

JULY 1966 35 CENTS

Popular Science

MONTHLY

**Last-Minute News!
What the '67 cars
will really be like**

All in This Issue:

**BUILD YOUR OWN
TREASURE FINDER**

**THE "HEART CART"
MAY SAVE YOUR LIFE**

**INSIDE STORY OF
BATMAN'S BATMOBILE**

**THE TRUTH ABOUT
WHEEL BALANCING**

**Amazing
Glass-
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**"WHAT I LEARNED
IN FAST-DRIVING
SCHOOL"**

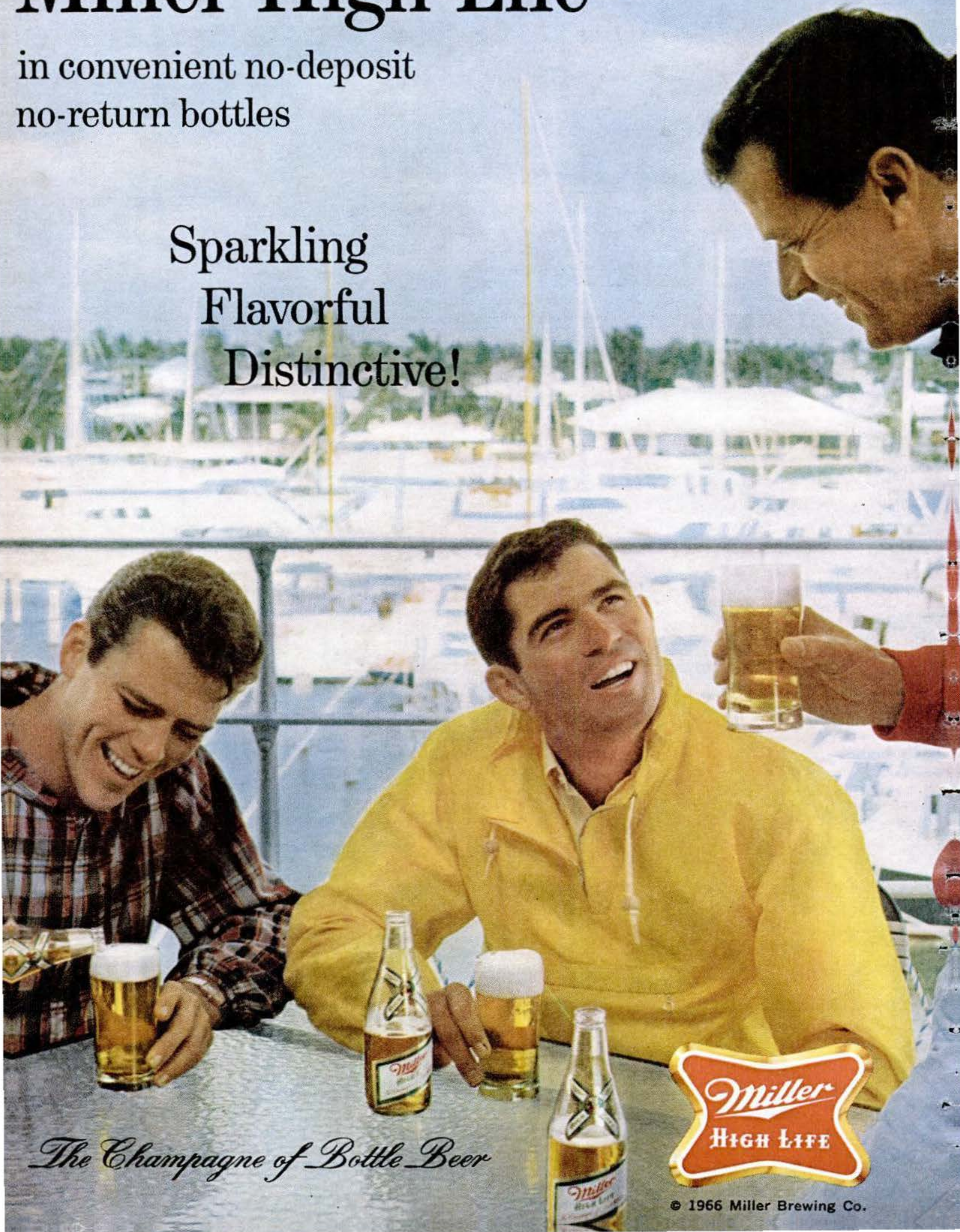


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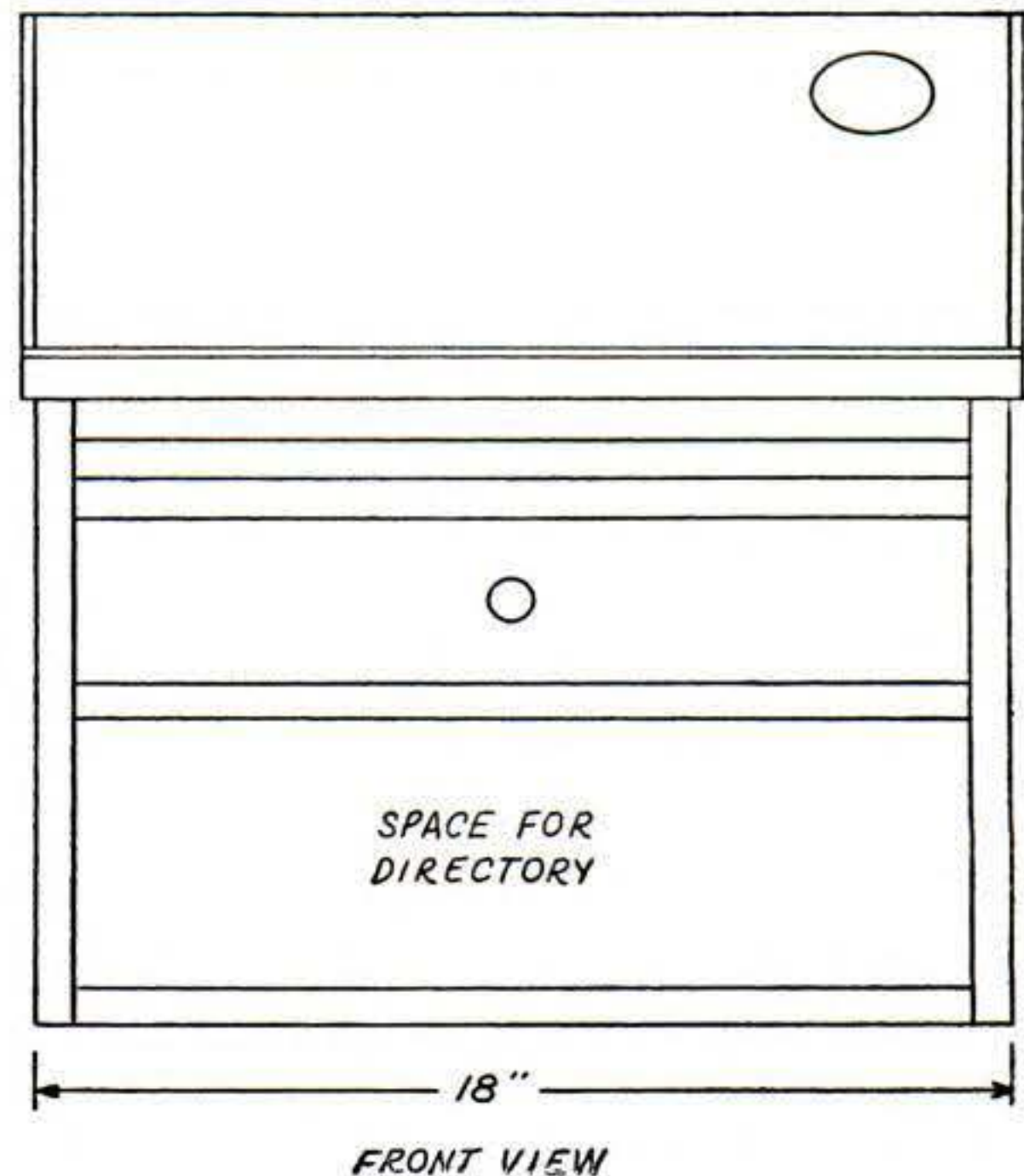
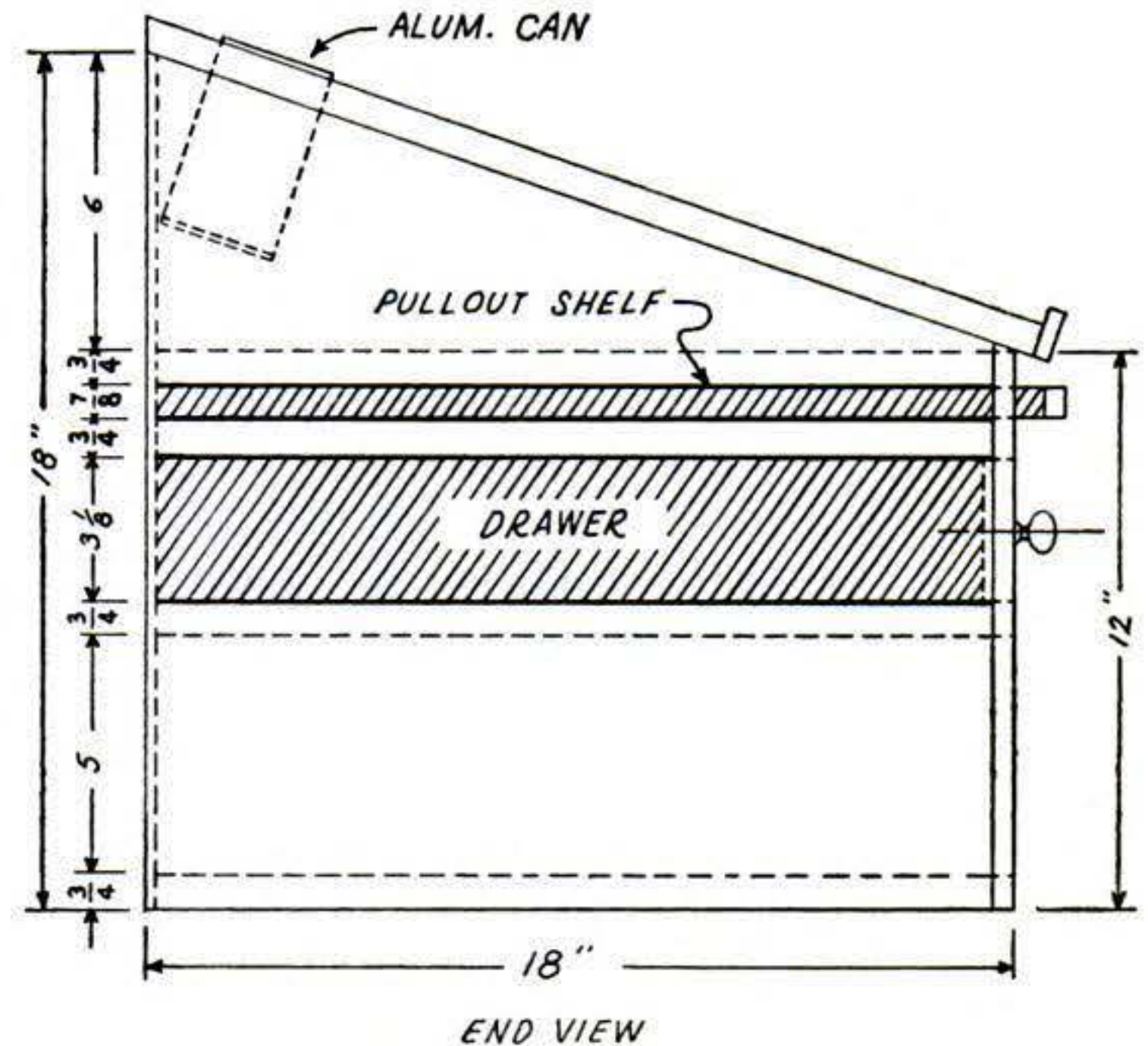
the whole family if you put your extension near your bench and near the laundry or game room.

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AT&T  **Bell System**
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and Associated Companies

HIGHLIGHTS OF THIS ISSUE:

The "Heart Cart" May Save Your Life PAGE 54

A doctor's invention snatches patients back from the far side of the gates of death.

Low-Cost Glass-Bubble Sub for Undersea Adventure PAGE 60

PS Exclusive: Inside story of an amazing underwater pleasure craft, now under development. Expected cost? Same as a cabin cruiser. Depth? The bottom's the limit!

What the '67 Cars Will Really Be Like PAGE 66

PS spy report lifts the veil on some surprises coming in next year's crop of cars.

School for Speed Teaches You Expert Car Handling PAGE 94

Come along for a lesson at Carroll Shelby's School of High Performance Driving.

A Treasure Finder You Can Build PAGE 110

Here's the next best thing to Captain Kidd's treasure map. Cost to build: \$30.

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COMING NEXT MONTH

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- **Sports Cars of the World:**
A spectacular roundup in full color
- **The Cold War in Space:**
Willy Ley tells you what's going on out there
- **The Great Brake Debate: Disks or Drums?**
PS auto editor Norbye vs. Smokey Yunick
- **Secrets of Those Amazing TV Camera Tricks:**
Backstage with the special-effects wizards

And here's the **HOW**—

- How to Install Easy, Safe Outdoor Wiring
 - How to Put a Waterfall in Your Back Yard
 - How to Build a Car-Top Boat for \$20
 - How to Take Sharper Photos
 - How to Save Your Car from Rust and Rot
- Plus: What you can do with those marvels of miniaturization, integrated circuits . . . All about sanding—the start that makes the finish . . . Building a BB trapshooting range . . . Gus Wilson . . . Detroit Report . . . And lots more.

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Who picks the Pure Oil entries?

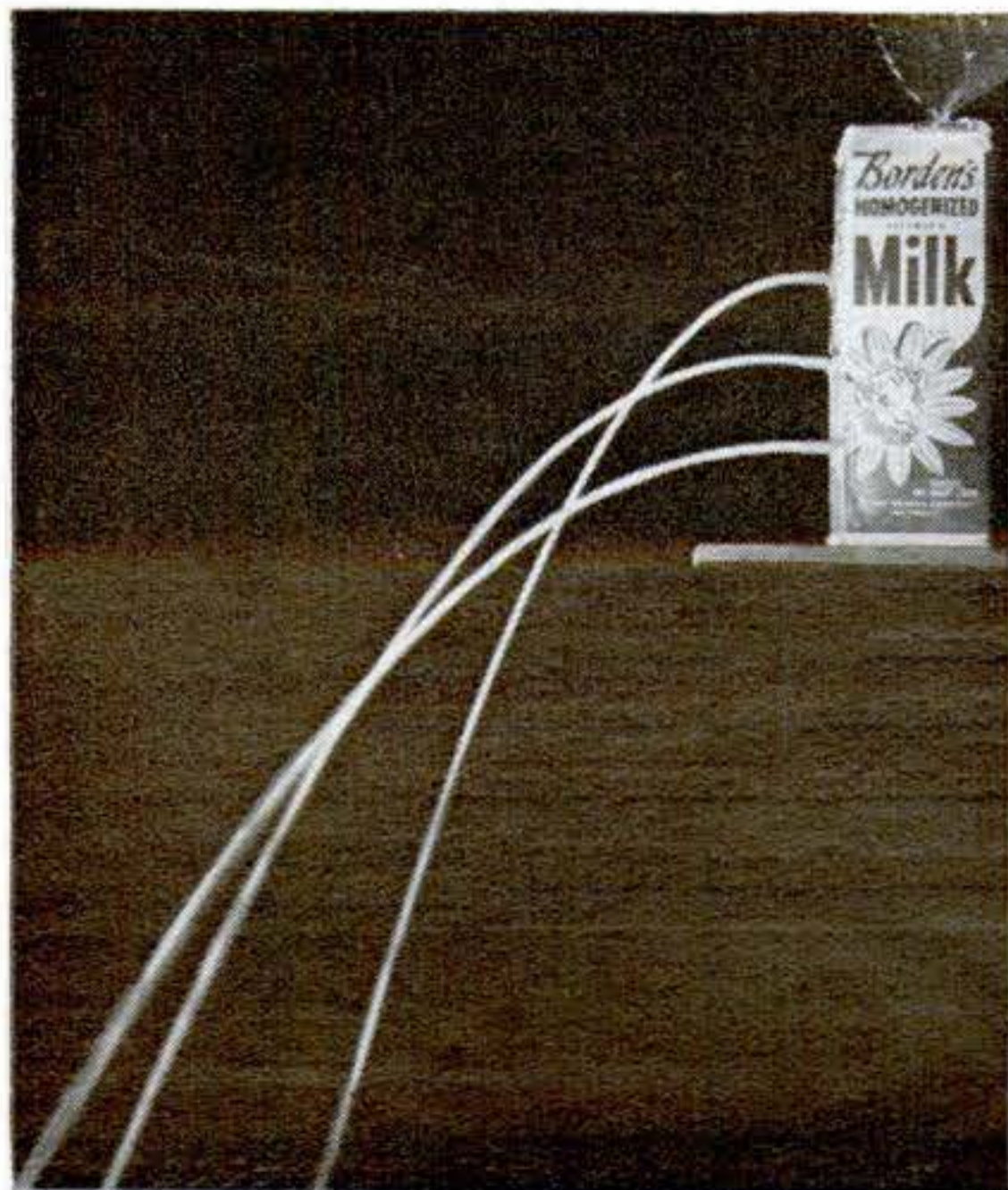
The Pure Oil tests ["Does Your New Car Have the Power to Stop?" April] strangely do not include the bread-and-butter full-size Ford, Chevrolet, or Plymouth—either six or eight cylinders (except the Caprice). There doesn't even seem to be a standard eight-cylinder classification. Who determines these limitations and omissions—and why?

HARRY C. WIERSDORFER, Hamburg, N. Y.

The manufacturers are free to decide which cars they want to enter. No selection is made by Pure Oil, NASCAR, or POPULAR SCIENCE.

Is the professor's theory holey?

Professor Miller's mystery of the three-holed can ["His Bag of Tricks Makes Physics Fun," May] says that the stream from the middle hole will have the greatest range when it hits the table top. If you reasoned that the lower hole stream will have the greatest range, you are right! The professor's answer is based on a gimmick—where they hit the table top. Here's a simple experiment I rigged up to show that



if you don't cut off the three streams, the lower hole's stream will have the greatest range.

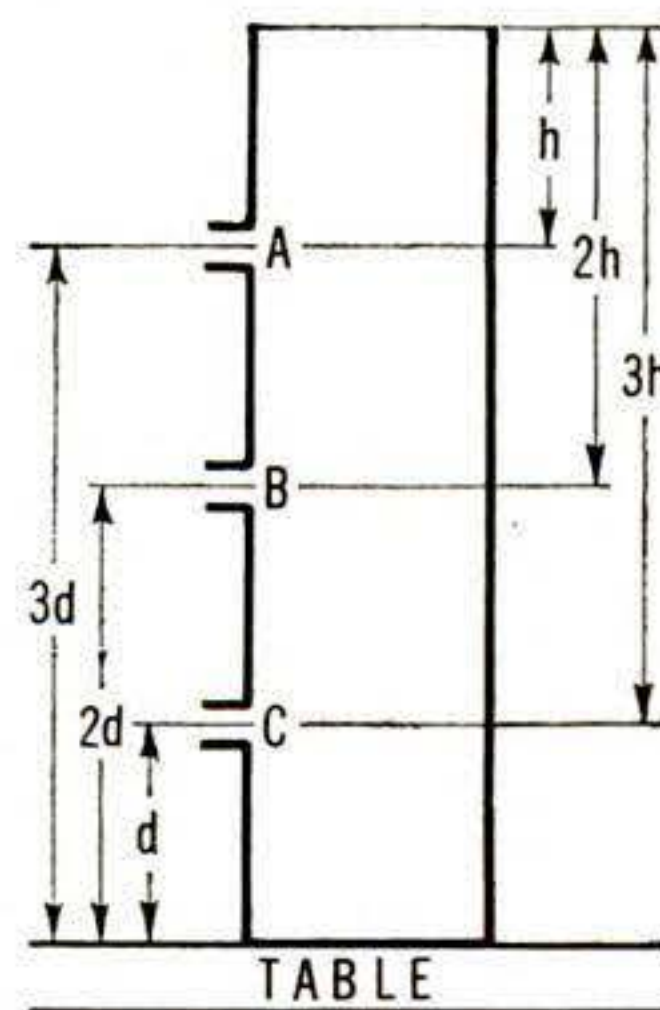
KENNETH M. SWEZEY, Brooklyn, N. Y.

... I tried Professor Miller's three-holed can trick and found that the bottom hole had the

greatest range. If the trick were done on a counter top, then the bottom hole would not be able to shoot its full range.

THOMAS C. BAHR, Lookout Heights, Ky.

... We have to admit that Professor Miller really knows his physics. The three-holed can problem was the toughest, and during the course of solving it, we consumed one hour—and three cans of beer each. We hope that the enclosed diagram and explanation will help those who still doubt the solution.



All we need to solve the problem is to know how fast (v) the fluid is moving from each orifice and how long (t) before each hits the table. This will give us the range (S). $S = v$ multiplied by t .

We can find v from Torricelli's Theorem: $v = \sqrt{2gH}$.

Where: v is the velocity of flow.

g is the acceleration of gravity.

H is the height of fluid above the orifice.

And we can find t from the basic formula for the acceleration of gravity: $d = \frac{1}{2}gt^2$ or $t = \sqrt{2d/g}$.

Where: d is the distance traveled in a free fall from rest.

g is the gravitational constant, approximately 32 feet per second per second.

t is the time in seconds of the duration of the fall.

Now, by applying these three formulas to each orifice, we get:

Orifice A: $v = \sqrt{2g(h)}$ and $t = \sqrt{2(3d)/g}$, so $S = \sqrt{12hd}$.

Orifice B: $v = \sqrt{2g(2h)}$ and $t = \sqrt{2(2d)/g}$, so $S = \sqrt{16hd}$.

Orifice C: $v = \sqrt{2g(3h)}$ and $t = \sqrt{2(d)/g}$, so $S = \sqrt{12hd}$.

Since the basic units, hd , are the same in all three answers, the numbers 12 and 16 show that B has the greatest range and A and C are equal.

GEORGE PAQUIN, Northeastern U., Boston
RAYMOND ROSCH, Berkshire Community College,
Pittsfield, Mass.

Bringing an old system up to date

David Scott's article about the inclined railway for Belgian canal boats ["Ships Float Uphill and Down," April] is a reminder that so much of what we consider new is actually old. The same principle was used nearly 200 years ago on a smaller scale to get canal boats around the falls in the Connecticut River. A Dutch

Continued

an example of the profits for you in electrical appliance repair

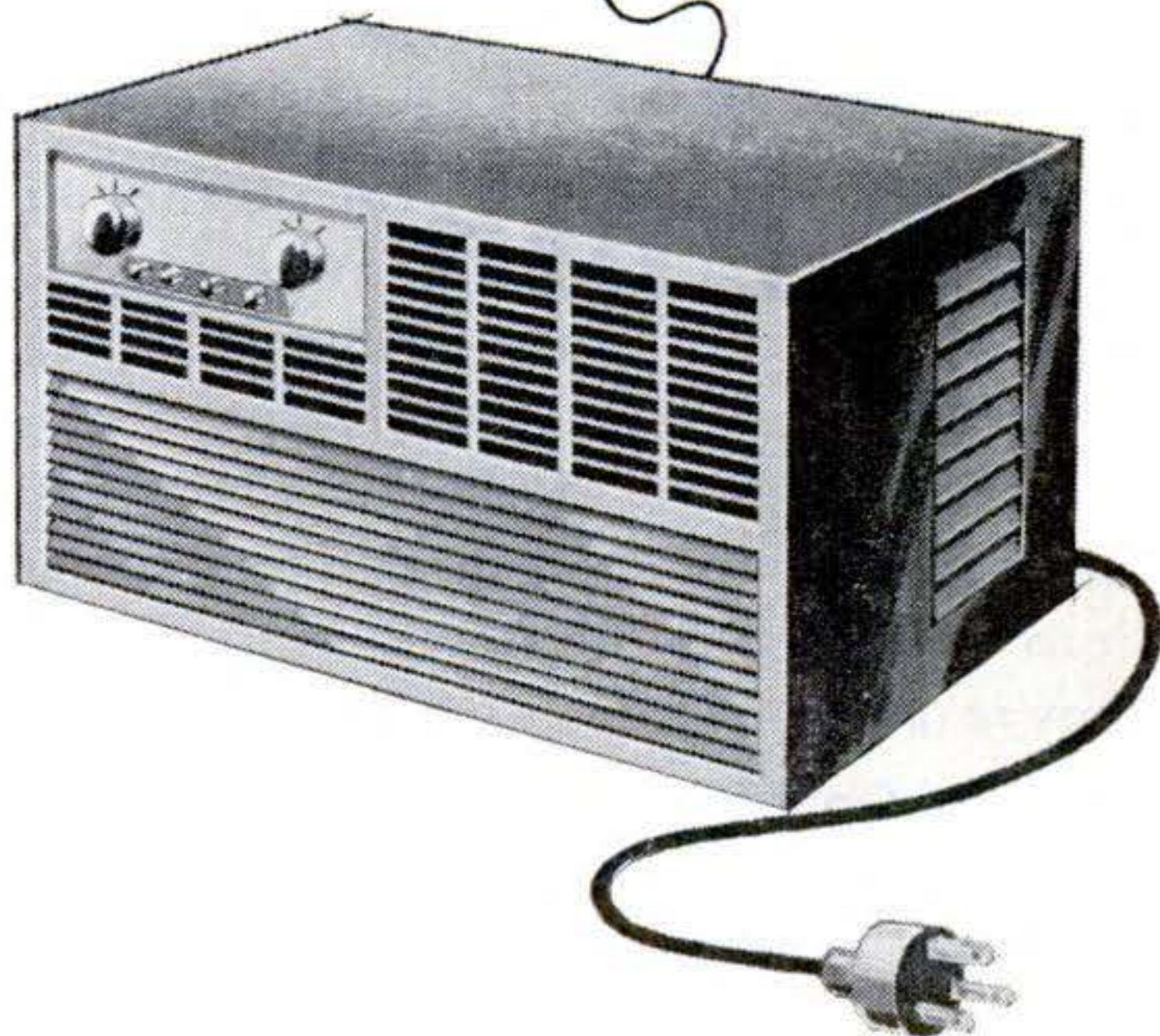
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Here's an example of the profits you can realize through NRI training in electrical appliance repair. With NRI training, you'd know how to check this air conditioner for leaks and recharge with freon.

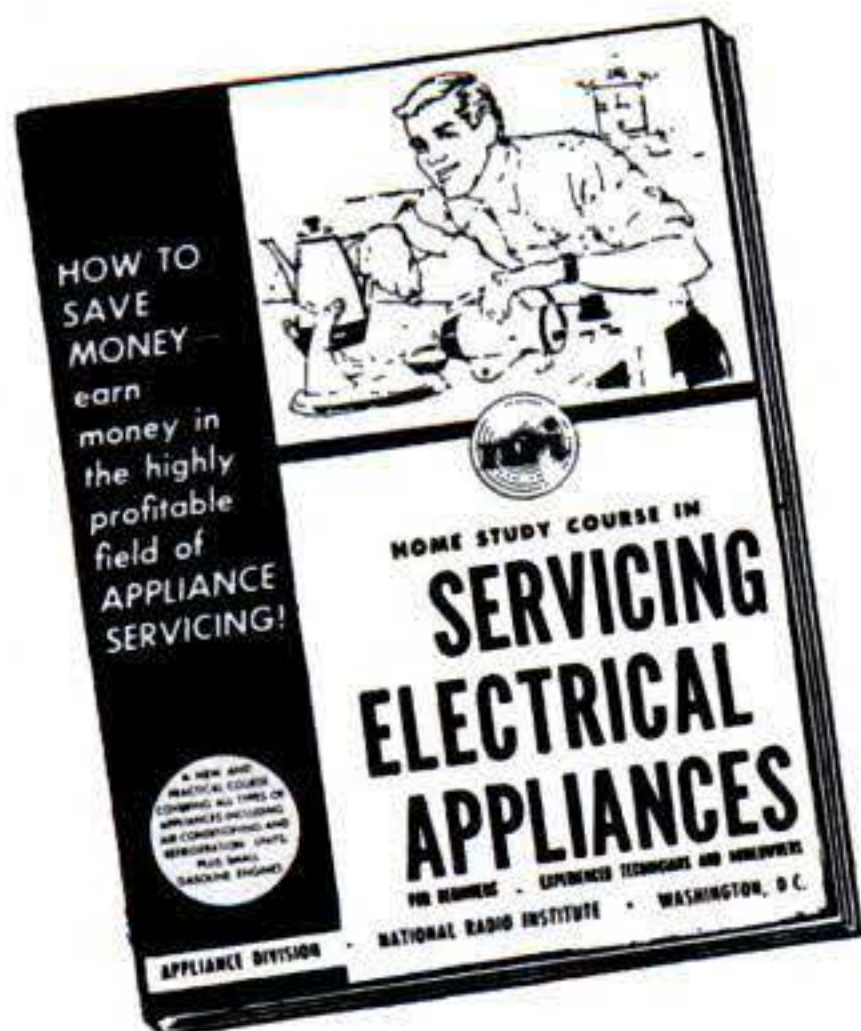
In this case, freon cost 50¢. As an Appliance repairman, you add 40% markup on parts or materials supplied. So you charge, in this case, 70¢ for the freon, \$10 for two hours labor, \$5 for a service call . . . for a total of \$15.20 profit on a \$15.70 repair.

That's just one example of more than 100 different types of small and major appliances you can learn to repair easily, profitably, quickly with NRI training. Time and profits vary with every job, but rewards are high for the man who wants to secure his future. You can do this work at home in your spare time, or start your own full-time business. Every home in your neighborhood is a ready market for your services.


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PS Readers Talk Back

[Continued]

engineer devised the system, which used a waterwheel powered by the flow of the river to hoist a car containing the boat up a ramp from the lower level of the canal to the upper level.

JAMES B. ALLEN, South Hadley Falls, Mass.

CB'ers read us loud and clear

You say in "Mobile CB: Two-Way Radio on Wheels" [May] that it's possible to talk on channels 8 through 14 and on channel 23. It is illegal to talk on channel 8 to another licensee. The proper channels are 9 through 14 and 23. You also failed to recognize REACT (Radio Emergency Associated Citizens Team), a nationwide volunteer group that monitors channel 9 for 24 hours a day. Teams cover 50 percent of the cities in the U.S. and have aided millions for everything from flats to statewide disasters.

JOSEPH MARTINELLI, Malden, Mass. KMA 4568

Thanks for catching PS's typographical error. Correct channels for transmission are 9 through 14 and 23.

. . . The idea of putting a CB radio in every car is just fine. But how can everyone have a good CB car radio when they cost so much?

LARRY BEALE, Hutchison, Kan.

Maybe it's worth saving for.

. . . Ronald Benrey's article on CB mobile radio was inspiring. All CB'ers would like to see more of this type of service to the public.

RONALD L. PEELING, Margate, Fla. KOP 0829

Venting a sun dome

In "Amazing Sun Dome You Can Build" [May], a very important fact was left out—the need for adequate ventilation. If the domes are used for barbecues, it is very important to take steps to assure that proper and adequate ventilation is present. Several cases have been re-



corded where charcoal barbecues have produced enough carbon monoxide in confined areas to cause severe illness and even death.

F. C. HARR, Sparta, Wis.

Challenging the Volkswagen

Your comparison of foreign compacts ["Volkswagen vs. Opel vs. Simca," May] was sadly incomplete. If you want to focus attention on the

Continued

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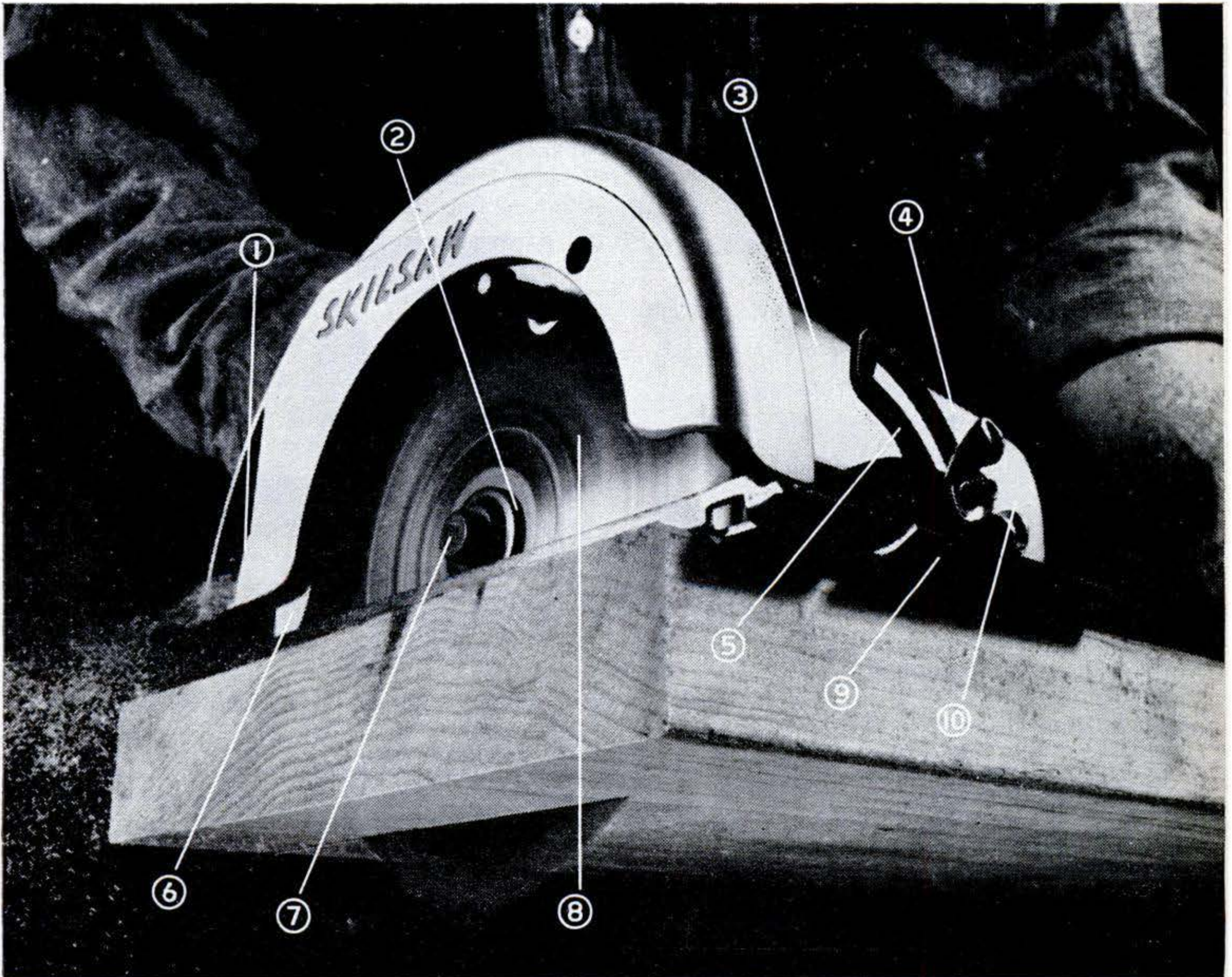
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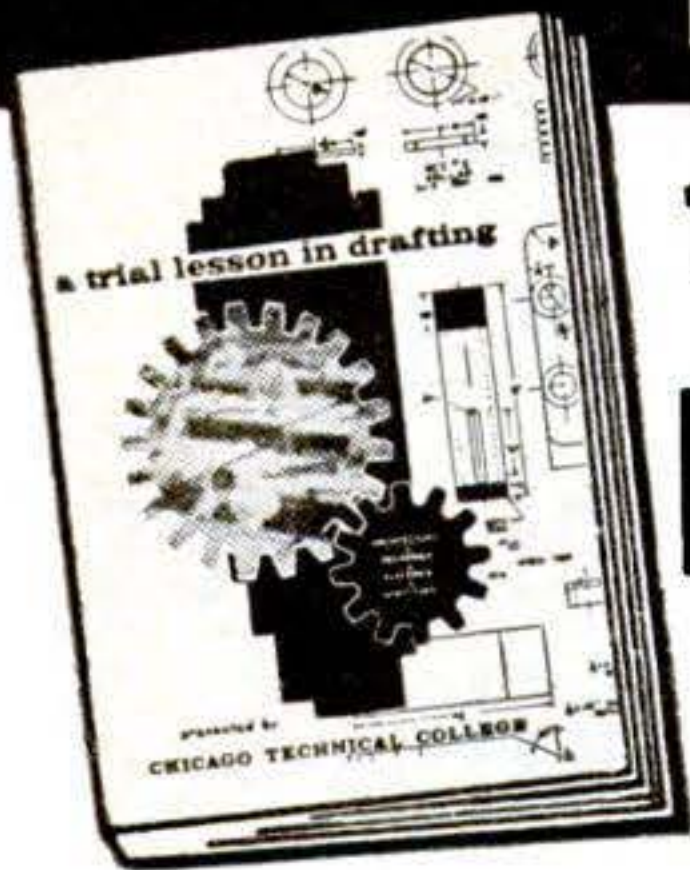
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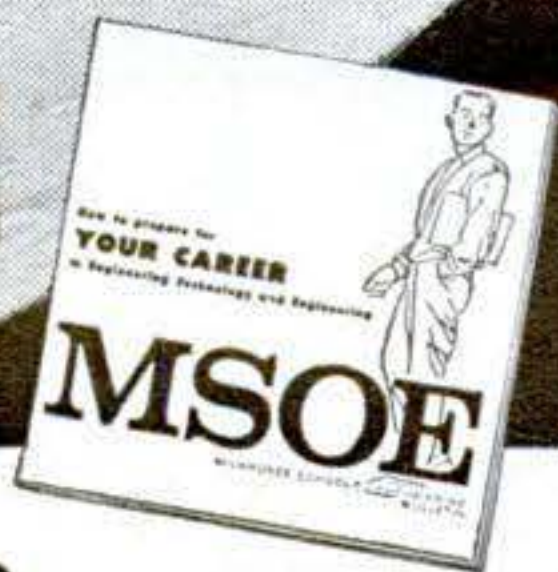
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PS Readers Talk Back

[Continued]

challengers of the VW, why not consider the VW's fastest-growing headache—the Toyota Corona? The Corona far outstrips your dynamic trio in passing power, room, and handling.

STEVE ROMEO, Boulder, Colo.

... Jan Norbye says in the section on parts and service that VW has the best in the world. But nothing is said about the availability of parts for the Simca and Opel. How about it?

DAVID FISHMAN, Albany, N. Y.

Auto Editor Norbye says Opel parts are as easy to get as Buick parts and Simca parts are no scarcer than other Chrysler parts.

... You say the two rear-engine cars are unstable in crosswinds. They are unstable because they are very light and have a swing-axle rear suspension, not because they are rear-engined. Would every successful race car be rear-engined if it was inherently unstable?

ROBERT FLAMING, Albuquerque, N. M.

The successful "rear-engine" cars you refer to actually have midships engines. "Rear-engined" should be used to describe only those cars with an engine that actually overhangs the rear-wheel drive shafts.

Right tent, wrong manufacturer

We are very much disturbed at the picture of our tent which appeared in "New Shapes Make News in Tents" [May]—identified with our competitor's name as the manufacturer. In addition



this tent (photograph) can easily sleep 10 or 12 people, not four.

L. W. COUSINO, Vice-President, Sales,
National Canvas Products Corp., Toledo.

Steam engines for cars—what about boilers?

All those articles on pretty steam engines for autos ["New Revolver-Like Steam Engine," Feb]! Who're you kidding? The most rudimentary steam engine in the book will do the job. The problem is in the boiler. Let's have the rundown on the state of the art. Stanley, the old White flash boiler, Doble, Baker, and I am sure there are others. No knowing engineer worries about the engine.

KEN GARDNER, Grand Junction, Colo.

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JULY 1966 | 13

"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.



A licensed helicopter pilot, Smokey flies his own chopper regularly on business.

.....

"I'd like to know the proper dwell angle for my 1965 VW 1200. The dealer says it is 52 degrees, or .017". The manual gives only .016". One book says 51 to 55 degrees. Another says 40 degrees for most four-cylinder engines. What's right?"

K. G. DOUGLAS, Hinsdale, Ill.

Either .016" or .017" isn't bad. Set the time as high as the engine will stand without knocking, and you'll have it as good as it can get.

"A friend says his '66 GTO automatic will outrace that same model with standard transmission. Since I read about a successful racing car with an experimental automatic, I couldn't disagree with him, but I think he's wrong. What's the up-to-date truth?"

LOUIS HEPBURN, Pittsburgh, Pa.

I would agree with your friend. Automatic transmissions can, and do, outperform manuals. The drivers who have eaten smoke from Jim Hall's Chapparral (with automatic) will bear witness. The automatic transmission shifts far faster than human hands, and without error. It also permits better ratio of torque and r.p.m.

"I have a '65 Buick Skylark with a four-barrel, 300-cu.-in. mill that's a real pinger. There is no ping on hard acceleration or on level ground, but start up a hill, and ping-a-ling she goes. The dealer retards the spark a little more each time I complain. Now he has it five degrees retarded from the 2½ BTC specified. It still pings occasionally, even burning superethyl. I can't complain about either the performance or the mileage, but will this spark retard hurt anything in the engine?"

BILL PITTS, Sacramento, Calif.

What you are really saying is that the timing is being retarded at idle. You don't mention what it is through the range. Remove the dis-

tributor, and have the advance curve checked and repaired if necessary. I believe it has wandered off the advance-curve specifications. Although it is retarded in the static setting, it could actually be normal or even high through the normal cruise and acceleration range. There are other possible causes for the ping, such as carbon buildup, but it sounds like a wandering advance curve to me.

"I have no trouble starting the engine of my 1962 Plymouth Belvedere V-8, but when it is running I can smell raw gasoline. Also, it doesn't give very good mileage. What goes?"

WAYNE FLANDERS, Jackson, Mich.

Aside from the usual checks of fuel lines and filters, check the fuel pump for a leaking diaphragm. The pump might have to be removed for this. Look around the base of the carburetor for fuel stains. Maybe the throttle shaft is loose in the carb base. Check also to determine if fuel is getting in the distributor through the vacuum advance. The gas that leaks and smells isn't helping your mileage.

"The oil on the dipstick of my '61 T-bird seems to get dark unusually fast. I use top-quality 10W30 (HD) oil and change the filter every other oil change, but the oil gets dark in a few hundred miles. Are these 'lifetime bronze oil filters' I see advertised any good?"

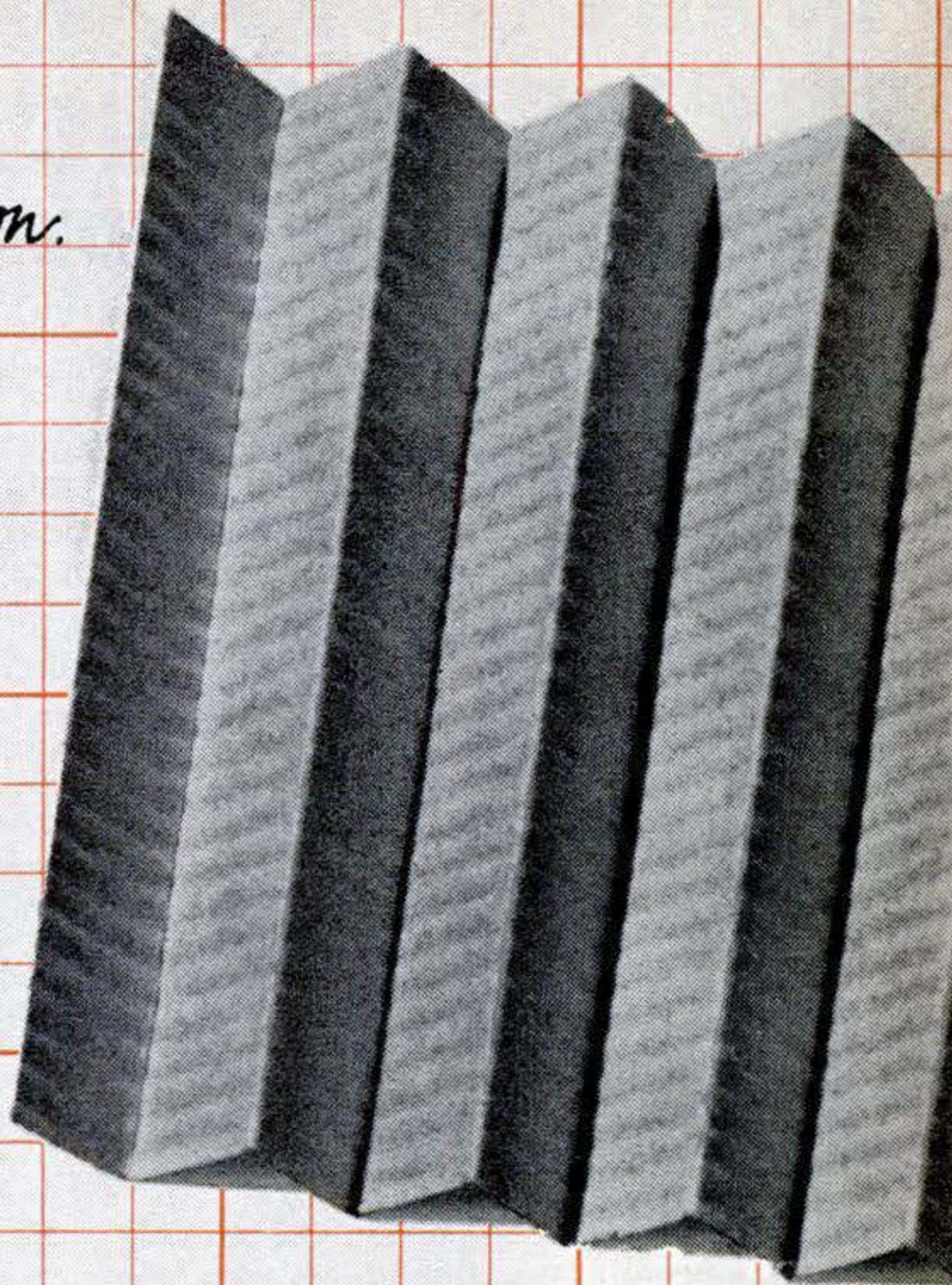
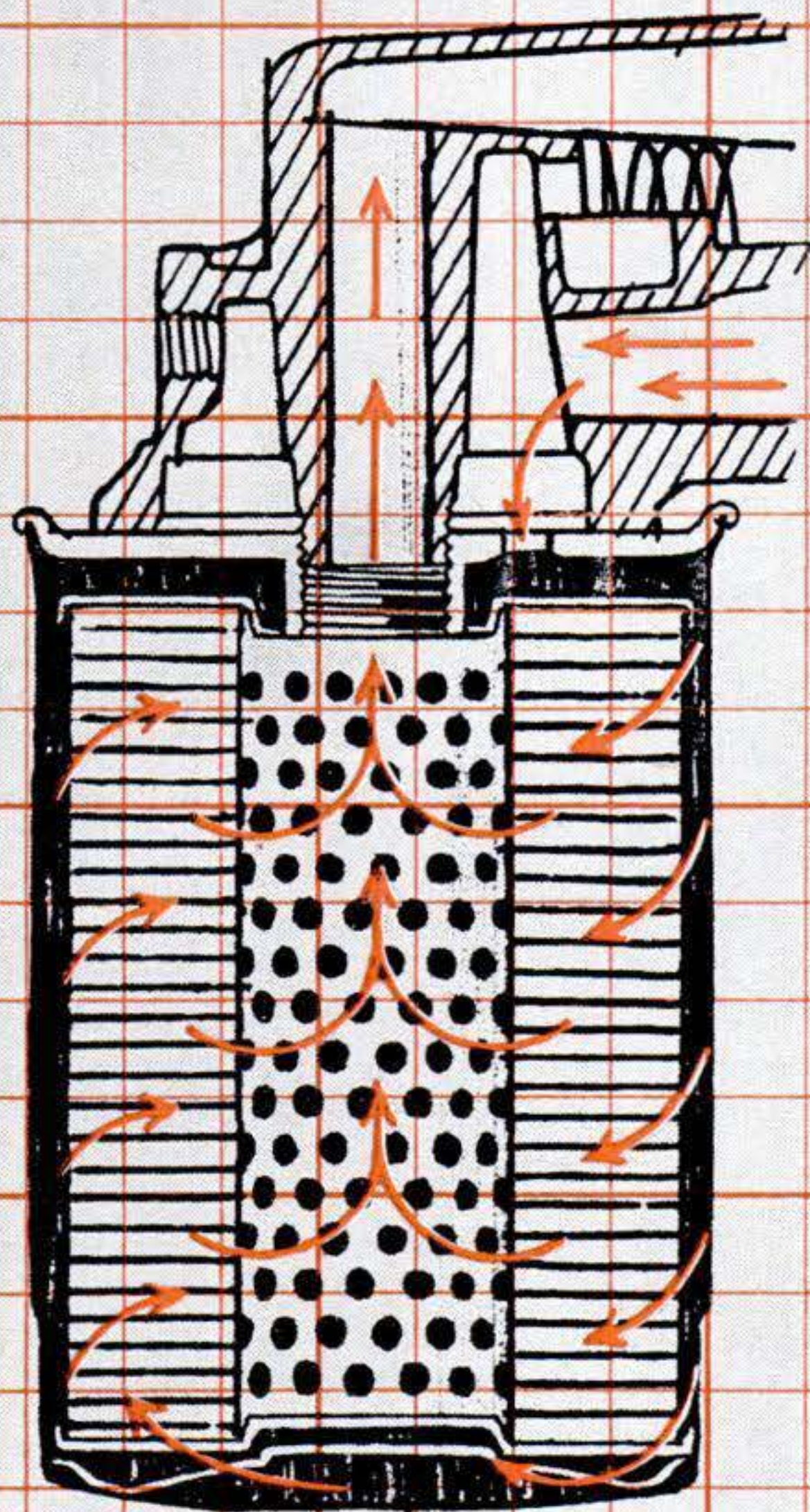
L. O. SANDMEYER, Anna, Ill.

To answer your last question first, all that I can say about these unconventional filters is that I don't see any of them used under real HD conditions by trucks and buses. Usually they use the conventional paper type. Your oil is getting dirty so quick because of a five-year buildup of engine deposits. There are lots of ways to remove these, but you might just make the condition worse by loosening them and getting them into the system. As long as your car

Continued

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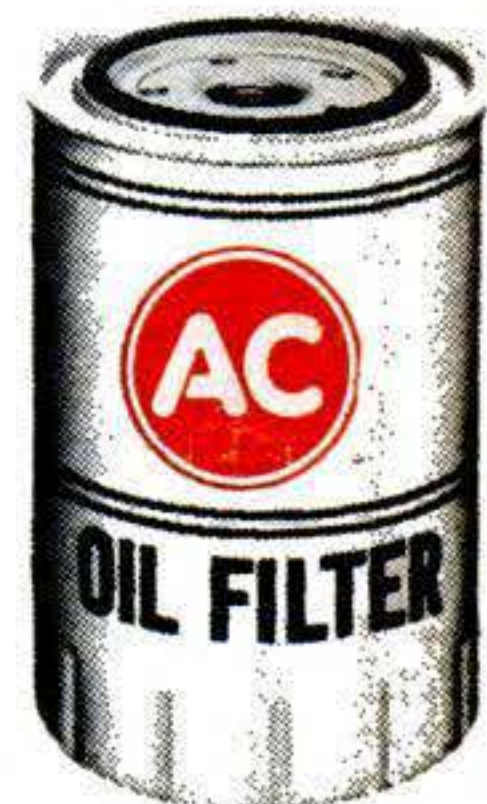
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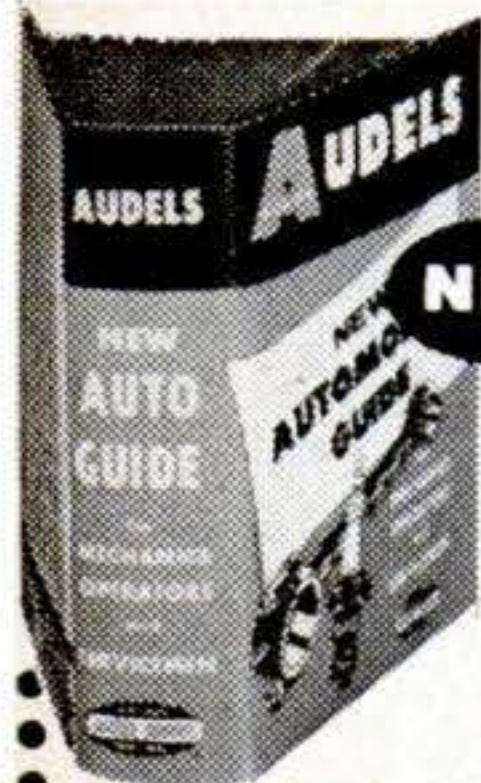
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"Say, Smokey—"

[Continued]

runs okay, why worry about the darkened oil?

"I have a 1964 Chevelle with a 283-inch engine, a four-barrel carb, and four-speed transmission. I have put four or five clutches in it. The last two were new GM matched units with faced flywheels and each whole unit balanced. None of it helped. Can you?"

REX CONWAY, Whittier, Calif.

Put in the Corvette HID assembly, and quit horsing it around so much.

"My 1965 Olds F-85 with ultracompression head and four-barrel carb won't start mornings unless I kick the accelerator pedal a few times. Then I must accelerate slowly for five or six minutes, or the engine dies. When warm, starts are normal. The automatic choke has been worked over and appears to operate normally. However, the linkage doesn't close the butterfly completely—by about 3/16 inch. The dealer's carb man doesn't know any more to do. Do you?"

ANDREW H. YOUNG, Lafayette, Calif.

You know the problem is in the carburetor and choke. Now find a shop—preferably an Olds dealer—who has a man who *knows* how to adjust a '65 Olds carb. If it's a Rochester, don't get mad if they don't get it right the first 10 trips. I believe the carb will be okay when updated to current specification.

"I have a standard, three-speed transmission in my 1963 Pontiac Catalina. At 28,000 miles it is giving me a lot of trouble, though rebuilt twice by Pontiac. It still vibrates on acceleration and pops out of gear. It also flunks when backing up. Should I rebuild this transmission again, or is there a unit I can put in that will last over 10,000 miles?"

DON E. CRAWSNICK, St. Paul, Minn.

I suspect your transmission is misaligned with the bell housing and flywheel. Another possibility is that, in repair, a defective part has been overlooked—such as a bad case.

"I read an article saying that molybdenum oils will put a coating of metal on cylinder walls and bearings. Are these claims true? Is it safe to use moly in a new engine—with 5,000 miles on it—and can it be mixed with detergent oils, and in what ratio? Do you recommend this?"

Q. C. DRIESSEN, Winnipeg, Canada

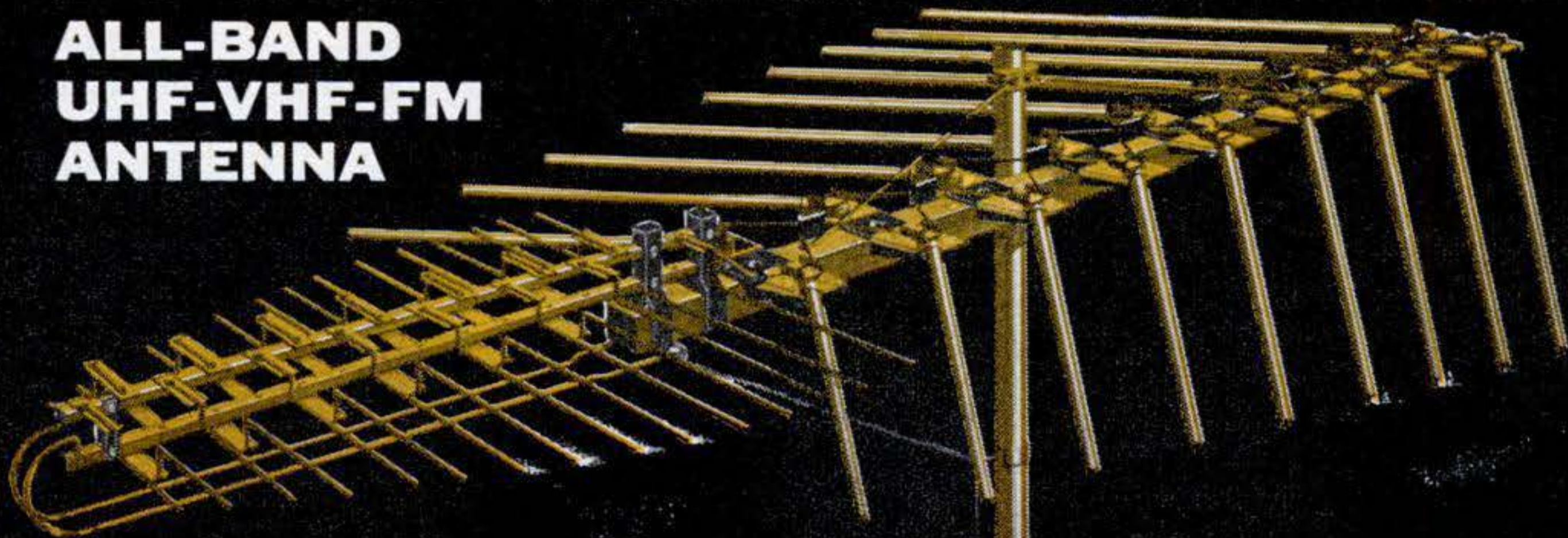
I'm no chemist, but let me pass on what I've learned through experience. None of the moly oils I've tried would stay in suspension. In a short time they wound up in the bottom of the oil pan. However, it's a very good lube so long as it stays put. I'd say no on adding it to your engine oil. Better stick with a premium name brand of the proper type as recommended by

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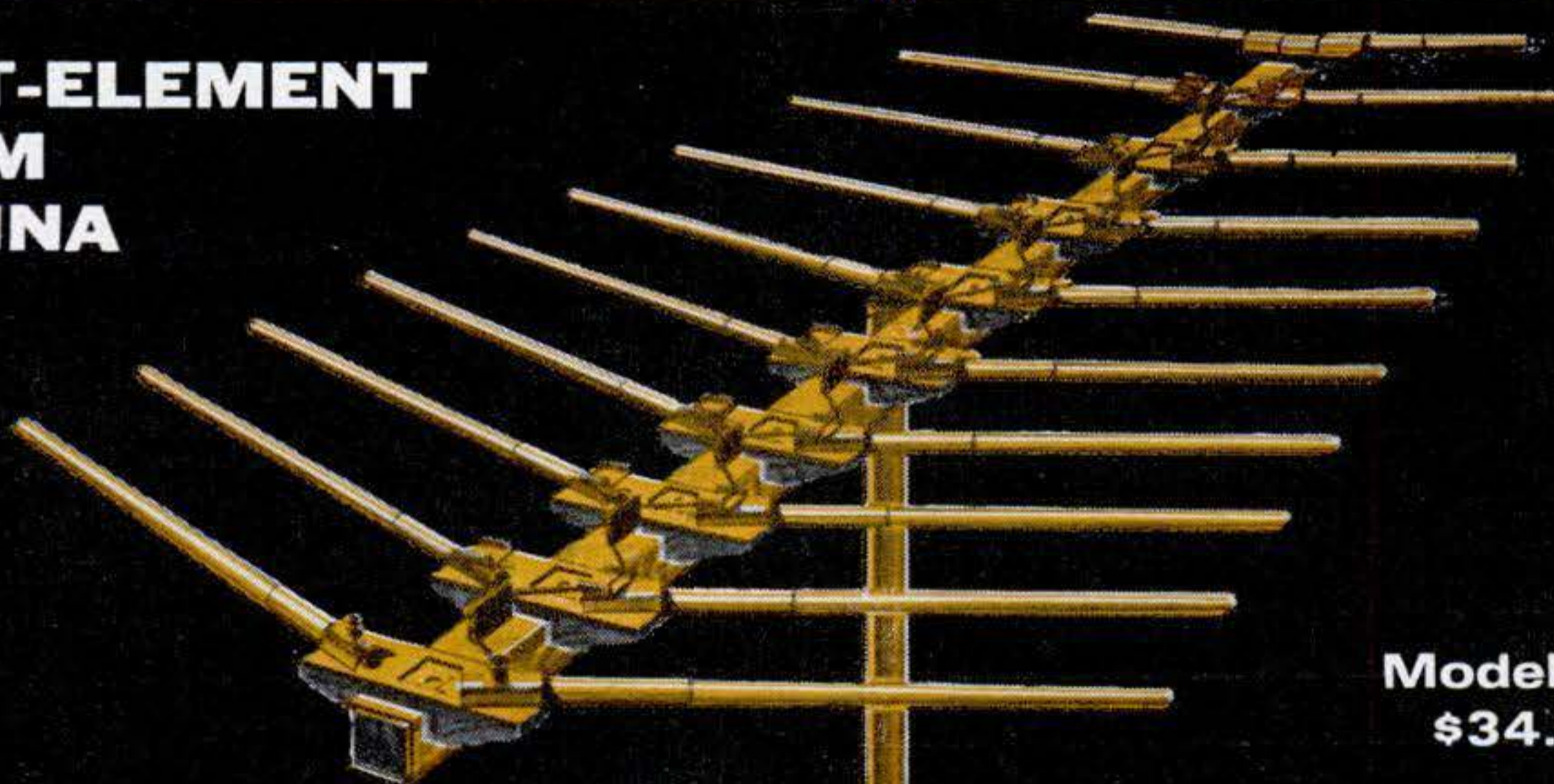


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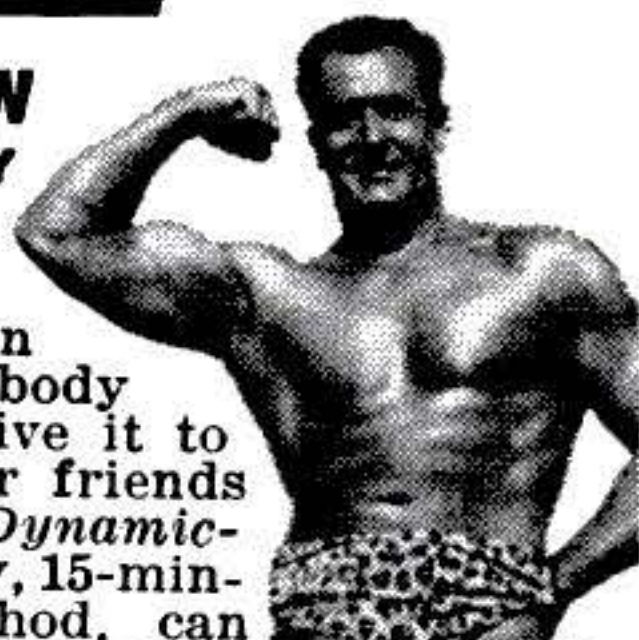
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"Say, Smokey—" [Continued]

the manufacturer in your owner's manual.

"At 500 miles short of the time I was to take in our new '66 GMC pickup to drain the break-in oil, I checked the oil level and couldn't get a register on the dipstick. I was about to add a couple of quarts to get me down to the dealer's when a filling-station mechanic said it would be better to drain the whole works and refill—it was bad to mix different brands. Is this fact or fancy? What's wrong with it? Would it hurt to add different oil in an emergency?"

BUTCH CLARK, Evergreen, Colo.

In this case the mechanic was right. Break-in oil is special and doesn't mix well with regular. No big disaster would result if you added other oil in an emergency—but just long enough to get to your dealer's. Most of the regular running oils will mix fairly well, but the chemical makeup varies from brand to brand so that the mixture could encourage the formation of carbons and other deposits. Parts might stick and cause accelerated wear or premature failure. My advice is—never mix 'em unless you have to.

"My '61 Falcon, with 52,000 miles on it, has a miss when I start up a hill. It also misses when I try to pass another car on a level road at about 30 m.p.h. It feels as if a spark-plug wire had been removed. I have replaced the plugs, points, condenser, carburetor, top of the distributor, and rotary arm. I also have checked the valves, timing, and wiring. Can you come up with an explanation of my trouble?"

KERMIT TUCKER, Creston, W. Va.

Skipping under load usually is an ignition problem. The trouble should show up at a shop with an ignition scope. It could be a plug wire. If the scope doesn't pinpoint the trouble, have the intake manifold checked for leaks, and look into the possibility of sticky valves.

"My 1966 Chevrolet with 327-inch engine pings and lacks pep on regular gas. Also, it seems starved for power when idling. The manual calls for premium fuel, but will it hurt to use regular?"

J. BARKER, Jackson, Tenn.

Better stick to what the manual says. Regular gasoline will hurt an engine that is built for high-test—mostly because of detonation. When you hear your engine pinging, you know those pistons of yours are in real trouble. Instead of burning progressively along a neat "flame front," the air-gas charge literally explodes.

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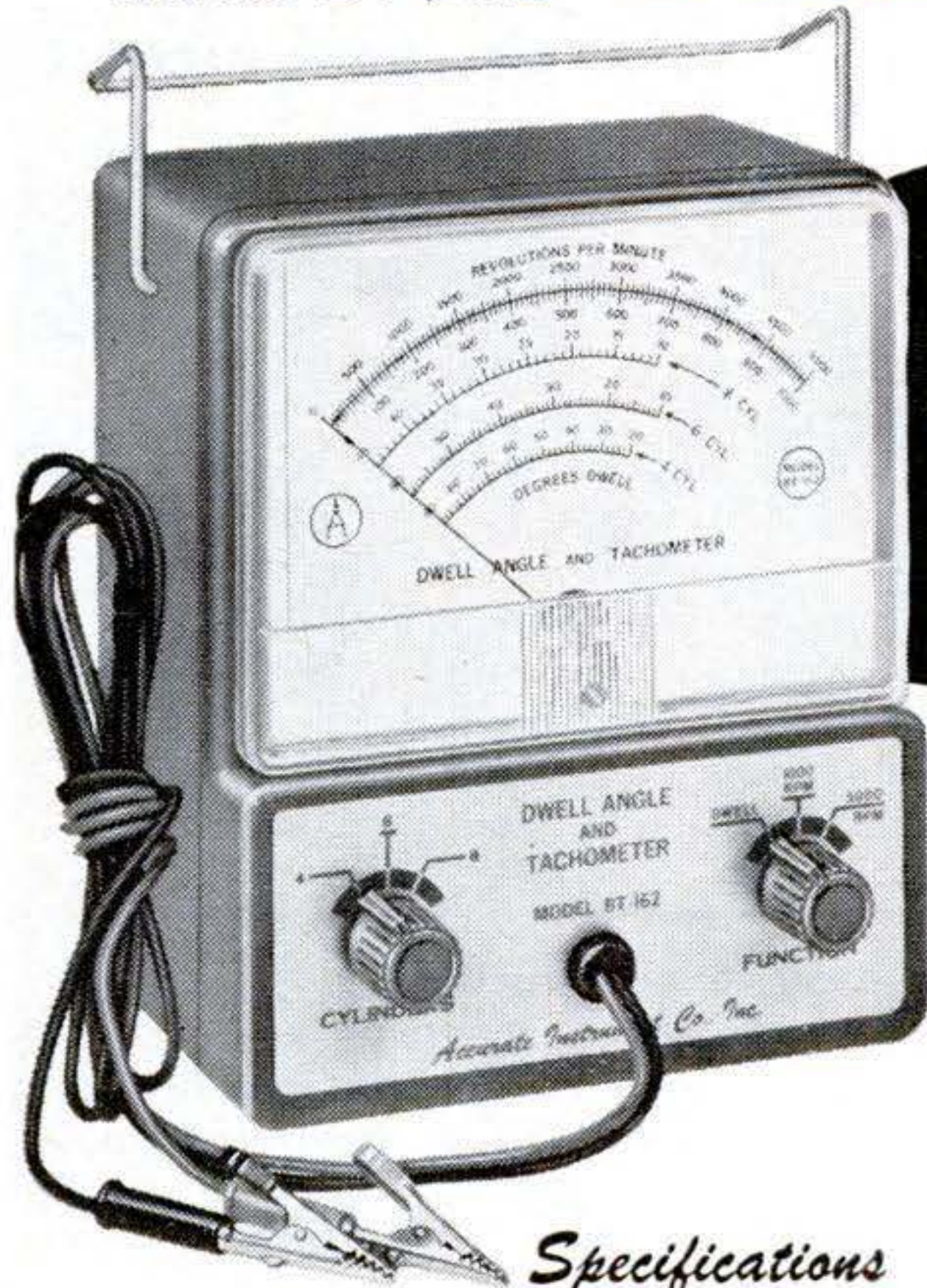
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Science Newsfront

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

By W. STEVENSON BACON

Magnet's field 88,000 times earth's

A superconducting magnet capable of generating a magnetic field 88,000 times as intense as that of the earth's has been put into operation at the Atomic Energy Commission's Argonne National Laboratory near Chicago. The magnet, made possible by recent advances in wire and other materials that lose all resistance to the flow of electricity when cooled to temperatures near absolute zero, is the largest of its type ever constructed. It is in the form of a doughnut 24 inches across with a center bore of 11 inches. The supermagnet is being used in place of a conventional magnet to direct the paths of atomic particles under study in a helium bubble chamber.

Two-cylinder engines for antismog cars?

Low-compression engines with two big cylinders might be the answer to the automotive air-pollution problem, according to Prof. John T. Agnew of Purdue University. In recent research, he discovered that the larger the cylinder, the more thoroughly fuel burns when ignited, and the smaller the volume of pollutants in the exhaust. Cylinder walls tend to quench burning by absorbing heat. In a large cylinder, the fuel stays hotter and burns more thoroughly because the fuel volume to surface ratio is greater—there is relatively less wall surface per unit of volume of hot gas. Another possibility would be to design an engine, made of special alloys, to run at high temperatures—as high as 2,500 degrees F. The hot cylinder walls would promote complete burning of fuel.

Electronic "dog" sniffs out enemy

A chemical sniffer designed to detect the presence of enemy soldiers in jungles and heavily forested areas has been developed by General Electric for the Army Limited War Laboratory and is currently undergoing evaluation tests. The device, which shows great promise as an anti-ambush weapon for use in South Vietnam, detects the nuclei of compounds evaporating into the atmosphere from the human body. It is light in weight and can be carried in a backpack.

Robot "doctors" may offer instant checkups

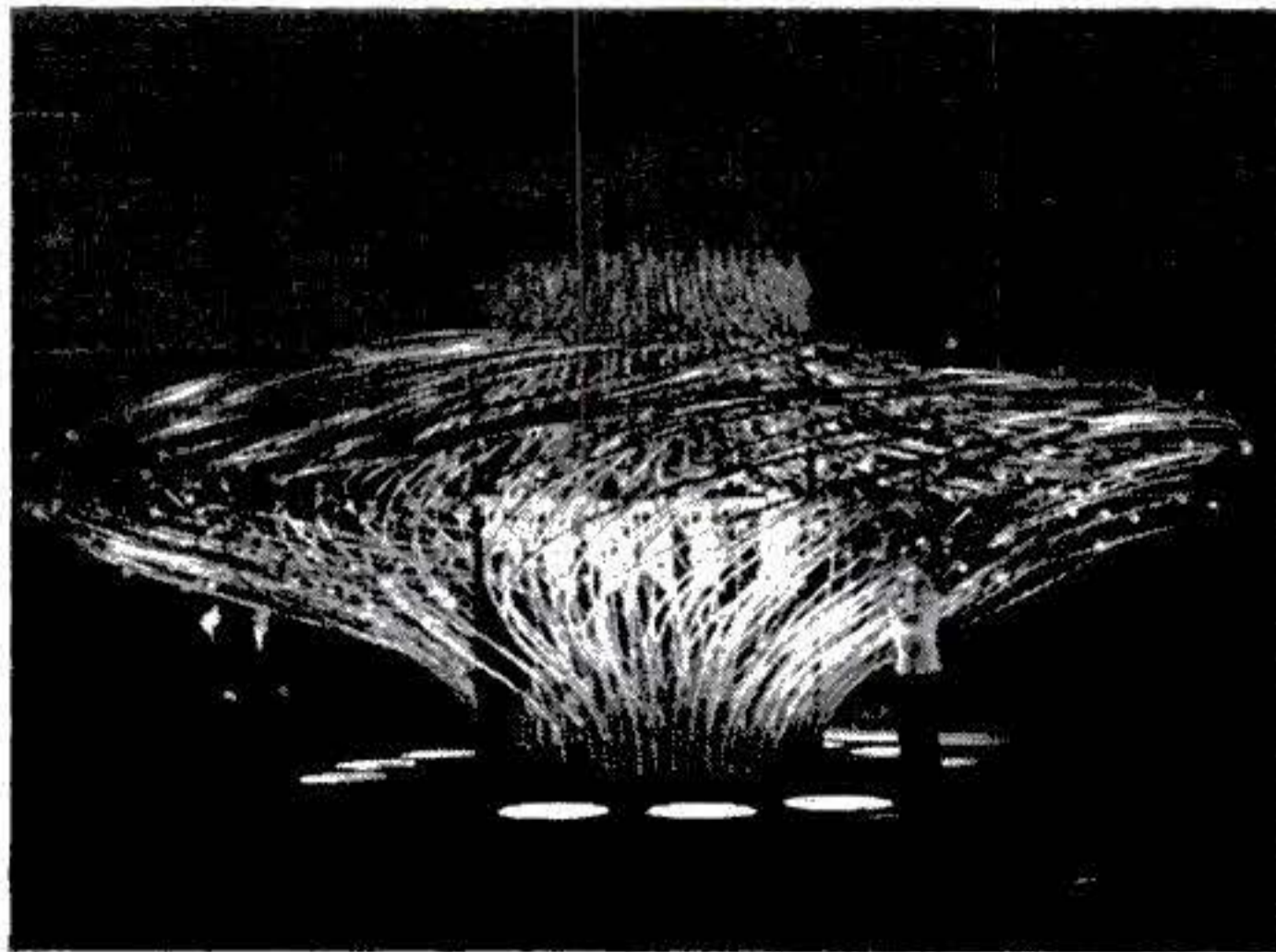
You fumble for a coin, put it in the slot, and step up to the "doctor." Minutes later, you have a complete medical diagnosis neatly print-

ed on a card along with the recommended treatment. Medical diagnostic machines that do the work of the family doctor are the prediction of Dr. David T. Lewis, British chemist who recently opened an Automatic Laboratory Techniques Exhibition in London. As a forerunner to his robot doctor, Lewis made note of a revolutionary new blood analyzer which in one day can do work that would take four technicians a month to complete. He foresees machines that will analyze body fluids, take temperatures, measure blood pressure and pulse, diagnose ailments, and even write out a prescription.

Concrete beams for construction?

Epoxy resin added to concrete may make it possible to use the material to form load-bearing beams. Long known for its great strength under compression, conventional concrete has a very low tensile strength. This weakness is often overcome by reinforcing it with steel. Now, French researchers have discovered that the tensile strength of concrete can be increased by as much as 250 percent by adding as little as four percent epoxy resin. The low quantity of resin needed for this much additional strength is important, due to its relatively high cost.

Continued



Giant convoluted tubes spiraling upward 18 feet represent a "chromosomal puff" in gigantic electrified model of a single gene 250,000 times life size. The Upjohn Company model has working parts inside to show how molecules combine to blueprint the cellular structure of all living things.

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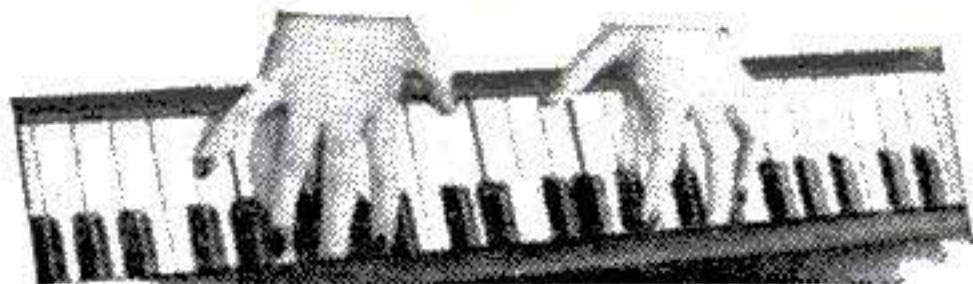
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Science Newsfront

[Continued]

Contact lenses of soft plastic

A unique plastic material that becomes soft when wet is being used to make comfortable contact lenses that mold themselves to the shape of the cornea. The plastic, known as Hydron, is the invention of two Czechoslovakian scientists, Drs. Otto Wichterle and Drahoslav Lim, and is now being produced in this country. When dry, the material, described as a modified hydrophilic acrylic polymer, is hard and transparent, and can be cut and ground into lenses. It is permeable to water, however, and becomes soft and pliable when wet. Lenses made of it are saturated by the wearer's tears, and mold themselves into place.

Hip pack helps carry heavy loads

A simple device that transfers most of the weight of heavy loads to the hips, making it possible to carry more with less effort while maintaining better body balance and greater mobility, will shortly be produced by the Rotary Company, Inc. of Buffalo, N.Y. The device is the Bell Hip Pack, patented in 1964. It consists of a frame contoured to the shape of the upper trunk and lined with padding for the wearer's comfort. Shoulder straps and a waist belt keep the unit closely coupled to the body. The Hip Pack is already in use in a large number of military and commercial applications.

Electronic sleep machine

An electronic sleep machine, claimed to be as effective as phenobarbital but with no side effects, has been patented by Prof. Omar Wing of Columbia University. The transistorized, battery-powered device is about the size of a cigar box, and applies harmless low-voltage pulses at about 30 cycles per second to the head through pads at the nape of the neck and the eyelids. The pulses are adjusted so that the wearer experiences the sensation of alternately seeing black and white. If clinical tests of the sleep inducer prove successful, an inexpensive home model (about \$100) will be produced.

What causes freak lightning?

Ball lightning, strange moving blobs of colored light that have been known to dance on the wingtips of airplanes, in the rigging of ships, and to drift in open windows and doors, sometimes exploding with a violent bang, does exist and has a natural explanation. Often dismissed as folklore, this strange phenomenon is a luminous, high-temperature region of air having high electrical conductivity, according to Drs. M. A. Uman and C. W. Helstrom of Westinghouse, who have formulated a theory of ball lightning with the aid of a computer. The heating occurs when direct currents of electricity funnel through a particular region between storm clouds and the ground, making the air in that region hot enough to glow. A

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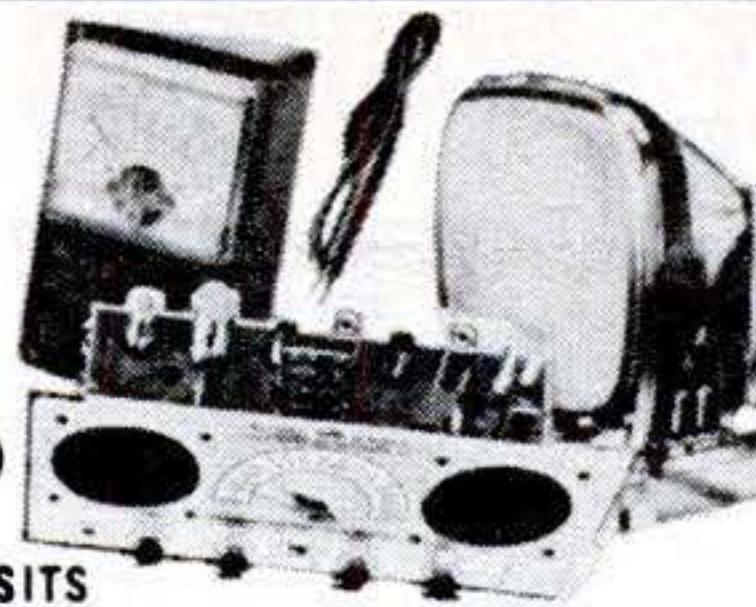
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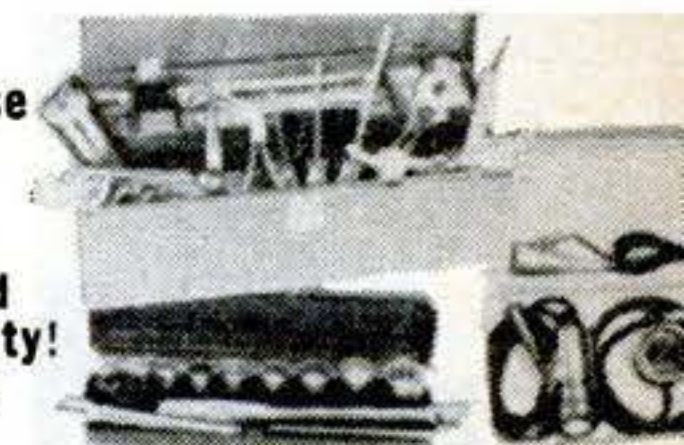
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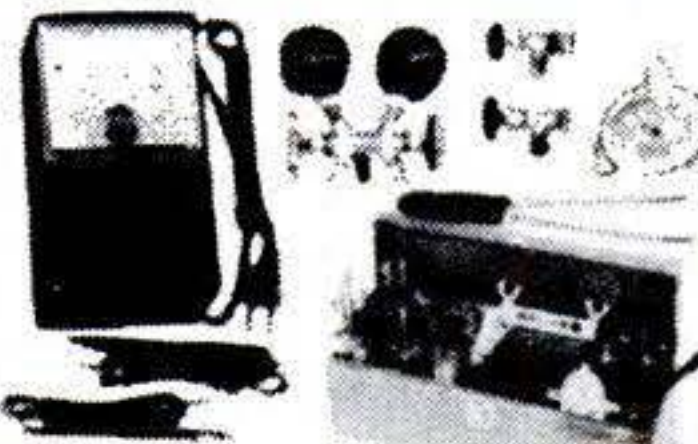
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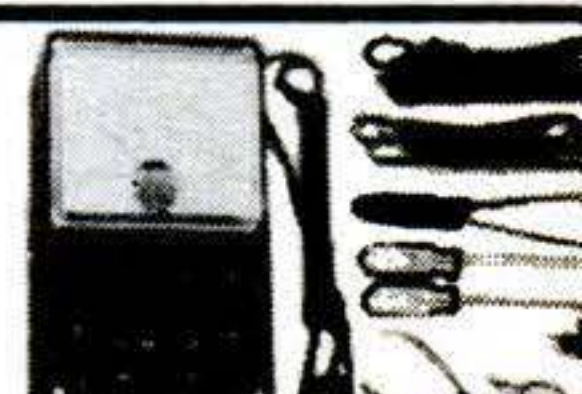
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Science Newsfront

[Continued]

ball, which may be eight inches or more in diameter and brighter than a 1,000-watt lamp, forms when the right amount of air is heated.

Throwaway artificial kidney

An inexpensive disposable plastic "kidney" has been developed in Sweden which, like the U.S., has more patients needing the aid of artificial kidney machines than it has machines available. The plastic filtering device is the invention of Prof. Nils Alwall of the University of Lund, who developed it in cooperation with one of Sweden's major packaging manufacturers. Although the throwaway plastic kidney must be used with a machine costing \$8,000, it drastically reduces costs and makes it possible to treat three times as many patients.

World's longest radio antenna

A steel-and-aluminum cable two miles long has been stretched over a fjord between two mountain peaks in northern Norway to form the world's longest antenna. It is designed to serve a very-low-frequency radio station, part of the international Omega navigational system by which ships can determine their positions by tuning in the signals. Reason for the length of the antenna is the very low frequencies used, where wavelengths are miles long. At these frequencies, an antenna must be very long to function efficiently.

X-ray TV to aid doctors, researchers

Heart cases and patients with broken bones are among those expected to benefit from a new X-ray device that produces continuous X-ray TV pictures. Designed to study the effects of violent acceleration on the internal organs of astronauts, the machine uses a low-power X-ray tube that emits 60 pulses every second to make 60 pictures. After passing through the body, the X rays excite an intensifying screen which is scanned by an extremely sensitive TV camera. Only 1/80 of the radiation emitted by an ordinary X-ray camera is needed to make a single picture. Because of the low radiation, the machine, developed by Admiral Corp. for the Air Force Aerospace Medical Division, can be used to help doctors set bones, do surgery, study cardiac cases.

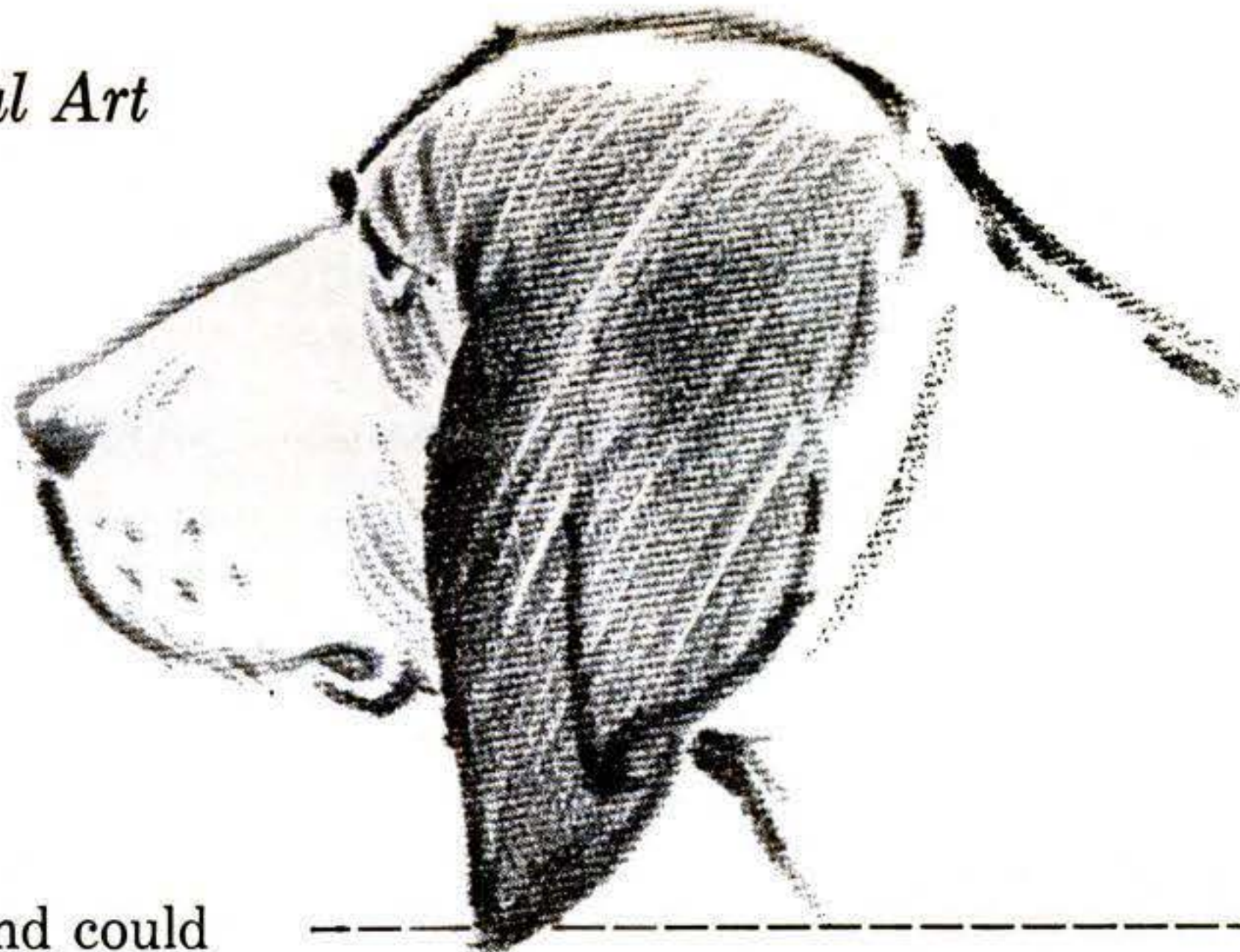
Fuel-cell power plant demonstrated

A silent fuel-cell power plant that burns air and natural gas, has no moving parts, and is twice as efficient as a gasoline-driven generator has been demonstrated by Pratt & Whitney Aircraft. The fuel-cell unit produces 500 watts at 32 volts, and could be used for home auxiliary power or as a portable source of electricity. The largest fuel-cell device of its type ever built, it can burn a variety of hydrocarbon fuels including gasoline and jet fuel without producing noxious exhaust gases.

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Detroit Report...

WHATEVER HAPPENED TO PONTIAC'S SPORTS CAR? Last summer we thought Pontiac might produce a light two-seater for 1967. They won't. Last spring Pontiac built a stylish coupe called Banshee, sent us pictures, and said it would be in the New York Auto Show. It wasn't. What's going on? The talk around Detroit is that Pontiac may be working on another new car, with its own version of Fisher's F body used for the Chevrolet Camaro or Caramout (ex-Panther).

Watch for two safety developments to be rushed into the 1968 models—collapsible, energy-absorbing frames, and sweptback dashboards. Ford seems to be leading in work on collapsible frames, and is studying the benefits of energy-absorbing sheet-metal structures. Goal: to bring the effects of a collision at 30 m.p.h. down to the level of a six-m.p.h. crash, mostly through redesigned frames and fenders. Sweptback dashboards present problems. Set close to the firewall, they leave little room for heater ducts, plenum chamber, windshield-wiper motors, glove compartment, radio, and speaker. So engineers are designing narrower plenum chambers, offsetting windshield-wiper motors, and otherwise reworking the under-dash space. A new dashboard assembly, now under development at Ford and General Motors, could help. Hinged at the bottom, it swings away from the windshield to reveal the complete underside. It will help both in assembly and repair.

Just like Indianapolis tires, high-performance passenger-car tires next year will get wider and lower. Auto people are convinced the low tires look better, and give greater safety on turns, better traction, and superior high-speed performance. A study by U. S. Royal shows that while tires have improved dramatically in the past five years, tire life has increased less spectacularly, due to the increased demands of modern driving. For instance, tread wear improved 65 percent between 1960 and 1965, but harder use lowered the overall improvement figure to 15 percent. Skid and traction improved 33 percent in the same period. High-speed safe limit for tires jumped from 95 m.p.h. in 1960 to 115 m.p.h. this year. Biggest obstacle to longer tire life? Power steering. Wider use of this option, especially by the ladies, has raised hob with tire longevity.

Lincoln's line for 1968 will feature separate frame and body construction (just the opposite of Imperial's move this year), longer wheelbase, and a wider variety of models. Lincoln will pay

special attention to developing a "low-price" model to round out its offerings. This decision is directly opposed to the Lincoln formula of five years ago which said that only a minimum number of different models would be built.

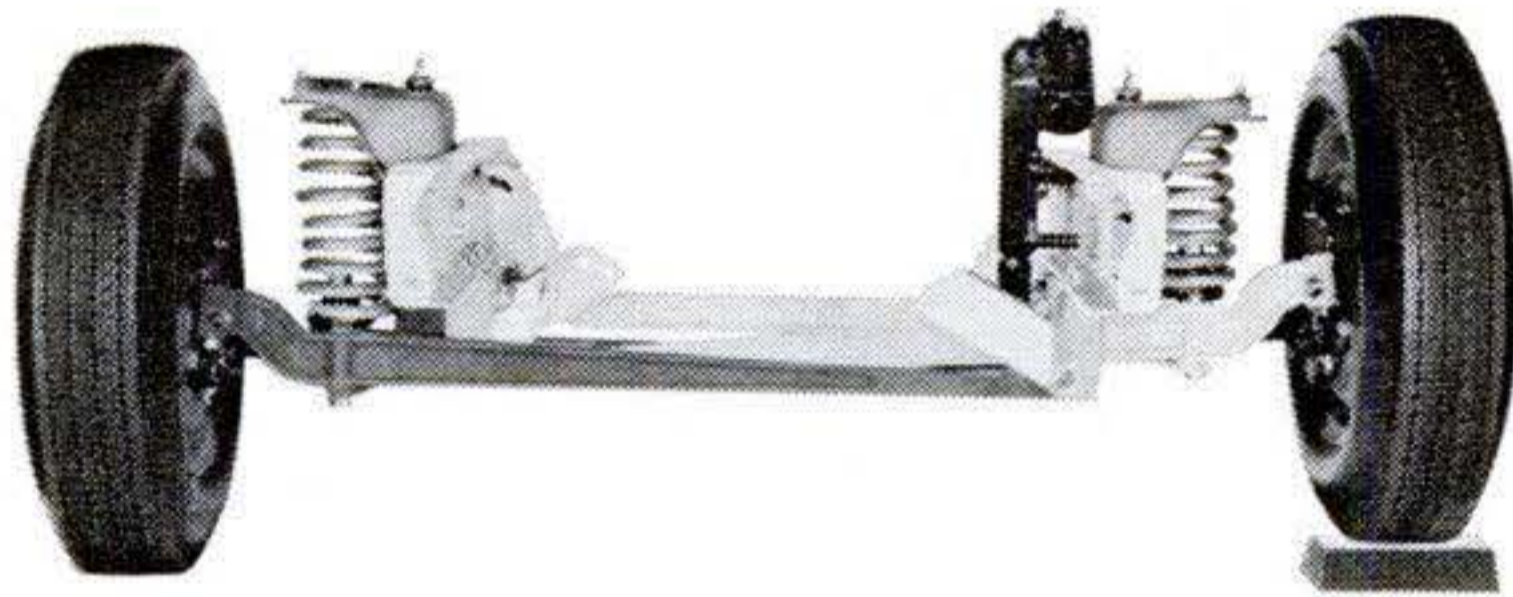
Front-drive future? Cadillac's entry into the front-drive field with its Eldorado will put heavy pressure on Ford Motor Company to come up with its own front-drive car. Lincoln is planning to meet Cadillac model for model within two years, and a new Mercury model will compete with the big Buicks, Olds, and Chryslers. Somewhere in Ford's future is a car resembling the Toronado and Eldorado. Look for a special Mercury within two years that uses the basic Lincoln body with front drive. It will come in a variety of models—hard-tops, four-doors, convertibles. Price class: upper-medium.

The '68 Ford will probably have a new kind of voltage regulator. The electromechanical type will be scrapped in favor of an all-electronic unit about the size of a coat button. Heart of the tiny new regulator is an integrated circuit—a tiny, carefully fabricated crystal of silicon that does the work of a handful of conventional electronic components [see PS, Oct. '65, p. 94].

Be your own car expert. With the '67 models on the way, it's time you were straight on which body is which. Here's a handy guide to the GM cars. If you read "A" body, it means Chevelle, Tempest, F-85, Special. "B" body refers to the regular Chevrolet, Pontiac, Olds, and Buick. "C" is Cadillac, Olds 98, and Buick Electra. "E" is Toronado, Riviera, and now Cadillac's '67 Eldorado. Corvair and Chevy II share their bodies with no other cars, and thus have no letter designation. Finally, "F" is the body to be used on Chevy's answer to the Mustang and possibly, as noted above, a new Pontiac.

Jan P. Norbye
Automotive Editor

Two smooth ideas from Ford solve rough driving problems!



Truck operators, sportsmen and others who often find the going rugged can take comfort from Ford's latest advances in vehicle suspension systems. One bright idea, found only in Ford light-duty trucks, is a front suspension with *two* axles. These axles, forged from steel "I" beams, make each front wheel work independently to soak up road shock. Result: Ford pickups ride almost as smoothly as a passenger car!



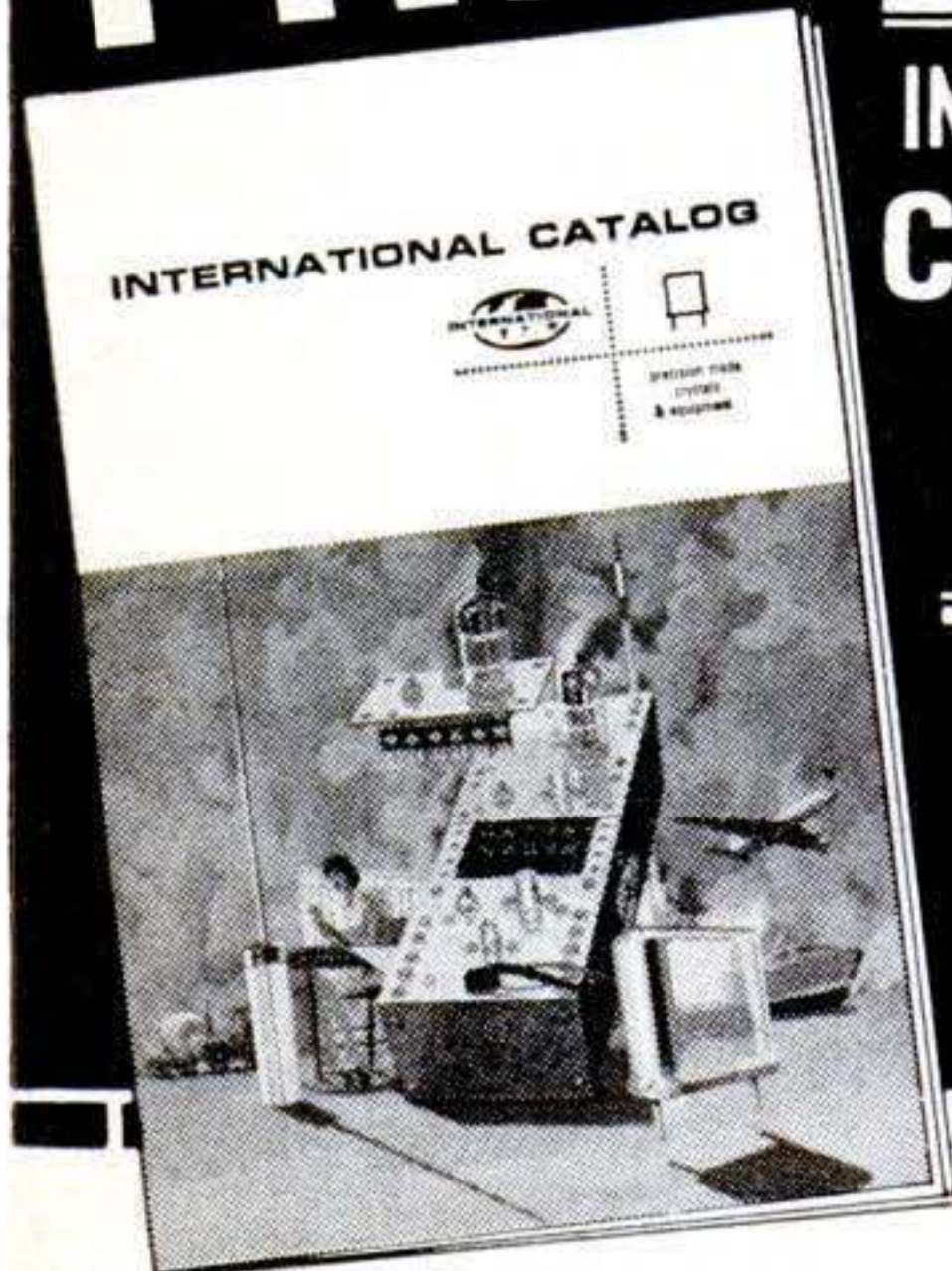
Another Ford development: Bronco's unique Mono-Beam front-wheel suspension—one reason why this 4-wheel-drive fun car handles back roads and mountain trails with ease. Here, the driving axle is connected to the frame by forged steel radius rods through heavy-duty rubber bushings to absorb vibration. A front track bar aids stability and axle

alignment. And there are high-deflection-rate coil springs and double-acting shock absorbers to make big bumps feel like ripples in the road.

Making the road ahead of you easier and more pleasant to travel is our business—and your Ford dealer's. See him now for a '66 Ford pickup or a fun-filled Bronco. You've never had it so smooth!



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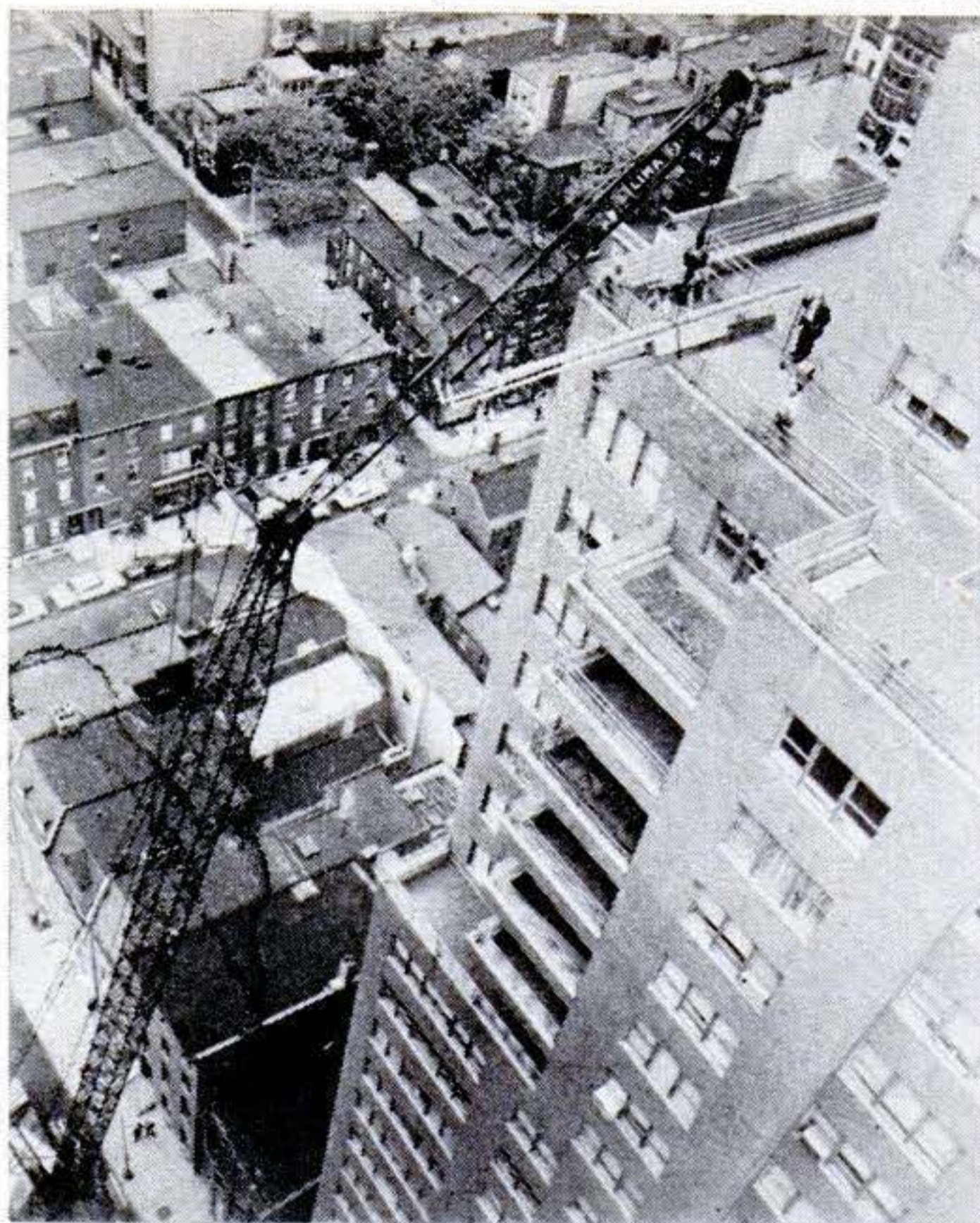


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Tall crane makes roof delivery

A replacement for a fire-damaged cooling tower in the air-conditioning system of a 24-story Philadelphia hotel was carried from street to roof without disturbing the guests. Using a crane with 250-foot boom, the contractor lifted all materials to the roof in three hours. Conventional rooftop hoisting would have taken four days.



Tent has built-in foam mattress

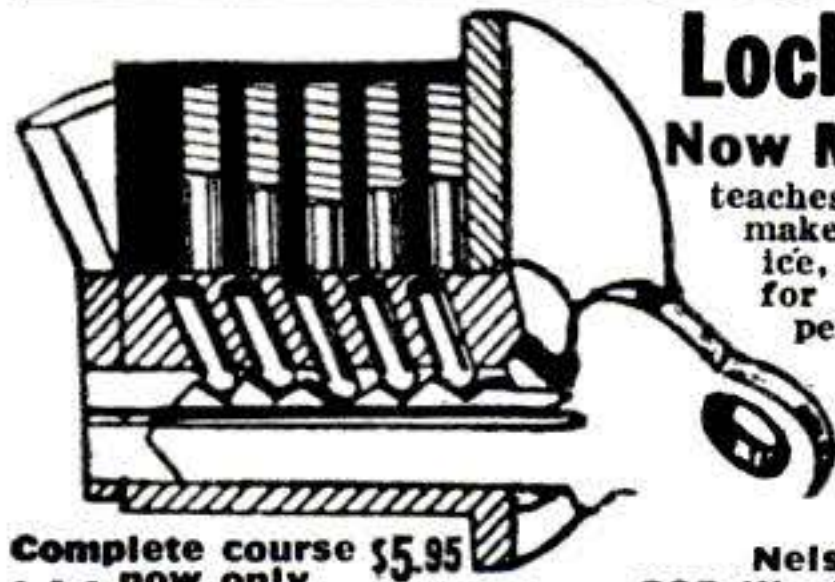
This nylon tent has a rubberized floor, built-in foam mattress, and snap-in dacron liner and sleeping bag. Front and middle are supported by fiberglass wands; the back rests on the one occupant's legs. Front panels zip shut. The Marine Corps tent weighs less than seven pounds.

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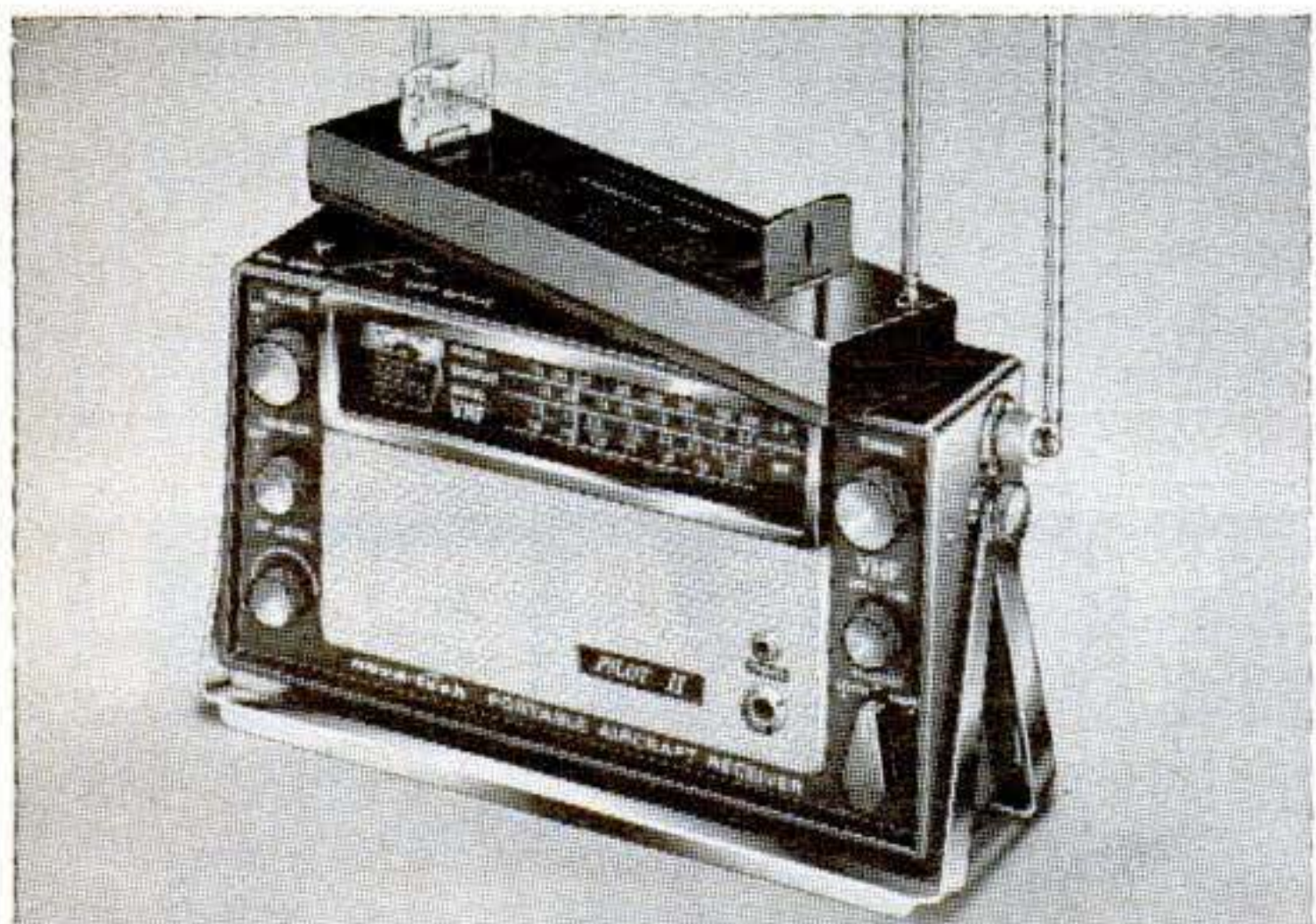
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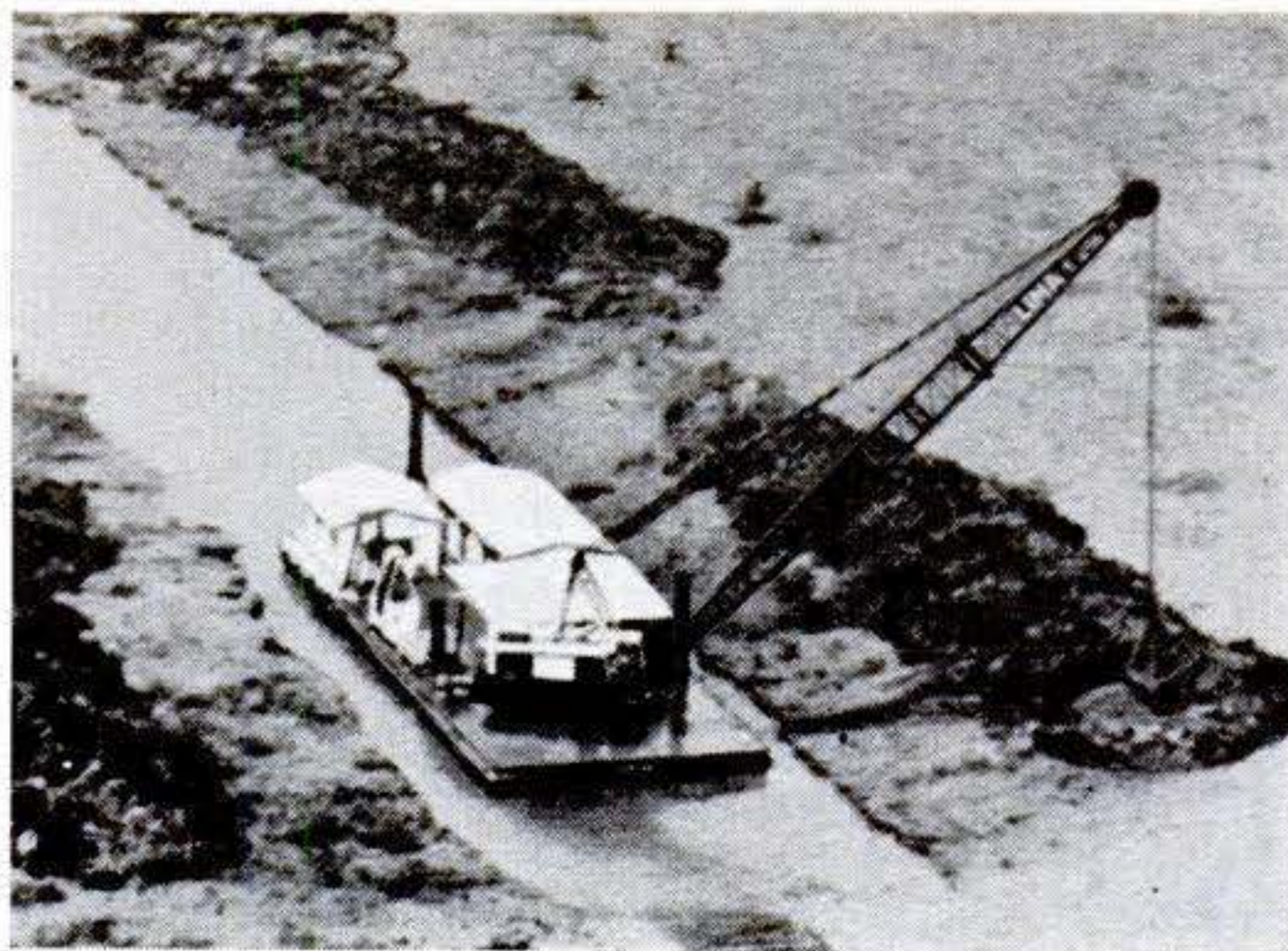
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Floating derrick digs own canal

Working off the Rio Usumacinta, on Mexico's Gulf Coast, this barge-mounted crane scoops out a waterway in front as it moves along. A four-yard clamshell bucket on the derrick excavates 5,200 cubic yards in a 22-hour day, digging a 50-foot-wide, eight-foot-deep canal for transporting heavy oil-field equipment through marsh.



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If you like to draw, you may have a God-given talent

By Norman Rockwell

I can't think of a greater waste than being blessed with a natural ability . . . and doing nothing about it. A talent for drawing is a wonderful gift. It can bring you such a rewarding life that it just doesn't seem right not to give it a chance to develop and grow.

Nobody knows this better than I. I was born in a tenement in New York. I always wanted to be an artist. When I was six, I was drawing pictures to amuse my friends. At fifteen, I had earned enough from odd jobs to go to art school. Then, over my parents' objections, I left high school so that I could attend two art schools at once.

Many times I became terribly discouraged and wanted to give up art school to start earning money. But my instructors encouraged me to continue. One day a friend urged me to submit my work to *The Saturday Evening Post*. To my surprise, they bought the first three pictures I showed them. This sale started me toward the realization of my dream . . . making the most of the talent I was born with.

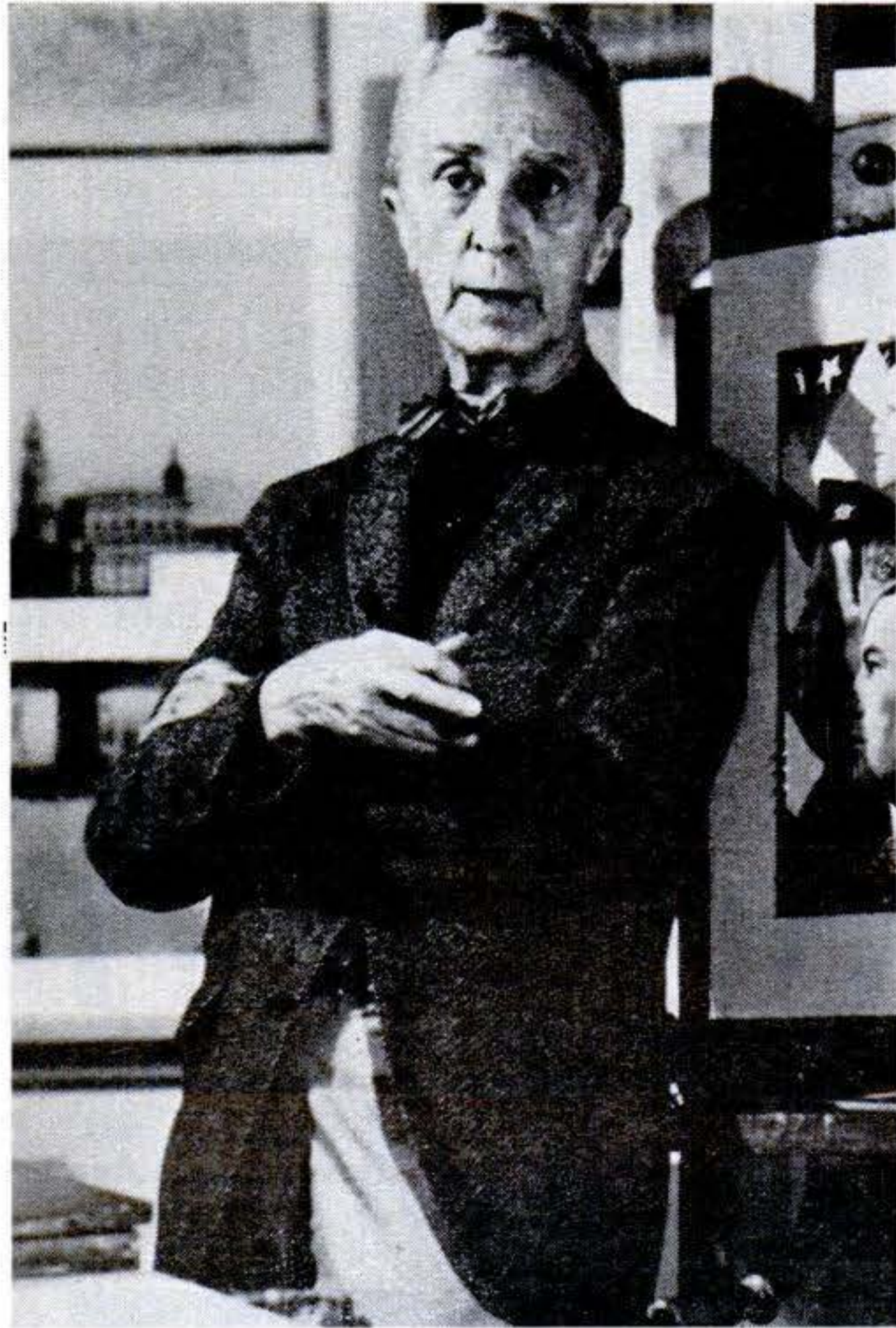
Other artists overcame greater hardships. Albert Dorne left school at 13 to support his family, studied art at home in his spare time. At 22 he was earning \$500 a week. Stevan Dohanos drove a truck before turning to art. Harold Von Schmidt was orphaned at five. Robert Fawcett left school at 14. They all became world-famous artists.

A plan to help others

To help people who never had the opportunity to study art, I joined with these and other famous men to find a way to pass on our extensive knowledge of art, our professional know-how, to promising students everywhere. First we put everything we knew about drawing and painting into a magnificent set of textbooks. Then we developed probably the most personal way of correcting a student's work by mail ever devised. Our Famous Artists Schools have won international respect for the high quality of its home-study teaching.

Our students succeed

We've helped thousands win success in art. James Ryan of Los Angeles, Calif., is a good example. If his God-given talent for drawing had gone undeveloped, he might still be a clerk, unhappy with his low-paying job. Taking our



Norman Rockwell — America's best-loved artist

course changed his whole future. Today he has a good job as an illustrator at Hughes Aircraft.

Virginia Bartter, a housewife from Ohio, found that our training helped her earn extra income for her family. Last year she received over \$1,000 for paintings she did in her spare time and is now holding art classes in her home.

Do you like to draw? Do you have the desire to train toward a full- or part-time career in commercial art or fine art? If your answer is even a tentative yes, I urge you to take steps to develop your God-given talent to its fullest.

Unique Art Talent Test

Norman Rockwell and the other Famous Artists have created a revealing 12-page talent test. It is offered free and graded free. Men and women who do well on the test — or can offer other evidence of art talent — may enroll in the School. But there's no obligation, of course. (If card is missing, write to Famous Artists Schools, Studio 5180, Westport, Connecticut 06880. Give your name, address, age, and ask for Art Talent Test.)

The easiest way to get started in writing

By J. D. Ratcliff

I can't imagine why more beginners don't take the short road to publication — by writing magazine and newspaper articles.

I've made a good living for 25 years writing articles, and I've enjoyed every minute of it. I've interviewed Nobel Prize winners and heads of state. I've covered stories from Basel to Bangkok to Buffalo.

It's a great life. No commuting, no office routine. Whether I'm at home or abroad on assignment, I write from eight to noon every day — no more, no less. My afternoons are my own.

What editors look for

Knowing *what* to write is about half the battle. The other half is knowing *how*. Editors want pieces on almost any subject that comes natural to you — but they demand that your writing be sound and professional.

To produce saleable articles, you must master the tools and techniques used by all successful professional writers.

You might develop these skills on your own through sheer blood, sweat and rejection slips. But when I look back, I can't help thinking of all the time and agony I would have saved if I could have found a real "pro" to work with me.

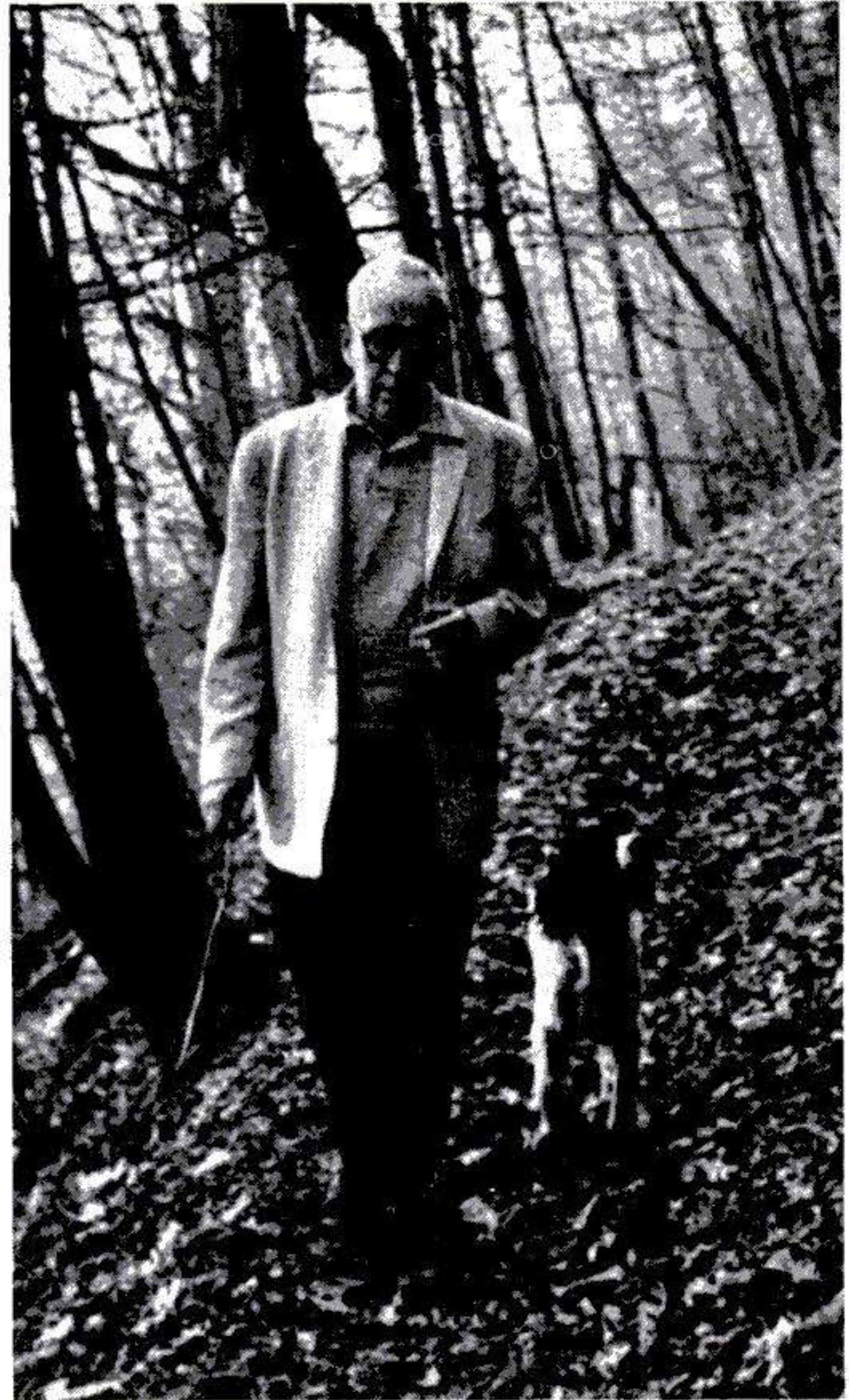
Such help is now available to beginners everywhere through the Famous Writers School — founded by Rod Serling, Faith Baldwin, Bruce Catton, Bennett Cerf, Max Shulman, Mignon G. Eberhart, Bergen Evans, Red Smith, John Caples, Rudolf Flesch, Mark Wiseman and myself.

A new kind of writing school

We poured everything we know about successful writing into a course which trains you at home, in your spare time. You learn to write *by writing*, beginning with the fundamentals. Then, you specialize in articles and other non-fiction. (Or you may choose Fiction, Advertising or Business Writing.)

When you complete an assignment, one of our instructors — each a professional writer or editor — spends up to two hours analyzing your work. He blue-pencils corrections on your manuscript, much as an editor does with established authors. And he returns it with a long letter on how to improve your writing.

This training works well. Our students have sold their writing to more than 100 publications, and many have won jobs and promotions. Arthur Emerson, Ft. Lauderdale, Fla., writes:



"Jack" Ratcliff is one of America's highest paid free-lance writers. Although he works only four hours a day, he has had hundreds of articles published in top magazines, including over 100 in the *Reader's Digest* alone.

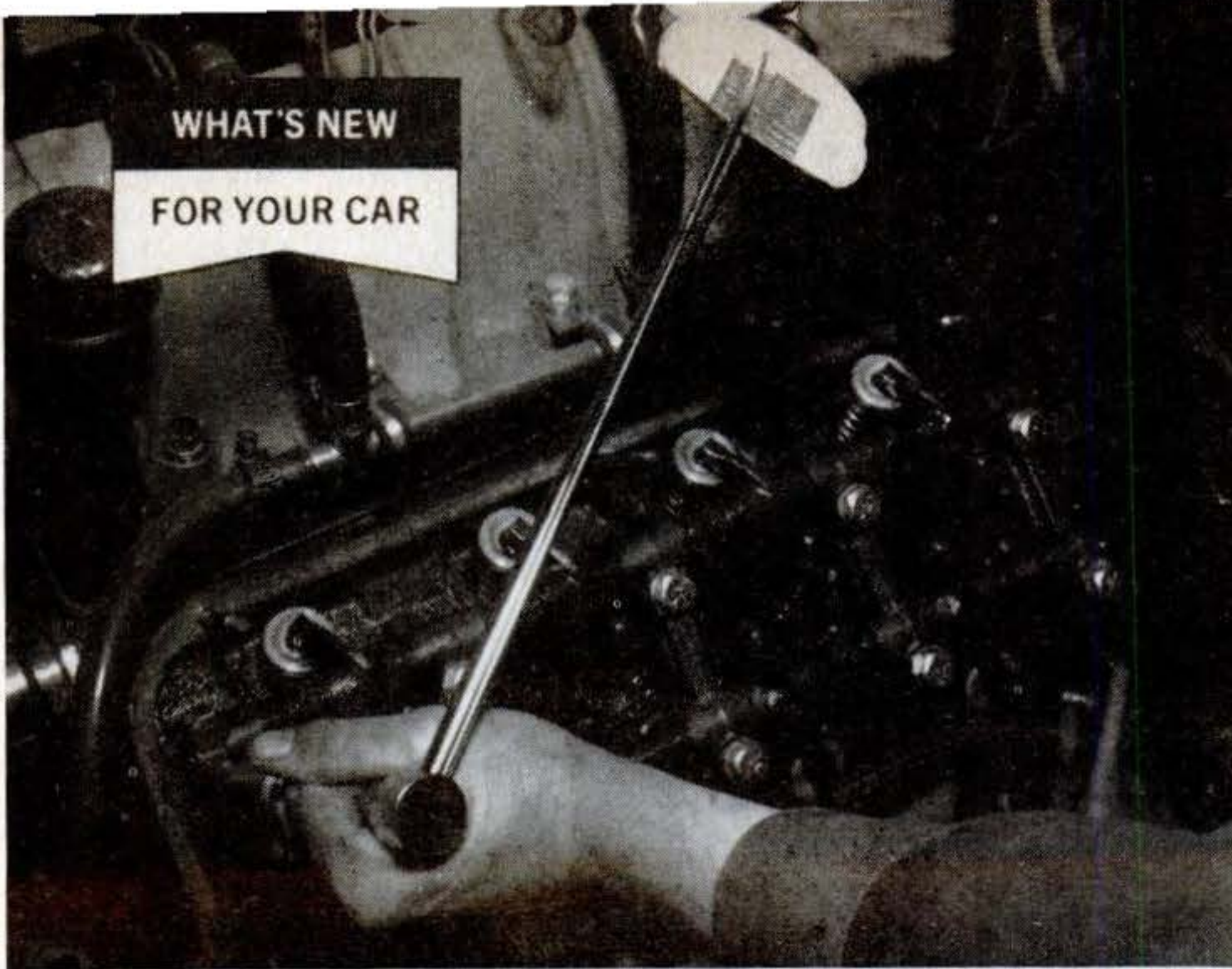
"Thanks to your training, I left my gas station job to become a writer for a large company in my area." James Ruse, Rochester, N. Y., says: "With your help, I have been promoted to editorial supervisor at General Dynamics."

Writing Aptitude Test offered

To find other men and women with ability worth developing, my colleagues and I have devised a revealing Writing Aptitude Test. The postpaid card next to this page will bring you a copy of the Test and a 48-page School brochure.

If you test well — or offer other evidence of writing aptitude — you may enroll for professional training. However, you are under no obligation to do so. (If card is missing, please write to Famous Writers School, Dept. 6943, Westport, Conn. 06880. Give name, address, age and ask for Writing Aptitude Test.)

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Torque wrench for novices

The big news about Montgomery Ward's latest torque wrench is a special chart, right on the tool, that specifies torque values for lubricated bolts from $\frac{1}{4}$ to $\frac{3}{4}$ inches. The various grades of SAE bolts are identified by head markings. Torque capacity is 150 foot-pounds, and the wrench will fit in most tool boxes. Other features: a new direct-reading scale, spring-steel pointer, and custom-ground and heat-treated measuring element. Price to be announced.

Automatic speed control

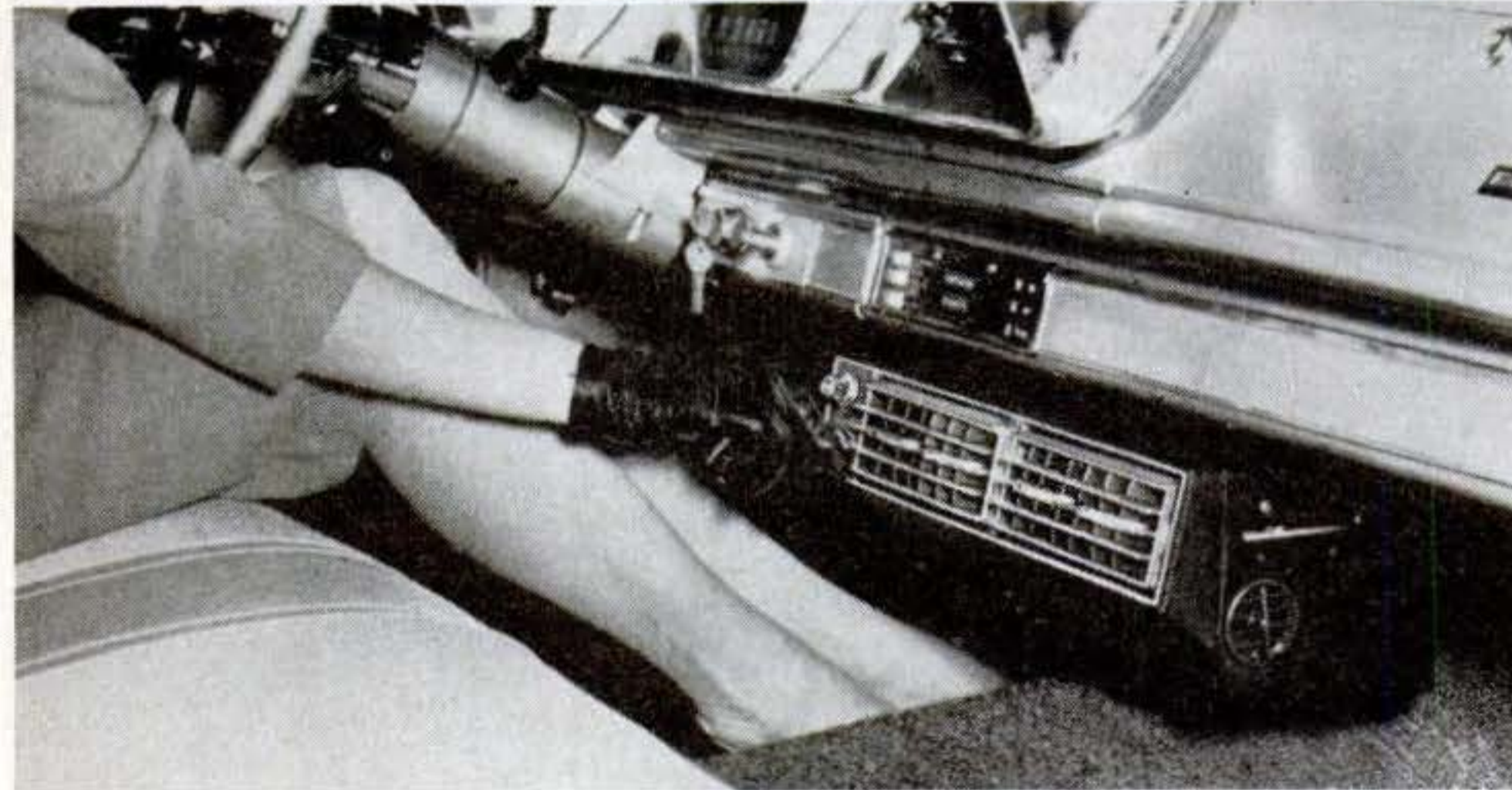
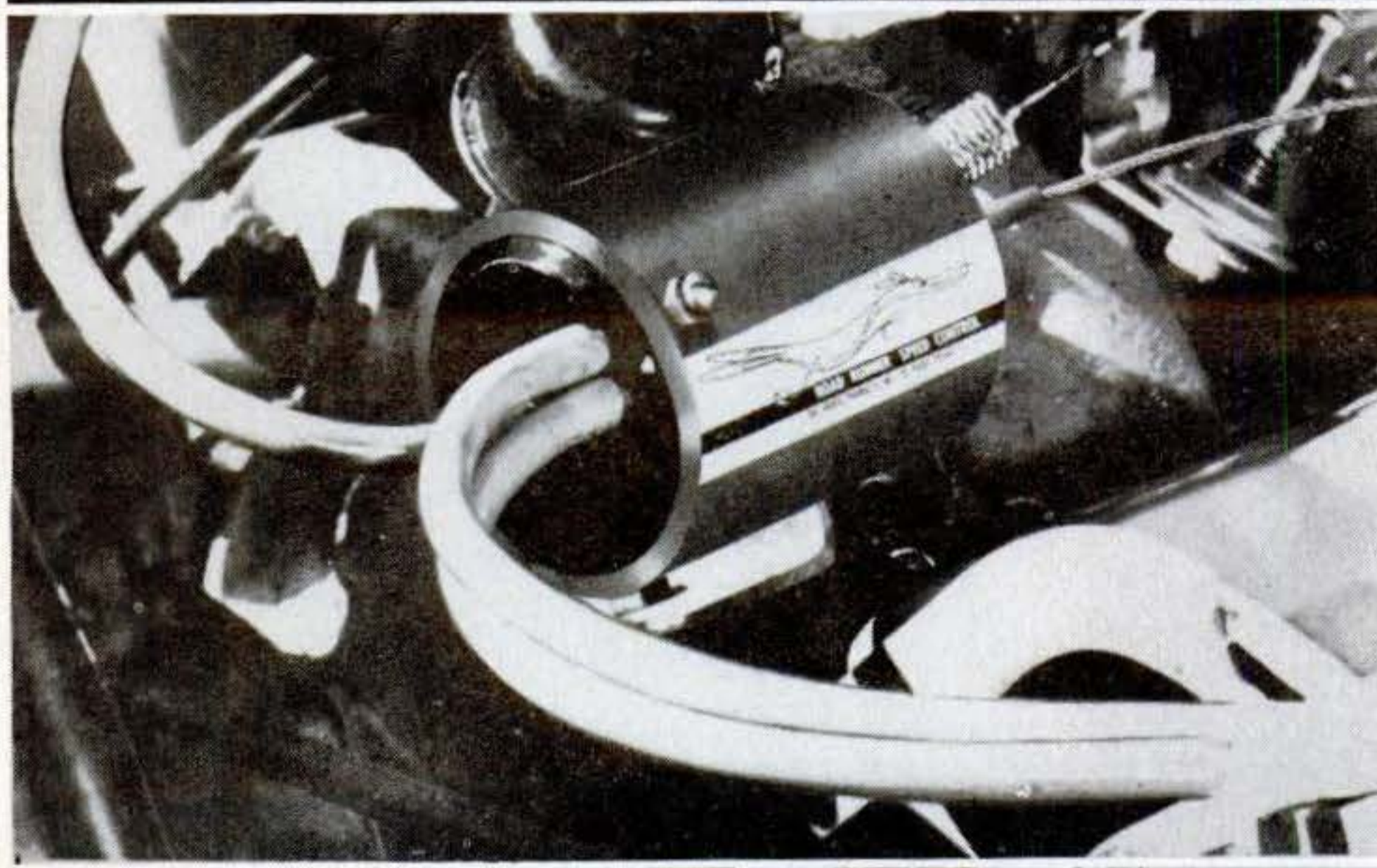
The Road Runner automatic speed control fits all U.S. cars made in 1960 or later. It can be installed in an hour by the mechanically inclined owner, perhaps in less time by a competent mechanic. Priced at \$45 for the complete kit and installation instructions, it's the least expensive speed-control system on the market. Del Norte Products, P.O. Box 3837, El Paso, Tex. 79923.

Easy-to-fit air conditioner

Air conditioners are now available with precharging to facilitate installation. There are only three components to mount, three simple quick-connect refrigerant couplings, and three electrical connections. Other features include three-speed blower control with double outlets, and a warranty on the parts. Thermo King Corp., Minneapolis, Minn. 55420.

Check tire pressures the easy way

The PiMeter is really a dust cap with a built-in tire gauge. All readings can be made practically without loss of air. The device is shock-proof and resists heat, cold, mud, sand, snow. Cost: \$3.50 each or \$12 for four. I. J. Bochory Corp., 250 W. 57th St., NYC 10019.





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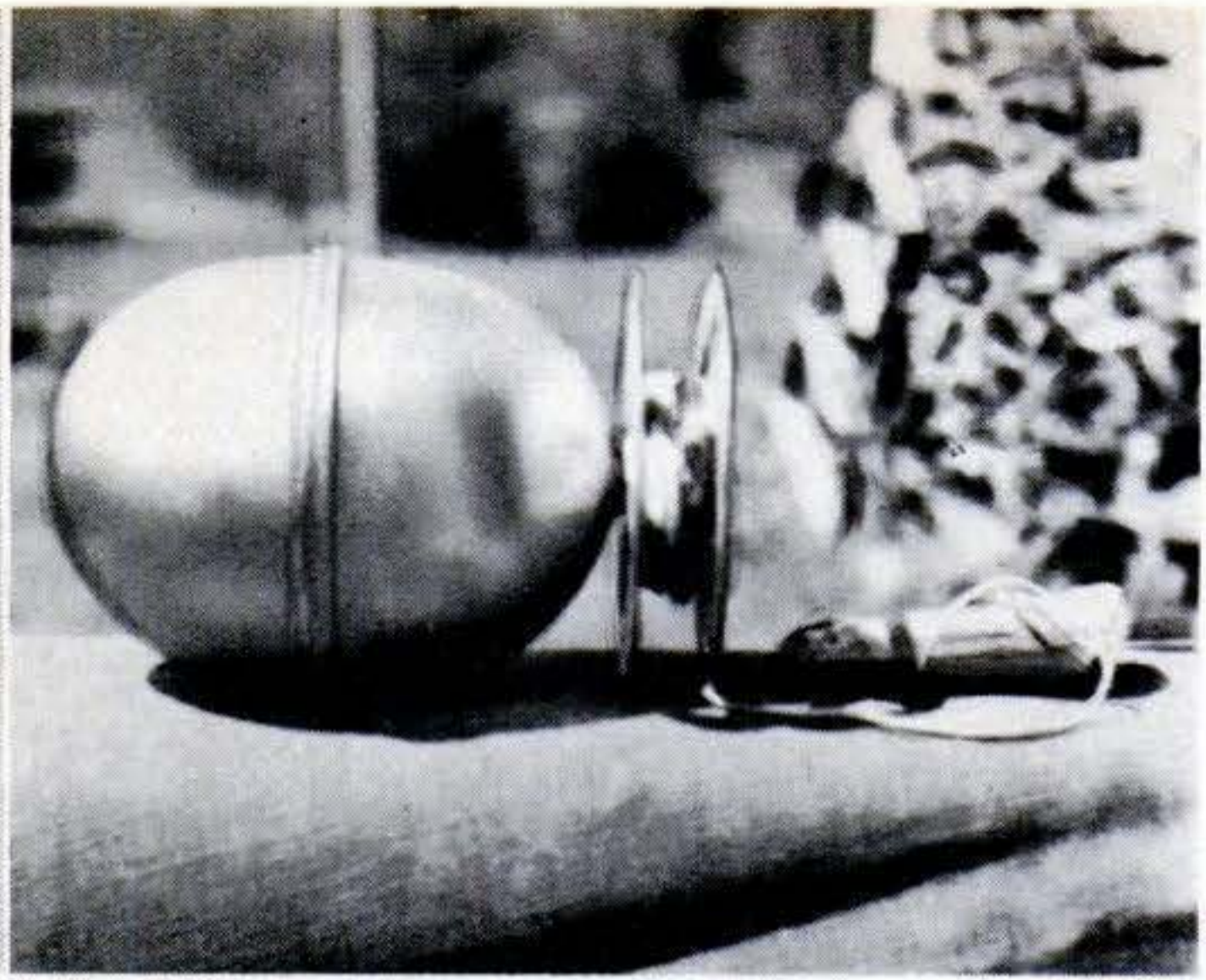
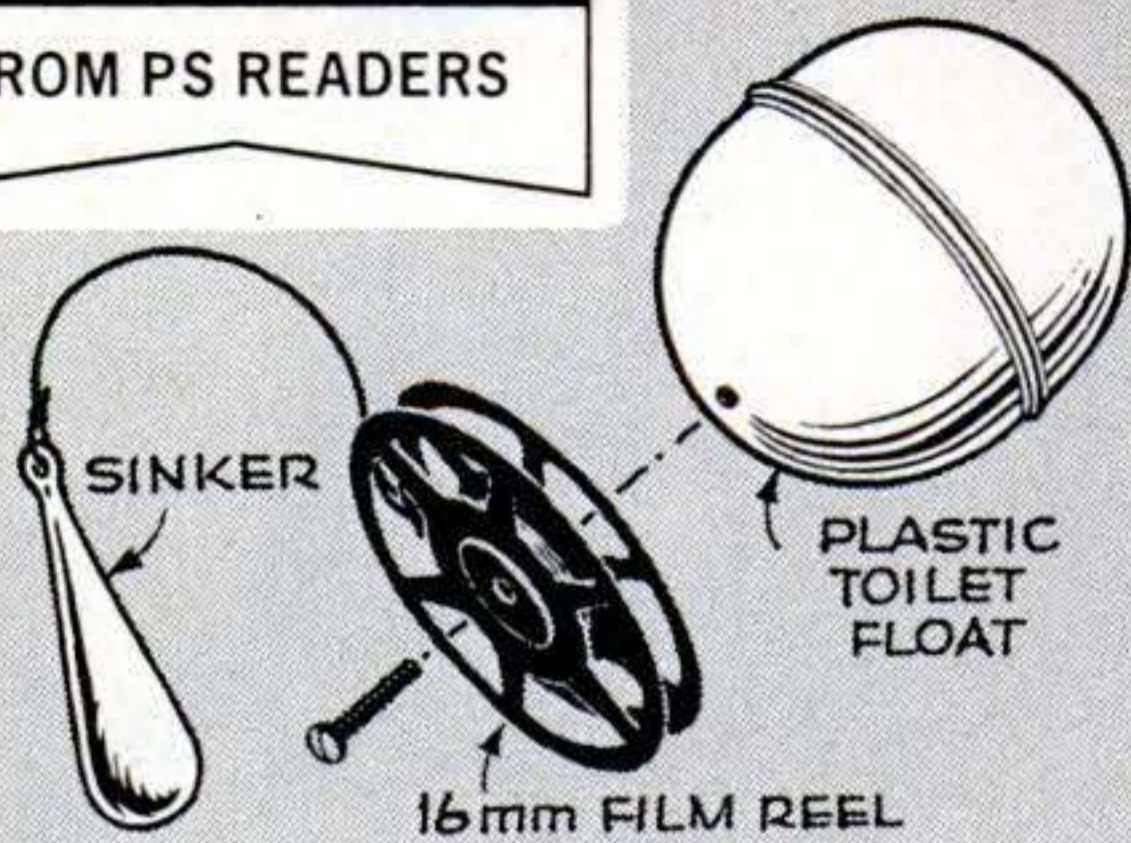
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SHORT CUTS AND TIPS

FROM PS READERS



Float marks spot of first fish strike

When trolling for school fish, it is helpful to know just where the first strike is made. I mark the spot with a homemade float—a 16mm film

reel bolted to a plastic toilet float. About 30 feet of line and a heavy sinker complete the rig. When I hook a fish, I just toss the lightweight float unit overboard.

W. E. BAKER, Glens Falls, N.Y.

How to store left-over roofing cement

Merely recapping a partly used can of roofing cement will not preserve it because air trapped in the can causes a heavy skin to form on top of the remaining cement. Prevent this by filling the can nearly full of water before capping it. Do not store where it can freeze. When needed again, the cement will be fresh.

E. DELARM, Malone, N.Y.

Rack up knives in wasted space

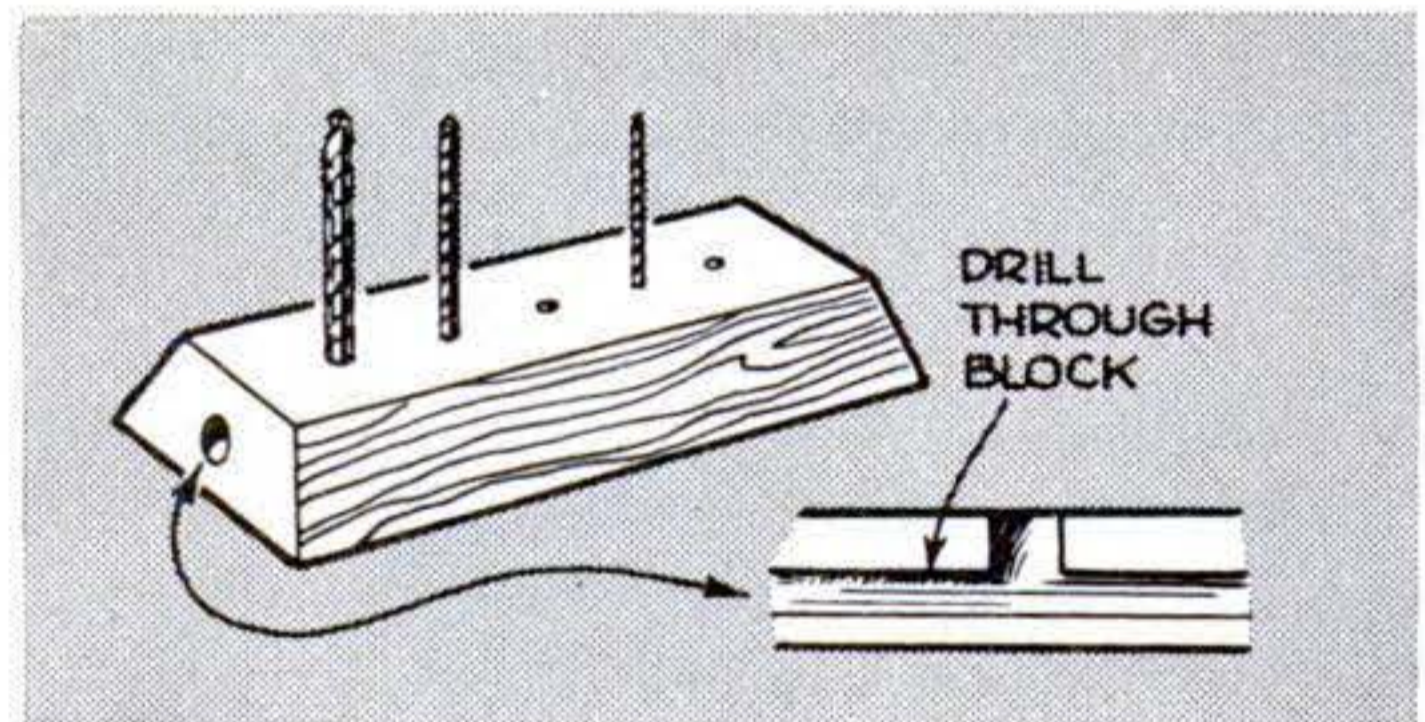
A handy place to store bread and meat knives is in the small gap between a free-standing range and the kitchen counter. This can be done by cutting slots in a long piece of $\frac{3}{4}$ " stock and fitting it in the opening with small angle irons. Knives stored in the slots are out of the way, yet handy to the working area.

J. A. SPENCE, Pittsburgh.

Nonclogging rack for drills

By simply drilling a hole lengthwise through the block used as a drill-bit holder (right), you can prevent sawdust and dirt from clogging the holes that hold the various sizes of drill bits. Blowing through the horizontal hole, or running a bottle brush through it occasionally, will get rid of any accumulated matter.

DANIEL BOUSHA, Jackson, Mich.



Slide-on clamp pads prevent marring

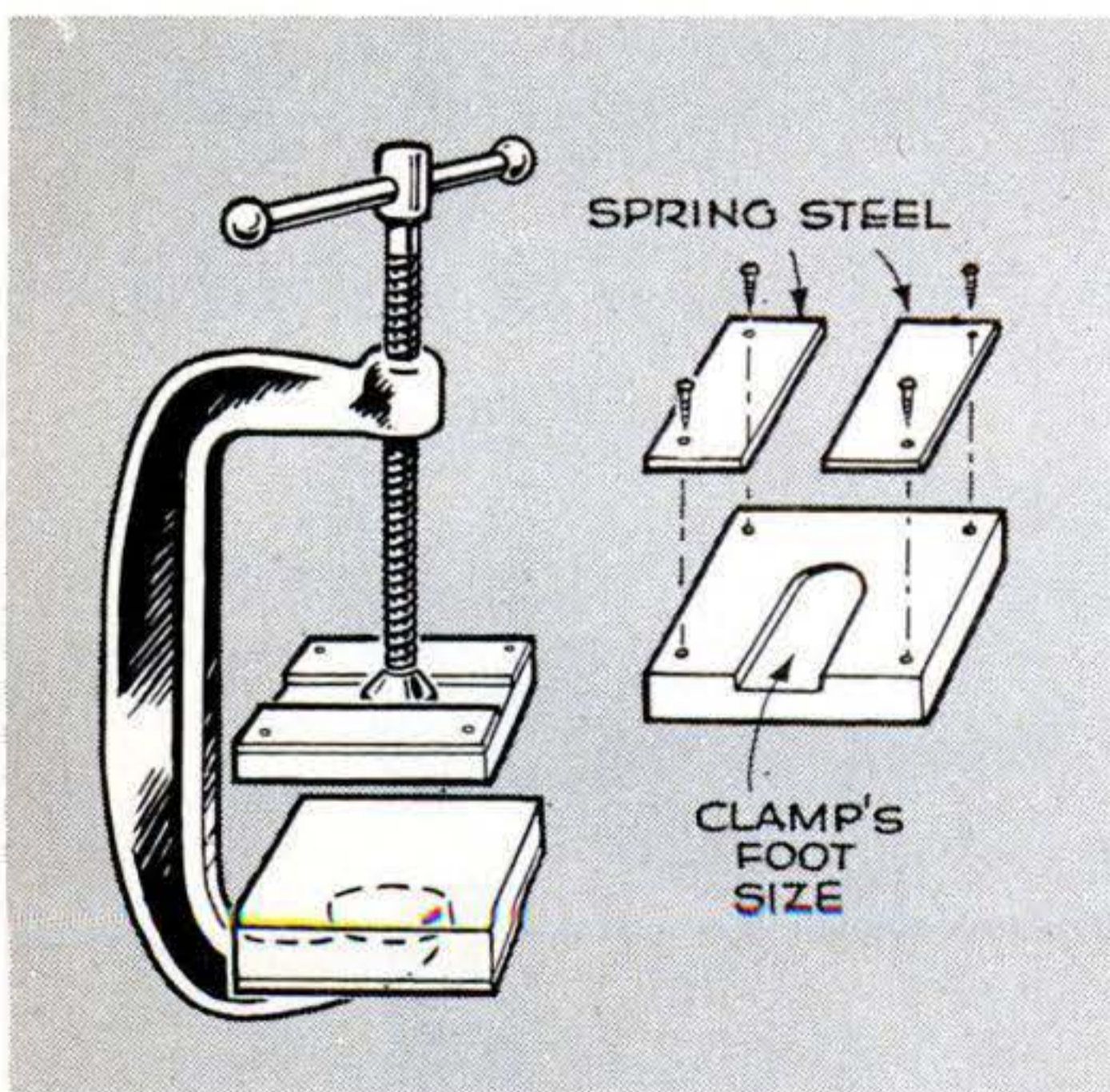
With removable pads on your C clamps, you'll glue with less chance of marring the work. Cut grooves in two blocks of wood (left) and screw spring-steel strips along the edges of the groove. Cut the groove to just the depth of the edge of the clamp foot and attach the strips so they press against the back of the foot.

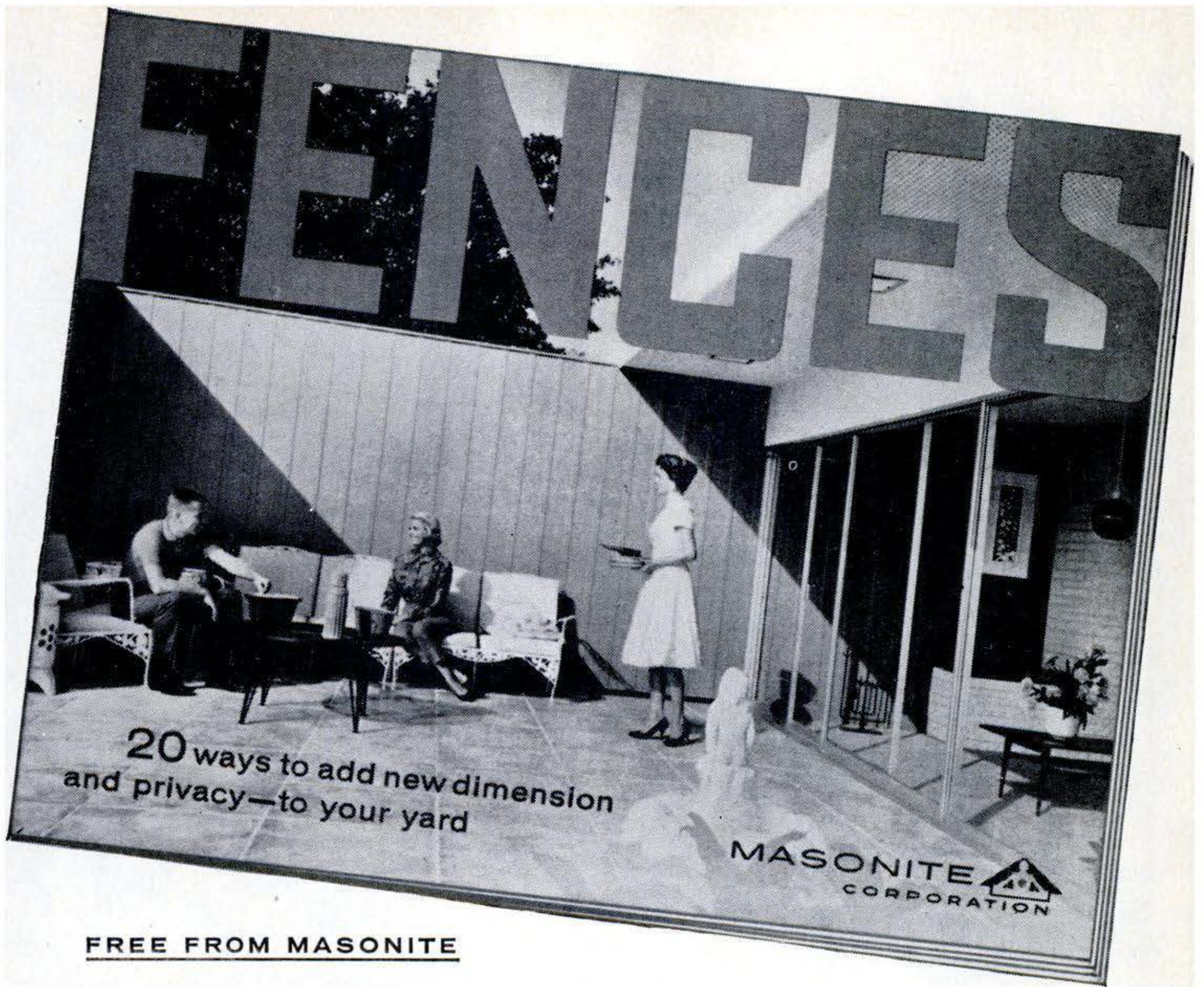
P. LEGON, Malden, Mass.

Squeeze bottle makes oil squirter

Metal machining calls for special cutting oil or "milk" to keep cutters and drill bits cool and free of chips. A dishwashing detergent bottle of flexible plastic makes an ideal dispenser because it holds more than an ordinary oil can and gives a more enthusiastic squirt.

K. R. EBELING, Portland, Ore.

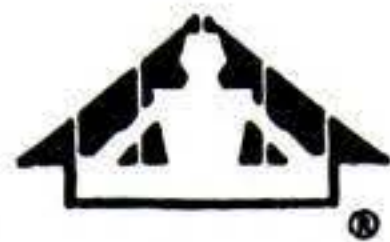




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DAFFY RIDE IN A HOT-AIR BALLOON



Ever fly through wispy treetops or call to fishermen while floating in the air with no visible means of support? Here's your chance



Amateur Francis talks with professional Barnes before takeoff.

By DEVON FRANCIS PHOTOS BY BILL MORRIS

At the hour of 6:30 a.m. a few weeks ago, when sensible people were still abed, I tramped through an alfalfa field on the outskirts of the bucolic textile community of Chester, S. C., to take a flight in something I had never stepped foot in before. I'd been up in practically everything else in my lifetime, but this was different. This was a hot-air balloon.

The envelope lay stretched out inert in folds on the ground, like a giant sack of meal emptied of its contents. Inflated, it would hold 90,000 cubic feet of air. When the air was heated, the balloon would be able to tote quite a load—1,800 pounds.

The owner of the balloon, Tracy Barnes, an aeronaut of some distinction, had built it for a transcontinental flight



Composed? That clicking sound from the author's choppers told a different story

Envelope, limp before filling, is made of Dacron, which can withstand heat without damage. It contains 1,000 square yards, weighs 200 pounds. Fabric is acrylic-coated for airtightness. It is flame-resistant—it will burn under a direct flame but goes out when flame is removed. Heat input will carry balloon to maximum height of 15,000 feet, Barnes also manufactures sports balloons selling for \$1,800.

he was about to undertake. I would be given a preview. This contrivance used no helium or hydrogen for lift. It had no engine, no anything—just hot air generated by propane burners.

Riding on the wind. All that a hot-air balloon can do is go up or down. Barnes' aircraft, in other words, was a "free" balloon, which had a disturbingly literal interpretation—once aloft, it had to voyage anywhere the winds took it.

The thing we would ride in—the gondola—was pretty big itself, a triangular contraption measuring nine feet on a side. It lay dumped over, its propane burners pointing horizontally toward the skirt of the envelope. That's the crazy way it is with hot-air ballooning.

Hot air, of course, is man's oldest tool for flight. The Brothers Montgolfier of France first demonstrated in 1783 that if you heat a bubble of air, thereby reducing its density, it

will rise. The hot-air balloon was a fixture in county fairs in the early years of this century. Today, hot-air balloonists stage time-distance races at various meets. The oldest of these is a feature of the St. Paul Winter Carnival.

My pilot, Barnes, was an ex-paratrooper and sky diver. He currently holds seven out of 10 world altitude records for hydrogen balloons, the highest of these more than seven miles, 38,700 feet—all set during one flight in a tiny plastic gondola.

If I said that I was perfectly composed on this early Wednesday morning, I would be a candidate for the Ananias Club.

"How are conditions?" I asked awkwardly of Barnes while his ground crew busied themselves checking the fuel tanks and yanking a big fan, fired by a gasoline engine, into life.

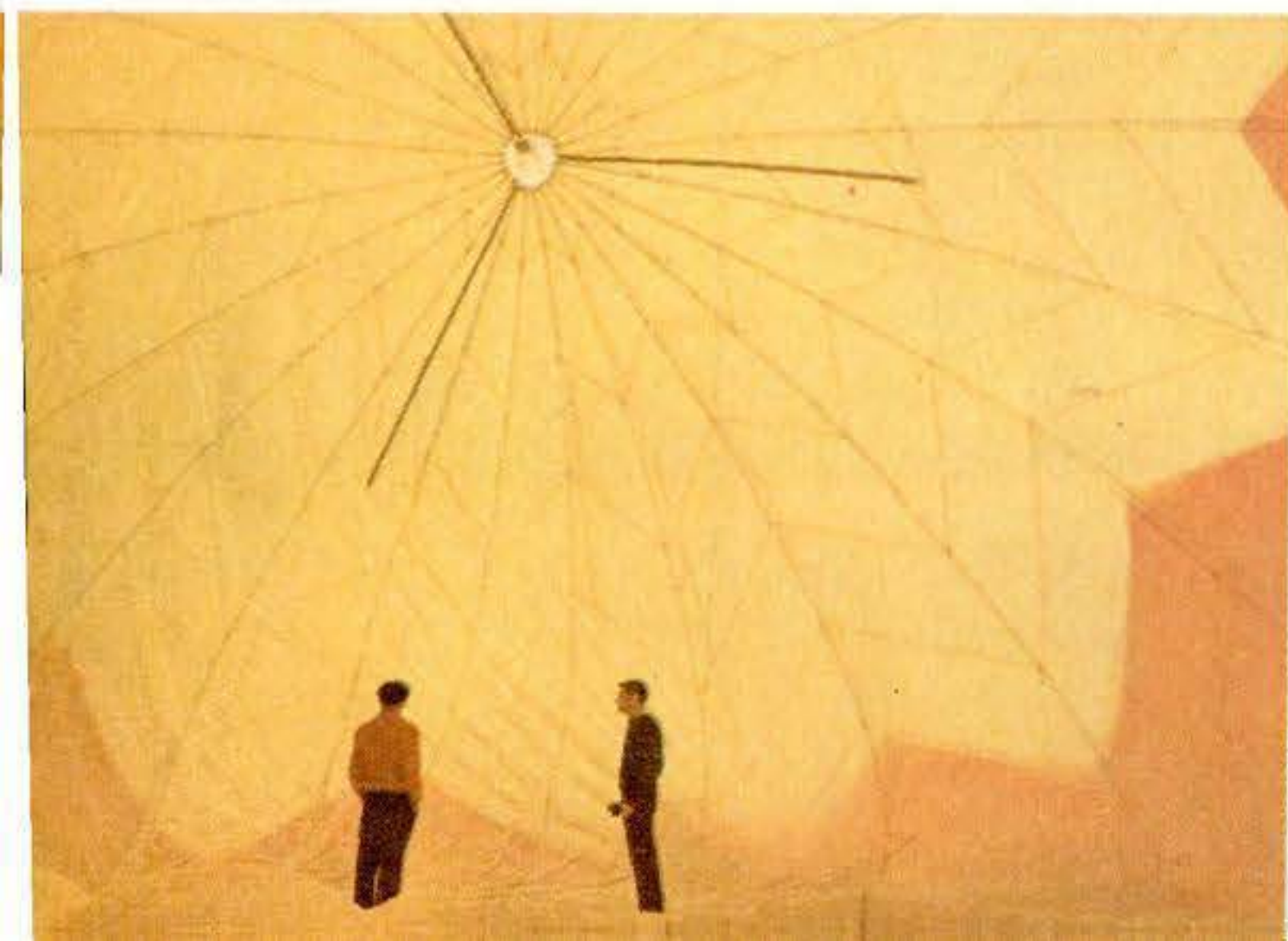
"Fine," said Barnes, preoccupied. He held a wet finger to the wind. "Fine."

We couldn't take off if the wind velocity exceeded eight miles an hour. Too dangerous.

Continued

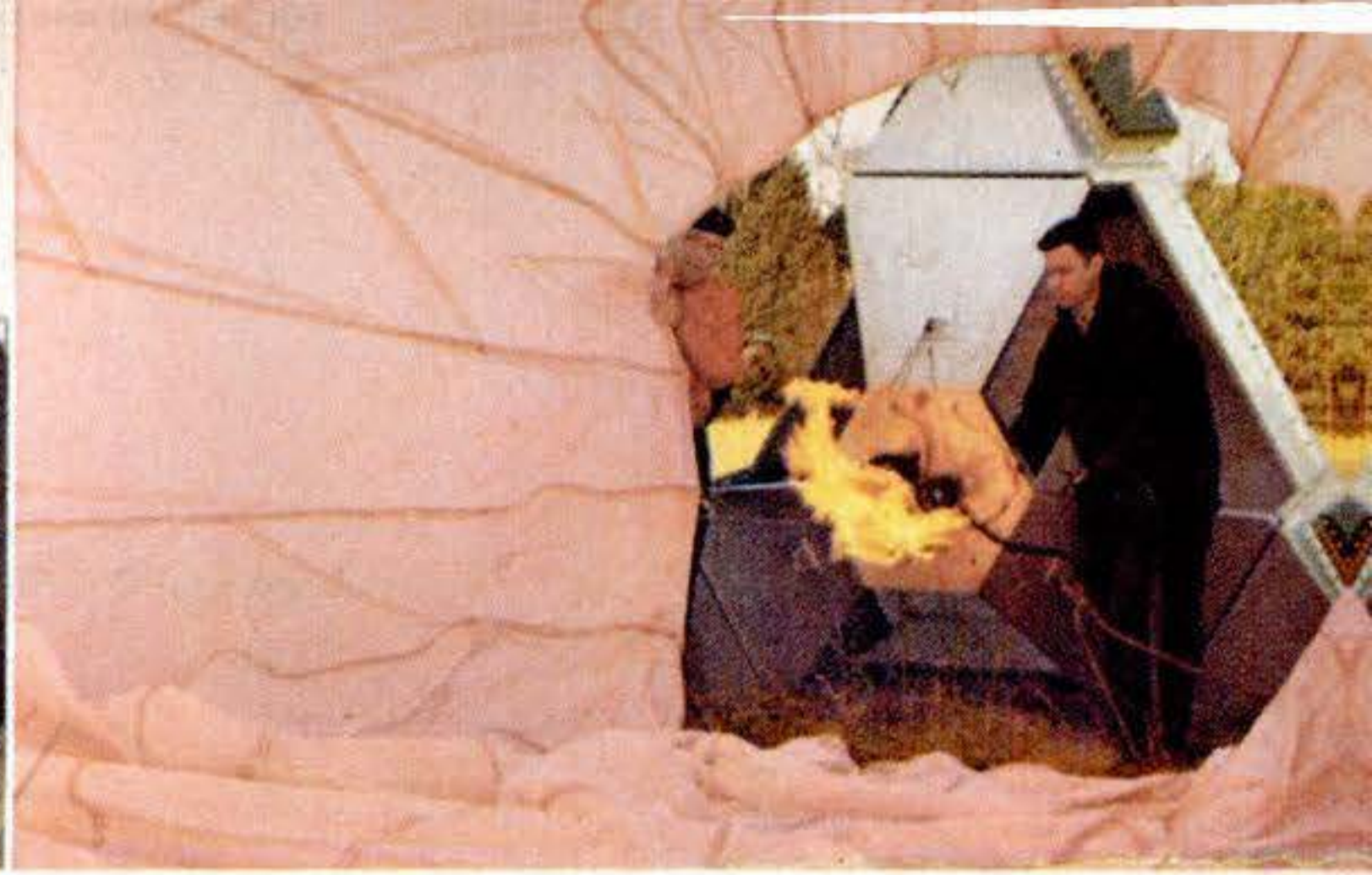
Balloon is partly filled at this stage. Air is just warm. Apex is in background. If burners should fail in flight, envelope becomes in effect a parachute, descending slower than a standard chute.

Hot air begins to lift envelope to vertical and pull up gondola. Envelope is 60 feet in diameter when fully inflated. Gores, or fabric panels, are 90 feet long. Opening at base is 10 feet across.





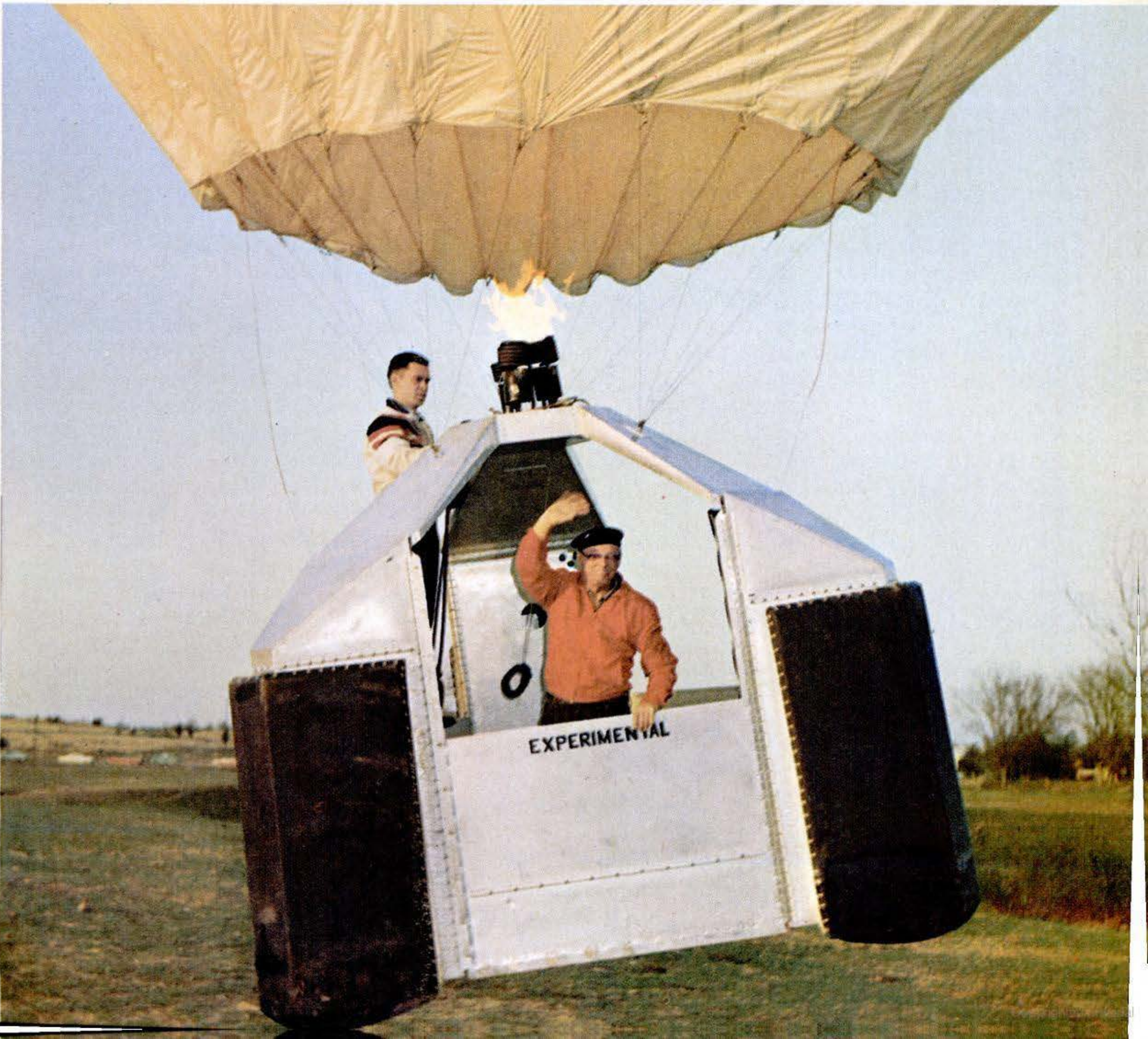
Ordinary, attic-type ventilating fan — this one, however, gasoline-powered — is used to pour in air to get balloon half filled before heat is introduced. Complete integrity of envelope is not vital to successful flight. Barnes has flown under full control with an envelope rip 10 feet in diameter. A hot-air-balloon pilot's license is the easiest flying ticket available: Just make one takeoff and landing.

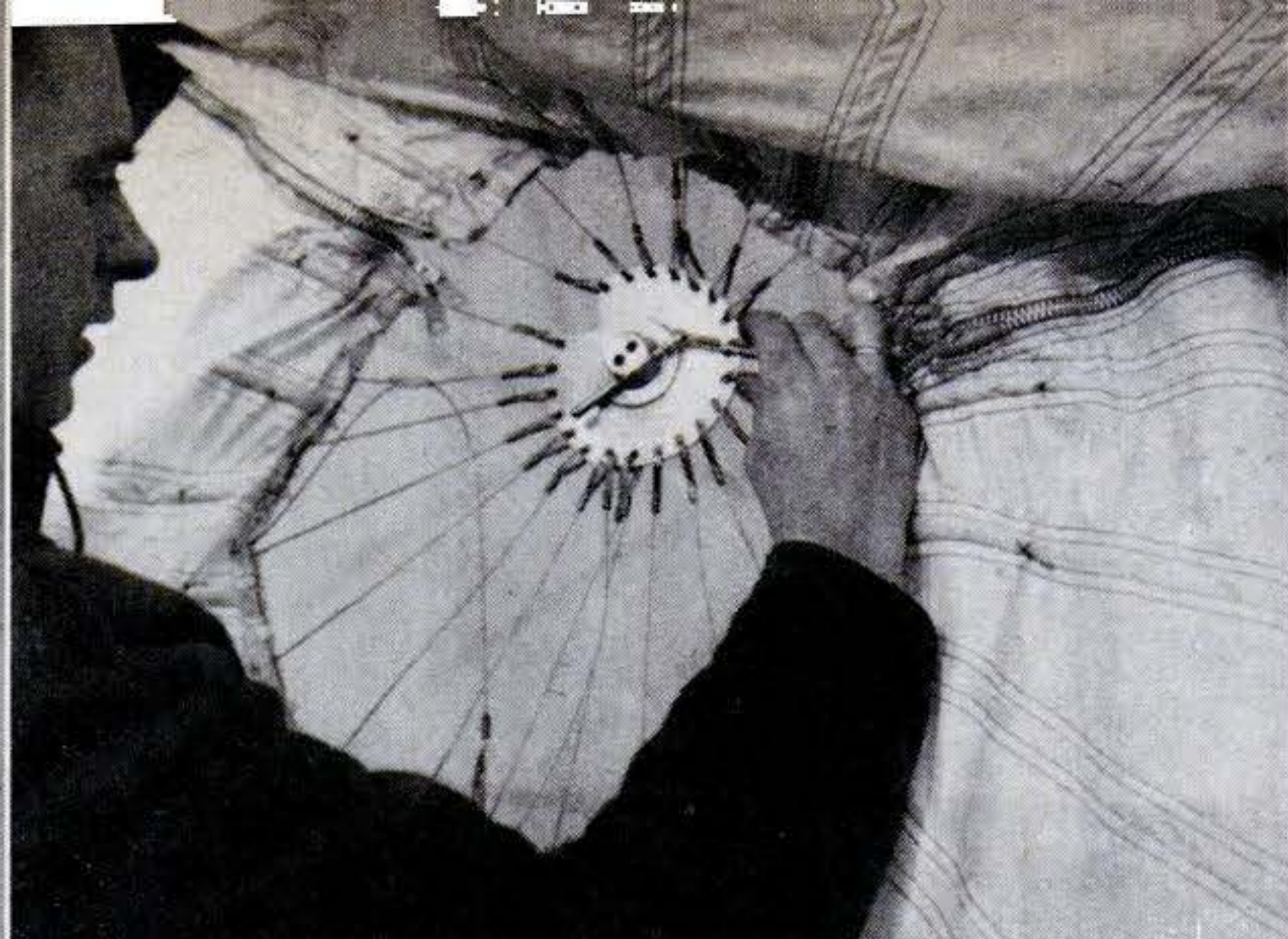
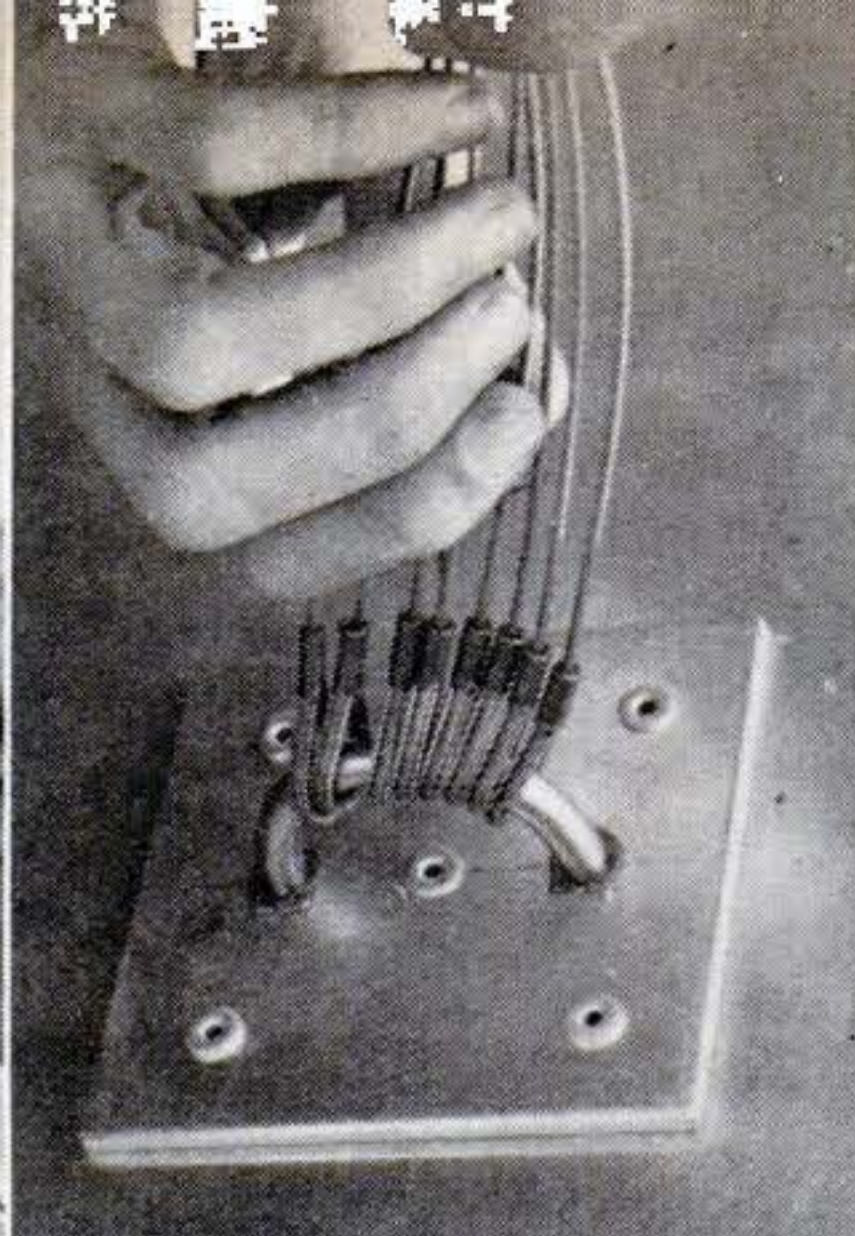
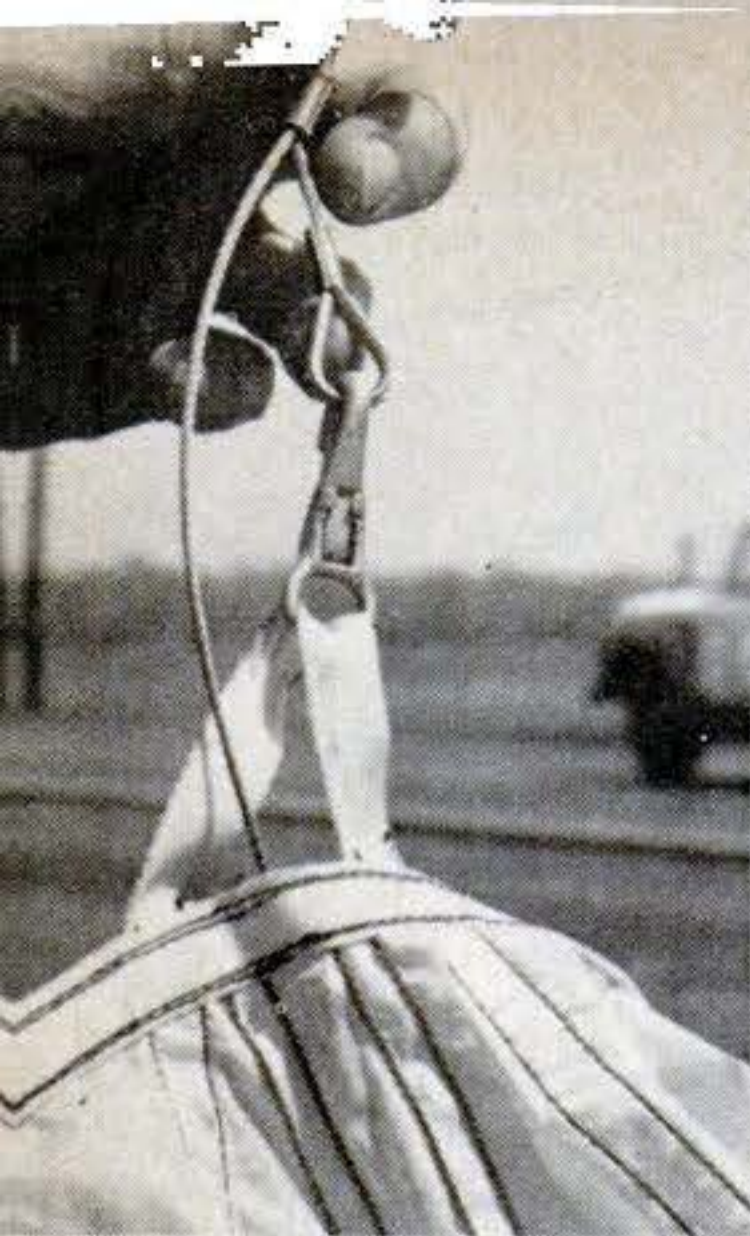


Portable burner is used for initial heat. This is a view of it from inside envelope. Normal temperature inside balloon in flight is 250 degrees. Hottest spot is at top. Burners can lift 1,800 pounds of balloon, gondola, and passengers at summer outside temperatures. In frigid air, lifting capacity is almost doubled. Burners produce eight million BTUs an hour, equal to output of 80 home furnaces.

PS's valiant passenger — no doubt a little confused at this point — manages a wave from gondola as it clears the ground. Pilot Barnes is standing nonchalantly on edge of one of three "fences" forming

enclosure. Sensation, reported Francis, was something like going up in an old-fashioned, sort-of-tired elevator. He is still nervously mulling over question put to him before takeoff: "Do you carry matches?"





Twenty-four steel cables—1/16-inch aircraft type—like this one (left), snaked through envelope's double seams, support gondola. In groups of eight, they are secured to gondola top with U bolts (right). Fuel costs are low. Nine propane tanks, enough for 24-hour flight, cost \$16.20. Aeronaut watches air temperature with instrument in envelope's interior.

Three aluminum plates anchor gondola-supporting cables at balloon's top. By contrast, yesteryear's hot-air balloons merely had a net slung over envelope to carry aeronaut's basket. Plates also anchor three zippers, each 11 feet long, positioned between gores. On landing, a rip cord opens zippers to spill out the hot air. A spare cord insures against trouble.

He gave me a sharp second glance. "What are you so nervous about?"

Barnes shot air from the fan into the skirt of the balloon. The envelope writhed. It began to rise. Barnes ignited a propane burner. Heat poured into the balloon's interior. In no time at all the envelope was upright. It pulled the gondola to the vertical. It tugged at the cables that anchored it to the gondola.

Barnes clambered over the side. "Hop in," he commanded.

That took care of my absolutely inflexible indecision. I boarded meekly.

"Do you carry matches?" asked Terry Wright, Barnes' chief engineer, standing alongside.

"Why?" I asked.

Wright turned away without answering.

"Does he mean," I asked Barnes, incredulous, "that the fire may go out?"

"Hang on," said Barnes crisply to his ground crew as he pulled on a cord feeding propane to the burners. The burners roared.

"Okay," said Barnes, releasing the cord.

The Barneses—Tracy and Brenda—pose for a photograph. Both hold records in hot-air ballooning.



They let go of the gondola. Suddenly we were encased in a vast, all-pervading silence. We lifted free of the ground, slowly, majestically. The ground receded. Faces, looking up, shrank. Someone yelled, "Wave!"

I waved, feeling silly. I craned my neck around the gondola superstructure and looked up through the skirt of the envelope, 70 feet above. Nothing but air, no visible means of support.

Barnes blasted the burners again, then jumped on top of the gondola wall and peered at them.

"Yup," he announced, "pilot light's still lit."

Going along with a gag. It finally percolated through my thick head that these jokers were giving me the business. That figured. None of this was real, anyway. Barnes was a Rover Boy. He was Tom Swift and His Wonderful Balloon. He was Jules Verne, going Around the World in 80 Days."

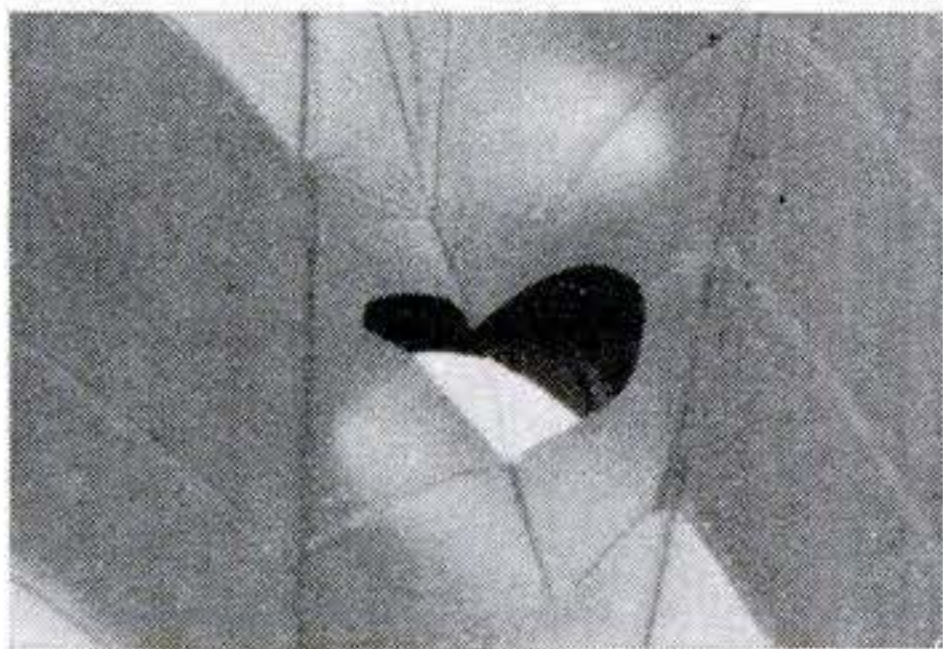
"If the pilot light goes out," I announced, getting into the act, "I've got matches."

Barnes blasted in some more heat. Then, again, that utter silence. We were only a couple of hundred feet high. We could hear cows moo. Cocks crowed. Birds twittered. A roan horse eyed us, snorted, and galloped away. We could hear his hoofbeats. A small housing development drifted by beneath. Barnes beamed.

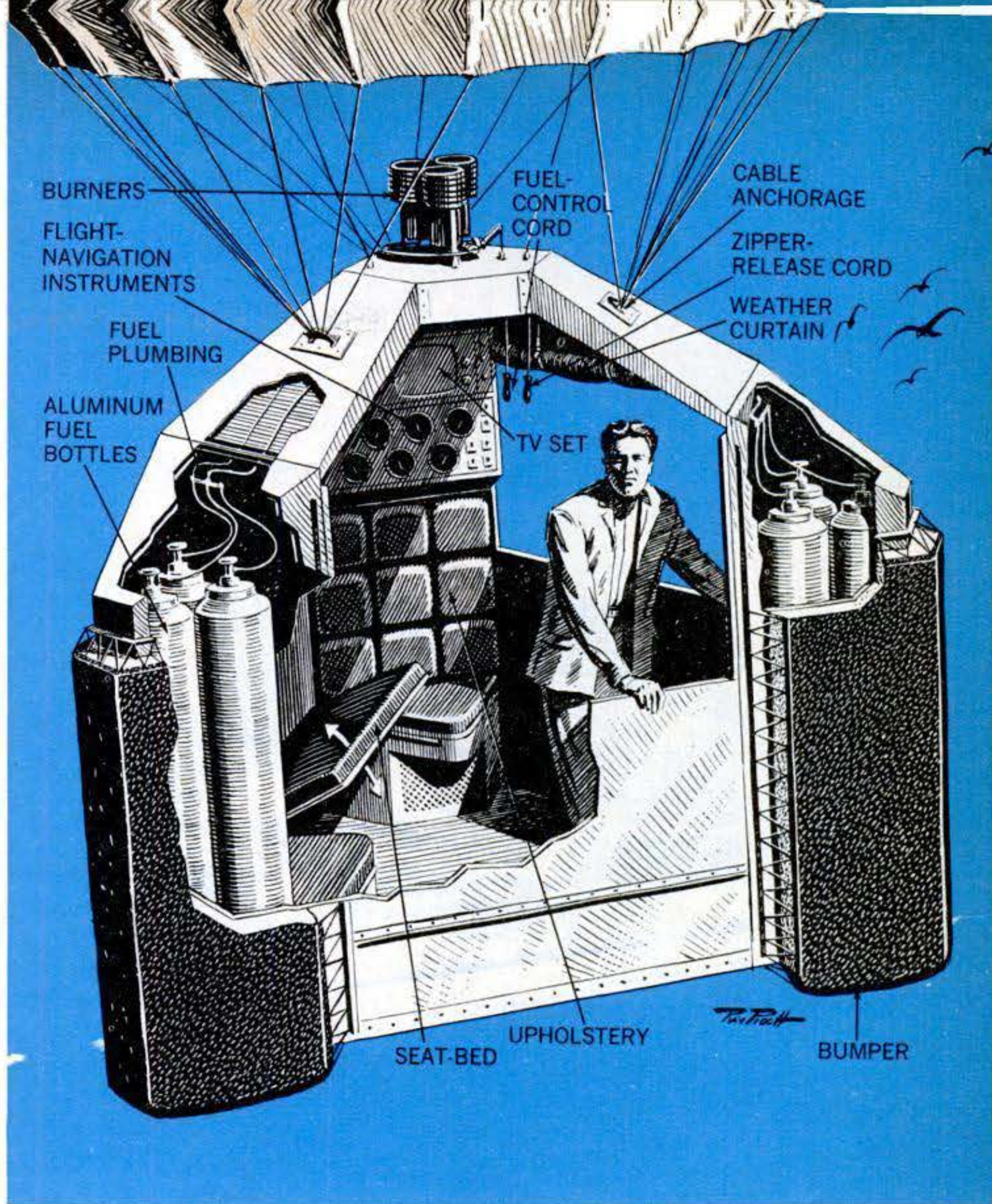
"Once, I got stuck 10 feet right over a house," he ruminated. "No wind. Not a whisper. Just sat there. Had to ask someone



Barnes' transcontinental balloon is shown in outline compared with a sport balloon of 21,000-cubic-foot capacity. Smaller envelope weighs only 40 pounds, pilot's basket less than that, for easy portage to a road if landing is at remote spot.



Small maneuvering vents like this one aid in up-down control, along with burners, by releasing small amounts of hot air. They close automatically from inside air pressure when wire that opens them is released. Lennox Industries, Columbus, Ohio, maker of heating and air-conditioning equipment, sponsored the long transcontinental trip by Barnes.



Gondola is made of .019-inch double-walled aluminum with plastic foam as sandwich filler. Foam-filled "bumpers" at corners and on bottom ease landing jars. Three pods hold three 50-pound propane tanks each. Valves permit drawing fuel from any one tank or series. For cross-country trips, gondola has direction-determining instruments, altimeter, rate-of-climb/descent meter, small TV set to receive pictorial weather broadcasts, communications radios, radar transponder for identification to airways control stations. It has no air-speed dial because balloon is always stationary relative to wind. Flight direction can be controlled roughly by altitude because winds often vary in direction with height.

to throw me a garden hose so they could tow me to a vacant lot to get down."

I checked the story out later. It was true. Another time he began getting hungry, drifting around over Knoxville, and landed on the University of Tennessee campus.

"Hey," he called to a couple of students, "will you hold my balloon for a minute?"

He ran into the Student Union building, got a sandwich and a milk shake "to go," and trotted back. The students were clinging dutifully to his gondola.

"Thanks," he said, and took off with a blast of propane.

We drifted lower. "No fun, flying high," said Barnes. "Can't see anything."

Up and down. Hot-air ballooning is simpler

than flying on helium or hydrogen. A gas balloon has to valve out precious gas to go down, off-load ballast to go up. We carried no ballast. To go down we valved out a little air or waited for the air to cool. To go up, we yanked on a fuel cord.

Below, a yellow school bus cruised along a road. Kids leaned out the windows. "Hi, Tracy!" they yelled. Barnes is a celebrity in Chester.

A mile off to the left a Jeep raised a tornado of dust on a dirt road. It was our ground crew, chasing us.

Here was a wispy treetop, right in our path. I reached for a pine cone and missed. Barnes fed some more heat into his en-

[Continued on page 166]

1955

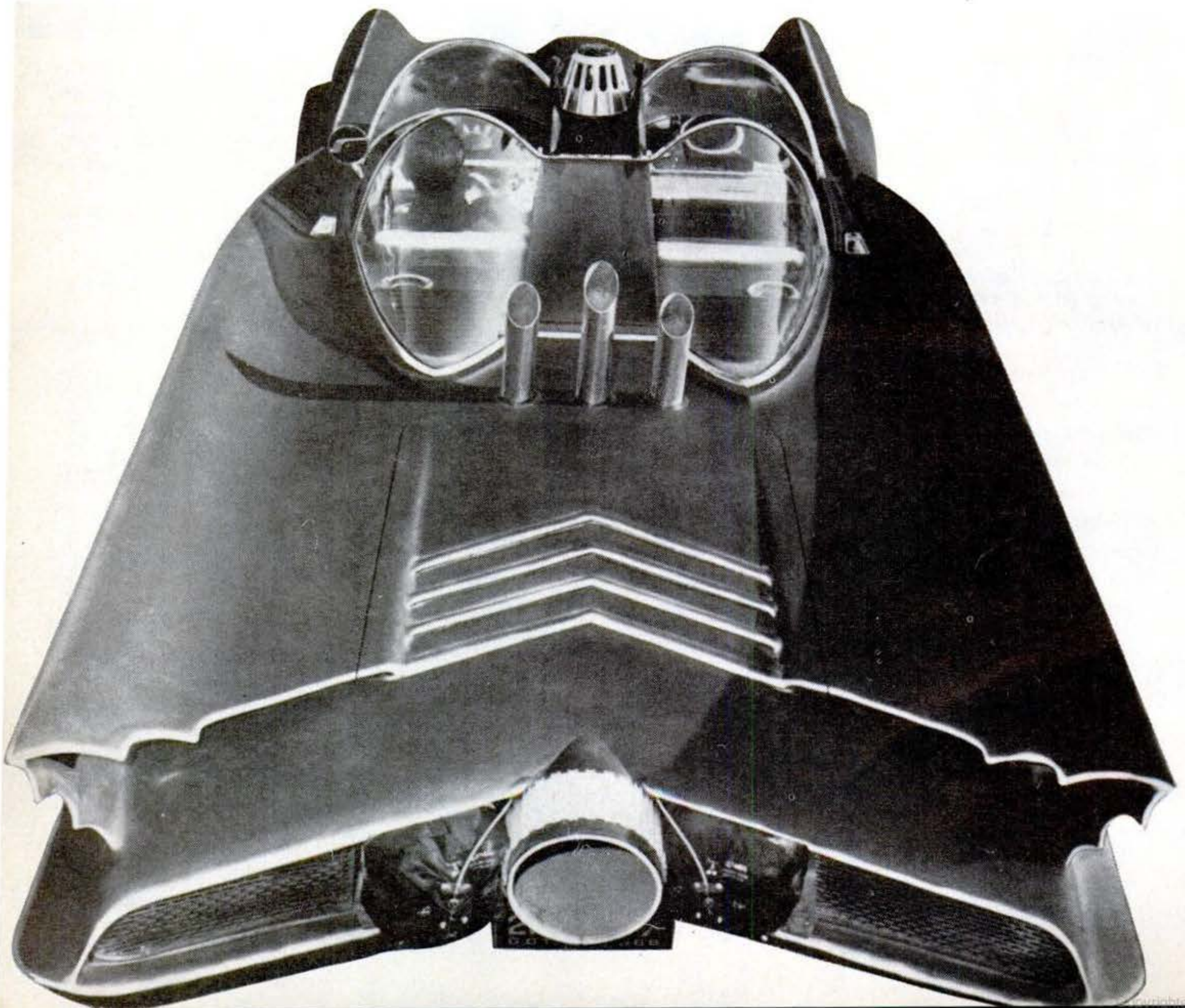


Here's what Lincoln Futura looked like when it was startling auto-show visitors around the U.S.



BATMAN'S

Back in 1955, POPULAR SCIENCE published a picture (left) of the brand-new Futura, "most novel of the year's dream crop." Its pushbutton controls for Turbo-Drive automatic transmission; warning lights for fuel, battery, and temperature; and unique rear-fender scoops for air conditioning and brake cooling aroused much interest. The hand-made Lincoln Futura was built at a cost of \$250,000.



1966



Here's the revamped Lincoln—a vehicle built to strike fear into the heart of any batcreek.

BATMOBILE

Here's the inside story on that spectacular car driven by the Caped Crusader. It does everything but fly

When the Ford Motor Company unveiled its Lincoln Futura dream car in 1955, little did its imaginative stylists suspect it would be the car in Batman's future.

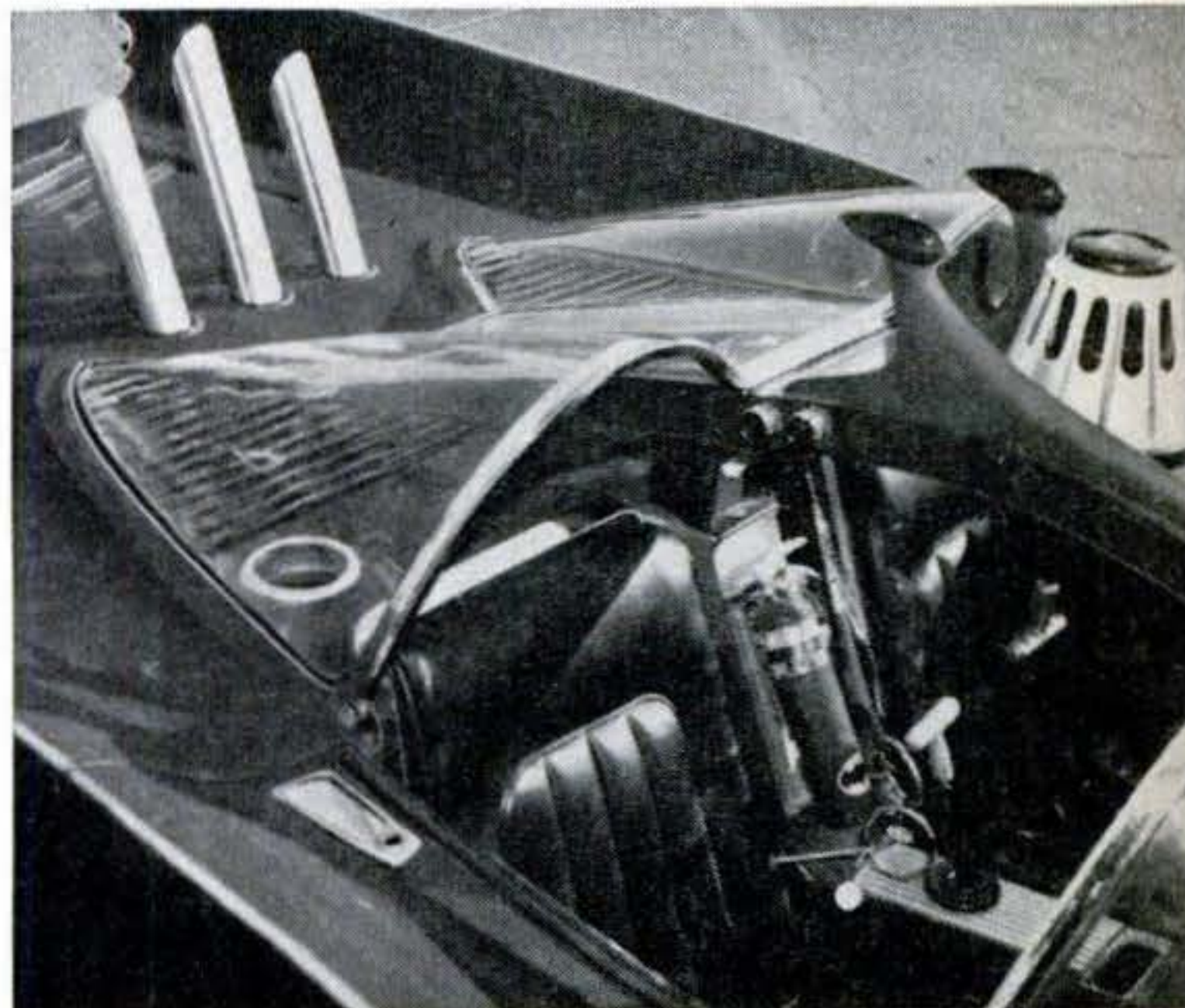
The car that now enlivens the hottest TV show of the year originated as a \$250,000 Lincoln experimental chassis with a special 500-hp. supercharged Continental engine. It has a 19-foot-long hand-formed steel body, a 129-inch wheelbase, and weighs 5,500 pounds.

The experimental car's twin-bubble plastic canopy, rear-fender air scoops for air conditioning and brake cooling, and pushbutton controls created a mighty stir when the vehicle was introduced at auto shows around the country. Later the Futura starred in the 1956 movie *It Started with a Kiss*, sharing top billing with Glenn Ford and Debbie Reynolds.

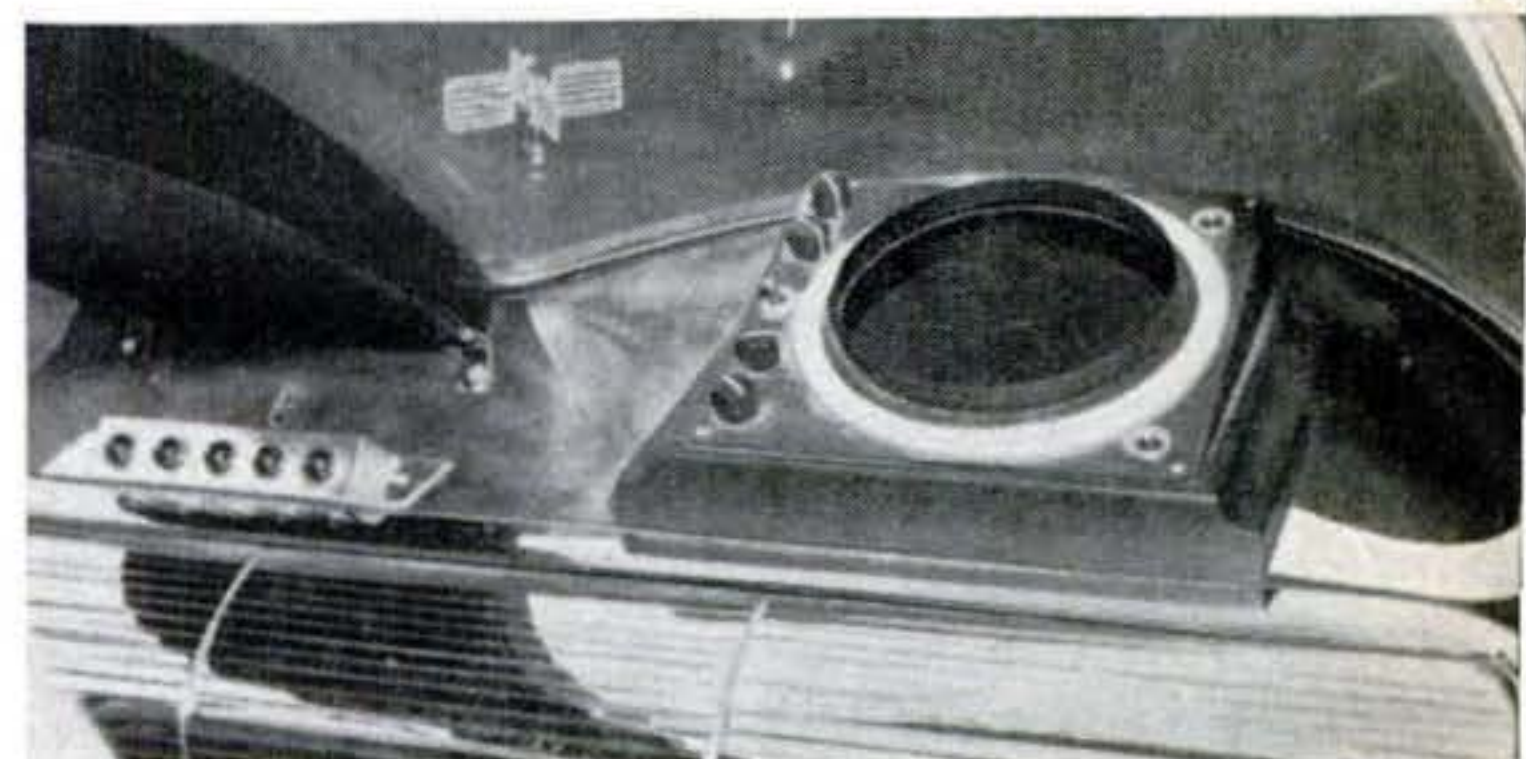
Its movie days were limited, however, and the Futura seemed destined for the same fate as many of the stars of the silent screen. Then it was bought by George Barris, a Los Angeles custom-car specialist who thought he could peddle it to a company interested in making a science-fiction movie. But it stayed forgotten until last fall, when another company hatched even more fantastic plans—to put Batman on TV. Producer William Dozier asked Barris if he could convert the Futura into the Batmobile.

[\[Continued on page 168\]](#)

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Batmobile's steering wheel looks like those in planes. Console has arm-powered accelerator.



Batscope in dashboard above is hooked up to a closed-circuit TV camera for anti-theft control.

Miniature anti-crime computer gives Batman clues to crook's methods and whereabouts.



REPORT FROM THE DRIVER'S SEAT

Comet Cyclone GT • Chevelle



You get power and speed, combined with safety, in these hot cars with heavy-duty suspensions and tough brakes

By **JAN P. NORBYE**/PS Automotive Editor

PHOTOS BY BILL MORRIS

I have just finished test-driving three of the hottest cars around: the Dodge Charger, the Chevrolet Chevelle SS 396, and the Mercury Comet Cyclone GT. They have suspensions that give you better control on the road than you can get with most standard sedans. They have brakes that are fast-acting and sure. They have steering that puts you—quickly and safely—where you want to be.

And they have whopping engines: 425 hp. for the Charger, 360 for the Chevelle, 335 for the Comet.

Too much power? Not for me. As long as horsepower is safely mated to car design, I want all of it I can get. What I do *not* want is

an unsafe combination: a growling Indy-type engine in a car made to take a barbecue-spit motor.

To the skilled driver, extra power means

Comet understeers firmly and has a tendency to lift its inside rear wheel when approaching limit on a turn—slowing it down but giving rise to no danger.



SS 396 • Dodge Charger



...Three Hot Ones You Can Handle

extra safety: the ability to pass on two-and three-lane roads, to merge into expressway traffic fast, to accelerate out of trouble.

Now let's see how these vehicles are constructed and how they perform.

First off, they are better balanced than most standard sedans. Slowing down in the middle of a turn can upset the balance of many cars. Using the brakes in a turn can lead to complete loss of control. The Comet, Charger, and Chevelle were forgiving in such

Chevelle understeers moderately and has more rubber on road than the other two cars, giving it a greater safety margin for hard cornering or emergencies.

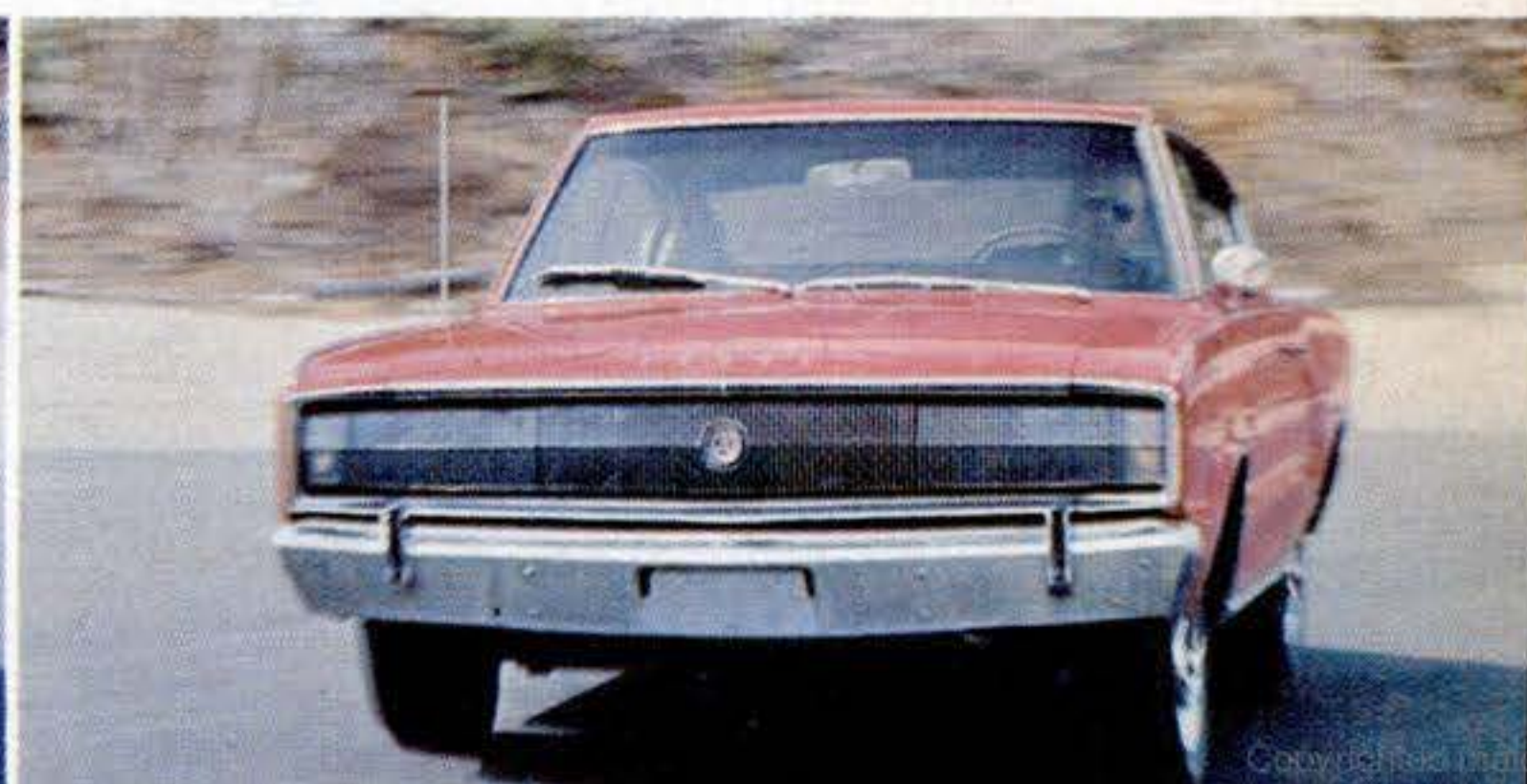
situations. Even deliberate mistakes could not bring them out of control—or even into embarrassing positions.

A car's performance depends on power, gearing, and weight. The Charger had the most power, but it was unable to outrun the Chevelle because of a higher-gear axle and about 400 pounds' extra weight.

You no doubt know that stock cars, reaching 175 m.p.h. or so, have no standard suspension parts. Springs, axles, knuckles, rods,

Continued

Charger understeers slightly when entering curve but a heavy throttle foot soon brings the tail out, and the car exits in an oversteering attitude.





Comet had 10-inch drums, heavy-duty linings, no power assist. In a panic stop from 65 m.p.h., this car recorded a 0.95-G maximum deceleration. A 1.0-G reading corresponds to 32-feet-per-second-per-second retardation. The car stopped in a straight line with no side pull.



Chevelle had 9.5-inch drums and sintered-iron linings. Power brakes gave same test performance as the Comet: 0.95-G retardation after the usual warm-up. Again, there was no side pull, and the car skidded to a full stop in a straight line. Its brakes are practically fade-free.



Charger had disk brakes on its front wheels—there's no disk-brake option for either the Comet or the Chevelle. Charger showed 0.96-G retardation with complete braking stability, and despite a faster heat build-up than the drum-brake cars, it needed no recovery stops.

wheels—everything is beefed up. The Charger, Chevelle, and Comet come with a simplified suspension package that improves stability and handling precision.

The Chevelle SS 396 has 30-percent stiffer springs than the regular V-8 Chevelle. The Comet GT is a special model with both a high-performance engine and heavy-duty suspension. The extra cost for the Charger's hemihead V-8 (\$974) includes bigger torsion bars at front, an extra leaf in the rear springs, recalibrated shock absorbers, and a front stabilizer bar. The Comet and the Chevelle have reinforced stabilizer bars. Special brake linings (mostly sintered iron) are automatically fitted on all cars with high-performance engines, regardless of make. A new \$88.20 option came on the Charger's front wheels: Bendix disk brakes.

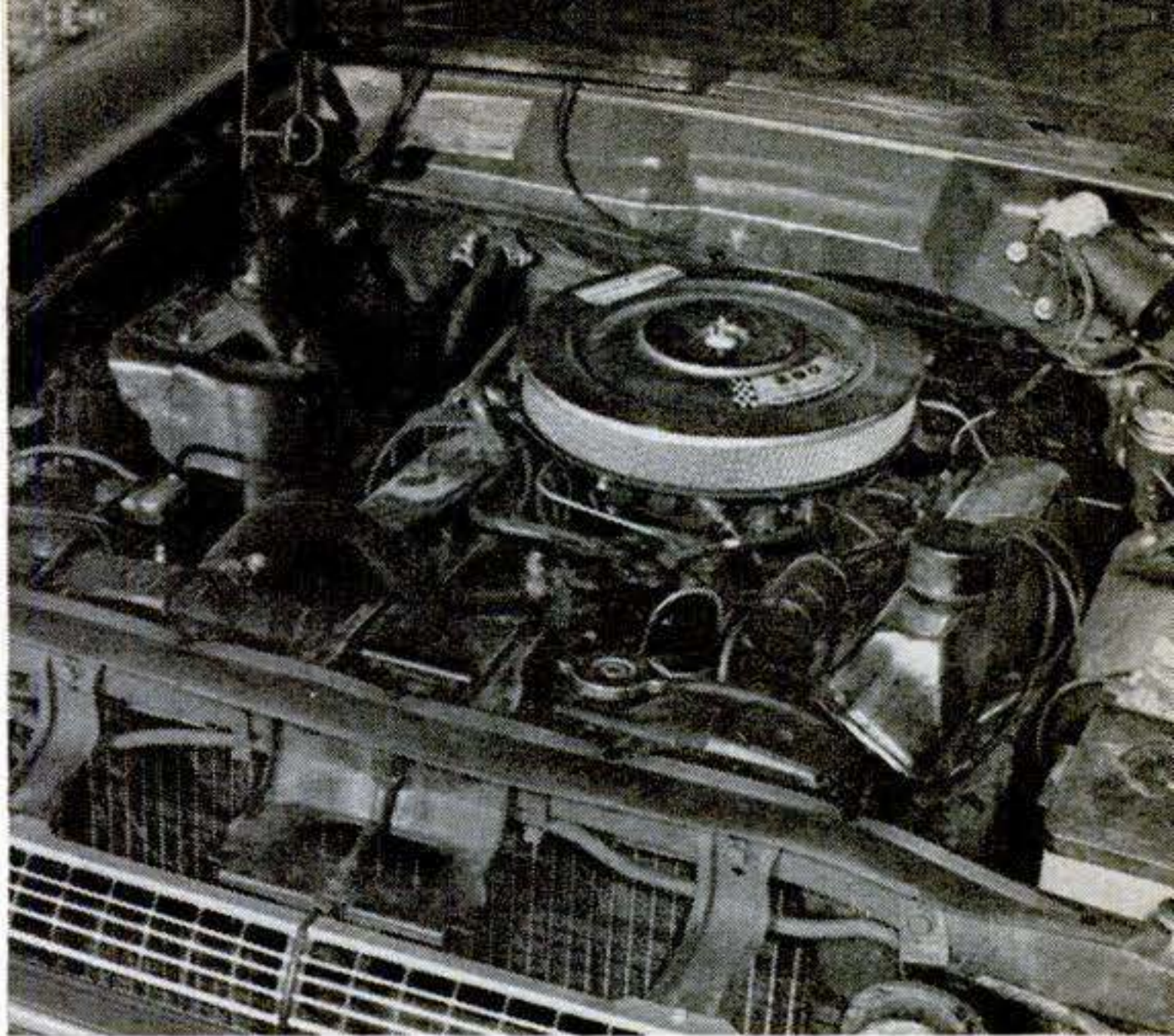
It's worth noting here that a handling package could improve the response and stability of lower-powered cars, too. In fact, I think all cars could be made better with a judicious selection of chassis options—which have been masquerading in parts catalogues as heavy-duty this or that for years. Police cars were first to use a full suspension package. Though highway patrol cars don't necessarily have more power than yours, they do have modified suspension systems and special brakes for safe handling at all speeds.

Steering. The Charger and the Chevelle had power steering; the Comet did not. The Comet, as expected, gave the best road feel, but the steering was slow-gearred and I can't believe it has to be *that* hard. The valving in the power-steering units on the two other cars was set to permit rapid wheel movement without loss of power assist, and I never had a moment's concern about the steering, even during some speedy laps at the Bridgehampton race track. The Comet and the Chevelle were both stable, with about the right amount of understeer and little body roll.

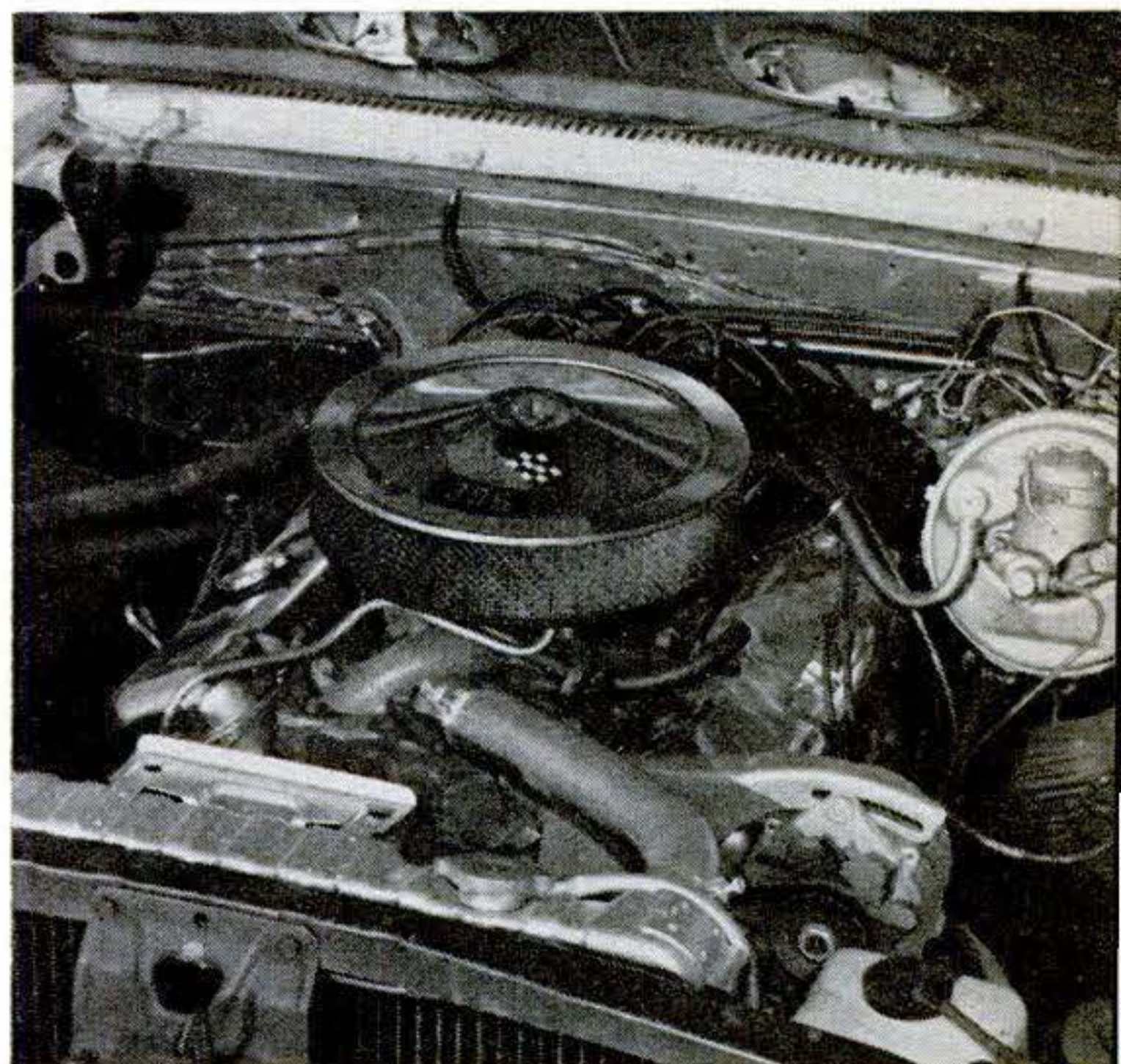
Four-on-the floor transmissions were fitted on all three. The Muncie box used on the Chevelle gave the easiest and quickest shifts; it's also the least expensive one at \$105.35. The Comet's four-speed Ford transmission had longer movements and a very tricky reverse engagement. Extra cost: \$184.

The heavy and extremely robust Dodge transmission in the Charger compares with the Comet's in ease of operation, but has a slightly lower extra cost: \$182.88.

Clutches were smooth and progressive in

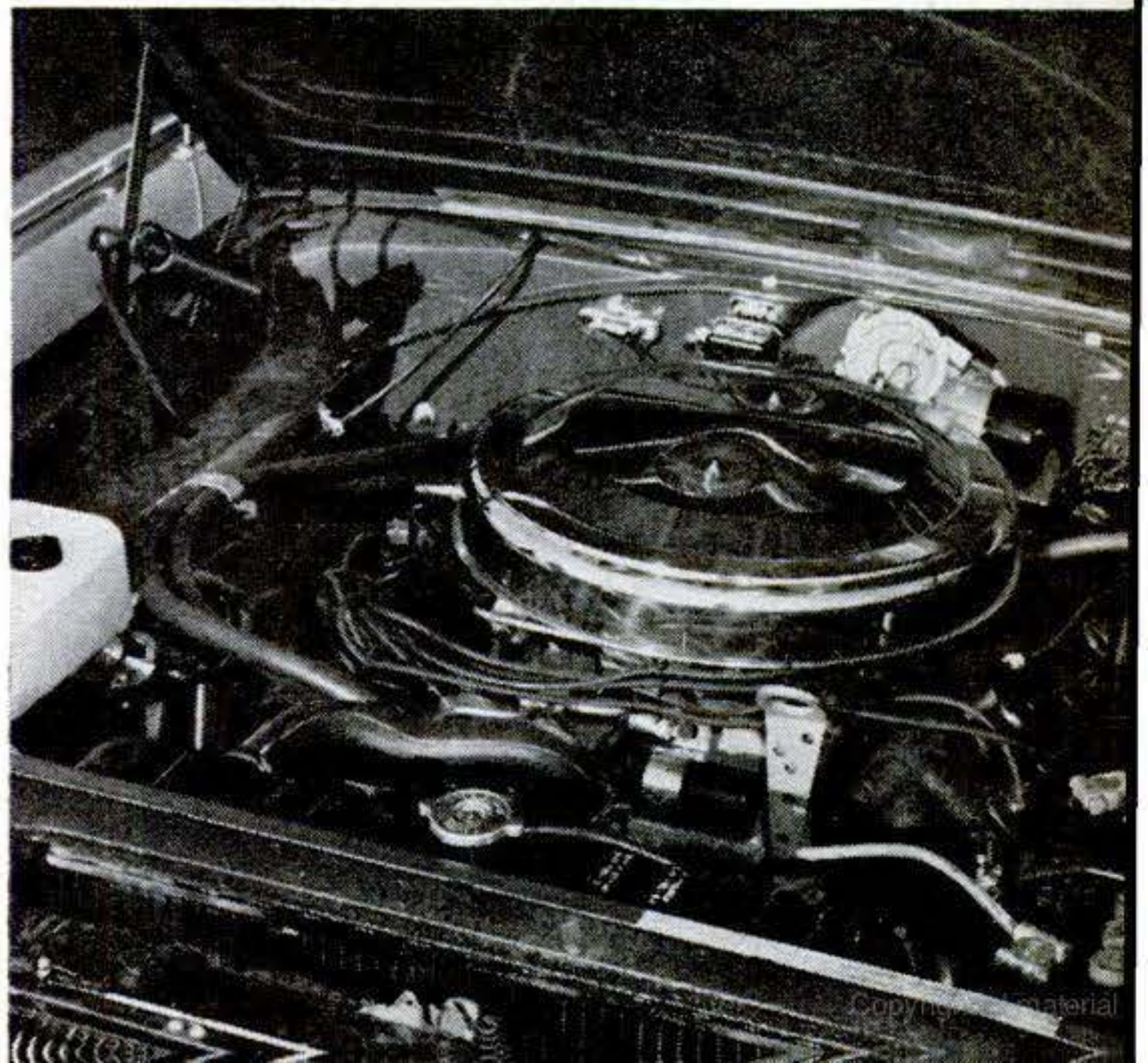


Hot Comet puts out 335 hp. and revs to 5,000 r.p.m. with hydraulic lifters. Valves are bigger than standard, and camshaft has higher lift, longer duration.



Hot Chevelle puts out 360 hp. and revs to 6,000 r.p.m. with hydraulic lifters. It has a special camshaft and a single Rochester Quadrajets carburetor.

Hemihead Charger engine puts out 425 hp. and revs to 6,000 r.p.m. The valve lifters are mechanical and the engine has two four-barrel Carter carburetors.



action on all the cars. Pedal pressure was highest in the Comet, lowest in the Chevelle.

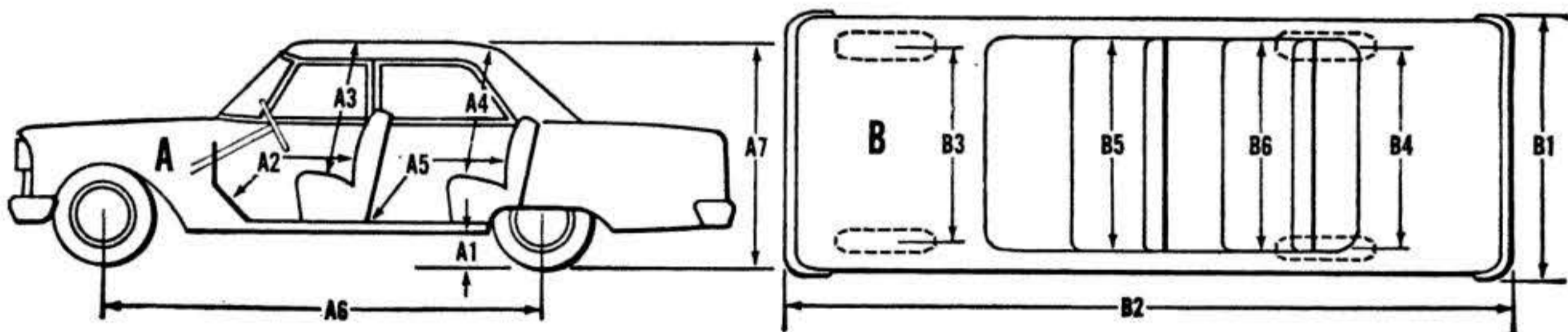
The ride. These cars have a hard ride. Is handling precision more important than ride comfort? I'll let you answer that for yourself. A soft ride, of course, is not incompatible with higher handling precision. The Chevelle had a softer ride than either the Charger or Comet, in addition to being faster on the track.

I have a feeling that the Goodyear Blue Streaks on the Charger were too small for the car—it needs more rubber on the road. The tread was only five inches wide against 5.5 inches on the Firestone Super Sports fit-

ted on the Comet and 5.75 inches on the General G tires on the Chevelle. I was impressed with the General tires; they not only gave the largest margin of safety on turns but stood up better in the brake tests. The Comet and Charger tires developed flat spots—the Chevelle was unaffected.

Driving the Charger was a noisy experience. The exhaust roar at 6,000 r.p.m. reminded me of a big jet starting off down the runway. Even at low r.p.m., in town, the noise was often irritating. The Comet was relatively quiet, but had nothing like the Charger's performance. The great surprise was the Chevelle. It sort of reflected the

[Continued on page 167]



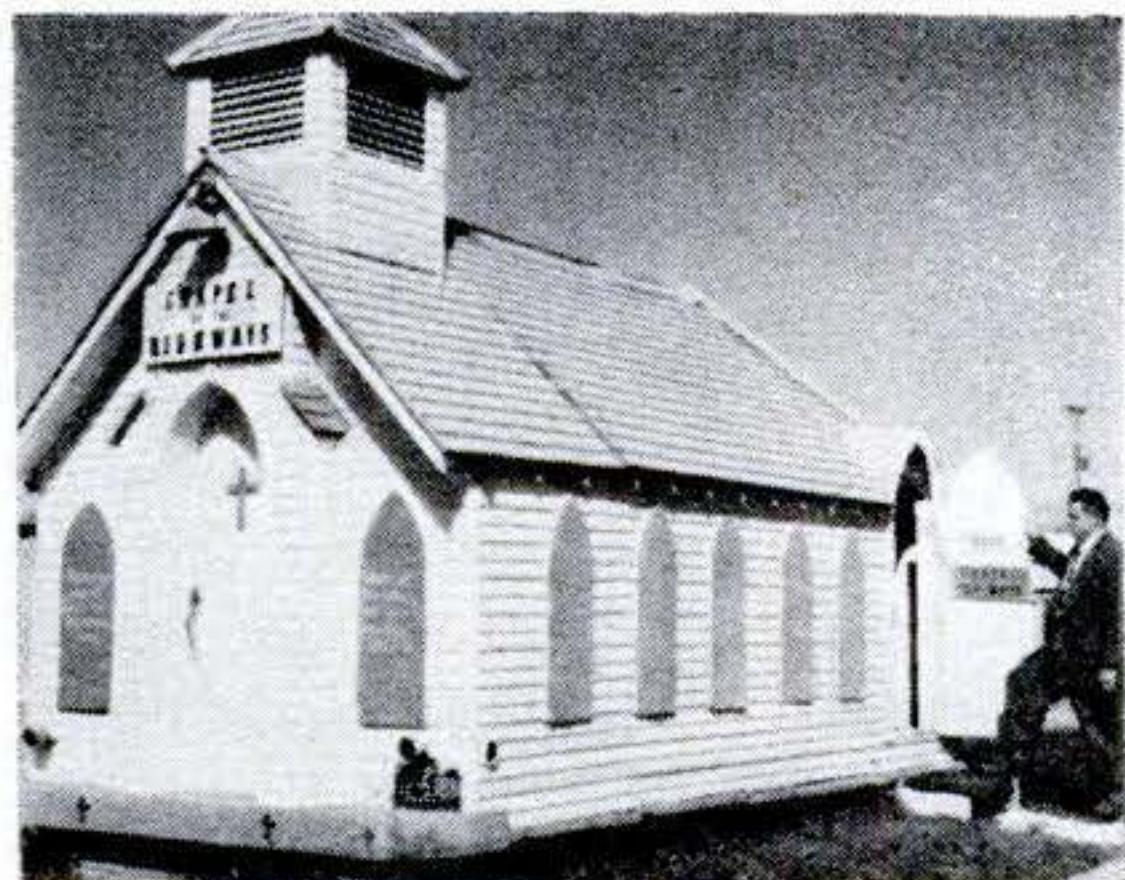
	MERCURY Comet Cyclone GT	CHEVROLET Chevelle SS 396	DODGE Charger
DIMENSIONS (inches)			
A1 Ground clearance	6.5	5.0	5.3
A2 Front leg room	42.5	44.4	45.25
A3 Front head room	36.25	37.0	36.5
A4 Rear head room	33.5	31.7	32.25
A5 Rear leg room	37.0	34.0	35.0
A6 Wheelbase	116.0	115.0	117.0
A7 Overall height	54.3	51.9	53.0
B1 Overall width	73.8	75.0	75.3
B2 Overall length	203.0	197.0	203.6
B3 Front track	58.3	58.0	59.5
B4 Rear track	58.3	58.0	58.5
B5 Front-seat width	24.5 (2)	23.0 (2)	22.0 (2)
B6 Rear-seat width	53.0	52.5	19.0 (2)
SPECIFICATIONS			
Engine type	OHV V-8	OHV V-8	OHV V-8
Bore & stroke	4.054 x 3.78	4.094 x 3.76	4.25 x 3.75
Displacement	390 cu. in.	396 cu. in.	426 cu. in.
Compression ratio	10.5:1	10.25:1	10.25:1
Carburetion	Single 4-bbl.	Single 4-bbl.	Dual 4-bbl.
Power @ r.p.m.	335 @ 4,800	360 @ 5,200	425 @ 5,000
Torque @ r.p.m.	427 @ 3,200	420 @ 3,600	490 @ 4,000
Transmission	Manual 4-speed	Manual 4-speed	Manual 4-speed
Axle ratio	3.25:1	3.73:1	3.23:1
Tire size	7.75 x 14	7.75 x 14	7.35 x 14
Steering ratio	29.4:1	20.4:1	19.0:1
Turns (lock-to-lock)	5.25	4.0	3.5
Turning radius	20.8 ft.	20.1 ft.	20.5 ft.
Brake-swept area	282.6 sq. in.	268.6 sq. in.	455.0 sq. in.
Curb weight	3,600 lb.	3,530 lb.	3,935 lb.
Basic price	\$2,891.00	\$2,776.00	\$3,122.00
Price as tested	\$3,169.00	\$3,675.25	\$4,759.08
PERFORMANCE			
0-60 m.p.h.	6.1 sec.	5.5 sec.	5.7 sec.
0-80 m.p.h.	13.2	11.5	11.8
25-70 m.p.h.	7.9	6.5	7.1
40-60 m.p.h.	3.1	3.0	3.2
SS 1/4-mile: elapsed time	15.0	13.7	13.8
terminal speed	85.9 m.p.h.	88.3 m.p.h.	87.9 m.p.h.
Fuel economy (average)	12.0 m.p.g.	13.3 m.p.g.	11.7 m.p.g.



Plane downed in Vietnam is recovered by helicopter

This striking photograph of an air rescue shows an Army Chinook helicopter recovering a two-engine transport shot down in combat over Vietnam. Crews stripped the transport of

engines and parts of the tail section, which were loaded into two other helicopters; then the fuselage was hung from a sling and flown 185 miles to a base where it was repaired for action.



Trailer chapel resembles small country church when lowered to ground by jacks.

Hinged roof lifted and one side lowered for pulpit platform, preacher is ready to address congregation seated on outside.



Chapel goes to migrant farm hands

A trailer chapel designed to look like a church is used by a Phoenix, Ariz., minister, Rev. D. L. Gabbard, to conduct services for migrant farm workers at their roadside camps. The trailer is

25 feet long and eight feet wide, has a side that swings down for use as a pulpit. There's a loudspeaker under the electrically or manually raised roof. Behind the pulpit are an organ, seats for a choir, and storage space for 100 chairs for worshippers at the traveling chapel.

Because a young doctor turned inventor in the battle to save accident and cardiac victims—to bring them back from death itself—

The "Heart Cart" May

By HANS FANTEL

When she got to the hospital her heart had stopped. Fifteen minutes before, she had swallowed the wrong way and a chunk of beef had jammed in her windpipe. After a desperate try to cough it up, Sally Kohler had sunk into unconsciousness at a drive-in just outside Philadelphia.

While her boyfriend rushed her to the hospital, her blood—deprived of replenishing breath—gradually lost oxygen. Without oxygen, her heart faltered. When the car swung onto the emergency ramp, Sally was dead.

Ten days later, she jauntily walked out of the hospital.

Sally owes her revival to a remarkable new device developed by Dr. Joel Nobel, a surgeon at Philadelphia's Pennsylvania Hospital. Its purpose—in the words of the inventor—is "to stop the process of dying."

What is death? "We may have to change our definition," says Dr. Nobel, a compact man of 31. "A person is clinically dead when his heart and his breath stop. But thanks to modern resuscitation methods, he needn't necessarily stay dead."

Sally's case and an encouraging number of others have proved that heartbeat and breathing can be restored even after com-

plete standstill. But it must be done fast. Four minutes is the longest span allowable between clinical death and revival. Otherwise the brain gets damaged by the prolonged lack of oxygen, and the victim, if he survives at all, becomes a physical and mental cripple.

Four minutes against a lifetime—a desperate gamble. But as Sally was rushed to the hospital, a phone call from the drive-in alerted the emergency-room staff, and Dr. Nobel's life-saving gadget was waiting for her right at the ambulance entrance. Within 29 seconds after arrival, she was hooked up to the revival machine.

Basically the machine is a cart equipped with every conceivable sort of life-saving aid. The patient is placed on top, and the various instruments immediately team up in a massive effort to pull the dead or dying body back to life.

As soon as Sally was stretched on the cart, a nurse stuck a tube down her windpipe. A powerful pump sucked the misplaced bite of beef from her throat. Immediately after, an automatic respirator started to flush Sally's exhausted lungs with oxygen in a regular breathing sequence.

Simultaneously, a pneumatic plunger rammed Sally's chest. Powerful, precisely timed thrusts on her breastbone forced her heart into a rhythmic beat. The blood, which for a few minutes had been stagnant in her veins, again began coursing through her body, picking up oxygen from her force-fed lungs and distributing it to her organs.

Meanwhile, three electrode leads were recording her heart condition on an oscillo-



Dr. Joel Nobel, 31, as much at home in the machine shop as in the operating room, invented cart at Pennsylvania Hospital to stop "process of dying."

Save Your Life



Here's the heart cart—a mobile life-support system that can help bring the dead back to life, if treatment of the victim is started within four minutes after he dies.

scope. The screen showed that her heart—despite the chest compressor—had no power of its own. The electric pulses that trigger heart action were entirely lacking—a condition called cardiac standstill, usually the prelude to death.

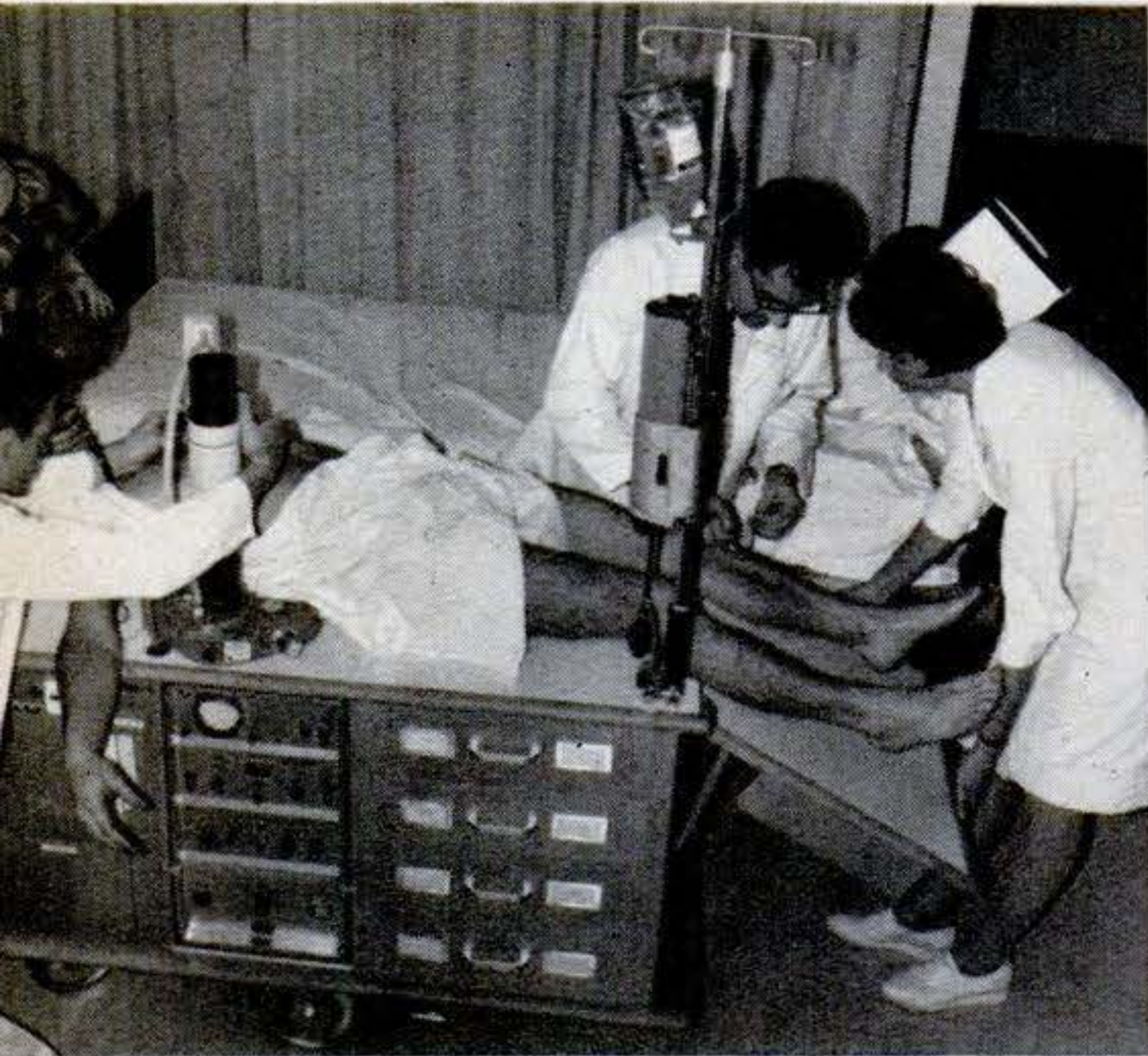
Into the shadow of death. But the cart is equipped even for this extremity. Two pacemaker electrodes applied to the skin over the heart soon were sparking Sally's

heart back into action. To augment the effect of the electric stimulator, an intern cut into Sally's arm and inserted a plastic tube that sluiced a solution into her veins to stimulate the heart and counteract the paralyzing poisons of decay that had begun to form in her body during its brief sojourn in death.

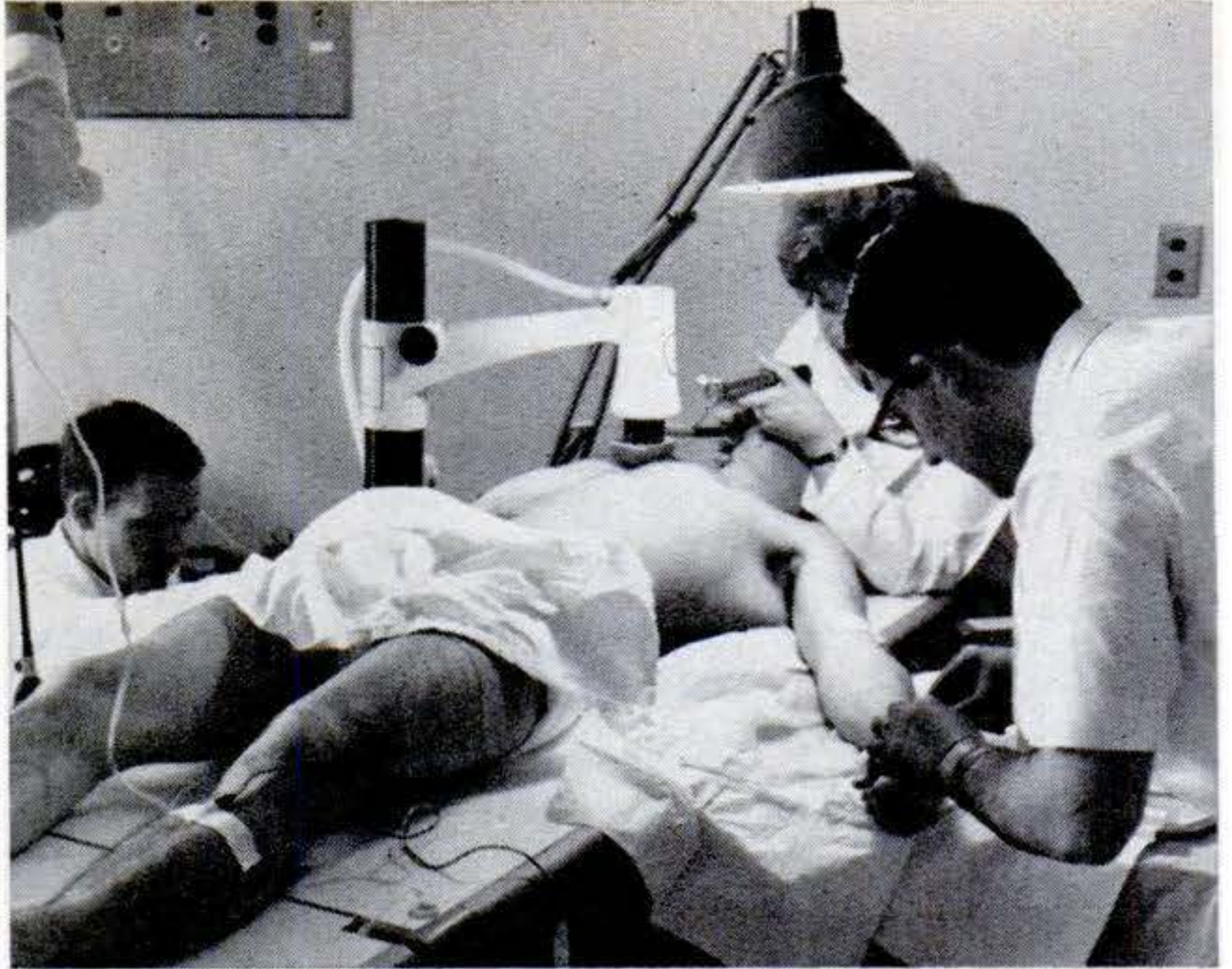
The machine, in effect, was simulating

Continued

It takes split-second teamwork to bring the dead back to life in four



As patient "dies," specially trained heart-cart crew swings into action. Patient is lifted aboard and in seconds life-saving procedure is under way.



External heart massager begins rhythmic effort to restore victim's heartbeat while electrodes are being attached to monitor the expected body responses.

life in Sally's body. After 22 tense minutes, the electronic monitors built into the cart at last registered a response. Sally's "dead" body "remembered" its reflexes after the long prompting by the machine. Her heart once more started beating on its own. The brain centers controlling breathing once more commanded her chest muscles to expand and contract. Gradually, pulsing, breathing life again entered into her.

The current model of Dr. Nobel's cart is designed for hospitals. But the neurosurgeon is working on a stripped-down lightweight version to be carried as a detachable pod on a helicopter. Battle casualties will be first to benefit, but Dr. Nobel also expects the airborne survival machine to be used for quickly reaching accident victims on crowded highways. It will fit into a road ambulance, too, facilitating air-to-ground or ground-to-air transfer of the injured without a moment's loss of the machine's revival functions.

"Speed is the key to survival," says Dr. Nobel. "We must get the equipment to the victim before he is irrevocably dead."

Death—the highwayman. In many highway deaths, explains Dr. Nobel, bodily damage as such is not fatal. Unless the head is crushed or major organs destroyed, persons now left for dead may really be good candidates for revival.

"With proper ambulance equipment in

the hands of well-trained crews," says Dr. Nobel, "many deaths might be preventable. The cart would provide breathing, heart action, and fluid replacement to keep all vital functions going until the damage is repaired by the surgeon at the hospital."

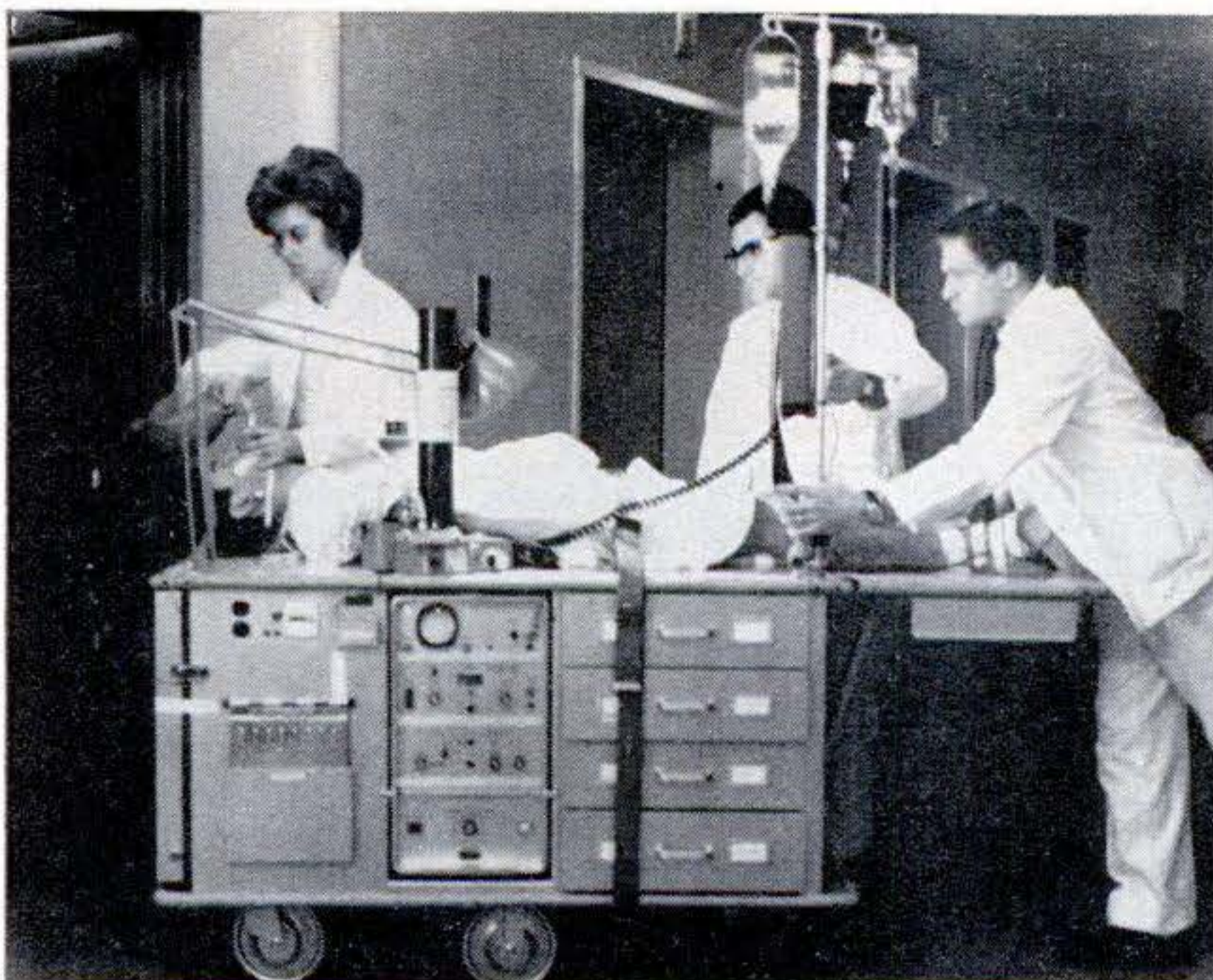
Though the revival of a dead person is always a dramatic event, most cases are not spectacular. Most persons revived by the cart have suffered heart attacks. They "died" right in the hospital and owe their revival mainly to the fact that the cart reached them within less than four minutes after their hearts had stopped.

Of every 100 persons admitted to U.S. hospitals after a coronary heart attack, 25 to 30 percent will die during their hospital stay from a secondary attack. About 18 percent die within 72 hours after reaching a hospital. Resuscitation techniques could keep alive 40 percent of them if the routine were quick and competent.

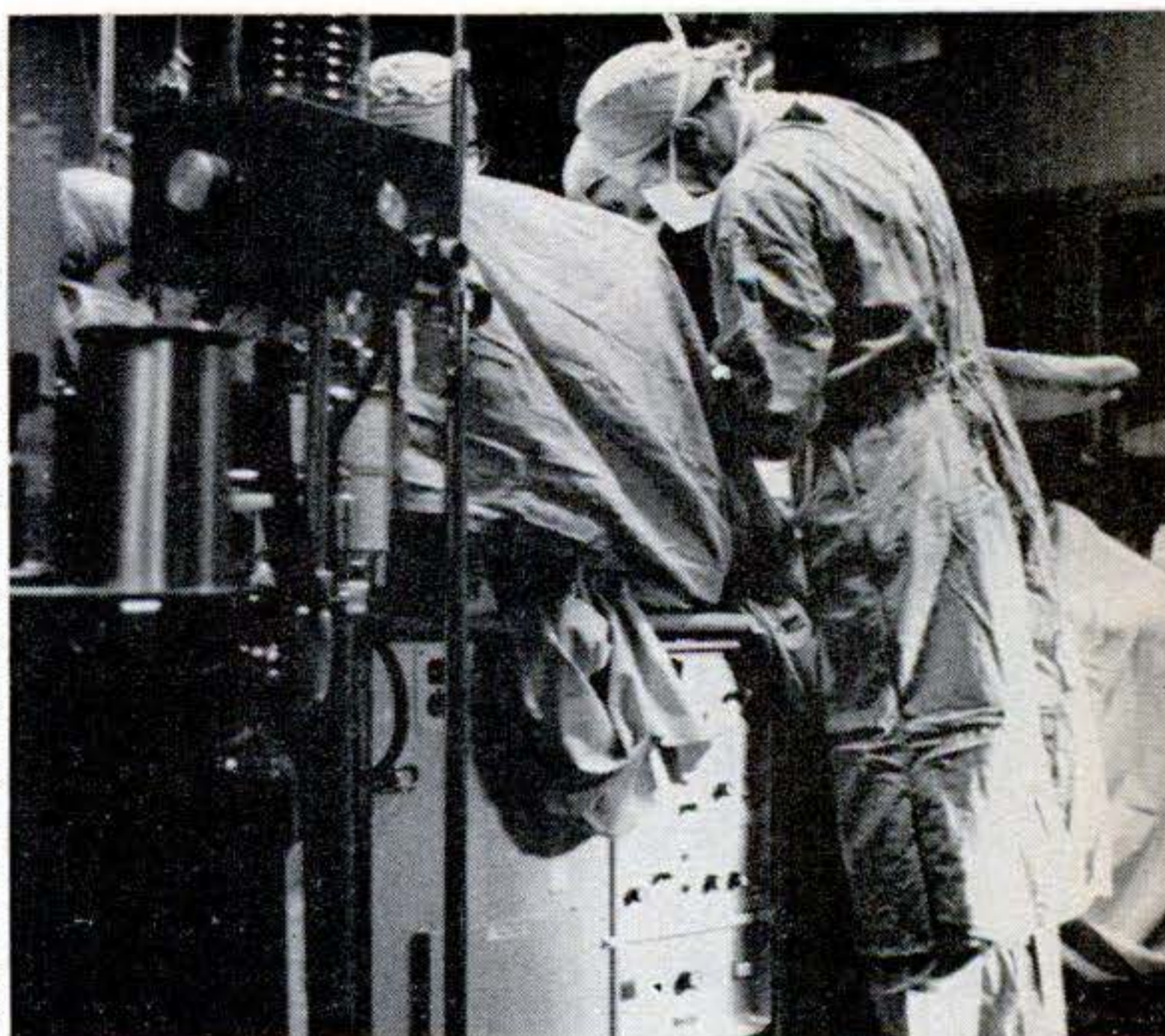
That's a big if. Dr. Nobel recalls several cases where a dead patient could not be revived simply because doctors, nurses, and technicians stumbled all over each other in the excitement.

The cart is designed to rule out mistakes and minimize confusion. "It's an assembly jig for work on the patient," explains Dr. Nobel. "All necessary equipment is at hand and grouped around the patient in logical order. And it keeps the staff from getting in each other's way. Without the cart, it

minutes—or less—with the aid of the life-saving heart cart



Tube is placed down throat of patient to feed oxygen directly into the lungs, and intravenous solutions are administered to stimulate the heart into action.



Patient is wheeled into operating room, under continuing treatment. The heart cart is a self-contained operating table, so patient need not be moved.

takes a hospital emergency team of six to eight to do all the necessary jobs. The cart cuts down the staff to three.”

Modern revival methods were introduced in 1960 when Dr. James R. Jude and Dr. William Kouwenhoven of Johns Hopkins Medical School found they could pump stopped hearts without opening the chest. They stretched out a patient on a hard surface, tilted the head back for easier breathing, and pushed on the breastbone—hard and slow—about once per second with a force of about 75 pounds. The big advantage was that external heart massage of this sort could be entrusted to laymen in an emergency. Soon the two doctors were teaching external heart massage along with mouth-to-mouth breathing to members of the Baltimore Fire Department.

News of this spread quickly. Committees throughout the country began training their police, firemen, ambulance crews, even their Boy Scouts, in external heart massage and artificial respiration.

Nobody knows how many lives they saved. Certainly they kept alive thousands near the point of death. Rarely, however, can these simple methods alone revive a person after death has occurred. The cart can, because it combines and coordinates all available techniques.

The nerveless machine. Dr. Nobel stresses the advantage of mechanized massage and respiration over manual methods. “Even

doctors can muff the job in emergencies,” he says. “I’ve seen excited interns pushing on the chest too fast, squeezing the blood out of the heart without giving it a chance to return. Or they don’t push hard enough; they’re afraid of hurting the patient. They forget he’s dead already. After all, a cracked rib isn’t much of a price to pay for a regained life.”

So far, only a few carts have been built, but they’ve racked up an impressive record of lives saved. The next project is a hospital-wide alarm system to get the cart into action in the shortest possible time. The aim is simultaneous mobilization of communications, personnel, and equipment. Dr. Nobel is presently working with American Telephone and Telegraph to put such a system in operation.

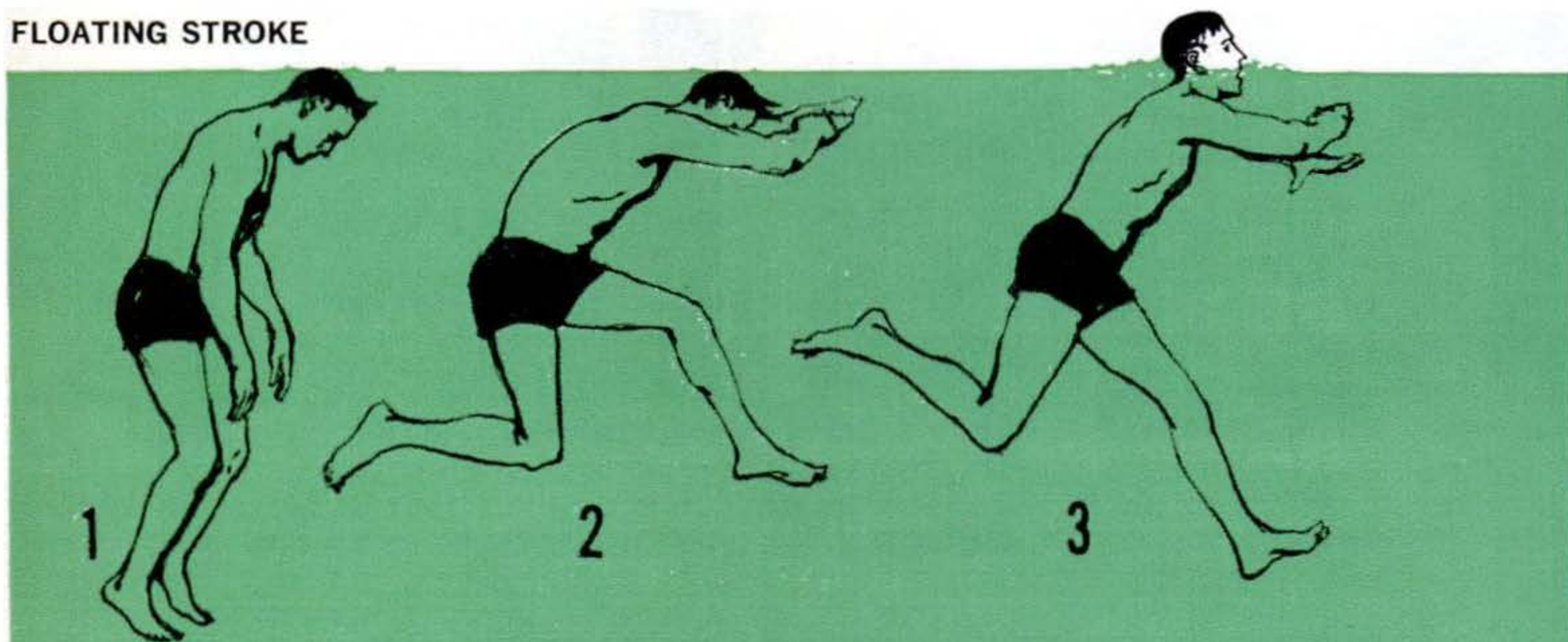
Dr. Nobel thoroughly enjoys the mechanical part of his job. As much at home in a machine shop as in the operating room, he did much of the construction work on the prototype cart. “If more medical schools could afford the time to teach students how to use a lathe,” he grumbles, “we’d have better medical equipment.”

He is now mapping out new research in life-saving methods. “It’s the ancient struggle of the doctor against death,” he says. “We still do not know the limits of what is possible, but now, for the first time, we are carrying the fight into Death’s own territory.”

PS

DROWNPROOFING Keeps

FLOATING STROKE



After taking a deep breath, let your body go limp and your head dangle forward (1). The air in your lungs will keep you afloat. Only a patch of head or back should show above water. Just before you need to breathe, slowly cross your arms so your forearms are together in front of your brow. Then extend one leg behind you, raise the other leg in front (2). These movements should be so leisurely that you stay in a vertical position. To breathe, start exhaling as you raise your head until only the chin

is in water. Sweep your crossed arms outwards, palms facing down; step downwards with your legs in a scissors kick; raise your head out of water and breathe in through your mouth (3).

The movements of arms and legs should be vigorous enough to support the weight of your head as you gulp air, but not so forceful your shoulders rise above the surface. After breathing, relax. Drop your hands to your side with just enough force to keep you from sinking more than an inch or so below

TRAVEL STROKE



Travel stroke is an extension of the floating stroke, enabling even a nonswimmer to travel, slowly and with little effort, toward a boat, the shore, or a float. It should be learned only after the floating stroke has been thoroughly mastered. Breathe and relax as in step 5 of the floating stroke. But instead of immediately going limp and resting, lower your head, face down, cross your forearms in front of your brow, and spread your legs apart. Your rear foot should be raised as high as possible in back (1). As

your body approaches the horizontal, extend your arms in front of you (2). Then, scissor-kick.

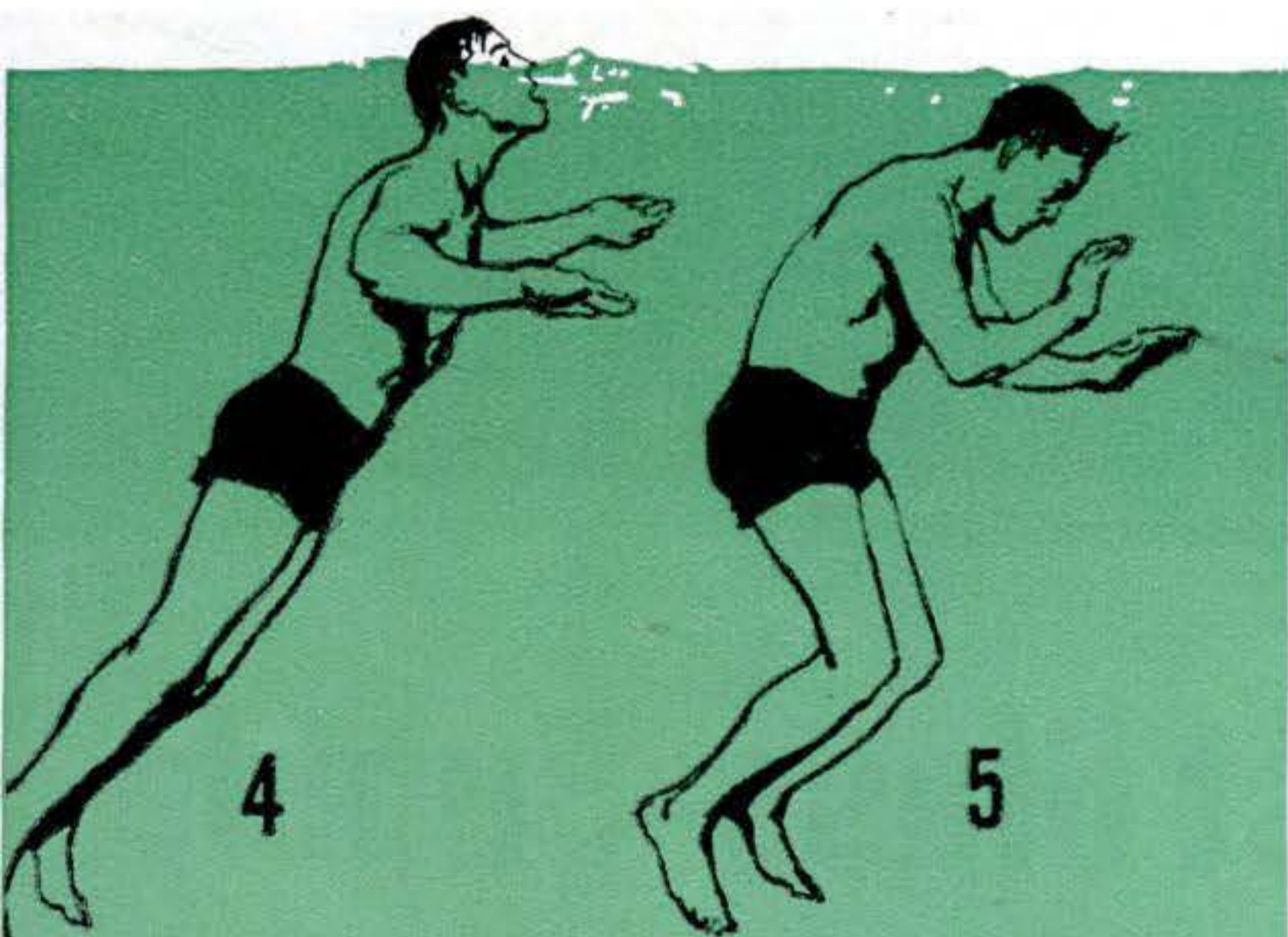
As your legs finish the scissors kick, gently sweep your up-stretched arms toward your thighs. The sequence of scissors kick and sidestroke will propel you forward and upward. Once your palms reach your thighs, begin to exhale through your nose (3). Return your body to vertical before breathing. Do this by hunching your back; bringing your knees to a crouch position; crossing your forearms in front

Here's how you can use the body's natural buoyancy to stay afloat—even in rough water—with almost no effort

You Afloat Till Help Comes

By REAGH C. WETMORE

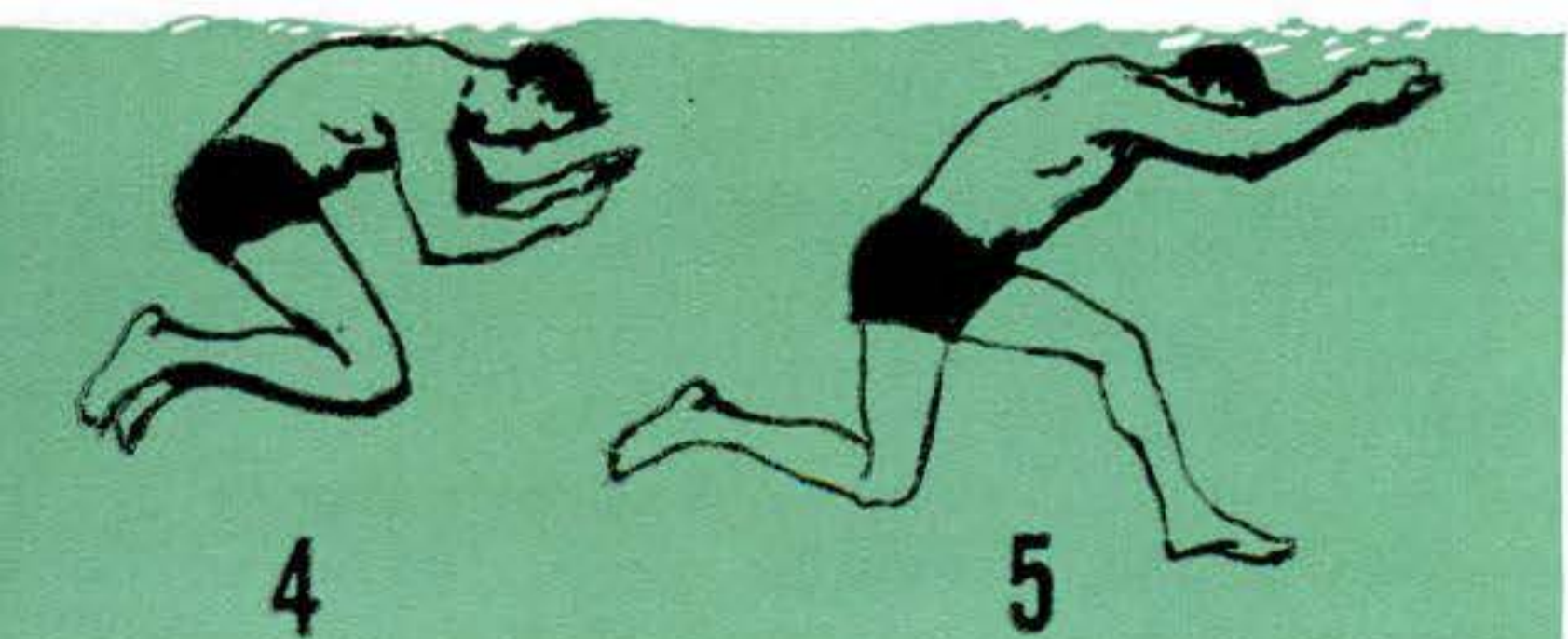
Swimming coach, Phillips Academy, Andover, Mass.; instructor on drownproofing, Peace Corps.



the water (4). Go limp as in step number one (5). When you need to breathe, shift into step number 2 and so on. A few rounds of practice should allow you to follow the drownproofing method smoothly and efficiently.

Developed almost 20 years ago by the late Fred Lanoue, former head swimming coach at Georgia Institute of Technology, drownproofing is foolproof except for a few people who tend to sink in water; they must use the travel stroke to stay afloat.

DRAWINGS BY DANA RASMUSSEN



of your brow (4). Open your legs from the crouch to the scissor position (5). This brings you to the position shown as step 2 of the floating stroke.

Carry through the breathing procedure outlined for the floating stroke. The advantage of the travel stroke is that—unlike the usual strokes—it requires minimum exertion and can be stopped at any point to allow the swimmer to simply rest and breathe. Even swimmers suffering from cramps or other injuries can use the travel stroke to reach safety.

Not long ago, a flight to the West Indies crashed in the Caribbean Sea. Before the plane wreck sank, one woman managed to crawl out of a window and into the water. She had neither life jacket nor floating wreckage to cling to. Yet she was still alive 20 hours later when rescuers spotted her.

The woman survived not because she was a good swimmer, but because of a revolutionary development in water safety called drownproofing. Using the technique, even a fully clothed nonswimmer can keep from drowning for at least 24 hours in rough water.

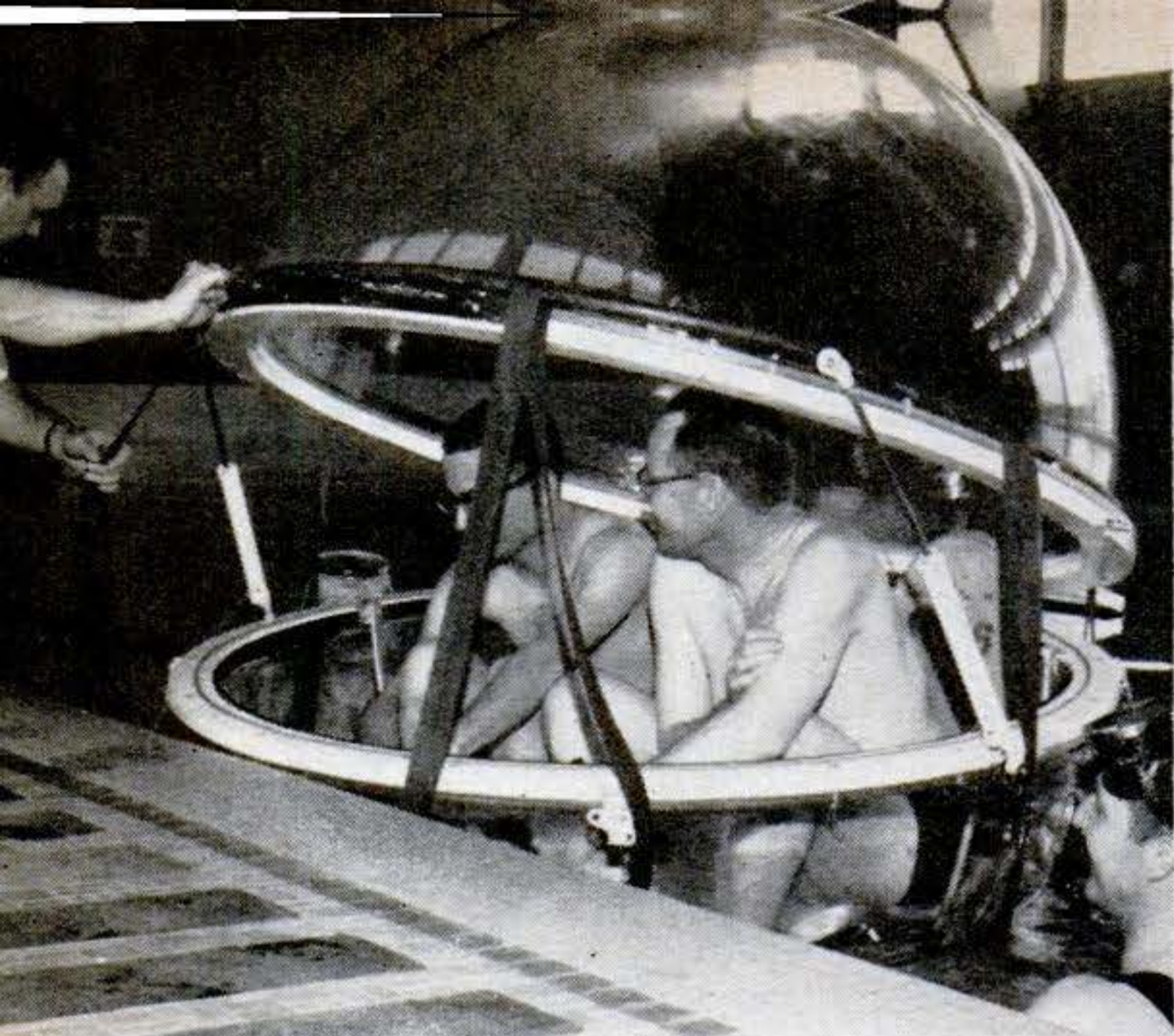
Drownproofing sidesteps the two main causes of water deaths: panic and exhaustion. When a crisis confronts a swimmer—a cramp, a fall into deep water, a strong current toward open sea—reason is often blotted out by fear. The drownproofing method avoids exhaustion by taking advantage of the body's natural buoyancy. There is no reason to panic, since a steady supply of air is assured.

If a swimmer takes a deep breath and adopts a crouch position—body angled forward at waist, arms and legs hanging loosely, head bent toward chest—his natural buoyancy will do the work of holding him at or near the water's surface. Most important, staying near air requires no effort.

A series of strokes, designed to use up the least possible amount of energy, enable him to raise his head briefly every six seconds or so and inhale a fresh lungful of air. Just one limb can be thrust downward with enough force to enable the swimmer to raise his head.

A modification of the stroke enables a swimmer in bad shape to reach a nearby boat, float, or body of land by moving forward at about a mile an hour.

Part of drownproofing's growing acceptance—it's now taught by the Peace Corps—is that anybody can learn whether or not he can swim.



Diving in a bubble: Dr. William B. McLean and colleagues of the U.S. Naval Ordnance Station at

Low-Cost Glass-Bubble

From the amazing discovery that glass spheres get stronger as they go deeper comes a new craft for undersea pleasure cruising

By **W. STEVENSON BACON**
DRAWINGS BY RAY PIOCH

Does the thought of exploring the undersea depths fascinate you? Then here's news: If development work now under way is successful, as appears likely, it will soon be possible for you to own a revolutionary low-cost glass-bubble submarine that can dive to the ocean floor. It will cost about the same as a small cabin cruiser, and you'll handle it the same way, trailering it down the highway and launching it at a convenient spot.

The glass-sphere cabin is on a hinge like a clamshell: You open it and climb in. Inside, you and your partner lower yourselves into comfortable, molded bucket seats, lock the clamshell, and cruise on the surface to deeper water. A flick of the wrist starts the pontoons flooding, and slowly, gently, the dive begins.

Down to a depth of 140 feet, you'll enjoy sights on equal terms with the fish: the bizarre varieties of plant and animal life,

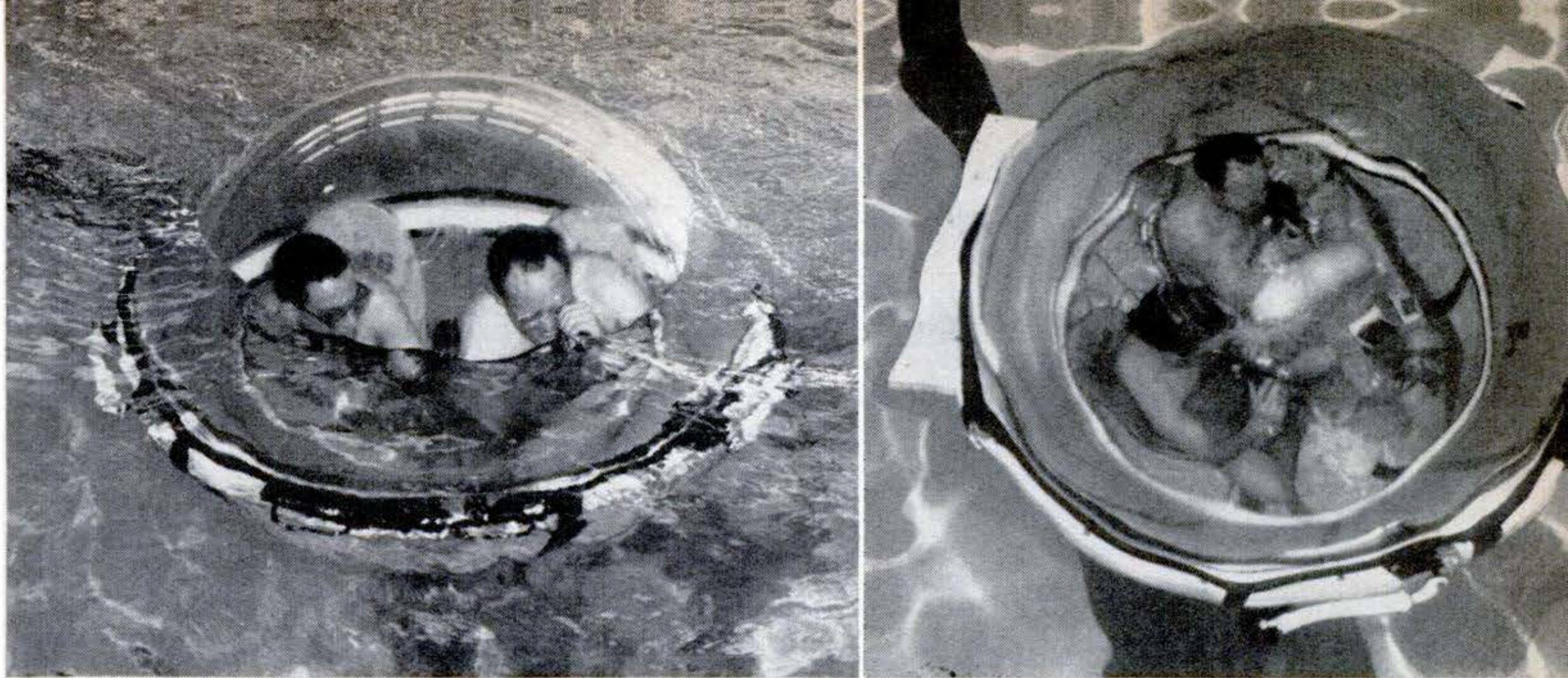
sunlight streaking down through the water. If you've brought a movie camera along, you shoot through the sides of the sub, recording sights few people have ever seen.

Gradually, the water becomes darker as you go deeper, till suddenly you find yourself surrounded by a layer of weirdly glowing plankton. At 900 feet, there is only a pale glow of light, and you switch on the pontoon lights. If your vessel is equipped with a "slurp" gun, you may choose to collect specimens of marine life; the gun sucks them in and deposits them in a container.

If you have ventured out into the ocean beyond the continental shelf, you may want to go even deeper, exploring the volcanoes, mountain ranges, and plains found between 9,000 and 20,000 feet.

Incredible? Yes, it is. But such a craft is now on the drawing boards, and is being supported as part of the U.S. Navy Deep Submergence Program. And, at the Navy's China Lake, Calif., Ordnance Test Station, a group of dedicated men are already adapting the plans and ideas to a civilian model.

And what a craft it will be! Because it will be made of glass, it will be the safest, most economical submersible (under \$10,000) ever constructed. Transparent, it will offer its two occupants the most spectacular, fascinating panorama of the ocean ever seen.



China Lake, Calif., water-test a 56-inch Plexiglas prototype of two-man submarine cabin.

Sub for Undersea Adventure

How it began. Although the idea of using glass for submarines has cropped up a number of times, the practical concept, if it had a beginning, began with H. A. Perry of the suburban-Washington U.S. Naval Ordnance Laboratory. In 1963, Perry published a paper on "Feasibility of Transparent Hulls for Deep-Running Vehicles." In

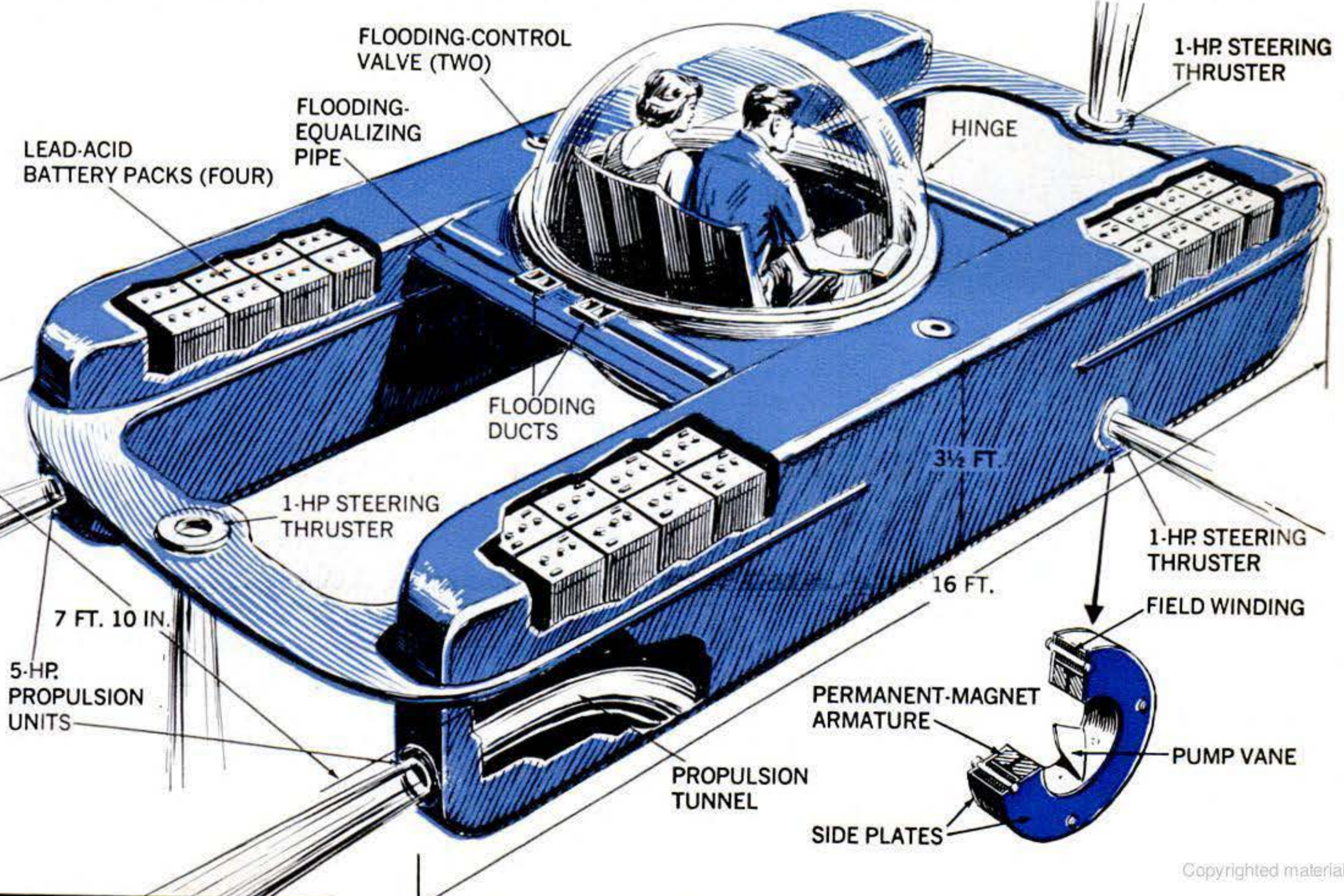
simple language, his theory was this: Glass owes its reputation for fragility to its poor fracture resistance under tension. This lack of fracture resistance is due to tiny surface flaws in the glass.

But the resistance of glass to compression, which determines the strength of a glass hull under pressure, Perry argued, is so

Continued

Simple construction makes it possible to build glass sub for well under \$10,000. The two fiberglass pontoons, open to the sea, contain all machinery except

photoelectric control box for signaling through glass hull and life-support system. In an emergency, the glass sphere can be released to float to the surface.



Glass, much lighter and stronger than titanium or steel, will make

great that it is almost impossible to measure. What's more, under the enormous, crushing pressures at the bottom of the ocean (over 500 atmospheres, or 16,000 pounds per square inch), the strength of a glass-hulled submarine would *increase*.

Remember the simple high-school experiment? Fill a glass bottle with water, carefully eliminating all the air bubbles, and you can drive nails with it.

It was this amazing strength of glass under compression, added to its extra bending strength under pressure, that prompted Perry and Dr. John P. Craven, Chief Scientist of the Navy's Special Project Office, to urge the Navy to make actual underwater tests. In March, 1964, the go-ahead was given, and the stage was set.

The test program. On board the USNS Gillis, cruising over the Puerto Rico trench off San Juan, are model glass spheres, 10 inches in diameter and .36 inches thick. They are to be subjected to the violent explosive force of a one-pound charge of pentolite at underwater depths of 300, 7,200, 14,500, and 22,000 feet.

The test setup is simple. A steel pipe 20 feet long slides up and down a cable anchored far down in the deep water of the trench. A pentolite charge will be fastened to the top of the pipe and a glass sphere, held in a net, to the bottom. If glass becomes stronger as the ocean presses against it, as Perry maintains, it will become more and more difficult to break the spheres as the tests move deeper.

The first spheres are lowered 300 feet into the ocean with the pentolite 20 feet away at the top of the pipe. The explosion shakes the ship with sledge-hammer force, yet the glass spheres remain unbroken until the pentolite charge is moved down the pipe two feet closer.

At the next depth, 7,200 feet, the glass should begin to show the "depth-hardening effect." The rig descends. The explosion, a muffled thud at this depth, is heard, and the sphere hauled up. No damage with the charge 20 feet away.

The distance between charge and sphere is decreased in two-foot steps until the explosive charge is a mere 5½ feet away. At that point, a glass model finally cracks. Perry grins happily. The thin glass sphere has been strengthened tremendously by be-



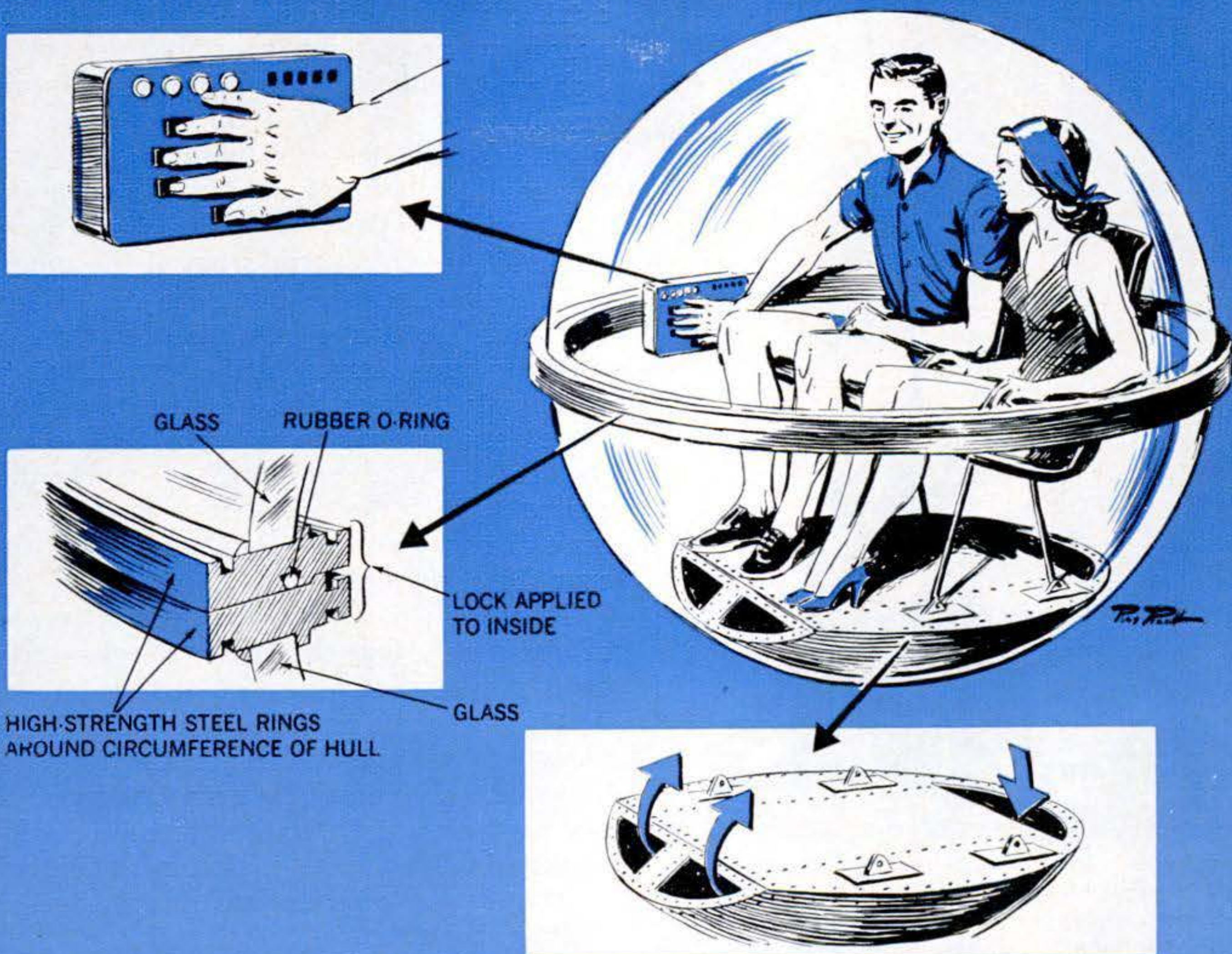
First of the big glass bubbles: Corning 44-inch hemisphere (slightly smaller than the 56-inch units now being cast) is placed in an asbestos-lined annealing oven. Annealing eliminates internal strains.

ing lowered to 7,200 feet and can withstand over 13,000 pounds per square inch—the pressure of the sea plus that of the explosive shock wave. Add a protective coat of transparent plastic, and you have the perfect material for a submarine.

The Deep Jeep man. It is Dr. William B. McLean, however, who deserves the credit for putting Navy ideas to work in building a civilian sub. As technical director of the Navy's China Lake installation, he did much to make Deep Jeep, the Navy's steel-hulled submersible, a success [see PS, Aug, '64]. Deep Jeep pioneered many ideas being used in the first glass submarine.

Famed as the physicist who developed the Sidewinder air-to-air missile, McLean was awarded the 1965 Rockefeller Public Service Award for Science, Technology and Engineering. The prize money, \$10,000, is being devoted to adapting Navy research to the glass sub.

this submarine the safest deep-diving craft ever constructed



Sub's transparent cabin contains photoelectric control box (top), and scrubber unit for removing excess CO₂ and moisture (fan inside unit circulates air). The joint between the two hemispheres will be

made of steel or titanium, sealed with rubber O-ring and locked with a clamp from the inside. Also included will be floor-mounted bucket seats, a small oxygen tank, radio, cameras, and other gear.

"I'd like to explore the ocean myself," says McLean, who is deeply interested in underwater research and is a scuba hobbyist. "The purpose of the glass submersible is to make it possible for small institutions and even private individuals to take part in opening up a new frontier—the sea."

Building the sub. In the glass submersible now under way—a wet mockup will be in the water this summer—all the equipment and machinery, except for the life-support system, will be in the two 16-foot fiberglass pontoons. Cross members will support the 56-inch-diameter sphere.

Since no electrical leads, rods, or other devices can be inserted through the 1½-inch-thick glass hull—to do so would weaken it—the sub will be controlled by photoelectric cells mounted outside the sphere and activated from inside by shining a flashlight on them or by turning simple disks to shade them from reflected light.

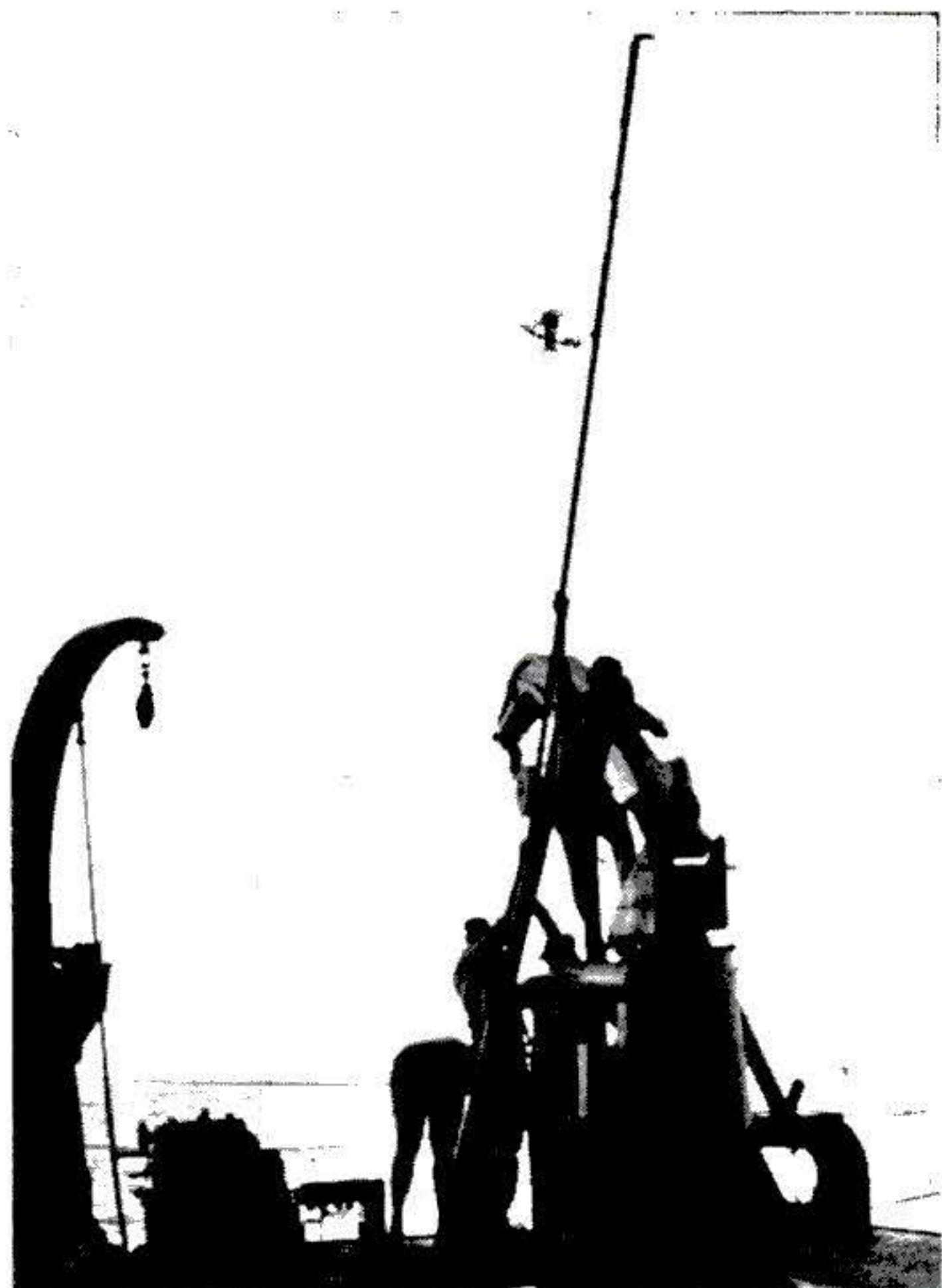
The most likely type of propulsion units are reversible axial-flow pumps. These are actually hollow-shaft, three-phase AC electric motors and pumps combined. Constructed with their field windings potted in a plastic compound, the pumps are lubricated by sea water pushed through them by vanes in the hollow shafts.

Two pumps, one at the end of each pontoon, are mounted in tunnels. Rated at five hp., they will push the sub through the water at three knots or better. Four other one-hp. pumps, mounted in the sides of the pontoons and in the extreme front and back cross members, are "thrusters," designed for steering sideways or up and down.

Power for the pumps will be supplied by heavy six- or 12-volt lead-acid batteries mounted on tracks in the pontoons' tops. Here, the team led by Dr. McLean borrowed an idea from Deep Jeep. As in that

Continued

Glass-hull subs will open up a spectacular view of the ocean



Glass spheres were lowered into the ocean and subjected to violent blasts to prove H. A. Perry's theory: The strength of glass increases with depth. Above, glass model hangs from steel-pipe test rig.

vehicle, the batteries will be topped with a protective coating of oil and will simply be left open to ambient pressure of the sea, eliminating heavy battery cases.

Why mount the batteries on tracks? The batteries are the heaviest weights aboard the vessel; by gently nudging them back and forth with a motor-driven lead screw, it will be possible to keep the sub in perfect trim. In an emergency, they can be dumped so the vessel can rise.

Casting the hulls. How do you go about casting the thick, heavy, glass hemispheres the sub needs? It's a complicated problem, but it's being solved by the Corning Glass Works, Corning, N.Y., which recently delivered the first 56-inch spheres.

In the Corning process, molten glass from a furnace is collected in an accumulator. A gate is opened, and an enormous glob of glass flows into a huge bowl-shaped mold. The mold is the spinning type, driven by an electric motor. As the mold spins, centrifugal force spreads the glass evenly and thinly upward like glowing lava to create a perfectly shaped hemisphere.

Ballast, buoyancy, and trim. Buoyancy is a tricky problem in a sub—it might be compared with keeping your balance on a tightrope without the tightrope. Riding smoothly on the surface of the water, the glass sub will have its pontoons closed to the sea, its heavy ballast for submerging (200 pounds of concrete blocks or stones) stacked in a container in front of the sphere.

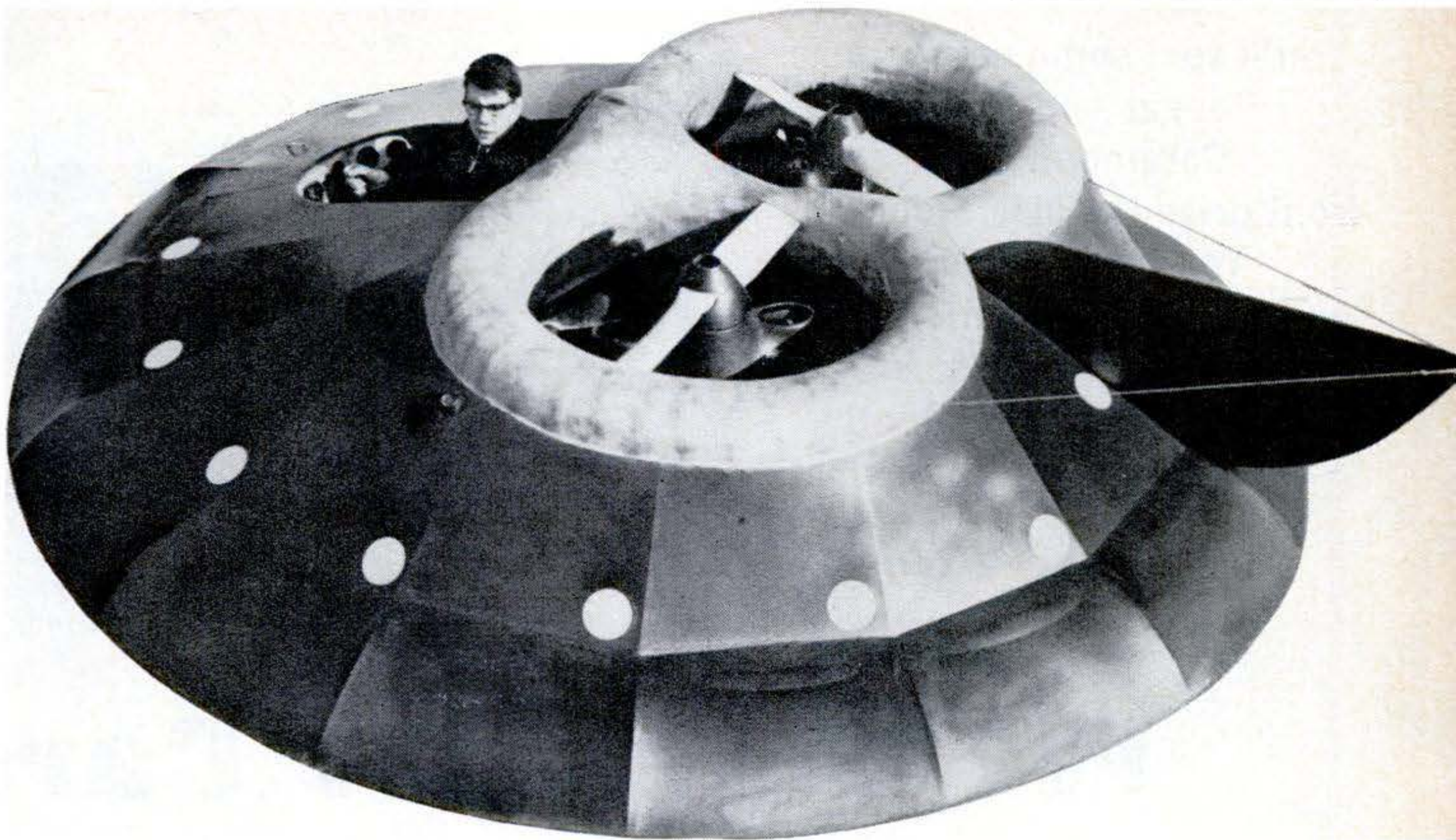
To submerge, the pontoons are flooded (ducts in the center of a pipe between the two pontoons insure that they fill at an equal rate to keep the sub trim), and the vessel begins its descent. On the bottom, the ballast is dumped by a mechanical scoop. With the pontoons flooded, the craft is now neutrally buoyant, and hovers over the ocean bottom.

To return to the surface, a small packet of gas-generating chemicals is released in each pontoon, driving out the water and making the craft positively buoyant. A simple safety feature will make the glass sub the safest submersible ever designed. In case batteries or water cannot be unloaded to provide buoyancy, a simple device will release the lightweight glass sphere from the pontoon structure.

The problem of keeping the occupants of a small, closed capsule alive over long periods of time has been successfully solved; "scrubbing" systems are now available that remove the excess moisture and carbon dioxide and replace the lost oxygen—whether it's in a spacecraft or a submarine. Basically, the glass sub will use the same scrubber as Deep Jeep—containers of lithium chloride to remove CO₂ and silica gel to remove moisture. A small oxygen tank will replace lost oxygen.

At \$1 to \$3 a pound, a glass hull costs a tiny fraction of a much weaker steel or titanium hull. Glass is light in weight and provides its own buoyancy—an important point, as bathyscaphes such as the Navy's Trieste require large gasoline-filled "balloons" to float them back to the surface.

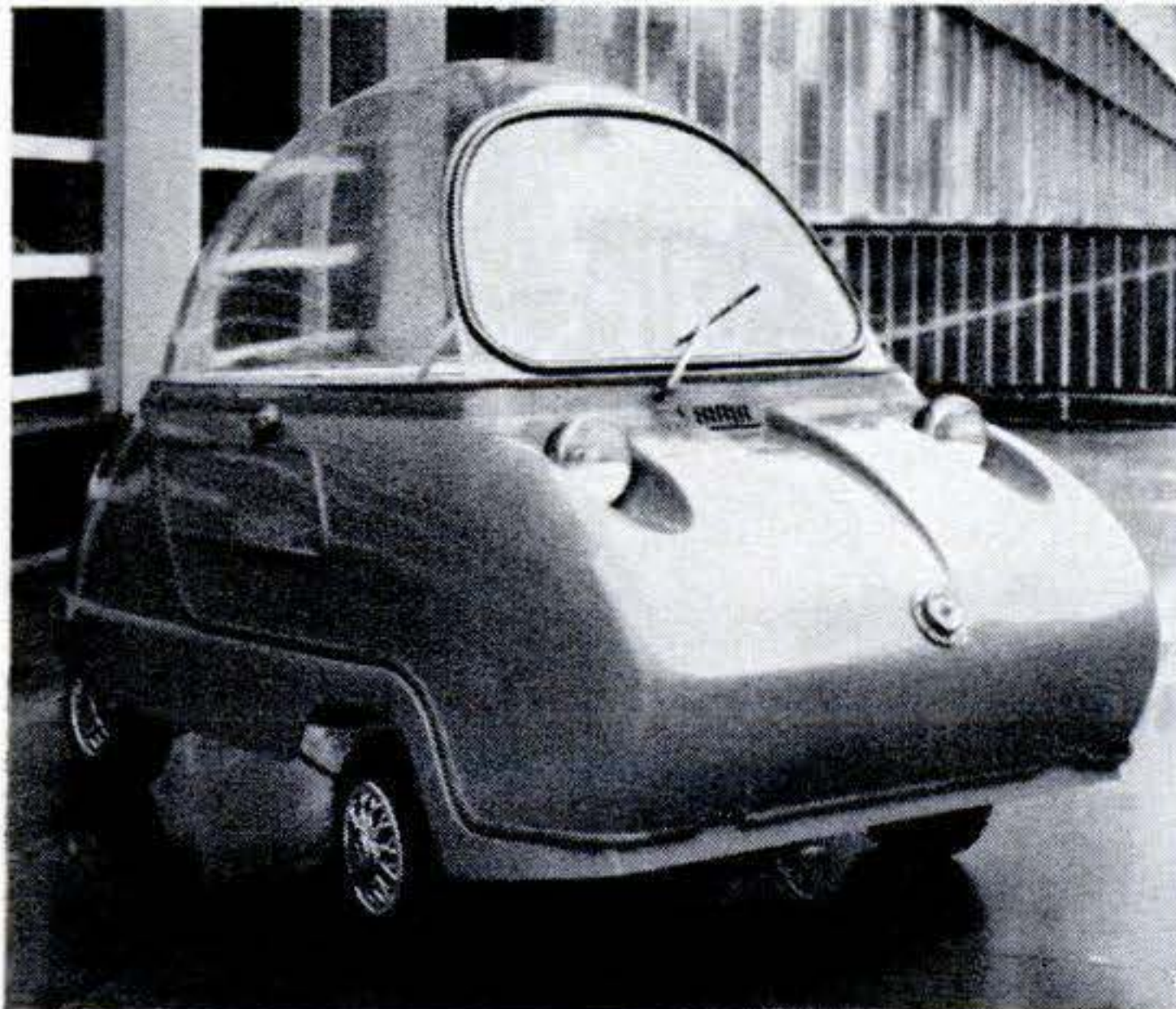
Finally, glass subs offer the ultimate in visibility. To date, we have had only tantalizing glimpses of the ocean depths through tiny, cloudy windows built into the enormously heavy hulls of bathyscaphes or deep-diving subs. Glass subs will give underwater explorers a full, 360-degree view of the ocean depths—the first real view we have ever had. P 5



Ducted rotors make helicopter a real flying saucer

This flying saucer was built by a 29-year-old aerodynamics professor at the University of California. It flies on two cut-down props driven by 72-hp. engines. Aluminum sheeting and doped fabric cover the steel-tubing frame.

It weighs 300 pounds and is four feet high. Prof. Paul Moller has flown the craft a few feet off the ground, and is building another designed to fly at 5,000 feet. He hopes to have that one mass-produced for about \$4,000.



Trident's five-horse motor has toothed-belt drive.



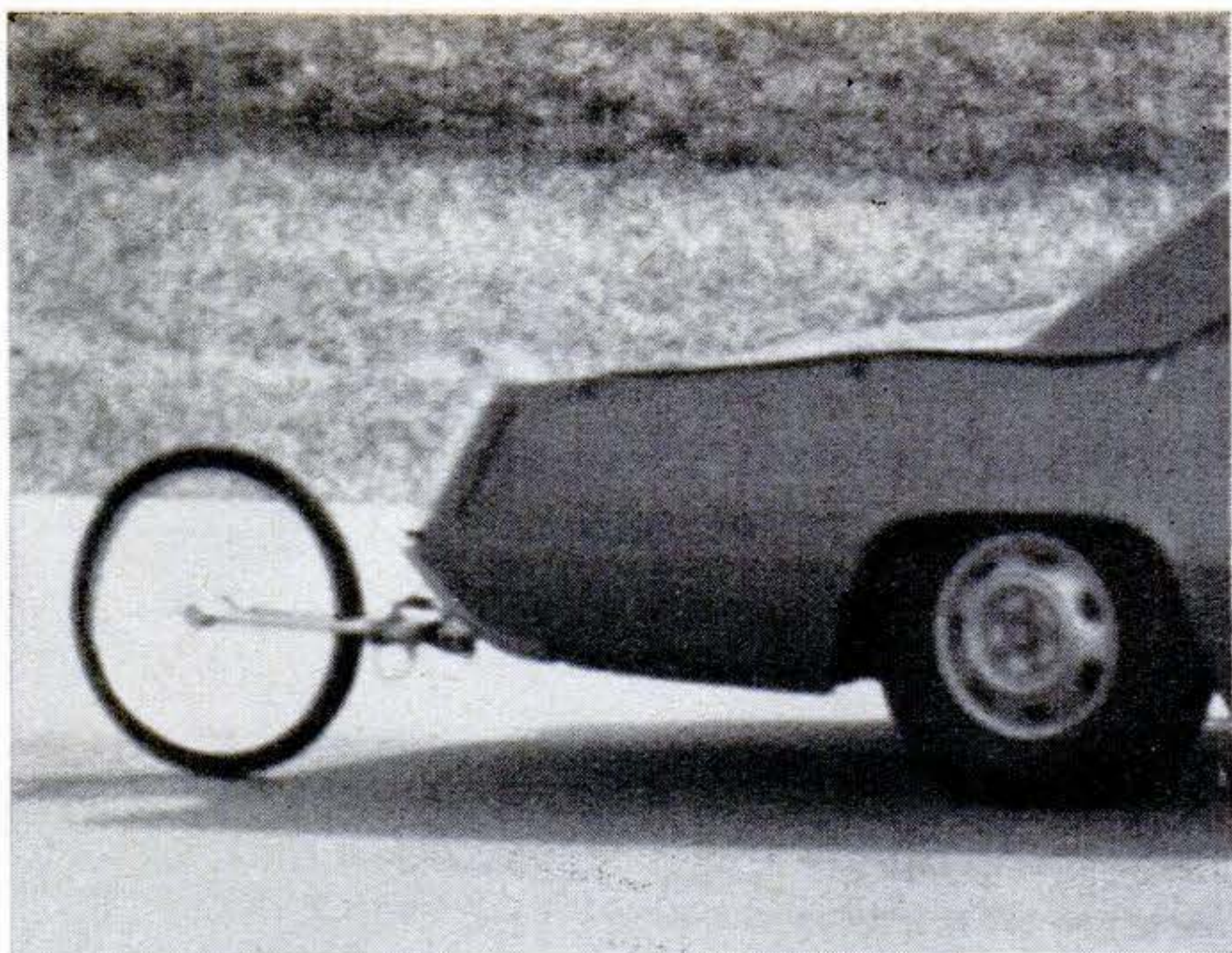
Two lightweight motors drive Scamp's rear wheels.

Battery-run minicars may cure London's rush-hour traffic ills

Sponsored by Britain's Electricity Council, these tiny cars may help solve London's growing traffic problem. Peel Engineering's Trident (left) is six feet long, has a battery-run five-hp. motor, 35-m.p.h. top speed, and 40-mile range. Scottish Aviation's seven-foot Scamp (right)

turns in a 16½-foot circle, has two-seat fiberglass body, weighs 1,000 pounds, cruises at 30 m.p.h. Cost to run either is a half-cent a mile. Batteries recharge overnight. Used by commuters, the little cars would reduce city traffic jams and eliminate fumes.

**You'll spot some new names:
Cougar and Camaro—or
Caramout. You'll see a
front-drive Cadillac Eldorado.
You'll be eyeing all-new
T-birds and Imperials. And
you're in for some surprises
from Rambler, Pontiac,
and Chevrolet**



Cadillac's front-drive Eldorado will come in only one

What the '67 Cars

AN EXCLUSIVE PS STAFF REPORT

Two and a half years ago Ford hit the jackpot with a low-priced car that had a long snout and a short rear deck. It was called the Mustang. For 1967, the reverberations of the astonishing popularity of this vehicle are still echoing through Detroit.

The idea is busting out all over. All-new models to be introduced this fall will have that long hood and bobbed-tail look:

Chevy will have its Camaro (or Caramout, or make your own guess—the early code name was Panther) to face the Mustang.

Lincoln-Mercury will have its Cougar, based on the Mustang concept but bigger

than the Mustang and more luxurious.

Ford is renovating its Thunderbird to fit the times.

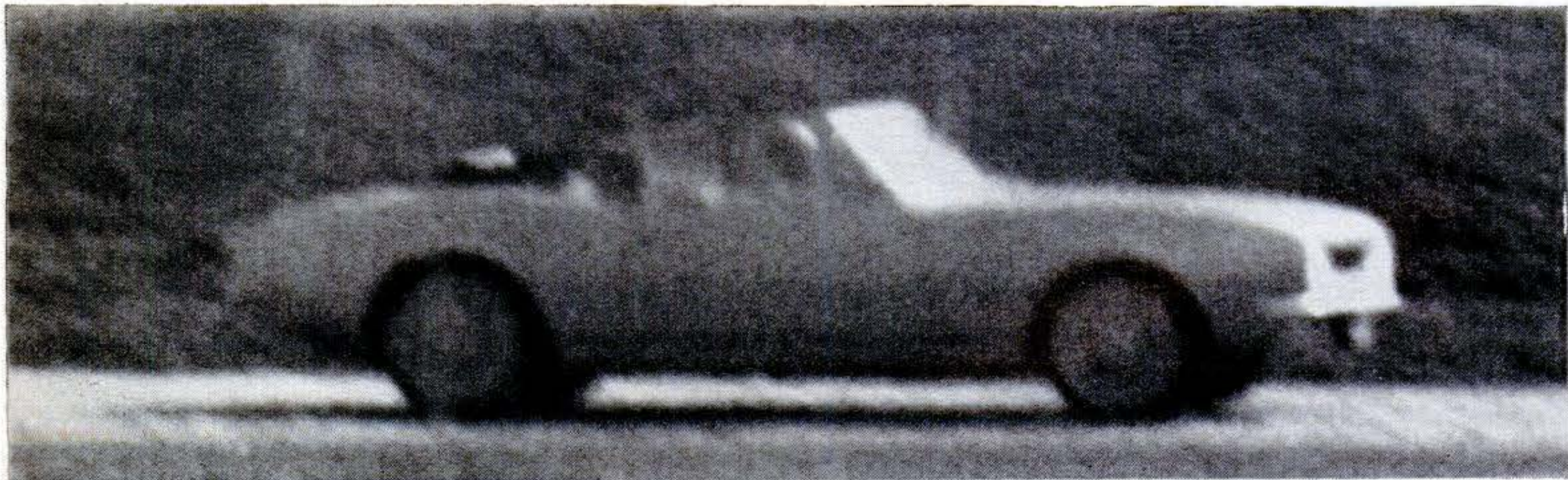
Chrysler-Plymouth is revamping its Barracuda.

And in the money's-no-object class, Cadillac's front-drive Eldorado is following in the tire tracks of Olds' Toronado.

Perhaps the most prominent superficial styling gimmicks on all the '67 cars, whether they are coming on the scene completely new or as retreads, will be in the headlamp and tail-light treatment.

Before we get into the cars that are completely new, inside and out, let's take a look at the engineering changes. They're big.

- Pontiac gets a new 448-cu.-in. light-



Chevrolet's answer to the Mustang, whatever its name, will come out as a separate line for



body style: six-seater two-door hardtop. Rear-seat passengers will enjoy high degree of privacy.

Will Really Be Like

weight cast-iron V-8 to replace the 421-cu.-in. unit.

- Buick gets a 430-cu.-in. lightweight cast-iron V-8 to replace the 425-cu.-in. engine.

- Rambler gets a 343-cu.-in. V-8 in addition to the new 290-cu.-in. V-8.

- Chrysler's Imperial switches from separate-frame to unit construction.

- Thunderbird drops unit construction and gets a new body on a Mercury frame.

- Disk brakes will be standard equipment on several full-size cars from the Ford Motor Co. and Chrysler Corp., and will become optional on some GM cars.

- Dual master cylinders will be standard across the board.

- GM and American Motors will standardize collapsible steering columns.

- Cadillac's variable-ratio steering gear will become optional on some Buick, Olds, and Pontiac models.

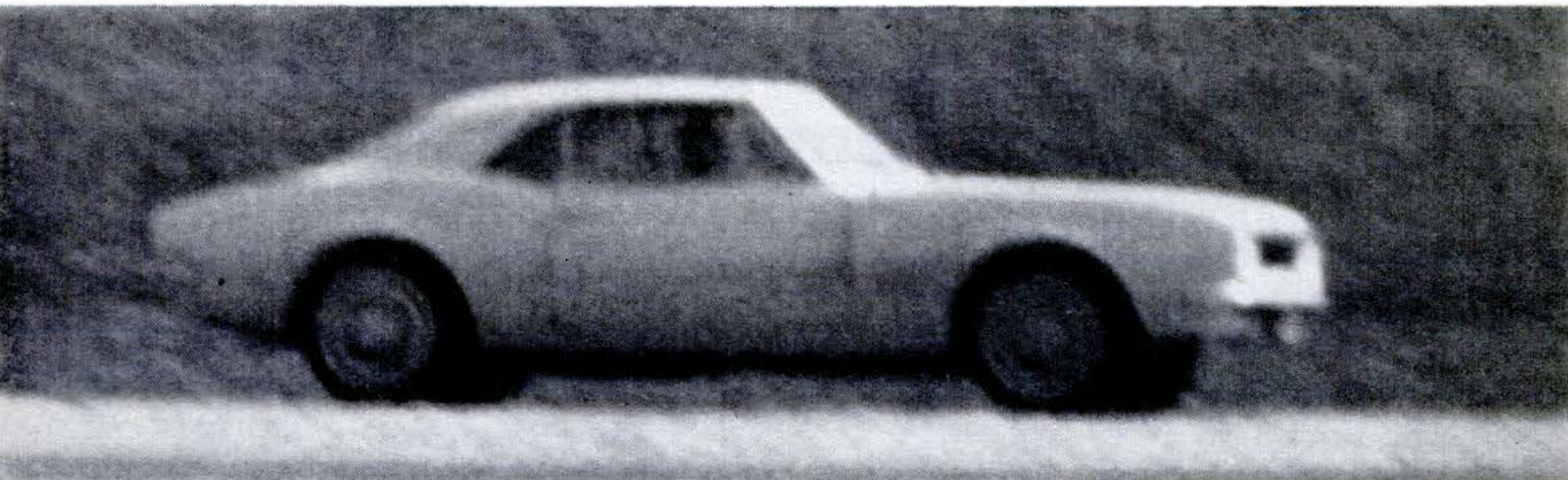
- Tilt-and-telescope steering wheels will spread further down the range, becoming optional for Pontiac's GTO, Olds' 4-4-2, Buick's Skylark GS, and the Chevelle SS 396.

- Chrysler's 440-cu.-in. wedge-head V-8 may supplant the 426-cu.-in. "street hemi" in Plymouth Belvedere and Dodge Coronet.

- Mercury's "wrist-twist" steering system may reach production during the '67 model run.

- Wide-rim wheels and high-speed tires

Continued



1967. Here, the hardtop coupe has just passed the convertible. A fastback may be added later.

will be optional on all high-performance models for 1967.

Now for those all-new automobiles:

Cadillac Eldorado. The engine is not a V-12; it's not even an overhead-cam V-8. It's a souped-up version of Cadillac's standard 429-cu.-in. power plant with about 375 hp. The front-drive setup is much like the Toronado's, but the transmission will have different shift points and the final drive ratio will differ. The Caddy uses a new type of constant-velocity universal joint, and the springs are softer than the Toronado's.

The Eldorado's underbody is the same as that of the Toronado and Buick Riviera, but the outer skin is pure Cadillac. Wheelbase is the same, at 119 inches, but the Caddy's overall length is about 225 inches against the Toro's 211.

Cadillac plans to build about 25,000 front-drive cars during the first year, and the delivered price, with the usual extras Cadillac buyers demand, will be right up at the \$7,000 level.

Mercury Cougar. Much of the Mustang's basic design has been carried over into Mercury's new car for the sporty market. But the car is bigger and more luxurious than its cousin. Wheelbase is set for at least 111 inches—three up on the Mustang. Cougar will *not* offer a six-cylinder engine, but comes with V-8s up to 390 cu. in. Slated price: about \$100 above Mustang.

Headlights, hidden behind the grille, pivot into operating position. At the rear, a similar grille about half the height runs the width of the car. Six tail lights hidden behind it—three to a side—operate sequentially when the turn signal is used. At first, the Cougar will be strictly a two-door hardtop, but a sweet-looking fastback is in the works and will probably be out as a half-year model in January. Suspension, steering, brakes, transmission, and optional extras will be adapted from Mustang and Comet

components with considerable freedom.

Plymouth Barracuda. The Barracuda will get entirely new and individual styling, and will add a two-door hardtop and convertible to go with its fastback, matching the Mustang model for model. Engine and transmission options will remain much the same, but the car will no longer look like a swinging sister of the Valiant. The 106-inch wheelbase will be stretched at least two inches, perhaps going to 110.

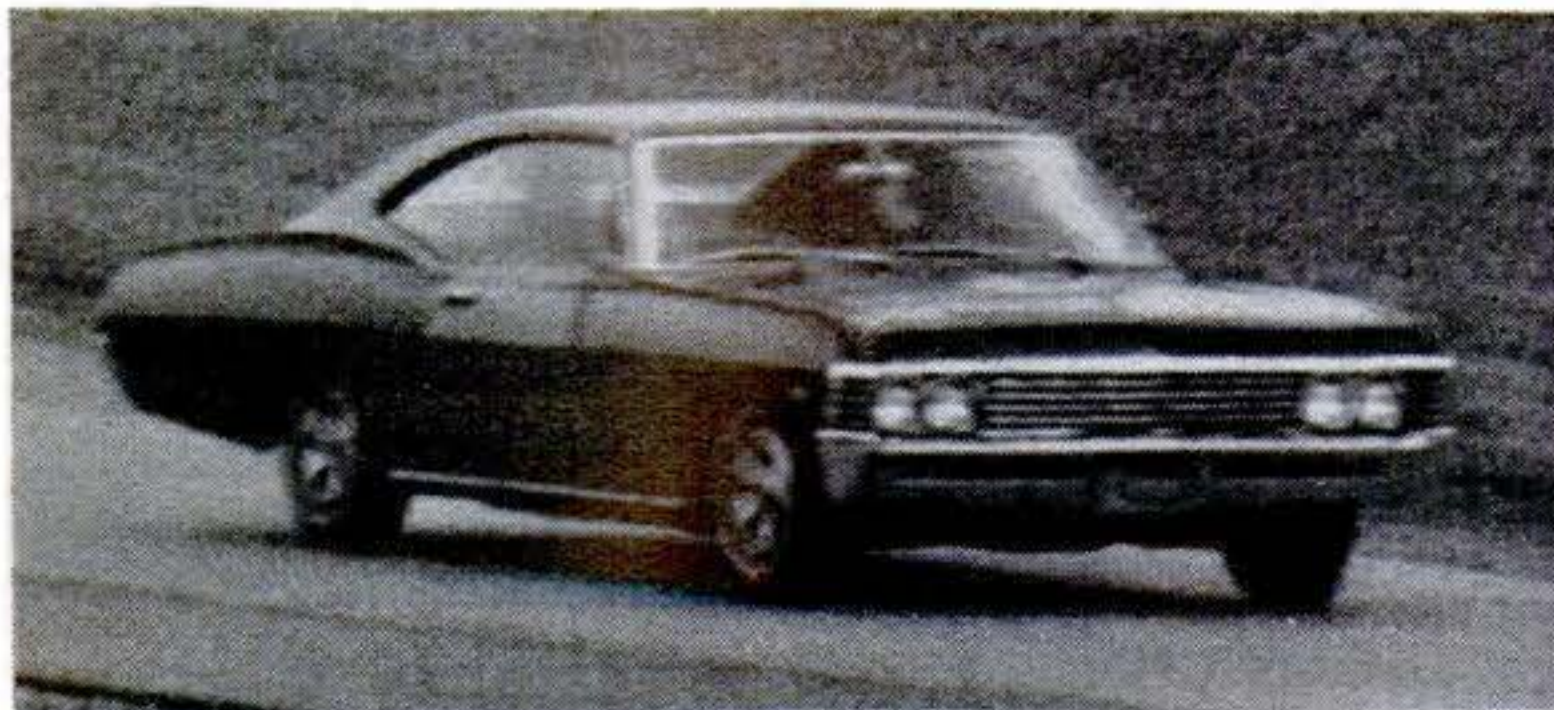
Ford Thunderbird. The Bird will move up in length, interior room, and wheelbase, as Ford's "personal" car moves to meet the challenge of Riviera, Toronado, and Eldorado. Four inches will be added to the wheelbase and there'll be a four-door model for the first time. (The convertible won't appear next fall, but may come later in the year.) Other added goodies—flow-through ventilation, hidden headlights, single-piece front-door glass, as well as increased power from a 428-cu.-in. engine. Suspension will be coil springs all around.

Chevrolet Camaro or Caramout. We've called this one the Panther up to now [see PS, Dec. '65], but there are hints of a rechristening. Since Chevy favors names beginning with C, Cheetah, Catamount, and even Cougar (Ford Motor take note) have been suggested.

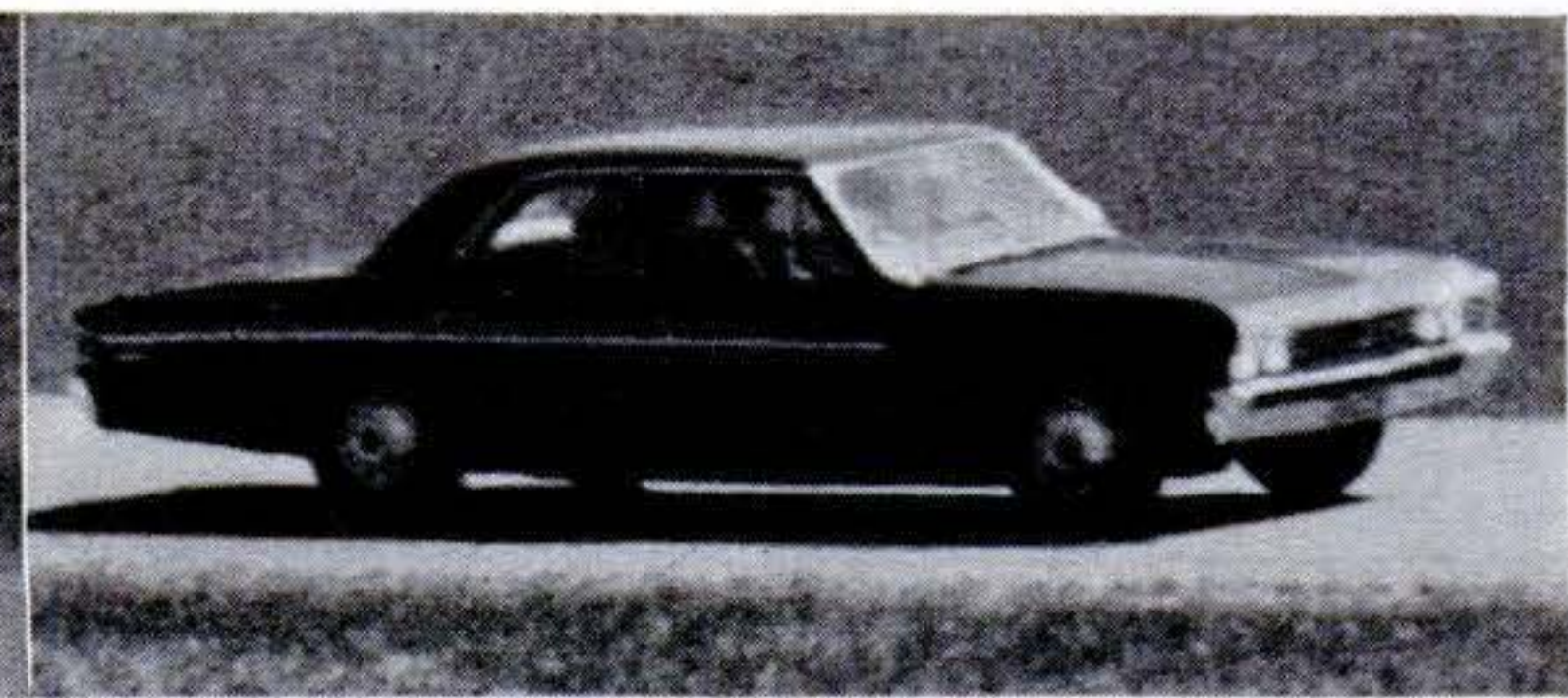
Now we hear that the new Chevy sporty car will be called Camaro or Caramout (*ka-ra-moot*). The final decision will be made just before introduction time. Don't look them up in the dictionary. Like Toronado, they aren't listed.

The car will be built as a two-door hardtop and a convertible, with later, perhaps, a fastback. It will have the long-hood, short-deck look Mustang capitalized on. Most of its mechanical components will be borrowed from existing hardware on Chevy II. Engines will start with a six and go up to a 327 V-8. There are three series: SS, RS,

GM styling stresses bulging hips, breaks out with many startling headlamp

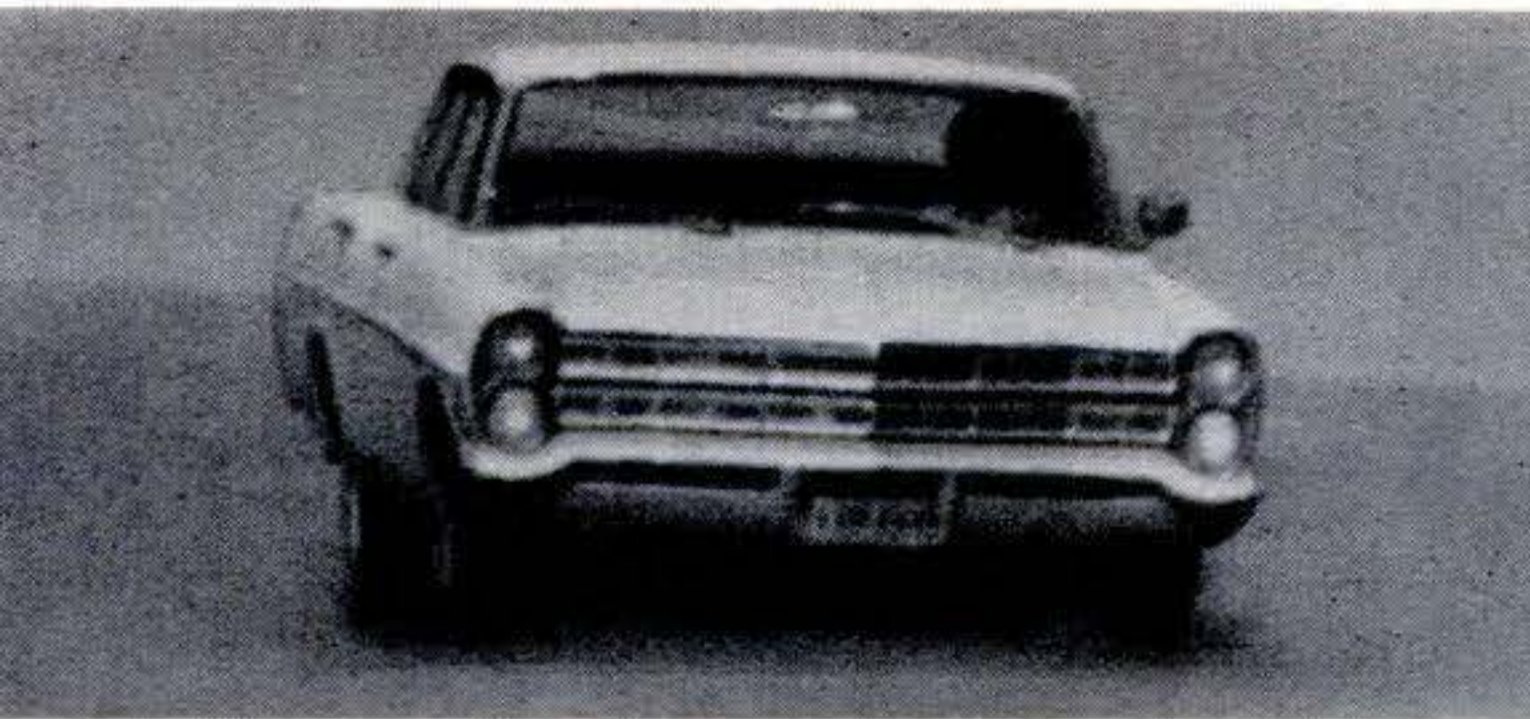


Chevrolet Impala two-door hardtop



Chevelle four-door sedan

The Ford Motor Company intensifies its challenge to General Motors



Ford Galaxie four-door sedan



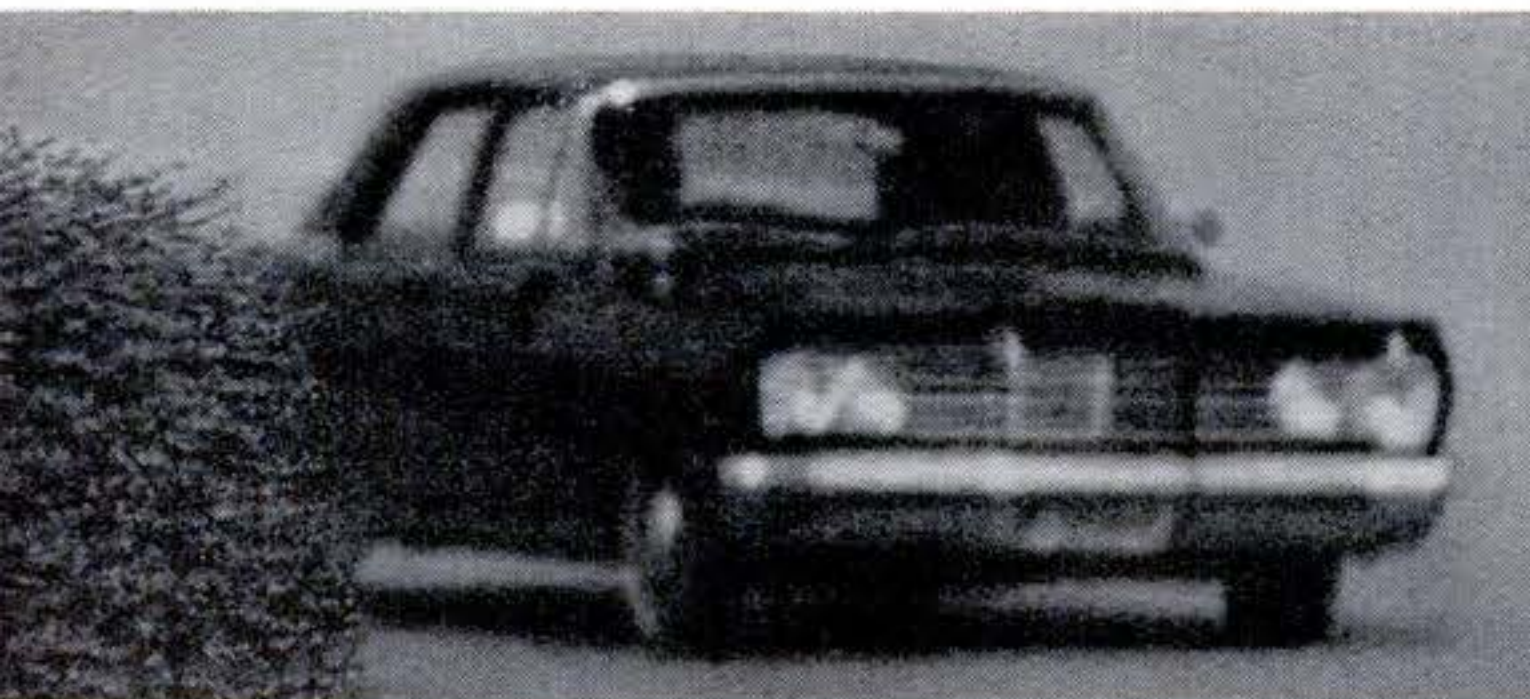
Ford Mustang coupe



Mercury Cougar coupe



Ford Falcon two-door sedan



Mercury Montclair four-door sedan



Ford Thunderbird four-door sedan

and RS 335. Wheelbase is set at 108 inches. Prices will be close to Mustang, model for model.

Under the front lip of the car's long, sloping hood, the grille is "blacked out" like the background of Ford's Mustang. Single headlights are at the extreme ends of the grille with parking lights adjacent to them, toward center. Full wheel cutouts are featured. Unlike most of the new cars, this

one will have front-door vent windows.

What else is new from Chevrolet? Standard Chevrolets will get all-new sheet metal, but will still have that all-Chevy look. Wagons will come in with a two-way rear gate just like Ford's. No new V-8 engines are in the works, but a six-cylinder special may be ready for the fall. GM's Turbo-Hydramatic automatic transmission will be adopted as Powerglide is phased out com-

Continued

treatments, but shows continuity of '66 themes



Pontiac Bonneville four-door hardtop



Pontiac Catalina four-door sedan

Three surprises from Chrysler Corporation



Dodge Polara two-door hardtop



Chrysler Newport four-door hardtop



Imperial four-door hardtop

pletely. Chevy II, all new for '66, will get a facelift. Corvair will be little changed, waiting a drastic "image" change in 1968. Its seven models will be cut to three or four.

Inside story at Pontiac. All-new sheet metal is ready for the big cars, with Bonneville and Grand Prix sharing a 123-inch wheelbase for the first time. Tempest will up the horsepower of its overhead-cam six, but body lines will be little changed.

At Oldsmobile and Buick. The big Olds 88s and 98s will carry a grille partially split at center by a sheet-metal extension of the hood, drooping over the front of the car. The F-85 will have a more conservative look. Toronado will get a facelift, front and rear. Those "eyelids" just above the headlight panels will go; more brightwork will be added to the rear end. Since Buick shares its basic bodies with Oldsmobile, Olds changes apply to Buick also.

It's all change at American Motors. All Ramblers will be restyled—the first total

changeover in AM's history. The cars will be lower, with sloping roof and fender lines, for a longer, leaner look. You'll note a strong resemblance to the '66 Chevrolet.

The Marlin will be bigger. Previously built on the Classic wheelbase (112 inches), the Marlin for '67 will be based on the Ambassador. Next year's Ambassador will have its wheelbase stretched from 116 to 118 inches, its body widened by two inches. For the first time, overall length will exceed 200 inches. The Classic nameplate may be dropped.

What's Ford up to? The Mustang will get new sheet metal, making it look rounder and squatter. It will have the Falcon's front and rear suspension with wider track and higher roll stiffness.

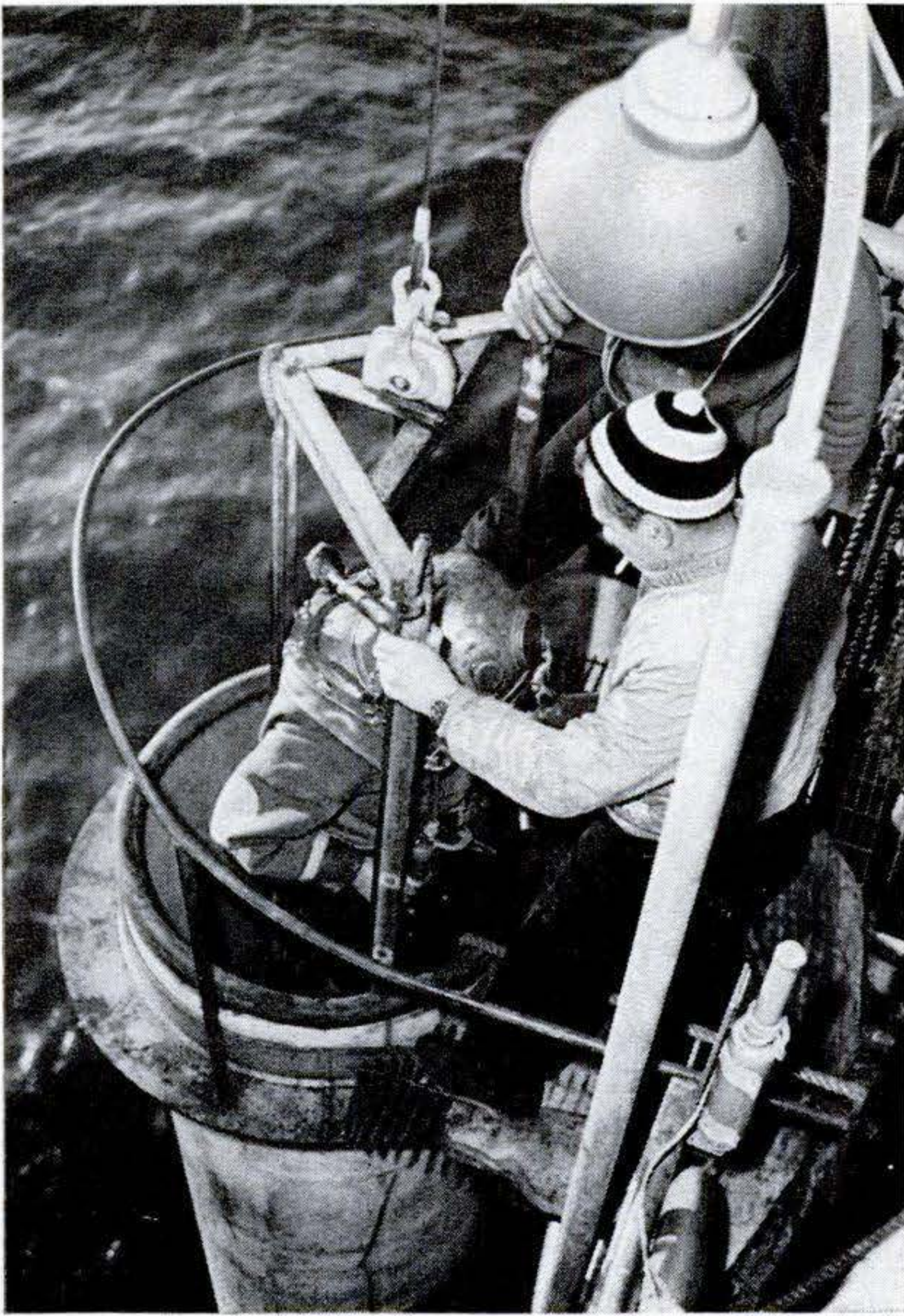
The Mustang fastback has a startlingly slick look. The roof line is straighter and carries right down to the rear bumper. The big Fords and Mercurys have new sheet metal, too, but show little obvious change. The big news is a special two-door hardtop Ford. Its roof line slopes to the middle of the deck lid before flowing into the belt line. The roof has a concave line from the top of the rear window to the spot where it flows into

the deck. Mercury will add a higher-price line called Marquis to face the big Olds, Buick, and Chrysler. Comet and Fairlane changes will be restricted to grilles and tail lights. Comet's split grille will be modified to make it look more like the big Mercury. Lincoln, too, will have little work done for 1967. This car is scheduled for a major change in 1968.

The Chrysler story. The compacts, Valiant and Dart, will get the heaviest restyling this fall. Valiant's wheelbase will go from 106 inches to 110; Dart, now 111, may add an inch or two. There will be no wagons.

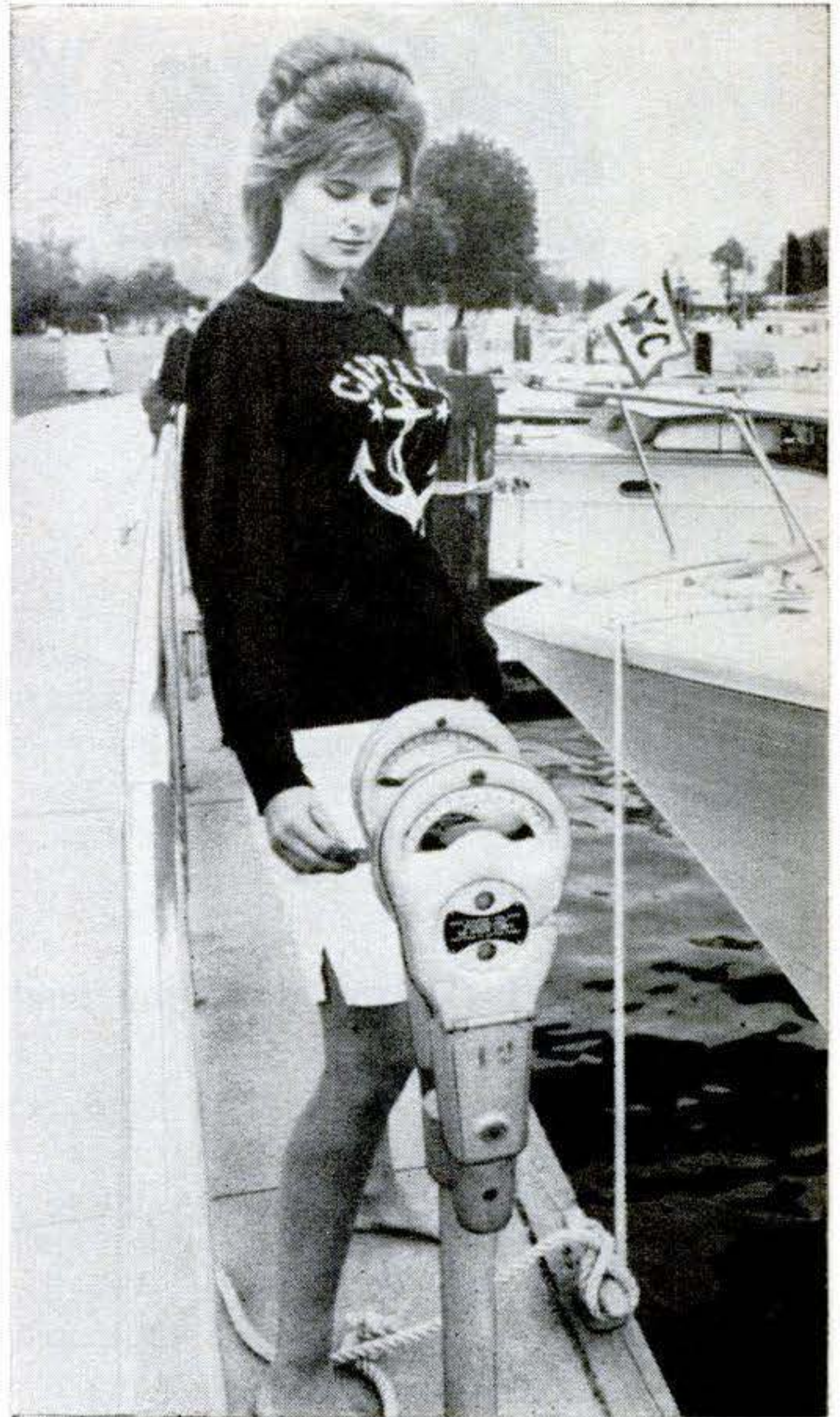
A common styling technique for the big cars, including Fury and Monaco, is a concave section in the sheet metal, running car length, just above the rocker panel.

Belvedere and Coronet got new bodies last year, so will show little change. The Imperial will be styled to compete with the T-bird, Toronado, and Riviera, as well as the Lincoln and the Cadillac. PS



Tube protects divers from current

A 250-foot-long steel tube driven into the sea bottom protects divers from exceptional tidal currents in Alaskan offshore oil exploration. Divers go down the tube on ropes without having to battle currents, leave through an opening at the bottom, spend all their time on the job. Coming up, they rest at set stages to prevent bends from too-rapid decompression.

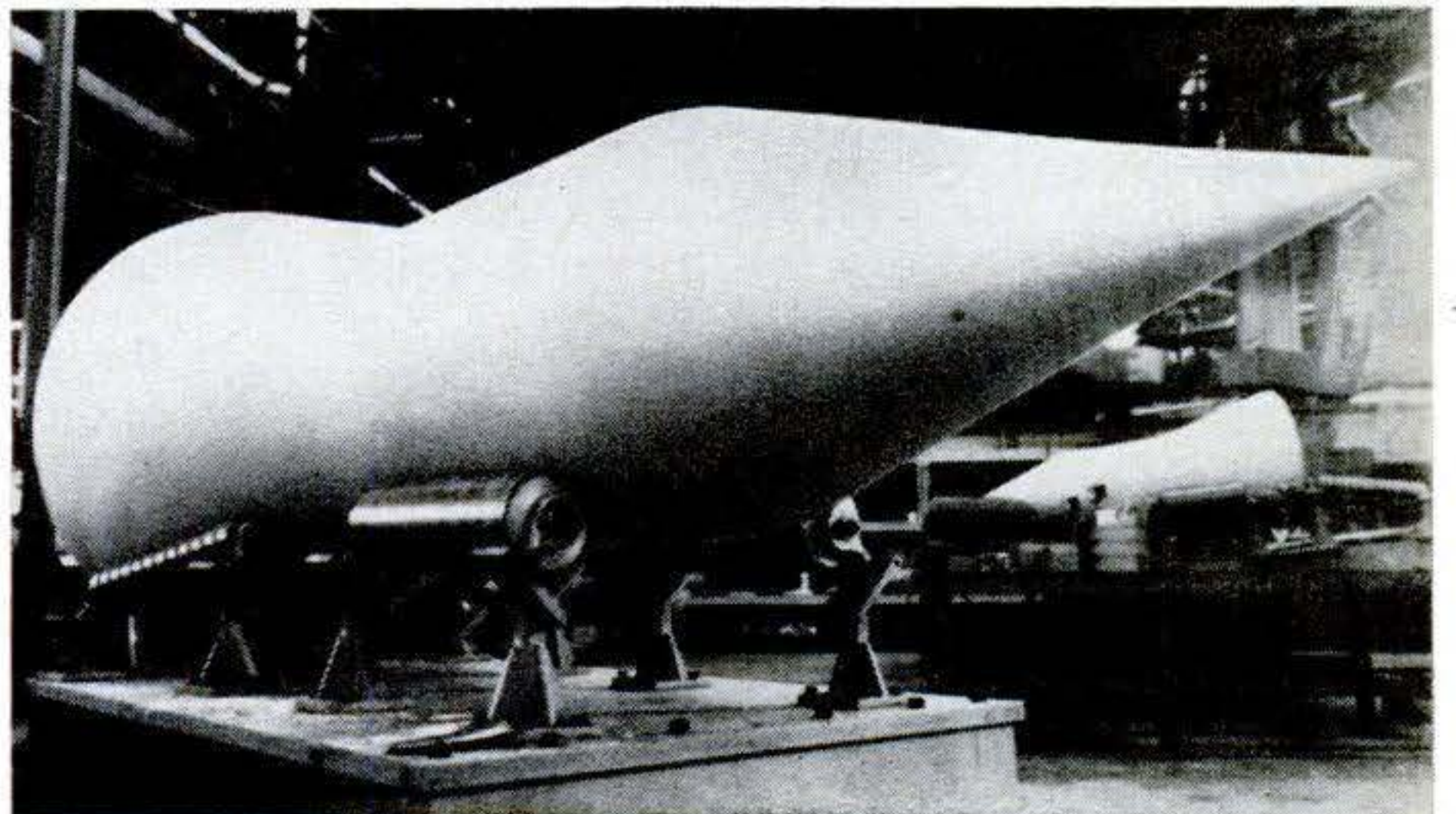


Parking meters take nautical turn

Now, with boating so popular, there are parking meters for boats as well as automobiles. The Lake St. Claire Marina near Detroit finds they boost turn-around rate at crowded docks and also provide revenue for construction of additional berths. The charge: 25 cents an hour to hook up for fresh water and electricity. Overparking: a 50-cent warning ticket.

Insulation burns up, protects missile nose

Cork-like insulation covering the nose cone of the Minuteman ballistic missile acts as ablative material on reentry into the earth's atmosphere. The cone's coating chars slowly in the intense heat but protects the cone itself, and the instruments or warhead it contains, from destruction. The cone withstands 15,000-m.p.h. speed and 12,000-degree reentry heat.



A's to Your Q's About

Are you paying more and getting less for your car insurance? Here are some hints on how to beat the rising cost of one of the biggest pieces of your auto budget

By THEODORE IRWIN

Year after year, you've probably found that the cost of car insurance keeps climbing. And the trend is toward further increases. How can you hold down insurance costs and get the most out of your policy when you put in a claim? The answers to the following questions may give you the answer.

Q What are the basic terms you ought to know in your policy?

A "Property-damage liability" protects you when your car hits someone else's auto or property. "Bodily injury liability" covers claims against you by (or for) people injured or killed by your car. "Medical payments" cover your doctor and hospital expenses, as well as those of other passengers injured in your car. "Collision" pays for damage to *your* car, no matter who's at fault. "Comprehensive physical damage" covers theft, glass breakage, or damage to your car by fire, windstorm, and other perils. What insurance men refer to as "10/20/5" means the company will pay up to \$10,000 for bodily injury to any one person you may hurt in an accident, a maximum of \$20,000 for all bodily injury claims for that accident, and up to \$5,000 for property damages.

Q What types of policies can you choose from?

A The Family type breaks down liability into three parts, such as 10/20/5, for bodily injuries and property damage to others. A newer type, usually called a Special, bunches all the liabilities into one fund for all claims—the approximate equivalent of 10/25/5 is a \$25,000 lump maximum. Its **advantage is that if you're sued for more than the single-individual limit, the policy**

can pay it all to that one person. It also automatically includes a \$1,000 death benefit, medical expenses, and towing-and-labor costs up to \$25 if your car breaks down. You pay extra for these items with a Family policy.

Q Can you save money by switching from a Family policy to a Special? If so, are there any drawbacks?

A You can shave 10 to 20 percent off your premium with a Special. Its disadvantages: You can't collect twice, as in the Family plan, for injury to yourself or family—from your Blue Cross-Blue Shield as well as the car insurance. The Special pays only hospital and medical bills above what you receive through other health insurance. The Special does not cover bodily injury claims arising from suits by one member of the family against another. The Family policy will.

Q Must you accept the insurance policy offered by your auto dealer or the finance company when you buy a new car?

A No. Usually, such a policy provides only collision and comprehensive coverage; you'd have to take out another for liability. Experts say you should have *all* your car insurance with one company. Otherwise, in case of an accident, you become involved with two companies. It may also be more expensive to carry two policies rather than one.

Q Do sports-car owners pay higher premiums, even with a clean record?

A Yes—if a sports car is used in competition. With other sports cars, there may be a somewhat higher premium for physical-damage insurance, theft, and fire. Last August, a new higher rating system

AUTO INSURANCE

went into effect in almost every state on high-powered models with a weight-to-horsepower ratio of 10:1 or less. Most affected are compacts with the biggest engines, such as a car with a 425-hp. engine. Not affected: a car like the Buick Riviera with a 360-hp. engine (11:1).

Q Do some owners pay higher premiums if their model has a higher frequency of accidents than others?

A No. There is no reliable data on whether some car models are involved in more accidents than others. But pressure is building up to institute such a system in which accident-prone models would be penalized. The N. Y. State Insurance Dept. recently started to canvass the nation's leading insurance companies to find out whether such data can be collected from their records. If any trends can be determined, it could lead to higher premiums on car models that statistically have a high rate of accidents.

Q What kind of insurance covers theft of nonautomotive stuff from your car—an expensive camera, for instance?

A You are already covered under the theft part of your Comprehensive clause for \$200 in your Special policy or \$100 if you have the Family plan. For additional protection, you can take out a personal-property floater policy. Most homeowner policies will cover up to \$1,000 loss if the car was locked.

Q Is there any way you can reduce the cost of your insurance if there's a teen-aged driver in the family?

A Have him take an approved driver-education course at school. In many states, this will cut your cost by nearly 20 percent on his added insurance.

Q How can you save on collision insurance?

A By raising your deductible to \$100 instead of the usual \$50. In most areas you'll save up to 40 percent.

Q How wise is it to drop collision insurance on an old car?

A As a car ages, the amount you can collect on it is reduced, but your premium is still just as high for several years. Suppose your car is worth only \$350 and the repair bill after an accident comes to \$625. The insurance company can settle for its actual cash value before the crash—only \$350. Of course, driving an old car without collision insurance is a gamble, but the odds are heavily with you.

Q What are the chances of your policy being canceled after a few accidents?

A Since 1961, major companies in all states except Massachusetts and Texas have agreed not to cancel any policy before it ends except for specified reasons—nonpayment of premiums, drunken driving, or conviction for three or more traffic violations within 18 months. Other companies, which do not spell out the reasons, can cancel at will—tightening up, for instance, in an area showing too many losses.

Q Suppose your insurance company refuses to renew your policy because of traffic violations or accidents, and others turn you down. What recourse do you have?

A Let's face it: You'll be "unattractive" to other companies. You can scout around for a minor company that will take you, probably at a higher premium. Some companies will accept you if you also give them other insurance business—your homeowner's policy, for example—so that they have a "balanced book of business" for you. Otherwise, you'll wind up in the "assigned-risk" plan.

Q Just what is meant by "assigned-risk" insurance?

A Every state now has a plan providing auto insurance for those who can't get it through normal channels. It's operated cooperatively by the insurance industry, and all companies accept motorists as-

Continued

signed to them. Except in New York and some other states, you have to pay an automatic surcharge of 15 to 35 percent on your premium. In a typical state like California, a "negligent operator" (drunk-driving conviction) also must pay an additional \$85; drivers with records not quite as bad but "worse than the average" of assigned risks may be charged \$45 besides the standard surcharge in the state.

Q Are you covered if you let a friend drive your car?

A Your policy protects you as long as you or your wife give permission. This goes for anyone, under any circumstances.

Q What's the "safe-driver" plan, and should you get into it?

A In most states, you can cut 10 to 20 percent from your premiums on liability, collision, and medical expenses on a Special policy if you're an excellent driver free of accidents (for which you're not at fault) and major traffic-violation convictions for three years. However, if you should get into traffic scrapes, the premium goes up, based on a point system. One or more accidents, for which you or other drivers in your household are responsible, may jump the cost five to 150 percent over the basic premium. If you already have a Special policy and recently accumulated points, start looking around for a Family policy (without a safe-driver plan) with other companies a few months before your present policy expires. Warning: Stay away from a safe-driver plan if you and your family are not perfect drivers.

Q Are you protected against a hit-and-run driver or a motorist who crashes into you but is not insured?

A Not in a Family type policy, but you can obtain it. As little as \$4 a year covers up to \$10,000 on one person, \$20,000 for everyone in your car. But this applies only to bodily injuries, not damage to your car or its contents. In the Special policy, you are automatically protected.

Q Can you save on comparable coverage by buying your car insurance through reputable mail-order companies?

A While the largest mail-order insurance companies have "relatively low" rates, they select their applicants with extreme care, and may not take you if you live in a

big city like Chicago, New York, or Philadelphia. Some restrict their policies to active or retired U.S. servicemen or government employees, or certain professional and occupational groups. A mail-order insurance company may not be licensed to do business in your state and your state can't help you when trouble arises.

Q Can you save on insurance if there are two cars in the family?

A If you have them both under one policy, instead of insuring them separately, your discount can be as much as 20 percent. If one car is used for business, you get a discount only on the pleasure car.

Q If you have an accident, must you wait until the insurance appraiser sees the car before you have it repaired?

A Some companies require that you get at least a couple of estimates on the repair job before you go ahead, if you don't want to wait for the appraiser. Others expect you to go to a certain repair shop where the company knows it gets a fair deal or to the company's own appraisal shop. If you're in a hurry and pick your own repair shop—and the costs, for instance, run to \$700—be prepared to have the appraiser scrutinize the bill and the car very, very carefully. As a rule, it's smart to call your agent or the company promptly and do what they tell you.

Q What should you do when it becomes obvious that a car-repair shop or a doctor is going to stick the insurance company with padded bills?

A You don't have to do anything, but there is the matter of conscience. The good citizen can first protest to the bill-padder, then air his opinions to his agent or insurance company. At any rate, if a bill is way out of line, chances are the insurance company will contest the claim. It may ask for an investigation, even prosecute for fraud. In that event, you may be called on to testify against the cheater. Still, whether a bill is high or low, you're protected by your policy.

Q Is it worth hiring an attorney to handle your claim in a serious accident case?

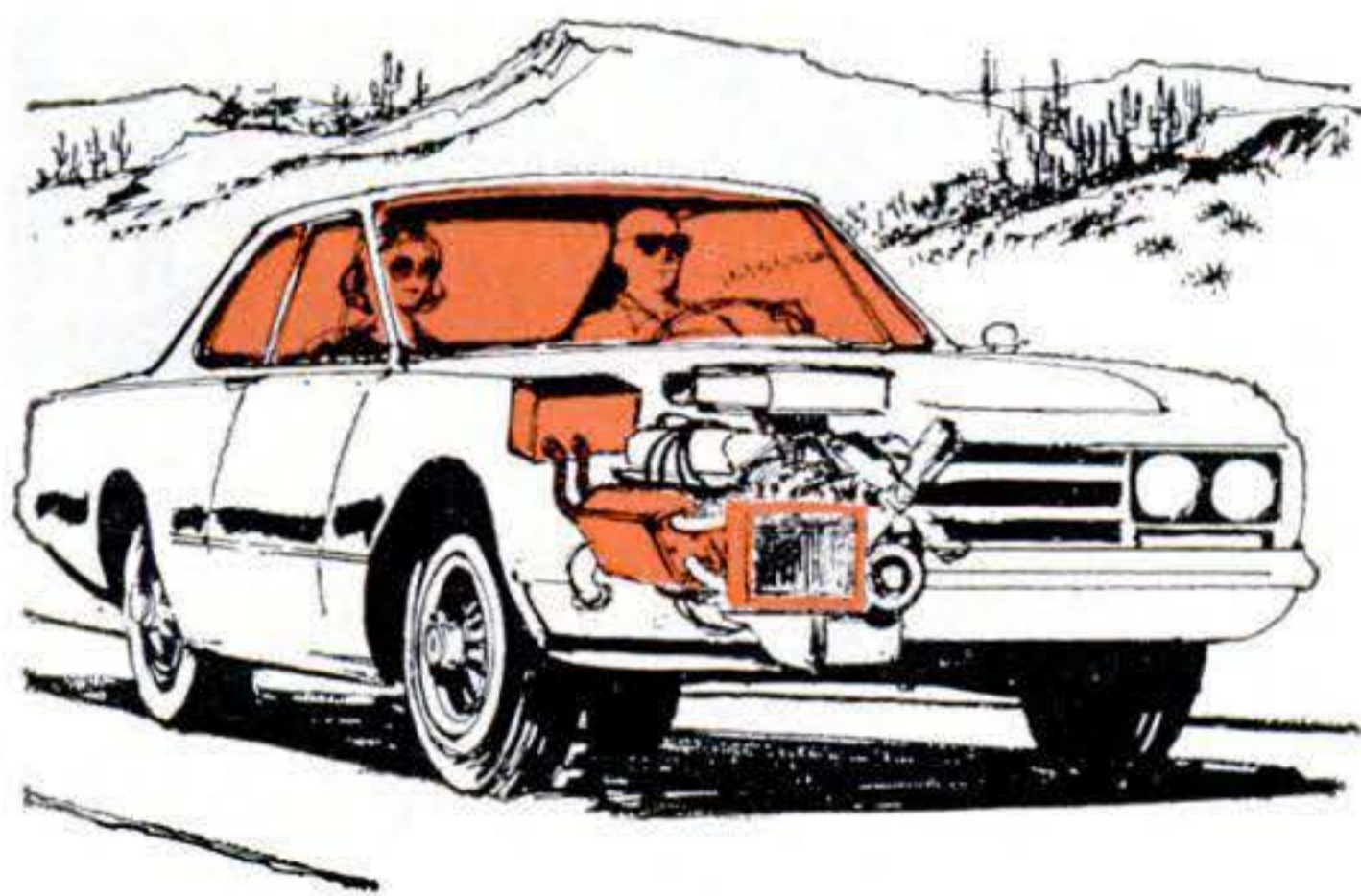
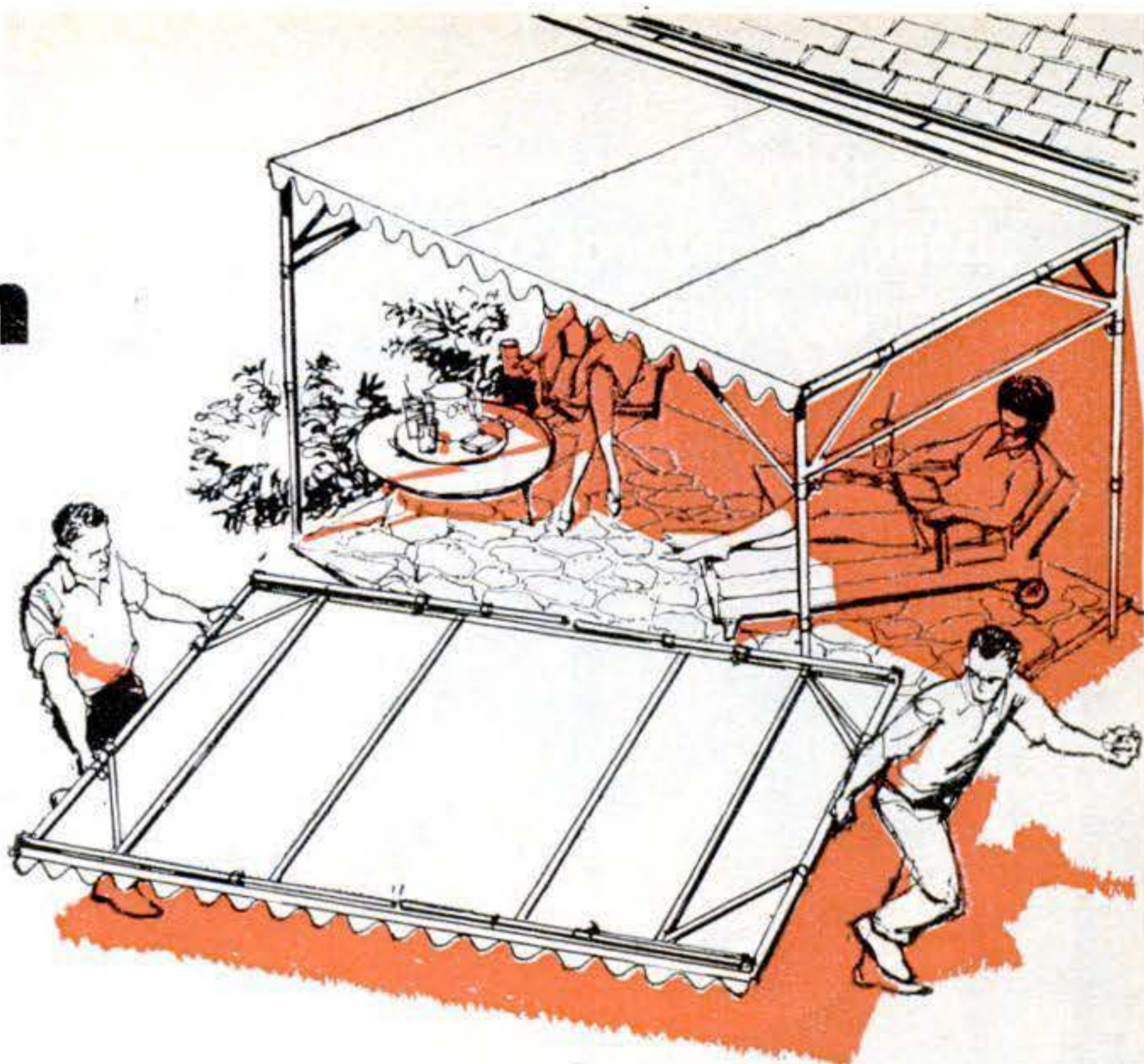
A Generally, anything involving the law is not a do-it-yourself project. Insurance companies say, however, that you

[Continued on page 173]

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

DRAWINGS BY DANA RASMUSSEN

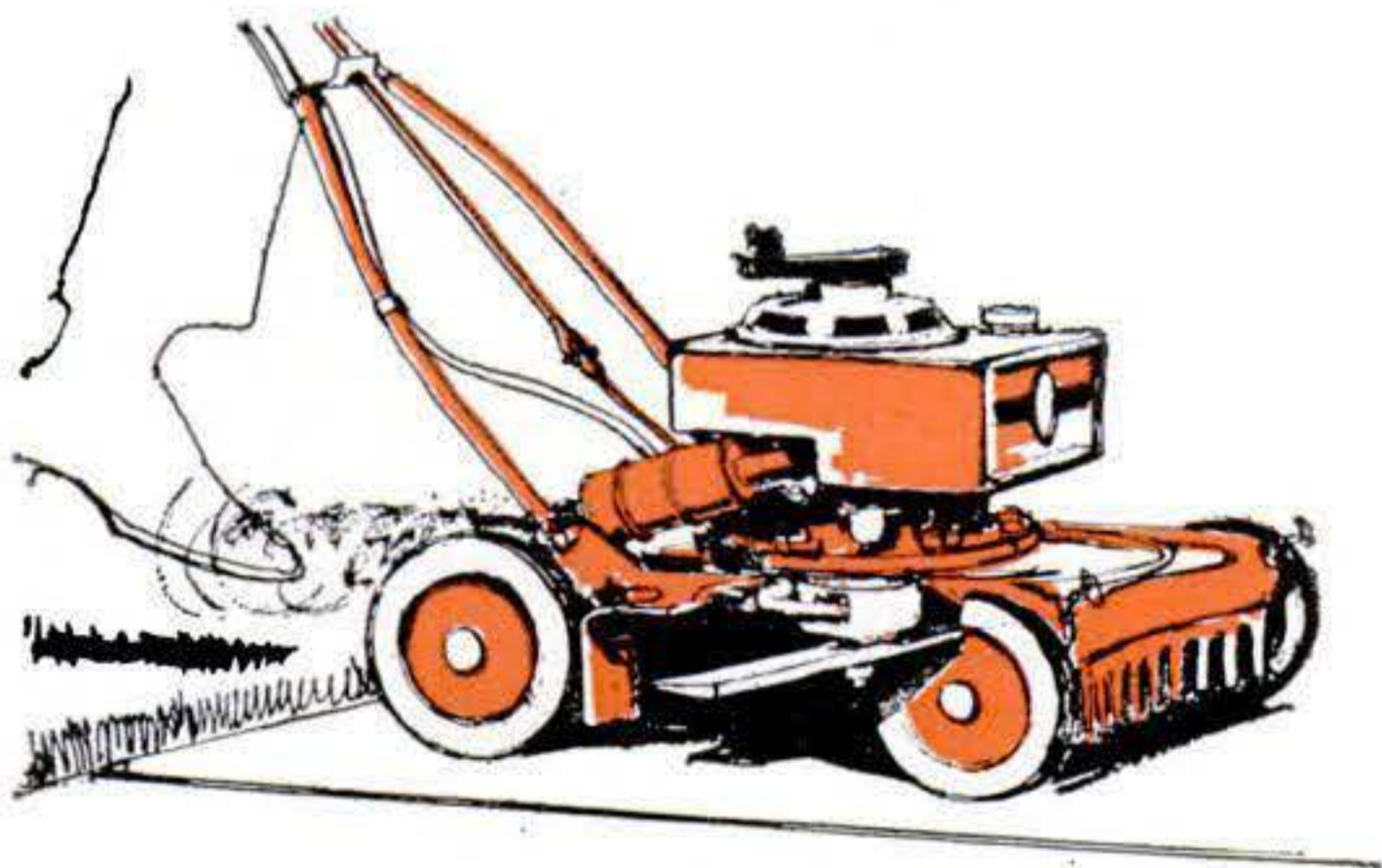
A folding canopy that would store flat, go up fast, and be easy to move from patio to barbecue pit, or even to a driveway to shade a car during the week.—*Mike West, Los Angeles.*



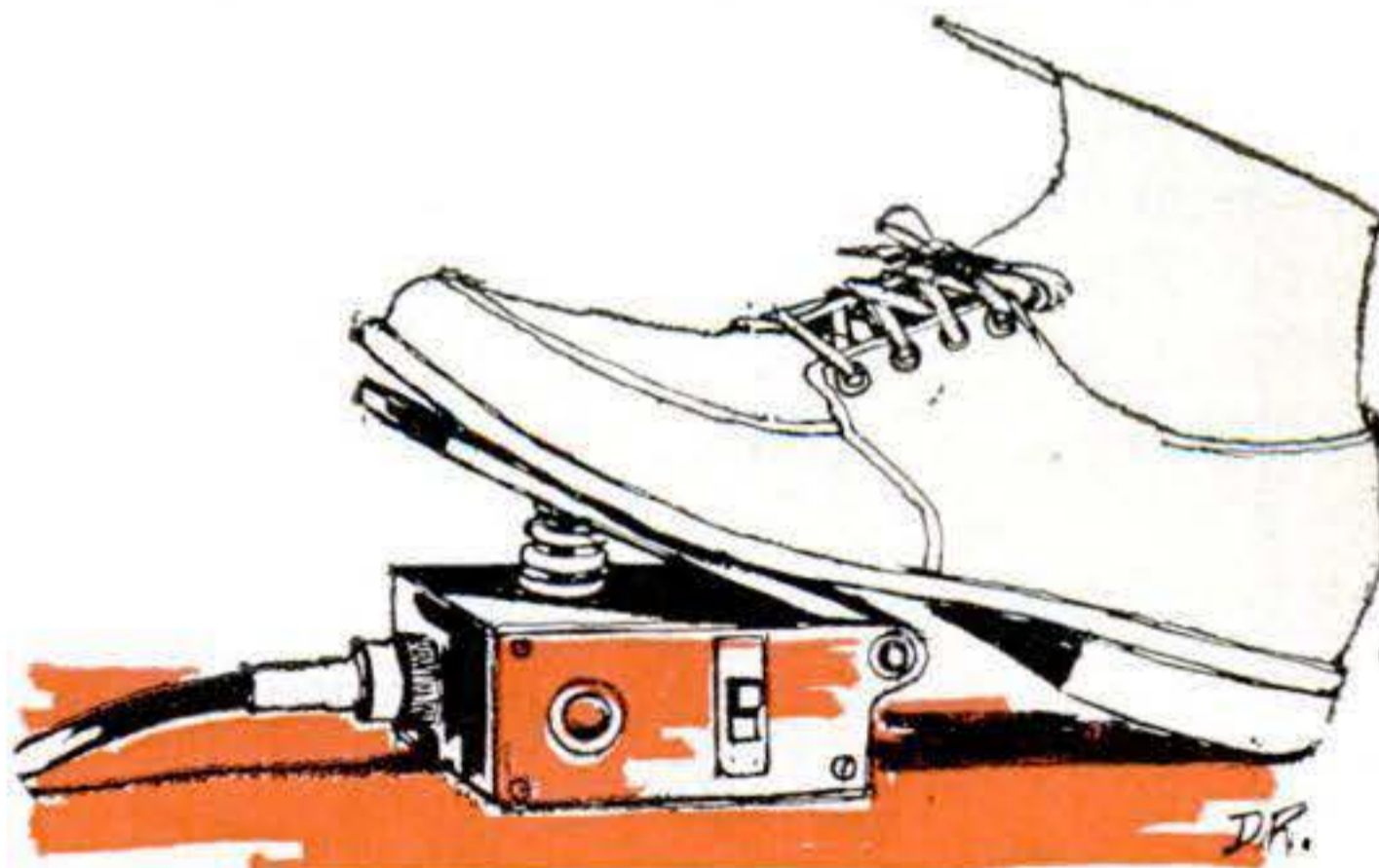
An air conditioner for automobiles that would use the car's wasted heat from exhaust to activate an absorption (gas-type) refrigerating unit.—*Allen Austin, Whittier, Calif.*



Tie-down tabs on plastic wading pools. They'd keep empty pools from blowing away in a high wind, full ones from wasting water through spillage.—*J. H. Hirrlinger, College Park, Md.*



A clutch to disengage the blade of a power mower. Then you wouldn't have to stop a hard-to-start mower engine just to cross a gravel driveway.—*Harold Harsch, West Allis, Wis.*



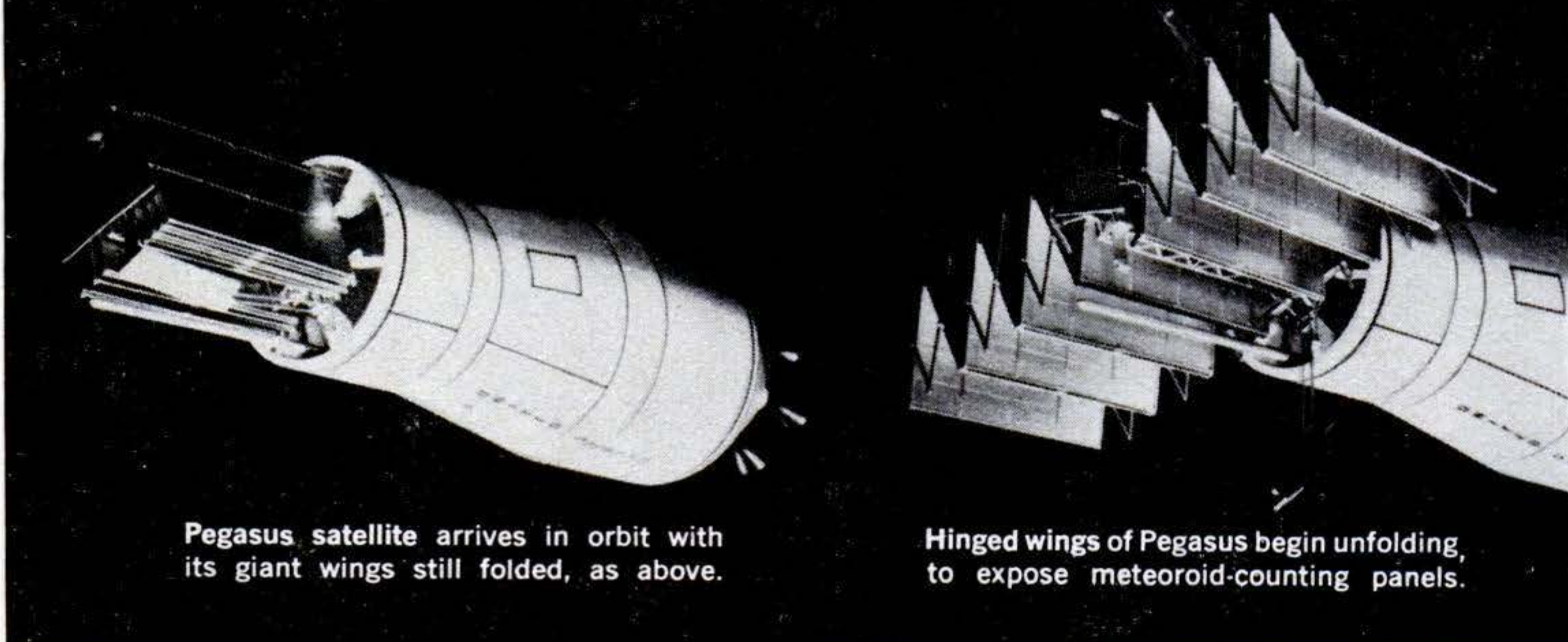
A foot-pedal control on a floor-based silicon-controlled rectifier so you could vary the speed of a drill while both of your hands were occupied.—*Jim Tankersley, Milwaukee.*

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

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What three giant unmanned satellites have told us about the hazards of micrometeoroids — the dust-size particles flying faster than bullets through space

THESE SPACECRAFT



Pegasus satellite arrives in orbit with its giant wings still folded, as above.

Hinged wings of Pegasus begin unfolding, to expose meteoroid-counting panels.

By **DR. WERNHER VON BRAUN**

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

Three giant Pegasus satellites, all launched during 1965 and still working at this writing, are closing a gap in our knowledge about the hazards of meteoroids to our astronauts and their spacecraft.

The Pegasus satellites are reporting the first observations ever made, at close hand, of the abundance of meteoric particles that can penetrate metal as thick as 1/60 of an inch. Because these particles are infrequent, compared to smaller and less-penetrating ones, a meaningful count in a

reasonable time takes a huge collecting area. Hence a Pegasus has a wing-like meteoroid-detecting surface of 96-foot span.

What we call "meteoroids" are pieces of matter hurtling through space, regardless of size. They become "meteors" if they enter our atmosphere, "meteorites" if they reach the ground unconsumed. Meteoroids come in sizes from a dust speck ("micrometeoroids") to a city block and more. The biggest are few and far between. Specks too tiny to puncture a space vehicle's skin hit a Gemini-size craft many times a day. It is the stuff of intermediate size that concerns a space-vehicle designer.

Dangers from meteoroids. Particles of only a few thousandths of a gram, whizzing at 15 to 20 miles a second, can penetrate a spacecraft's wall or a rocket's tank. They constitute a definite risk. If they puncture a tank or gas compartment, the result can be a serious leak—or, possibly, explosive rupture of a tank under pressure. Heat from their impact may ignite certain propellants, or materials in a crew compart-



Dr. von Braun (second from left) attends a NASA-Fairchild-Hiller conference on Pegasus project at Hagerstown, Md., plant of satellites' maker.

SAY "OUCH!"



With wings extended to full 96-foot span, Pegasus is ready for its space mission of reporting impacts by meteoroids.

ment's oxygen-enriched atmosphere. And meteoroid-caused "spalling"—ejection of flying fragments of a spacecraft's interior wall surface—can form secondary projectiles endangering the crew and vital parts of their craft's equipment. Determined and costly efforts have therefore been made by NASA to appraise the meteoroid hazard.

Before the Space Age, optical observation of shooting stars had yielded considerable data on the abundance of meteoroids, and radar observation later added more. But these methods detected meteoroids no smaller than about a thousandth of a gram.

Close-range studies. Beginning with Explorer I, the first U.S. satellite, space probes were equipped with microphonic and electrical devices to record the impact of meteoric dust. Particles as small as a million-millionth ($1/1,000,000,000,000$) of a gram were detectable. But the collecting devices offered a target area of only a few square inches—rarely hit by meteoroids big enough to interest space-vehicle designers.

The Pegasus project's aim was to fill the void of data on meteoroids weighing between about a thousandth and a 10-millionth of a gram. For launching the big 33,000-pound Pegasus satellites, the Saturn

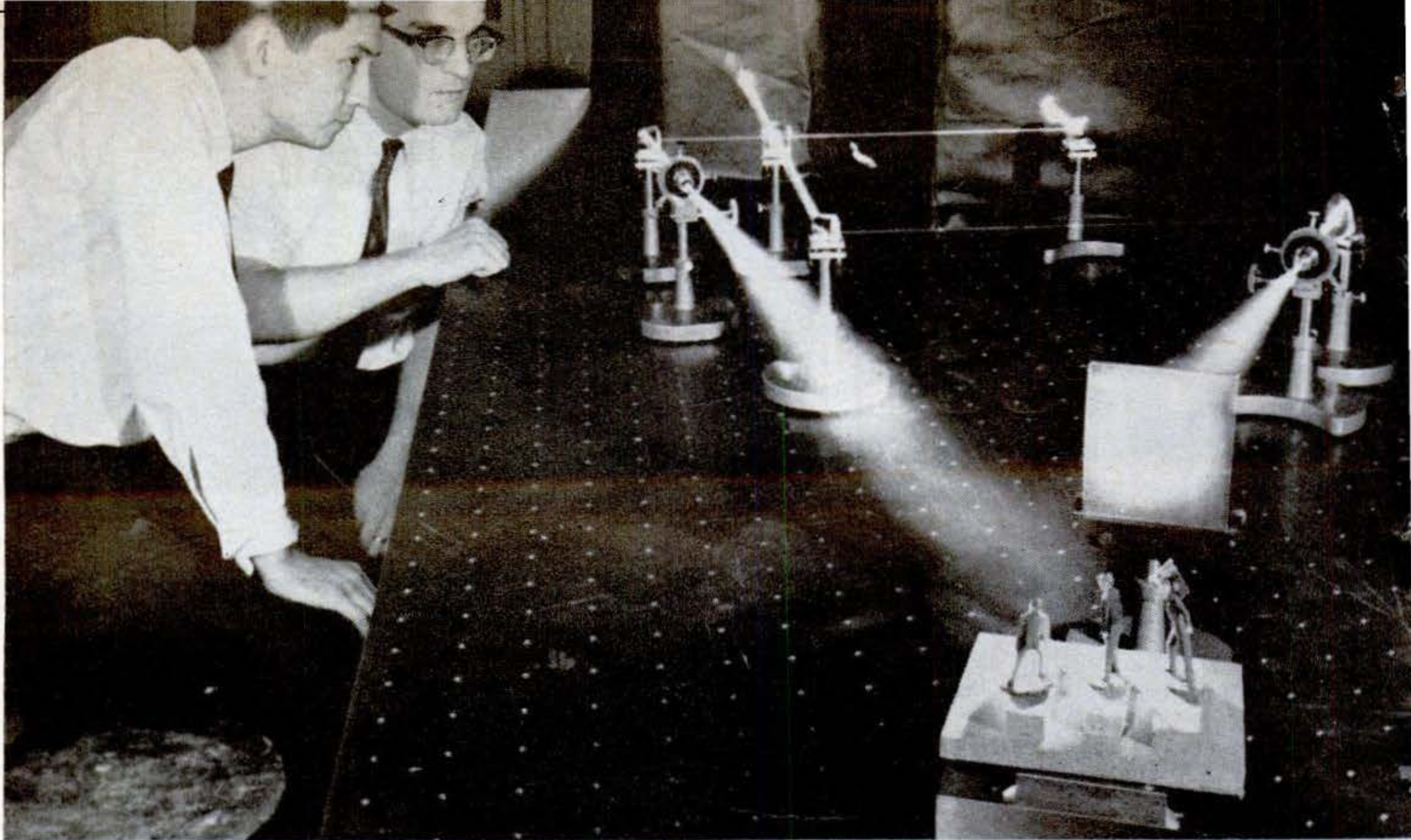
I rocket proved well suited. NASA's Marshall Space Flight Center, responsible for developing Saturn I, was also placed in charge of developing the Pegasus spacecraft.

A target as big as a house. The wings of a Pegasus, which unfold in orbit, are covered on both sides with aluminum plates that serve as targets for meteoroids. This provides a total collecting surface of more than 2,000 square feet—the floor area of a large one-family house. Most of the aluminum plates are $1/60$ of an inch thick. Others have a thickness of $1/120$ of an inch; a few, of $1/600$ of an inch. This enables a Pegasus to register meteoroids of three different degrees of penetrating power.

Pegasus has an electronic system whose main function is to say "ouch" every time a hit occurs—and say it in such a way that the signal received on the ground can be intelligently interpreted. Beneath each aluminum plate is a film of plastic, coated on the other side with copper. This aluminum-plastic-copper sandwich, forming an electric capacitor, is charged to 40 volts.

Each time a meteoroid punctures the aluminum, material vaporized by the impact momentarily short-circuits the ca-

[Continued on page 177]

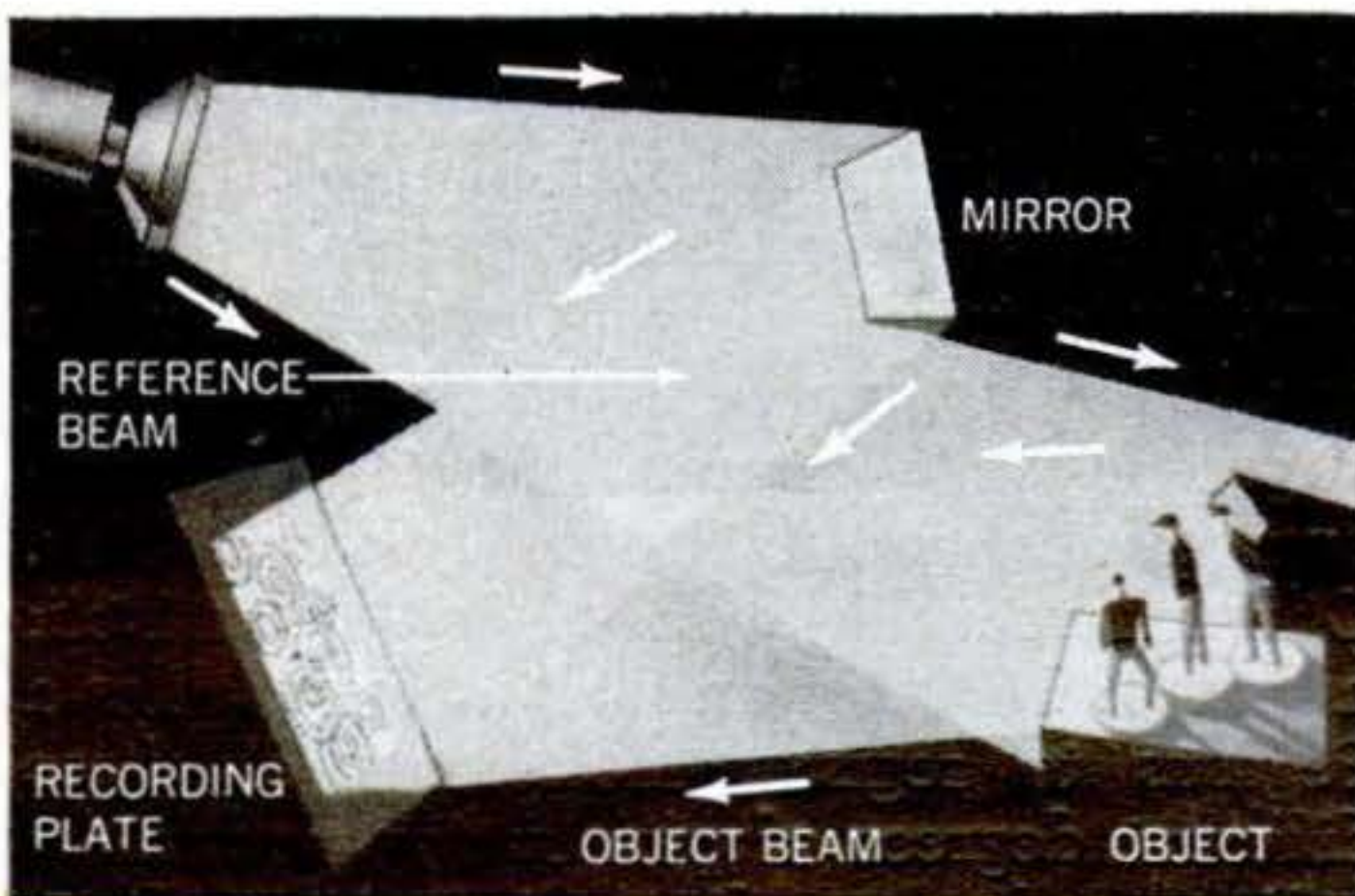


Breakthrough: Bell Labs scientists make one of first two-color holograms using red and blue lasers.

One part of the combined beam shines on the figures while the other part shines directly on plate.

THOSE INCREDIBLE HOLOGRAMS Amazing "Frozen Light Waves"

By C. P. GILMORE



Holography: 3D photography without lenses

Basically, a hologram is made by splitting a laser beam into two parts. One is reflected from a mirror (reference beam), while the other is reflected from the object photographed (object beam). Interference between the two creates a pattern that is photographically recorded, and that can be used to create a replica of the object.

In a laboratory at the University of Michigan's Institute of Science and Technology, research scientist Adam Kozma handed me a 10-inch-square piece of glass mounted in a black wooden frame. It looked like a dirty windowpane—about as fascinating as a snowball to an Eskimo. Yet the grayish square may contain the most remarkable image since photography itself was invented more than a century ago.

Kozma stood the glass on a pedestal in the middle of the laboratory, turned off the lights, and switched on a laser at one end of the room. A brilliant ruby ray stabbed across the darkness and through a lens that spread its pencil-thin shaft into a cone of light. The cone bathed the back of the "windowpane."

Suddenly, I was looking not at a piece of glass, but through a window into another



Emmett Leith, head of University of Michigan team that developed laser holograms, shows sample.

Viewer in the room could change angle and see all of the geometrical construction (shown at right).

Give First True 3D Pictures

world—one that hadn't been there a moment before. Directly ahead of me, perhaps three feet beyond the odd window, was a toy tank. Jutting into view on the right was a football-size three-dimensional geometrical figure that looked like a futuristic Tinker Toy.

"Get close and look to the right," said Kozma. I put my face near the glass and looked around. Far over to the right I could see the rest of the Tinker Toy not visible from my original position. Beyond that was a model carriage, drawn by four small horses.

The weird world behind the glass was totally three-dimensional—as solid looking as though it had been carved in stone. The 3D movies and stereo slides that have been around for years give an illusion of depth, but viewpoint is fixed. You can't look around objects.

The scene in the Michigan lab was *real* 3D—without special glasses. By lifting my head, I could look down on the top of the

tank's turret; when I stooped, I was on eye level with the treads. I could move my head and look around things. And the closer I got to the window, the wider my field of view became, just as you can see more of the outside world by standing next to a window than you can from across the room.

3D movies and TV? The glass that created this startling illusion is the product of a bustling young science called holography, almost unknown two years ago, yet already promising a host of startling new developments. Among them: 3D movies and television so real the images seem alive, and a clutch of scientific gizmos useful in fields from fog dispersion and rainmaking to stress and vibration analysis.

Many technical difficulties must be overcome before some of the possibilities—especially movies and TV—become practical. But some holographic wonders—scientific instruments and special 3D advertising

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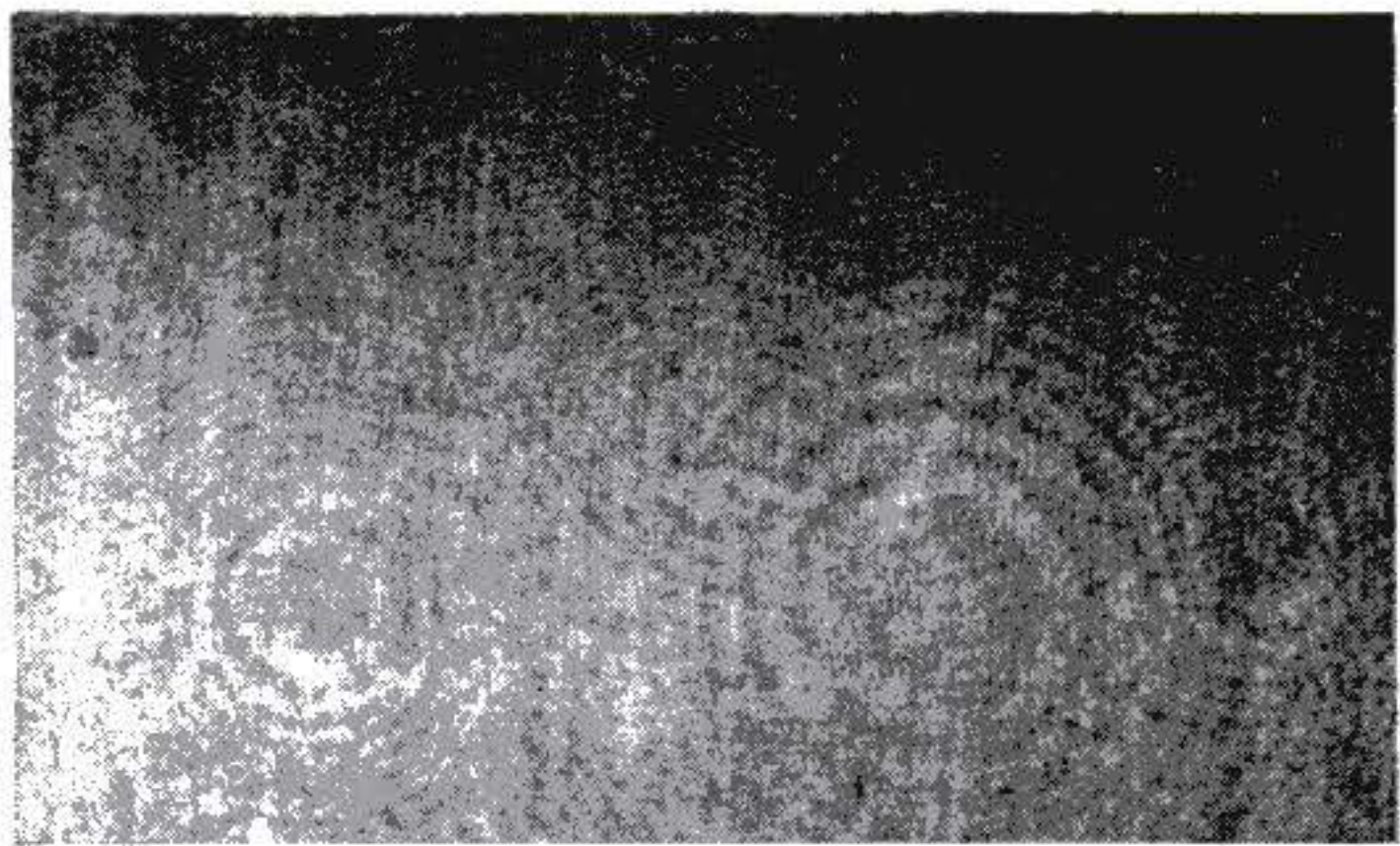
How holography freezes light to recreate a scene

A hologram records not an image, as does a conventional photo, but light waves. When the waves are released, they travel on, oblivious to elapsed time, and re-create the same image in the eye as the original scene.

Light waves to be recorded on a hologram have two important properties: brightness and phase. The film easily records brightness, but—like the human eye—is totally insensitive to phase. If two waves are marching along precisely in step, they are in phase. If totally out of step—the peak of one matching the valley of another—they are out of phase.

In any real scene, there are an extremely large number of light waves, and the phase relationships that exist between them are very complex. These phase relationships make up the wave front to be recorded.

Scientists solved the problem of recording phase by going back to a 150-year-old principle. The English scientist Thomas Young aimed a bright light at a screen through two pinholes. The beams went through the pin-



Holograms (magnified view at far right) look like this regardless of subject. Swirls are due to dust.

holes, then spread into overlapping cones of light. Where they overlapped, Young saw a pattern of alternating dark and light lines.

The lines were due to a phenomenon known as interference. Where the paths of the beams through the two pinholes were precisely the same length, the light arrived in phase—in step—and made a line (or fringe) twice as bright. At other points, where the light from one pinhole traveled over a shorter distance, the beams canceled each other, creating a dark fringe.

displays, for example—are here already.

If you haven't seen a hologram, it's hard to believe how realistic the images are. Imagine you're looking through a window. The light rays from all objects you see—a tree, the lawn, the fence, a parked car—are all pouring in through the glass to your eyes. As you move your head, you can change your perspective and see things from different angles. Move closer to the window and you can look out to left and right and see the entire yard.

Now suppose you were somehow able to freeze instantaneously all light rays coming in through the glass. Later, when you unfreeze or release them, they continue on their journey to your eye. You see exactly the same scene you were seeing before. You can move to look around objects or get closer and see a wider field of view.

Holograms work in precisely this way. They record not the image of the scene, as does a conventional photograph, but the light rays reflected from the scene. As a result, a hologram illuminated for viewing doesn't look like a picture, but like a window through which you see a real, three-dimensional world.

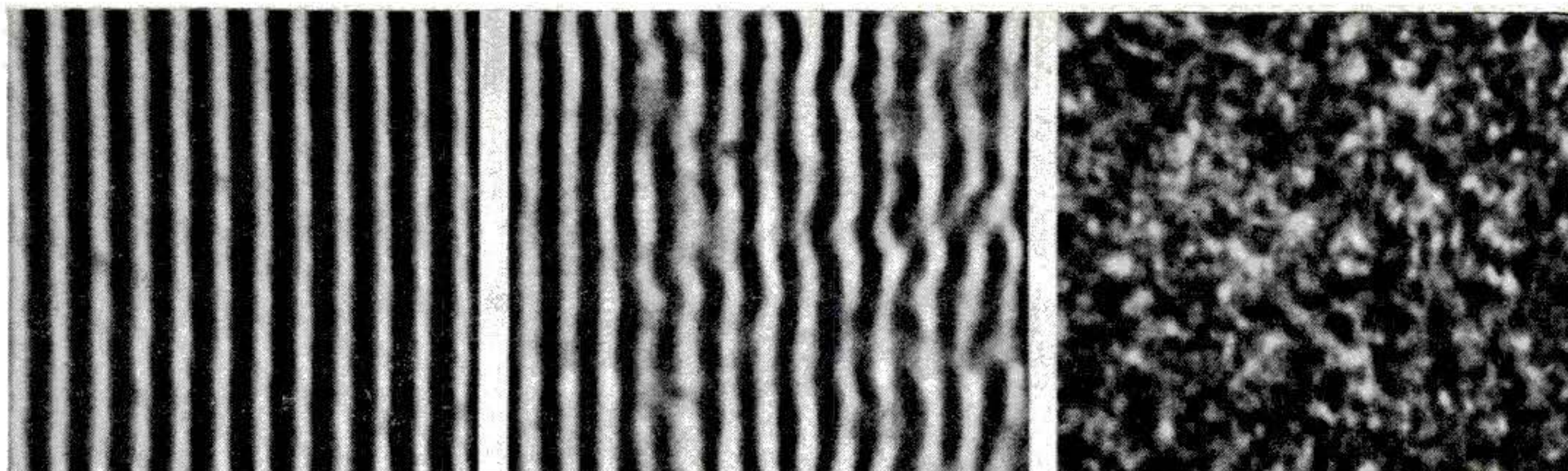
A holographic plate, which behaves in a

spectacularly different way from a regular photograph, is made in a completely different way, too. In standard photography—the kind you use to take Aunt Maude's snapshot—the photographer uses light rays from the sun, a flashbulb, or some other source. The rays hit Aunt Maude, bounce off, and pass through the lens of a camera. The lens focuses the rays into an image, which is recorded on film.

Using an optical trick. The holographer is not interested in recording an image, therefore he doesn't use a lens. What he wants is to record the total pattern of light waves hitting the film.

To begin with, the holographer uses not a flashbulb or the sun to light his subject, but a laser. The laser produces *coherent* light, in which the waves are all in step like a row of marching soldiers. He splits the laser beam into two parts. One, by means of mirrors, he sends directly to the film. This he calls the reference beam. The other hits the subject, as in regular photography, and bounces back to the film.

As the two beams converge on the film from different angles, they create what optical scientists call interference fringes. These fringes, so small they must be viewed



Distinct fringe pattern (enlarged) is hologram of mirror.

Mirror-like but irregular object creates the fringe pattern above.

Most magnified holograms of irregular objects look like this.

To create the sharpest interference pattern, light should be "coherent"; that is, all waves must be nearly in step. White or multicolored light, in which individual waves are badly out of step, tends to create so many fringes at so many places that they wash each other out.

To get light to record both its brightness and phase on a hologram, scientists developed a variation of Young's technique. They divided the coherent, one-color light of a laser beam into two parts. One part illuminated the object to be photographed. The

other, the reference beam, went to the film.

This process sets up a complex interference pattern, which, although it appears meaningless, contains all the information needed to re-create the light waves from the object. When a coherent light is shown through the fringe pattern, the waves are refracted back into an exact replica of the waves that created the pattern in the first place—brightness, phase, and all. When the eye intercepts this re-created wave pattern, it sees a perfect replica of the object.

under a powerful microscope, look like a series of squiggly lines or irregular black and white splotches. But far from being as meaningless as they appear, they contain, in a kind of optical code, complete information about the light rays coming from the object being photographed—the direction, intensity, and phase or timing of every bit of light from every point on the object.

"Light waves recorded on a hologram are like scrambled eggs," says Paul Kirkpatrick, emeritus professor of physics at Stanford University, "and it's almost a law of nature that you can't unscramble eggs. Yet that's what we can do with a hologram. It's almost unbelievable."

The unscrambling comes when a laser's coherent beams are directed back through the developed hologram. These light waves "play back" the information recorded in the first place, re-creating in complete detail all the light rays that were present when the hologram was made. It is precisely as though the rays had been frozen in the photographic plate when the hologram was made, then released when the image is re-created. And the final images are formed not on film, as in a regular photograph, but in the eye, as when we look at an actual scene.

The "frozen light" pattern on a hologram not only creates realistic 3D images, it has other fantastic properties as well. In holography, for example, unlike conventional photography, light from every part of the scene being photographed falls on every part of the photographic film. The entire scene, consequently, is recorded everywhere on the film, but at the same time at no spot exclusively. This can be proved in a spectacular way. Cut the film in half and each half still contains the full scene. You're just peeking in through a smaller window. Cut it in half again and again; each time each piece shows everything. Eventually the scene loses sharpness, but by that time it's too small to see through conveniently.

Double images. A hologram is tricky in still another way. More than one image can be recorded on the same piece of film like so many double exposures. Then each can be viewed, alone and without interference from the others, by illuminating each one with a beam striking it at the proper angle. This, as will be seen later, may be of great importance.

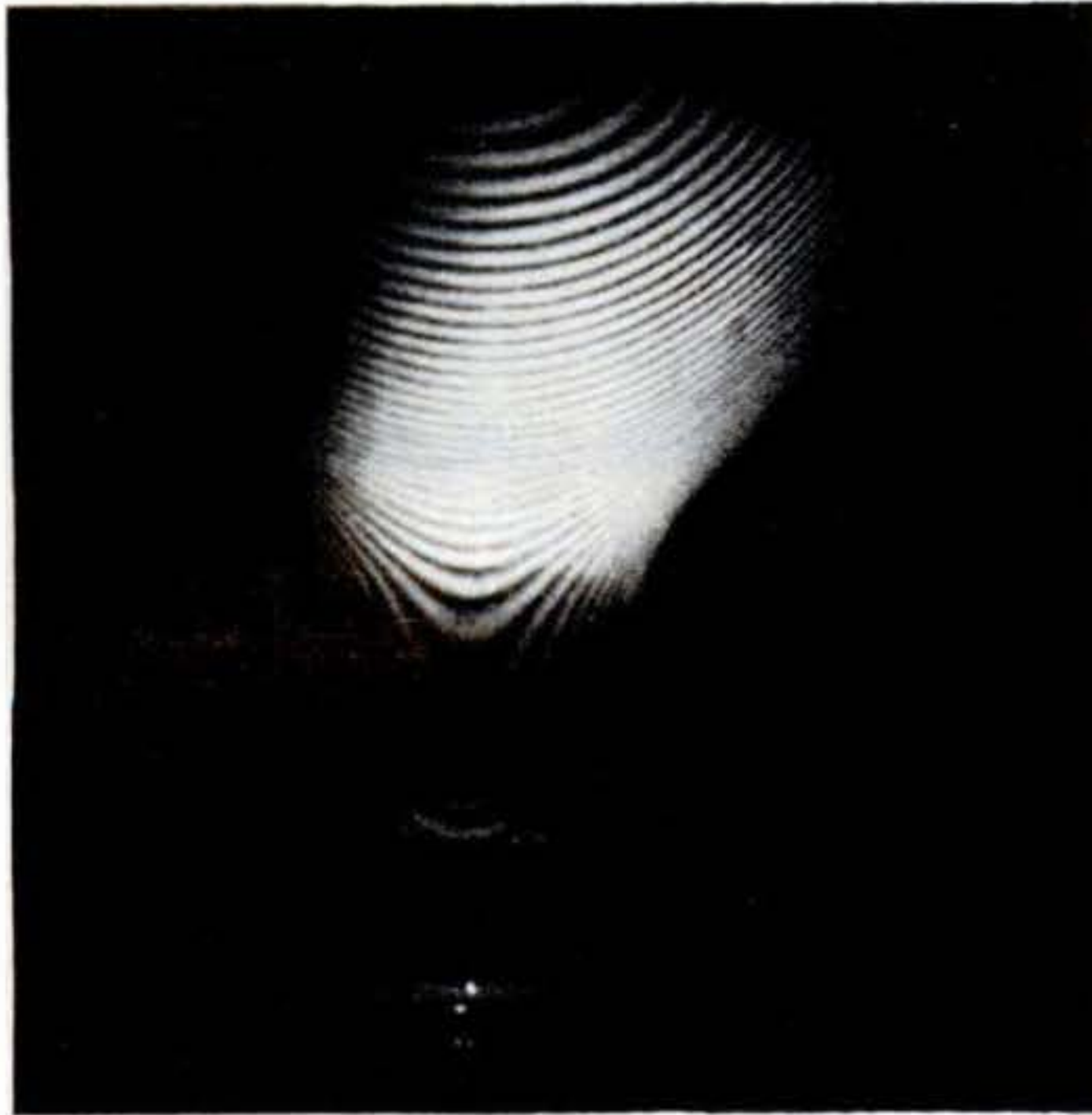
Holography, although it got into high gear just about a year ago, is not totally

Continued

Spectacular full-color holograms and 3D movies are next



Two conventional photos of a single reconstructed hologram show its true 3D nature. Focusing on the figurine of a girl in a rickshaw throws top of sign out of focus; focusing on sign defocuses rickshaw.



Contour map of light bulb is made by using laser emitting two closely spaced light frequencies resulting in interference pattern. Researchers say system could be used to make aerial maps automatically.

new. The idea was originated by an English physicist, Dr. Dennis Gabor, of London's Imperial College of Science and Technology, shortly after World War II. But there were no lasers, and no source of coherent light then available was good enough to make high-quality 3D holograms.

In the late 1950s, two scientists working on optical techniques at the University of Michigan, physicist Emmett Leith and electrical engineer Juris Upatnieks, improved on Gabor's technique of making two-dimensional holograms with available light sources. Then, in the 1960s, laser light was added to the list of improvements,

and the first realistic 3D holograms were made by a group working under Leith.

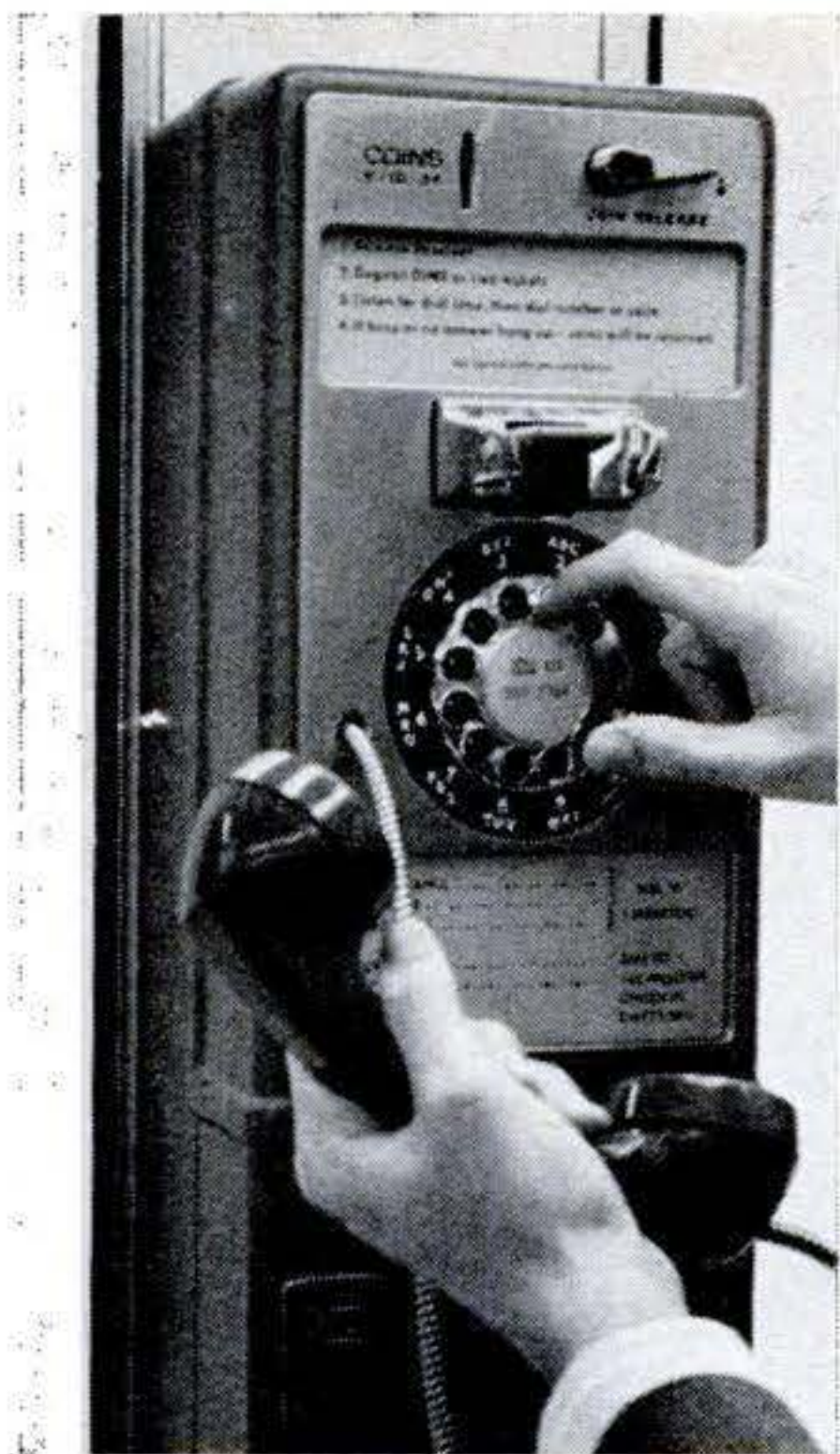
In the spring of 1964, Leith and his colleagues took some of their spectacular holograms to a Washington meeting of the Optical Society of America. The scientists attending were awestruck; many returned to their laboratories and began trying to duplicate and improve on the work of the Michigan team. In the two years since, nearly 100 new holography research projects have sprung up.

Most people find their first look at a hologram an astonishing encounter. "There's a characteristic delighted giggle that seems to go with the first experience," says Thomas Vogl, director of Westinghouse's hologram research program. Even scientists and engineers, who usually know that holograms exist, are fascinated. "Last year at the convention of the Institute of Electrical and Electronic Engineers in Washington," says an official of Conduccion Corp., a company involved in holographic work, "we had a hologram on display. Everybody spent his time looking at the hologram and ignoring the rest of our booth."

Multicolored images. Meanwhile, holographic scientists continue to improve their technique. Until recently, all holograms used a single color of light. If taken and reconstructed with a red laser, the image was red; a blue laser produced a blue hologram, and so on. Last year, two scientists at Bell Telephone Laboratories, Keith S. Pennington and Lawrence H. Lin, made a hologram using two lasers, one red, one blue. The result was a multicolored image. Since then, other workers have reproduced holographic images in full, natural color. Only the light is colored, incidentally. Even for full-color holograms, the interference patterns are recorded on black-and-white film.

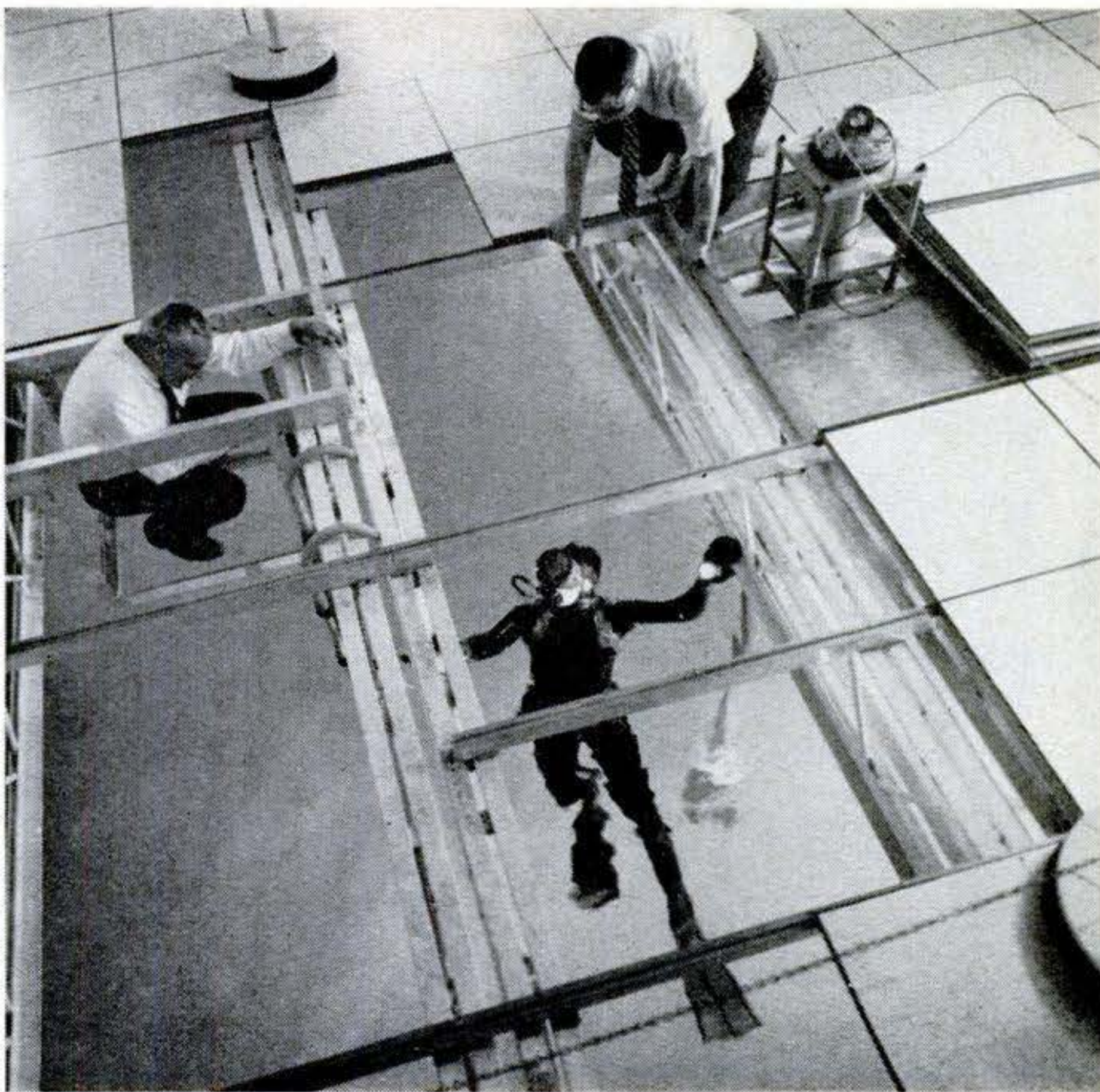
Before holograms can be widely used outside of the laboratory, ways must be found to eliminate the need for lasers—at least for the reconstruction. Lasers cost thousands of dollars each, and full-color holograms require several. Researchers at a number of institutions have taken the first steps in this direction by making holograms that can be viewed in white light. When they're made, light from each of the color lasers is aimed at the plate at a slightly different angle.

[Continued on page 174]



Single-slot pay phone

No more fumbling around to be sure your nickels and dimes go into the right coin slot when you telephone: Bell now makes pay phones with only one coin slot. Silent electronic signals, instead of gongs denoting the channels they slide down, let the operator know the number and type.



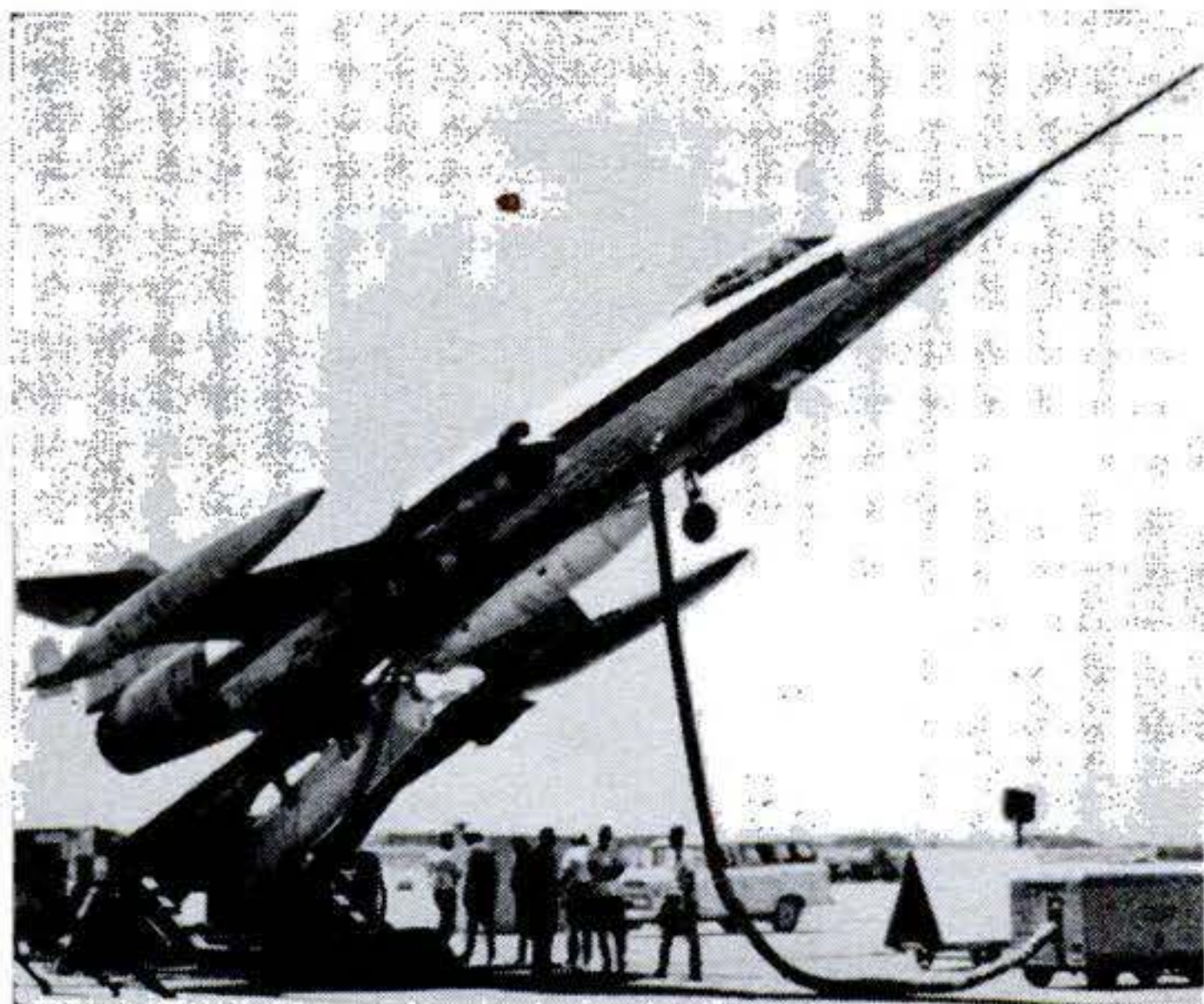
Scuba-garbed researchers swim under lab's floor

A 30-foot-deep water tank 30 feet in diameter lies below ground level under the basement floor of Westinghouse's research laboratories in Pittsburgh. Access is through removable sections of the floor. Scuba-diving scientists use it for research on sonar systems, underwater instruments, and the propagation of sound waves through the water.

Launch pad replaces runway for rocket-assist supersonic-jet takeoff

With a rocket booster under its fuselage, the Mach 2-plus F-104 Starfighter takes off below from a zero-length launch pad, or ZELL, without benefit of runway. Lockheed developed the technique for the West German Air Force,

which may use it to deploy Starfighters away from airfields to scattered clearings where there is less chance of discovery and attack. Rocket and cradle are jettisoned when the jet reaches sufficient speed and altitude.





Compressed-air sprayers. Air is pumped into these sprayers after they're filled. When pressure in the tank drops, you repeat the pumping. Because you mix chemical and water in the tank, you get accurate concentration. Spray is a fine mist, suitable for

low plants and shrubs (above, left), and lawns. You can get large- or small-capacity tanks; also a carrying strap. Don't use these sprayers on big trees, though. The man in the photo at right, above, is missing the high spots with this 15-foot-range sprayer.

Which Garden Sprayer

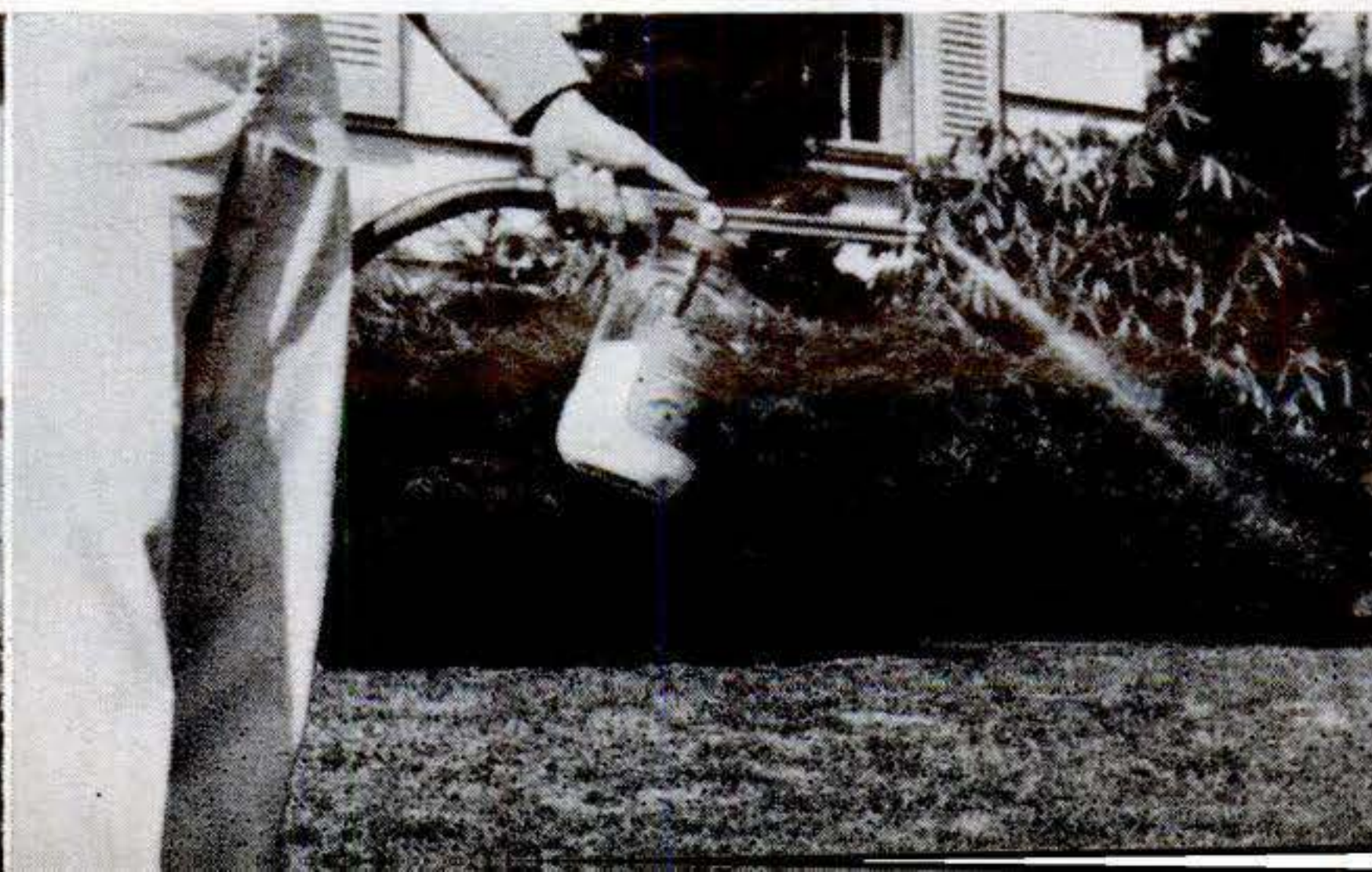
There's quite an array. You can pay from a dollar or so to \$200. Here's how to buy wisely

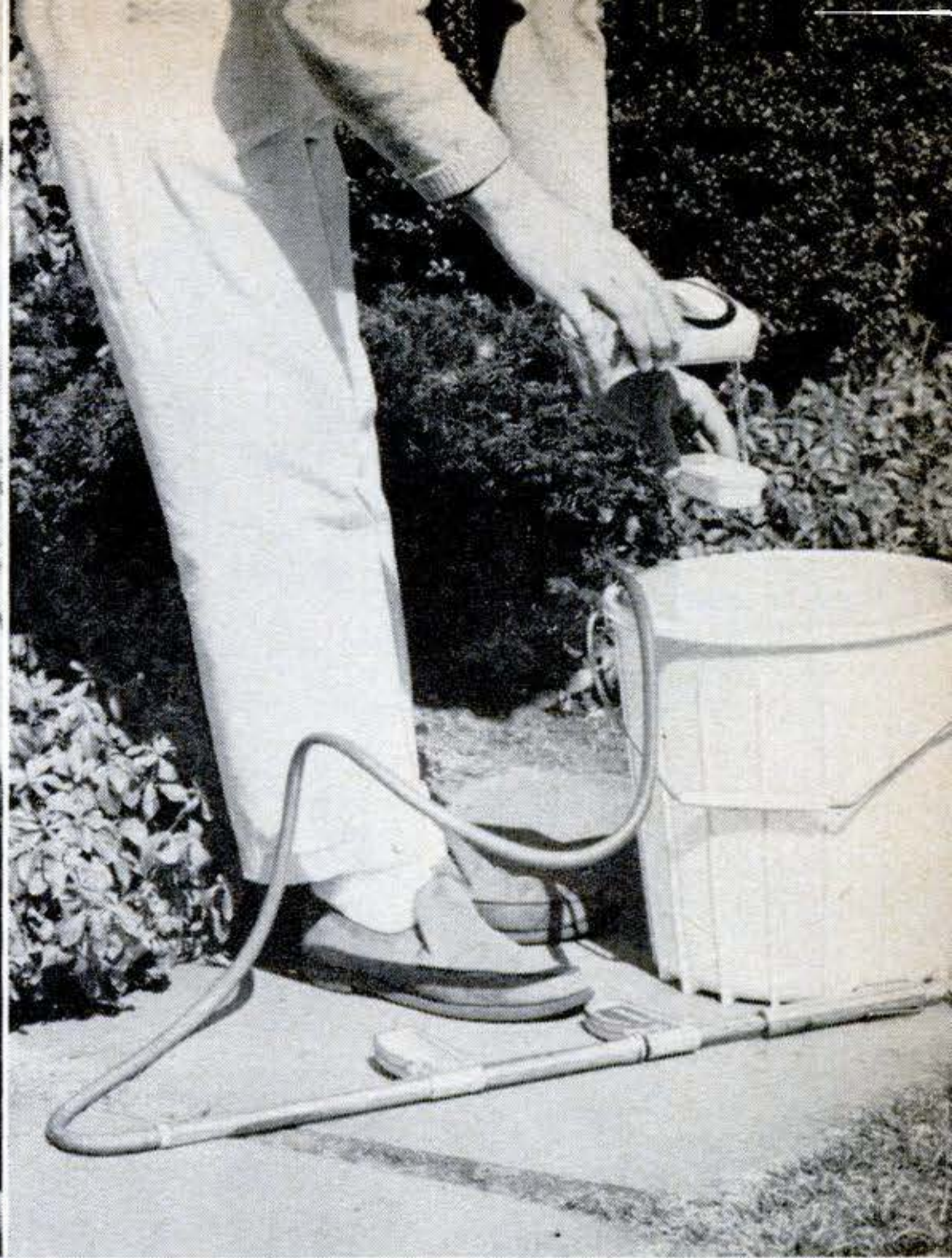
By **WILLIAM L. MEACHEM**

Hose-end sprayers. These use hose water to propel the spray, but you won't get consistent distance or concentration because water pressure varies. Some use straight-liquid concentrate (below, left); others require premixing of water and insecticide (right).

The big difference in garden sprayers is in the power that operates them. That's where the money difference comes in, too. For a small garden, you don't need high-powered sprayers—use hand-pumped ones, pressurized cans, or even your paint sprayer. If you have a large area to spray and sizable trees, don't waste money on equip-

A third type which attaches directly to insecticide can is precision-drilled for accurate concentration. A sprayer used with weed killer should be reserved for that purpose, never used for plant spraying. Check all hose-end sprayers for anti-backflow valve.





Slide-pump sprayers. Here's the right equipment for spraying small trees. The hand-pump (seen on ground, above at right) will give you the pressure and distance you need. For lawns, however, the bucket that holds the liquid hampers mobility,

making the sprayer difficult to use. A nozzle lets you adjust jet stream to fan spray for shrubs. You mix the chemicals in the bucket. Use a spoon or the cap of the can to measure chemicals and follow exactly directions on the label for best results.

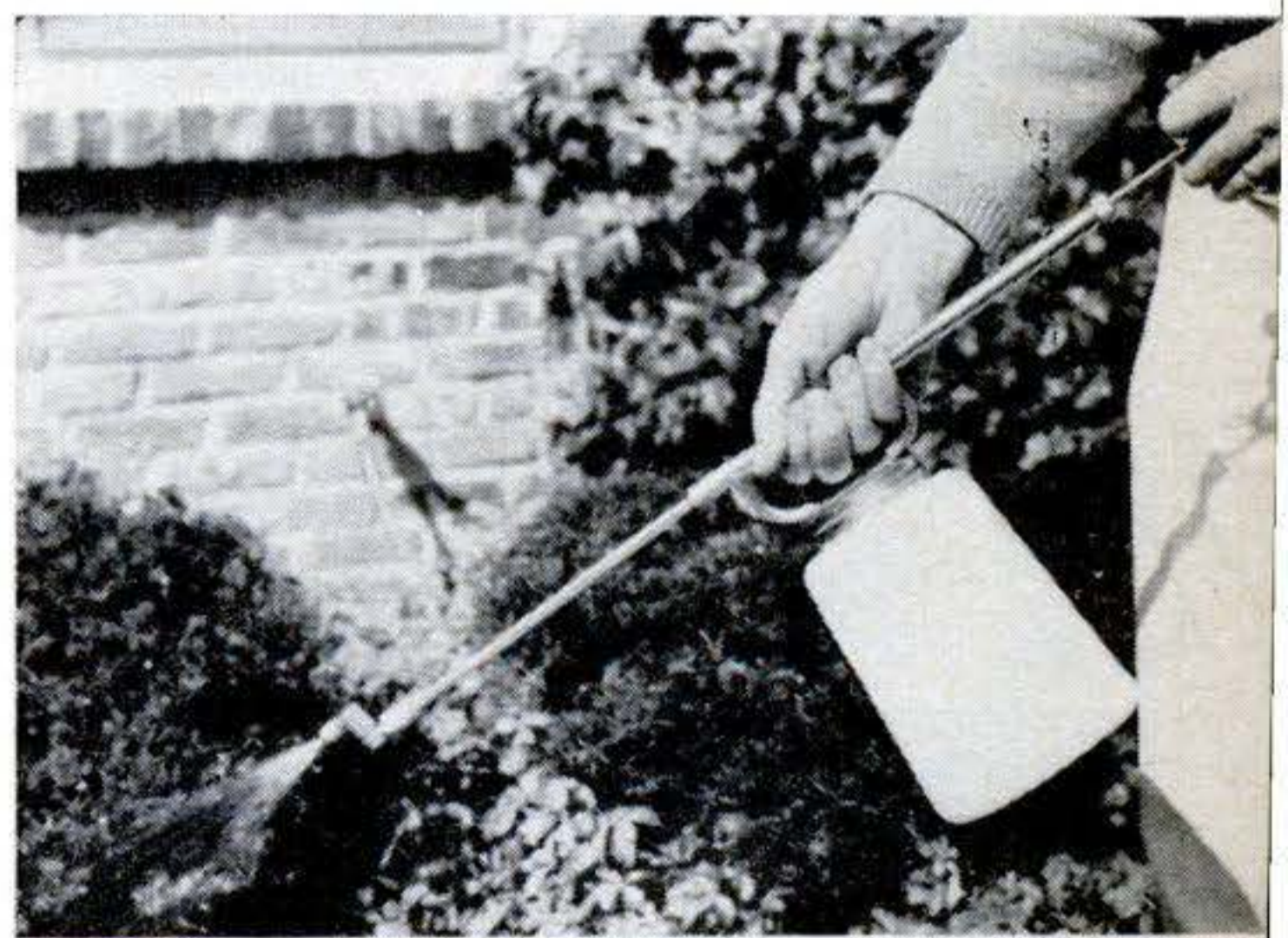
Should You Choose?

ment that hasn't the power and range to do an effective job.

Many kinds of sprayers—big and little—were tested by engineers of the Geigy Chemical Corp. Results showed that you can combine mobility with moderate capacity in hand-pumped compressed-air models and water-powered garden-hose sprayers. Pressurized cans and hand-pumped sprayers will do spot jobs on localized infestations. Whichever sprayer is best for your garden, remember that accurate mixing of the chemicals is as important as equipment. And measure carefully. If any insecticide gets on your skin, wash it off right away.

Hand sprayers. Slide-action model (upper right) gives good pressure for treating low plants. It sprays in fan or jet stream. Hand-pump sprayer (lower right) is useful on localized plant infestations.

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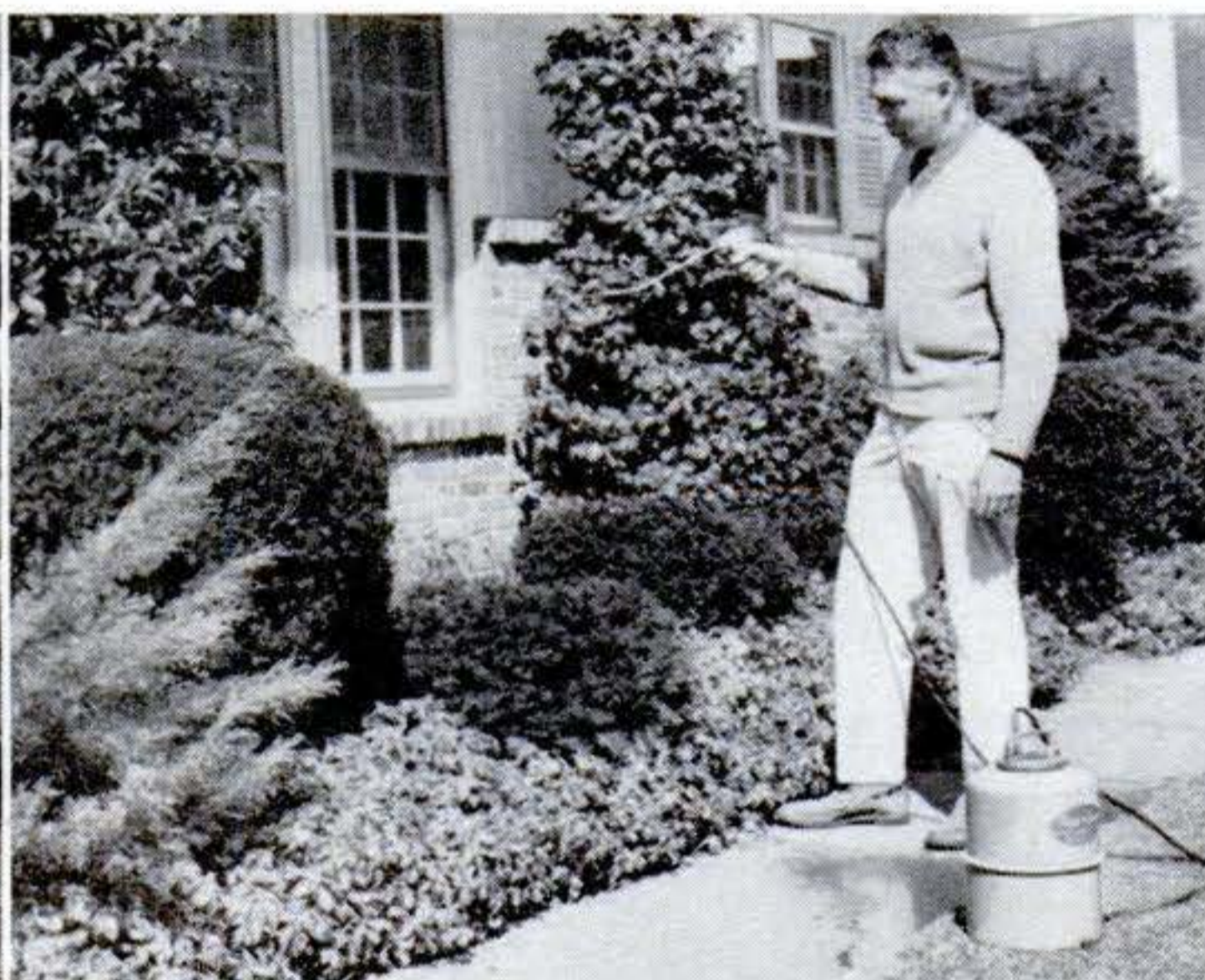


Sprayers come big and small—pick one to fit the job

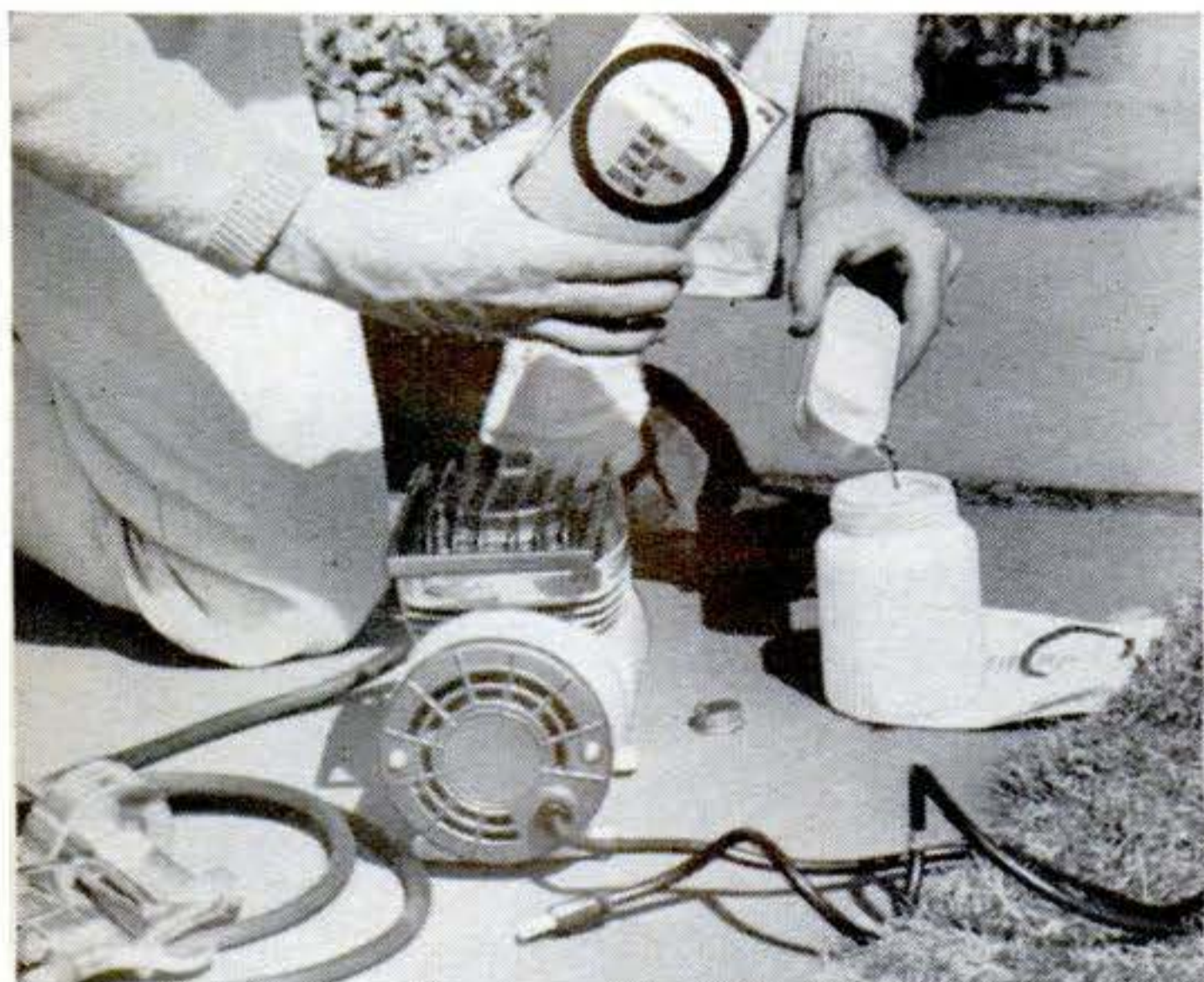
Power sprayers. Run by a gasoline or electric motor, these are an expensive investment few want to make. But for big jobs once or twice a year, you may be able to rent one. They do all spraying, from flowers to trees.



Knapsack sprayers. Here's mobility and a drenching spray for lawns and plants. You pump as you spray, and you'll need a strong back for a full tank.



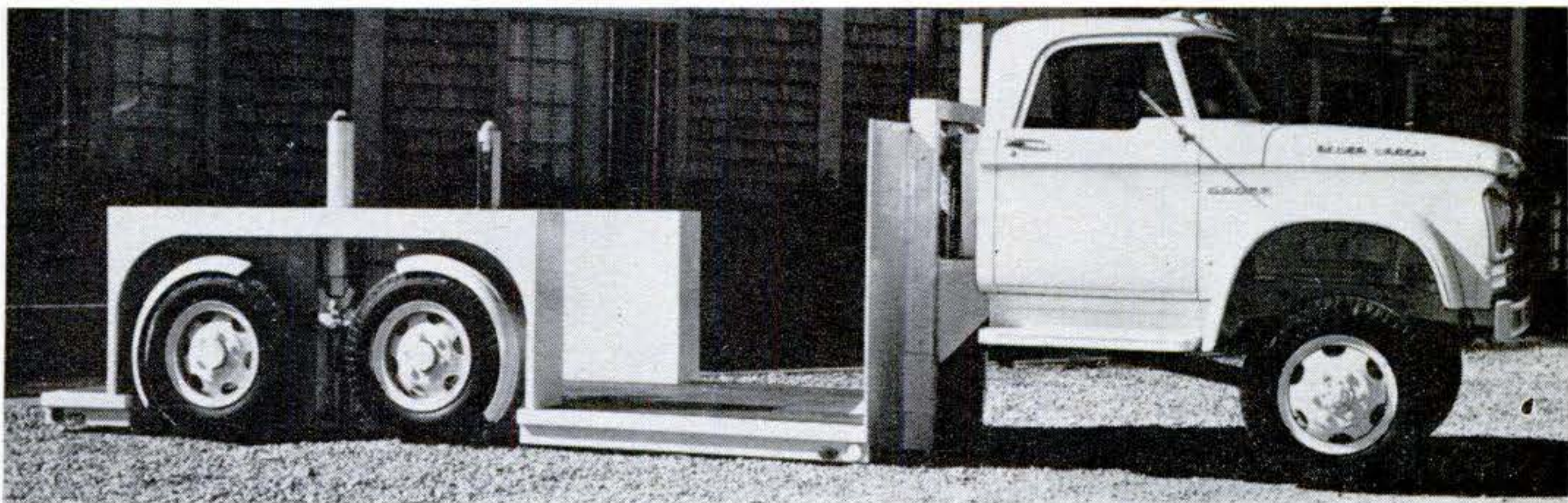
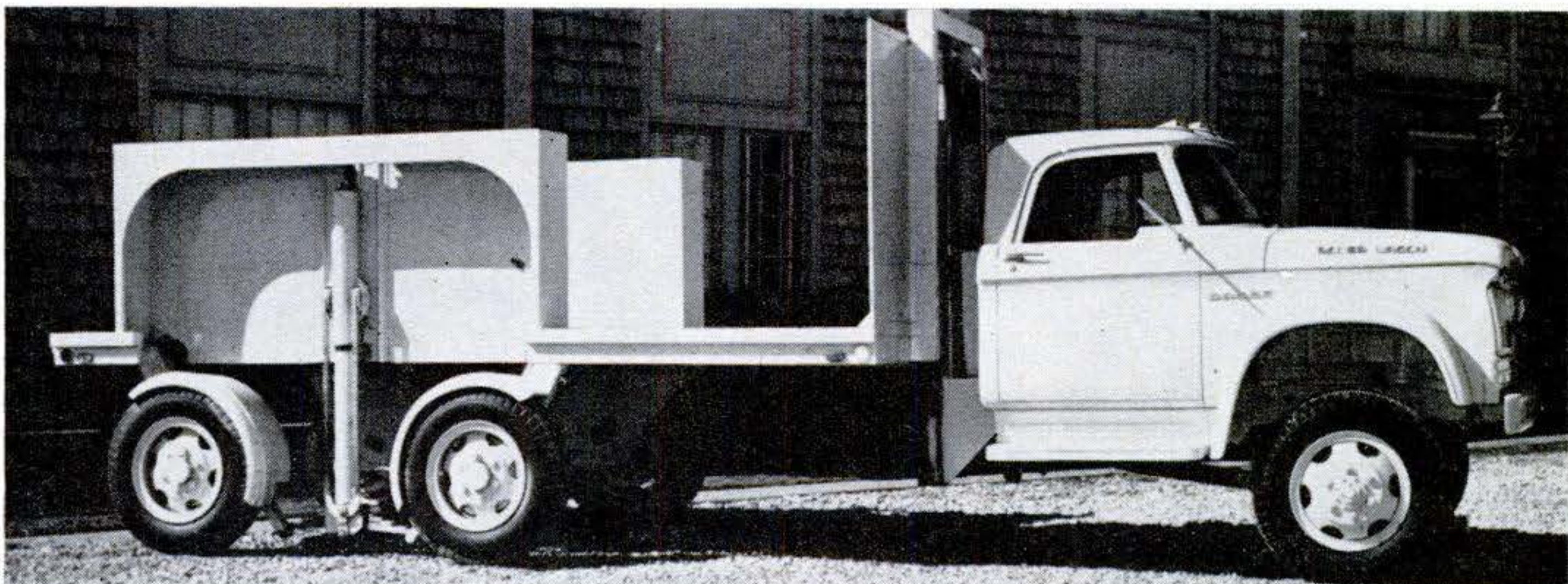
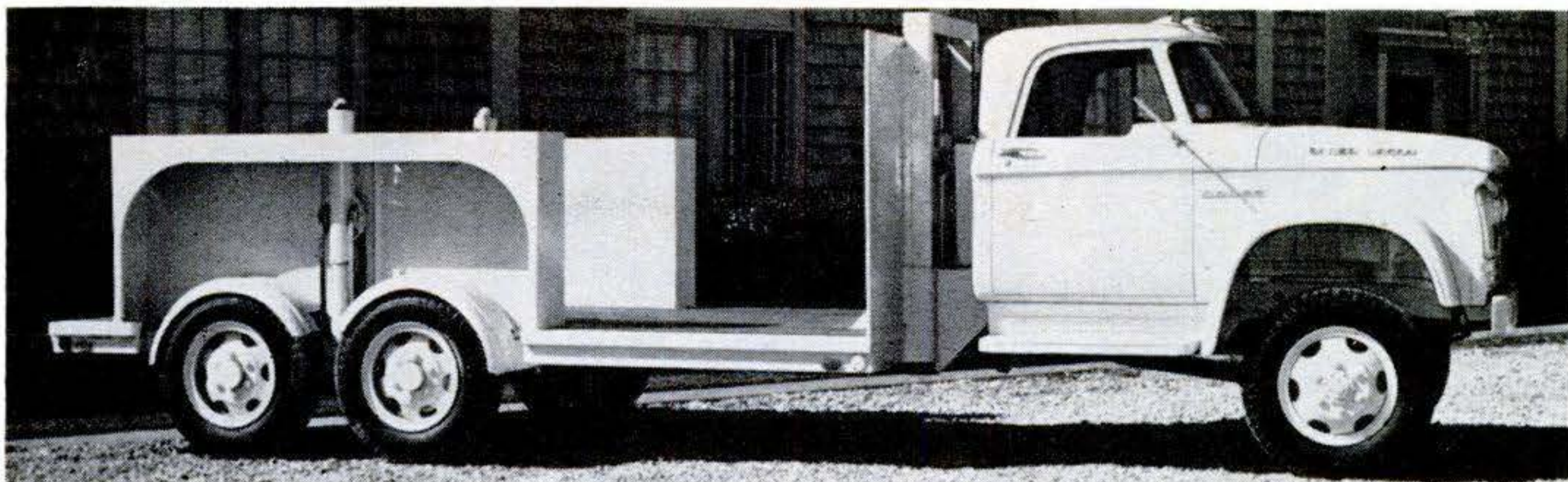
Hose-tank sprayer. This one-of-a-kind sprayer uses water pressure to propel the spray—there's no pumping to do. Hose water has no contact with chemicals.



Paint sprayers. Those with compressors will work in a garden, but chemicals must be fully diluted. They give a fine mist, so don't use one on windy day.



Pressurized cans. They offer ready-mixed pushbutton convenience for spot application. Keep can 18" from foliage so propellant gas won't injure leaves. **PS**



Variable-height truck bed levels with ground or rises to dock

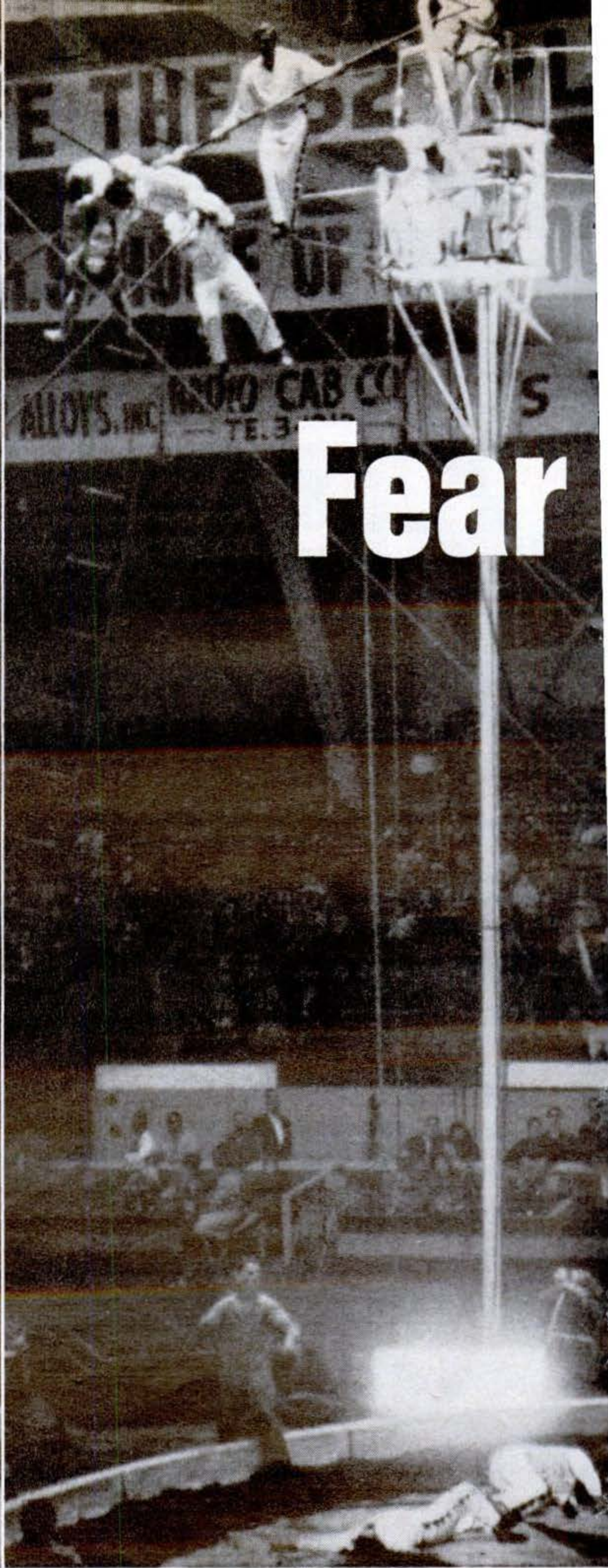
Hydraulic jacks in this new four-wheel-drive Hi-Lo Dodge truck lower its bed to the ground or raise it as high as four feet for pushing cargo on directly from a dock. The sequence of photos shows the bed at 25-inch running level,

raised to full 48-inch height, and lowered to the ground. The bed also tilts forward, backward, or to either side for leveling with the dock or curb. Optional are van and special bodies, detachable top and side curtains.

Land scooter takes to water

With floats like water skis mounted at both sides, a standard Lambretta land scooter has been converted to amphibious use for a demonstration at Portsmouth, England. A propeller attached to its rear wheel pushes it at speeds up to 11 m.p.h. on water with a passenger in addition to the rider. The propeller is said not to interfere with road travel.





Fear

Tragedy—worst ever for U.S. circus performers—strikes The Great Wallendas

The inimitable human pyramid of The Great Wallendas collapses over the center ring of the Detroit Shrine Circus. Two of the aerialists tumble toward the floor (left) as the others desperately cling to cable. Circus workers (right) go to aid of fallen performers.

Every time these daredevils
step out under the Big Top,
they stake their lives on
the skill of their riggers

By BILL BALLANTINE



Karl Wallenda (left) and author Bill Ballantine.

on the High Wire

There were no nets under the slanting walk-up cable as The Great Murillo started his ascent to the high wire at the annual Shrine Circus in Detroit's State Fair Coliseum last February. "This separates the boys from the men," he claimed.

Using only his outstretched arms and hands to maintain his equilibrium—for the 32-year-old Chilean aerialist also disdained balancing poles—Luis Murillo climbed slowly up the 45-degree slanting wire. When he reached 38 feet, Murillo suddenly lost his footing and plunged to the sawdust-covered concrete floor. The audience looked on in horror as an animal act was hurriedly brought on to hide the seriously injured performer from view.

While the public is appalled by such disasters, hardened circus veterans regard these grim matters calmly. To them, performing is not a courtship of death, but of the audience. "The public pays to see the aerialist do his job. If you fall, you fall," they say. Such hardboiled fatalism doesn't rule out fear. Well disguised by spangled bravado, there is always a degree of fear on the high wire.

Karl Wallenda, who brought Luis Murillo to this country to work in his troupe—America's best-known high-wire walkers—says, "We never want anybody up there with us who is not afraid. Whenever you get too cocky, that's when you fall."

Karl knows whereof he speaks. His troupe was almost annihilated in 1962, ironically in the same arena, because one

of its members had so little respect for danger. On that night, The Great Wallendas, the most ambitious of all multiple wire-walking constructions—an inimitable three-high, seven-people pyramid—suddenly came apart over the center ring of the arena. The fall was the worst tragedy to happen to performers in American circus history. Two young men were killed; another, Karl's son, Mario, was permanently crippled; two others were hospitalized.

Tragedy in the making. The Wallendas' pyramid actually was more of a triangle. Its base rested lengthwise on the wire, and the apex was made by a girl (called the top-mounter) seated on a chair that was balanced on a long metal bar fitted with double crook ends, which rested snugly on the shoulders of two men below. They each stood on a similar bar, yoked in the same way between each pair of four men who stood on the wire itself—in circus parlance, under-standers.

The front under-stander, an inexperienced German youth named Dieter Schepp, who was killed, let go when the troupe was two-thirds across the wire. He dropped his pole and tumbled after it, dragging two other under-standers with him 40 feet to the floor. The others managed to grab and clutch the wire, until they were helped to safety.

Schepp had felt only contempt for the high wire and never took its dangers seriously. When the going got rough that fate-

Continued

“If you put a net under me,” says high-wire man Luis Murillo, “there is no more act”

ful night, his cockiness and resentment were no help to anybody. Schepp somehow expected the others to bail him out, even though he'd been told they would all go, if one went. A solo performer has an advantage over a group. He doesn't have to worry about being hit by other bodies.

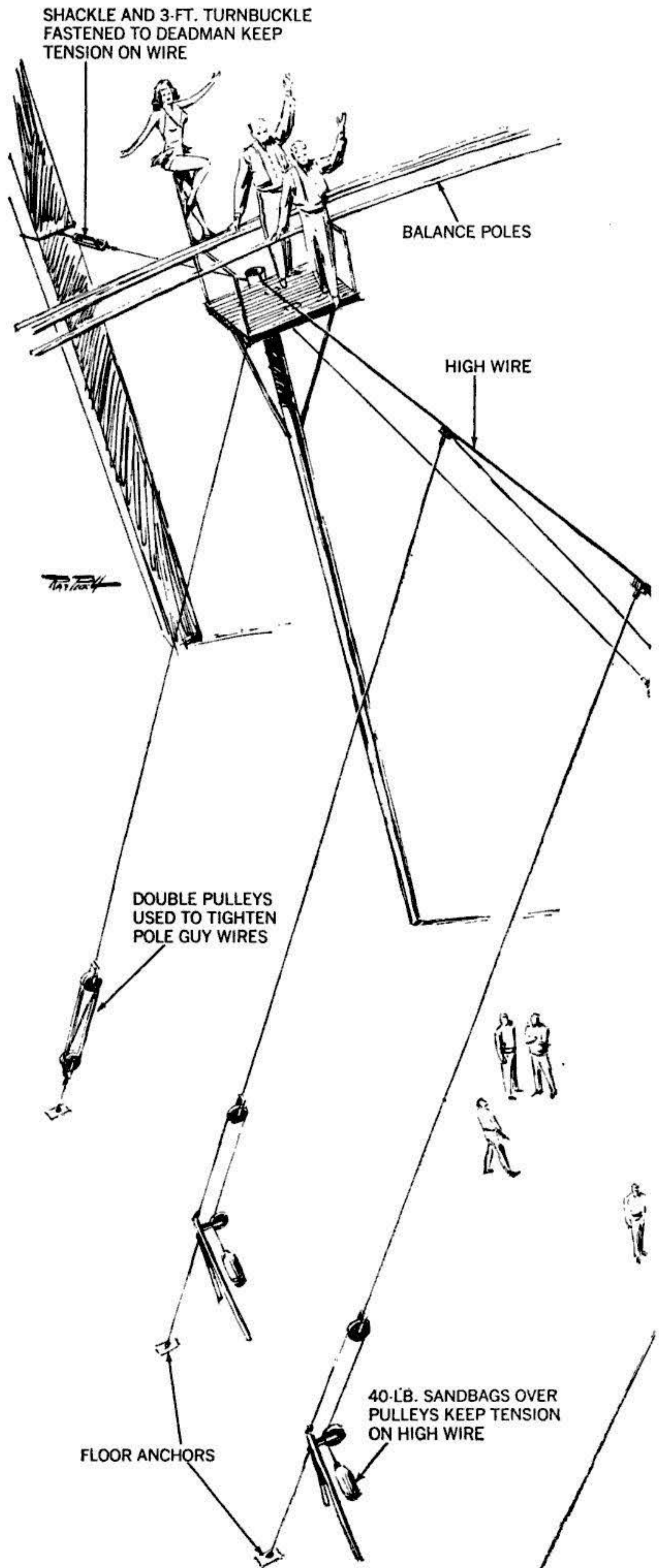
The prime rule of a falling aerialist is to snatch a wire, if possible—or just tuck in your chin, fold your arms across the chest, and land on your shoulder blades.

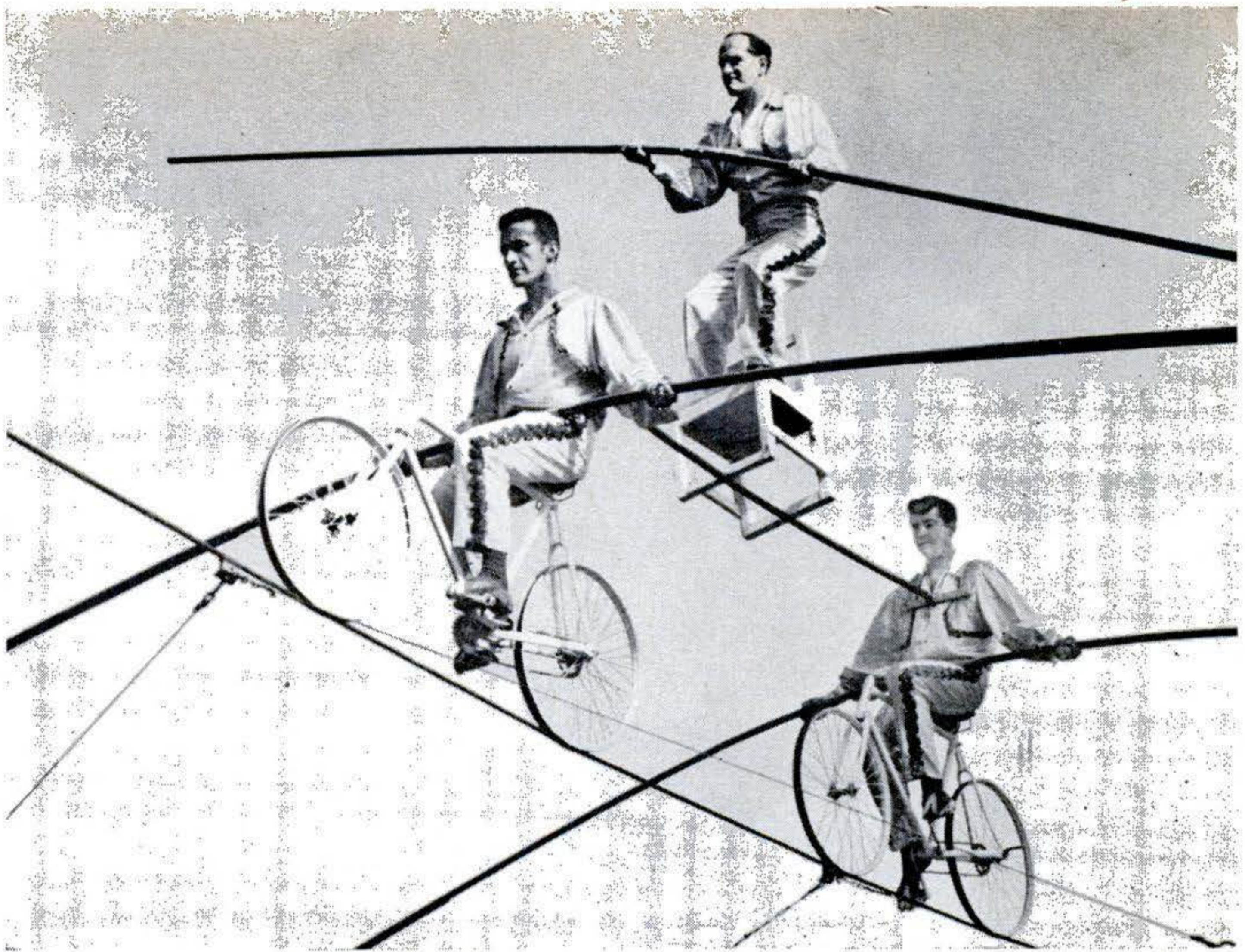
Because their lives depend on it, rigging is a matter of great concern to high-wire performers. But setting up the equipment is a job for the circus riggers, and the performer must trust them and limit his part of the work to checking stress points after it is up. Often there is not even time to make a practice run on the high wire to check it out before a performance.

The rigging. The standard high-wire rig consists of two uprights—usually of hollow aluminum tubing—about six inches in diameter and 35 feet high. These rest on heavy metal blocks that are chained to the ground. Each pole is topped by a small platform, and a 48-foot, $\frac{3}{8}$ -inch steel cable is stretched between the uprights. Separate cables guy this to the ground and equalize tension. Cables also stretch from the poles to a deadman—an immovable anchorage.

Karl Wallenda says, “We're as careful as possible with our rigging, but one little sway can bring us all down.” Wallenda has fallen twice from a height of 40 feet to a wooden floor. But it doesn't stop him from performing. Now 61, Wallenda, with his reduced troupe of four wire walkers, performed all this season at Shrine circuses around the country.

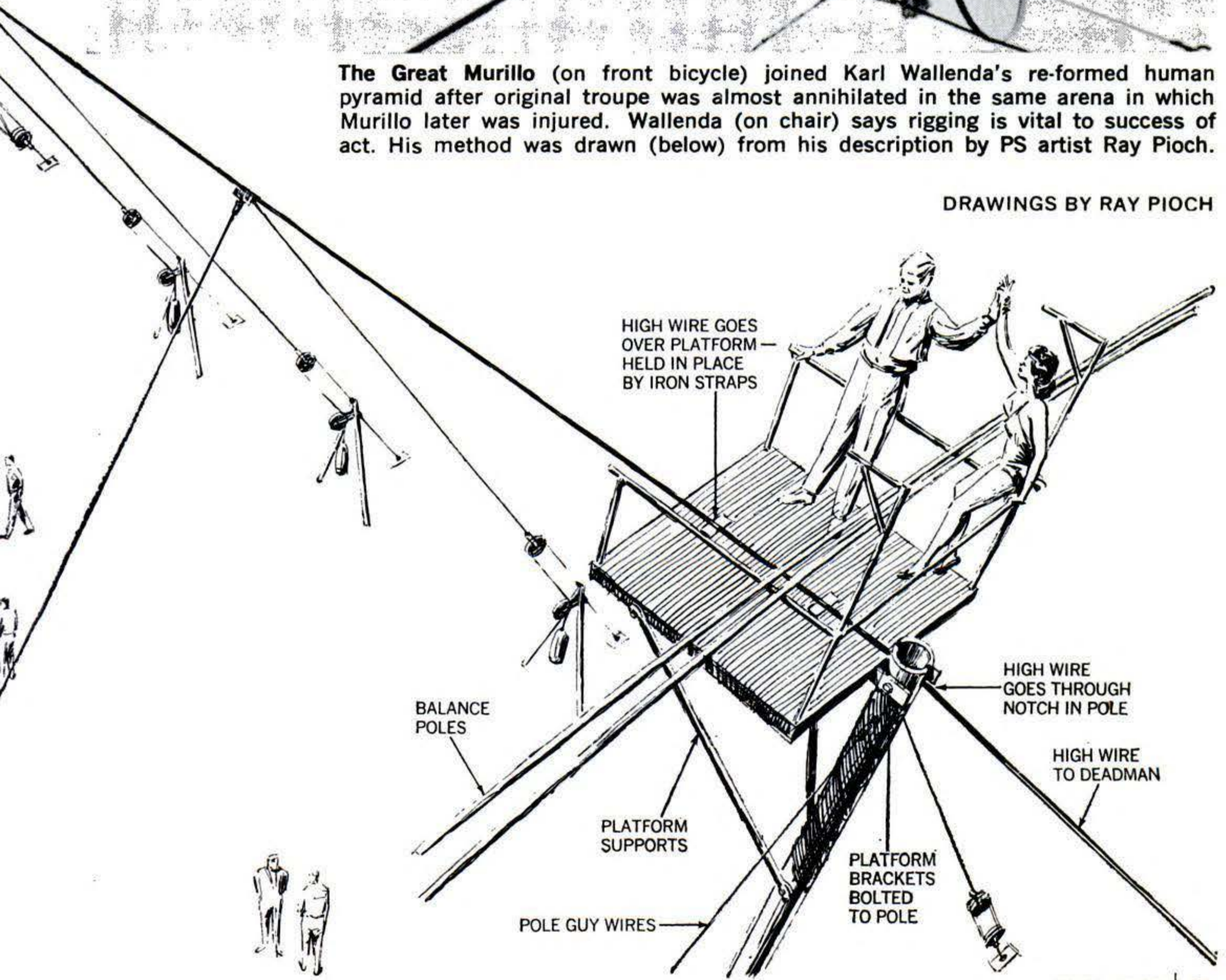
Even Luis Murillo, who hovered near death for four days and spent over two months in a hospital, is now planning to resume his act—without nets. He told Alexander Drobitch, his producer, “If you put a net under me, there is no more act.” Drobitch says it's this threat of death or serious injury that gives high-wire acts their appeal. “After Murillo's accident, we broke all attendance records in Detroit. It's what the public wants.”





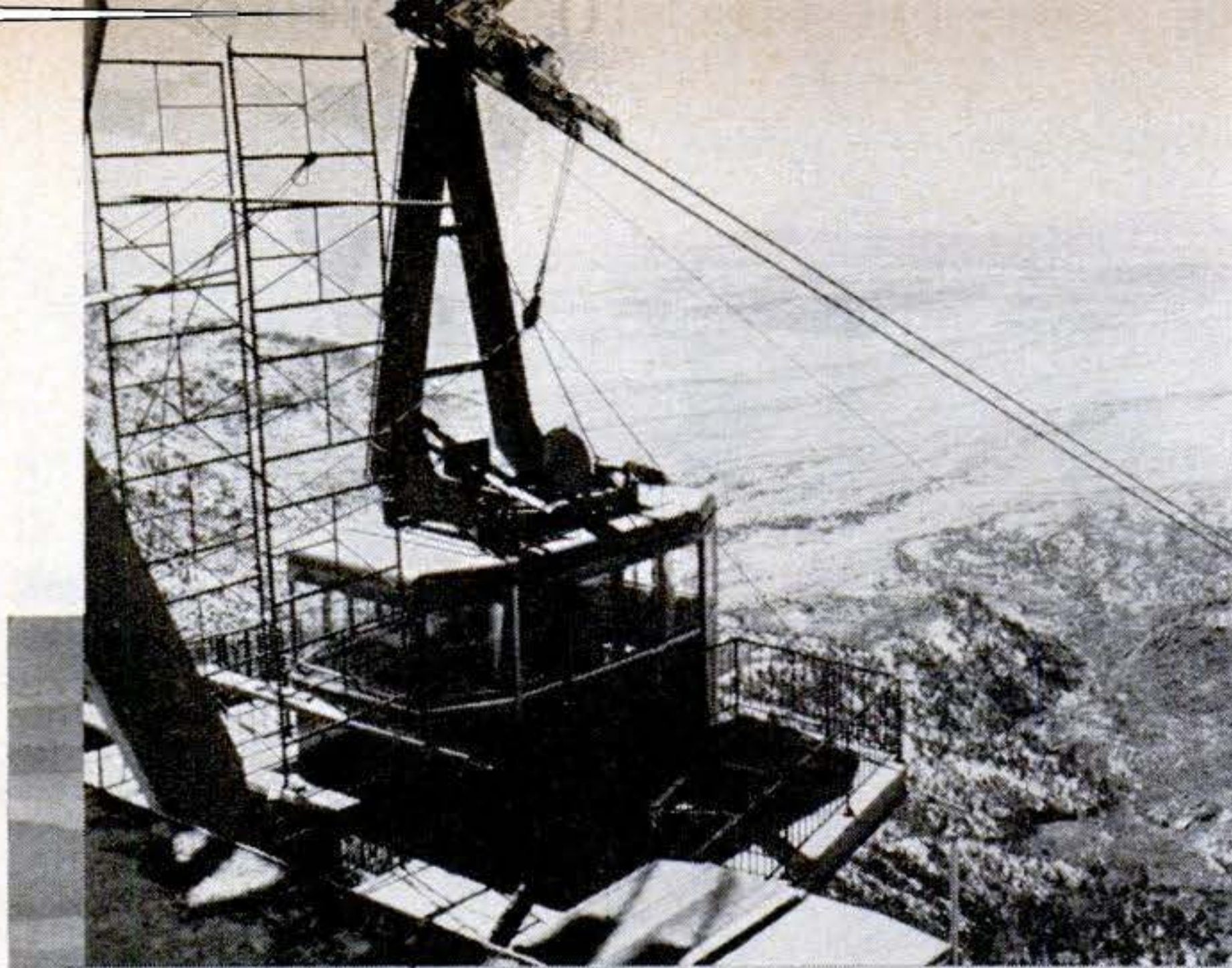
The Great Murillo (on front bicycle) joined Karl Wallenda's re-formed human pyramid after original troupe was almost annihilated in the same arena in which Murillo later was injured. Wallenda (on chair) says rigging is vital to success of act. His method was drawn (below) from his description by PS artist Ray Pioch.

DRAWINGS BY RAY PIOCH



World's

Sky cars give passengers



At top, view takes in 11,000 square miles. Car, pictured during construction, awaits hauling cable.



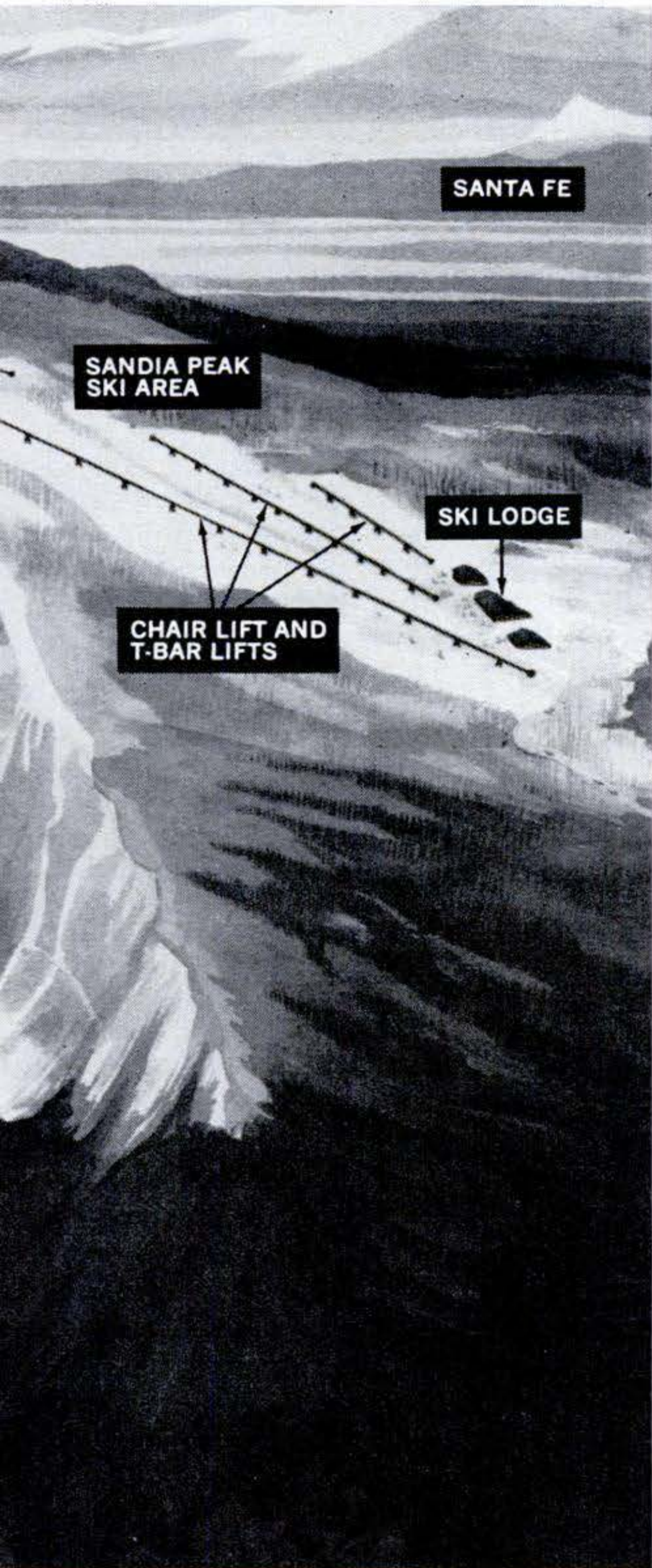
Sixty-passenger cable cars give a thrilling 10-minute sky ride to a ski playground atop a scenic mountain, on the newly opened Sandia Peak Aerial Tramway in New Mexico. At its upper terminal, a restaurant-and-lounge building commands a breathtaking full-circle view of 11,000 square miles.

The 2.7-mile line sets a world record in length for one of its "jigback" type—a two-car tramway on

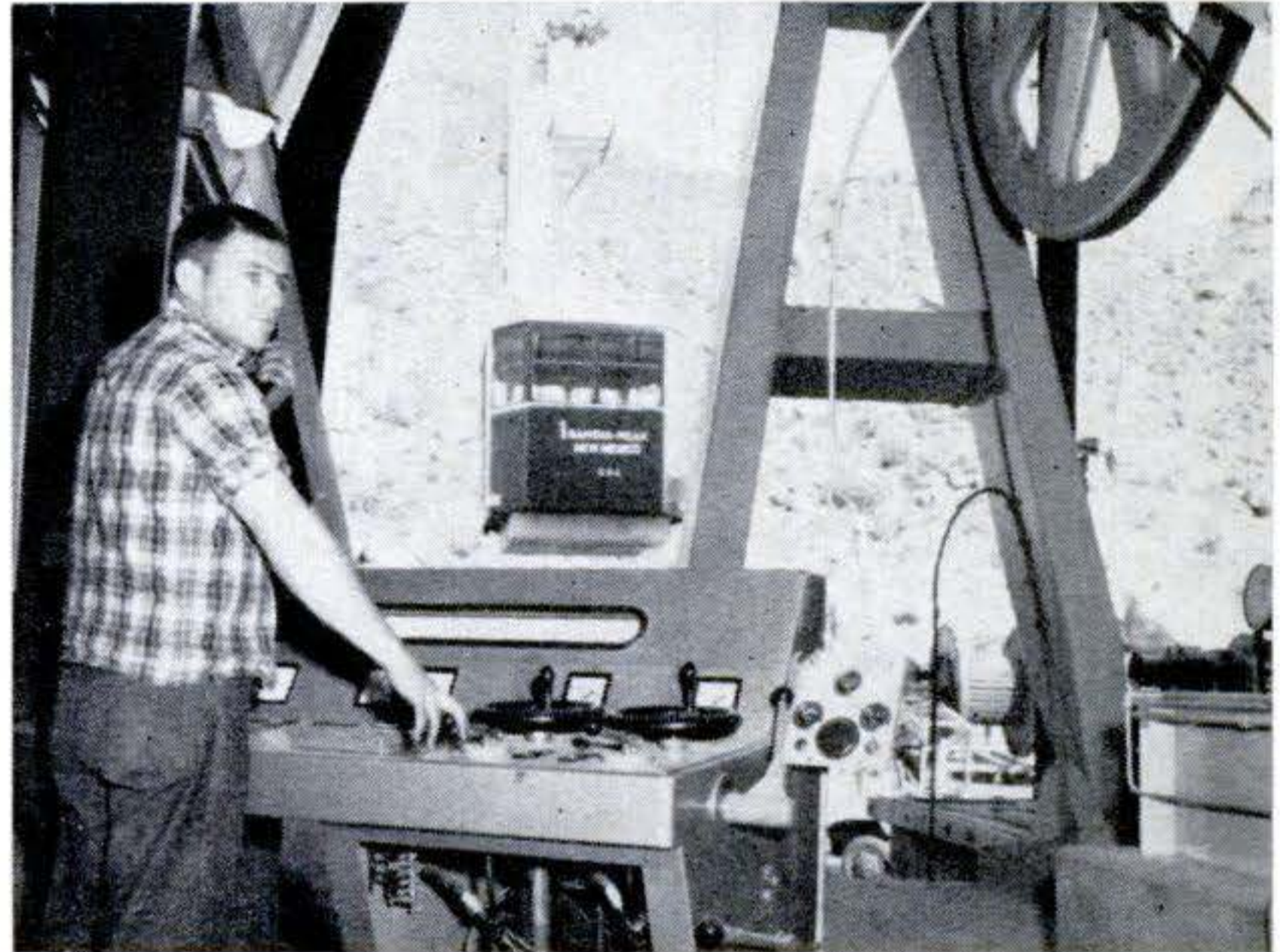
which one car ascends as the other comes down. Its track, supported by two towers along the way, consists of two pairs of $1\frac{5}{8}$ -inch cables. These are anchored at the upper end in rock, and at the lower end in 90-ton concrete counterweights that maintain even tension regardless of the cars' movements. A separate and endless hauling cable, driven by an 850-hp. motor, propels the cars at up to 17 m.p.h.

Longest "Jigback" Aerial Tramway

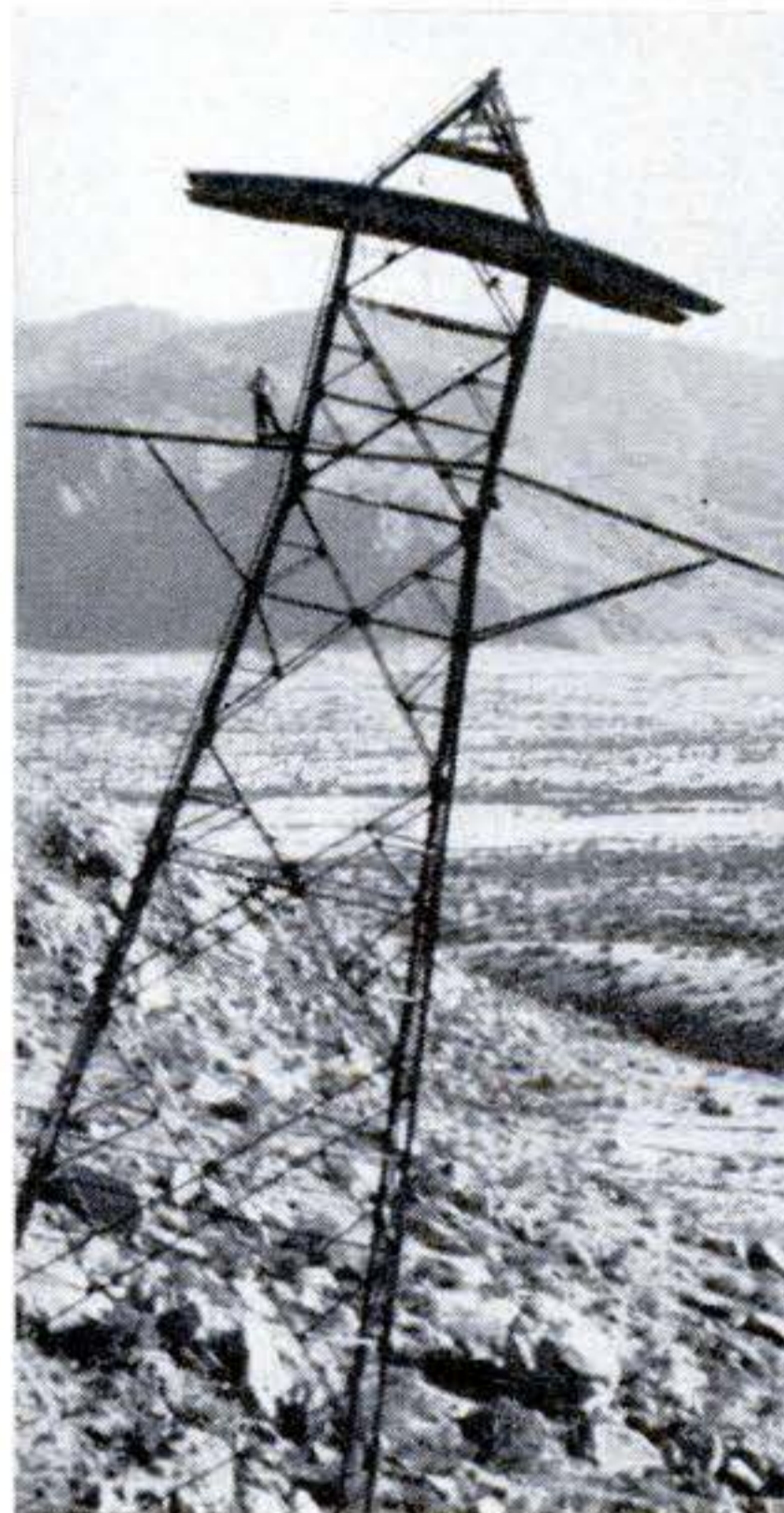
an exciting 2.7-mile trip to a ski playground atop a New Mexico peak



Shown in the drawing above are the tramway's setting and principal features, including a swoop of 7,720 feet between Tower No. 2 and the upper terminal—a clear span exceeded in length only on one aerial tramway in France and one in Venezuela. Accompanying photos were made during construction of the line.



Control panel, in lower terminal, operates endless hauling cable that raises one car and lowers other. Operator can talk by phone with an attendant riding in each of the cars.



"Leaning tower," No. 1 of tramway's two, slants 18 degrees from vertical for most effective bracing. Man near top is standing erect. Members above him support track cables, not yet installed in this construction view.



Massive counterweights of concrete, hanging on lower ends of track cables in 70-foot-deep pit, rise and fall to maintain even tension as cars move. Two of the four 90-ton counterweights are seen in the photograph above.

SCHOOL FOR SPEED

Teaches You

Expert Car Handling

Come along for a lesson in the art and skill of fast driving in Carroll Shelby's outdoor classroom at Riverside Raceway

By JAN P. NORBYE / PS Automotive Editor

PHOTOS BY CHAN BUSH

SPEED KILLS. All over the country, signs like this warn the motorist against speed on the highway. Standing alone, the warning is, of course, not true. It is not speed that kills. (Most fatal accidents occur at under 40 miles an hour.) It is *unplanned* and *uncontrolled* speed that kills.

A car can be unsafe at any speed if it is driven too fast for conditions—the condition of the car, the driver, the road, the weather, the traffic density.

With that off my chest, let me tell you about a lesson that I have had lately. I enrolled at a school that teaches driving at high speeds—well-planned and well-managed speed. It is not for the average motorist. It's for race drivers.

But some of its lessons are for everyone who slides in behind the wheel of a car, whether he drives at 30 m.p.h. or 100.

It's Carroll Shelby's School of High Performance Driving at Riverside, Calif. Carroll Shelby is a former winner of the LeMans 24-hour Enduro. He has held both the U. S. Auto Club and Sports Car Club of America championships. He also builds Cobra and Mustang GT 350 cars.

Shelby's classroom is one of the world's most challenging race courses. Riverside Raceway is 3.275 miles long with nine deceptive turns. An error in judgment is an open invitation to spin-out.

My instructor was John Timanus, who has raced Scarab and Lotus cars for many years.

My mount, supplied by the school, was a slightly tired Mustang GT 350. It was only moderately powerful—271 hp. at 6,000

r.p.m., with a torque of 312 pound-feet at 3,400 r.p.m. The tach was on the dash at eye level. I showed up dutifully for my student chores at nine o'clock on a spring morning. In the next three days I was reminded that proper control of my steering wheel, accelerator, and brake pedal would:

- Over and above all, improve the essential safety of my driving, whatever the speed.

- Afford my passengers more comfort.
- Improve my tire life.
- Give me better fuel economy.
- Extend my brake life.

This was a no-nonsense school. We drove directly to one of the turns, with my instructor at the wheel. Parked there was a panel truck with a blackboard tacked to its side. What's a classroom without a blackboard? Timanus drew a diagram to acquaint me with the trickiness of this curve. And was it tricky!

There were others, I was to discover. One had not one but three apexes. (An apex is the point where a car is at its shortest turn radius.) In time I would learn to take that curve at a sharp clip without turning a hair.

I thought we were ready to roll.

"Now," said Timanus, "we'll walk it."

Out on the track we went, walking through the turn. I had to memorize the radius, the brake point, the shift points, the apex.

"Okay," said Timanus, "let me show you."

He climbed behind the wheel while I watched from the right seat.

"You have to be comfortable to drive," he

[Text continued on page 98]



First thing to learn about fast driving is finding a correct seating position. Shelby's thorough, no-nonsense course costs \$500 if you drive your own

car. If the school supplies the car, it's \$1,000. Roll bar and a quick-release seat harness are musts. That's Auto Editor Jan Norbye in the crash helmet.



Each turn is a lesson. It starts with a blackboard diagram and a detailed explanation of brake points, shift points, drift points, turn radius, and apex. Then comes a guided walk around the turn.

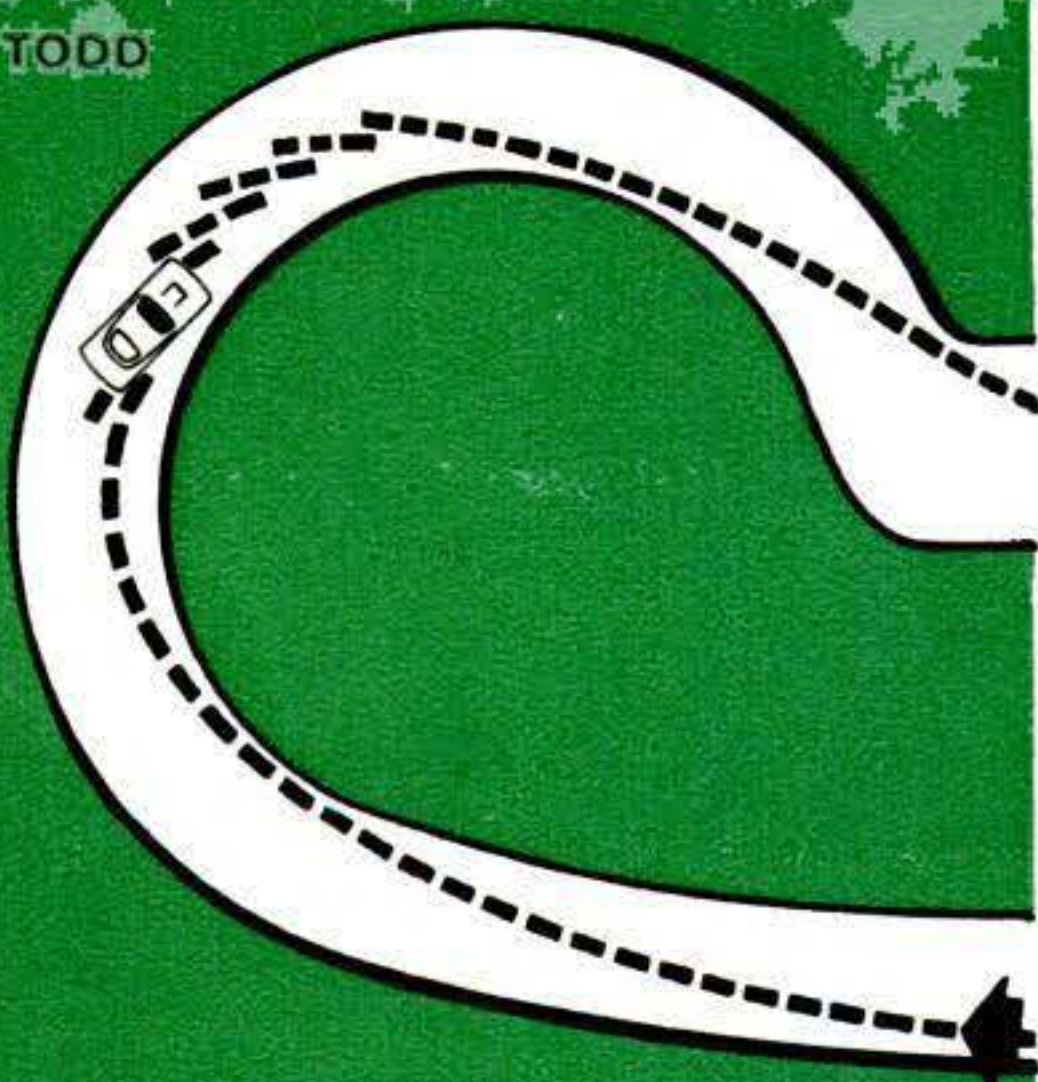


After a tour of the turn, a study of the approach, apex, and exit line, driving begins. First the instructor demonstrates; then the pupil takes the wheel. You start off slowly, raise your speed gradually.

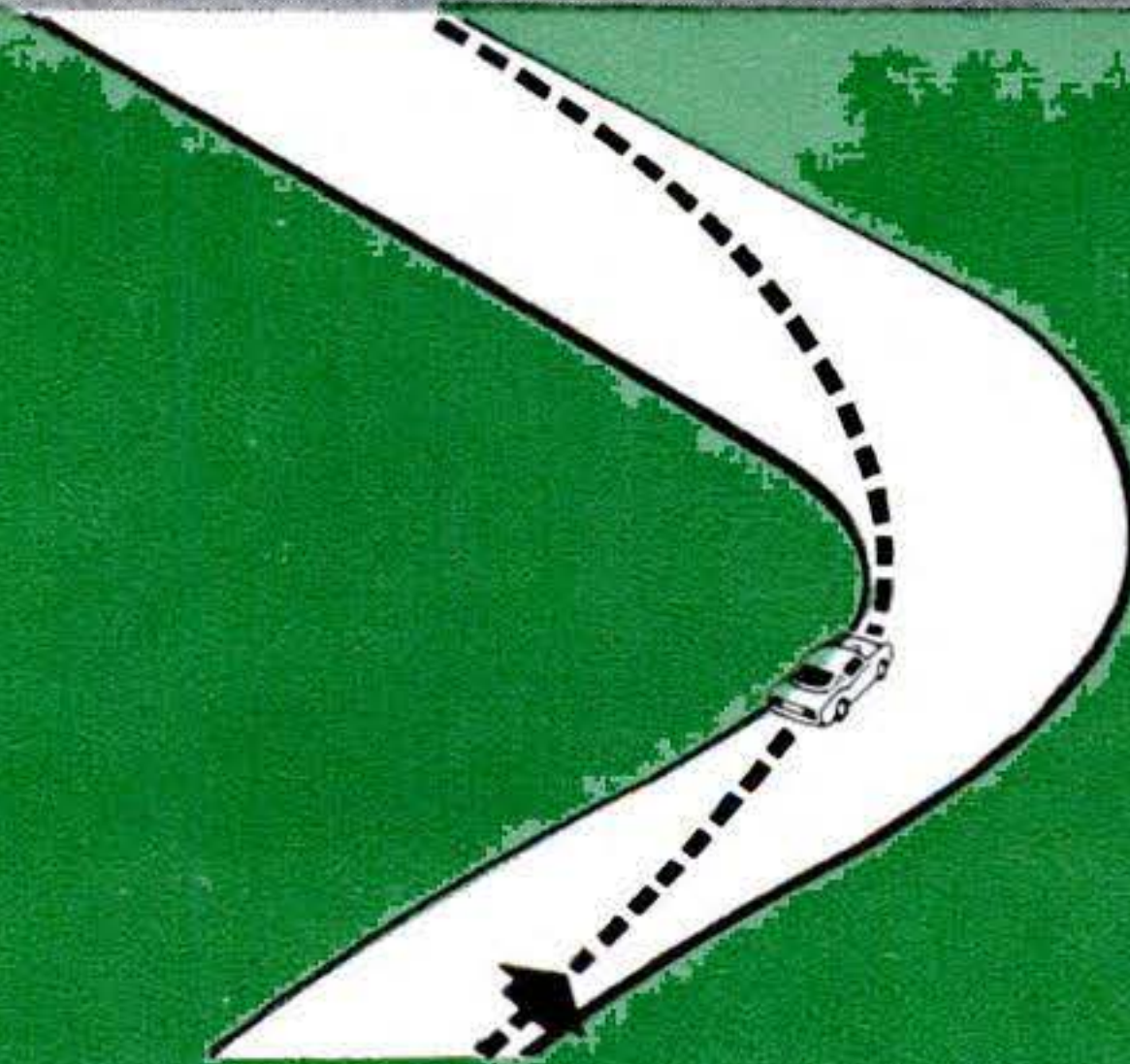
The secret of fast cornering is to stay on the line that



WINGS BY DAN TODD



1 Trickiest of all of Riverside's turns, this hook has three apexes—approach, main apex, and exit. The car in the photo is set up in a drift, aimed for the main apex. You enter "blind" (the exit is out of sight) and take a line that allows you a long turn radius and an exit line that gives smooth transition to the next straight. The trick is to feed in the right amount of drift.

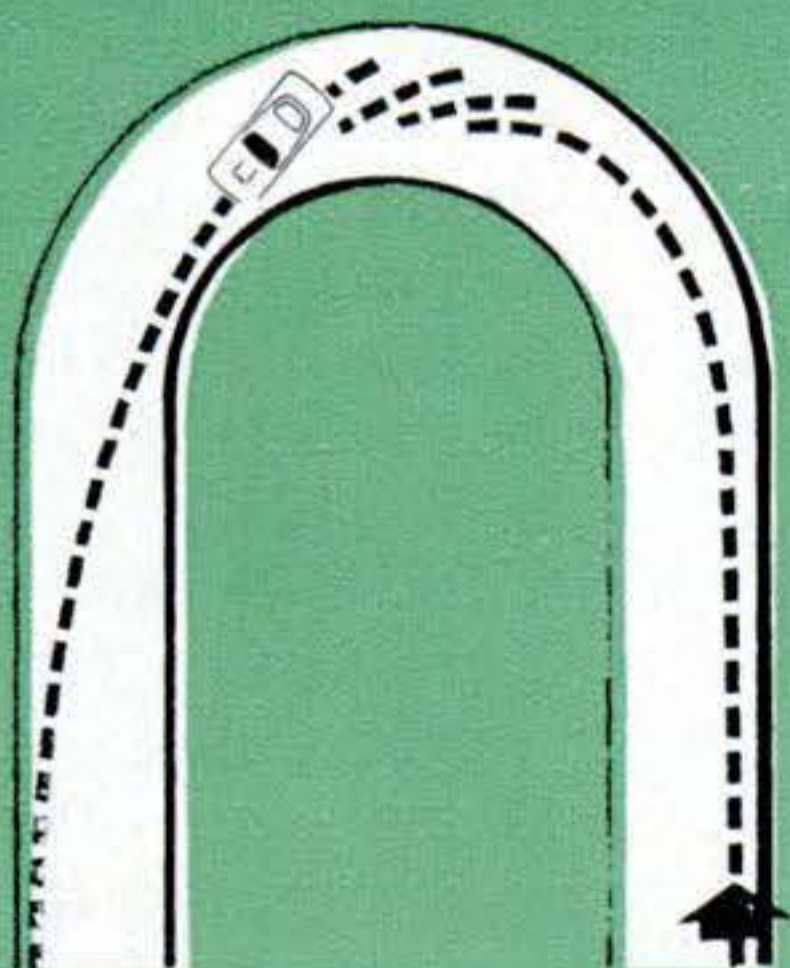


2 From the slow hook you accelerate on full throttle to this easy left-hander. Change up from second to third gear before hitting the apex, and stay hard on the gas until you can move into high, well down the straight. Exiting from this turn, you ease the car over to the right, using full road width. When the car finds its own way, you know you're saving tires, gaining speed.

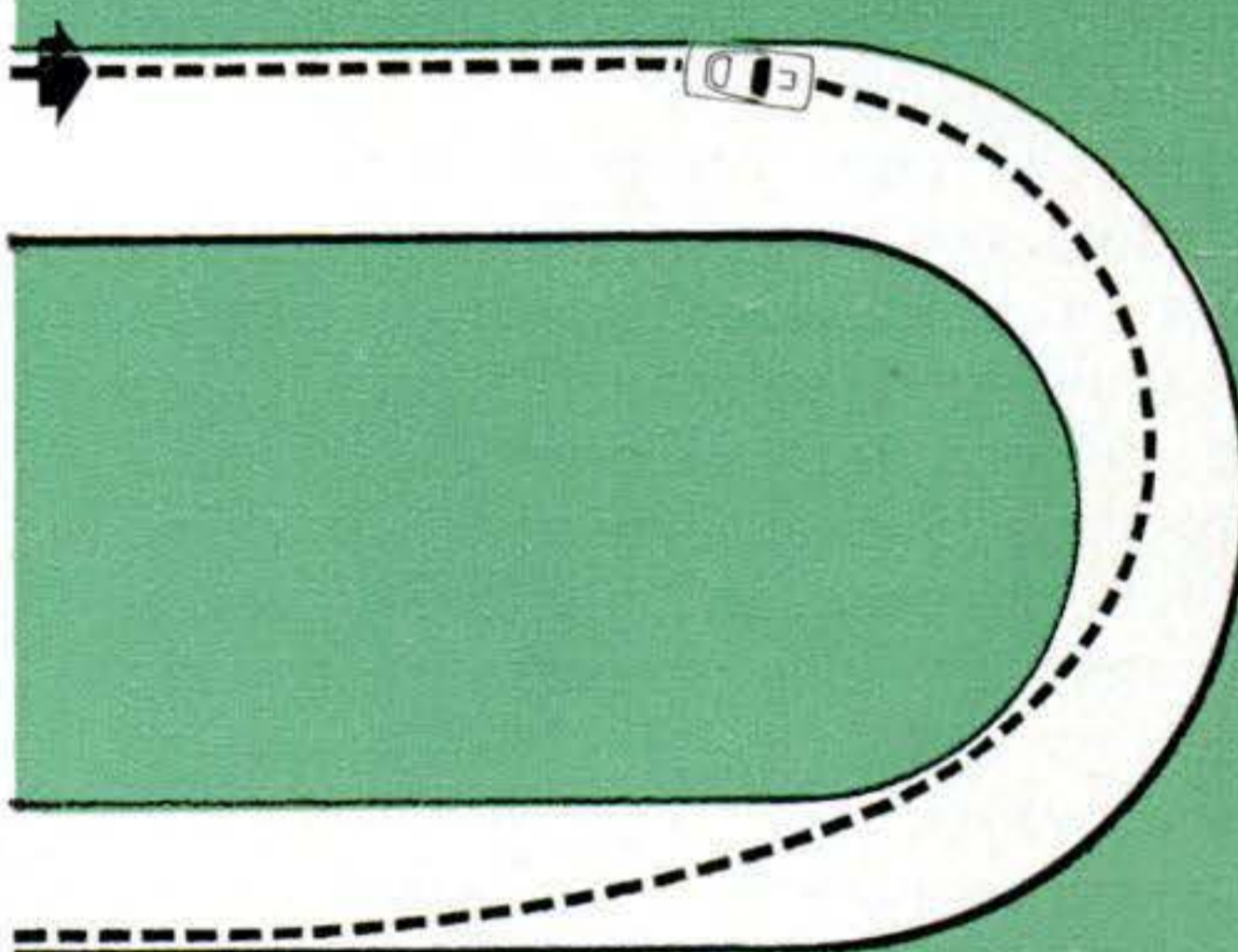


5 A series of S bends can be taken at amazing speed when the turn radiuses are lengthened by cutting corners. Timing of wheel movement is critical—too early places the car wrong for the following straight, and too late causes tire scrub and loss of speed. You don't sail through on a steady throttle opening—you slow down before each turn, speed up as you come to the straights.

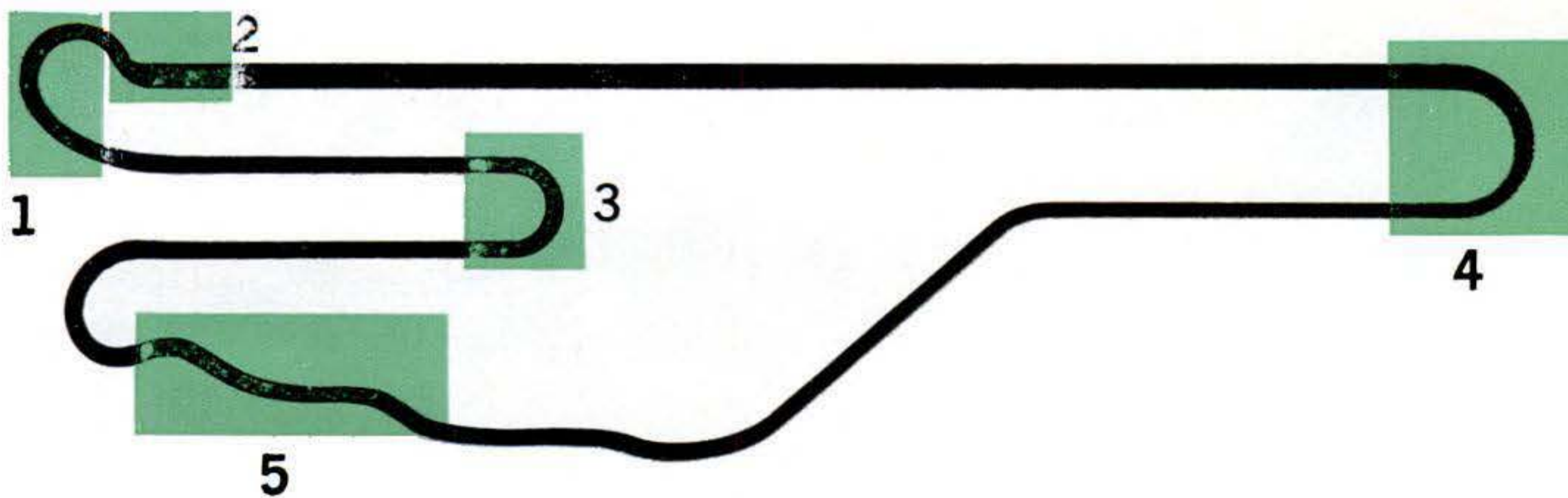
lengthens straights and permits higher turn speeds



3 Downhill left-handed U turn with no banking calls for slight drift in middle section. All braking is done before you turn the wheel; thus you enter the turn in a balanced state. A late apex straightens the exit line and allows an early upshift from second to third gear. During the drift, you literally steer the car with the throttle, approximating a steady state.



4 Slightly banked right-hand U turn is surprisingly fast. You enter at 4,000 r.p.m. in third gear after braking hard from the long straight, and keep a steady throttle foot while aiming the car toward a late apex. Your right foot should be on the floor before you reach the apex, and you'll need full road width when leaving the turn. Stay in third along the pit straight, just ahead.



began, getting right down to fundamentals. He scrunched down in his seat, turning this way and that, moving his shoulders, and making sure that his reach was just right for both wheel and gearshift.

We approached that first turn.

"There's a proper curve, or line, to follow around each particular turn," he said. "Everything a racing driver does, he does to save time. He brakes as late as he can. In the turn he accelerates as early as he can. This line"—he demonstrated—"will get you in and out of the turn at the highest safe speed."

More lessons. We went back to the blackboard for a review. Did I remember? Here was the point to use the brake. Here I would downshift. Here I would start a controlled rear-end drift. Had I got the turn radius firmly in mind? Right here was its apex.

We buckled ourselves in once again. I went through the gears, accelerating. Maybe I was a touch too high on speed. I braked slightly. I entered the turn. Was I on the proper line? I hoped so.

There was the apex. I missed it by going too far into the road and was badly placed for the next turn. Yes, immediately beyond was another.

I was in second gear now, and while my drift was no cause for worry, I knew it was too great to get an A from Timanus. Naturally, I messed up the second turn.

Timanus did have a word of praise.

"You were smart," he said of the first

turn, "not to use your brake *in* the turn. You use your brake *before* the turn. Then you enter the turn with your car in a completely balanced state." He gave me a slight smile. "I also see that you know how to steer with your throttle in a drift."

Then he clobbered me. "But you should have braked more firmly before the turn instead of rubbing off your speed with your tires."

We studied another turn, on the blackboard and on foot. I climbed into the car again. Gradually I was relearning some old lessons that I had tucked away somewhere and forgotten. Like any pupil, I wanted to keep my instructor out of my hair. I avoided sudden changes in speed. That had its application to everyday driving—passengers must be calm and comfortable.

The same thing went for brake applications and steering reversals. The fewer I made, the happier my passenger. Beyond that, it saved tires, brakes, and fuel. And beyond *that*, it meant safer driving.

"You can't watch your dials," cautioned Timanus, "in a turn. Check them on the straights."

When entering a turn I kept the tach in the corner of my eye. I established landmarks for brake points, shift points, and apexes, and the tach told me if my speed was right. Timanus was a strict teacher. If he told me that the proper engine speed for entering a turn was 4,050 r.p.m., he didn't mean 4,000 or 4,100. He meant

[Continued on page 181]



"After studying and practicing each corner separately, gradually speeding up until I was taking each at the optimum speed for the Mustang GT 350, I be-

gan to link the turns up with the straights," says Norbye. "Soon I was able to drive around the circuit at racing speeds. My schooling was complete."



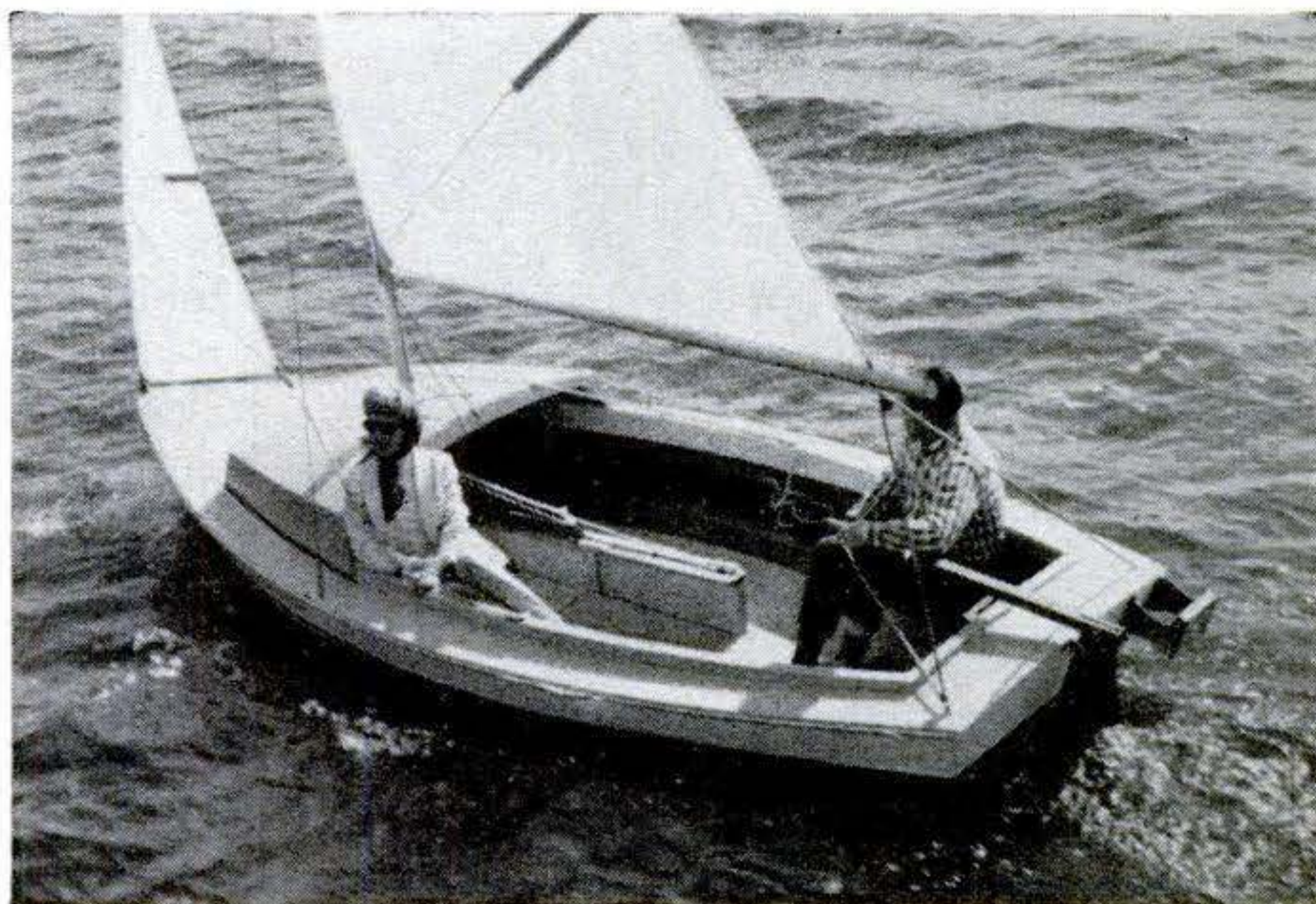
Want to row your own canoe? You can with this new rig

Here's how to convert your canoe to oar power for extra speed: Attach a Canoe-Swift rig. Designed by a college-crew coach to turn any canoe into a practice racing scull, it consists of racing oars and oarlocks, sliding seat, adjustable

stretcher, and rowing shoes that fit over your sneakers or camping boots. All the metal parts are bronze or stainless steel. The installation weighs 25 pounds and sells for \$175. Tool Tech Corp., Windsor Locks, Conn., makes it.

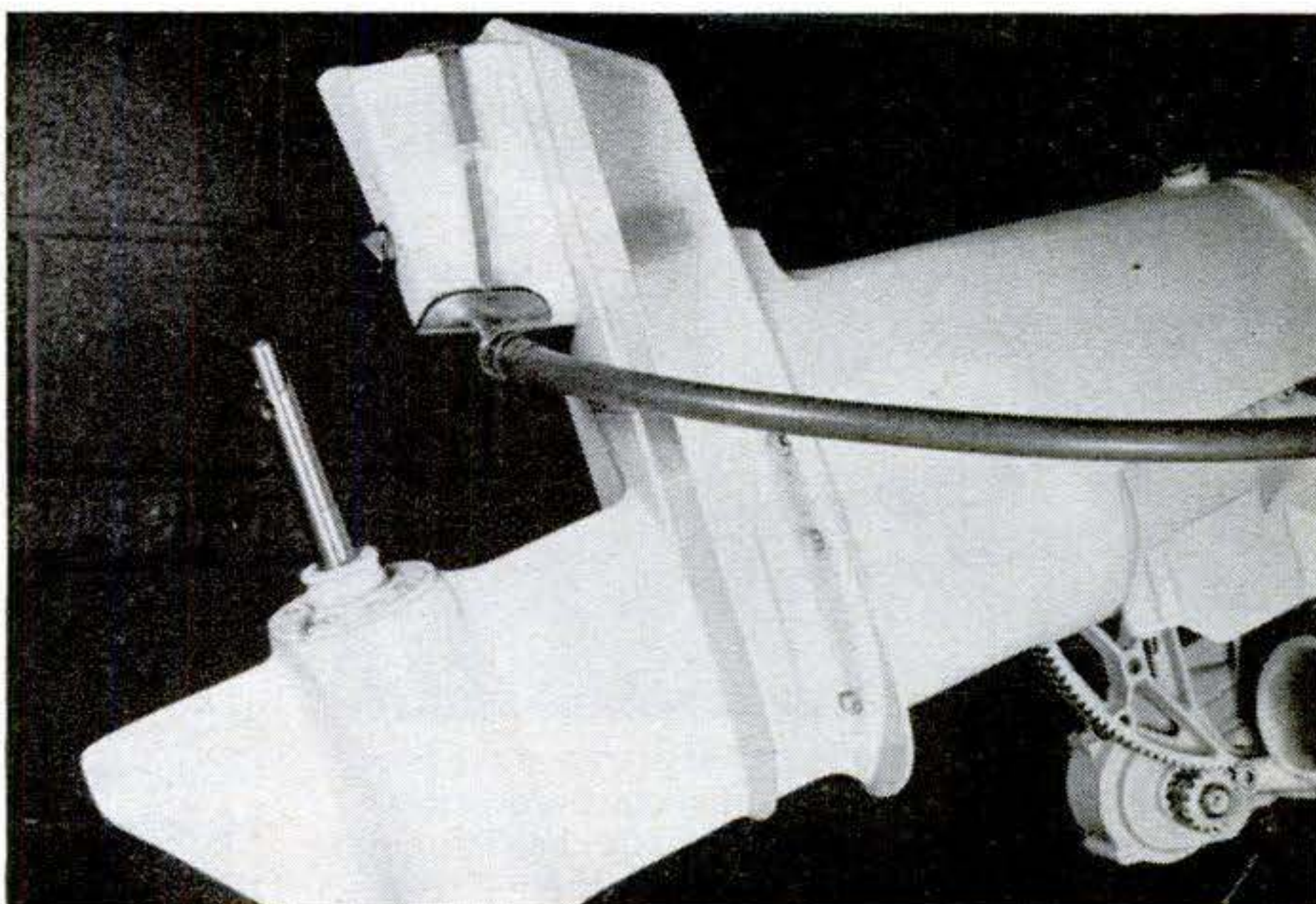
Assemble-it-yourself boat kits

No experience in building boats is needed to put together a new line of fiberglass boat kits. Factory-molded hull and deck, and everything else you need, come with the kits. The Lee-ward sailing sloop shown in photo at right sells for \$699, comes with sails and rigging. The maker, Luger Boat Kits, 9200 W. Bloomington Fwy., Minneapolis 55431, will send you a free catalogue showing kits for sailboats in 14' to 26' sizes, and runabouts and cruisers from 12' to 30'.



Run your motor on dry land

With a Testit Flushette you can check and tune your motor before you leave home, flush away salt and silt on returning, and operate it during lay-up to keep a protective coating of oil on the moving parts. You clamp it over the water intake and turn on the hose for about five minutes while you run the motor slowly. It comes in two models to fit standard outdrive and in-board-outdrive motors. Tempo Products, 6200 Cochran Rd., Cleveland, sells it for \$4.95.



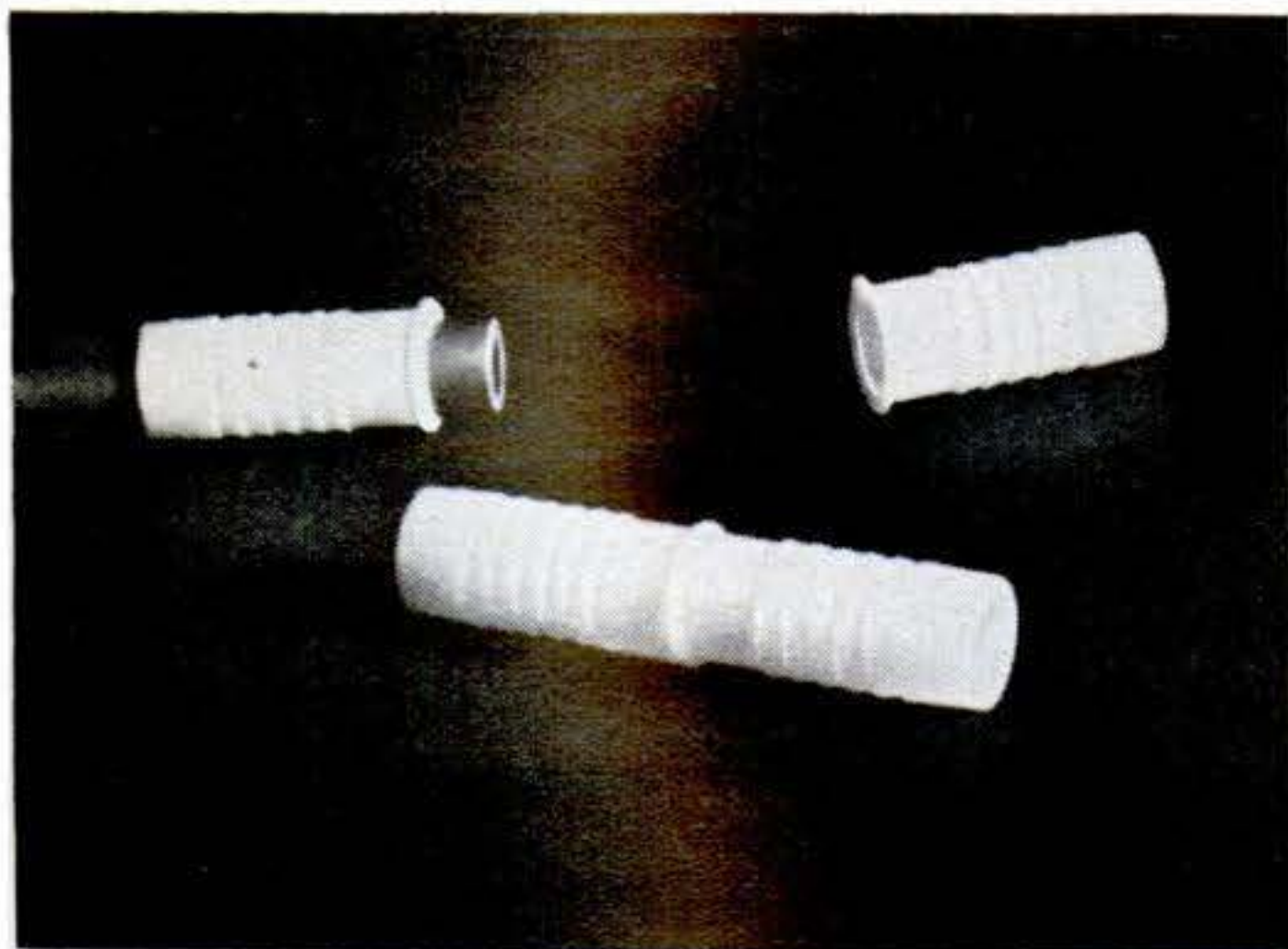


Build This BEACH DOLLY

By EARL WOBECK



Force the axle through the hole in the center of the pneumatic boat bumper. The axle will be easier to insert if you first inflate the bumper to make it more rigid and coat the steel rod with Vaseline.



Bearings that don't corrode or need grease are made from nylon pipe nipples sold at most hardware and plumbing-supply stores. Cut them in half through the center flange and gently hammer them in place.

Stop hand-hauling your skiff back and forth from car to launching site. You can take the sweat out of the job with this beach dolly that stows in your car trunk. Its wide, barrel-like roller wheels ride over sand, mud, rocks, and bumps. The boat bottom is protected all the way into the water. Two will launch a catamaran.

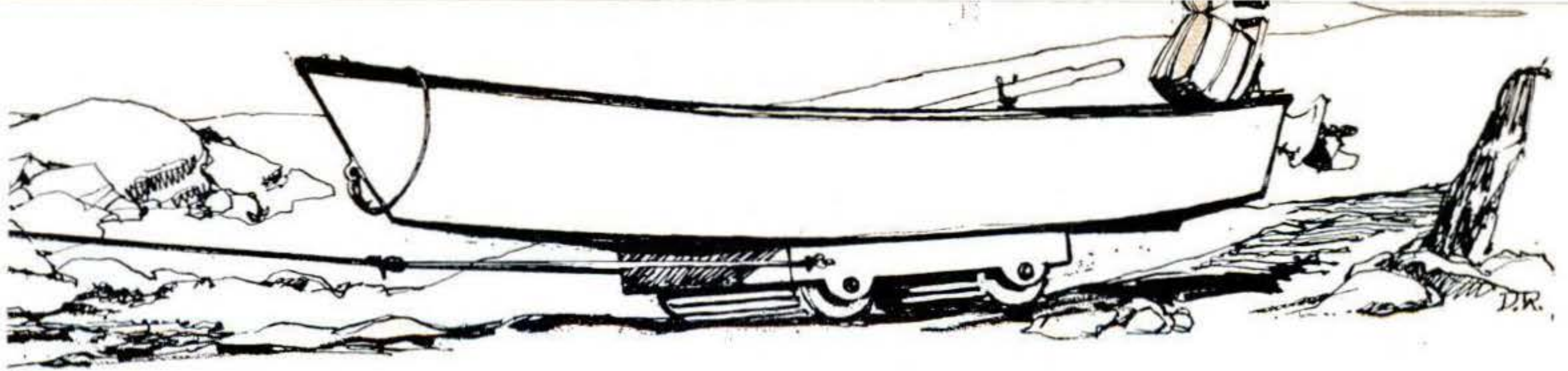
The rollers are actually a pair of soft, vinyl-plastic boat bumpers of the type made by Peters and Russell of Springfield, Ohio. The size used here, eight by 20 inches, will handle most boats you'd normally launch by hand. You can also buy six-by-15 inch rollers to make a dolly for smaller, car-top boats, or 10-by-26-inch ones that will haul about anything you can tow on the beach by manpower.

With different size bumpers, you have to change the width and height of the dolly to get the right clearance. Also, you can add chocks or change the slope of the dolly's top to suit the bottom of your boat.

The hole through the middle of the bumper fits snugly on a $\frac{3}{8}$ -inch-diameter axle shaft. The axle turns in nylon pipe-nipple bearings.

The dolly shown is made of exterior plywood, but you can use one-by-eight stock instead. Glue and nail all joints. Use waterproof plastic-resin glue, silicon-bronze annular-thread boat nails, and finish it with marine paint.

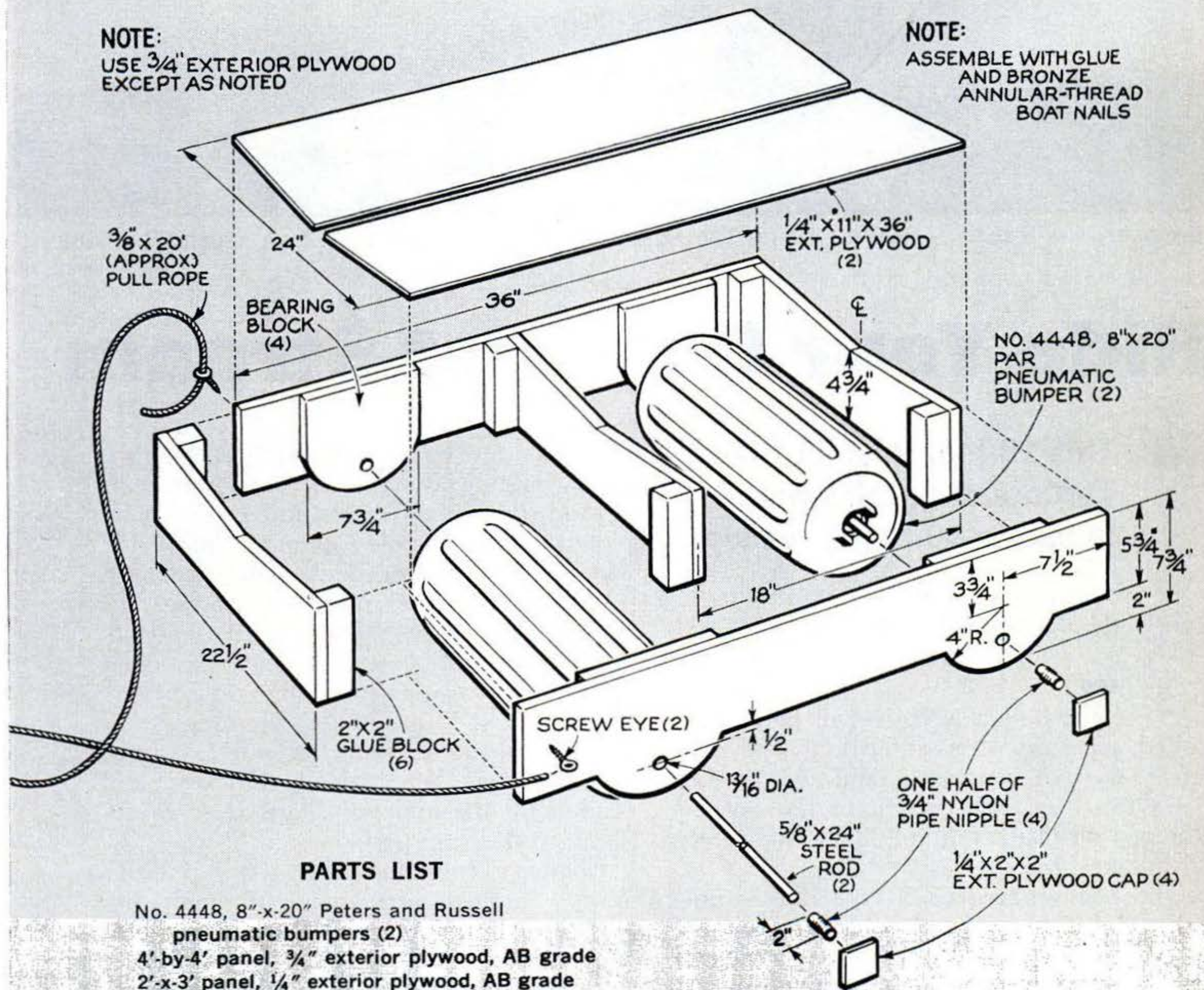
Cut out all the pieces, and glue the bearing blocks in place. Fasten the two ends and the center member onto one of the sides; then put both bumper and axle assemblies in place. Attach the remaining side, making sure the ends of the axles bear loosely against the plywood caps. The top pieces go on last.



FOR YOUR BOAT

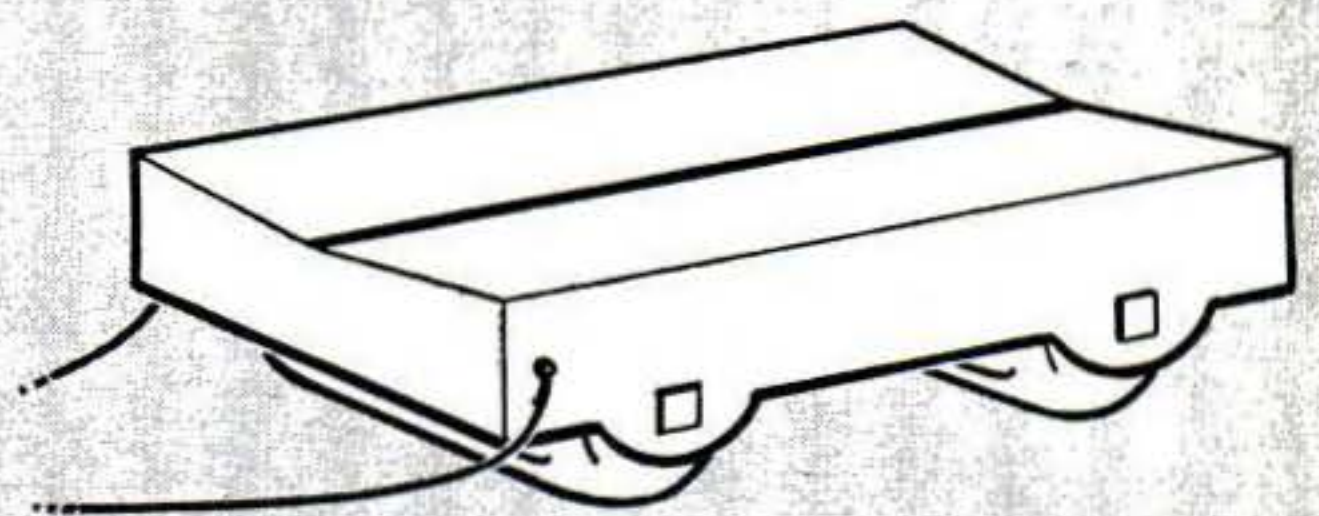
NOTE:
USE $\frac{3}{4}$ " EXTERIOR PLYWOOD
EXCEPT AS NOTED

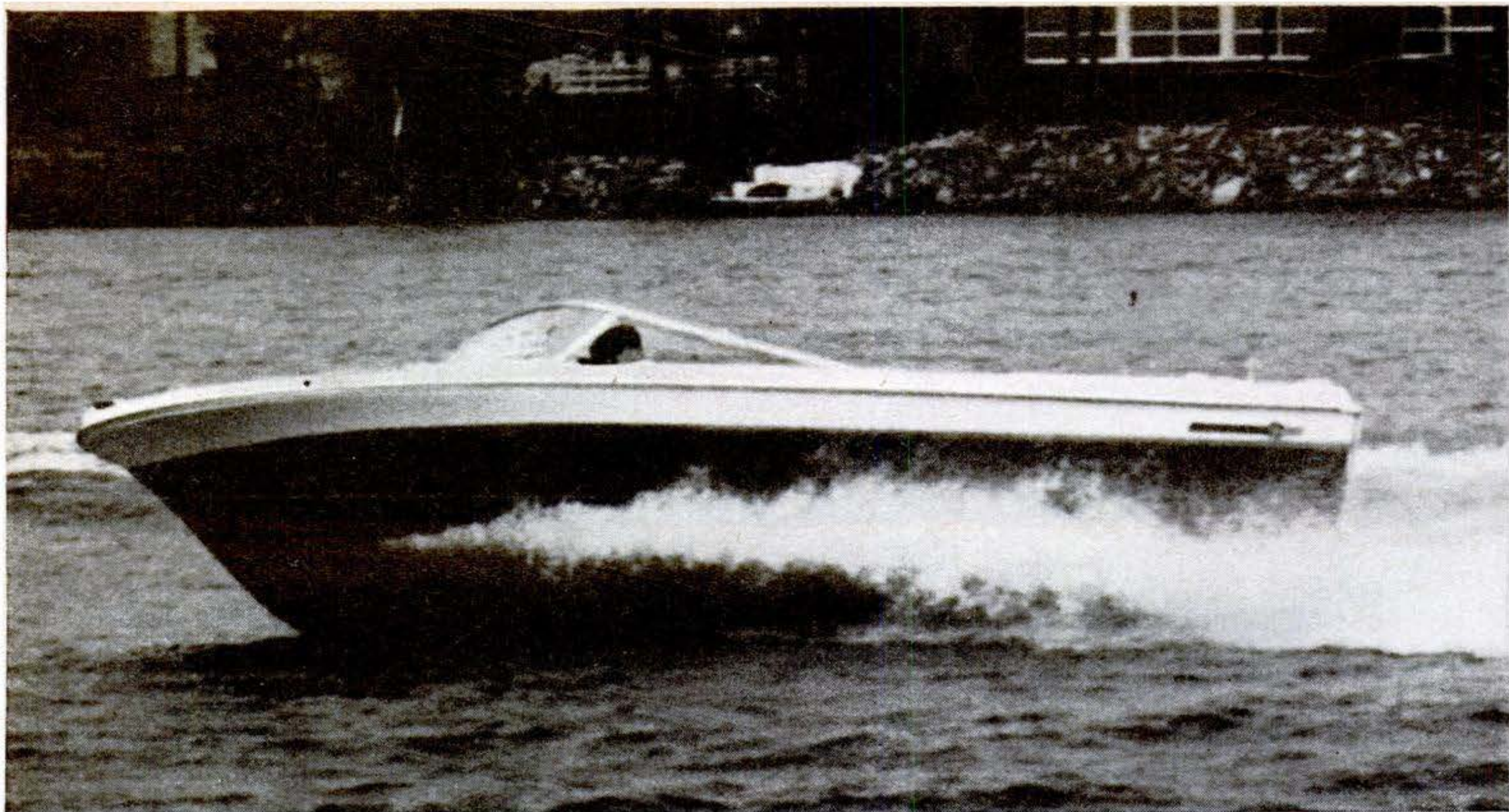
NOTE:
ASSEMBLE WITH GLUE
AND BRONZE
ANNULAR-THREAD
BOAT NAILS



PARTS LIST

- No. 4448, 8"-x-20" Peters and Russell pneumatic bumpers (2)
- 4'-by-4' panel, $\frac{3}{4}$ " exterior plywood, AB grade
- 2'-x-3' panel, $\frac{1}{4}$ " exterior plywood, AB grade
- 3' two-by-two pine stock
- $\frac{5}{8}$ "-dia.-by-36" cold-rolled steel rods (2)
- $\frac{3}{4}$ "-dia.-by-4" nylon pipe nipples (2)
- 1 lb. waterproof resin glue
- $\frac{1}{2}$ lb. $1\frac{3}{4}$ " silicon-bronze annular-thread nails
- $\frac{1}{4}$ lb. 1" silicon-bronze annular-thread nails
- 2 screw-eyes
- 20' (approx.) $\frac{3}{8}$ " rope





Swoosh! Now it's here—now it's there. The Bolero leaves a white wake—at high speed. The boat

Ride Your Own Jet Stream

This 18-foot Buehler Bolero Turbocraft guzzles water to pack a 40-m.p.h. wallop

By **JIM ROE** / *PS Boating Editor*

The Bolero is 18 feet of pump-propelled pleasure. It's a hustling hull that lets you have your cake and eat it, too: She's lively enough to delight the hot-rod side of your character, yet offers solid safety advantages, too.

The boat's fiberglass V-type hull is propelled by a two-stage Buehler turbopower jet unit. Water in large quantities is sucked up through a grille in the bottom and forced astern through the nozzle at high velocity. Newton's Third Law being what it is—"for every action there is an equal and opposite reaction"—this king-size water gun shooting astern causes you and the boat to leave the area with a dramatic swoosh.

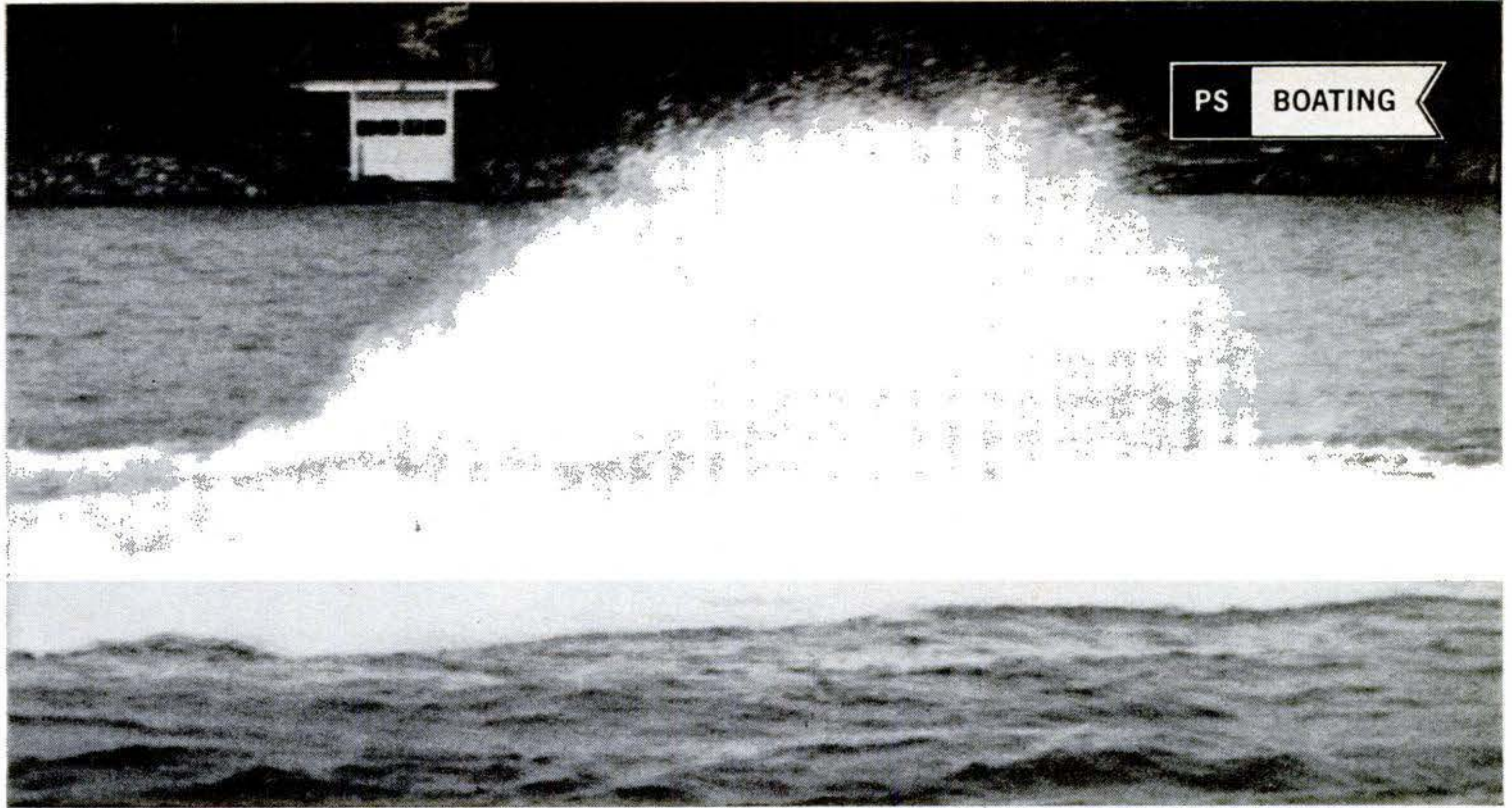
Most owners of jet-propelled boats will tell you safety is one of the big reasons they chose this form of propulsion. This safety works two ways: It enables you to

scoot along in water with shallows or debris that would bend or break the lower units of propeller-driven craft; and it also completely removes the spinning propeller, which can endanger skiers and swimmers.

My own biggest surprise in testing the Buehler was in the quality and dependability of its manufacture. This particular boat came off the assembly line on a Friday afternoon. At 7:30 the next morning it was on its way to the water for our test runs. We launched her, turned the key, and headed for the opposite shore. And everything worked to perfection.

Engineer Bob Stevenson and I put this newly hatched slick chick through her paces. First was the fuel-consumption test. At near-idle r.p.m. of 1,000, the fuel-flow meter gave a reading of a half-gallon per hour. At cruising r.p.m. of 3,200 it was eight gallons an hour, and at maximum 4,200 r.p.m. we were burning fuel at the rate of 18 gallons an hour. This was with a 210-hp. Chrysler marine engine.

On her speed trials, the Bolero got up on plane at 2,850 r.p.m., and fell back off when the r.p.m. dropped below 2,750. This meant she would slide along comfortably on plane at something less than normal cruise



can also navigate handily in water hardly deep enough to get your feet wet if you step overboard.

for More Fun and Safety

power. Acceleration is terrific. We swished through a $\frac{2}{10}$ -mile course in 21.15 seconds from a standing start. Response on this quick takeoff is quite different from that on a propeller-driven boat, since the tach will go from idling speed to 4,200 r.p.m. in less than one second.

Running this same accurately measured test course, our top speed at 4,200 r.p.m. was 41.44 m.p.h. At cruising speed of 3,200 r.p.m., our speed was 27.84 m.p.h.

No boat is completely perfect, and the Bolero has two or three characteristics that take getting used to. Each is a result of its

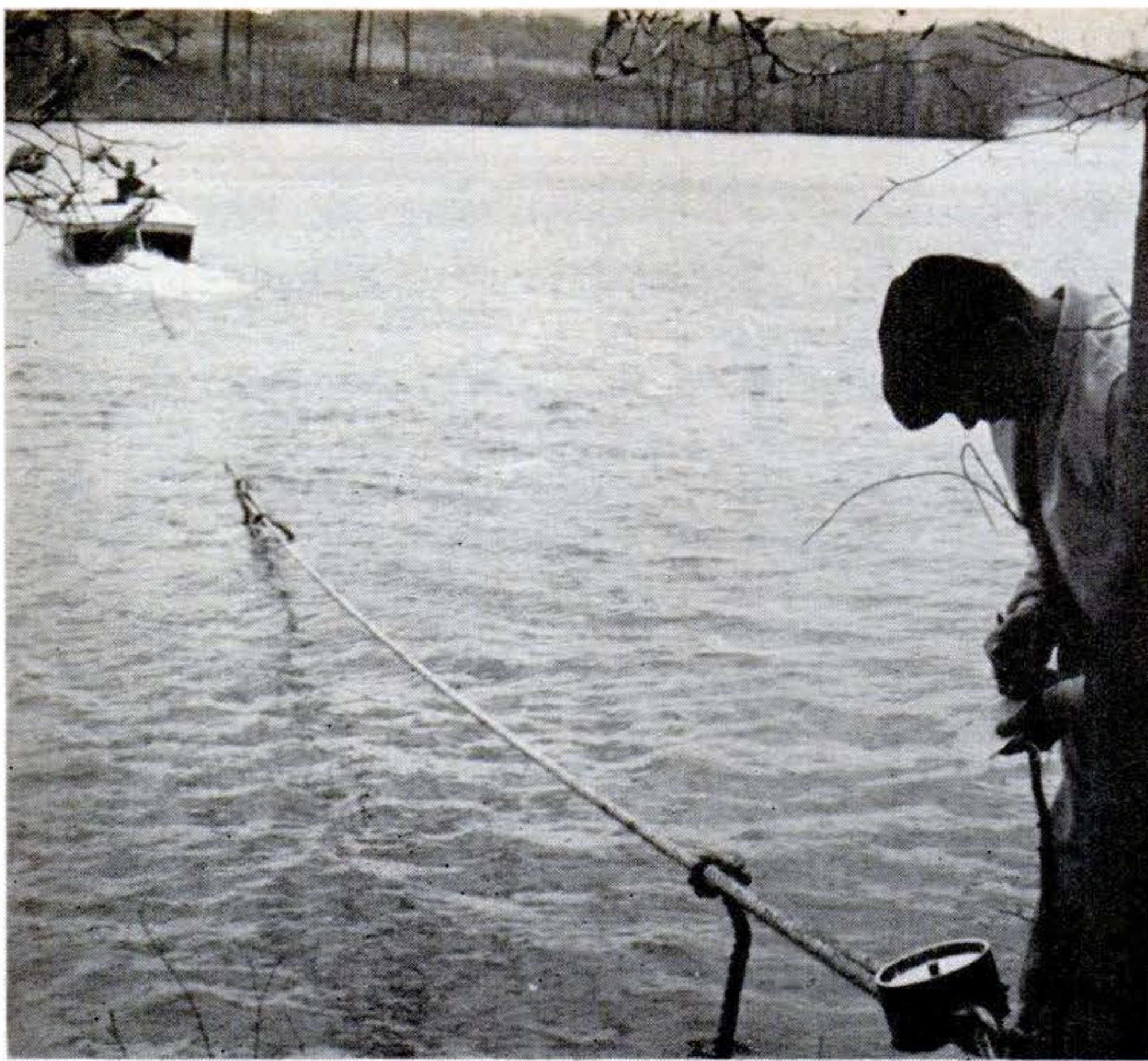
Continued



It goes in here. Water is sucked up through this grille in bottom of Bolero's hull. Only projections are two shallow antiskid keels. They allow free water movement to pump inlet in a hard turn.



And it comes out here. Discharge orifice turns for steering. To reverse, gate drops down forward of discharge point, deflecting water flow down and toward bow of boat. Steps allow swimmers to board.



Measuring thrust: Here the pull is relatively light, as shown by sag in the line. However, when jet is really putting out, line is as taut as a bowstring.

Scale interposed between tree and line to boat tells the story of the maximum thrust exerted by jet discharge. At 4,200 r.p.m., it was 1,350 pounds.

jet-type propulsion. Since there is no rudder, directional control is achieved only by the flow of water through the pump and out the rear discharge. At low r.p.m. this flow is relatively slight, and I found myself constantly working the steering wheel, tack-

ing back and forth slightly in order to travel in a generally straight line. The first few times one docks a jet-propelled boat, this is a problem, but it is soon familiar and I found relatively little difficulty in bringing the Bolero in.

Another feature of a jet-propelled boat is the lack of a real neutral power position. The pump takes in and discharges water all the time. In theory one can achieve a perfect balance by lowering the reversing gate just enough to have half the discharging flow work to reverse the boat, while the other half works to drive her forward. In practice, this perfect balance is seldom achieved—at least by me.

But these are relatively slight idiosyncrasies for a boat that can drop off the assembly line and literally alight running. She'll do better than 40 m.p.h., turn on a dime at high speed, and operate in water so shallow you'd hardly get your feet wet if you stepped overboard. She'll never have a bent prop or shaft, never break a lower unit on a sneaky log. Swimmers can climb up the built-in steps at the transom while the engine is running, with never a fear of a spinning prop.

In sum, the Bolero is a fast boat—and a well-behaved one, too.

Buehler Turbocraft

Length	Beam	Draft	Freeboard		
			(Fwd.)	(Amid.)	(Aft.)
18' 5"	7' 1 $\frac{3}{4}$ "	10 $\frac{1}{2}$ "	28 $\frac{1}{2}$ "	26 $\frac{1}{2}$ "	25"
Construction	Minimum Thickness			Flotation	
	(Bottom)	(Sides)	(Transom)		
Hand-layup fiberglass	$\frac{3}{8}$ "	$\frac{1}{4}$ "	$\frac{5}{8}$ "	Foam chambers	
Weight		Recom. Max. Load	Recom. Hp. Range		
(hull only)	(with engine)				
2,130 lb.	2,740 lb.	1,300 lb.	190-250		

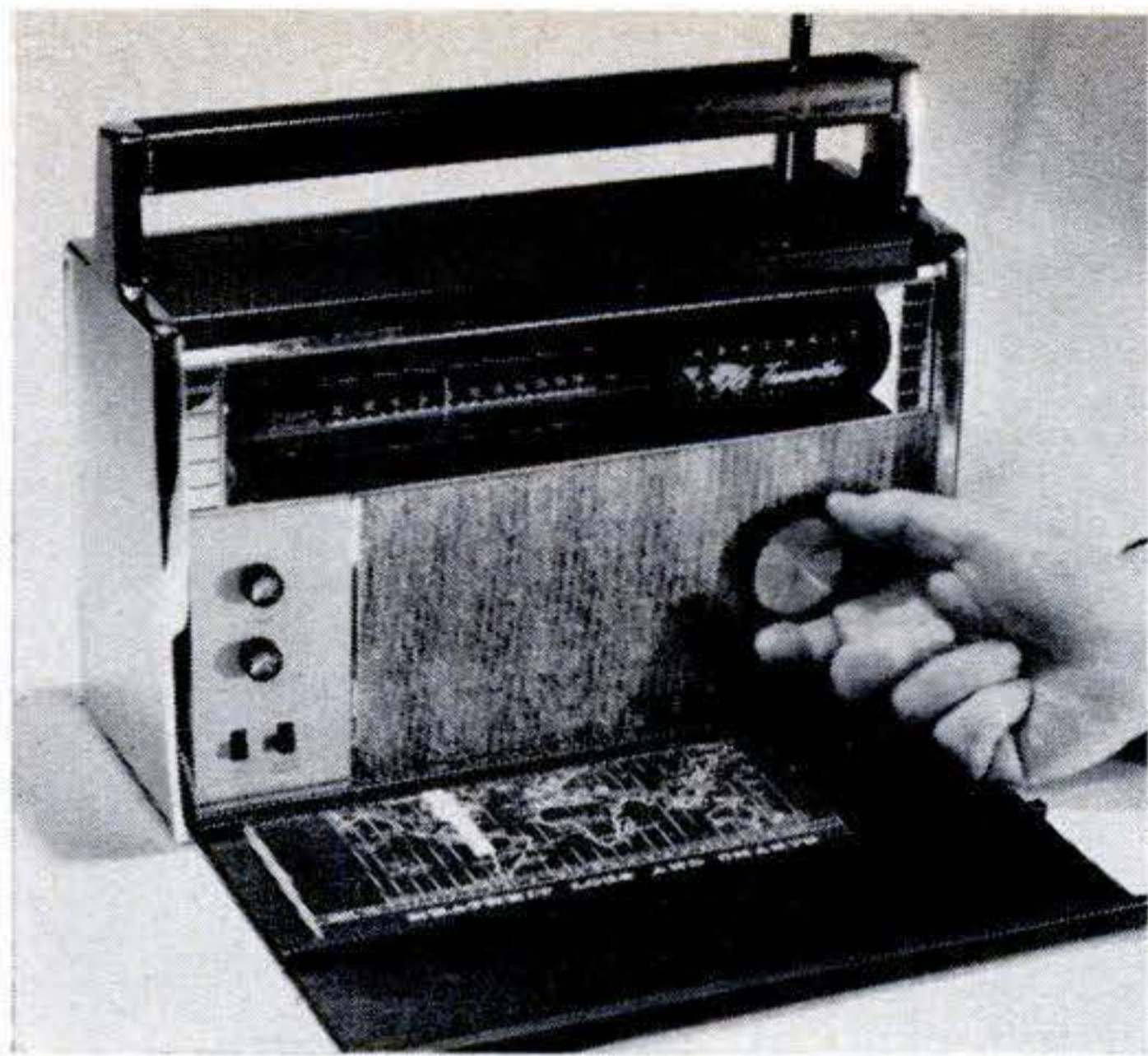
Accommodations:
Seating for six.

Standard Equipment:

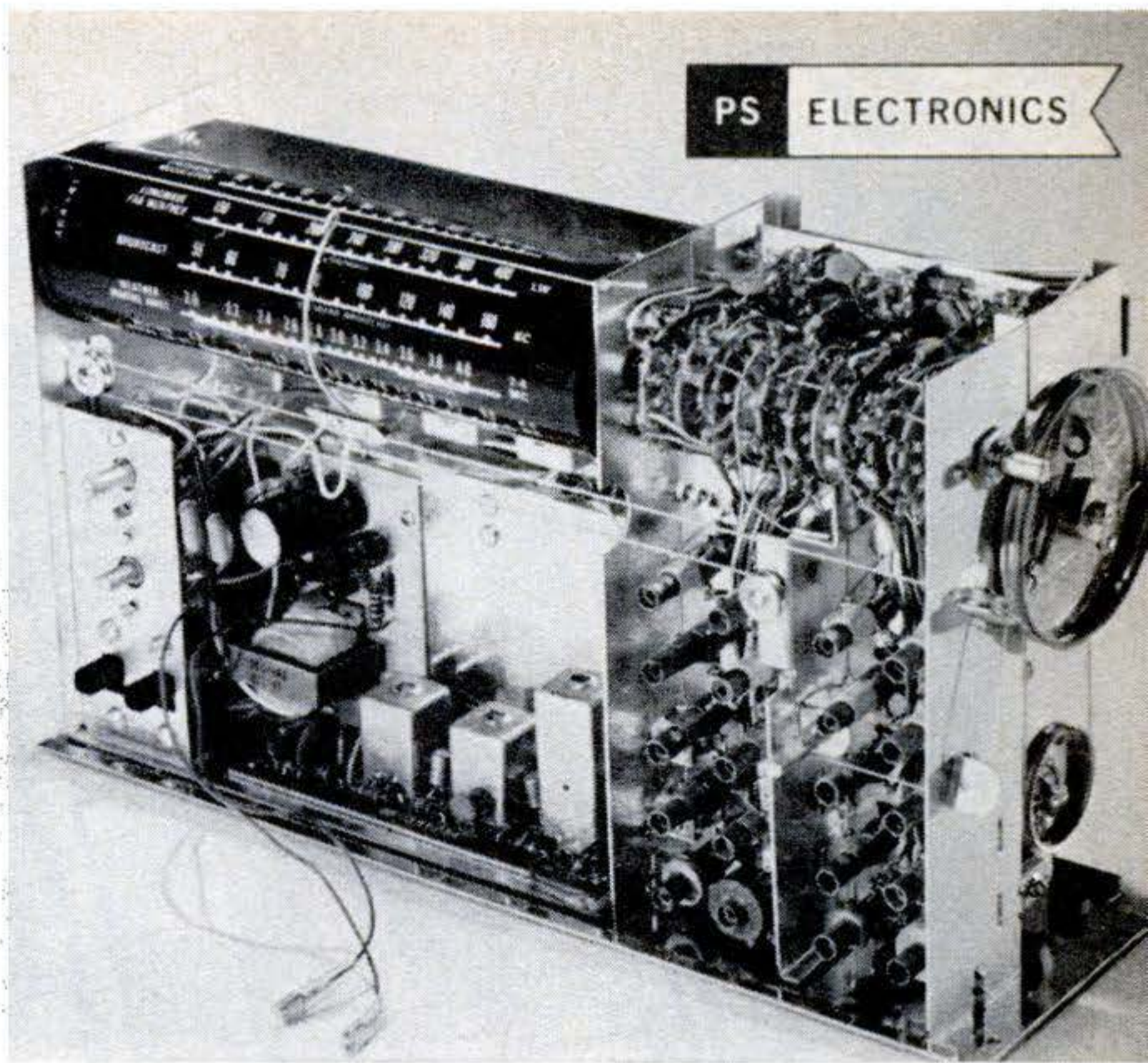
Running lights, Morse steering, 12-volt battery, bow eye and lifting rings, 30-gal. fuel tank, transom boarding handles, tachometer, ammeter, oil-gas-temp. gauges, step pads, bilge pump, cleats and chocks, Plexiglas windshield.

Price: \$5,395

Manufacturer: Turbocraft Division, Buehler Corp., Indianapolis, Ind.



Drum dial turns with the band switch so you see only the dial markings for the band you're listening to. Circuit uses 16 transistors and six diodes, tunes 10 bands: AM and FM broadcast, long-wave F.A.A. weather, seven shortwave bands.



PS ELECTRONICS

PERSONAL-USE REPORT:

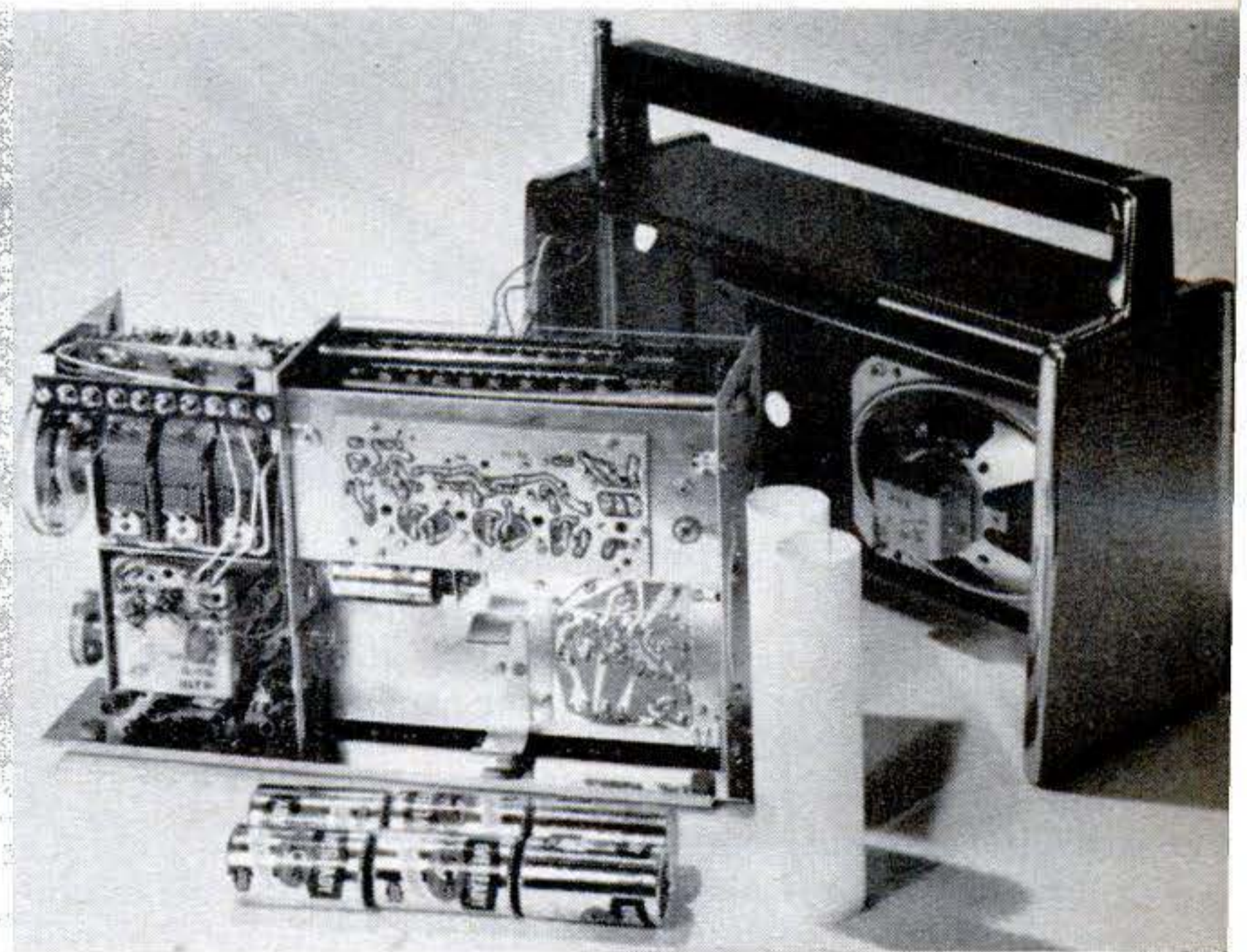
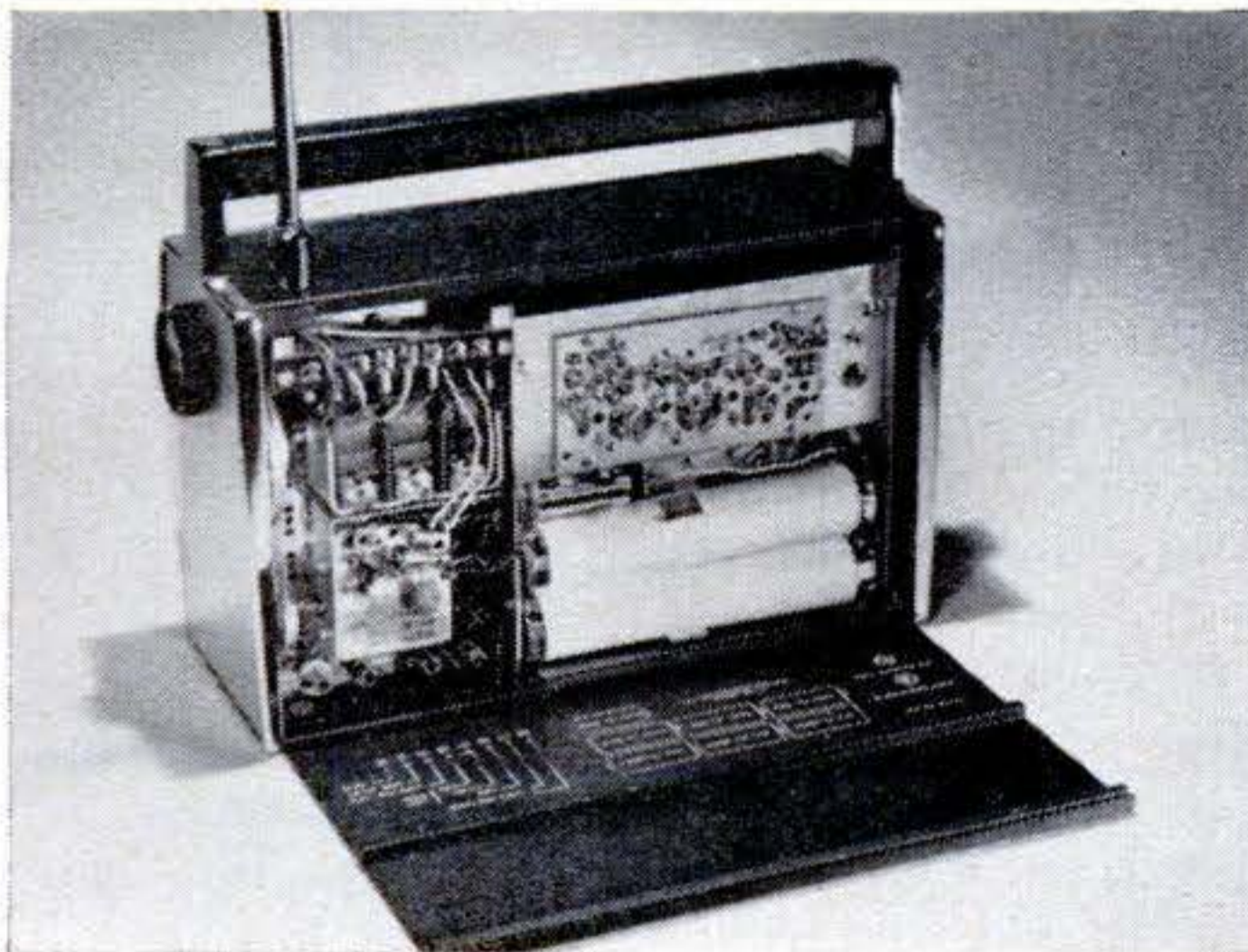
Kit-Built All-Wave Portable Receives FM, Too

This handsome portable receiving station is just about the last word in listening pleasure and adventure.

You can easily assemble the kit over a weekend and still have time to mow the lawn, polish the car, and have a barbecue. The critical AM and FM tuner circuits come factory-built and aligned. All you do is wire three printed circuit boards, connect controls, and finish mechanical assembly.

Within a few minutes after I had tightened the last screw, I had tuned in Moscow, London, Cuba, and South Africa on the shortwave bands. FM reception is a particular joy—distortion-free music against a background of velvety silence. And no drift. Even AM stations jammed close together on the dial can be tuned in with clarity. Price: \$159.95 from Heath Co., Benton Harbor, Mich.—*Hubert Luckett.*

Six D flashlight batteries power the radio. A battery-saver switch cuts drain for normal listening. A large ferrite rod in handle is the AM antenna; for FM and shortwave there's a five-foot whip.





New Ideas from the Inventors

DRAWINGS BY WILLIAM CASTIMORE

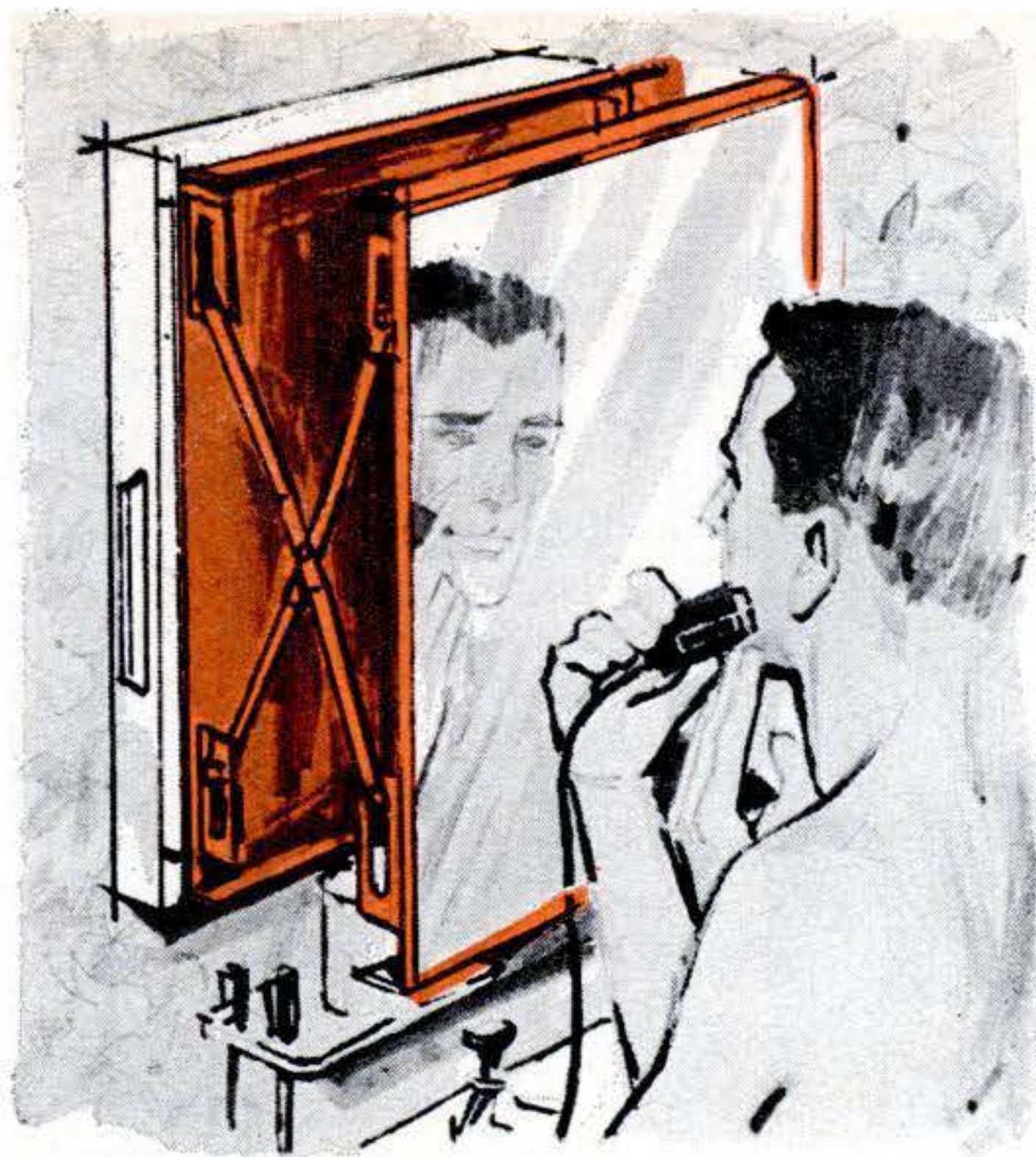
Photo is enlarged by stretching. You could blow up pictures in an instant if the photosensitive coating were on a stretchable plastic film that could be pulled to the size you wanted, according to this recent Polaroid patent. Either positives or negatives could be enlarged this way, and processing would be more or less conventional. Films that shrink can be stabilized chemically or by mounting.



Telescoping tiller extends reach. You could keep your outboard under control from any part of a boat if you had an extension arm like this connected to the regular tiller of the motor. A universal joint would let you steer in the normal way and adjust the throttle with a twist. The attachment would let you sit forward for visibility and would help in rough water by letting you adjust your position for better balance.



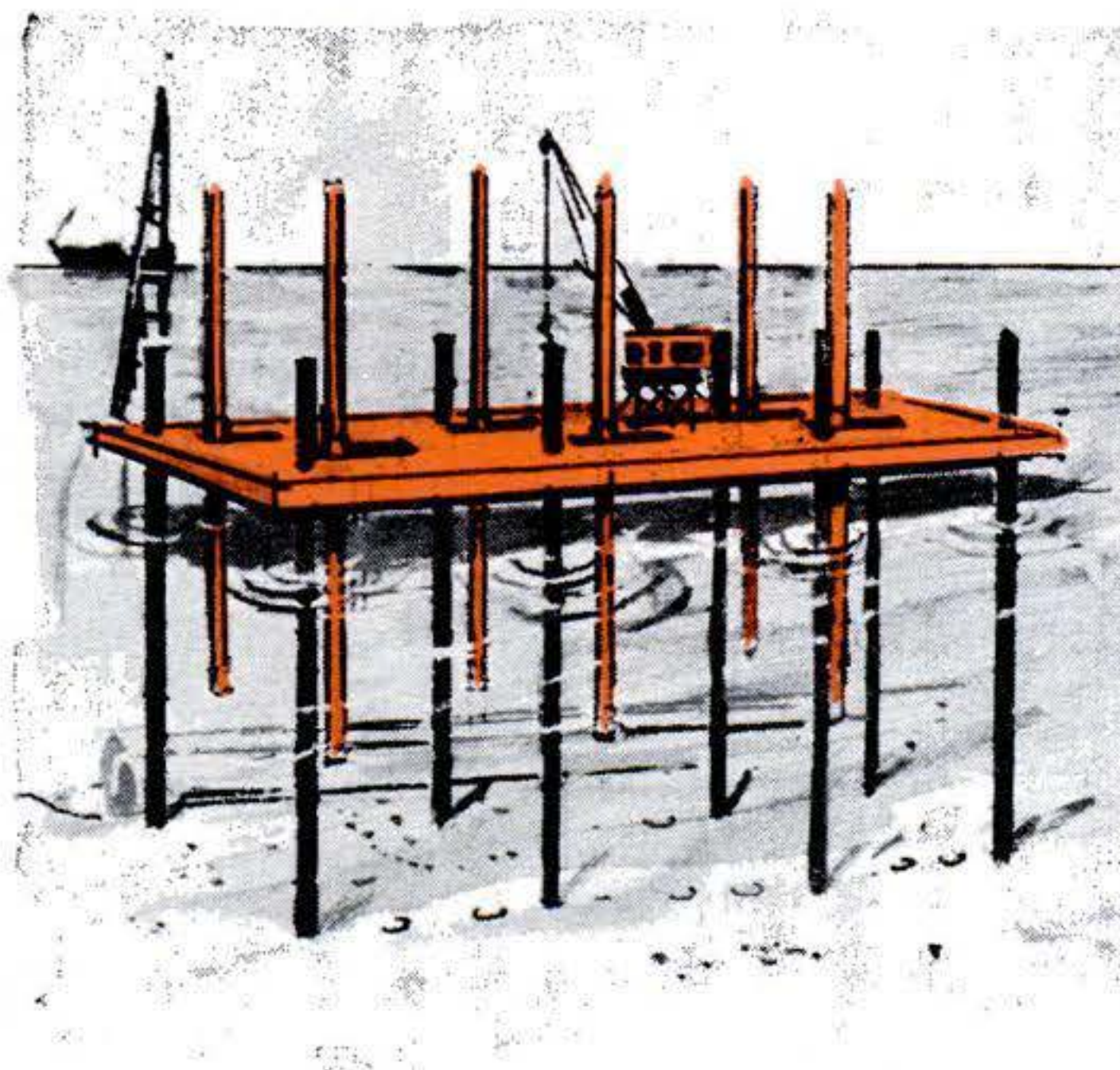
Drowse alarm minds your speed. The average driver, according to this Ford patent, makes steering-wheel movements at a fairly constant rate. But the rate increases if he goes too fast for road or weather conditions, slows down if he gets drowsy. This system would keep track of changes. If the number went up or down significantly from his preset average, an alarm would warn the driver to slow, or wake him.



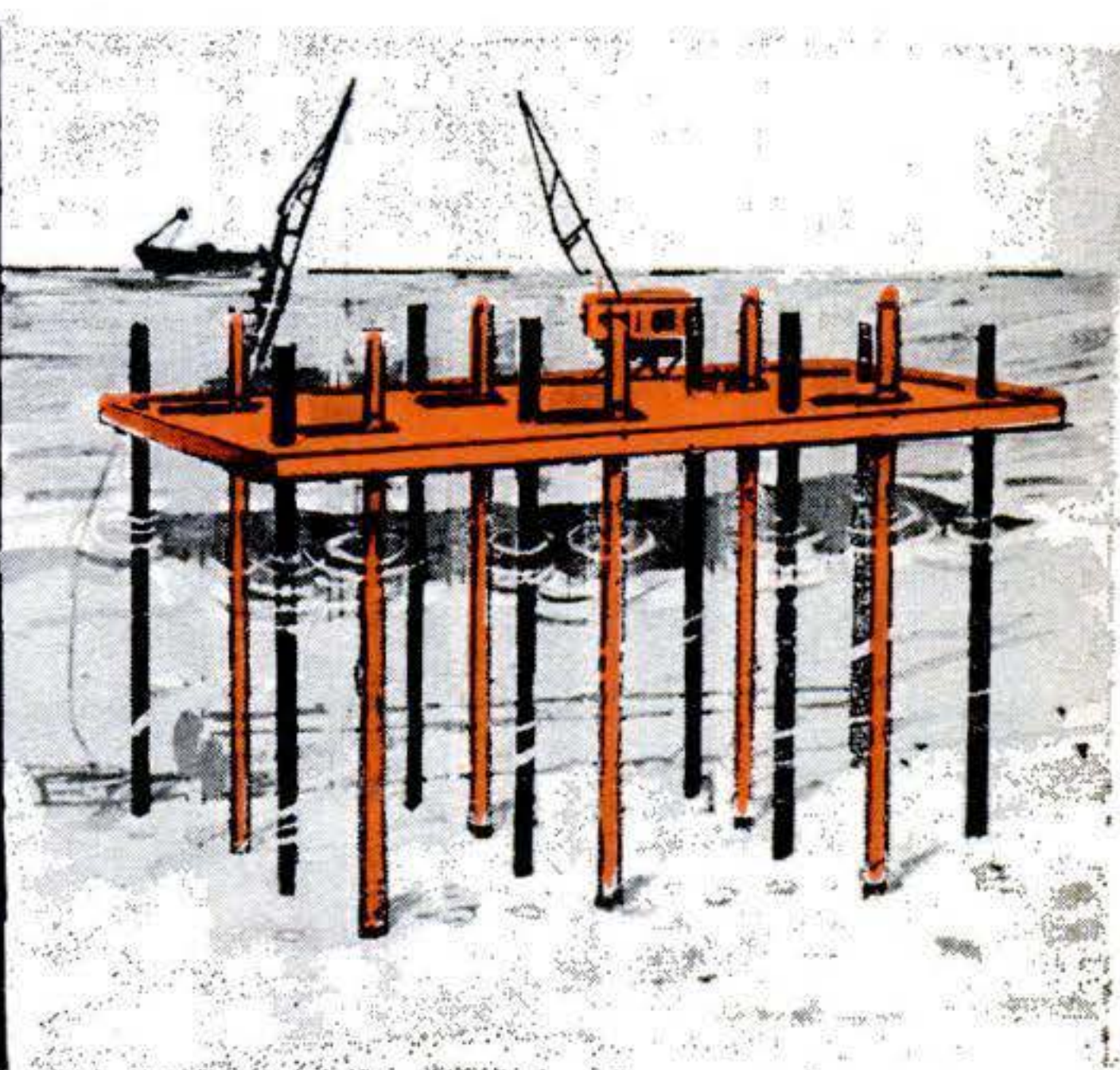
Mirror comes to meet you. Scissor-like tongs set between a medicine cabinet and its mirror would let you bring the glass closer when you wanted a better view, and make it unnecessary for you to lean over a wash basin while shaving. Flanges on the mirror (not shown in the drawing) would conceal the extender mechanism when the glass was pushed back.



Mower blade edges grass. Attached to the housing of any power mower, this swing-out blade would lift leaning grass along walk or fence margins and feed it into the cutters. Supported in a cylindrical housing, the cutter shaft would be held down by a spring but would be free to ride up over obstructions or bumps. The cutter would fold flat when not in use.



Construction barge walks to work. Laying pipe on the bottom of a shallow waterway might be eased by a walking barge supported by two sets of legs. With the fixed legs down, the mov-



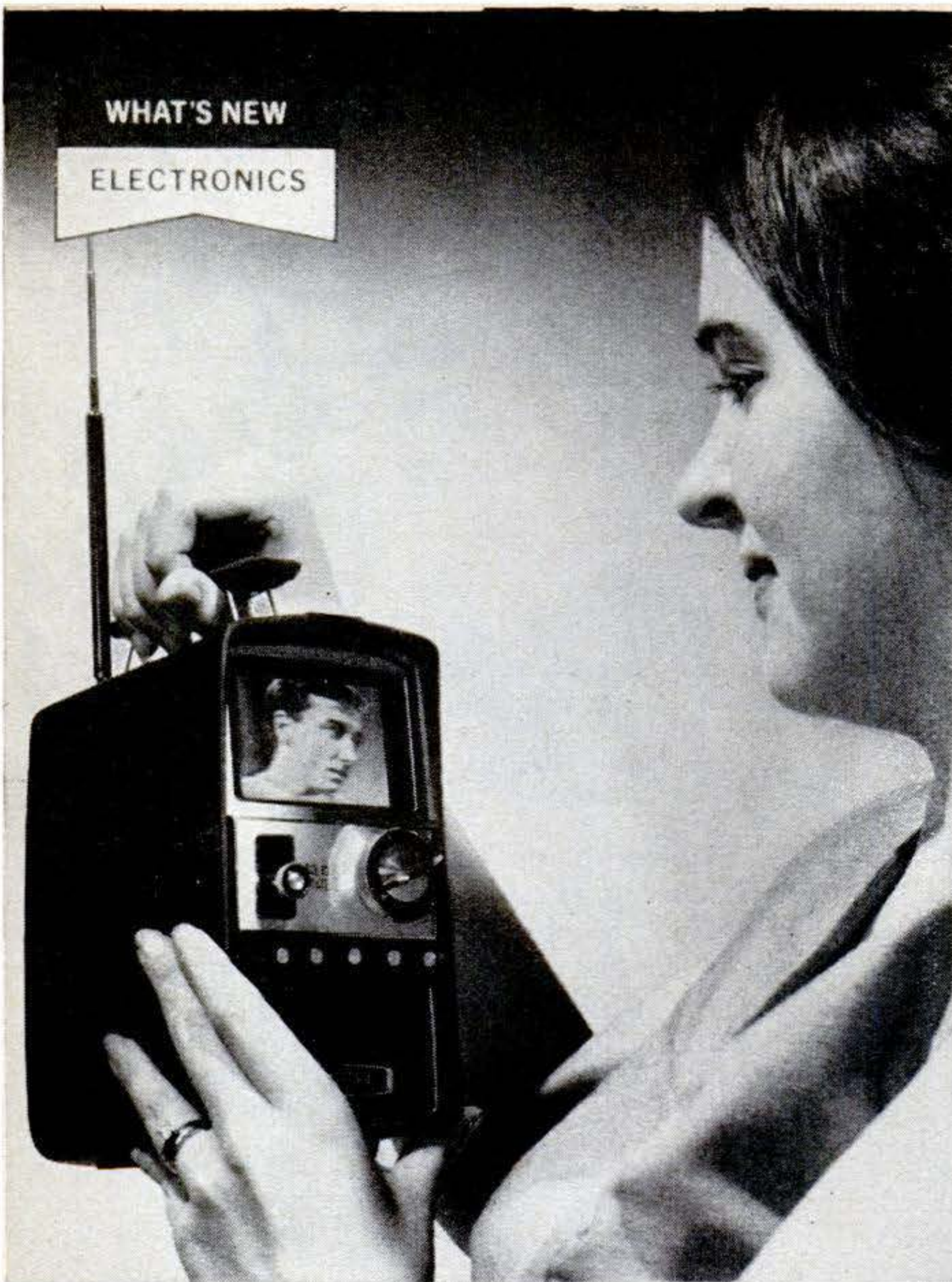
able ones would be shifted forward in their slots (left), then lowered to lift the fixed legs while the platform moved forward (right). The movable legs would then be raised for repeat.

The following patents have been issued on these inventions: Enlarging film—No. 3,222,168 to E. H. Land, Cambridge, Mass.; Tiller arm—No. 3,174,357 to A. G. Conklin, Toronto, Can.; Drowse alarm—No. 3,227,998 to F. N. Platt, Ann Arbor, Mich.; Retracting mirror—No. 3,159,439 to G. C. Miller, Freeport, N.Y.; Mower blade—No. 3,197,951 to F. W. Zick, Beaver Dam, Wis.;

Walking barge—No. 3,230,721 to L. B. De Long, Seattle, Wash., and C. B. Finkelson and G. E. Suderow, NYC. 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.

WHAT'S NEW

ELECTRONICS



First Report: The Tiniest TV Yet

The Japanese have finally done it—built a fully transistorized TV set that's *almost* too tiny to watch. But not quite. The Symphonic Minni-3's snapshot-size, flat-faced 3" picture tube is adequate for solo viewing from a foot or two away.

The \$150 TV is only 6 $\frac{3}{4}$ " high by 6" deep by 3 $\frac{1}{2}$ " wide, and weighs in, with batteries, at 5 $\frac{1}{2}$ pounds. It can be powered by nine C cells or a rechargeable alkaline battery pack (the set has a built-in recharger), by a 12-volt battery in a car or a boat (an accessory connector plugs into the cigar-lighter socket), or by a 120-volt AC power line. You get about six hours of viewing on a set of dry cells or on an overnight recharge of its alkaline battery.

A carrying case, a car antenna, and a mounting rack for a car's back seat are available as accessories. Symphonic Electronic Corp., 470 Park Ave. So., NYC, sells the set here.



A car tape player for your living room

Now you can listen, at home, to pretaped music cartridges designed for your car's dash-mounted tape player. The Satellite II is an AC-powered tape-cartridge transport that plugs into the "tape" input jacks on your stereo amplifier. It costs \$50. Telepro Industries Inc., Cherry Hill, N.J., makes it.

Important news: The "Hertz" is in . . . the "cycle" is out

What the heck is a Hertz? It's the new—and universally accepted—name for the measure of frequency. Recently, several international scientific organizations agreed that henceforth the "Hertz" (abbreviated "Hz") will replace the common phrase "cycles per second" (or "c.p.s.") in technical literature. POPULAR SCIENCE will switch over also, starting in this issue.

Why the change? Most important: to create a scientific symbol for frequency that remains the same in any language. Cycles per second is strictly an English-language expression. And its abbreviation, c.p.s., can be confused with

the abbreviations of other scientific terms—"candle-power seconds," for example.

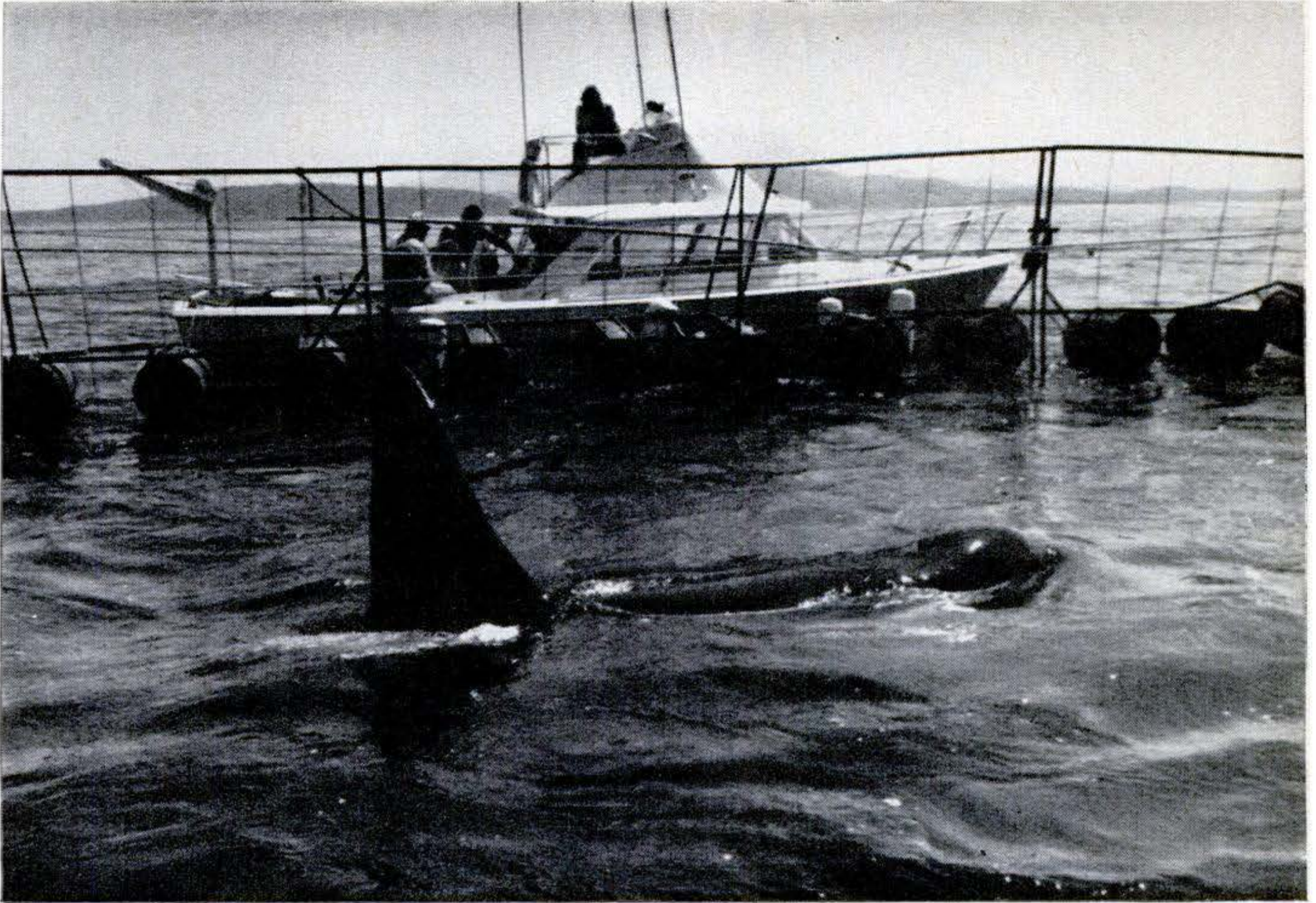
A less important reason is to honor permanently Heinrich Hertz, the 19th-century German physicist who first discovered that tuned circuits can radiate electromagnetic waves.

Here's a short table that compares the old and new frequency terms:

Cycles per second (c.p.s.) = Hertz (Hz)

Kilocycles per second (k.c.p.s.) = kiloHertz (kHz)

Megacycles per second (m.c.p.s.) = megaHertz (mHz)



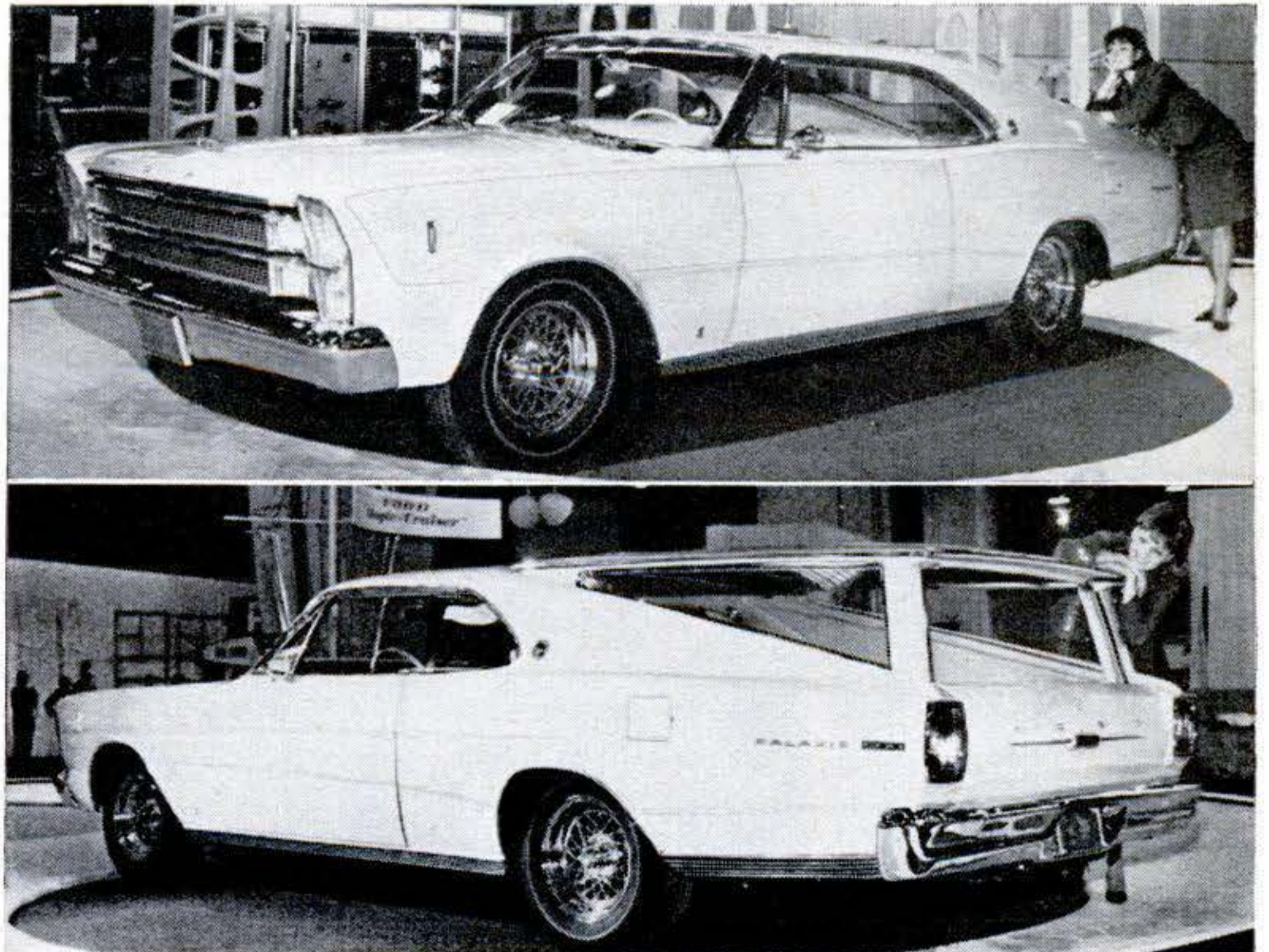
Whale talks for science while transported in underwater pen

With hydrophones and tape recorders installed in an accompanying boat, Namu, a killer whale that blundered into fishing nets off the British Columbia town of that name, carried on an animated conversation with uncaptured whales

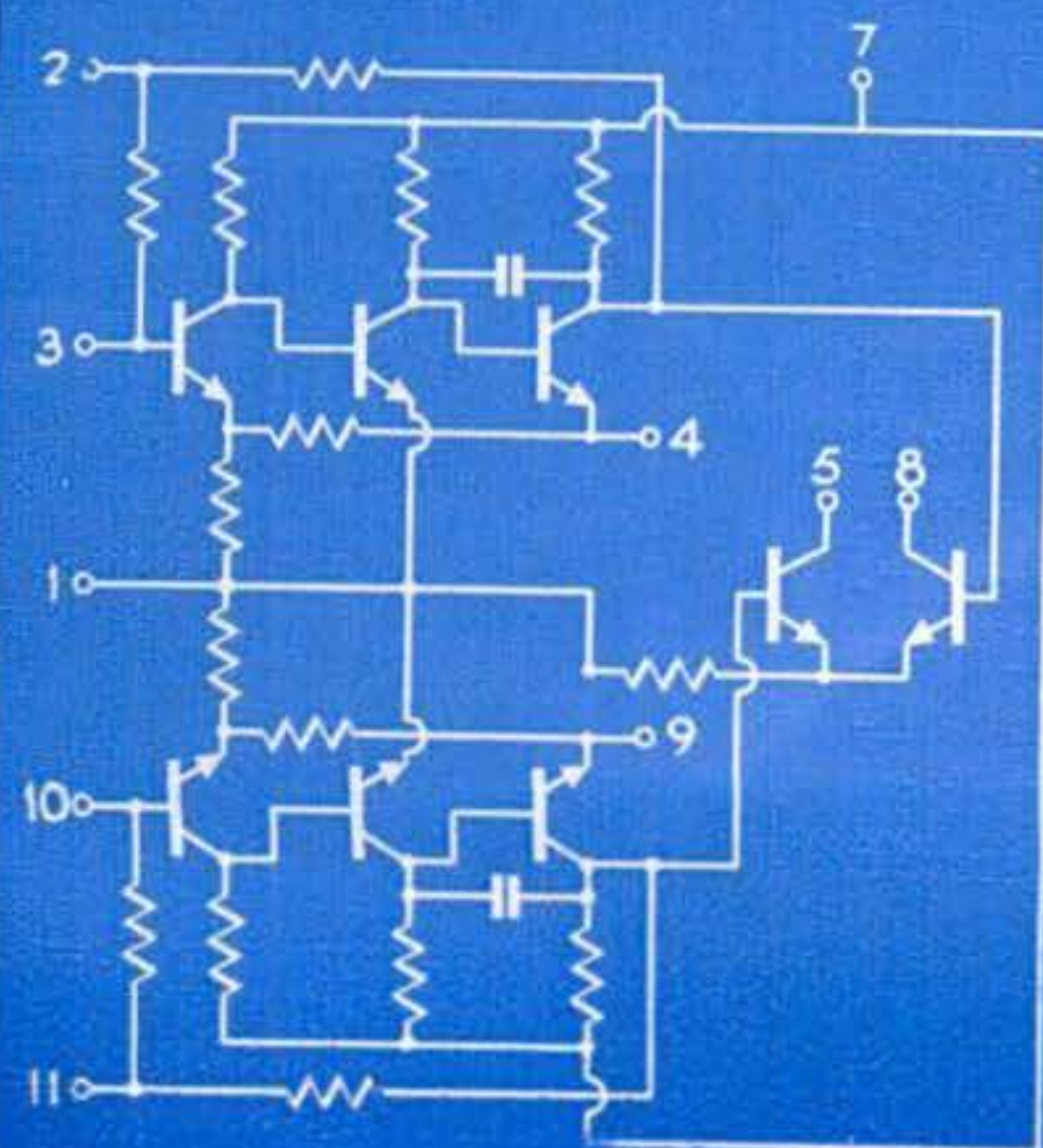
while being transported in a floating cage to a Seattle aquarium. Scientists got 23 reels of tape recordings, good for nine hours of "meaningful" data now being correlated with underwater movies. They are attempting a translation.

Ford fastback converts to wagon

The new custom-styled fastback at top right turns into a station wagon. The fastback section of the roof and two side panels with windows rise electrically (bottom). Lowering the tailgate permits entry to a rear-facing third seat. Designed by Ford and built by George Barris, Los Angeles custom-car expert, it's an experimental convertible, but could be put on the market if there's enough demand.



A Treasure Finder



Heart of the treasure finder's receiver is the tiny integrated circuit (far left). Inside is a chip of carefully prepared silicon the size of a pinhead that can perform the same circuit functions (see diagram, left) as a chassis-full of conventional transistors and parts.

Thirty dollars' worth of parts and a few evenings of work give you the basic tool you need to hunt for buried treasure

By RONALD M BENREY / PS Electronics Editor

PHOTOS BY ROBERT D. BORST

Here's the next best thing to Captain Kidd's personal treasure map when you go hunting for buried treasure: an easy-to-build electronic metal detector. This sophisticated cousin to the old-faithful Army mine detector is perfect for ferreting out subterranean objects—including buried treasure. Of course, all that glitters is not gold, and this unfussy instrument will respond with equal gusto to buried beer cans. But false alarms are half the fun of searching for underground booty. And, as a bonus, when you're home from the treasure hunt, you can use your metal detector to locate gas, water, and sewer pipes under your property.

How it works. The device consists of a low-power transmitter and a sensitive radio receiver, mounted like the weights of a dumbbell on opposite ends of a parallel pair of nonmetallic connecting rods. The transmitter broadcasts low-frequency radio waves—roughly at a frequency of 120,000 Hertz (or 120 kHz). (Note: the "Hertz" is the new symbol for frequency. See page 108 of this issue for details.)

The receiving and transmitting antennas

are both highly directional multiturn loops, mounted, respectively, on the rims of the receiver and transmitter enclosures. They are oriented at right angles to each other—in a mutual "null" position—so that normally the receiver doesn't pick up any of the transmitted signal.

In the vicinity of a metal object, however, the electromagnetic field of the transmitted signal is distorted, and the receiver does pick up part of the transmitted signal. In effect, the metal mass acts like a third antenna that picks up and then rebroadcasts the signal in the direction of the receiver.

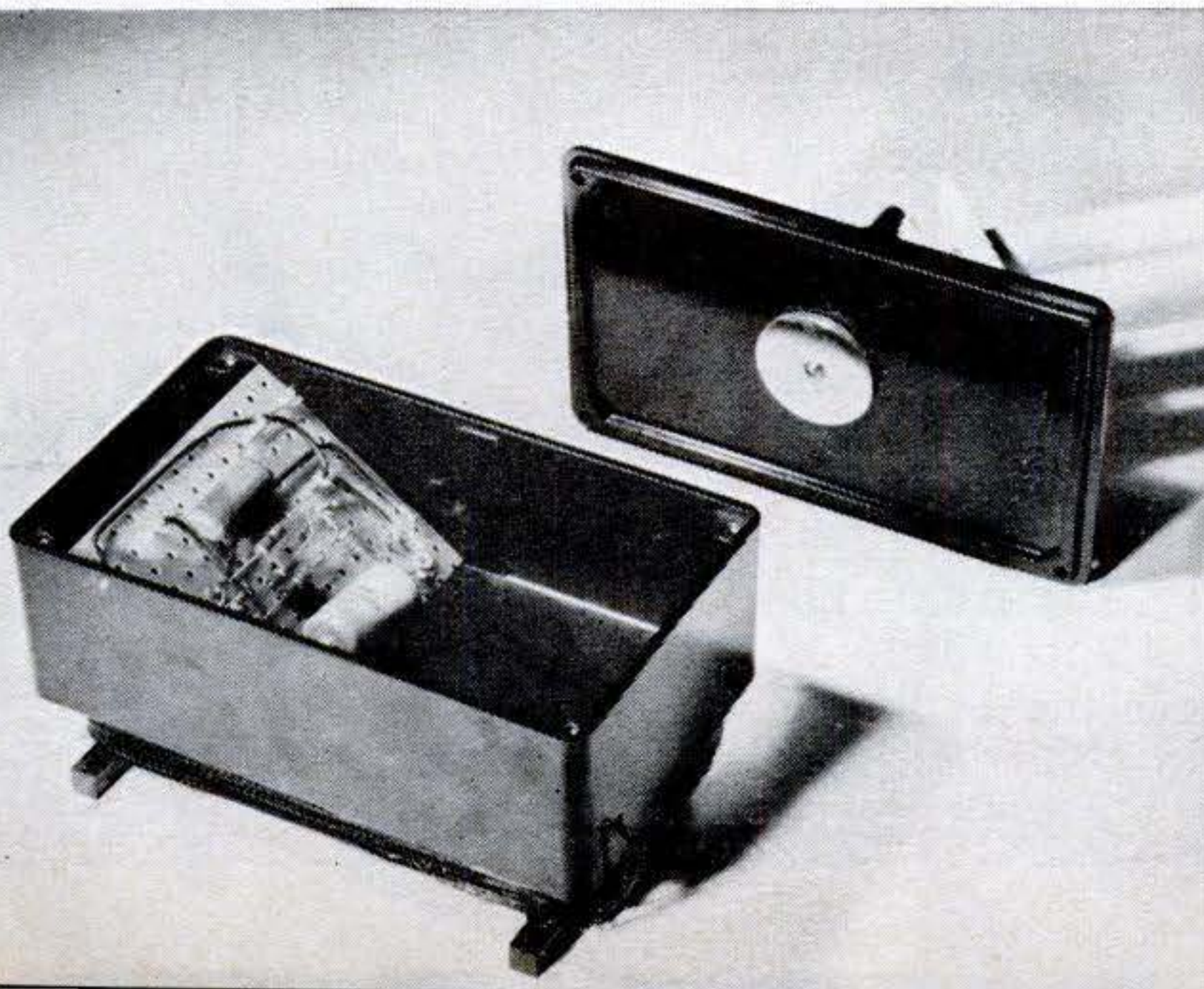
Circuitry. Heart of the transmitter is Q2 (see diagram), a silicon-controlled rectifier (or SCR). It functions as an electronic switch. Each time it is triggered "on" by an output pulse from unijunction transistor Q1 (which is wired to form a fixed-frequency pulse generator producing 200 pulses per second), it discharges capacitor C2 through two turns of the transmitter's coil, L1.

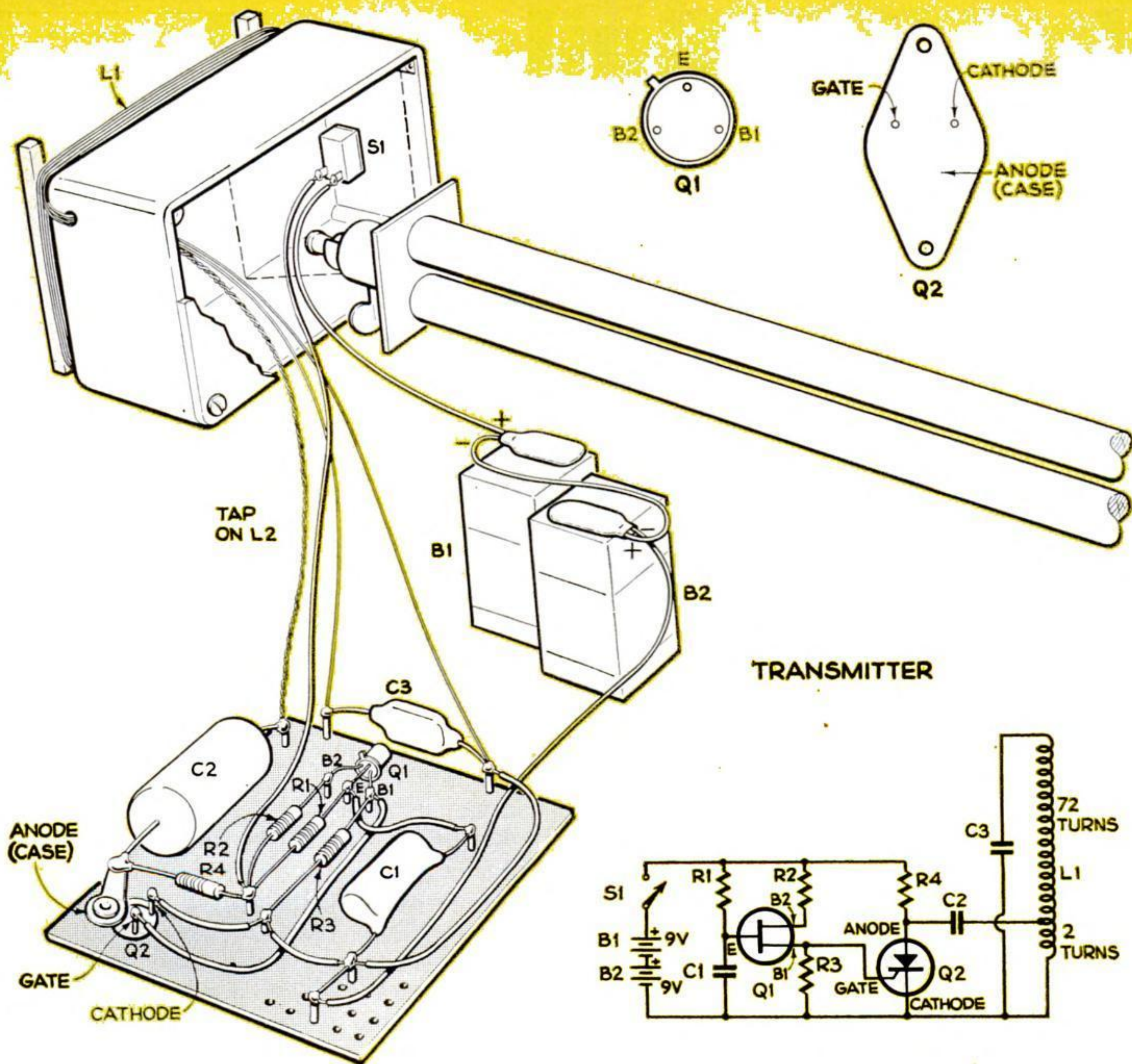
The sudden burst of current causes the tuned circuit, composed of L1 and C3, to

Continued

Transmitter circuit board is held in place by the center moldings inside the instrument case. Two nine-volt batteries fill the remaining space. L1's leads enter the case through a $\frac{1}{8}$ " hole.

Cement coil forms, as described in the text, on the bottoms of both the transmitter (shown below) and receiver instrument cases. The two phenolic cross-bars prevent wound coils from spilling off the form.





oscillate for a few thousandths of a second at a frequency of 120 kHz. In the vicinity of a metal object, the receiver detects each of these bursts. Since they occur about 200 times per second, the audio output of the receiver's headphones is a 200-Hz tone, whose volume depends on the dimensions and nearness of the metal mass.

The receiver circuitry is built around an integrated circuit (or IC) amplifier, Q3. Inside this transistor-size component is a tiny chip of silicon that contains a complete audio amplifier circuit—including eight transistors, 14 resistors, and two capacitors.

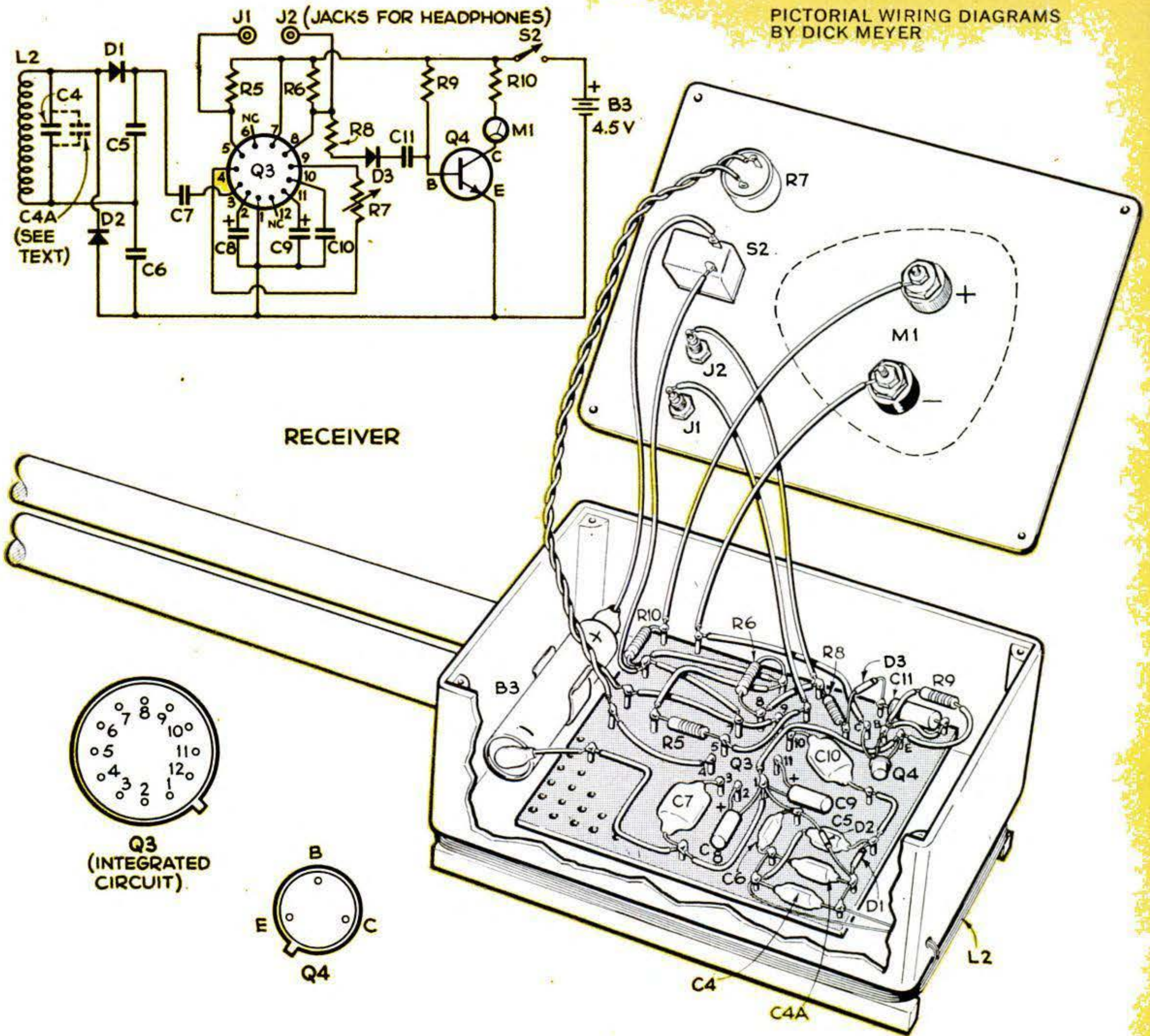
The receiver is basically a highly amplified crystal set tuned to the transmitter's operating frequency. The receiver's antenna coil, L2, and capacitor, C4, form a

tuned circuit that responds to 120-kHz radio signals. Radio-frequency signals picked up by the circuit are detected by the germanium diodes D1 and D2, and the audio tone signals are amplified.

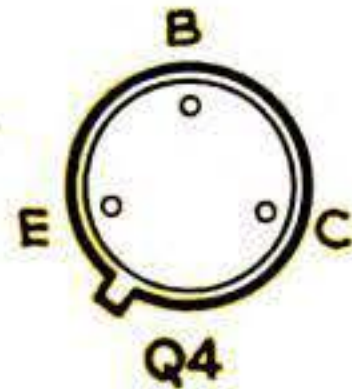
Conventional transistor Q4 serves as a meter amplifier, and provides a visual indication of the signal strength received on panel meter M1.

Building it. Mount the transmitter components on a 3½"-by-2⅞" piece of perforated phenolic chassis board (Vectorboard). Fashion a scrap-metal bracket to hold the two nine-volt batteries in place inside the case.

Cement (with epoxy) four ½" pieces of ¼" phenolic or wood dowel to the corners of the bottom of the transmitter case, to



RECEIVER



PARTS LIST

- R1—15,000-ohm, 1/2-watt carbon resistor
- R2—220-ohm, 1/2-watt carbon resistor
- R3—22-ohm, 1/2-watt carbon resistor
- R4—470-ohm, 1/2-watt carbon resistor
- R5, R6—270-ohm, 1/2-watt carbon resistors
- R7—5,000-ohm carbon potentiometer (audio taper)
- R8—47,000-ohm, 1/2-watt carbon resistor
- R9—330,000-ohm, 1/2-watt carbon resistor
- R10—1,800-ohm, 1/2-watt

- carbon resistor
- C1—0.3-mfd., 200-volt paper capacitor
- C2—1-mfd., 200-volt paper capacitor
- C3, C4, C5, C6—.001-mfd., (1,000-pf.) mylar capacitors (any voltage rating)
- C7, C10—.003-mfd., 200-volt paper capacitor
- C8, C9, C11—10-mfd., 10-volt electrolytic capacitor
- D1, D2, D3—1N34A germanium diodes
- Q1—GE. 2N2646 unijunction transistor

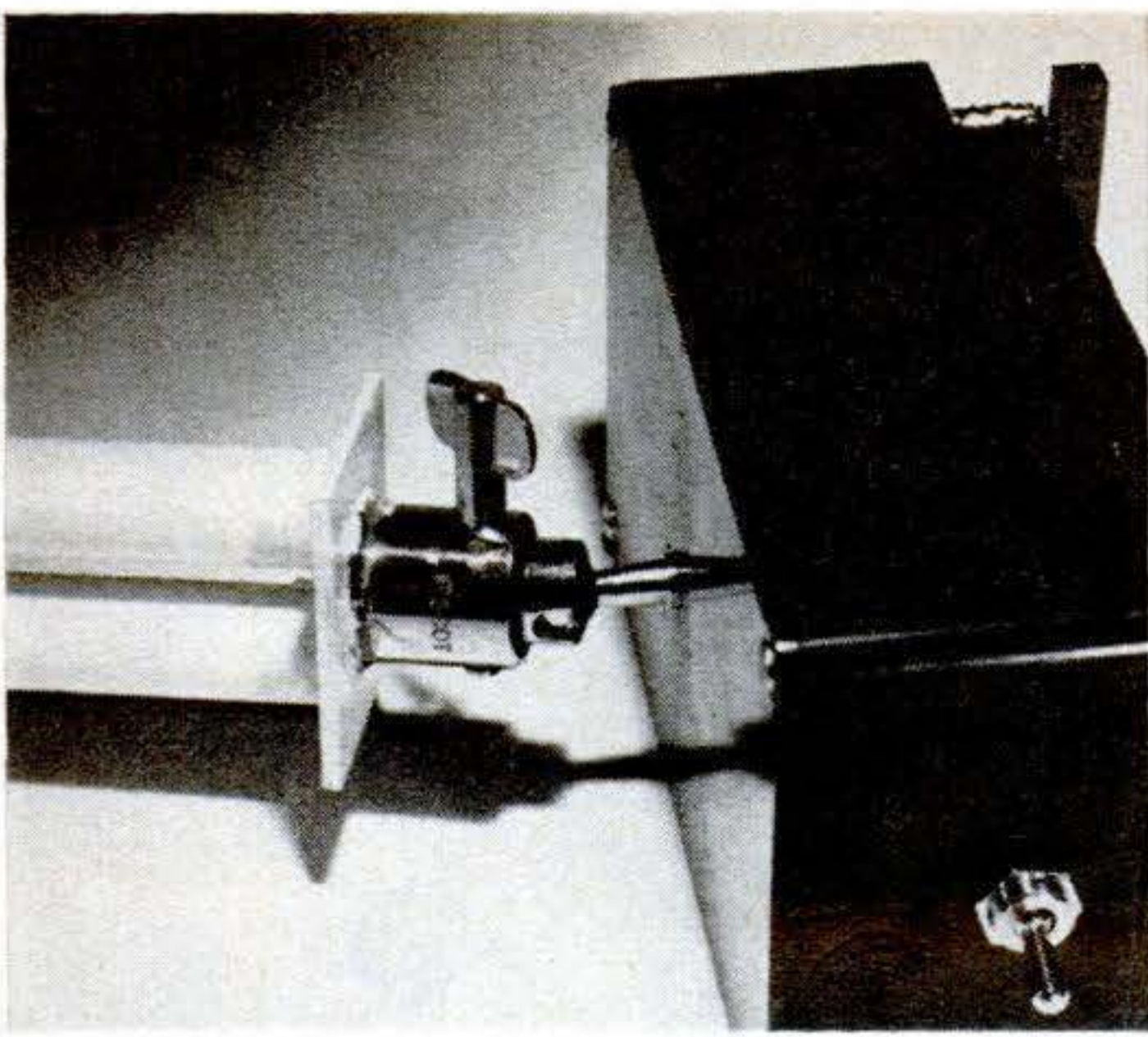
- Q2—RCA 2N3228 silicon-controlled rectifier
- Q3—Westinghouse WC 183T integrated-circuit audio amplifier. (Write: Westinghouse, Molecular Electronics Div., Box 7377, Elkridge, Md., for name of dealer.)
- Q4—2N1302 NPN transistor
- S1, S2—SPST toggle switch
- J1, J2—phone-tip jacks
- Phones: 4,000-ohm communications-type magnetic headphones
- Meter—0-1 milliampere

- DC panel meter (Parker model S-35, 0-1 ma.)
- B1, B2—Burgess 2N6 carbon-zinc 9-volt battery
- B3—Burgess APX-19 mercury 4.5-volt battery
- Instrument cases—transmitter: 6 1/4" x 3 3/4" x 2" plus cover; receiver: 6 13/16" x 5 9/32" x 2 5/16"
- Misc.—perforated chassis board; push-in terminals; battery-connector clips; #27 enamel-covered magnet wire (1/4-pound will wind both coils); phenolic rod; phenolic tubing

make a coil form and support for coil L1. Add two phenolic crossbars to prevent the wound coil from slipping off. A photo shows the coil form on the receiver case—the transmitter form is made the same way.

L1 consists of 74 turns of #27 enamel-coated magnet wire close-wound on the form, and tapped two turns from the cold (or grounded) end. Wind two separate

Continued



A camera tripod tilt-and-pan head (available at photo-supply shops) serves as a universal joint that allows you to adjust the transmitter's orientation to the receiver to produce a sharp null.

coils—one with two turns and the other with 72 turns—in the same direction on the form. Solder together the top lead of the two-turn coil and the bottom lead of the 72-turn coil to form the tap.

The receiver is also built into a Bakelite instrument case. Wire its circuit on a second perforated chassis board. Make a socket for the IC by forming a ring of 10 push-in terminals on the board. Note: Two of the IC can's leads—numbers 6 and 12—are dummies, and are not connected to the internal silicon chip. Cut them off close to the can before mounting the IC. Attach a clip-on heat sink to each of the other leads before soldering in place.

Mount panel meter M1, volume control RR7, power switch S2, and headphone tip jacks J1 and J2 on the instrument-case lid.

The panel meter specified in the parts list is a rugged—and relatively expensive—0-1-milliampere DC movement. If you wish, substitute a less expensive meter.

Mount the receiver-circuit board in the instrument case with machine bolts and metal spacers. Make a scrap-metal bracket to hold B3, the cylindrical 4½-volt mercury battery. Use snap-on terminals to connect the battery.

Add a coil form to the bottom on the case, as described earlier, and wind receiver coil L2. It consists of 68 turns of #27 enamel-coated magnet wire, close-wound on the form.

Connecting rods. Make these from 2' or 3' lengths of ¼"-o.d. phenolic tubing or wood dowel. Cement the rods to the re-

ceiver case in the positions shown in the diagrams. Mount a universal joint, made from a photographic-tripod tilt-and-pan head, on the transmitter end of the pair of rods (see close-up photo at left). It allows you to adjust the relative orientation of the receiver and transmitter coils to produce a perfect null.

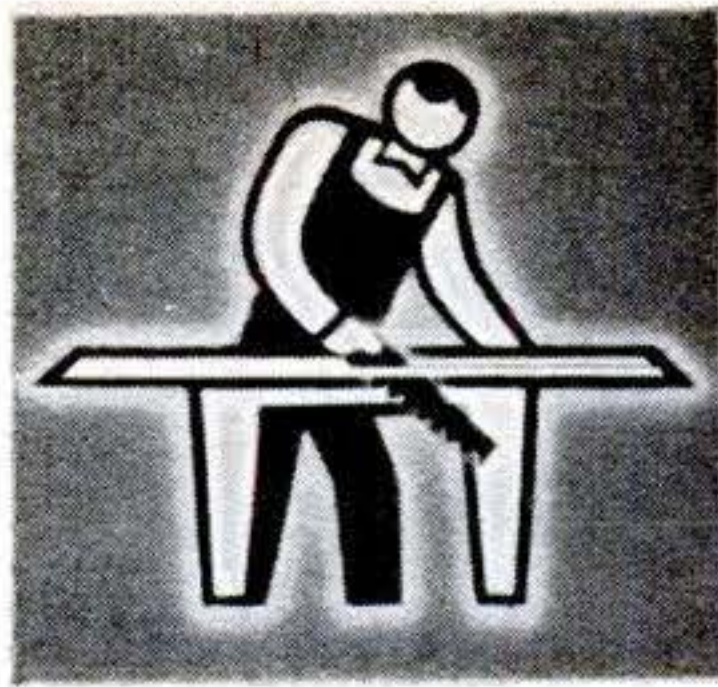
Here's how you install the joint: Cement free ends of the connecting rods to a 1½" square of ½" hardboard or fiberboard. Then cement the base of the tilt head to the other side of the square. Finally, bolt the ball portion of the head to the lid of the transmitter's instrument case.

Tuning up. The transmitter is fixed-tuned and requires no adjustment. The receiver, though, must be fine-tuned to the output frequency of the transmitter. This is a one-time-only job, and is done by adding experimentally one or two extra .0005-mfd. (500-pf.) capacitors in parallel with C4. Note: On the schematic diagrams this additional capacitance is labeled C4a.

Start by separating the completed transmitter unit from the connecting rods (just unbolt the tilt head), place it about 10' from the receiver, and switch it on. Turn the receiver's volume control full up, and orient the receiver's coil for maximum volume in the headphones (and highest reading on the meter). Then turn the receiver off, and wire a 500-pf. capacitor across C4. Carry out the listening test again. If the additional capacitor lowers the maximum volume (or the meter reading), remove it—your receiver is tuned up as is. If the capacitor boosts the signal strength, leave it in place and try adding a second extra capacitor.

Using it. This instrument works best at finding moderate to large (tin-can size and larger) metal objects buried at depths of up to 5' in average soil. First step in searching is to adjust the universal joint for a receiver/transmitter null. Unlock the joint and carefully position the transmitter for minimum tone volume in the headphones.

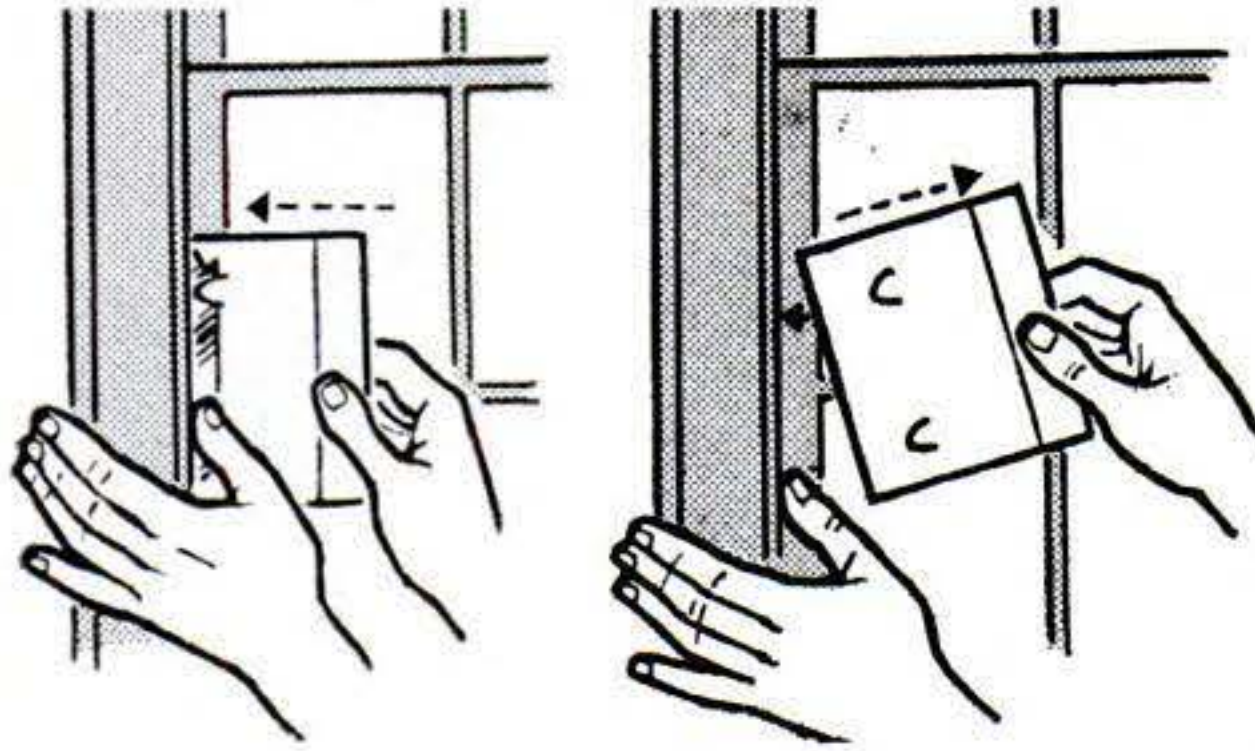
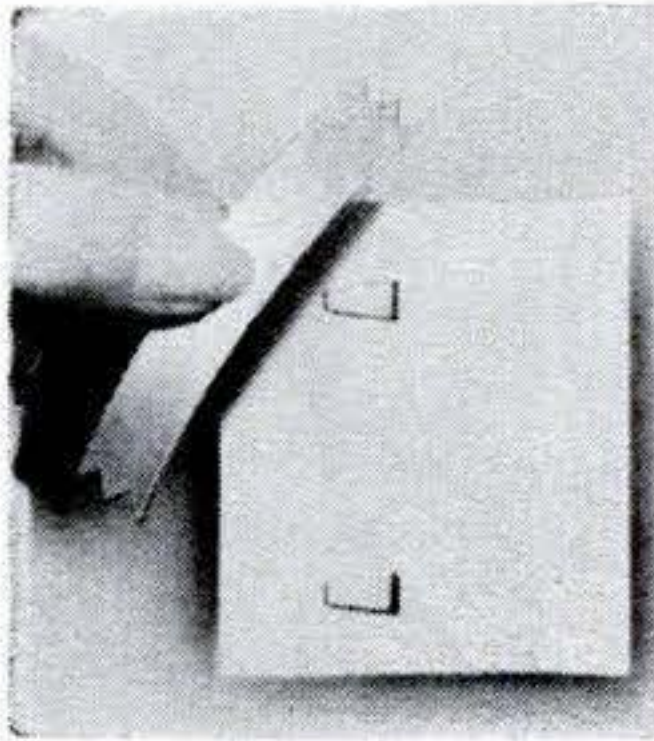
Hold the detector so that receiver coil L2 is close to and parallel with the ground. In hilly terrain, you can grip the detector by the connecting rods; when searching over flat ground, fasten a carrying strap made from a 4' length of canvas webbing to the ends of the connecting rods—it will add to your endurance since you can hunt without stooping. PS



Shop Talk

By ROBERT P. STEVENSON

How to live happily with a broken sash cord—or none at all



A century-old inconvenience in my home has finally given way before an ingenious 1966 product that may be just what you need, too!

Some weeks ago I received a package of Window Control Gliders, curved strips of stainless-steel spring $\frac{1}{2}$ " wide and 3" long. These are designed to stop window rattles. They also make it unnecessary to tear a window

apart to replace a broken sash cord. You use a metal guide to flatten them for insertion in the crack between sash and window stop, one on each side of the window. When you remove the guide, the curved spring exerts pressure between the sash and window stop, but the sash still moves up and down normally.

My home was built around 1850—before double-hung windows with sash cords had become common. In the original windows that remain, only the lower sash moves, and all through the years it has been necessary to keep a stick handy to prop it open. I've now thrown away the sticks. The gliders keep each window open right where I want it, just as they would a modern window with broken cords. Eight gliders and a metal guide cost \$1.49 from Silent Window Glider Co., 533 N. La Cienega Blvd., Los Angeles 90048.

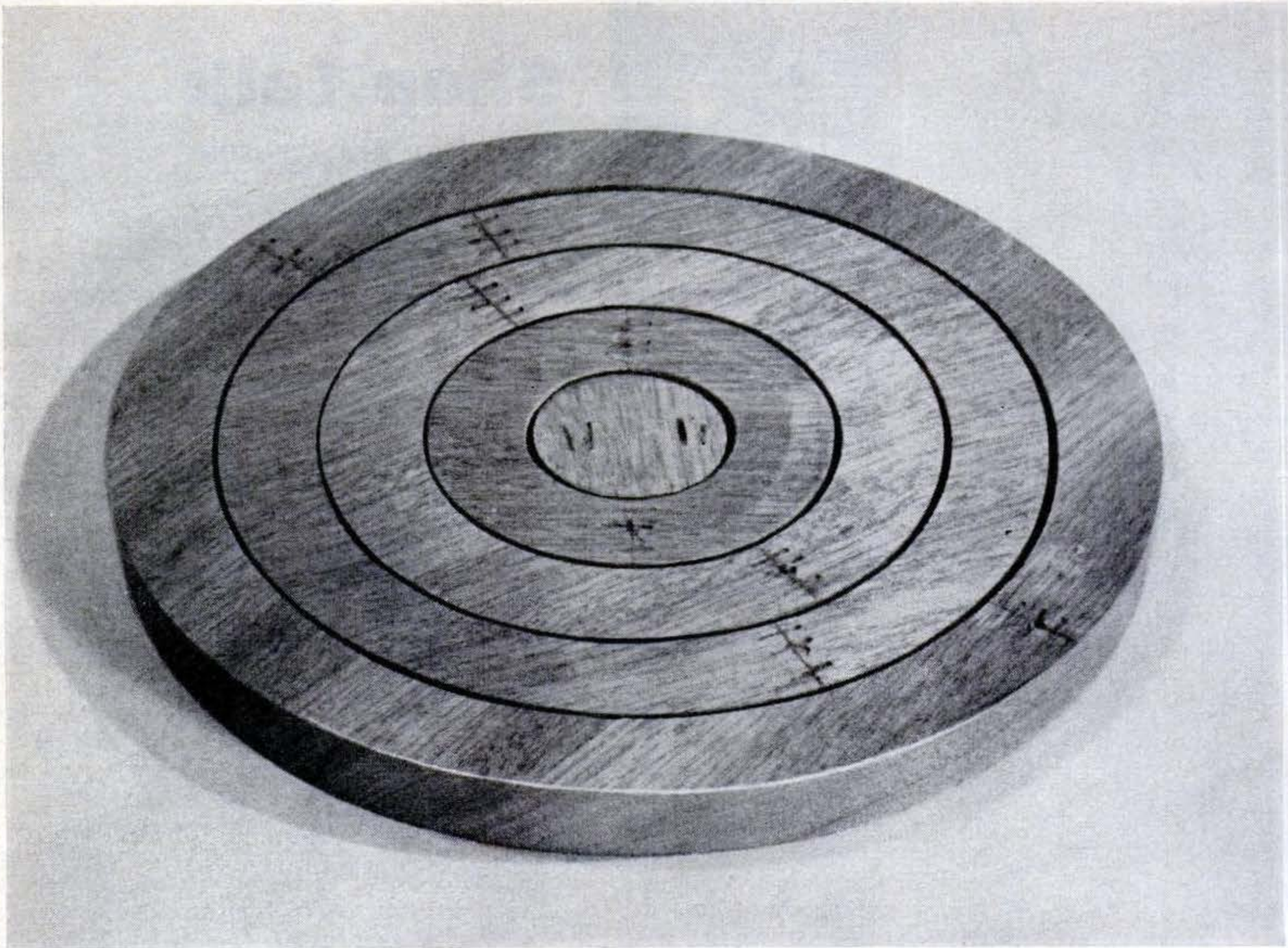
Brief reports about new products and free guide books

The makers claim it's just about impossible to break a new 15-watt portable fluorescent extension light, that it can even be operated safely when totally submerged in water. Write K & H Industries, Angola, N.Y. 14006 . . . Crimped wire that resembles a woman's bobby pin is a new solution for loose screws. Bend it into a V; insert it in the hole. Screw Grip kit contains six 6" pieces of the wire, costs 50 cents postpaid. Address Mobius Enterprises, 1121 Elmwood Ave., Buffalo, N.Y. 14222 . . . The latest tips for putting up gypsum wallboard are included in a new brochure available free from A.S. Melville, Bestwall Gypsum Division, Georgia-Pacific Corp., 2 Industrial Blvd., Paoli, Pa. . . A booklet containing plans for 10 household projects is available free by writing to Paul Silken, Inc., 21 W. 46 Street, NYC. Ask for the Woody's Workshop plans booklet.



New straight-line finishing sander is styled like an iron

Wen's new 310 finishing sander is a very comfortable little handful. It weighs only $3\frac{1}{2}$ pounds and you can use it with ease in any position, even high on a wall or overhead to smooth a drywall joint. Because it's styled like a clothes iron and budget-priced at \$14.95, the Wen merchandisers think it may appeal to the lady of the house, prompting her to take on such tasks as refinishing the family furniture. That may or may not prove true but, whoever uses it, you can be sure that its $\frac{3}{16}$ " straight-line strokes, at a rate of 7,200 a minute, will smooth a lot of area very, very fast.

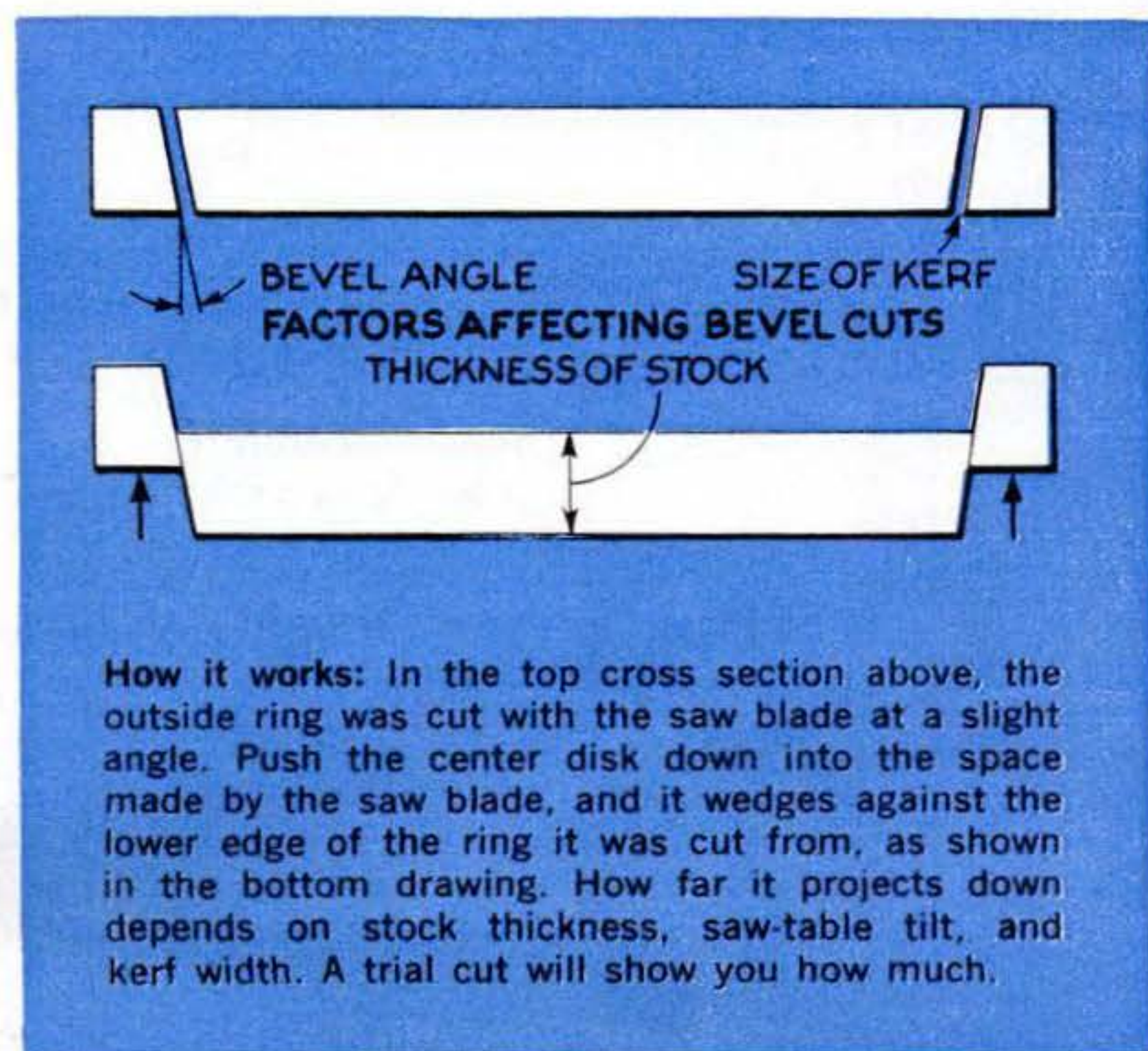


How to Use the Drinking-

By R. J. DE CRISTOFORO

Here's a clever way to make deep shapes in wood. You do it with a flat board using the old idea of the collapsible drinking cup. How does it work? Jigsaw a disk in the center of a board, and the disk drops through the opening. Do the same thing with the saw table tilted about five degrees, and the beveled disk falls only part way through the beveled opening. Then it jams tight like a bung in a bunghole.

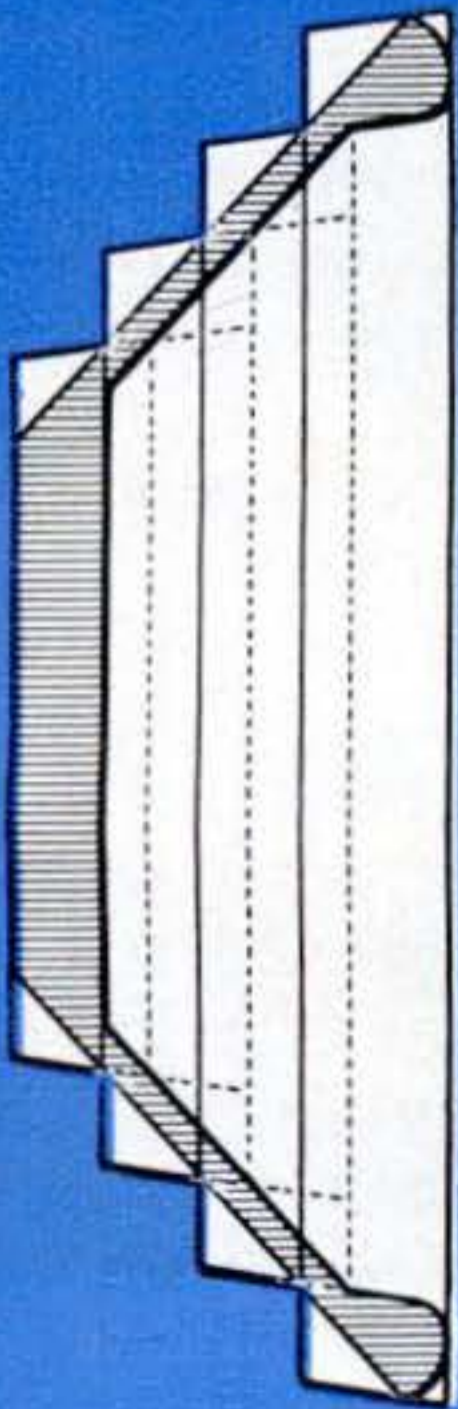
Now cut a series of concentric beveled rings. Each sinks down in the opening it was cut from, and you get a cone shape. The more rings you cut, the deeper the cone you can make.



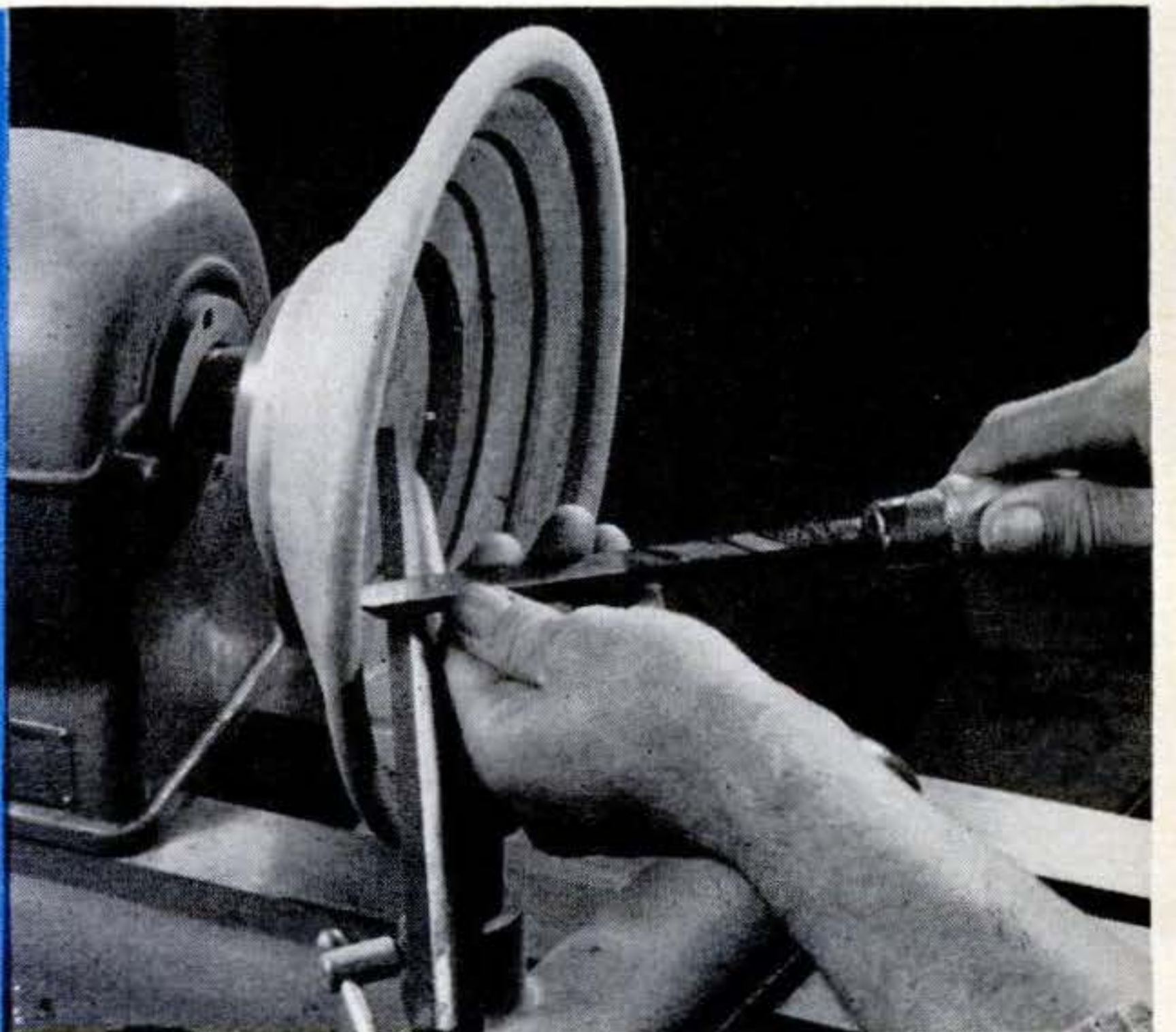
parts of a collapsible cup

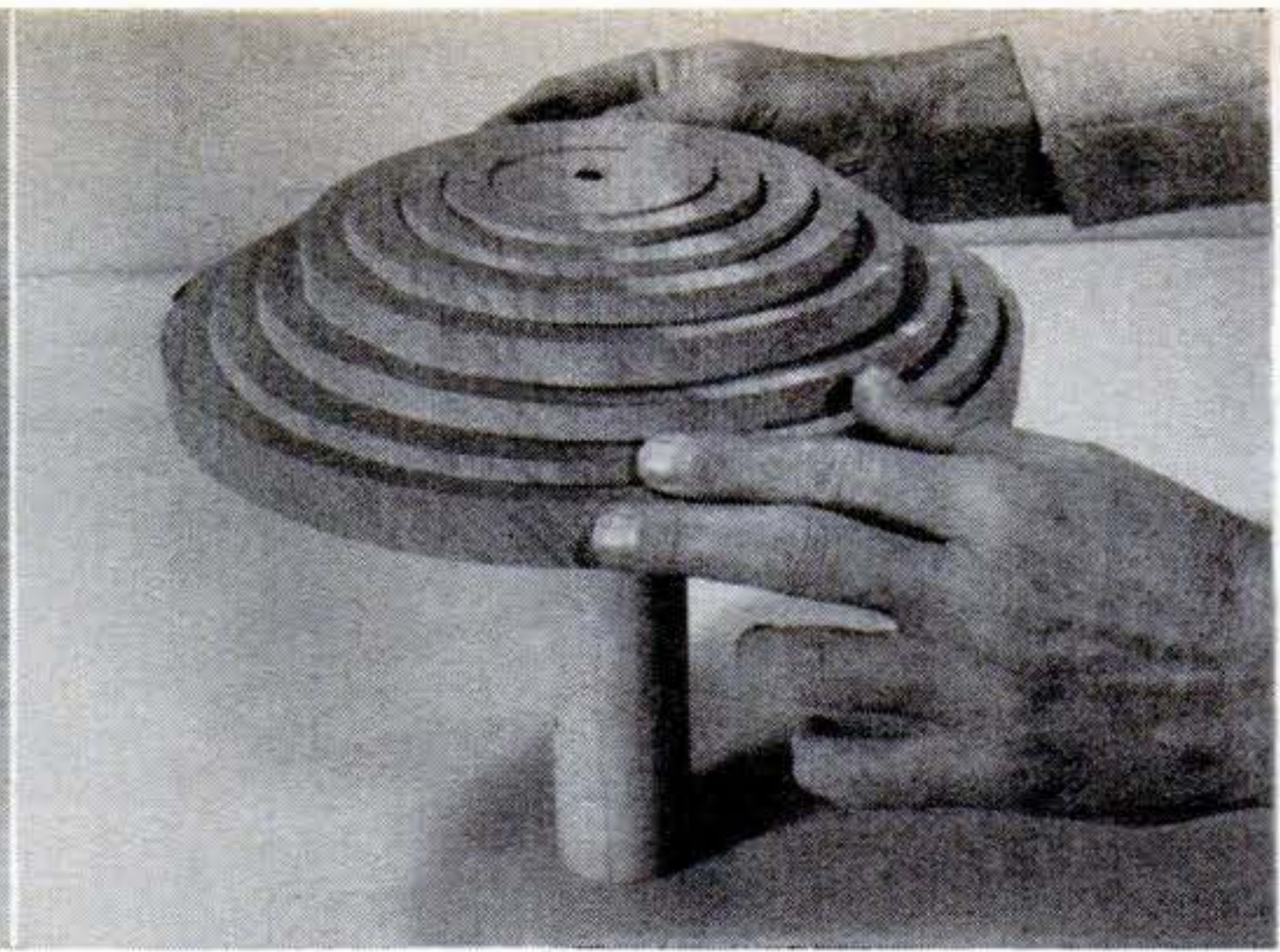
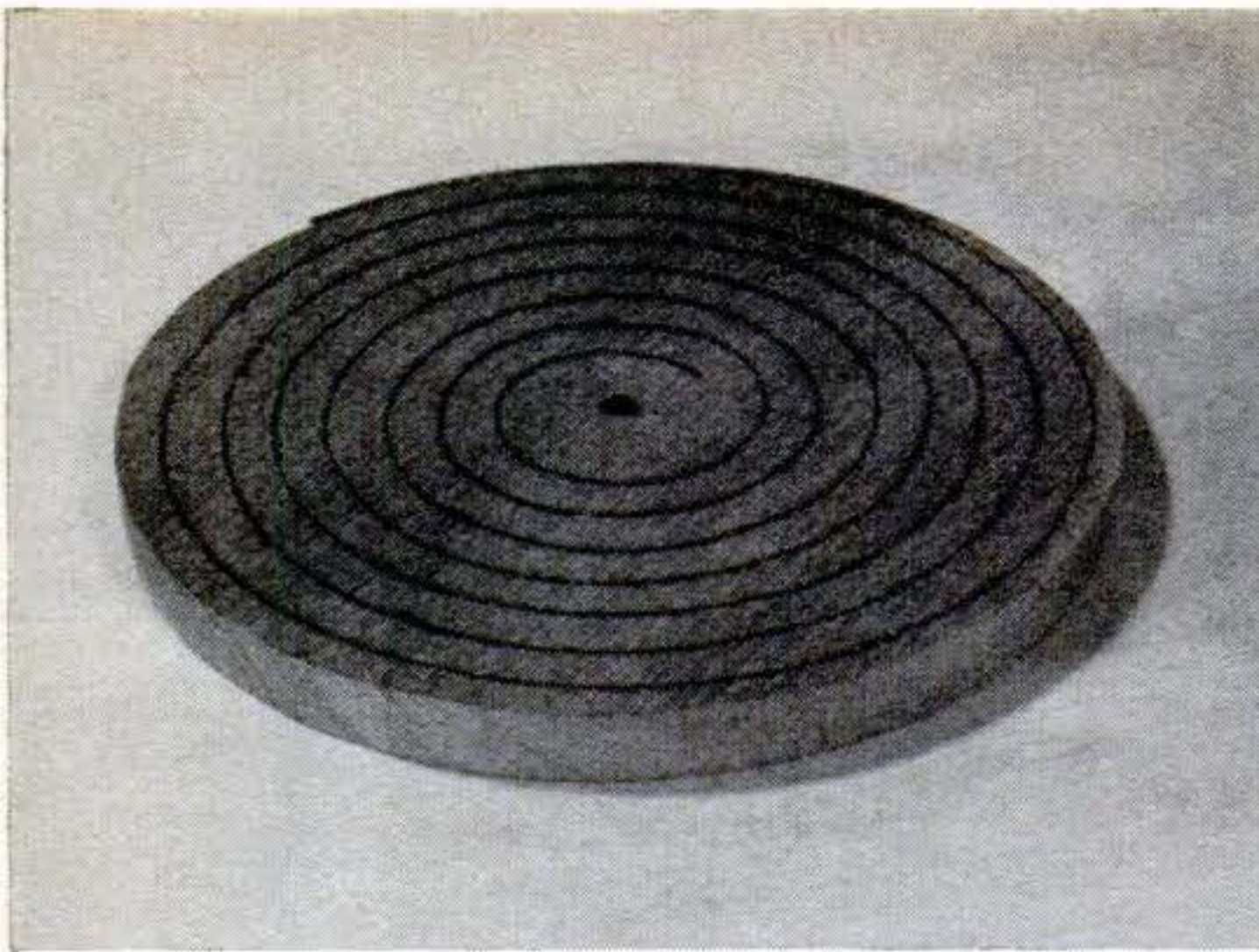


Cup Trick in Woodworking



Blanks for lathe-turning deep-shaped objects are easily built up by this trick. Several factors determine wall thickness, so you have to plan the project. The best way is to make a full-size layout of a cross section of the lathe blank, as at left, and sketch in the contours of the piece to be turned.

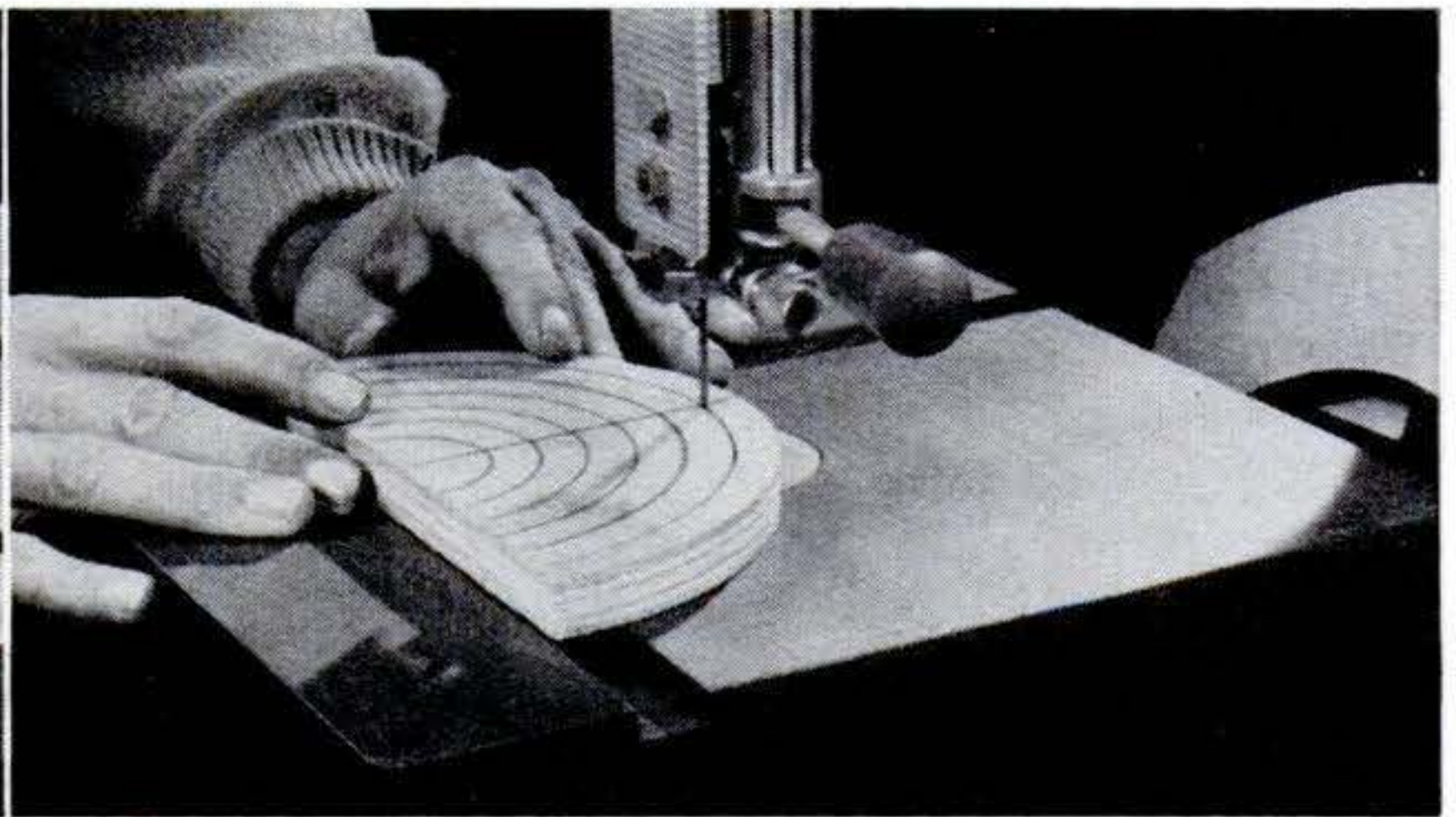
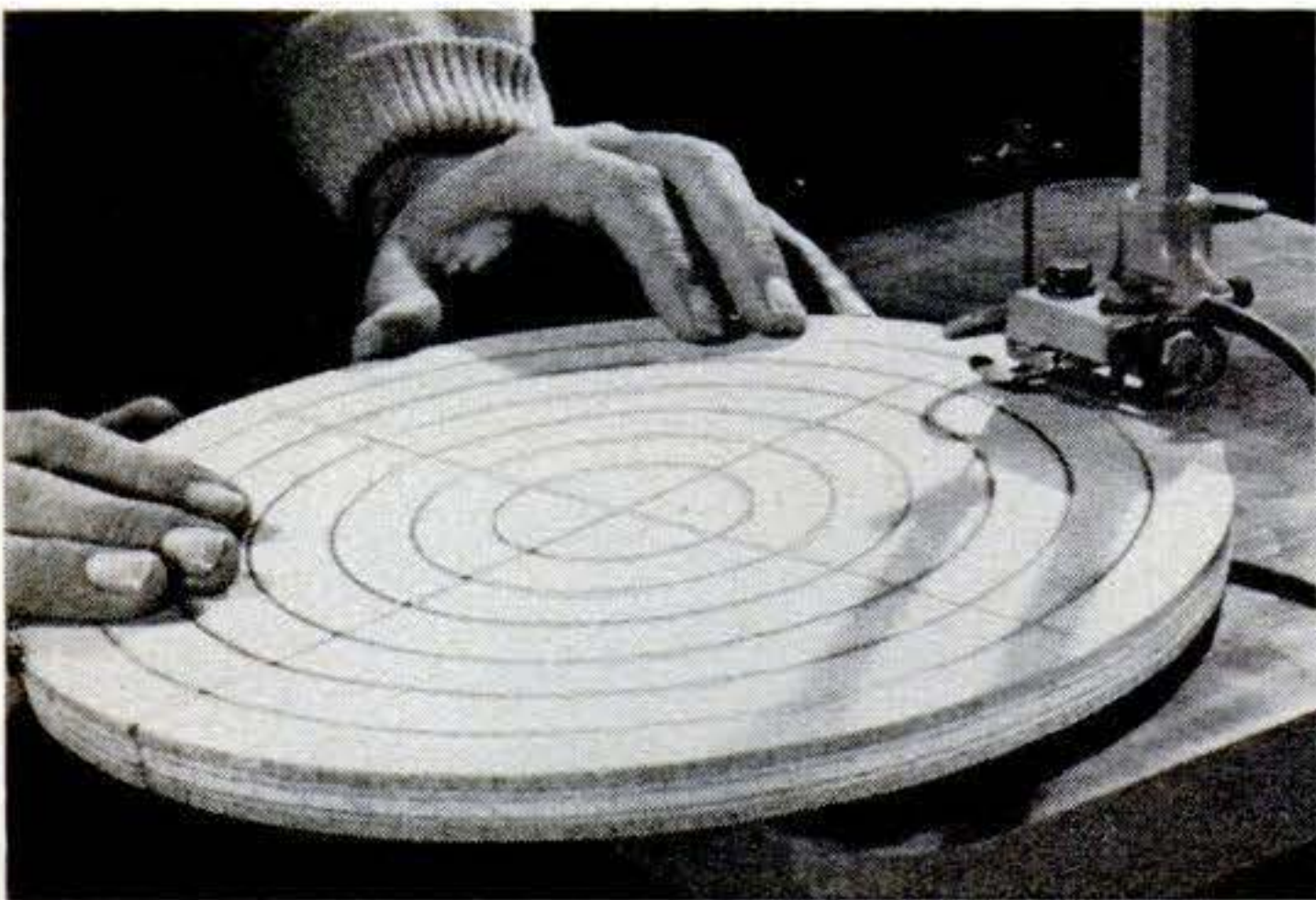




Spiral cut with a jigsaw also yields deep shapes

Spiral cut gives you the same kind of projection you get with concentric rings. Big advantage: You don't need a starting hole for the blade, and you make the

bevel cut in one continuous line. The method works with either a jigsaw or bandsaw. Slim brads hold the projected shape while the glue sets.



How the cuts are made on either jigsaw or bandsaw

Blade-insertion holes are needed for jigsawing. Drill the holes at the same angle at which you will do the cutting, and make them just big enough for the blade to go through. A bandsaw blade can't be

inserted through a starting hole, so you have to cut the blank in half, saw the half sections, and then rejoin them. Make clean, careful cuts. You can't sand afterwards; it would enlarge the kerf.

What can you make with the shapes? Here are some ideas: planters, raised bases, hollow hulls for boats models, trays with raised lips, signs with raised letters, panels with raised sections, drawer pulls cut directly from the drawer front, and, of course, blanks for lathe-turning bowls, plates, and trays. As you experiment, you'll find more possibilities.

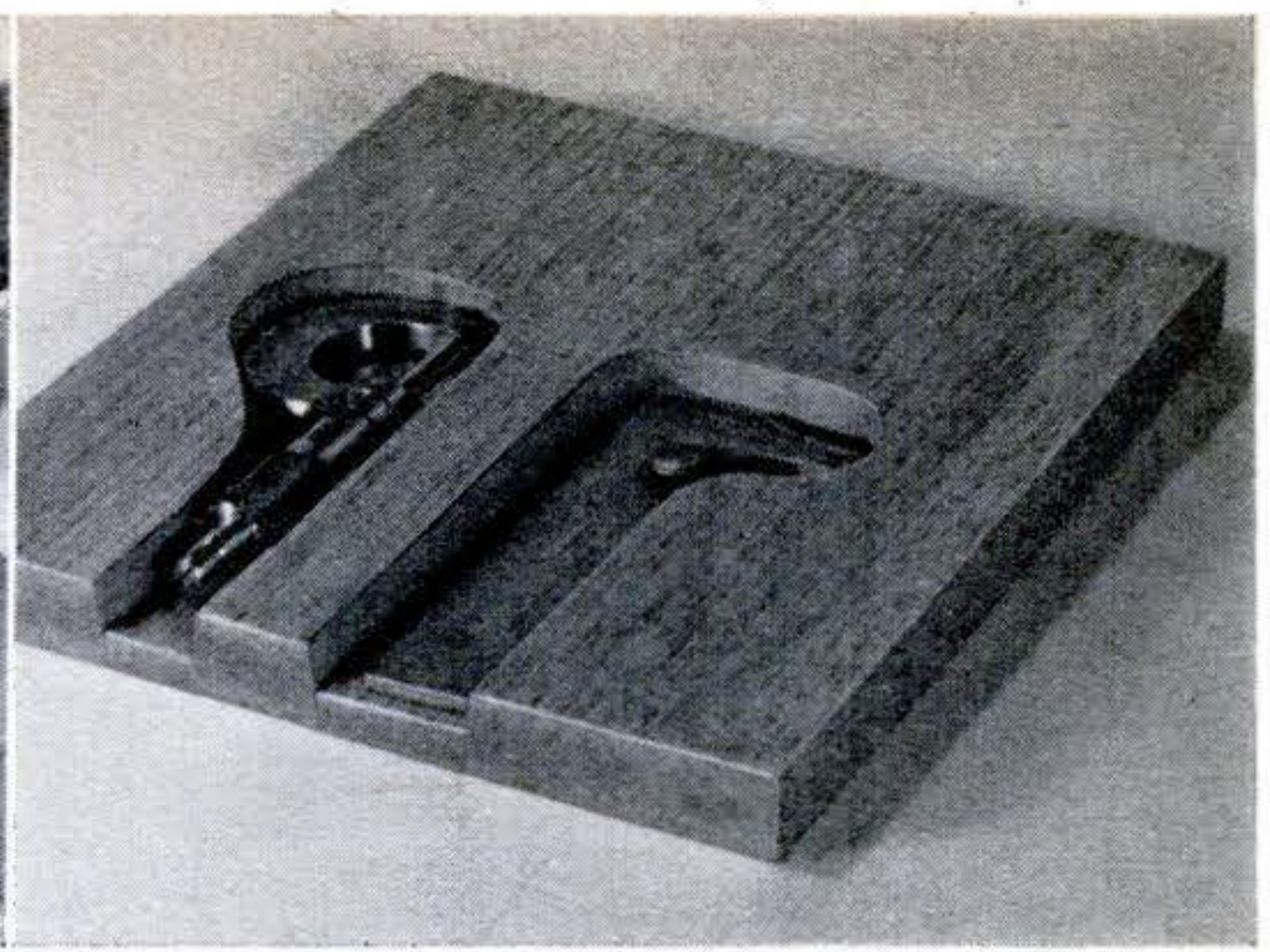
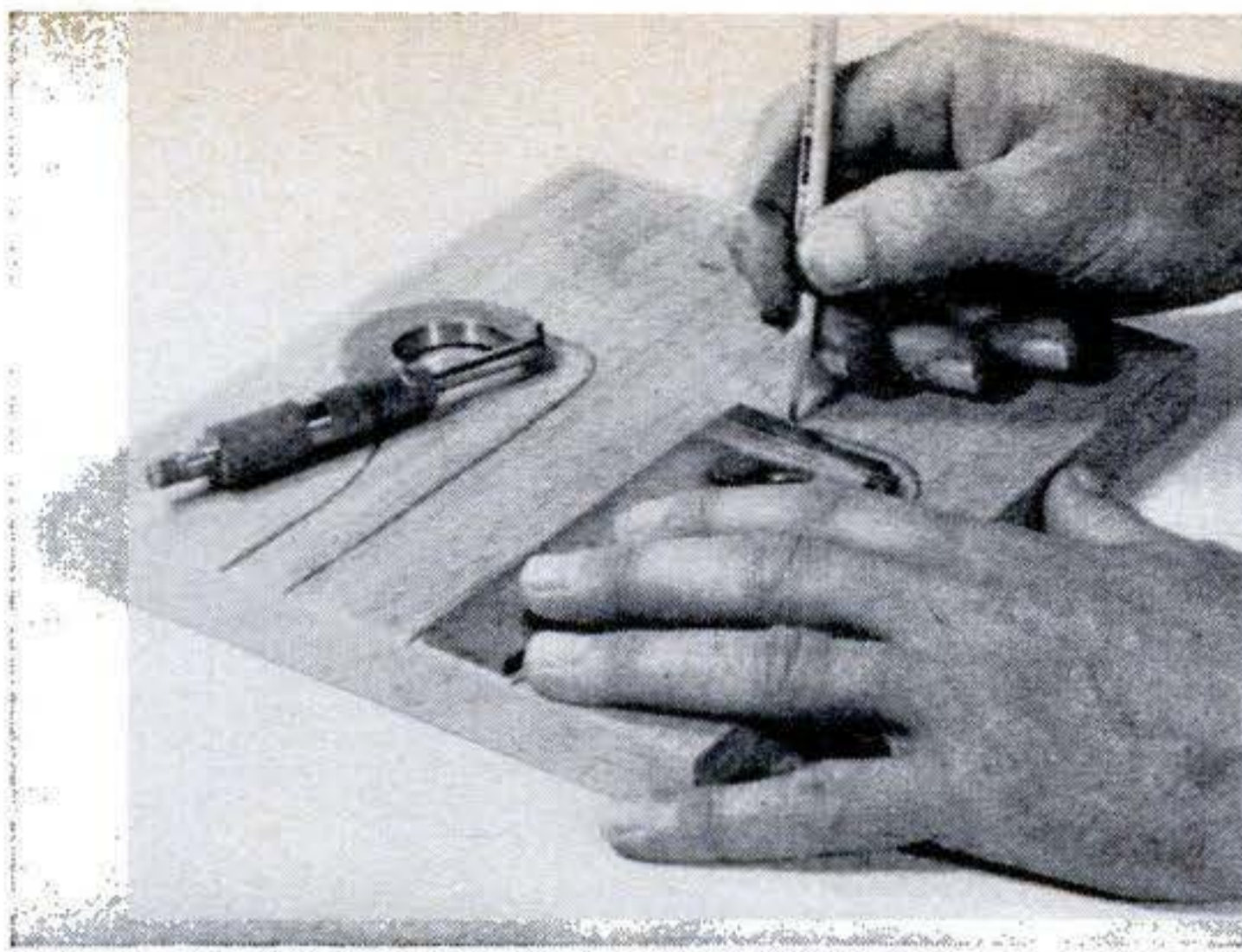
The shape you get depends on the contour of the sections, the wall thickness, the number you cut, and the projection of each. For example, if you cut six concentric rings in a $\frac{3}{4}$ " board 6" square, and each ring projects $\frac{1}{2}$ ", you get a bowl shape that's 6" across and $3\frac{3}{4}$ " high. There's no point in trying to figure out beforehand just how

much projection you'll get; it depends on the stock thickness, table tilt, and kerf width. It's easier to make a trial cut in some scrap and measure it.

The less table tilt you use, the greater the projection of each individual piece; the more pieces you cut, the greater the total projection. Using too little tilt and cutting too many pieces will give you a shape with very thin wall thickness. This makes it difficult to do a good glue job.

A table tilt of two to five degrees works pretty well in materials from $\frac{1}{4}$ " to $\frac{3}{4}$ " thick if you don't use a blade that makes a heavy kerf. A $\frac{1}{8}$ " or $\frac{1}{4}$ " blade with a slight set works fine on the bandsaw; one .020" thick by .110" wide with 15 teeth to the inch

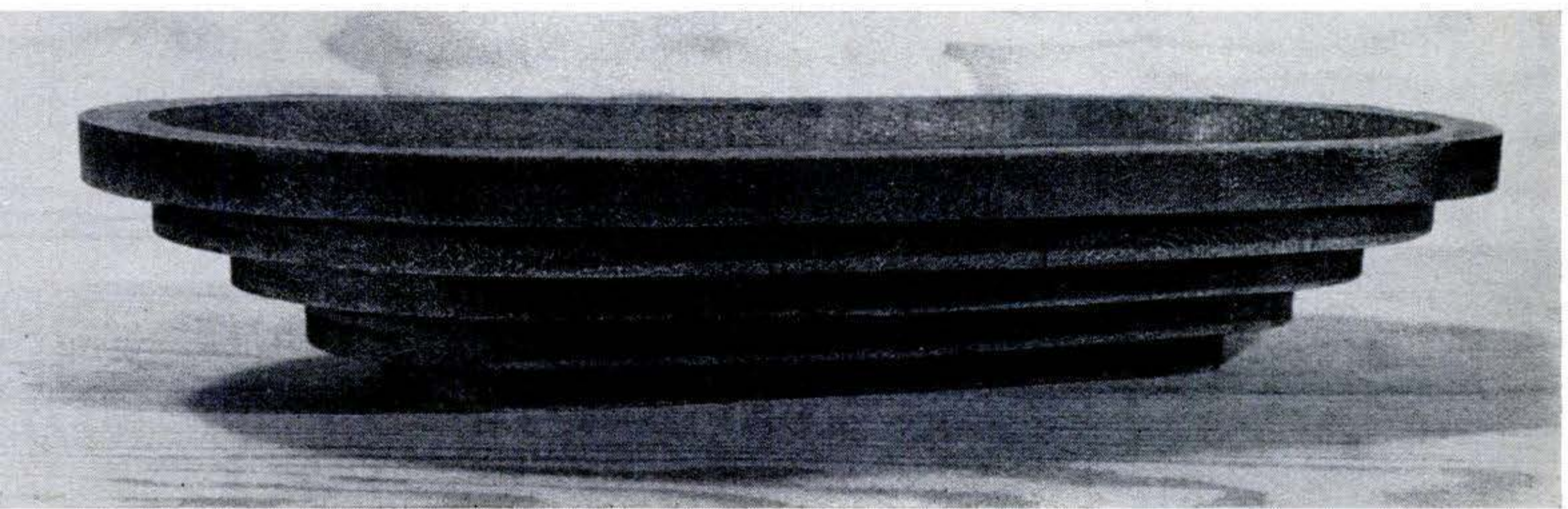
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You can use bevel cuts to make tool pockets, too

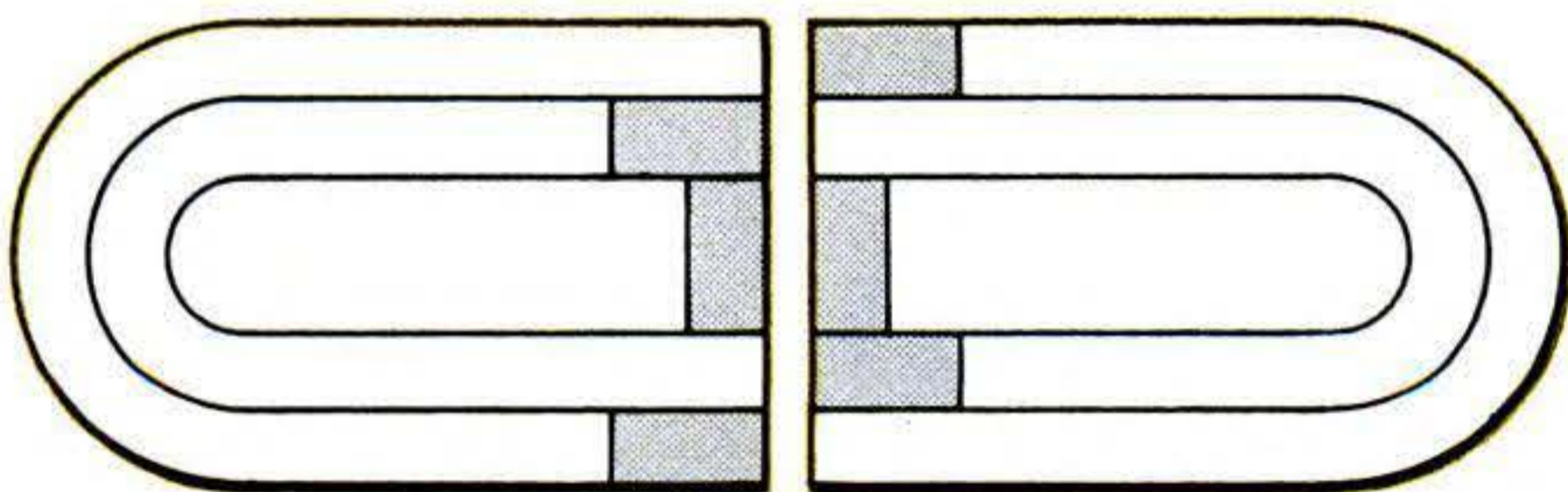
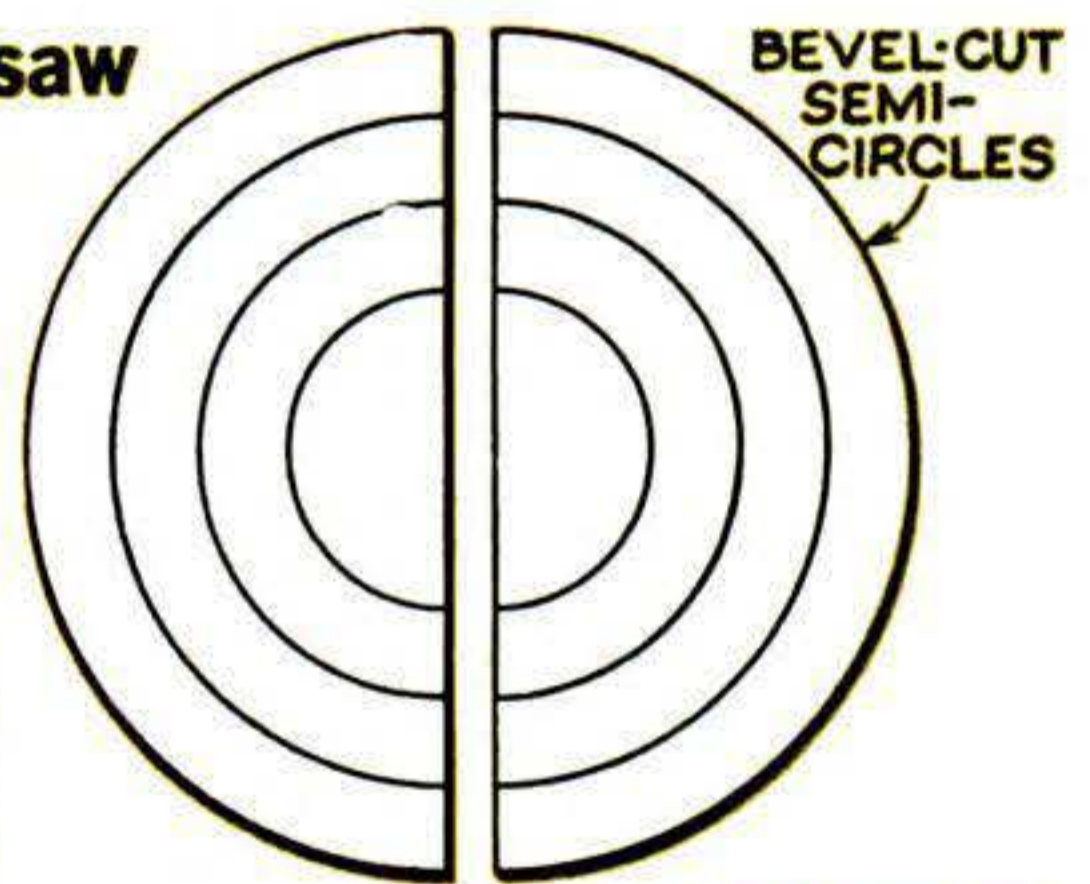
Nonsymmetrical contours make useful projects, too —like the sliding tool tray above. To make it, trace the outline of the tool as at left, then bevel-cut.

Plane down the projecting piece, and you get a neat-fitting pocket (right). Felt flock sprayed in the pockets protects delicate instruments.

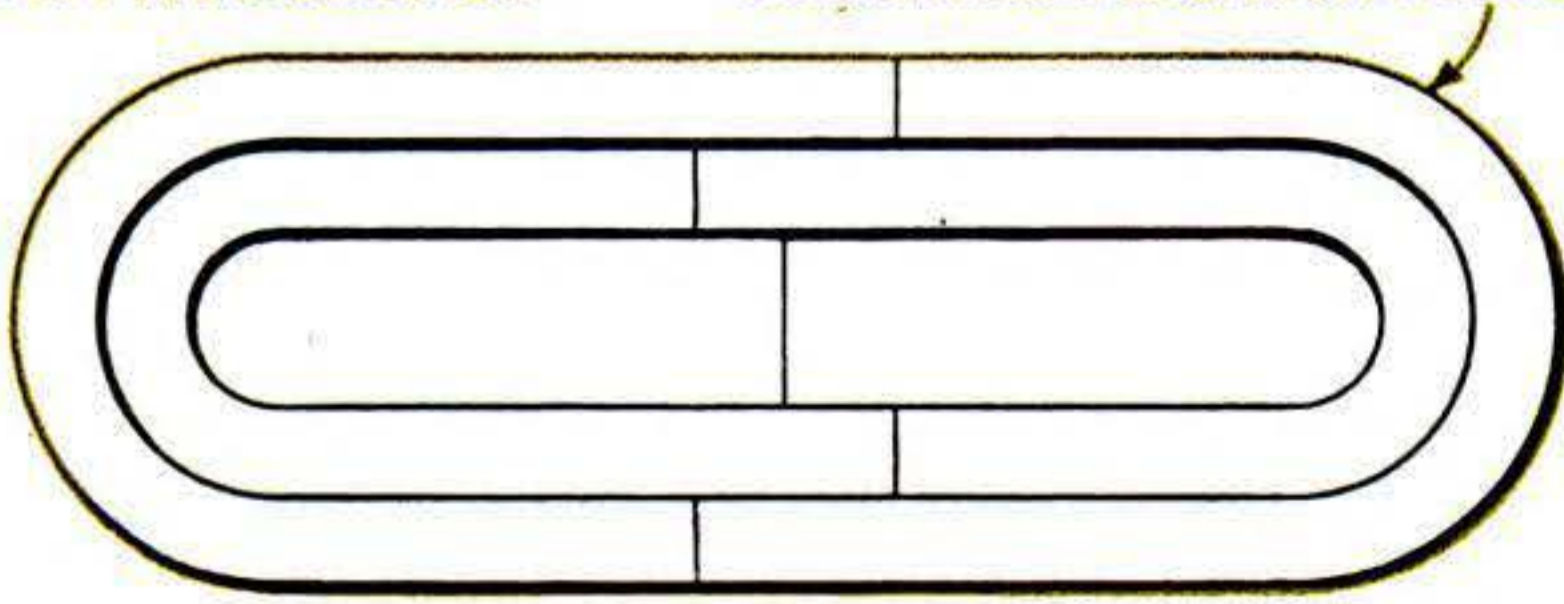
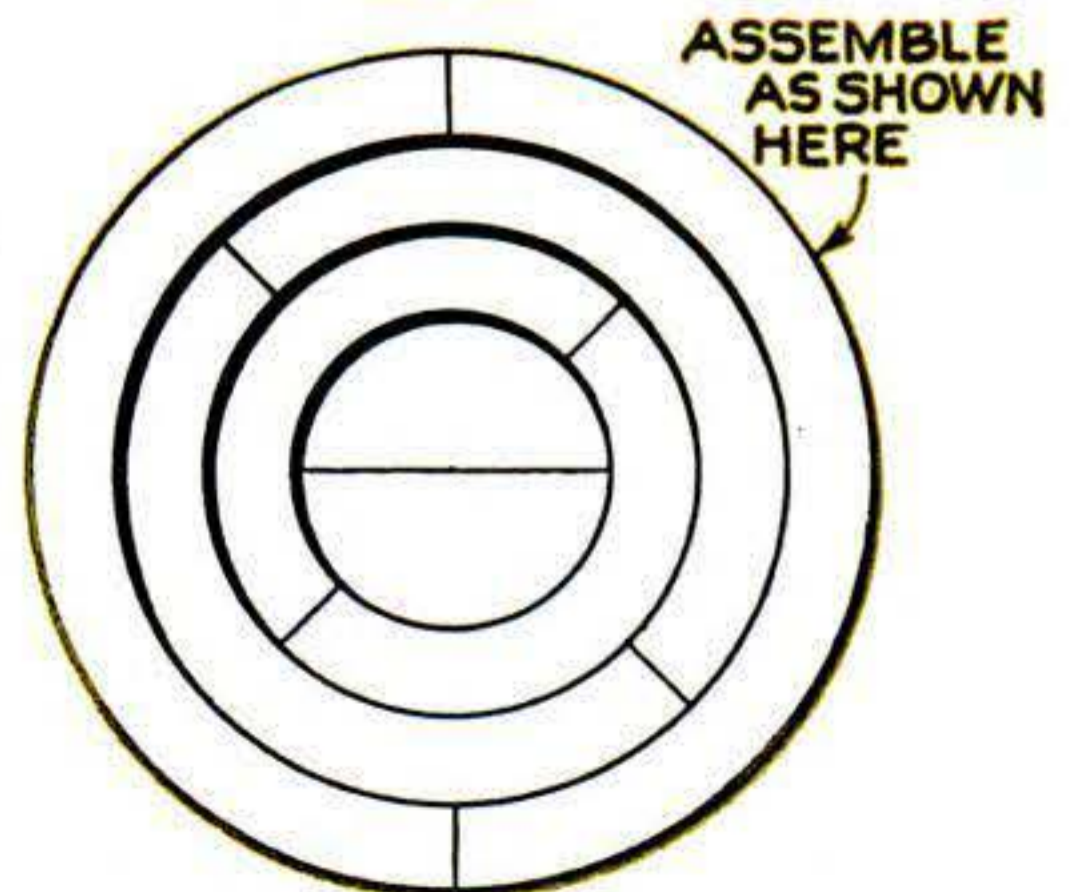


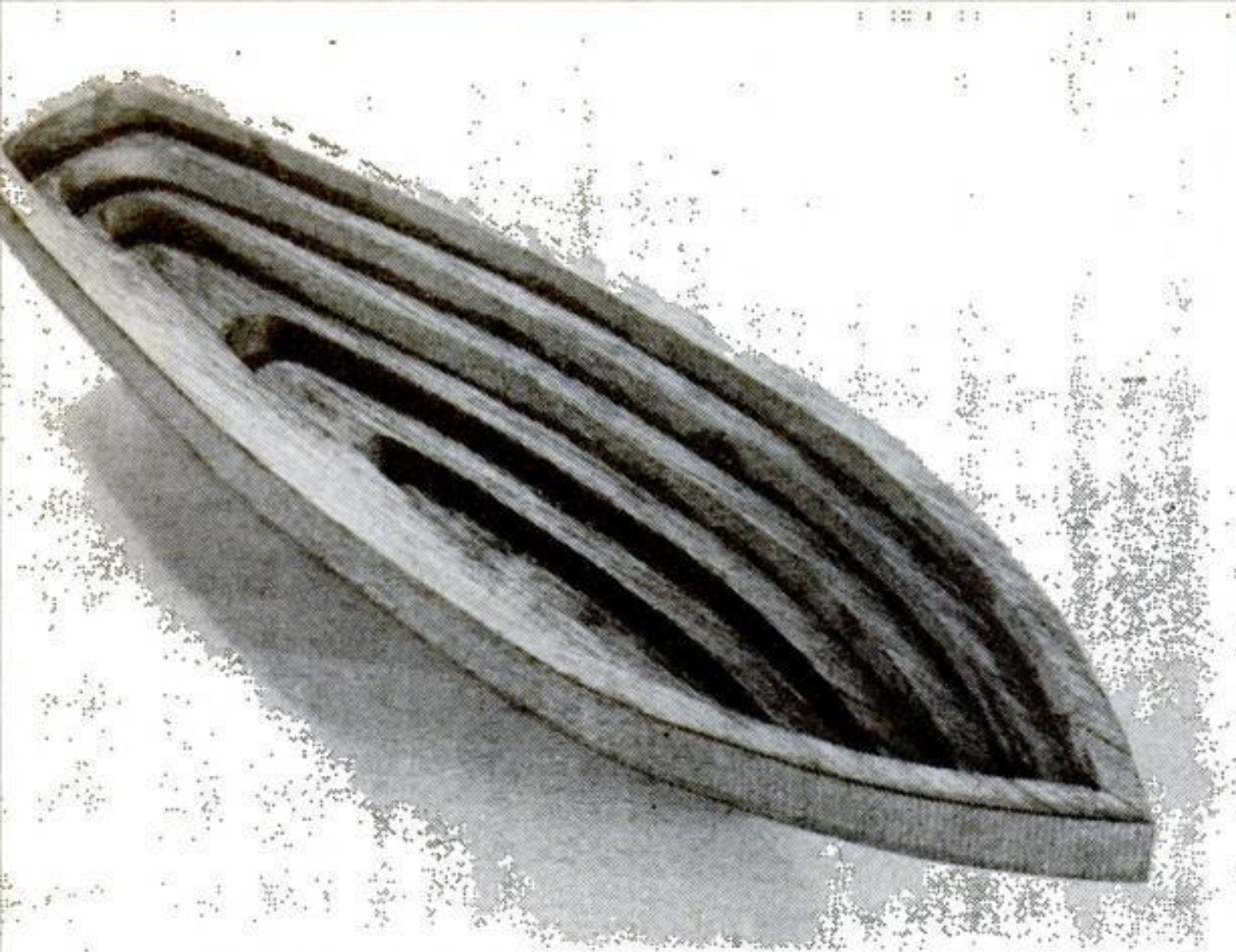
How to assemble segments cut on a bandsaw

Bandsawed half sections are reassembled with staggered joints. With semicircles, turn the rings as shown at right. With other shapes, make the sections longer than necessary and cut them to size, staggering joints as in bottom drawing.

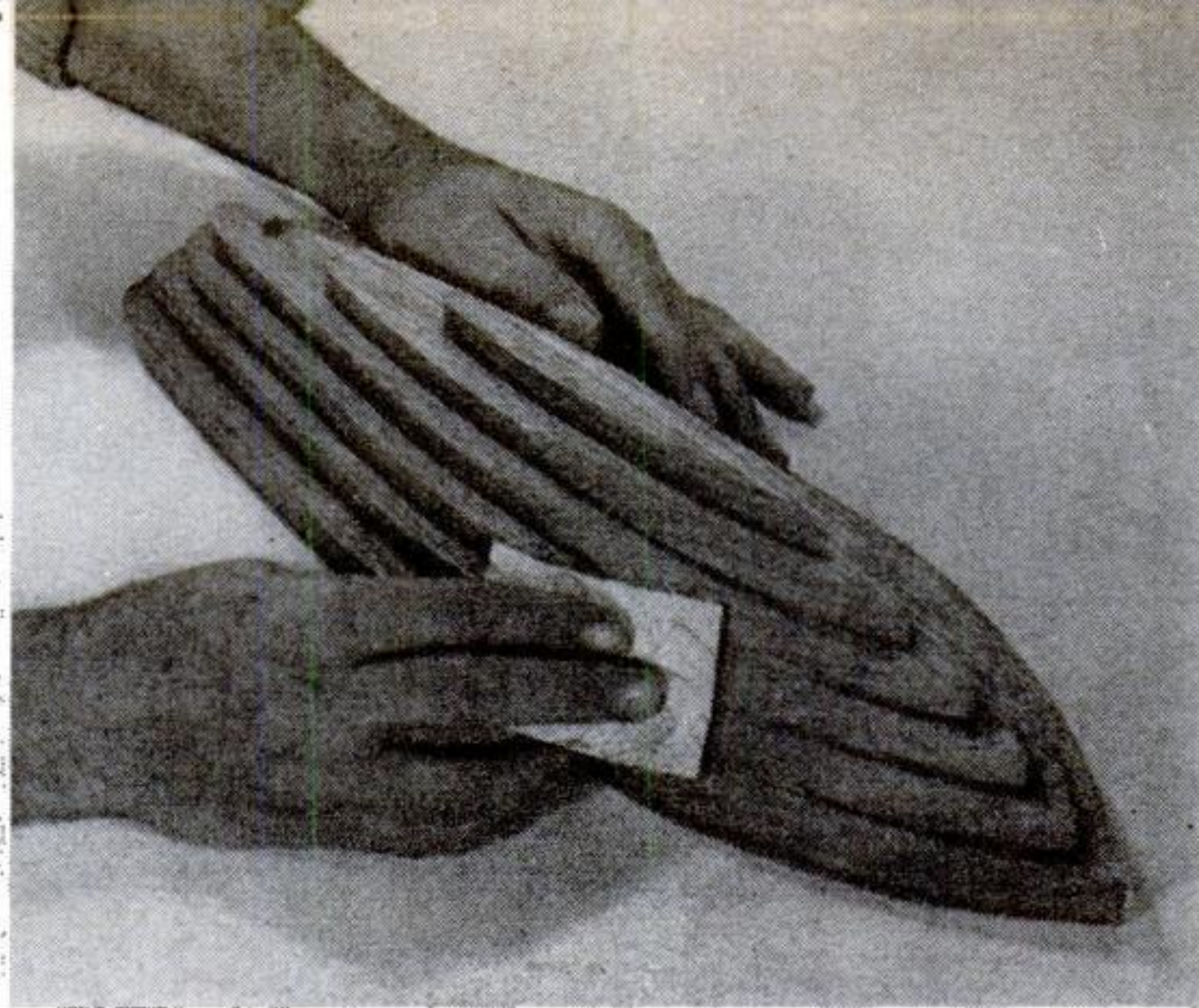


THEN, TO GET STAGGERED JOINTS, ASSEMBLE AS SHOWN HERE

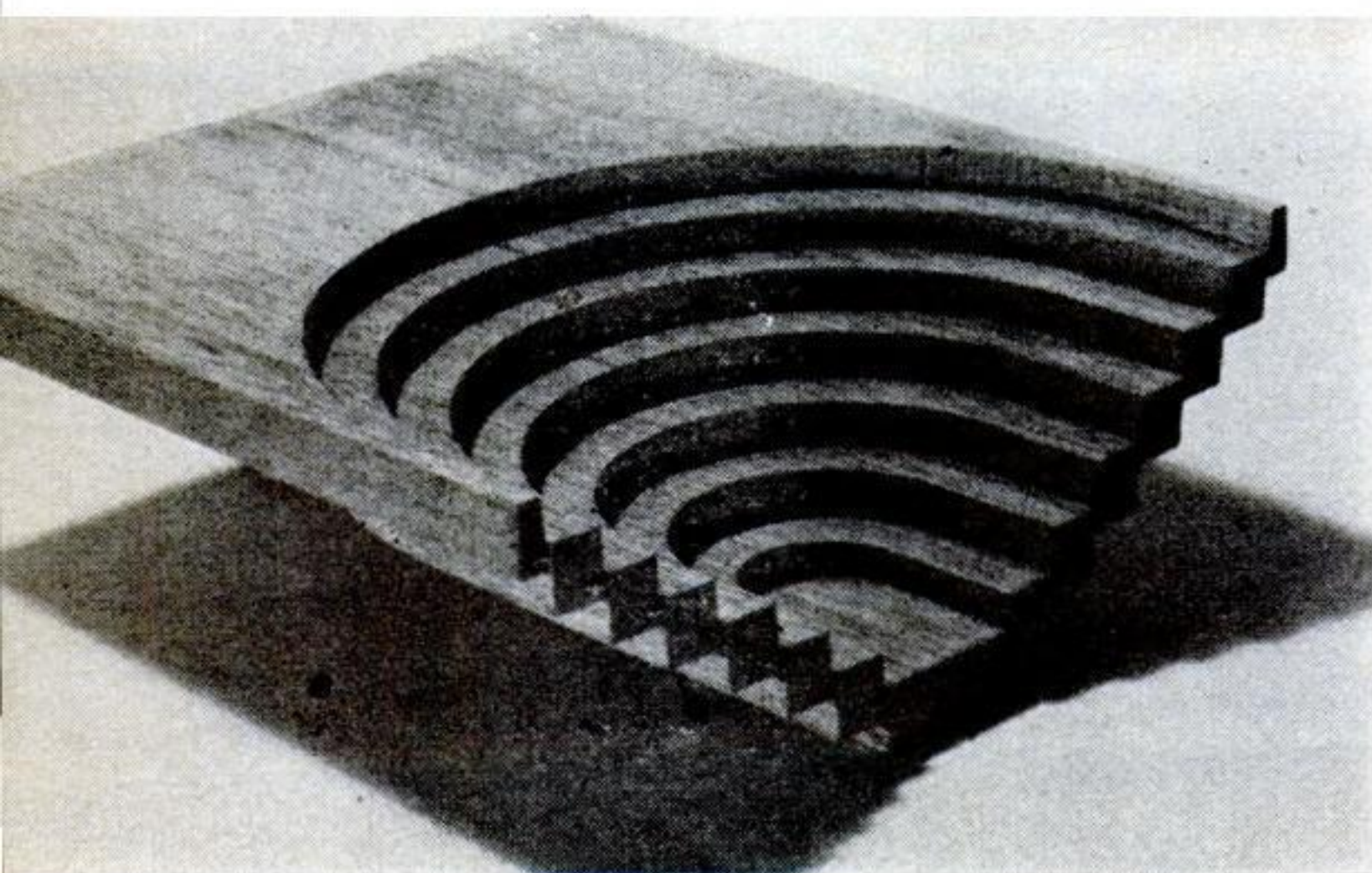




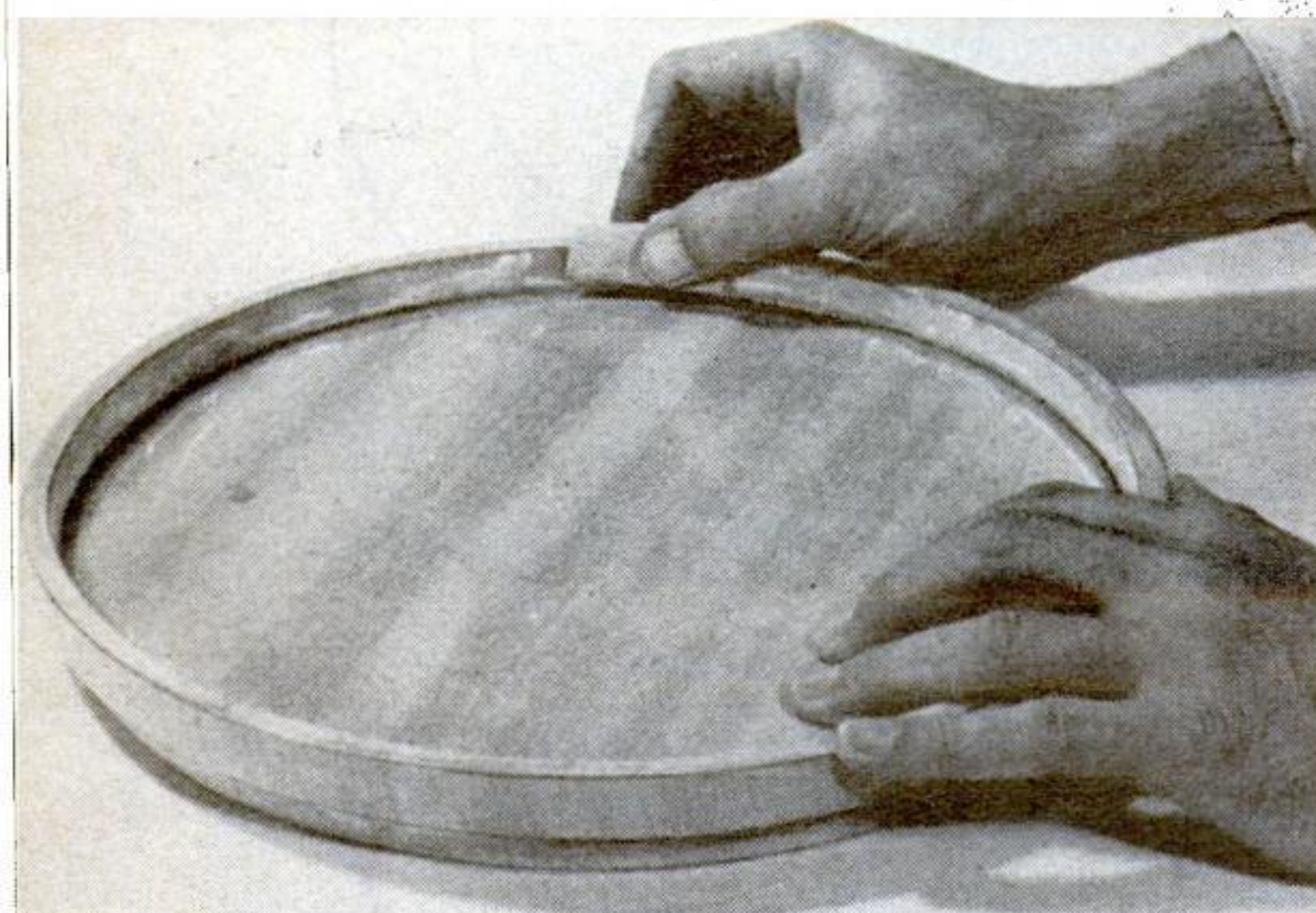
Model boat hull shown above is an example of what can be done by varying the contour of the cut. To plan the shape, draw a profile view and a top view of



the hull before you lay out the stock. Assemble with plenty of glue, and use a sharp chisel and sandpaper to arrive at the final hull shape.



Half of a project (above) shows you how the sections open up to make a deep shape. Before gluing, cut sections so they mate with joints staggered. Staples clamp the sections while the glue sets.



Trays and plates with raised lips are simple to make with bevel cuts. Make the cut on a jigsaw using blade-starting holes, and jam parts together with enough pressure for gluing. Clamps aren't needed.

is about the right size for the jigsaw.

These recommendations are just to get you started. There's no reason why heavier blades (for thicker stock) or lighter blades (for thin stock) can't be used.

When you cut, keep the inside piece (the part that will project) on the same side of the blade. Otherwise, you'll change the bevel direction and you'll be in trouble—the pieces won't fit.

P S



Planter, 6" deep and 10" in diameter, was cut from a piece of stock 1 $\frac{5}{8}$ " thick by 10" square. The edge of each piece was coated with glue; it was then forced tightly into the piece it was cut from.

Repairing Basement Leaks

Take a tip from tunnel builders—plug up leaky cracks in basement walls with hydraulic cement. Unlike ordinary cement, which will separate and wash away if water runs into it before it sets, hydraulic cement is ideal for working against running water. It sets fast, and as it cures, it expands instead of shrinking. This makes it a good plug against seepage.

You can stuff it into an open crack to stop the flow of water running through it. But for a neater job, wait until the water subsides to a trickle. Either way, you must first enlarge the crack with a hammer and cold chisel to a minimum depth and width of $\frac{3}{4}$ ". Slightly undercut both sides of the chiseled groove for a secure repair.

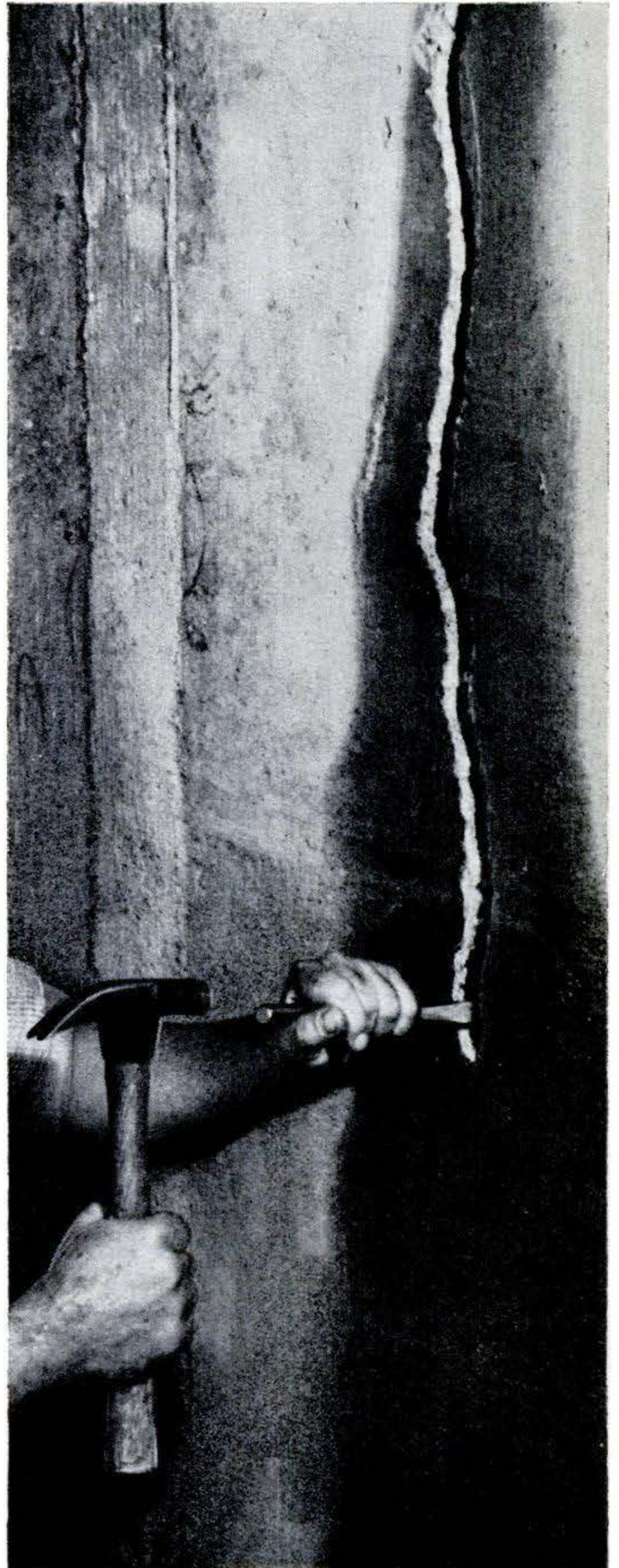
Packing the crack. Flush away chips and dirt. When the surface is clean, mix a small amount of the cement and force it into the crack, starting at the top and working downward. If water is only trickling in, pack the crack full of cement and hold the trowel over it for several minutes, while it sets. If water is flowing vigorously, hold a ball of cement in your hand until you can feel it getting warm or becoming dry. Then pack it firmly into the crack and exert full pressure with the palm of your hand or the trowel for several minutes. Do not release pressure too soon—water might break through partially set cement. When you're sure that the patch is holding, use the edge of the trowel to cut the patch even with the wall.

A bit at a time. Continue mixing small batches of fresh cement, and work your way down the crack six or eight inches at a time. Wet the area occasionally as you work, and keep the patch damp for at least 15 minutes after completing the job to keep it from drying out too quickly.

When dry, the patch will look dark gray against the lighter masonry wall. Conceal it with cement-base waterproofing paint.

Two popular brands of hydraulic cement are Gold Bond Hydro-Chek and Thoro Waterplug. A \$1.98 can filled the crack shown, with some left over.

HERBERT R. PFISTER, Glen Head, N.Y.

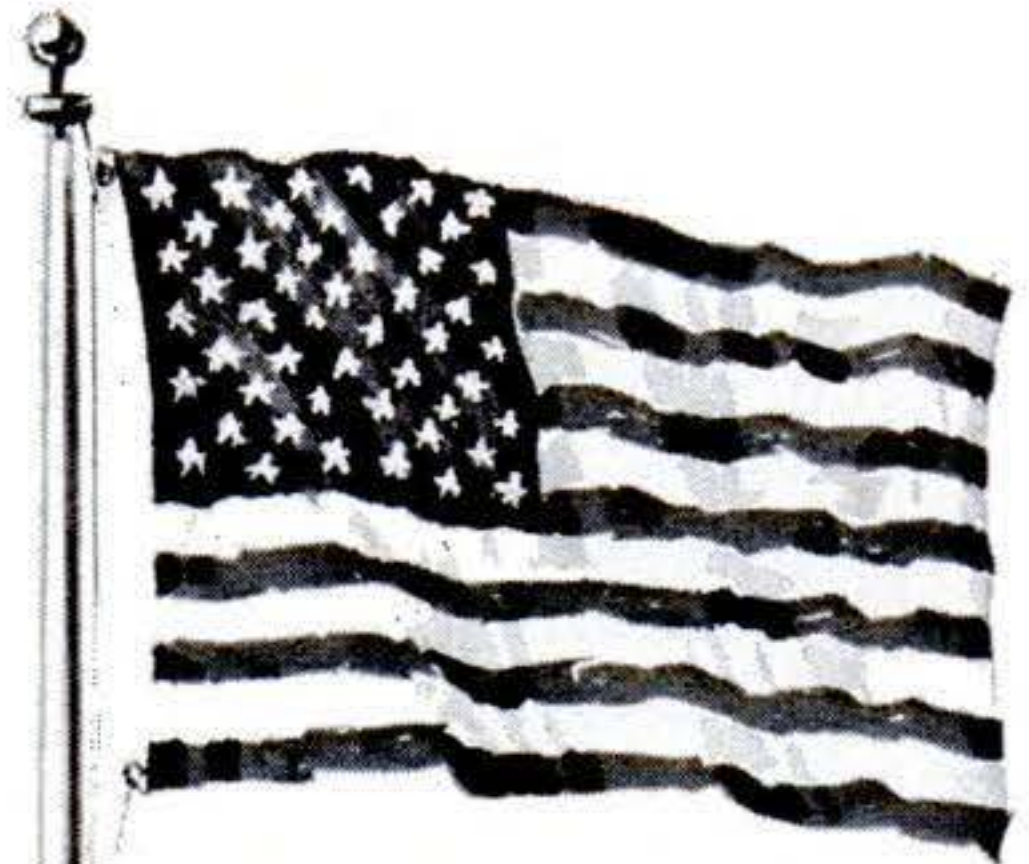


Cement won't fill a hairline crack, so you have to enlarge it by chiseling out concrete on both sides until you have a $\frac{3}{4}$ "-square groove centered over the crack. Undercut sides slightly to key patch in.

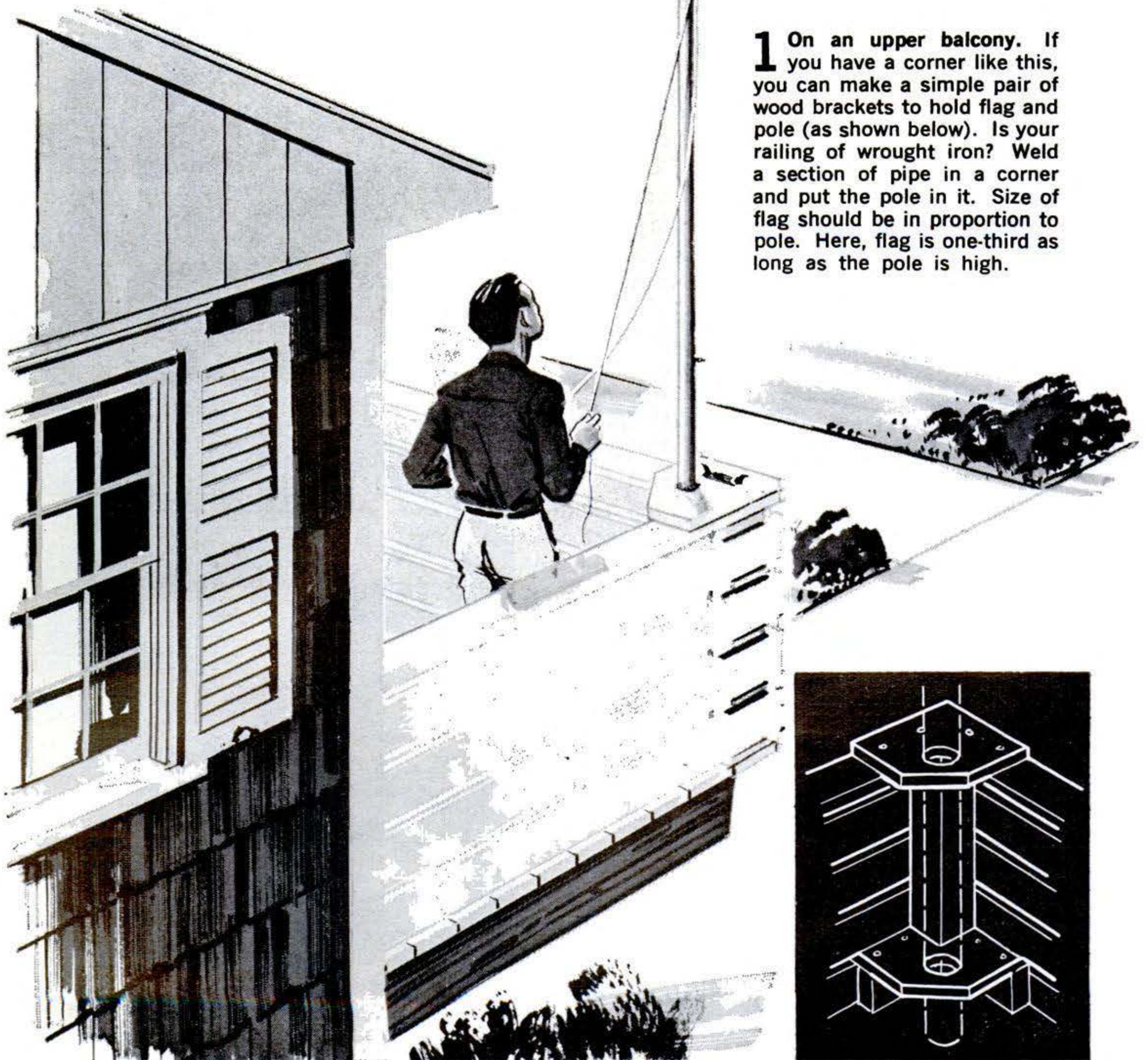
FIVE WAYS TO FLY THE

Every home has someplace where the flag can catch a breeze. All you

Fly your flag proudly, but correctly. Any of the locations shown here will raise it high enough so that it doesn't touch anything below it—one of the first rules of flag etiquette. You can make brackets of wood for the pole or you can buy various metal ones at hardware stores or by mail order. Sectional poles can be dismantled for storage. Remember, the flag is displayed from sunrise to sunset, rarely at night, never in bad weather. When it is hoisted, as every Boy Scout knows, you face it and salute.



1 On an upper balcony. If you have a corner like this, you can make a simple pair of wood brackets to hold flag and pole (as shown below). Is your railing of wrought iron? Weld a section of pipe in a corner and put the pole in it. Size of flag should be in proportion to pole. Here, flag is one-third as long as the pole is high.



AMERICAN FLAG

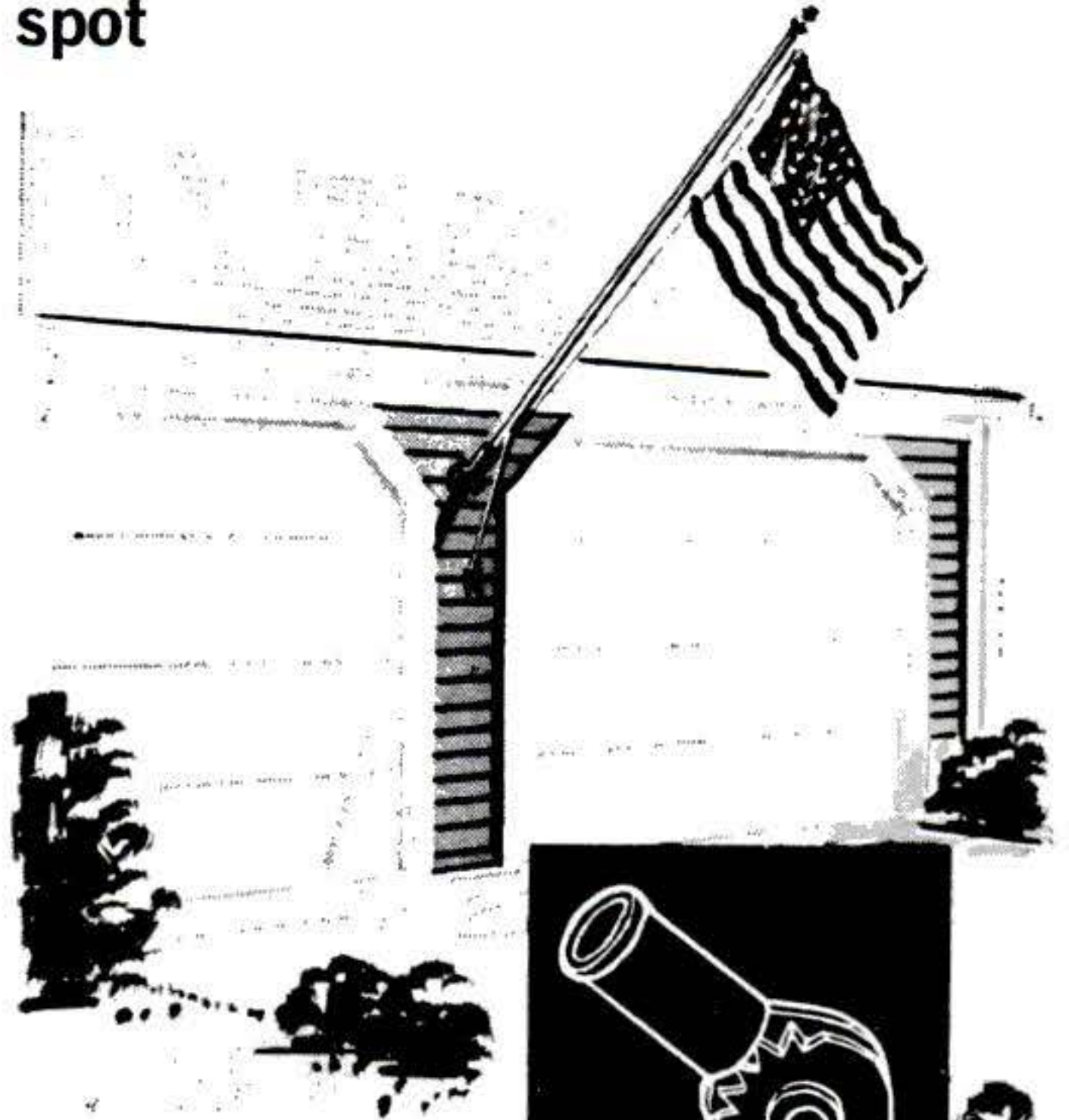
By CARL T. SIGMAN

DRAWINGS BY SIGMAN-WARD, INC.

need is the right bracket in the right spot



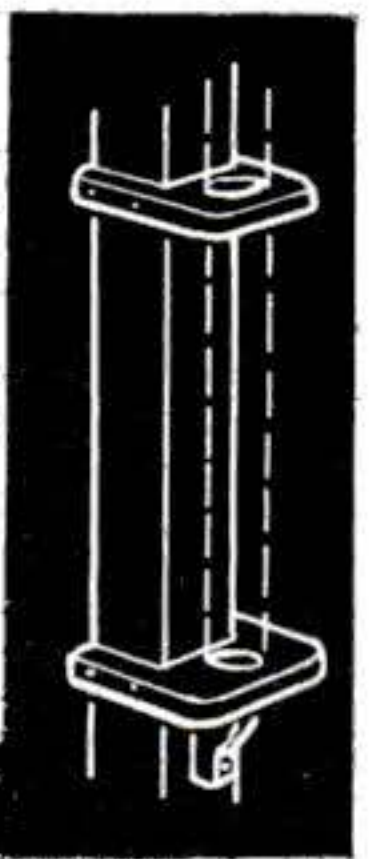
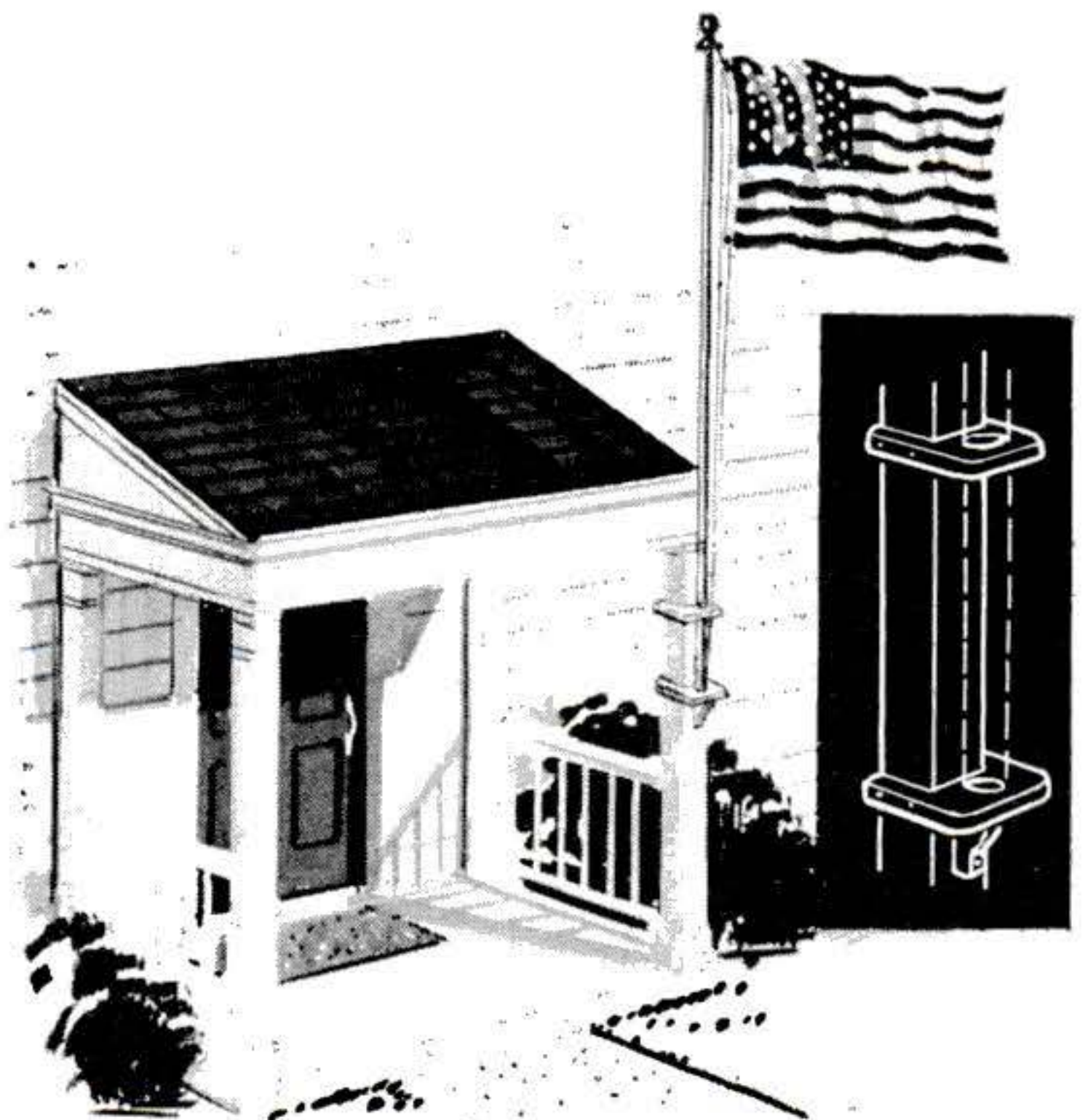
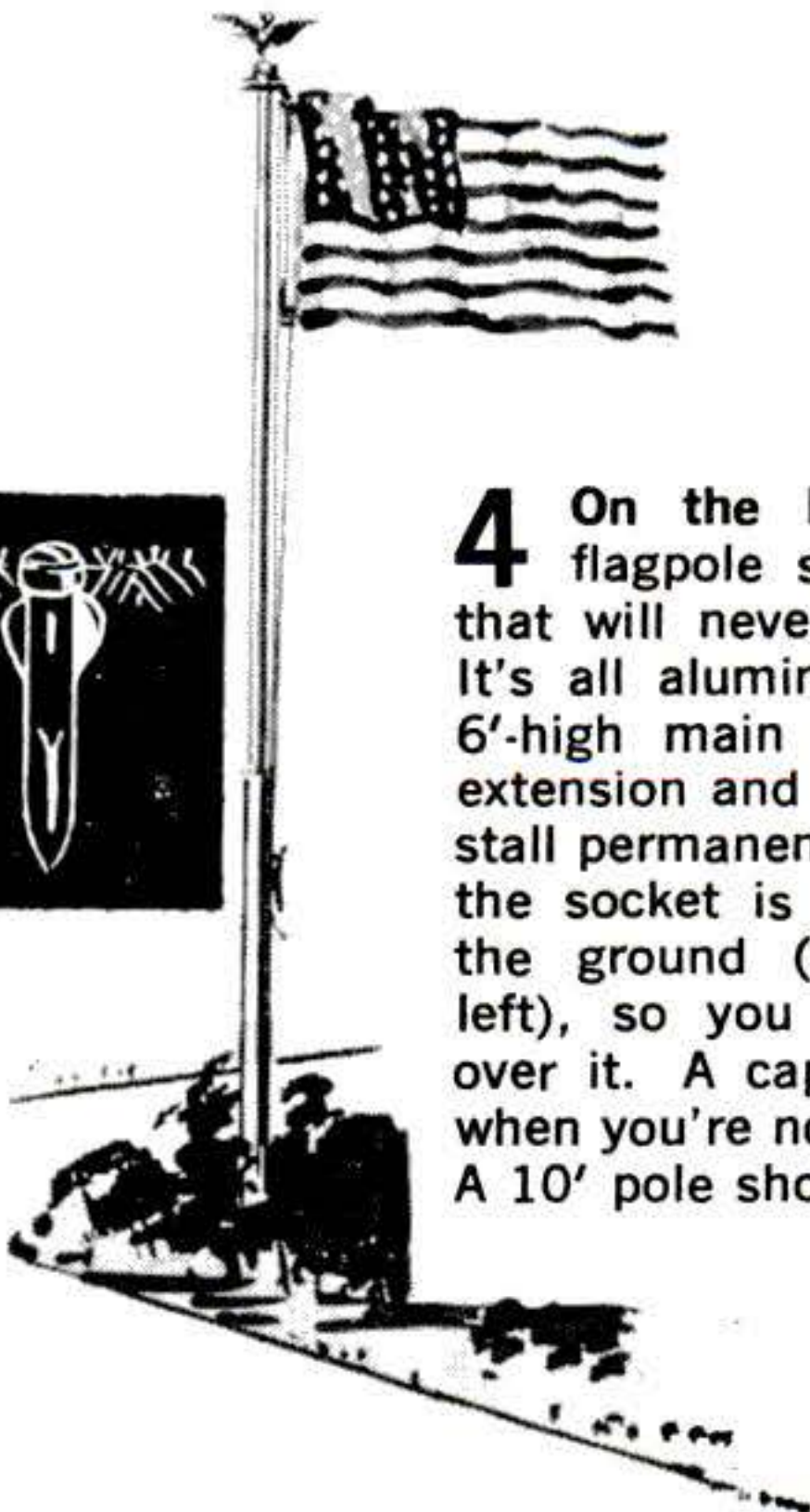
2 On a windowsill. At the right are three standard metal brackets you can buy to mount outside a window. They hold the pole at a 45-degree angle. Also pick up a metal cleat around which the halyard (the rope for raising and lowering the flag) can be wound to anchor it. Use a 6' pole with a 3'-by-5' flag displayed like this.



3 Between your garage doors. An adjustable bracket, such as the one shown above, will allow you to control the angle of the pole by loosening and tightening a setscrew. A 45-degree angle is the most popular. Mount the bracket low enough to avoid any interference from overhang.



4 On the lawn. Here's a flagpole set you can buy that will never need painting. It's all aluminum. You get a 6'-high main pole with a 4' extension and a socket you install permanently. The head of the socket is sunk flush with the ground (see drawing at left), so you can mow right over it. A cap keeps out dirt when you're not flying the flag. A 10' pole should fly a 5' flag.



5 On a porch post. Set the mast in a pair of horizontal brackets you can put together yourself. Cut the wood the width of the post and screw strips at the sides; or cut a U out of a single piece of wood. An angle bracket below the lower bracket (note drawing) will support the bottom of the flagstaff.



A little room, a small press, and a few supplies are all you need to print amusing novelties, serious writing, unique greeting cards, useful stationery. You can even make money printing for others. Some samples of amateur printing are shown bordering these pages.

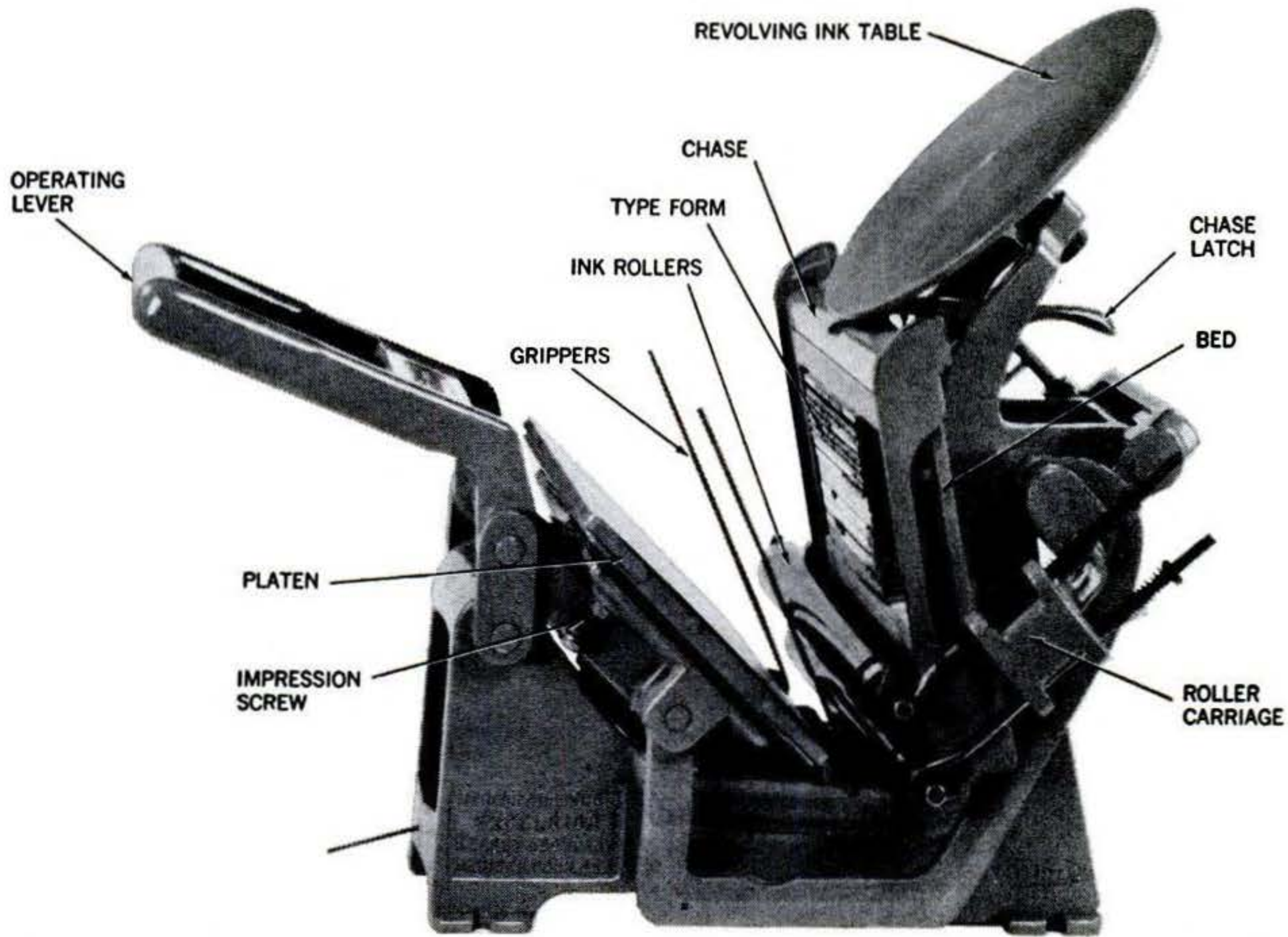
How to Set Up a HOME

Take up printing as a hobby—it's fun, it's useful, it's easy

You can do printing—the kind done on a real press—even if you don't know a quad from a quoin. You'll find it's easy to learn. Every day more people discover the joy of running their own printing press. Some print just for fun, some for personal needs. Some print small newspapers or journals. Others get such a kick out of it that they create designs, show their work at exhibitions, and join printing clubs.

Your printery, as hobbyists call it, can be any size from a drawer to a full





Parts of a hand press are few and simple, as shown above, but the press works just like the big ones of commercial printers. Pushing down on the operating lever moves the ink rollers over the type and brings the platen, with paper on it, to bear against the type form.

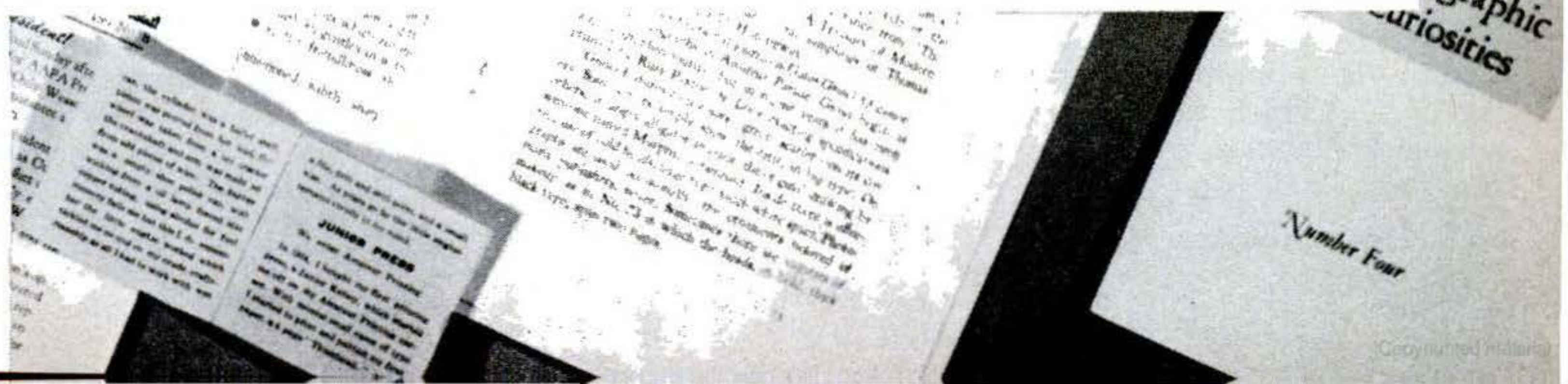
PRINT SHOP

By JOHN BURROUGHS

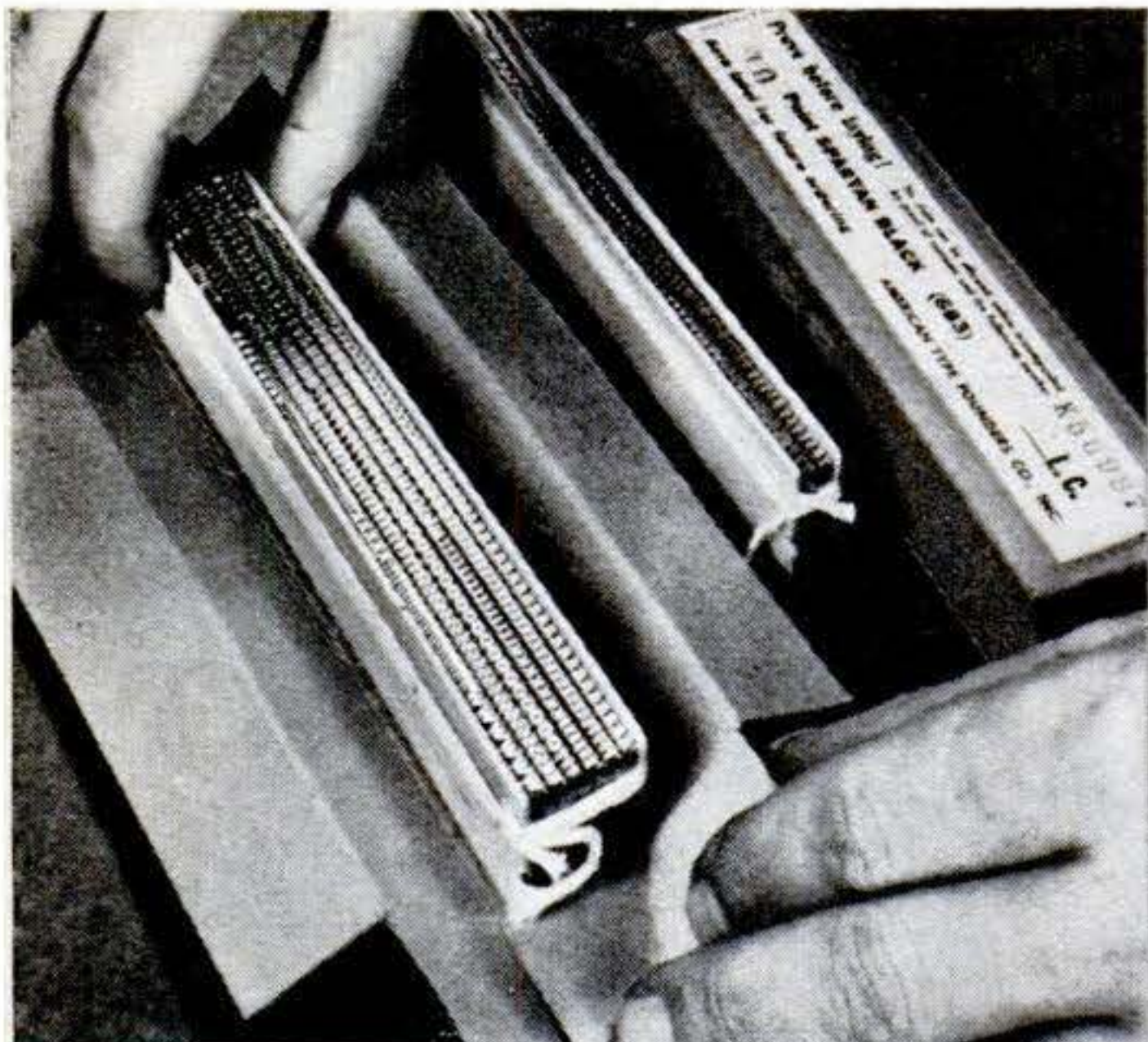
to learn. Here's what you need to know to start

room. And your printing can be as simple as adding your name to store-bought Christmas cards or your address to stationery; it can be elaborate enough to create your own Christmas cards, announcements, bookplates, signs, labels, tickets; it can be as advanced as printing your own newspaper or book. You can print whatever you please, and you can make just one copy or hundreds of copies. Here's how to get started:

Your first step is the purchase of a small hand press like the one shown in
Continued



Type, rules, borders, ornaments, cuts—these are the



Type comes in fonts (assortments) as shown above. You put each letter of the alphabet into separate compartments in a type case. This makes it easy to pick them out when you're setting the type in words.

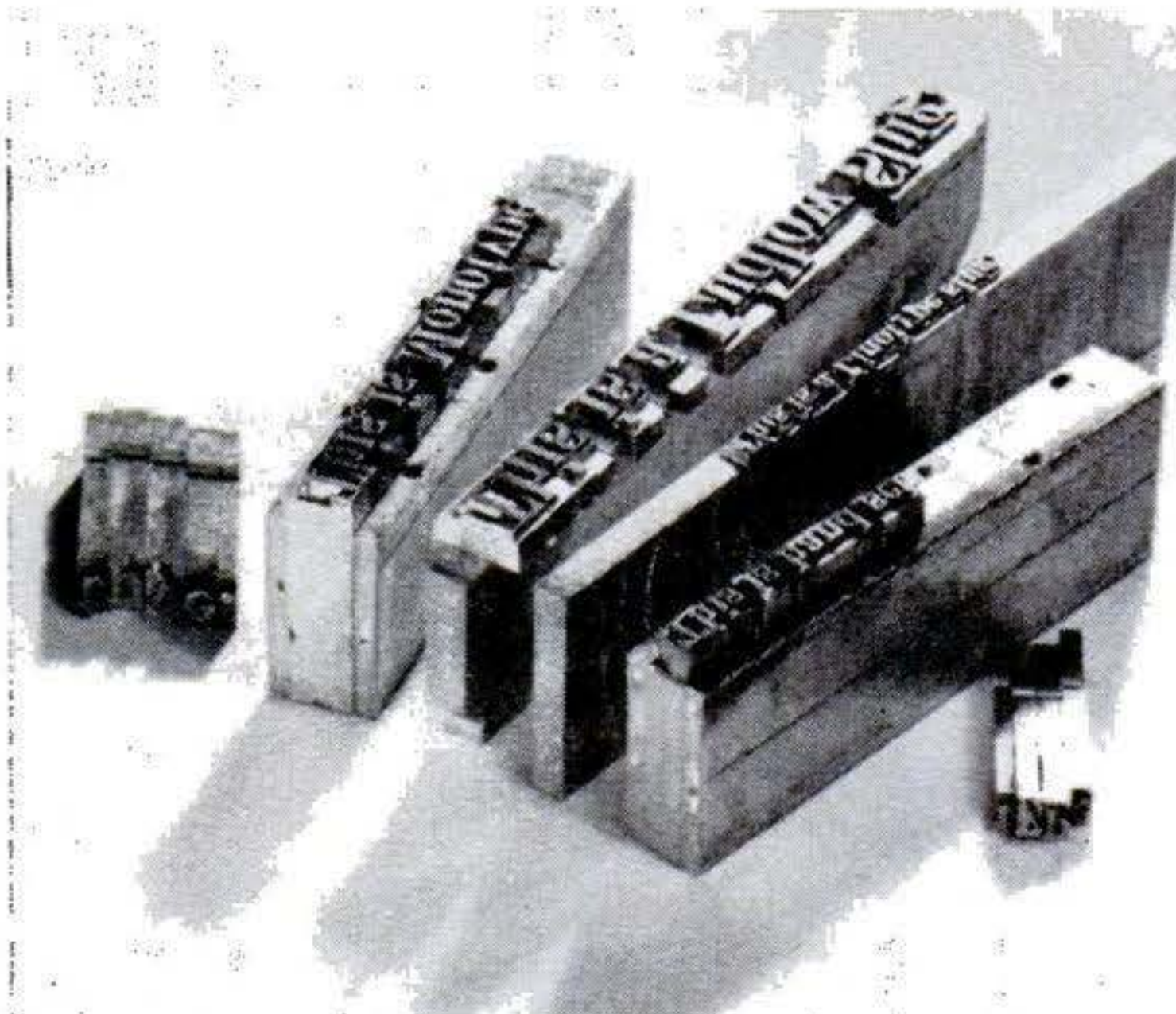
the photos. A hand lever operates it, and it turns out work equal in quality to printing you'd pay for.

Among makers of hand presses: Craftsmen Machinery Co., 75 W. Dedham, Boston; Kelsey Co., Meriden, Conn.; Sigwalt Mfg. Co., 4410 N. Ravenswood Ave., Chicago 60640; Chandler & Price, 6000 Carnegie Ave., Cleveland 44103; Adana Presses Ltd., 1 Industrial Ave., Woodridge, N.J.; Popular Printing, 90 Hudson St., NYC.

Selecting a press. Decide how big a press you want. Sizes range from 3" by 5" to 9" by 13". These are the dimensions of the printing area; the paper you print on can be much larger. With a 3"-by-5" press you can print letterheads, envelopes, calling cards, tickets, signs, and lots more.

Press prices go up pretty fast with increasing size. Craftsmen, for instance, sells a complete outfit for \$50 that includes a 3"-by-5" press, type, composing stick, ink, and other accessories. But by the time you get to a 9"-by-13" press, you pay a couple of hundred dollars. If you plan to print newspapers, booklets, and larger items, you'll need a big press.

You can get started for less by buying a used press. Given care, a hand press lasts indefinitely, and there are lots of old ones around that will turn out fine-quality printing. If you think a used press is for you, look for one in the classified ads in newspapers and the yellow pages of the phone book



Some kinds of type (left to right, standing up): hand set—letters on separate slugs; Ludlow—cast line of large type; Linotype—line of words cast in one slug; Monotype—machine-cast individual letters.

under printing equipment, and talk to your local commercial printer (he may have an obsolete one he'll sell you).

What about type? There are literally thousands of typefaces (styles) to choose from. You can buy a font (an assortment of one size and style) of type for hand setting for \$2 to \$10 (higher for very large sizes). Price depends on the size of the letters, quality of the metal, and the number of letters the font contains.

Type size is measured in points (72 points equal one inch). This article is set in nine-point Caledonia type and has one point of spacing between the lines.

Type bought from any reputable supplier is cast in hard metal that, with care, will stand up for thousands of impressions. For very large letters, you can use wood type. It's cheaper, and it lasts almost as well.

How many letters a font contains is designated by the number of capital A's, the number of lower-case a's and the number of l's. A 12-A font will have about the same number of the letters I, N, O, R, S, and T, with proportionately fewer of the less frequently used letters: B, W, Q, etc. Some fonts include numerals and punctuation; some don't.

You also need an assortment of spaces and quads (blocks of metal lower than the type, used to fill in blank spaces). You buy spacing material for each *size* of type.

bits and pieces you put in a press to do a printing job

18 point Venus Light Italic

14 point Bank Script

12 point Times Roman Italic

10 point Century Expanded

8 point Garamond Bold

6 POINT COPPERPLATE GOTHIC NO. 4

HAIRLINE RULE

FOUR POINT RULE

SCOTCH RULE

The typefaces you see here are just six of the thousands you can choose from. Rules to print lines (shown below the type) come in strips, which you cut to the length you need. They're cast in metal.

It makes no difference what typeface they're used with.

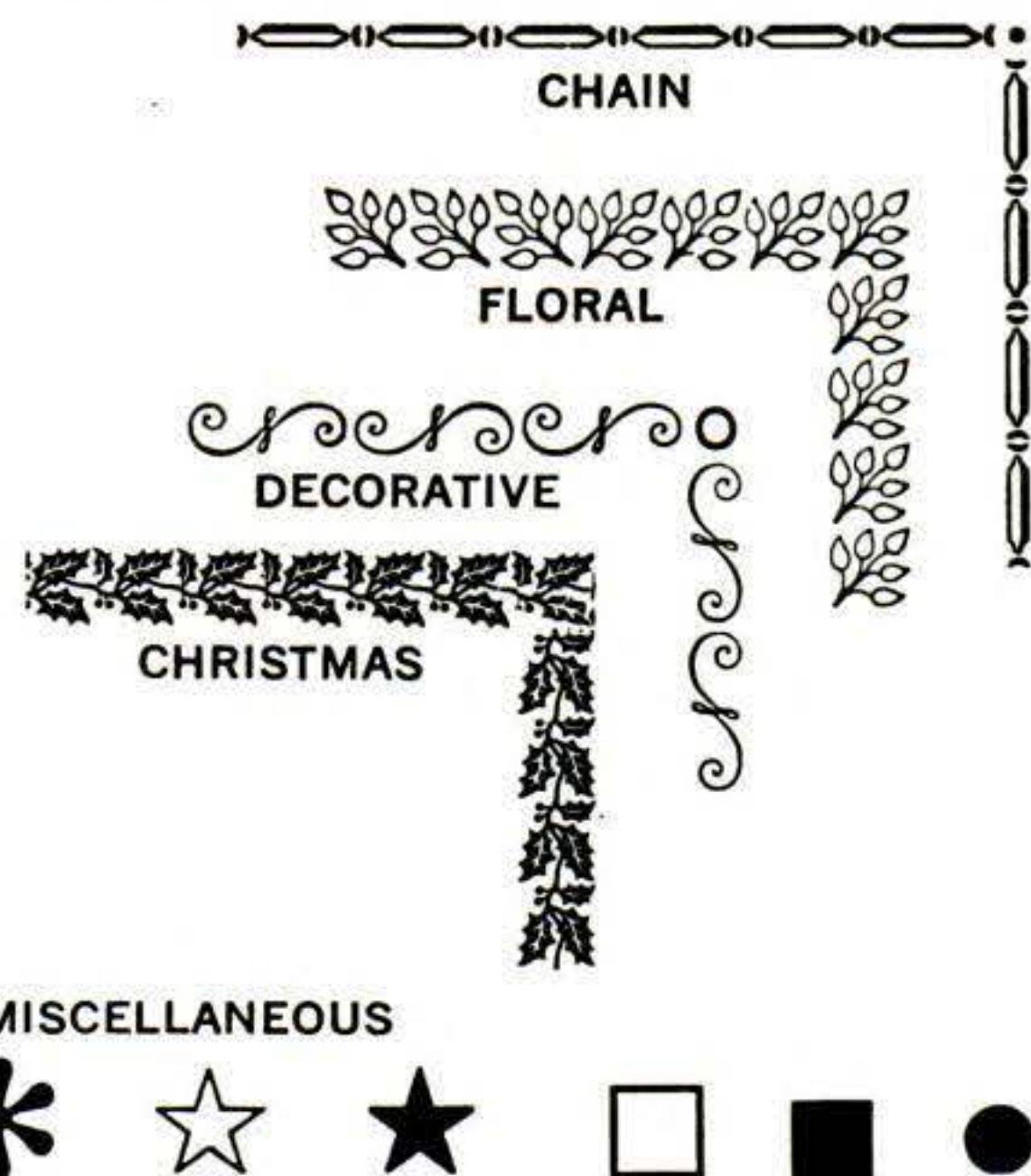
You can get a type catalogue from American Type Founders, Elizabeth, N.J. Craftsmen, Kelsey, and Popular Printing sell type, as well as ink, paper, and other supplies.

You can make do for some composing equipment that you may eventually want:

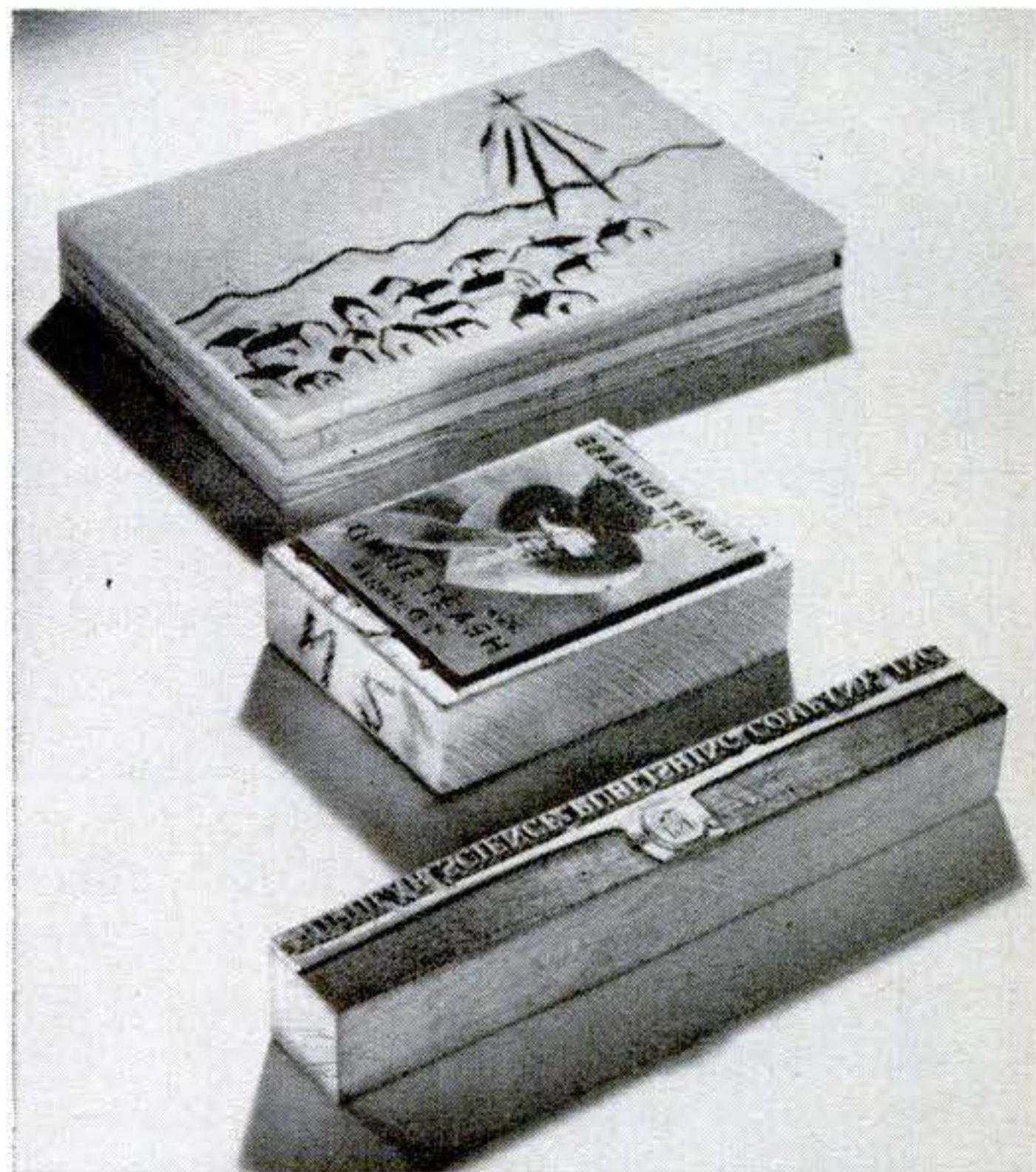
- A type case or compartmented shallow drawer for storing the different letters—use a tray of pillboxes or paper cups.
- A composing stick for setting type—set your type directly in the chase.
- Furniture (wood strips for filling in space between type and chase)—saw them up yourself from scraps of hardwood.
- Leads (thin strips of metal for spacing out lines of type)—substitute heavy paper.
- Quoins (metal wedges for clamping type in place)—make matched wedges of wood.

A lot of home printers take pride in using only hand-set type, but you can use machine-set type. You pay a typesetter to do this. It's handy when you want a typeface you don't have, or when you have a lot of type to set. Price varies, so ask what it costs first.

Photos and drawings. You print these with cuts, or printing plates made of zinc or copper with the drawing or photograph etched into the metal. Black-and-white hard-line drawings make line cuts. Con-



To embellish your printing, type suppliers carry borders and ornaments like these. The borders come in strips, which you cut to size, but the miscellaneous ornaments are cast on individual metal slugs.



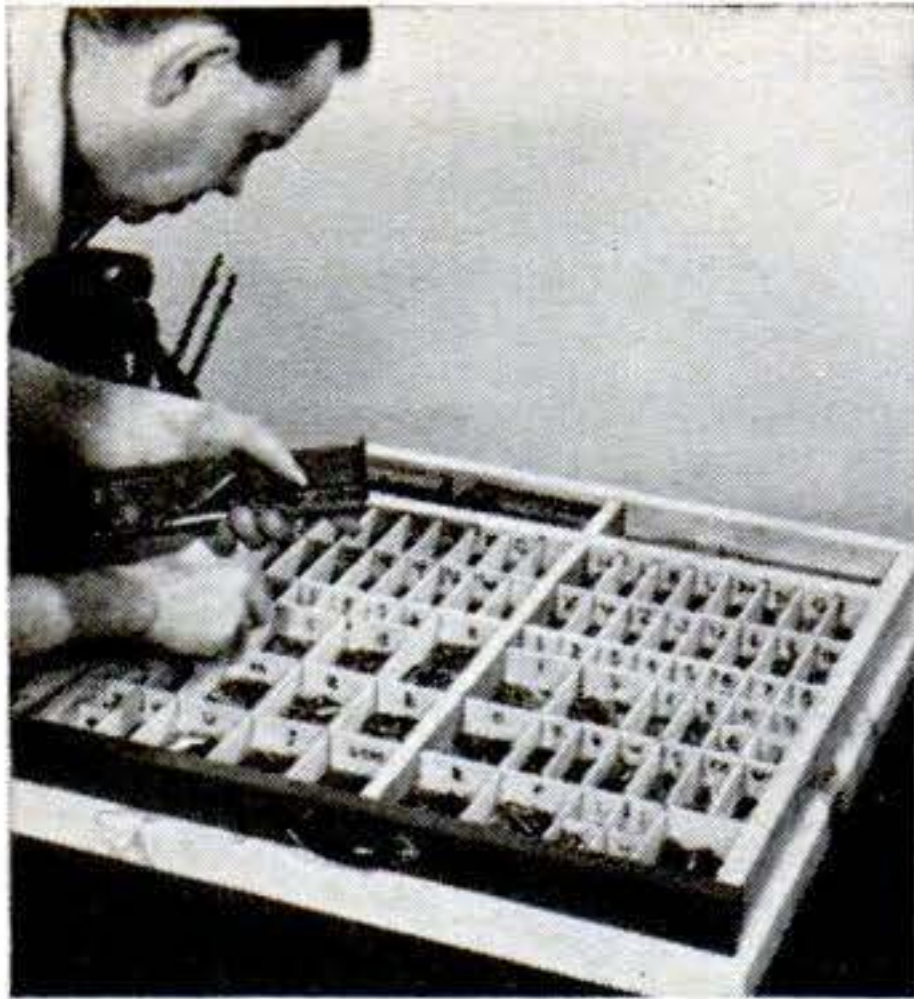
Cuts (engravings) print drawings and photographs. Three types (top to bottom) are: linoleum block you carve yourself, halftone engraving of photograph, line engraving of drawing. All are mounted on wood.

tinuous-tone art, such as photographs, with shadings from black to gray, is printed with halftone cuts. A halftone prints small dots of various sizes (look at one of the photos on this page under a magnifying glass).

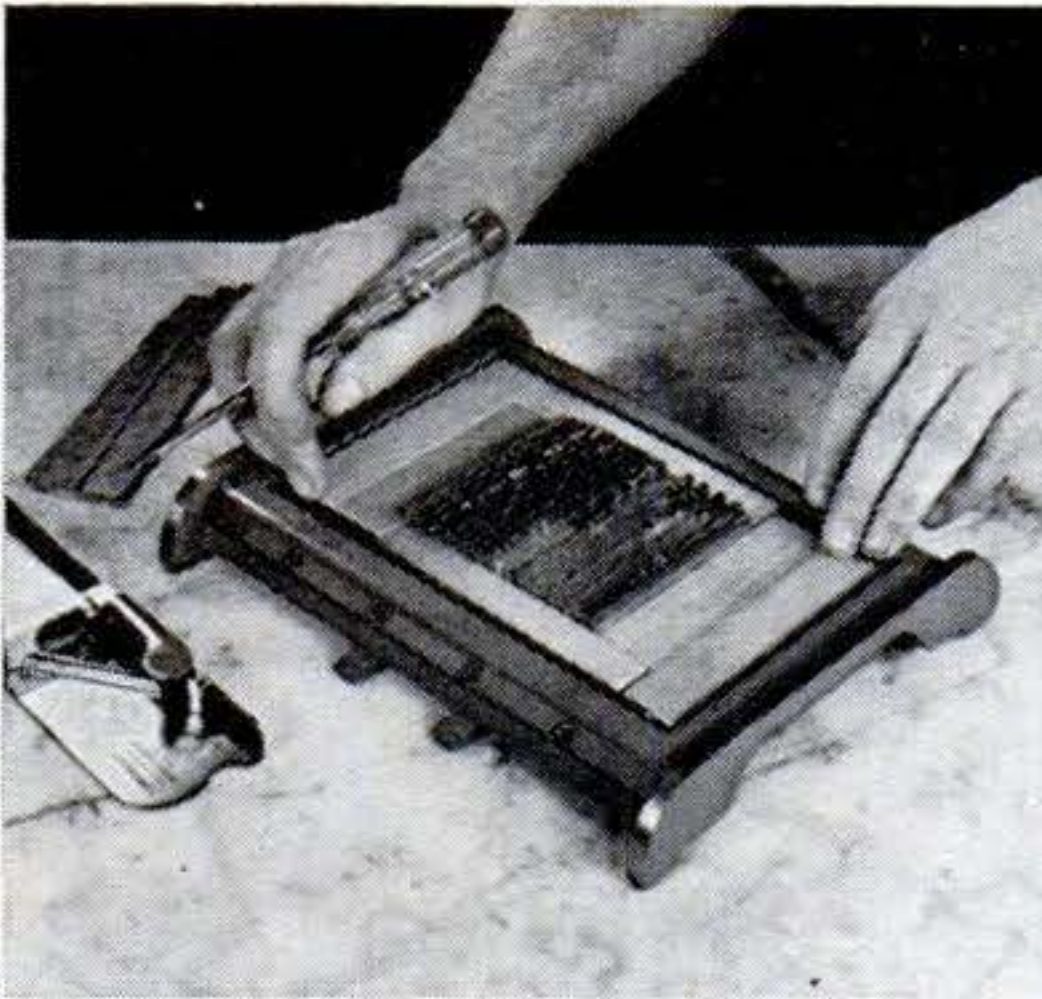
You can buy stock cuts of ornaments and decorations for Christmas cards and other purposes from printing suppliers. Or you

Continued

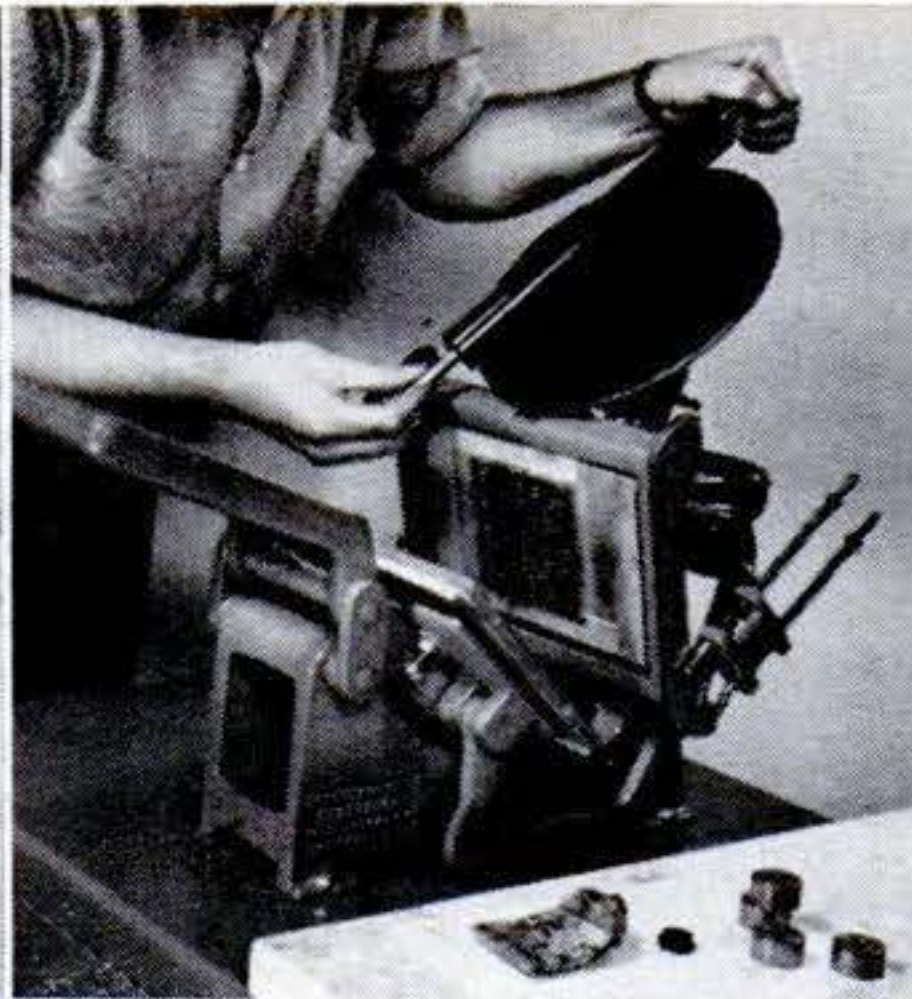
Here's how you set type by hand and operate your hand press



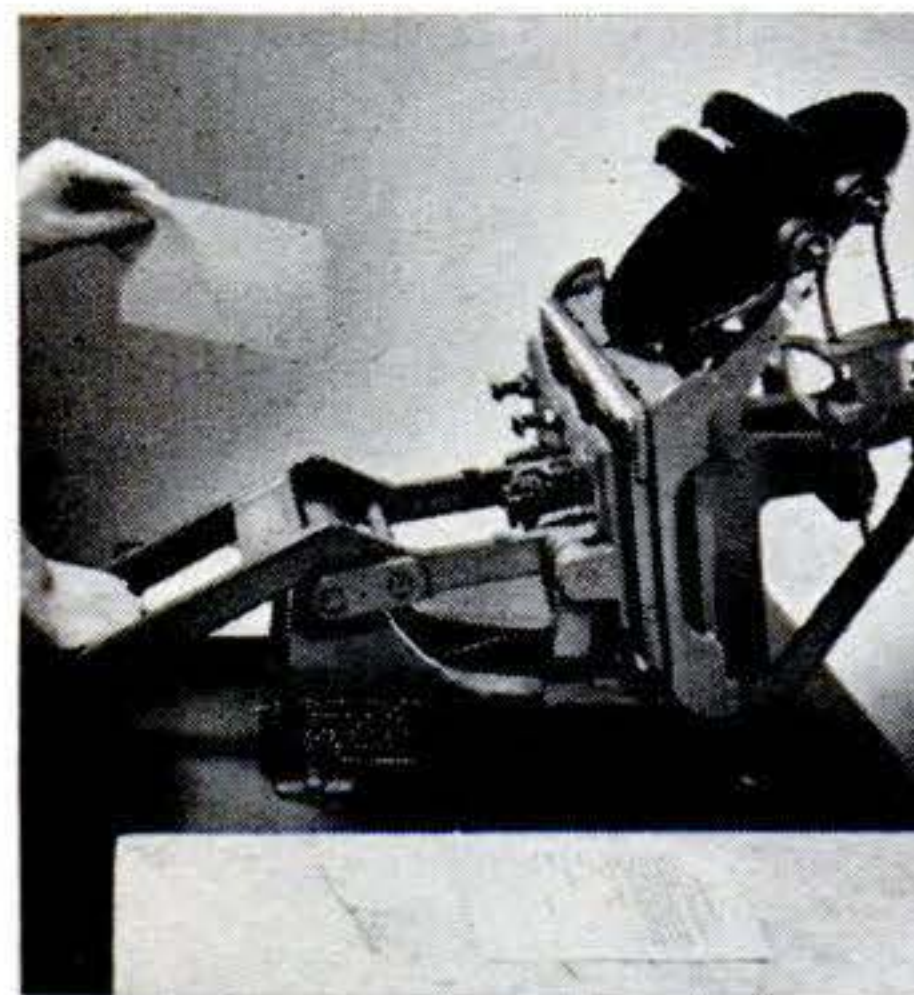
Compose type by picking up each letter from type case and placing it in composing stick. Varying word spacing makes line even.



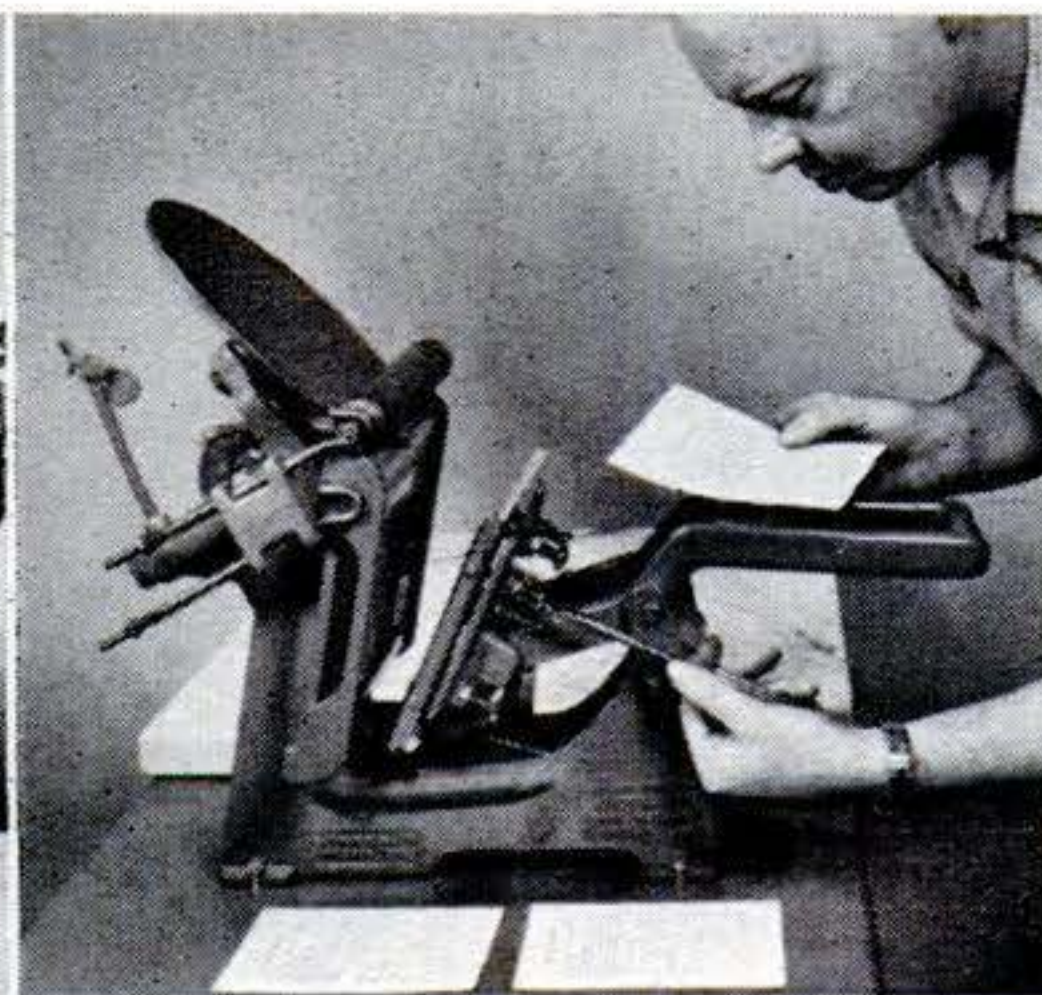
Lock up type and cuts in chase. Space around type is filled with furniture (wood blocks) before chase screws are tightened.



Ink up by rolling a thin, even coat of ink on the ink table. Either a separate roller or a press roller as shown above is used for inking.



Print by pressing down on the hand lever. The first piece will likely show uneven printing, with some type too dark, some too light.



"Makeready"—adjusting impression of paper against type to get clear, evenly inked printing—is done by turning screws.



Washup is cleaning ink off rollers, table, type, and cuts when you're through printing. Use type cleaner, benzene, or kerosene for this.

can have engravings made from your own drawings and photographs. Look in the yellow pages of the phone book under Photo Engravers to find out where to have these made. Sometimes a local newspaper plant will do engraving for you.

You can make your own line cuts out of wood or linoleum blocks. Art-supply stores sell the blocks. You draw the design on the block and carve away the surface you don't want to print.

Buying the ink. Just a dab does a lot of printing, so some suppliers sell ink put up in small, quarter-pound tubes for the hobby printer. There are dozens of standard colors to choose from. And, following instruction booklets you can buy, you can mix hundreds of colors yourself, using just a few colors and black and white.

You can print in any color on your hand press, and in as many colors as you wish

on one sheet of paper. Just print one color, let the ink dry, and set up the type or cuts for the next color. Then, with a different color ink in your press, put the paper through the press again. But you can't print full-color photographs. This takes special equipment and know-how.

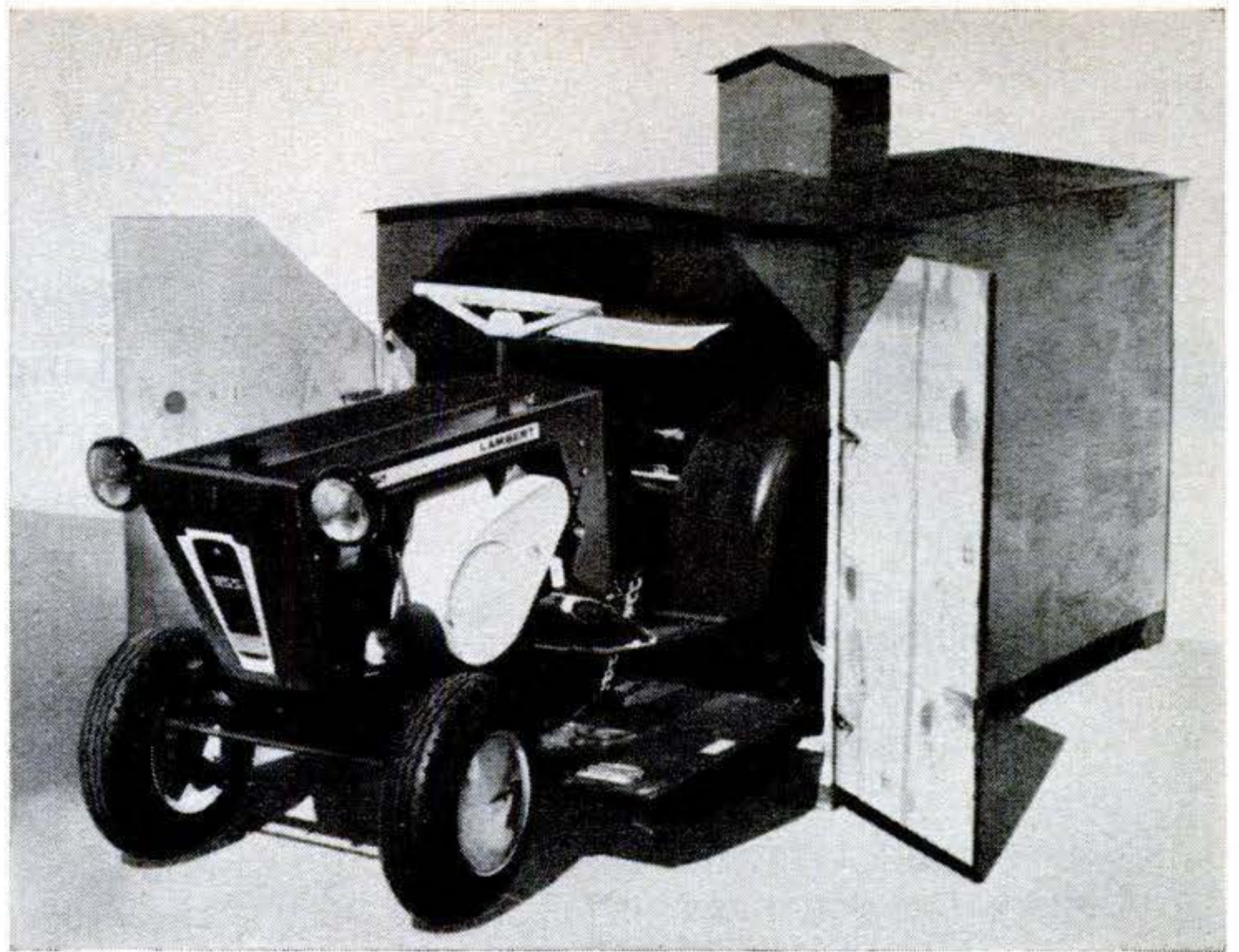
Choosing the paper. For a lot of jobs, you can use plain stationery bought at the dime store. If you're friendly with your local commercial printer, he might sell you small quantities from his own stock. But the greatest delight is to do your own printing on one of a myriad of fancy papers you can buy. Textures vary from smooth and shiny to eggshell and antique; colors from purest white to pastel shades to brilliant hues; weights from thin, filmy sheets to heavy card stock. You can get paper with deckled edges, two-colored paper, sheets

[Continued on page 176]

What's New for Your Yard

Tractor comes in its garage

There's no problem here about where to keep your brand-new garden tractor. Lambert, Inc., Dayton, Ohio, ships its tractor in a crate that converts to a back-yard storage shed.



A precut playhouse you can assemble

Children will have a ball in this little house all their own. There's more than 20 square feet of floor space for them to play in. Instructions for assembling come with each package. Potlatch Forests, Inc., calls the construction method Lok-Blok. The floor and walls are of white pine, the roof of structural exterior plywood. No foundation is needed, and the lightweight building is portable. The assemble-it-yourself kit of precut interlocking parts and all hardware needed costs \$89.95.



Garden rake adjusts to the work

You can adjust this fan rake to any spread from eight to 21 inches by means of a thumb nut. The handle and a spring clip slide down in the eight-inch position for extra support. Teeth are tempered steel. The 48-inch handle is hardwood. Bissell, Inc., Grand Rapids, Mich. \$2.70.



Popular Science AWARD

Popular Science Monthly announces another in its series of Awards introduced to give recognition to companies and individuals making outstanding contributions to American living in fields of interest to PS readers. The seventh selection of the Popular Science Editorial Board:

Outdoor Power Equipment Institute

The outdoor power equipment industry has taken a giant step forward in lawn-mower safety. Its pioneering, self-imposed safety code—which covers more than four million mowers on sale this year—has ushered in a new era of industrial responsibility for protection of the consumer.



The seal of the American Standards Association on all mowers that meet the OPEI code is destined to take its place as a symbol of quality and safety.

EUGENE S. DUFFIELD
President

ERNEST V. HEYN
Editor-in-Chief

YOUR NEW

New power-mower safety standards are a great step forward in accident prevention—but much still needs to be done

By HERBERT SHULDINER

The nation's leading lawn-mower manufacturers have launched one of the greatest voluntary safety crusades ever undertaken by private industry.

Working through the Outdoor Power Equipment Institute, the lawn-mower makers have adopted a safety code that insures that any power mower you buy this year—if it bears the institute's triangular seal (and over 90 percent of the mowers on sale do)—is the safest and most durable one you've ever been able to buy.

Despite these improvements, no power mower on the market is absolutely safe—nor can it ever be. That's because the machine is only one of the causes of accidents. The operator and environment also contribute to creating mishaps.

But safety experts are unanimous in the opinion that the OPEI mower code is a big step forward in safer power mowing. "The OPEI has set a precedent in the initiative they've taken and other organizations would do well to copy them," says Hans Grigo, a technical consultant of the National Safety Council. "They are pooling engineering know-how for safety and have pledged not to sacrifice safety for innovation."

The code does three basic things to increase the safety of power mowers:

- Reduces the possibility of your coming into contact with the blade.
- Cuts your chances of being struck by missiles hurled out of the grass-discharge chute or from under the mower housing.
- Insures that cutter parts of any mower made under the code are highly durable.

Prof. L. W. Knapp Jr., chief of the Accident Prevention Section of the University of Iowa's Institute of Agricultural Medicine

MOWER...safest one yet

and one of the nation's leading experts on farm- and garden-machinery hazards, says, "The new code should be your beginning when choosing a new mower because it protects you from buying a hunk of junk."

But Professor Knapp feels there is room for even more improvements in mowers. Many industry representatives echo these feelings, but fear consumer resistance to safer machines.

Walk-behind rotary mowers are the biggest problem. "By the time you render a rotary mower safe, you limit its ability to

do the job the average person demands," says Sherman C. Heth, vice-president for engineering of the Jacobsen Mfg. Co.

He cites the experience his company has had in making rotary mowers for export to Sweden, which has the strictest power-mower safety code in the world. The Swedish machines must be completely enclosed. No discharge chutes are allowed. Guards all around the deck and between the wheels make the machine a "virtual battleship." But many Swedish customers buy this machine and then cut away part of the side deck

Continued

DRAWINGS BY
DANA RASMUSSEN

The new look in safer power lawn mowers

Main features of the new safety code adopted this year by the nation's leading mower manufacturers are illustrated here. Any mower that meets these specifications qualifies for the triangular seal of the Outdoor Power Equipment Institute. About 10 percent of the more than four million mowers on sale don't — so for safety, look for the OPEI seal before you buy.

Engine speeds are limited so blade-tip speed won't exceed 21,000 feet per minute. This cuts force of hurled objects.

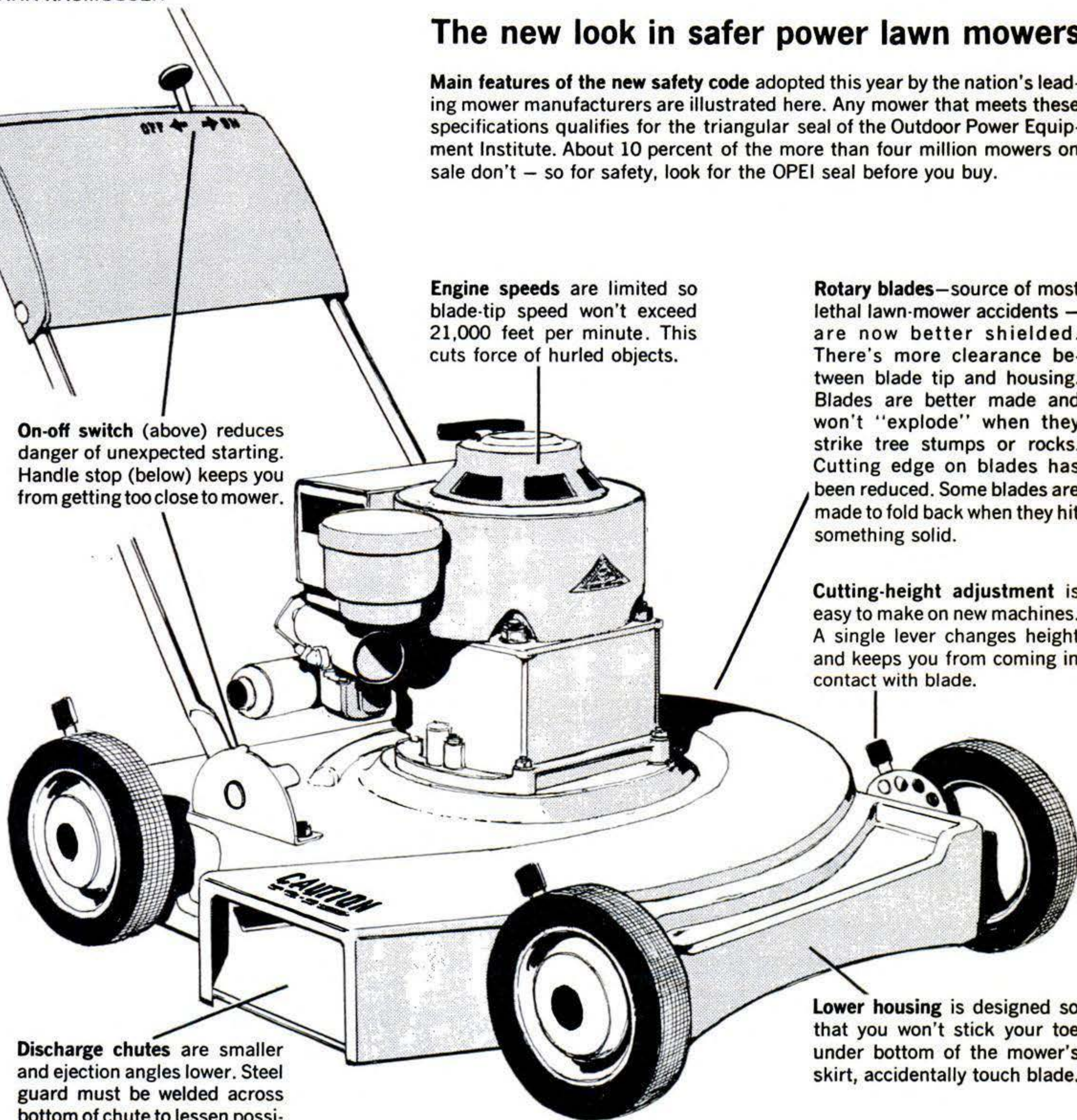
Rotary blades—source of most lethal lawn-mower accidents — are now better shielded. There's more clearance between blade tip and housing. Blades are better made and won't "explode" when they strike tree stumps or rocks. Cutting edge on blades has been reduced. Some blades are made to fold back when they hit something solid.

Cutting-height adjustment is easy to make on new machines. A single lever changes height and keeps you from coming in contact with blade.

Lower housing is designed so that you won't stick your toe under bottom of the mower's skirt, accidentally touch blade.

On-off switch (above) reduces danger of unexpected starting. Handle stop (below) keeps you from getting too close to mower.

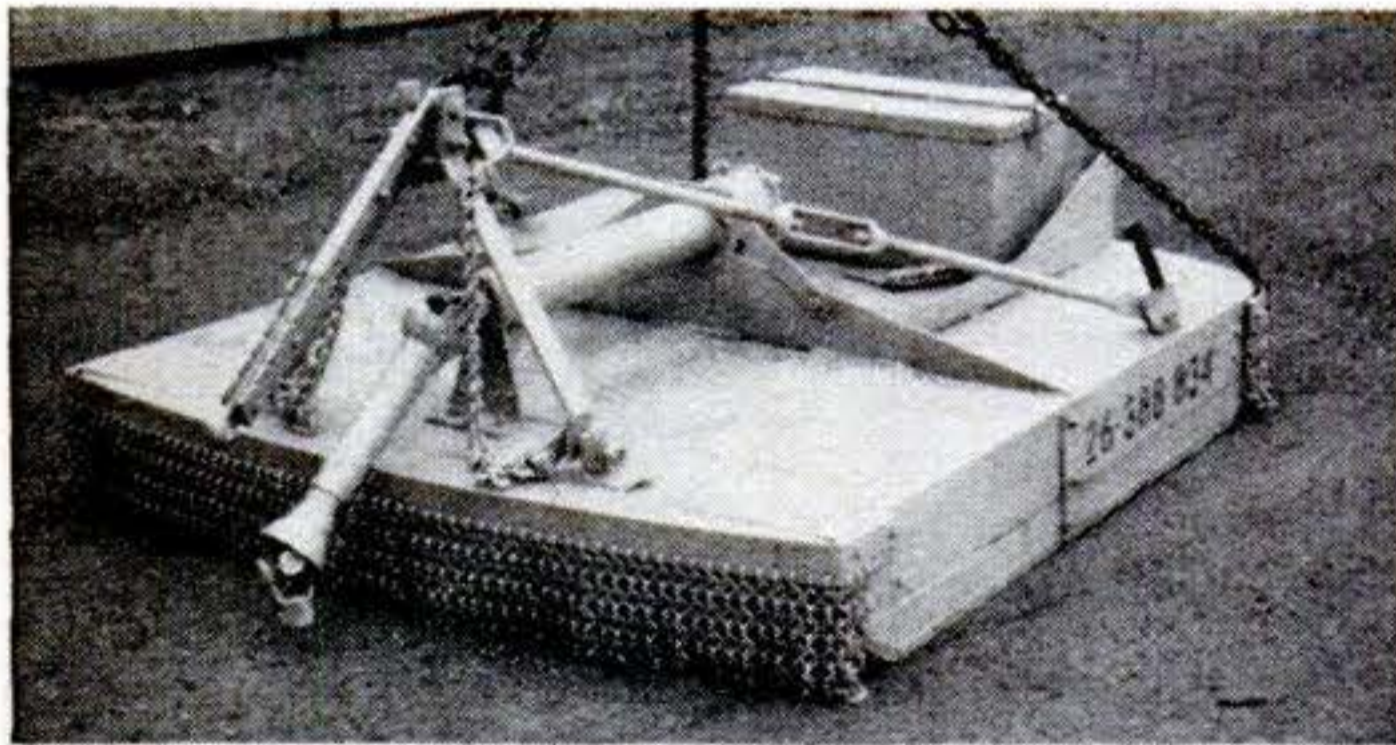
Discharge chutes are smaller and ejection angles lower. Steel guard must be welded across bottom of chute to lessen possibility of contact with blade.



Here are four good ideas to promote power-mower safety

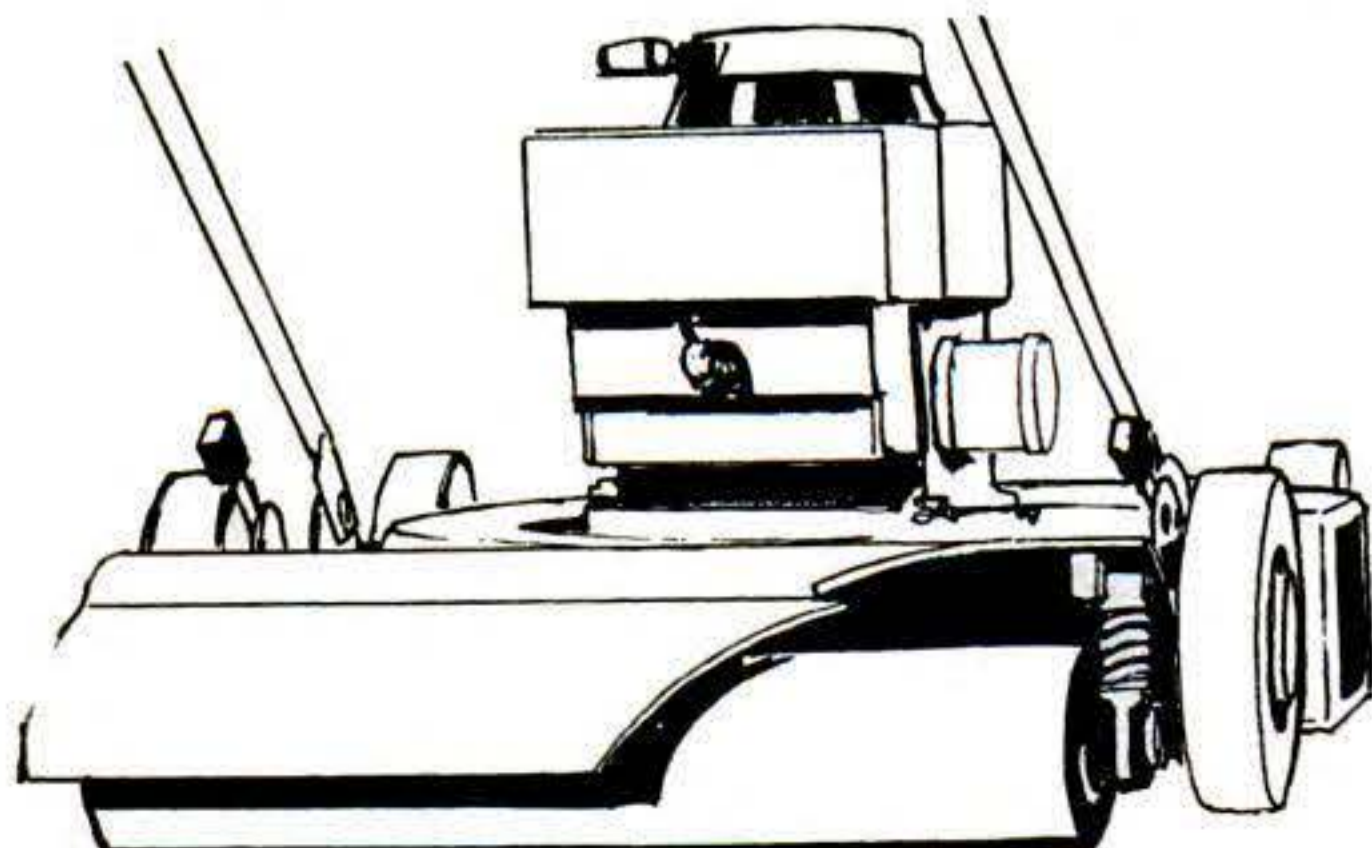


Safety seat on Toro riding mower exceeds minimum code requirements. When you get up from the safety seat, the mower wheels stop and the blade locks, giving the mower a sort of deadman's control. OPEI code provides that all moving parts, gears, and chains of riding mowers be covered adequately and that they have stability on grades. But most riding mowers aren't made to stop if you fall off. A deadman's control would be an effective way to prevent unattended mowers from running over anyone.



The Ohio Highway Department rigged up this device to protect its employees from missiles thrown out from under the housing of some machines it uses. The protective "fence" is made of chain links that drag along the ground.

Antimissile device, proposed by Prof. L. W. Knapp of Iowa Institute of Agricultural Medicine, might help cut down on greatest source of injuries to mower operators—hard objects thrown out between the rear wheels. Knapp suggests installing a spring-loaded roller between the rear wheels to maintain constant contact with the ground and block off most of the rocks, wires, or nails flying off rotary blades.



to improve cutting and make lawns neater.

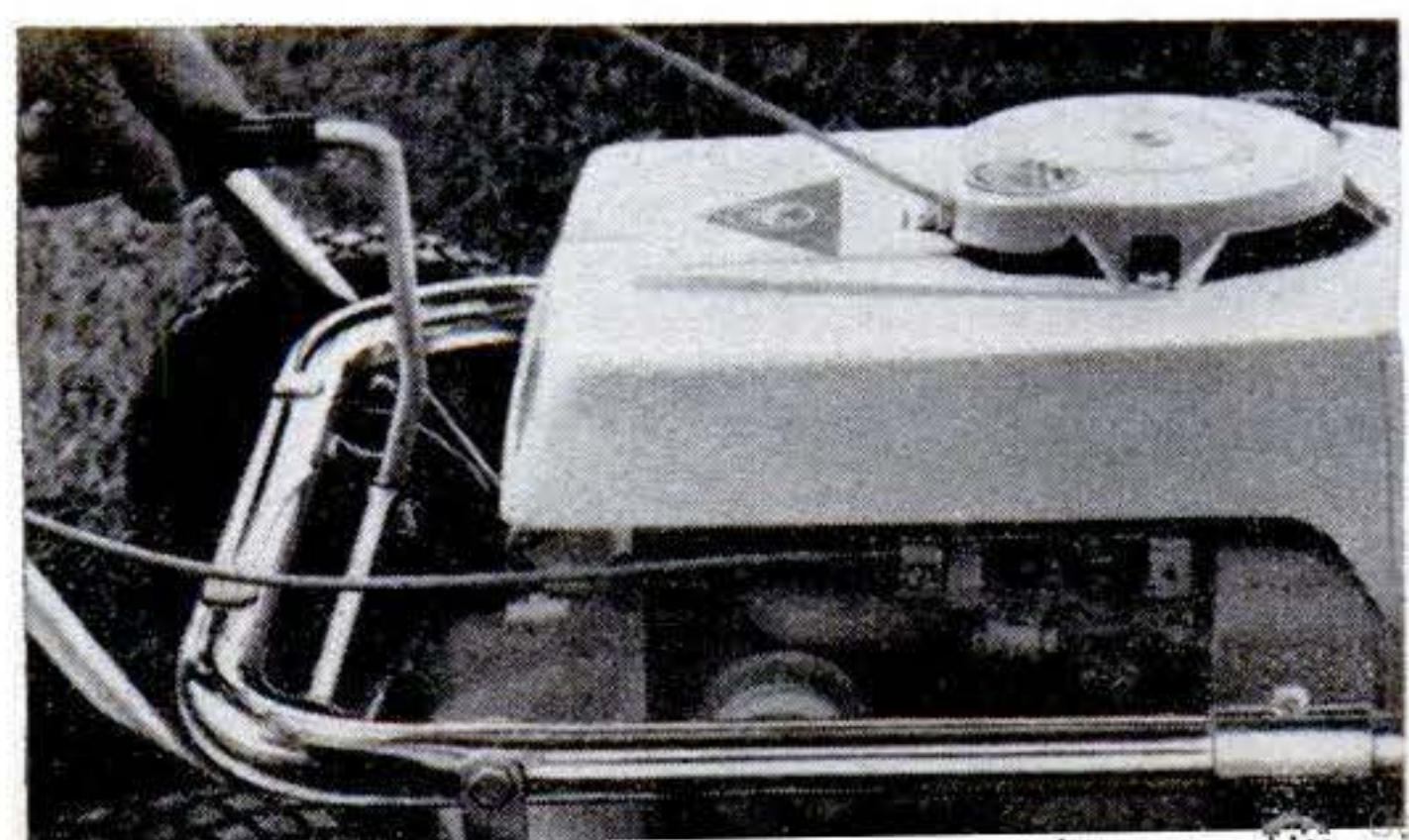
Despite the feeling in industry that consumers tend to resist paying for safety innovations, an even stricter safety code is in the offing. Lyle S. Richardson, a vice-president of the George D. Roper Corp., one of America's largest lawn-mower manufacturers, says an OPEI committee is working on a revised and strengthened code.

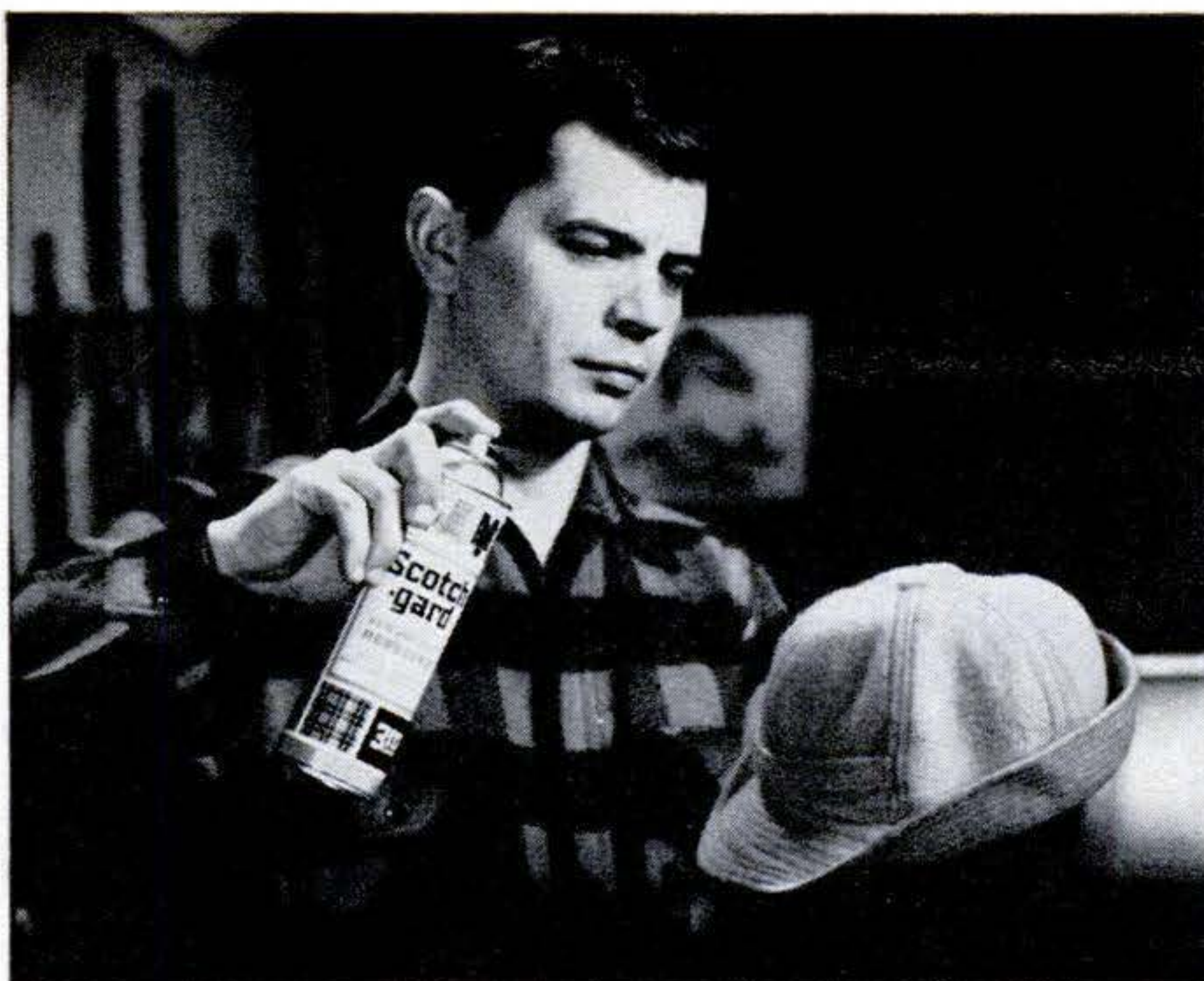
Closing up the rear end. Extensive research is now being sponsored by the U.S. Public Health Service to better pinpoint what hardware improvements could be made to prevent accidents. One project conducted by Professor Knapp points to the need for closing up the rear end of the machine. Knapp and an associate, W. H. McConnel, found that the most frequent accident to the mower operator is caused by objects hurled back between the rear wheels. If some kind of spring-loaded roller (see drawing at bottom, left) which would always maintain positive contact with the ground could be made standard on rotary mowers, most of these accidents might be eliminated. Knapp says a simpler adjustment for cutting height is needed, too.

"Slowing down the machine would also make it safer," Knapp says. The average mower motor now runs at 3,200 r.p.m. Some run as slow as 2,600 r.p.m.—which is still pretty fast. The reason for the speed is that to get a good grass-cutting job out of a rotary running at slow speed, the blade must be real sharp. In practice, few people keep blades sharp enough to do a satisfactory cutting job at slow speed. And they want machines that can cut grass with dull blades.

But Knapp warns that there's a limit to improvements: "You can make the rotary mower so safe that it will cut grass poorly, and nobody will want to buy it." **PS**

Safer way to make cutting-height adjustment is featured in new AMF Homko lawn mowers. Wheels are suspended from a monorail track, which allows you to vary height of all four wheels at once by moving a lever, as below. Homko mowers have a stainless-steel Flexor blade, which is designed to stay sharper longer and is so constructed that it flexes back when it makes contact with any solid object.





What's New for Camping

Easy way to make outdoor clothes water-repellent

It's Scotchgard rain and stain repellent in aerosol spray cans. You can also use it to protect your canvas shoes, sleeping bag, tent, pack, tarpaulin, and other fishing and camping gear. There are two kinds: one for dry-clean fabrics, one for washables. A can costs \$2.98.



Sleeping bags with a choice of blankets

With a layered sleeping bag, you crawl into whichever layer is best suited to the outside temperature. The All-Temp shown above, made by H. Wenzel Tent & Duck Co., St. Louis 63132, has two compartments: one with a one-pound cover for warm-weather sleeping, another with a three-pound cover for chilly weather. And you don't need to buy a mattress: There's a foam one built into the bag. Cost: \$35.95.

You get three choices of sleeping warmth with the Tri-Temp made by the Coleman Co., Wichita, Kan. 67201. It's extra large and warm for its weight, and the bag is made so you can zip it up without having the slide catch. It's one of 10 new bags, ranging from 2¼ to four pounds, made by Coleman.



Camping experience designed these tents

Coleman, an old hand at making outdoor equipment, now offers seven new, light, roomy, and easy-to-put-up tents. Even the largest one, the 10-by-13 foot Oasis shown above, goes up in a few minutes with no strain. Spring-loaded, self-adjusting aluminum poles keep the tent taut. They're color-coded to simplify putting them together right. The extra-large doors and windows are screened with nylon mesh. A free catalogue is available from the Coleman Co., Wichita, Kan.

Guide to camping and outdoor living

Tips on selecting equipment and preparing for a camping trip, and a list of campgrounds, are in a 52-page booklet you get when you buy Johnson's insecticide or insect repellent.

Have trouble staking down a tent? Here's a mallet to make the job a lot easier



Tent stakes won't split when you pound them with this new Champion mallet, which has a hard-rubber head permanently mounted on a rust-resistant steel handle. A specially designed, welded stake-extracting hook at the other end of the handle makes dismantling a tent easy. It's imported from France by I. Goldberg & Co., 429 Market St., Philadelphia 19106. Price: \$1.75.



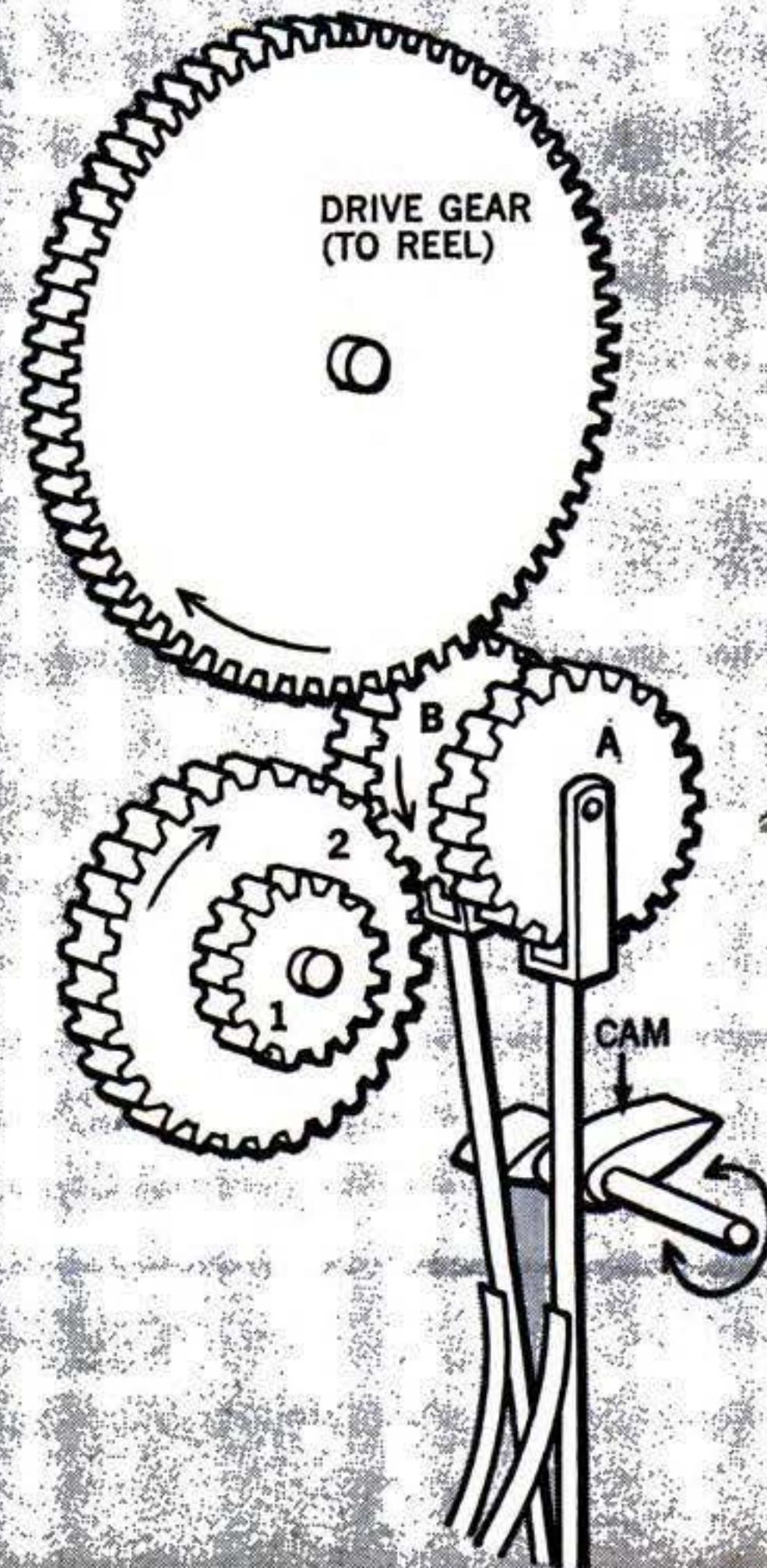
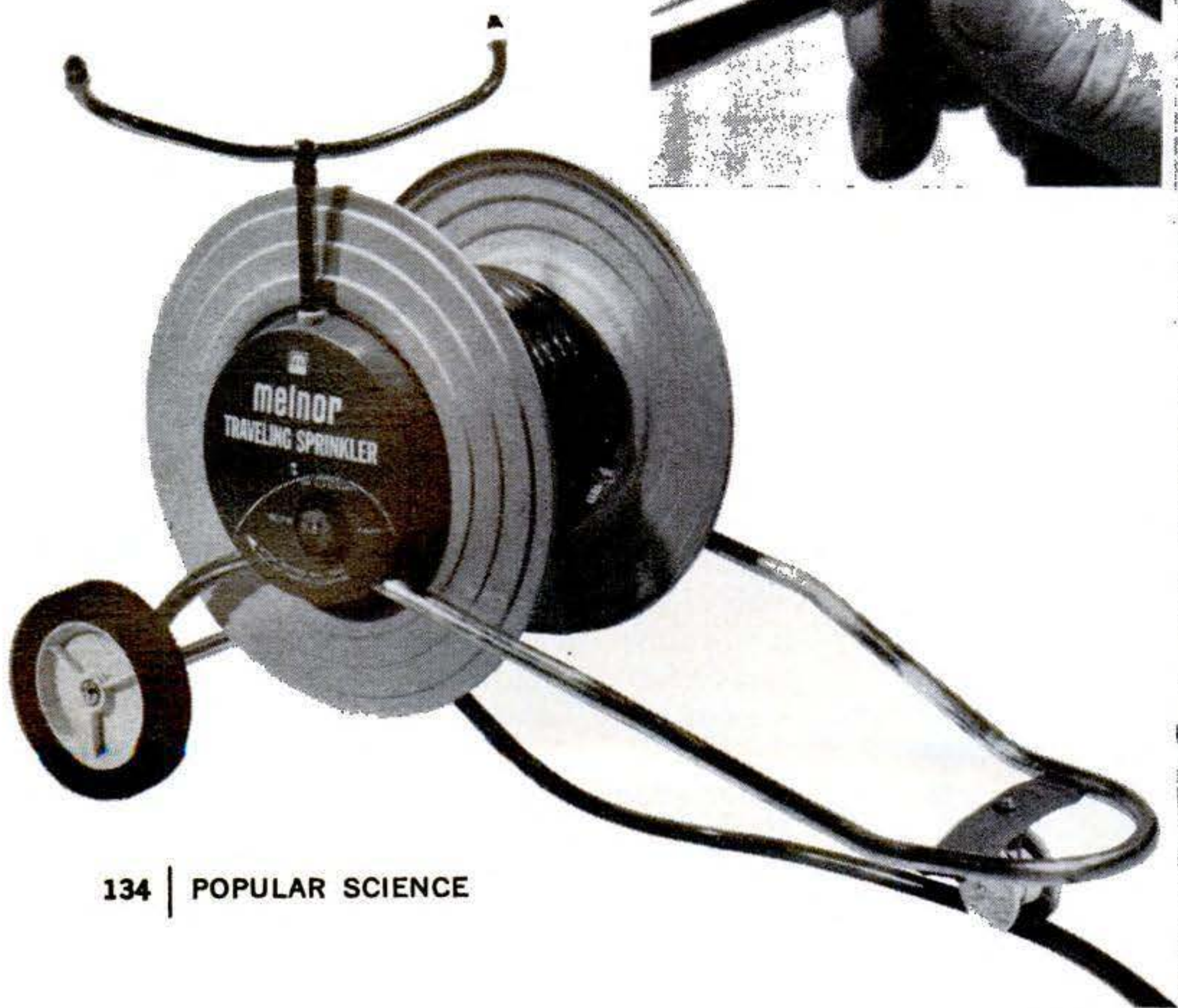
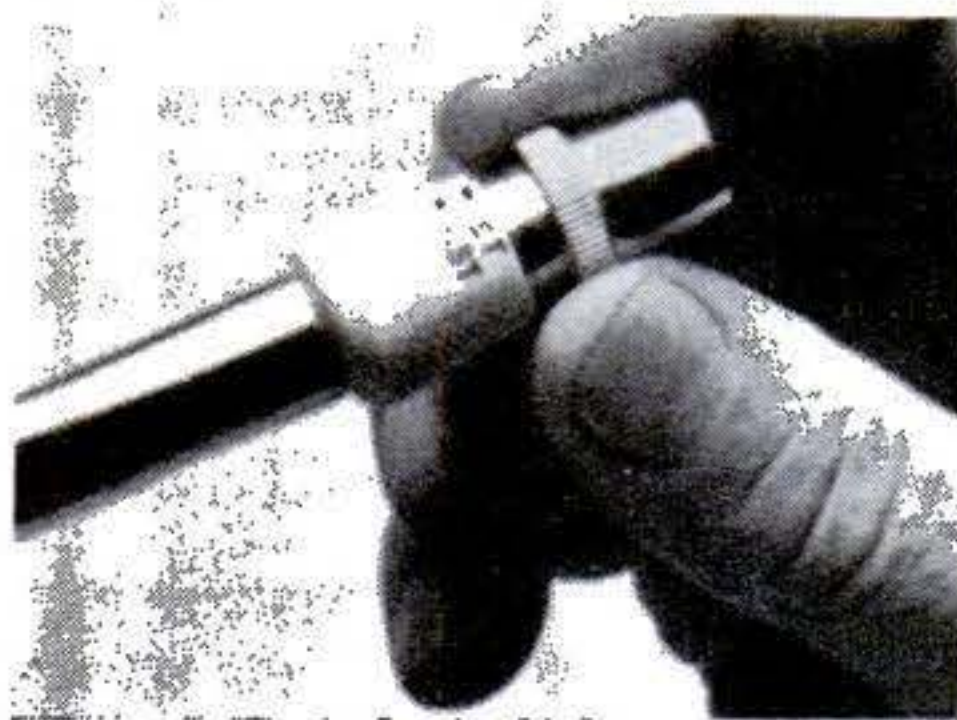
The Greenest Lawn

The less it rains, the more you need an efficient lawn sprinkler, not only to keep the grass alive but to conserve water. Some sprinklers throw half their spray away. Others, subject in recent years to

some pretty ingenious engineering, can be programmed to water only where you want water, to deliver the size droplet you want, to move themselves around the yard, and to shut themselves off.

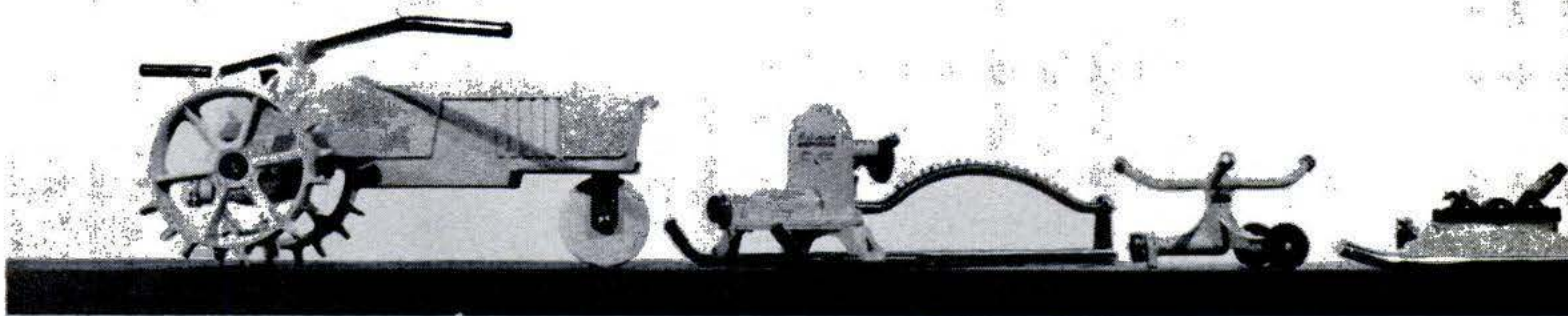
Some traveling sprinklers follow the hose as they water the lawn,

DRAWINGS BY DAN TODD



Smart engineering in new lawn sprinklers puts moisture where you want it with a minimum of waste and bother

By JACKSON HAND PHOTOS BY ROBERT D. BORST



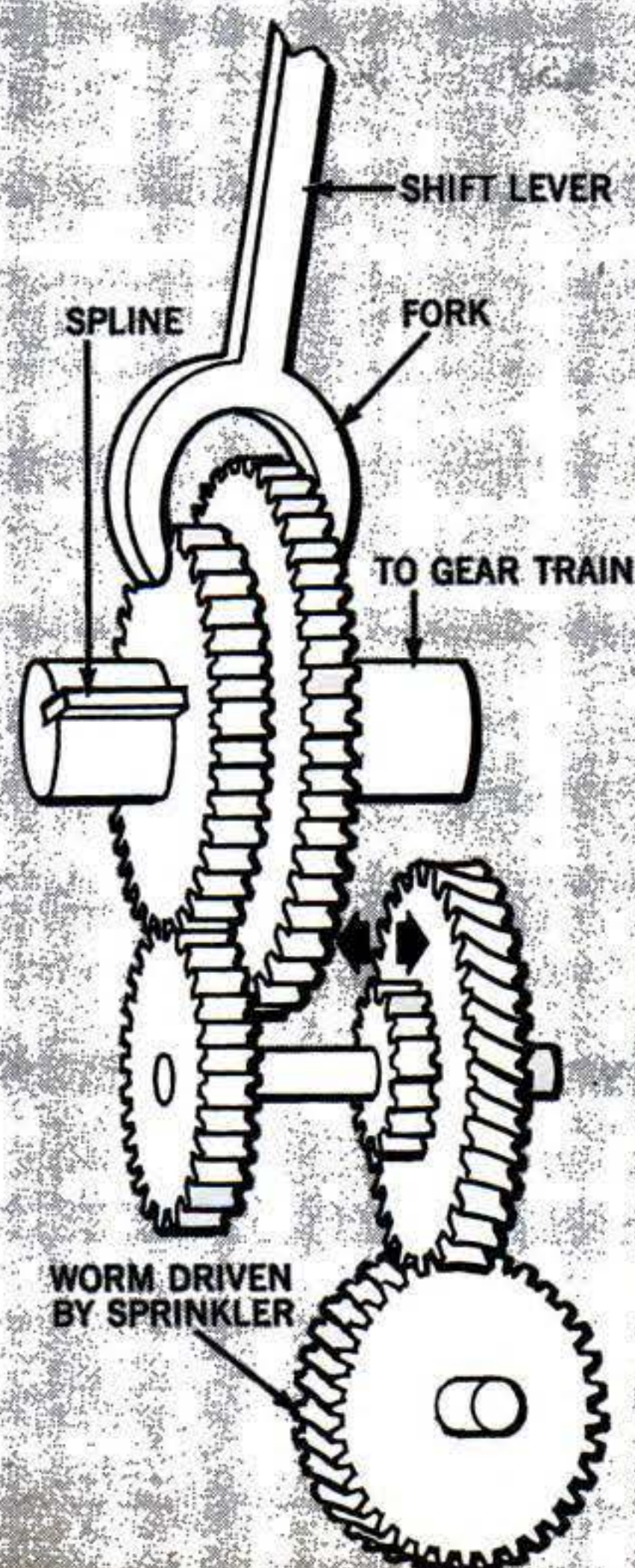
for the Least Water

An example is a little \$4 spinning sprinkler that its manufacturer (L. R. Nelson) calls the Poppy. It has three arms that spin, and it throws a square pattern—from about 5' by 5' to about 45' by 45'.

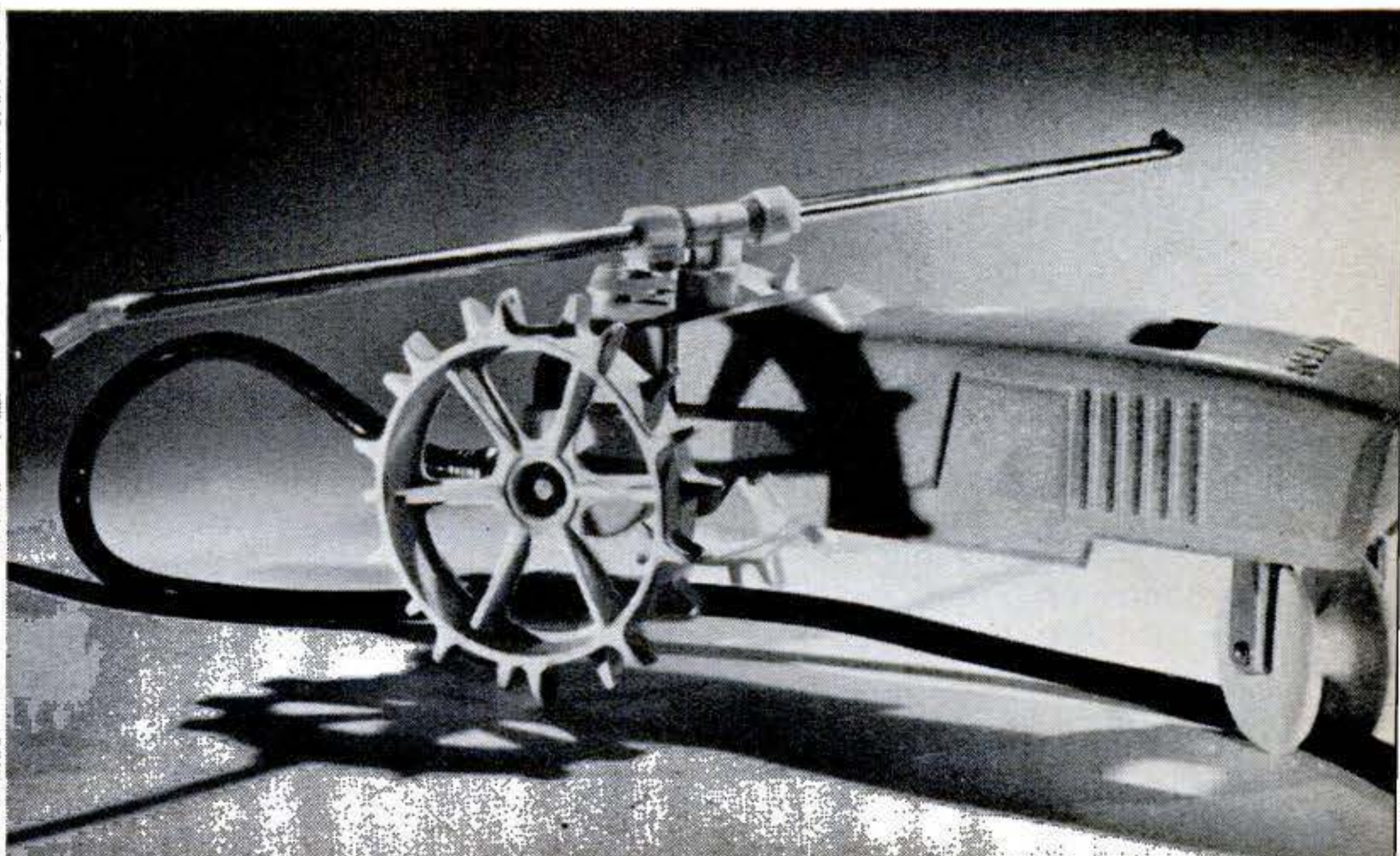
Toward the other end of the scale is the \$20 Contour Rain Dial by Gates Rubber Co. You can program this one to water the yard around a kidney-shaped swimming pool—or just about any other shape—with-

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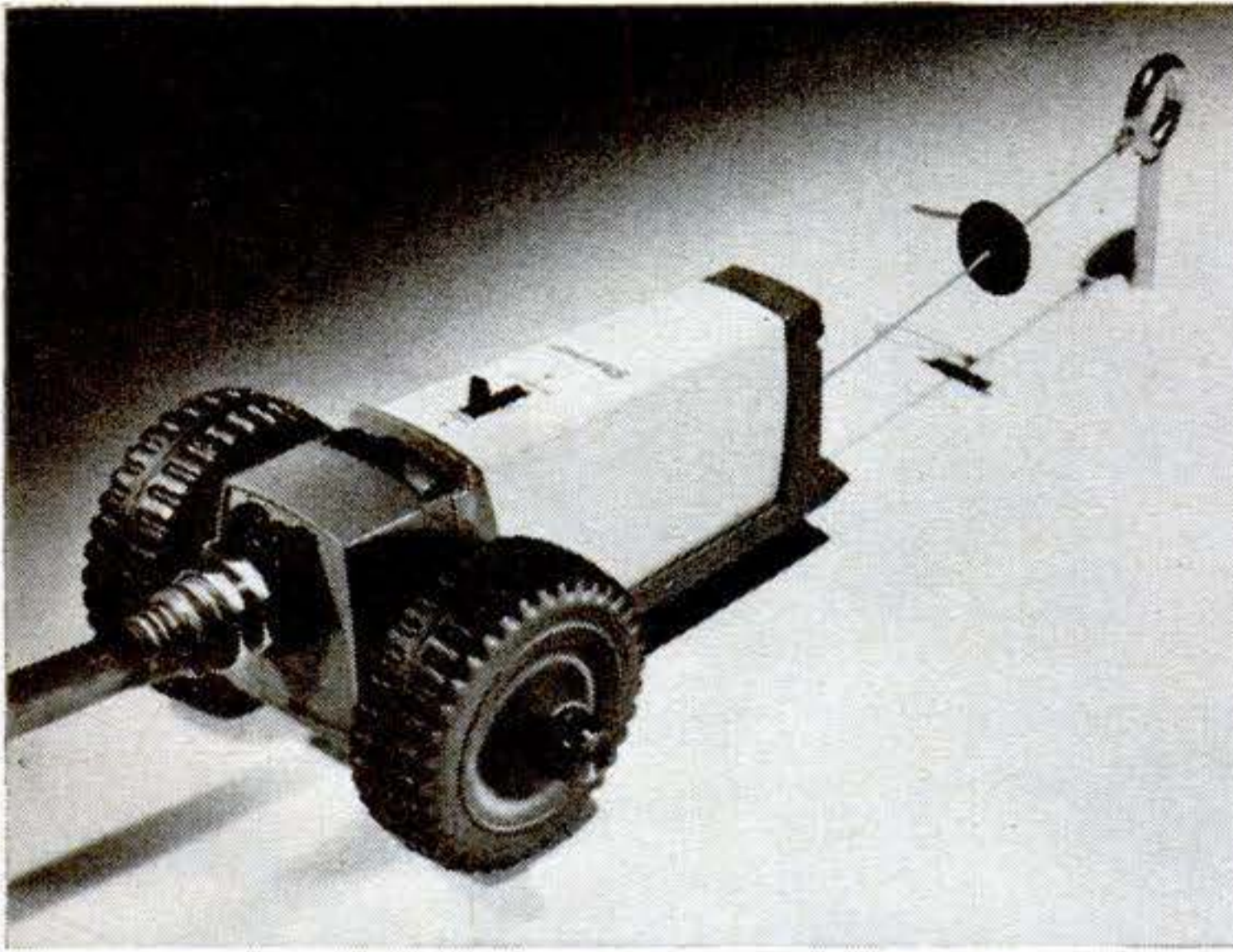
and on two of them you can shift gears to vary the speed



Jet action causes sprinkler arms to revolve. The Melnor at far left has adjustable nozzles (see small photo). The revolving arms drive gears that propel the sprinkler along the hose. Two speeds let you water light or heavy—since the sprinklers throw the same amount of water at either speed. Left, the Melnor double-idler system has two idler gears (A and B), mounted on flat springs. They match with gears of two sizes (1 and 2). When you turn the speed knob, the cam forces either of the idlers into position, one producing more speed than the other. A quarter-turn turns the cam so neither idler engages. This provides stationary watering. The Nelson, below, has a spline system. The shift lever, terminating in a fork, slides the dual gear along a splined shaft, so that it can engage either the high-speed or low-speed gear from the worm-drive system. The shaft, in turn, drives the gear-down to the tractor wheels.



Traveling sprinkler winds up tether to pull itself along, as vacuum



Oscillating traveling sprinkler made by Sherman gets its power from a diaphragm motor. In each wheel is a plastic dome, sealed with a rubber diaphragm. Fastened to this is a laterally moving

out a drop landing on forbidden ground. Beneath its plastic housing are 16 red dials that control the direction and distance the water will be thrown at various points as the nozzle makes a slow (90-to-120-second) revolution.

You follow the nozzle through one cycle, adjusting knobs for the distance required to cover the area you want to sprinkle. From then on, the machine takes over, never forgetting what you told it the first time.

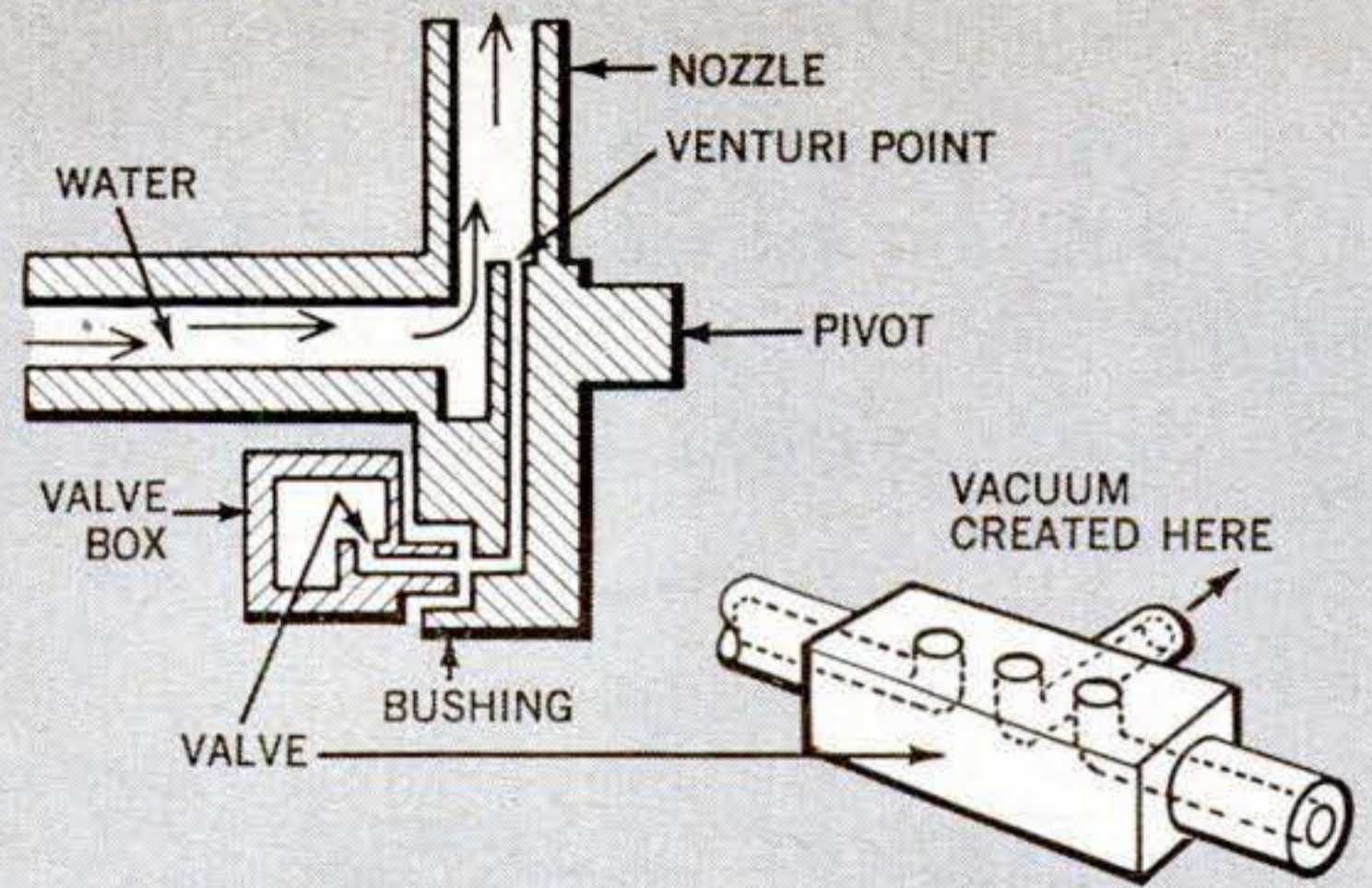
The five kinds of sprinklers. Although all sprinklers overlap in general utility, each type has one or two special features or functions. Basically, there are five kinds:

1. Rotating or whirling sprinklers.
2. Oscillating sprinklers that wave a fan of water over an area.
3. Impulse sprinklers.
4. Turret sprinklers, devices with a fitting that allows the selection of the kind of spray head desired.
5. Simple spray heads, each designed for a specific kind of spray or pattern.

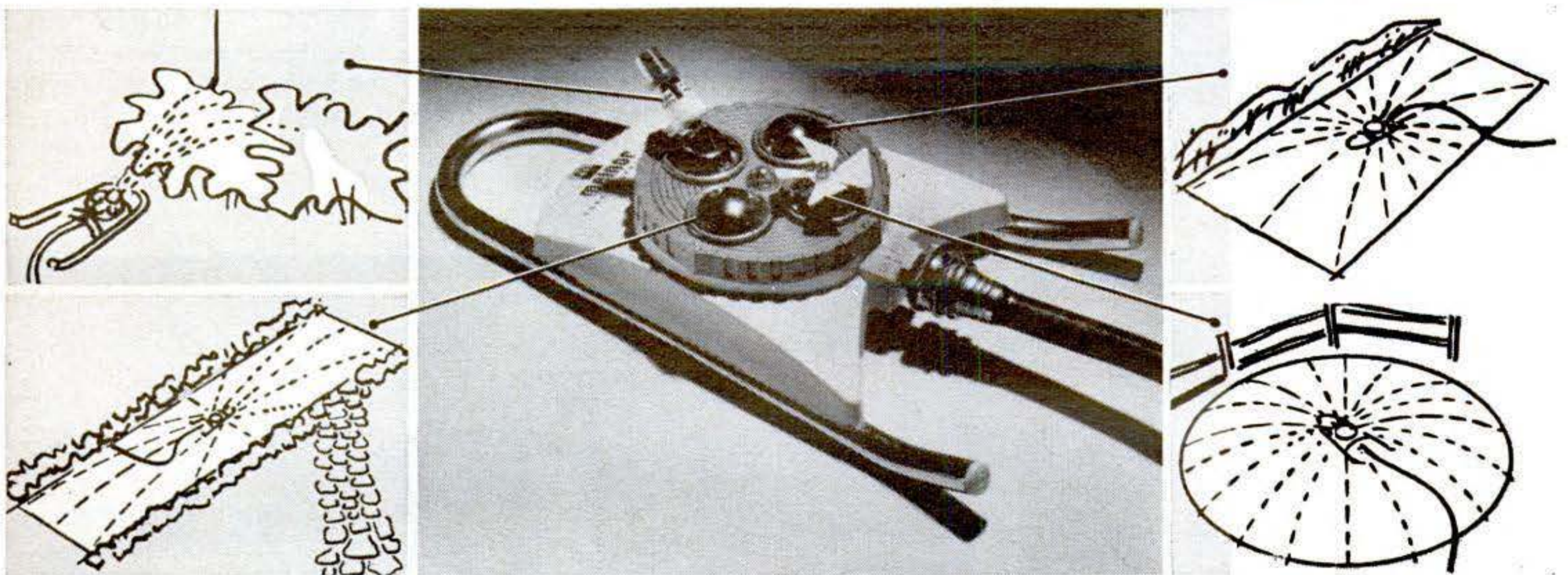
The advantages of each sprinkler become most apparent in terms of specific applications. For a tiny lawn, for instance, your best bet is a small sprinkler head that throws a square pattern.

If you grow large expanses of grass, you

shaft in the form of a hollow tube. As the water passes through the sprinkler, it creates a vacuum (venturi principle) and draws the shaft to one side. At the end of this stroke, a tiny lever opens a valve



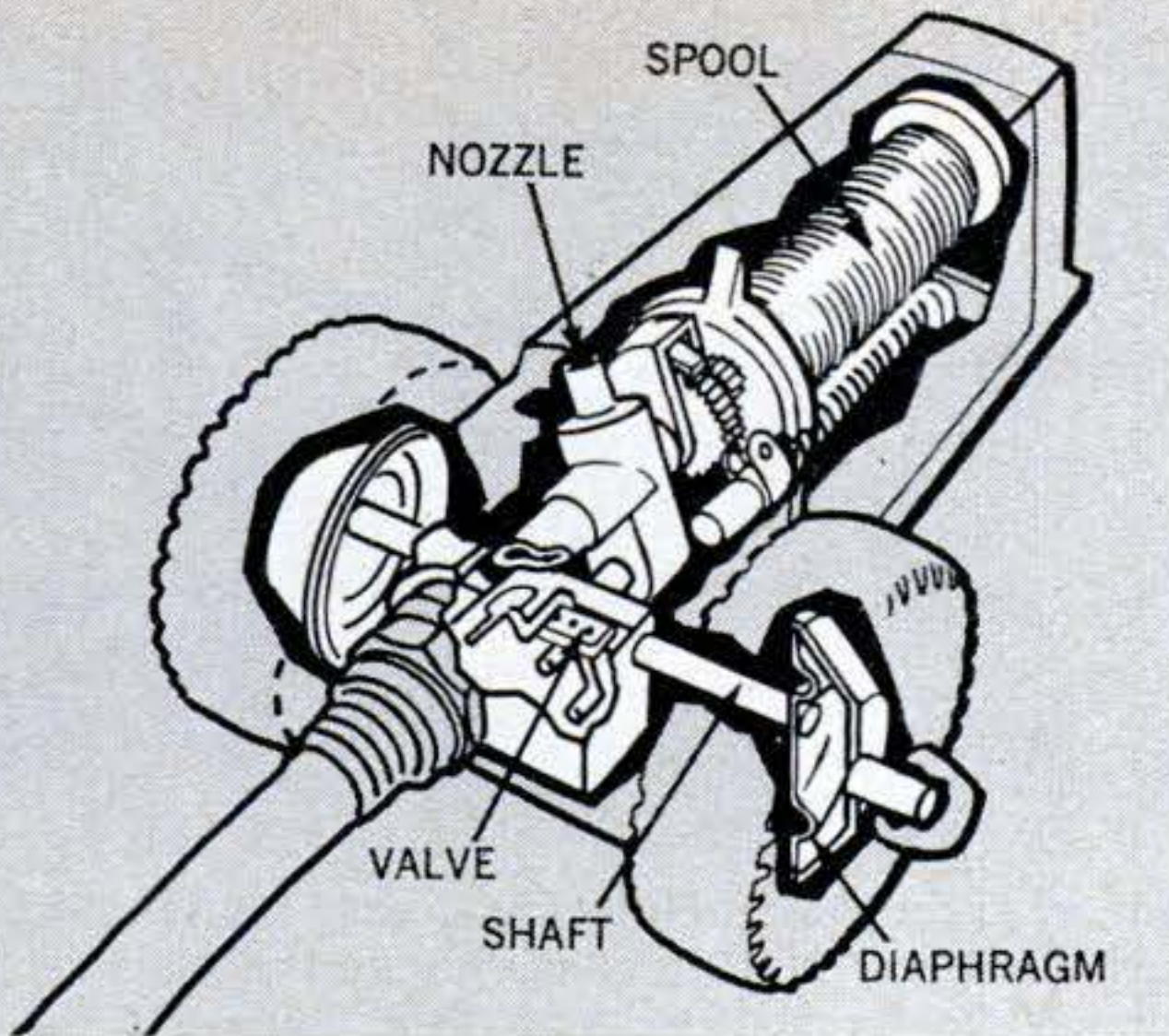
Turret models give you a choice of several sprinkling patterns



Pancake turret on top of this sprinkler mounts four different heads, each with openings designed to produce one of the patterns of spray shown in the sketches. Selecting the one you want for any job is as simple as turning the turret until it click-stops. From model to model and manufacturer to manu-

facturer, heads are available in a wide variety. Take a walk over your lawn, establish the shapes you need most, and then pick the best model for your yard. Skids make the Melnor sprinkler shown above easy to move about. These are designed for no-dig-in balance with automatic shut-off.

switches spray from side to side



in the shaft, and the shaft returns. The valve closes and the cycle repeats. The back-and-forth motion of the shaft activates the oscillating nozzle and drives a ratchet that winds up the cord on a spool.

should look at big oscillators, spinners, or impulse rigs—something that throws a lot of water. But you should also look for mobility, quite likely a sprinkler that travels. (People in this category may also need one or more of the little jobs.)

The oscillators. This type is probably the best choice for most lawns. Here's why:

- They cover a big area, up to 50' by 55' or 45' by 70' or more, depending on water pressure.

- They are easy to move. Most are mounted on sled-like runners. Set them up at the far end of the lot, then simply haul in the hose to move the pattern.

- Within a price of, say, \$15, they include adjustments from a 3'-by-3' square up to large areas. Part of this range is controlled through water pressure, part of it by limiting the arc through which the oscillator travels.

- Most important, they can be adjusted to cover just a narrow strip, a frequent requirement in watering. The more flexible models have an infinite number of wide-to-narrow adjustments. All of the better machines can be set to water only to the left, only to the right, or right down the center. The advantage of this is that you can put the sprinkler close to the house and set it to spray a strip right up to the foundation without touching the house itself.

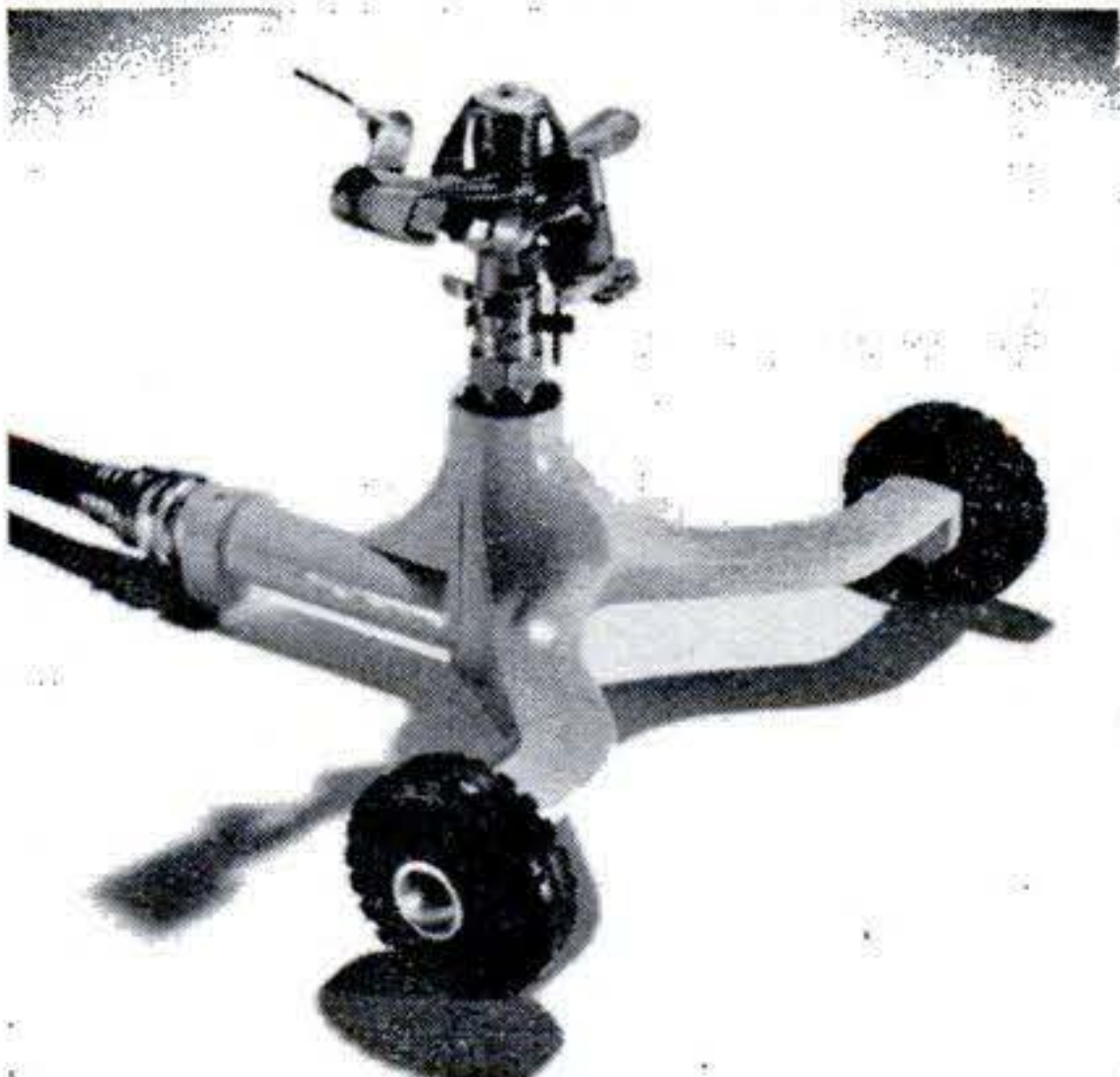
Oscillators have disadvantages, too. They tend to leave too much water at the edges, since the ordinary crank-driven oscillator must come to a stop at the end of each stroke before it can start back. This is licked by the use of a heart-shaped cam on an oscillator made by Nelson.

Another disadvantage, though slight, is nonadjustability of the type of spray. The water comes out in a stream that breaks into droplets. There is no way to control the size or frequency of the droplets to prevent damage to new seeding.

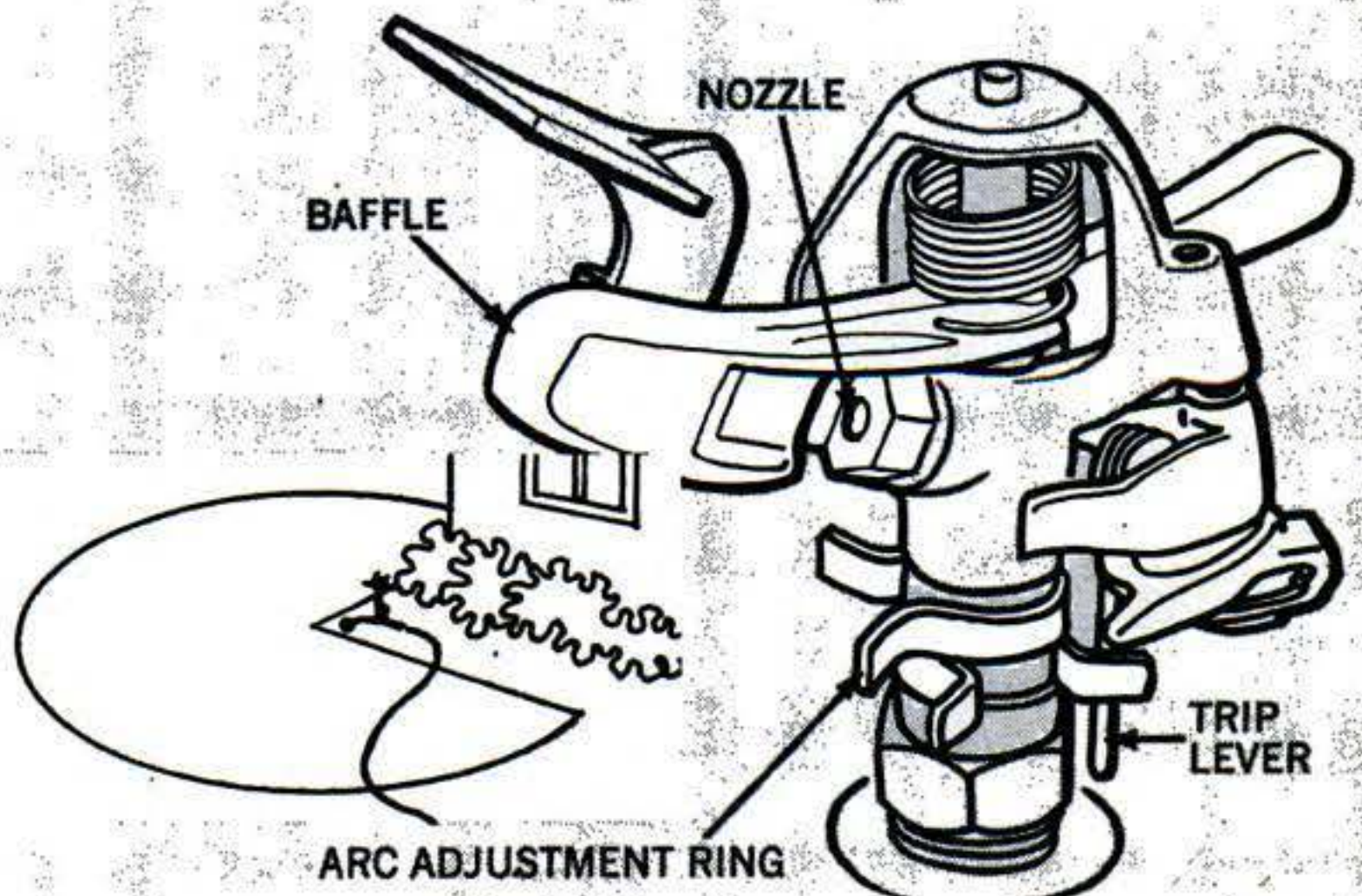
Whirling sprinklers. Except for little prodigies like the Poppy, whirling sprinklers throw circular patterns. You miss the corners. There is no efficient way to water a rectilinear area with a circular pattern. However, when the area is big, the advan-

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Impulse sprinklers go part way around circle and then reverse

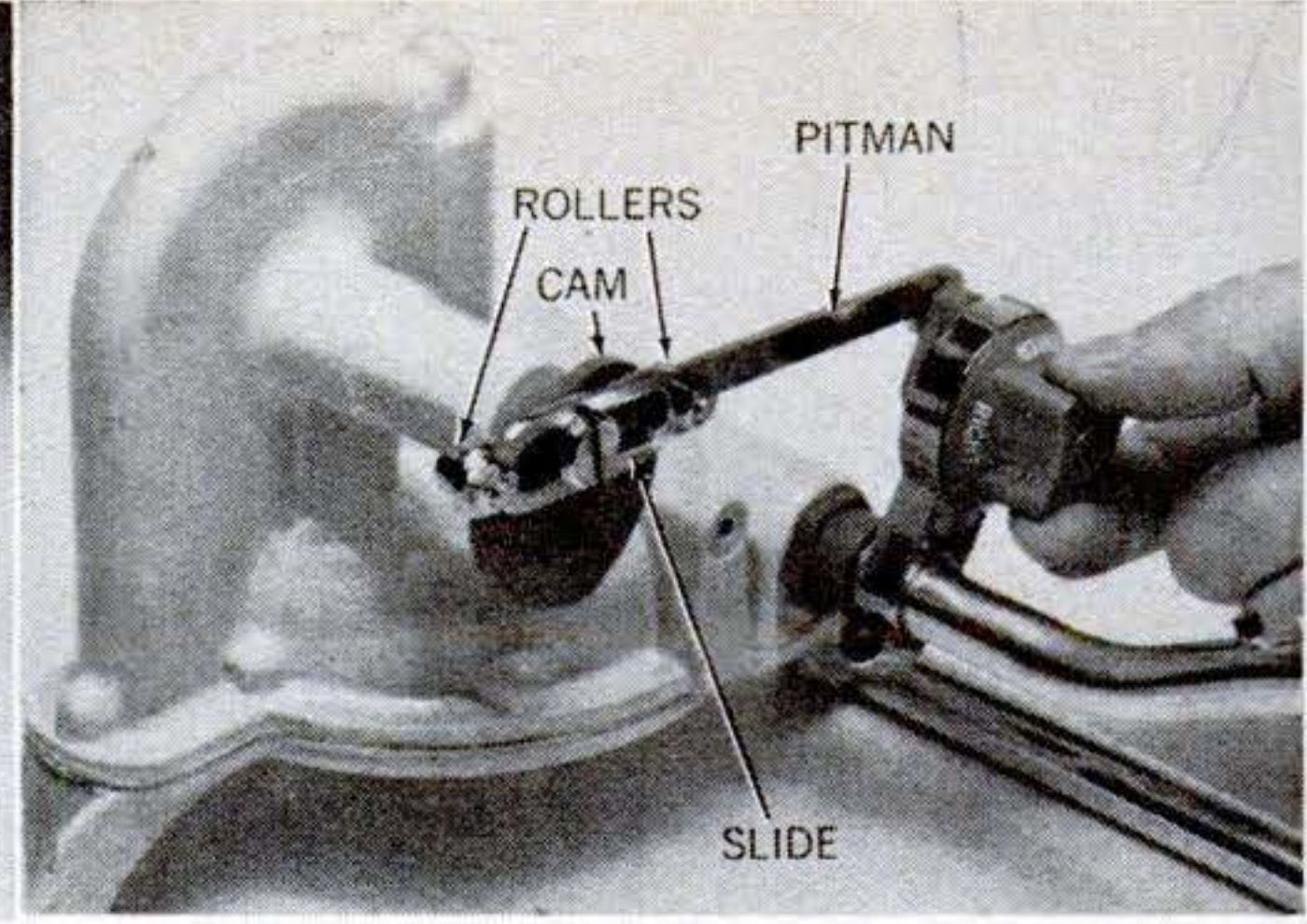
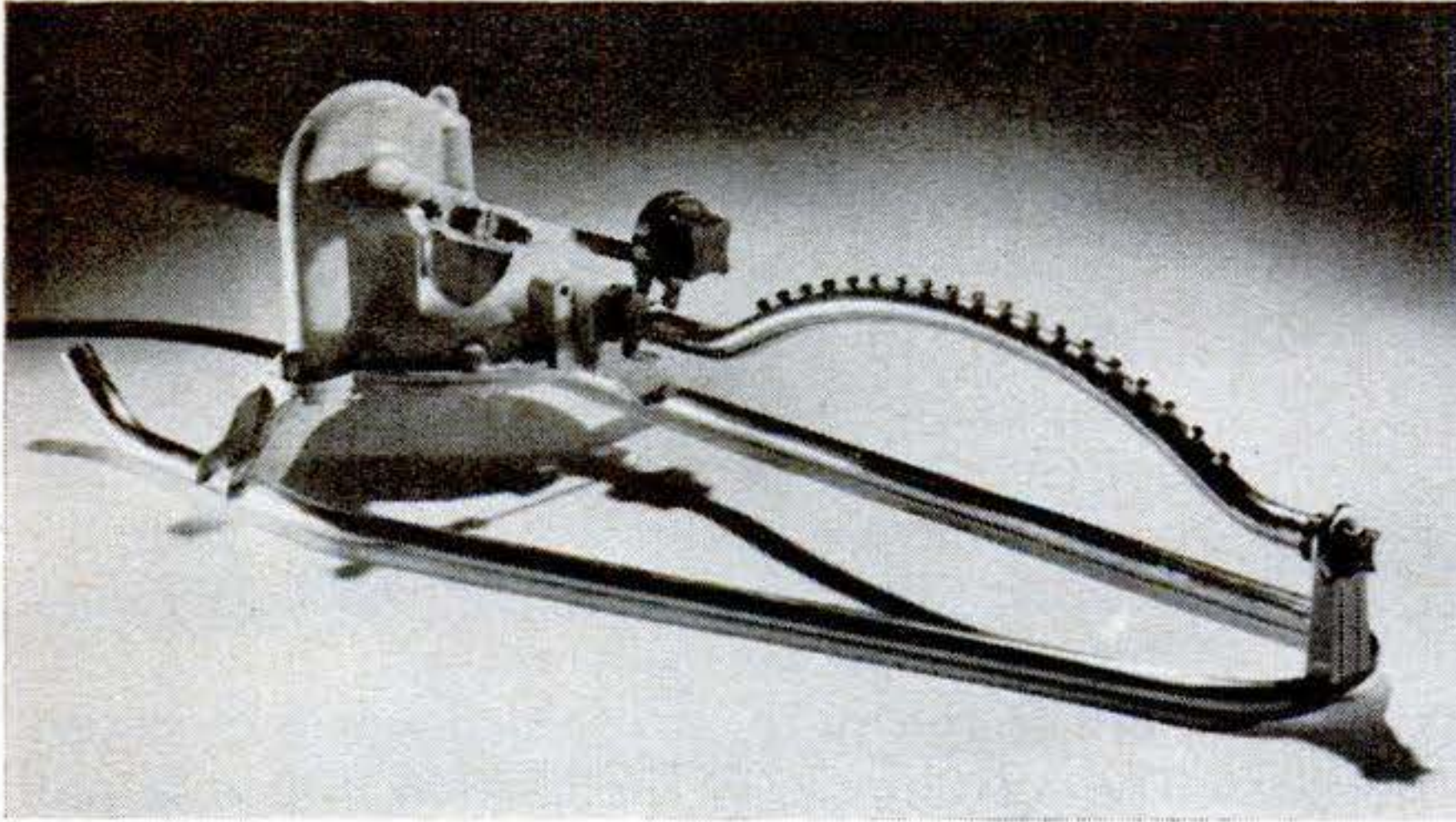


In impulse sprinklers, a jet from the nozzle strikes the spoon-like end of the impulse arm, causing the arm to pivot aside. A coil spring drives the arm back, however. As it strikes home, momentum turns the sprinkler head slightly. At the end of the rotation the trip springs into place, preventing the



arm from swinging out but still allowing it a small arc of travel. This reverses the impulse, and the sprinkler slowly swings back. By positioning stops located on the base of the sprinkler, you can make it trip and reverse at any point, thus establishing any segment of a circle you want to sprinkle.

Oscillating sprinklers get their power from a simple turbine, let you



Oscillating sprinkler waters a rectangle. On its way to the oscillating delivery tube, the water turns a simple turbine, driving a worm gear that produces a crank action to oscillate the tube. On this Nelson,

a control knob on the crank lets you vary the length of the oscillating arm. You thus change the placing and size of the rectangular area that you want to water. You can water to the sprinkler's left, to the

tages of the whirling sprinklers are great:

- Whirlers have the largest throw—up to a radius of 80' or more.

- They generate a lot of power for mechanization. With the tips of the arms slanting backward, a strong jet force sets up the whirling action. Through gear-downs, this fast-whirling spinner can power mechanisms that move the sprinkler across the yard.

- The better whirlers have adjustable nozzles, which can be set for a strong, far-reaching stream or for a gentle misting spray. They can be set, also, to throw high or low, to avoid being carried by the wind.

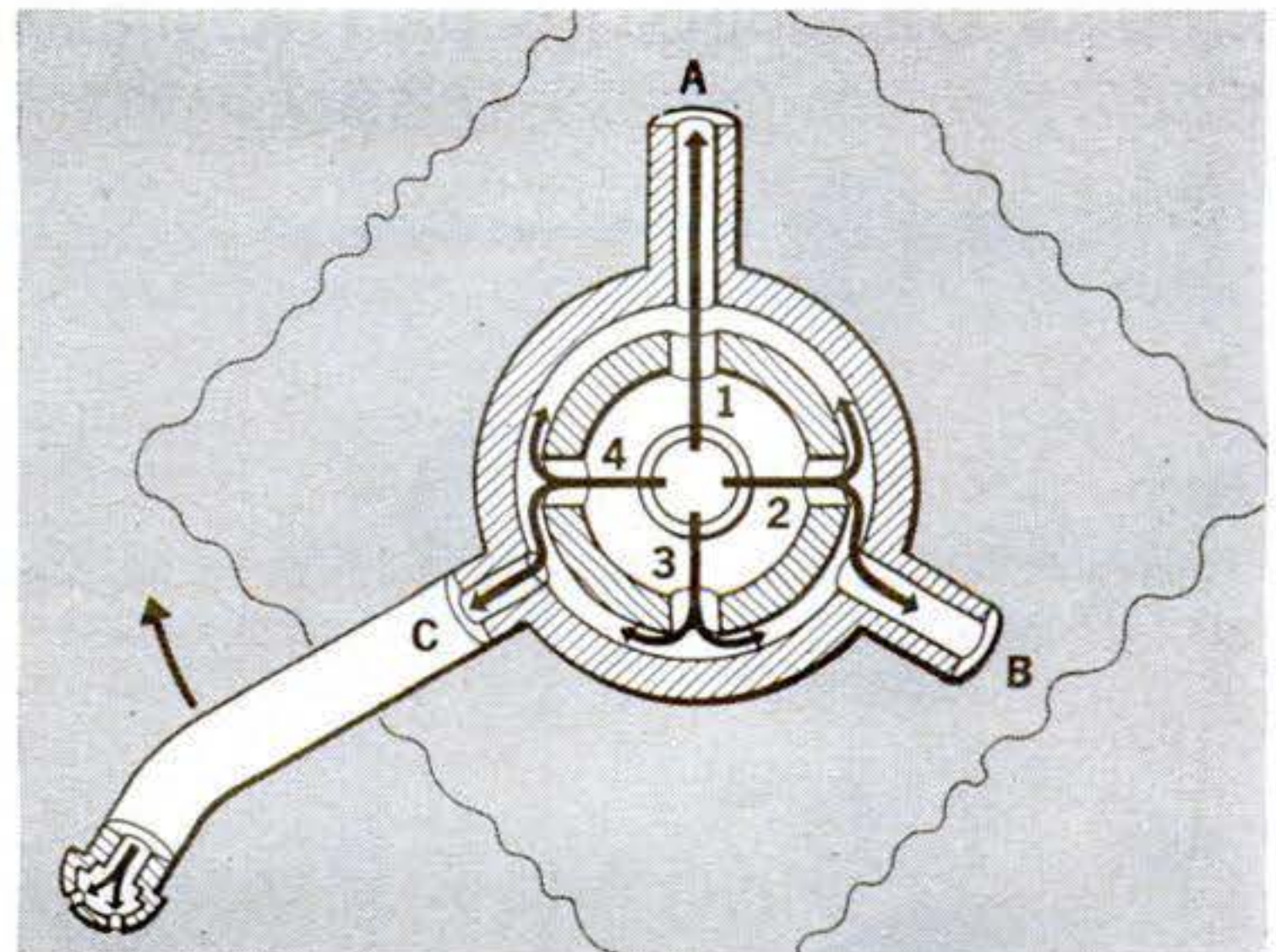
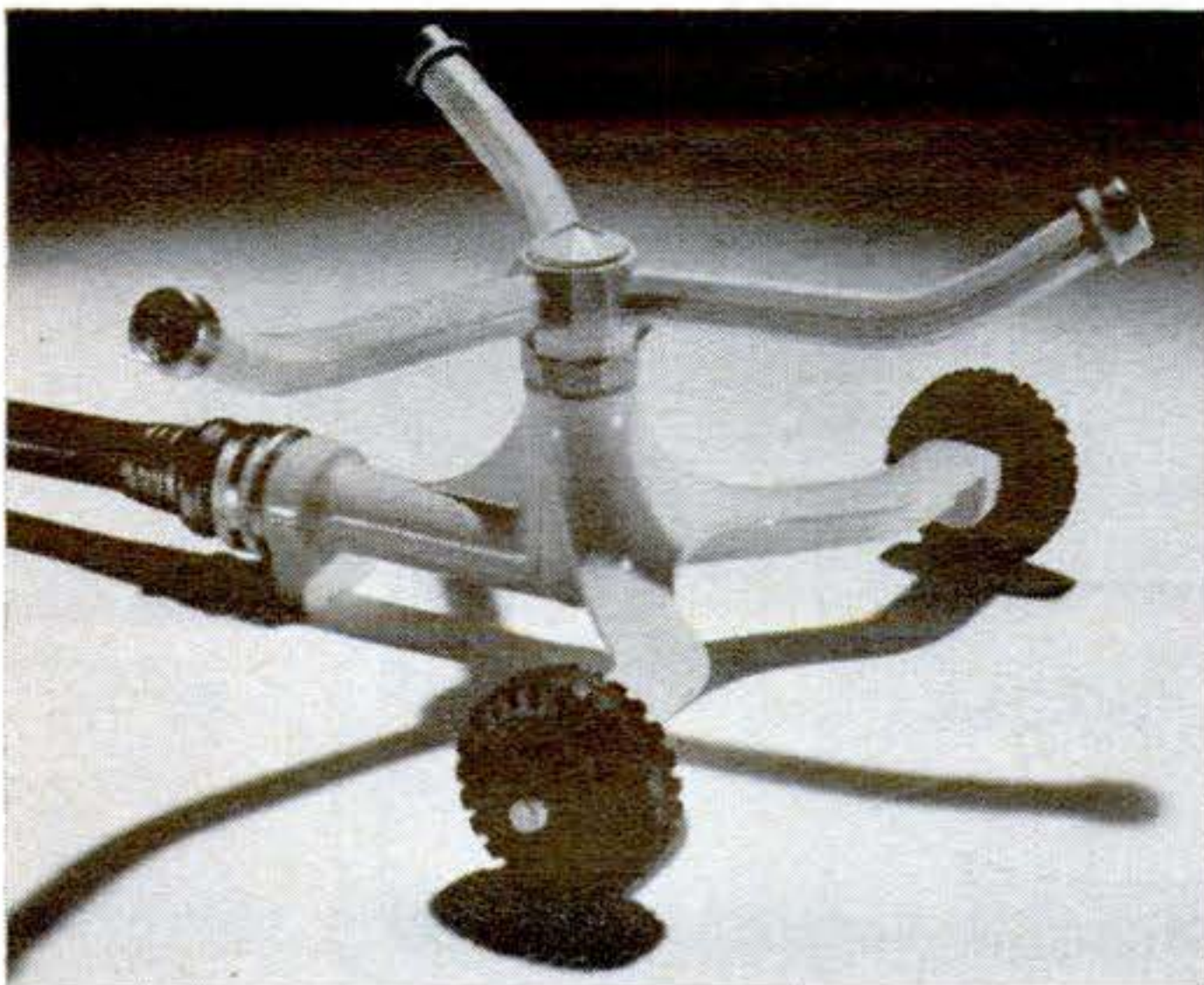
Impulse sprinklers. An impulse-sprin-

kler pattern is always circular, but it has a special advantage. It will throw *any segment* of a circle. Set up an impulse sprinkler right at the corner of the house. It will water right up to the foundation in front—clear around and up to the foundation at the side. Set it up in an L; it will water from one wall 90 degrees over to the other—and no more. Set it in the middle of the yard; it will water a circle 80' or more in diameter.

Turret models. A turret-model sprinkler may be three or four, or more, sprinklers in one. It may provide you with:

- A head that sprinkles 30' by 30'.
- A head that sprinkles 5' by 50'.

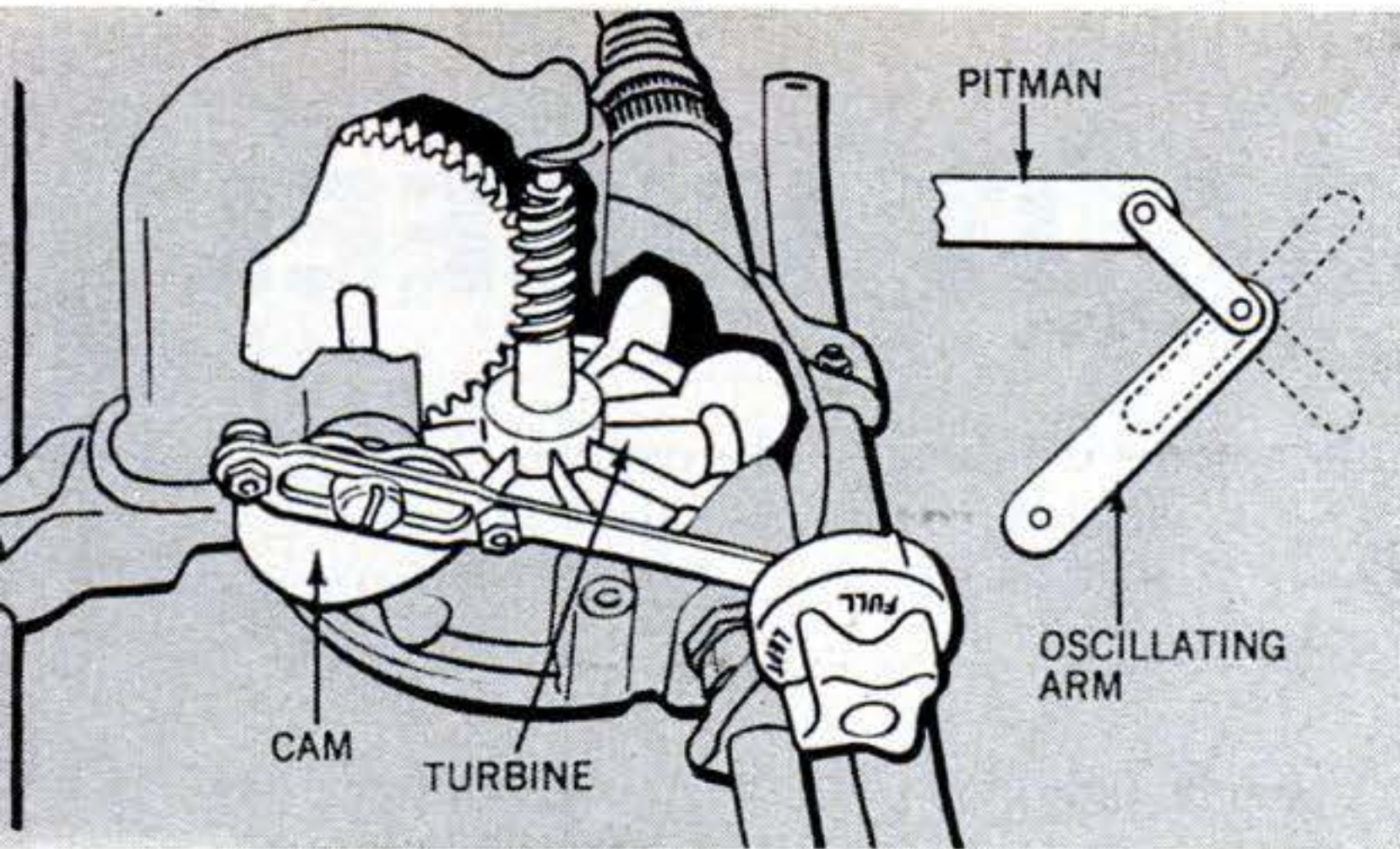
How three rotating arms spread water over a square area of lawn



In Nelson's Poppy, three arms radiate from a dome over a four-hole bushing. Water rises through the bushing, filling the dome. As each arm passes a hole in the bushing, water pressure is direct, as in arm A and aperture 1 shown in the drawing, and the water shoots out without restraint, forming a corner

of the square. As the dome turns, the A-1 aperture closes gradually, water isn't thrown so far, and the C arm begins to approach aperture 4 flow. Soon it is a straight shoot, and that corner of the square gets its share of water. Meanwhile, arm B is closing in on aperture 3, and arm A is about to reach 2.

spray a rectangular area of any size



right, or a varying distance to both left and right. To avoid puddling at the edges, the heart-shaped cam causes the tube to whip back faster at the end of each oscillation of the sprinkler.

- A head that sprinkles 10' by 50'.
- A deluxe hose nozzle that adjusts to do all the things an ordinary nozzle does.

In some instances, the nozzle may be replaced with a 20'-by-30' pattern. Melnor, for example, offers a turret with either range of sprinkler selections, and points out that with reduced faucet pressure each is reduced in size, in exact proportions.

Travel-type sprinklers. These have a special convenience of their own, since you can set them up to sprinkle a tremendous area without further attention. They work in one of three different ways:

- You place the sprinkler, then string out a nylon cord or stainless-steel tape (as in

Sunbeam) and fasten the end to a steel stake. As the sprinkler runs, it winds up the tape or string, dragging the "rain" along as it goes. At the stake, it shuts off.

- You take the sprinkler out to the end of the hose, laying the pattern you want the sprinkler to follow. The spinning mechanism winds up the hose on a drum, and the sprinkler follows the hose home. This gives you great versatility, since you can walk the hose around corners, over banks and slopes, wherever you want it to go.

- You take the hose out as above, but place the sprinkler astride; it heads back toward the faucet along the route you laid out. By means of a big collar or a heavy pulley-like wheel, the sprinkler turns and twists wherever the hose goes.

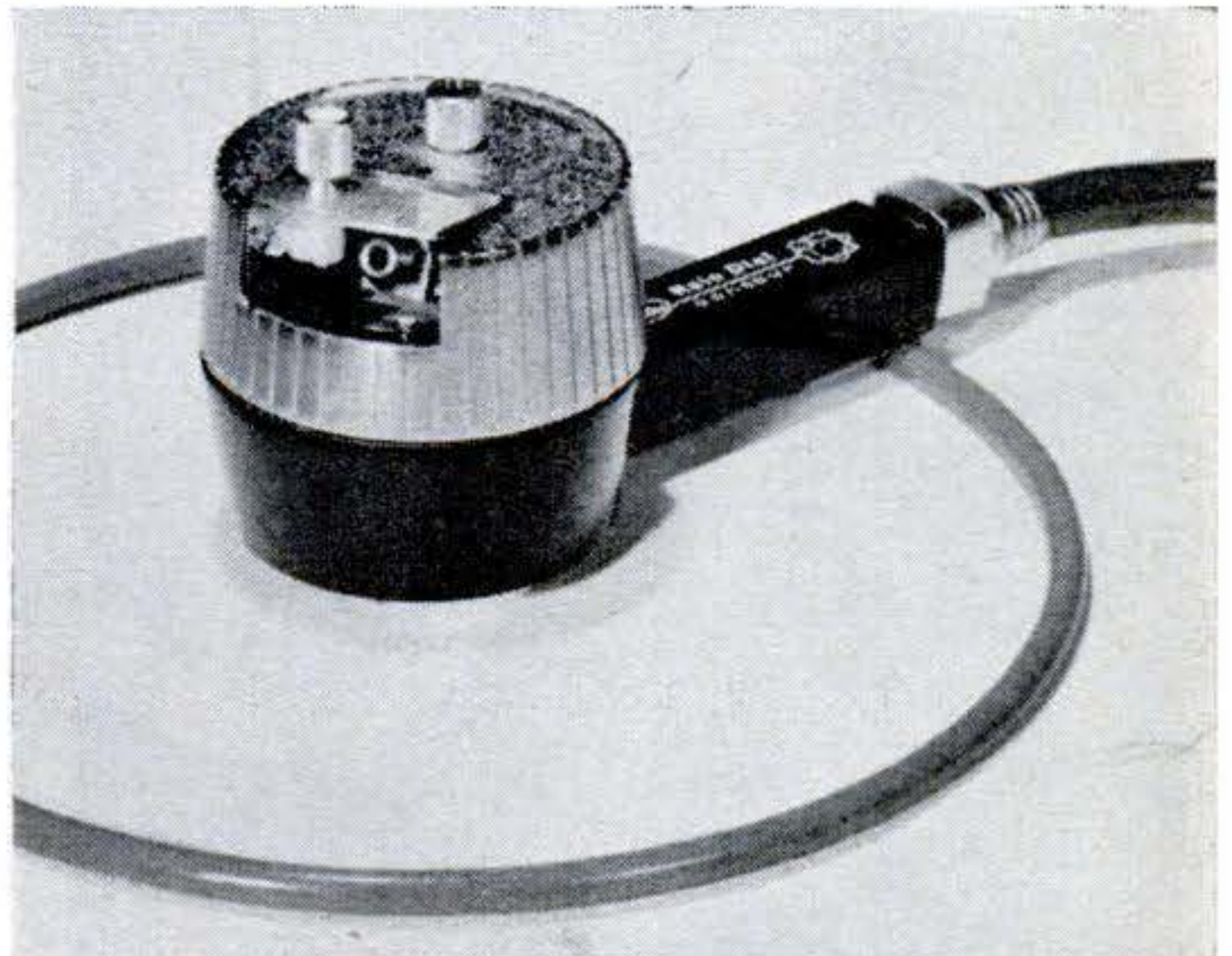
Names and addresses of manufacturers whose products are discussed in this article (plus several other leading producers of similar equipment) are:

H. B. Sherman Mfg. Co., Battle Creek, Mich.; Melnor Industries, Inc., Moonachie, N.J.; Sunbeam Corp., 5600 W. Roosevelt Rd., Chicago; L. R. Nelson Mfg. Co., Inc., 1725 S. Washington St., Peoria, Ill.; Gates Rubber Co., 999 S. Broadway, Denver; Rain Bird Sprinkler Mfg. Co., 7045 N. Grand Ave., Glendora, Calif.; True Temper Corp., 1623 Euclid Ave., Cleveland; Bernz-O-Matic Corp., 740 Driving Park, Rochester, N.Y.; Disston Div., H. K. Porter Co., Inc., 601 Grant St., Pittsburgh; W. D. Allen Mfg. Co., Bellwood, Ill. P 5

Control dials on these two new sprinklers vary the pattern



New Sunbeam traveling sprinkler can be set to spray widths from 5' to 50', travel the length of its 90' stainless-steel tape, and shut itself off at the end. You set the width of throw by turning a dial on top of the arms. At wide throw it moves more slowly to keep the degree of watering constant.



You can program the new Gates contour sprinkler to cover virtually any shape around a central point, using the 16 dials under the housing. A single nozzle revolves slowly. Water glances off a baffle that raises and lowers according to your settings, thus controlling the distance the water is thrown.

Shimmy, shake, tramp, and other troubles—how to tell what kind of unbalance you've got and what to do about it

THE TRUTH ABOUT WHEEL

By RICHARD DAY

You can save money on wheel balancing by knowing when to say "bunk" to a sales-minded mechanic and when to ignore the advice of a know-it-all neighbor.

If your front wheels are unbalanced, the hood vibrates up and down in time to wheel rotation. The steering wheel shakes and sometimes wiggles from side to side.

To check for rear-wheel unbalance, place a sheet of paper on the rear seat and have someone see if it bounces up and down with the tramping rear wheels.

At highway speed, only four ounces of unbalanced weight in one spot around the tire causes a force of 35 pounds to act up and down, forward and backward on the wheel as it turns. At every revolution, your tire, and front or rear suspension, get kicked by this rampaging force. It "cups" tires, wears bearings. It beats up ball joints and overworks tie-rod ends and suspension-arm pivots. Shock absorbers take a whipping, too.

The present industry standard is to balance wheels to the nearest $\frac{1}{2}$ ounce. Some experts feel that this isn't close enough for

high-speed driving and expect $\frac{1}{4}$ -ounce balance weights to come into general use. Some shops already use them. A $\frac{1}{4}$ -ounce weight is just a little heavier than two pennies.

What is balance? There are two kinds of balance: static and dynamic. Static balance is balance at rest; dynamic balance is balance in motion. A wheel that is statically balanced can be way off in dynamic balance.

When the weight of a wheel assembly is equally distributed around the spindle, it is in static balance. Static unbalance makes a wheel hop up and down as it rolls along the pavement. It often is harmonic; that is, its effects may be strong at a certain speed and weaker at other speeds.

Dynamic unbalance is an unequal distribution of weight around the vertical centerline of the wheel. It usually shows up at about 60 m.p.h. and above. It makes each front wheel shake rapidly one way and the other on its steering axis.

New-car balancing. The auto makers hold wheel balance to be so important that they balance all rotating components: tires, wheels, and brake drums.

Most bare-wheel unbalance is caused by runout, which is either wobble or eccentricity as the wheel turns. Maximum runout usually is specified by the auto manufacturer at .045 inches.

All large auto makers, in the U.S. and abroad, use Micro-Poise automatic balancers to check their wheel assemblies.

The simplest balancing method uses a bubble balancer to balance wheels statically. A bubble balancer does not balance dynamically. Don't let anyone tell you otherwise. It is nothing more than a fancy, highly accurate level. The bubble moves to the wheel's lightest side, showing where balance weights are needed.

The big controversy. The experts can't agree on the value of bubble balancing. Those in favor point out that it is simple, quick, and inexpensive. It's an ideal method for a tire dealer. The wheel is already off. All he has to do is put it on the balancer

Continued



Check your wheel balance by pressing an eight-inch pulley mounted on a 3,450-r.p.m. motor against the jacked-up front tire. Feel for vibration in the bumper. If the wheel is in balance, there should be none. Spin the rear wheels with the car engine.

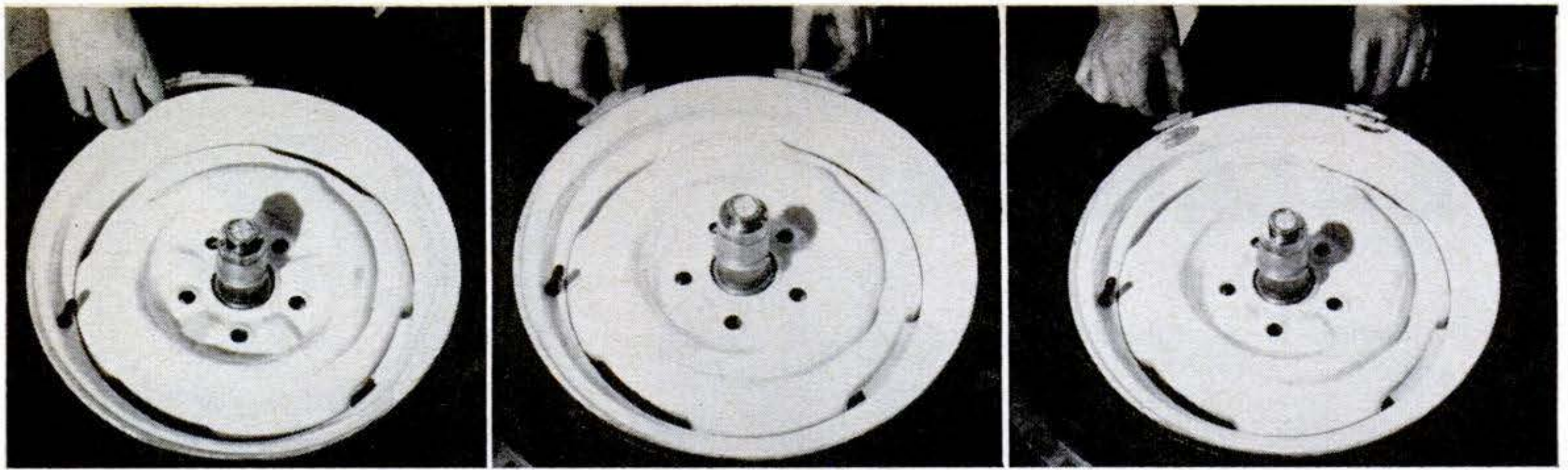
BALANCING

Static-dynamic off-the-car balancer (shown below) spins tire, wheel, and drum to balance them. The bearing-block ends of the free-sliding shaft are stationary, even though the wheel turns at 70 m.p.h.



Shimmy detector spins front wheel at 70 m.p.h. while the operator feels bumper for vibrations. This should be done on your car twice a year.





One-weight bubble balancing is the simplest and cheapest of all methods. The single weight is placed at the light spot on the wheel (usually on the inside flange of the rim). To avoid affecting dynamic balance one way or another, it may be exchanged for two weights making up the same total weight, with the smaller weights placed one on inside and one on outside flange.

The two-weight method uses a pair of balance weights totaling more than is needed to balance the wheel. The weights are moved away from the light spot until the bubble is centered. Then the weights are pounded on to the rim flange. Depending on chance combination of the weight and the heavy spot, dynamic balance may be improved or worsened this way.

Four-weight method is like two-weight method except that two pairs of weights are used. When the point of balance is found, the weights are split between inside and outside rim flanges. The biggest advantage with this balancing method is that any dynamic unbalance present in the wheel is not worsened by the weights. Only drawback: cost of extra weights.

and install the weights. Bubble balancing is so simple you can even do it yourself. A mail-order balancer of this type, with instructions for its use, sells for less than \$20.

Against bubble balancing is one convincing argument: It will not handle jobs that require dynamic balancing.

On-the-car balancing. While bubble balancing is done off the car, other static-balancing methods permit on-the-car balancing. Using this method, you can balance the entire rotating mass of your car. No mismatching of wheel, brake drum, and hub is possible.

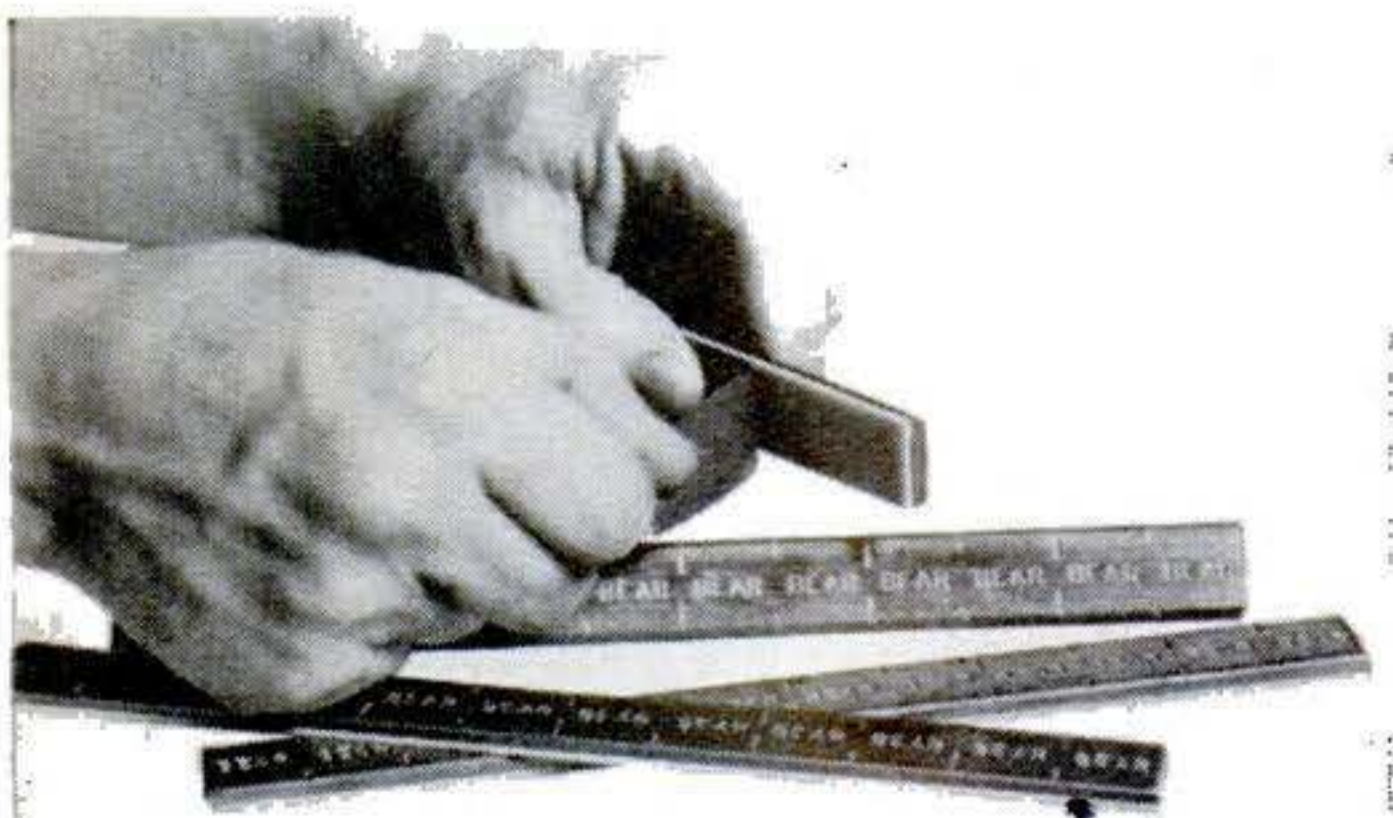
These on-the-car balancers produce what is termed a running static balance. Clamped to the rim, they spin with the jacked-up wheel. Through a complex system of gears, controls on the outside let the operator

move test-balance weights around in the inside of the balancer until he gets them positioned so that the wheel stops vibrating.

Electronic balancing. A newer form of on-the-car balancer uses a stroboscope flasher to pinpoint unbalance. A vertical pickup held to the suspension arm vibrates up and down with the spinning wheel. As the heavy part of the wheel hits bottom on each revolution, it triggers a flash of short enough duration to visually stop the spinning wheel. The operator notes the position of a chalk mark on the tire and halts the wheel in this position to locate the heavy spot at the bottom. Balance weight is added to the top and the balance rechecked. This assures a running static balance.

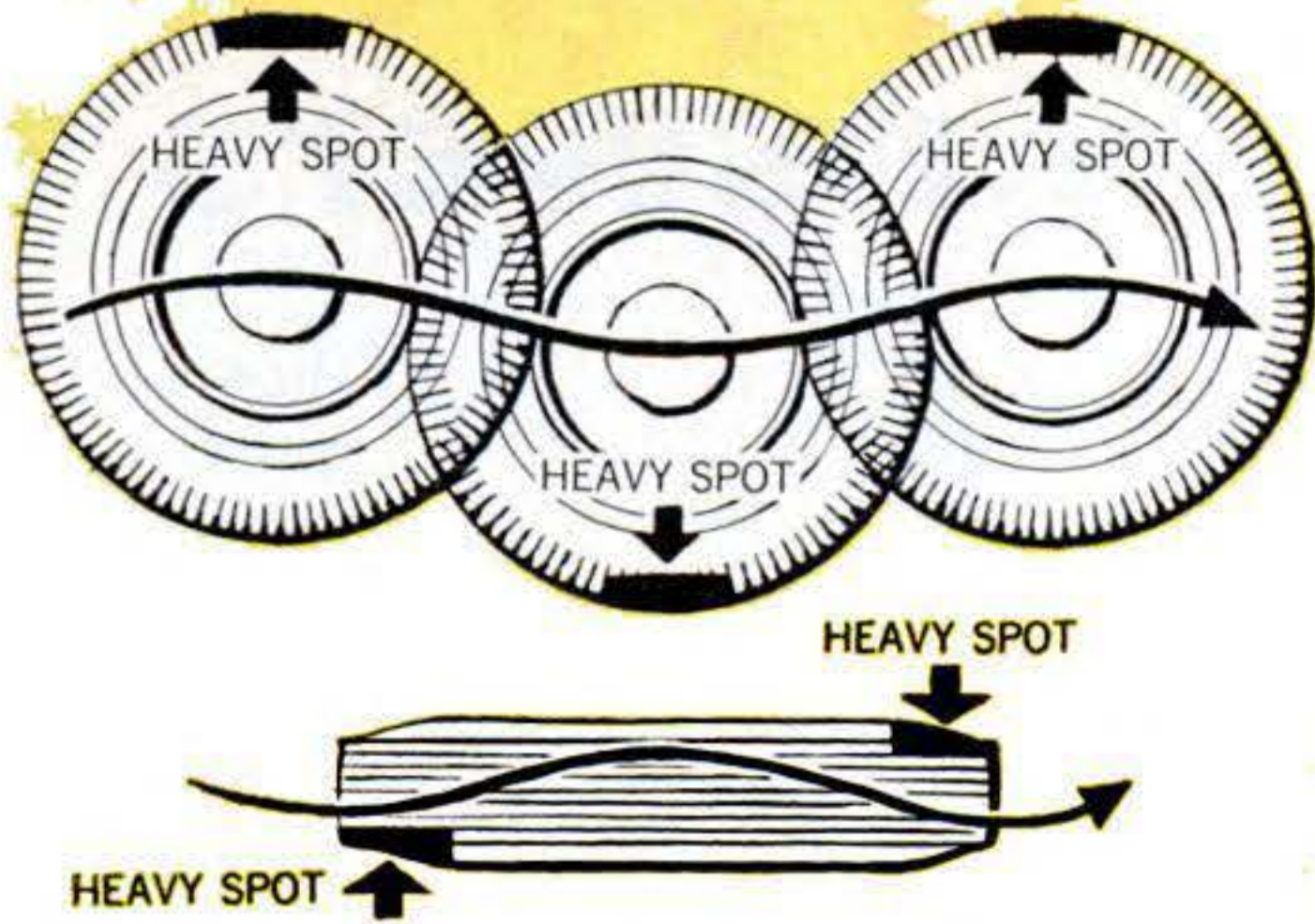
A further development on the strobe balancer is said to achieve dynamic as well as static balance. These machines feature a horizontal vibration pickup that attaches to the brake backing plate and stroboscopically pinpoints side-to-side vibrations as well as up-and-down ones, according to the manufacturers. These balancers sound like the ideal solution to fast, sure static-dynamic wheel balancing. Some experts disagree, however. They point out that side-to-side dynamic vibrations are dampened by the inertia and drag of the steering linkage. This type of balancer cannot give reliable dynamic-unbalance readings, they say. Other industry experts support the method. Chevrolet even shows one of these

[Continued on page 178]

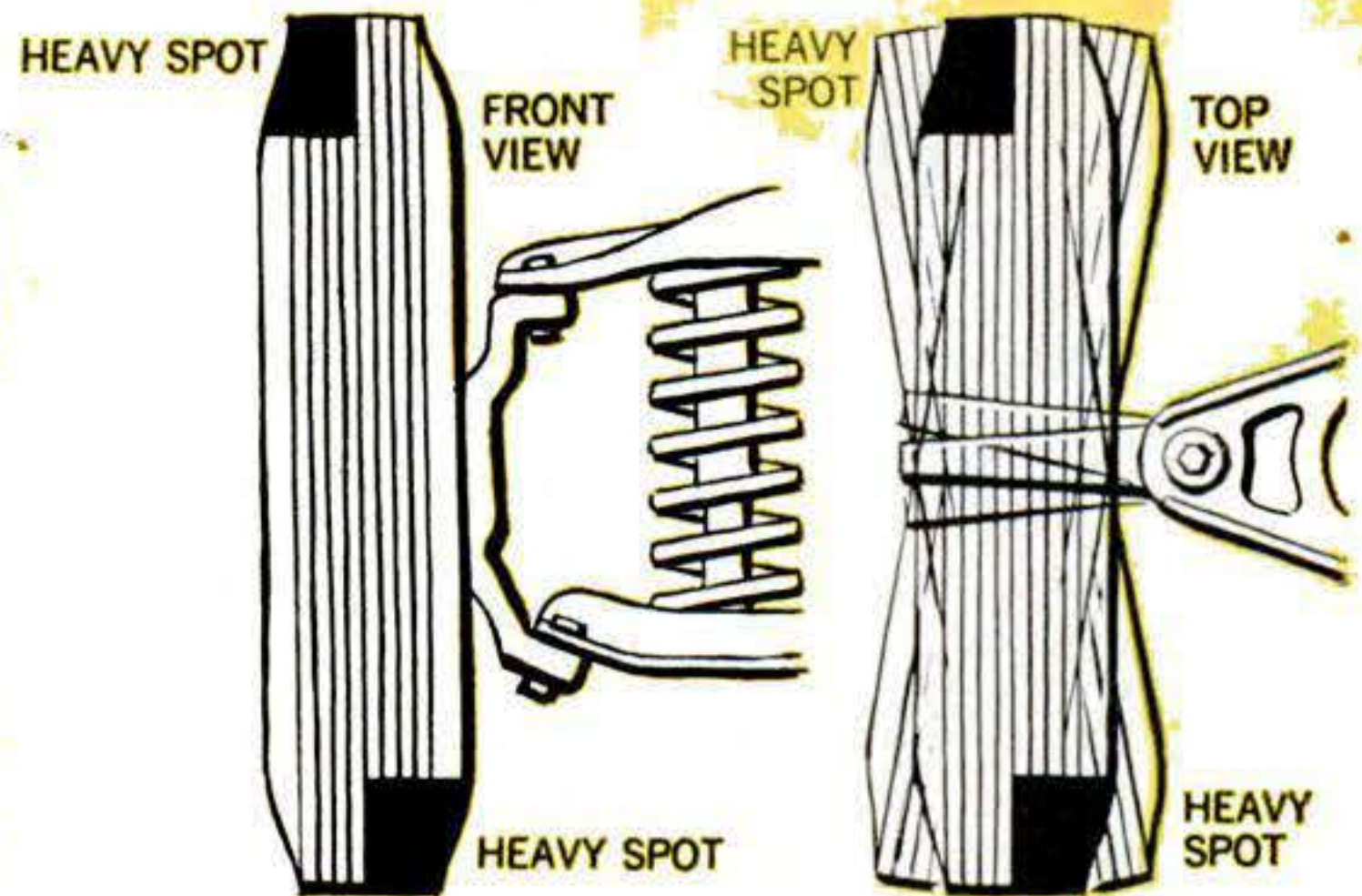


New strip weights are cut to size and stuck to the rim. One type (shown above), made by the Bear Mfg. Co. to meet wheel-balancing needs at the Indianapolis Speedway, is now available to the public.

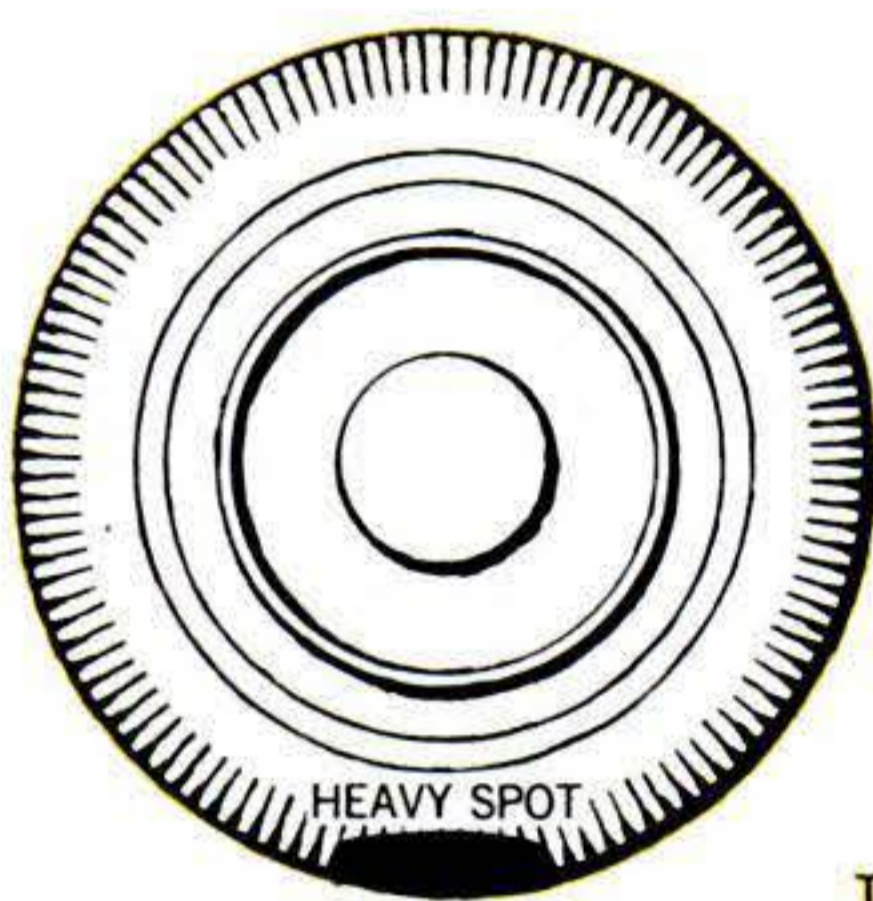
Each separate cause of unbalance in a wheel has a different cure



Static unbalance causes hopping and tramping. Dynamic unbalance causes wobble. Balance weights are added to counteract the unbalanced forces.



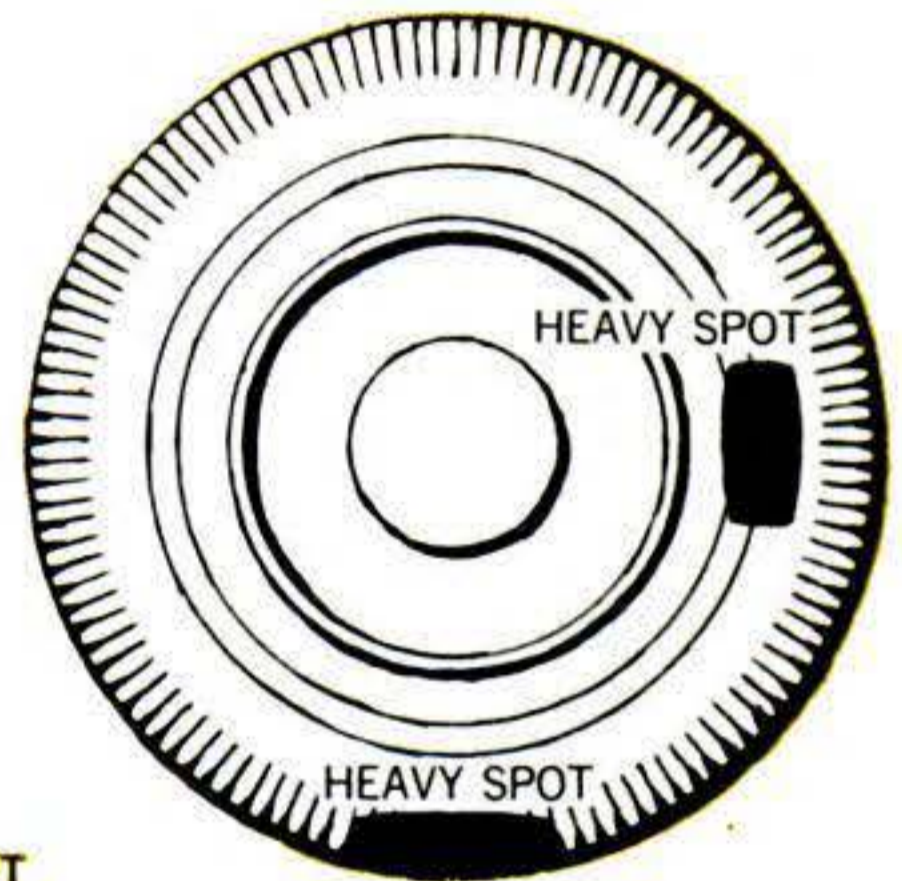
Dynamic unbalance exists when unequal weight on either side of the wheel's centerline tries to get centered. Wheel wobbles one way, then the other.



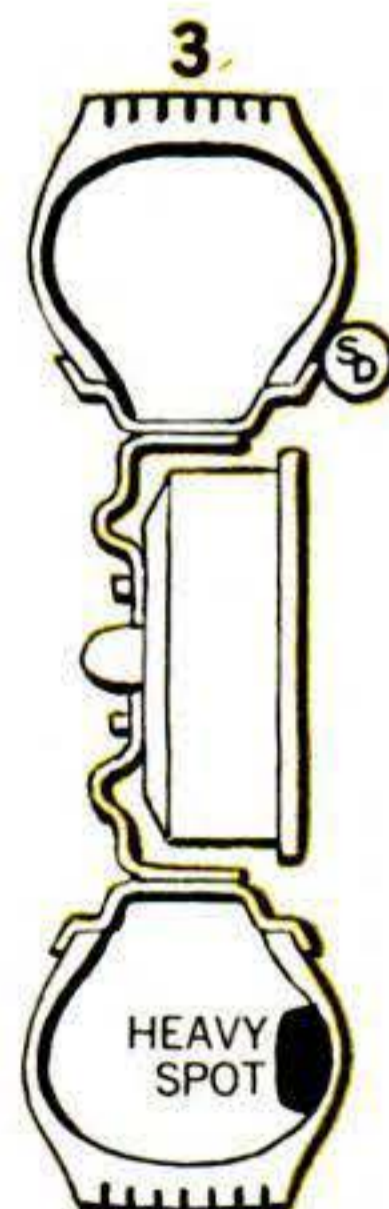
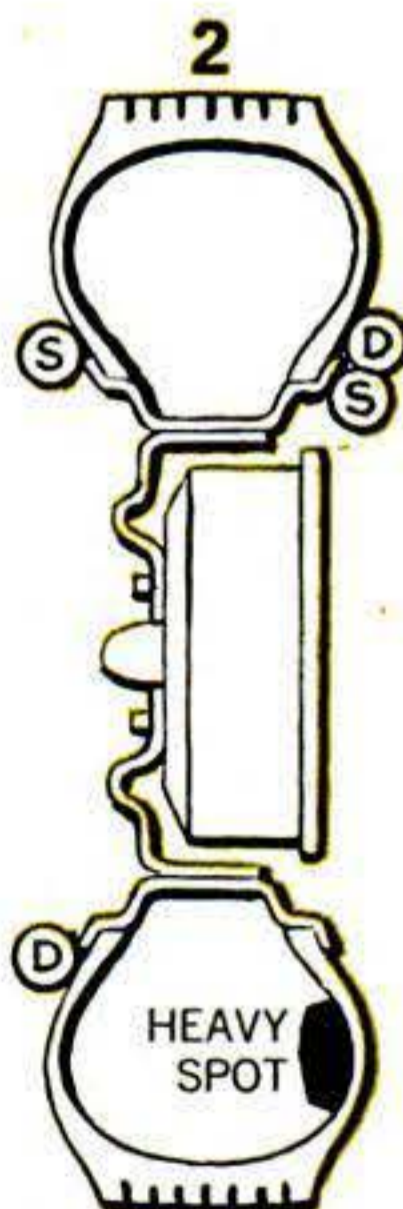
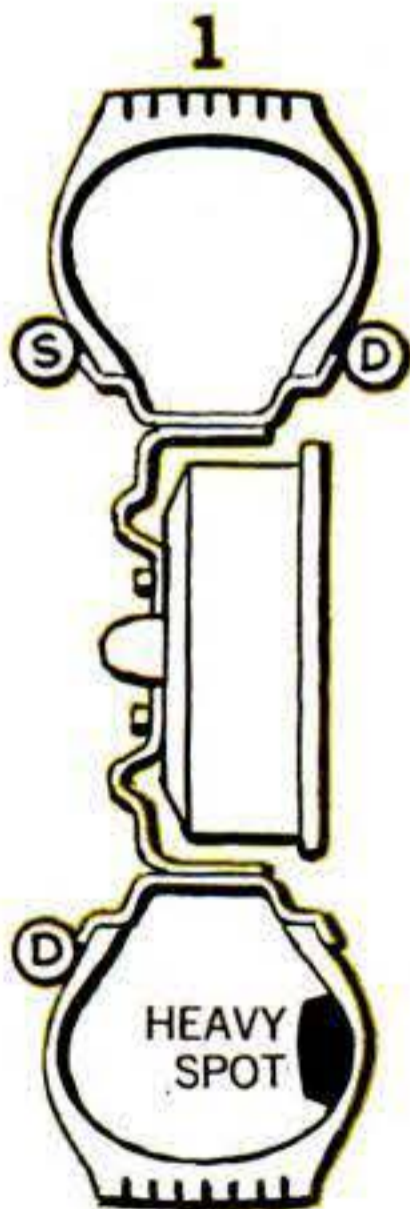
Tire unbalance can be caused by excess rubber in one part of the tread. A wheel should be rebalanced every time it is repaired or the tire on it is replaced.



Out-of-round wheel or tire causes the wheel spindle to rise and fall as the wheel rolls along. Excessive runout causes tramp—only limited runout can be balanced.



Heavy spot in sidewall causes both static and dynamic unbalance because it's not on centerline. In tread, it causes static unbalance because it's centered.



All three wheels are statically and dynamically balanced. At left, static weight S is placed to balance wheel statically, and weights D are needed to correct a worsened dynamic unbalance caused by the heavy spot plus the weight S. In center, static balance weight is split into two smaller weights, one on each flange. Two more dynamic weights are then needed.

At right, static weight is merely moved to the inside flange of the rim where it corrects both static and dynamic unbalance. Sometimes one weight at one spot is not enough and additional weights must be used. As a general rule, the less weighting on a wheel, the better. It means less unsprung weight and lower cost to you for the balancing.

60-Second Answers to

Hundred-percent success really is too much to ask of any photographic process, but today's Polaroid cameras and films are pretty close to foolproof and your failures should be very few—if you follow the rules.

Usually, those who don't get good results haven't done their homework; you must read the instructions thoroughly and learn the simple techniques of operation. If you're not satisfied with your Polaroid pictures, get out the manual and read it again.

Owners of roll-film Polaroid cameras may be surprised to learn that they're now outnumbered: The Polaroid Corp. reports that pack film now outsells roll film by a good margin.

Here are some hints that can make the difference between success and failure:

Outdoors, try to have the light on the subject coming from behind you.

For best color pictures, place your subject in bright sunlight.

Move in close to get a big image in the print.

Choose colorful subjects for your Polacolor pictures.

Pick a good background—one that contrasts with the subject and isn't too busy.

Pull the tab correctly—straight and swiftly, without hesitation. This operation should take about as long as it takes you to say “pull it.”

Keep an eye on the temperature and develop accordingly.

Time development carefully.

Most important rule for good picture-taking: Plan and think before you shoot.

Why do some Polacolor film packs carry an instruction to set the Lighten/Darken control one mark toward LIGHTEN for all pictures made with that pack?

Slight variations in film speed occasionally occur from lot to lot in all films, conventional as well as Polaroid. Usually, the manufacturer lets the film's latitude absorb any such minor speed variation. Although Polacolor film has a latitude of about one stop on either side of optimum exposure, Polaroid goes to the trouble of printing special instructions on Polacolor film packs of

runs that, as revealed by quality-control testing, require a bit more exposure for perfect results. When you turn the L/D control one division toward LIGHTEN, you increase the exposure by ½ stop. In the absence of special instructions on the pack, use the “normal” L/D control setting.

The Lighting Selector on my Automatic 100 camera has two settings for color pictures: BRIGHT SUN ONLY and BRIGHT SUN OR DULL DAY/ALSO FOR FLASH. When do I set it at BRIGHT SUN ONLY?

With the Lighting Selector at BRIGHT SUN ONLY, you get a smaller lens opening and a slower range of shutter speeds than at the other setting. A smaller aperture adds apparent depth to your picture by bringing more near and far objects into sharp focus at the same time. Except when this effect is desired, shoot Polacolor at the all-purpose setting: BRIGHT SUN OR DULL DAY/ALSO FOR FLASH.

Strong back lighting “fools” the electric eye of my automatic camera and results in underexposure of the subject, yet there are times when I must shoot against the light to get my picture. What can I do in this situation?

Back lighting poses problems for any camera, but electric-eye cameras are most vulnerable. The electric eye averages all light it receives, both from behind (and near) the subject and on the subject. Thus strong light behind the subject causes the lens to close down, leaving the subject underexposed. Such pictures frequently offer a special “mood” effect, and you may find them more attractive than a “properly” exposed picture.

If you're not after mood shots, however, but want the face of your subject to show clearly, here's how to improve your results (although it's not a guarantee of correct exposure): Turn the Lighten/Darken control all the way to LIGHTEN; this increases exposure by two stops. If subject is now overexposed, back up two divisions to the halfway point for a one-stop exposure increase. Another way to light up your sub-

Polaroid Problems By PAUL WAHL

PS Guide to POLAROID PICTURE-SPOILERS

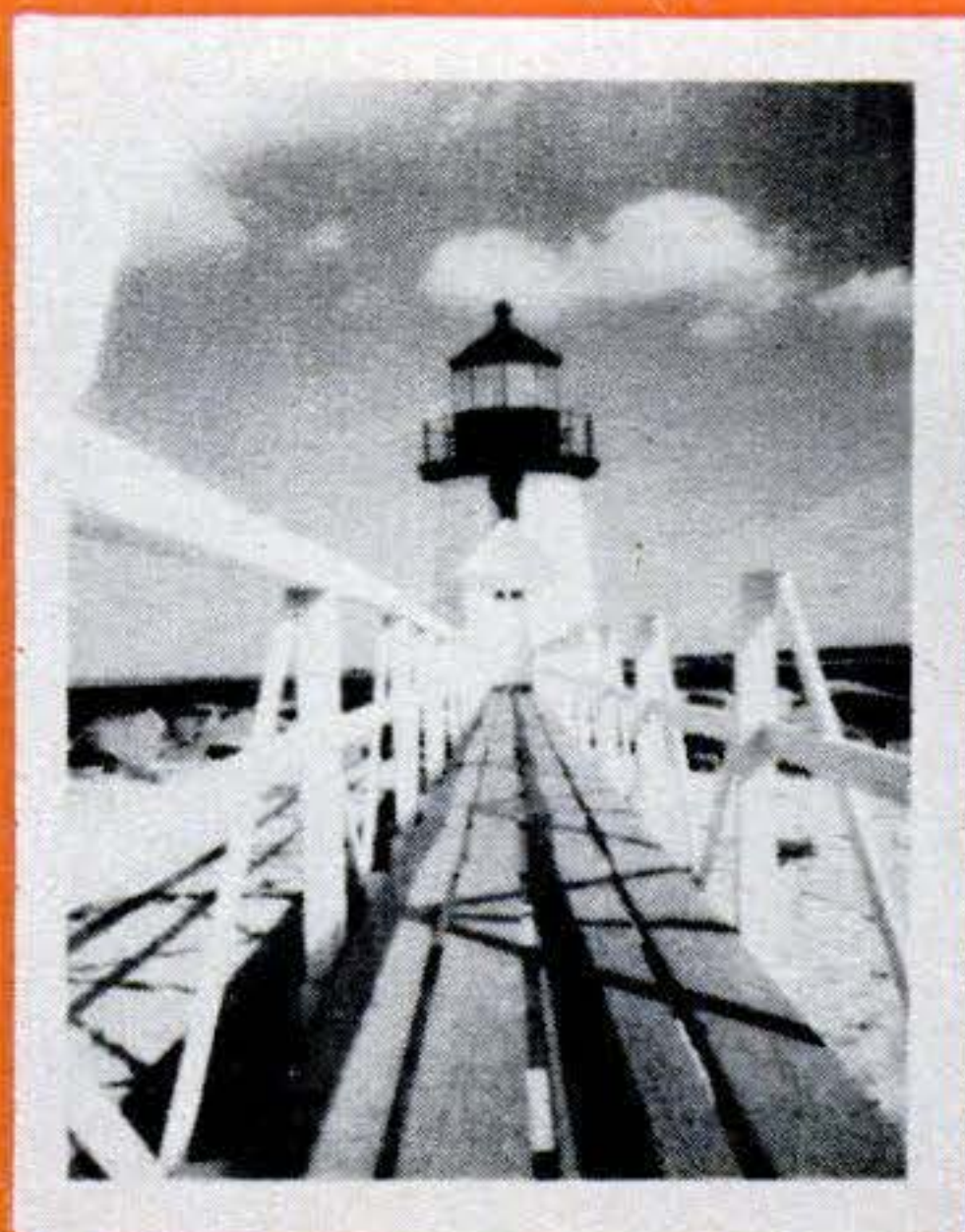
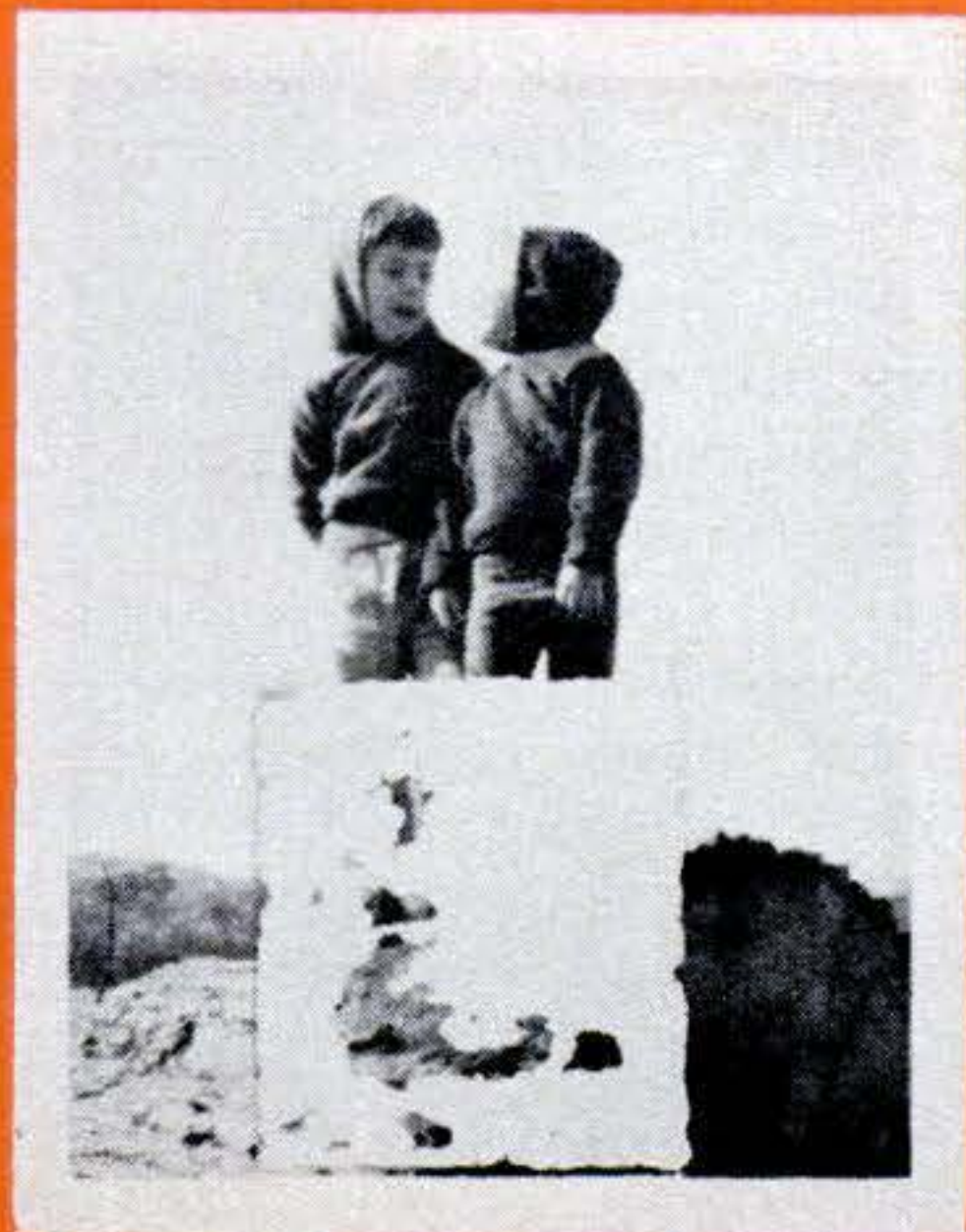
PICTURE TROUBLE	CAUSE AND CURE
White, faint image or none	Film greatly overexposed or light-struck. With b&w, you probably had camera control set for color (75 speed); reset for b&w (3000 speed). Films will be light-struck if you pull out the safety cover before loading film pack or if pack is removed after cover has been pulled.
Black, faint image or none	Film greatly underexposed or not exposed at all. If color print shows a few faint details, control probably was set for b&w instead of color. When no details are visible, shutter didn't open. Perhaps you didn't cock the shutter (No. 3 button on color-pack camera); or camera front wasn't pulled out all the way and locked; or battery is dead; or shutter is damaged.
All pictures too dark	Probably Lighten/Darken control was set incorrectly. If it's set toward darken , move it to normal ; if that's where it was, turn toward lighten . Where only a slight correction is indicated, move L/D control one division.
All pictures too light	Also incorrect setting of L/D control, opposite of above.
Repeated white spots in picture	The rollers of your camera are dirty, probably caused by bits of developer collecting on them. Clean them—never scrape—with a water-dampened cloth, and dry.
Subject too dark	Electric eye has been "fooled" by strong back light. A strong light behind or near subject is averaged with light on subject, and subject is underexposed. Light on subject should be as bright as that on rest of scene.
Undeveloped corner	These are caused by pulling yellow tab (of film pack) out of camera at angle. They're white in b&w, reddish orange in color prints. Pull tab out straight and swiftly, all the way.
Oblong patch in print	You didn't pull the white tab all the way out, and, when you pulled the yellow tab, the white one was dragged back into the camera and spoiled the picture.
Colors weak, with pinkish cast	This happens with underdeveloped Polacolor prints. When in doubt about time, overdevelop—such prints may be slightly "cooler" in appearance. Severe overdevelopment may produce an objectionable bluish cast. Underdeveloped b&w prints are muddy gray.
Vertical streak across short dimension of picture	Hesitation mark—you stopped in the middle of pulling the film to start development. Pull straight out in one fast, smooth movement.
Flash picture light and blurred	Light was too weak for correct exposure and electric eye of automatic camera also accidentally made a time exposure, during which subject or camera moved. Caused by direct flash being too far away from subject (over 10 ft. with color, 15 ft. with b&w). If bounce flash was used with b&w: ceiling was higher than 9 ft. or too dark; subject was more than 5 ft. from camera; room was too light; or there was a strong light source in scene.
Double exposure	You didn't pull out and develop the first picture before you shot the second one; or, with flash, the first bulb didn't fire but a second one did and you got a faint image (exposure by existing room light) from the first try.
Subject fuzzy, rest sharp	Unless subject moved, you didn't focus carefully, and subject image is out of focus.
Entire picture fuzzy with a pattern of movement	You moved the camera during exposure—most common in fairly dim light, with long exposures. Under these conditions, use a tripod and cable release or, at least, brace yourself and camera. With automatic cameras, press button gently and hold it down—and don't move until you hear the second click as the shutter closes after exposure.

Typical photo spoilers like these are easy to spot and cure

Oblong patch means you didn't pull white tab of pack all the way out; it got into the camera.

Undeveloped corner is from pulling yellow tab at angle. Pull it all the way out, straight and fast.

Pattern of white spots is caused by dirty camera rollers. Clean them with a damp cloth, and dry.



For best results with Polacolor film, time the developing

ject's face: Use fill-in flash [see "Using Flash for Better Color Pictures," PS, May].

With M3 bulbs in the flashgun of my color-pack camera, maximum picture-taking distances are 10 feet with color, 15 feet with black-and-white film. Can I get brighter bulbs to extend my shooting range at sports events, weddings, etc?

Only M3 bulbs can be used in your #268 flashgun. GE 22B or Sylvania 2B screw-base flashbulbs should do the trick, giving about three times the range of the M3, but you'll need a flashgun that handles this type of bulb. Your camera dealer might have a good used one. To get proper exposure with the color-pack camera's automatic shutter, the special cord and plug of the #268 gun must be spliced to the cord of the flash unit for the larger bulbs (this cord with plug is available from Polaroid's Replacement Parts Department).

When I shoot Polacolor portraits in the shade, my subjects have unattractively bluish skin tones in the prints. How can I avoid this blue tinge?

The kind of light you get in the shade is bluish and so affects the picture. Using a UV filter will reduce the bluishness of color pictures made in the shade or under an overcast sky. No change in exposure is required with this filter.

My black-and-white scenics are uninteresting because the bright blue skies and fleecy white clouds that were there come out a dull, whitish, blank area in the picture. How can I get dramatic sky effects?

A cloud filter over your lens will darken clear blue skies and make clouds stand out beautifully. But don't use this orange filter with overcast skies, in fog or rain, or at night—and never with color film.

When is the best time of day to shoot color pictures?

Daylight films such as Polacolor are best exposed from two or three hours after sunrise to two or three hours before sunset. When the sun is low in the sky, the light has too much orange in it and pictures will be overly "warm" in tone.

I have one of the now-discontinued roll-film Polaroid Land cameras. Must it be modified to take Polacolor film?

Type 48 Polacolor picture rolls can be used in any of the 3¼-by-4¼ roll-film models, including the original Model 95. Some of the earlier cameras need a 50-cent set of slip-on teeth for the cutter bar, to bite through the film's tough plastic base. The J66 requires an inexpensive adapter kit. To use the Type 38 Polacolor 2¼-by-3¼ picture rolls, the J33 needs an adapter kit, and Models 80, 80A, and 80B Highlander must be factory-modified.

Must development be timed accurately for good results?

Margin for overdevelopment error is wide, but *don't underdevelop*—this usually means spoiled pictures. Moderate overdevelopment actually can improve print appearance: Contrast may be heightened and, in Polacolor film, hues often are richer.

Although recommended developing times at 70 degrees and above are 60-70 seconds for color and 10-15 seconds for black-and-white film, you can get satisfactory results at double these times. Cooler temperatures call for longer development. Since most people tend to underestimate brief time intervals, it's advisable to time development with a watch or Polaroid's development timer. If you must guess at the time, remember: *When in doubt, overdevelop.*

How does temperature affect development?

When the temperature drops into the 60s, action of the developer chemicals slows down progressively. At 65 degrees, Polacolor prints require at least two minutes' development. Below 65, Polacolor roll film should not be developed, and the pack type requires use of the Cold-Clip furnished with all color-pack cameras. Polacolor prints developed in cold weather without the Cold-Clip are dark, with muddy colors. With black-and-white film, increase development time by 10 seconds for each 10 degrees' drop in temperature below 70 degrees. At 45 degrees and below, develop prints for 60 seconds. PS



Instant color pictures are easy to take—if you follow the rules. If your color doesn't come out like this,

study the "picture spoiler" table two pages ahead to find out what you've been doing wrong.

Underdevelopment has weakened the hues of this Polacolor shot. Reason: Photographer didn't allow full developing time. When in doubt, overdevelop.

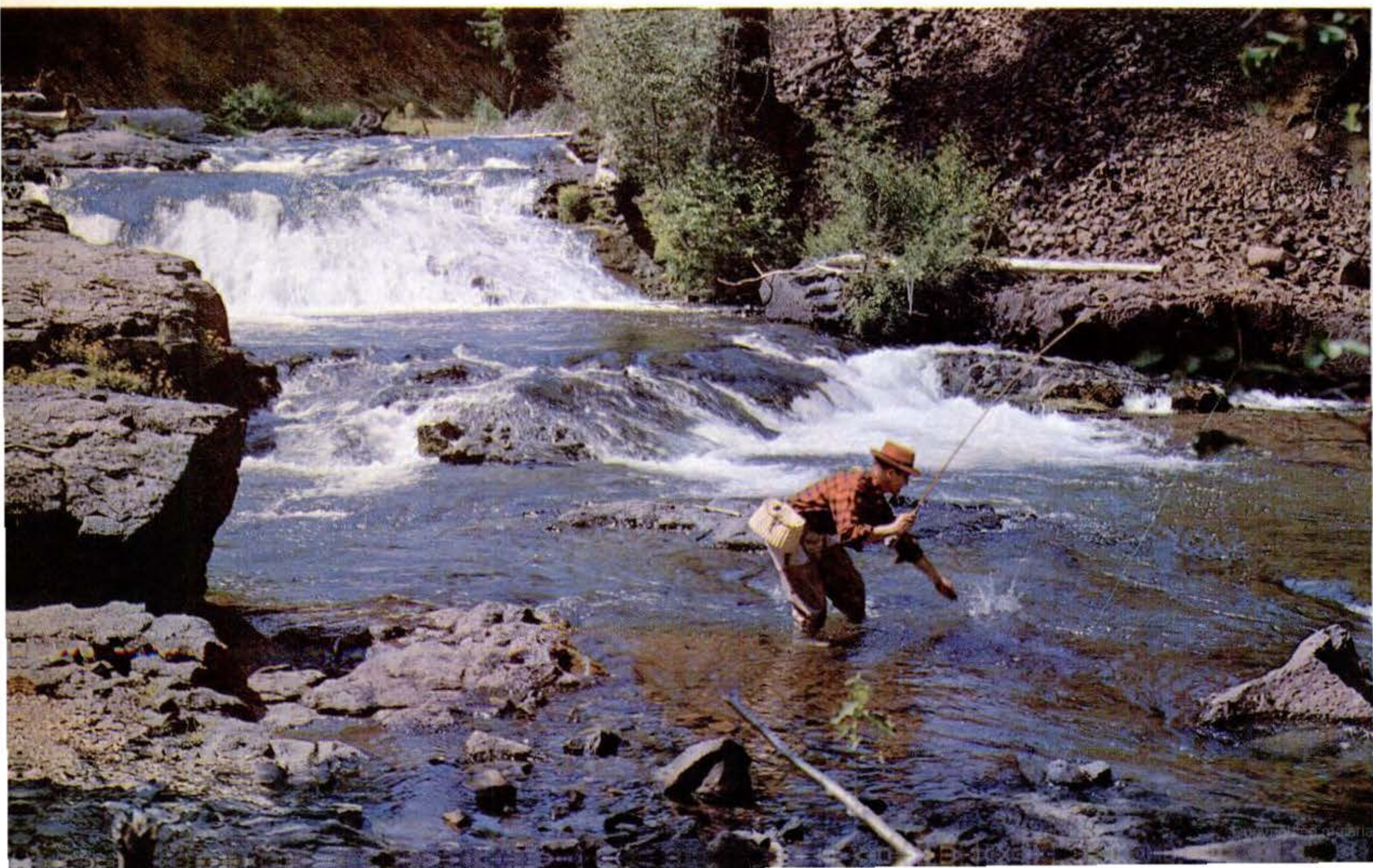
Back lighting—strong light behind subject—has tricked camera's electric eye. Face is shadowed—but you may like this kind of "mood" picture.





Basic outfits above (top to bottom: bait-casting, spin-casting, spinning, and fly-casting) are matched

to type of fishing, give you the best chance to land your catch, like the fly fisherman below.



How to Buy a Fishing Rod

Don't you think you can go to the store and pick up a fishing rod as you'd buy a can of beans; there's a lot more to it

By PHIL McCAFFERTY

Fishing is most fun when you catch fish. And a rod that helps you put the bait or lure where the fish are, and has the backbone and springiness to land the catch, goes a long way toward letting you get the most out of the sport. But which rod will do the job? The selection is bewildering. One maker offers no less than 249 different rods.

If you itch to take up this sport, which claims some 30 million addicts in this country alone, one of the first things to do is find an established tackle dealer who'll guide you in your first rod and equipment purchases. He'll know local fishing conditions and practices, and he'll handle good merchandise.

Choosing a rod is a lot like picking a bowling ball or a set of golf clubs. Much depends on you. If you're big, you'll feel better with a rod that has a husky grip. If you're tall and long-armed, you'll probably be able to handle a longer rod better than a shorter, smaller person.

What a rod does. Essentially, all rods do the same thing—help you place a lure in a tempting manner before a fish, and act as a spring to take the stress of hooking and fighting the fish.

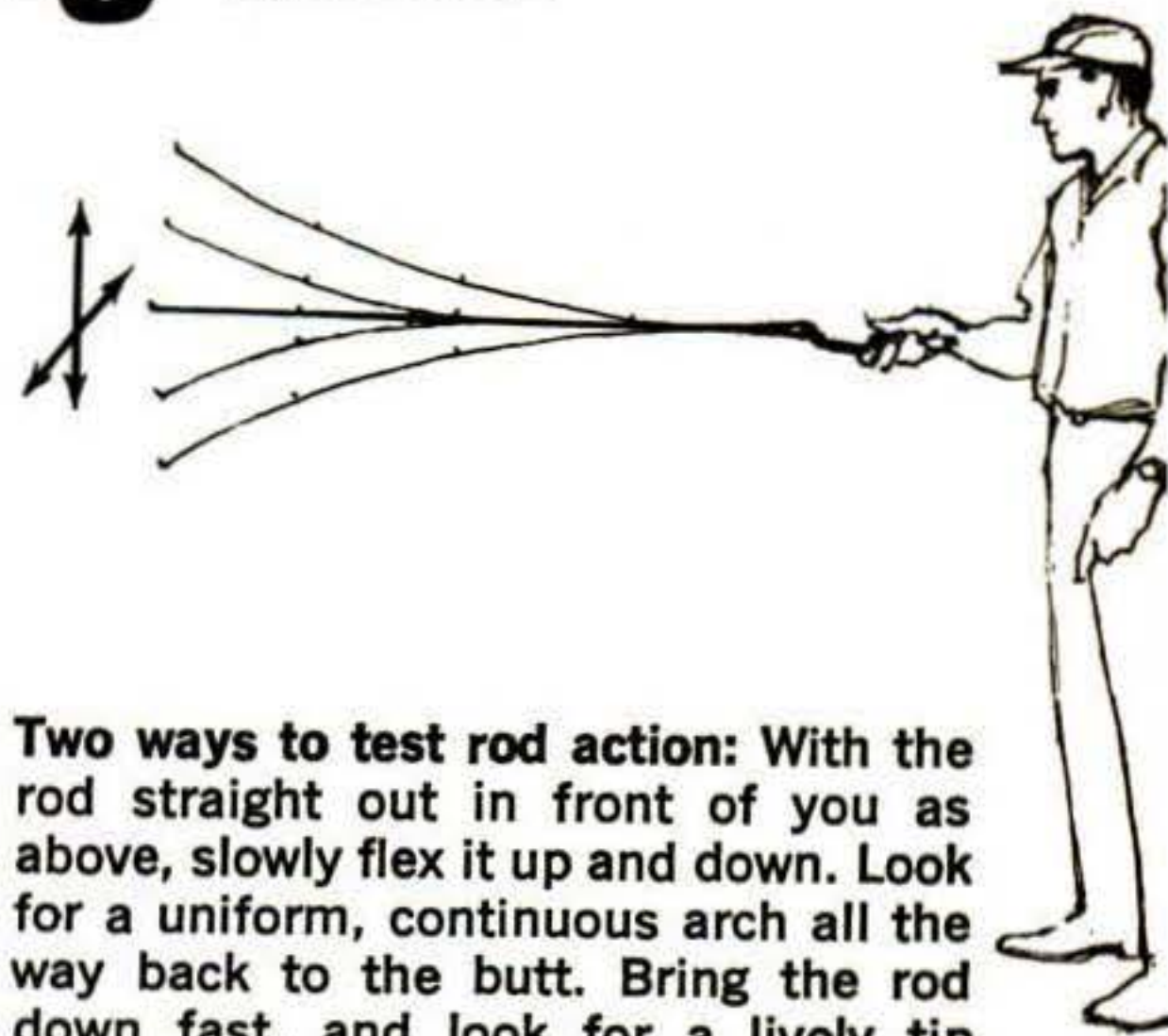
In casting, the springiness helps propel the lure. A lure too heavy for the rod will flex the rod too much; one too light will not flex the rod enough. In both cases, speed, distance, and control of the cast are reduced.

Most rods these days are "glass"—filmy strands of glass or glass cloth bonded in a solid or tubular rod shape with plastic. Glass rods are popular because they're light, springy, and less likely to take a permanent set. And they're not affected by water. You can't bend one double or slam a car door on it, but the punishment it will take is remarkable.

This is not to say that other rods are no good or won't catch fish. An alder branch will undeniably do the job. Cane and bamboo poles are widely used for still fishing and trolling. Fine split-bamboo fly rods remain, to many experts, the standard to which all other rods are compared. But good split-bamboo rods are carefully handmade, and command a substantial price.

The jobs. There are three basic ways to fish, still, trolling, and casting. Rods best at each job differ in

Continued

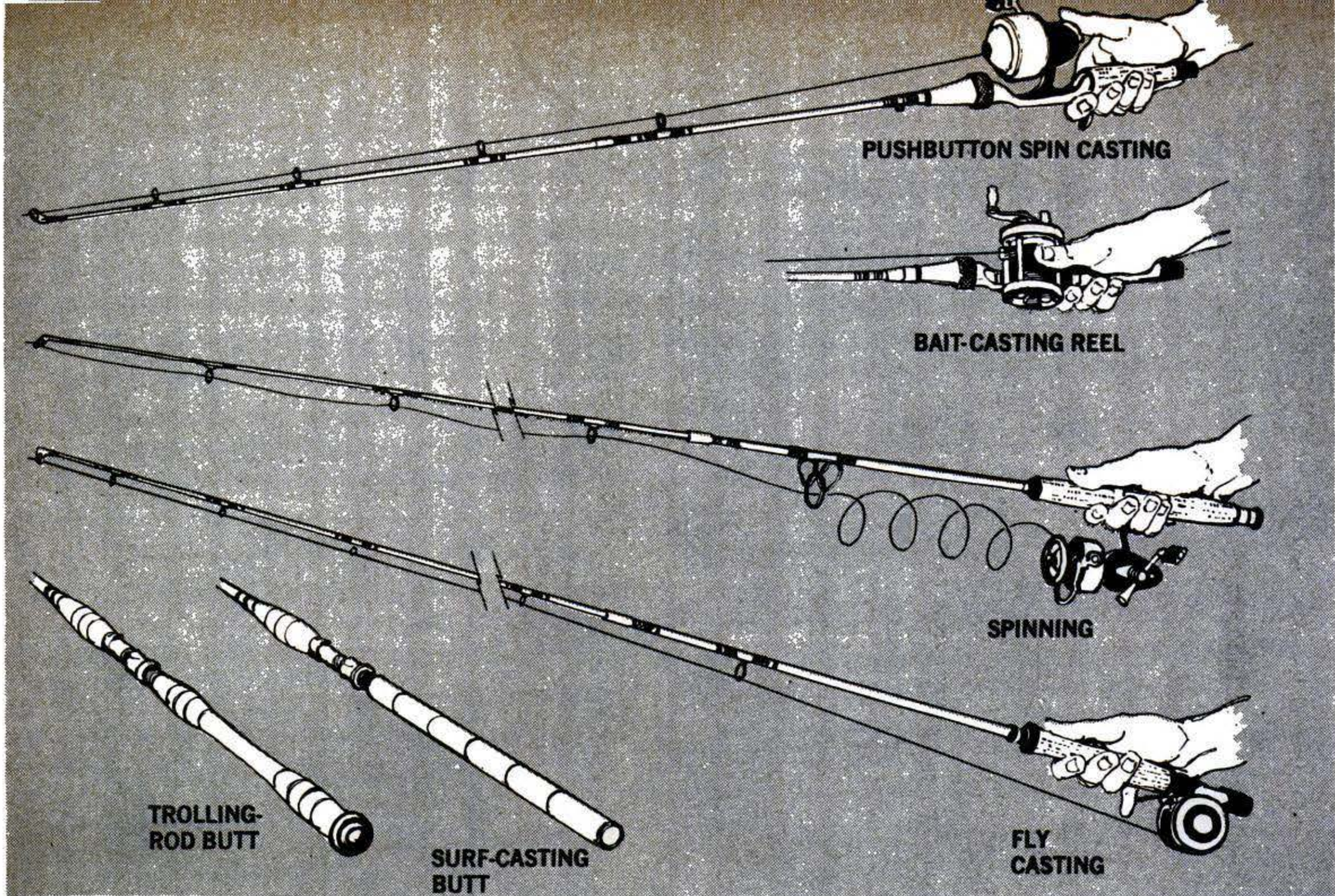


Two ways to test rod action: With the rod straight out in front of you as above, slowly flex it up and down. Look for a uniform, continuous arch all the way back to the butt. Bring the rod down fast, and look for a lively tip that recovers with little vibration. Tie the line as below, and slowly pull up. As the rod is loaded, it should bend first at the tip; as the load increases, the bend should travel evenly back toward the butt of the rod.



Kits for building your own glass fly, spinning, or spin-cast rods are made by Eagle Claw, Denver (\$11 to \$14). Also by Herters, Waseca, Minn.





Fishing rods team up with different types of reels to match the lure or bait you use, and the kind of

fish you're out to catch. Your choice depends on your build, skill, and the sort of fishing you do.

length, stiffness, butt-grip shape, and line guides.

Still fishing can be done with any kind of rod. You just plunk the bait into the water, and leave it there for the fish to bite. About the only requirement is that the rod have enough backbone to land the largest fish you expect to catch.

Trolling is simply towing a lure from a moving boat. Most people use bait-casting rods for fresh-water trolling, but larger spinning tackle—even rugged fly tackle—can be used. Special rods for trolling are offered by most rod makers, however.

In casting, the kind of fishing you do pretty much dictates the appearance, size, and shape of the rod.

Tackle, bait, and fish are matched. The weight of the lure or bait determines what the rod is like. Most makers now mark rods H (heavy), M (medium), L (light), and XL (extra light) to give you an idea of what their lure-handling capabilities are.

You could probably land your biggest fresh-water fish on an extra-light rod, but if you intend to cast one-ounce lures, you'd need a stiffer, more powerful rod. Also, it's difficult to cast ¼-ounce lures accurately with a heavy rod. Light lures call

for a light, flexible rod. The chart lists acceptable rod-lure combinations.

The choices. For the beginner to do a capable job of casting, pushbutton gear is the best equipment. You lift your thumb from a pushbutton on the reel, and the lure pulls the line from the spool. When the lure reaches the target, you depress the button, and the line stops unreeling.

Glass spin-cast rods come in both solid and tubular versions. The handle is offset for mounting the spin-cast reel, with a handgrip at the rear. Spin-cast rods often have a collet chuck at the front of the grip to allow takedown of the rod. Shorter rods may be one-piece.

Rods for bait casting are similar to spin-cast rods. You can usually interchange bait-cast and spin-cast reels. Bait-casting rods may have smaller guides than rods designed for a spin-cast reel.

For surfing, bait-casting rods come with a straight reel seat, a handgrip ahead of the reel position, and a long, two-hand butt grip. Guides are larger.

Trolling rods are often one-piece, more limber at the tip, stiffer near the butt, and have a two-hand grip.

[Continued on page 170]

BEST FINISHES FOR WOOD: PENETRATING RESIN... the perfect wood finish

By JACKSON HAND

Forget about the brush marks, sags, and bare spots that you sometimes get with varnish and other finishes. Forget about dust marks. Forget about water rings, and crazed, cracked, and peeling finishes. You can even forget about brushes! Open up a can of penetrating-resin finish (there are many brands) and you'll discover that it has become easy to put a good finish on wood.

Instead of lying *on* the surface like a varnish, penetrating resins sink *in*. They harden between wood fibers, in the air cells and other voids. When the resins are dry, the wood itself is measurably harder—and impervious to ordinary household damage. In a sense, the resins impregnate the wood with a substance that turns the wood into plastic.

But does it look like plastic? By no means. Penetrating finishes leave wood with the *look of wood*, only slightly darkened, and with the grain and fire accentuated.

How to put it on. Instructions are hardly necessary:

- Clean the wood; sand it smooth.
- Dry-brush or vacuum away dust.
- Brush on a coat of penetrating finish—or swab with a rag. Keep the surface wet with finish for at least half an hour, adding more material where it sinks in and turns dull. (Some brands ask for a full hour of penetration.)

- With clean rags, wipe *all* the finish off the surface. You must not leave any on. At times, the resin may rise to the surface in tiny shiny spots. Watch for this, and wipe the finish again if they appear.

- On particularly absorbent woods, a sec-



Penetrating resin gives protection to this pepper mill and salt shaker, but doesn't take away the look of natural walnut.

ond coat may be advisable to make sure the wood has soaked up all the resin it can. Some experienced finishers routinely apply a second coat the next day. This can't do any harm if you wipe it carefully, and it does insure maximum protection for the wood.

Continued

That's all—there is *nothing* more to do. The finish is washable, proof against water damage, alcohol-proof, and less liable to damage from heat than any other wood-finishing material now available.

How the wood colors. In the color photos below, you can see what 16 popular woods look like when partly finished with a penetrat-

ing-resin finish. Use any of the brands on the market and, basically, this is what to expect:

- The darker the wood, the more it changes color. Compare the darkening shown in rosewood with that in pale white gum.
- The change in color is toward the red-yellow-orange tints, making the wood warmer in color and emphasizing the fire

Penetrating finishes darken wood slightly but leave it with a natural



Antique Cherry



Rosewood



Walnut

Cherry



Pine



Korina



Pecan

Fir



in the grain. Notice how the slightly blue cast of walnut turns to good walnut brown.

- The more grain pattern the wood shows, the more it will be accentuated. Notice the effect on pecan, korina, lauan. Dull, flat woods like white gum are merely yellowed.

- Since there's no finish on the surface, the textures and pores of the wood are em-

phasized. For this reason, the finish is at its best on the woods shown in color here. (Naturally, no wood filler is ever used with the penetrating finishes.)

- Generally, old wood darkens more than new wood of the same species.

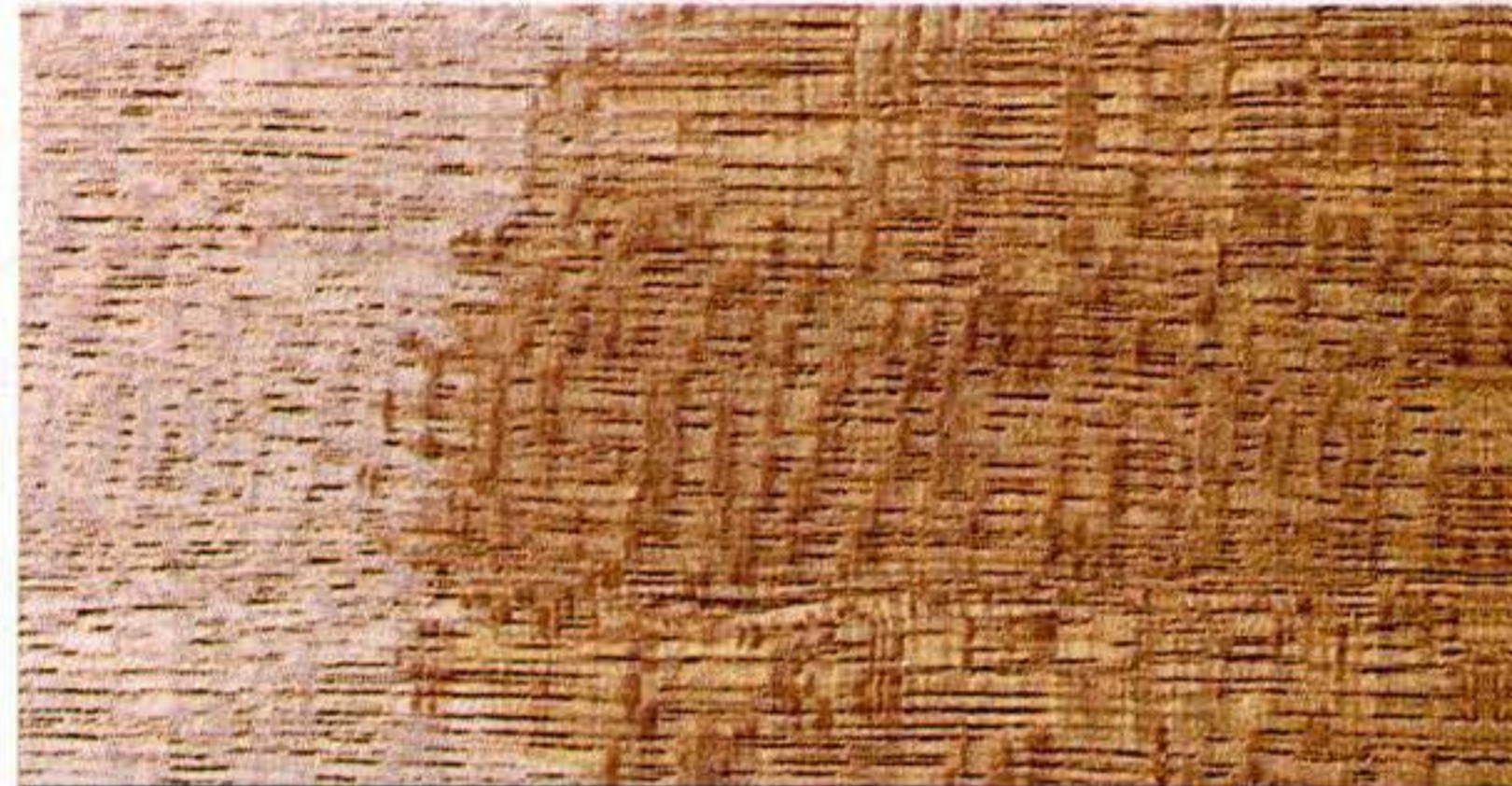
Stains and bleaches. You can control the

[Continued on page 168]

appearance. Look what happens on 16 different kinds of wood



Maple



Lauan



Cedar



Teak



Oak



White Gum



Mahogany



Birch





ILLUSTRATION BY RAY QUIGLEY

Gus Tracks Down a

It looked like brake failure when the convertible broke away and rolled downhill. Was Gus's relining job at fault?

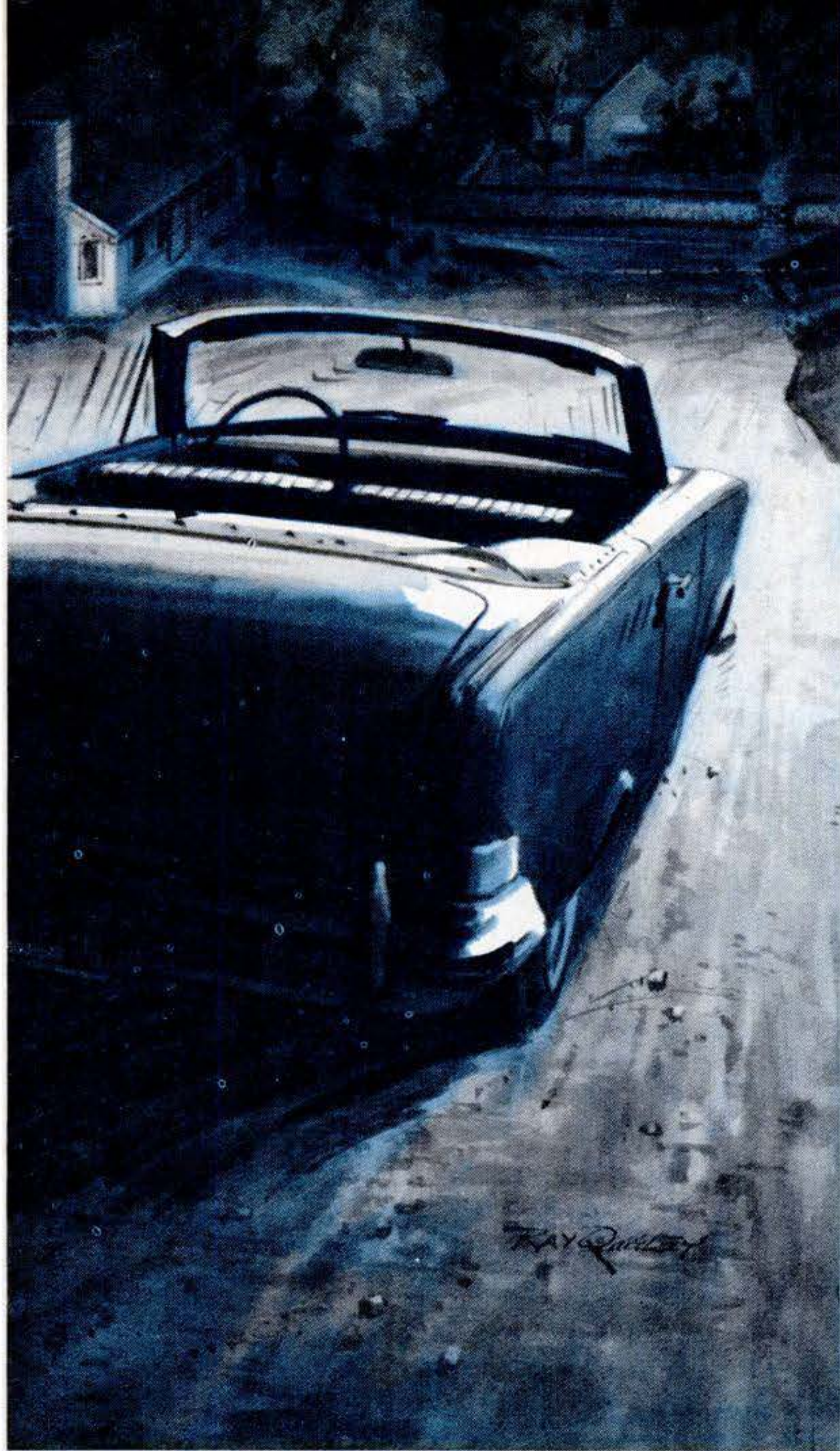
By **MARTIN BUNN**

Tree shadows lay long in the late afternoon sunlight as Gus Wilson swung the Model Garage tow truck into a pleasant residential street. Two blocks farther on, Marlow Lane made a sharp right turn and began to climb. A block after that, it came to a dead end.

There Gus pulled up just below the driveway of the last house. Above the driveway, front wheels cramped against the curb, stood a small convertible. A girl wearing slacks and a floppy hair-do came down a long flight of steps, closely followed by a sulky-looking youth.

"C'mon, Karen," he pleaded. "Just a short hop to the malt shop."

The girl shook her head. "Hi, Mr. Wil-



When Gus hit the street, the girl close behind him, the car was 30 feet away and gaining speed.

Cold Clue

son," she said. "You sure were quick. But it isn't my car this time; it's Dad's, there in the drive. He wanted to go out for cigarettes, and it wouldn't start. So I got them in mine. It's lots nicer to drive since you relined the brakes."

The boy bent close to whisper urgently in her ear. She shrugged her shoulder.

"Flake off, Eddie. I'm not allowed to lend you my car and I'm all dated up for the dance Friday. Okay?"

The boy, a lanky figure in very tight pants, glared at her, then at Gus.

"That your last word, Karen?"

"Do you want to have it in writing?"

The boy's face flushed darker. "You're going to be sorry about this."

Gus, who had been busy taking out his tool kit and helper battery, looked at the lad for a moment. Black eyes glowered back. Then the boy strode off down the street.

"You don't leave the keys in your car, do you?" Gus asked the girl.

"Never. But I have to park it in the street because we've only got the one garage. Don't worry about Eddie Larkin. He's a drip, but harmless. Only why should I lend him my car, when he's just smashed up his own? Or date him, when there are so many dreamier boys around?"

Gus lugged tools and battery up the short but very steep driveway, where a 1964 Chevelle stood nose down.

"We just had the garage floor painted," the girl chattered on. "So Dad parked it here. He was afraid to try to start the engine by coasting, he said, on account of having an automatic transmission."

Gus turned the ignition key to "start." There was a hard thud in the engine. He turned the key off and opened the hood.

Battery, solenoid, and ground connections were all tight, and the cables apparently in good shape. That solid thud suggested two possibilities other than a poor starting circuit. One was a stuck starter pinion. The other . . .

Gus pulled out the engine dipstick. The oil level was at the full mark.

Full, with the car at this angle?

The thin fluid on the stick dripped freely, and smelled of gasoline. Gus put the dipstick back and got out a wrench.

As he disconnected the fuel line at the carburetor, gasoline flowed out. Gus plugged the line with a pencil stub.

"Please call your father, Karen."

The girl scurried off. Gus removed a spark plug. It came out dry. The second one oozed gas. Hastily Gus screwed it back. A heavy-set, gray-haired man came out.

"Got the battery boosted already?"

"It isn't a weak battery, Mr. Bronson, but hydrostatic lock. Watch this."

Holding a can under it, Gus removed the loose plug. Fluid gushed into the can.

"There's probably that much gas in three or four cylinders," explained Gus. "The starter can't turn the engine over, because

Continued

you can't compress a fluid as you can the normal air-fuel mixture."

"It was running fine two hours ago," protested Bronson. "When I stopped to fill up on the way home, it started right off."

"Sure, but then you parked at this steep angle," said Gus. "That put your full gas tank higher than the carburetor. Maybe the float valve stuck open, or its seat is bad. Anyway, the hydraulic head from the full tank was strong enough to lift the fuel-pump check valves. Gas dribbled through, into the carburetor, then into the cylinders with open valves, and the crankcase."

"Can you fix it tonight?" asked Bronson. "I have appointments at three of our

Chevelle out and road-tested it. Then he turned into Marlow Lane. Lights glowed in its houses, but the last street lamp, well up the hill, left the Bronson house shadowed. The convertible stood in the same spot as before. Gus drove beyond it, turned, and parked behind the smaller car.

Once more Karen greeted him, this time at the door. "Dad heard you come. He's calling a taxi to take you back."

At that moment a look of incredulous horror transformed the girl's pretty face.

"Oh, no—no—it just can't . . ."

Swinging around, Gus followed her transfixed stare. What he saw sent him flying down the long flight of steps. But the convertible had too much of a start. When Gus hit the street, the girl close behind, it was 30 feet away and gaining speed.

He pounded after it, stopped as Karen clutched his arm.

"What's going to happen?" she gasped.

"It may run into a curb. We better keep after it. Come on."

They ran on. Rolling surprisingly straight, the car climbed the curb beyond the curve, and crashed into a hedge.

A scream rang out. A porch light went on and people

spilled from the house.

"It's Eddie! Looks like he's hurt," shouted a man's voice. "Call a doctor!"

A woman ran back into the house. As Gus ran up, a stout, bald-headed man in shirt sleeves swung toward him.

"This your car?" he demanded.

"It's mine," cried Karen.

"Kid drivers! You the Bronson girl?"

"Yes. Oh, Eddie, I'm so sorry."

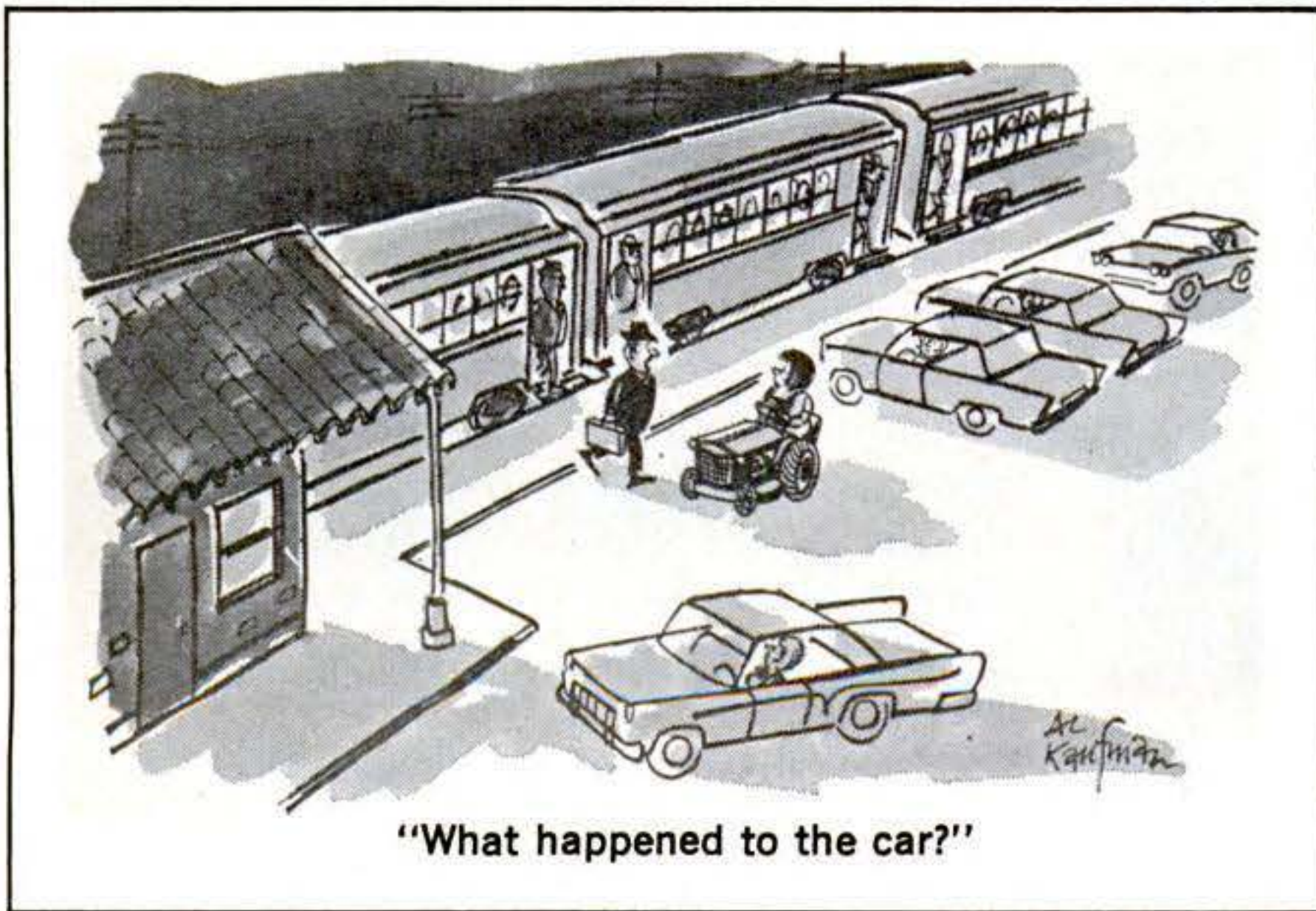
Beside the car, which was jammed into the hedge, lay the boy Gus had met that afternoon, his body twisted, his breath coming in harsh gasps.

"Don't touch him!" warned the big man.

A middle-aged woman ran out of the house and sank down beside the boy. "Eddie, where does it hurt?"

Groans were the only answer. The woman shuddered. "Oh, Eddie, if only you hadn't gone out to find that lighter!"

"How could it happen?" Karen sobbed to Gus. "I left it in low gear, like Dad said, and put the brake on hard, too. I know I



"What happened to the car?"

branches tomorrow. I need the car badly."

"If I tow it in now," mused Gus, "I should have it back this evening."

Easing the car down into the street, Gus hoisted it up behind the tow truck. In the Model Garage Stan Hicks, his helper, drained out the gas-diluted oil.

Two other cylinders were partly flooded. Gus drained them, blew in air to dry out any remaining gas, and squirted oil into each cylinder to restore lubrication. Stan put fresh oil in the crankcase.

At quitting time he left, while Gus went out for a light supper. Returning to the shop, he removed the four-barrel carburetor, which had two separate float systems. He wasn't surprised to find a little gas in the primary float, and a groove on its arm where it bore against the needle valve. Gus replaced the defective float and installed new seats and needle valves in both systems. Then he made the float settings.

It was dark by the time Gus drove the



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did! If—if Eddie doesn't get well, I'll never drive again."

A big sedan with MD plates swept up to the house. Gently Gus led the girl off.

Her father met them at the house door and glanced toward the curb.

"Where's your car, Karen?" he asked.

The girl ran past her father, tears running down her face. Gus explained.

"You relined those brakes," said Bronson. "Did the hand brake hold right?"

"It held fine," declared Gus.

"Or did you bump her car with mine when you parked it?" pursued Bronson.

He walked down the steps. The Chevelle's wheels were turned well into the curb.

"Sorry," muttered Bronson. "Guess I better phone and report to the police."

"Wait," said Gus, starting downhill.

He flicked on the Chevelle's lights. They illuminated a glistening object Gus had seen reflecting the distant street lamp. It was a plastic bag, edges fluttering a little in the breeze. Gus walked down and picked it up thoughtfully.

"Yes," he said, the bag limp in his fingers. "Ask Chief Eldon to come here."

Sam Eldon made the scene in minutes.

More than an hour later, after Gus had returned to the garage for his truck and towed the convertible back to it, the office phone rang.

"Come to Bronson's," said Chief Eldon, "so I can explain to everybody at once."

"I'll be there," agreed Gus.

He was surprised, on entering the living room, to find Eddie Larkin present.

"I just drove Eddie back from the hospital," said Eldon. "Thought you'd like to see he's okay, and hear what he has to say."

The boy looked from Gus to a red-eyed Karen, her anxious mother, and Bronson.

"Just that I'm sorry," he muttered. "I'll pay for the damage. Can I go?"

Eldon nodded, and the boy walked out.

"You hit it, Gus," said Eldon as the front door closed. "Eddie faked being hurt to pay Karen back for brushing him off. He probably thought it would get him lots of attention from her from now on. But when I told him what we knew, there in the hospital, he confessed the whole thing.

"He's an orphan, recently come to live with his aunt and uncle. He hasn't adjusted to them very well as yet, they told me. He's moody, so when he rushed out in the middle of a TV show, saying he wanted to look for a lighter he'd lost, they weren't surprised. Actually he'd been watching the street through a window. The moment he saw the car roll under the street light, he ran out. When it crashed into the hedge, he went into his act."

"But he couldn't have *known* the car was going to run away," said Karen.

"He sure could," said Eldon. "He rigged it. He'd gone out about an hour earlier. He came up here, straightened the wheels, let the brake off, and put the shift in neutral."

"But you said he was in the house when the car rolled down," Bronson objected.

Eldon grinned. "You tell it, Gus."

"He used a timer," explained Gus, "cracked ice in a plastic bread bag, jammed in front of one wheel. When the ice melted down enough, the car took off. What gave it away was the cold water left in the bag."

Chief Eldon rose. "That winds it up, unless you want to press charges. Eddie's folks will pay for the car repairs, and they've promised to get the boy psychiatric help." Eldon shook his long, heavy-jowled head. "Beats me, but he told me he got the idea from seeing that ice-cube trick on a TV murder show."

"What's more amazing," put in Bronson, "is that Mr. Wilson caught on to it."

"What's amazing about it?" asked Gus with a grin. "I saw the same show." **PS**



Italianized Jaguar

The little four-seater at left is a British Jaguar S artfully disguised with Italian coachwork by Bertone. The low, thin-roofed two-door body with immense glass area has a Latin look, but retained is the aggressive front and classic grille that's all Jag. Interior trim is real pigskin.

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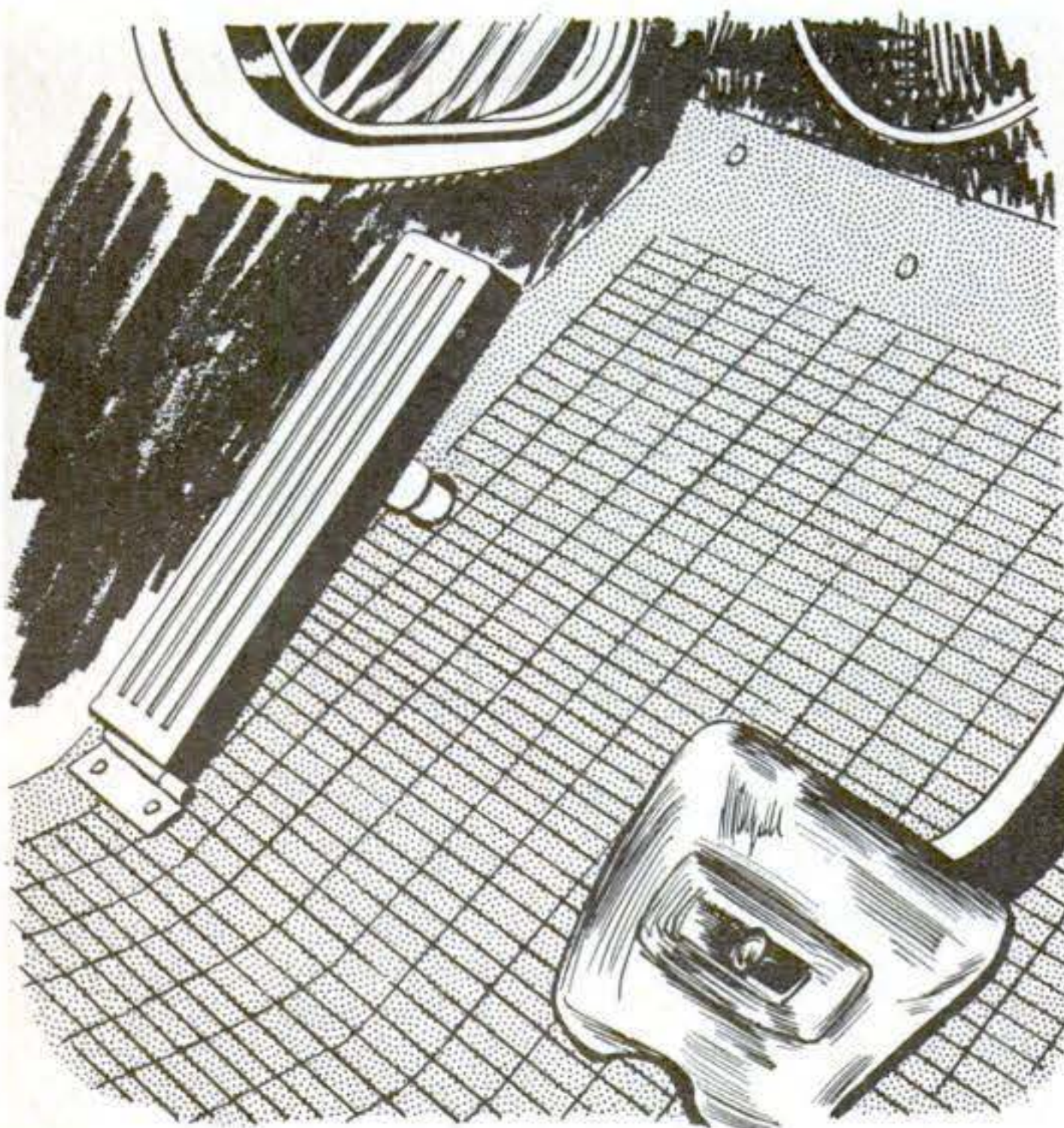
Hints from the Model Garage

DRAWINGS BY RAY QUIGLEY

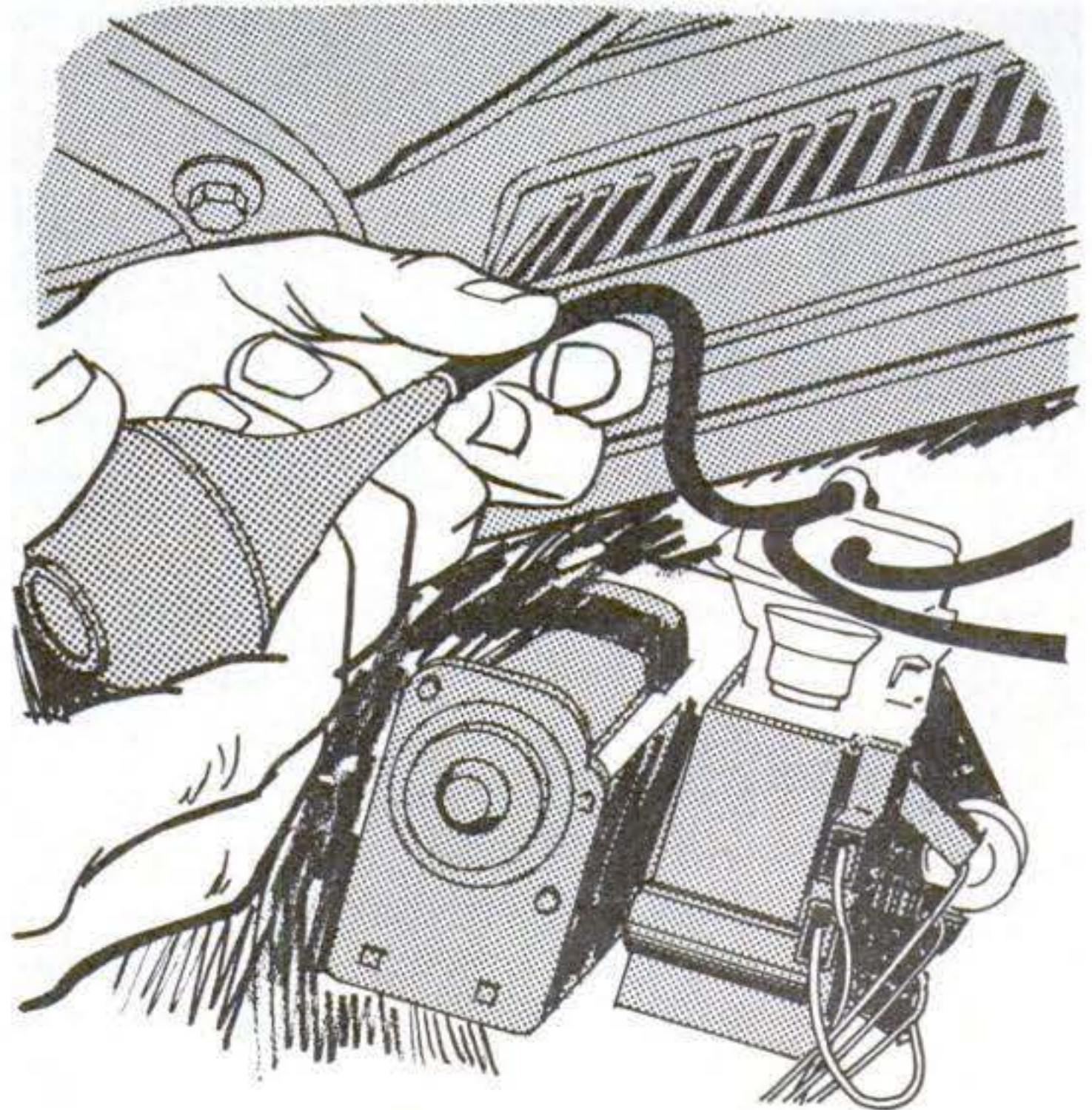


When installing a new set of seat covers, try this trick: Lay them out in the sun or in some other warm spot for at least 15 minutes before you put them on. That way, you'll get the material to stretch fully, without wrinkles. If the

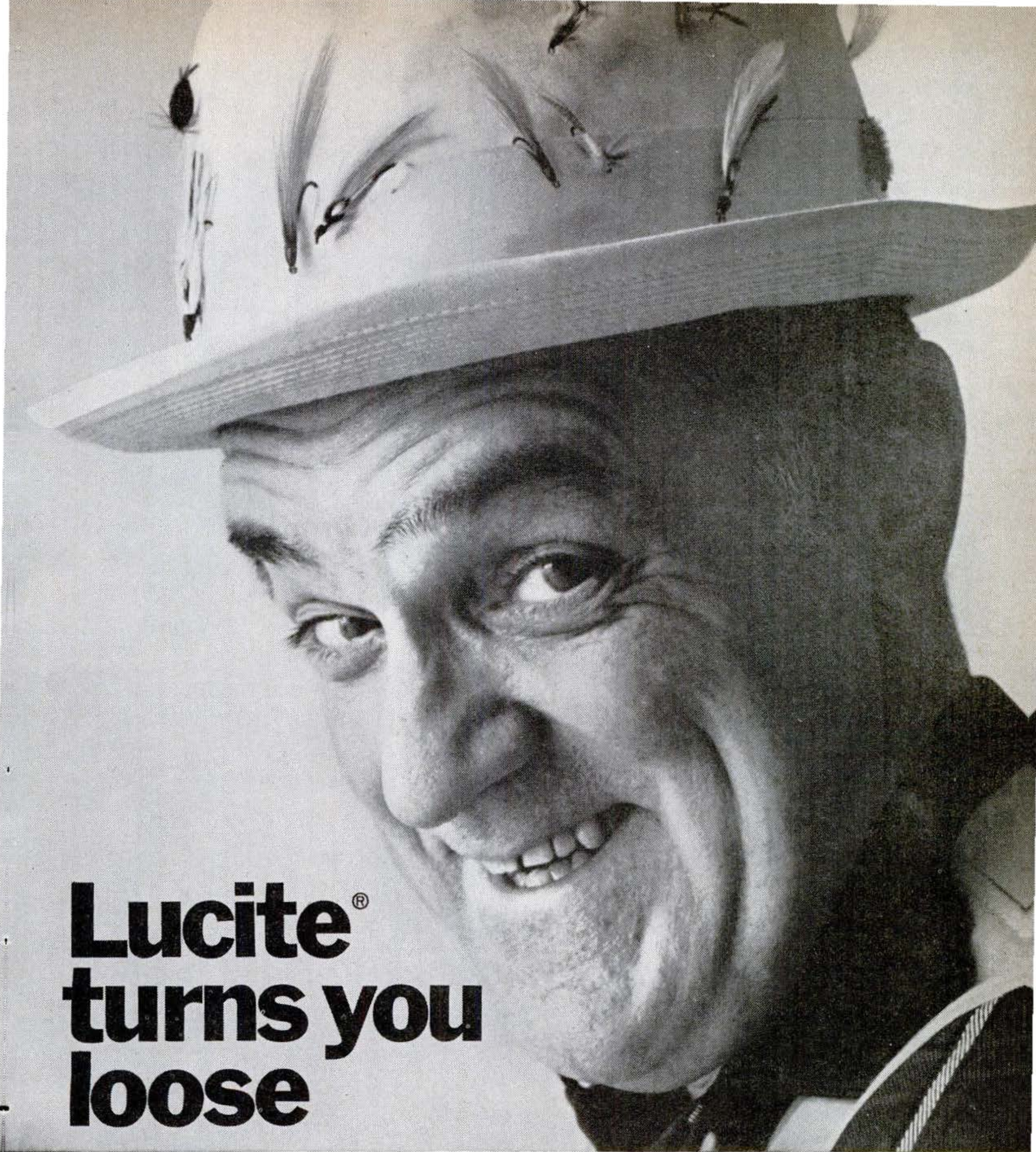
seat covers are installed cold, they'll be sure to stretch when warmed up by body heat or when the car is parked in the extreme heat of summer sunshine. The result of that, of course, is ugly and uncomfortable wrinkles.



On many cars and trucks, you really have to stretch your foot to reach the dimmer switch. On some autos (especially trucks), you even have to look for it first. To make the switch easier to find, attach an old accelerator pedal to a hinged bracket. Bolt the bracket to the floorboard with the pedal over the switch.



Check valves in the electric windshield-washer pump motor sometimes get clogged. There is no need for you to take the pump apart—just disconnect one of the water-outlet hoses and the inlet hose. Fill a syringe with fairly warm water and force it into the tube via the inlet tube. This will clean out the check valves.



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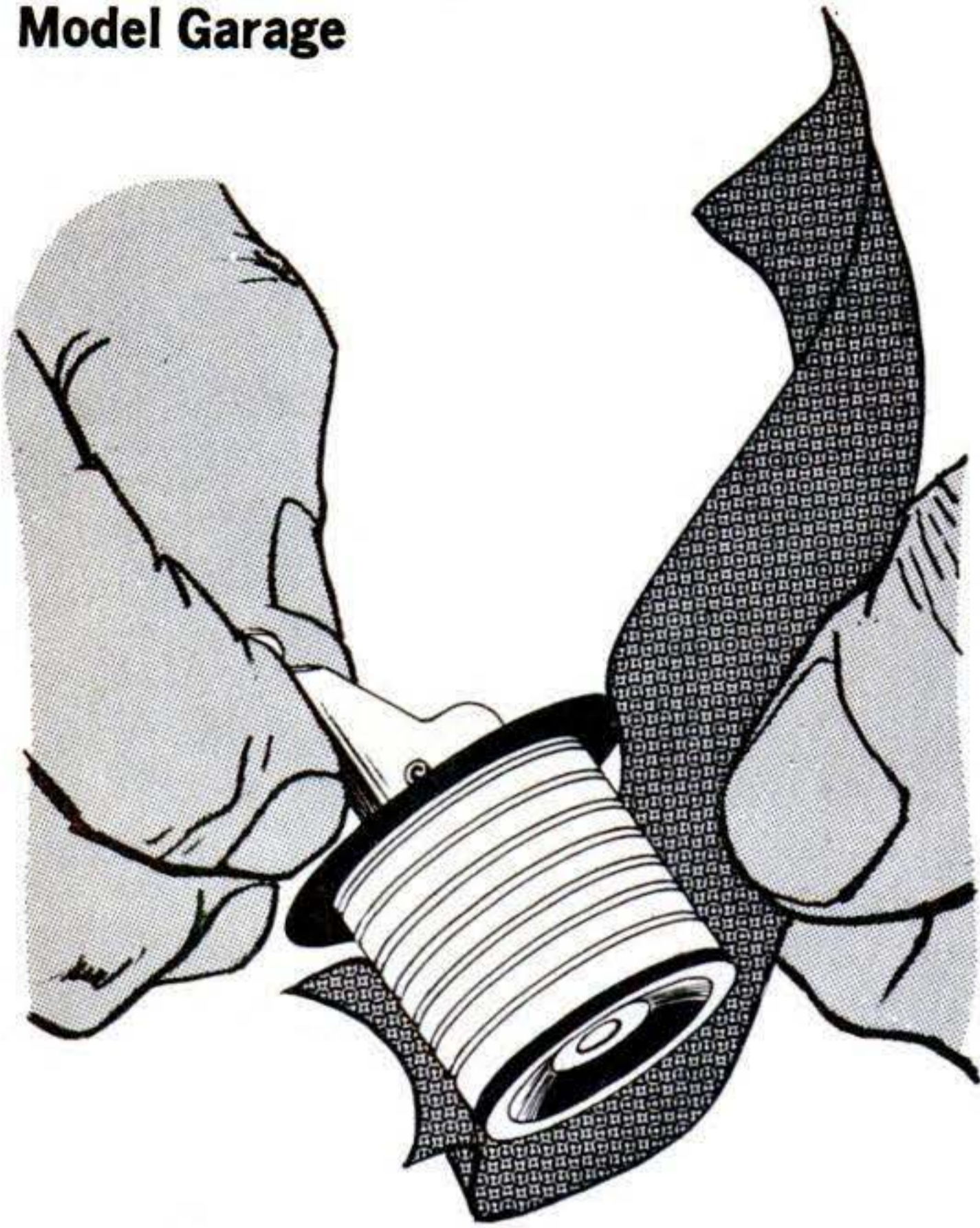
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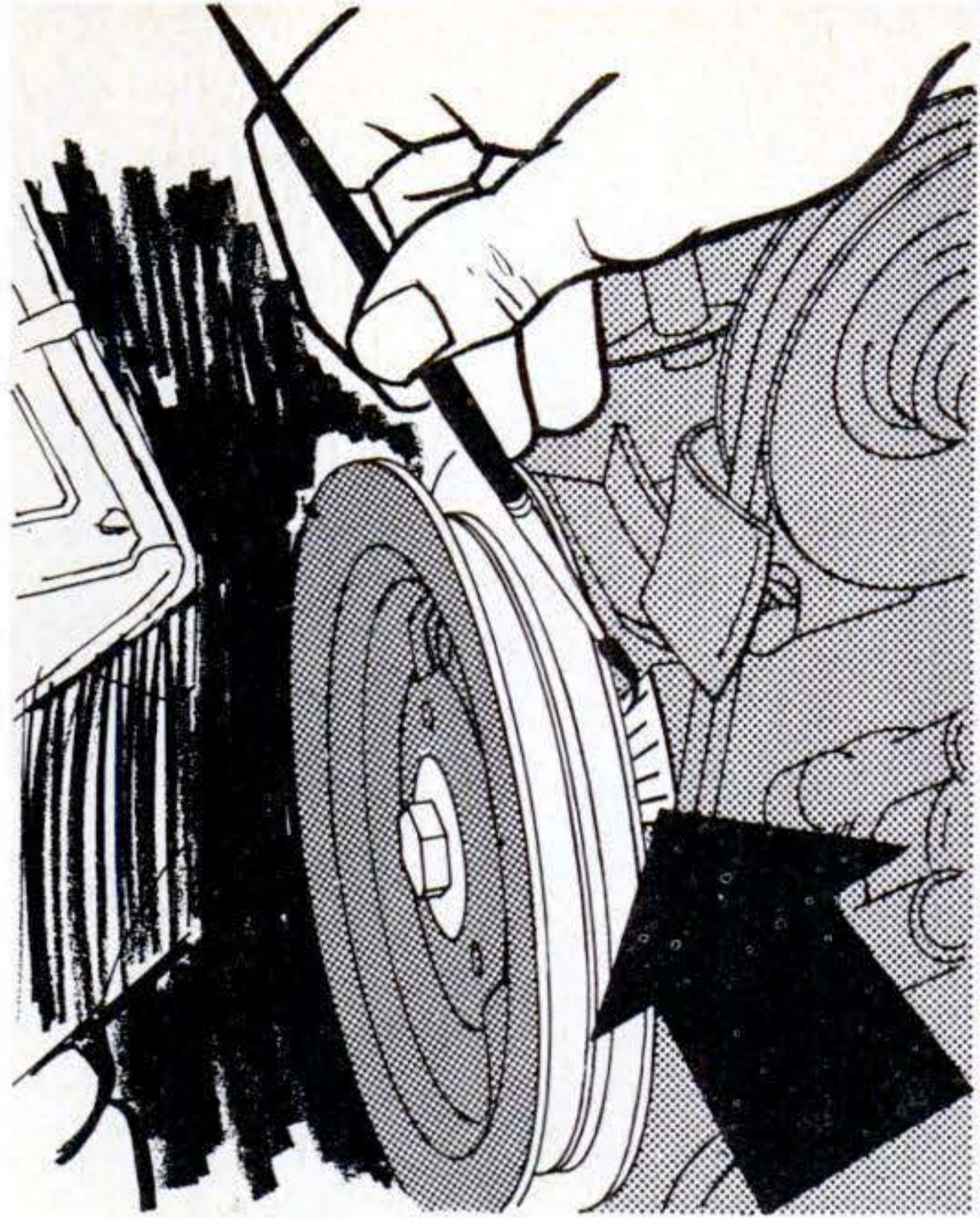


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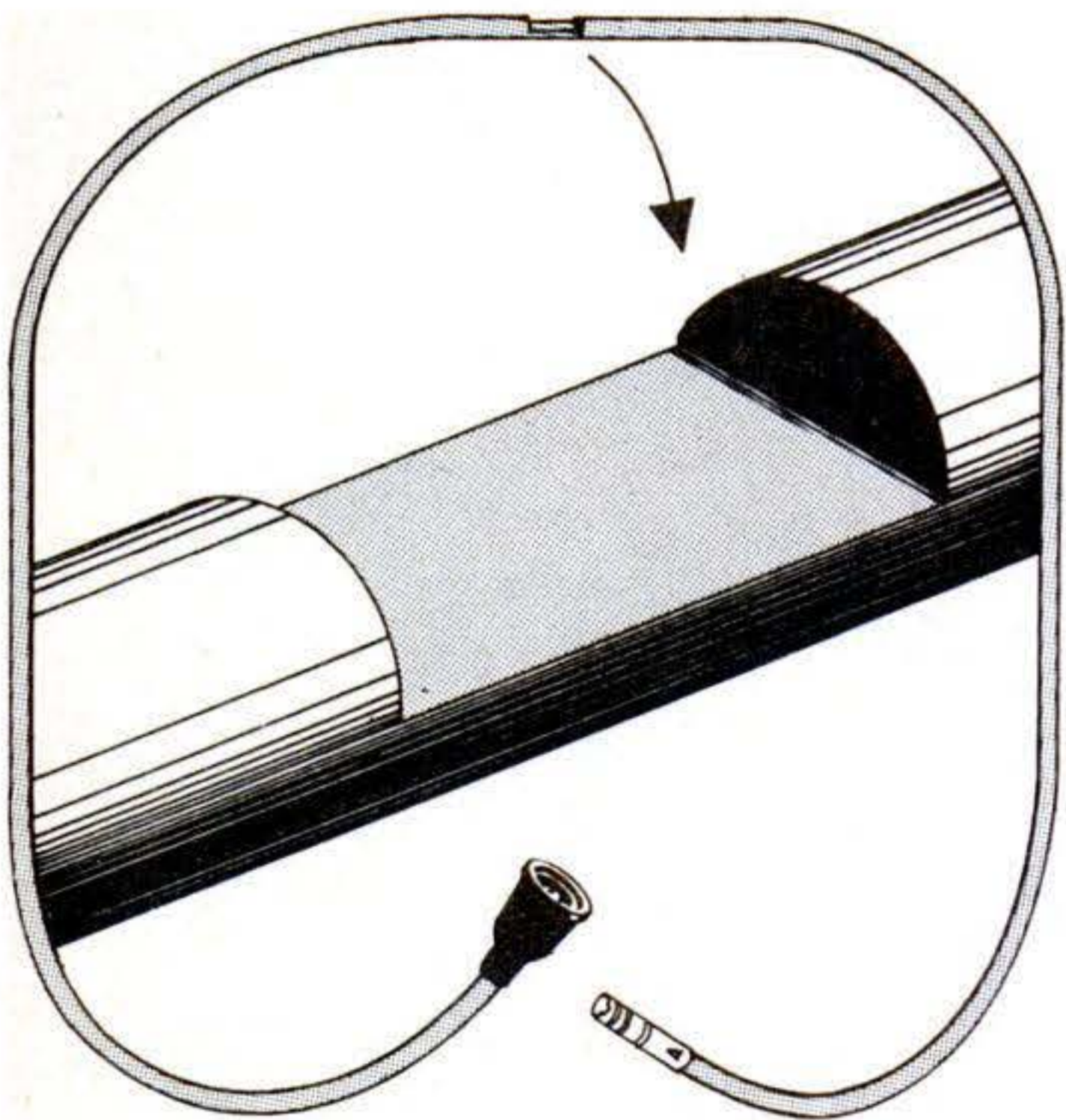
More Hints from the Model Garage



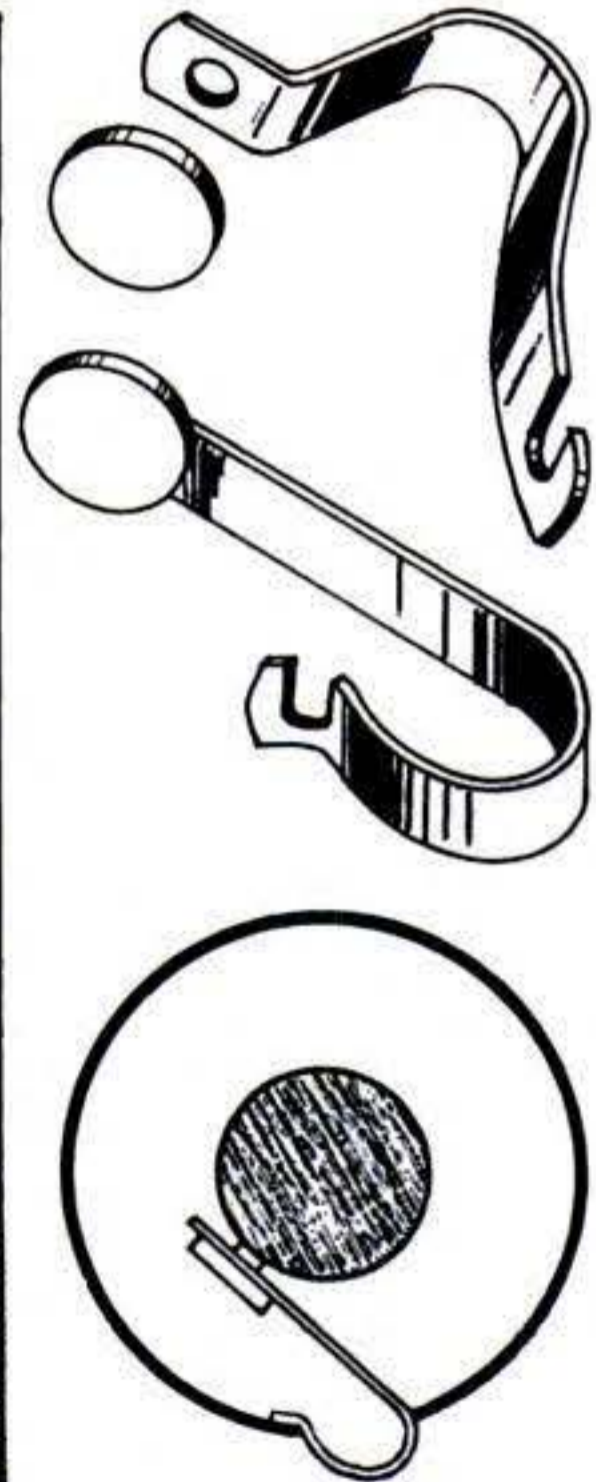
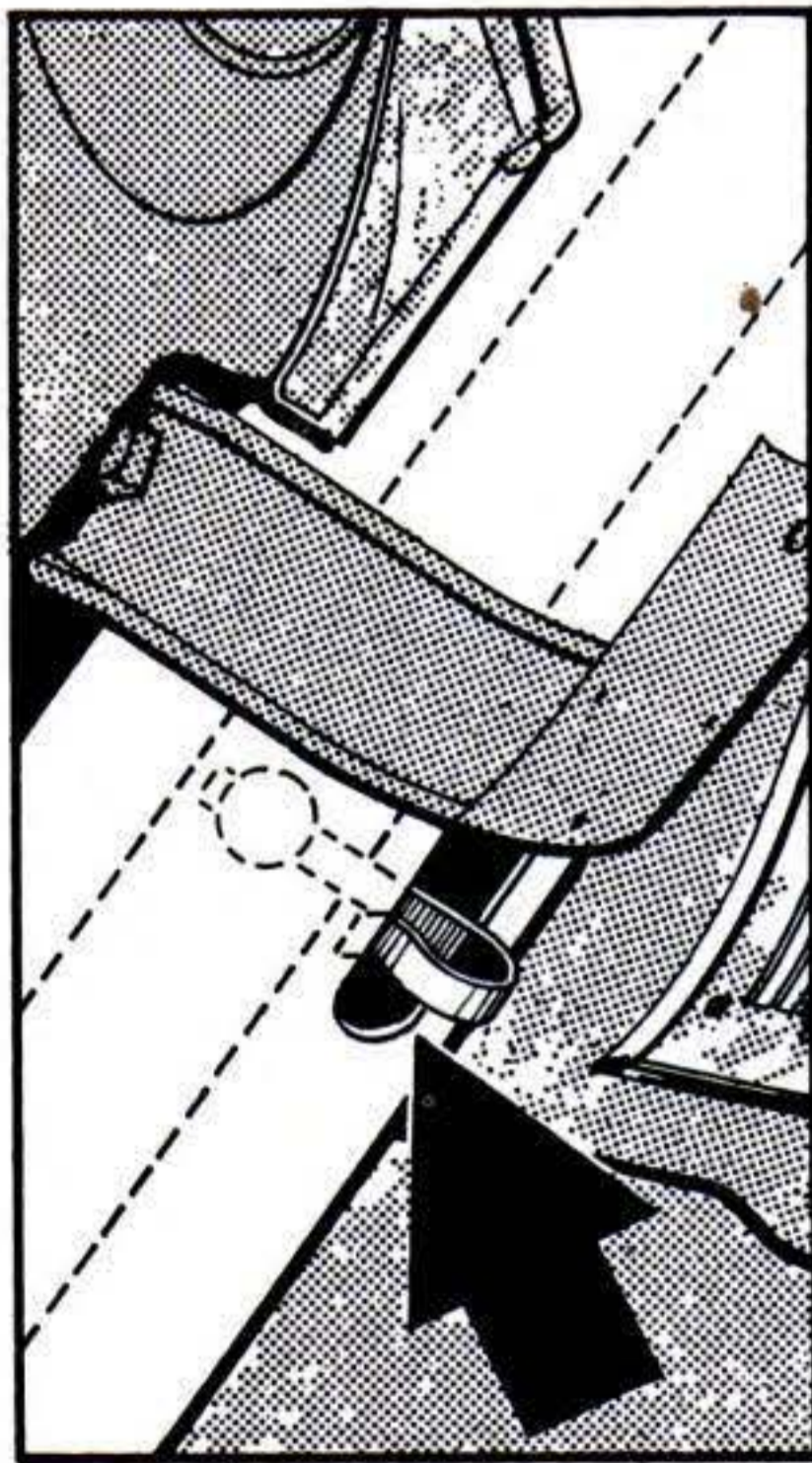
In case you lose a core plug (from your cooling system) on the road, here's how to get going again: Get a Thermos-jug rubber stopper at a drugstore and wrap a few layers of rubber insulating tape around it until it fits the core plug hole. Use rubber tape only—it has to stretch.



Timing marks (next to the fan-belt pulley) are often hidden under a layer of grease and dirt. To make the marks more visible under the beam of a timing light, try this: Wipe the surface clean and, using luminous paint, fill in the marks with thin stripes of the easy-to-see paint.



Making a good slip-proof connecting point for a timing light is easy. Hunt up a piece of spark-plug wire (about as long as one plug lead), fit the proper terminals to it, and make a $\frac{1}{2}$ " cut through the insulation near the middle of the wire. Fit your timing-light clamp in the cut.



Horns that work intermittently or not at all can be cured by a better ground connection. Fit an old starter brush snugly in the hole at the end of a breaker-arm spring. Insert the spring inside the steering-shaft jacket, near a mounting bracket, where a slot will give access.

SOWING PENNIES

to Harvest Dollars when they are needed

How hundreds of far-sighted men are using spare hours now to assure themselves of a ready made income in the event of lay-offs or recessions that might affect their jobs.

All over the country it's happening. You may even know some of the men who already have started home operated businesses of their own in their spare hours. They keep their jobs. The "boss" doesn't know they are planning for independence. They do not have any heavy investments in equipment or inventory, because they buy their raw materials as they are needed. They have no overhead expense because they operate their businesses from their homes.

Yet hundreds are quietly developing a second source of income—an extra income right now for their spare hours; and a business that can be quickly expanded if it were ever necessary to look to it for complete support.

These "little" home businesses are little only in the sense that they require little capital to start and run, and they require little time on the part of the owner. The margins of profit in some of them are so fantastic as to be almost unbelievable—far greater than those usually enjoyed by big investment manufacturing.

And, there are many kinds and types. For the man who is mechanically inclined there are businesses in which he can use his hands as well as his head. For those who have no aptitude with tools there are small manufacturing operations that are almost automatic in their production methods.

One of the features found in many of these businesses is a wide and ready market for the product. Usually it is a product too small in total national market to attract the attention or envy of the big investors. So, the danger of competition from big operators is absent. Usually it is a product that enjoys a neighborhood demand so that good markets are found in any size community from the small town to the neighborhoods of the big city. Usually the cost of the raw materials is only about one tenth the selling price. One such product costs 11c for raw materials, yet sells readily for \$1.00. Another sells for \$18.95, yet the raw materials cost only 55c. Still another returns \$2.75 for each 27c worth of raw materials.

In the same way that history had its "Minute Men," quietly trained and ready at a moment's notice, so today, we have a constantly growing number of "Ready Men." They are working at steady jobs in offices, stores, factories, gas stations. They have a regular income *now*—an income that only a few months ago was considered both *regular* and *dependable*. But when the signs went up, they started quietly to prepare for independence. They are ready. They have mastered the details of their businesses. They have been making twenty, thirty, forty, or more dollars a week as *extra* money—now—



some times with others in the family helping. They have established the outlets for their products. But, more important than their present extra income, they are ready, overnight, to give their full time and to expand their businesses into full-fledged operations at increased income.

The fear of layoffs is gone from their hearts. The worried look induced by threats of recession has vanished from their faces. They face the future with confidence because they have sown the pennies that will be reaped as dollars when more dollars are needed—they have attained a sense of personal independence that puts them above worry and fear.

What are these businesses? There are a number. One that is especially interesting and that you can own outright for less than \$300.00 is the manufacture of a product used in quantity in every office and factory in the nation—and by millions of individuals.

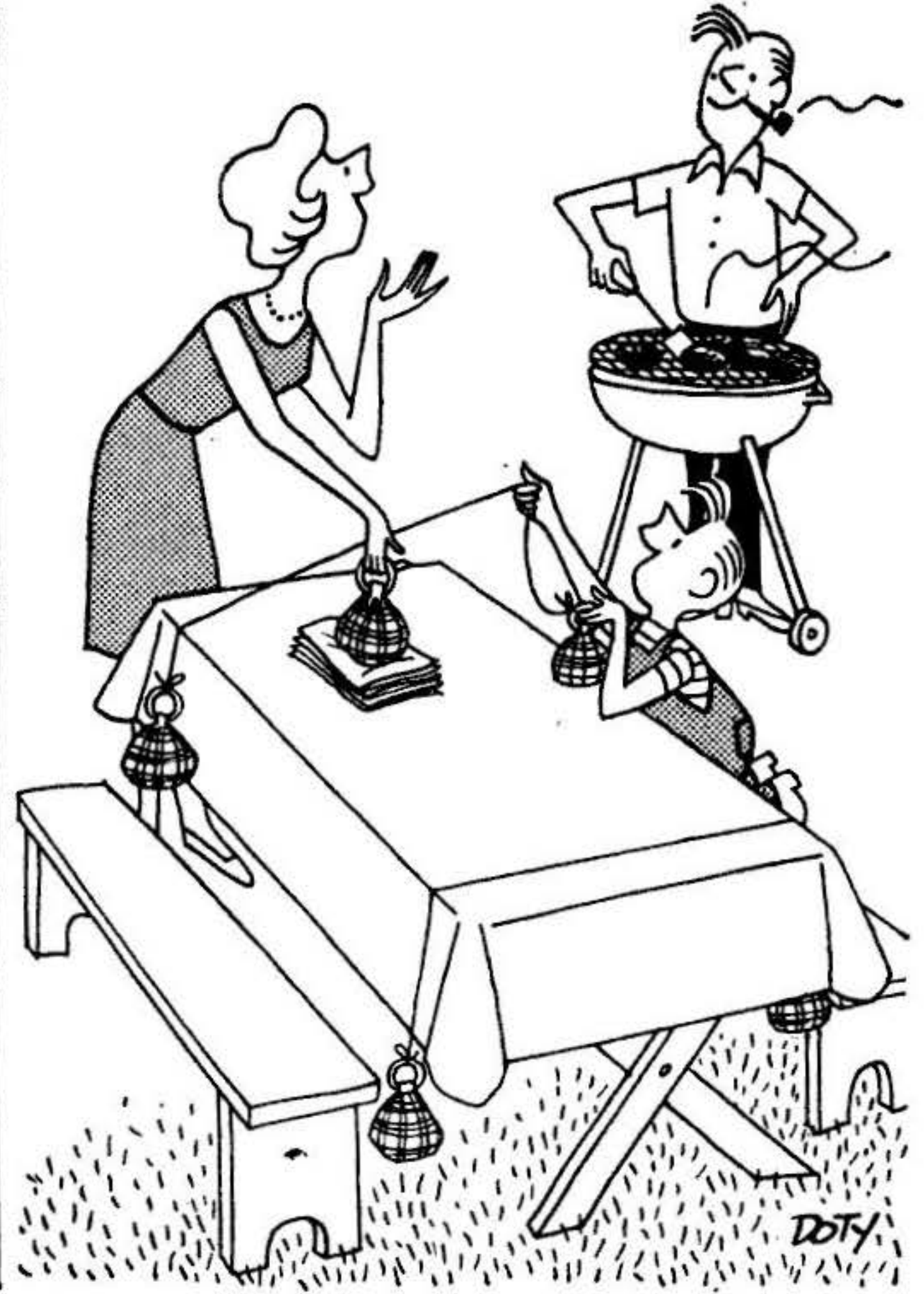
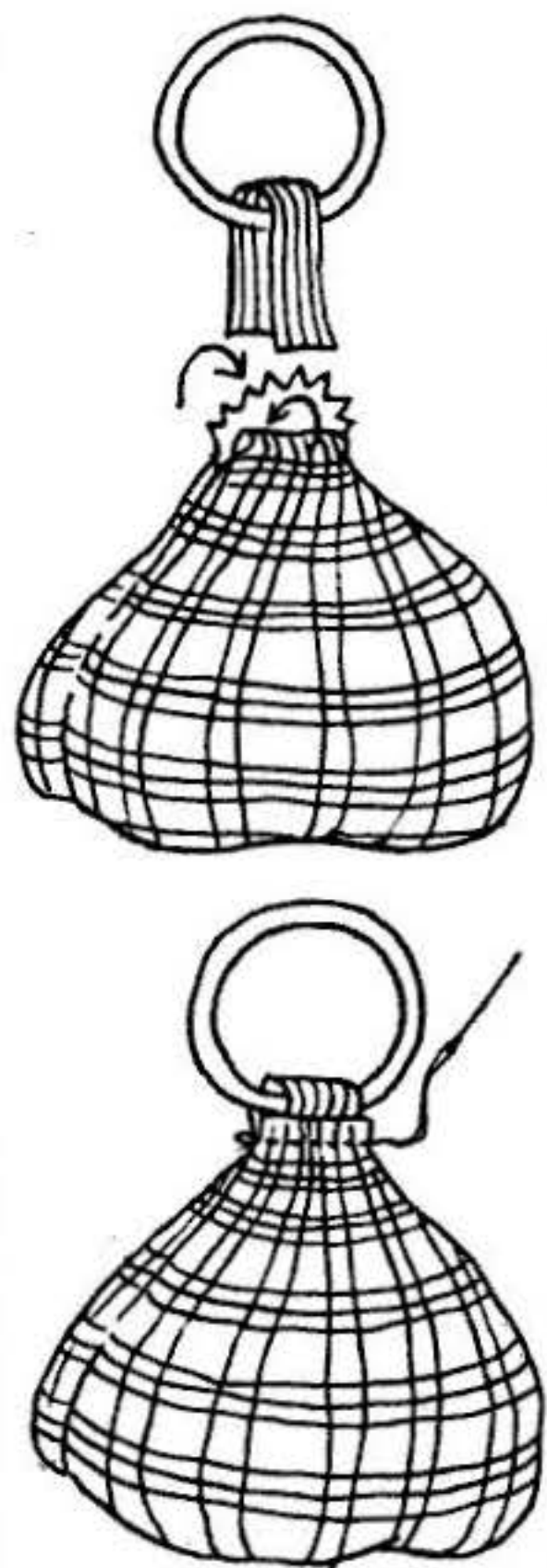
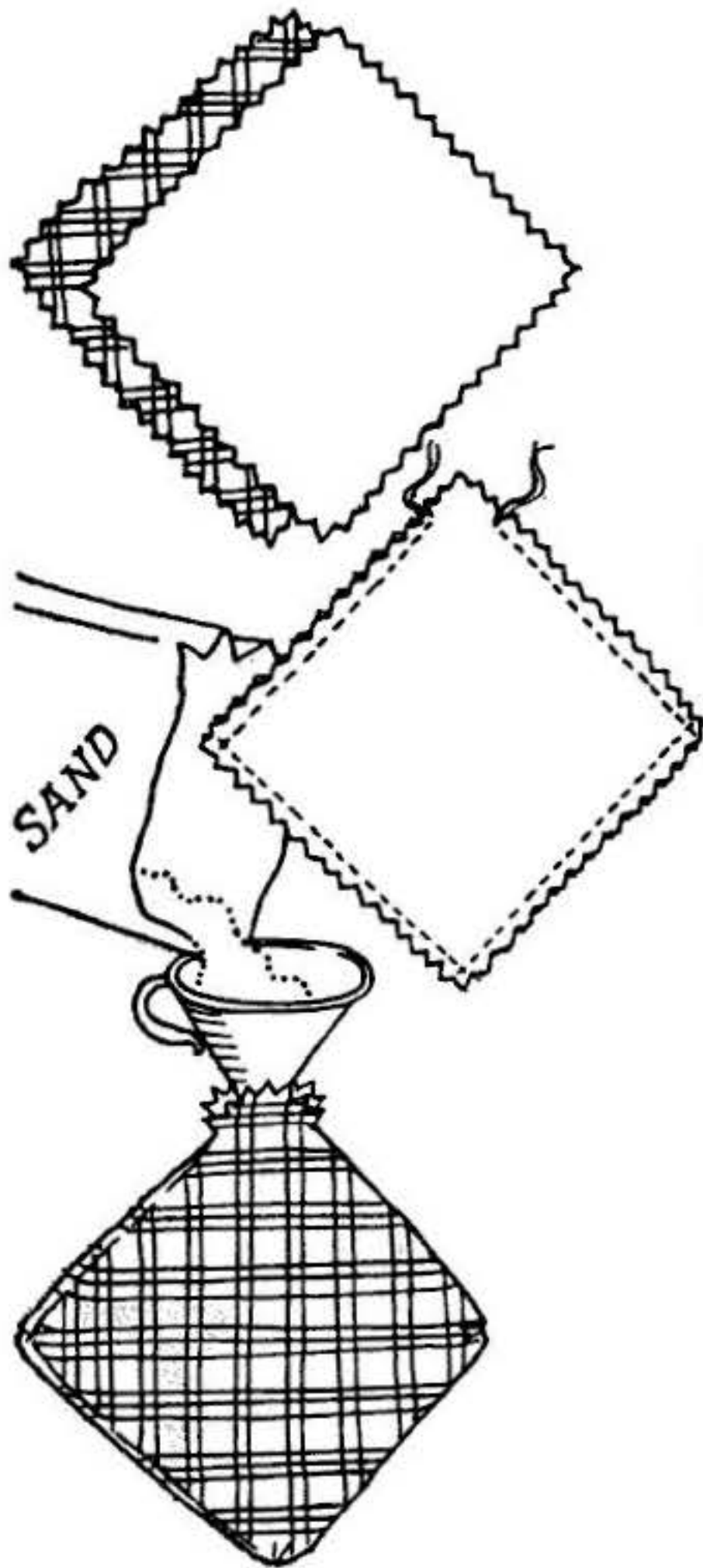
The product is light in weight and can be delivered to customers by mail for just the cost of a few stamps. And 27c worth of material, to which you add nothing but your own time, brings back \$2.75 in cash at retail. The entire "factory" takes so little space that it can be operated on a table top in any spare room, the basement or garage and it is such a simple process that even the junior members of the family can help. The equipment is supplied by The Warner Electric Company who also give seven different methods of selling the output and give financial help to the men who want to start. The sales methods include a plan by which others sell your product so there is no canvassing needed on your part; another plan by which you sell by mail.

Complete information concerning this and other businesses is free. Information is mailed, postage prepaid, to anyone who is interested. There is no obligation and, since the company has no salesmen, you are not bothered by anyone trying to "sell" the equipment. On the basis of the information mailed, you decide in the quiet of your own home whether you are interested.

It is not necessary to write a letter. Just send your name and address on a postcard and say you want complete free information on various home businesses offered by Warner Electric Company. Address your card to Warner Electric Company, at 1512 Jarvis Ave., Dept. R-3-HX, Chicago, Ill. 60626. You may want to plan a degree of security for the future that is not experienced by men who depend upon the ups and downs of others' businesses for their livelihood.

Wordless Workshop

By ROY DOTY



Can you get by with a cheap hammer, or should you buy a Stanley "Steelmaster"?



You might get by with a cheap hammer. It'll bang nails in and yank nails out. But someday the head will loosen up (and just might fly off the handle). Someday the handle will crack. Someday a claw will snap off when you're prying out a stubborn nail. But a cheap hammer is good for a while.

A STANLEY "Steelmaster" is the finest hammer you can lay your hands on. Its head is drop forged (not cast) from tough special analysis steel. It's heat-treated 6 times to strengthen the steel — ground and polished *by hand!* And the striking surface is "*rim tempered*" to minimize chipping (nobody else takes this safety precaution).

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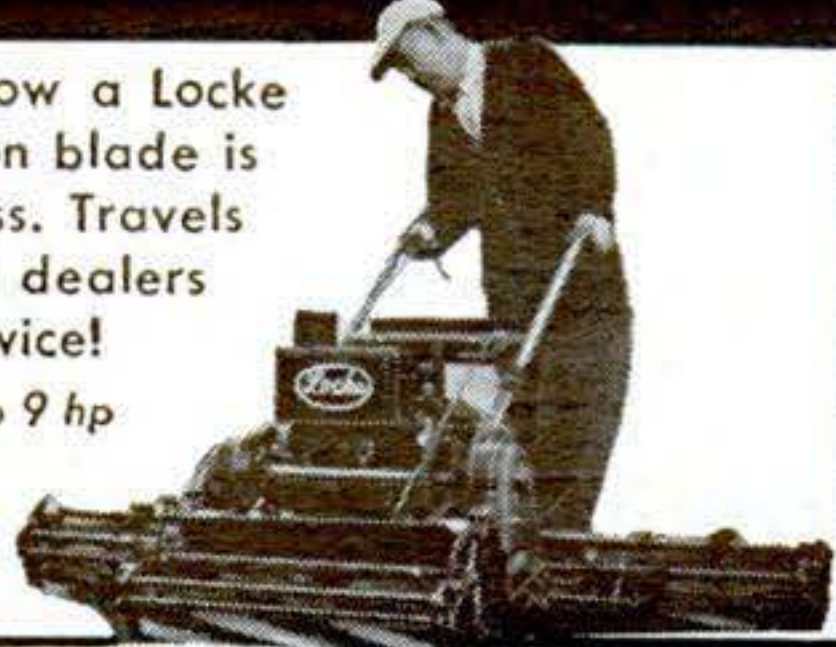
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A Daffy Ride in a Hot-Air Balloon

[Continued from page 45]

velope. A taller line of trees loomed ahead. "Trees," I said uneasily, "a line of trees." "Yup," said Barnes, "probably smash right into 'em."

It was a funny thing about those blasts of propane. It took about 15 seconds for the heat to overcome the inertia of the balloon. After all, there were 5,000 pounds of air in that envelope. We rose, clearing the trees easily.

We crept up on a small lake. It mirrored gondola and bag, upside down.

"Hey," I called to a lone fisherman, "catch anything?"

He held up a fish. He didn't ask what we were doing there, suspended between earth and sky.

"Another time," reminisced Barnes, "I landed on newly seeded lawn. That wasn't so bad, but dozens of people began crawling out of the woodwork and trampling the lawn. Cost me \$30 to have it reseeded." He valved out a little hot air. "It's hazards like that in hot-air flying," he concluded deadpan, "that make you think twice."

Coming in for a landing. We were very low now. Ahead was a tiny field. Our speed over the ground was maybe five miles an hour. Was he going to land *there*? I flinched.

We touched. We scraped. The balloon wouldn't stop. We were headed straight for a barn.

"Grab it!" yelled Barnes to a husky man who suddenly appeared in our path.

The man grabbed. It was none too soon. We stopped. Barnes was unperturbed. He yanked on a wire that opened zippered panels in the balloon's top. The envelope began swishing to the ground beside us.

"Say!" exclaimed the husky man who had intercepted us—and this to me, mind you—as I climbed out. "Could I have your autograph?"

Well, a man who was obviously sagacious, perceptive, urbane, cultured, intelligent, and properly appreciative of human courage deserved an autograph. I obliged him.

Barnes isn't the only record holder in Chester, S.C. A pretty girl of 22 who goes by the name of Brenda Bogan and who works for Barnes, holds the world's altitude record for hot-air balloons of 21,000-cubic-foot capacity—a height of almost two miles. That's her real name, Brenda Bogan. Only it's not Bogan any more. It's Barnes. Last January she married her boss. **PS**

Three Hot Ones You Can Handle

[Continued from page 52]

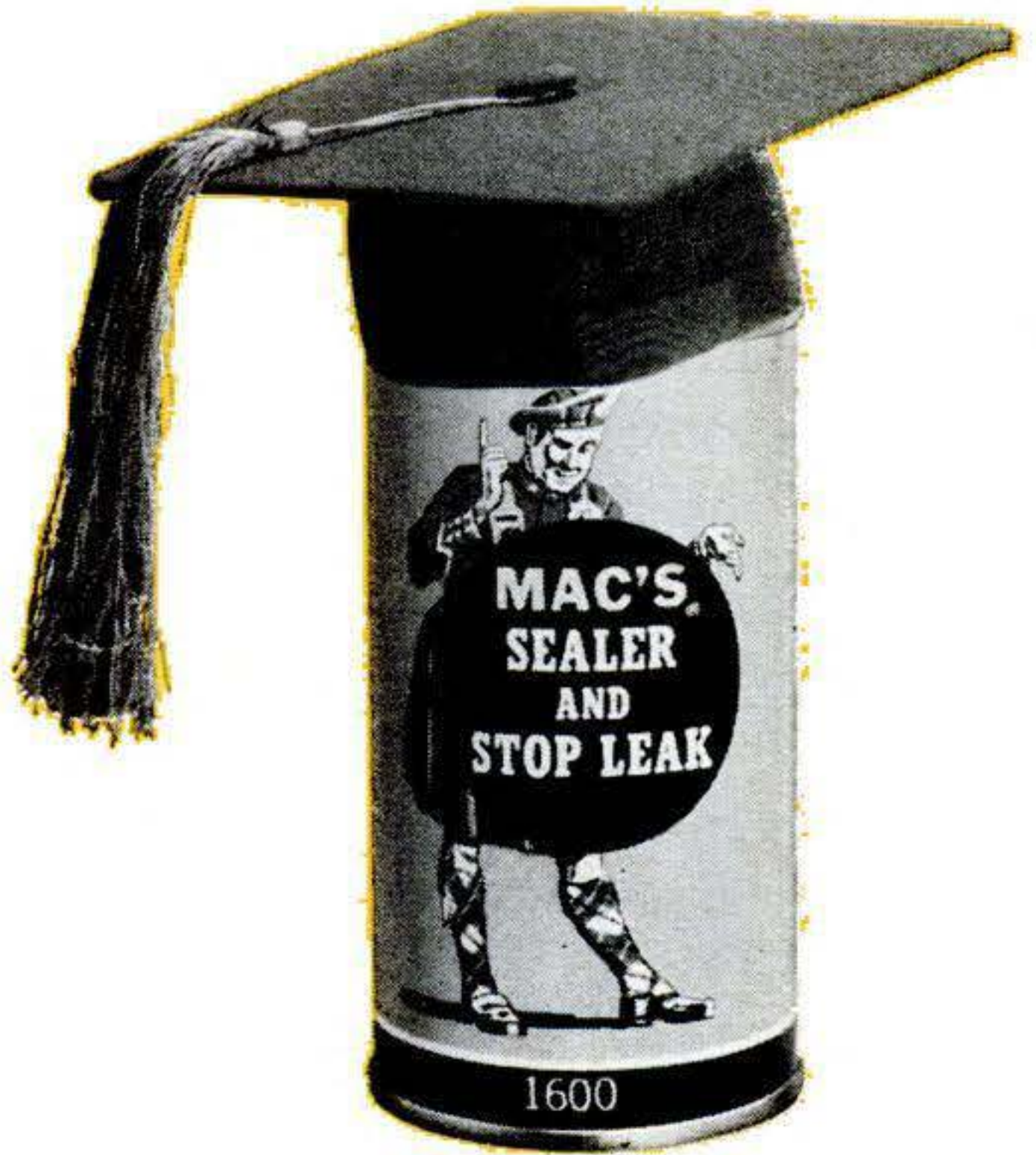
driver's mood. It could be eased through traffic as silently as a hearse; yet when performance was needed, the SS 396 came on as the hottest of them all.

Interior space. Getting in and out of cars is not a major concern of mine. I'm more interested in being properly seated during all the hours I drive than in saving a second or two when entering or leaving the car. But for the record, the Comet has the highest door opening (37 inches against the Chevelle's 36.6 and the Charger's 36), and the Charger has the widest doors (45.5 inches against the Comet's 44.5 and the Chevelle's 42.3). Access to the rear seat was best on the Comet. With the front seat all the way back, there's an 8.5-inch gap between the seat and the door line on the Mercury, compared with 7.5 inches on the Chevelle and six inches on the Dodge.

Surprisingly, the biggest car in the group (Charger) did not have the best space for the passengers (see data box). Its rear bucket seats are narrow, and the Comet has more leg and head room in the back. For tall drivers, however, Mercury and Chevy cannot match Dodge in either leg room or seat-to-wheel distance. With the seat all the way back, the Charger driver has 17.5 inches of free space vs. 16 on the two others. For back-seat passengers who like a view of the road ahead, the Comet has a higher seat than the other two: 11.25 inches against 9.5 in the Chevelle and six inches in the Dodge.

The rear seats. If the Charger's rear seats are poor, it has the extra feature that one seat may be folded to accommodate long, unbending cargo, while a person occupies the other one. The area behind the rear seats is 22 inches long, and the minimum width between the wheel wells is 45.3 inches. By opening the partition between the interior and the trunk after folding both rear seats, you get a cargo area 92 inches long—almost that of a full-size wagon.

The Charger is a 1966½ model and will continue unchanged for '67. I expect no major changes in the Comet or Chevelle lines this year, so you may use this test as a guide to some of next year's "muscle cars." Hot cars by other auto makers include a hemihead Plymouth Satellite, Ford Fairlane GT, Pontiac GTO, Oldsmobile 4-4-2, and Buick Skylark Gran Sport. Then, of course, there's the Corvette! PS



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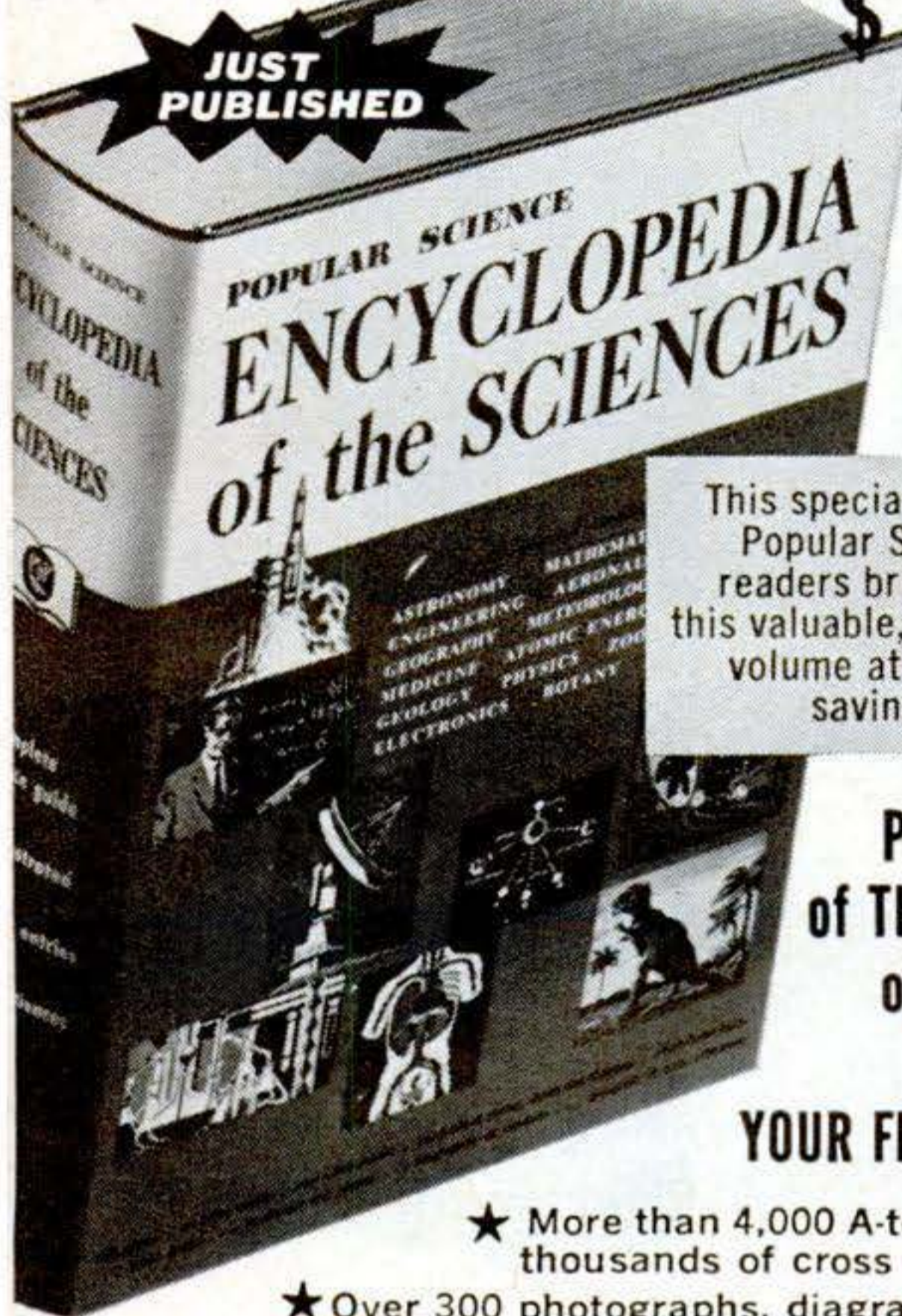
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Batman's Batmobile

[Continued from page 47]

Barris took just three weeks to change the Lincoln stylists' dream car into the Batmobile that gives Gotham City's bad guys nightmares. "It's really the same car underneath," he says. But the Futura's rear fins were made seven feet long and fluted at the ends to form bat wings.

The hood was reshaped to resemble a bat face, with a long scoop to the grille forming the nose. The grille cavity itself is the mouth and has rockets that give Batman added "teeth." The mouth also has projecting blades that "cut" through road blocks. The fenders are shaped into bat-ears, and the right and left "eyes" extend into the "ears." The "eyes" simulate dual 450-watt laser beams, supposedly able to cut through rock and steel, but their amber lenses actually conceal operational headlights.

Bulletproof, aircraft-type Plexiglas bubble windshields have replaced the Futura's original canopies. A center roll-bar arch splits the new cockpit. Atop the roll bar are several trouble and warning lights.

Just to the rear of the roll bar are three awesome-looking "anti-theft rocket tubes." (The Futura had a less spectacular circular antenna there.) Right in back of them is a so-called "turbine exhaust tube." Unfortunately, the Batmobile really has a 500-hp. supercharged Lincoln V-8 engine.

Fighting the evil forces. After the exterior changes were made, the original frost-white blue gave way to 40 coats of nitrocellulose velvety bat-fuzz black, with an outline trim of fluorescent cerise. If all this isn't enough to frighten the forces of evil in Gotham City, the cockpit occupied by Batman and Robin is equipped with a terrifying array of crime-fighting gadgets. An antenna reactor-receiver relays messages from the Batcave's computer and message center. Hooked into the dashboard are such devices as a revolving closed-circuit camera with a Bateye switch for anti-theft control. If a villain gets away with the Batmobile, the Caped Crusader can use a remote-control ejection seat to foil him.

"Despite all these frills," Barris says, "the Batmobile is a working car. We get it up to 80 m.p.h. for some chases. And we have to service it every week—especially to get off the footprints that Boy Wonder Robin puts on the fenders, getting in and out of the car."—Herbert Shuldiner.

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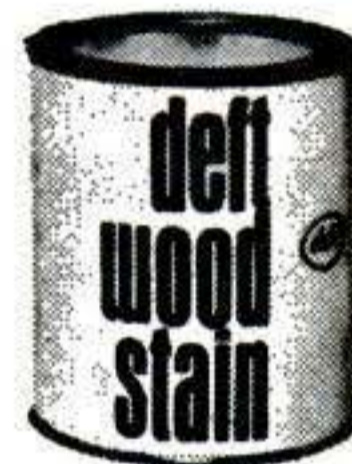
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How to Buy a Fishing Rod

[Continued from page 150]

Like spin casting, spinning is a fairly new way to go after fish. The spinning reel hangs underneath the rod on a long shank. And big guides take the free-flowing monofilament line. Long, straight grips have movable reel seats to allow the reel to be placed in any comfortable position.

Fly casting. Many fishermen think fly casting is the most difficult fishing skill to master. In other casting methods, a heavy lure carries the light line. In fly casting, light flies are propelled by a heavy line. The only purpose of the reel is to store line. Casts and retrievals are made from line coiled in the hand. The reel seat on a fly rod is at the extreme rear end of the grip.

With fiberglass fly rods, more fishermen—

particularly novices—are finding that shorter rods work best. But if you fish in areas requiring very long casts, a longer rod may prove more effective.

Most fly rods are used for relatively small fish, but it's possible to use long, heavier fly rods for big salt-water fish.

For best action and comfort. Salesmen's talk about special tapers often just adds to the beginner's confusion. While such rods may work wonders in the hands of an expert, many anglers are most comfortable with a conventional straight-taper rod.

When you've narrowed your choice to the type of rod you'll use, sort out the various makes you have to choose from and check the feel and action of each. Two

MATCHING A ROD TO YOUR FISHING

TYPE	KIND OF FISHING		ROD CHOICES	REEL	LINE WT. (lb. test)	LURE WT. (oz.)
SPIN CAST-ING OR PUSHBUTTON	Very Small	Panfish, crappie, small trout	Light 6'-7'	Pushbutton	4-8	1/8-1/2
	Small	Pickereel, big bass; trolling	Light-medium 6'-7'	Pushbutton	8-12	1/4-5/8
	Medium	Pike, muskie, walleye; trolling	Medium-heavy 6'-6'6"	Pushbutton	12-20	3/8-1
BAIT CASTING	Very Small	Panfish, trout, fluke	Extra light 5'2"-5'8"	Light-reg. level wind	4-10	1/8-3/8
	Small	Bass, pike, pickereel	Light 5'6"-6'6"	Light-reg. level wind	8-12	1/4-5/8
	Medium	Walleye, North. pike; salt-water casting, trolling	Medium 5'2"-6'6"	Regular level wind	12-20	3/8-3/4
	Large	Big trout, muskies, large catfish; salt-water casting, trolling	Heavy 4'8"-5'8"	Heavy level wind	15-50	3/4-5
SPINNING	Very Small	Bluegill, panfish, perch, small trout	Extra light 5'6"-7'	Light spinning (open or closed face)	1-4	1/8-1/4
	Small	Rainbow, shad, bass, flounder	Light 6'-7'	Regular spinning (open or closed face)	2-8	1/4-1/2
	Medium	Big bass, steelhead, Dolly Varden	Medium 6'-7'6"	Regular spinning (open or closed face)	6-12	3/8-1
	Large	Salmon, snook, bonefish, channel bass; surf fishing	Heavy salt-water class 7'-12'	Heavy-duty spinning (open face)	12-20	1-4
FLY FISHING	Very Small	Sunfish, crappie, brook trout	Extra light 7'-8'	Automatic fly reel	#4	Wet-dry flies, small streamers, poppers, eggs
	Small	Rainbow, brown trout, grayling	Light 7'9"-8'6"	Automatic fly reel	#5-#6	Wet-dry flies, small streamers, spinners
	Medium	Big bass, cutthroat, walleye, steelhead	Medium 8'6"-9'	Automatic or single-action fly	#5-#7	Wet-dry flies, bass bugs
	Heavy	Salmon, striped bass, tarpon	Heavy 8'6"-9'6"	Single-action fly reel	#6-#8	Bass bugs, streamers, spinners
SPECIAL-PURPOSE RODS						
TROLL-ING	Medium	Bass, catfish; light salt water	Medium 5'6"-8'	Spinning or level wind	12-20	3/8-3/4
	Heavy	Salt water, large fresh water	Heavy 8'-9'		18-30	3/4-5
SURF-ING	Medium	Salmon, flounder, steelhead	Medium 8'-10'6"	Spinning or level wind	12-30	1-5
	Heavy	Shark; heavy surf	Heavy 9'-12'		15-40	2-6

How to Buy a Fishing Rod

good ways to test rod action are shown in drawings at the beginning of the article.

If your choice is a glass rod, you'll find solid rods are usually cheaper. But pound for pound of rod weight, a tubular glass rod is stronger.

While glass rods differ in construction, all reputable brands will do the job. Some makers tint or paint their rods. The natural color of solid glass is almost clear. Tubular rods are naturally amber colored. Painting or plastic-coating a rod dresses up appearance. Unfortunately, a heavy coating can also cover up poor workmanship. Best advice: stick to reputable brands.

Price and quality. These vary considerably. You can buy a light bait-casting rod for well under \$5, or over \$50. A general recommendation is a medium-priced rod. There are lots of very good rods of all types in the \$8 to \$25 range—good enough to give years of fishing pleasure. A weak or clabby rod, or one with hardware that won't take it, can sour you on the sport in a hurry.

There is a lot of price discounting in fishing tackle, with many stores using the gear as loss leaders. So compare asking prices, not "suggested-price" tags. And compare rod construction for quality differences. Look for hard chrome; stainless- or carbide-steel line guides; even, firm windings protected with varnish; heavy, rust-preventive coatings on metal parts; and double, locking, reel seat nuts.

Better-quality rods have overwound ferrules, and joints with tiny rubber O rings to keep parts snug and aligned.

Make sure there are enough guides. A 6½' rod, for example, should have at least four guides in addition to the one at the tip. Examine the reel seat clamps on spin- and bait-casting rods. There are important differences. Check for handy little extras like keyed-chuck ferrule shanks and hook keepers. Here are new things to look for:

- Colorful, anodized coatings to protect aluminum parts and improve appearance.
- Tough, plastic guide windings in place of the traditional silk thread.
- Nylon and other plastics for never-seize, never-rust reel seats and ferrule chucks.
- Kits containing everything you need to make your own rod.
- Packaged matched sets consisting of a rod and a reel prewound with the proper line.

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Penetrating Resin . . . the Perfect Finish

[Continued from page 153]

color of the wood under a penetrating resin finish—within limits. A bleach such as Blanchit lightens the wood. Then the finish darkens it somewhat. By experimenting, you can establish the degrees of bleaching needed to balance the darkening. The result is a beautifully protected wood that looks as though it has no finish whatever.

Conversely, you can stain the wood if you want a different or a deeper color. Oak, for example, is much admired in dark brown colors. Stain it—then put on the penetrating finish. It is important, however, to use a *dye* stain, not a pigment stain, unless you do not mind the extra emphasis the pigment type gives to the wood pores, which fill with pigment.

Penetrating finishes are particularly good on furniture as they go on so easily. For the same reason, you can't beat them for paneling. They're also excellent floor finishes. Not surprisingly, such brands as Butcher's, Bruce's, and others intended primarily for floors are also among the best for furniture.

How to buy. There are two kinds, basically. One is formulated on phenolic resins, the other on alkyds. The phenolics tend to penetrate deeper. But usually it won't matter which type you buy. Look at the label for the words *penetrating* and *resin*. Or directions to brush it on, wipe it off.

Every major paint manufacturer has a penetrating-resin finish. Examples are Watco, Deep Finish Firzite, Clear Rez, Clear Minwax, Dupont's Penetrating Wood Finish. Some other materials are similar in application but they are based on oil, not resins. These should be used only where protection of the wood is not important. **PS**



Soft cloth offers easiest way to apply a penetrating finish, but you can brush it on if you wish.

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A's to Your Q's About Auto Insurance

[Continued from page 74]

don't need a lawyer—who will take your case on a contingency basis and get a third to a half of the award. You might first try for an out-of-court settlement directly with the insurance company. If you're satisfied with the final offer, you'd save that 33 to 50 percent. But if you get no satisfaction, you could then go to a competent lawyer.

Alone, you might not evaluate properly what would be a fair amount for your suffering and permanent injury. All kinds of legal loopholes may trap you. So in the long run, if you're in a serious accident, it's best to get yourself expert legal advice as soon as possible.

Q Should you report a minor accident when you risk having your premium raised?

A That depends on how many other accidents you've had. With an accumulation of accidents, your company is less likely to renew at the same rate. However, it is usually unwise not to report an accident—no matter how minor—because the other driver may later sue you for bodily injury and your insurance company could have a hard time defending you if you never reported what happened.

Q What kind of information should you get from the other driver in the event of an accident?

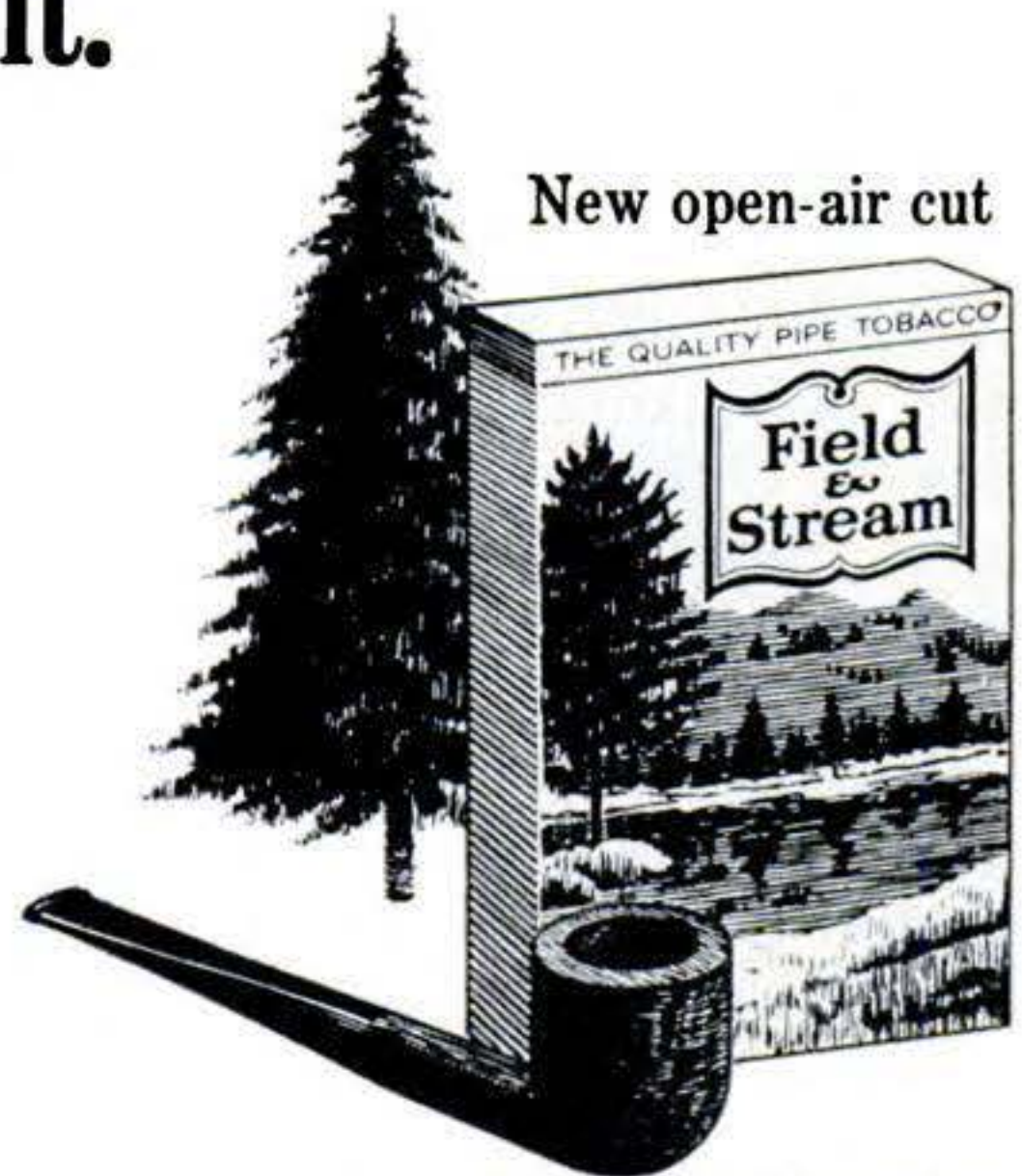
A Note the license number of his car. Get his name and address; you can ask for his driver's license to establish identification. Jot down the exact time and date of the accident, location, visibility, weather, and road conditions, status of traffic signals, car directions, estimated speeds, a diagram showing the type of intersection if any, point of impact, and position of the cars after the accident. Don't forget the names and addresses of any witnesses. When a cop or highway trooper arrives, get his name, badge number, precinct, or barracks. Don't discuss how much insurance coverage you have or whether you were in any way responsible for the accident.

But your goal, of course, is to stay out of accidents. To this end, keep your car in top-notch condition, your driving increasingly skillful, and insist that any teen-ager in your household enroll in driver-education courses at school.

PS

If you've got Field & Stream in your pipe and don't notice the aroma of a great autumn day,

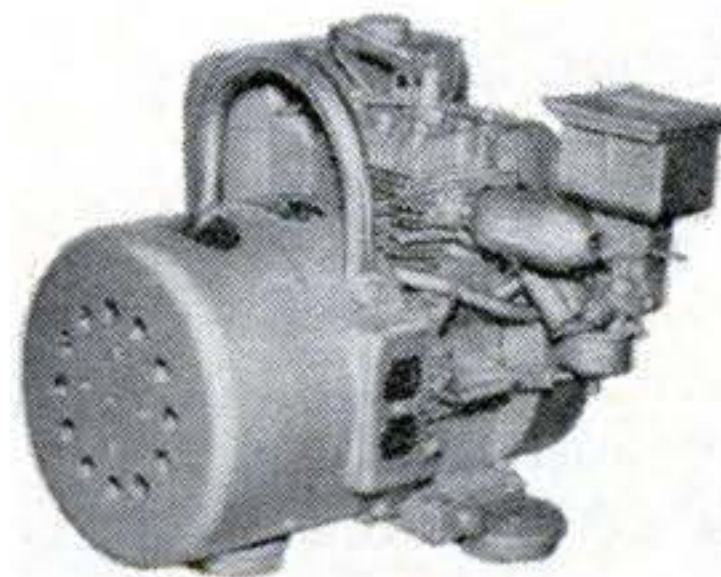
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"Frozen Light" Gives First True 3D

[Continued from page 82]

Then the hologram is reconstructed with white light, which, of course, contains all colors.

The interference patterns on the hologram, however, are formed in such a way that each automatically selects the color of light that was used to illuminate it while it was being made. The red interference pattern is illuminated only by red light and rejects other colors, for example. Such holograms are not yet as sharp as those reconstructed with lasers, but should improve.

As advances in holography continue to be made, scientists across the country are putting the new technique to work in a variety of ways. For example:

- Technical Operations, Inc., of Burlington, Mass., has built a device called a disdrometer. It measures the size and distribution of fog particles, important to Air Force scientists who are trying to figure out how to disperse fog to make bad-weather landing safer. Mounted in an airplane, it may give rainmakers the cloud information they need.

- Michigan scientists have demonstrated holographic methods of measuring stress and vibration to millionths of an inch without gauges, of making aerial contour maps automatically with contours showing as clearly as if they had been painted on the landscape, and of making an absolutely unbreakable secret code.

- Workers at General Electric, IBM, and elsewhere have made holographic devices that can automatically read letters, numbers, or words into a computer. A similar system built by Perkin Elmer scans blood cells through a microscope and picks out those of interest to doctors.

From a layman's point of view, the most interesting holographic device made so far may be the world's first hologram movie. It lasts four seconds, and was made by Matt Lehman of Stanford. The sequence shows a steel ball rolling down an incline. It's strikingly three-dimensional, but lacking somewhat in drama.

Making the movie wasn't as simple as it seems. Since holography requires extremely fine-grain film, and since such film is inherently very insensitive and requires long exposure (Plus-X film is 20,000 times more sensitive than the most commonly used holographic film), Lehman blocked the ball at a number of different locations on the incline

and made a series of time exposures.

Making movies for public display will be even more difficult. It may eventually be possible to shorten exposure time by getting more sensitive films. It may even be possible to use powerful flashes of laser light to illuminate the scene, and devise some method of doing it without damaging the actor's eyes. But there's a more fundamental problem: There is no way to project a hologram. Project it on a flat screen and it becomes a two-dimensional image.

Furthermore, there is no way to magnify it. It must be shown at the size it was taken. There is a basic law of optics that magnification in all directions is not equal. Magnify a flat picture 10 times so that it is 10 times as wide and high as it was, and its *depth* is magnified by the square of that figure—100 times. If the image is flat to begin with—a conventional movie or slide—the unequal magnification makes no difference. But magnify a three-dimensional hologram by 10 and a man would come out six feet tall and 10 feet thick.

The only solution seems to be in making very large holograms—10 feet square, say. While conventional movie cameras to handle film this size would be impractical, it may not be necessary to build them.

A duck in 3D. In the University of Michigan Laboratory, Adam Kozma handed me a four-by-five-inch hologram. "Hold it in the laser light," he said, "and rock it from side to side." When I held it up, I saw a toy duck in perfect 3D. As I moved the film, changing the angle at which the laser light struck it, the first duck disappeared and another in a different position took its place. Then another and another and yet another. Each of the ducks had been photographed on the same piece of film in a different rocking position. Now, by varying the angle of reconstruction, I could pick out any of the images superimposed on the film.

As I rotated the film, the toy duck casually rocked back and forth, a perfect little 3D movie all on a single piece of film. So far, as many as seven pictures have been superimposed on the same film without mutual interference. "We know we can put tens, perhaps hundreds, of images on a piece of film," says Emmett Leith, director of holography research at Michigan's Institute of Science and Technology. "The question is whether we can put on thousands." If so, an

"Frozen Light" Gives First True 3D

entire movie or a large part of one might be photographed on a single large sheet of film, then played back by rapidly changing the angle of the illuminating laser light.

Holographic television, although it won't be hampered by the magnification difficulty, has problems of its own. First, the resolution of the present system—its ability to reproduce small details—doesn't begin to approach that necessary for holography.

But that's only the beginning. Even if the camera and reproducing equipment were available, the signal couldn't be transmitted by present methods. "Today's television requires a bandwidth—a channel—of about six megacycles," says Leith. "A hologram system would need about 100,000. There just isn't room in the entire radio spectrum to transmit a single holographic signal."

Techniques for TV. But again, the picture is not entirely black. Already scientists are working on ways to reduce the bandwidth requirements. Some detail might be sacrificed. And second, it might not be necessary to transmit the entire picture 30 times a second, as is now done with television. Most of the background of any TV picture remains the same for relatively long periods. Perhaps a system might be developed to transmit information only about the changing parts of the picture.

How long will it be before holographic TV and movies are available? "In every development you need not one breakthrough but three," says Vogl of Westinghouse. "First is a scientific breakthrough that shows it's possible in principle. Then you need an engineering breakthrough. That shows it can be built. Finally you need an economic breakthrough that lets you build it at a price people are willing to pay.

"To make a comparison, the first breakthrough in color television—the scientific one—was about 15 years ago. We're just in the third—the economic one—now. With holography, I'd say the scientific breakthrough is about 75 percent here."

Thus as holography progresses on a broad variety of fronts, it's difficult to tell what may ultimately turn out to be its most important application. "Right now, people are doing all the fun things with holograms," says Kendall Preston Jr. of Perkin Elmer.

"Chances are, the real, solid applications in holography won't appear before 1969 or 1970. And they may well turn out to be things we haven't even thought of yet." ■

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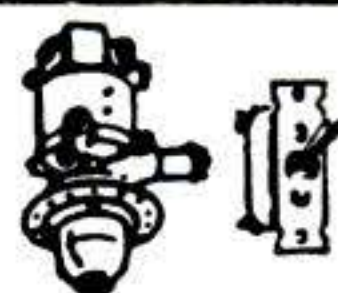


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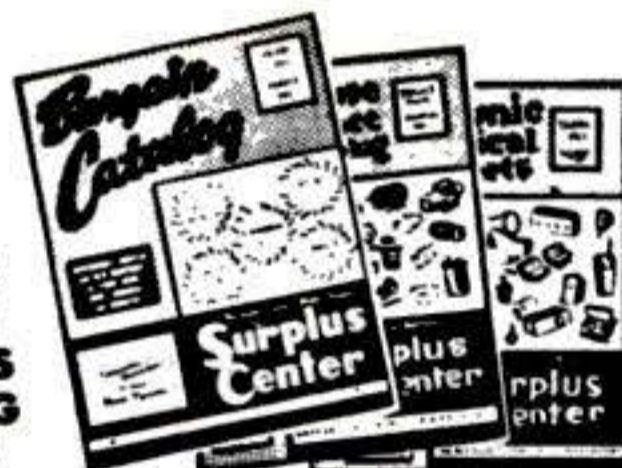
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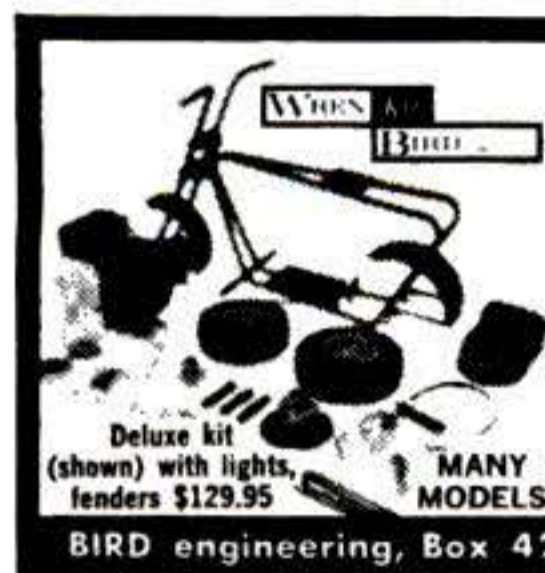
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How to Set Up a Home Print Shop

[Continued from page 128]

embedded with metallic bits or grass leaves, patterned sheets, and sheets with watermarks.

Most paper suppliers won't bother with the small orders of a hobby printer, but there are plenty of other sources. Art-supply stores are a good place to look. Many also have paper and envelopes for greeting cards and announcements. Department stores sell unprinted, boxed stationery. For a great bargain, get a friendly local printer to sell you his offcuts (waste trimmed from a print job) at a reduced rate.

You buy paper by weight, asking for 70-pound stock, for example. This means that 500 sheets of the paper measuring 25" by 38" weigh 70 pounds. The sheets—too large for a hand press—must be cut to size.

You can also print on cloth, leather, plastic, even on wood pencils. Some materials take special inks. Your supplier can tell you what you need.

Your bindery. This is a fancy name for any nook where you do folding, trimming, padding, stapling, pasting, sewing. Your fingers make the best folding machine.

For binding, you can use any stapler big enough to let one side of the booklet slip under the arm. The best kind has a pointed base so you can slip the folded sheets over it, saddle-fashion.

Shop clamps will hold sheets together for making pads. You just apply a rubber-based padding compound you buy. A darkroom-type paper trimmer will do the job of cutting paper to size and trimming the edges of booklets.

When you start printing, you'll need advice. The instructions you get with a new press help, but a good beginner's book is better yet. A fine one is *Printing as a Hobby* by J. Ben Lieberman (\$3.95, Sterling Publ. Co., 419 Fourth Ave., NYC 10010).

Another way is to join a chappel (printing club). To find out about the National Amateur Press Assn., write J. Rolfe Castleman, Ijamsville, Md. 21754. For details on the American Amateur Press Assn., write Leland Hawes Jr., 5009 Dickens Ave., Tampa, Fla. 33609. If you can attend the NAPA Annual Meeting on the July 4th weekend at the Holiday Inn, Frederick, Md., you'll meet a bunch of very friendly hobby printers. The AAPA meets at the Causeway Inn, Tampa, Fla., over Labor Day weekend.

PS

These Spacecraft Say "Ouch!"

[Continued from page 77]

pacitor—and a memory system records the event. On ground command, Pegasus reads out all data. This gives a count of the meteoroids that have pierced a known area of each thickness in a known time.

Since the Pegasus satellites are still collecting data, their findings are not yet complete. However, a chart made public by NASA summarizes what they have told us in their first 10 months of operation.

What the satellites say. According to this preliminary summary, the yearly meteoroid punctures in a square foot of aluminum sheet, on the outside of a spacecraft in low orbit, can be expected to number somewhere near:

- 7, for 1/600-inch sheet.
- 0.6, for 1/120-inch sheet.
- 0.13, for 1/60-inch sheet.

Now, an intact 10-foot sphere, which has a surface area of 314 square feet, could safely withstand an internal pressure of one atmosphere and provide an earthlike environment for astronauts in outer space, if made of 1/60-inch aluminum. But the Pegasus findings indicate that it would be punctured about 40 times a year. So that wall thickness, for a manned spacecraft, would expose a crew to serious meteoroid hazard during extended space flights.

Fortunately, spacecraft capable of reentry into the atmosphere—like Mercury, Gemini, and Apollo—have a healthy padding of heat protection that greatly reduces the penetration hazard. But space vehicles and space stations without reentry capability are under development for extended operating times in space. So adequate meteoroid protection is becoming more important than ever. With better meteoroid data, designers will be able to provide enough "armor" to reduce the risk from meteoroids, in any given space mission, to a figure commensurate with other risks that must be accepted.

The gap in our knowledge is not yet completely closed. We'd like to know the abundance of meteoroids that can penetrate aluminum sheets as thick as 1/25 and 1/10 of an inch, figures representative of many space-vehicle structures. NASA has announced that it plans to tackle the problem of that remaining gap during the coming year. Satellites still larger than Pegasus, or a greater number of Pegasus-size satellites in orbit at once, could be possible ways. **PS**

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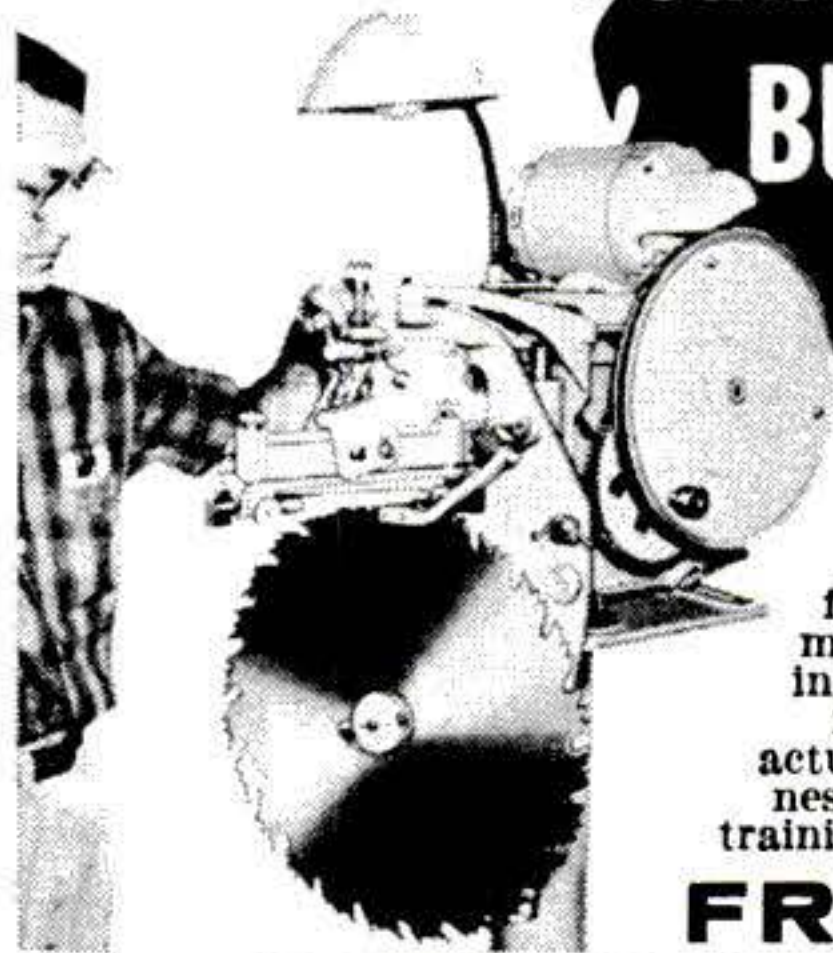
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The Truth About Wheel Balancing

[Continued from page 142]

machines in a technical-manual chapter on wheel balancing.

On-the-car balancers are excellent for use on rear wheels. They are also able to handle most complaints of front-wheel unbalance. Oldsmobile's new Toronado, with its front-wheel drive, should have this kind of balancing for its front end.

The best balancing. The experts agree that off-the-car static-dynamic balancers do the best job. This method has been used officially for 32 straight races at Indianapolis. The same type of machines are used to balance passenger-car wheels. Even the worst problem wheels can be successfully balanced on these machines.

Most off-the-car static-dynamic balancers handle drum, wheel, and tire all at once. Cars with disk front brakes as yet do not need the hubs and rotors balanced, since they check very closely on that score.

One type of off-the-car static-dynamic balancer mounts the wheel assembly on a shaft that is free to slide at both ends. First the assembly is balanced statically by adding weight to the light side. Then it is spun at 70 m.p.h. and balanced dynamically. A spark dial shows where to position the dynamic balance weights. I witnessed such a balancing in which the free shaft ends of a fully balanced wheel, whirring at 70 m.p.h., stayed as still as though the wheel were at rest.

Another type uses a wobble plate to find the plane of dynamic unbalance.

Balance checks. Checking balance is simple, requiring only a jack and a wheel spinner. Most shops don't even charge for it. After a short drive to flex the tire and get rid of flat spots, the front end is jacked up. A slow wheel spin at first lets the operator look for runout. Wheel-bearing maladjustment and wear can be felt as grinding in the front bumper. Then the wheel is speeded up to about 70 m.p.h., where a hand resting on the bumper can feel for vibrations. Any amount of vibration is too much.

Rear wheels are checked by jacking them up one at a time. With the tire about two inches off the floor the speedometer is run up to 35 m.p.h. (the free wheel turns twice that fast).

Sometimes rear-wheel unbalance is confused with drive-line vibration. The two can be separated by blocking up the car's

rear end and removing the rear wheels. Two lug nuts are replaced to hold each brake drum on, the selector is put in "drive," and the engine is run at about 70 m.p.h. If the vibration has disappeared, wheel unbalance is indicated.

Once a wheel is balanced, it does not always stay in balance. Still, you can't run into the shop for a balance job every time the tires show a little new wear. Experts say a twice-a-year wheel-balancing check is best. Thus, if you're the average motorist who drives 10-12,000 miles a year, wheel balancing can be combined with wheel-alignment checks on a spring and a fall basis. Not all shops will make balance checks. Some charge for actual adjustments, even though they may not be needed. A wheel should be balanced any time a tire is repaired or replaced. Regular and snow tires should be balanced whenever one set is replaced.

Problems with the wheel proper can affect balance. While a wheel with an excessively eccentric or wobbling rim can be balanced, vibrations will still be there. A new wheel is the only real cure. Make sure that *it* doesn't have any wrinkles in it.

Wheel covers and balance. A beautiful balance job can be upset by a heavy, off-center, or unbalanced wheel cover. Some late models sport wheel covers that weigh six pounds or so, heavy enough to wreck a balance job. It's an industry problem and the equipment people are working on it. Ideally, such wheels should be balanced with the covers on, but only a few machines can do it (notably the stroboscopic balancers).

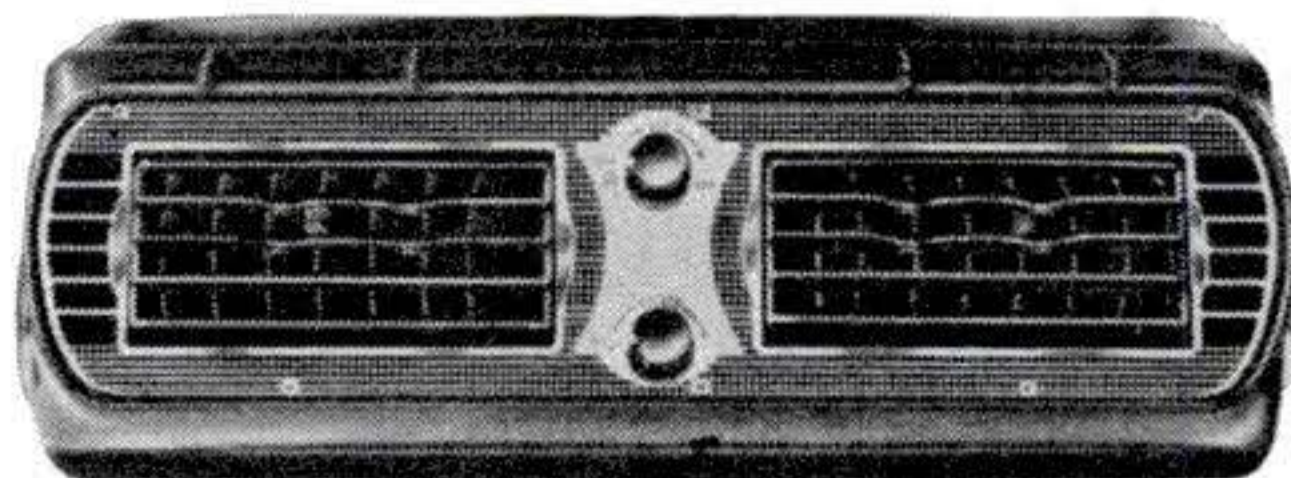
Out-of-round tires are not as prevalent as they used to be. Neither are tires with hard spots in the tread. While hard spots are not dangerous, such a tire can sound unbalanced as it slaps along the pavement. This is irritating and nerveracking when you're on a long trip. Replacement is the only solution.

There is money in balancing wheels and it's your money. An equipment manufacturer tells shop owners that they can net more than \$5 a car on an \$8, four-wheel balance job. Only one such job a day brings in \$1,500 a year to the shop. Few would deny that a year or so of safer, smoother, vibration-free driving is worth \$8. You just want to be sure you get it, that's all. **PS**

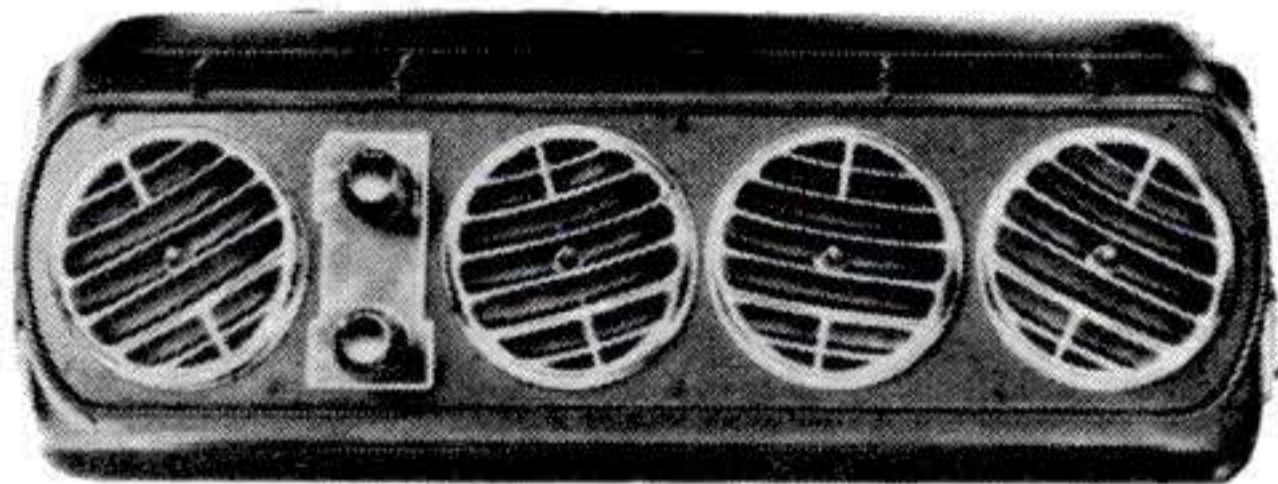
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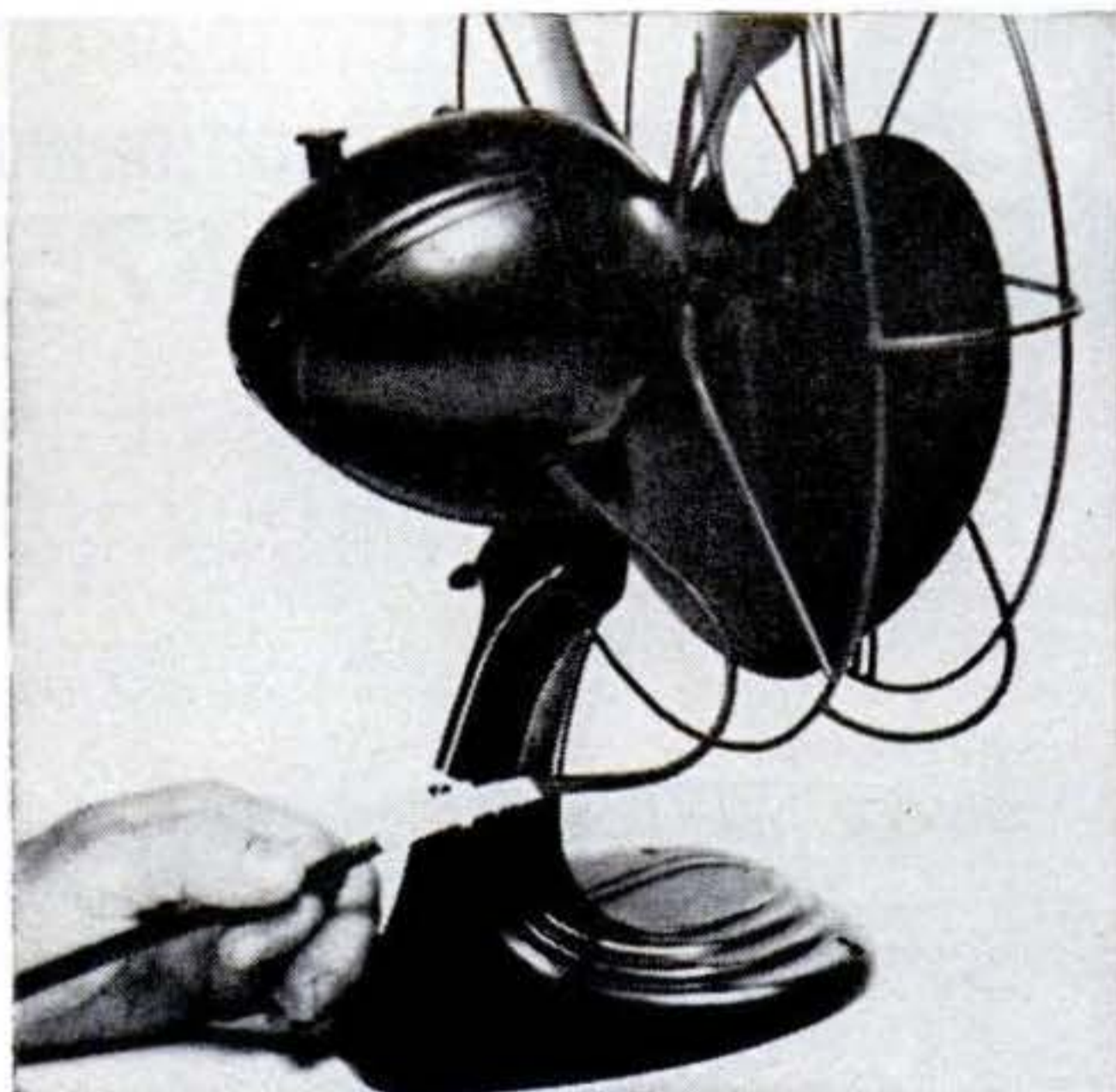
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SHORT CUTS AND TIPS

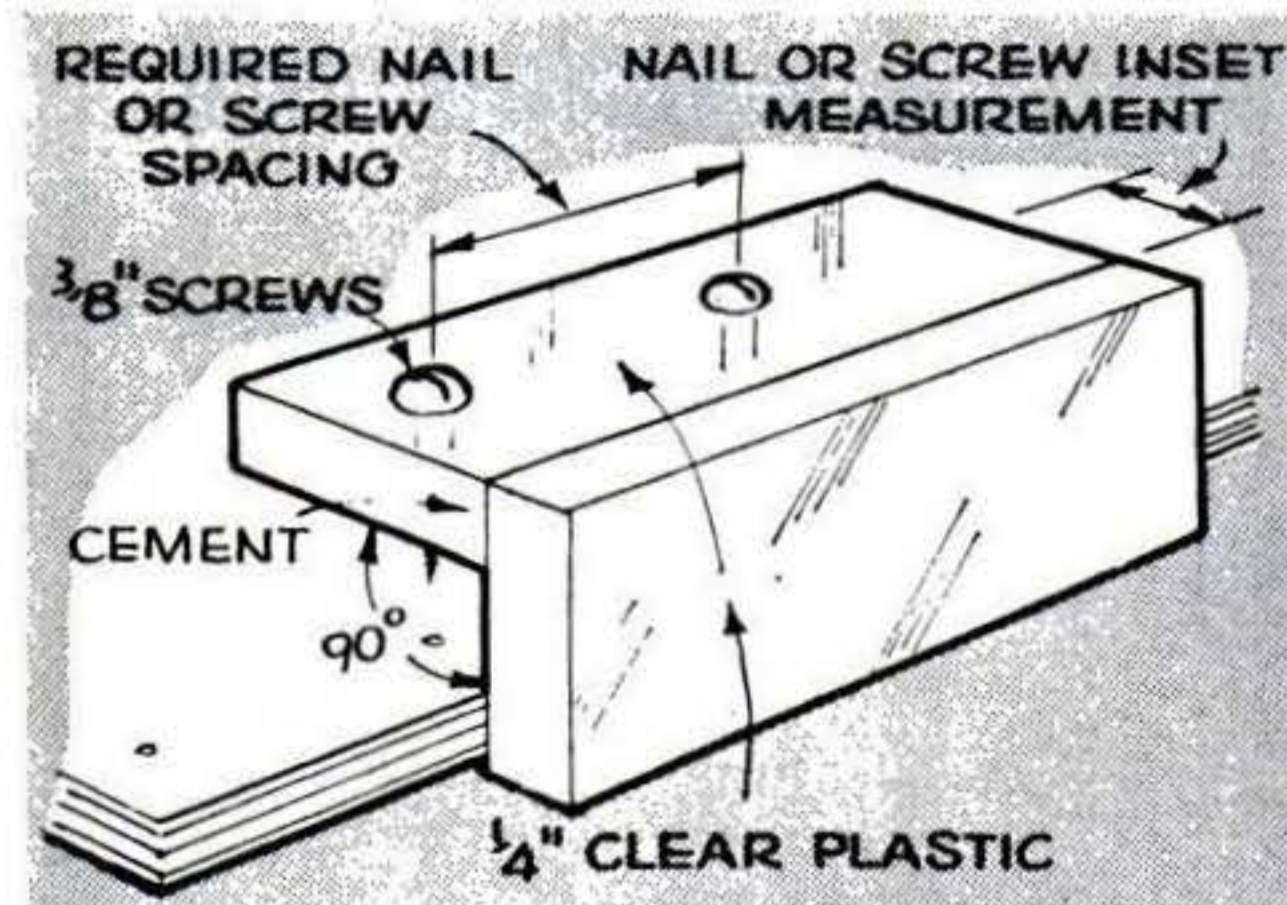
FROM PS READERS



Cord tied to fan reduces wear

The line cord of any oscillating fan will be less likely to wear away at the point where it enters the motor mount if you tie it to the fan's pedestal with loosely looped string. For reinforcement, wrap some adhesive tape around the section of the cord where the string will be tied. Make sure, though, that you allow enough slack in the string to cover the full swing of the fan.

R. HERTZBERG, Douglaston, N.Y.



Why measure over and over again?

Next time you have a project that requires a large number of evenly spaced nails or screws, make the small spacer-scriber shown above. It will prove a timesaver. All you do is cement one piece of plastic at a right angle to another, and insert two small wood screws at the desired spacing. Pressure on the screw points will leave marks on the wood that you can easily follow as you work.

A. WEBER, Edmonton, Alta.

Speed School for Expert Car Handling

[Continued from page 98]

4,050, lap after lap after lap. I have no idea how fast I took the turns in m.p.h. Each turn was only a number on the tachometer.

The drawings on pages 96 and 97 show the proper line on the key turns that I learned at Riverside. On the road, you cannot use the full road width, of course, but you can use your full lane width. You can also time your steering-wheel movements to match the cornering characteristics of your car and the needs of each turn.

Yellow lines in the roadway—remember—usually have nothing to do with the turn radius, and only experience can tell you about changes in road camber or gradient.

On the highway, you don't drift around turns. But your tires still have some slip angle. The tires flex under the added side force and the car travels at an angle to where it's actually pointed, like a boat crossing a river. (The boat lands not where it points but where the current carries it.)

Tips from a pro. My instructor was full of pointers. The commonest fault of novice racing drivers (and for that matter, workaday motorists), he said, is making too many steering corrections. If properly set up for a turn, a car will automatically come out right and needs no corrections. Some drivers brake too early and too softly. Others brake too late, causing imbalance by sudden weight transfer.

I came away from my schooling at Riverside with a fresh appreciation of what makes a good racing driver—and, by extension, what makes a good driver on the highway. The engine in the good racing driver's car always sings—it's never running far off the high spot on the torque curve. His shifts are carefully timed and very quick, both up and down. He spends no time coasting. He brakes hard and he accelerates hard, but the car's motions are always smooth. The car drifts around and turns under perfect control—just short of sliding sideways.

They come in all ages, these students at Carroll Shelby's school, from a Norbye to a 72-year-old farmer from Minnesota who had just bought a Cobra and took the course just to learn how to handle the car properly at all speeds. His best-ever pupil, Timanus said, was a 38-year-old ex-racing driver who wanted to get back into the sport in a sane and safe manner. P.S.

Painful hemorrhoids?

All too often, humans who sit and stand pay the price of vertical posture. Sitting and standing combine with the force of gravity to produce extra pressure on veins and tissues in and around the rectal area. The result may be painful, itching or burning hemorrhoids.

The first thought of hemorrhoid sufferers is to relieve their pain and discomfort. However, of the products most often used for hemorrhoids, some contain no pain-killing agent at all...others have one too weak to provide necessary relief...and still others provide only lubrication.

Now at last there is a formulation which *concentrates on pain*. It actually has over 8 times more pain-killing power than the topical anesthetic most commonly used in hemorrhoid remedies. 8 times the power to ease the itching, pain, and burning of hemorrhoids.

The name of this product is Nupercainal. Nupercainal starts to work *on contact*. Provides *prolonged* relief from pain. Soothes and lubricates.

When you suspect you have hemorrhoids, check with your doctor. If hemorrhoids are the cause of your discomfort, chances are he'll recommend Nupercainal.

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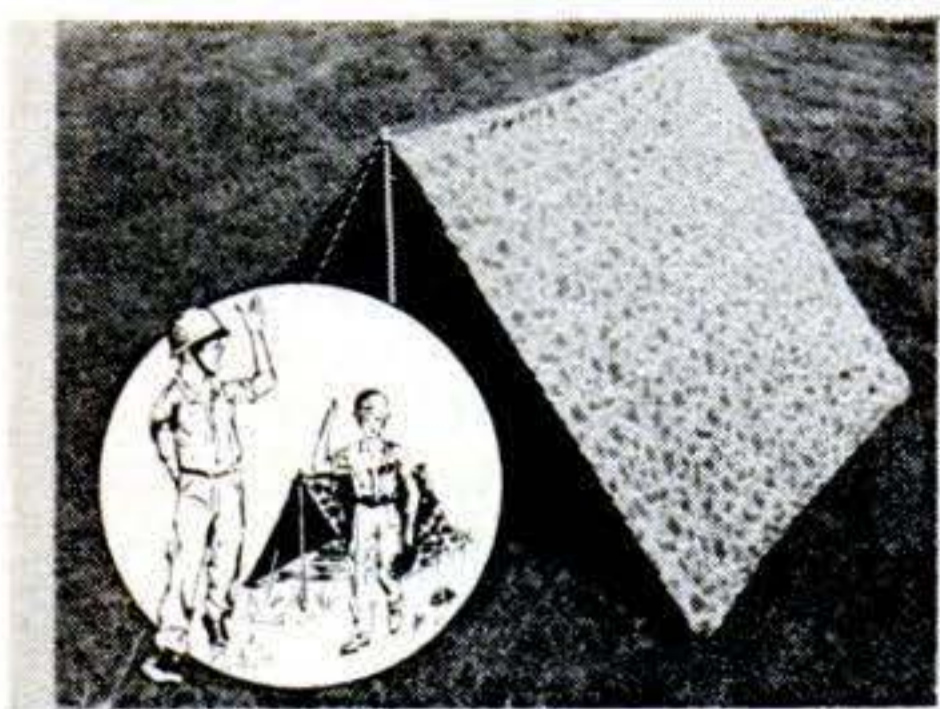
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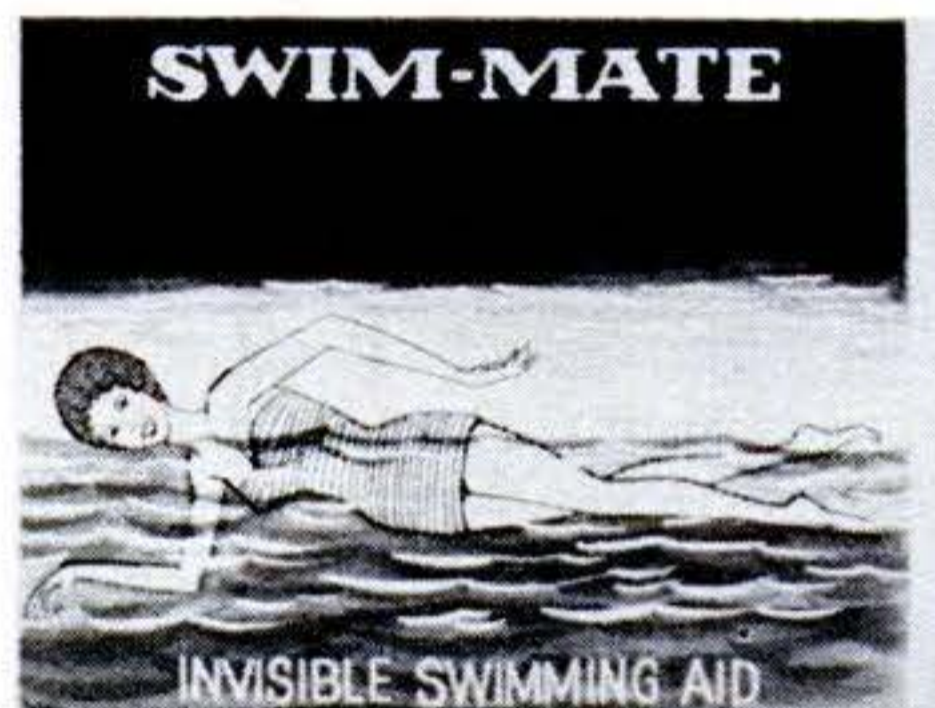
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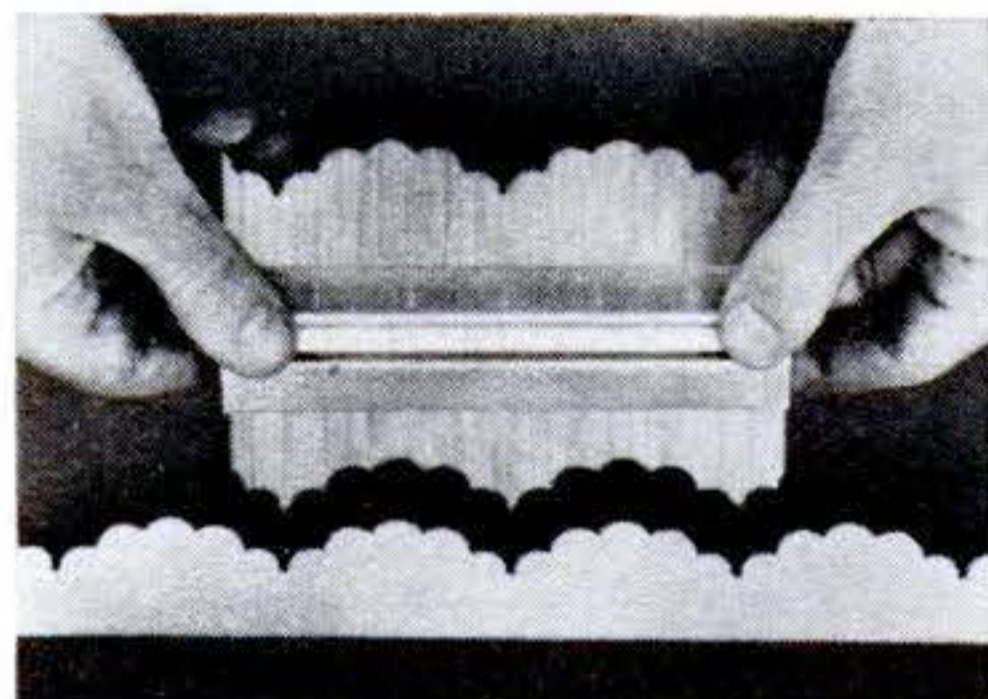
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Now you can beam light wherever you want it! The flexible shaft bends and turns to throw light into tiniest crevices—beams it into holes. Here is indispensable help for mechanics, appliance repairmen, hobbyists, doctors, dentists, and housewives, too. Overall length, 11 inches. Operates on two "C" batteries (not included). Case is durable ivory plastic. \$3.95 + 35¢ pp & hdg. Alexander Sales, Dept. PS-766, 125 Marbledale Rd., Tuckahoe, N.Y.



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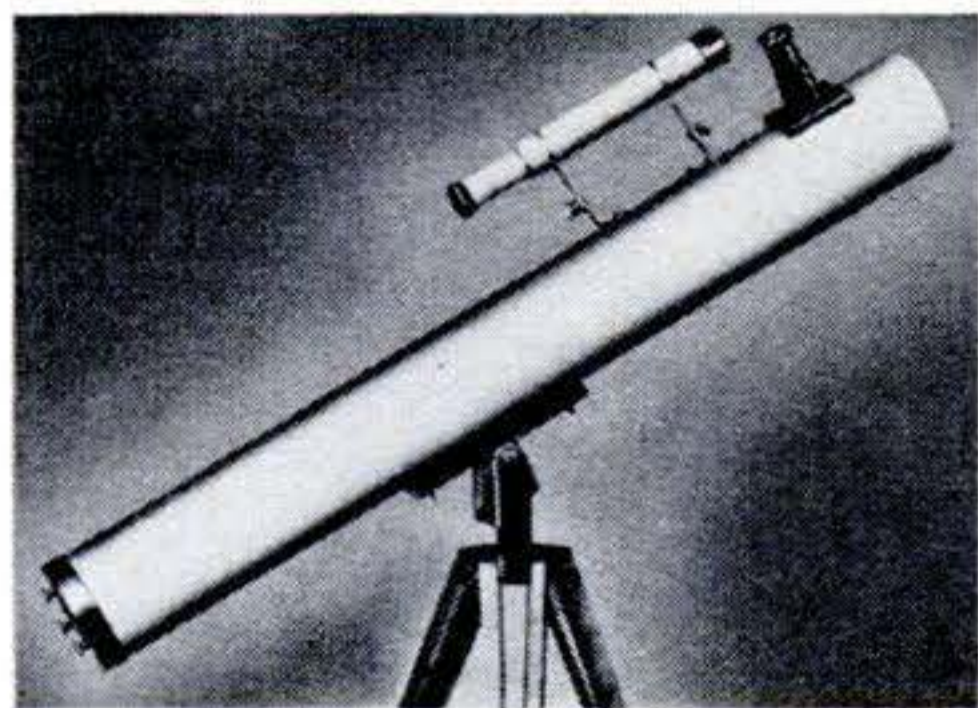


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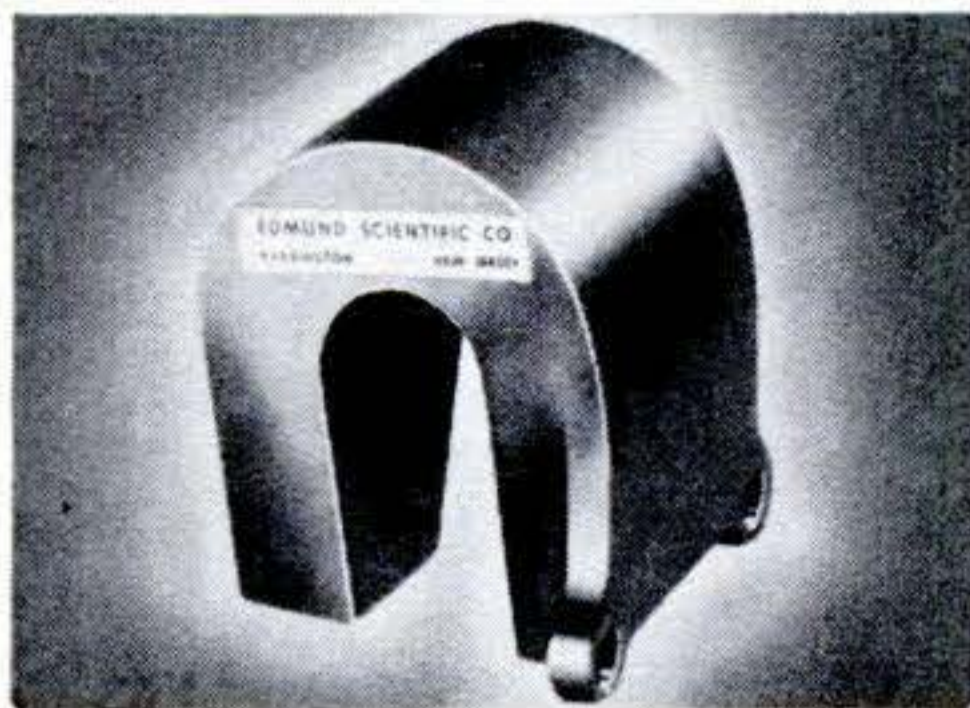
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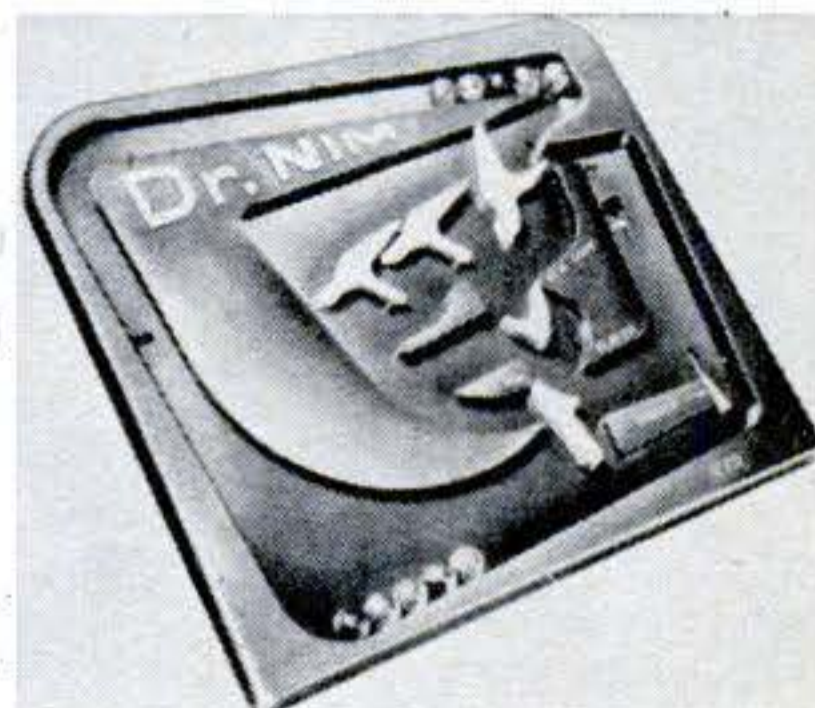
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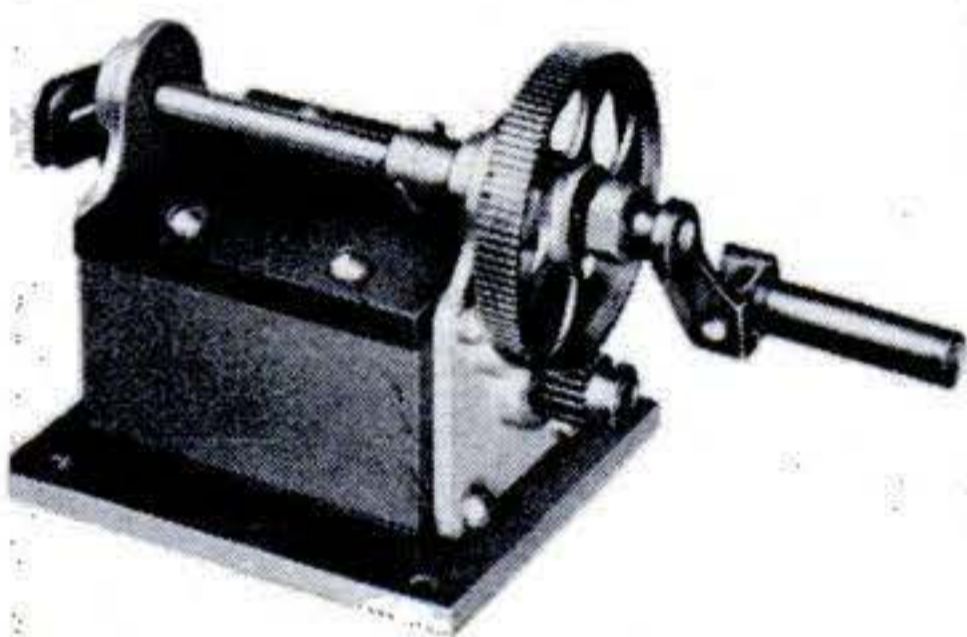
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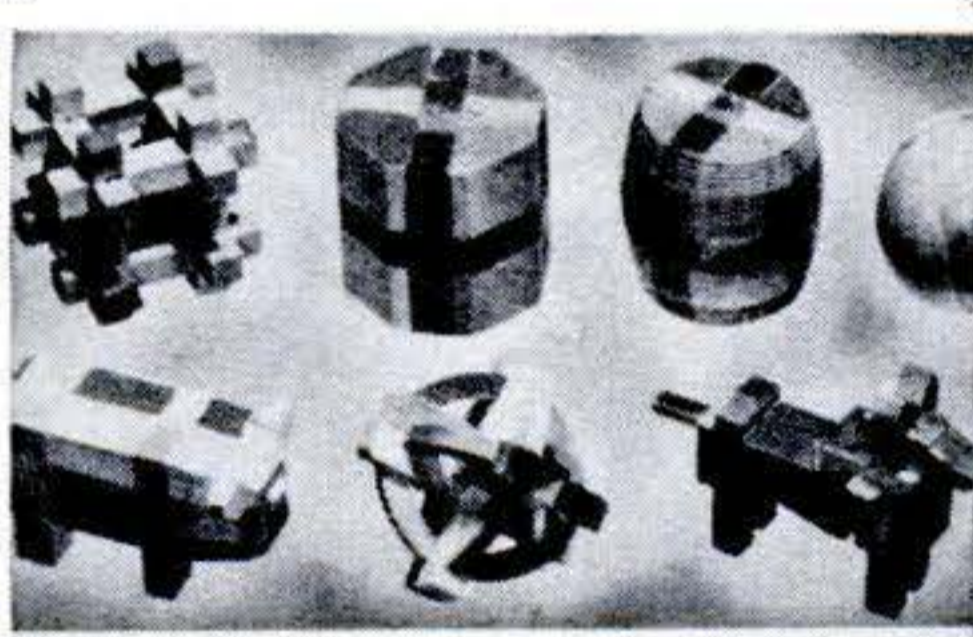
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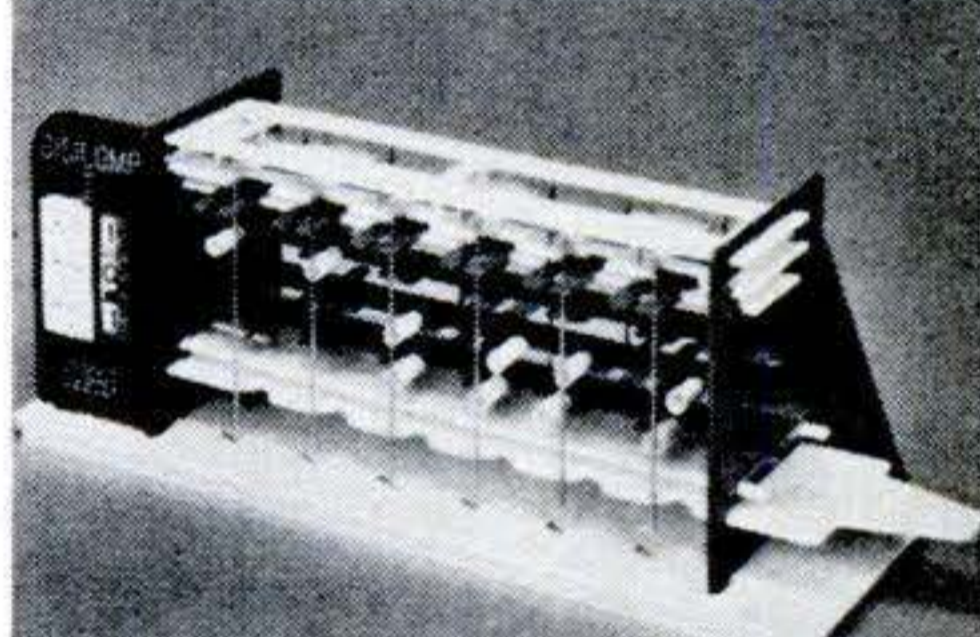
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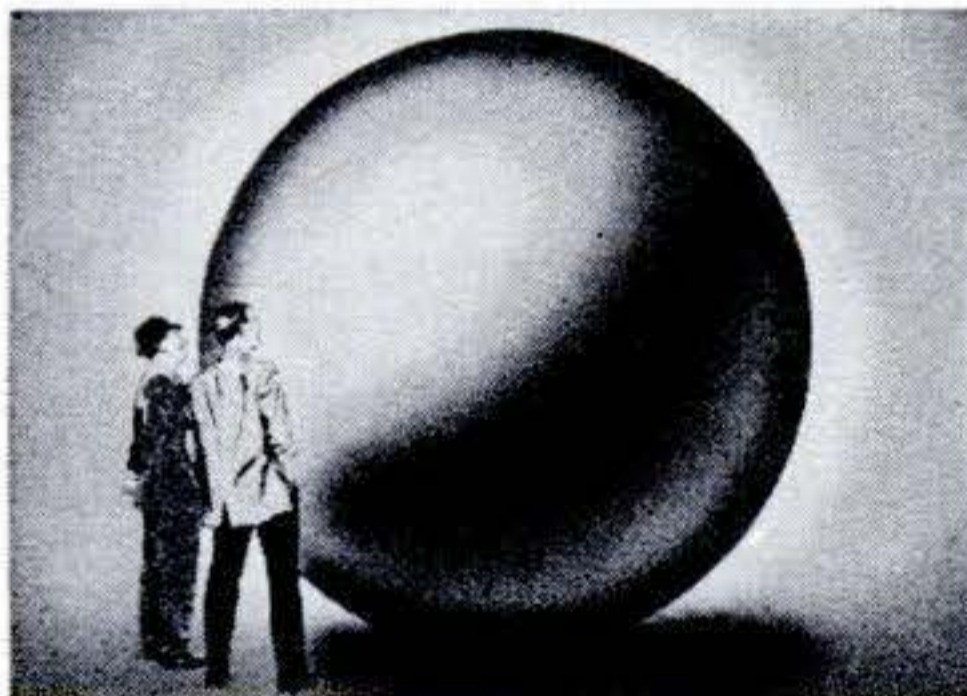
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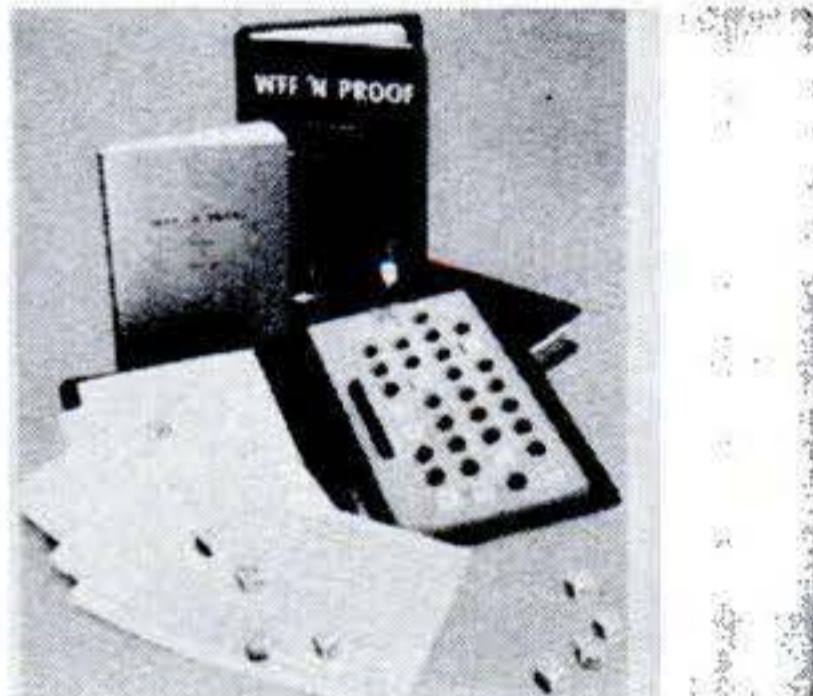
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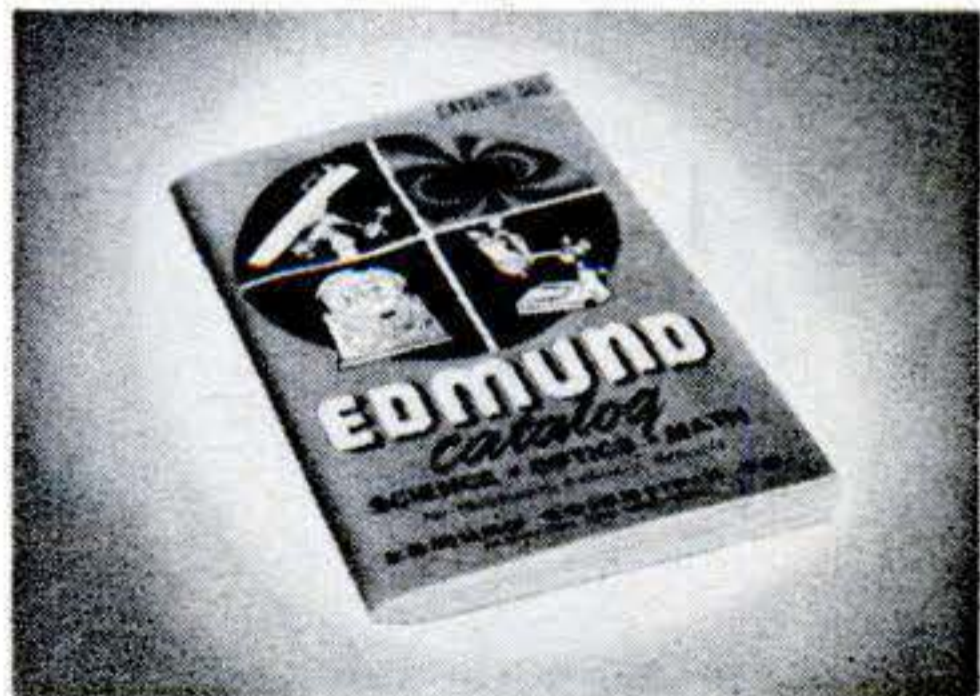
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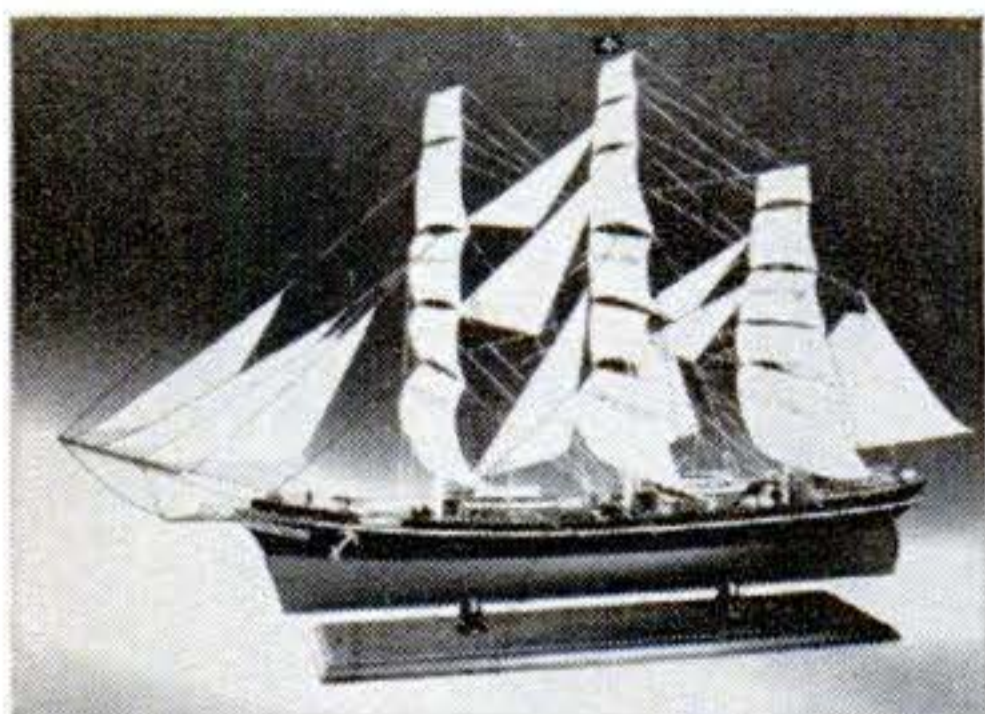
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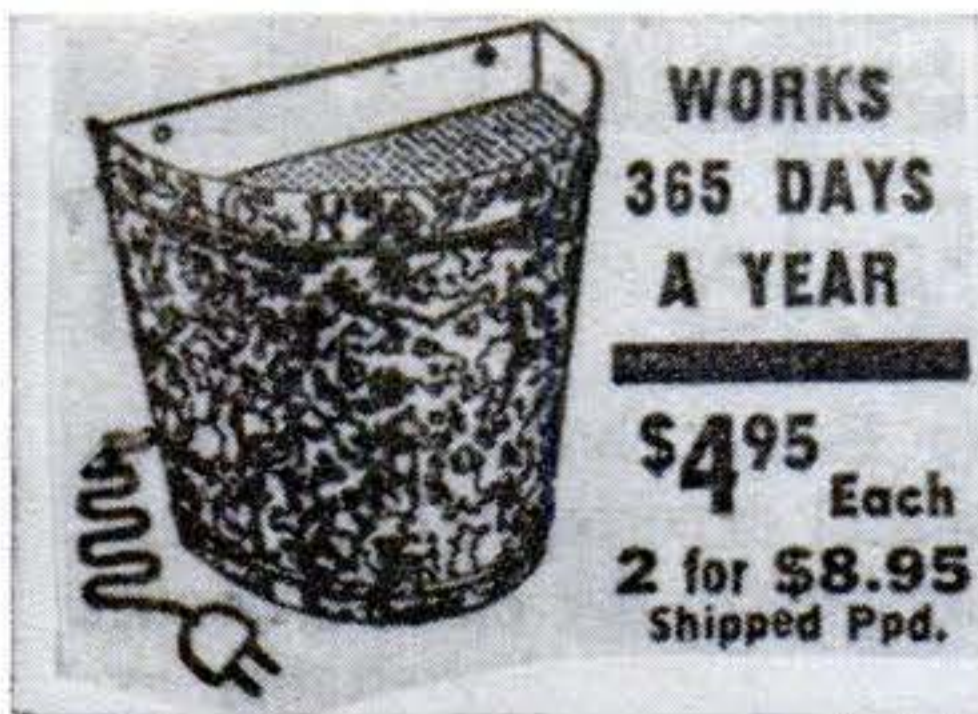
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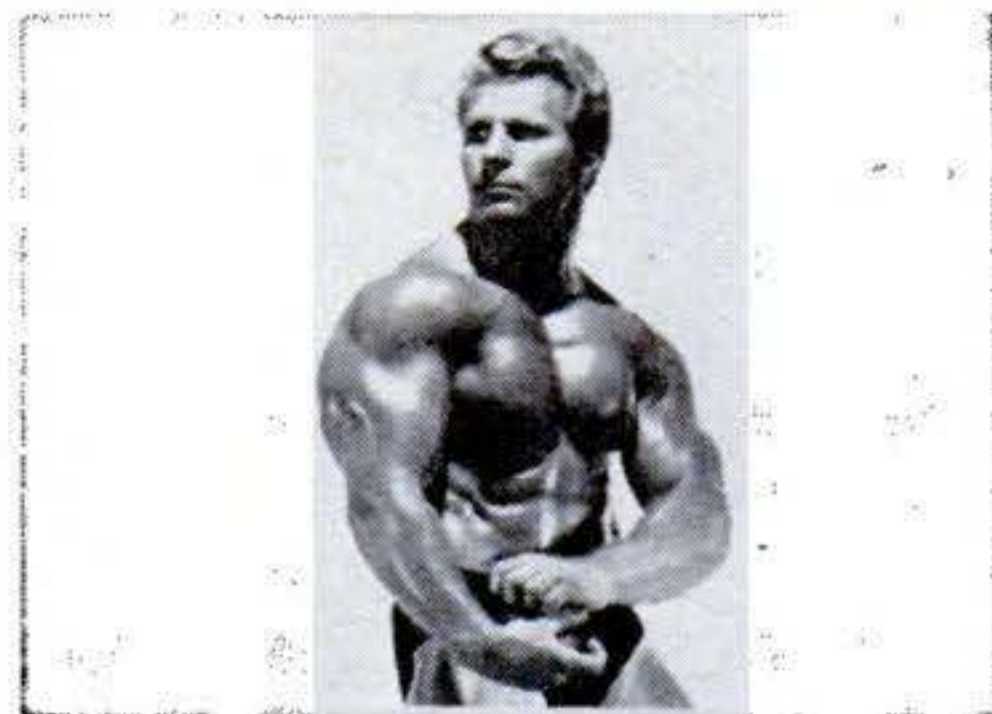
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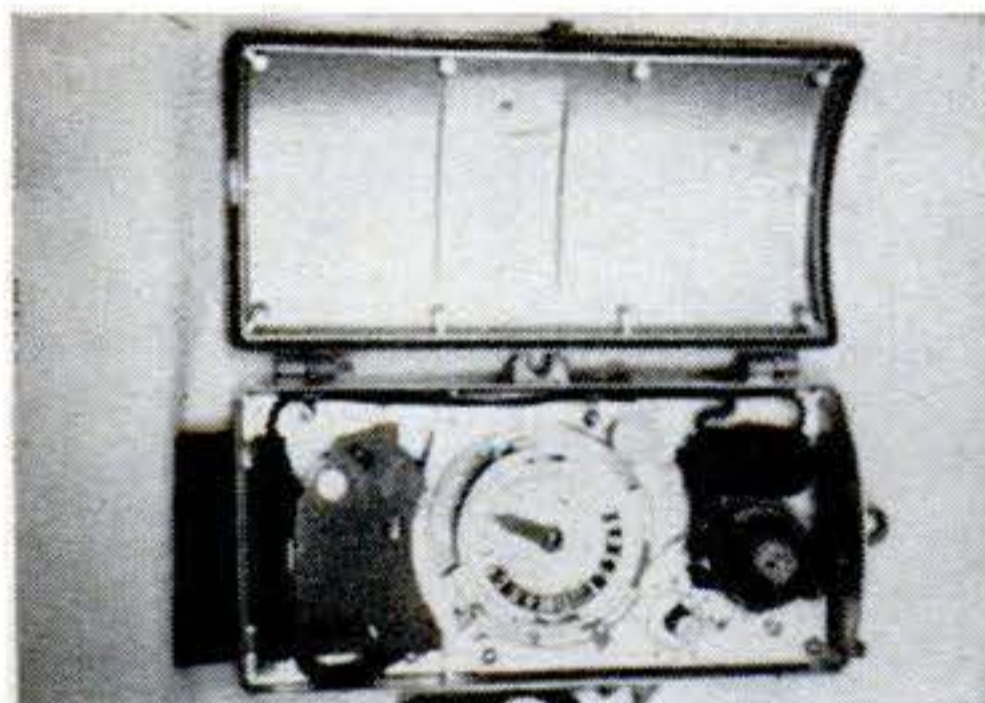
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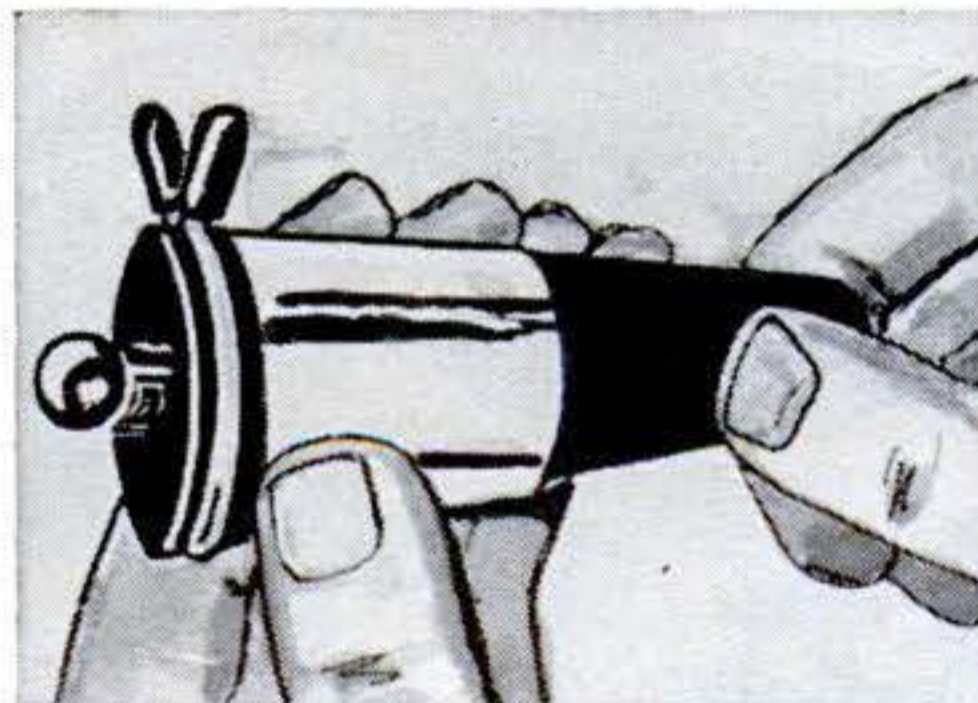
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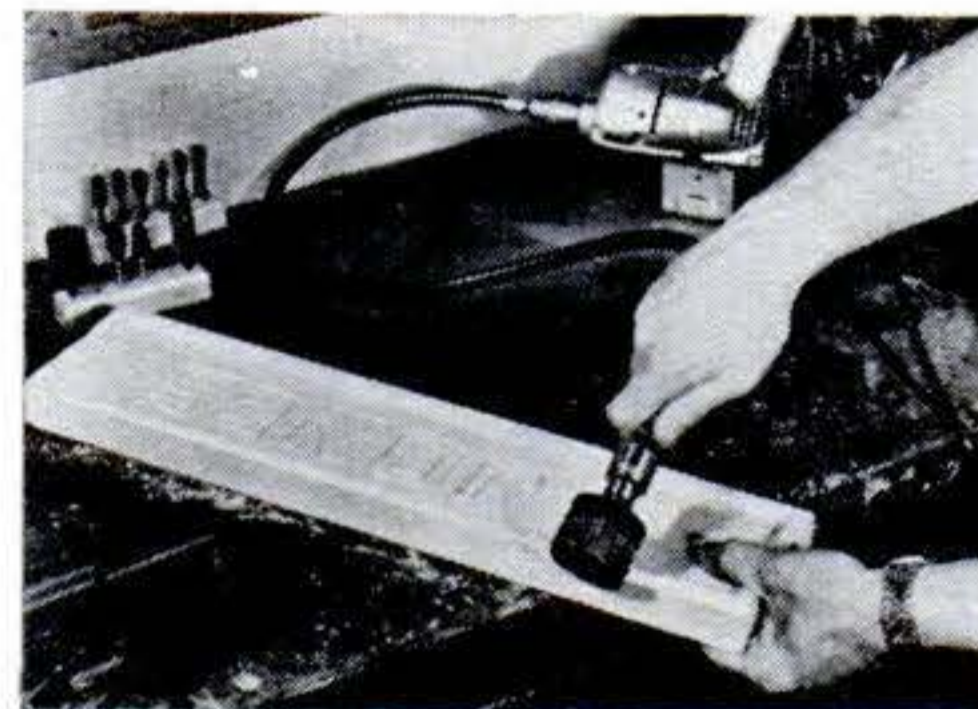
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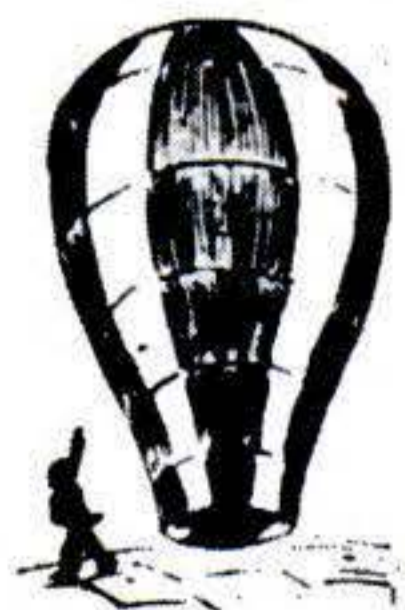
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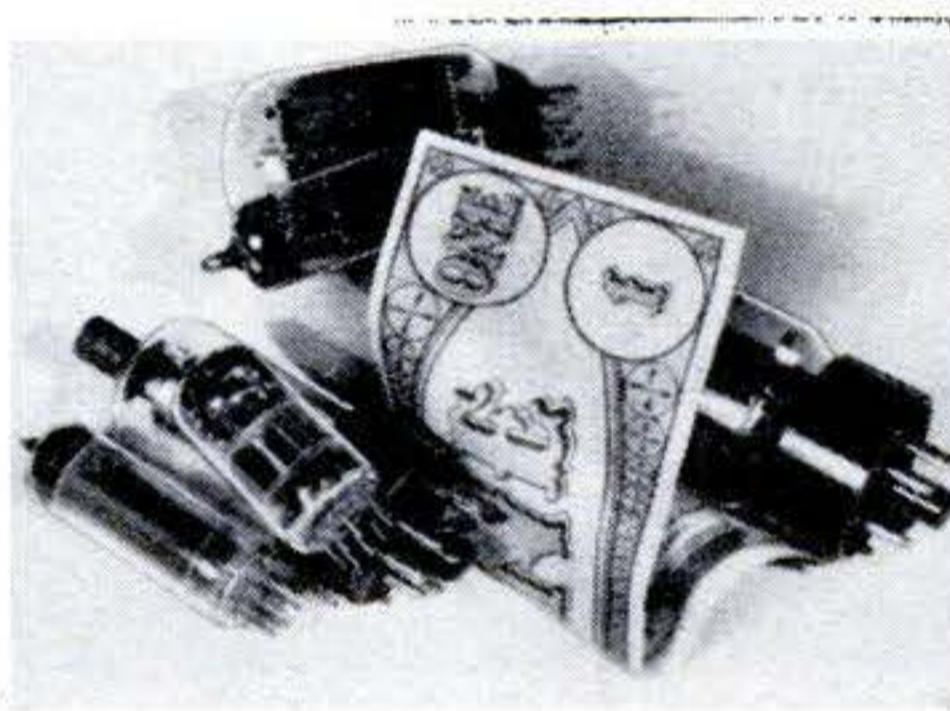
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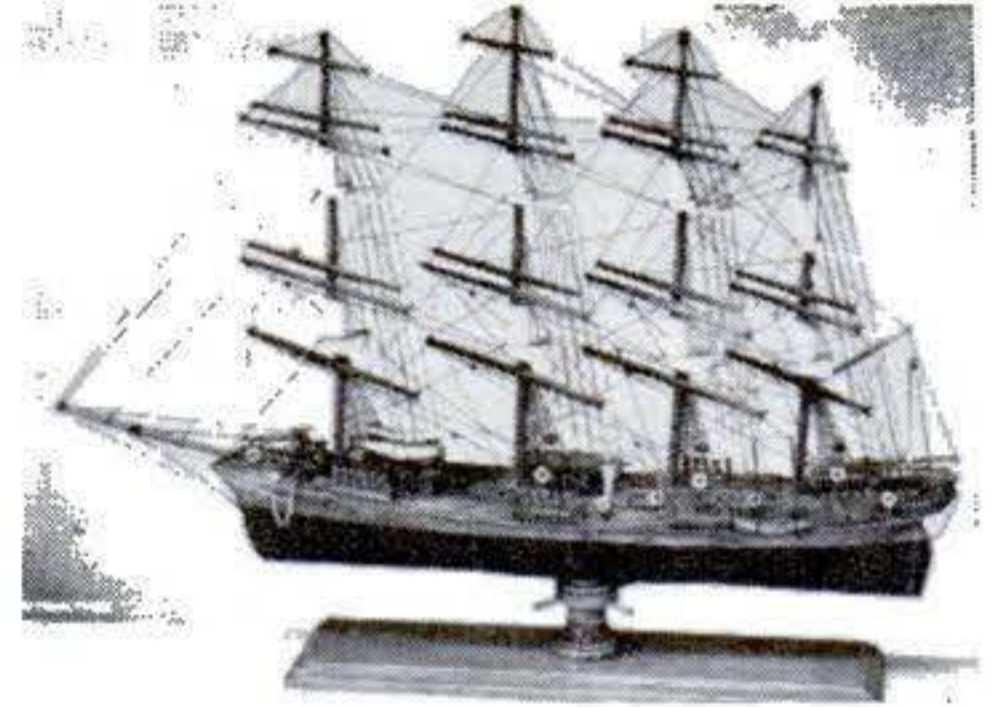
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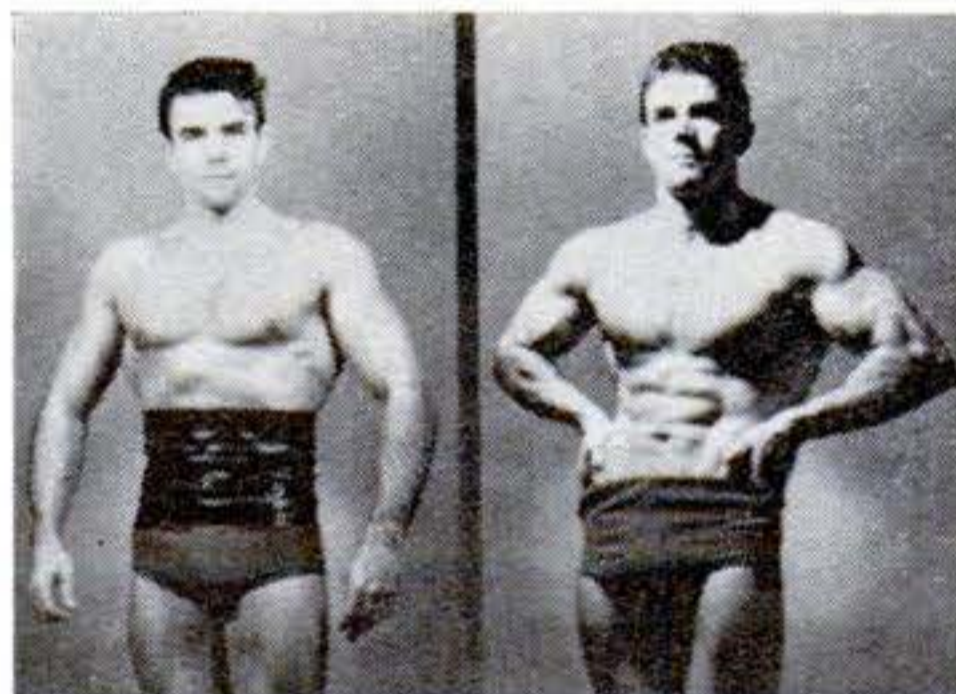
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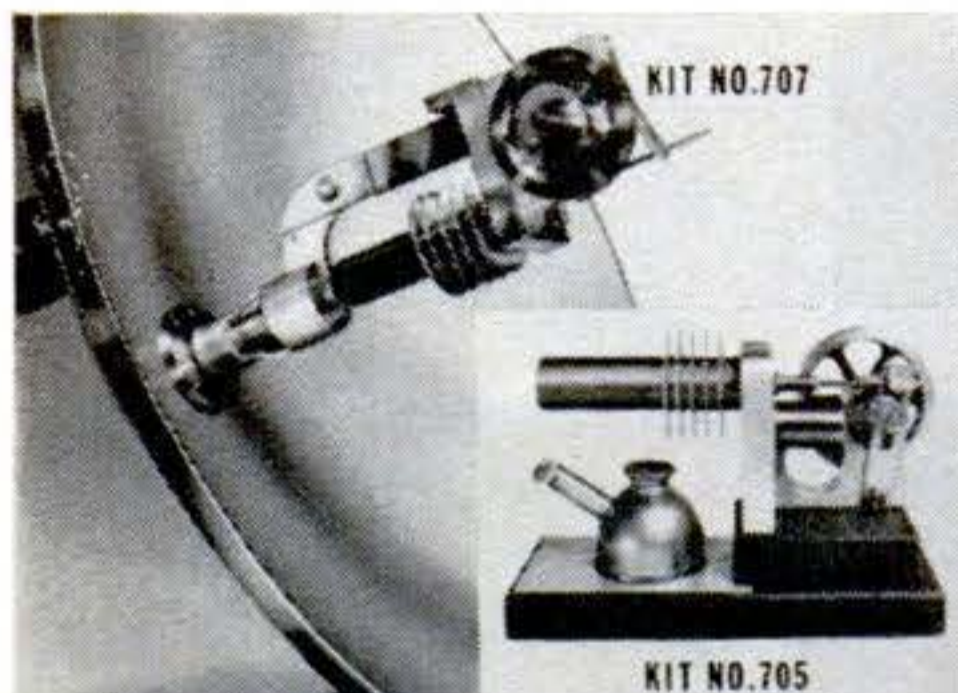
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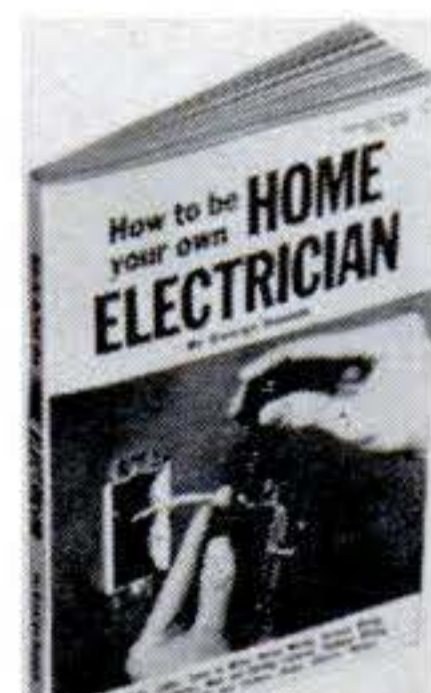
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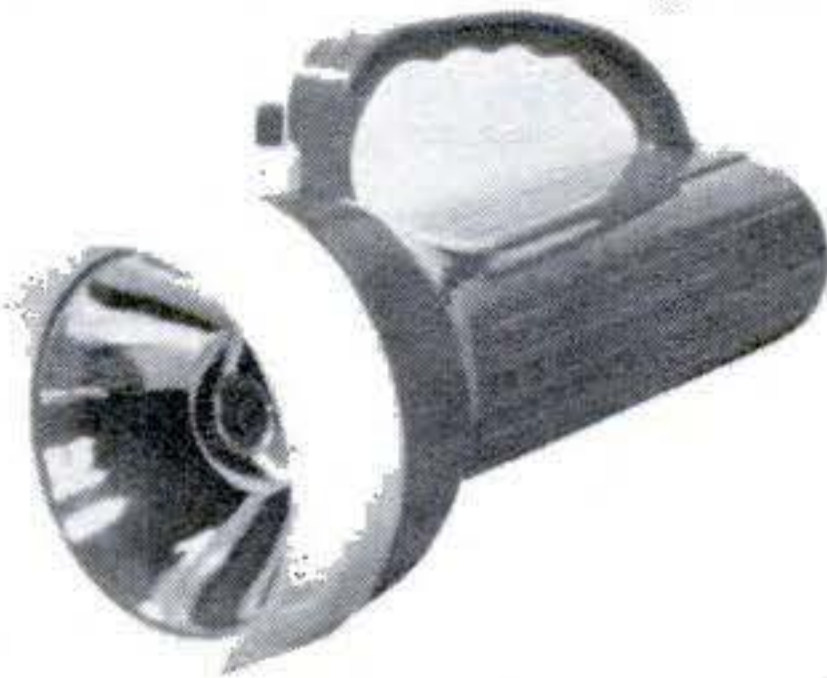
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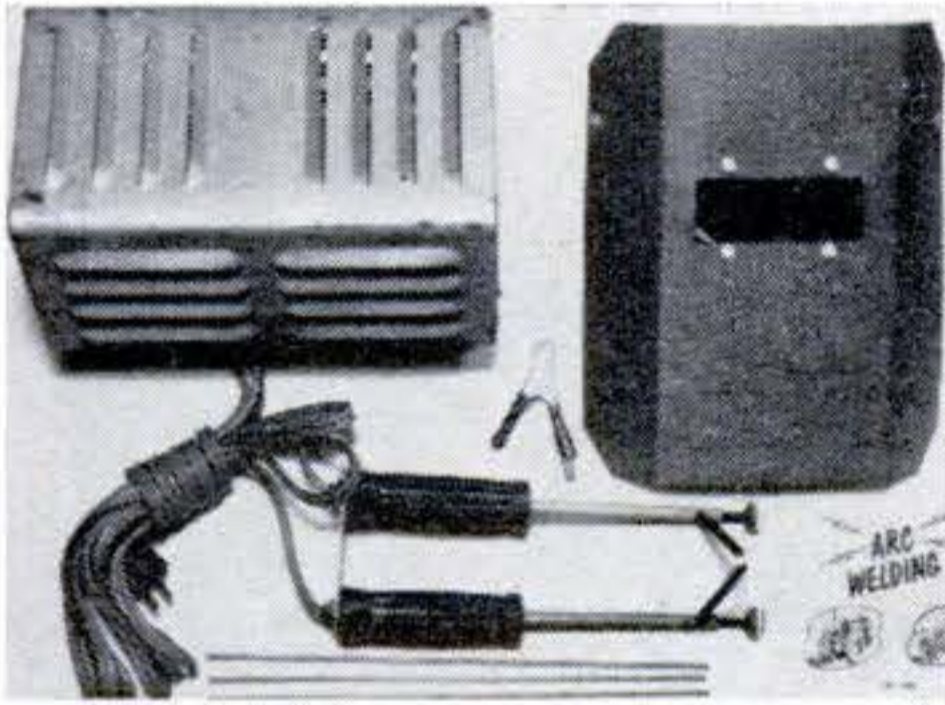
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Telephone snooper lets you hear two-way conversations without lifting the receiver! Just place this tiny ingenious unit against the back of the phone and you'll pick up everything clear enough to record it. Pretty sly little gadget, an outgrowth of one made for the military. Fits in pocket without a bulge. Just think of the fun you'll have with this one. \$14.95 postpaid. Day Co., Dept. PS-7, Box 311 Gracie Sta., New York, N.Y. 10028.



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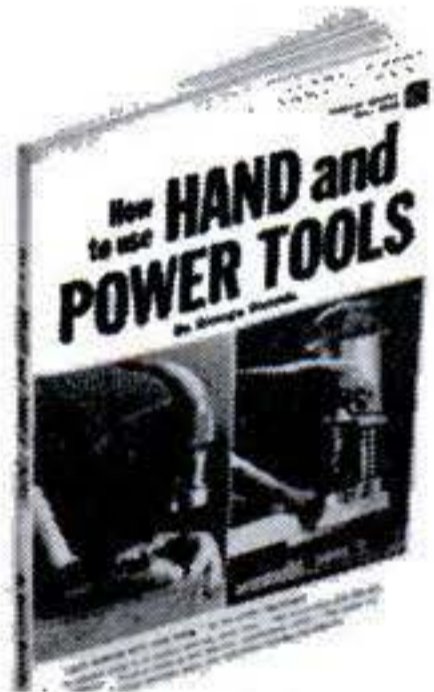
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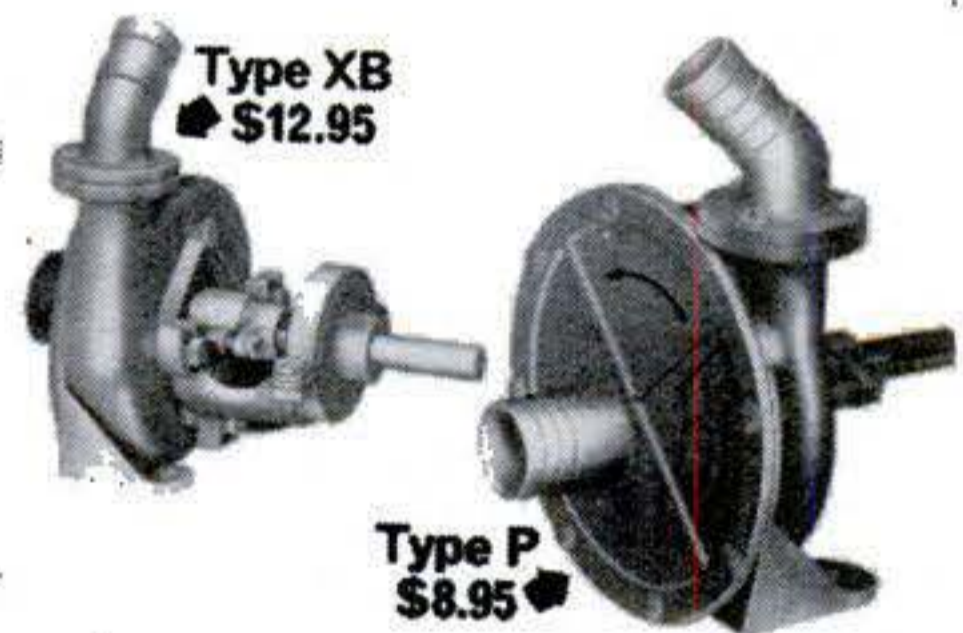
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"How To Use Hand and Power Tools," by George Daniels. Complete tool-by-tool coverage—everything from try-square techniques to versatile new power tools, clearly explained & illustrated. How to choose & get top results with basic saws, chisels, rasps, drills, routers. Special chapters on glues, clamps, abrasives. Plus shop safety, & project debugging. 6" x 9 1/4". Many photos. Only \$1.50. Popular Science Skill Books, 355 Lexington Ave., New York 10017.



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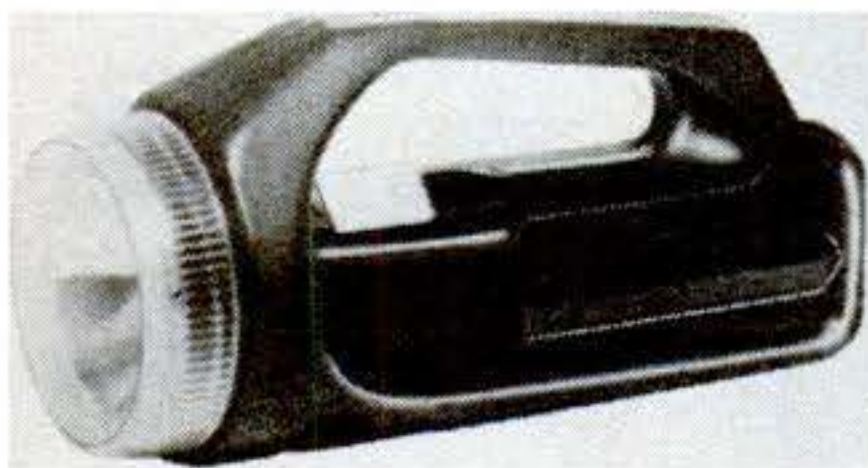
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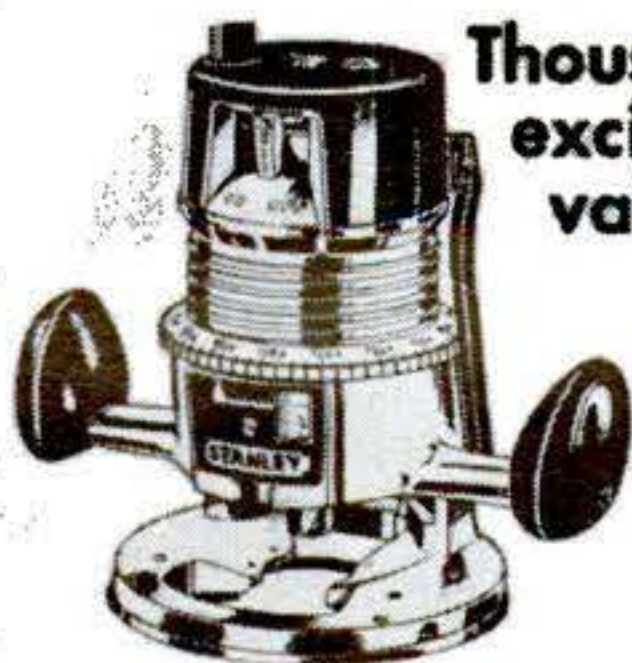
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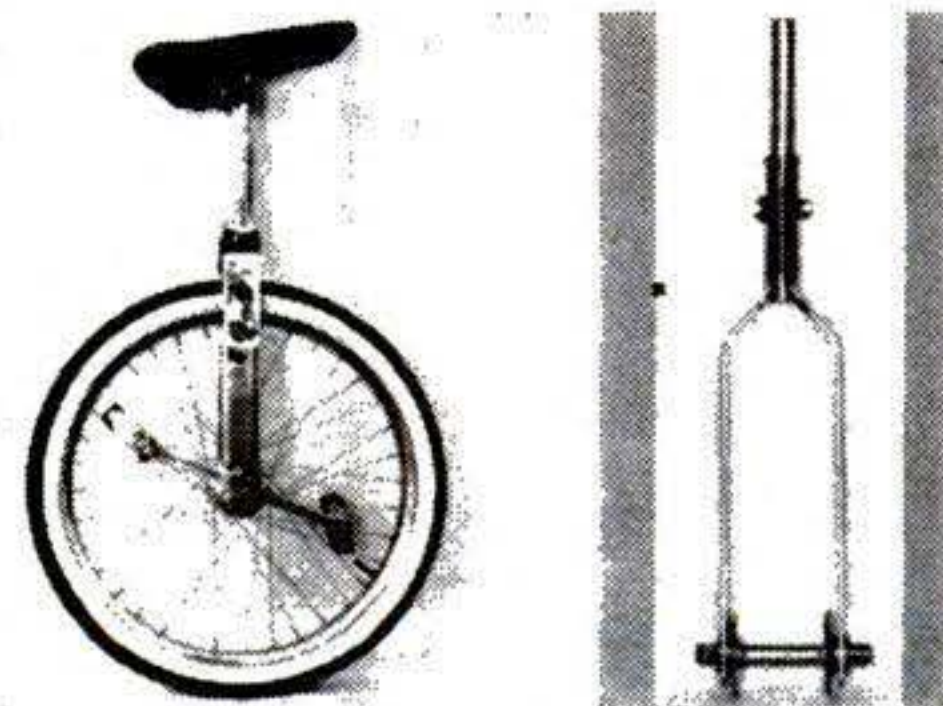
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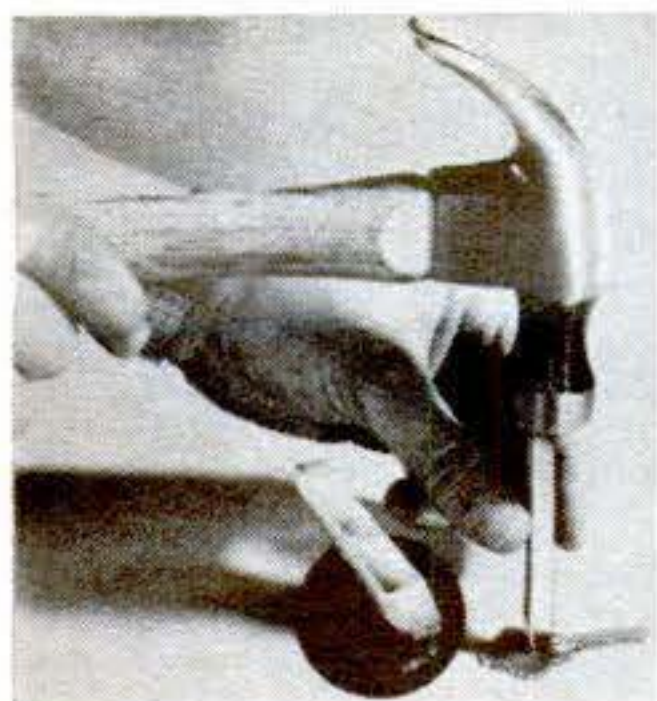
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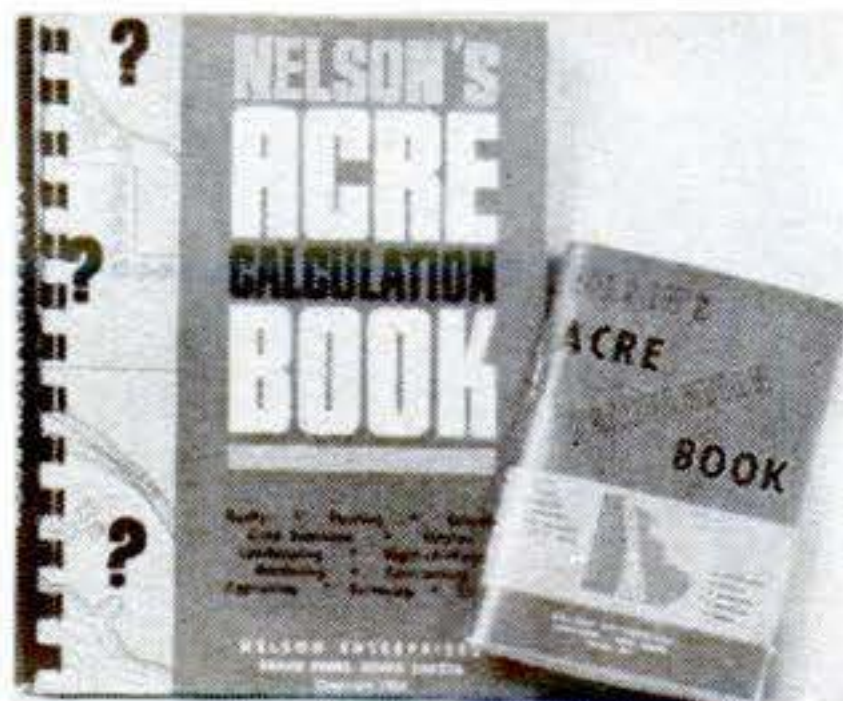
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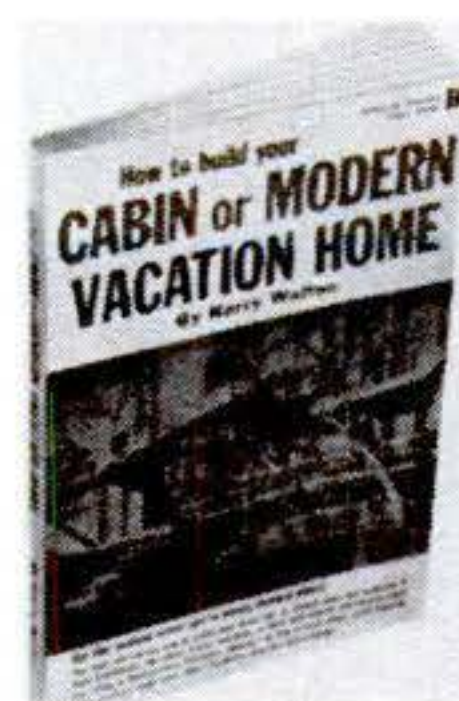
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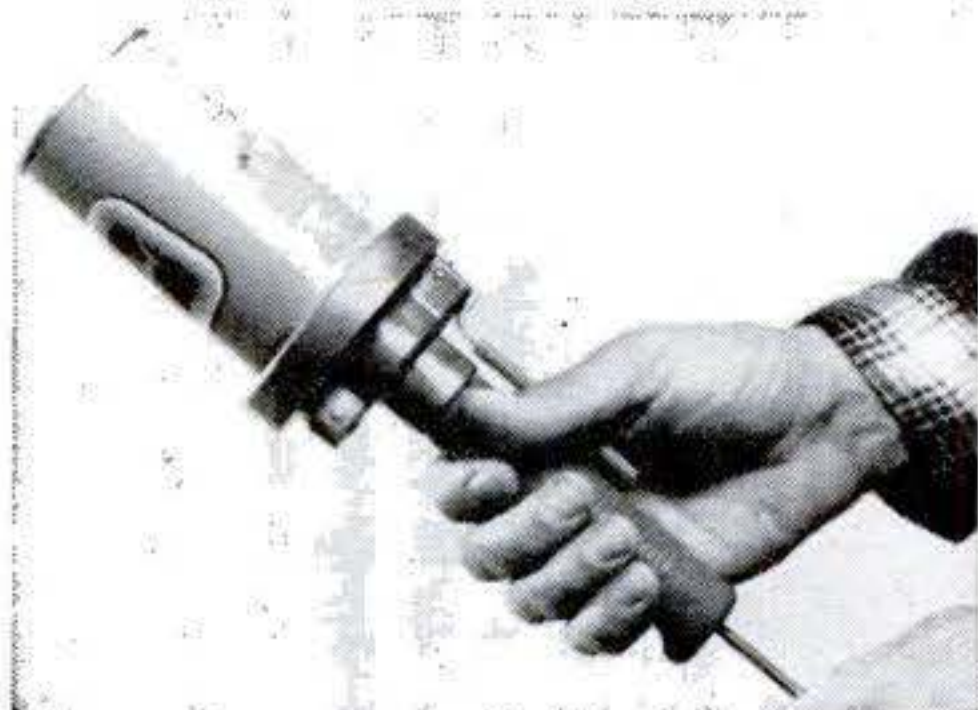


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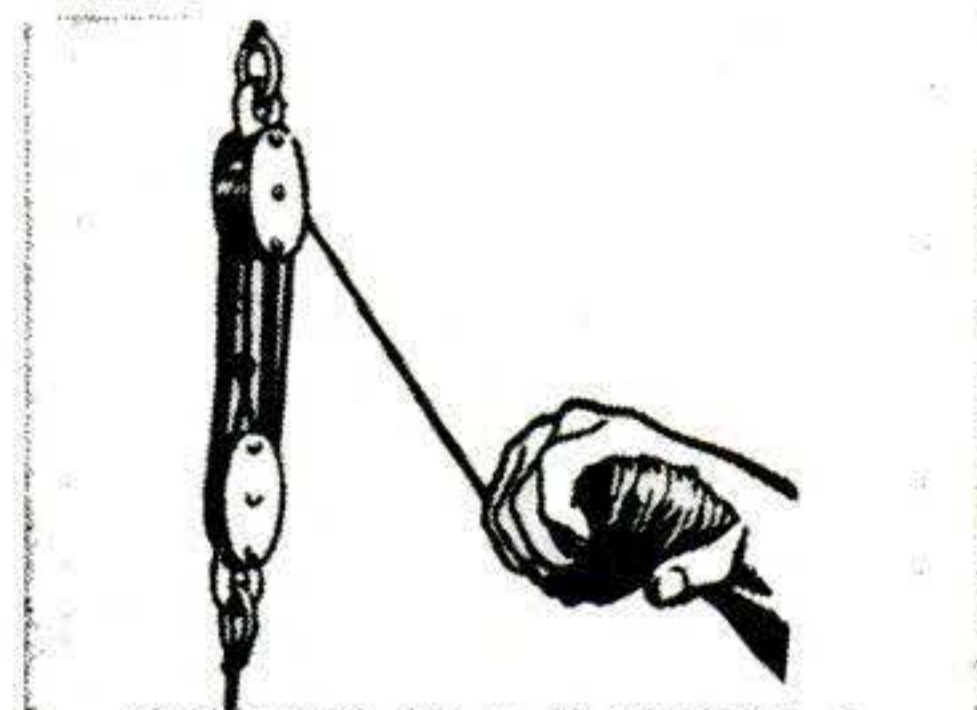
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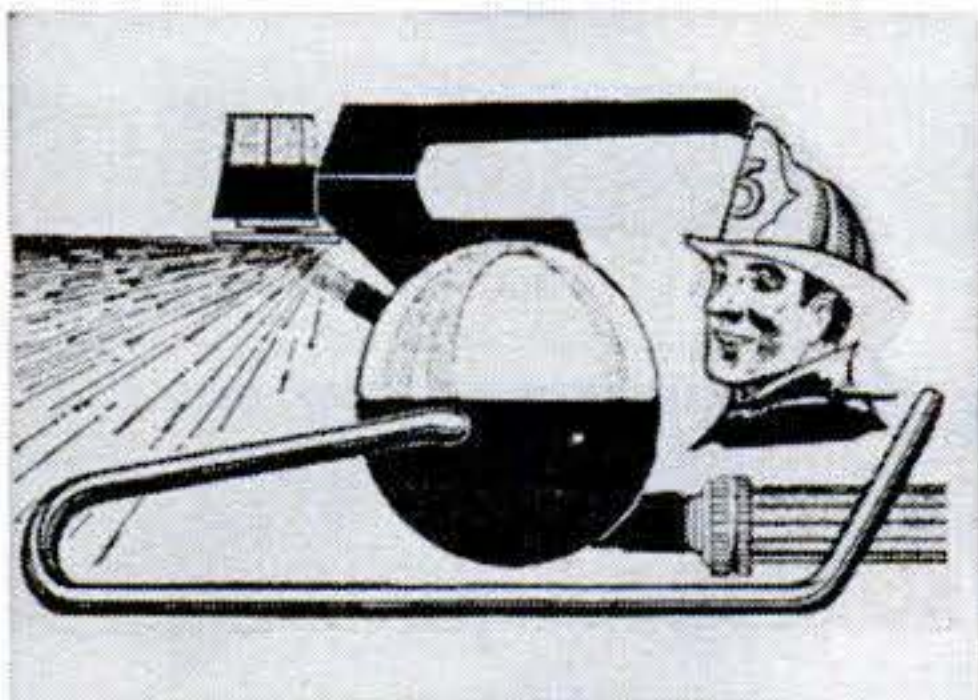
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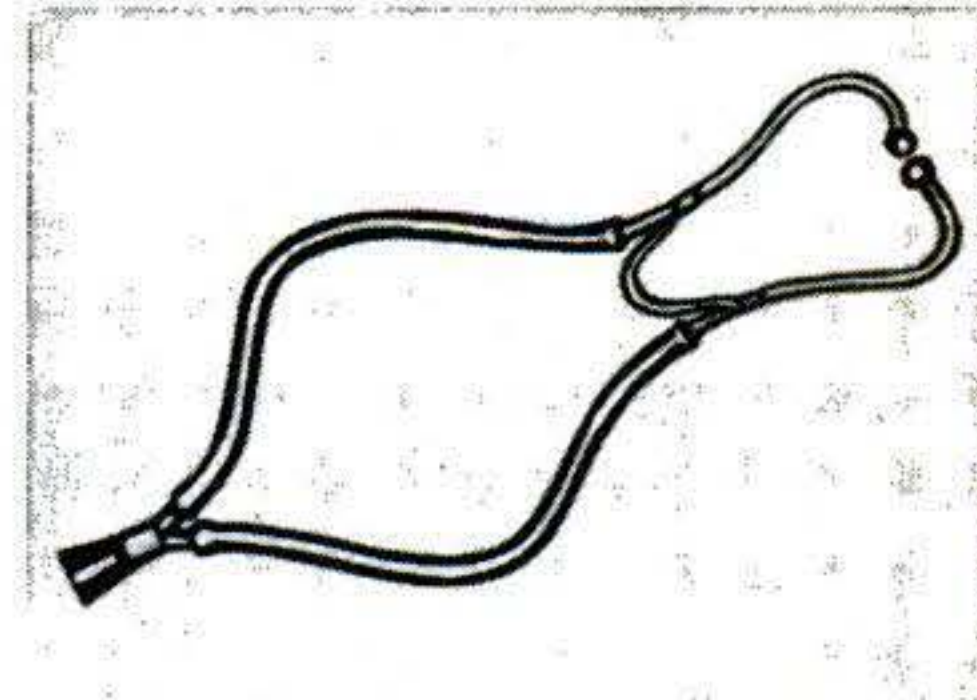
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Windproof inspired design—like a fire pump—sprays flat trajectory virtually unaffected by even stiff winds. Water hugs ground, soaks under windows without a drop going thru windows. There's no back spray. Pick it up, move it, adjust it. When you lift it, it stops rotating. No need to shut off water just to move it. Dial your distance. Get full distance or just ten feet. \$12.96 ppd. Marshall Fire Pump Co., 349 Mfrs. Exchange, Kansas City 5H, Mo.



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Have you ever tried to buy one of these? They're hard to find and usually expensive. This brand-new surplus United States Medical Corps stethoscope is ideal for doctors, engineers and mechanics (to check trouble spots in motors, etc.), educational for kids and adults. It's also handy in the country & a real bargain for 1/3 gov'ts cost! \$2.95 ppd. Send check or money order to Klines, Dept. PS-7, 333 East 50th Street, New York, N.Y. 10022.



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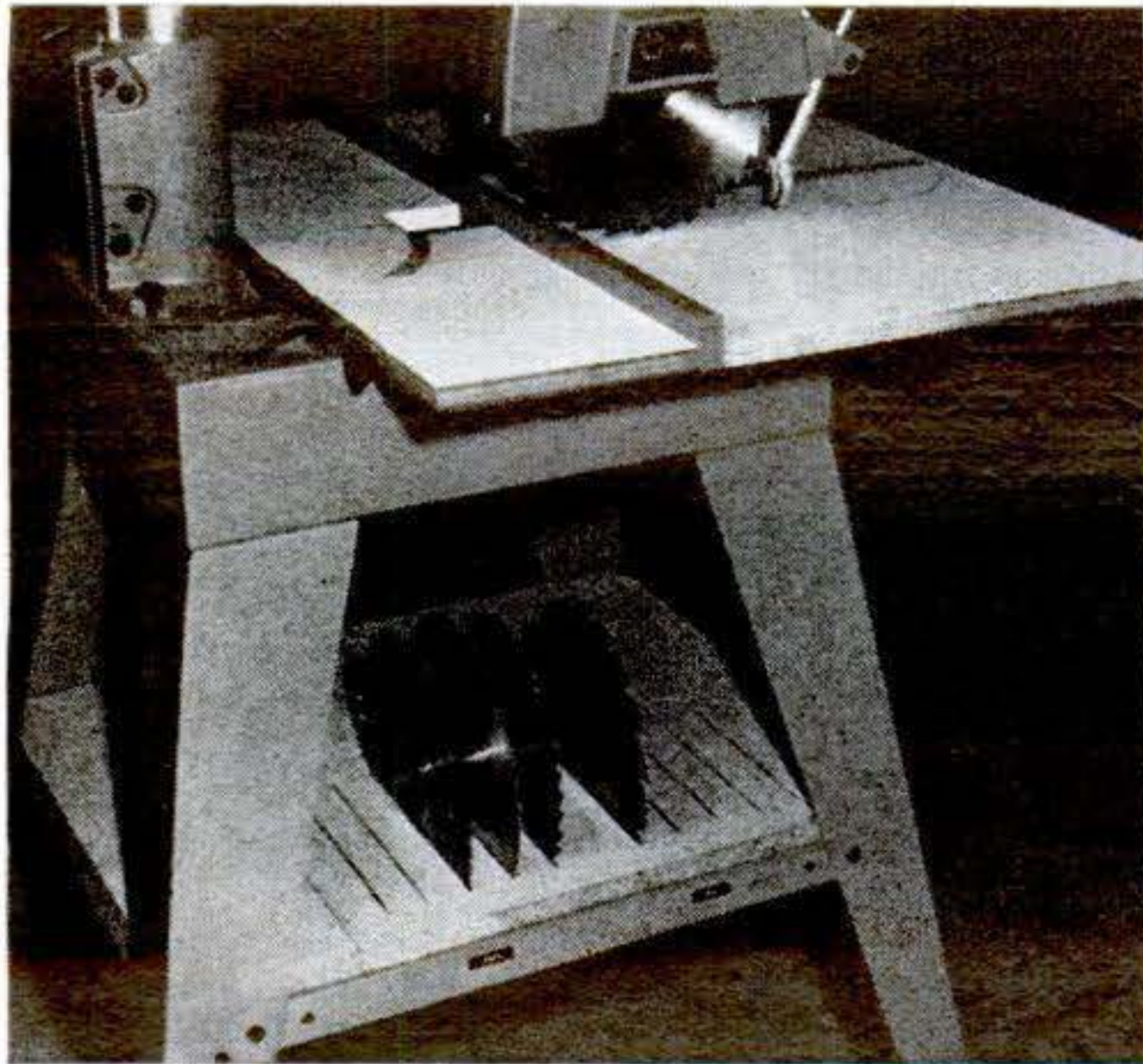
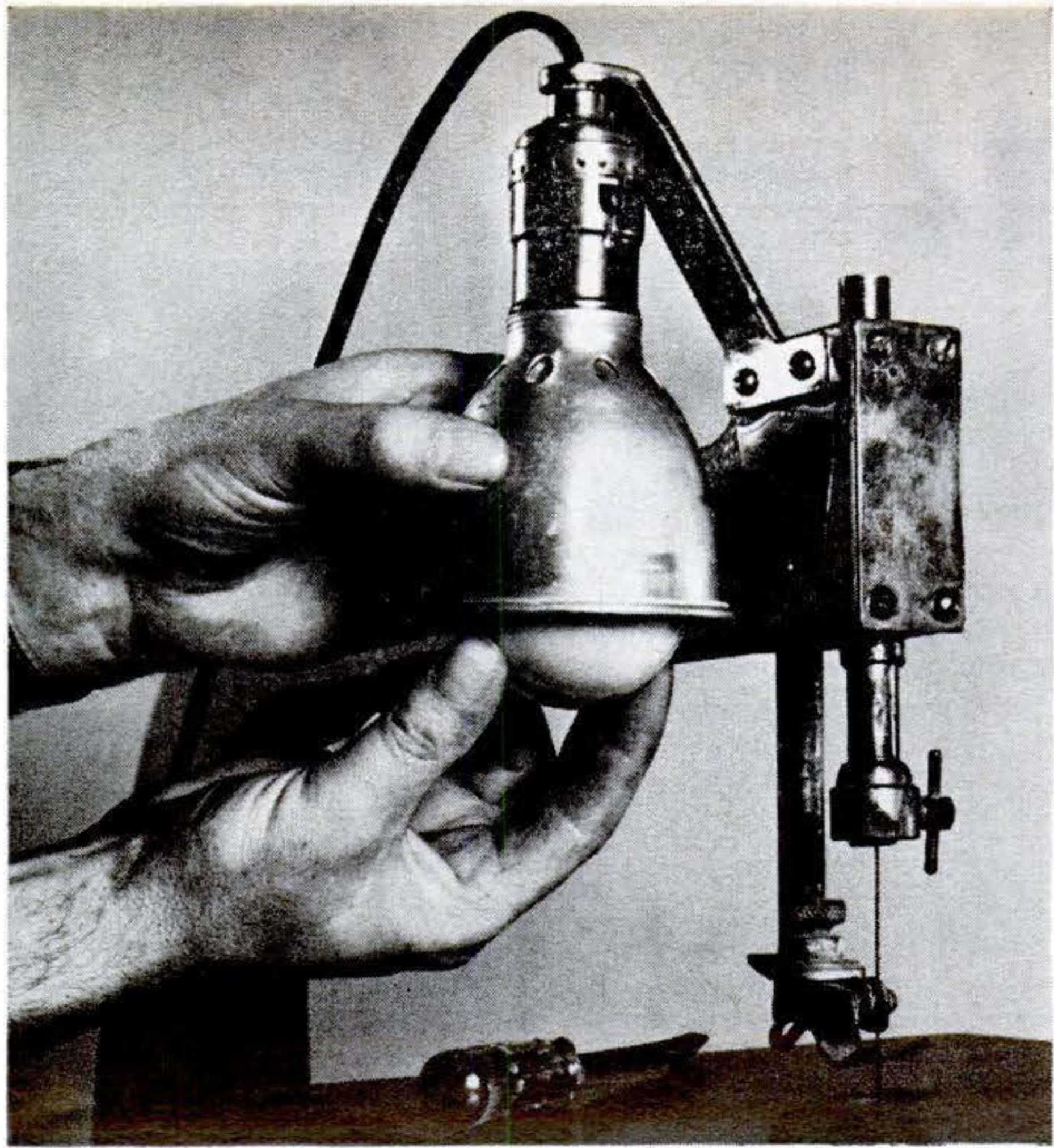
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Keeps precision time and score for golfers up to 99 strokes. One pushbutton records one stroke at a time. Other pushbutton returns count to 0. 17 jewels, anti-magnetic, shock-protected, unbreakable mainspring & crystal, chrome steel case, matching expansion band. U.S. retail value \$40. Only \$19.95. Add \$1 for airmail shipment. Send dollar bills, money order or bank check (no personal checks). Ollech & Wajs, Dept. K-20, 8039 Zurich, Switzerland.

Get plenty of light for close power-tool work

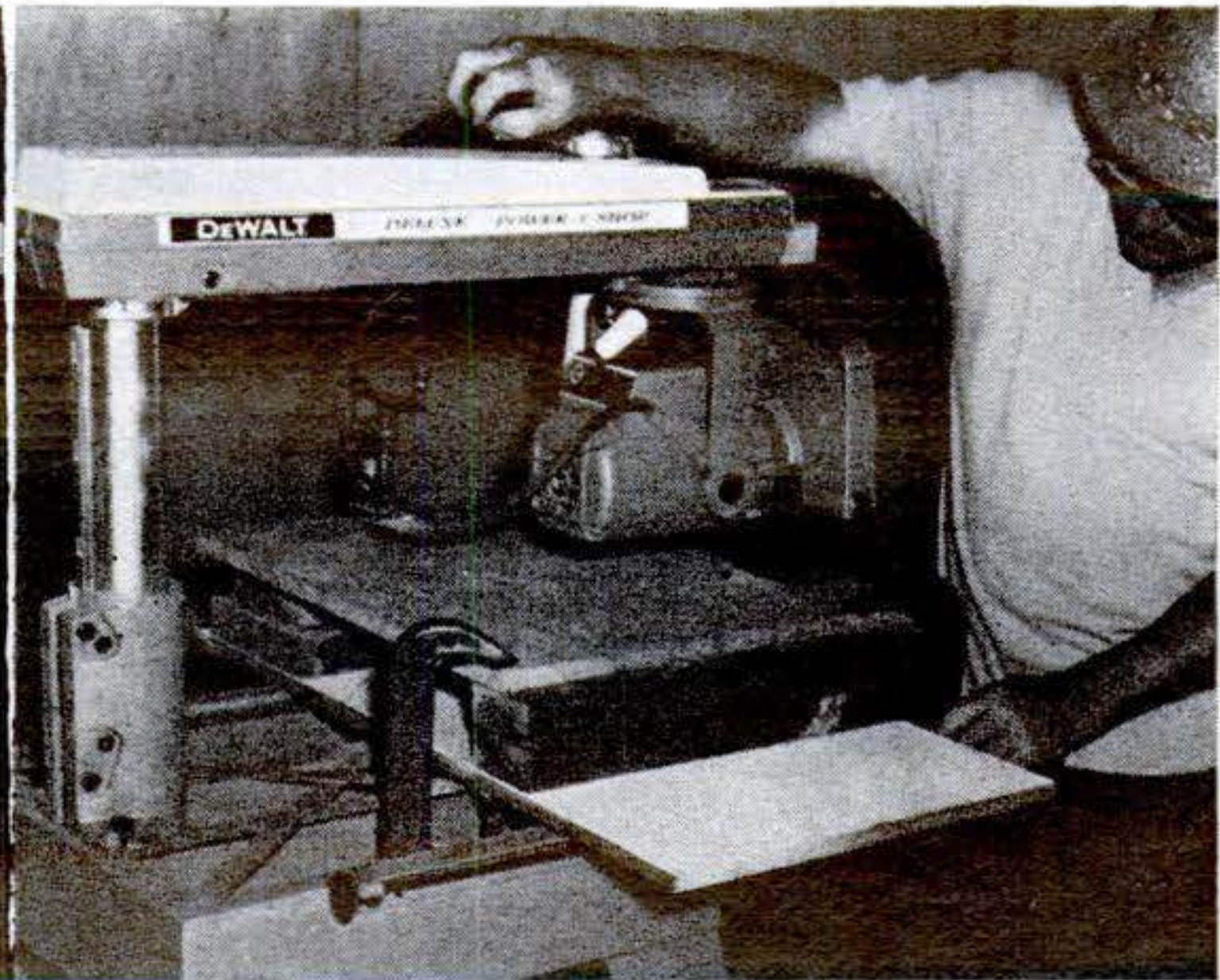
Individual work lights mounted on your power tools will eliminate shadows and let you see more clearly what you're doing. You get maximum light by putting the unit as close to the work surface as you can, without its getting in your way. The one shown here, on a jigsaw, puts out 500 foot-candles. You may have to drill and tap to put in mounting screws. I bent the mounting bracket from $\frac{1}{8}$ " steel to keep it from vibrating with the movement of the tool.

JOHN BURROUGHS
Tacoma, Wash.



Store the blades below your saw table

A handy and safe place to keep blades for either a radial-arm or table saw is a slotted holder under the table. Make plunge cuts in a sheet of plywood. Use your widest-set blade and size the length of the cuts so blades won't fall through. On a table saw, use the fence to



guide the holder down into the saw. Move the fence sideways for each cut. With the radial-arm saw, put scrap two-by-four stock under the holder and clamp it so you can lower the blade for a plunge cut (above, right). Make the cuts at $1\frac{1}{2}$ " intervals. Use one side to store sharp blades, the other for blades to be sharpened.

W. G. WAGGONER, Sacramento, Calif.

Magnets hold back shower curtains

Here's how to keep the curtains, particularly the lower portions, from pulling in and sticking to you while you're taking a shower. Attach several small magnetic clips to the bottom edge.

They will hold it to the metal tub. The magnetic clips are like those used on a clipboard. They are on a round base or disk, $1\frac{1}{4}$ " in diameter, and can be bought at some supermarkets. I paid 25 cents for each.

J. T. THOMPSON, New Hebron, Miss.

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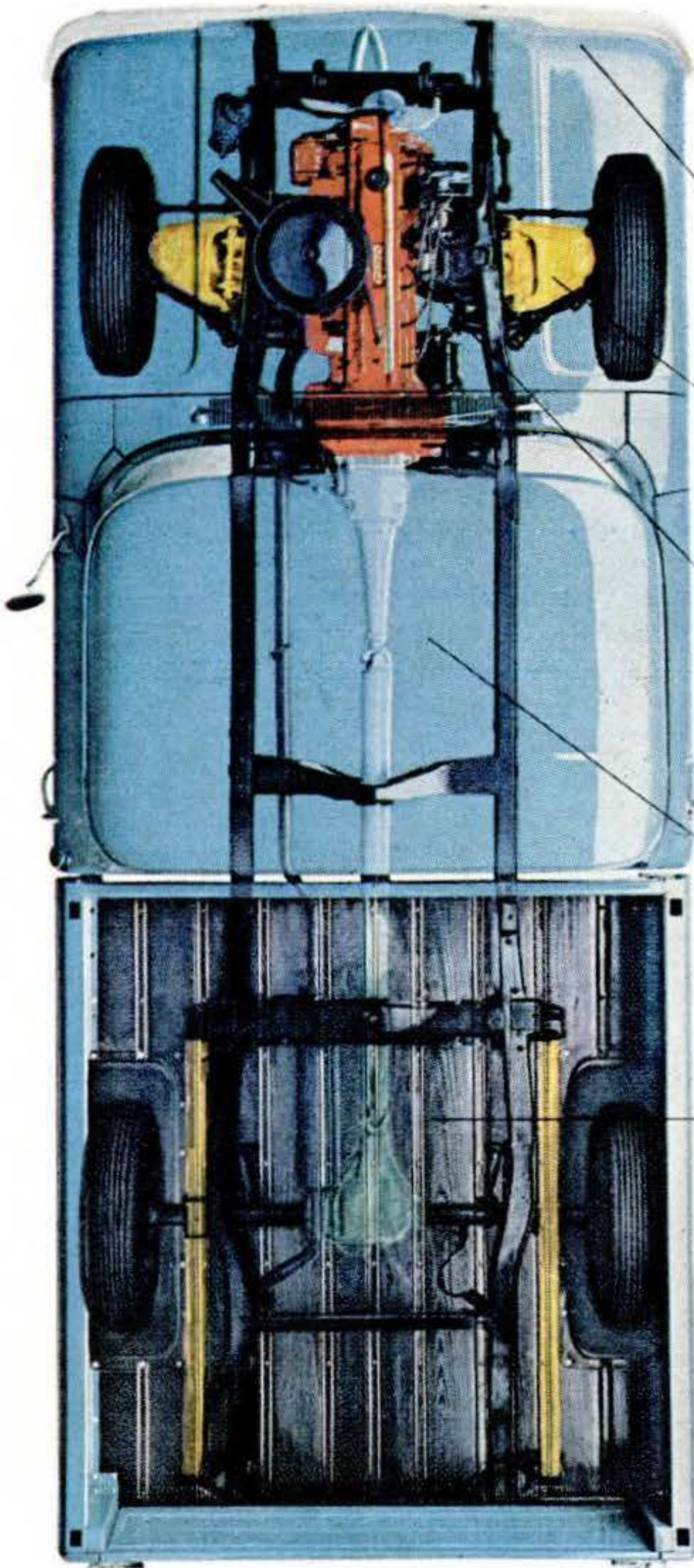
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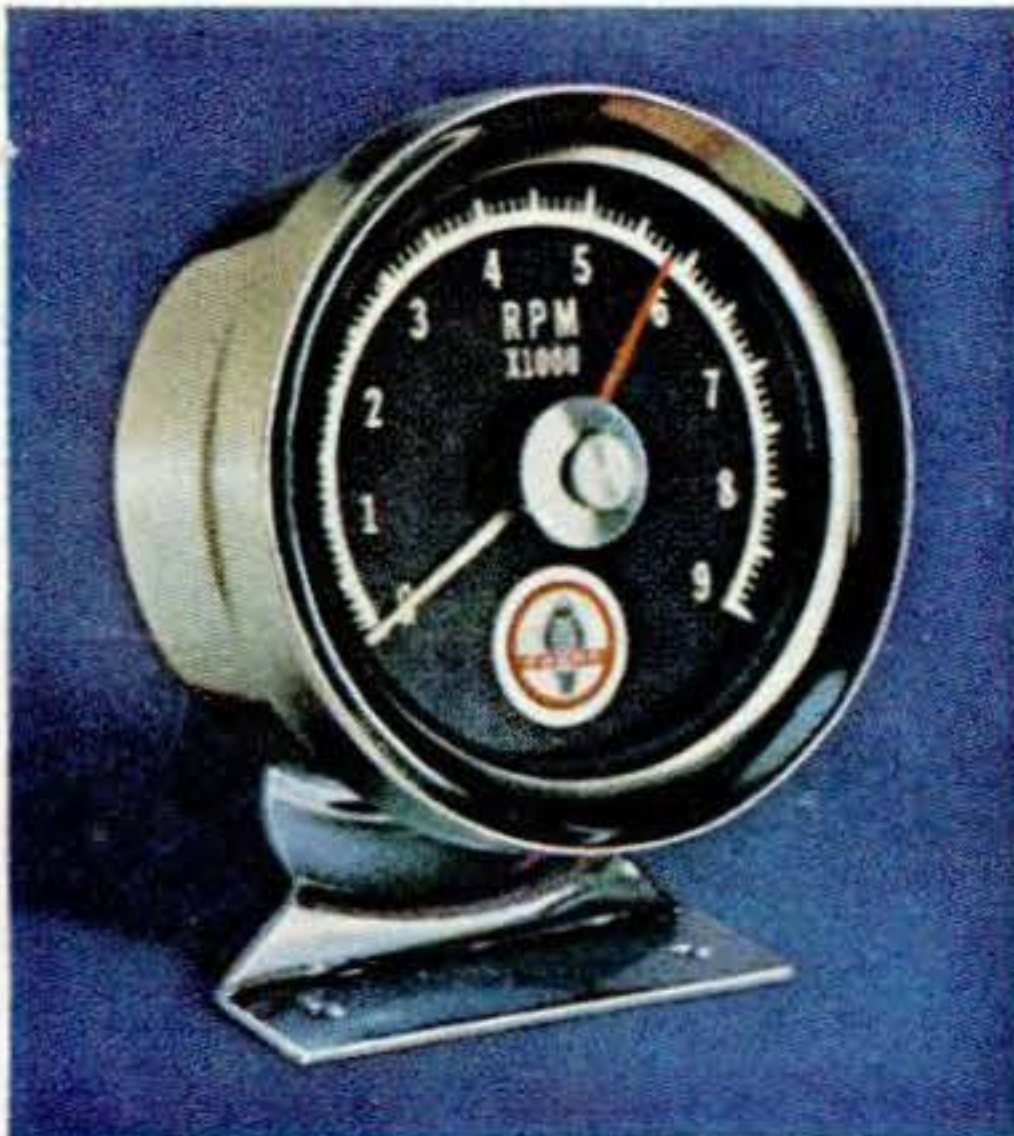
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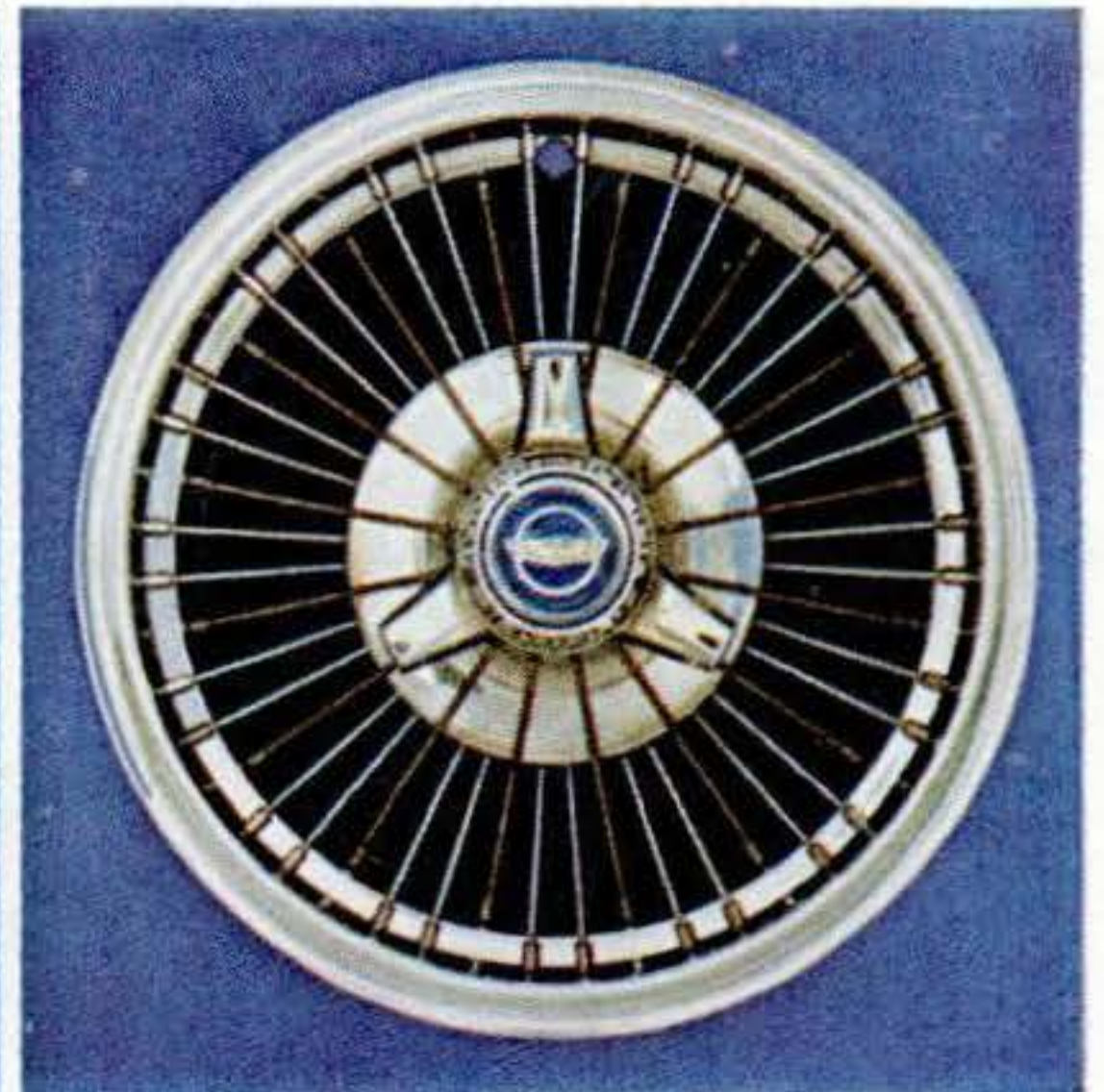
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