

SEPTEMBER 1972 60 CENTS

Popular Science

THE **What's New** MAGAZINE

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What You Don't Know About
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Will Hurt You

HOME AIR CLEANERS
What Can They Do for You?

Stunning New Photos
of Mars Show the
RED PLANET
ISN'T DEAD

23 Pages of Fresh Ideas to
IMPROVE YOUR HOME

- "Old West" Family Room
- More Comfort from Your Heating Dollars
- 5-Door Phone Booth
- Build a Sauna? No Sweat
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ggs: 19 mg. "tar," 1.3 mg. nicotine—
0's: 20 mg. "tar," 1.5 mg. nicotine av. per cigarette. FTC Report Apr. 72

Warning: The Surgeon General Has Determined That
Cigarette Smoking Is Dangerous to Your Health.

Want magnum performance from your standard 2³/₄ inch chambered shotgun?

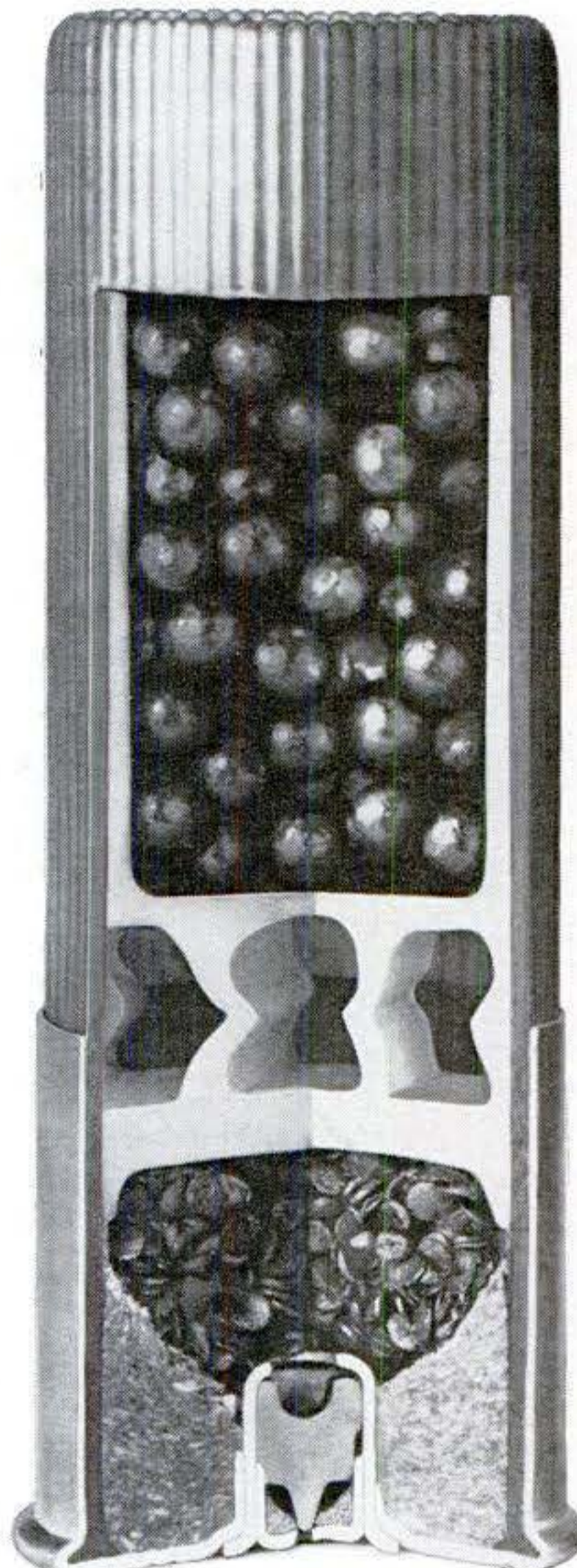
What you get out of your shotgun depends on what you put into it. The shell on the left is a standard 2³/₄" long-range load. The shell on the right is a 2³/₄" magnum load (we call it our "baby magnum"), which delivers more pellets and a denser pattern at longer ranges. Both shells fit all standard 2³/₄" chambered shotguns.

Here's what a baby magnum can do for you: When you load up with Remington or Peters 2³/₄" magnum shells, you're putting in approximately 20% more shot than that carried in standard 2³/₄" shells. For example, 12 gauge baby mags carry 39 more pellets of #4 shot than standard field loads. (See chart below showing average pellet count.)

You waterfowlers can appreciate what a difference this can make. More shot, of course, means a denser pattern at the point of impact, and that's when the baby magnum earns its keep. How many times have all of us hunters sat in blinds hoping the geese would fly a little lower or ducks would pass closer? The standard-length magnum will increase your effective range by at least ten yards, and that can often mean the difference between a successful hunt and being skunked. Pellet count and pattern density are critical to your success when 40-yard shots are common and will help in reducing cripples, too.



Standard 2³/₄" 12 Ga. load



Baby magnum 2³/₄" 12 Ga. load

five more grains of a slower-burning powder, which provides the necessary power to drive the heavier loads while maintaining sufficient chamber pressure.

Baby magnums are available in 12, 16 and 20 gauge and in a variety of shot sizes as well. (See chart below.) The 12 gauge 2³/₄" magnum and most other Remington and Peters shells are loaded with our famous "Power Piston" one-piece wad to help you get all the power you pay for. By helping to reduce pellet distortion, the "Power Piston" actually puts more shot in your pattern than other wads, and that will improve any hunter's chances. A specially designed plastic shot protector is used in 16 and 20 gauge baby magnums to allow for maximum pellet count and weight.

Now, doesn't it make sense to carry a supply of baby magnums the next time you go hunting? They're not only an excellent selection for waterfowl, but are recommended for pheasants, big western grouse and the wily wild turkey. Baby magnums are real handy when shooting through heavy foliage, and if you tote a side by side or over and under to the field, a wise hunter will keep one in the choked barrel for that long second shot.

12 Ga. Shot Size	# Pellets per Ounce	Standard 2 ³ / ₄ " 1 ¹ / ₄ oz.	Baby Magnum 2 ³ / ₄ " 1 ¹ / ₂ oz.	Pellet Increase	% Inc.
#2	87	109	130	21	19.2
#4	134	168	207	39	23.2
#6	221	276	331	55	19.9

Remington research and development have modified the base wad of the standard 2³/₄" hull to provide more internal volume. Heavier loads need a proportionate increase in powder for velocity and range. Remington 2³/₄" magnums contain

Baby Magnum Gauges	Shell Length Inches	Ounces of Shot	Shot Sizes
12	2 ³ / ₄	1 ¹ / ₂	2, 4, 5*, 6
16	2 ³ / ₄	1 ¹ / ₄	2, 4, 6
20	2 ³ / ₄	1 ¹ / ₈	4, 6, 7 ¹ / ₂

* #5 shot—Remington brand only.

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What You Don't Know About "Shocks"

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Bad Shock absorbers not only cause poor handling—they can cost your life.

The Red Planet Isn't Dead

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Close-up photos reveal a turbulent Mars: PS interviews Dr. Carl Sagan.

Coming—New U.S. Tire-Labeling Standards

PAGE 76

You'll know what you're buying when grades are molded into the sidewalls.

A 4'-by-6' Color TV Picture

on Your Living-Room Wall PAGE 78

Qualities that can't be rivaled by the small screen—on the market just about now.

23 Pages of Fresh Ideas to Improve Your Home

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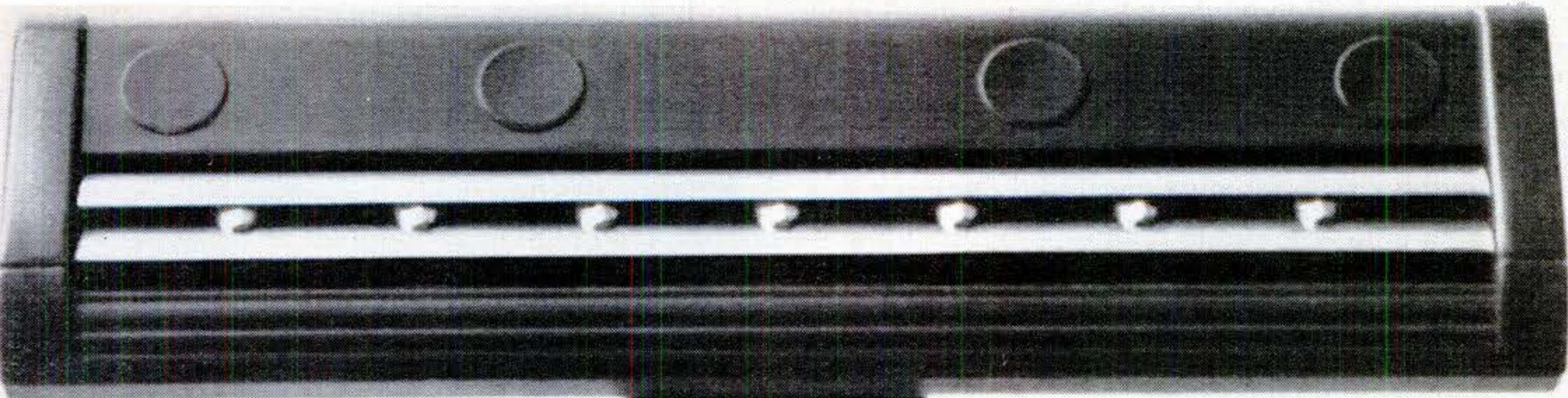
TRANS MEDIC Stops transmission troubles, Eliminates slippage, down-shifting.



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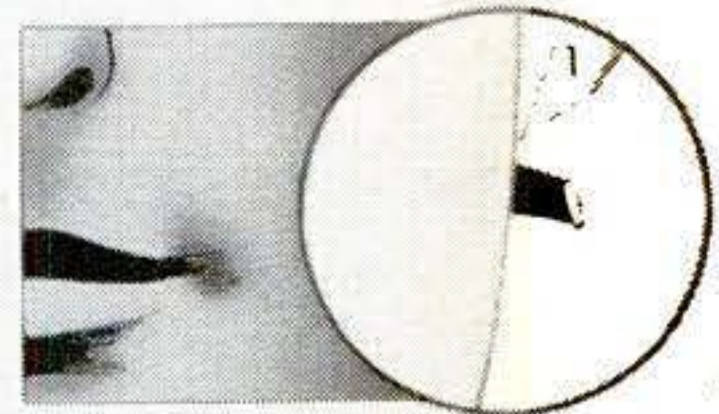
RADIATOR SPECIALTY COMPANY
Charlotte, North Carolina 28201

It's not like shaving twice with your one blade razor. It's better.

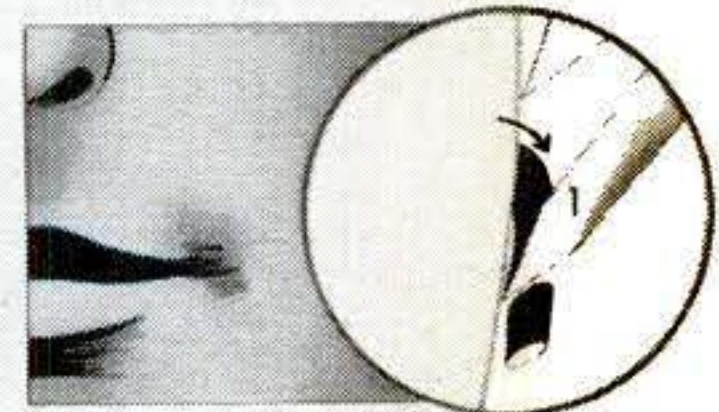


Here's why.

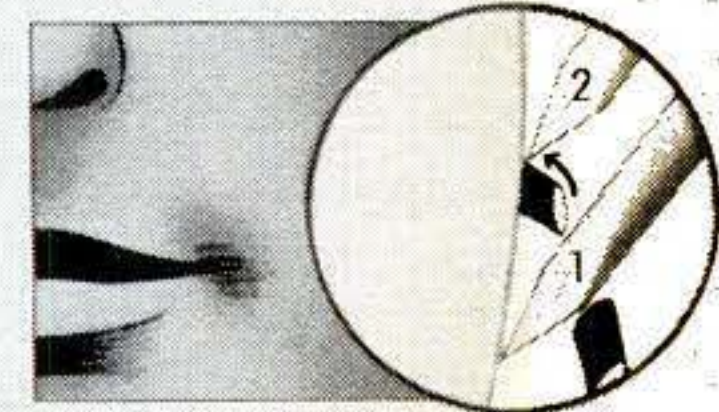
(1) As the 1st blade of the TRAC II shaves your whisker ...



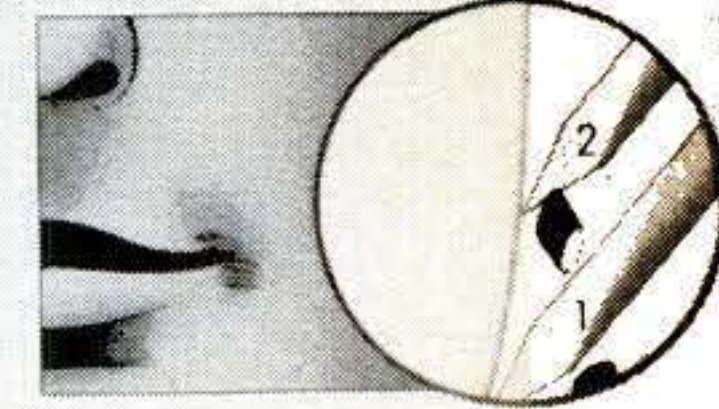
(2) it actually stretches it out from below the skin for a moment, exposing extra whisker.



(3) Then, before that whisker can snap all the way back, the 2nd blade comes along ...

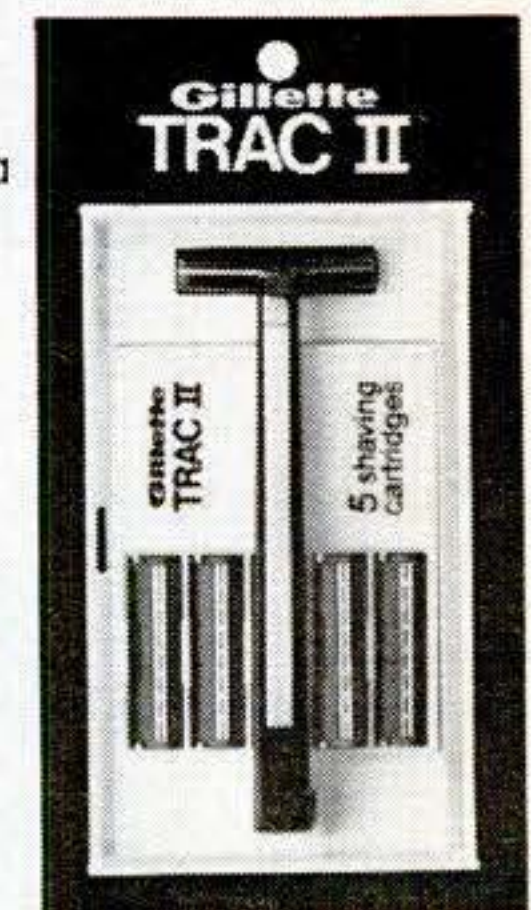


(4) and can shave that whisker again.



Even if you shaved twice with your one blade razor you could never come back fast enough with a second stroke to get all that extra whisker before it snaps all the way back.

And since 2 blades shave you so close, we were able to recess them for extra safety. That's why no one blade razor made can match the TRAC II two bladed razor for closeness and safety combined.



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This one



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NASA's Supersonic "Flying Scissors" Jetliner
The ABCs of Cutting Metal
How They're Putting the Hush on Snowmobiles

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EDITORIAL OFFICES: 355 Lexington Ave., New York, N. Y. 10017

PUBLISHED MONTHLY by Popular Science Publishing Co., Inc.,

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

SUBSCRIPTION SERVICE

New or Renewal Orders: Send to: Popular Science Subscription Department, Boulder, Colorado 80302. One year \$6, 2 years \$11, 3 years \$15 in U.S., its possessions, and Canada. Elsewhere, 1 year \$9.50, 2 years \$18, 3 years \$25. Single copy 60¢ in U.S. and Canada.

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Microfilm editions are available from University Microfilms, Ann Arbor, Mich. 48106.

ADVERTISING OFFICES

NEW YORK: 355 Lexington Ave. (10017), Tel. 212-687-3000; CHICAGO: 401 N. Michigan Ave. (60611), Tel. 312-527-0550; DETROIT: 1716 Fisher Building (48202), Tel. 313-872-7060; LOS ANGELES (Pacific West Coast): 3550 Wilshire Blvd., Suite 908 (90005), Tel. 213-380-1936.

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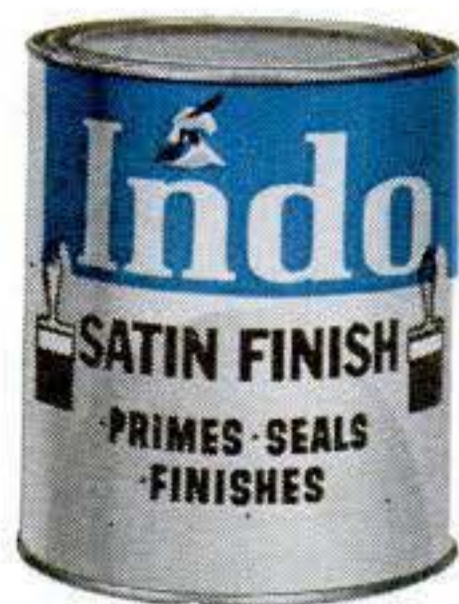
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PS Readers Talk Back

Where you voice your views . . . and the editors do the listening



Modular homes: Are they the answer?

Mark Walker's "Tomorrow's Housing Is on the Way" [May] presented a somewhat optimistic view of the future of modular homes. He spoke of hundreds of speedy, efficient modular-home plants. A recent article in Business Week revealed that of 196 companies building modular homes last year, 50 dropped out. Reasons: 1) Costs per square foot can and do run higher than for regular homes. 2) High cost of shipping boxes. 3) Modularity, unlike mobile homes, must satisfy local building codes. 4) There are inventory and cash-flow problems due to the fact that lending institutions will not grant loans on the homes until they're set up.

Modular homes may become the home of the future, but currently they are extremely risky business.

C. P. EDMONDS, Asst. Prof. of Finance
Georgia Southern College
Statesboro, Ga.

Barn in the yard

We had to write and tell you how pleased we were with your Little Red Barn for Backyard Storage [plan 5510, \$3.95], which we recently constructed. It was a great idea. We used red asphalt shingles instead of the red cedar shingles because the former are easier to put on and look just as nice as cedar shingles.



We also set the barn on the edge of the woods to give it an attractive background.

R. GITTELMAN and G. MAHA
Ambler, Pa.

Music-making computer

In "Muse-Space-Age Music Box" [July], Paul Wahl tells everything about the device except where to buy one. What's the story?

RICHARD B. SIMS, Boston, Mass.

Sorry, we ran out of space. You can get the Muse from M. S. Fredkin Co., 15017 Ventura Blvd., Sherman Oaks, Calif. 91403.

CBers: "clown banders"?

The facts dispute your statement in "Look What They've Packed Into Those New CB Radios!" [July] that the slant of the Citizens Radio Service growth curve is "straight up." Current FCC figures show a drop of 40,000 from the peak of 887,000 licensees two years ago.

I suspect a major reason is that many new licensees quickly become disillusioned at the obscene language and arrogant violation of regulations that unfortunately are all too characteristic of today's CB activity. Some in the industry do claim "straight up" growth, but do not seem ashamed that what they are boasting about is largely unlicensed operation flaunting FCC authority.

JOHN HUNTOON, Gen. Mgr., American Radio Relay League, Newington, Conn.

Nitrogen and the environment

I wish to take issue with Ross Firestone's letter in PS Readers Talk Back [July]. While he is undoubtedly sincere in stating the benefits of nitrogen oxides, he shows an ignorance of basic ecological facts by saying that they can be used "to make grass grow greener." While certain nitrogen compounds are essential to the growth of plants, many others, nitrogen oxides included, cannot be utilized by plants.

G. R. TROMBLE, Wichita, Kans.

. . . Mr. Firestone's letter states that nitrogen oxides must be beneficial. His reasoning is that since nitrogen-enriched fertilizers are good, anything with nitrogen must be. By the same reasoning, one could say that carbon monoxide is beneficial since both carbon and oxygen are "readily accommodated by natural environmental processes." Carbon monoxide is readily absorbed into the bloodstream of man, even more so than oxygen, but this does not mean that it is beneficial.

JOHN THRO, St. Charles, Mo.

Keeping time with Time Cube

I've completed the construction of your Time Cube ["Time Cube—A Unique Digital Clock You Can Make," June] and found that it sequences properly, but loses about a minute a day. What's wrong?

WALTER SODIE, North Brunswick, N.J.

To conserve power and reduce heat, the power-supply board in the clock was designed to produce the minimum volt-



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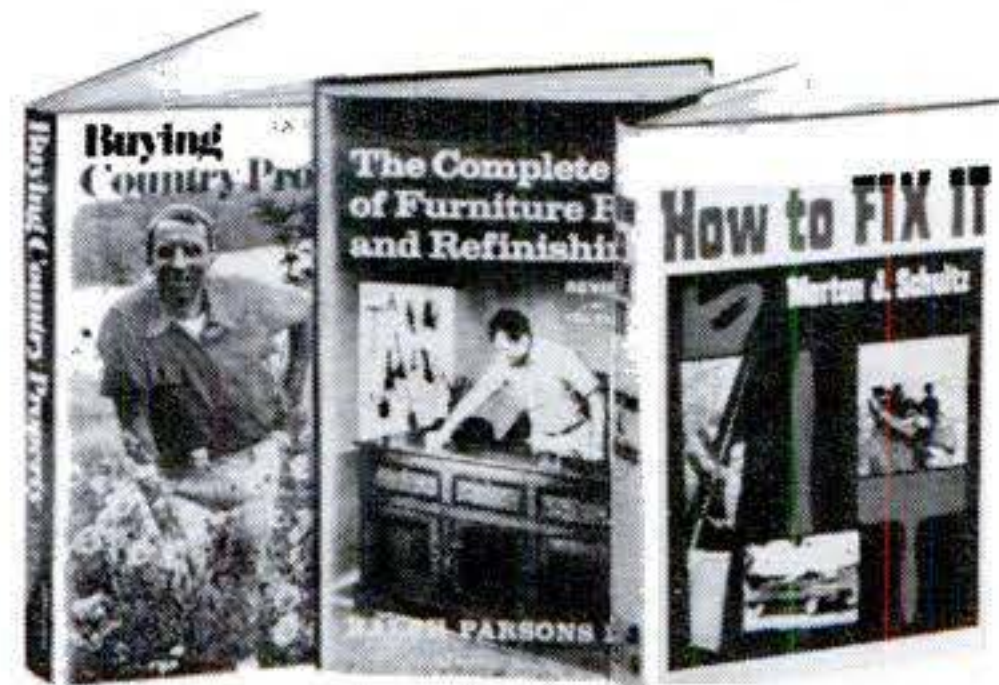
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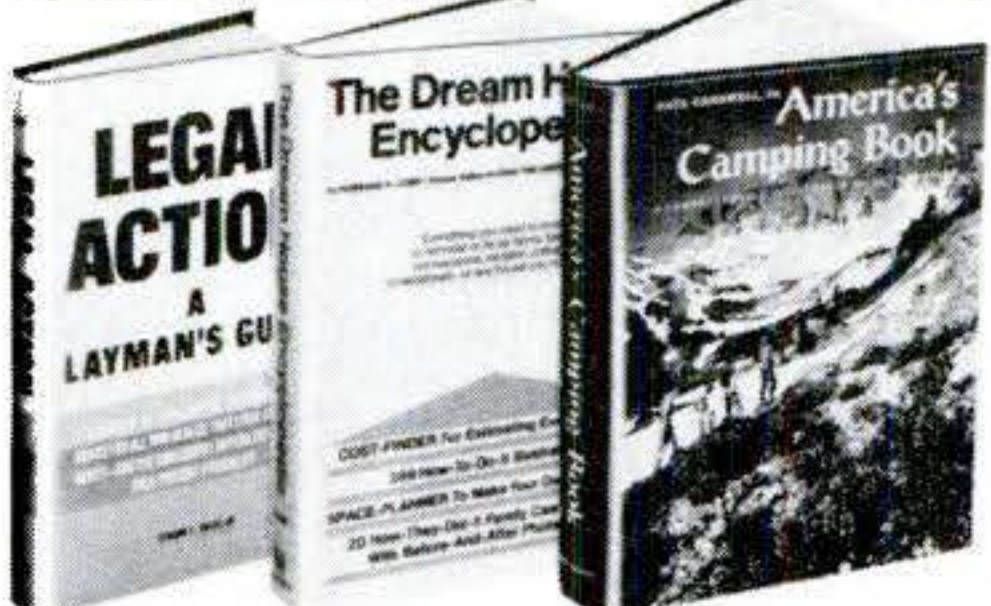


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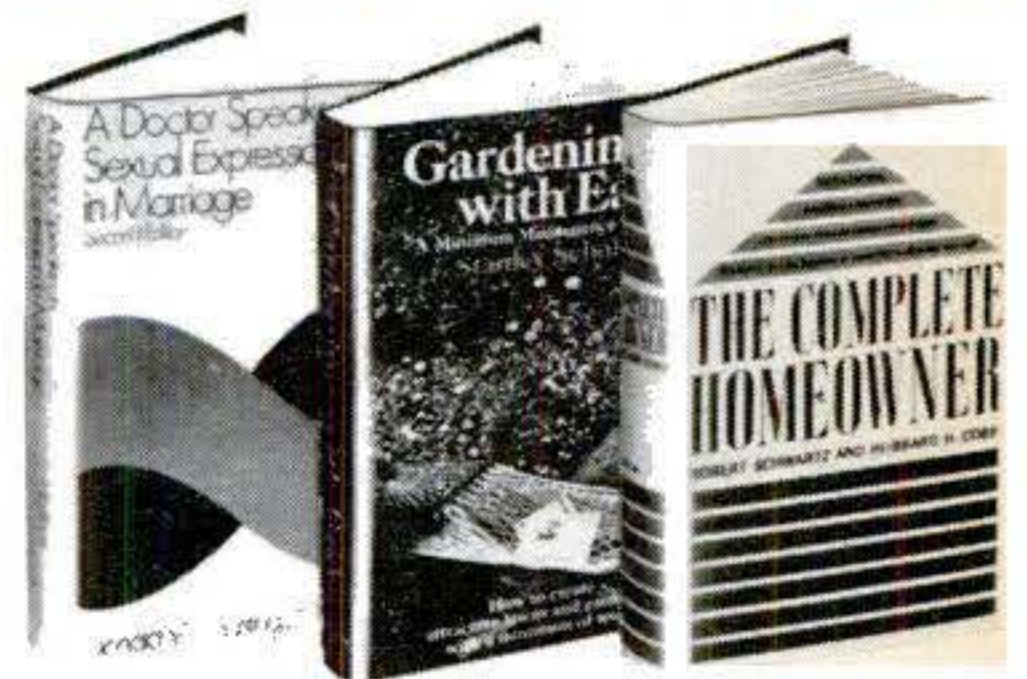
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PS Readers Talk Back

[Continued]

age necessary to operate the circuitry. Because the supply is unregulated and the components are subject to tolerances, the voltage may dip below the IC operating level whenever a scan is initiated. This problem can be eliminated by lowering the value of the five-ohm, five-watt resistor (R3) in one-ohm steps until the clock operates accurately.

One more thing on pipes

In "Collector's Items You Carve Yourself" [July], you neglected to mention a most important step in making a pipe: curing it. Unlike manufacturers' pipes, briar blocks are not thoroughly cured, and believe me you can taste the difference. To cure the pipe, just place it in an oven at 150 degrees F for four to six hours (being sure to remove the stem) after you have carved it. This will remove most of the bitter saps.

JAMES CARRY, San Diego, Calif.



Norbye/Dunne on mini-pickups

I must say I was disappointed with the July Norbye/Dunne Report on "Those Mini-Pickups." Norbye says the Datsun is down on power. But you stated yourselves that the Datsun has more horsepower than the Ford; it's just not so fast. The Datsun also has more torque. The only one topping the Datsun is the Toyota, which has the biggest engine.

Also, both Norbye and Dunne point out the comfortable ride as one of the reasons for preferring the Ford Courier. Is it more important to have a comfortable ride or a car that handles well in an emergency? I think it's more important to have one that helps you "cope with trouble when you're already in it." (That was the cover story in the same issue.) Comfort? Who cares? I value my life more than my bottom.

JON EVANS, Conifer, Colo.

... Your article on the four mini-pickups from Japan was excellent. I own a '70 Datsun pickup and really like it. Just proves that the Japanese "have a better idea."

J. ARNOLD, Birmingham, Ala.

Cooling-comfort problem solved

I have a window air conditioner in my room and during hot summer nights it's a delight, but in the cool summer morning it's like frostbite! So I decided to use a regular air-conditioner/heater thermostat to keep my room livable. Then I got a bright idea. A thermostat completes an electrical circuit when a pre-designated temperature is reached. A light switch does the same thing, except it completes the circuit manually. So I removed the light switch from the wall opposite my air conditioner, which controls a nearby electrical outlet. I re-

placed it with an old thermostat we had lying around. I just connected two wires, plugged the air conditioner into that outlet, and set the thermostat. Now I have a climate-controlled room.

RON GALEN, Livingston, N.J.

Those car seats for kids

I am writing in regard to "Safe or Unsafe? The Truth About Car Seats for Kids" [May]. I had wondered for a long time about the value of the car seats specified for use by children. I would like to thank you for finally clearing it up for me and identifying the best seats for this purpose.

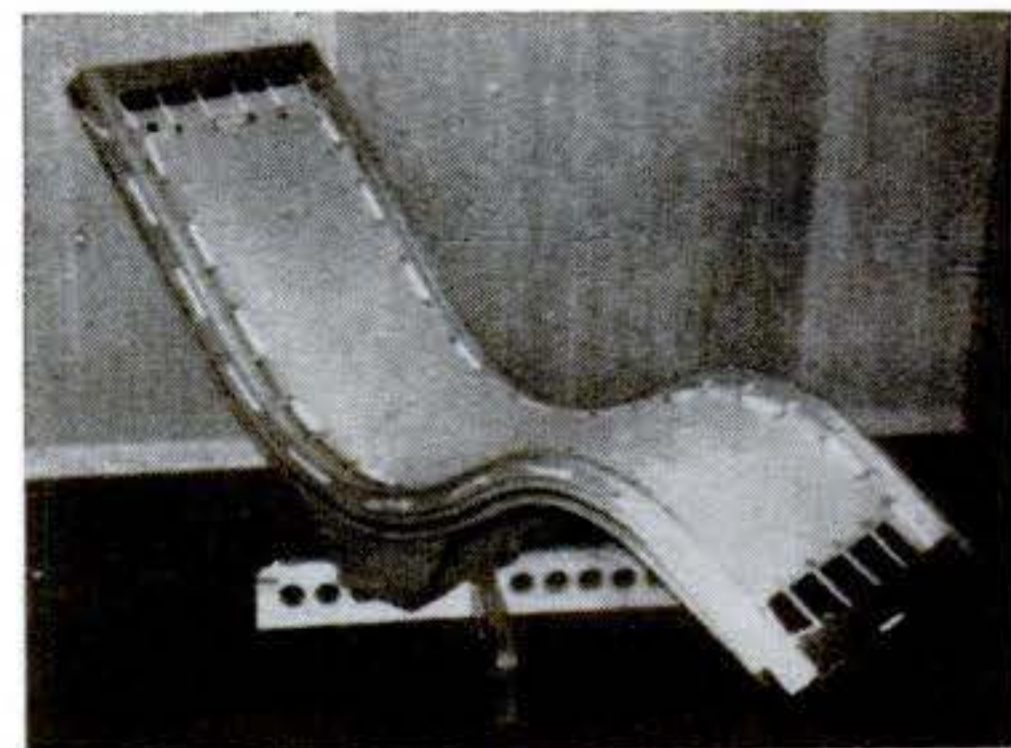
FRED STOEKER, Cedar Rapids, Iowa

... Car seats for kids was a good story but I think that the first rule for kids' safety in automobiles should be to have them sit in the back seat, not in the front as in your photograph.

J. SPENCER, Indian City, Tex.

Build-it-yourself lawn chair

I made this chair from the plans you published in a past issue of PS ["Laminate a Lawn-Chair Frame," Apr. '70].



It turned out beautifully, and it's comfortable to relax in. There's lots of admiration from all who see it.

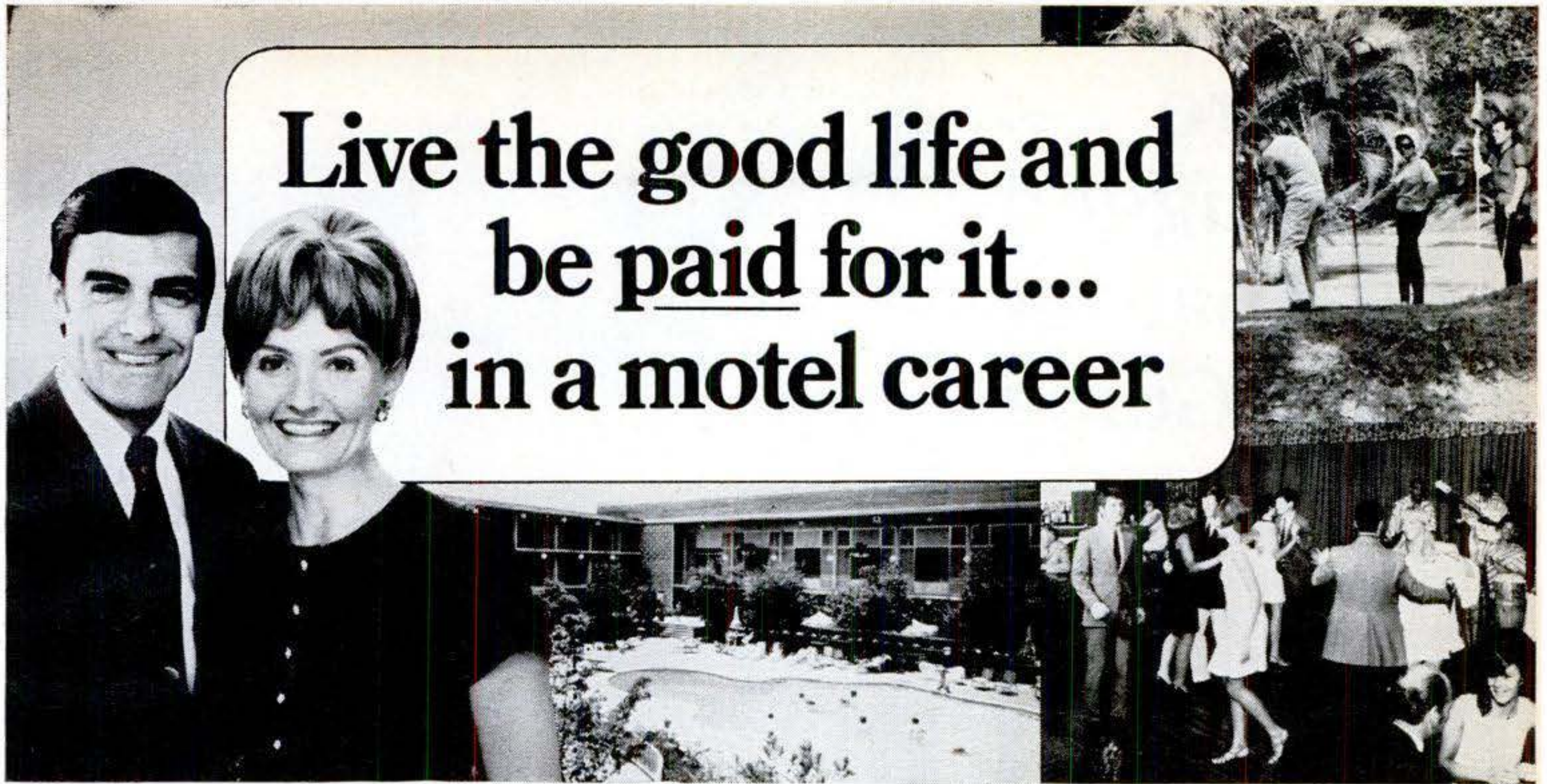
RONALD OLSON, Mt. Vernon, Ohio

Preventing stolen tape decks

A "well-done" to Bill Hawkins for his article, "The New Take-Along Music Systems" [June]. However, he did fail to mention a very simple anti-theft installation: the slide-in, slide-out mount. This system allows you to remove your tape deck with a minimum of effort when leaving your car. The mount can also add versatility to your sound systems. By installing half the mount in more than one vehicle, you can take one tape deck almost anywhere. And by making use of a 12-volt power supply (Audiovox has one on the market), you can even make use of your tape player in your home. It's a worthwhile investment for anyone considering a "take-along music system."

JIM BORWALD, Indianapolis, Ind.

Want to get something off your chest? Write "PS Readers Talk Back," Popular Science, 355 Lexington Ave., New York, N.Y. 10017.



Live the good life and be paid for it... in a motel career

America's motels need more people for well-paid executive careers

The demand for trained executives, supervisors and managers is so great that AMERICA'S ASSOCIATION OF 7,000 MOTELS AND HOTELS has authorized LaSalle to teach you in your spare time at home.

Imagine working and living in vacation surroundings. Dining on good food. Enjoying close-at-hand golf, swimming, other recreation facilities in your leisure hours. Meeting and mixing with interesting, fun-seeking people the year round! That's the kind of life enjoyed today by thousands of successful executives in the motel/hotel field. And very good pay to go with it all! If you're interested in making it your kind of life, here's how to get started.

You are needed now

The hospitality industry needs top managers. Supervisors. Department heads and assistants. Executives from the junior level and up. But there aren't enough trained people to fill all the 25,000 new openings each year. So the American Hotel & Motel Association's Educational Institute has authorized LaSalle to train people like you at home for a career in their industry.

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When you receive your LaSalle Diploma and pass the exam for the AH&MA's Certificate of Achievement, the Institute's placement assistance is available to you to help you get started. Each month all the member motels and hotels of the AH&MA are notified of new certificate holders. Your name would be among them. You get this valuable help — free. Of course, no reputable school can guarantee a position. But it's good to know that over 7,000 motels and hotels will be told about your availability.

Good opportunities galore

The young man or woman interested in an attractive growth career — as well as the mature person looking for a good income in pleasant surroundings — will find that there are many well-paid openings for newcomers. LaSalle's authorized AH&MA training program was

specifically designed to prepare people like you — with no previous experience — to enter the field and eventually qualify for executive earnings.

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The better jobs in the industry pay \$10,000 to \$15,000 and frequently go much higher, depending upon experience. When you include the extras that are often yours when you work and live in a resort or big-city hotel or motel, these positions are especially rewarding.

Take the first step

Get the facts about this fascinating field, the jobs available and LaSalle/AH&MA training — send for free illustrated booklet. There's no obligation.

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21N

Pro 24: A Rugged Boat for Rough Going

A big boat for her size, with nothing fancy, she'll delight fishermen and bathers

By JIM ROE / PS Boating Editor

I first saw the Pro 24 tied up at Florida's Marco Island. She looked like just the boat for those waters: good visibility from the helm and a shoal draft for exploring the back-country mangrove waters—but also the right hull and plenty of power to run off Marco into the Gulf of Mexico.

The next time was up in Lake Michigan. The word there was: a great offshore boat in Lake Michigan's chop, and a competent fisherman out where the lake trout and salmon are found.

Finally, at Florida's Cypress Gardens, I got a chance to take the helm of a Pro 24 and find out what everyone had been talking about.

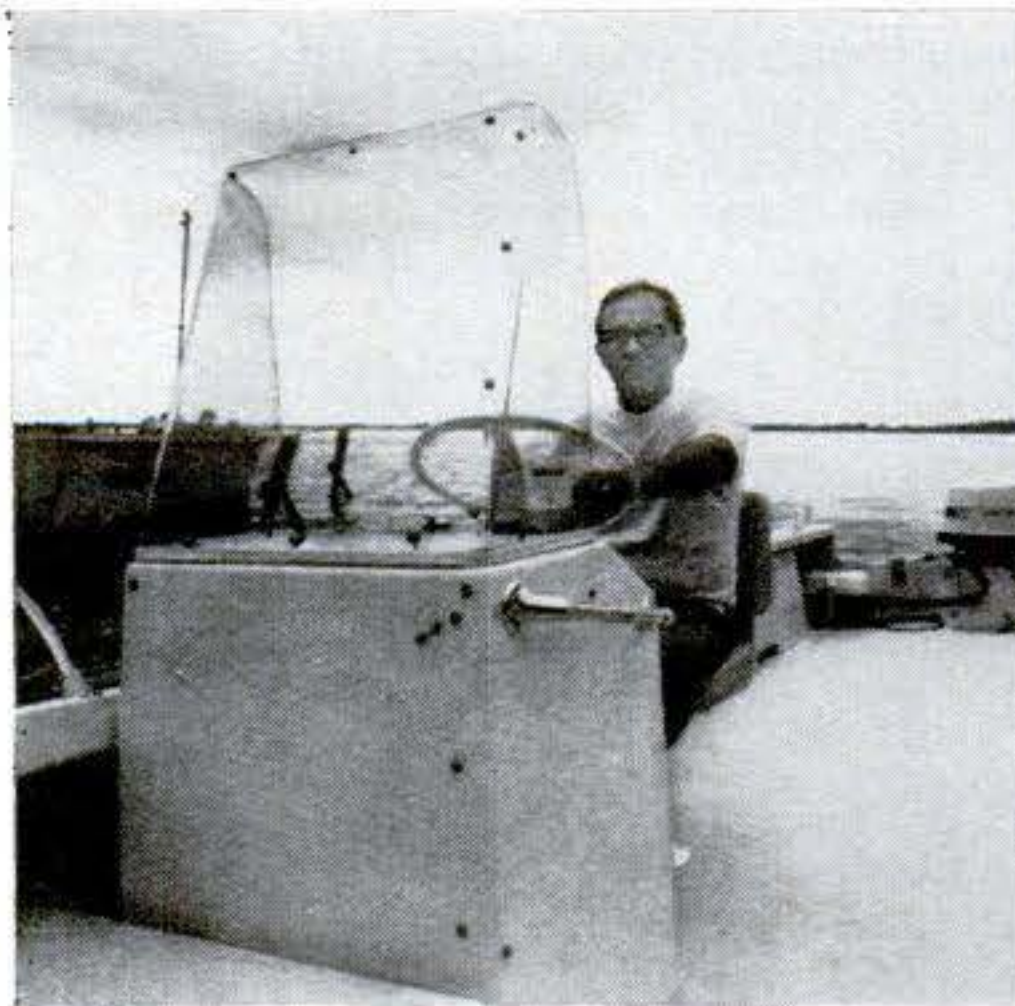
This is a big boat, not simply 24 feet long but big in space when you get aboard. And very open. It seems as if there's room for a square dance behind the steering station, and plenty of space forward for the fiddlers. Long and lean-looking from the dock, she actually has a seven-foot eight-inch beam. There's nothing—absolutely nothing—behind the steering station. The bow compartment is also open. The result is as large an area of usable space as you'll find in an outboard.

The steering station, well forward on the starboard side, is located for good visibility and control. On most open boats, I have been forced either to scrunch down in the driver's seat so I could look under the top frame of the windshield, or sit up on the seat back to see over. You forget both approaches on the Pro 24. The shield stands high enough to protect the helmsman even in standing position, and there's no metal rim on the thick plastic to cut into your vision.

The PS test boat. Our power was a new 125-hp Johnson outboard. Cast-



The competent Pro 24 hull handles rough-water and shallow running equally well.

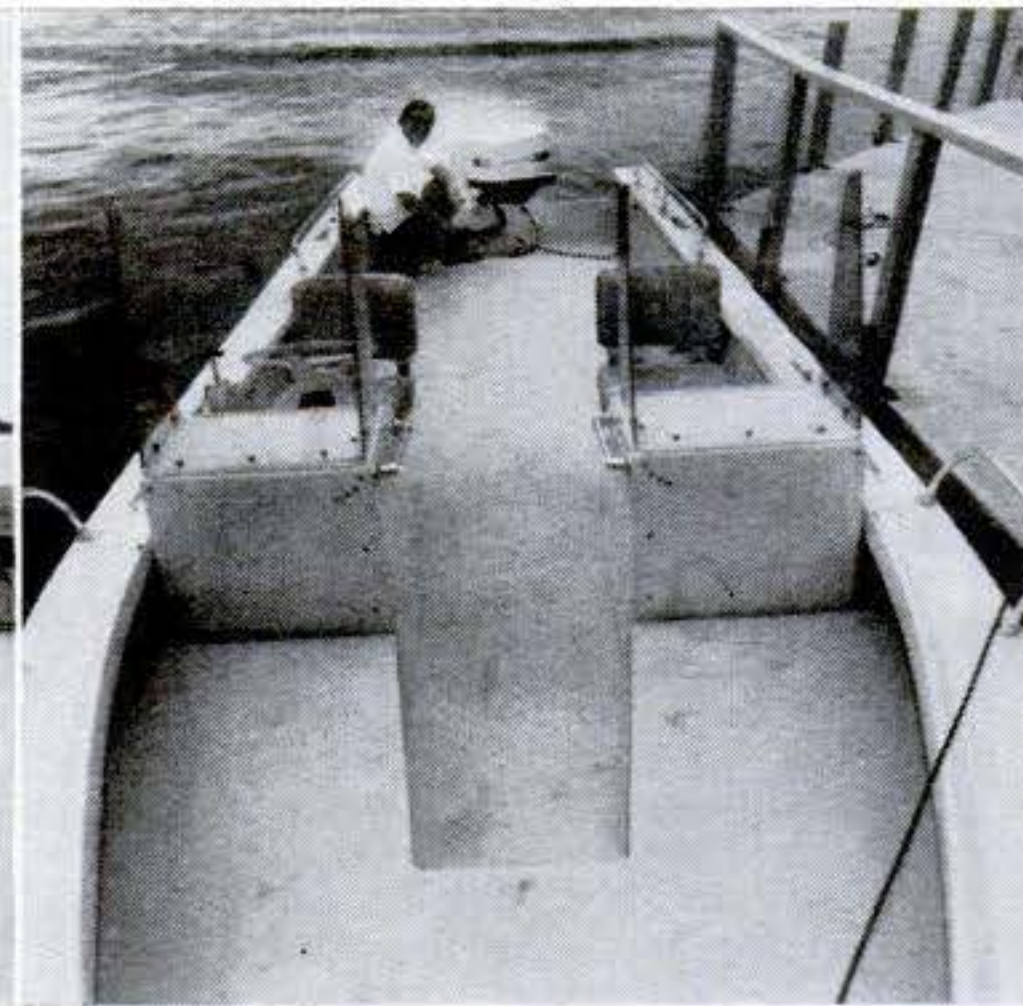


Helm station with full-height windshield puts you in control at all times.

ing off, we maneuvered through Cypress Gardens' narrow twisting channels and out into the lake. The extreme length of the boat gives you a handling feeling that's unusual for an outboard, but she maneuvers well.

On the open water the Pro 24 drives like a big boat. The bow has dory lines—a foolproof design in a wide variety of water conditions. There's a flat planing surface aft that provides great stability when casting.

Even with the Johnson 125 out back, this boat's not a hot rod. Our normal boat-test maneuvers of wave-jumping and fancy turns are not the Pro 24's cup of tea. But the absence of playfulness in her performance is



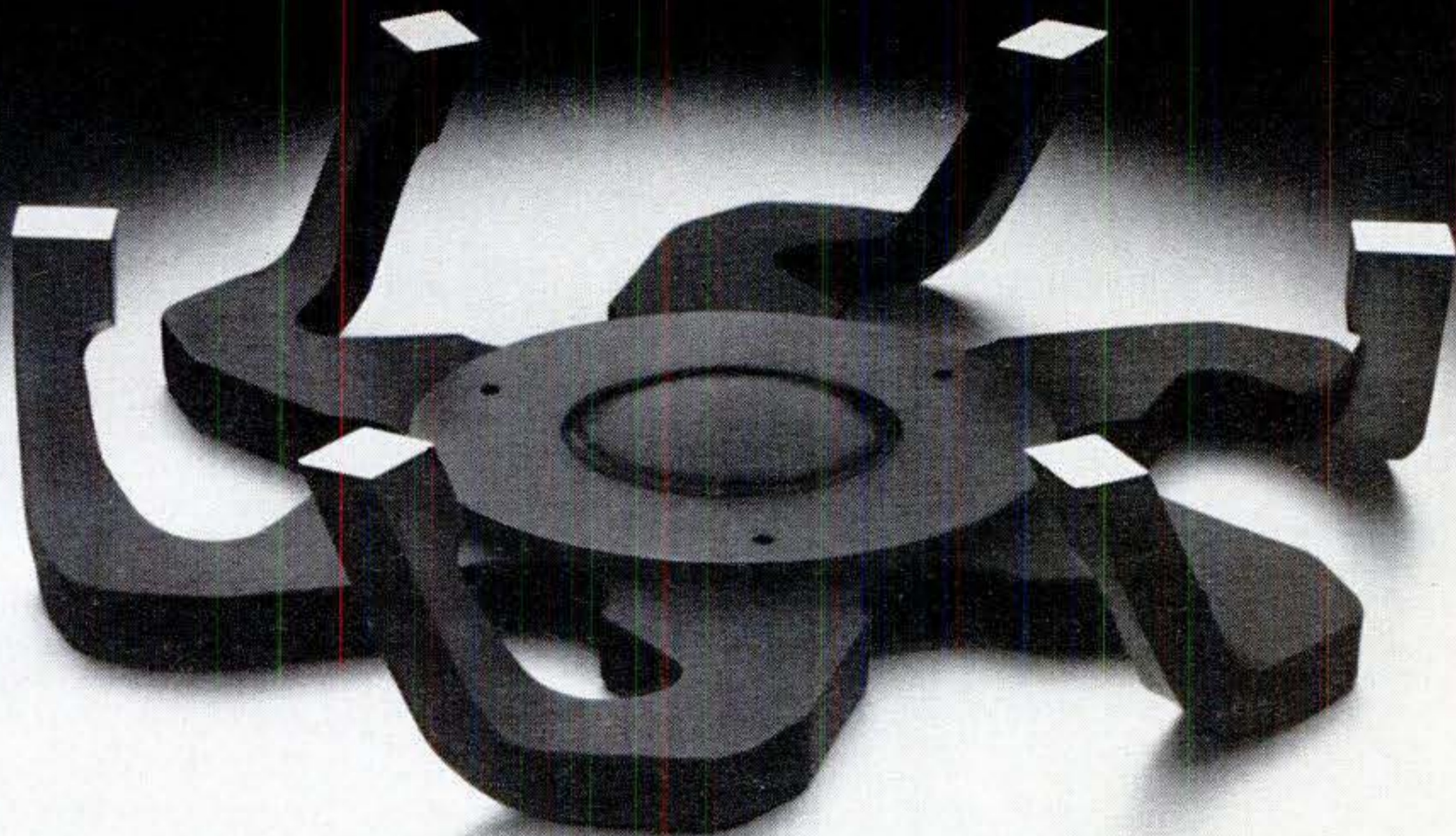
She has more deck space than many larger boats, good footing everywhere for fishing.

replaced by steadiness and assurance when the going's rough—something that will delight offshore fishermen.

The boat is built with a full inner liner, and is designed to be completely self-bailing. Standard equipment includes bow rail, convertible stand-up top with wind curtain, twin consoles and helm seats, a built-in 18-gallon fuel tank, mechanical steering, all hardware and lights, and rod racks.

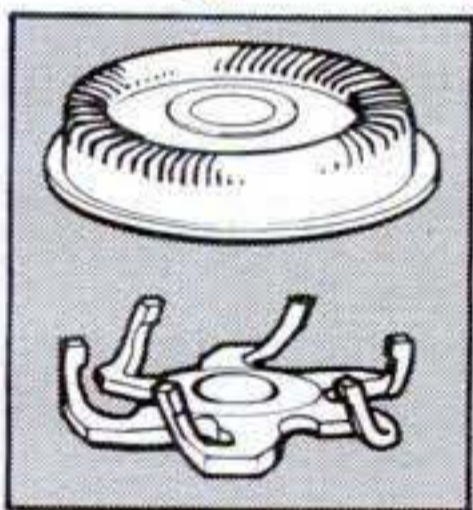
From there, you can equip this boat in almost any number of ways. The manufacturer offers a bait well, extra gas tanks, marine head, and a canvas cover for the bow platform.

She's made by Pro-Line, Inc., Crystal River, Fla. PS



The blade that sets the standard of closeness doesn't fit in a razor.

It's the Norelco 6-edged surgical-steel rotary blade. And everything about it is designed to shave closer and more comfortably than any blade you've ever used.



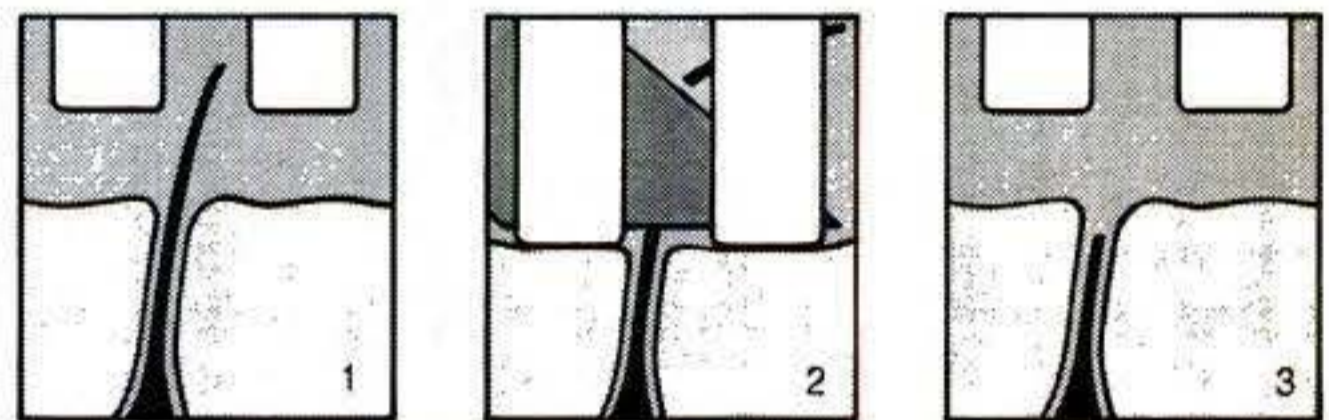
Rotary blade as it fits in slotted head.

As you shave, this unusual blade constantly hones itself, so it stays sharp day after day. You don't have to worry about replacing it.

Because it rotates, its motion is smooth and continuous, so it can't nick or pinch you.

And since it works inside floating heads (which bring it comfortably into every nook and cranny of your face), it does something else that's really remarkable.

As the diagram shows, our rotary blade can actually shave *below* skin level! And that's how it sets the standard of closeness.

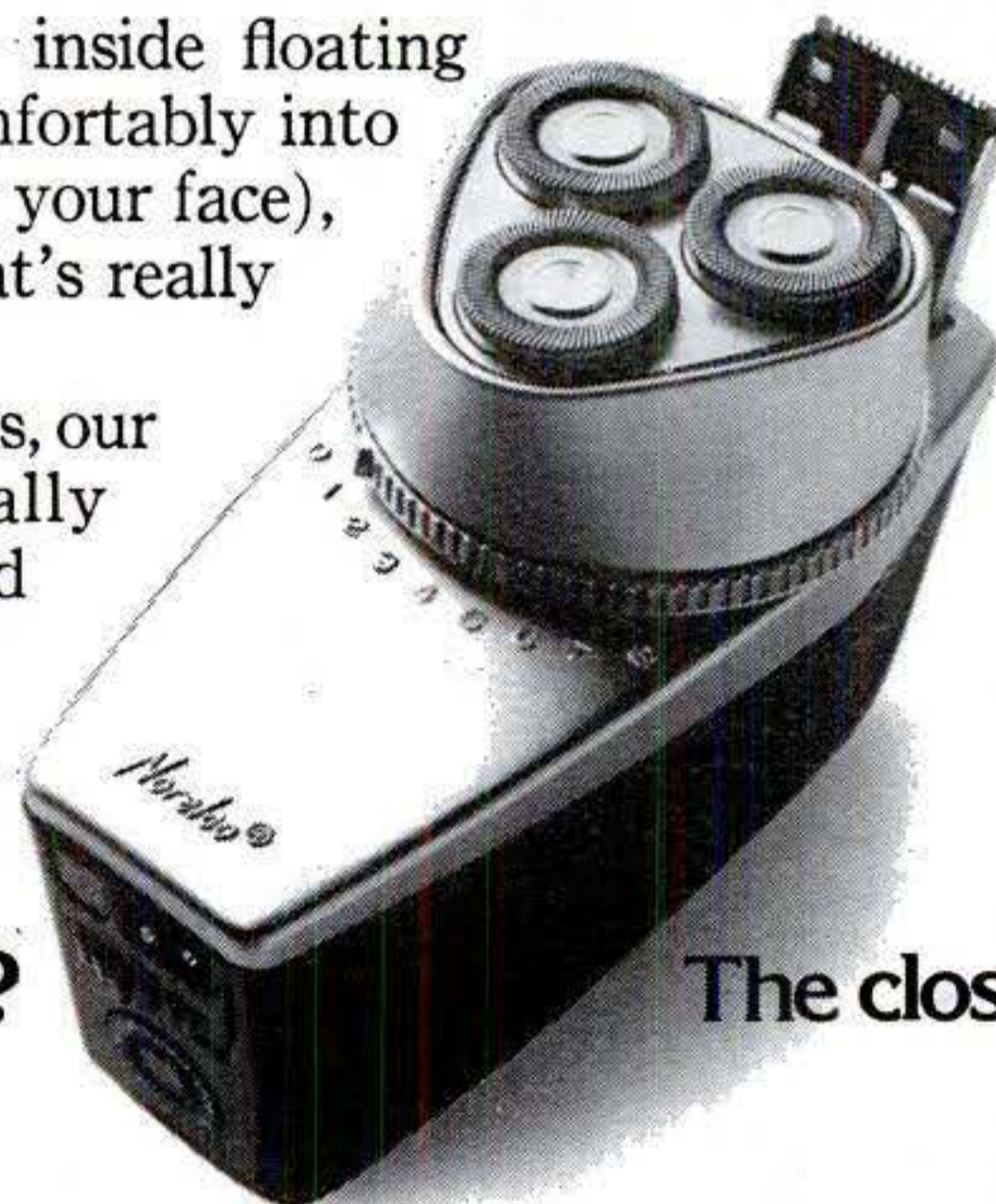


How VIP shaves below skin level. 1. Head approaches whisker. 2. Presses skin down, so blade can cut whisker. 3. Skin returns to normal, leaving whisker below skin level.

This blade is the heart of the most unique shaving system ever created. The adjustable Norelco VIP™ Tripleheader. Because not only can you shave below skin level. You can do it with remarkable *comfort*.

The VIP lets you choose from 9 different closeness-comfort settings. One setting is for very heavy beards. One is for very light. One is just perfect for you, no matter what kind of beard you have.

No wonder we dare to match shaves with a blade.



The *Norelco*® VIP

The closest shave.

Detroit Report...

By JIM DUNNE / PS Detroit Editor



Now there are three types of GM rotary engines

Six cars equipped with GMRE (Wankel) engines were shown to GM's board of directors at their annual product show earlier this summer. The cars were Vega, Nova, and Corvette, plus three small front-wheel-drive Peugeot 304s. They were equipped with three different versions of the GMRE.

The highly secret directors' meeting is held annually to give GM brass a chance to see all future products at one time. Usually, only the next two years' models from Chevy, Buick, Olds, Pontiac, and Cadillac are shown, but the Wankel vehicles stole this year's show.

The Vega had a twin-rotor unit rated at 206-cu.-in. displacement. Same for the Nova. The midships-engined 'Vette had a similar engine of 266-cu.-in. displacement, which produces about 250 hp. The three Peugeots were outwardly similar but had different engines. One had a single-rotor 103-cu.-in. engine; another had the 206-cu.-in. Vega/Nova engine; and the third was powered by the 266-cu.-in. Corvette engine. Since the Peugeot weighs but 2000 pounds in its standard configuration, the engines represent a power potential that ranges from good to outstanding. Purpose of the GMRE power display was to acquaint top management with all the GMRE projects the company has under development.

Wankel fever—temperature runs high

Everybody in Detroit is talking about Wankel engines—and with good reason. Chevrolet alone has four projects in its engineering center.

You are familiar with the 1974½ Vega [PS, May]. Most spectacular is the midships-engined Corvette, now scheduled for 1975. But the most significant is a front-wheel-drive four-door sedan about the same size as the Nova. This project could be ready by late '75—and the other car divisions may get their own versions of this car. Finally there is the mini-compact commuter car with a single-rotor GMRE. This too is front-wheel drive, but could be the last of the four Chevys to hit the market. None of the programs has an official go-ahead, but all are aimed for tentative introduction dates.

A Wankel for the Mustang—or the Capri? Or both?

Ford is not to be left behind in the Wankel race, even though the company has a late start. Designers at Dearborn are hoping to bring out a Wankel-powered Mustang sometime in 1974. The company is in an all-out race to beat Chevy's Vega rotary to the market. It isn't possible for Ford to build its own engine in that time, so other sources are being considered.

Ford is reportedly hoping to use a Mazda rotary. But there are obstacles. First, Ford may have to wait in line: A number of other auto makers also want to buy the Japanese engine for their own cars. Of course, Ford of Europe is licensed to make Wankel engines, and the German branch at Cologne is reported to be revamping a whole plant for rotary-engine production. But it's well-

known that the major part of Ford's research on Wankels is done in Dearborn, not in Germany—so it's doubtful that production can get started in time for Ford to build a Wankel-powered Capri by 1974. But that seems to be their goal.

Under the terms of the agreement with NSU/Wankel, Ford has the right to sell Wankel-powered cars built in Germany in the U.S. without incurring any additional royalty, but does not have the right to import Wankel engines made in Germany for installation in U.S.-built cars.

A fury over the Fury

Chrysler says the slow sales of its big cars, especially the Fury, are not part of the general trend toward smaller cars. Instead, it shows a weakness in the product. This surprising confession comes from top Chrysler executives, who say that sales of the big cars are the corporation's number-one priority right now.

Before Chrysler can look to other fields (like the subcompact), it must first put the big-car situation in order. The first move in improving big-car sales comes this fall when the 1973s hit the showrooms. The new cars have radically changed front ends. For one thing, the loop bumper is gone. In its place are grilles that look very much like the competition's, especially Chevrolet's and Mercury's. Chrysler stylists may have gone too far astray with the loop-bumper approach, and this could explain the decline in sales, some Chrysler insiders now speculate.

More subcompacts are on the way

Both Chrysler and American Motors have firm plans to build smaller models in the next four years. All

they are waiting for is an official okay from company brass.

Chrysler's will be a subcompact about the size of the Pinto and Vega. The company has been left behind in the domestic-subcompact race, and will make a move soon to catch up. This car, which won't appear until 1976 at the earliest, will be built in the U.S. and will have a Wankel engine. That's the word at Chrysler right now.

It's certain that they'll have to build a new engine for the car, and a four-cylinder reciprocating engine just won't do the job. "We need more power in these cars, and we need lightweight power," a Chrysler executive told me. "The best answer is the Wankel."

American Motors' plans include a line of cars smaller than the Gremlin. These would also use Wankel engines, but AM is not saying where the engines will come from.

New roof type for GM wagons

A new station-wagon design that has the rear portion of the roof slide forward for easier loading is planned by GM for its big wagons within two years. The sliding roof, along with a two-way door gate, would give unequaled access to the rear cargo area for loading and unloading.

This is the latest in a series of attempts by GM to combat Ford's lead in the station-wagon field. GM is desperately searching for an alternative to the Ford three-way gate. So far GM, for all its efforts, has not gained an inch on Ford. The sliding-roof concept is completely different from the new tailgate on GM's 1973 intermediates, and it looks as though GM is preparing this one as insurance in case the new model doesn't catch on.

More competition for the Jeep

I'm talking about the four-wheel-drive civilian Jeeps and Jeepsters, and their direct competition, which includes the International Scout, Ford Bronco, Chevy Blazer, and GMC Jimmy.

Now Dodge is hoping to build a vehicle in this class in late '73. Chrysler will follow the example of the Blazer, build the vehicle off its light truck pickup chassis. Like the Blazer, the Dodge will have no permanent roof, and door frames will be cut off at the window level. A semi-permanent fiberglass roof will be offered as a factory option.

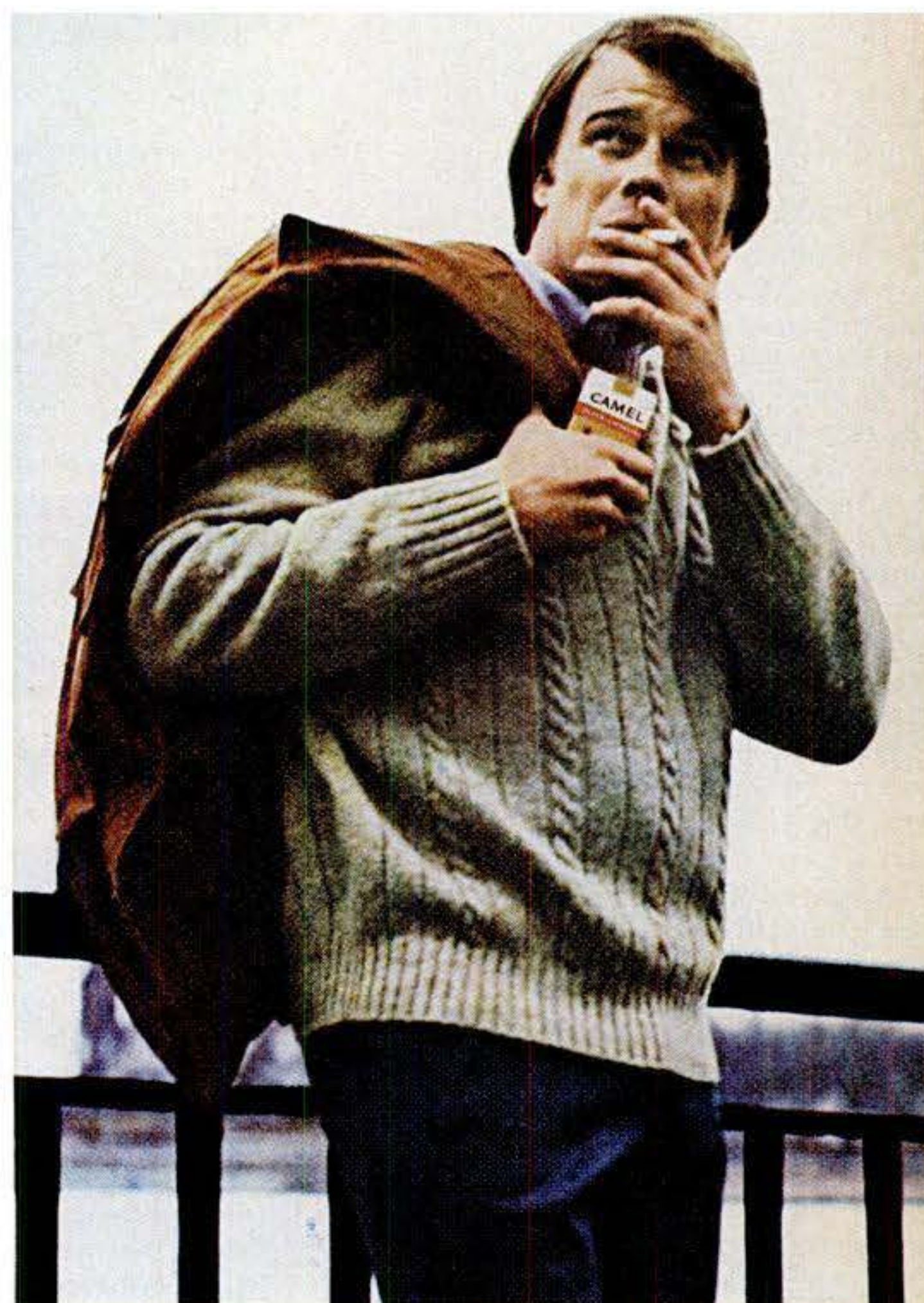
Full-time four-wheel drive

One point worth watching on that new vehicle: It looks like a safe bet that Dodge will offer full-time 4WD, since one of the best new units is made by New Process, a Chrysler division. The full-time 4WD has five positions—lock low and high, unlock low and high, and neutral. By the time the new Dodge appears (as a 1974 model), most other recreational vehicles of this type will have full-time 4WD, too. PS

The latest gimmick at Maxine's Massage Parlor is to offer customers her own brand of roll-your-own filter cigarettes.

Now everybody will be smoking Maxine's roll-your-own filter cigarettes

...almost everybody.



©1972 R. J. Reynolds Tobacco Company, Winston-Salem, N.C.

Camel Filters.
They're not for everybody.
(But then, they don't try to be.)



Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

19 mg. "tar," 1.3 mg. nicotine av. per cigarette, FTC Report APR.'72.

Recreation Roundup

... on the go with PS

By HERBERT SHULDINER



Rear-engine motor home is a whale of a new camper

The new FMC 2900R motor home is one of the largest production RVs ever offered. It is 29 feet long, 8½ feet high, and eight feet wide, and has a seven-ton GVW. Luxuriously furnished inside, it sleeps four adults. The FMC motor home is powered by a rear-mounted 440-cu.-in. Chrysler V8, and has rear drive. It's built on a custom-made chassis and has an aluminum upper cage and 10 built-in roll bars.

Is fun making us deaf?

"Too much of our recreation no longer recreates—it self-destructs," according to a recent article in *Family Safety*, published by the National Safety Council.

The article says that factory noise, jets, city traffic sounds, and construction noise are the most noticeable "assaults on the ear." But recreation noise is sneakier and potentially damaging. For example, it rates motorcycles, snowmobiles, all-terrain vehicles, and the din of a cocktail party as very loud—100 decibels. The crowd roar at a basketball game and amplified rock music rate "uncomfortably loud" at 120 decibels. Hunters are "at the threshold of pain" when they shoot: The rifle-shot noise is 140 decibels.

The article warns that noises that aren't painful—as rifle shots are—should be respected just as much. "Hearing damage happens gradually, like wearing down the tread of a tire," the article says. Here's how to tell if motorcycle, powerboat, or snowmobile might be affecting your hearing:

If, in an arm's-length conversation, either you or your companion has to shout, you're in a "danger zone."

Other warning signs are ringing in the ears after exposure to loud noise and hearing a muffled quality in speech after leaving a place where high noise levels were present.

If you can't avoid loud noise, wear ear plugs to cut down on the noise. But make sure they're a good fit; otherwise they won't help.

For the do-it-yourself outdoorsman: an easy way to remove a shell camper from a pickup

Removing the camper is usually a rough job. But with this rack, one man can do it alone. The rack also doubles for off-the-ground storage.

To make it, dig four postholes 18 in. deep, spaced so you can back pickup between them (see drawing). Set a four-by-four-in. pressure-treated post—long enough to reach six in. above the camper base—into each hole. Tamp earth around the posts to firm them up.

Mark each post for a hole centered two in. above the camper base. Auger-bore the four 1½-in.-diameter holes. Cut two ¾-in. pipes to span each pair of posts and protrude six inches.

To use, back in and unbolt the shell. Lift it and slide in the rear pipe. Repeat in front. For a heavy camper, use a jack and padded T lifting block.

New line of Pop-Tops



The Pop-Top Co. offers three new kits for raising the roof of your van. They come in three sizes: 70 by 40 in. (\$340), 77 by 46 in. (\$350), 88 by 46 in. (\$395). Weights are 140, 170, and 180 pounds. All are made for a precise fit to roof contours. You can get full details and installation instructions from the company at 8903 Mentor Ave., Mentor, Ohio 44060. Pop-Top claims to have the broadest line of custom-fit, fold-down tops. They're available for all sizes of vans, including VWs, for model years from 1962 through 1972. The tops, which fold down to 5½ in., provide 22 in. of additional headroom when open. That's enough to turn ordinary vans into campers.

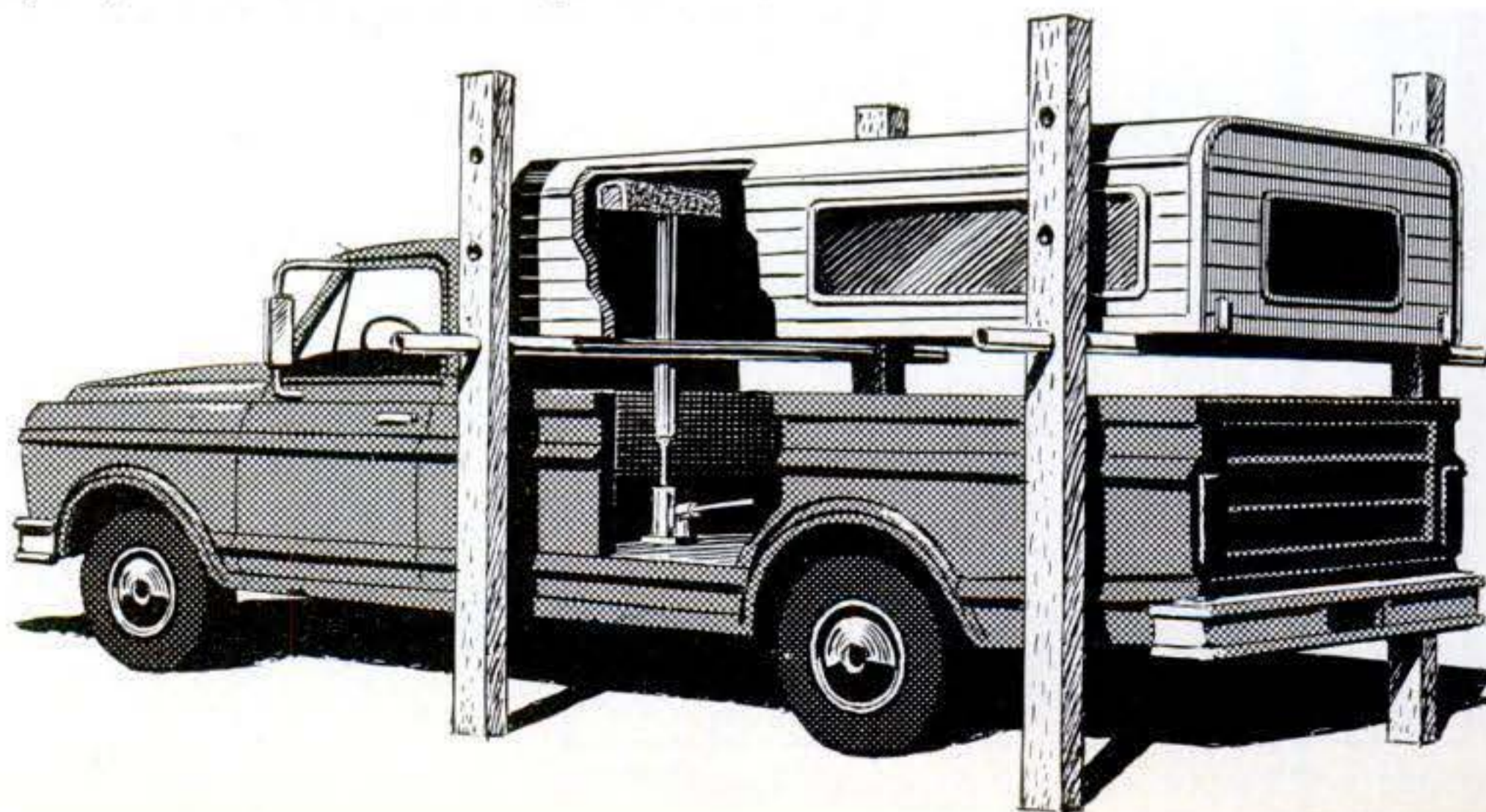
Off-road vehicles on federal land

No great change is forthcoming in the use of off-road vehicles on federal lands, we've been told by federal officials who've been weighing the environmental impact of these vehicles.

The Bureau of Outdoor Recreation Task Force Report on Off-Road Vehicles, which was released last May, found that little apparent environmental damage was caused by fun vehicles, despite much emotional outcry against their use. Secretary of the Interior Morton has nevertheless ordered a review of ORV use on lands administered by his department. But when the hue and cry is over, you should in general be able to use any ORV on government land where you've used it up to now.

Things to write for

Explore is a handsome new booklet designed to introduce you to the recreational facilities in our National Forests and Grasslands. It's 35 cents. *Bicycling for Recreation and Commuting* contains a map section with 29 trails in the National Recreation Trails System and an illustrated history of bicycles. Price is 45 cents. Both booklets can be obtained from the Government Printing Office, Washington, D.C. 20402.

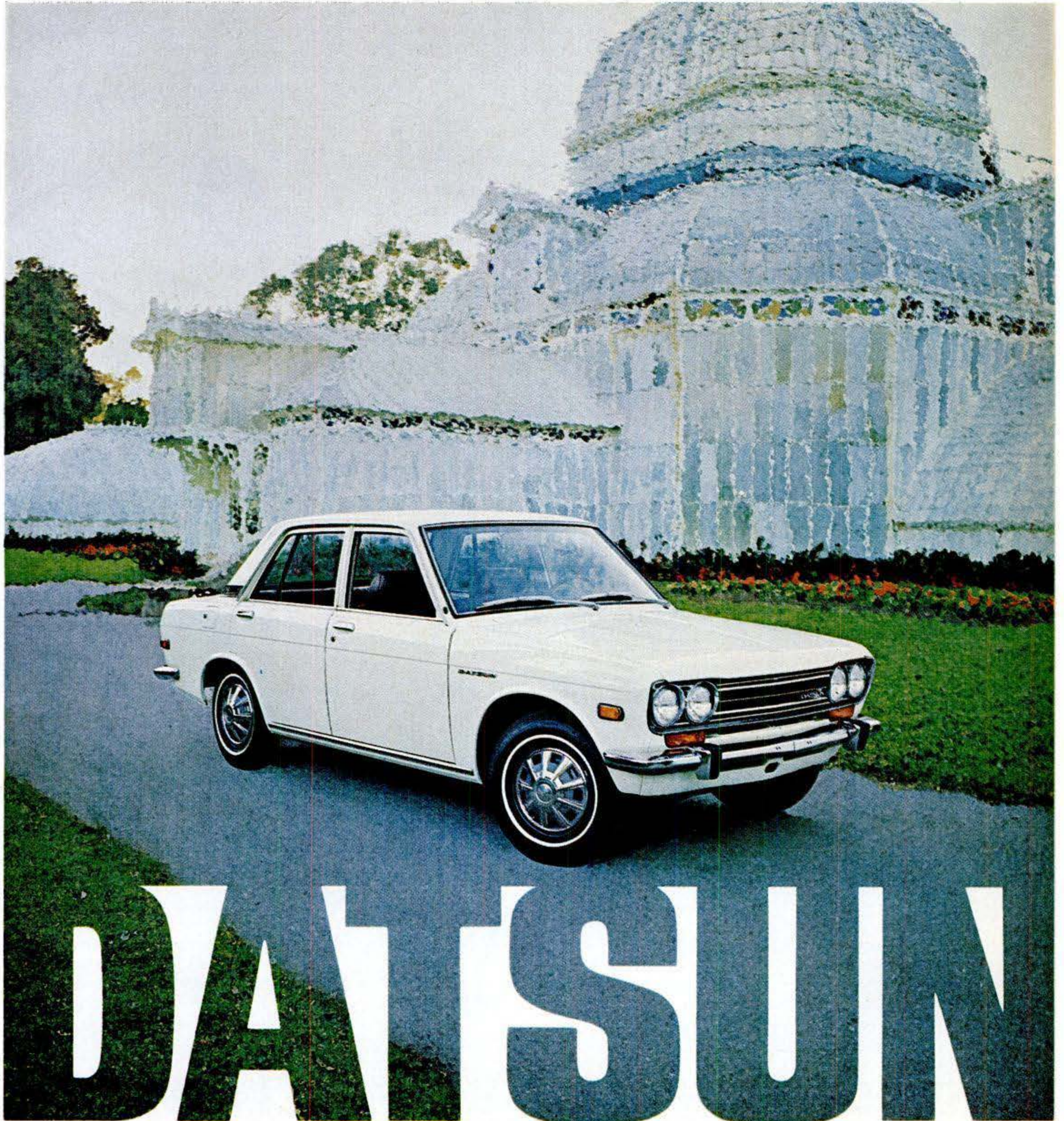


Almost everything you'd want to add is already on it.

We don't like plain vanilla cars any more than you do...even when they're economy cars. So our 510 4-Door Sedan comes with all the trimmings. Whitewall tires, tinted glass, fully reclining bucket seats, nylon carpeting and lots more are all

standard equipment. So is technical sophistication, like our safety front disc brakes, fully independent rear suspension and overhead cam engine. If plain vanilla isn't your favorite flavor, try something a little richer.

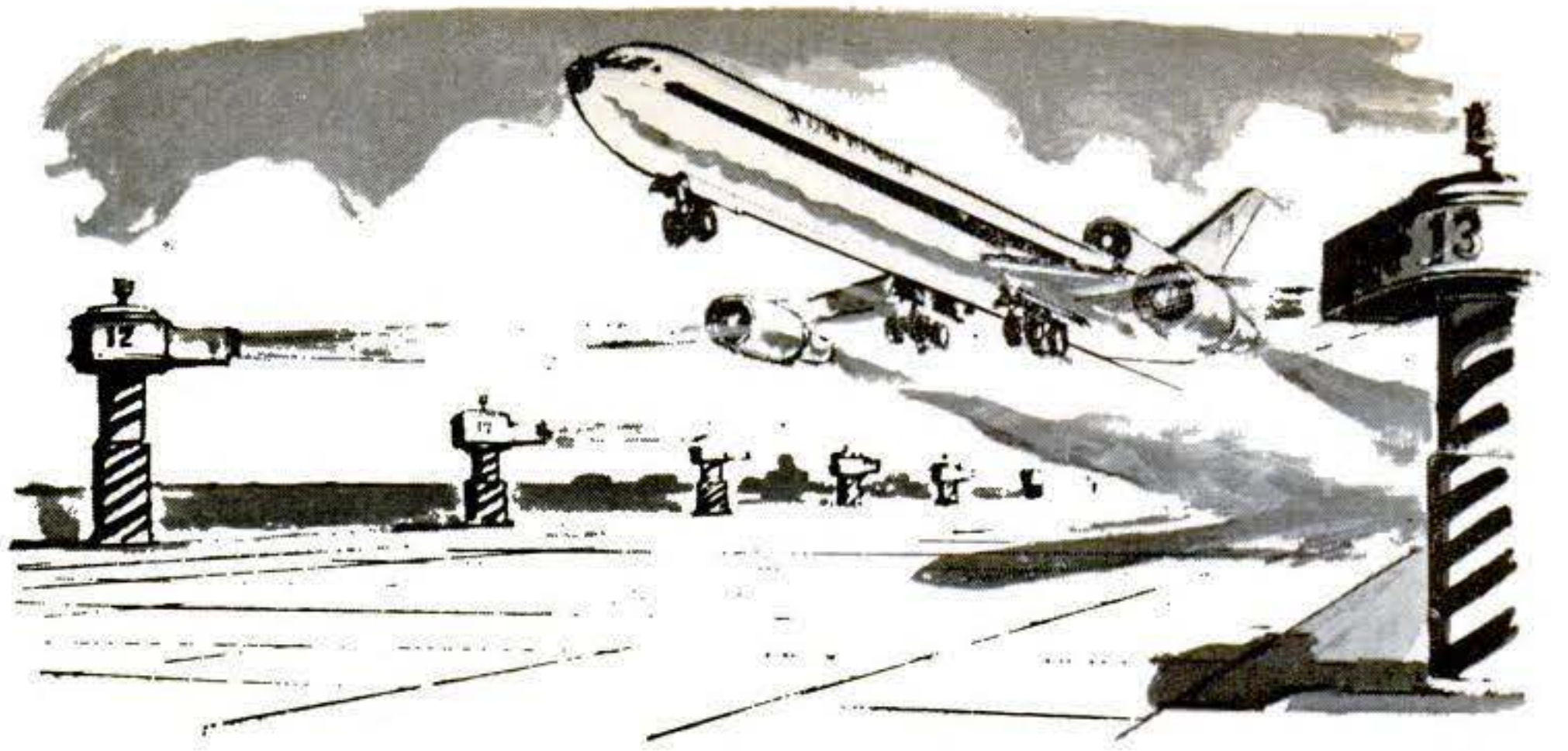
Drive a Datsun... then decide.



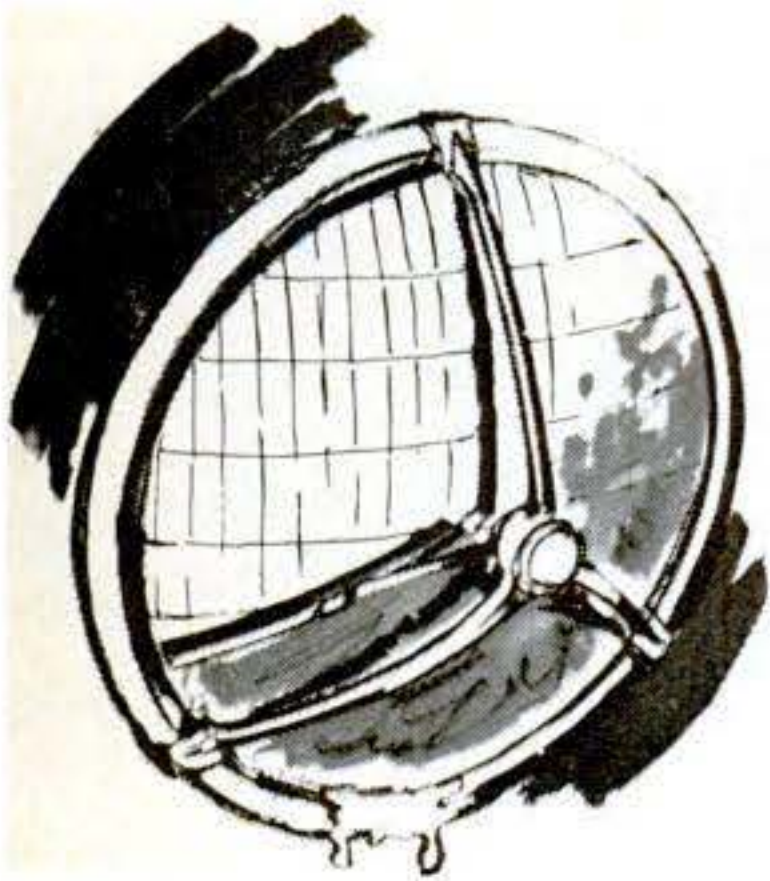
FROM NISSAN WITH PRIDE

New Ideas from the Inventors

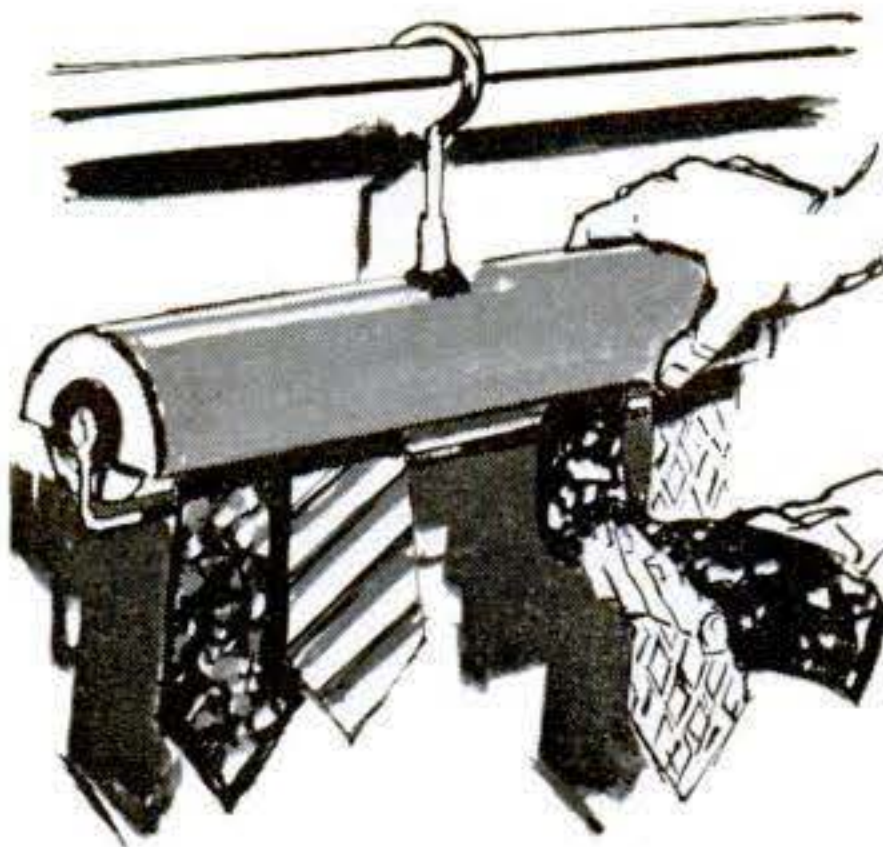
ILLUSTRATIONS BY DANA RASMUSSEN



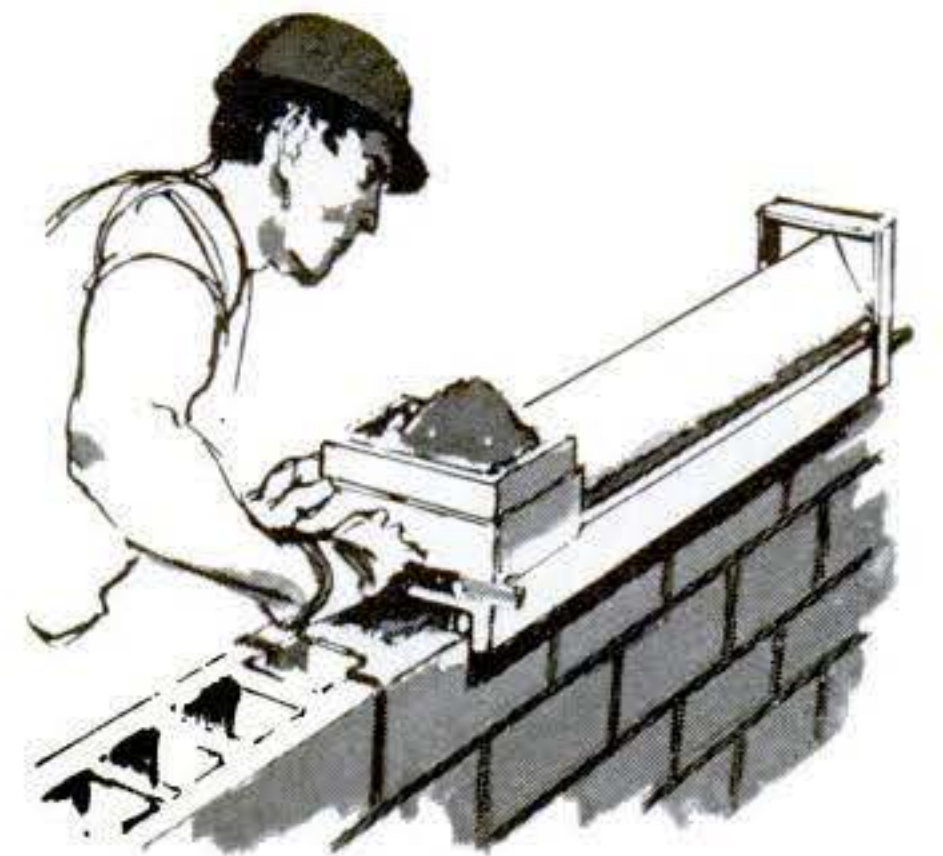
Runway jets shorten takeoff. Manufactured surface winds, according to this recent patent, would reduce the power needed during a plane's lift-off, lessen brake and tire wear in landing. These high-powered blowers, placed along a runway or carrier deck, would direct streams of air across a plane's airfoils. They'd make shorter runways practical for both takeoff and landing.



Washer cleans headlights. Fastened to the rims of a car's headlamps and connected to the windshield-washer piping, these attachments would spray off light-dimming road grime. Their wipers, driven by center-mounted rotary motors, could be switched on independently or through the regular wiper circuit.



Travel roller hangs ties. Rolled onto the sponge-rubber core of this hanger, neckties might travel without wrinkling, then be hung out for easy storage, convenient selection. You'd slip a stretchable, trough-like container over the rolled ties to hold them, slip the container off to hang them out.



Hopper spreads mortar ribbons. Laid along the top of a course of brick or blocks, this spreader would lay even ribbons of mortar as you moved it along the guiding beams. You'd refill the small hopper with fresh, soft mortar for each course or two; it would flow into position along angled plates.



Cutter lifts shrubs. Pivoted in front of a wheel-mounted motor, this curved, chain-driven cutter would reach down and under a small shrub or tree. Sweeping side to side, it would saw out a bowl-shaped ball of earth. Lifted out, the tree could be transplanted in a similarly cut hole, or balled, with its roots inside burlap, for safe, live shipment.



Pleats vent umbrella. Rain and high wind often arrive together, turning many umbrellas into hard-to-handle parachutes. Separate but overlapping vanes on this umbrella would open under wind pressure to vent the gusts instead of containing them, to save you from being hauled about and save the umbrella from being turned inside out.

The following patents have been issued on these inventions: **Runway jets**—No. 3,544,044 to B. Stahmer, Omaha, Nebr.; **Headlight washer**—No. 3,546,732 to K. Kuester, Kingston, Ont.; **Tie hanger**—No. 3,537,625 to B. Nuttall, Salt Lake City, Utah; **Shrub cutter**—No. 3,534,487 to J. Arnaz, Mountain View, Calif.; **Mortar spreader**—No. 3,545,159 to M. Brewer, Spring

Valley, Calif.; **Vented umbrella**—No. 3,559,661 to J. O'Rear, Woodstock, Vt., E. Hanselman, Hoosick Falls, and K. Gifford, Eagle Bridge, N.Y. 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, address him (by name and patent number) in care of the Commissioner.

Crescent[®] really put some teeth into socket sets.

We put 44 teeth in our ratchets. Tough teeth that give you better maneuverability with less effort. Strong teeth that bite and hold, no matter how tough the nut. Plus we knurl the handle for your comfort, and cold-form the drive tang for added strength.

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Cricket turns its back to the camera; facing the lens (with cars grouped clockwise) are the Colt, the Pinto, and the Vega.

SUBCOMPACT WAGONS: Stylish, Practical, and Sporty

Suddenly, small wagons are IN, and Ford, Chevrolet, and Chrysler are setting the pace

By JAN P. NORBYE / PS Automotive Editor and JIM DUNNE / PS Detroit Editor PHOTOS BY ORLANDO GUERRA

The small-car boom that led Ford and Chevy to produce the Pinto and Vega is still going on—and still gaining momentum. And it's spreading to mini-pickups [PS, July] and mini-wagons, too.

The station wagon is perhaps the most logical body for a subcompact. It offers the most useful space for a given overall length, and the usual wagon-type features (tailgate, folding back seat, and flat cargo floor) provide extra versatility.

In the short time subcompact wagons have been on the market, they've gained enormous popularity. About one in three Pintos is a wagon, about one in four Vegas. Chrysler doesn't have a domestic subcompact, but of-

fers two captive imports—the Cricket, built in England by Chrysler UK, and the Colt, built in Japan by Mitsubishi Motors (in which Chrysler holds an interest).

Both of Chrysler's subcompact wagons have four doors, giving them an advantage over the domestic products, which have two-door bodies only. All have conventional chassis layout, with front engine and drive through a rigid rear axle. The Vega and the Cricket have all-coil suspension; the Colt and the Pinto have coils in front and leaf springs in back.

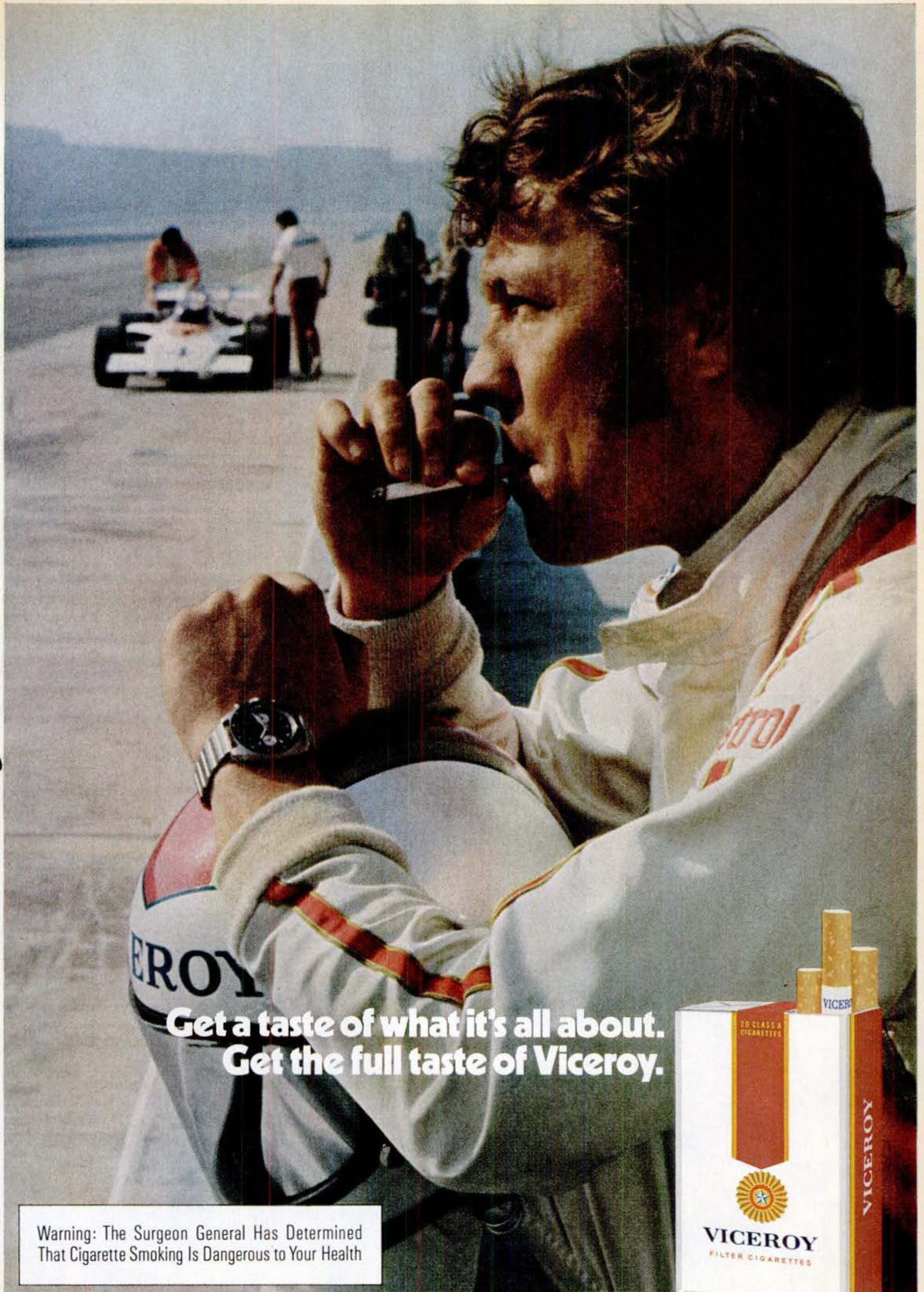
We chose standard engines and manual transmissions in our test cars (three-speed automatics are available for all). You sit low at the wheel of

the American cars, with reduced vision. The imports have higher seats and give a better view, making it easier to judge the exact length and width of the cars in tight quarters. Inches of cargo space differ:

	Vega	Colt	Pinto	Cricket
Length (with rear seat up)	36	42	36.25	41.5
Length (with rear seat folded)	66.5	59.5	63.75	63.0
Width (between wheels)	40.25	38.5	42.0	40.0
Height (at center)	25.25	32.25	30.25	32.0

Vega Kamback—least wagon-like. The body seems more like a sports sedan. The rear window is no farther

Continued



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Pinto gave shortest stopping distances, with hot brakes or with cool ones, but it could not match the brake performance of the Pinto Runabout [PS Feb.].



Cricket's brakes worked fine, but its narrow tires stretched stopping distances. Fade resistance was very strong.

back than in a compact coupe, and the extra noises that usually crop up in wagons are missing.

It has four-passenger capacity, with fair room for back-seat riders (but front-seat travel is shorter than in the sedan and coupe versions). The rear seat folds forward to form a flat cargo floor, without need to swing the seat bottom forward. One simple latch releases the seat back. The spare tire stows conveniently inside, under the floor at the rear.

Vega's new shoulder-harness storage position is way ahead of the competition: A regular shelf keeps the straps from falling down when not in use. An inside hood lock is standard, and the rod that holds the hood open has been moved to the left, the side the oil dipstick is on. The Vega is the only one of the group with a heated tailgate window for de-icing.

Pinto Squire—most wagon-like. Its extra rear overhang and body styling maintain the wagon look. Though bigger overall than the others, it gains no advantage in useful space.

The rear seat folds forward on release of one handy lever, and you get a long flat floor without tilting the seat bottom. Swing-open rear side windows add ventilation.

Instrumentation is ultra-simple. Small controls differ in shape, making touch-identification a cinch.

The right front seat is fixed in place (runners are optional). The spare tire stores under the cargo floor at the rear, inside the car.

The Pinto is the only wagon with a steel-belted radial-ply tire option. The tires gave the car an important advantage in fuel economy, hard-pavement noise, ride, and handling.

Dodge Colt—smallest wagon. This baby of the group was also the most economical to run. It gave the best gas mileage by far, yet was fully competitive on acceleration. Interior equipment reaches a very high standard—beyond that of the others.

Front seats recline; the steering column adjusts for height. There are armrests, assist straps, a glove box plus parcel shelf, and more-complete instrumentation. Warning lights are

Continued



Pinto was fast in the low-speed slalom, but strong roll oversteer showed up, exaggerating the severity of the maneuver.



Colt in the slalom had the benefit of very light steering and ultra-rapid response, but handling accuracy was poor.



Vega in the lane-change test (top) matched Pinto (above) for speed, but was hampered by the progressivity of its variable-ratio steering, plus strong initial understeer. The Pinto went through with large slip angles on all four wheels. Steering effort was high.



Colt in lane change (top) was slowest, and driving it through the grid was like driving on marbles. Cricket (above) was as fast as the Pinto and Vega, despite its tires. Cricket steering effort was higher, but the stability of this car was clearly superior.

The secret of teaching yourself music

It may seem odd at first—the idea of teaching yourself music. You might think you need a private teacher at \$4 to \$10 an hour to stand beside you and explain everything you should do—and to tell you when you've made a mistake.

But the fact is, you don't. Thousands have taught themselves to play with the lessons we give by mail. And you can too. Guitar, piano, accordion—you can learn any of ten popular instruments.

The secret lies in the step-by-step way our lessons teach you. Starting right from scratch, they show you with simple words and pictures exactly what to do. You'll learn to play the right way—by note, from sheet music. Without any gimmickry.

But how do you know you're doing it right? Easy. A lot of the tunes you'll practice first are simple songs you've heard many times. Since you know how they're supposed to sound, you can tell right away when you've "got them right."

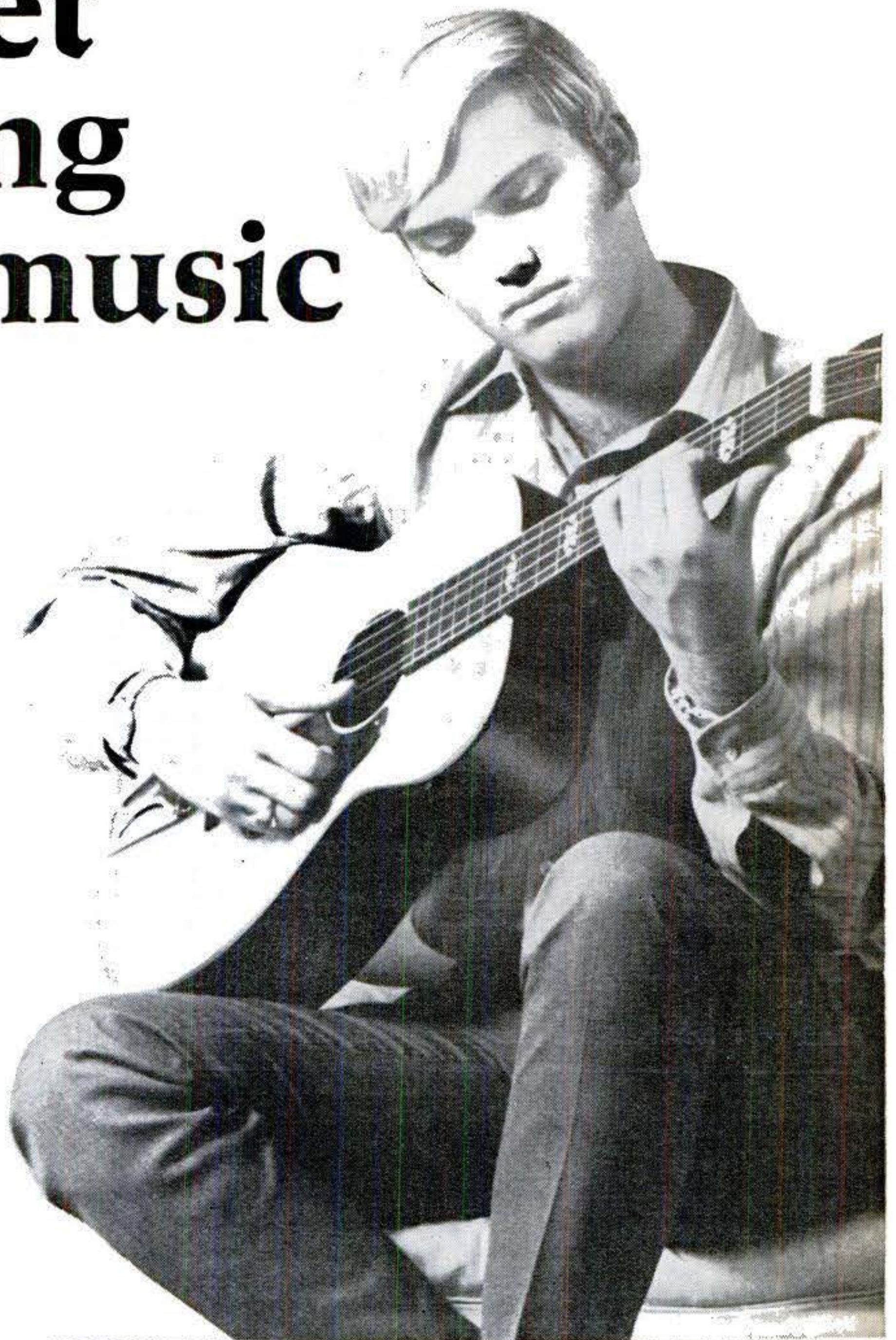
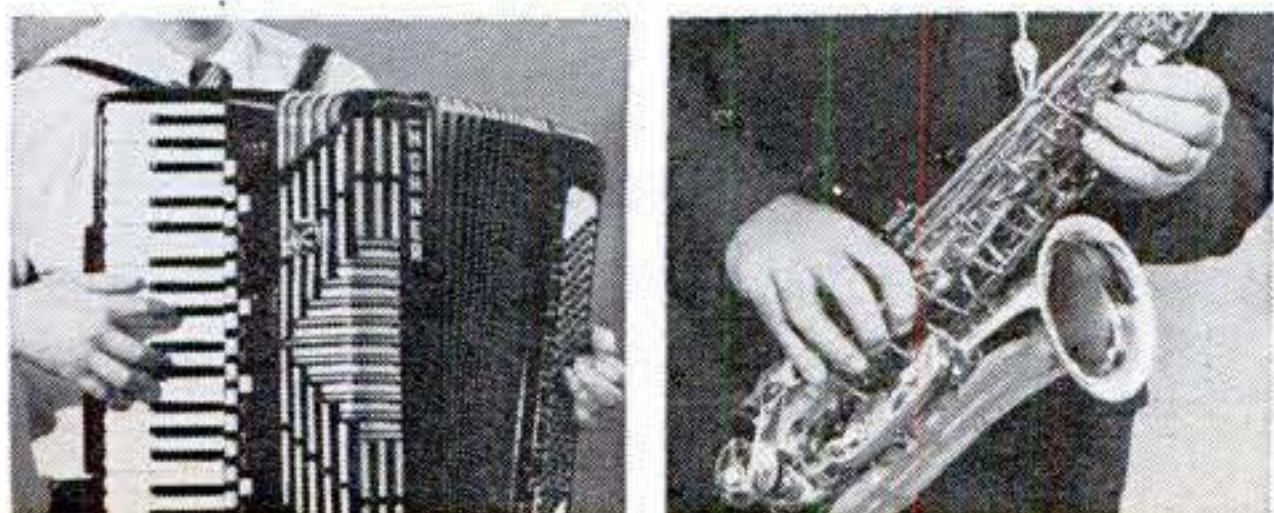
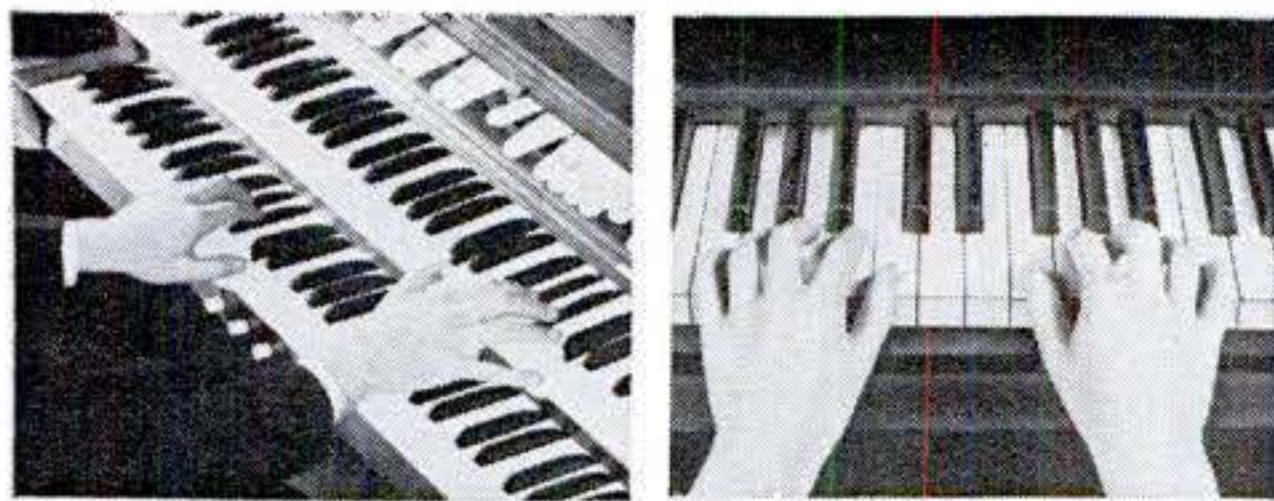
By the time you go on to more advanced pieces, you'll be able to tell if your notes and timing are right, even without being familiar with the songs. Sooner than you may think you'll be able to play whatever kind of music you like. Popular. Classical. Folk music. Hymns.

"The course is the most complete I have ever seen," writes Mrs. Norman Johanson of Maple Valley, Wash., one of our recent graduates. "My daughter has taken lessons for 8 years from a private teacher, and now she asks me questions about some of her lessons."

For more information about this pleasant, economical way to learn music, just mail the coupon. We'll send you our free booklet, *Be Your Own Music Teacher* and a free Piano "Note-Finder." No obligation.

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|---|---------------------------------------|------------------------------------|
| <input type="checkbox"/> Piano | <input type="checkbox"/> Steel Guitar | <input type="checkbox"/> Accordion |
| <input type="checkbox"/> Guitar | <input type="checkbox"/> Saxophone | <input type="checkbox"/> Mandolin |
| <input type="checkbox"/> Organ—pipe, electronic, reed | <input type="checkbox"/> Violin | <input type="checkbox"/> Clarinet |
| | | <input type="checkbox"/> Ukulele |

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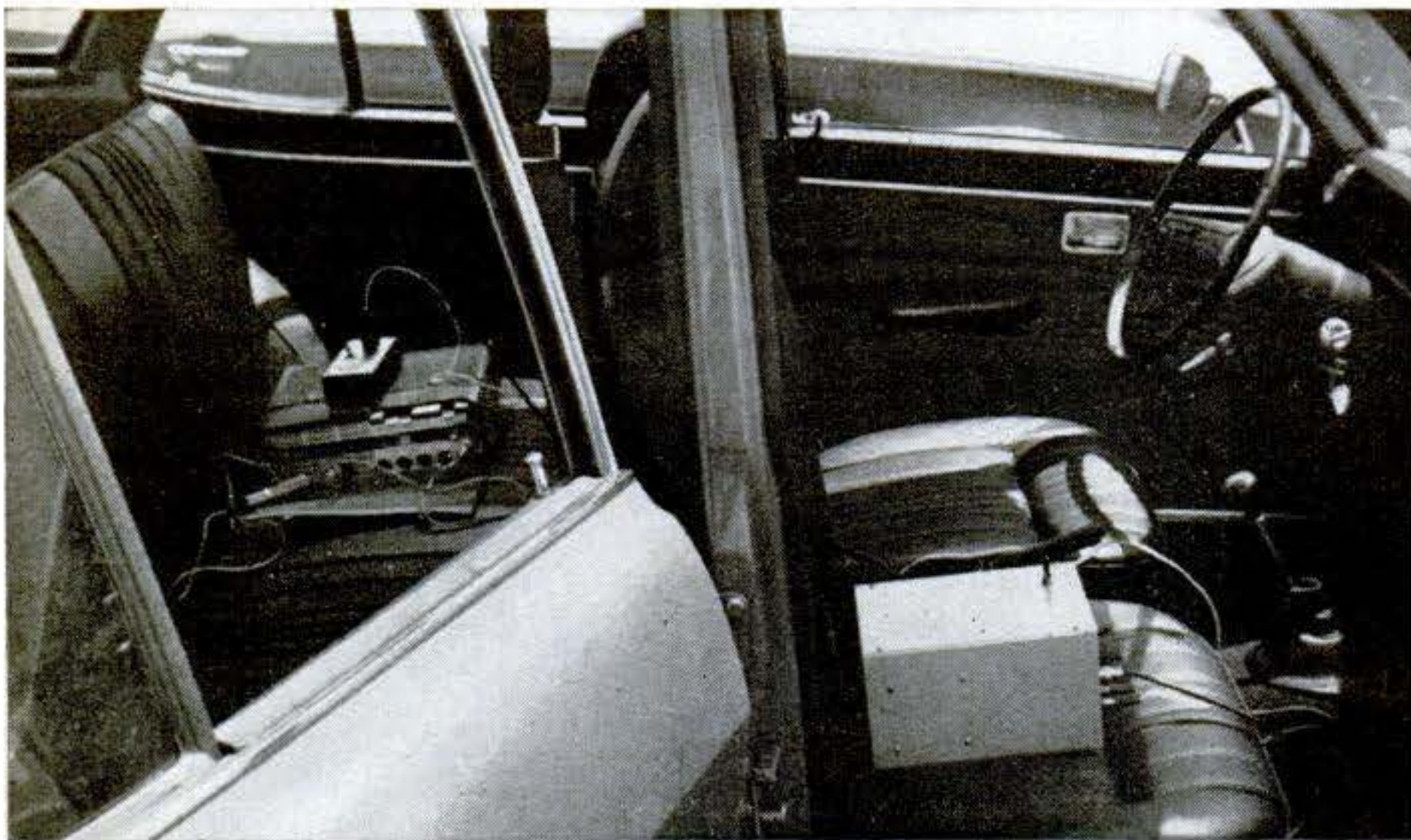
159

PS adds a new test: ride comfort

We have been experimenting with vibration sensors to measure ride comfort for over a year now. We have tried many things, and some of them just didn't work out. We are still experimenting, but we believe that we now have a promising method.

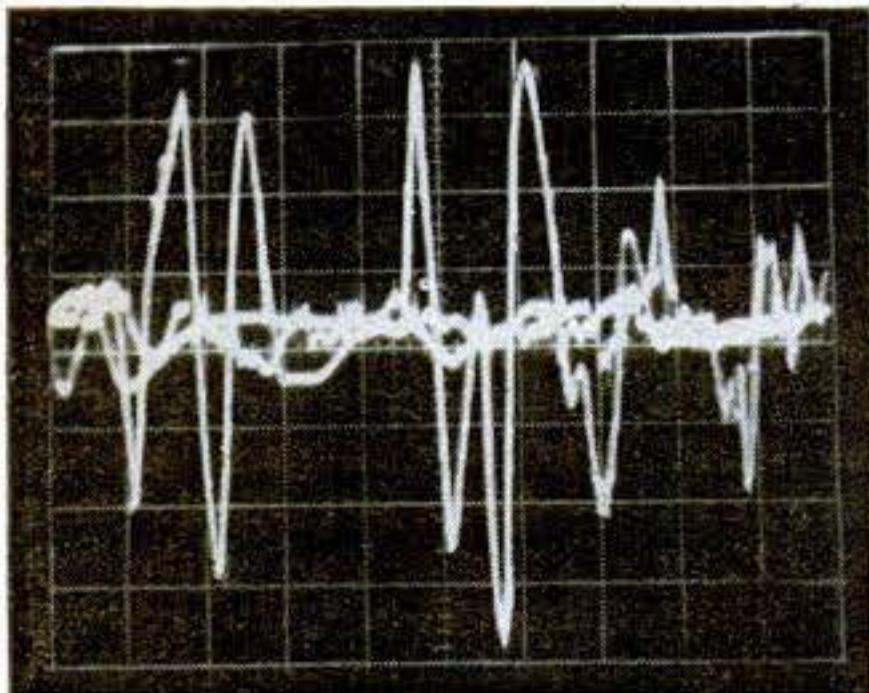
We think that what the equipment is trying to tell us correlates well with our subjective judgments

of ride comfort. But we haven't got enough experience with enough different cars to develop a ride-comfort index. We do not yet know enough about interpreting the readings to pin things down to a simple index number for a given car, but we'll keep trying. Look at our test equipment and oscillograms in the photographs below and learn along with us!

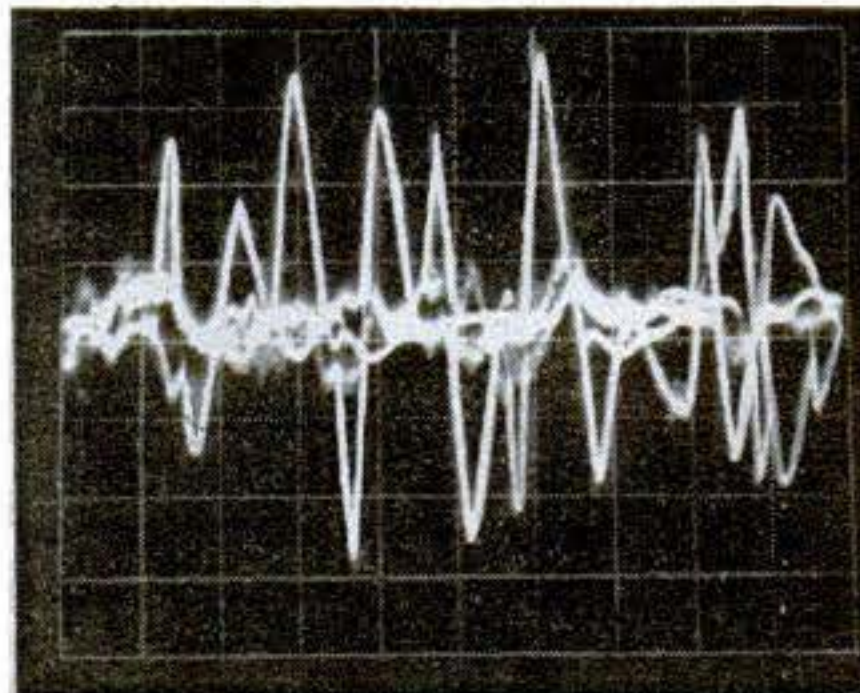


Test bump is 2-by-8 plank taken at 60 mph. Sensor in front seat registers vertical accelerations. Ride motion frequency and amplitude are fed into Uher tape recorder (on back seat). Tape is played back on a Heath EU-70A oscilloscope,

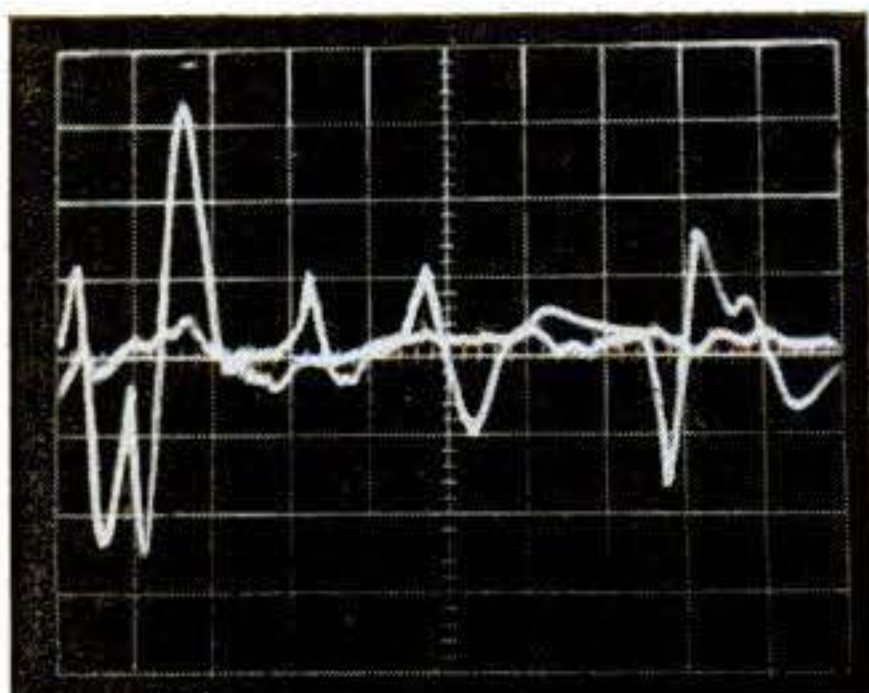
and the picture shot with a Polaroid CR-9 camera. Charts, seen below, plot amplitude (up and down) against time (left to right). Charts show multiple lines because the photo is split in three and superimposed on the first third.



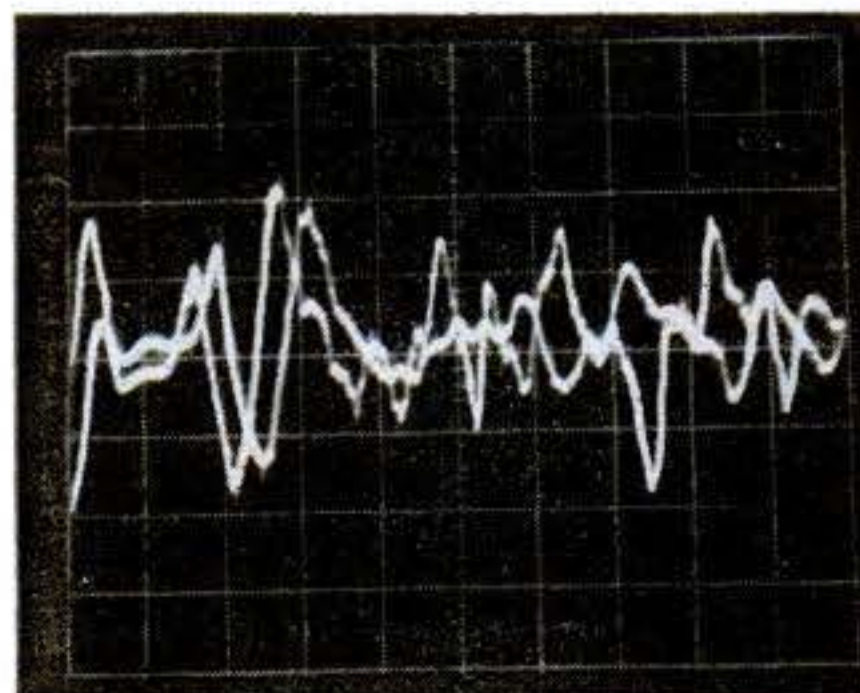
Vega seat took a hard blow (big up-down swings), though its pitch was low (dual lines close to the neutral line). Ride comfort is judged fair.



Colt suffered shocks in the seat, and the busy zigzag lines at the base show a high incidence of both pitch and bounce. Ride comfort: poor.



Pinto took the bump very nicely, and the ride smoothed out almost instantly after the shock. Some light pitch was experienced. Ride comfort: excellent.



Cricket shows good damping of overall shock, but large suspension bounce movements degenerating into pitch. Ride comfort: very good.

used only for oil pressure and battery charging. The wiper/washer switch is in the turn-signal stalk.

Our test car had air conditioning, which explains the high as-tested price, and must be allowed for when you read the test data. The A/C system absorbs up to eight hp and cuts five-six mph off your top speed.

The rear seat is barely adequate for
Continued



Cricket cargo area gives you a full 60 cubic feet of space, and the rear wheel-housing protrusions are fairly modest.



Vega wheel housings are least annoying, but its cargo space is smallest—50.2 cubic feet—and liftover height is greatest.



Pinto holds five-foot ladder, with the back seat folded, and cargo space totals 60.6 cubic feet, despite wheel housings.



Colt has the narrowest rear track and farthest-protruding wheel housings, but its cargo area is still 52 cubic feet.

The Poulan XXV.

Here's why it's America's hottest selling chain saw.

14-inch bar and chain. Not 12". You won't find this on another chain saw for \$129.95. (You'll have a hard enough time finding another chain saw for \$129.95 anyway.)

New! Automatic chain oiling. It's about the only improvement we could make! (For extreme cutting conditions, we left a manual override on.)

The best service in the industry. Thousands of dealers coast to coast with complete service.

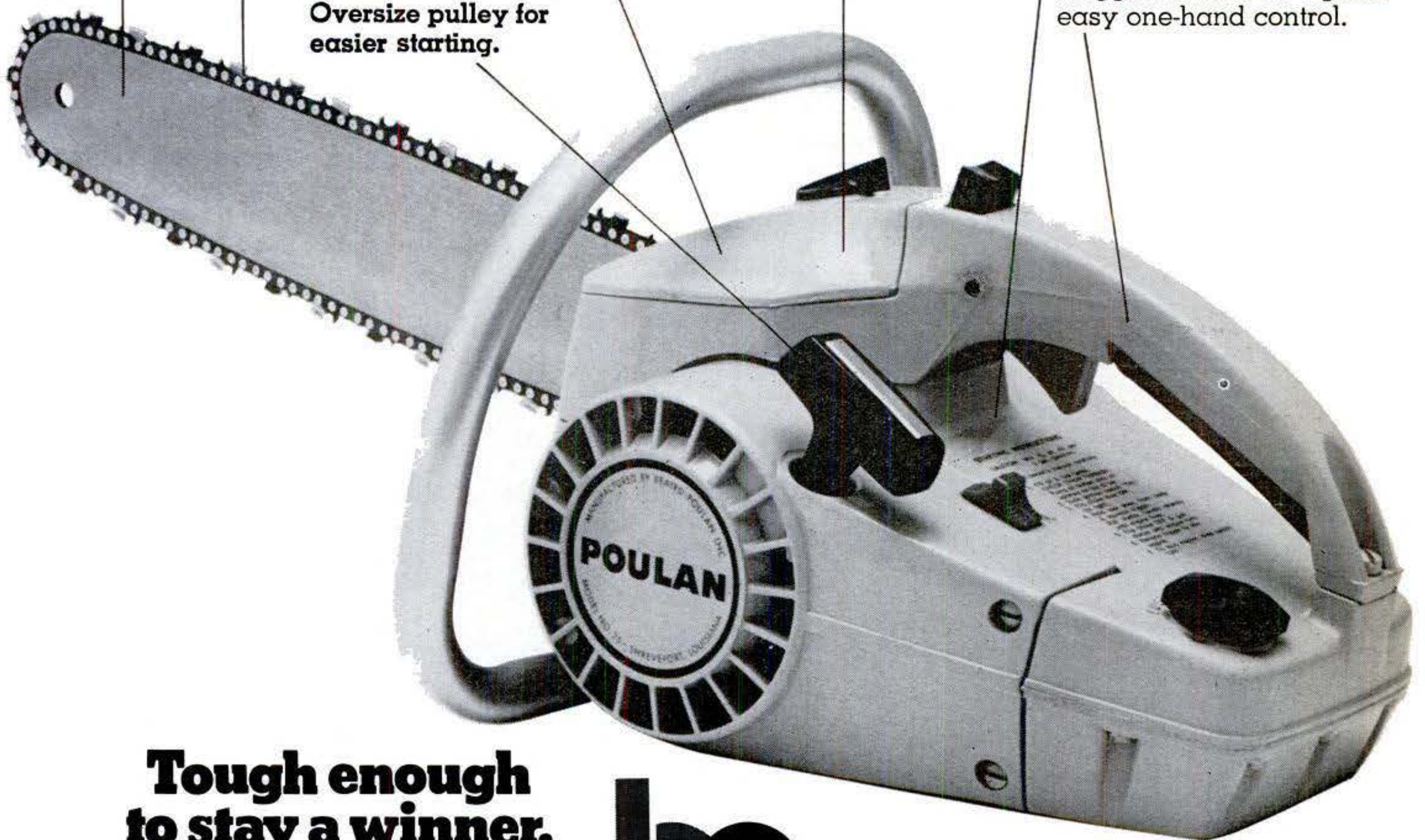
Lightning fast cutting. Buzzes through an 8" log in 4 seconds flat.

Tillotson diaphragm-type carb with fuel finder. Translated, this means the Poulan XXV cuts in any position. Even upside down.

All magnesium housing. Not an ounce of plastic. So it looks and performs like a machine, not a toy.

Oversize pulley for easier starting.

Trigger handle on top, for easy one-hand control.



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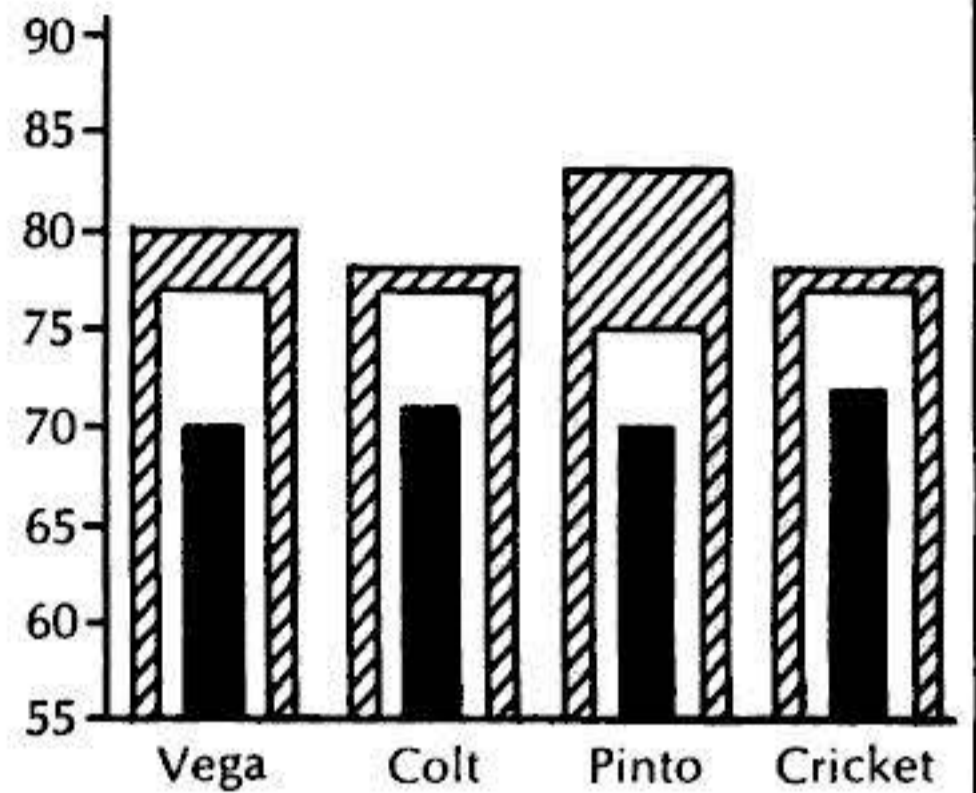
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How comparable vehicles have fared in our tests

CAR	DATSUN 510	FIAT 124-S	GREMLIN X	OPEL 1900	PEUGEOT 304	RENAULT 12	RENAULT 16	SAAB 95	SAAB 99	TOYOTA Corolla	TOYOTA Corona	VW Squareback
Accel. 0-60	16.2	15.4	14.7	16.2	20.3	19.0	17.2	13.1	15.0	18.6	16.6	19.8
Accel. 0-80	32.6	31.3	31.5	30.8	36.75	37.9	32.8	24.4	32.3	37.8	31.9	39.6
Accel. 25-70	16.8	17.5	17.2	17.4	21.8	21.15	18.6	15.0	17.6	22.0	17.6	21.5
Brakes 60-0 (hot)	225.9	134.9	134.5	132.1	147.3	145.1	166.9	150.3	136.5	167.7	166.8	135.5
Lane change (mph)	53.0	59.5	60.0	58.2	60.0	58.2	50.6	53.0	62.4	49.8	49.8	55.4
Slalom (mph)	26.0	26.7	26.8	29.1	27.6	29.6	25.6	26.6	26.4	24.2	24.7	26.3
Fuel (mpg 45 mph)	33.0	34.2	12.8	25.8	33.1	30.7	31.1	28.1	24.2	35.3	27.7	30.0
Noise (60 mph)	77dba	79dba	70dba	74dba	75dba	78dba	77dba	77dba	70dba	77dba	76dba	81dba
Price	\$2035	\$2065	\$2940	\$2311	\$2541	\$2195	\$2582	\$2617	\$4061	\$1798	\$2225	\$2499

NOISE-LEVEL TESTS

We measure interior noise in decibels under three sets of conditions, on three different scales. For quick reading of the results, we give you only the A-weighted scale, which is most like human hearing in overall sound pickup. A decibel difference of one or two points is perceptible to a driver; five points make enormous difference.

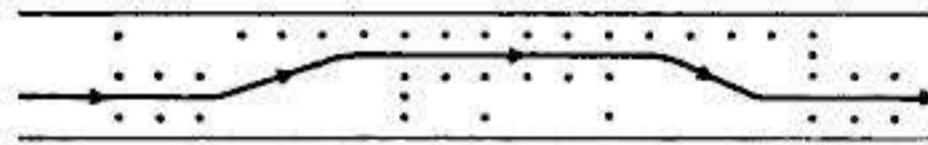


30 mph smooth road
 60 mph smooth road
 30 mph rough road

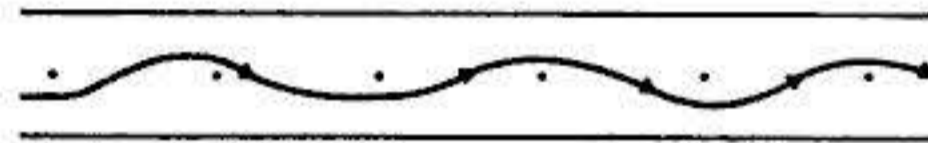
How PS tests cars—and what the tests show

Brake test shows a car's ability to stop from 60 mph without wheel locking. Test is first made with cool brakes, then repeated after 10 warmup stops from 60 at one-minute intervals with 0.5g deceleration. First test shows braking capacity, balance; the second, fade. Excessive pedal pressure indicates fade. Excessive distance indicates fade, incipient or partial locking, or combination of both.

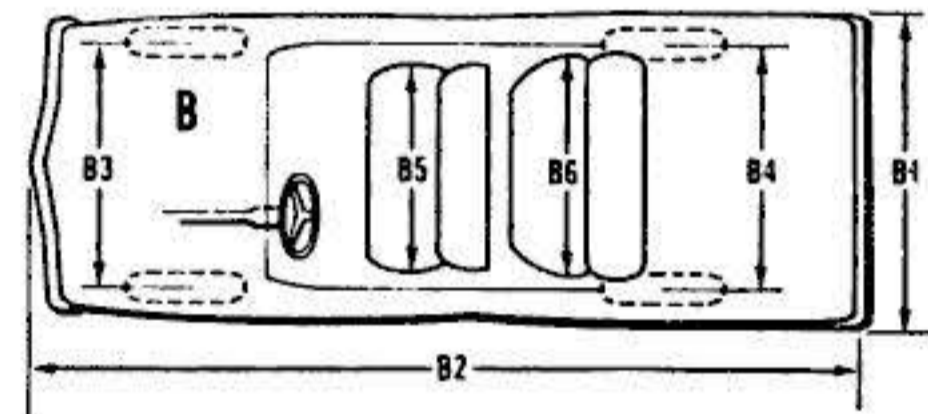
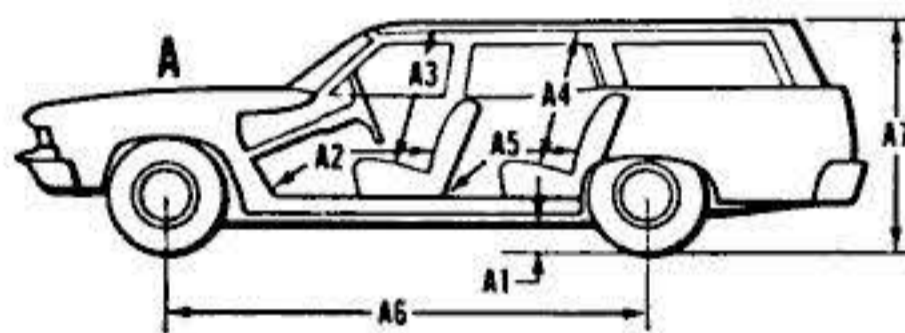
Acceleration test at 0-60 mph shows a car's ability to reach cruising speed from standstill. The 0-80 mph test shows its high-speed power reserve; 25-70 mph test simulates a highway merging situation. Cars with automatic transmission are tested in DRIVE.



Two lane changes in quick succession show a car's ability to make an emergency maneuver at speed. Lanes are blocked 120 feet apart, and lane-change gaps are 60 feet long. Each car is put through test at increasing speed until its maximum is established.



Low-speed emergency maneuver test means snaking a car as fast as possible through pylons 48 feet apart. In both handling tests, times clocked by two stopwatches are converted to mph.



DIMENSIONS (inches)	CHEVROLET Vega	DODGE Colt	FORD Pinto	PLYMOUTH Cricket
A1 Ground clearance	4.8	6.7	4.8	6.3
A2 Front leg room (max.)	42.75	44.0	42.25	46.5
A3 Front head room	37.5	38.0	38.0	37.5
A4 Rear head room	36.25	35.75	39.0	37.0
A5 Rear leg room (min.)	35.0	36.0	34.0	37.0
A6 Wheelbase	97.0	95.3	94.4	98.0
A7 Height	52.0	53.6	51.8	54.9
B1 Width	65.4	61.4	69.7	62.5
B2 Length	169.7	161.2	172.7	166.9
B3 Front track	55.1	50.6	55.0	51.0
B4 Rear track	54.1	50.6	55.0	51.3
B5 Front hip room	21.0 (x2)	22.0 (x2)	20.5 (x2)	21.5 (x2)
B6 Rear hip room	42.5	46.0	49.0	51.0
SPECIFICATIONS				
Engine type	SOHC 4-in-line	SOHC 4-in-line	SOHC 4-in-line	OHV 4-in line
Displacement (cu.in./cc)	140/2292	97.5/1597	122/1995	91.4/1498
Compression ratio	8:1	8.5:1	8.2:1	8.5:1
Carburetion	One 2-bbl.	One 2-bbl.	One 2-bbl.	Two 1-bbl.
Net hp @ rpm	90 @ 4800	83 @ 5600	86 @ 5400	70 @ 5400
Net torque @ rpm	121 @ 3000	89 @ 3600	103 @ 3200	75 @ 3500
Transmission	4-speed	4-speed	4-speed	4-speed
Axle ratio	3.36:1	3.89:1	3.55:1	3.89:1
Tire make	General	B.F. Goodrich	Firestone	Goodyear
Tire type	Belted Jumbo	4-ply rating	Steel Belted Radial	Custom G8
Tire size	A78-13	6.00-13	175R-13	5.60-13
Turn diameter	33 ft.	30.2 ft.	31.5 ft.	31.9 ft.
Turns, lock to lock	3.25	3.75	4.15	3.7
Brakes	Disk/drum	Disk/drum	Disk/drum	Disk/drum
Fuel tank (gal.)	11	12	11.5	10.8
Cargo space (cu.ft.)	50.2	52	60.6	60
Liftover height (in.)	25	22.5	23.33	24.5
Curb weight (lbs.)	2459	2204	2455	2182
TEST RESULTS				
Acceleration 0-60 mph	16.9 sec.	18.8 sec	18.2 sec.	18.85 sec.
Acceleration 0-80 mph	32.4	38.3	32.85	39.1
Acceleration 25-70 mph	18.8	22.2	21.6	23.9
Braking (cool) 60-0 mph	140.5 ft.	170.9 ft.	121 ft.	141.9 ft.
Pedal pressure	125 lbs.	140 lbs.	115 lbs.	80-120 lbs.
Braking (hot) 60-0 mph	162.9 ft.	159.6 ft.	153.6 ft.	168.75 ft.
Pedal pressure	200 lbs.	150 lbs.	200 lbs.	80-120 lbs.
Max. speed—lane change	60.0 mph	58.2 mph	60.0 mph	60.0 mph
Max. speed—slalom	27.6 mph	26.8 mph	29.1 mph	29.6 mph
Gas mileage (constant 45 mph)	19.787 mpg	28.356 mpg	24.222 mpg	21.283 mpg
Price (basic)	\$2285	\$2451	\$2265	\$2399
Price (as tested)	\$2490	\$2963	\$2603	\$2541

two adults. To form a full-length cargo floor, you must unhook a latch on each side, lift the seat bottom, and tilt it forward to form a well into which the seat back swings down. The spare wheel is under the car, vulnerable to road dirt and dust, with less theft protection than on the American cars.

Plymouth Cricket—plain jane. A typical American car built in Europe, it has no glaring faults, and does everything you expect from it quite well. On the other hand, it doesn't excel in any particular sense. It's just a plain, good car.

The back-seat folding arrangement is similar to the Colt's, but cargo space is close to the Pinto's. The glove box is a deep bin, and storage recesses are built into the front doors. The instrument-panel design is neat and modern, with four dials: gas, oil, temp, and batt. A unique light-and-wiper switch stalk extends to the right of the steering column.

Seats are almost chair-high, well-padded and comfortable. The Cricket has the best rear seating.

The spare-wheel storage is like the Colt's, without dirt and theft protection. And the chrome rails on the cargo floor reflect in the rear window and rear-view mirror.

Conclusions

Dunne: My first choice: the Pinto. It's quiet and rides well at highway speeds, doesn't burn too much gas, and has great carrying capacity.

Norbye: I'd take the Cricket, for its four-door convenience, superior seating comfort, greater visibility, and overall driver satisfaction.



"You name it and I've put Champion Spark Plugs in it."

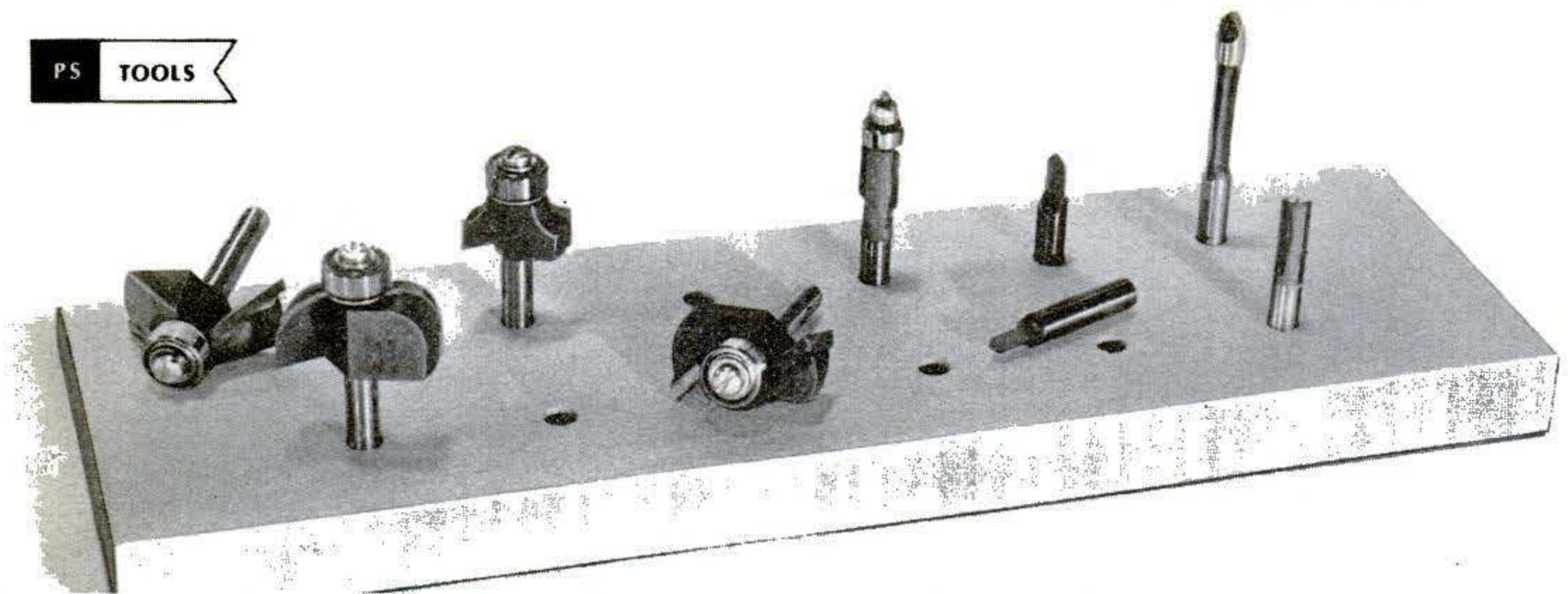
"I'll tell you this. For 24 years I've put Champions in every single car we tune up at my service station . . . from Caddys to Fords and Chevys to these new

Japanese machines.

"They're the best darn plug you can put in any engine or my name isn't Robert Tank, Omaha, Nebraska."



20 million people have switched to Champion Spark Plugs.



Typical super-bit designs: At left are bits with ball-bearing pilots; at right are carbide-tipped or solid-carbide straight bits.

FOR YOUR ROUTER—

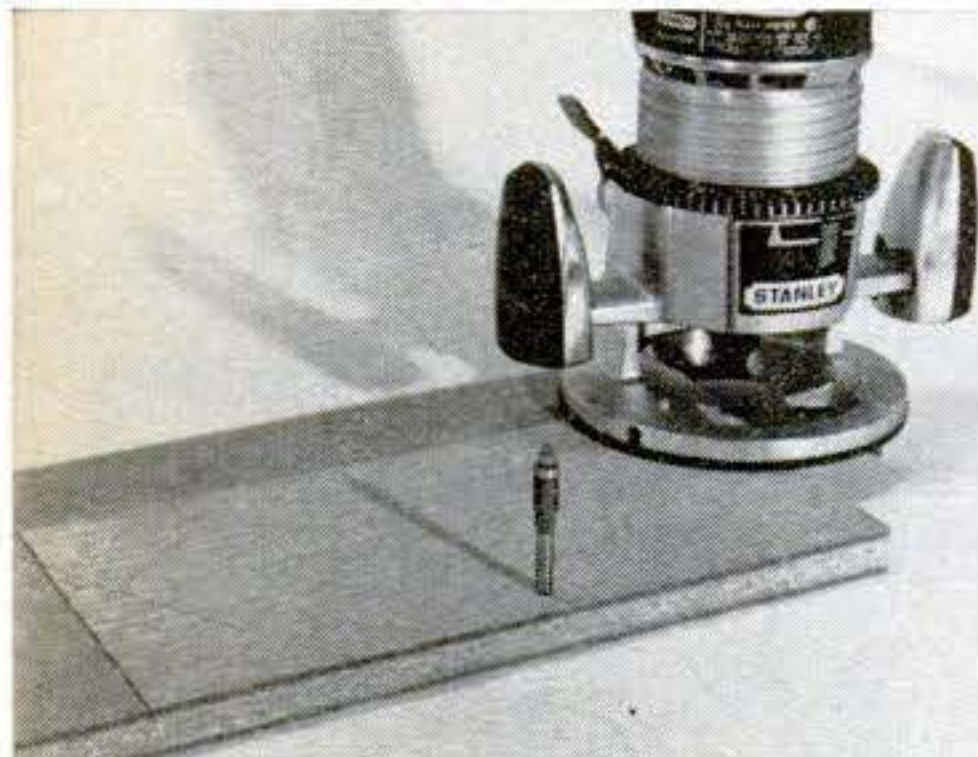
Super-Smooth Super Bits

They're made for the pro, but why shouldn't you enjoy these great cutters, too?

By R. J. De CRISTOFORO



In a drill press, with slow rpm, super bits still do an impressive job. Ball-bearing pilot makes possible a slow feed rate.



On a brittle veneer, trimmer bit worked fine. Carbide makes a superfine cut, and bearing permits slow feed without heat.

So smooth and effortless are these new super bits that you'll be tempted to put extra effects on your projects, just for the fun of using them. They're a sure way of improving both the quantity and the quality of your portable-router work.

The secret of these new Stanley bits? Thick carbide inserts, diamond-honed with micro-fine abrasives. The result is as close to a mirror finish as you can get.

Besides that, whenever the design of the cutter permits, a ball bearing is used in place of an integral solid pilot. If you've ever worked with a portable router, you'll know the advantage of that: no burning, no indenting of the work edge. The ball bearing rotates relative to the feed speed, instead of turning at the rpm of the cutter. Zero friction!

The new bits do not affect your normal router techniques. You use them as you would other bits—but you get better results, and you might well now try your router on materials you previously shied away from—



On hardboard-surfaced plywood, super bit produced this smooth, chipfree cut, ready for finishing without sandpaper touch-up.

hardboards, plywoods, particle and composition boards. The bits are so sharp that chipping is no longer a problem, even on a thin-surfaced laminate. And deep-throated gullets and sharp hook angles contribute to fast chip clearance and a fast feed rate.

What do they cost? You don't buy carbide and ball bearings for peanuts. Although the new bits can save you a buck in the long run, just like a carbide-tipped saw blade, they are expensive to buy. A two-flute cove bit with a one-inch total diameter costs about \$18.35. A rabbeting bit that cuts 1/2 inch deep by 3/8 inch wide—and can be used without an edge guide on the router—is about \$17.50. These, and others like them, have a ball-bearing pilot. (Replacement bearings cost about \$2.65.) A nonpiloted, solid-carbide straight bit with a 3/16-inch cut width runs about \$10.25.

The use of carbide makes for a fine cutting tool, but carbide is brittle and must be treated with care—not so much when being used, but when mounting, dismounting, or storing. You must avoid knocking those fine edges against hard surfaces. When storing the bits, provide plenty of separation between them. A drilled block (photo at top of page) offers safe storage, or you can hang the original see-through package on a nail or peg-board hook.

Stanley catalogues these bits as industrial tools, so your local hardware store may not have them. If you have trouble finding them, write to The Stanley Works (195 Lake St., New Britain, Conn. 06050) for a source of supply, and also for a complete list of profiles.

New square-cornered Sylvania picture tube

Handsome woodgrain cabinet, at no extra cost. (Offered only by NRI)

6-position detented UHF channel selector

Modular construction with plug-in circuit boards

Automatic color control

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Automatic tint control

100% solid state chassis

Automatic fine tuning



NOW... learn color TV servicing while building this NEW 25" SOLID STATE SET created by NRI for home training

NRI wanted more than a hobby kit TV . . . so we built one from the circuits up, specifically for teaching advanced electronics. You can only get this superb set from NRI . . . it's exclusive with NRI Color TV Servicing Course.

NRI was first to supply home study students with custom-designed training kits to give practical hands-on experience as you learn. Now NRI scores another first . . . with the exclusive 25" picture tube, solid chassis, color TV set designed-for-learning. You build it yourself with NRI's TV-Radio Servicing Course.



Kit for kit, dollar for dollar, you get more for your money from NRI.

The TV-Radio Servicing Course includes a wide-band service type oscilloscope and a color bar cross-hatch generator . . . along with

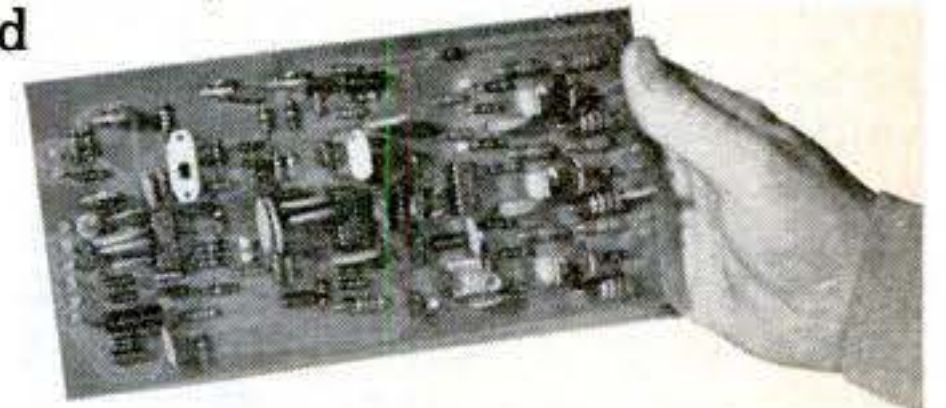
other valuable equipment you will use to perform experiments and make repairs on your own and other sets.



You'll soon find yourself earning \$5 to \$7 an hour, in your spare time . . . even before the course is completed.

Learning at home is easy . . . the simplified NRI way. Texts are "bite-size" and fully-illustrated, leading you step by step, stage by stage, to a thorough

knowledge of electronics. You can introduce defects into circuits, perform experiments, and discover the how and why of circuitry and equipment operation.



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"Say, Smokey—"

A clinic on cars by America's most famous mechanic

Each month in POPULAR SCIENCE Smokey Yunick answers questions on cars—family cars, high-performance jobs, hot rods, and racing cars—selected from those sent in by readers. Got a problem? Send it to: "Say, Smokey—" Popular Science, 355 Lexington Ave., New York, N.Y. 10017. Questions cannot be answered by mail.



Our 1964 Jeep Wagoneer has two major problems. First, when the engine is idling it runs smooth for a second, then rough, then smooth, and so on. Second, there is a considerable lag in power when I first accelerate. What's the cause of this and how can it be remedied?

SCOTT WYATT, Boise, Idaho

Sounds to me like you need an old-fashioned tune-up. Start first with a compression or blow-by check. If that shows reasonably even compression that's up to specs, next pull the distributor and check it for wear and operation. You should have a distributor machine to check the advance. Then a carburetor check and a look at the plugs. The best way to handle the carburetor is to remove it and clean it, then reassemble it according to the manual. Determining whether the plugs are good or bad can usually be done visually. Your lag on acceleration is probably a combination of late timing and lean fuel condition due to a weak accelerator-pump shot.

When wheel wells are packed with accumulated snow, ice, and salt from winter roads, is it better to drive into the garage and melt it out after each trip, or will there be less rust if the ice stays frozen? How about the engine? If the garage stays 30 degrees warmer than outside, perhaps there will be significantly less wear during warm-up, which might add miles to its life. Then there is the electrical system: Is the body of the car enough protection, or will outdoor weather destroy the insulation, rubber, or other nonmetallic parts? On balance, what do you think is better for a car—indoor life or rugged outdoor life?

ALLAN SNOW, Wallingford, Conn.

As you can imagine from my far-south address, I'm not much of a snow expert. But I'd vote for the heated garage. Cars are basically designed for an ambient air temperature of 60 degrees and would last longest in that environment. Of course, they are tested to both extremes—hot and cold. But I believe you are on the right track; keep going.

My 1967 Dodge Dart 270 with a 225-c.i.d. engine has 75,000 miles on it. The problem is that it keeps on stalling even when going 25 mph, even if I accelerate slowly. I had the carburetor overhauled

and gas pump changed, had a complete tune-up, and switched to high-octane gasoline. I've just about had the whole engine overhauled, and still mechanics are baffled.

BRUCE WEINSTEIN, Oceanside, N.Y.

Back to the carburetor, Bruce. When it stalls it's either getting too much fuel, or not enough. The best way to check it is to have the mechanic along, drive the car, and when it stalls pull the top of the carburetor and see where the fuel level is. Then go from there. There is an outside chance that you have an ignition problem, though I doubt it. To be sure, pull the coil wire and turn the engine over, and observe the color and length of the spark. You should get a blue-spark jump of at least 1/4 inch. This may sound kind of corny, but it will get you working in the right department.

Help! I own a 1970 Ford station wagon with the 390 engine, two-barrel carb, and stick transmission. I thought the 390 would pull anything I wanted, but I find it won't even pull itself. Trans. ratios are 2.42 first and 2.33 reverse. The rear axle is 3.25:1. If I park on a hill I'm lucky if it can pull itself up. With a light trailer it's almost impossible to move. Once the clutch is fully engaged at walking speed, the 390 will pull it anywhere. The worst problem is between dead stop and rolling, when the clutch takes a real beating. What can I do to save my clutch without great expense? Please don't suggest a new differential, because I like my mileage. Is there one gear I can buy? Can I drop in a 351 trans.?

ALAN BRUNSMAN, Yellow Springs, Ohio

You about know the answer yourself. You are overgeared for low-end torque. But you want to have your cake and eat it, too, with that 3.25:1 rear end. And I don't blame you. So you have two choices: Either pick up the low-end torque, which would be hard and expensive to do, or change the low gear ratio. I think that last is the answer. Most Ford transmissions are very interchangeable, so go to a Ford dealer who has time and cares, and I believe you can change the ratios around in your transmission and solve your problem cheapest that way.

I have a 1963 Chevy 283 which runs fairly well for its 130,000 miles, but the automatic-choke coil rusts out. It looks as though moisture comes through the heat-riser tube from the manifold. Is this possible? What can I do about it? Also, the heat-riser valve tends to stay in one position with weight up next to the spark plug regardless of engine temperature. It's not stuck, and can be moved easily by hand. How much should this arm move, and in what position should it be when the engine is hot?

CARL CARTER, Albuquerque, N.Mex.

Moisture does rust the auto-choke, but it's not leaking water, it's simply making the moisture from extreme temperature changes. There's not much you can do except replace it with a stainless-steel part. The heat damper is spring-loaded to be closed on a cold engine. When the spring is heated, the weight overcomes the spring and should flop down and open the restriction.

What would cause the pilot bushing in the clutch of my 1966 Mustang to go out in less than a month's time? I've had a bad body shake when engaging the clutch in either first or second gear since buying the car about three years ago. A good shop completely overhauled the clutch and found the pilot bushing worn in a distinct oval shape. The overhaul cured the problem for about a month—then it started shaking again, soon building up to its previous level. The car had a short set of shackles installed when I bought it. Adding a set of rear spring stiffeners helped very little.

R. S. REYNOLDS, Richfield, Minn.

The transmission is not lined up with the crankshaft. Probably misalignment is happening in the bell housing. Check the motor mounts to see if any are loose or broken. Be sure the rear axle is fastened to the springs and that the spring shackles and bushings are in good shape.

I drive a 1968 Dodge Van and recently, twice, while traveling 60 mph I hit some washboard-type bumps and the left-front wheel seemed to jump out of its socket. It felt like it was going to come off as the whole car shook and vibrated. While slowing down and pulling off to the side the wheel went back into place, and everything seemed normal. How dangerous is this, and can it be cured?

WALTER CARLSON, Los Alamos, N.M.

Dangerous? Hell yes! When this jumping starts, the wheel (or wheels) are about out of control. If you ever pushed a piece of furniture with caster wheels on it too fast and remember how the wheels wiggled, you know about what's happening to your van. There is usually exaggerated caster—either way—that, coupled with some play in the steering linkage, causes the problem. Have your truck checked for alignment in its loaded or usual driving attitude. Be sure all tolerances in the steering parts are okay. Also check the steering-gear-to-frame mount for tightness or cracks, and for twisting when the steering is

moved from left to right. Also check the tires and wheels for balance and turning true in lateral and horizontal plane.

My '69 Ford LTD with 390-c.i.d. engine pings. Does a chemical such as Carbon X V66 Carburetor and Combustion Conditioner made by Delco Rochester have any merit for eliminating the carbon?

JAMES MITCHELL, Fredericksburg, Va.

Yes, it's worth a try, and I think you are on the right track. If it doesn't work, remove the head and clean the carbon manually. Stay with the ashless type of oil in the future and that will slow down carbon buildup.

I have just rebuilt the engine in a 1961 Corvair. After attaching the starter motor and the transaxle and wiring up the battery, the engine would barely turn over. I bought another used starter and still the engine won't turn over fast enough. The battery cables burned off their insulation. All the bolts in the engine were torqued to specs, and manually the crankshaft will turn with 25 foot-pounds of torque. Help!

ROBERT HARRISON, St. Louis, Mo.

Be sure the starter is in good shape. The best way I know to do this is to take it to an auto-electric shop and have it tested under load. Then be sure the battery voltage and gravity are as they should be. Make sure the battery is grounded well to the engine, and that the hot cable to the starter, and the solenoid are in good shape. She should spin just fine if all this checks out. If it still won't spin, you may have to retrace your work in the engine for too much drag somewhere. I know you stated that 25 pounds of torque is all it takes, and that is okay, but maybe someone or something has tightened up since you got that reading.

I have a 1969 Buick Wildcat with H-D suspension and glass-belted tires. It has an annoying periodic vibration that gradually gets worse from 55 mph to 75, when it shakes the whole car. Cruising at 70 on an ordinary concrete freeway it's not too noticeable, due to the rough surface, but on a new, smooth blacktop it drives me nuts. Tires are balanced and not out of round more than the usual acceptable degree. What's your guess? I can't find any place in Tucson that has a test track where it can be observed at speed.

C. E. GREGORY, Green Valley, Ariz.

These things sometimes really get involved, but here is how I would try to pin it down with your local conditions. Borrow a set of wheels and tires that will fit from a car that runs smooth at those speeds. Then see if the vibration still persists. If not, you have your answer—tires and/or wheels. If the problem is still there with the borrowed set, then go after the drive line, and if that is clean check the engine balance and motor mounts. But my best guess is it will turn out to be the wheels and/or tires, and truing the tires will end the shakes.

PS



Car and Camera.

Behind the wheel or the viewfinder, speed counts.

When Mario Andretti shifts gears, he doesn't have time to take his eyes off the road. With a Minolta SR-T 101 you don't have to look away either.

To adjust exposure, simply align two indicators in the viewfinder. A scale shows the exact shutter speed, so you never lose sight of your subject.

As the official camera of the Vel's-Parnelli Jones Racing Team, we're running the biggest automobile photography contest ever—The Minolta Car and Cam-

era Competition. Grand prizes: 2 Alfa Romeo 2000 Spider Veloces, each with a Minolta SR-T 101. Other prizes: \$9,000 worth of Minolta equipment. All prizes will be awarded.

For details and official rules and regulations, see your photo dealer or send a postcard specifying your name, age, address and present camera brand to The Minolta Car and Camera Competition, P.O. Box 229, Cooper Station, New York, N.Y. 10003.

Minolta

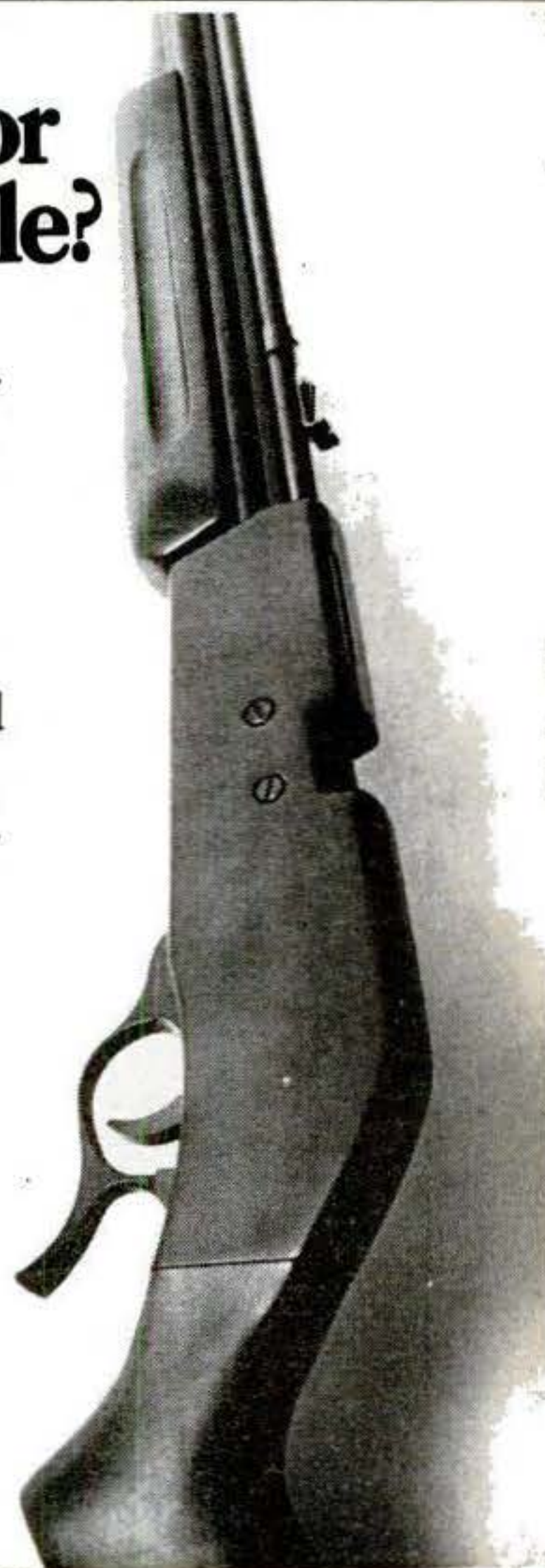
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When identified by a factory-sealed "M" tag, Minolta 35mm reflex cameras are warranted by Minolta Corporation against defects in workmanship and materials for two years from date of purchase, excluding user-inflicted damage. The camera will be serviced at no charge provided it is returned within the warranty period, postpaid, securely packaged and including \$2.00 for mailing, handling and insurance.

Is your son ready for a full size .22 air rifle?

This new single-shot pellet rifle is great for indoor target practice and outdoor plinking. It's 40" long, with a real hardwood stock, a rifled steel barrel, an automatic safety, a grooved forearm for easy pumping and a receiver that takes a telescopic sight. Velocities are variable to over 600 fps. It has the kind of Smith & Wesson precision that lets you make dime-sized shot groups at 33'. And your son can fire away all day for less than 1/2¢ a round. Best of all, it's a full-sized Smith & Wesson for just \$42.50. Is your son ready for it?

Smith & Wesson 
Springfield, Mass. 01101



Look and Listen

News, comment, and opinion from the world of home-entertainment electronics

By C. P. GILMORE



High-speed tape copies

I doubt if you'll ever have a machine like this one in your living room, since it costs \$160,000 and takes up a lot of room. Besides, you don't need it. But it may have an important effect on your home televising in two ways.

The device is a new high-speed video-tape copier recently introduced by Ampex. It copies tape at 10 times normal speed and makes three copies simultaneously, thus for the first time opening the way for rapid mass copying and distribution of taped programs. Several major program distributors are already using the machine; the results will soon show on your home TV screen in the form of a wider variety of taped syndicated shows.

But perhaps even more important, the new technique may be just the ingredient needed to make mass duplication of video cassettes for home playback practical. If and when video-cassette machines become popular home items, such duplicators could help keep prerecorded-cassette quality up and prices down.

The new machine doesn't simply play back a master tape and rerecord it simultaneously on another tape—the way copying is done now. Instead it uses a mirror-image master, recorded on a

special super-strength (high-coercivity) tape. The master and copy tape are pressed together as they run through a special copying head. The head shakes up the magnetic particles in the copy tape, and the particles take on the magnetic pattern of signals on the master tape. The whole thing is more like a high-speed printing press than the electronic playback and rerecording technique normally used.

The machine Ampex demonstrated recently is designed for two-inch-wide broadcast tape, but the same principle could be used for tapes meant for home cassettes.

Strong signals from the video disc

A couple of years ago, a company owned jointly by Telefunken and British Decca startled the home-entertainment world by introducing the Teldec video disc—a plastic phonograph record that plays not music, but TV pictures [PS, Oct. '70]. Such a system has tremendous advantages: The playback machine promises to be a lot cheaper than video-cassette players, and records holding up to an hour of color TV programming would cost no more than \$5 or \$6—compared to \$30 or \$40 for a video tape cassette.

Such powerful advantages have promoted a lot of activity in the industry. Teldec, which demonstrated the original video disc, now says it will have a \$400 machine on the market in 1974. Panasonic is said to be negotiating with Teldec for a license to make the same machine. And Teldec is known to be dickering with several U.S. manufacturers as well.

Now the giant Zenith company has held a private showing for its distributors and shown them *its* version of a video-disc player, which it says it has developed independently. RCA is also reported to have developed yet *another* video disc. And both of these companies are rumored to be aiming for a 1974 introduction. If all—or even part—of this chatter turns out to be true, a whole new chapter in the home-video-recording business could open about two years from now as a completely new crop of recorders operating on this different principle—all no doubt mutually incompatible—begin to compete for the consumer dollars.

Button-down that station

The mechanical tuner—the thing that clicks when you turn your TV channel selector knob—has gotten us through the first two decades of the TV era pretty successfully. But it has problems. It's complicated and expensive. Its mechanical-switch contacts wear and cause noise and jittery pictures. It needs a motor for remote control.

Now Panasonic has shown two experimental tuners that are entirely electronic—no contacts, no motors, no moving parts. Tuning is done by varactors, which switch stations electronically.

In one version, the front panel contains two pushbuttons. Push one and the set jumps up to the next station it can find; push the other and it jumps down. A more complicated version has

10 buttons. You punch in the channel you want, including several preset UHF channels; the set tunes automatically and displays the selected channel digitally on the front panel.

The entire circuit of both tuners uses digital-logic techniques and integrated circuits. It should be cheaper, simpler, more reliable. I suspect all companies are working on something like this, and some version of automatic electronic tuning will probably be standard within a few years.

But how do you know it's working?

If you use portable audio-cassette recorders as much as I do, you'll appre-



ciate a new development demonstrated by Panasonic that I hope will soon be introduced on commercial models. My problem is that I'm always wondering whether the machine is working properly; yet when I'm recording an interview, I don't want to hang over the recorder every minute.

The new Panasonic prototype presents an ingenious solution. On the transparent window through which you watch the tape, engineers have mounted a liquid-crystal tape-counting display. When the tape is moving, the 1½-inch-high numbers—easily visible across the room—keep ticking off footage. And a light-emitting diode flashes off and on as long as recording level is right. It glows continuously or goes out altogether if level becomes too high or too low.

Result: You can tell with an occasional glance whether the machine is okay. No marketing plans have been announced.

News on the four-channel front

The matrix battle is over. CBS and Electro-Voice—proprietors of the two major competing matrix systems—have signed an agreement that they will exchange all patent rights and technology and make all matrix systems compatible.

It's obvious, though, as one trade publication put it, that the agreement is more a non-aggression treaty than a love match. With RCA pushing its discrete-disc systems hard and a major discrete-vs.-matrix battle shaping up, the matrix people obviously decided they'd be in a stronger position if they could get together.

continued

Jeep[®] Commando. Escape artist.



Jeep guts make it as adventurous as any sport wagon can be.

When you want to make the perfect getaway, climb into a vehicle that's got the guts for it. The Jeep Commando.

The Commando's world-famous 4-wheel drive, powered by a standard 232 CID 6-cylinder engine, can take you places where fish are biting and the deer outnumber the people. Places where you'd never get to in an ordinary vehicle.

Because of the Commando's new "open-end" front axle, it can maneuver even better in those tight spots. And you can get away in



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Last but not least, with a Commando you take off in style. Nine lively exterior colors, handsome interiors, and great lines add up to the sportiest Commando ever made.

So test drive a Commando at your Jeep dealer. Check it out. You can get away for a lot less than you think.

Toughest 4-letter word on wheels.

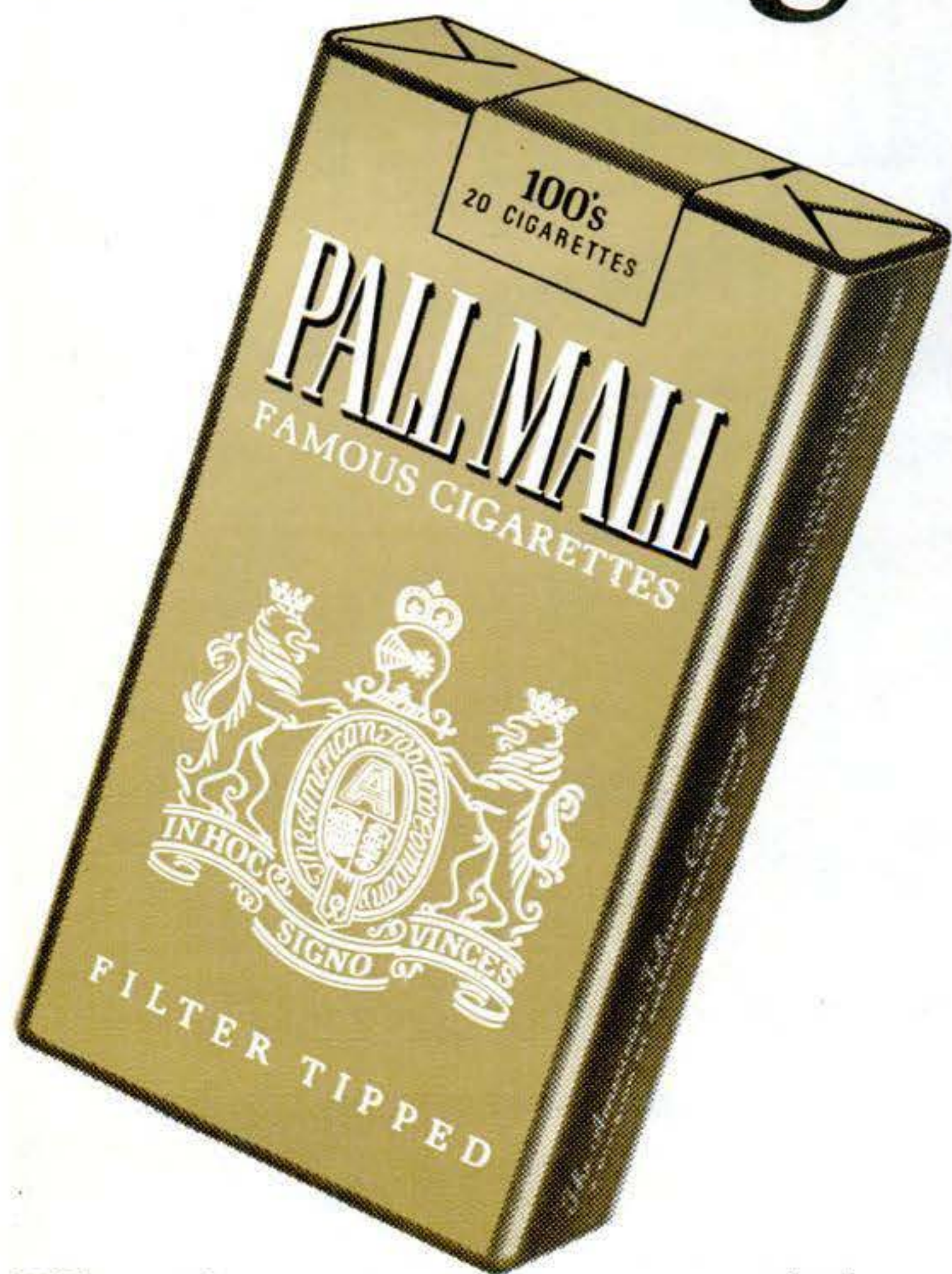
Jeep

Drive your Jeep vehicle with care and keep America the Beautiful.

Latest U.S. Government figures show

PALL MALL GOLD 100's

lower in 'tar' than the best-selling filter king!



Yes, longer...yet milder



PALL MALL GOLD 100's... "tar" 18 mg.—nicotine, 1.3 mg.
Best-selling filter king..... "tar" 20 mg.—nicotine, 1.4 mg.
Of all brands, lowest..... "tar" 1 mg.—nicotine, 0.1 mg.
18 mg. "tar" 1.3 mg. nicotine av. per cigarette, FTC Report APRIL '72.

Look and Listen

[Continued]

As the fight warms up, an interesting suggestion comes from audio pioneer Leonard Feldman in an article in *Audio* magazine. Feldman sees no reason why both sides can't agree on a disc totally compatible with both systems—and with regular-stereo playback. Play it on a matrix decoder and you'd get matrix-four-channel sound. Play it on a discrete system and it would produce discrete four-channel. It's an interesting idea; let's see if there are any takers.

Stereo AM?

Almost 15 years ago, several manufacturers tried to develop a stereo-broadcasting system for AM radio. But FM was easier, a two-channel system was adopted, and everyone forgot about stereo AM. *Almost* everyone. Now Kahn Research Labs announces that it has been testing a stereo-AM system on a Mexican station for two years and has applied to the FCC to try it on station WWDJ in Hackensack, N.J. The decision should come soon.

Four-channel discs: some steps in the right direction, by Ken Furie

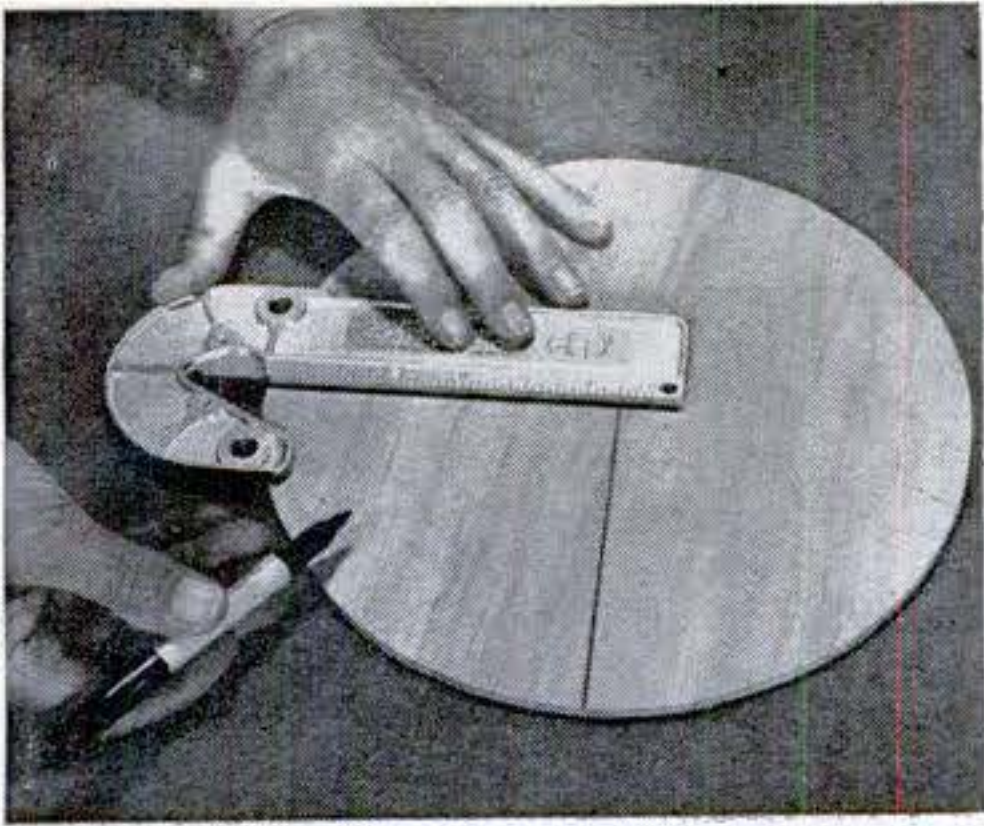
Since my last report [L&L, May] I've been encouraged by some recordings that make sensible use of four-channel and by a better decoder for SQ-encoded discs.

The new decoder (Lafayette's SQ-L, \$80) has a limited electronic-logic circuit to improve front/rear separation. CBS' SQ matrix preserves nearly full left/right separation, but at the expense of front/rear. Rehearing SQ discs I had played through a logic-less decoder, I was impressed by the improved definition of the sound around me. Columbia's *Switched-On Bach*, for example, now had some of the directional games that I'd heard only on the (discrete) Q8 cartridge.

But a better decoder helps only if there's something worth decoding. Which brings me to recordings. Vanguard's first batch of SQ-encoded discs finally arrived, and they're good.

Unfortunately most were "demonstration" discs—great if you like going from choo-choo trains to Baez to Mahler. But they demonstrate the quality of the recordings they're drawn from. Judging from these excerpts, I'd recommend Maurice Abravanel's very good Mahler *Third Symphony* over several better performances that don't benefit from Vanguard's quadrasonic engineering.

It's my impression that, unlike other "four-channel" recordings that merely remix conventional multichannel masters, Vanguard's were originally engineered for four-channel reproduction. In any case, their use of the "classical" four-channel approach (rear channels normally confined to reverberation) does what the medium ought to do for such recordings: It improves clarity and definition. Listen to the choruses from Handel's *Messiah* (conducted by Johannes Somary, available complete or as a disc of excerpts) and you'll understand every word—an improvement on the already clean two-channel version. PS



Intersection of two lines drawn with new Stanley tool is center of the circle.

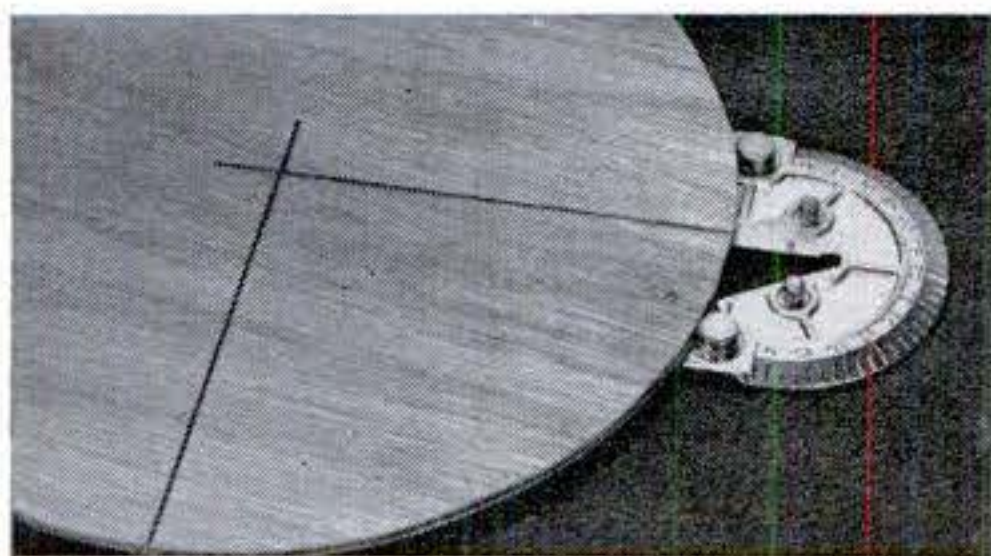
PERSONAL-USE REPORT

A Square for Centering

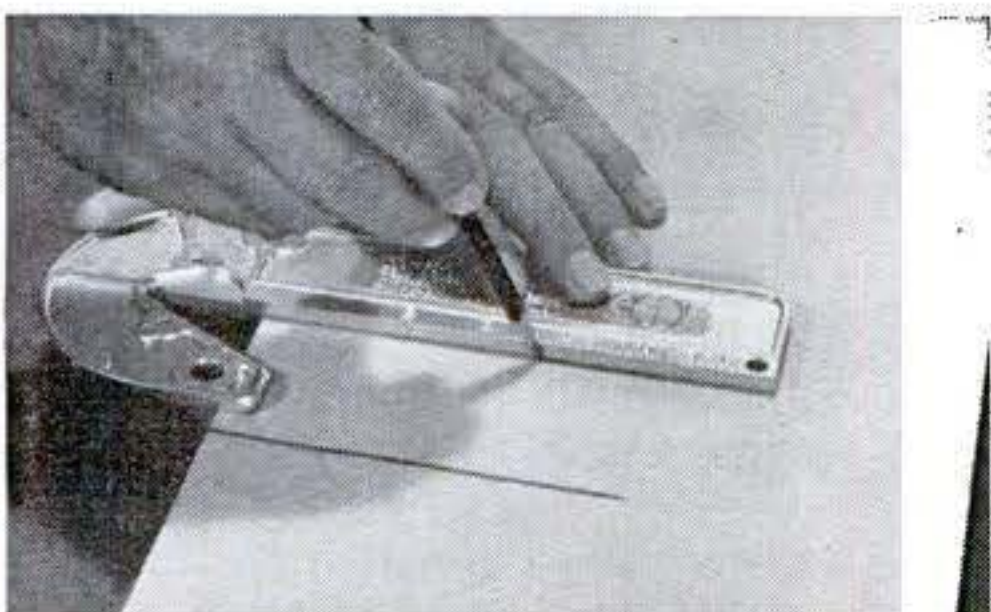
Butt two pins on the underside of Stanley's new Center Square against the edge of a disk and draw a line. Move the tool about 90 degrees and draw another line. The two lines intersect at the center—which you'll want to find to put an umbrella pole in a table or round work in a lathe.

You get big pins for big circles (to 12" in diameter; for larger circles just extend the drawn lines); small pins for small circles (under 2½"). An indent in the tool finds the centers of circles under 7/8" diameter.

But why does Stanley call it a Center Square instead of a Center Finder? Because when you butt it against a straight edge, it works as a square, too. It's \$1.99—and worth it. —R. J. De Cristoforo



Pins are on "bottom" side—big pins for big circles; small, for small circles.



Tool becomes a square when you butt it against a straight edge, as above.

Latest U.S. Government figures show

PALL MALL GOLD 100's lower in 'tar' than the best-selling filter king!



Yes, longer...yet milder



PALL MALL GOLD 100's... "tar" 18 mg.—nicotine, 1.3 mg.
Best-selling filter king..... "tar" 20 mg.—nicotine, 1.4 mg.
Of all brands, lowest..... "tar" 1 mg.—nicotine, 0.1 mg.
18 mg. "tar" 1.3 mg. nicotine av. per cigarette, FTC Report APRIL '72.

Science Newsfront

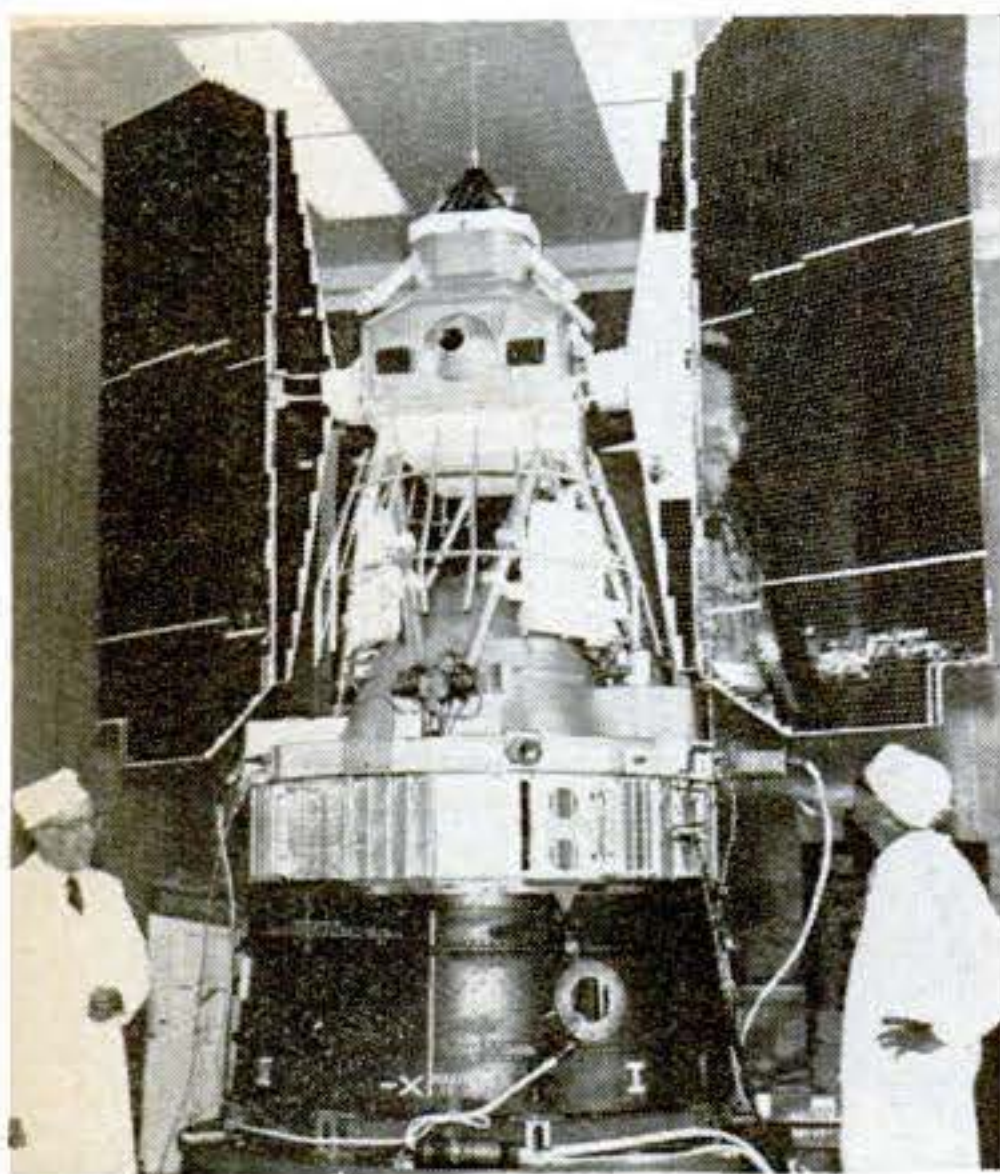
Last-minute news and notes to keep you up-to-date

By ARTHUR FISHER

A fan with no moving parts?

An Army research team is working on a gadget that would have the air-moving performance of a conventional fan, yet would have no moving parts and virtually no noise. Impossible? It's based on a phenomenon called "electric wind" that was discovered by a scientist named Chattock in 1898. It results when a DC field is impressed across an air space between two poles of opposite charge, activating ionized molecules, which are always found in the air. Experimenters at the U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va., were working on an unrelated project involving electric fields when they made the happy discovery that they could use a field to blow up a storm—moving air at a rate greater than 2000 fpm, or more than twice the velocity of air in conventional heating and air-conditioning ducts. Now they're hopeful of developing an "ionic airflow" device without motors, fans, or bearings.

Earth resources from space



The first Earth Resources Technology Satellite, ERTS-A, appears here at the end of a successful test-deployment of the solar paddles, which are retracted at launch. From its 500-nautical-mile, sun-synchronous, near-polar orbit, the NASA spacecraft, produced by General Electric's Space Division, will send back invaluable information in such areas as agriculture, forestry, water resources, geology, and mapping. For at least one year following its launch this summer, it will transmit some 10,000 color, black-



Electronic eavesdropper fingers noisy vehicles

This electronic noise-monitoring apparatus will join the battle against highway vehicles that violate legal noise restrictions. The CBS Labs device takes a split-image photo of an offending vehicle and a chart recording of the sound level it produced. It's triggered when a microphone senses a noise level higher than a preset maximum.

and-white, and digital-tape images of Earth's surface every week. The images will be made by three return-beam vidicon cameras and a multispectral scanner; each will cover a 100-by-100 nautical-mile chunk of Earth.

My dentist uses needles

If the thought of dental acupuncture is too painful for you to bear, skip this item. But it has been tried, successfully, in England, at least three times. Dr. Felix Mann, head of the Medical Acupuncture Society in London, reports that a dentist placed needles in his patients' hands and feet, then drilled near a nerve, with no pain in two of the patients and only slight, momentary pain in the third. No mention of how painful the needles were.

Laser cane

A space-age version of the blind man's stick has been developed at the Research Institute of the Swedish National Defense. About 50 inches long, it consists of a tube made of plastic reinforced with glass fiber, attached to a gallium arsenide laser; a midget transmitter and receiver; and an amplifier, all powered by a ni-cad battery. The laser beam is projected at right angles to the cane, which means forward and upward, at about 1000 pulses of light per second. If the beam strikes an obstruction, it is bounced back to the cane and transformed into a loud beep. The low-power laser beam poses no danger.

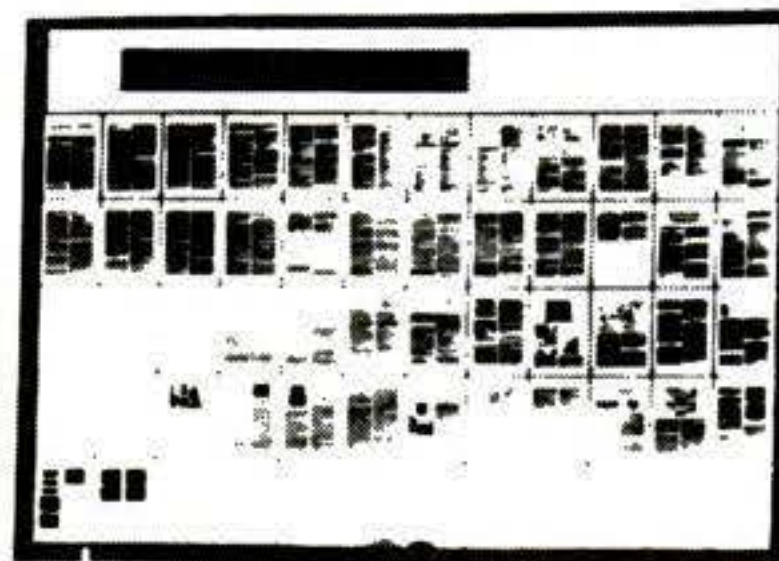
Navigating by the galaxies

Scientists at the Naval Research Laboratory believe they have found a basis for a jam-proof, all-weather, all-day, worldwide navigation system. The source: radio emissions from space, including quasars and radio galaxies. The sources could provide world-wide coverage for very-long-baseline-interferom-

etry (VLBI) navigation over distances comparable to the Earth's radius.

The HUMMER for people and machines

The information explosion has prompted the development of many ingenious information-retrieval systems. One problem: They're suitable either for people or for machine processing—never both. Now the Harris-Intertype Corp. has come up with a storage card that is both "Human Readable/Machine Readable," abbreviated to HR/MR and dubbed the "HUMMER." It looks, as you can see here, like a conventional microfiche (microfilm card). It stores 60 pages of information that can be read out by human users with standard microfilm readers. The black strip at the top, however, is completely unconventional. It is a holographic record of the information in digital form, which can be read by a computer. Holography, which photographically records interference patterns rather than optical images, can cram 2.5 million bits of information onto a square



inch of film, and can record the information, using a laser scanner, at a rate of 250,000 bits per second. The new man/machine system was developed under an Air Force contract and will be installed in the Air Force's Rome (N.Y.) Air Development Center this fall.

Continued

Wanted: Race Drivers



A/A Fueler
Dragster



Pinto
Funny Car

If drag racing turns you on, you'll get a real kick out of "driving" either of these two authentic Cox dragster models. Both are powered by a hot little Cox .049 gas engine, most dependable and popular model engine made.

The Funny Car, precision built of high impact styrene, is modeled after champion driver Bill Schifsky's famous Pinto. With a gear ratio of 4:1, it streaks down a taut line, then automatically deploys a drag parachute and shuts off the engine. The action is thrillingly fast and realistic!

Cox's Funny Car is in 1/12 scale. Has racing slicks. Internal roll cage. Instrument panel. Dragster steering wheel. Simulated Hemi engine and supercharger. Bill Schifsky racing team red and blue

stripes. Costs less than \$19.00 complete with guide line and anchor pins.

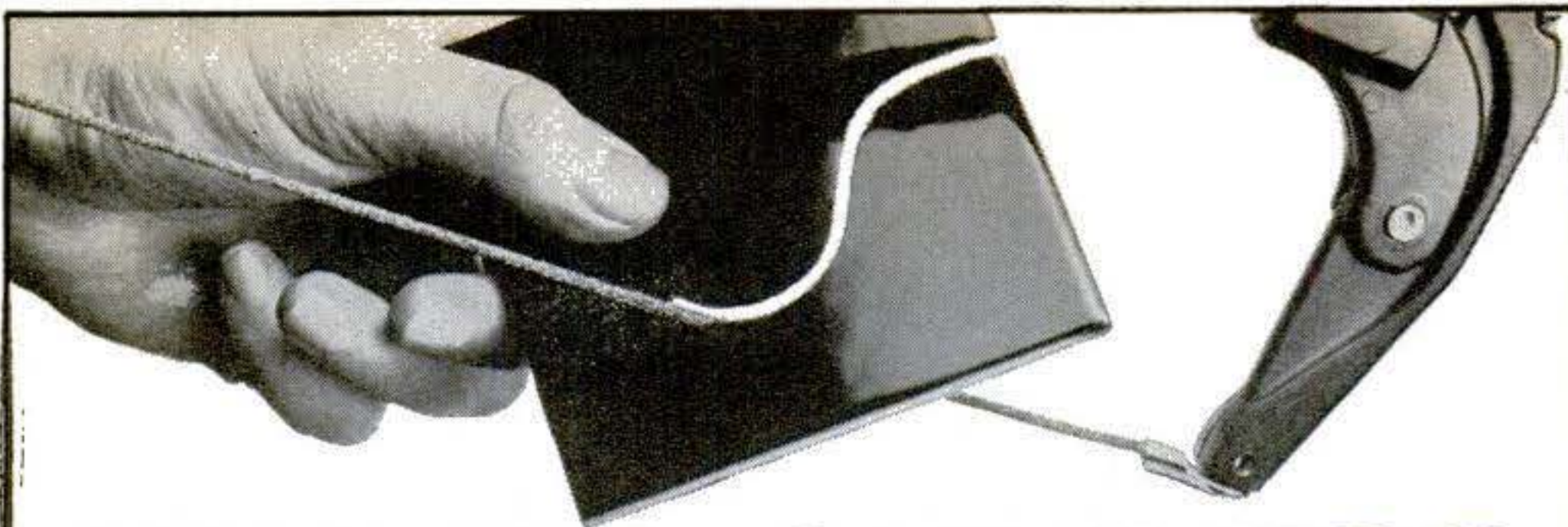
Just as exciting is Cox's A/A Fueler, 14½" long. Modeled after champion Danny Ongais' dragster, it's beautifully decorated, has mag-type rear wheels with racing slicks and "bicycle" wheels on the front. Uses a launch platform, taut line and drag chute. Less than \$18.00.

If you want great competition, race the A/A Fueler against the Pinto! Get both at your favorite hobby, toy or department store.

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THE TOOTHLESS WONDER.

GRIT EDGE

Our amazing saw blades are perfect for the tough cutting jobs you may have—ceramic tile (see above), wire rope, hardened steel, fiberglass, tempered hardboard, even cola bottles. In many actual cases, the harder the material, the better our saw blades cut. And nothing short of a diamond saw can cut hard materials as well.

We sell our blades under the brand "Grit-Edge". The name signifies our exclusive process of permanently bonding

tungsten carbide particles to steel. So our blades have no teeth to snag, dull or break. The blades last up to ten times longer than ordinary ones. They never need sharpening. And most are completely reversible. "Grit-Edge" blades are available in rod saws, hacksaws, saber saws, and circular saws. To find out which blade to use for your specific cutting problems, see your hardware dealer or write: Remington Arms Company, Inc., Dept. 572, Bridgeport, Conn. 06602.

Remington DU PONT

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GENERAL ELECTRIC

Science Newsfront

[Continued]

Moon has crust, mantle, and core

A meteoroid impacting the moon with the force of 200 tons of TNT has given scientists confirmation that a crust 38 miles thick exists just below the rubble-strewn surface, as well as an underlying mantle and, possibly, an inner core. The evidence was the seismic record picked up by four seismic stations established on the moon by Apollo astronauts. Dr. Gary Latham, of Columbia University's Lamont-Doherty Geological Observatory, said that the signals seemed to indicate the presence of a core starting about 600 miles down, although this conclusion is still very tentative. Dr. Latham is principal investigator for NASA's seismic lunar experiment.

The micrometeoroid, which struck north of the Apollo 14 landing site at Fra Mauro, on May 13, was about six feet across and blasted out a crater 300 feet across.

Amplifier for color TV cameras

On-the-spot color movie photography for TV coverage is often difficult or impossible at dusk and at night because there just isn't enough light for low-speed color film. Now there's a device from CBS Laboratories that can overcome the problem.

It's a color light amplifier that can be attached between a standard lens and the front of a movie camera. It amplifies light—in true color—an amount equivalent to seven f-stops, so that a color film rated ASA 160 would in effect be boosted to ASA 16,000, approximately. TV coverage of sports and public events will benefit from the elimination of bulky lighting equipment.

Carbon monoxide—naturally!

In a worldwide study, scientists at Argonne National Laboratory have found that natural sources contribute at least 10 times more carbon monoxide to the Earth's atmosphere than man does—about 3½ billion tons per year against about 270 million tons from industrial and automotive pollution. Most apparently stems from the oxidation of methane (marsh gas); the decay and growth of chlorophyll accounts for a fraction, and so possibly do oceanic processes. The study was sponsored by the Coordinating Research Council, on behalf of industry and government.

Hair-pulling in the Olympics

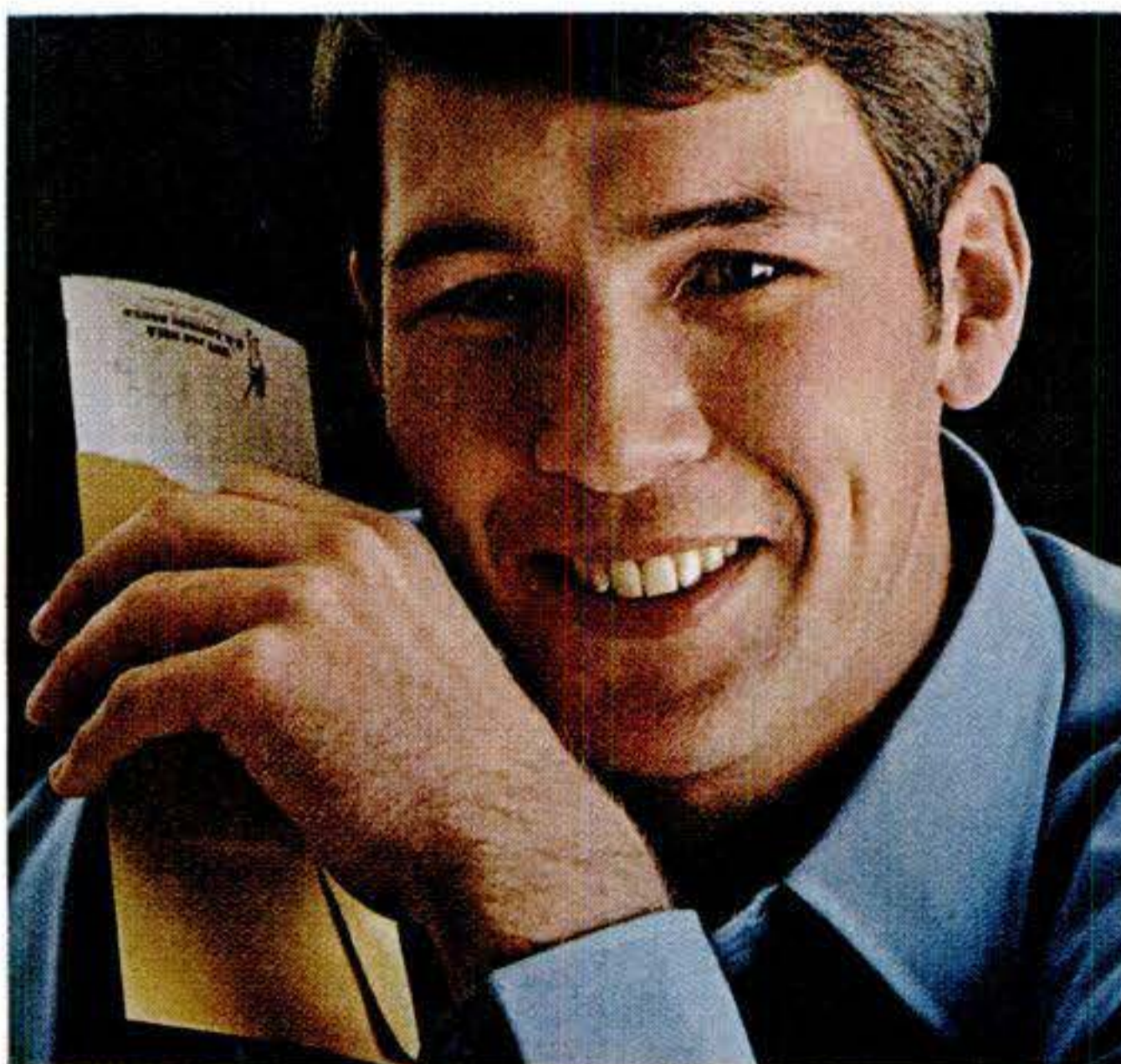
The Olympic Medical Commission has announced that women athletes in this year's games in Munich will have to submit to some scientific hair-pulling in order to qualify. A few hairs plucked from their heads will provide the sample hair roots to verify whether they are indeed females and not altered males masquerading as females or females with an abnormally overmasculine genetic makeup, both of which would confer an unfair advantage in competition with normal women. The test involves a microscopic examination of hair cells to see whether chromosomal bodies are typically female. Vive la différence! [E]

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It pays to go to meetings.**

CYANOACRYLATES ARE HERE...

Super-Strength Glue

"The trick is to use a drop at a time," says V-P Mort Plonchak, of the Rexco Corp., about Permabond 102 glue. What? A company exec telling you to use only a little? Yep, that's all you need with a cyanoacrylate—a solventless, colorless, slightly syrupy liquid adhesive, until recently found only in factories.

Now you can buy them. In addition to Permabond, there are Eastman 910 and Super Bonder 94.

All three of these cyanoacrylates

have these characteristics in common:

- They bond nonporous materials. They will work fine for you on most plastics, metals, glass, ceramics, porcelain, and rubber.

- They have high bond strength. Their tensile strength depends on what you're gluing, averaging around 2000 psi. Some materials glued tested up to 5000 psi.

- Their set time is fast for most materials—between 15 seconds and a minute. Bonds reach 60 to 70 percent strength in two or three minutes; full cure in about 12 hours.

What makes it stick? Curing results from a chemical reaction triggered by the slight film of moisture on any surface you're gluing. Set time takes longer if a room has high humidity, but the stuff is *still* quick drying. It offers reasonable resistance to extreme temperatures, too (65 to 100 degrees below zero all the way up to 300 degrees F).

Okay, now the bad news. Cyanoacrylates won't bind porous materials



For small jobs like repairing a clock or a coffee mug, cyanoacrylates are handy. You apply them to only one surface.

Glass-to-glass bonds work exceptionally well; glue is clear so bond is hard to see.



This is a hazard. It is illegal in 21 states* It's ordinary window glass

Plexiglas® acrylic sheet is the best safety glazing material to safeguard against injuries in the home from broken window glass.

Plexiglas, manufactured only by Rohm and Haas Company, meets the safety requirements of states with "safety glazing" laws. It conforms to recommendations of the Consumer Safety Glazing Committee based on standards of the American National Standards Institute (ANSI Z-97).

Don't wait for an accident to happen in your home. Replace ordinary window glass with Plexiglas now in storm doors, garage doors, tub and shower enclosures and other hazardous locations.

Get Plexiglas at your local hardware store, building supply dealer or glass shop.

*In states that have passed "safety glazing" laws, it is illegal to install ordinary window glass in storm doors and other hazardous home areas in which injury is likely to occur from broken glass. It is also illegal to sell components which contain ordinary window glass for these applications.

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Insist on approved PLEXIGLAS® ... there is a difference ACRYLIC SHEET

for Tough Jobs

By DOUG GARR

like textiles and papers. The adhesive is soaked up before you can stick the surfaces together. And the glue won't fill in gaps. In fact, recommended bond lines are thin—between .001 and .005 inches.

Another perhaps bigger drawback: It's expensive; two-gram containers (Eastman and Permabond) cost \$2, and yield about 132 drops.

It really sticks. I glued glass to metal, metal to rubber, rubber to plastic, and other similar and dissimi-

lar combinations. Mostly, it took a lot of peeling and pulling to break the bonds. And that was after only a few minutes of drying. On one glass-to-glass experiment, I broke the glass, not the bond.

I also tried to glue on my car door's weather stripping (rubber to metal). After 10 minutes, I pulled the strip off; there were black patches on the door where the rubber (admittedly old) gave up. When I repaired a broken dinner plate, the bond line

was so thin, I had to look closely to see where it was glued.

How to use the stuff. Clean surfaces really well. A smidgen of dirt or dust will weaken the bond or make the glue useless. Then:

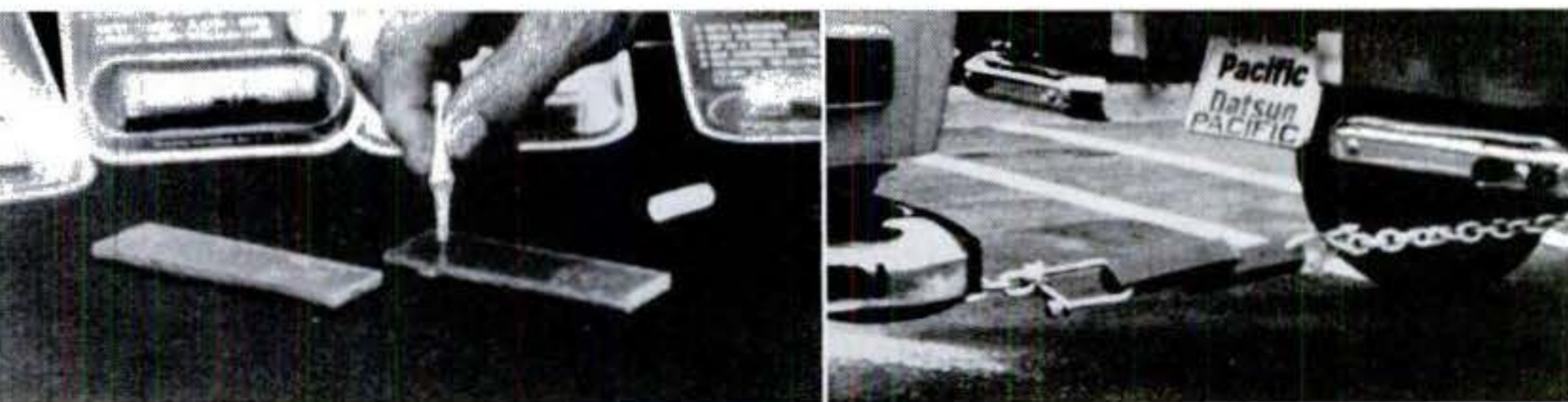
1) Use only one drop per square inch. Too much will weaken the bond by putting extra space between surfaces.

2) Unless you plan to use whatever you're gluing immediately, resist the urge to test the bond until full or nearly full cure.

Although nontoxic, the cyanoacrylates stick to almost anything—including your skin. If it gets on your fingers, you may not be able to get it off unless you use a solvent (recommended: acetone or nitromethane).

The glue has a shelf life of about a year. Eastman 910 and Loctite Super Bonder 94 carry an expiration date on the label. Permabond is guaranteed for one year from purchase date, but the Rexco Corp. says it will last longer because they add a fluid-stabilizing preservative.

The sources: Permabond—Rexco Corp., 43 W. 47 St., New York 10036; Eastman 910—Tech Spray, P.O. Box 949, Amarillo, Tex. 79105; and Super Bonder 94—Loctite Corp., 705 N. Mountain Rd., Newington, Conn. 06111.



For a strength test used in a TV commercial, Rexco Corp. glued two pieces of plastic together with Permabond 102. What followed is seen in photo at right.

Two linked pickup trucks revved up to go separate ways, but couldn't break the cyanoacrylate bond. Loctite ran a similar test of Super Bonder, using dragsters.

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The View Down the Road

...news and comment on cars and driving

By JAN P. NORBYE / PS Automotive Editor

Is the import boom over?

As mid-year registration figures are released, it is obvious that the growth rate in auto imports has been checked. A year ago, imports held over 16 percent of the nationwide car market, and now the figure is down to 14.4 percent.

Does this mean that the domestic subcompacts have stemmed the flow of imports? It's an obvious—and therefore very probably a flawed—conclusion.

Let's look at what has been happening. You remember the import surcharge that came with the Phase I price freeze last August? Followed by repeal of the federal excise tax on auto sales? Then came the period of the floating dollar and the realignment of the gold price.

When the smoke cleared, the yen and the D-mark had been revalued upward vis-a-vis the dollar, and Japanese and German cars suddenly cost much more here. The domestic-car prices had become a lot more attractive. For instance, if you wanted to spend \$2250 last year, you could get a Vega—or a Toyota Corona. You can still get the Vega, but the Toyota you get at that price now is the smaller Corolla.

Actually Toyota has maintained its 1971 sales level—and even added a few thousand units—but the growth rate is insignificant. Datsun sales are off 10.5 percent, and the parent company, Nissan Motors, has announced that its 1972 sales target in the U.S. has been trimmed from 280,000 to 255,000 units.

Toyota is number two among imports, Datsun number three. Volkswagen is still in first place, but its sales are down 22.5 percent compared with six months of 1971. Opel, which has been steadily dropping in the ranking list, is now in fifth place, and sales are down 24 percent from last year.

Behind the front-rank makes from Japan and Germany, however, are others, in the same countries, enjoying increasing success in the American market. The German-built Ford Capri is up 72 percent (mainly due to the availability of the V6 engine and a better supply situation). Sales of Mazda cars with either rotary or piston engines are up several hundred percent (mainly due to expansion of the distribution network and higher allocations from the factory).

Capri and Mazda prove that price isn't everything. Both have some-

thing unique to offer, and the way the economy is going, the selective customer has no problem financing the purchase of cars like this.

And higher-priced cars?

Mercedes-Benz sales are practically at 1971 level, despite drastic price hikes. With sales averaging 3000 units a month, at an average price approaching \$9000, that works out to a projected annual sales figure of \$324 million! That tells you that Americans who want fine cars aren't deterred by price.

Volvo has almost managed to maintain its sales volume, and Saab has made substantial gains this year. (The Swedish krona has not been revalued relative to the dollar.)

Fiat, the best-selling car on the European continent, is slowly expanding its American operations, and 1972 half-year sales are 25.4 percent above 1971 half-year sales.

It seems to me that what the big fellows are losing is just about made up for by a larger number of small fellows who continue to grow. I predict that the import average for the calendar year 1972 will come within half a point of the 15-percent mark (of total U.S. market sales).

Mazda expands rotary-engine capacity

Mazda is reportedly building a new engine factory that will handle only rotary engines. The plant, due for completion this year, will give Mazda the needed production capacity to handle Wankel-engine orders from other car makers who want to use the RX2 or RX3 engine in their own cars.

Mazda has the right to sell its engines on that basis, according to the terms of its contract with Wankel/NSU. The buyers will have to pay a royalty to the original licensors, however.

Both Nissan (Datsun) and Toyota hold Wankel licenses, and there is speculation that one or both may buy engines from Mazda to get rotary cars into production and into the field with a minimum of delay.

I don't think they will. Both Toyota and Datsun are much larger companies than Mazda, and they have a history of making most of their own components—especially large items such as power units.

Mazda, on its side of the fence, knows that any deal with Toyota or Datsun for supplying rotary engines would be purely a temporary arrangement. For that reason, I feel that it would be more logical for Mazda to furnish rotary engines to *smaller* auto

makers—not necessarily just in Japan, but all over the world.

Both Datsun and Toyota will exhibit Wankel-powered prototypes at the Tokyo auto show in November. The power units are most likely to be their own handmade experimental jobs, since production is at least a year away, and the show cars aren't required to be in running order.

Both Datsun and Toyota have intensive Wankel-engine research programs under way right now, and both are making progress. Each has applied for a number of patents, in Japan and in the U.S., for a variety of advances and refinements. Both are looking at machine tools for the production of Wankel engines, and inviting bids, and that's hardly a matter of priority if you're going to buy ready-made engines from an outside supplier. You'll get confirmation on this when the tooling orders go out. Watch this space.

End of tire rotation?

You have always been told that tires must be rotated—that is, moved from one wheel to another (with or without including the spare) at regular intervals. The owner's manual for your car has specific recommendations for tire rotation.

But if you buy a set of Pirelli CN 75 tires for your car, you can forget about rotation. Even on a big American car? Yes, this tire is designed for and tuned to American suspension systems for optimum ride quality and comfort.

Just what is the CN 75? It's a steel-belted radial, with *two* steel belts around a rayon carcass. The tire is guaranteed for a tread life of 40,000 miles—like most steel-belted radials, for which the manufacturers still recommend rotation.

How can Pirelli eliminate tire rotation? The secret is part design, part quality control.

The CN 75 tread elements are arranged in such a way as to equalize tread wear and thereby extend tread life. And X-ray control during production provides a check on the accuracy of positioning all components in the tire during assembly, to assure uniformity.

And Pirelli's quality-control procedures are not just a matter of spot checks or random samples: 100 percent of the production run undergoes the X-ray check.

The CN 75 is now in production in a complete range of sizes for U.S. passenger cars. P 5

Whatever you drive, wherever you go,
Pennzoil is worth asking for.



Dry is no way to smoke.

Come all the way up to KOOL.
The only one with
the taste of extra coolness.



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Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health

King Size, 18 mg. "tar," 1.4 mg. nicotine; Long Size, 19 mg. "tar,"
1.4 mg. nicotine av. per cigarette, FTC Report Apr. 72

PS: What's News...

Keeping You Posted from Behind the Scenes

What do you do when the elements of a cover illustration you're assigned to produce just don't exist in a nice tidy package? That's the problem Art Director Harry Samuels and photographer Orlando Guerra faced with this month's cover.

To give you timely information about this remarkable new TV system, we had to produce our cover before the finished working models were ready. Samuels tells it like this: "When we arrived at the Advent plant, the only working equipment where a TV image could be photographed on the screen was in their lab [photos, pages 79 and 80]. And the only place that could be made to look reasonably close to a set-up in a home was an emptied-out, carpeted showroom. We arranged a projector cabinet and screen in the showroom the way they would be in your living room and made a photograph with the screen blank. Frank Federman, chief engineer for Advent, was our model. Portions of the top of the projector cabinet were cut away to show some of the works inside. We then moved into the lab and placed the camera in exactly the same position relative to the screen as it had been in the showroom. The engineers fed a video-taped color photo into the system and we photographed the actual TV picture on the screen. Although the final cover picture was assembled from three separate transparencies, there was no tinkering with the TV images. It is straightforward color photography."

Watching the time

As soon as the Timex quartz watch [Jan. '72] came on the market, three of us here on the staff each acquired one to see if they were really as accurate as claimed under the ordinary conditions of everyday use. After nearly three months, we can say they are. In fact, the "ordinary conditions" were not so ordinary in one instance. Assistant Editor Doug Garr has worn his during a number of parachute jumps and skin-diving expeditions. His watch ran as much as 12 seconds fast at one point during the test period, but has now dropped back to eight seconds ahead of the correct time as set three months ago. Executive Editor Gilmore's watch and mine have not varied more than 10 seconds.

Someone called my attention to an article we ran in August 1969 in which a sidebar described an experimental quartz watch then under development at the Horological Electronic Center in Switzerland. The experts were predicting we would be wearing a quartz watch by 1979. Here it is only 1972 and practically every major watch company has a quartz watch on the market or due to be soon.

Misplaced resources

One of my favorite Bucky Fuller quotes is "Pollution is another name for a resource out of place." In another context he said it's "a natural resource we are failing to harvest." A lot of real things have been happening in this area since our report in the April issue last year, "How Science Will Help Us Get Rid of Our Mountain of Junk." Not just paper dreams, but concrete-and-steel efforts to harvest this resource now labeled solid waste.

At a meeting the other day, I heard Mayor Bev-

erly Briley of Nashville, Tenn., describe the plant his city is building. It will supply steam for winter heating and chilled water for summer air conditioning, and pipe it to the entire downtown area. That in itself is scarcely news; district heating plants have been around in some cities for a long time—although this is the first to supply both heating and cooling. The payoff is that it will use free fuel. It will be capable of consuming over 700 tons of municipal waste each day when the first phase is completed in 1974. Everybody wins. The new plant will save the city about three dollars per ton on garbage disposal over the present system of landfill and about \$72,000 a year on transportation; it will provide customers with cooling and heating for about 25 percent less than the cost of operating their own boilers and chillers; it will relieve the environment of the burden of garbage dumps; it will make the air cleaner, thanks to efficient combustion and modern pollution-abatement devices; and it will reduce the drain on our already overburdened electric-power networks. The only residue is a sterile ash that the U.S. Bureau of Mines estimates has a recovery value of two to three dollars per ton of solid waste burned.

In a similar vein, I hear from Goodyear that they will be burning old tires in a new odorless, smokeless installation in Jackson, Mich. The project is scheduled to be completed by the time you read this. The first of its kind in this country, the boiler will consume more than a million tires a year to produce steam needed for new-tire production. Pound for pound, tires have about 50 percent more heating value than coal, and we now discard old tires at the rate of about 200 million a year. The great boon from "mining" this resource is, of course, that it cleans up the countryside instead of tearing it up.

The plastics industry is getting into the act, too, with new research and information showing that many "facts" circulated about the incineration of plastics simply are not true. One such charge has been that PVC is a serious pollutant when burned and that it damages incinerators because when burned it gives off a gas that combines with moisture to produce hydrochloric acid (HCl). Recent studies by two New York University engineers show that HCl is not a significant pollutant in municipal incinerators, even when burning 26 times the current volume of PVC. HCl is generated by burning ordinary waste containing common salt found in food, highway litter, grass clippings, paper, and many other materials typical of our refuse collections. Still, there is very little HCl in the atmosphere. The clean-air standards do not even include it. A modern incinerator can readily handle polyethylene and polystyrene, too. Much of the folklore about these has arisen from trying to burn them in the open air or in outdated furnaces. In fact, the plastic packaging materials are helpful in a modern incinerator because of their high Btu or heat content. They help burn wet garbage and similar hard-to-burn refuse.

Hubert P. Luckett

Editor-in-Chief

SEPTEMBER 1972 | 47

What You Don't Know

Your car's shock absorbers aren't just there for the ride—they also play a vital part in the car's safe performance

By JAN P. NORBYE / *PS Automotive Editor*

If someone tries to tell you that shock absorbers are just for ride comfort and have nothing to do with safety, he obviously isn't aware of the dangers of worn-out shocks. You are talking to someone who just doesn't realize that improperly functioning shock absorbers can cause complete loss of control and a resulting collision just as surely as a broken steering linkage or a lost wheel.

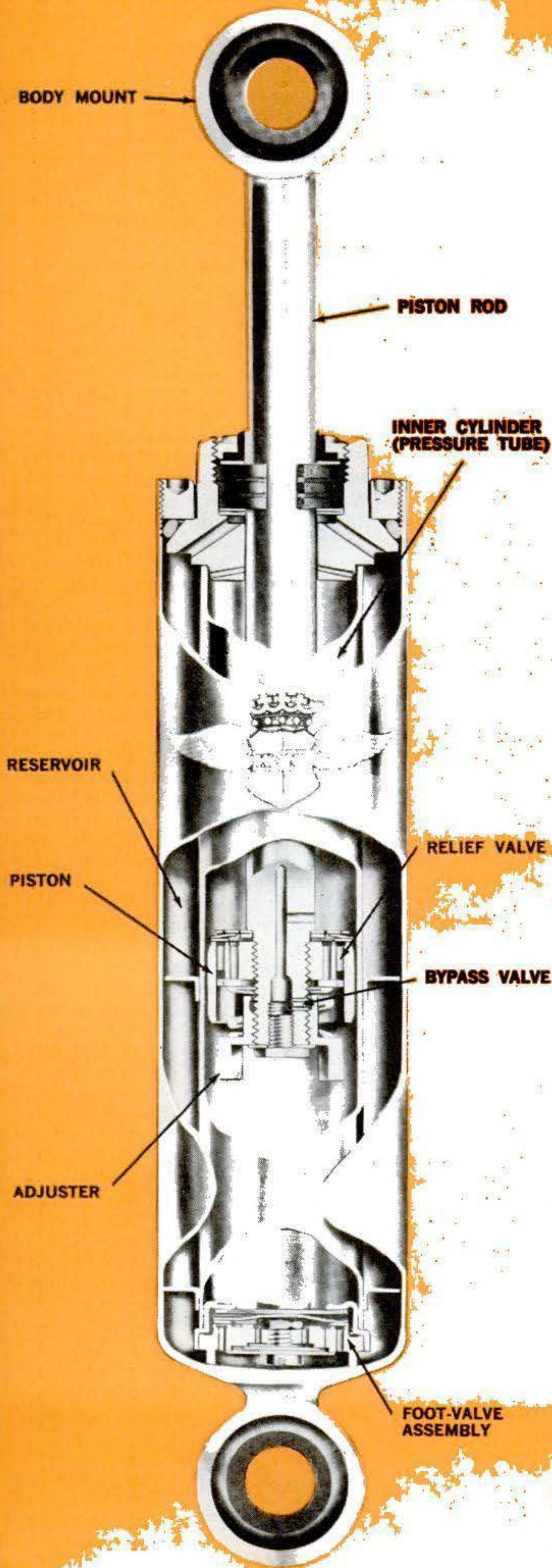
Shock absorbers are necessary to keep the wheels firmly on the road. They do this by controlling spring action—helping maintain stability in the entire vehicle.

Worn shock absorbers allow the wheels to bounce and spin in the air. This results in loss of steering and braking control. Worn shock absorbers give rise to severe vibration and shock loads in the suspension system. This can cause fatigue failures and breakage in critical parts. Worn shock absorbers offer less resistance to pitch motions in the car, reduce tire life, allow axle tramp, and lead to steering-wheel fight (wobble or shimmy).

How do you know when to get new shocks? One problem is that deterioration in efficiency is so gradual that the driver never notices a sudden change, and tends to compensate in his driving for the loss of stability and handling precision.

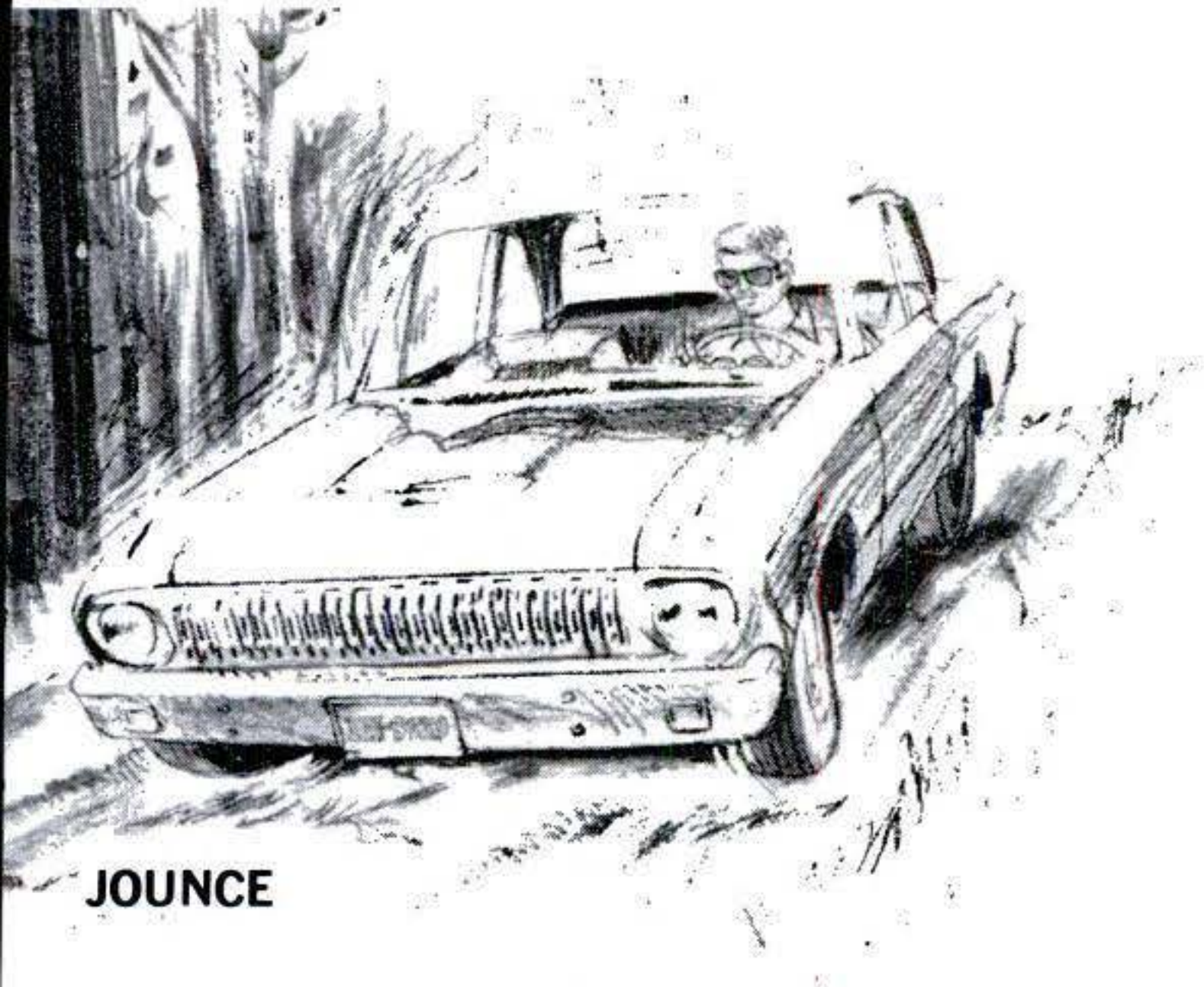
You can tell your shocks are shot when the car gets "sloppy" on the road. Probably half the cars on the road have defective shock absorbers. Many cars come off the assembly line with barely adequate shocks.

Shock-absorber life varies a great deal with the kind of roads you drive on and how fast you go. For normal driving, on a variety of roads, from country dirt roads to turnpikes, standard shock absorbers can give from 12,000 to 25,000 miles. Hot-rodding on poor roads can kill a set of shocks in 6000 miles or less.



The inner works of an adjustable shock absorber laid bare: Note the watchmaker's precision of the small parts and the complexity of this high-grade shock absorber. Sectional view at left shows the insides of a completely assembled unit in intimate detail.

About "Shocks" Will Hurt You



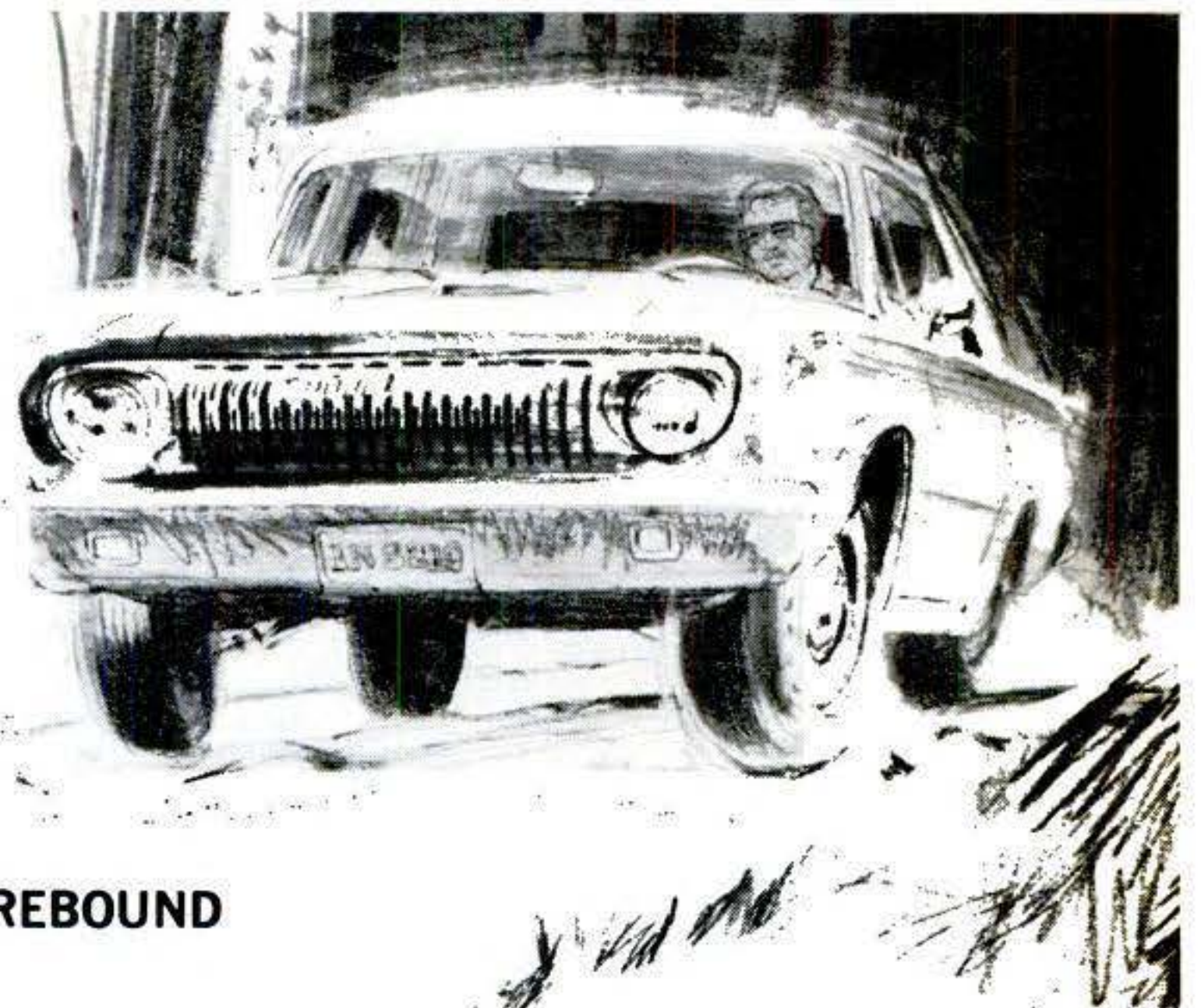
JOUNCE

Worn shock absorbers can cause your car to go out of control! You know they're worn when the car feels sloppy. Look what happens: Springs flex freely, and the front wheels undergo major

Just what does the shock absorber do? It's easier to explain what it *doesn't* do. For one thing, it does not absorb shocks. The spring is the element that cushions shocks. The shock absorber is just a brake on the spring to keep it from continuing its spring action. The shock absorbers should really be renamed spring dampers.

The shock absorber is a telescope unit partially filled with hydraulic fluid. It is mounted concentrically with the coil spring on many cars; on others, it is mounted separately. The shock absorber consists of two concentric tubes, a piston and rod, and valves for controlling hydraulic resistance.

The inner tube is a pressure tube. It works as a cylinder in which the piston operates. The upper end is sealed by a piston-rod seal. The lower end is closed by the compression-valve assembly. Resistance to fluid motion inside the shock absorber imposes a restriction on its compression or extension and gives the required damping



REBOUND

Changes of camber angles and toe-in/toe-out. Nothing that you do with the steering wheel can change this. The car loses directional stability and may bounce right off a road, even on straight-away.

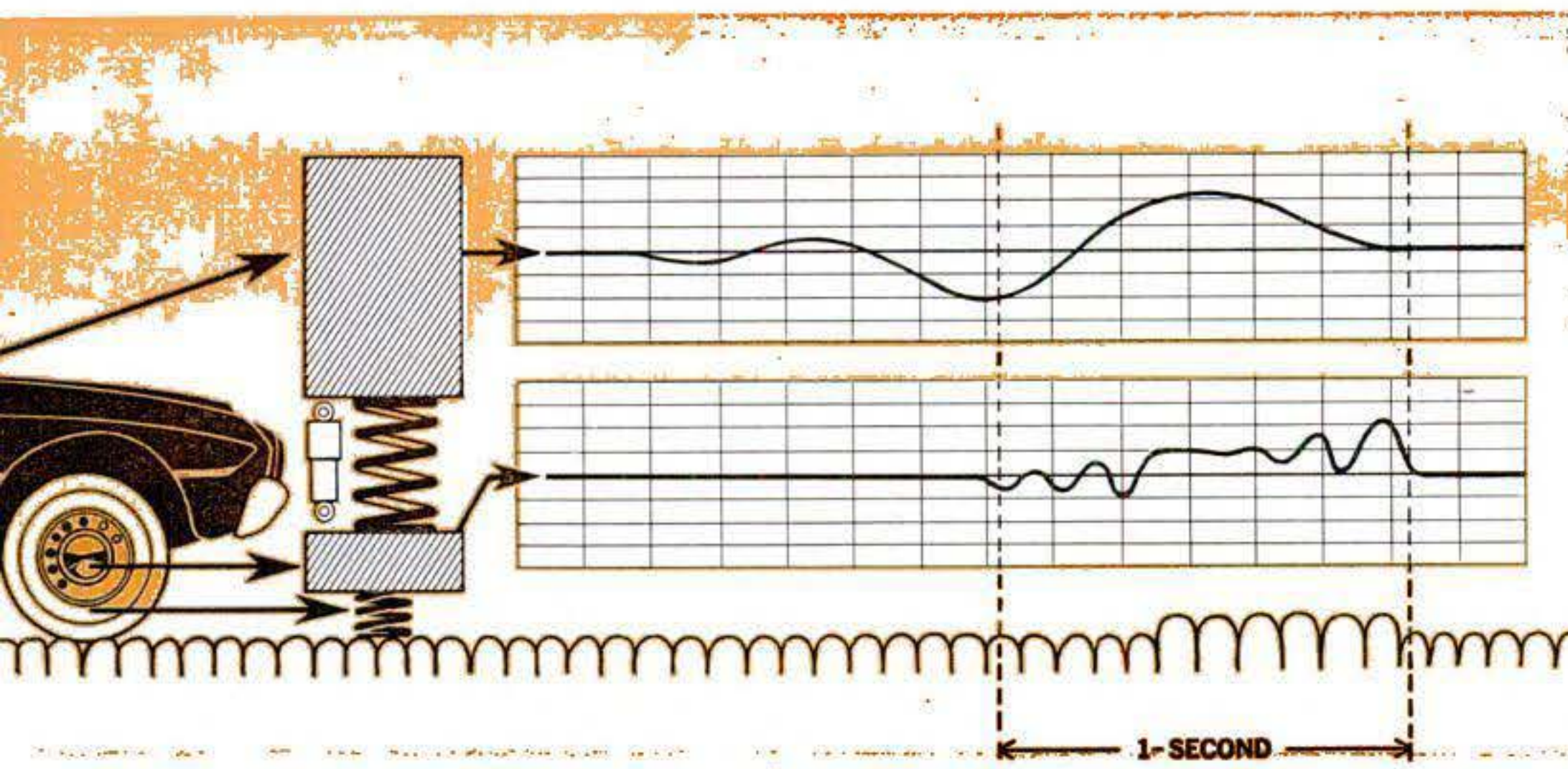
effect on the spring action. The compression valve is also called foot valve, since it is located at the base of the unit, or bump valve, since this is where jounce movements (bumps) are resisted.

The inner tube is completely filled with fluid at all times. The outer tube works as a reservoir. It provides space for reserve fluid and for overflow from the pressure tube.

Rebound forces are resisted by the piston, through the action of its relief valve and bypass valve. The piston rod and the outer tube, which form the upper end of the shock absorber, are attached to the vehicle frame or unit body. The pressure tube—the lower end—is attached to the suspension linkage.

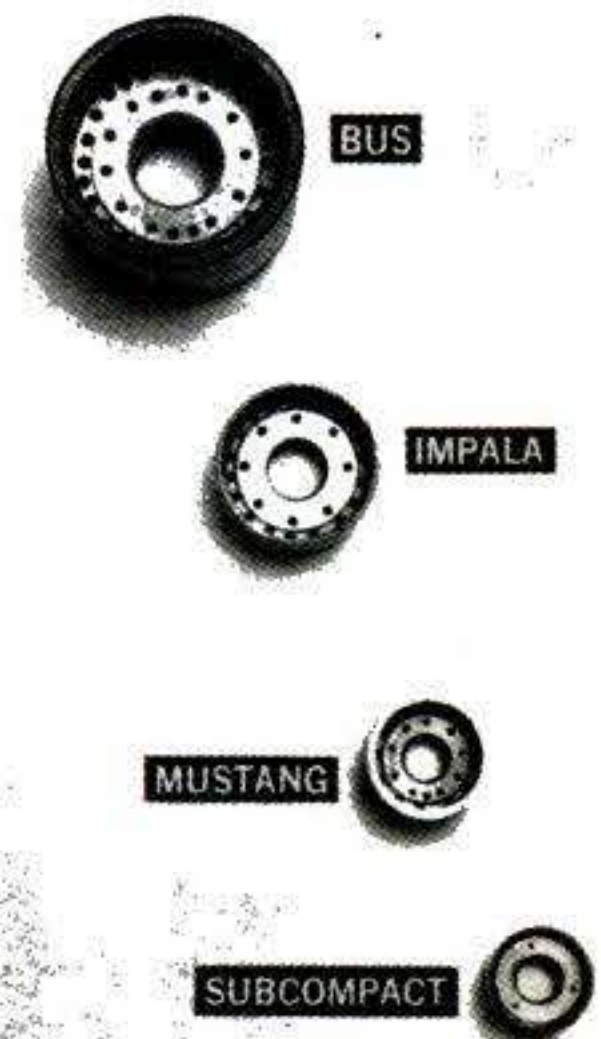
The main design parameter for shock absorbers is size (as defined by piston diameter). Shock absorbers that are great for a light car will be intolerably inadequate on

Continued



What happens when the wheels hit a bump? Tires flex, acting like a spring directly on roadway. Wheel is unsprung mass, taking jolts passed on by tire. The sprung mass

(car body) rides on springs dampened by shock absorbers. Sprung mass continues to oscillate after unsprung mass returns to normal. Shock absorbers lessen this action.

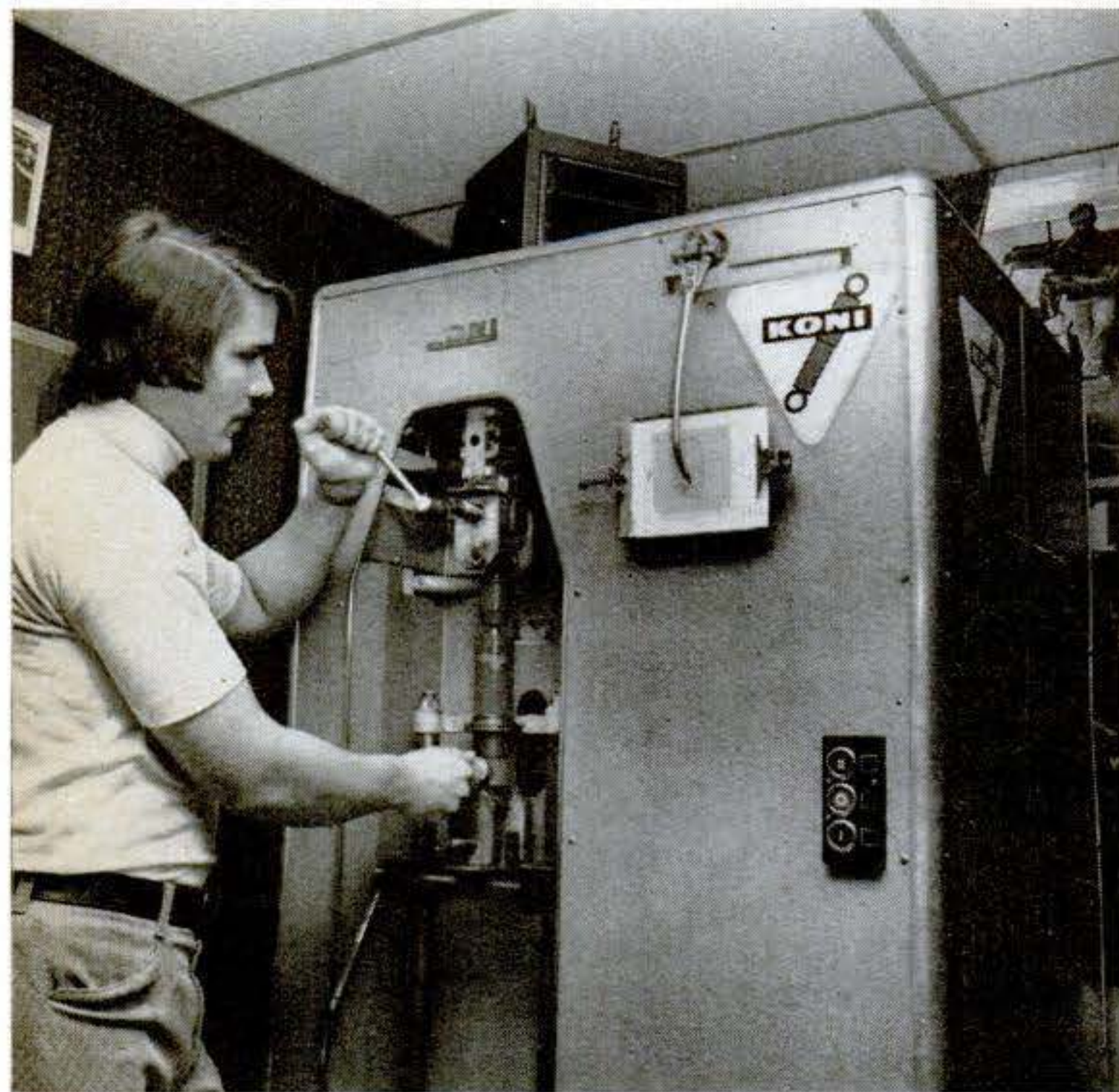


Shock-absorber resistance is basically dependent on size: Increased piston diameter means more damping. Shown above are pistons from vehicles of various sizes.

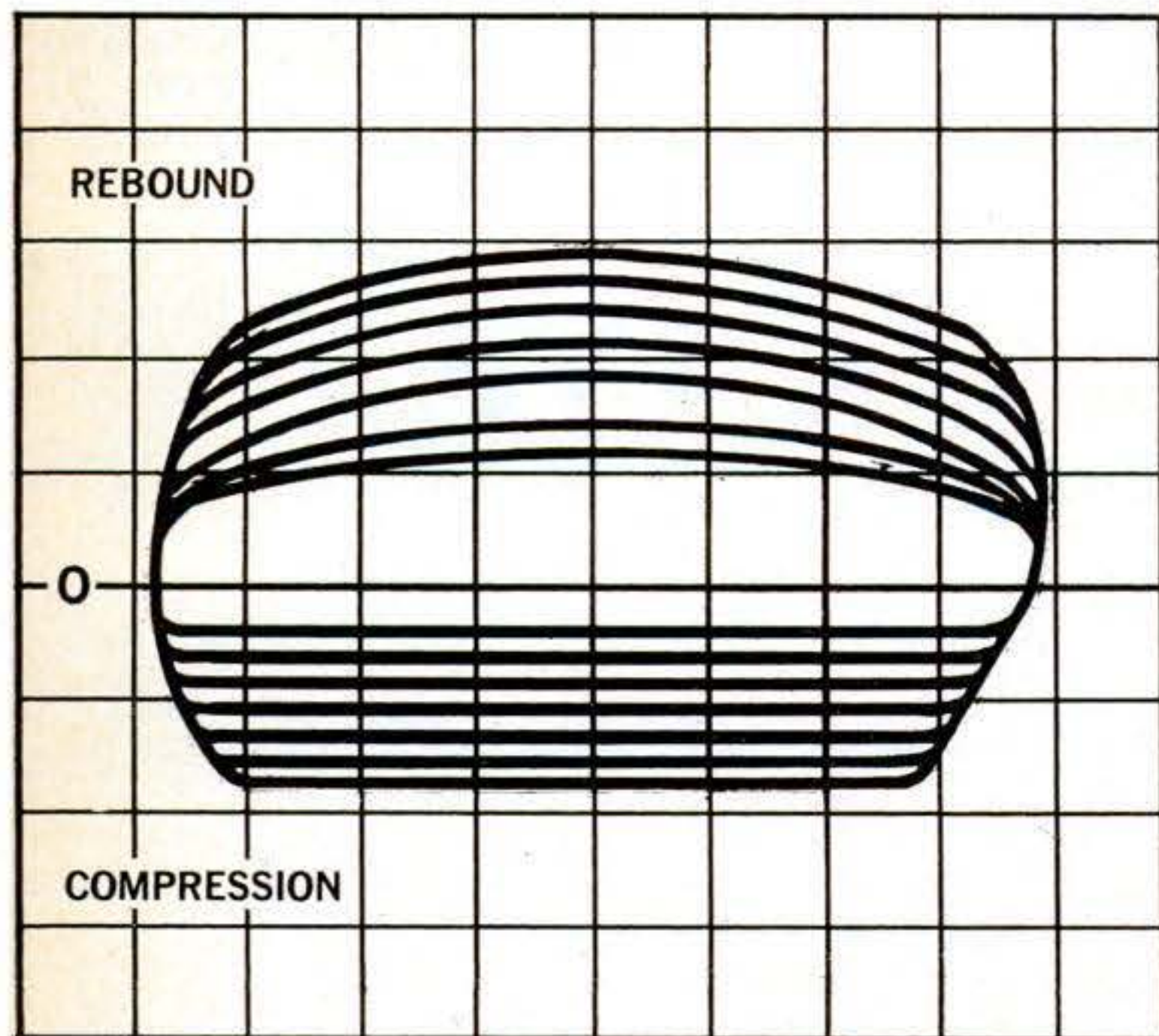
a heavy car. No matter how the insides of the shock absorbers are designed and calibrated, there's no substitute for size. As the wheel moves up and down, the spring is compressed or elongated. Simultaneously, the shock absorber is telescoped or extended. The action of the shock absorber forces the fluid to move two ways:

- Between the pressure and reservoir tubes.
- Between upper and lower sides of the piston.

There are only two movements in the shock absorber—compression (bump) and extension (rebound). To keep each condition separate in your mind, we'll deal separately with shock-absorber action in each case.



Professional way to test shock absorbers is to mount them in test machine. Crank-driven, it expands and compresses the shock absorber and records resistance buildup on a chart (below). Koni's John Oldenburg is testing a unit with three-inch travel each way at 68 cycles per minute (according to SAE standards).



Damping resistance is measured on the vertical scale, and piston movement on the horizontal scale. All these lines were made with the same double-adjustable Koni. Resistance buildup is faster on rebound (upper left) than on bumps (lower right). In all cases, resistance is held high to the end of piston travel. Bump and rebound lines for each setting must be viewed as a whole.

Bump (jounce) action. Compression of the shock absorber drives the piston down. This raises hydraulic pressure in the lower end of the inner tube. Fluid escapes along two different paths: through the compression valve to the reservoir, and through the relief valve in the piston to the top end of the pressure tube.

The task of the relief valve is to equalize pressure on both sides of the piston. Fluid flow through the relief valve is controlled by the number of orifices in the valve and their diameter.

The compression valve offers little resistance to flow to the reservoir. In a typical shock absorber, the compression resistance is considerably lower than the rebound resistance. That's because the shock absorber is not intended to fight the bumps, but to limit continued spring movements to a minimum. Without a shock absorber, the spring would keep bouncing in natural frequency.

Rebound action. When spring action returns the wheel to the ground, the shock absorber is extended. This raises pressure in the top of the pressure tube and lowers pressure in the bottom.

In this operation, the relief valve remains closed: It's a one-way passage for upward flow only. Downward flow is instead directed through the bypass valve, which has a quite different construction. The bypass valve itself is a ring with a rill (a circular groove) screwed into the piston. The valve is spring-loaded against its base. Rill size controls low-velocity-flow resistance (large rill = more fluid flow = less damping).

The flow path is through the piston rod, via one large radial orifice, and a circular arrangement of rod holes inside the piston that in turn connect with the pressure side of the bypass valve. The size of the rod holes controls high-velocity-flow resistance. During this process, the compression valve at the lower end acts as a suction valve, and admits fluid from the reservoir to enter the pressure tube.

Most shock absorbers are replacement items. They are not designed to be maintained or repaired. Standard shock absorbers are low-priced, and replacement usually costs less than a repair job would.

By spending a little more, you can get "lifetime" shock absorbers. I'm talking about adjustable shocks that will maintain their as-new damping characteristics for the life of the car.

Why do shock absorbers wear out? There's only one critical area: the piston skirt. Wear on the piston gives rise to leakage, which means reduced damping. In the adjustable shock absorber, you compensate for leakage by restricting fluid flow through the piston.

The adjuster is mounted at the lower end of the piston rod. Turning it clockwise drives the screw deeper into the rod, which blocks off one of the rod holes feeding the bypass valve. Continued turning will block off more rod holes, which adds rebound resistance.

Koni shock absorbers—the best-known of all adjustable units—have several types with external adjustment. Adjustment is performed at the top, with a small wrench or an Allen key. You can also set your adjustable shock absorbers to give you the exact damping characteristics you want, to improve ride and handling. There's hardly a rally car in the world, driven by a professional, without adjustable shock absorbers.

Final tips for choosing shocks. Before you rush out to buy a new set, keep a couple of other points in mind. If you have a station wagon or habitually carry heavy loads in the trunk, you should probably go to shock absorbers with overload springs (such as Monroe Load-Levelers). And when you buy new shocks, don't expect them to correct defects in other systems, such as sagging springs or faulty wheel alignment. They can only do what they are intended to do: damp out ride motions in the car. **PS**

The changing face of the red planet...

Close-Up Photos Reveal a Turbulent Mars

A PS INTERVIEW WITH
CARL SAGAN



Dr. Sagan discusses Mars during interview in Washington, D.C., where he spoke on Mariner 9 at the National Academy of Sciences.

What is Mars like? Until very recently, the best answer, based on the desolate, eroded, crater-strewn vistas viewed by Mariners 4, 6, and 7, was that Mars was a dead planet, a fossil world whose geological activity lay in the remote past, waterless and incapable of sustaining life, more akin to our moon than anything else.

Now Mariner 9 has changed all that. In almost 7000 spectacular photos taken from mid-November to early April and several hundred since June, it has confronted scientists with a dramatically different planet, a turbulent world of super winds and swirling dust storms, towering volcanoes, huge chasms including a gorge far longer, wider, and deeper than the Grand Canyon, chaotic landscapes signaling massive upheavals in the recent geological past. Most astonishing of all: Not only are there many features that seem to have been hewn and molded by torrents of running water; there is evi-

dence that the polar ice caps consist at least partly of frozen water. The question of water-dependent life on Mars is thus alive once again.

For an interpretation of this remarkable turnabout, PS sought a uniquely qualified scientist. Dr. Carl Sagan is Director of the Laboratory for Planetary Studies and Professor of Astronomy at Cornell's Center for Radiophysics and Space Research. Now on leave at Caltech, he heads the Variable Features Working Group of Mariner 9's television experiment team. Besides serving on many advisory groups to NASA, he is: Editor of ICARUS, the international journal of solar-system studies; an officer of the planetary commission of the International Astronomical Union; and VP of the working group on the moon and planets of the International space organization COSPAR. The following interview was conducted in Washington, D.C., this spring.

Arthur Fisher/Group Editor, Science and Engineering

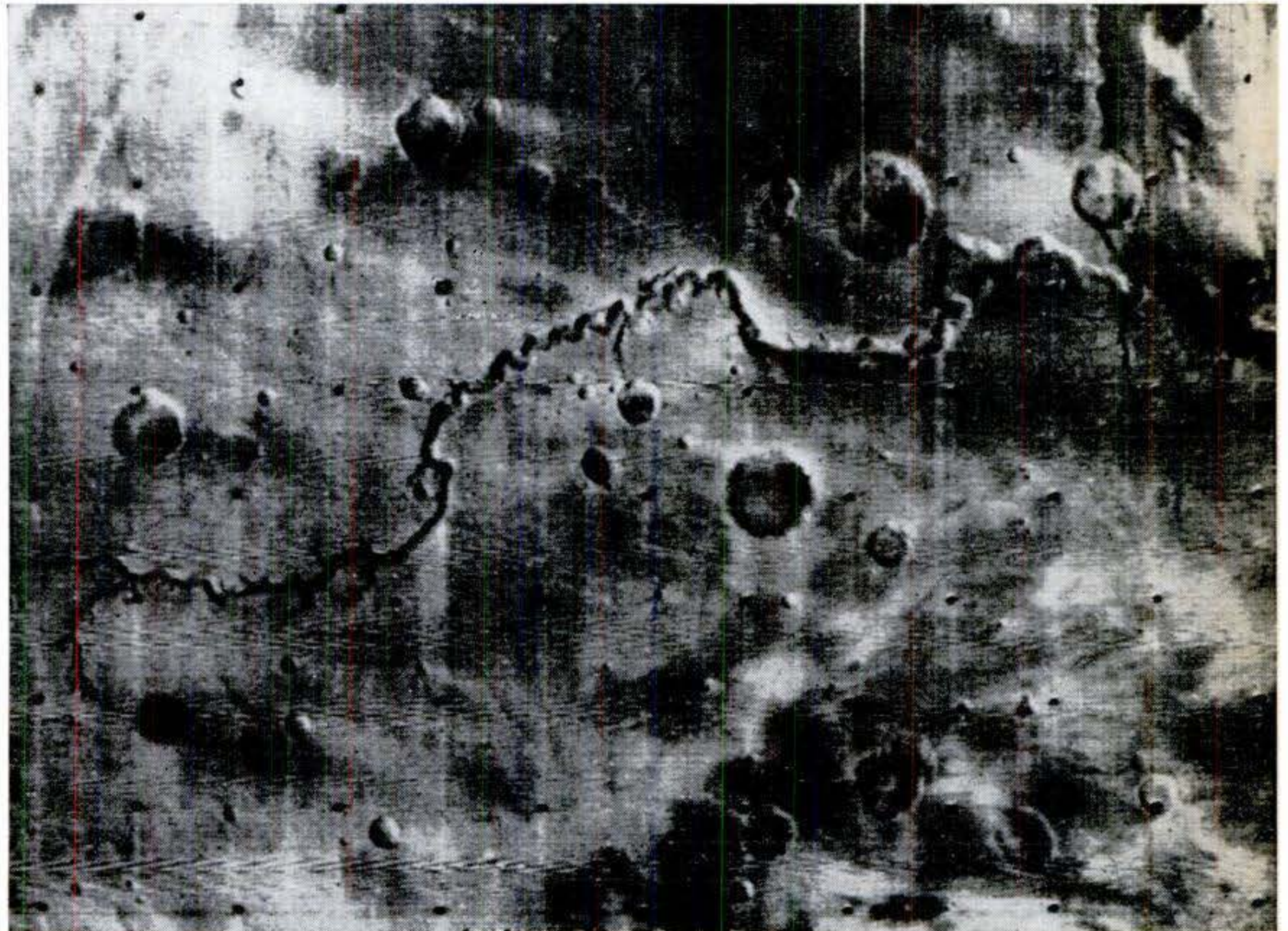
Fisher: Dr. Sagan, was there any singularly dramatic moment during the picture retrieval at Jet Propulsion Laboratory?

Sagan: They were all dramatic. I mean every day you'd arrive and there would be 72 new pictures for you to look at. At least a few of those pictures would show phenomena that you had never seen before and never guessed existed on the planet Mars. It's a time of extremely high scientific excitement. That time is not yet over.

Fisher: Which of the Mariner 9 picture results have been the most significant to you personally?

Sagan: Well, I think the widespread evidence of dramatic changes due to windblown dust; the compelling evidence for volcanic activity on a

Continued



A watercut valley on dry Mars? This gully-like feature snaking through a cratered terrain is about 250 miles long and three to three and a half miles wide. Its meandering shape resembles the sinuous

rills (cracks) seen on the moon; and meanders can be formed by flowing lava. But the branching tributaries suggest this valley, like an arroyo on Earth, was cut by flowing water.

massive scale; the evidence suggestive of running water in some not-so-distant time in Martian history; the details of the recession of the polar cap showing that there is a remnant of the south polar cap which just doesn't go away in southern summer; and the first closeup pictures of Phobos and Deimos, the two moons of Mars. I would say that those are the highlights in my mind.

CHANGING MARKINGS

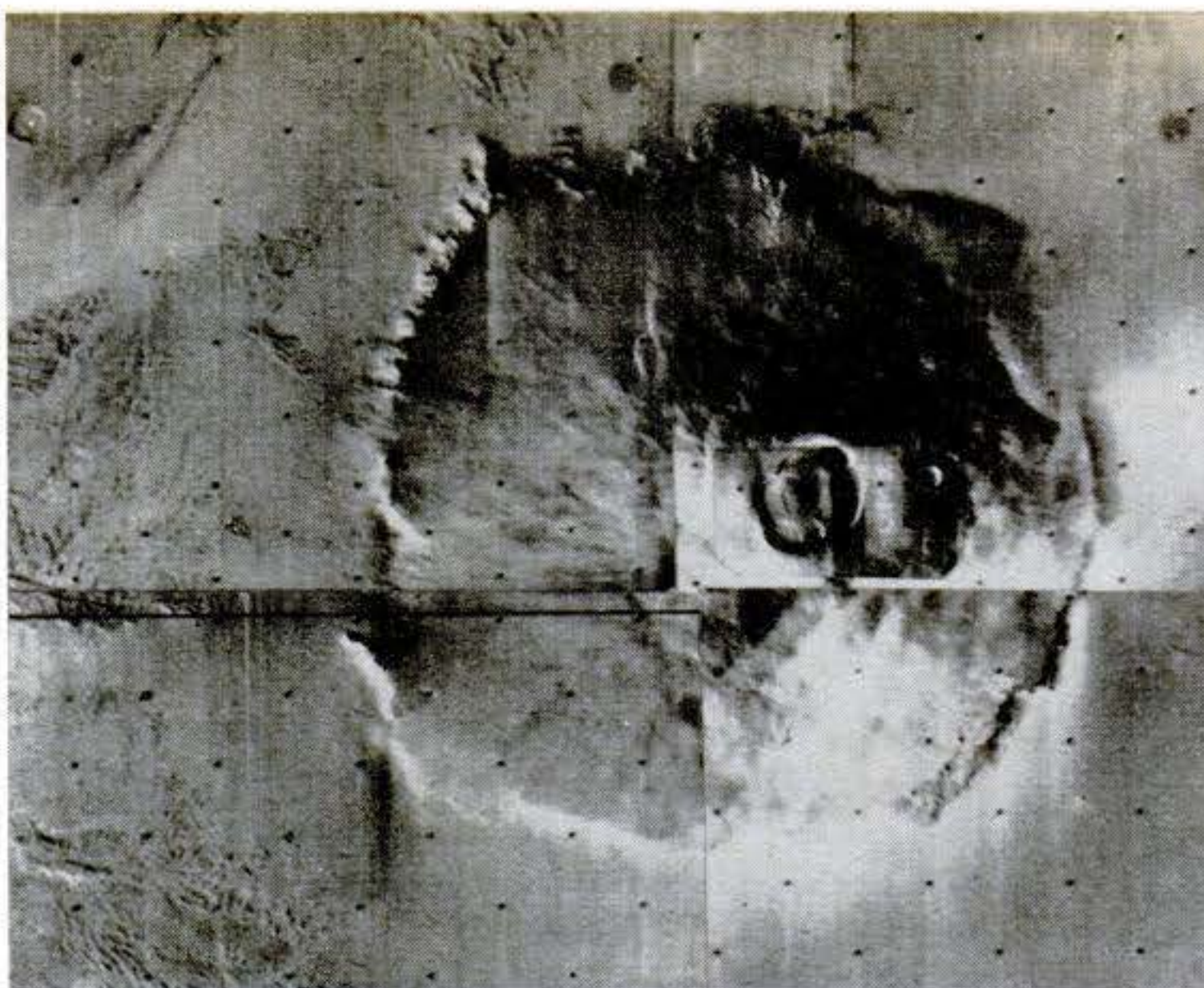
Fisher: What about variable features?

Sagan: Bright and dark markings have been seen on Mars since men began looking at it through a telescope. It was observed, in the middle 19th century, that these markings sometimes seemed to change seasonally. Around 1870, a popular theory had it that the apparent seasonal changes in the Martian bright-and-dark markings were due to vegetation darkening the landscape in spring and summer, when the polar caps, thought to be frozen water, partially melted as the climate warmed. The sort of model people had in the back of their minds was an algal bloom, or perhaps the spring flowering of the arctic tundra in Canada and Siberia. Now, since this 19th century model, whether the changes are truly seasonal has been called into question. But, as we'll see, widespread changes in the Martian surface have certainly been verified by Mariner 9.

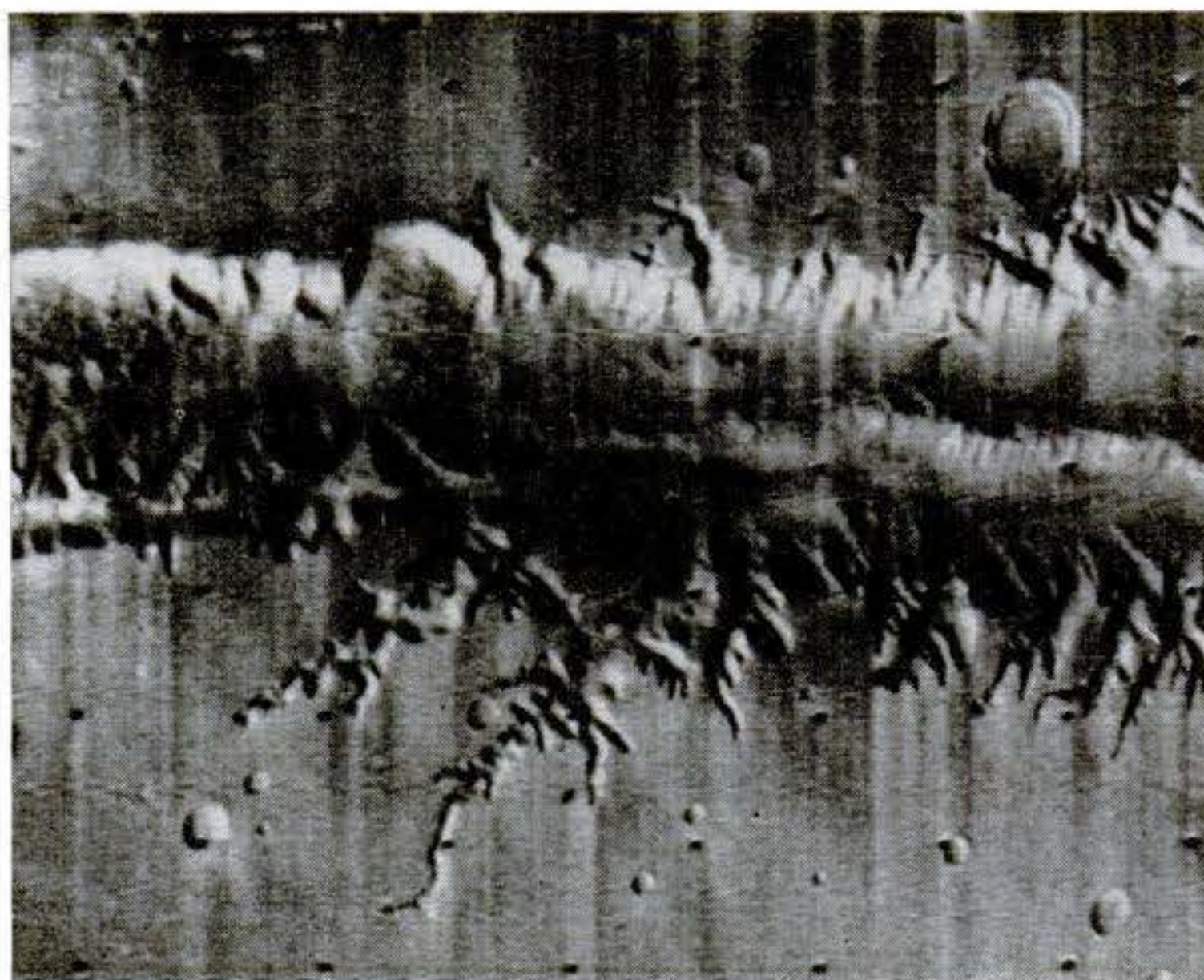
Fisher: What about the so-called canals?

Sagan: They were discovered in 1877 by Giovanni Schiaparelli, who observed, to his surprise, a network of fine straight lines interlacing and covering the surface of Mars. An American diplomat-turned-astronomer named Percival Lowell was quite excited by Schiaparelli's findings and established an observatory in Flagstaff, Ariz., to pursue such observations. Schiaparelli described what he had seen as *canali*, Italian for channels or grooves. But Lowell and others mistranslated this word as "canals," which had a clear implication of design. Lowell believed in a literal canal network that carried liquid water from the melting polar cap to the thirsty inhabitants of the equatorial cities of Mars.

There were a great many books written on this kind of speculation. In English, a set of more than a dozen novels by Edgar Rice Burroughs was based on a gentleman adventurer from Virginia named John Carter, who was able to get to Mars by standing in an open field and wishing hard at the planet. And when he arrived he found it populated by beings of all sorts, including ones who were very human.



Nix Olympica, a giant volcanic caldera, or mountain with a complex volcanic vent, is 310 miles across at the base, looms some 40,000 feet. The main crater is 40 miles across. It dwarfs what it closely resembles on Earth—the volcanic pile forming the Hawaiian Islands and culminating in Mauna Loa. Lack of erosion shows volcano is very recent.



Part of a giant gorge like East Africa's Rift Valley, this vast chasm with branching canyons eroding the adjacent tablelands is in Tithonius Lacus, 300 miles south of the equator. Gorge is almost four miles deep in spots; length of this part of chasm is 300 miles. Origin of tree-like branching tributaries may be running water.

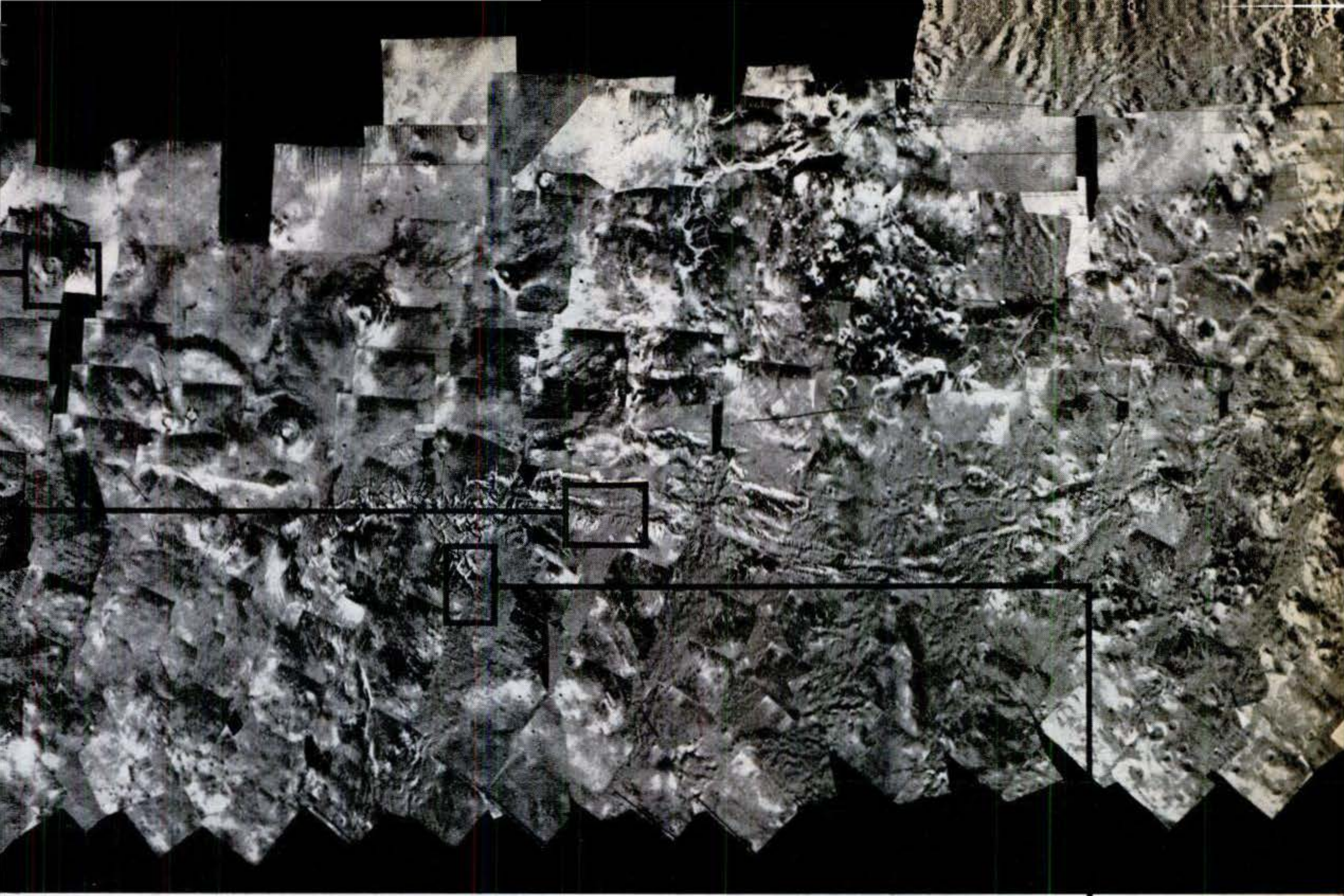
"People said the Martian environment was too severe

In Germany, a writer named Kurt Lasswitz wrote a similar piece of romantic fiction called "On Two Planets," which played a role in helping a very young man named Wernher von Braun develop an avid interest in spaceflight. So, the Lowellian interpretation of what had been seen on Mars turns out to have played a significant role, not because it was right—it's almost certainly dead wrong—but because it was dramatic and excited many boys and young men to study Mars who have in one way or another been involved in the most recent studies of the planet.

Fisher: Did you receive similar stimulation?

Sagan: Yes, I was similarly intrigued when I read the John Carter stories by Edgar Rice Burroughs. Well, the actual story on the canals appears to be that there are no lines "like those on a fine steel etching," as Percival Lowell described them. The canals seem to be a sort of psychophysiological rather than an astronomical problem. The eye tends,

when the "seeing," or atmospheric turbulence is pretty bad, to string up disconnected fine detail, because it's easier to remember a straight line than a patchy, disconnected matrix of blobs. The observation of the best visual observers in the last 50 years has been that they *can* see canals when the seeing is bad. But as the seeing improves to the best it ever gets, they are unable to resolve the straight lines into disconnected fine detail. So even before Mariner close-up photography of Mars, most astronomers studying the subject were prepared to believe that there was not actually a network of straight lines—exceptionally straight lines crossing the planet, going for thousands of kilometers following great circle routes and so on. And indeed Mariners 4, 6, and 7 found virtually not a trace of anything at all like such canals. Now Mariner 9 is providing the first full coverage of the Martian surface, where everything has been photographed with a resolution of one kilometer except for a little cap at the very north pole.



Mosaic of the Martian surface, assembled like a jigsaw puzzle from individual photos at Caltech's Jet Propulsion Laboratory, shows a strip 120° wide extending 30° north and south of the equator. At upper left is a group of four massive volcanoes, includ-

ing three in a chain. Beginning just to the right of this group and along a line south of the equator is a chain of canyons, 2500 miles long, 75 miles wide, and in places almost four miles deep. Striking features are discussed left and below.

for life... an exceedingly provincial conclusion."

Well, it turns out that there *are* more or less straight lines on Mars in various cases. But they are not at all as Percival Lowell imagined; they are as Schiaparelli imagined, that is, channels and grooves, although not necessarily in the places that he drew them. Not only does Mars have channels and grooves, it has an enormous rift system like the east African rift system, which is involved in continental drift on the Earth. And the geological significance of such rift valleys on Mars is extremely high.

Fisher: Does that mean these huge valleys are evidence of recent tectonic activity? [See "Plate Tectonics," PS June.]

Sagan: Yes. The rift valleys tend to surround and come radially out from an extremely high region in the part of Mars called Tharsis, which contains volcanic calderas; very high mountains with holes in the top that have been formed by successive episodes of lava outwelling from the interior. The largest of them are larger than the island of Hawaii, which is

the biggest such feature on Earth. We can see from the photos that they are very recent, on a geological time scale, because they are not battered by meteoric craters or worn down by other forms of erosion.

Fisher: Recent on a scale of billions of years?

Sagan: Yes. Whether they are 10 million years old or one million years old, we don't yet know. This, together with other evidence, shows that Mars is not an ancient, dead planet, but is geologically active in recent times, geologically young in the sense that the Earth is. But let's get back to variable features.

There were originally two spacecraft intended to be launched to Mars: Mariner 8 and Mariner 9. [See PS, Nov. '71] each with its own mission. Mariner 8 failed and landed in the Caribbean, where it is not even sending back oceanographic data! Since we have only one craft, Mariner 9, we do not have a mission that has been optimized for variable features.

Continued



Dubbed the "chandelier," this feature consists of an intricate network of mighty canyons that seem to hang below the Martian equator. It is about 335 miles long from base to tip. The terrain is jumbled and chaotic, full of signs of immense upheavals characterizing tectonic activity on a very large and recent scale.

"Every day you'd arrive and there would be 72 new pictures to look at..."

Nevertheless, we've found them much more easily than we expected. In fact, Mariner 9 has been a spectacular success.

One problem in looking for things changing is that you might look at the same object two weeks apart but under different lighting conditions, and if you forget about that you might think there's been a real change when, in fact, it's just a different sun or viewing angle. The spacecraft orbit has been arranged so that we can look at the same area on one-day turnarounds and on 19-day turnarounds, in both cases with the lighting angles all very closely constant. So, if we see any significant changes either a day apart or 19 days apart, then we can have fair confidence that that's a real change and not a result of lighting conditions.

We have indeed found such variable features; they fall into several different categories. One category is what are called blotches. These are dark markings that weren't there the last time we looked but are there now.

Where they are smaller than craters there's a certain tendency for them to appear in the inside of the crater. Where they are larger than craters they tend to wash over the craters.

We have some quite striking cases where we look at a given area and see an array of bright and dark features, we come back and look at it two weeks later or so and there are all the old features plus one *new* dark feature that just wasn't there before. Then we continue looking at that area on every successive opportunity and only small changes appear. This kind of time scale is absolutely characteristic. In time scales of between several days and two or three weeks, features tend to change on Mars. Characteristic changes that we have been seeing are the appearance of dark features where they previously did not exist.

Fisher: Are we always talking about a feature that is at least a kilometer in diameter, something the size of Yankee Stadium, say?

Sagan: Yes. In fact, I'm talking about features that are ten or 15 kilometers in diameter that just suddenly appear. For example, there's one feature called the Spearhead, because that's what it looks like. In one picture it's not there, and in the next picture it's there, and in all subsequent pictures it just stayed there.

Fisher: What could possibly account for such a performance?

Sagan: I've mentioned one possibility, which is more than a century old: namely, that we're seeing the growth of dark vegetation into a region previously not populated by this vegetation. There is another possibility that my co-workers and I have advocated for the last five years—that we are seeing a manifestation of wind-blown dust. We believe the appearance of a feature like the Spearhead is due to horizontal winds carrying fine bright dust off the surface, revealing underlying dark material. And that the so-called seasonal changes are due to seasonal wind patterns that cover and uncover underlying dark material by windblown bright material. And we can see from the existence of planet-wide storms, at least at certain times on Mars, that dust can easily be carried quite significant distances.

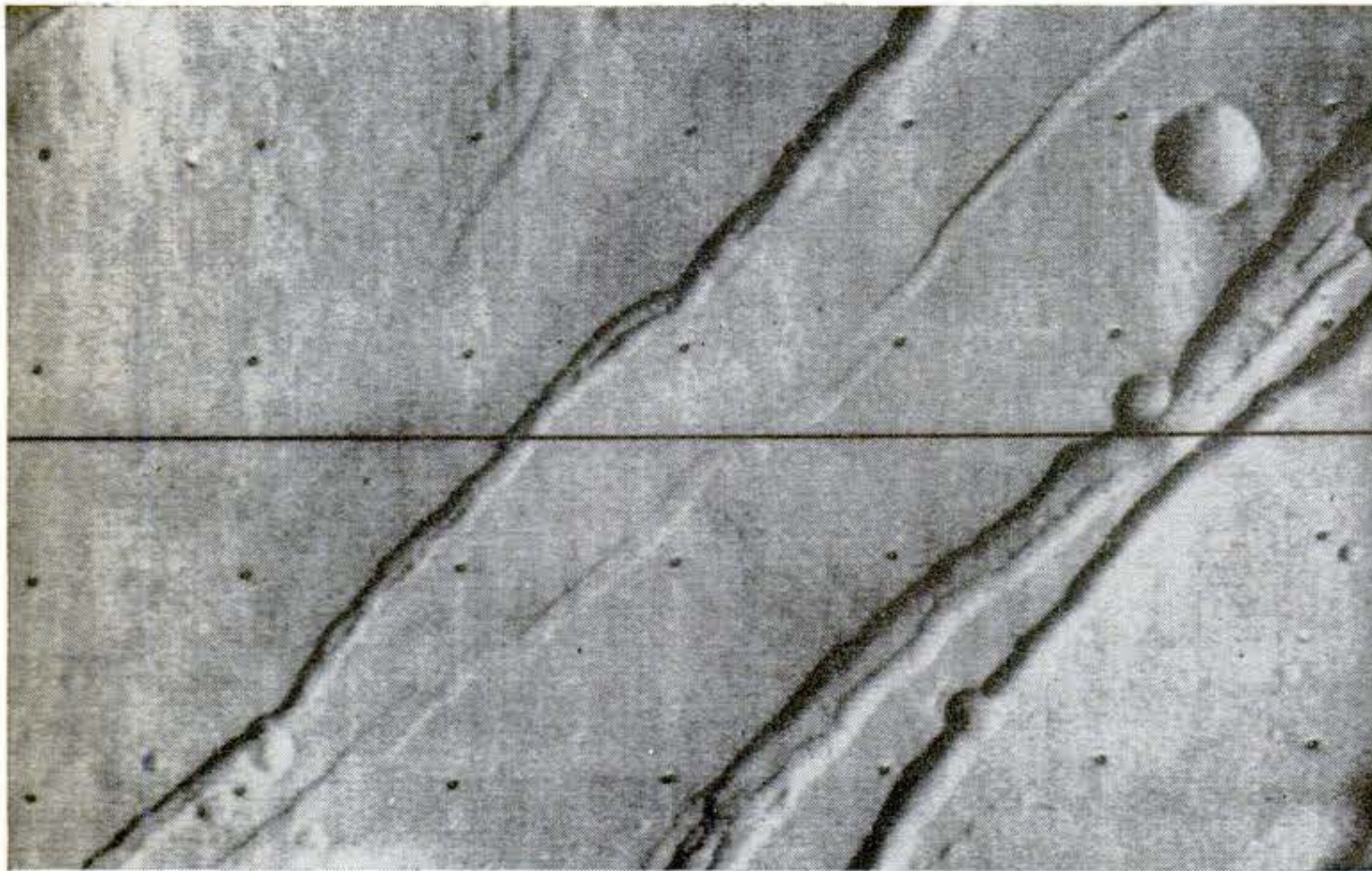
Fisher: Would this mechanism account not only for the random appearance and disappearance of blotches, as you describe them, but also for what has been called the progressive wave of darkening?

Sagan: Okay. Now let me say a word about the wave of darkening. It's been called that because some observers thought this seasonal change had a wavelike progression from the polar cap towards and across the equator at about 35 kilometers a day. Some years ago we did a statistical study to show that it was hardly an invariable wave; it does not work like clockwork. Sometimes an equatorial place darkens long before a polar place darkens. And so I think the phrase is probably a misnomer. To some degree the same kinds of darkenings occur every Martian year. I think that that is due to the repetition of the same wind patterns—which are tied, of course, to the seasons—covering and uncovering the dark stuff.

Fisher: At Jet Propulsion Laboratory last November you gave an analysis of the kinds of wind velocities that would be necessary to raise dust storms on Mars. Could you go into that?

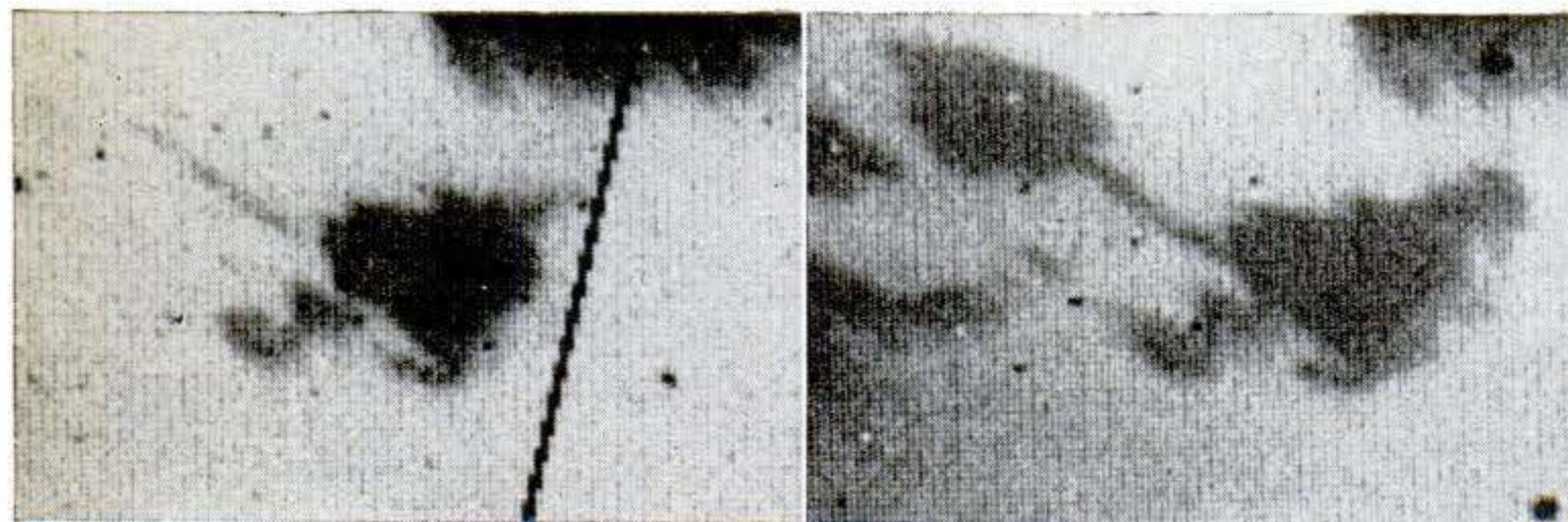
CRATER TAILS

Sagan: Sure. Let me first, before



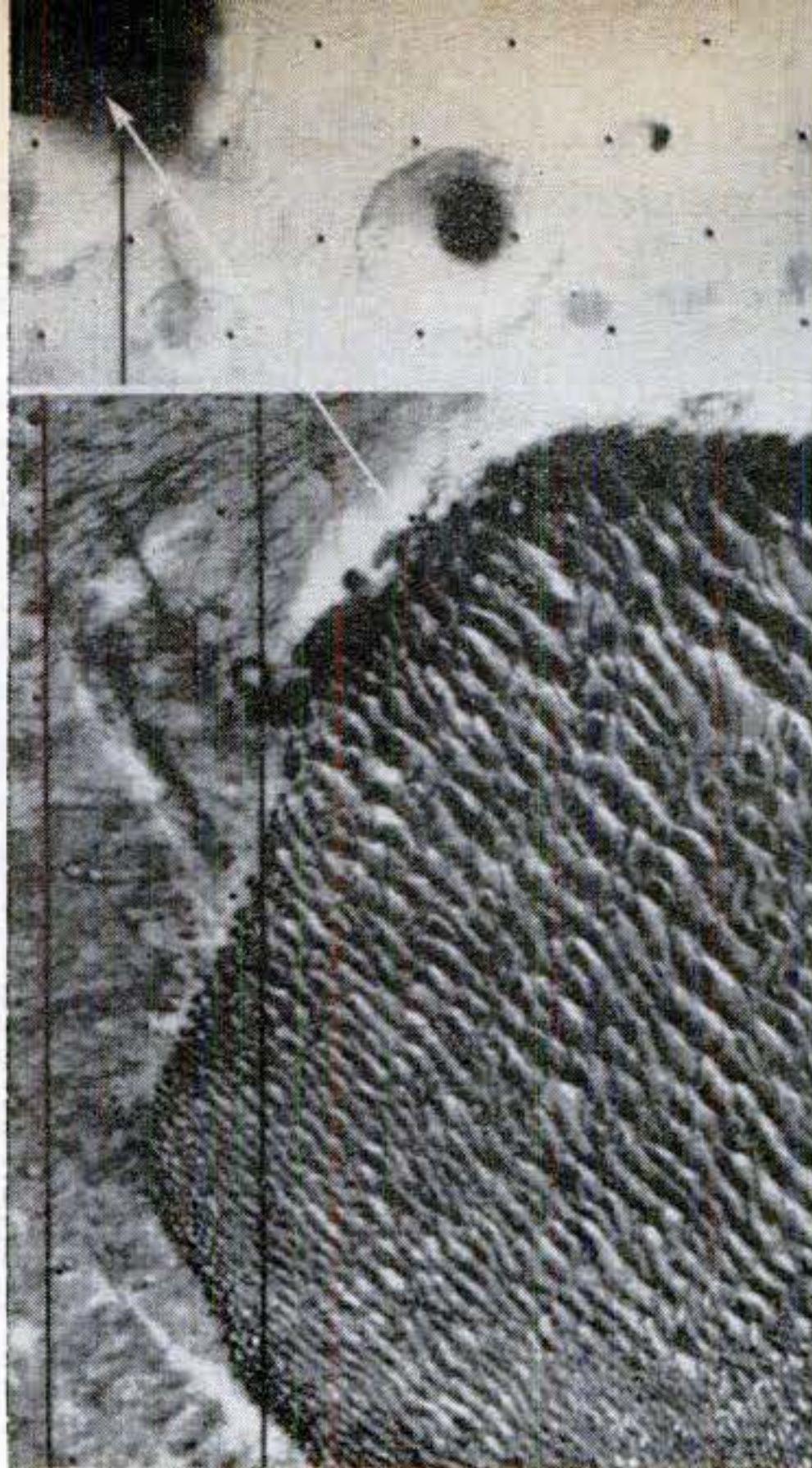
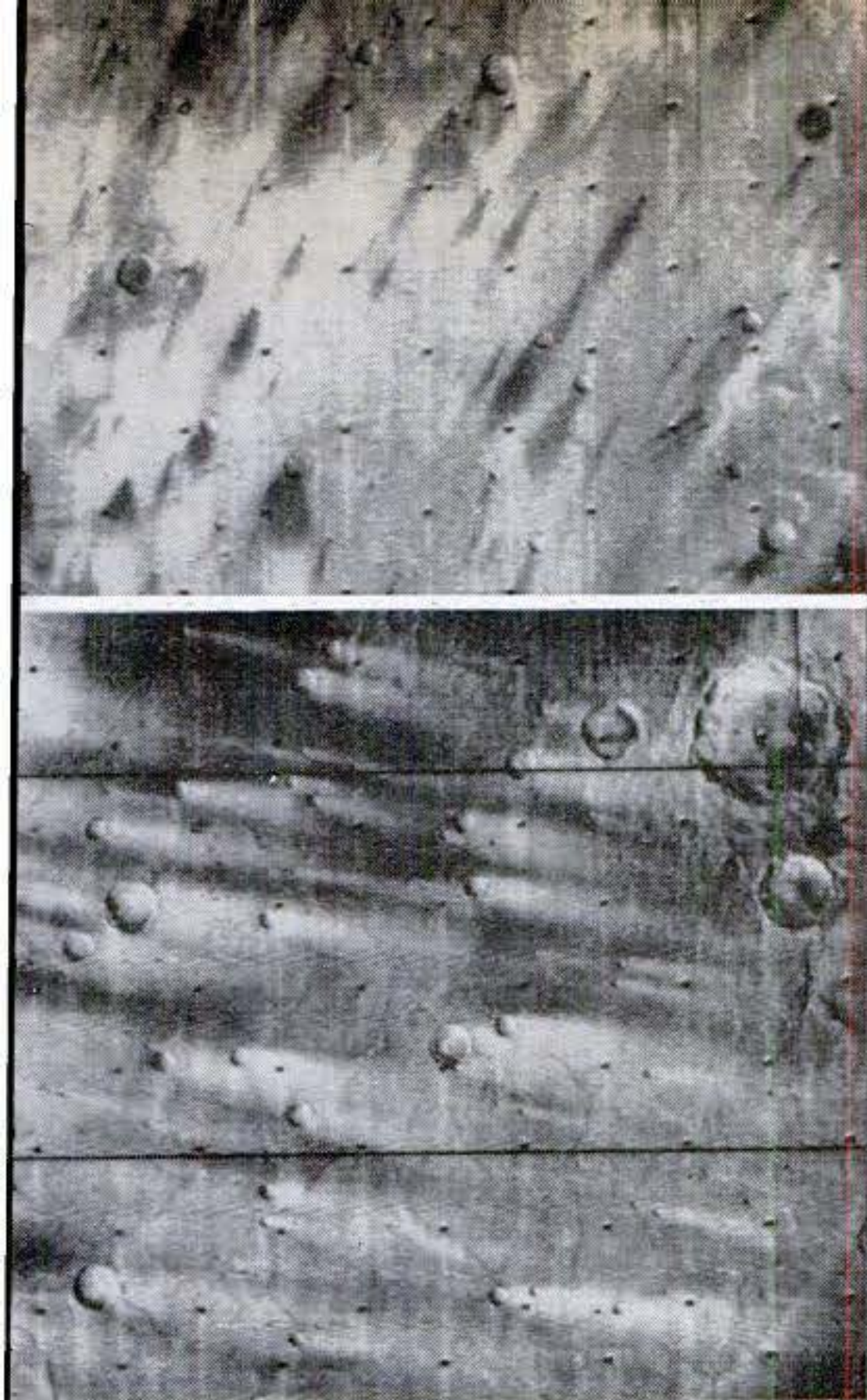
Cracks in the Martian crust, these rills are part of a system of parallel fissures extending more than 1100 miles along the surface. The one at upper left is about a mile across.

The rills are probably the result of stretching of the upper rock layers. They may correspond to some of the "canals" reported by earlier astronomers.



The Spearhead: Now you don't see it, now you do. Photo on right was taken 13½ days after the photo on left. The spear-shaped feature, which is roughly six to nine miles

across, simply materialized in less than two weeks, and persisted in all subsequent pictures. Probable cause: wind-blown dust uncovering dark material.



Crater tails, black and white: The bottom photo shows a number of craters, all with bright tails streaming out in precisely the same direction—an indication that bright dust is being blown out of the craters by wind. But top photo shows craters with dark tails. Either there is dark wind-blown dust, too, or dark tails are “wind shadows.”

Dune field of loose material appears as black splotch on floor of crater in wide-angle view (top). But telephoto view reveals many long, parallel dunes spaced about a mile apart. As in dune fields on Earth, dunes at the edge of the field are smaller. Orientation and size of dunes implies formation by strong wind blowing in one direction.

Phobos, Mars’ innermost moon, seems extremely battered in this computer-enhanced photo, the most detailed image we have. Profusion of craters suggests Phobos is very old, has been pitted by collisions with interplanetary debris for billions of years. Camera aboard Mariner 9 was 3444 miles from Phobos when this picture was made.

I do that, say something about another kind of variable feature on Mars—tails. Most commonly, tails emanating from craters. There’s a crater, and coming out of it for let’s say 10 or 20 crater diameters is a long, bright or dark tail. If there are other craters nearby, they generally have tails parallel to that first one. There are some cases where we have 30, 40, or 50 tails, all parallel, all emanating from craters, all going in the same direction. We think that at least some or most of the bright streaks represent bright material trapped in the craters that has since been blown out by winds—another piece of evidence for extensive wind-blown dust on the planet.

The situation is more complex than I’ve indicated because there are also *dark* tails coming out of craters. And so, are we to imagine two kinds of materials, bright and dark dust, with dark dust settling in some places and bright dust in others? Or is it possible that the dark tails are not tails at all, but wind shadows? Say a big cloud of bright dust comes along and is deposited everywhere except downwind of obstacles. Then, looking at it from Mariner 9, we see a dark streak downwind of the crater wall, not because dark stuff has been blown out of the crater, but because

the wall has prevented the bright stuff from being deposited where we see the tail. Some places we see streaks behind—not craters, but small hills showing that there are certainly cases of wind shadowing occurring on the planet. We think there’s a pretty good array of evidence that wind-blown dust is a very important aspect of the Martian environment. We arrive at Mars November 13 and see the entire planet obscured by dust; the dust settles out and then we see on the surface features that are changing, and streaks coming out of craters—both, likely, due to wind-blown dust.

SUPER WINDS

Now, what’s necessary to move dust around on Mars? The Martian atmosphere is extremely thin, much thinner than Earth’s. That means that you have to move the air much faster to get something to move forward. It turns out that to move the same-sized grain of sand on Mars that you are moving on the Earth requires winds 10 times faster. If you believe any dust is moved around at all on Mars you have to immediately assume winds . . .

Fisher: You’re saying, just to pick it off the surface?

Sagan: Just to make it roll over.

You have a little grain that is projecting up slightly at some small angle above the Martian surface; the wind comes along and just makes it fall down. How fast does that wind have to be? According to present theory, you need winds of about 80 meters a second just to start dust grains moving on Mars. That’s around 180 miles an hour. It’s a very fast wind.

Fisher: How could such winds arise on Mars?

Sagan: On the Earth, the winds are driven primarily by the fact that the equator is hotter than the pole. Air rises from the hot equator and falls at the cold pole, and that produces a circulation in which the air returns along the ground from pole to equator and circulates aloft from equator to pole. On Mars, the equator-to-pole temperature difference is even larger than on the Earth. There are no seas to moderate temperatures. There’s also a longer year on Mars—687 days. So that temperature difference is larger and the resulting winds are larger. But they are not large enough, as far as we can tell. That’s not the source of the high-velocity winds that stir up the dust storms.

Fisher: I think you’ve said previ-

[\[Continued on page 122\]](#)



Typist hits same keyboard as that on conventional typewriter, but the words are electronically displayed on screen (inset). Corrections are made before words go on paper. When all is perfect, just push a button and presto! Out comes finished copy.



Typewriter with a Mind of Its Own

With TV display and pushbutton editing, you can't go wrong

By PAUL WAHL

The Videotype, at a glance, looks rather like a dismembered electric typewriter: Atop its desk-sized console, keyboard and printer are separated. In front of the typist, where the paper ordinarily would be, there's a TV-like screen—actually a cathode-ray tube (CRT).

As the operator types, the text appears letter by letter in a green light display on the black screen. Except for the 15 Videotype command keys, the typewriter keyboard is the one familiar to every typist. Corrections, deletions, and additions are made instantly simply by pressing buttons.

In case you're wondering just *how* the characters are generated on the CRT display screen—the engineers who developed the Videotype aren't telling.

When the displayed copy has passed its proofreading, the typist pushes a command key to store the text—instantaneously—on a cassette tape in the Videotype console. This cassette is physically identical to the standardized audio cassette used in recorders. Each cassette has a 30-page capacity, and includes an index for easy recall as needed.

To transfer text to paper, another button is pressed and the stored copy is typed—at the rate of 144 words per minute—by the system's automatic printer (essentially the printing component of an electric typewriter modified for robot operation). The text is printed out exactly as it appeared on the visual display screen. With a Videotype, the typist can, in effect, do two jobs at once: One page

can be keyboarded while another previously completed is being printed on paper.

Videotype has instant recall. To recall a particular document to the screen, the operator inserts the proper cassette, touches the *Index* button and scans the displayed "table of contents." After setting the position indicator at the selected title, he presses the *Next Page* button, and the desired page appears on the screen. Full pages can be recalled to the display screen in three seconds for review or editing.

Documents that are used often, but altered each time for specific purposes, can be recorded through a special *Archive* feature, so that despite repeated revisions, the original copy remains intact on the tape.

Here is an example of Videotype's unique capacity for text revision—a sentence requiring the addition of more information:

, the one with the pink shutters,
The third house is incompatible with
the others. ^

To make the addition, the typist moves the position indicator to the point of insertion and pushes the *Edit* button. The line of type is broken and the remainder drops below like this:

The third house
is incompatible with the others.

The additional words are added after "house," thus:

The third house, the one with the
pink shutters,
is incompatible with the others.

By pressing the *Merge* button, the type is brought together automatically:

The third house, the one with the
pink shutters, is incompatible with
the others.

Want a flush-right margin? Touch the *Justify* key, and here's what you get:

The third house, the one with the
pink shutters, is incompatible with
the others.

This whole revision can be accomplished in less time than it takes you to read these paragraphs.


This quickie example is a simple demonstration of the capabilities of Videotype. Among other things, it can move whole paragraphs from one page to another—and with equal ease.

Videotype's "brain." This is a computerized text processor, a special-purpose digital logic system capable of "thinking" in the formal structure of the English language. As text is keyboarded, the information is captured by the logic circuitry and displayed on the CRT monitor. Thus held, the text may be manipulated by pressing appropriate command keys.

Who needs it? Any office that makes constant use of typewriters: law offices, advertising and public relations agencies, publishers, banks, accounting firms, insurance companies, government agencies. Typing is expensive; it's cheaper to let a machine do more than half the work.

It doesn't take extensive training to become proficient with the Videotype. According to the maker, an average typist can gain full command of the system with only six hours' instruction.

Price tag on this equipment is \$16,000. (It can be leased at \$375 per month.)

Videotype is the product of the Lexitron Corp., 9600 DeSoto, Chatsworth, Calif. 91311. 

Electronic

By DOUG GARR

Dirty air's a problem. There's little you can do about the pollutants huge factories spew out of their smokestacks. But you can do something about the dirty air in your home with an "electrostatic precipitator"—a machine that collects dust with a high-voltage electrostatic field. Thinking of buying one? Chances are, all the brochures have you confused.

Air cleaners have been around for quite some time now, and the manufacturers also realize there's some confusion. The air-filters section of the Air-Conditioning and Refrigeration Institute (the industry's trade agency for central units) is now working hard setting up a certification program for air cleaners. They'll randomly test these devices, slap on their seal of approval (when they do what the maker claims), and publish a directory of the certified units. You will be able to tell what they really can do and thus, more important, how one company's air cleaner stacks up against another's.

Meanwhile, how do you know whether one of these appliances can help you? And if it can, how do you choose the right unit? To find the answers to these questions I talked to engineers in the industry and at ARI, doctors, allergists, and experts at the Food and Drug Administration.

I found out some important things that should help to clear the air about what an electronic air cleaner (EAC) can and can't do. But first, let's take a look at just what kinds of air filters are available.

Three kinds and what they do. The simplest filter is the mechanical (or fiber) type commonly found in a furnace or air conditioner. It removes 10 percent or less of the particles in the air—the larger ones. Most of the five billion or so dust particles in a cubic foot of air are too small to be trapped—they recirculate right through the fibers. Better is a one-stage electrostatic precipitator; it removes some 40 to 60 percent of the air's particles.

Still better is the kind we'll talk about: two-stage electrostatic precipitator that removes between 80 and 90 percent of airborne solid matter. These EAC's are available in either portable or central types.

What will they do? The chart on page 60 shows specifically what they



Cover lifts off Nautilus 777 portable to reveal electronic cell (right), detachable for

washing. Cleaner has two fan speeds, draws 50 watts, weighs 23 pounds.



Furniture-style cabinets dress up some portable units like this West Bend Air Care. It weighs 49 pounds, draws 98 watts at high fan speed, costs less than \$200.

Two-cell central unit from Honeywell has collapsible handles for carrying. You can wash the cells by hand, with soap and water, or even put them in your dishwasher.

Air Cleaners:

What Can They Do for You?

Yes, they'll keep the air in your home a lot cleaner. But what will they do about kitchen odors? And what about the ozone problem?

will remove from the air. Particles are so small they're measured in microns (25,400 make up one inch). Generally, anything smaller than 10 microns is invisible to the naked eye. An EAC can actually remove some airborne particles that are as small as 0.03 microns.

Obviously, efficiency will vary with the size of the particle. The smaller the particle, the tougher it is to collect. And keep in mind that an air cleaner cannot make dirt disappear. It can only *collect* particles from the air. (Yes, a section of the unit must be cleaned.)

What difference will it make in your house? It could make plenty. If you live in a house with lots of carpets, bedspreads, drapes, dogs, cats, and a bunch of kids tracking in dirt—in short, a dust-prone environment—an EAC may do a lot of good. It can reduce your cleaning bills. Your walls and ceilings won't gray or dull as fast, so you won't have to repaint as often. And your furniture may not need dusting quite so often.

Loren O'Dell, a Honeywell engineer says, "We've performed tests that show the average length of time between redecorating will double."

What efficiency means. When an EAC is labeled with a given efficiency, you can expect it to remove that percentage of airborne particles *on an average* at a given airflow rate (measured in cubic feet per minute). Naturally, the size of the particle affects efficiency. Most EAC's are 99 percent efficient in removing pollen (it has pretty large particles).

If your investment is likely to repay itself in reduced household maintenance (we'll talk about cost later), an EAC may be for you.

What an EAC won't do. An air cleaner's efficiency drops off sharply in the super-tiny particle-size range—0.01 to 0.001 micron. And an EAC's electrostatic field won't pick up gases (such as the sulfur oxides and carbon monoxide) and cooking odors. These are not particulate matter. Gases are suspended freely in the air and don't settle. There's little you can do about them. Some air cleaners have charcoal filters (usually an option) which will trap some of the gases, but don't expect too much.

Health and medical benefits. This subject's as cloudy as the polluted

air we're living in. The Food and Drug Administration is cracking down on some misrepresentation on product labeling. Dr. Joseph Davis, a director in the FDA's Office of Medical Devices, says, "There are no true medical claims you can make for air cleaners." An EAC can't cure your allergy, but will it help at all?

I spoke with Dr. Leone Claman, chairman of the Committee for Public Education of the Allergy Foundation of America. Although the Foundation is hazy in its position on EACs, she says, "Air cleaners make an attempt to improve the environment by making the air freer of pollens, particles, and other pollutants."

As a supplement to the treatment of allergies caused by mold spores, pollen, dust, and other allergens, Dr. Claman has recommended an air cleaner in some cases.

So many variables are involved in symptoms, and allergy cases differ so widely, that it's impossible to say how much an air cleaner will help. But as one company engineer puts it, "it's reasonable to assume that if particles in the air are causing ill health, and an EAC will remove some of them, then it can be beneficial."

If you decide to buy an air cleaner, how do you shop for one and inter-

pret the technical statistics in the advertising brochures?

Portable or central? If you have central heating or cooling, you can get a central unit to fit in the return air duct. You'll be able to clean the air in every room that's heated. If not, you'll have to settle for a portable, which of course cleans the air only in the room that it's in.

When you start shopping, look only for those EAC's labeled "two-stage electrostatic precipitators." Some companies include "pre" and "post" mechanical filters as stages and call them three- and four-stage air cleaners. The two stages refer *only* to the electronic collector section.

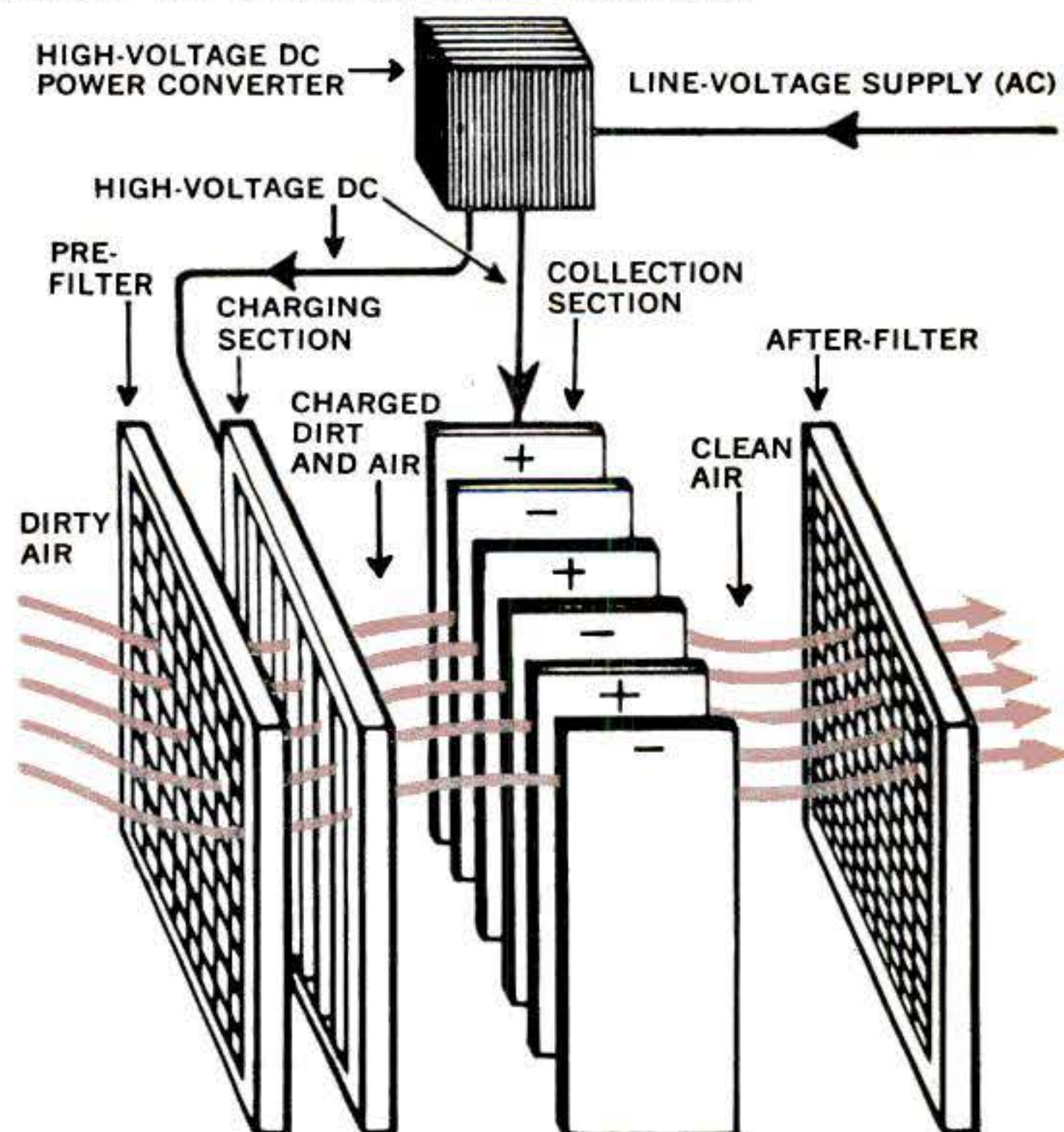
Make sure the collector cell is of metal. Have the dealer open the unit to show you. There are less efficient types of two-stage units with media collectors. These have a foam-plastic section that is usually replaced instead of washed when dirty. They're expensive to replace. Also, the media type loses much of its air-flow capacity when the collector gets dirty.

If the air cleaner has more than one rated cfm speed, make sure the unit is rated for all the speeds. The higher the air-flow rate, the lower the effi-

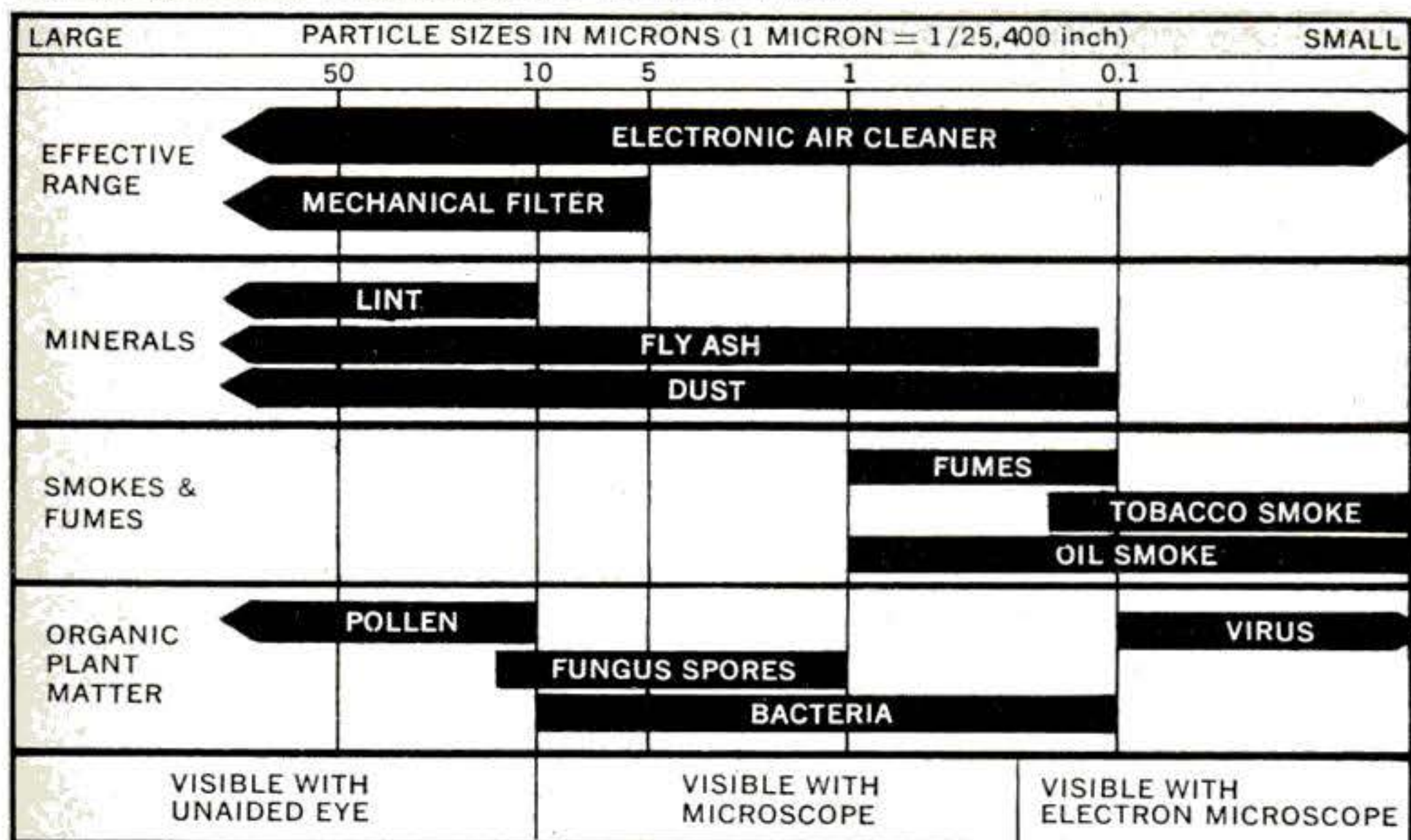
Continued

What's on the inside of an electronic air cleaner?

Power converter in the EAC provides 5000 or more volts DC from a 115V outlet. As fan draws dirty air into the EAC, a mechanical pre-filter collects large particles. High-voltage ionization section charges small ones positively. Next, particles go through collector plates, which are alternately charged. Positive particles are repelled by positive plates, attracted to negative ones, and collected. (Particles actually curve toward negative plates.) Air flows past after-filter to trap any particles that might have fallen from the cell. Distance between parts is exaggerated to show air flow and operation.



What an EAC will remove from the air



EAC vs. mechanical filter: Chart above shows what particles they remove. Effective range of mechanical filter drops off at five-

ciency, because particles pass through the collector section faster and are recirculated.

Make sure the brand you're buying uses the "atmospheric dust spot test for efficiency," in accordance with ARI, the National Bureau of Standards, or the American Society of Heating, Refrigeration, and Air-conditioning Engineers. That's a lot to remember, but it's the best indication of what the unit will do.

Other efficiency tests may be made by particle weight—not size. These are misleading because a mechanical filter, for example, is extremely efficient in removing heavy particles and inefficient in removing light particles. Look for a dust-spot test efficiency of at least 70 percent—preferably between 70 and 80.

Measuring your home for a unit. First, figure on at least three, and closer to six, air changes per hour. That means you have to calculate the total number of cubic feet that you want to clean. For example, say you

want a portable for a room that measures 10 by 15 by 8 feet:

The volume is 1200 cubic feet. Multiply that by the number of times per hour you want to change the air (say six, which comes to 7200). Then divide by 60 to get the number of cubic feet per minute that must be moved to accomplish those changes—in this case, 120 cfm, the right size unit for the room.

If you are buying a central unit, be sure the tested cfm coincides with the cfm of your furnace fan.

Installing a central unit. It's not too hard to put an EAC in your return duct. There's some sheet-metal work involved and a little wiring. Two things to remember:

First, make sure the unit is wired so the EAC operates only when the furnace fan is on. Then there won't be any ozone buildup in the air cleaner's parts. Not only is ozone bad for you (see box below), it's not good for your EAC, either.

Second, make sure the airflow over

the face of the EAC is uniform if your unit is installed near a curve in the air duct. You may have to install turning vanes in the curve to direct the airflow evenly. If the airflow is uneven, you'll notice a buildup of dirt and dust in only one section of the collector plate. The rest will be relatively clean. Make sure you have the maker's directions before you do it yourself.

With either central or portable EAC's, you have to perform one single, simple chore—washing the collector cell every few months. If there's a big buildup of dirt on this section, efficiency drops. Most cells are easily removable and several brands have lights that flash when it's time for a wash. When you take out the cell, the voltage automatically shuts off.

Some central units have built-in wash cycling. There's a hose attachment for washing the collector cell without removing it. They cost more, and you have to plan on a hookup to your water pipes.

How much do EAC's cost? A lot. Most portables run between \$150 and \$300 depending on cfm capacity. The central units cost between \$250 and \$500 depending on size and other options, such as in-place wash, extra mechanical or charcoal filters, and number of collector cells (some large units have two).

Installation costs are difficult to estimate because of labor-charge variations. Figure between \$50 and \$150. If you install an EAC as part of a central-system package deal (along with air-conditioning and heating) you may get a discount installation quote from a dealer.

Does it pay to buy one? Weigh all the variables—from the dirty air in your city, year-round and seasonally, to the dust found daily in your home. If the investment will repay itself in the years you'll live in cleaner air, it should make a welcome addition to your house. PS

Air cleaners and ozone production

Although EAC's do clean your air, they also produce ozone while doing it. Recently, there has been controversy over ozone production from air cleaners. Ozone, a three-atom form of oxygen, is a highly toxic, generally colorless gas. It's produced by the sun's ultraviolet rays and electrostatic fields (such as the one in an EAC). You may have smelled its pungent odor in the atmosphere after a thunderstorm.

At PS press time the Food & Drug Administration published a proposed standard to limit the ozone concentration produced by "ozone generators and other devices emitting ozone" to 0.05 parts per million (ppm) by volume. That's a tiny amount, but ozone is 1000 times more toxic than carbon monoxide.

The "Federal Register" said "... ozone has no useful medical application..." At high levels (0.1 ppm and higher) ozone causes eye, nose, and throat irritation. Higher levels can cause

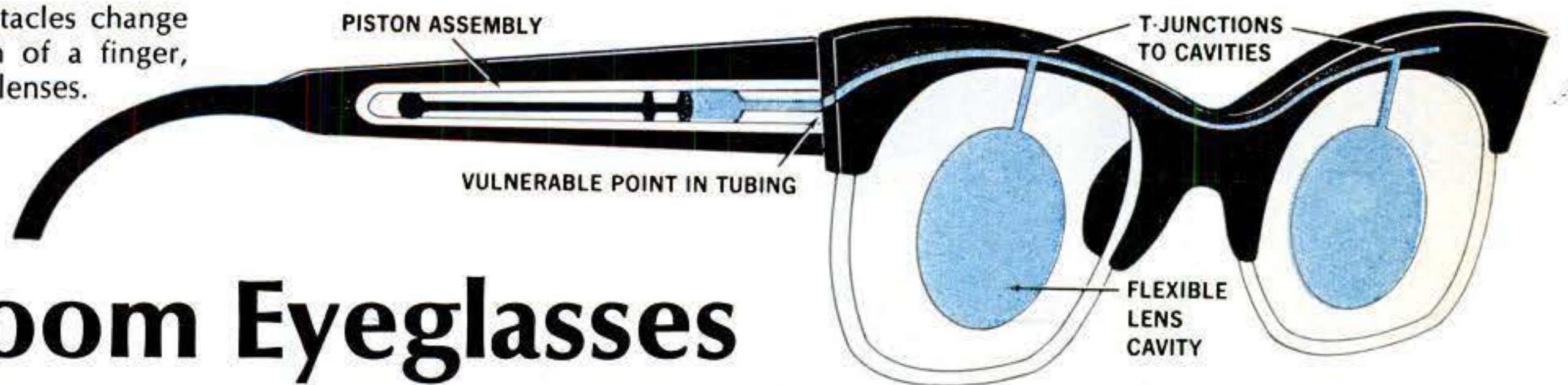
chest cramps, fatigue, and low blood pressure.

Does this mean EAC's are dangerous? No, not if they're operating properly. Ozone production of most EAC's is usually lower than the 0.05 ppm—around 0.01 ppm or less. In tests, engineers at Carrier found the ozone level more than two times greater outside a house than inside when their EAC was running (in Syracuse, N.Y.; ozone levels vary according to city).

The larger the unit, the more ozone it produces. Make sure that yours isn't too large for your house. If you smell what you think may be ozone, check to see if you have duct leakage and whether the unit is operating properly. If your unit has a charcoal filter, the activated carbon's life span may be over. Replace the filter with a new one. A portable EAC may be too large for the room in which it is operating. If it has more than one fan speed, turn it on low. Should the odor still be detectable, place the unit in a larger room. Still smell it? Have your unit checked for defects.



Binoculars? Almost—spectacles change focal point at the touch of a finger, eliminating bi- or trifocal lenses.



New Zoom Eyeglasses Zero in on "Middle-Aged Vision"

Just slide the control knob and these glasses focus on objects at any distance

By DAVID LAMPE

Do you need two or three pairs of glasses? One for reading and close-up work, one for distance, maybe one for in between?

Then you're in the company of millions of people afflicted with "middle-aged vision," an inability adequately to focus close-up, and you need bi- or tri-focal glasses.

Dr. Martin Wright, a physiologist employed by the Medical Research Council of Great Britain, suffers from middle-aged vision, but could never get used to cumbersome bifocals or having to switch glasses. So he invented zoom spectacles, which allow him to zoom in on and focus on objects at any distance—at the touch of a button.

Unlike bifocals, these new glasses will always offer uniform correction over the entire useful area of the lenses in front of your eyes, not just across their tops or bottoms.

The lenses are made of ordinary optical glass, but they're in two layers. The outer layers are conventional lenses ground to correct your optical

deficiencies at distances. (If you don't need glasses for distance vision but still need zoom spectacles, your outer lenses will be plain glass.)

The inner glass element. It's spherically curved optical glass 15 hundredths of a millimeter thick—so tissue-paper thin that it is flexible. The two layers are heat-fused together, separated only by a cavity of polyvinyl butral, a transparent plastic with the same refraction index as optical glass.

The diameter of the cavities between the lenses is about 25 millimeters, roughly your full useful field of vision at close range, and each cavity is connected to plumbing in the frame by two-millimeter holes, one in each lens. This airtight pipe-work runs through the top of the spectacle frame, where it exits through a plastic tube at the temple-piece hinge. There, it connects to a tiny piston assembly which is controlled by a sliding knob in the earpiece.

Want to move in on a blurry image? Simply slide the control knob forward. As you do, the piston forces a saturated aqueous solution of calcium bromide and glycerol, a clear liquid with roughly the refraction index of optical glass, through the pipework and into each cavity of the lenses. The pressure of the liquid in the cavities then bows out the back lenses, al-

tering the focal point: You see up close. Slide the knob back and the liquid is drawn from the lenses making them right for distance vision.

In a field test of the new system, the glasses have been prescribed for several hundred people in the London area. Many of them are ophthalmic physicians or their patients. All the wearers have found the glasses better than anything they've ever worn, but several minor faults still have to be rectified by the designers. Only then can zoom spectacles be marketed commercially.

The problems. For one thing, the plastic tube at the hinge fatigues and eventually breaks from constant flexing. Replacing it is a finicky job. Not only is it difficult to work on, but the line must be bled of air while under vacuum.

Most serious stumbling block has been in trying to prevent the extremely thin rear lenses from fracturing. Simply cleaning the glasses while they're set for close-up would cause the entire cavity and lens to rupture.

National Research and Development Corp., the British company that plans to market zoom spectacles, believes these are simply developmental problems and the principle has been proven. If they're right, they plan to have these new glasses—right before your eyes—within two years. ■

Slaking California's mammoth thirst with The World's Largest Water



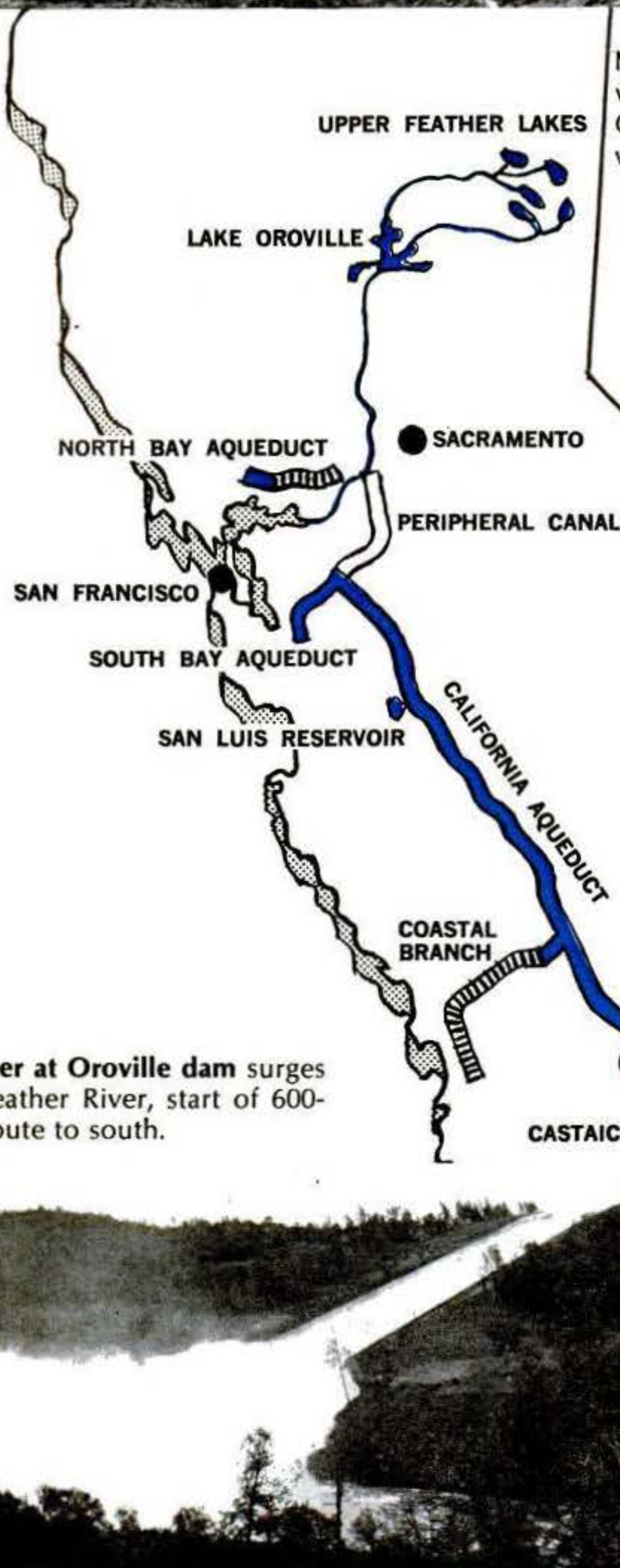
Surplus water from the north now flows to arid regions via this gigantic \$2.3 billion project

By JOSEPH ZMUDA

DRAWINGS BY RAY PIOCH

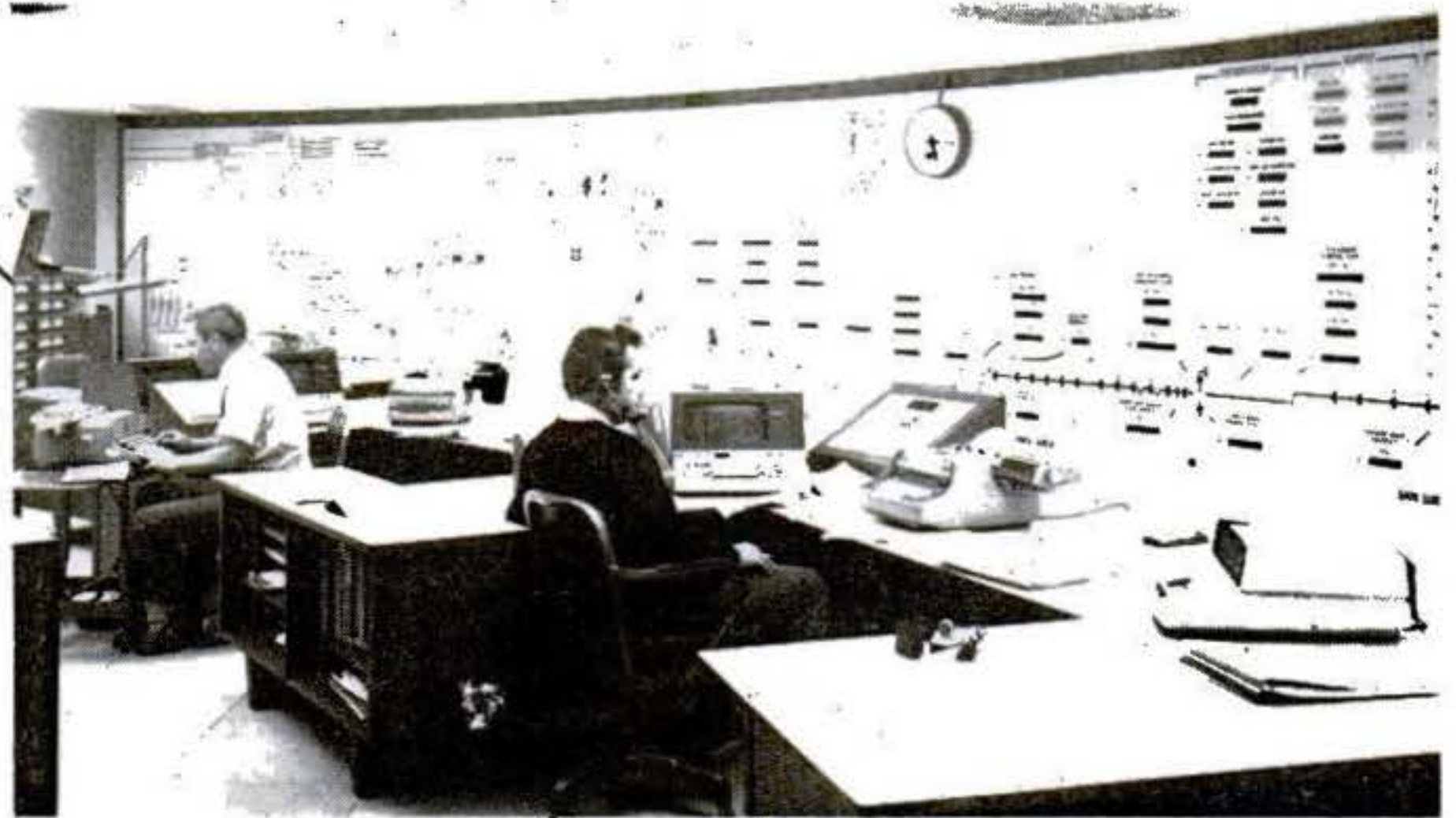


Underground power plant at Oroville dam. Floor covers bulk of electrical generators.



Northern reservoir for water is 15,800-acre Lake Oroville. At center: spillway for 770-ft.-high dam.

Spillover at Oroville dam surges into Feather River, start of 600-mile route to south.



Main control center in Sacramento monitors data from sensors for project, but regional centers handle most functions.

Main trunk of aqueduct begins south of San Francisco. Peripheral canal and coastal branch are not yet constructed. Tehachapi crossing is 35 miles southeast of Bakersfield.



Project

From a cliff edge high in California's Tehachapi Mountains, the parched terrain of the southern San Joaquin Valley stretches out before you. There, one hot noonday, I scanned the V-shaped concrete aqueduct I had followed some 300 miles from the state's water-rich north. The canal promises new life for this water-hungry valley and the densely populated land to the south.

Far below me, at the A. D. Edmonston Pumping Plant, huge pumps were overcoming the last water-flow barrier north of Los Angeles: A gigantic water column 12½ to 14 feet in diameter was being rammed 1970 feet up the mountain. The water would then cross the Tehachapis, which are ridden with active earthquake faults, for distribution to reservoirs in arid Southern California.

Both the California Aqueduct and the engineering marvels for the Tehachapi crossing are major elements of the California State Water Project conceived some 25 years ago. Now in limited operation—with portions still under design and construction—the project won this year's American Society of Civil Engineers Outstanding Achievement Award. Among its superlatives when completed:

- Six power plants, 22 dams and reservoirs, six major aqueduct systems, and 23 pumping plants.

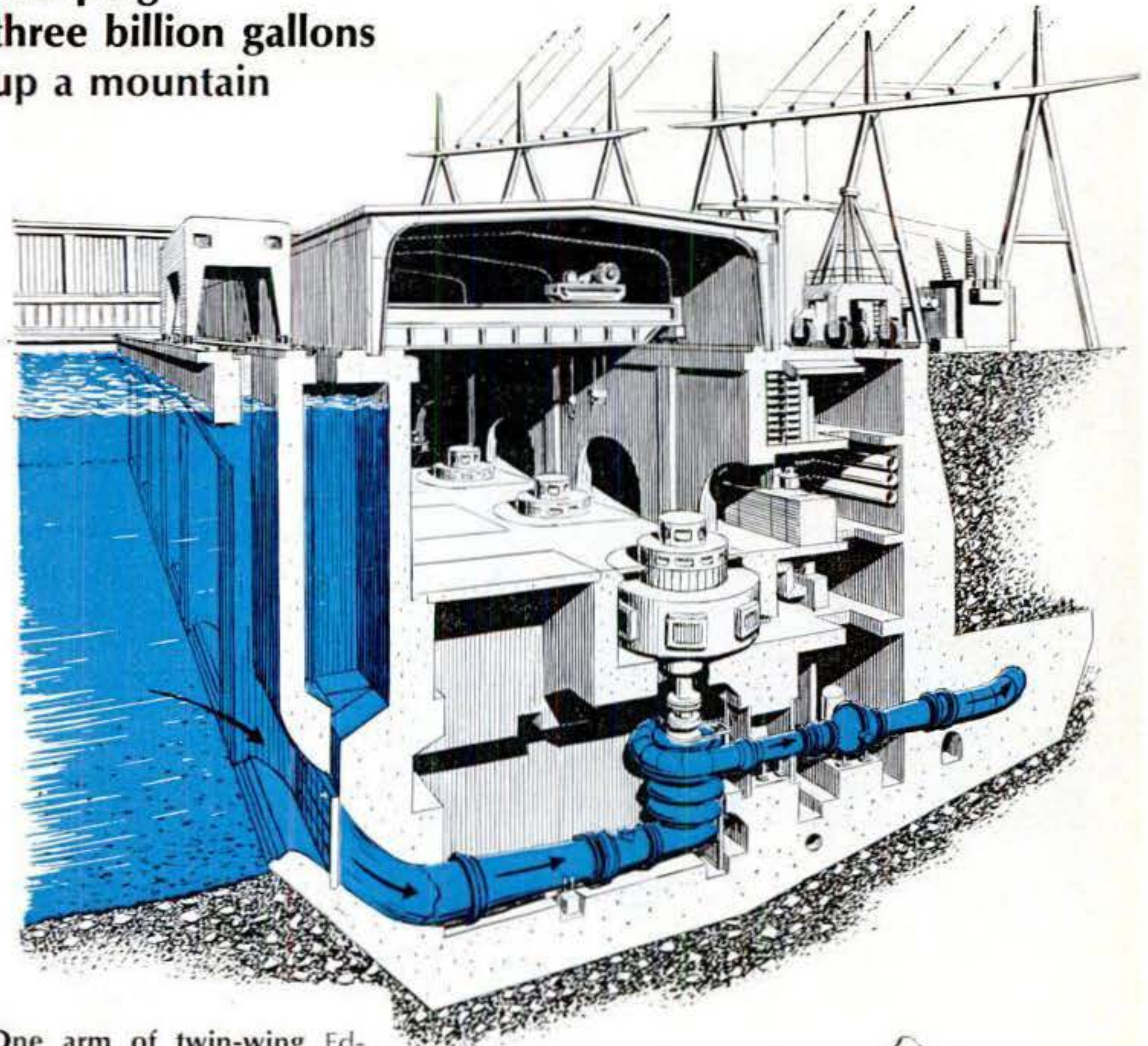
- A bigger volume of water (4.23 million acre feet) delivered annually to users than with any other distribution system.

- At Lake Oroville, the highest earthfill dam in the country [PS, Feb. '67].

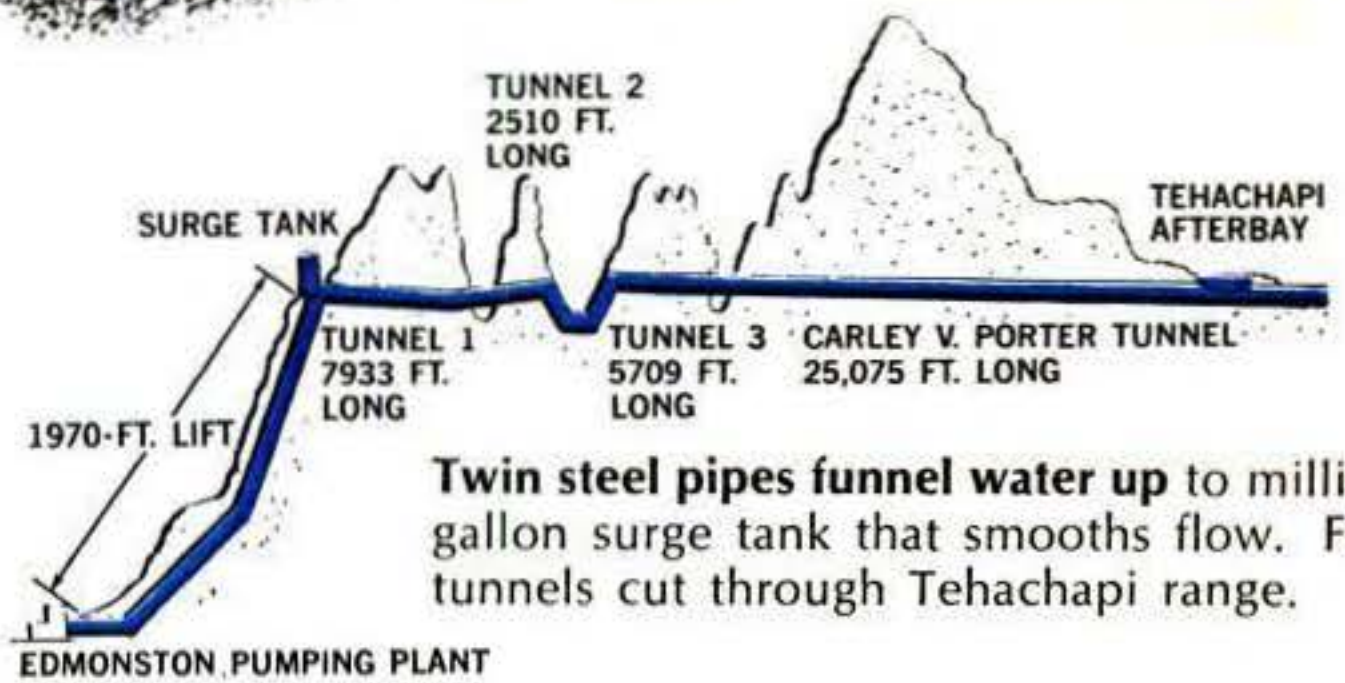
- At the Edmonston pumping plant, a greater volume of water lifted higher than ever before attempted anywhere in the world.

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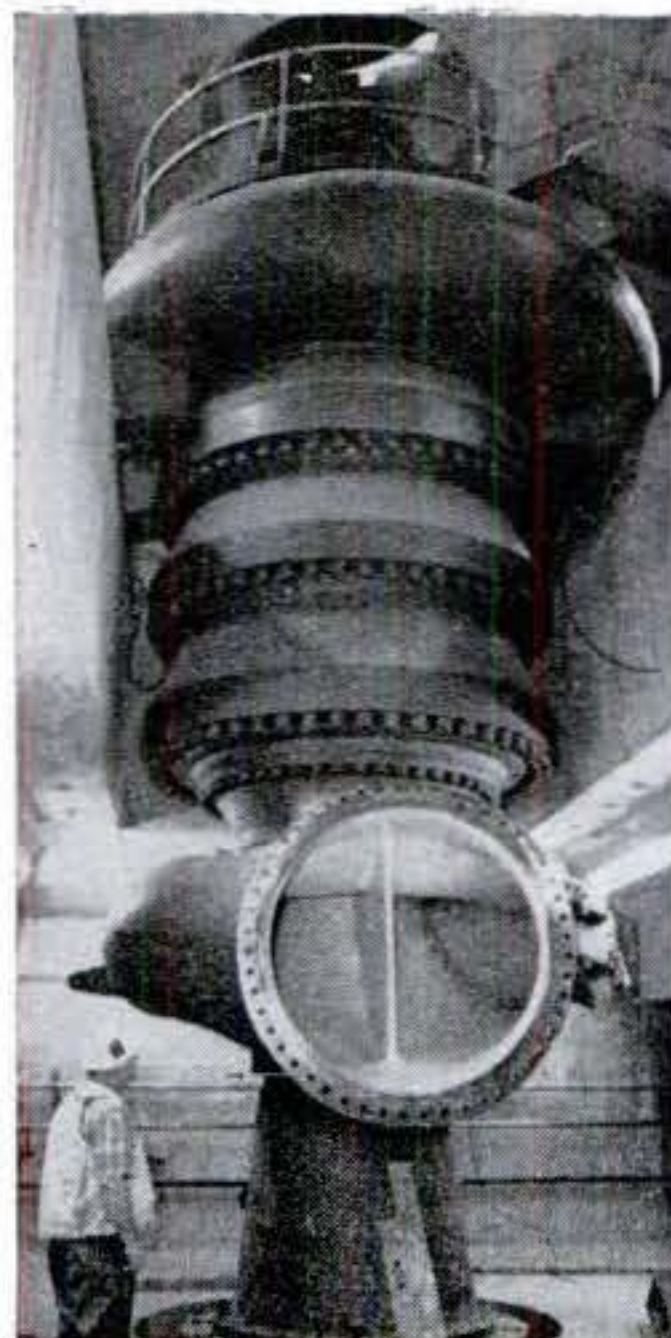
Pumping three billion gallons up a mountain



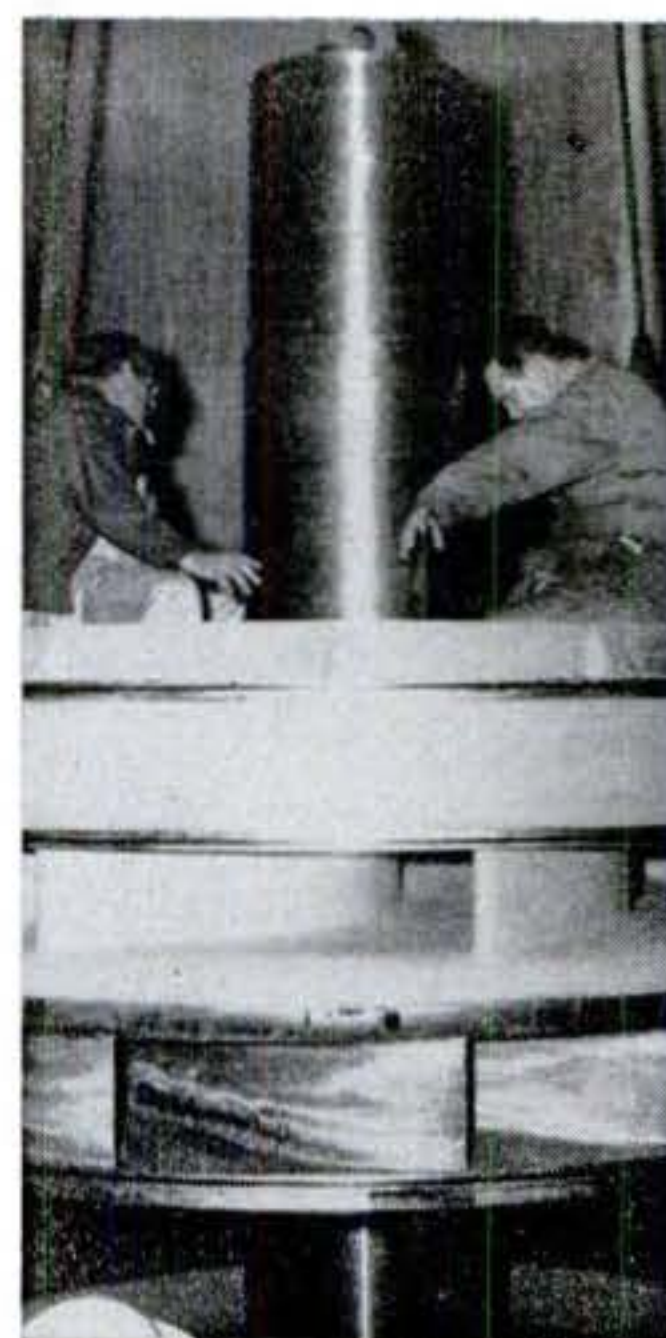
One arm of twin-wing Edmonston pumping plant, designed for half the station's 14 pumps (eventual full capacity). Water enters pumps 77 feet below surface of pool. Tremendous pressure boost can force three billion gallons daily over Tehachapi range, drawing 830,000 kw.



Twin steel pipes funnel water up to million-gallon surge tank that smooths flow. Four tunnels cut through Tehachapi range.



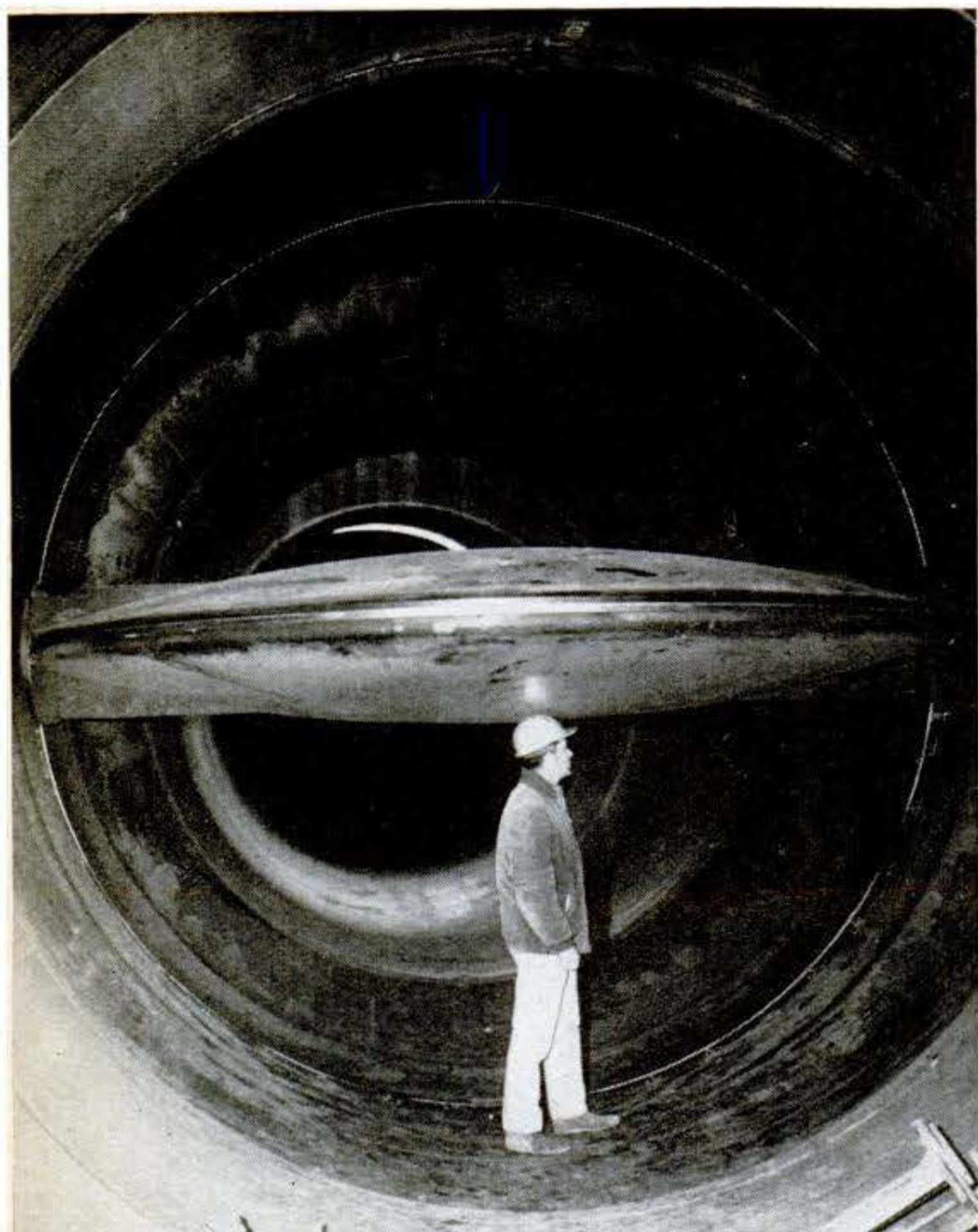
Four-stage centrifugal pump, shown with intake pipe removed, is 31 feet high and weighs 200 tons. Drive shaft enters from floor above.



One of four impellers, or spinning-blade sets, for a pump is readied. Spinning at 600 rpm, blades move water in corkscrew flow.



Link to Southern California along 444-mile-long aqueduct is U-shaped A. D. Edmonston Pumping Plant. Tehachapis loom over plant.



Giant 14-foot "butterfly" valves control water flow in two steel-lined discharge tunnels at beginning of Tehachapi crossing.

Not only does the project assure a firm supply of quality water, it provides flood control in winter and spring, clean hydroelectric power, recreational sites readily available to urban areas, and improved fish and wildlife habitats through water management.

It all begins in the northern section of the state. There, winter rains and runoffs from the Sierra Nevada Mountain snowpacks fill reservoirs on three forks of the Feather River, flowing into the Lake Oroville basin. In summer and fall, water stored at Oroville is released to supply downstate demands. Spilloff at Oroville Dam generates electricity at the underground Edward Hyatt Powerplant, and, at night during off-peak power use, surplus electric power runs pumps that store additional water in Thermo-

lito Afterbay. During peak electrical demand, water is released to furnish inexpensive energy.

Most of the time, a regulated flow from the Feather River's main branch moves into the Sacramento River, then to San Francisco Bay and out to sea. But at a pumping plant on the Sacramento Delta, surplus water is raised 213 feet above sea level to the beginning of the California Aqueduct—a wide V channel that can accommodate more than 10,000 cubic feet of water flow per second.

Once in the aqueduct, water runs by gravity to other pumping plants where the level is eventually boosted 3480 feet above sea level. Miniature pumping plants divert water to local districts and private users.

To regulate facilities along 600 miles of aqueduct canals, engineers designed a system of computer monitoring and control involving 12,000 separate functions. When fully operational, sensors will continuously read water levels, gate positions, flow rates, status of pumping and generating units, and other essential data.

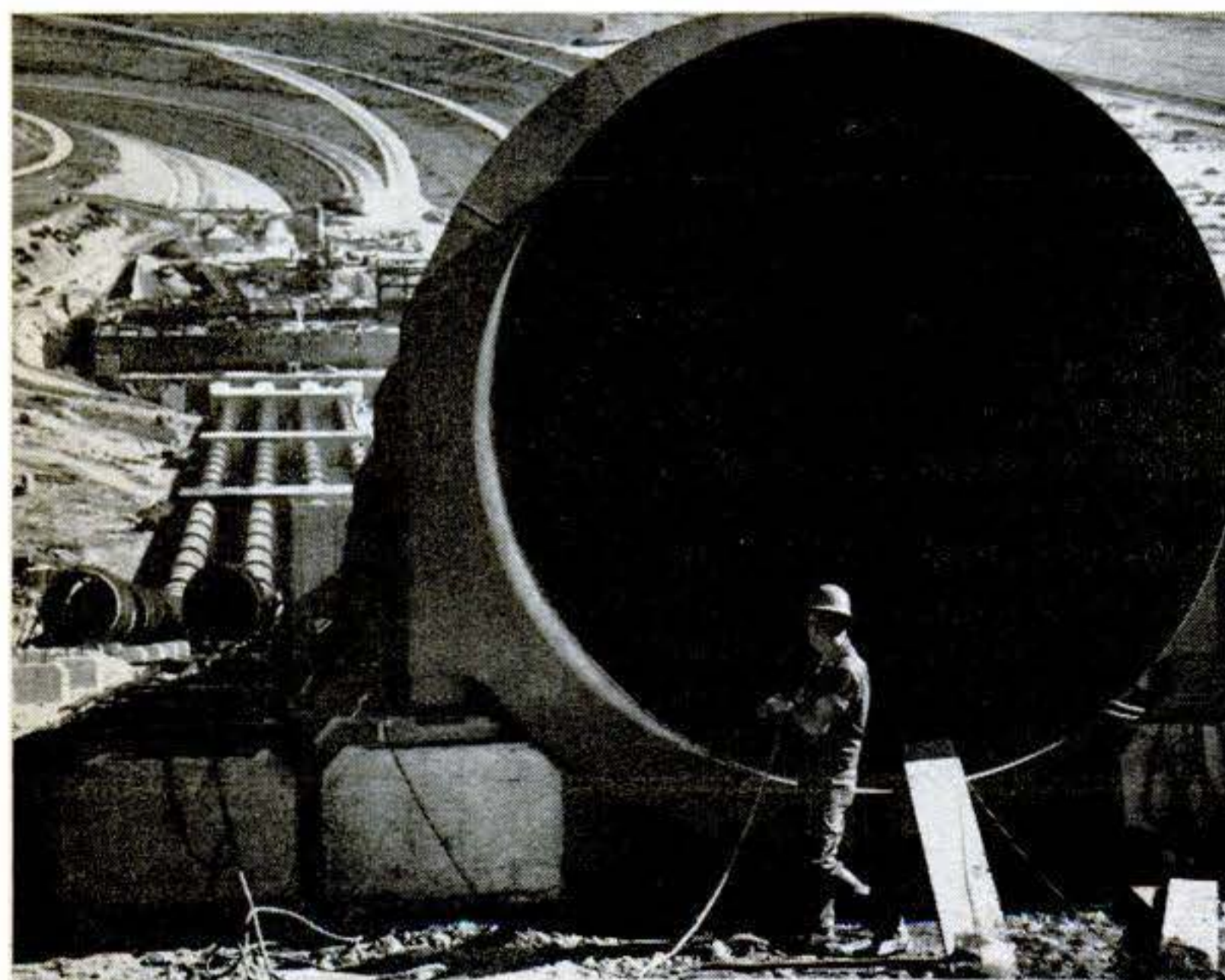
Monitoring at central control. Responsibility for this automation is divided among control centers at five major field divisions. In addition, the project control center monitors and logs all operational data, develops overall system water and power schedules, and coordinates operations of individual centers.

The scope of the Water Project is awesome; nowhere is the sheer complexity of the effort more evident than at the Edmonston Pumping Plant. My guide there was engineer Bill Curry from the San Joaquin field division.

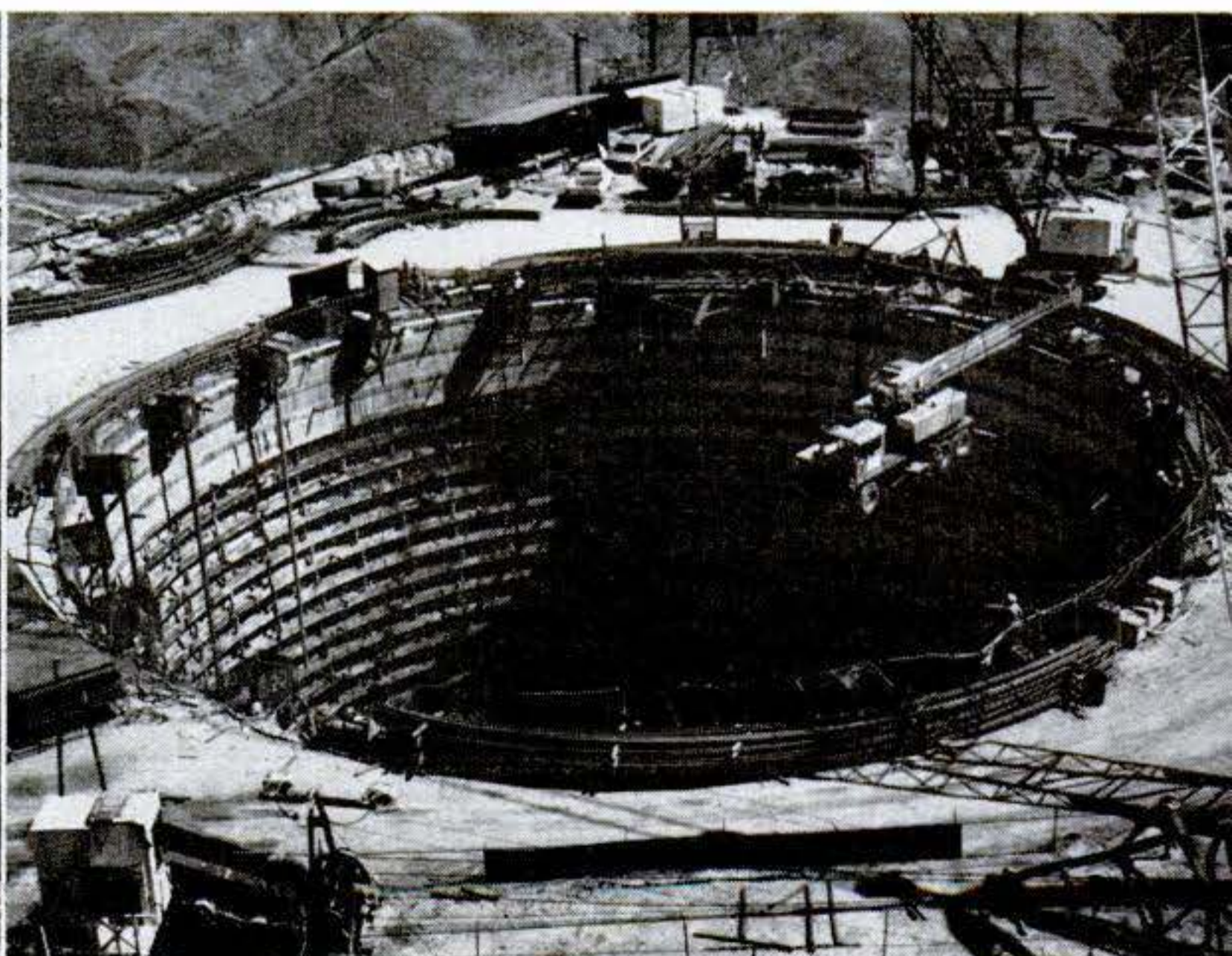
The swept wings of the pump building encompass a deep pool into which the aqueduct flows. Water is drawn into each wing of the plant through separate intakes and past steel trash racks that screen out debris. A six-bay electrical switchyard receives 230,000-volt power from all four California suppliers.

When I visited the plant, only three motor-pump combinations were fully operational. Eleven pumps of the station's maximum 14 have been contracted for to meet future demands. One pump runs all day; two others go on line at night to utilize cheaper electrical power.

The pumping plant itself, with concrete walls six or 12 feet thick, is like an iceberg—what's visible at the surface is a small part of what's underneath. When Curry and I entered the top observation gallery, men far below us were stacking individual rotor plates of another motor. A portable oven would later be placed over the stack to achieve the 1/20,000-inch sweat fit that holds it to the main shaft. The second floor provides access to the pump-motor coupling; the third contains the sealed compart-



Discharge line dwarfs worker at the Wind Cap pumping plant.



Angeles Tunnel surge chamber nears completion in the south.

ments for each electric motor. As I opened a compartment door I felt my ears pop at the sound: over 100 db produced by the 80,000-hp Westinghouse synchronous motor. The motor is directly coupled just above the pump (see drawing); each pump-motor combination towers 65 feet and totals 420 tons.

To prevent a potential brownout when starting each motor, one of two motor-generator (MG) sets is put on the line first. Then, outside power is removed and the MG set is connected to the pump-motor. When the units lock together at 120 rpm, the MG set is reconnected to the utility-system power supply and both units brought up to 600 rpm. The MG set is then used to start the next motor, at a rate of one every six minutes.

While the operation of the Water Project appears relatively smooth, getting this far hasn't been all clear sailing. Animals are constantly falling into the aqueduct and even the romantic tumbleweed clogs up trash racks to seriously impede water flow.

Most setbacks involving the human element initiate some ingenious countermeasures. Once a discharge valve arrived with a large crack because water trapped in a lower cavity after testing had frozen during shipment. Later valves were designed with drainage holes.

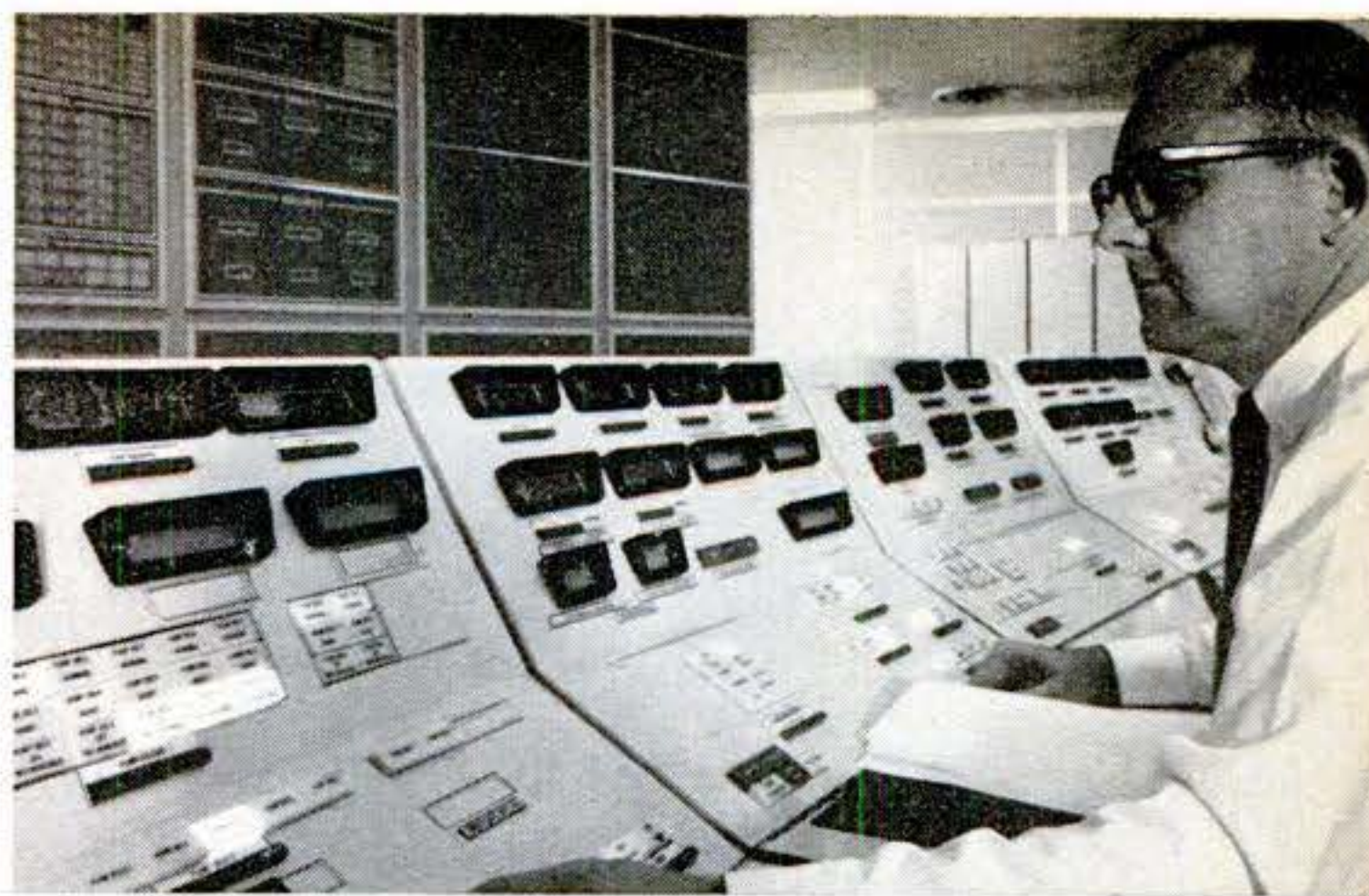
Valve failure and labor walkoffs. Bill Curry relates a near tragedy caused by poor design on the drainage valve for the Edmonston discharge lines. Back pressure of 800 psi—enough to cut a man in half—is reduced to 50 psi in the operation. But when the valve was tested the surge proved too great. The pipe leading back into the pumping pool whipped out of the concrete wall and burst, showering everyone in the lower vault with water. Fortunately, no one was near enough to be injured.

Labor disputes also have presented problems. In fact, just as I was preparing to leave Southern California I was told some workers were planning to walk off the job.

Don McKillup, chief program liaison control officer, was quick to remind me of Murphy's law: Anything that can go wrong *will* go wrong.

Says McKillup: "It's hard to believe that NASA made it to the moon with all the trouble we on the Water Project have had." But he happily conceded that despite every setback, they are close to making all schedules.

Next year, by the time of its first-phase completion, the California Water Project will be routinely redistributing water to the southern two-thirds of the state, where 80 percent of the need is. The country's first statewide water, at a completion cost of \$2.3 billion, will help slake California's thirst well into the 21st century. **PS**



Sacramento control panel can run entire project if necessary.



Visitors watch first water lifted over Tehachapis flow south.

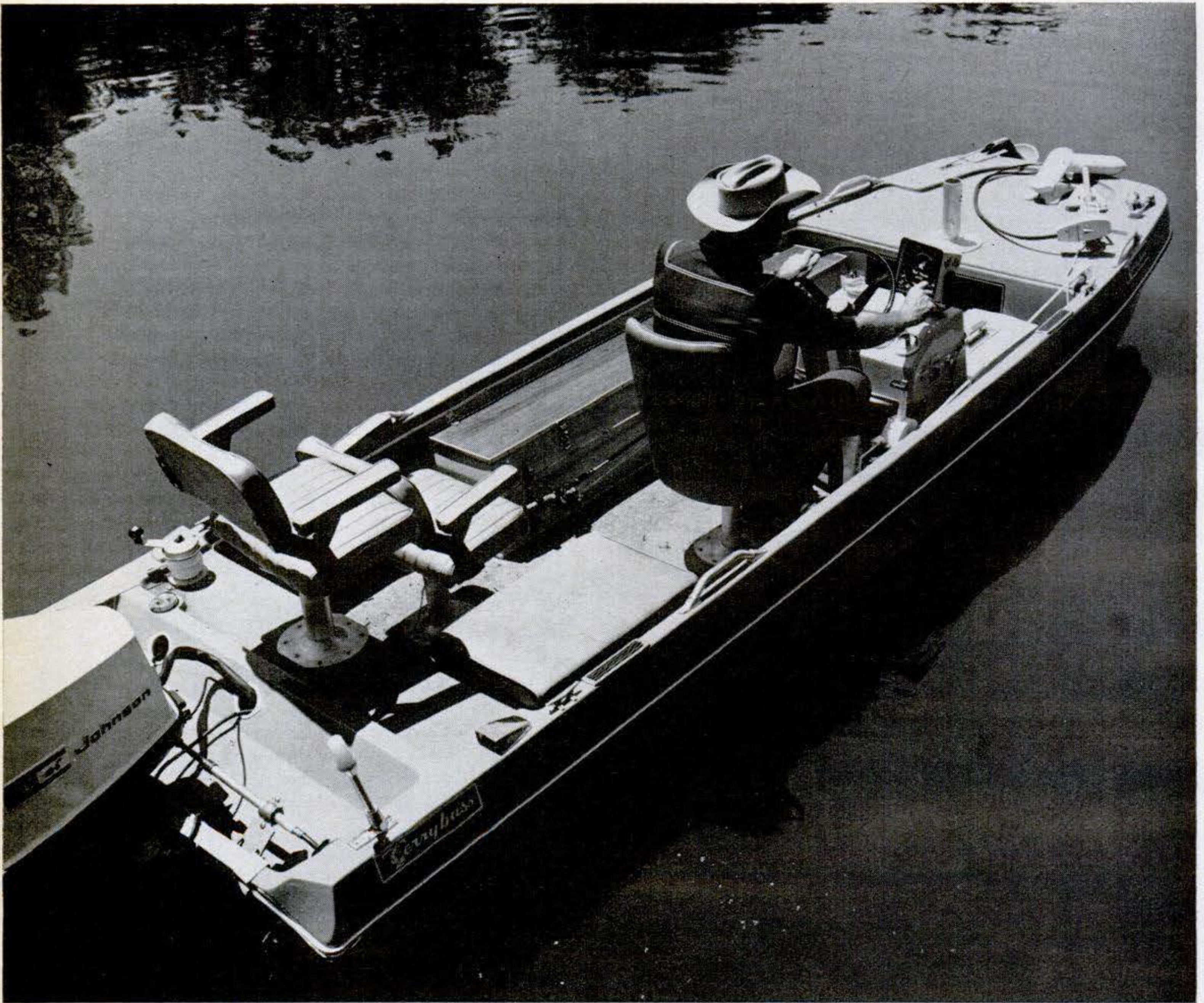


Discharge lines at Buena Vista station empty into aqueduct.

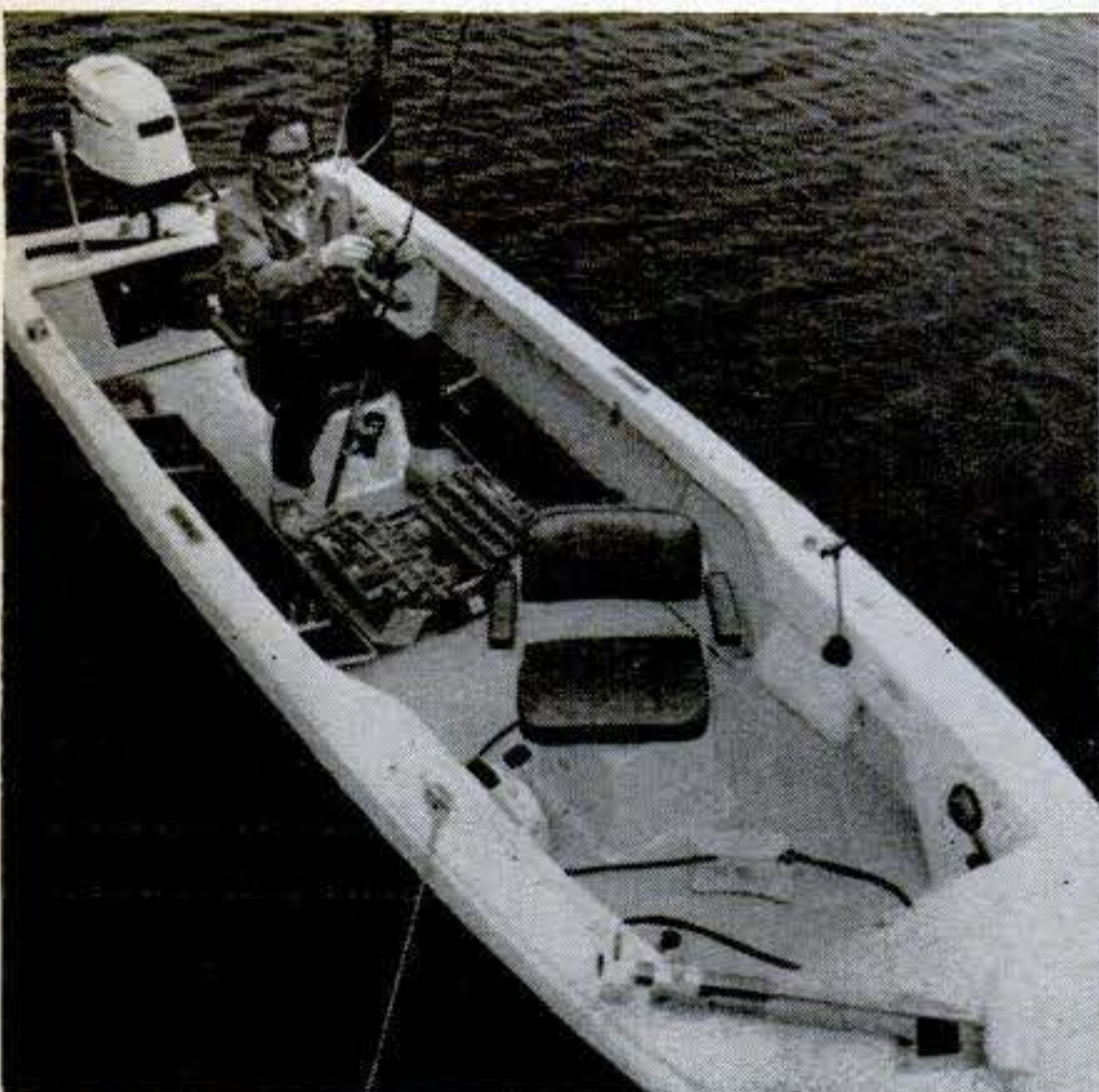


Aqueduct twists through Antelope Valley in Southern California.

The Big New Wave



Bass boats like this Terry (from Delhi Mfg. Co.) are ideal for sneaking up on the big ones. Sportsman Grits Gresham is at the helm.



There's plenty of room aboard Glastron's 14½-foot Beau Jack for two fishermen and plenty of gear. She'll handle lots of horsepower



to get you quickly to another fishing spot, and she has a mount for a small electric trolling motor with a foot control (right photo).

of Bass Boats

Lean, fast, bristling with built-in gear, loaded with cubbyholes, these fish chasers are among the hottest things afloat

By JIM ROE / PS Boating Editor

If you're a member of America's bass-happy fishing group, you may already know all about that breed of fishing machine they call the bass boat. If you're not, you're in for a few pleasant surprises. They're sleek, handsomely designed, and chock-full of useful standard equipment just for the fisherman.

When Glastron let out the word about its new fisherman-designed Beau Jack ("first of a new breed of fishing machines" and a full-blooded bass boat) I flew at once to Naples, Fla., to take a look.

I first saw her up on a dolly in the Outboard Marine test station, with several of Dewey Craig's outboard wizards completing her rigging. They clamped a new '72 Johnson on the transom, installed a small battery-powered electric maneuvering motor at the bow, and were trying to make sure the bow and stern mushroom anchors would behave themselves. Johnson's Ron Pedderson came from Waukegan, Ill., and Glastron's Jim Rice had flown in from Atlanta for the test.

While the riggers added their finishing touches, I crawled around inside and under the boat to get a close look at what it is that so excites the bass-catching fraternity.

What's a true bass boat? Generally it's a sleek-looking, narrow-beamed runabout completely open from bow to transom. Some say this is because it's only a few generations removed from its ancestors: the pirogue and classic johnboat. But there's a big generation gap.

The changes are apparent, from the bottom up. The Beau Jack is built on Glastron's Aqua-Lift II hull. This gives the boat stability while trolling or at dockside, and also good performance at high speed. The hull is equipped with full flotation, tested to float upright even when completely filled with water.

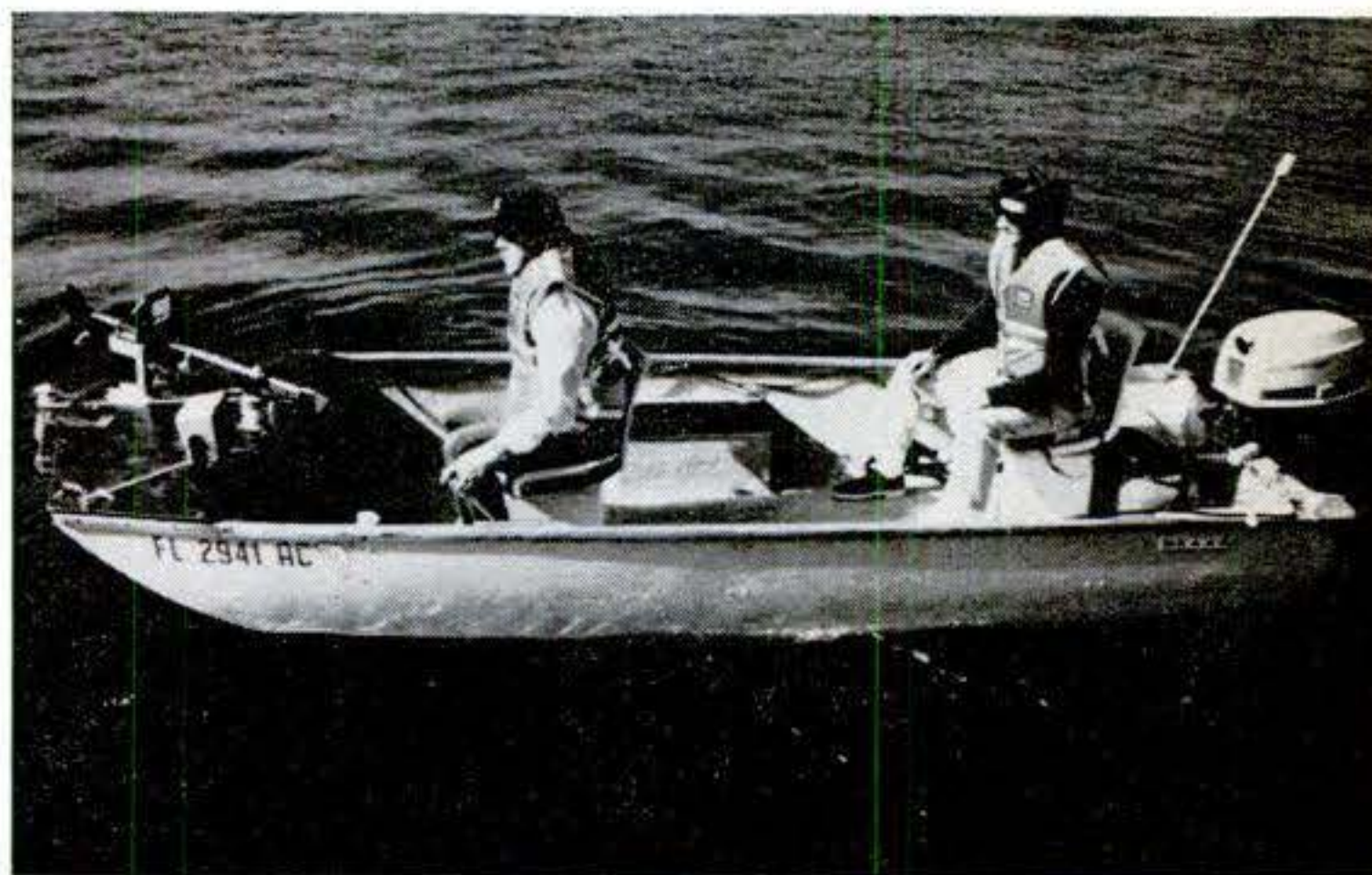
Glastron engineers built and equipped the Beau Jack only after interviewing several hundred fishermen and fishing-boat dealers. The result is a boat full of clever "you asked for it" touches.

Basically, she's equipped with two pedestal-type 360-degree rotating fishing chairs—one forward, one aft. She has stick steering from the forward position. And the mechanical stick-steering lever is located portside, with throttle and shift control on the starboard side. She's also equipped with a plywood-reinforced mount for an electric trolling motor on the bow. She can handle options like a fish-finder, speedometer, and compass.

Beau Jack is designed for two mushroom-type anchors, both of which can be easily controlled from the bow-seat position. Anchor lines lead to rewind mechanisms to port and starboard. The top surface of the gunwale itself is indented with handy little nooks and crannies. Some hold drinkables; others hold lures and other fishing gear. There are tie-downs in the base of each fishing chair—handy for securing the battery for the bow trolling motor, or for lashing down tackle boxes. Foam-cushioned rod holders designed to hold six fishing rods are built-in under the gunwales. There's a lockable storage compart-



Ouachita makes six different models of bass-fishing boats, running from 13 to 16 feet long. Prices range from \$536 to \$1115



Author Roe takes the new Sears Bass-Chaser fishing in Fort Myers, Fla. Trihedral hull is fiberglass with yellow gel-coat finish.



Chrysler's Bass Runner comes in both 15- and 16-foot models. Both have 360-degree swivel seats and plenty of storage space.

ment under the bow. And there's a good deal of extra storage space under the gunwale along each side.

Result? A boat loaded with useful fishing equipment. It's all designed to sell at a base price around \$929 (for the 14½-footer) with standard equipment. In addition, the 14-footer is offered with a steering console built in forward of the aft fishing seat. The 16-foot V-168 with mechanical stick steering has room for three fishing chairs.

An ideal place to test a bass boat. Naples has endless miles of water byways among the mangroves. And, to test the mettle of both boat and fisherman, the often boisterous Gulf of Mexico is right at hand. Throughout our test, boat, motors, and steering worked flawlessly.

There are, however, safety points you need to consider—with all bass boats. One is proper outboard horsepower. Fishermen will sometimes overpower their boats in order to get out to the fishing grounds faster than the next guy.

[Continued on page 118]

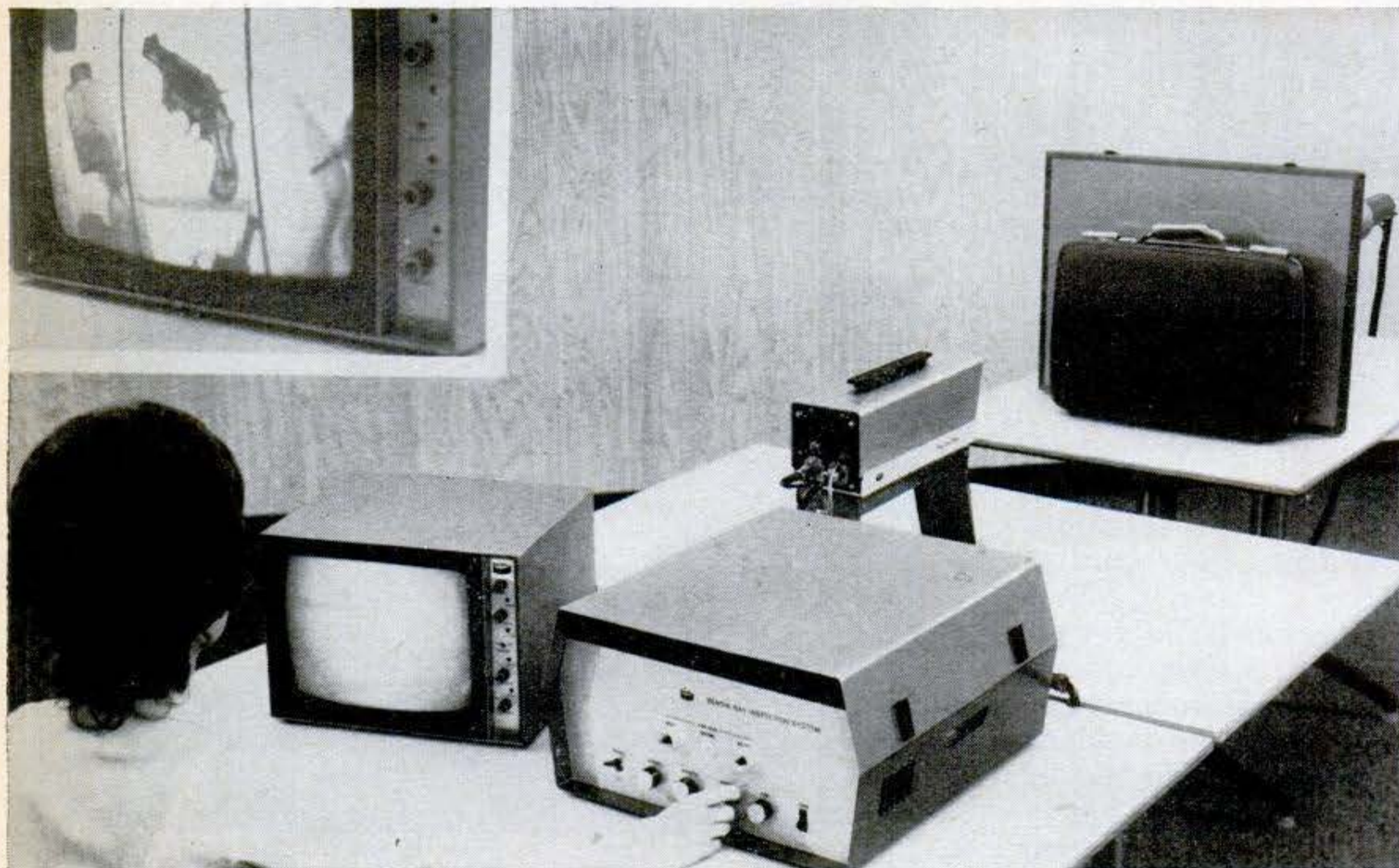
What's New

A PICTURE ROUNDUP OF NEW PRODUCTS AND DEVELOPMENTS



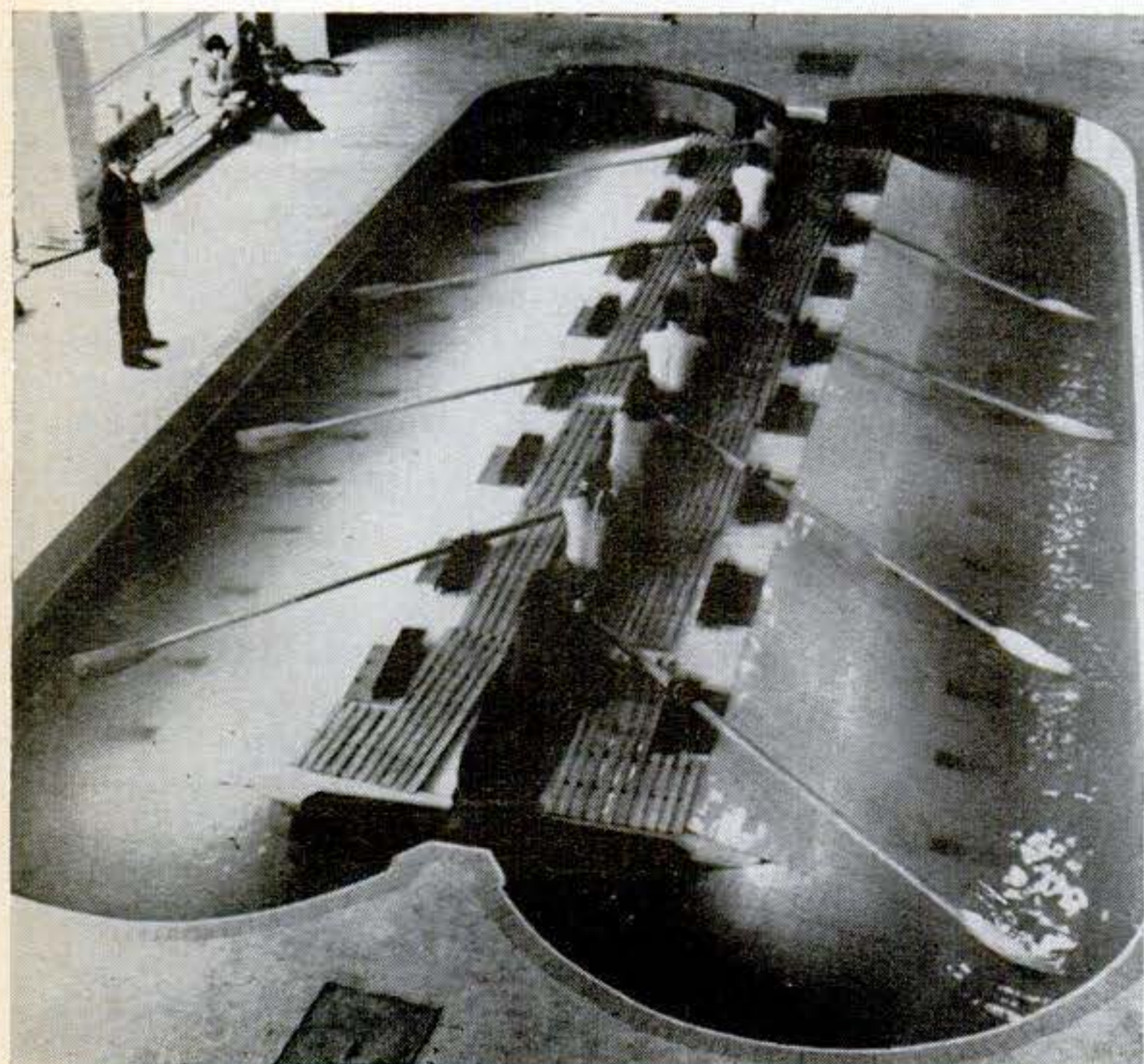
Car ionizer

This little gadget might make you more alert when driving. It emits negative ions, countering the effects of positive-ion buildup. Some theorists think excessive positive-ion levels induce fatigue. The ionizer draws 10 watts. Medion Ltd., Box 1, Oxted, Surrey, England.



For airport security: a quick-pulse X-ray detector

Your suitcase may get a low-dose X-ray burst from this new detection system before your next trip. Bendix Corp. is making it so airlines can see luggage, briefcase, and parcel contents on a TV screen (see gun in inset photo). Luggage contents—even photographic film—are unaffected by the low radiation dose. In 40 billionths of a second, an X-ray pulse penetrates the parcel, is electronically boosted, and is converted to a stored TV image. Operators can zoom in for a detailed view.



Rowing pool

Crewmen burn up a lot of calories getting nowhere at this pool. It's the new twin rowing pool installed in the Kiev Physical Culture Institute in the Ukraine, USSR. Water is circulated past the rowers at a preset speed.

Rugged phone

Vandalized coin phones may decrease as this super-tough mounting goes into service. A rugged aluminum hood limits access to sides. Bell Labs engineers designed the mount for use with new single-slot phones. The handset has a steel-encased cord.



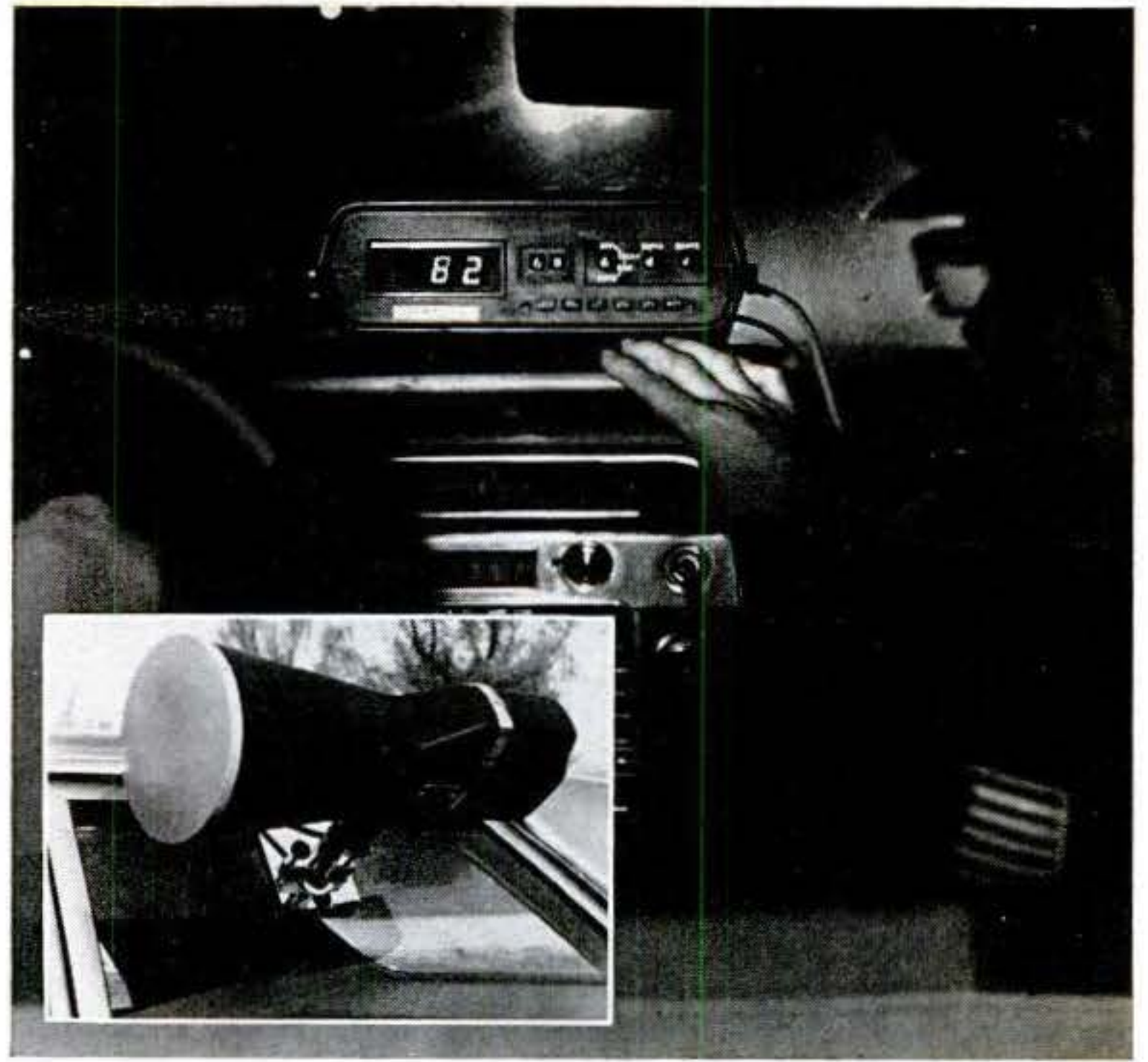
Pull-tab sealer

Ever try to reseal a beverage can after removing the tab? You probably lost the fizz. These reusable beverage savers make an airtight seal, says the maker, and won't pop off. Eight for \$1 from American Products, 318 N. Pearl St., Dallas, Tex. 75201.



Moving radar

Police in a moving car can now log a speeder coming at them. A radar antenna (inset) beams signals to the oncoming car (to measure closing rate) and to the ground (to give the patrol car's speed). The difference is shown on a panel. MR7 system is made by Kustom Electronics, Box 511, Chanute, Kans.



Restraint pad

These cushioned pads press lightly against your chest. If a crash occurs, they lock into position, absorbing energy as you move forward about one foot. Knee restraints are also used with system. They're not yet in production. Accles Britax, Ltd., Oldbury, Worcs., England.

Skid-test truck

That 726-gallon water tank helps this vehicle check road-surface skid resistance without disturbing traffic. A water jet is sprayed in front of a small test wheel. Skid resistance is monitored electronically. W.D.M. Ltd., Bristol, England.

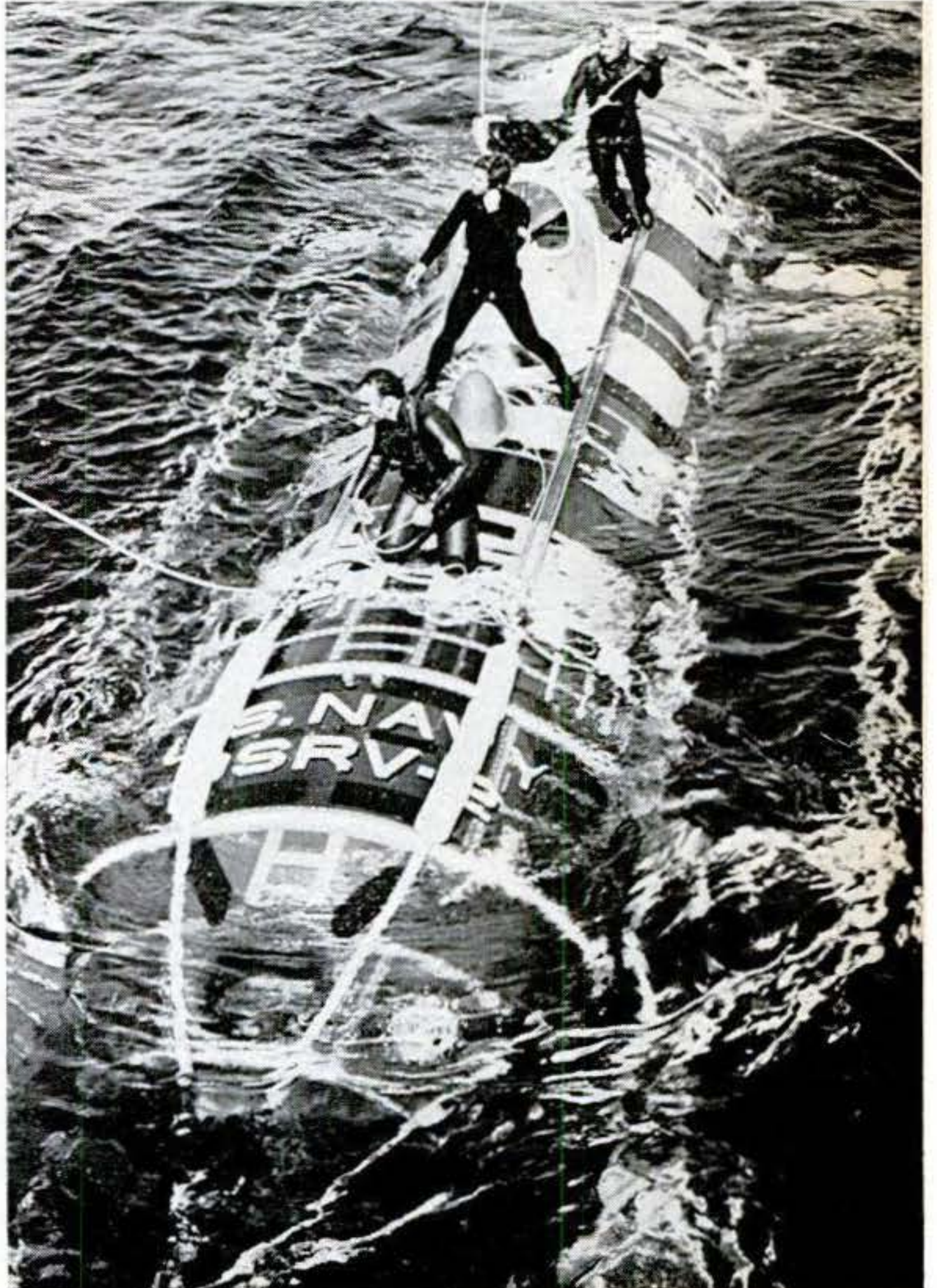


Battery power

Here's a pollution-free electric cycle for fun and work. It travels up to 50 miles on twin batteries before recharging is necessary. Vehicle speed: up to 15 mph. It's made by Stelber Industries Inc., 33 W. Hawthorne Ave., Valley Stream, N.Y.

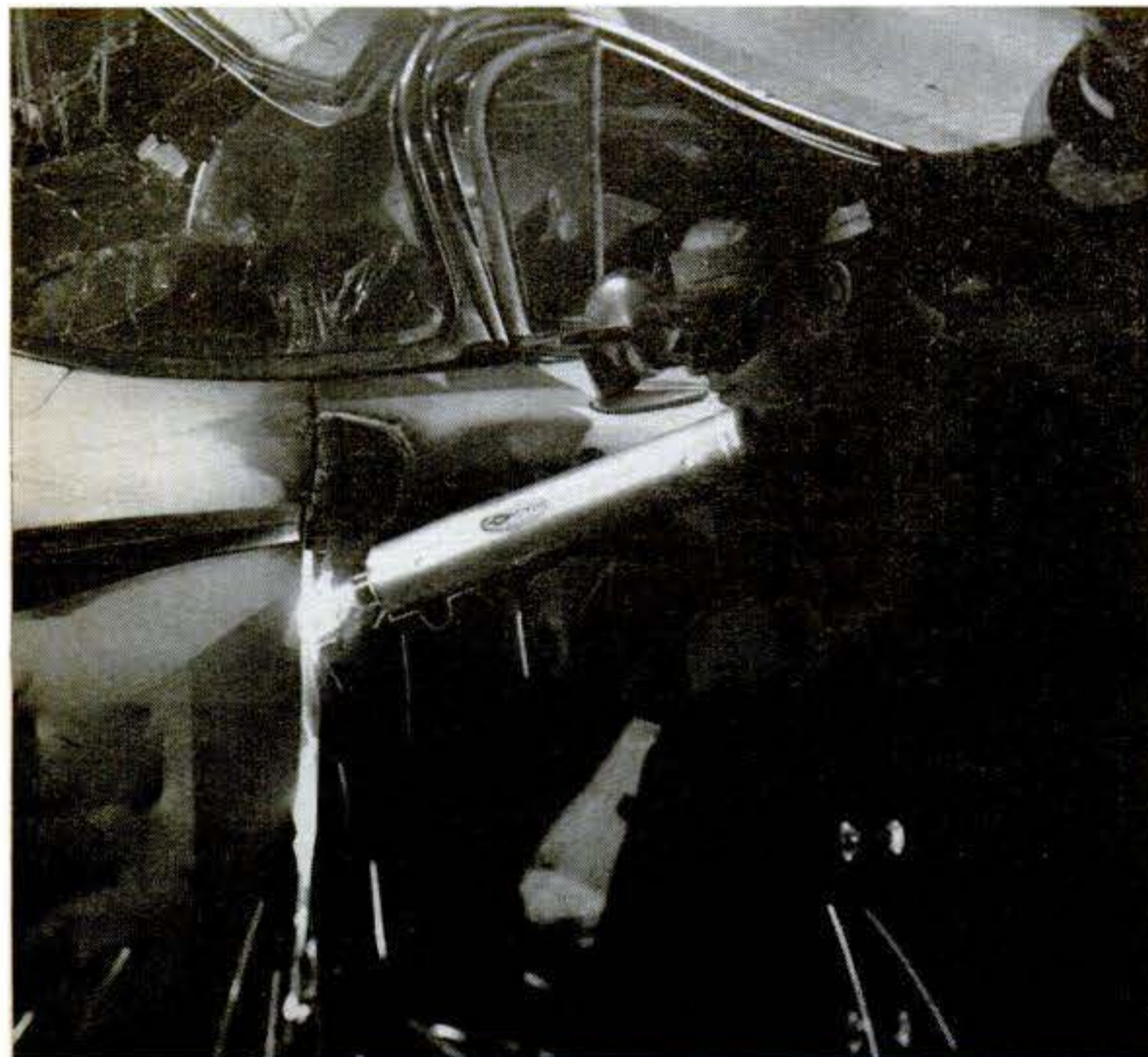
Sub rescue vehicle

Up from the deep, the Navy's second DSRV—Deep Submergence Rescue Vehicle—is pulled toward its mother ship. The Lockheed-built sub descended one mile during acceptance tests. It can rescue 24 men at a time from a disabled sub.



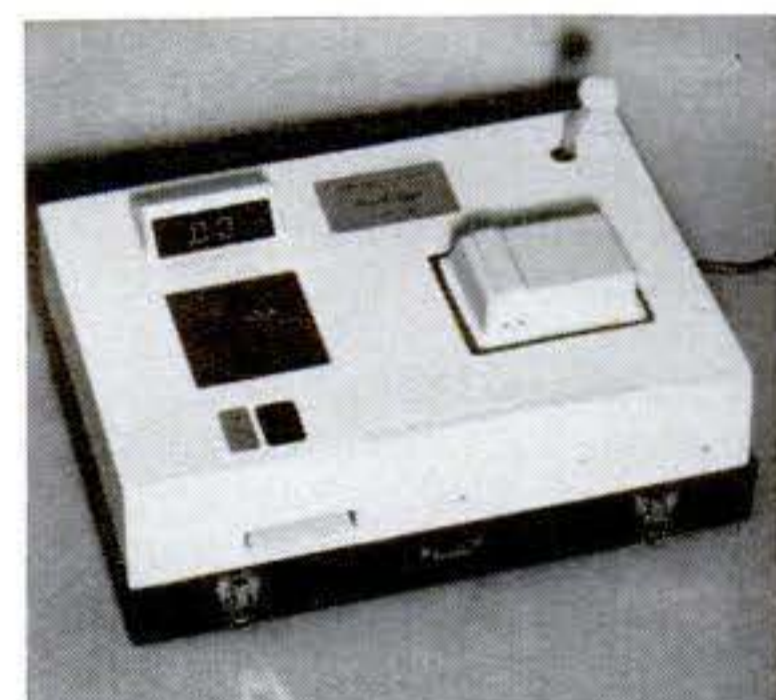
Electronic watch

Here's another entry in the Great Quartz Watch Race—the Techniquartz, by Benrus. It's \$99—lowest price yet, says the maker, for a quartz-crystal watch—has a claimed reliability of a minute a year, and is guaranteed for two years. A women's version sells for \$119.



Rocket torch

Turn a rocket around, as United Aircraft engineers did, and it's a torch. The 6 $\frac{3}{4}$ -lb. Rocket Torch produces a 5500-degree flame for three minutes. It's completely self-contained—no tanks, no hoses—and is designed for emergency use by police and such. The fuel? Plexiglas rods and an oxidant.



Tattletale

Don't drink if you're driving—especially if your local police department has one of these new Breathalyzer 1000 units. Upon insertion of a breath sample, the unit automatically gives both a digital-display reading and a print-out of blood alcohol content. It's made by Smith & Wesson Electronics.

Fiber-optics signs

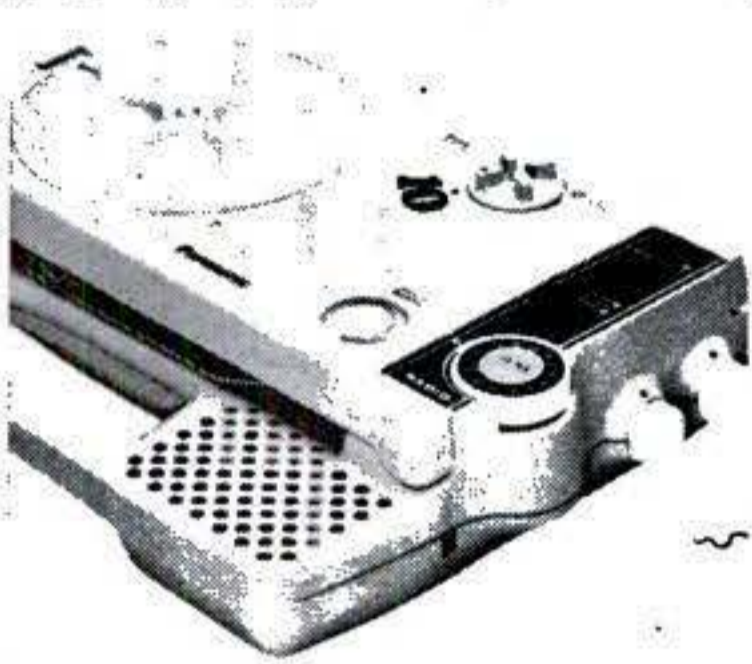
A single light source illuminates these signs, by means of plastic fibers that carry—and "bend"—the light to create a dotted outline. Result: clear, sharply outlined letters, easily readable, day and night, to taxiing pilots. The signs were made by LTV Aerospace for the Dallas/Fort Worth Airport.



Rolling pad

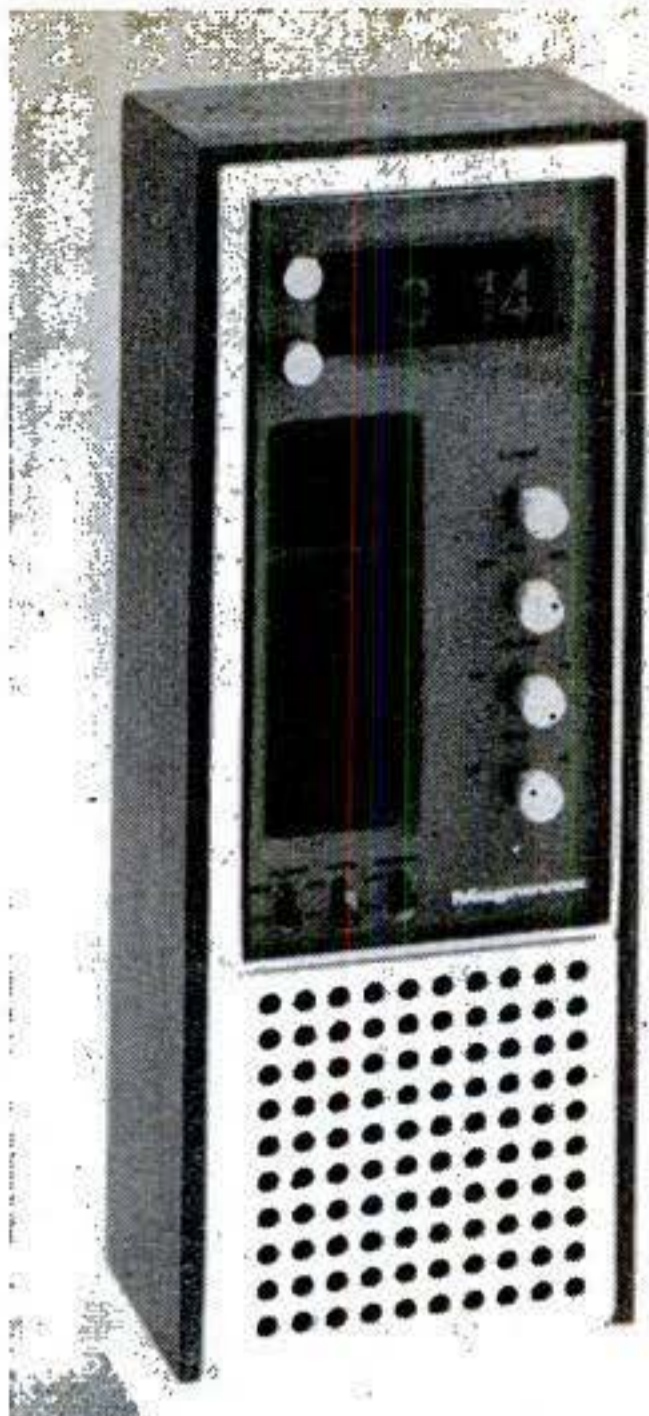
Look what they've done to this Dodge van—turned it into a padded cell. There's a shag rug on the floor, padding on walls and ceiling, and, for extra comfort, a 600-gallon water bed. The Sin Bin is made by Chinook Mobilodge.

What's New IN ELECTRONICS



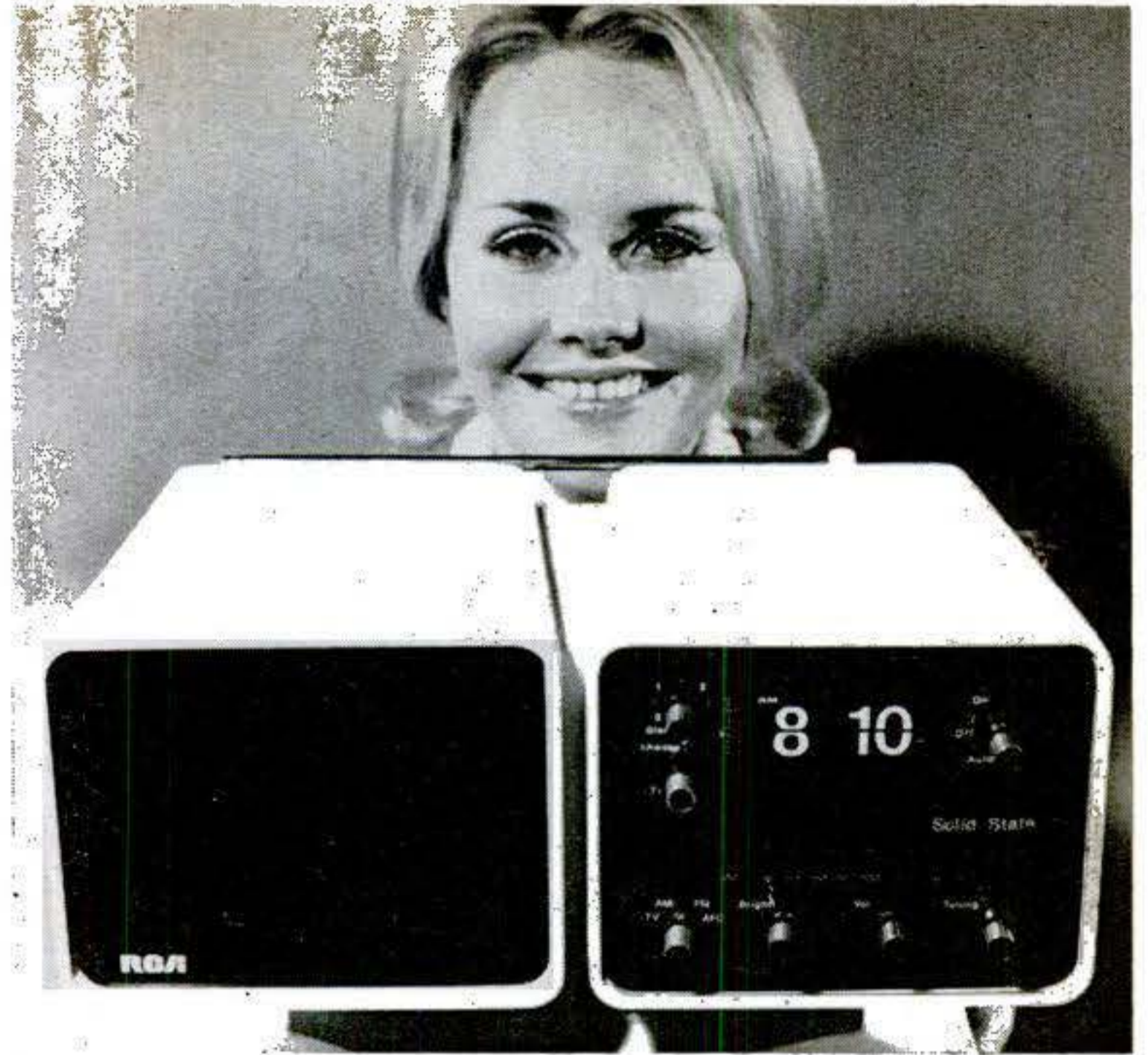
Portable phono/radio

For youngsters (or anyone on the go) here's a two-speed phono with built-in AM radio. Panasonic's Joplin (SG-400) runs on AC or battery. An electronic governor maintains turntable speed despite voltage changes. Close the lid and the arm automatically returns to rest position. Price: \$44.88.



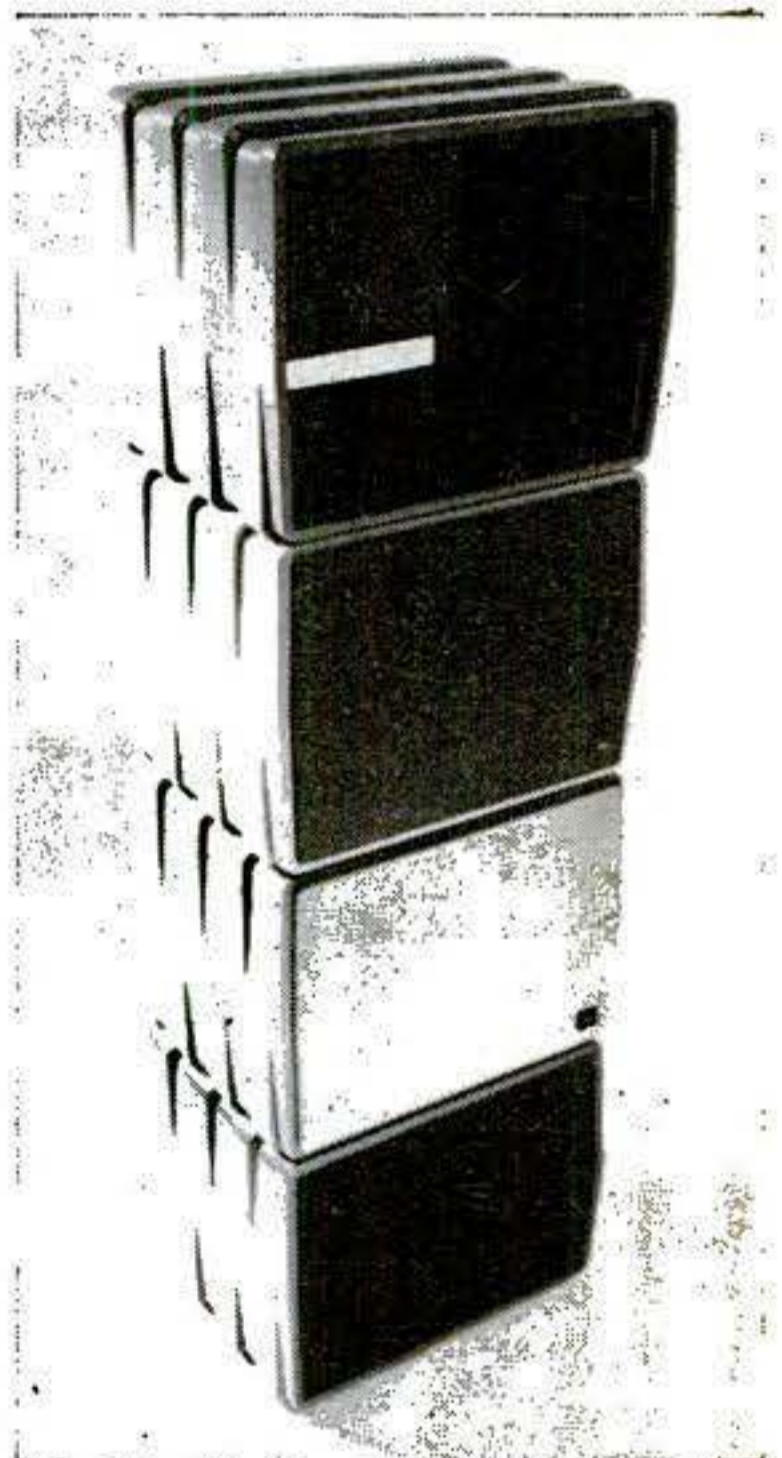
Radio tower

This 14-inch column from Magnavox (model 1784) has an FM/AM radio and flip-card digital clock. Toggle-switch controls set a 24-hour alarm and slumber feature. The radio features no-drift AFC for FM, built-in AM and FM antennas, and a tone control.



Entertainment pods

Packaged in twin pods are a five-inch black-and-white TV receiver, FM/AM radio, and digital clock. There's an ear-phone jack for personal listening and a tinted picture booster for daylight viewing. The white side-by-side pods are mounted atop a sculptured base. RCA calls it Lunar I.



Module speakers

You can stack 'em, listen to 'em—even put your hi-fi gear in 'em. They're James B. Lansing Sound's speaker systems with optional storage modules and shelves. Interlocking surfaces aid in assembling the entertainment center. The Prima 25 speaker is \$126.



Floating hands

It's eerie reading the time on Panasonic's RC-6500 See-Through clock radio. The hands—four transparent panels—seem to float in air. Panels, with no visible means of support, are moved by a power source concealed in the unit. So far the RC-6500 is only in the prototype stage.



Memory dialer

Touch a button, and this low-cost accessory automatically dials your calls. You install the Name Caller yourself, programming up to 38 names with a lead pencil. Macom Industries, 12530 Beatrice, Los Angeles, Calif. 90066, makes home and business models. Under \$50.



Portable stereo radio

Plug that little adapter (far left) into any Sanyo radio and get stereo FM. The adapter contains integrated-circuit amplifiers and a multiplex decoder. Sanyo's RB-9000 Stereocast Adapter includes stereo earphones. Here it's used with model RP-5310 AM/FM Stereocast radio.

What's New

IN HOME IMPROVEMENT



Anti-smoke grate

Getting smoky fires from your fireplace? Here's one cure: The Garden Way grate elevates logs for a good draft, and movable log supports keep flame in the rear. A 15-by-21-in. model is \$27.50 plus shipping; a 13-by-19-in. unit, \$22.50. Garden Way Research, Charlotte, Vt. 05445.



Seaside tile

It's like having the beach—waves washing the shore—in your home with this new bathroom tileboard pattern. Royal-tile "Swirl" surfaces, baked on tempered Masonite hardboard, are resistant to moisture, heat, and denting.



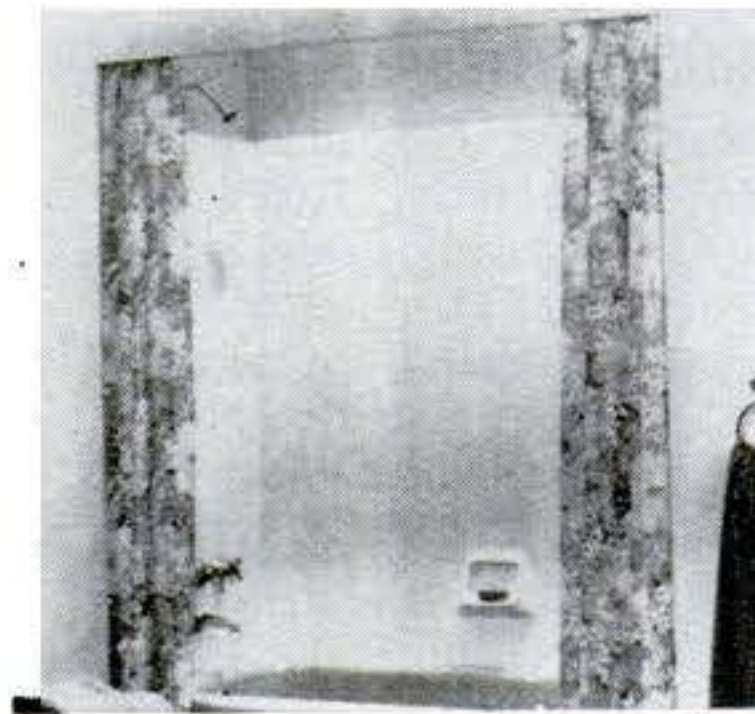
Rechargeable alarm

Worried about prowlers entering your motel room or home? Hang this rechargeable ni-cad-battery-powered alarm on a doorknob, insert the trigger between door and frame, and a loud buzzer will surprise them. It's \$14.95 from Dynatron, 26 Fahey St., Stamford, Conn. 06907.



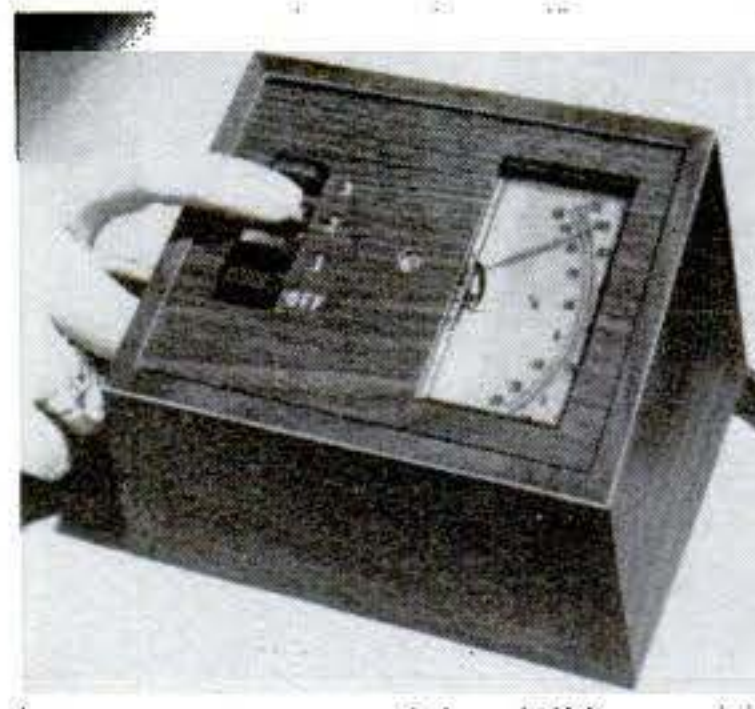
Picture-frame kit

Pour a picture frame? You can, with a Frame Maker molding kit. Each kit contains two pounds of molding powder, molds, hangers, and color materials. Four designs, each \$4.95. Wetstone Craft Co., Box 11881, Atlanta, Ga. 30305.



Tub-wall kit

Looking for an easy way to modernize a bath? This \$89.50 kit includes three fiberglass panels for refinishing walls above tubs up to 62 in. long. You cut holes for plumbing outlets and apply mastic. Maker: Swan Corp., 721 Olive St., St. Louis, Mo. 63101.



3-way thermometer

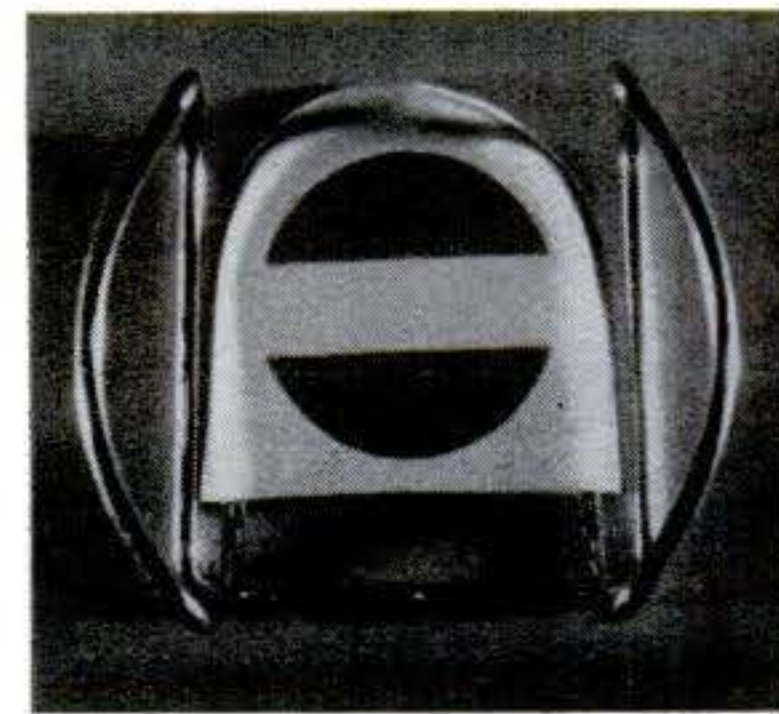
Press the buttons on this battery-operated electronic thermometer for readings—20 below to a hot 122—from three different locations. Probes work up to 1000 ft. away. \$39.95 (two probes) from James Electronics Inc., 4050 N. Rockwell St., Chicago 60618.

What's New

IN OUTDOOR RECREATION

See-through hooks →

These lightweight fishhooks—made of GE Lexan—are tough and corrosionproof. They'll bend double, and the spreading barb makes escape tough even for that largemouth. A \$3 pack has six No. 6s, two 3/0s, one 8/0. Happiness House, 198 Columbus Ave., Pittsfield, Mass. 01201.



Tennis-ball holder

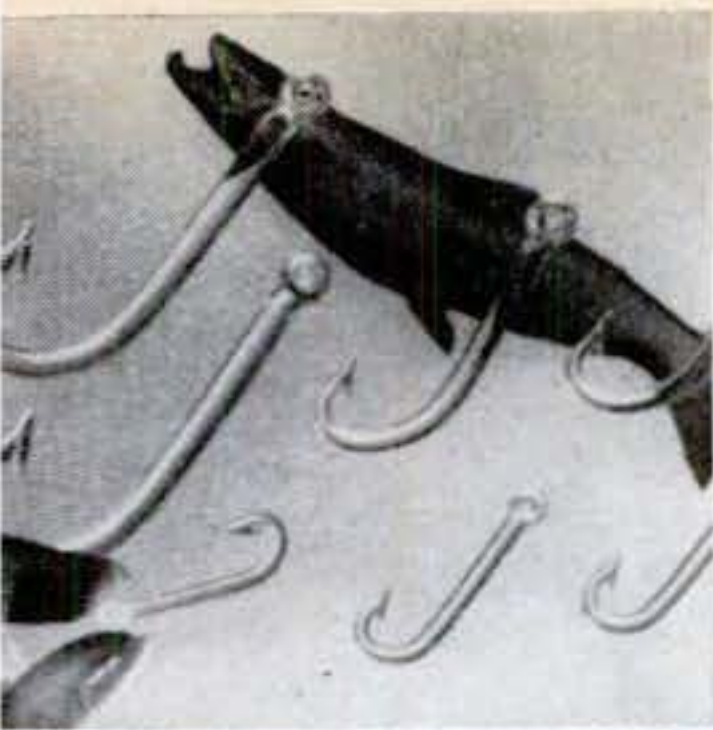
Fasten this gadget to your waist when you play tennis. It holds an extra ball firmly, leaving your hand free during serves. You're also ready for two-handed shots. The Third Hand is \$1.95 from Continental Marketing Sales, 8631 Truxton Ave., Los Angeles 90045.



Cook-in bags

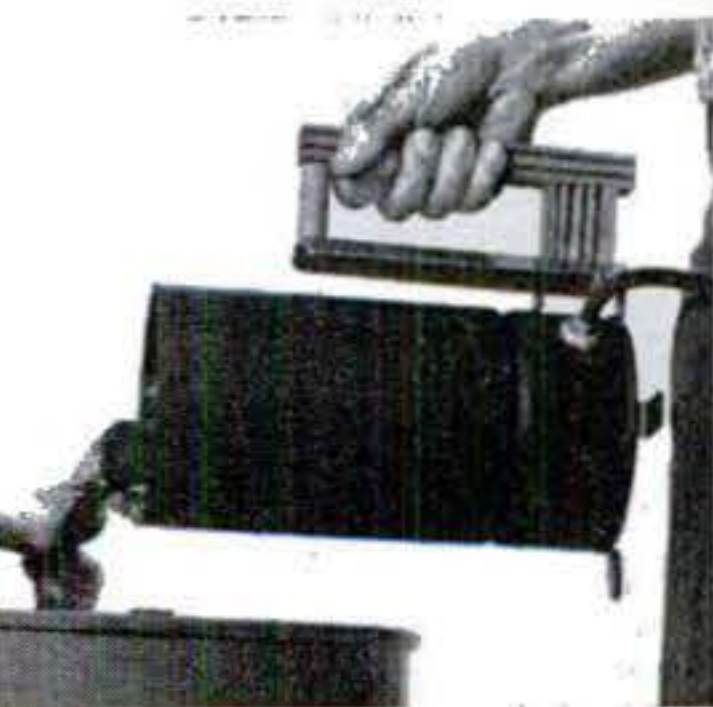
Here's a way to lighten your camping load. Trail Chef bags 74 items—foods, beverages, entire meals—in these mix-in, cook-in bags. You add water, shake, cook in (or drink from) the bag. Burning the bag makes disposal simple. Trail Chef, 520 N. Michigan Ave., Chicago 60611.

What's New IN BOATING



Dry cooler

Having problems with soggy foods in your ice cooler? With this chest, food is kept dry above the ice, on a perforated divider. It's molded from a high-density plastic in several colors, comes in 40-qt. size. Moco makes the High&Dry cooler.



Charcoal starter

No fluid, no fuss in starting a fire—just put charcoal briquettes into this electric igniter and, when they've caught, pour 'em into your barbecue. Rating: 350 watts. Price: \$11.95. It's made by Metalways, Inc., Hancock, Wis. 54953.



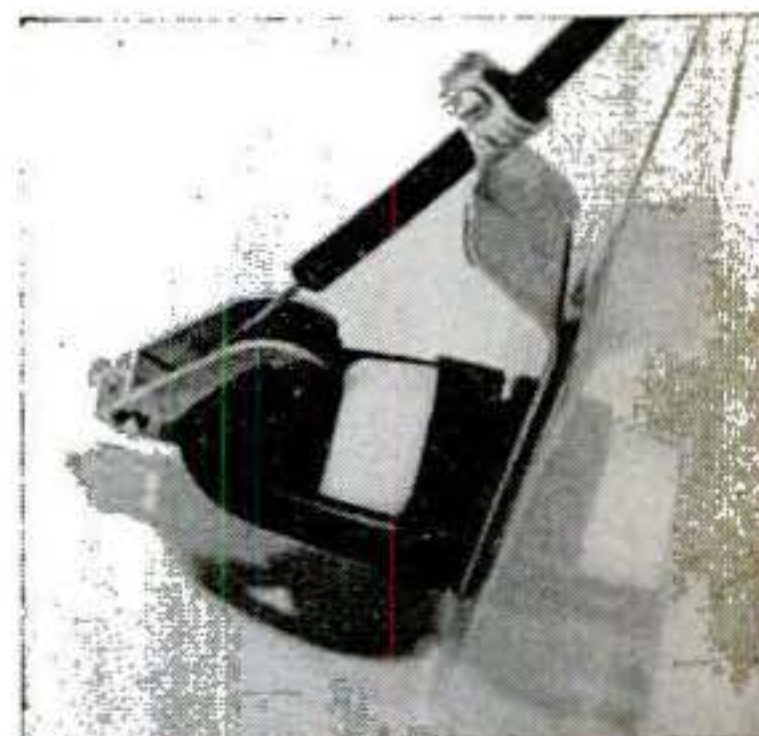
Portable head

Carry your head in your hands? Small-boat owners can, with the Sani Pottie. The \$99.50 fold-up unit has a push/pull valve, bellows flush pump, capacity of 100 flushes. It's leakproof when carried. Maker is Mansfield Sanitary, 150 1st St., Perrysville, Ohio 44864.



Outboard lift

A little leverage goes a long way for tilting up a big outboard. Hook the rod-arm fingers on Bremer's Stowable Motor Lift on the engine handhold. Then slide the collar to the best leverage point. It's \$11.95. Maker: Bremer Mfg., Box 548, Elkhart Lake, Wis. 53020.



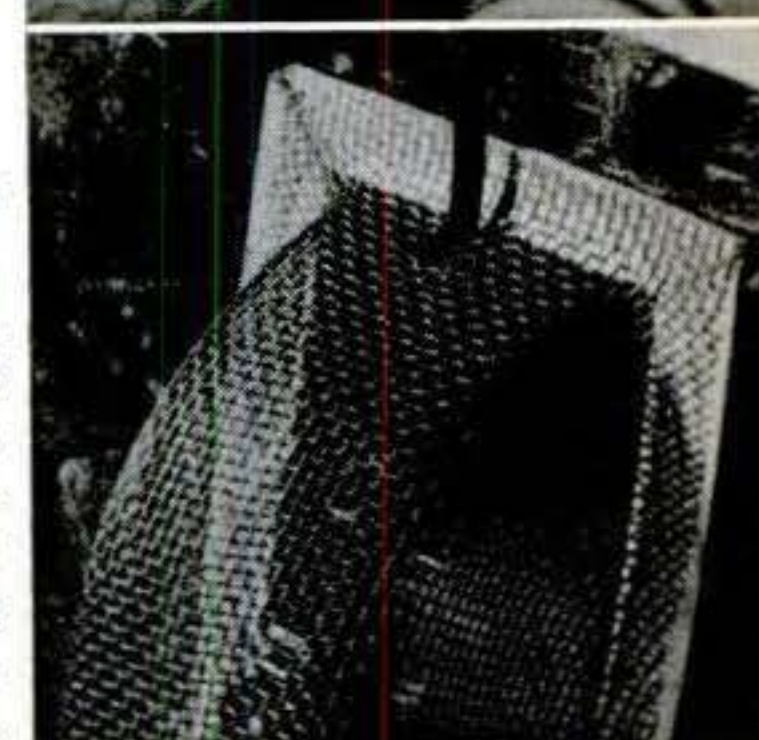
Gas detector

Here's a dandy alarm system that sniffs out combustible gases, sounding a buzzer. A meter indicates concentration level, and you preset alarm sensitivity. Model AG-1100 (12v DC) is \$109.50. International Sensor Technology, 2930D Grace Lane, Costa Mesa, Calif. 92626.



Remote bailer

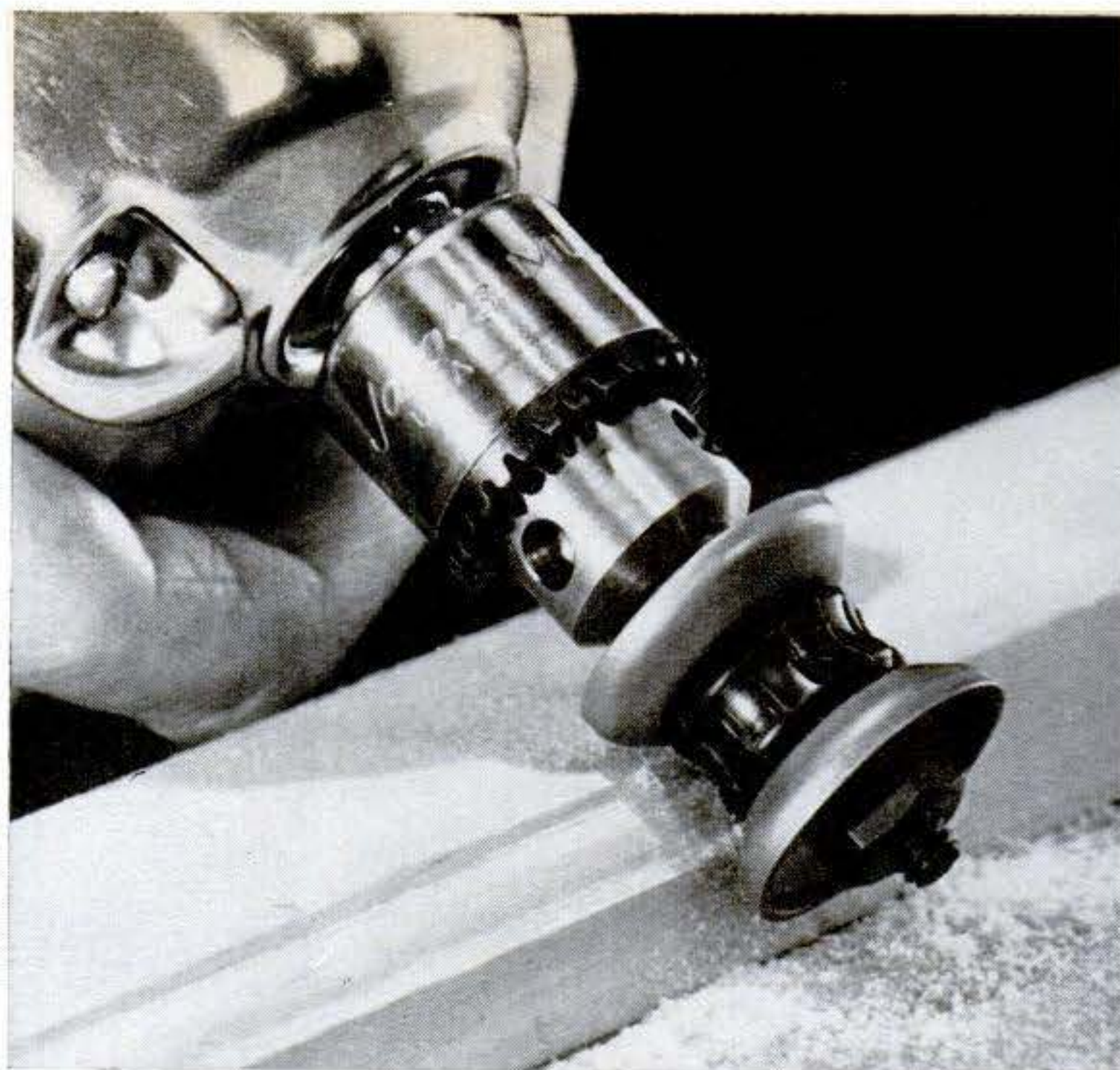
You install the Bilge Bailer in your boat's transom drain tube (top right). Then—underway or on the trailer—pull the dash handle to drain. The protective screen keeps debris from the valve. \$19.95. Northwest Marine Products, 8570 S.W. Cecilia Terrace, Portland, Ore.



What's New IN TOOLS

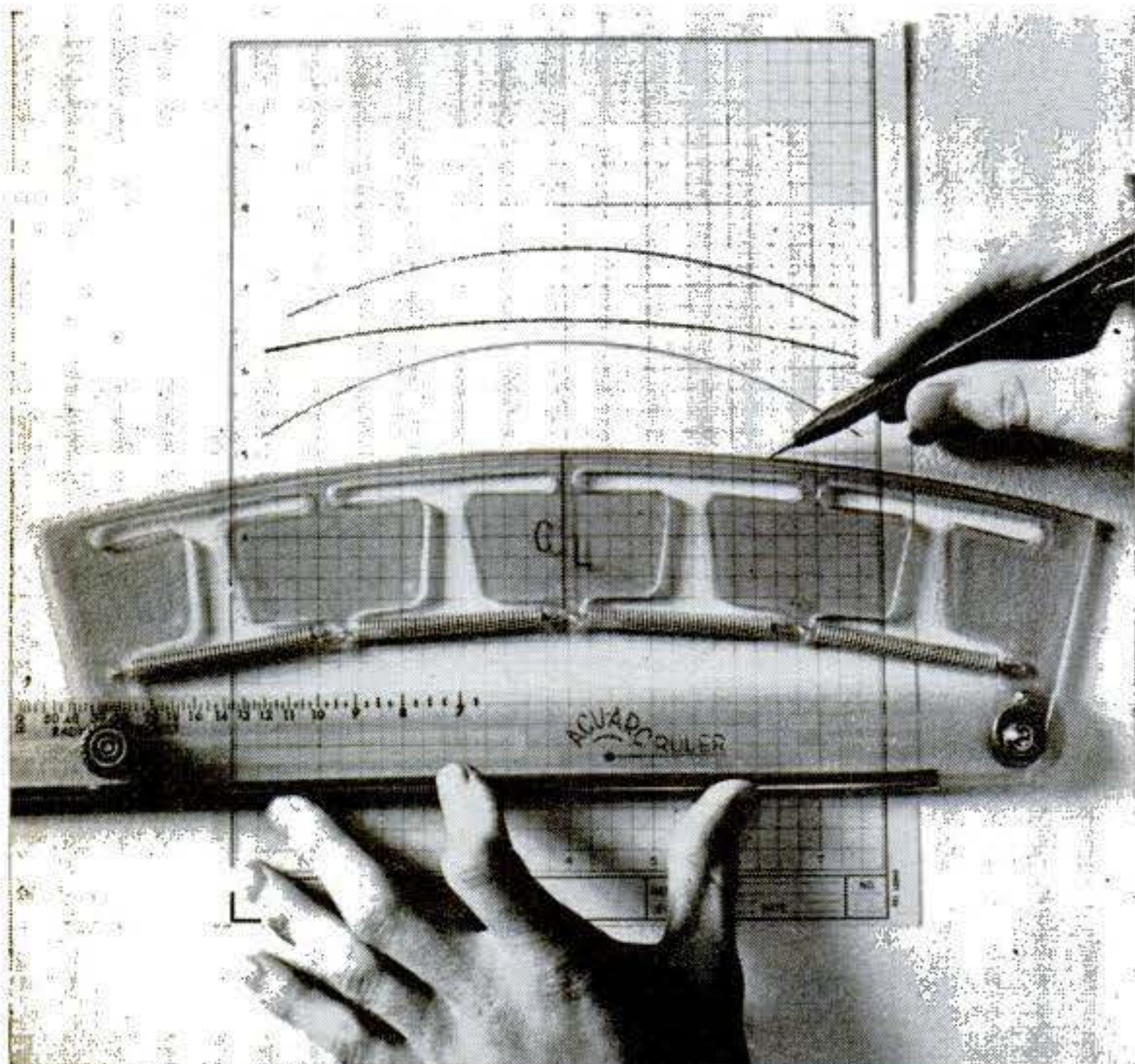
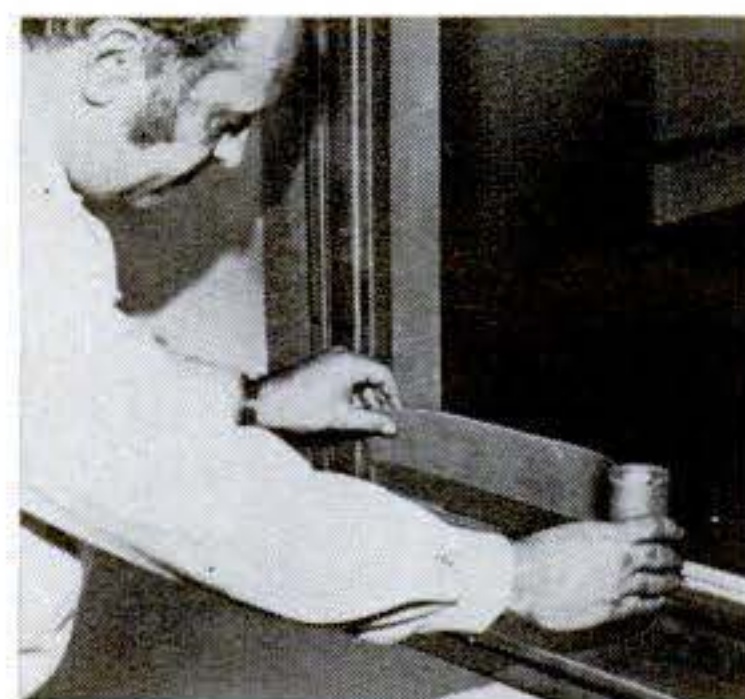
Shaper set

Turn your electric drill into a router? Almost, with this new Black & Decker 70-970 shaping set. It includes three interchangeable cutter heads with washer guides that hold a consistent cutting angle. The set is designed to turn out corner-round, beading, and bevel cuts on wood. It's \$4.95.



Curve maker

Transparent plastic lets you see the linework beneath the new Acu-Arc when you draw a curve—any curve with a radius between 6 $\frac{3}{4}$ " and 200". Springs adjust the instrument to draw, or determine the radius of a curve. \$14.50. Hoyle, 302 Orange Grove, Fillmore, Calif. 93015.

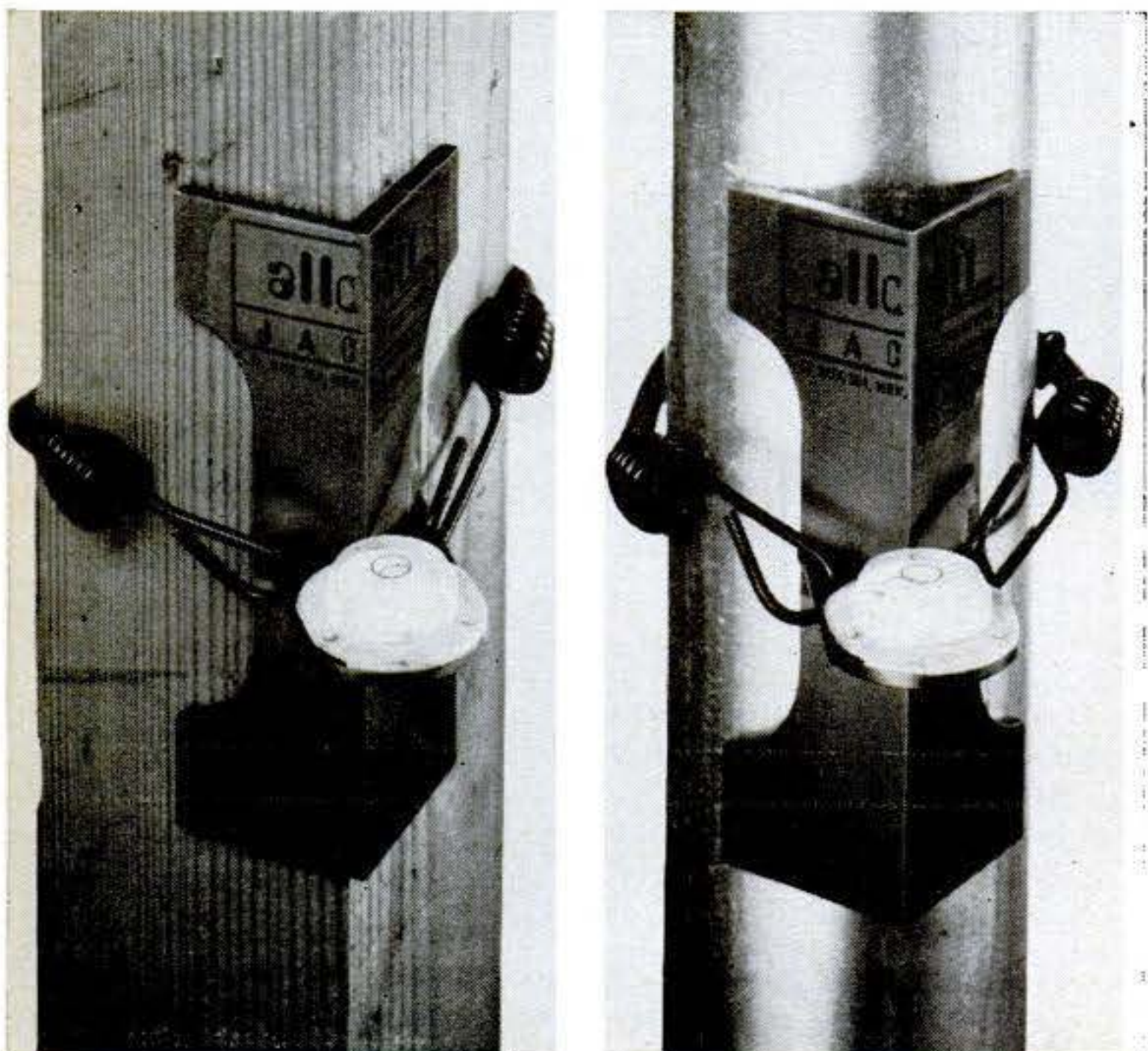


India-ink ballpoint

It's a first, say the Higgins Ink people: a ballpoint pen with a cartridge containing India ink. It's designed for graphic-arts work and drafting—wherever an intensely black line is needed. The Boldstroke pen sells for \$3.95 in art stores. Cartridges are 79 cents for six.

Easy-off tape

A new adhesive on the Easy Mask one-piece tape/drop-cloth combination lets you peel the stuff off any surface weeks after application, says the maker, Daubert Chemical (709 Enterprise Dr., Oak Brook, Ill. 60521). It comes in 3"-24" widths, or a 4"-by-25-yd. pack.



Non-ratchet ratchet

Ratchet action without a ratchet? Yes. This speed wrench "ratchets" around a nut one way by means of cutouts in the jaw, yet locks on when you turn it the other way. Four wrenches ($\frac{3}{8}$ " to $1\frac{3}{16}$ ") \$14.95 from Blue-Jay Co., R.D. 1, Schnecks-ville, Pa. 18078.

Strap-on level

Setting a post or pole? Here's a hands-free way of making it plumb: Hang a Lev-All pole setter on it. The bubble level is held securely by a stretch strap. It's made by Allcraft, Box 384, Newark, Calif. 94560.

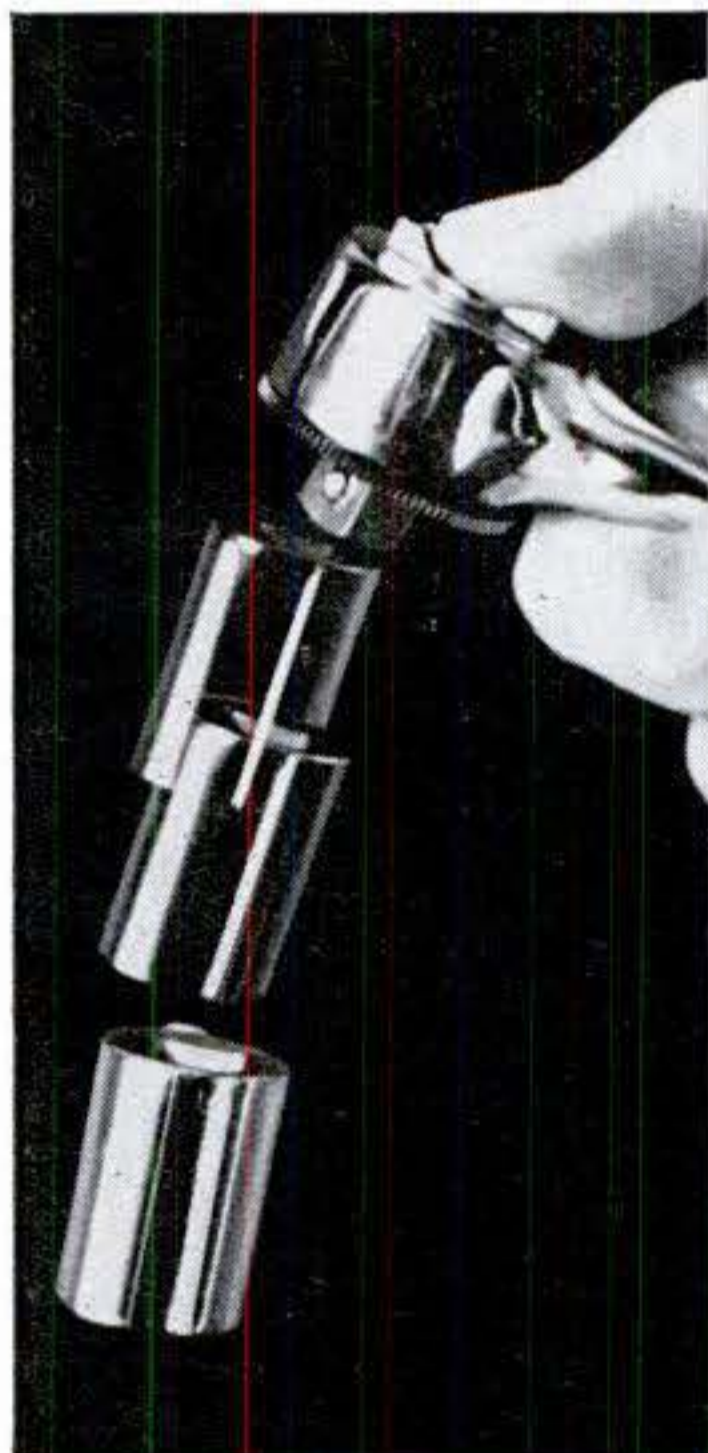


Nonstall chain saw

An automatic clutch release prevents stalling (and possible motor burn-out) under excessive load, on the new Homelite 110 electric chain saw. Designed for home owners, the saw weighs 9½ pounds, has a 12-amp motor, 12" guide bar and chain, pushbutton starting. It's \$94.

Pushbutton ratchet

Touch a button on the new Husky KSR ratchet wrench, and off pops the socket—even a tight or greasy one, says the maker, New Britain Machine, of New Britain, Conn. The ¾" ratchet also incorporates a knurled spinner for faster, easier run-up of nuts, cap screws, or spark plugs.



L-key driver

Slip a bushing on an L key, and the GLA Universal Key Driver will turn it—any L key, it's claimed, to 0.217" (5.5mm). A 20-piece set (driver, nine bushings, nine-piece hex-key set, and wooden box) is \$14.25 from Jensen Tools and Alloys, 4117 N. 4th St., Phoenix, Ariz. 85018.



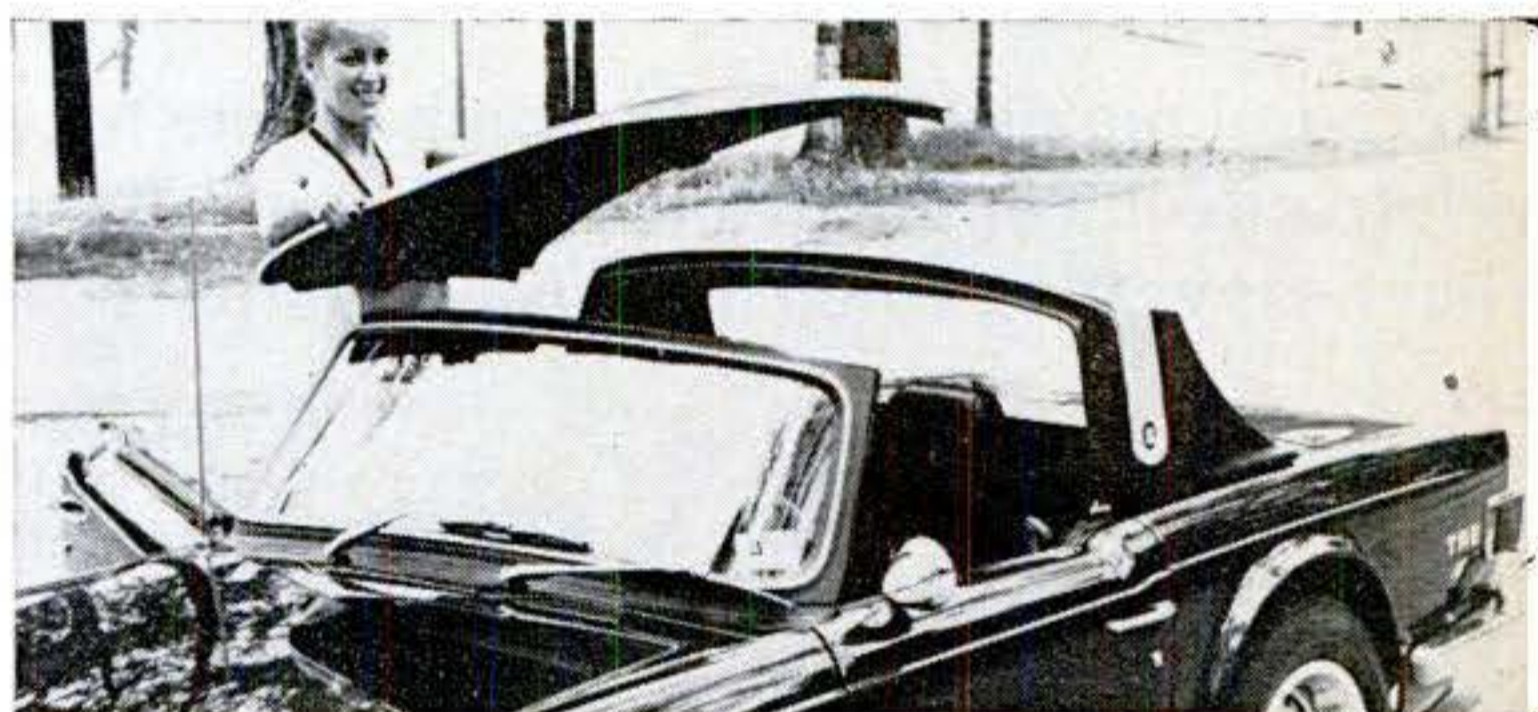
Pipe clamp

Arched gripping surfaces of the Pony 32 spring clamps give them an extra use—holding round work like pipes or dowels. The clamps come with jaws from 4" to 12" long, jaw openings from 1" to 4". Maker: Adjustable Clamp Co., 417 No. Ashland Ave., Chicago, Ill. 60622.

What's New FOR YOUR CAR

Windshield de-icer

Fill your car's windshield-washer reservoir with this new Hot Melt solution, says its maker, and your icing problems are over. Chemicals in the stuff react with ice, snow, and water, generating heat and melting windshield ice. A half-gallon sells for \$1.98 at service stations.



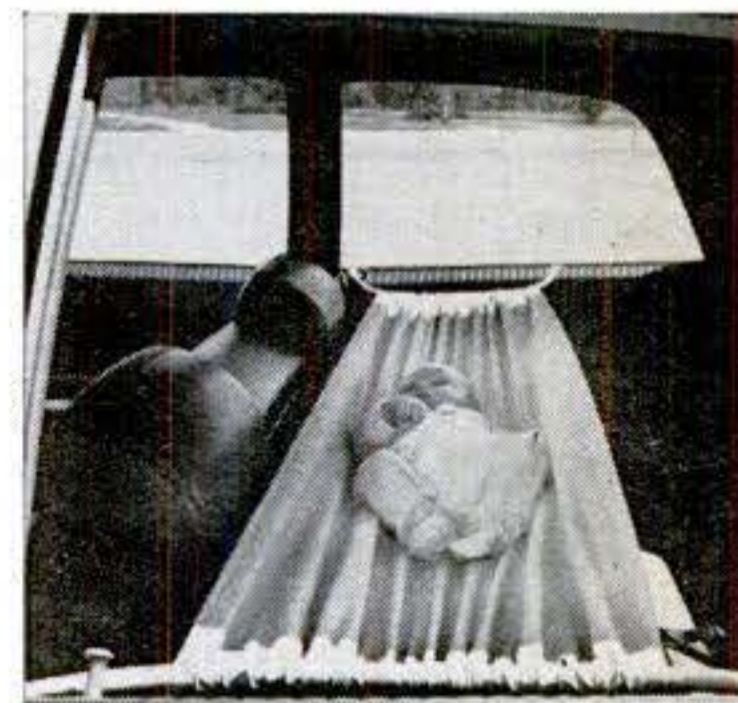
Conversion for imported convertibles: a solid top

Turn your imported ragtop into a hardtop? That's what the Suntop does. Made of fiberglass, the top is finished on the outside in black or white vinyl, inside in flat black. The section above driver and passenger snaps out for storage in the trunk. The rear window is of safety glass and (an option) can be removable. Another option: a steel roll bar encased in the fiberglass. Cost: between \$250 and \$325. Maker: Space Age Products, Box 624, Houston, Tex. 77001.



Rolling gauges

You've got four tire gauges going for you with the Arocom system—one on each wheel. Permanently screwed on your tires' valve stems, they show the air pressure in each tire. You inflate the tire right through the gauge. A set of four is \$3.98 from Arocom, 201 W. Cedar, Akron, Ohio.



Car hammock

Taking a toddler along on a family picnic? Here's a device to let the kid nap while you're stoking the barbecue: an infant hammock that's secured in the car-window channels. It's \$10.45 from Brand-L-Products Co., Box 233, Arlington, S.D. 57212.



Coming—New

New tire grades will be molded into sidewalls starting next year: Numerals stand for tread life, stars for tractive ability, and letters for high-speed capability. In this illus-

tration, the tire would have a tread life 25 percent greater than the control (average) tire; traction would be average; and high-speed capability would be over 105 mph.

Soon a unique new federal grading system for tires will go into effect. For the first time, a buyer will know exactly what he is getting when he puts his money down

By HERBERT SHULDINER

The guessing game about what kind of tires to buy for your car is going to get a little easier. The reason? New government standards will soon not only grade the tires you buy, but force manufacturers to put the grade directly on their tires. Three vital areas will be covered:

- High-speed performance.
- Traction.
- Tread life.

Unlike current federal standards for tires, which set minimum safety requirements, the new labeling standards will actually grade the tires.

How will the system work? Starting some time next year, the new grades will be molded right into tire sidewalls, National Highway Traffic Safety Administrator Douglas W. Toms and Dr. Edward H. Wallace, chief of the NHTSA tire division, told POPULAR SCIENCE in an exclusive interview. Tire makers will also be required to attach a label explaining the ratings to buyers.

Tread-life grades will be numbered 1 to 6. Traction grades will be indicated by stars. High-speed performance will be graded A, B, or C.

The system will take some getting used to. Usually "Grade 1" and "Grade A" signify the best quality to most buyers. But the new tire-grading system, illustrated below, puts these grades at the bottom. But when

you get used to them, they will offer much clearer guides to tire performance than such current terms as "premium," "first line," etc.

Congress realized this, says Toms, when they put a tire-labeling provision in the Highway Safety Act of 1966, which created all the safety standards governing automobiles today. "The consumer couldn't tell a good-performing tire from a poor-per-

forming tire," Toms says. "There didn't seem to be any sanity or reason connecting price and performance."

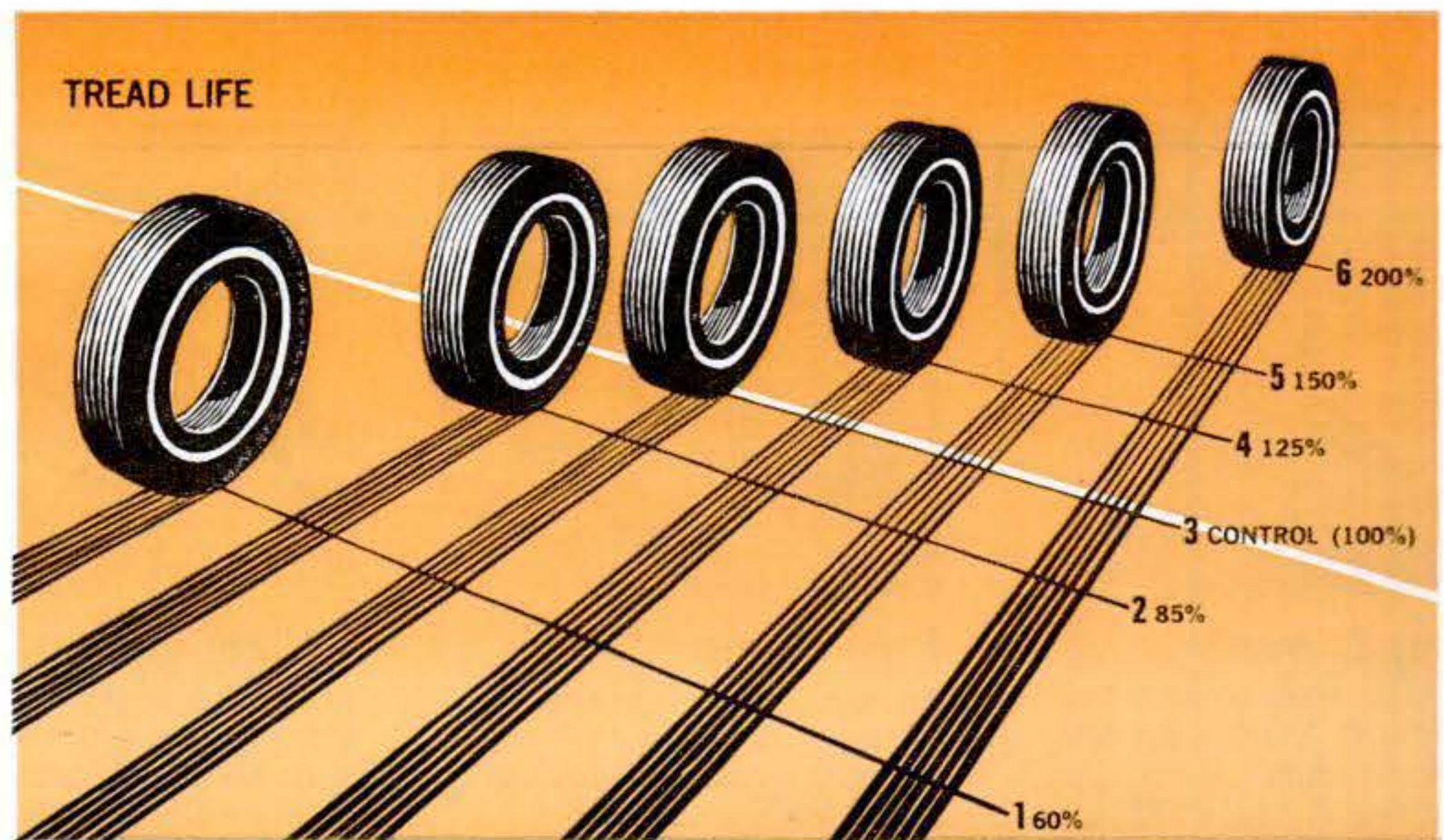
How to end this confusion? Toms is convinced that "labeling, embedded right in the sidewall of the tire, is the best approach. It tells the consumer how the manufacturer certifies his tires will perform."

And, adds Wallace, the new labels will show the consumer that "he's got the government standing behind him on the value of the tire."

If Congress and NHTSA were so sold on tire grading, why did it take so long to create a system? "There were important elements of the tire industry, like the auto industry, that did not want to be regulated," says Toms. "The tire industry wouldn't settle down and produce the information we needed until they had a thorough opportunity to test our resolve. When we came out with a series of standards, they realized that if they didn't produce they were going to wind up in a difficult position."

What Toms referred to was a tire-grade-labeling proposal announced in September 1971, which asked manufacturers to grade tires for high-speed performance, endurance, road-hazard resistance, and uniformity and balance. This brought a bellow of protest from both tire and auto makers—and surprisingly from many consumer groups, too.

Here's what the new uniform tire-grading



Six grades of tread life will be indicated on a scale of 1 to 6. Tread life is not stated in actual mileage because this depends to a great extent on individual driving habits and road-surface materials. The standard sets up a control tire—Grade 3—that would be aver-

age in tread life, according to the government grading regulations. Grades 1 and 2 would be below "average" in expected tread life, while there are three grades that are better than the average or control tire in tread-life expectancy.

U.S. Tire-Labeling Standards

The proposal, which would have gone into effect this month, was attacked as "too complex for the consumer." Further, said the tire companies, if grading standards were to be useful, they should include tread wear.

In the face of this outcry, NHTSA scuttled its original proposals. After months of studying counterproposals from the rubber companies, Detroit, and consumer-advocate groups, Toms says, NHTSA concluded that the standards the public wanted most concerned tread life, traction, and high-speed performance.

Traction and tread life. These, says Dr. Wallace, are the most difficult to grade—and, further, you can't grade one without the other. If you graded tread life and not traction, the tire companies would change their manufacturing techniques to put out a tire with a long tread life, but at the expense of traction. Obviously a long-lasting tire would be one with a low coefficient of friction. But how would you stop your car on slippery surfaces with such a tire?

At the same time, there exists great controversy over whether there is a reliable test for tire traction—without which, of course, there can be no performance standard. In fact, the Traction Studies Group of NHTSA, following a lengthy series of tests, recently concluded that "tire grading

or classification in terms of tractive performance cannot be achieved."

A. H. Neill, group manager, says the tires were tested in a J-turn maneuver on a wet skid pad and there was surprisingly little variation in results—regardless of tire types. The one exception was racing slicks, put through the same tests.

How can NHTSA propose a traction standard in view of this? Dr. Wallace says a control tire developed by the American Society for Testing Materials (ASTM) would be used to establish a traction-grading standard. The control tire and a candidate tire will be run on a two-wheel trailer, under identical conditions. Performance of the candidate tire will be compared to the control tire and graded accordingly.

The control tire. It's a bias-belted type designed to perform, on average, like the original-equipment tire of the major auto manufacturers. It is not exactly like any tire, however. It has no tread pattern, just circumferential ribs. It is made, under very controlled conditions, by a master tire builder, at a cost of about five times the price of a standard tire.

The ASTM control tire was originally designed to test the frictional property of pavement, to tell highway agencies when to resurface their roads. NHTSA researchers I spoke to had deep reservations about the

use of this tire as a traction-control tire. It could show up well in a test on one surface, they told me, yet do poorly on another surface, since the tire must interact with the road for good traction.

A typical trip can include many kinds of pavement, especially on long hauls. You could start out with a tire that has great traction on one road, yet will do poorly on other roads.

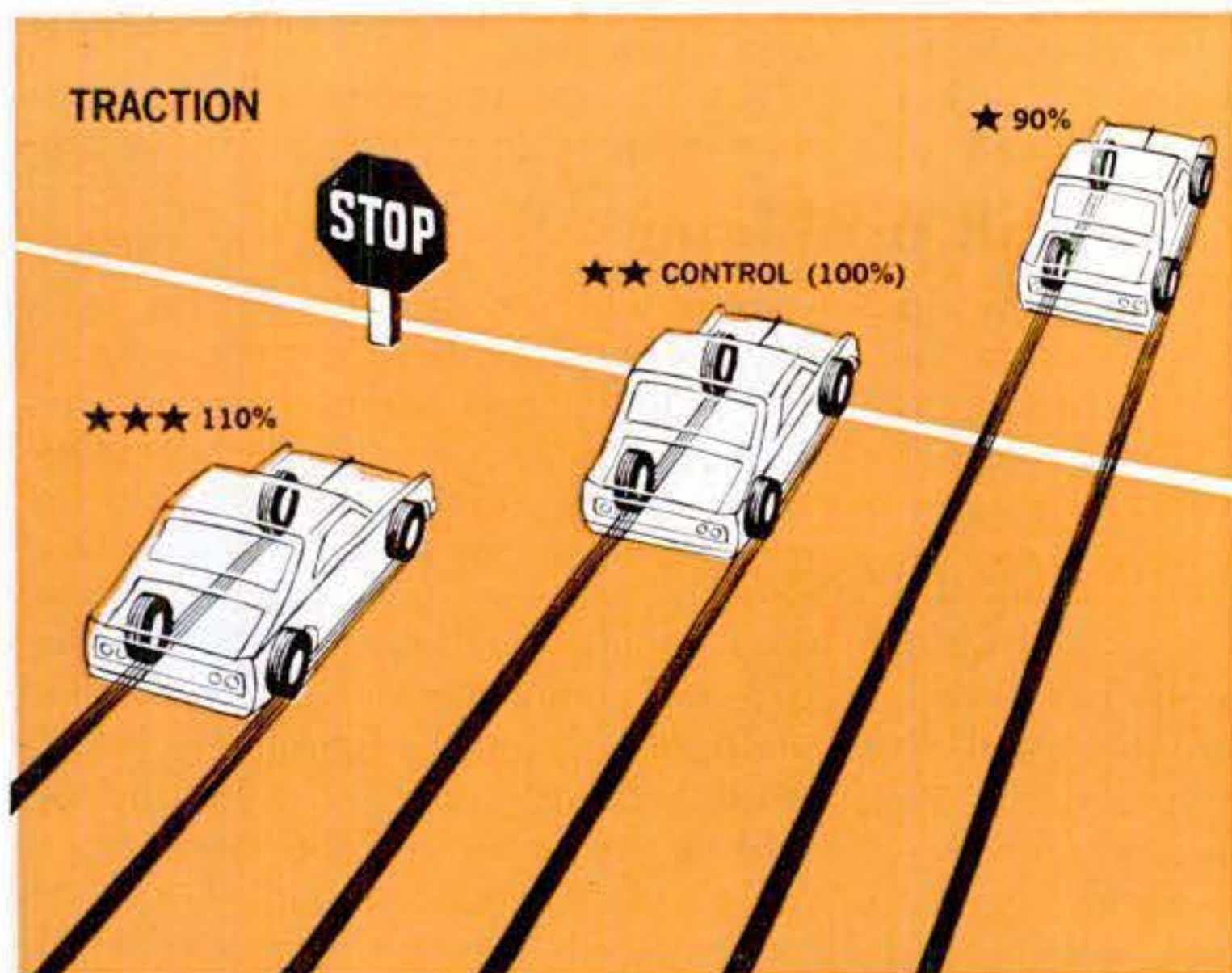
Still, the public wants a tread-life standard. And that means a traction standard, too. And NHTSA is going to give them that—based, apparently, on the use of the ASTM control tire, and despite the reservations of its own researchers.

How much tread life can you expect for each grade? You won't know. The six initial tread-wear grades will tell buyers only that they're getting an average-wearing tire with Grade 3, then progressively better-wearing tires as they select products with higher grade numbers. If they're not interested in long tire life, they can buy Grades 1 or 2.

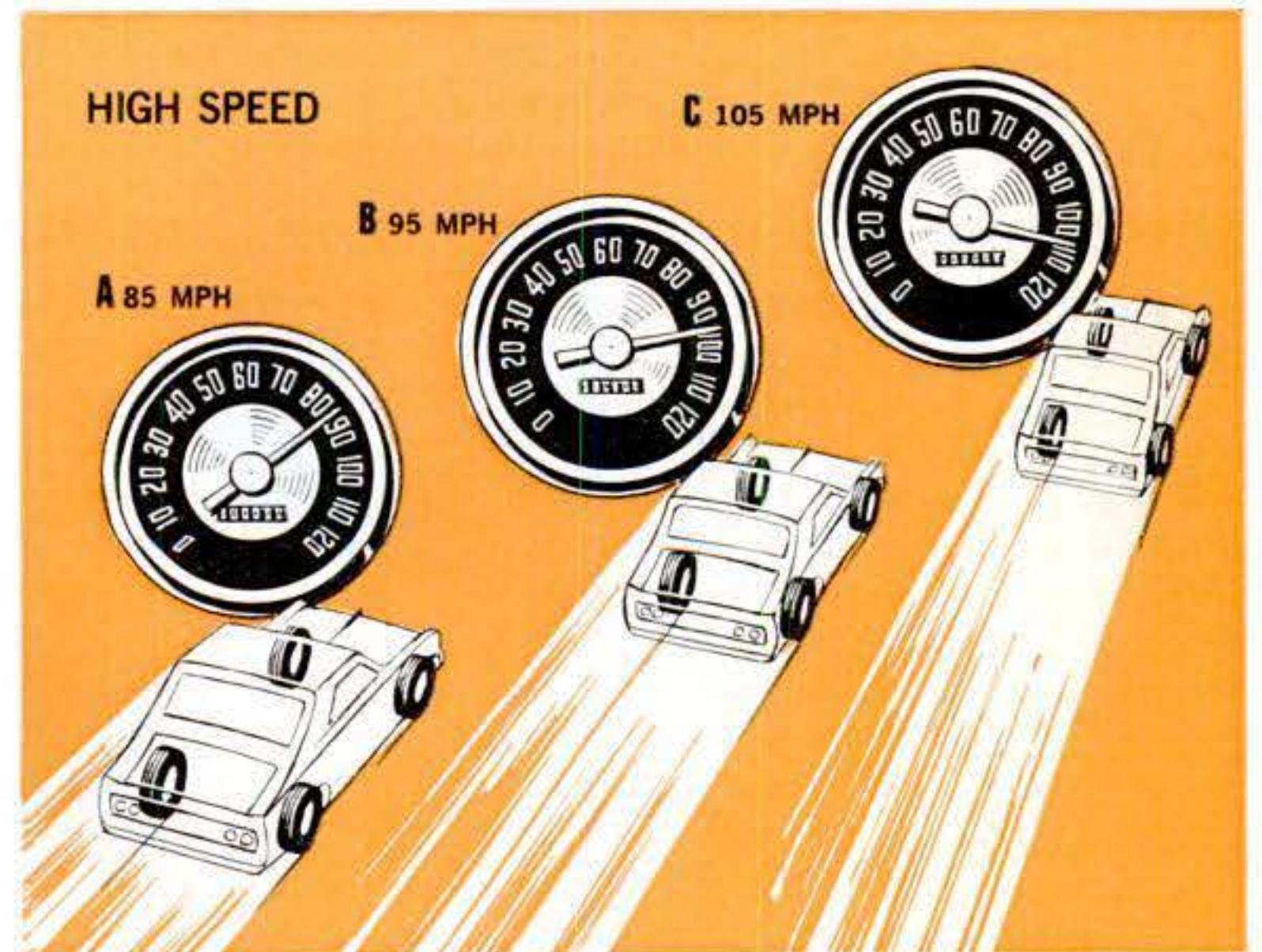
Why can't the tread-life standard state the actual mileage a tire is capable of? Driving habits and road variations play such a big part in tread life, says Dr. Wallace, that it is impossible to create a national tread-wear standard in terms of absolute mileage figures.

[Continued on page 132]

labels mean in performance



Traction grading will work on a star system. Three grades have been established by the government for this characteristic. One star indicates 10 percent less stopping power than the two-star "average" control tire. A three-star tire has 10 percent greater stopping ability than the control tire. There is considerable controversy over the reliability of the test procedures for this.



High-speed category offers three grades: Minimum-grade tire (A) is perfectly good for all normal driving, including high-speed turnpikes; B and C are designed to take higher sustained speeds. The 85-, 95-, and 105-mph designations indicate performance on a test wheel. Equivalent highway speeds are actually less demanding, say government officials involved with the tests.

Now—a REALLY big show!

A 4'-by-6' Color TV Picture

Since the beginning of TV, companies have been trying to develop big-screen television for home use. Now there's one you can buy—and others are under development

By C. P. GILMORE

PHOTOS BY ORLANDO GUERRA

CAMBRIDGE, MASS.

There on the wall was the bigger-than-life image of a smiling President Nixon getting off Air Force I in Poland and shaking hands with officials. It looked like a clean, sharp movie, only brighter.

But it wasn't a movie. What I saw was happening at that moment. The President was live and in color on a startling new giant-size color projection-TV system—the first designed for home use. The unit—the one you see photographed on these pages—was a laboratory prototype. But the commercial model will be on the market about the time you read this.

The six-foot-wide picture—12 times the size of the biggest (25-inch) direct-view set made—is big enough for a small auditorium. But in your living room, a few feet from your favorite viewing chair, it delivers qualities that can't be rivaled by the small screen. Impact. And sharpness. And clarity. It's better in these departments than anything available on the market.

Now for the bad news. The unit will sell for \$2500. Later models will be cheaper. How much cheaper and

how soon it will arrive are unknown.

Of course projection sets aren't new. Special sporting events such as championship fights are shown in movie theaters with a device known as the Ediphor projection system. It costs a hundred and thirty thousand dollars. General Electric has a projection system for classroom and industrial use. It runs \$39,000.

The new home model, ridiculously cheap by previous projection-TV standards, was developed not by one of the big TV makers, but by the Advent Corp., a firm known until now for its work in the high-fidelity field. Prime mover is Advent's president, audio pioneer Henry Kloss.

How it works. The unit contains three projection tubes—one for the red image, one for blue, a third for green. Three color images are projected separately to the screen, where they combine for the full-color image.

The picture is not only big, it's super-sharp. In a conventional shadow-mask tube—the kind in most present TV sets—each individual picture element on the tube face is made up of a "triad," three color dots that blend to produce one final spot of



The projector's control panel will be concealed by a small door in the production model. Controls are the same as those on conventional sets, except for three convergence controls (see text). The set is designed for serviceability: Power supply is at the bottom; other electronics are on plug-in circuit boards on swing-out chassis.

color. Image sharpness is limited by the relatively large size of the color triad. The projection tube has no shadow mask, hence no such sharpness limitation.

Result: sharpness even better than that obtainable on an expensive stu-

The other systems — promising, but there are still problems

At least two other big-screen projection-TV systems are under development. Sony demonstrated one early this year [Look and Listen, PS, May]. To my eye, the picture is excellent. But brightness is a problem. The device, with a 12-inch extra-bright Trinitron as the picture source, projects the image through a five-inch lens onto a 2.5-by-3.3-foot screen. Image brightness is about three footlamberts—about like an 8mm home movie. To get a good picture, it must be viewed in near darkness. The Sony unit (including receiver) will sell for about \$2500.

I recently saw another fascinating system in Los Angeles—by far the most sophisticated one I've heard of. Developed by Dr. Theodore Maiman, who built the world's first laser in 1960, the

system predictably uses a laser as the light source. The laser oscillates at three different wavelengths, producing a beam containing red, blue, and green light simultaneously.

The secret of Dr. Maiman's system lies in two advanced devices he will not discuss at present. One is a solid-state, nonmechanical unit that sweeps the laser beam through the usual TV raster across and down the screen. The other simultaneously but independently modulates each wavelength so the precise amounts of red, green, and blue light are delivered to each point on the screen to produce a balanced color picture.

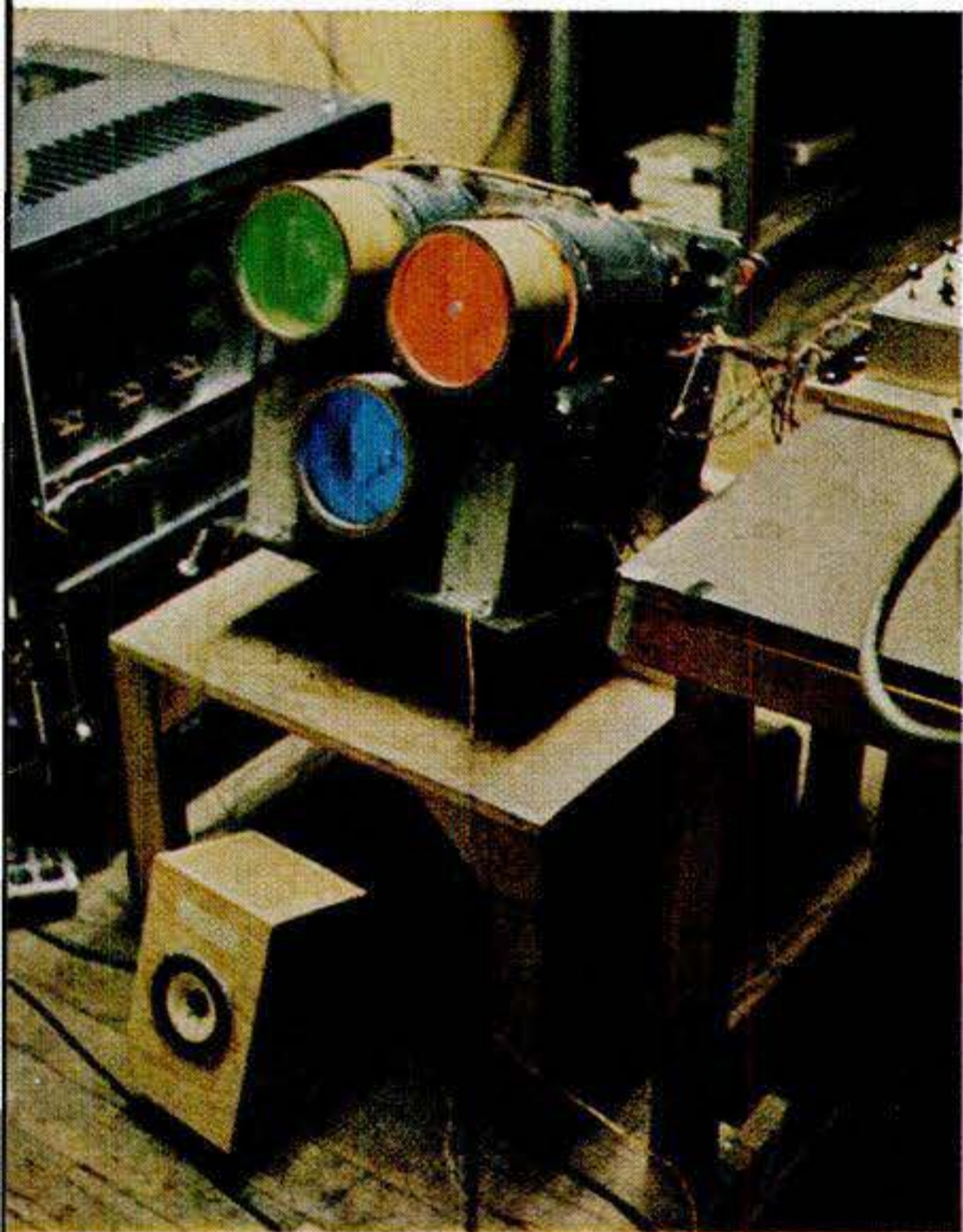
Performance is impressive. The picture I saw was not bright enough, but Dr. Maiman says optimizing the optical

system will increase brightness by a factor of 10—plenty bright enough.

The unit I saw had a three-by-four-foot screen and was 30 inches deep. It is a rear-projection machine with internal mirrors that fold the beam and conserve space. Dr. Maiman also showed me a mock-up: same screen size, but only *nine inches deep*, hanging on a wall like a picture. He has already worked out the technique for folding the beam into this package.

Dr. Maiman's company hopes to have a 30-inch-deep commercial model on the market in about a year. Primarily for institutional use, it will cost between \$8000 and \$12,000. A year later, the nine-inch-deep home version will be available for \$2600. Price should eventually drop to about \$1200.

on Your Living-Room Wall



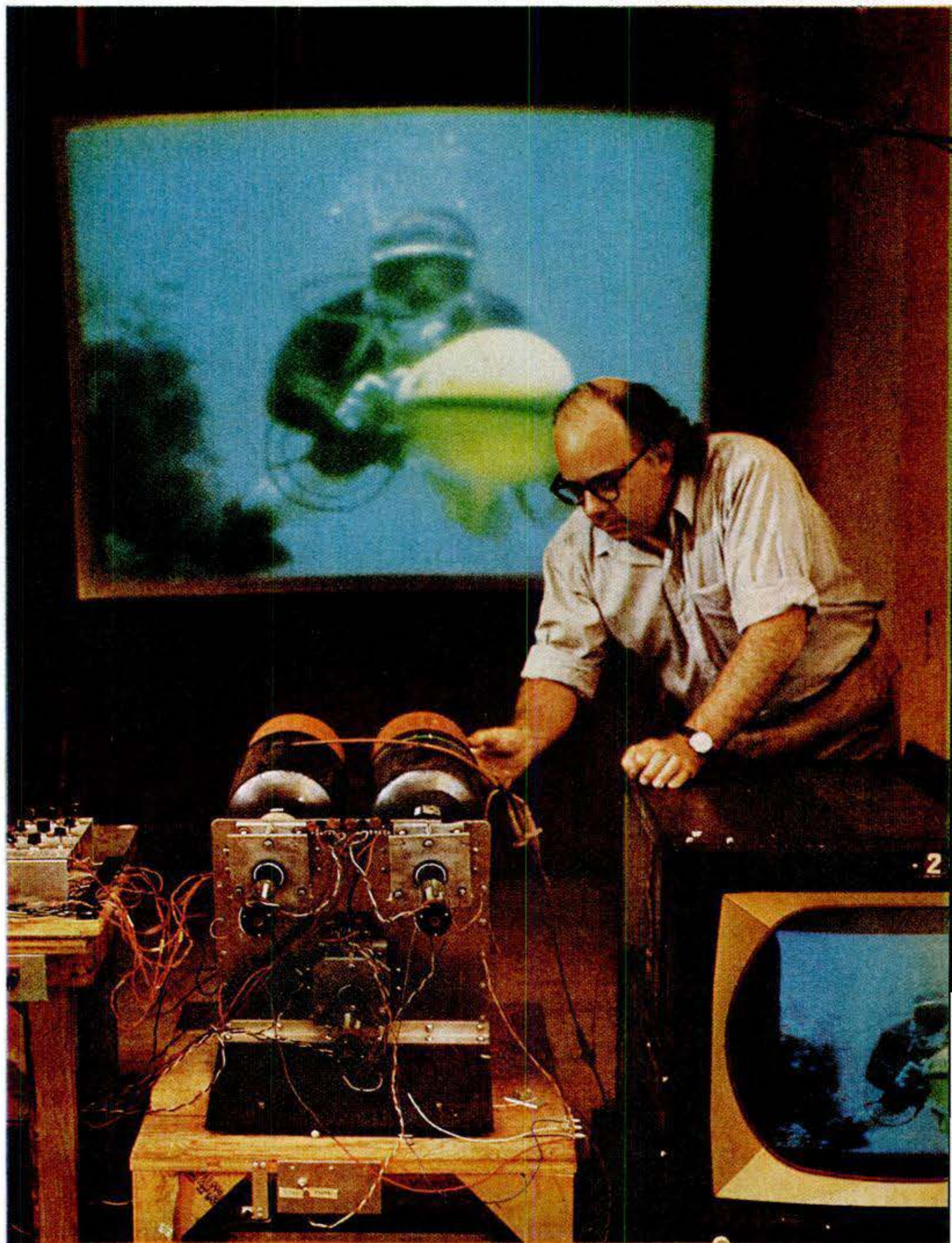
Heart of projection system is this triad of color tubes, one each for red, blue, and green images. A small acoustic-suspension speaker, flat from 80-12,000 Hz., projects sound toward the screen, from which it is reflected. At right, inventor Kloss adjusts prototype. Comparison picture can be seen on studio monitor at bottom right.

dio monitor—the kind networks use to check their signals. Kloss had such a monitor set up for comparison. When a test pattern came on, I could see finer detail on the projection screen. The set has an inherent 1000-line resolving power, which means it can produce twice as much detail as our present 525-line TV system.

Sharpness is just the beginning. "The entry fee on projection television is brightness," says Kloss. "Until now it has never been paid in a home system." Screen brightness of the new Advent system is over 15 footlamberts. In practical terms, the set might be viewed in normal room lighting; in moderately subdued lighting of the kind you find in many living rooms, the picture is brilliant.

Brightness grows out of the projection principle used. The face of any TV tube glows when a beam of electrons hits its face. The more electrons (the greater the beam current), the brighter the picture.

One big trouble with the conventional shadow-mask tube is that the shadow mask itself interrupts the



beam a lot of the time as it plays back and forth across the tube face, thus sharply limiting the number of electrons that get through to the phosphor coating to produce the picture.

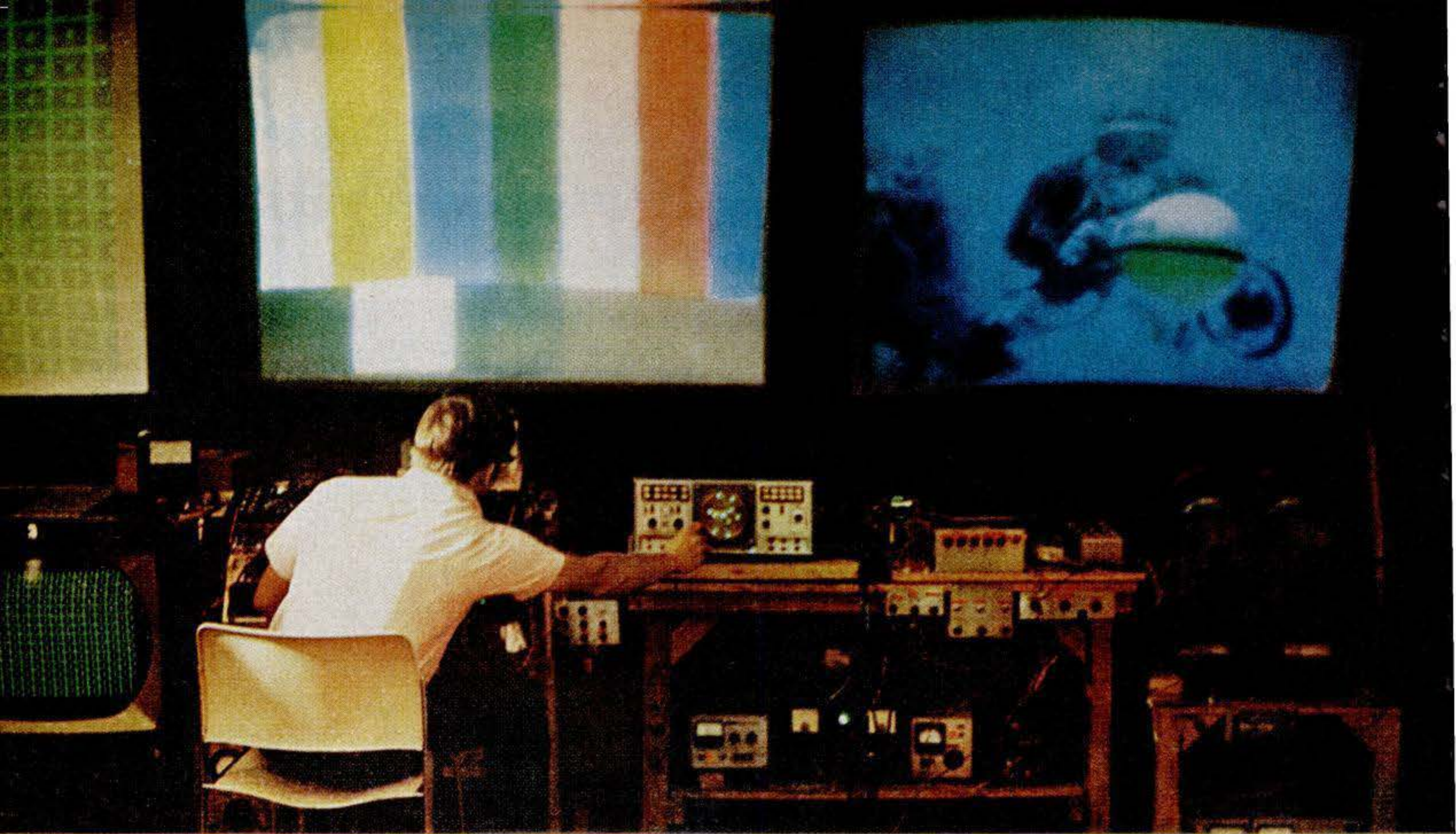
The Advent projection-tube phosphors, on the other hand, work 100 percent of the time. Thus they crank out some five times as much total light as a conventional tube.

When this light is projected on a screen, about two-thirds is lost through the optical system. But a screen of highly reflective aluminum

gives a gain of 10 (the image reflected from it is 10 times brighter than the same image projected on a plain white surface). The net result of all this arithmetic is a picture not as bright as the one that you see on a conventional set, but still bright enough, even though it covers 10 times as much area.

Design tricks cut costs. Projection tubes similar in principle to the Advent version have been built before. But they cost thousands of dollars per tube. Clever manufacturing tech-

Continued



niques cut the cost at Advent to a fraction of that figure.

To produce an undistorted image, the reflecting mirror in the tube should be parabolic in shape. But a parabolic mirror is very expensive, and must be ground and figured—or corrected—by hand. A spherical mirror, on the other hand, can be made cheaply by an automatic machine.

In the early 1930s, a German op-

tician named Bernard Schmidt figured out how to make a cheap spherical mirror do the job of an expensive parabolic one. He designed a corrector lens to go in front of the mirror that predistorted the light in such a way that it exactly canceled out the distortion introduced by the spherical surface. The Schmidt telescope quickly became widely used by astronomers and today is still one of

the most popular astronomical instruments.

Advent used a computer to calculate the shape of the corrector lens needed to go with a Schmidt projection system of the necessary size, then had a high-precision machine shop grind out a steel blank to this shape. The blank became a mold.

In production, a technician puts acrylic powder into the mold, heats

TV projection tube—a cross between a TV set and an astronomical telescope

Electron beam leaves the gun at left and travels to the target. Deflection coils around the neck (not shown) create TV raster pattern. Beam strikes the 2½-inch-wide phosphor-coated target, creating the TV image. Light thus generated is reflected by the spherical mirror out through the front of the tube. There, distortion introduced by the spherical mirror (see text) is canceled out by a special corrector lens, which is mounted in a plastic bracket and slipped on to the front of the tube. The small target size means that beam deflection is only 15 degrees, making for extreme linearity of picture.

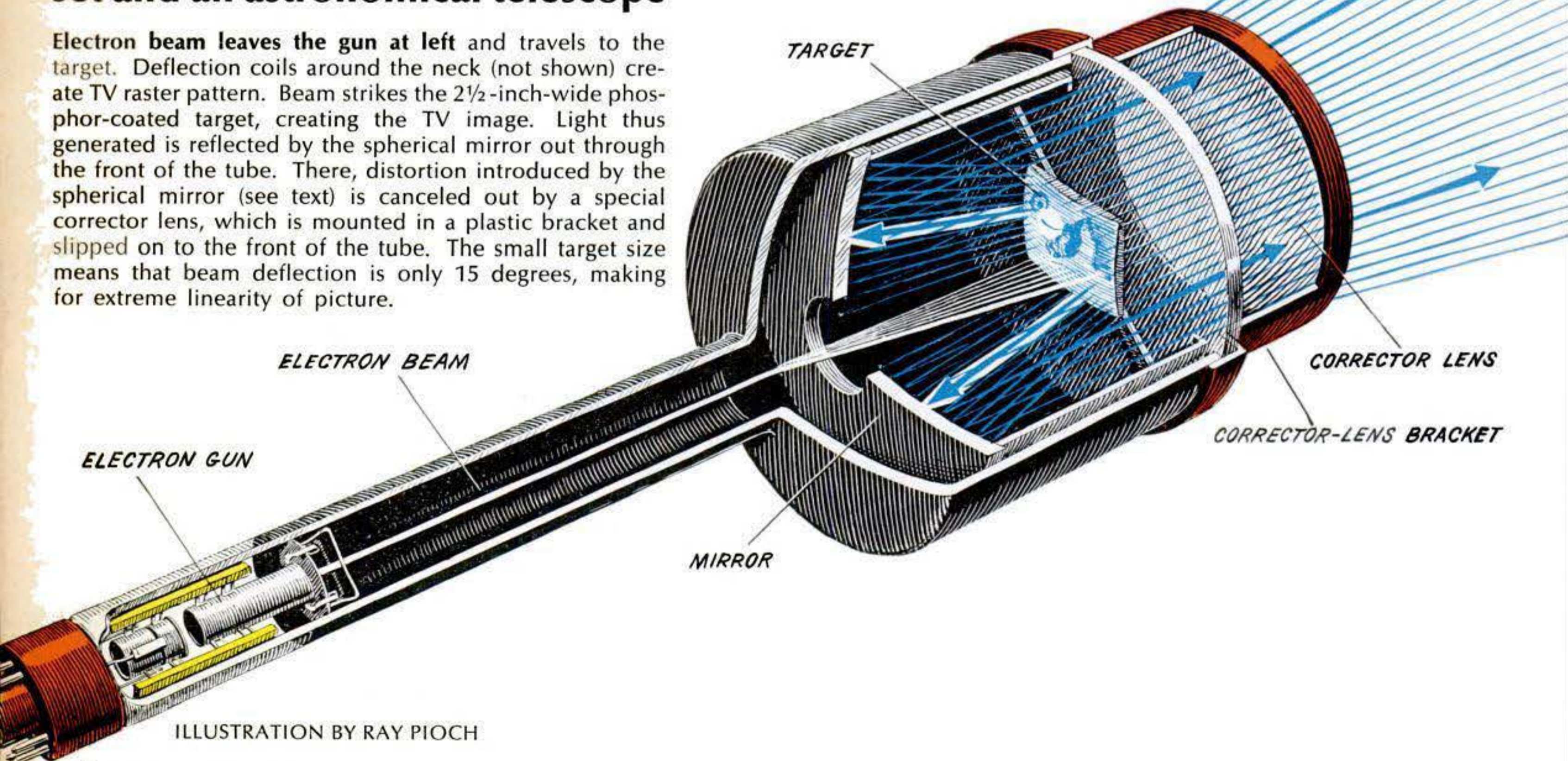
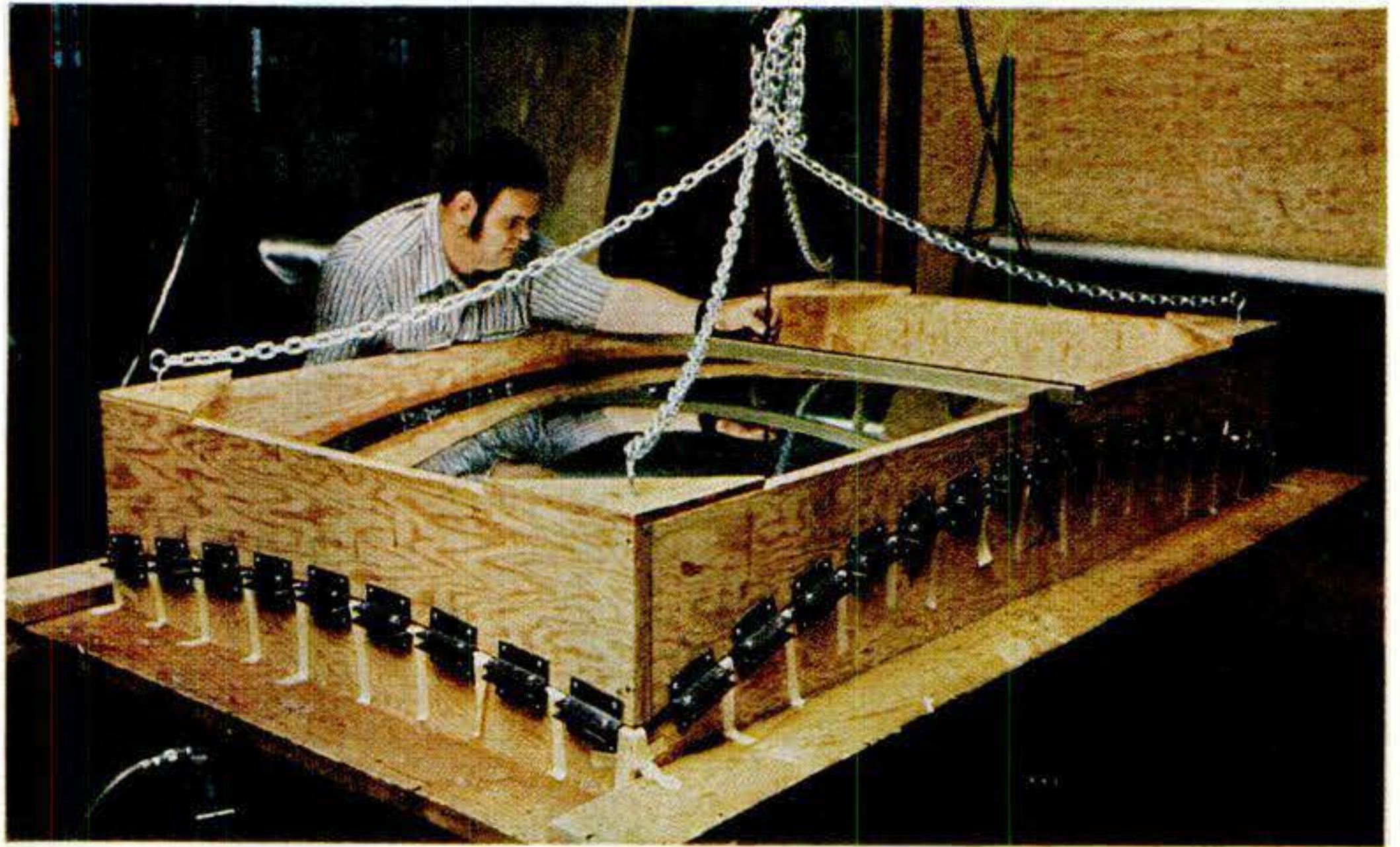


ILLUSTRATION BY RAY PIOCH

Three laboratory units simultaneously produce picture, color bars, crosshatch pattern



Projection screens are made in this special jig. A sheet of a special highly reflective aluminum foil is pulled across lower part of jig, and the top is lowered by chains. Air pressure blows the aluminum into a perfect spherical section of exactly the proper radi-

us. A form of precisely the same curvature rises from below to support the fragile aluminum, and a plastic foam that hardens into a rigid material is poured on top of the bubble to produce a light, rigid, highly reflective screen for sharp pictures.

it, applies pressure, and cools it. Unlike normal plastic injection molding, it's a slow technique, but it produces a precise lens that doesn't shrink or distort. And it's cheap.

Kloss's general philosophy also helps to reduce costs drastically. "This is a single-purpose device built to do one thing well and nothing else," he says. "The picture size is fixed. The position of the projector is fixed. All of the optical elements are precisely made and then adjusted and locked into position. Nothing can get out of adjustment. All of this cuts cost."

Since it bypasses the whole complex shadow-mask principle, the Advent set doesn't have the usual complex convergence controls used to align the three color images. But it does need convergence of a kind. Since each tube projects its image from a slightly different angle, each

projects a trapezoid on the screen instead of a perfect rectangle.

To correct for this distortion, special circuits have been built into the projection system. The controls are on top of the set, easy to get at. To make an adjustment, the user punches a button that puts a crosshatch pattern on the screen. Then he adjusts the three controls until all are perfectly aligned.

Drawbacks? Other than price, only one important one that I could find: Contrast is not so great as it is on a direct-view tube. I didn't notice it at first, but spotted the difference in careful comparison with the studio monitor. The problem is inherent: The screen reflects some room light, so blacks aren't as black as they could be. But I don't think you'd notice it without a comparison. And for full contrast, you can turn off the room lights.

What's ahead? When the Advent projection TV first appears on the market, it will be available in one form at one price. Price should come down as engineers find cheaper ways.

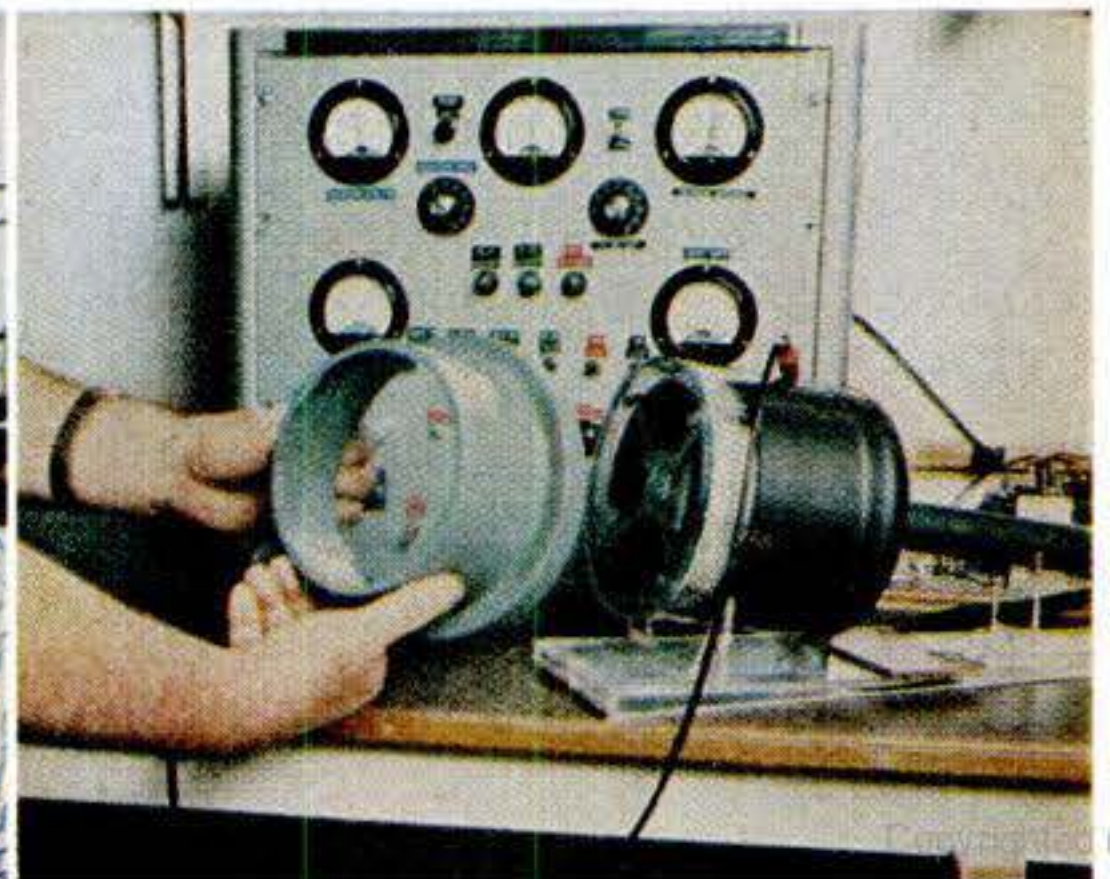
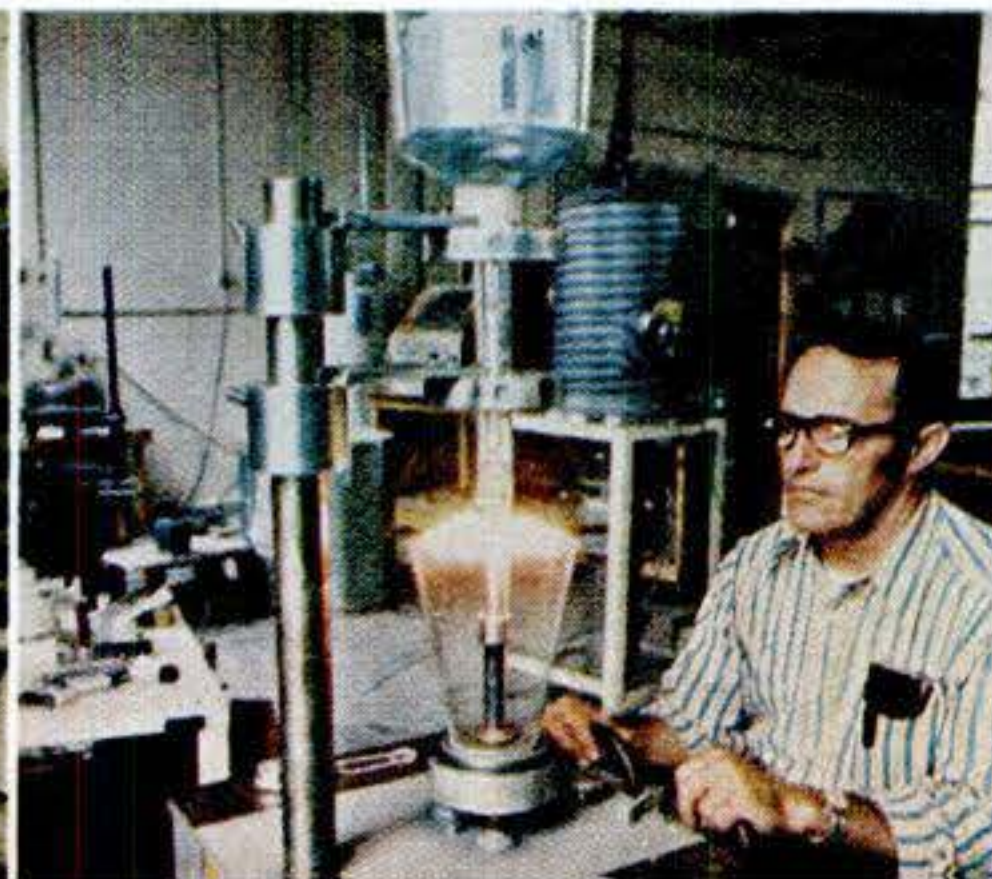
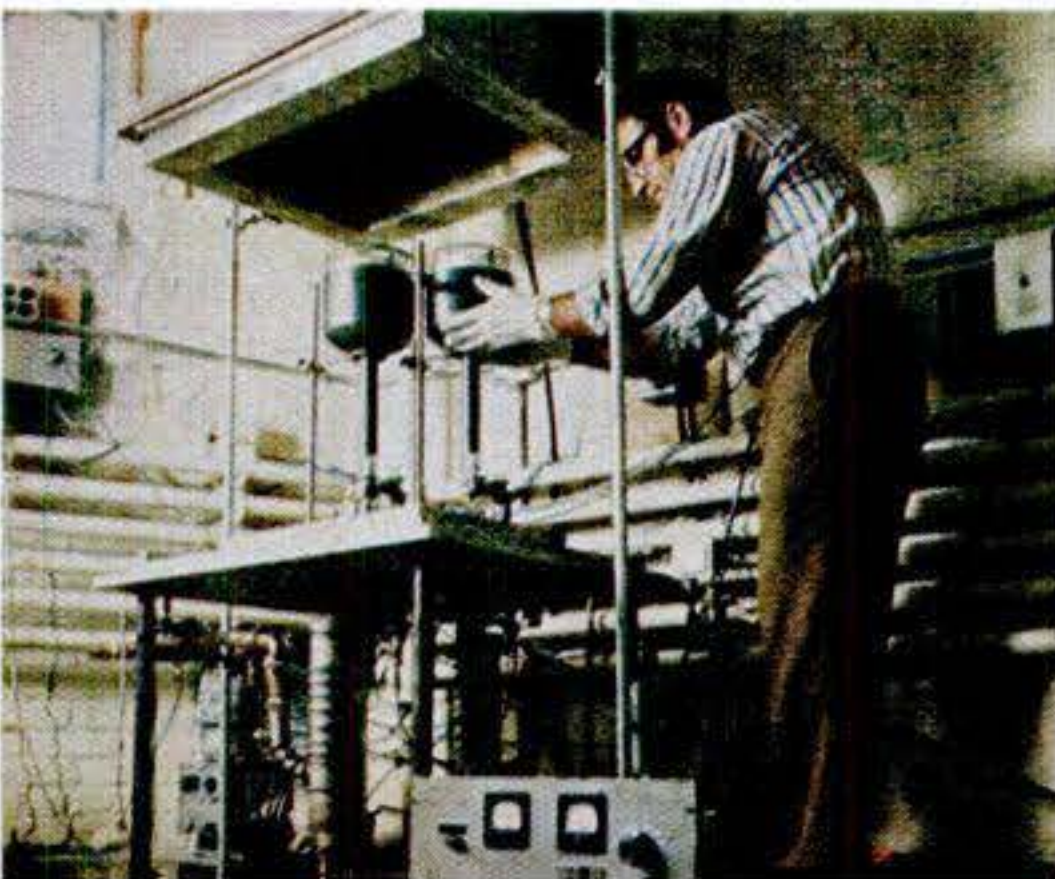
For example, they could probably make the projection tubes smaller. And given time to develop it, they could use electrostatic instead of the far more expensive magnetic focusing. Many such refinements could be made. "Given time," says Kloss, "we can undoubtedly design more-sophisticated optics, work the phosphors harder, make the tubes smaller, find cheaper ways to do things without sacrificing quality."

Kloss is thinking of other versions, too. A ceiling-mounted projector would eliminate the console in the middle of the floor, as would an all-in-one rear-projection model. If the present version is successful, these could follow later. P 5

The Advent tube is quite different from normal TV tubes, so the company manufactures the tube, as well as many components not readily available on the market. At left:

Tubes are placed in vacuum equipment that will pump air out. Vacuum equipment can be seen beneath the work surface; box at top is an oven that will lower to heat

tubes during pumpdown. Center: Whirling flames preheat the neck of the tube before sealing. Right: A corrector lens in its bracket is slipped over a tube.





Beginning here: 23 pages of home-improvement ideas

For this annual fall section, we turn our attention inward, closing the door on yard and garden projects for the season. This year, our attention turns downward, as well. Five major articles in this section focus on the basement—that least-utilized of all home spaces. We tell you how to keep it usably dry... how to convert it into a fun room or sauna... how to extend it with wood foundations... and how to be sure its heating plant is giving you your money's worth. The whole section is designed to make your fall and winter cozier. —Al Lees



Two new types of paneling—both from Marlite—were ideal for the “fancy barn” effect we’d chosen; they form the setting for the poker party above. Darby Brown Weatherboard faces the room walls. It closely simulates mellowed, rough-sawn barn siding. On the walls of the bar recess are panels of True Red Marvelour, with a heavy flock coating—fine as a background for bold hangings such as marine charts and old posters. Resilient floor is a plank-

style, wood-grain tile and conventional ceiling panels are suspended in metal grid strips that have a dark wood-grain finish. Photo at right shows simultaneous action at opposite end of basement. (We’ll offer plans for a bumper-pool table in a winter issue.) Note how construction lumber, distressed and stained to match the Weatherboard wainscot, forms shadow-box display wall, and helps to mask the electrical entrance box (behind door at far right).

BASEMENT REMODELING:

Old West Flavor with

Novel wall panels combine with rough lumber and plank floor tile to set our theme

The fun of converting a basement into a recreation area comes from doing it a little differently. Here’s one place in your home where you can let your imagination go.

New materials prompted our choice of decor—we took the popular barn-siding route, and ended up with a rustic Old West setting. With the same basic materials, your basement might be transformed into an old firehouse, a Spanish wine cellar, or whatever you fancy.

Select your paneling first. You’ve

a broad choice here, even if you choose the same Marlite surfaces we did (as described above). Weatherboard also comes in a charcoal tone, Marvelour in a variety of solid colors and patterns. Both panels are 16” wide by 8’ long and have tongue-and-groove edges to simplify installation.

It’ll help to sketch out the area to see what’s involved in your situation. Things to plan around include floor drains, windows, electrical entrance boxes, heat ducts—maybe even the heat plant itself.

Now’s the time to add electrical outlets and make any changes in ductwork. In my planning I found I could cover up the ends of a couple of heat ducts, which were lower than the rest of the ductwork, with a valance treatment that actually enhanced my

built-in bar—a much better solution than dropping the entire ceiling to cramp headroom in the rest of the space.

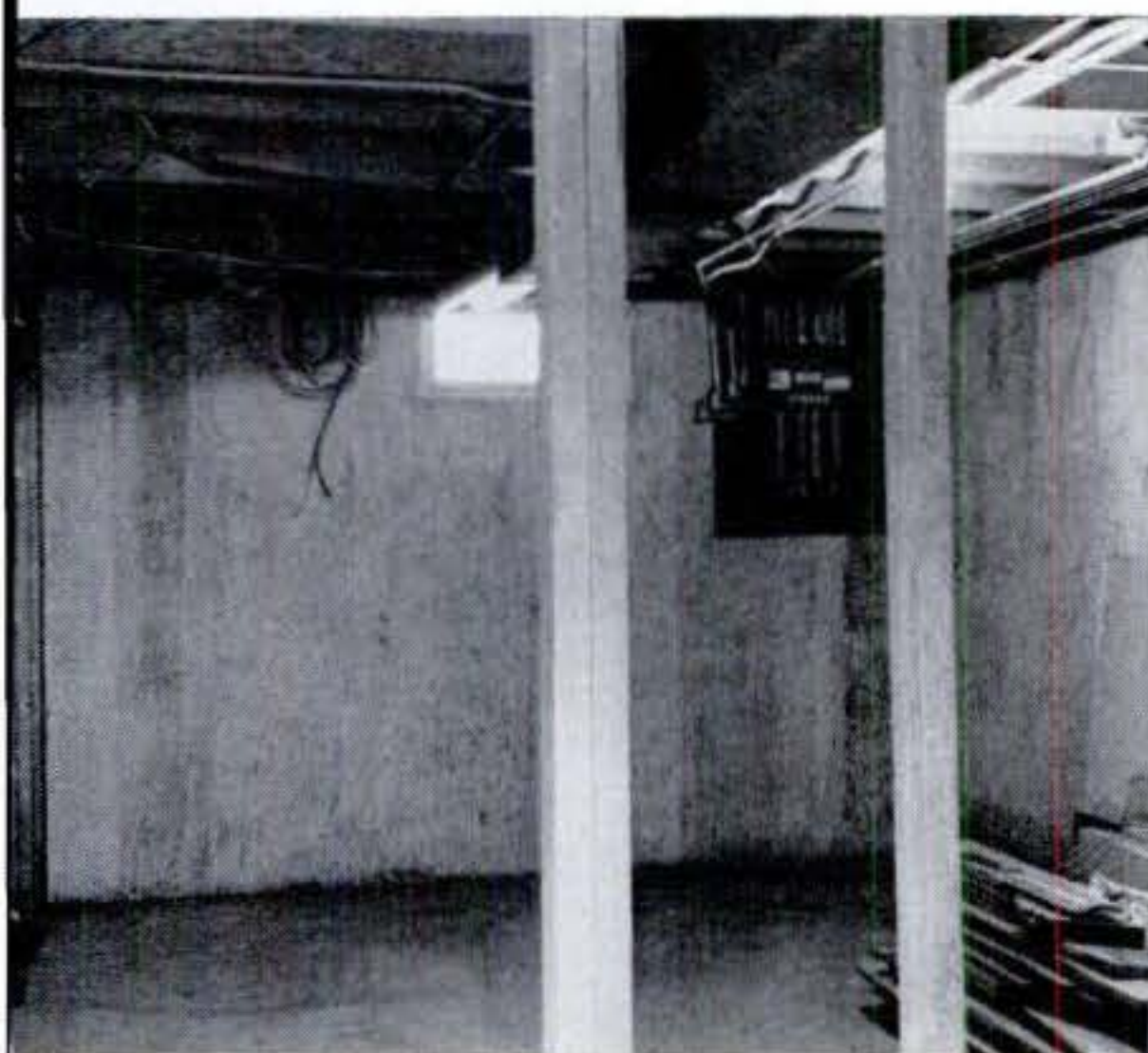
By framing the opposite end of the room with two-by-sixes, I not only achieved the desired effect of old barn construction but was able to hide the entrance box and create niches for display and storage.

A rustic effect has several advantages. The work needn’t be fussily perfect. And you can use construction-grade lumber for all exposed wood; it’s cheaper, and knots or defects enhance the effect. Your local paint dealer can prepare stain to match a sample of the Weatherboard paneling. Or mix your own to the formula you’ll find further along in this issue. **PS**

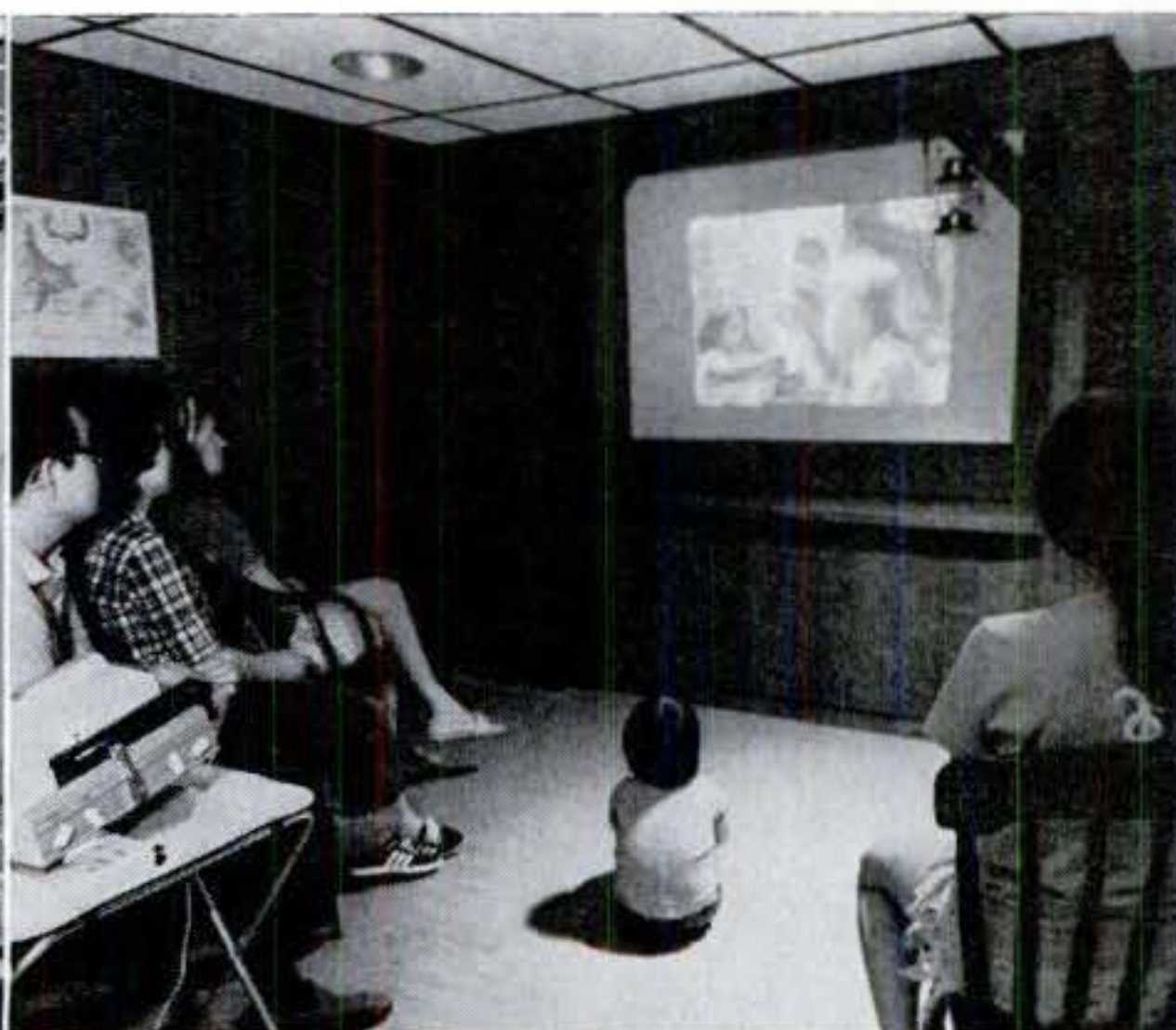


New Materials

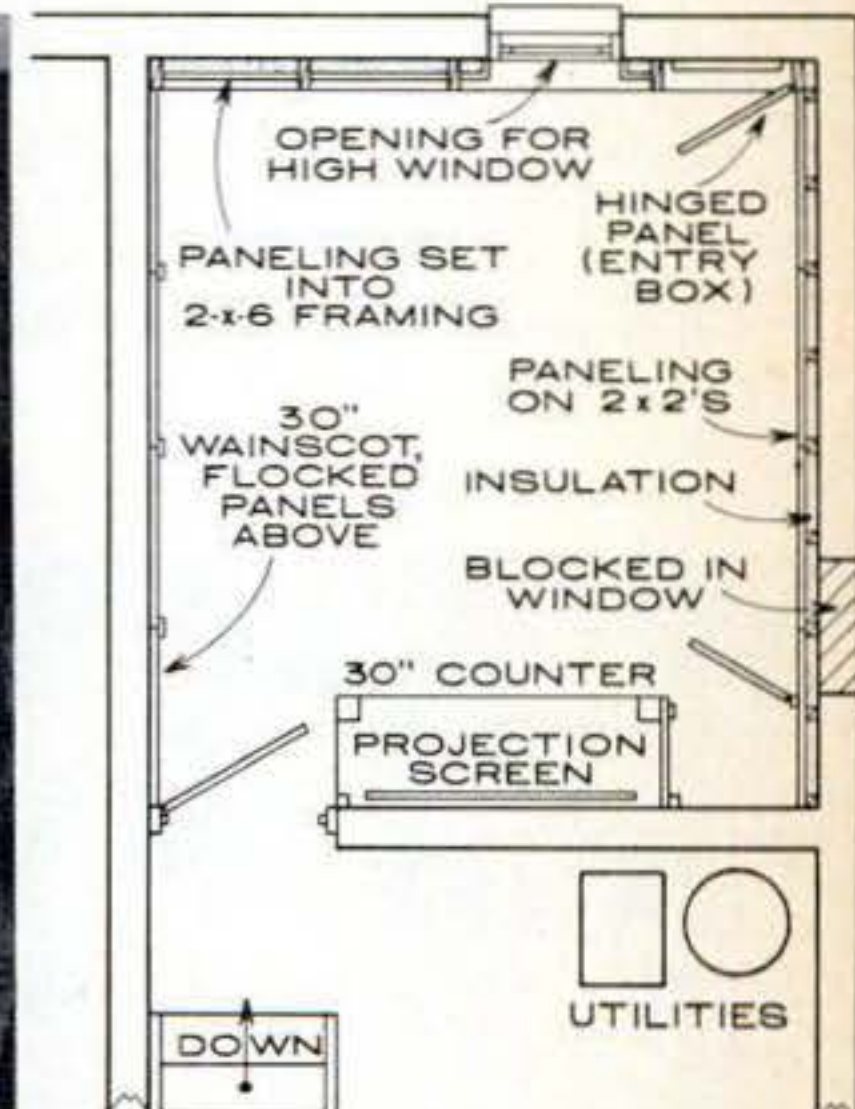
By MACK PHILIPS



Same view as above shows unpromising basement to start with, presenting usual problems: exposed utilities, supports.



Counter end has many functions. When poker table is drawn aside, it becomes a theater, with pull-down screen.



Floor plan orients photos and points out built-in features. A similarly convertible corner exists in most homes with basements.

See page 120 for how-to details



IMPROVE YOUR HOME

Build Your Own Sauna? No Sweat

Radiant-glass heating panels make the job a snap—and they give you clean, dry heat without stealing any space

By A. J. HAND / PS Home Workshop Editor

Want a sauna in your basement? Unless you know a carpenter who will do the job—do it right, when you want it done, and at a reasonable price—your best bet is to build it yourself.

Sound like a lot of work? It's not. Basically, a sauna is nothing more than an insulated box with a built-in heat source. If you can use a hammer and saw you can build the box. The heat source? That's even easier. The Continental Radiant Glass Heating Corp. (663 Fifth Ave, New York City 10022) makes heating panels you can fasten in place in a matter of minutes. Hook them through a thermostat to a 220 line and you're all ready to cook.

Sound easy enough? Okay, let's go through a complete sauna installation from start to finish and cover what you need to know to do it yourself.

How big? If you're cramped for space, or out to save money, a sauna the size of a closet works fine. But if you have room for it, a lie-down sauna is more relaxing than one of phone-booth dimensions. Make a box 7' long and 3' or 4' wide and you'll have enough room for two to stretch out comfortably (on stacked benches). A larger room is great, but it also takes more time and money to heat it up to torrid temperatures.

Once you've decided on a size, you

can start framing. Ordinary 2-by-4s on 16" centers do the job. To provide space for insulation all around the sauna, you'll have to frame all four walls—even if you build into a corner as in the basement installation shown here. And you should frame in a "false bottom" and a new, lower ceiling, too.

Use 2-by-4s on edge for the floor framing, and the same treatment for the new ceiling. Make the ceiling height about 7'. Take it higher, you'll waste heat; lower, and double deck benches are a tight fit.

What about the door? There's no need to use a special heavily insulated door, an ordinary flush door will do. When you get down to lining the sauna you can nail a layer of the redwood paneling to the inside of this door to improve it as an insulator.

Framing in place? Next, staple in the insulation. Use 3½" fiberglass batts—foil side in—for walls and floor. For the ceiling use 5½" of insulation with a full moisture barrier.

Paneling the interior. The ideal sauna liner is 1" tongue-and-groove redwood, kiln-dried. It's a good insulator, and has the dimensional stability to handle rapid temperature and humidity changes. Equally important, it won't feel uncomfortably hot to touch—even in a 180-degree sauna. Make sure you get clear stock,

though. Touch a knot at 180 degrees and you'll understand why.

If a knot feels hot at 180, a nail-head feels even hotter. Blind-nail the redwood to floor, walls, and ceiling. To blind-nail, you drive nails into the siding at a 45-degree angle—right at the base of the tongue. This hides the nailheads, but can split the wood. Predrill the redwood to prevent this, and use aluminum nails to prevent corrosion stains.

Now for the heat panels. Install these (they just screw to the wall) and run the wires to a junction box near the thermostat before you cover the outside of the sauna. The diagram shows how our sauna is wired. The three panels—two 1000-watt and one 1500-watt units—gave us about 18 watts per cubic foot of sauna. This is a good rough figure to shoot for with radiant heating.

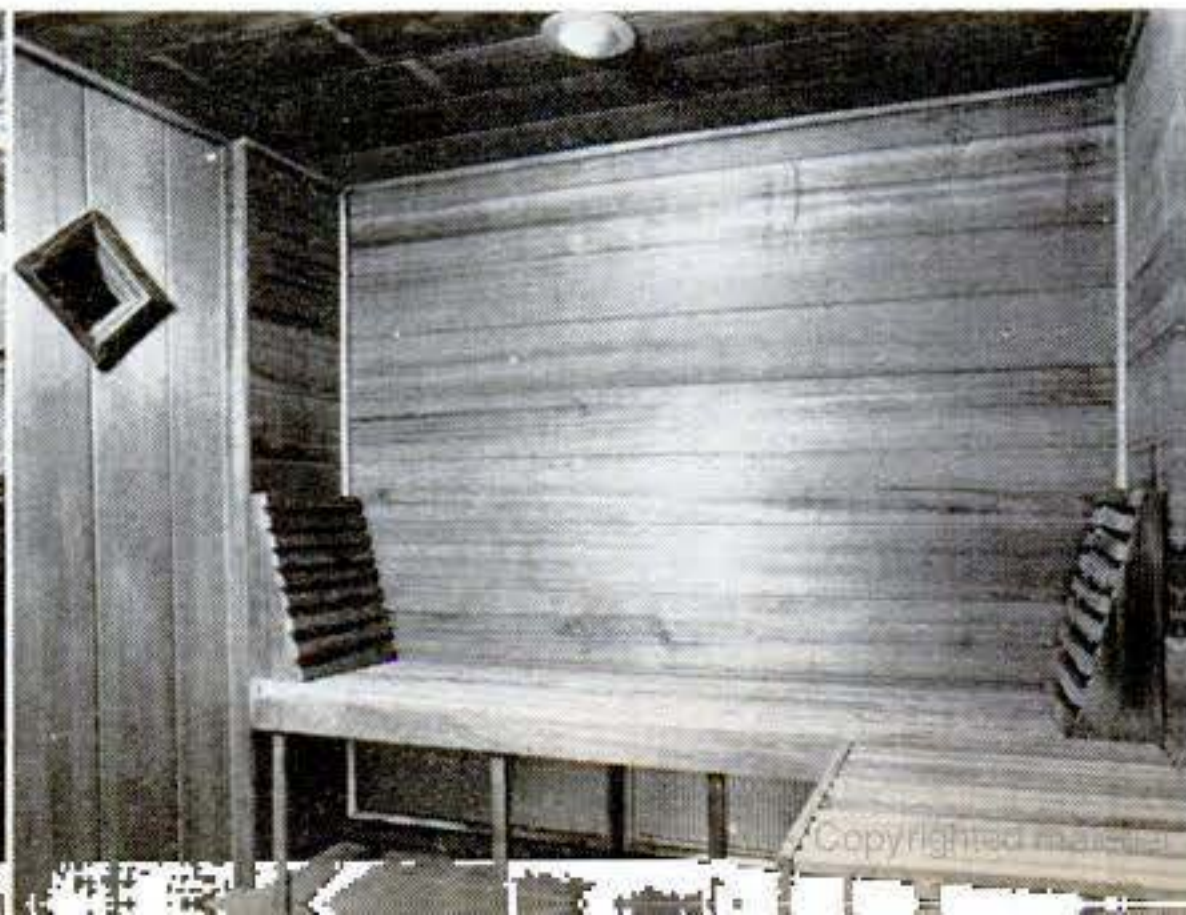
When the wiring has been completed, cover the outside of the sauna. Plasterboard makes a good economical exterior. But to add class, we ordered Georgia-Pacific's Winter Elm Vinyl Shield paneling along with our G-P redwood. When you hang the door, aim for a good fit—but don't worry about perfect sealing. You need a little leakage for ventilation.

Now install the benches, turn up the thermostat, get out of your clothes and into a towel. **PS**

Heating panels install easily. Bob Vested built the sauna shown here into the basement of his Connecticut home using a few simple tools and typical home-shop skills.

Insulate, insulate . . . it's the key to fast and economical warmups. Foil side of batt-type fiberglass insulation should face in but should not touch sauna liner.

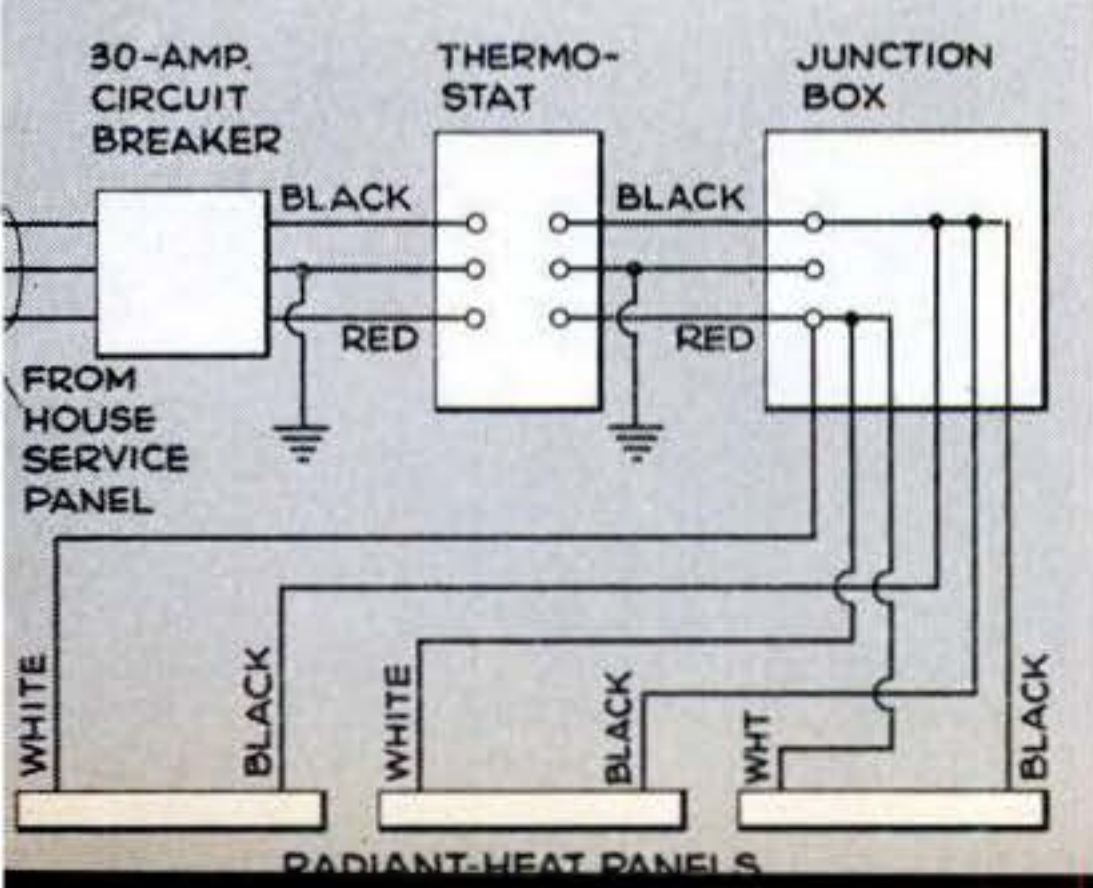
Clear heart redwood makes an attractive and durable liner. Benches, door liner, and trim can all be cut from same tongue-and-groove stock used for the paneling.





Two Glasheat panels under the bench, and a third mounted on opposite wall are space-saving heat sources in this home-built sauna

Heat-panel wiring goes like this. Vested used a bulb-type thermostat (Robertshaw Controls, Fort Washington, Pa.) mounted outside sauna with the sensor bulb inside.



A sauna needs a nearby shower. Check this installation trick

For a truly convenient sauna center you won't want to hike far to a shower. If your installation is in the basement, as shown here, this may call for special treatment. Installing the one-piece fiberglass Unishower (Universal Rundle Corp., 217 North Mill St., New Castle, Pa. 16101) was easy enough, but the drain was below soil-pipe level. Builder Bob Vested's solution? A laundry-tub pump in the waste line set into a hole knocked in the floor. The pump (Shellback Mfg. Co., 1320 East Eliza, Hazel Park, Mich. 48030) goes on automatically whenever water fills the shower drain, lifting the waste up above soil-pipe level for disposal.





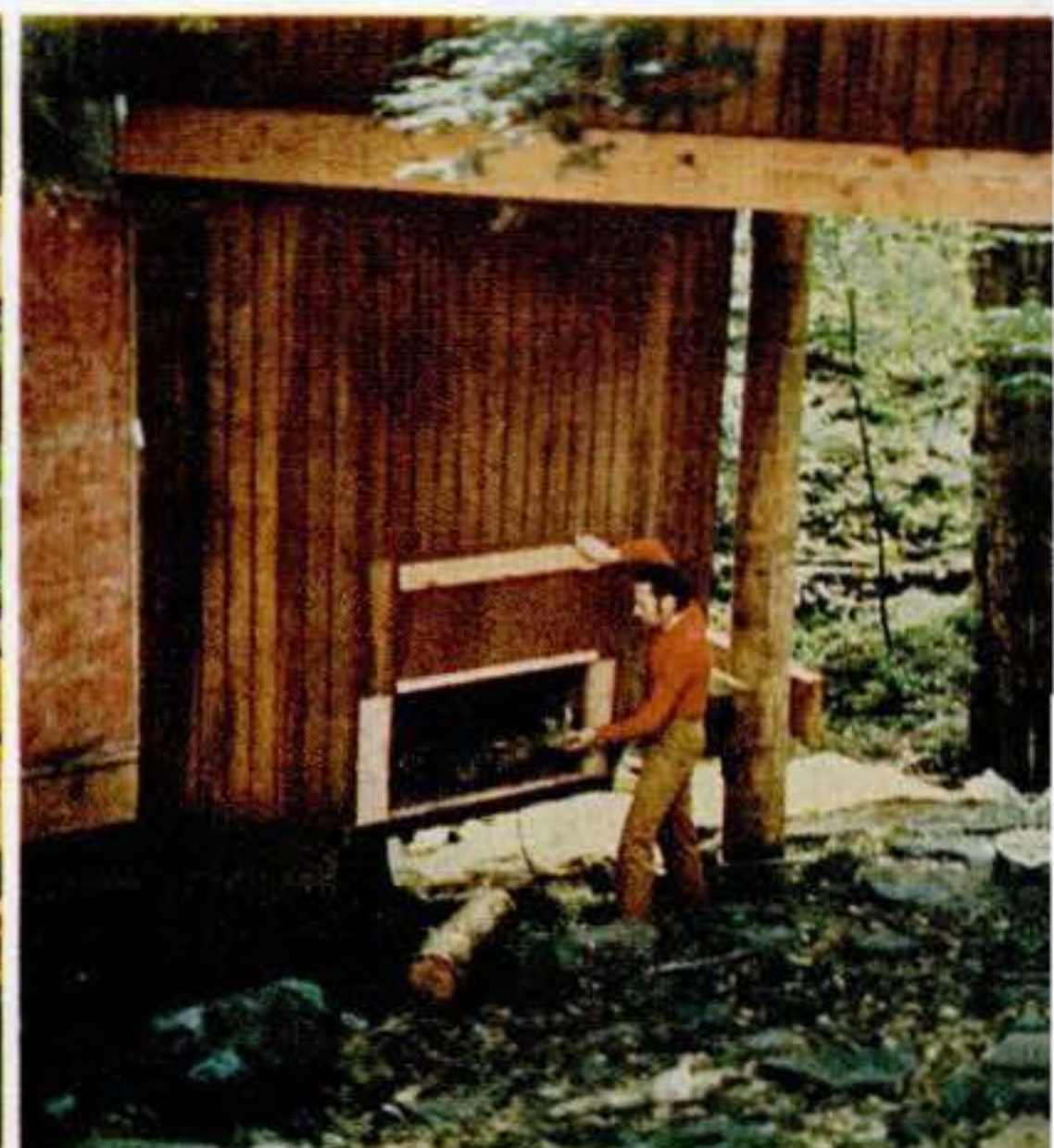
Platform installation let us tuck big woodbin under metal firebox. Raised hearth makes fire tending and grill cookery handier, too.

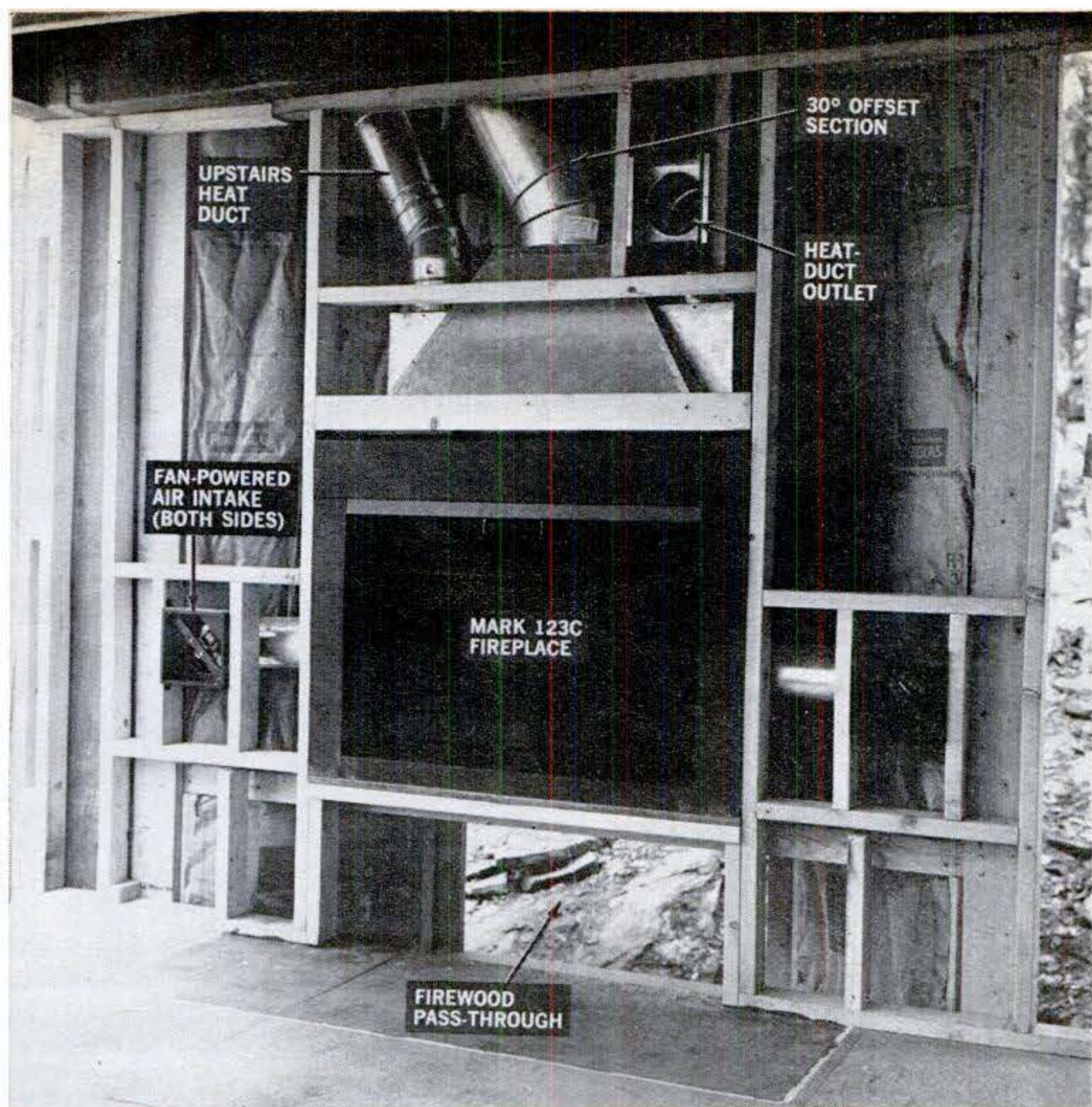


Total-security theme of Lockbox is preserved by two husky drawbolts to fasten removable panel, barring break-in from rear.

Exterior views of chase (shot before rest of house was sided) show how tapered shape matches triangular wing chase hangs from. Above it (in near photo): molded-Fiberglas entry door. Far photo: easy-loading bin.

A Fireplace





Same siding used on house encloses chase. It's Texture 1-11 plywood, Non-Com-treated by Koppers, Pittsburgh, to be fire-resistant.



Chase is part of wall, so must be fully insulated if house is to be winterized. One roll each of 15" and 23" Fiberglas does it.



Metal firebox slips into place on platform. Note pre-scored side hole for inlet duct has been punched out at both sides.

New two-chamber controlled-heat circulator permits zero-clearance installation in tapered chase of Lockbox—or on plywood platform in your present home

Fourth in a series

for the Lockbox

By AL LEES
Group Editor, Reader Activities

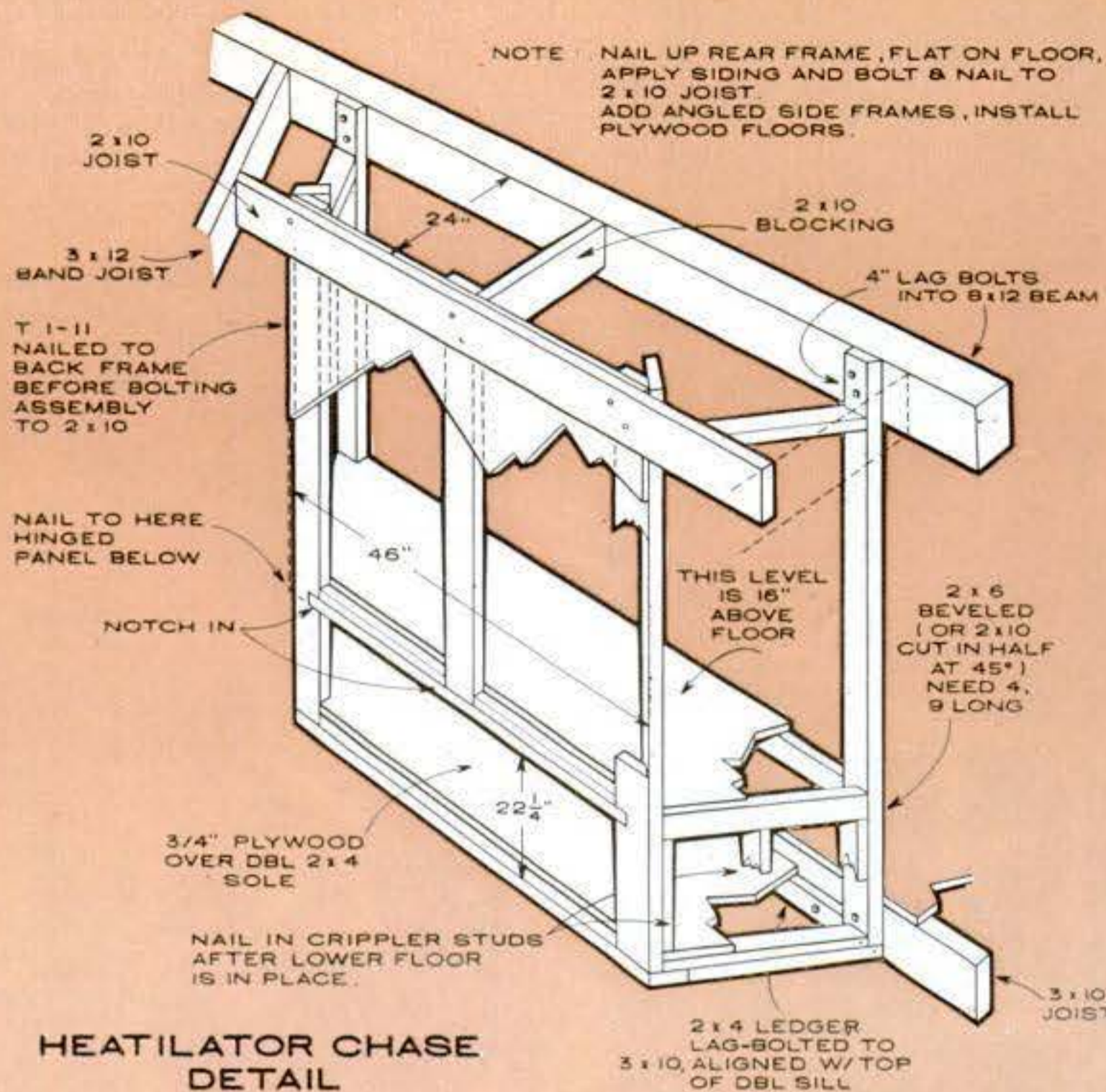
The delights of an open fire are so evident that few of us demand a practical contribution from a fireplace, as well. For leisure homes, especially, we're likely to settle for a free-standing unit that's little more than a pleasant accessory.

This wasn't good enough for our Lockbox pole house (now marching down its Pennsylvania mountain toward completion). We wanted both winter-weekend and year-round retirement options built in—which meant built-in heat sources. Our major heaters are radiant-glass panels recessed into various walls, upstairs and

down; but, efficient as these are, electric rates are steep—and climbing—so we wanted our fireplace to offer more than delight: It had to help heat.

That meant a heat circulator. We gritted our teeth as we went in search, expecting the cumbersome metal inserts of the past, with their clearance requirements, their masonry foundations and facings. The Lockbox is a tight house, engineered for total space utilization. Would we have room?

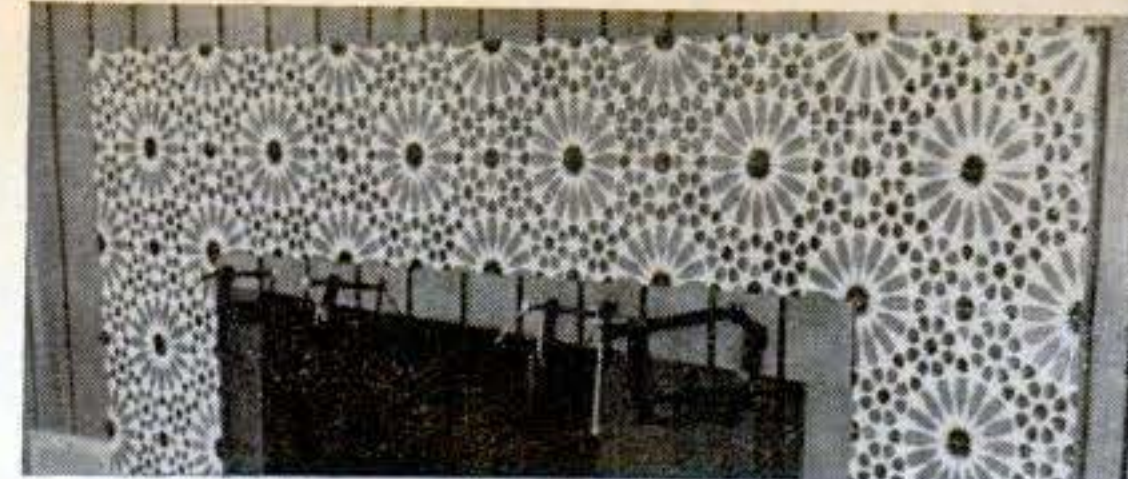
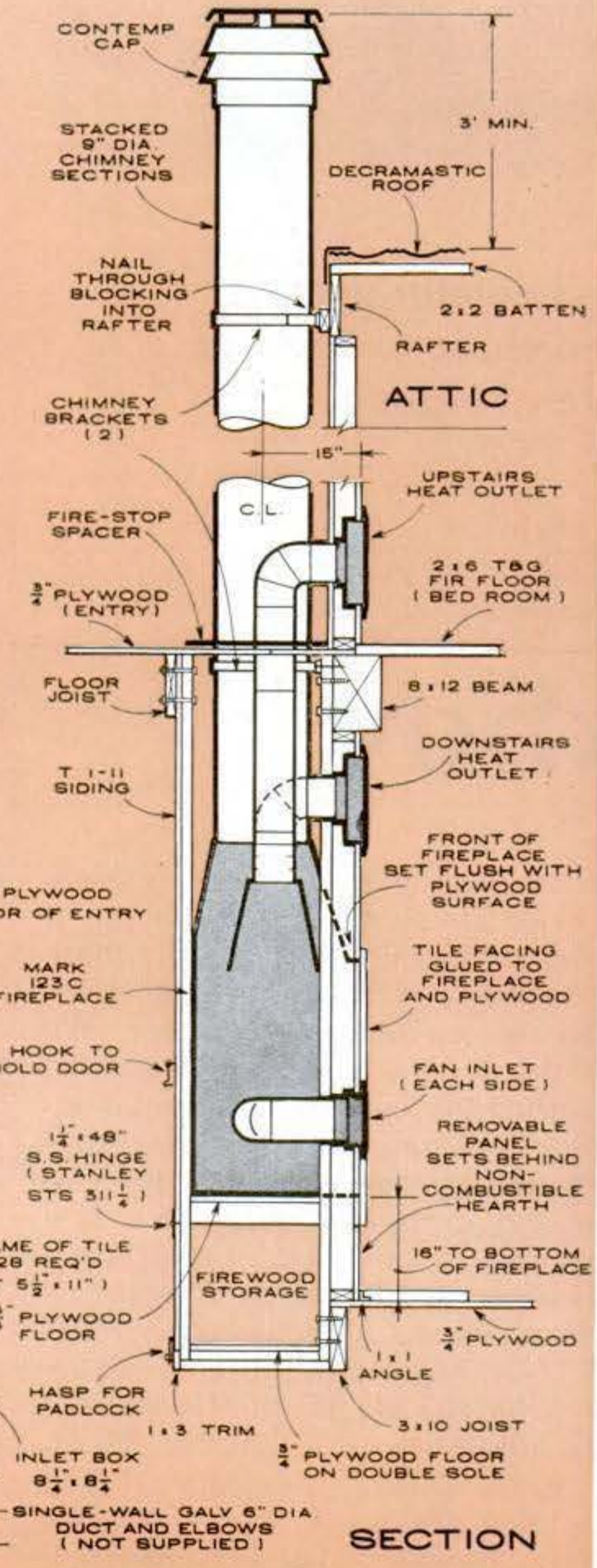
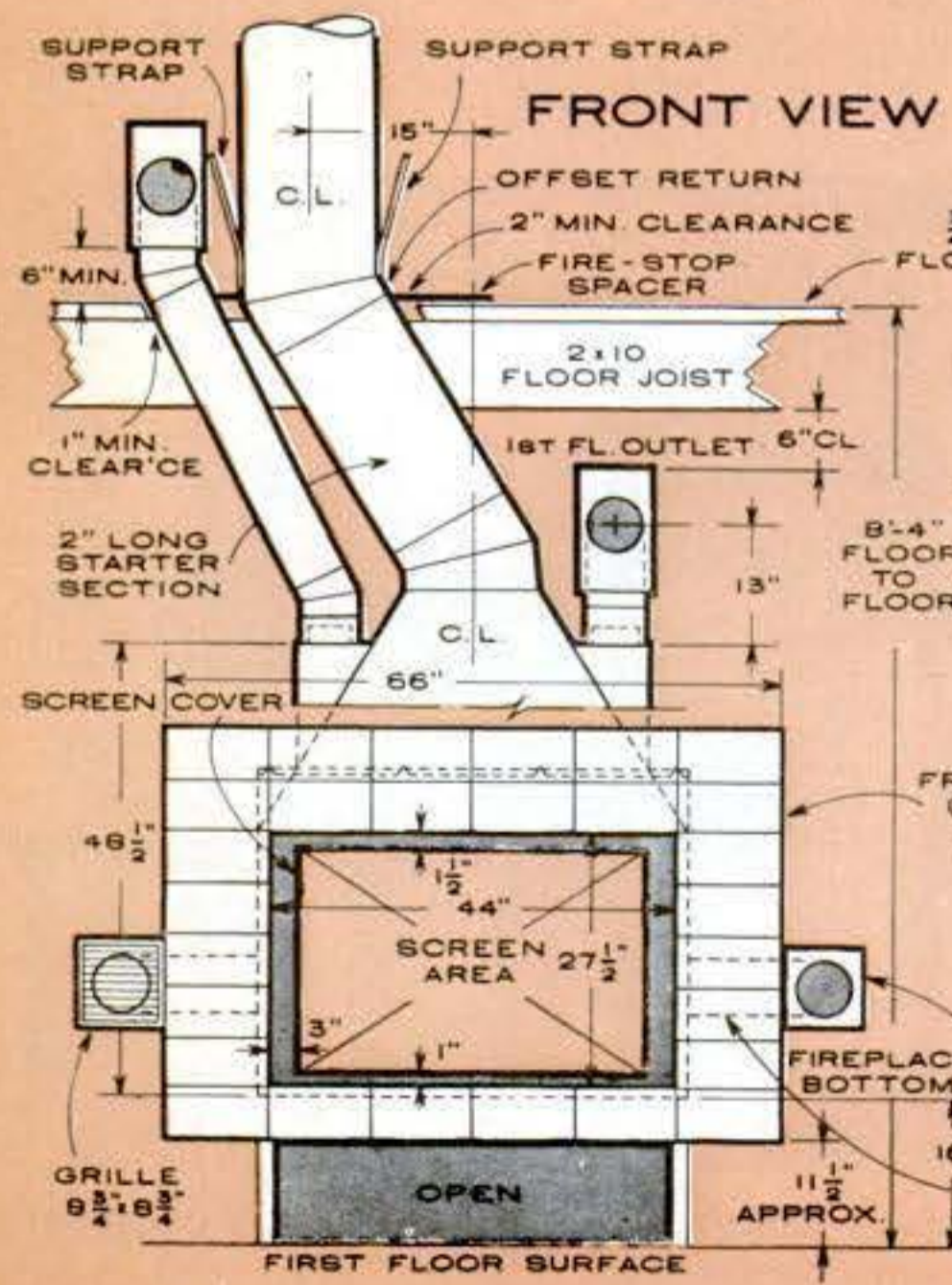
"Have we got a fireplace for you!" said George Andrews, director of research for the Heatilator Division of Vega Industries (Box 409, Mt. Pleasant, Iowa 52641). Seems he'd just completed design work on the Mark 123C—a breakthrough in heat-circulating fireplaces, since it's the first to



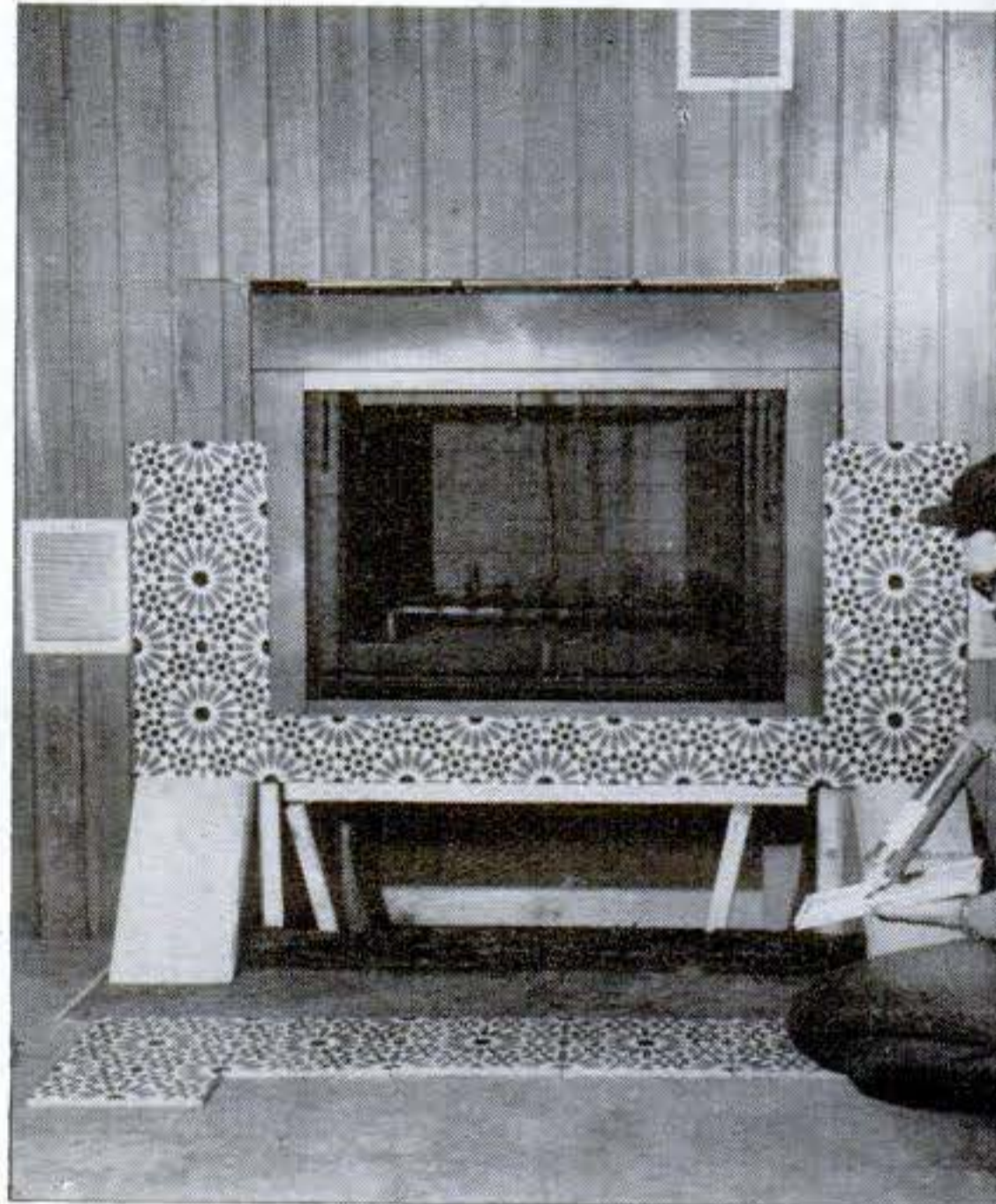
HEATILATOR CHASE DETAIL

PARTS YOU'LL NEED FOR LOCKBOX

- 1 Mark 123C fireplace (Heatilator catalog #3138); includes 2' chimney starter section, fire screen, two outlet assemblies including duct sections (two each #606, #612, and #690)
 - 1 12" duct section, additional (#612)
 - 1 Adjustable duct elbow, additional (#690)
 - 1 Fan-powered inlet kit—two units (#600)
 - 1 30-deg. chimney offset/return (#3930)
 - 2 2' chimney sections, 9" dia. (#912)
 - 4 3' chimney sections, 9" dia. (#913)
 - 1 Contemporary cap (#921) for pitches from flat up; includes one chimney bracket; flashing halves; cone, collar, and cover
 - 1 Chimney bracket, additional (#923)
 - 2 Joint bands, 9" dia. (#922)
 - 1 Grate (#26)
 - 1 Barbecue grill (#6260)
 - 1 Fire-stop spacer, oval (#3931)
- Misc. (not supplied by Heatilator): 2 6"-dia. adjustable elbows (single-wall) and 2 6"-dia. 1' duct sections (single-wall) for inlets; 3 11-oz. cartridges 3M adhesive (EC959) for tile; 28 5 1/2"x11" tile or equivalent; non-combustible hearth; 4 2x6s 10' long; 6 2x4s 8' long; 1 4'x8' sheet 3/4" exterior plywood; 3 4'x8' sheets plywood siding (T1-11); 1 roll each of 15" and 23" Fiberglas wall insulation; 12 1/2"x4" lag bolts; 6 1/2"x5" carriage bolts; continuous hinge (Stanley STS 311 1/4), padlock hasp, screw hook, 2 interior drawbolts for removable panel.



Tile frame must have support while adhesive sets. In photo below, Lees applies beads of 3M's EC959 before pressing tile firmly across joint between firebox and wall panel. Bottom row has scrap-wood props.



Chimney sections stack—and lock with twist—to extend upward from offset/return, which has support straps for nailing to adjacent studding. Smaller pipe to left is double-wall duct for upstairs heat outlet.

fer zero clearance. This means you can mount the metal unit directly on wood floor or platform and frame it with studs snugged against the firebox—no space lost, no fuss with masonry. Yet it's one of the most efficient open-fire heaters we've seen.

Two separate heat chambers. Each has its own outlet duct. As the labeled photo and our sketches indicate, we brought the right-hand duct back into the living room, above the fireplace opening, and angled the left-hand duct up to the second-floor bedrooms. We angled the chimney, too, to move the fireplace a comfortable distance from the corner and still tuck the stack alongside our upstairs hall.

To further customize his fireplace in our house, Andrews designed a compact, tapered chase to hang from our entry joists—an installation that doesn't rob an inch of space from the living room—and contributes a firewood storage and pass-through bin. We're proud of our unique chase, by George! (George Andrews, that is.)

All Heatilator parts are designed for foolproof assembly, and the instructions packaged with various units are clearly written and illustrated. We got the optional fan-driven inlet kit without it, heat circulation depends on natural airflow through firebox (lots). The kit complicates installation: You must duct, frame, and wire the two inlet boxes.

The facing frame. You can use any material you fancy—even picture-frame molding: zero clearance applies here, too; the front of the fire box sets flush with the finish wall surface, so you're mainly interested in covering the gap between. Heatilator sells three- or four-piece sets of black glass. But for the Lockbox we wanted a bold tile design. Our search took us to a factory in Seville, but there are attractive domestic patterns available.

We'd recommend ordering the full line of accessories at far left. (For local-dealer addresses, write the company. Basic fireplace package lists at \$309; for extra parts and accessories, add another \$300. The grate is tailored to the tapered firebox, and the chromed grill sets into a socket provided at the left of the fireplace opening, to suspend food over coals. (Or you can line the grate with foil and use charcoal briquets for an indoor barbecue.) The Lockbox fireplace provides all the basic delights—and helps heat the house as a bonus. **PS**

Architect's plans available. Detailed build-it-yourself plans for the Lockbox pole house are now available for \$15 (two sets \$20) from Popular Science Plans Div., 355 Lexington Ave., New York, N.Y. 10017. Free with each order comes a 12-page reprint of the first three installments. **Plan 5547.**

You Can Box the Unit Inside an Existing Room

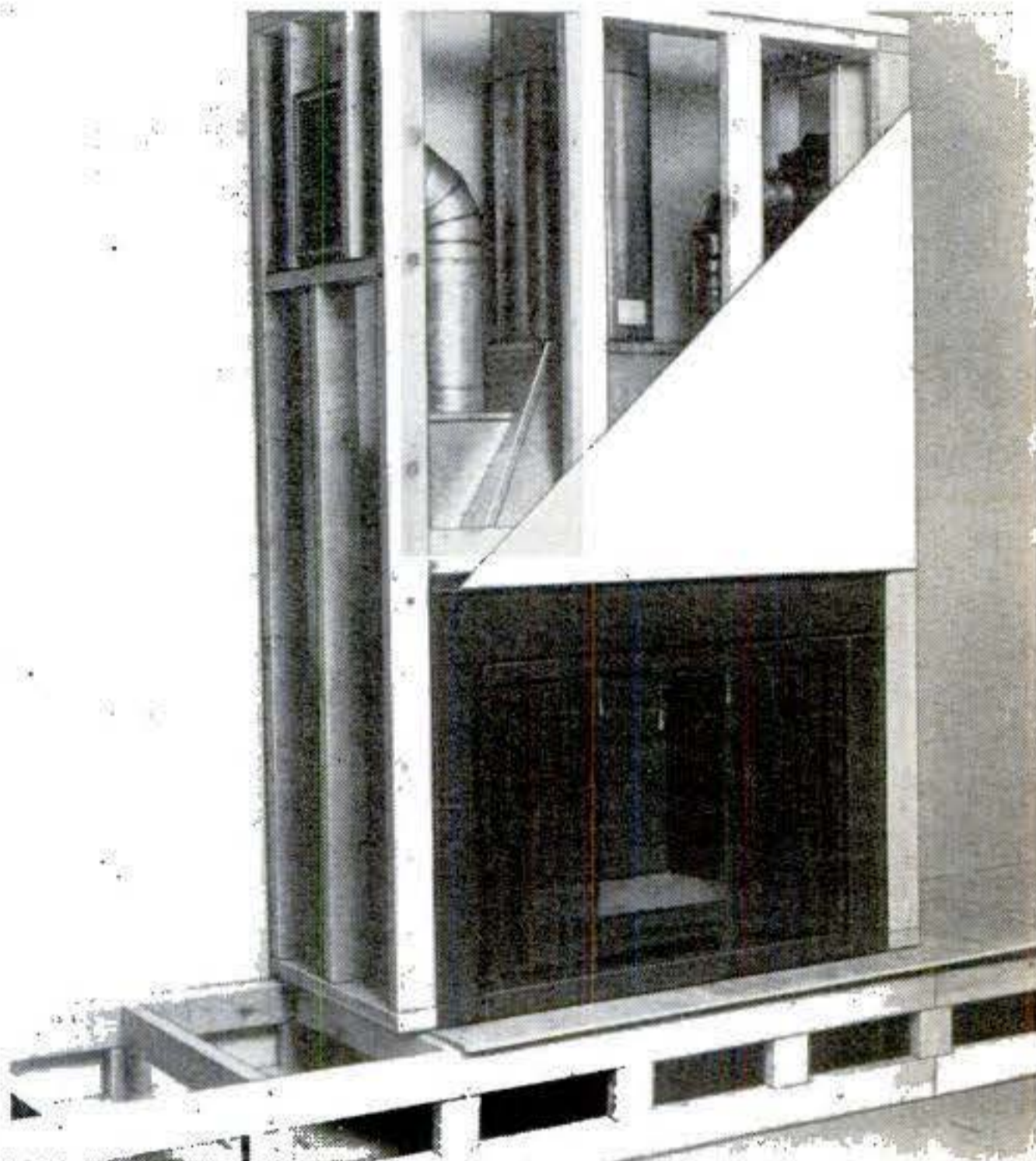


Like the looks of our Lockbox fireplace? Why not install one in your own home? The Mark 123C is as easy to add to an existing home as it is to build into new construction.

We're still talking about a simple carpentry job: no masonry work, no need to beef up your floor for support.

Various designs let you put the firebox against a wall, in a corner, between rooms, or in an island in the middle of a room. Add ductwork and chimney sections. Conceal fireplace, chimney, and ducts with ordinary two-by-four framing and your choice of wall materials. Plasterboard works well; hardboard paneling in a brick or stone finish gives the look of masonry.

Once you add a roof termination—Heatilator supplies these in a variety of styles—you're ready to open the damper and light up. Firewood and kindling? That's one thing Heatilator's left up to you, though the Mark 123C even has provision for a gas log.



Installation on platform gives raised-hearth effect and projection into room that vents heat outlets to sides. The zero-clearance Mark 123C can be installed directly on the floor if you like.



Finish the job with one of various terminations, such as red or white brick pattern, plus your choice of caps. (Lockbox installation leaves chimney exposed, topped with Heatilator's Contemporary cap.) For safety, termination should extend a minimum of 2' above ridge on peaked roof, a minimum of 3' above a flat combustible roof.



Now You Can Build on a WOOD Foundation

Whether you're building an addition or a new home, wood foundations can save you time, work, and money

By A. J. HAND / PS Home Workshop Editor

They aren't building foundations the way they used to. They're building them faster and for less money. And in any kind of weather—pouring rain and freezing cold included. They're building them not with blocks, mortar, and trowels, but with wood, hammer and nails. And you can do it too if you're looking for the simplest way to get a new home or addition “off the ground.”

Right off you're skeptical. Wood foundations? Well, relax. The wood foundation is backed by extensive industry- and government-sponsored testing. It's been approved by both the Federal Housing and Farmers Home Administrations for mortgage-insuring programs.

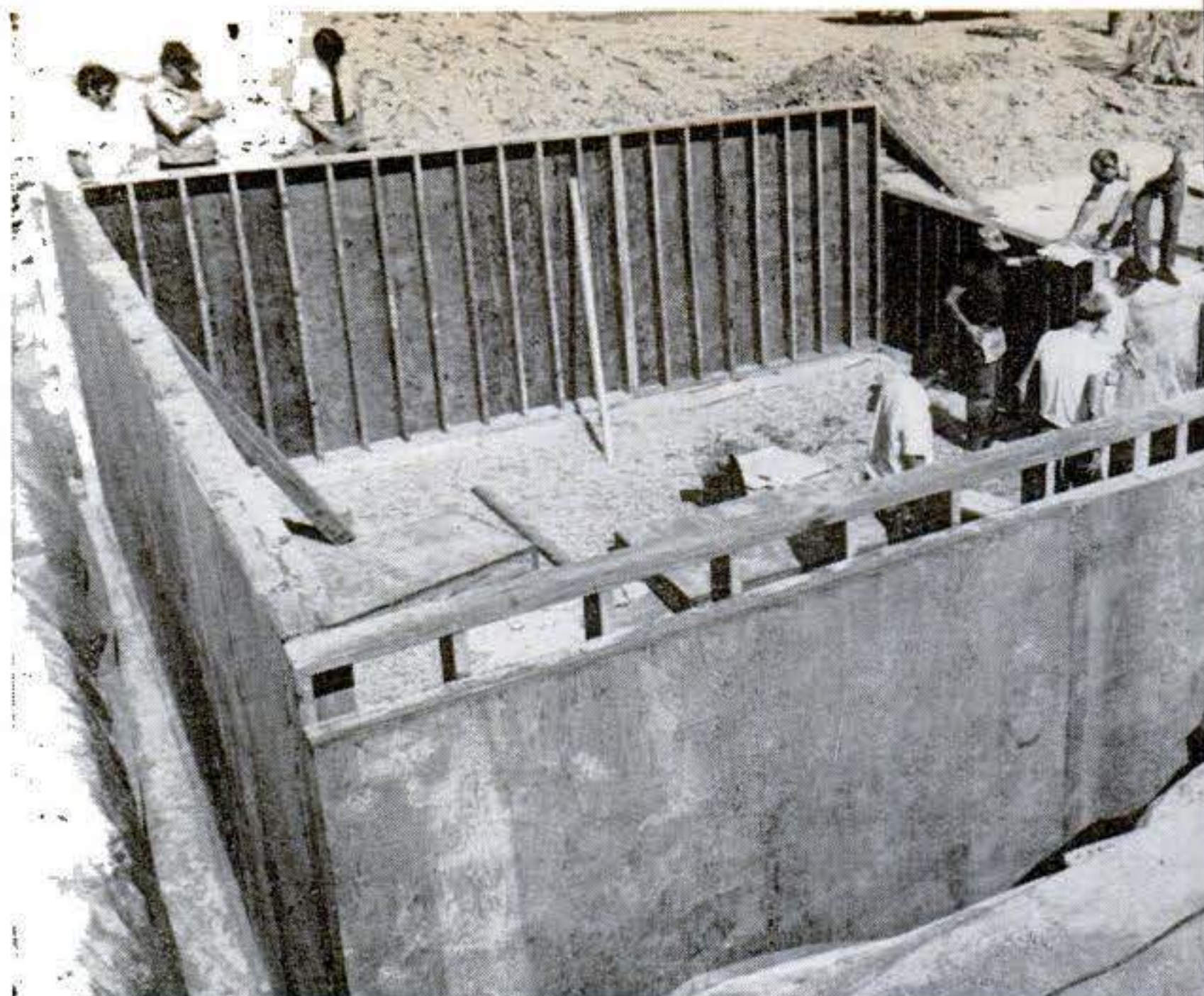
Of course, these foundations aren't built of just any wood. They're made of special, pressure-treated lumber—wood impregnated with chemicals like the Koppers Company's Wolman salts—to resist decay and insect attack. And they're built to a system of specifications developed from actual experience with test homes built in the U.S. and Canada. So successful is the system that Koppers (Pittsburgh, Pa. 15219) offers a 30-year performance bond on foundations built of Wolmanized lumber.

The answer to amateur-built additions. The wood foundation was developed primarily for commercial builders, but its simplicity makes it ideal for the amateur, too. If you're like most home craftsmen, you're a better carpenter than you are a mason. And if you're planning an addition to your home, wood is simpler in another way: When you add a concrete block extension to an existing block foundation things get messy. You have to knock holes in the old wall so you can “weave in” blocks from the new to get a solid connection. With wood, all you do is spread an asphalt-type sealer along the joint and fasten new to old with hardened masonry nails.

Sound easy enough? The rest of the work is simple, too. Here's how the whole job goes:

Start as you would for a masonry foundation—if you want a full basement, excavate a hole of proper size. Around the perimeter of the excavation, directly under the planned location for foundation walls, dig 2" deeper than you do for the rest of the excavation. This provides a solid base for the foundation footings.

If you plan on plumbing, place the service lines now. Run them in under the level of your excavation. Then place and level a 4" layer of gravel over the entire floor of the hole. Around the edges, of course, the gravel will be 6" deep. A series of stakes, spaced evenly over the base-

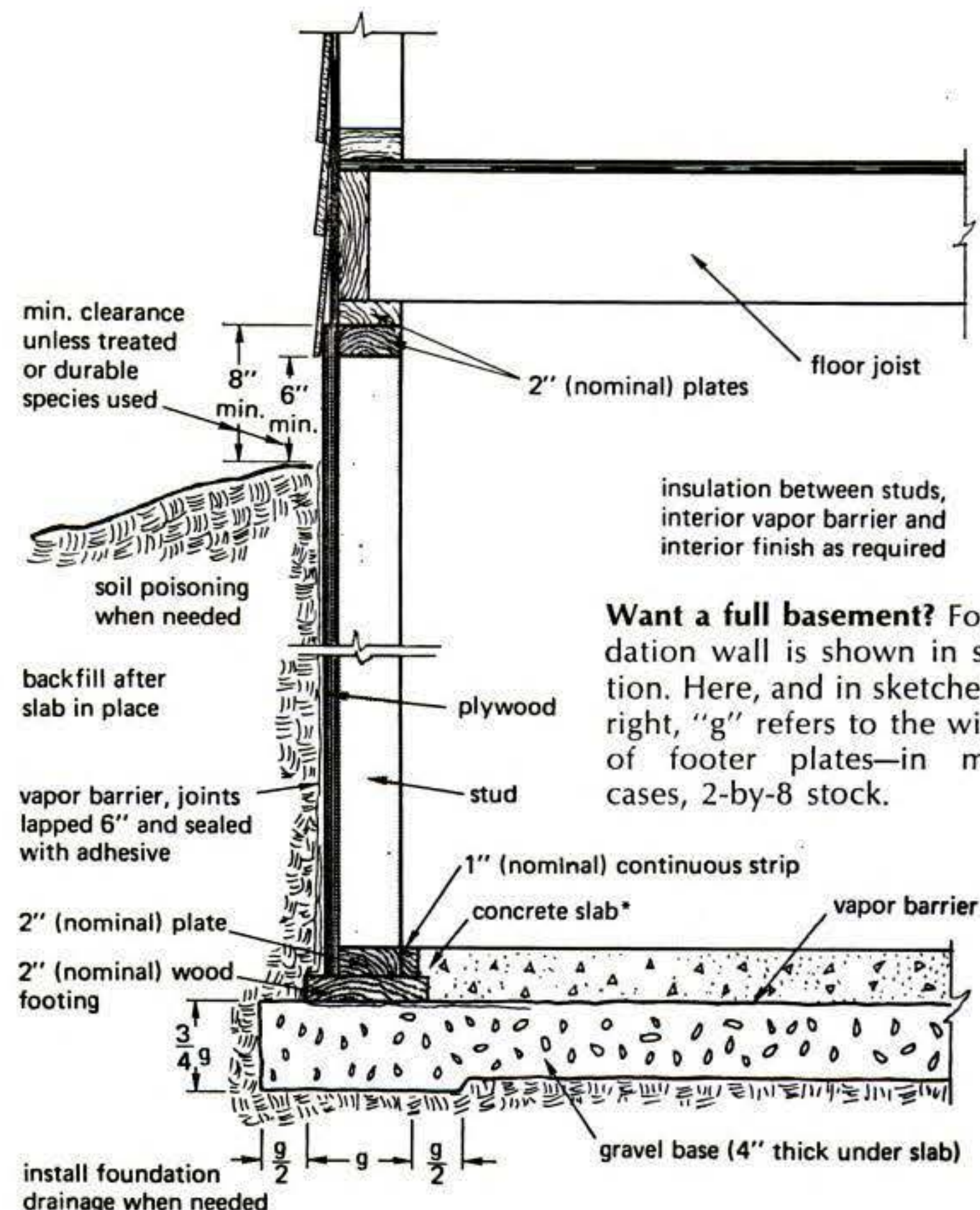


Foundation in place looks very much like above-grade wall construction. Finishing interior is simple—just nail facing to foundation studs.

ment floor area, and driven into the ground so their tops are all at the same level will give you handy reference points to simplify the gravel-spreading operation.

Next comes a layer of six-mil polyethylene over the gravel and up the sides of the excavation. Overlap all joints in this vapor barrier at least 6" and seal with Flintkote Adhesive No. 746, or an equivalent.

Now you're ready to lay the footer plates for the actual foundation. In most cases, pressure-treated two-by-eights do the job. When you buy the pressure-treated lumber for this, make sure it has the American Wood Preservers Institute (AWPI) stamp indicating treatment in accordance with the LP-22 standard. Setting the footer plates is simple—just lay them in place on the vapor bar-



Want a full basement? Foundation wall is shown in section. Here, and in sketches at right, “g” refers to the width of footer plates—in most cases, 2-by-8 stock.



Polyethylene moisture barrier covers entire excavation floor and runs up sides of the hole, too. It prevents water seepage.

Foundation panels are assembled flat; then you lift them onto the footer plates and nail in place. All joints are caulked.

rier. Double-check for proper positioning and leveling.

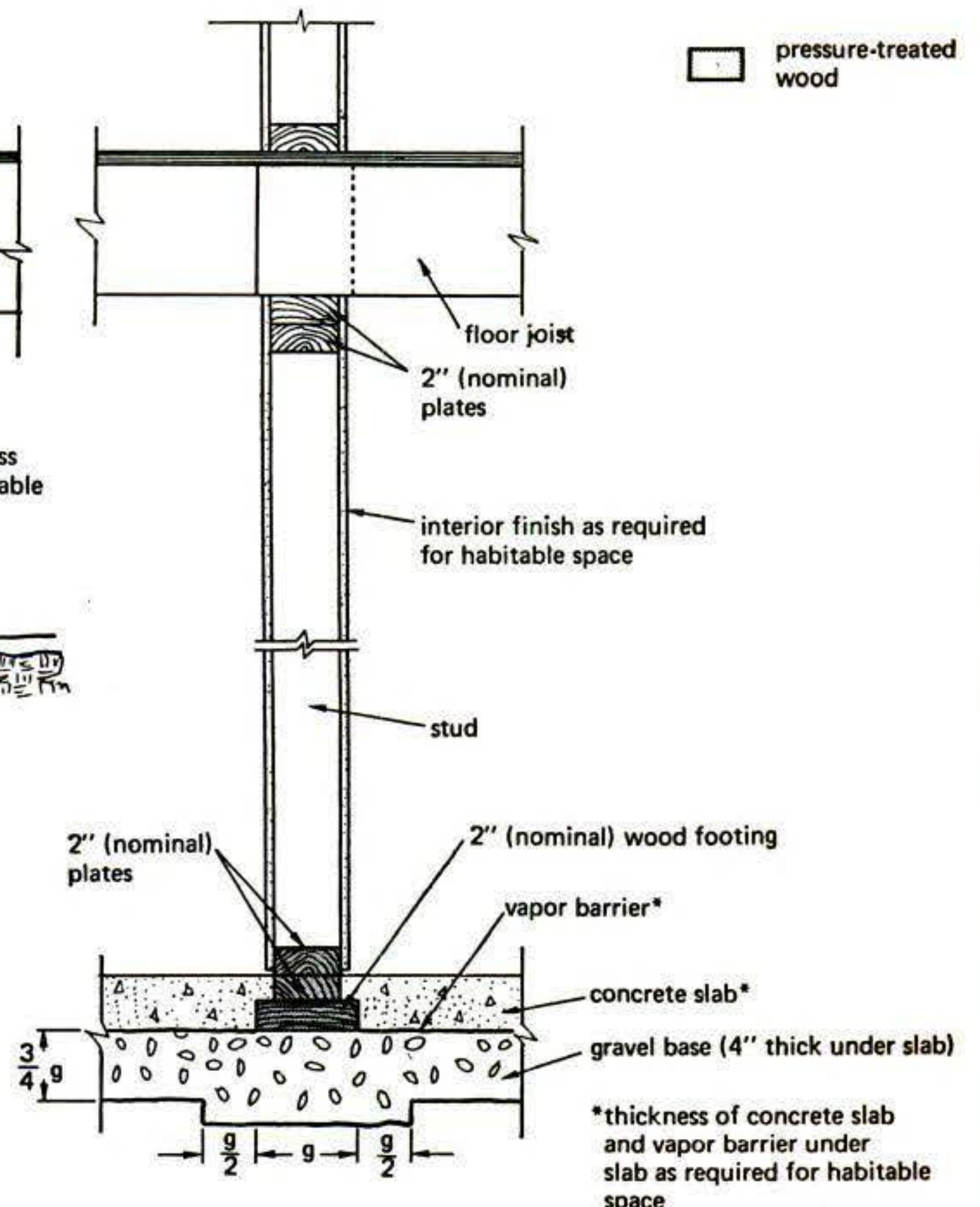
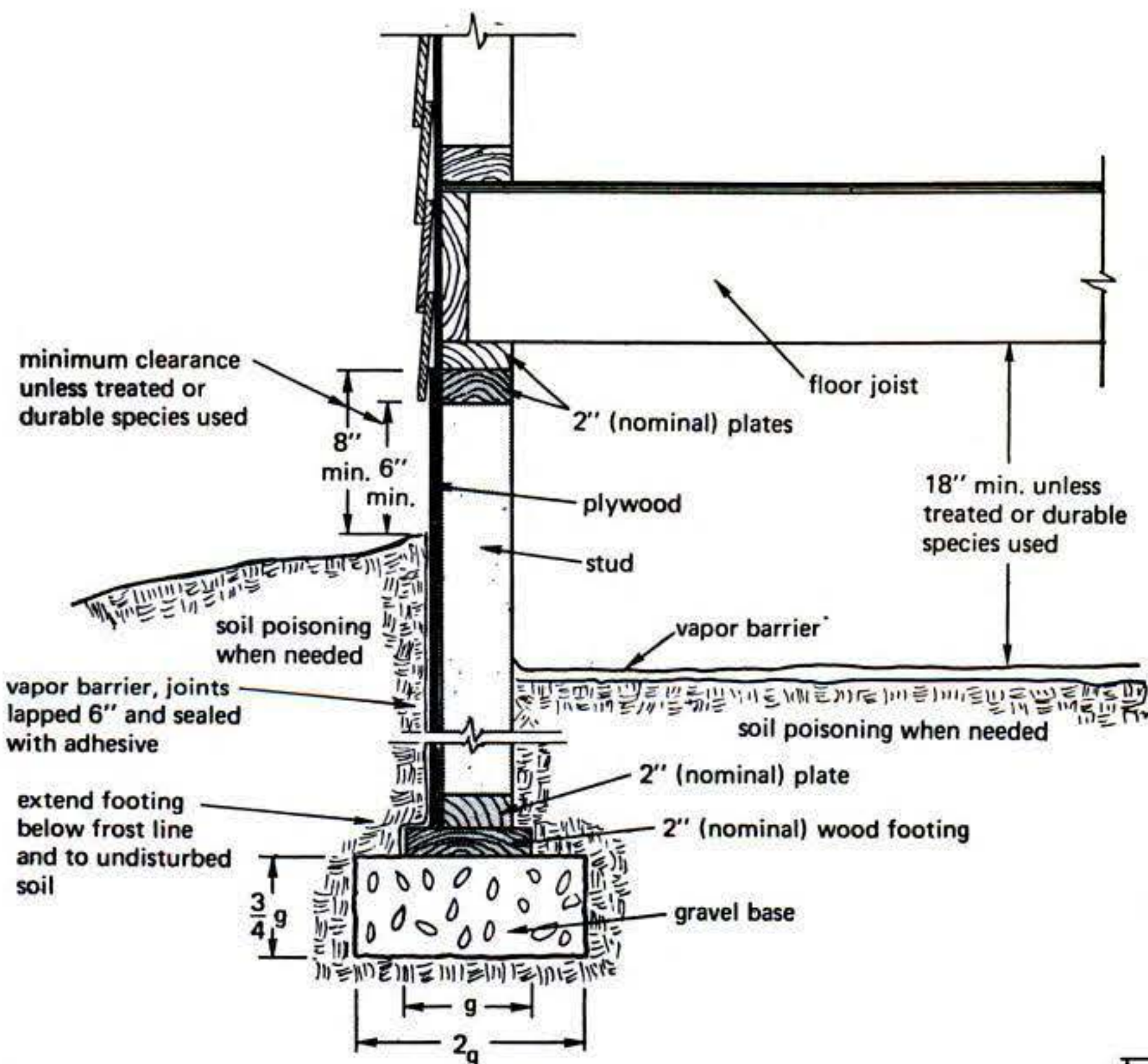
The foundation panels. Make these next. In most cases, each panel is nailed up with pressure-treated two-by-six studs and top and bottom plates, faced outside with a sheet of $\frac{3}{4}$ " exterior plywood. You can lay the panels flat on the ground to nail them together. Use 16d hot-dip galvanized nails to place the studs 16" on center, then put on the plywood with 10d galvanized nails, 12" on center.

When all panels are ready, pick a pair that form a corner and stand them up, centered on the footer plates. Nail them down to the footer plates, and spike them together at the corner. Seal all joints with a butyl caulk and move on, erecting the rest of the panels, until the whole foundation is in place. Finally, nail a two-by-six

top plate around the upper edge of the entire foundation. This top plate needn't be pressure-treated; ordinary lumber will do, but be sure the plate joints do not match with joints between panels.

That's it, except for pouring the concrete slab. When it's set, it anchors the foundation walls firmly, and you're ready to start building.

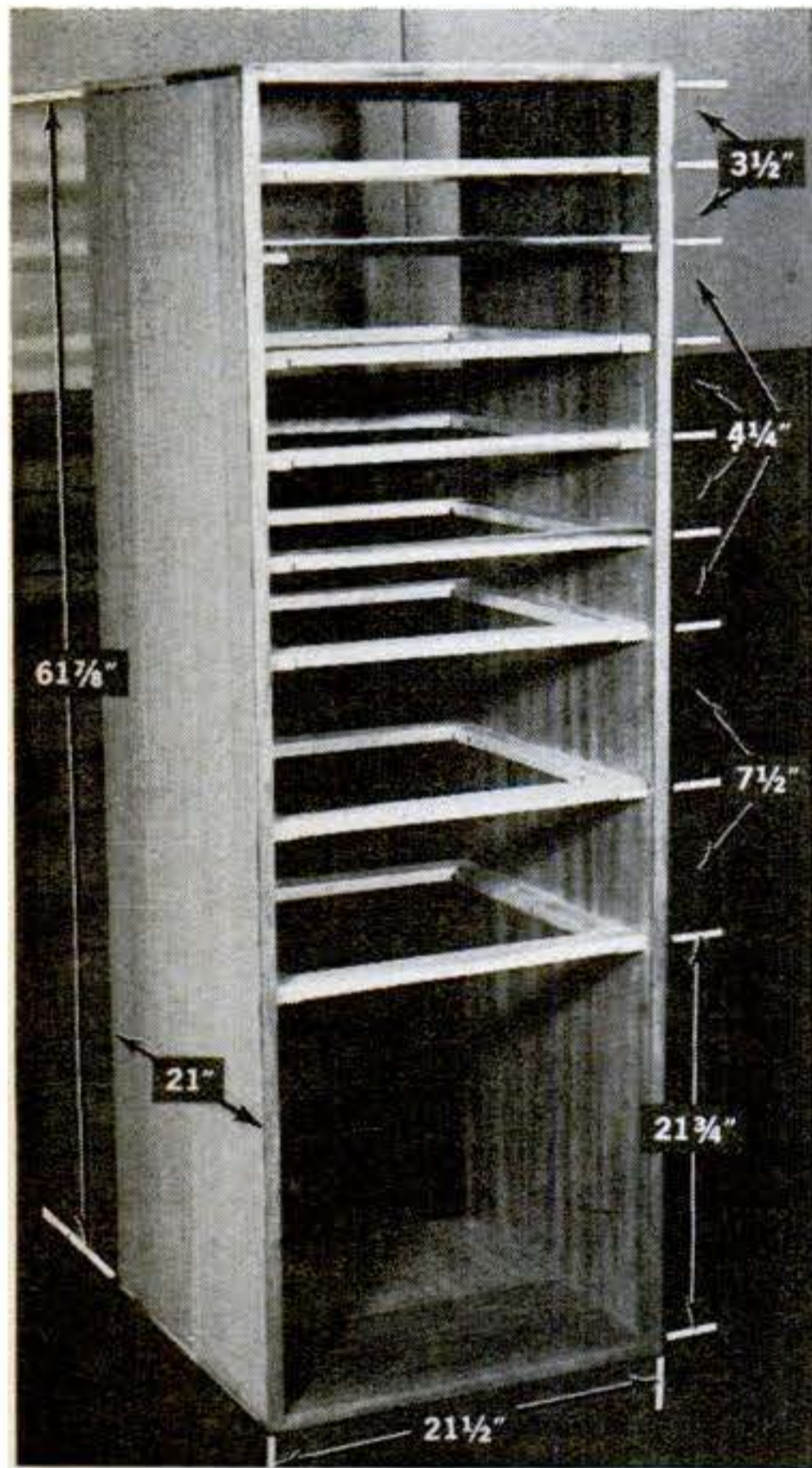
If you are interested in knocking together your own wood foundation, you can get detailed plan sheets from AWPI (1651 Old Meadow Rd., McLean, Va. 22101). Ask for sheet LCM for full-basement or LCL for crawl-space foundation (each, 50 cents). For a booklet discussing the system, write Nat'l Forest Products Assn., 1619 Massachusetts Ave., Washington, D.C. 20036. P 9



Construction of crawl-space foundation wall (above) is even simpler than full-basement type—you need only dig trenches, not a complete excavation. Sketch at right shows details for an interior load-bearing wall, required for support in a large addition.

Build a Closet Organizer

By RICHARD C. SICKLER

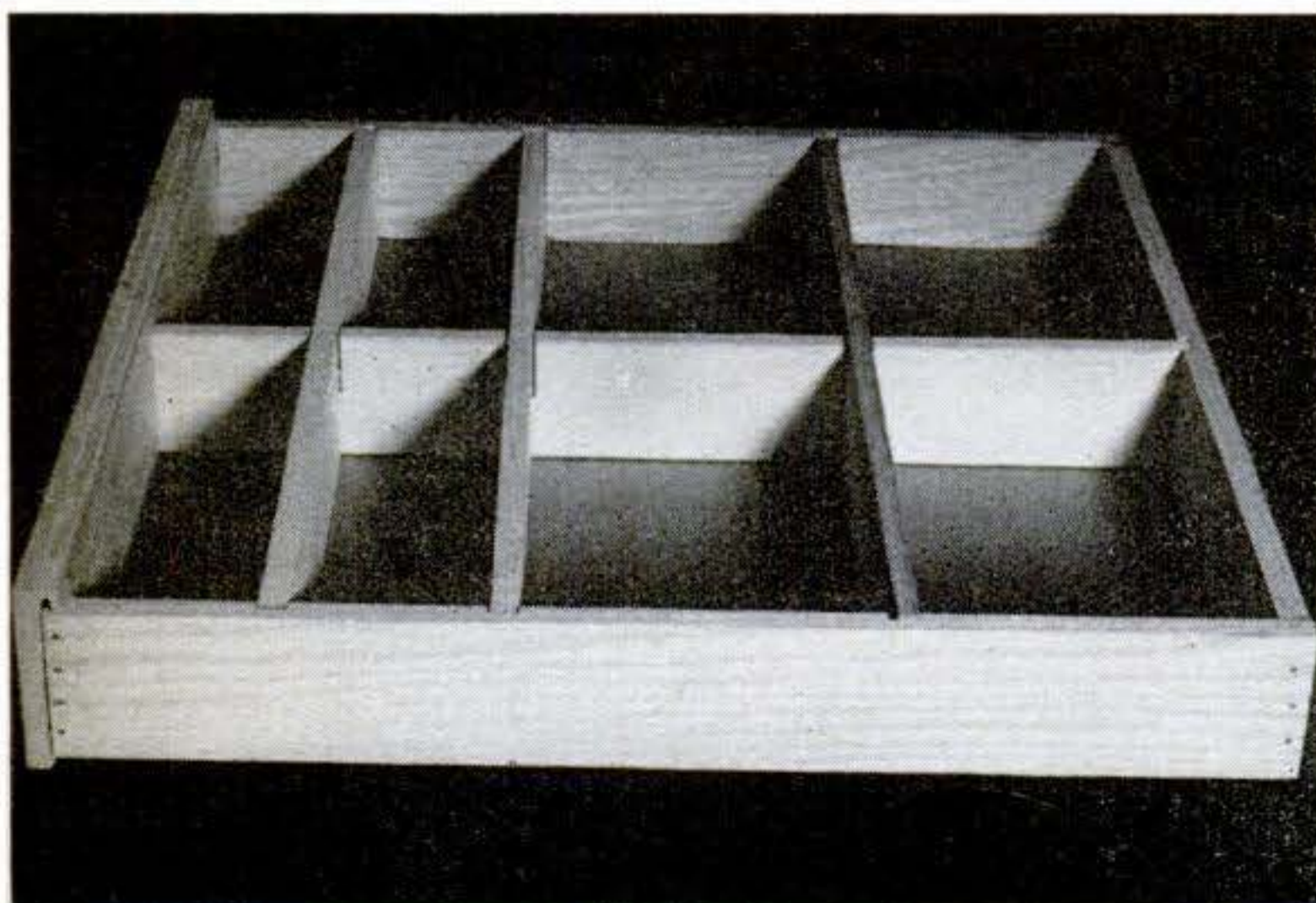
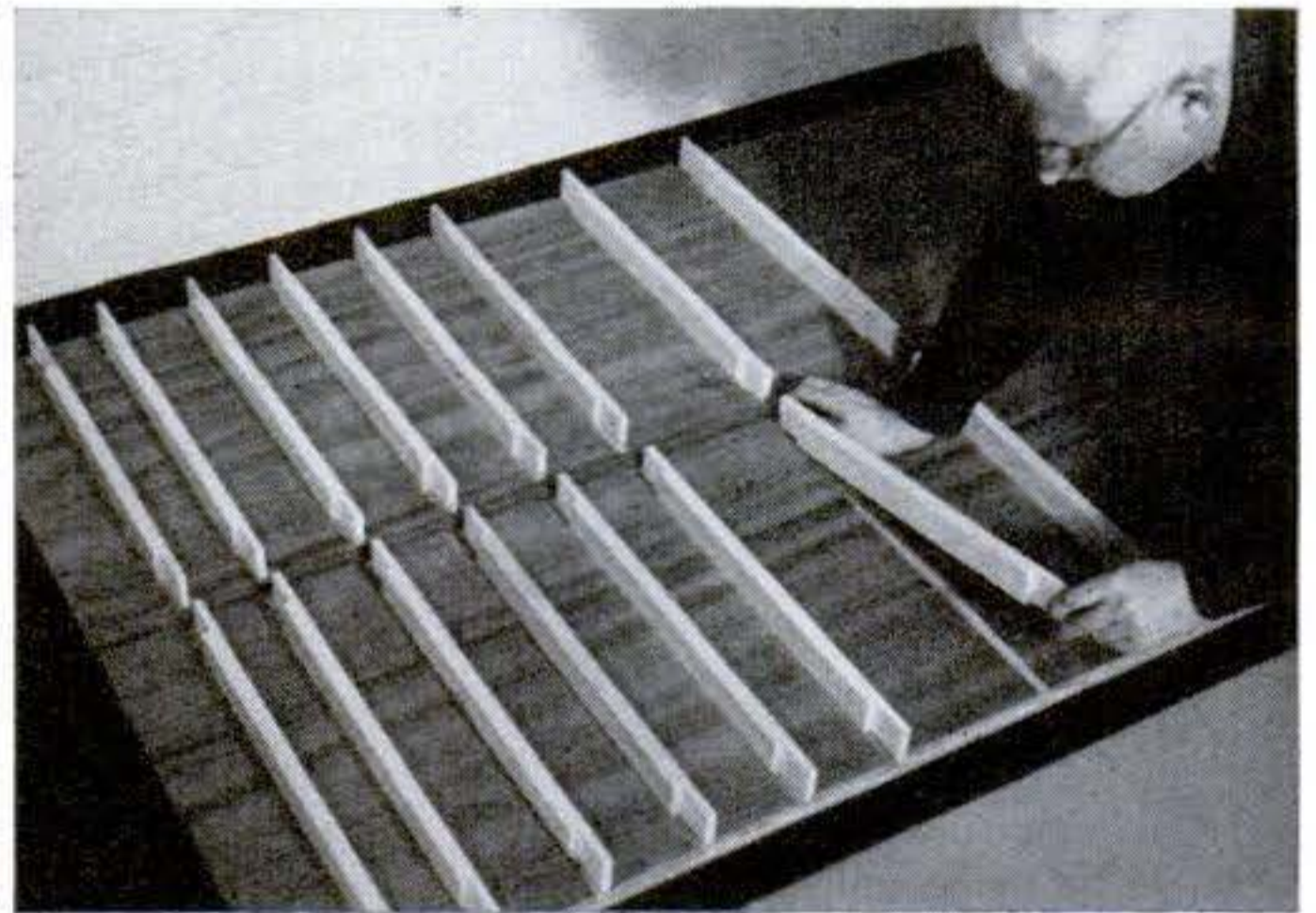


Solution to closet clutter anywhere in the house can be a slide-in cabinet. This one was built of $\frac{3}{4}$ " Philippine-mahogany plywood, just tall enough to slide under lower shelf 62" from floor. Cabinet is 3" less than

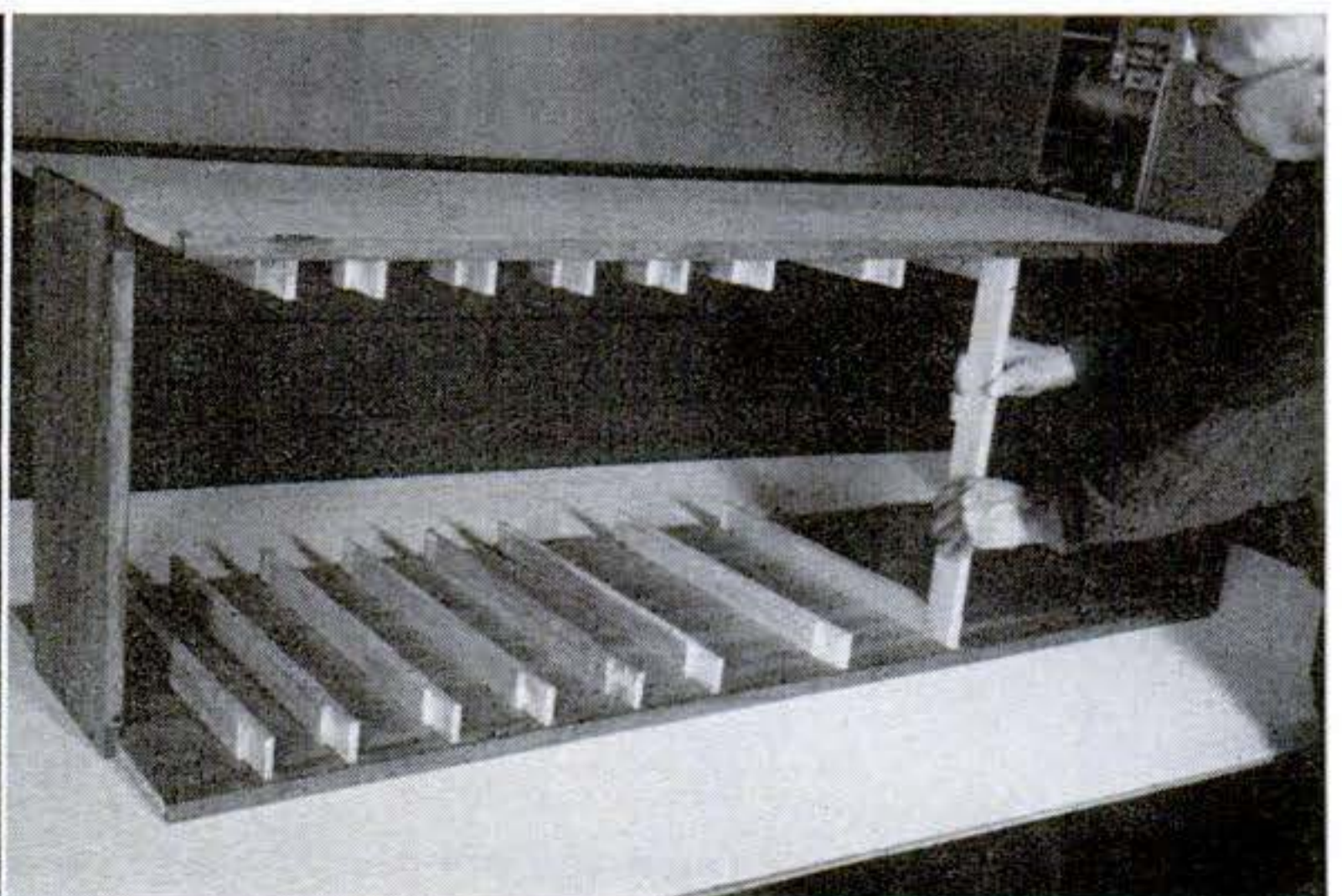
closet depth of 24"; total width is 21 $\frac{1}{2}$ ", leaving usable space on either side of it in 36"-wide closet. In closet shown, sliding doors in grooved tracks were installed in front of shelves above cabinet.

Support frames, recessed $\frac{3}{4}$ ", act as stops for the drawer fronts. Back is not needed if cabinet goes against wall. Glides were installed on bottom (left).

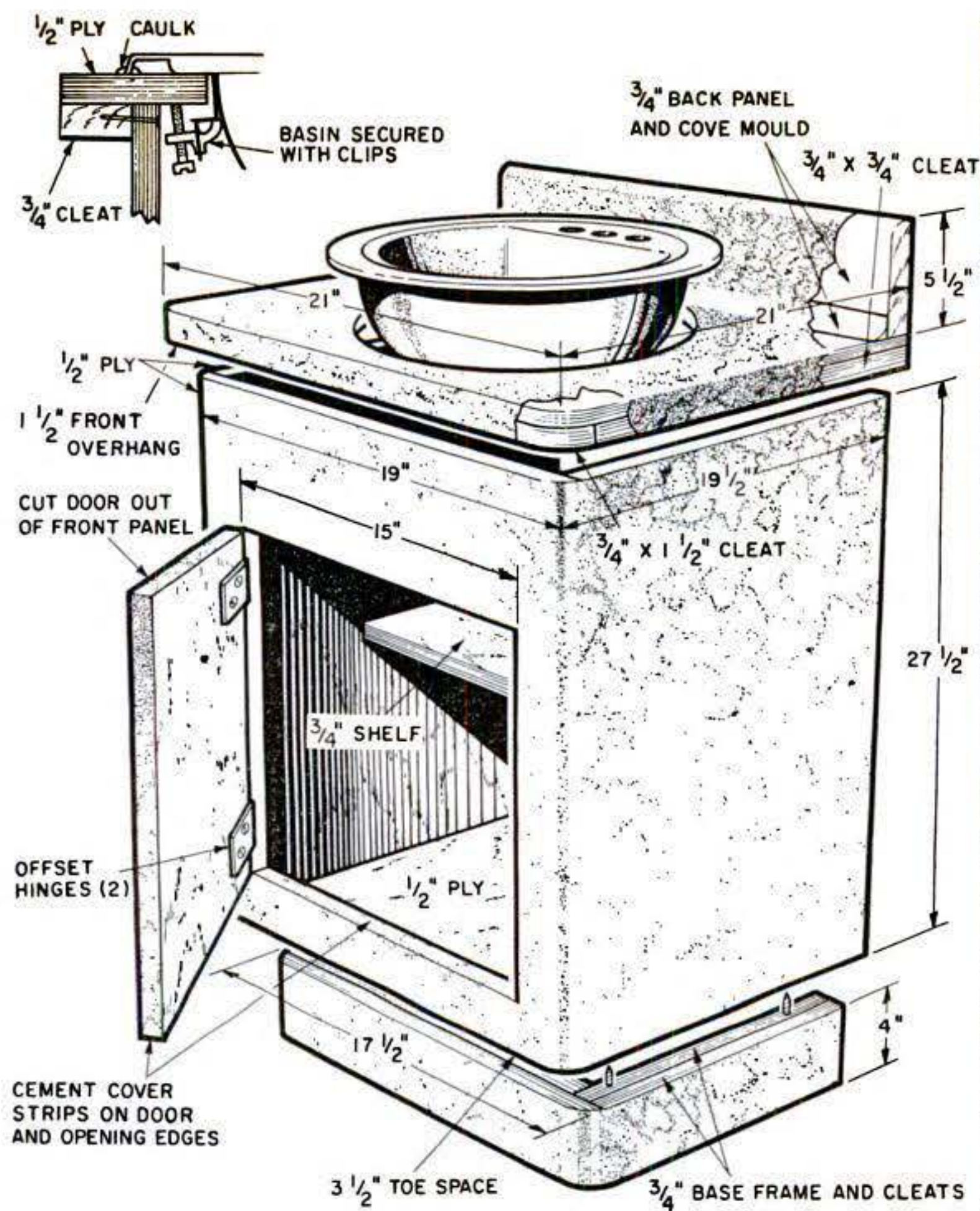
Both plywood sides for cabinet were dadoed at same time. Sides were then placed on the floor and the oak drawer supports were all mounted with glue and 2 $\frac{1}{4}$ "-#8 f.h. screws (right).



Partitions were placed in some of the drawers for convenient storage. Notice the egg-crate assembly. Note that the drawer fronts—flush on three sides—have a $\frac{3}{4}$ " lip on the top edge.



Bottom and top members held the sides of the cabinet while the front and rear drawer supports were being installed. Supports were half-lapped and mounted with glue and $\frac{5}{8}$ " f.h. screws.



Add a Modern Vanity to Your Bath

By HANK CLARK

Want a modern bathroom vanity? Install it yourself—and save a wad. The job's mostly simple carpentering.

Change the counter length to suit your space if you can't use exactly the size shown here. But you'll usually find that the other two major dimensions—the height and depth (from the wall)—are what you want.

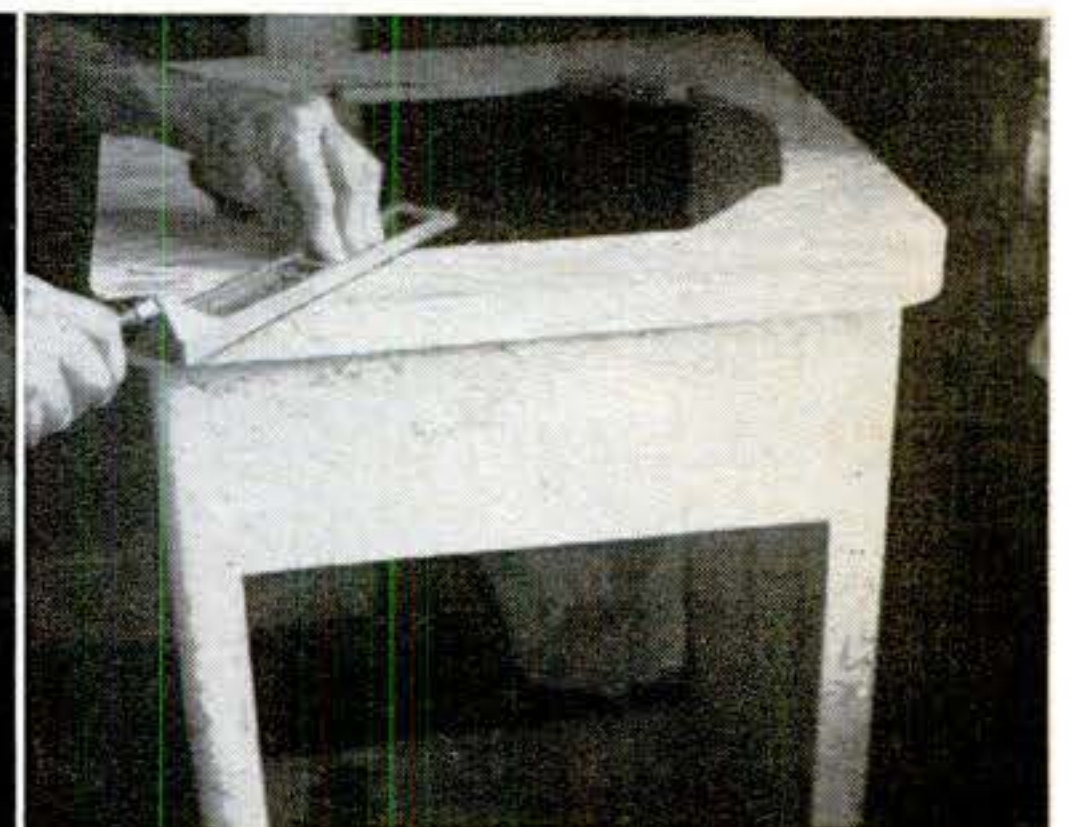
Buy the lavatory before you start. Turn it upside down on the piece that will become your counter top, mark around it, and make the cutout with a saber saw. The rest is like making a box with two sides, a front, and a bottom. No back is needed since the pipes enter there.

After sides, front, and bottom are glued (use waterproof) and screwed together, lay out the door on the front panel and make the cutout, again with a saber saw. The saw kerf clears away enough wood to let you edge the door and the opening with the vinyl or other covering that you choose for the vanity. Cover the door edges before you surface its front.

Applying the surfacing material over the plywood was a simple matter. We used a flexible Goodyear vinyl
Continued



Wrap flexible surfacing material around entire cabinet after rounding corners and applying mastic with notched trowel. Let the mastic set, then cut out door opening.



Edge the top panel with a continuous strip of covering. A Surform and sanding block can be used to smooth off covering edge for a neat meeting of edge and top surfacing.



Apply top surfacing last, letting it overlap the edging. Trowel the adhesive right out to the edge for a good bind. Curve the covering over back panel as seen in sketch.



Set the bowl into a bead of caulking inside its edge as shown here for water-tight seal. Then lift off entire top panel, turn over, and fasten the bowl to its under surface.

Add a Modern Vanity

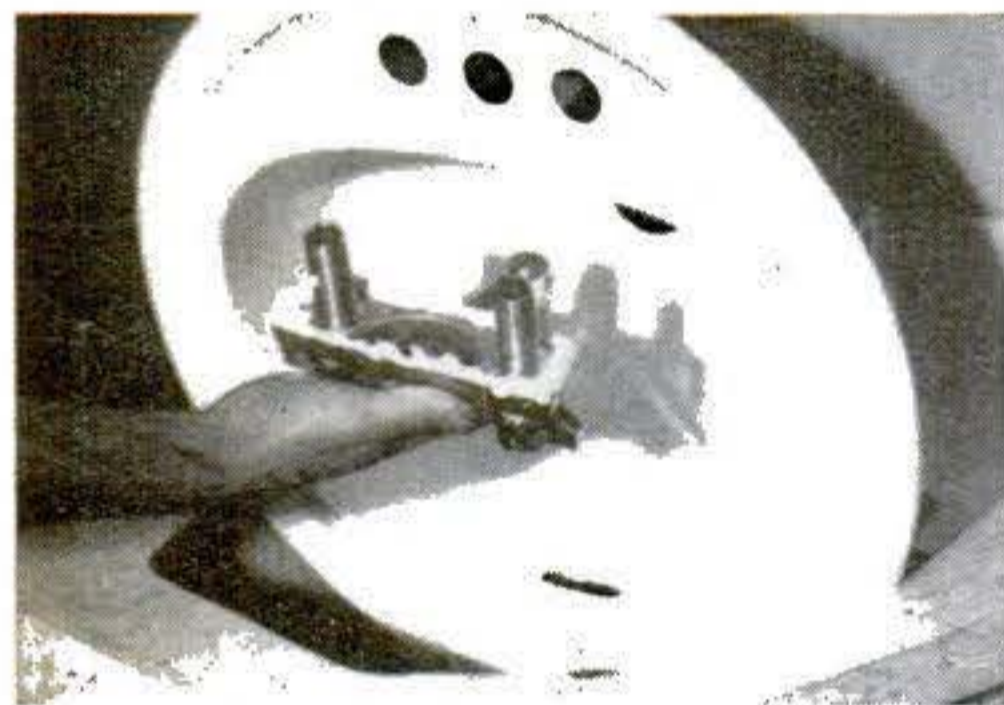
[Continued]

(Conolite) and found that it turns a $\frac{3}{4}$ " radius nicely. Set this into adhesive applied with a notched spreader. When you form the covering around a radius, apply pressure on both sides of the bend to get a smooth turning. Wipe off adhesive at once.

Before setting the bowl into the counter, apply caulking to the base of the fixtures and set them into the bowl openings. Secure the fixtures with nuts turned up underneath. It's also best to caulk the drainpipe into the sink before setting it.

You can reach through the door to angle securing screws up into the counter top after setting the bowl and fastening it with clamps.

When you have placed the cabinet against the wall, you may want to call a plumber to make the connections. However, there's no reason you can't do it yourself if you've ever worked with copper tubing. **PS**



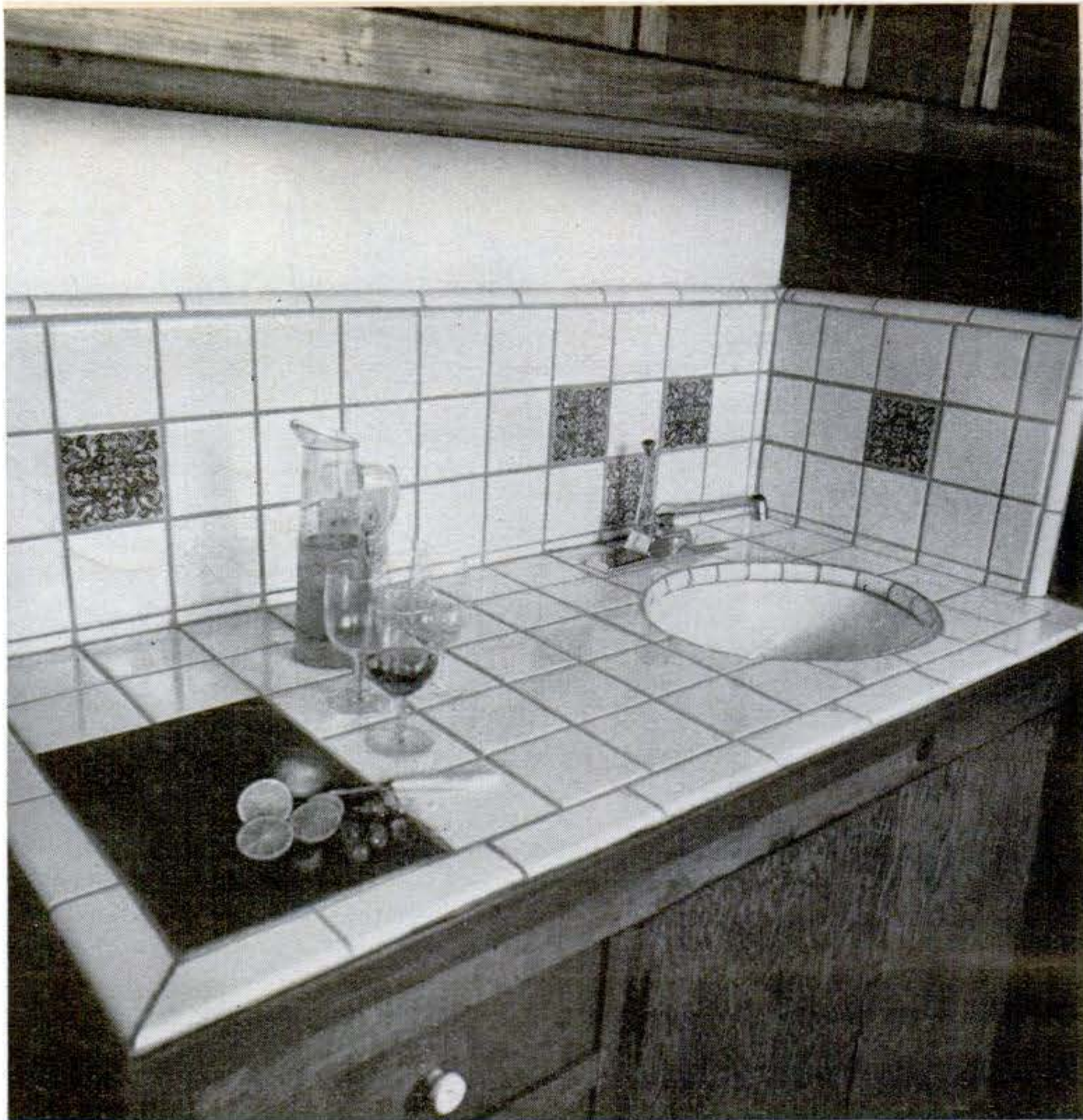
Attach fixtures and firm them up before you mount the bowl to the vanity. Caulk liberally around faucet base as shown.



Installing the sink's drainpipe is also an easier task before the bowl is set into place. Put caulking around the pipe rim.



Invert the cabinet for easy access to the screw clips that secure bowl to counter top. Wood blocks may be needed under clamps.



IMPROVE YOUR HOME

Tile a counter? Tile a wall? The job you do is practically the same in either case. Choose accent tiles if you wish. Adhesive mastics simplify the application.

Are do-it-yourself tiles limited to

Now You Can

By **ROBERT WORTHAM**

The extreme hardness of ceramic tile makes it an excellent choice for the walls and counters in your bathroom and kitchen. Yet with the proper tools you can cut this durable material almost like wood. And today's new adhesive mastics make it easy to install, too.

You can apply tile to any sound structural surface. On counters use $\frac{3}{4}$ " plywood for the top and backsplash, with no greater longitudinal span than 36". Prime areas that are exposed to water by applying a skim coat of mastic over the entire surface, using the flat side of the trowel. Let this prime coat dry to a tough film which will not be broken by application of additional cement.

Mastics are applied with a notched spreader that has $\frac{1}{8}$ " saw-tooth

notches spaced $\frac{3}{16}$ " on center. The spreader controls the amount of cement, with no excess to squeeze between tiles. Tile can be set immediately. Do vertical surfaces first and lay tile on them before applying mastic to the counter top.

Choose the right adhesive. White-latex emulsion is recommended for installation of ceramic and mosaic tile on walls not exposed to water. This mastic is nonflammable, has an unusually long open time (four to six hours), permitting large areas to be tiled in one session, and cleans up with soapy water. It is relatively water-resistant. But where moisture is a more serious consideration, a solvent-rubber-base mastic is the one recommended.

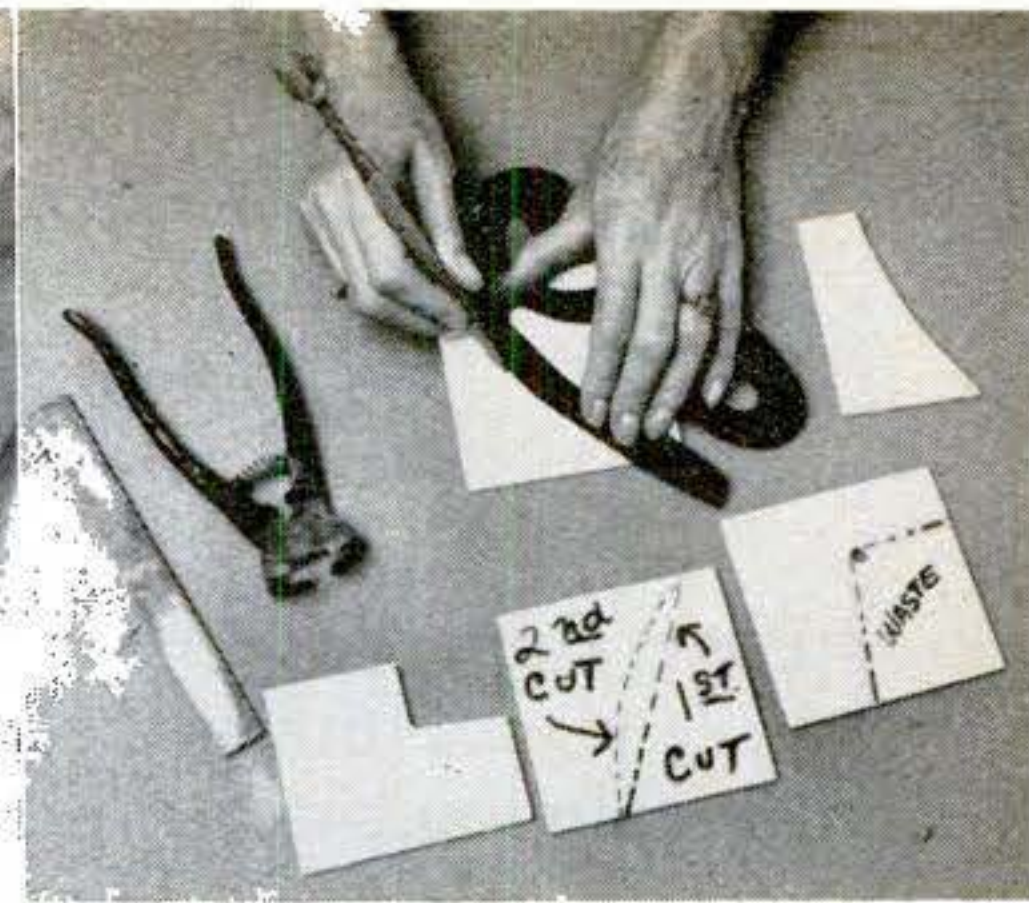
The latter should be used for showers, sink tops and backsplash, on walls around tubs, and in areas exposed to heat. Because it has a



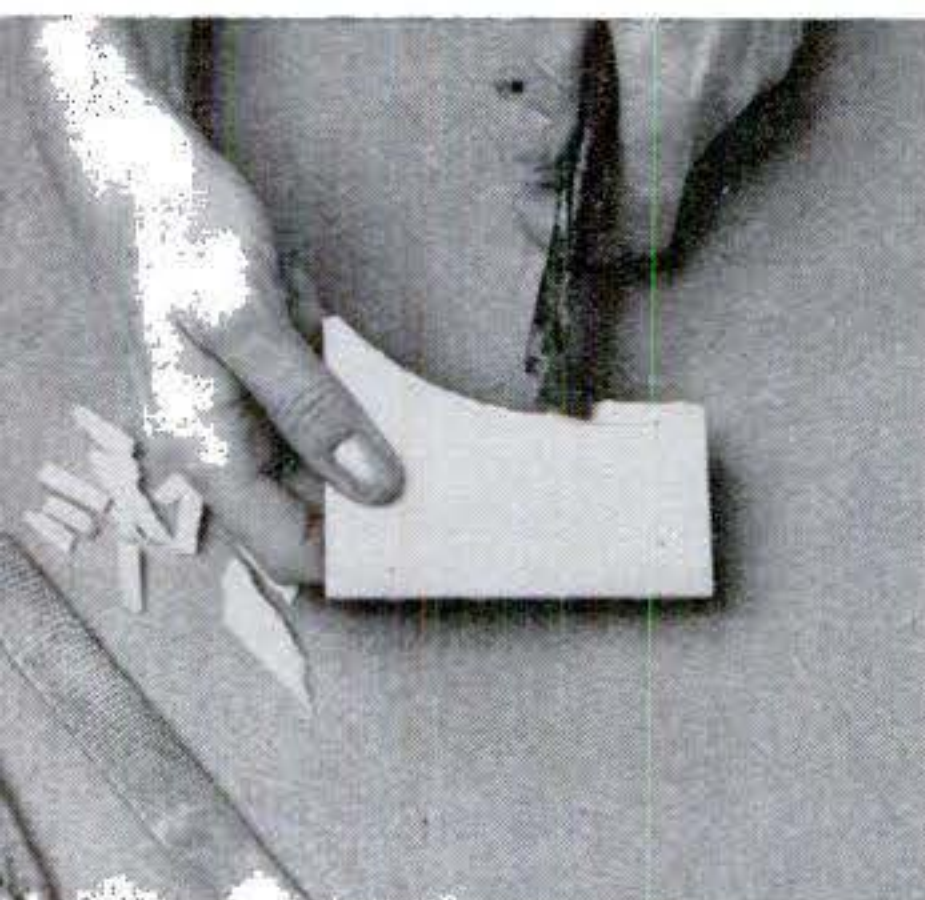
Plan the job by making a dry layout of all tiles first. Spacing for grout line usually is $\frac{1}{16}$ ", but can be wider if desired. Layout lets you plan and mark all tile for cuts.



To make straight cuts, score tile, using a metal square as a straightedge. Place a tile on firm edge and break downward, using fork of the special cutter as shown in photo.



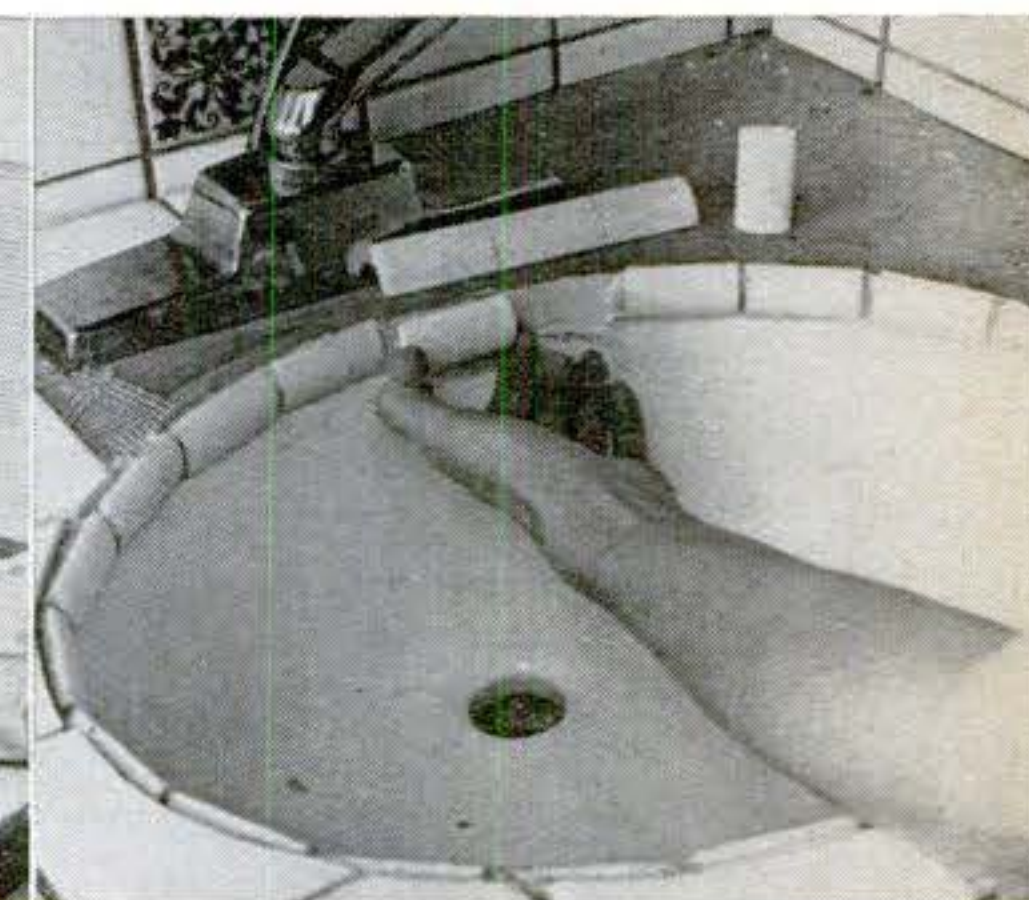
Make radius cuts in two or more takes. Use a straightedge for first cut to remove the waste. Scribe final cut with French curve. For inside cuts (right), drill radius hole.



Use **tile nippers** to nibble away tile from a radius line as shown here. Take very small bites and you'll produce a remarkably even edge. Smooth with rounded bastard file.



Install tile on backsplash first. Establish level course at top and work down. Apply mastic with notched spreader. Buttering the back of tile keeps it from vertical slippage.



Bull-nose in 1"-by-6" size was cut into 2" pieces to edge this sink, its top edge set level with surrounding tile. Butter two flat edges with mastic before installing.

plastic and self-sticks? No more:

Apply Ceramic Tiles

shorter open time (one hour), apply it to small areas at a time. This mastic is flammable, so follow the maker's safety instructions. Use paint thinner to clean tiles and tools.

Apply tile with a slight circular twist, seating it firmly in the mastic. After each course is finished, seat the tiles by tapping with a block of wood and hammer. On vertical surfaces it is sometimes necessary to lightly butter the back of each tile to insure against slippage. This applies particularly to small portions of cut tile in bottom courses and in corners.

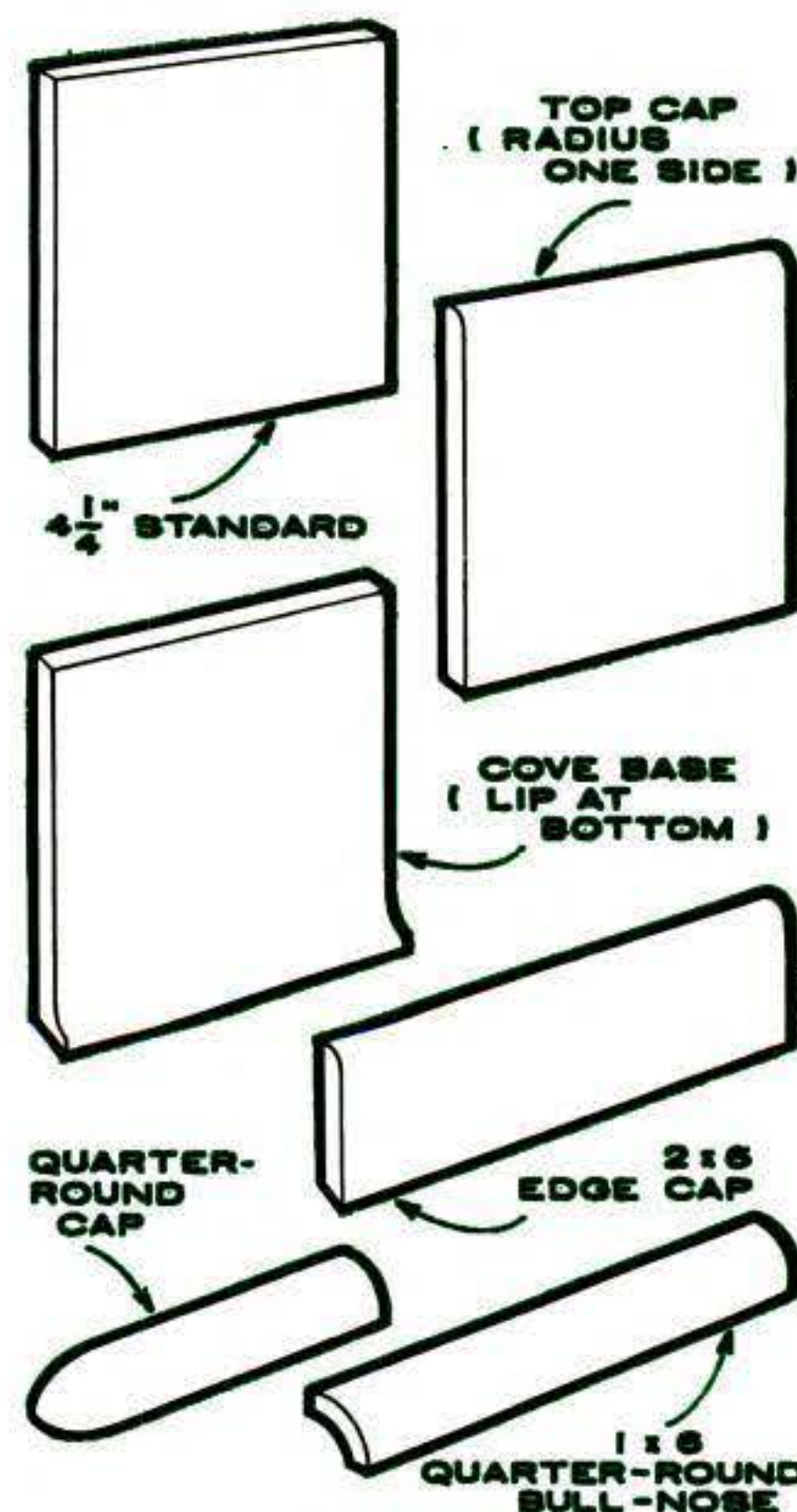
Many tile-supply companies rent cutting equipment to their customers, or you can buy the pencil-type tile cutter and nippers in a hobby store for less than five dollars. To make a cut, score the tile with the carbide-tungsten tip of the cutter.

Set tile should dry overnight before grouting. Mix dry grout and water

to the consistency of mayonnaise and apply diagonally across the grout lines with a squeegee. In about 30 minutes, remove excess with a wet sponge. After grout has dried overnight, remove haze from tile with a piece of dry burlap.

A final step: sealing. For waterproofing and easy maintenance of tile, seal the grout lines. There are several products available for this purpose, and they vary in application. The sealer is a clear liquid that is sprayed on or applied with a brush or sponge. Follow the manufacturer's directions for applying it.

Sealing is particularly important where the grout line is wider than the $\frac{1}{16}$ " standard. On the project illustrated, I spaced the tiles $\frac{3}{16}$ " and tinted the grout with dry lampblack to a shade of light gray for emphasis. Tint colors are available where tiles are sold.



Common tile shapes are shown. Quarter-round bullnose is used for sink trim, top of backsplash; quarter-round cap for vertical trim.

Exciting new developments help you get More Comfort for Your

Burners from rocket research, heat exchangers from missile electronics, and sophisticated solid-state controls are revolutionizing a once staid home-heating field

By C. P. GILMORE / PS Executive Editor

Until recently, one oil or gas furnace was pretty much like another, this year's model hard to tell from the one on sale last year or the year before that. The field was as innovative as the buggy-whip industry, as exciting as stewed prunes.

No more. Today, in a burst of creativity, manufacturers and the oil and gas trade associations are developing a host of dramatically improved new techniques, devices, and ideas that will soon bring to your home-heating plant new levels of performance, comfort, reliability, and economy. Among items I discovered in a recent survey of the field:

- A super-efficient heat exchanger—heart of a furnace—the size of a coffee can.
- Two new oil burners that work on entirely new principles and solve a lot of old problems.
- A new heat-transfer device, based on heat pipes developed for space vehicles and atomic reactors, that opens up lots of possibilities.
- Supersensitive, versatile solid-state controls that keep your home more comfortable with no annoying temperature swings, no drafts.
- Advanced new all-in-one home comfort centers—factory-engineered units that contain heating, air condi-

tioning, and humidification equipment all in one efficient package.

Some of these developments are on the market now; others soon will be. Some are revolutionary spinoffs from high technology; others are refinements of older devices.

But they all have one thing in common. They'll soon be making your home a better place to live in by heating—and otherwise treating—the air to make you more comfortable at less cost.

Just in from space

About five years ago, Raytheon engineers faced a tough problem. The amount of power you can get out of a radar tube depends on how effectively you cool it. One common method is to run water through small pipes built into the tube, but that only works up to a point. When the tube gets hot enough, steam forms on the inner surface of the cooling channels, forming what engineers call a stagnant boundary layer. The water can't conduct heat as well and the tube usually burns up.

You could pump more water or colder water, but that makes for bigger and heavier equipment. And although nobody said so, it's a good guess that what was really needed

was a small, high-efficiency, low-weight device to do the job in guided missiles and space and aircraft radar.

Engineers finally came up with a new development that worked something like this: They filled the coolant channels with a lot of small metal balls—sort of like BBs—then heated the whole thing until the balls fused slightly with each other and with the walls of the coolant channels. Heat from the outside was conducted rapidly through the matrix of balls.

Water flowing through this maze of small spheres was forced to come in contact with a lot of metal surfaces. Thus it could collect and carry away immense quantities of heat. The tortuous pattern through the fused balls also created a lot of turbulence, which scrubbed away the stagnant boundary layer, improving the heat flow still further.

This heat exchanger, dubbed the HTM (for heat-transfer module), was so efficient that it occurred to its developers that a unit the size of a two-pound coffee can would be able to heat an average house. They turned it over to a Raytheon subsidiary, Amana Corp., which began work on a commercial unit.

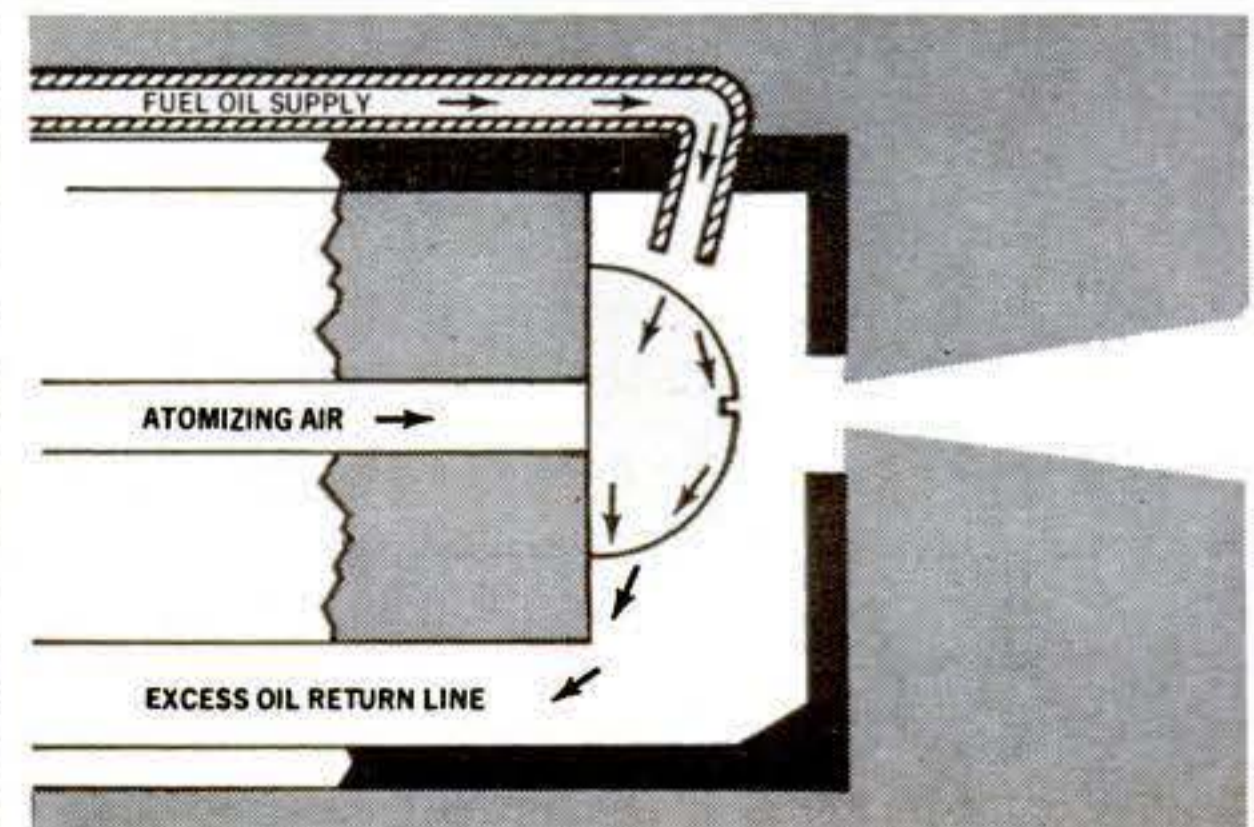
Now, after several years of development and testing in private homes, an HTM unit will appear on the market. The first product: a central unit containing both an HTM-equipped gas-fired furnace and a five-ton central air conditioner. Both reportedly will be in a package hardly larger than an air conditioner of that capacity alone.

New trouble-free nozzle the size of your thumbnail



The Rocketdyne Division of North American Rockwell builds rocket engines. Now its technical experts have used some of their knowledge to design this oil-burning nozzle called Una-Spray. The domed structure looks like a hard hat for an elf; actually it has three almost invisible slits in the top cut by an electron beam. As fuel oil drips down over the dome covering the slits (diagram), a low-pressure pump drives a stream of air out through the slits. The air stream ruptures the fluid film, tearing the oil apart almost molecule by molecule. The result is an extremely fine low-velocity spray, which, because of extremely uniform particle size, burns more efficiently than a conventional burner spray. The mechanism is also

smaller, lighter, cheaper, and almost impossible to clog. Company spokesmen say it should operate reliably in your home for at least three years without requiring any service or attention.



Heating Dollar

Since Amana is not officially announcing the new device until the middle of September—several weeks after this issue of *POPULAR SCIENCE* appears on the newsstands—no specific details or photographs were available at press time. The picture at the top of this page is an engineering prototype of the HTM built some time ago and published in a scientific journal. It shows the fused-metal-ball construction, but commercial versions could be quite different in specific details. Its first use will be in central units.

What's happening to oil burners?

These furnaces have been installed by the millions, but they still have problems. Fuel oil is a syrupy glop that doesn't burn well unless broken into fine droplets that can vaporize and mix easily with oxygen. The standard practice is to spray it out of a nozzle.

But oil sprayers with their high-pressure pumps and precision nozzles are expensive. And nozzles clog—the biggest single cause of furnace failure and service calls.

The Una-Spray nozzle shown on the opposite page is almost clogproof, since only air is forced through the slits. It works at low pressures so pumping equipment is relatively simple. The Una Corporation will sell the unit for original equipment and in a version that can be used for burner replacement in older furnaces.

Another ingenious nozzle uses sound waves to break the oil into droplets. The Sonicore nozzle, made by the Sonic Development Corp., directs a blast of air down a tube. This creates a low-pressure area at the mouth of an intersecting tube, which pulls a fine stream of oil into the air stream in exactly the same way that a perfume sprayer works.

This stream of mixed oil and air is then blasted into a small cup an inch or less from the tube's opening. The distance and air velocity are so arranged that the air vibrates at a supersonic frequency and rips the already small oil droplets into extremely small particles. This forms a misty, highly uniform spray that burns cleanly and efficiently.

More Btu for the buck

Want more heat from your furnace without burning more fuel? Every

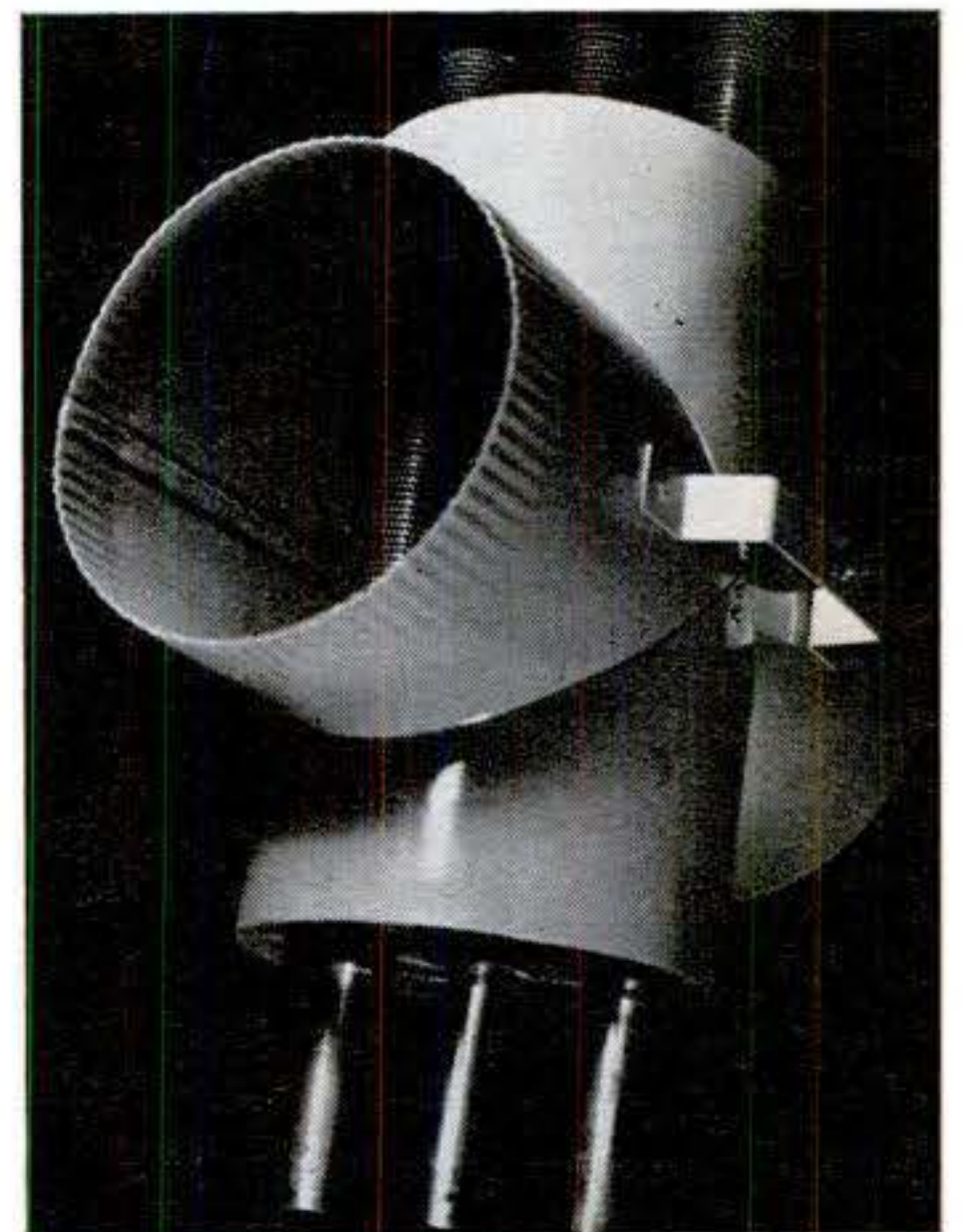
Continued

Coffee-can size, heat exchanger developed to cool high-power radar tubes can make your next furnace smaller, cheaper, more efficient. Fuel shoots down into center hole, is ignited by spark plug. Water flows in and out of tubes at the top, then circulates through matrix of fused metal balls.

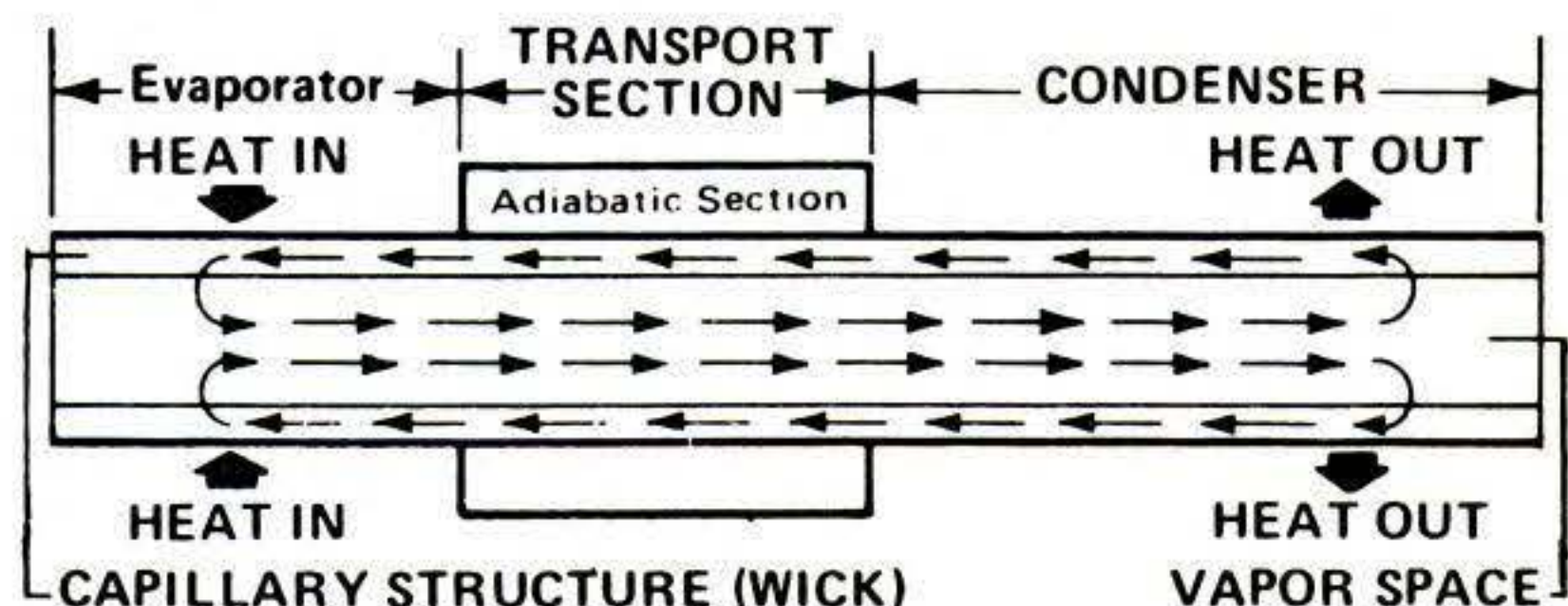


New way to capture heat your furnace wastes

If your furnace is not of the most modern design, chances are, a lot of the heat you're paying for is going up the chimney. Now, there's something you can do about it. Over past decades, NASA and the AEC have spent a lot of money perfecting a device called a heat pipe, used to transmit heat from one part of a space vehicle or nuclear reactor to another. A heat pipe is simply a metal tube containing a wick-like material and a small amount of fluid—water in this case. Air is pumped out and the unit is sealed. When one end is heated, the water at that end boils (at a very low temperature since air pressure is near zero). The water vapor migrates rapidly to the other end, where it cools and condenses, giving off its heat. The water is transmitted back to the other end by capillary action within the wick and the whole process starts again. Such a device, with no moving parts to go wrong, is amazingly efficient; it can transmit 500 to 1000 times as much heat as a solid copper rod—an excellent heat conductor. Now, Isothermics, Inc., is marketing a heat-pipe device called the Air-O-Space to collect all those Btu escaping from your furnace. The unit pictured at right is installed on the furnace flue so that the finned ends of the heat pipe at top protrude into the



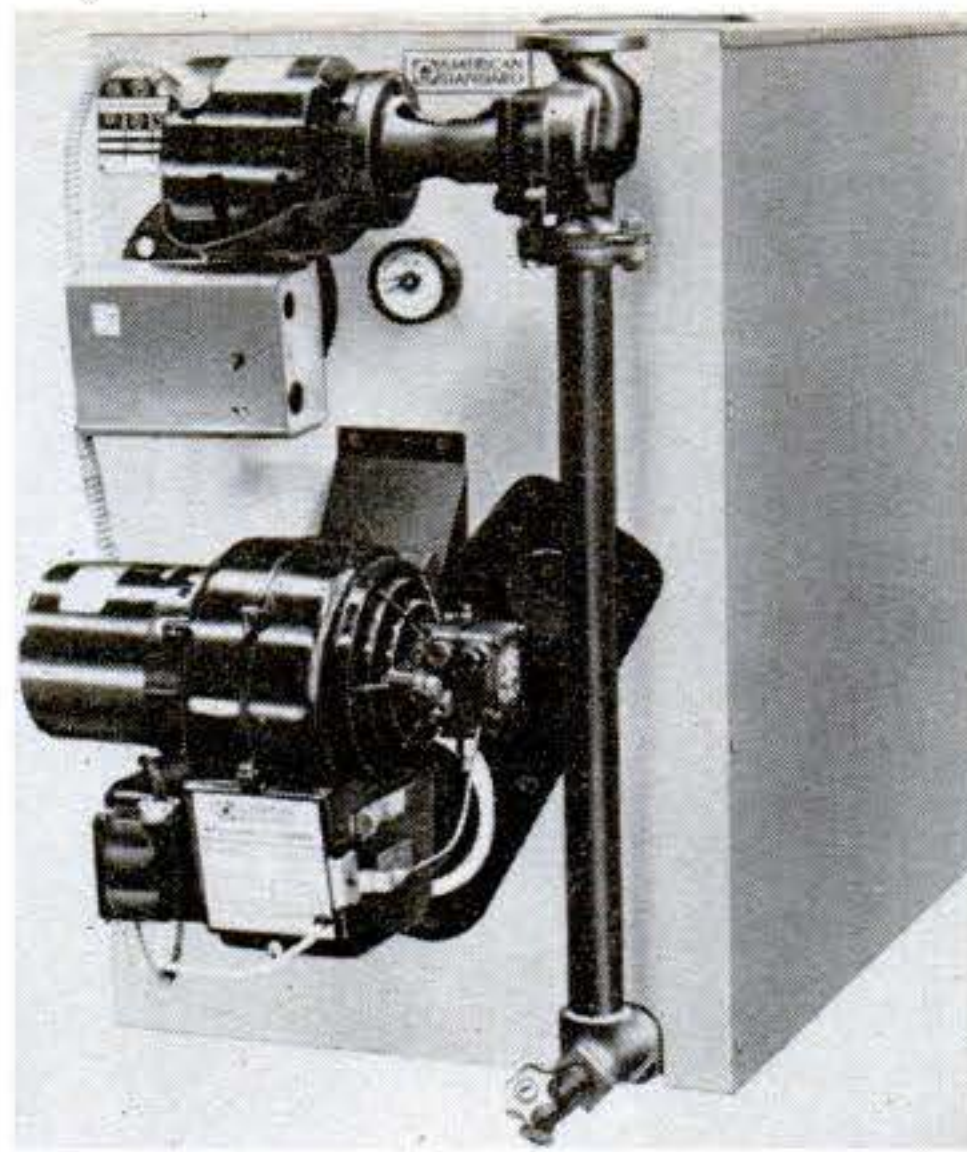
flue-gas path. A small fan blows air over the heat pipes at the center of the cross to remove the heat. The output comes from the open end nearest the camera. Total output under average conditions: 5-10,000 Btu. The Air-O-Space sells for \$100 installed. It's designed to improve the efficiency of any unit with a stack temperature of 400° or more.



“...if you don't need new equipment, but still want maximum comfort for



“Modulated” heating is newest concept. This GE gas furnace automatically selects from three different flame levels, three blower speeds, for maximum comfort.



Even hot-water furnaces are adjustable now; this American Standard unit comes with two nozzles. Use one for current needs; switch later to add up to 20,000 Btus.

furnace wastes some heat. Hot gas escaping up the flue must be at least 300 degrees to create a good draft and prevent condensation. But many older installations—and some relatively new ones—have flue temperatures as high as 800 degrees. A new device called the Isothermics Air-O-Space heater (diagram) can salvage this waste heat and give you more Btu for the buck. The copper fins of this heat pipe are in a tight spiral pattern, so you screw them into or out of the air stream until they collect all surplus heat and leave just enough for the unit to operate properly.

Once the heat is collected, it could be simply dumped in your basement, from which it would tend to migrate upward and thus reduce the heating required for the entire house—and your fuel consumption. Or it could be ducted to a cold room, an addition to the house, or any other place it's needed. The unit is recommended for any furnace with a flue temperature above 400 degrees.

Controls go solid-state

Old furnaces have two operational modes. On. And off. When the temperature in the house has dropped to a preset level, the thermostat turns the burner and fan on full blast. Heat pours out of the registers until the thermostat has enough, when it shuts the system down. You can't set the off and on points too close together or your furnace will cycle almost constantly.

Such a system works. But it lets the temperature fluctuate more than some people like. And since rooms are constantly warming up and cool-

ing down, drafts form as air near windows cools off, gets heavier, falls to the floor, and moves across the room.

The fix, with solid-state controls, is relatively simple. In a new Rheem-developed unit called the Imperial, for example, a continuously adjustable thermostat reacts when room temperature drops a minute amount. It notifies a solid-state control of the changing condition; the control turns up the idling flame a bit. A solid-state sensor called a thermistor in the air stream detects the slightly rising temperatures and notifies a silicon-controlled rectifier (SCR) to edge up the blower speed.

This carries heat away from the combustion chamber and into the house. As temperature rises slightly at the original thermostat, the stat gradually, imperceptibly eases back the whole system. The result is an

extremely delicate, precise control that keeps room temperature to within a fraction of a degree. No noticeable temperature variation. No drafts.

Almost everyone is now beginning to produce units with more sophisticated controls. GE's Executive line, for example, has three fan speeds and three burner settings; Montgomery Ward's Dual Flame system has one with two settings on each.

Many companies now put furnace, central air conditioning, air cleaner, and humidifier into one expertly engineered package. Consider this approach when you build or remodel.

Treating that dry air

Whether you're buying a new furnace or not, one standard item in the total-comfort package is a must: a humidifier. If your house can take it and you don't have one, you're wasting money and not getting what you could in terms of comfort. But there are reservations. Humidification will not be very effective—and can actually be dangerous—unless your house is fairly tight and has a built-in vapor barrier.

If your house was built before 1930, it probably has neither vapor barrier nor insulation. Your heating bills are high and humidification won't help. The moisture will go through the walls as if they weren't there.

If yours is a typical house built in the thirties or forties, with insulation but no vapor barrier, humidification could actually be dangerous. In such a case, moisture travels through the insulation to the inside of the outer walls. There it will condense on the cold surfaces where you can't see it. So the inside of your walls stay wet all winter and you'll soon have rot. There's not much you can do in such circumstances except live in dry air.

If you have a typical house built

The heat pump—an old idea whose time has come?



Development began in 1932, and a successful heat pump has been “just around the corner” ever since. It's a good idea; it can both heat and cool, and it's totally electric—yet more efficient than ordinary resistive electrical heating. In summer, it removes heat from the air inside the room, pumps it outside. In winter, it removes heat from the outside air (there's still plenty there) and pumps it inside. Heat pumps bombed out for two reasons; 1) Early machines didn't work very well. 2) The lower the outside temperature, the less efficiently they work. General Electric now says that it has the problems solved. If so—and if the price is right—you should soon be seeing more heat pumps around.

your money, these 10 rules can help you get it..."

since about 1950, it is probably relatively tight and has both insulation and vapor barrier. You're in luck. The vapor barrier, on the room side of the insulation, keeps the moisture from migrating through to the cold outer walls, so it cannot condense there.

You'll still have to determine how much humidity you can take. Anywhere from about 30 to 70 percent will be comfortable. But the higher you get, the lower you can turn your thermostat and still be comfortable. Most authorities recommend that you not go above 20 or 25 percent relative humidity when the outside temperature is zero, and up to 35 percent when it's 35 degrees outside.

Why? Moisture begins to condense on windows if there is too much of it in the air. If you have double-glazed windows or tight storm windows and good weatherstripping, you can probably get the humidity higher without condensation problems. But if you begin to see condensation on the windows, crank it back.

If you haven't investigated before, you may be amazed at the size of the unit you'll need. The small table models the doctor sometimes recommends for a sick child's bedroom will do almost nothing for a house. It may evaporate a gallon or two a day. Depending on general tightness (air changes per hour) you might need a unit that can pump up to 20 gallons a day into the air for a 2500-square-foot house. A dealer can help you make the calculations.

The easiest kind of unit to install—and the cheapest—injects moisture into your circulating hot-air system near the furnace. But if you have hot-water heat, you don't have to give up. You can buy a console-type unit that looks like a piece of furniture. Or you can get a model designed to go in the unused top of a closet or other convenient space and spew out moisture through a grille in the wall. Or mount it in the basement and release moisture through a floor grille.

Type makes no difference as long as the capacity is sufficient. But you will have to use an evaporative unit if you have hard water. The atomizing kind will deposit fine white dust over everything if it is spraying water with high mineral content. Finally, select one you can hook permanently into your plumbing if possible. Filling a portable unit daily is a nuisance.

Jacking up the old system

Modern heating equipment is great and humidification will help. But maybe you're not ready to buy new

equipment and would still like to get maximum comfort for your heating buck. Is there anything you can do? Absolutely. They aren't new, but these 10 rules work:

1) Rewire your hot-air furnace so the blower runs all the time, not just when the burner is on. This prevents pools of cool or hot stagnant air from collecting and keeps air at a more even temperature.

2) Maintain your equipment properly. Having an out-of-adjustment burner is like burning dollar bills. It makes a flame, but you don't get much out of it. A soot-coated heat exchanger wastes as much as half of its heat. Have your unit serviced at least once a year, or learn how and do it yourself.

3) Keep air filters clean, furniture and draperies away from registers so air can circulate. If you have hot-water or electric heat, dust radiators or radiant panels frequently. A relatively light dust coating can cut down on radiating efficiency.

4) Don't monkey with the thermostat. Set it and leave it alone. Exception: Turn it down at night if you like, but not more than five or 10 degrees.

5) Make sure your thermostat works. If it's more than 10 years old, suspect it; it may let the temperature swing back and forth too much.

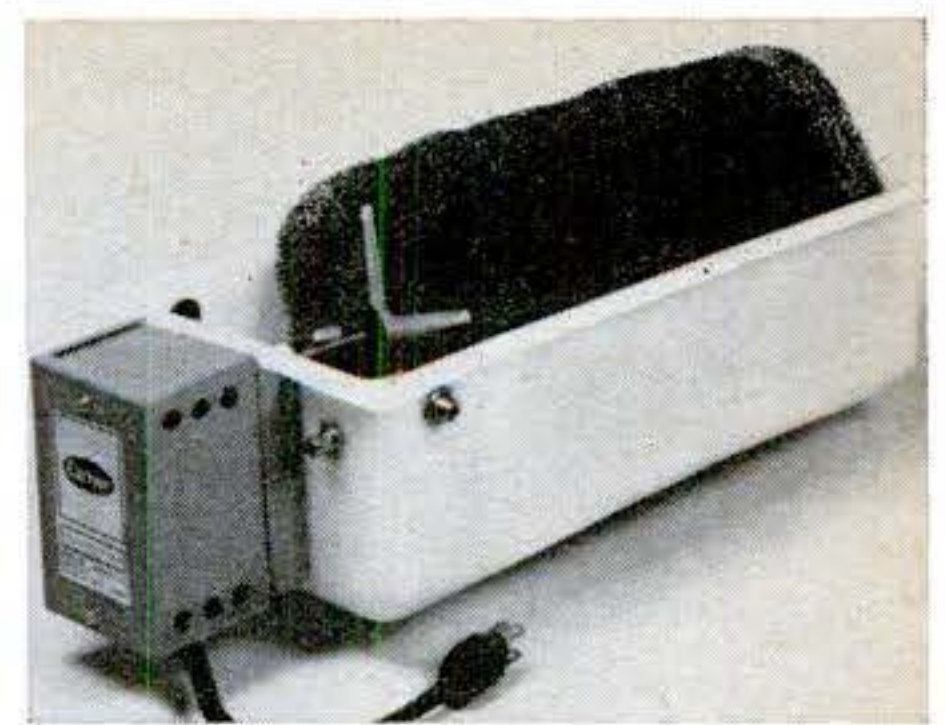
6) If you have a fireplace, keep the damper closed except when a fire is going. You can blow an enormous amount of expensive heat up the chimney by leaving it open.

7) Sunshine is free. On sunny days, pull back draperies and let it shine in the windows. At night, close the draperies; use lined ones if possible. This really works. My house has what amounts to almost a glass wall on the southeast. In sunny winter weather, the furnace stays off all day, no matter how cold it is outside, yet the house stays warm. If it turns cloudy, the furnace comes on in a few minutes.

8) Keep the kids from running in and out as much as possible. One study shows that each child increases the yearly heating bill three percent—simply by opening doors a lot.

9) Make sure your system is balanced so you don't turn the thermostat higher than necessary to get a chilly room comfortable, thus wasting heat elsewhere.

10) And you've heard this one before, but it is crucial: Insulate. Weather-strip. Install storm windows. A really old house may present a problem, but anything that you can do to stop the loss of heat will put money in your pocket. P.S.



Humidification— it can cut fuel bills, give greater comfort

Average relative humidity on the Mojave Desert is 15%. As the chart below shows, your house in winter is usually drier than a desert if you don't humidify. The situation has nothing to do with the kind of heating plant you have; it's a matter of physics.

The warmer the air is, the more moisture it can hold. Suppose outside temperature is 20°; and humidity a typical 50%. When you bring that air inside and heat it to 70°, it is capable of holding far more moisture. So the relative humidity plummets to an arid 10% that dries out your respiratory tract, making it an easy target for infection. Your body's evaporative cooling system works overtime in the desert-like climate and you feel chilly. You turn up the thermostat to get comfortable again, thus raising your heating bill—about 3% for every degree over 70. In addition, the dry air lets static charges accumulate so you get a nasty shock after walking across a rug. Book bindings dry out and crack. Wooden furniture shrinks and glue joints pull loose. What can you do about it? Install a humidifier such as the one above.

Make sure it has the capacity to raise relative humidity to at least 20-30% (see text for details). You'll soon pay for the unit in fuel savings, household possessions will hold up better, and you and your family will be somewhat healthier.

OUTDOOR TEMP	OUTDOOR RELATIVE HUMIDITY	INDOOR RELATIVE HUMIDITY*
-10 F	30%	1%
	50	1
	70	2
0 F	30	2
	50	3
	70	4
10 F	30	3
	50	4
	70	6
20 F	30	4
	50	7
	70	10
30 F	30	6
	50	10
	70	15

Without a humidifier, you get a desert-like dryness in your home all winter

Sure Cures



The materials (left to right): paint containing aggregates, hydraulic cement, cement formulated for small-volume setting, two epoxy coatings, cementitious paint.

Time was, the only real way to fix a leaky basement was to dig down along the foundation wall and patch it from the outside. Today, new materials make it easier and better to fix it from the inside. Even when the leak is actively running water. Even when an entire wall may be damp with water seeping through from the earth outside. Even along the base of the wall, where hydrostatic pressure is so great that it will dislodge any ordinary patching material.

What makes it possible to do the impossible is a foursome of new and near-new materials, each performing its own form of magic, and some of them combining for double magic:

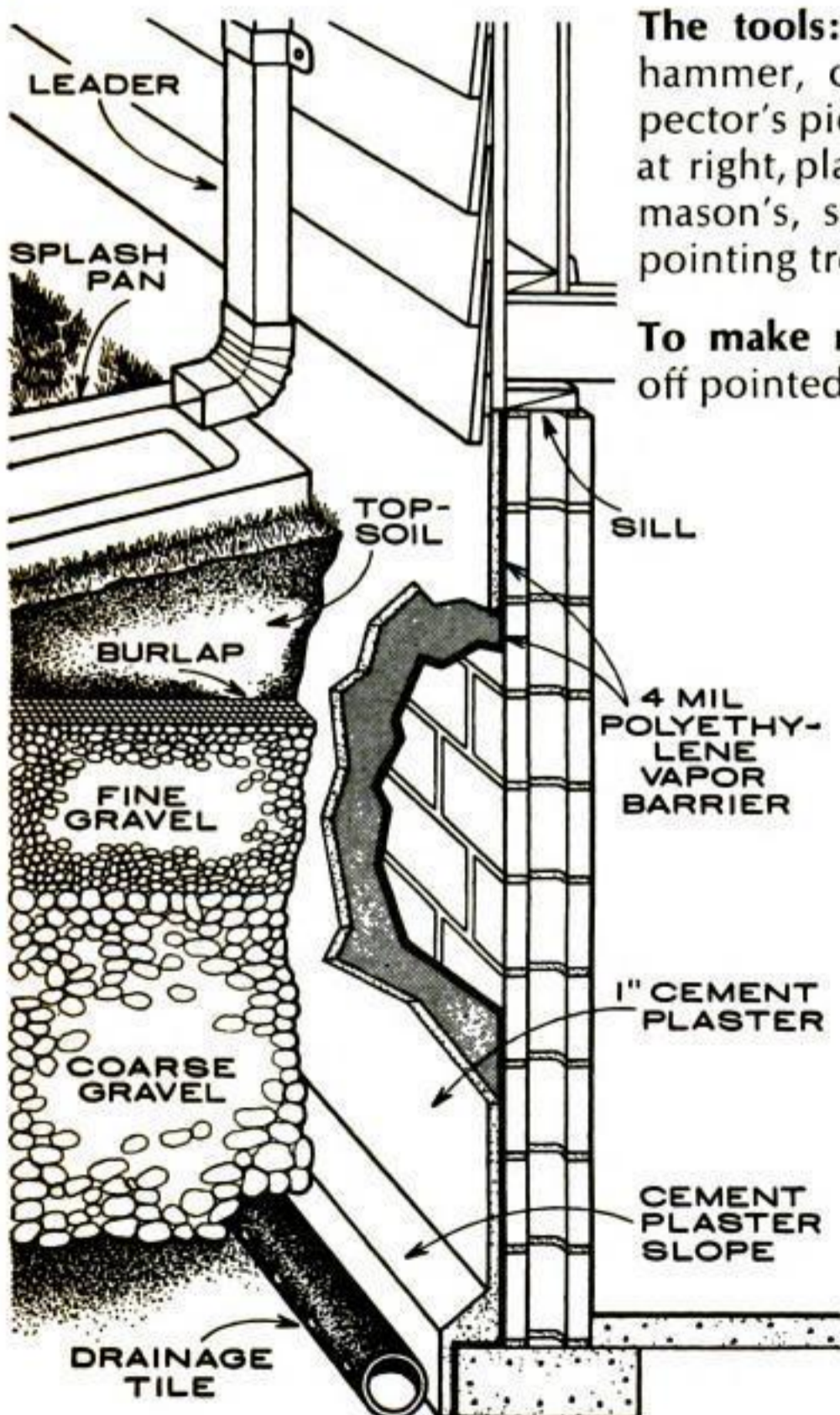
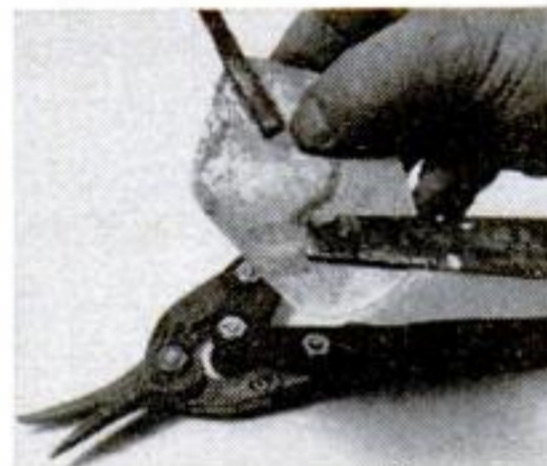
- Epoxy mixes that brush or trowel on a surface, sealing it completely, adhering indefinitely. These mixes come in two-can put-ups, or in a single can that contains the "body" in a plastic bag and the hardener in a small bottle. (The can is for mixing the two together.) Two quarts of the stuff will coat a typical wall—not too deeply textured—10' by 10'. The cost: about 15 cents a square foot. Typical brands: Epoxite by Boyle-Midway, Perma Cement by C.G.M. Inc., and Zap! by Construction Chemicals Corp.

- Hydraulic cement, a fantastic material that sets in minutes, even in the middle of gushing water, and has a tendency to increase in volume (instead of shrinking, as ordinary cement does) when it sets. Because of the quick set and the "cork" effect,



The tools: At left are mason's hammer, chipping chisel, prospector's pick, cold chisel. Above at right, plaster, round-end, small mason's, square-end, and tuck-pointing trowels.

To make round-ender, snip tip off pointed trowel, deburr edges.



Five steps in patching a cracked basement wall



Hammer and chisel-chip the edges of crack. Undercutting avoids thin, nonsetting edge in patch. (Widen crack to 3/4" for ordinary



patching cement or hydraulic cement.) Above, holding plaster trowel as "hawk," trowel mortar in firmly with square-ender

Construction details that insure a permanently dry basement are shown in architect's drawing. It's something to keep in mind when building your next home.

Keep water outside by plugging up your walls from the inside?
You can, in most cases, with the magical new materials

for Leaky Basements

By JACKSON HAND

you can use it to plug holes and cracks that no ordinary material could handle, because it would simply wash away. Typical brands: Rockite by Hartline Products, Waterplug by Standard Drywall, Quick Plug by Reardon Co., and Hydraulic Cement by Rutland.

● Cementitious paint, a special formulation of cement and adhesive materials that can be mixed to thick paint consistency and brushed on a wall that has a tendency to weep all over. Worked well into pores and hairline cracks, it becomes part of the wall. As a bonus, you get a lovely white wall, or you can tint it with cement colors. Most common brand is Thoroseal, by Standard Dry Wall.

● Aggregate paints, which are similar to ordinary paints, but with solids intermixed in the liquid. The paint-type material provides adhesion and water resistance, while the aggregates fill pores and small cracks. One brand is Super Sahara, made by U. S. Paint, Lacquer and Chemical Co.

One additional material not intended primarily as a basement-leak remedy but mighty useful in that role is a special cement mix that will set even in thin layers or small quantities—which ordinary cement will not. It can be used effectively as a trowel-in filler for cracks. The waterproofness comes from an overcoating of one of the materials mentioned above. Top 'n Bond is one brand—part of the well-known Sakrete line.

Why walls leak. Three basic kinds

of leaks plague home owners. Sometimes an entire wall may weep—continuously wet, sometimes with trickles, sometimes just everlasting beads of moisture. The reason for this is overall porousness of the basement wall material and failure of the contractor to coat the outside properly.

Sometimes a wall leaks through cracks, or through the mortar lines in block construction. This can be more serious than a little creek of water running across the floor. It may mean that external pressures are too great, and the wall is in actual danger of breaking inward. Lay a straight plank across the area; if you detect a bulge, call in a construction specialist.

Most often, a basement wall leaks at the base, where the wall was built atop the slab. This provides a joint that can leak, and that does so often because it is at the bottom of the wall where hydrostatic pressure is greatest. (Actually, with proper construction, the pressure is not greatest there, because a tile drain should have been laid along the footing to carry away water that runs down the wall.)

Actively running leaks. Let's start with the most bothersome leak—although it is not necessarily the hardest to fix. First—are there predictable dry periods? If so, the crack can be filled with ordinary sand-mix cement. If you can't wait for a dry situation, use hydraulic cement. Follow these steps:

- Chip away all loose masonry.
- Chisel the edges of the crack at

right angles—or as near right angles as possible—to the surface. This minimizes the danger of poor set-up of the filler material. Do not deliberately widen the crack if you will fill with Top 'n Bond-type material. But if you plan to use hydraulic cement or a regular sand-mix, make the crack at least $\frac{3}{4}$ " wide.

● The accompanying photos show the basic techniques for troweling cement into the crack, when it can be handled during a dry period.

● Working in a wet situation, with hydraulic cement, form the material into carrot-shaped spears (radish-shaped for shallower cracks) and thrust them into the crack, side by side, each blending into the other.

● Hold each application in place with your hand until it hardens sufficiently to stay by itself—usually two to five minutes.

● Slice off any hydraulic cement that rises above the surface.

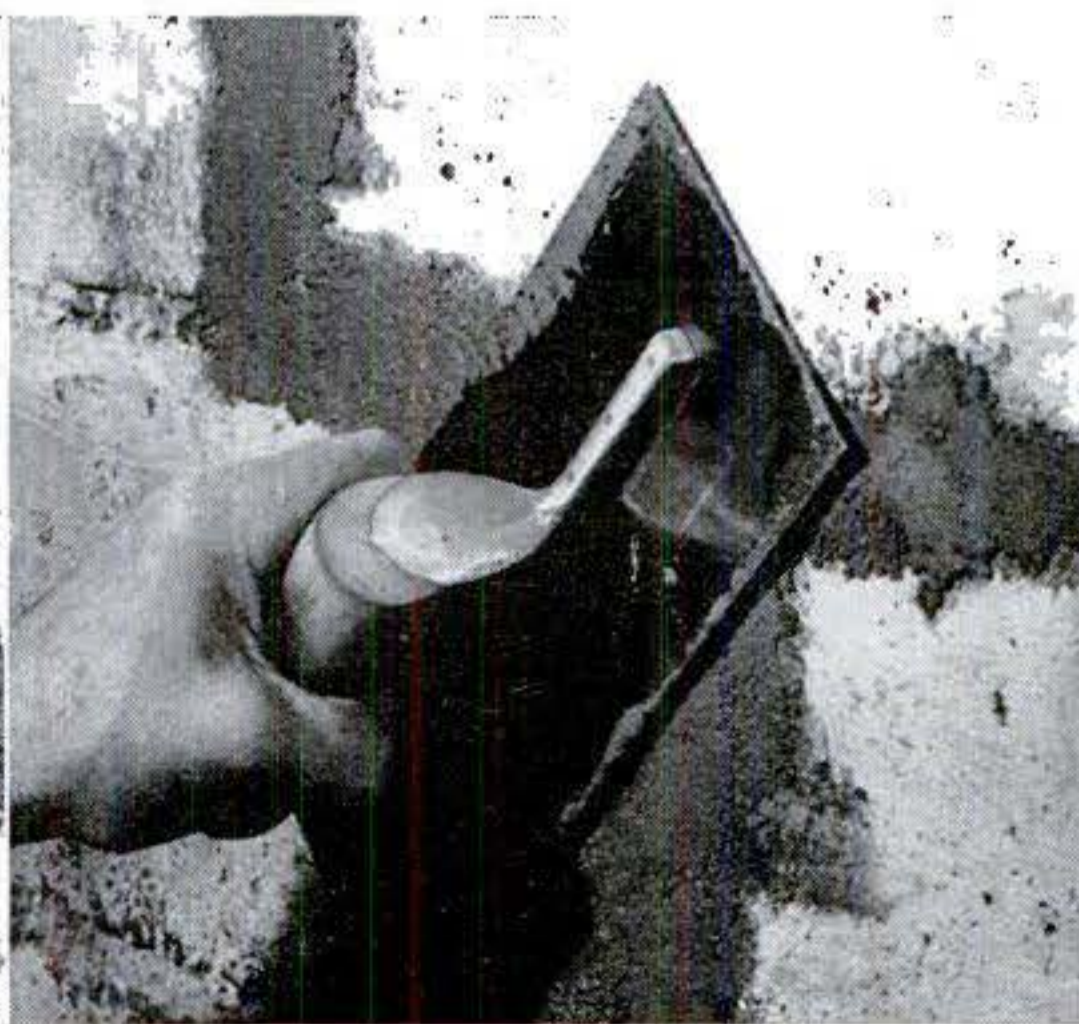
Important: Read individual manufacturers' instructions for any variations in methods. And wear rubber gloves or use the plastic-bag technique shown in a photo on the following page, because hydraulic cement—like any other—may be a skin irritant.

If you press hydraulic cement firmly into the crack and eliminate voids, you should have a dry wall almost immediately. If there are still dribbles, go back the next day with smaller "carrots" to hit the voids. A final step may be to paint the wall, if

Continued



or small mason's trowel. Narrow tuck-pointing trowel (above) is handy for forcing material into crack, filling it completely.



Alternate tuck-pointer and spreading trowel until crack is jammed full. Plaster trowel (above) then reverts to normal smoothing



job. Final step: cementitious paint to fill remaining cracks and pinholes, smooth the wall, and make the color uniform.



Mixing trick: To avoid handling hydraulic cement, which may irritate skin, mix it in sandwich bag. Apply stuff in gobs when it starts to feel warm to the touch.



For a cove, special mixes such as Top 'n Bond are excellent. Clean and dampen cove area, trowel in cement, smooth with round-pointer, finish with a sealant.

appearance is important. Use a cementitious paint or one of the latex formulas that work excellent on masonry. The cementitious paints can be tinted, or used white or gray.

Leaks at the base of the wall. It's best, if possible, to wait for a dry spell to work at the base of the wall. If you can, the "cove" system, shown in the picture above, at right, will work. If you can't, you'll have to chisel a crack along the wall to accept hydraulic cement.

Assuming a dry spell, all you need to do is chip away any loose masonry, sweep the area dustless clean, dampen it thoroughly, wipe up standing water, and trowel cement firmly into the crevice. Cutting an inexpensive trowel into a round-tip version (see photo on first page of article) gives you a tool that will lay and smooth an ideal blend from floor to wall.

After the cove has hardened, brush on a coat of the epoxy sealant, the cement paint, or the aggregate paint.

This treatment takes advantage of the extra adhesive qualities of the cement, plus the sealing qualities of the topcoating. However, remember that the hydrostatic pressure can be great—especially if the earth outside the wall is full height—and most especially if downspouts do not deliver water well away from the basement wall. That's why it may be necessary to take the laborious route of outside digging and tile laying, which should have been done in the first place.

When the whole wall weeps. It is standard construction procedure to coat the outside of a basement wall with asphalt or other material that makes it waterproof. When this coating deteriorates—or when it is inadequate, or neglected—most concrete or concrete-block cement walls will seep moisture constantly.

The problem can be licked without too much trouble, except in extreme situations. If the wall is actually running with water, it would sluice away

any material you tried to coat it with. However, most of the coating materials can be applied over surfaces that are damp; in fact, spraying the wall is often part of the routine.

If you can wait for a dry spell to cut down water below the flow level, do so. If you can't, you may want to resort to a trick professionals use. Deliberately cut holes through the wall at the base, and let the pressure drain away. Then apply the material to the entire wall, and finally use hydraulic cement to plug the weep holes.

It is important to check instructions carefully when you use any of the brush-on materials. They call for careful preparation of the surface; some may be used over paint, others won't stick to paint; some require removal of whitewash; some call for dry surfaces.

In all cases it is important to lay the stuff on and work it into pores and cracks—never brushing it out thin. Two coats are usually recommended, and in some cases the manufacturer suggests a base coat of one material, topcoated with another.

What can you do outside? Although most leaky basement problems can be handled from the inside with today's materials, there are still operations that can be—must be—taken care of outside.

First, be sure that downspouts carry rain well away from the foundation or are connected to a storm drain.

Second, be sure that the pitch of the soil around the house is away from the wall. Even when the lay of the land is such that the entire yard cannot slope away from the house, it is generally possible to make it slope

[Continued on page 117]

Leaky-basement repairs at a glance

Kind of Leak	Material	Preparation	Application	Topcoat
CRACK				
Running water	Hydraulic cement ¹	Chip crack to width no less than 3/4"; remove all loose particles	Mix small quantities, form between hands and press into crack in successive globs	For looks only
Dry	Regular cement ²	Chip crack to 3/4" with square or undercut edges; dampen	Small trowel or tuck-point trowel	Epoxy or cementitious paint
	Top 'n Bond or Watta Bond	Remove loose particles and dampen	Trowel	Epoxy or cementitious paint
Hairline	Cementitious paint such as Thoroseal	Clean area down to bare cement; dampen	Heavy brush	For looks only
BASE OF WALL	Regular cement	Chip away all loose masonry material; cut groove 3/4" wide and deep if possible; dampen	Square-tip or round-tip trowel	Epoxy or cementitious paint
	Top 'n Bond or Watta Bond	Remove loose material; brush clean; dampen; no free water	Square-tip or round-tip trowel	Epoxy or cementitious paint
OVERALL WEEPING WALL	Epoxy ³	Remove all loose paint, crumbling masonry particles; dampening unnecessary, but material sticks to damp surfaces	Brush	For looks only
	Aggregate paint	Same	Brush	For looks only
	Cementitious paint	Clean surface down to bare concrete; dampen	Brush	For looks only

Important: Be sure to read manufacturers' instructions carefully, since each material may have individual preparation or application requirements. 1) Waterplug, Standard Drywall, Bristol, Pa.; Quick Plug, Reardon Co., St. Louis, Mo.; Rockite, Hartline Products, Cleveland, Ohio; Hydraulic cement,

Rutland Fireclay, Rutland, Vt.; C.G.M., Inc., Trevose, Pa. 2) Sakrete, Standard Drywall; Watta Crete, Canaan, Conn.; Embecco, Master Builders, Cleveland. 3) Zap, Construction Chemicals, Danbury, Conn.; Epoxite, Boyle-Midway, New York, N.Y.; Epoxy Coatings, Hayward, Calif.

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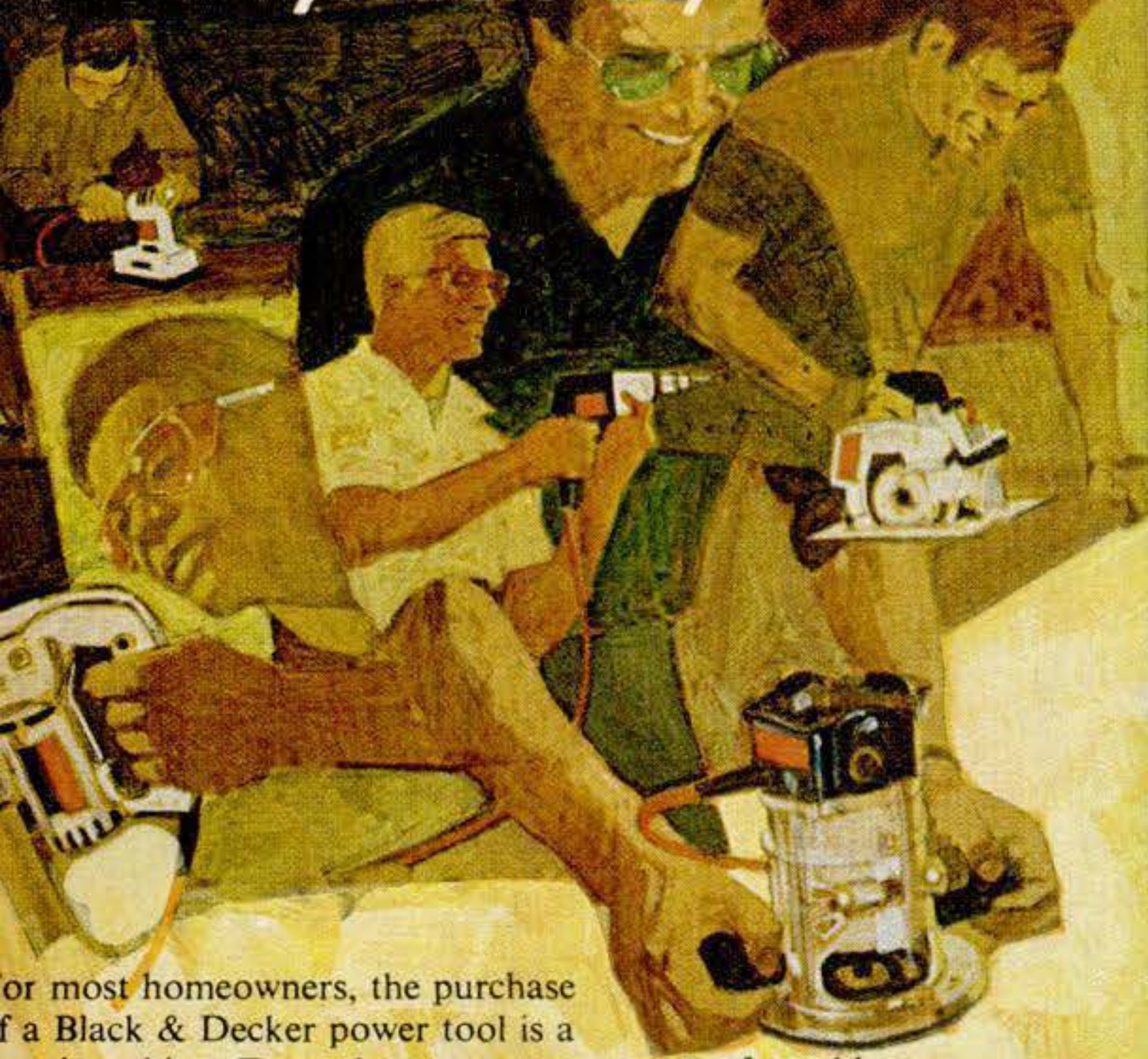
Or:

See your Navy man right now. He's listed in your phone book under U.S. Government, Navy. He's got all the answers—or he knows where to find them.

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Send in the attached coupon and we'll send you some more information.

possibly the only power tools
you'll ever buy



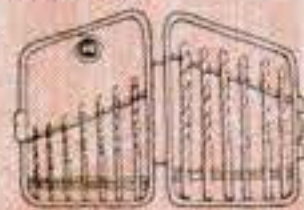
For most homeowners, the purchase of a Black & Decker power tool is a one-time thing. From then on, you get years of trouble-free service from drills, saws, sanders, and other tools crafted as carefully as the projects you create. To do a job right, do it with a tool that's built right... B&D. For your dealer, call free, (800) 243-6000. Conn. (800) 882-6500.

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the ultimate drill?

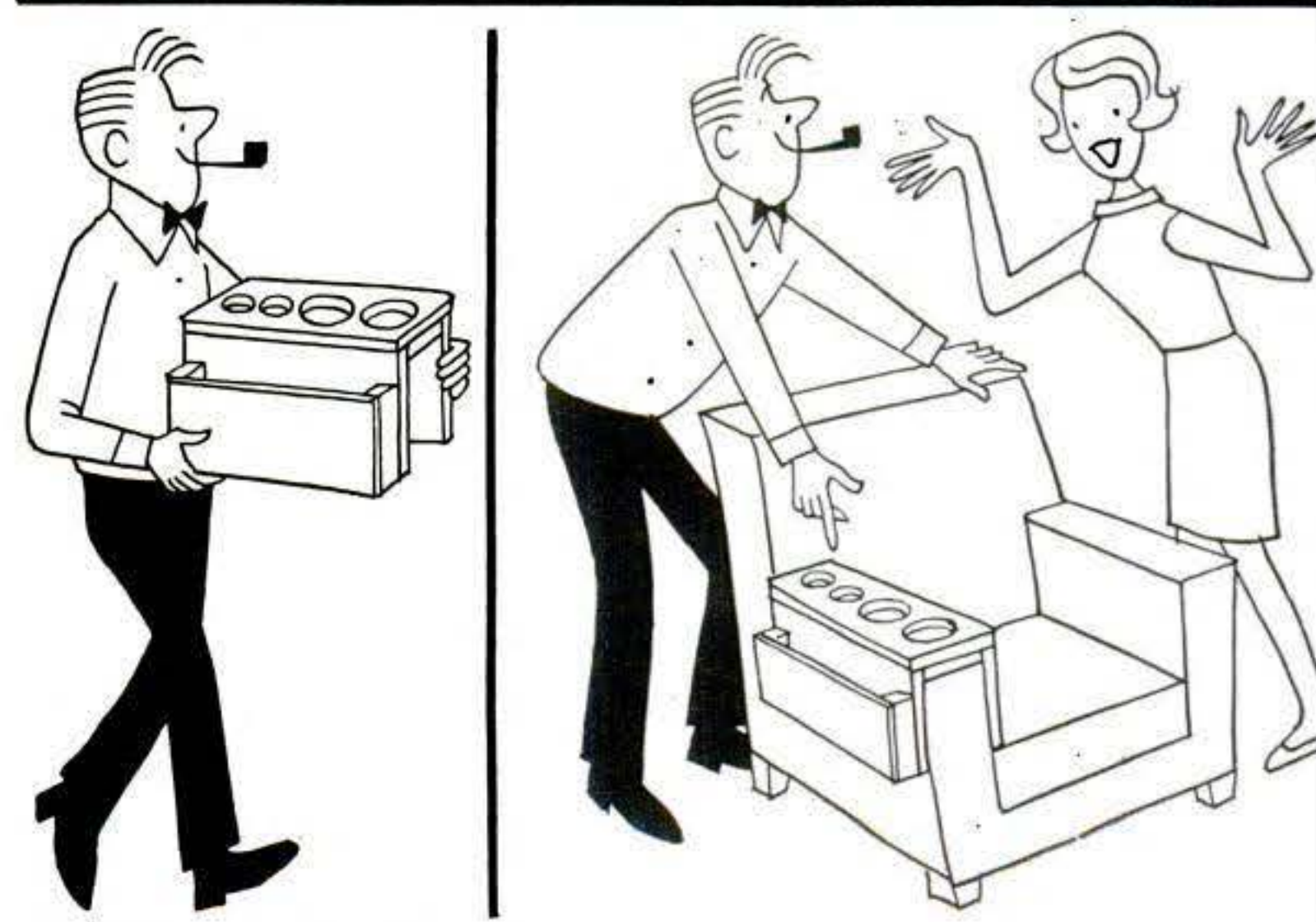
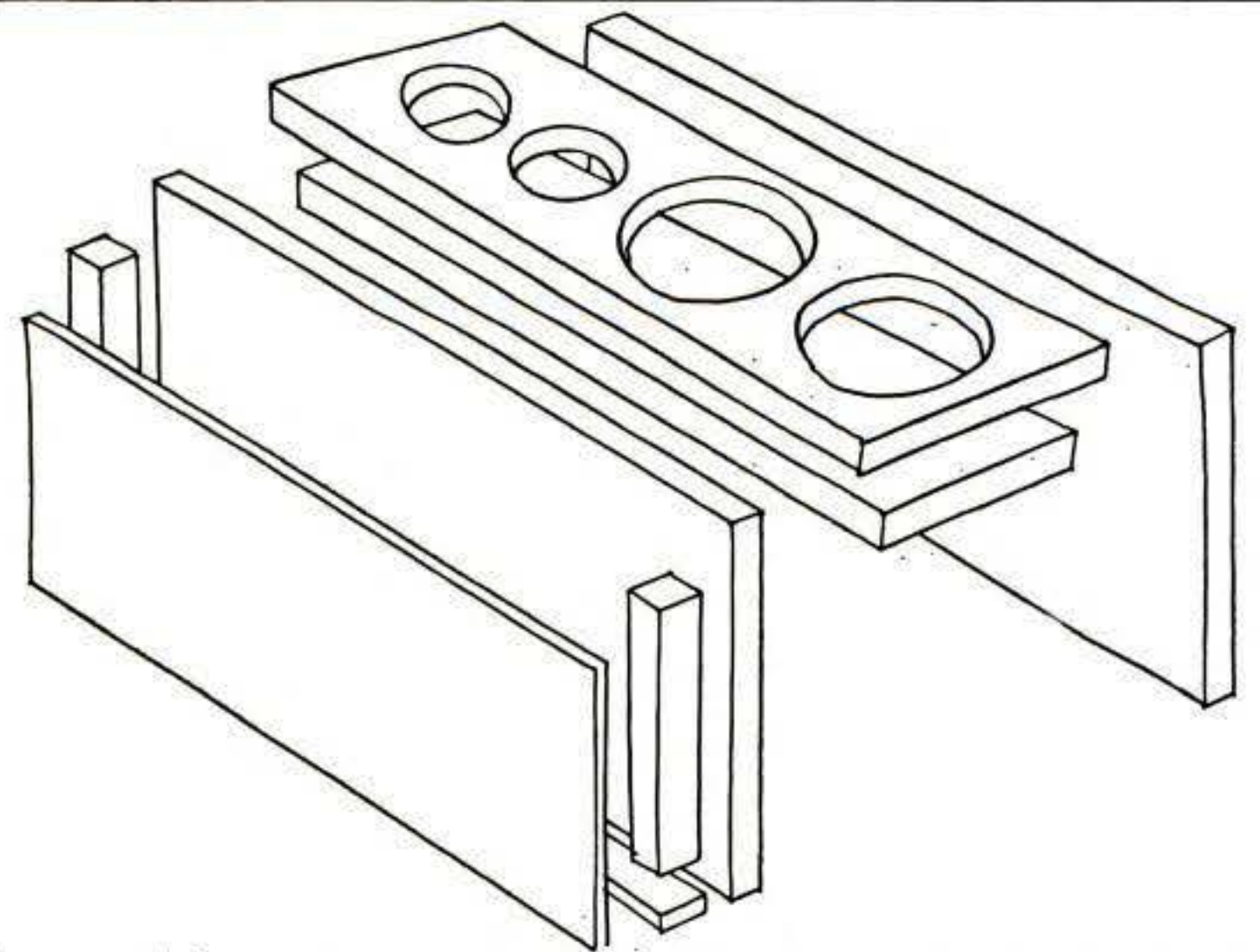
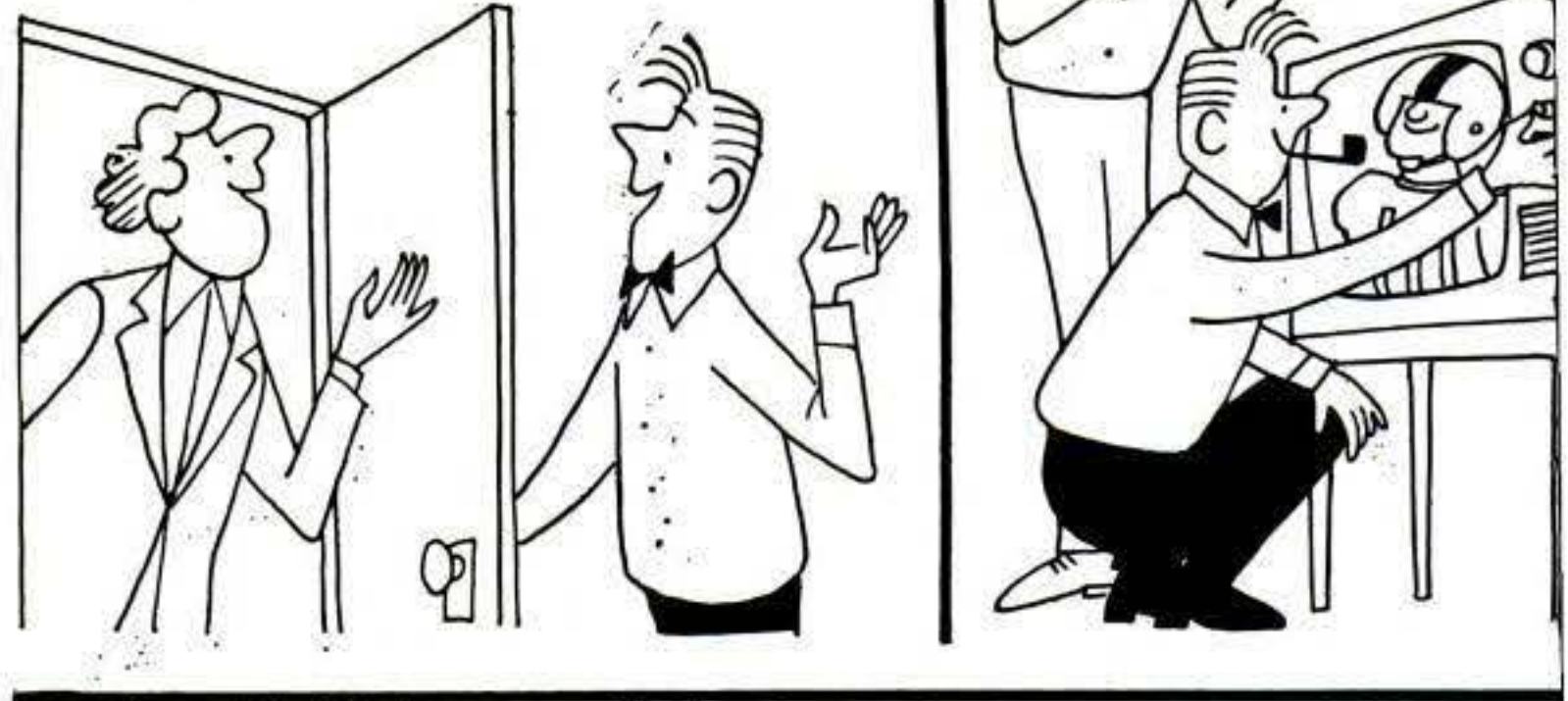
Handle dozens of jobs with B&D's 3/8" Variable Speed Reversing Drill. Accelerator trigger matches speed to job. Reverses to back off screws, nuts, etc. Double insulated to eliminate grounding. 7150 \$39.99, 13 high speed bits in case U1564 \$6.99.

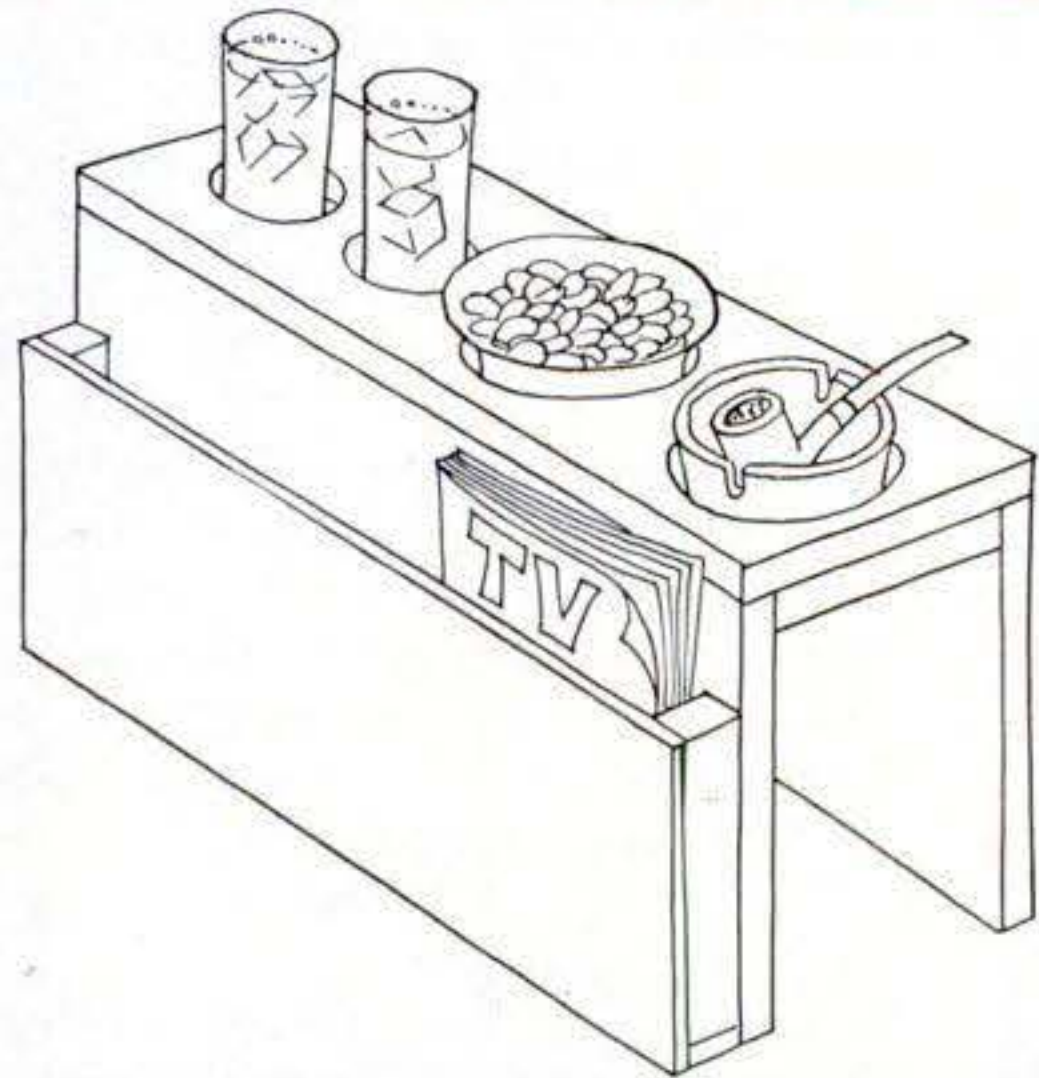


expect the best from Black & Decker

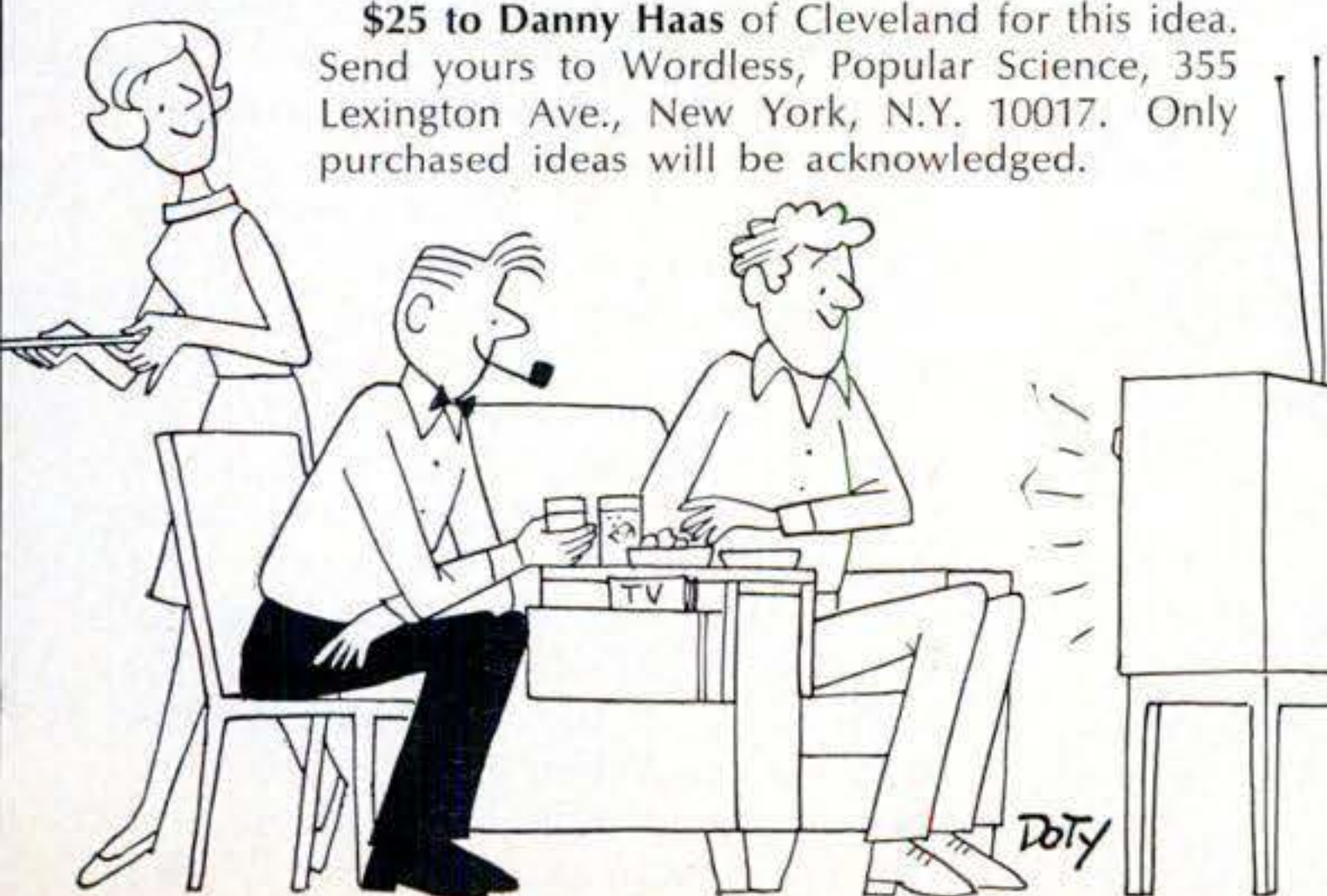
Wordless Workshop

By ROY DOTY

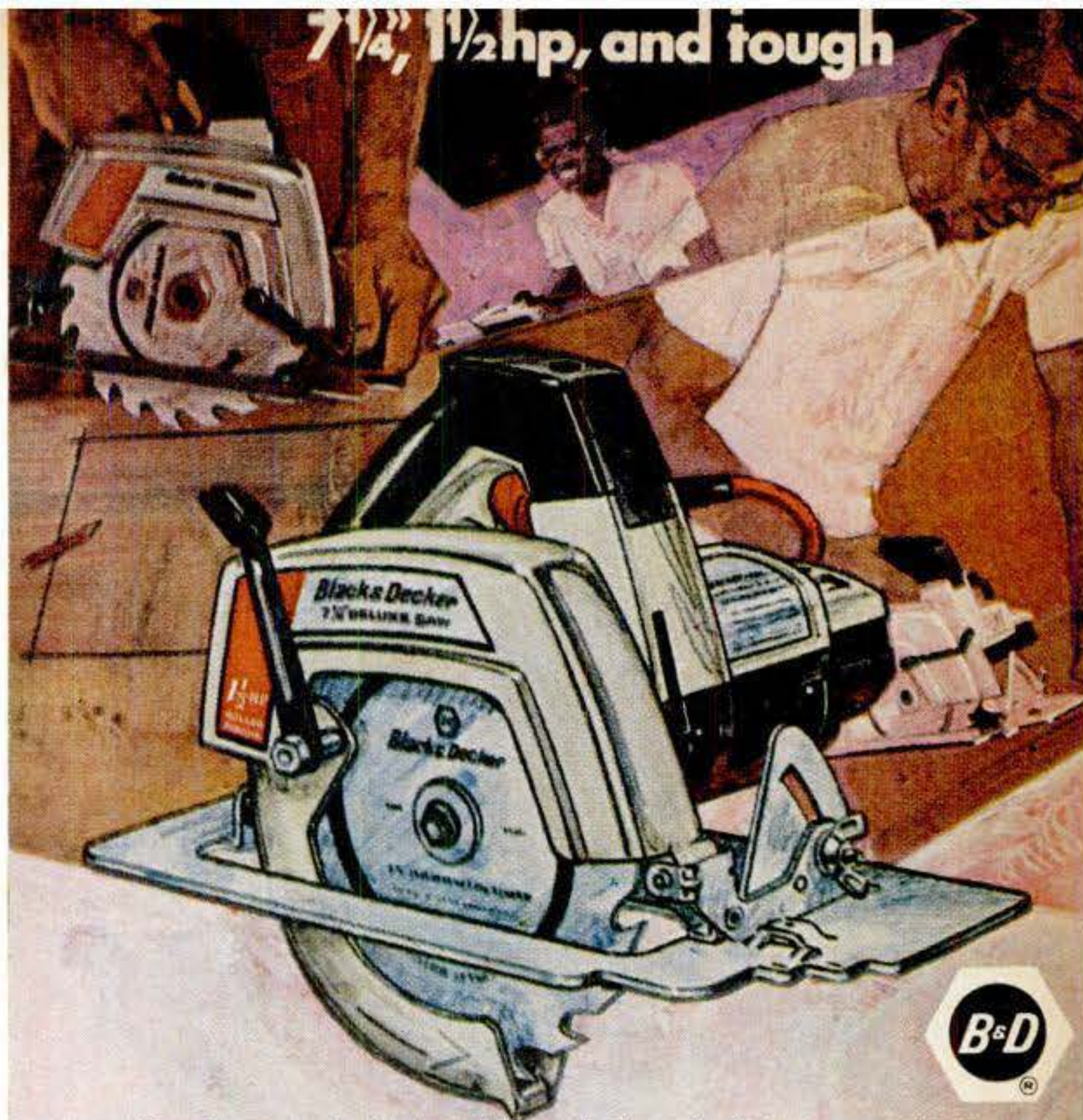




\$25 to Danny Haas of Cleveland for this idea. Send yours to Wordless, Popular Science, 355 Lexington Ave., New York, N.Y. 10017. Only purchased ideas will be acknowledged.



7 1/4", 1 1/2 hp, and tough



B&D

Here's a saw built to delight the hand of the man who knows what he's doing. Cuts 2 3/8" at 90°, 1 7/8" at 45°. Work-hungry 1 1/2 HP motor has roller bearings at heavy load points for smooth action and long life. Excellent balance and control. 7320 \$39.99. 3 in 1 Blade Pack . . . three most popular types, \$8.27 value, 73-300 only \$5.99.



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two sanders in one



B&D

Get double duty out of B & D's Deluxe Dual Action Sander. A flip of a lever converts it from orbital action for fast sanding to straight line for fine finishing. Flush sands on three sides. 7420 \$24.99. Also an assortment with dustless attachment, 10 sheets of abrasive paper, filler, spatula. \$35.12 value, 7421 only \$29.99.



expect the best from Black & Decker

Five-Door Phone Booth

for Your Family Room

By A. J. HAND
PS Home Workshop Editor

If you've ever tried to hold a phone conversation over the sound of a rousing game of Ping-Pong, you know what our family-room phone booth is for. Step inside the carpet-lined booth, close the twin cafe doors, and you're suddenly in a private world of your own.

Industrial designer Gary Gerber created the phone booth out of five doors—the twin cafe doors plus three stock flush doors that form the H-shaped structure itself. Take a look around back of the booth and you'll find a handy bonus—a compact wardrobe with plenty of space to store jackets, boots, and hats.

How to make it. To start, fasten the three flush doors together using four 3" T braces and white glue. Then add the rear shelf to make the assembly rigid.

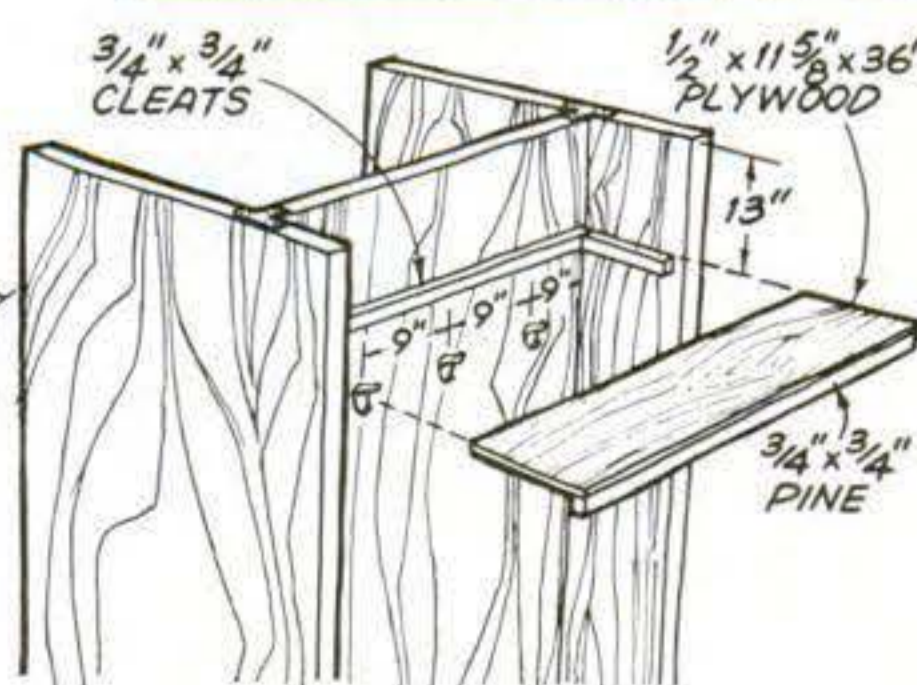
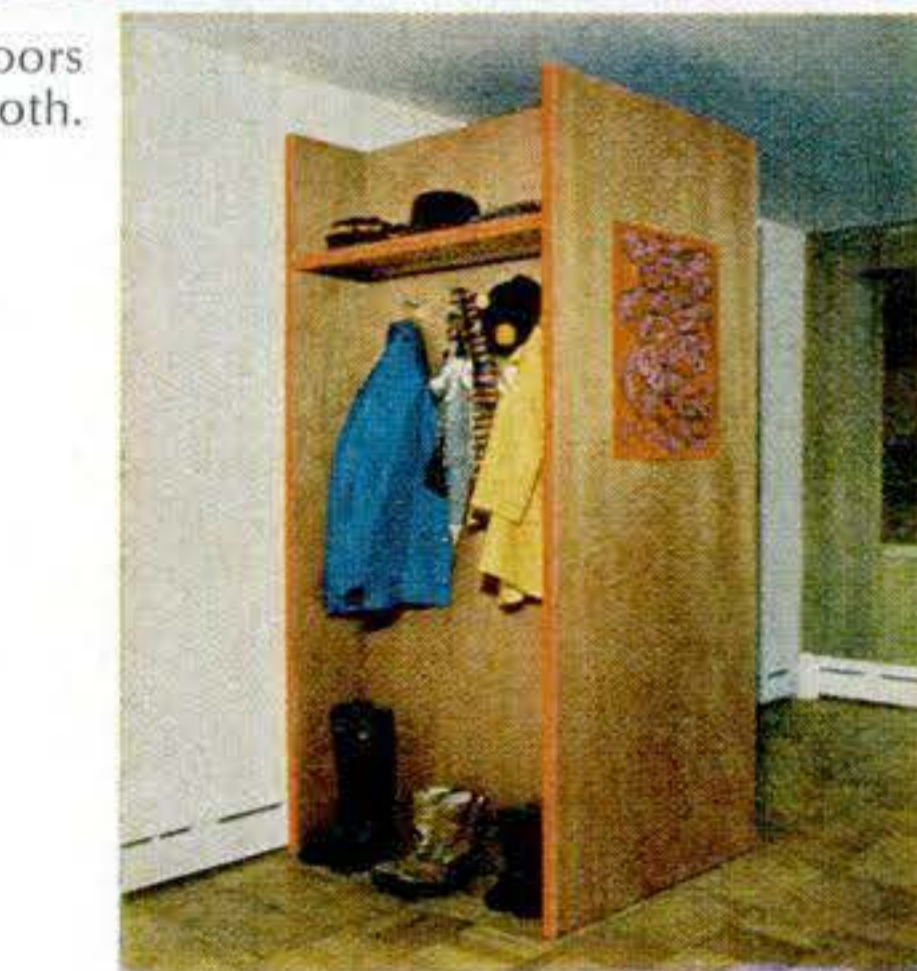
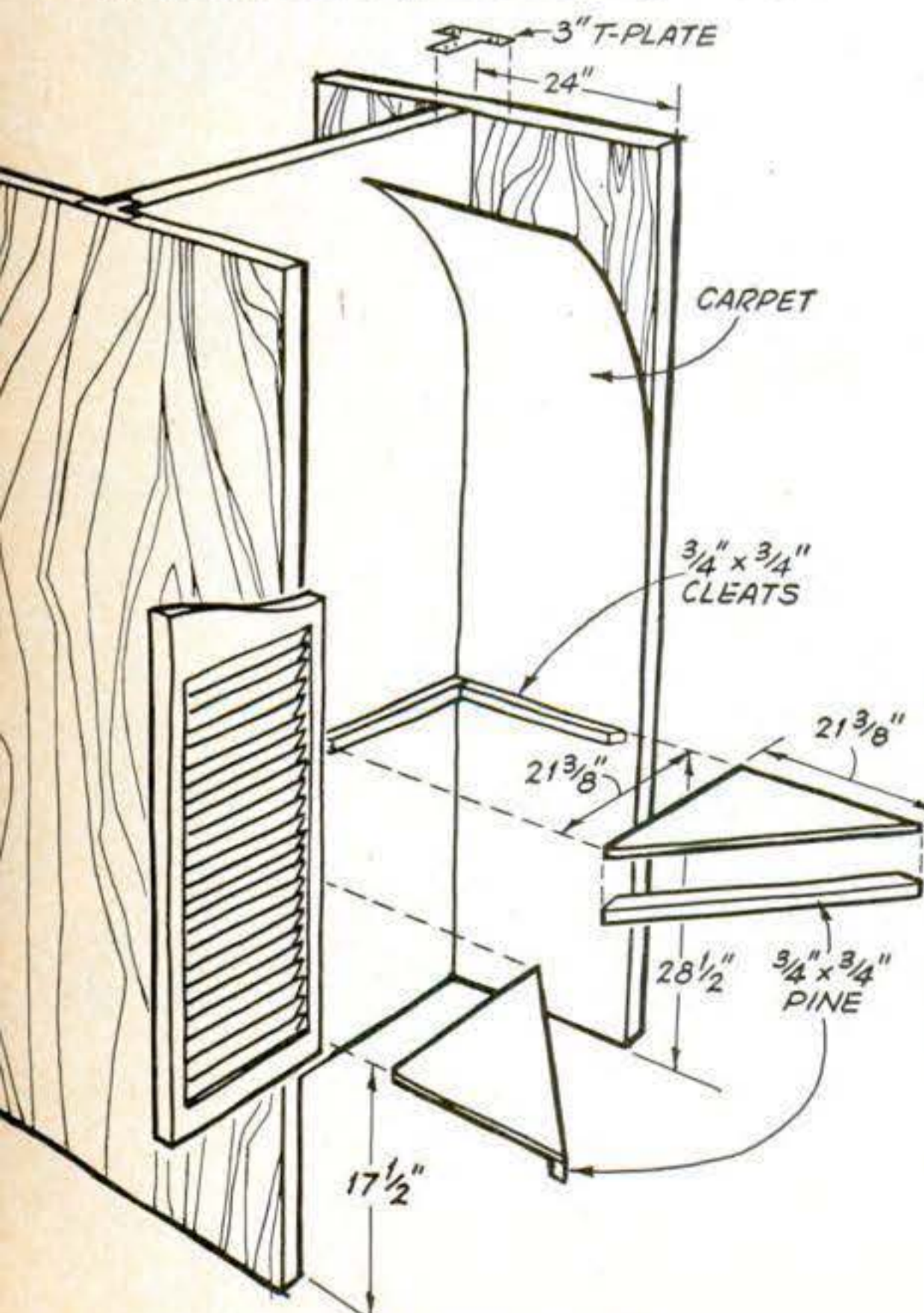
The carpet lining comes next. You'll need three pieces: one 36" by 80", and two 24" by 80". The type with foam-rubber backing is the easiest to apply. (Another alternative? Self-stick carpet tiles.) Apply carpet with ordinary carpet cement; this is easiest if you lay the booth on its side while you work.

Now before that cement sets completely, measure up from the bottoms of the door panels to find the position of the triangular shelf and seat. Take a sharp knife and cut away the carpet where the blocking for the seat and shelf goes. Clean off any remaining cement, then glue and nail the blocking in place, and install the seat and shelf.

Trim both 3' cafe doors to 17 1/4" wide and mount. Add coat hooks around back. Pick an accent color from the carpet and use a matching enamel to paint shelves and seat, the cafe doors, and flush-door edges. Finally apply a natural finish to the flush doors. When it's dry, step inside, dial your neighbor, and ask him over for a game of Ping-Pong. **PS**



Sound-absorbing carpet lining and twin cafe doors cut family-room decibels to minimum inside booth. Phone directories go on the triangular shelf.



Bonus in back of booth is a wardrobe for storage of outdoor clothing. Five-door booth is made of three 36"-by-80" flush doors and two 3' louvered cafe doors.

Nothing runs like a Deere



New John Deere JDX Snowmobiles. The styling will send you. The spirit will move you.

Take charge of a blitz-black JDX8 and take off for high-performance action. Command the responsive power of a 438cc reed-valve engine. Conquer the curves with shock-cushioned steering and wide-stance skis. Feel how John Deere's trailing-arm bogies help soften washboard bumps. Ride an energy-absorbing seat that's deep-cushioned for day-long comfort.

Speedometer, tachometer, shock absorbers, cushioned handlebars, carbide-inserted skis, and storage cover are all standard JDX8 equipment. A lot of snowmobile for your money.

And for even less you can ride our snappy JDX4. Same sharp styling with a twin-cylinder 292cc engine developing 25 h.p. Only \$995*. Your John Deere dealer has financing and color-matched snowmobile fashions.

For folder write John Deere, Dept. SM, Moline, Ill. 61265. For the name of your nearest dealer see the Yellow Pages or phone toll-free, any time, 800-243-6000. In Connecticut call 1-800-882-6500.

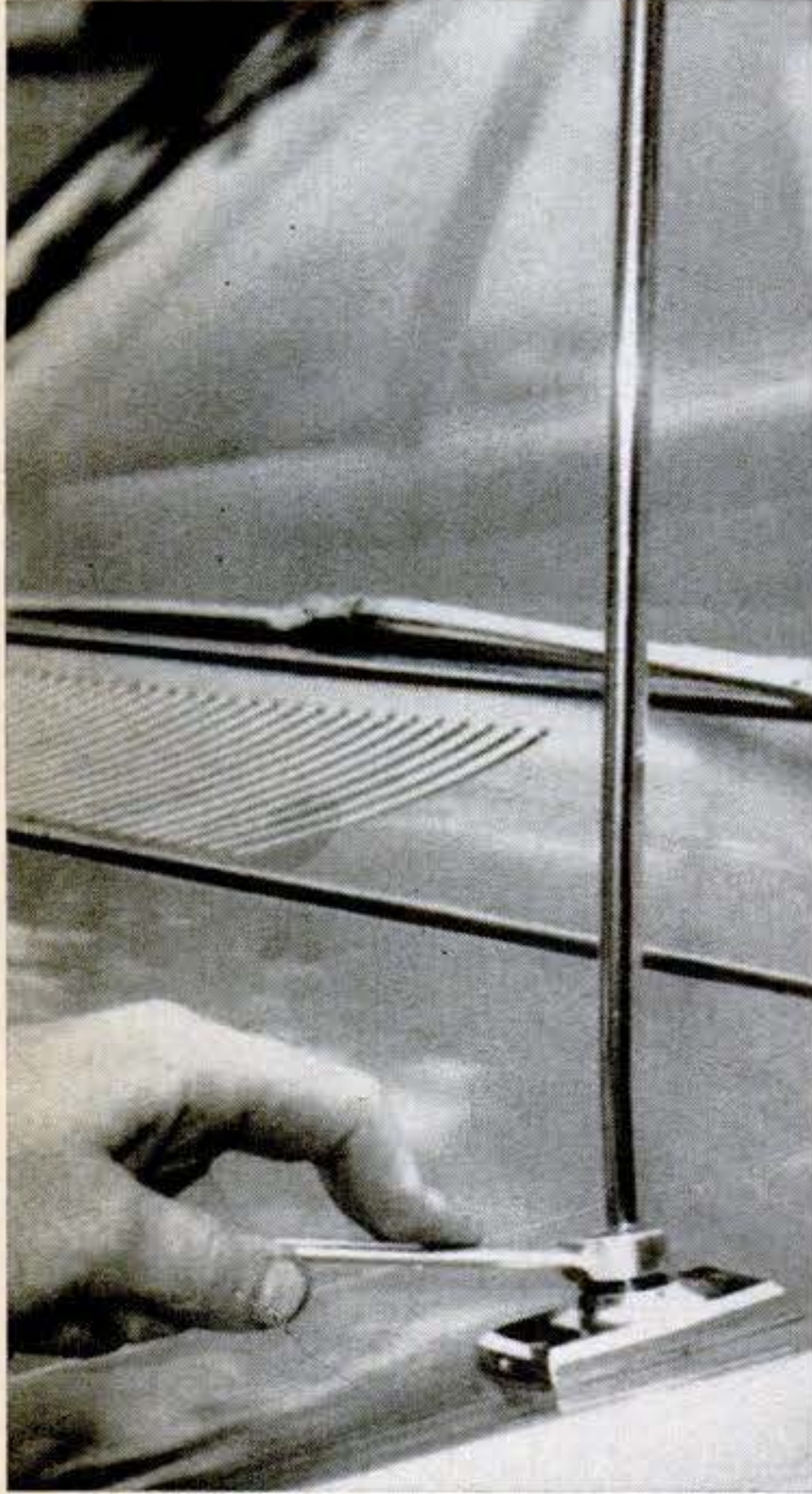


*Manufacturer's suggested U.S. retail price, excluding freight.

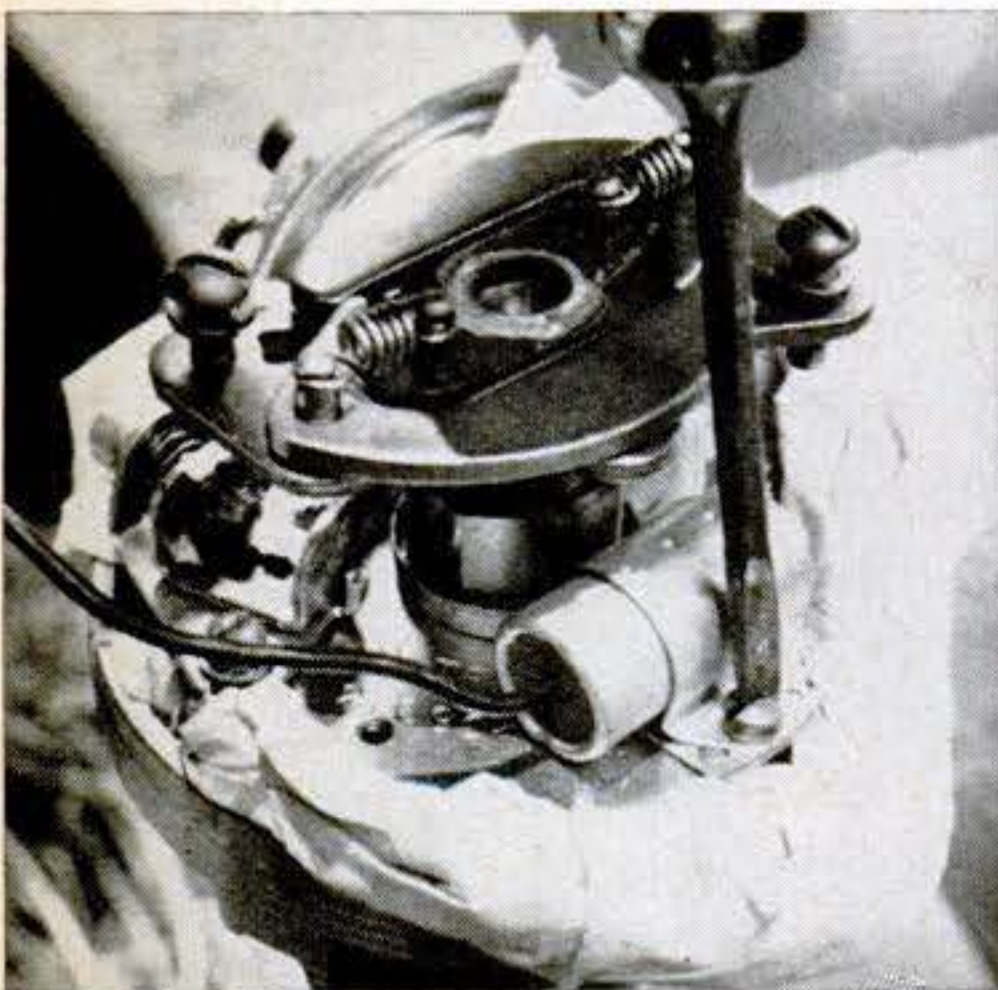
Taking Care of Your Car

Good hints others have used

Got a car tip? We pay \$25 for each one accepted. Send it to Car Care, Popular Science, 355 Lexington Ave., New York, N.Y. 10017. None are returnable.



A loose antenna can lead to excessive radio static and mast breakage. When installing a new antenna, or tightening an old one, tighten until the mast-stud shoulder bottoms against the threaded insert of the antenna base. Then tighten another $\frac{1}{8}$ ".



When replacing points and condenser or disassembling centrifugal-advance weights and springs for lubrication, stuff paper or rags around the breaker-plate openings so that if any screws slip out of your fingers they won't drop under the breaker plate.



Flushing your car's cooling system can be quick and easy with this flushing tee made from standard pipe fittings. Cut a 4" nipple in half and screw one half in one end of the tee and the other half in the opposite end. Then screw a standard pipe plug into the bull of the tee and splice the tee into the heater hose with hose clamps. An adapter for flushing can be made by fitting a pipe nipple into the end of an old garden hose. Now you can flush the cooling system conveniently whenever you want.



Bolts with rounded heads in hard-to-reach places—such as below an exhaust manifold—can sometimes be removed with a metric socket that's slightly smaller than its American counterpart. For example, a 14mm socket can be used on a $\frac{7}{16}$ " rounded head.



Thermostat working? You can check it by placing it in a baby-bottle warmer. With a thermometer that reads above the boiling point, note the temperature at which the thermostat opens. If it doesn't open at its rated temperature, it's bad. Replace it.



Any one of these four oils is right for your car.

Sunoco Special takes all the worry and confusion out of buying the right oil for your car. You see, Sunoco Special 10W-40 is really four oils in one.

It does all the work of a 10W, 20, 30 and 40 motor oil. Sunoco Special is one oil you can use in both summer and winter—in fact, all year round. Sunoco Special meets or

exceeds the warranty standards of all car manufacturers.

What's more, it gives you extra protection against thickening or breaking down under heavy-load, high-speed driving conditions. So change to Sunoco Special and know you're getting the right oil for your car...the right oil for all seasons, all driving conditions.

Sunoco Special. The long mileage motor oil.

At Last—a Low-Cost

Ground-Fault Interrupter



Quik-Gard from Square D replaces conventional circuit breakers. Test button simulates ground-fault condition, causing the breaker to open and indicator lamp to light.

GFI's kill the power before the power can kill you. And soon, they'll be mandatory

By **WILLIAM J. HAWKINS**

PS Electronics Editor

If it happens while you're in the shower fiddling with a portable TV, it's called your fault. If it happens when you dive into a backyard pool that's equipped with underwater lights and electric filter, it's called a ground fault. Wherever the fault lies, however, the only consolation you'll have if you're electrocuted is the assurance that you'll never make the same mistake twice.

What's a ground fault? The unintentional flow of current from the hot line to ground through an appliance—and, possibly, you. Until now, ground-fault detectors that sense this relatively low amount of fatal current have been quite elaborate and expensive. Now, however, Square D has come up with the Quik-Gard, which acts as a conventional circuit breaker for neutral to hot-line shorts, but also

All connections to the GFI are identical to those of a standard breaker except for the addition of a ground wire.

has ground-fault capability. The cost: only \$45.

Ground faults can occur in any electrical device, but generally three conditions must be met:

1) An electrically conductive case of metal on the appliance.

2) Separate ground wire to the exposed metal lacking or lost.

3) The hot side of the power line touching the conductive casing.

When these conditions are met, watch out! The casing is alive. Grab on, and current can pass from the power line through you to the nearest ground. It doesn't take much. Currents in excess of 18ma (18/1000 amp) cause contraction of the chest and halt breathing. Breathing may resume if shock is eliminated, but if it continues, unconsciousness and death will follow in minutes.

A ground-fault interrupter works like a circuit breaker, except that it monitors current flow from hot line to ground. If there's more than 5ma, it trips, interrupting the power and possibly saving your life.

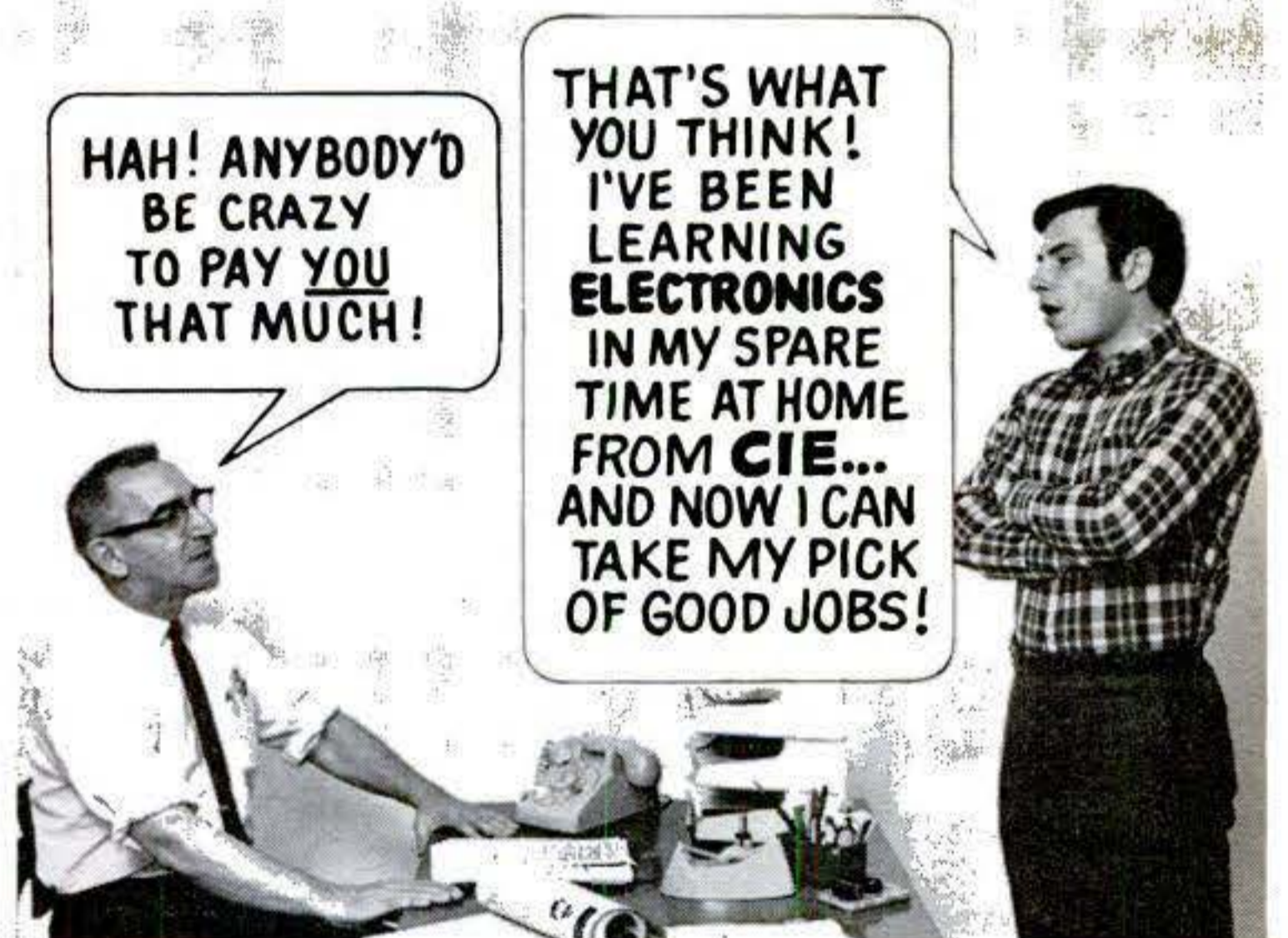
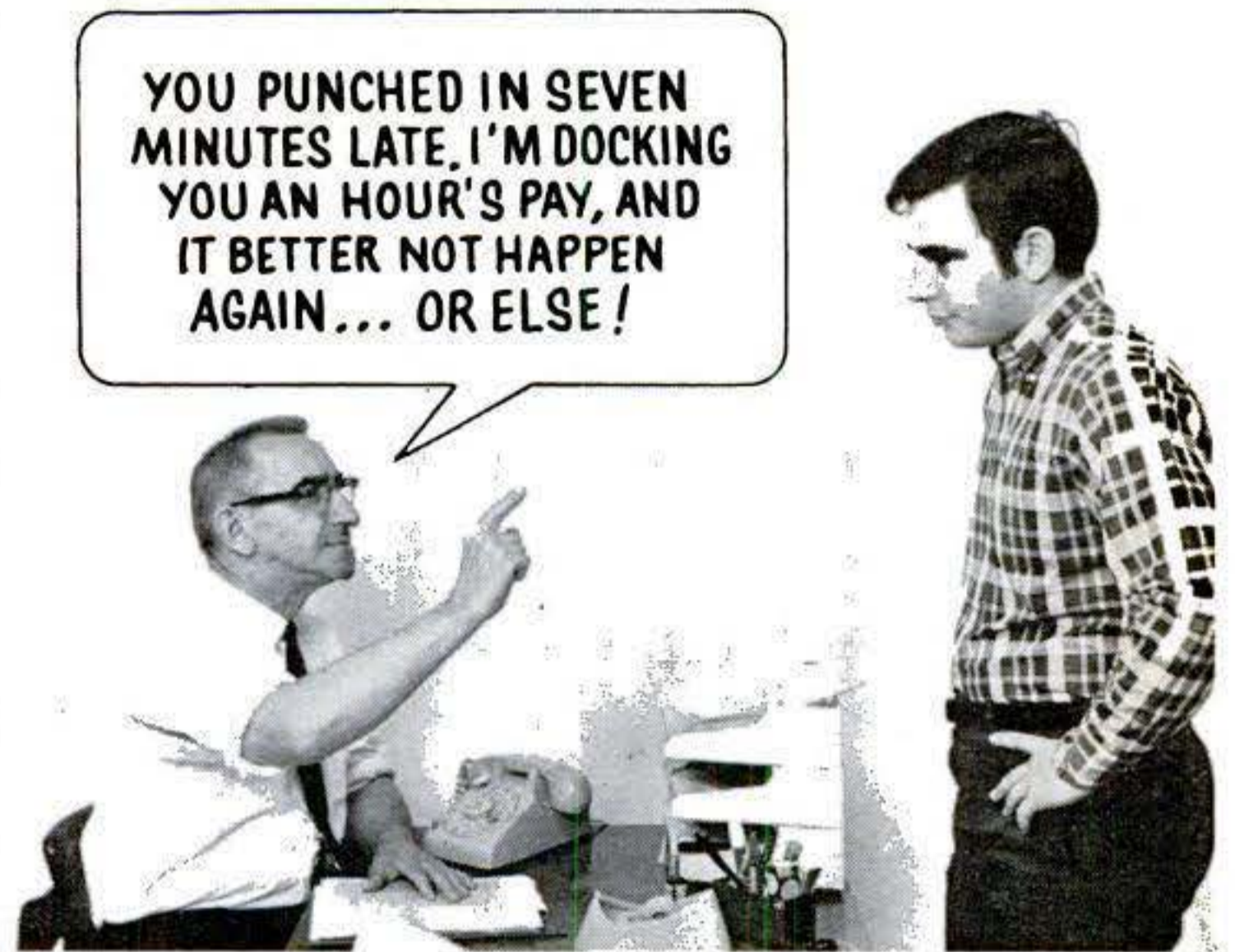
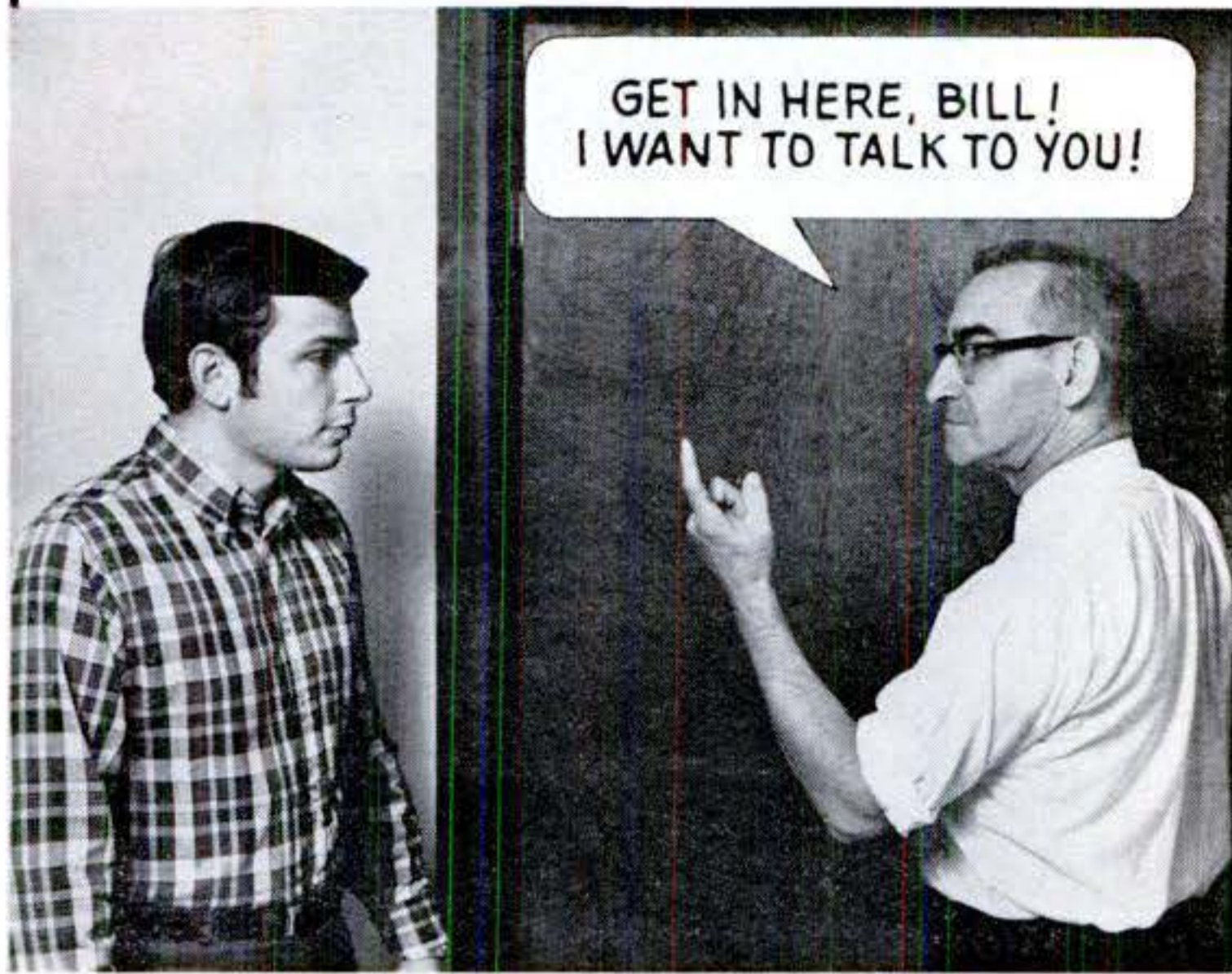
Where do you need protection? Come January, the National Electric Code will *require* ground-fault interrupters on all outdoor, 120-volt, single-phase, 15- and 20-amp receptacles on or around your home. That means any outside outlet you have for your swimming pool, backyard lighting, electric barbecue, and so on. For your own protection, however, you'll do well to extend that protection to any area of your home where electric current and good grounds exist in the same place. The bathroom, laundry, and kitchen would make a good beginning.

Square D has made its unit simple to install by encapsulating the electronic circuit in a standard circuit-breaker container. You merely replace your circuit breaker with the Quik-Gard. Wiring is identical, except for one additional ground wire, which connects to the power-box casing. Simple installation and low cost make the Quik-Gard a very desirable home safety device.

But bear in mind that Quik-Gard, or any other ground-fault protector, only prevents shock hazards from hot lines to ground, not hot line to neutral. Ground-fault interrupters are merely additional safety precautions, not substitutes for standard electrical-safety practices and methods in the home.


PS

The day Bill told off his boss



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It stops them. It'll stop you. Safely and surely. Next time, don't just say "Replace the brakes." Say "Be sure it's Grey-Rock."

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SHOP TALK

By ROBERT P. STEVENSON

Useful new booklet about tools for your shop library

However expert you become in the use of tools, you can always learn something new and useful; I am convinced of that. It's an endless process that sometimes does end, however, when self-complacency assumes control over a one-time eager and inquiring mind.

An organization of tool manufacturers now offers all of us a new chance to learn. This learning approach is commended in a new booklet that the Service Tools Institute is distributing. The booklet's major theme is safety—there's no doubt of that. But keep going and you'll find new facts, too. Members of the Institute make wrenches, pliers, chisels, punches, screwdrivers, hammers, metal-cutting snips and shears, wheel and gear pullers, valve tools, toolboxes, and body and fender tools. Naturally, the 30-page booklet is devoted to such tools. Its title: *Proper Uses and Common Abuses of Striking and Struck Tools*. Cartoon characters depict good and bad practices. Sharpening instructions are included for tools that require it.

It's an excellent book, and if I didn't already have one, I'd get one right away. Send 25 cents (to cover handling) to Service Tools Institute, 331 Madison Ave., New York, N.Y. 10017. Shop teachers may want a copy for each student. For such situations, the Institute offers a price break—15 cents a copy for orders of 100 or more.

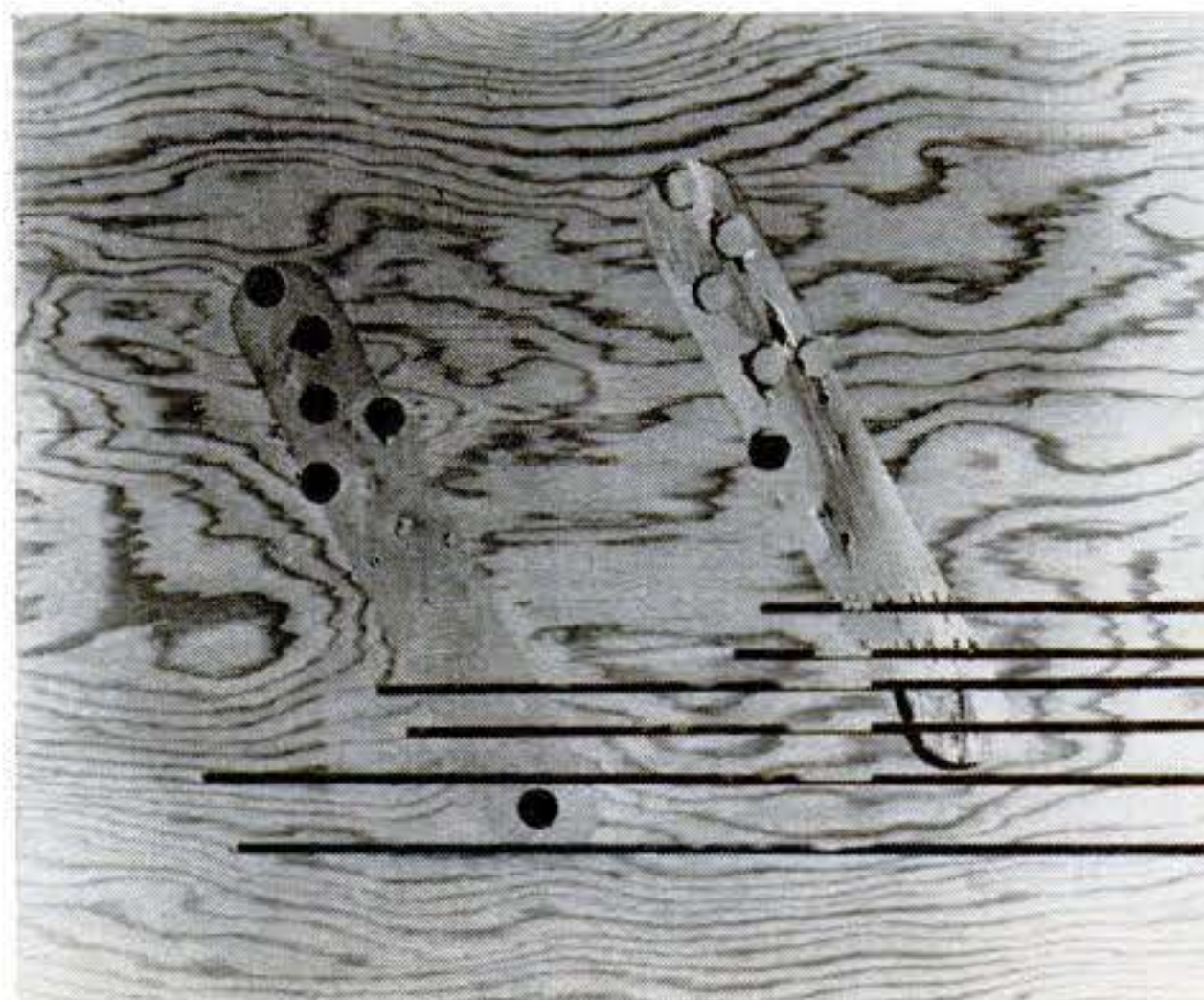
Stainless-steel gutters and downspouts? They're here

Aluminum downspouts and gutters are more expensive than those formed from galvanized sheet metal. In turn, stainless-steel systems are still more expensive than aluminum, the guttering costing 65 cents a foot in a new all-stainless system. But properly installed, all-stainless "is the final word in permanence." That's the claim made by the Washington Steel Corporation, of Washington, Pa., for its Microflex system now being sold to builders and sheet-metal contractors on a regional basis only—New York, New Jersey, Delaware, Maryland, and Pennsylvania. All fasteners are stainless steel, too—blind rivets, sheet-metal screws, and ring nails. Joints can be soldered if a special flux is used—or some builders may prefer a gutter sealant.

Brief reports about a variety of products

Want to make your own stained-glass lampshades? You can buy reusable Styrofoam forms on which to build them. For information, write to Whittemore-Durgin, Box 20651, Hanover, Mass. 02339. . . . A new company has set up in Canada to supply exotic foreign woods for turning and general woodworking. It will also handle foreign-made tools. For a list of available items, write to Handy Wood Craft Co., 977 Sierra Blvd., Mississauga, Ont. . . . A Georgia-Pacific plant is producing factory-finished polyvinyl chloride moldings. The PVC moldings eventually will compete with unfinished-wood moldings.

In your woodworking future: plywood with better patches



The 3M Co. has offered plywood manufacturers a new patching system to fill voids left after defects are routed out. The 3M system makes use of a rapid-curing, two-part liquid polymer instead of wood patches. The American Plywood Assn. has found the material exceeds test specifications. The photo shows results of a machining test. A panel containing a polymer repair (at the left) and a conventional wood patch was sawed, nailed, and drilled. The polymer repair did not chip out, and did well in weathering and paint tests.

Cures for Leaky Basements

[Continued from page 102]

away for a distance of 10, 15, 20 feet. Even if it means bringing in fill, the pitch away from the foundation is important, because it relieves water pressure on the basement walls.

Third, in extremely difficult situations, when repairs from the inside may not take care of extensive pressure, you may have to ask a contractor to dig down to the footing, install a tile footing drain, and trench the water away from the house.

And while he's there, you might check the waterproofing on the outside of your house to see what it's like. The University of Illinois Small Homes Council (Circular F2.0) recommends:

- For extremely severe water conditions (where standard drainage methods cannot relieve water pressure against walls or floor) a "membrane extending above waterline on outside of foundation, and continuously under slab."

- For average conditions, where normal footing drains can cope, a half-inch-thick coating of mortar over the masonry foundation of the house, with a bituminous coating on the outside of all foundations from grade to footing.

One more interesting and new operation that can be done from the outside is a process of coating or re-coating the wall without excessive digging. Special contractors shove an applicator down along the wall, then feed waterproofing material under extreme pressure. It flows out—spreads—over an area of the wall. Then they move the tube and force another batch in place. This patchwork system eventually coats the entire wall. Try the Yellow Pages, under "waterproofing." PS

POPULAR SCIENCE



"\$125? Hm, well how much would it cost to get it running just good enough to get to another garage?"

SEPTEMBER 1972 | 117

Free. How to save money tuning up your car with Krylon.

It's all in our how-to booklet "The Engine Protectors". It'll show you how to save time and money for almost any tune-up job. From cleaning your choke, to sealing your ignition. (You can buy Krylon® automotive sprays individually or in the handy Muscle Spray pack.) Just mail in this coupon with a stamped, self-addressed envelope and we'll send you the how-to booklet "The Engine Protectors" to get things humming again. Krylon, Borden Chemical, Division of Borden Inc, Dept. PS-9, 50 West Broad Street, Columbus, Ohio 43215.

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State _____ Zip _____



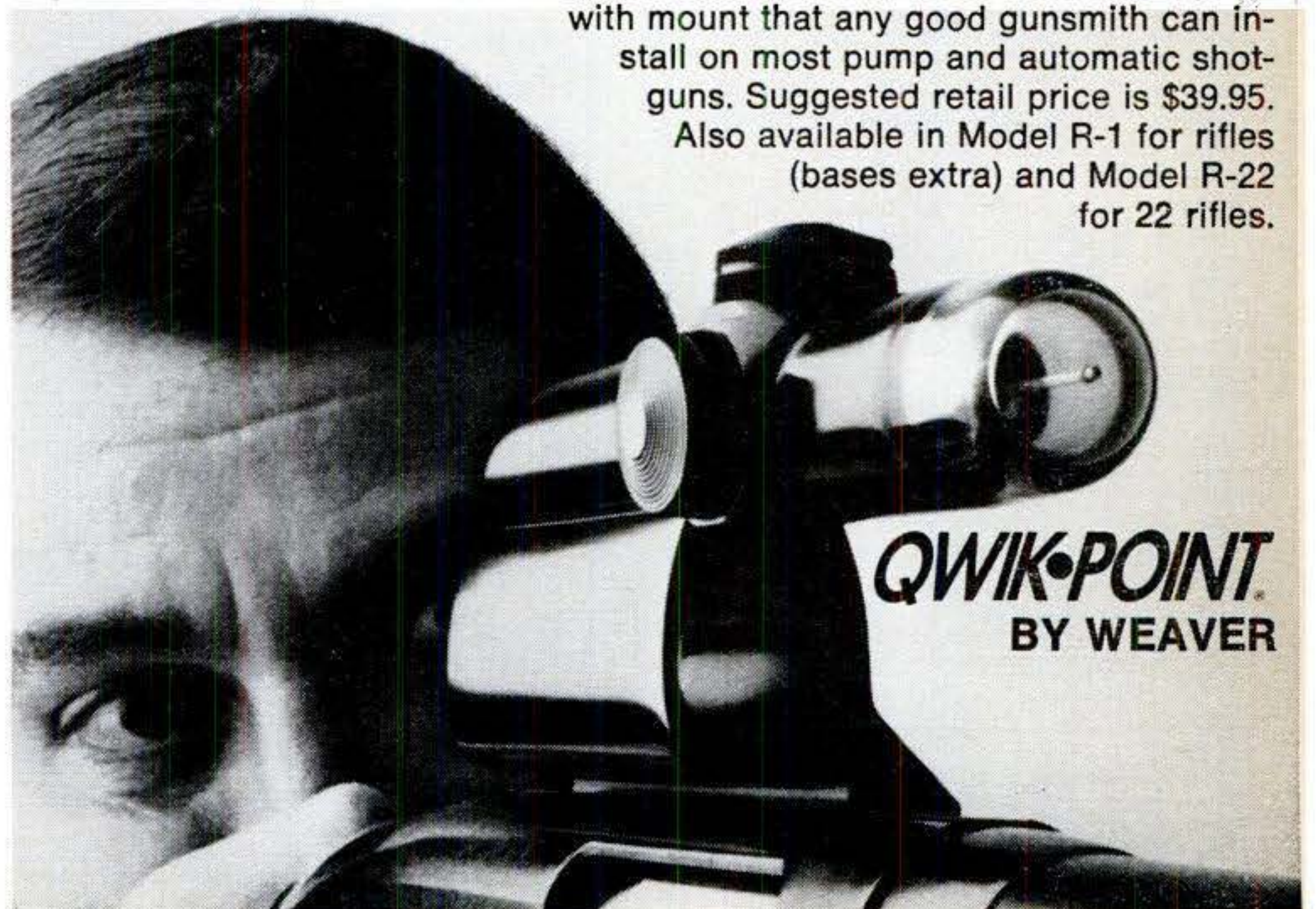
Qwik-Point can make you a great wingshot.

If you don't have thousands of shells and the time to spend learning to be an accomplished wingshot, try a short-cut. Qwik-Point. The remarkable new shotgun sight.

It's easy to use. You see a bright red dot suspended in space. Just swing it across the target. Hold the right lead. Pull the trigger. Tell Rover to go fetch your bird.

Qwik-Point Model S-1 is supplied complete with mount that any good gunsmith can install on most pump and automatic shotguns. Suggested retail price is \$39.95.

Also available in Model R-1 for rifles (bases extra) and Model R-22 for 22 rifles.

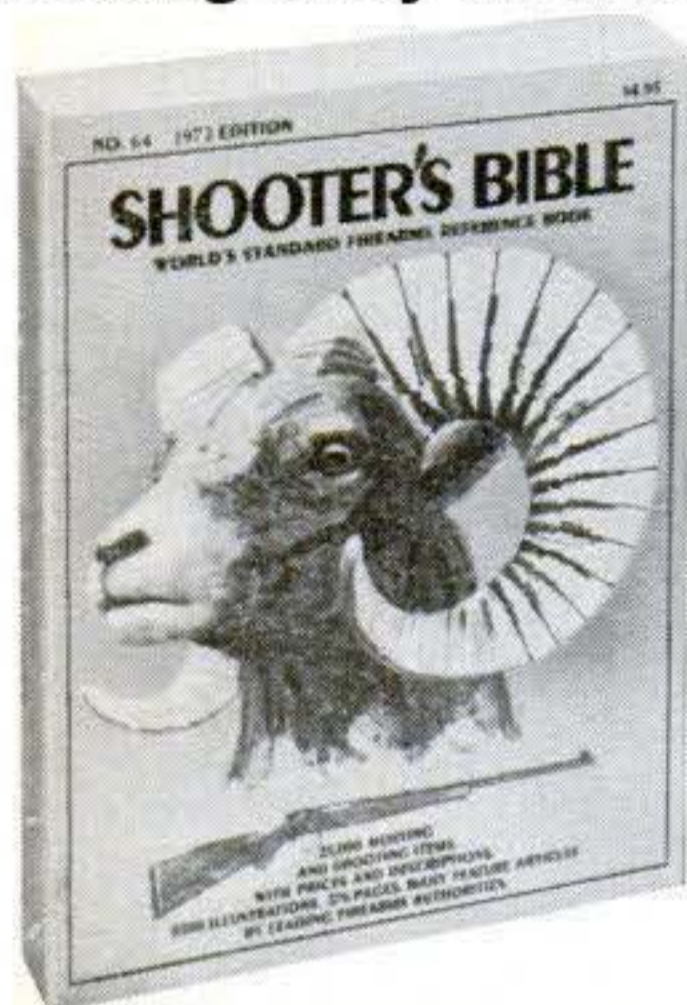


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Stoeger Arms

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The Big New Wave of Bass Boats

[Continued from page 67]

But it's a dangerous practice in boats of this size and beam. A bass boat isn't designed to go 50 mph safely.

Mechanical stick steering. There is considerable discussion among boating engineers at this time about stick steering. With moderate horsepower and speed, stick steering is really handy. Just push the stick forward and the boat goes to starboard. Pull the stick back and she swings to port. But with the rapid-control stick, abrupt steering maneuvers at excessive speeds can flip the boat.

Besides that, you feel very vulnerable way forward, high in a fishing chair, with each hand out to the side controlling steering and power. Every time we hit top speed, I had the nasty feeling I'd do several cartwheels before hitting the water if the boat hit an obstruction and catapulted me from the exposed front seat.

There are other seemingly innocent things you have to watch carefully, like the anchors—particularly the one in the bow. It's slung overboard, ready for instant dropping, controlled by a wind-up reel inside the boat. If this wind-up reel allows the anchor to drop down while the boat is at speed, the mushroom-type anchor can trip the bow and flip you out in an instant. A cure, of course, is simple: Never operate the boat

with the anchor dangling over the side. But that's an easy thing to forget.

If I were rigging my own bass boat, I'd find a foolproof method of making sure that anchor was inside before we got underway. One way to do this is simply to abandon the scientific reel-and-block system, and go back to a coil of anchor line inside the boat. Not as neat as the present system—but a lot less messy than a cartwheeling boat at high speed.

Bass shopping mart. The chart below shows just a sampling of what's available for bass enthusiasts. You can get a boat as small as 12 feet for only a few hundred dollars or go right up to the 16-foot-plus deluxe jobs costing over two grand. What, besides size, do you get for the money? Standard equipment and elaborate hardware jack up the cost.

The little ones have just enough space for yourself, a friend, fishing rods, and some bait. The luxury models come with lots of extras—upholstered swivel seats, handrails, extra storage lockers, rod racks, live-bait wells, and running lights for night fishing.

What's right for you? There's a size range for everyone. It depends on just how much comfort you want for the hunt. P S

What some typical bass boats are like

Manufacturer	Model	Length	Beam	Height	Max. hp	Price	Standard Equipment
Appleby Mfg. Co. P.O. Box 591 Lebanon, Mo. 65536	Charger 1+1	14'4"	5'4"	1'8"	60	\$ 750	2 swivel seats, motor well, running lights, padded deck, step pads
Boston Whaler, Inc. 1149 Hingham St. Rockland, Mass. 02370	Bass boat	16'7"	6'2"	1'9¼"	100	\$2292	2 swivel seats and cushions, storage box for pilot seat, rod racks
Chrysler Corp. Marine Products P.O. Box 2641 Detroit, Mich. 48231	Bass Runner	16'	5'	2'4"	70	\$ 930	2 swivel seats, locking side compartment, rod holders, running lights
Delhi Mfg. Co. Box 7 Delhi, La. 71232	Terry Bass	15'	4'8"	1'8"	45	\$ 980	Stick steering, motor well, 1 pair step pads, 1 pair hand rails (rear)
Duo Marine Box 577 Goshen, Ind. 46526	Fisherman I	14'3"	5'3"	2'4"	50	\$ 825	2 swivel seats, underseat storage, rod storage compartment, lights
Glastron Boat Co. P.O. Box 9447 Austin, Tex. 78757	Beau Jack	14'6¾"	5'5½"	2'5"	60	\$ 929	2 swivel chairs, lockable forward compartment, 2 anchor mounts
MFG Boat Company Morrison Industries, Inc. Union City, Pa. 16438	Fishing Gypsy	15'½"	6'4"	2'6"	85	\$ 999	2 upholstered swivel seats, storage lockers, rod racks, running lights
Ouachita Marine & Ind. Corp., 721 Main St. Little Rock, Ark. 72201	Convincer M	14'11"	5'2"	2'1"	75	\$ 941	Lights, deck cleats, rod holders, motor well, gunwale tray, bow pad
Rebel Boat Co., Inc. 3601 Jenny Lind Rd. Ft. Smith, Ark. 72901	Fastback	16'5"	5'3"	1'7"	80	\$1995	Trailer included, 7-foot rod racks, console storage, live-bait well
Sears, Roebuck & Co. 303 E. Ohio St. Chicago, Ill. 60611	Bass Chaser	13'6"	4'8½"	1'4¾"	20	\$ 450	2 swivel seats, live-bait well, vinyl-upholstered wood deck, lights
Smoker Lumber Co., Inc. New Paris, Ind. 46553	Bass boat	15'8"	5'9"	2'4"	40	\$ 855	Self-draining motor well, vinyl-covered wood seats
Tidecraft 1616 Shreveport Rd. Minden, La. 71055	Mr. Pro	16'	5'8"	2'2"	80	\$1254	Storage compartment under driver's seat, 4 rod holders, instrument panel

Notes: Specifications supplied by manufacturers. Boats listed have fiberglass hulls, except Smoker's bass boat, which is aluminum.

Before you spend a couple of thousand for a new roof, spend a couple of minutes to learn about roofing.

Protecting your home from wind and water damage

A leaky roof means rotting attic timber, stained ceilings and walls – and in a bad storm – costly water seepage that can ruin furniture and furnishings.

The Bird Wind Seal® line of asphalt shingles helps protect you from high winds.



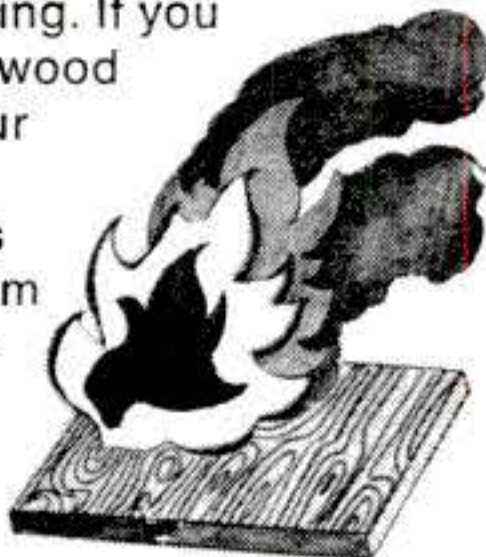
Bird Other Shingles

Each shingle is made with thermoplastic dots (about 19,000 on an average roof). The sun's heat melts these adhesive dots, welding the shingles together in a grip that fights against letting go – even in hurricane-force winds. (To get Underwriter's Laboratories approval for wind resistance, shingles must be tested in 60 mph winds. We tested Bird Wind Seals in 120 mph winds. In this test not a shingle ripped off, while those without the Wind Seal feature tore loose, allowing water to come in.)



Protecting your roof from fire

Wood shingles, or shakes, are attractive, but can be dangerous. Flying embers – even sparks from a fireplace chimney – can ignite them. That's why they're outlawed in some areas. The Bird Firescreen® shingle rates Class "A" in resisting fire – the UL's highest rating. If you still like the look of wood shakes, look into our Bird Architect® 70 shingle. It simulates the beauty of random wood shakes, combined with the fire protection of finest quality asphalt.



Cost of labor vs. cost of shingle

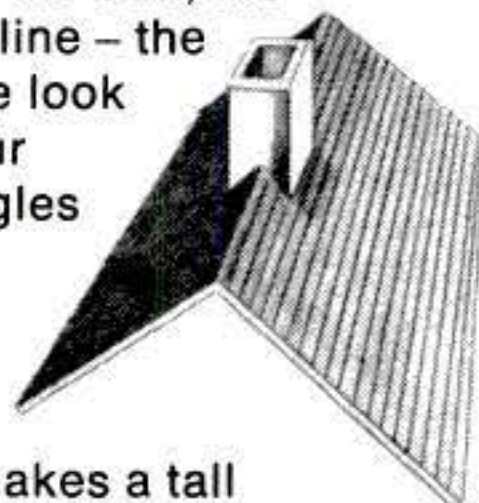
If you check out slate shingles, you'll find the cost in materials and labor prohibitive. Wood shingles, too, are costly

to buy and apply. That's why today's sophisticated asphalt shingles are such a good buy. Whether you buy the low end of the line or the highest quality, you get excellent value and minimum, if any, upkeep.

Remember this – the costs are comparable for labor to apply the best asphalt shingle or the least expensive. Since the labor cost will be very much the same, you should think about paying a little extra for a top quality shingle with all its extra protection and beauty. What's more, the best shingles offer a 25-year materials guarantee, the less expensive ones 15 years.

Choosing the right shingle for your home

The architecture of your home and its surroundings dictate the style of shingle to buy. A roof should present a long, clean line. It should show deep shadow lines at the butt edges (the butt being the part that shows). The thicker the butt, the deeper the shadow line – the more impressive the look of your roof and your home. All Bird shingles with the important Wind Seal feature have thick butts.



Don't overlook color. A dark roof makes a tall house look shorter, a light roof adds height to a one-story house. A medium color blends nicely into wooded backgrounds. Greens are restful, white cooling and a bright roof adds its own "surroundings" in an area bare of trees.

Another aesthetic feature is *random-embossing*. Instead of conventional cut-outs, many Bird shingles have vertical indentations. They add to your roof's long, clean line – no more broken-up, cluttered look that old-fashioned cutouts give.

The Bird Wind Seal JET® looks great on ranch-style and long contemporary roofs. And the Bird Architect 70, with its wood shake look, is ideal for gambrel, mansard and barn-type roofs. And stunning on colonial homes.

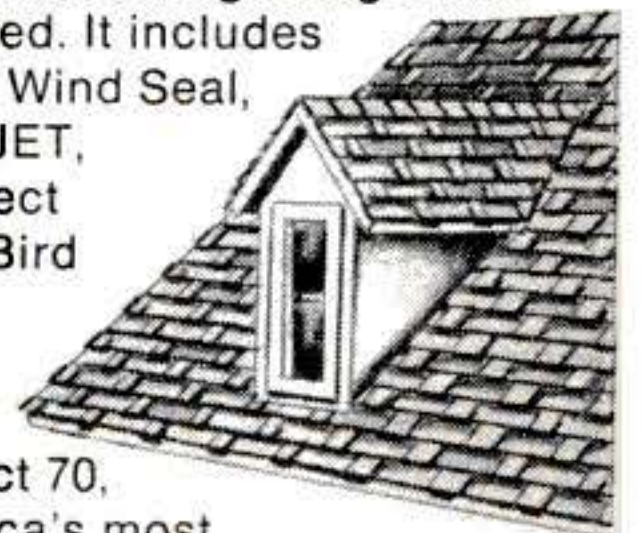
How shingles are sold

Shingles are sold by the square – a square being enough shingles to cover 100 square feet. You can buy them and arrange for application at a lumber dealer's, a home improvement company or a contract roofer.

Shingle weight determines its cost. The lower the weight, the lower the price. But the heavier the shingle, the better your roof. Since labor is a large cost factor, do not discount the heavyweights. The price spread between the Bird Wind Seal at 235 lbs. per sq. and the Bird Architect 70 at 345 lbs. per sq. isn't so great that it should discourage you from considering the finest protection and beauty for your home.

The Bird Shingle Line

The Bird asphalt roofing shingle line covers every need. It includes the famous Bird Wind Seal, The Wind Seal JET, The Bird Architect Mark 25®, The Bird Firescreen and the new bold, brawny, beautiful Bird Architect 70, probably America's most beautiful shingle.



To see Bird shingles first hand, mail coupon for an illustrated brochure, or see the Yellow Pages for the name and address of the Bird dealer nearest you.

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Popular Science
September 1972

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How to Assemble the Old West Basement

You've seen the exciting finished room in our color section. Here's how we achieved the rustic Western motif by framing around two new Marlite panels: One simulates deeply weathered siding; the other, red plush.

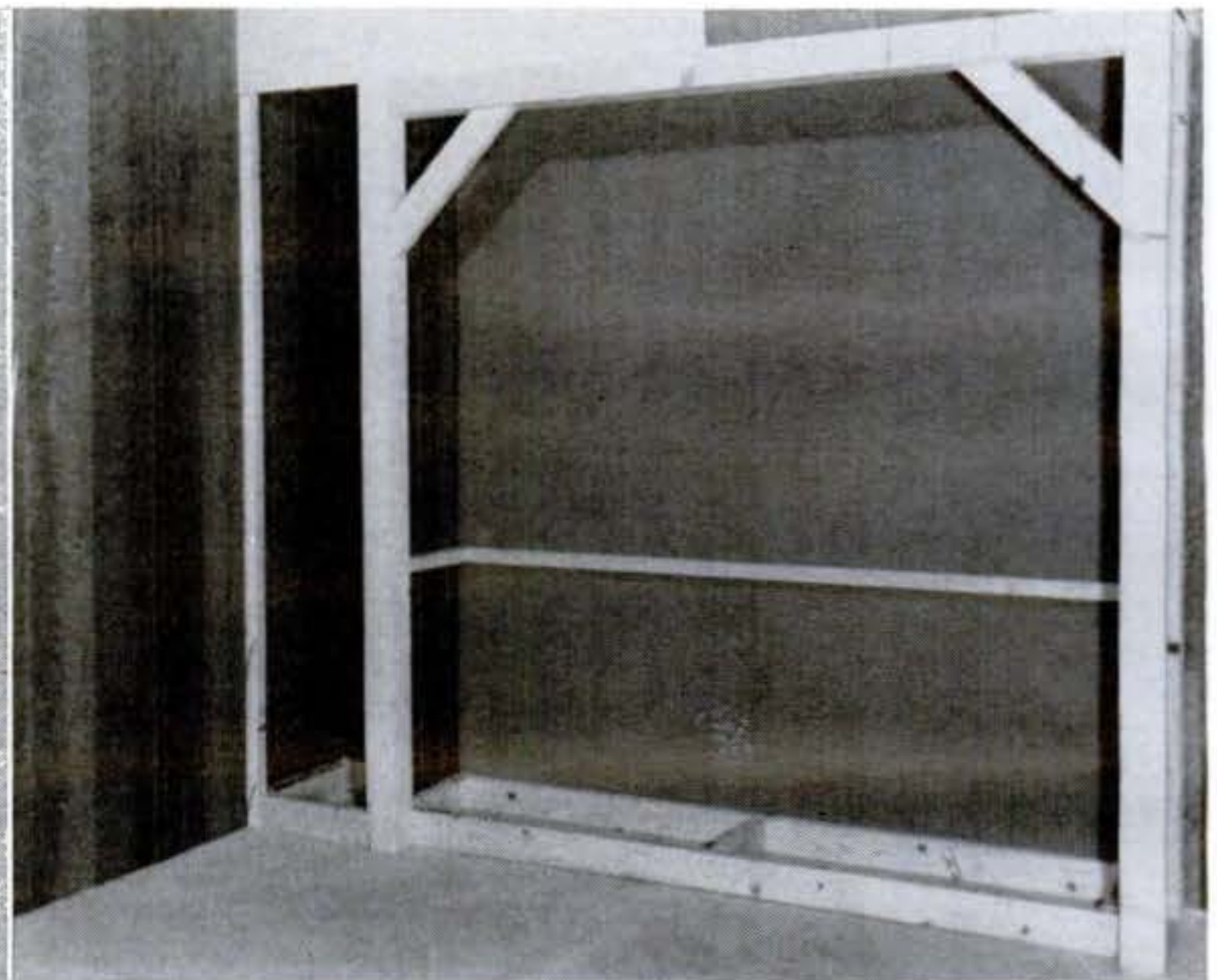


Paneling goes up with special clips that provide automatic spacing. Note header between studs to which framing for storage cabinet will be nailed once paneling's done.

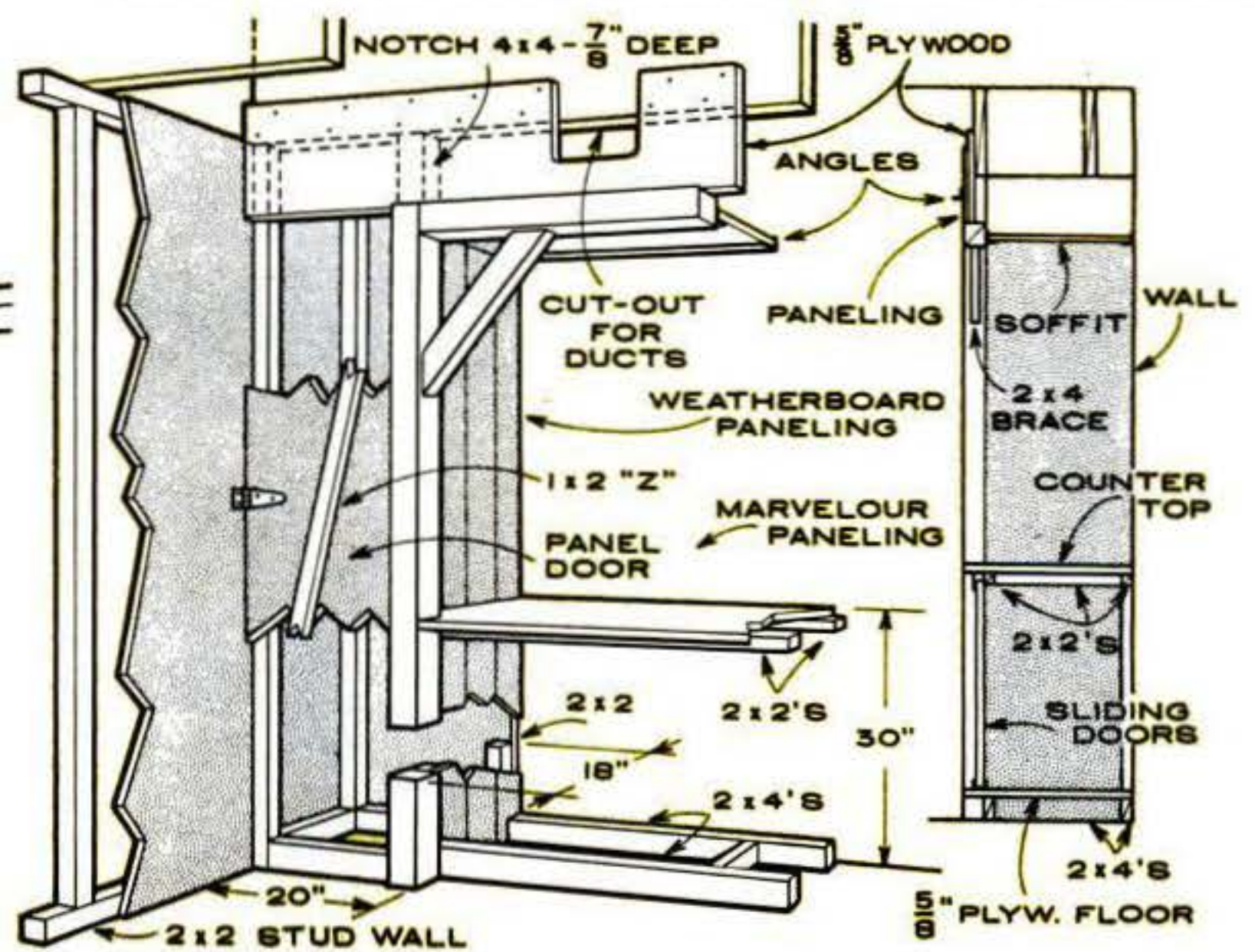
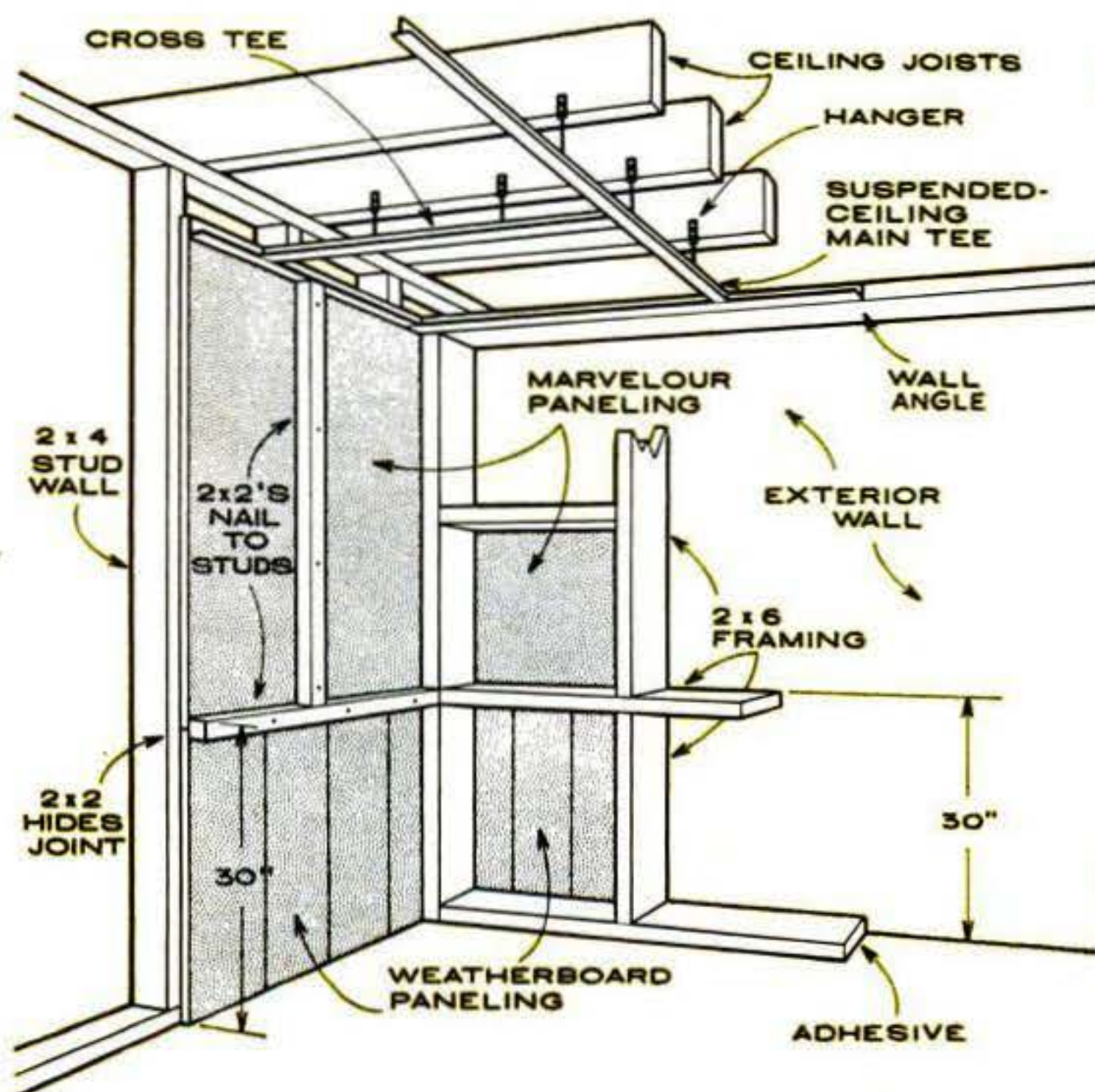
Framed-in wall must be insulated as individual sections, with fitted piece of paneling recessed in each. In foreground: self-stick vinyl-asbestos wood-grain floor tile.



Special insulation batts for furred walls are stapled between two-by-two studs on outside walls—assuming masonry is sealed.



Frame counter alcove after paneling (red flocked type) is in place within. Set bottom shelf on two-by-four frame for toe clearance.



Paneling procedures differ on adjacent walls (left): On one, it goes up conventionally, then two-by-two beams are added; around corner, two-by-six framing is cemented to floor and walls, panel sections inserted later. Doors for counter are glued-up paneling.

Old West Basement

[Continued]

Both paneling designs come in 16" planks, easy for one man to handle. They're designed for installation via a special mastic to a sound, smooth surface, or by means of metal clips. Our installation used both methods.

One wall is solid Weatherboard paneling. Another was given a wainscot treatment, by paneling the bottom 30" with Weatherboard and the upper section with flock panel, hiding the joint with a two-by-two stained to match the Weatherboard.

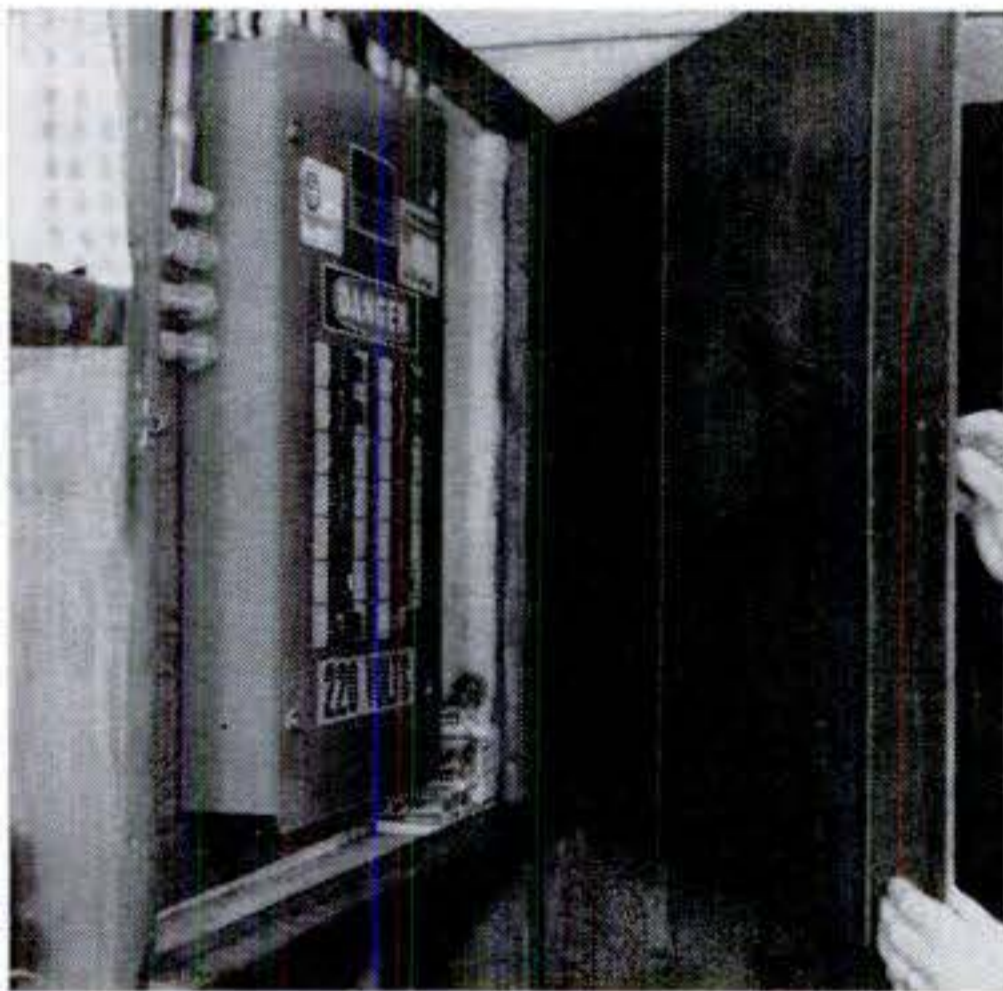
If a wall isn't smooth and flat, it's a good idea to nail up a covering of Sheetrock and glue the paneling to that. When using the clip system instead, be sure to trim the corner panel to width so its edge falls on the center of the first nailer.

You can either fur outside walls with 3/4" strips anchored with standard concrete fasteners, or build a stud wall with two-by-twos. (First, of course, you'd want to solve any moisture problems; see this month's article on wet-basement cures.) The two-by-two framing lets you insulate those outside walls with batts made for the purpose. Install panels flush with the floor and run them up the wall high enough to be covered by the ceiling.

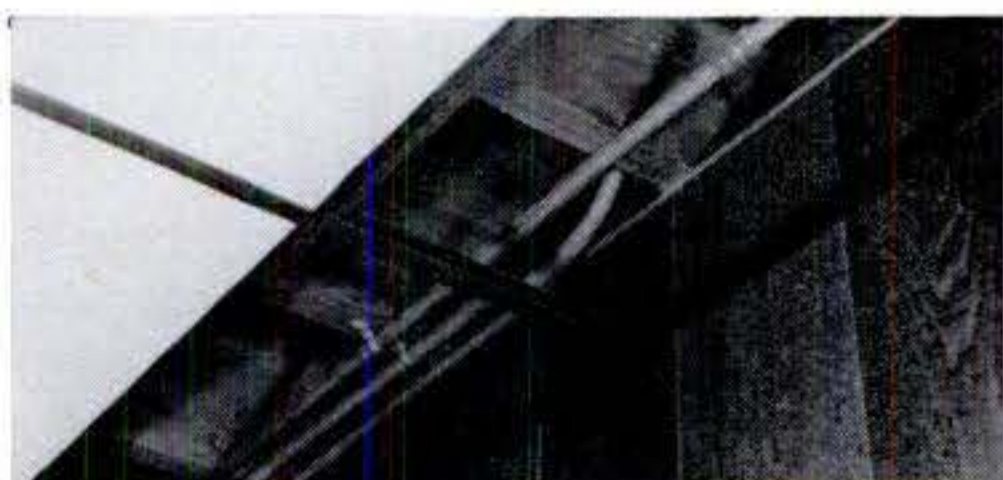
Match all exposed framing to the weathered siding. Rasp down edges unevenly; add a few wormholes with a drill; whack the surfaces here and there with a chain. Finally, carve some family initials into the beams to make it a real family room.

Want to mix your own matching stain? We brewed a one-coat flat finish from equal parts of several McCloskey Flat Hue Lumber Life stains: flat natural, flat rustic cedar, and flat charcoal. Mix well, brush on, and let dry without wiping.

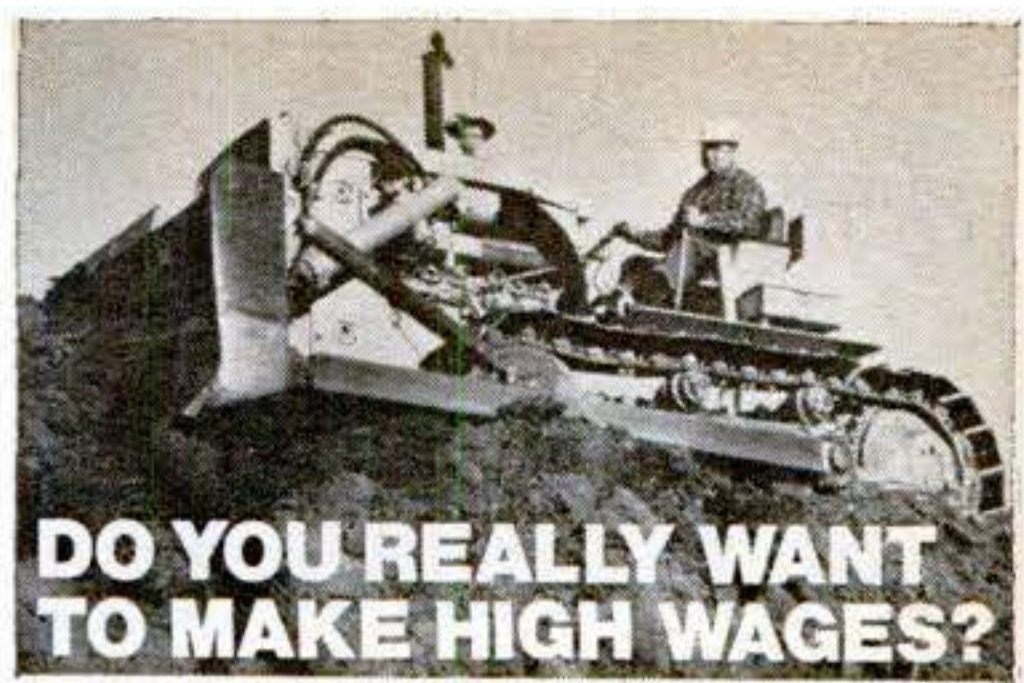
Installations of suspended ceiling and tile floor were standard, but we chose patterns compatible with our rustic motif: The metal-grid strips and vinyl tile were both wood-grained.—Mack Philips



Hinged door hides entrance box on outside wall. Glue t&g edges of 16"-wide panels together to form wider panels, as with sliding doors that hide under-counter storage.



Wood-grained grid for suspended ceiling is installed over paneling. Ceiling hides all utilities, is dropped lower within counter alcove to form soffit (see section sketch).



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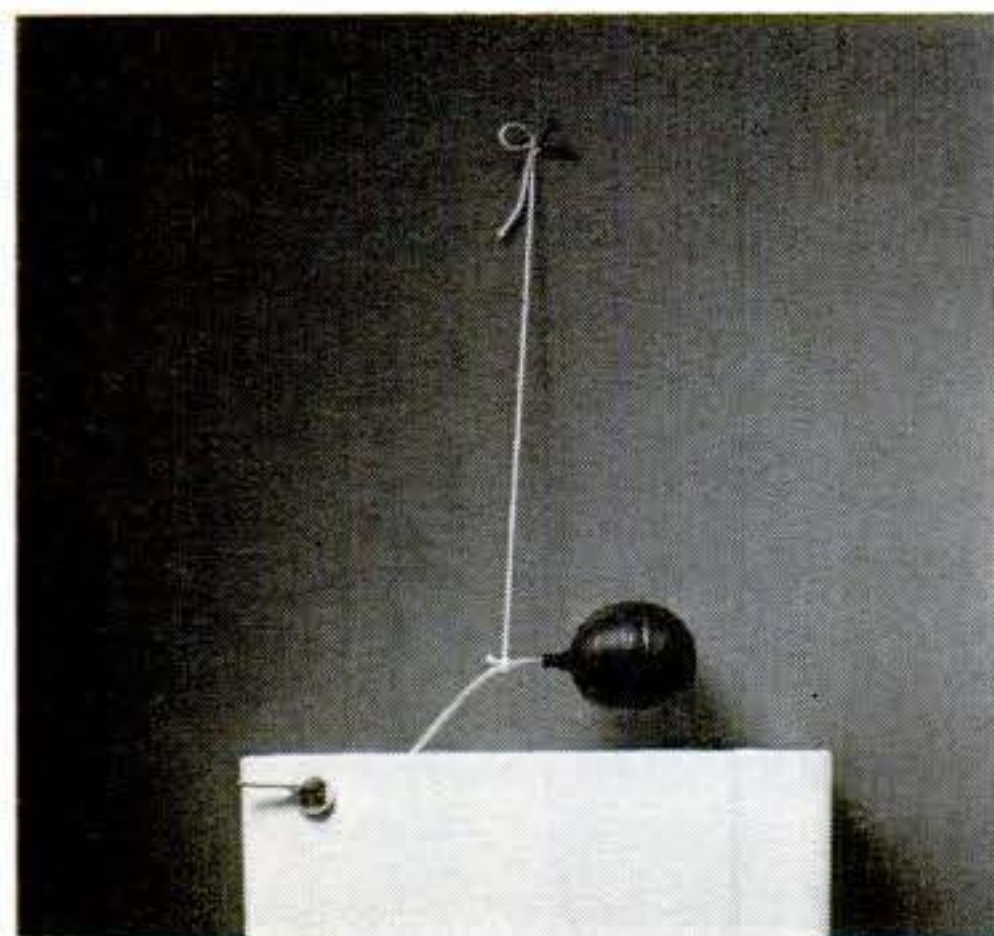
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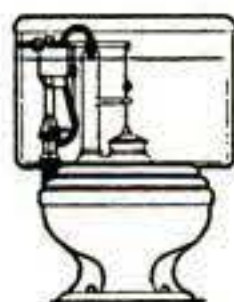


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Close-Up Photos of Mars

[Continued from page 55]

ously that they would contribute a wind of about 40 meters a second.

Sagan: Yes. That seems to be the way the calculation goes. So, if you have that wind going in the right direction and then another wind comes along parallel to it, then the two winds can add and reach your 80 meters a second or more. But there are two other kinds of winds which we think are important on Mars and may be more directly responsible for wind-blown dust. One of them is dust devils. They're common in the American southwest—whirlwinds only a few meters across which stir up dust. Then that column of circulating dust itself slowly moves across the desert. The conditions on Mars are much more favorable for the production of dust devils than conditions in the American southwest, and it's possible that the generation of the dust storm that we saw on Mars is produced by sets of such dust devils, even though none has actually been photographed on Mars.

The other source of winds clearly capable of producing dust storms is what we call slope winds. And these occur in cases where the elevation differences are comparable to the characteristic thickness of the planet's atmosphere—the scale height of the atmosphere, which on Mars is around nine kilometers. Now there are elevation differences on Mars of nine kilometers and in fact, twice nine kilometers. It's a situation very different from that on Earth, where the elevation differences tend to be quite moderate compared to the atmospheric scale height. As a result, we calculate that on Mars there's just a brand-new category of wind that runs along these high-elevation slopes. Since Mars has quite striking elevation differences, the wind velocities get to be very high. In fact, 80 or 100 meters a second, all by themselves.

CHANCES FOR LIFE

Fisher: What kind of picture of atmospheric conditions on Mars do we get from this analysis?

Sagan: That Mars is a dusty and very windy place, even though the atmosphere is quite thin; temperatures near the equator at noon are very comfortable by human standards, but the temperature at night or very early in the morning is extremely low, maybe 150 Fahrenheit degrees less than room temperature. There's little oxygen in the atmosphere. There is very little ozone, so ultraviolet light from the sun is

Close-Up Photos of Mars

[Continued]

not absorbed as it is in our atmosphere and penetrates to the surface relatively unimpeded, if there's no dust storm. This would pose a serious hazard for exposed organisms of a terrestrial variety.

Putting all those factors together, people in the past said the Martian environment was probably too severe for life. In my view that's an exceedingly provincial conclusion. We, and others, have done experiments in which we simulate all these conditions in the laboratory. We found that even a wide variety of terrestrial organisms survive those conditions perfectly well. They survive the ultraviolet light when they're under a tiny fragment of rock, and they even grow during the warm part of the day if there are small quantities of liquid water available in the soil, which is by no means out of the question on Mars today.

Fisher: What kinds of organisms are you talking about?

Sagan: I'm talking about microorganisms: bacteria—spore forming, or non-sporeforming bacteria.

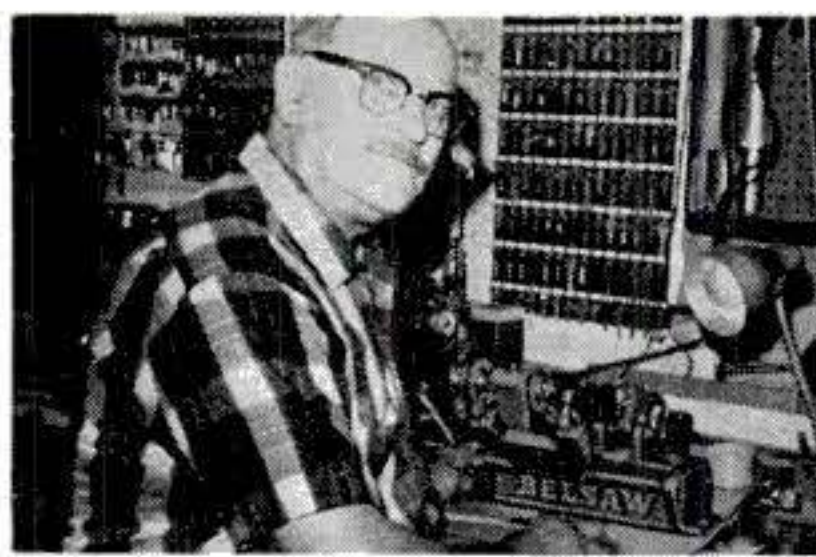
Fisher: But nothing like lichens?

Sagan: Well, lichens are the kind of standby in the speculation about life on Mars because they are supposed to be hardy and all, but they're not at all hardy under Martian conditions. If there is life on Mars, what's clear is that—unless we've contaminated the planet by not sterilizing our spacecraft—life we find is going to be extremely different from life on the Earth. At least that's my own belief. Life on Mars will have gone through 4½-billion years of independent biological evolution. There are so many arbitrary branch points in evolution . . .

Fisher: . . . that is, 4½-billion years ago . . .

Sagan: Yes, 4½-billion years ago. Well, life certainly is not arising now. The conditions on Mars today are much too perilous for the *origin* of life. That requires very protected conditions. But they are not too perilous for the *maintenance* of life. The origin of life on Mars, just like the origin of life on Earth, must have occurred a great interval of time ago in the past. I mean the origin of life on Earth could not have happened on the Earth, either, if conditions were like today's—much too hostile. For example, we have an enormous poisonous atmosphere of oxygen which would prevent the origin of life. Mars is in fact better in that respect by not having much of this poison gas. Oxygen oxidizes organic com-

Continued



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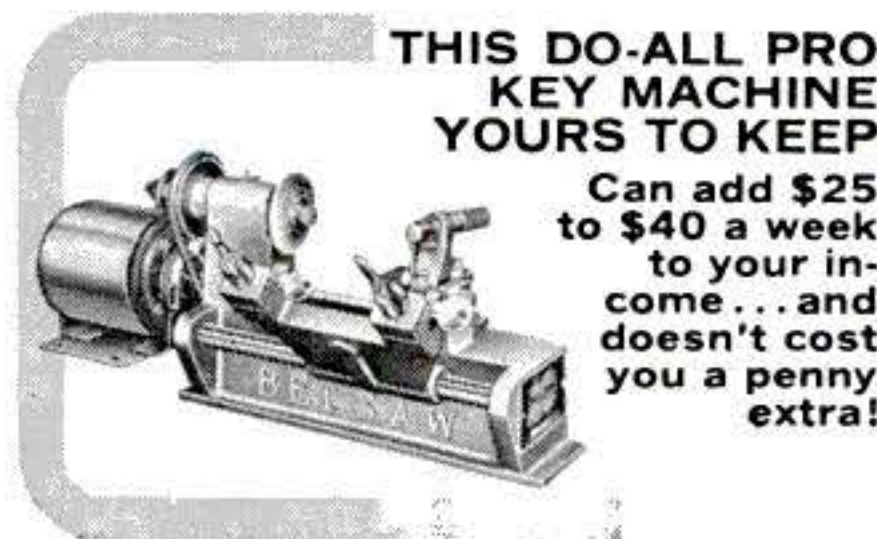
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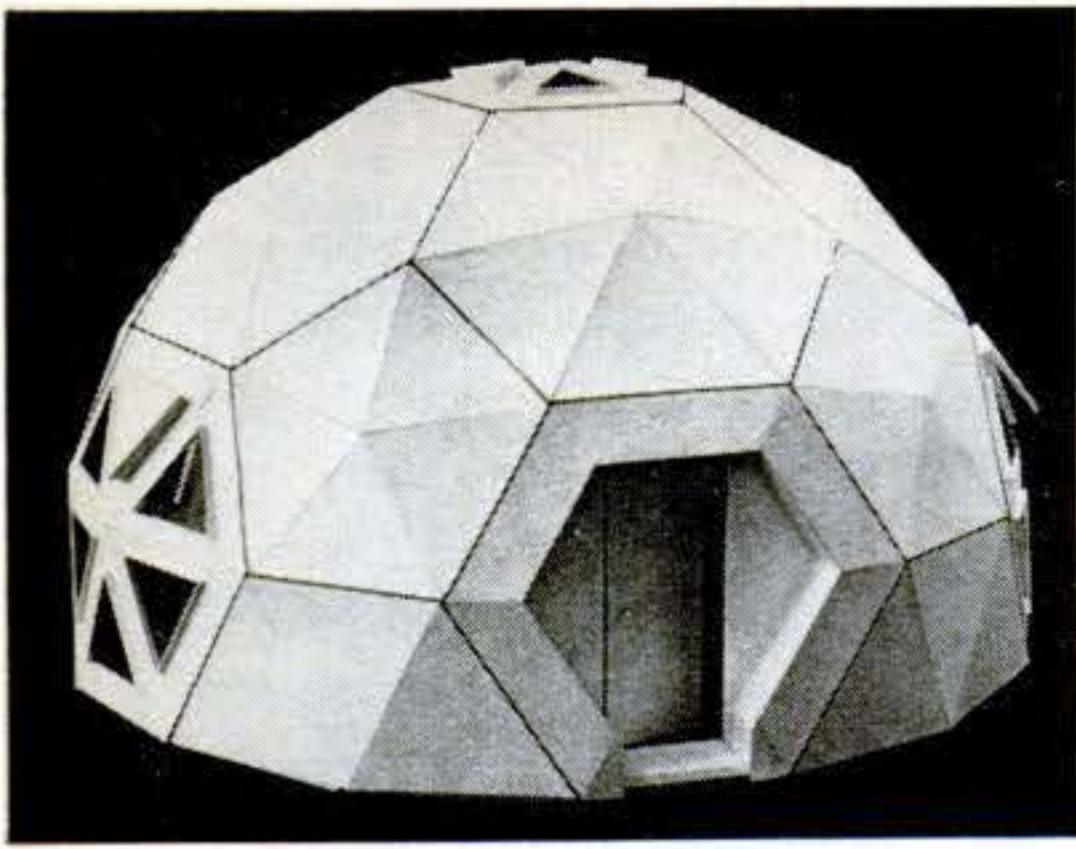
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Buy Popular Science and start licking



BUCKY FULLER'S Hexa-Pent Dome

Buy construction plans for Bucky Fuller's new Hexa-Pent Dome—and go right to work. Famous inventor of the geodesic dome developed the plans especially for do-it-yourselfers. Cut and shape the two-by-four framing pieces with a table saw, radial-arm saw, and jointer—or have a local woodworking shop make the cuts—and then assemble the parts into hexagon and pentagon building units for a dome shell. (CAUTION: Hand tools are not sufficient for this project.)

Along with detailed building plans you get an engineering load study made on the prototype dome. This should help you get a building permit if one is needed. Materials for the original 24-foot diameter dome cost about \$1000—for the finished waterproof shell, without insulation, interior wall surfacing, flooring, utility lines, or interior partitions. For these details, make your own choices from conventional home-building practices. A five-eighths dome of 24-foot diameter stands about 14 feet at the center. Therefore, you can have at least a partial second floor. For other details, see Popular Science for May and June 1972.

\$1500
PLAN 5544



A PLASTIC SUN DOME to warm your swimming pool

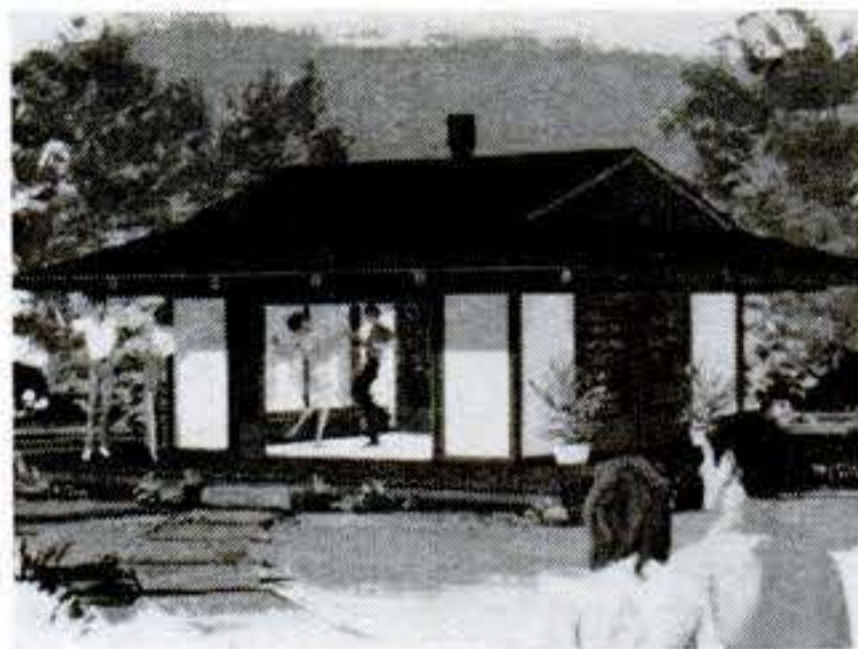
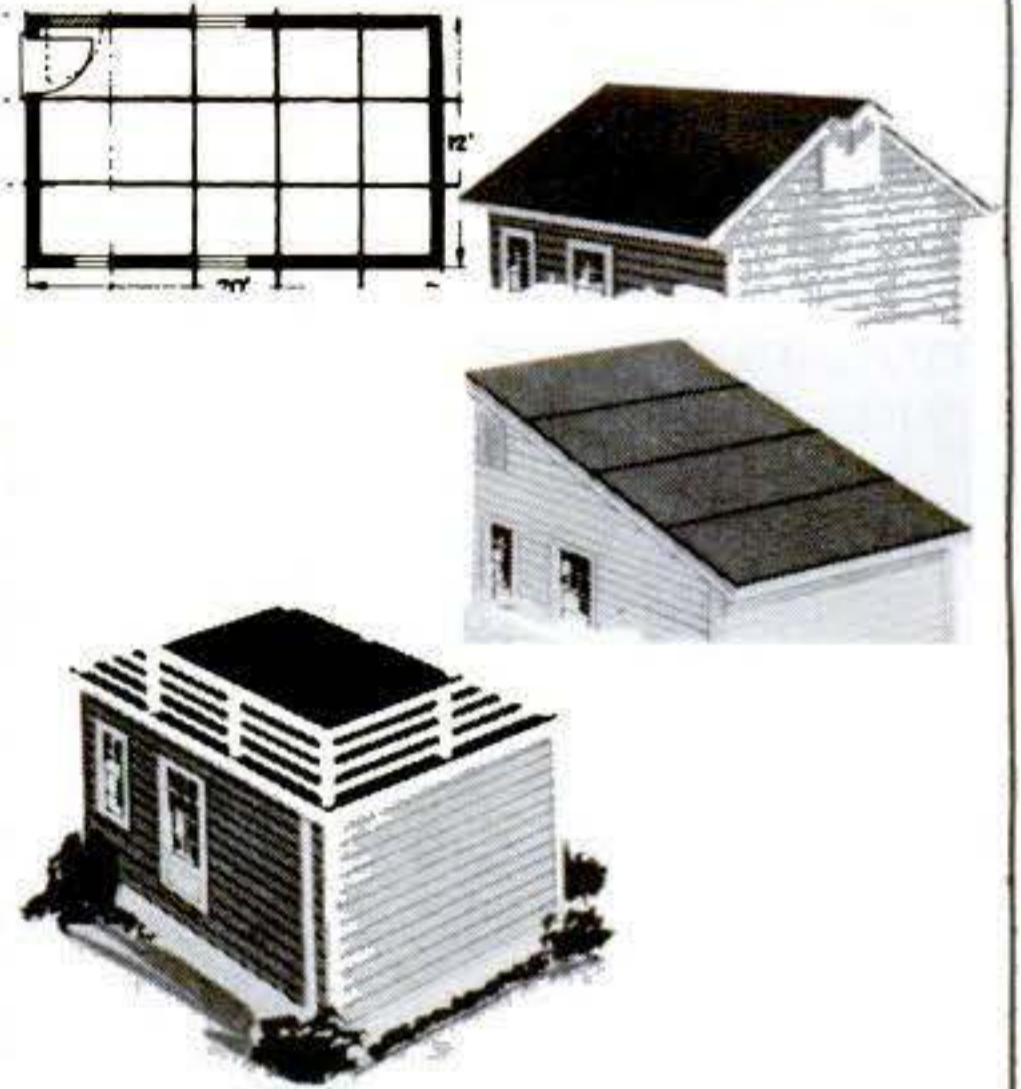
What you build actually is a geodesic dome, patterned after the unique structure conceived and patented by the famous architect R. Buckminster Fuller. Along with the plans, you get instructions to build one of the domes, in various sizes, ranging from a diameter of 16-feet up to about 32 feet. Most builders have used the domes over circular swimming pools. Or build a small one for use as an inexpensive greenhouse.

\$500
PLAN 5519

A ONE-ROOM ADDITION for your house

A new room is the most satisfactory way to get extra living space in your home. Have a place to add a square room? A rectangular room? The builder-tested Popular Science plans give you a choice of either shape—with also a choice of roof styles: gable, shed, or flat. The professional blueprints show all the foundation details, framing, and finishing information. Undertake the job yourself. Or use the plans to file for a building permit—and get bids from a professional builder.

\$395
PLAN 5517



OUTDOOR FAMILY ROOM in Japanese teahouse style

Handsome as it is versatile, this backyard structure has the appearance and flexibility of a traditional teahouse—including 20 self-storing shoji doors, half of them screened, half of them glazed with translucent plastic to simulate rice paper. Interior space is 12 ft. by 16 ft. for entertaining; with all doors pushed back in their simple tracks, room opens onto a 5-ft. deck on all sides, sheltered by the projecting roof. In the winter, you use it to store bulky out-of-season gear.

\$395
PLAN 5543



TAKE TO THE AIR IN A KITE

A man-carrying kite? Sure thing. And you can build it yourself. Then fly it—in as thrilling a sport as you could possibly experience. Towed by a speedboat, you rise as much as 75 feet above the water.

Ken Tibado, famous watershow performer at Florida's Cypress Gardens, designed the kite. The plans include a complete parts list, with a price for each fitting and accessory, to give you the option of building as much as you can and buying any part not locally available.

\$500
PLAN 5504



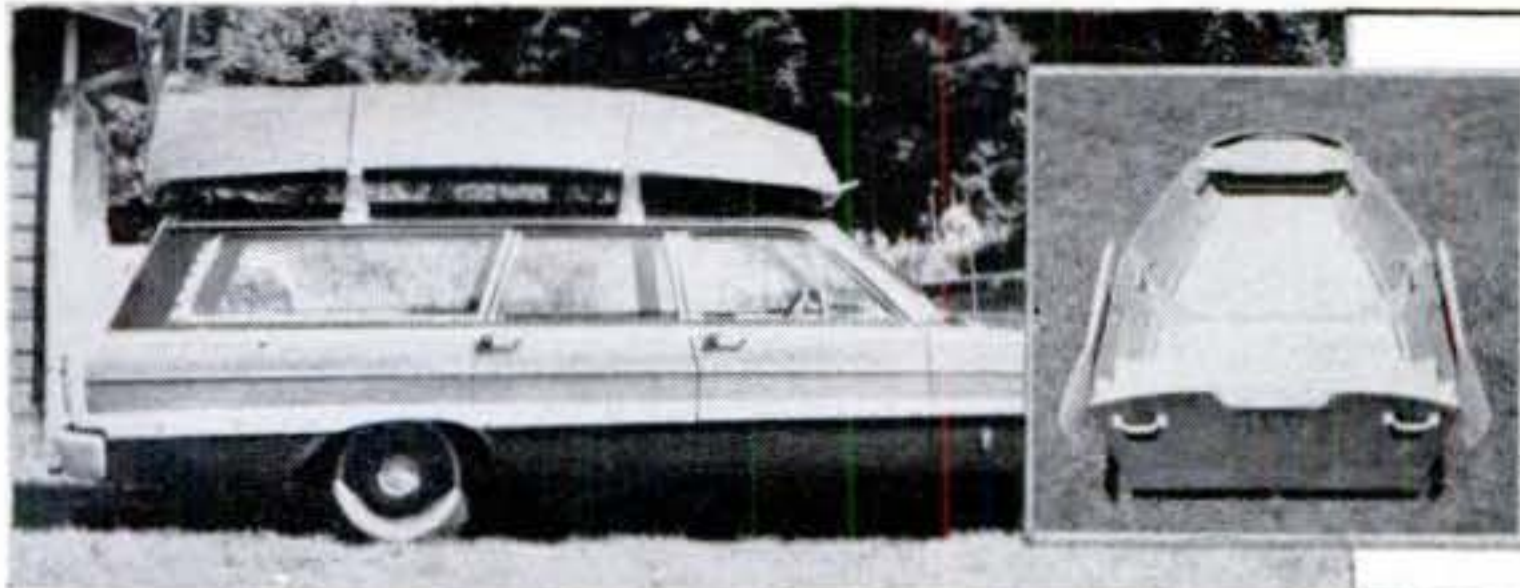
A LITTLE RED BARN for backyard storage

Why settle for an ugly shed or other storage structure? Put real style into your backyard. Build this miniature Pennsylvania Dutch barn. A riding mower or garden tractor rolls right in when you open wide its four-foot sliding door. The handsome little building sits on an eight-foot by 12-foot site. If there's space left over after storage of your yard and garden equipment, add a swimming-pool dressing room. Use the loft for dead storage.

\$395
PLAN 5510

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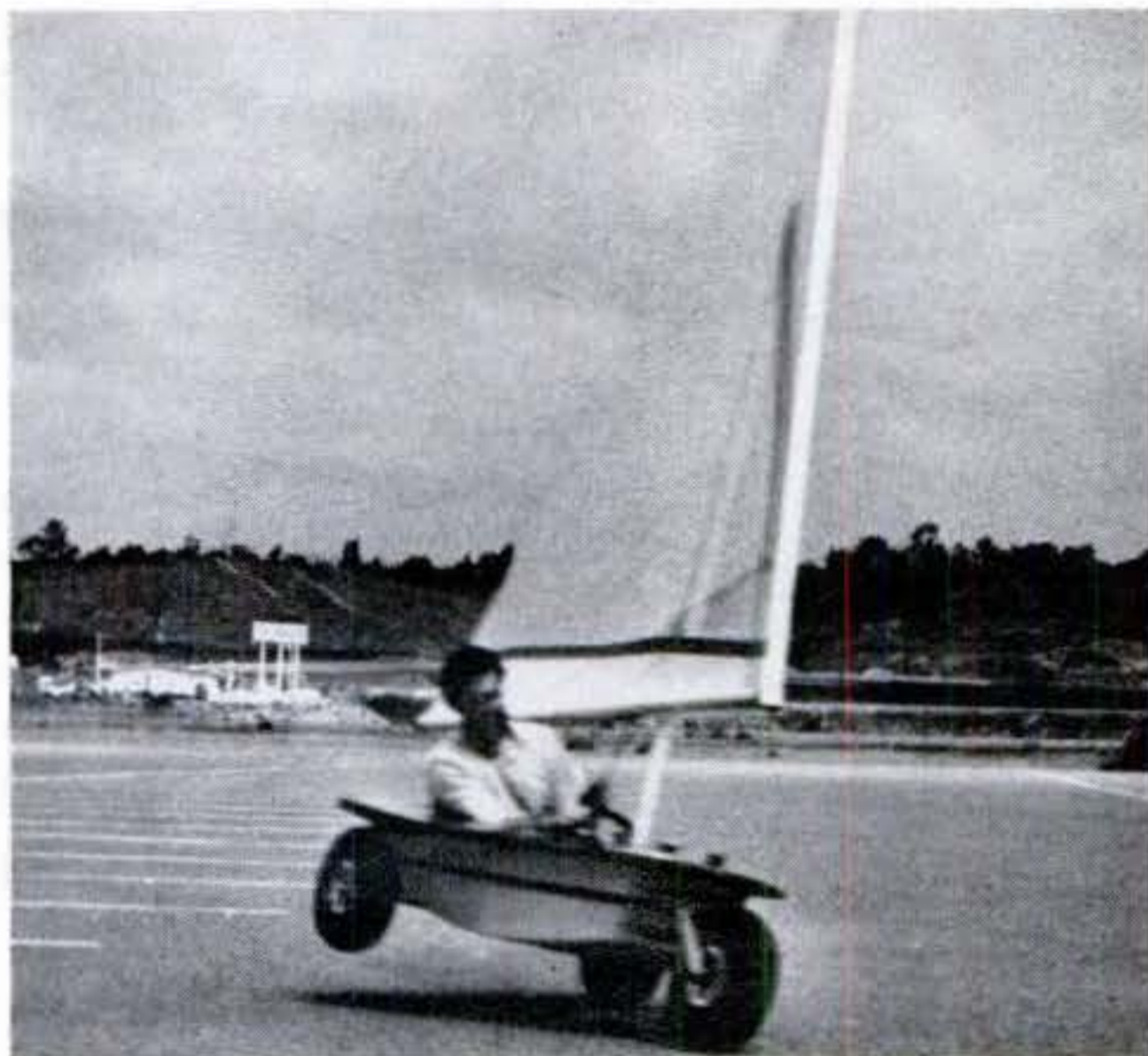


10-FOOT CAR-TOP BOAT . . . build it for a song

Ten feet long, 44 inches wide across the transom, built largely of inexpensive plywood, it cost the designer-builder less than \$20 several years ago. Turned turtle on a station-wagon roof, it fits neatly over camping equipment. Row it . . . or clamp on a 3-hp outboard. Boat plans first published in Popular Science in August 1966.

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PLAN 5520



PUMPKIN SEED SAILBOAT that you can build

For a cost of less than \$500, you can build your own fleet sailboat—a new scow-hull, Marconi-rigged design just introduced by Popular Science. When you sail—on a lake or protected bay—your boat will probably not be the only one of its type either, at least not for long. Arrangements have been made so that, as soon as enough boats have been built, the owners will be organized into a new International Pumpkin Seed Class Assoc.

Large-size plans and exact-size cardboard templates for frames, bow, transom, and other parts are available to help you build Pumpkin Seed. The plans include a full materials list. The plans (5545) cost \$10, the templates (5551) another \$10.

\$10⁰⁰

PLAN 5545



LIGHTWEIGHT SAIL CAR for the parking lots

Like to sail? Interested in race cars? Buy this plan, build the lively little sail car it describes, and you can combine the sports of sailing and car racing. Sailing on parking lots and beaches, the prototypes have been stopping traffic in California. The motorists couldn't believe their eyes! You can build one of the plywood racers for little more than \$100 (including sail). Original article in Popular Science for March 1972. A national club of sail-car builders is now being organized, and races will be held. Details with the plans.

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PLAN 5534



MOST BEAUTIFUL CAMPER on the road

That's how many have described our trim bubble-top camper, with its walls of redwood siding. An architect designed the Tourineer redwood camper after failing to find what he wanted among commercial campers. The first plans were for Ford Ranchero only. Now they have been adapted to the El Camino, Sprint, and most half-ton pickups made in the U.S. One set of plans shows variations required for all vehicles. Materials cost from \$600 to \$800.

\$1495

PLAN 5508



PADDLE YOUR OWN CANOE

Build it of strips of redwood or other suitable wood. Then apply fiberglass and resin over the wood. Thousands have built this canoe successfully since Popular Science published the plans in 1967.

If you don't want to take time to scale up templates for the different stations along the length of the 16-foot canoe, you can buy ready-made cardboard templates for transferring to plywood. For the plans only, send

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PLAN 5511

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Close-Up Photos Reveal a Turbulent Mars

[Continued]

pounds. It's not a good thing to have around. Because we humans breathe it we think it's terrific. That's also a provincial point of view.

The conclusion I'd like to make about life on Mars is that there is certainly no compelling evidence for it, but there is equally certainly no compelling evidence against it. Mariner 9 was not designed to detect it nor has it detected life on Mars. The Viking mission will be the first serious attempt to find life on the planet. At the present time the conditions on Mars are certainly not too hostile for life to exist. We must merely keep an open mind until more data is in.

WATER ON MARS

Fisher: You mentioned water in connection with the possibility of life on Mars. I understand that Mariner 9 photos show some geological features that look as though they had been carved by water. Others show the recession of the south polar cap in a way that seems to suggest there is at least some water ice in the ice caps. What about the problem of water on Mars?

Sagan: Something around 100 years ago it was obvious that the Martian polar caps were made of ordinary ice, water ice. Because, what else could they be? Six years ago it was obvious the Martian polar caps were dry ice, frozen carbon dioxide. Today it's clear that the situation is much more complex than that. The temperatures in Martian winter are certainly low enough to condense out CO₂. We know CO₂ is the major constituent of the atmosphere—it has to condense out. On the other hand, we now see in Martian summer that although the south polar cap recedes, a portion remains right through the summer, despite the fact that the temperatures are too high for carbon dioxide to remain in the frozen state. This suggests that the remnant we are looking at is a water cap. And so it's not terribly astonishing that if you have both water and CO₂ on the planet, and the polar temperatures are very low, that you condense out both CO₂ and water at the polar cap. Then you heat things up and the one that goes away first is CO₂, the one with the higher vapor pressure. Then you're left in summer with the water cap.

We hope to look at the north polar cap in the summer. We know from ground-based observations that the size of the remnant of the cap is much larger in the north than in the south, indicating much more frozen volatiles (probably water and CO₂) in the northern cap than in the southern

cap. In fact it looks as if there may be an immense quantity of frozen CO₂ and water in the north polar cap. So much so that if you were able to vaporize all of it you could dramatically increase the total surface pressure on Mars and make it more likely that you could have running water on the planet and, through the greenhouse effect, provide an increase in surface temperatures and make conditions much more clement.

Whether in the course of Martian history there ever are natural events that free that CO₂ and water is a question that many of us are debating. I propose that this does happen during the precession of the equinoxes on Mars and that there are epochs in Martian history in which conditions are very different from today, that in fact we are examining Mars in an ice age, and that some 10,000 years from now conditions may be much warmer and much wetter. Under such conditions we can understand the features on Mars that look as if they were carved by running water: things that look like dry arroyos, river beds, and very difficult to understand on any other terms. They pose a serious mystery because you cannot have extensive liquid water on the planet today. The pressures in the atmosphere are just not large enough. It's the same reason you cannot have liquid CO₂ on the Earth. You have dry ice and you have gaseous CO₂. Now, the characteristic sign of things due probably to running water is tributaries, such as the ones you see in some of the Mariner 9 photos. Tributaries are not produced by flowing lava and pose serious difficulties for being understood in any terms but running water. They are the key to the water hypothesis.

Fisher: Well, what's the current thinking? Are there any other hypotheses that explain these pictures?

Sagan: There is another hypothesis that goes as follows: I can't believe that there was ever any liquid water on the planet. Therefore, there is some other cause, which I don't understand, that produces that phenomenon.

Fisher: You call that hypothesis B?

Sagan: Yes, hypothesis B, brand X.

Fisher: Then as far as you personally are concerned, you think it is likely that the obvious explanation is the correct one?

Sagan: That's right. I propose on other grounds that such conditions existed *before* the Mariner 9 photo-

Continued



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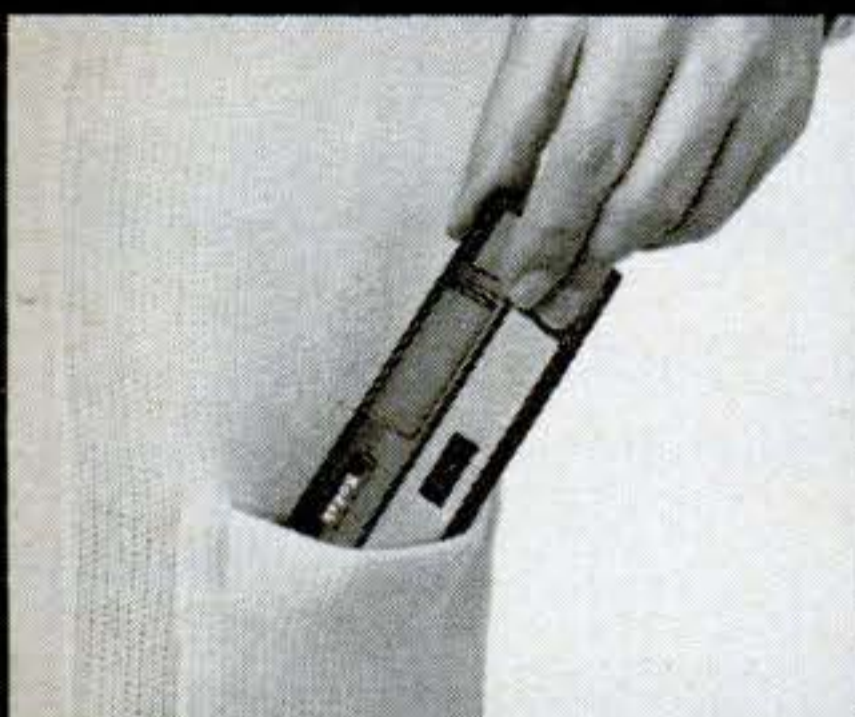
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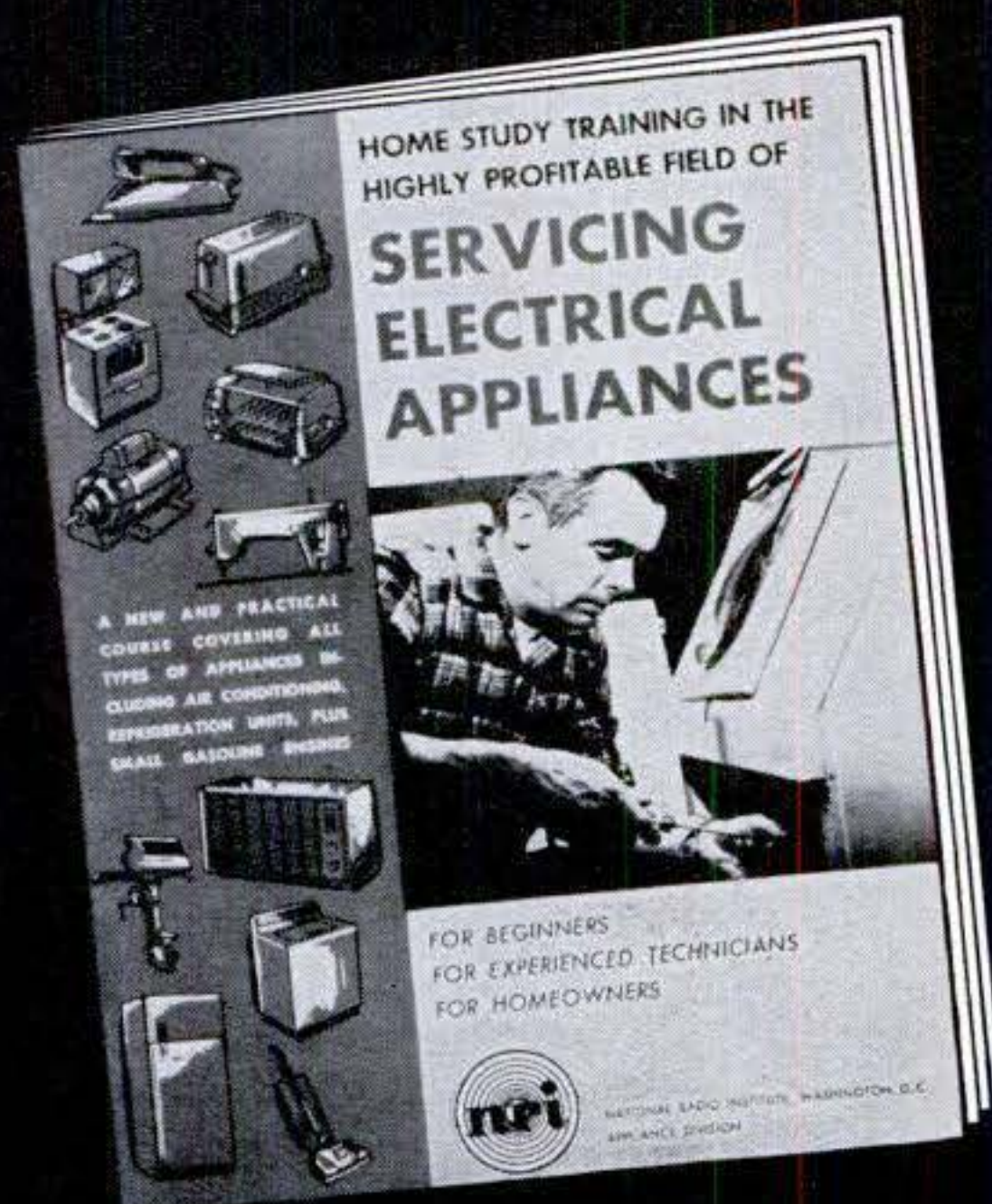


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Close-Up Photos of Mars

[Continued]

graphs were in. I'm naturally attracted to this hypothesis.

Fisher: That would also go a longer way toward fostering the idea that life could have originated at some time in the planet's past during a previous non-ice age?

Sagan: Yes. It also means that organisms on Mars may now be in hibernation. That is, if the period of time between successive epochs in which there is extensive liquid water, if that time is small in a geological sense, then it may make sense for organisms to just shut up shop for the long winter and wait for the spring to come. A way to test that is to drop Martian soil samples into liquid water, which would be the cue for hibernating organisms or spore formers that the precessional spring has come. At that time, the organisms should go do their stuff.

Fisher: Dr. Sagan, what can we expect next from Mariner 9?

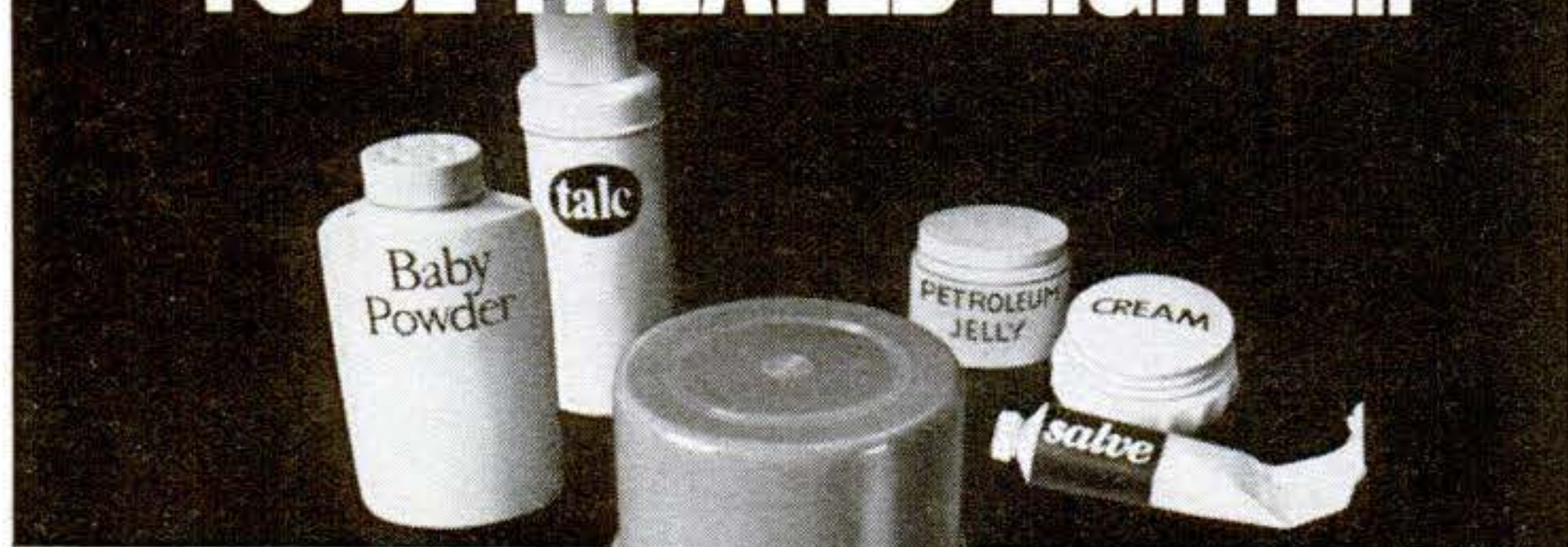
Sagan: If the spacecraft works, we're going to get just extraordinary pictures during the summer. There's a great deal of picture processing to be done, which will bring out details that could not be seen before. There will be an enormous amount of interaction among the experiments. I believe that some of the most dramatic scientific payoff is going to come in another year or two, when we've done those things. So I don't think the most exciting aspects of Mariner 9 are in yet at all.

Fisher: What kind of pictures will be taken when Mariner resumes?

Sagan: There will be some pictures taken for Viking landing-site selection. There will be, I hope, a great many pictures taken of variable-feature sites, because now we have a very long time baseline. Many, many months have elapsed. What has changed in that period of time? In fact, in the last few weeks before we went off the air in March things seemed to be changing all over the planet. I'd like to see if that's continuing. I'm personally very excited to see what signs of variable features there are at end of summer. We'll have our first look at the north polar cap, which for reasons I mentioned before is very important. We will begin to get some global coverage. Up to now we've been very close, just seeing little postage-stamp-size frames, and we've been mosaicking them together. There are a great many very exciting things coming up and I am just talking about TV, not the thousands of spectra and other very important data acquired by Mariner 9.

Fisher: Thank you, Dr. Sagan. **PS**

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PERSONAL-USE REPORT A Quiet 16-hp Workhorse

Called QT, meaning quiet-twin, Bolen's new 16-hp tractor checks out at 69 dbA at 50 feet. This means that the blating, tin-can muffler racket that can almost make you yearn for the hand-push days is gone. It also means that Bolens is seriously concerned about the Chicago noise-level ordinance—a maximum of 70 dbA for '75.

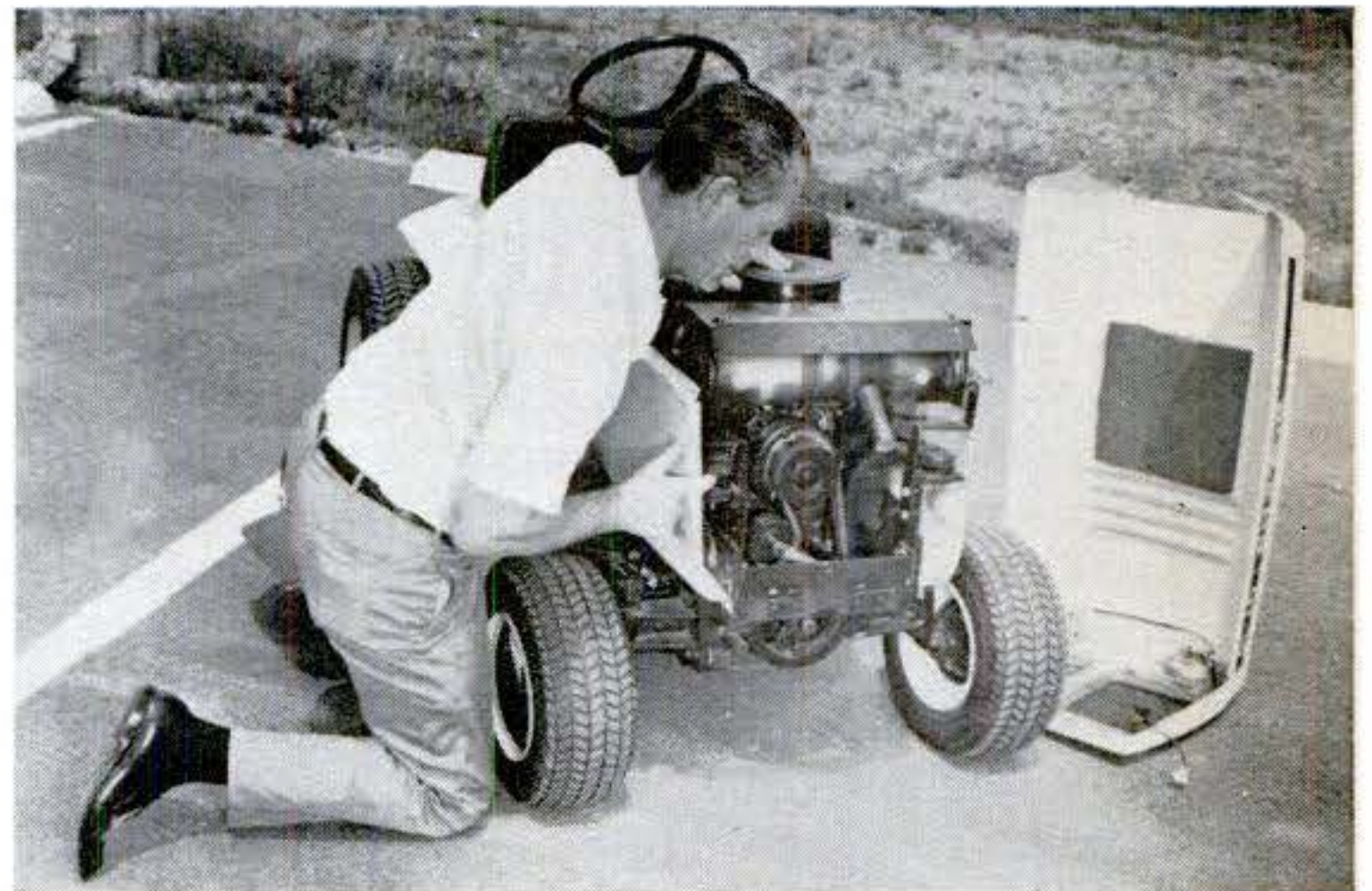
We expect other makers will soon jump on the bandwagon, but this is the first really husky tractor I've seen—and heard—that hums instead of bellows.

The tests are certified by an independent laboratory. According to Chicago rules, tractor noise tests are run at 50 feet from the noisiest side of the tractor, at normal operating speed, and with the mower (48 inches on this one) set at two inches over grass.

How did Bolens cut the noise? Mark Nemschoff, project engineer for the QT, summed it up like this:

- Two-cylinder, horizontally opposed Onan engine to cut vibration.
- Cradle-mounted engine on rubber mounts with cradle points at engine CG.
- Curved structural panels to stop oilcan and vibration effects.
- Side enclosures all around.
- Sound-dampening material on panels.
- Mower redesign for low cutter noise.

The tractor is extremely smooth in operation, and I admired its VW-size muffler with downward discharge. According to Nemschoff, most mower decks generate



Engine in cradle, with pivot at center of gravity, is suspended by rubber pads. Other sound dampers: front muffler, curved panels.

three to four db in blade and mechanical noise. He says the QT deck produces about 1.5 db, even though it meets all of the foreign-material safety standards. Part of the silencing may be in the reduced drive-line speed to the blades, although blade speed is normal.

It's worth trying a QT, just as a standard of comparison. It shows what can be done. Price is \$2095 with 48-inch mower.—E. F. Lindsley



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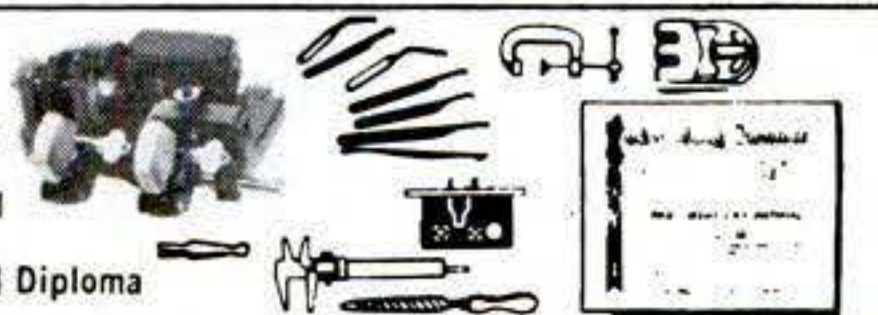
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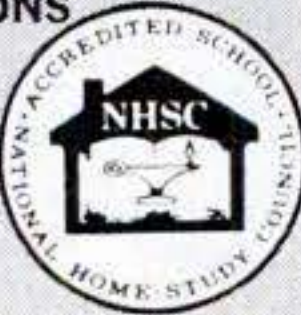
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Coming—New U.S. Tire-Labeling Standards

[Continued from page 77]

Studies have shown, for example, that the worst places in the country for tread wear are Charlotte, N.C., and Salt Lake City, Utah, because of the substances used in the roads. Other areas are better in varying degrees.

High-speed performance. These grades will be based on the use of a test wheel. To meet the minimum capability of a Grade A—or 85-mph—tire, a tire must equal the performance of a control tire run on the test wheel at simulated speed of 85 mph for one hour. This is actually indicative of considerably more speed under actual highway driving conditions, and it would mean that all Grade A tires would be capable of all legal turnpike speeds in the U.S.

The Grade B and C tires will be required to equal control-tire performance at speeds of 95 and 105 mph. These tires would be of use for driving in states where ultra-high speeds are permissible, or for police agencies and such that require top-performance tires.

Three criteria dropped. Three of the original proposals—road-hazard resistance, endurance, and uniformity and balance—will not be included in the first tire-grading standard. There are various reasons, says Dr. Wallace. The increasing use on new cars of radial tires, which have superior road-hazard resistance, has made this element less crucial. Endurance has been dropped, apparently because of

The U.S. cracks down on tire-advertising claims

While the new grading system is being put into effect, the government is cracking down on tire companies on a related front—demanding documentation for advertising claims. The order by the Federal Trade Commission requires 18 manufacturers to supply documentation for advertising claims concerning 75 brands of passenger-car tires.

Typical claims for which the government has ordered documentation include:

"Uniroyal Masters give you extra mileage."

"The KM300 provides unexcelled traction."

"The Michelin 'X' m+s is the safest ice and snow tire ever made."

Among makers and distributors requested to document claims are Sears, General Tire, Goodyear, Firestone, Goodrich, Dunlop, Marcor, and Penney.

unsatisfactory control procedures for setting up grades.

Uniformity and balance will not be included in the grading standard initially, but Toms points out that they are included indirectly, because those qualities have a bearing on tread life. And apparently they will be included at a later time.

Retreads will not be covered when the standards first go into effect, but Toms indicated that they would eventually be covered just like new tires. There will be no grading of trailer, camper, or truck tires at first, either. Eventually, however, they will also be covered, NHTSA says.

As POPULAR SCIENCE went to press, NHTSA was still wrestling with the problem of grading mud and snow tires. They will not be included in the first proposals, Wallace says, but will ultimately be included.

Enforcing the standards. What is NHTSA going to do? The agency is gearing up right now for compliance-testing of the tires. Special equipment is being installed.

"If a tire doesn't meet the classification that has been placed on the sidewall of a tire, we can issue a recall," says Toms.

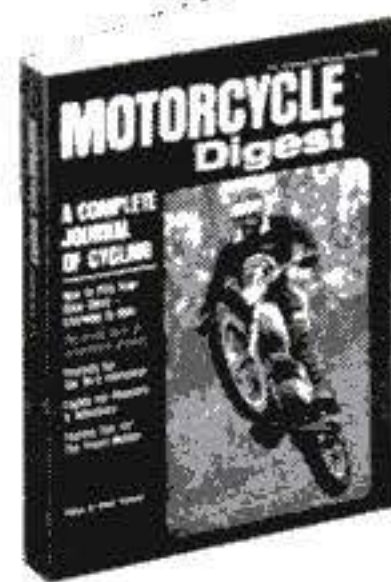
Recalls are not new to NHTSA; already this year 100,000 tires have been recalled by two companies for failure to comply with Motor Vehicle Safety Standard 109. Last year, close to 200,000 tires were recalled for the same reason. Still, compared with the 150 million new tires and 50 million retreads produced each year, the number is small.

Toms is optimistic about the effect of the new grading standards. He expects them to be an antidote to salesmen who wax enthusiastic about tires they try to sell you "often with little or no regard to how they will actually perform for you."

Protection for the buyer. The agency will have the power to levy fines against companies whose tires do not meet the stated grades on the tires. And, says Toms, it should make it a lot easier for you to get warranty satisfaction from tire companies if their tires don't measure up. Motorists will certainly welcome that!

These grading proposals will be out just about the time that you read this issue of POPULAR SCIENCE. They will be open to comment by the public just as the previous ones were, but there's little likelihood that they will be substantially revised, as the original proposals were. There's little doubt that the three grading standards mark the beginning of a new era in tire shopping. **P.S.**

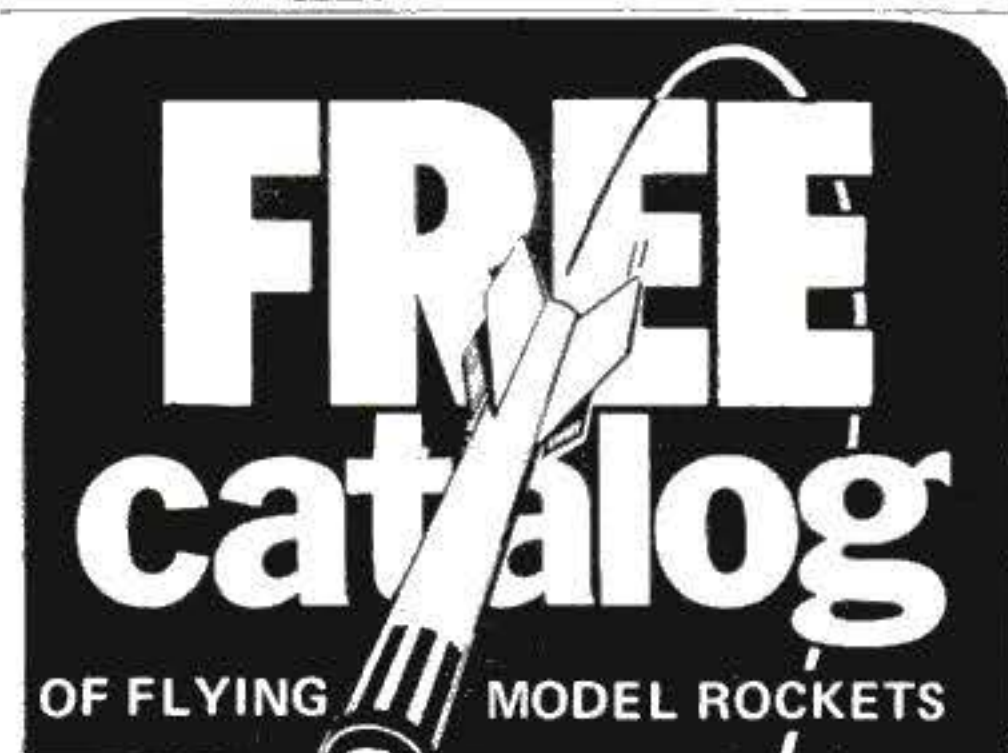
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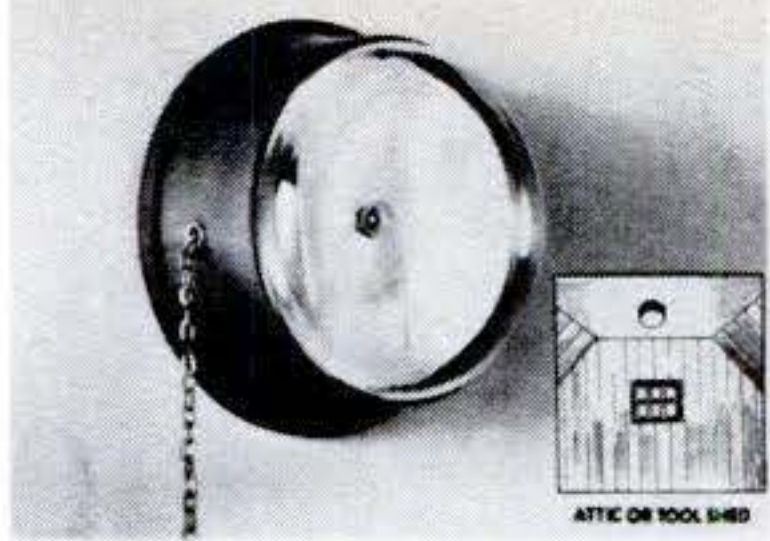
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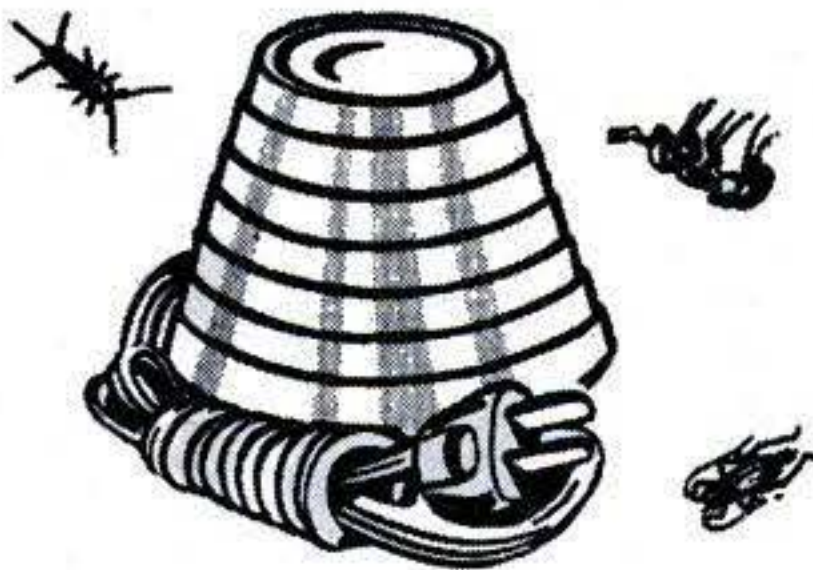
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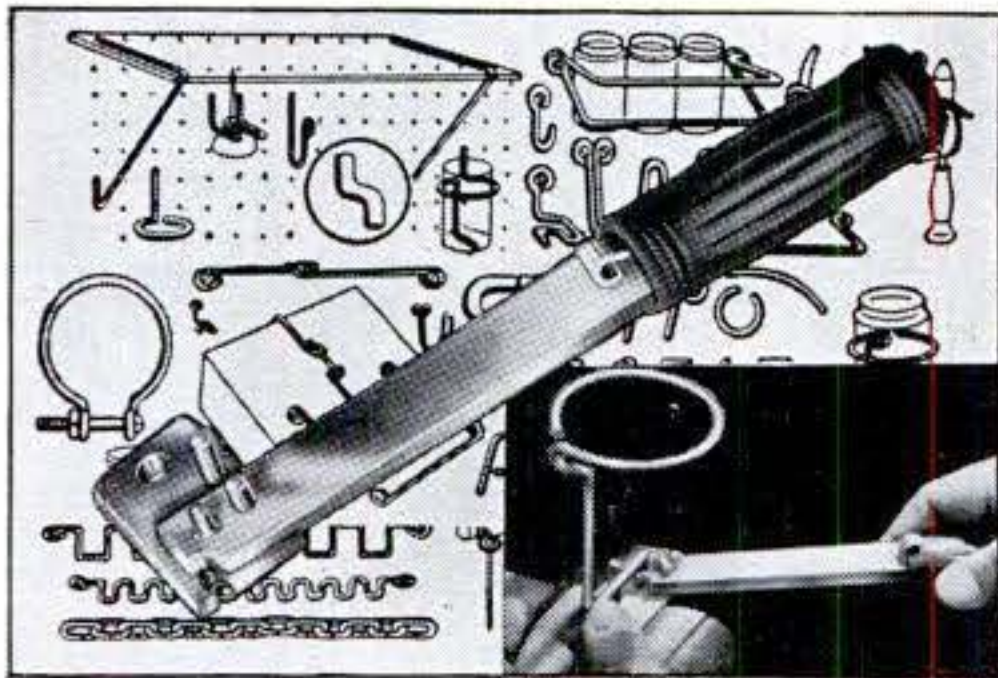
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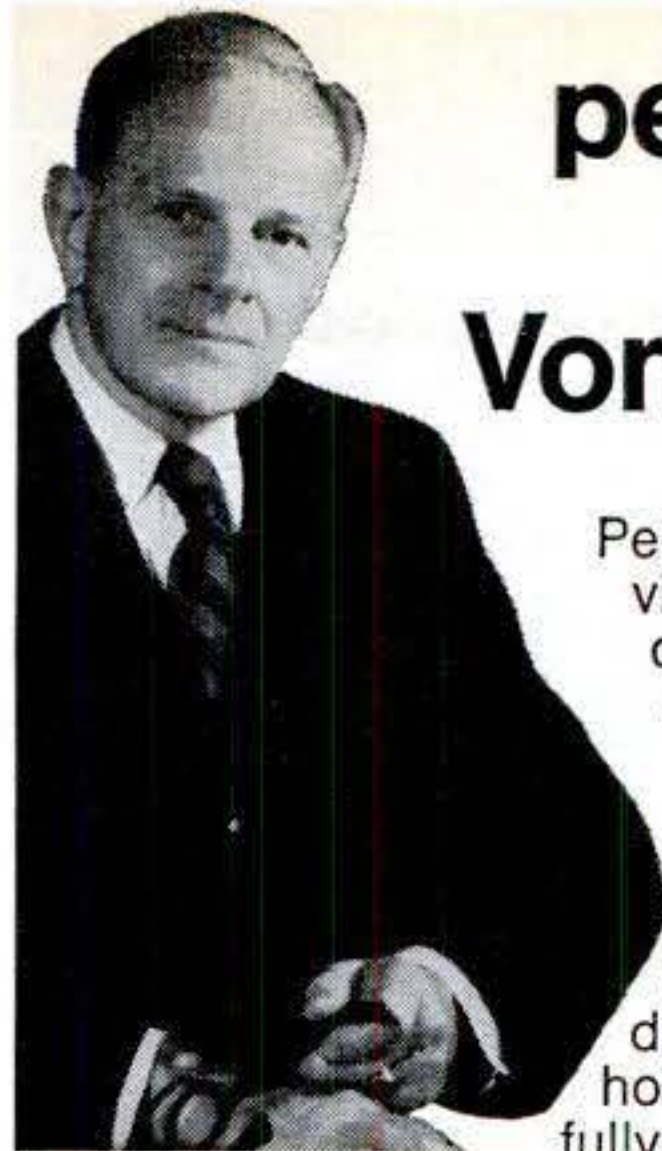
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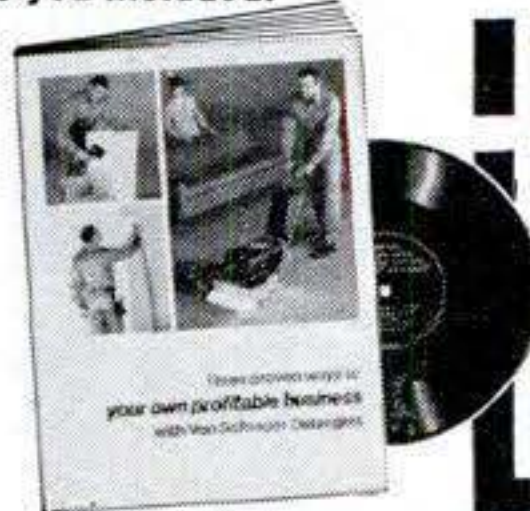
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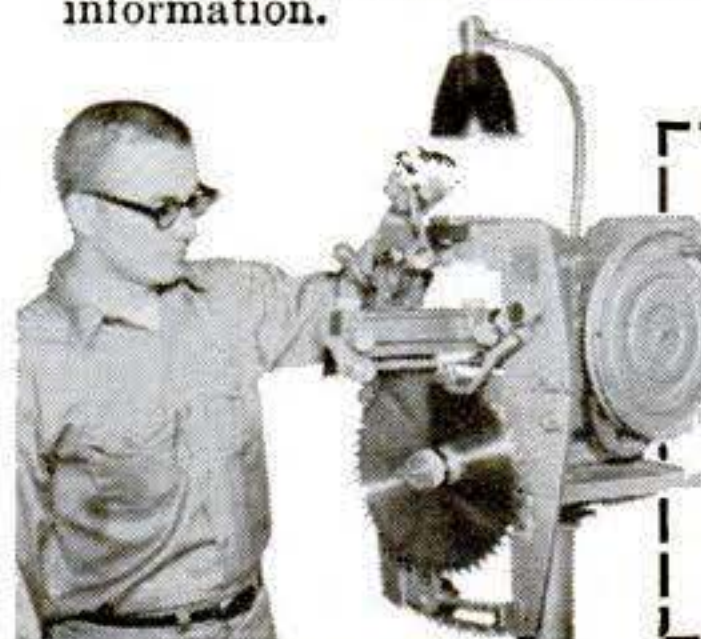
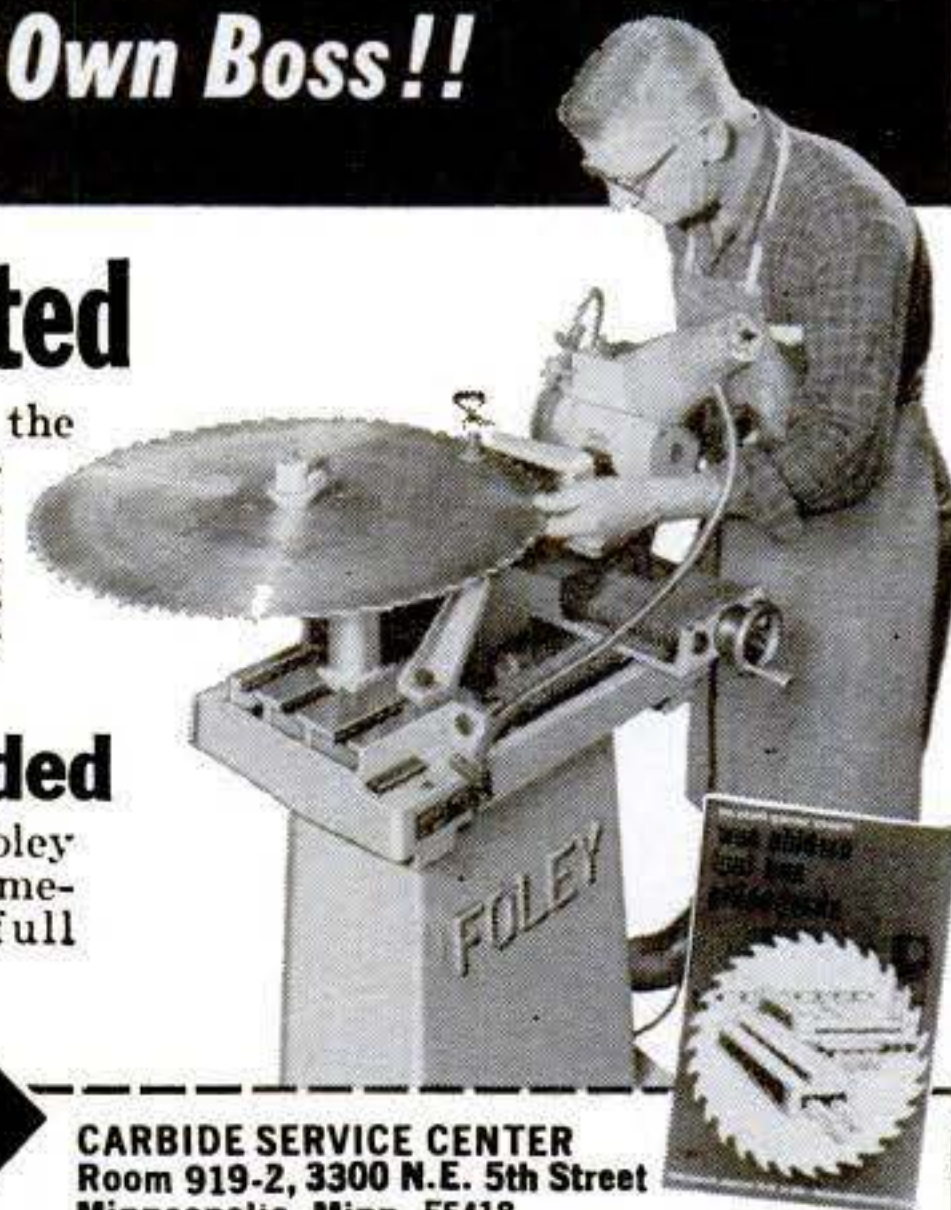
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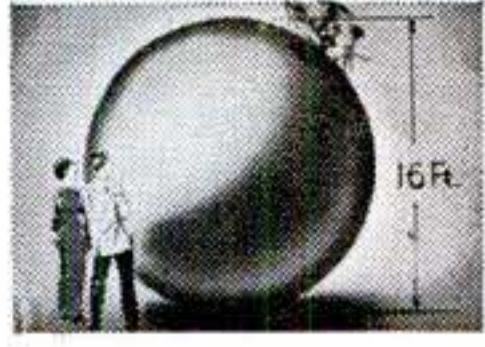
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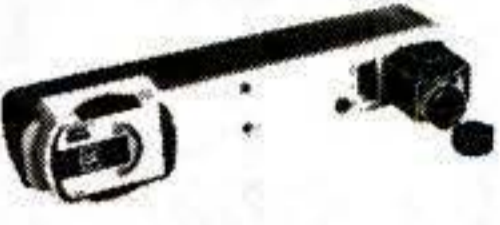


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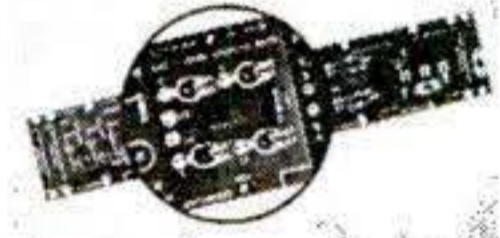


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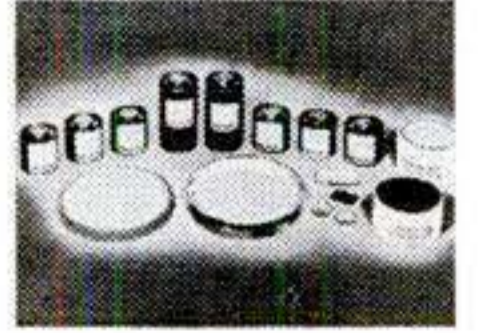
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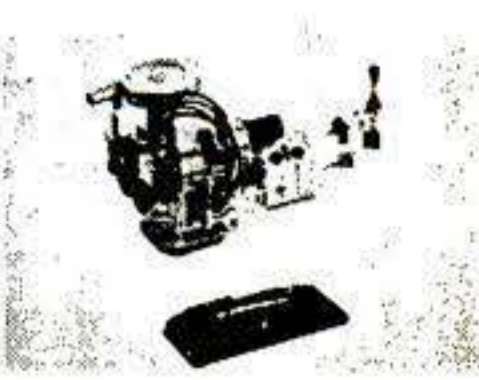


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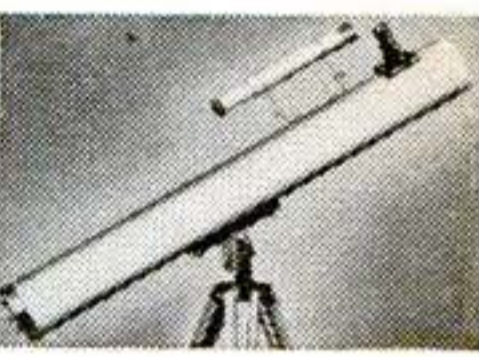
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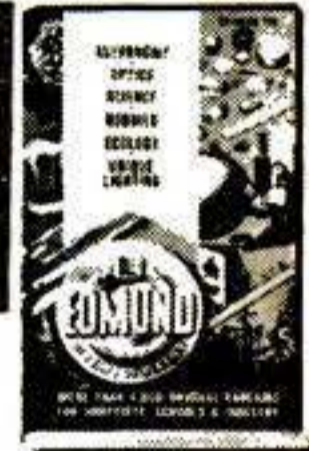
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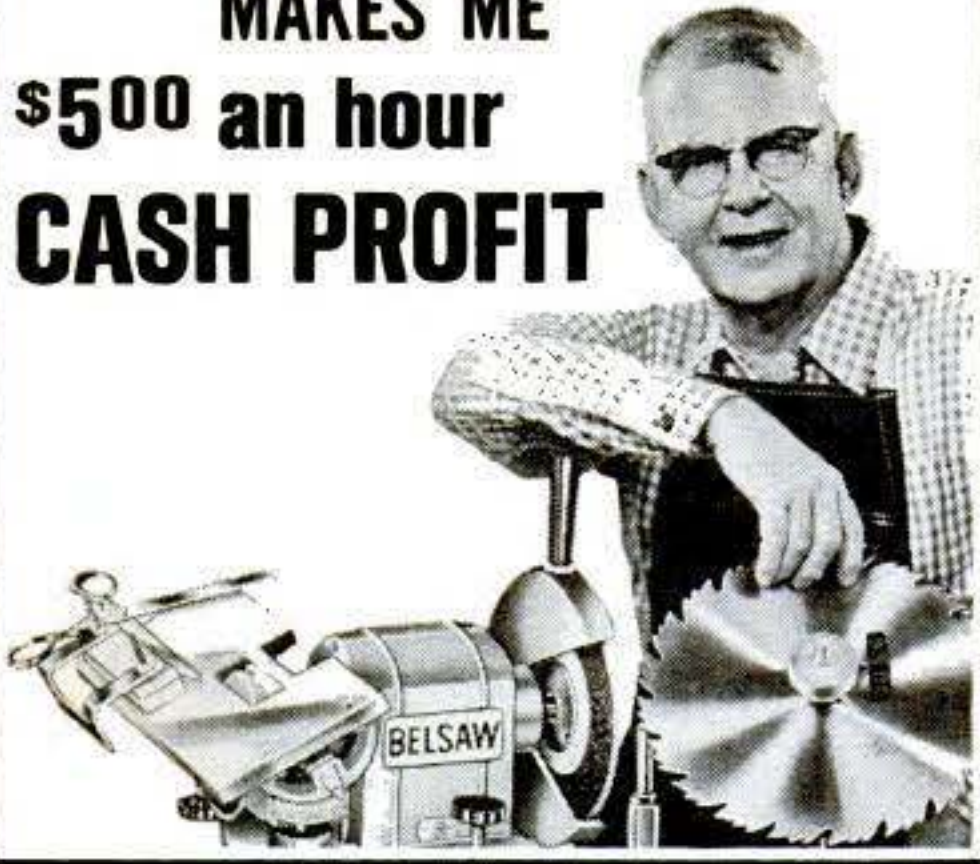
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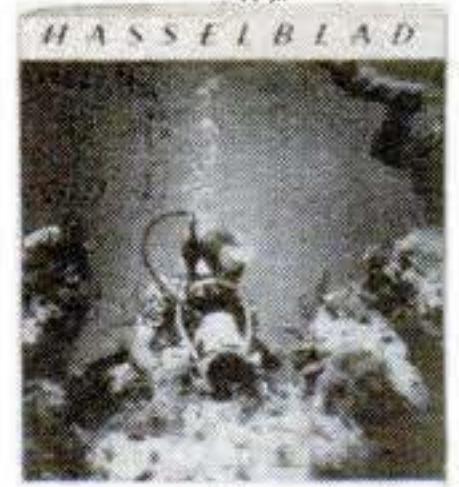
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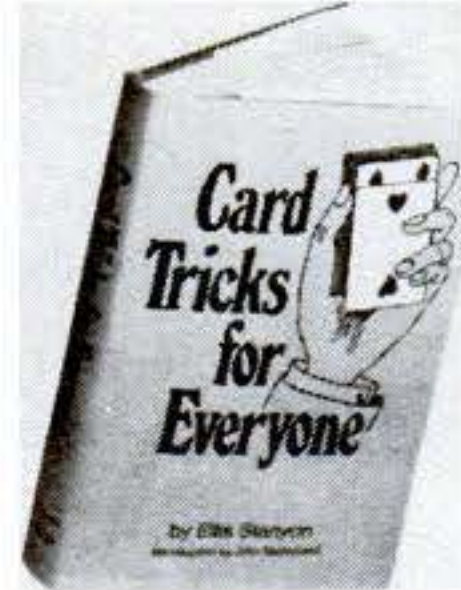
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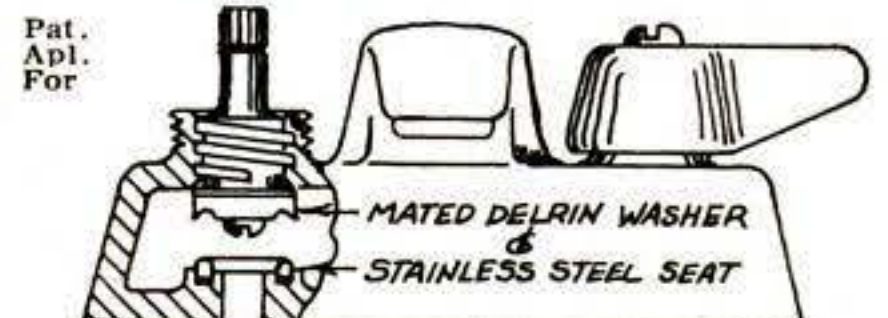


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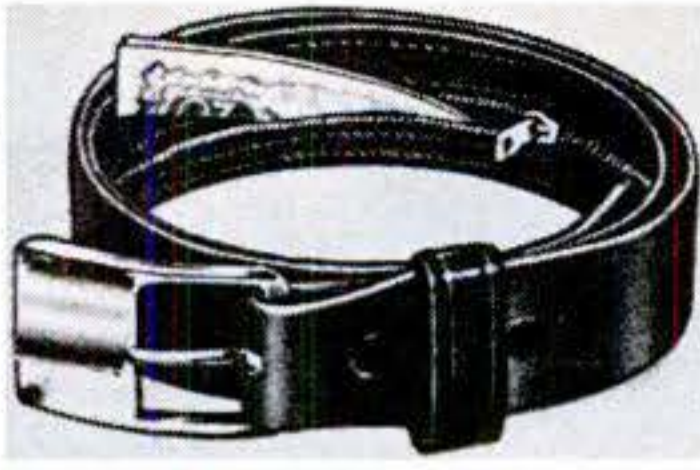
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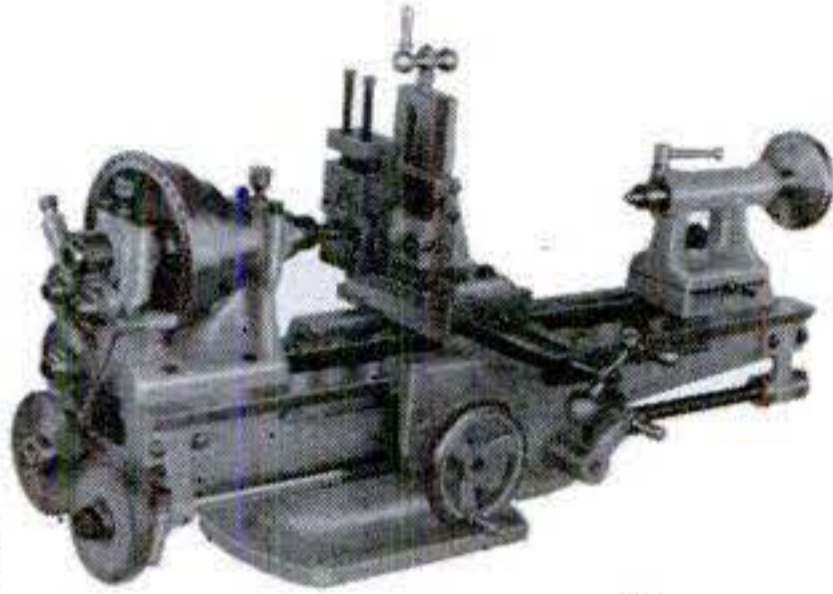
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Weld, braze, solder or cut most anything made of metal. No experience necessary. Follow simple instructions to make repairs on cars, trailers, farm and lawn equipment, bicycles, appliances, etc. Make campers, boats, furniture, hundreds of valuable items. **NOTHING ELSE TO BUY!** Comes complete with full face shield, pack of welding and brazing rods, heavy duty power cables, special electric torch attachment, ground clamp, flux, easy-to-follow illustrated instructions, rod holder, etc. Uses standard 1/8" rods to weld iron, steel, brass, bronze, aluminum, other metals. New improved HEAVY DUTY circuit gives more welding power. Gives 4 times the heat needed to melt toughest iron. Plugs into ordinary 110V outlet. 6 WELDING HEATS plus continuously variable carbon-arc heat regulation control lets you weld anything from "tough" jobs to light-weight metals with ease. This important feature saves you money and time. Makes it possible for even beginners to start welding professionally the very first day. Pays for itself quickly. An excellent gift for any occasion. **IT'S AUTOMATIC:** Current is turned ON when arc is struck, OFF when rod is lifted from work. Eliminates need for troublesome foot switch. Speeds up work. Lifetime guarantee.

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7 Million readers read his ads and almost overnight the sacks of mail began pouring in! Thousands of orders stuffed with CASH and checks! More money in 30 days than he could make in a year!

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It's a fabulous business! You can start on a shoestring. Begin in your spare time. Pick a winner and you're set for the rest of your life! Like the unique Cigarette Holder which Mail Order Associates 'discovered' for their members. A dial on the holder permits the smoker to inhale less and less smoke. Millions of people are looking for ways to stop smoking. Then, PRESTO! You've got the item millions want!

A Million Dollars!

Over 200,000 of these holders were sold at \$4.95. A million dollars on just one item! Your cost is \$1.10 and they mail for 8 cents postage. You can see the profits in Mail Order — and how shrewd beginners get rich very quickly! No wonder successful members of M.O.A. send in letters of praise to the firm that helped them get started.

L. L. Bean of Freeport, Maine built a \$1,500,000 a year Mail Order business selling sportsmen's equipment. His first and still leading seller — a special waterproof boot for hunters.

A man from California parlayed a \$60 investment and made a million dollars

in Mail Order selling toy balloons and ant houses!

Bob Carter tried direct selling but got discouraged with few sales and little profits. On a hunch, he tried a small ad in House Beautiful. It pulled \$5,000 in orders! A lot better than ringing doorbells. He repeated the ad and grossed over \$100,000 before the year ended!

Boyce Wilkes joined Mail Order Assoc. to earn extra money for his family, while holding his regular job. He began with products, ads and catalogs supplied by M.O.A. Now he has his own 100 page catalog, his own advertising agency, and as Boyce puts it . . . "my business is growing so fast I can hardly handle it. I will go beyond \$300,000.00 in sales this year." He goes on to say, "I owe my success to Mail Order Associates."

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If you are over 21, and can see the tremendous advantages of owning a Mail Order business of your own . . . then ACT NOW! Write to: Mail Order Associates, Inc., Dept. 254, Montvale, New Jersey 07645.

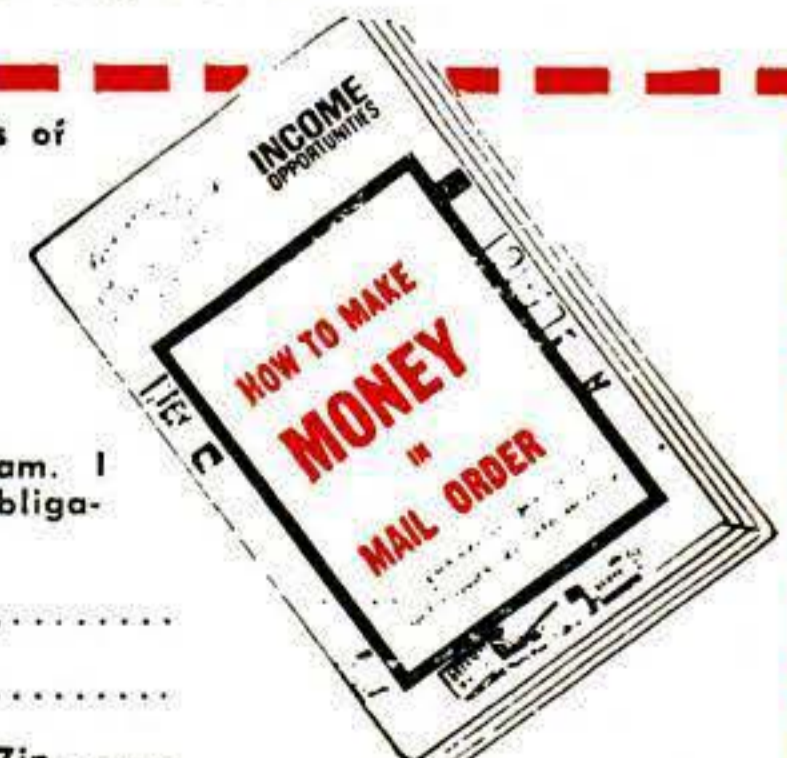
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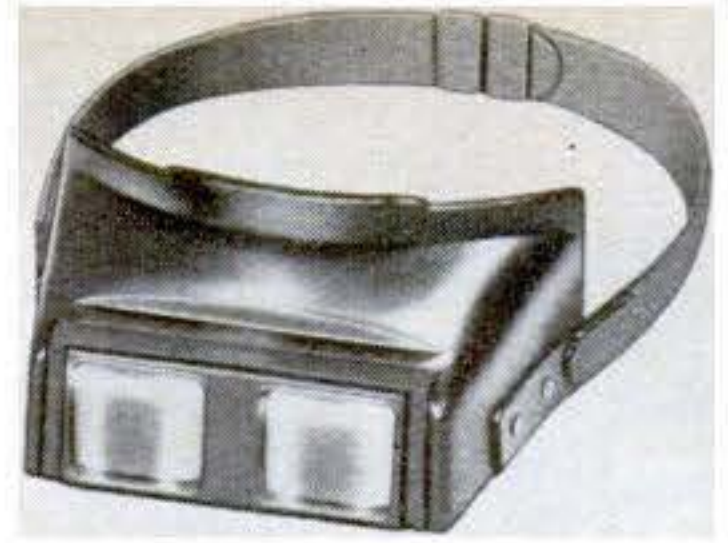
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Please rush complete details on your Mail Order Program. I understand everything is free and there is absolutely no obligation. I am over 21.

Name
Address
City State Zip



Shoppers'



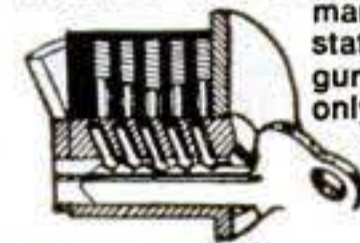
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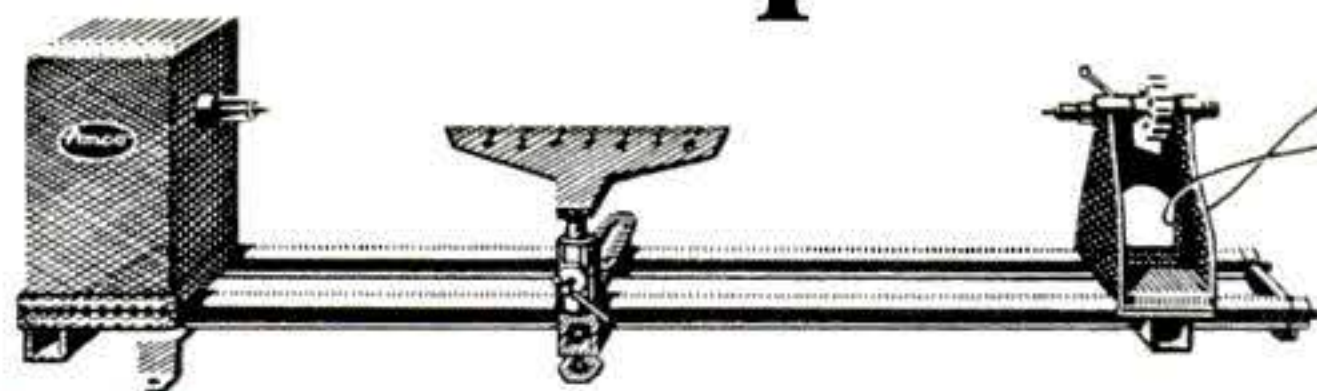
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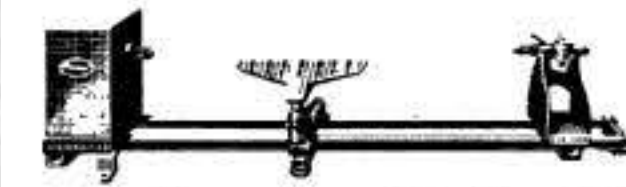
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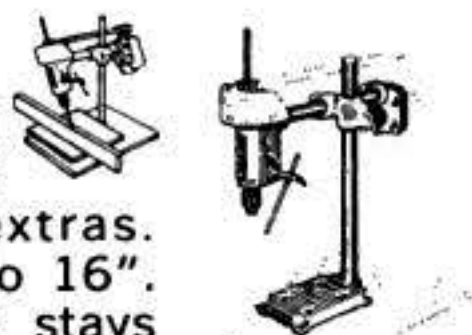


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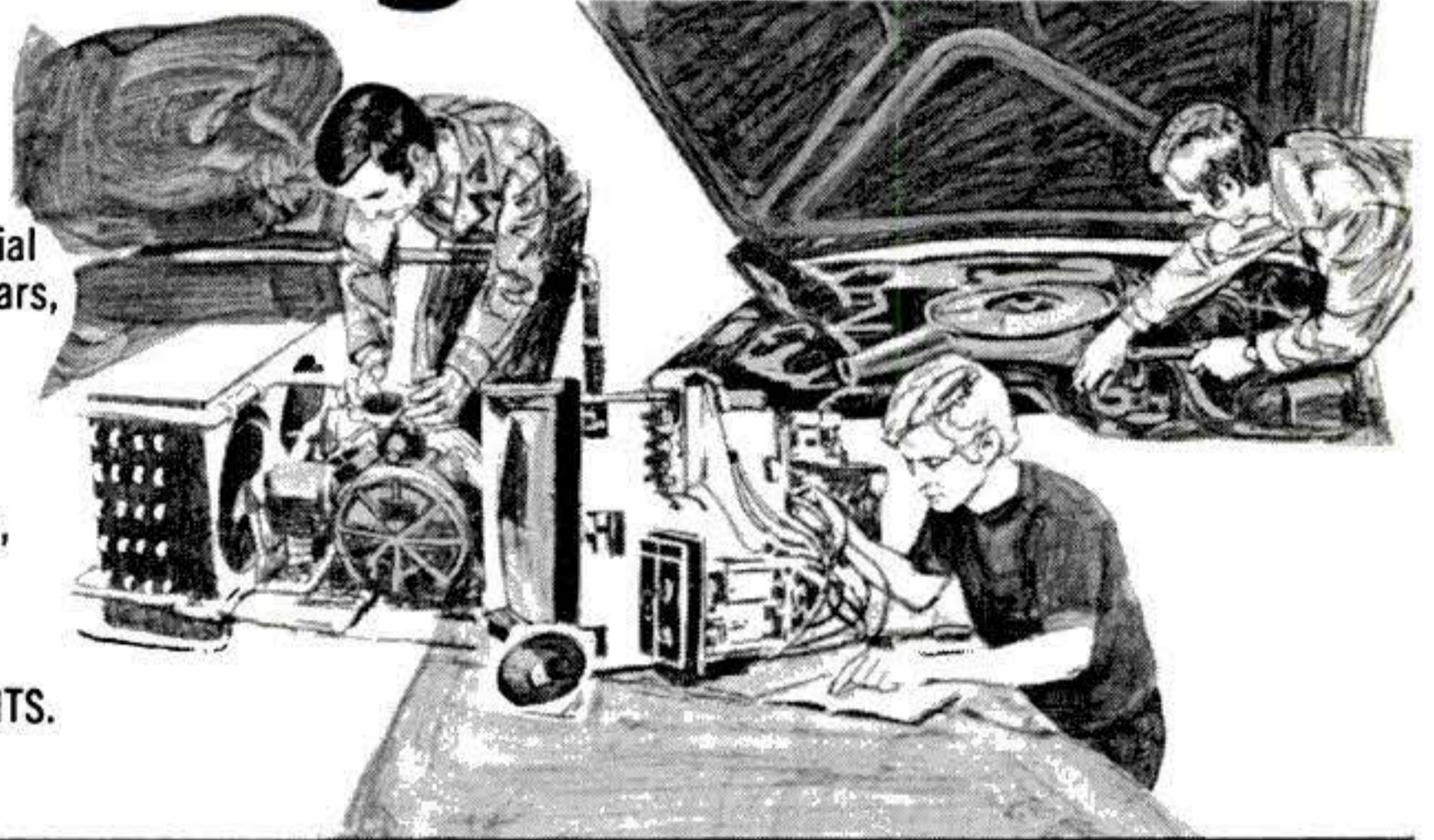
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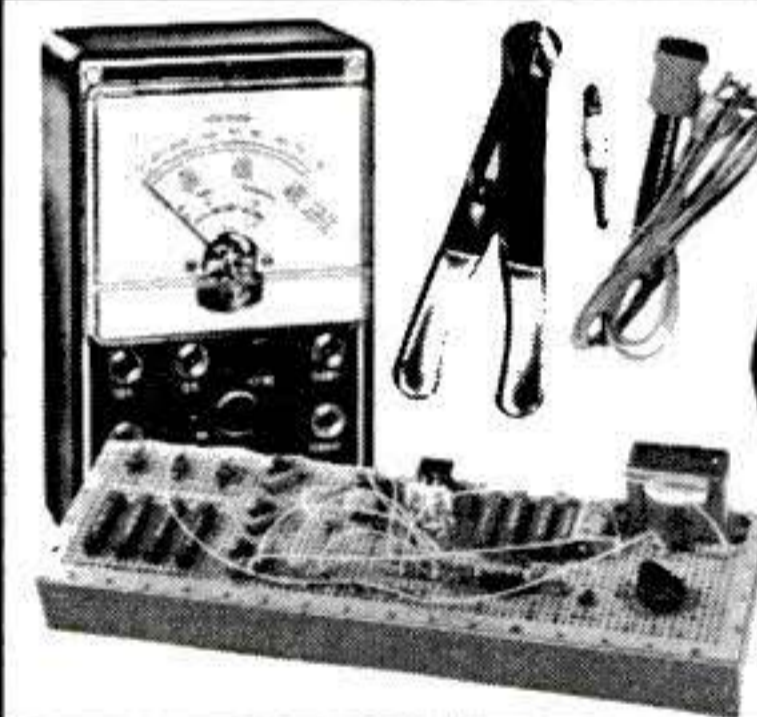
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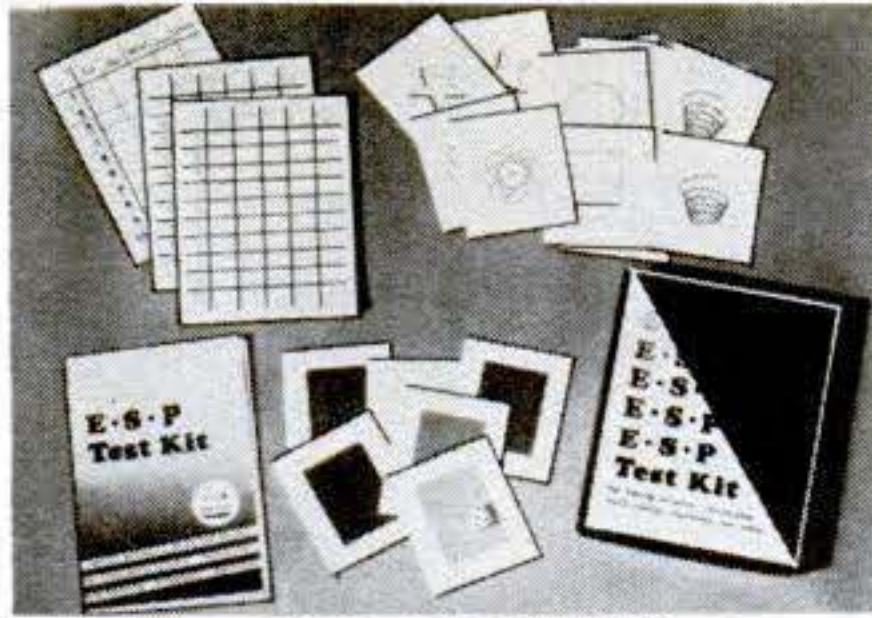
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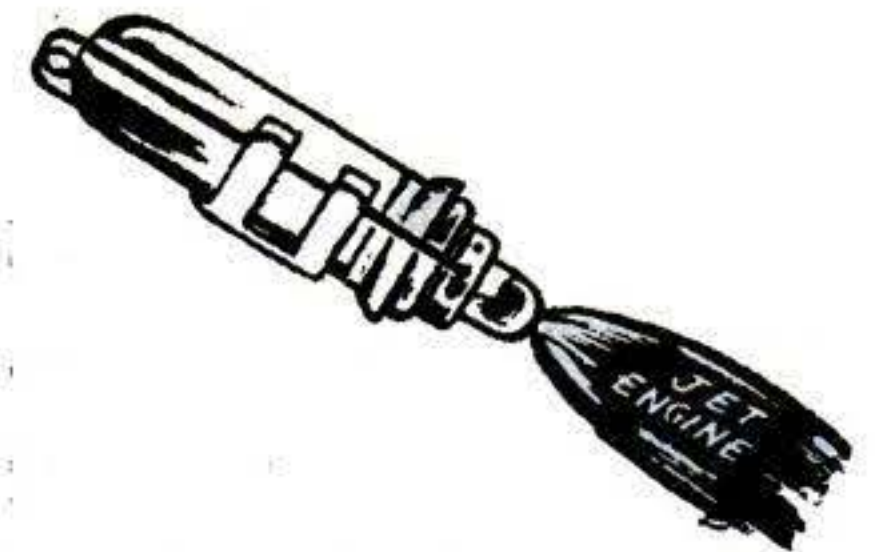
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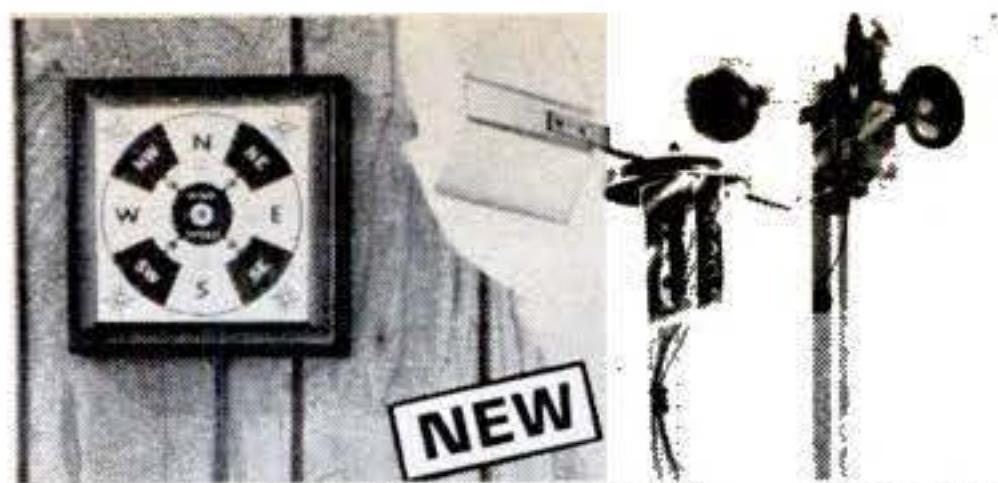
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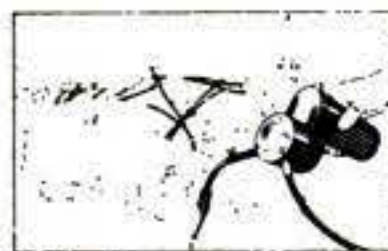
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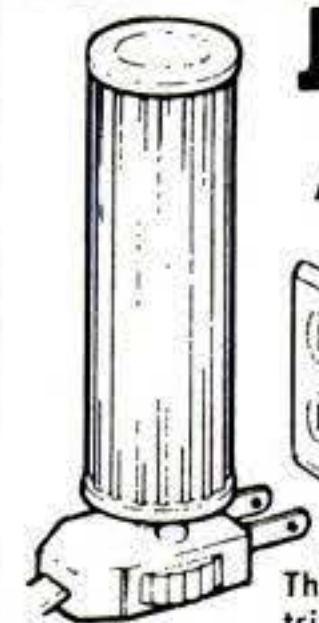
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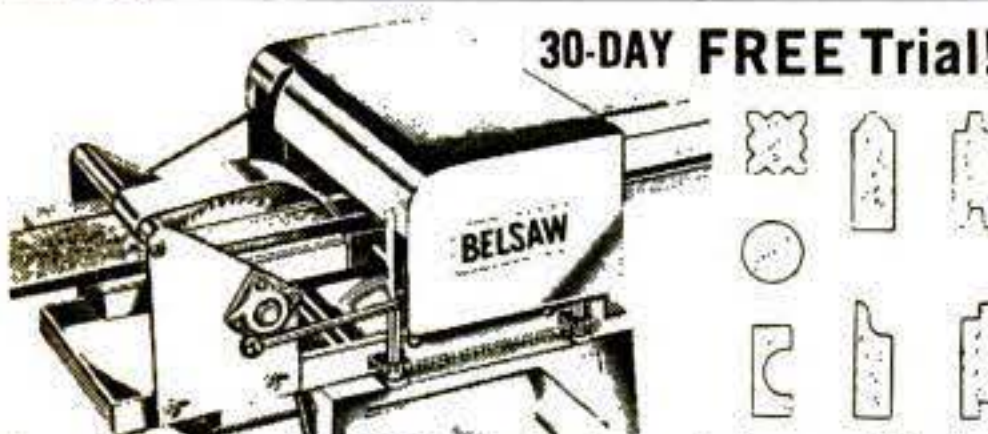
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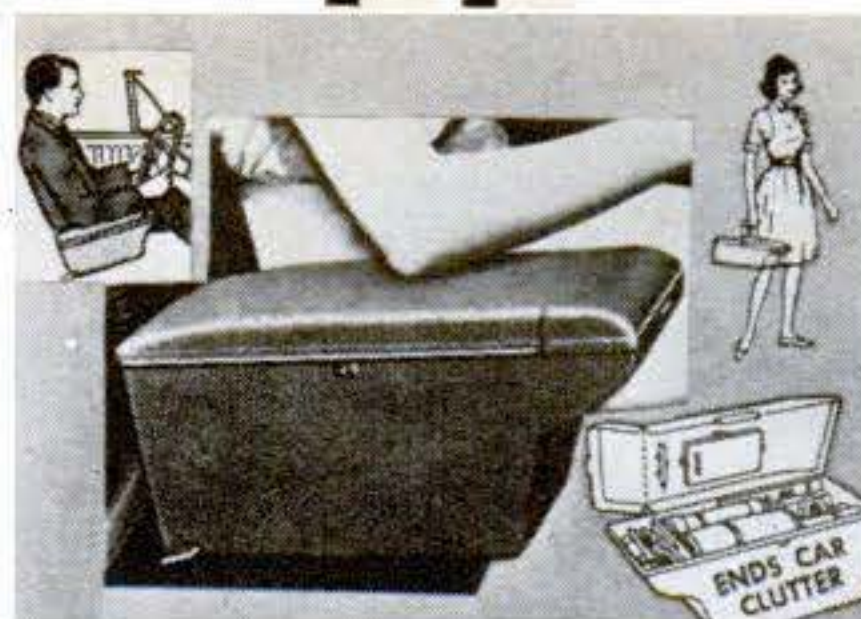
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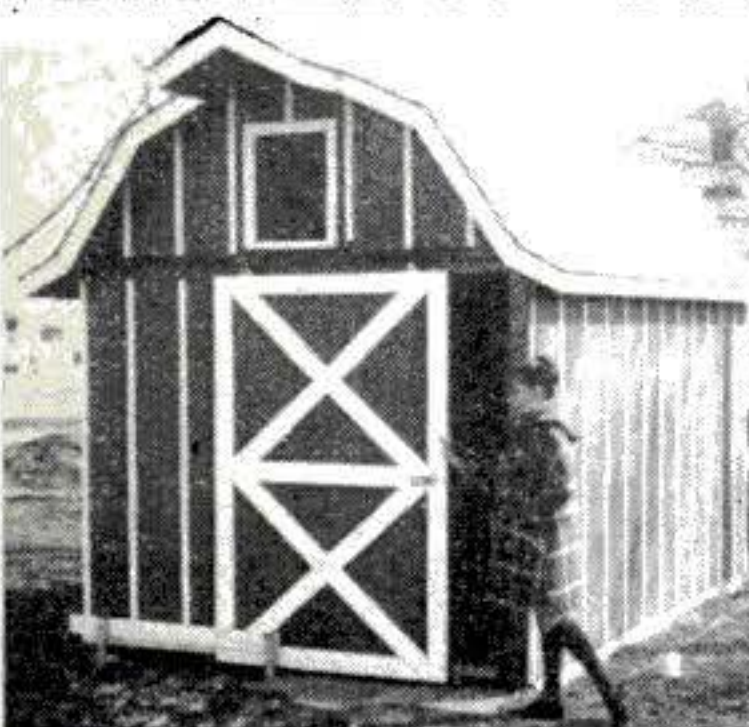
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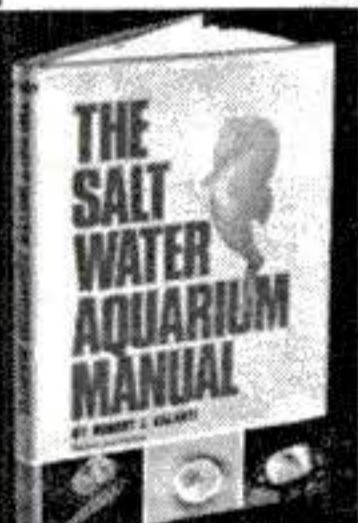
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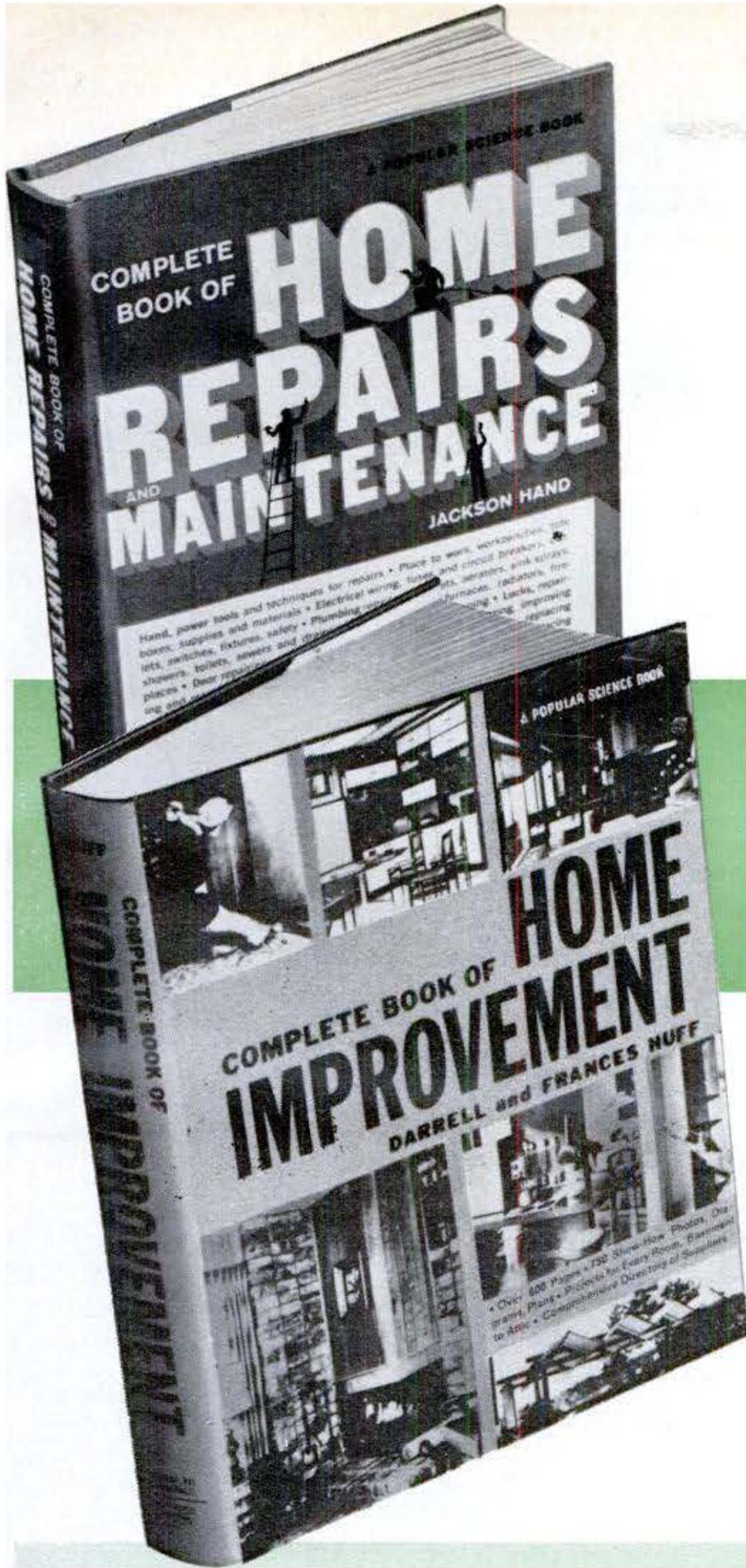
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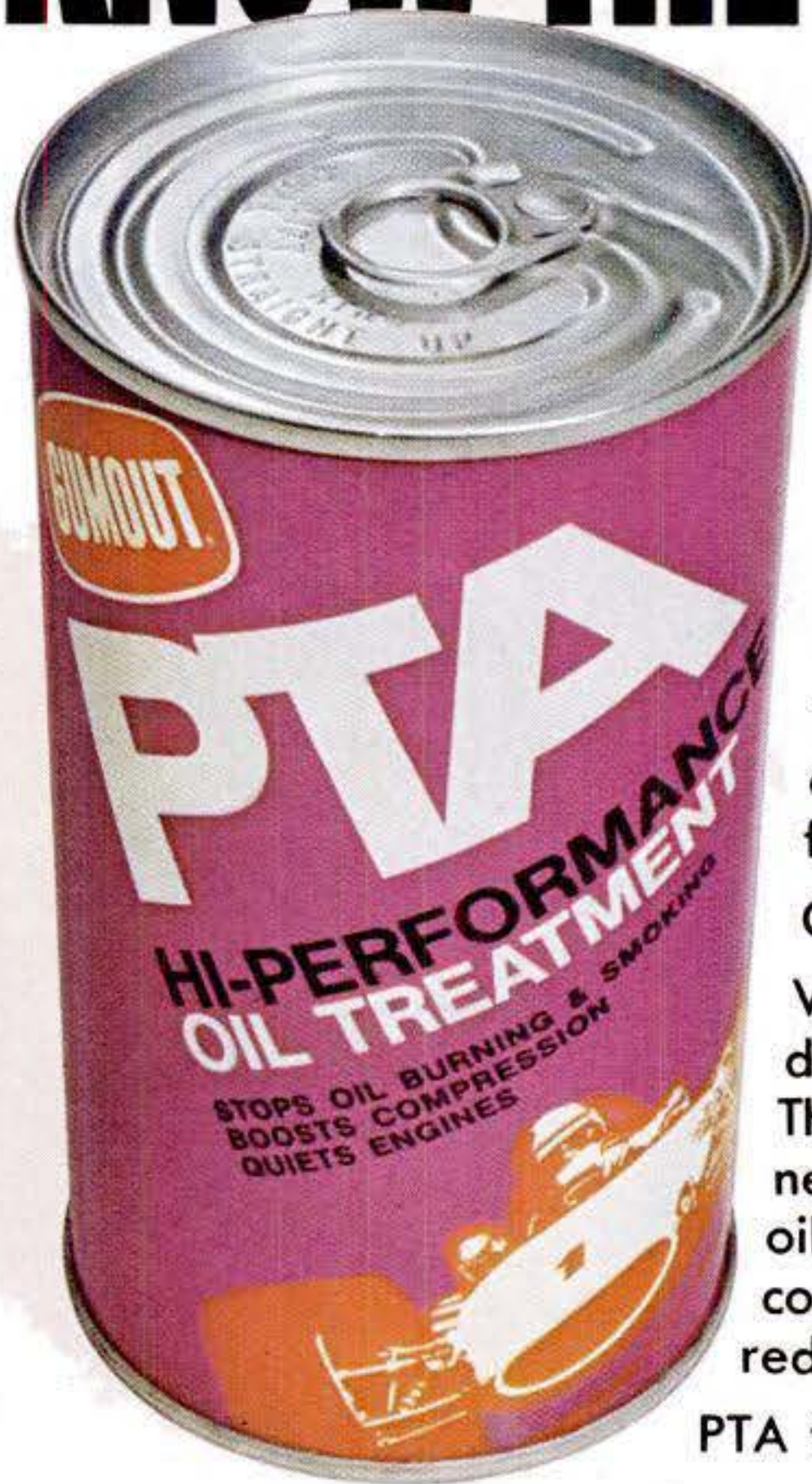
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