. Plants, De Witt, Ark.; **Ladder bracket**—No. 3,312,441 to D. A. Molenda, North Royalton, Ohio; **Heated scoop**—No. 3,299,838 to R. N.

Thietje, Kennewick, Wash.; **Carrier**—No. 3,295,881 to S. W. Worthington, Waterloo, Iowa.

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.



# Evinrude Rigs a COHO CHARGER

The new Sportfisherman may not cure "coho fever,"  
but it will make the sport more fun

By JIM ROE / PS Boating Editor

**T**hroughout many parts of the country there has sprung up a thing called "coho fever." It is suffered by fishermen who are dedicated to going after this variety of salmon. It is particularly virulent in the area of Lake Michigan, which was seeded with about three million of the fish. Many other waters have been similarly stocked.

Now Evinrude has come out with a brand-new boat ideally suited for the sport. Called the Sportfisherman, it has been dubbed the "coho charger" by the eager fishermen who have had a preview go at it—for it gets them out to their favorite fishing grounds fast.

The Sportfisherman will be available this month, but POPULAR SCIENCE had a chance at it last April, and we promptly checked out the boat where the test would be most meaningful—out in Lake Michigan's choppy water.

Of course, this is not just a Lake Michi-

gan boat. It's a tough and rough fishing craft that will give a good account of itself offshore in either ocean or the Gulf, as well as all the Great Lakes.

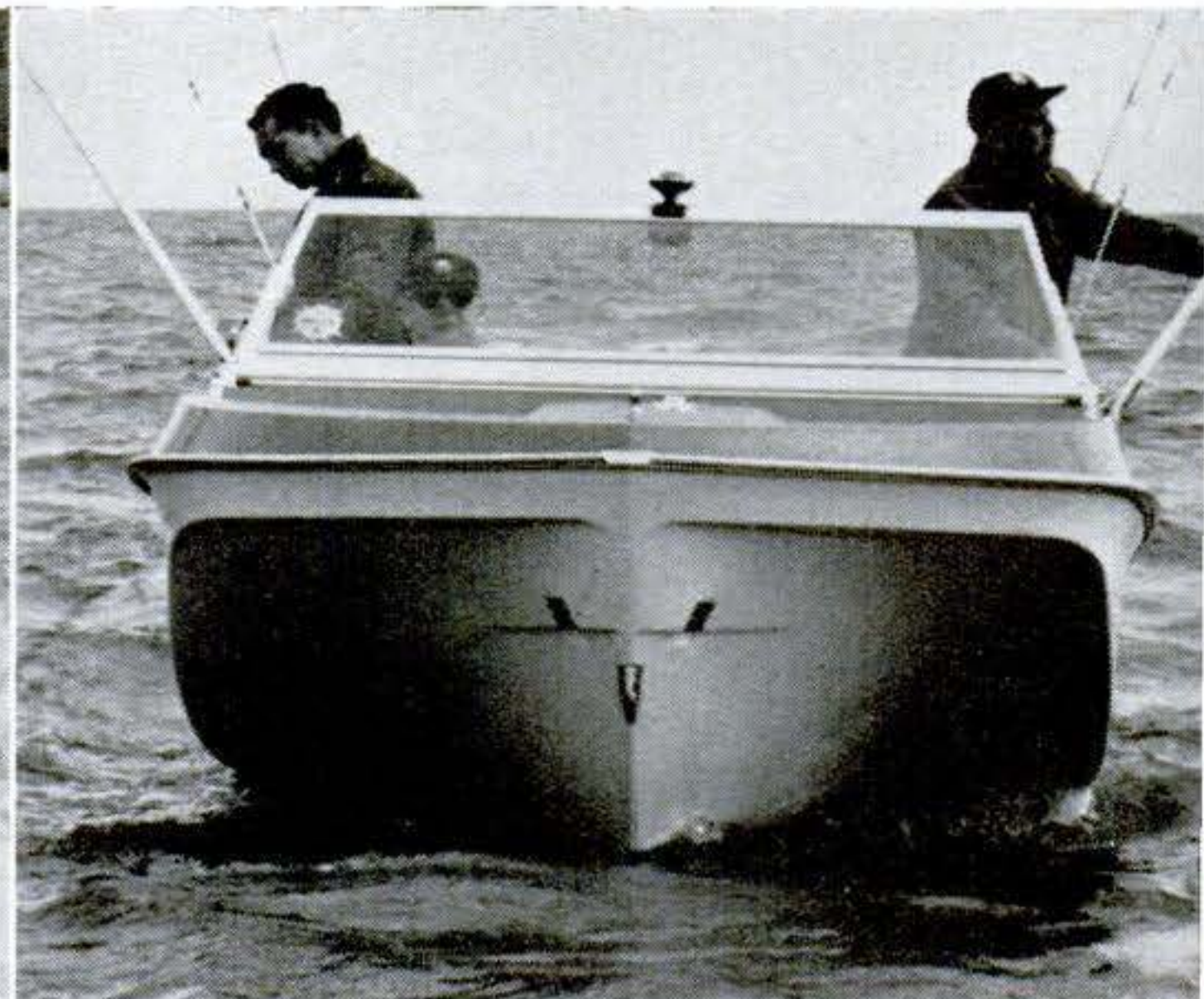
The new boat began with a 19-foot version of Evinrude's Gull-Wing hull. This fiberglass craft has already proven its stability and seaworthiness in waters all over the world. It does indeed fly like a bird on smooth water. In a nasty chop, its triple-keel effect gives it excellent stability. It doesn't tilt even when almost everyone rushes to one side. As a luxury family runabout and ski boat, this hull has given a great account of itself, usually powered by a 200- or 210-hp. stern-drive engine.

A fisherman's requirements, however, are a bit different. So the first thing Evinrude did was to install a 120-hp. stern drive. This gives greater economy for all-day trolling. Our test boat was clocked at 36 m.p.h. off Milwaukee. And we had a full 24-gallon fuel tank, three men, and complete fishing and safety gear aboard.

*Continued*



Coho charger gets out there fast. Rods in holders at the stern have lines extending straight down. Multikeel hull dampens chop effect; smooths ride.



Gull-Wing design is shown in this head-on photo. It gives the Sportfisherman her stability and easy handling in rough water. No problems here.





Roomy is the word for the new coho charger. Uncluttered cockpit has plenty of room for tackle

boxes, ice chests, and fuel tank for the auxiliary six-hp. outboard. Beam is seven feet, four inches.



Sportfisherman easily handles four lines. Two are rigged from rods in holders amidships, with lines extending up and out from the outriggers. Trolling

was comfortable and easy, both with the regular 120-hp. inboard and with the six-hp. outboard. Multikeel dampens chop effect for better fishing.

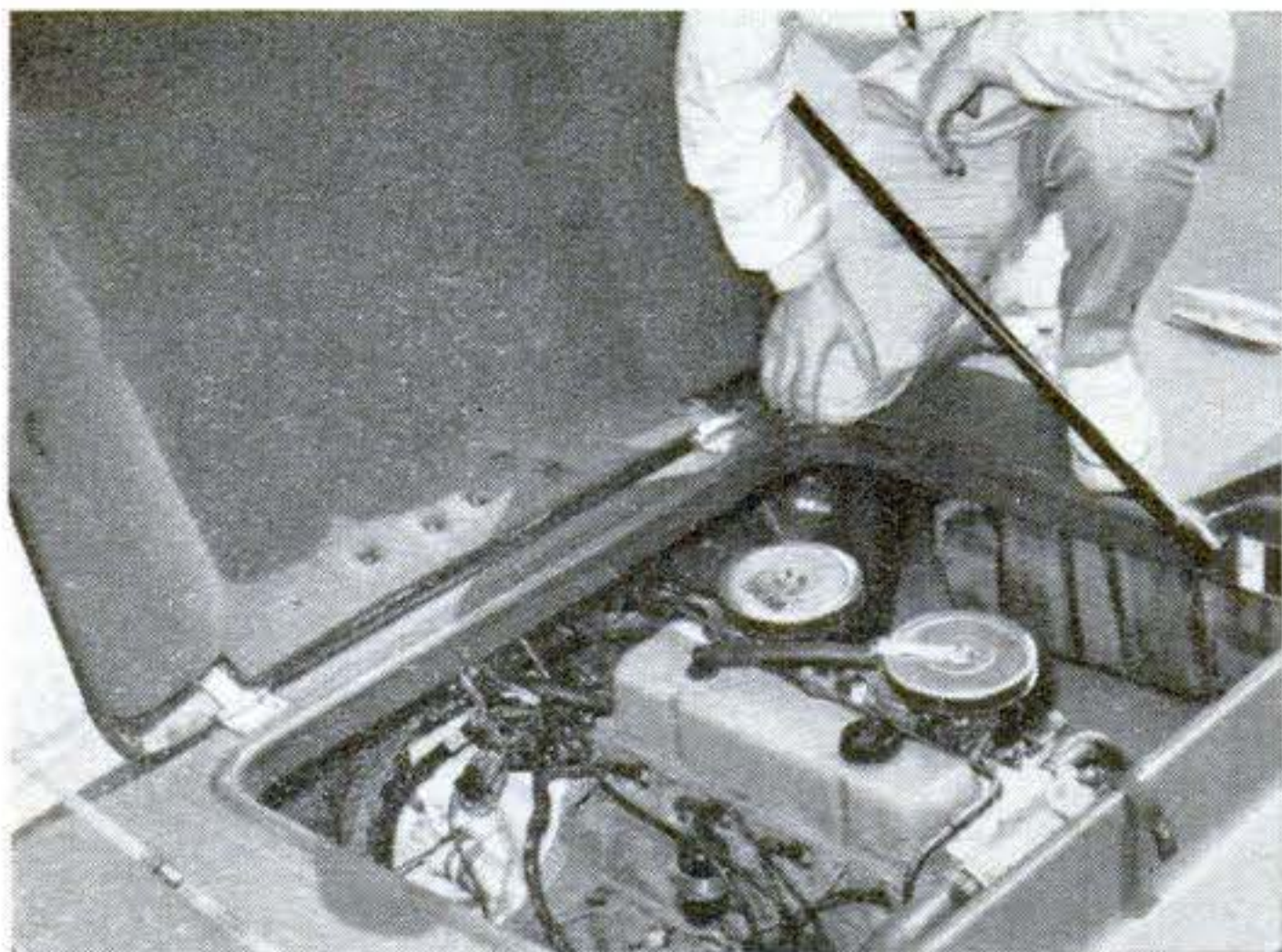




Here's fishing tackle in the fishing box. A place for everything and everything in its place is the order of the day in this new boat. All gear tucks neatly out of the way in handy stowage compartments.



Coho fishing—or any kind of fishing offshore—needs a lot of equipment. Here is some of the gear installed on the POPULAR SCIENCE test boat—including safety devices and necessary fishing tackle.



A 120-hp. engine powers the Sportfisherman, instead of the 200-210 job used in the same hull type for the family runabout. The 120 horses proved ample, however, giving a top speed of 36 m.p.h.

The Sportfisherman also comes with these items as standard equipment: power tilt for the stern drive, tachometer, fuel gauge, ammeter, bilge pump and bilge blower. And there are a few other appetizing items that had not yet been fully worked into the specifications when we made our test.

For an auxiliary, if we needed it, our test boat was rigged with a six-hp. Evinrude outboard as an economical source of standby power. And some people like to troll with a light outboard instead of with the 120-horse inboard. We tried it, and it had plenty of power for trolling even with a moderate chop on the lake. The outboard wasn't connected to any steering device, but we found the boat responsive by turning the steering wheel and using the regular stern-drive lower unit as a rudder.

Fancy fittings are fine when you expect to have bikini types aboard. But for coho charging you want a *working* boat. This, Evinrude gives you in the new Sportfisherman—removing the lounge seats and leaving the entire after three-fourths of the large cockpit free and empty, with lots of room for fishermen to move around. The boat handles four lines with ease. **PS**

### Specifications: Evinrude Sportfisherman

<b>Dimensions</b> .....	Overall length—19' Maximum beam—7'4"
<b>Performance</b> .....	Slow troll to over 32 m.p.h.
<b>Seating</b> .....	2 bucket seats forward
<b>Hardware &amp; equipment</b> . . .	Washable vinyl flooring, bilge pump and blower, battery, electric power tilt, trailer bow-eye, bow and stern lifting eyes, four deck cleats, glove compartment, built-in ski and rod storage troughs, rear-view mirror
<b>Windshield</b> .....	One-piece windshield with air vent, on Rogue without deck hatch
<b>Fuel tank</b> .....	24-gal. fuel tank in stern
<b>Capacity</b> .....	1,800 lb.
<b>Cockpit area</b> .....	55 sq. ft.
<b>Weight</b> .....	2,400 lb.
<b>Flotation</b> ....	35 cu. ft. high-density polyurethane foam

#### SPECIFICATIONS FOR 120-HP. STERN DRIVE IN THE SPORTFISHERMAN

<b>Horsepower</b> .....	120
<b>Number of cylinders</b> .....	4
<b>Bore and stroke</b> .....	3.88" x 3.25"
<b>Displacement</b> .....	153 cu. in.
<b>Compression ratio</b> .....	8.5:1
<b>Type of engine</b> .....	4-cycle
<b>Weight (basic unit without shipping carton)</b> .....	568 lb. (approx.)
<b>Full-throttle r.p.m.</b> .....	4,000-4,400
<b>Electrical</b> ...	30-amp alternator—full transistor regulator
<b>Spark plugs</b> .....	AC-44N or comparable



## WHAT'S NEW

### BOATING

#### Another winner from Winner

They call this fiberglass run-about "Wildcat." Its 17-foot hull features a high-performance deep-V design, a spacious cockpit, and a one-piece wraparound rear deck gunwale. It takes outboards up to 125 hp. for speeds to 42 m.p.h. and stern-drive power options of 120 to 225 hp. Approximate boat weight is 1,000 pounds, load capacity 1,950 pounds. Winner Boats, Inc., Box 449, Dickson, Tenn. 37055.

#### Keep your weather ear tuned

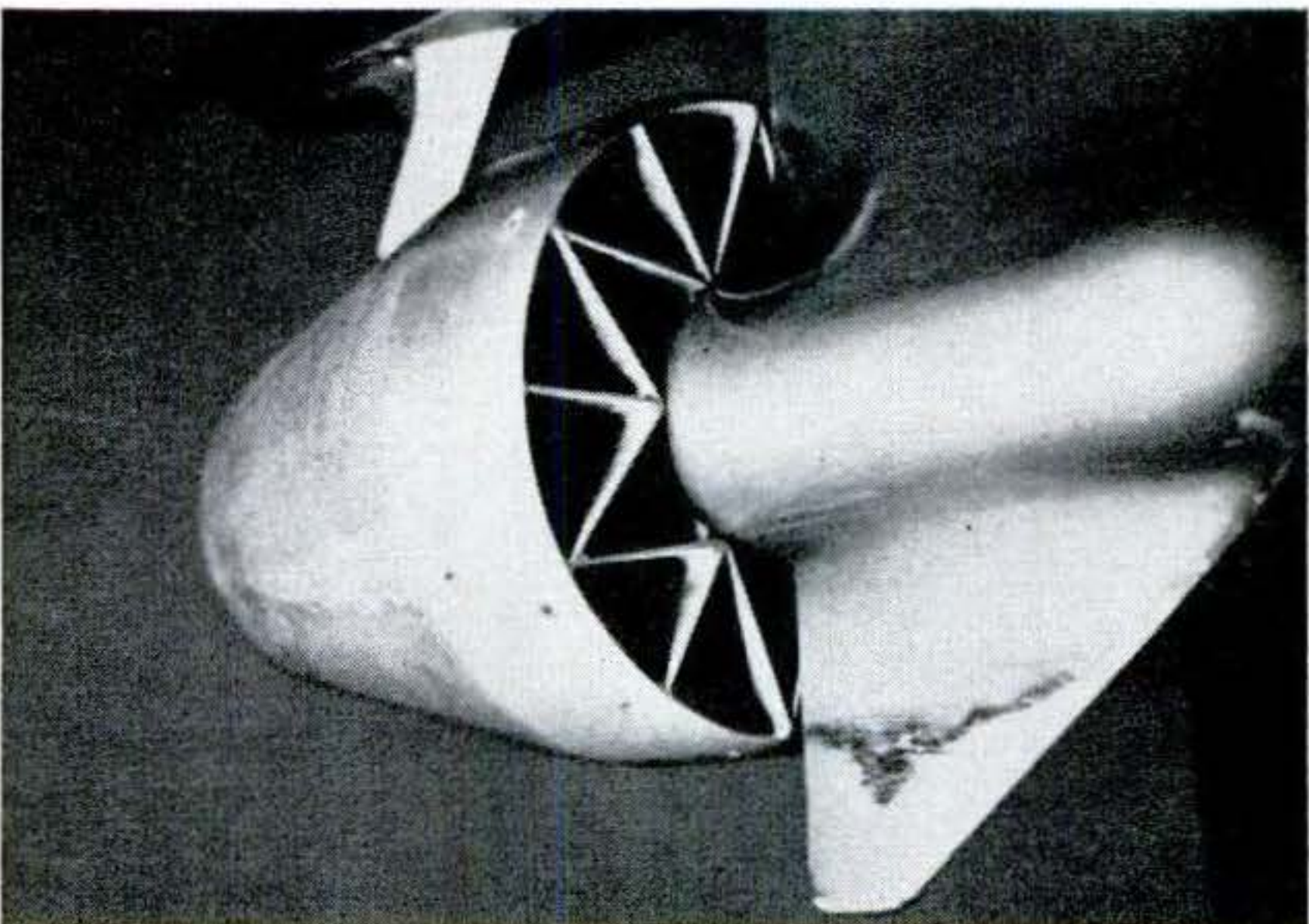
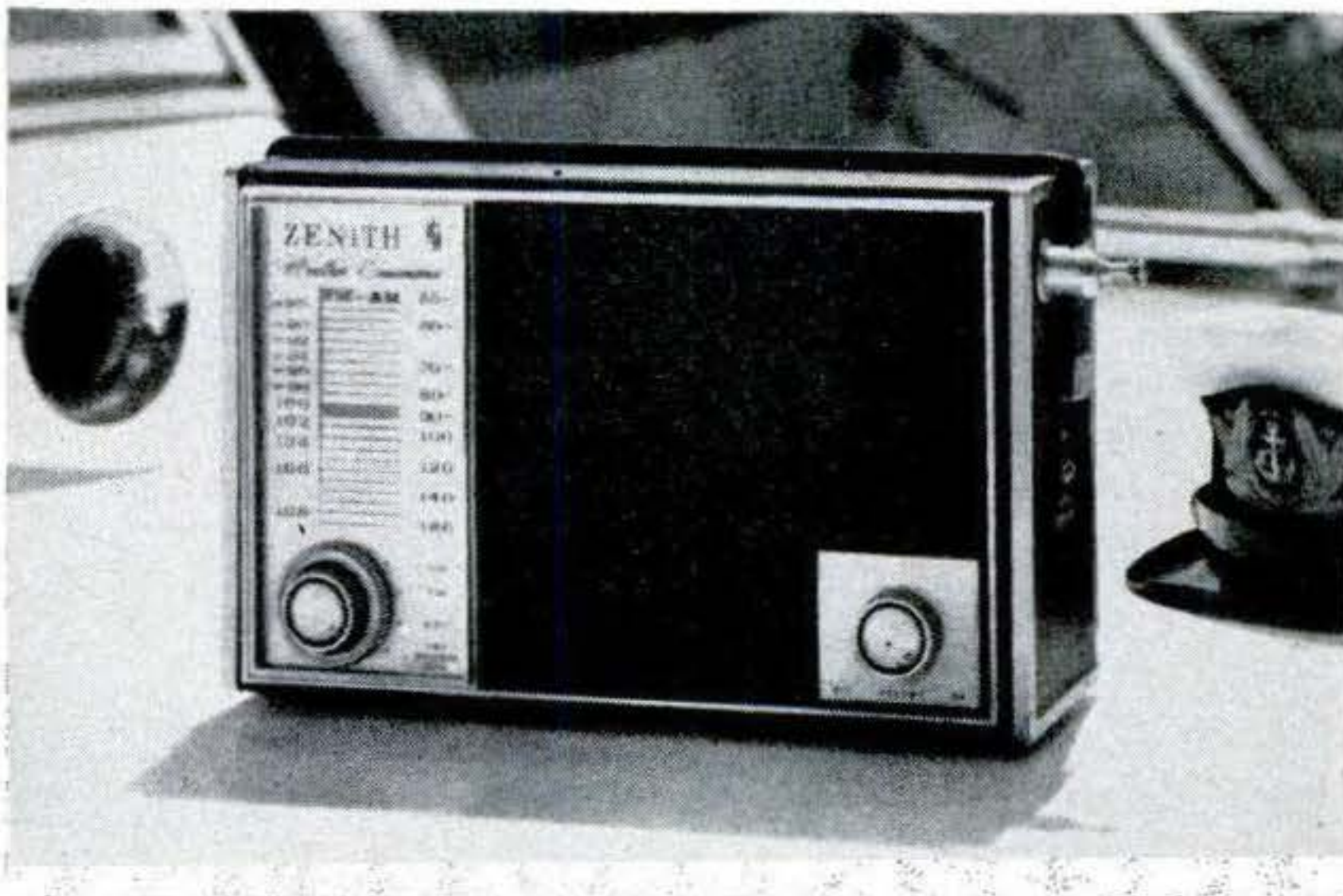
No thinking boatman goes offshore without a weather-watching radio aboard. Zenith's 13-transistor Royal 92 Weather Command has one of its three bands permanently tuned to 162.55 MHz—the VHF-WB frequency used by weather bureaus for continuous forecasts of local marine weather. It also has AM and FM bands. Zenith Sales Corp., 1900 North Austin Ave., Chicago 60639.

#### A Cutlass for coho fishing

Chris-Craft's 22- and 26-foot Cutlass models are well suited for coho salmon fishing. They have a broad beam and a cuddy cabin well forward to provide a roomy cockpit for fishing chairs and gear. Hulls are of lapstrake construction, with a sharp sheer and convex bottom designed for ocean going. The 22-footer with 210-hp. inboard power peaks at 39 m.p.h. Chris-Craft Corp., Pompano Beach, Fla. 33061.

#### Jet drive for your outboard

Engineered to fit all Johnson and Evinrude 40-hp. electric-shift or 100-hp. motors and all Chrysler 75- and 105-hp. motors, this accessory converts an outboard to jet power. Inside the cone-shaped housing is a rotor that attaches to the shaft in place of the conventional propeller. Hall Marine Corp., 134 Nassau St., Princeton, N.J. 08540.

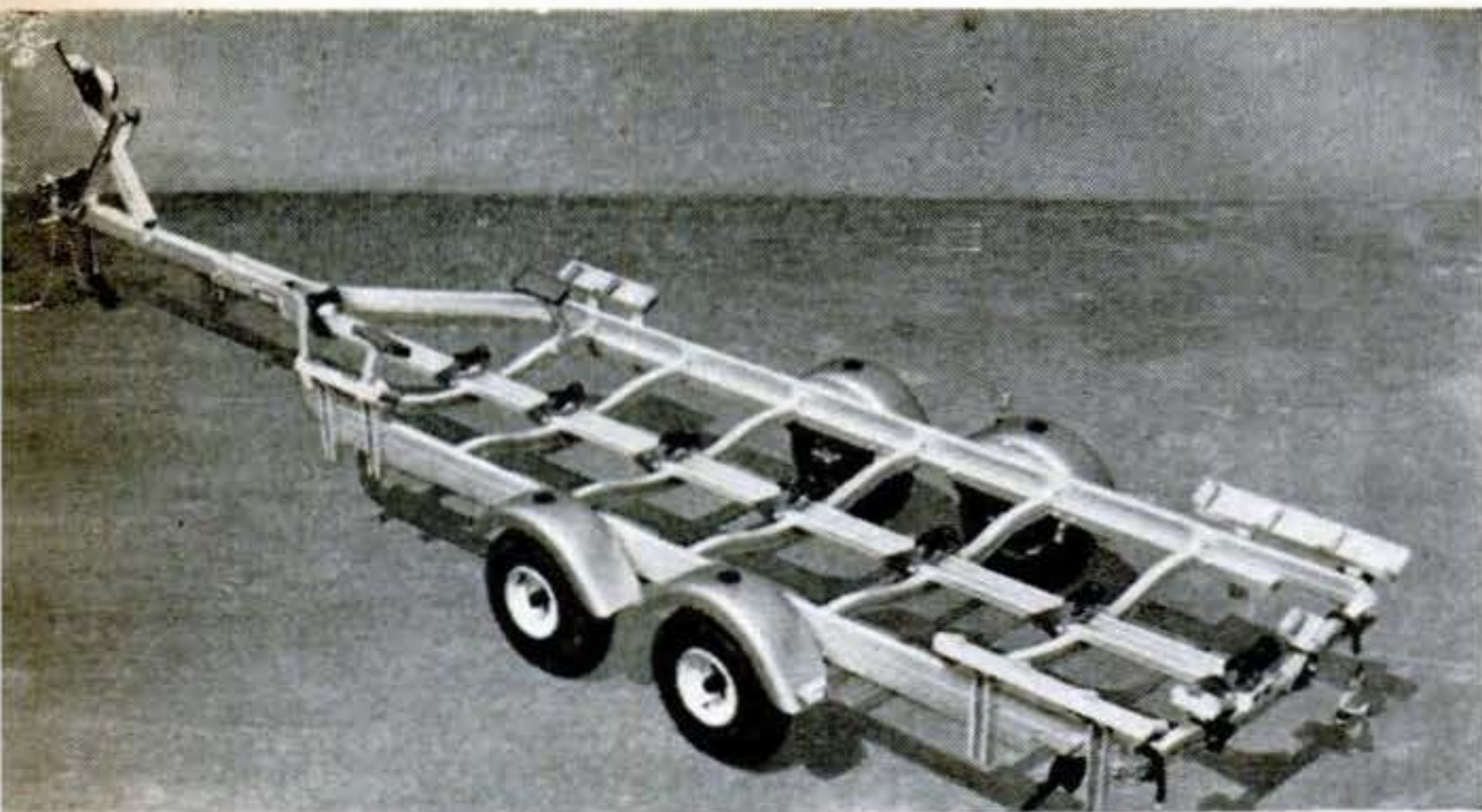






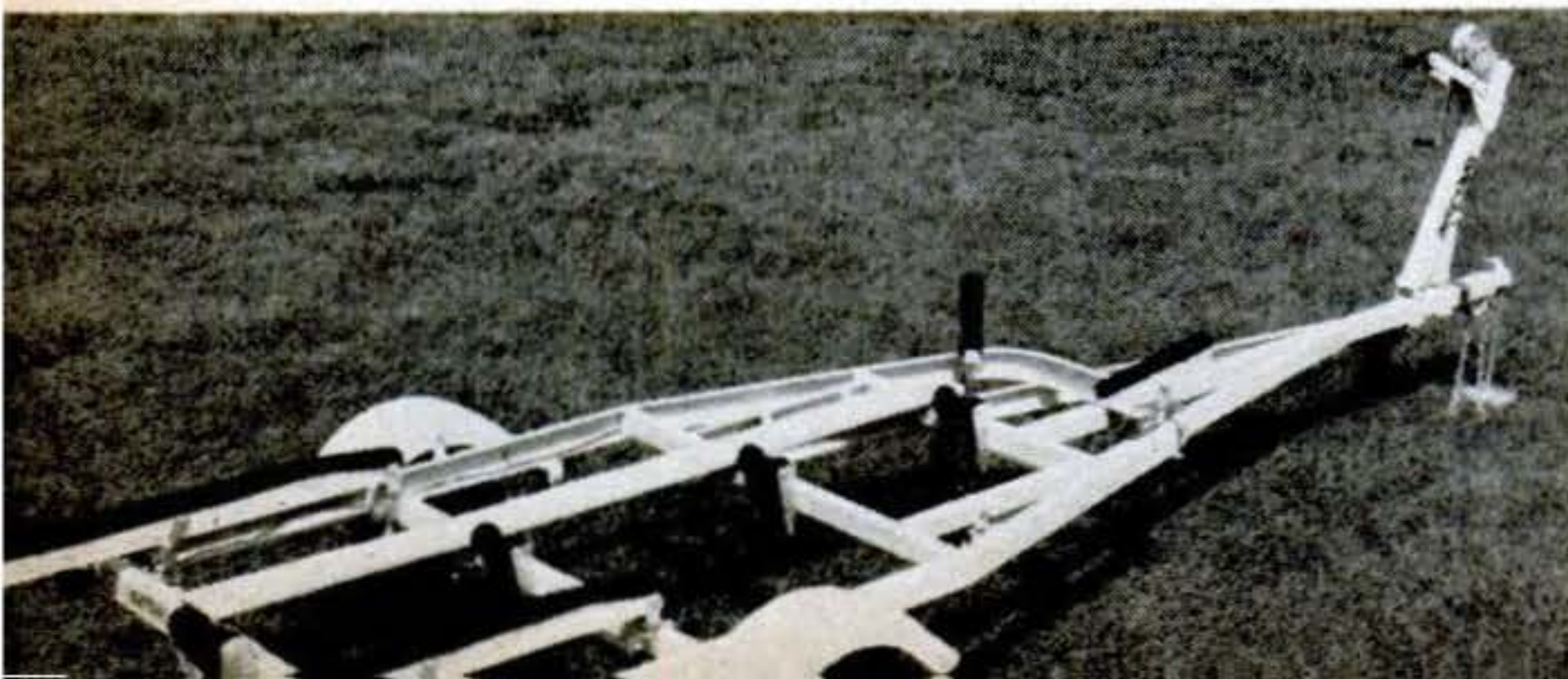
Handling on soft ground or dirt ramps is easier when you push your trailer with the front bumper of your car instead of pulling in the standard manner. It gives you increased maneuverability and safety.

## TRAILER TIPS and



This tandem-wheel trailer was designed specifically for V hulls. Vertical and horizontal adjustments give you support for every contour of the boat.

Designed for 16-18-foot boats, this trailer is engineered to travel safely at turnpike speeds, or at a sedate rate over bumpy country roads.



Choose and use your trailer right, and you'll preserve your boat and double your fun afloat

by CHARLES MEYER

**P**icking the right boat trailer can extend your boating range by thousands of miles. Making a poor choice can possibly damage your hull, create traffic hazards, and even cause costly accidents.

A quality boat trailer is a skillfully engineered dry dock. A flimsy, bargain-priced rig can be a traveling boatman's Waterloo. When balanced and fitted to your hull, a trailer provides maximum hull support, effortless portability, work-free launching and loading, and a sensible platform for off-season storage.

Newcomers to pleasure boating will scrimp and save to buy the best hull and engine available, then cheerfully settle for a cheap, inadequate trailer. They'll spend





A well-balanced boat-trailer combination makes it easier for you to travel long distances on an Interstate Highway or over back-country roads. It calls for less driving effort. For greatest safety on the road, keep your tires properly inflated, don't weave between lanes, and be sure to stay on the right at all times.

PS BOATING

# TACTICS for Boatmen

a small fortune on marina or boatyard maintenance for their boat—and leave the trailer exposed to the elements with nary a drop of lubrication.

More boats are damaged ashore by makeshift, inadequate trailers than by a raging sea. More hulls contract fatal diseases on land than afloat.

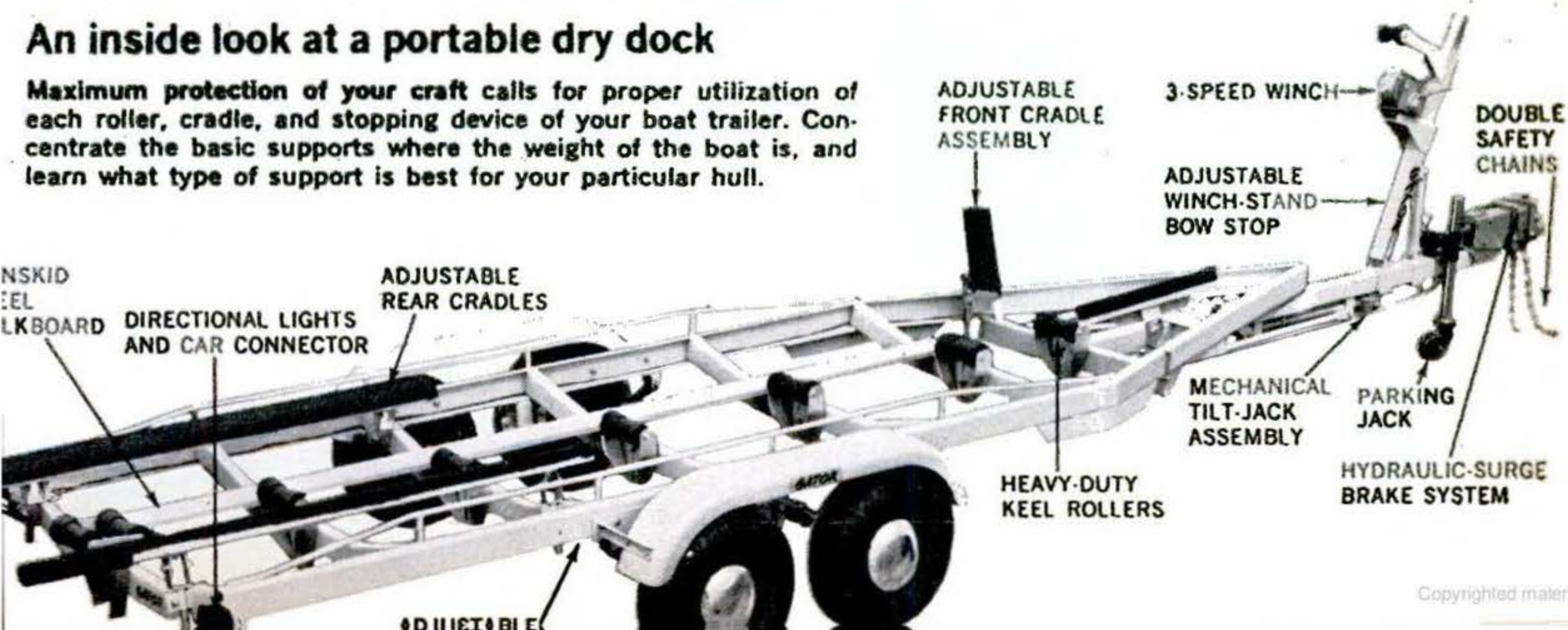
New houses and new “boat-motor-trailer” combinations have much in common.

Your dwelling needs electric appliances, heating, and other essentials before you'd dream of moving in. The hull and propulsion power are the raw essentials of boating; the trailer is of prime importance since it's the boat's home away from the water. Figuring that your boat may spend up to 95 percent of its life on the trailer, it isn't impractical to allocate about 20 percent of your boating budget to it.

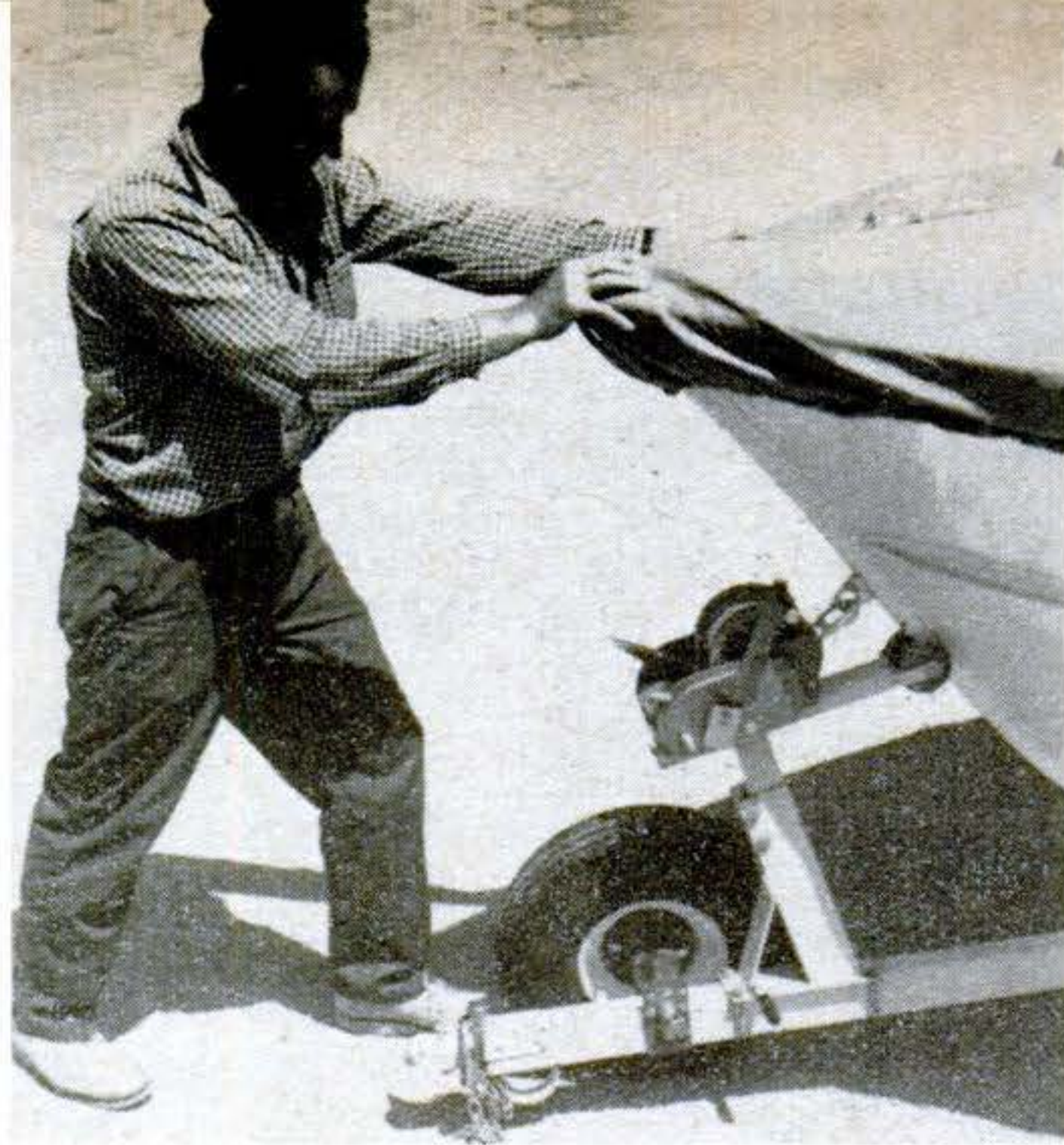
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## An inside look at a portable dry dock

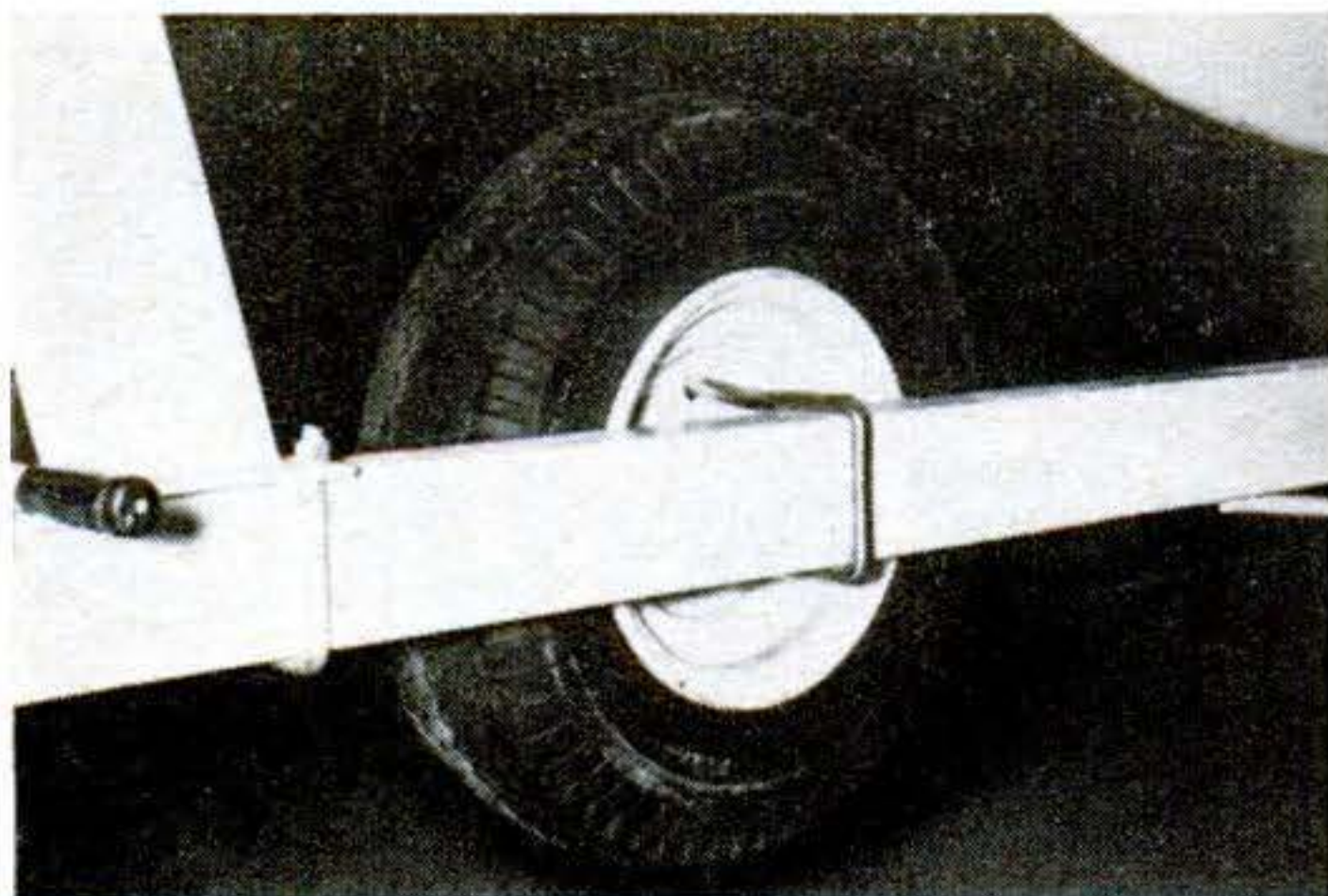
Maximum protection of your craft calls for proper utilization of each roller, cradle, and stopping device of your boat trailer. Concentrate the basic supports where the weight of the boat is, and learn what type of support is best for your particular hull.







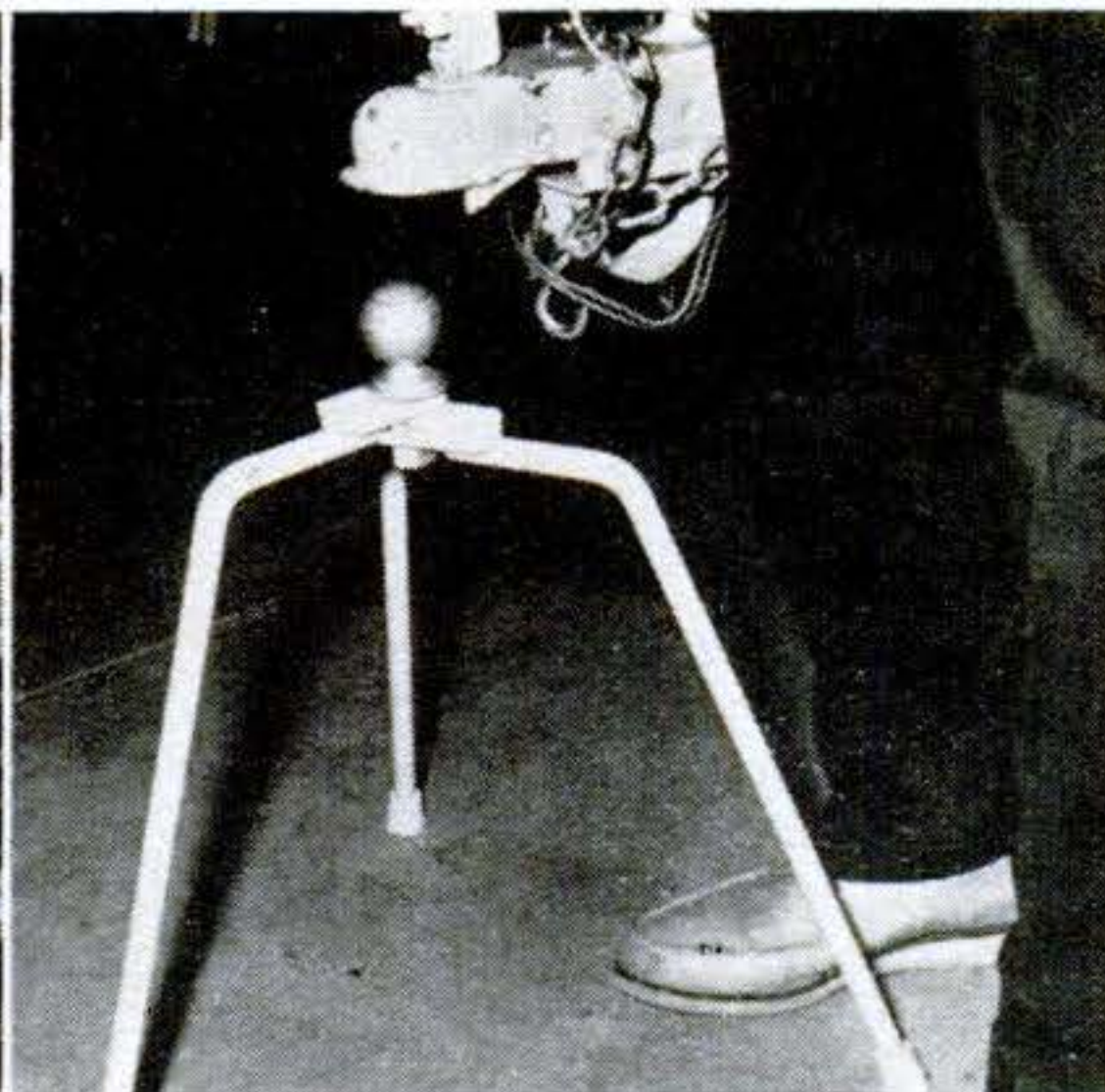
**Golden Rod trailer** shown above has a dual-purpose spare-tire mount that is also a dolly to ease the job of moving your boat and trailer around. Wide tires help to give traction off pavement.



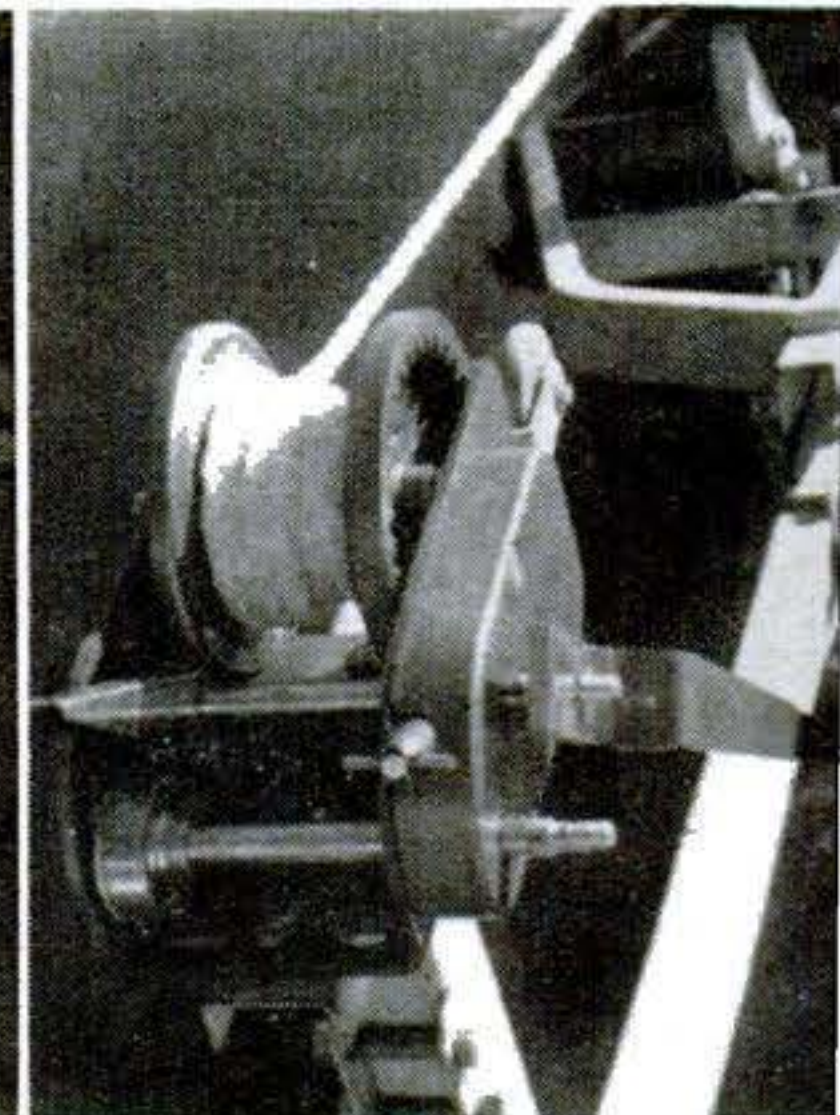
**Dutton-Lainson unit** has convenient spare-tire carrier that's designed for any trailer tongue up to three by four inches, with rim tightened as shown. It functions as a support for unhitched trailer.



If you run a dry trailer, it will soon break down. Check wheel bearings before and after each season's use. They should also be inspected from time to time during an extended trip. Submersion or heat expansion may make grease leak.



A good trailer-tongue stand should be light in weight, fold up compactly, and provide three-point support. The one shown above has those qualities. Its coupling device locks securely to prevent accidental movement of the rig.



A gearing system like the one shown above has a triple reduction and a brake. This makes retrieval operation safe and easy. You can catch your clothing or hands in this type of

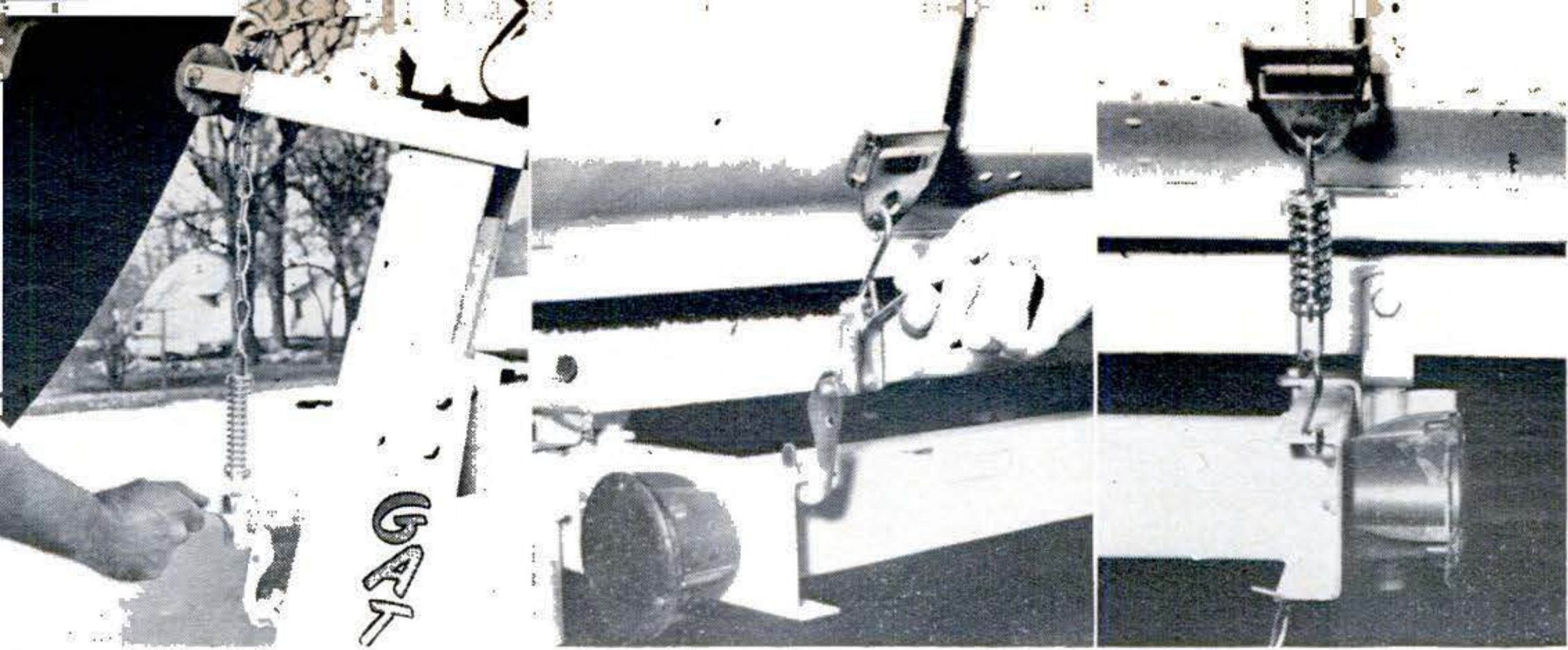
Buy a better trailer. Get one slightly oversize so you can trade up to a larger boat next season. If you intend trailering approximately 100 miles this year, set your sights on a rig that will easily roll 5,000 miles. You'll discover that it pays off in the long run.

**Initial considerations.** Some skippers berth their boats at a dock or marina, using a trailer only at the beginning and end of their nautical season. This is truly minimum trailering, and they'd be as well off renting for the occasion. If circumstances force you to buy, get an unpretentious rig, preferably from the used-merchandise columns of your local newspaper. Chock your hull securely with planks or other cradling devices during your brief trips over secondary roads. Jack the rig clear of the ground and support it with cement blocks or wooden boxes over the winter months to take pressure off the tires.

Don't consider this as a functional highway trailer for regular use. Basically, it's a dry dock for raising the hull so you can paint the bottom or store her during the off-season.

The short-haul trailerman is a weekend skipper who pulls an outboard rig less than 50 miles. As long as he avoids overloading, bouncing at speed over rutted roads, and other common trailering pitfalls, he can get by with a moderately priced rig close to the load limit pre-





**Hold-down device**, consisting of a strong chain, two-inch eyebolt, tension spring, and sturdy, extra-wide hook, helps keep a trailered boat from bouncing when on rough roads. It's plated to resist rust.

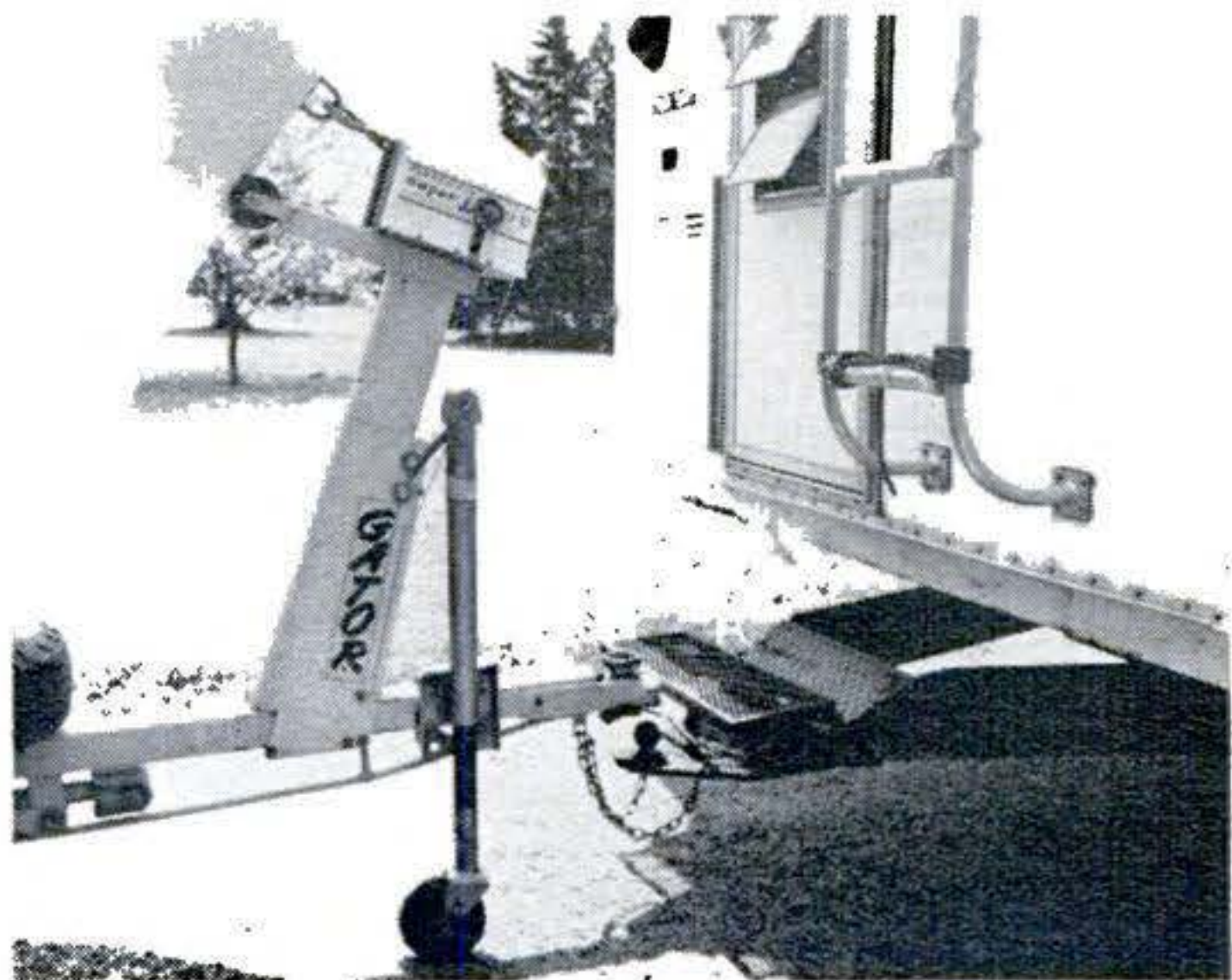
**Stern tie-down** shown above is made of top-quality white-nylon webbing. A tension spring at one end of the unit hooks to the frame. It also has a cam-action safety lock that attaches to the trailer.

**With web straps** adjusted to the proper length to match your boat, the buckles are secured. Attaching and removing the tie-down is easy—a job that takes just a few seconds under normal conditions.

scribed by the manufacturer. If you're in this category, your trailer needs frequent adjustment check-overs (to make certain the boat rests on all rollers and pads), plus gentle handling. It should be lubricated, bolt heads tightened, rollers freed, wheel bearings packed, and have other standard maintenance at least once every season.

While floating, a boat is supported by the entire surface of water bearing on the hull. On a trailer, she rests on a series of rollers or cloth-covered pads, chocked laterally by pivoting braces, tied down with shock cord or some variety of canvas

[\[Continued on page 174\]](#)



**An extension** was needed for this trailer hitch so the owner could clear the rear entrance door of his Jeep pickup camper. The rig has power winch and parking jack for launching-retrieving ease.

## Tire Load Capacities

How much air should you carry in your trailer tires? This Boating Industry Assn. table gives load capacity with various inflations, at 50-m.p.h. maximum speed, for common trailer-tire sizes. Achieving a balanced ride often depends on trial and error; try different combinations of fore-and-aft pressures to get the best ride.

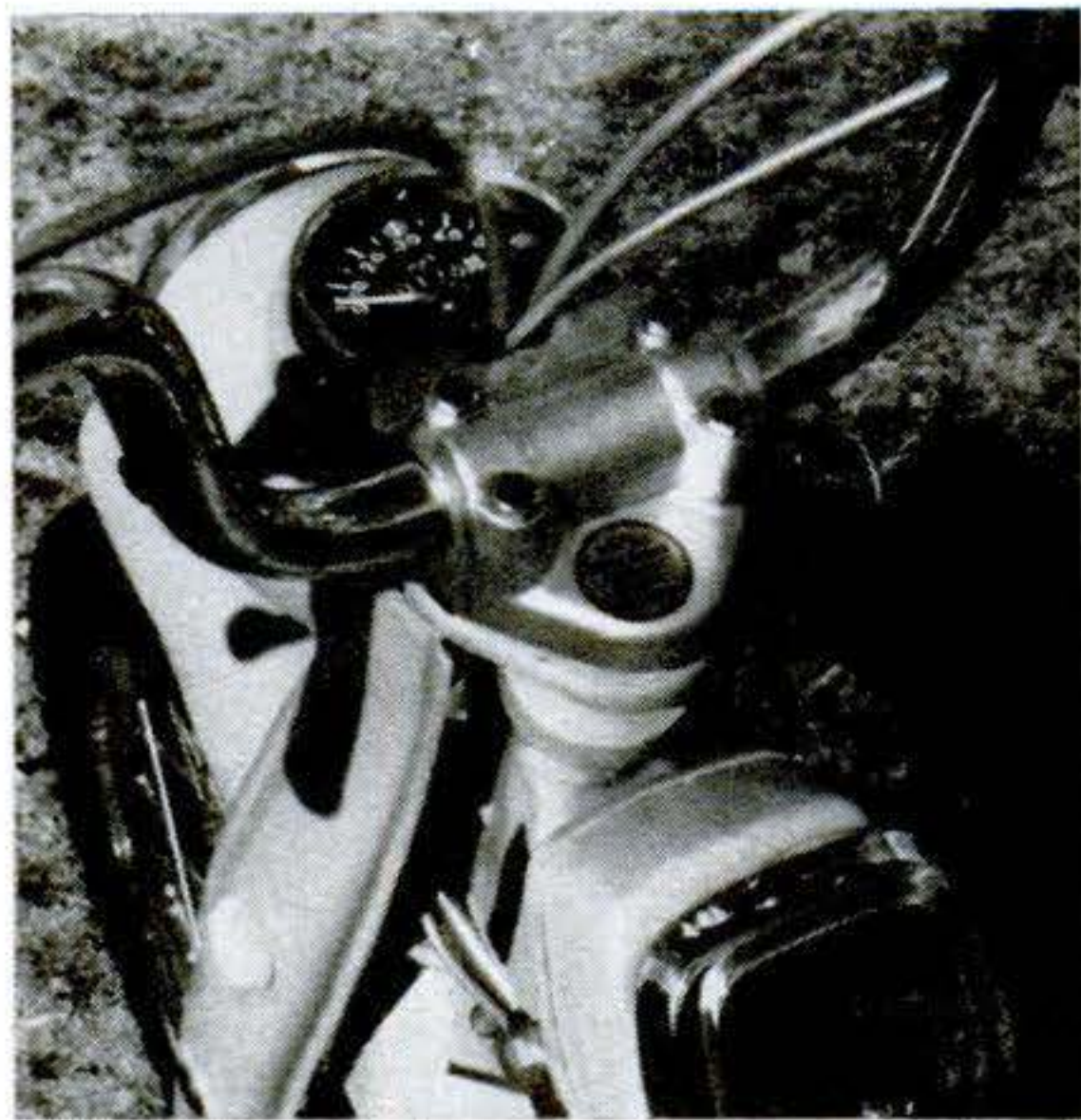
		Load Capacity at Various Inflations														
Tire Size	Ply Rating	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
4.80/4.00 x 8	2	380														
4.80/4.00 x 8	4	380	420	450	485	515	545	575	600							
4.80/4.00 x 8	6	380	420	450	485	515	545	575	600	625	650	675	700	725		
5.70/5.00 x 8	4		575	625	665	710										
5.70/5.00 x 8	6		575	625	665	710	750	790	830	865	900					
5.70/5.00 x 8	8		575	625	665	710	750	790	830	865	900	930	965	1000	1030	
6.90/6.00 x 9	4		785	850												
6.90/6.00 x 9	6		785	850	915	970	1030	1080								
6.90/6.00 x 9	8		785	850	915	970	1030	1080	1125	1175	1225	1270				
6.90/6.00 x 9	10		785	850	915	970	1030	1080	1125	1175	1225	1270	1320	1365	1410	1450
4.80/4.00 x 12	4	545	550	595	635	680	715	755	790							
5.30/4.50 x 12	4	640	700	760	810	865	915									
5.30/4.50 x 12	6	640	700	760	810	865	915	960	1005	1045	1090	1135				
6.00 x 12	4	855	935	1010												
6.00 x 12	6	855	935	1010	1090	1160	1230	1290								



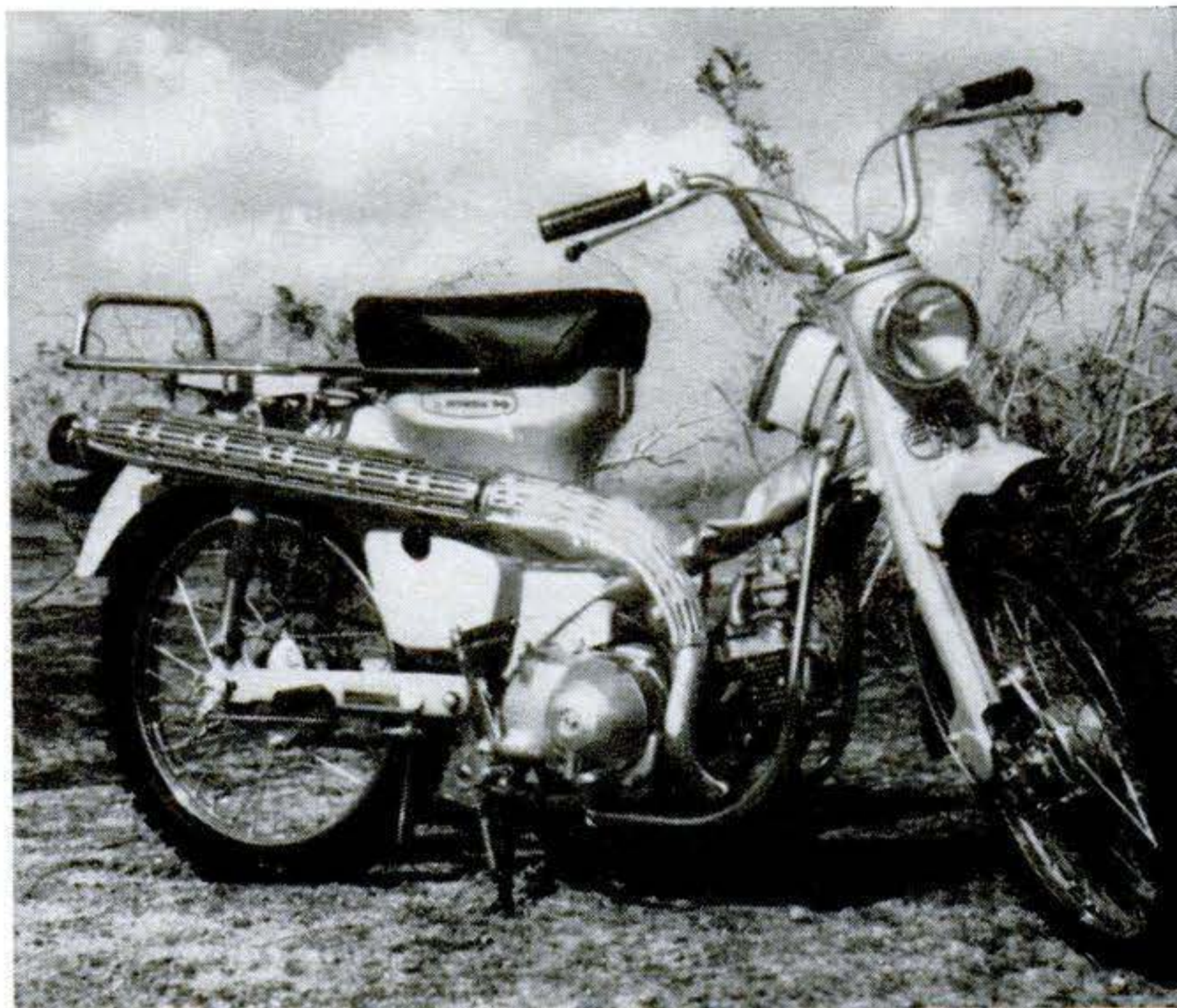
# HONDA Gives You Two



Little one-lunger is so small you might doubt its power to move a lightweight bike—but it puts out a full seven horsepower and takes the bike to 57 m.p.h.



The instrument panel is simple but complete. The speedometer shows maximum cruising speeds in trail gearing, top speed, and number of miles covered. No hooks, straps, nuts, or bolts hold seat on—just a hinge and two suction cups.



It may look like a glorified girl's bike, but it will do a man's job. The Honda is at home in the rough or on the street.

By JIM DAVIS

**M**otorbikes that will let you zip along the highway at nearly 60 m.p.h. usually will not let you climb rough mountain slopes or cross rivers. The Honda CT 90 does both with equal ease because of its dual-range transmission. To switch, you merely flick a lever. In either range, you have four forward speeds. And the clutch is completely automatic.

Before I get into the transmission details, let me tell you that this little Honda is one of the finest and most unusual on-and-off-the-road motorcycles to hit the American market.

Really, the CT 90 looks like an overweight bicycle with the engine slung beneath the main downtube. But did you ever hear of a bicycle with a top speed of 57 m.p.h.? The tiny overhead-cam engine delivers peak power at 8,500 r.p.m. and seems to thrive on high revs. Front and rear wheels have springs that give a good highway ride and can also take the jolts of rough terrain without shaking the rider to pieces.

**No clutch?** Now, let me explain the transmission. The little bike doesn't even have a clutch lever. If you were to peek inside the clutch housing, you'd see an ordinary-looking multiplate clutch—but for one detail. On the outboard side



# Bikes in One

you'd see a set of counterweights riding on springs. As engine speed increases, centrifugal force throws the counterweights out. This compresses the override springs, and cams on the face of the counterweights press against the clutch disks. It's as simple as that. Those of you who can remember looking inside an old Victrola phonograph will have seen practically the same thing.

Counting the ratios in the standard gearbox and adding those produced by the dual-range subgearing, the CT 90 has eight forward speeds. All the trail-gearing ratios are quite "short," but first gear is out of this world. It works out to 52.904, which means that every time the rear wheel turns once, the crankshaft rotates almost 53 times! I felt as if I could almost climb a telephone pole in that first gear. For street use, you merely flick the lever back into normal position.

The pressed-steel frame may be heavy, but it's also extremely rigid and just about impossible to bend. My neighbor backed his automobile over his son's CT 90, and all the damage we could find was some gouges in the yellow paint.

Perched on top of this frame is a small single seat. If you pop the two suction cups (that's right, I said suction cups) that hold it in place, you'll find the gas tank and filler cap. (Some leakage around the filler cap was the only flaw that I found in the bike, but use of a thicker gasket should take care of this.) The tank holds less than two gallons, and if that doesn't seem like very much, remember that this little motorcycle will average around 175 miles to the gallon. For 50 cents, you could get a pretty good start on a tour of the world.

**The suspension.** The front wheel is carried in a "bottom-link" type of suspension. That's about as simple a setup as you can find on a motorcycle. It consists of a shock absorber, a rebound spring, and a small arm that pivots on a rigid mount. The other end of the arm holds the spindle and wheel. As the wheel bounces, the pivot arm moves and the shock-and-spring unit absorbs the jolts. Most heavier bikes use an oil-damped telescopic front suspension, but this lightweight machine just doesn't need it.

The rear wheel rides in a swinging-arm suspension system—common on most modern bikes. The arm is mounted on the frame and lets the wheel move up and down, with deflections controlled by

[\[Continued on page 191\]](#)

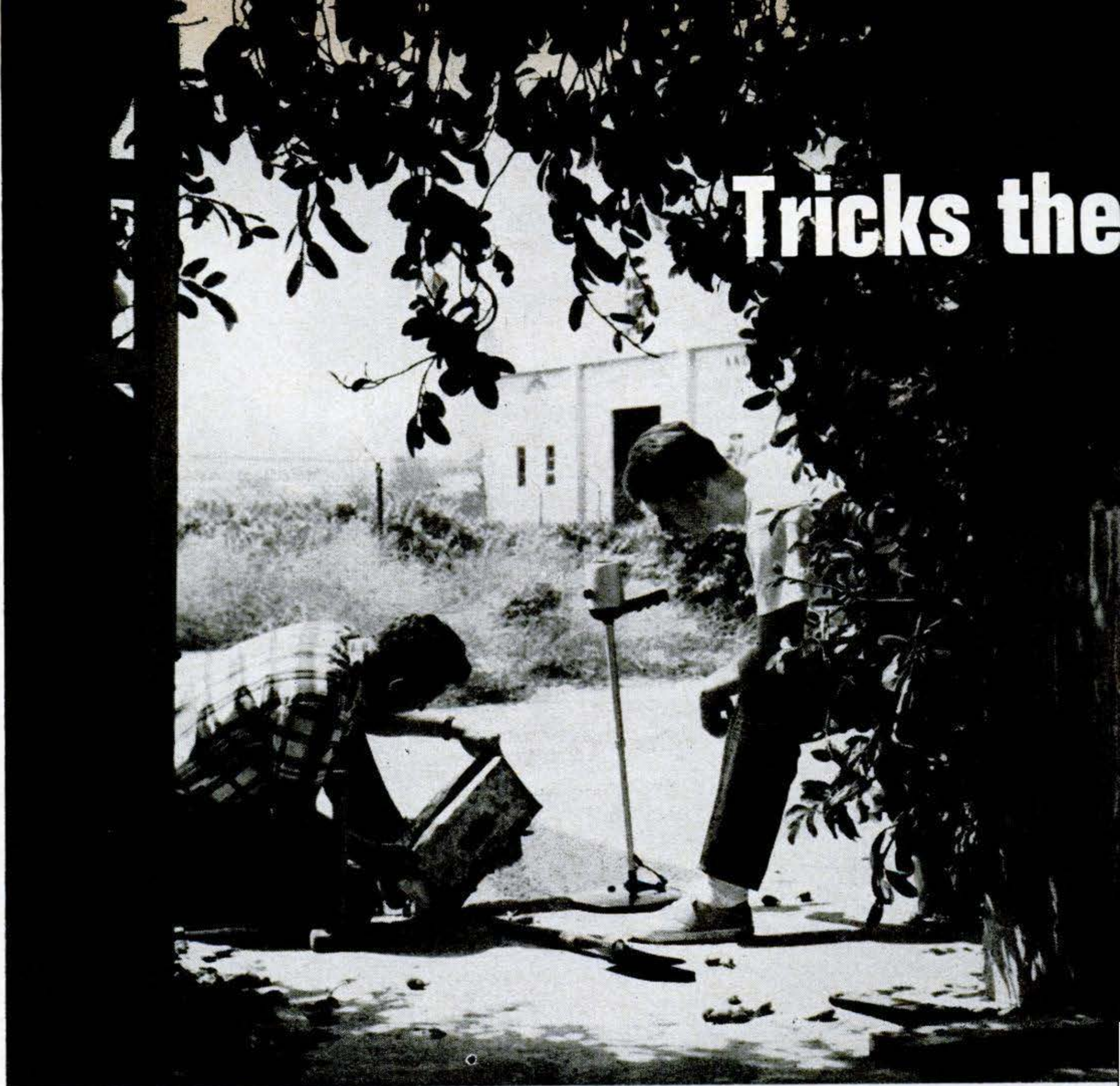
Dual-range four-speed transmission makes the Honda Trail 90 suitable for both street and off-highway use



Jim Davis shows how the Honda fords rivers. He is an active motorcycle racer.



# Tricks the



Under abandoned patio, author found a metal box—empty. It might once have held valuables.

Knowing how and where to search can lead to paydirt. Here are tips on getting the most from your metal detector

By V. LEE OERTLE

**L**uck has very little to do with locating treasure these days. The easy finds are drying up fast. That's why thousands of hunters are afield with metal detectors. Also, today's successful hunter is a researcher first, a field hunter second. He digs into old newspaper files looking for stories of lost mines, banks that burned down, gold wagons that disappeared en route to a known destination.

Remember this: A metal locator is merely a tool. It's not a magic lamp that leads the user to secrets hidden under-

ground like an electronic Ouija board. But used scientifically it can increase your finds. With that in mind, try some of the following tips to help improve your score.

**The techniques.** Learn to fine-tune your instrument. Soils differ tremendously from one region to another. Depending on mineral content and surface contour, the instrument should give a reading that is regular in tone. Adjust the detector by twisting the tuning knob until you hear a barely audible signal. You will notice that if you walk along lifting and lowering the instrument, the tone will rise and fall. That simply means



# Treasure Hunters Use

ou aren't moving it parallel with the ground. The instrument's head should be an inch or two off the ground, held as readily parallel as possible. If necessary, fine-tune it every few yards as the soil changes.

There are three ways you can use a detector: 1) by watching the direct-reading dial; 2) by using earphones; 3) by using a sound amplifier that requires no earphones. Sometimes the dial and the audible signal are used simultaneously. Pick the method that suits you best.

Get some method into your searching pattern. For example, one old prospector carries a small sack of flour. When he gets a strong reading, he drops a pinch of flour and goes right on without pausing. After an hour of this procedure he has a half-dozen likely places spotted for his pick and shovel. If time is short, he'll dig the most promising spots first. If you stop and dig at every reading, you'll unearth a lot of tin cans and bottle caps. By searching a wide area first, you'll at least have a choice of spots.

After crisscrossing an area, you'll begin to spot a sort of pattern to the signals. Many hunters actually trace it out on paper. That way, you can often outline an object. It's like an unseen

*Continued*



Old beams sometimes are hollow—so don't pass them up without a test. Look in particular for places that look as though the wood has been drilled out and a plug tapped back in and painted. That was a popular trick.



Any old fireplace is a strong possibility. Check in particular the area under the hearth, up inside the flue, and as far up as the smoke shelf. A Midwest treasure hunter found \$60,000 in gold, buried in three earthen pots.



**“Never overlook the obvious places,” says an old treasure hunter**



Heavy-duty detectors are used for locating large objects deeply buried. They don't have the sensitivity to pick up small "treasures," even when near the surface. Good for finding old dump sites, however.



Around old homesteads, the areas under porches are a particularly good prospect for hunting. Many older people instinctively buried valuables. Porches were handy, easy to remember, and easy to watch.



An important technique to master: holding the locator head steady, and parallel with the surface. It should be a few inches above ground. No up-and-down motion.

shadow: a box, a round pot, perhaps a long rifle. If you plot it on paper you'll learn to recognize certain patterns before they're even completed.

Keep the right tools handy: small pick, sharp pointed shovel, perhaps a small sledge hammer for breaking out walls. Treasure hunting is composed of just about equal parts of searching and digging.

Suppose you have heard that a valuable old chest was buried near an old homesite, deep enough to provide only a scant reading. Here's how to increase the signal strength: Wet the spot down with a hose or bucket. Do this for a couple of days, then try another reading. Moisture increases conductivity, which means a louder signal. Right after a rain is a good time to search.

Incidentally, a detector is just as workable over snow or ice or concrete as it is over soil. But remember, every inch of snow or ice counts just as much as soil on the maximum-depth scale.

You may have read that the best time to hunt on beaches is the day after a big holiday. Bunk. The real pros hunt right after a big storm. Wave action scoops up millions of tons of sand along the coastline, churning it over and over. Get there at the crack of dawn. Beaches are sometimes littered with old jewelry, coins, shipwreck items.

**The spots to search.** Check all the doors and windows in old buildings. If you find any wood that looks as though it had holes in it that are filled again—that's a hot prospect. Old-timers sometimes drilled holes in the top edge of a door, inserted coins or currency, then pounded in wood doweling and puttied over it.

Wooden ceiling beams are another good bet. First, look on top of them. Valuable objects ma





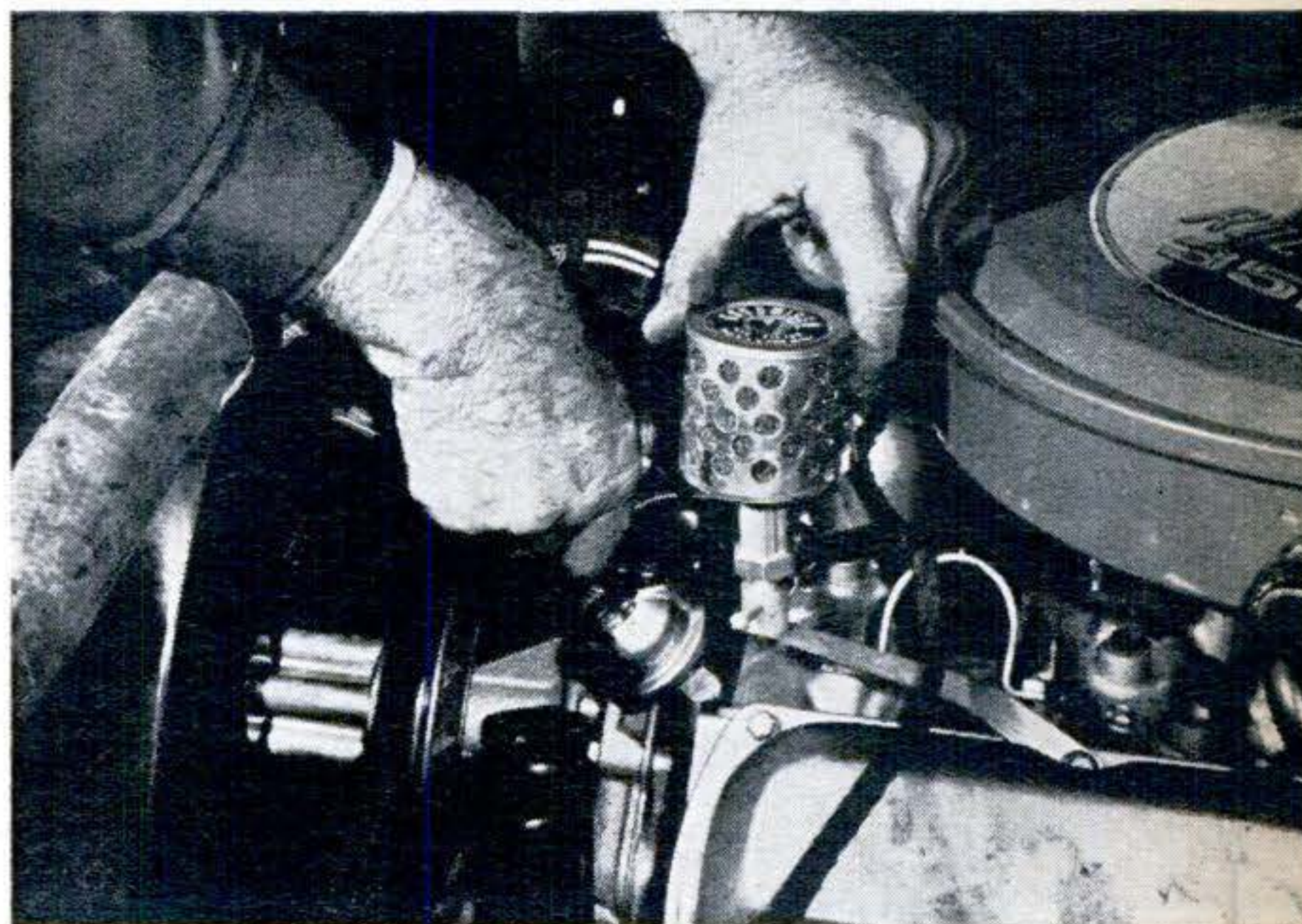
Test cycle was established by closely duplicating Norbye's natural driving pattern.

ly controlled conditions, though we cannot pretend to the same precision as in laboratory tests. Our test technician, Charles Bishop, runs the repair shop for B. J. Corrigan's Gulf station at Bridgehampton, N. Y. He installed the gadgets on our test car, a '68 Olds Cutlass S with a 310-horsepower, 350-cubic-inch V-8, four-speed manual transmission, 3.23:1 final drive ratio, and F70-14 tires. The engine was properly tuned and timed, and we never altered the settings.

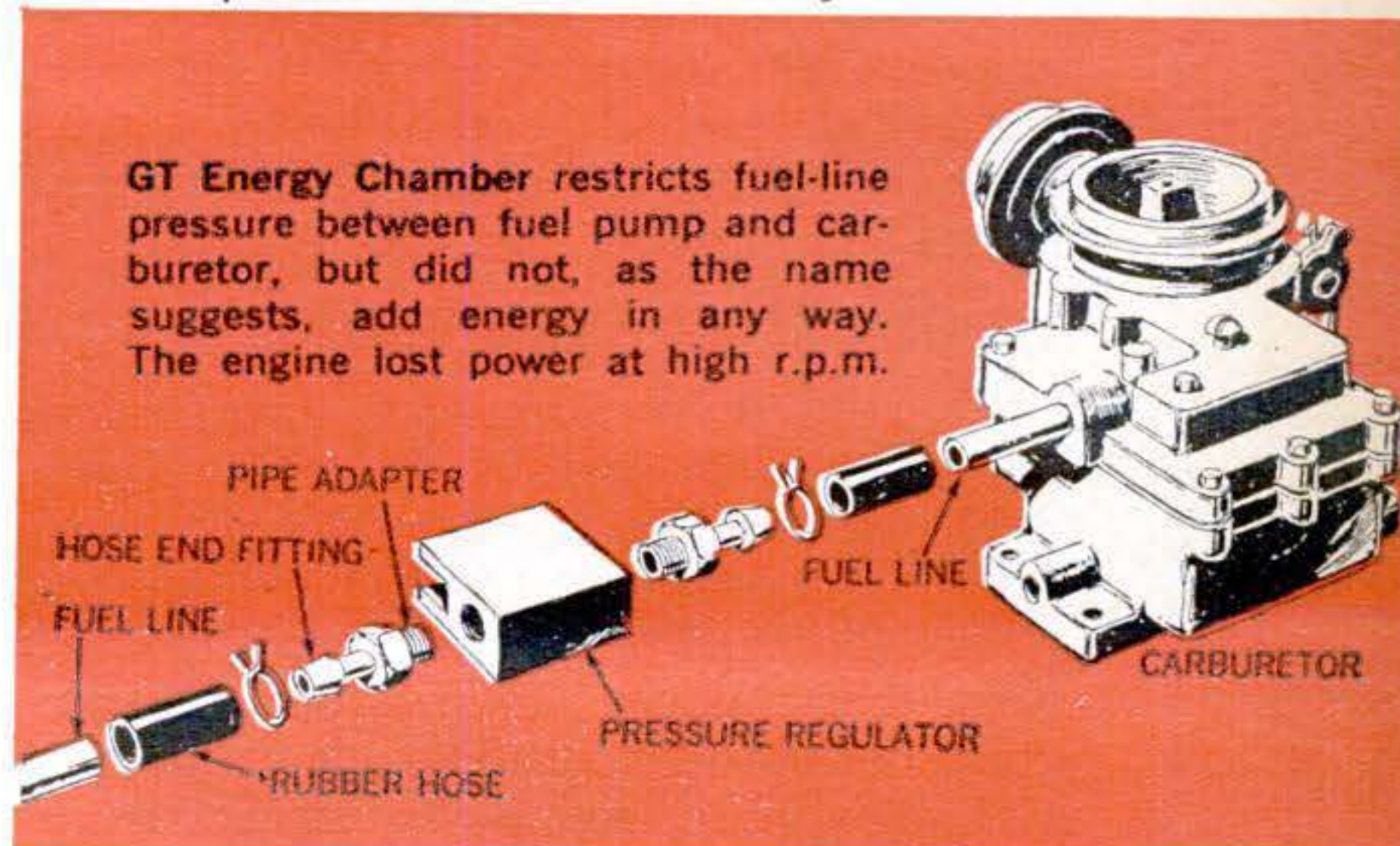
**How we tested.** We used the Bridgehampton race circuit, where we established a test cycle by letting Norbye drive around the track at normal speed (while Dunne made notes), running at 60 m.p.h. on the straights and slowing to 45 on the turns, except for one turn at 30. On the back straight, we made a full stop and let the engine idle for 10 seconds. To eliminate any possibility of partiality toward any gadget, which might show up in the driving, Norbye did not know which one Bishop had installed.

We had a one-gallon fuel container inside the car; the exact distance the gas took us was recorded on an electric odometer (driven by a fifth wheel), giving us a miles-per-gallon reading accurate to within one-thousandth of a mile. To cancel the effect of up or down gradient on the track, we braked the car to a normal stop (0.35g retardation) instead of letting it

*Continued*



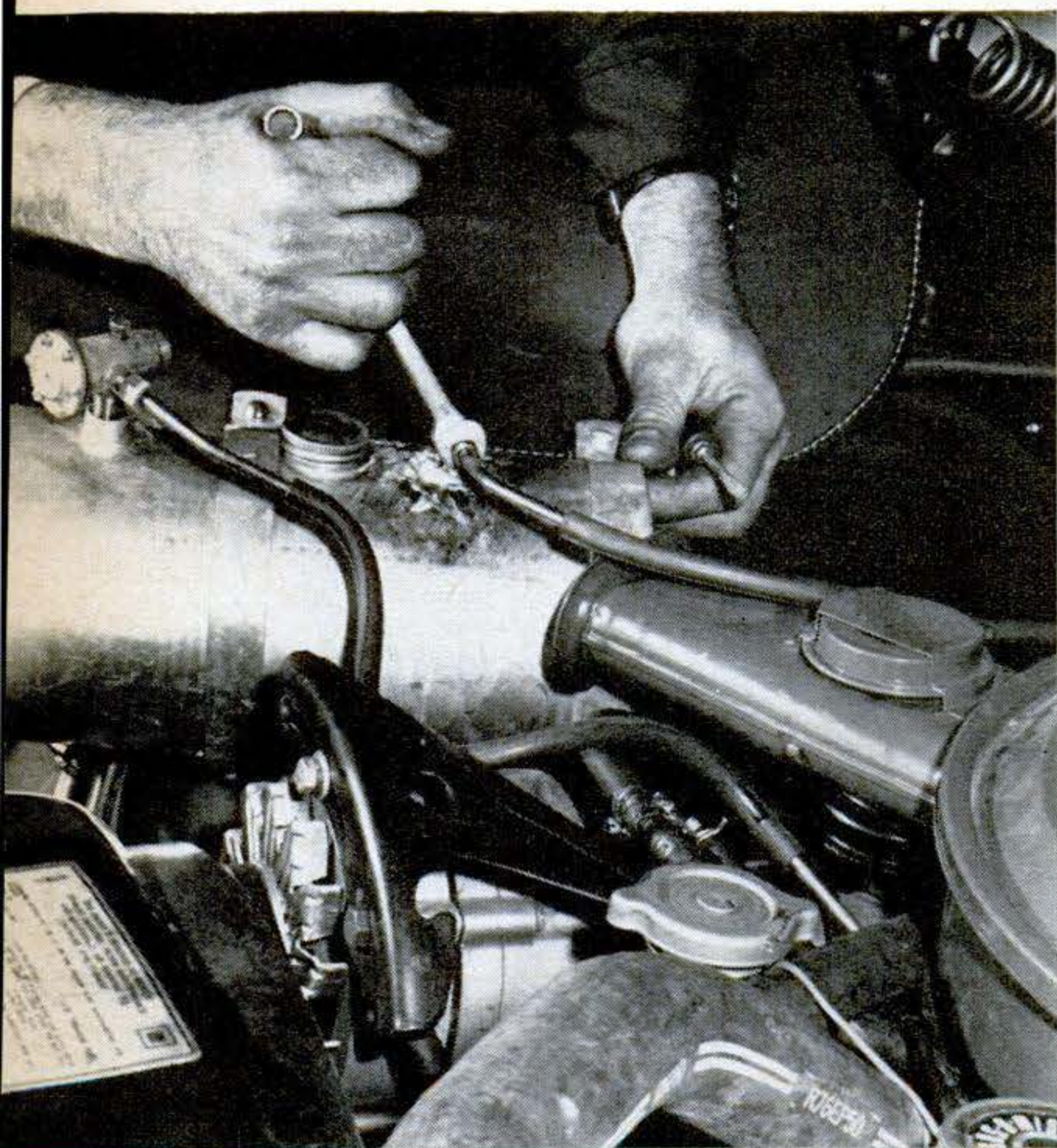
Fitting the Gas-O-Miser on the intake manifold was an easy half-hour's job, said Bishop. This was one gadget that gave a slight improvement in both the performance and the economy tests.



GT Energy Chamber restricts fuel-line pressure between fuel pump and carburetor, but did not, as the name suggests, add energy in any way. The engine lost power at high r.p.m.



On each day of testing, we first ran the car without



Octa-Gane installation took twice as long as any of the other test installations, and called for drilling and tapping one hole in carburetor body. The tank contains a 50/50 mixture of water and alcohol, which is injected into the carburetor throat according to manifold vacuum (engine load).

roll to a standstill when the gasoline was used up.

We also ran a 25-70-m.p.h. acceleration test (average of two runs in opposite directions) with each gadget to check its effect on engine power.

Our first test was to run the car in standard form. Temperature was 51 degrees, humidity 40 percent, barometric pressure 30.9 inches, and wind velocity 1.5 m.p.h. from NE. Gas mileage: 10.755 m.p.g. From 25 to 70 m.p.h.: 8.4 seconds.

### THE GT ENERGY CHAMBER

Distributed by American Automotive Units, 550 Fifth Ave., NYC 10036. Cost: \$6.95. Installation time: 1/2 hour.

This unit is inserted in the gas line between the fuel pump and carburetor, where it is supposed to level out pressure waves in the fuel flow. The ads claim that it enables your engine "to extract more raw, blazing energy and more gasoline

economy." The car ran normally in the consumption test but power flattened out at 60 in the acceleration test, with all the symptoms of fuel starvation. Gas mileage was 10.9 m.p.g. From 25 to 70 m.p.h.: 9.6 seconds.

### THE GAS-O-MISER

Distributed by Lempco Products, 5490 Dunham Rd., Bedford, Ohio. Cost: \$15.95. Installation time: 1/2 hour.

This unit is a vacuum-control valve designed to prevent gasoline from being sucked into the engine by a sudden drop in manifold pressure. It mounts on the intake manifold and admits extra air whenever the throttle is suddenly closed. The maker claims better acceleration, better winter starting, reduced oil consumption and engine wear, plus up to 25-percent savings on gas. Gas mileage: 10.887 m.p.g. From 25 to 70 m.p.h.: 8.3 seconds.

### OCTA-GANE

Distributed by J. C. Whitney & Co., 1917 Archer Ave., Chicago 60616. Cost: \$29.95. Installation time: one hour.

The Octa-Gane kit includes a separate tank for under-hood installation, containing a 50/50 mixture of water and alcohol. An injector operating on manifold pressure allows the water/alcohol mix to enter the carburetor throat *below* the throttle valve. This is claimed to stop pre-ignition, get high-octane performance from low-octane gas, cool the engine internally, and improve fuel economy. Gas mileage: 10.65 m.p.g. From 25 to 70 m.p.h.: 8.7 seconds.

### ECON-O-MISER

Distributed by J. C. Whitney & Co. Cost: \$6. Installation time: 1/2 hour.

This unit is a fuel-pressure regulator with a diaphragm designed to maintain a steady four-p.s.i. delivery pressure in the fuel line into the carburetor (against eight p.s.i. standard). It has the added feature of an over-ride on full throttle, so that pressure can rise to a full eight p.s.i. for acceleration. The maker claims improved fuel economy, prevention of flooding, stalling, and hard starting. Gas mileage: 10.19 m.p.g. From 25 to 70 m.p.h.: 8.0 seconds.



gadgets, and measured gas mileage and 25-70-m.p.h. time

## FIRE INJECTORS

Distributed by J. C. Whitney & Co. Cost: \$11.92 per set of eight. Installation time: 1/2 hour.

The Fire Injector is really nothing but a spark plug with six surface gaps. The maker claims improved fuel economy, gains in horsepower. Gas mileage: 10.6 m.p.g. From 25 to 70 m.p.h.: 8.55 seconds.

*Three more gadgets remained to be tested at the end of the first day. We resumed operations the following morning, when temperature was 55 degrees, humidity 48 percent, barometric pressure 31 inches, and wind velocity 0.5 m.p.h. NW. Accordingly, we ran a new base-line test with the car before adding gadgets. Gas mileage: 12.288 m.p.g. From 25-70 m.p.h.: 8.4 seconds.*

## SOLAR VOLT SUPERCHARGER

Distributor: Albert R. Charles, Inc., 18 Marshall St., Norwalk, Conn. 06856. Cost: \$9.95. Installation time: five minutes.

This unit replaces the rotor in the standard distributor. In addition to firing the right plug, it is supposed to "supercharge the gas-air mixture" by breaking up the gasoline molecules and speeding ignition. Gas mileage: 11.44 m.p.g. From 25 to 70 m.p.h.: 8.25 seconds.

## GANE AIR FLOW NEEDLES

Distributed by J. C. Whitney & Co. Cost: \$1.50. Installation: 15 minutes.

The air-flow needle is designed to bleed extra air into the carburetor throat under high-vacuum conditions. Maker's claims include better idling, reduced carbon deposits, faster acceleration, reduced oil dilution. Gas mileage: 11.87 m.p.g. From 25 to 70 m.p.h.: 7.9 seconds.

## GAS SAVER CHAMBER

Distributed by Em El Associates, 590 Main St., Monroe, Conn. 06468. Cost: \$5.95. Installation time: 1/2 hour.

This unit is a fuel-line pressure-control device, restricting delivery to three p.s.i. The makers "absolutely guarantee an increase of at least 20 percent on gas mileage or your money back." They also say the unit prevents vapor lock, gives smoother idling and faster starts, prevents flooding and stalling, and increases engine life. Gas mileage: 11.784 m.p.g. From 25 to 70: 9.25 seconds.

## CONCLUSION

Our main conclusion is that changes in the weather made more difference in fuel economy than any of the gadgets. Beyond having negligible effects, some either improved performance at some loss of economy, or vice versa. PS



**Solar Volt** all-electronic supercharger shown above fits in place of the standard distributor rotor. It proved disappointing in gasoline economy but gave some slight improvement in car performance.



**Fire injectors** take the place of normal spark plugs and do the same job. PS tests showed insignificant differences compared with standard plugs—but there was certainly no improvement.



**WHAT'S NEW**

**PHOTOGRAPHY**

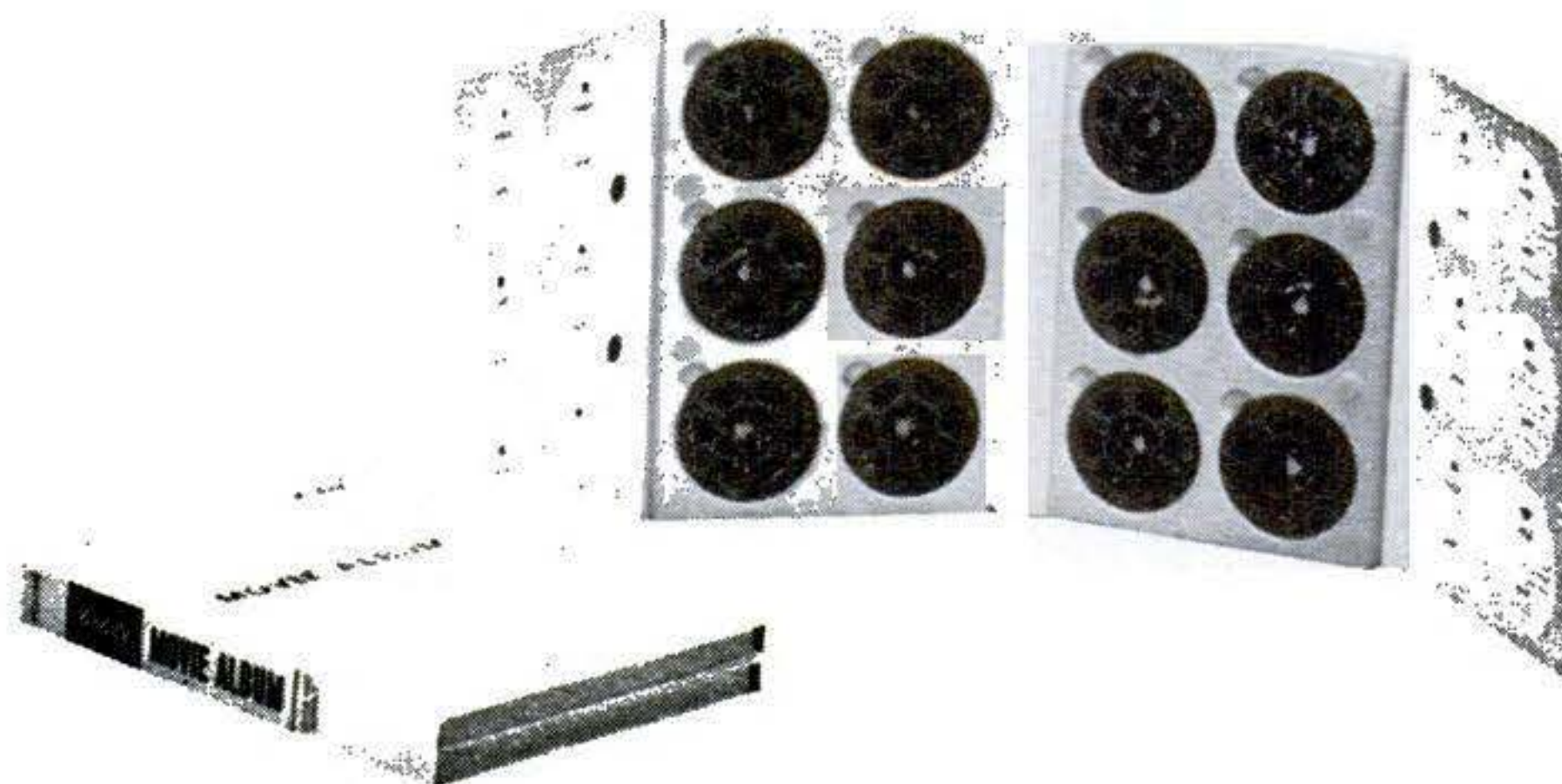
**New Canon SLR offers through-lens spot meter**

A new Canon 35mm single-lens-reflex camera offers through-the-lens CdS spot metering at a moderate price. Called the Canon TL, it comes with an  $f/1.8$  lens as standard, will accept the full range of Canon lenses, from 19mm to 1,000mm. The center-spot meter measures 12 percent of the picture area. Other features: circuit switch, depth-of-field preview, quick-load system, 25-2,000 ASA range. Cost: about \$200.



**New palm-size movie camera**

The latest in Kodak's compact super-8 movie cameras, this palm-size Instamatic M20 measures only  $6\frac{5}{8}$  by 3 by  $2\frac{1}{4}$  inches. It features power zoom (13mm to 28mm) with fingertip control on top of the camera; through-lens viewing and electric-eye exposure control; insufficient-light signal; pistol grip and wrist strap (at no extra charge). The camera takes instant-load film cartridges and is powered by AA batteries. About \$100.



**Movie album folds like a book for easy storage**

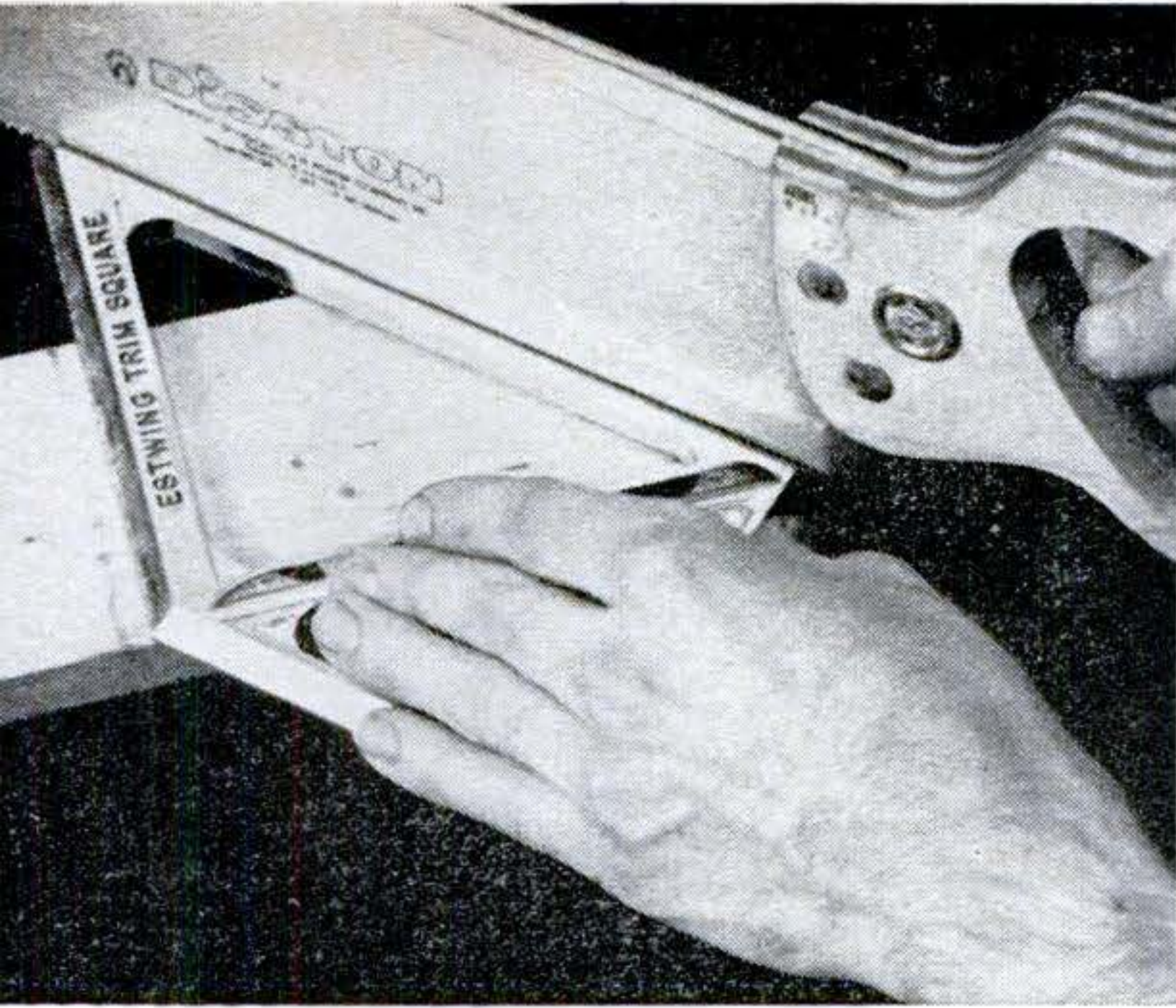
Open this Kodak album, and you can file 12 reels of movie film inside, with index space on the flaps for identification (matching labels go on the reels). Close it, and it resembles a book, for easy storage. About \$4.



**Light-up nose makes handy slide previewer**

This cordless pointer has an extra feature besides pointing out details of slides on the screen: You can preview slides by holding them against the long translucent nose. It's \$9.95 from Ednalite, Peekskill, N. Y. 10566.





### Tool gives neat miter joints

Tuck this tool in your pocket the next time you have a room to trim out, and you can leave your miter box in the shop. Called Trim Square by the Estwing Mfg. Co., the new device is made of tough, lightweight aluminum alloy—and, claims the maker—insures perfect miter joints every time, even for beginners. Price is \$2.98 at most hardware stores.



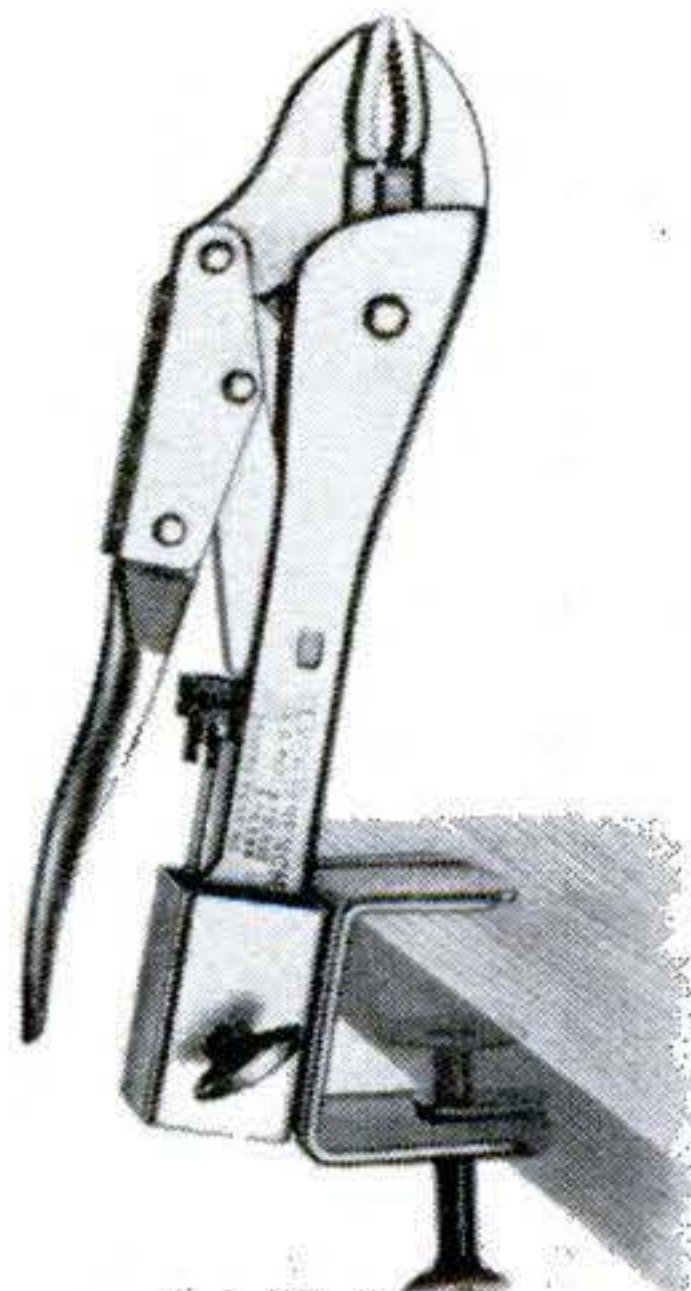
### Planing tool cuts hardened plastics

Smooth, trim, or shave a wide variety of materials fast with Sears newly designed "rasplane." The blade has been improved—cutting edges hardened, inner core strengthened—so that it can be used to work all soft metals, wood, hardboard, vinyl and asphalt tile, and fiberglass. It even cuts hardened auto-body filler plastics. With flat blade, \$3.19.



### Hammer head can't fly off

A new handle design makes certain that this Taper-Lock fiberglass hammer from Stanley will never lose its head. Upper end of handle and eye of head are both tapered, with the top of the handle wider than the eye. The handle is inserted through the head, bonded with adhesive. \$6.50.



### Self-adjusting wrench

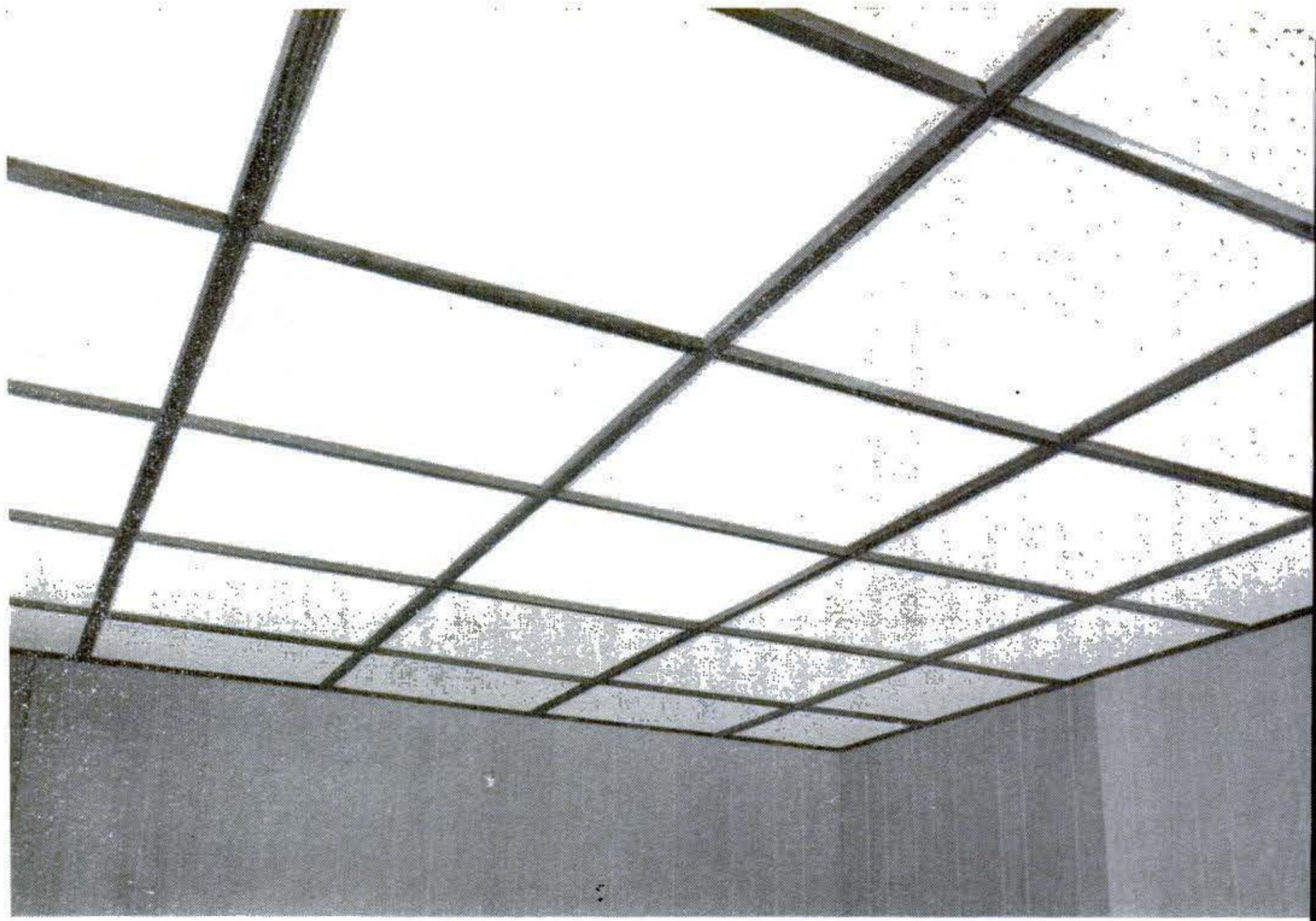
Here's a wrench that clamps any object up to 1 $\frac{3}{8}$ " instantly—because there's no adjusting screw to fiddle with. Used with a vise bracket (shown), the tool becomes a portable bench vise. LeverWrench, about \$7.50. Leverage Tools, Glenview, Neb. 68941.



### Cordless electric drill

For use on all hobby materials, this tool will grind, drill, carve, and deburr. Three precision collets take bit and tool accessories from #80 to 1/8". Drill with case, three collets, drill bit, center punch, and grinder: \$5.95 (less batteries). X-acto, 48-41 Van Dam St., NYC 11101, makes it.





# How to Install

By R. J. DE CRISTOFORO

**W**hat do you do overhead if you're remodeling a garage or other structure with joists 10' high and you want a ceiling of average height? One answer to this and similar problems lies in the Simpson Timber Company's new red-wood-grid suspended ceiling, which you can drop anywhere from 3" to 24" below the existing construction.

**How it works.** The ceiling hangs from 12-gauge galvanized wire, attached with nails to the face of the joists. It forms an extremely rigid structure because of the bracing action of the tick-tack-toe pattern between walls. If you plan to hang the new system under an existing ceiling, you can do so by attaching the hanging wires to screw-eyes instead of nails. The screw-eyes would have to be long enough to penetrate the ceiling material and continue into about 1" of joist. This step is not as tedious as it

may sound since the wires may be spaced as much as 4' apart.

Basic gridwork components consist of 8' main runners and 2' or 4' cross runners, providing for a 2'-by-2' or a 2'-by-4' pattern. All runners are prime redwood, shaped and milled so they'll mesh together in smooth joints without further attention. The only cutting required occurs at the walls where perimeter pieces must be sized to fit.

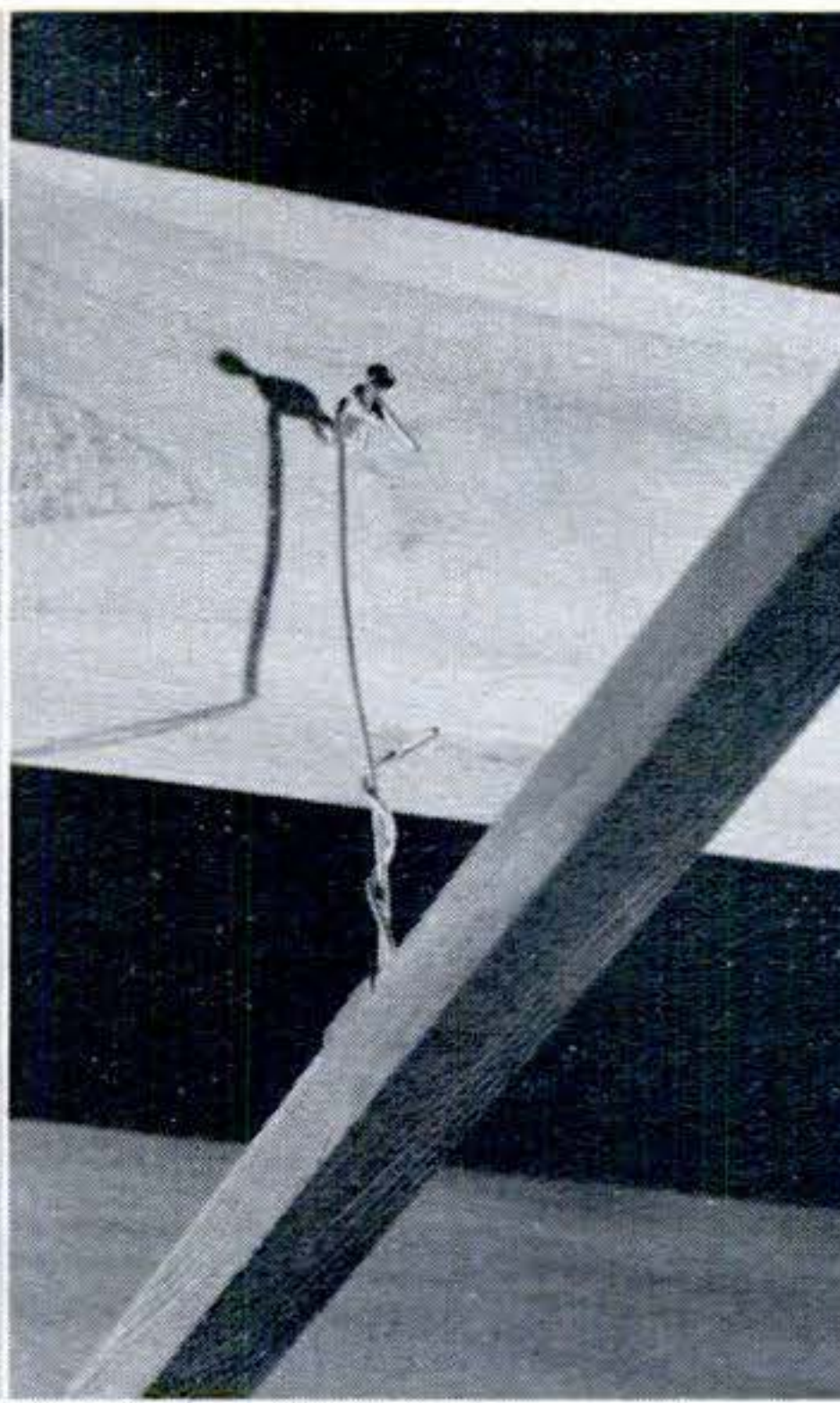
**How it goes up.** The main runners are butted end-to-end and locked with a special metal clip. Smaller hanger clips that slide on mated grooves in the main runners are located wherever there is a hanging wire. Special molding, shaped and milled like the runners, runs the perimeter of the room to complete the grid framework.

Panels of acoustical or decorator type are installed after the gridwork is complete; cutting is necessary on perimeter pieces only. Translucent-plastic panels are available for flush-lighting effects.

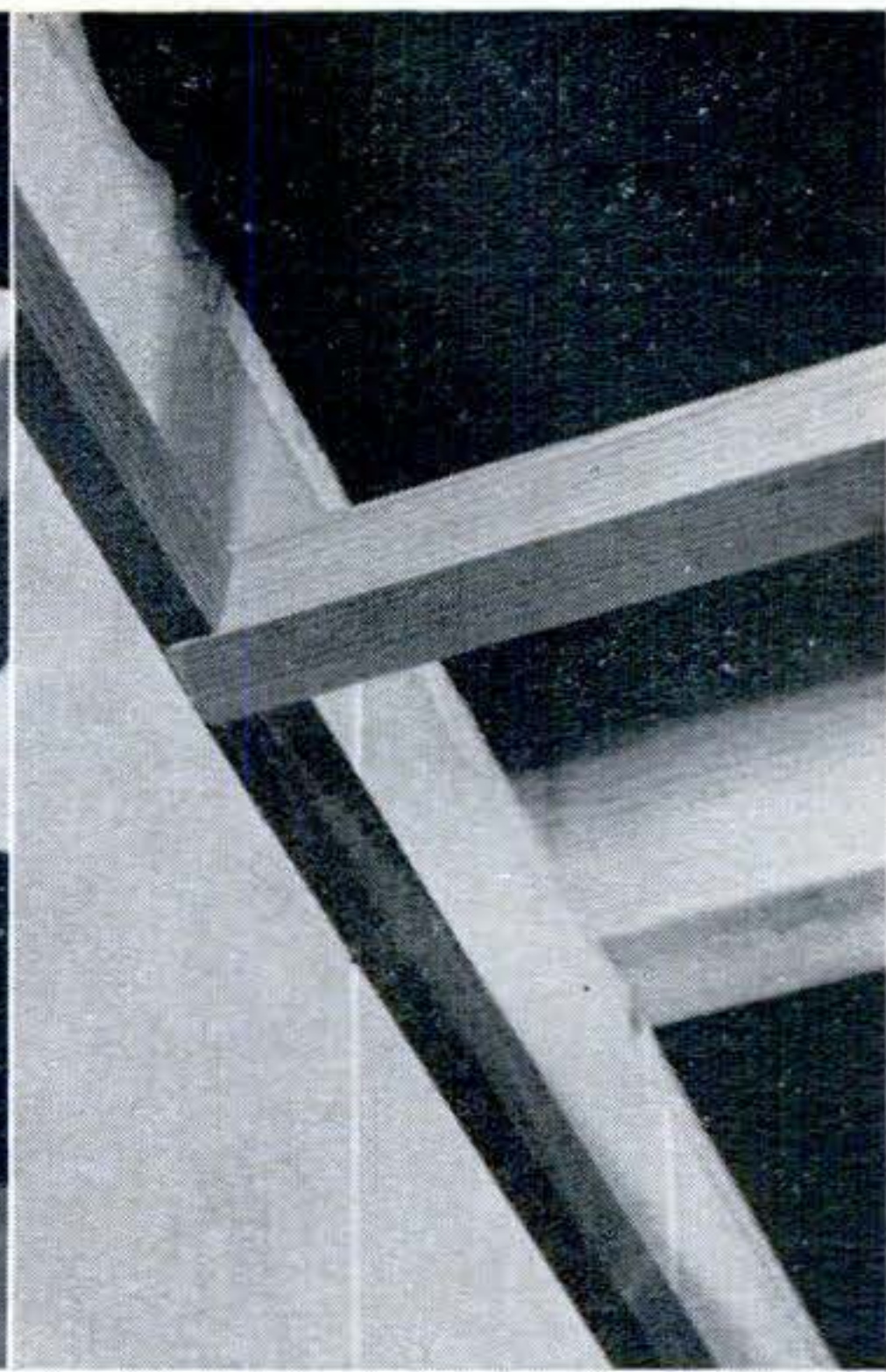




spans of more than 8', main runners are butted end-to-end and held by metal clip. Clips have a hole, drilled tabs through which a larger wire is threaded. Smaller clips go anywhere along the runner.

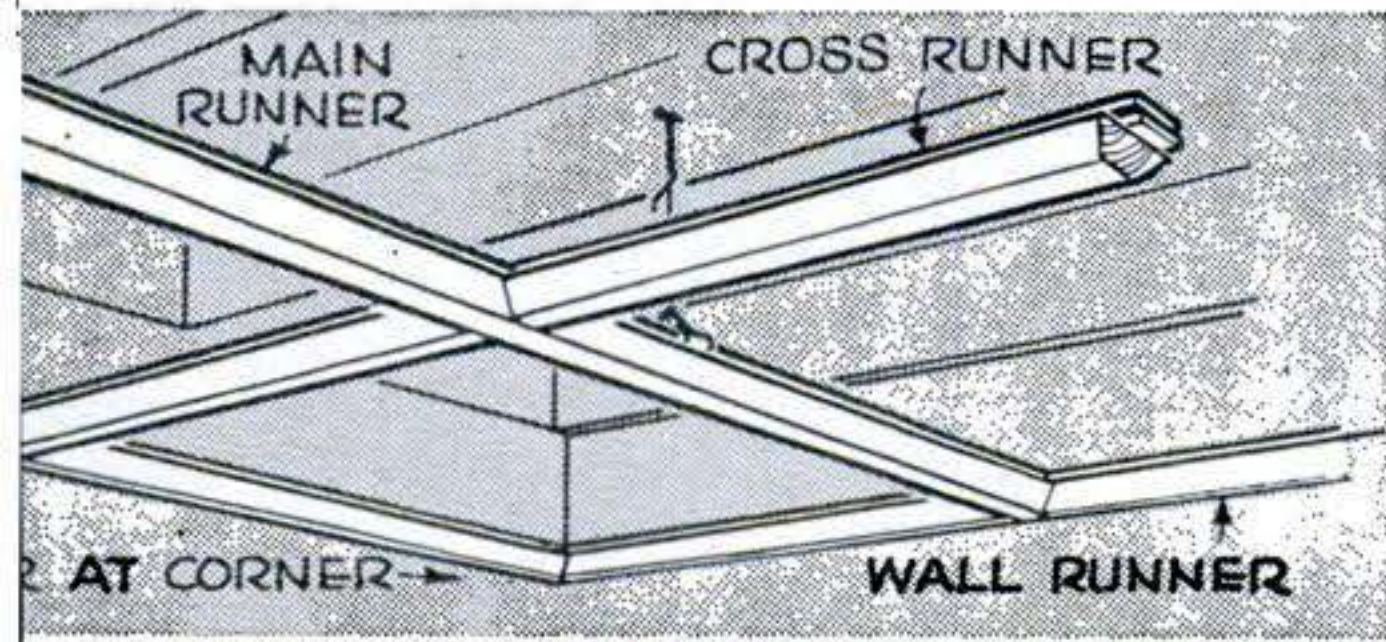


Ceiling hangs from wires secured to nails or screw-eyes in joists. Free end of wire threaded through clip is twisted up and around itself. Ceiling level is established by alignment string from wall to wall.



Runners end up butted against wall. Spaces between are filled with wall molding, end-milled to match and fit against side profile of runners. The design results in a very rigid grid to support panels.

# Unuspended Ceiling



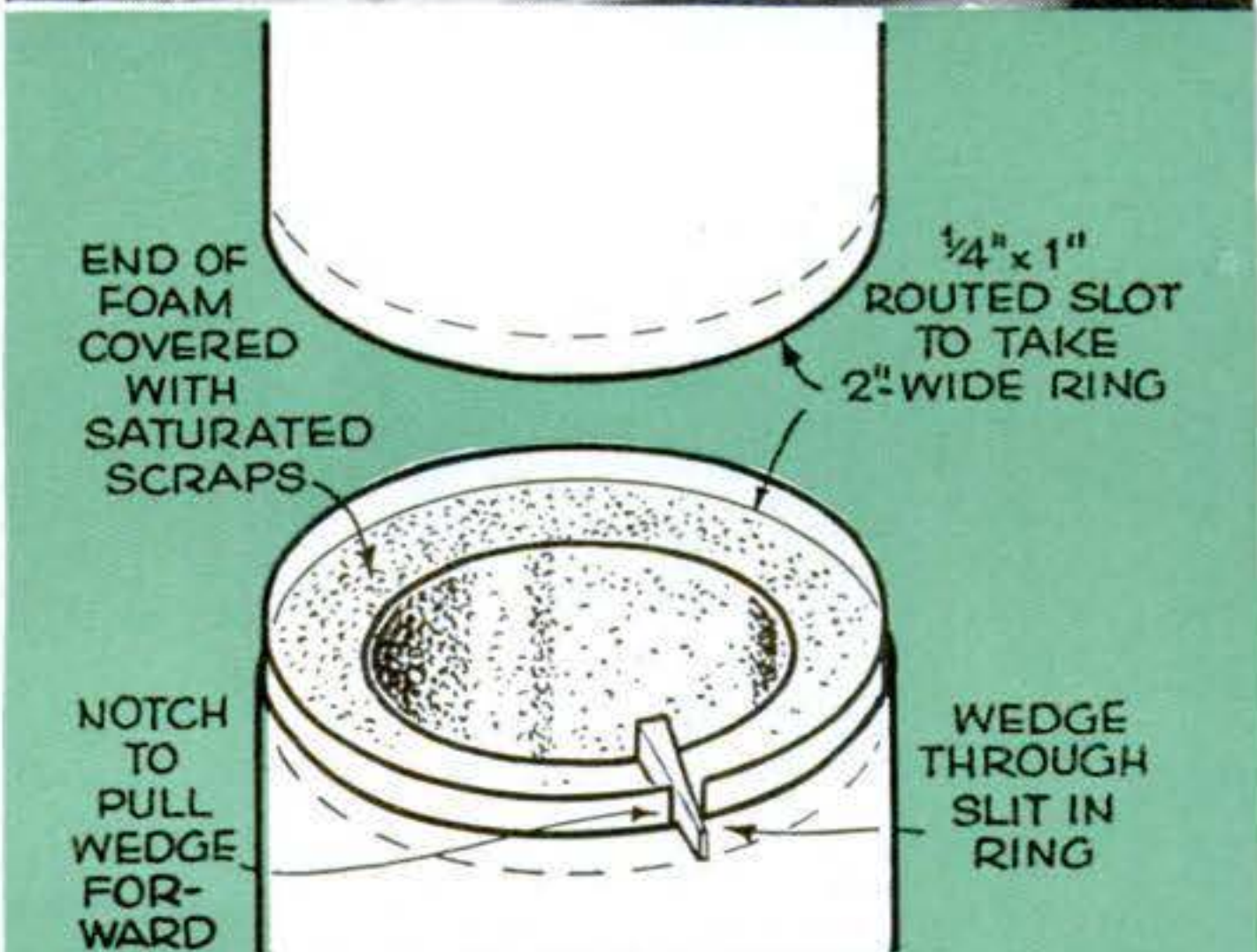
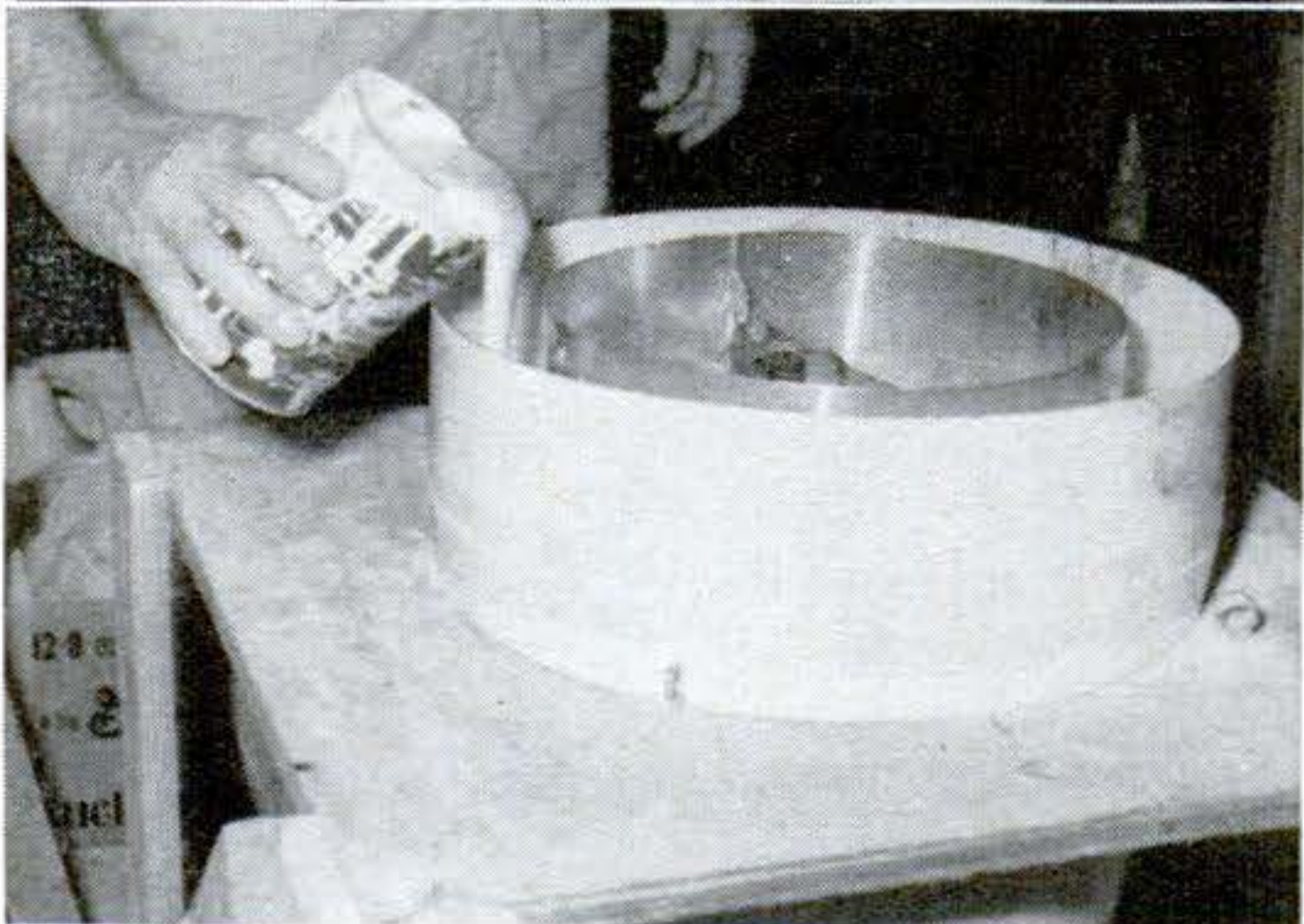
Ends of cross runners are milled to mate with the sides of the main runners, as shown in sketch above. Cross runners 2' long are used for a 2'-by-2' pattern, and 4' cross runners for a 2'-by-4' pattern.



Panels take only minutes to install, after the grid-work is up. Simply tilt them through openings and lower them to rest on the runner flanges. Anything overhead is still accessible on removing panel.



# Build the **VERSA-CAT**



## Joining the pontoon sections

Transition sleeves join cones to straight body sections. These 4" rings (background, top photo) are cut from extra body-skin fiberglass and butt-joined with tape after routing edge groove. (For foaming data, see text.) Sketch explains how untapered sections are joined.

Continuing the construction of the most versatile craft afloat—and one of the safest

## Part Two

By KEITH VINING

**L**ast month we showed you how to construct and use the molds for forming the pontoon sections of fiberglass-reinforced polyester backed with urethane foam. You should now have four nose-cone sections and eight body cylinders.

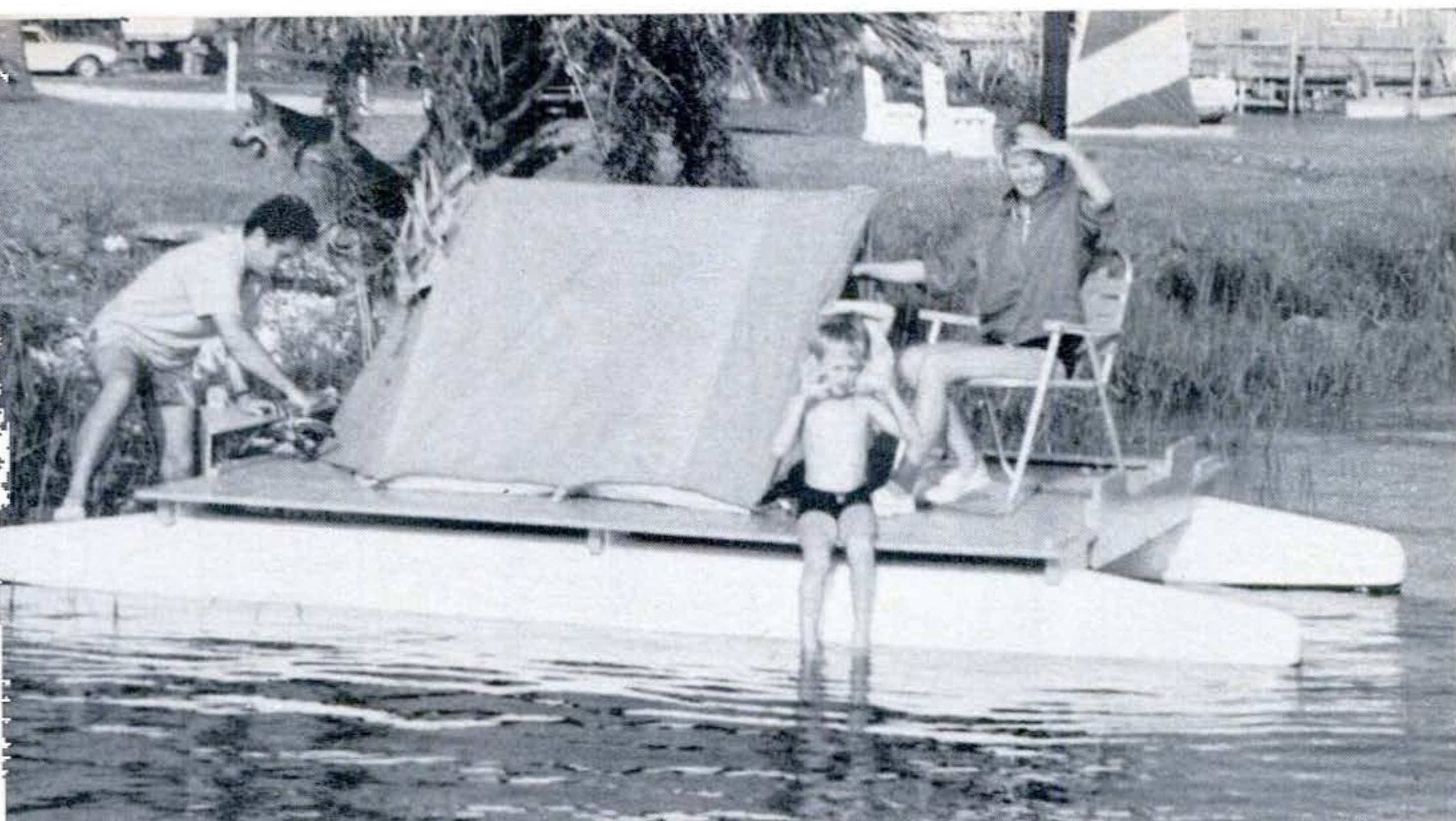
To assemble these units into two 14½' hollow-core pontoons, you'll need a couple of extra fiberglass "hides," which you lay up in your body-section mold as described, stopping short of the foaming operation. You'll slice these into four 4" transition sleeves and 10 2" rings; the latter are split on one side with the cutoff wheel so that they can be compressed in diameter.

**Sleeves and cones.** To fuse the transition sleeves to the cone sections, as shown in the photos at left, you first rout a 1"-deep groove in the cone's foam, about ½" wide and just inside the fiberglass hide. Set the sleeve atop the cone so that this groove will run just inside it and anchor it by sticking polyethylene tape around the outside of the joint. Then lay strips of fiberglass around and around the inside groove, saturating these with resin worked well into the joint.

As shown in the lower photo, you'll need a core mold for the foaming. Make a ring of aluminum the same diameter as the aluminum core of your body mold and slightly wider than the sleeve. This ring's clamp lips are bent inward, and can be held with battery clips.

Seat this within the cone's core foam until its top edge is flush with that of the sleeve. Mix and pour the foam before the fiberglass joint has fully set. Clamp the top plate of your body-section mold on top and weight with bricks. After ex





**Want a houseboat?** Just flatten the hinged deck seats and pitch a pup tent for sleeping.

pansion and cure, remove top plate and sand or file the foam flush with the sleeve.

Joining untapered sections requires no transition sleeve; joints are secured internally by means of split rings and a wedging device. As the sketch on the opposite page shows, you first rout a  $\frac{1}{4}$ " groove, 1" deep, just inside the hide of both sections to be joined. Sand butting surfaces flat, smooth, and wax-free. Cover

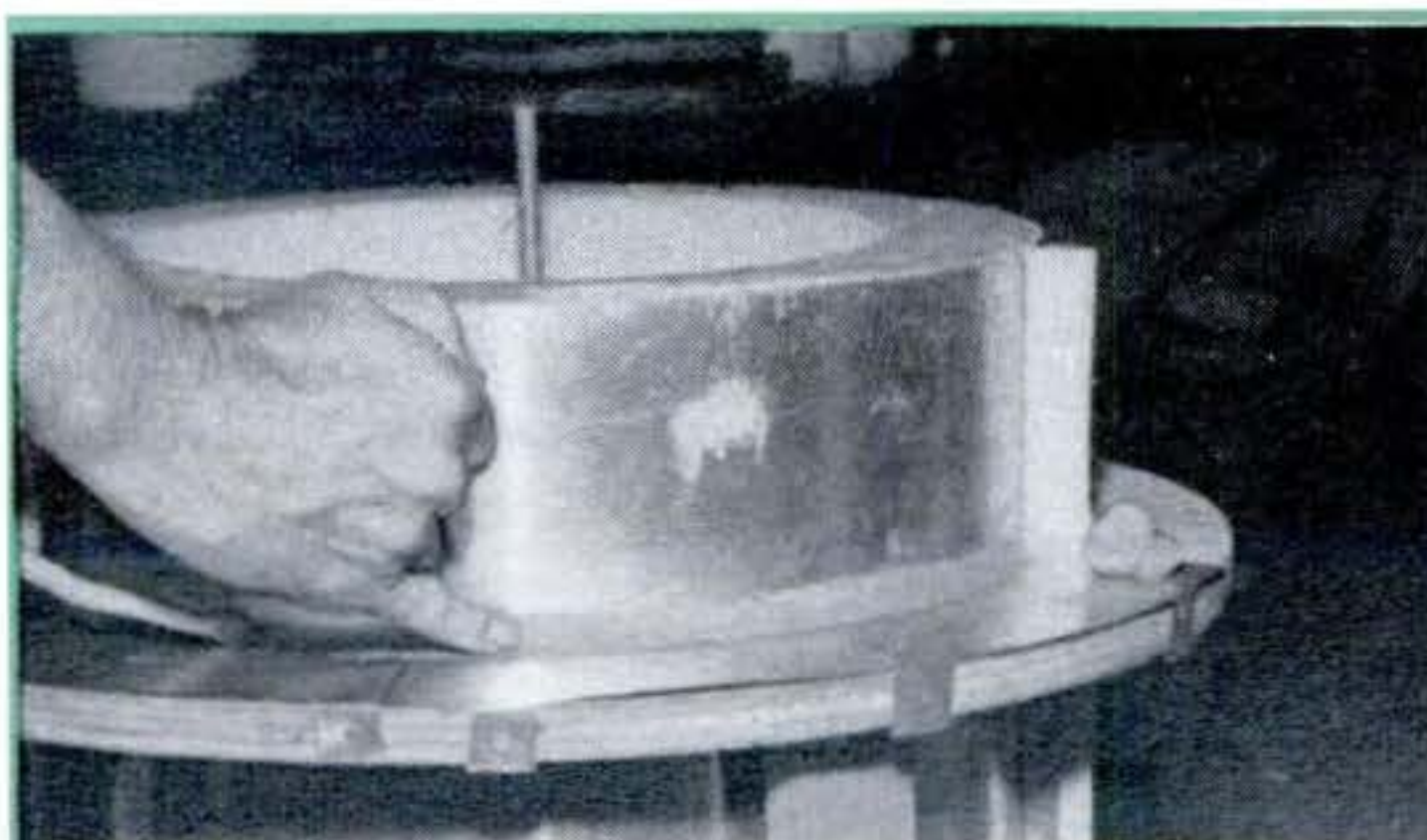
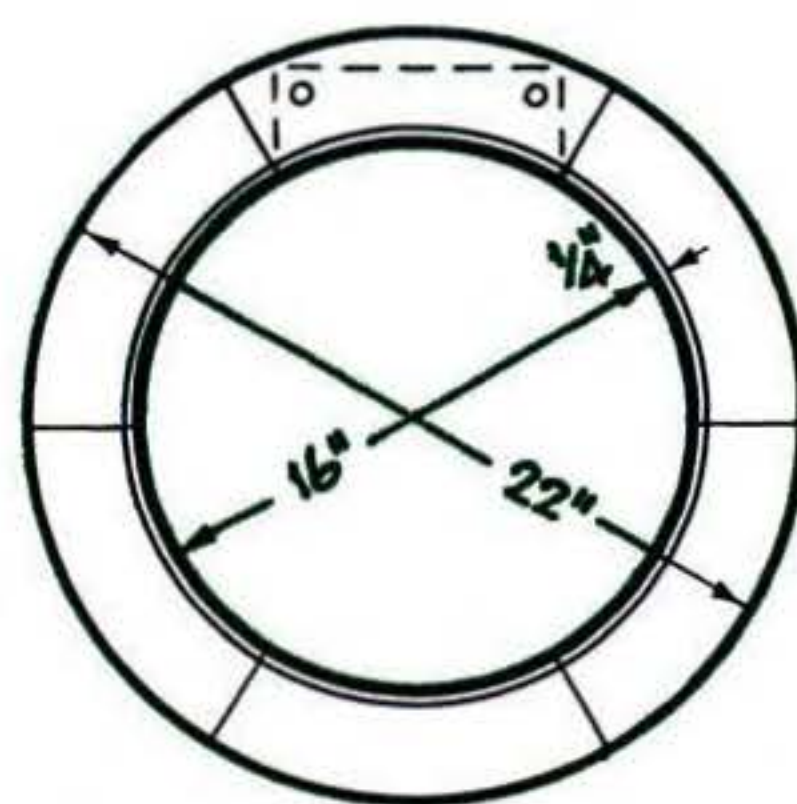
the end of the foam with scraps of resin-saturated fiberglass. Coat the outside of the split fiberglass ring with resin and seat it in the groove of the lower section.

Before starting this assembly, build up wedges of resin-coated layers of fiberglass to a thickness great enough to prevent their pulling free when the ring is fully expanded. Seat one of these in a notch, as shown. Now, set the upper

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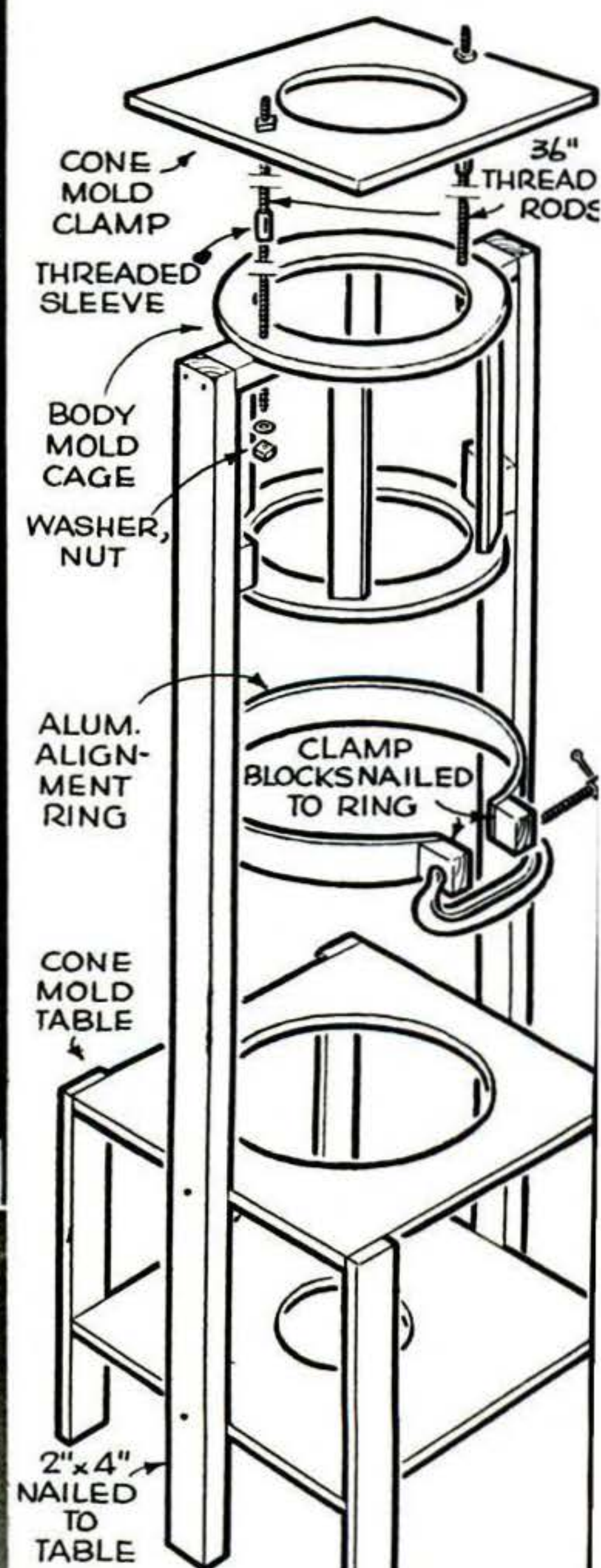
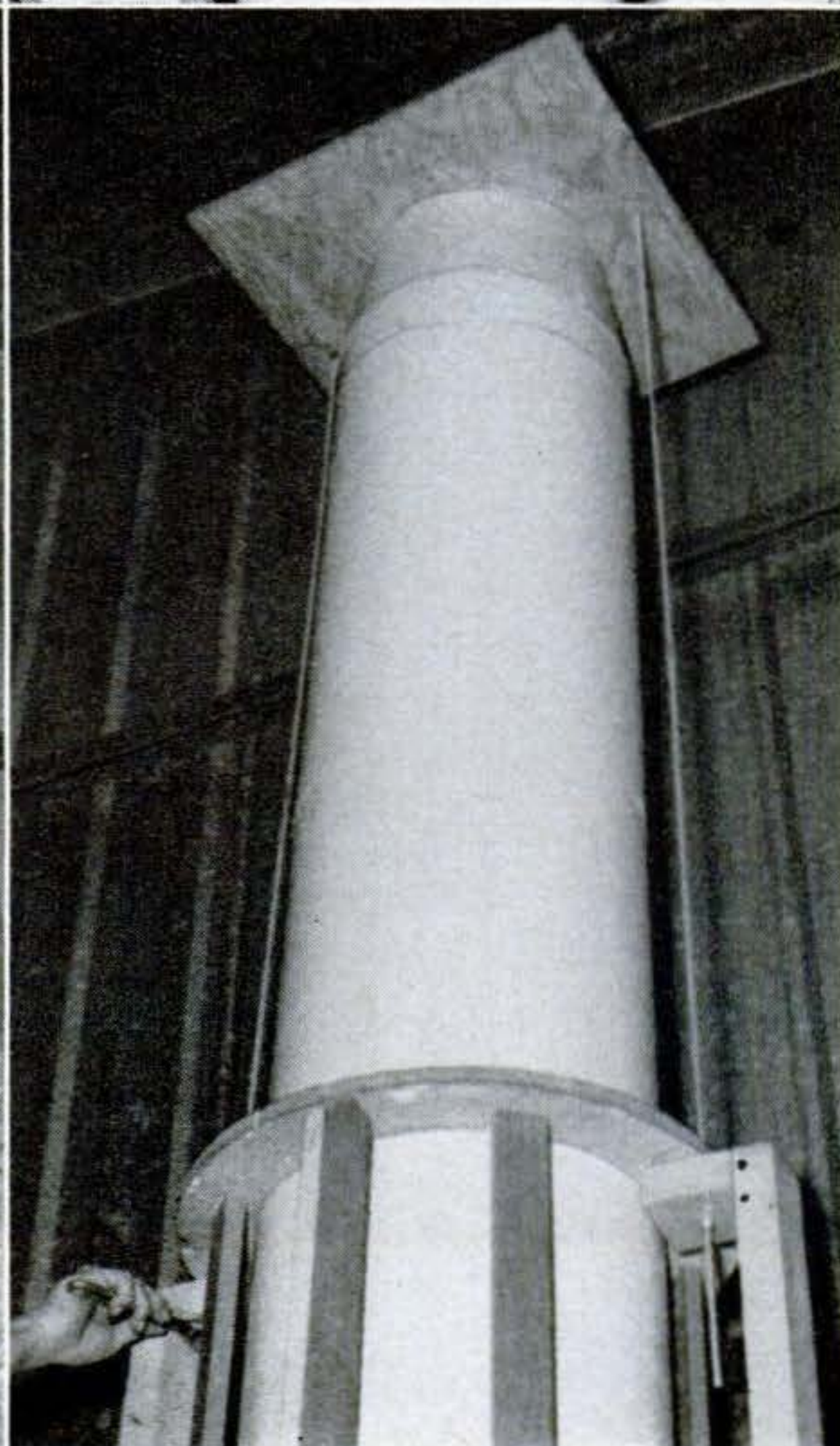
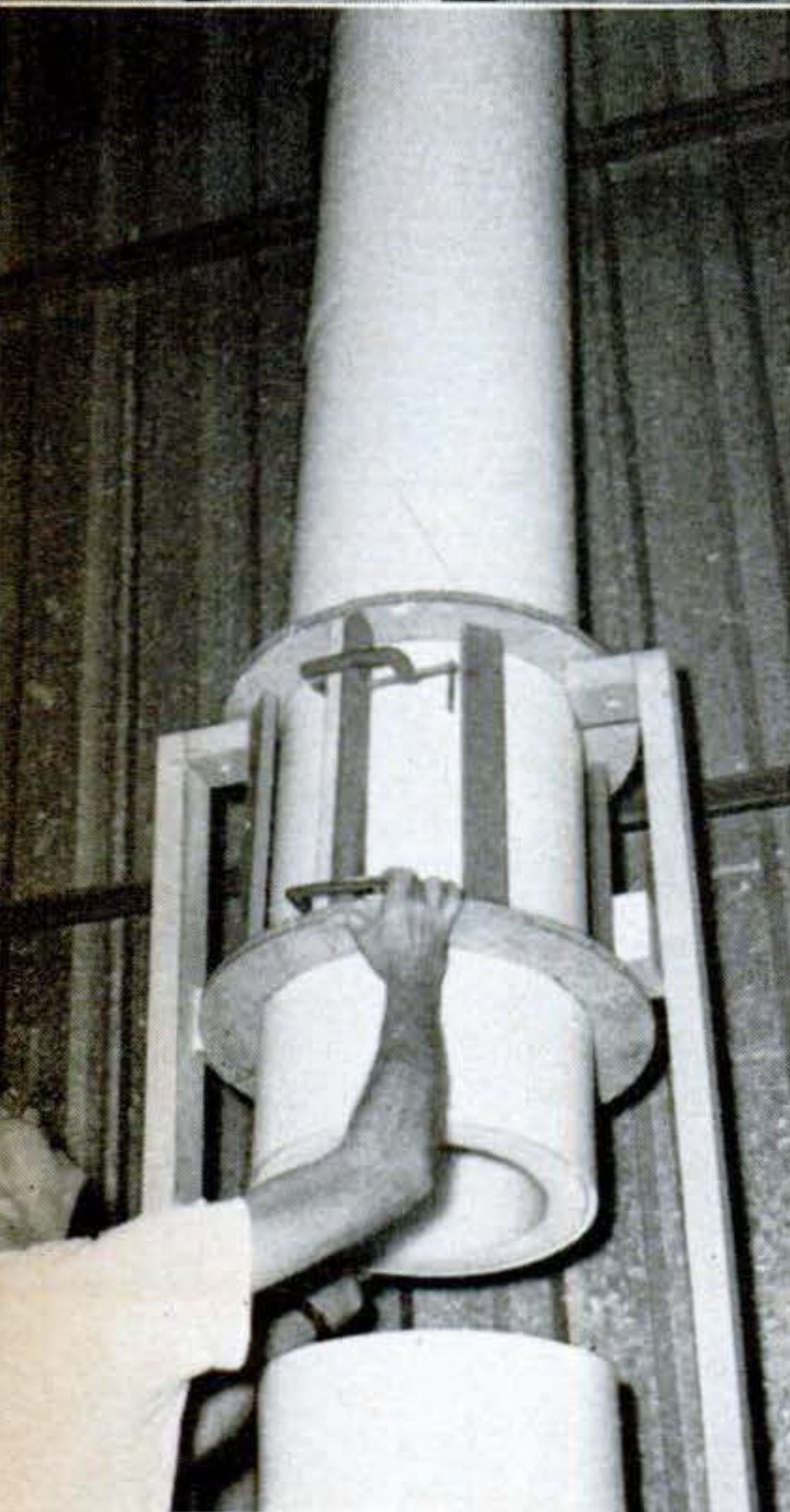
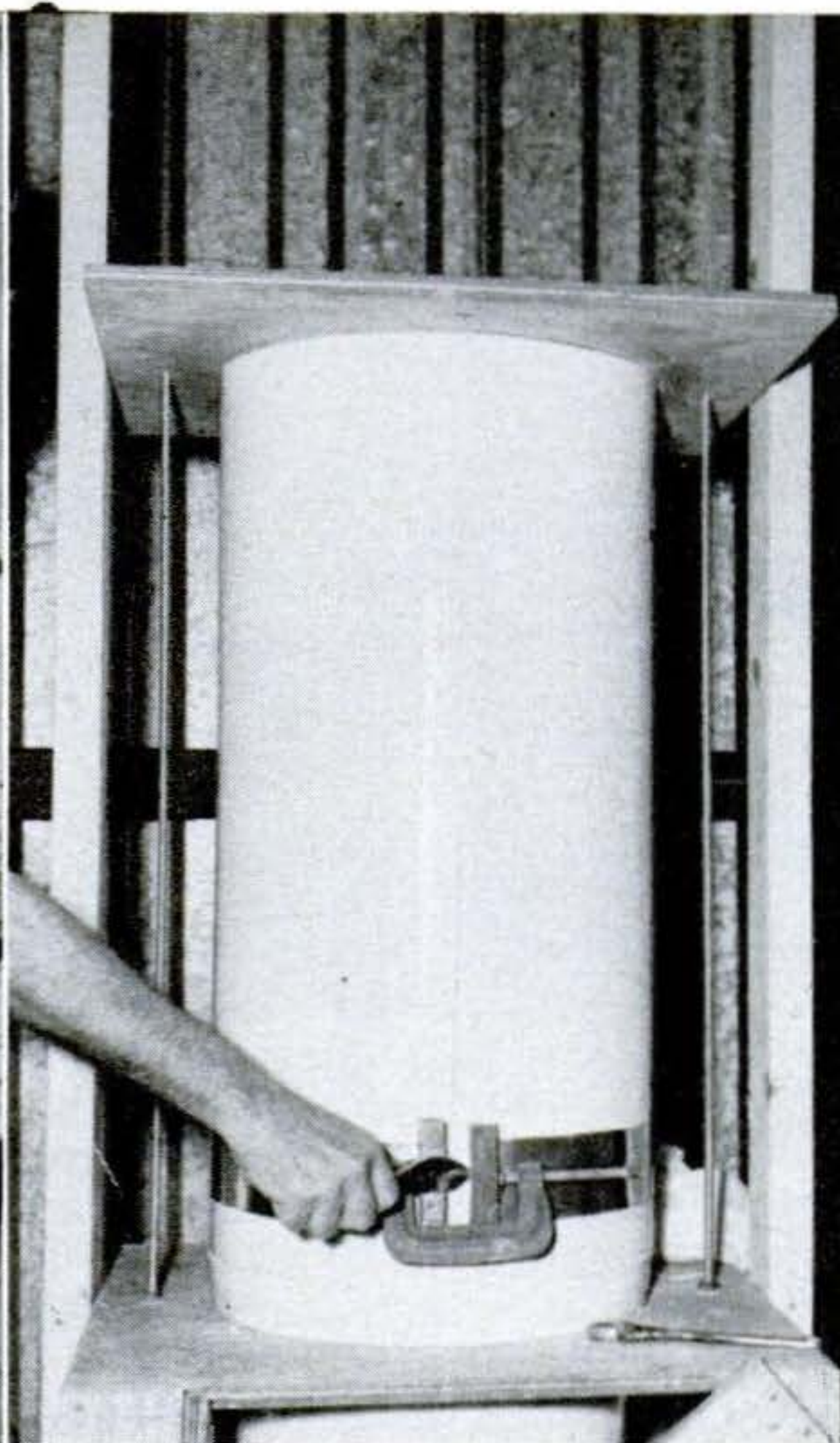
## Molding a ring for the deck-beam brackets

Mold for laying up the ring already exists. After you foam last (eighth) body section, leave it in its mold to stiffen the outer aluminum sleeve; cover top face of upper ring with aluminum. Run bead of child's play clay along joint and round with finger (below, left) to soften corner. Apply paste wax to all surfaces. Cut plenty of fiberglass strips with notches along one side; brush with resin and apply in layers, alternating notches up or down, until you build  $\frac{1}{4}$ " thickness 2" high and width of ring. Set blocks under lower ring so that threaded core rod and drilled two-by-four can be used as wheel puller to strip off ring. When cured, segment.





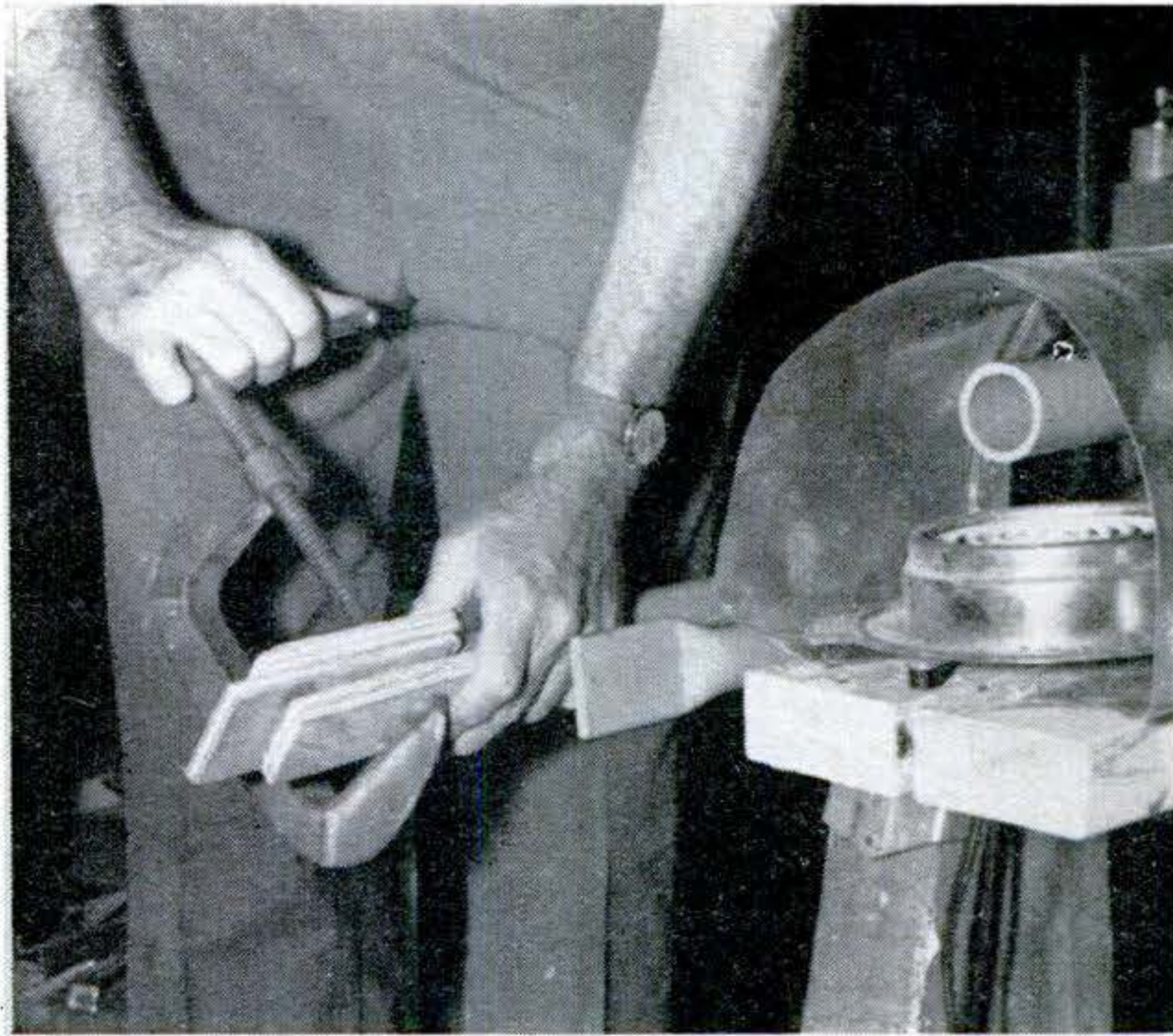
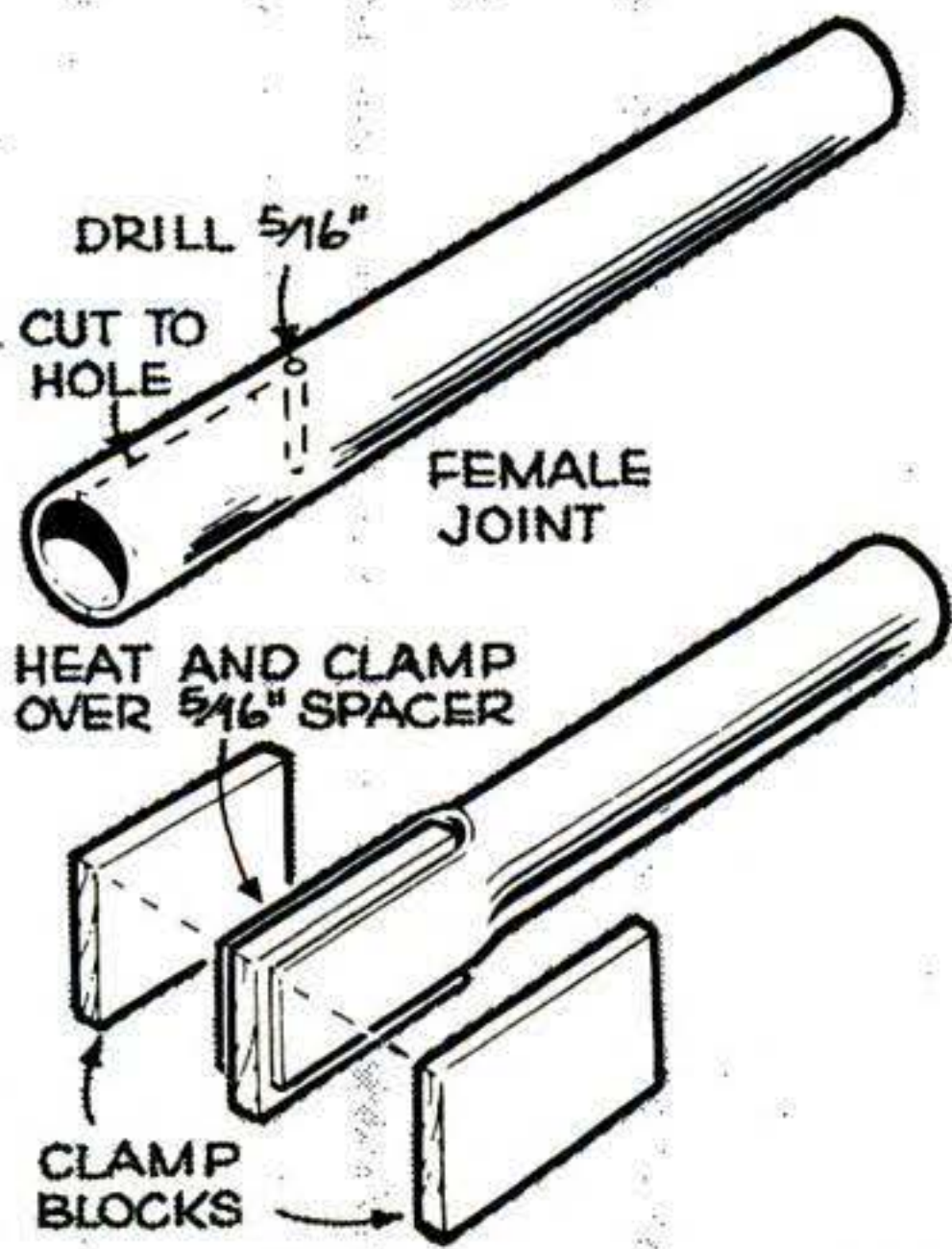
# Going up! It's best to assemble the pontoons vertically



**SCAFFOLD FOR FINAL PONTOON ASSEMBLY**

Scaffold to erect sections and exert joint pressure makes use of mold parts. Place a cone (with sleeve fused on) in cone table, keeping split fiberglass ring handy (top left photo). Attach body section as described in text. Top right photo shows how aluminum alignment ring clamps joint while fiberglass wedge is drawn out to spread ring inside. Note: This subassembly vertically clamped with threaded rods. Add central subassembly and remove from scaffold. Place second cone in table; add body piece and lower the long assembly through cage of body mold (bottom left). Slip plywood plate over top cone and secure with threaded rod





## Even the spars are plastic—heat-formed from PVC pipe

Since pipe is thermoplastic, it may be reshaped after heating. A scrap of aluminum, hooded over any small burner, creates a reflector oven (right). Turn the material frequently to avoid scorching. Form

female ends as shown. Slip aluminum tubing into each spar for reinforcement before other end is formed. Male end is simply clamped shut. Top of tripod mast is capped with hardwood block.

section down over the protruding ring and draw the wedge toward you with pliers, as in the top right photo on the opposite page. This expands the inner ring against the interior face of the fiberglass hide of both units. Once the plastic sets, you saw the wedge flush and file it smooth. (Incidentally, when grinding or sanding fiberglass, save the dust. Mixed with resin, it makes excellent putty or crack filler for the pontoons.)

**Erecting a scaffold.** You'll note from the photos and sketch at left that erecting a scaffold for vertical assembly lets you apply even pressure to the joints while they set. A subassembly system is used for each six-section pontoon; it consists of a cone and body piece joined, two fused body pieces, and another cone and body pair. Once two of these pairs are joined, the assembly requires special handling. I sliced through one side of the plywood rings of my body-section cage and nailed in clamp strips to draw the cage into a tighter diameter. I then suspended the cage at the top of my scaffold to act as a guide for lowering this long subassembly atop the final third. I climbed a ladder to position a clamp ring over the top cone, and ran two threaded rods down to the cage as

shown. I joined 36" sections of rod with threaded sleeves for this long pull.

**Fiberglass brackets.** To assemble the finished pontoons to the deck beams, you'll need fiberglass brackets cut from the angle ring fabricated as shown in photos and sketch on a previous page. Cut the ring into six equal segments, grind each to shape, and drill for  $\frac{5}{16}$ " bolts, as indicated. Cement three brackets to each pontoon as described in the caption on the next page.

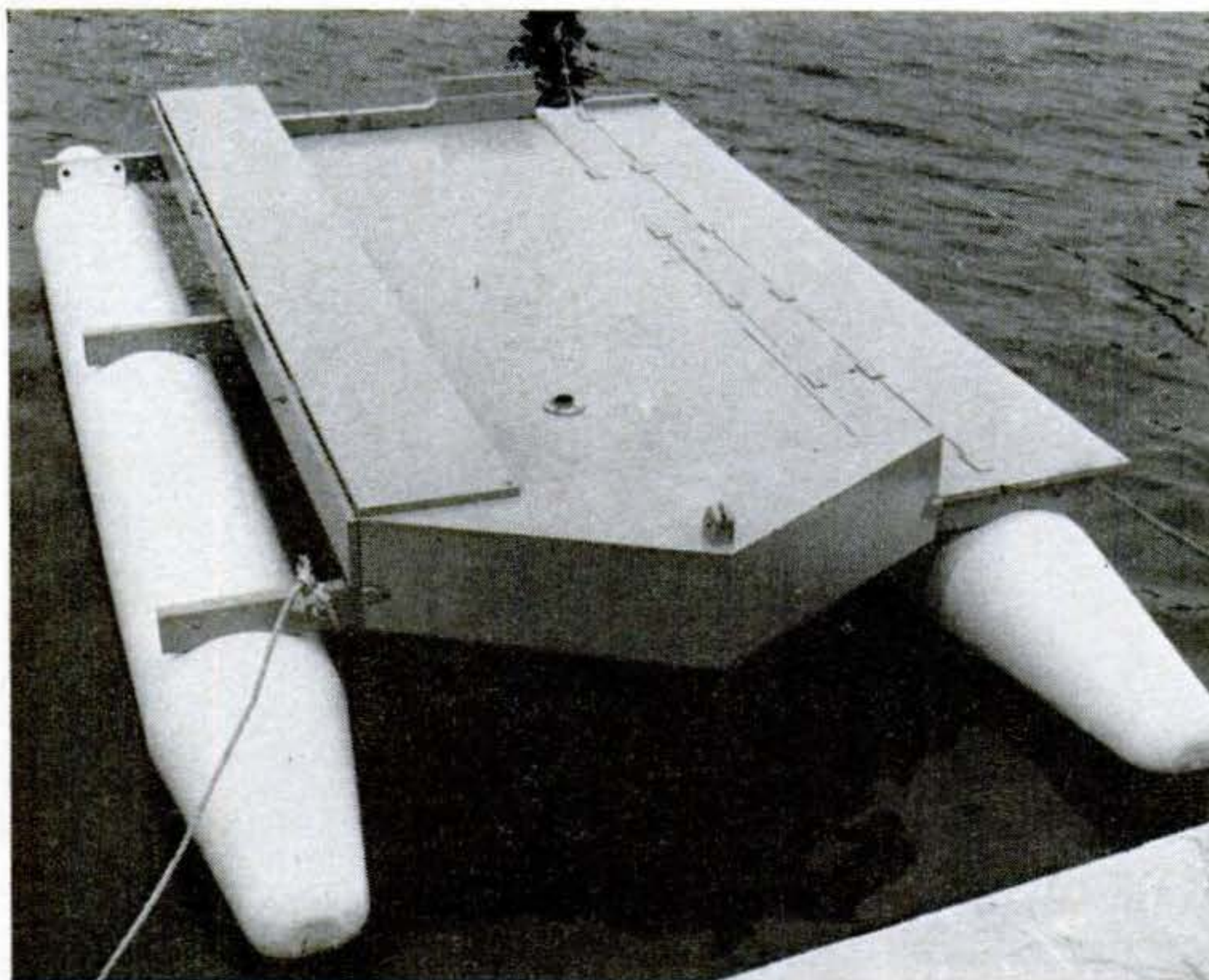
A marine construction-grade plywood is best for the deck panels and transom. Cut all pieces to the dimensions given on last month's blueprint. Trim three 8' spruce two-by-fours to 82" for the deck beams, and shape the ends to match the 16" diameter of the pontoons. Paint deck and beam members separately before final assembly. The fiberglass pontoons require no finishing.

The simple design of the deck lets you nail or bolt on any additional accessories wherever you want them. To hold the boom horizontal when the sail is furled, I tacked an inverted V of one-by-fours to the transom, as shown in the photo that led off last month's article. I ran the sheet line to the boom through a double

*Continued*



## Three beams bridge the pontoons to support the deck



Begin assembly by tacking 4'-by-10' marine-plywood deck panel to properly spaced beams. Sawed-out arcs at each end of beams align the pontoons. Clamp fiberglass brackets to beams and use their holes as template for drilling through beams. Bolt on brackets, mark positions on pontoons, sand areas, and apply three layers of resin-coated fiberglass to cement three brackets to one pontoon. Weight that side, let set, repeat for the other pontoon. Drill through deck and beams for bolts. Add bow and transom and attach deck wings with polypropylene hinges. Starboard side is in bench position to show oar socket and bolts for leeboard and base of spar.

### WHAT THE VERSA-CAT COSTS

MATERIAL	QUANTITY	UNIT COST	TOTAL
Polyether urethane two-component foam	10 gal. (5 of each)	\$8.10 gal.	\$ 81.00
Polyester resin	5 gal.	8.20 gal.	41.00
Fiberglass cloth	7.5 oz.: 60"x20 yd.	1.85 yd.	37.00
3/4" Ext. ply	2 pcs. 4'x10'	.40 sq. ft.	32.00
3/4" Ext. A/C ply	2'x4'	.30 sq. ft.	2.40
1/2" Ext. A/C ply	2'x4'	.25 sq. ft.	2.00
3/4" Int. A/D ply (for molds)	4'x8'	.27 sq. ft.	8.64
5/4" Lumber	4"x14'	1.40	
1/2" Lumber	12"x12'	1.80	3.20
2x4 Spruce	4 pcs. 8'	.12 ft.	3.84
5/8" Carriage bolts (galv.)	2 1/2", 3", 5", and 7" lengths		4.20
Alum. flashing (for molds)	28" (roll width) x 24'	.32 sq. ft.	8.40
Polypropylene hinge strip	10'	.50 ft.	5.00
<b>TOTAL (less sail and rigging):</b>			<b>\$228.68</b>
Dacron sail (for Sunfish, Scorpion, etc.)			42.30
PVC pipe: 1"	43'	.24 ft.	
1 1/4"	12'	.32 ft.	14.16
1" alum. tubing	27'	.32 ft.	8.64
1 1/4" galv. pipe	32"	(plus cap and floor flange)	3.91
1/4" Nylon rope	40'	2.00	
2" Nylon pulleys	3	1.25 ea.	5.75
<b>TOTAL, sail rig:</b>			<b>\$ 74.76</b>

pulley lashed to this scaffold. This makes the Versa-Cat instantly convertible for trips where I'll be using both sail and motor—alternately or in combination.

You'll find that whenever the wind is at all favorable, the sail steadies the craft, and you can run the motor at half throttle for steering. To switch to sail alone, tilt the motor up (or lift it forward) so you can place an oarlock in a hole in the transom. I can bring about the Versa-Cat with a couple of swift sweeps on the oar.

I often leave the tripod mast in place even when I remove the sail for trolling with the motor; I use the mast to steady myself when standing to cast.

**The costs.** The breakdown presented at left is to help you estimate your expenses, not to serve as a precise buying guide. It's figured on the basis of a single builder paying full catalogue prices—and buying a Dacron sail (standard for such boats as Sailfish, Sunfish, and Scorpion).

If you combine forces with builders who want a Versa-Cat of their own, as described last month, the cost of materials diminishes as the quantities you buy increase—especially if you can line up a wholesale source for the fiberglass and resin. You'll get plenty of use out of those molds to justify the labor. **PS**



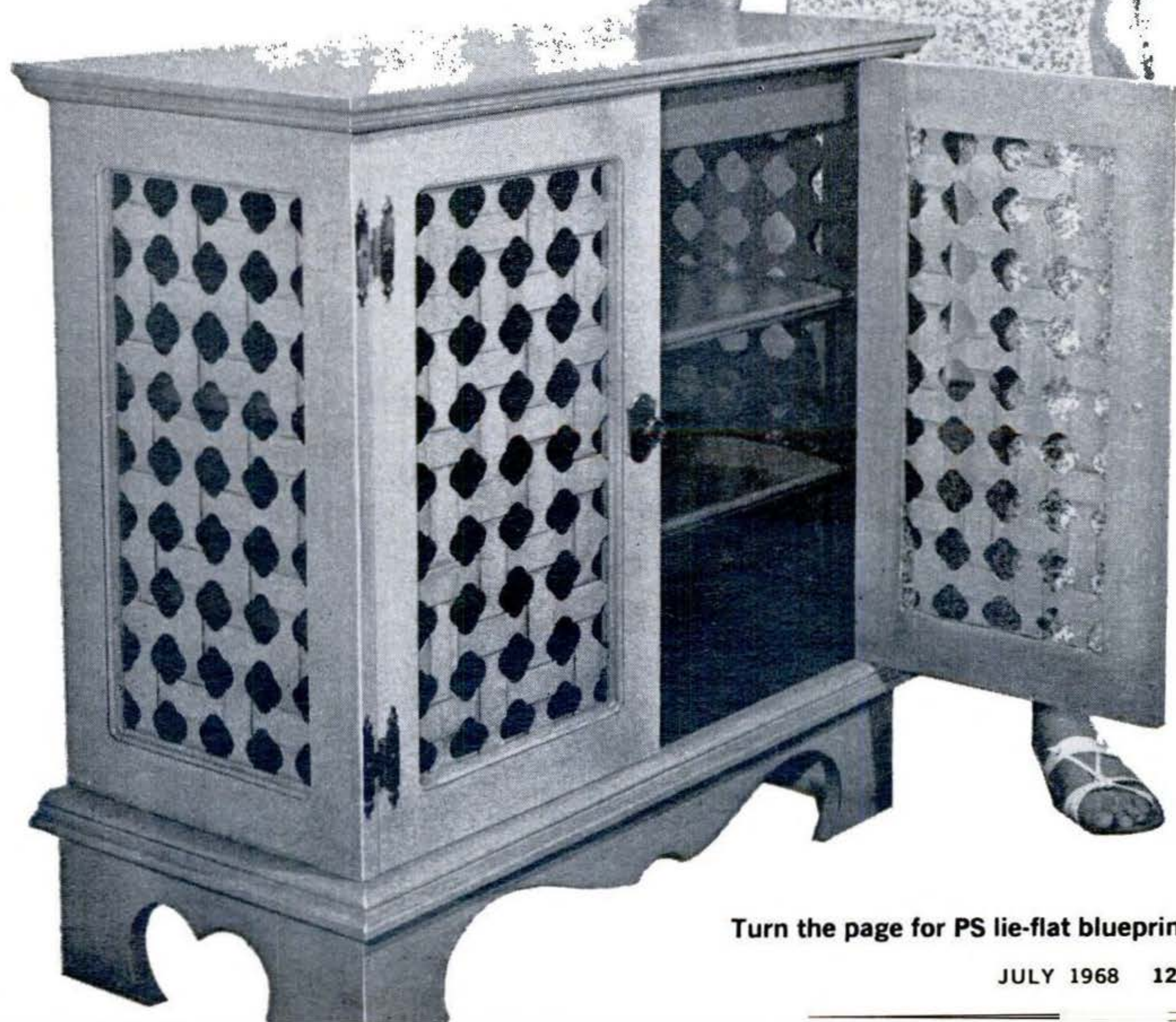
# Buffet with Woven Panels

You make the strips of lattice yourself to build this handsome, versatile chest

By JERROLD R. BEALL

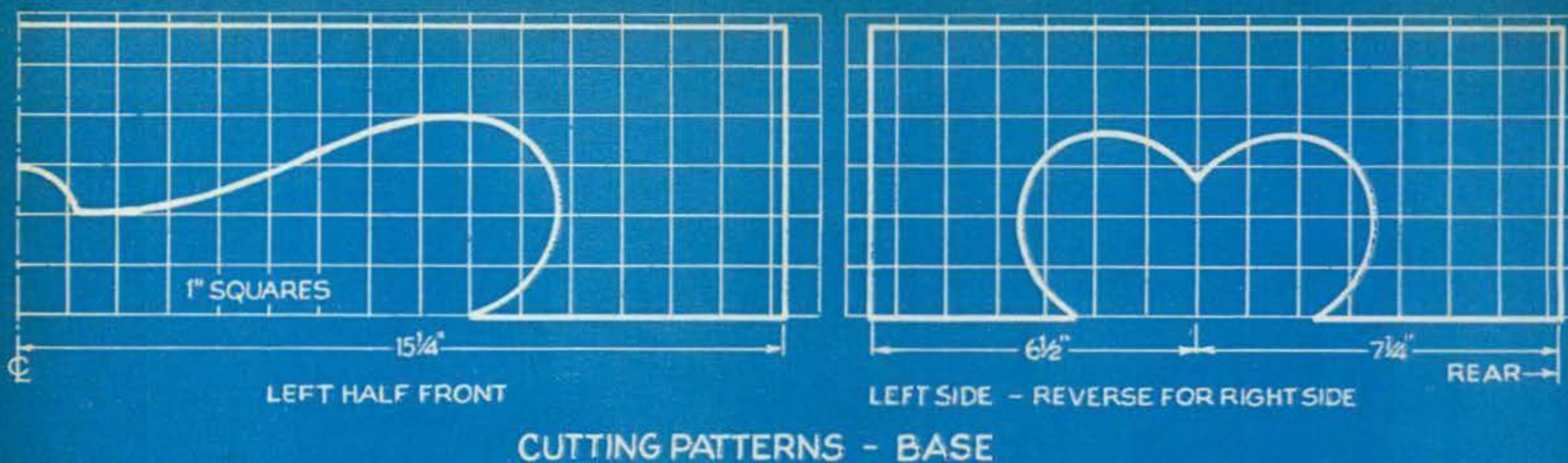
The buffet was a standard fixture in dining rooms 30 years ago. Today's popular "dINETTE sets" for smaller dining areas usually include only a hutch-type cabinet with the table and chairs. And that creates a problem in most homes. There never seems to be enough room for storing linens, cutlery, and other dining accessories. Building this chest not only

*[Text continued on page 124]*



Turn the page for PS lie-flat blueprint





## MATERIALS LIST

### PINE (clear or knotty)

- 1 pc. 1 1/4" x 16" x 6' (top, base)
- 1 pc. 1" x 14" x 5' (shelves)
- 1 pc. 1" x 6" x 5' (legs)
- 3 pcs. 1" x 3" x 8' (stiles, rails)
- 1 pc. 1" x 4" x 2' (shelf knee supports)

### CLEAR PINE

- 1 pc. 1 1/4" x 12" x 30" (lattice strips)

### PLYWOOD

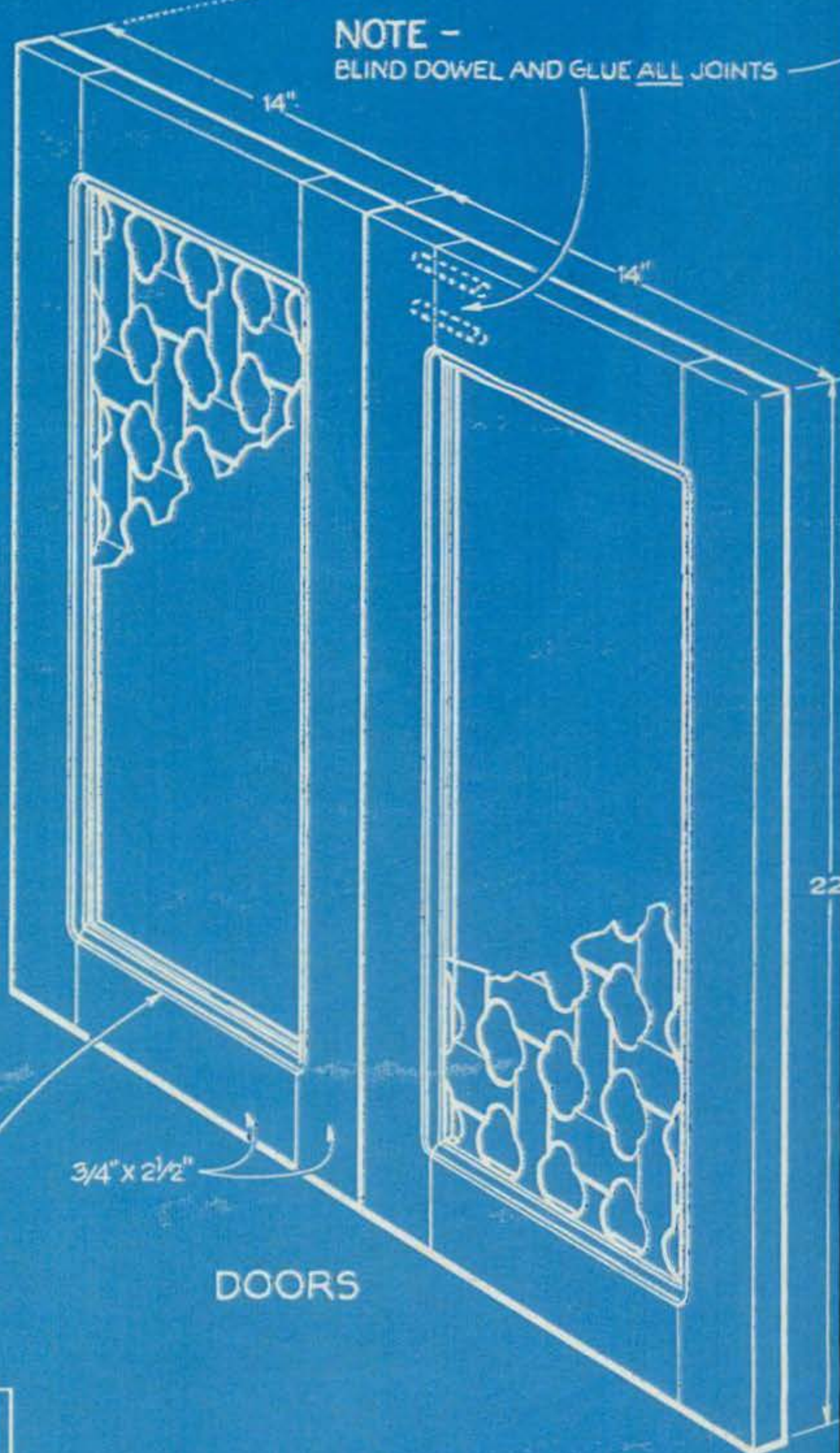
- 1 pc. 1/4" x 22" x 28" (back)

### HARDWARE

- 2 prs. V658-4A hinges
  - 2 knobs V274-4A
  - 2 backplates V6331-4A
  - 2 magnetic catches
- } National Lock

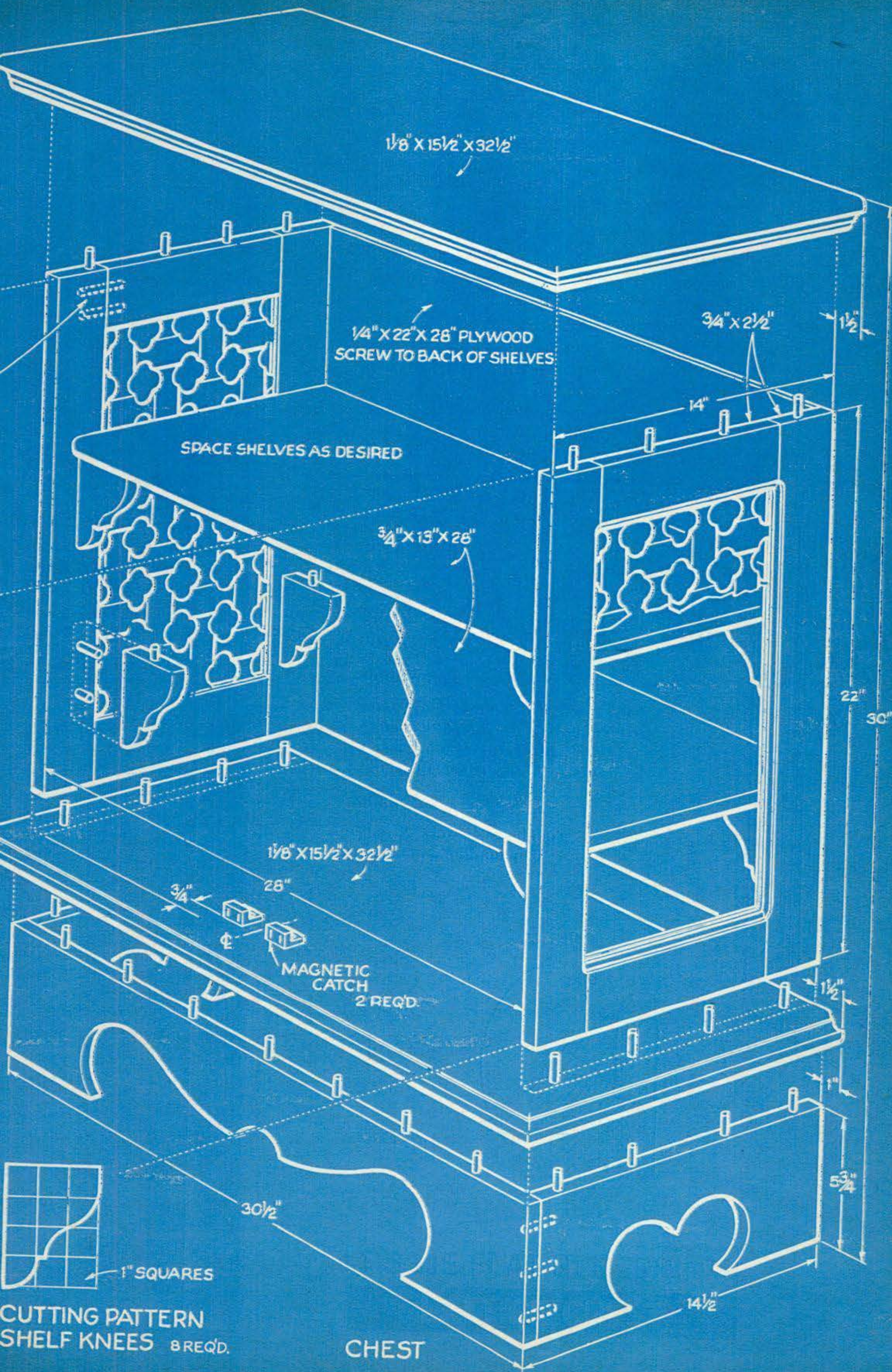
### MISC.

- Glue, 3/8" dowels, sandpaper, 3/4" #8 f.h. screws, antiquing kit



**PS LIE-FLAT BLUEPRINT**  
**LATTICE CHEST**





$1/8" \times 15 1/2" \times 32 1/2"$

$1/4" \times 22" \times 28"$  PLYWOOD  
SCREW TO BACK OF SHELVES

$3/4" \times 2 1/2"$

SPACE SHELVES AS DESIRED

$3/4" \times 13" \times 28"$

$1/8" \times 15 1/2" \times 32 1/2"$

28"

MAGNETIC  
CATCH  
2 REQ'D.

22"

30"

1" SQUARES

CUTTING PATTERN  
SHELF KNEES 8 REQ'D.

CHEST

$14 1/2"$

$5 3/4"$

$1 1/2"$

1"

14"

$1 1/2"$

$3/4"$

$\phi$

2 1/2" Holes

$30 1/2"$

2 1/2"  
2 1/2"  
2 1/2"



solves that storage problem, but adds a new technique to your woodworking skills as well.

The chest itself is simply constructed—the sides and doors are actually four identical frames. You'll need a molding head and cutters to make the lattice. If your shop lacks this versatile tool, this project alone could justify buying a set. You'll find them at Sears (complete set about \$24). Or you can have the dados cut at your lumberyard for a slight charge.

**Building the cabinet.** If you can't get wide enough stock for the top, base, and shelves, edge-glue narrow stock to the required width. Note that the top and base are exactly the same size. If you eliminate the shaped edges, cut both pieces 1" shorter in length and 1/2" less in width than the dimensions on the blueprint. After shaping and sanding, set the pieces aside.

Cut the stiles and rails for all four frames. Before assembling them, rip the grooves on the inside edges to accept the lattice. Since the grooves must be 1/16" wide, use a planer blade (with no set on the teeth) to cut them. The frames shown were butt-joined with dowels, but mortise-and-tenon, half-lap, or mitered joinery could be used. The shaped inside edge is made with a bead cutter (sketch at right) in the router after the frames have been assembled.

**The lattice.** Select an absolutely flat piece of 5/4" stock (actual size 1 1/8") for the lattice. Even a slight warp will show

up in the finished work. Twisted stock will cause the dados to vary in depth, making a neat weaving job just about impossible.

Cut the lattice stock to 10" by 28". Using a try square, measure and mark off 10 increments spaced 2 1/4" apart along the edge of the board. Install the molding cutter (see sketch) in the head and mount it on the saw to cut to a depth of 5/16". Dado the 10 cuts across the board using the miter gauge and a work hold-down. Flop the workpiece and make another 10 passes, each cut exactly opposite its mate on the first side.

Next, mount a hollow-ground planer blade on the bench saw and set the rip fence 1/16" from the blade. Rip off 32 strips—enough to do the four panels.

To find the exact length of the 16 vertical strips, fit one into the bottom groove on a panel and trim the other end until it can be snugly inserted into the top groove. When you're satisfied with the fit, trim 15 more strips to the same length. Horizontally, you will need 32 strips. Using the same method for sizing, you'll get two strips from each of the remaining 16 strips.

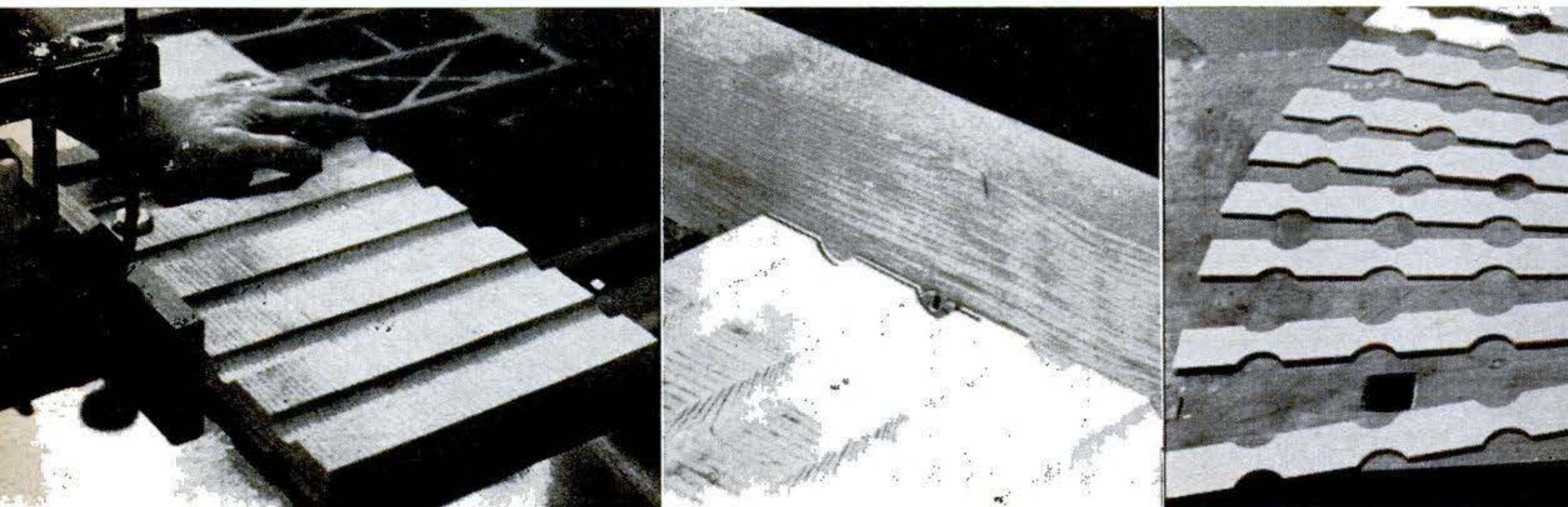
The weaving operation is simple. A standard over-and-under basket weave is used and each strip is aligned as it is placed. Glue is unnecessary; friction of the strips against each other holds them firmly in place.

**Assembling the buffet.** The coped legs are attached to the base first, the end

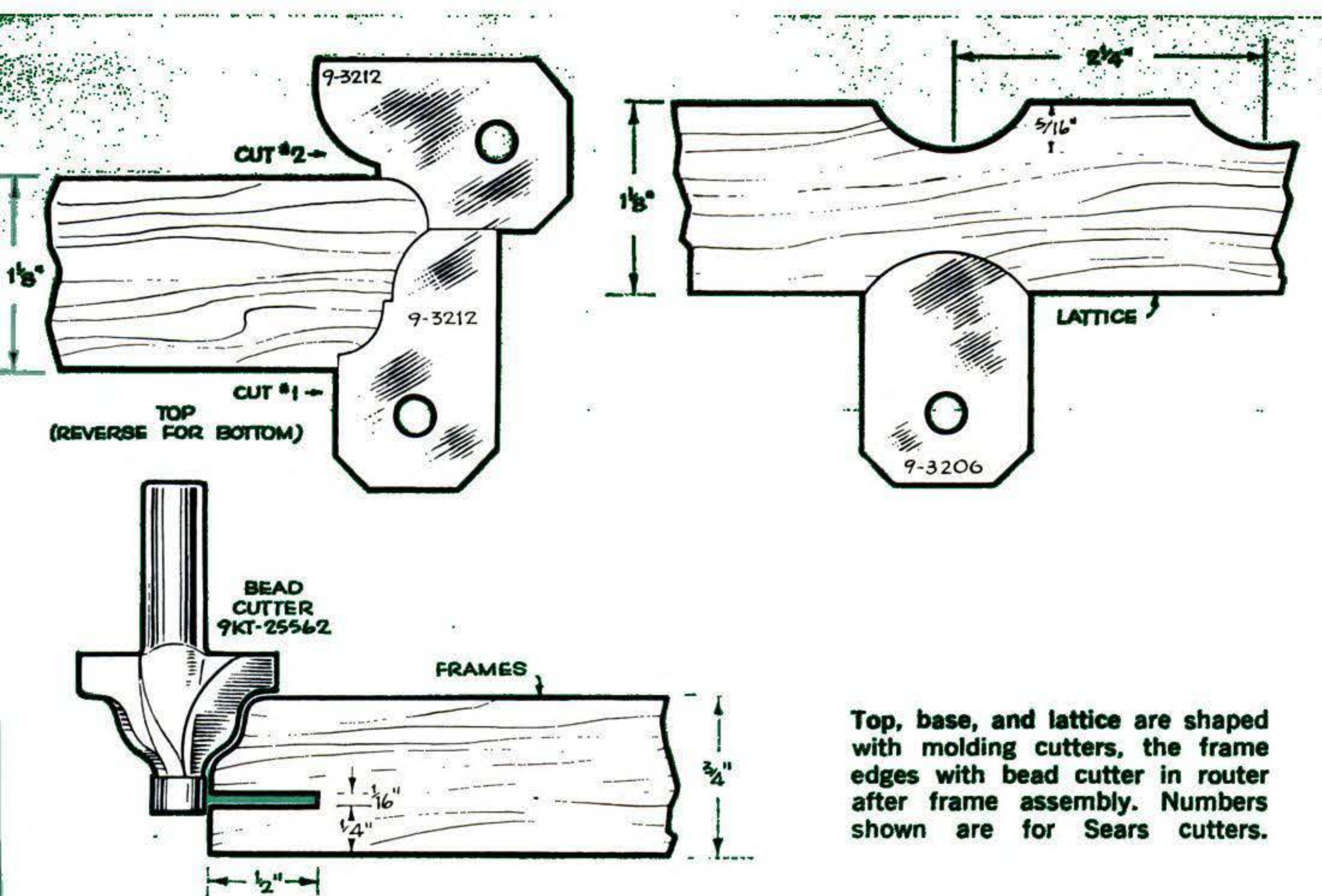
## How to turn out the lattice the easy way.....

Dadoes are cut on both sides of 5/4" stock, using a miter gauge and work hold-down (below, left). The rip fence is then positioned 1/16" from the blade

(center) and 32 strips are ripped. First nine strips off the production line (right) illustrate why clear, knotfree stock must be used to make the lattice.







Top, base, and lattice are shaped with molding cutters, the frame edges with bead cutter in router after frame assembly. Numbers shown are for Sears cutters.

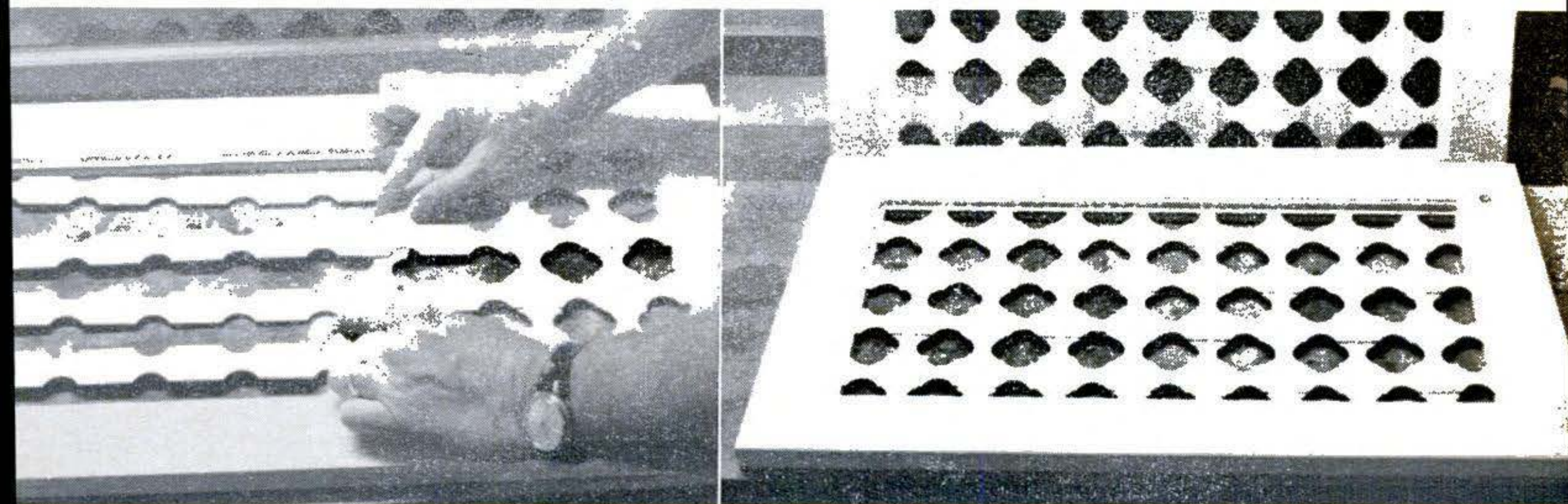
panels and top added, and the shelves installed on their fancy knee supports. Finally, the 1/4" plywood back is glued and screwed to the shelves. Blind dowel joinery was used throughout (except for the back). But if you are going to paint your buffet, well-set nails could be used for all assembly and the holes filled and sanded.

**Finishing.** Since accent color was wanted

in the room in which the buffet shown would stand, it was finished with an antiquing kit. If your plans call for a natural finish to match existing dining-room furniture, stain and finish the lattice strips before the weaving operation. It's easier to do in reverse order and goes a lot faster. If color accent is desired with a stained cabinet, tack material, such as burlap, inside the lattice. **RE**

Simple over-and-under basket weave is used to form geometric shapes with a Mediterranean theme. Strips are forced into saw kerf; tension holds them

there. Each panel uses four full strips vertically, eight half-strips horizontally. If buffet is to be left natural, stain and finish strips before weaving.





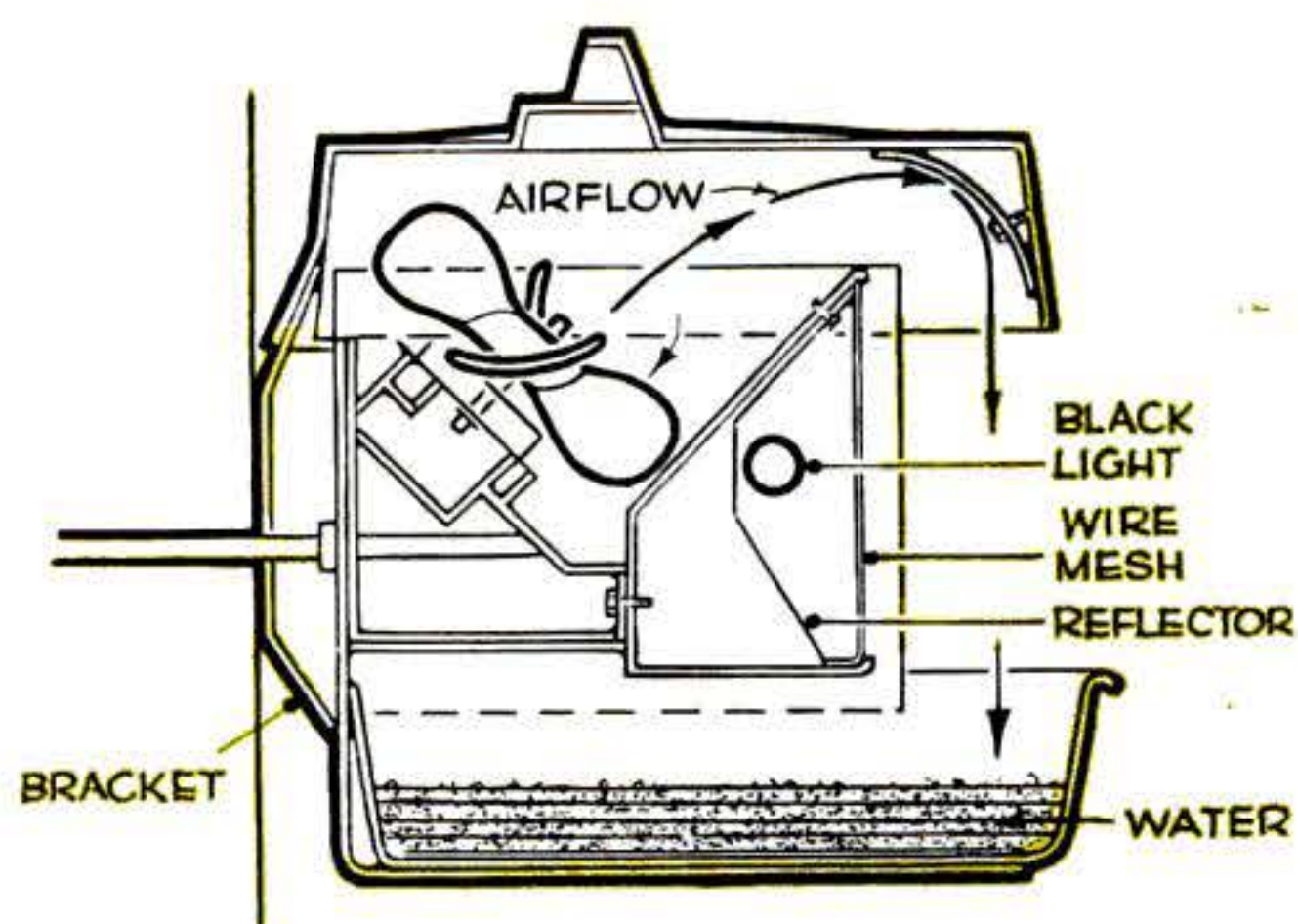
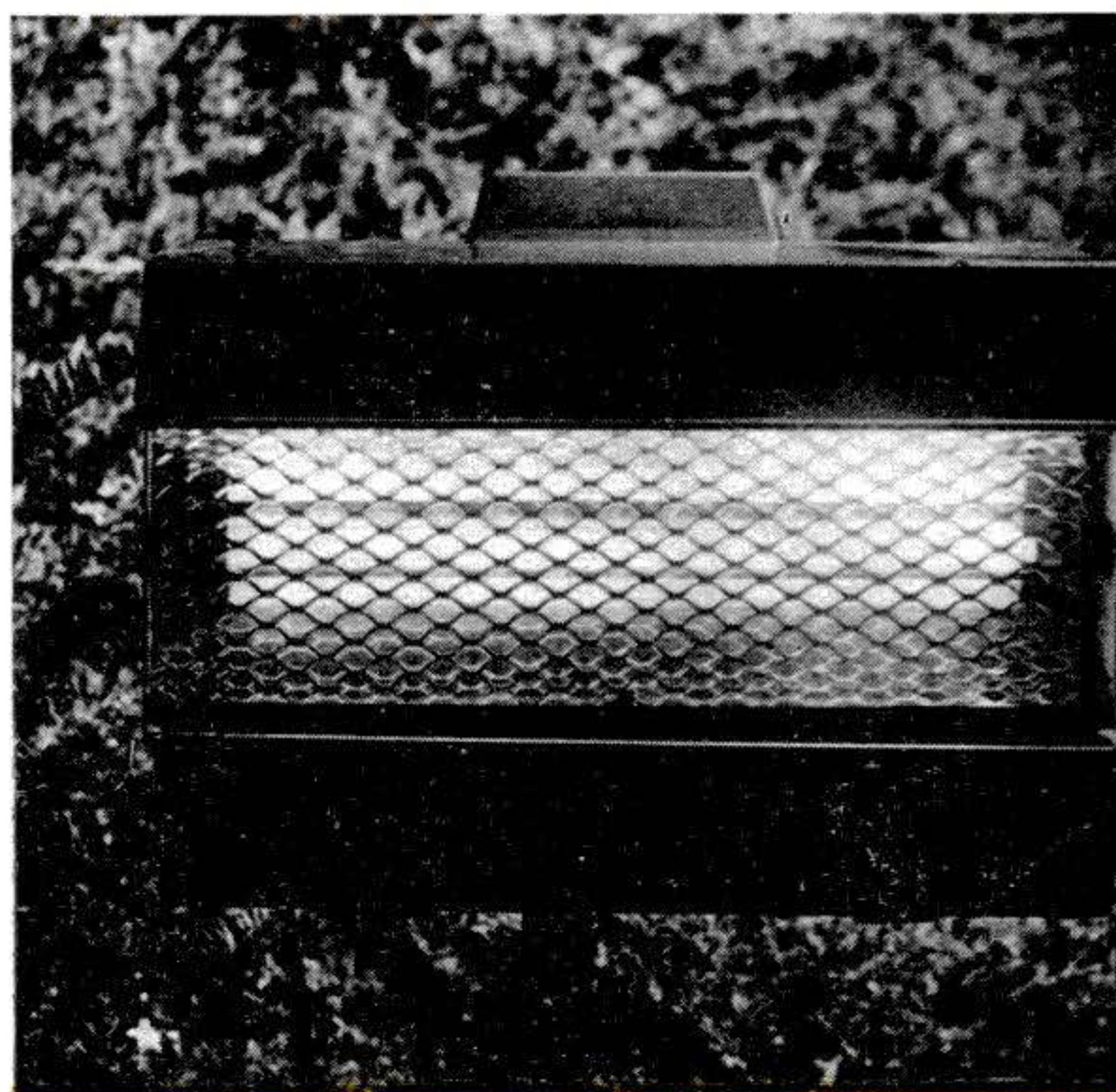
# How Light Kayos the Patio Bugs

Turn on a light trap and you turn off the insects

By HARRY WICKS



The best place for a trap is a far corner of the yard. That way, night-flying insects can be lured away from a patio or other outdoor relaxing area. If illumination is needed on patio, use low-wattage yellow bulbs that don't draw bugs.



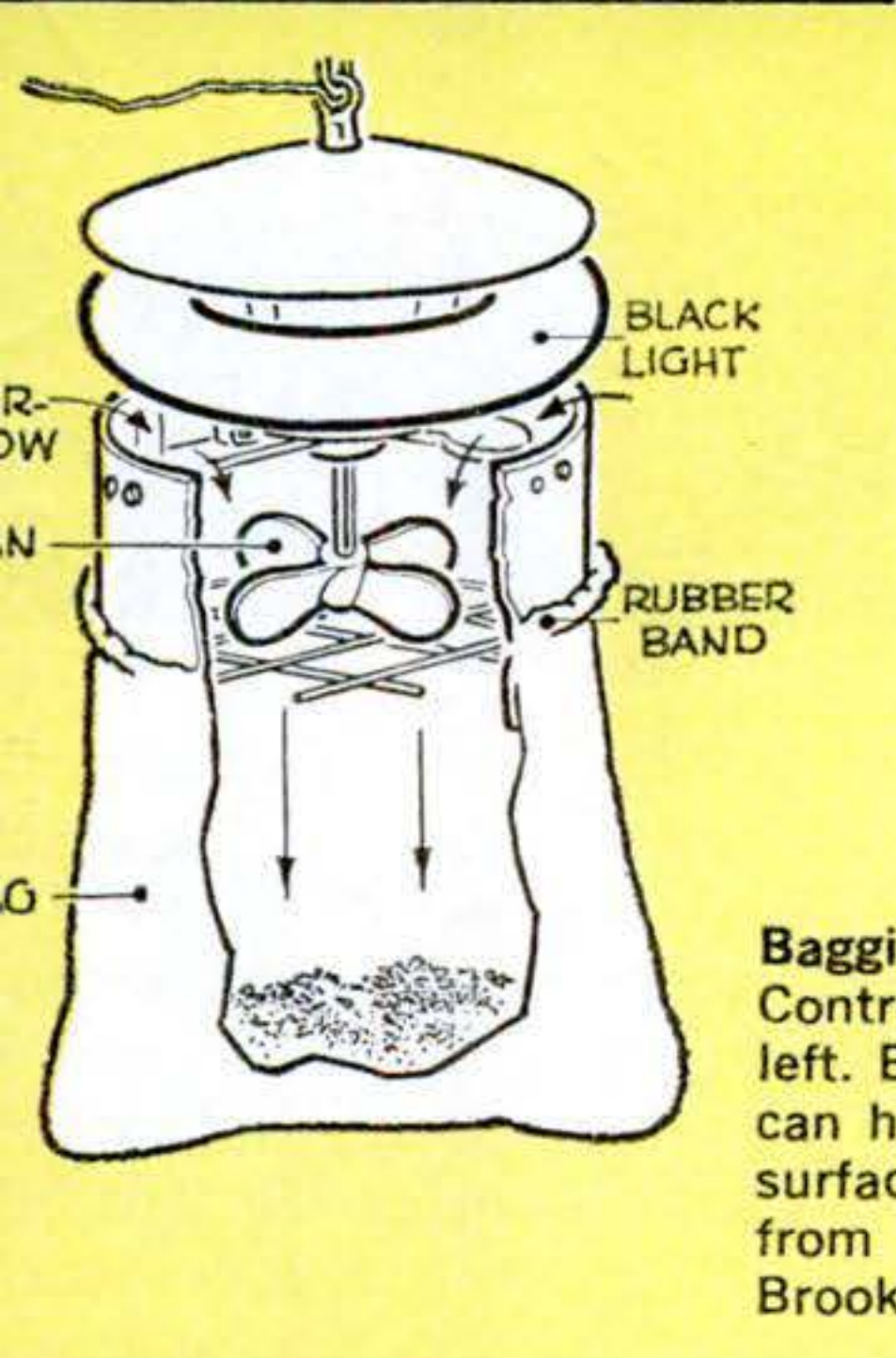
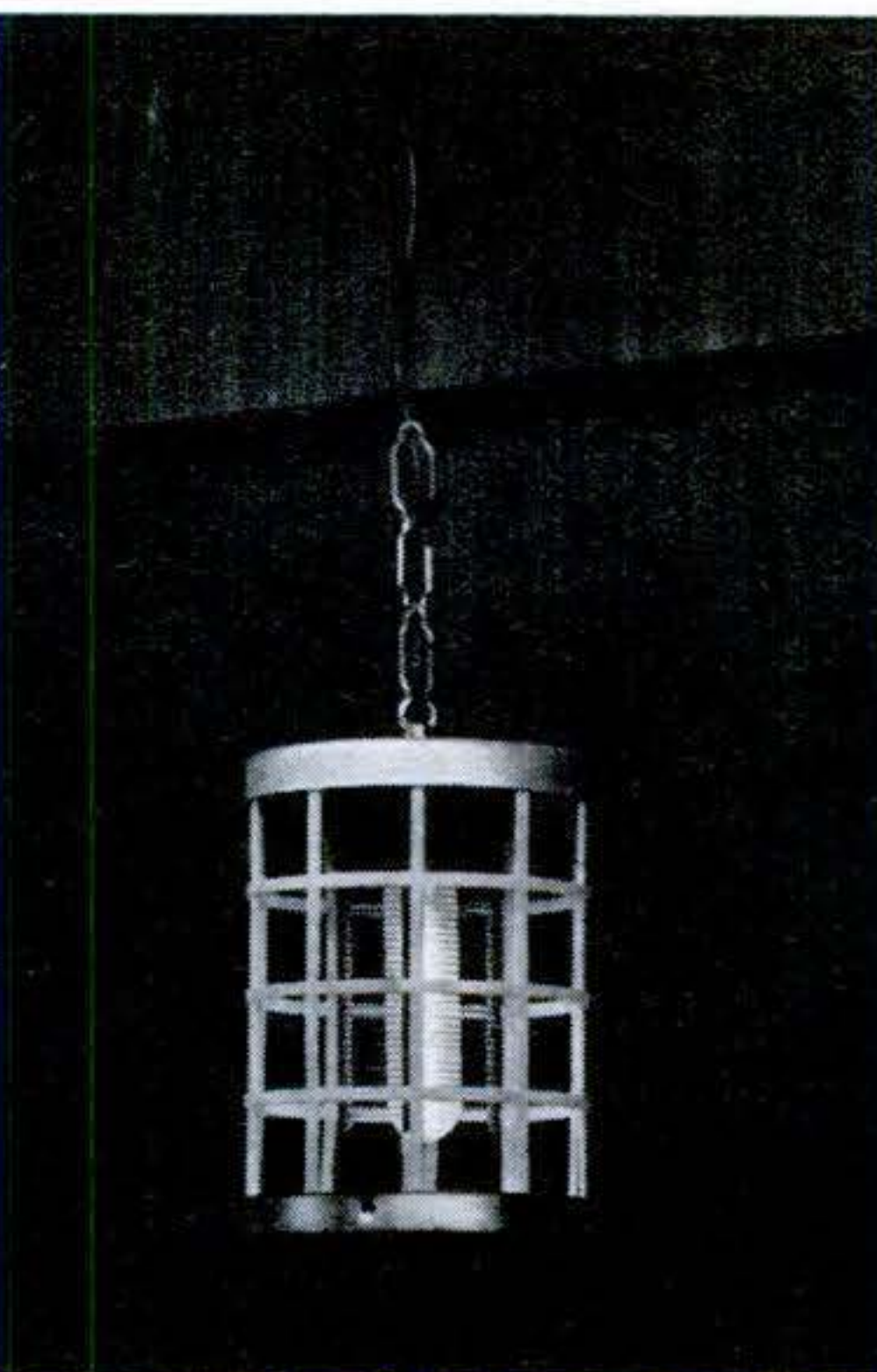
This trap drowns the bugs. A small fan blows insects down into a tray of water spiked with a couple of tablespoons of household detergent. The Night Watch black-light trap sells for \$35. IMS Corp., Box 3399, Albuquerque, N.M. 87110, makes it.

**A**re those new insect light traps worth buying? Will using one of them cut down the number of mosquitoes and other insects that swarm around your yard after dark? After experience with several makes, I can say that the answer to both questions is yes.

The traps are of two types. One uses ordinary white light. The second, and perhaps more effective, relies on black light. In both versions the bulb is simply the bait; once drawn to the trap, the bugs are killed off by one of several methods.

Several POPULAR SCIENCE staff members tried out one of the Night Watch patio traps made by IMS Corp., Albuquerque, N.M. In each case, its black





Bugs are electrocuted in the white-light traps shown directly above and at right. They practically disintegrate on contact with a charged grid. Since dead bugs act as insulation, they should be cleaned off grid periodically. Prices of these traps range from \$10 to \$20.

Bagging bugs is method used by Jet Control, photo top left and drawing left. Black light is the attraction. Trap can hang from a chain or be fixed to surface (after drilling housing). \$25 from A. K. Electric, 231 Front St., Brooklyn, N.Y. 11201.

WHITE-LIGHT BULB  
CHARGED GRID



light attracted and killed an amazing mass of insects in a very short time.

A statement from IMS Corp. points out that the term "black light" is really a misnomer. It refers to light in the near-ultraviolet region of the spectrum—just beyond the end of the rays that are visible to humans as light. But flying insects are attracted to black light just as they are to the light that we can see. For control of insects that crawl, an insecticide is still needed.

A bluish glow is visible from a black-light trap. A GE expert told me that this is not black light, but light in the blue region of the visible light spectrum.

"It could be filtered out," he said,

"but since blue light also attracts insects, it would be pointless."

I tried both white- and black-light traps on several different nights. Results were good; moths, gnats, beetles, and mosquitoes were trapped in great numbers. All of the traps attracted and killed bugs in my yard (located about 20 miles outside New York City). And they all made a marked improvement in bug control over the insecticide I had previously been using.

A feature I like about a home-model light trap is its portability. You can bring one indoors to trap house pests overnight or carry it along with other vacation gear for use at your summer cottage.



# Why Power Planes Pay Off



By HARRY WICKS

**A** power plane is probably the least understood, and most under-rated, portable electric tool in the hardware store. The fact is, it is a marvelously useful, easy-to-handle tool.

It's amazing how many times you can

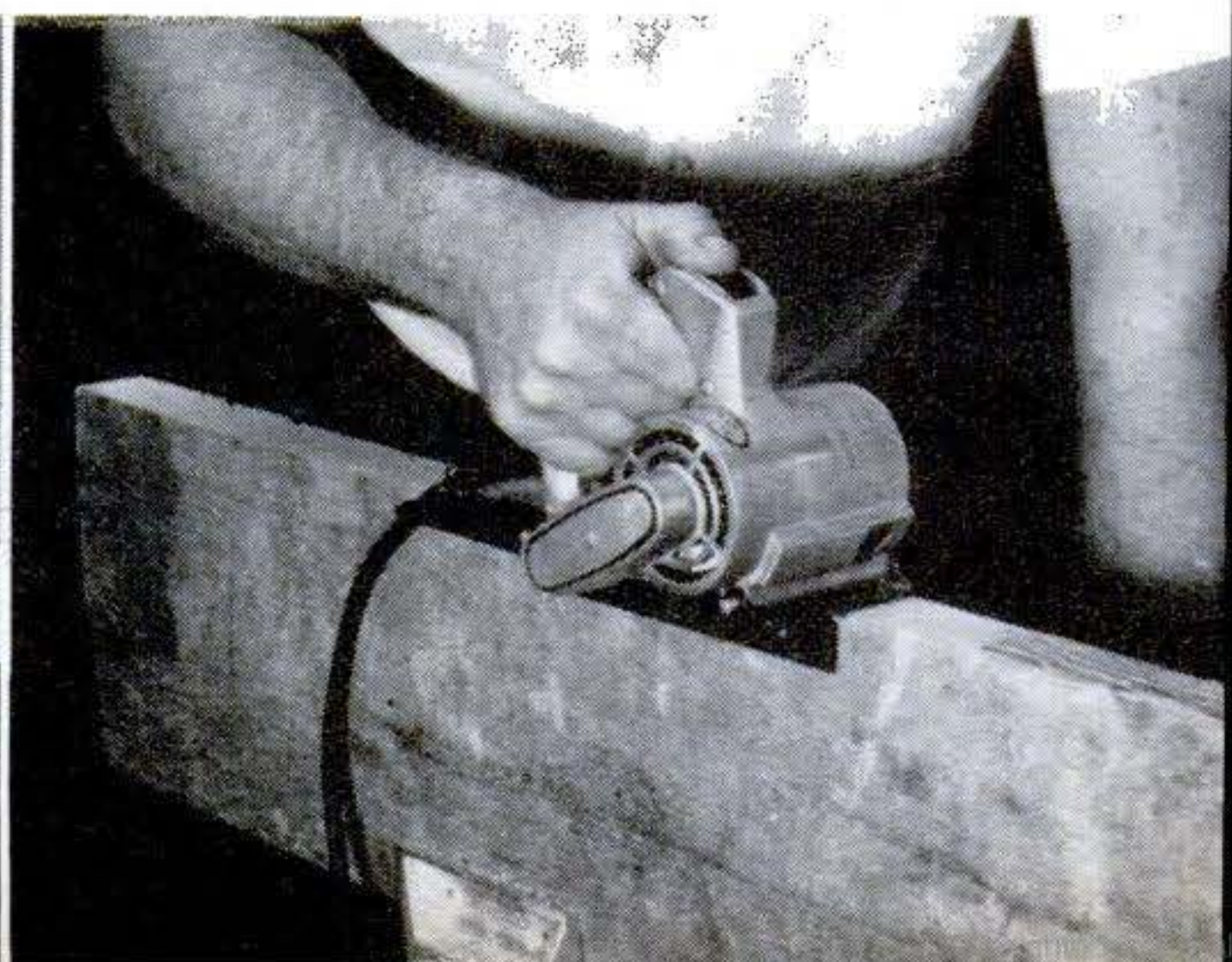
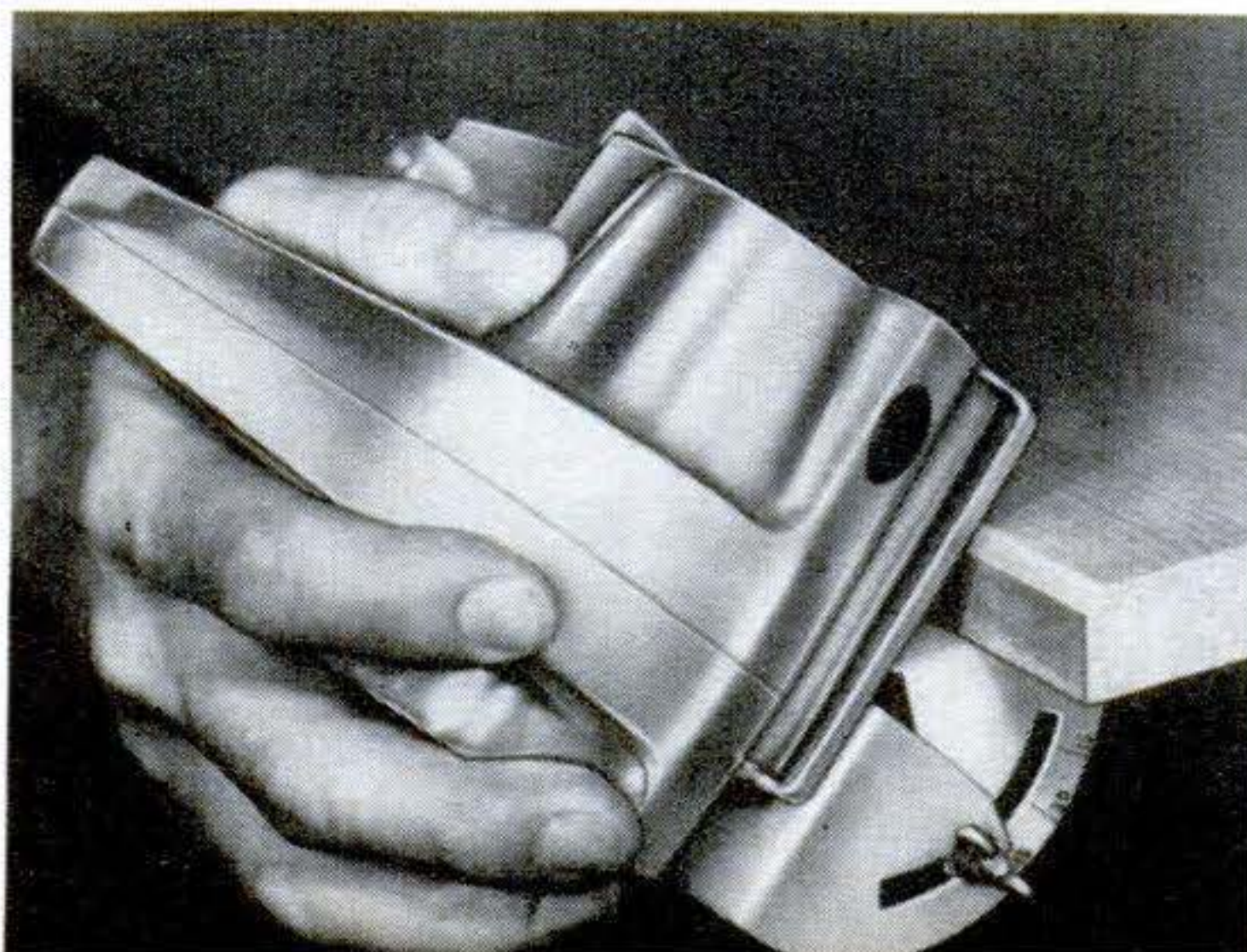
**Block plane** is a good choice for most home craftsmen. Beveling is fast—and accurate—because the adjustable guide can be locked at desired degree.

turn to an electric plane to bail you out of trouble on a knotty problem. And I mean just that—you can even plane knots with one. And end grains. And doors. And rough-sawn lumber. In short, anything you now plane by hand—but with a difference: You'll do a better job and in less time.

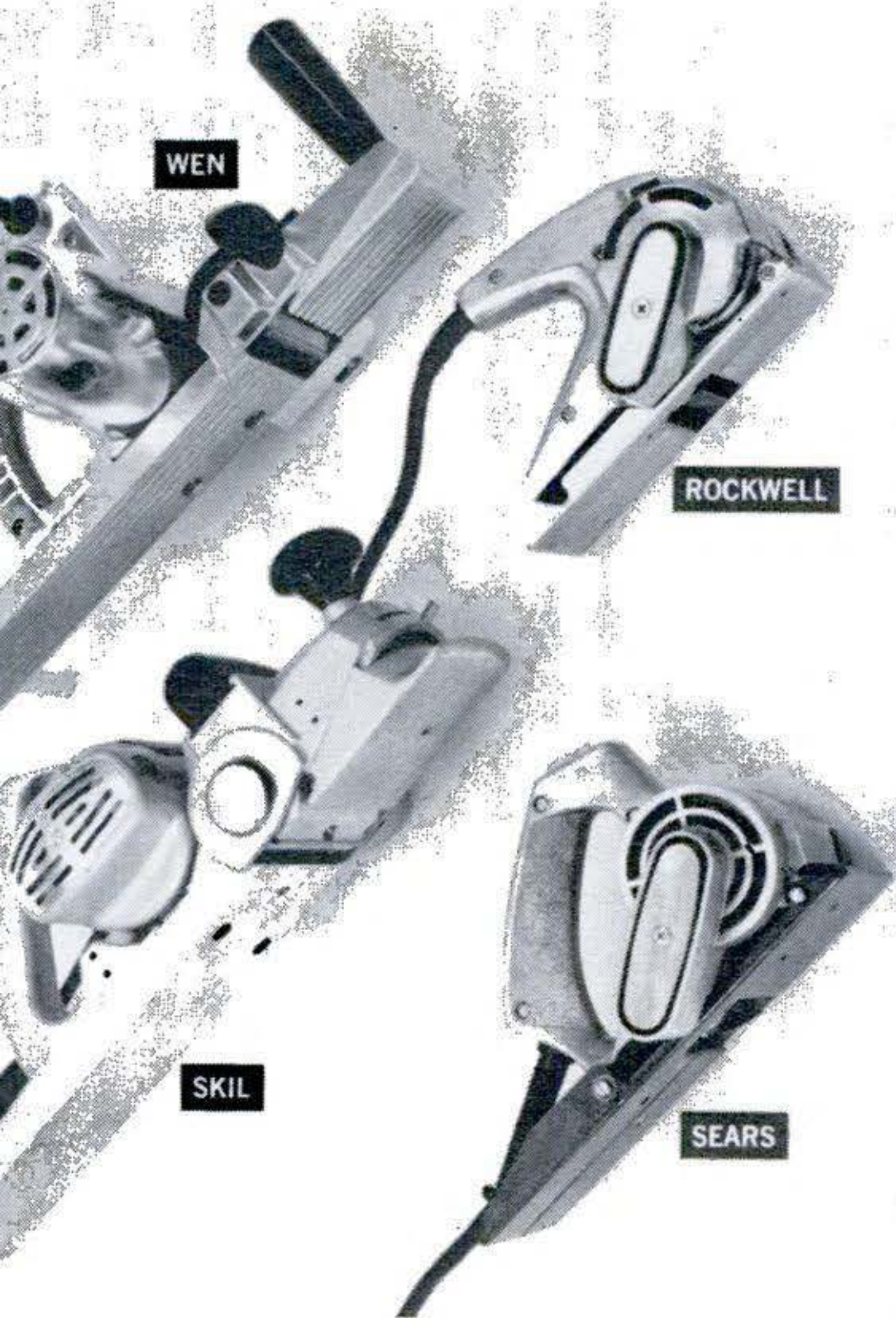
Let's look at some of the jobs you're most likely to use a power plane on:

- Hanging doors. A mistake here can

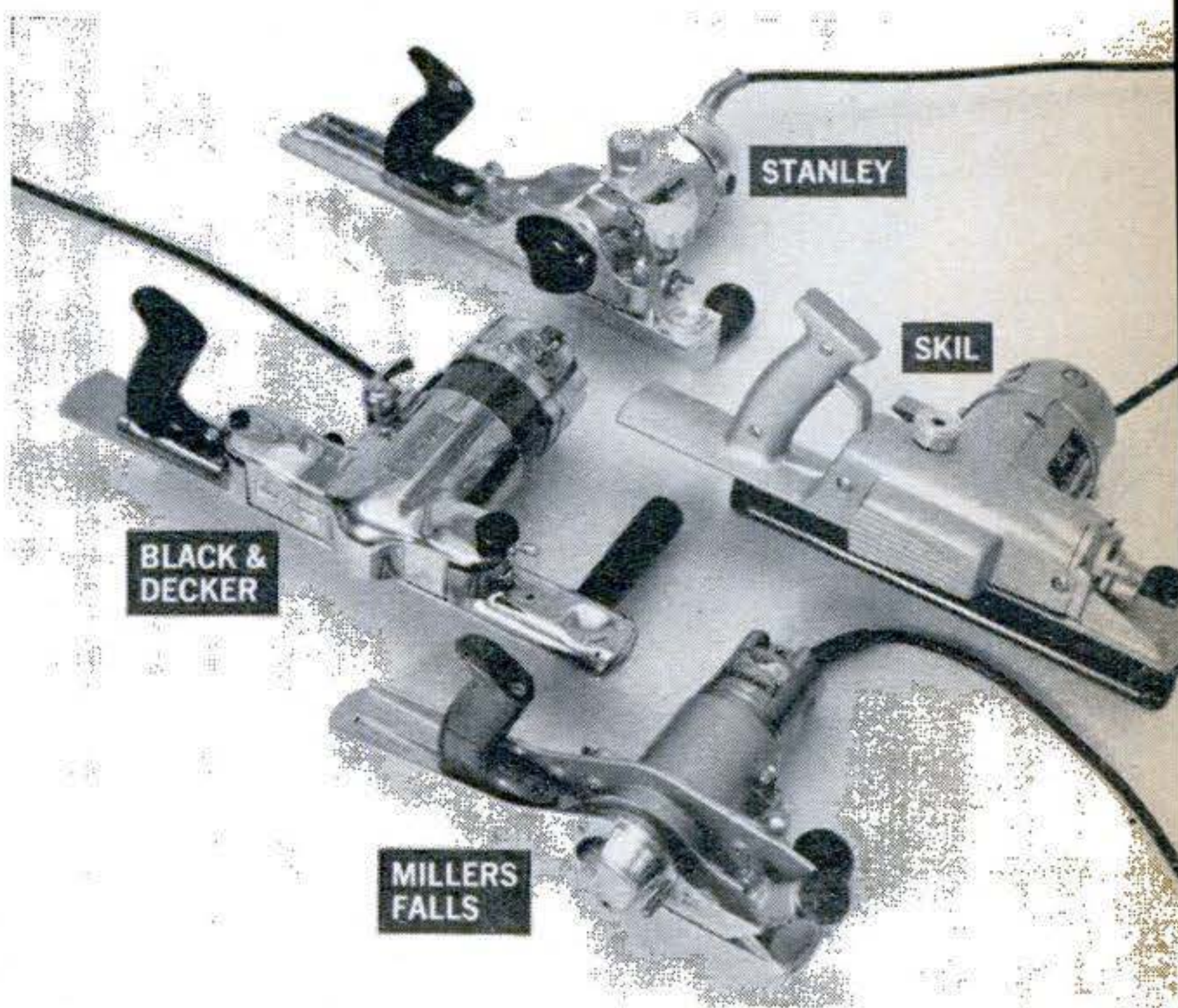
**Sears model** will edge-plane stock up to 1 7/8" wide in one pass. Dressing rough stock is best done with several shallow passes instead of one deep cut.







Most major manufacturers have joined the power-plane parade and make at least one of the three available types. Heavy-duty and block planes (photo, left) are designed strictly for planing jobs. Don't underestimate what the small-looking block planes can do—they offer a lot of power in a little package. Router-plane models (below) do double duty and are worth investigating if you have neither tool in your shop. With attachments, the removable motor powers a router.



be costly. Taking just a "whisker" off the top, or bottom, of a door has caused groans from carpenter and handyman alike. There is no problem with the rail because you're running with the grain. But you have to shave those whiskers off the stiles, too. A power plane does it easily, and with far less chance of splitting them.

- Shutters: If you're hanging two pairs, chances are you'll have to take  $\frac{1}{16}$ " (or

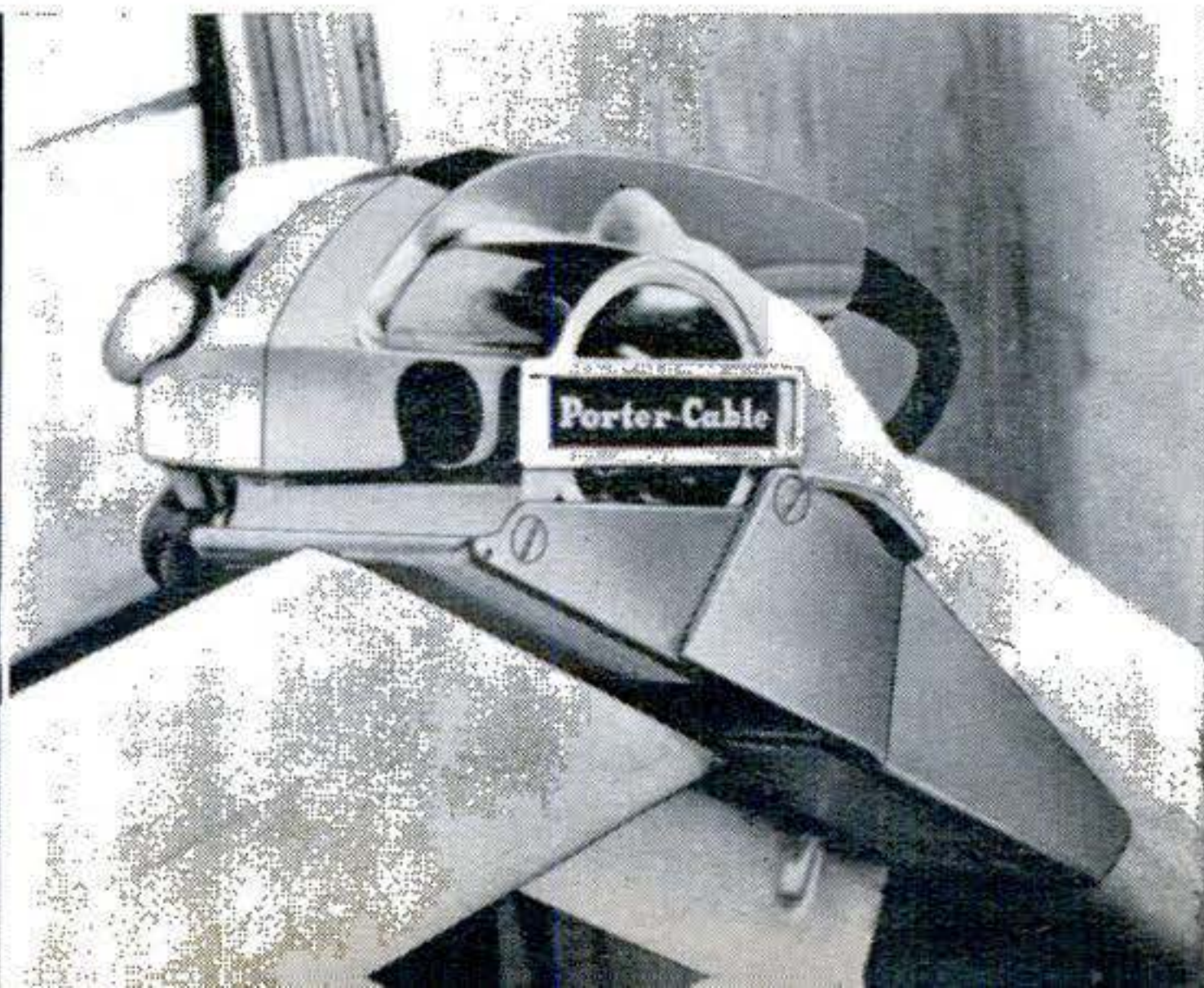
more) off eight edges. Full-window shutter treatment doubles the number of edges to be planed. Either way it's a time-consuming job, and with a hand plane a wearying one. Jobs like this are a snap with power. Since you operate the plane with one hand, the other is free to hold the work steady.

- Dressing rough stock: A power plane almost makes this chore a pleasant one. Even hardwoods (which dull cutting

*Continued*

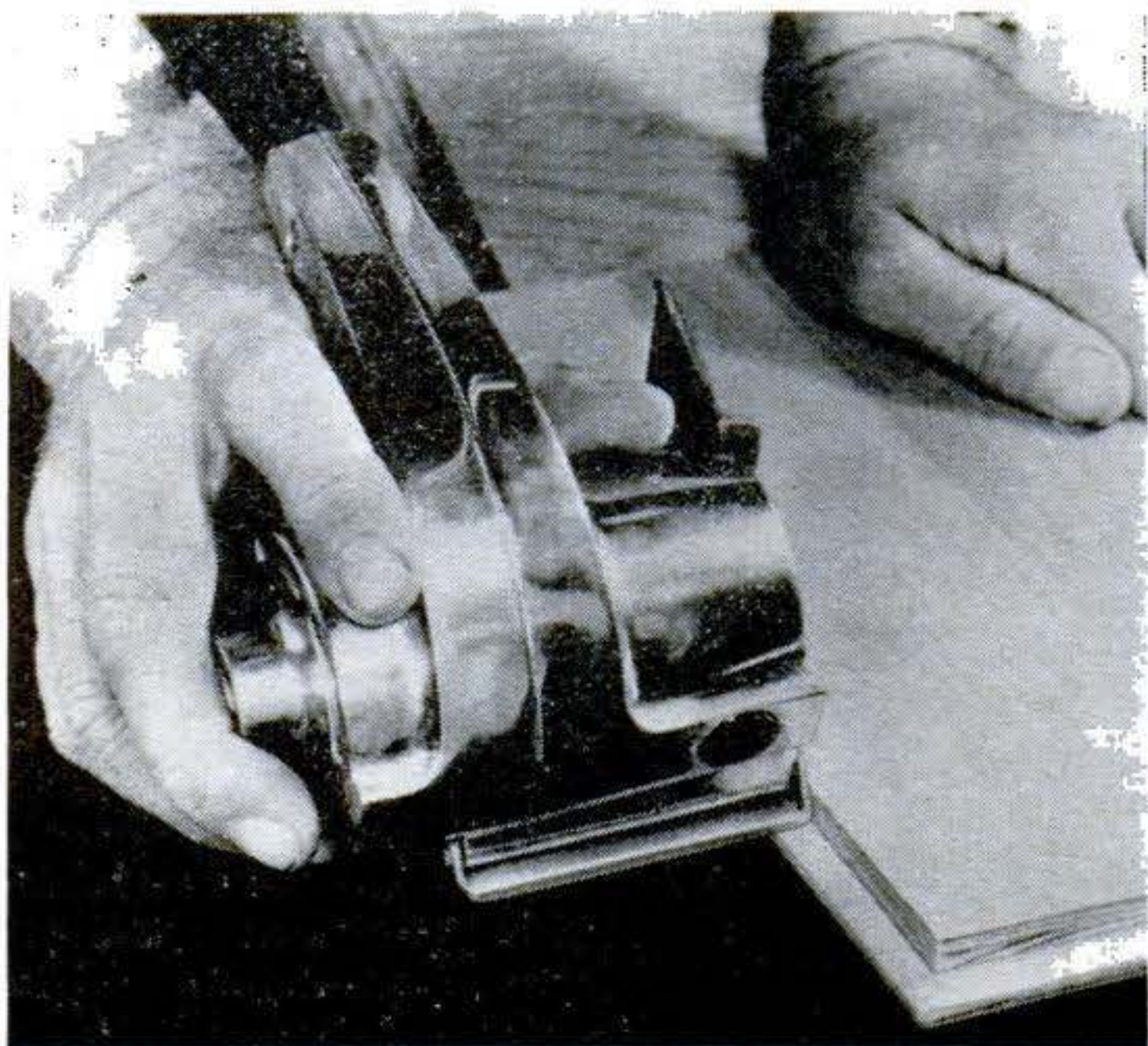
Is this any way to plane an end grain? You bet it is. Note the backup board clamped on to prevent splintering as the plane's cutter leaves the work.

Poor miter joints can be touched up quickly. With the guides set at a slight bevel, joint is planed with a back cut to assure a professional look.





## Here are four more jobs an electric plane does speedily



Fast, neat rabbeting is possible because cutter extends to shoe edge. A clamped straightedge is used as a guide to start, removed after initial passes.



Power planes pay off when plywood or particleboard edges have to be planed—a tough job with a hand-driven plane. A backup block is used here, too.

edges fast) can't resist the whirling cutter. You can adjust the cutting depth (on most models from 0- $\frac{1}{8}$ " ) and make several shallow passes to get the job done. And you won't get musclebound doing it.

- **Planing plywood and particleboard.** Working either of these with a hand plane is a mean job. The first splinters easily; the other is just plain ornery and chips out frequently. A power plane makes the job as easy as shaving pine.

- **Finish work.** The plane more than earns its keep in the shop squaring edges on stock to be butt-jointed, cutting rabbets, and smoothing stock. Set for scant removal, it is as useful on fine cabinet work (when fitting and joining) as a chisel.

**The right tool for the job.** It's true, of course, that some of these jobs can be performed with some other power tool. A belt sander, for example, can be used with a coarse-grit belt for stock removal. But a sander isn't designed primarily for this type of job. A plane is. It takes the former far too long—and extended running time causes overheating and possible damage to the tool.

To prove the point, I set up a 3' length of two-by-three in my vise (narrow side up). With a brand-new #60-grit belt, the sander removed  $\frac{1}{32}$ " in one minute. The power block plane took a heavy  $\frac{1}{8}$ " off in the same running time.

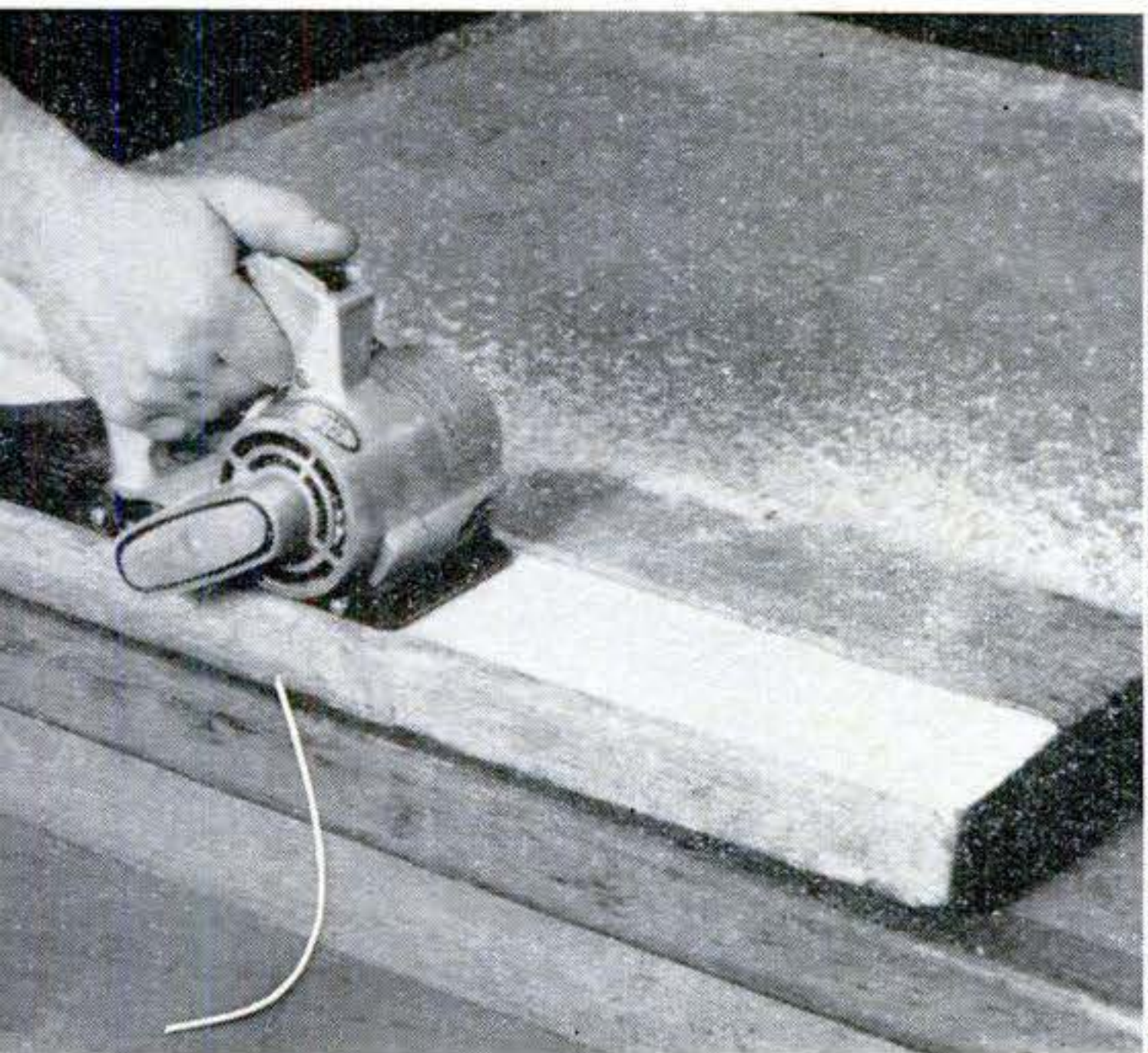
**What's available.** A power block plane is the best bet for most home craftsmen. It's light, comfortable to grip. Its  $\frac{3}{8}$  hp. handles any shop work, and it's easily toted to household jobs. The block plane is also the least expensive—you can get one for \$35 or \$40.

The heavy-duty plane (most boast a  $\frac{1}{2}$ - or  $\frac{3}{4}$ -hp. motor) is for the man who will use one regularly. It offers more power and can be run for an extended period of time. With one of these you can walk through any wood, removing  $\frac{1}{8}$ " as you go. As you would expect, they cost more—prices are around \$100.

**Two-way tools.** Several manufacturers now produce a power plane that is convertible to a router. The motor is removable, and router attachments are available for making the conversion. The design requires that the motor hang outboard to one side instead of above the cutter. I found them a little uncomfortable to work with because you have to support the  $\frac{7}{8}$ -hp. (or larger) motor weight while planing. If you already own a router, pass these by. If you don't, and want to get two tools at a saving, test the various makes before buying. One of them is sure to have a more comfortable heft than the others. These rigs go for about \$110-\$125.

All the manufacturers offer a cutter sharpener (to fit the plane they make) either as part of a kit or as an extra. Buy-





**Pocket-size powerhouse** smooths a rough-sawn plank fast. This block plane will do everything its bigger brother does—it just takes a little longer.



**One of the big ones** chews its way down a length of two-by-four—removing  $\frac{1}{8}$ " of stock as it goes. Adjustable chute directs sawdust away from operator.

ing one will up your initial outlay about \$10, but it's money well spent. With it you can keep your cutter razor sharp with little effort. And you'll sharpen the cutter like a pro—the attachment includes a guide to prevent you from grinding the wrong degree bevel.

**Plane facts you should know.** Don't force a block plane beyond its capacity. Straining it (a deep bite in tough hardwood for example) results in a high incidence of drive-belt breakage. And the belts aren't exactly cheap—average cost is about \$1.70. Once you get the feel of the plane, though, you can play it by ear. The sound of the whine lets you know if you should stop the plane to decrease depth of cut.

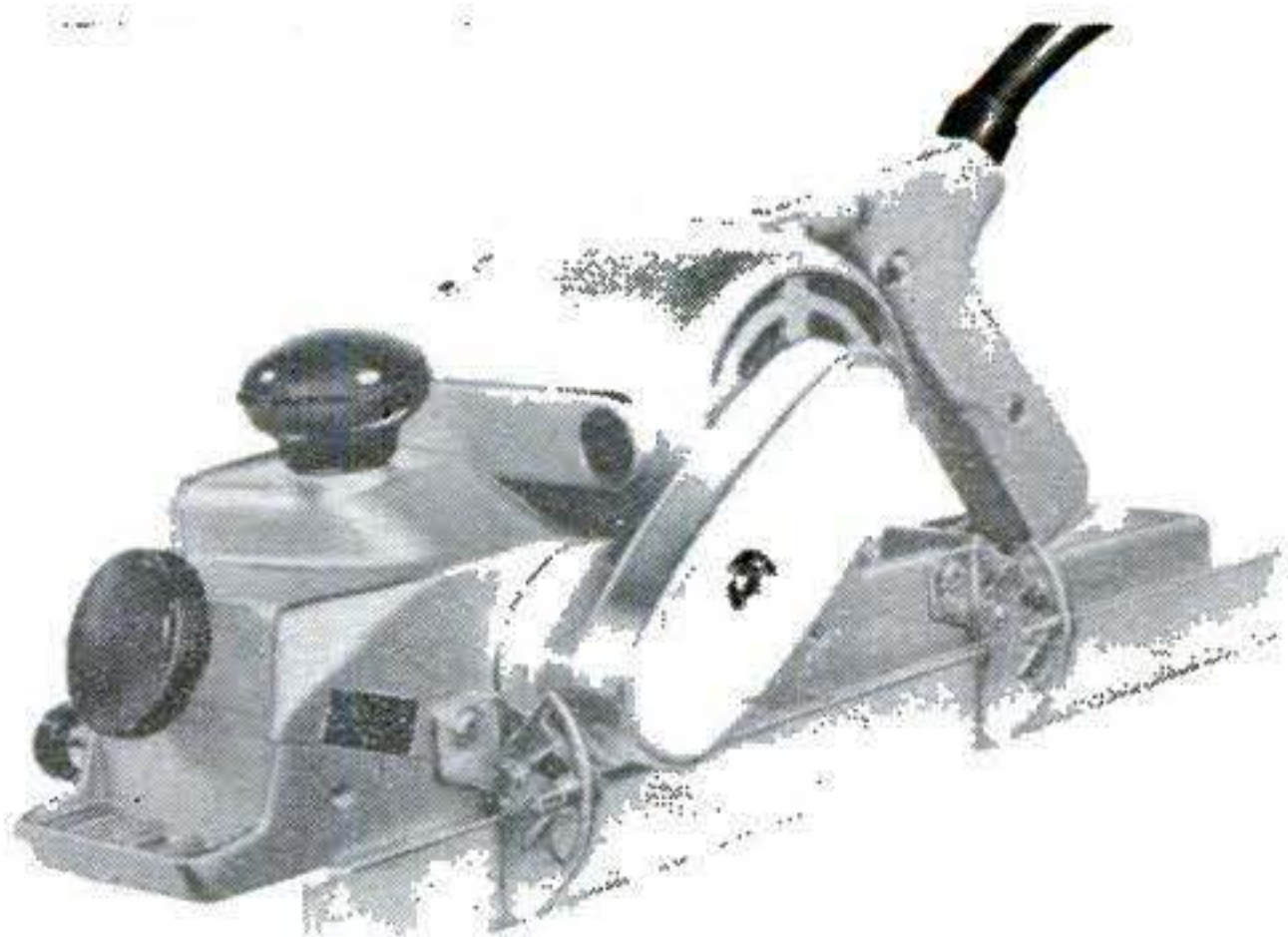
When you first use an electric plane, you will probably find that you have a tendency to "dip out" as you start and finish the planing stroke. It happens when the plane is not held level. Overcome it by following the same principle you use with an ordinary hand plane. Start the pass with pressure applied to the front shoe; at the other end (as the plane leaves the board), reverse pressure and transfer weight to the rear shoe.

Once you have decided on which type to buy, the field is narrowed. Now, it is a matter of comparing brands. Check cutter width (this varies from tool to tool). If the plane is to be used mainly to dress rough lumber, or for edge-planing

thick stock, you will want the widest one you can get. And while you are looking at the cutter, count the cutting edges if speed is important to you. Most rigs are equipped with a two-lip cutter, but there are a couple with three. These, obviously, can be pushed at a faster feed rate.

Check how depth of cut is adjusted. Some planes are faster and easier to adjust than others. If you anticipate frequent depth changes, it's important.

But no matter which type or model you select, all your planing jobs will be easier and go a lot faster with power. And when a particularly tough job comes up, the screech—as the plane bites the wood—will be music to your ears. PS



**Latest entry** in the heavy-duty class is a 3" plane by Shopmate that features a rabbeting extension.





Narrow shop at left has plenty of worktop, ample storage. Drawers in cabinet (above) are built half-depth (see sketch at right) to limit their projection into walkway. Storage shelves are accessible from the side to utilize space behind the drawers.

# How to Get Wide Use from a Narrow Workshop

By JACKSON HAND and HARRY WICKS

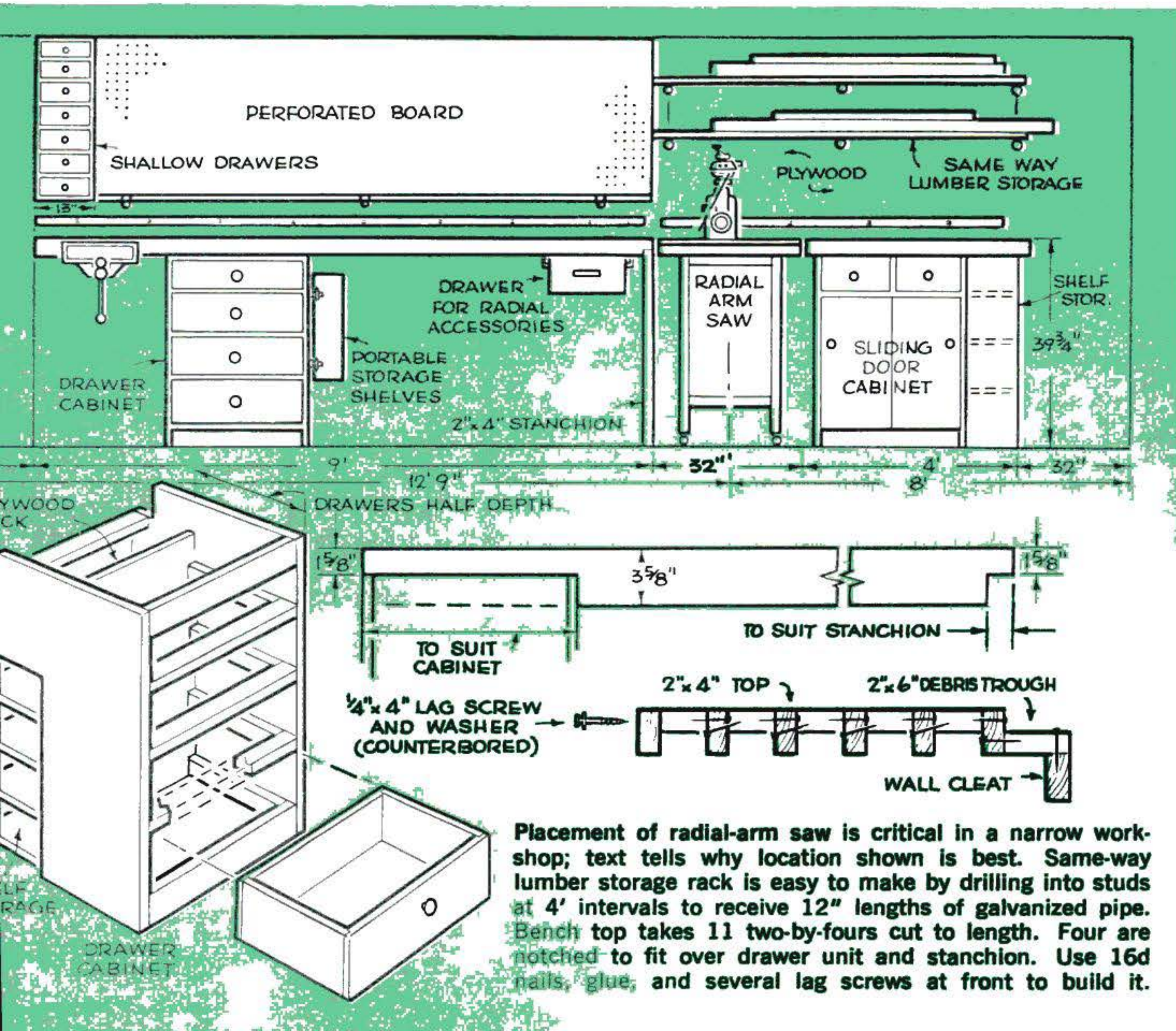
Planned carefully, a narrow shop can rate with the best. Use these ideas and you'll have one that does

**C**ould you install a full-use workshop in an area the shape of a bowling alley? This challenge was flung at POPULAR SCIENCE some months ago.

Why not? Narrow space for possible workshop use is not uncommon. You find it in many basements and practically all garages.

The challenge came from the Brooklyn Union Gas Co. The utility has now completed renovation of a Victorian brownstone





Placement of radial-arm saw is critical in a narrow workshop; text tells why location shown is best. Same-way lumber storage rack is easy to make by drilling into studs at 4' intervals to receive 12" lengths of galvanized pipe. Bench top takes 11 two-by-fours cut to length. Four are notched to fit over drawer unit and stanchion. Use 16d nails, glue, and several lag screws at front to build it.

town house in the Park Slope section of Brooklyn. Included in the remodeling plans was a basement workshop. The allotted space was narrow and long—about 5' by 20'—and bounded on one side by the foundation wall, on the other by a row of masonry pillars.

**One-wall planning.** It was obvious that the shop had to snug up against the wall. Lack of floor space also suggested we get along without all the floor and bench-mounted tools often found in shops. But that would be no hardship. A radial-arm saw is ideal for a one-wall shop; with accessories, it can serve as every-tool-in-one.

Other ideas for getting the fullest use from available space:

- Hang all tools you can on the wall, using either perforated hardboard or plywood and nails or other hangers.
- Leave yourself standing room at the end of the bench. A one-wall shop doesn't deprive you of worktop dimension

from front to back, but you're ahead of the game if you can work from three sides.

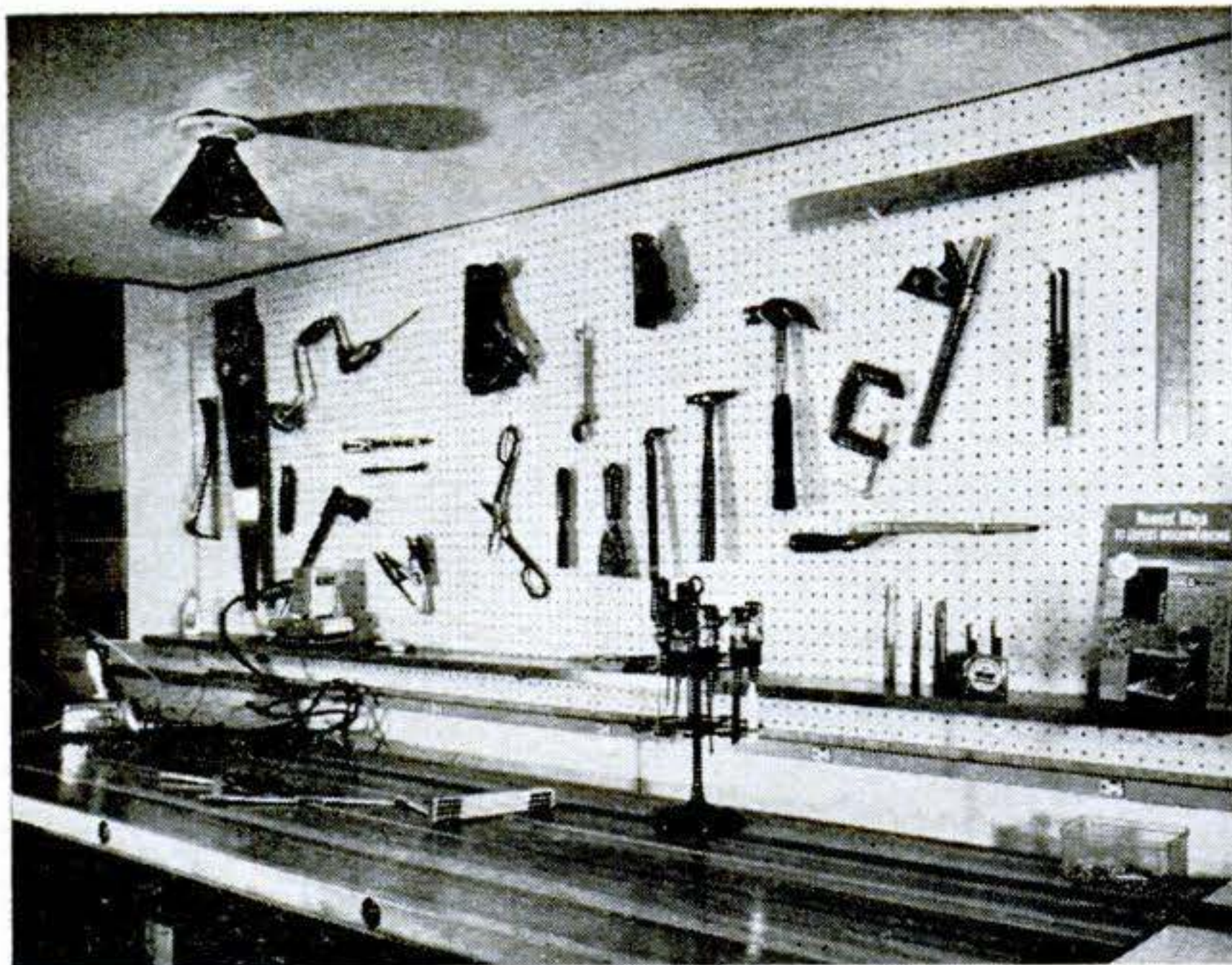
- If cabinets are used under the work surface, install sliding doors. Swinging doors take up too much space.
- Keep any under-the-bench drawers from coming out too far, to get in the way. Make them short, front to back.
- Generally, open space under the bench is better than drawers or cabinets. Use the floor for storage. Hooks screwed up into the top's underside can take many items. Sliding-track hangers like those used in kitchen cabinets can be used to mount pull-out tool racks.

● Facilitate lateral movement—and the handling of electric tools—by installing plenty of outlets. A strip of Plugmold (several receptacles in a surface-mounted strip) is an easy way to get them.

**One-wall power tool.** A radial-arm saw

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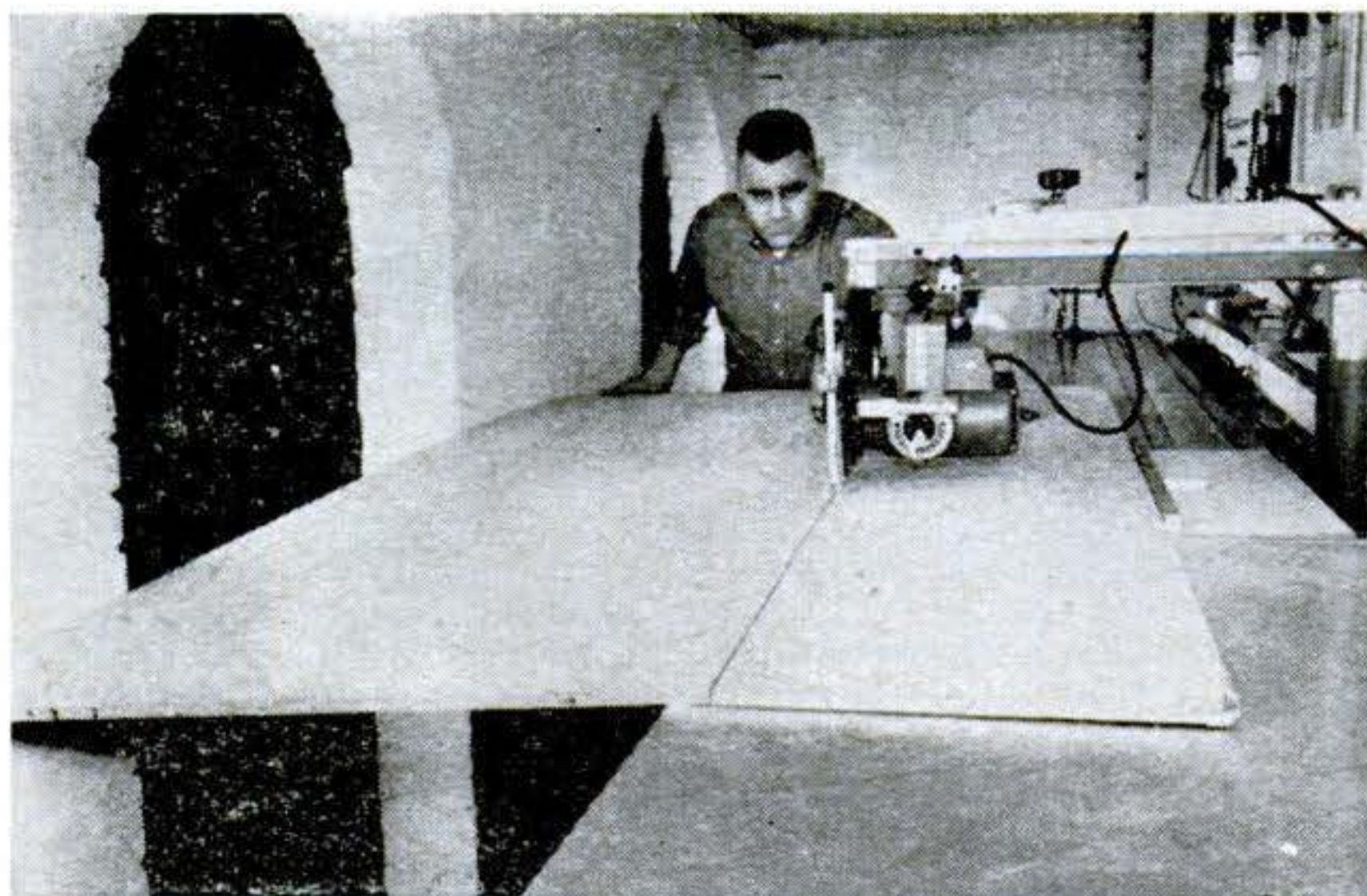




Narrow shelf above bench gives handy space for materials and tools in use; bench-to-ceiling perforated hardboard holds those that aren't. Rack holding chisels, screwdrivers, etc. is an old rubber-stamp holder from used-office-furniture store.



Portable swing-out shelf mounted on cabinet side gives storage for small items. For more storage, sacrifice portability; install several on slide-out track instead.



It's cutting it close, but carefully planned shop permits ripping 4'-by-8' plywood panel. Photo shows need of good storage in narrow shop. Since bench top doubles as a work support, feeding large pieces will be impossible if it's cluttered.



Synthetic-fiber carpeting is easy to keep clean, provides comfort underfoot. Extra power in today's shop vacuums pulls ground-in sawdust out of carpet pile.

makes a narrow shop practical. Designed to stand against the wall, its pivoting, sliding blade housing means you never have to rotate a piece of stock end for end. Crosscutting, ripping, and mitering are all done with the board in the same position—parallel to the wall. This is a must, of course, where there is no room to swing a long board around.

To take best advantage of this one-way board feature, devise lumber storage parallel to the cutting position. Wall-mounted over the saw, same-way racks let you lift a board down edgewise, not lengthwise, handle it on the saw, and replace leftover material with minimum

effort. Lumber is always out of your way.

Where the saw is positioned along the wall is important. At first glance it seems best to center it; but it doesn't work out that way. By placing the saw blade 8' from one end wall, you can crosscut a 16' board in half. More important, you can trim stock up to 12' long. By dividing a 20' shop this way, you gain maximum flexibility in that space. If your room is longer, maintain the 8' dimension and put the gain on the other side.

**Big-shop conveniences.** Regardless of shop size or shape, there are some big-shop features that can be included in any

*[Continued on page 184]*



## PERSONAL-USE REPORT:

# Cox Superlight Chain Saw

By E. F. LINDSLEY

PS Outdoor Power Equipment Editor

**D**ubbed the Beaver by its maker, the L. M. Cox Mfg. Co., a new, 8½-pound, one-hp. chain saw checks out as a good bet for campers, firewood cutters, and weekend yard workers. Although obviously not intended for felling heavy trees, the little saw packs a good punch. Effective cut-bar length is 12 inches.

In addition to its light weight, three bonus features make the Beaver especially appealing:

- Automatic chain oiling.
- Adequate fuel and oil tanks.
- Extremely easy starting.

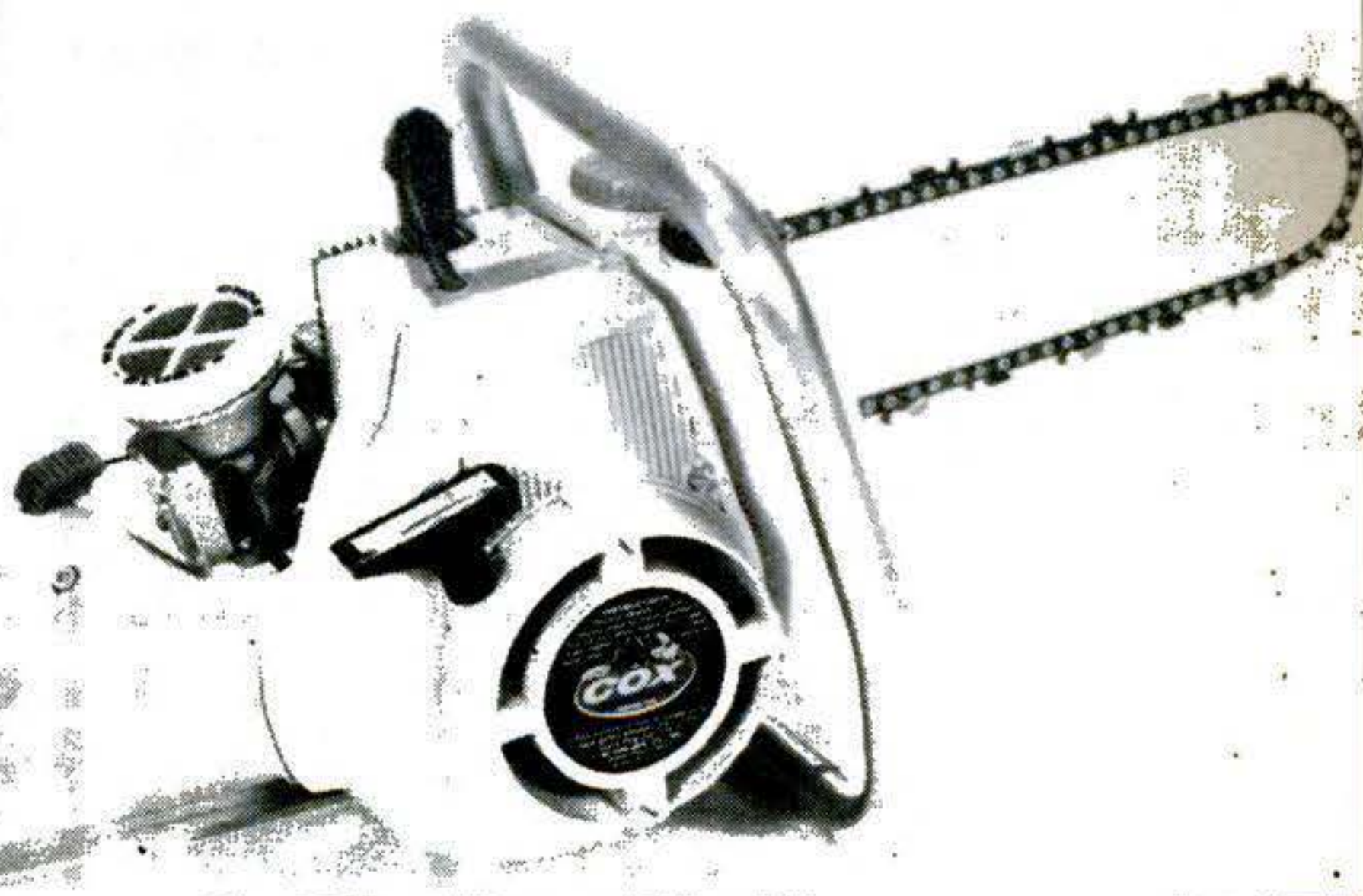
The automatic chain-oiling feature operates from crankcase pulsations. This eliminates the old bug-boo of failing to punch the oiler button. Chain-oil and fuel capacity probably seem extra large for the small engine and blade, but one filling will likely last through all the cutting the average person cares to do at one time. The small engine makes rope-pulling seem easy; at no time while I was testing the saw did I find that it takes more than two pulls to be off and snarling. Momentary depression of a primer button charges the engine for cold starts. No priming or choking was needed for warm starts.

The proper technique in using the Beaver is a light touch with absolutely no forcing. That gives the high-revving engine the best chance to work most efficiently.

The emphasis on light weight reflects the maker's long experience with model-airplane engines. It pays off on one-handed sawing from a ladder or for awkward cuts under low branches. Price is \$99.50. L. M. Cox Mfg. Co., 1505 E. Warner Ave., Santa Ana, Calif. 92702.

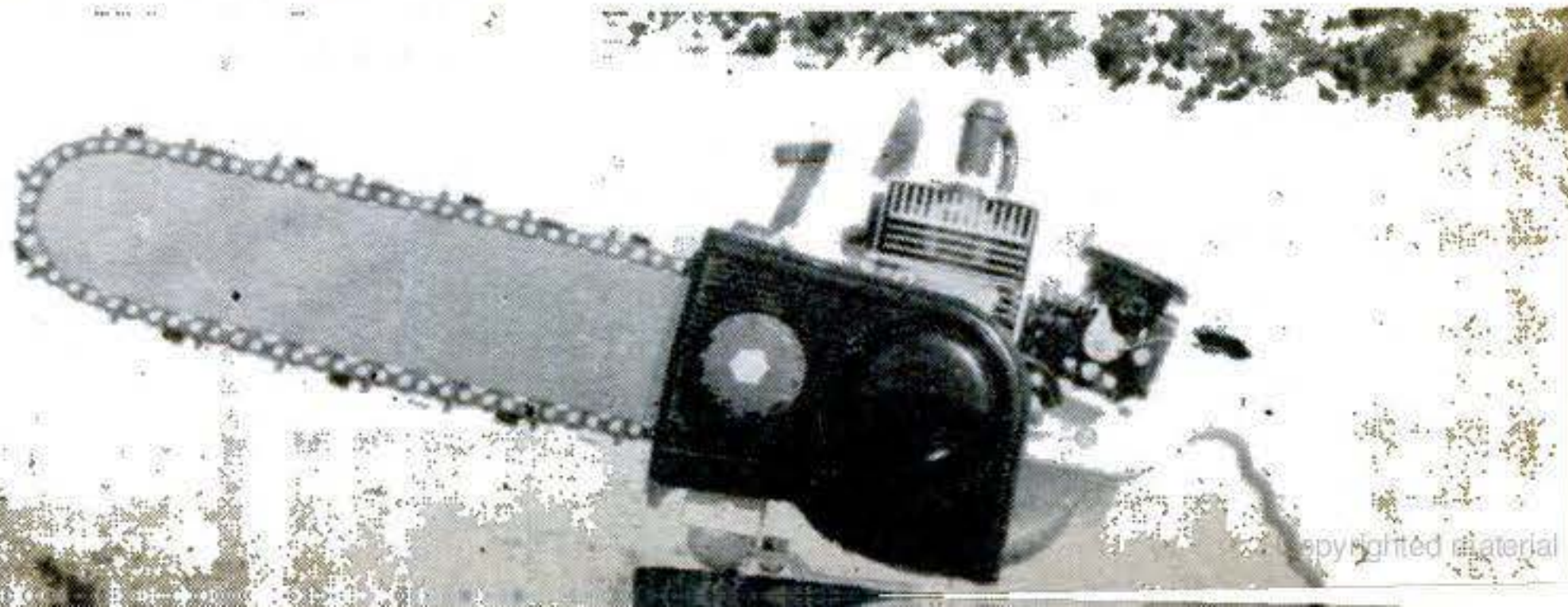


In typical trimming operation, lightweight chain saw cuts cleanly with little vibration. Chain oiling is automatic.

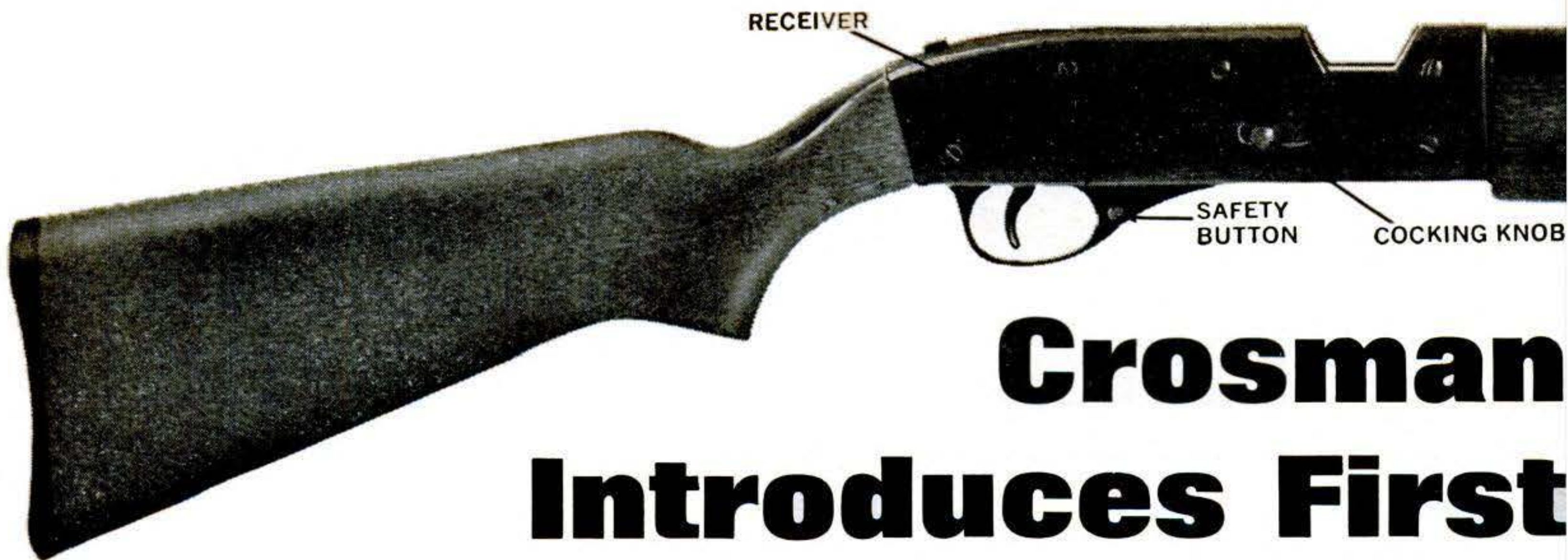


Stirrup offers handy grip when starting. You hold it securely while pulling rope. The saw starts easily.

Chain-drive cover and a few other parts are plastic to keep down weight, but basic structure is tough and rugged.







# Crosman Introduces First CO<sub>2</sub> Shotgun

It's part of a low-cost skeet outfit. And there's also a uniform-trajectory CO<sub>2</sub> rifle

By ROBERT P. STEVENSON

**L**ong a leader in carbon-dioxide guns, the Crosman Arms Company has now come up with a double-barreled surprise in that field—a CO<sub>2</sub> shotgun and a super-accurate, consistent-trajectory CO<sub>2</sub> rifle.

The shotgun is the first successful weapon of its kind. It accepts a special plastic shell of .380 gauge. Each shell contains about 55 No. 8 shot. The single-shot rifle compares favorably with super-accurate air rifles being made in Europe.

Power comes from two CO<sub>2</sub> cartridges, loaded end for end to face two piercing pins. Tubing carries gas to valve. When you pull trigger, cocked hammer hits valve stem, releasing metered charge of gas that knocks wads from shell and carries shot

It comes in two sizes—for .22-caliber pellets or for .177-caliber pellets and BBs.

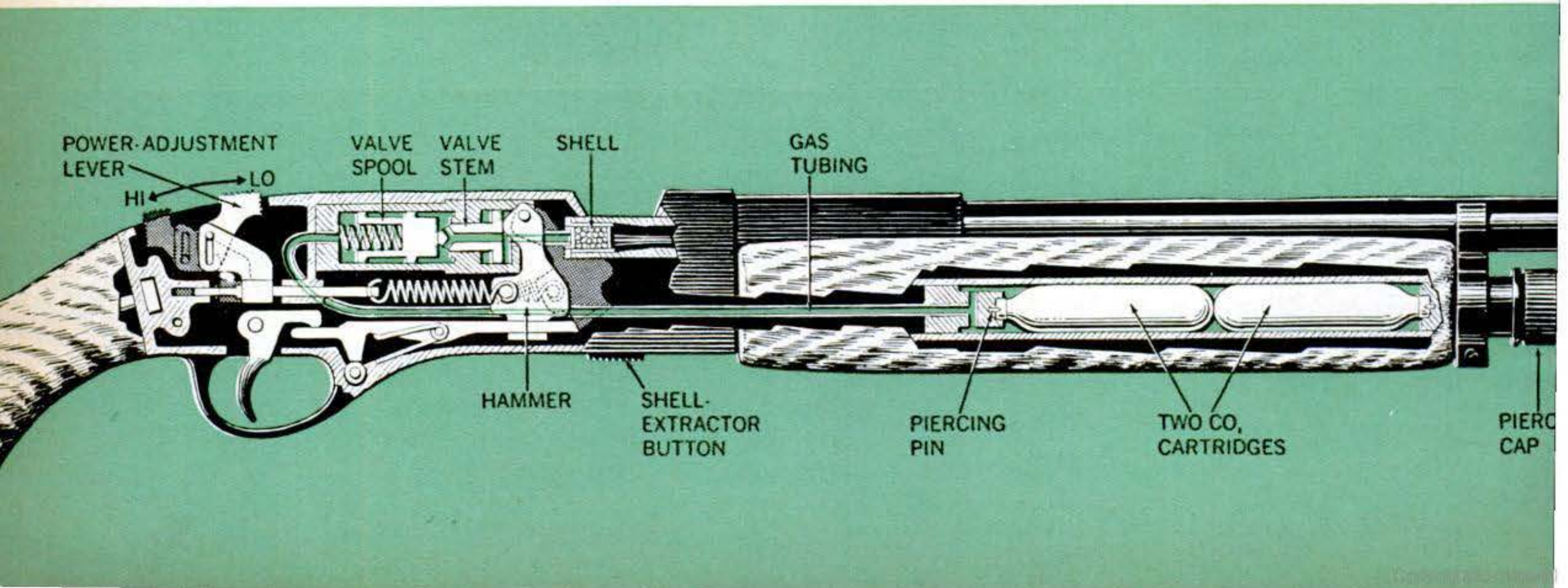
Both shotgun and rifle do everything that the maker claims for them. I have used both over a considerable length of time, and can vouch for that.

**Low-cost skeet shooting.** That's the purpose for which Crosman has introduced the shotgun. Along with the gun, which is priced alone at under \$50, the company offers a CO<sub>2</sub> skeet trap and reusable plastic targets. Cost per shot averages out at far less than the lowest possible cost for conventional powder shooting. Thus you can afford to shoot more often to sharpen up your eye.

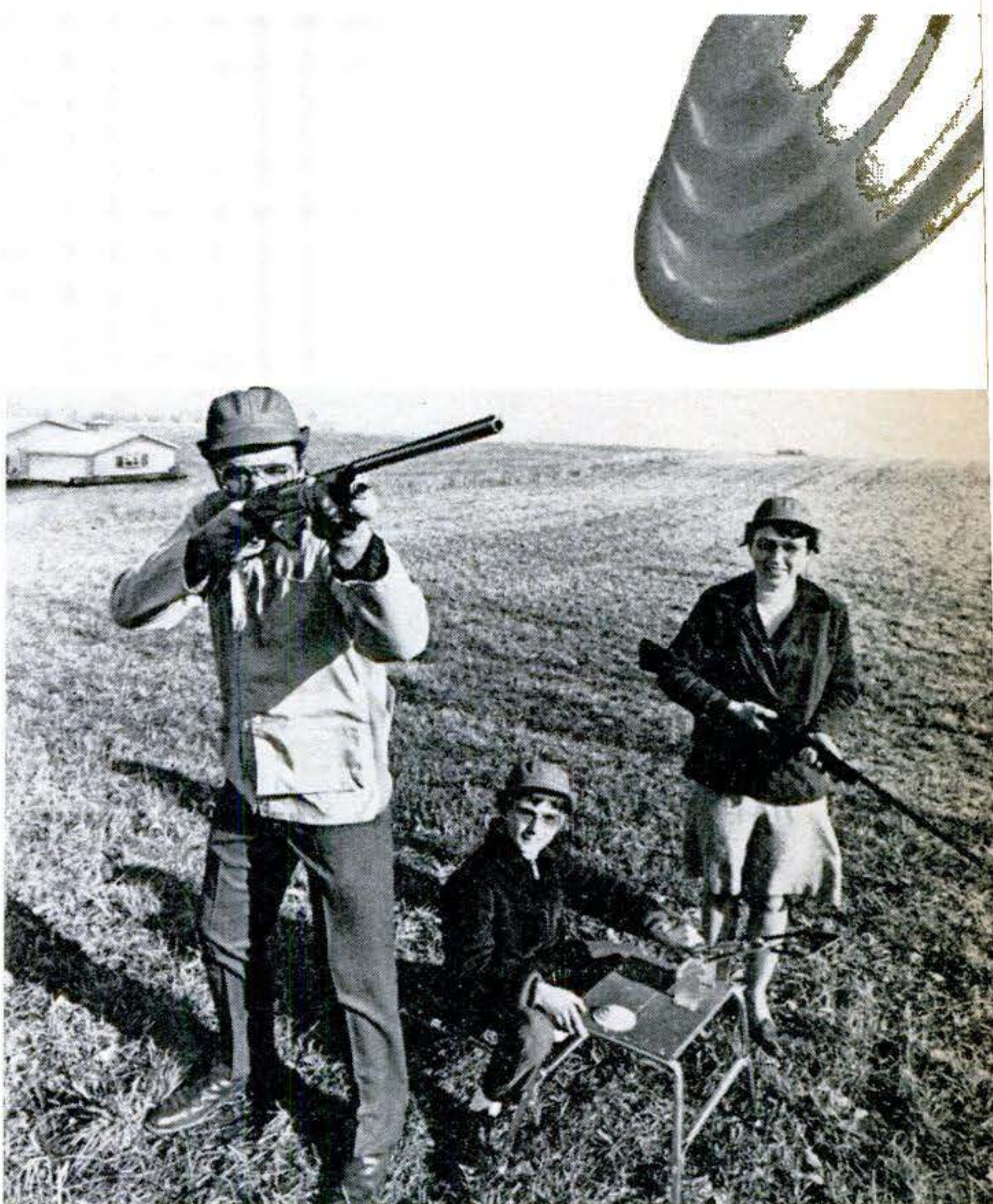
CO<sub>2</sub> skeet shapes up as practically a new sport. Because the effective range of the gun is limited to about 40 feet, you can use it in places where a powder gun would be barred. You can shoot in spa-

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out of muzzle. Power-adjustment lever varies tension on hammer spring. This determines how hard hammer hits valve stem—and whether a large or small charge of gas is released. Release button lets barrel snap forward, open breech, eject shell.





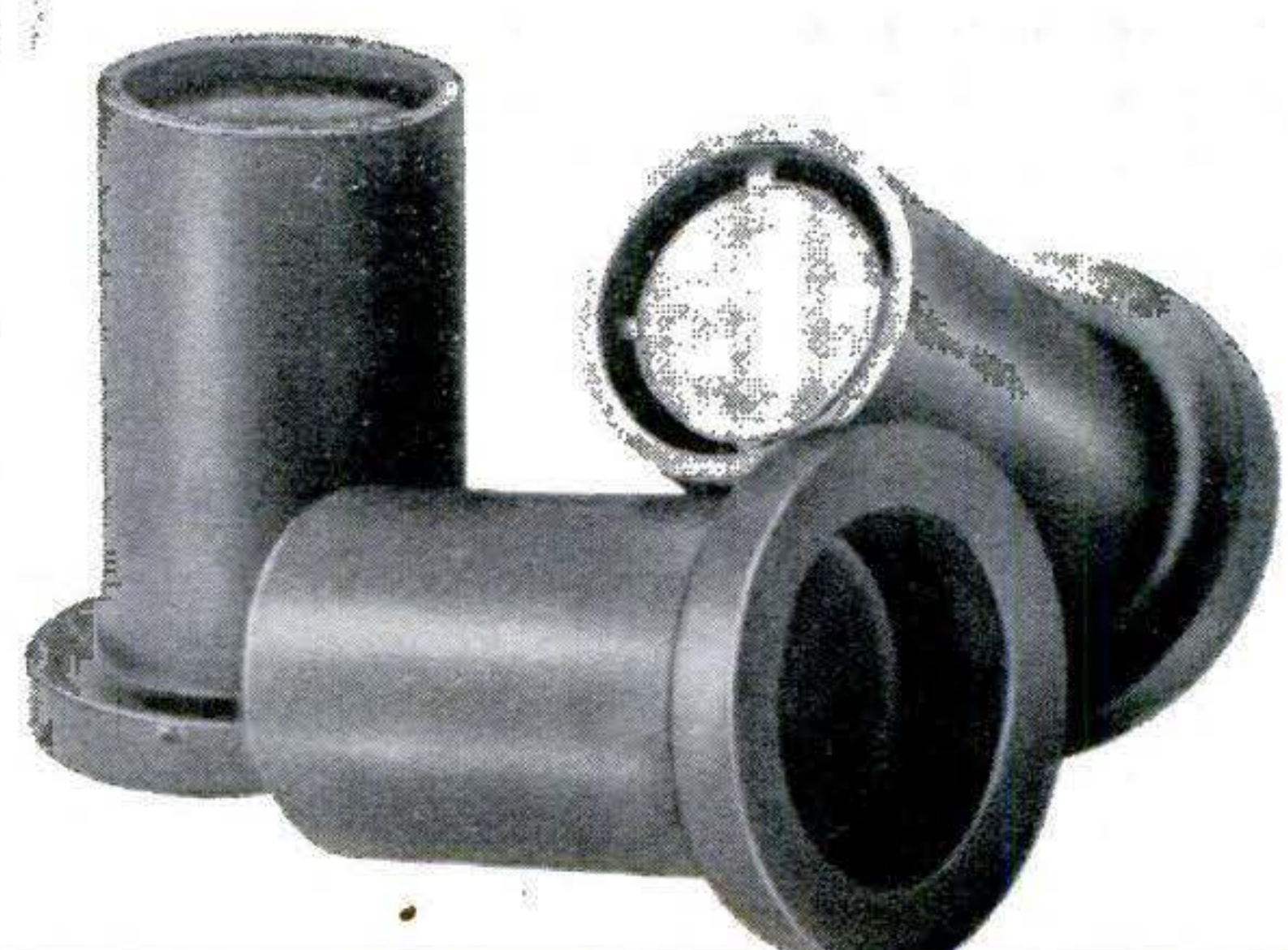
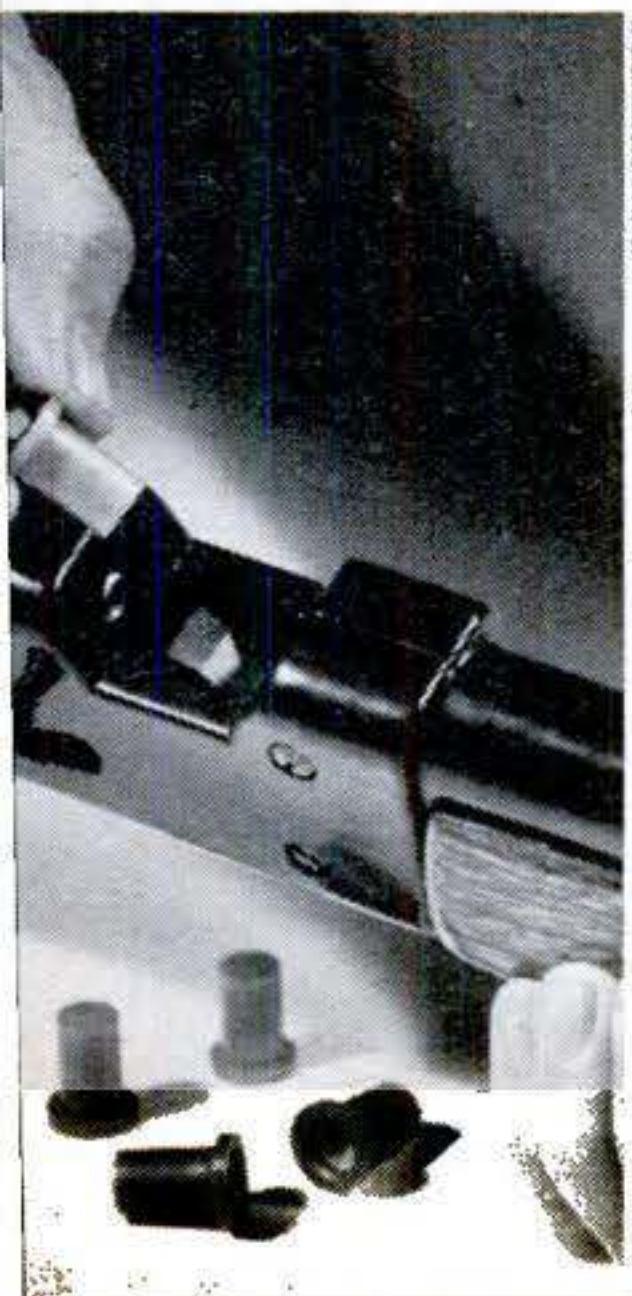


**Full CO<sub>2</sub> skeet outfit** consists of gun, trap, 25 plastic targets, 100 shells, and 10 CO<sub>2</sub> cartridges. Trap

has remote foot release and auxiliary arm for miniature clay targets. Full set: about \$90.

**Plastic shells** are loaded into the breech as at lower left. The shells are  $\frac{3}{4}$  inch long, have cupped wad at rear and a front closure attached at four points (center photo). Each shell has about 55 lead-chilled No. 8 shot. A box of 100 costs \$2.98.

**Domed plastic targets**—shaped like clay pigeons—are part of the outfit. When target is hit, an outer ring breaks away. The targets can then be recovered, put together as you see below, and used again. A box of 25 targets costs \$3.50.





## New Crosman CO<sub>2</sub> rifle has uniform velocity for life of cartridge



**Pellmaster 700** shown above and its companion 707 are 36 $\frac{3}{4}$  inches long, measure 14 inches from butt to trigger, and weigh four pounds. Note cartridge-piercing button at rear and high-comb Monte Carlo stock. Cocking knob is pushed forward to cock gun. Disk just ahead turns rotary magazine. Pellet is loaded nose first through hole atop barrel. You then turn disk to rear to chamber pellet.

cious home areas, even in large basements, at camps, or perhaps down at the dock. One person can operate the system, casting out the birds and shooting at the same time. Shooting is almost noiseless.

The gun gives excellent shooting training. Its shot pattern is about 14 inches in diameter at 40 feet. Consistent scoring on the break-apart plastic targets demands heads-up shooting. Do this and your skill should carry over well into powder skeet or gamebird shooting.

It looks like a powder gun. Designers of

Crosman's Trapmaster Model 1100 obviously had this carryover in mind. The CO<sub>2</sub> shotgun looks and hefts like a powder counterpart. It has an overall length of 46 $\frac{1}{2}$  inches, a 14 $\frac{1}{4}$ -inch length of pull. The full-rib 28-inch barrel is .380 gauge, true cylinder bore. On the shooting grounds you know you have a gun in your hands. It weighs 6 $\frac{1}{4}$  pounds.

Stock and forearm are of contoured hardwood with a walnut finish. The gun has a metal bead front sight and positive cross-bolt safety. Action is a one-stroke, side-cocking single-shot. You also have a power-selector lever—for high or low

[\[Continued on page 168\]](#)

**TO REMOVE SECTION for loose-leaf binding, 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.**



**PS EXTRA! 16-Page  
Save-It Section**

# Care and Repair of Your Power Mower

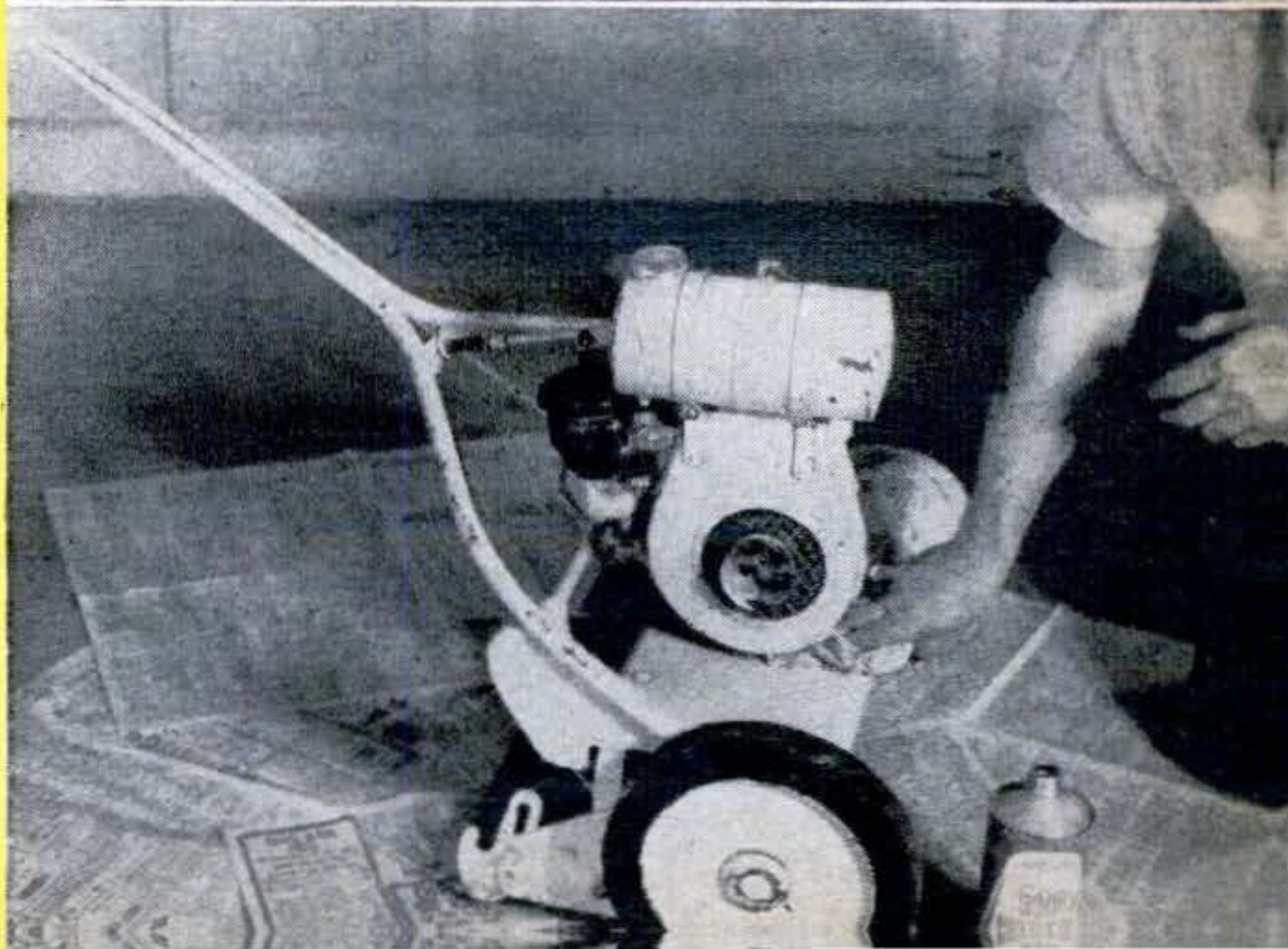
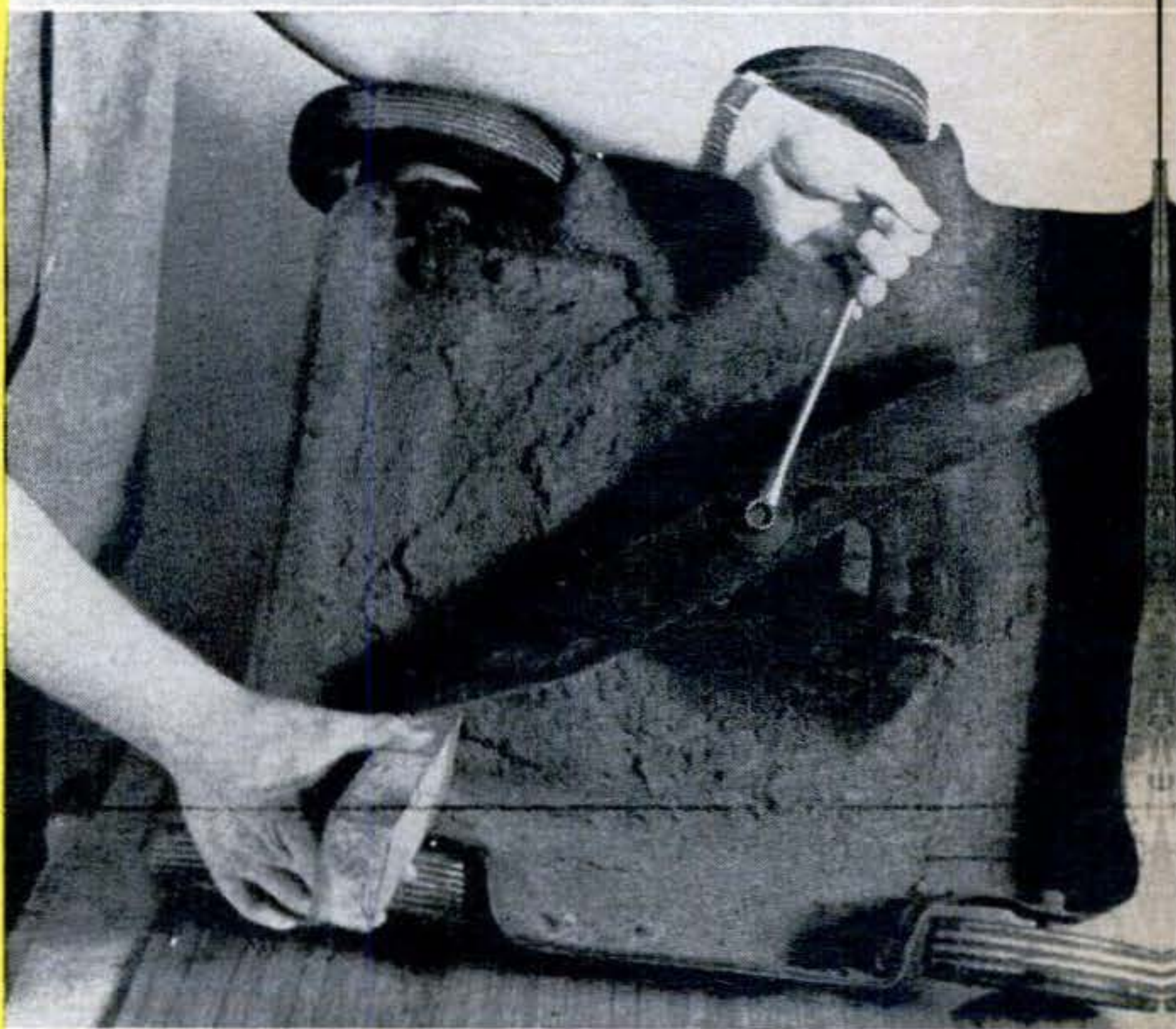
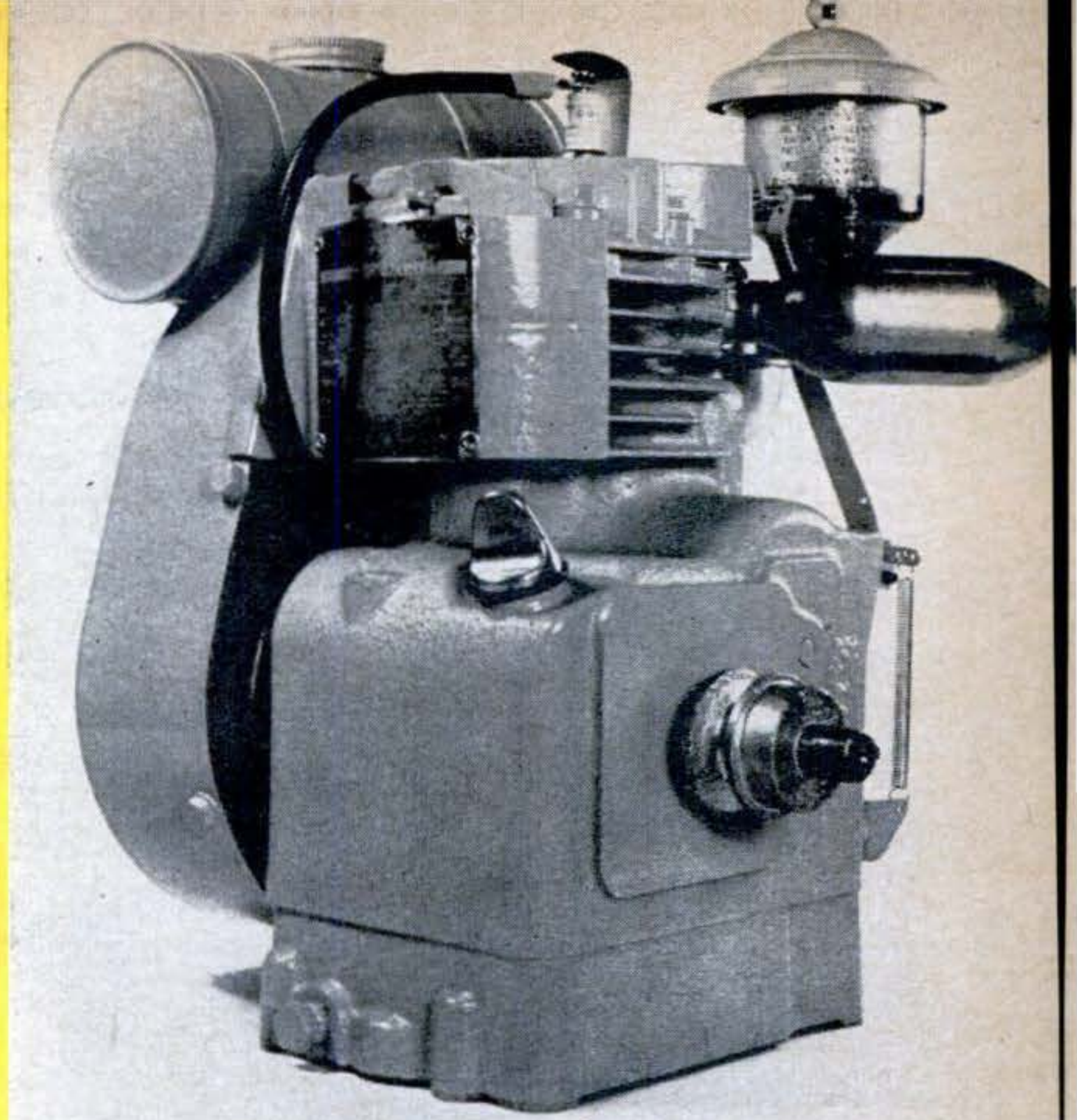
A collection of useful tips  
that'll get you out of trouble  
in your yard, keep you out of  
trouble—and save you money

By E. F. LINDSLEY  
and JOHN BURROUGHS

**M**ost lawn mowers these days are powered by one-lung gasoline engines. These are rugged, beautifully designed little power plants built to run nearly forever, and they do—when well maintained.

Every owner ought to have a handbook, giving the information needed for periodic servicing of his machine—changing the oil and greasing it, keeping the engine in tune, and cleaning out accumulated grass and other debris picked up during operation. But sometimes repairs are needed beyond this.

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## Is yours a one-lunger? 4-cycle? 2-cycle? Here



1 DOWNGOING PISTON  
DRAWS CHARGE  
THROUGH INTAKE  
VALVE



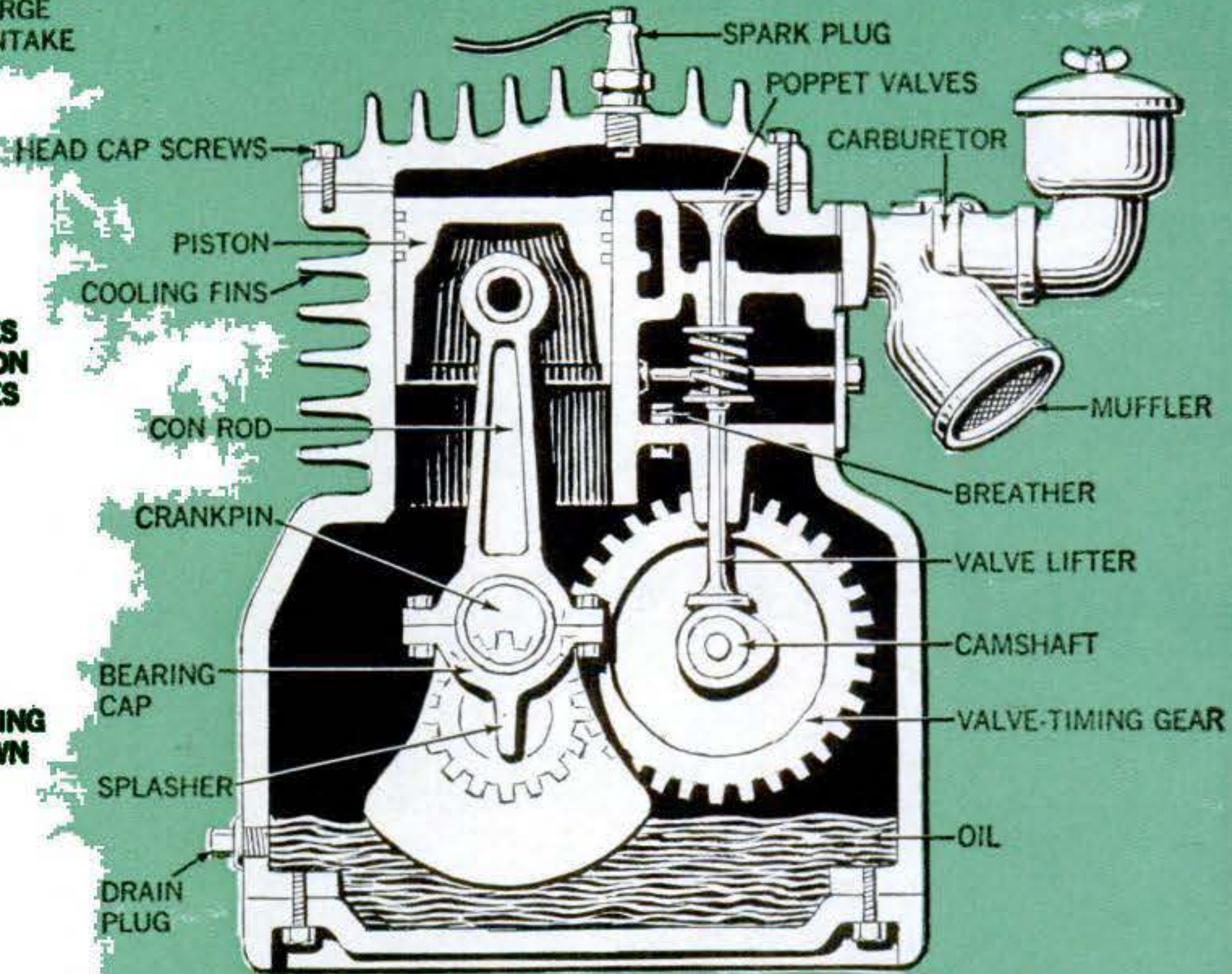
2 WITH VALVES  
SHUT, PISTON  
COMPRESSES  
CHARGE



3 CHARGE IS  
FIRED, DRIVING  
PISTON DOWN



4 ON  
UPSTROKE,  
PISTON  
EXPELS  
EXHAUST



TYPICAL 4-CYCLE HORIZONTAL-CRANKSHAFT ENCASEMENT (side view)

A four-cycle engine fires once for each two revolutions of the crankshaft. In an L-head automobile engine, a four-cycler has a camshaft geared 1:2 to crankshaft. Cams on the camshaft lift spring-loaded, poppet-type intake exhaust valves (shown overhead in the diagram above for greater clarity). Crankcase serves as a reservoir for oil splashed up into the cylinder.

There are five main reasons why mowers go haywire:

- Dirt—in gas tanks, crankcases, bearings, and gears.
- Rust—in tanks, in internal engine parts, bearings, and controls.
- Lube failure—sometimes in engines, more often elsewhere.
- Vibrations—always present with one-lunger engines and on rough ground.
- Misadjustment—of cutting blades, controls, clutches, belts, engines.

Each of these ailments hits mowers regardless of whether they are simple push rotaries, self-propelled reels, big riding rotaries, or tractor-type units. Enough engineering talent and expensive seals could probably lick part of the dirt problem, but within the range of practical costs it doesn't pay to build yard machines that way.

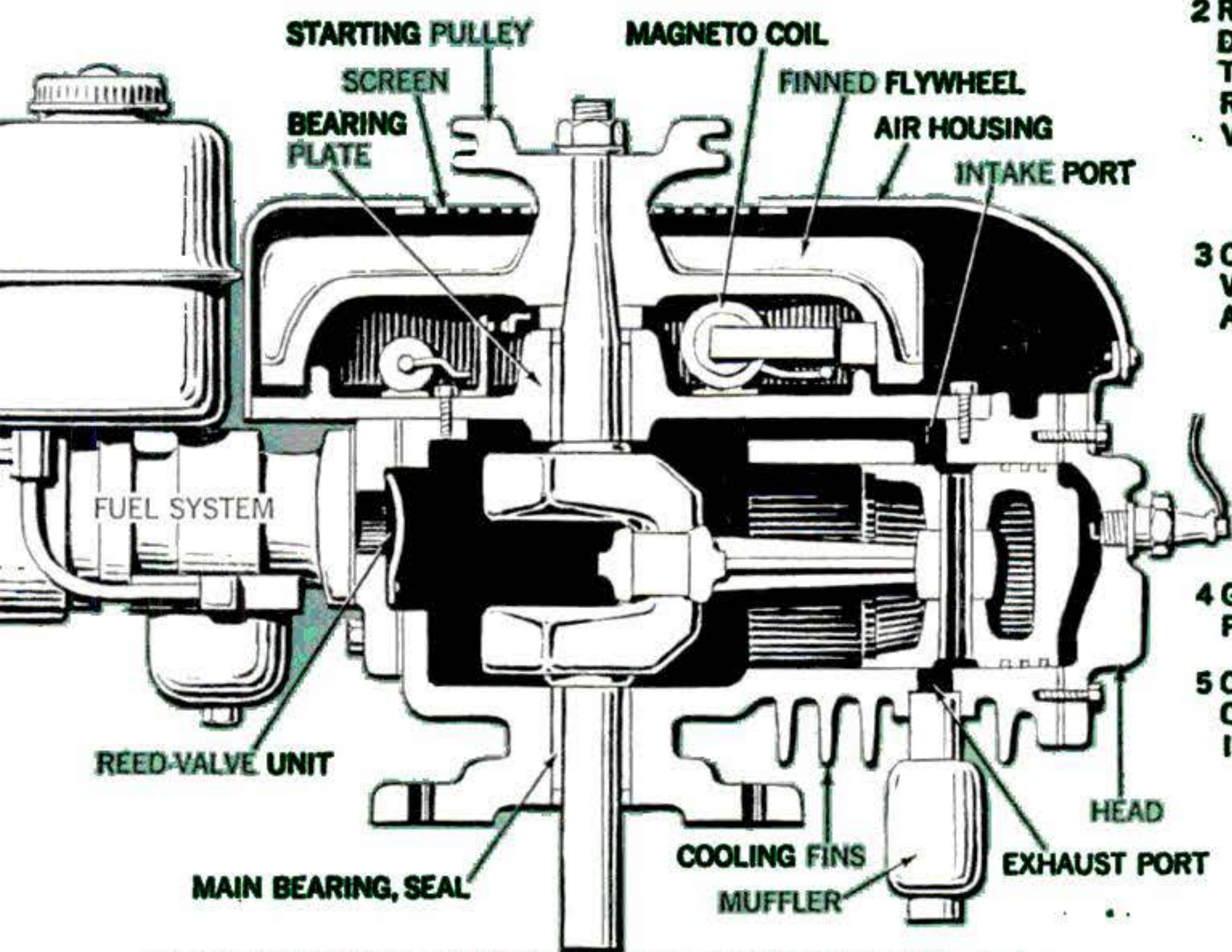
Rust comes from wet, soggy grass, casual storage, mowers left in the rain and dew, improper winter storage. Internally,

it can be reduced by draining and oiling before storage. Externally, frequent cleaning and touch-up painting will fight rust pretty well.

It goes without saying that running a four-stroke engine without oil, or failing to have the proper gas-oil mix in a two-stroker, is fatal. Other lube failures tend to be less spectacular. Wheel bearings run without grease or oil, low transmission-oil level, and missed grease fittings on the rotary-blade hubs will show up as wobbles, poor performance, and ultimately a junk mower. In some cases special lubricants are called for in the instruction manual. It pays to use them.

Vibration sometimes results in a long flashlight search in the grass for a missing bolt or part. This may turn up night crawlers but seldom the lost part. A complete going-over, preferably several times a year, will stop most of the dropouts. Never fix a really loose bolt or nut by just tightening. Ten to one the thread





**TYPICAL 2-CYCLE VERTICAL-CRANKSHAFT ENCASMENT (side view)**

1 PREVIOUS CHARGE IS COMPRESSED

2 RISING PISTON DRAWS CHARGE THROUGH REED VALVE

3 CHARGE IS FIRED; VALVE CLOSES AUTOMATICALLY

4 GASES DRIVE PISTON DOWN

5 CRANKCASE CHARGE IS COMPRESSED

6 PISTON UNCOVERS PORTS

7 CHARGE ENTERS ABOVE PISTON

8 EXHAUST GASES ESCAPE

A two-cycle engine fires once for every crankshaft revolution. The moving piston draws a fresh charge of air-fuel vapor through a leaf-spring reed valve to the crankcase; then through an intake passage and port into the cylinder. Since the engine has no oil in the crankcase, oil must be mixed in a 1:16 ratio to the gasoline to provide lubrication of the moving parts.

are worn and will never come up tight and hold. If the mower manufacturer seems to have been neglectful in choosing secure fastenings, use your own engineering genius. Add a lock washer, a star washer, a cotter pin, or some Lok-Tite for a permanent cure.

The effects of dirt, rust, lube failure, and vibration all accumulate and show up as misadjustment. Things just plain get out of whack. Continuing to run in this condition will lead to expensive repairs, especially on the more complex riders and reel mowers. Use the instruction book when making adjustments. Some of the linkages and belts on modern mowers are complex; they must be set up properly. If you can't seem to get results with the proper adjustments, it's probably time to take the mower to your authorized service agency.

Remember, though, the service agencies are extremely busy fixing the tough problems and don't really have the time

to give the mower the detailed and complete going-over that you can do at a more leisurely pace.

**Don't junk a one-lunger.** One-lunger engines usually give out because of neglect—before they wear out. More often than not they're run until their ignition systems fail (the usual trouble when they won't start). There's absolutely no valid reason to junk such an engine, as is commonly done.

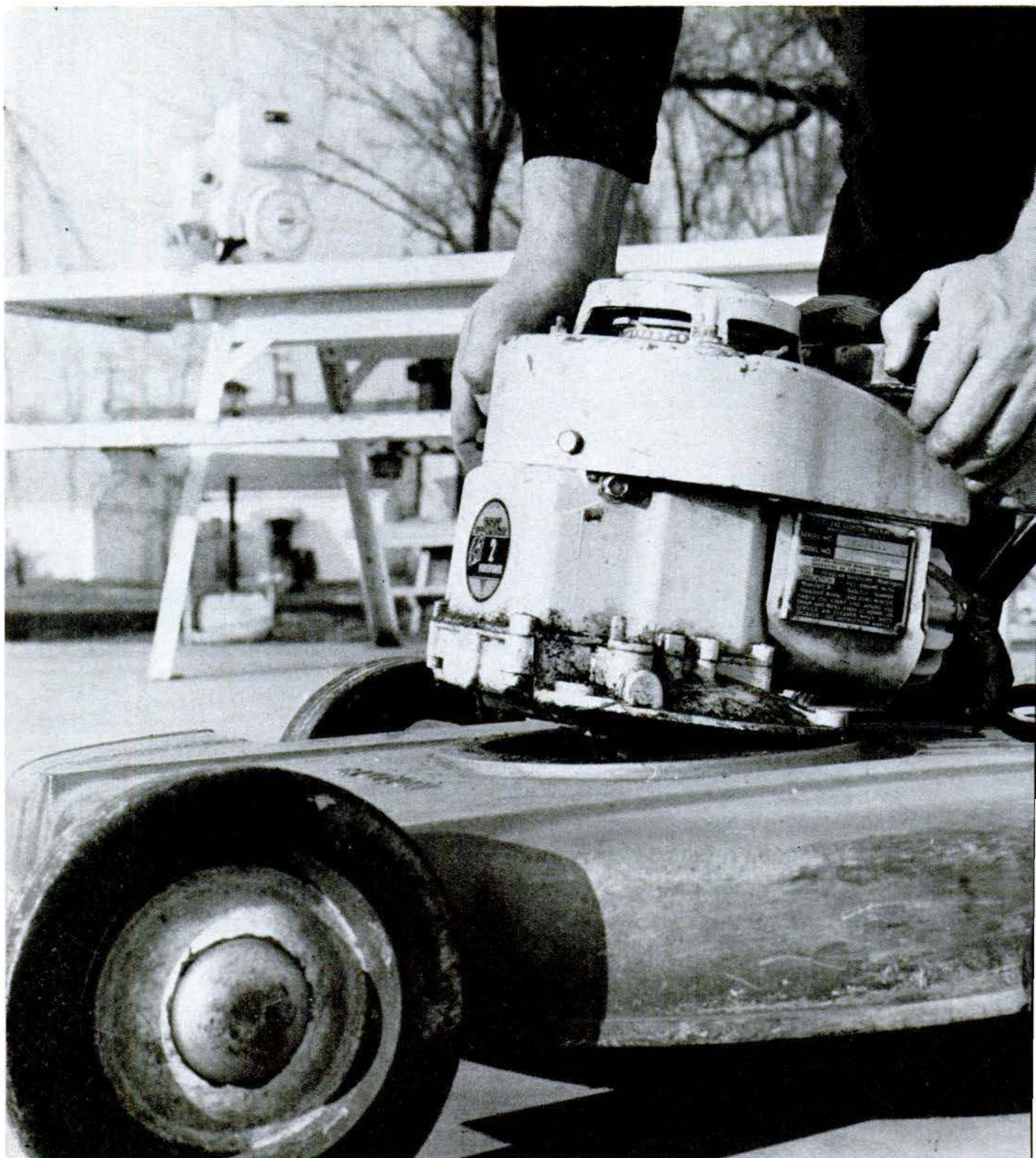
That's a good clue for you. You can find lots of discarded one-lungers in junk shops. Such engines can be real bargains, especially if you need spare parts for an engine you already own.

Even a decrepit-looking used engine probably will still be in reasonably good shape internally. Cylinder, rings, and bearings may not be as tight as new, but chances are they'll still be serviceable. Cleaning and readjustment will get magneto and carburetor working.

*Continued*



## Does the engine on your rotary mower need work? Here's ho



Removing one-lunger from a lawn mower usually makes it easier to carry out repairs on the engine—or perhaps you'd like to remove it for replacement with a rebuilt or new engine. See photos at right.

If parts are missing or broken, you can usually get factory replacements. New parts are expensive, though, and when they have to be ordered it may take time to get them. When a one-lunger needs replacement parts, it's often cheaper to hunt up a second engine of the same make and salvage the parts needed.

**There are engines and engines.** Some

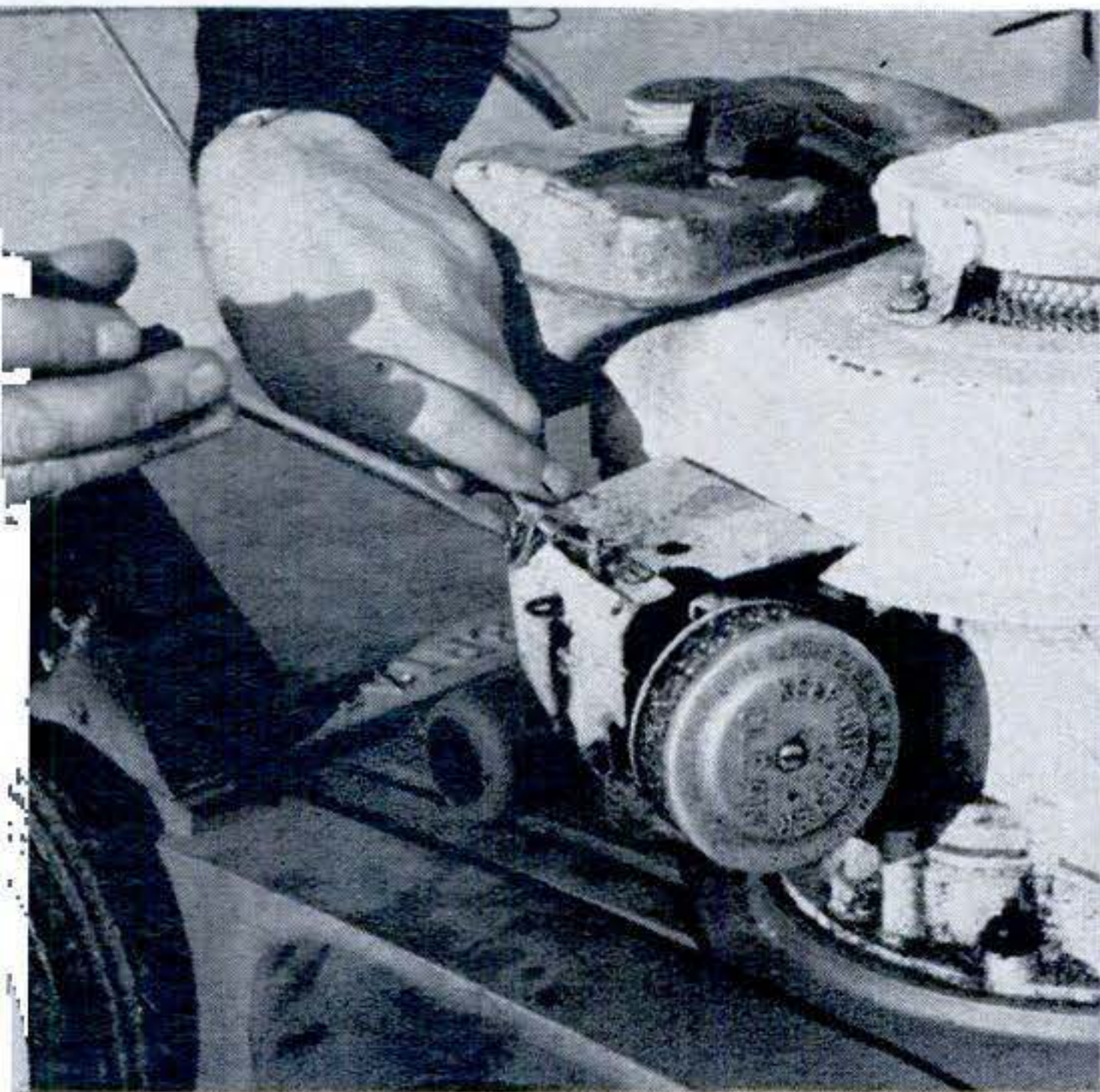
16 U. S. firms manufacture small air-cooled engines, and most build more than one kind—in all, quite a variety of types, models, and sizes.

There are two basic types: four-cycle engines (with poppet valves as in auto engines), and two-cycle engines (in which the piston opens intake and exhaust ports at the bottom of each stroke). Engines



to remove it so you can do the job

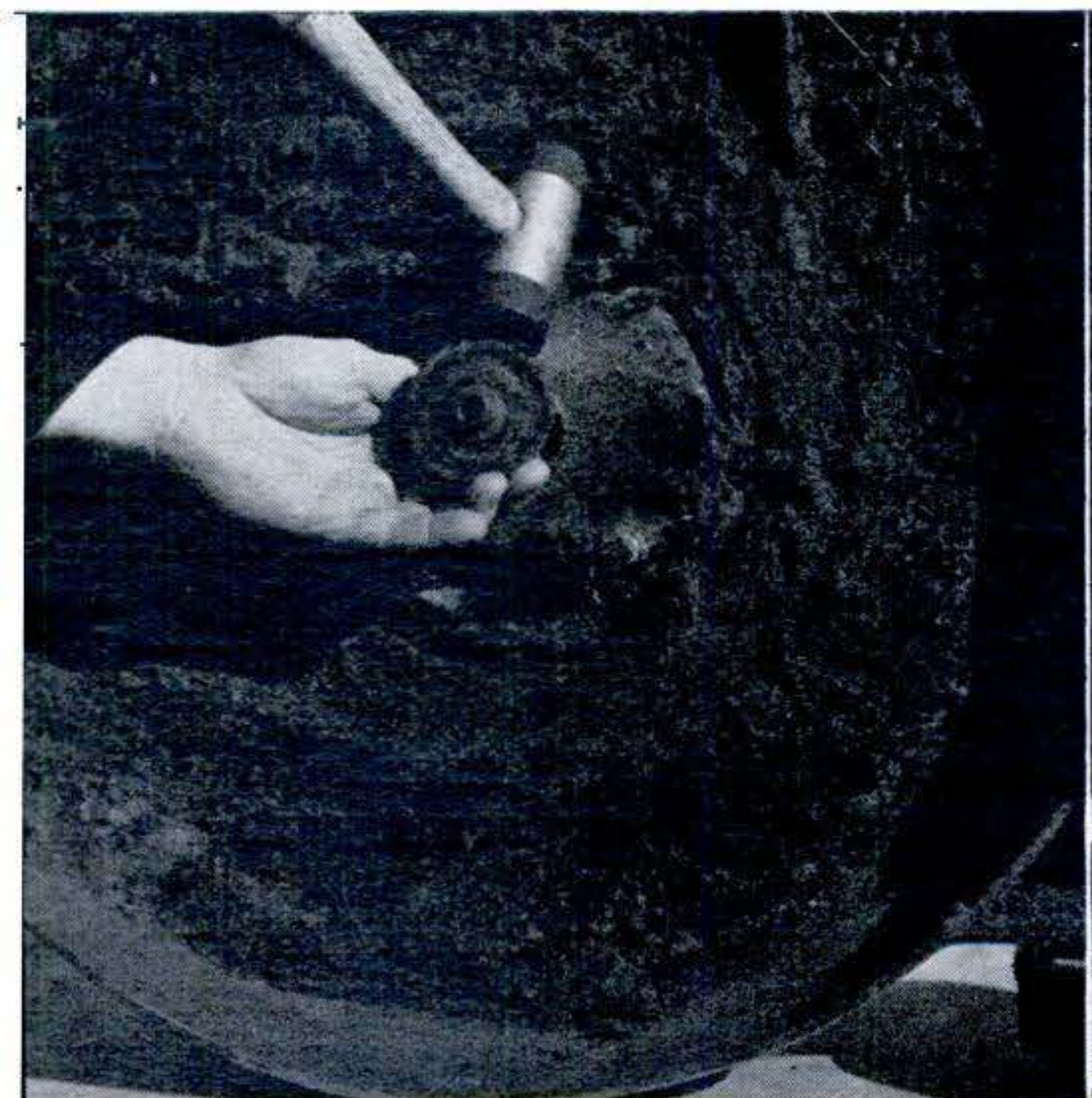
## PS Extra: POWER-MOWER CARE



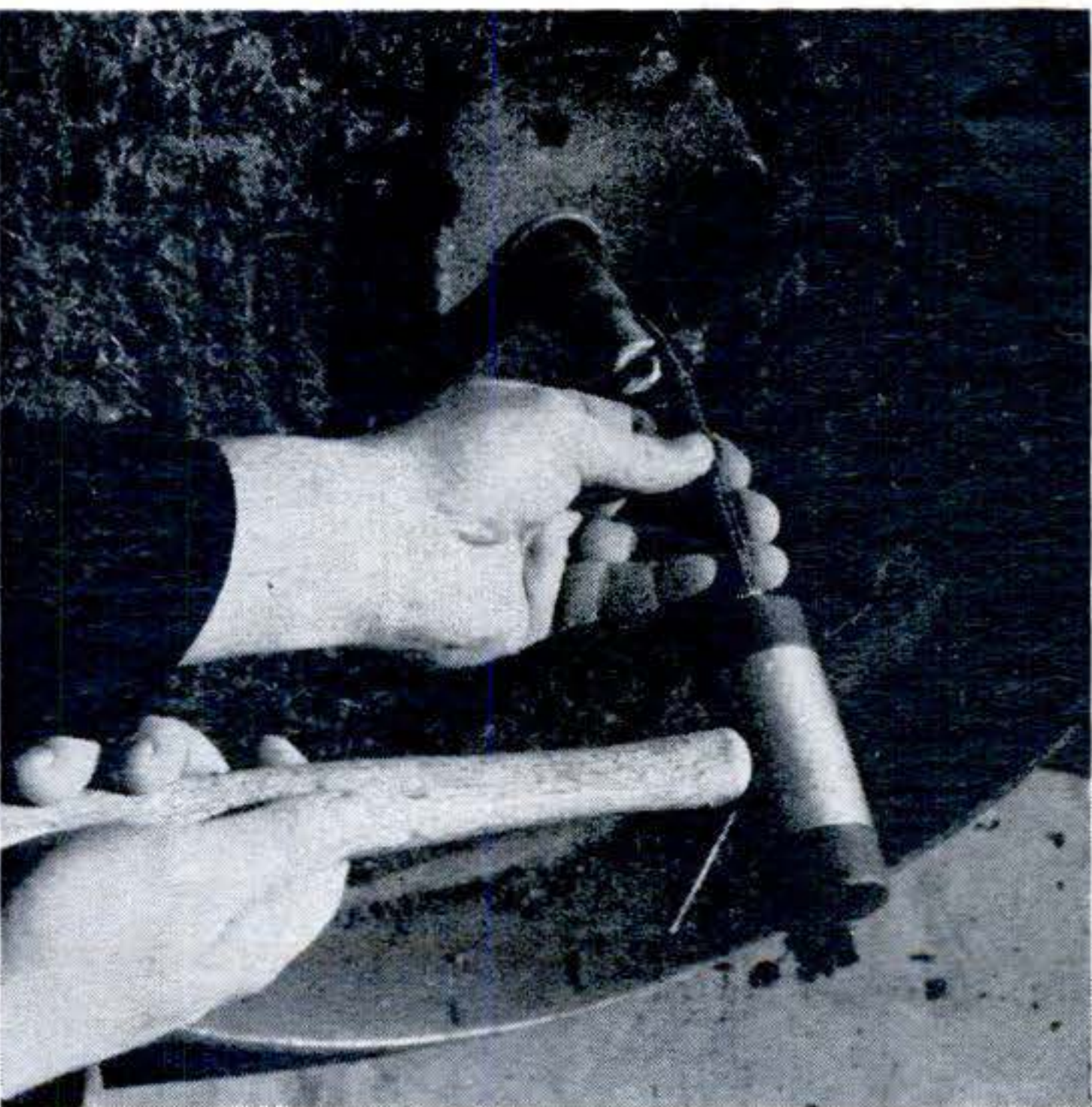
First, lift wire from plug and wrap terminal with electrician's tape to avoid accidents with blade when you turn the mower over. Disconnect the throttle wire.



Tilt mower on its side with carburetor up to keep oil from spilling out. Then remove the cap screw and lock washer that hold blade and hub to crankshaft.



Remove blade hub from the crankshaft by tapping gently with a mallet (not hammer). For ease of reassembly, keep parts in same order they are removed.



Remove woodruff (half-moon) key from crankshaft and all but one of bolts that hold engine. Right mower, remove last bolt, lift off the engine.

of each type are made in both horizontal-crankshaft and vertical-crankshaft models. Power ratings, roughly a function of piston displacement, range from one to 12 horsepower.

Cylinders in some engines are cast iron; others are alloy aluminum with or without cast-in liners. Main bearings may be sleeve-, ball- or roller-type. Car-

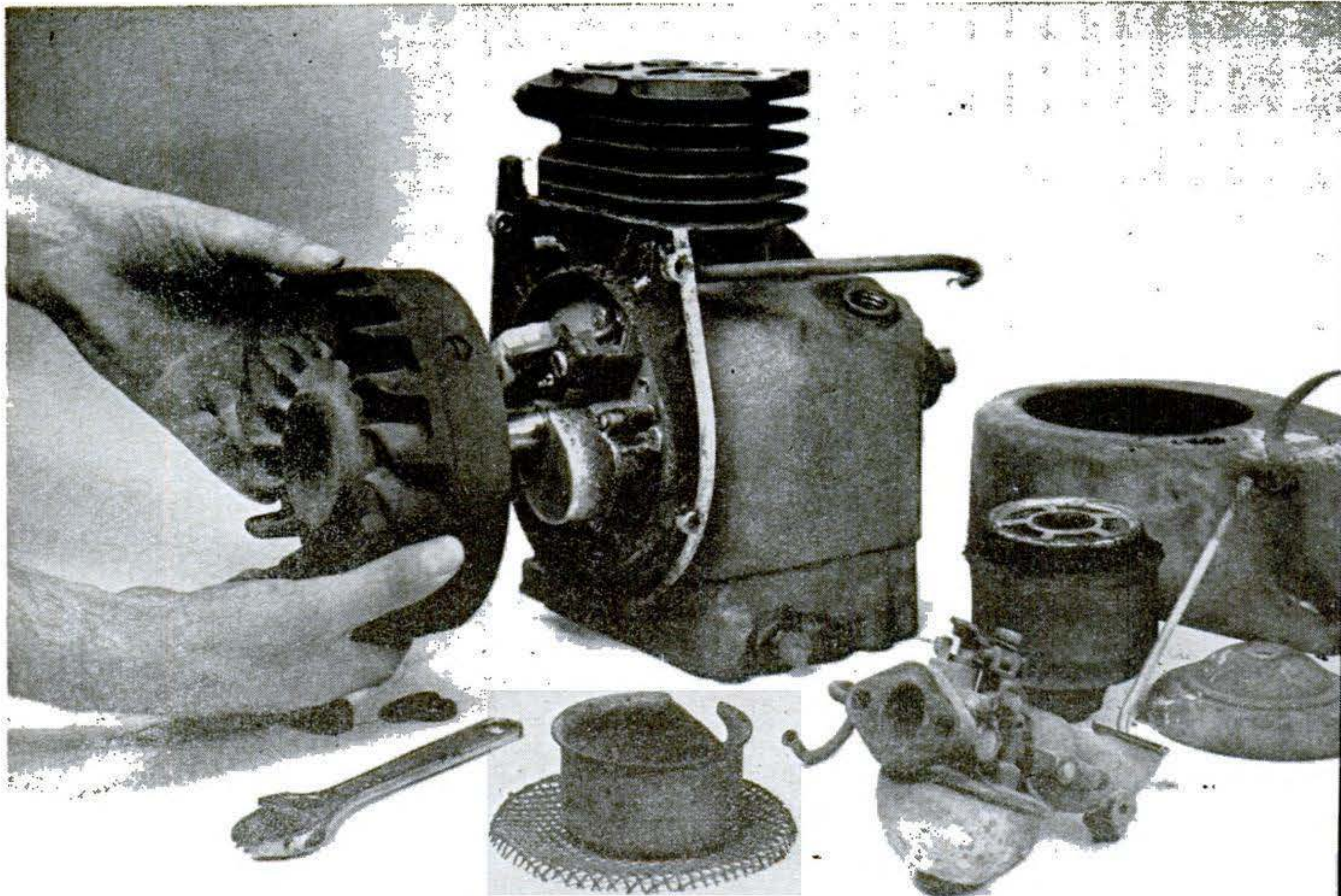
buretors, gas tanks, air cleaners, and mufflers on various makes differ only superficially.

Getting a neglected engine back in shape involves: 1) stripping it to its encasement; 2) cleaning dismantled parts individually; and 3) checking the engine's compression, ignition, and carburetion—

*Continued*



## Want to strip down a one-lung engine and repair it? Here's



**1** To strip engine, unbolt gas tank, carburetor assembly, and sheet-metal flywheel housing.

the three things that make a gas engine a gas engine—as you reassemble it.

Accompanying photos show a typical clean-up, tune-up job. The one-lunger pictured is an elderly four-cycle horizontal-crankshaft two-hp. Clinton.

**Stripping.** It's good practice to scratch- or punch-mark parts as you unbolt them to indicate how they should be replaced.

The flywheel is the only part you may have difficulty removing. If you find when you've loosened the retaining nut (or on some engines the recoil-start clutch housing) that the wheel won't slip off the crankshaft, squirt in penetrating oil; and then (with the nut screwed on to protect the threads) rap the end of the shaft smartly with a brass hammer. If that doesn't work, heat the wheel's hub with a torch and try again.

Flywheels on Briggs & Stratton and some other engines have holes for puller bolts. When this is the case, you can improvise a puller using suitable bolts and a chunk of steel bar.

Most engines have a brass or alumi-

Then pull the flywheel. Don't open the encasement (block-crank-piston assembly) unless for overhaul.

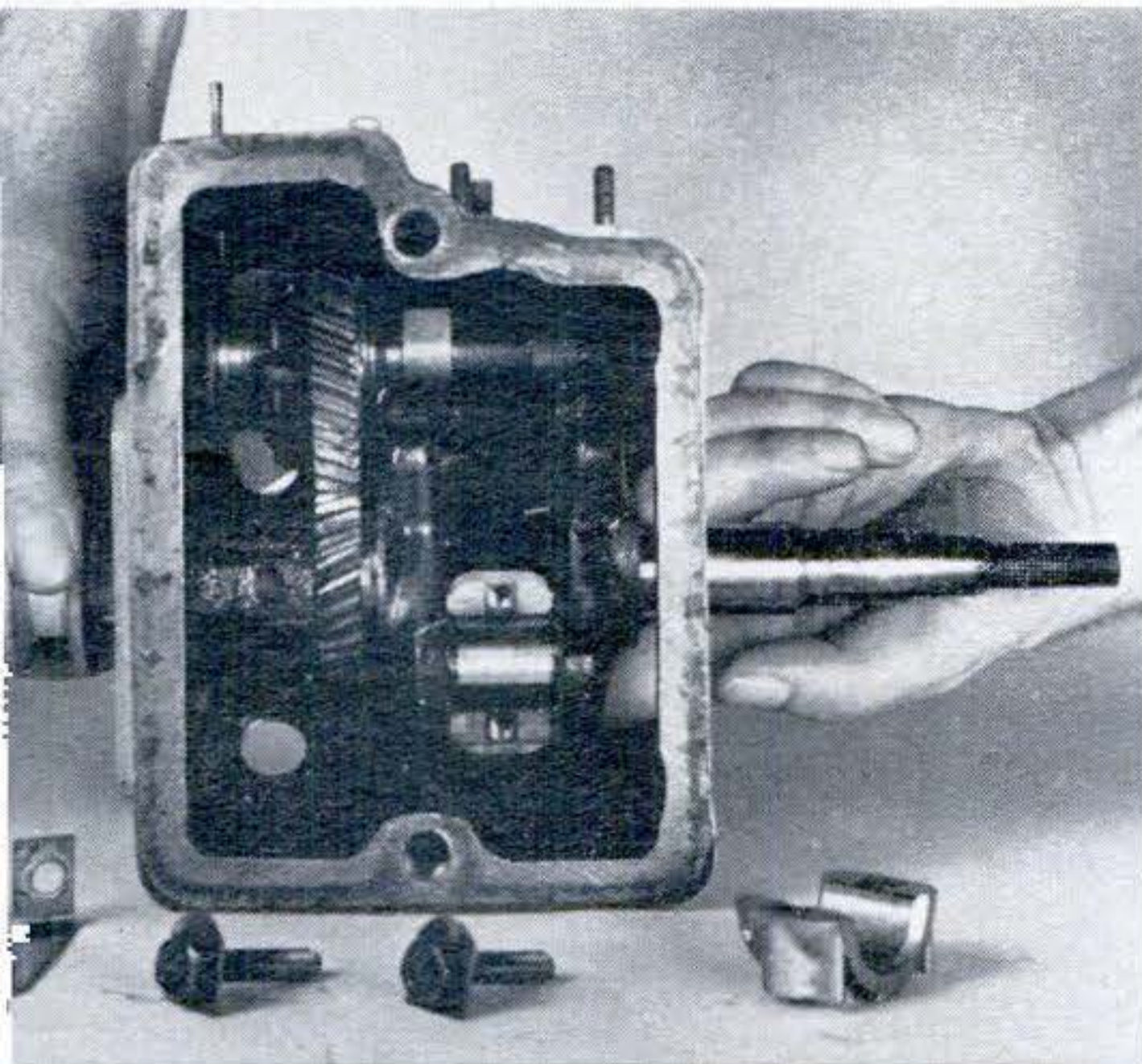
num key (meant to shear should the engine somehow jam) keying the flywheel to the crankshaft. A key that's partly sheared, bent, or worn loose should be replaced.

**Cleaning.** After scrubbing dismantled parts with solvent, disk-sand off rust spots or loose paint. Scraping the cylinder's cooling fins purposefully with a knife blade removes scale.

To check the condition of the con-rod bearing, press firmly on the piston with one hand, feeling for looseness, while rotating the crankshaft with the other. If you can feel play, remove the encasement's base or side cover plate, unscrew the rod bearing's cap, and inspect the crankshaft's crankpin.

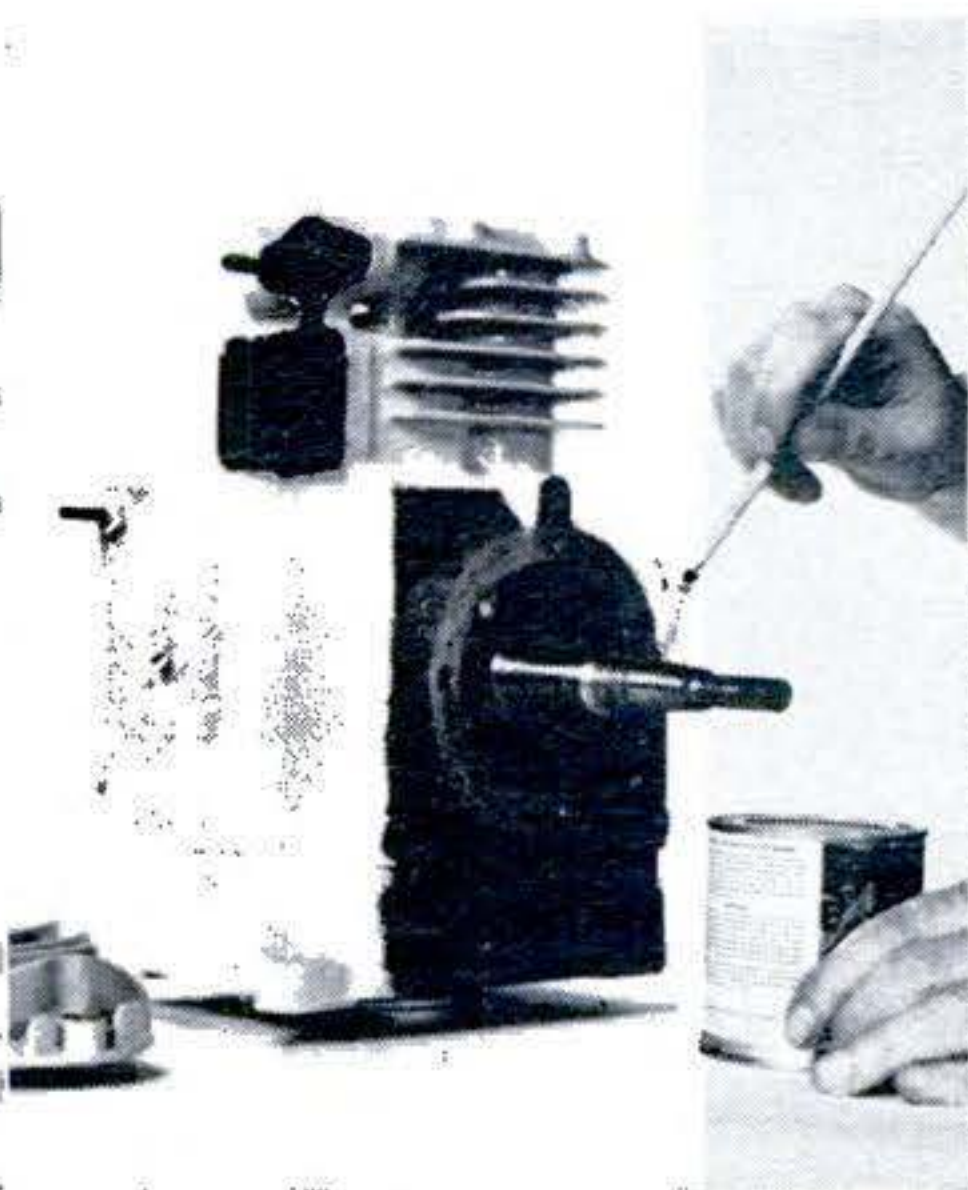
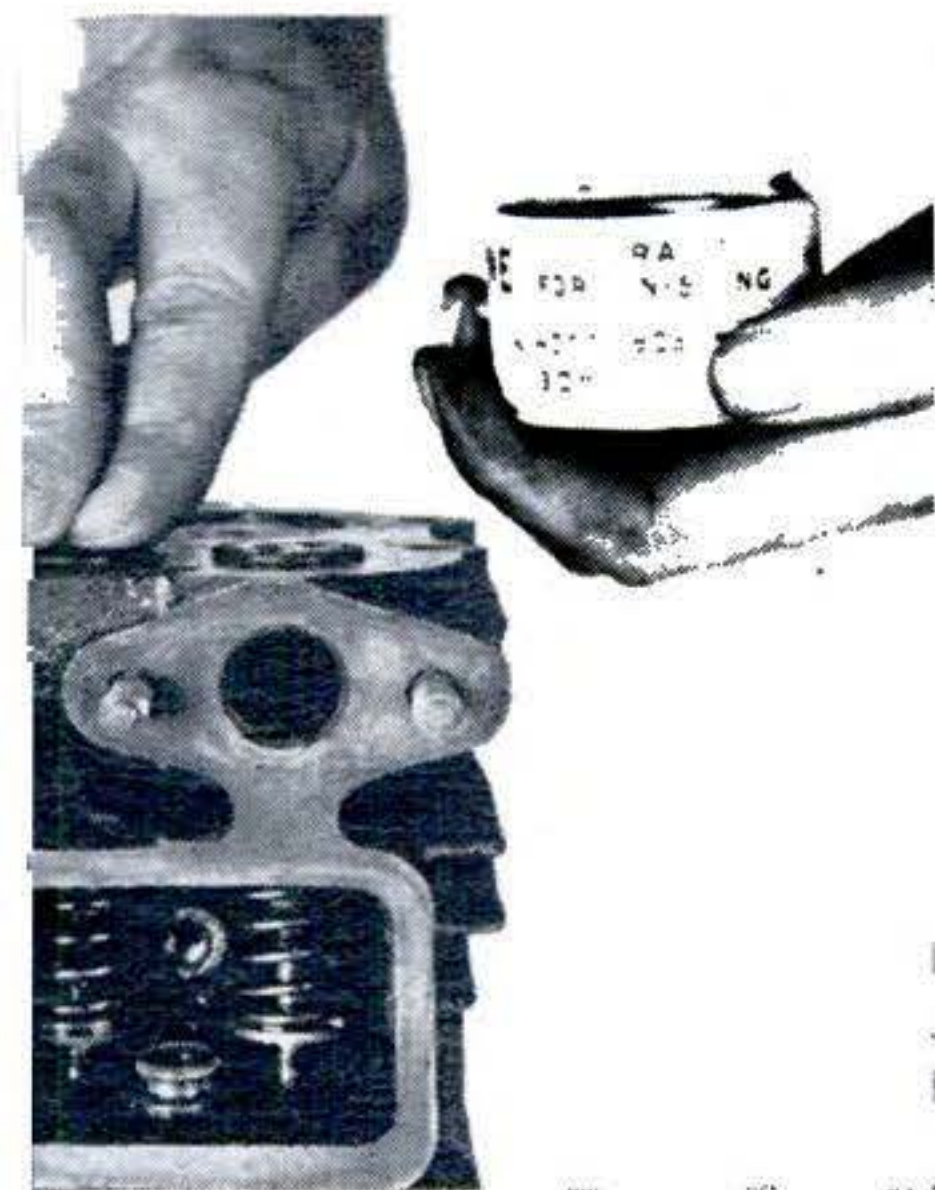
Factory service shops replace or machine-grind crankshafts with burned, scored, or out-of-round crankpins. It's usually possible, however, to do an adequate makeshift job of retrueing a rough crank journal by hand, first smoothing down scores with strips of fine silicon-carbide paper backed with a strip of flex-





**2** If con rod feels loose, open encasement and unscrew cap. Smooth crankshaft journal with extra-fine abrasive paper if burned or scored, file cap to reduce play. Don't fit bearing too tightly.

**3** Scrape the block of the one-lunger to remove all carbon deposits and clean out the head. The height of the ridge around the top of the cylinder indicates the amount of cylinder and ring wear.



Valves can be lapped against their seats without removing them. Position crankshaft to release spring tension and rotate the heads with your fingertips.

**5** Clean up encasement, scraping rusty scale from the cooling fins and scrubbing the block with solvent. Then paint with heat-resistant machine-gray enamel.

**6** Cut gasket used under bearing plate from gasket paper of correct thickness to take up end play in crankshaft. Cement gasket to insure against leaks.

able fiber, and then finish-polishing with crocus cloth. To do a more precise job, cast a half-round lead lap.

Aluminum con rods in most small engines have integral bearing surfaces, not replaceable inserts. When filing the bearing cap to take up play, don't fit it too tightly. Small journal bearings need .002-inch running clearance and .004-inch or more total end clearance.

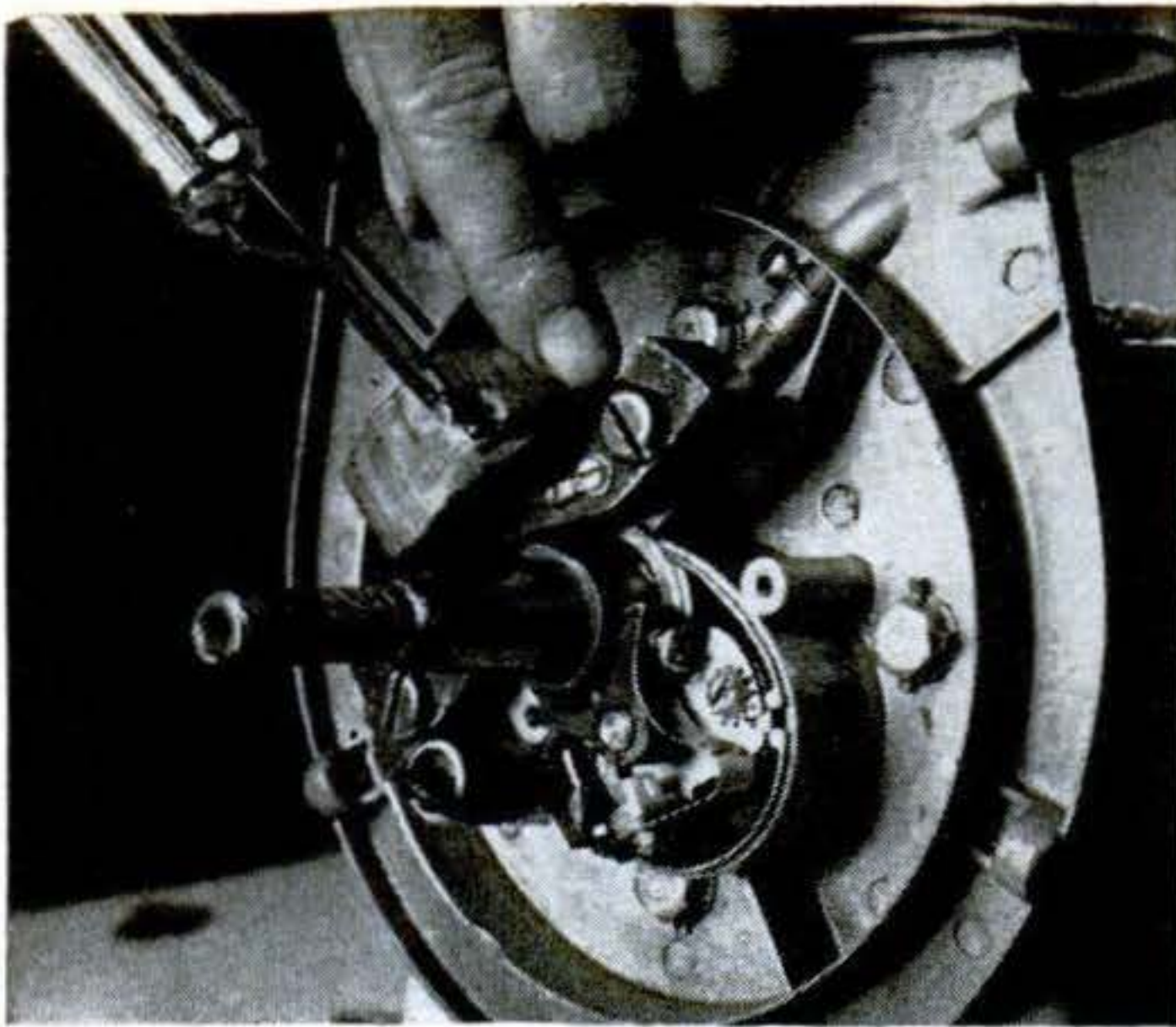
**Compression.** The height of the ridge around the top of the cylinder wall will

indicate the amount of wear in the bore.

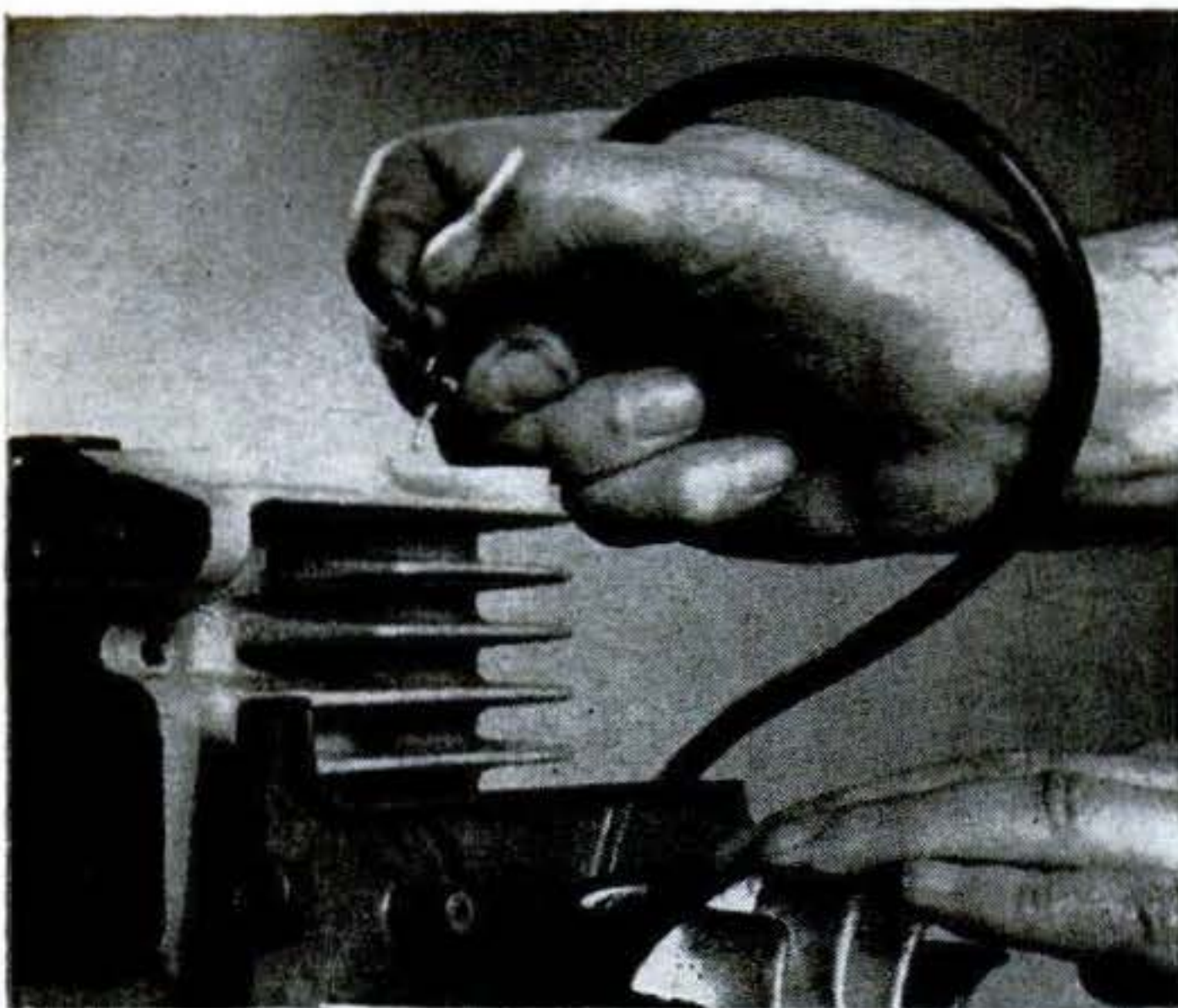
If the wall isn't scored, don't be concerned if it shows moderate wear. According to service manuals, cylinders worn .005 inch should be rebored for oversize piston-and-ring sets, which is true when the engines must run at top efficiency. In the jobs for which most one-lungers are used, however, optimum power and fuel economy aren't prime requirements. A small engine's cylinder and rings can be

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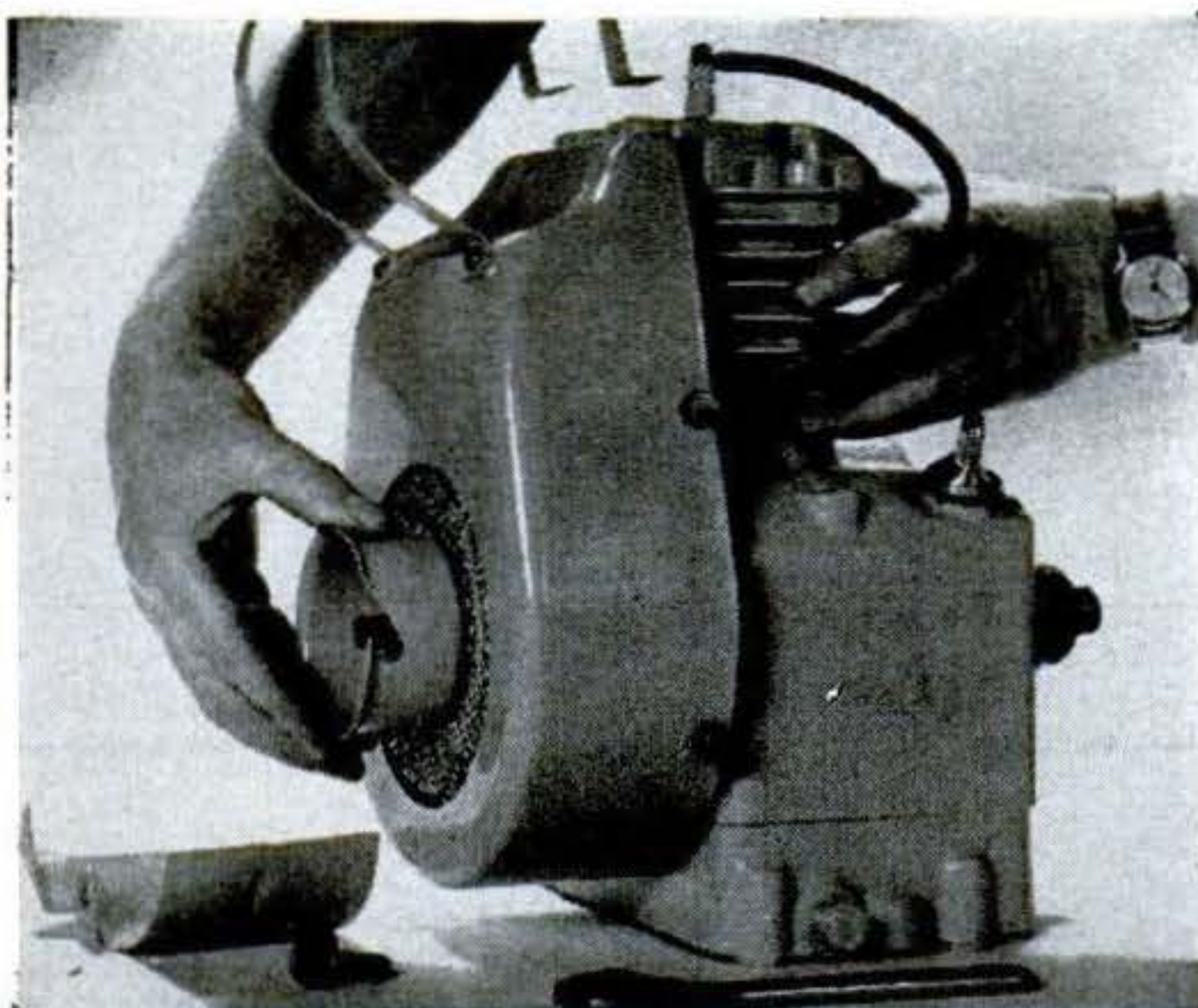




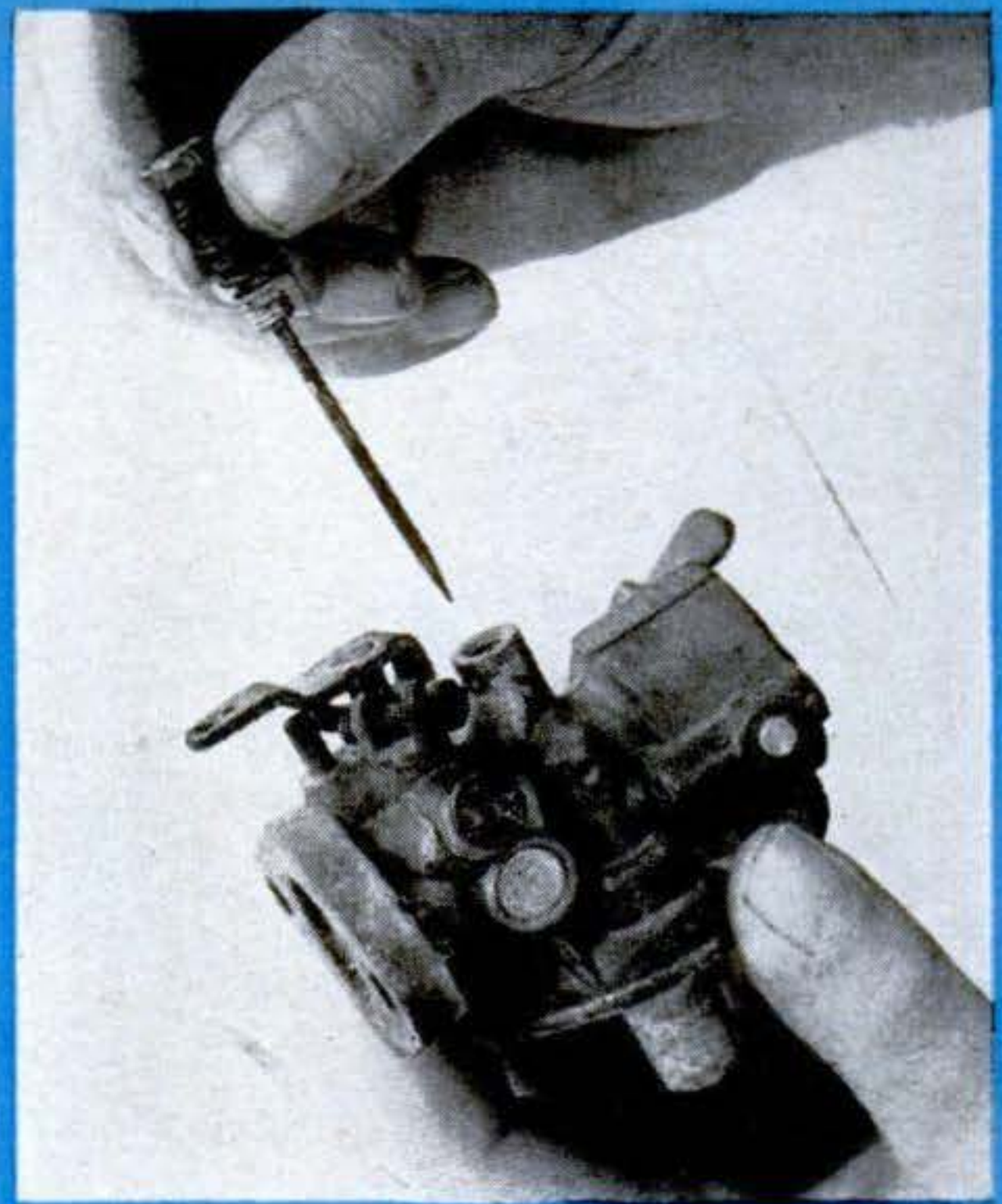
**7** Ignition system—don't disturb coil or its laminated armature when cleaning. Dress and regap points. Replace worn spark-plug lead.



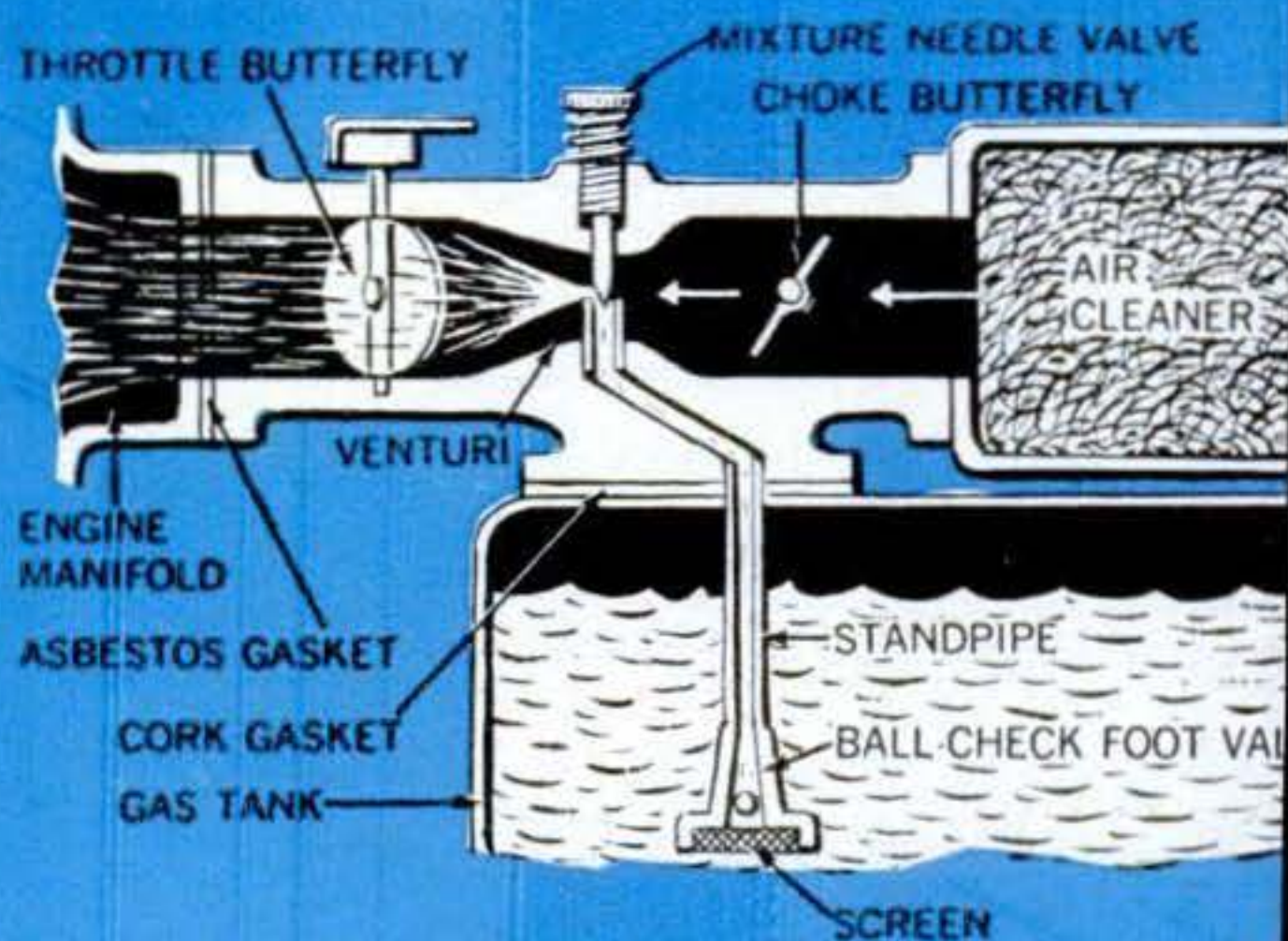
**8** Magneto is working satisfactorily if spark will jump  $\frac{1}{16}$ " when you spin flywheel. If spark seems weak, recheck points, replace condenser.



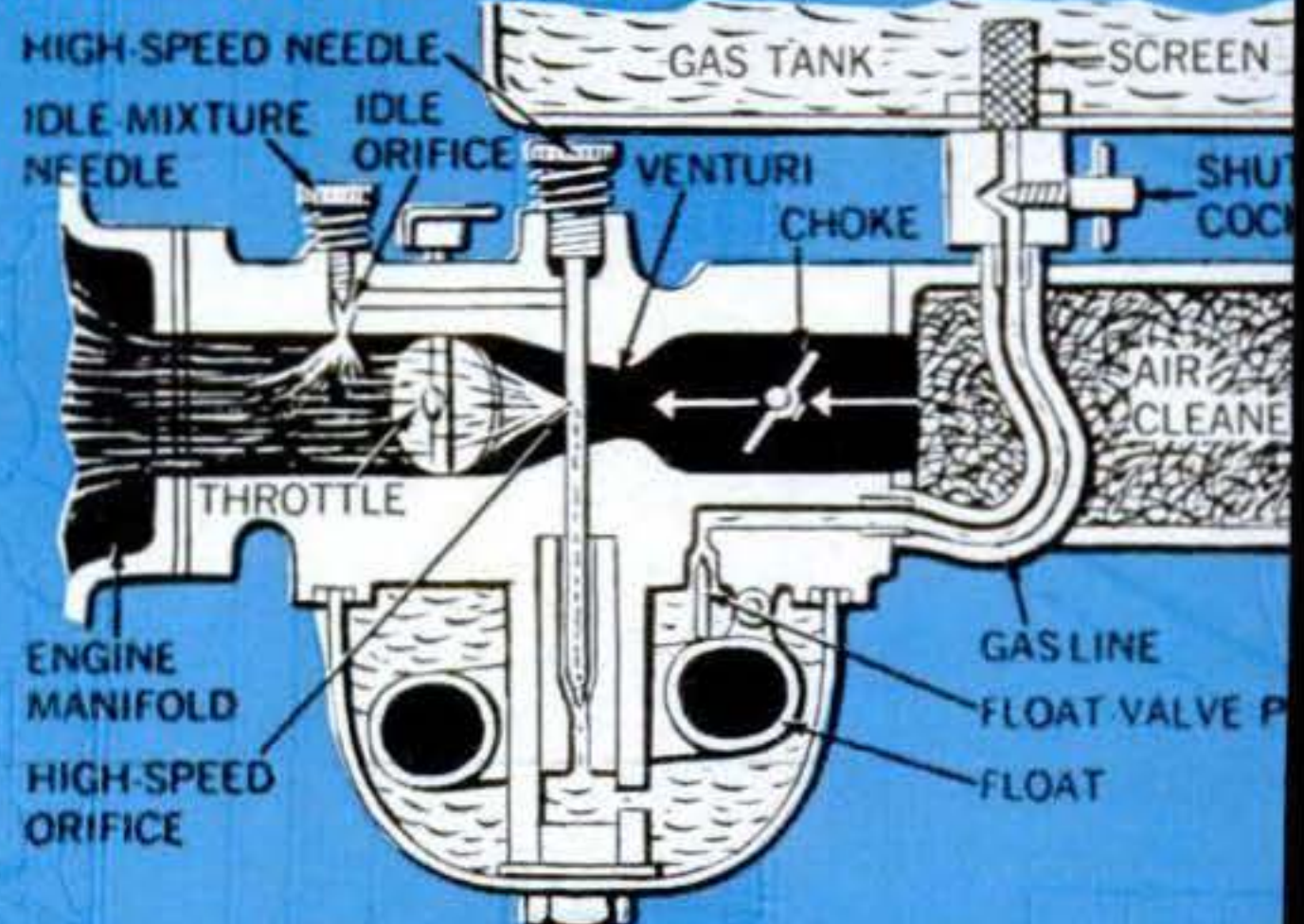
**9** When bolting on blower housing, spin crankshaft to make sure the flywheel doesn't rub. Hammer out dents in sheet-metal housing.



#### TYPICAL SUCTION-FEED CARBURETOR



#### TYPICAL FLOAT-FEED CARBURETOR



**10** Carburetor can be salvaged even if badly corroded. Remove corrosion with fine abrasive paper and scrape out passages. Clean all parts with lacquer thinner. Remove air-cleaner element and clean it thoroughly in gasoline.



worn quite loose, but still (provided the valves and head are tight) develop plenty of compression for satisfactory operation of the mower.

The valves in an old four-cycler probably will need attention. If you find when you've scraped away carbon that the valve faces aren't badly burned, simply lap the valves against their seats with fine compound. If they are burned, pull the valves and have them machine-ground. Replace the exhaust valve if its head is heat-warped.

Valve lifters in most small one-lungers do not have adjustment screws. Clearance between lifter and valve is adjusted by removing the valve and grinding the end of its stem. This clearance (checked with a feeler gauge after the valves are lapped in) ordinarily should be .009 inch for the intake valve and .011 inch for the exhaust.

When reconditioning a two-cycle engine, scrape out carbon from the ports to prevent power loss, and see that the muffler isn't carbon-clogged.

Most cylinder heads are aluminum castings. Try the head on a flat surface to be sure it isn't warped before replacing it (if it is, rub it true on 240-grit abrasive paper taped to plate glass). Use a new asbestos head gasket. Lube the head's cap screws with graphite grease and tight-

en them gradually in crisscross order.

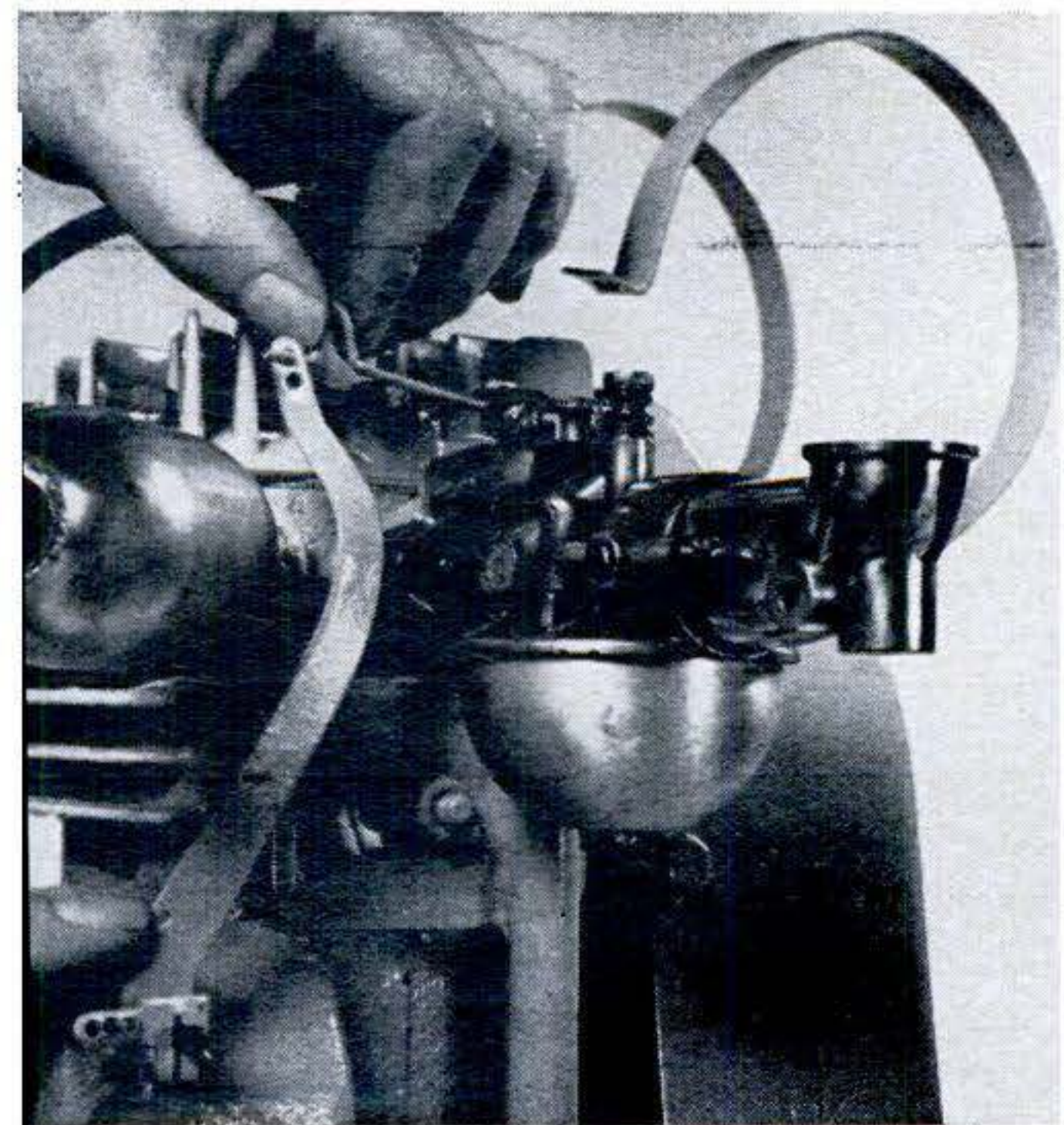
**Ignition.** While some larger one-lungers have camshaft-driven rotor-type magnetos, most smaller engines have flywheel-magneto ignition systems.

In a flywheel-type magneto, strong permanent magnets mounted on the flywheel's rim revolve past the armature of a stationary coil. As the magnets sweep past the poles of the coil's laminated-metal armature, voltage is generated in the coil's primary winding. Just as this voltage reaches its peak, breaker points opened by a cam on the crankshaft break the primary circuit; and the resulting sudden collapse of the primary winding's magnetic flux induces a voltage in the secondary winding high enough to fire the spark plug.

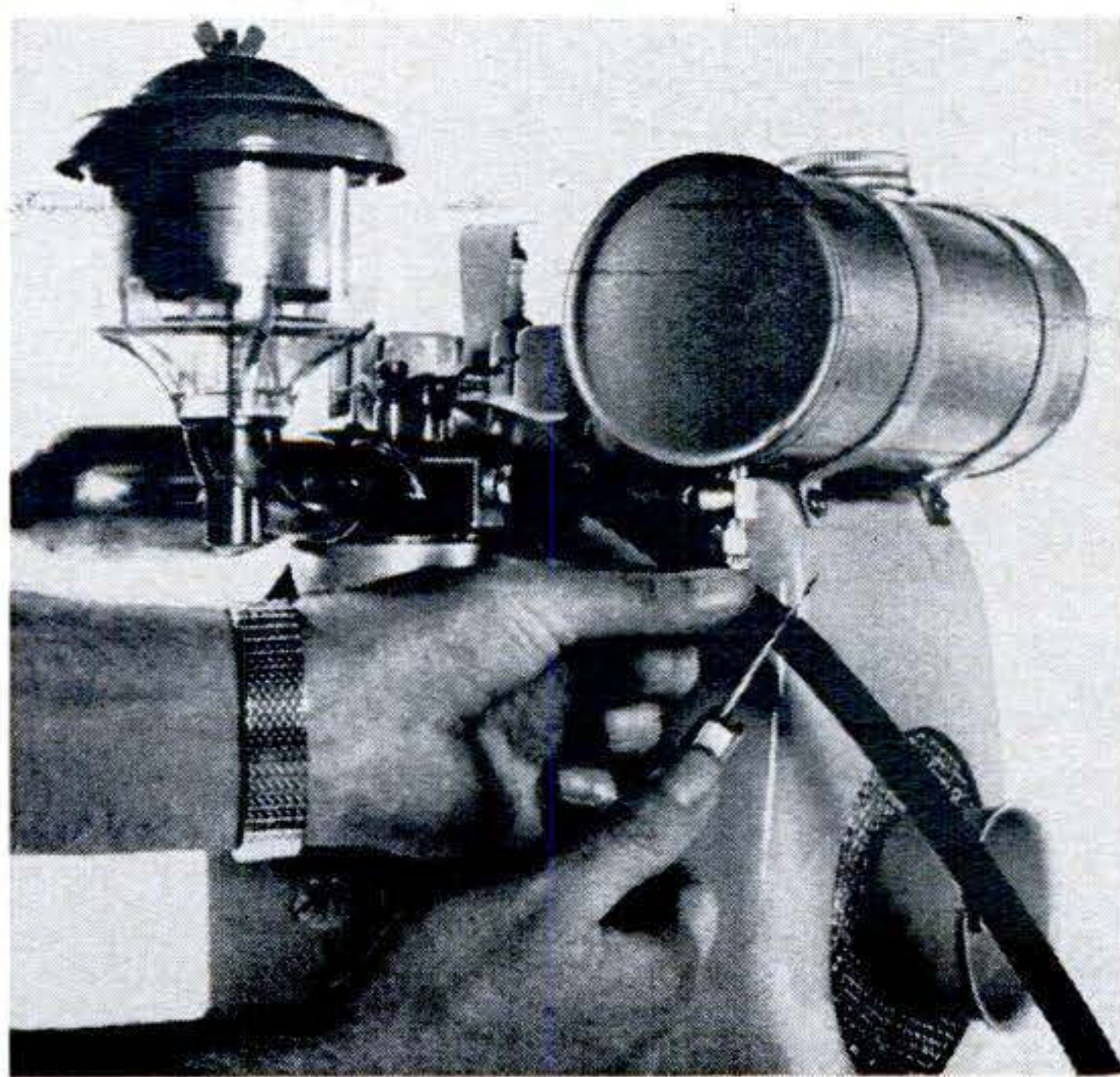
Though all flywheel magnetos work similarly, they vary somewhat in design. Breaker points may be either rocker or shuttle type. On some Briggs & Stratton engines the coil is mounted immediately above (rather than within) the flywheel of the unit.

But all are easy to trouble-shoot. Since coils seldom give out, failure nearly always can be traced to dirty points that won't close to complete the primary

*Continued*



**11** Governor may be centrifugal-weight (in crankcase) or air-vane (above flywheel) mechanism. When spring-loaded linkage is right, governor opens throttle as engine slows under load.



**12** You can substitute similar part from another make or model. Mower gas tanks, mufflers, air cleaners can be interchanged; Neoprene gas line is easier to install than metal tubing.



If your engine's a four-cycle, make these checks

**Is the gas okay?** That's not just a silly question. It's possible for an engine to be gas-starved even though there's some in the bottom of the tank. And what about the age of the gas? If stored for a long time, gas can lose some of its volatility, form gum and varnish in the tank and carburetor, or take up water.

**What about compression?** On older engines, pull starter to point of strongest resistance. Release cord and note whether engine snaps back. If you can't locate this position, or rebound is feeble, see if you're losing compression because spark plug is not tight. (This may not work with new "easy-start" engines.)

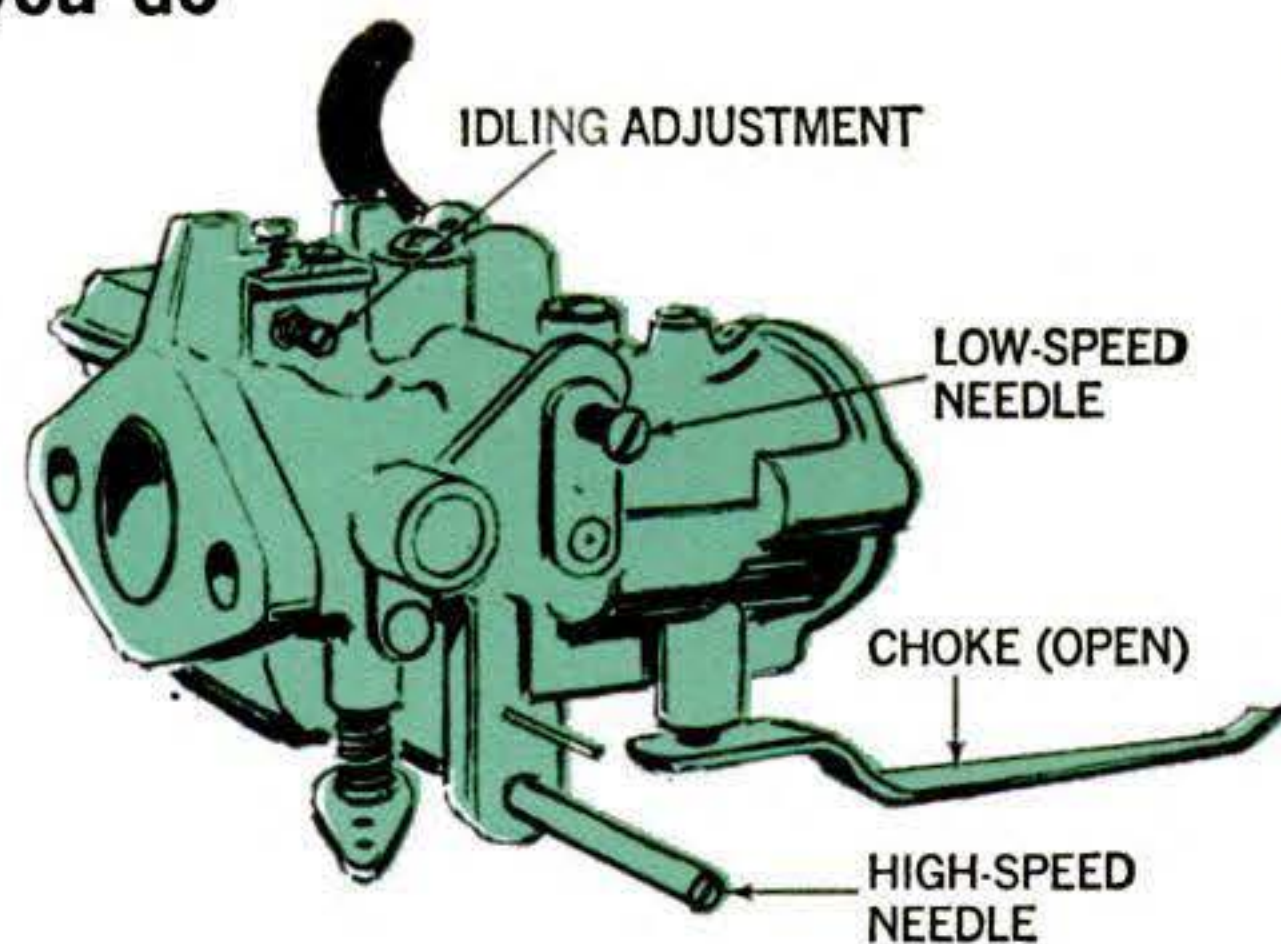
**What about the ignition?** Perhaps the plug or cable is wet. Dry it. If this doesn't work, remove plug. Check it by attaching ignition wire to the top. Hold plug's threaded body against clean metal on engine, with fingers away from the terminal, and crankshaft. A spark should snap across points. Install a new correctly gapped plug if porcelain of old one is cracked, tip fouled, or points are burned.



If your engine's a two-cycle, here's what you do

Make all basic checks as for a four-cycle—gas supply, compression, wet plug or cable, whether you get a spark from plug, and whether tank breather hole and supply line are open.

To clear flooded two-cycle engine, turn high-speed carburetor needle shut, remove plug, and crank until vapor stops coming out of hole. Overchoking fouls plug because of oil in fuel. So clean and dry it. Reset high-speed needle and try engine again. Plugs with cut-back electrodes resist fouling best.



circuit. Flex-stoning and regapping the points (usually to .020 inch) probably will restore normal operation. When it doesn't, the points' condenser (usually .20 mfd.) and the coil's spark-plug lead should be replaced.

An air gap of .010 inch between the flywheel's rotating magnets and the end

faces of the coil's armature is usually sufficient.

On most small engines ignition timing is fixed (at about 21 degrees before top center) and needs no adjustment.

**Carburetion.** To check out a one-lunger's fuel system, just trace the flow of gas from the tank through the carburetor and



# WHEN A ONE-LUNGER WON'T RUN

**Has the engine been flooded?** It's easy to do this by overchoking, especially while trying to start a cold engine. If you suspect this to be true, crank the engine with the spark plug out until vapor no longer comes out the hole. Then try the engine again.

**What about carburetion?** Remove spark plug, hold thumb over open hole, and crank engine a few turns. If fuel is reaching cylinder, thumb should become moist with gas.

Next check the tank. Wipe the cap clean, remove it, and blow through the pinhole vent. Clear with a pin if clogged. Inspect tank; rust in it could have clogged gas line or carburetor. On float-feed engines, disconnect gas line at carburetor. If gas flows, trouble is in carburetor. Your next check is there.

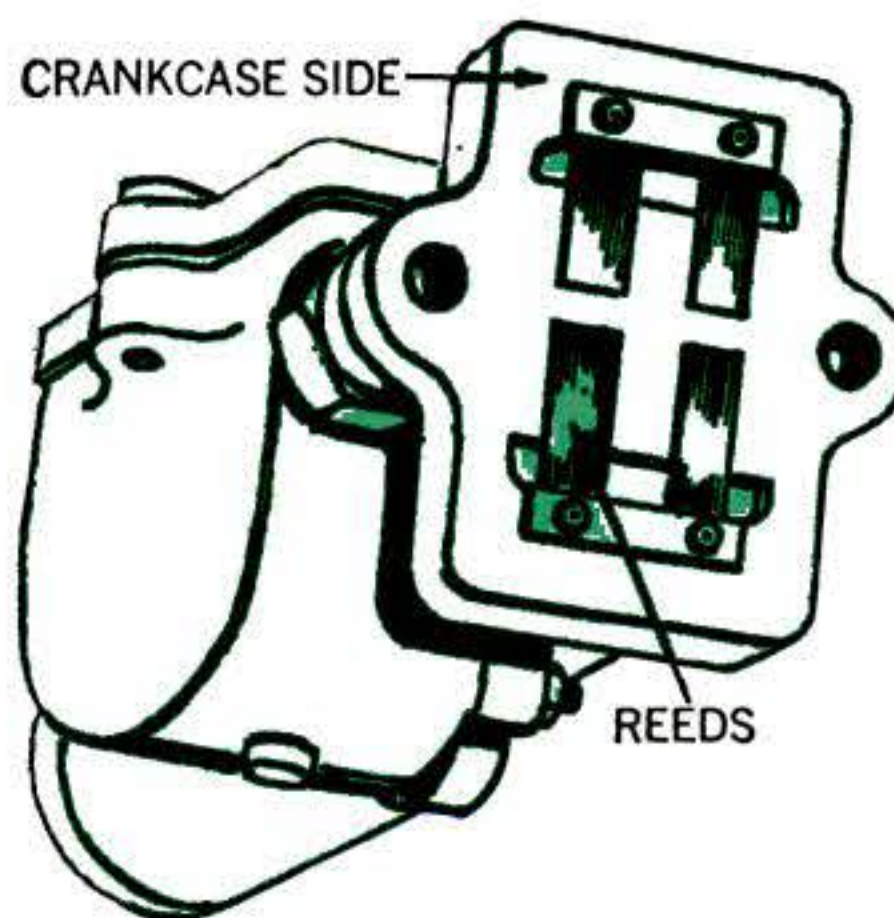
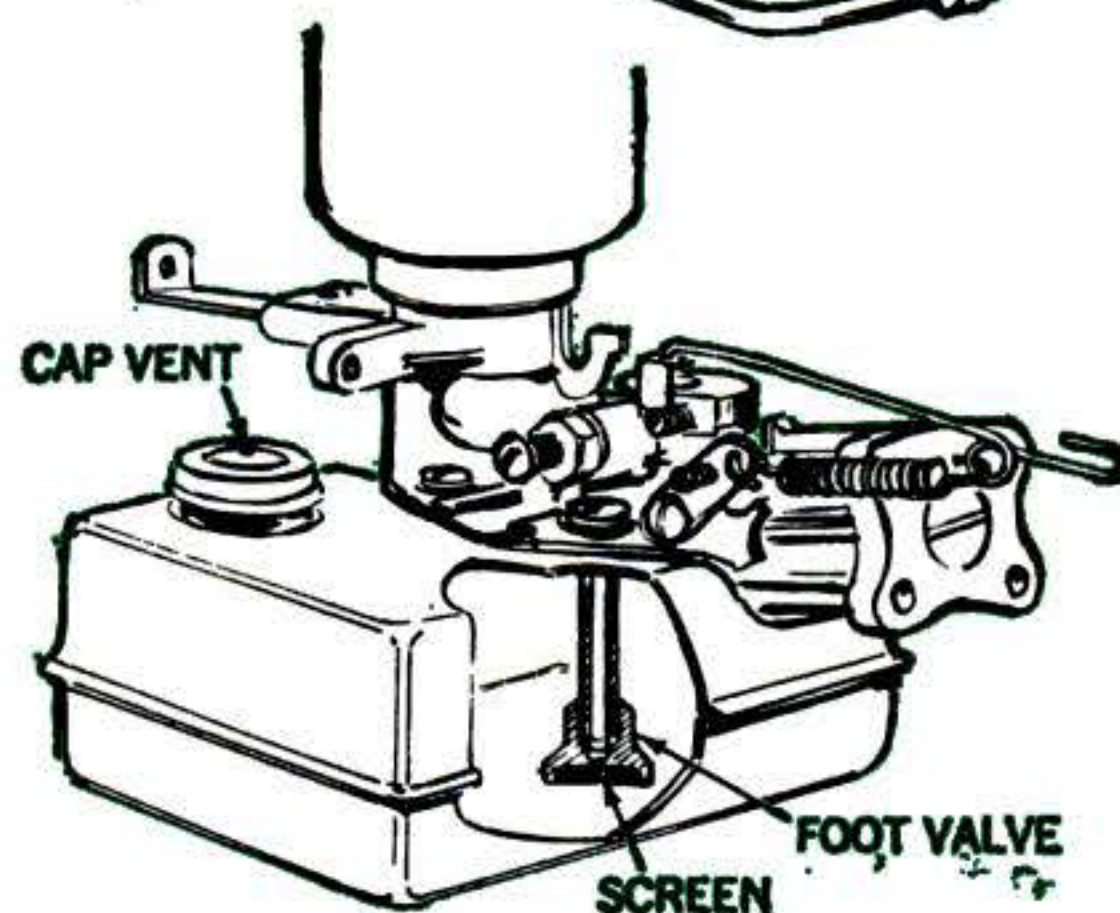
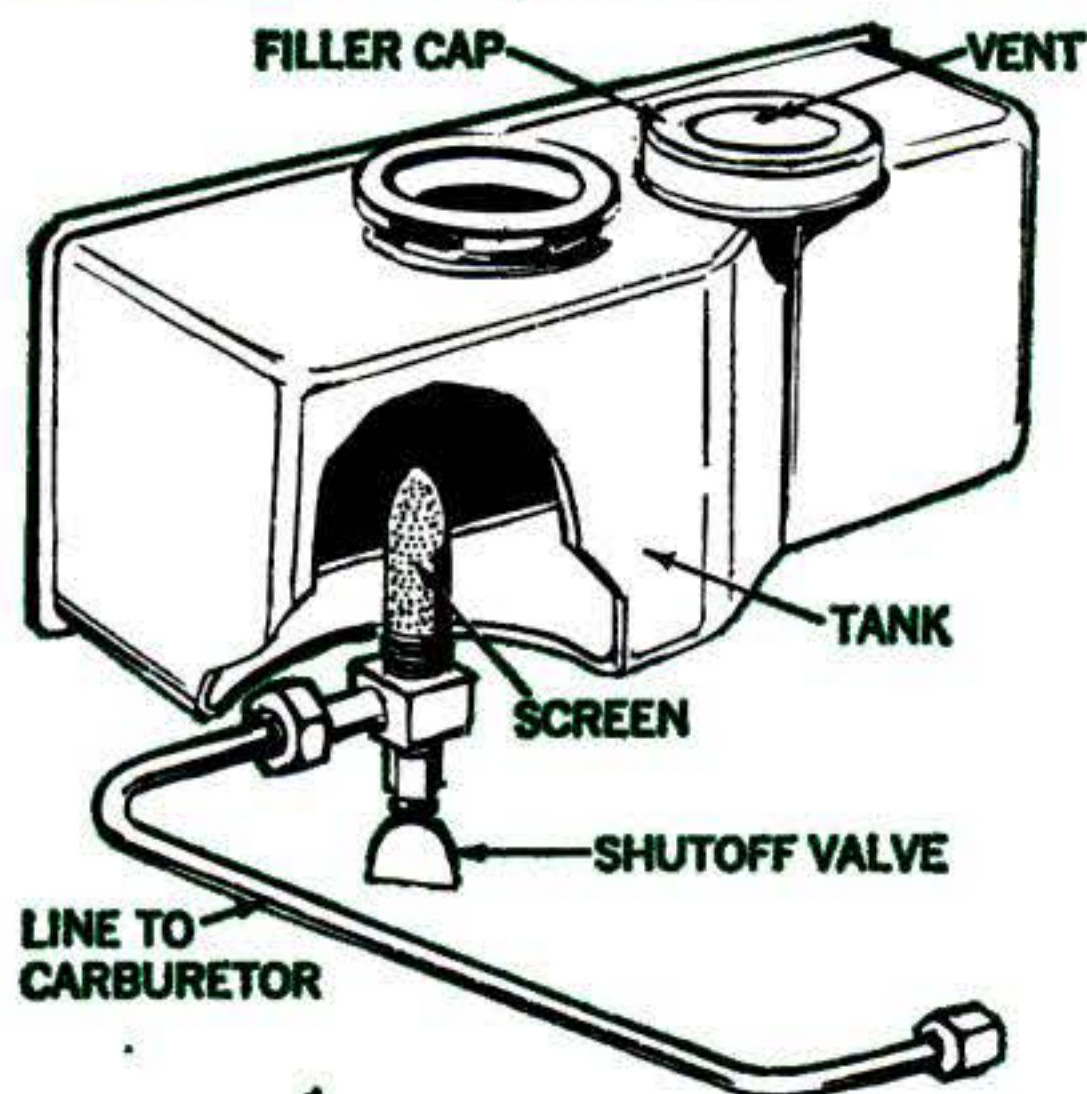
On suction-feed engines, detach carburetor to remove foot valve inside tank. If screen or valve is clogged, soak it in lacquer thinner. You should be able to blow through from lower end of valve but not from top. If you can blow both ways—or neither—get a new foot valve from your authorized mower dealer.

To check carburetion, remove main or high-speed needle. With tank valve on, gas should flow out. If gas has been left in carburetor for a long time, oil, gum, or varnish may have clogged it. Pour in lacquer thinner. If carburetor checks out but gas is not reaching cylinder, inspect gaskets and seals at cylinder, crankcase, carburetor joints.

**What about the reed valve?** This is a plate between carburetor and crankcase, with flexible metal reeds that open to let fuel charge into crankcase but close to let piston force it into cylinder. Remove bolts or nuts holding on carburetor, being careful not to damage any gaskets, and lift off carburetor and reed plate. See that reeds are not blocked by dirt, or rest more than a hairline off their seats. If you can see light under them, install a new plate. In doing so, remember that reeds must open inward, toward crankcase.

look for trouble—obstructions, gas or air leaks.

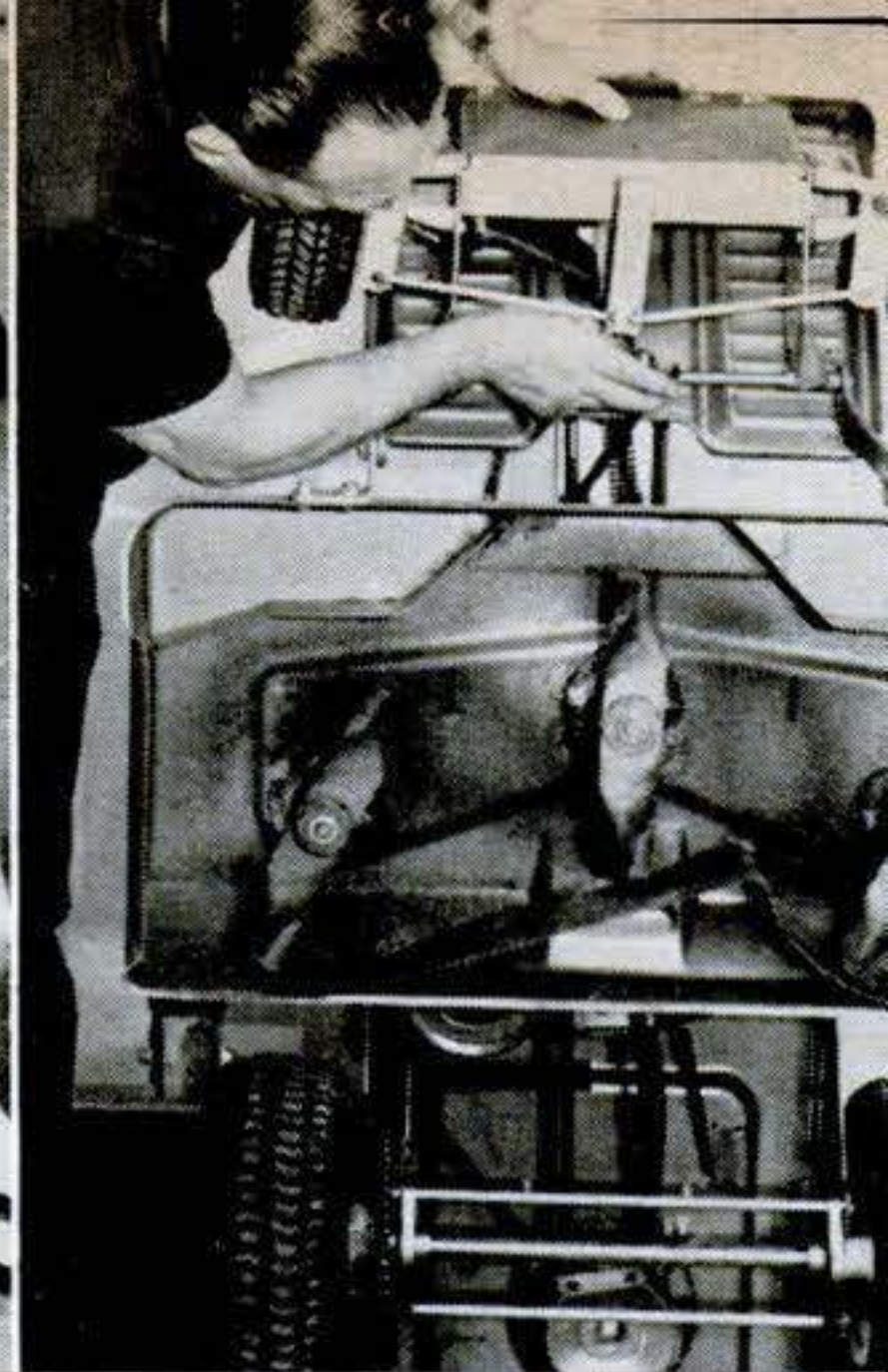
All small-engine carburetors simply spray gasoline into the air gulped by the engine. They differ, however, in the way fuel is fed to the orifice, or jet, in the venturi. A one-lunger may have either a suction-feed or a float-feed carburetor.



On an engine with a suction carburetor, the tank is located directly beneath the carburetor. Air flow through the carburetor's venturi sucks gas from the tank up a standpipe and through an orifice into the air stream. A brass needle valve limits the rate at which fuel will be

*Continued*





## What to do about your mower's running gear and cutting machine

**Unseen grease fittings** like these on the underside of Gravelly cutter deck should not be overlooked. Rotary hub without a fitting should be taken apart, washed, and re-packed with grease once a season.

A modern riding mower usually has an axle differential; some have planetary reductions in wheel drives. At least once a year, clean all such parts and their housings until they shine. Lubricate well.

Up-end a small rider before fill with gas and oil, for access to nuts and bolts and to make adjustments on the underside. Vibration of the engine takes an unseen toll here, loosening many of the parts.

sucked from the orifice into the air stream.

On an engine with a float carburetor, the tank is mounted somewhere above the carburetor. Fuel gravity-feeds down a gas line, through a float-controlled inlet valve and into a bowl under the carburetor body. As air flow through the venturi sucks fuel from this bowl, the float valve opens and refills it. (In a few carburetors a vacuum-operated diaphragm rather than a float opens the inlet valve.)

Most float carburetors (and some suction types) have two orifices discharging

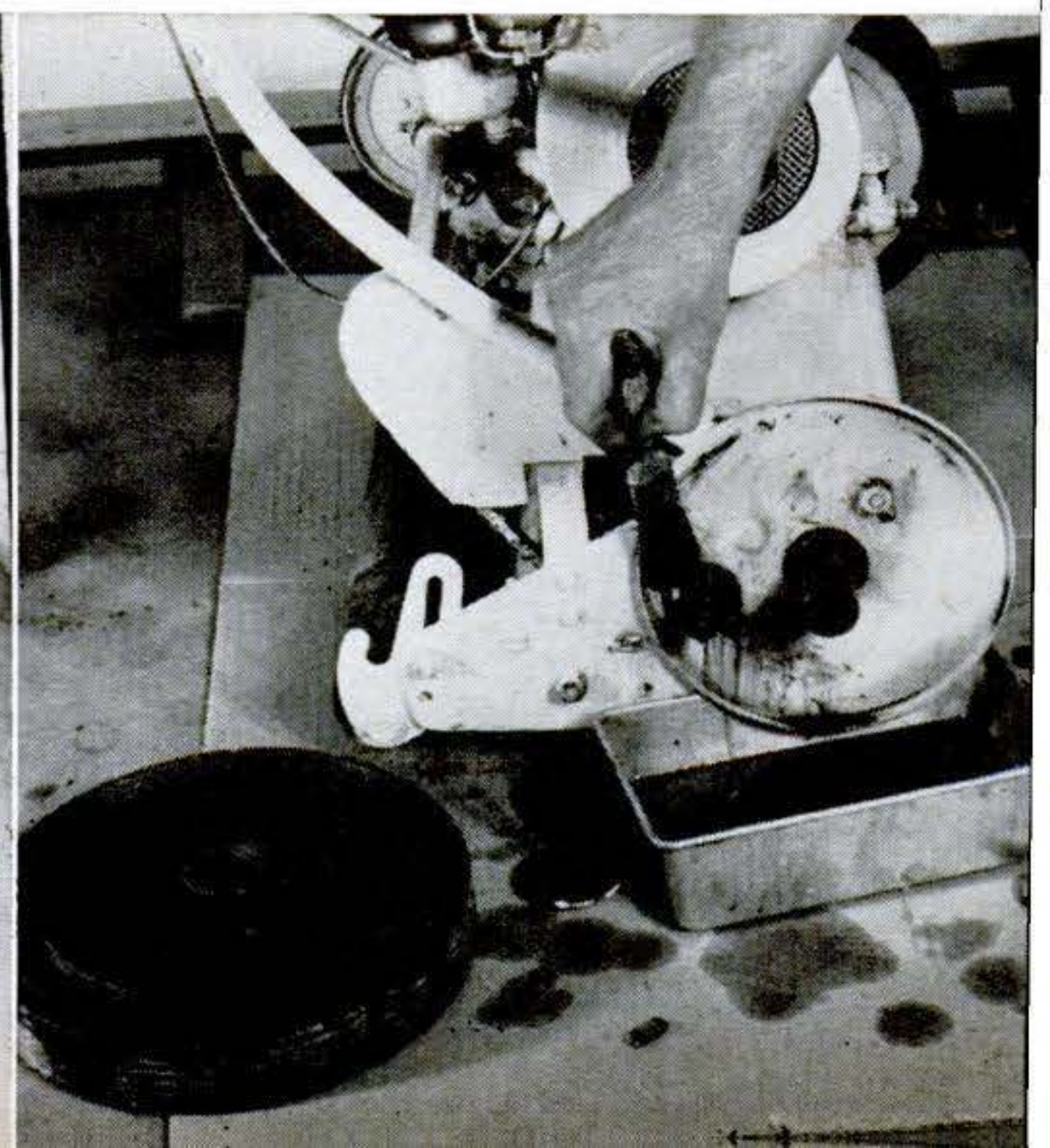
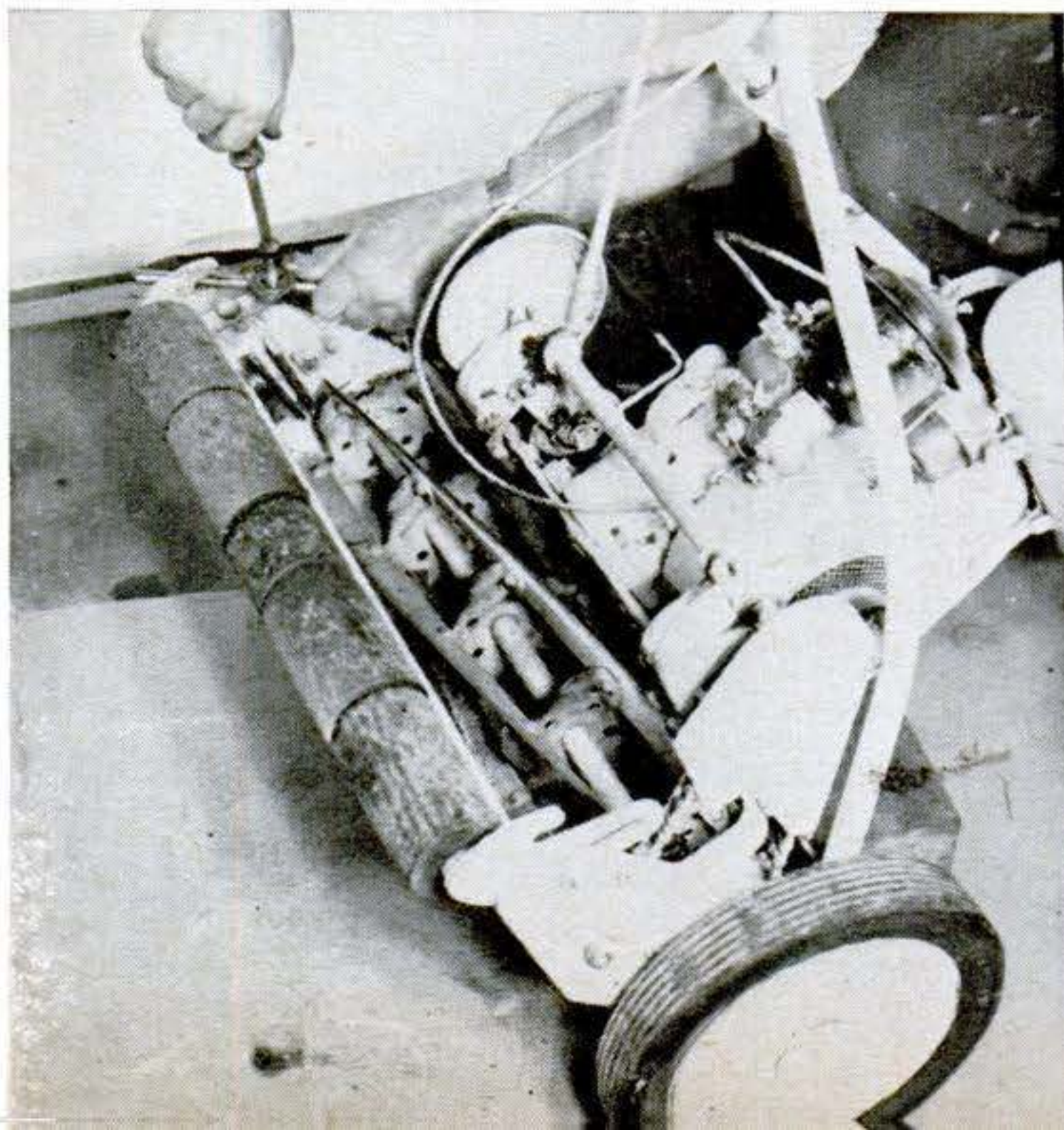
fuel into the venturi, each with its own needle valve. One supplies the fuel the engine draws when idling; the other the fuel for high-speed, full-power operation.

Usually you can scrub up a dirty carburetor without removing the throttle and choke butterflies. Use carburetor cleaner (first removing any nylon parts) to dissolve gum, fine abrasive paper to scour out corrosion. Worn needle valves should be replaced.

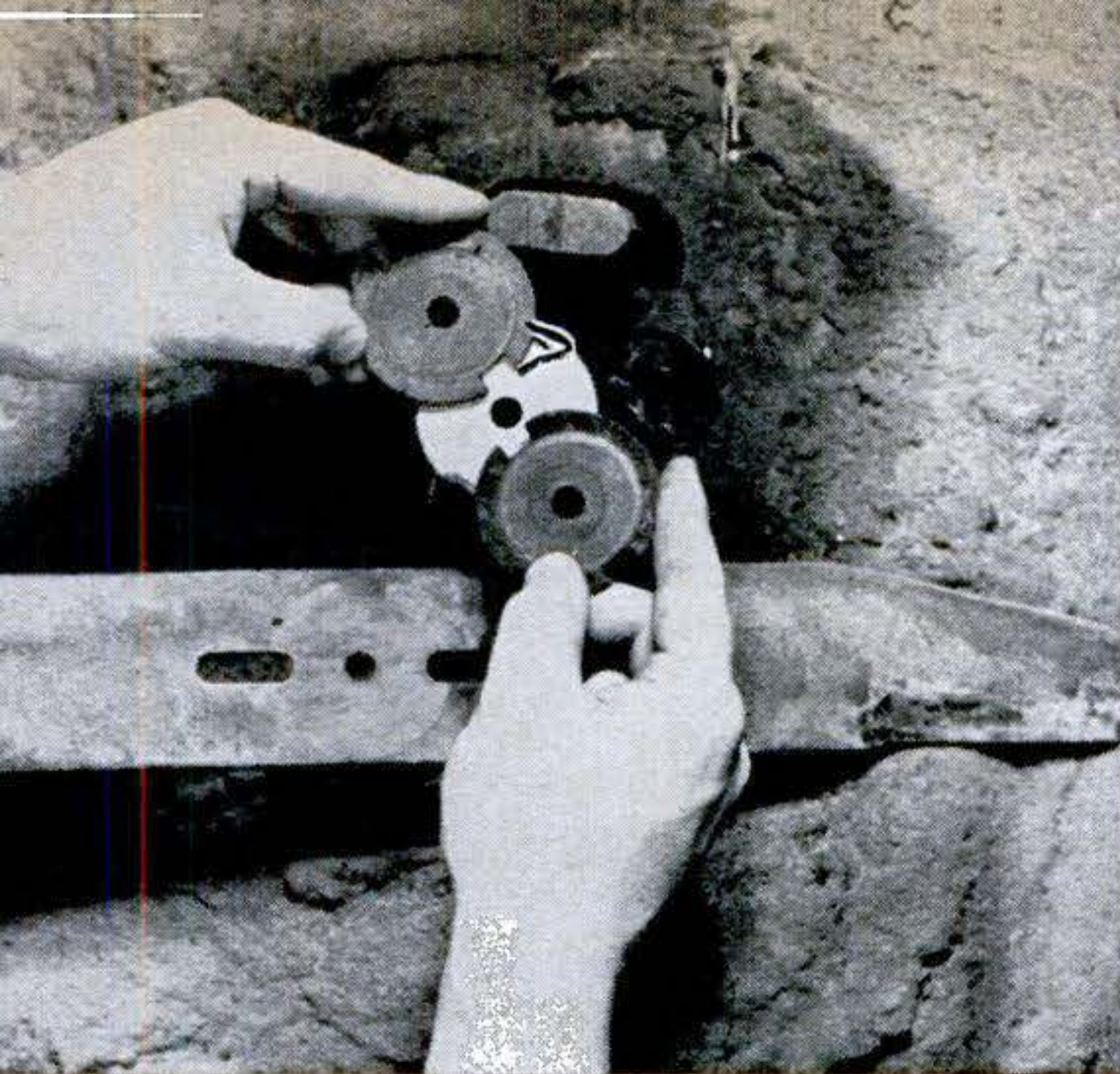
When cleaning a suction carburetor, be sure that the standpipe's one-way foot

**Two maintenance jobs** for reel mowers. Rust often freezes the screws that adjust cutter height. When this happens, soak them free with penetrating oil and run them through a threading die so precise

adjustment and locking will be easy. Because considerable dirt always collects on the drive pinions and wheel bearings, it's advisable to remove wheels and wash all parts in solvent and apply new grease.







**PS Extra: POWER-MOWER CARE**

**to keep them always in tip-top shape**

Sharpen rotary blade frequently, remembering to remove and tape spark-plug wire for safety before up-ending mower. If you remove blade, make careful note of the stack-up of spacers and washers. Washers shown let blade slip if it hits an obstruction. In resharpening, maintain original blade angle.

Always keep blade in balance. Balancer above consists of nail driven through board and tire-valve cap pressed into blade bolt hole. Blade pivots on nail point placed inside conical-shaped valve.

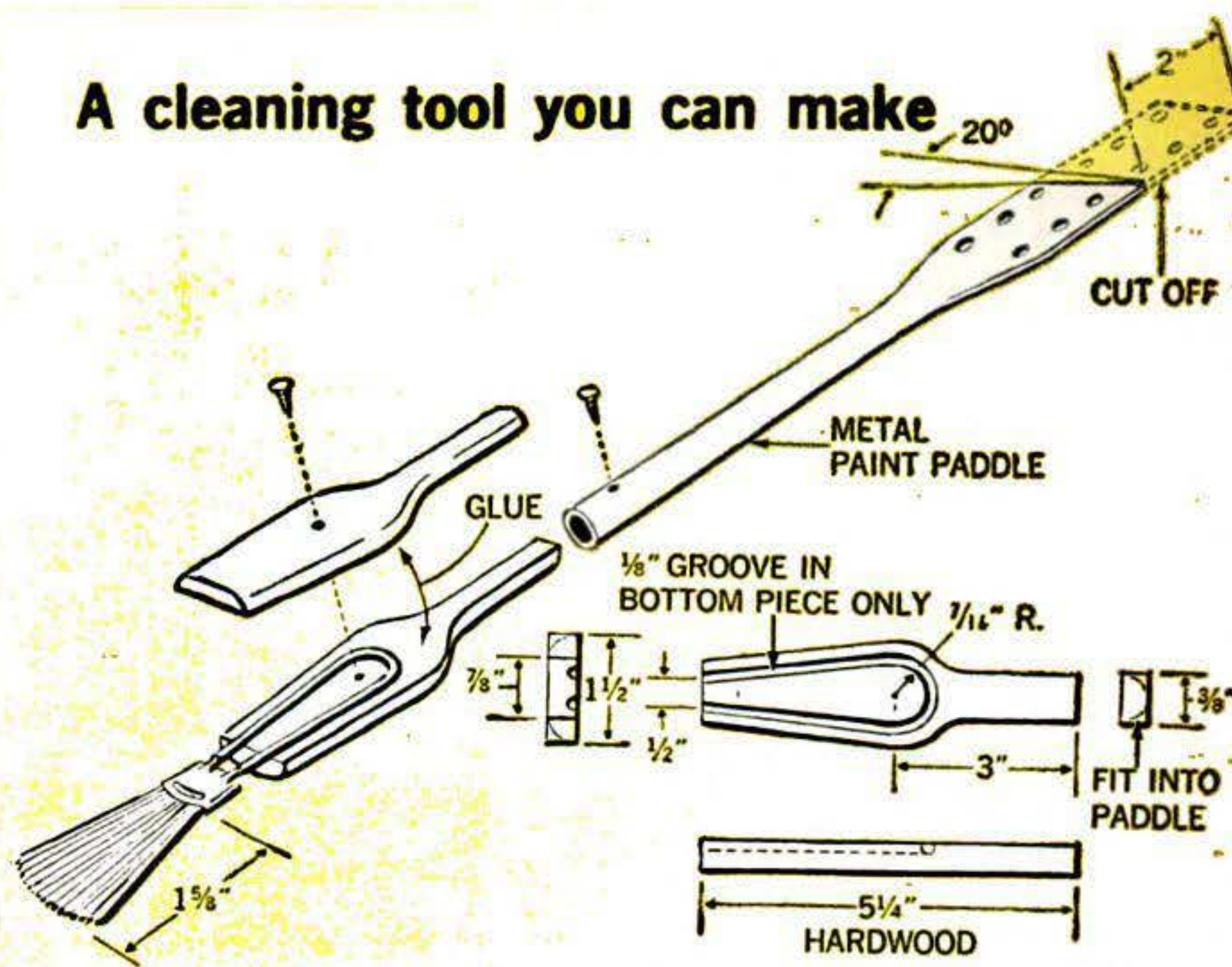
valve works freely. When cleaning a float carburetor, see that the float operates without sticking and that the valve pin seats tightly as the float lifts to horizontal. Use a new cork bowl gasket.

Adjust the needle valves with the engine running. If the carburetor has a single needle, first unscrew it enough to permit the engine to start (usually 1-1½ turns), and when the engine reaches operating temperature, adjust the needle for smoothest acceleration as the engine is throttled. If the carburetor has two needles, open both one turn, adjust the high-speed needle for best acceleration under load. Top speed usually shouldn't exceed 3,400 r.p.m.

**Repair work.** Engine parts that need repair often can be fixed with hook-or-crook tinkering or a bit of welding. But before tackling extensive repair work, particularly on a five-hp. or larger one-lunger, consult a service manual. You can find manuals covering most makes in big-city public libraries, or ask a local

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**A cleaning tool you can make**

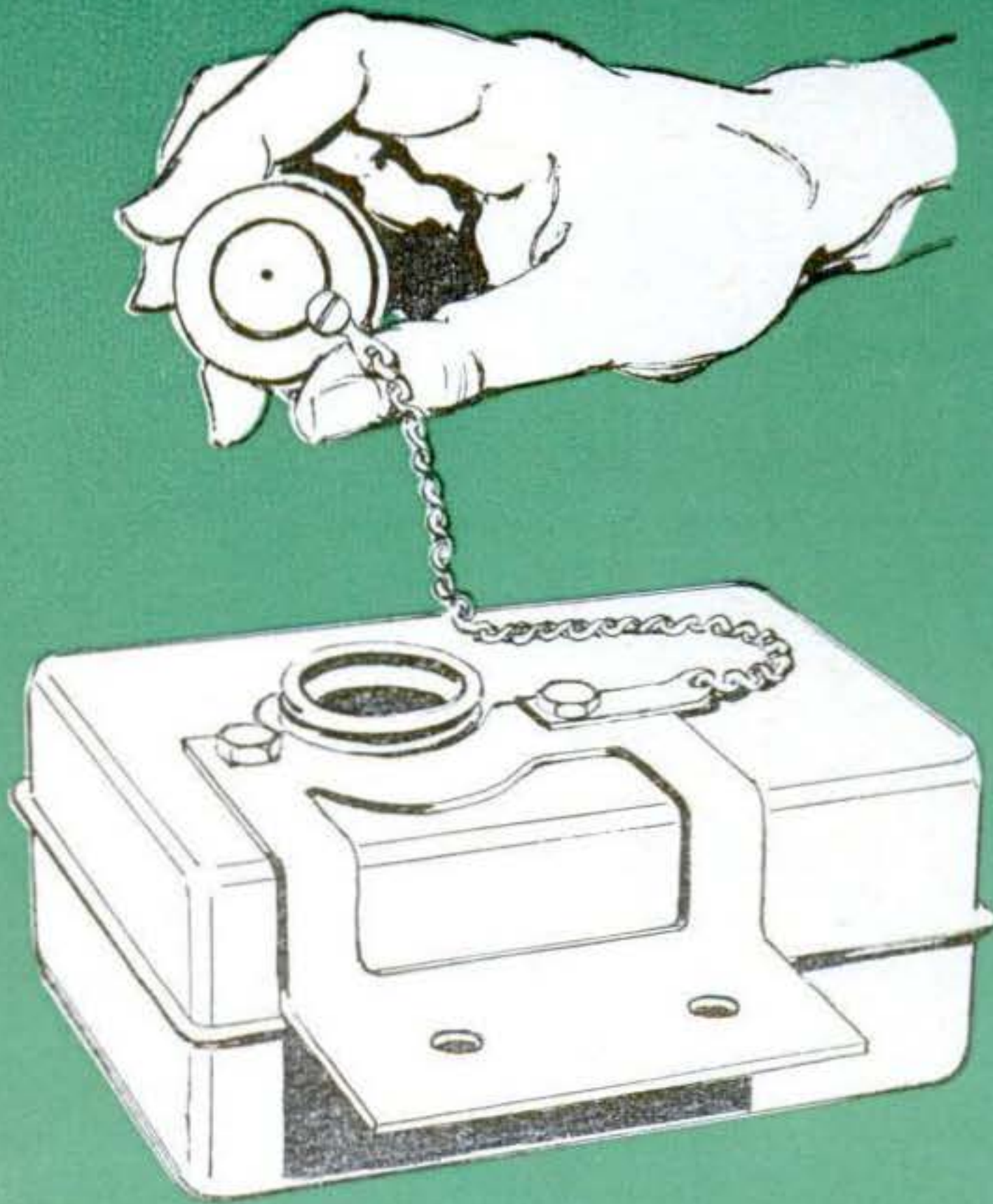


Cleaning grass cuttings from the underside of a rotary after each mowing is a good rule. The homemade tool shown here makes the job easier. It's a scraper on one end (a metal paint-mixing paddle), a small wire brush on the other. Both are standard hardware-store items. Sketch shows how to assemble. Brush is handy for cleaning dust and grass particles from the engine, particularly around carburetor air intake.

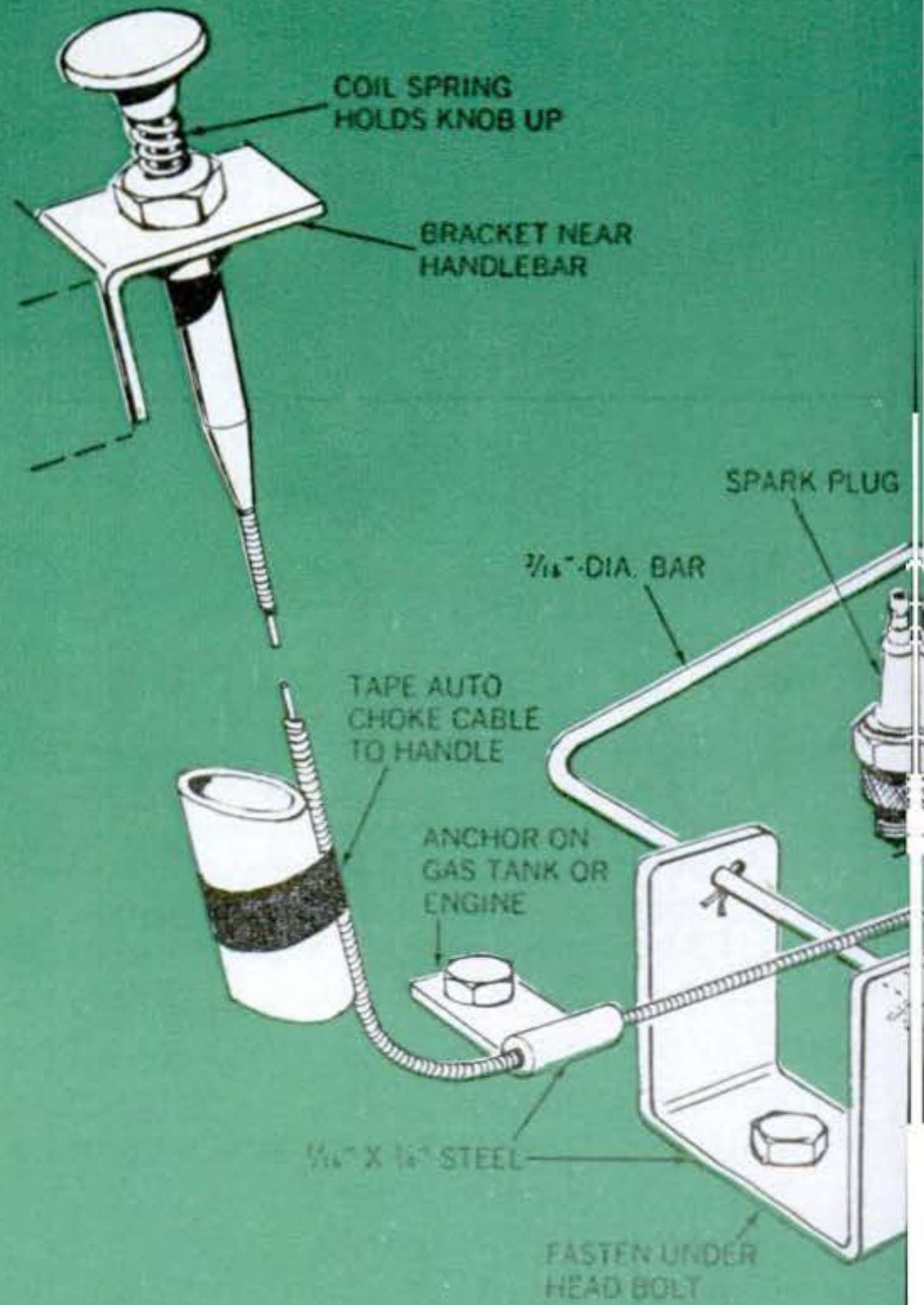


## Additions you can make to just about any type of mower to get

**Tie down that gas cap!  
Install a remote-control  
shutoff for the engine**

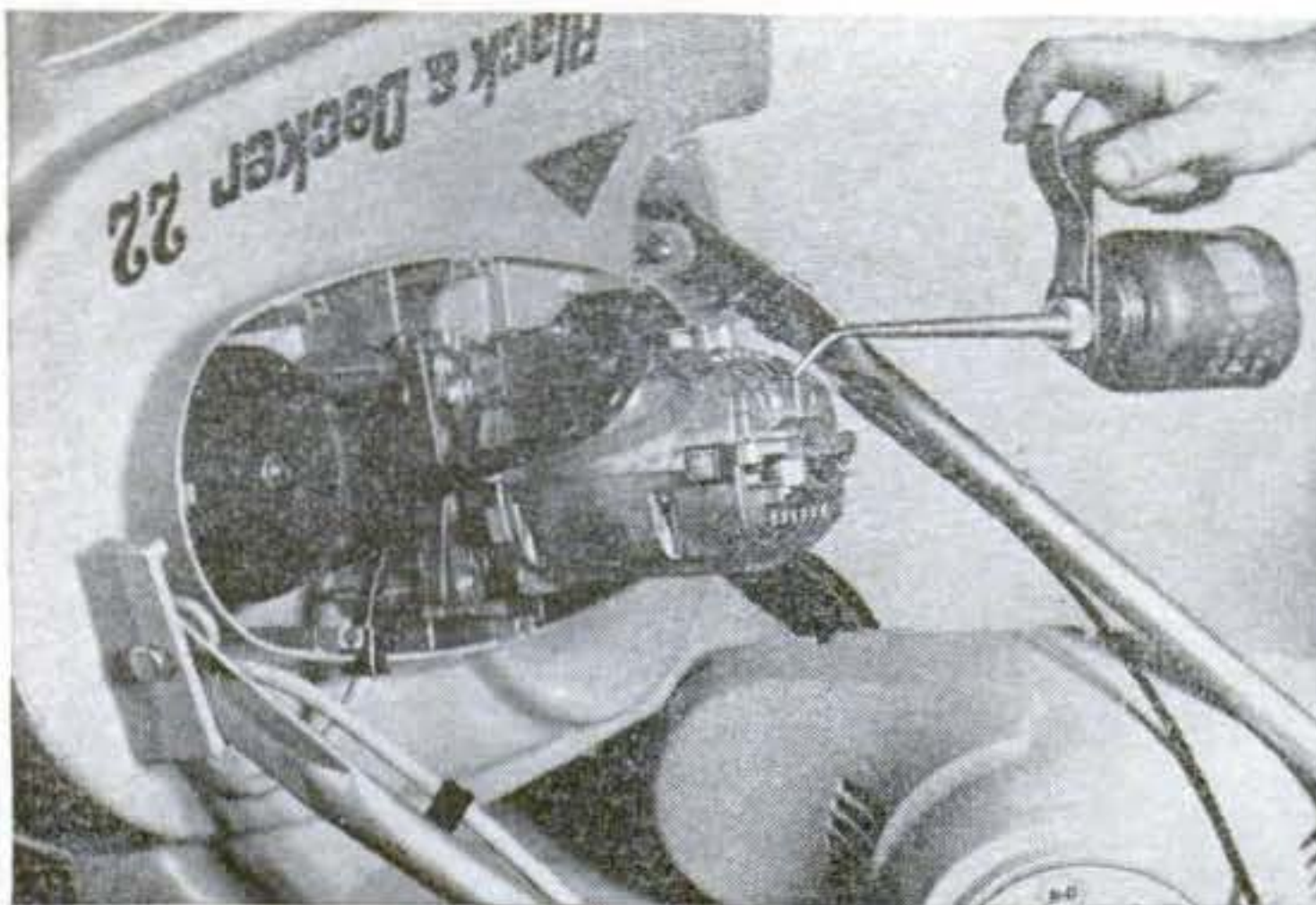


Lose your gas cap? Some people do. But you won't if you bolt a bit of light chain to the tank and run it to a nut soldered to the cap top. But be careful that you don't obstruct the air vent in the cap.

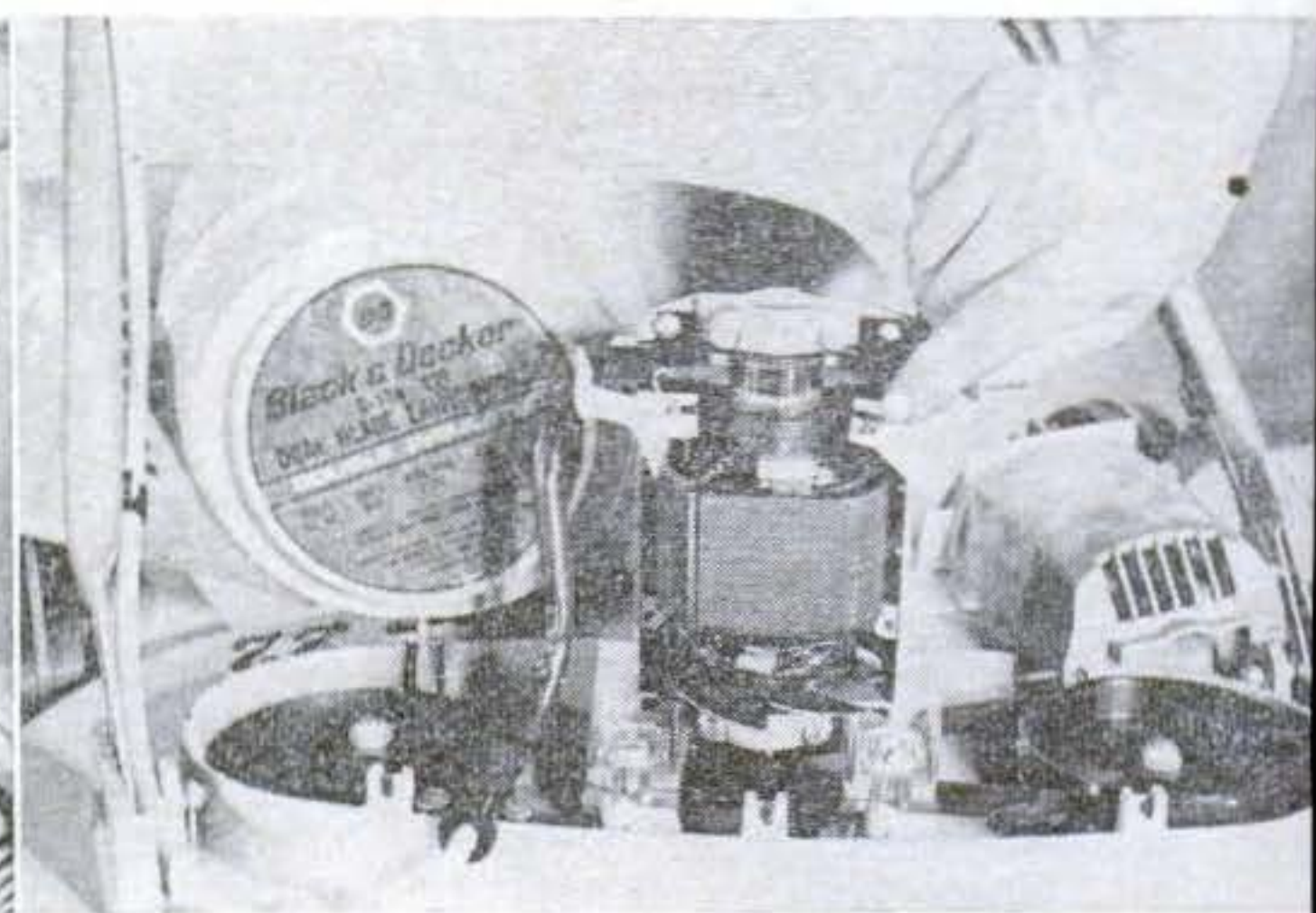


Add a pushbutton shutoff. Why walk around from the handlebars of a walking mower to shut off the engine? Here's a simple control you can install to short out the engine, and the parts are inexpensive.

## How to get the best results from an electric mower



**Keep them oiled!** Makers of electrics will tell you that this is the most important maintenance rule for their machines. But be sure to do the oiling as maintenance book prescribes. Never use more than a few drops. The book says five in above case.

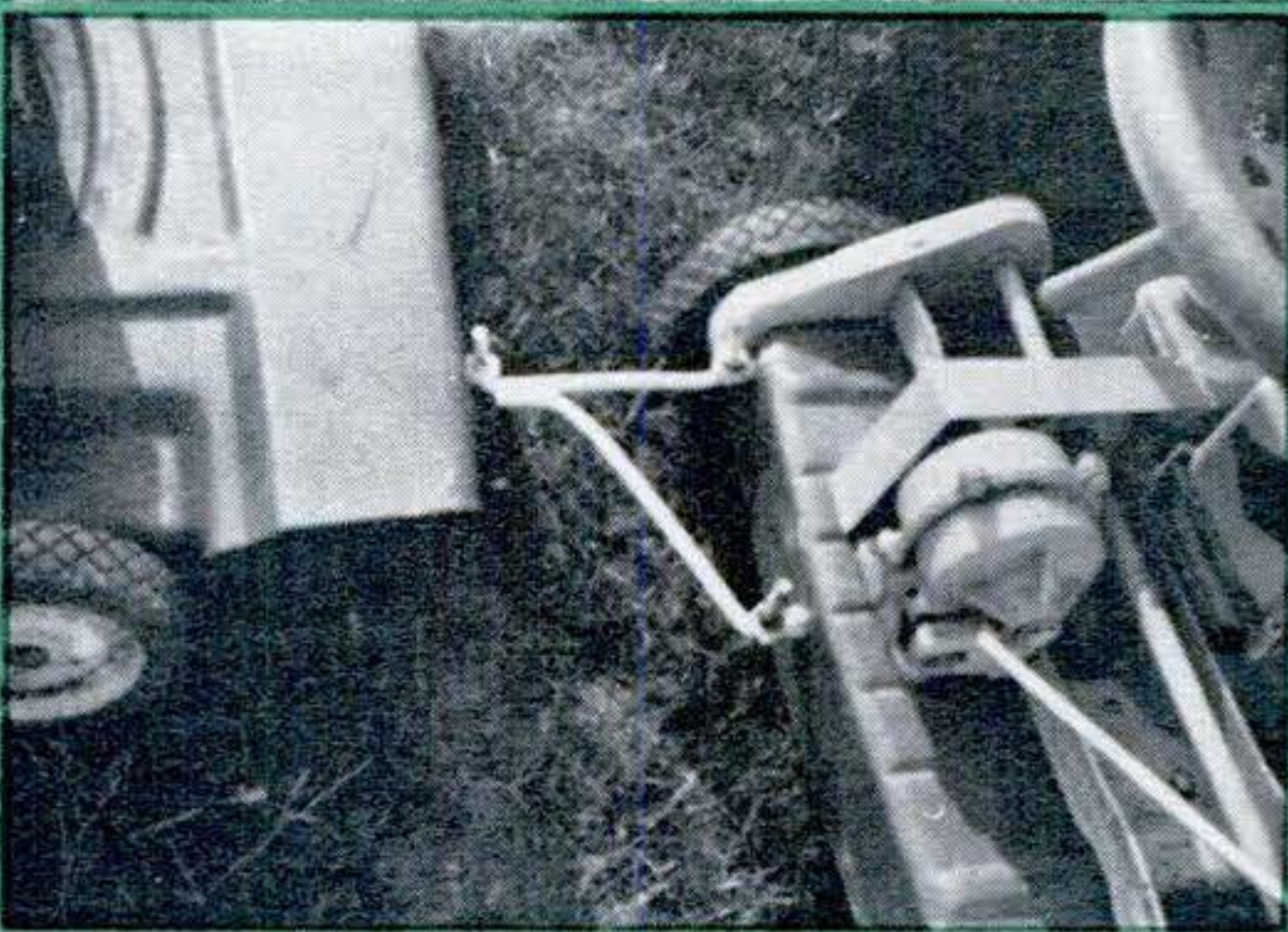
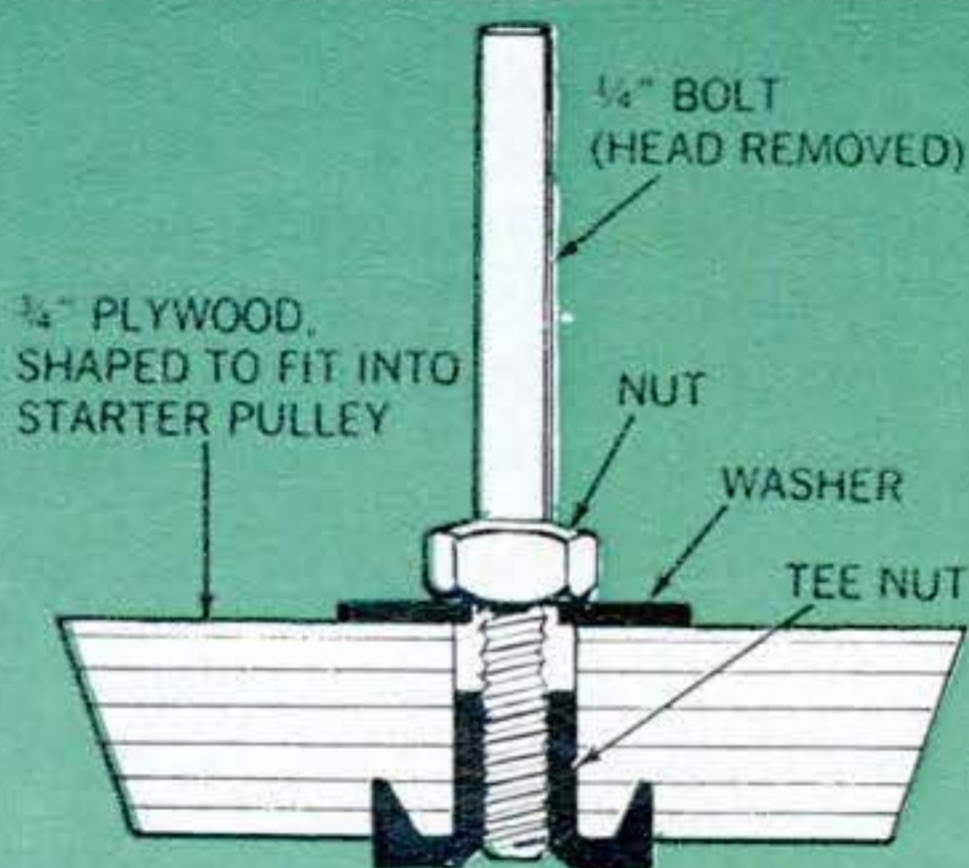


**Blow dust and dirt out of the motor at least once a season and check out the brushes and commutator for best service. Replace brushes if worn. Black & Decker machine opens up by pulling four screws. Keep the blade sharpened as for a gas mower.**



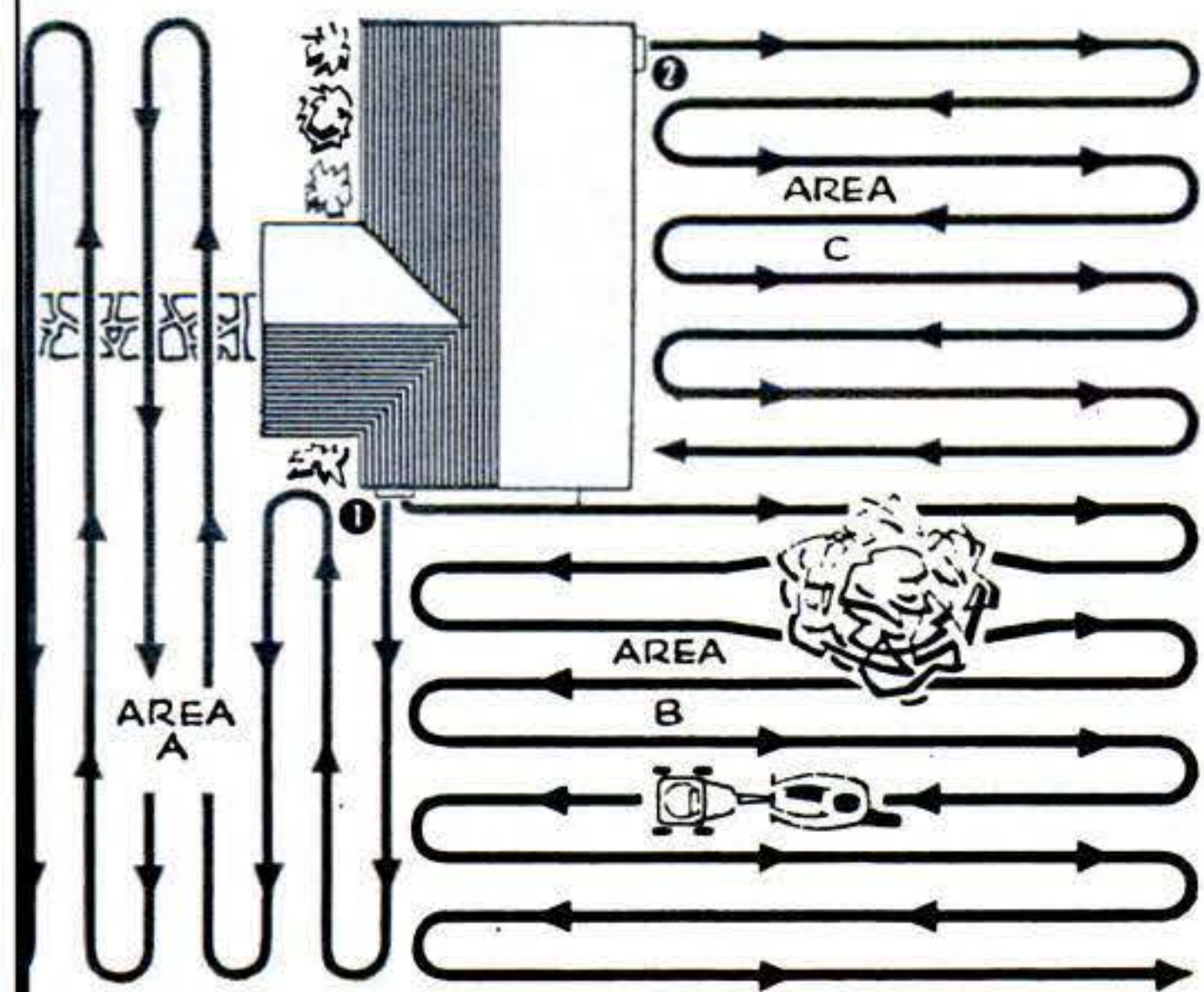
better lawn service from it

**PS Extra: POWER-MOWER CARE**



Electric-drill starter can give you a lift if your mower has one of those old-style, rope-pull starter pulleys. Make this clutch to fit into the open end of the pulley—and then use your electric drill to crank the engine. A 1/4" drill will readily start an engine of up to two hp. It will make the mowing chore easier.

**Double your swath**—if you own a riding mower and also a push-type rotary, you can speed up the job of lawn cutting with this simple three-point hookup. The hand mower quickly detaches for trimming.



Outside outlets strategically placed are important in getting the most out of an electric. Here's an example of a good mowing pattern. Note that from outlet No. 1 you can mow areas A and B, and from No. 2 area C. Always move away from outlet.

parts dealer to let you see one of his manuals.

A few repair notes:

- A scored cylinder can be honed oversize with the same tools and procedure used to recondition auto-engine cylinders. Reaming the cylinder's ridge permits removing the piston. After rough- and finish-honing the bore (use kerosene for a smoother finish), fit new oversize rings. Insert the rings in the cylinder, check their end gaps (which allow heat expansion) with a feeler gauge, and correct the gaps with an ignition-point file. The top ring usually should have a .010-inch gap; lower rings, .008. Also check the ring's side clearance in the piston grooves (to leave them free to spring)—.002 inch is sufficient.

*Continued*



## Take time to be safe!



Look behind before you back! The legend for this Outdoor Power Equipment Institute photo calls scene above "most tragic of all."



Know all hidden hazards of your property if you operate a riding mower or tractor. Upset like this is a potential widow maker.



Fired up! This man forgot one of the first rules of mower or tractor operation. Never refuel if mower is running or engine is hot.

## PS Extra: POWER-MOWER CARE

- Most small four-cycle horizontal-shaft engines have splash-type oiling. Many four-cycle vertical-shaft engines, however, have gear- or plunger-type oil pumps. Be sure that the oil pump works properly if the engine has one. A malfunctioning pump is death on an engine.

- Factory-replacement bushings for sleeve-type main bearings must be pressed in and finish-reamed one at a time, a job that takes a special aligning reamer. It's sometimes practicable instead to turn new bronze bushing on a metal lathe.

- Some ball- and roller-type main bearings are press-fitted on the crankshaft (by heating the bearings to 300 degrees in oil); others are pressed into the encasement or retained with snap rings. When a pressed-in bearing is difficult to remove, heat the encasement on a hot plate to free it. Ball bearings should be installed shielded-side in.

- Remember when you replace the crankshaft of a four-cycle engine to match the index marks on the valve-timing gears.

- It's advisable, when replacing bearings, also to renew the crankshaft oil seals—usually metal-backed Neoprene O rings. Oil the new seals and slide them on the shaft with care to avoid tearing them.

- When reconditioning a two-cycle engine, be sure that both the crankshaft oil seals and the reed-valve unit under the carburetor are airtight, since the crankcase must hold compression on the downward stroke of the piston.

- A four-cycler usually has a crankcase breather with a flutter valve opening into the valve compartment. This valve maintains slight vacuum in the crankcase to minimize oil leakage.

Given reasonable maintenance, a good mower will last a lifetime. And that's where many home owners slip up—which is a shame. A mechanically minded man would have to look hard to find an activity that pays off better: Just a few hours each season will not only keep your machine in good running order, but save you the pain in the pocketbook of buying a new one every few years.

PS





# Shop Talk

By ROBERT P. STEVENSON

## What does a cement worker do with a cheater?

A tool bible for men who work in the trowel trades—masons, bricklayers, and plasterers—is the catalogue that comes annually from Goldblatt, of Kansas City, Kans. Leafing through it, I always marvel at the strange and unusual tools these men use. One really stumped me when I first saw it. What could be the function of a “cheater”? How does it differ from a groover, which it somewhat resembles? I put these questions to Ted Isaac of Goldblatt. A groover, as I already knew, makes grooves as deep as  $\frac{1}{2}$ ”, 1”, or  $1\frac{3}{8}$ ” in the still-wet slab. These grooves serve as relief points for stresses that develop. If the slab fractures, it does so along these lines—and no problem is created. A cheater, Mr. Isaac tells me, makes grooves only  $\frac{1}{8}$ ” deep. It’s used just as a decorative tool; the grooves aren’t meant to relieve stresses.



## How to know which sandpaper to use where—and when

A friend at 3M has suggested that POPULAR SCIENCE home shoppers might like to have a free copy of the 3M Sandpaper Grit Guide for their shop wall. If you do, write to Grit Guide 202, Abrasives Div., 3M Center, St. Paul, Minn. 55101. Supply is limited.

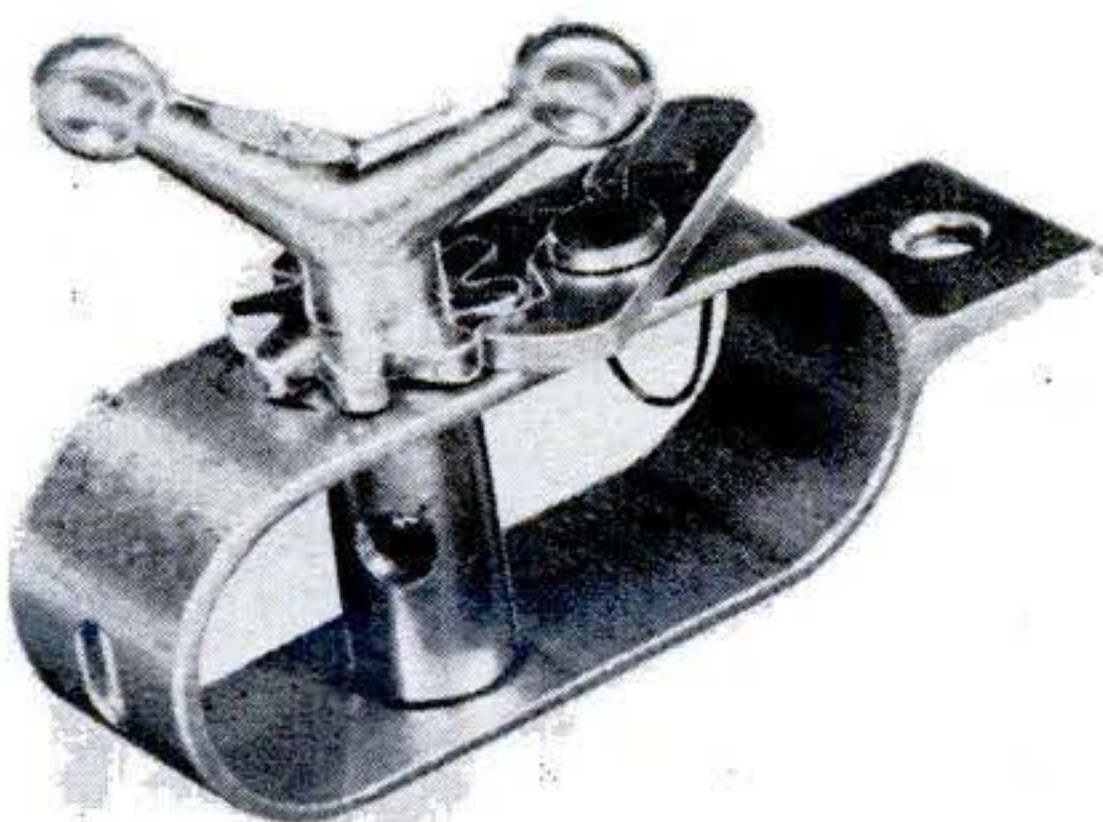
## Book worth noting: “Small Tractor Service Manual” by Technical Publications

Specs and information about almost all makes of modern garden tractors are included in this 132-page book. In addition to data on running gear and power trains, there’s a good section on the engines used—Briggs & Stratton, Kohler, Tecumseh-Lauson, Wisconsin—and another on accessories such as starters and hydraulic lifts. Price is \$5 from Technical Publications, 1014 Wyandotte St., Kansas City, Mo. 64105. The same company also publishes “Small Engines Service Manual.”

## Noteworthy products for use around the house and yard

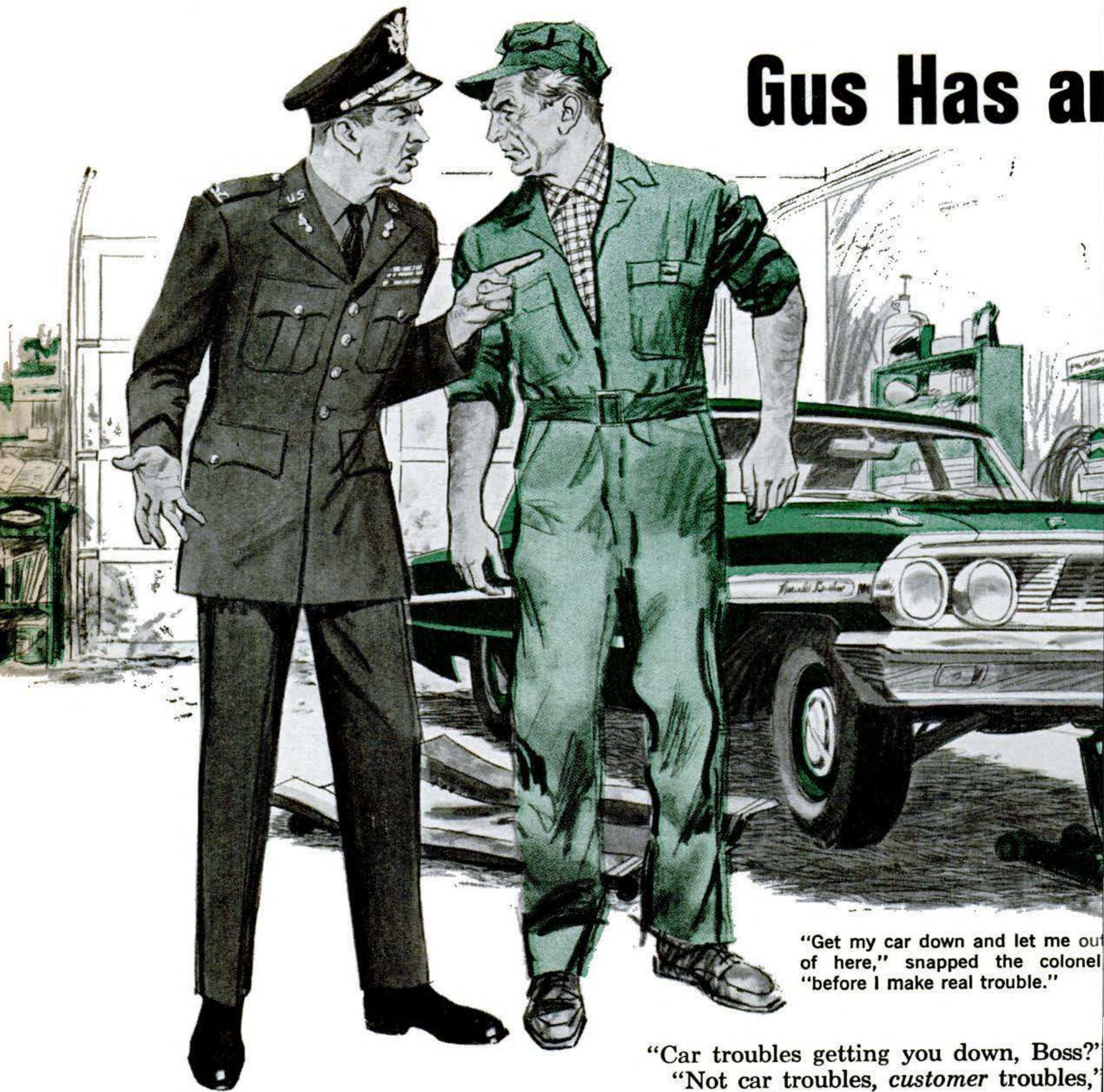
Mobil Oil has introduced a new oil especially for four-cycle lawnmower engines. Unlike the automotive oils normally used, Mobil spokesmen explain, the new formulation is carefully matched to the operating characteristics of the lawn machines . . . A new tiny heat fuse is offered by Littlefuse, 800 E. Northwest Highway, Des Plaines, Ill. It guards against overheating in such equipment as automatic coffee

pots, home movie projectors, phonographs, and air conditioners . . . A clever piece of hardware for tightening guy wires, clotheslines, and electric farm fences is made by North Central Plastics, Inc., of Ellendale, Minn. See it in the photo. It’s aluminum . . . Birds eat your fruits or berries? Conwed Corp., 332 Minnesota St., St. Paul, Minn. 55101, sells a plastic netting to cover the bush or tree . . . This is a good time of year to remove soot from your chimney. Chimney Sweep is a product that will help with the job. It’s made in several forms by Miracle Adhesives Corp., 250 Pettit Ave., Bellmore, N.Y. 11710, under the Coughlan brand name.





# Gus Has a



"Get my car down and let me out of here," snapped the colonel "before I make real trouble."

The cocksure colonel told Gus exactly how to fix his car, but Gus was not taking orders

By MARTIN BUNN  
ILLUSTRATION BY RAY QUIGLEY

**G**us slammed the hood of an early-morning repair job at the Model Garage.

"Man, if I ever closed a hood like that..." Stan Hicks, his assistant, complained, poking his bony legs into his coveralls.

"Car troubles getting you down, Boss?"  
"Not car troubles, *customer* troubles," corrected Gus.

"I *thought* that was Harry Baxter's old clunker," chuckled Stan.

"It's his, all right. How many times has that stubborn character tried to tell us how to fix his car? Well, he's at it again. Bring my car and follow me back to Baxter's house. We'll have to shut up shop for a few minutes."

Riding with Gus on the way back, Stan asked about the Baxter car. "What was he complaining about now?"

"Claimed the valve job we did last winter was making his car hard to start. He even talked me into wasting time on



# Argument with the Brass

a compression check.”

“Compression was okay, huh?”

“The trouble was that Baxter put on a new coil himself after we’d told him he needed one. He got the battery and distributor leads to the new coil switched. With the low-voltage juice flowing the wrong way through the coil, the high-voltage current flowed the wrong way through the spark plugs. That way it takes about 30 percent more juice to jump the gaps. Made the car hard to start.”

“Next time Baxter needs a valve job,” said Stan, “you’ll send him packing to some other shop, I’ll bet.”

“Next time I’ll look for the trouble logically instead of listening to him—or any customer,”

vowed Gus, holding up one hand.

As they drove up to the Model Garage, Gus spied a neatly uniformed Army officer standing in the drive beside a well-kept ’64 Ford sedan.

The officer strode over to Gus as soon as he stepped out of the car. “You look as though you’re in charge,” he said.

Gus grinned. “I hope so.”

“I’m Colonel John T. Wayland of the Ordnance Ammunition Command. I’ll be stationed at the base for a while and I need someone to fix the front brake on my car. It makes a funny noise. Comes every time I use the brakes hard in the opposite direction they were used hard the last time.”

“Let’s go for a ride and listen to it,” suggested Gus.

“No need to. I already know what the trouble is. I had to slam the brakes on

hard trying to avoid a chuckhole in the road a few weeks ago. The self-adjusting mechanism broke. It lets the brake shoes move around too much.”

“I’d still like to hear the noise myself,” said Gus.

“Just take off the right front wheel,” the colonel insisted, “and put on a new self-adjusting setup. You’ll save us both time.”

“If it’s just the same to you,” said Gus, moving toward the car, “I’d like to hear the sound before I fix it.”

“Very well, if you insist. But I can produce the noise right here in your driveway. I’ll show you,” the colonel said, climbing into his car.

“It’s the right front brake,” he called out. “Stand over on that side and you’ll hear it when I stop.”

Colonel Wayland backed up the car and braked hard. Sure enough, a pronounced clunk came from the right front. He shot the car forward a few feet, jammed on the brakes again. The same clunk.

“Now, watch,” said Wayland. “I’ll go forward again and stop, but there won’t be any noise this time. Only happens in the opposite direction to the time before.” The car jerked forward; the colonel braked. As he had said, there was no sound other than that of normal hard braking.

“Satisfied?” Wayland asked.

“Let me try it once,” said Gus. The colonel tightened his lips and banged the steering wheel hard with his fist. Then he slid over.

When Gus put on the brakes going backward, the clunk seemed even louder than it had outside the car.

“I have a hunch,” said Gus. He got out, opened the big shop door, then drove the car in. The colonel watched as Gus jacked up the front end and rolled under the center of the car on a creeper.

“Now, wait a minute,” the colonel snapped. “You can’t fix a broken brake-adjusting mechanism from there.”

“I don’t think the trouble is in your brakes,” said Gus. “It sounds more like the suspension.”

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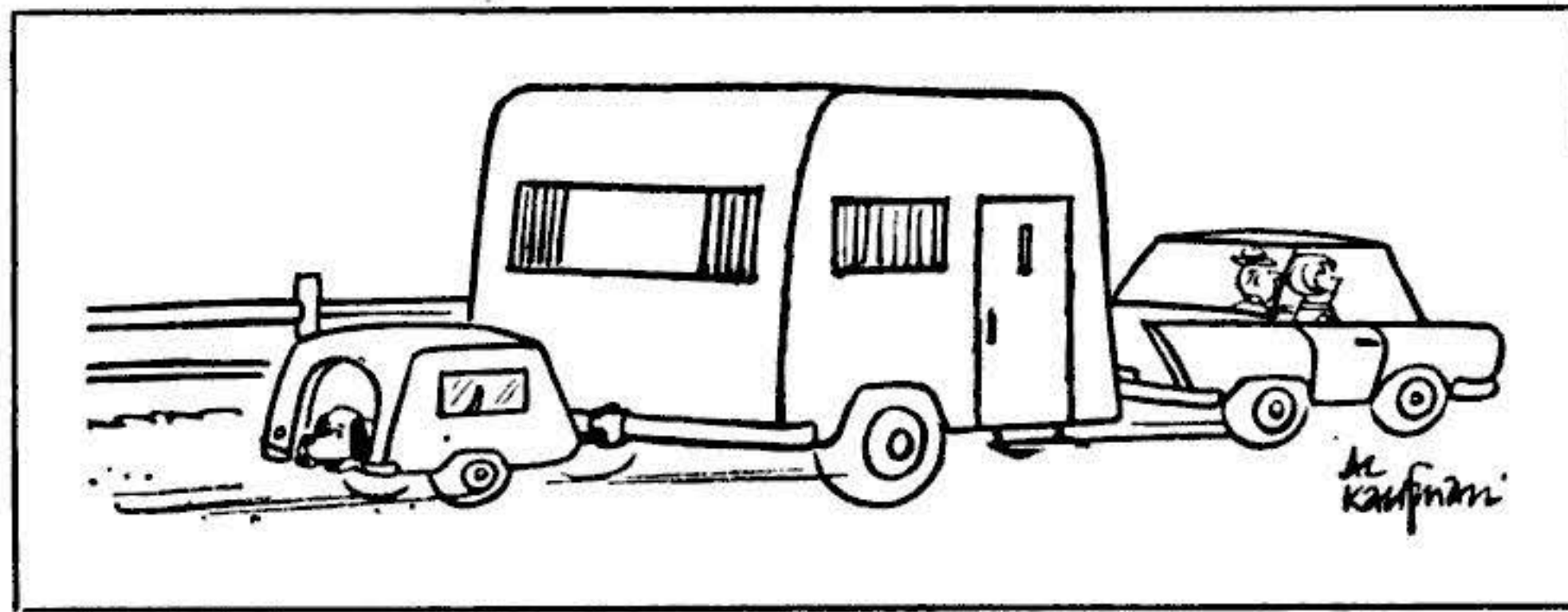
"Hold it right there," Wayland commanded. "I know it's the brakes. Just take off that front wheel and you'll see."

Gus remembered his vow made only half an hour before. He rolled out from under the car and got up.

"Tell me this, Colonel," he asked. "Did you miss that chuckhole?"

"No, as a matter of fact I hit it quite hard," admitted the officer. "That's when the ratchet let go."

Gus plunged ahead: "When you hit that chuckhole, the front suspension took an awful jolt. The wheels were locked. And the weight shift from braking was toward the front end. I think it damaged your front suspension."



"So that's the game," stormed the colonel. "You want to sell me a whole new front end. If you'll let my car down off that jack, I'll be on my way."

"First let me show you the problem as I see it," said Gus. "If I'm right, it won't involve a whole new front end. If I'm wrong, I'll pull the wheel and look at your brake. No charge for the suspension check. Fair enough?"

"Nothing doing, mister," snapped the officer. "I didn't get to be a colonel by being a patsy."

"Now, look here," Gus interrupted, his blood pressure rising.

"No, *you* look here," shot back the colonel. "Get my car down and let me out of here before I make real trouble. I've had it with you chiseling mechanics. I'll get one of the men at the motor pool to fix my car."

"You do just that," said Gus as he gave the jack-release knob a hefty turn. The car's front end came down so fast it bounced. The colonel got in, slammed the door, and drove off furiously.

"I'll never see *him* again," Gus muttered to himself. "I hope."

For several weeks the unhappy incident plagued Gus. "I know I'm right about that car," he told Stan one day, "but maybe I should have pulled that wheel off, anyway."

"Cheer up, Boss," said Stan. "You may have lost a colonel, but you've gained a corporal." Stan gestured toward a familiar car as it pulled up in front of the Model Garage. It was Colonel Wayland's, but a youthful corporal sat at the wheel.

"Are you Gus Wilson?" the corporal asked as he climbed out of the Ford.

"What can I do for you?" Gus asked warily.

"I'm Corporal Jannings from the motor pool over at the base. And I'm in real trouble unless you can help me.

"Well, Colonel Wayland—that's his car there—ordered us to stop a noise in his brakes. We aren't supposed to work on private cars, but the colonel was madder'n heck and he pulled some strings. Guess who got the job? I tried every

thing in the manual, but the noise is still there. Unless I find it, the colonel will have me busted before I can wash the grease off my hands."

"What makes you think I can help?" Gus asked.

"Colonel Wayland told the officer in charge of the motor pool that you'd tried to gyp him on fixing his car. But we guys figure you probably know just what's wrong with it."

"I think I do," agreed Gus. "Drive in and I'll show you."

A few minutes later, Gus rolled out from under the jacked-up Ford, stood up and opened the hood.

"I found your noise," he said. "Look down between the engine and radiator and you'll see the forward part of the lower suspension arm. What most people call the A frame. See that small bell-crank affair the A frame pivots on?" Gus pointed with the hook on his drop light. "One end of the crank is locked to a sleeve that's bonded in rubber, and the rubber is fastened firmly through the car's frame. Besides the pivoting action you find in the suspension of all cars, the crank end the



# The next time some guy tells you a used car is "just like new" ask for the guarantee.



When all the smooth talk is done, a guarantee is about the only thing this kind of guy is guaranteed not to give you.

Which might explain why so many people find it rough going with a used car they got from a smooth-talking salesman.

VW used car dealers aren't smooth talkers. In fact, they aren't talkers at all. Their guarantee says it all.

A Volkswagen dealer will repair or replace any of the major working parts of his guaranteed used cars, for 30 days or 1000 miles,

whichever comes first, free.

The engine, transmission, rear axle, front axle assemblies, brake system, electrical system are all covered.

He can cover them because he fixes what needs fixing beforehand. When he inspects his trade-ins.

If they don't pass inspection, of course, they don't get the guarantee.

But if they do, anything he has to say about them he says in writing.

It's all the conversation you need.





holds the A frame is free to swing as much as the rubber around it will allow. The bell crank was a suspension-softening system used by Ford in 1963 and '64."

Jannings peered closer.

"Keep watching that right bell crank," Gus instructed, "while I push back on the front wheel." Gus kicked his heel hard against the right front tire. It bounced back half an inch.

"The crank moved," said Corporal Jannings in amazement.

"I have the bell crank loosened now so it's easy to move, but even when it's tight, the rubber-mounted crank gives slightly when the tire hits a bump. That lets the outer end of the A frame move back. Probably when the colonel hit a chuckhole he tore the bond between the rubber mount and the bell crank. Now the crank slips too far one way and the other."

"You mean that's what the noise is?" The corporal grinned with delight.

"That's it. When I first heard it I had a hunch it was too loud to be coming from a brake."

"What's the fix?" the corporal asked. "A new rubber mount?"

"There are two ways," said Gus. "You can put in a new bushing in place of the unbonded one, or leave the old setup in and put a special stabilizer bar across the front end between the right and left bell cranks. The bar will hold the cranks from moving independently. It won't matter if their bushings are bonded or not. They can't turn."

Jannings nodded. "Which way would you recommend?"

"I recommend the stabilizer," Gus said, rolling under the car to tighten the bolts he'd loosened. "It costs about five bucks and should beef up the handling quite a

bit. It holds that caster from moving all over the map. The car will need a wheel alignment, too."

"I sure appreciate your help, Mr. Wilson," Jannings said. "You've saved my life. I'll pick up a stabilizer bar and install it. How much do I owe?"

"Forget it. Glad to help," Gus said as he lowered the car to the floor.

Gus had forgotten the incident by the time Colonel Wayland confronted him again. Gus was under the dashboard of a car removing a radio and speaker.

"Mr. Wilson," the colonel said hesitantly as he peered down at Gus, "I'm not very good at apologies, but—well, I sure owe you one."

"Forget it," said Gus, unwinding himself and getting out of the car.

"I can't forget it," Wayland went on. "I said some pretty rotten things. I can say I'm sorry but that doesn't seem enough. I want to pay you for what the job would have cost."

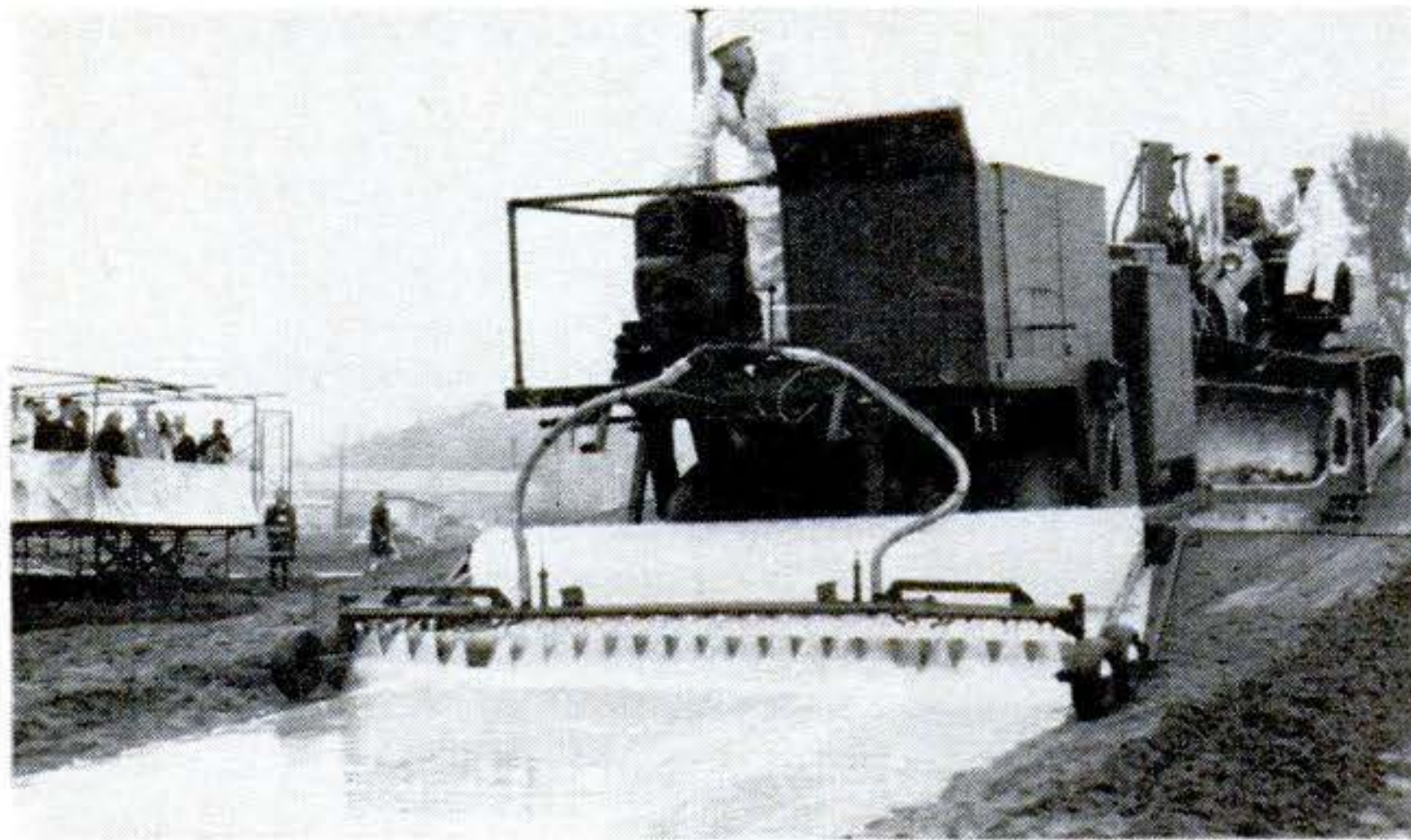
"Can't accept pay for a job I didn't do," said Gus.

"I figured you'd say that. Well, I'll tell you this. I'm through telling mechanics how to do their work." With that, Colonel Wayland shook Gus's hand warmly, smiled for the first time that Gus could recall.

"You're pretty good at stabilizing things, Boss," Stan commented as the colonel strode off down the street.

"Yeah," Gus said, "that stabilizer bar should do the trick, all right."

"I don't mean the car, I mean the colonel," Stan chuckled. "He sure has cooled down. I'll bet life will be a lot less jumpy for the guys in his outfit from now on." P 5



### Dune buggy delivers instant roads

Towed by a bulldozer that smooths the way in loose soil or sand, this "dune buggy" lays down an 11-foot-wide fiberglass mat. This is sprayed with a resin solution to form a durable roadway that can be used in 30 to 45 minutes. The machine, developed by the Boeing Co. under contract for the U.S. Marine Corps, is shown at work on a test tract in Seattle.



# The less you use, the more you like it.



An oil's reputation often depends on how little you use.

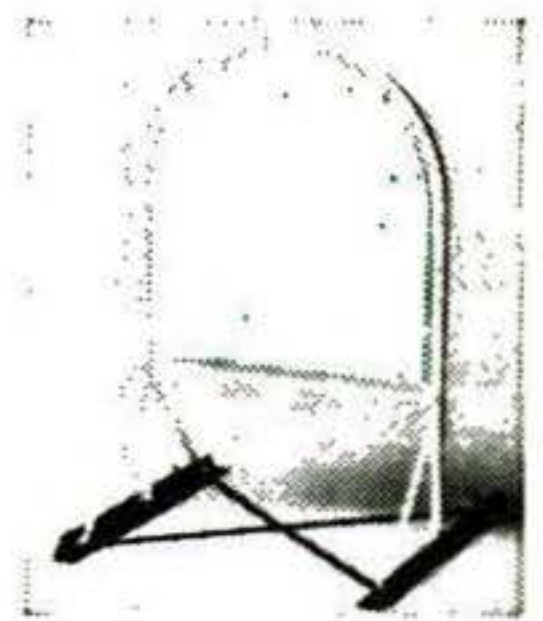
Quaker State comes by this reputation naturally.

Refined from 100% Pure Pennsylvania Grade Crude Oil, it has a special lubricating power to protect engine parts longer. Prevents oxidation and break-

down, even in the fierce heat today's engines generate.

Others prefer Quaker State for a practical reason. It exceeds all car makers' warranty requirements.

But most drivers who have used Quaker State within the past 50 years prefer it for the first reason. You use less.



kee

**AMERICA'S  
#1 SELLING  
PICKUP  
COVER  
AND  
TOP  
DOLLAR  
VALUE**



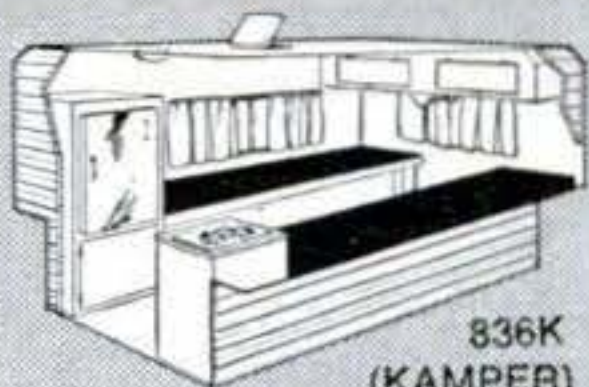
824D  
COVER



830RD  
COVER



836D  
COVER



836K  
(KAMPER)



SPORTS PICKUP COVER

These units represent over 36% of all pickup covers sold in the United States last year. Buy a winner, get real value. Manufactured and sold by over 170 Assemblers across the U. S. A.

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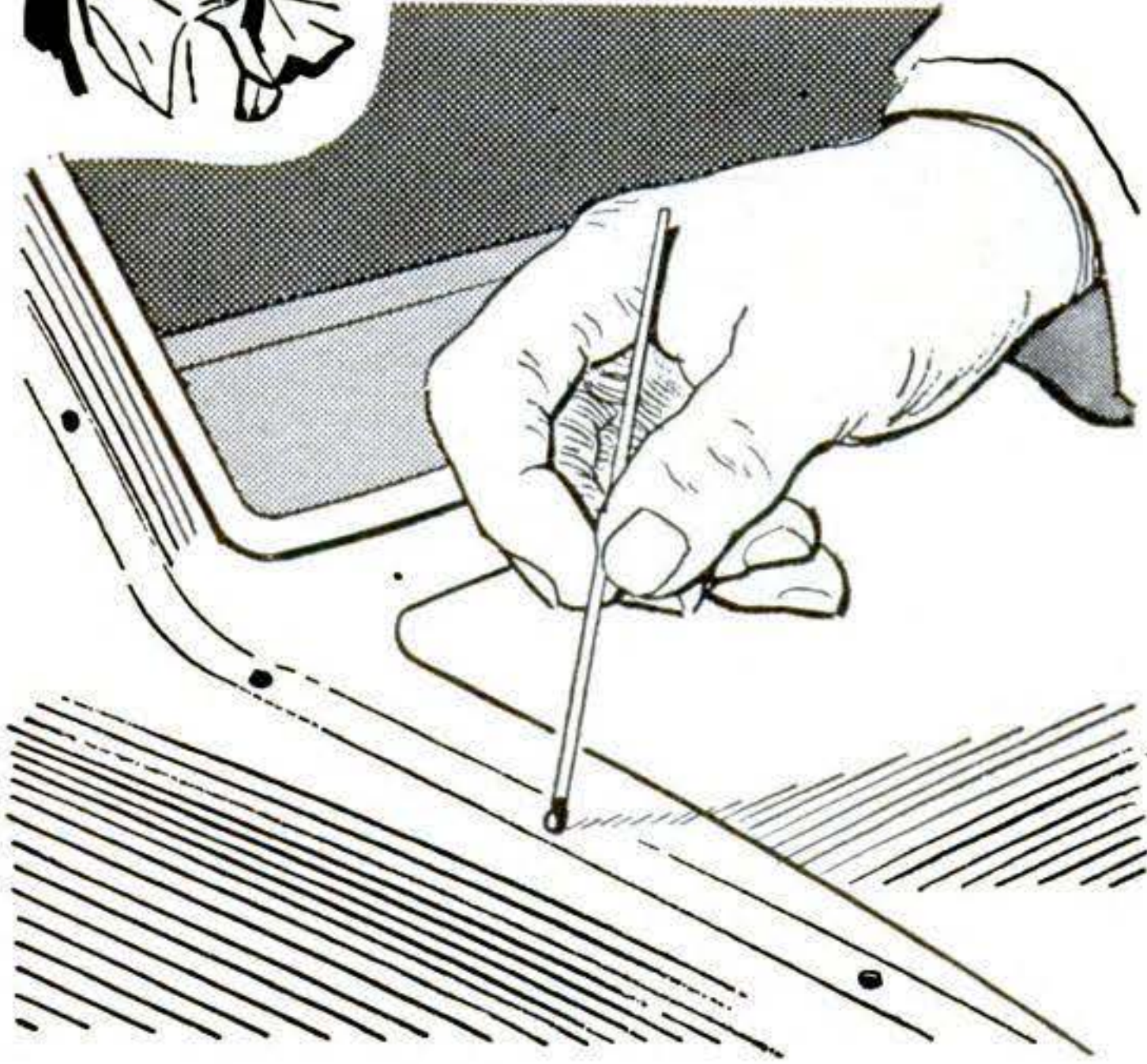
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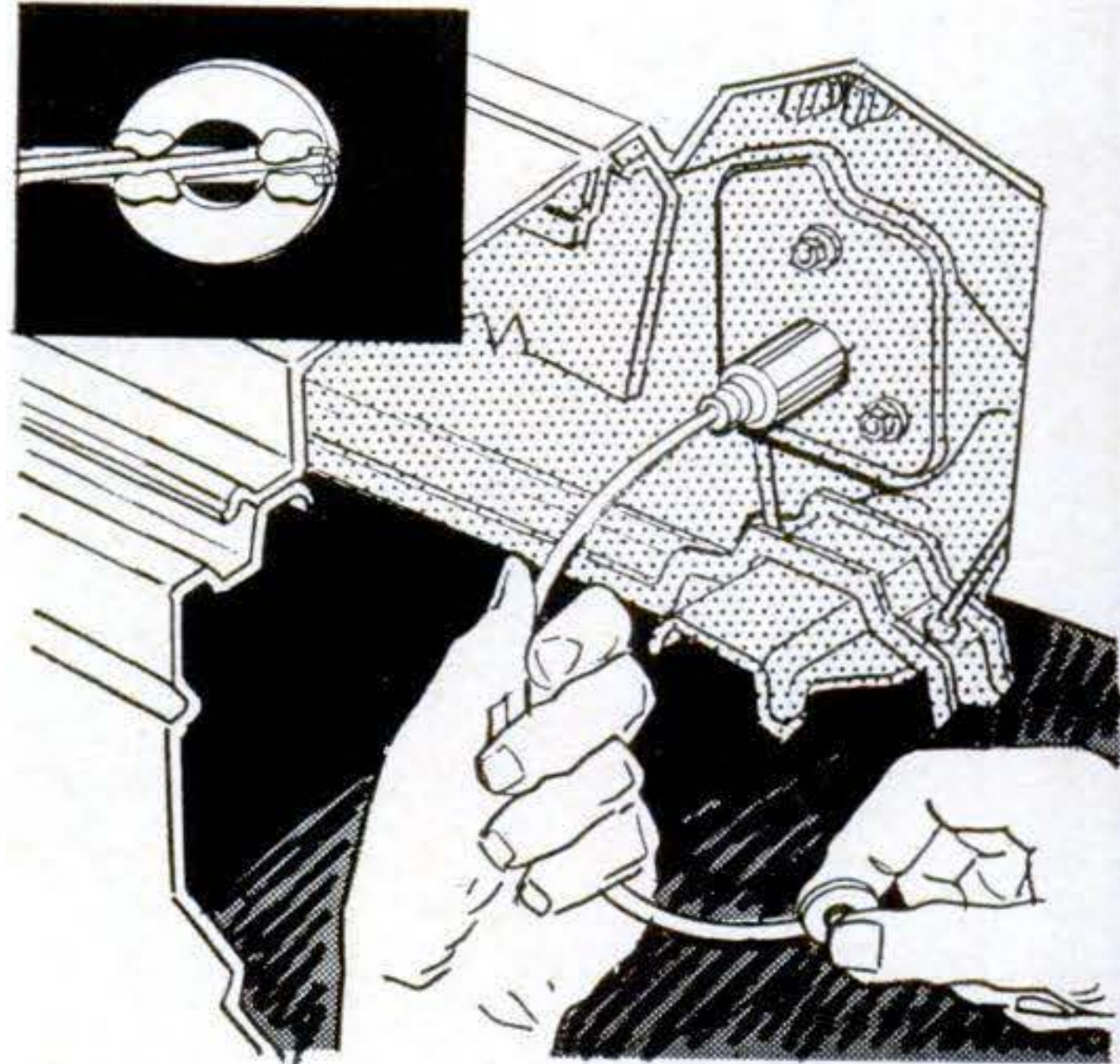


# Hints from the Model Garage

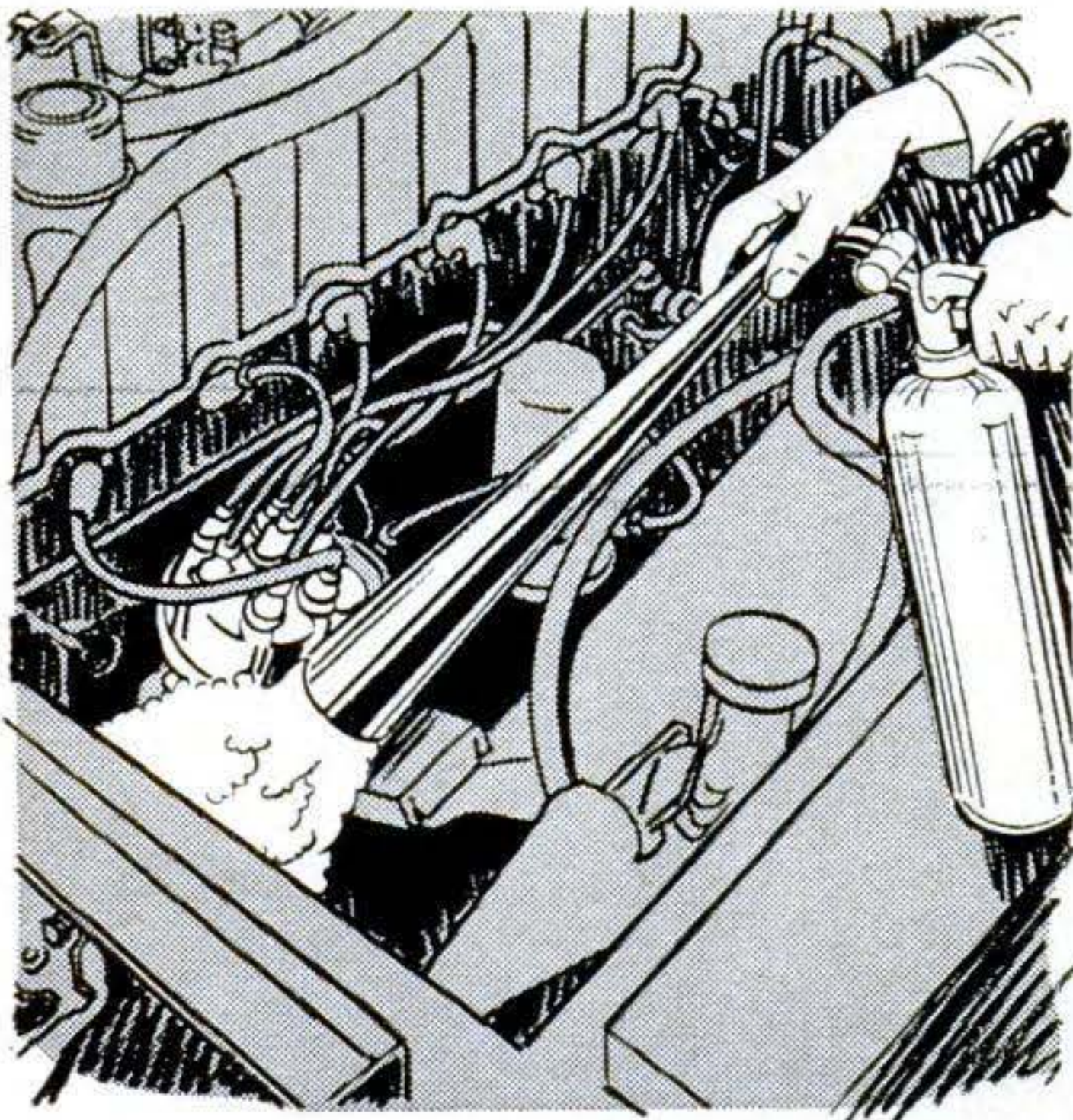
DRAWINGS BY DAN TODD



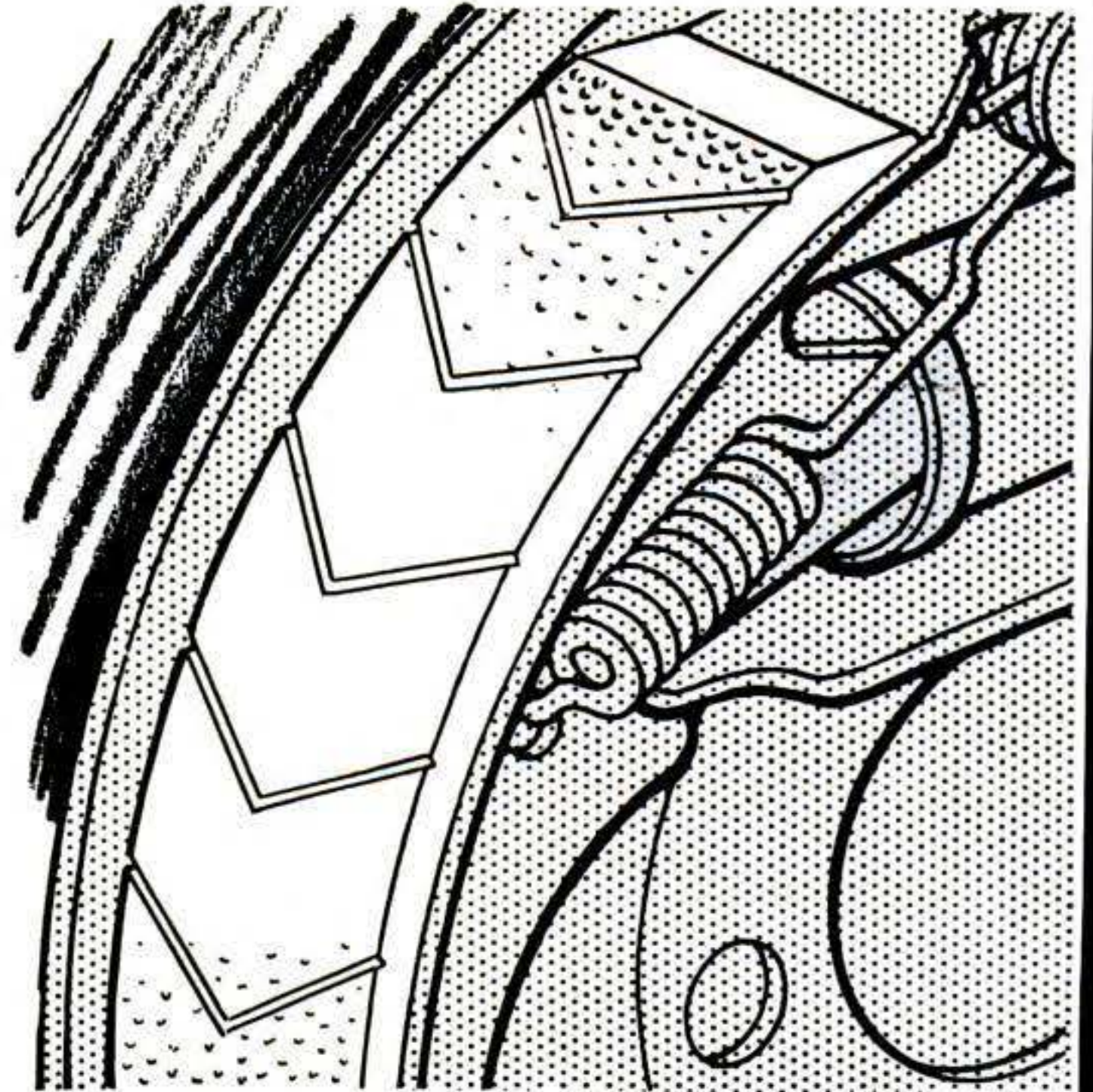
When moldings have been replaced, rust may develop around the molding fastener holes. Reason: Tightening the screws cuts through the paint. Put in a few extra minutes applying a drop of shellac or varnish to each of the screw holes to seal out the moisture.



A stuck speedometer head can be fixed with a simple tool made up of a short length of old speedo cable with a flat washer welded or brazed to its free end. The keyed end is inserted in the instrument, and the cable twisted alternately to right and left.



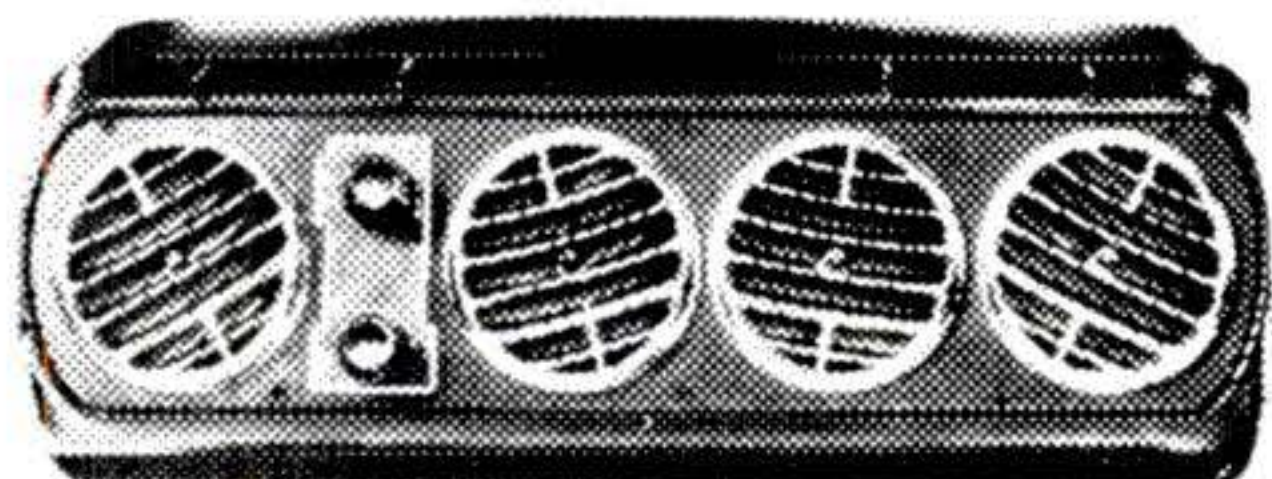
If you can't time your ignition because the distributor is stuck, all is not lost. You can free it with a CO<sub>2</sub> fire extinguisher. Aim its nozzle below the distributor base and spray for about 10 seconds. This treatment will usually free the most stubborn unit.



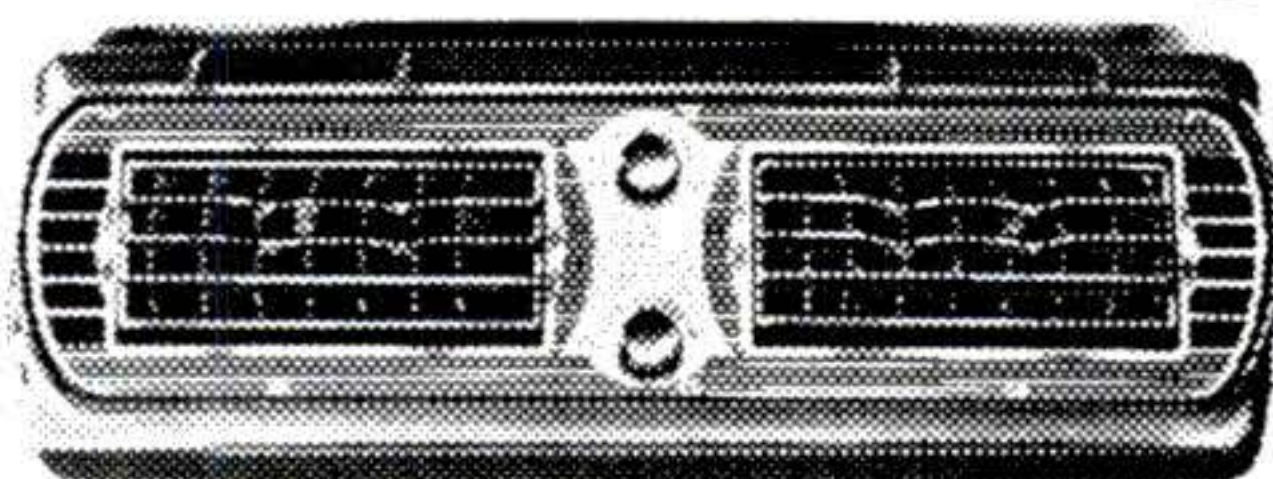
Squeaks from bonded brake linings can be eliminated by cutting V-shaped grooves in the linings, pointing in the direction opposite to the drum's rotation. This lets air carry dust to the outer edge of the shoe, where it can cause no vibration or squeal.



# Save up to \$200 or more on auto air conditioning!



STANDARD



SUPER AIR



SUPREME

Demand for Comfy-Kit Units has been so great, we've increased production this year by 3,000 units. This means we can lower prices to just \$138 on the Standard - \$148 on the Super Air-and introduce the brand new Supreme for only \$165.

The new Supreme (pictured) has neat, trim lines that actually improve the appearance of your car's interior. Takes up no usable space, and it installs quick and easy just like the other Comfy-Kit units.

Performance on all Comfy-Kit units is unsurpassed. Cooling power is greater than that of other brands costing two or three

times the price of Comfy-Kit. And...you save extra money when you trade cars because Comfy-Kit is easily switched to your new one.

Installation is simple - a matter of four to six hours. It's just like being paid up to \$50 an hour for your time. Everything is furnished - including the loan of special tools if you need them.

Let someone else pay big prices for air conditioning. Comfy-Kit is a better unit...and saves you lots of money to boot.

Mail in the coupon today - and enjoy cool, comfortable, windows-up driving all summer long.

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- Enclosed is \$138 for Standard Unit.
- Enclosed is \$148 for Super Unit.
- Enclosed is \$165 for Supreme Unit.
- Enclosed is \$30 deposit on a  Super Standard  Supreme Unit. I will pay the balance, plus C.O.D. charges when delivered.
- Enclosed is \$8.00 deposit for a set of four tools, which will be returned to me when I return the tools.
- I would like to see the instruction book before I order. I enclose \$1.00 for the instruction book only. I understand this will apply on any future Comfy-Kit order.
- I would like information on a Comfy-Kit dealership.

Name .....

Address .....

City.....State..... Zip .....

My car is a ..... (year)..... (model)

Engine displacement.....Horsepower.....

Power Steering ..... yes ..... no

Floor shift ..... Steering column shift .....

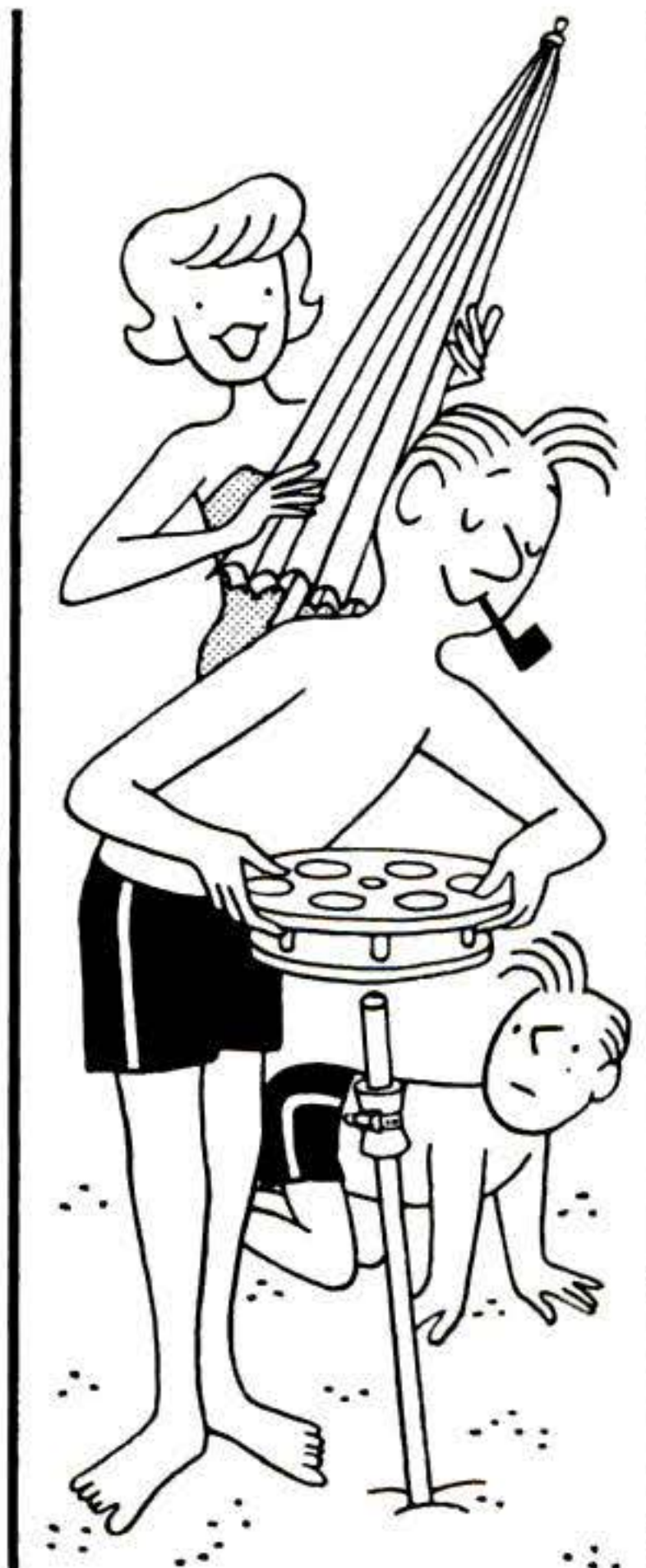
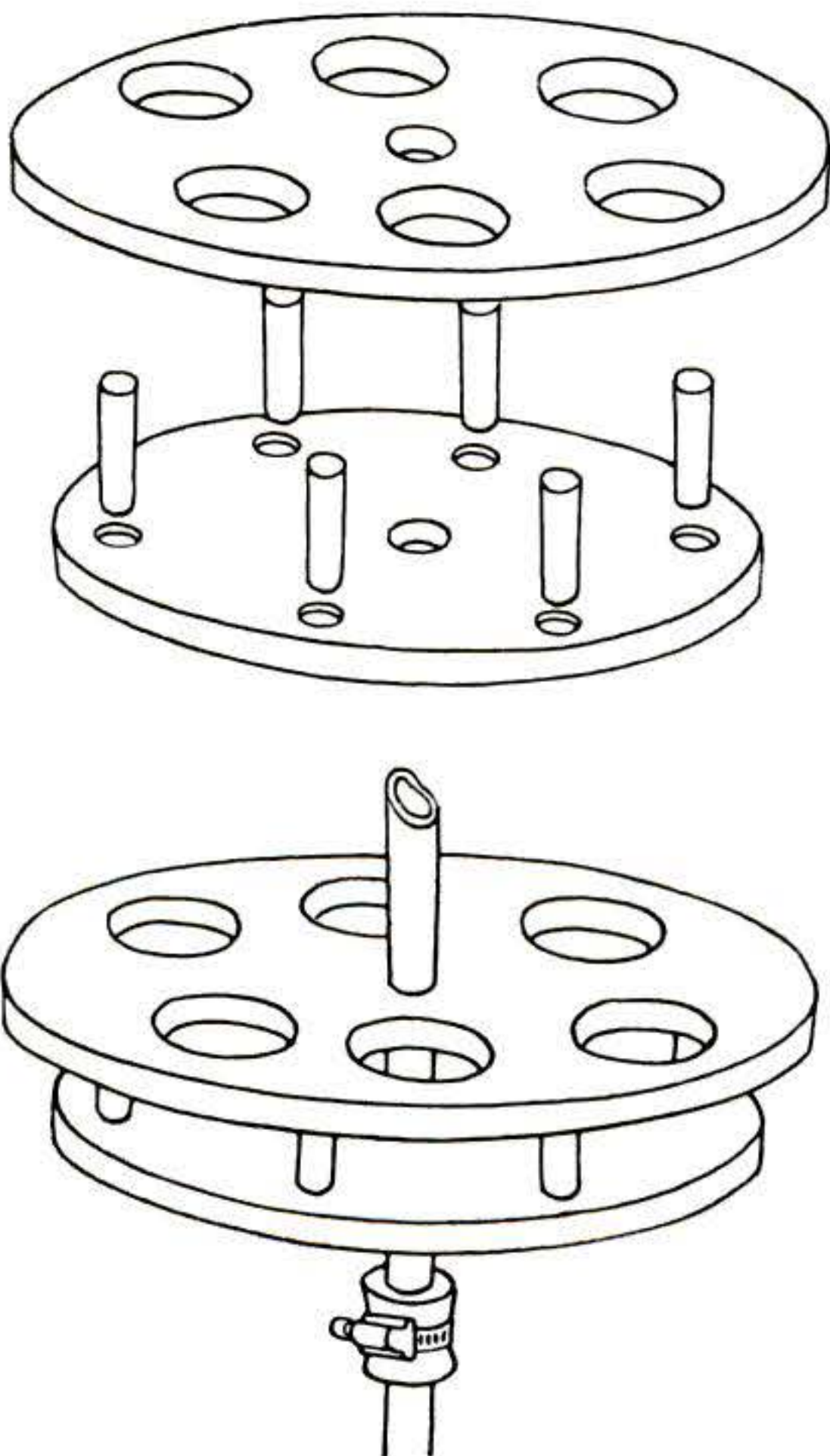
Smog pump ..... yes .....no

\*plus state tax where applicable



# Wordless Workshop

By ROY DOTY





# Most any paint looks good going on. Spred<sup>®</sup> House Paint goes on looking good.



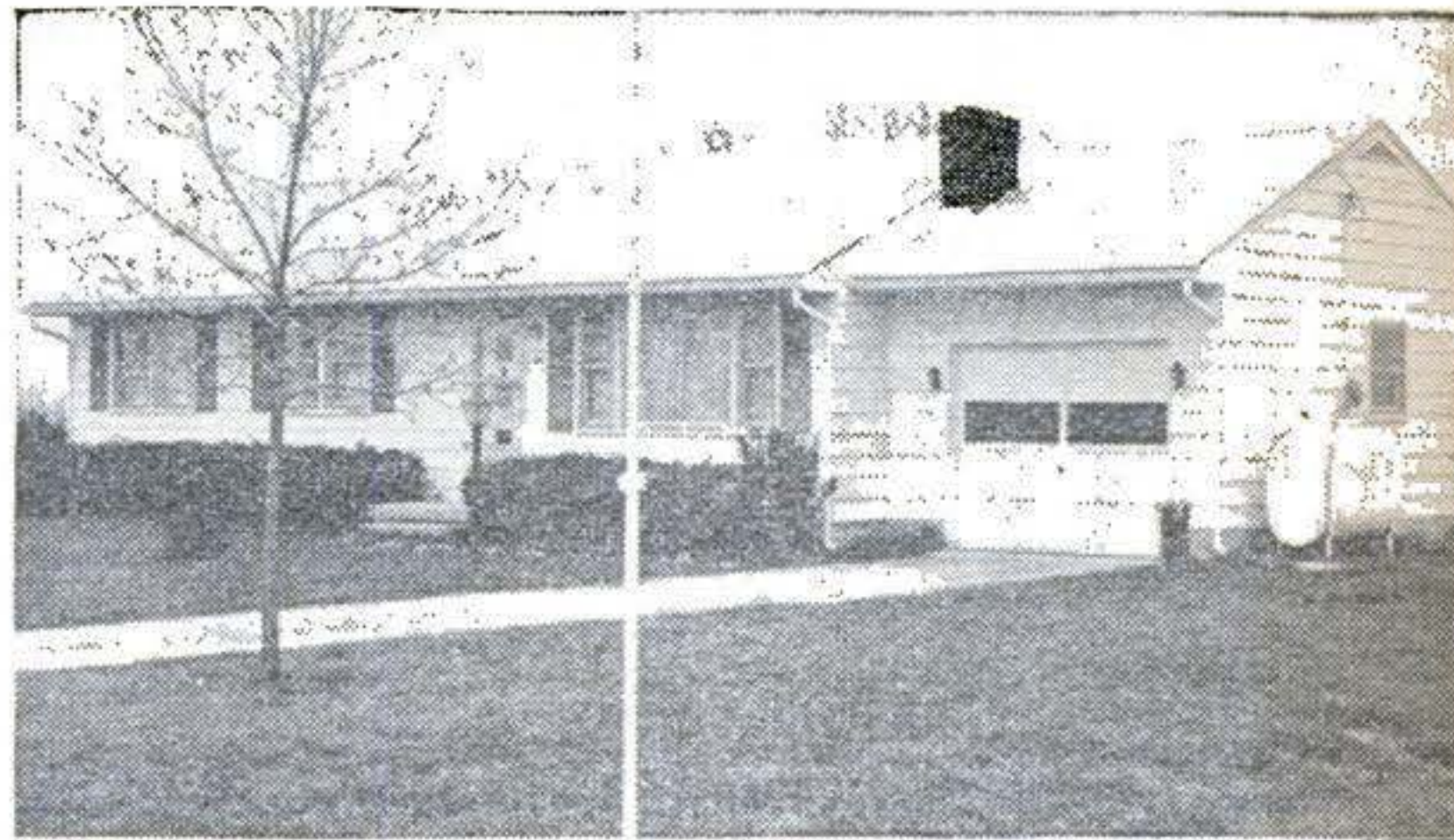
**6 YEARS, CANADA.** "Cold winters and strong sun are hard on paint. But our house has come through beautifully. Several neighbors switched to Spred House Paint." S. K. McBirnie.



**3 YEARS, COLORADO.** "Had to paint four times in two years because of severe blistering. Then tried Spred House Paint in 1965. It stopped the blistering and looks great." D. M. Craig.



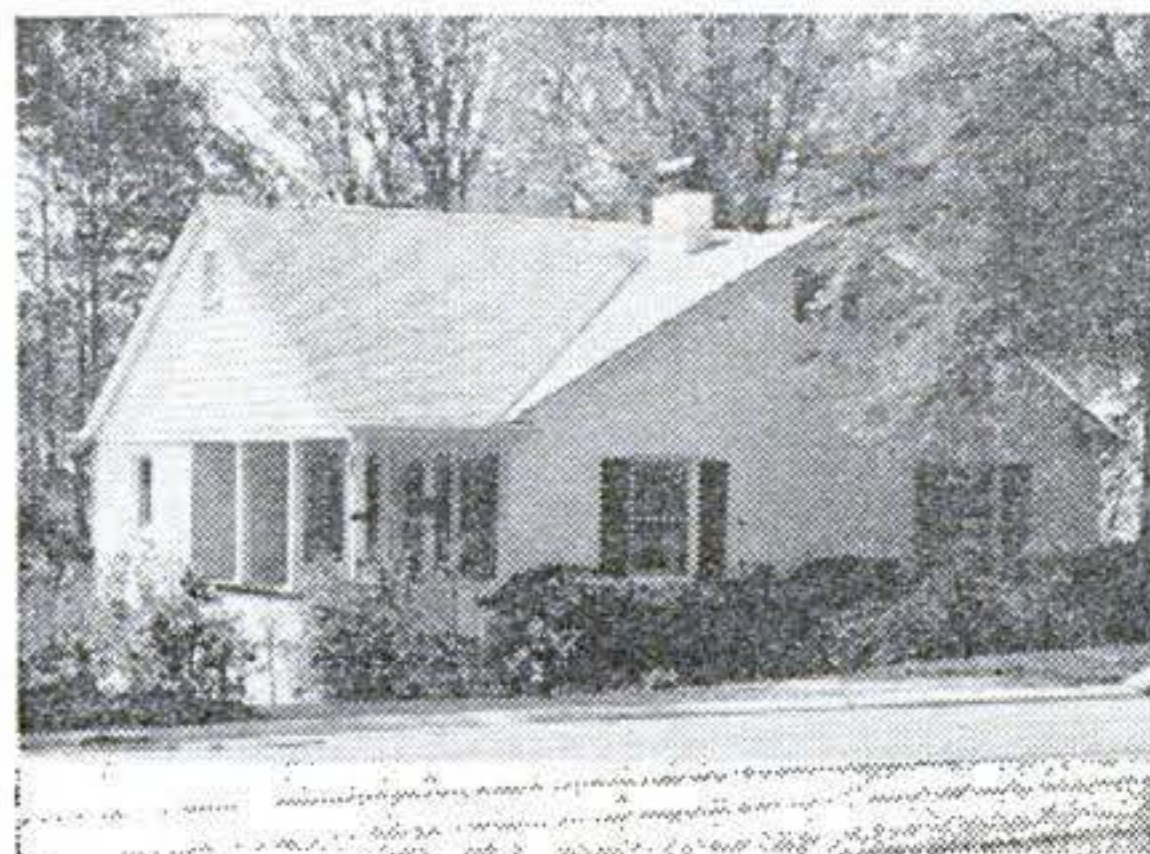
**6 YEARS, CALIFORNIA.** "No switching paints for me. Used it on siding, masonry and metal. No sags, no runs, no lap marks show. We have a basketball backboard that needed painting every six months — until Spred House Paint!" C. Schaffer.



**8 YEARS, OHIO.** "Spred House Paint solved a terrific blistering problem. I did repaint one side, south, after six years, but other three sides still don't need repainting." T. S. Trippett.



**3 YEARS, MINNESOTA.** "Still looks like we just put it on — flowed on easier than any house paint I've ever used. No brush drag." H. E. Griffin.



**6 YEARS NORTH CAROLINA.** "Spred House Paint gets a real test in this mountain area — cold nights, hot days, and fumes from a nearby textile plant. There's no discoloration." J. B. Smith.

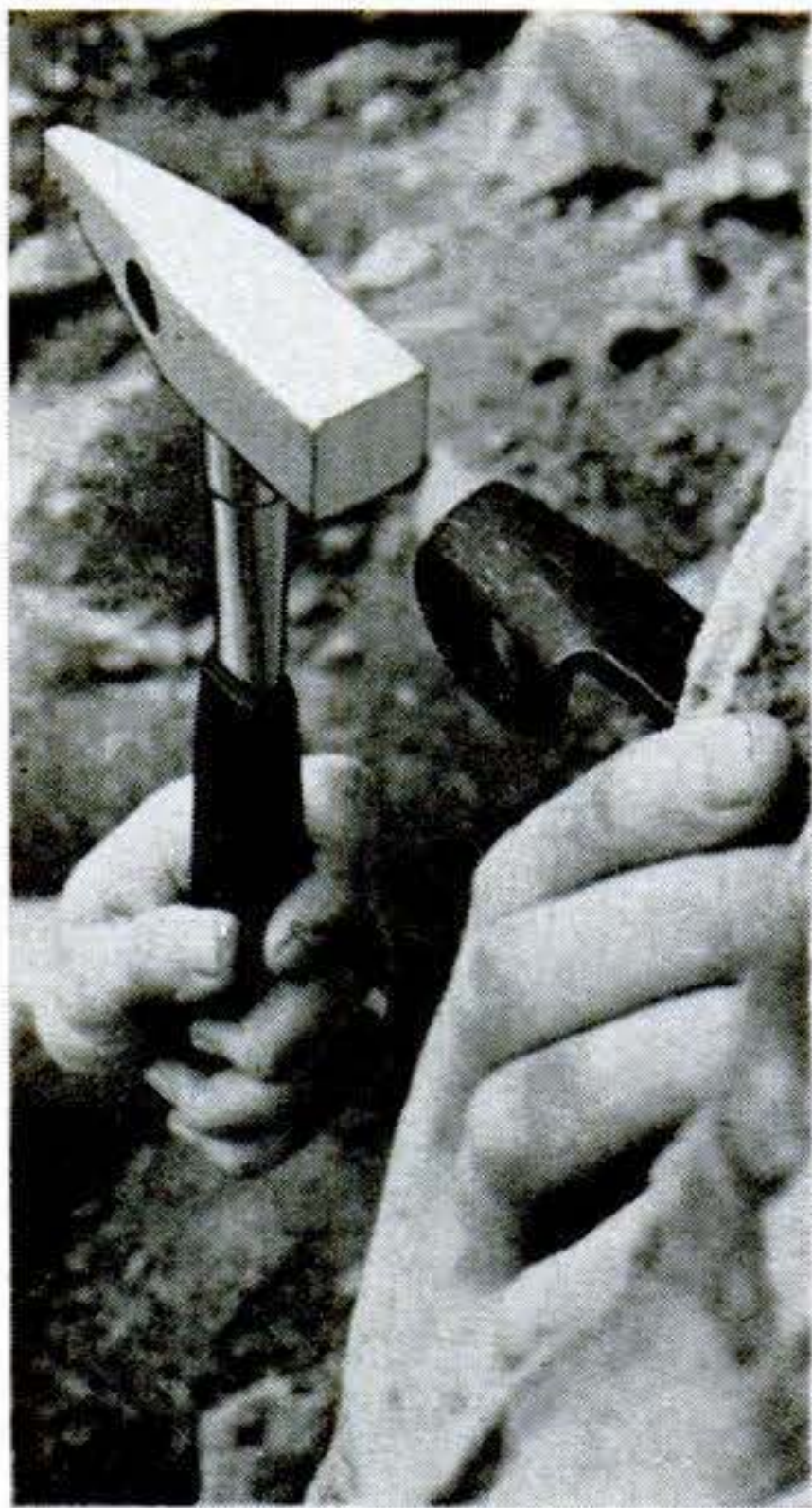


**GLIDDEN COATINGS & RESINS**  
CLEVELAND, OHIO 44115  
IN CANADA: THE GLIDDEN COMPANY, LTD.

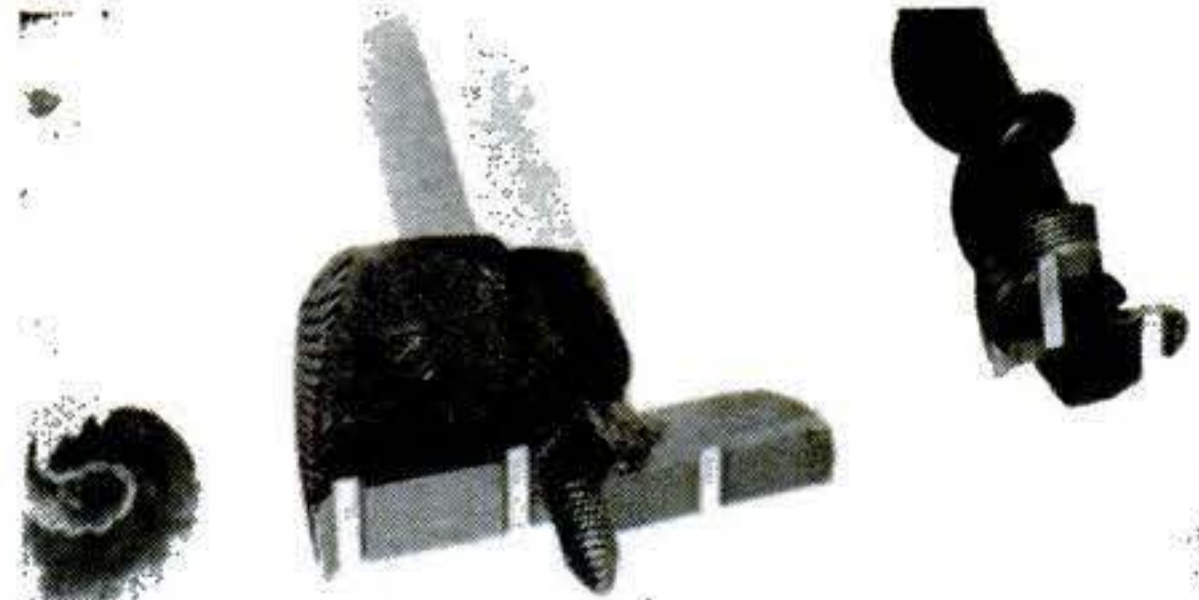
**SCM** SCM CORPORATION



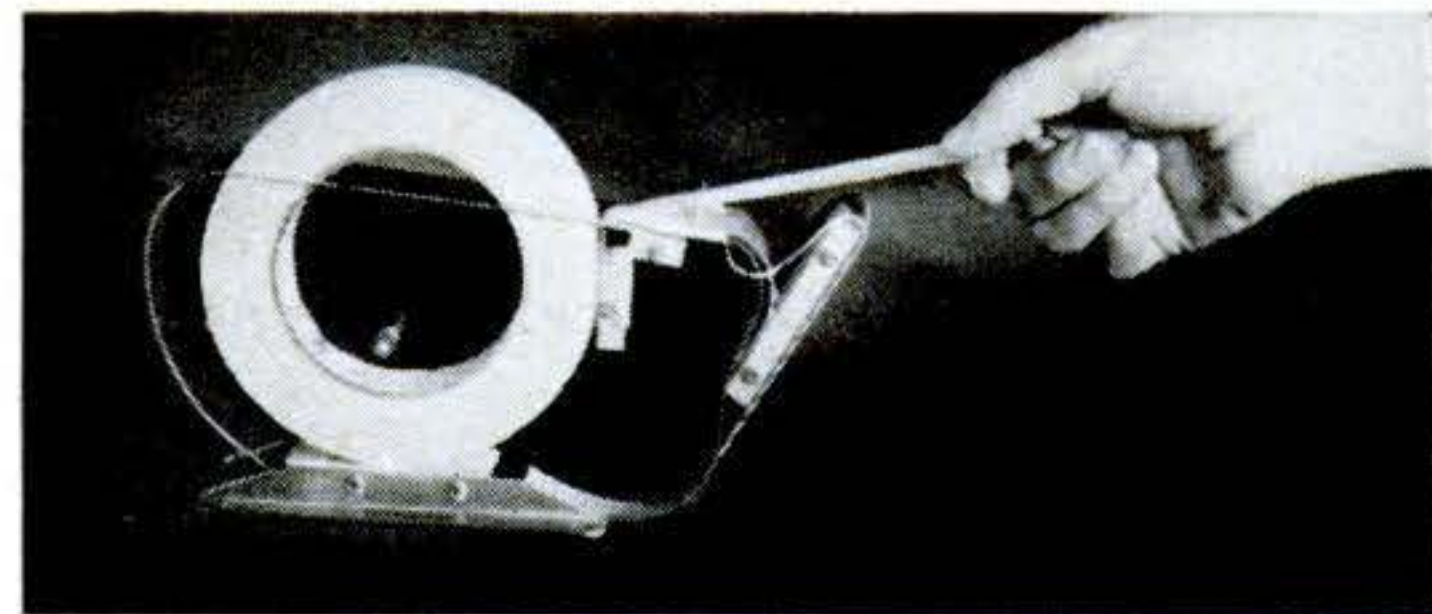




A hole in the head is just what you need in a mountain climber's piton hammer (above). It accepts a carabiner to extract pitons for re-use. The head of the perfectly balanced tool is drop-forged of chrome-moly steel; a thick-walled tubing handle is pressed into it under tons of pressure. Colorado Mountain Industries, 4800 E. Jewell Ave., Denver 80222, has a new ice axe with a flat adze, too.



Planetor Skip-Chip bits bore deep holes with less torque because there is less friction. Notches varying in shape and number with bit size are machined in the bottom plane of each tool. Available in portable and machine bits, sizes  $\frac{1}{8}$ - $4\frac{1}{2}$  inches. Price & Rutzebeck, Box 30, Hayward, Calif. 94543.



Double-coated-tape dispenser separates the tape from its liner automatically, delivers ready-to-use clean unwrinkled tape. Three models accommodate  $\frac{3}{4}$ -, one-, two-inch tapes in all core sizes. Prices: \$12.95 up, plus 45¢ shipping. Swell Products Co., 123 Papurah Rd., Fairfield, Conn. 06430.

## Special Tools for Special Jobs



Paint is atomized by hydraulic pressure in the DeVilbiss electric airless spray outfit—there's no compressor. The unit delivers a full 40 ounces of paint a minute, even at peak-pressure delivery of 3,000 p.s.i. Powered by a one-hp. motor, for use with 115 volts AC, the rig pulls less than 14 amps.



Four-in-one wrench for work on air conditioners has a fingertip pawl that reverses ratchet action instantly. One end fits  $\frac{3}{16}$ - and  $\frac{1}{4}$ -inch-square valve stems, the other end fits  $\frac{1}{2}$ - and  $\frac{9}{16}$ -inch hex heads. K-D Mfg. Co., 3575 Hempland Rd., Lancaster, Pa. 17604. \$5.95.



Intermediate pneumatic nailer is first to drive nails of  $1\frac{1}{4}$  to  $1\frac{7}{8}$  inches. Fed up to 300 nails in a plastic strip, and operated by a trigger or touch-trip mechanism, it can drive nails at low pressure—about 80 p.s.i. Duo-Fast Fastener Corp., 3704 River Rd., Franklin Park, Ill. 60131, makes it.





## We put fiber glass in FGA\* shingles for the same reason it's in helmets: *lightweight protection.*

J-M's lightweight FGA\* shingles give your roof special protection from weather, plus long roof life and low maintenance. Because fiber glass in shingles (as in helmets) resists cracking, curling, rotting and warping.

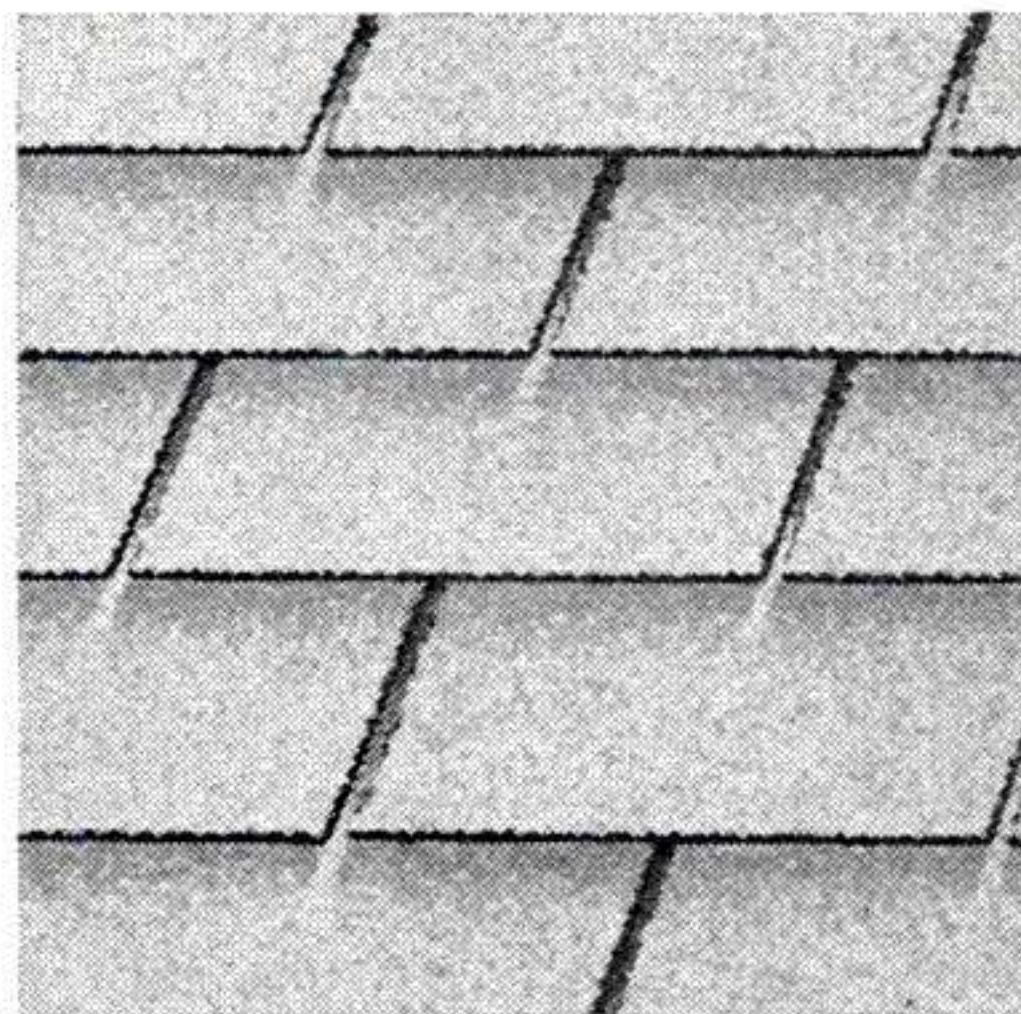
The combination of fiber glass and asbestos in FGA shingles also gives you extra fire protection. They've been awarded the Underwriters' Laboratories Class A fire rating—the highest given. And our Seal-O-Matic® feature makes them exceptionally wind resistant. They've actually withstood hurricanes.

If your roof needs replacing, do it with FGA shingles. They come in 14 wife-pleasing color blends. See them at your J-M dealer's.



**Johns-Manville**

Johns-Manville trademark





## Crosman Introduces First CO<sub>2</sub> Shotgun

[Continued from page 138]

power—on the upper bend (receiver section) of the gun and a pushbutton extractor for the disposable plastic shells.

**Preparing to shoot.** You charge the shotgun with two CO<sub>2</sub> cartridges, not just one. Instructions caution that anything but Crosman Giant Powerlets Model #231 may damage the valve or piercing system. The two cartridges are loaded butt to butt in a chamber within the forearm. Piercing pins are located at each end of the chamber.

Copper tubing pipes the gas charge from this chamber to a valve in the receiver section above and ahead of the trigger.

Pressing a release button directly below the breech lets the barrel snap forward, opening the breech so you can place one of the special shells in firing position. Sliding the barrel back closes the breech. Push the cocking knob forward and the safety button in, and you're ready to fire.

When you pull the trigger, the spring-tensioned hammer strikes the valve stem, releasing a metered charge of gas. This charge propels the front and rear wads from the shell and the load of lead-chilled shot out of the muzzle and (hopefully for you) against and around the flying plastic bird.

After firing, you push the release button below the breech opening, permitting the barrel to snap forward, the breech to open, and the extractor spring to automatically eject the spent shell.

A loading of one pair of CO<sub>2</sub> cartridges will give you about 35 shots at the low power setting and 25 at the high setting before the charge begins to drop off. Getting this shot capacity was the engineering reason for designing the gun for a twin charge. After you have fired about this number of shots, you are well advised to discharge the rest of the gas as described in the instructions and load with fresh cartridges.

The instructions suggest that you have on hand a 1/4-inch wooden dowel 32 inches long to check for and remove any barrel obstructions. You insert the dowel from the muzzle end only. Presumably, you may have greatest need for the dowel when the cartridges are so nearly spent

that the weak charge may not drive all of the wad out of the muzzle. That's an excellent reason for not using cartridges down to their last gasp of gas.

The bright-yellow polyethylene targets are launched for distances up to 55 feet from the portable trap. The trap can be adjusted to vary the throw through 90 degrees of elevation and 25 degrees horizontally. The 14-pound trap also has an adjustable throw arm for fast or slow targets.

**Now for that rifle.** When the people at Crosman sent word that they had a CO<sub>2</sub> rifle that gave a steady trajectory throughout most of the life of the cartridge, I was skeptical. It didn't seem logical that power could hold up. Now I'm convinced.

My sons, John and Pete, and I have now shot out perhaps 20 cartridges with this gun. A cartridge is good for about 44 shots. Through that many shots we have never been able to detect any of the steady drop in power that has always been a characteristic of CO<sub>2</sub> shooting. The forty-fourth shot whammed the target with just about as much force as the first.

At that point, however, there's very little left in a cartridge. Better to discharge it and install a new cartridge than run the risk of getting a pellet jammed in the barrel. This is no real problem, though. A ramrod quickly gets it out.

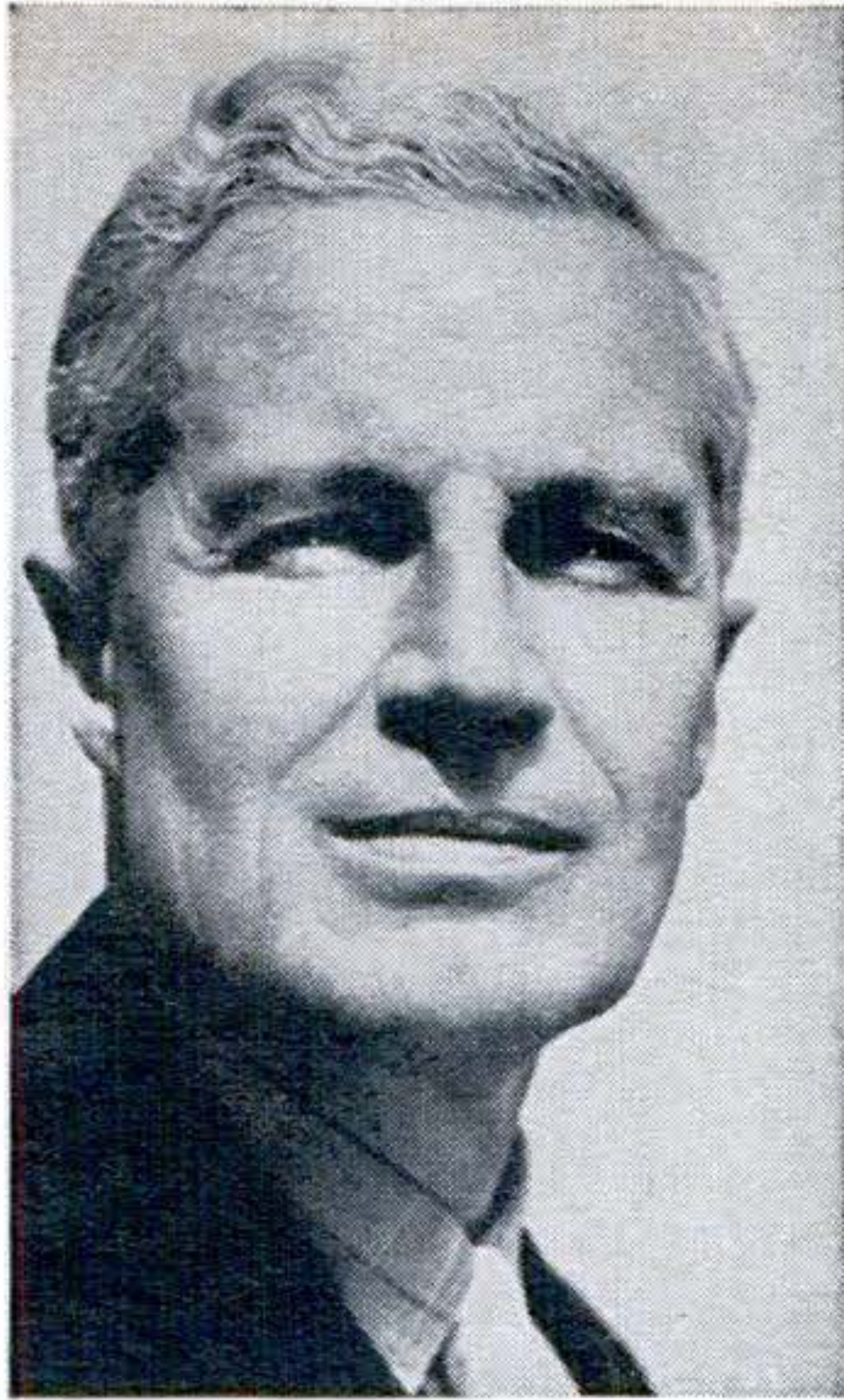
Crosman attributes the consistent trajectory to a new and reliable in-line valve-and-gas-chamber concept.

**It's accurate, too.** We shot a Pell-master 700, the .22-caliber job. I have never used a more accurate weapon in either the CO<sub>2</sub> or air-rifle categories. Bull's-eyes and near ones came with satisfactory regularity on an indoor range of 25 feet.

An engineer at Crosman told me that the 700 and its companion 707 (.177-caliber pellets and BBs) are probably more accurate than most of the people who use them. That's good to know—and gives you something to strive for.

Both the 700 and 707 are expected to have wide usage in the National Rifle Association's 333, or 10-meter, competition in which new superaccurate foreign-made guns have previously taken international honors.





# I'd like to give this to my fellow men... while I am still able to help!

I was young once, as you may be—today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my

summer home, my Cadillacs, my winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things, of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish!* And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned!* I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

## I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to

gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

## A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows." It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own." It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

## Are You Mechanically Inclined?

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**VICTOR B. MASON**

1512 Jarvis Ave., Suite M-3-HO  
CHICAGO, ILLINOIS 60626



## Riding High in Search of the Perfect Wave

[Continued from page 69]

worth \$35 wholesale, and in 20 minutes, using an electric plane like a wand, he had shaped it and routed out the rudder slot. He also had covered himself—and me—with plastic dust. I was still picking bits from my clothing weeks later.

The board was constructed of two polyurethane halves separated by a stiffener—a one-inch stringer of balsa sandwiched by two 1/2-inch strips of redwood—running from nose to tail.

After a preliminary sanding, Bruno laid two layers of polypropylene fabric on the board and bonded them to the surface with polyester resin. Later he brushed on two more resin coats. Use of polypropylene is new in making surfboards. Ordinarily the boards are covered by fiberglass. But Hannon finds the new material stronger and more flexible, weighing less than half as much.

**Finishing.** After more sanding with medium (#100) and fine (#160) paper in a rotary sander, Bruno applied masking tape and painted on distinctive stripes. (The design had been previously selected by the guy who ordered this particular board.) Then the whole thing was covered with a coat of clear resin.

Next, the board was gone over with very fine (#380 and #400) wet sandpaper and rubbed with buffing compound. (All that finishing, incidentally, produces a slick board. Before you get into water, you must wax the top surface to make the plastic *less* slippery.) The last step was the addition of the replaceable, polypropylene skeg, a half-foot rudder that prevents yaw, held in place by a bolt.

The whole operation took eight hours.

The finished light, sleek model is a big change from the solid-wood behemoths of the '40s. In addition to losing all that weight, the design has been improved. One example is the "rocker," a slight upturn to the nose and tail. In the old days when you'd slide down a wave the nose would often "pearl," dip into the water and keep on going to the bottom, then zap back up again clear of the surface. Surfers used to stay underwater until they heard the thwack of the board hitting the surface.

The rear end of the new boards is up-

ended a bit so an expert surfer can step back, raise the front, and swivel.

I haven't learned to do that. In my subsequent surfing lessons I was content simply not to get thwacked when the rides ended. But with each try I learned a little more. I learned, for example, that you don't slide straight down the wave, but must turn so you slide diagonally across its front. And I learned that to turn the board I simply slow down one side by shifting my weight onto it. And I learned that I shouldn't try to ride over rocks.

Further, I found that every surfer quickly becomes an amateur oceanographer. He knows that:

- Water doesn't really move forward with the waves. Like a rug or rope flipped from an end, the apparent horizontal movement actually is a result of sequential up-and-down movements. Thus the board never is *pushed* toward shore, but slides down the water hill toward it.

- Though waves in the deep ocean may speed along at more than 50 m.p.h., the maximum velocity attained at the shore is usually less than half that. Waimea Bay, on Hawaii's Kauai Island, is generally cited as having the fastest waves used in surfing: just under 35 m.p.h.

- Waves are formed as ripples far out in the ocean and are pushed into huge swells by the wind. They travel in sets of six to eight, with the middle one or two the largest. Each wave breaks when its height equals the water depth.

- The perfect wave that surfers are always talking about isn't big, but small and long. As one of the guys put it, it's "the kind of wave that makes you whisper to it."

It doesn't take an awful lot of experience to be able to ride that kind of wave—and you *do* talk to it. ("Don't hurry me," for instance.) And this is one reason so many people are being stoked by surfing—you don't need a lot of lessons before you can do at least something.

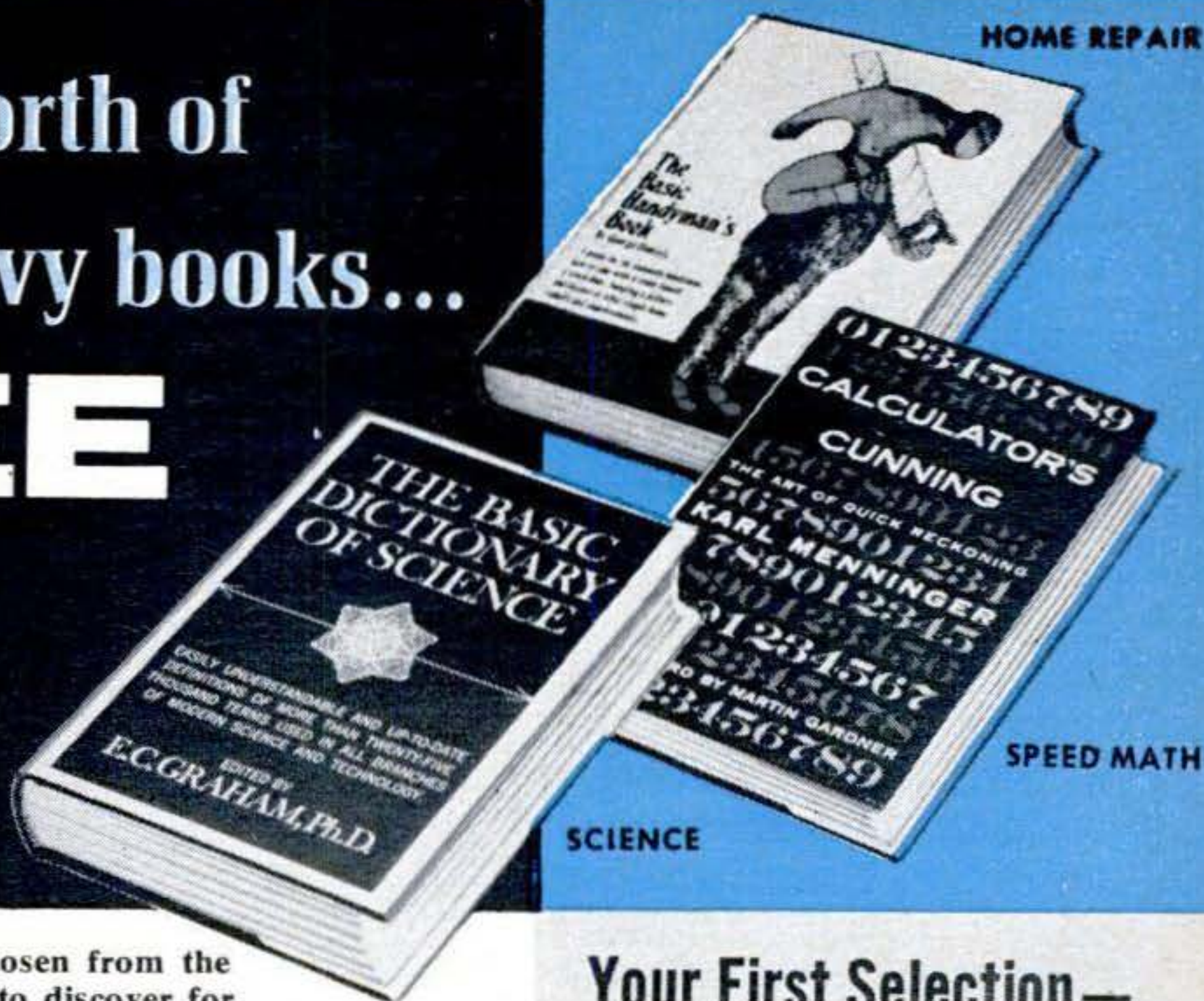
Maybe if you can forget the cold and the aches and the charley horses and the board zonks and the aggie-size bone growths under the knees and on the insteps—then possibly you will really get plugged in.



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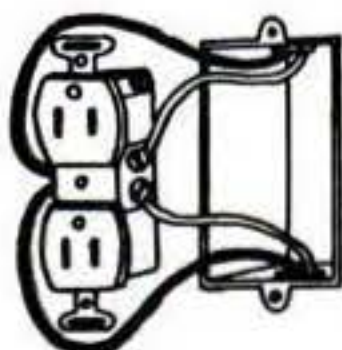
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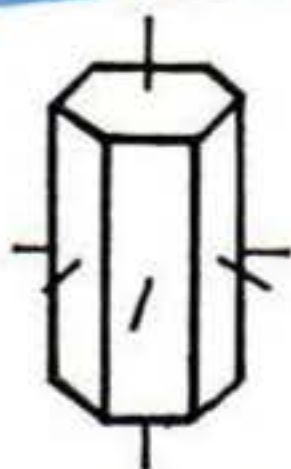
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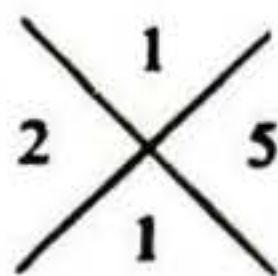
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## Trailer Tips and Tactics for Boatmen

[Continued from page 91]

straps, making her far more vulnerable than at sea.

Flat-bottom keel boats must be positioned so they rest on all rollers, with the longitudinal axis parallel to the trailer frame. Keep the hull level. Make sure each roller bears an equal proportion of the weight. Check on them during the course of the season, tightening bolt heads and fasteners so vibration doesn't cause droppage. Look over the rubber for splits that might permit the keel to slip down upon the metal frame. Pay particular attention to bow rollers where there may be bounce or pull against the winch cable.

**Beware of a short trailer.** Stern rollers should be positioned directly under the transom for maximum support—not 18 inches or two feet forward. With your outboard engine aft in normal trailering, it's imperative that the dead weight receive direct support. The best rigs have two-to-three-foot rear cradles with complete vertical and horizontal adjustment for every hull contour, dropped mechanically for ease in loading and launching. All rollers are sleeved to help guide the boat aboard.

Front pads keep the boat from swaying sideways by virtually locking the bow against a stop mounted on the winch stand. For V-bottom boats, the trailer framework curls to accommodate the shape of the hull. Trihedrals and other specially designed boats require trailers matching the contours of the hull.

**Trailer tires.** It would be fine to use the identical rims and tires for both your towing vehicle and boat trailer—except that the boat would perch so high off the ground that only a giant could reach over the gunwales. For the average outboard skiff in normal highway operation you'll need 4.80-8 four-ply, 6.00-9 six-ply, or the equivalent "midget" tires.

Carry a spare. Just as you have a completely mounted and inflated wheel for your car, do the same for your trailer. I even stow a couple of extra tire lugs in my emergency kit. A compact hydraulic jack and a four-way lug wrench service either the trailer or car in case of trouble.

Inflate your tires according to the manufacturer's recommendations. If you have doubts or are guessing at the total pound-

age aboard, load all fuel and water tanks, stow your baggage, and then drive to the nearest truck scale to get a positive answer. If you experience pronounced whipping or fishtailing with a tandem-wheel boat trailer, it can sometimes be reduced by increasing the air in the rear tires and slightly reducing the amount up forward.

**Tongue weight and tire inflation.** One trailering authority suggests a five-percent tongue weight for a rig loaded up to 1,500 total pounds, seven percent for those over this limit. This means about 75 pounds on a 16-foot skiff powered by a 55-horse outboard, 200 pounds (approximately) on a twin-engine 21-footer. It means that you can use a snap-down parking wheel forward on the lighter rig but that you'll need a crank-type parking jack and wheel assembly with the heavier boat.

Insufficient tongue weight causes an upward thrust, tending to lift the trailer coupling off the ball instead of weighting it down in the normal position. Insufficient tongue weight makes the boat's bow rise and the stern fall—a cause of whipping, weaving, swaying, or fishtailing.

**Frame and bumper hitches.** Use a quality frame hitch, designed and fitted to the towing vehicle, particularly with heavier boats. Bumper and axle-type hitches are practical only if you tow lightweight rigs infrequently and over short distances.

In tight corners, where maneuvering is difficult, try a front-bumper hitch. Push, don't pull, your boat. Keep her out front where you have maximum visibility coupled with an instant response to a turn of the steering wheel.

Use a highly geared manual winch or power winch that operates off your car's 12-volt battery. Don't break your back cranking your boat up every slight incline. Get a loading-guide accessory so the boat positions herself on the trailer. Use all the labor savers so small-boating ashore is as painless as the trailer engineers can make it.

Long-distance trailering is as specialized as pilotage, night navigation, or marlin-spike seamanship. Any duffer can limp by, but it takes an experienced old salt to travel thousands of miles without trouble.



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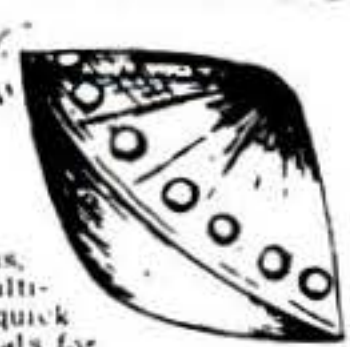
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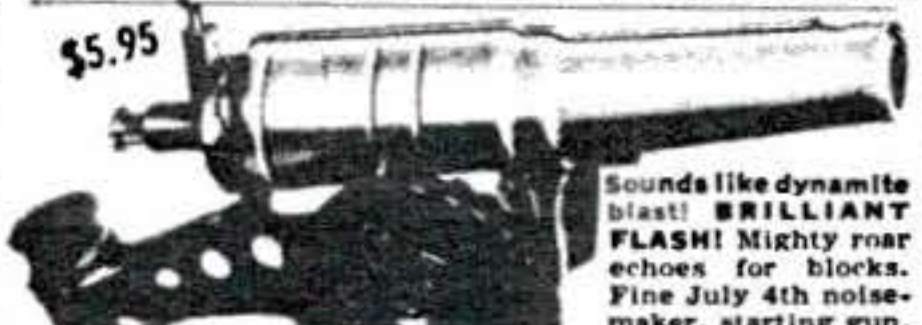
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## Ford's Stratified-Charge Engine

[Continued from page 48]

can also be duplicated by the road Lincoln. Burning regular gasoline, there was not the slightest ping or knock that would show the need for more expensive fuel. And the test Lincoln has a higher compression ratio than the standard Lincoln engine, due to the redesign of the combustion chamber.

**A look under the hood.** Except for the unfamiliar fuel pump and delivery system, the Lincoln engine compartment looks the same as a production car. Using the standard block solved all the problems of fitting the engine under the hood. The engine mounts were beefed up to protect the chassis from the extra harshness of the engine, though these changes are not visible. Valve covers, fan belts, ignition wires, and the standard accessories you find on this size car are all in their normal places under the hood.

Inside, the Lincoln is strictly stock. The one change in the ignition system—a separate solenoid-operated electrical circuit—is hidden under the instrument panel. This extra circuit is necessary to shut down the fuel delivery at the same time the ignition is turned off. Engine shut-down is instantaneous without running-on (dieseling).

Two claims for the engine that I could not check out are its lower maintenance costs and its smog-control capabilities. Aladar Simko did say that the spark plugs, which will cost slightly more than the standard plugs now on the market (perhaps \$1.25 each), will have the same life as ordinary plugs. And, while distributor points may need maintenance, too, the elimination of the carburetor solves all its problems of adjustment and maintenance.

As for the smogfree exhaust, I was able to observe—in a strange way—some indication of the clean-burning combustion. It smells bad. That's the simplest way of describing a clean exhaust, and that is the way this engine exhaust affects you. It has the same noxious smell that you get from any superventilated engine. (For the hairsplitters, "smog-free" as used here means that the emissions are within government smog-control specifications.)

**Listing the drawbacks.** The exhaust smell is the FCP's major fault. The others are minor when compared with the benefits of FCP:

- **Engine harshness.** Operating pressures throughout the combustion chamber and exhaust system are higher than in a carbureted engine, cause vibrations and noise that require stronger chassis frames and more soundproofing. In the test Lincoln I barely noticed any engine vibrations.

- **Higher cost of the FCP engine** limits its economical use to vehicles driven much more than the 10,000 to 12,000 miles a year of the average car—20,000 miles is cited as a probable break-even mileage. No figures are available right now, but the cost of the engine is roughly figured as \$100 to \$150 more than a standard engine. Comparable 320-hp. gasoline engines cost about \$1,000.

- **Slow warm-up.** The test car I drove demonstrated perfectly the slow warm-up quirk of stratified-charge combustion. I picked up the car on a cold day and drove out to the parking lot to take pictures. I let the engine idle. After 20 minutes, the engine temperature gauge still showed *Cold*. However, after five minutes of driving, the engine warmed up and stayed warm.

Bishop says the cold air inside the combustion chamber insulates the combustion from the cylinder walls, keeping them cool at idle speeds, and no thermostat can heat up the engine coolant. What actually happens is that burning is confined to the center of the chamber, and not all the air that is drawn into the chamber has a chance to heat up. It will not burn since it is not mixed with fuel, and the heat at idle speed is not hot enough to warm it up.

That sums up the good and bad points. Now, the question is, how soon will the engine be on sale? Ford engineers say that it will take three to seven years to get the FCP to market, depending on demand. If the Government wants the engine for its Mutts, it could be out in three years. If no crash program develops, the engine might have to wait the full seven before you can park an FCP car in your garage.





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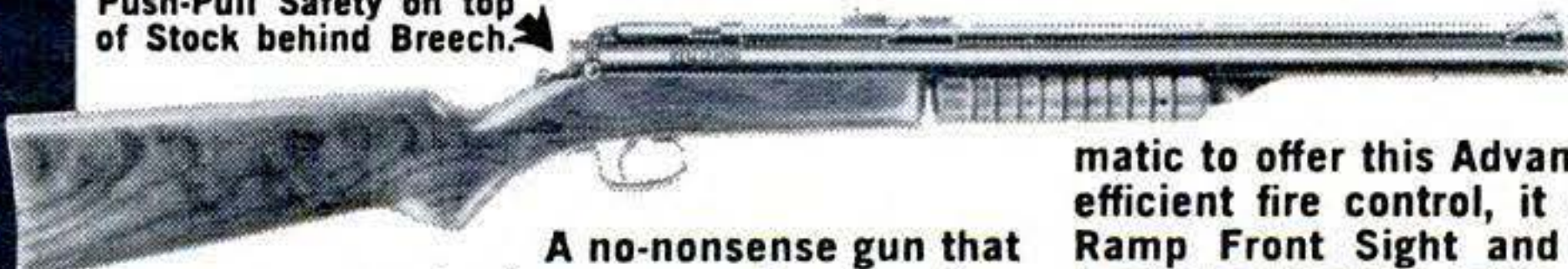
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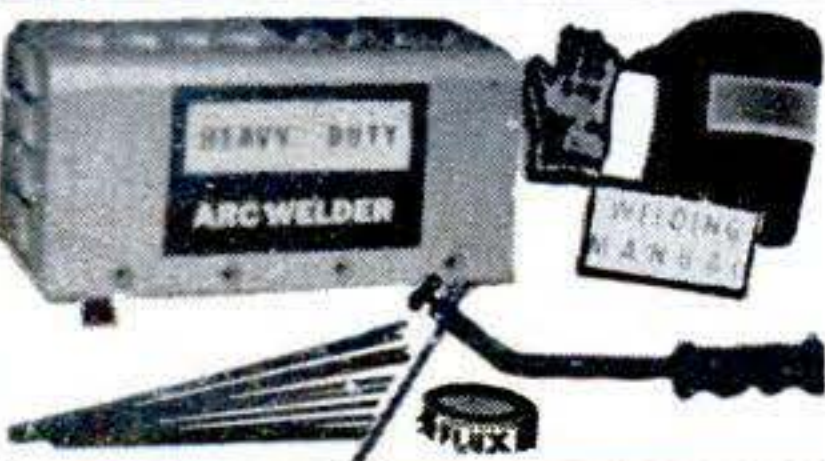
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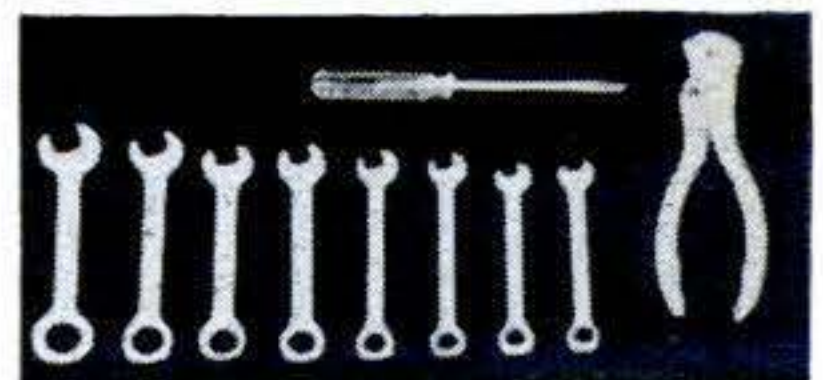
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## Coast-to-Coast in Under 45 Hours!

[Continued from page 39]

immediately. We looked for the toll gate with the least delay. We kept a constant watch on all lanes when traffic was heavy. Before we left the New Jersey Turnpike, we had jumped ahead of schedule. We started with a full tank and were nearly across Pennsylvania before we needed to fill up with gas.

At service stations, we sought out a free gas pump and started filling up without waiting for attendants. They saw the signs on the wagon and got the idea. Most of them cleaned the windshield hurriedly, without a word. While one of us rushed to the rest room, the other pumped gas. The "rested" man would complete the job, pay for the gas, and wait for the other at the wheel, with the engine running. We never stayed over five minutes at any station.

**No candlelight dinners.** We didn't even have dinner together, nor did we stop to eat or buy any food or beverage. For our high-speed meals, we carried a supply of roast-beef sandwiches, hot tea in thermos flasks, grapes, oranges, and apples, plus some candy. We found variety of food to be more important than quantity.

We also carried 15 gallons of gas in five-gallon jerricans, but we never needed them. That was one of the surprises of the trip. Far from finding ourselves lost in the desert at two a.m. without any sign of civilization, we were within reach of an open gas station every time we needed to tank up.

**To sleep and dream.** Most of us don't sleep very well while traveling, even on jet planes. How would you expect to sleep in the back of a wagon? We did. An air mattress plus a sleeping bag gave insulation from the car and shut out light and noise. We placed the bunk lengthwise, as in an ambulance, with the feet near the wagon's tailgate.

Just stretching out completely and closing your eyes as if asleep is a good way to rest. Luckily, neither of us had any symptoms of motion sickness at any time on the trip. The only thing that was sure to wake a man up was a stretch of winding road. He'd fall out of bed or find himself pressed against the wall on the turns.

The driver had full freedom to move his legs because we had ordered the car

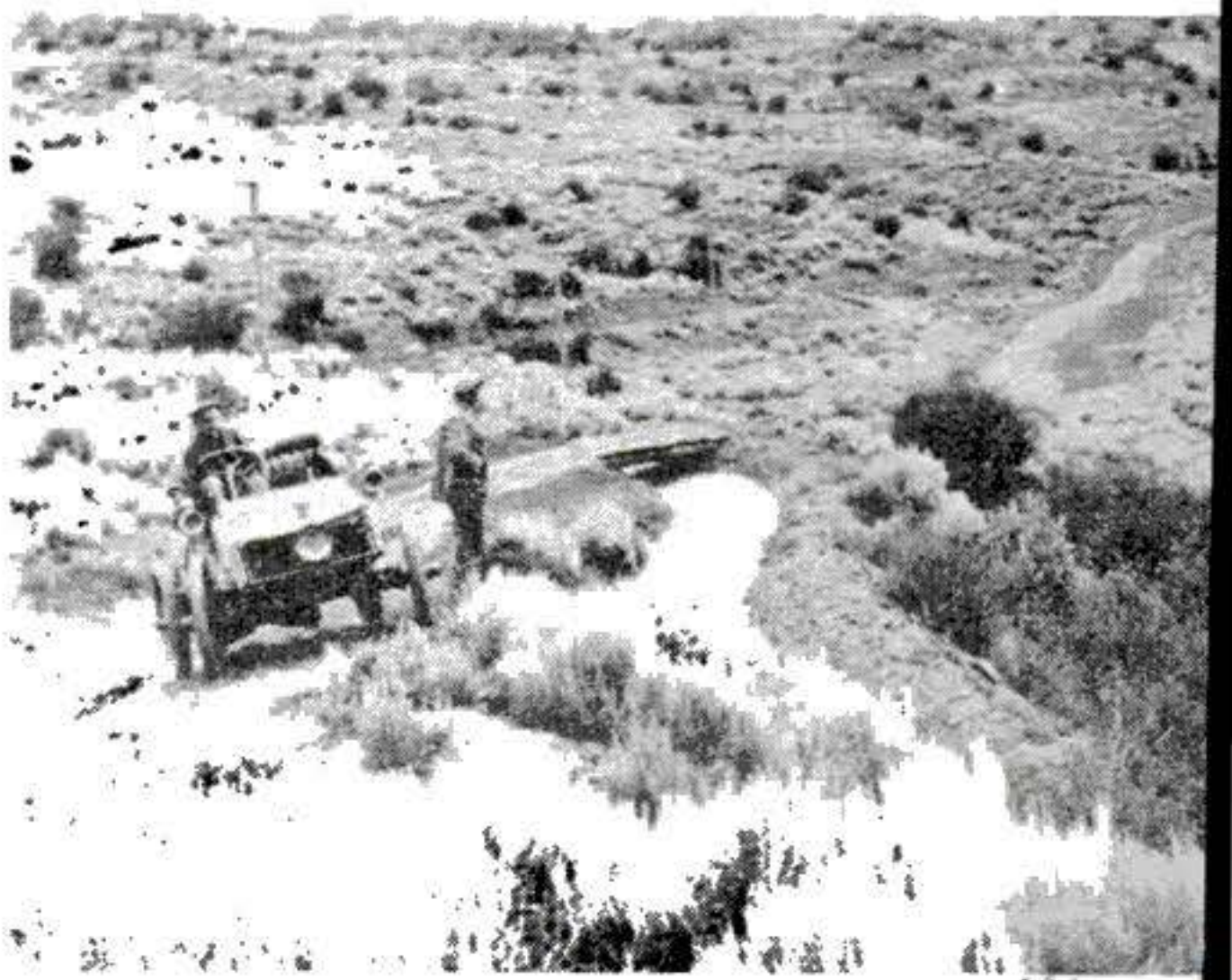
with automatic speed control. This was a major factor in our success. On the turnpikes, it kept us from wasting time in case the driver inadvertently eased his foot off the accelerator. Conversely, it helped him resist the urge to press the loud pedal to the floorboards. In 50-m.p.h. zones, even in 35-m.p.h. zones, no matter how short, we used the automatic speed control to allow the driver to concentrate on finding his way.

**The first night.** We hit our slowest parts during the hours of darkness—getting out of Columbus, Ohio, was a tedious process. On the highway from Indianapolis, Ind. to Effingham, Ill., we almost lost our advance. The Interstate Highway program is nowhere near completion in this area and we were mostly on two-lane roads with trucks going both ways. But after St. Louis, Mo., we made excellent time waiting for dawn.

We had traveled for 22 hours, 22 minutes, and 22 seconds as we approached Oklahoma City and we knew we were winning. At the 24-hour mark, we were at Weatherford, Okla. The car ran so smoothly it might have had a turbine under the hood. There was never the slightest hint of a malfunction during the whole trip. We had confidence in the car when we started; we had even more at the halfway point.

**Keeping awake and fresh.** We had ordered a six-way power seat and a tilt wheel as the best combination for driver comfort.

*Continued*



When Tom Fetch crossed the country with his Packard in 1903, there were practically no roads. He went through uncharted territories and met with heavy rains. The car's top speed was 27 m.p.h.





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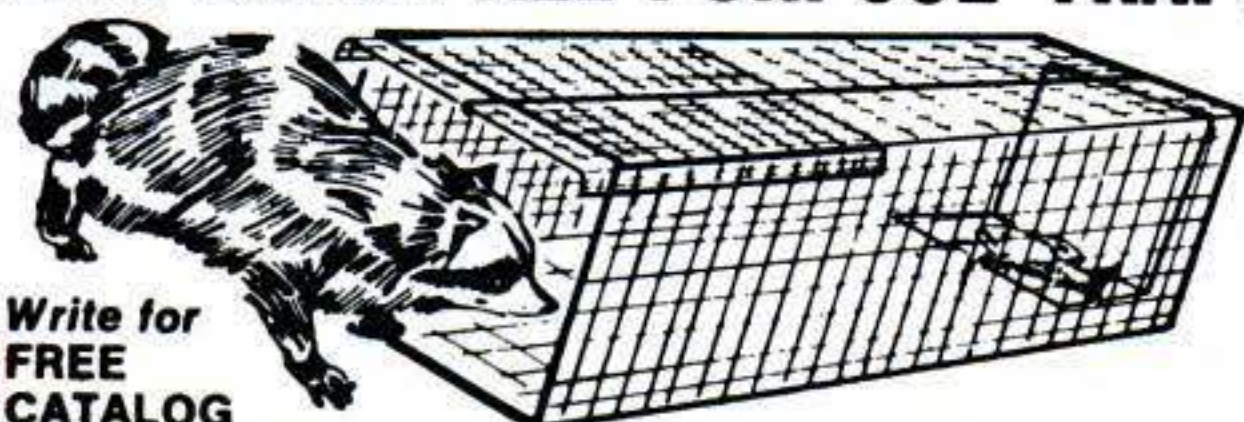
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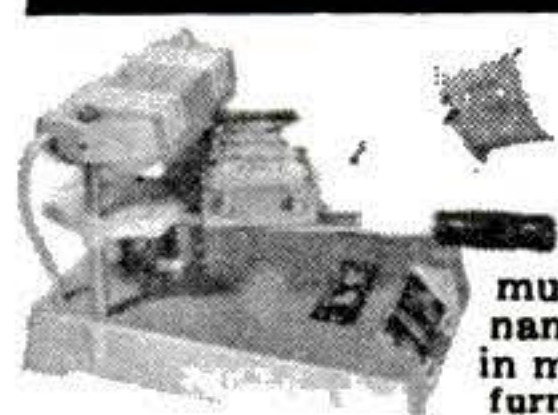
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**California, here we come.** It wasn't suddenly. It was a long trek across the Arizona mountains. Traffic flow was smooth and we crossed into California about a half-hour after midnight. We were happy about the kind of time we were making, and we began to talk about the biggest surprise of all—*how easy it was.*

About 75 percent of our total distance was Interstate Highways, or roads of equivalent quality in terms of width, surface, and marking. Most of the time, we were in territory neither of us had seen before.

This nation's network of highways is unique. Nowhere else in the world can you drive for similar distances at that kind of speed. Yet we feel that the speed limits were too low. Many cars passed us, mostly driven by ladies or middle-aged men, with passengers and luggage. They drove at a steady clip, with excellent lane discipline, and made no mistakes. Their cars were usually late-model luxury cars, with an occasional Mustang or Charger. We could only conclude that the cars and highways are suitable for higher speeds than are now allowed.

The last hundred miles were as uneventful as the first 2,771. When we arrived in Los Angeles, we wanted a shave, a shower, and clean clothes more than rest and sleep. We felt we could just turn around and go back to New York again. The last man who did that was Bob McKenzie, back in 1935, with Plymouth. He covered 6,429 miles in 12 hours and 52 minutes, driving solo.

Who was the first coast-to-coast record holder? Tom Fetch, a Packard foreman. In 1903, he went from San Francisco to New York in 61 days.

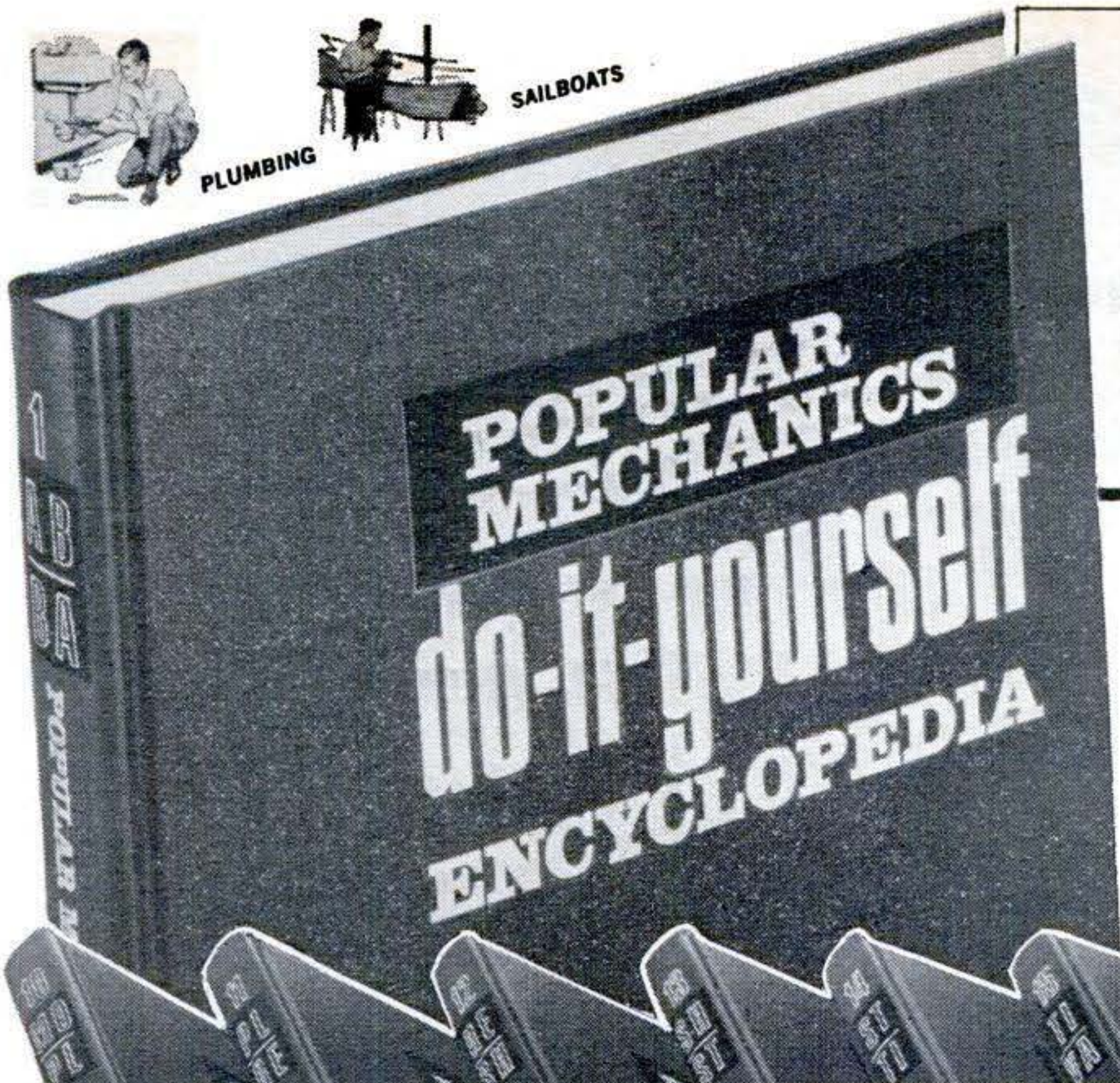




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Spacecraft Tell What Moon Is Made of  
[Continued from page 74]

basalt rock of the Hudson River Palisades and other familiar formations on earth, as well as to "basaltic achondrites" that have been found in meteorites.

In another mare site, Surveyor VI's almost identical analysis confirmed that much of the moon's surface is of this composition. Even in the highlands near Tycho, Surveyor VII's report did not depart widely from the others. (One difference—a little less iron in the highlands' rock—possibly might help account for their lighter color than the mares.)

Surveyor VII, uniquely, carried both a digging tool and a chem kit. Thus the tool could dig up material to be analyzed. It could also pick up and move the analyzer to a desired spot. And the tool dramatically came to the rescue in an unexpected crisis:

After the last Surveyor had brought off the riskiest landing of any, in rough new terrain, the chem kit failed to descend on command. Stuck, it dangled tantalizingly, far from the soil. At the Goldstone console, an operator commanded the excavating tool to try to nudge the box downward and free. It worked, and the day was saved.

A "moon hop." Among the feats of the Surveyors—designed and built by Hughes Aircraft under the direction and supervision of NASA's Cal-tech-operated Jet Propulsion Laboratory, Pasadena—was another unprecedented one. By firing its three vernier engines, Surveyor V hopped from its lunar landing site to a new one eight feet away. Its six-second flight, though short indeed, made it man's first vehicle to travel across the surface of the moon. It also showed that the blast effect of a rocket engine on lunar soil is quite mild.

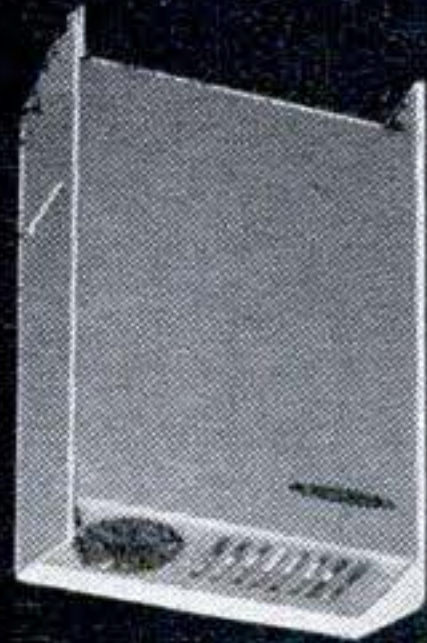
Most importantly, from a practical viewpoint, our Surveyors show that the moon is actually a most benign place to land upon. If we could have chosen ideal soil conditions for man's first landing on another heavenly body, we would have come pretty close to writing down the specifications actually met by the moon. Even the rugged and supposedly forbidding region visited by Surveyor VII now looks entirely acceptable as a site for later manned landings.



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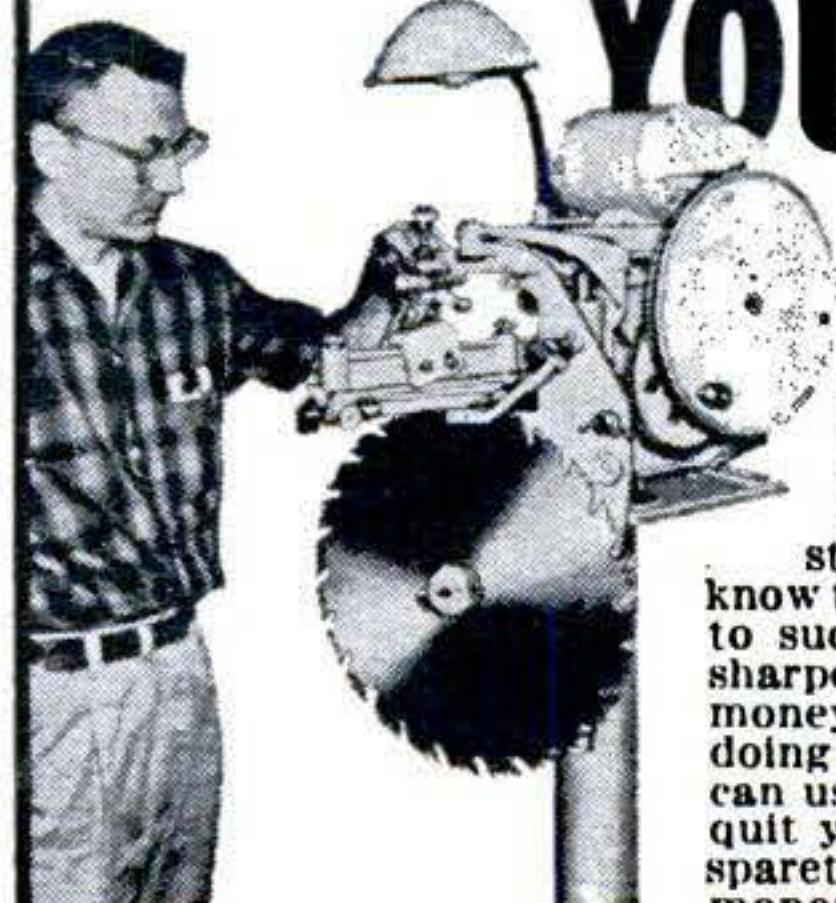
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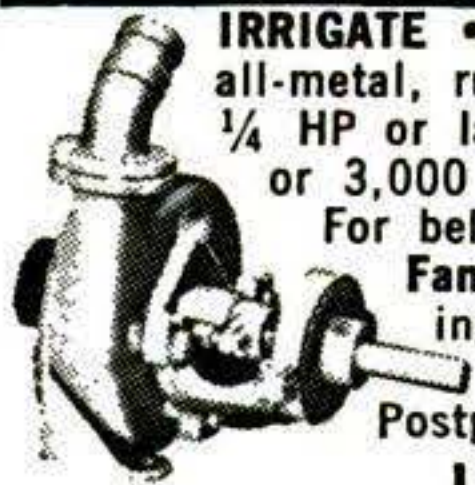
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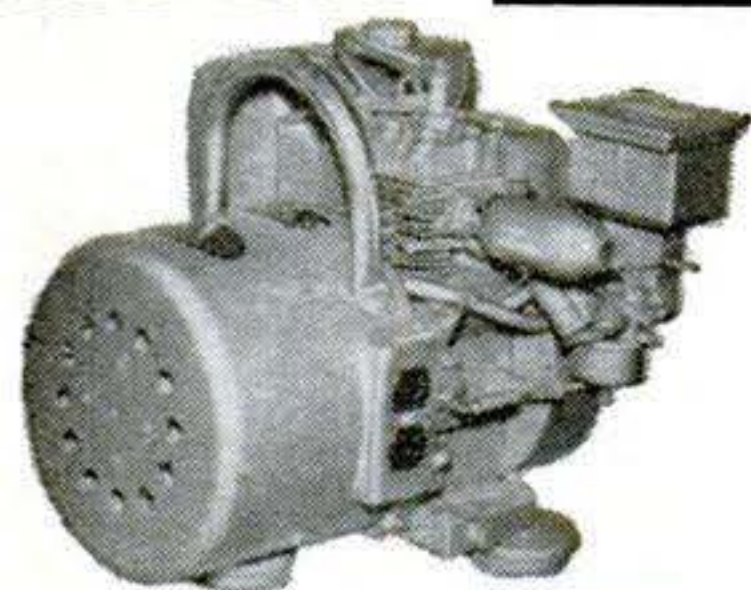
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### Wide Use from a Narrow Workshop

[Continued from page 134]

workshop—even a narrow or small one.

Bench-top construction is one. The top in this case was made of two-by-fours alternately flat and on edge. Those on edge give rigidity, the flats economy. If you want maximum rigidity, though, place all two-by-fours on edge to create a laminated top.

A little forethought about cleanup can save you time and work later, and keep the floor debris-free while you're working. The top here is designed with a shavings trough, a standard—and good—feature on many professional woodworking benches. When it's necessary to clear the work area as you do a job, you brush dirt into the trough—not on your feet. At the end of the work session it's simply brushed into a cardboard box or waste receptacle held at either end.

You'll also find the trough handy when you're working with large pieces of material. Tools can be laid in the well where they will be below the work surface and won't mar the material being handled on the bench.

Since a radial saw is best installed with benches on both sides (to support long workpieces), keep the bench tops level with the saw table. For ease of cleaning and greater mobility, mount the saw on casters. This way the saw can be rolled out of its pocket if desired.

Unless you install extra lighting over the workbench, you'll be working in your own shadow much of the time. Minimize this by painting the walls and toolboard off-white, or a light color, to reflect light and provide better visibility.

Carpet on a workshop floor? Why not—if it's the new indoor/outdoor type? In this case, a strip from Viking Carpets was placed in front of the workbench. The carpet gives comfort underfoot when standing on concrete for long periods of time. Since it's stain-resistant and non-absorbent, cleanup is simple; spilled liquids can be mopped up quickly with sponge or cloth. It costs about \$14 per square yard installed.

The basic rule to keep in mind when you come to lay out your own shop is orderliness. Though you can cram a lot into that odd shape, the narrow shop just has no room for clutter.



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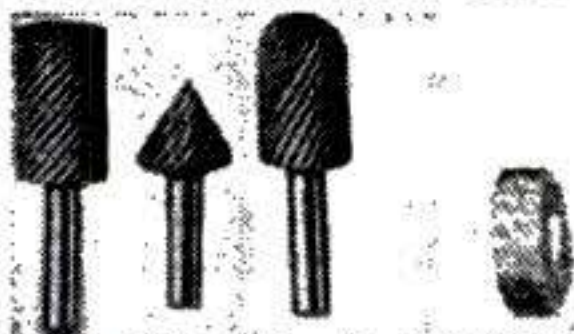


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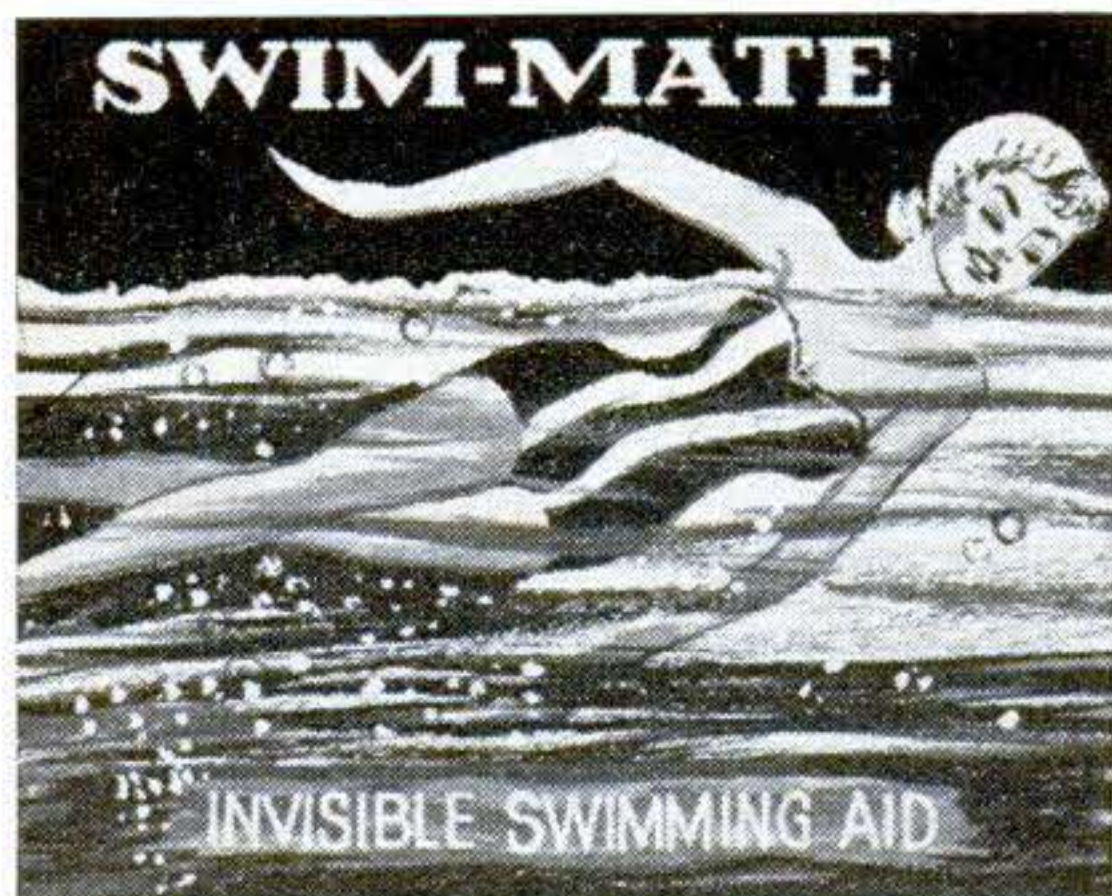
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## Tornadoes: Death Does the Twist

[Continued from page 53]

almost defies comprehension. The Tulsa twister was equivalent to the energy generated by as many as several hundred thousand cells operating simultaneously. (The average thunderstorm contains about five cells, or active electrical centers.) The release of a charge in this amount, strong enough to create a large, sudden shift in the earth's magnetic field, should be detectable anywhere on our globe."

With such unharnessed raw energy on the loose, is it any wonder that tornadoes whirl at nearly the speed of sound, roar with the noise of 100 freight trains, and make furious winds that turn normally harmless objects into dangerous missiles?

Flowers have been driven into pieces of wood, chips have knocked holes in limbs of trees, riverbeds have been sucked dry of water, and 70-ton railroad coaches have been carried 80 feet in the air and laid in a ditch.

**Spotting tornadoes in the making.** As a result of Dr. Fujita's study of 37 tornadoes that struck the Midwest on Palm Sunday, April 11, 1965, weather forecasters at the Local Severe Storms Warning Center in Kansas City now can identify with radar about 80 percent of the "rotating" thunderstorms that spawn deadly twisters.

Had there been a warning system in effect on March 18, 1925, approaching that in readiness today, the casualty list of the worst tornado in U.S. history would have been much lower.

This treacherous storm occurred in Reynolds County, Mo., and was all the more devastating because it didn't follow the rules. A typical vortex cloud did not appear. Eyewitnesses reported blackness, flying limbs, but no snaky funnel. But in its wake, the tornado left 689 dead, 2,000 injured, and a property loss of more than \$16 million.

Dr. Chang hopes to learn how to build structures that will withstand such high winds as occurred in Reynolds County by observing the indoor whirlwind he has constructed.

His tornado-in-a-cage spins up to 100 m.p.h., sucking up pieces of confetti and a cardboard model house into a funnel of smoke. The low pressure in the eye of



**Tornadoes: Death Does the Twist**  
 Chang's miniature storm replicates the vacuum effect of a real tornado as it passes over a house. The outside pressure is suddenly sucked away and the pressure inside the house explodes outward to fill the void.

Weather modification of the sort that would make tornadoes harmless is a job the U.S. Environmental Science Service Administration (ESSA) could take on, suggests Dr. Stirling Colgate, who is a member of the National Sciences Foundation and heads the New Mexico Institute of Mining and Technology.

**Alerting for tornadoes.** "Since we now have positive evidence that tornadoes are electrically powered phenomena," says Dr. Colgate, "the next step would be for ESSA to mount a program to relate this knowledge and other tornado research into a coordinated body of facts. ESSA could then develop an organization capable of acting within minutes of a severe tornado warning."

Colgate and others have suggested this might be a civilian weather-modification corps which would have the instant retaliatory capability of the Strategic Air Command. Fast-flying "weather" jets would blast off and drop bombs that would cause an electrical "short" in a tornado.

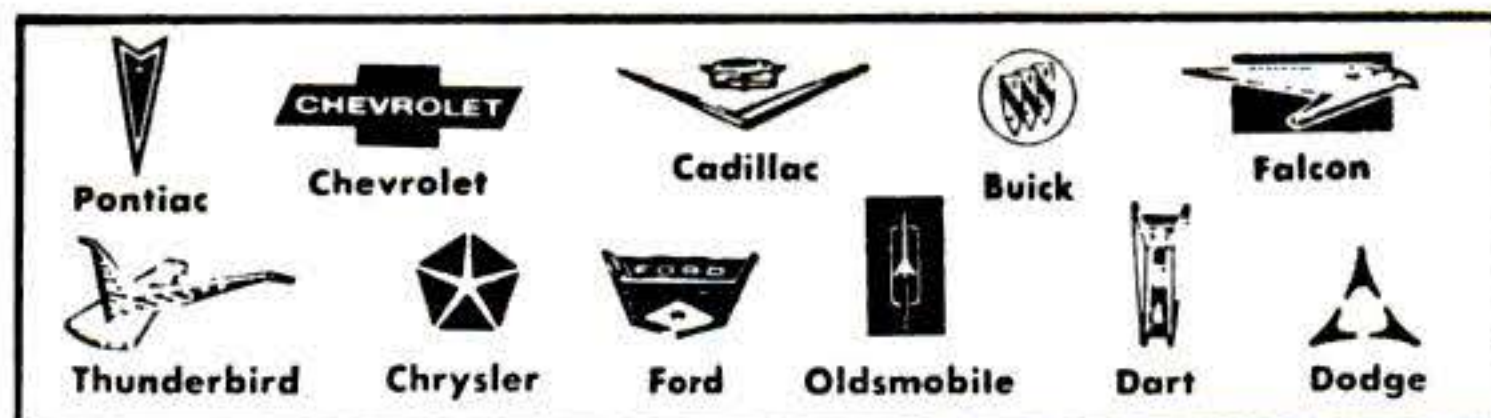
One of these bombs might contain fine wire chaff composed of aluminum-coated fibers that would short out the electrical heat-generating process in the cloud from which the twisting black funnel below draws energy to sustain its fury and destruction.

The only safe places when a tornado strikes are ventilated underground cellars, or caves. Lacking such protection, follow these rules:

- In a city or town, seek shelter inside a strong, reinforced building. Stay away from windows. In a house, the corner of the basement facing the tornado offers the best protection. School children should be placed near an inside wall on the lowest floor.

- In open country, move at right angles to the tornado's path. If you can't escape, lie flat in a ditch.

- Above all, keep calm. People have been killed by running into the streets and turning back into the path of a whirling tornado.



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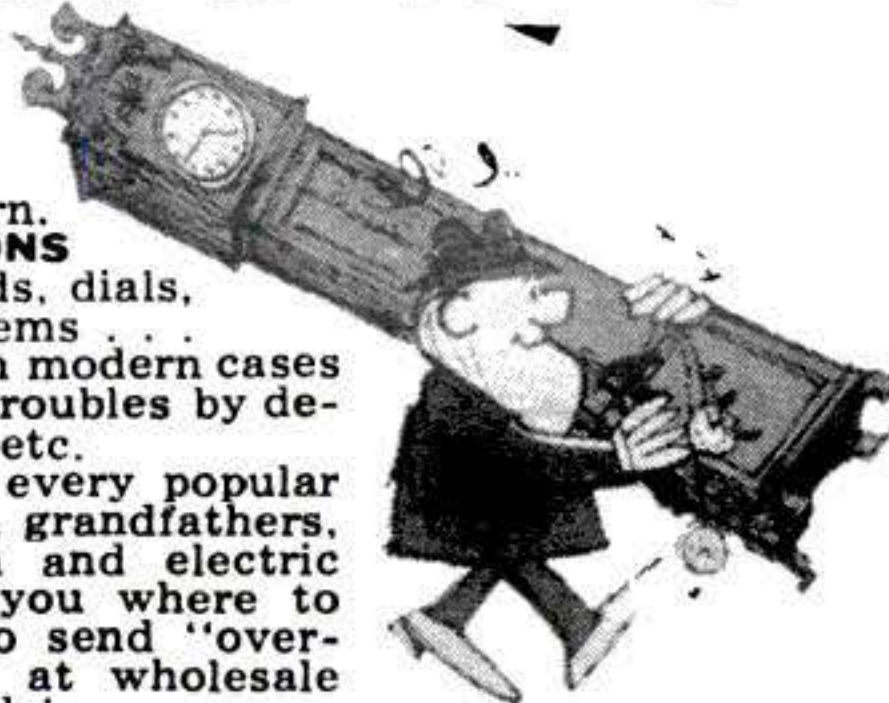


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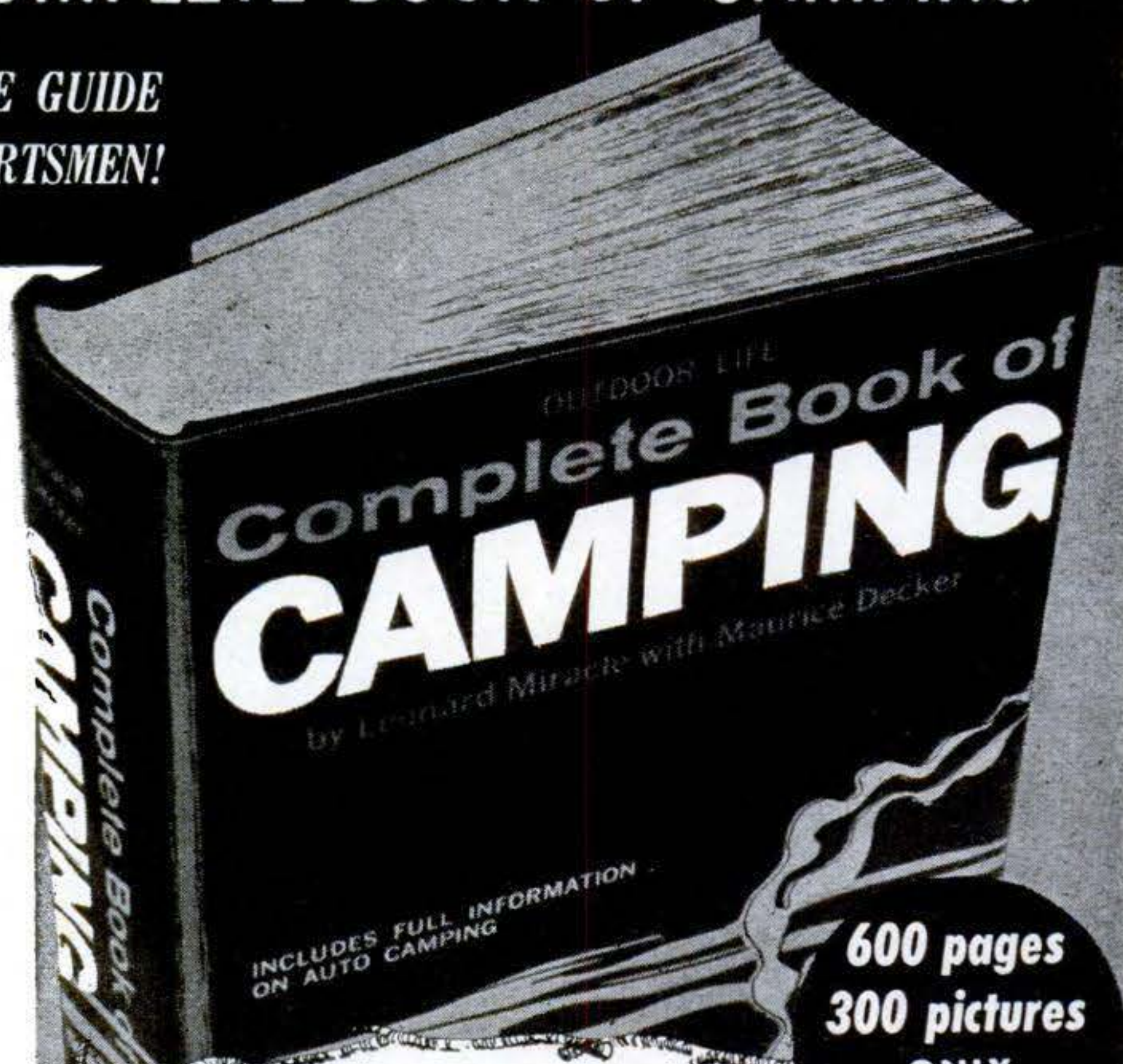
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**The \$2,000 Imports**  
 [Continued from page 81]

tection. Two amber, one blue, and one red light on dash are not labeled in any way. There's no glove box at all, just a shelf. The windshield has an unusually wide unwiped area on the right.

Datsun's front seat in its normal position (all the way back) makes it difficult to reach the rear-door window crank.

Sunbeam has a questionable overall quality. The starter gear had a tendency to get hung up on the flywheel. The rear axle had an ever-present loud moan (except in reverse); the valve train developed a noise during our tests; and the speedometer gave off a constant click-click-click. Against this, note that Chrysler sells this car with a five-year or 50,000-mile warranty. With four occupants in the car, the suspension kept bottoming on moderately bad roads.

Built in Britain, the Sunbeam was originally designed for right-hand drive. In the U. S. model, the hood release stayed on the extreme right—out of the driver's reach.

The door locks are simple in principle but inconvenient in practice, being remote from the door handles and in an unnatural position. Vent windows are nearly impossible to unlock and open with one hand.

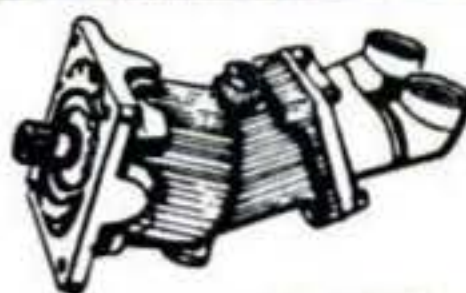
Toyota's braking performance must stand as its worst feature. Other irritants include a wide unwiped space on the right side of the windshield; an instrument panel studded with knobs sticking out at least an inch (something of a hazard in a collision); unusually hard steering for such a light car; and hard-to-reach rear-door handles. The designers seem to have forgotten that rear-seat passengers have to open doors from inside.

**CONCLUSIONS**

NORBYE: My choice is the Datsun. I appreciate engineering refinements such as an overhead camshaft and independent rear suspension. It's handy in city traffic, quiet and directionally stable on the turnpike, with a comfortable ride.

DUNNE: My vote goes to the Sunbeam. It's a fine little sedan with excellent brakes and great handling. I am sure, from other Sunbeams I have driven, that our test car had an above-average share of quality-control problems. P 5

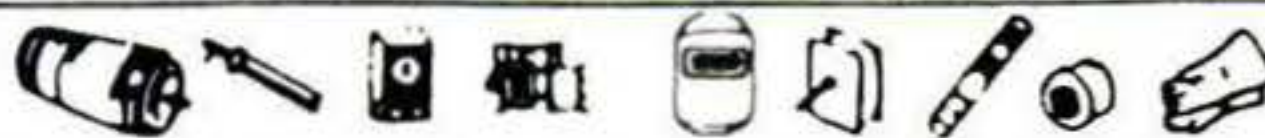
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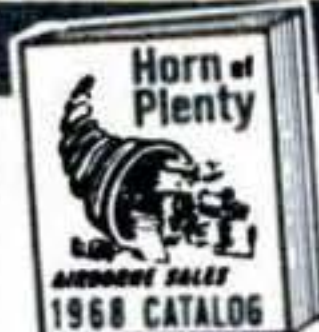
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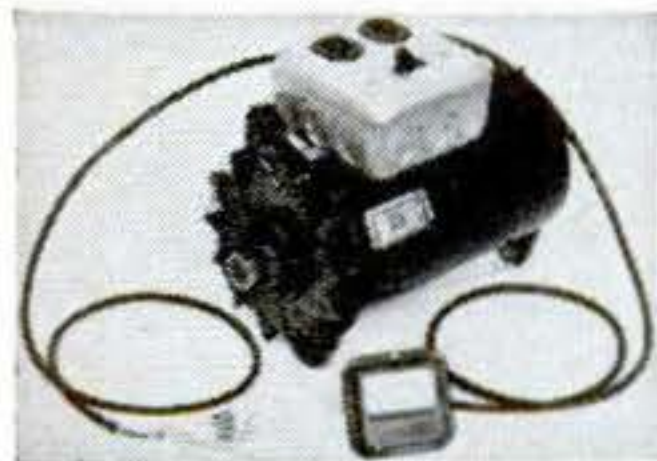
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## Tricks the Treasure Hunters Use

[Continued from page 97]

that showed the location of boardwalks and important buildings before a fire wiped them all out. By taking new photographs and comparing them with the old, he was able to accurately plot the spot he wanted to search. It proved rewarding for this enterprising treasure hunter.

When hunting around an old mountain town, look on the steep slopes under each old cabin. That's where they threw refuse in those days—out the back window. You may find some objects of no value when discarded, by now worth money as antiques.

Sometimes a box of valuables was hidden in a shallow hole under a young sapling—which over many years grew into a huge tree. The roots often completely encircle a strong box and it must be chopped out. But searching every tree in sight would be a monstrous undertaking. Narrow it down to solitary trees standing on knolls or ridges above old homes, or to trees growing in back yards, or to any tree which for some reason seems prominent or noticeable. Use your detector around the base of the tree and over any hollow parts of the trunk. Old trees are always worth checking, both above and below ground.

Don't be fooled by color. Anything buried in damp soil quickly changes color, and the texture gets rough, flaky, and streaked. Gold turns black or sooty. One hunter described old gold nuggets as resembling barbecue charcoal. Silver and copper turn green, or greenish blue, or black. In fact, silver coins in salt water might be nearly completely dissolved, so don't expect to find clean round shapes. Look for misshapen, dull-colored, caked metallic-looking objects.

Searching in barren fields or in generally uninhabited areas is pointless. You're not a mineral prospector. You're seeking valuable objects that were buried or lost by persons long ago. This means that old buildings, ranch houses, ghost towns, old family homesteads, stage depots, and other signs of historic habitation are the best bet. There are other good areas—plenty of them. But make sure your territory was occupied by human beings at some past time.

Happy treasure hunting!



## Honda Gives You Two Bikes in One

[Continued from page 93]

a shock-and-spring unit. I found that any jolts the suspension missed, the soft sponge seat took care of.

If you suspect that the Honda is a glorified street bike, you're wrong. Take the combination of step-through frame and dual brake levers on the handlebars. Being used to a clutch lever on the left side of the bars, I didn't like this arrangement at first.

**Great in a rock slide.** One day later, I thought it was the best thing that ever happened. We took the little Honda to the local mountains, and packed in for a weekend. My compatriot had no luggage rack, so he used a small backpack. I carried most of the equipment on the rack of the Honda. We were working our way up a rocky mountainside when, without any warning, the entire side of the hill broke loose. If I had tried for the foot-brake, I would have been knocked down. Instead, I jammed on both brakes on the bars, and slid off the front of the seat, firmly planting both feet.

Other than two rock-bruised shins, I had no problem staying on the side of the mountain. The pile of camping gear would have been too high for me to throw my leg over and dismount, so the step-through frame and dual handbrakes kept me out of trouble.

To wrap it up, the Honda CT 90 is well made, well finished, extremely reliable, and does the jobs it was designed to do. And it's really two bikes in one (at the price of just one). P S

### Facts on the Honda Trail 90

Engine type	SOHC 4-stroke single-cyl.
Displacement	5.48 cu. in.
Compression ratio	8.2:1
Power @ r.p.m.	7 hp. @ 8,500
Clutch	Automatic multidisk
Gear ratios	Street: 1st-28.339:1 2nd-17.998:1 3rd-13.287:1 4th-10.697:1 Trail: 1st-52.904:1 2nd-33.587:1 3rd-24.810:1 4th-19.975:1
Tire size	2.50-17 front, 2.75-17 rear
Starting	Folding kick starter
Wheelbase	71 inches
Weight	181 pounds
Ground clearance	5.5 inches
Price (POE West Coast)	\$330



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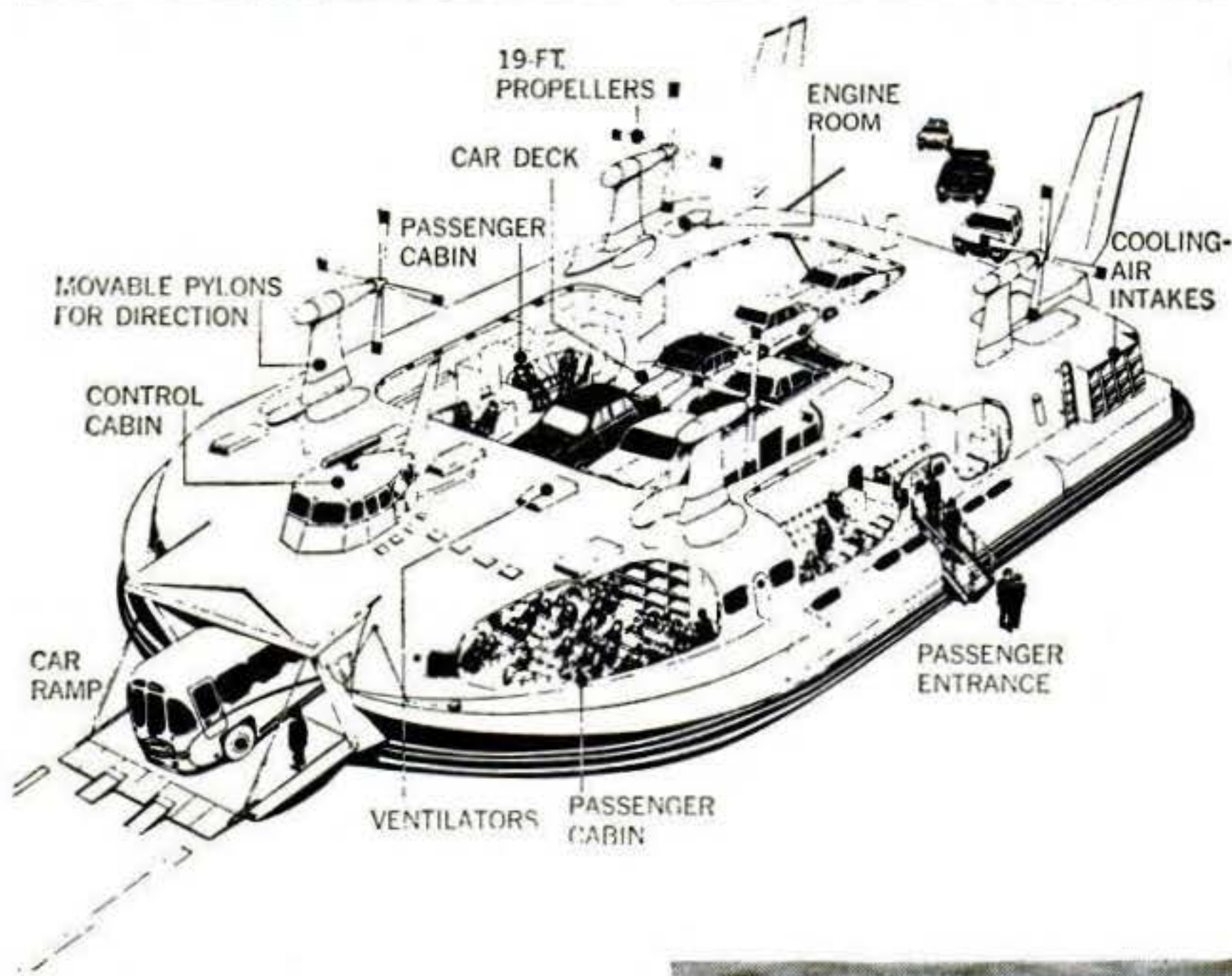
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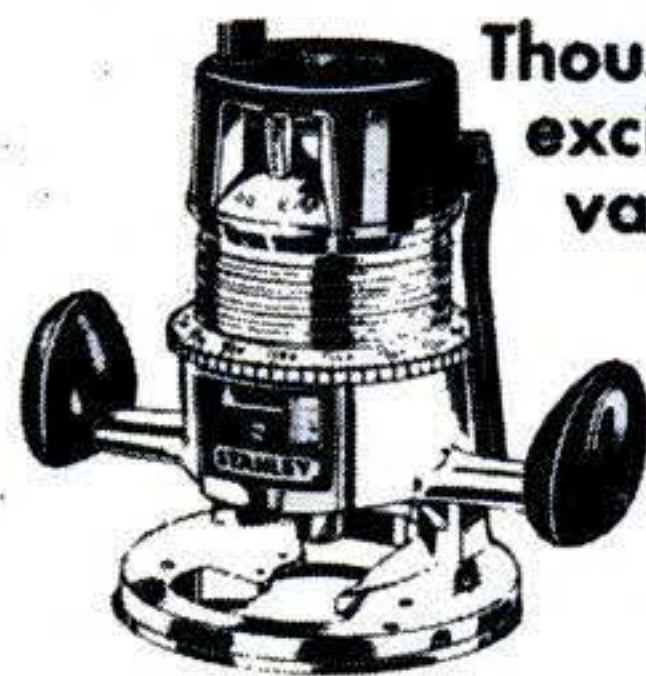
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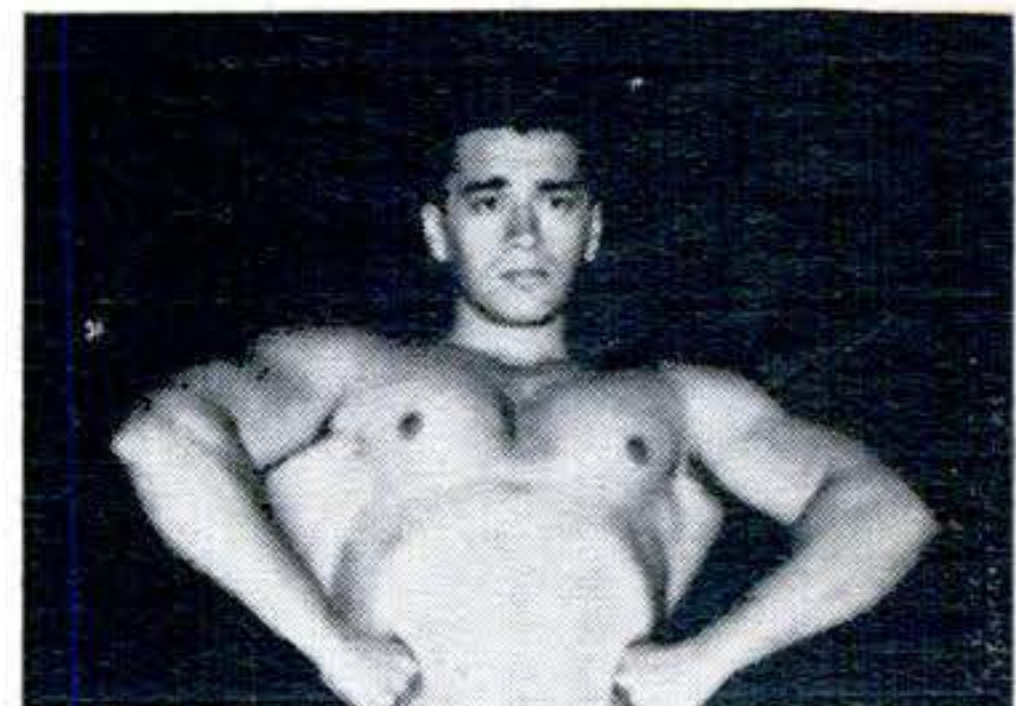
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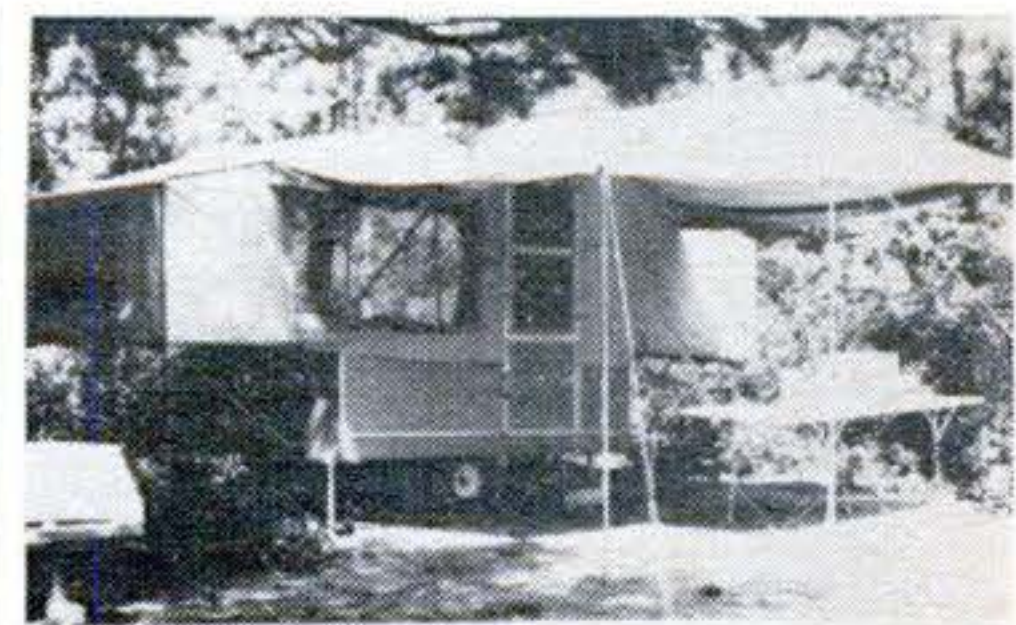
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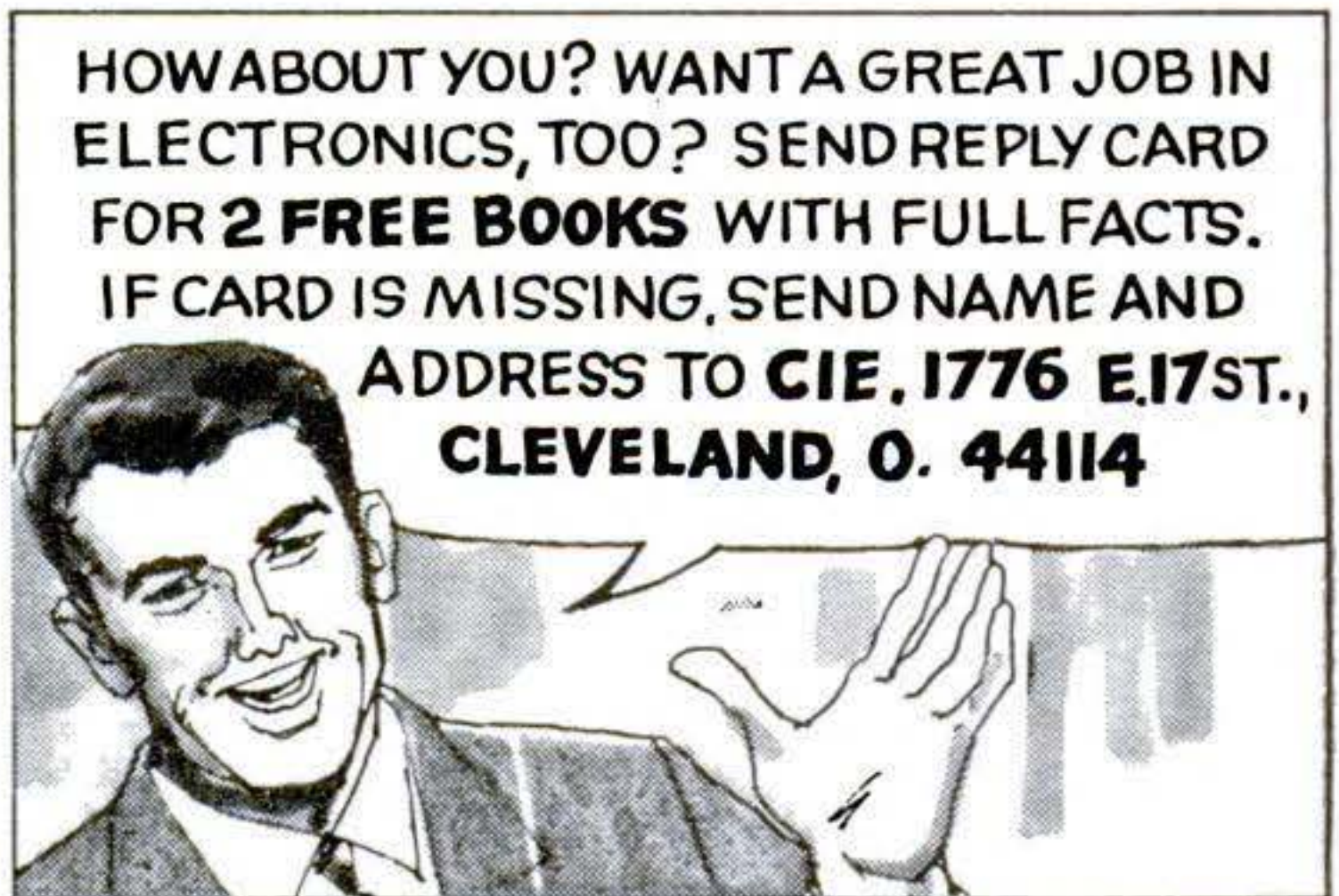
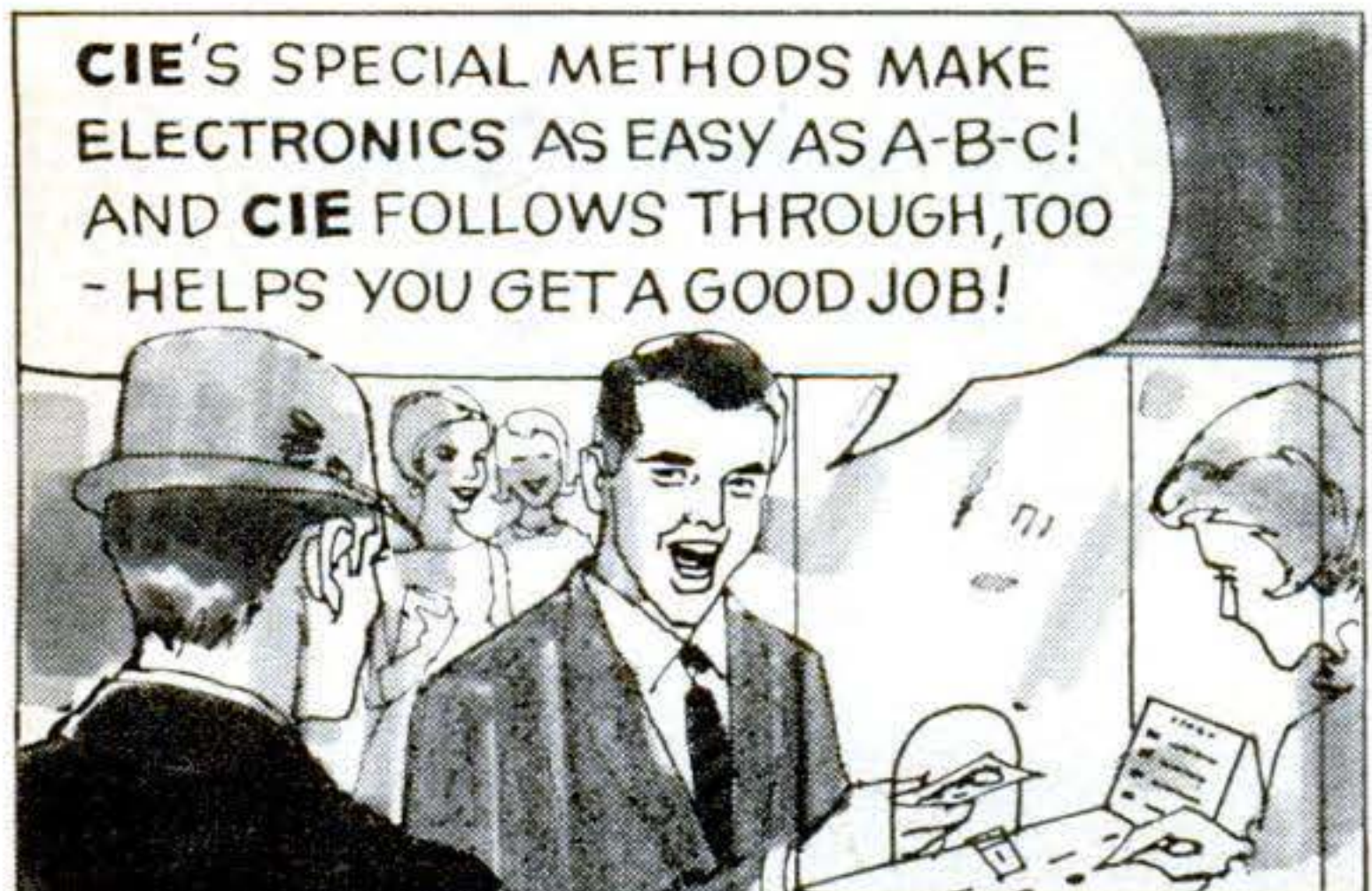
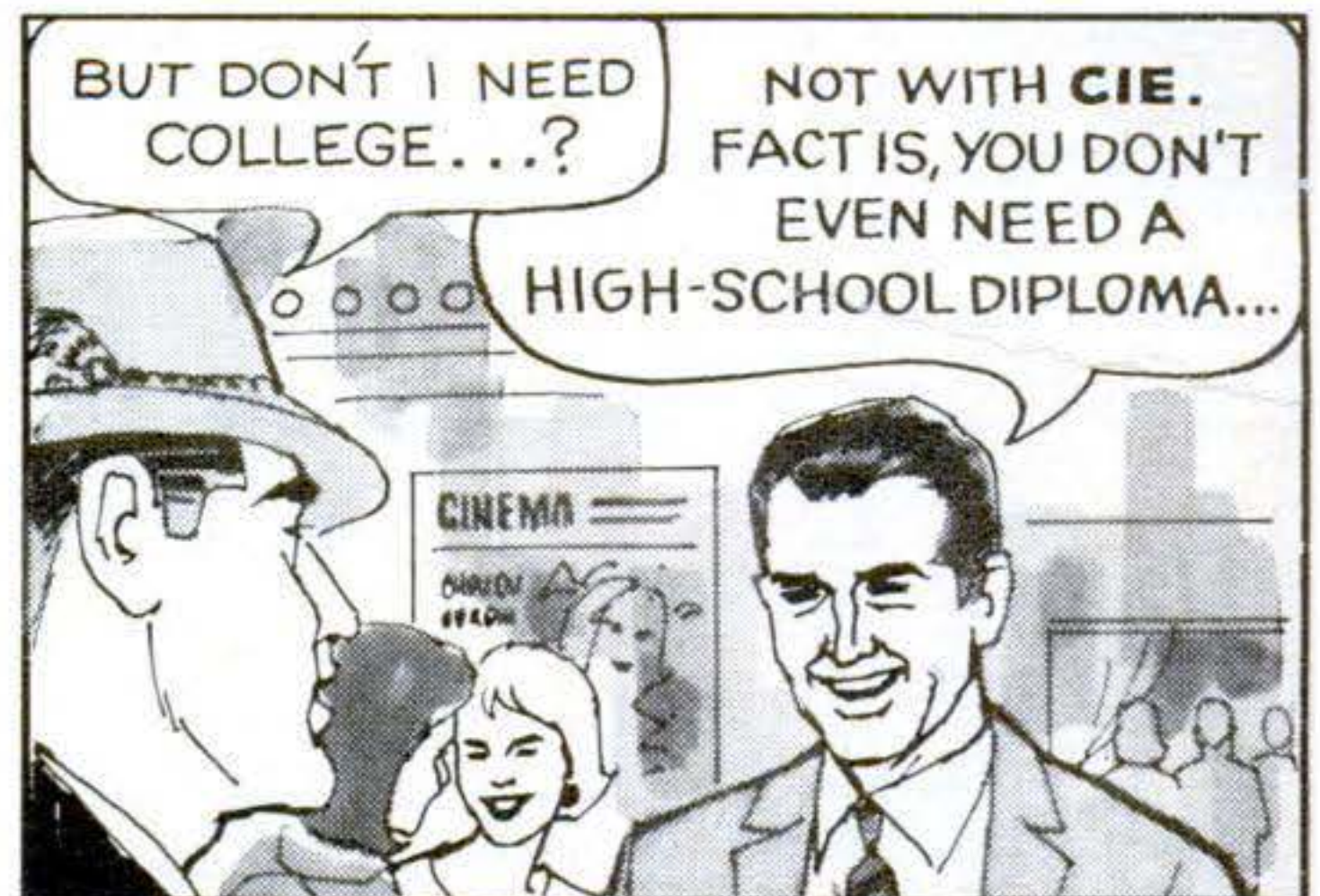
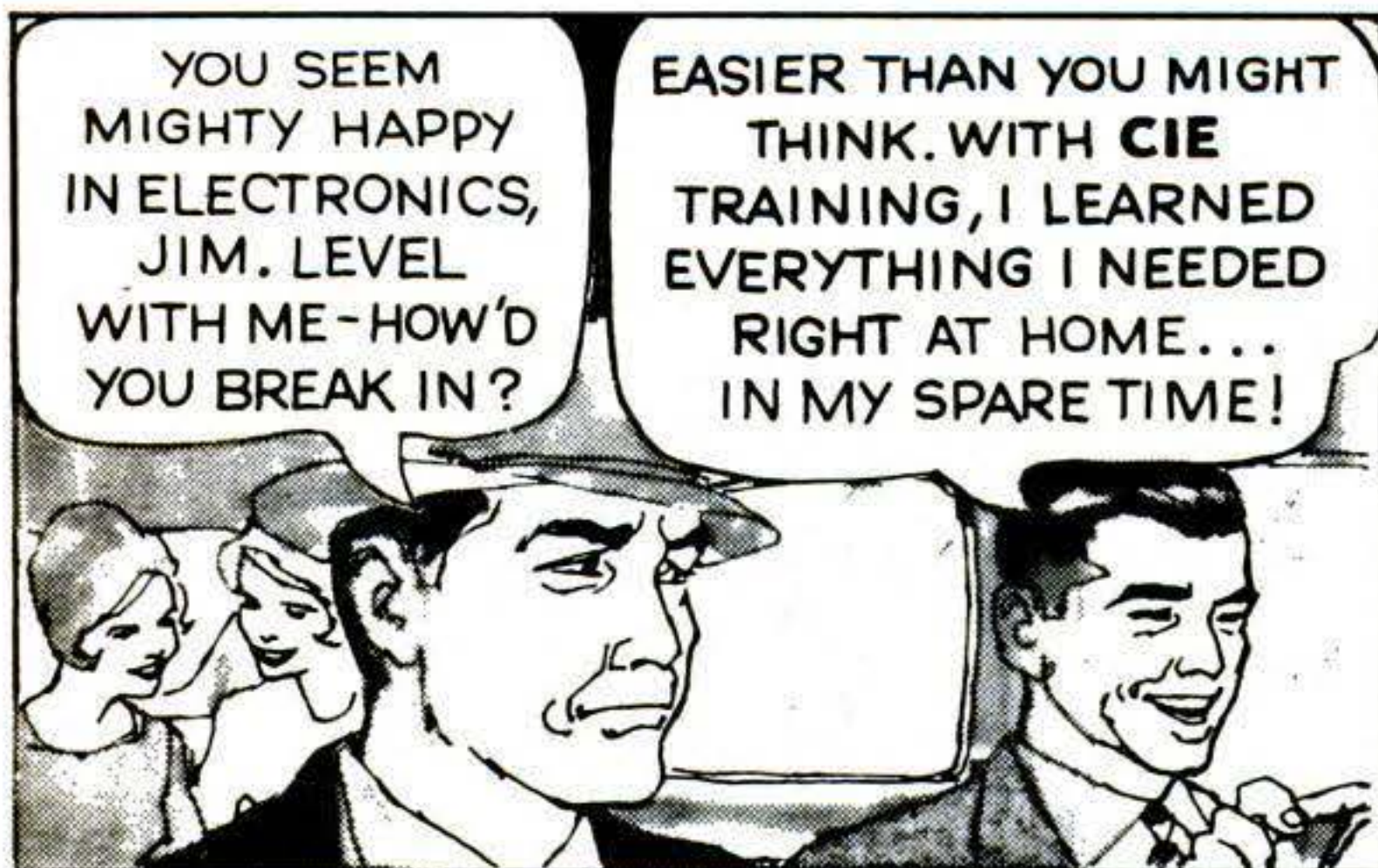
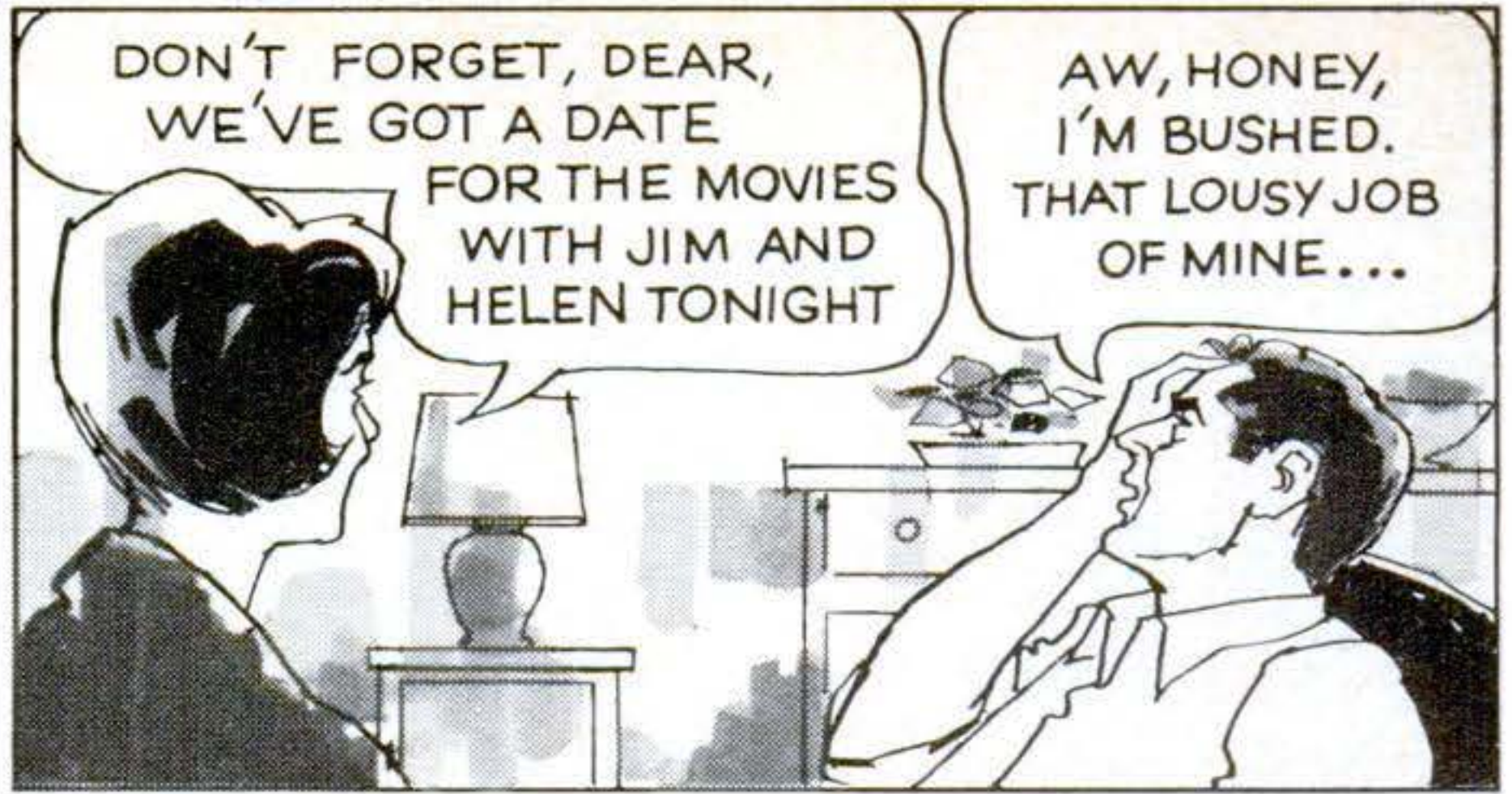
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