

MARCH 1972 60 CENTS

# Popular Science

THE *What's New* MAGAZINE

## PS Tests Five New CAMPING TRAILERS DESIGNED FOR YOUR SMALL CAR

**OUR SECRET RESEARCH  
ON LASER WEAPONS**

**What Can Be Told**

**MAN-POWERED  
PLANES GET  
NEW LIFT**

**WHEEL-DRIVE  
PASSENGER CARS**

**Are They on the Way?**

**PARKING-LOT  
MILCAR YOU  
CAN BUILD**

**POLLO 16**

**Why We're Going Back**

**to WERNHER von BRAUN**

**SPECIAL 12-PAGE  
CAMPING SECTION**

**New Trends in Tent  
Campers...Motor Homes  
Travel Trailers...**

**Truck Campers...Vans  
that Double as Wagons  
and More**

**NEW TV  
ANTENNAS**

**How to  
Choose One**

**plus 13 other exciting  
articles, What's New Digest,  
dozen great every-month features**



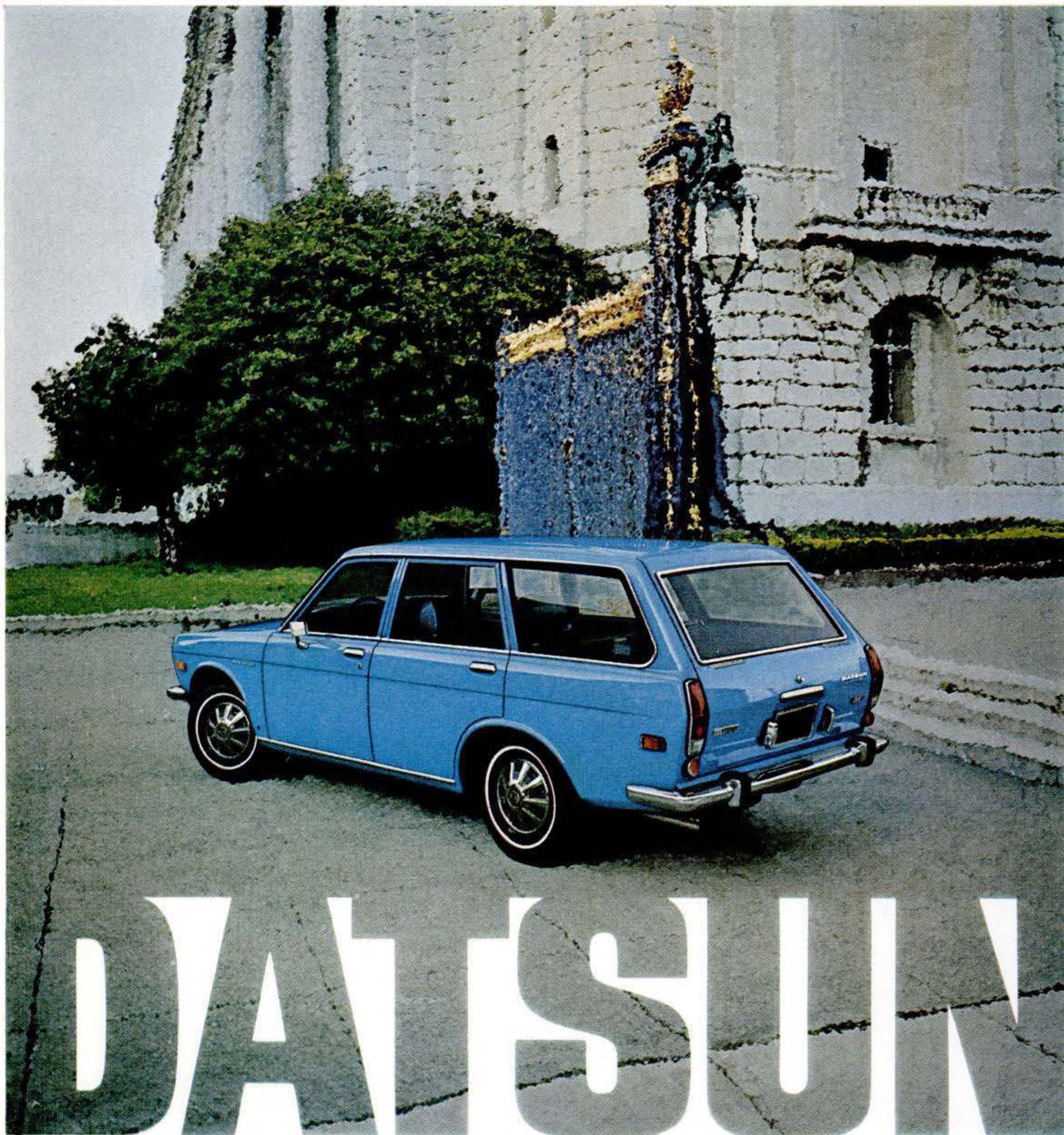
# We've got our ins and outs. Five of them.

If you don't think five doors on a wagon is a big deal, try getting something bulky into or out of a three-door wagon. It can be a real wrestling match.

That's why the Datsun 510 Wagon has five doors. We don't think you should

have to go two out of three falls with Aunt Sophie's antique armoire, even in a wagon from the economy price group. Try our five-door accessibility. It's the easy way to get to the ins and outs of station wagons.

Drive a Datsun... then decide.



FROM NISSAN WITH PRIDE

# If you shoot left-handed, we've got a new way to do it. Automatically.

Introducing our new left-hand Model 1100 automatic shotgun—the latest entry in the extensive 1100 series. Actually, this new left-hand model is *two* entries—a 12 gauge and a 20 gauge. Both are true mirror images of the right-hand 1100. And both are perfect for the left-hand shooter bothered by ejecting hulls from right-hand automatic shotguns; or the shooter with a left master eye.

You're going to love this new left-hand 1100, because it has all the ruggedness and dependability that the Model 1100 is famous for—superior performance in any weather. The same performance that has made the Model 1100 a consistent winner in the Grand American Trap Shooting Championships and World Skeet Championship since 1963.

Our new Model 1100 left-hand is offered in field, magnum, trap and skeet grades. All with ventilated rib barrels.

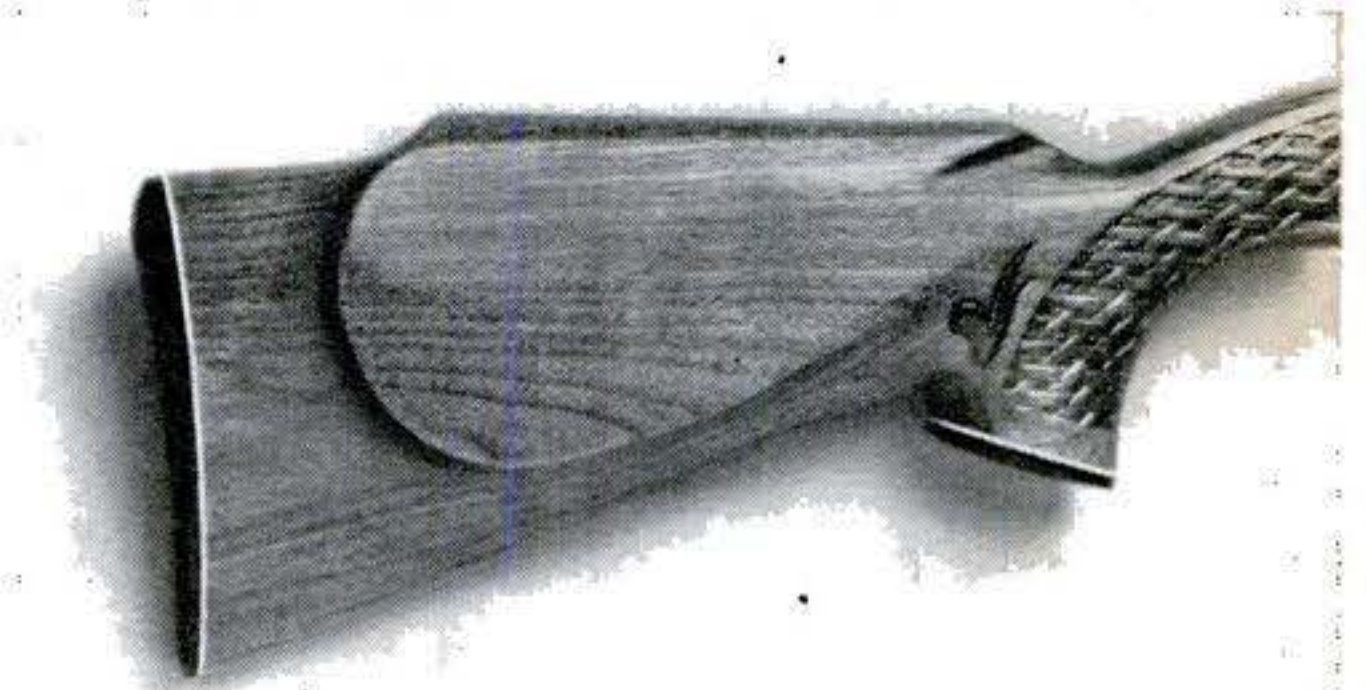
The unique gas-metering system of the standard 1100 is designed to operate with all 2¾" standard velocity, "Express" and 2¾" magnum loads without gun adjustments.

This same system also takes the "kick" out of the 1100. So there's less recoil sensation than you get from any other shotgun action. Your shoulder feels a "push" instead of a "punch".

But you will get a kick out of the great looks of this 1100: The white line spacers. The teardrop pistol grip. The decorative scrollwork of the solid steel receiver. The deep rich blueing—inside as well as outside—made possible by our "vibra-honing" metal finishing process. And, of course, the gleam-protecting RK-W wood finish, which gives tough, scratch-resistant protection

against weather and wear. All in all, quite a gun for the southpaw.

And we have some others, too. In fact, Remington offers more left-hand guns than any other gun manufacturer. Our Model 870 "Wingmaster" is a true left-hand. The Model 581 and 788 have left-hand bolts. And our Model 742 and 760, while not truly left-handed, are available with a left-hand cheek piece and



left-hand safety. (Check our new catalog for complete information on all these models.)

Of course, there's no such thing as left-hand ammunition, but whether you shoot left or right, you want the most dependable ammunition you can get. And that's Remington and Peters. Ammunition that's designed to work together with your gun for top performance.

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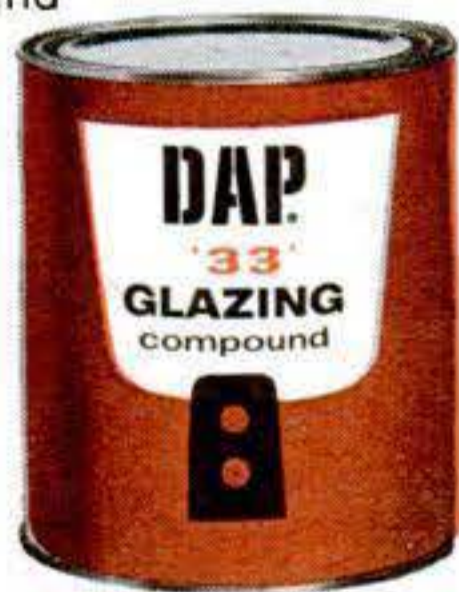
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Here's the untold story of a heat weapon that defense planners have sought for a decade. It's already shot down a drone plane. What's ahead?

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Look—up in the sky! It's a man . . . pedaling. A progress report on the art.

#### Full-Time 4-Wheel-Drive Passenger Cars PAGE 75

Hottest item now cooking in Detroit—several systems are on their way.

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PS tests five new little campers, with five popular subcompact cars to tow them. Here's what we find about safety and handling.

#### Parking-Lot Sailcar You Can Build PAGE 118

Surprising new design is narrow and light—for exciting race-car handling.

COVER PHOTO BY A. J. HAND

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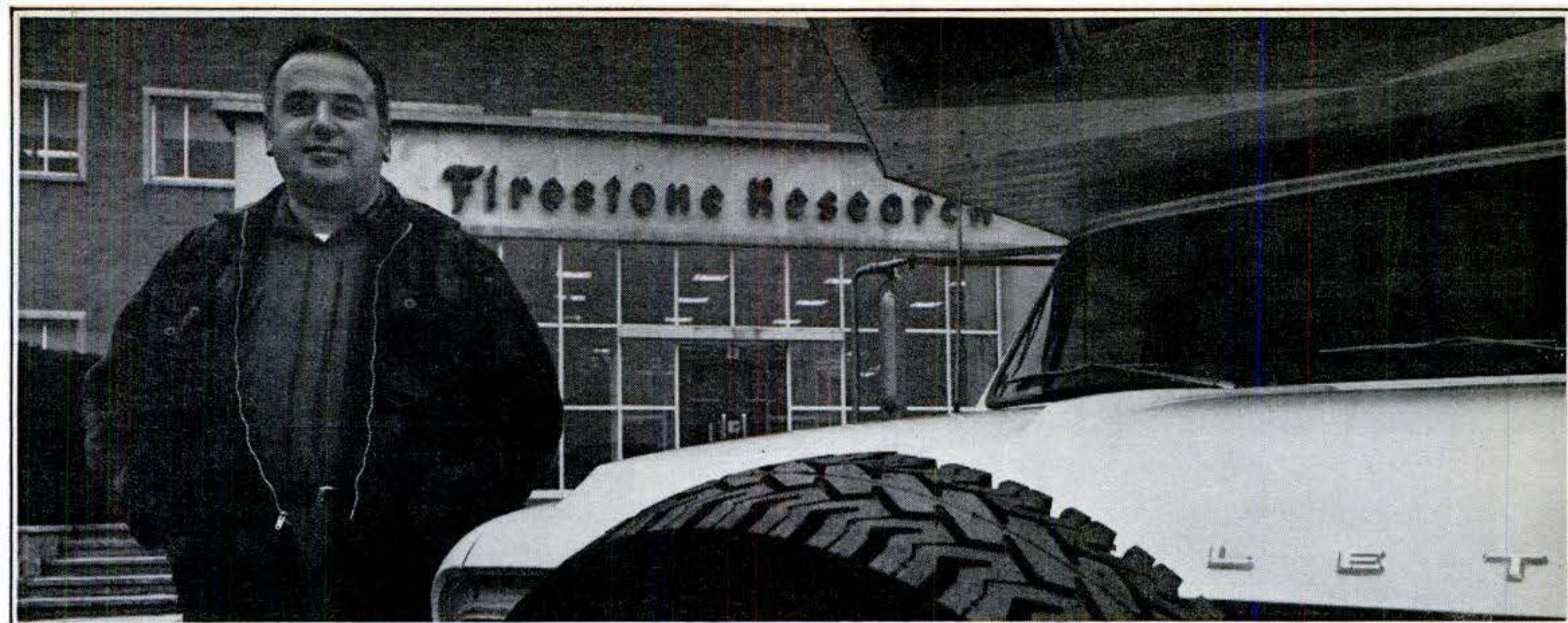
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**STEVE PETRASEK, TIRE ENGINEER,  
COULD PUT ANY TIRE WE'VE GOT ON HIS CAMPER.  
HERE'S WHY HE'S SWITCHED TO FIRESTONE'S  
WIDE OVAL TIRE SYSTEM.**



Steve ran our racing tire engineering division for 12 years. He knows high-speed tires. And today as head of our tractor tire engineering team, he understands off-the-road driving problems.

Every year Steve and two buddies leave Akron in a light camper pickup with a jeep in tow. 31 hours later they're isolated in the wilds of Montana hunting elk.

Now with his knowledge of tires Steve *could* even design special tires for his equipment if he thought they'd work best.

But what Steve recommends is what you should use on your camper. Here's how it works:

**On the front,** you put Firestone's Transport 500 Wide Oval® truck tires. They're the *steering* part of The System. These tires have a wide, wide tread to grip the road for more mileage under normal conditions than the tires they replaced in our line. (The Transport Wide Oval.)



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Two pairs of Firestone tires teamed together to provide your camper with stability, traction, and long tire life.

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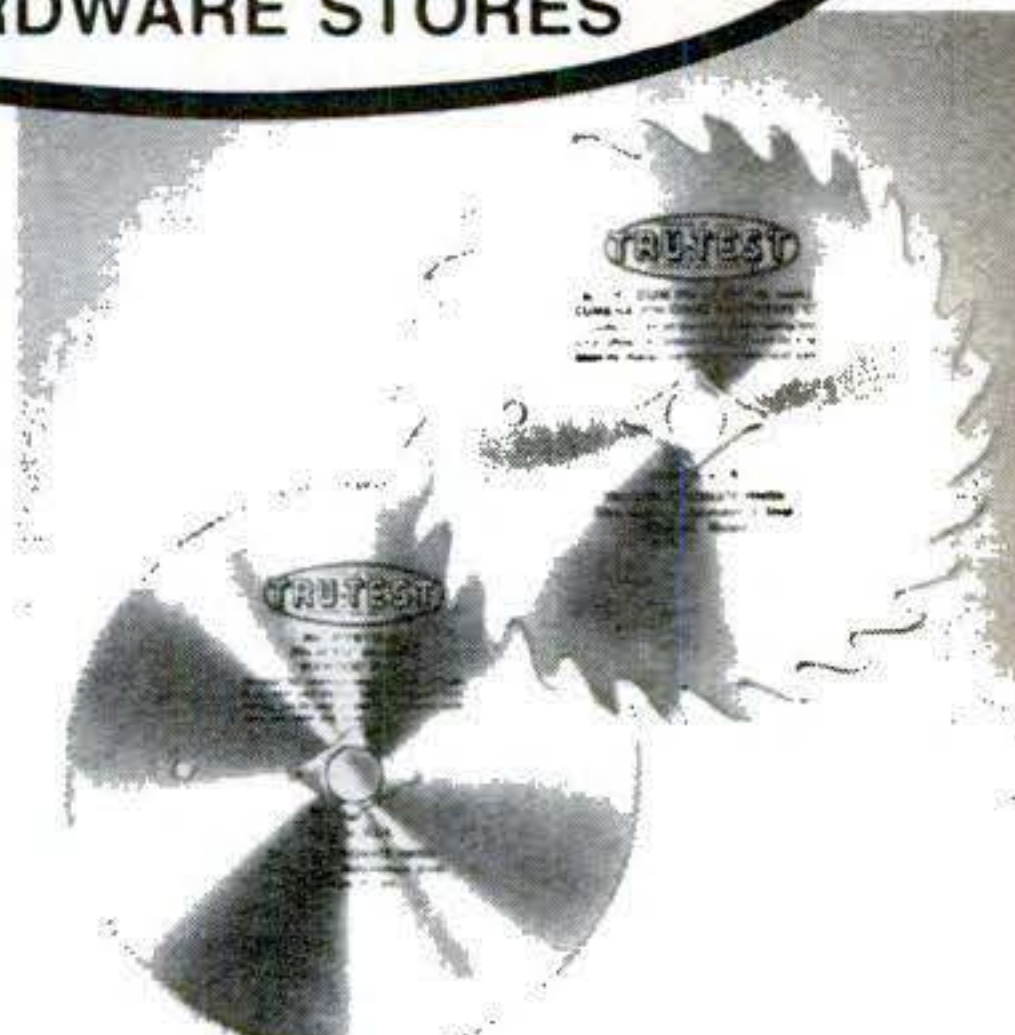
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## PS Readers Talk Back

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



### No-wheels train

In "New No-Wheels Train Gets a Lift from Magnets" [Jan.], David Scott makes the train sound like one of the best inventions ever. It's a partial answer to overcrowding in mass transit while at the same time emitting little or no pollution. What's more, it will provide a faster, safer, and more comfortable ride. What I would like to know is how long will it be until it is introduced and widely used in the U.S.? It looks like just what we need to solve the transportation problem.

DAVID LUSTIG, Belle Harbor, N.Y.

*The Dept. of Transportation may exhibit the experimental rail car at Transpo '72 in May. Maybe enough citizens will demand action when they see what could be done.*

### Flood relief

Excellent planning! The January issue, with "Secrets of Keeping Your Automatic Dishwasher Trouble-Free," arrived just a few days before my Kitchen Aid went nuts, flooding the kitchen floor. The inlet valve wouldn't



shut off, so—following the advice in the article—I took it out and cleaned it. This solved the problem. Thanks for the article.

GEOFFREY ORTON, Rensselaer, N.Y.

### Wankel displacement mystery

Re "Wankel-Powered Car Proves Silent, Powerful, and Trouble-Free" [Jan.], on page 85 you have the Mazda RX2 Sedan rated at 140 cu. in. If it has two rotors at 35 cu. in. each, it would be 70 cu. in. total, not 140 as in your report.

SAMUEL PICKETT, Jacksonville, Fla.

*It's true that the displacement per chamber is 35 cu. in. Yet the Mazda RX2 is rated at 140 cu. in., not 70. Why? Because it has the same air consumption as a 140-cu.-in. reciprocating-piston engine. With two rotors and a chamber displacement of 35 cu. in., the engine takes in 70 cu. in. of air per mainshaft revolution. The 140-cu.-in. Vega engine*

*consumes the same amount of air, with 35 cu. in. in each of its four cylinders, because only two cylinders go through an intake stroke during one crankshaft revolution.*

. . . On page 85 of the article on the Mazda, you said the Wankel engine is economical to operate. The specs indicate that the gasoline mileage one can expect is a pathetically poor 17.9 mpg. By 1964 standards, this car should get about 32.2 mpg for its weight; and figuring an anemic four-percent increase each year, a 1971 car's gas mileage at the same weight should be 42.4 mpg. I think the Wankel engine stinks because of this low fuel economy.

The Wankel engine does have low pollutant emission. But I believe you should point out to your readers that the same devices it uses could be used with the reciprocating engine.

MICHAEL C. CIUZAK, Ramona, Calif.

*PS Auto Editor Jan Norbye replies: "RX2 fuel consumption is right in the ball park for that kind of performance (17.4 mpg in Audi LS 100, 19.6 mpg in Volvo 144-S). You are comparing it to low-horsepower, low-torque engines. For the piston engine to meet 1975 emission standards, it looks like it will need everything but the kitchen sink: afterburner, exhaust-gas recirculation, and a catalytic converter. The Wankel engine has automatic gas recirculation, more-efficient afterburning (due to hotter gas), and inherently lower nitrogen oxides emission."*

### High time for RV safety standards

Being a truck driver, I was happy to see that the Dept. of Transportation has seen fit to inspect rec vehicles ["RV Safety Standards on the Way," Jan.]. Truckers must pass through inspection stations; tourists should, too. If a truck is overweight, the driver gets a ticket. There are a variety of things a trucker can be nailed for. Yet if the laws were stricter on the tourist, I'm sure he'd scream police harassment.

I had occasion to drive a ¾-ton pickup with a camper on it. After the first mile, I decided it was one of the most dangerous vehicles on the road today. I wondered how one could safely handle one of these rigs in a crosswind. I hope the new standards will make RV owners more safety-conscious.

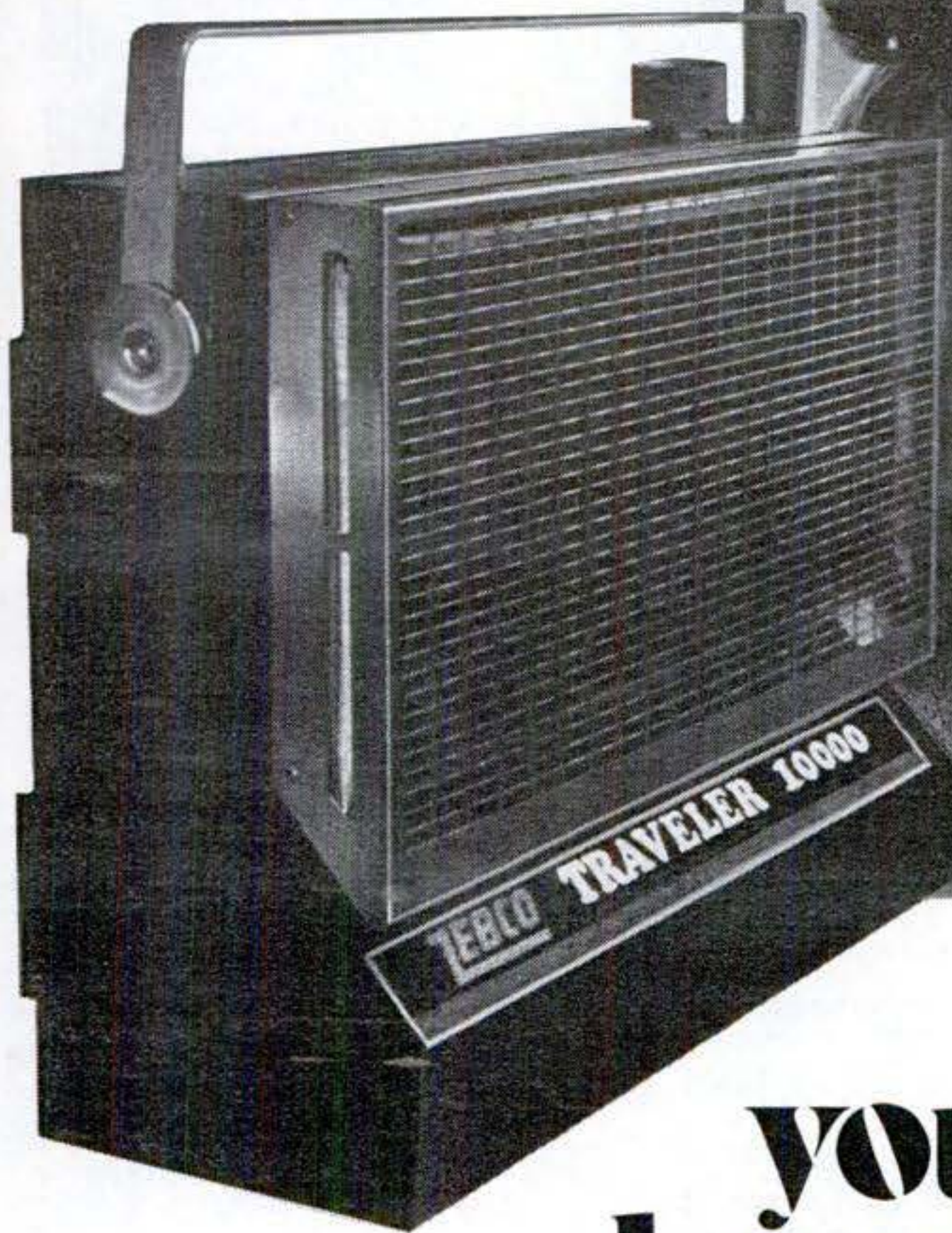
WILLIAM DAWE, Lehman, Pa.

### Marine-radio feedback

"They've Changed the Rules for Marine Radio" [Dec.] may create the inac-



# New Zebco Traveler 10000®



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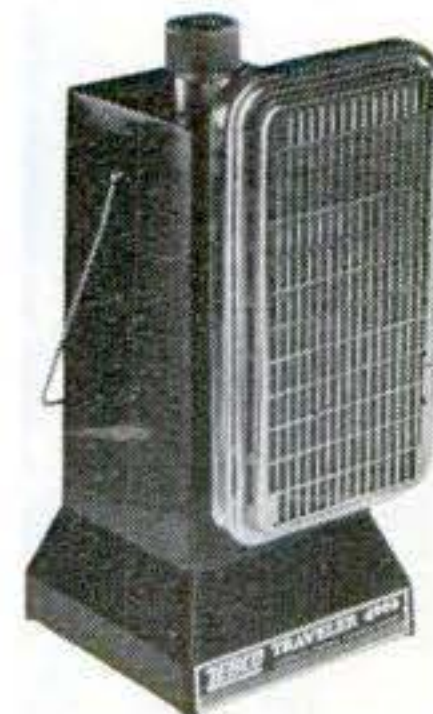
With proper ventilation, you can light the Zebco Traveler 10000 indoors—count on it for flameless, odorless performance without overheating. Its new

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**712 LOS INDIOS TABA-JARAS** Yorks LP, 8TR, CASS

**707 RCOA STEREO SYSTEMS TEST RECORD** Yorks LP

**267 DIONNE WARWICKE** I'll Never Fall In Love Again Scept LP, 8TR, CASS

**355 THE 101 STRINGS** Beatles' Million Seller Hits Aishi LP

**275 CANNED HEAT** Live At Topanga Corral Wand LP, 8TR, CASS

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Mercury LP, 8TR, CASS



**277 B. J. THOMAS**  
Greatest Hits Vol. 2  
Scept LP, 8TR, CASS



**774 5TH DIMENSION**  
Reflections  
Bell LP, 8TR, CASS



**060 JESUS CHRIST SUPERSTAR**  
Counts as 2 records  
Decca LP, 8TR, CASS



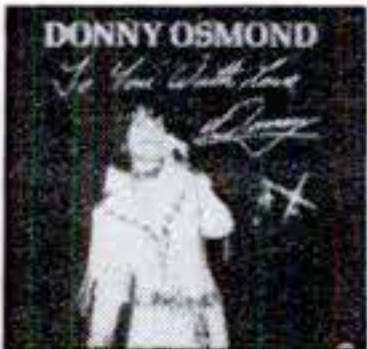
**123 STEPPENWOLF**  
For Ladies Only  
Dunhi LP, 8TR, CASS



**906 ROBERT GOULET**  
I Never Did As I Was Told  
MGM LP, 8TR, CASS



**905 2001:**  
A Space Odyssey  
MGM LP, 8TR, CASS



**907 DONNY OSMOND**  
To You With Love,  
Donny  
MGM LP, 8TR, CASS



**770 PARTRIDGE FAMILY SOUND MAGAZINE**  
Bell LP, 8TR, CASS



**117 JAMES GANG**  
Live In Concert  
ABC LP, 8TR, CASS



**370 JAMES TAYLOR & THE FLYING MACHINE**  
Eupho LP



**119 GRASS ROOTS**  
Their 16 Greatest Hits  
Dunhi LP, 8TR, CASS



**264 GUESS WHO**  
Born In Canada  
Wand LP, 8TR, CASS



**118 THREE DOG NIGHT**  
Harmony  
Dunhi LP, 8TR, CASS

**900 OSMONDS**  
Homemade  
MGM LP, 8TR, CASS

**764 MOUNTAIN**  
Nantucket Sleighride  
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**354 THE 101 STRINGS**  
Webb & Bacharach's Million Seller Hits  
Aishi LP

**908 ERIC BURDON & JIMMY WITHERSPOON**  
Guilty  
MGM LP, 8TR, CASS

**600 OCEAN** Put Your Hand In The Hand  
KamSu LP, 8TR, CASS

**308 JOAN BAEZ**  
Joan Baez 5  
Vangu LP, 8TR, CASS

**380 ABBIE HOFFMAN**  
Wake Up America!  
BigTo LP, 8TR, CASS

**700 TCHAIKOVSKY**  
1812 Overture  
Yorks LP, 8TR, CASS

**263 B. J. THOMAS**  
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(a small handling and mailing fee for your free LPs or tapes will be sent later). If you can't find 3 LPs or 1 tape here, you can defer your selection and choose from expanded list later. This entitles you to LIFETIME MEMBERSHIP—and you never pay another club fee. Your savings have already more than made up for the nominal membership fee.

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## PS Readers Talk Back

[Continued from page 6]

curate impression that an FCC licensee may continue to use certain obsolete equipment after Jan. 1, 1972, on a vessel other than the vessel for which a license was issued before that date, without action by the FCC to modify the radio-station authorization involved. The article states, "You can transfer the old HF-DSB radio and its license to your new boat."

That's true, but two of the prerequisites for such use are: 1) that the licensee submit a formal application to the FCC for authority to operate the old HF-DSB radio on the new boat, and 2) that the licensee submit the old license for cancellation. In order to preclude inadvertent rule violations (with resulting violation notices) by licensees among your readers, this point should be clarified.

JAMES E. BARR, Chief,  
Safety and Special Radio Services  
Bureau, FCC, Washington, D.C.

... I would like to express my thanks for Forest H. Belt's concise article. Its only shortcoming was the omission of the broadest product line of advanced-design, state-of-the art VHF/FM marine radiotelephones, produced by INTECH, Inc. These sophisticated radios are compact, completely solid-state, and designed to aerospace standards, with all circuits on interchangeable plug-in modules.

DEL AQUILA  
Intech, Inc., Santa Clara, Calif.

### Flying for the birds?

In "A Brand-New Way to Learn to Fly" [Dec.], Norbert Aubuchon says the cost of Cessna's new program will be from \$1,000 to \$1,500, and the time involved will remain about the same as the old method. I fail to understand how Cessna's new program is attacking the two main reasons for quitting: the high cost of flying and too much time involved. For \$1,500, I'll take the old method with a conscientious flight instructor. I received my private license for \$700 three years ago.

STEPHEN CROUCH  
Los Angeles, Calif.



### The seat-belt story

Detroit automobiles are a nightmare of belts and buckles fastened to the roof, confusing and difficult to put on. Once adjusted, the belts choke you to death instead of saving your life. Is it any wonder that such a small percentage of drivers use them? I tried them once and stopped.

Let's take a look at a foreign car (which is shorter, narrower, and higher than the domestic car). We find a combination seat and shoulder belt fastened to the pillar instead of to the roof, with

one buckle, one adjustment, and no retractor. It holds a four-year-old as well as a 270-pound tackle. You put it on in less time than the domestic type because it's easier to operate. It's comfortable when on, easy to store when off. And it probably costs less.

Why then must Detroit persist with the present snake-pit monstrosity of belts and buckles, which, because of non-use, leads to air bags, sensors, and ignition interlocks—all at our expense? The remedy is obvious—seat belts that are easier to use and store.

J.B.W.

Highland Park, Ill.



### One more option

The entire auto industry is now trying to curtail auto thieves. Why don't they offer an alarm system as optional equipment? There are thousands of people who pay up to \$150 for auto alarm systems now. Factories could equip a Sears-type alarm for \$50. A good investment.

MILES B. HEYMAN, Dayton, Ohio

### Embellishing a new idea

The emergency runway for crippled planes ["New Ideas From the Inventors," Nov.] is a good one. But the initial shock of the wings against those outrigger grips fills me with apprehension. I envision the wings being torn off, perhaps ripping open the body of the plane. Instead of grips, I suggest adjustable flexible-support rails rising from the ground at both ends to an apex at the center. Along the top of these rails, a perforated hose would ooze water. The wings sliding up the oozing hose would aid in deceleration and reduce the chance of fire triggered by friction. The rollers should be partly set in a pond also to help reduce fire risk.

AMBROSE UCHIYAMADA, Eastport, Me.

### For pollution—try the sniffer

I have read with great interest the recent swarm of articles concerning man's attempts to salvage something from the mess he has made on this planet. I've a question pertaining to the environment, and I hope you will be able to help me: Is there a reliable, uncomplicated, and inexpensive means available for an individual to determine the pollution content of the air in a specified locale?

DENNIS J. FISH, Gasport, N.Y.

See "Little Tester Sniffs Air Pollution" in PS Feb. '71, page 12.

Want to get something off your chest?  
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Popular Science, 355 Lexington Ave.,  
New York, N.Y. 10017.

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00D 3



Test pickups: the Chevrolet Cheyenne Super 20, Ford F-250 Ranger XLT, International 1210 Custom, and Dodge Adventurer 100 SE.



PHOTOS BY A. J. HAND

# New Pickups Combine Utility and Elegance

Pickups are getting plusher and quieter as private uses of light trucks keep growing

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

Nowadays, the pickup truck—that jack-of-all-trades—is also the favorite of the recreational-vehicle crowd. Increasing family use of pickups has brought about improvements in interior design and finish as well as ride comfort.

For our tests of the top four pick-

ups, we chose models that are suitable for both truck-camper mounting and trailer hauling. Gross vehicle weights range from 6,100 pounds for the Dodge, 7,500 for the International and Chevrolet, and 8,100 for the Ford. Dodge claims its D-100 with the 360 V8 can pull trailers up to 5,500

pounds; Ford specifies Class-II trailers (2,000-3,500 pounds) for its F-250 with the 360 V8. Chevrolet and International trucks with 350- and 345-c.i. V8s are rated strong enough for Class III trailers.

In all four, beneath the high-grade interiors and passenger-car-type accoutrements, you still find all the toughness of a real truck. Quality construction is apparent from the solidity of the chassis, the tightness of the body, and the lack of vibrations and rattles.

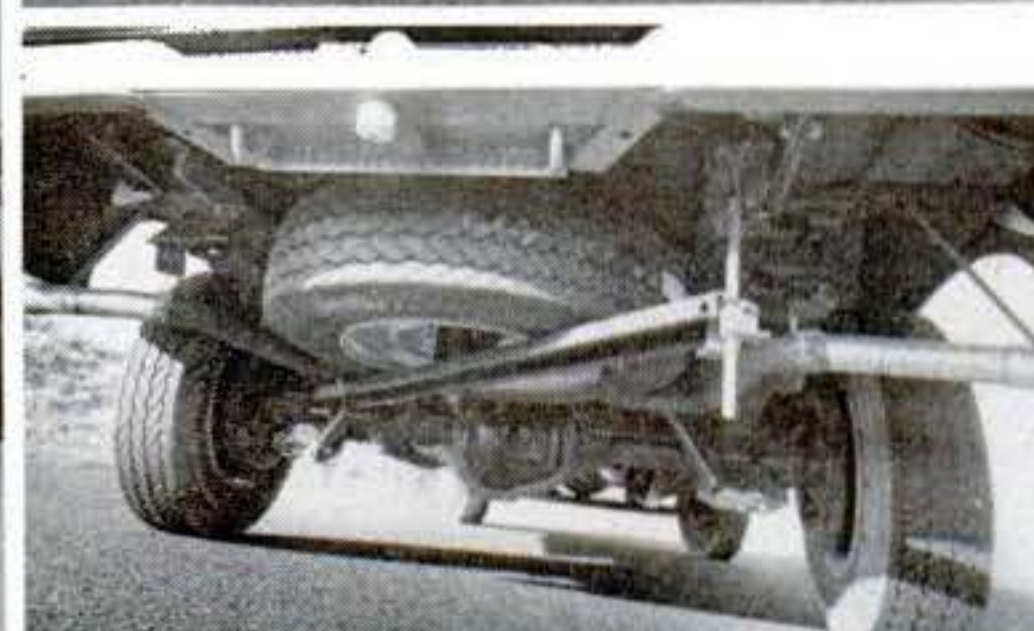
Seating comfort in some ways is better than in passenger cars. High seats, large windows, short hoods make for excellent visibility. Entry and exit are easier and head room is far better. Our only complaint is restricted fore-and-aft seat travel—it's difficult to get far enough back from the wheel. All have carpets on the floor, and all have vent windows in the doors. If you're not used to driving pickups, you will find it surprisingly easy, especially if you order automatic transmission, power steering, and power brakes.

We requested front disk brakes on our test vehicles—they can be had on all except the International, which has drums front and rear. The im-

*Continued*



International has lowest step height with 16.5 inches (Dodge 18; Ford 19.25; and Chevrolet 20.5 inches).



Lockers are hidden in body sides of Ford (shown), Dodge, and Chevy. Spare wheel behind rear axle is hard to reach.

provement in braking performance since our last pickup test [PS, June '69] is enormous. Stopping distances are far shorter, and fade has been cut to insignificant levels.

All of the trucks, however, have a front/rear balance problem in their brake systems. There's no provision for altering brake-force distribution to fit load. The same line pressure is delivered to the rear whether the truck is running empty or fully loaded. With light loads, this causes premature rear locking, which leads to swerving and possible loss of control.

We believe the driver of an empty pickup—and a lot of them run without load much of the time—is entitled to the same protection as one with a laden truck. The solution: antilock brakes (optional on many cars and some wagons). We think most pickup buyers would pay \$100-\$150 for antilock on the rear wheels.

In our brake tests, the trucks toted five 90-pound cement bags (on the theory that 450 pounds represent an average load), as did the trucks in 1969, so comparisons are valid.

The vehicles have similar tailgate convenience; one hand opens or slams them shut. The Dodge gate is removable without tools for fast camper installation. All are available with extra-wide, opening rear windows, junior West Coast mirrors at sides, cargo lights, and overload warning devices. All but the International have lockers in the body side.

But none has an ideal spare-wheel location. Getting the spare out from under the back bumper, with a camper aboard, is all but impossible. What's the answer? Fitting the spare above the front bumper can hurt air flow to the radiator. As a rule, there's not enough free space between the cab roof and the camper body. On top of the hood, it blocks vision. Can't camper manufacturers plan for a suitable spare-wheel mount somewhere?

**Dodge Adventurer SE.** This is the newest. Chrysler Corp. spent \$50 million to design, develop, and tool for it, and is to be congratulated on the result. It has better visibility and greater ease of entry than the old model, and the widest seat of all pickups. Doors are enlarged two inches, and swing at a wider angle. Seat height is raised to give better leg support. A 25-gallon tank is standard, and an optional auxiliary tank, great for campers, holds another 25 gallons. Campers should also note availability of special chassis with 9,000- and 10,000-pound GVW.

The Dodge was fastest in our acceleration tests, and had the best fuel economy. The brakes were adequate, as efficiency only fell from 100 to 87 percent after 10 warm-up stops.

The cargo box has double-wall construction, but stake sockets protrude on the inner wall. The auxiliary gas tank is under the floor, and the filler neck does not steal cargo space.

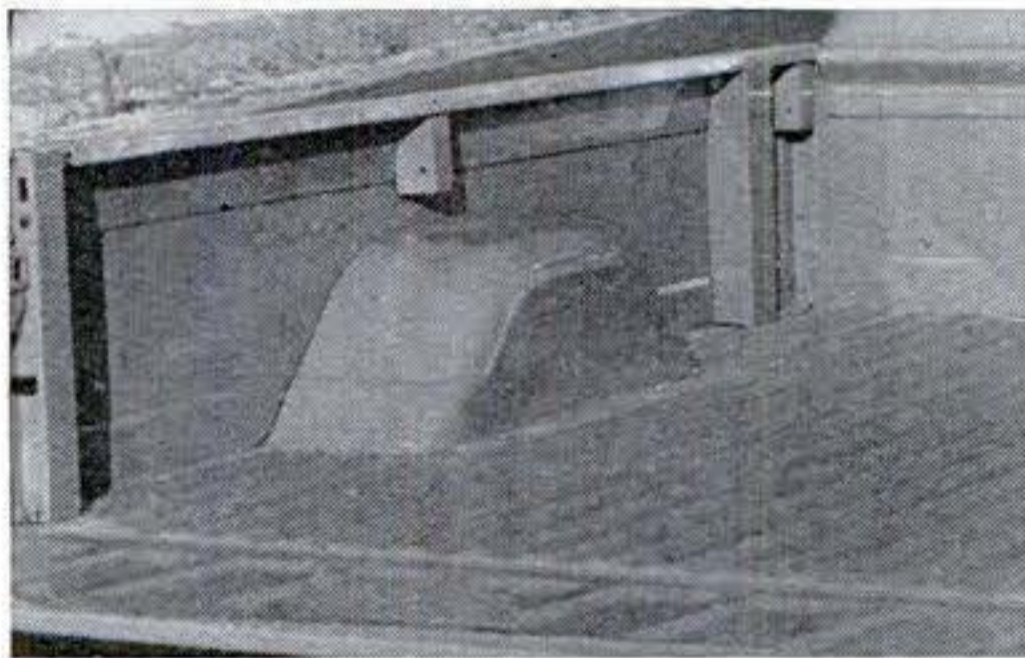
**International 1210 Custom.** This is a real workhorse. Yet it, too, has all the passenger-car appeal of the trucks built by car makers. More surprising, it handled as well as many large cars despite its typical truck suspension. It matched the Chevy's speed in the lane-change test.

Its drum brakes are dimensioned for hard use, and were completely fade-free. Efficiency was in excess of

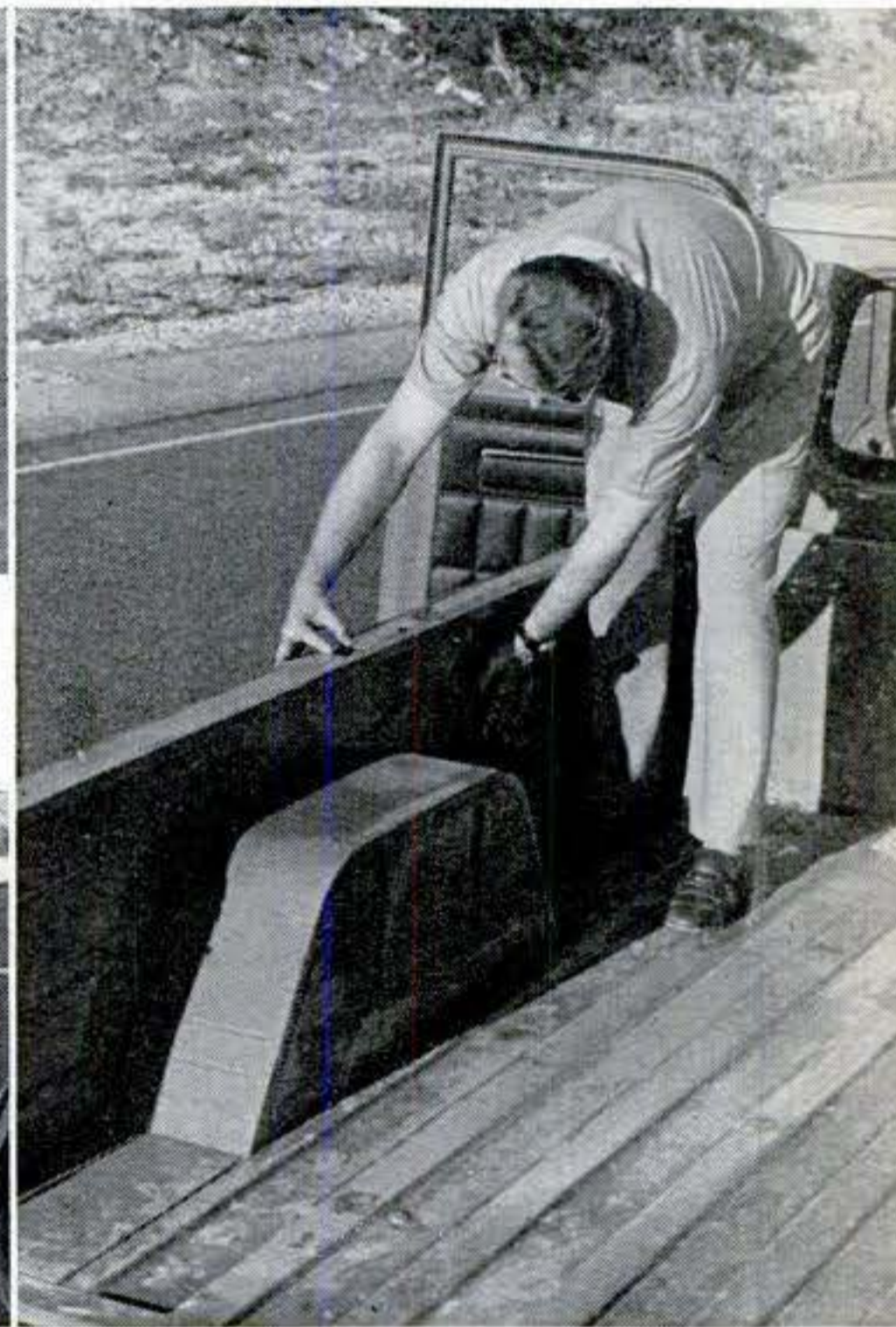
100 percent both before and after warm-up, and the stopping distances were creditable for passenger cars!

Controls are passenger-car type. Kick-panel air intakes plus vent windows furnish excellent ventilation. The gas tank is outside the cab, making gas sloshing less noticeable. Service is easy, with distributor, coil, and plugs right out in the open. The oil filter is accessible from below. The International now has a semisealed cooling system (like Cadillac and Buick).

**Chevrolet Cheyenne.** This truck is  
*Continued*



**Chevrolet stake sockets** protrude into cargo area—can tear bagged cargo or catch hardware when it's slid in or out.



**International stake sockets** are recessed between full-depth cargo-box walls. Inner walls have a smooth surface.



**Dodge tailgate** can be removed in half a minute without use of tools. Refitting it is equally simple and easy.



**Rear window that opens** and cargo light on back of the cab are typical camper accessories that can also be useful for non-campers. This is the Chevy pickup.



**Handling tests—at passenger-car speeds!** International (upper left) and Chevrolet (lower right) were fastest; Dodge (lower left), slowest; Ford, in between. International has semi-elliptic springs front and rear, with I-beam axle in front. Others have independent

front suspension—Dodge and Chevy, passenger-car types; Ford Twin-I-Beam, all with coil springs. All have rigid rear axles carried by longitudinal semi-elliptic leaf springs. Ford shows least body roll, Dodge highest rear roll-steer effect.

the most improved since '69, despite very slight exterior change. This applies to its brakes especially. With front disks, efficiency actually rose from 99 to 100 percent after warm-up. It was fastest in the handling tests, with the highest difference in the low-speed slalom.

**Ford Ranger XLT.** This is the T-bird

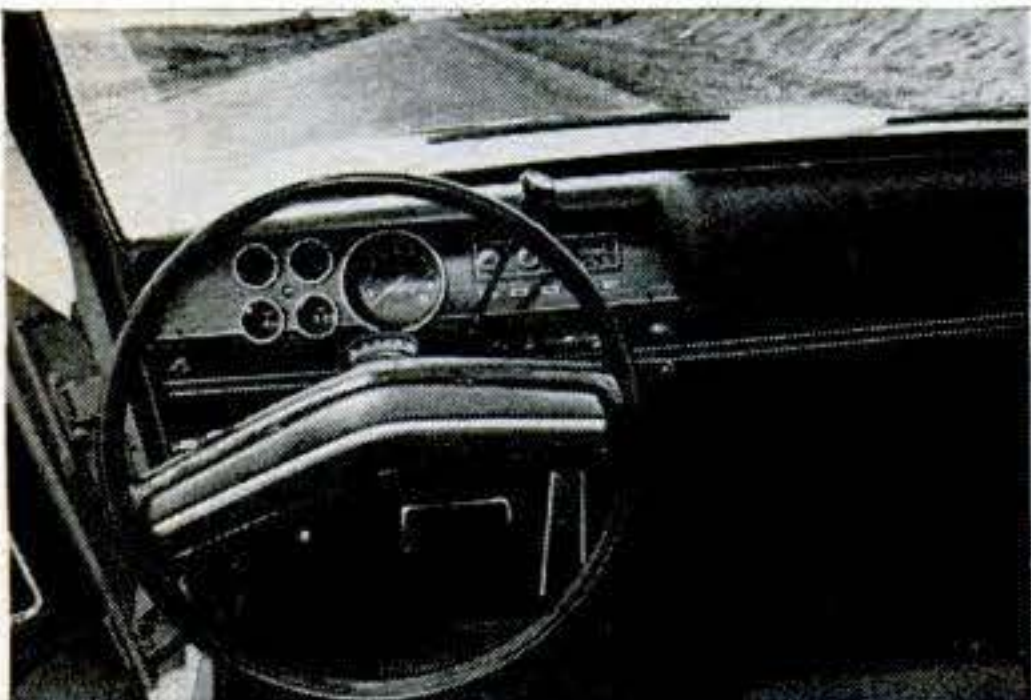
of pickups with its fancy interior, yet it is fully competent in all functional respects. A number of little things may irk the driver: Small controls, hard to reach. Very noticeable sloshing of fuel in the tank directly behind the seat. Cargo box double-walled only halfway up. But the Ford mechanic has an easier task: Despite air

conditioning on our test unit, maintenance points on the engine are within easy reach.

**Conclusion:**

We cannot pick a "winner" in this group. Whatever your transportation needs, all companies have models and options that will hit the target equally

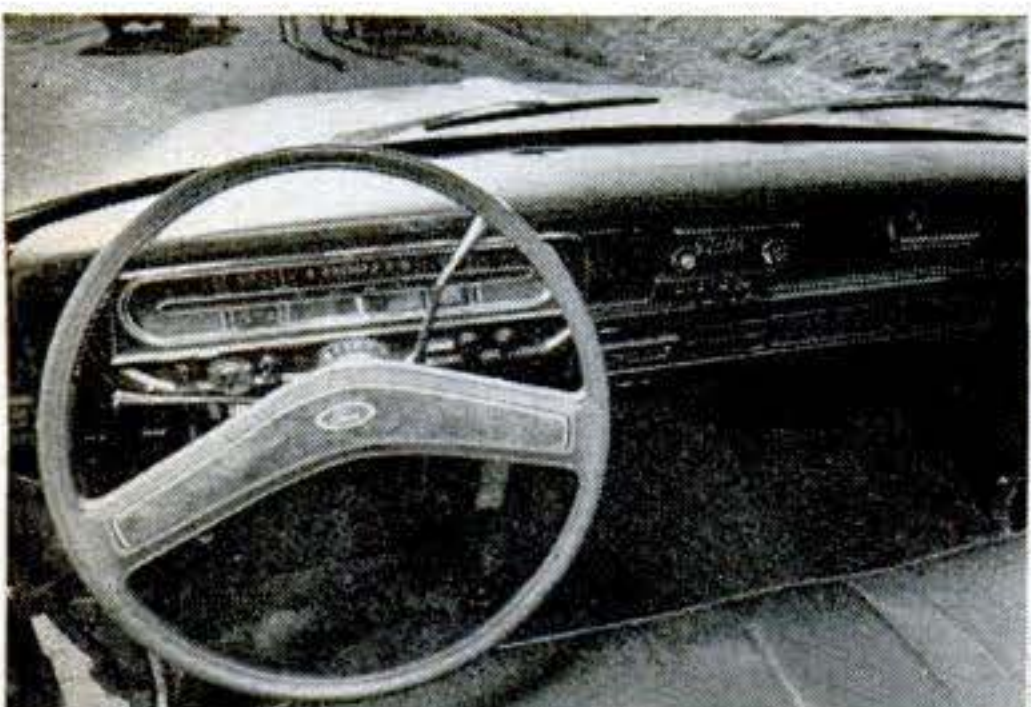
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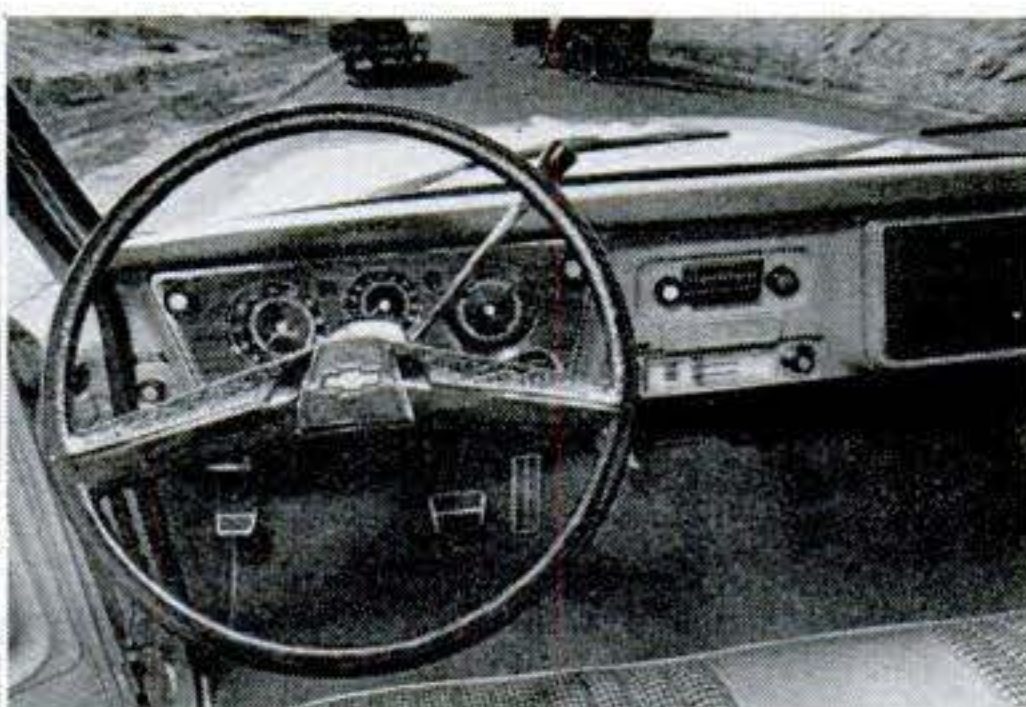
**Dodge** alone has a steering-wheel lock. Gauges are clear, knobs within reach.



**International** has lighted labels for small controls, fuses in glove box.



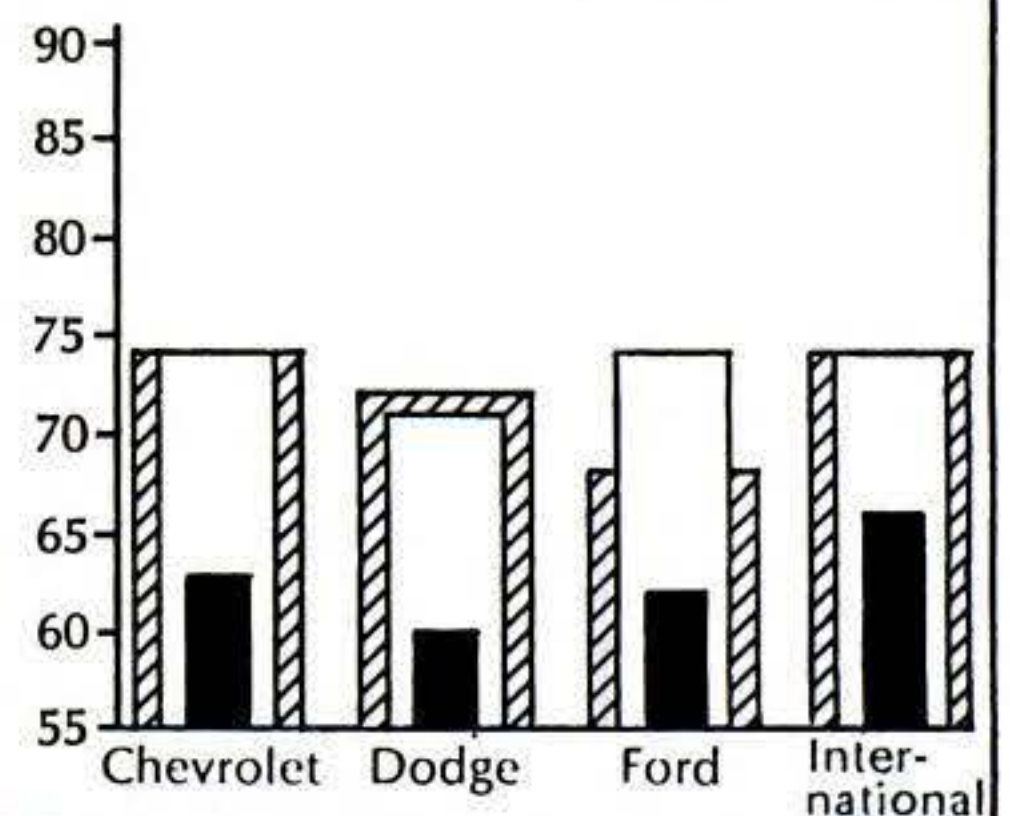
**Ford** knobs are unlit and below easy reach, heater controls beyond reach.



**Chevrolet** has handy knobs, easy-to-read gauges, and a man-sized glove box.

**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



# Why the new Gillette 2 bladed razor shaves you better than a one blade razor.



There are a number of theories explaining why the Trac II™ Twin Blade Shaving System gives you such a close shave.

The most unusual of these theories is based on a little known phenomenon we call the "Hysteresis Effect."

It works like this.

When the first blade ① cuts your whisker, it can also lift it out a little from below the skin, exposing extra whisker.

Now, if the theory is correct, a fraction of a second later, the second blade ② comes along

and can shave that extra whisker again before it has a chance to snap back below the skin.

A razor with only one blade, no matter how good it is, simply can't shave you the same way our 2 bladed razor can.

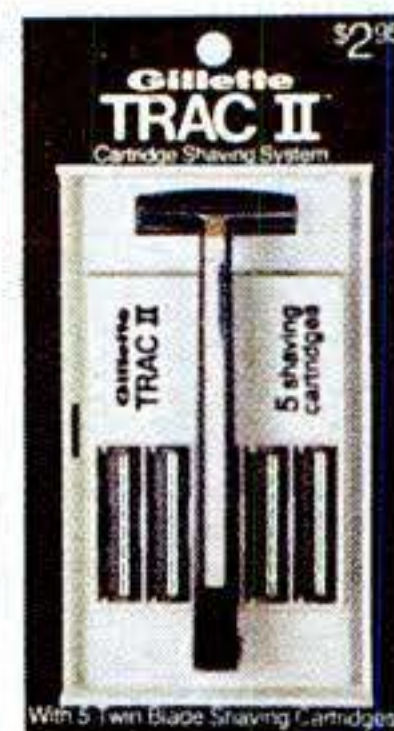


Remarkably enough, despite its closeness, our 2 bladed razor delivers one of the safest shaves you'll ever experience.

You see, because 2 blades give you extra shaving efficiency, we've been able to set the blades at a very safe angle, reducing the risk of nicks and cuts and irritation.

**The new Gillette Trac II  
2 bladed razor.**

**We think it's one blade better.**



**The New Gillette TRAC II  
Twin Blade Shaving System**

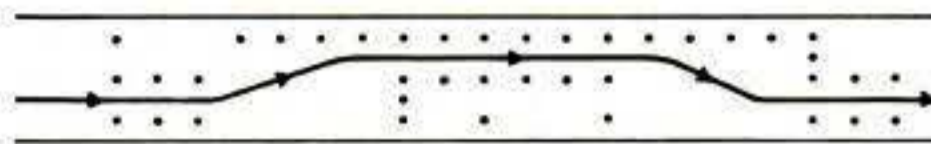
# How other cars have fared in our tests

CAR	CHEVROLET C-10	CHEVROLET El Camino	CHEVROLET SportVan	DODGE D-100 (1969)	DODGE Sportsman	FORD Club Wagon	FORD F-100 Ranger	FORD Ranchero	GMC C-1500	INTERNATIONAL 1000-D	INTERNATIONAL Travelall	VOLKSWAGON Microbus
Accel. 0-60	13.0	9.0	17.2	11.4	13.9	15.3	13.6	7.5	11.1	14.0	17.7	38.0
Accel. 0-80	27.7	15.4	34.9	21.0	30.4	32.4	28.0	12.0	20.8	24.8	32.4	—
Accel. 25-70	16.1	9.9	22.4	13.4	16.85	19.75	18.2	7.9	13.9	16.6	17.4	—
Brakes 60-0 (hot)	234.9	204.0	201.3	234.4	146.6	180.0	184.5	150.3	271.9	209.5	180.4	155.4
Lane change (mph)	53.6	58.8	51.3	50.8	48.5	49.9	53.6	53.6	53.6	53.6	48.25	48.0
Slalom (mph)	21.4	22.2	23.3	19.6	23.3	24.6	21.5	27.6	21.4	21.4	20.4	26.0
Noise (60 mph)	—	—	76 dbA	—	76 dbA	76 dbA	—	—	—	—	71 dbA	—
Fuel mpg (45 mph)	10.9	10.7	13.4	10.7	12.2	11.6	9.4	7.7	10.6	8.9	12.5	22.3
Price	\$3,777	\$3,614	\$4,323	\$4,148	\$4,267	\$4,733	\$3,787	\$3,582	\$4,314	\$4,224	\$4,734	\$2,885

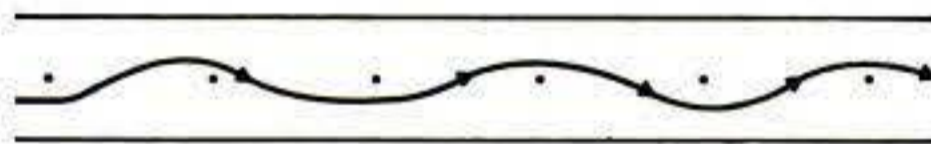
## How PS tests cars—and what the tests show

**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.

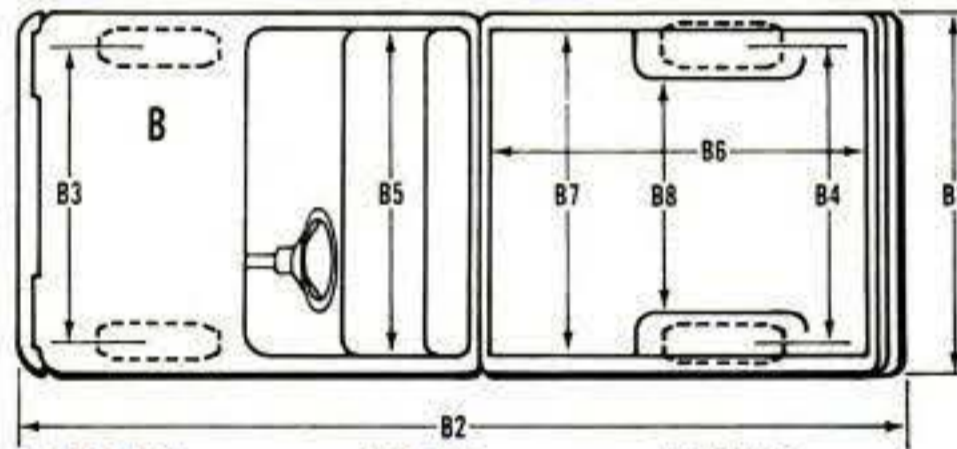
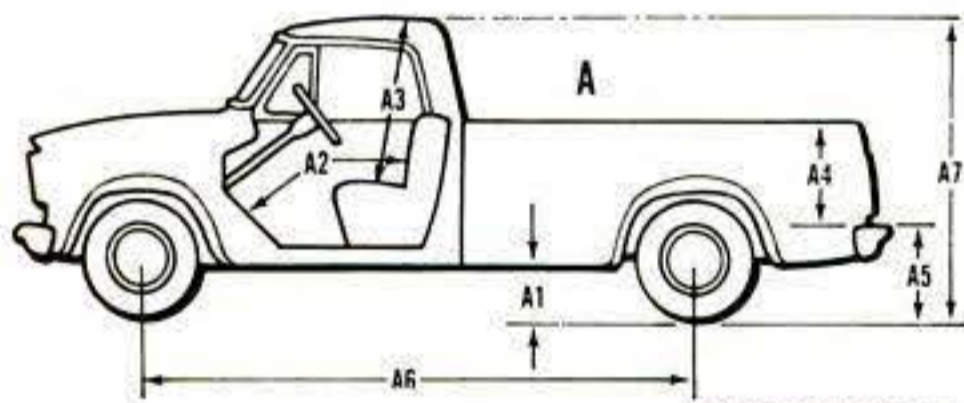
**Acceleration test** at 0-60 mph shows a car's ability to reach cruising speed from standstill. The 0-80 mph test shows its high-speed power reserve; 25-70 mph test simulates a highway merging situation. Cars with automatic transmission are tested in DRIVE.



**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 Cheyenne Super 20	DODGE Adventurer 100 SE	FORD Ranger F-250 XLT	INTERNATIONAL 1210 Custom
A1 Ground clearance	7.0	7.5	7.2	7.3
A2 Front leg room (max.)	41.0	33.4	39.0	42.5
A3 Front head room	40.0	40.0	40.6	38.0
A4 Platform wall height	18.7	19.0	19.3	19.2
A5 Tailgate liftover	30.5	28.0	31.0	31.6
A6 Wheelbase	133.0	131.0	131.0	131.0
A7 Height	69.0	67.9	71.6	69.0
B1 Width	79.0	79.5	70.0	77.6
B2 Length	207.75	213.6	207.6	201.7
B3 Front track	66.0	65.0	63.7	63.5
B4 Rear track	64.0	63.4	62.4	63.0
B5 Front hip room	64.8	65.5	63.7	61.3
B6 Platform length	98.0	98.75	98.25	97.5
B7 Platform width	72.0	70.75	70.0	65.5
B8 Width between wheels	50.0	50.0	49.0	48.5
<b>SPECIFICATIONS</b>				
Engine type	OHV V-8	OHV V-8	OHV V-8	OHV V-8
Displacement (cu.in./cc)	350/5,735	360/5,906	360/5,905	345/5,699
Compression ratio	8.5:1	8.8:1	8.0:1	8.05:1
Carburetion	One 4-bbl.	One 2-bbl.	One 2-bbl.	One 2-bbl.
Net hp @ rpm	175 @ 4,000	180 @ 4,000	156 @ 4,000	182.3 @ 3,800
Net torque @ rpm	290 @ 2,400	295 @ 2,400	267 @ 2,400	303 @ 2,000
Transmission	3-speed auto.	3-speed auto.	3-speed auto.	3-speed auto.
Axle ratio	4.57:1	3.20:1	4.10:1	3.73:1
Tire make	General	Goodyear	General	Firestone
Tire type	Jumbo Power Jet	Power Cushion	Jumbo Power Jet	Transport 500 WO
Tire size	8.75-16.5	H78-15	8.00-16.5	8.00-16.5
Turn diameter	48.7 ft.	49.2 ft.	52.2 ft.	49 ft.
Turns, lock to lock	4.25	3.8	4	3.75
Brakes	disk/drum	disk/drum	disk/drum	drum drum
Fuel tank (main)	21 gal.	25 gal.	19.5 gal.	16 gal.
Fuel tank (aux.)	19 gal.	25 gal.	25 gal.	21 gal.
Curb weight (lbs.)	4,463	3,870	4,488	4,005
<b>TEST RESULTS</b>				
Acceleration 0-60 mph	13.35 sec.	11.5 sec.	14.9 sec.	13.6 sec.
Acceleration 0-80 mph	23.6	23.65	28.45	26.8
Acceleration 25-70 mph	16.2	12.9	17.95	17.35
Stop distance 60-0 mph (cool)	148 ft. 11 in.	135 ft.	194 ft. 10 in.	150 ft.
Pedal pressure	80 lbs.	70 lbs.	85 lbs.	55 lbs.
Stop distance 60-0 mph (hot)	162 ft. 4 in.	186 ft. 7 in.	173 ft. 6 in.	149 ft. 9 in.
Pedal pressure	85 lbs.	90 lbs.	90 lbs.	60 lbs.
Max. speed—lane change	56.3 mph	53.0 mph	51.5 mph	56.3 mph
Max. speed—slalom	25.7 mph	23.9 mph	25.0 mph	23.3 mph
Gas mileage (45 mph)	11.18 mpg	13.45 mpg	11.52 mpg	10.65 mpg
Price (basic)	\$3,128	\$3,013	\$3,157	\$3,044
Price (as tested)	\$5,216	\$4,696	\$5,483	\$4,284

well. Yet each make is known for certain qualities, such as:

**Durability: International.** Their engines never wear out.

**Ruggedness: Ford.** It's built like a tank and is great off the road.

**Comfort and quiet: Dodge.** It's the most modern and refined of pickups.

**Maneuverability: Chevrolet.** It fits in tighter spaces and is tops in ease of driving. PS



International is basically unchanged since '69 but has a new grille for '72.



Dodge is all-new for '72—chassis, body, engines, transmissions, the lot.



Ford is full of recent detail changes but is basically the same as in 1967.



Chevrolet was new in '69 and has had the benefit of detail refinements since.

# BOLENS<sup>®</sup> HUSKY "PUPS" FOR '72.

Small lawn tractors  
that work like big ones...  
to get you off the grass  
and into the fun faster.



When you hitch up to a Bolens Husky<sup>®</sup> Pup you're getting much more than a mower with a proud pedigree. You're getting yearlong versatility. Because the Pups not only mow, they take attachments, too. Snow blades and casters. Utility carts and lawn sweepers.

There's a Husky Pup that's just right for your needs and budget: 5, 6 and 8 hp with 28, 32 and 38-inch triple-bladed mowers. (Most other lawn tractors only give you two blades.)

No matter which Pup you choose, you're getting the same standards of quality and durability Bolens builds into its line of larger garden tractors. So see them soon at your nearest Bolens dealer. He's listed in the Yellow Pages.



Bolens Huskys—a breed for every lawn and garden need.

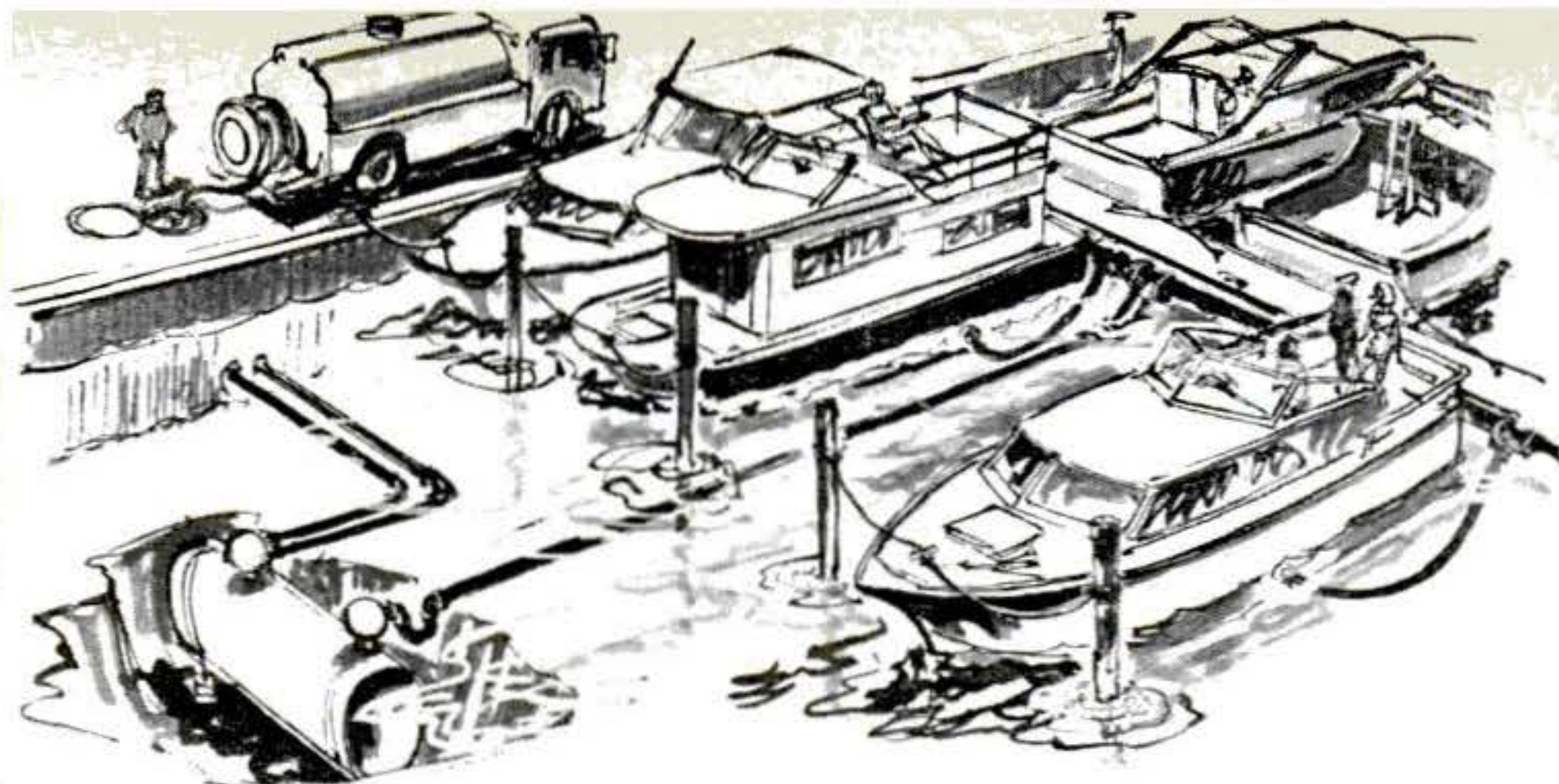


## BOLENS

BOLENS DIVISION, FMC CORPORATION, PORT WASHINGTON, WISCONSIN  
Bolens, Husky and Bolens Husky are Registered Trademarks of Bolens Div., FMC Corp.

# New Ideas from the Inventors

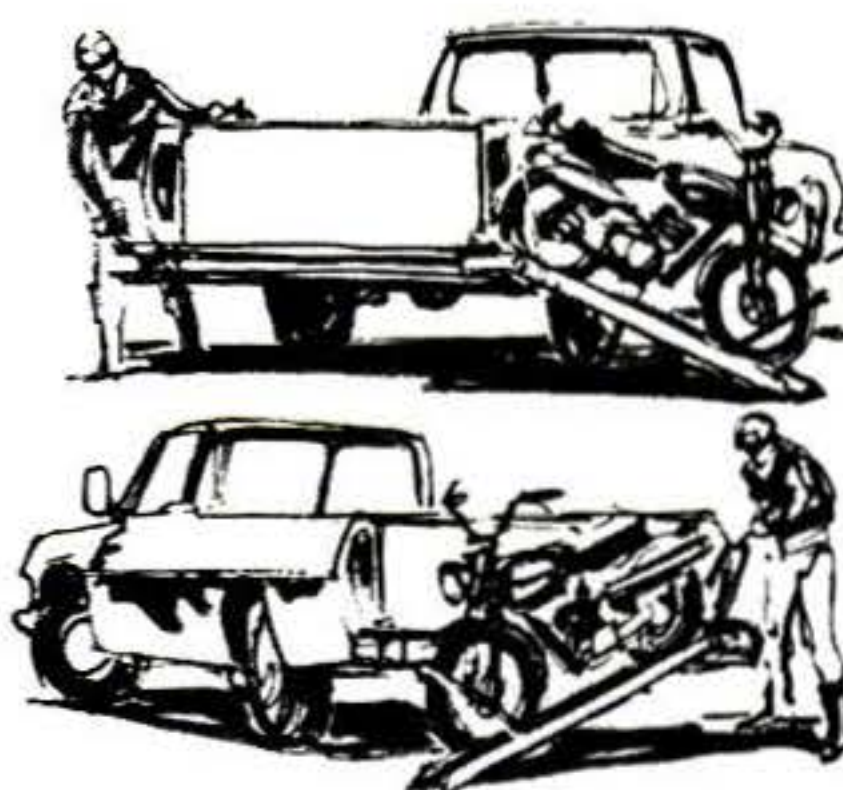
ILLUSTRATIONS BY DANA RASMUSSEN



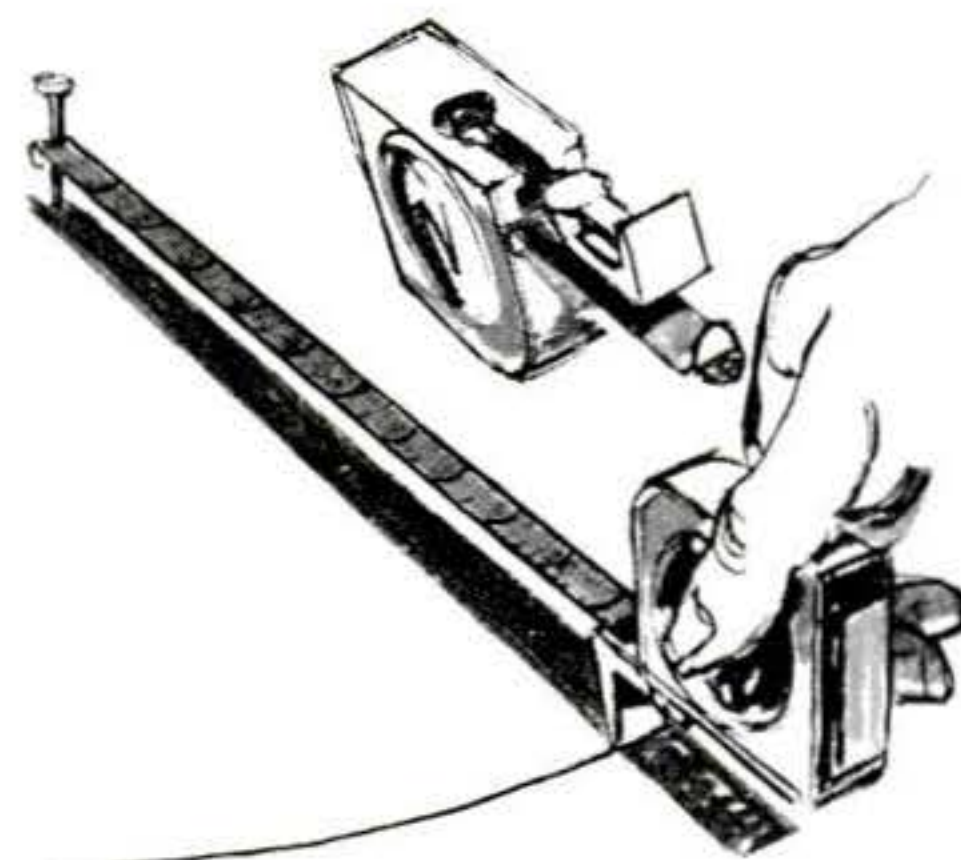
**Marina tank collects sewage.** Waste disposal from docked pleasure boats has turned many marinas into less-than-pleasant places to tie up. This recently patented system would protect the waterfront by providing a collection pipe at each mooring. Drain wastes would be gravity-fed into submerged tanks that could be floated—or pumped out—at intervals for collection and disposal.



**Timed egg tips up.** Clipped onto a pan, this timer would lift a boiled egg clear of both water and rising steam. You'd set the timer, then cock the mechanism by pressing down a lever arm and its suspended egg cup. When the timer released the lever, the arm would lift the egg up and out.



**Bumper rack totes cycle.** Swinging out and down to form an easy-loading ramp, this carrier would make it simpler for a camper to carry—and use—a motorcycle or scooter. Bracketed to the bumper, the carrier would lock the bike's wheels and frame in transit, pivot at either end to roll the cycle on or off.



**Tape fittings scribe work.** Anchored at the free end by a zero-centered point, nail, or weight, this flexible tape could be used for marking measured lengths or for drawing or scribing arcs or parallel lines. The scribes would slip onto fittings when needed or slip off for inside-the-case storage.



**Holster radios alert.** With this transmitter fitted on his gun belt, a policeman or security guard would send out a signal automatically any time he drew his gun. The alarm (which could also be triggered manually) would alert other officers and summon assistance. It would go off, too, if the officer was forcibly disarmed or his belt was unbuckled.



**Clip racks oar.** You could secure a wet oar on this rest without cluttering your boat or letting it drip on you or your gear. The hinged, U-shaped, spring-metal hook would be screwed to the gunwale. You'd flip it outward to support the end of the oar, turn it up and in when it wasn't in use to keep it from snagging against a dock or bumper.

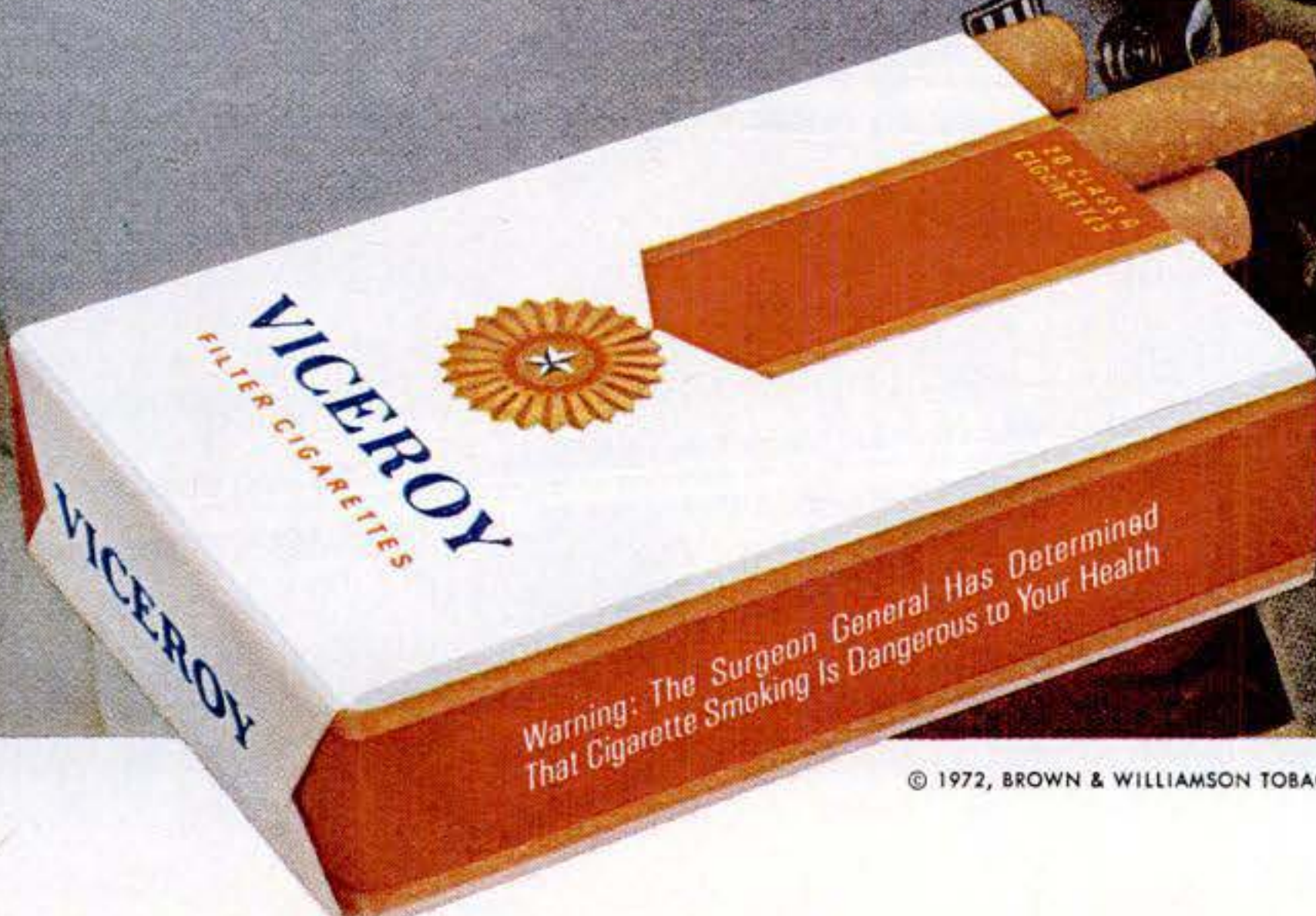
The following patents have been issued on these inventions: Marina waste collector—No. 3,528,462 to Harold G. Quase, Kensington, Md.; Egg timer—No. 3,529,535 to Richard Andrey, Lausanne, Switzerland; Bumper cycle rack—No. 3,529,737 to Melwyn L. Daugherty, Bishop, Calif.; Flexible-tape scribe—No. 3,526,964 to Edward B. Clark Jr., Curlew, Wash.; Holster

alarm—No. 3,530,451 to Edward Devine, Chicago, Ill.; Oar rest—No. 3,500,483 to Wilhelmina Schohn, Oak Park, Ill. 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.



**Get a taste of what it's all about.**

**Get the  
full taste  
of Viceroy.**



© 1972, BROWN & WILLIAMSON TOBACCO CORP.

17 mg. "tar," 1.2 mg. nicotine av. per cigarette,  
FTC Report Aug. 71.

**Plenty has happened to pickups lately. So, whether you're shopping for your first pickup or your tenth...**

**let's make sure the pickup you buy is the pickup you need.**

What's been happening is this: Year after year we have been adding new advantages and variety in our Ford pickups. This is just great for the buyer. Your pickup can fit your requirements much more closely. Problem is though, each year the increased choice makes picking the exact pickup you need just a little more complicated. So maybe it's time for some help. We can't give you all the answers here...but we certainly can suggest some questions you should be asking.

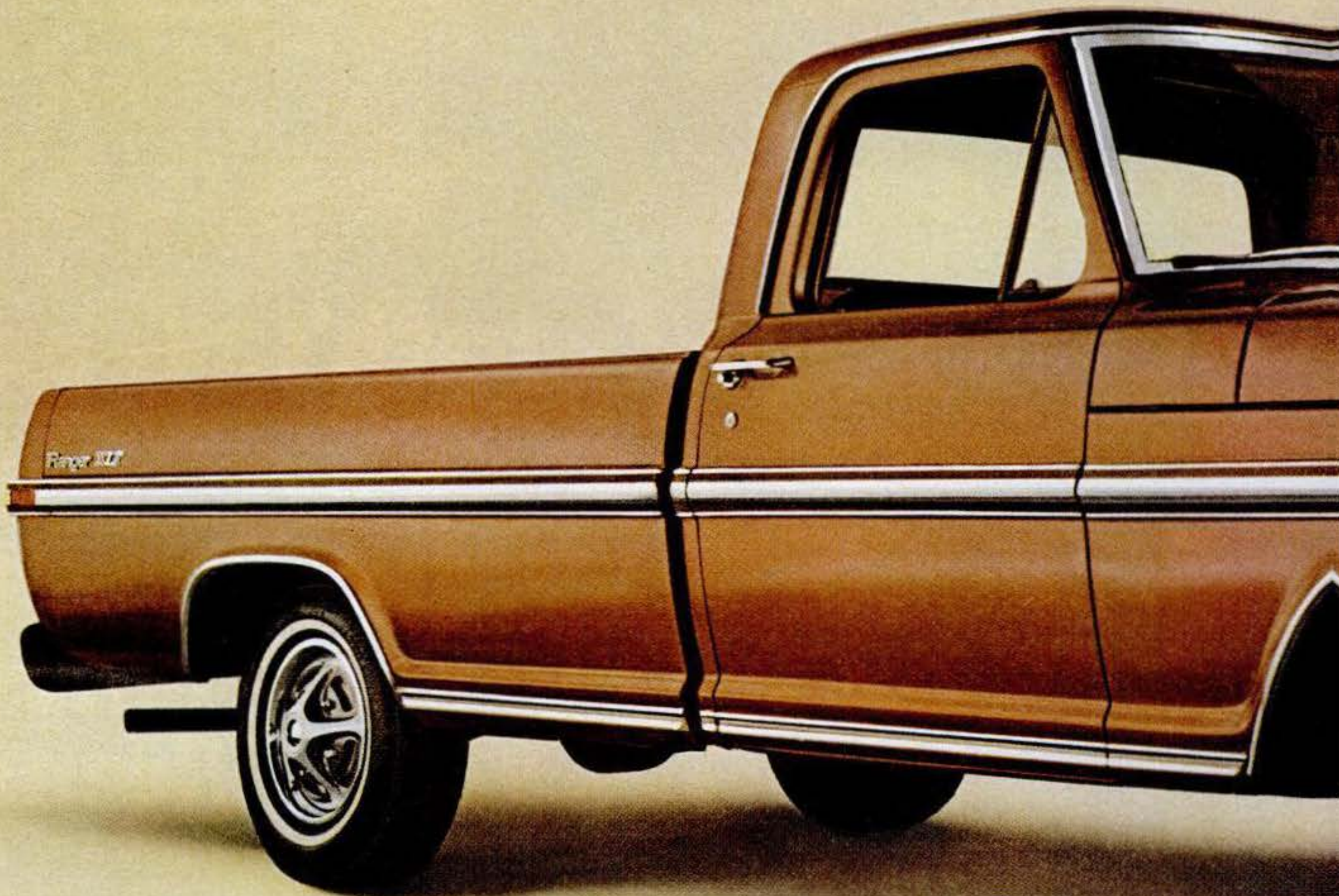
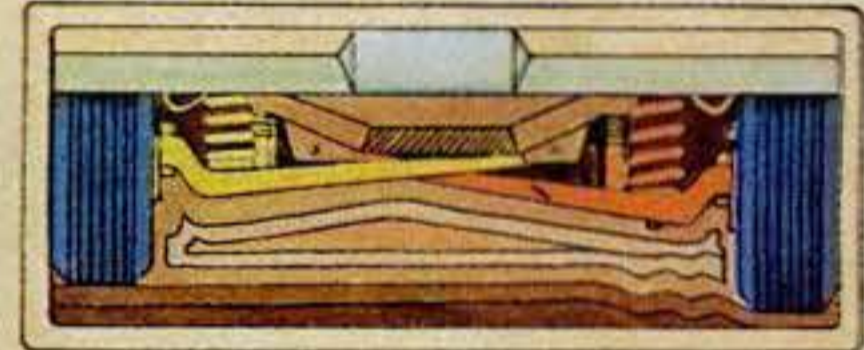


**For starters, will you be using it on the job, just for fun, or both?**

What is the heaviest weight you expect to carry? Planning to haul a camper unit? If so, how big? If your needs are mainly personal transportation with light loads, our F-100 model is near perfect. It can be equipped to haul up to 1835 lbs. For bigger loads—and for campers—you'd probably want our F-250, equipped to carry up to 3720 lbs.

**Does a pickup have to ride and handle like a truck?** It used to. But our ex-

clusive Twin-I-Beam independent front suspension changed all that. Each front wheel has its own forged-steel I-Beam axle which acts independently to insulate against road shock. What's more, Ford pickups have easy-riding coil springs up front and stable leaf springs in the rear... another reason Ford pickups ride so well, work so hard.



**The 1972 Ford Ranger XLT**

**If it rides well with heavy loads, how's it going to ride without?**

For years you had to resign yourself to a certain measure of roughness. Springs could be stiff to handle big loads. Or they could be flexible for easy riding. But Ford's come up with an entirely new approach. It's called Flex-O-Matic rear suspension. With Ford's heavy duty rear springs, you get long flexible leaf springs for easy ride and exceptional stability. As cargo weight is added, a unique shackle member automatically shortens the working length of each spring, stiffening it to match the load. Result: an excellent ride, with a load and without.



**Did you know you can get just about all the options you can get on a car... and many you can't?**

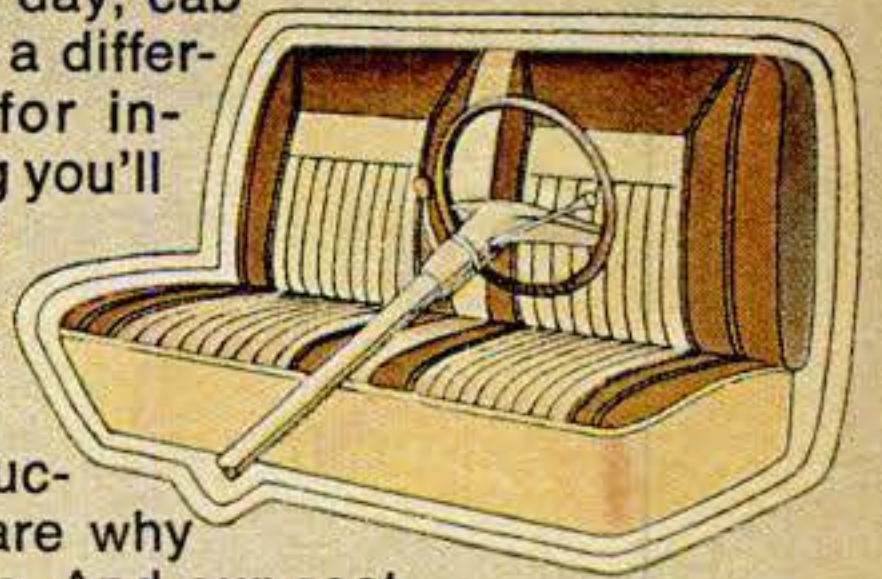
Sure, most pickup buyers know they can order things like western mirrors, special axle ratios, power steering, and power disc brakes. But mag-type wheel covers? Air conditioning? Tinted glass? AM/FM stereo radio? Camper Special package? They're all available, and a lot more besides. There's even a special convenience group with extra lights, including a really handy one on the back of the cab, to illuminate the cargo area. So, before you order, study the list in the pickup catalog your Ford Dealer will give you. It would be a shame to settle for less pickup than you could have enjoyed.

**What about your choice of body lengths, style and dressiness?**

Again you have plenty of variety. We offer 6½- or 8-ft. long boxes in either smooth-sided or rear-fender styling, plus a 9-ft. model in the fender style. And you can choose from four levels of dressiness: Custom, Sport Custom, Ranger, and Ranger XLT. Take your pick and personalize your Ford pickup to suit your taste.

**What's important to you inside the cab?**

Whether you'll be in it for only short periods or for hours every day, cab comfort makes a whale of a difference. Take roominess, for instance. That's the first thing you'll notice about our cabs. And the first thing you'll like. Our slanted instrument panel allows knee room aplenty. Our solid construction and thick insulation are why Ford cabs are so quiet, too. And our seat cushions don't skimp on support springing, either. But nothing we can say says it quite like an old-fashioned sit-down-and-stretch-out test. So go ahead and grade us. Borrow a pickup from your Ford Dealer and see how hard we've worked to make it soft for you.



**And another thing...how's your wife going to like it?**

You know how much wives drive pickups these days. We sure do. That's why we pay a lot of attention to what they say. Bright, colorful interiors. Easily cleaned upholstery. Courtesy lights. Power assists. Things like that. And not surprisingly, husbands like these things, too.

**Finally, what about price...and durability?**

Ford Dealers sell more trucks than anybody else. So you can just bet their prices are right. Check around. See how great a deal you can get on any Ford pickup. All the way from our basic Custom up to our luxury Ranger XLT with all the extras. And as for how long they'll last: 92 out of every 100 Ford trucks built in the past 12 years are still on the road. Any more questions?

**Works like a truck,  
rides like a car**

**FORD**



A better idea for safety: Buckle up.

# Recreation Roundup

... on the go with PS

By HERBERT SHULDINER

## The Outdoor Nation

A "summit meeting" to tackle the most serious problems confronting camping and outdoor recreation has been proposed by one of the nation's leading RV experts.

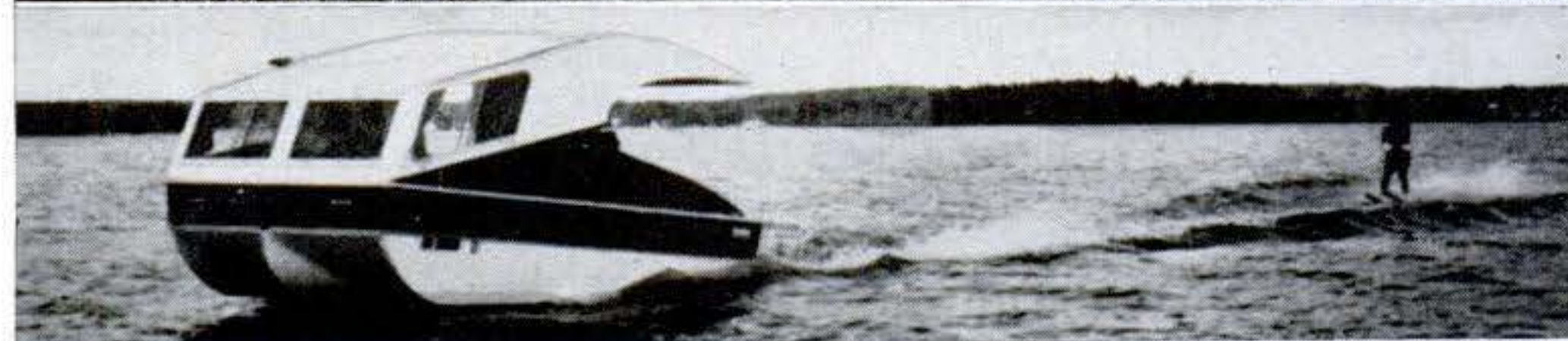
He's Robert C. Honke, Ford's recreation-vehicle sales manager, a highly informed and articulate spokesman for making "the outdoor life of America the best it can be for everyone."

Honke offered Ford's financial assistance in bringing together the elements of what he calls "The Outdoor Nation"—camper manufacturers, ecological groups, government park and forest officials, camping associations and writers, and campers themselves—to explore possible solutions to the major camping and recreation ailments.

The leading problems are overcrowding, and the deterioration of the ecology of our parks, forests, and other recreation areas. Some of the possible solutions Honke mentioned are:

- Putting campgrounds and parking lots outside overcrowded parks like Yellowstone, and using people-movers to get visitors into recreation areas. These could also provide transport inside.

- A system of privately run campgrounds inside state and national parks,



## Land-sea camper doubles your outdoor fun

The Voyageur camper-cruiser gives you a double-action vacation. It's powered in the water (bottom) by a 130-hp I/O engine with enough pep for water skiing, and is light enough for easy trailering on land. The camper—17 feet three inches long—is completely self-contained and can sleep four. The clamshell top can be completely closed for trailering. It's made by Pleasure Industries, Ft. Dodge, Iowa.

so rangers can be freed to devote more time to upgrading the ecology of the outdoors.

- A national campground reservation system in which 50 percent of all state and national camp sites could be reserved as far ahead as 90 days. Another 25 percent could be reserved only five days ahead, and the rest assigned on a first-come, first-served basis.

- Designation of certain areas where vehicles cannot go—and others where

snowmobiles, dune buggies, and ATVs "can go as free as a bird."

Honke told a recent gathering of outdoor writers at Seaside Park campground, Key West, Fla., which I attended, that some of his ideas might meet resistance from some groups. But he's hoping that the first meeting of The Outdoor Nation, expected to take place this month, will take off from this point and go on to devise other solutions for preserving our great outdoors.

## Let's get everybody together on RV hitches



I'd like to see a companion "summit meeting" called to bridge sharp differences that now exist in guidelines laid down by camp-vehicle makers, hitch manufacturers, and the automotive industry. These differences result in confusion and inconvenience to RV purchasers.

When you ask for advice from an RV maker, camper dealer, hitch manufacturer, or auto company on the type of hitch you need chances are you'll get differing counsel. I discovered this last summer when I borrowed an Apache Roamer camper for a test. I planned to use an Oldsmobile Custom Cruiser wagon

as a towing vehicle. Olds said I needed an equalizing hitch to pull the camper, which has a hitch weight of 232 pounds. Engineers for Reese Products, Inc., a major hitch manufacturer, recommended the same type of hitch.

On the other hand, the owner's manual in the Roamer warns against towing the camper with a load-equalizing hitch—indeed states that the camper warranty is voided by towing with that type. Apache spokesman Charles Grant says company engineers have tested the vehicle extensively and find that a standard, frame-mounted ball hitch is safe.

But why would the warranty be voided

if a customer decided to pull the Roamer with the load-equalizing hitch? Apache sales-manager Neil Dodge says the reason is that camper owners tend to overload the front of the trailer when using this type of hitch. This can bend the trailer frame and result in an unsafe condition.

I've observed that auto and hitch manufacturers tend to be more conservative, recommending heavier-duty, more expensive hitches. Trailer manufacturers and dealers tend to lean toward the most economical hitch. Frame-mounted hitches run about one-third the price of a load-equalizing hitch, or less.

Does fear of adding perhaps \$100 to a consumer's investment motivate RV dealers to recommend lighter hitches, rather than risk losing a sale?

Some dealers might feel this way, but I doubt that any would jeopardize the safety of a customer just to make a sale. I think there's simply a lack of reliable standards to consult. That's why I'd like to see a "summit meeting" of experts sift through the conflicting standards and issue a unified code.

PS





# THE '72 MERCs. 4 TO 140 HP. NOTHING'S COME UP TO US YET.

The Mercs for '72 are every bit as good as they look. There are big and little changes. But we made them all for just one reason. To give you the finest pleasure machines that ever put a prop to water.

To start with, there's the new Merc 1400. At 140 hp, the most powerful production outboard you can buy. There's the new 3-cylinder Merc 650. At 65 hp, smaller and lighter than competitors' 60-hp models. New "phase-maker" Thunderbolt ignition in the smaller Mercs (20, 9.8, 7½, 4 hp) improves idling and high-speed performance. And every '72 Merc has a drainless crankcase which prevents oil or gasoline from draining into the water.

Mercury engineers took everything we've learned—from racing wins, performance runs, endurance tests, customer use—and redesigned features on every engine in the line. Improving. Strengthening. Simplifying.

We make the world's most dependable outboards. That means we keep making them better. They're waiting for you now . . . at your Mercury dealer.

Complete range of power: 4, 7½, 9.8, 20, 40, 50, 65, 80, 115, 140 HP. • For nearest Mercury Dealer, see the Yellow Pages under "Outboard Motors."  
Kiekhaefer Mercury/Division of Brunswick Corp./Fond du Lac, Wis./Canada, Ltd./Australia Pty. Ltd.



**MERCURY**  
OUTBOARDS



# We've got over 300 good, steady jobs.

Jobs in construction, transportation, communications, computers.

Jobs for photographers, printers, truck drivers, teachers, typists, TV cameramen and repairmen. Cooks, electricians, medical aides, meteorologists. Motor and missile maintenance men.

Jobs for young men. And young women.

Jobs in Europe, Hawaii, Panama, Alaska. And just about any place in the States.

We'll train you to do the jobs. Train you well, in good schools, under excellent instructors, with the best equipment obtainable.

And you get full pay while you train.

You also get unusually good fringe benefits, including a chance to continue your education. In many cases at our expense. In most cases with at least 75% of your tuition paid.

And if you qualify we'll give you your choice of training. We'll put it in writing, before you sign up.

**Today's Army  
wants to join you.**

Army Opportunities Dept. 200, Hampton, Va 23369	Date _____
I'd like to know more about the job-training and promotion opportunities in today's Army.	
Name _____	Date of birth _____
Address _____	
City _____	County _____
State _____	Zip _____ Phone _____
Education _____	

# Science Newsfront

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

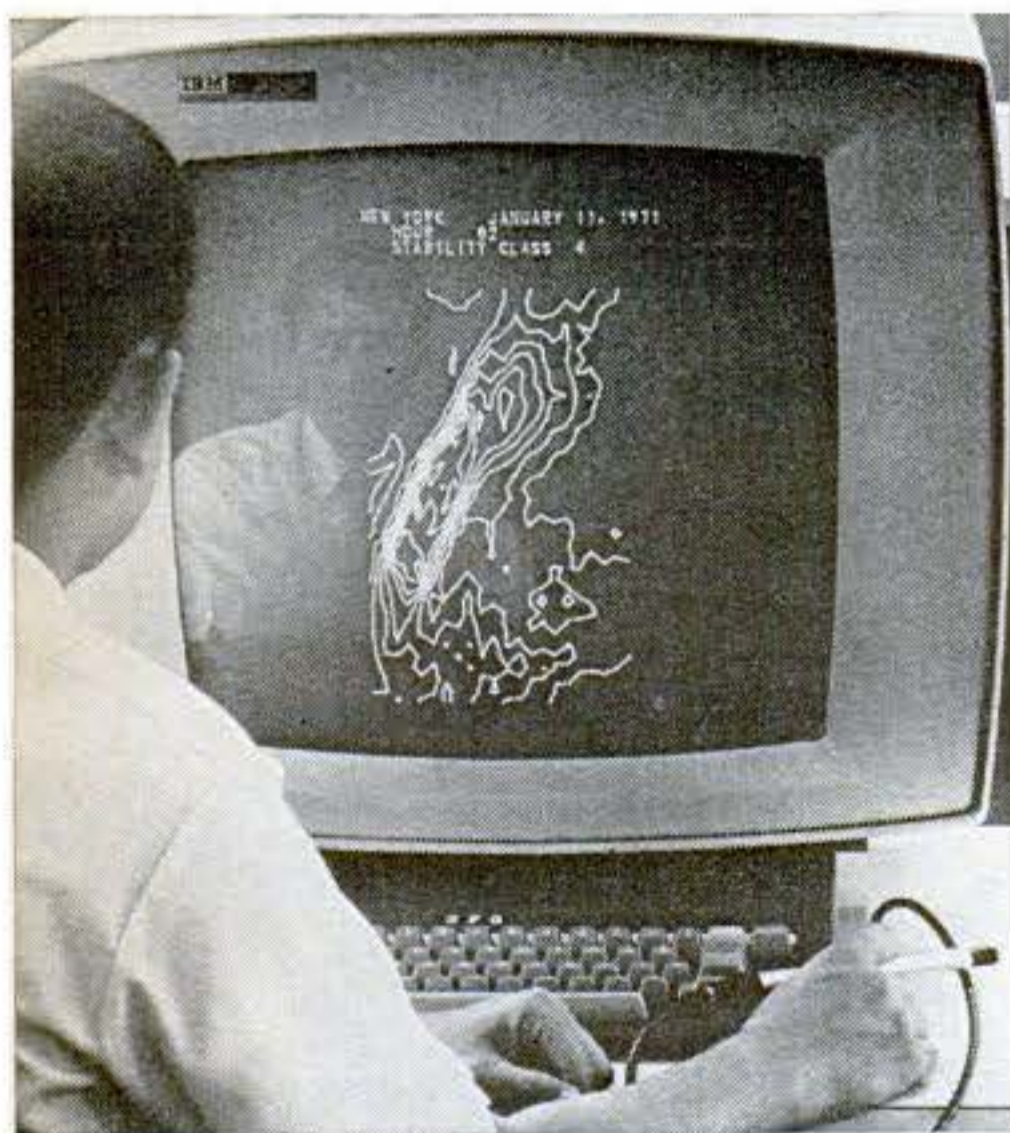
By ARTHUR FISHER

## Hydrogen and oxygen over Mars

Russian scientists have reported that data received from their two Mars orbiters—Mars 2 and Mars 3—indicates the presence of both oxygen and hydrogen atoms in the upper atmosphere of Mars. They found a hydrogen belt at a height of about 6,000 to 12,000 miles above the surface of the planet, and oxygen at about 600 miles up.

## Computer pictures pollution

This computer has been fed a program that enables it to predict—within 0.05 parts per million—the concentration of sulfur dioxide in the atmosphere in areas measuring up to 1,600 square miles. The experimental program, developed by a team of IBM investigators working under Dr. L. J. Shieh, takes into account a host of complex modifiers of the pollution situation, including weather data, the landscape, and sources of the pollu-



tant, smokestack by smokestack. In the photograph, Dr. Shieh is watching as the computer projects a map of sulfur dioxide pollution over New York City. The technique could help authorities decide when to limit or shut down plants, refineries, or incinerators that were generating the gas. Sulfur dioxide has been linked to respiratory illnesses.

## Soviets score nuclear first

The world's first large-scale commercial nuclear reactor of the type called



## New device protects electrical equipment from power surges

General Electric has introduced what it calls a new family of semiconductor devices—GE-MOV metal oxide varistors—to protect home, industrial, and automotive equipment from damage resulting from high-voltage transients, which may be caused by lightning strikes, switching transients, and the on/off operation of many circuit components. The devices are connected in parallel with the component to be protected. When faced with a high-voltage transient, the varistor changes in resistance from an insulator to a good conductor. In the photo above, the wafer-shaped varistor is protecting a diode from a 5,000-volt spark simulating the effect of a lightning strike.

“fast breeder” has been built—not by the U.S., which was the first nation to prove (in 1951) that such reactors can indeed produce more fissionable “fuel” than they consume—but by the Soviet Union. The Russians have announced completion of a 350,000 kilowatt plant that will not only provide electricity for the town of Shevchenko on the arid coast of the Caspian Sea, but also furnish enough extra energy to distill 30 million gallons of salt Caspian water into fresh to provide drinking water.

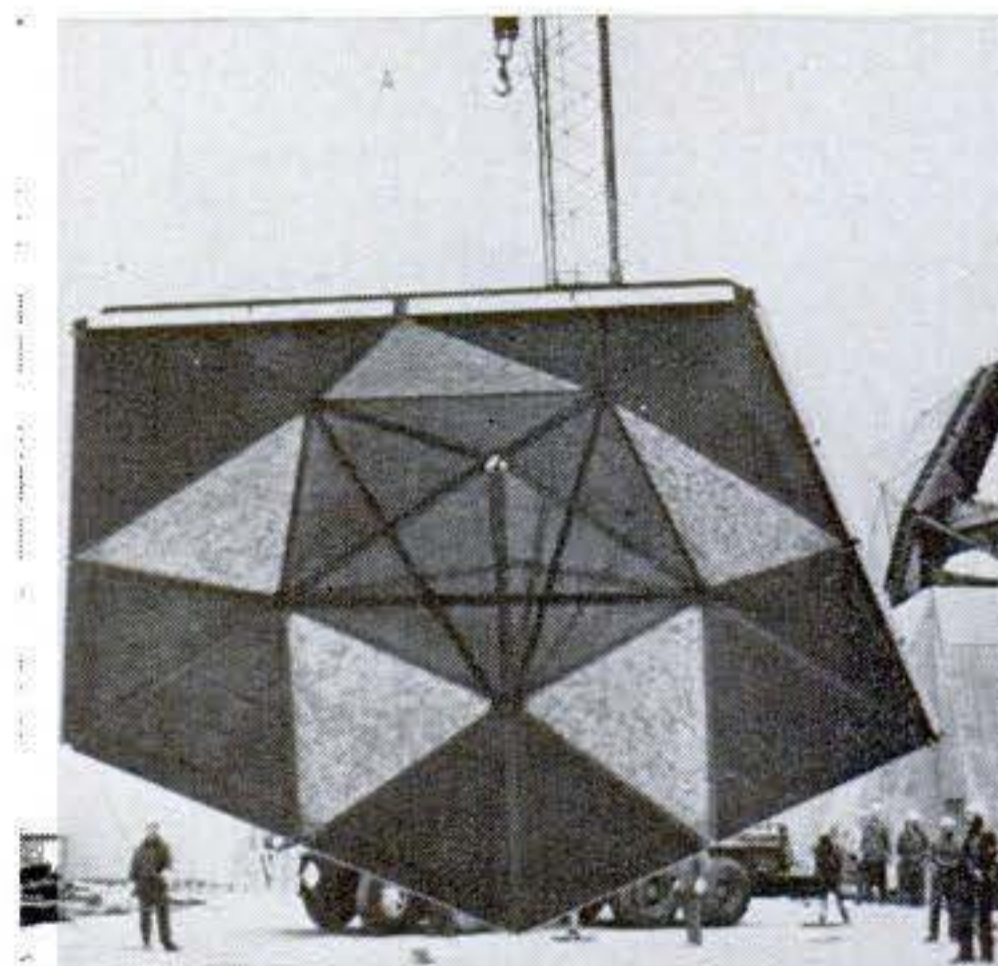
In the fast breeder reactor, fast neutrons released through the fission of plutonium are allowed to “breed” more plutonium from uranium 238. This country's low-priority fast-breeder program last year received a nudge from President Nixon.

## Shellfish poison analyzed

Ten years of research by Henry Rapoport and associates at the U. of Calif. (Berkeley) have uncovered the chemical structure of one of the most potent poisons. The substance—saxitoxin—is present in tainted shellfish and associated with the periodic “red tides” that often devastate fish living in the ocean, and are actually a population explosion of single-celled organisms that manufacture saxitoxin and a reddish pigment. Shellfish ingest saxitoxin without peril to themselves, but men and other mammals who eat the shellfish often die. Ingesting just ten millionths of an ounce of saxitoxin means a 50 percent chance of survival. The successful research may lead to an antidote.

## Beer-can dome completed

A few months ago [Oct. '71] we brought you the stirring saga of a unique geodesic dome built from unusual materials—beer and soda cans, with their tops and bottoms removed, sandwiched in plastic to make translucent panels. The idea was to recycle cans that would otherwise litter the landscape, and incidentally provide a roof for the world's largest bubble chamber at the National Accelerator Laboratory at Batavia, Ill. For those of you who thought the whole



thing was a leg-pull, here's a picture of one of the last sections of the dome before it was lifted into place. The dome, now finished, used about 120,000 cans.

The bubble chamber is designed for work with high-energy particles from the new NAL 200-500 billion electron

Continued

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Filter Kings, 17 mg. "tar," 1.2 mg. nicotine; Longs, 18 mg. "tar," 1.3 mg. nicotine, av. per cigarette, FTC Report Aug. '71

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## Science Newsfront

[Continued]

volt proton synchrotron. The high dome of the "can-do" dome will permit a crane to swing experimental equipment inside.

### Universe: bigger, older?

If the "big bang" theory favored by many cosmologists is correct, the Universe was born in one great cataclysmic burst, with the galaxies flung outward from the center of the explosion. Based on the speed with which the galaxies have been observed moving away from each other—and us—astronomers have dated that primal bang at roughly 10 billion years ago, and calculated the

present size of the universe on that basis.

Now, however, an astronomer has suggested that new measurements may force us to revise our ideas about the age and distance scales of the cosmos—perhaps doubling them. Prof. George O. Abell, chairman of the astronomy department of the University of California, Los Angeles, has measured the relative brightness of galaxies in eight giant galaxy clusters. He has concluded from these measurements that the galaxies have actually traveled  $1\frac{1}{2}$ -2 times as long as previously thought, which would put the age of the universe at 15-20

billion years. This means the galaxies have also traveled up to twice as far, doubling the intergalactic distance scale. Dr. Abell and his colleagues made their observations over a 13-year period.

### Cable cane is collapsible

What could an auto windshield scraper and a cane have in common? They might both be constructed on a new principle developed at MIT's Sensory Aids Evaluation and Development Center (SAEDC). The cane you see here, in both extended and folded positions, was designed by SAEDC after many blind people complained that their canes, which must be very rigid to supply the necessary tactile cues, were cumbersome because they could not be folded compactly. So engineers at SAEDC came up with a new cane that weighs 10 ounces and folds into the package you see, only eight inches long. The secret: The cane is made of swaged aluminum tubing; the top part of each section narrows and fits into the expanded bottom of the section above it. A 100-pound-test cable runs through the  $\frac{1}{2}$ -inch tubing and can be tensioned with a toggle arrangement in the cane's handle. The firm manufacturing the cane, Hycor Corp. of Woburn, Mass., say that a supportive walking cane of similar design is selling madly, and they expect to produce long-handled brushes and windshield scrapers that operate in the same way.



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### Land down or sea up?

Don't look now, but the sea level along the Atlantic Coast from Maine to Virginia has been creeping up at a worrisome—and unprecedented—rate since 1963. That's the conclusion of a scientist at the National Oceanic and Atmospheric Administration, Steacy D. Hicks. Hicks' study, based on monitoring of sea levels at 115 different locations along U.S. coastlines, shows that during the last 100 years, the sea has risen about one foot along the Atlantic Coast. But since 1963 the sea has risen at a rate more than three feet per century in the Maine to Virginia area. The increase may pose a threat to coastal industry and recreation.

Oceanographers disagree on whether the sea is actually rising or the land falling; it makes little difference, since the effect is exactly the same. Many scientists think the rise in sea level actually results from a combination of the two, caused, for example, by glacier melting and by the depletion of water and petroleum from the ground.

PS

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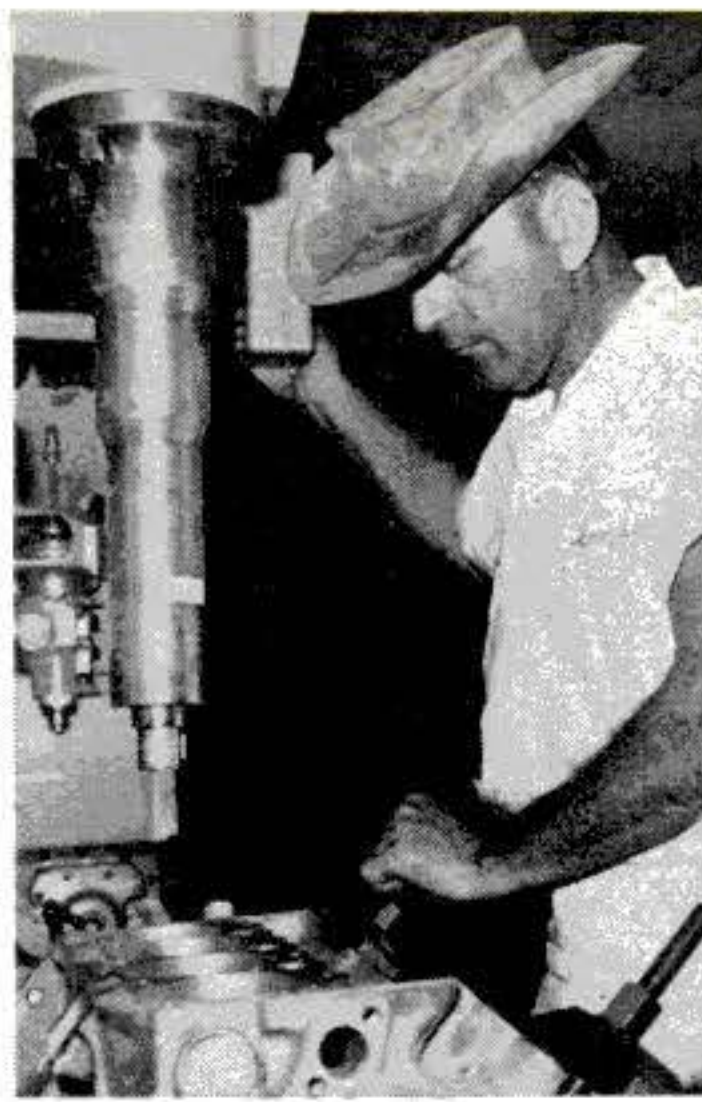
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# "Say, Smokey—"

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

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



I'm moving from New York to the mile-high city of Denver. What will require readjustment to suit high-altitude driving?

W. R. RANDOLPH, Green Brook, N.J.

*Generally speaking, you would set the carburetor leaner, retard timing, and add cooling. Why? Because at 5,000 feet you'll be in less-dense atmosphere, your engine will be working harder and producing less power. But as cars are built today, I doubt that you'll have any real trouble. I wouldn't advise doing anything until you get there.*

In 16,000 miles my 1967 Cougar XR7 has had four grease-seal replacements and installation of brake linings on the rear wheels—mostly the right rear. All work was done under warranty, and no reason was given for the cause. I'm concerned that there must be a definite reason for this trouble.

J. A. HUPPERTZ, Cincinnati, Ohio

*I don't believe that you have a permanent, unsolvable problem. My guess is that the rear axle isn't vented properly, and the pressure buildup blows oil out the seal. This contaminates the brake lining, and they've had to change both rears to keep brake balance. By the way, you shouldn't park the car in such a way that the right rear wheel is substantially lower than the left. If you do, I believe your trouble will continue. I'm assuming that the seal surface is undamaged and that the installation is correct.*

Can you please explain why the treads on glass-belted tires wear unevenly all around the tire? My car has been checked for balance and alignment. Many people I've talked to have had the same problem with various kinds of glass-belted tires. How can I solve this problem?

REGENT THIBAUT, Puslinch, Ont.

*This problem occurs in other types of tires, too. The only thing I know that's effective—assuming balance and alignment are as good as you say—is to keep the tire manufacturer's recommended pressure in them and "X" the tires every 3,000 to 5,000 miles. It's really a combination of problems in both chassis and tires, and no across-*

*the-board bulletproof fix exists. One thing, though: Wheels that aren't true excite this condition.*

The three-speed with overdrive transmission on my 1955 T-Bird is shot. I'd like to keep it close to the original. What automobile transmission will work?

TOM PARROTT, Murray, Ky.

*If I was fixing it I'd use a '55 T-Bird three-speed transmission with overdrive. When you change a major part, a whole lot of changes are triggered, and the job almost always winds up more expensive, regardless of the cost of original parts. If you change from original anyway, Ford has a whole family of transmissions that basically fit that car and engine. With one of these you can use the maximum number of old parts such as the drive shaft.*

I'm not looking for superb performance and high speed, just a decent engine that will last. Would a four-cylinder engine be more advantageous than a six? I would like a four, but not if it would quit on me prematurely. Could you clear the air on this before I buy a car?

FRANK M. LAMB, Arlington, Mass.

*If the number-one object is to get from point A to point B as cheaply as possible, I don't know a better way than with a four-banger. I also know one four-letter word that could be your answer—Vega.*

Recently I blew both head gaskets and cracked the left cylinder head on my 1962 Rambler Ambassador 327-c.i. engine. I replaced the gaskets and cracked head and had both heads planed in case they were warped. Now the left bank burns oil, but the right bank doesn't. How can I fix this?

GARY RUDA, Englishtown, N.J.

*I think the trouble is valve seals. Also check for a lack of oil drainage in the left head. Be sure that you used the proper head gasket. Also don't overlook the possibility of ring problems on the left bank—it's possible to have ring problems on one side only. Also, did you change anything on the left side with reference to venting?*

My 1971 Plymouth Duster six with column shift, now at 3,000 miles, jumps out of high gear when going down bumpy roads. The column shift lever also shakes vigorously when the roads aren't smooth as silk. The dealer says it shouldn't shake, and I agree, but he can't seem to find the cause for popping out of gear.

D. L. STEPHENSON, Red Bank, N. J.

*Either the tail shaft or the main drive gear in the transmission has end play. Also the detent in high gear could be weak, the shift not going fully into high, though this is the least likely cause. But if the transmission and gear-shift column vary in distance by the hootchie-kootchie you've described, it could be pulling out of gear.*

The 390-c.i. V8 in my 1965 Mercury has done a fine job for over 86,000 miles. In ordinary operation the oil-pressure gauge shows normal. But I'm disturbed about another condition. During long engine-idling tie-ups on the local expressway, the indication gradually drops almost to zero, even since I switched from 10-30 to 10-40 oil. My mechanic said not to worry unless I began to hear from the valves; but they are still quiet. He installed a new sending unit for the gauge, with no more favorable indication.

I wouldn't mind installing a new oil pump, if that's needed, but I'm fearful of meddling with an engine that runs well when the prospects of improvement are so uncertain. Can you offer any suggestions?

J. J. HORAN, Willow Grove, Pa.

*First I recommend an accurate, mechanical oil-pressure gauge that reads in psi, temporarily installed as near the end of the oil-system route as possible, for a sort of quick master-gauge reading. Assuming that this master gauge confirms your suspicion that oil pressure is down, then let's determine where the trouble starts.*

*With hot 10-30 oil you need 15 psi minimum at idle speed, and should have a minimum of 35 psi at 55 mph. Assuming you get a low number, have the miraculous leak-proof oil pan pulled, and you'll find a plugged oil-pump screen—I think. If you don't find the screen plugged up, better get out your checkbook and hope your mechanic knows and cares what he's doing, because it's going to turn into a major operation. But if it is a plugged screen, think about more frequent oil changes and a little chemistry once or twice a year. But be careful with the chemistry.*

I have a 1971 Chevrolet Impala. At 2,000 miles the Turbo-Hydramatic transmission started slipping for about 15 minutes each time I took off from a stop sign. Then for a while it worked okay. I took the car to the dealer and the transmission failed to show any slippage in driving tests. So he informed me that it was probably temporarily clogged with a little trash which was blocking a valve. Now with 5,000 miles on the car, the transmission

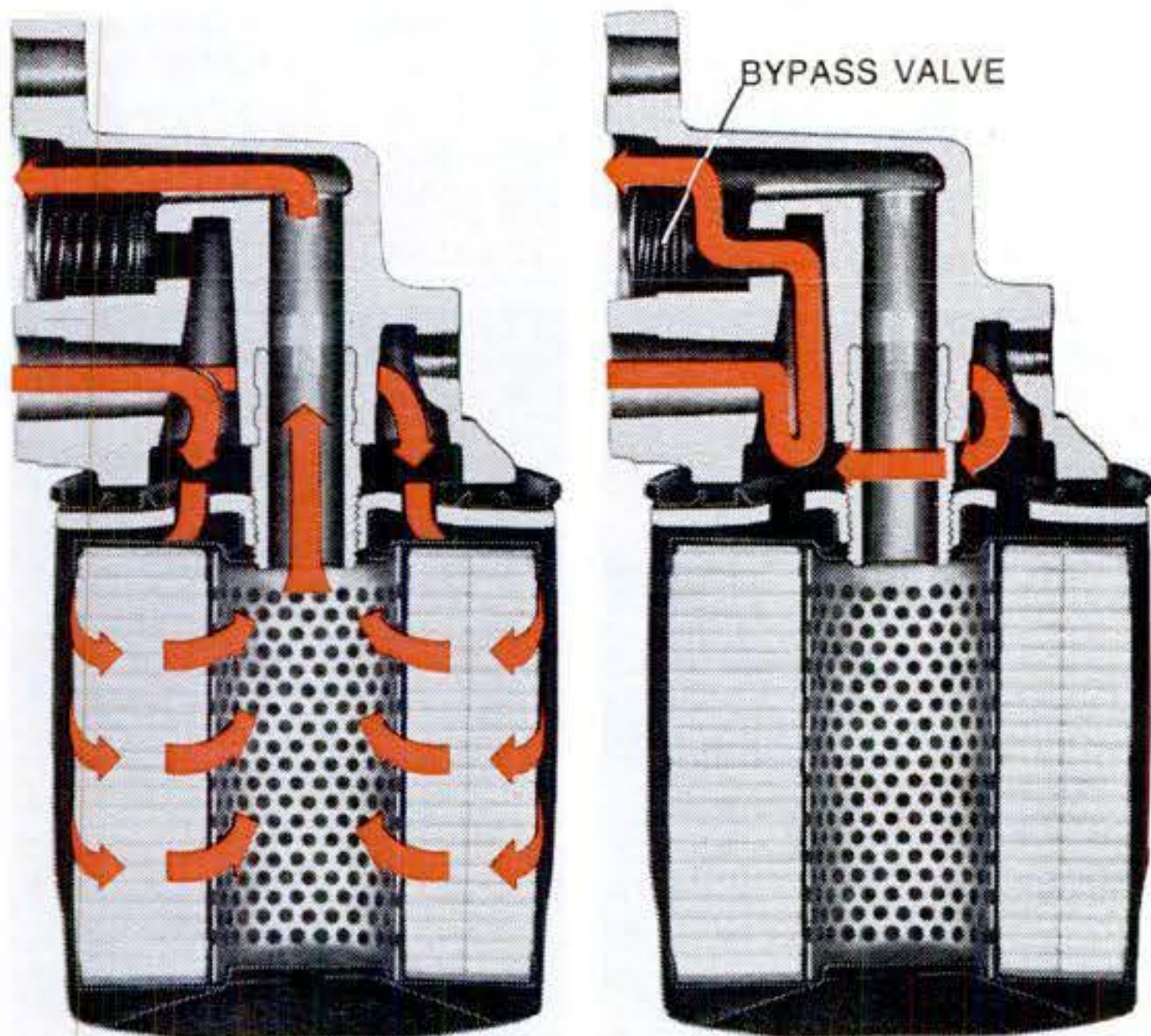
*Continued*



# ASK THE AC ENGINEERS

“ Why is it important to change my oil filter at recommended intervals? ”

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Oil flows from engine through filtering material . . . oil returns to engine after all harmful abrasives are removed.

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efficiency for only a specified period of time or mileage . . . depending on driving conditions. Then, it should be changed to prevent driving with a clogged filter.

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makes and models. For top engine protection, change your oil and AC Oil Filter at recommended intervals.



AC SPARK PLUG DIVISION OF GENERAL MOTORS

MARCH 1972 | 43

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## "Say, Smokey—"

[Continued]

still slips occasionally. I'd like to know what's causing the problem and what other parts might be damaged because of the slippage.

HALLIS W. HALL, Paducah, Ky.

*I think your dealer gave you a fairly good estimate of the problem, except that a lack of clearance may also be involved. But the hooker is that if one of the problems doesn't clear up you may run out of warranty. The fair solution would be to have the transmission pulled down and fixed now since the problem still exists. Slipping certainly isn't normal. There probably won't be any damage caused by the slippage, but if it continues to slip, problems could eventually arise.*

The engine on my 1970 Ford LTD starts fine when it's cold. But when it's hot I have a very hard time starting it. The car has been to the Ford people twice without any result. Can you help?

W. C. LUM, San Francisco, Calif.

*I recommend you see a good carburetor man. I'm pretty sure that when your engine is hot you're faced with a wet, over-rich system. Another thing to check would be ignition output with the engine hot. Many times the available spark-plug voltage drops, due to a bad coil or condenser, or ex-*

*cessive starter draw. Also, the ignition switch and starter solenoid sometimes don't make proper contact and electrical distribution when hot.*

I have a problem with the power steering in my 1969 Buick Gran Sport 350. The car is all over the road on a calm day, and a lot worse with a crosswind. It has been like this since new, and no one here seems to know what to do about it. Would reducing the power steering help? How is it done?

R. DEROY, Central Falls, R.I.

*I think your problem is roll-steer. That is, as you drive, when the car leans from side to side or wags its tail, the wheels are moved; steering is taking place even though you're not turning the steering wheel. Fixes would be things that stiffen the car against side-to-side and front-and-rear movements; also fixes that retard or limit up-and-down motion. A solution would be stiffer shocks, sway bars, and tires with less sidewall deflection, and making sure that all suspension attaching parts are as close to zero tolerance as practical. If you do all this, though, you'll end up with a harsher ride.*

Ever since I bought my '69 Olds Tornado it has been in and out of the repair shop with starting problems. When I try to turn over the engine, it'll start, then

immediately conk out—even when the gas pedal is floored. After the engine turns over a few more times a lot of exhaust comes out of the tailpipe, the engine shakes violently, stalls, and usually won't start again until it gets to the repair shop. I have had new plugs, points, and fuel pump installed, but nothing seems to work. Also, when driving home from work one day, I completely lost all brakes. My dealer says the master brake cylinder and the power-fluid pump were shot. He couldn't explain why.

JOHN VOUGHT, Englewood, N.J.

*On the hard-start problem, I believe you're working in the wrong area. This sounds more like a carb problem, and you're much too rich at startup. After you get a carburetor and choke checkup, have a scope put on the ignition to observe the condition. I think you'll find everything's okay there. But you should also check the battery cables. They're small in this model, and unless they're in top condition they could be causing the whole deal. On the brake problem, you're not too clear. I believe you intended to refer to the master cylinder and power-brake assembly. A leak is a leak, and what causes it I don't know. But the biggest causes of this failure are bad brake fluid or a mix of two different brake fluids that are not compatible—and dirt that enters the system.* **PS**

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# Look and Listen

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

By C. P. GILMORE

## Cartridge TV—don't hold your breath

One day last spring I was invited to visit the shining new plant in Rockleigh, N.J., where CBS makes and duplicates cassettes for EVR players. I saw huge new color electron-beam recorders that had just been installed, duplicating printers, an impressive and versatile master-control section, and much more. There was even room for expansion.

Well, that expansion space won't be needed. Neither will anything else. CBS is shutting down the world's only commercial video-cassette manufacturing facility and writing off a \$10 million loss, before the operation really got cranked up. Anybody wanting EVR cassettes from now on will have to go to an English combine that will soon be equipped to produce them.

This is just one in a series of disappointing announcements that is bringing an air of reality back to the cassette-TV business, following all the optimistic predictions of a year or two ago. It shows as clearly as anything can that the cartridge-TV boom is still a long, long way off.

## Other straws in the wind—

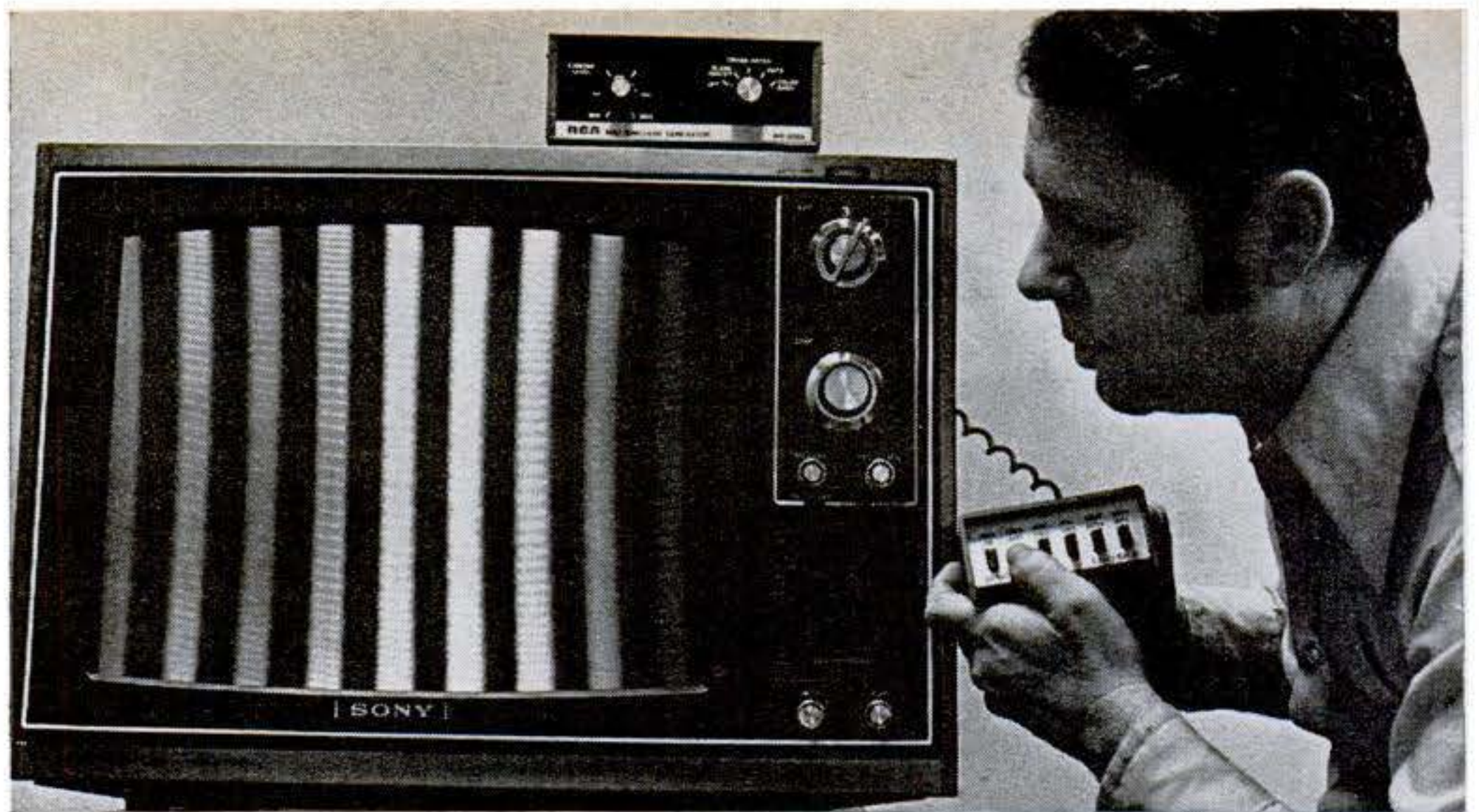
Ampex has announced yet another delay in the introduction of its Insta-video system. The date originally announced—fall '71—had been changed to spring '72. Now it's late '72.

And that U.S. demonstration of the Teldec color disc, originally scheduled for this spring, has also been put off. The group of European companies that showed the color disc in Berlin last fall says further development is needed for the U.S. version, and it won't be ready until next fall.

## On the positive side—

● The firm won't confirm or deny it, but it is rumored that the giant MCA company is developing a disc video system that uses a laser for recording. Each disc plays up to 30 minutes (contrasted with Teldec's five minutes per side). Price predictions: \$150 for the player and \$8 for a feature movie, both lower than anybody else's projected costs. Of course, cost estimates have a way of growing.

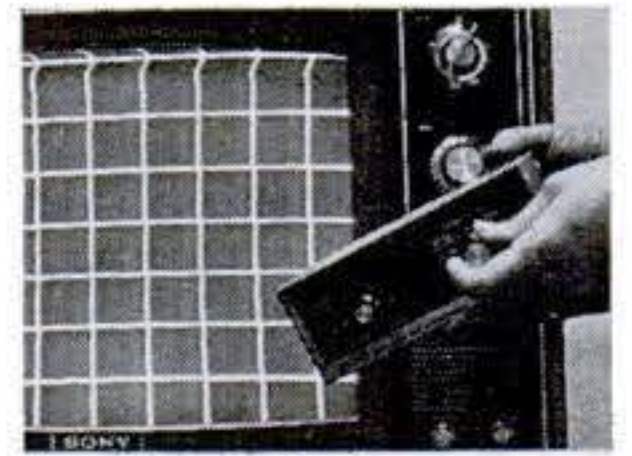
● Another company has hopped on the Cartrivision bandwagon. Teledyne



## Get a sharp picture—and save money

For first-rate picture quality, a color set should be put through a process called dynamic convergence once or twice a year. This brings the color images—red, green, and blue—into perfect registration, eliminating color fringing that develops with time. A service man will charge about \$20 to reconverge a set. So most people don't have it done very often. You could do it yourself, but you would need a generator to put a pattern of dots or bars on the face of the screen.

Now two companies have come out with small, low-cost generators that can do the job. One is the RCA WR 508A (on top of set in top picture). It sells for \$75. The other is the Sencore CG22 (in my hand in top picture), which costs \$89. Complete setup—including reconvergence—isn't hard if you're willing to follow detailed instructions carefully and are at ease with electronic gadgets. TV manufacturers publish convergence instructions for technicians; some will give you the ones for your set if you ask. You can also get a Sams Photo-fact folder containing setup and other technical information on your set. It costs \$3 from the mail-order houses or your local radio-TV parts store.



Packard Bell becomes the fifth brand name scheduled to appear on units that should reach the market by mid-1972. Other trademarks that will show up on the video record/playback machines: Admiral, Emerson, Wards, Sears.

## Discrete-four-channel broadcasts?

Last month I reported that RCA, Panasonic, and JVC had announced improvements on the JVC discrete-four-channel disc and a projected beginning of marketing in 1972, but that chances for any early change in FM-broadcasting standards to allow transmission of discrete four-channel were remote.

This month, I think "remote" was too optimistic. The chief of the FCC's broadcast-standards division says even consideration of such a move is "way down on the list." Even if the agency does eventually decide to explore the issue, remember it took seven years from the beginning of stereo recording to the establishment of broadcast standards in 1961. Remember also that *matrixed*-four-channel material—unlike the discrete kind—can be broadcast right now, and an estimated 70 stations around the country are doing it.

Related news: Radio Shack, Fisher, and Harman-Kardon are reputedly taking out licenses for CBS' SQ matrix system, and other major companies are preparing to follow. If I had to bet on which system will be in the strongest position—at least for the foreseeable future—I'd have no trouble deciding where to put my money.

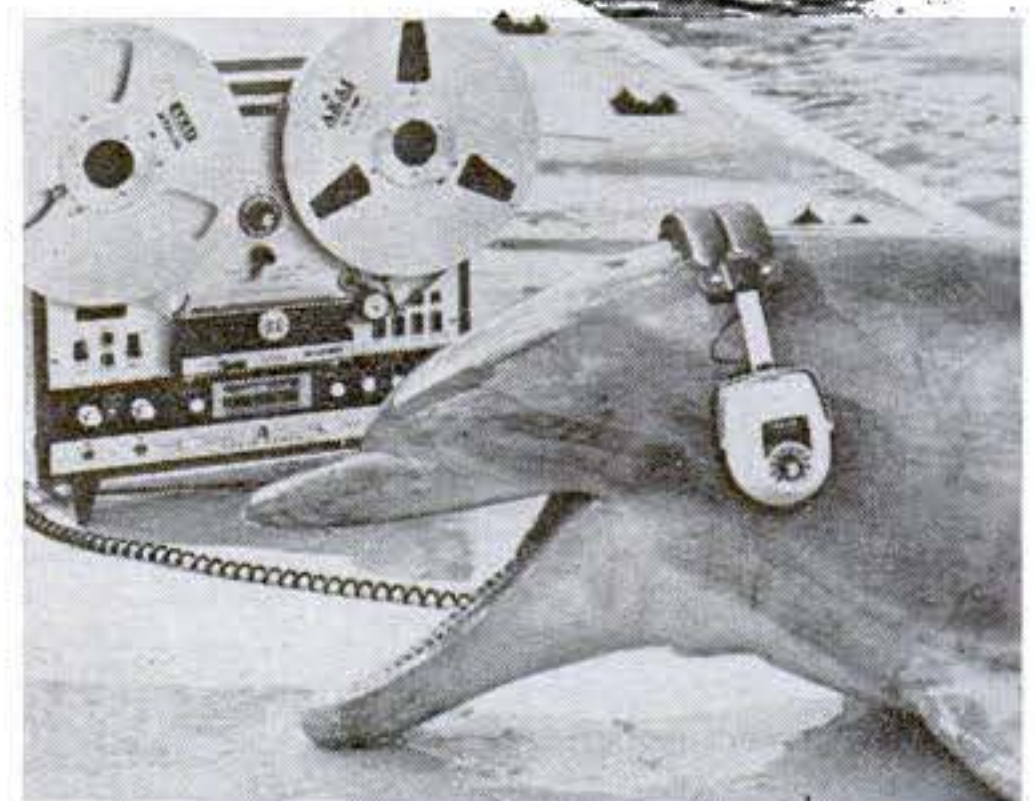
## Dolby rides again

Nearly every major sound-equipment maker in the world has taken out a license with Dolby Laboratories to manufacture gear incorporating the noise-reduction circuitry developed by Ray Dolby. But there was one glaring gap: Japan's giant Sony Corp.

No more. A Dolby team just returned from Japan with a sheaf of new contracts. One of the names on the dotted line: Sony. Expect to see a new Dolby-ized Sony line soon.

## Press agentry: lesson one

The problem: Your company wants to promote its stereo headphones and X-330 tape recorder. How can you per-



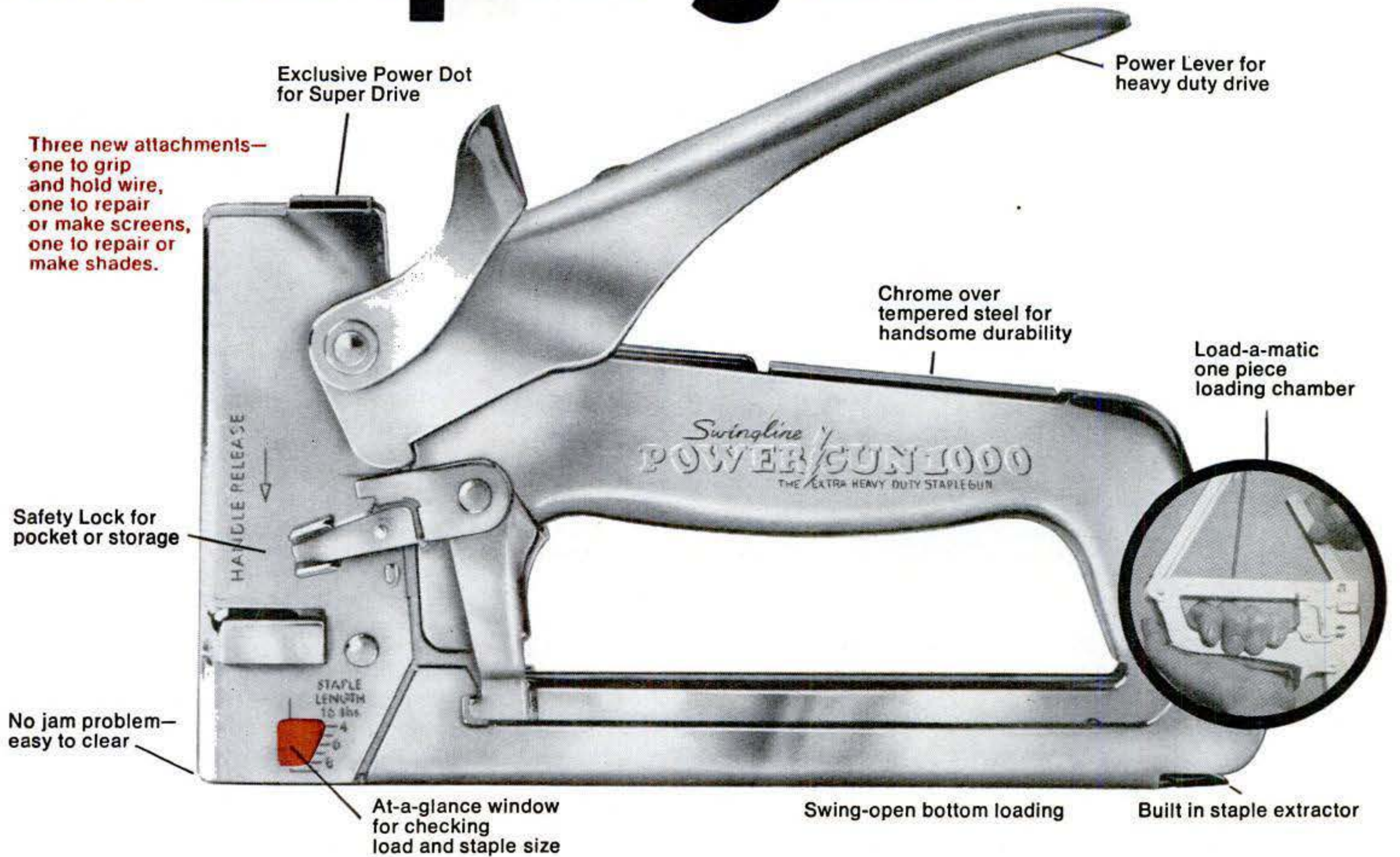
suade magazines to run photographs?

Answer: Put the headphones on a dolphin and dummy up a photo to make it look like he is listening to—and en-

*Continued*

**Introducing:**

# A great new breed of staple gun...

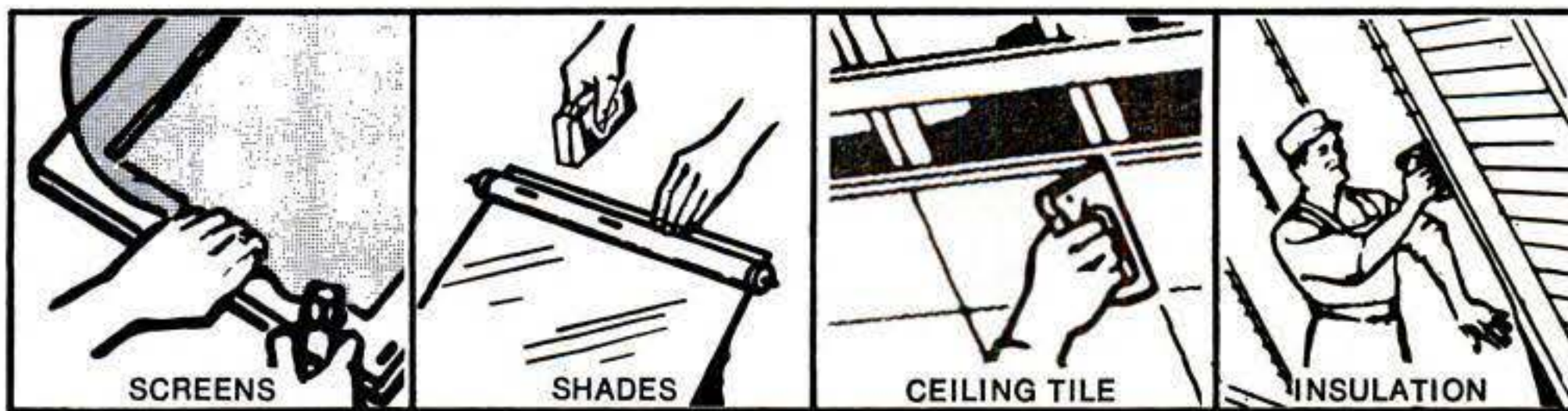


# new Power Gun 1000 does more!

If you're a homeowner you've got to own the new Swingline Powergun 1000, the first extra heavy duty staple gun that does it all. You name it. You'll find hundreds of uses, indoors and out.

Suggested retail price.

**\$13<sup>95</sup>**

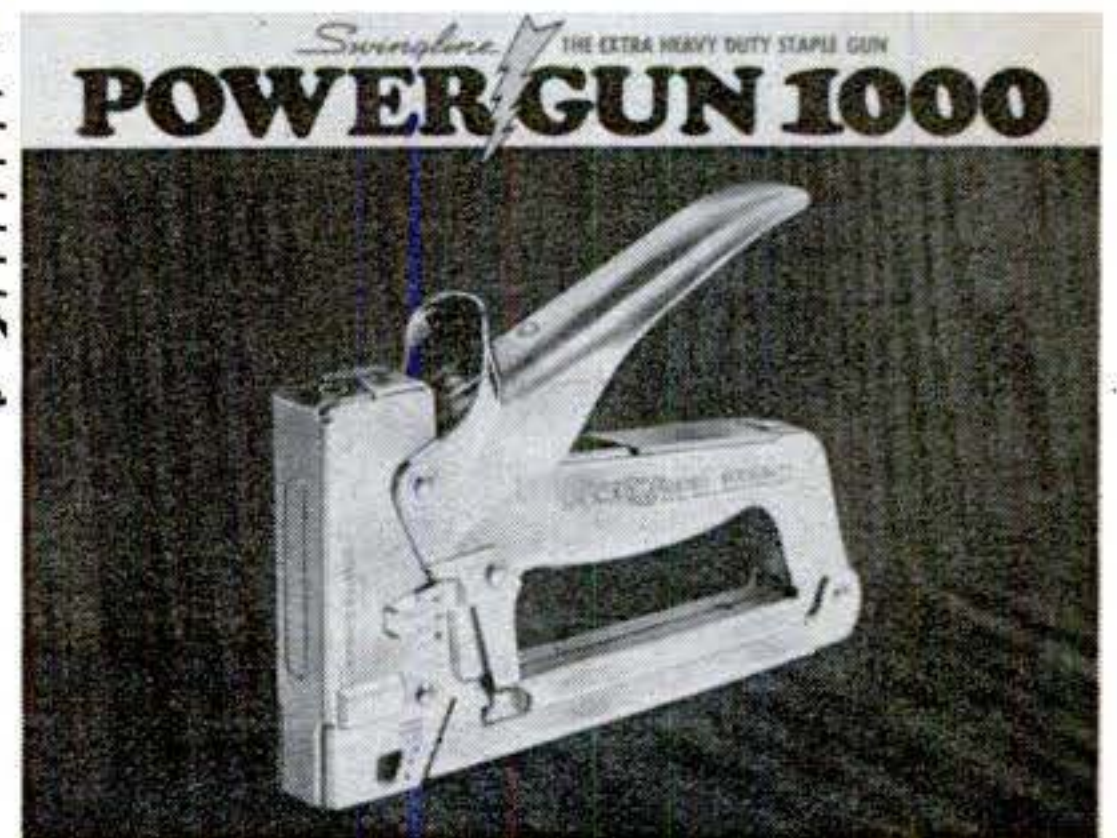


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and three magnets (more than any other brand). This means ultra-wide frequency response and separation while tracking at forces so low they barely touch your records. POPULAR SCIENCE MAGAZINE summed it up very well when they picked the Empire cartridge hands down for "The stereo system I wish I owned". Empire four channel cartridges are available at better hi fi stores.



For further information, write Empire Scientific Corp., 1055 Stewart Avenue, Garden City, New York 11530.

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World Famous Stereo Components



## Look and Listen

[Continued]

joying—music from the tape recorder.

Well, it worked—at least for Akai. Next questions: How many dolphins can afford such a rig? Or like music that much?

### On the record

I've commented before on the improving but still frequently inferior quality of cassettes as compared to discs. I've also been impressed by the consistently high quality of DGG products, discs and cassettes. So I recently got both versions of three new DGG recordings by Herbert von Karajan and the Berlin Philharmonic: *Rossini Overtures* (disc: 2530 144; cass.: 3300 186); Bizet's *Carmen and l'Arlésienne Suites* (disc: 2530 128; cass.: 3300 182); and Mendelssohn's *Hebrides Overture and Scotch Symphony* (disc: 2530 126; cass.: 3300 181). In the Bizet and Mendelssohn, cassette and disc were practically indistinguishable—clean and sharp, broad frequency response, good sound on both. The Rossini cassette was clearly inferior: no lows, peaky, constricted.

It is clear that the high-speed duplication process used to produce cassettes simply isn't yet as reliable as the disc pressing procedure—although we still get an occasional bad pressing, too. But it seems to me there is reason to be encouraged. The early stereo discs were certainly uneven. And I strongly suspect that with the rate of improvement shown by makers, most cassettes will soon be as good as the best are now.

● *The Grambling College Marching Band*. Mercury SRM 1 618 (disc).

Looking for a lot of oom pah pah and a sprinkling of Sousa marches? Forget it. This band, soloists, chorus, and organ—yes, organ—play everything from the *Grambling Alma Mater* to *Ode for Billie Joe*. Performance: as full of spirit as a hall full of Irishmen on St. Patrick's Day. Recording: so-so.

Disc reviews by Arthur Fisher—

● *Earl Scruggs: His Family and Friends*. Columbia C 30584.

The world's greatest banjo picker, with such luminaries as Joan Baez and Bob Dylan, in music to delight Foggy Mountain fans. Sound: adequate.

● GABRIELI: *The Glory of Venice*. E. Power Biggs, organ; choruses, brass ensemble; V. Negri. Columbia M 30937.

Antiphonal music sumptuously recorded in the cavernous San Marco Cathedral in Venice. A sonic knockout.

● WAGNER: *Lohengrin*. James King et al.; Bavarian Radio Chorus and Symphony Orch., Rafael Kubelik. DGG 2713 005 (five discs).

Despite some vocal deficiencies in the title role, this is probably the best *Lohengrin* available. Choral and orchestral work are superb.

Disc review by Ken Furié—

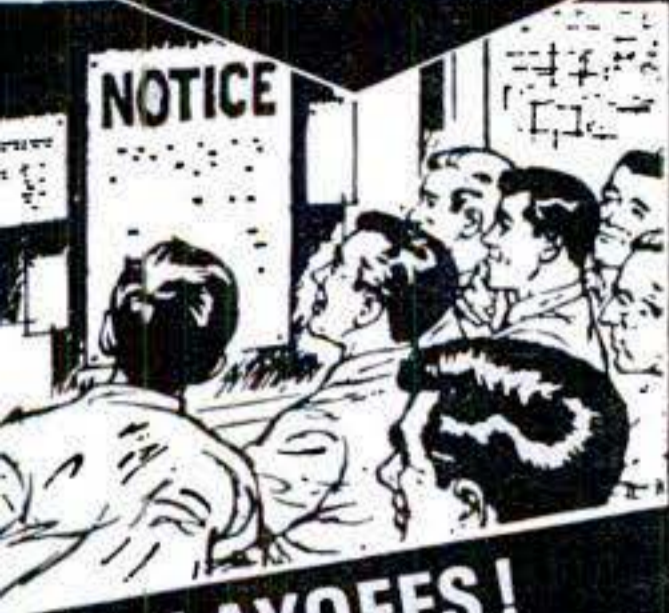
● MAHLER. *Kindertotenlieder*. *Songs of a Wayfarer*. Hermann Prey; Concertgebouw Orch., Haitink. Philips 6500100.

Credit Prey, Haitink, and Philips with a flawless disc. Prefer a female voice? Janet Baker (Angel 36465) is memorable in these cycles. PS

## Once every hundred years...

We're celebrating Popular Science's centennial with a big extra-special issue in May 1972—extra pages, extra color, extra features by the top men in science and technology. Don't miss this great 100th-anniversary issue—it'll be a long wait for the next one!

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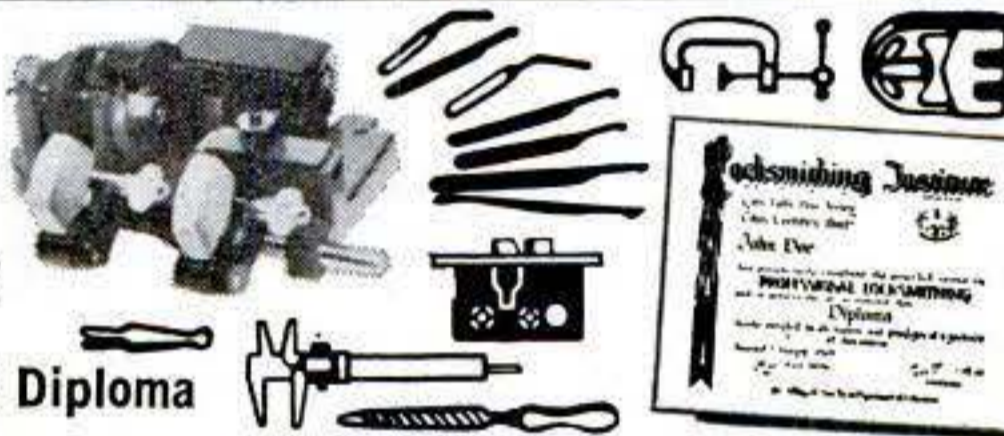
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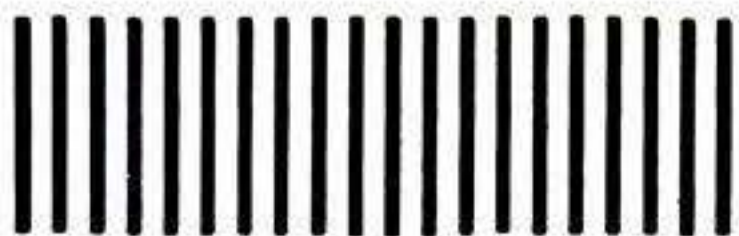
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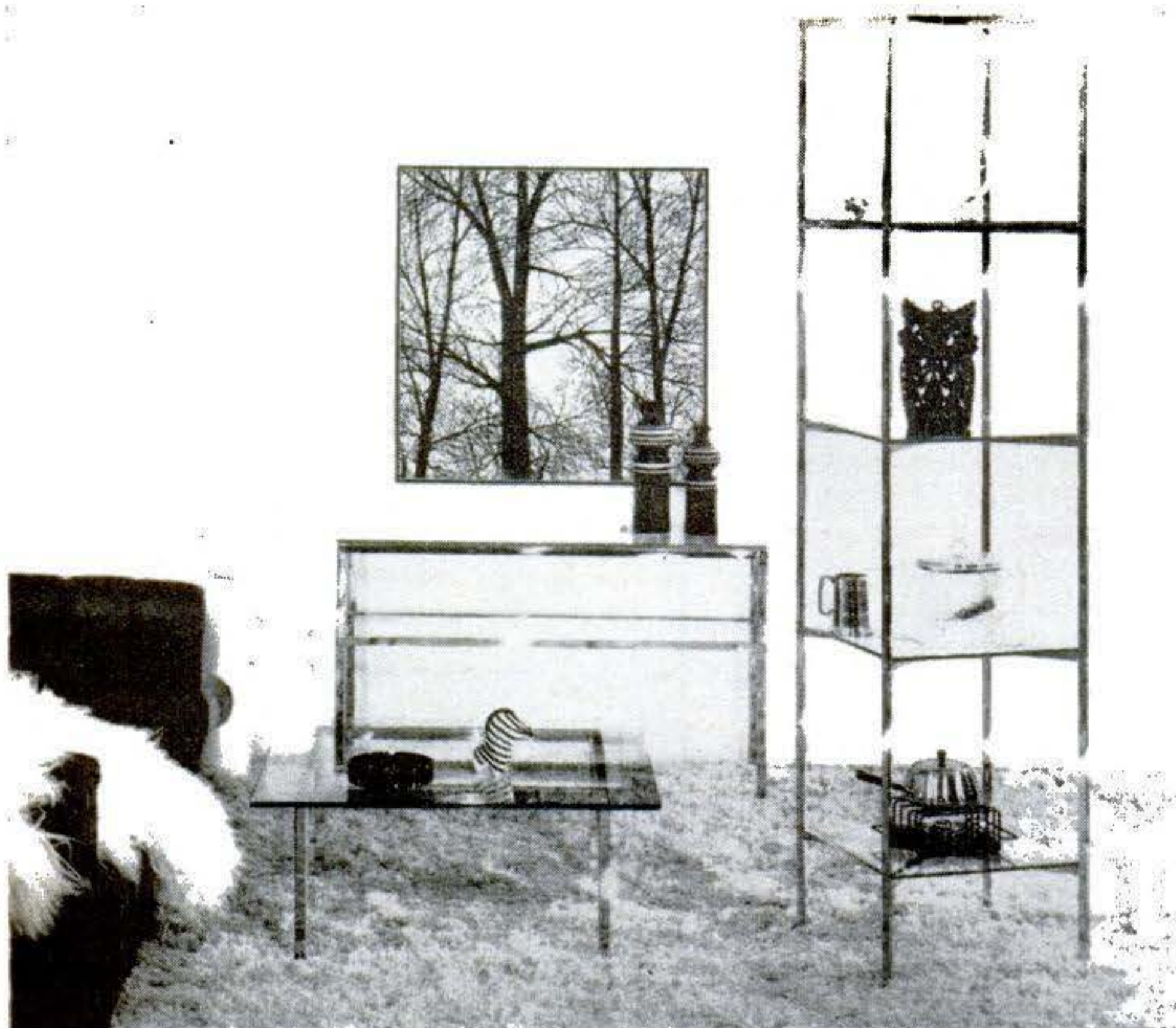
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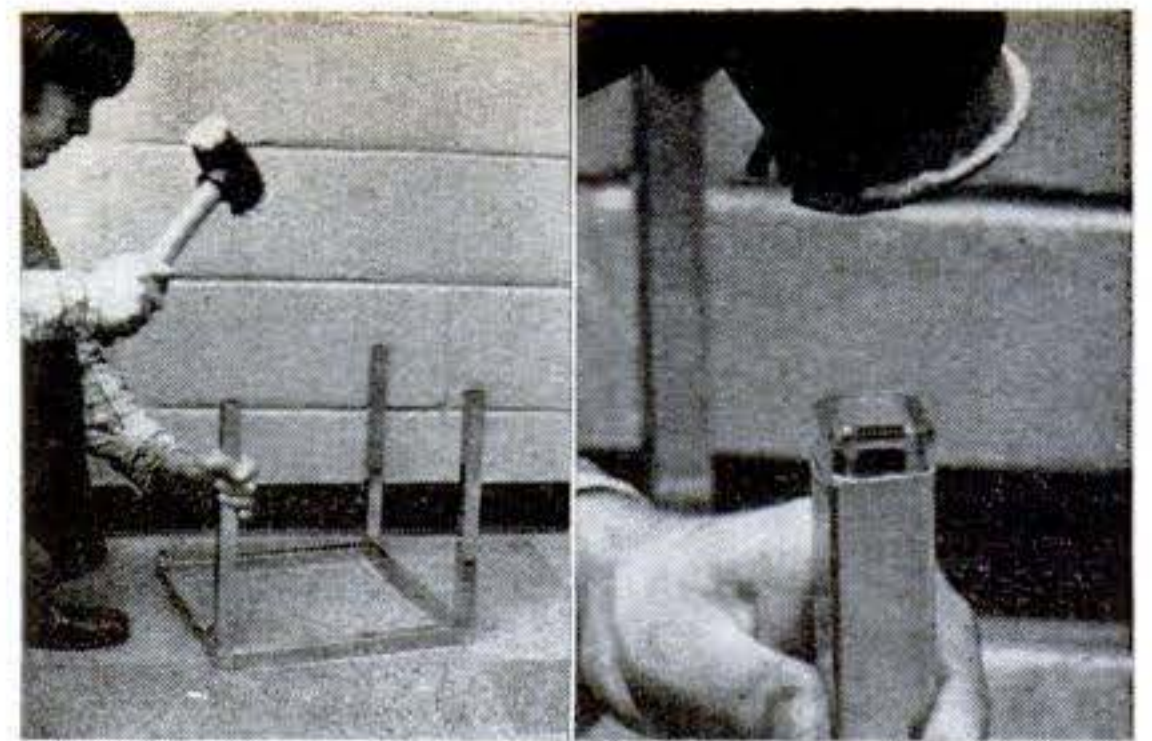
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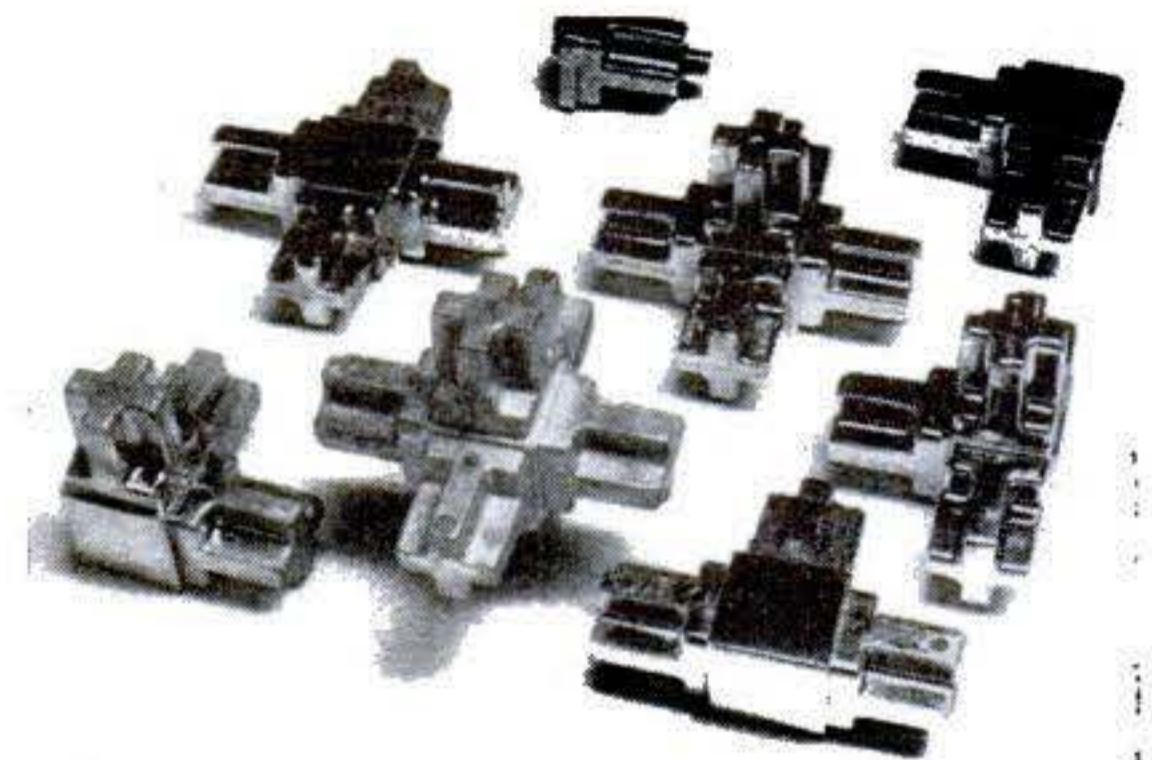




Living room shows off chrome cocktail table, Parsons table with shelf, and four-tier etagere. Company sells all the parts you need, including mallet and glides.



Twelve-inch legs tap easily onto fitting to make cube end table (above, left), while one shot with mallet locks plastic glides in tightly (right).



Eight types of fittings hold DIY chrome furniture together. They come in right angles only.

## CHROME FURNITURE: All You Need's a Mallet

Just tap the fittings in the tubing for "instant" furniture

By DOUGLAS GARR

You're no longer restricted by designers' styles with do-it-yourself chrome furniture. Integral Cubics (a division of Kason Hardware) came up with the bright idea of selling pre-cut tubing, fittings, and glass tabletops—and letting the customer do his own thing.

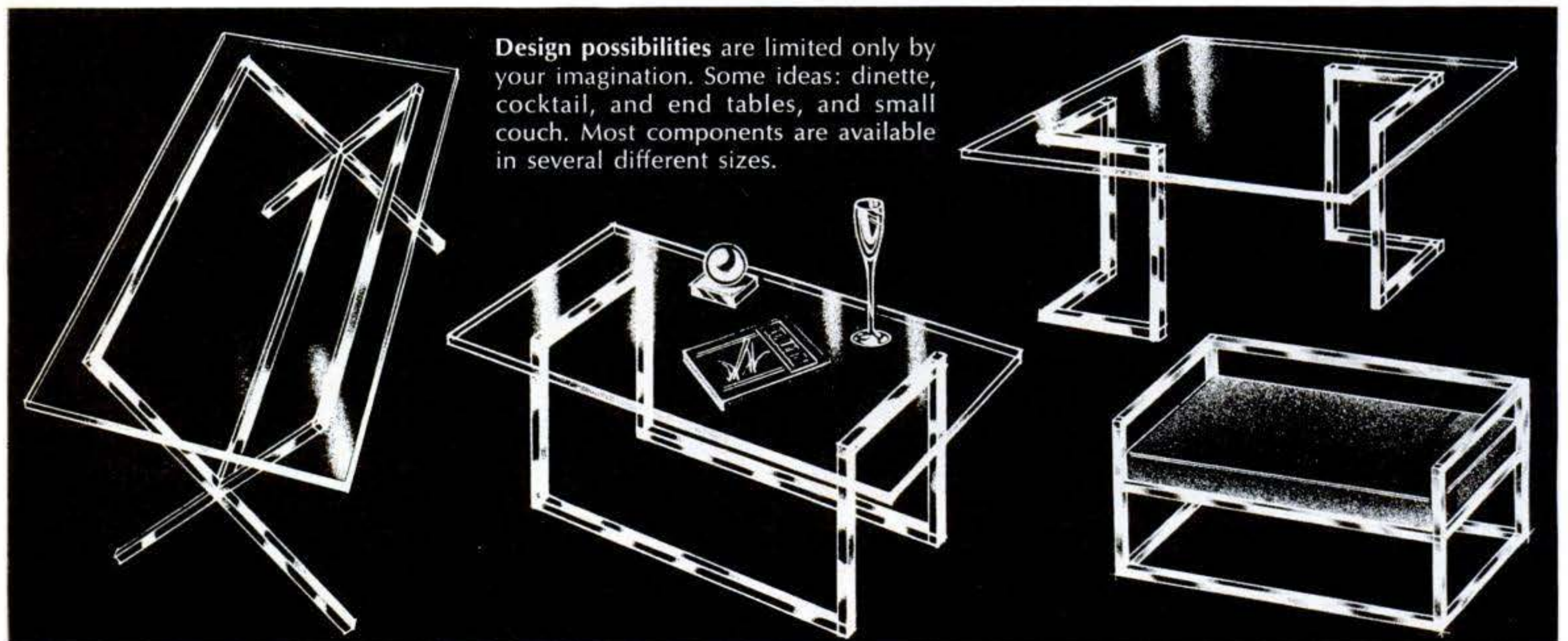
If you're not creative, their catalog shows over 20 different items—cocktail, end, and lamp tables; desks; servers; couches; beds. Ambitious? Try a sofa or bunk bed.

Assembling small tables takes only a few minutes. Just bang the fittings in the tubing with a mallet. Each fitting has soft metal posts; it shears slightly to wedge in snugly when hammered. And the fit *is* tight.

Cost? Chrome has an expensive reputation, but you can save more than 50 percent of retail cost by doing

it yourself. Your savings increase geometrically: The bigger the unit, the greater the percentage saved. Fittings cost about \$2 each, one-inch tubing about \$2 a foot. The triple-plated 16-gauge chrome comes in either one- or 3/4-inch square tubing.

The most expensive component in the furniture is the glass. It's also heavy and costly to ship. Best bet is to buy the glass locally, or use hardboard or plywood instead. Integral Cubics is at 39-06 Crescent St., L.I. City, N.Y. 11101. PS

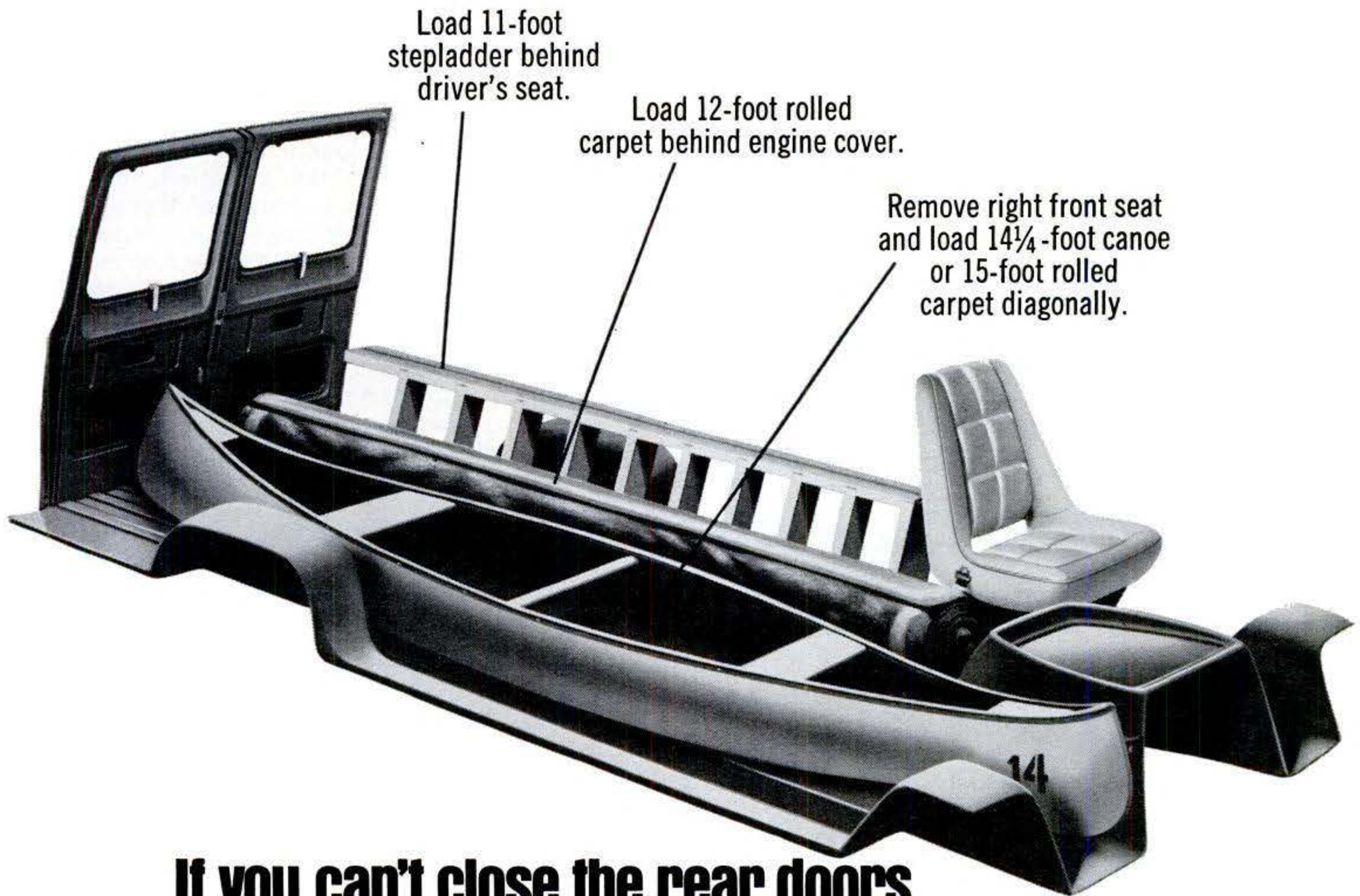


Design possibilities are limited only by your imagination. Some ideas: dinette, cocktail, and end tables, and small couch. Most components are available in several different sizes.



# How to tell which is the largest compact van built in America.

(No matter how you look at it.)



**If you can't close the rear doors,  
you haven't loaded a Dodge Maxivan Strong Box.**

And you'd better get one.

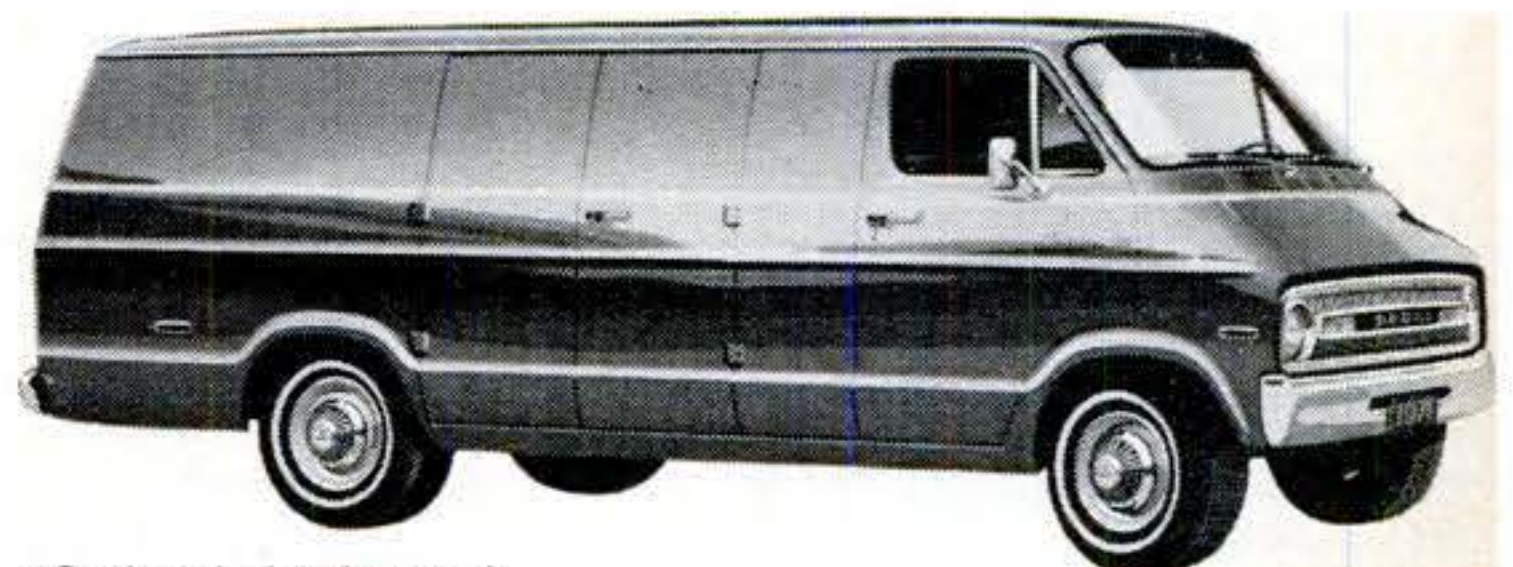
**Dodge Strong Boxes give you a lot more than just more room:** Independent front suspension and longer 127-inch wheelbase mean better handling and ride.  Shorter turning circle. Even with a 127-inch wheelbase, you have greater maneuverability.  Wind-tunnel body and curved windows reduce wind-sway effect.  Front wheels can be inexpensively aligned on passenger-car equipment.  Biggest V8 engine offered. 360 cubic inches.\*  Three-speed TorqueFlite automatic transmission\* with a choice of three engines available on all models.  Integral power steering.\*  Power brakes.  Fresh Air air conditioning\* and exclusive Fresh Air heater provide even flow of clean air. Air is not recirculated.  High-level air intake helps keep incoming air cleaner.  Front passenger's seat does not block side cargo door entrance.  Both front seats are easily adjustable.  Concealed side safety-step offers firm footing since it doesn't collect ice or snow.  Wider front doors and door steps and less wheelhouse intrusion make for easier ins and outs.  Full-foam padded bucket seats up front give softer ride and more comfort.



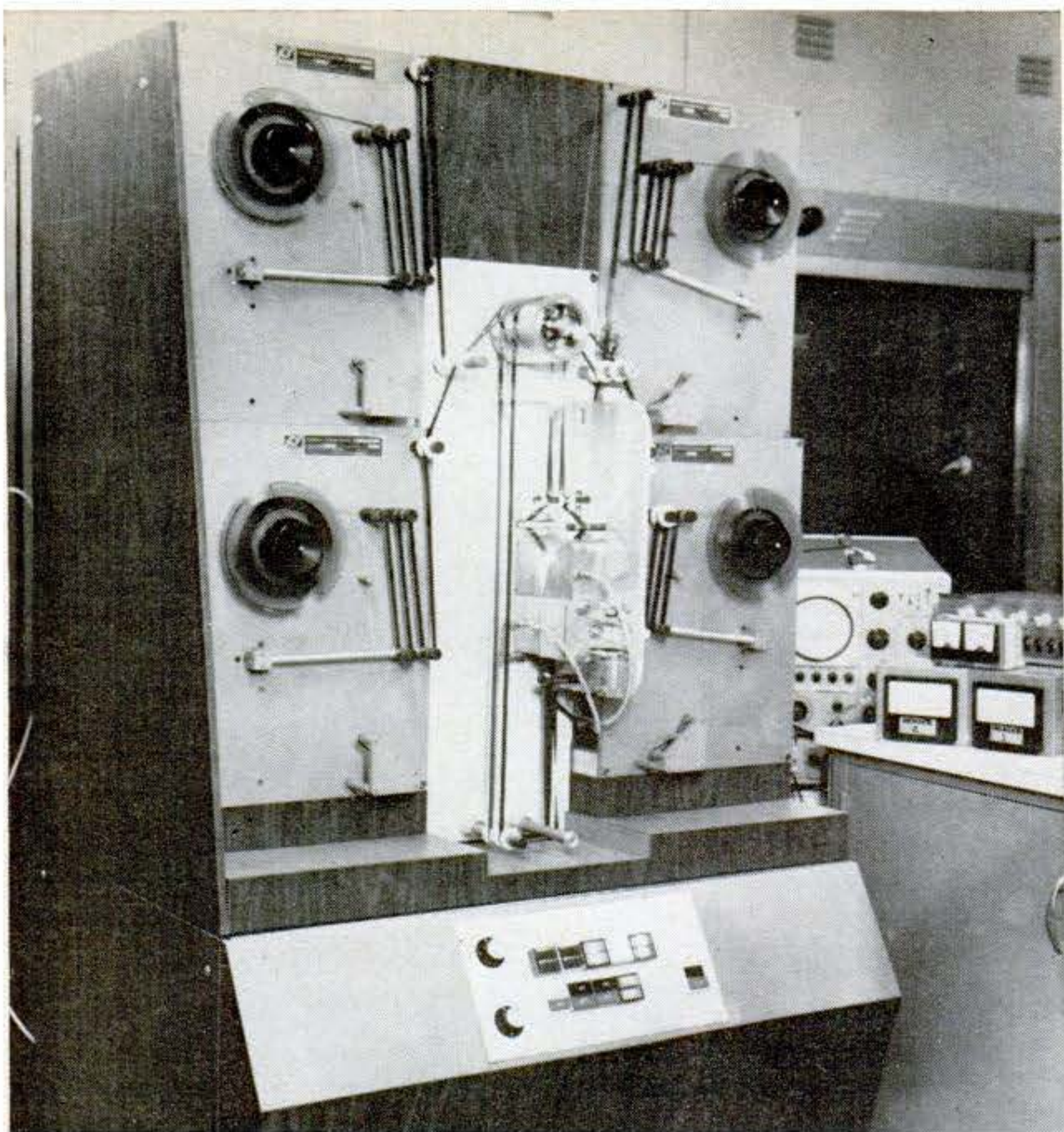
Two-stage door checks conveniently hold doors in two positions.  Biggest gas tank. 26 gallons.  Smaller engine cover is easy to remove for servicing. Also, easier for driver to reach back seats.  Extra rust protection on undersides, doors, and panels.  Large hood opening. Battery, dipstick, and radiator are easy to reach.  Engine can be removed quickly and easily through the front.  And the list continues at your Dodge Dealer's.



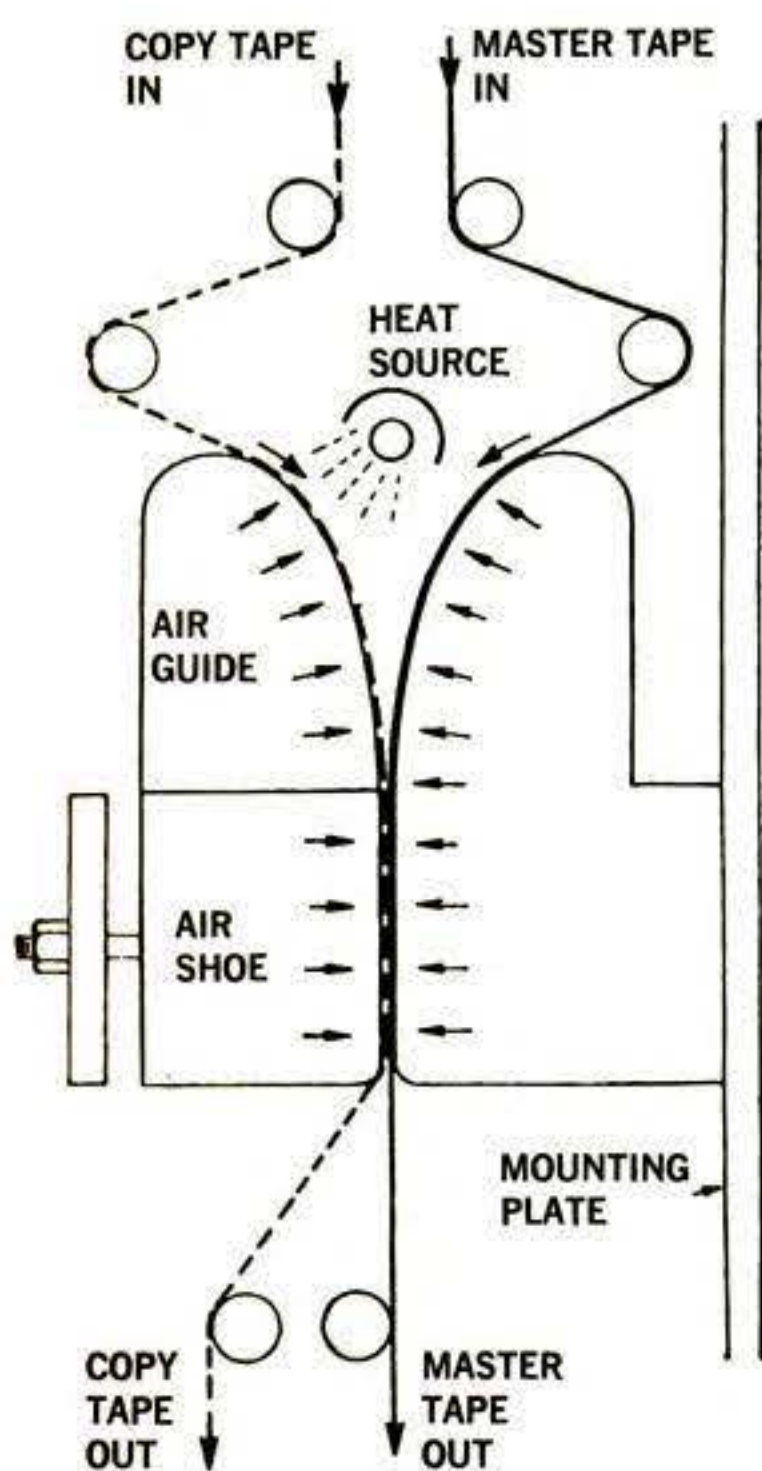
**Dodge Maxivan takes the "packed" out of compact vans!**



\*Optional at extra cost.



Du Pont copier uses heat in place of traditional recorder electronics.

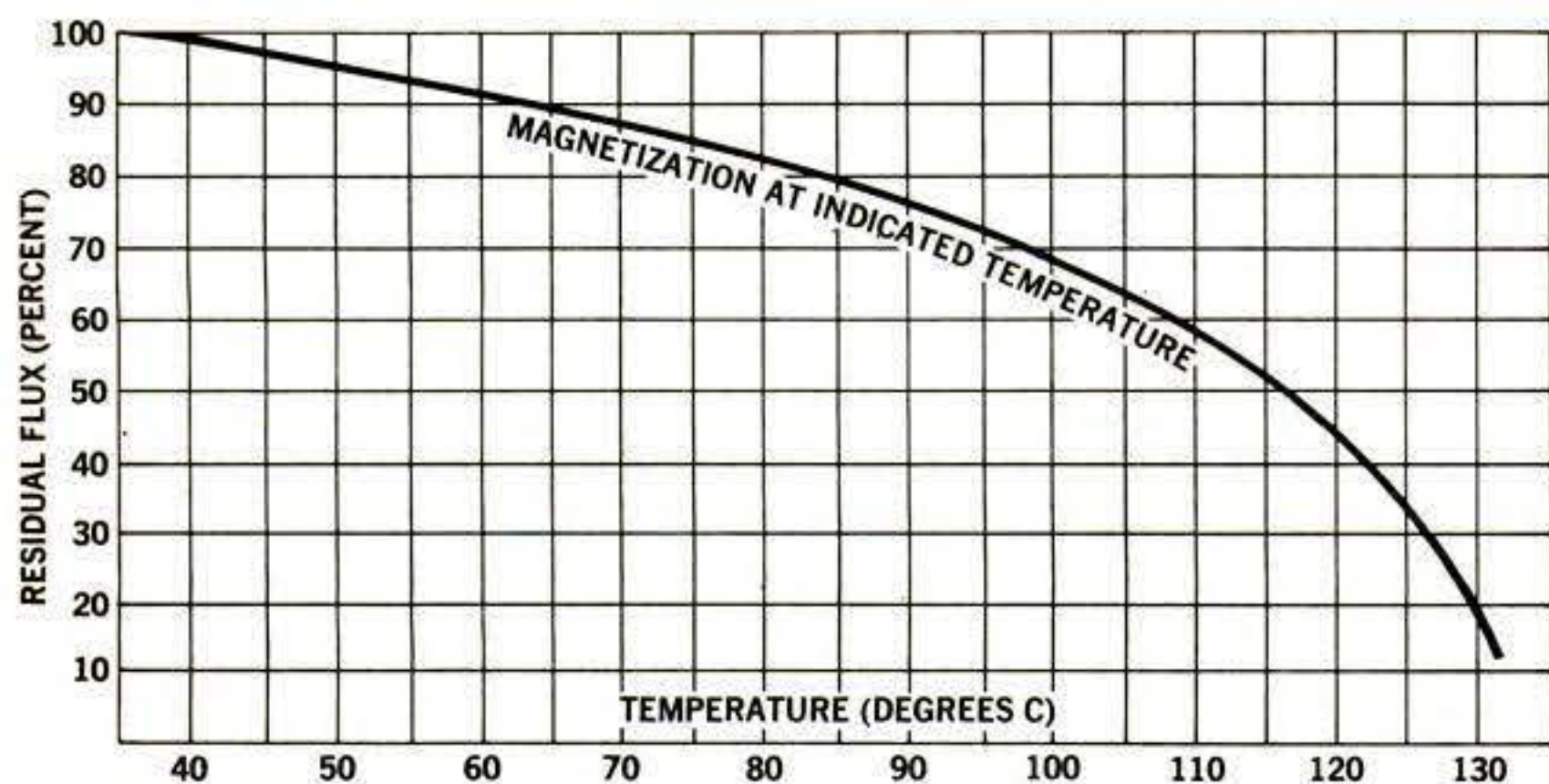


## Faster Way to Copy Video Tape

Thermoremanent copier speeds tape duplication 10 to 15 times over previous methods

By WILLIAM J. HAWKINS  
PS Electronics Editor

Copier is simple in principle, but high speeds demand ultraclose tolerances.



Graph shows change in residual flux (ability to hold charge) with temperature, for Crolyn tape. Curie point (tape demagnetized) is 130 degrees C.

The long-awaited video-cassette player for the home may have received another shot in the armature recently with a new high-speed tape-to-tape copy system developed by du Pont. Called a Thermal-Remanent Magnetic-Tape Duplicator, it's du Pont's answer to the mass-production problems of video cassettes.

Until now, the bottleneck in the production of home video cassettes has been the manufacturer's inability to make duplicate tapes quickly and economically. Master-to-copy time was the same as the playback time of the cassette; half-hour shows took half an hour to reproduce.

Du Pont's copier takes an entirely different approach to the art of recording on tape; you won't see a set of record or playback electronics in the entire package. What you will see is tape whizzing through what appears to be an oversize record head at speeds of 150 inches per second.

What's the trick? The machine takes advantage of an inherent but little-known property of magnetic recording tape called *thermoremanency*.

Thermoremanency takes place when a tape has been heated to its Curie temperature. At this point (the exact temperature depends on the kind of magnetic material), the heated tape loses virtually all residual magnetism. But, once the tape begins to cool from this temperature, a very interesting phenomenon occurs. If cooled in the presence of a very minute magnetic field (tens of oersteds), the tape will again become magnetized, but in proportion to the outside field. On reaching room temperature, the tape becomes stable, with the applied magnetic field now permanently recorded.

In du Pont's duplicator, the copy and master tape first enter the machine from the top through a series of rollers, to remove all slack. The copy tape then zips past 1,000-watt tungsten halogen lamps, where it is heated to its Curie point. Air suction holds the copy and original tapes in place around the air guide into the air shoe, where they are pressed together. The copy, now cooling, acquires the signal from the master tape and exits, along with the master, through the bottom. Each tape is wound on a separate take-up reel.

The duplicator is simple to look at, but, because of high running speeds, requires ultraprecise tolerances.

Iron oxide won't work. Each kind of tape has its own Curie temperature, which is, of course, vital to the process. Iron oxide tape, for example, has a Curie temperature of 575 degrees C. At that temperature, the tape would be permanently damaged from the heat—long before thermoremanency would occur. So du Pont is relying on its own "Crolyn" chromium dioxide tape for use in the new duplicator.

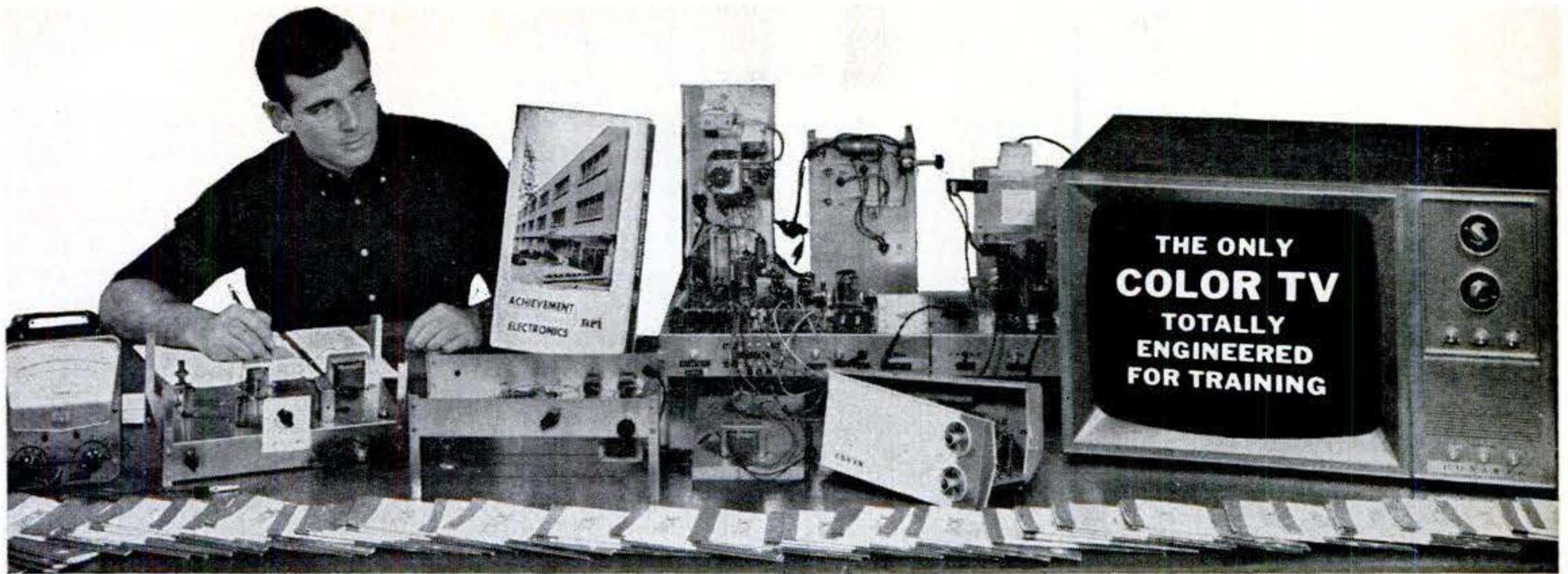
Crolyn has a Curie temperature of only 130 degrees C, and it's completely stable at room temperature. This makes it perfect for use in the high-speed copier.

At present, most of du Pont's emphasis is on the reproduction of video tape, since that's where the biggest tape-duplication problem is. But there is no reason why the process could not also be used to improve the quality of audio-tape reproduction as well.

Du Pont has no plans now for manufacturing the thermal tape system, but will help licensees develop commercial models.

Standardized video-tape cassettes may still be a long way off, but they're one step closer. **PS**

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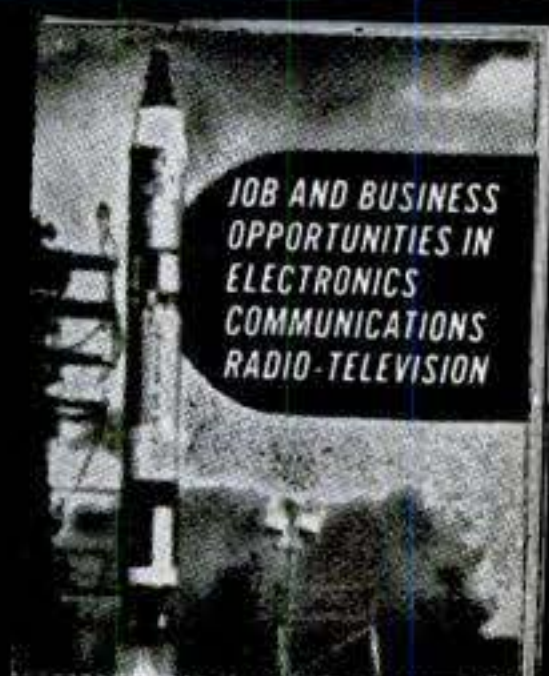
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# Detroit Report...

By JIM DUNNE / PS Detroit Editor



## There's just no stopping that wonder—the Wankel

It has become perfectly clear, inside GM, that there is no stopping the progress of the Wankel engine. General Motors has already spent \$15 million for the rights to the Wankel, and more millions inside the company working on the project. Most important, Ed Cole, GM's president, has put all his prestige and enthusiasm behind the project. Cole, who worked his way to the top through the engineering ranks of Cadillac and Chevrolet, now spends a couple of days each week personally overseeing the work being done on the GM rotary. Under his direction, the company is simultaneously developing the engine, creating automated manufacturing techniques for its production, and working on new car concepts to make full use of its compact size. All this effort will bear fruit by the end of this year when GM will have the capability of producing a small number of prototypes on a semi-automatic engine line that will prove out all systems before full production gets underway. Later mass production may be fully automated.

## All-iron Wankel for lower cost

Early reports out of GM show that the Wankel engine being developed there will be quite different from the Wankels produced by Toyo Kogyo and NSU. GM engineers are working on an all-iron engine, a departure from the practice of building an aluminum engine case sandwiched between two iron end covers. Though this will make the engine slightly heavier—it will eventually weigh out at about the same as the Vega aluminum four—the cost of casting and machining the nodular iron will be much less than that for the aluminum design. GM plans to build the engine with a single spark plug for each of its two rotors. This design is still being worked out, but the savings inherent in a single plug are just too great for the company to settle for the two-plug design used by Mazda. Also under consideration is an electronic fuel-injection system that will aid in controlling emissions. General Motors has almost settled on a two-rotor design for all its Wankels, making a large rotor for its higher-power engine, a smaller one for the low-power versions that are slated for the Vega-size car.

## Aluminum for lightweight bumpers

Aluminum companies have long hoped for a breakthrough that will put their product in automobile bumpers, and it looks as if they will finally get their wish when the 1973 Ford models are introduced. At least they will be halfway home. Ford plans to build a combination steel-aluminum bumper for its full-size cars that will take advantage of the strength of steel and at the same time make use of the lightweight characteristics of aluminum. The Ford design will have a chromed faceplate backed up by a U-shaped bar of aluminum. The two parts will be bolted together to form a very strong box, one that

will easily withstand the required five-mph barrier crash, and then some, without damage. One reason for bolting the bumper parts together is to reduce the cost of repairs. If the faceplate is damaged in a low-speed collision, the owner need not replace the complete bumper assembly—a new faceplate alone will make the system as good as new.

## Cushioning the impact

It is likely that GM will have a number of different systems for its five-mph front bumpers when the 1973 models are introduced this year. GM's prime design uses two shock-absorber-type telescoping devices that its Delco Division developed. These will be used on all 115-inch and longer wheel-base models that GM produces—intermediate-size cars on up. In the smaller cars though, a number of different designs are being considered, including the Pontiac and Oldsmobile systems used on the 1972 full-size cars. Because of their lighter mass, the smaller cars do not need the expensive shock absorbers, so the individual GM divisions will be free to come up with their own designs. Delco's units permit the jacking or towing of the car without damage. They will be used only on the front bumper of the 1973s, but are expected to be used both front and rear in 1974 when the safety requirements are expanded.

## Air-bag problems licked

Allied Chemical, a supplier of seat belts to the automotive industry and one of the leading developers of air bags for cars of the future, claims that present seat-belt systems can be harmful to passengers in accidents equal to 30-mph barrier crashes. Air bags, on the other hand, offer good protection to passengers in accidents far above the 30-mph level. Allied is currently supplying 500 air-bag systems to Ford for prototype testing in

the company's fleet cars. These new bags are designed to overcome most of the faults revealed in the original bag designs. Noise levels are lower, the "standing child" is no longer injured, the pressure of the stored gas is lowered from 3,500 to 2,300 psi, tailored bag designs offer equal protection in all sizes of cars, and the bags do not block driver vision nor cause the driver to lose control of the car.

## Drive by computer

By now the auto makers are convinced that the car of the future will have to have its own computer if all the electronic wizardry that will bring on safer, more pleasant driving is going to be carried on board. GM has an experimental car equipped with a computer that gives a hint of what to expect in a car of the later 1970s. Among the computer-controlled items on this special car are: antiskid brakes, voltage regulator, headlamp dimmer, speed control, windshield wipers, engine speed governor, fuel injection, electronic ignition, and window defroster. All these are available on today's cars, but they have individual controls performing duplicate jobs. With the computer, one nerve center would take care of all logic functions. Additional items that the computer will be called on to control are: heating and air conditioning, ignition lock, drunk test, diagnostic equipment, fuel economy, computer, door locks, air-bag warning, gauges on the instrument panel, transmission shifting, acceleration inhibitor, and automatic braking. This is not pipe-dream stuff. You'll see it on production cars before 1980.

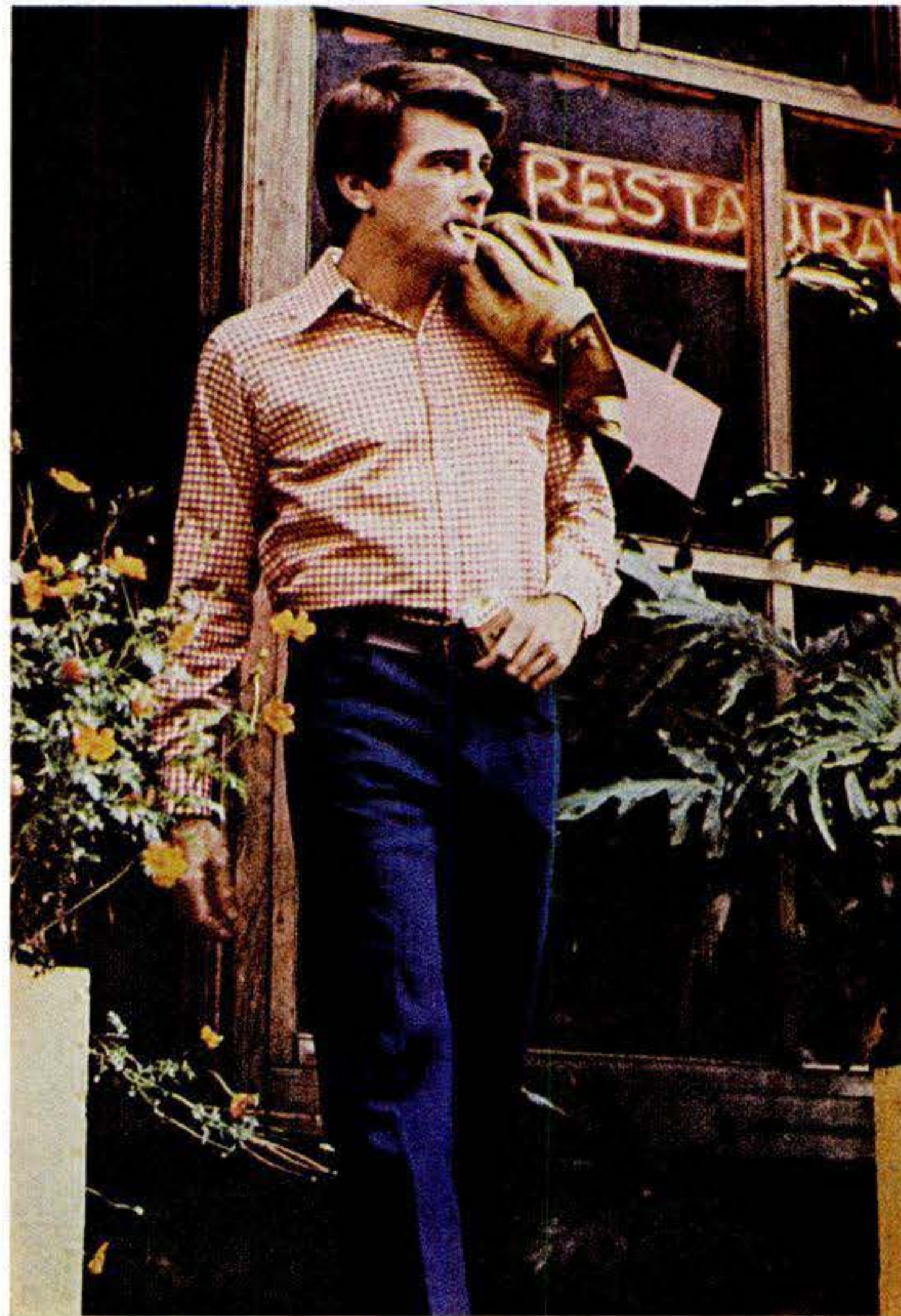
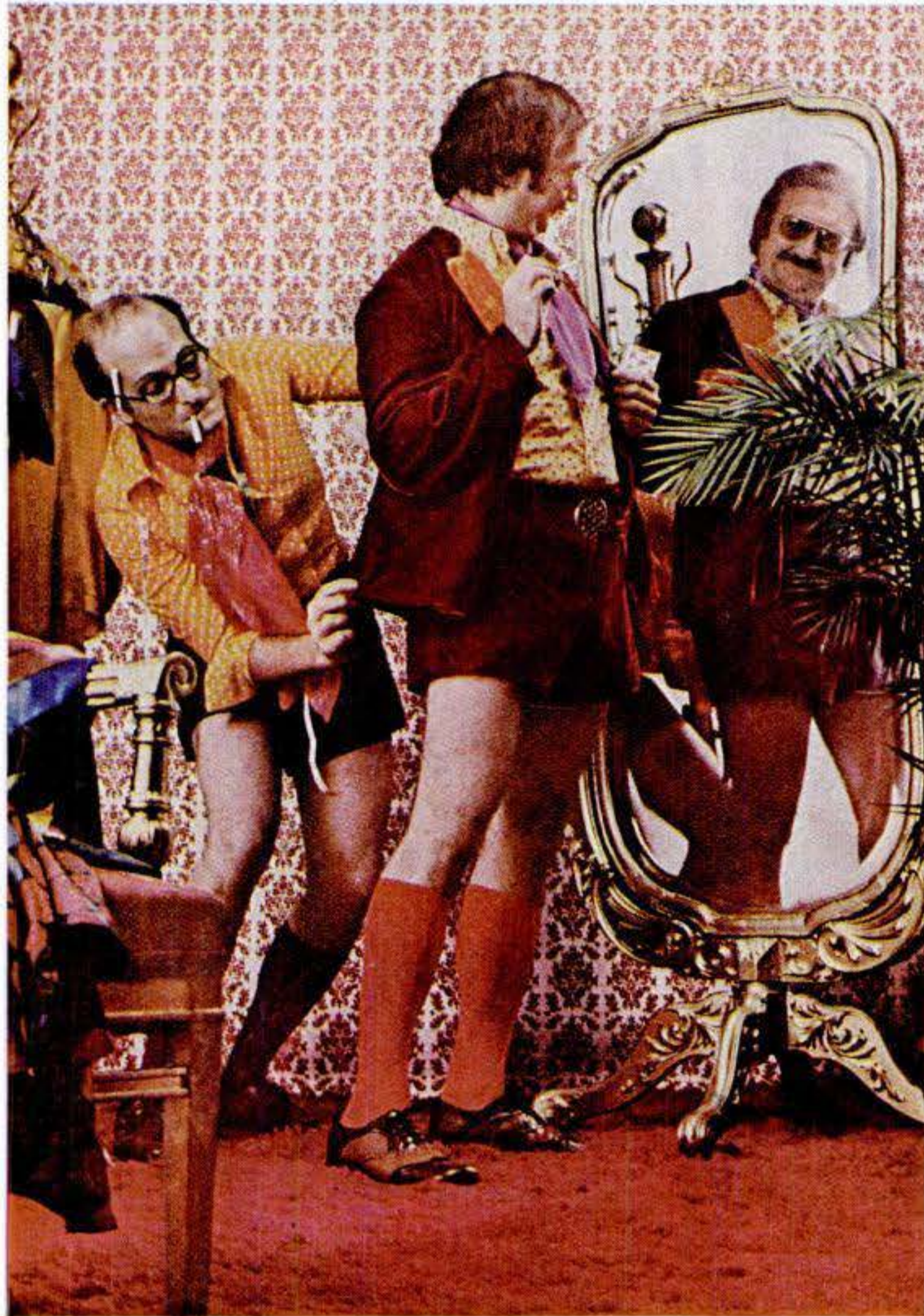
## 1973 changes in styling

Styling changes will be widespread in the 1973 models, proving once again that Detroit is not giving up on the idea as a basic precept of the automobile business. Ford has scheduled all-new bodies for its full-size Fords and Mercurys. Chrysler will make roof and deck changes in the intermediate and full-size lines. American Motors' Gremlin and Hornet will have new lower body panels to make the cars appear leaner than present styles, and a hatchback model will be added to the Hornet line. GM, which skipped major changes in 1972, will have the greatest number of new bodies. The intermediate models will be completely restyled. A new hatchback model will be added to the compact lines. This body will be introduced by Oldsmobile when its new compact line is unveiled, then Chevy and Pontiac will show their versions shortly afterward. Also scheduled for complete styling changes are the Monte Carlo and Grand Prix. GM plans three models in the Chevy and Pontiac intermediates, a two-door, four-door and station wagon. Olds and Buick will have four models with a formal roof two-door as an added body in the intermediate line. Also, the new protective bumpers will be required on all 1973 automobiles. P 5

With every pair of Mr. Stanley's Hot Pants goes a free pack of short-short filter cigarettes.

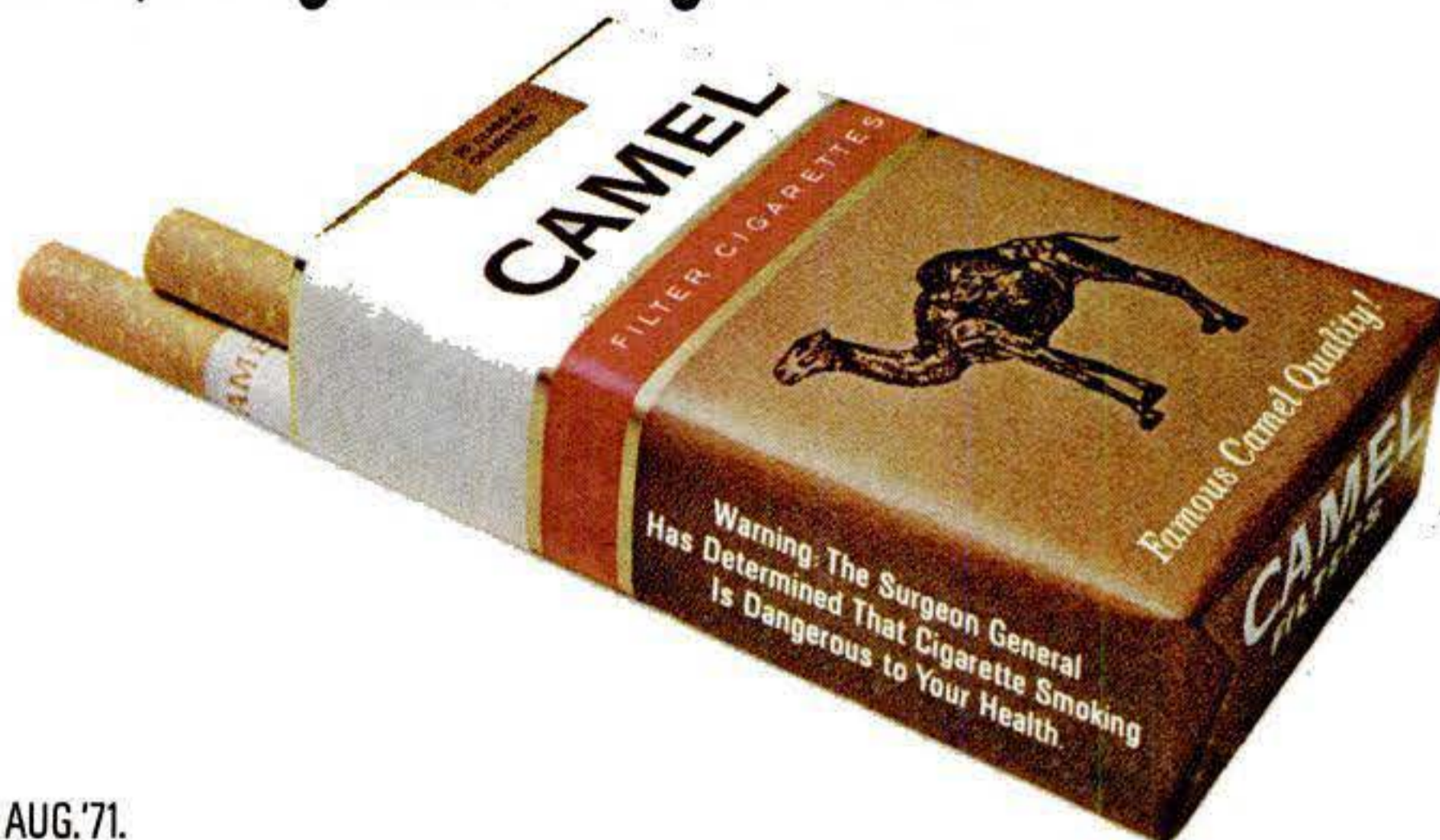
Now everybody will be wearing hot pants and smoking short-short filter cigarettes

...almost everybody.



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



20 mg. "tar," 1.3 mg. nicotine av. per cigarette, FTC Report AUG.'71.

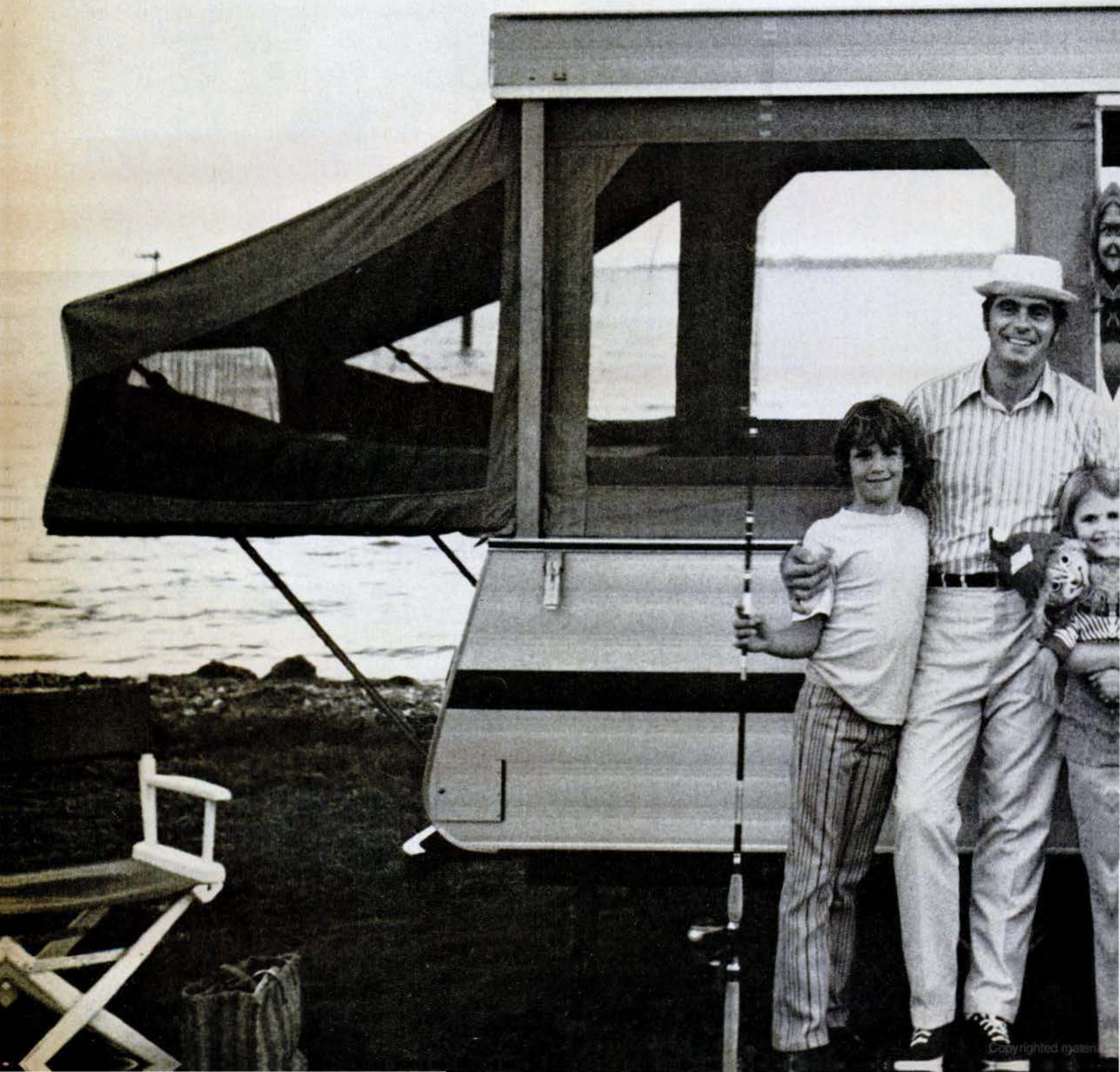
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# Our competition is

**4th best selling camper.** These people know you need more storage room in your camper than you've been getting. So they added a wardrobe closet like ours to give them the second largest storage capacity in the industry. Who was the first? Starcraft. **7th best selling camper.** Someone at the 7th best selling camper noticed what happens to

campers when they're backed into trees. Crunch. So they built a strong, steel bumper to their camper frames. The fact that Starcraft had it first means we've had more time to improve it. **3rd best selling camper.** How can you run the same appliances off your car battery as campground outlets? Number three found the solu-

tion in a Starcraft. A 110/12 volt converter system. But they haven't found a way yet to make one so good that it passes all the states' codes like ours. **2nd best selling camper.** Taking pity on the camper's wife, our friends at number two raised the working height of their kitchens from 28" to 35." One year after we at Starcraft



# getting the best of us.

did it first. **5th best selling camper.** You don't have to crank up the fifth best seller to get at the ice box. Because they've located it opposite a door on the side. The same place we put ours the year before. Convenient. **6th best selling camper.** The best lift mechanism in the business lets you set up your camper

in less than five minutes. The number six camping trailer thought it was so far ahead of all the others they bought rights to use it from the people who invented it. Starcraft.

**Starcraft.** Some of our competitors have some of our features. None have all. Maybe that's why we're the number one selling camping trailer. Some

features are so new that the competition hasn't had time to duplicate them yet. Like our ceiling mounted lights, side trunks, convertor lighting and roof vents. If they add them next year, fine. By that time we'll be a year ahead again. Write for your free catalog. Starcraft Company, Dept. 2PS-3 Goshen, Ind. 46526

**What the others should be a Starcraft is.**



**STARCRAFT**

Campers · Boats · Travel Trailers · Motor



# The View Down the Road

...news and comment on cars and driving

By JAN P. NORBYE / PS Automotive Editor

## And the winner is . . .

It is becoming clearer and clearer that you can look to the gas turbine as the long-term solution for clean-air cars. General Motors has practically said so in a recent report that demonstrates the turbine's superiority over any steam engines GM has built or tested.

What's more, GM has just consolidated all its passenger-car turbine activities into a single task force headed by Tibor Nagey, who was director of gas-turbine research at Detroit Diesel-Allison in Indianapolis. If you remember, it was back in 1966 that GM felt its turbine research had progressed to the point where the development program could be transferred from the central staff to an operating division. So the gas turbine went to Detroit Diesel (later merged with Allison) for development of a heavy-truck turbine engine. This power plant is now ready for production for industrial uses—including truck installation—but GMC and Chevrolet have not yet adopted it.

In the meantime, the top turbine men at GM decided that the passenger-car field could become even more important, and management acted on their recommendations. Don't forget that during the past five to six years, GM Research has been working closely with Williams Research Corp.—builders of the New York City clean-air turbine car [PS, Nov. '71]. The contract with Williams calls for design, construction, and delivery to GM of prototype passenger-car gas turbines. Of course, this doesn't mean you can go out and buy a turbine-powered Impala—not tomorrow, and probably not for five to eight years. It may be even further away. After a satisfactory prototype engine has been developed, production engineers take over, and they'll need three to five years. You can expect turbine cars to be phased in from 1978 onwards.

## What will GM build in the meantime?

That's where the Wankel engine comes in. It will need some of the same antipollution equipment as the V8, but is basically cheaper to produce and offers more room for ancillary equipment around it. It's not a long-term solution, but it can be made to meet 1975 and '76 standards—and fill the gap until the turbine is ready.

GM is forging ahead on its Wan-

kel plans, and the supplier industries are preparing for the switch. The machine-tool industry quickly saw a challenge in devising production equipment for the Wankel. The Cross Co. of Fraser, Mich., says it has now developed methods for machining both the rotor and the engine casing. Moore Special Tool Co. of Bridgeport, Conn., has invented new precision machines suitable for either pilot production or mass production. And the Gleason Works of Rochester, N.Y., has developed both a trochoid generating grinder and a trochoid milling machine, both offering high productivity with high-quality bore surfaces. Gleason also looked at the problem of machining the curved grooves for rotor side seals, and solved it by modifying a hypoid gear machine equipped with special cutters.

## What will Ford and Chrysler do?

Both are preparing Wankel engines. Ford has a technical agreement through its German subsidiary, and hopes to get access to Toyo Kogyo's know-how by buying stock in that company. Chrysler has long been negotiating with Curtiss-Wright. As for American Motors, they will buy Wankel engines from GM. The point is that while Ford and Chrysler are slow in making their own preparations for Wankel-engine production, a whole new industry is being created around them, making parts and tools that they will need, but won't have to invent themselves. This will shorten their lead time, and the introduction of Wankel-powered cars from Ford and Chrysler may not lag very far behind GM.

## Why no antiskid brakes on pickups?

In this month's Norbye/Dunne Report, we complain of rear-wheel locking on pickup trucks when running unloaded or with a moderate load. The problem is that fixed front/rear brake-effectiveness ratios are badly suited for the high load variations that are common in light trucks.

We recommend antilocking rear brakes as standard, and as proof of what they do we ran an International Travelall through our full brake test—with no extra load. With cool brakes at 60 mph, it stopped in 165.4 feet. With hot brakes, 173.9 feet. Rear-wheel locking was effectively prevented by the antiskid system, a Bendix product offered as

optional equipment by International (but not yet on pickup trucks). It detects incipient wheel locking, and releases and reapplies the rear-wheel brakes in rapid cycles. This assures complete stability in the vehicle and provides the driver with an important safety feature.

## Octane: a new numbers game

This month your local gas station will begin posting the octane rating of its fuels right on the pumps. This will help you avoid buying more expensive gas with higher octane ratings than your engine needs.

Well—that's the idea, anyway. In practice it's not so simple. Last November I explained the difference between the Motor and Research methods of setting octane ratings. Current owner's manuals list octane requirement in Research numbers. The pumps won't have Research numbers on them because they're not a true indication of a fuel's anti-knock properties. The Motor method is much better, but has wide discrepancies from the traditional Research method. So the pumps won't carry Motor numbers, either. The number they will carry represents an average:  $(M+R)/2$ . You add the Motor and Research numbers, and divide by two.

Texaco proposed this Alexandrian solution, and the other oil companies got behind it, and the Federal Trade Commission approved it. Of course, you still don't know what octane your engine needs. Until the auto makers tell us, all you can do is test for yourself. Buy lower and lower octane until your engine starts to ping under load. Then go back up a couple of points.

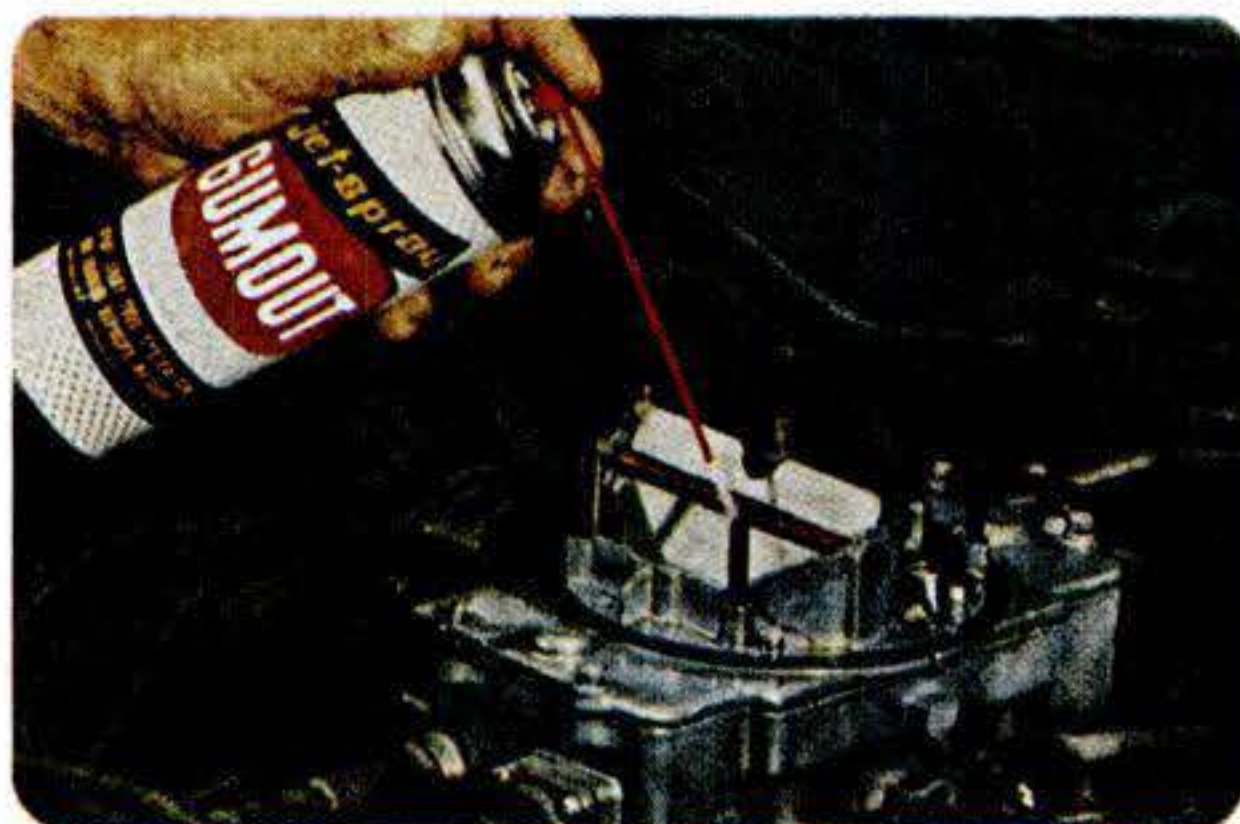
## The city car of the future

It may well be electric. I reported in January that Citroën is working on an electric car in cooperation with Total. Now Volkswagen has started an electric city-car project in association with the Rhine-Westphalia Electric Co. The first prototype will be a van for local use, with a top speed of 45 mph and a range of about 60 miles. VW wants to use normal lead-acid batteries, but develop easy replacement methods. After tests with 10 to 20 prototypes, VW intends to build a preproduction series of 200 cars in 1974. Meanwhile, the service industries ought to take steps toward catering to needs of electric cars for battery exchanges, and/or recharging. **PS**

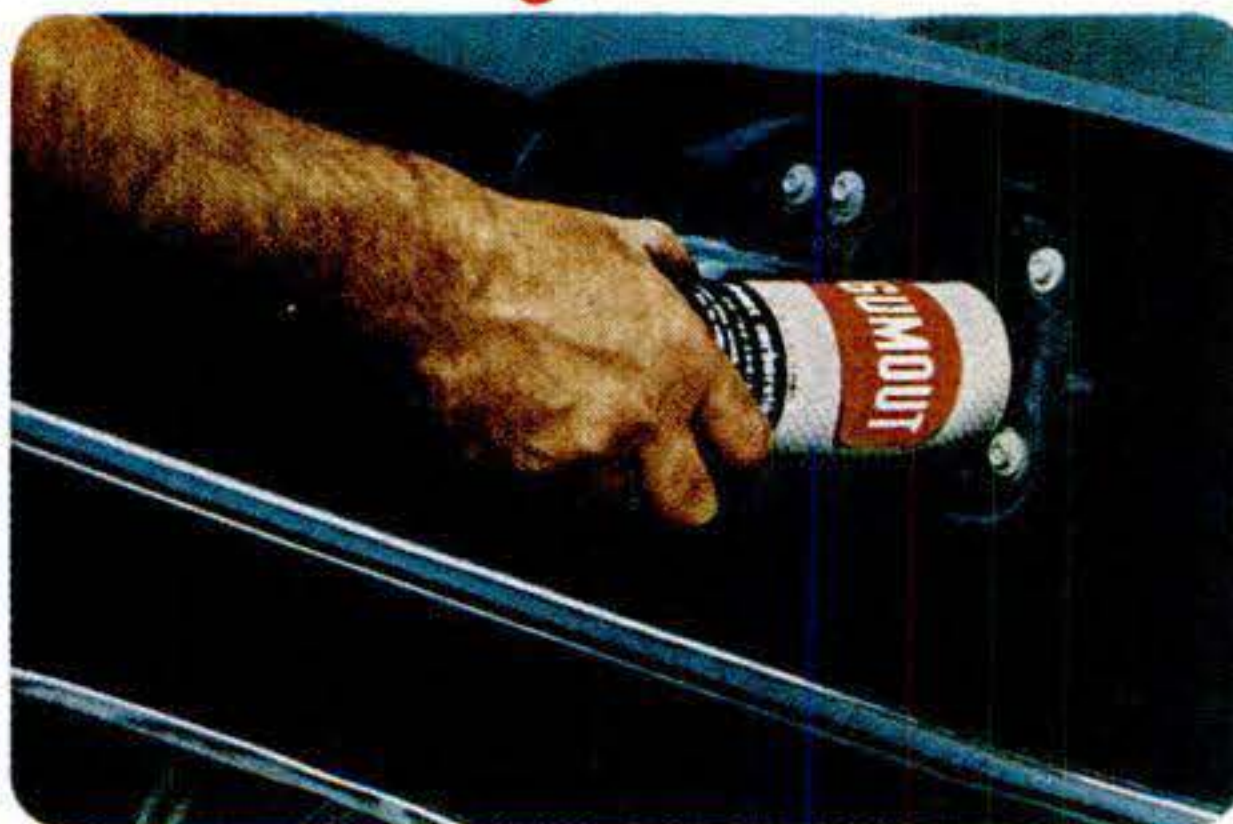


# The clean team

Take a typically  
dirty carburetor (like  
yours maybe) clean  
it...and get easier starting,  
smoother idling, no stalling, faster  
take-offs and better mileage.



**1** Clean it outside in seconds with Jet-Spray Gumout. Takes less than a minute to get this! Throat, choke valve, linkage, throttle plate—all clean like new. Grime and gum that can foul up the carburetor's job are gone. Completely.



**2** Now pour a pint of Gumout in your gas tank. It does the same great job inside your carburetor as you drive. Cleans out all the jets and passages, removes the gum and varnish.

**GUMOUT** Division  
PENNSYLVANIA REFINING COMPANY, Cleveland, Ohio 44104

# Chevrolet. Building a better way to see the U.S.A.



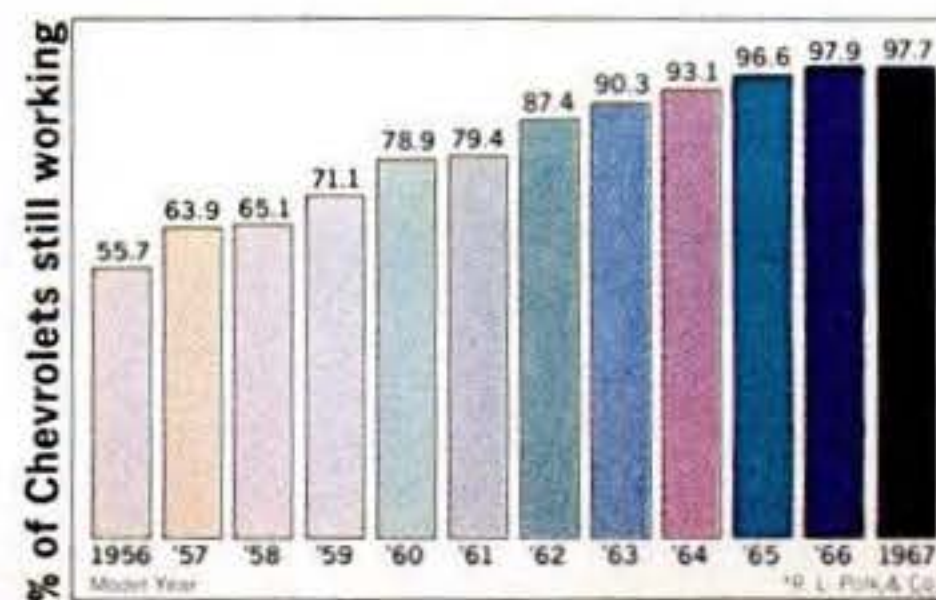
*4-wheel-drive Blazers at Good Harbor Beach, Massachusetts.*

## '72 Chevy Blazer. Because the good places start where the good roads end.

Blazer just happens to be the toughest, roomiest, widest track runabout of them all.

Just happens to come from a family of trucks that last longer, too. Take a look at the chart at right. It shows that over 55% of Chevy's 1956 model trucks are still working.

No other make has even half. Blazer. Your best bet for the good places. For a good long time.



# PS: What's News...

## Keeping You Posted from Behind the Scenes

**O**ur cover story this month is in response to a number of reader queries about towing a trailer with a small car. Even though more people are choosing smaller cars every year, the recreation industry seems to be ignoring this trend. The choice of suitable trailers is limited, and the best advice available from most rec-vehicle dealers seems to be, "Get a bigger car."

At the National Recreation Vehicle Show in Louisville last December, I walked through acres of new rec vehicles on display and talked to dozens of exhibitors. Over 110 manufacturers were represented. It was obvious that the "bigger is better" attitude dominates the industry. Motor homes, travel trailers, pickup campers, tent trailers—with few exceptions the main distinction in the new models over last year's is that they are bigger.

If you'd prefer a quality product with ingenious design wrapped in a small package, let me hear from you. I'll see that the right people hear your ideas.

### "The Fine Art of Mating a Camper and Pickup"

The story with that title, which appeared in *POPULAR SCIENCE* last March, earned author Jerry Copeland the second-place award in the magazine category of the Press Awards Program co-sponsored by the Recreational Vehicle Institute and the Outdoor Writers Association.

### The world's largest radio-radar telescope

The 1,000-foot-diameter antenna reflector at the National Astronomy and Ionosphere Center [*PS*, June '69, p. 72] in Arecibo, Puerto Rico, is getting a retread. When the renovation is completed, radio astronomers will be able to "see" with a hundred times greater precision. By replacing the steel-wire mesh surface of the reflector with 37,000 adjustable aluminum panels, they will be able to operate the antenna at much shorter wavelengths—the shorter the wavelength of the radio waves employed, the finer the detail that can be observed. For example, astronomers will be able to study details on Venus (26,000,000 miles from Earth) with the same accuracy they now enjoy in studying the moon (240,000 miles from Earth).

### Using space technology on Earthly problems

NASA is seeking promising ideas that will demonstrate possible applications of NASA-developed technology to public problems. The idea is to accelerate the spread of space-related technology to help solve everyday problems of air pollution, water pollution, solid-waste management, and clinical medicine. They've received more than 250 proposals, which will be reviewed by teams of experts. One or more projects in each subject may be selected for the award of a contract.

### Color from black-and-white film

Prodded by a newspaper clipping sent in by a reader, we checked out the report that color telecasts were being made from black-and-white film over the North Bergen (N.J.) Cable Television sys-

tem. We had an article on such a process in our July '69 issue, but had heard no further from the company that developed it. As it turns out, it's the same system being used, and the original company—Technical Operations, Inc.—is now part of a larger corporation named ABTO, Inc. The CATV system has been telecasting color from black-and-white film since October '71—mostly for covering local sports and news. While the system is not likely to revolutionize network TV, it's a great boon to local stations and cable operators. It costs about half as much as shooting with color film, according to a spokesman for ABTO. The film is processed just like any other black-and-white film—the secret of the system is in the special camera lens and the color-decoding projector back at the TV studio.

### Biggest atom smasher—the gamble pays off

When the mile-diameter proton accelerator in Batavia, Ill., was being planned [*PS*, Oct. '70], funds were slashed from \$350 to \$250 million. It looked as though the world's biggest atom smasher might be scuttled before it got off the drawing boards. So the project director, Dr. Robert Wilson, devised a bold but risky plan to stay in business. He would cut corners and shave tolerances—but go for the big target.

A few months ago the beam was turned on for the first time—and there was trouble. Many of the magnets used to focus and direct the proton beam blew out. Moisture had condensed on the magnets—partly because air conditioning had been among the frills eliminated.

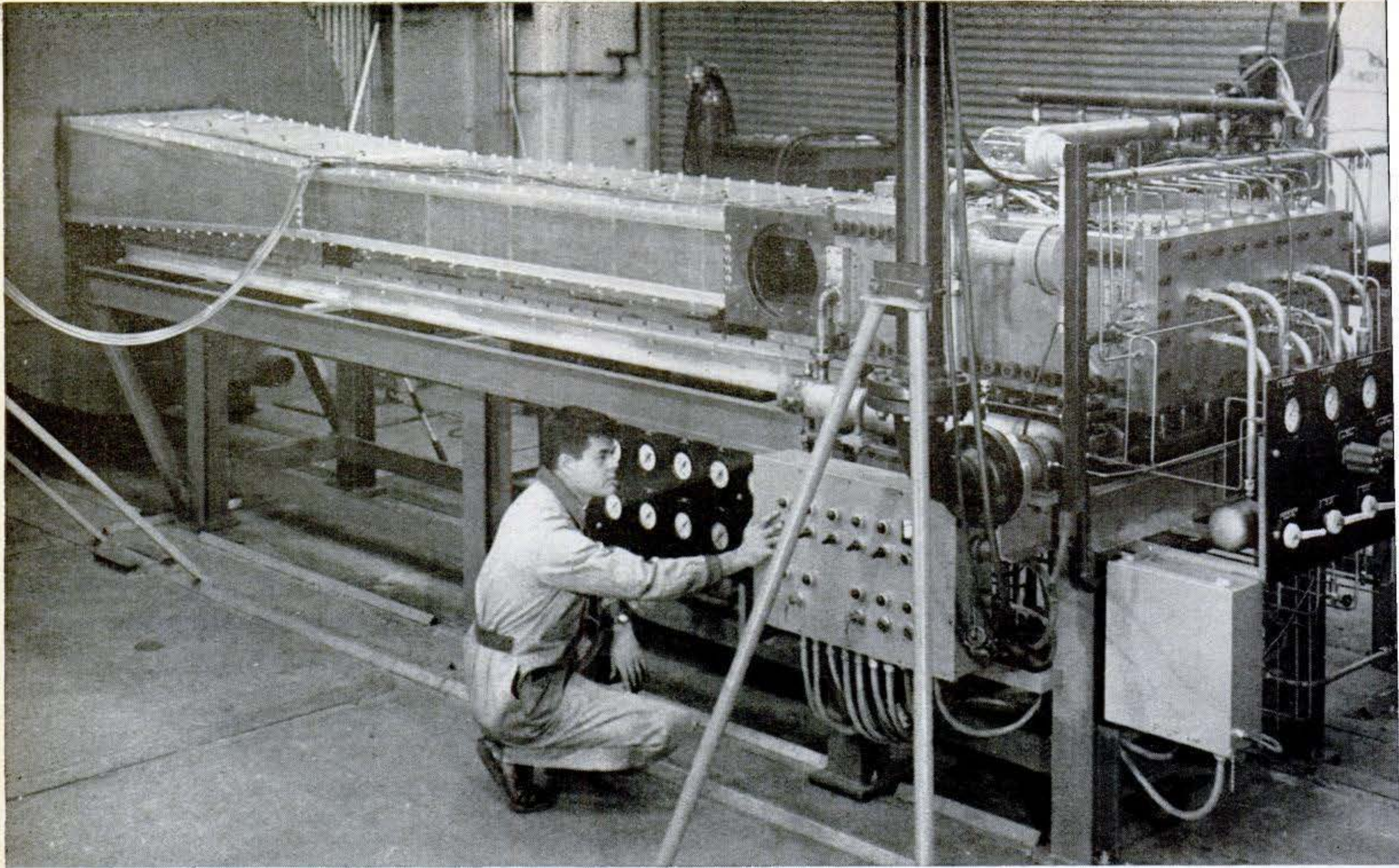
Last winter, with more than one-third of the 1,000 magnets replaced, the water problem seemed about over. But another problem developed: The proton beam would decay after about a half second. Scientific detective work revealed this situation: In cutting the acceleration tube to replace the magnets, workmen had accidentally left metal slivers where they could later interfere with the protons racing around the machine. So scientists built a plunger filled with plastic diaphragms and swept it through the four miles of pipe several times, each time coming up with bunches of slivers.

The situation is better, but the beam is still decaying too fast. Two possibilities: There may still be slivers hanging around, or there may be too many heavy molecules in the near-vacuum of the tube. The latter should clear up with time.

Despite these hitches, Wilson's overall gamble seems to be succeeding. Original target for full-power operation was July 1, 1972. It seems almost certain that the date will be met. Most astonishing, total cost will be about \$200 million—\$50 million less than original estimates. Obviously pleased, Deputy Director E. L. Goldwasser recently told me they're planning to use the leftover \$50 million for additional experimental areas. It's nice to hear of an instance where we're actually getting *more* for our money than we thought.

*Hubert P. Luskett*

Editor-in-Chief



### Gas-dynamic laser—best weapon bet?

Lasers work by “pumping” atoms or molecules to a high-energy state. The atoms decay to the normal state and get rid of excess energy by “lasing”—giving off laser light. Most lasers are pumped

with light or electrical energy. The gas-dynamic laser uses heat. Burners are similar to rocket engines. The heated gases (nitrogen, helium, or carbon dioxide) expand tremendously and rush out through the rocket-like nozzles at supersonic speed. In the nozzles, the gases suddenly expand and cool. Through a complex

# LASER WEAPONS—

**For a decade defense planners have desperately sought a laser heat weapon. Here’s the untold story of our secret—and successful—research program**

By **NELSON ALBRIGHT** ILLUSTRATIONS BY RAY PIOCH

“The Incredible Laser,” read the fading title page of a Sunday supplement taped to a sun-drenched office door at Hughes Aircraft Company’s posh research laboratories overlooking the crystal blue Pacific at Malibu. The picture showed a beam of light emerging from the barrel of a cannon—an obvious allusion nearly 10 years ago to the fictional notion of a laser “death ray.” Beneath the title was scribbled the reply: “For the Credible Laser, See Inside.”

The scientist-author of the gibe would have scoffed at any suggestion that within a decade these quiet hill-top laboratories where the world’s first laser was coaxed into life only 12 years ago would be trying to help

make that “incredible laser” come true. Yet this is exactly what has happened as Hughes Aircraft and many other research organizations have become involved in one of the most revolutionary technological dramas in American history—the development of the laser radiation weapon.

### We’re close to the goal

While laser-weapon development projects are supersecret, some notion of progress to date can be glimpsed by putting together bits from here and there. For example:

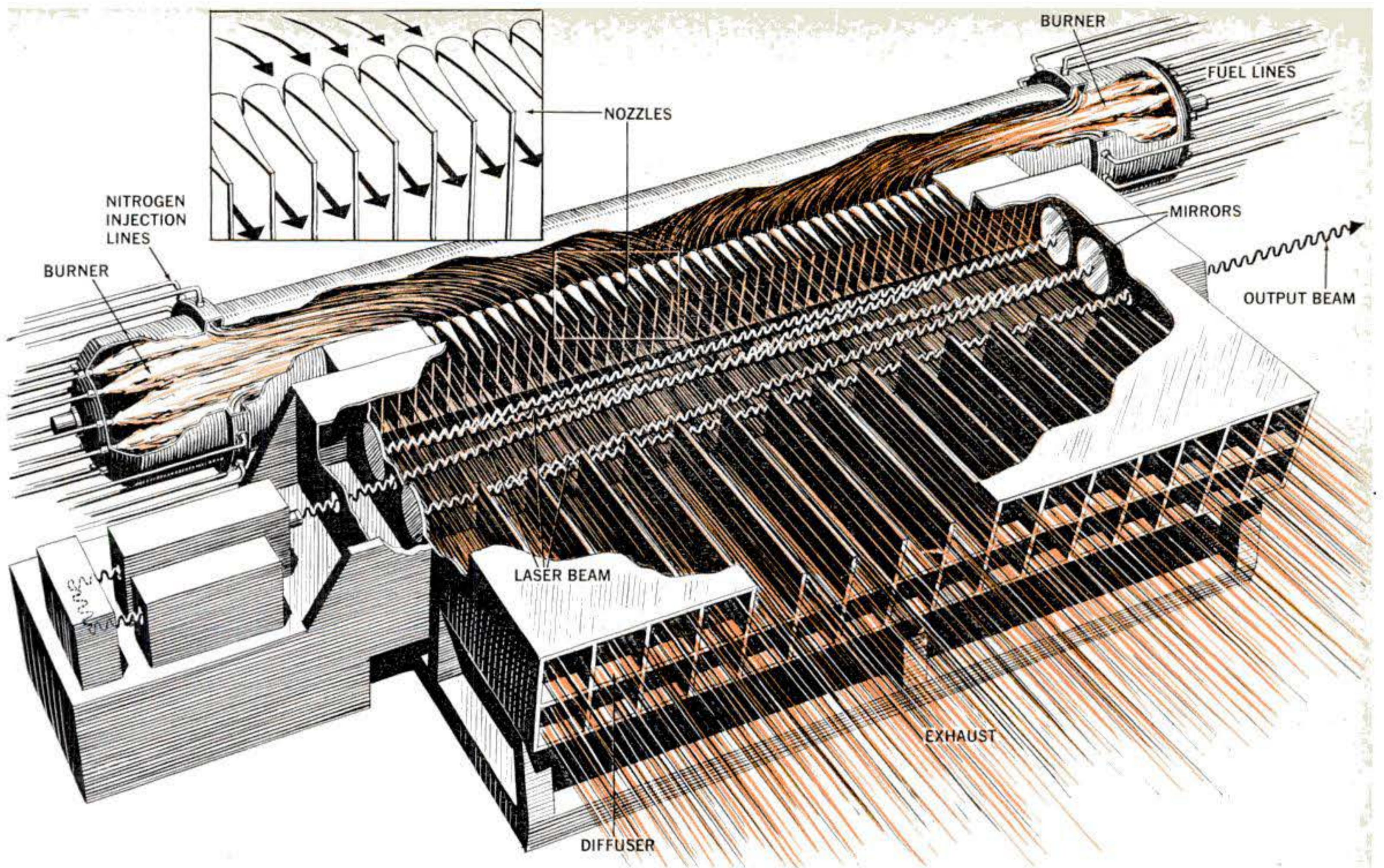
- Brig. Gen. Robert M. White, Commander of the Flight Test Center at Edwards Air Force Base, told

a meeting of experimental test pilots in Beverly Hills last September that the Pentagon is backing the search for laser weapons much as it did the development of the atomic bomb in World War II or the ICBM in the late 1950s.

- A Commerce Department publication that lists contracts recently listed one between the Air Force and developers of the new B-1 bomber. It calls for an investigation into the possibility of using a laser to defend the bomber against fighters.

- A similar weapon is under study for the Air Force’s upcoming F-15 air-superiority fighter. Vice Admiral Thomas J. Walker, head of naval air forces in the Pacific, at the same meeting addressed by General White, called these “Buck Rogers-ish weapons” potential successors to the 20mm gun of naval aircraft in Vietnam.

- Details are secret, but it has been learned that military researchers have shot down at least one small drone aircraft with a laser beam.



process, the ratio of CO<sub>2</sub> molecules in a high-energy state increases with respect to those at a lower energy level, bringing about the so-called "population inversion" needed for laser action. Lasing takes place in the excited gas as the light beam bounces back and forth between the mirrors. The high-speed

gas flow gives another advantage: It carries away huge amounts of heat created by the lasing action. A variation of the gas-dynamic laser, the electro-aerodynamic laser, is similar but uses electrodes to heat the gas. It offers one advantage: Gases can be recycled. Photo shows gas-dynamic laser built by Avco.

# How Close Are We?

- Grant Hansen, Assistant Secretary of the Air Force, told a House Committee that defense officials think it possible to build a superpower laser system that "... could track a ballistic missile from a space-based defense system and kill it over the country it was launched from." Code name for the project: Spade.

- Says a veteran researcher associated with the laser-weapon program from its inception (but who could not allow his name to be used): "Laser thermal weapons are practical if the military wants them."

The enticing notion of laser "death rays" sparked interest in lasers within the Defense Department more than a year before the successful operation of a ruby laser by a shy Hughes scientist, Dr. Ted Maiman, early in 1960.

## Pentagon was fascinated

The prospect of a weapon projecting its destructive force over great distances, at the speed of light, and

with little diminution in its destructiveness was attractive to defense planners. So they awarded a handful of early exploratory laser development contracts even before Maiman had made the first laser work.

The big problem through the early sixties: A successful laser weapon would have to generate incredible energy to destroy targets by heating them. But lasers at that time, despite the remarkably high power densities of their beams, produced relatively little sustained energy.

The invention of the highly efficient carbon dioxide laser in the mid-1960s rekindled the never completely abandoned weapons effort. CO<sub>2</sub> lasers have now been built that can produce a continuous 60-thousand watt (60-kw) beam. But an even bigger boost for weapons planners came about five years ago with the invention of the gas-dynamic laser (see diagram). Gas-dynamic lasers now in operation achieve output powers of hundreds of kilowatts, which may be sufficient for

some weapons applications. A short time later came yet another important development: the chemical laser (see diagram). While this device is not presently as powerful as the gas-dynamic laser, it has several characteristics that make it an ideal weapons candidate. Weapons development scientists are working on both.

Before gas-dynamic and chemical lasers came along, the possibility of developing a laser weapon was slim for two reasons. First, to get enough energy in the beam, an enormous electrical power supply would be needed. Second, cooling of the laser itself was a super-tough problem.

The two new lasers go a long way toward solving both problems. The reactant gases flow through them at high speeds and carry off huge amounts of heat. And they require little electrical power. The energy comes in one case from gases heated by a rocket-like burner, in the other from a chemical reaction. And both

*Continued*

are relatively light and compact in proportion to their energy output when compared to conventional lasers and the electrical power supplies they require.

Most of the speculation about laser weapons has revolved around the old idea of the "death ray." Although the new lasers could certainly kill or disable men at great ranges, they won't be used for that. Current weapons—from rifles to hand grenades—are cheaper, more portable, easier to use.

Military planners want lasers for use where their instant-reaction time and speed-of-light delivery are important. For example, the laser offers, by its nature, a possible solution to the toughest problem in ballistic missile defense: that of sorting real warheads from decoys. The coherent output of a laser, like all electromagnetic energy, travels at 186,000 miles per second

—faster than any other weapon today.

If the laser could disable an incoming missile warhead, the defense would have time—seconds, even minutes—to study the threat, make its decisions. It could even hold fire until warheads and decoys penetrated the earth's atmosphere. The lighter decoys would burn up, leaving only real targets. Then, with the speed of light, a laser beam could impale a target.

### Radar tracking, too

Still another advantage: A laser beam, like microwave energy, can be used for radar. But its accuracy is far greater because of its shorter wavelength. The same beam might initially serve at low energy as a radar tracker. When it had the missile pinpointed, it could simply increase power and zap the target. This would totally

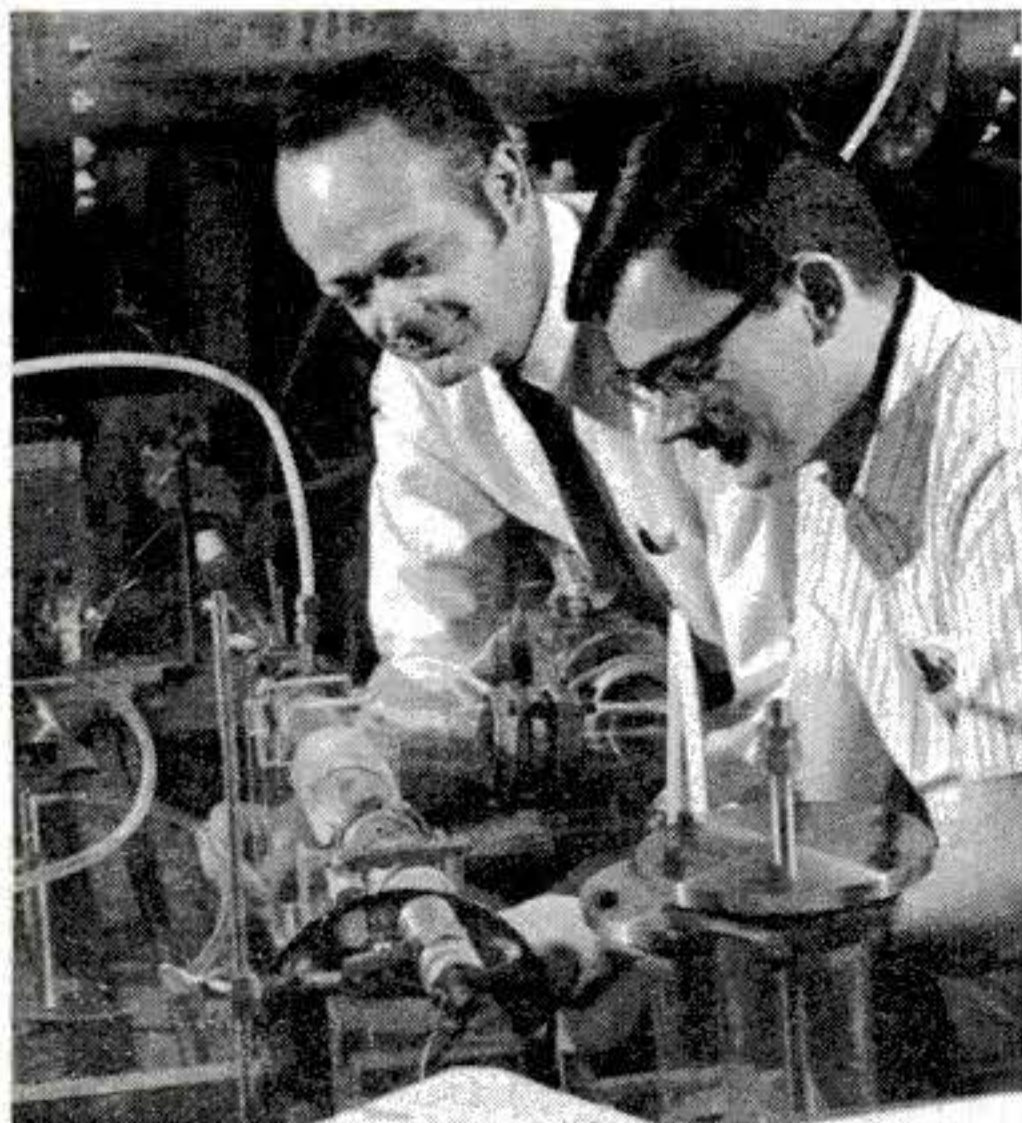
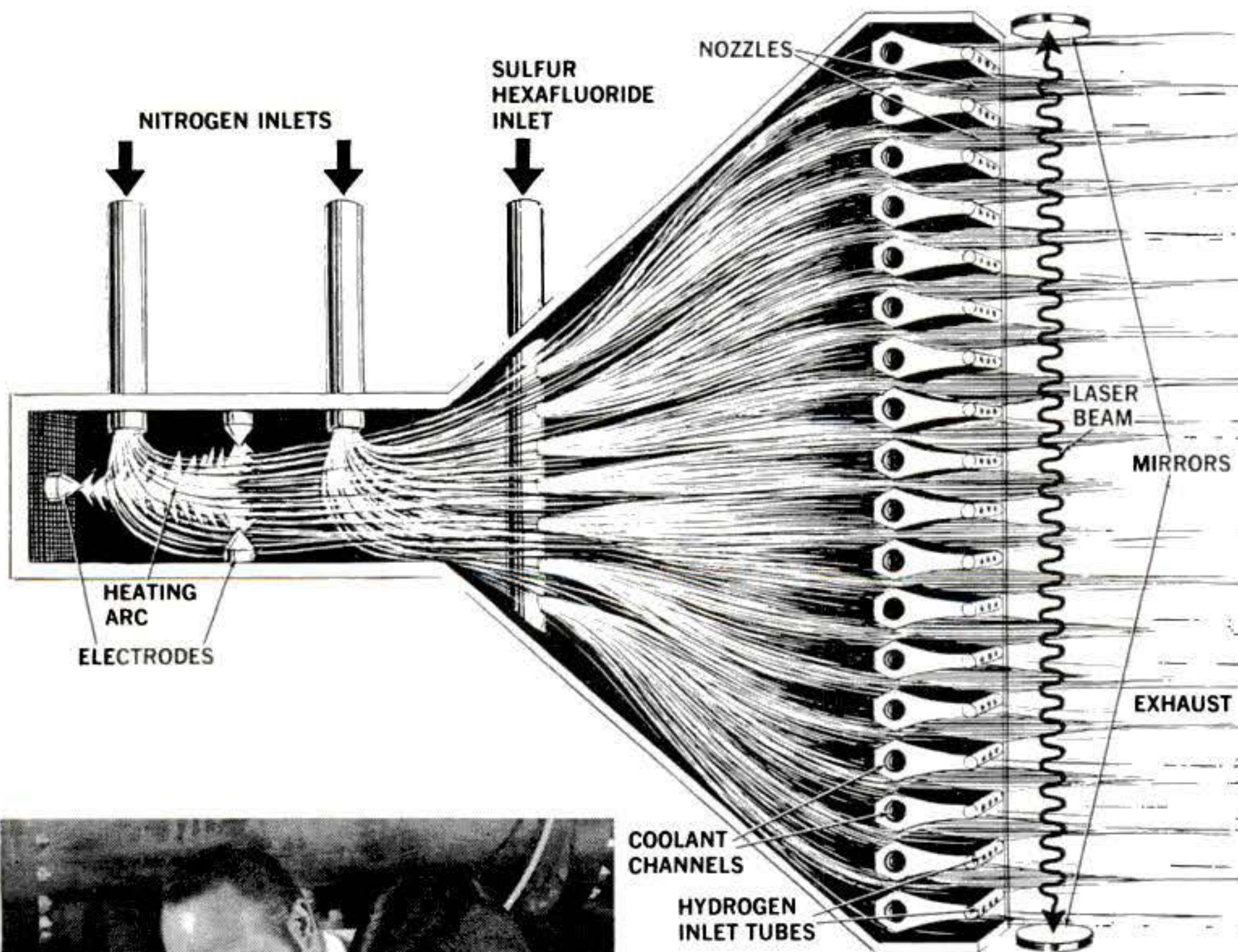
eliminate the usual costly, time-consuming computations of target trajectory needed to calculate target intercept positions. Finally, the laser radiation weapon would pour intense heat into a very small target area. It wouldn't atomize the target as does the nuclear warhead of an antimissile missile. Thus, there would be negligible danger of nuclear fallout.

While the real payoff from a laser weapon would be in protecting the country from missile threats, other perhaps more immediate applications are attracting attention, too. For example, the Navy is concentrating its radiation-weapon work on devices designed to protect ships from ship- and air-launched cruise missiles. These deadly weapons can be fired over the horizon against American ships by small enemy patrol boats. The missiles hug the water surface, hiding themselves from intended victims until it is too late for ship-based defenses to react. But laser beams can be swung by the motion of mirrors alone. So designers can build inertialess laser-defense weapons that have nearly instantaneous coverage in any direction. The combination of rapid self-tracking and instantaneous weapon slewing would be a natural solution to the need for rapid shipboard reaction to naval cruise missiles.

Today, most U. S. laser radiation work is centered at the Weapons Laboratory at Kirtland AFB, near Albuquerque, under the code name, "Eighth Card." (Kirtland is where the target drone was shot down about two years ago.) It's run by the Air Force, which is managing a tri-service effort supported by the three services and Advanced Research Projects Agency. Work is also underway at government locations in diverse locations: Boston, Dayton, Los Angeles, Huntsville. The two main industrial contractors are United Aircraft's Florida Research and Development Center, W. Palm Beach, and a team made up of Avco and Hughes Aircraft. Avco has concentrated on laser devices; Hughes on laser pointing and tracking optics.

One by one, the objections of scientific doubters have been brushed aside by an accumulation of encouraging evidence, turning a growing number of skeptics into believers in laser thermal weapons. For example, the fear that laser beams exceeding certain energy density would produce a ballooning effect in the atmosphere, causing a sharp electrical breakdown akin to lightning, hasn't materialized. Atmospheric absorption could be a severe problem, but primarily under a narrow set of conditions, especially in the rare instance where both target

[Continued on page 142]



**Molecules in a chemical laser** are pumped to a high-energy state not by electrical or thermal energy but by a chemical reaction. In this version, built by Aerospace Corp., jets of nitrogen introduced at left are heated by an electric arc. The sudden heating forces them at supersonic speed to the

right, where they are mixed with sulfur hexafluoride. Finally, at far right, they are expanded through a series of small nozzles similar to those in the gas-dynamic laser and hydrogen is injected into the gas stream. The hydrogen combines with the atoms of fluorine from the sulfur hexafluoride to produce excited hydrogen fluoride. A beam of infrared energy is created as these excited molecules lase between the two mirrors. As in the gas-dynamic laser, the rapid gas flow solves the cooling problem. Chemical lasers are attractive candidates for weapons because they require little or no electrical power and produce huge amounts of energy in proportion to their size and weight. The photograph shows an experimental chemical laser developed by Terrill A. Cool (left) of Cornell, shown here with graduate student assistant, Ronald R. Stephens.



Tow-launched to 10 meters altitude, Josef Malliga's skycycle is pedaled 400 meters through the blue. It takes off man-powered, too.

# Man-Powered Planes Get a New Lift

Look! Up in the sky! It's a bird . . . it's a plane . . . it's a man pedaling?

By PAUL WAHL

**T**hings are looking up in the slightly wacky world of man-powered flight. Not too far up, of course: In this kind of flying, altitude is measured in inches, and just getting off the deck calls for huzzahs.

Here's what's happened since we last reported on the subject, in January 1971.

- One of the planes we previewed then—the Weybridge—made a successful maiden flight in September.

- Students at California's Northrop Institute of Technology are building the Flycycle—a two-man pedal plane that they hope will be the first man-powered craft to fly

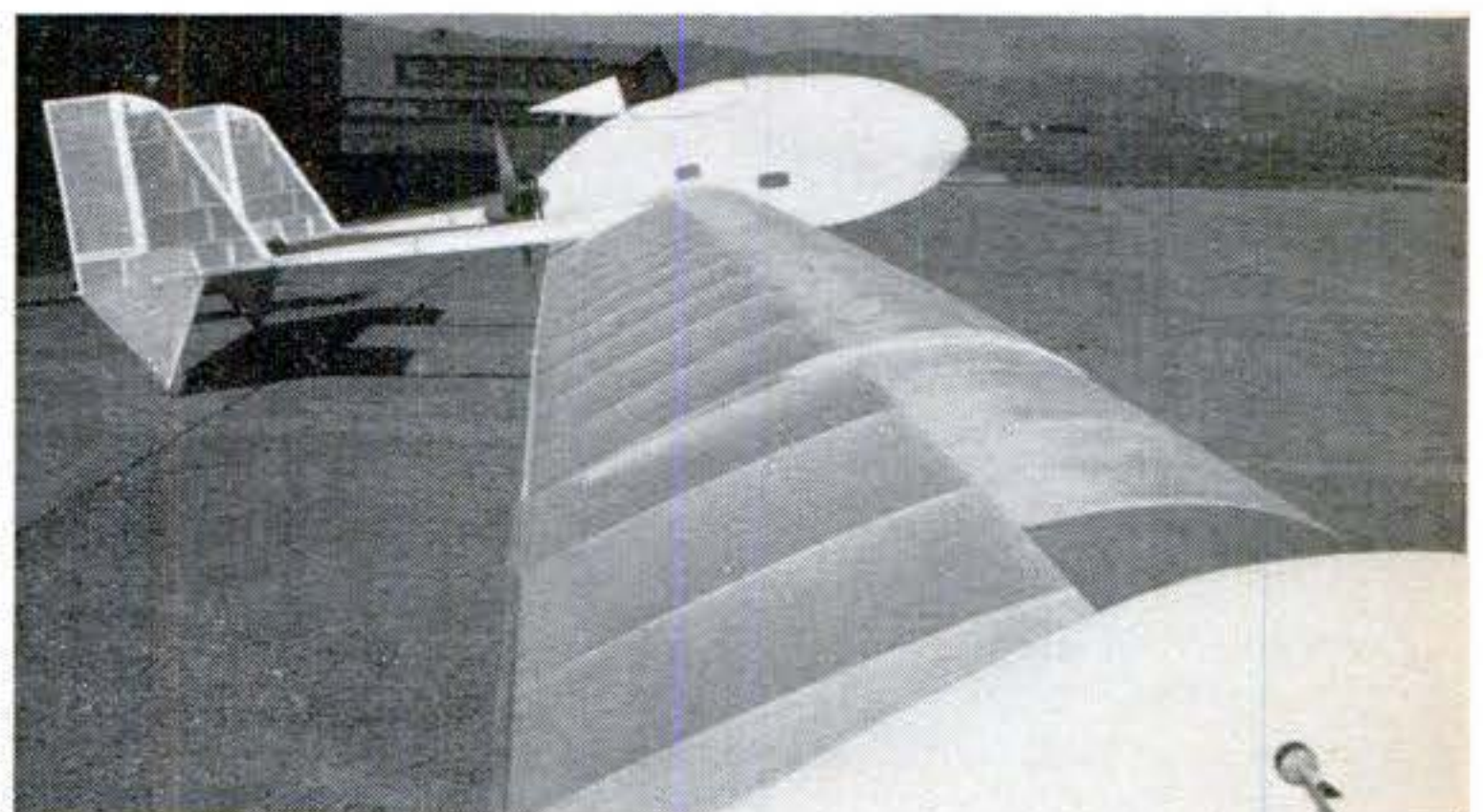
in the United States. It will have an 80-foot wing.

- We've turned up a remarkable—and successful—skycycle from Austria; one that's practically unknown—the Malliga.

- A trend has developed toward making man-powered flight a popular sport, like soaring. We've learned that there may soon be an announcement of national U.S. competition—with substantial cash prizes—for the design, construction, and flight of such sport skycycles, whose forerunners might just be the Malliga and Liverpuffin machines pictured here.

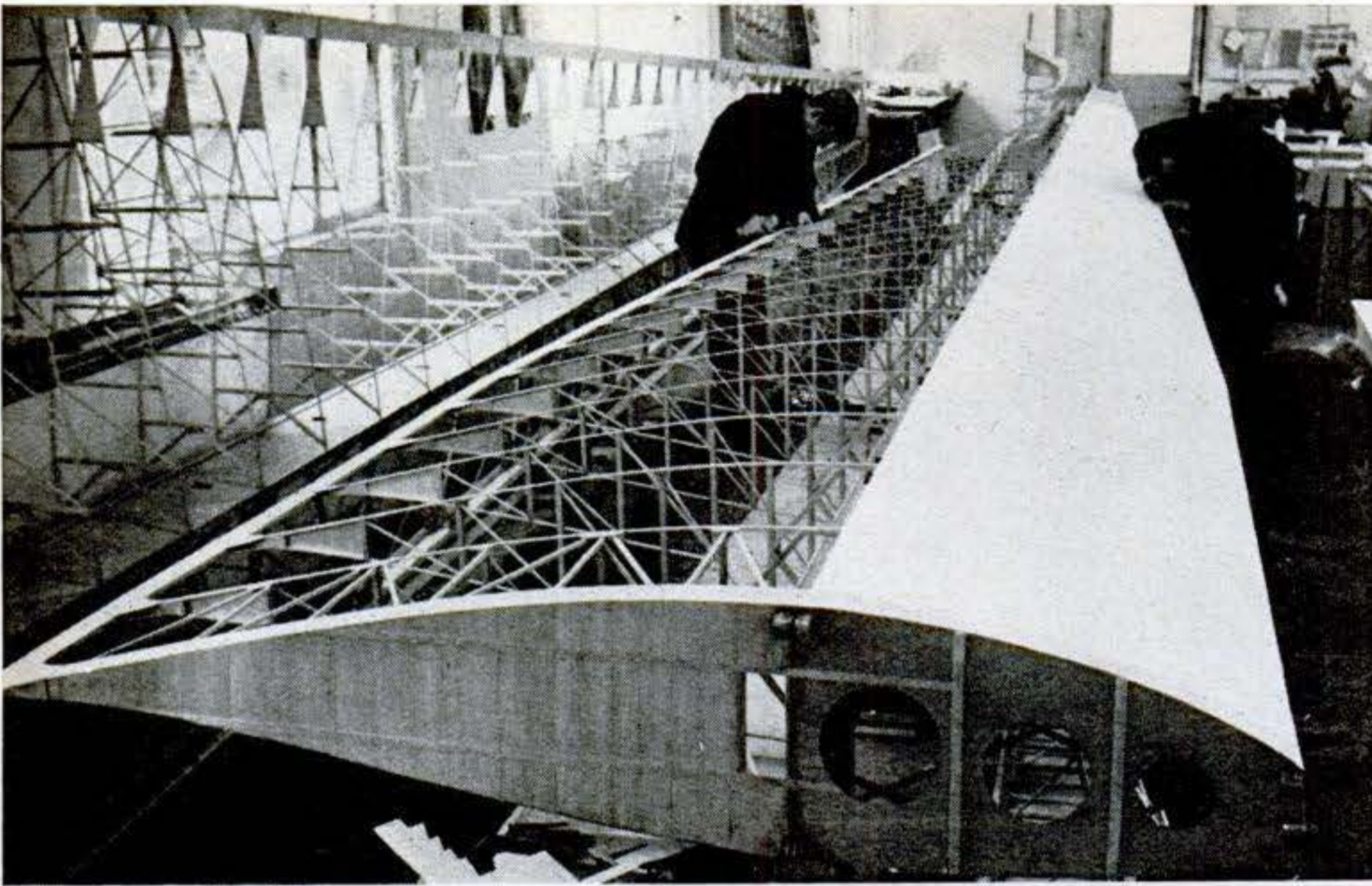
- For those who missed the previous article on man-

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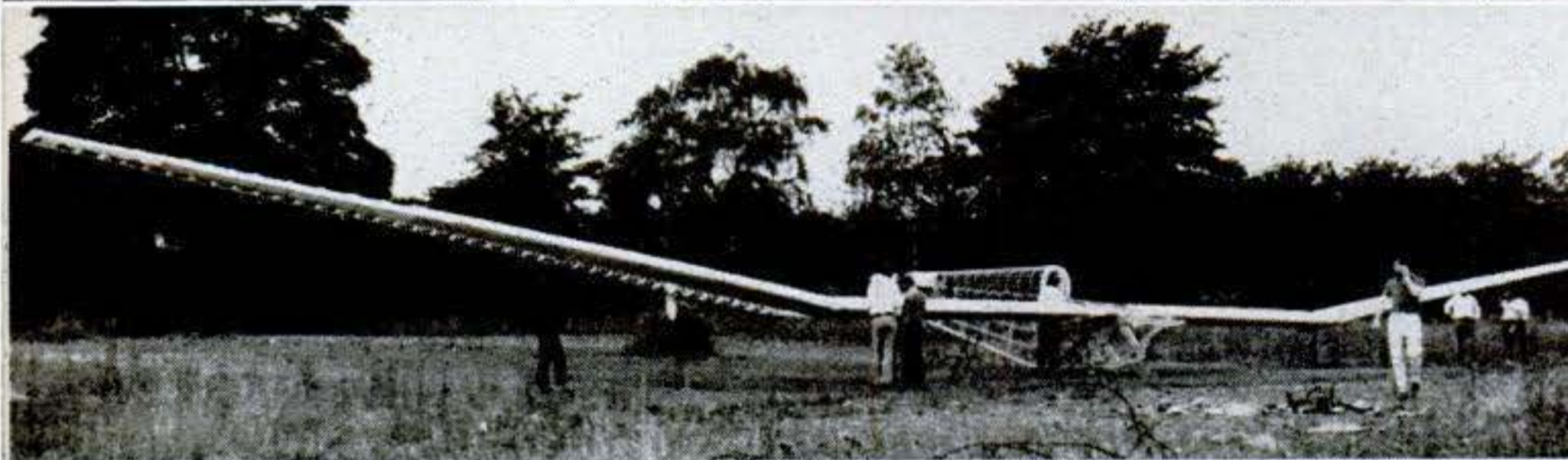


**Proved by many flights**, the Austrian Malliga machine is a very simple, paper-covered pedal plane. Wingspan, 65 ft. Weight, empty, 113 lbs. With 126-lb. pilot aboard, it has flown 150 meters, at one-meter height, from an unassisted muscle-powered takeoff.

While others may fly high and fast, man-powered planes are going low

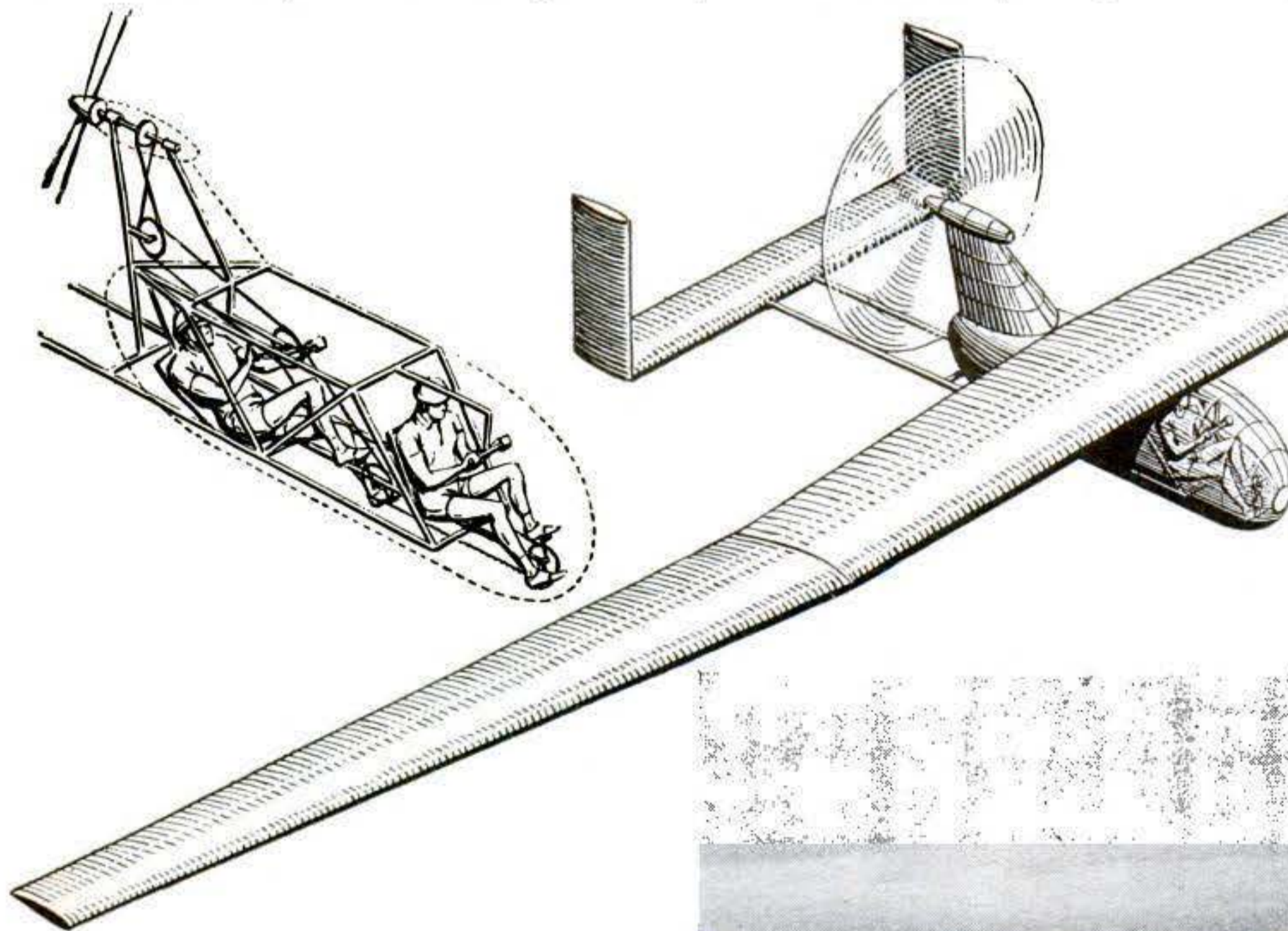


Pilot Chris Lovell, seated in Weybridge cockpit (nose fairing off), demonstrates the plane's controls. Shaft in front of him, turned by the pedals via a gear system, transmits power to drive propeller.



Biggest, most sophisticated man-powered plane yet, the Hertfordshire Pedal Aeronaughts' "Toucan," a skycycle-built-for-two in the works five years, nears completion

in England for flight this spring. Upper photo: wing under construction. Span is 123 ft.; plane weighs only 145 lbs. Lower photo: trial assembly, wing and fuselage.



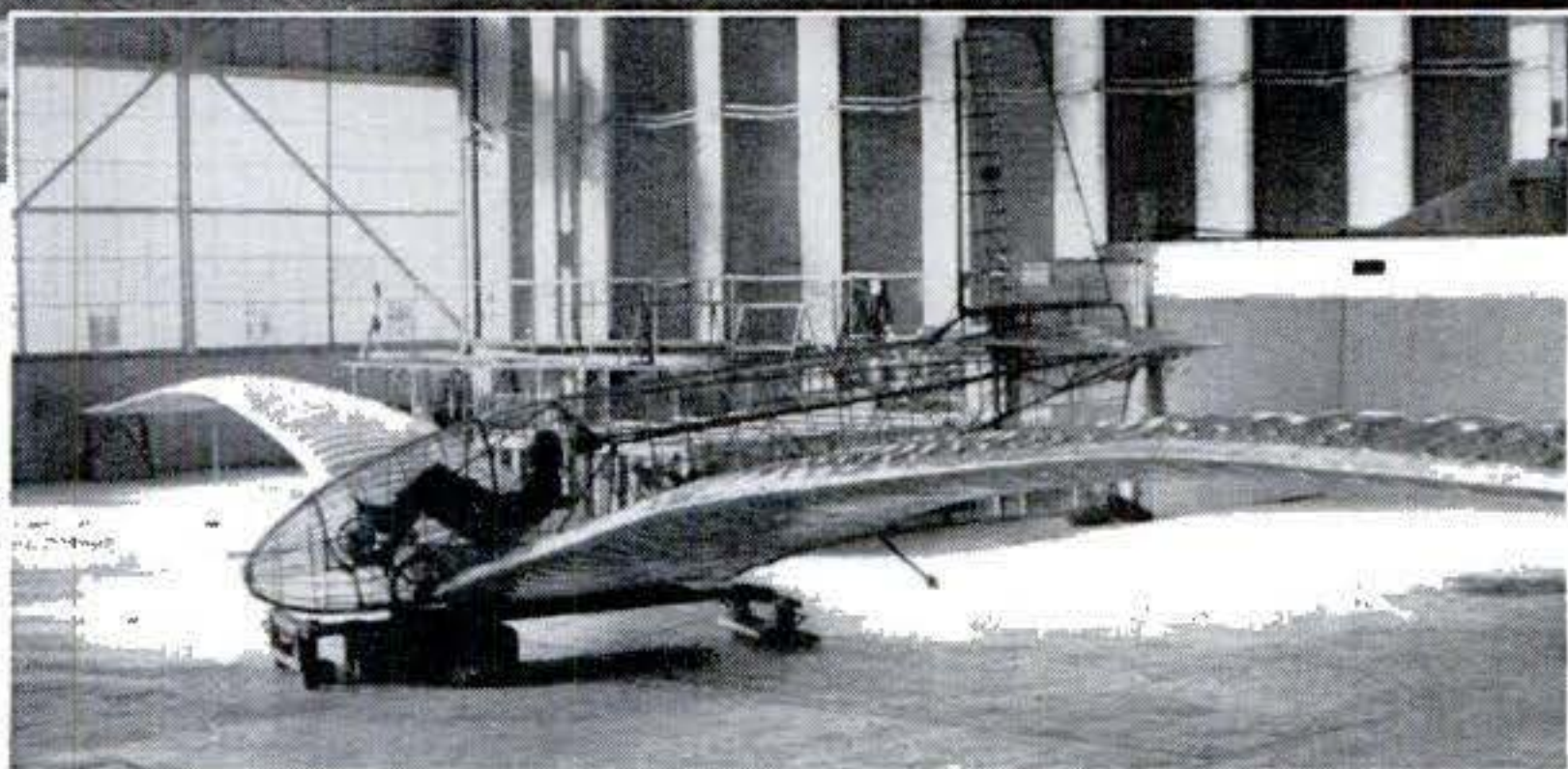
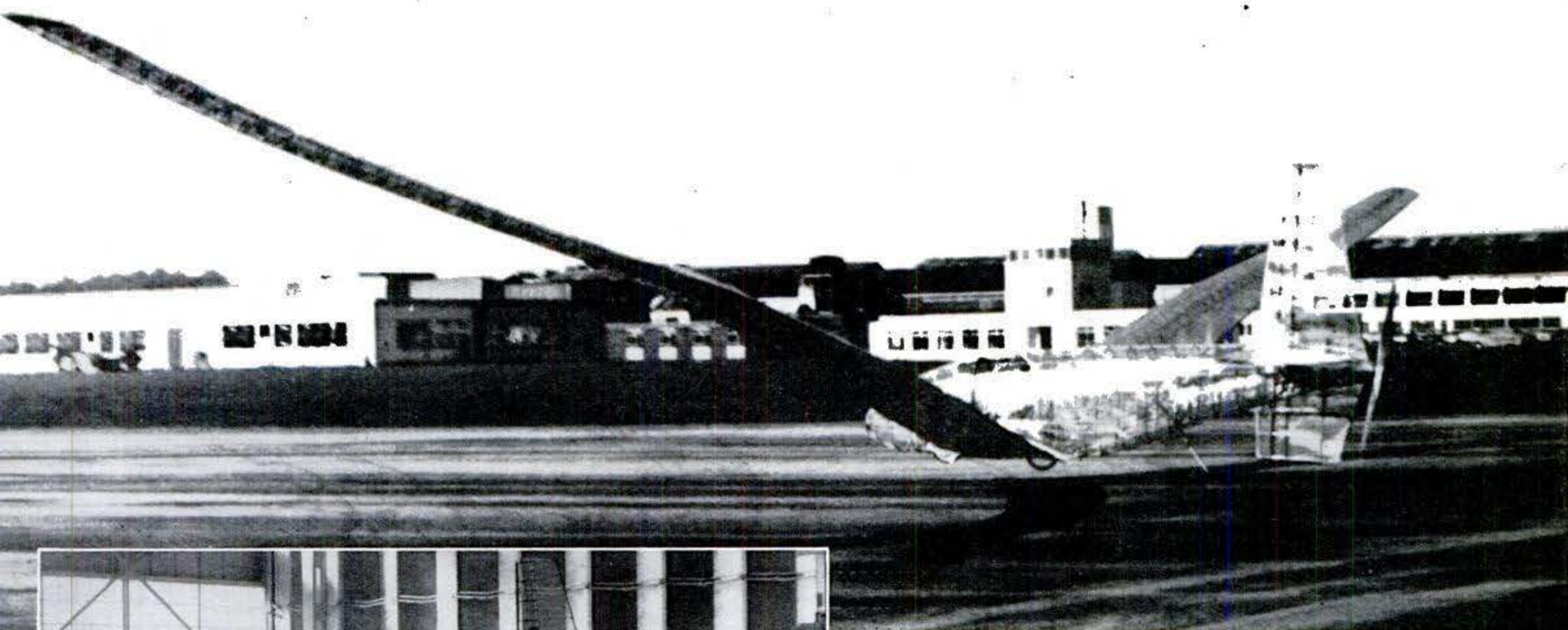
"Flycycle," two-man pedal plane, is a student project at California's Northrop Institute of Technology. Advanced design and ultra-lightweight construction are expected to result in a 70-lb. aircraft. A computer says 80-ft. wing will weigh just 15 lbs.! The builders hope to make first U.S. man-powered flight this year.

Forerunner of an exciting new generation of man-powered aircraft, "Liverpuffin" is a sports skycycle designed for short 100-200-yd. hops. The single-seater weighs 125 lbs., has a 65-ft. wing demountable for convenient transporting. Built by Liverpool University students, craft is scheduled for flight trials this spring.





**and slow: about three feet off the ground at less than 20 mph**



**Airborne!** Clearing ground by three ft., the 125-lb. man-powered Weybridge makes its first flight—50 yards—on Sept. 18, 1971. Note that at rest tips of the 120-ft. wing droop (left), but lift and straighten in flight (above). One-man plane was built in three years by the Weybridge MPA Group—mostly employees of British Aircraft Corp., Weybridge.

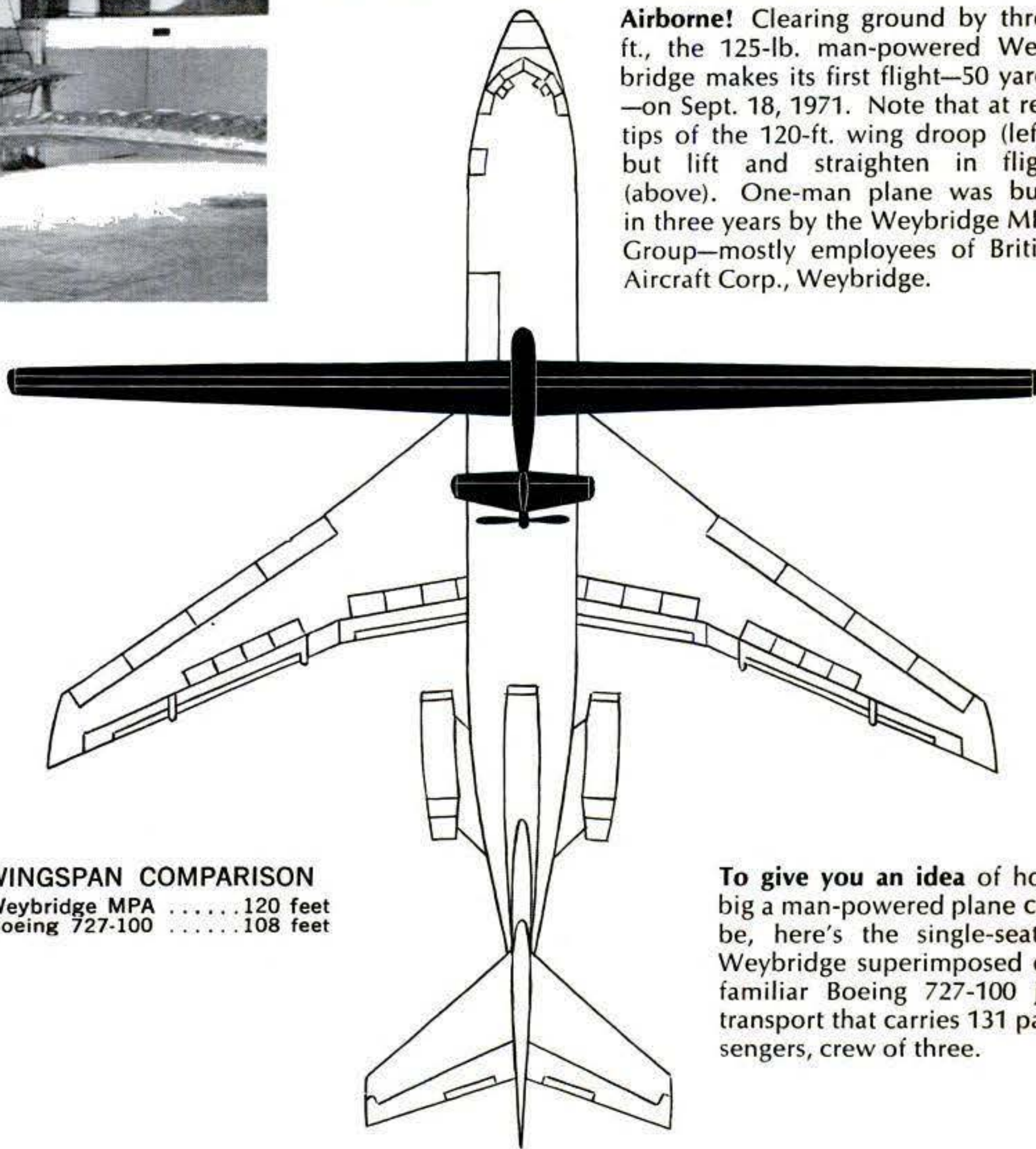
powered flight [PS, Jan. '71], and are wondering what a “man-powered plane” is: Imagine a cross between a sailplane and a bicycle, with airframe construction much like that of a flying model airplane. Given strenuous pedaling by the pilot to drive the propeller, the man-powered plane flies low, slow, and not very far. Of course, it does the almost impossible in just getting airborne, handicapped as it is by the worst “engine” in aviation.

**Strength is all.** Under the strain of simultaneously pedaling and controlling such an aircraft, an average physically fit man can sustain an output of 0.3 to 0.5 horsepower for only a few minutes.

It takes an airframe of high aerodynamic efficiency, extremely light weight, and a relatively large wingspan for a skycycle to fly on the minimal power available. This is the real challenge of man-powered flight: It's only barely possible.

During the past decade, 10 muscle-driven planes were flown successfully: five in Japan (Linnet I, II, III, and IV, Sato-Maeda OX-1), four in England (SUMPAC, Puffin I, Puffin II, Weybridge), one in Austria (Maliga).

It was the Kremer Prize (£5,000) that got man-powered flight off the ground in the Sixties. Named after London industrialist Henry Kremer, it was announced in 1959. To win, a



**WINGSPAN COMPARISON**  
Weybridge MPA ..... 120 feet  
Boeing 727-100 ..... 108 feet

To give you an idea of how big a man-powered plane can be, here's the single-seater Weybridge superimposed on familiar Boeing 727-100 jet transport that carries 131 passengers, crew of three.

heavier-than-air machine had to take off and aviate, under human muscle power alone, around two pylons a half-mile apart, crossing both start and finish with at least 10 feet of ground clearance. Energy-storing devices and lighter-than-air gases were prohibited.

In 1961, the SUMPAC, built by Southampton University students, became the first craft to take off and

fly on muscle power alone—but only for 650 yards. In 1967, his prize unwon (not even tried for), Kremer doubled the purse to £10,000. At the same time, the competition, previously restricted to British entries, was opened to all nationalities.

To date, no man-powered plane has attempted the Kremer course. Why? A leading authority, Liverpool Uni-

*[Continued on page 148]*

PERSONAL-USE REPORT

# SUPERBIKE:

## Water-Cooled, Three Cylinders, and a Hot 105 mph



GT-750 is a big motorcycle—no doubt about that. In spite of its size, handling is superb at both high and low speeds.

### SUZUKI GT-750 SPECS

Engine	three-cylinder, two-stroke
Radiator capacity	five quarts
Hp @ rpm	67 @ 6,500
Bore and stroke	70 x 64mm
Displacement	738cc
Compression ratio	6.7:1
Ignition	battery and coil
Carburetion	three 32mm Mikunis
Lubrication	oil injection
Clutch	wet, multiplate
Gear ratios	1st—14.92:1 2nd—9.11:1 3rd—7.15:1 4th—5.90:1 5th—4.84:1
Front brake	quadruple leading shoe
Rear brake	single leading shoe
Starting system	electric and kick start
Wheelbase	58 inches
Weight	522 pounds
Top speed	105 mph
Price	\$1,575

Motorcycle with a radiator? Right. Even idling till its plugs fouled, it wouldn't overheat

By JIM DAVIS / PS West Coast Editor

One of the wildest motorcycles ever to roll off an assembly line is Suzuki's new water-cooled, three-cylinder 750. Why water-cooled? Because cylinder distortion caused by heat-producing friction has kept two-stroke-engine tolerances on the slack side. Water-cooling eliminates the variations in temperature that occur with air-cooling—permitting finer machining and tighter tolerances.

The thermostat controlling the 750's pressurized cooling system opens at 203 degrees F. The fan doesn't begin turning until water temperature reaches 221 degrees. When the fan starts, it runs until the temperature drops to 212. I let my test bike idle until the plugs fouled, and the engine refused to overheat. It didn't even get hot enough for the fan to come on.

Each water-cooled cylinder cranks out over 22 horsepower, adding up to a whopping 67 ponies at the drive sprocket. If you hold the three big 32-mm carburetors open, you're quickly rolling along at 105 mph.

At high speed or chug-through-traffic speeds, the 522-pound Suzuki handles as light as the proverbial feather. Suspension, telescopic up front and swing-arm in the rear, is more than up to the job, even when you're carrying a passenger and luggage.

Brakes? Up front there's a quadruple leading-shoe unit—combining two sets of brakes from Suzuki's T-500. Front-wheel braking is as good as, or better than, that of many bikes with disks. The test-machine brakes faded a trifle under very hard usage, but the average owner shouldn't encounter these problems in everyday riding. The rear brake is an external-expanding single leading shoe.

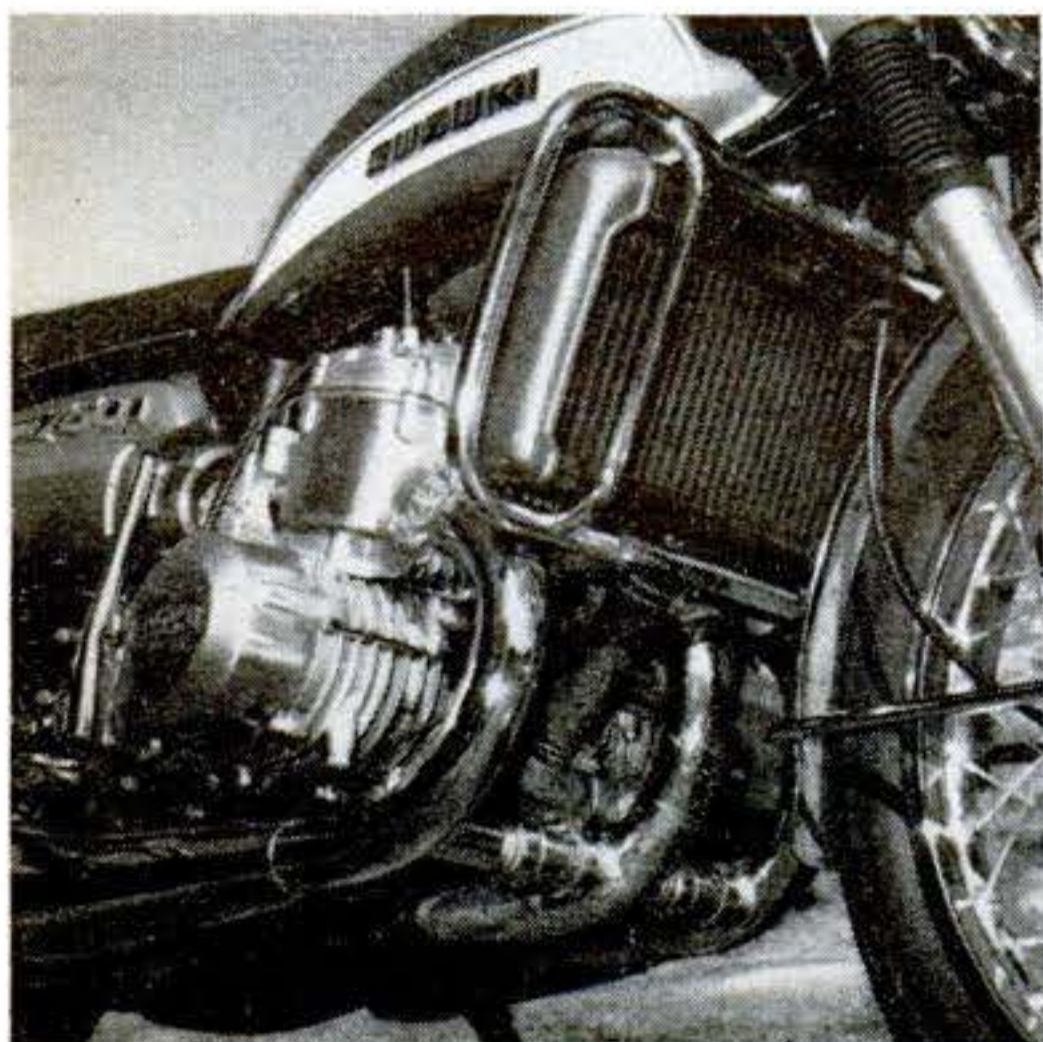
The battle is on among motorcycle makers to see who can produce the most exotic multicylinder engine. Score one win for Suzuki. PS



Muffling system is great. Even at high speed, all you hear is the roaring wind and a faint purring sound from the engine below.



Instruments are shock-mounted. The temperature gauge is in the center. Ignition key is conveniently in the center, too.



Five-quart radiator up front does a first-class cooling job. The author was unable to make the big engine overheat.

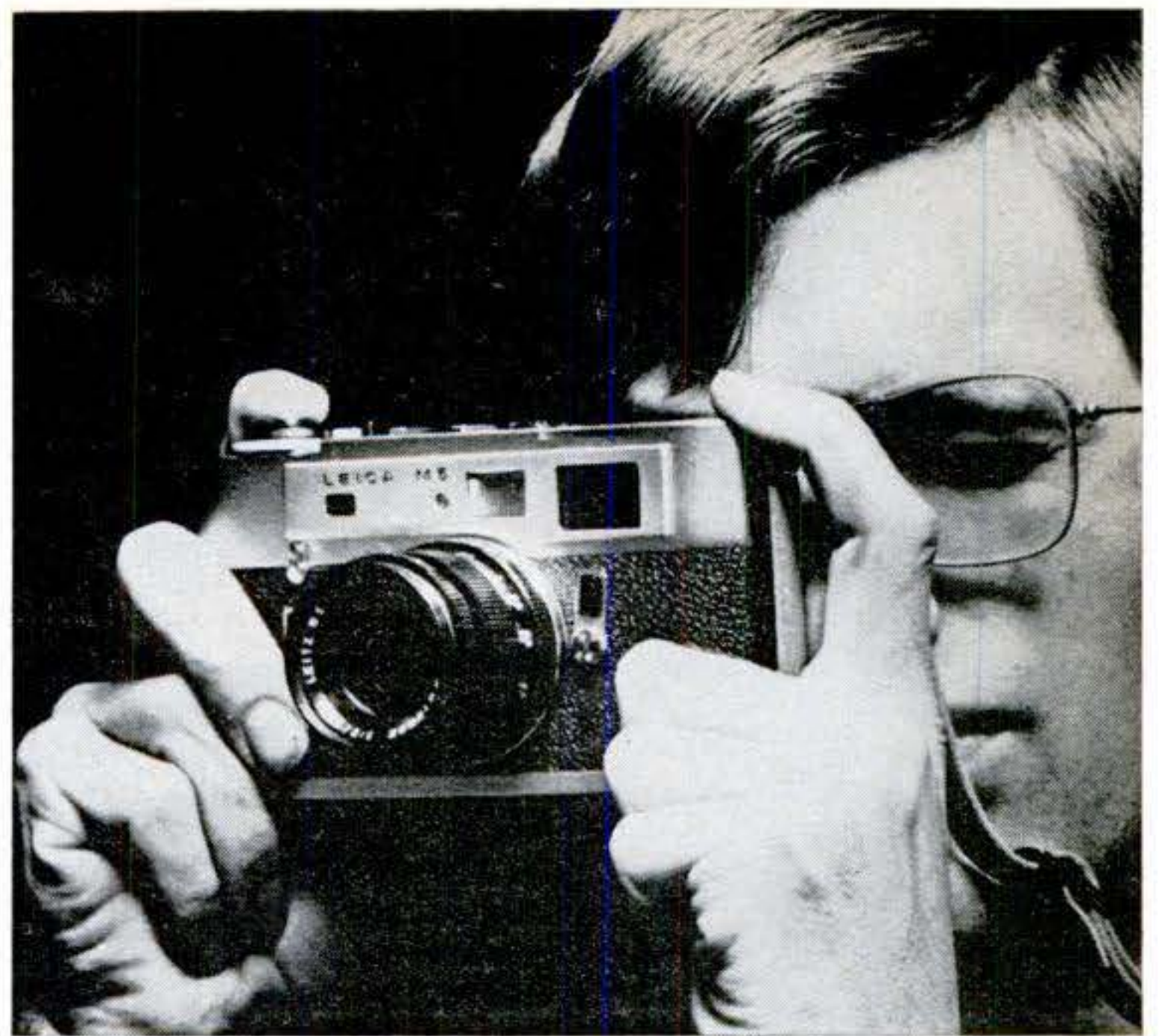


Good brakes? You bet. Instead of using disks up front, the GT-750 features an effective quadruple-leading-shoe setup.



Front-mounted controls are almost identical to those on the M4 (M5's predecessor). Lever to right of lens selects viewing frames. Film-rewind crank? It's recessed into camera bottom.

Largest Leica yet, M5 is still small—so small in fact that ham-fisted author had trouble gripping it firmly without blocking rangefinder window with his fingers.



PERSONAL-USE REPORT

# New Leica M5: Outstanding in Existing Light

They've put a through-the-lens meter in this classic, slick-handling rangefinder camera—for faster shooting in any light

By A. J. HAND

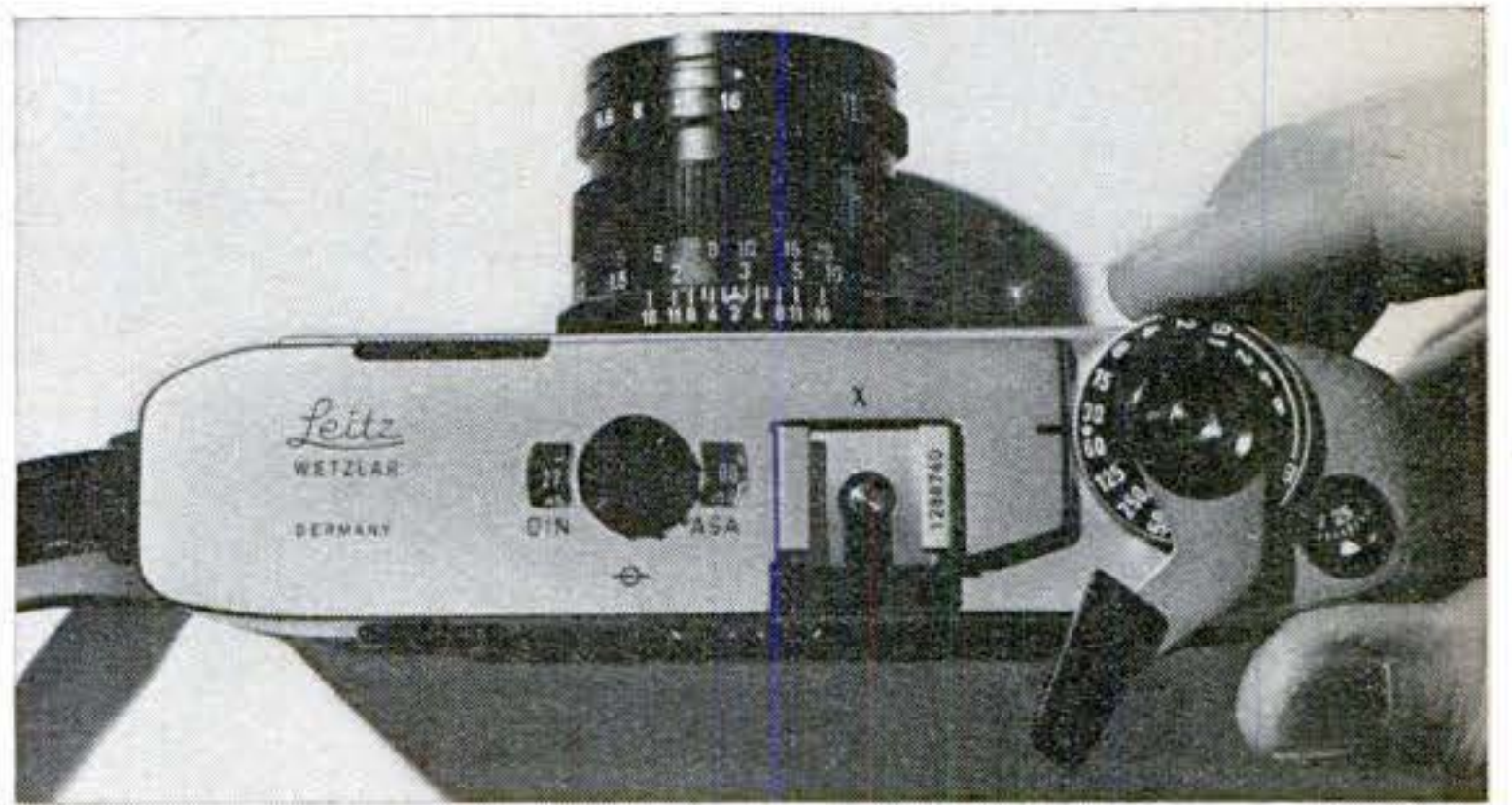
They finally did it. They put a through-the-lens meter in a Leica. Now the smooth, fast-handling rangefinder 35 is faster than ever, and even stronger in its specialty—shooting in existing light. Until now, the inherent ease of focusing and composing through a bright rangefinder/viewfinder had been largely offset by the need for a separate or clip-on meter. The M5 changes all this. Let's take a look—first at the meter, then at the camera.

The meter is very sensitive. It reads down to around a second at f/2 (set for ASA 400) at the bottom of its range, on up to scenes brighter than you'll ever encounter on Earth. It's accurate, and consistent when you switch lenses. It's a spot meter, ideally suited to the tricky metering situations you find in contrasty available light. It responds quickly to the camera controls.

A few weaknesses. I did find some. If I didn't center my eye perfectly behind the viewfinder, the meter readout at the bottom of the frame was blocked out (I wear glasses). In very low light, and when shooting against a large light background, the meter readout faded into near invisibility. In these situations, the instruction booklet says to block the viewfinder with your finger while taking a reading. This brightens the readout image.

How's the rest of the camera? Lenses: No questions here, Leitz makes some of the best around. Most M-series lenses fit the M5. Some (21s, 28s, and others) need modification. Shutter: Smooth and quiet, continuously variable, and the easiest to set of any—on any camera. But the slowest speed is one-half second. Overall construction: rock solid. Price: \$700-plus.

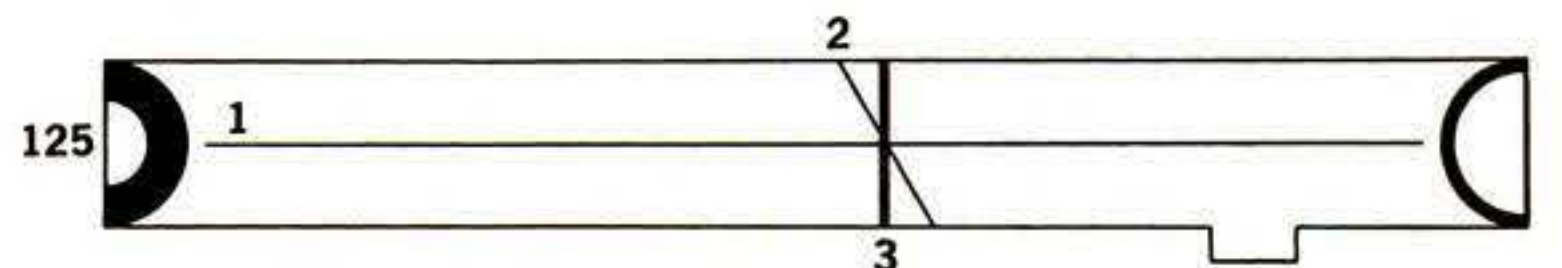
PS



Instant control of shutter speeds is easy—you can turn the giant dial with one finger. Speeds are continuously variable.



Meter cell sits on pivoting arm directly in front of focal-plane shutter. It swings down and to the side for exposure.



Meter readout looks like this below your viewfinder frame. At left is shutter speed; 1 is a fixed cross line; 2, a setting needle coupled to shutter-speed dial; 3, aperture-activated meter needle. Exposure is right when 1, 2, and 3 intersect.

# New Champ in the Skyscraper League

Constructed in nine modular tubes, Chicago's 110-story Sears Tower will rise to 1,450 feet — to become the world's tallest building

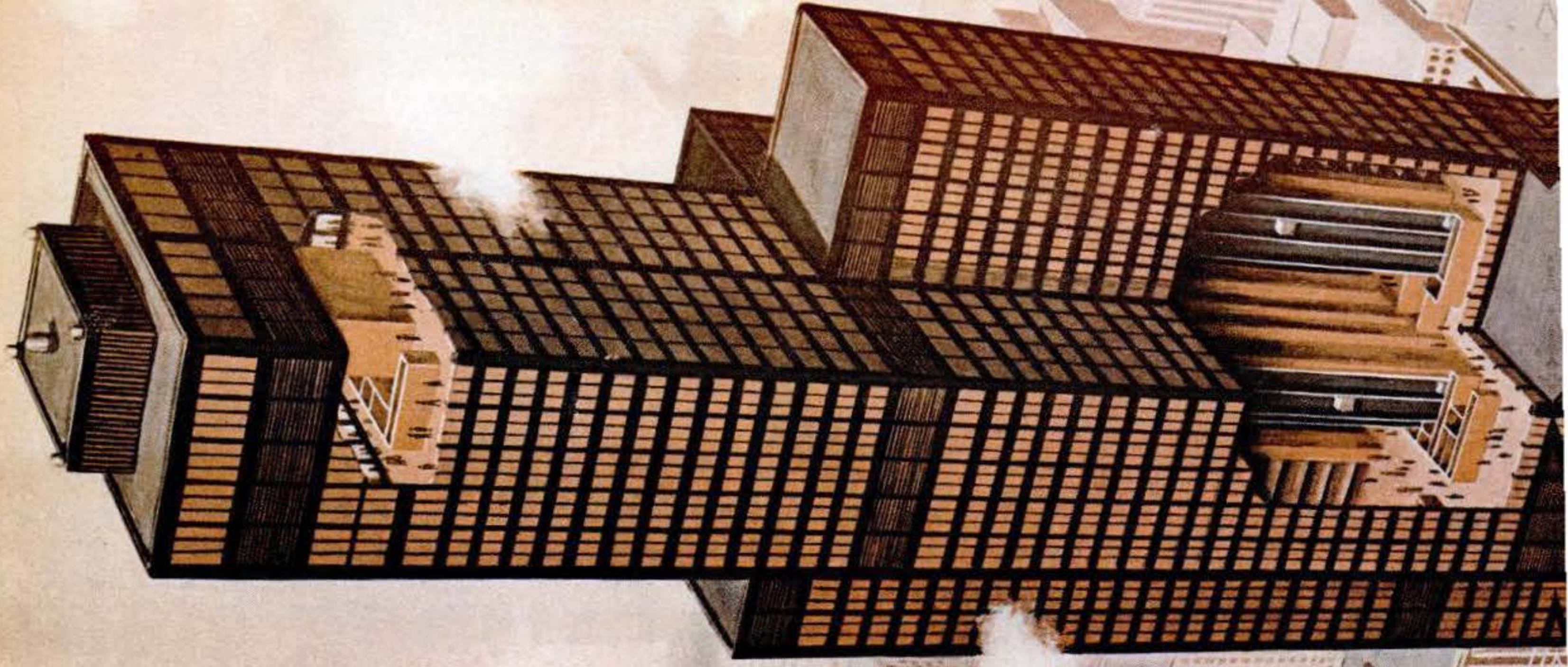
By HERBERT SHULDINER  
ILLUSTRATION BY RAY PIOCH

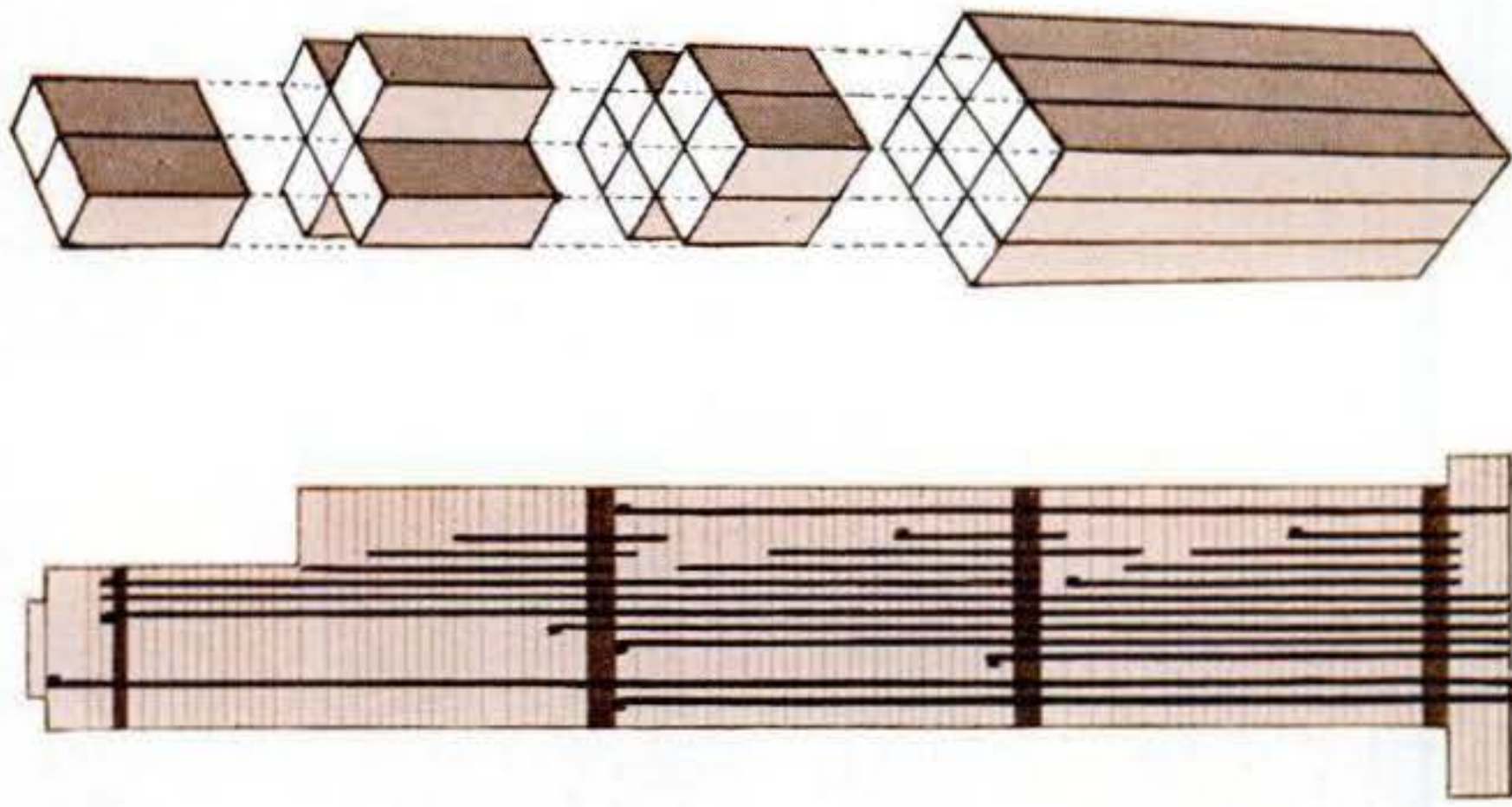
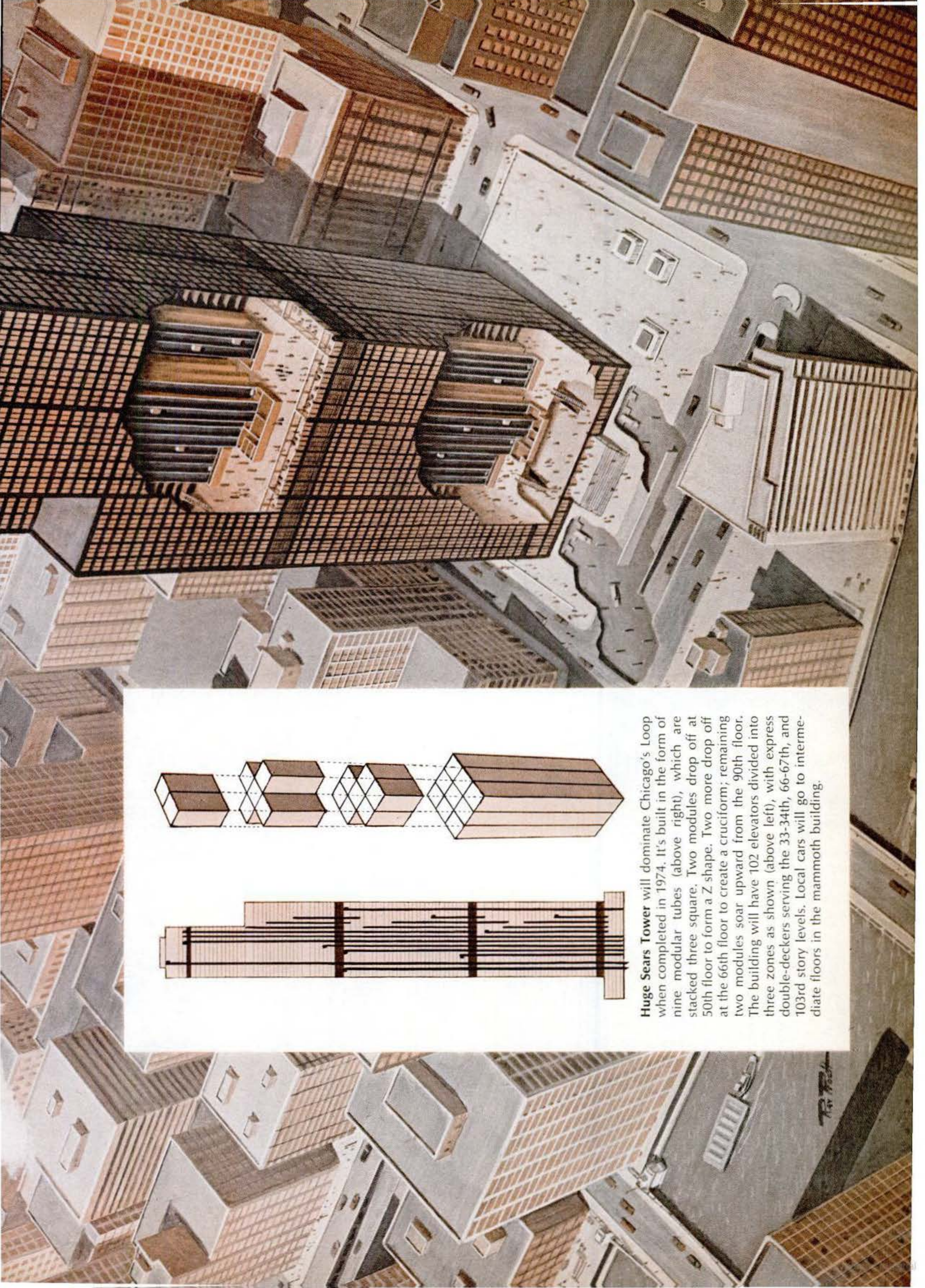
Soaring upward at the sizzling rate of two floors a week, the steel framework of Chicago's new Sears Tower is nearing the halfway point this month on its heady climb toward becoming the world's tallest building.

The new champ in the skyscraper league will top out late this fall at 110 stories — 1,450 feet high. It will, upon completion, eclipse the 100-story John Hancock Center (now Chicago's tallest building), the Empire State Building, and even the not-yet-completed World Trade Center in New York City [PS, May '71], whose twin 110-story towers presently hold world's-tallest-building honors. The Sears Tower will be 100 feet taller than the World Trade Center.

Of course, there are several giant TV antennas that are taller than the Sears Tower will be, but they're not buildings in the sense that people live or work in them.

In the heart of town. The Sears Tower is rising on a three-acre site in downtown Chicago. It occupies little more than an acre *Continued*





**Huge Sears Tower** will dominate Chicago's Loop when completed in 1974. It's built in the form of nine modular tubes (above right), which are stacked three square. Two modules drop off at 50th floor to form a Z shape. Two more drop off at the 66th floor to create a cruciform; remaining two modules soar upward from the 90th floor. The building will have 102 elevators divided into three zones as shown (above left), with express double-deckers serving the 33-34th, 66-67th, and 103rd story levels. Local cars will go to intermediate floors in the mammoth building.

# The Sears Tower will provide floor space equivalent to 16 city blocks



Structural-steel columns arrive welded to 15-foot spandrels—with welds pretested ultrasonically. At the site, ironworkers bolt the units together with splice plates.



"Christmas trees"—the familiar name for the prefabricated columns—are erected by 40-foot stiff-leg creeper derricks, which climb inside walls of the steel framework.

of the total parcel—the rest will become a granite-surfaced plaza.

Before the building started going up, some 180,000 cubic yards of earth had to be dug out and carted away by trucks to create a 100-foot-deep hole for the foundation. Then, nearly 200 caissons were put in to supply supports for the skyscraper and its plaza.

The building itself, which was designed by the famed architectural firm of Skidmore, Owings & Merrill, boasts a unique modular design never before used in a skyscraper. It's a takeoff on the conventional tube-type skyscraper, in which perimeter columns brace the structure against winds. The Sears Tower has a bundled or modular tube design. There are nine tubes, 75 by 75 feet square, with common interior columns.

The tubes are stacked three by three at the base and terminate at various heights to form a series of setbacks—until only two tubes remain for the top 20 stories.

**Skyscraper's nemesis: wind.** The setbacks will help reduce wind sway by breaking up the flow of wind against the skyscraper. The resulting turbulence minimizes oscillations, say the architects. The building is designed to withstand up to 36 inches of lateral sway at the top.

Two models of the tower—one rigid and one elastic—have been subjected to extensive wind-tunnel tests at the University of Western Ontario, London, Ont., to determine how the bundled-tube building will behave aerodynamically.

The tubes are "punctured in a minimum way for windows," say the architects, and they tend to function like a solid-wall tube. This preserves the building's stiffness and helps resist lateral sway caused by winds and other stresses. It gives added strength,

too—helping save on the amount of steel that goes into the frame of the building.

About 73,000 tons of structural steel are being used by American Bridge, the structural-steel-fabricating and erecting division of U.S. Steel, in the Sears Tower. That's enough to build more than 50,000 cars. But this amounts to only 33 pounds of steel per square foot of gross area. A conventional frame design would have increased the amount of steel to 60-70 pounds per square foot.

**Simplifying construction.** The structural-steel columns come to the building site in unique prefabricated modules called "Christmas trees." Each "tree" is a 25-foot-high column with a 15-foot-wide spandrel welded to it. The spandrels come in different configurations based on their position in the frame.

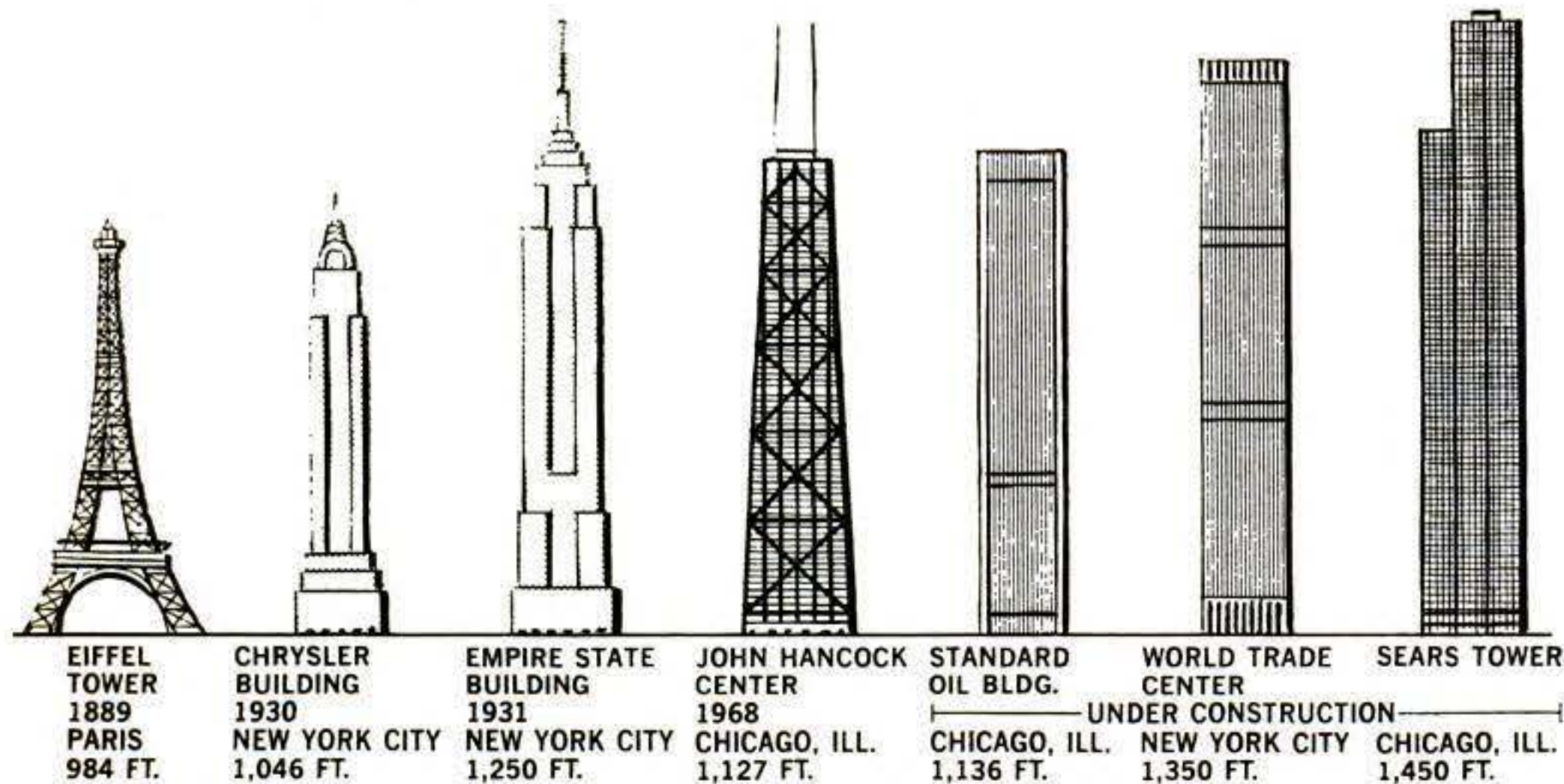
Spaced at 15-foot intervals along the perimeter of each modular tube, the "Christmas trees" carry the major gravity load of the building.

The spandrels are attached to the columns by electro-slag welders. It takes about 25 minutes to fuse a spandrel to the column. The welds are then checked ultrasonically by inspectors to detect any flaws that can be repaired on the spot. All this is done at an off-site location to save time in construction.

Column/spandrel units are fastened together at the site with splice plates, with jibs used to keep splices to close tolerances. Four 40-ton stiff-leg creeper derricks climb along the inside of the tower's steel frame to erect some 5,000 trees per month—enough to complete eight floors.

The structural frame will be covered by a wall of anodized aluminum, processed to achieve a dark, rich color.

*[Continued on page 148]*



**Going up:** Here's how the Sears Tower—which will become the world's tallest building this fall when it reaches 1,450 feet—

compares with other monumental structures here and abroad. (There are some giant TV antennas that still will be taller.)



Sears Tower is shown as it appeared last December—about one-third completed. It's rising at the rate of two floors a week.

# Full-Time 4-Wheel-Drive Cars Are On the Way!

Several systems are fully perfected and only await Detroit's go-ahead to make four-wheel drive optional

By JIM DUNNE / PS Detroit Editor



Dana Corporation's 4WD Ford wagon storms through splattering mud with full traction.



Michigan State Police are testing this Plymouth Fury with GKN-Birfield's 4WD system.

Full-time four-wheel-drive systems are possibly the hottest item now being worked up inside the auto industry. And I'm not just talking about off-road and recreational vehicles. Four-wheel drive is also being developed for passenger cars. Why?

Let's go back to the RV field for part of the answer. What does 4WD do for your Jeep? Simple, you say—that's what makes it a Jeep! In other words, 4WD gives the vehicle extra off-road mobility, an ability to go with a load where two-wheel-drive vehicles cannot follow, and an ability to haul trailers and rescue other vehicles that get stuck in wild terrain.

For the passenger car? Here, the picture is quite different. Yes, the 4WD passenger car has extra mobility in mud and sand. Still, it doesn't become a Jeep (mainly because of its low ground clearance and considerable overhang, front and rear). The most important aspect of 4WD for passenger cars is the superior traction, more effective braking, and the safer handling it offers under low-friction conditions.

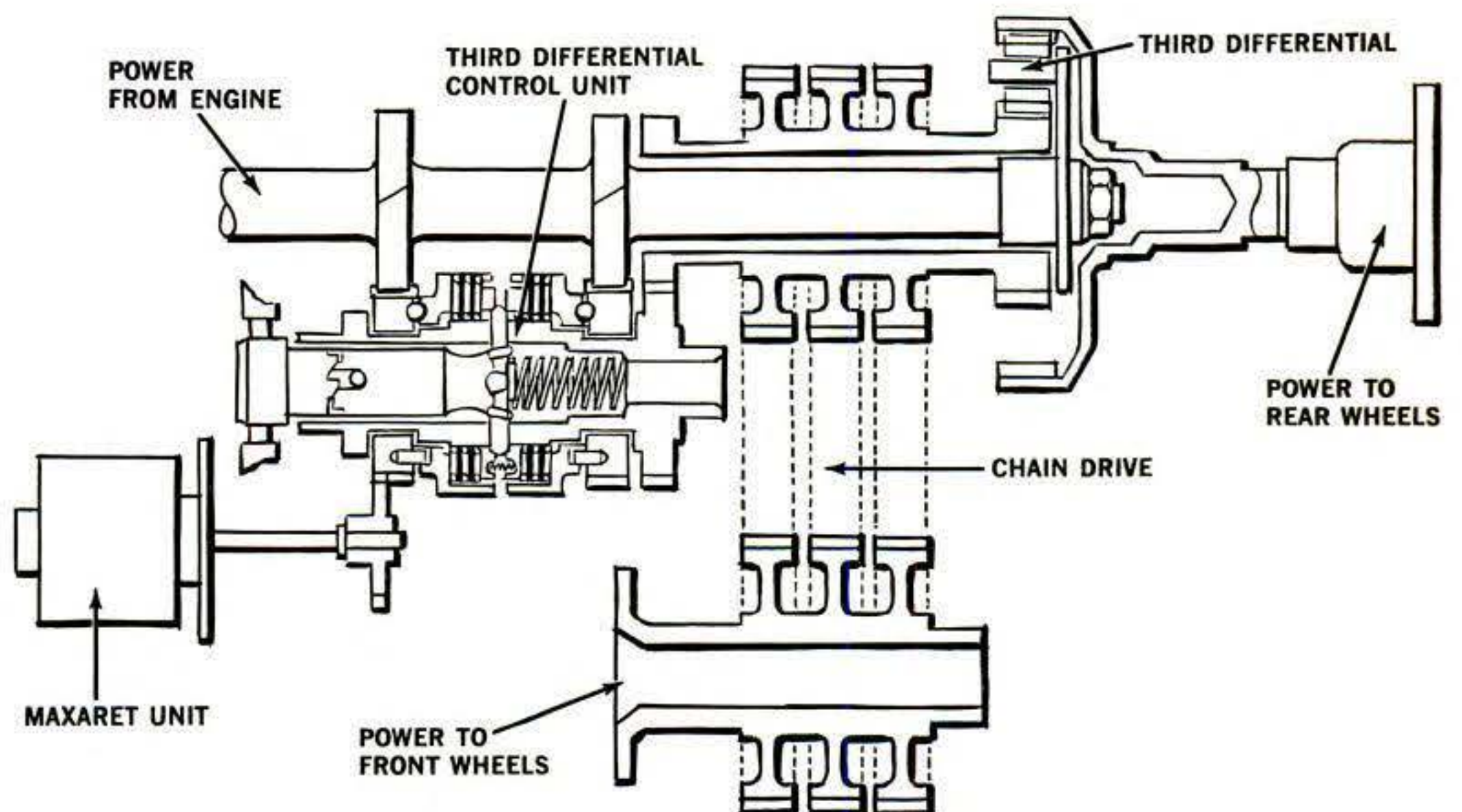
Cars are made to go on roads. They are at their best on smooth, dry highways. Rain cuts tire-to-road adhesion, and it rains everywhere from time to time. Most northern and mountain states have problems with snow and ice. Under such conditions, 4WD is an important safety factor. That's

why ordinary-looking cars with experimental 4WD systems are being built and tested by several companies. Most systems are the full-time type—drive to all four wheels is permanently engaged.

These developments have been aided by an opposite trend: Off-highway vehicle users want highway

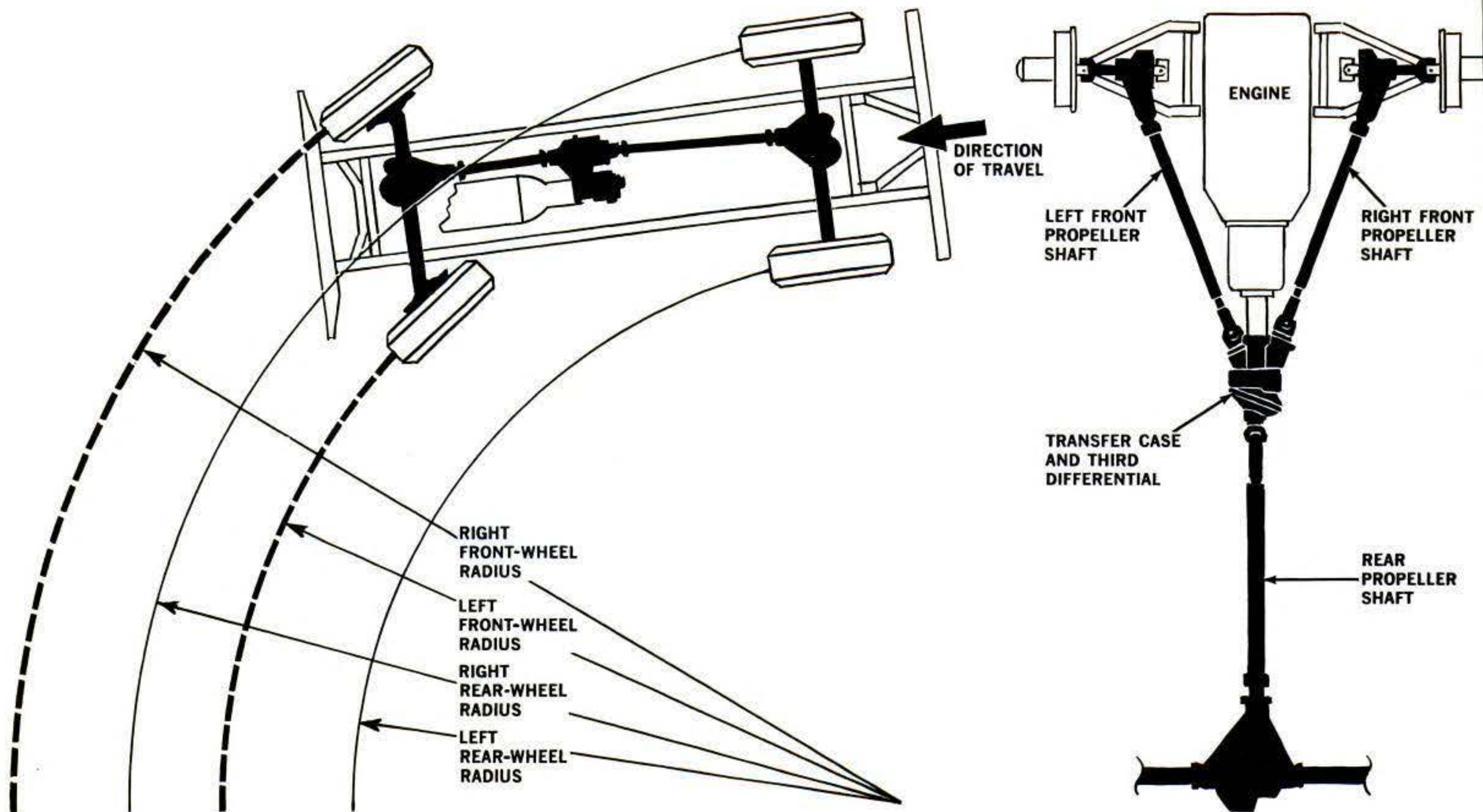
cruising capability with a minimum of fuss. The modern full-time 4WD system is the answer. Why? Because of its limited-slip center differential (between front and rear). A drawing and caption (page 76) explain the need for the "third" differential.

The systems are claimed to be fully *Continued*



GKN-Birfield 4WD system is based on Ferguson patents. Sketch shows center differential and Maxaret antiskid system. Drive is taken from automatic-transmission output shaft and fed straight into center differential. Control unit limits front/rear differential action by locking up a clutch in front- or rear-wheel drive line to suit need.

Front wheels can overrun rear ones by 20 percent, but no more. Gear ratios are selected to give 1.7:1 torque split between the two axles, so that 37 percent of torque goes to front, 63 percent to rear. This limits understeer (associated with front-wheel drive) and takes advantage of rearward weight transfer on acceleration.



**Old-type 4WD systems** cause problems of handling, drive-line wear, and tire wear. Front drive must be uncoupled when the vehicle is driven on hard-surface roads, then shifted back into action when going gets slippery. With these systems, front

and rear wheels are locked together and turn at same speed. But as drawing shows, the front wheels travel a longer path in a turning maneuver. They must be allowed to freewheel, or be provided with differential action from the vehicle's rear wheels.

**Dana's V drive** has a third differential incorporated into the transfer case, with individual propeller shafts to each front wheel. The system is suitable for installation on conventional passenger cars, with low engine mounting and low hood.

perfected and awaiting only the go-ahead from Detroit.

- GKN-Birfield is the most sophisticated.
- Borg-Warner has a simplified system at far lower cost.
- Dana Corporation has a unique V-drive system.

**How they work.** There are differences in each system.

The GKN-Birfield drive was first used in a British police car [PS, Nov. '69]. The installation on a Plymouth U.S. police car is similar, using the same limited-slip center differential. A drawing tells how it works. Cost is estimated at about \$1,000 a car, while the Dana and Borg-Warner are said to be cost-competitive with existing 4WD systems.

The Borg-Warner system is based on the same sort of drive train found on Jeeps, Scouts, Broncos, and Blazers, using a front axle; it differs mainly in its use of a third differential. It is not presently suitable for passenger cars, but can give new versatility to off-road vehicles.

Dana's V drive offers a different solution to putting 4WD on passenger cars. The front wheels have individual drive shafts branching out of the gearbox on opposite sides of the engine. With this design, the engine can remain at its design height. Dana claims that the standard suspension used on passenger cars need not be radically changed with its system, an advantage in lower cost to buyers.

Dana has a Ford station wagon

with its system and, on the exterior, it is indistinguishable from a production car. Other forms of 4WD, lacking some features offered by the full-time systems, are being developed.

Chrysler is working on a system with a positive locking device instead of a third differential. That limits it to off-highway use, but it's noteworthy that engagement of 4WD is via a dashboard knob, not a big lever.

**On-demand 4WD.** Detroit Automotive Products and Eaton are developing "on-demand" 4WD systems; the vehicle is normally driven in the 2WD mode, but 4WD is engaged automatically when needed.

The rear axle ratio is so set that the rear wheels turn about three percent slower than the front ones. In normal



**Dodge pickup truck** above is equipped with the new manually operated Chrysler 4WD system with positive front/rear locking.

**Chevy Blazer truck** at left, fitted with Detroit Automotive Products on-demand 4WD system, was test-driven by Jim Dunne.



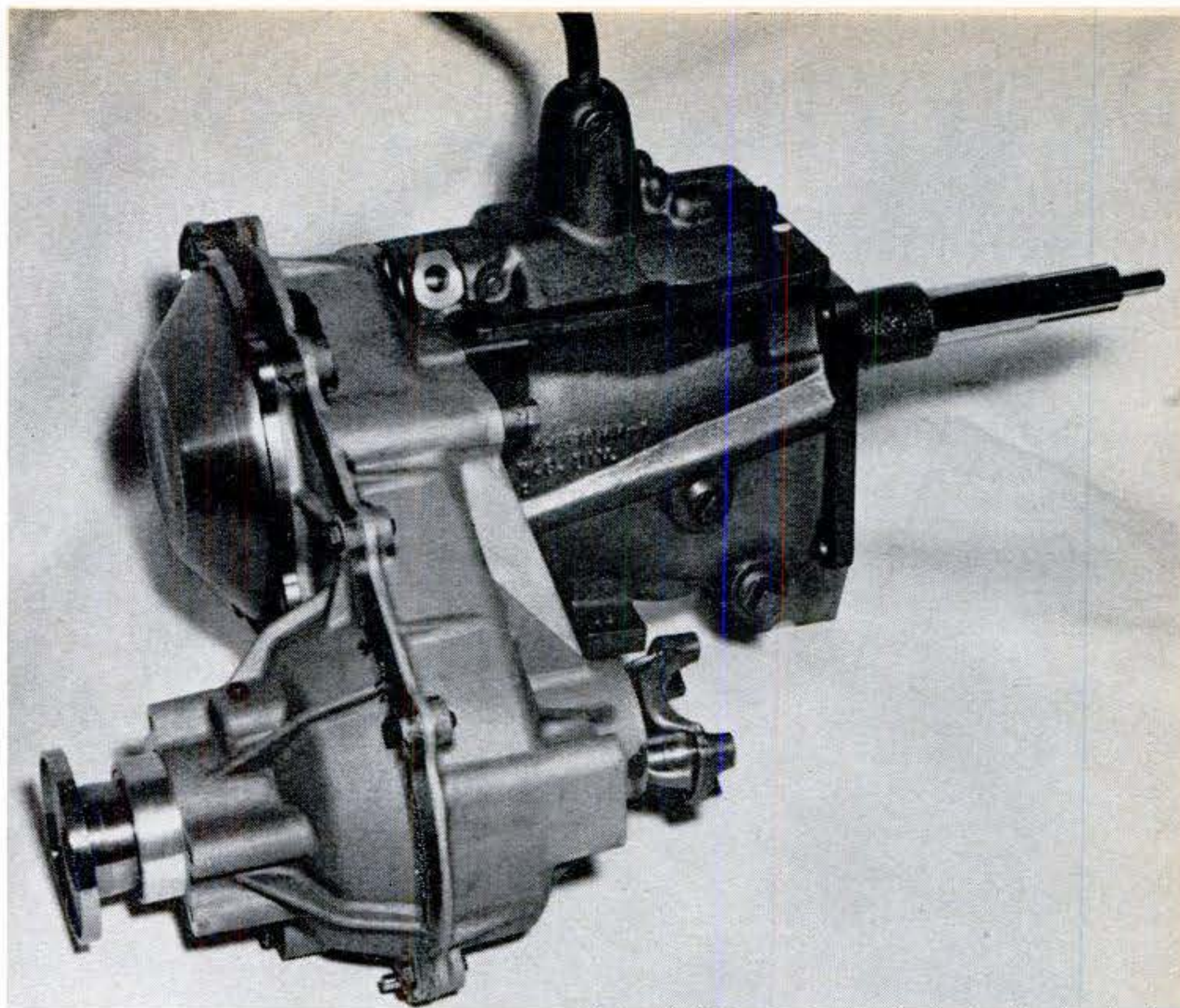
driving, this permits the front wheels to freewheel. But when the rear tires lose traction on slippery surfaces, the rear axle turns faster and catches up with the speed of the front axle.

When that happens, a ratchet-type connection between the front and rear axle engages, and the front and rear drive shafts turn as one unit. This provides the power to all four wheels. Then, when the rear wheels return to a normal road surface they stop spinning faster than the front wheels, and the ratchet connection is disengaged. On-demand 4WD cuts in and out as quickly as needed.

Detroit Automotive Products is aiming its system at the RV field. Eaton has started production of a unit for highway tractors (now optional on International trucks).

A hydrostatic transmission developed by GM's Saginaw Steering Gear Division provides a novel form of manually-controlled on-demand 4WD (see illustration). It is intended mainly as an emergency device, for short-duration operation only.

Some 4WD systems are scheduled for introduction in RV applications during the next 12 months, and it may not be much longer before standard passenger cars will be offered you with 4WD as optional equipment. **PS**



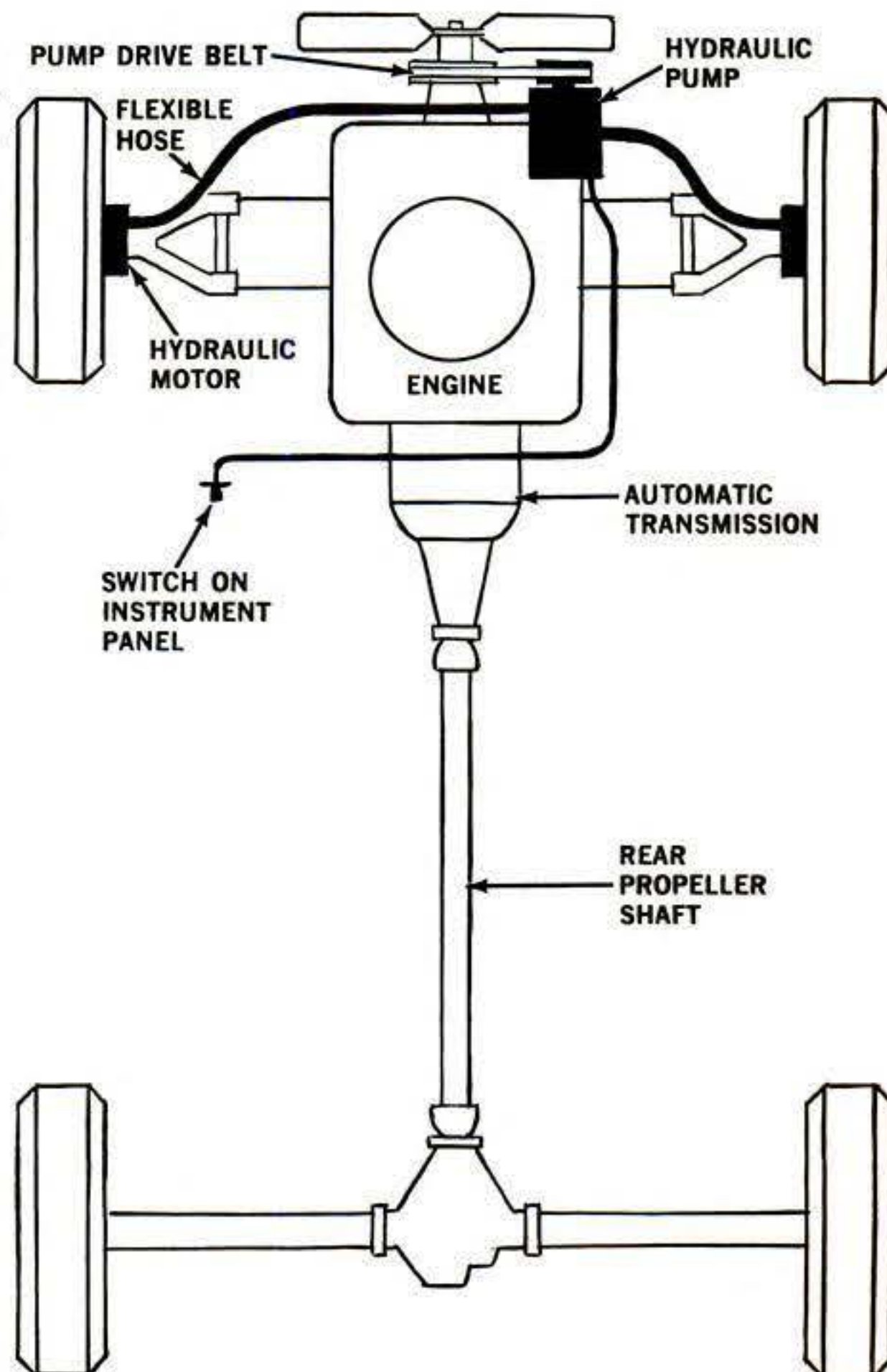
#### TEST RESULTS

	2WD	4WD
Circle test (50-ft. radius; average time)	34.1 sec.	31.6 sec.
Circle test (25-ft. radius; average time)	25.9 sec.	21.4 sec.
Slalom test (240-ft. length; average time)	20.2 sec.	17.6 sec.
Acceleration (48 ft. from standstill)	9.45 sec.	5.65 sec.
Acceleration (240 ft. from standstill)	20.65 sec.	11.83 sec.

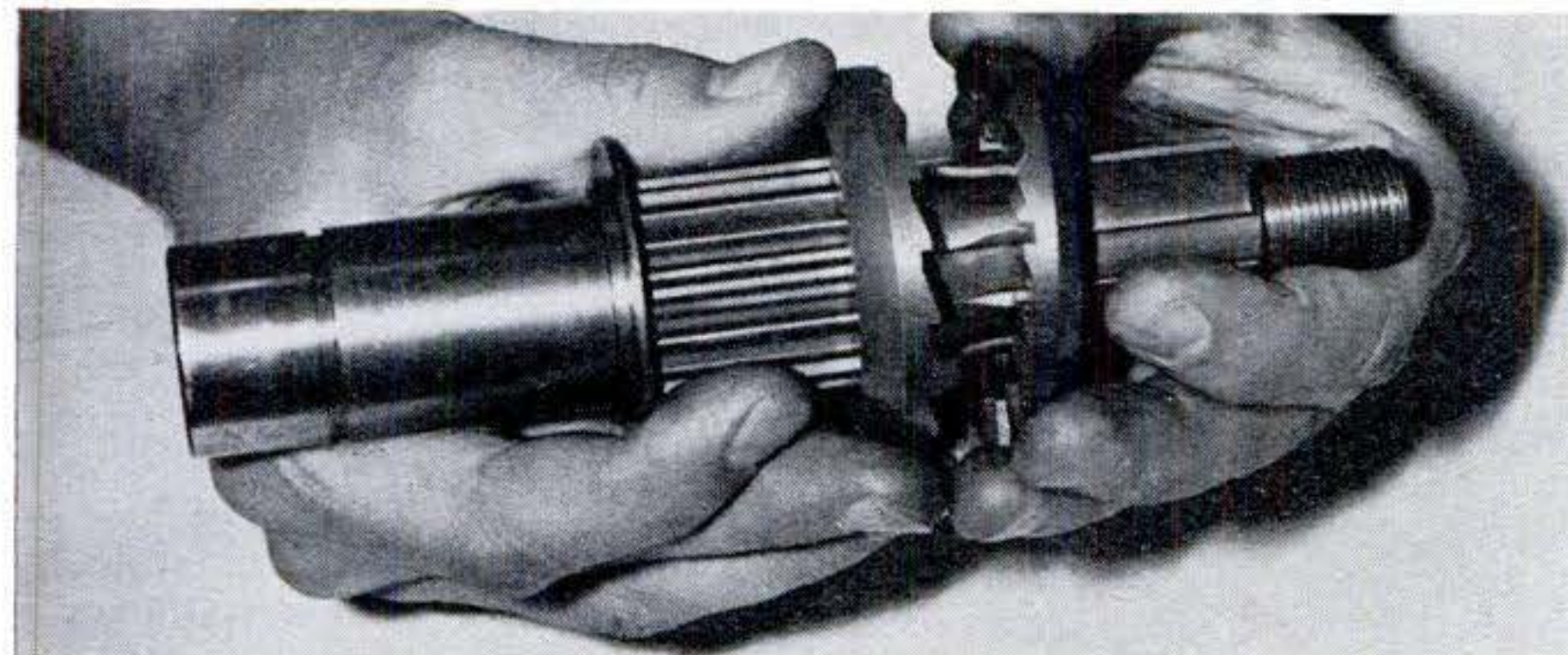
**Borg-Warner's compact unit** combines transfer case and third differential for full-time 4WD. Table above shows results of tests run on icy surface with same car in

two-wheel and 4WD modes. Acceleration gains are spectacular, and improved speed capacity for maneuvering promises greater safety in emergency situations.

**A different approach to 4WD** used by GM's Saginaw Steering Gear Division: hydrostatic drive to the front wheels, with retention of the standard drive train to rear wheels. A hydraulic pump on the engine builds up the pressure needed to run hydraulic motors built into the front wheel hubs. Flexible hoses connect the motors to the pump. Low efficiency restricts its use to short periods at low speed, but with high torque. It could be answer for occasional 4WD, as for fishermen or campers.



**Transfer case and lockup unit** for the Chrysler 4WD system is seen here installed on the Dodge pickup. Front drive can be brought in and out of action with the simple flick of a switch, and should not be used on hard-surface roads. The system employs no third differential.

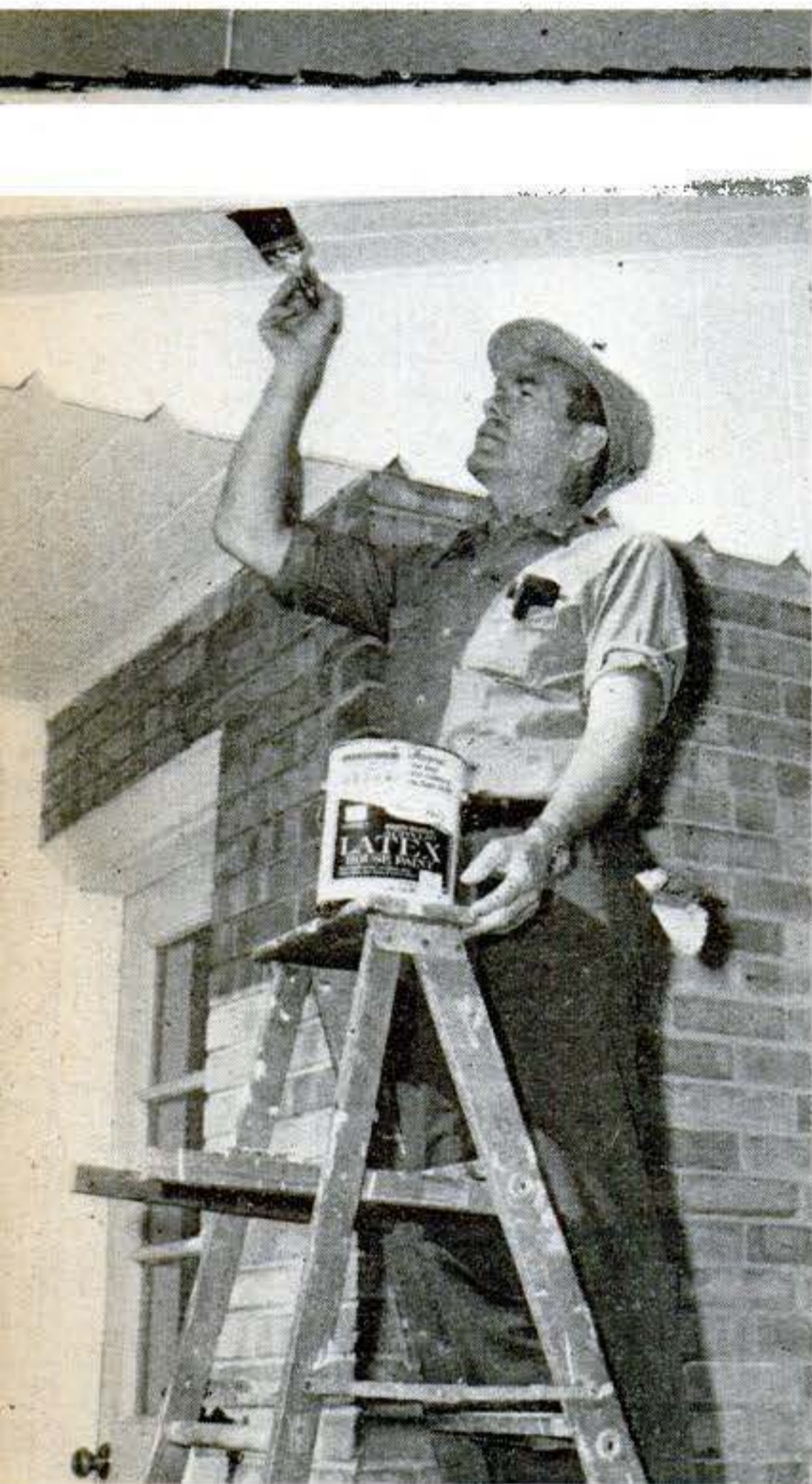


**This little unit is the heart** of Detroit Automotive Products' on-demand 4WD coupling. Simple splined shaft and gear system senses rear wheelspin and automatically engages front-wheel drive; disconnects it when not needed.

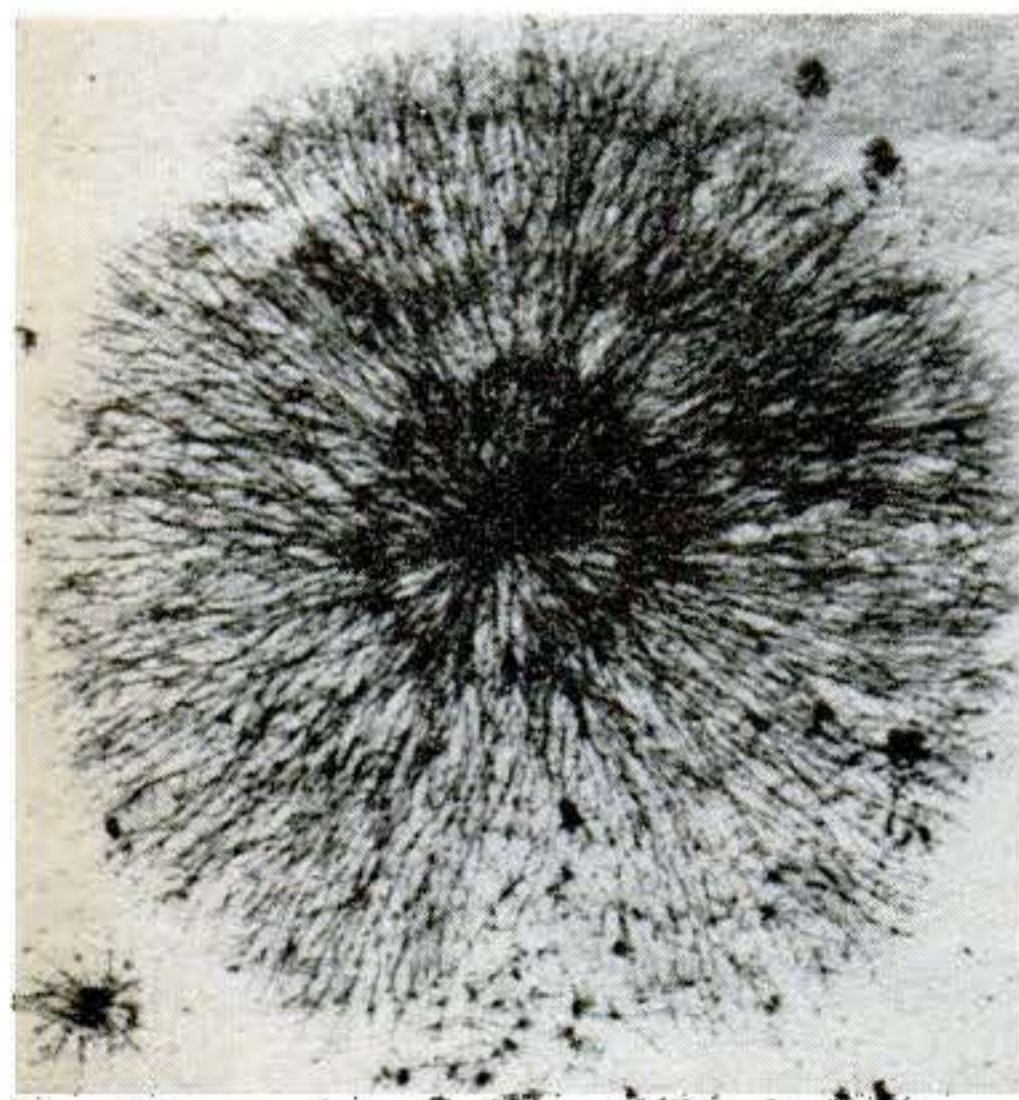
# NEW HOUSE PAINTS Fight Mildew

With lead out, mildewcides in, your next house paint will last longer and look better

By E. F. LINDSLEY / PS Midwest Editor



Mildewcide additives in acrylic latex flat paint will slow the darkening process on this overhang. But paint companies disagree on whether additives should be in prime, finish, or both coats.



Ever painted your house and, as the months went by, watched in disgust while the once-bright surface discolored, blotched, and faded? You are not alone and, judging by the responses of 46 paint manufacturers to a POPULAR SCIENCE query for advice, their anguish exceeds yours.

Most paint makers agree on what causes the troubles, and most have taken major steps to improve your next paint job. Summed up, paint that loses its good appearance before the normal toll of weathering is a victim of:

- 1) Physical discoloration from airborne dirt, or rust and metal washing.
- 2) Chemical discoloration from air-polluting chemicals. Usually it's from sulfur.
- 3) Biological discoloration from any of thousands of mildews.

Any of these, jointly or singly, can foul up your paint surface. Industrial dust, fertilizers, and chemicals may cling to the surface and dirty it. At the same time, they may react (for example, the alkali in cement dust) with the paint chemically. And while this is going on, mildew spores may be at work on their own private blotches. A lot depends on climate. Chemical problems are usually intensified by moisture. Mildew must have moisture to do its damage.

What's being done about it? Well, you'll find lead and lead-bearing pigments almost phased out of house paints. Lead, once the great paint base in a rural America, combines with sulfur in the air to produce chemical discoloration. Even if you don't live near a source of industrial pollution, marsh gas can mess up your paint. Sources? Sewer gases, decaying vegetable matter in roadside ditches, swamps, and drainage trenches. Mer-

cury compounds in paint, often used as a mildewcide, can also react with marsh gas to produce discoloration. All these unfortunate reactions are enhanced by damp surfaces.

Why worry if the makers are getting the lead out? For one thing, most repaint jobs will be done with latex paint. Latex is porous and allows gases to reach undercoats of old lead paint. If you've had gas discoloration with your old paint, use a good non-lead, oil-base primer to seal it before applying the new paint.

**Lead substitute.** Titanium dioxide does a better job than lead—but don't spoil it by adding lead-base tinting agents. Although the discontinuance of lead is generally claimed to be the answer to most chemical discoloration, the Tropical Paint Co. says, "The formulation and additives used to produce a successful coating for the Great Lakes area may not be adequate for the Gulf Coast region."

They also point out that emissions from a chlorine-producing plant may differ entirely from those of a steel mill. Your best bet is to watch the performance of various paints in your own neighborhood and select the most successful.

It may be hard to tell mildew from chemical action or dirt. Use a magnifying glass. Undeveloped mildew shows up as black, shiny spores, in contrast to dirt, which appears sand-like. Mildew is uniform and darker, and appears under magnification as branching filaments during growth. Another test: Put a drop or two of fresh household bleach on the spot. Mildew will usually bleach in a minute or two. Dirt usually won't.

**Stop mildew?** You can fight mildew, but most of the paint manufacturers say their paints are "resistant," not cure-alls. The O'Brien paint experts say, "If the moisture condition is chronic, killing the spores and repainting may be only a temporary solution." All makers insist that existing spores must be killed before painting. Their recommendation:

Scrub with a solution of  $\frac{2}{3}$  cup of trisodium phosphate (like Soilax),  $\frac{1}{3}$  cup of detergent (like Tide), and one quart of household bleach (like Clorox), in enough warm water to make a gallon. Rinse thoroughly and allow the surface to dry well—up to 48 hours. Then paint immediately. New spores can collect, and even though the paint may look fresh after scrubbing, the mildew can reappear in a few weeks.



Sulfide stains from air pollution occur in lead-base paints or improperly sealed base paints with a porous latex finish.

Mildew colony, when growing, looks like branching filament under 40X magnification. The black clumps are inactive spores.

# and Pollution

**Manufacturers on mildew.** From here on, paint makers disagree. Some say that mildewcide in the finish coat will do the trick. Others, like Allentown Paint, say: "It is just as important, if not more so, to have the primer mildew-resistant."

Sherwin-Williams says that "The additive (mildewcide) need only be used in the prime coat"—but in this case, they're talking about the user introducing a mercury compound into the primer at the job and using a finish coat *without* built-in mildew resistance. They feel that the use of this additive is usually unnecessary with mildew-resisting top coats.

So, for mildew problems that don't respond to less drastic treatments, they do offer, somewhat reluctantly, we suspect, the mercury dope to be used—four ounces per gallon in oil-base primer coats. The same chemical others use, Di(phenylmercury) dodeceny succinate, it's quite toxic.

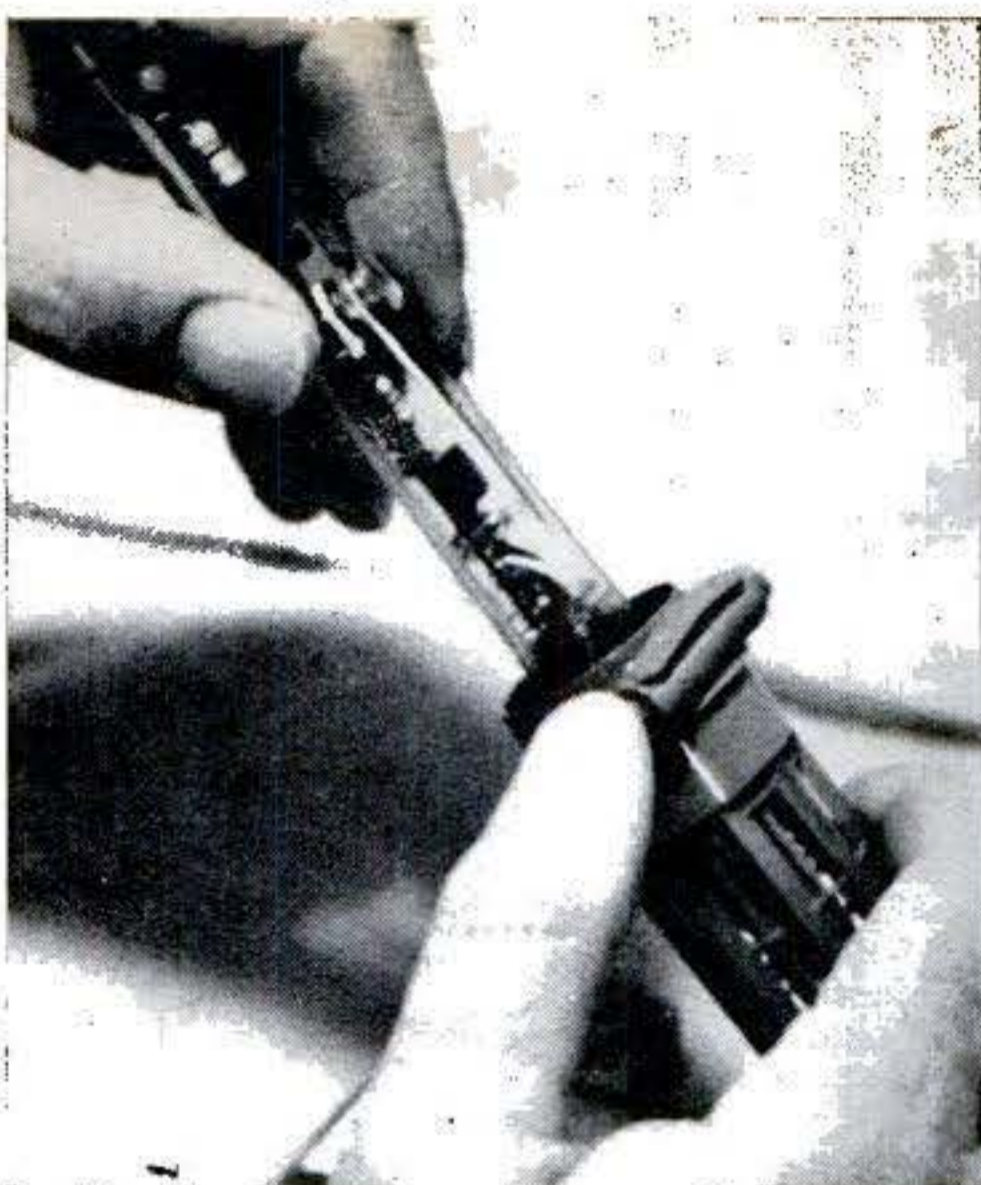
Since mercury may stain from sulfide pollutants, zinc oxide is more often used as a mildewcide. If hydrogen sulfide does go to work on the zinc, the result is white zinc sulfide, and discoloration is not a problem. Valspar uses Bar/met (barium metaborate) as a mildewcide and rust inhibitor in their new pollution-resistant acrylic house paint. Here are the main points to remember:

- Paints can resist mildews, not stop them dead in severe cases.
- Never apply fresh paint over mildew without the scrubbing treatment.
- Mildew can live on a painted surface without feeding on paint; it may, for example, feed on airborne pollen trapped in the fresh paint.

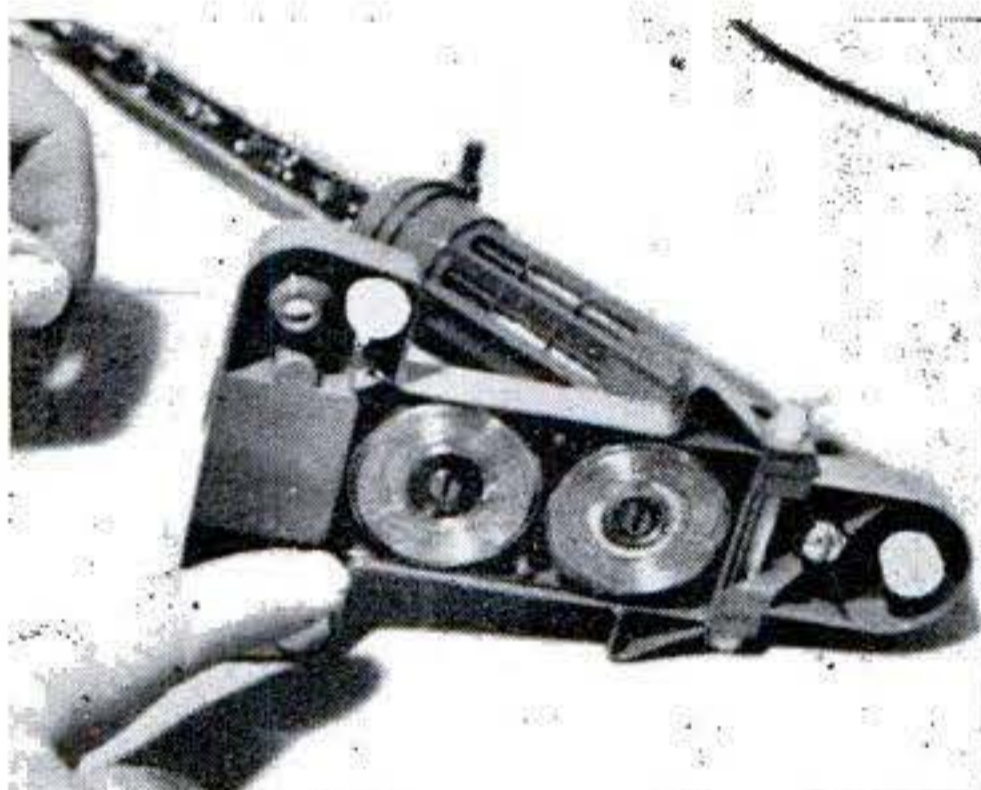
Surprisingly, paint itself is classified as an air pollutant in some areas (particularly California and New York) because of solvents released while it's drying.

One new paint development makes it easier to keep down pollution and still have gloss-finish trim on your house. Acrylic-latex trim enamels, unlike the more familiar flat-latex finishes including the acrylic variety, go on and wash up like any other latex base but leave the sparkling neatness of glossy trim. The basic ingredients of these gloss enamels hark back to Rohm and Haas Plexiglas.

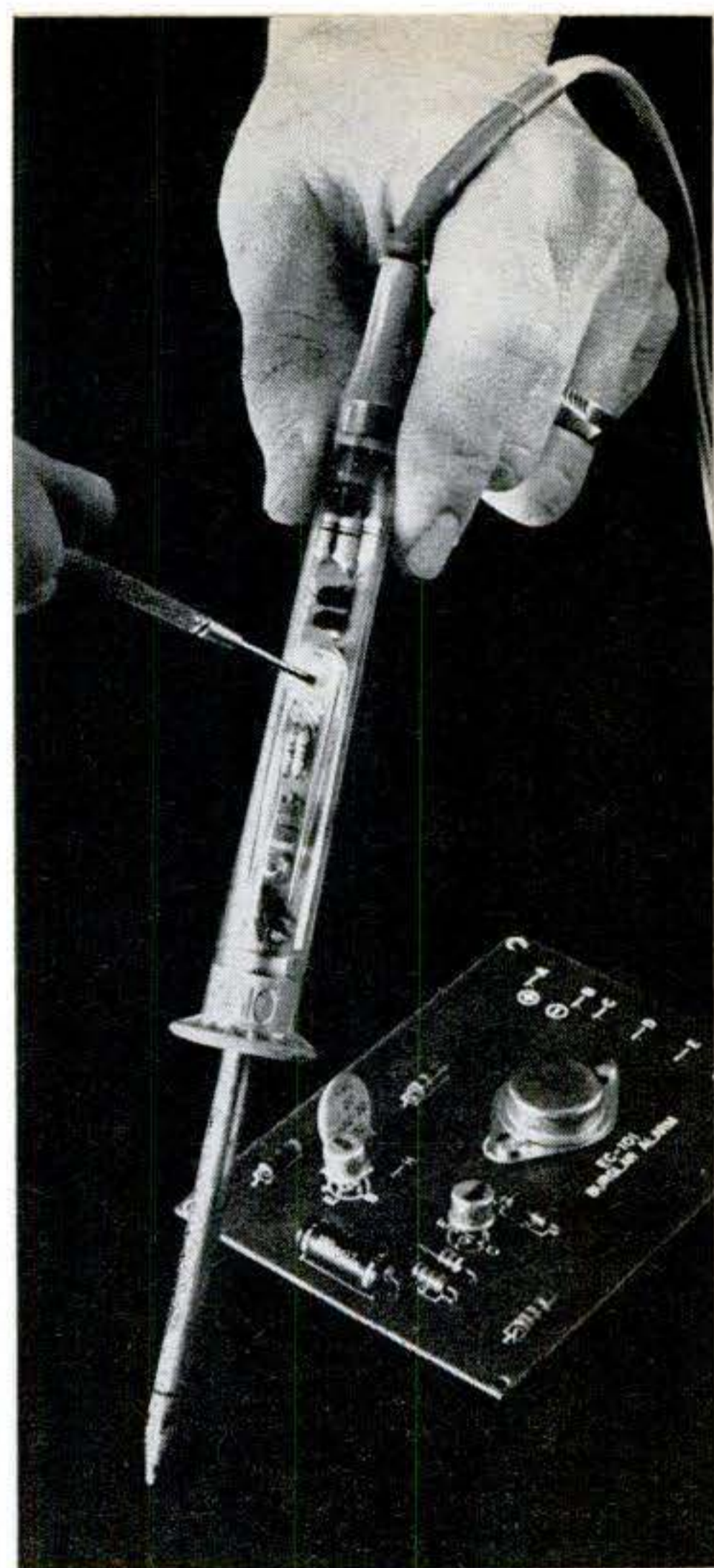
So on your next paint job you can forget about white-lead-and-oil mixes, expect less discoloration, gain mildew resistance, and enjoy water-based gloss trim paint. PS



**Pushbutton lock** keeps Loner in place when not in use. Push other way frees it.



**Base stand** holds two solder spools. Bench mount has a flux pot and magnifier.



**Adjustable heat-control dial** lets you set maximum temperature of the Loner.

## Now: A See-Through Soldering Iron

Here's a soldering iron that's not an iron. At least, Edsyn, its manufacturer, doesn't call it one. They call it a soldering *instrument*—for built into the Loner's handle is an electronic circuit that constantly and accurately controls tip temperature.

Use it on a small soldering job and the tip heats the connection to a preset temperature. (You set it with a potentiometer on top.) Use it on a large job and the tip is supplied with more wattage to raise the joint to the same preset level. When not in use, the tip idles at a mere nine watts, but ready to supply up to 50 if needed.

The circuit that does the brain work is basically a temperature sensor built into the tip and a differential amplifier controlling an SCR in the handle. When tip temperature drops below the preset level, the differential amp triggers the SCR, heating the element.

I found that the Loner's handling matches its looks. Its light weight (four oz.) and handle design make working with it a pleasure. Initial

heat-up time is around 30 seconds (great if you're the impatient type) and recovery time is extremely fast. There was never any cold-solder buildup on the tip due to the heat-sinking property of a large joint.

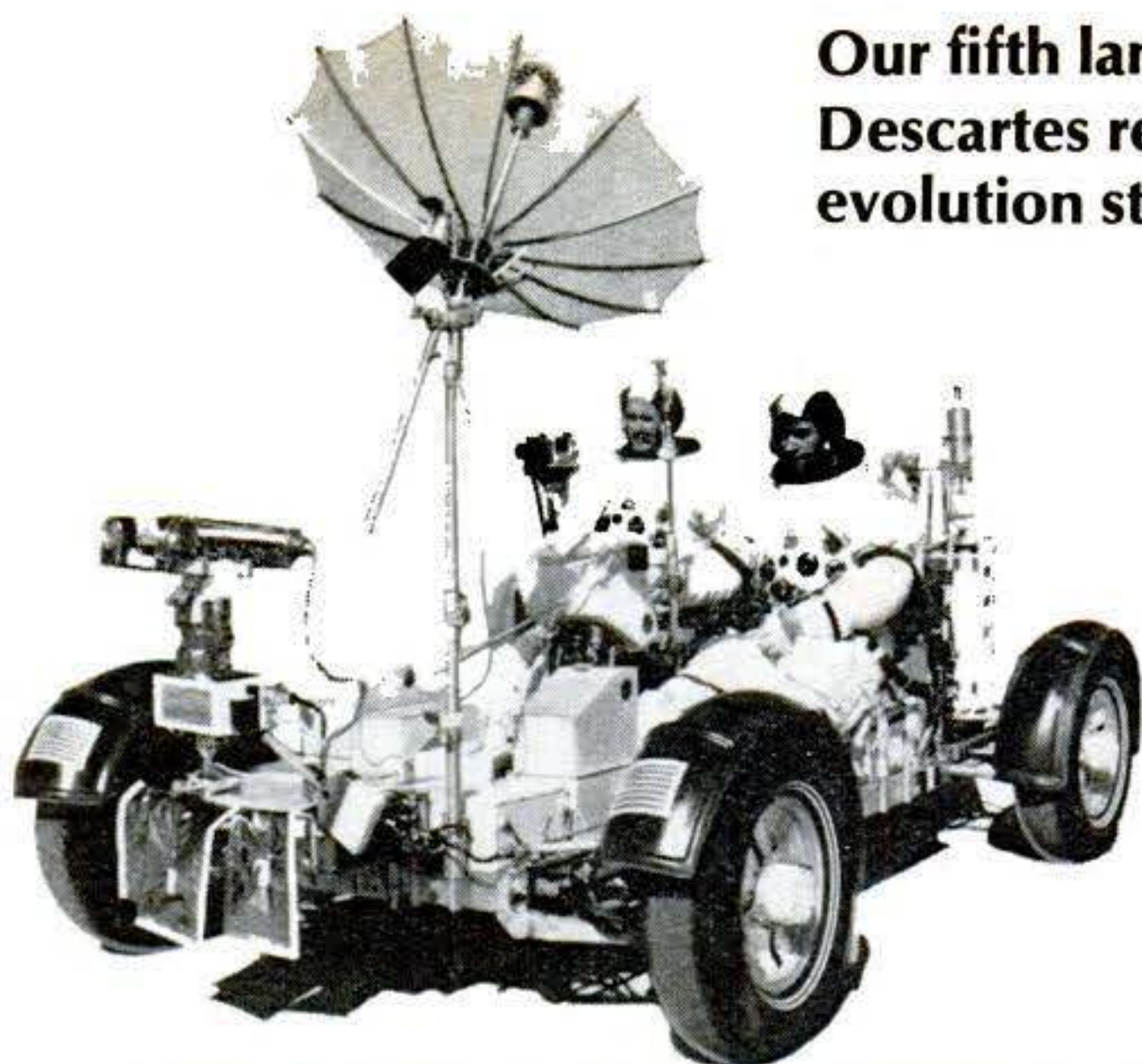
The Loner is well engineered right down to the stand that comes with it. You have a choice of two: bench mount or base mount. I chose the base mount and found a few welcome features.

On the underside are two spools of solder feeding through two holes in the top. Need solder? Just pull. The wiry stuff is kept neat and out of the way, but right at hand.

The normal tip-cleaning sponge is there, too, but the best idea is a button on top of the stand. Push it one way and the Loner can't come out; push the other way and it's free for use. You'll know the advantage to that if you've ever snared a power line with your feet or had inquisitive kids in the shop.

The Loner, including the stand of your choice, is \$39.50 from Edsyn Inc., 15954 Arminta St., Van Nuys, Calif. 91406.—W. J. Hawkins

Our fifth landing mission is slated for the mountainous Descartes region. Geological samples will round out the lunar evolution story as experiments probe for other moon secrets



# APOLLO 16

## Exploring the Lunar Highlands

By  
**DR. WERNHER von BRAUN**  
 NASA Deputy Associate Administrator  
 PS Consulting Editor on Space



**I**gnition! A jet of yellow-orange flame, triggered by the on-board computer, erupts from the Lunar Module's descent engine at precisely 2:54 p.m. EST on April 20. Twelve minutes later, if Apollo 16's timeline continues as planned, the LM will settle in the rugged Descartes region. Man, for the fifth time in four years, will set out to explore the desolate lunar surface.

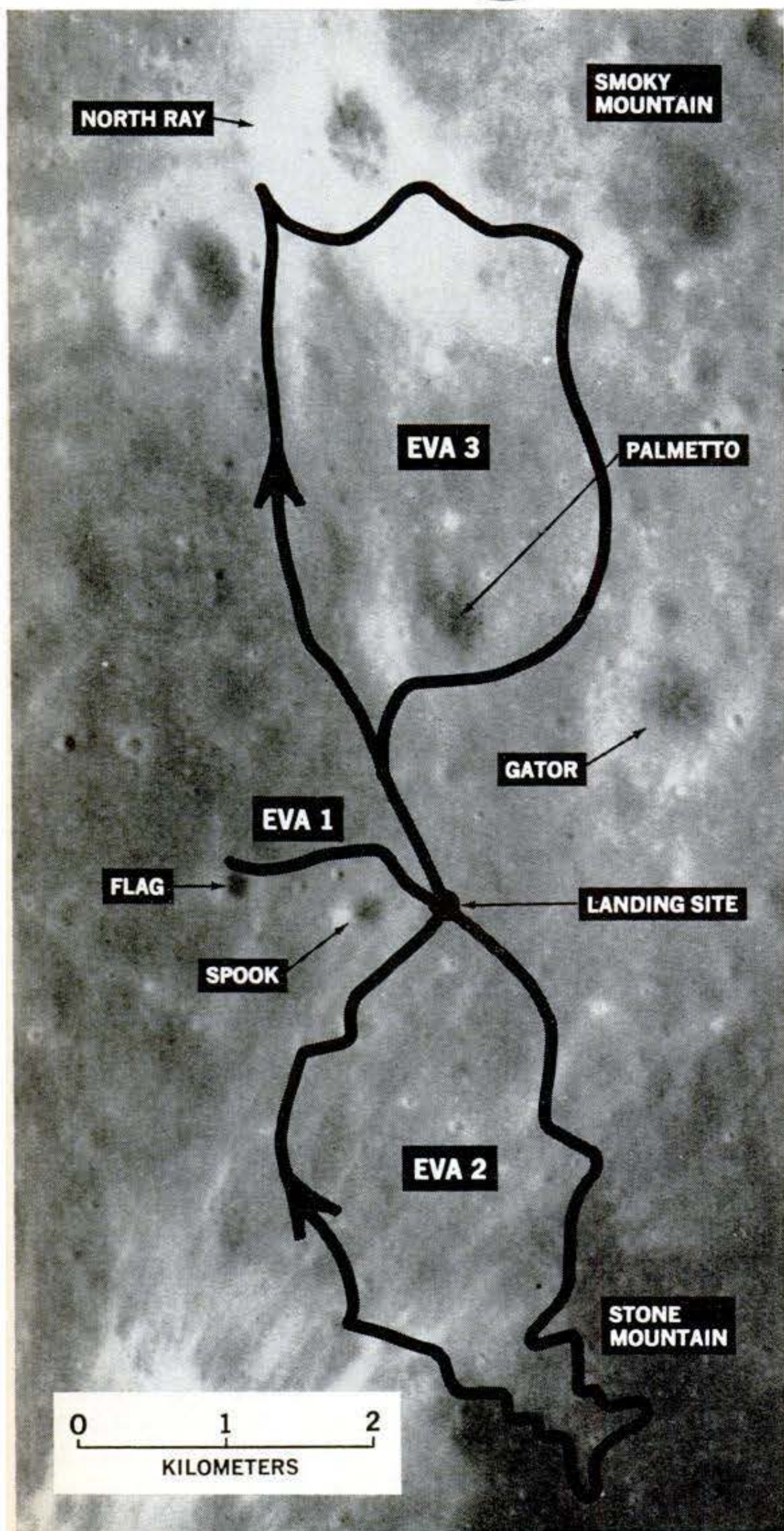
As the descent engine whines beneath their feet, Commander John Young and LM Pilot Charles Duke will arc downward toward the central lunar highlands. The Descartes landing site is surrounded by some of the most starkly beautiful terrain yet visited by astronauts—topographically one of the highest regions on the Earth-side hemisphere.

This site has been selected to complement the 1969 Apollo 11 and 12 missions to mare areas, Apollo 14's Fra Mauro upland site, and 15's exploration last July of Hadley-Apennine, a northern plain flanked by high mountains and a deep gorge. Apollo 16's site, as we'll see, provides distinct geological sampling objectives to help fill the gaps in lunar models developed thus far. A battery of scientific experiments is also planned.

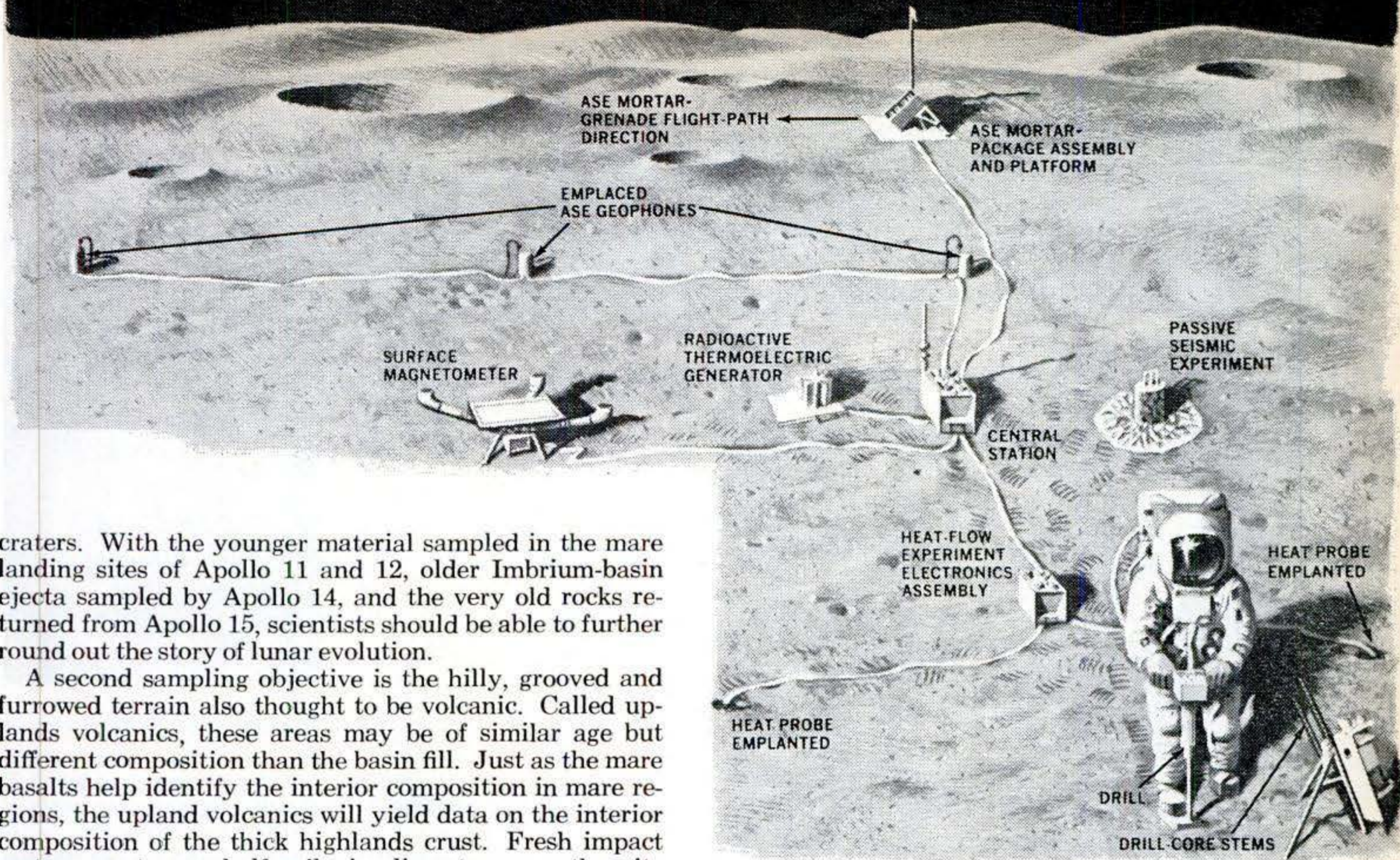
**Blastoff from Kennedy.** The mission is scheduled to get underway at 12:54 p.m. EST on April 16. Twelve minutes after the Saturn 5's five first-stage engines come to life, the third stage will be shut down and the spacecraft will enter a 90-nautical-mile circular parking orbit around the Earth. At 3:44 p.m., the third stage will have completed its second burn and Apollo 16's three-day unpowered flight to the moon will have begun. Twelve days later, on April 28 at 5:30 p.m. EDT, the Apollo 16 crew will splash down in mid-Pacific.

Skipper of Apollo 16, John W. Young, is a veteran of Gemini flights 3 and 10. John also served as command-module pilot on Tom Stafford's Apollo 10 "dress rehearsal" flight. Young's companion on the lunar surface, Charles M. Duke Jr., played a major part in many Apollo flights as capsule communicator at the Houston Mission Control Center. Thomas K. Mattingly II, who missed the ill-fated Apollo 13 flight because of exposure to German measles, will be command-module pilot.

Once at the Descartes site, the astronauts will explore and obtain samples from two lunar formations. The first involves the highlands basin fill. This is a volcanic-appearing material, flooding many of the old highland



Astronauts Duke and Young (top) practice with Lunar Rover similar to vehicle that will carry them over looped routes to sampling sites. They'll be on the lunar surface for three days and nights.



Central station receives data from site experiments and transmits the information to Earth. The mortar can be fired from Earth. Crewman here is drilling for a deep-core moon sample.

craters. With the younger material sampled in the mare landing sites of Apollo 11 and 12, older Imbrium-basin ejecta sampled by Apollo 14, and the very old rocks returned from Apollo 15, scientists should be able to further round out the story of lunar evolution.

A second sampling objective is the hilly, grooved and furrowed terrain also thought to be volcanic. Called uplands volcanics, these areas may be of similar age but different composition than the basin fill. Just as the mare basalts help identify the interior composition in mare regions, the upland volcanics will yield data on the interior composition of the thick highlands crust. Fresh impact craters up to one-half mile in diameter near the site should permit selective sampling to 600-foot depths.

**Roving the moon's surface.** The first extravehicular activity (EVA) will involve inspection of the LM, "grab bag" sample collections close to home, and deployment of the Apollo Lunar Surface Experiments Package (ALSEP). Also, the Lunar Roving Vehicle (LRV) will be removed from its LM cradle, unfolded, checked out, and used for a short ride. EVAs 2 and 3 will be round-robin land traverses to sites up to five miles from the LM.

Apollo 16's ALSEP will be similar to the three still-operating ALSEPs left by Apollos 12, 14, and 15. Most ALSEP instruments furnish local data, which are carefully compared to better understand phenomena involving the entire moon. However, the passive seismic experiments form a regular seismic network that can nail down the location of a distant meteoroid impact or a moonquake through triangulation.

Electrical power for the ALSEPs is provided by a Radioactive Thermoelectric Generator (RTG), which converts heat generated by a radioactive fuel capsule into electricity with the help of a thermocouple bank. One of the first tasks on the lunar surface is to transfer the radioactive fuel capsule from a crashproof cask on the LM descent stage to the RTG's converter casing.

Then the two subpackages making up the ALSEP unit (see photo) are separated so an astronaut can carry them like a barbell with the ALSEP antenna mast. When the various experiments are deployed, all elements are electrically connected with a central station that radios data back to Earth and receives instructions from Earth after the astronauts have departed.

**Launching rocket grenades from Earth.** Close to the central station will be the Passive Seismic Experiment (PSE). Its purpose is to measure seismic signals originating anywhere on the moon's surface (meteoroid impacts) or in its interior (moonquakes). The time required for seismic waves to reach each ALSEP station tells geologists a great deal about the interior makeup of the moon. The PSE looks somewhat like a large tin can and houses three mass-spring seismometers for the up-down, north-south, and east-west components of the tremors; in

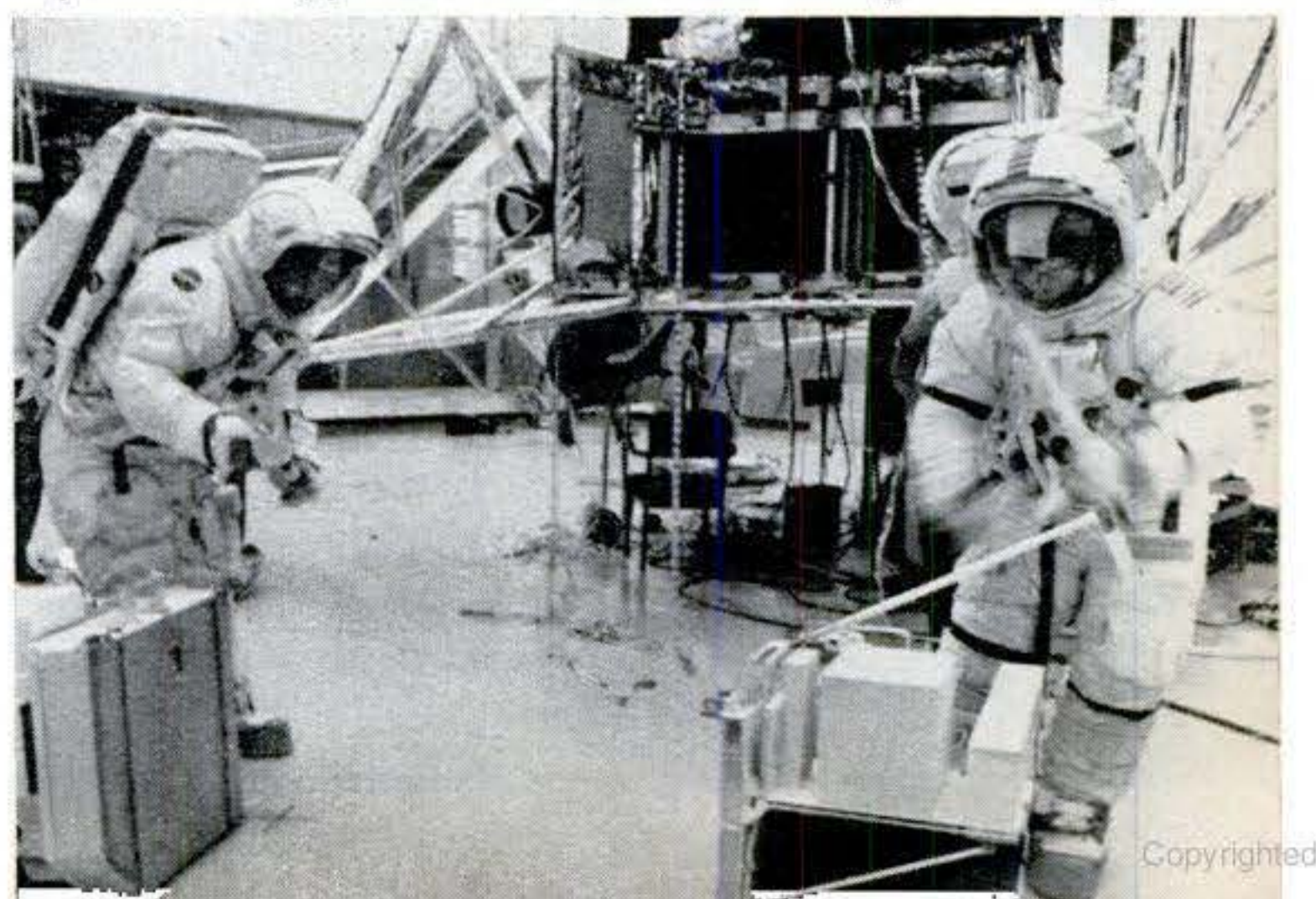
addition, there is a fourth seismometer for short-period up-down movements of higher frequencies.

The Active Seismic Experiment (ASE) will furnish data on the physical properties of lunar surface and subsurface materials. A string of three geophones about 150 feet apart will receive natural and artificially produced seismic waves. But since the central station can activate the power- and channel-consuming ASE only an average of about 30 minutes per week, we cannot rely on natural seismic-wave sources. The waves are therefore generated by a "thumper," a sort of pneumatic road hammer driven by shotgun charges fired by an astronaut at 15-foot intervals as he walks along the geophone line.

Apollo 16 introduces a novelty to the Active Seismic Experiment: A little rocket launcher will fire grenades up to 5,000 feet by Earth command after the astronauts have departed. The high-explosive charges will detonate on impact, and each grenade is equipped with a timing

*[Continued on page 144]*

Two subpacks, deployed from LM mockup in background, contain experimental apparatus that Duke and Young will set up at site.



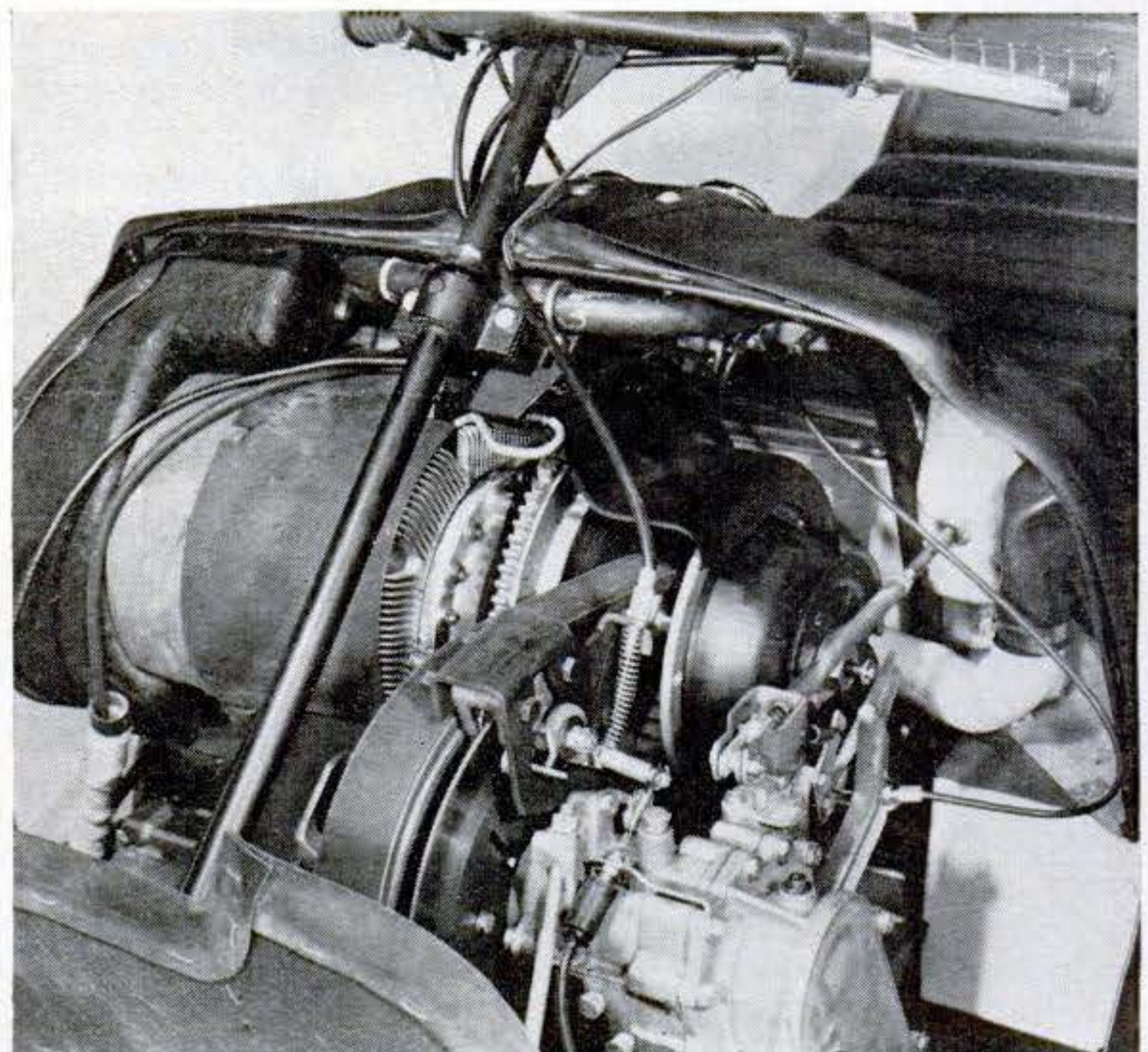
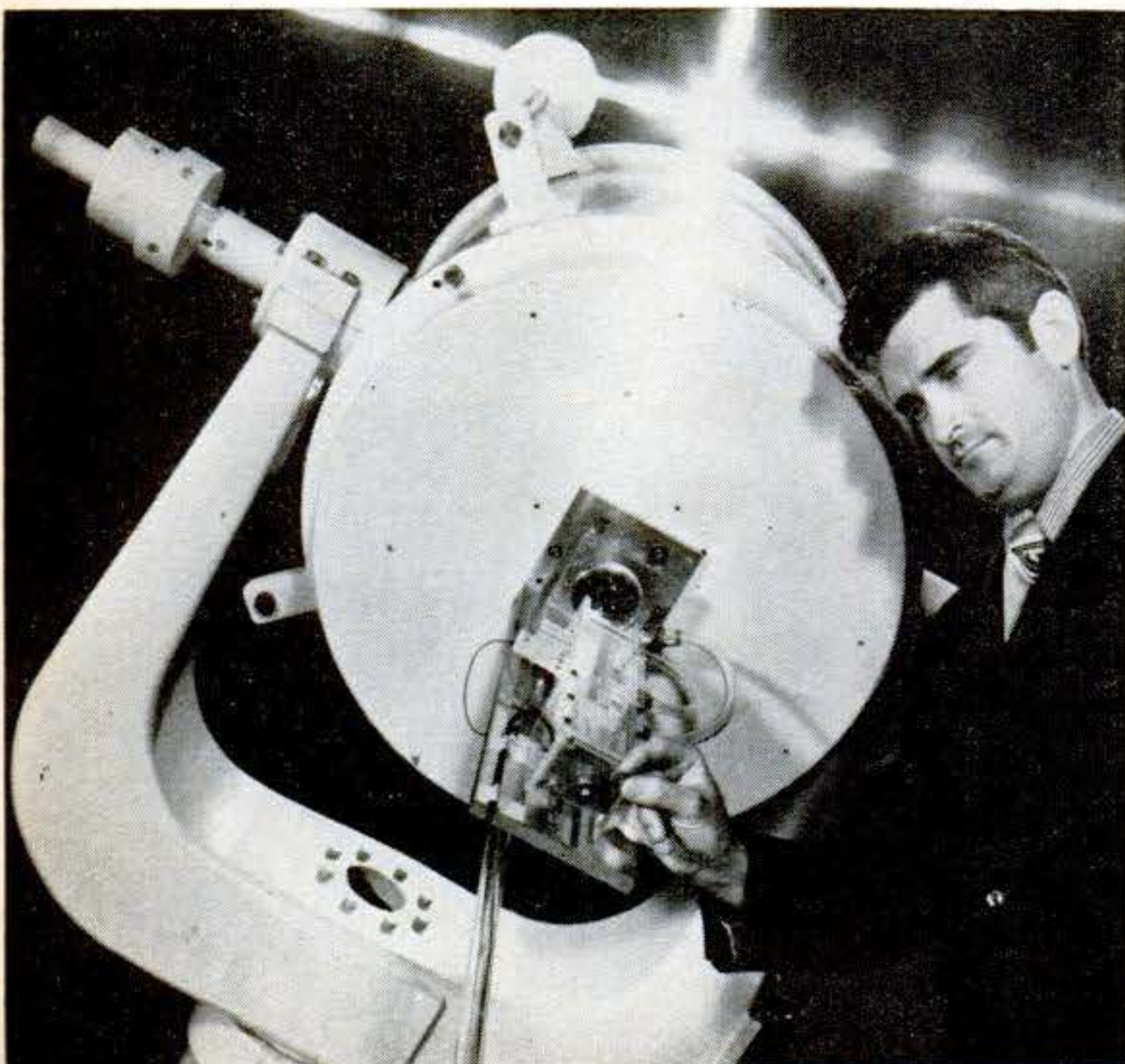
# What's New

A PICTURE ROUNDUP OF NEW PRODUCTS AND DEVELOPMENTS



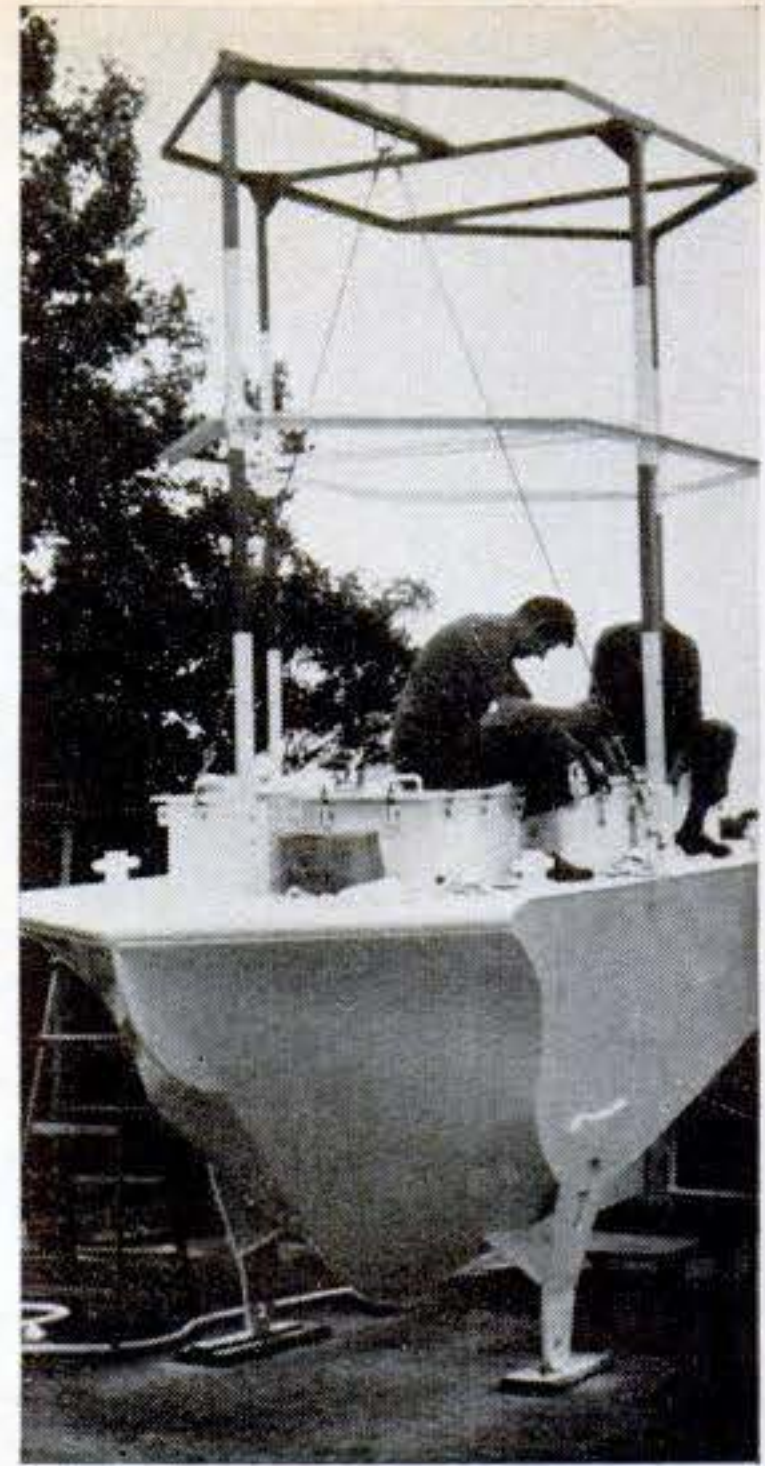
## Winged hovercraft—half plane, half boat

Trapping air under its downward-sloping wings as it moves forward, the Aerofoil lifts off the water to become a hovercraft. Claimed advantages over conventional hovercraft (which require a skirt to contain air): lower cost, better maneuverability, and ability to clear obstacles such as rapids. The test model, which has room only for its pilot, gets up to about 63 mph with a 45-hp engine. The craft was designed for the West German government by Alexander Lippisch.



## Sun-powered laser

Want to turn sunlight into laser light? This GTE Sylvania device focuses sunrays to produce a laser beam. It's for communications satellites; the laser beam can carry voice, data, and TV signals between the satellite and Earth.



## Robot weatherman

Hurricane blowing up? Mini-Nomads may be able to tell. They're floating, self-contained weather stations. The Navy plans to anchor three in the Gulf of Mexico, before the hurricane season, to transmit information to data-collection centers.

## Wankel snowmobile

Under the hoods of 150 Johnson and Evinrude snowmobiles zipping around the country there's something new these days: a 35-hp, 32.3-cu.-in. Wankel engine. The Wankel-powered snowmobiles are not for sale—just being field-tested, says the maker, Outboard Marine Corp.

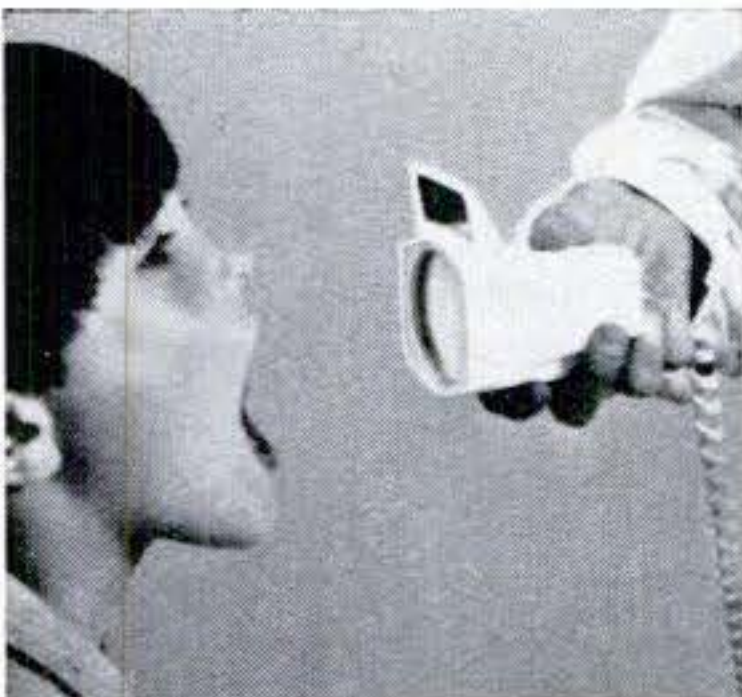


### Foreign 4WD

Want a 4WD utility truck made from a piece of the Iron Curtain? The M-4619, first vehicle imported to the U.S. from Romania, will be available in the fall. It's wider and lighter than American 4WDs, comes with a four-speed box, does 70 mph. Price: \$2,995.

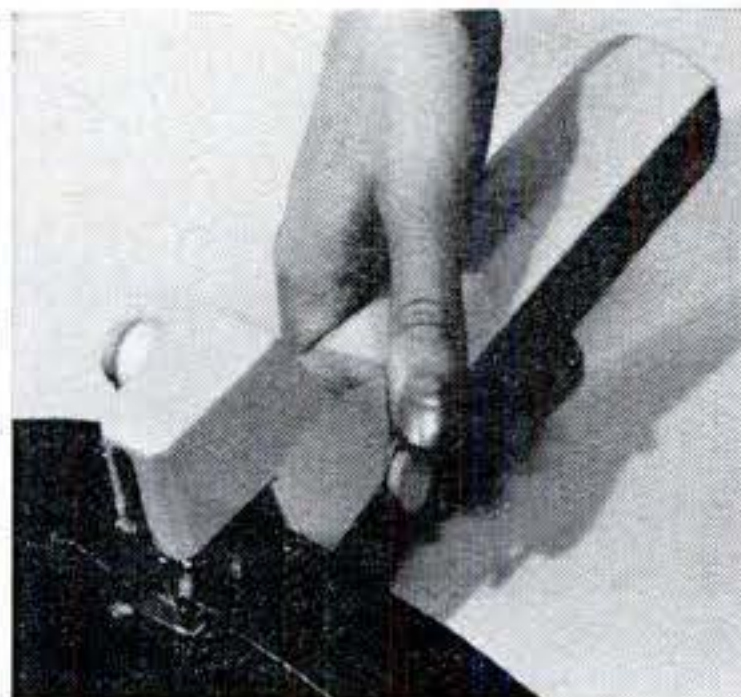
### Phone signal

A ringing bell isn't always the best way to signal a phone call. Western Electric's Signalman attaches to a phone and can trigger a lamp (to call the hard of hearing) or a fan (to summon the blind and hard of hearing), instead of ringing a bell.



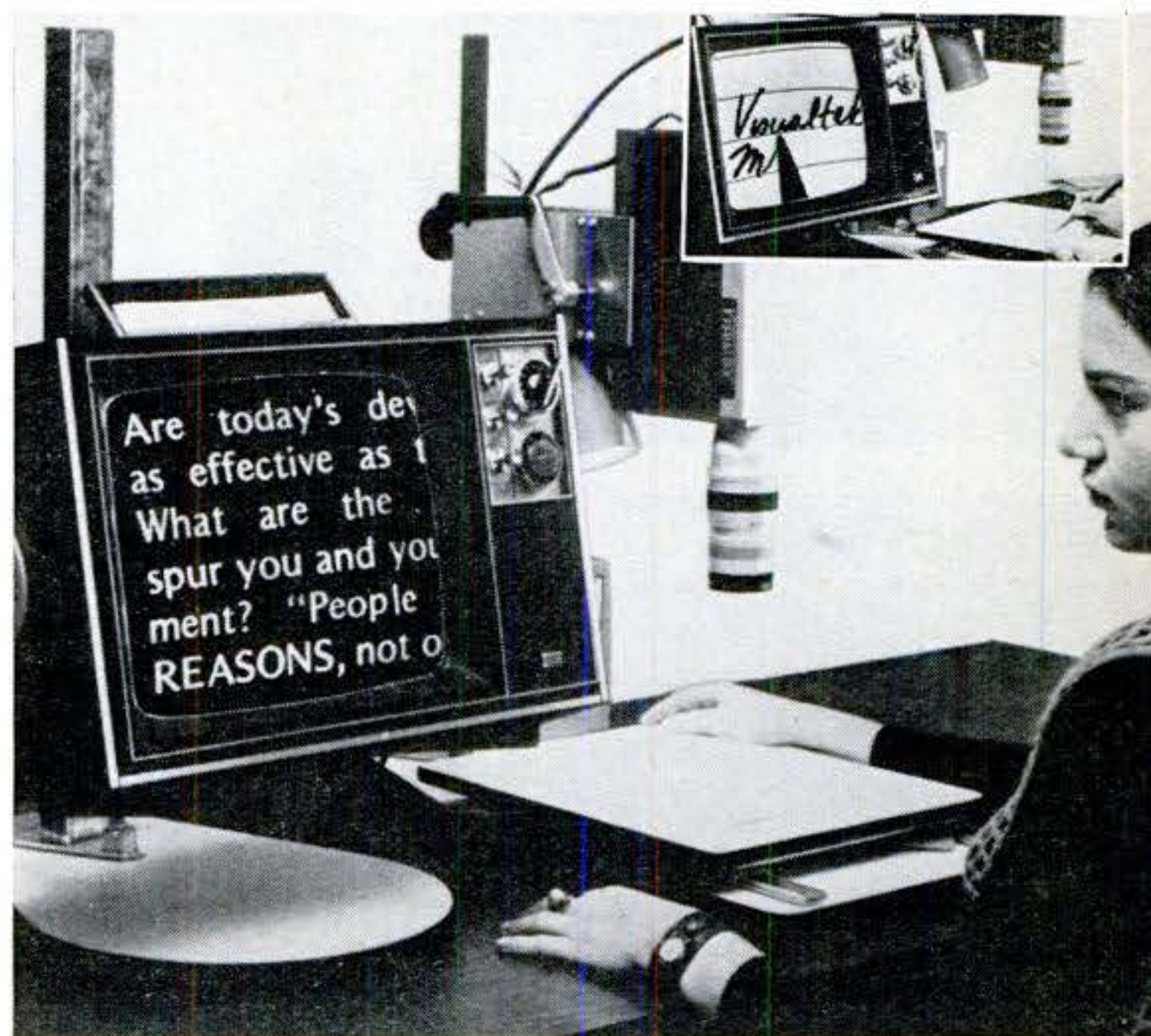
### Decay fighter

Know what plaque is? That invisible film you want to remove when you brush your teeth. Now there's a kit with specially filtered light and a "disclosing" solution that lets you see plaque so you can remove it. Plak-Lite kits are \$24.95 at drugstores.



### Hand stitcher

Big jobs or little jobs, this little hand-held sewing machine can take them on. Battery-powered, it sews top-bobbin stitching at normal speeds. Price? \$25 in stores. Brother International, 680 5th Ave, New York 10019, imports it.



### TV magnifier

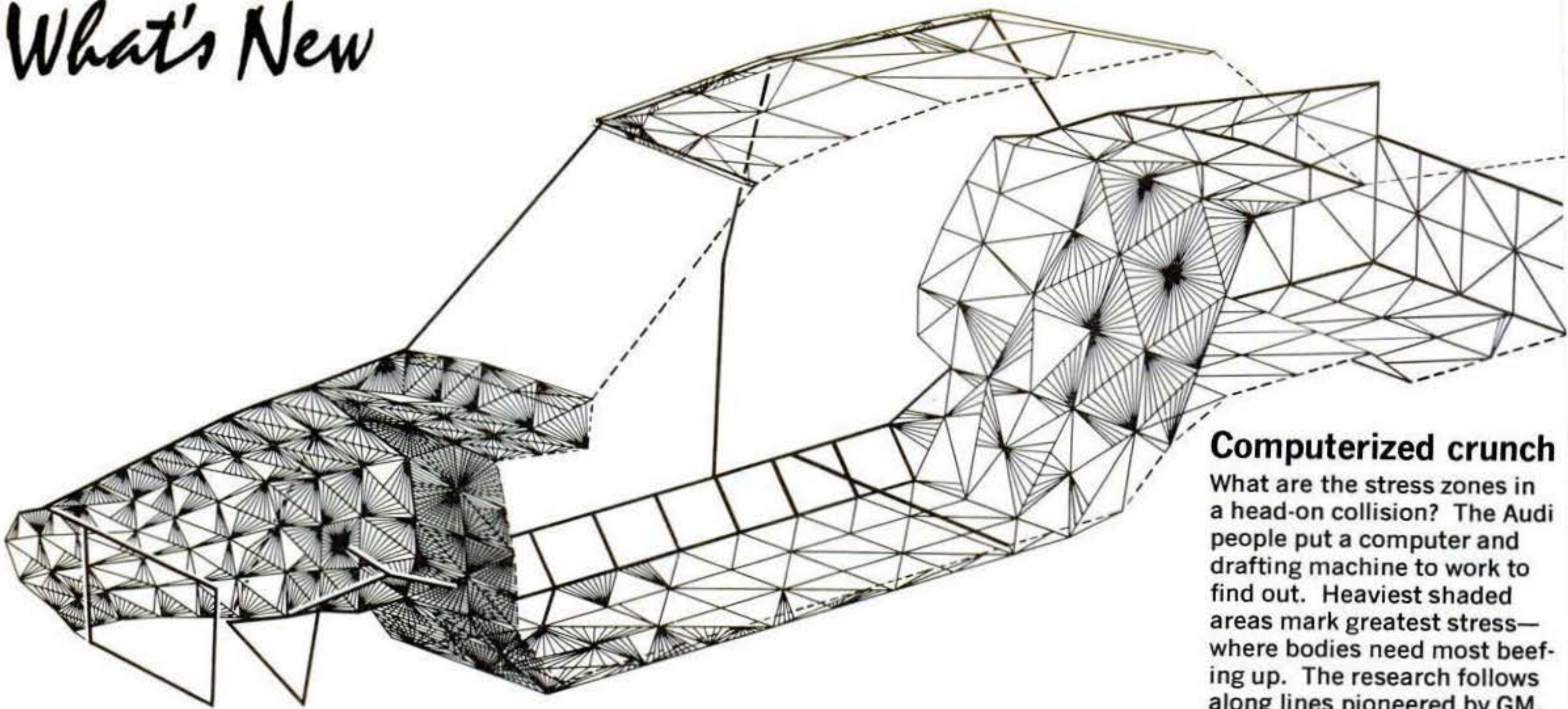
Magnify print or writing by transmitting it onto a TV screen, and thousands of the legally blind can see to read or (inset) write. That's the idea behind the Visualtek Read/Write System. It's by Visualtek, 1840 Lincoln Ave., Santa Monica, Calif. Cost: about \$800.



### Telltale taillights

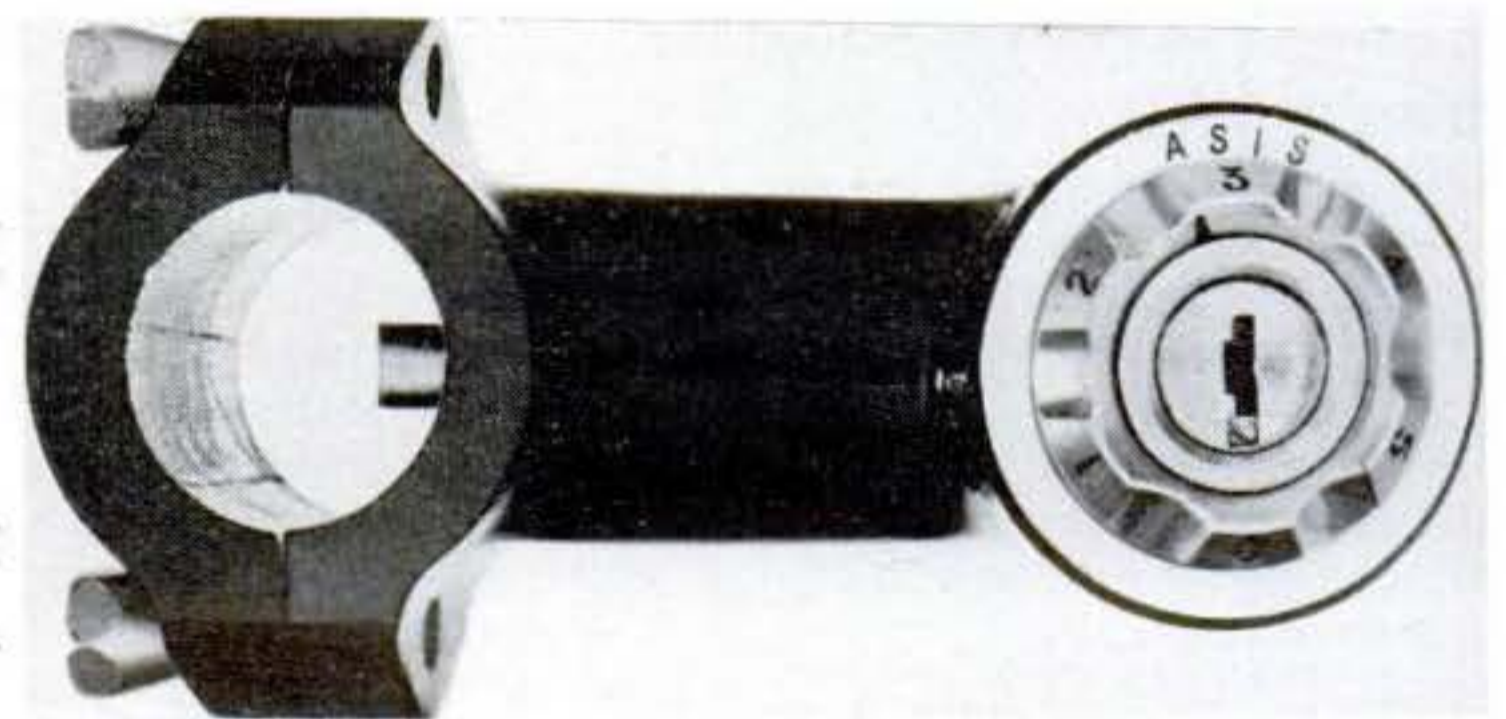
Ogle the rear end of the new Ogle Aston Martin and 22 taillights ogle back at you. And they tell a tale, too: Rear lights, reflectors, sequential flashers, backup lights, and six lights to indicate light, medium, and hard braking are included.

# What's New



## Computerized crunch

What are the stress zones in a head-on collision? The Audi people put a computer and drafting machine to work to find out. Heaviest shaded areas mark greatest stress—where bodies need most beefing up. The research follows along lines pioneered by GM.



## Drunk foiler

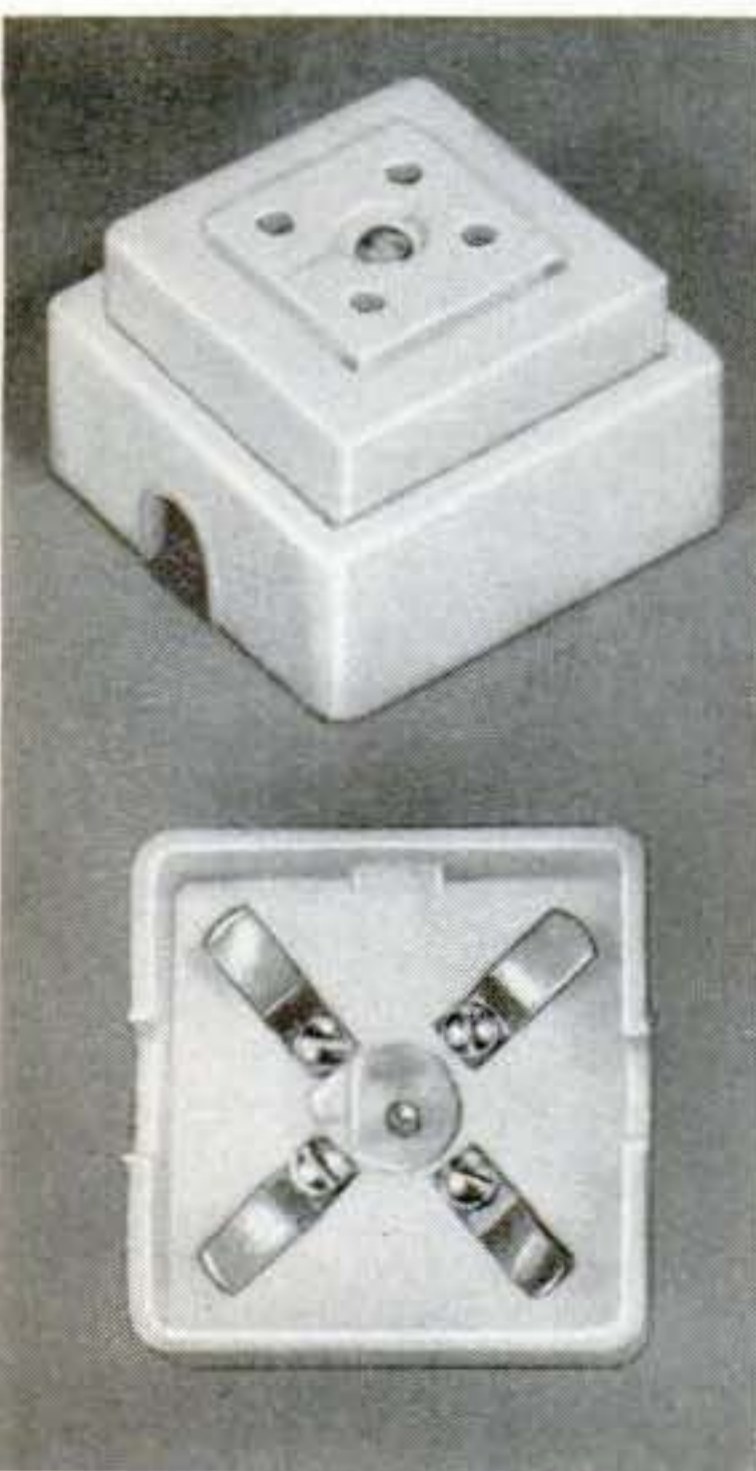
Drinkers can't drive, with this British Dwan Ltd. ignition/steering-wheel lock. It checks coordination, reaction time, and clumsiness. You have to set a selector ring (twice) and insert your key (no fumbling) in six seconds, or it's no go.

## Haircraft

Cross a hair dryer with a hovercraft and you get the Hover Hood, a German dryer that floats on air. The lift comes from a fan in the peak. A crown of combs inside keeps it from drifting off. The haircraft is made by Braun.

## Phone jack

Here's a slick way to turn one of Ma Bell's phone junction boxes into a jack. Instant Jack replaces the regular box cover and gives you a place to plug in an extra phone. Saxton Products, 215 N. Rte. 303, Congers, N.Y., makes it.



## Track conversion

About 15 minutes and \$3,000 convert your 4WD to a FTD (Four-Track Drive) that can tackle marshy terrain or snow. Or for half, you can convert a two-wheel-drive vehicle. Speed: to 40 mph. Imagineering Assoc., Box 3132, San Francisco, Calif. 94119.

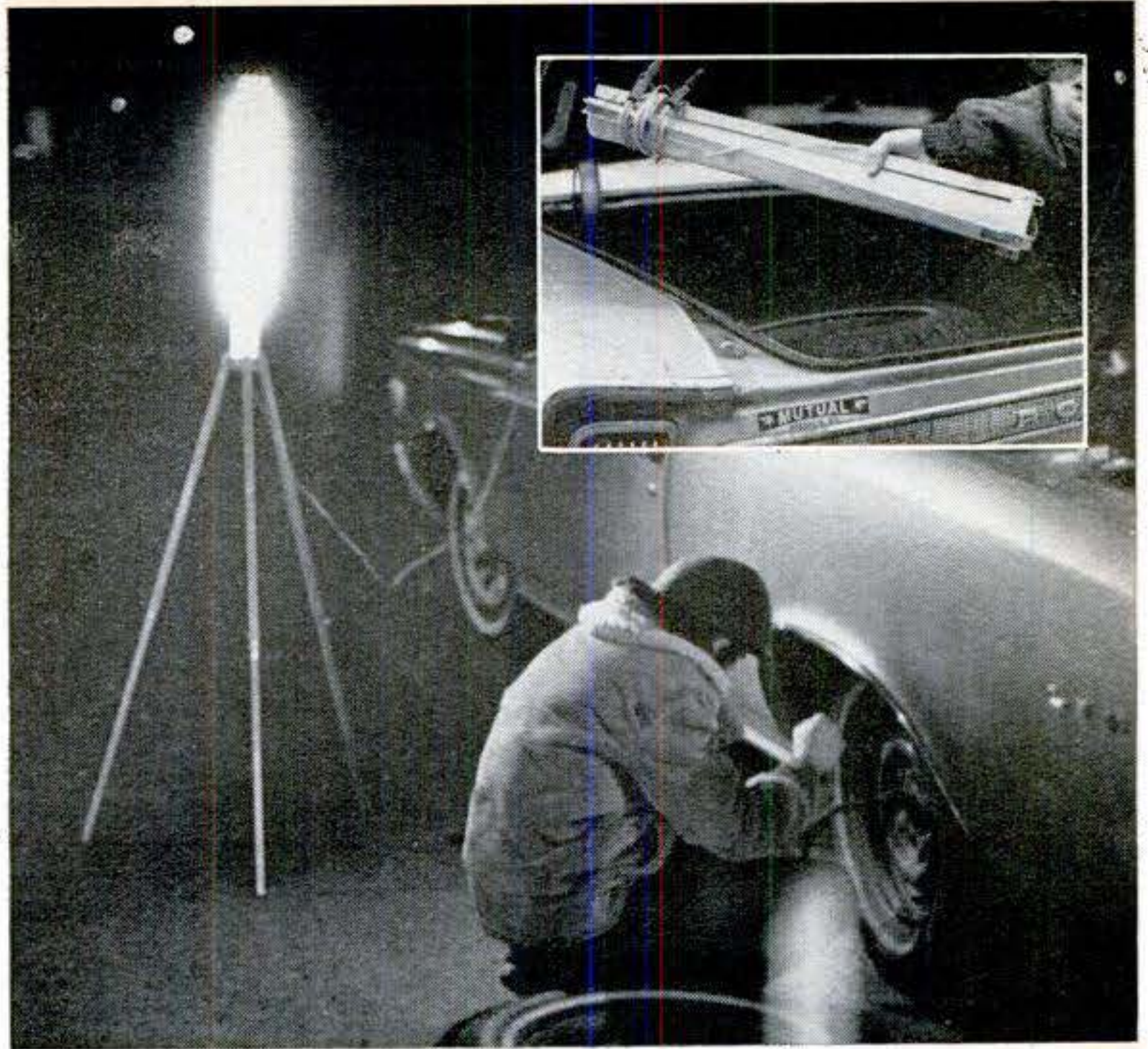




# What's New FOR YOUR CAR

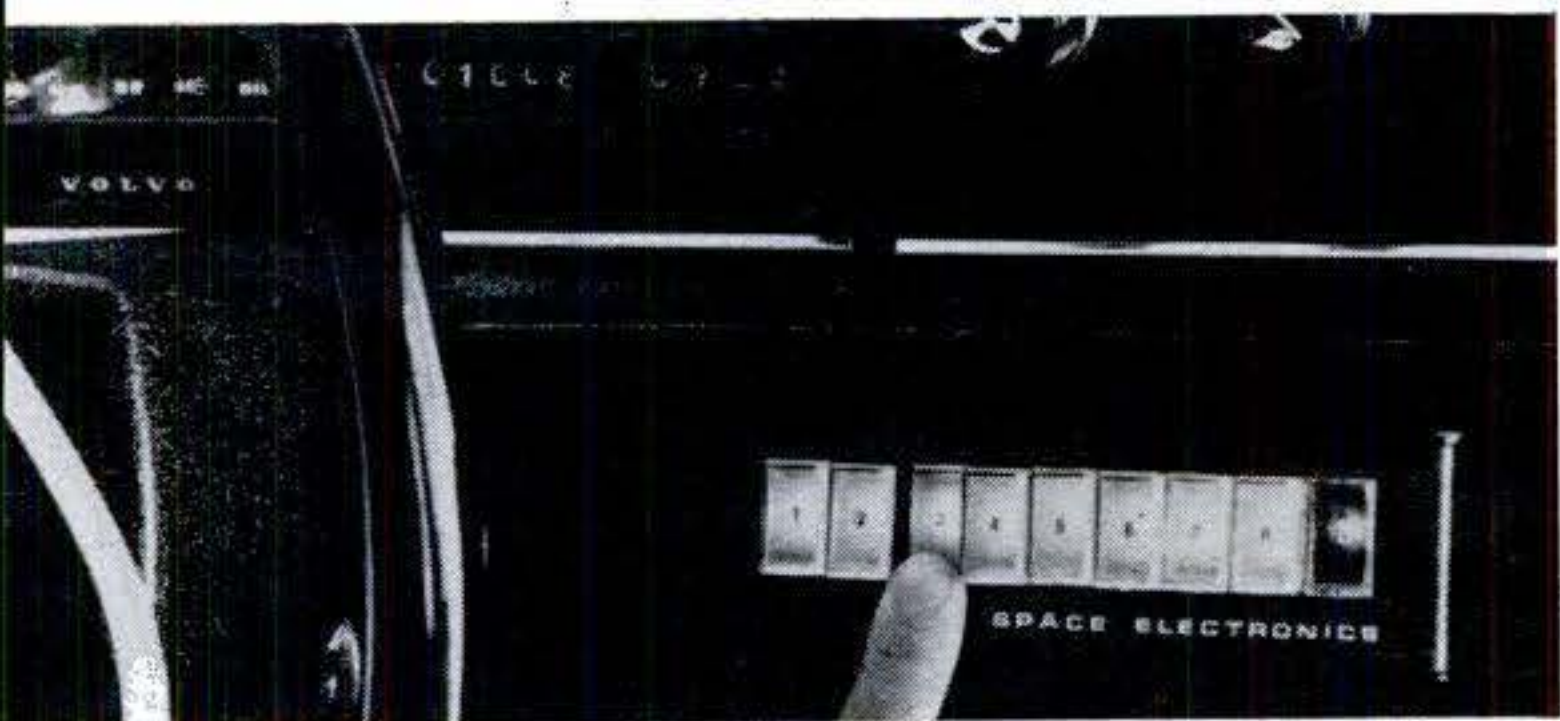
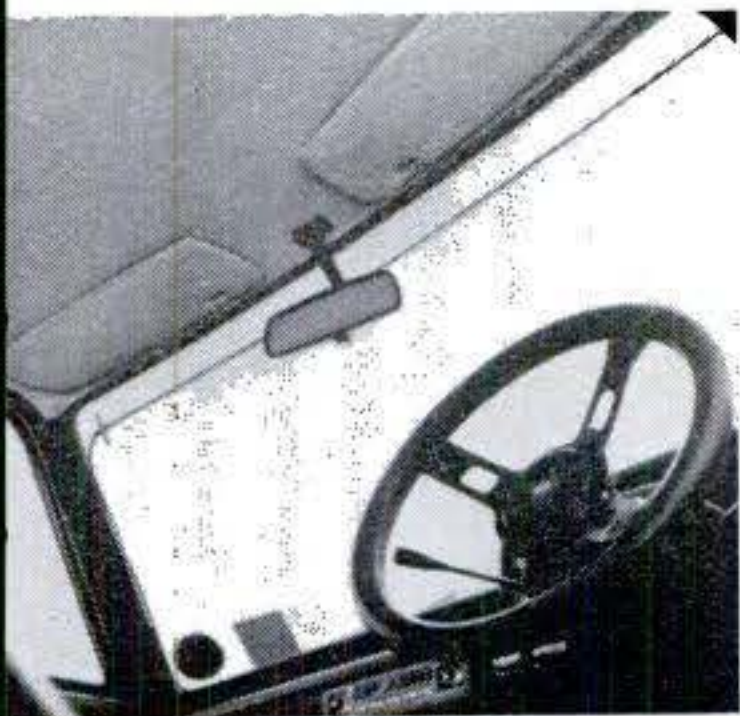
## Tripod light

It folds to fit in your trunk (inset photo), connects to your cigar lighter or battery to provide a flood of fluorescent light for emergencies or to light a campsite. The Jettson Lite is \$29.95 from Jettson Sales, Box 573, Anniston, Ala. 36201.



## Visor antenna

Add a tinted sun visor to your windshield and get a built-in radio antenna at the same time. The unit installs in seconds (with no tools), is removable, and works with your car radio or a portable. Mills Accessory Group Ltd., Two Counties Mill, Eaton Bray, Beds., England.



## Thief-stopper

A jump-proof ignition lock? That's what the maker, Space Electronics (Box 634, Littleton, Colo. 80120), claims. It has a pushbutton combination lock on the dash, and houses ignition parts in a tamper-proof, hot-wire-foiling steel box under the hood.

## Unmessenger

Slip it over your seat back and you have pockets in front for maps and toll money, pockets in back for books and magazines, toys and tissues. The Car Kangaroo is \$9.95 from Joyce's Choices, 2908 Columbia Ave., Lancaster, Pa. 17603.



## Backward viewer

You can't buy it yet, but the rear-view periscope is coming. This one, designed by Clipper Industries of Roseville, Mich. 48066, gives a wide view to the rear, with no blind spots at the sides. The Parascope is designed for either factory or home installation.

## Air wrench

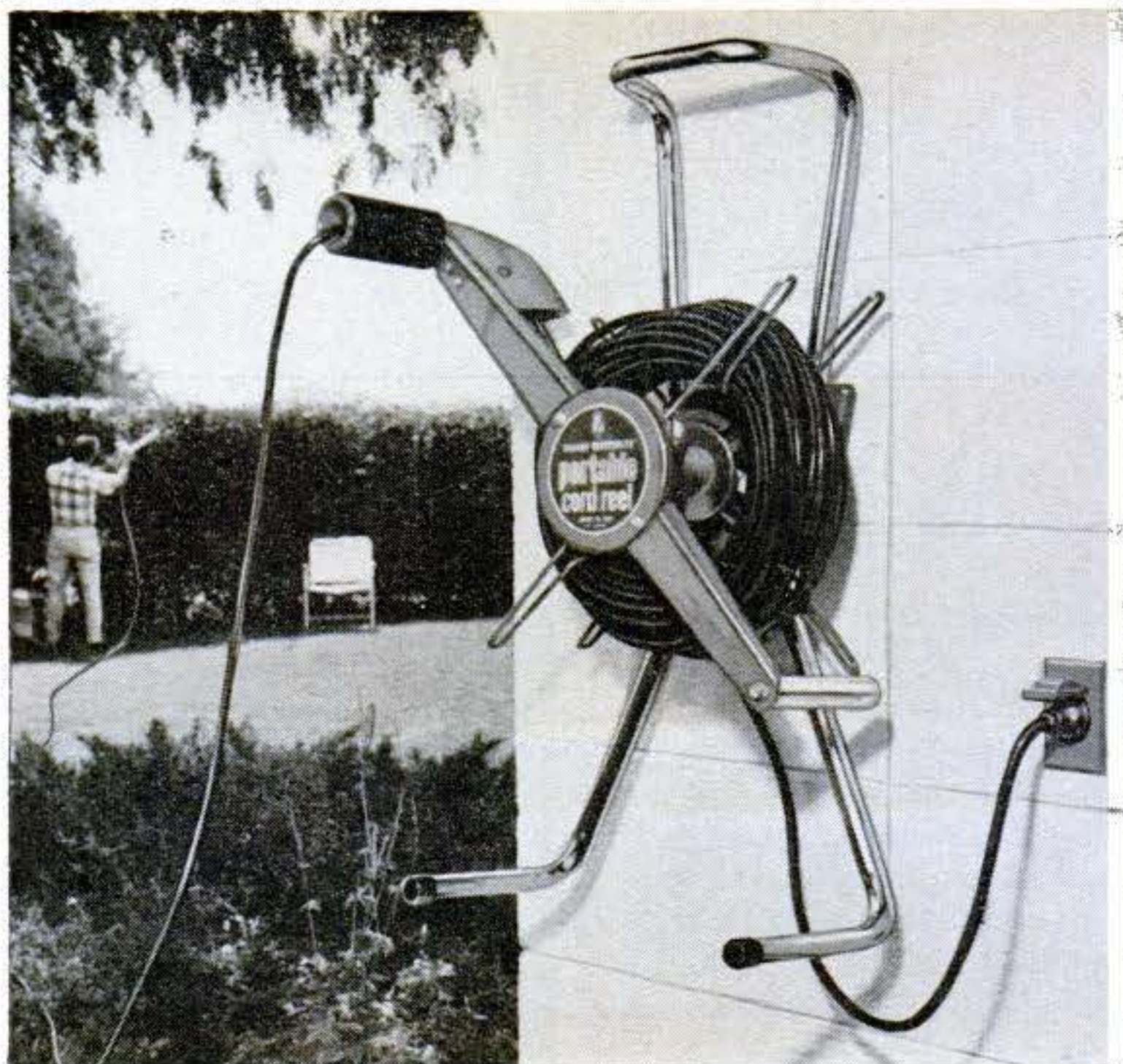
Tire-changing tire you out? Black & Decker has a new low-price impact wrench that makes the job easier. The 1/2-inch tool accepts flip sockets, has ball-bearing construction, and costs \$119 (\$99 if you have an old wrench to trade in).



# What's New IN HOME IMPROVEMENT

## Cord coiler

It's like a hose reel for electric cords—winds and unwinds without unplugging, holds about 150' of cord for electric mowers and other yard tools. Village Blacksmith, Box 260, Watertown, Wis. 53094, makes it with built-in stand/wall bracket/carrying handle.



## Do-it-yourself doors

There's no hangup with these doors. Georgia-Pacific's new Vinyl Shield prehung doors come complete with jambs, casing, and stop; slip into place in about 15 minutes; even have lock holes predrilled for you.

## Flood warning

Troubled by a wet basement? Here's an alarm that warns you of trouble at the first trickle of water. Water Level Alarm is \$14.95 from Edmund Scientific, 380 Edscorp Bldg., Barrington, N.J. 08007. Extra sensors (up to 50 can be used on one power unit) are \$6.95.

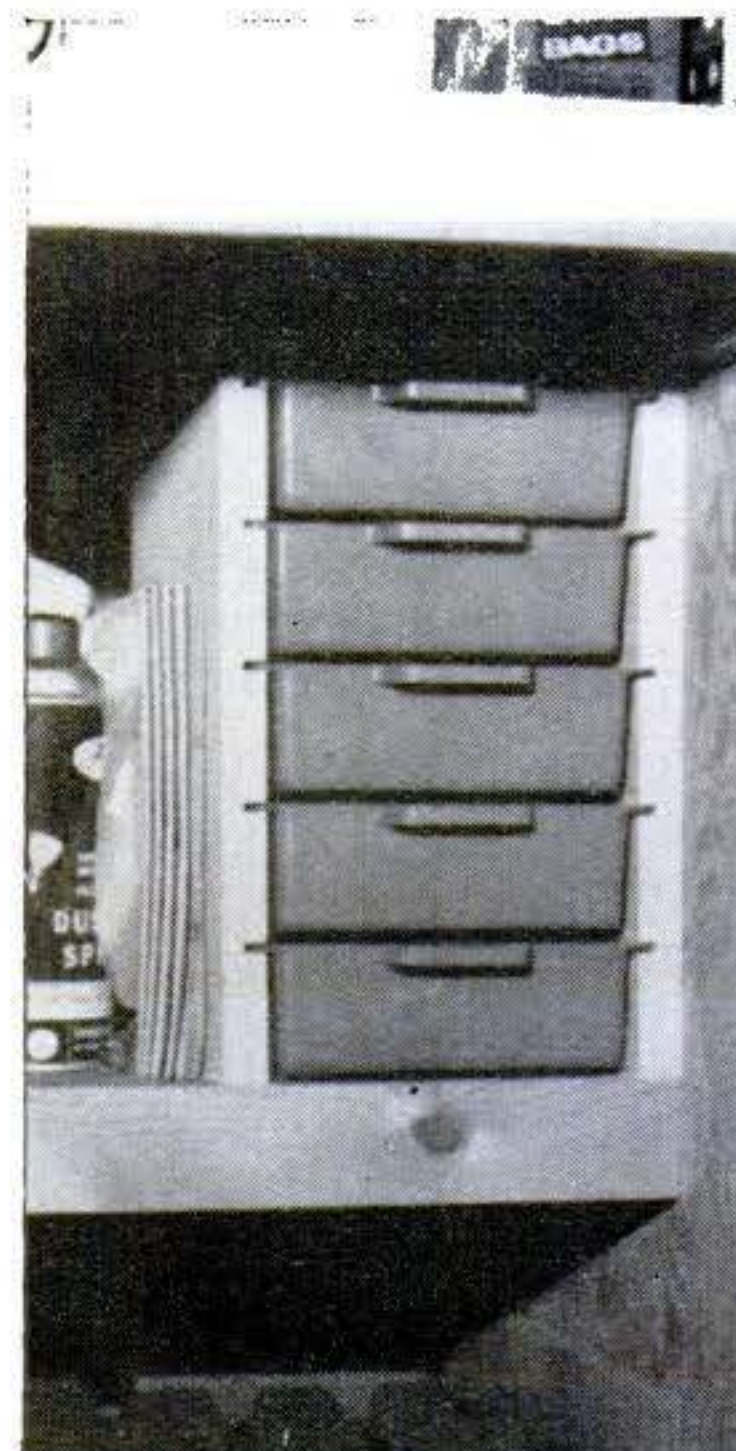


## Three-in-one unit

Let there be light, heat, and ventilation in one ceiling-mounted unit for the bathroom. Here it is—the Emerson Chromalox Front-Line H5011. It has a 1,335-watt heating element, 70-cfm fan, and takes a pair of 60-watt bulbs. The front removes for easy maintenance and cleaning.

## Easy sliders

Hurting for storage? These six-by-nine plastic Dandy Drawers are easy to install anywhere—a couple of saw kerfs take the built-in slides. Price is easy, too: 10 for \$5 plus postage from Baumbach Engineering, 126 Calderon Ave., Mountain View, Calif. 94040.

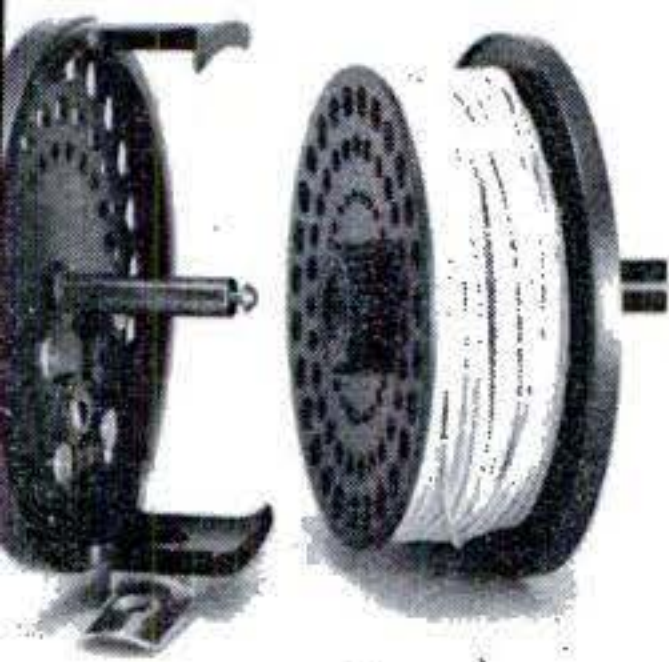


## The "I Hate to Cook" cooking center

Is this the kind of hot stove women claim they slave over? The oven cleans itself continuously. There's a built-in grill and a pair of conventional burners. All three—oven, grill, and burners—are vented to whisk smoke and odors outdoors. With optional accessories, the grill converts to a rotisserie, deep-fat fryer, griddle, and shish-kebab. There's a clock to control the oven, a built-in interval timer, and a lot of other features you'll have to write the maker—Jenn-Air Corp., 3035 Shadeland Indianapolis, Ind. 46226—to find out about.

# What's New

## OUTDOOR RECREATION



### Spools reel

Instant spool changing, light weight, exposed rim for easy spooling—these are three advantages of the new CFO reel. It's made with the same on one side only, by J. J. J. Co., 32 River Rd., Manchester, Vt. 05254. In left or right-hand use.

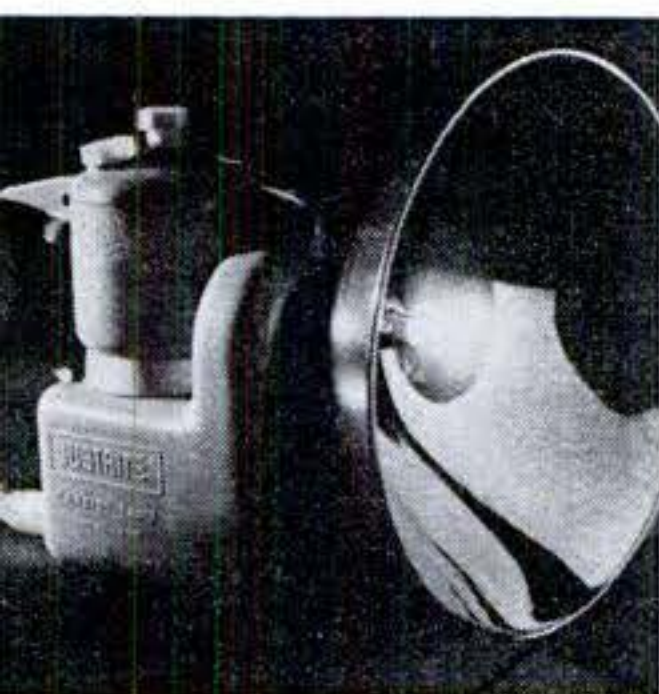


### Portable heat

Solid-fuel hand and body warmers? You bet. The Stag Hotstik hand warmers burn about nine hours on a stick of fuel; the body warmers stick it out for 20 hours (sticks can be snuffed and restarted). Hand units are \$2.95, body units \$6.95.

### Bike saver

Owning a 10-speed bike is like owning a Corvette—someone is always trying to steal it. Kurly Kable is a new cable lock that goes through the frame and both wheels and around any convenient pole to foil bike rustlers. Coils neatly for under-seat storage.



### Portable light

The carbide lamp is back—in new design for sportsmen—producing the brilliant white acetylene flame that lasts hours on a single charge of acetylene and water. No batteries, no bulbs, no petroleum products. Carbide Sports Lamp, Justrite Mfg., 2061 Southport, Chicago 60614.



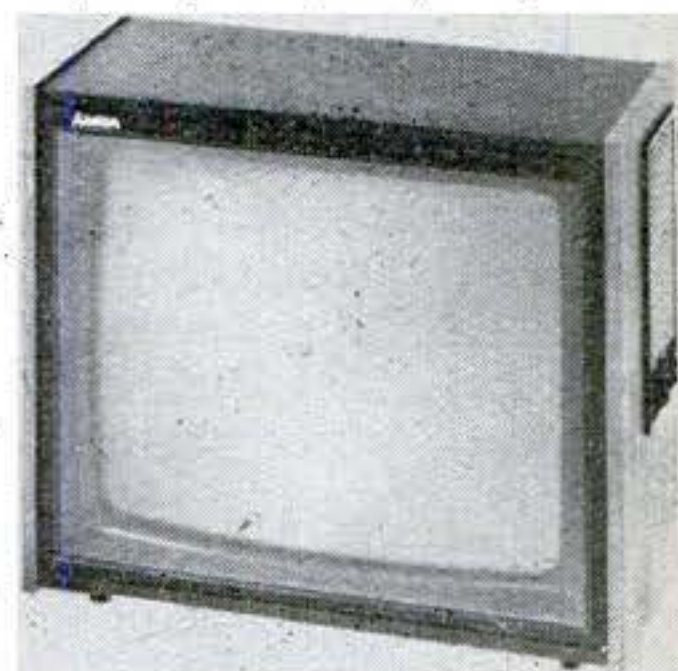
### Spare protectors

Want protection for your spare plugs and bulb for your snowmobile, motorcycle, ATV, or boat? The Plug 'N Bulb Protector is an airtight plastic case that does the job in style. Hand-size, it fits your pocket or any small storage compartment.

# What's New IN ELECTRONICS

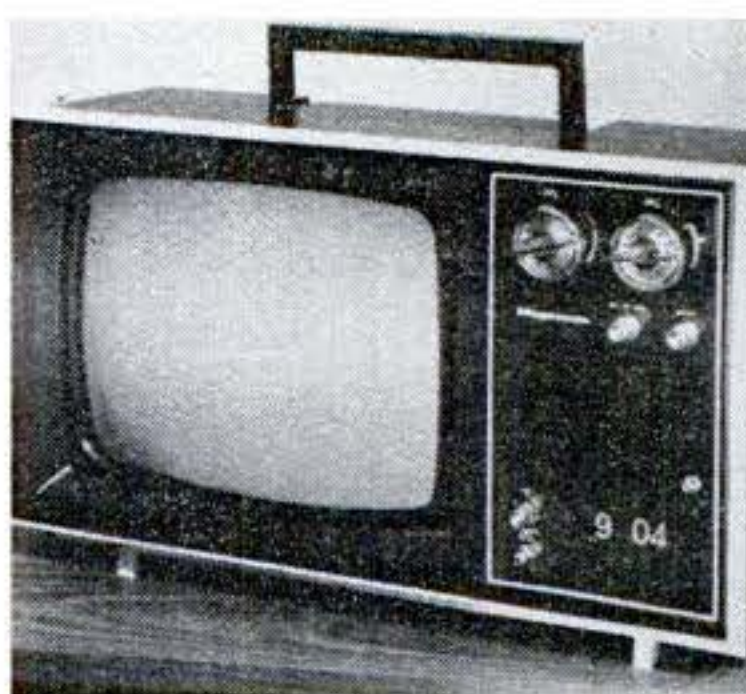
### Watt saver

Live in a small apartment or dormitory room? Then you don't need a bushel of power to fill the place with good hi-fi. This AM/FM stereo receiver, the Realistic 25-watt STA-18, is designed for small areas. It's \$129.95 in a walnut case, from Radio Shack.



### Remote-control entertainment center

On the right—a 13" B&W television. On the left—a combination digital clock AM-FM radio/master-control center. Together they make up a new entertainment center designed especially for the bedroom. The screen can go at the foot of the bed, yet you control it from the control center at the head of the bed. The clock in the control center can also turn on the TV (or radio or alarm) at a prespecified time, and turn it off. Look for it this fall when the first imports from Japan should reach the U.S. It's the MGA BS-135.



### Clock TV

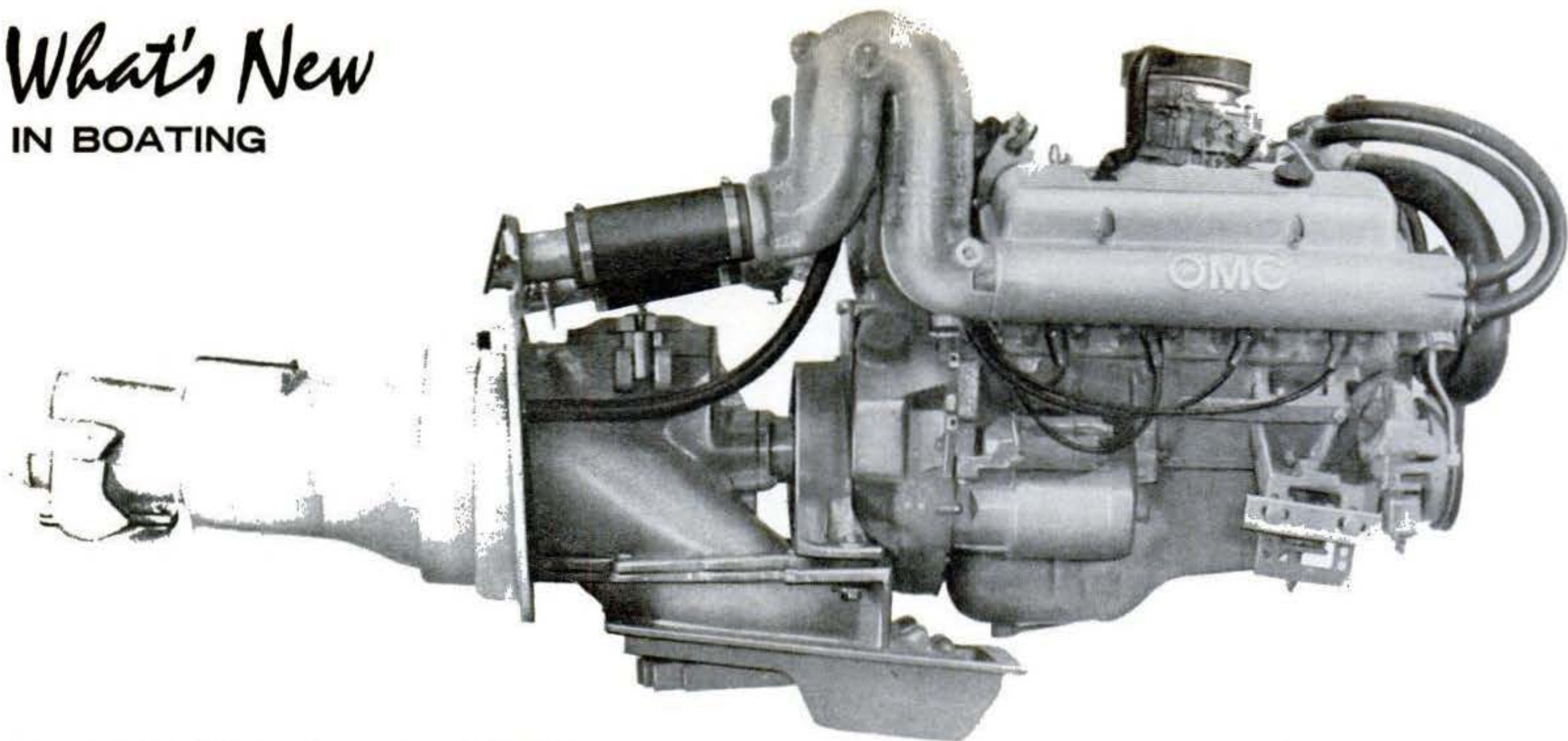
The clock radio is out—the clock TV is in. And of course the clock is digital. Magnavox makes the little 12" black-and-white TV shown, complete with wake-up switch, alarm, and automatic turnoff.



### Portable color

First 17" color TV made in the U.S.—that's the Sylvania CC1157WR. For \$400 it gives you automatic fine tuning, remote tuning control, a bright black matrix-type picture tube, plug-in transistors for easy service, and true portability.

# What's New IN BOATING

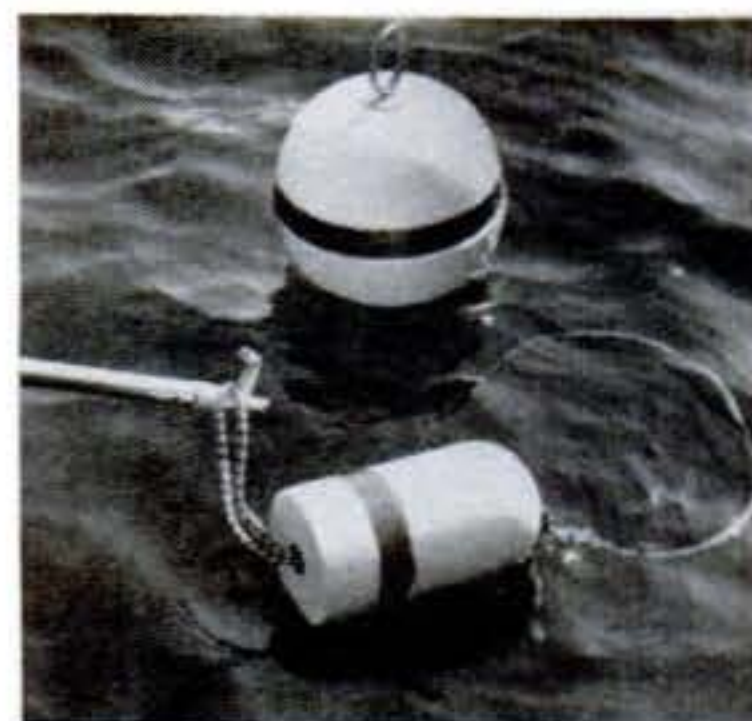


## Compact, high-performance jet drive

Here's a hot new 245-hp jet drive from OMC, combining a 307-cu.-in. V8 with "hot" Corvette cam and a jet unit. Result? High performance with an economical horsepower range. The jet—with a unique impeller design combined with large nozzle area—produces water flow that makes the JX-245 very efficient in midrange operation. The 245's trim deflector adjusts to change the boat's trim characteristics, and a steerable rudder gives increased low-speed maneuverability. OMC Stern Drive, 3145 Central Ave., Waukegan, Ill. 60085.

## No-scratch buoy

Touchy about marring your boat's finish? This plastic-foam mooring buoy (with optional pickup buoy for easier mooring) eliminates one damage source. The 12"-diameter buoy is \$16.50 (10", \$12.95; 18", \$42.95), the pickup buoy \$4.95. N. A. Taylor, Gloversville, N.Y. 12078.



## Stable tri-hull

This 18.5' tri-hull offers lots of features, plus exceptional stability. Behind the steering console: a compact galley with sink, icebox, and two-burner stove. A chair/table combination forms an L-shape bunk to sleep two. Fiberform, Bldg. 20, Spokane Industrial Pk., Spokane, Wash. 99216.



## Pontoon kit

Want to build 128 sq. ft. of deck space for cruising fun? Twelve interlocking pontoon sections go together easily—you provide the decking and bracing lumber. The 17'-by-8' boat is powered with 9½- to 25-hp motors. \$459. Roto-cast Plastic Products, 6700 N.W. 36 Ave., Miami 33147.



## Family-fun boat

Here's a 16' inboard-outboard tri-hull from Cobalt built for family fun. It features transom boarding steps, fold-down lounge seats, carpeting, and icebox. Engines, from 120 hp to 165, provide speeds to 46 mph. Cobalt Boats, Neodesha, Kans. 66757.

## Backpack boat

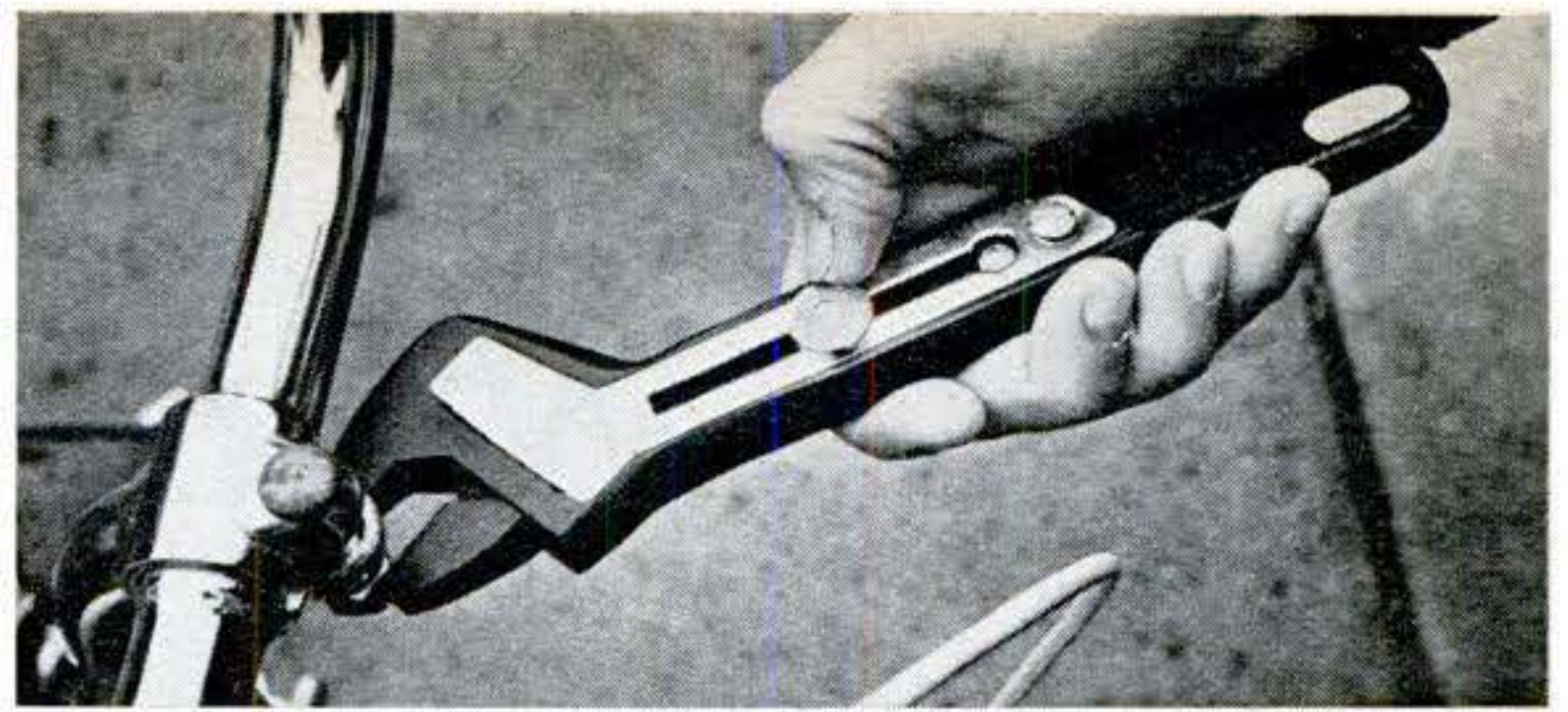
Three air compartments in this Float Pac boat make her safe and stable. The inflatable boat fits in a 12"-by-30" bundle, including collapsible paddles and foot pump. It inflates to 77" by 46" and holds two adults. Gladding Corp., Box 260, Syracuse 13201.

# What's New IN TOOLS

## Pushbutton wrench

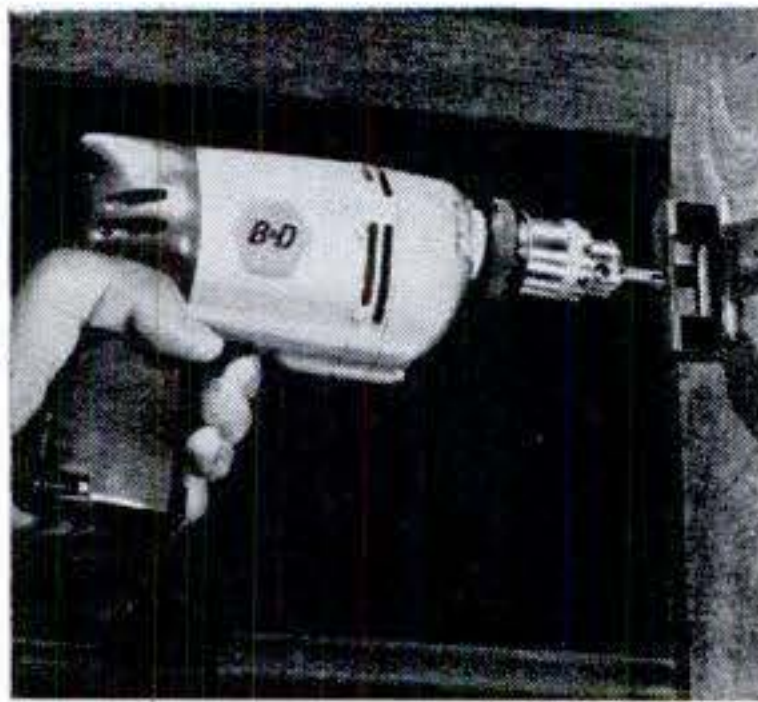
The speed of an open-end wrench, the versatility of an adjustable wrench—that's what you get in the Space Tool.

Simply moving the push-button adjusts it to the work. It comes in 8", 10", and 12" sizes (8" is \$8.95) from Gall Sales Co., Box 481, Pontiac, Mich. 48056.



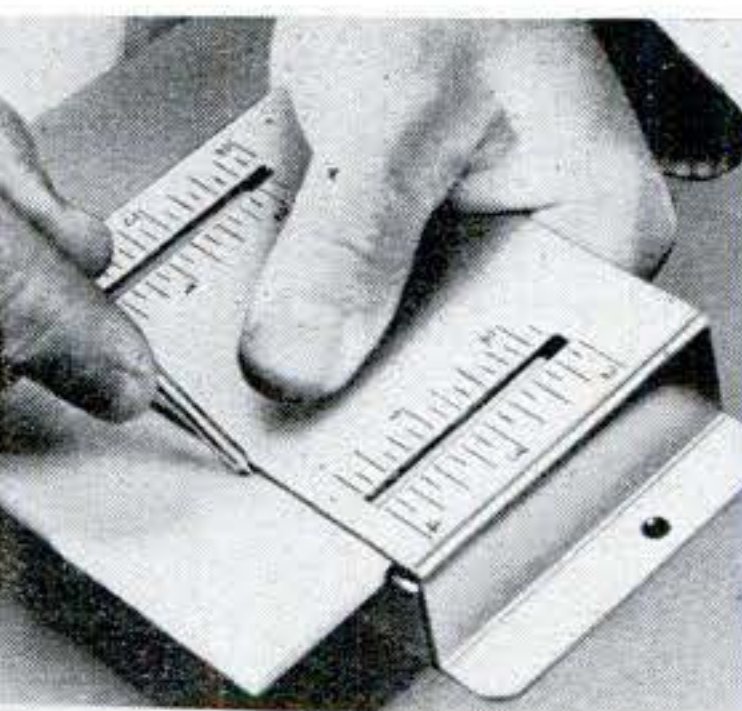
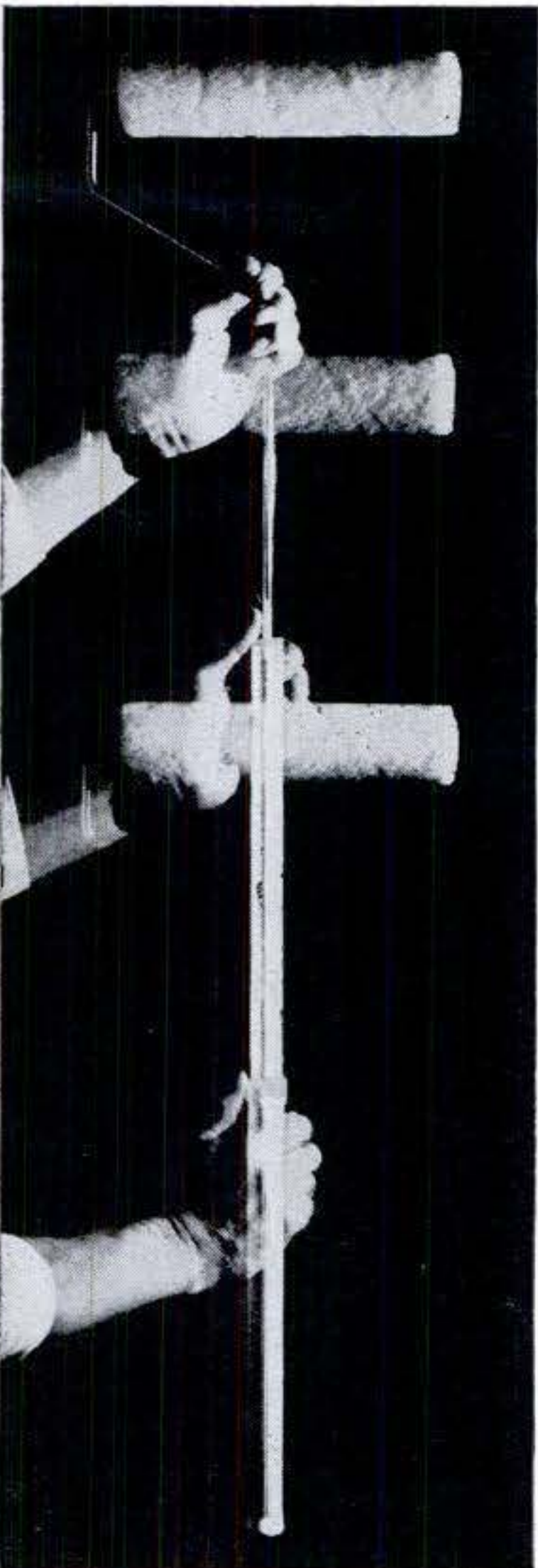
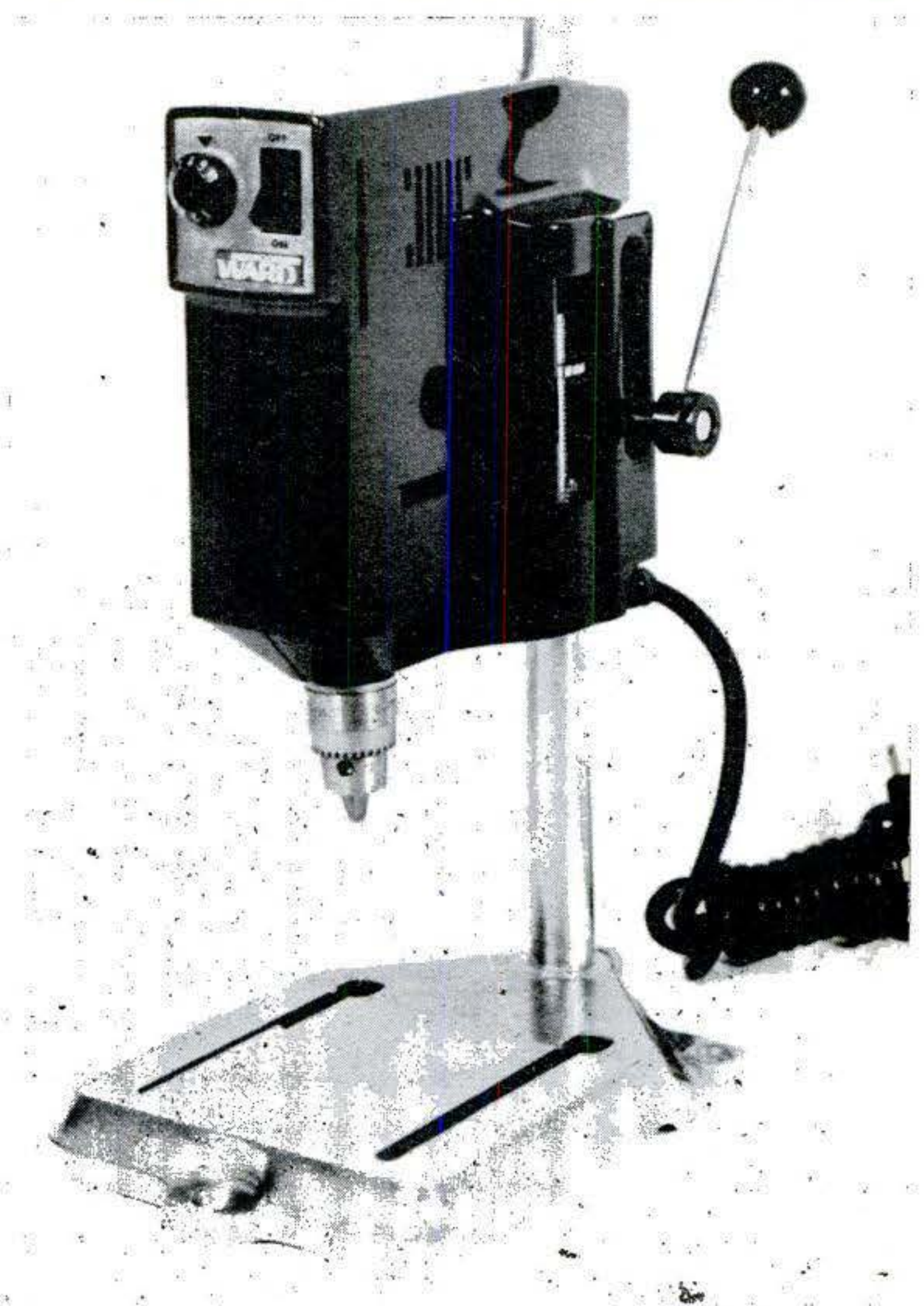
## Power driver

Need a rugged drill? Need a power screwdriver? Black & Decker's new 3/8" commercial-duty Scru-Drill (\$45) is both. A twist of the collar converts it. The 1/6-hp tool has a positive clutch that allows maximum torque while driving, yet disengages when the screw is seated to prevent damage to the head.



## Low-cost, solid-state drill press

You can dial your speed—from 700 to 2,000 rpm—with this new, compact 3/8" Powr-Kraft drill press. A full-feedback electronic circuit supplies full torque at all speeds. A safety lock for the chuck key prevents the key from being thrown and allows the machine to be locked. Other features: You can drill to the center of a 9 7/8" circle; adjustable depth stop; housing (of Cylolac) designed for heavy use; 1/4-horse motor. The unit stands 17" high. Price: \$49.95 from Montgomery Ward.



## Telescoping roller

Twist the aluminum extension handle on the new Ultra-Roller and you can adjust its length from 23" to 33"—handy for moving from job to job. Press a pressure plate and the 9" roller pops off for easy clean-up. It's \$4.99 from Montgomery Ward.

## Safety knife

Here's a sharp item that weighs only an ounce—Stanley's Mitey-Knife. Its carbon-steel blade has two positions for safety—out and farther out—and retracts into the nylon-resin body. For clipping, whittling, cutting string, or opening packages. About \$1 at hardware stores.

## Tile-cutting jig

Hold a standard 4" ceramic square in this jig, score it with the carbide-tip scribe provided, and snap off the projecting piece. It's as easy as that. Inch scales on both sides show length from either end. John M. Perkins & Smith Ltd., London Rd. Works, Braunston, Rugby, England.

## Layout fluid

Spray on a smooth, dark, non-glare coating to simplify machine-shop layout. Sprayon 603 does away with rags and spilled bottles—comes off fast with companion 606 layout-fluid remover. Sprayon Products, 26300 Fargo Ave., Bedford Heights, Ohio 44146.

# The New TV Antenna Systems— Which One Is for You?

The big ones are getting bigger—but a new breed of minis is coming on strong

By RONALD M. BENREY

Thinking of updating your old TV antenna system? Let's talk about the new equipment you'll be needing:

- Your new antenna, an all-channel VU model designed to pick up VHF (channels 2 to 13) and UHF (14 to 83), will be larger and more efficient than your old antenna, but mostly in ways you probably never thought of.
- It may be shaped like a wedge—wholly or partially—and will work along with at least one electronic device, such as a signal preamplifier or an amplified signal splitter.
- Your new system's transmission line will use coaxial cable.

And your new system will be more expensive. If you live in a fringe area, the basic components will run to upwards of \$150, plus installation.

To get the lowdown on the new antenna systems, I talked to design engineers at six major antenna manufacturers. What I learned is important to you—especially if you're fussy about the quality of the TV picture

you see. And picture quality is the criterion for antenna performance.

When a TV signal leaves the transmitter, it is strong and pure. But en-route to your set, it runs a gauntlet of tormentors that weaken, distort, adulterate, interfere with it.

Half of all bad-picture complaints are caused by weak signal, says Harry Greenberg, Channel-Master's director of engineering. Symptoms: a snowy picture, or one that fades, jitters, rolls, or loses color. Cure: an antenna with high *gain* feeding a transmission line that has low *loss*.

The other complaints result from interference of various kinds—from ghosting to idling automobile engines. Here, the symptoms are moving bars and patterns, double images, hash, and sometimes other TV pictures superimposed on the one you see. The solution is a highly directional antenna you can aim to ignore interfering signals, and a transmission line that keeps the signal clean on the way to your TV.

A new—and bigger—VU. Antenna gain . . . antenna directivity . . . transmission-line loss . . . signal protection—get these four factors in proper balance with cost, and you have the ideal antenna system for your home.

Half of all antennas sold are VU

(VHF and UHF) models, and the percentage increases each year. Virtually all newly designed antennas are VUs (including the controversial miniature electronic antennas.) Here's why:

Most of the country now has both VHF and UHF TV service, and a single VU antenna is simpler to install and maintain than a twin antenna system. A single transmission line brings both signals into your home (without additional couplers), and a lone VU antenna offers lower wind and snow loading. What's more, a VU model usually costs less than separate VHF and UHF antennas.

But, notes Allen Pawlowski, Technical Director of the Jerrold Electronics Corp., a VU antenna has slightly lower performance than an equal-size VHF-only model. He recommends that you go up a notch in size when you replace your old VHF antenna with a VU. This is one of the reasons I predict your new antenna will be larger.

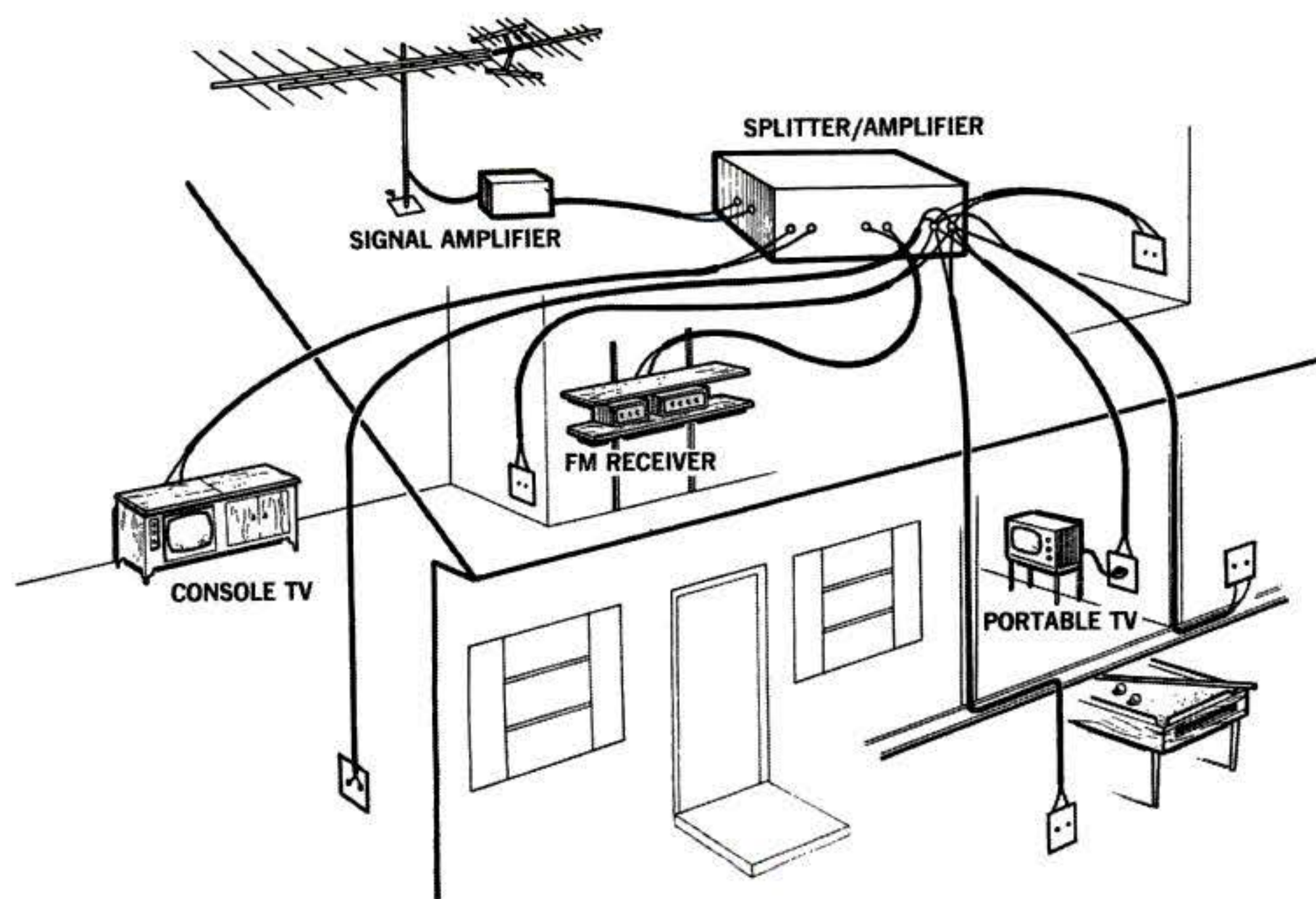
Is bigger better? "The performance of any well-designed antenna is proportional to its size," answered RCA's Don Peterson when I asked why RCA designed the 4GB69, reportedly the biggest antenna. First, a big antenna has a large electromagnetic aperture for capturing lots of signal—in other words, it has high gain. Also, greater length permits more parasitic elements that improve pattern shape and front-to-back ratio—the keys to ghosts and multipath-interference rejection.

These last two performance factors are receiving most attention today. Antenna design is pushing theoretical limits, as far as gain for a given-size antenna is concerned, but not for the critical front-to-back ratio.

Design emphasis, says Finco's Ed Nemeth, is on perfect patterns that pull in clean signals. If necessary, gain can be enhanced by an electronic amplifier, once the antenna has captured a perfect signal. But no preamp can get rid of ghosts or multipath interference.

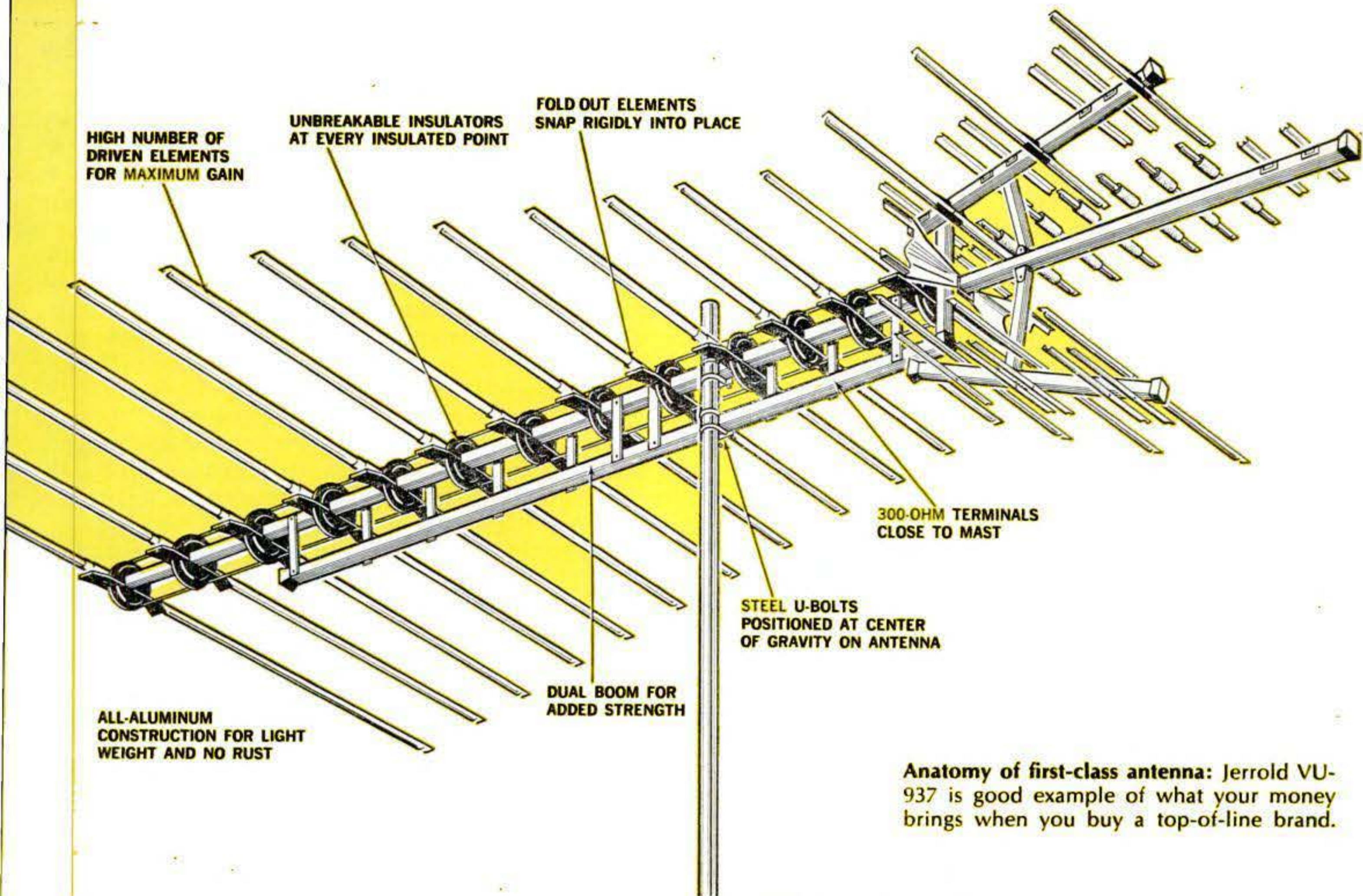
The new antennas, says Nemeth, are designed to have more gain on the higher channels than on lower channels, to compensate for increased propagation loss as the signal travels to your antenna.

Enter the wedges. All this adds up to



**High-gain system** has preamp at antenna to boost signal through line to splitter. Splitter amplifies, matches impedances for four

receivers—typically, one for color TV; one for FM set; the third to jacks for a wandering portable; the last, a spare.



**Anatomy of first-class antenna:** Jerrold VU-937 is good example of what your money brings when you buy a top-of-line brand.

one reason why several manufacturers are building wedge-shaped antennas. The configuration aids performance without increasing the number of elements. Another advantage: A wedge is an excellent structural design because it is its own trusswork.

Top-of-the-line models in Channel-Master's Color Vector series, Finco's "70" series, and Winegard's Color Wedge series, plus RCA's 4GB69 are wedge-type. But if you're a flat-antenna fan, the top-of-the-line JFD LPV-CTC series and Jerrold VU Finder series are still two dimensional.

A wedge is *one* solution to better pattern shape. The trend to larger antennas is obvious when you look at the monster deep-fringe models, but even near-suburban models are more complex than a few years back. One engineer who disagrees with the trend is Ron Grant of JFD. The small increase in performance when big antennas get bigger, he says, isn't worth the cost of the extra aluminum or the esthetic damage to your rooftop.

One of Grant's brainchildren is the JFD Stellar 2001 miniature integrated electronic antenna. It's just becoming available and will carry an \$80 price tag. Except for lower gain on lower channels, Grant claims performance is comparable to that of a conventional moderate-fringe antenna. And a family of Stellers is under develop-

ment to cover the complete antenna size range, he reports.

Actually, the Stellar is the second miniature electronic antenna. The first—the Winegard Sensar—was introduced late last year, and triggered a bitter controversy.

The Sensar is a single-element "slot" antenna coupled to an electronic amplifier. The suburban SR-10 will cost you \$40; the near-fringe SR-20, \$60 (both with cable and mounting hardware).

**Is a miniature for you?** The Sensar is a small and pretty antenna, but it has two drawbacks. Like the Stellar, gain is low on lower channels (because of the antenna element's small size). More serious, its dipole-like reception pattern on VHF gives it a 1:1 front-to-back ratio. This, of course, kayos ghost-fighting ability.

Robert Fleming, Winegard's Marketing Manager, summed it up: "The Sensar is intended for consumers who can't put up a conventional antenna—or who refuse to do so for esthetic reasons. Our contention is that the Sensar, in most locations, will work as well as much larger antennas, up to 40 or so miles from a transmitter."

My conclusion? I'd say consider the Sensar if you hate the looks of your conventional antenna *and* if you live in a ghost-free area. You'll pay a slight premium for good looks, though, since the Sensar costs more

than equivalent near-fringe antennas (although your wife may consider the money well spent).

What about the Stellar? Until many more units are sold, its comparative performances can't be judged.

**How to pick the best.** After all this, what is the best antenna for your home? Jerrold's Pawlowski says, "The best antenna is the smallest and least expensive model that will do the job."

True enough, but it leaves you with hundreds of models to choose among. And, unhappily, there's no magic formula to guide your choice. Should you use those handy "mileage" charts that give the range of different antennas? The engineers say no. Mileage to the transmitter can be meaningless, because it ignores such critical factors as elevation, terrain features, nearby buildings, and foliage density. What's more, you may need an extra-large antenna to screen out ghosts, and end up adding an attenuator to prevent overloading your TV set.

The best approach: See what kind of reception your neighbors have. Check for ghosting, snow, and overall picture quality. If it's generally good, a low-cost antenna will probably do. If not, look for one of the larger fringe-area antennas and start saving for a possible preamp addition.

I asked the experts, "Why are top-

*Continued*

of-the-line name-brand antennas so expensive, especially in comparison with cut-rate antennas on sale at discount stores?" I learned that laying out a bit more money will buy you four pluses:

- Thicker aluminum for the booms and elements, and better-quality anodizing for corrosion protection.
- Sturdier structural design to resist wind and ice-loading.
- Careful manufacture, using precision jigs, to assure precise location of each element on the boom—a must for high gain and clean patterns.
- Beefier hardware to hold the antenna to the mast.

As a rule, a bargain-basement antenna will work, but not for as long as a top-of-line model. The more expensive antenna will be cheaper in the long run.

**The electronic touch.** A major advance in antenna-system technology is the broad assortment of electronic accessories you can buy. Two highly popular are signal preamplifiers and amplified signal splitters.

A preamp (mounted close to the antenna, on the mast) boosts the received signal before it's fed to the transmission line. Three typical uses:

- In fringe areas, strengthening a weak signal to further eliminate snow. But, it will also amplify interference and noise, so the signal must be clean.
- Where a long transmission line is necessary, preboosting signal strength to compensate for line losses ahead.
- Where a tuner stage is weak, improving picture quality by giving the set a hefty signal to work with.

Preamps—typically \$30 to \$50—run on AC house current; a small power supply mounted near the TV feeds low-voltage DC up the transmission line to power the amplifier circuitry.

An amplified signal splitter eliminates another loss: the drop in signal strength that occurs when you chop one signal into two, three, or four parts to feed different TV and FM

sets in your home. A conventional passive (nonelectronic) three-way splitter may deliver only 1/10 the total signal to each set.

The amplified splitter's built-in booster amplifier compensates for splitting loss and adds a measure of gain as a bonus. Typical models cost between \$25 and \$50, depending on whether they are VU or only VHF models. All are solid-state, and usually have four signal outputs.

More-specialized electronic devices include traps that filter out FM-station interference or co-channel interference, and attenuators that reduce signal strength if overloading is a problem.

But before you shell out for electronic accessories, be sure that an all-passive system won't do the job. It's cheaper, it won't overload, and it's inherently more reliable.

**Coax versus twin-lead.** Most of the engineers I spoke to recommend that you switch to a coaxial-cable transmission-line system. Here's why:

Ordinary twin-lead carries a signal with relatively low loss. But its transmission characteristics change if it is wet, if it is run next to a metal gutter, mast, or pipe, or if it's sharply bent. Such changes make the incoming signal bounce around inside the line, and the signal ends up distorted. The effects are particularly bad on color TV. (To prove the point simply wind some of your present twin-lead tightly around your hand, and watch the colors change on the screen.)

More, the signal is unprotected as it travels along twin-lead. Nearby electrical machinery can contribute interference that blends right in with the signal. And in some cases, long horizontal runs of twin-lead can act as a second antenna that picks up ghost signals rejected by the rooftop antenna.

Coaxial cable, of course, armors the wire, so you can run it safely past motors, through pipes, even under-

ground, without affecting the shielded signal.

Coax has greater loss than twin-lead, which may be a problem in far-fringe areas unless you also use a signal preamplifier. You'll also need matching transformers to join coax to the antenna and to most TV sets.

**How much more does coax cost?** For a typical home antenna system (a single antenna driving an amplified signal splitter feeding two TV sets and one FM radio), coax transmission line costs about \$16 more than a twin-lead setup: about \$5 more for 100 feet of cable; \$2 each for the four matching transformers (one at the antenna, and one at each receiver); and about 50 cents each for the special connectors used at the ends of each piece of coax.

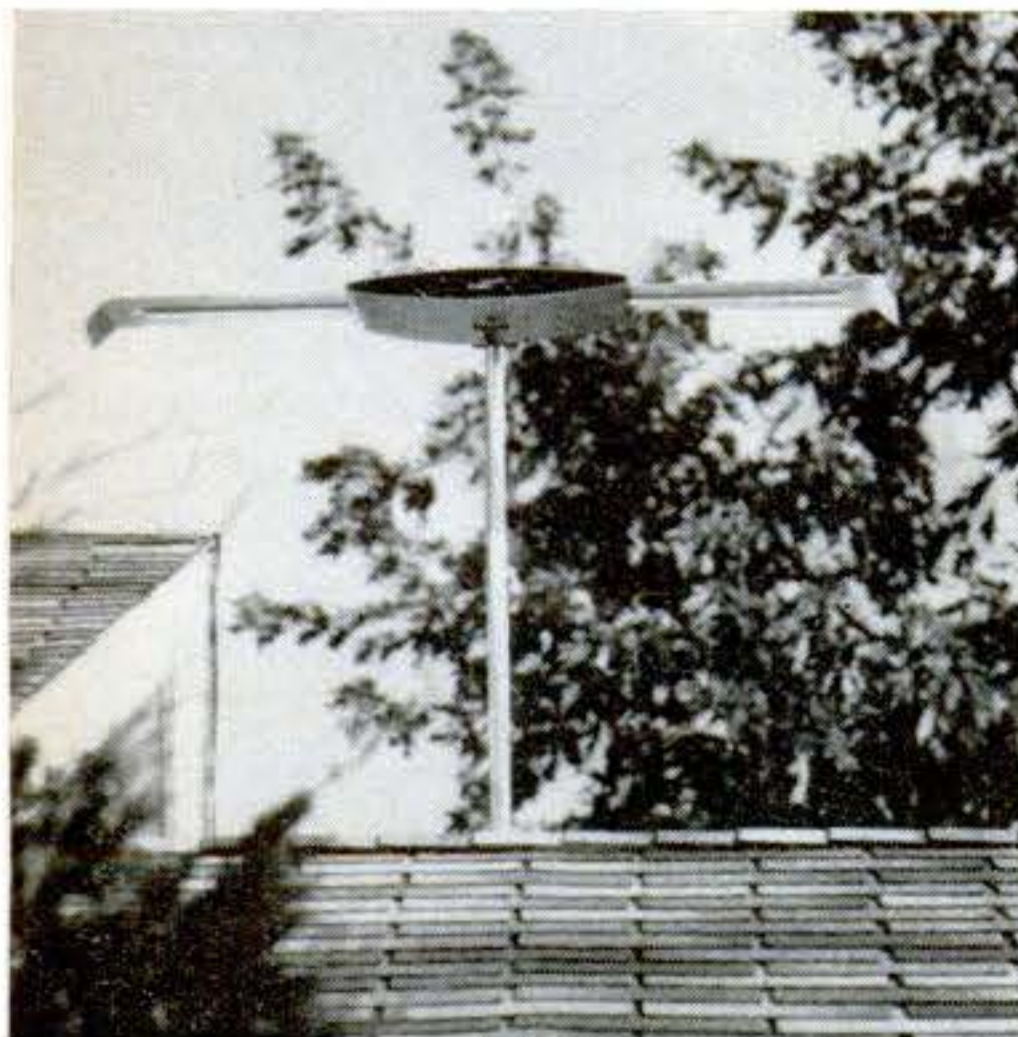
On the plus side, though, coax lasts far longer than twin-lead, so it may be cheaper in the long run; there is a much larger assortment of electronic gear available for coax installation; and coax is really "goofproof."

Since each piece of coax must terminate in a connector, there is no chance of accidentally splicing two or more receivers in parallel or having one of your connections break off just minutes after you have finished the job.

And, since there are no exposed wires after a connection has been made, there's no possibility of wind-blown cables twisting and shorting together.

Winegard's Carey Shelledy told me, "It's the perfect lead-in for do-it-yourself installation, since an amateur is less likely to make an installation mistake that will harm the signal."

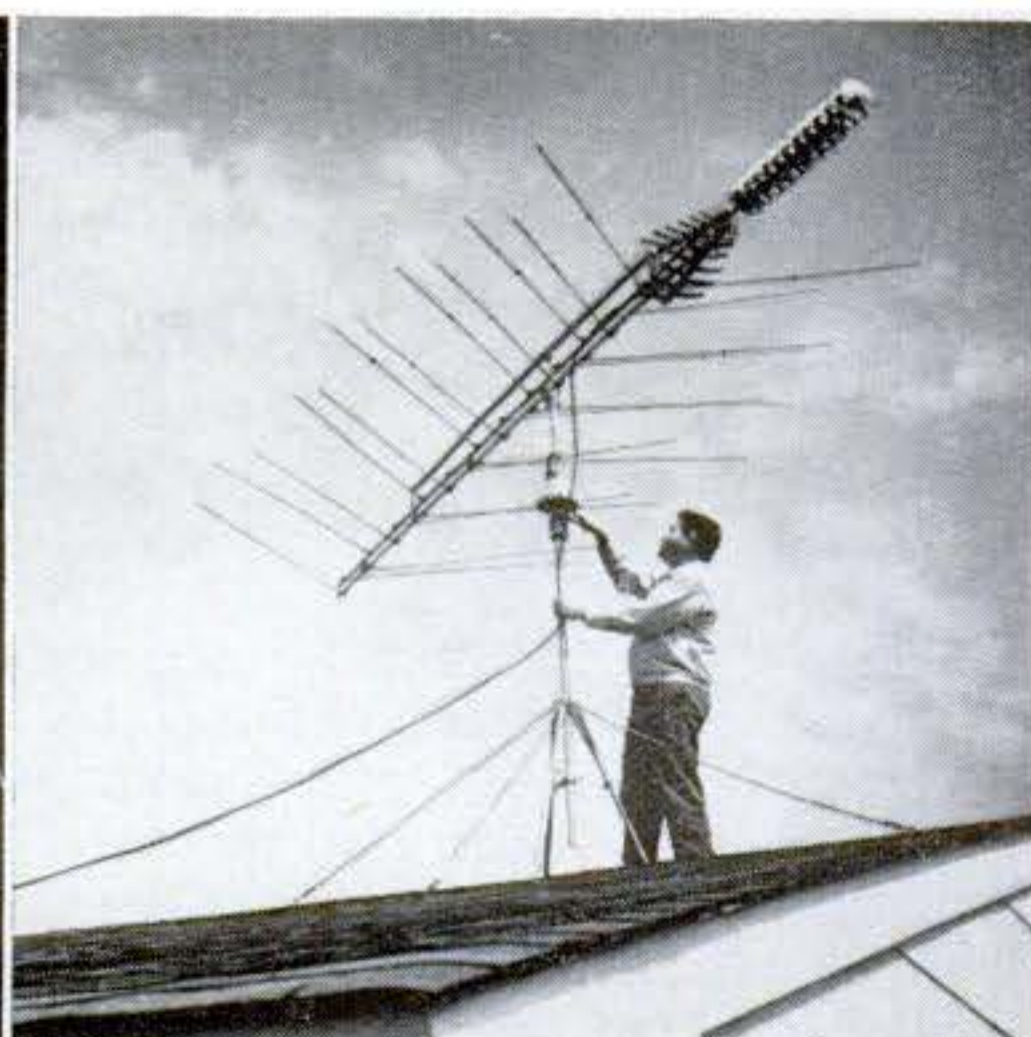
One extra bit of non-technical advice. Remember that you and your family may spend as much as 30 per cent of your free time in front of the tube. In dollars and cents per hour, a good system is cheap, considering the hours of pleasure you will get from it. P.S.



**Winegard Sensar**, first small antenna, is good to 40 miles, but ghosting is likely.

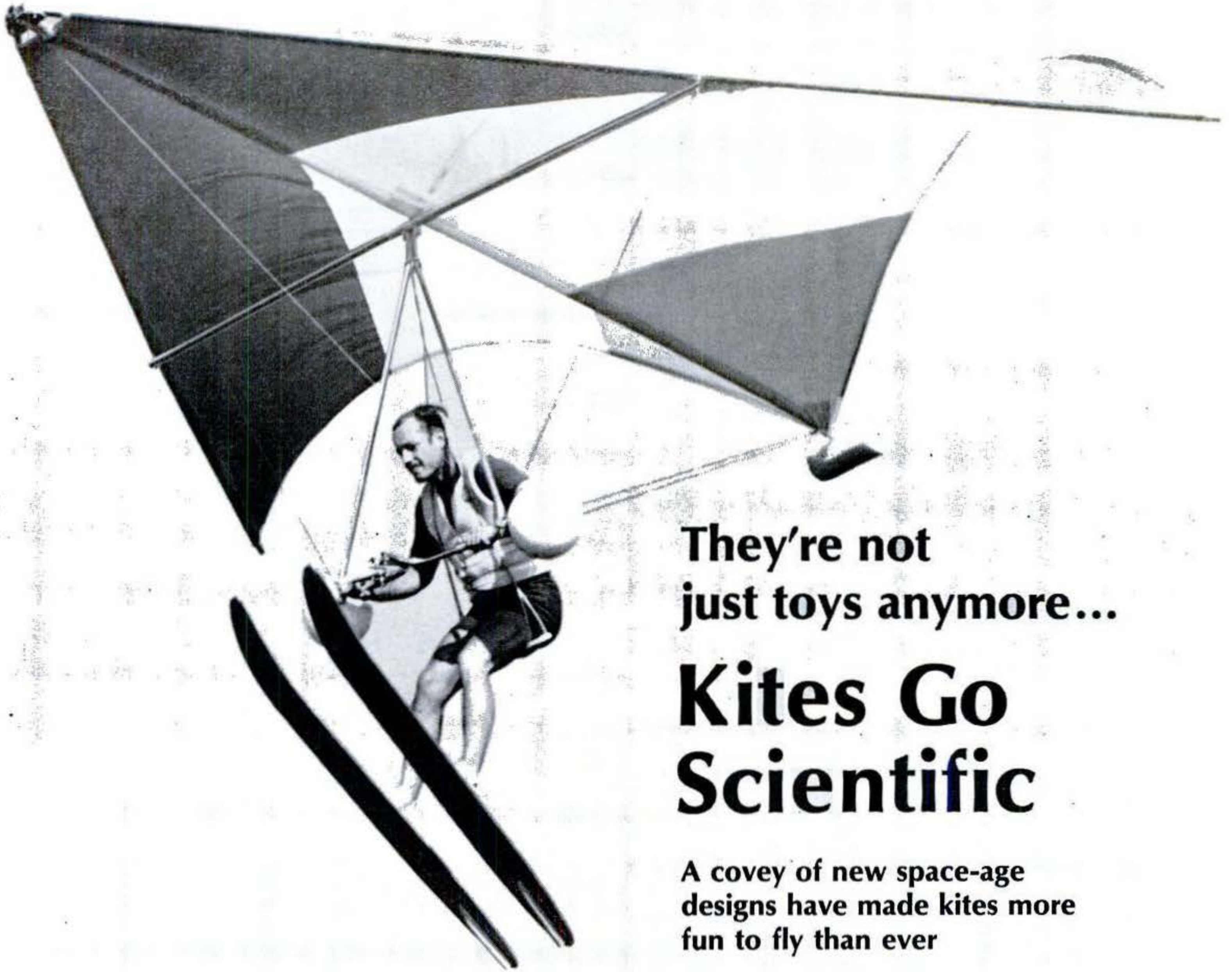


**JFD's Stellar** works along same lines, but not much is known about its new "wedge."



**Look big?** It should. JFD's deep-fringe antenna is 16 feet long, has 47 elements.





**They're not  
just toys anymore...**

# Kites Go Scientific

**A covey of new space-age  
designs have made kites more  
fun to fly than ever**

By **BEN KOCIVAR** / *PS Consulting Editor, Flying*  
COLOR PHOTOS BY THE AUTHOR  
AND ARTHUR FISHER

**Delta-wing kite**, towed behind speedboat, hiked Australian Bill Bennett to 2,900 ft. at

Cypress Gardens, Fla. Riding trapeze seat (above), he pushes front bar to rise, pulls

to nose down. Below, Bell Aerospace tests delta design for pilot ejection seat.

**F**lying kites is serious business these days. Scientists are using them to learn about weather making as well as weather forecasting. NASA scientists use them in aligning Navy tracking radars, to help guide Apollo spaceships back to safe landings. Special nonrigid versions are being developed for use as gliding parachutes, both for pilot ejection from damaged fighter planes and for controlled cargo drops into hostile territories.

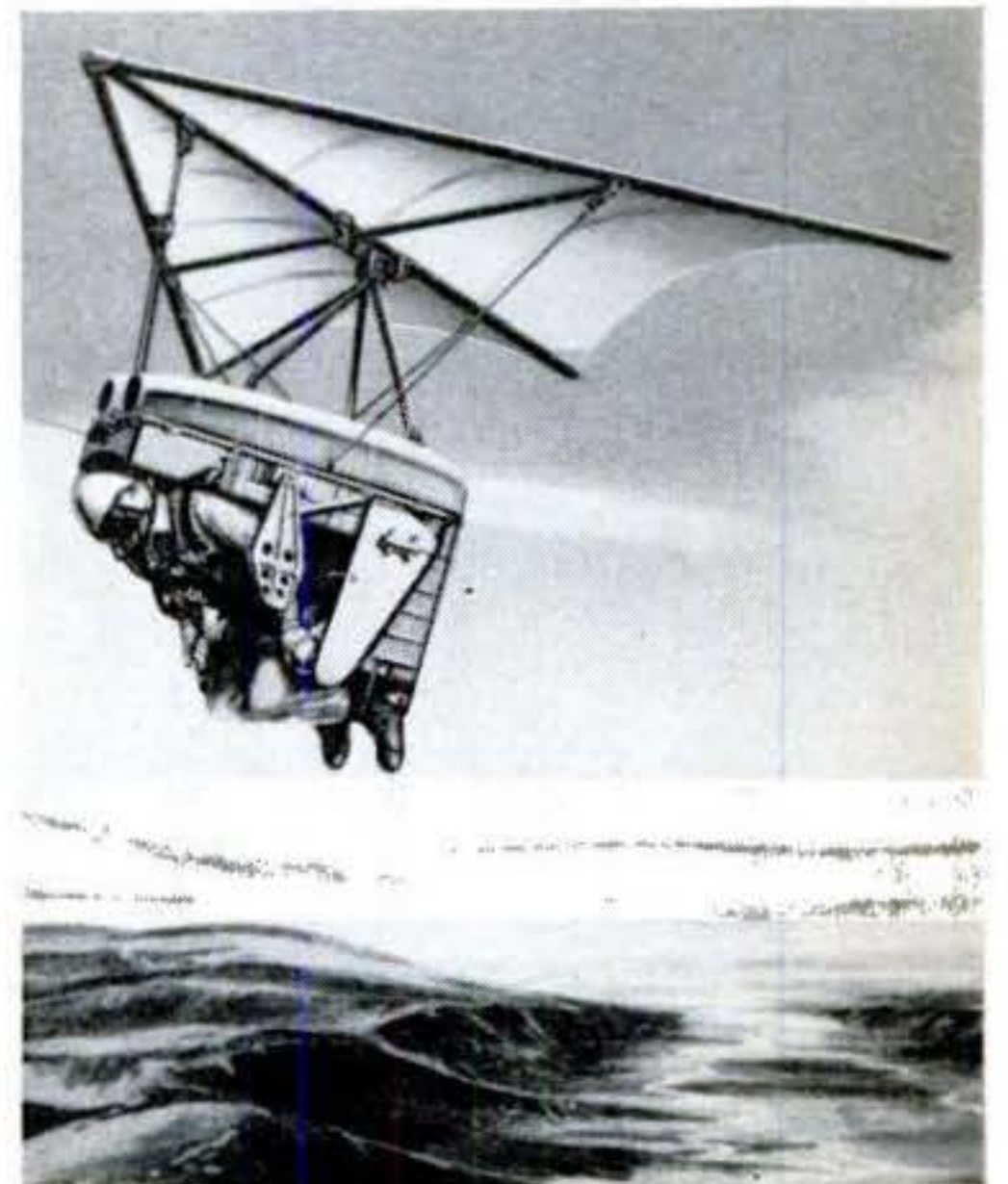
Your bonus? The fallout from this research is advanced designs that make kites more fun than ever to fly. Kiting is no longer just a backyard pastime for kids, but a fast-growing hobby for men fascinated by the mys-

terious skies and bird-like flight.

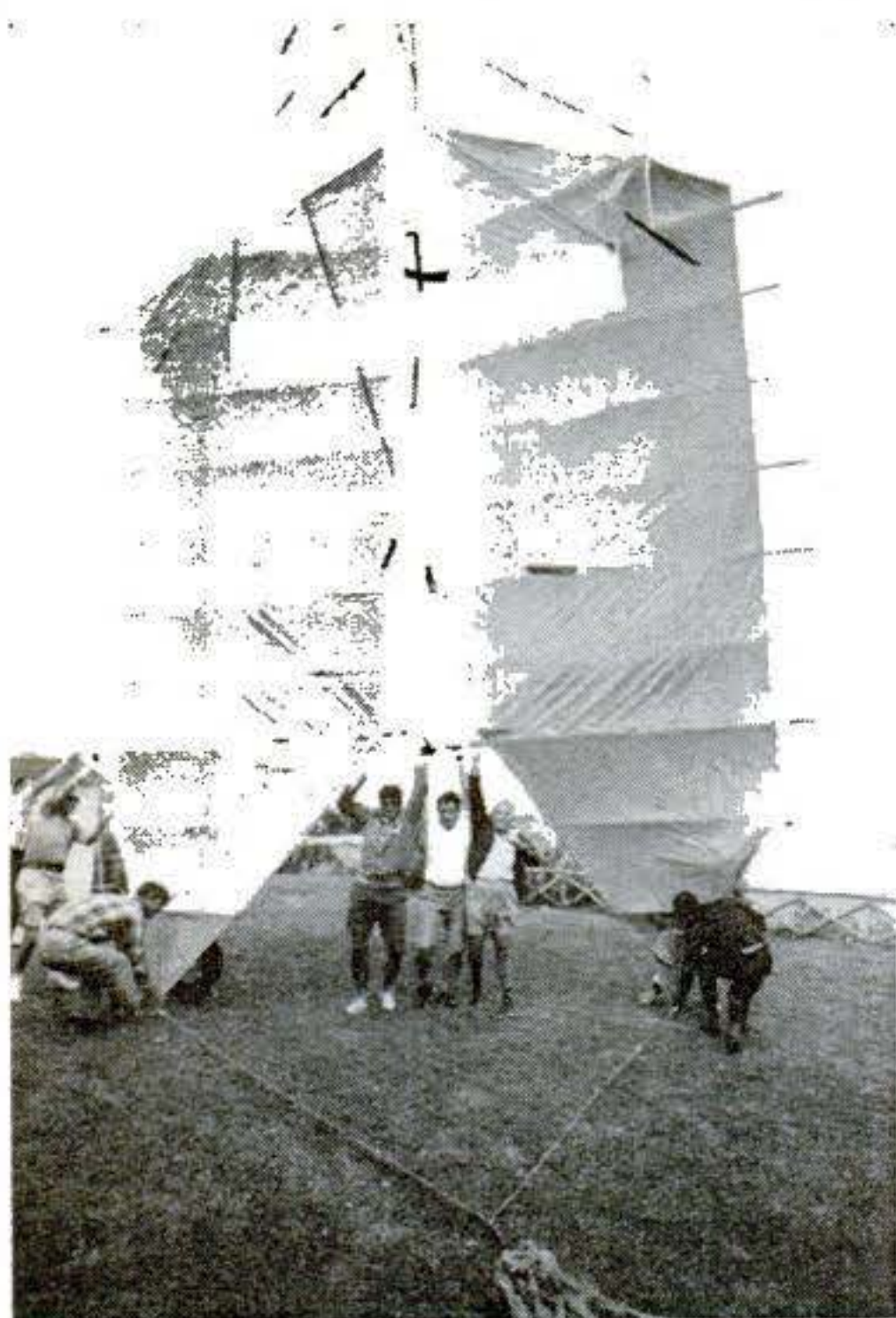
I recently surveyed new space-age kite designs—mostly on Bermuda beaches, where the winds are unusually steady. As you might expect, new rugged plastics and plasticized papers are being used for surfaces. But more interesting is the startling variety of new shapes in the sky.

You can get kites for light or strong winds, kites to fly almost straight up, and some that hover like hawks. Some are specifically designed to be load lifters. And a new generation of two-string controllable kites is designed specifically for aerobatics and controlled kite fighting.

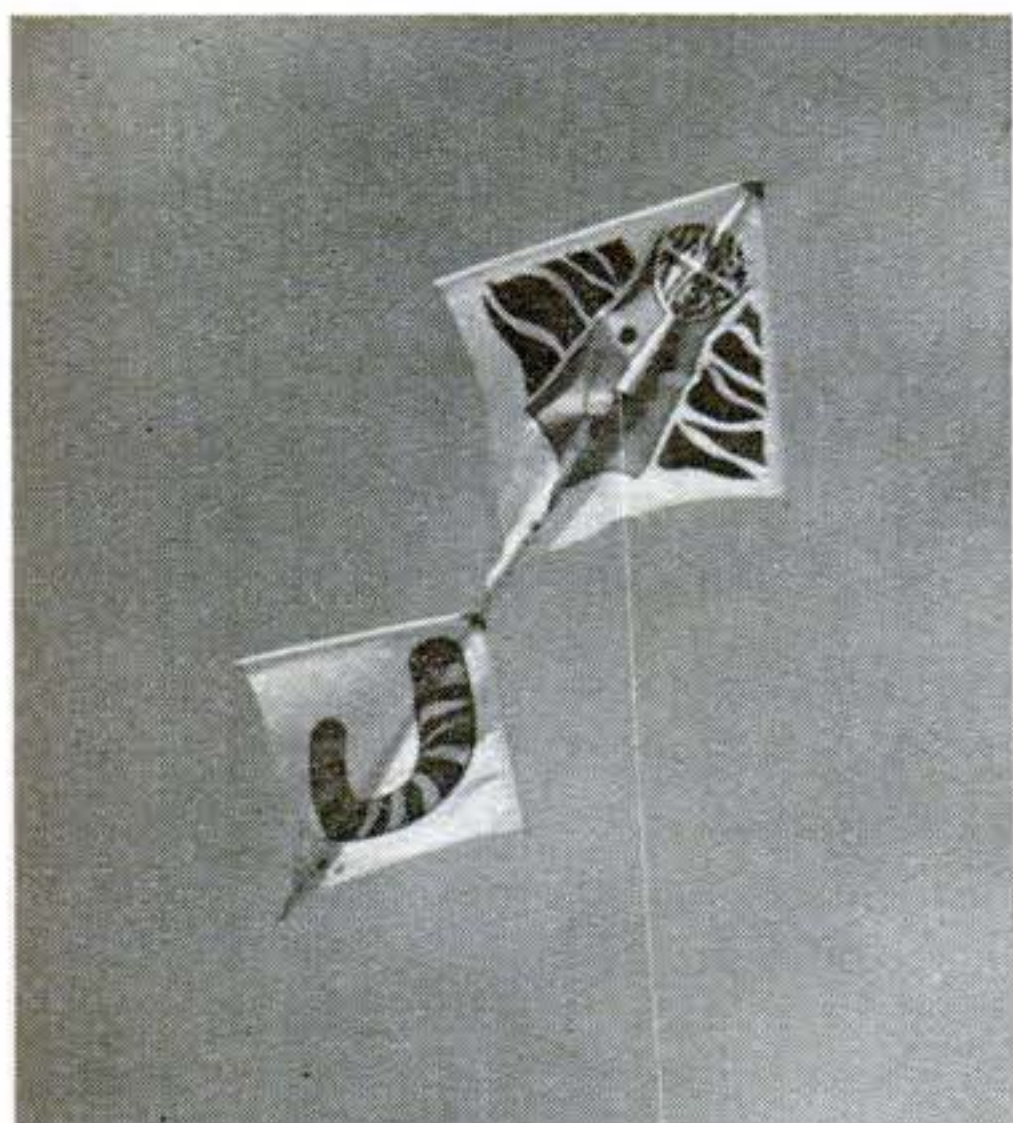
The new kite scene has five basic  
*Continued*



## New kite designs achieve aerodynamic shapes by using clever bridles



**Bermuda kite "season"** starts Good Friday, includes giants like this 15-footer made of complex aluminum spars, wire, and paper.



**Five-foot Tandem Tiger** is a modified double delta with wood dowels fitted into unusual plastic nose fittings. It needs no tail.



**Inventor of the parawing**, Francis Rogallo, launches small one at Kitty Hawk. Big versions of his design carry men aloft.

types: deltas, sleds, parawings, parafoils, and inflatables.

**The delta.** There are many variations, but essentially the shape is like the triangular or swept-back wing of a supersonic plane. Usually, there are three rigid sticks coming together to a point at the leading edge. There is considerable flexibility in the fabric or plastic sheet connecting, so that the sticks at the trailing edge will vary in distance from each other depending on the amount of wind and pull.

Some, like the Gayla, have a center keel—another delta, which provides directional stability and bears the attaching ring for the line. Others, like the Glite, have no keel.

Deltas are probably the most popular of the new commercial kites. They can be made to look like birds, planes, or airborne pop art. Their distinctive flying quality is that they usually zoom up almost directly overhead.

**Bird kites.** Possibly the most exciting new "floaters" I've flown are a series put out by the Airplane Kite Co., 1702 W. 3rd St., Roswell, N.M. 88201. These are among several novel designs by Ray Holland Jr., an MIT aeronautical engineer.

The birds are aerodynamically balanced, can even do a slow glide—maintaining stability when dropped by hand. Flown at the end of a string, they hold a correct angle of attack to the wind without a special bridle, keel, or even a long rag tail. Each sweeps around the sky with the string drooping below in a long bow.

As the kite changes direction with slight wind shifts it has the uncanny look of a live hawk shifting easily from side to side as it searches for prey. Don't fly this design near turkey or chicken farms. The realistic action could panic a flock.

**The parawing or Flexikite.** Designed

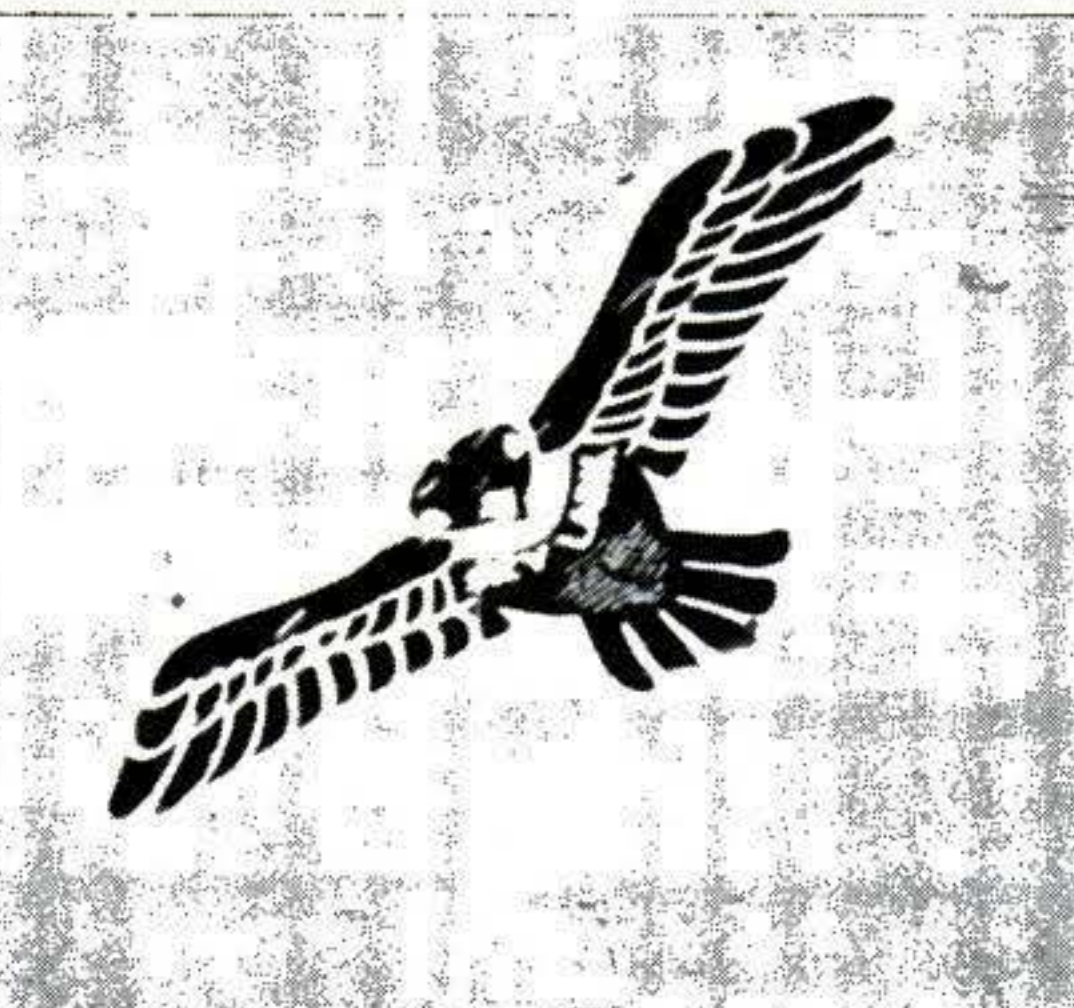
by Francis Rogallo, it was originally a kind of gliding parachute. The original parawing has no rigid wood or plastic members, but it does need a fairly rigid center crease for its keel. The rest of the shape is held by bridles. It is, like the delta, a high flier, and it needs a tail. Its great beauty is its ability to shrink and expand its direct surface area to the wind according to the forces it meets. Strong gusts make it pull itself together. Then when the wind slacks, it spreads out to get more lift in light air.

Parawings have been designed for space vehicles and as ejection chutes for fighters (to give the pilot a chance to glide away from enemy territory or dangerous obstacles), and have even been powered with engines to become "fleeps." The basic kite is tricky to make and to fly—not for the casual kiter.

**The Scott sled.** Designed by Walter Scott, its side keels make it look something like a snow sled—hence its name. It has only vertical stiffening, usually three rods, so that it can be rolled up. A variation on this is one kite I found which has three inflatable tubes that run vertically parallel to each other and act as stiffening. This one also has a double-slotted back that puffs out like an airplane wing to provide lift somewhat in the manner of the Jalbert parafoil described later.

The Scott sled has a triangular vent about two-thirds to the bottom, and this seems to be important for flight stability. The sled has a two-string bridle; the bridle-string length is critical. A lateral stiffener is sometimes used to keep the sled from collapsing in gusty conditions. The sled usually flies at a high angle, which means it can do well in light winds.

[Continued on page 146]



**Sky Lark**, made by Airplane Kite Co., flies flat, hovers like a hawk and even fools real birds into investigating it.



**Using old Portuguese fishing trick**, author Kocivar and kite champ Will Yolen launch a train of kites to tow small sailboat.

and ram air pressure



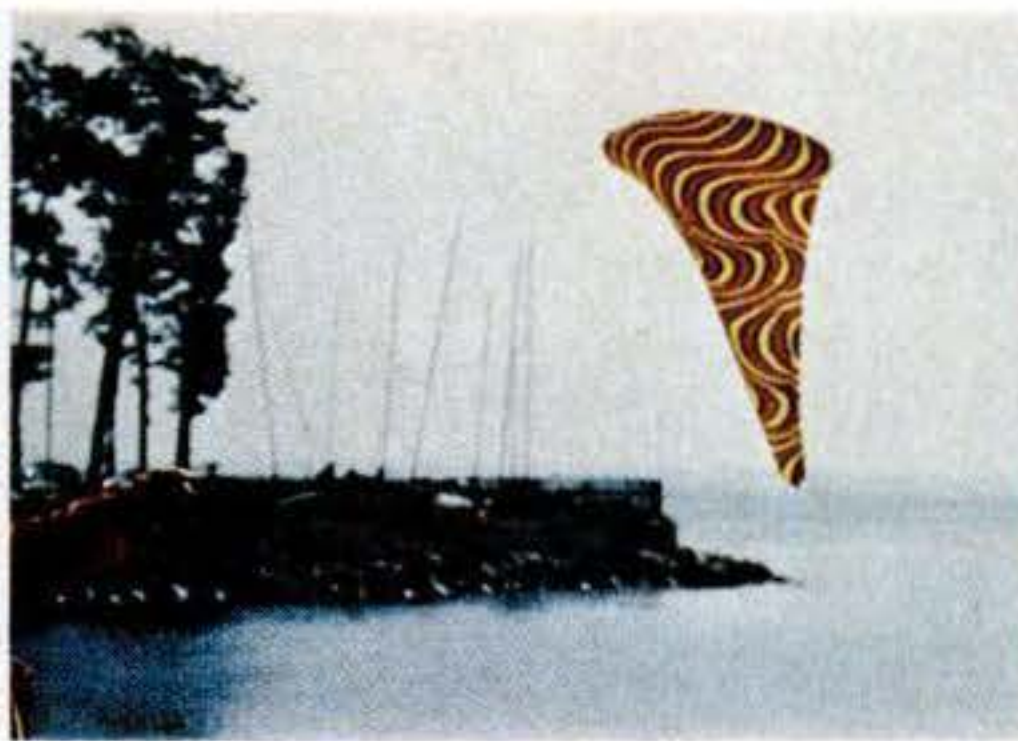
Home-built Red Baron biplane zooms up at contest sponsored by Smithsonian Museum and Natl. Park Service in Washington, D.C.



Traditional circular Bermuda design has giant trailing tails. A similar model won a marathon endurance contest; it was kept airborne for 35½ hours by team of four.



Steady breeze along Bermuda beach makes hand-launching this German Drachen delta with a keel as simple as letting out string.



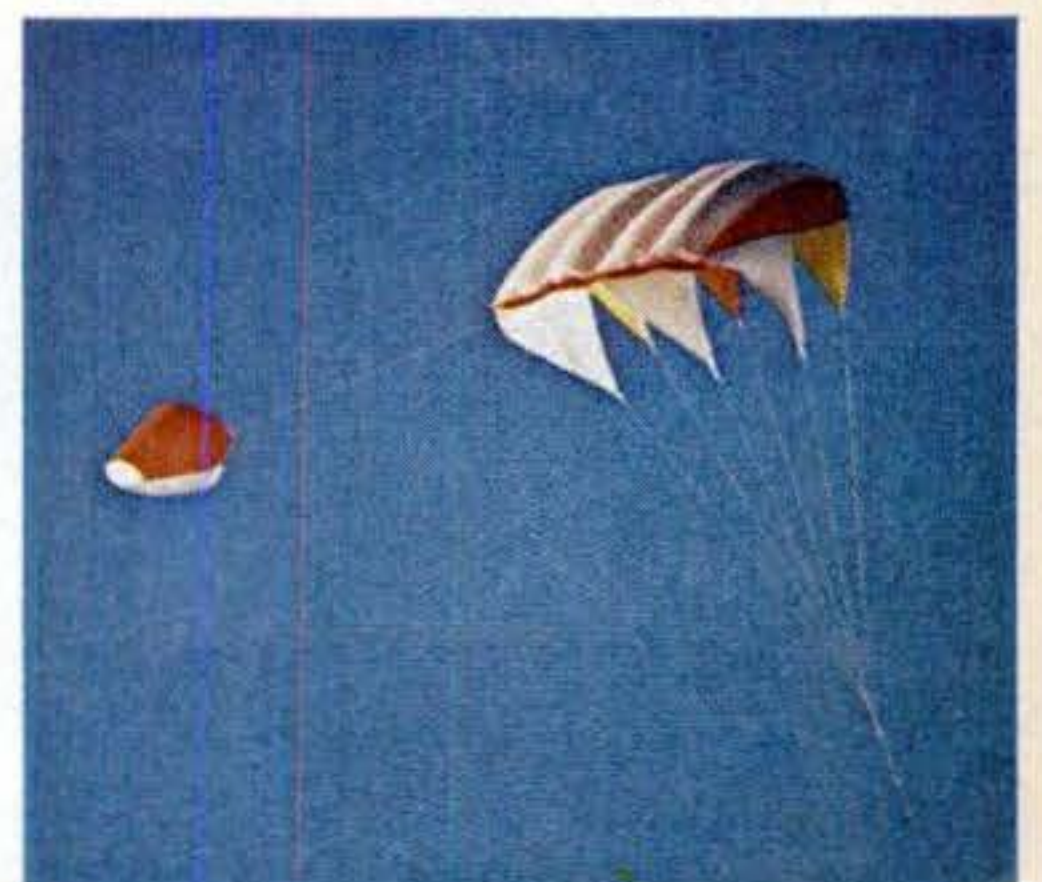
Puffer is blown up like balloon; it was offered by General Mills as box-top premium, flies steadily even in very light winds.



Two-line control flight makes this parawing do tricky acrobatics. Gayla and Northwest Industries make two-line models, too.



Domina Jalbert's Kytfoil is three-foot version of his famous big Airfoils used for atmospheric research and gliding parachutes. Open slots let ram air fill out sections to airfoil shape. Wind-sock tail cone (below) helps stabilize kite in strong gusts.



# PS Tests Five Camping Trailers

Can you match these little campers safely to your car? Here's what we found out

By HERBERT SHULDINER

The boom in subcompact cars is on, and outdoorsmen, like everybody else, are eyeing them. They're also looking at trailers to match. Before buying, however, there are some things camping buffs want to know:

- Do the small trailers designed for small cars offer sufficient space for camping comfort?

- Can a subcompact car safely tow one of these mini-trailers?

To find the answers to these questions, PS rounded up five RVs capable, their makers claim, of being towed by subcompact cars. We could have selected from perhaps a dozen others of similar size.

We also selected five popular subcompact cars to tow them. Then we put the complete rigs through stringent handling and braking tests, and ran them under traffic and highway conditions as well.

The five trailers we used were the Mastercraft Compact, Apache Eagle, Starcraft Starlite, Sprite Mark III 400, and Scotty Sportsman 13. A chart of specifications for the units appears further on.

The towing vehicles were the

Pinto is backed to hitch up with Starlite camper (foreground)—one of five rigs PS tested to check the safety of small-camper/subcompact-car combinations. Other rigs (front to rear) are Colt/Apache, VW/Mastercraft, Vega/Sprite, Gremlin/Scotty.

**Molded-fiberglass Compact Jr.** (not to be confused with Mastercraft Compact) is a 13-foot camper weighing 975 pounds. We didn't test this rig but it can be towed by small cars like Datsun

510 station wagon shown below. The trailer's pop top keeps overall height under seven feet when not in use, so you can garage it. At campsites (below), top raises for more head room.



# for Your Small Car

1972 **CAMPING**

Dodge Colt, VW Super Beetle, Chevrolet Vega, Ford Pinto, and AMC Gremlin. Maximum recommended hitch weights for some of the cars go up to 100 pounds.

**Hitching up.** The Starlite and Scotty exceeded the hitch-weight limitations by quite a bit, and the Sprite's GVW was over the limit unloaded. In general use, with a normal load of food and gear, even the Starlite and Scotty would undoubtedly exceed the GVW limit. For the purposes of this test, however, we decided to stretch the car makers' limits.

We used simple, ball-type hitches, mounted to the frame of the cars, except on the Colt. It was equipped with a multi-clamp-on bumper hitch, not recommended for towing trailers. But no other type hitch can be conveniently mounted on this car, according to the company. Neither the auto companies nor the hitch companies consulted would recommend load-equalizing hitches—too much doubt about the ability of the car frames to take the added pressure.

Our test team, PS Auto Editor Jan P. Norbye and Detroit Editor Jim Dunne, ran the tests at the Bridgehampton Race Circuit on Long Island, N.Y. The two major tests were braking (bringing the rigs to a halt from 60 mph in a 12-foot-wide lane, without locking the front wheels of the tow car) and handling (completing two lane changes in 180 feet, using two lanes 12 feet wide).

The Norbye/Dunne conclusions: All these combinations are reasonably safe at highway speeds. During the braking tests, all but the Colt stopped straight with no swerving of tow car or trailer. There was partial jackknifing in the Colt-Apache Eagle combination, but this could have been due

[\[Continued on page 124\]](#)

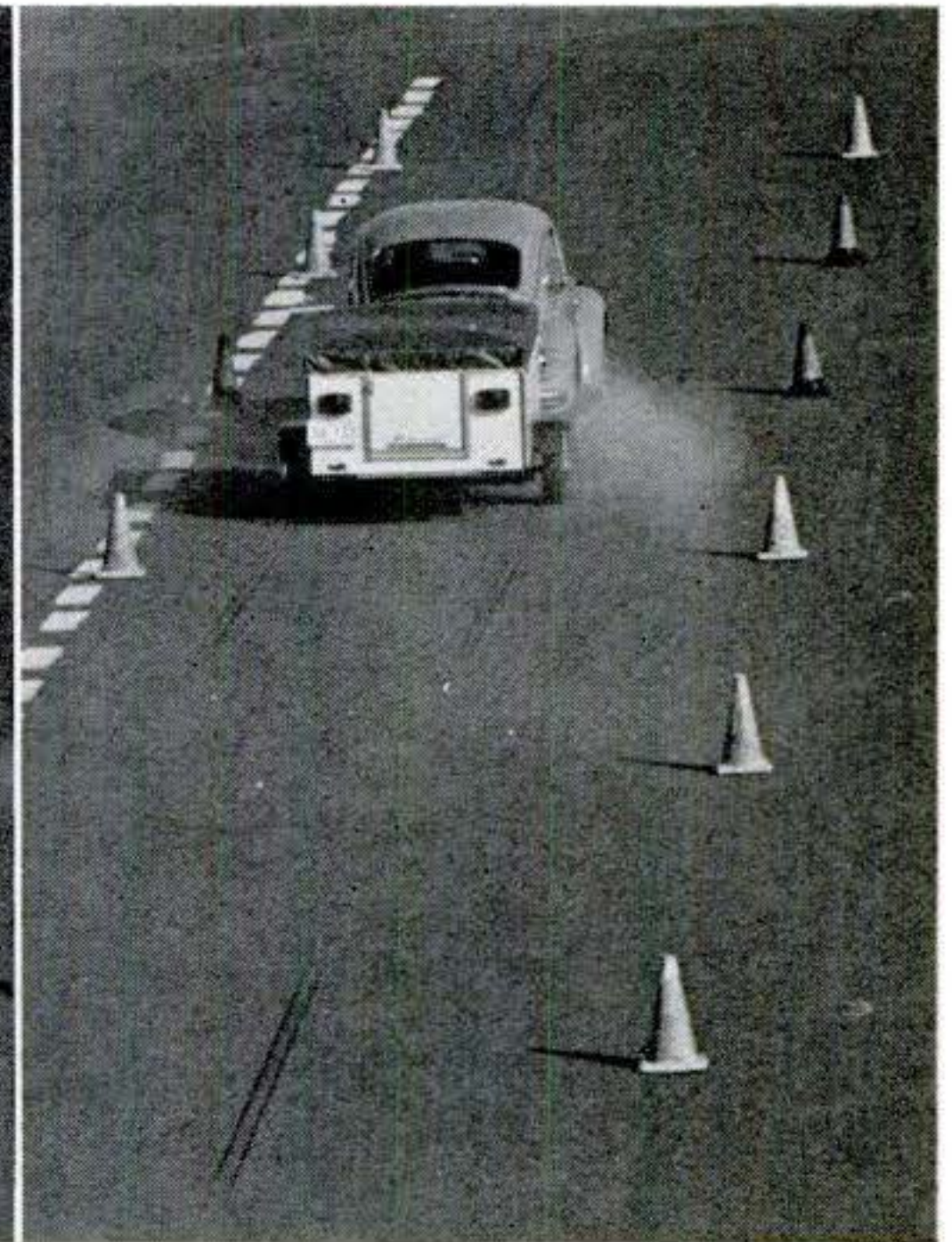


During lane-change test, Jan P. Norbye (left) and Jim Dunne, PS auto editors, discuss behavior of Dodge Colt/Apache Eagle

combination. Like the other light trailer combinations, rig's speed was only slightly slower than that of the car alone.



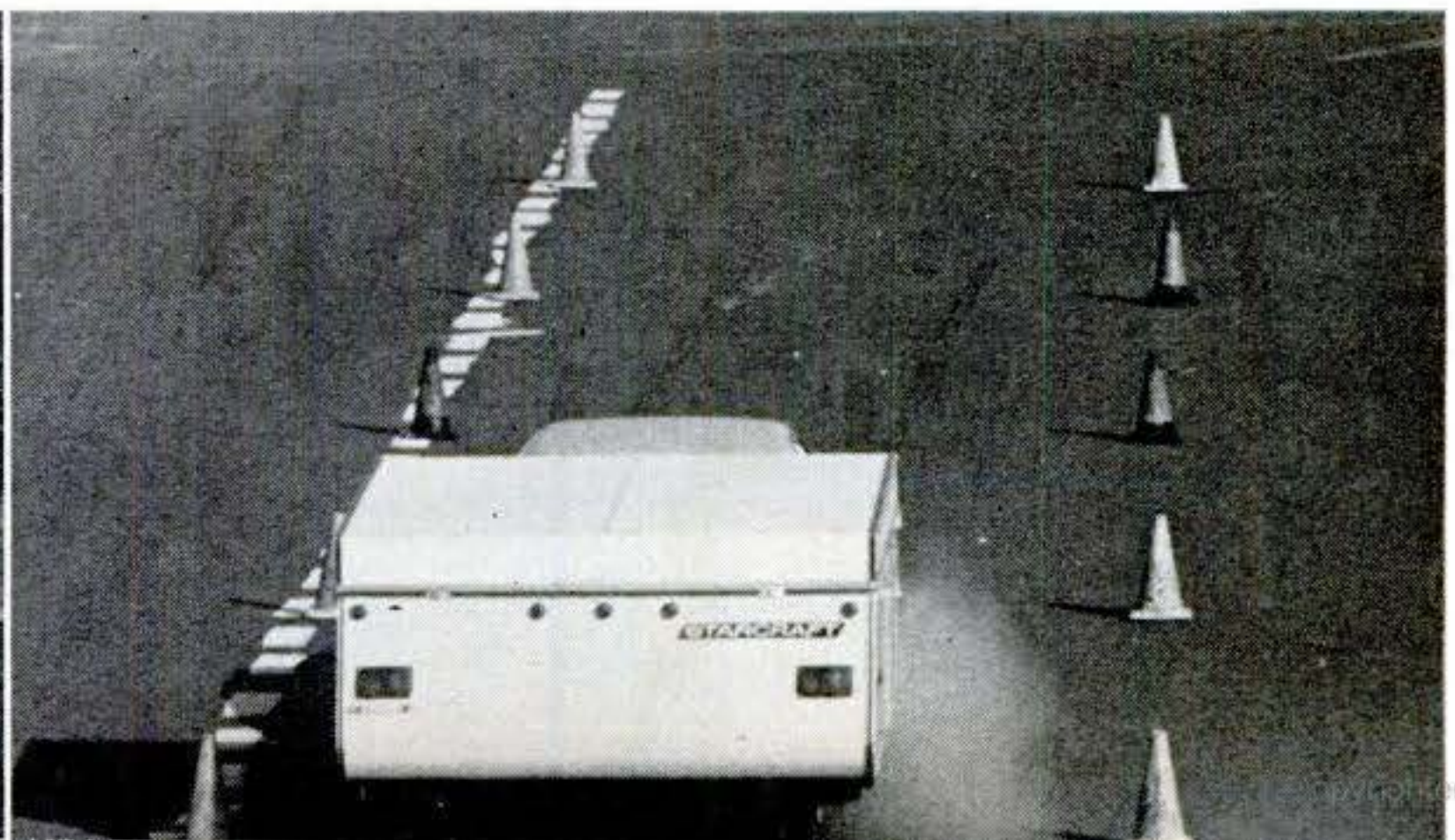
Vega/Sprite combination comes to a stop in brake test in 136 feet 10 inches, shortest stop of all rigs tested. Probable reason was the trailer's helping brakes.



Super Beetle/Mastercraft Compact stopped in 161 feet—some 47 feet more than for car alone. But rig is safe under highway conditions, our experts judged after test.

**Vega loses stability during lane-change test** while pulling the Sprite. The heavy trailers displayed tendency to lift the inside wheel and jackknife during severe maneuvers at high speed.

**Starlite camper, with Pinto,** took over 200 feet to stop from 60 mph during brake test. Our test team concluded the camper should be purchased with optional brakes because of its weight.



# THE '72 RVs: New

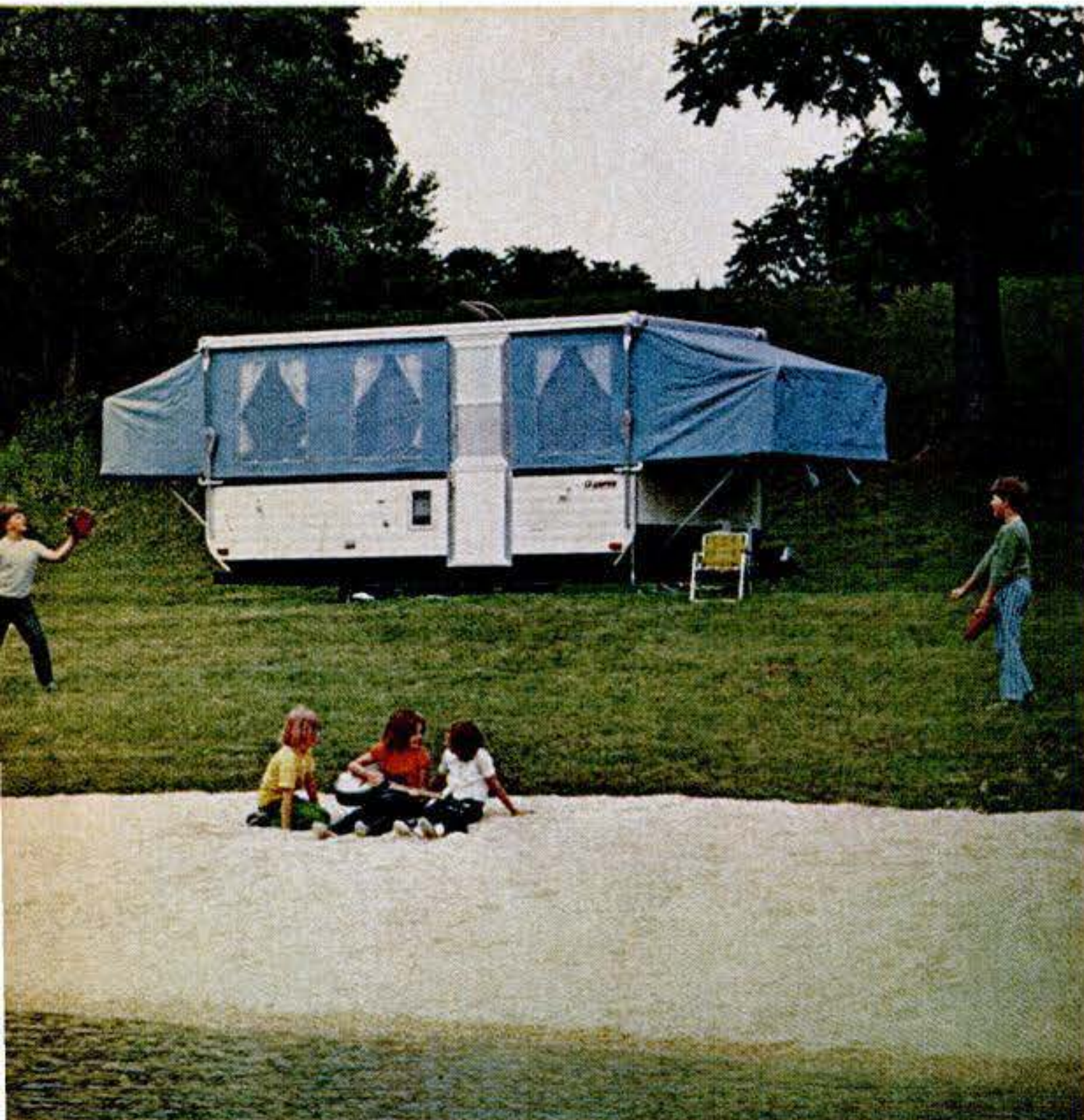
A preview of the newest campers, trailers, and motor homes, with impressions by PS editors who tried many of these rigs

In recent months, a team of PS editors has been visiting RV factories, attending camping shows, and testing prototype campers to find the ones that will be setting new trends this season. This special eight-page report reveals our findings: Motor homes are getting smaller and less

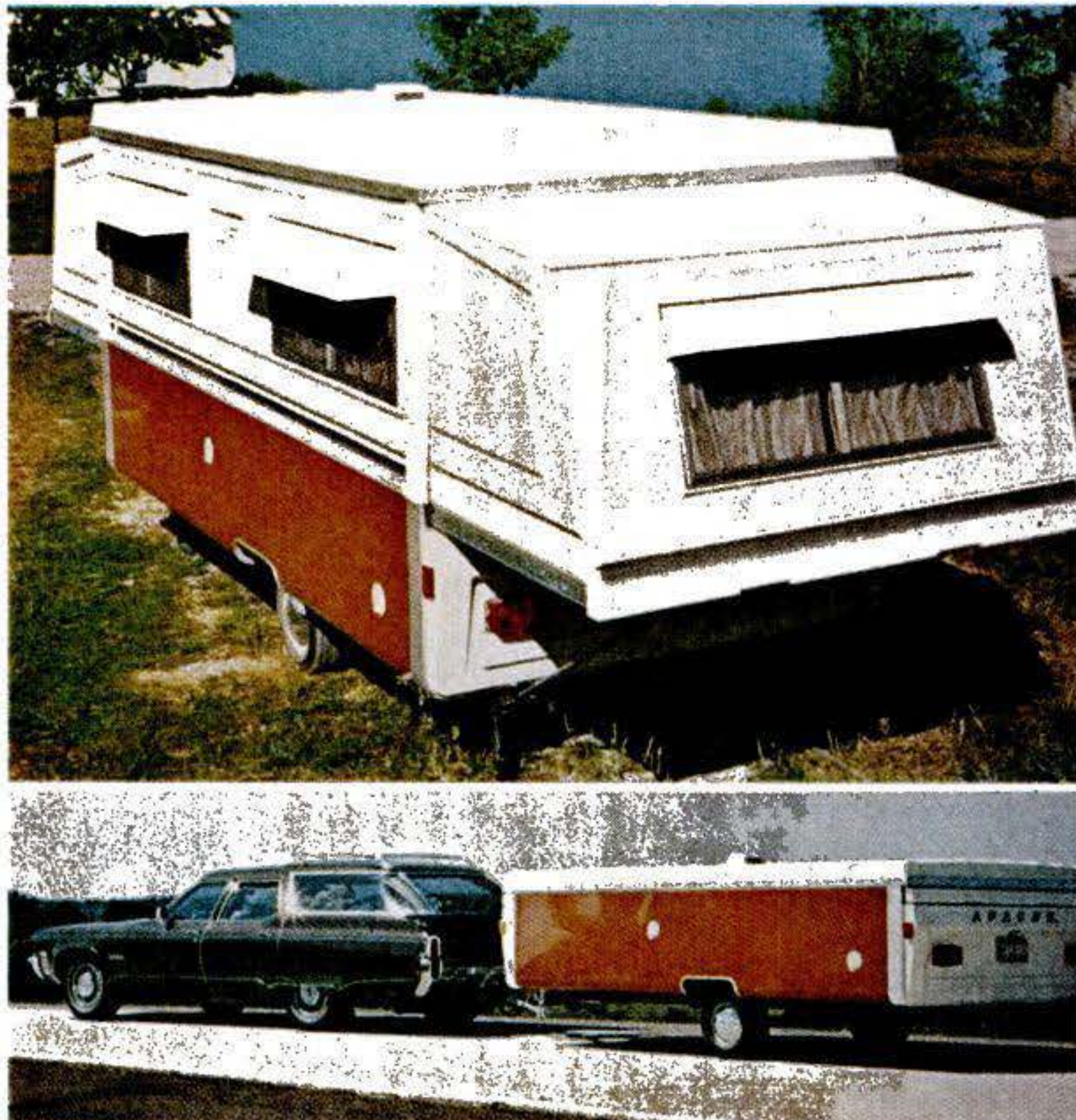


**Skamper Big-T** without its canvas reveals new luxury touches that tent campers are getting nowadays. Spacious dinette, big galley, lounge, and roomy bunks make life more comfortable in the woods. There's even a portable toilet in this model, and lots of bins for storage. It's equipped with four tandem running wheels.

## TENT CAMPERS:



**Skamper** opens up from 58-inch road height into this sizable vacation shelter. It has a rigid plastic roof to protect against elements, and screened windows for plenty of no-bugs ventilation.



**Apache Roamer**, one of the new no-canvas tent campers: It has look of permanence outside and inside. Solid plastic panels fold down quickly to provide low profile behind Olds wagon.

# Trends in Camping

expensive. They're also getting bigger and more luxurious. The pickup camper is getting a shot in the arm with new designs and concepts. A whole new way of towing travel trailers is spreading down the turnpike with the proliferation of fifth-wheel models. Even tent campers

are getting a new look inside and out, becoming every bit as "refined" as bigger RVs. The '72 RVs show that the days of roughing it are over for most campers, because this year's camping vehicles have all the comforts of home—and, indeed, may even have more.



Coleman camper expands into a surprisingly large interior with Mylar picture windows. Bunks are big and comfortable, and the large dinette (inset) makes a good place to sit around and talk.



Starcraft Starmaster 6 is medium-size camper with lots of interior space, big swing-up galley, and 12v converter for interior lighting. Starcraft has rugged steel frame, sandwich walls.

## The accent is on the homey touch

By HERBERT SHULDINER  
and DAVID D. VIGREN

Camping trailers have come of age. The former "plain jane" of RVs has been dressed up with new exteriors and cozy, cabin-like interiors that have turned it into a luxury vacation home instead of a tent on wheels.

What's more, some are tent campers only in concept. They don't have a stitch of canvas. Instead, they sport solid plastic walls and "bedrooms."

Whatever your type, canvas or solid plastic, you'll find more homelike touches than ever in the '72 camping trailers. Larger floor areas, roomier dinettes and bunks, fully equipped galleys, and curtained-off toilets are becoming more common.

But camper prices reflect the added goodies, running to \$2,000 and more for some models. Of course, there are many models less lavishly equipped that run from \$1,000 up.

PS Senior Editors Herbert Shuldiner and David Vigren recently tested two representative new campers. Here are their reports:

*Shuldiner:* It doesn't take long to get used to the lack of canvas in the

new "solid-state" Apache. In fact, it gives you a feeling of permanence when you're inside and the breezes don't make the walls billow. I found little difference in setting up the solid plastic walls and bunks of the Apache compared with a canvas camper. And the Apache's lift mechanism works smoothly.

Inside, the Roamer had tremendous space, and my family of five never felt cramped during evenings in the rig. The convenient galley and range make meal preparation easy. The dinette is cozy. The bunks are covered with vinyl-coated nylon for protection against rain-in.

Windows and screens are permanent, and they slide open instead of zippering. Visibility is better than with flexible plastic.

And there's one big advantage: You don't have to worry about closing up a mist-dampened camper in the mornings. This rig won't mildew.

*Vigren:* Comfort comes easy in the Coleman 596 camper. Well-made vinyl seats and bunks make lounging around a real pleasure. The huge picture windows give you a terrific view of your campground.

Everything works well in setting up the rig. The door is beautifully effective for a fold-down. Slip-in plastic gasketing seals around the channels make the camper as good against bugs as most houses. The canvas zips closed on three sides around bunks, and you can adjust the opening to suit the amount of ventilation you want.

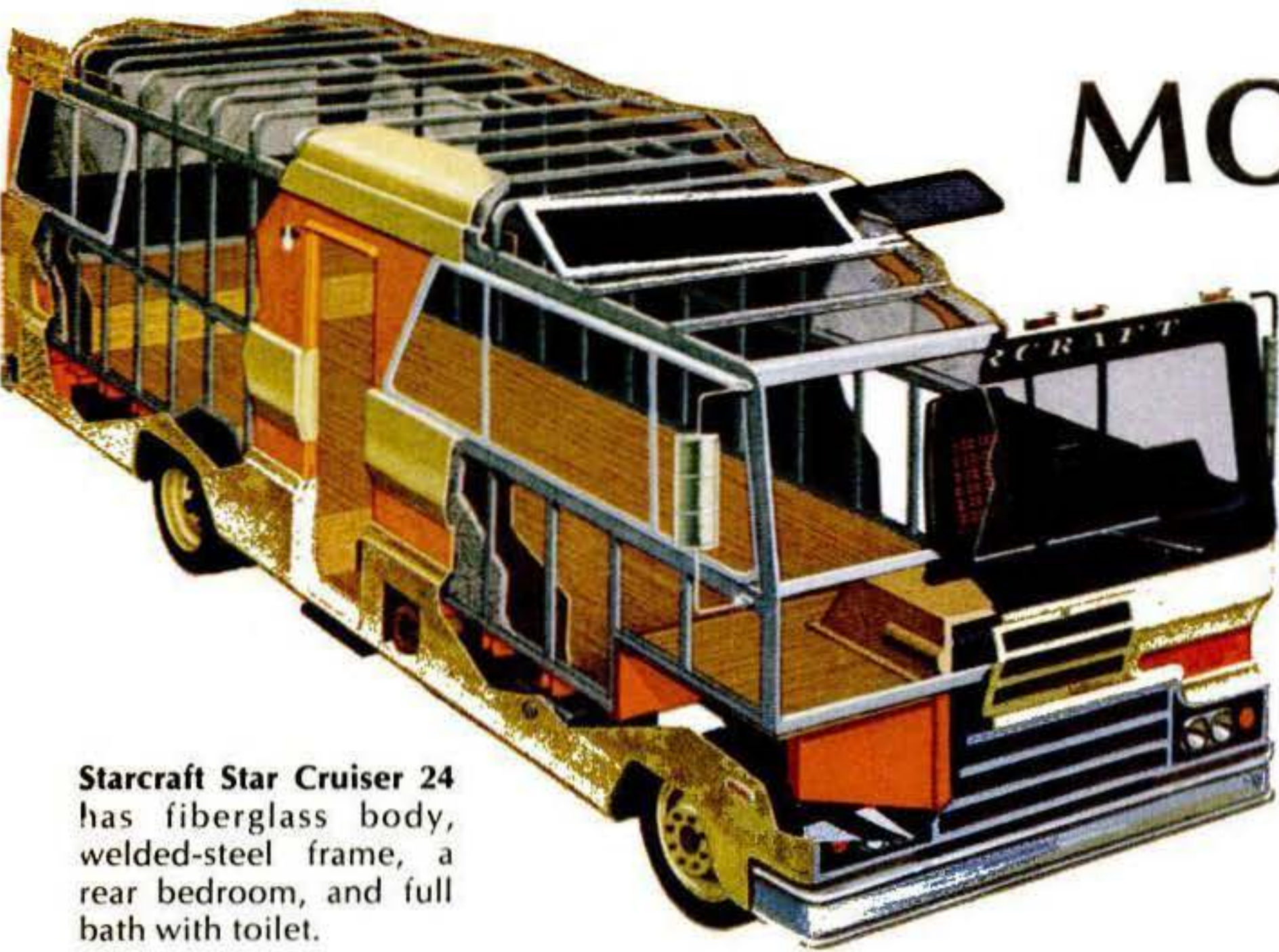
Taking down the camper is quick and convenient. Just unsnap, push the canvas and bunks in; and when you remove the pin the hardtop weight brings it down into a neat package. Hitch-up is simple and easy.

But best of all, the Coleman has all the conveniences that make life comfortable—while the canvas walls help you feel that you're really outdoors. That's what camping is all about. **PS**

Apache Roamer galley has neat three-burner range, oven, sink with city water connection, and easy-opening undergalley bins.



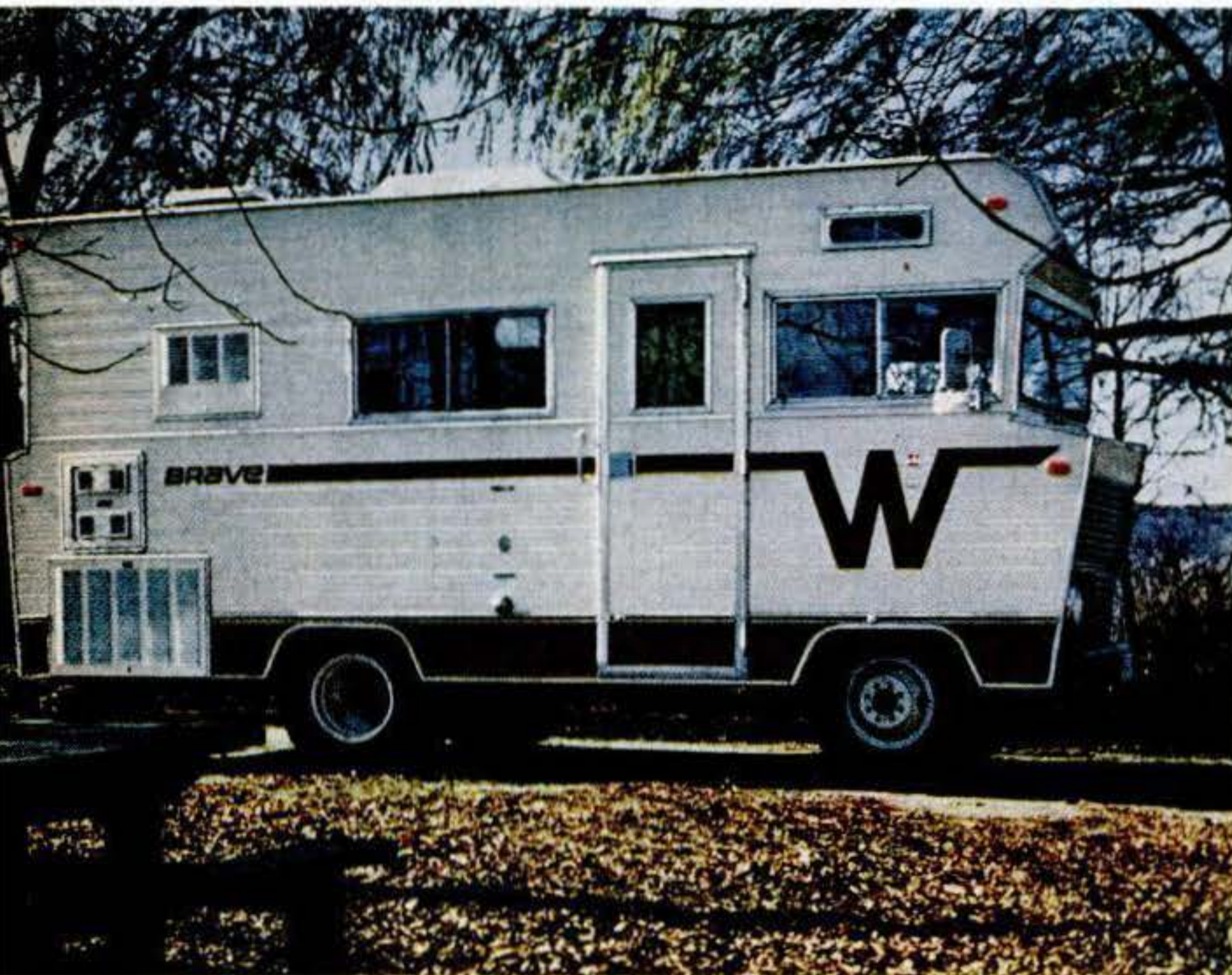
# MOTOR HOMES:



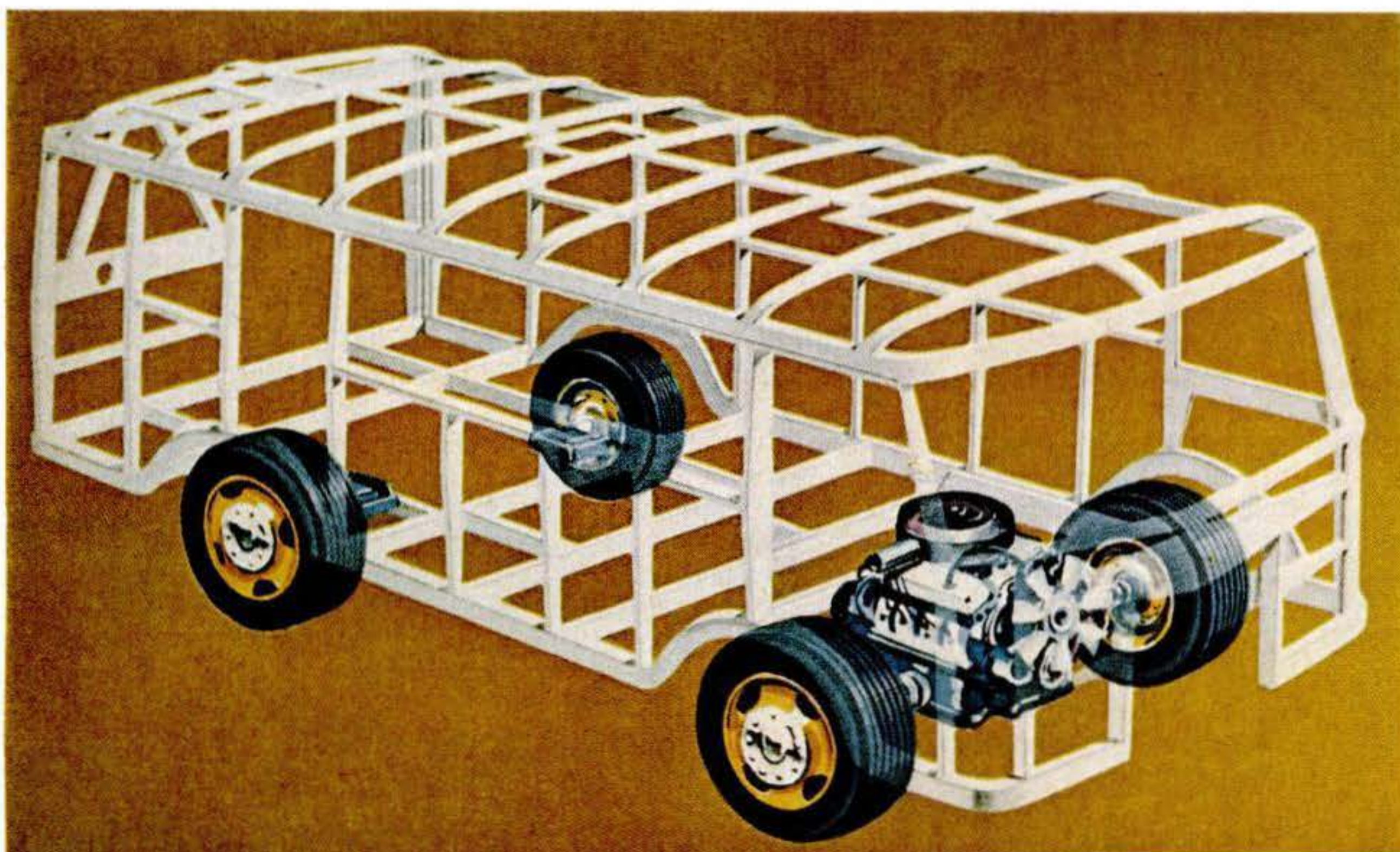
**Starcraft Star Cruiser 24** has fiberglass body, welded-steel frame, a rear bedroom, and full bath with toilet.



**Big 26-foot Kayot**, with no campsite near Chicago, was berthed by Ortners overnight in parking lot. It rolls on International chassis, sleeps six, has full kitchen, bath.



**Winnebago D-18** (left) offers big value—full kitchen, shower, bunks for four—for low \$6,795. Eighteen-foot length and 104-inch wheelbase give it maneuverability.



**Cortez motor home** brings you unibody construction and a steel frame and skin. It's built on a Tornado chassis, has powerful 455-cu.-in. Olds engine and front-wheel drive. Unlike most motor homes, it's designed for two persons. Despite 22-foot length, Cortez has a compact look.



# Live it up in luxury—or modestly

By EVERETT H. ORTNER, JIM DAVIS, and JIM DUNNE

Like the idea of spending your vacation rolling down the road in a yacht on wheels? It's more within reach now than ever.

Breakthroughs in prices and financing have brought motor homes within the budget of more and more outdoorsmen. Even expensive motor homes (over \$10,000) can be paid off over five to 10 years. And a herd of new mini motor homes and "budget-priced" standard jobs have brought starting prices down to under \$7,000. Makers expect to sell 70,000 units this year, against last year's 50,000.

Why the popularity? Space, for one thing. And fuller utilization while you're traveling—your wife can cook while you drive, or you can sack out while she's at the wheel. That's a big plus over a trailer. Luxury? You name it. Some models have staterooms, just like a yacht, and even bathtubs. And they're easier to drive than trailer rigs, and require no hitching; just pull into the campsite and you're set up.

Big disadvantage? You always carry your home on your back. Think of that when you need a quart of milk and you're five miles from town. That's why some campers carry motorcycles with them or even tow small cars.

About 140 brands of motor homes were shown at the December RVI show in Louisville, Ky. Prices for production models range from under \$7,000 to about \$24,000. A custom-  
[Continued on page 130]



**Starcraft 19-foot motor home** is built on cutaway Dodge chassis with a 127-inch wheelbase. It's powered by a 360-cu.-in. V8, is available with rear or side galley.



**Revcon unit** has a Toronado chassis with front-wheel drive. All-aluminum monocoque body of 25-foot RV lowers weight.



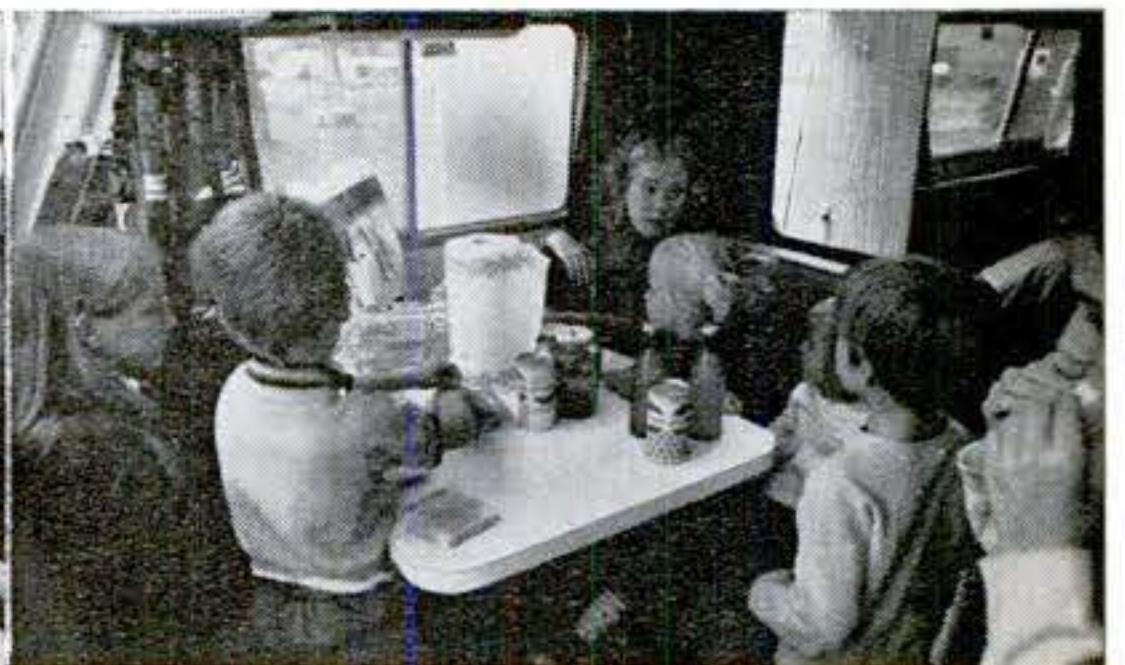
**Aristocrat 19-foot Miniliner** is built on Chevy cutaway van with 125-inch wheelbase. It sleeps six, is fully self-contained.



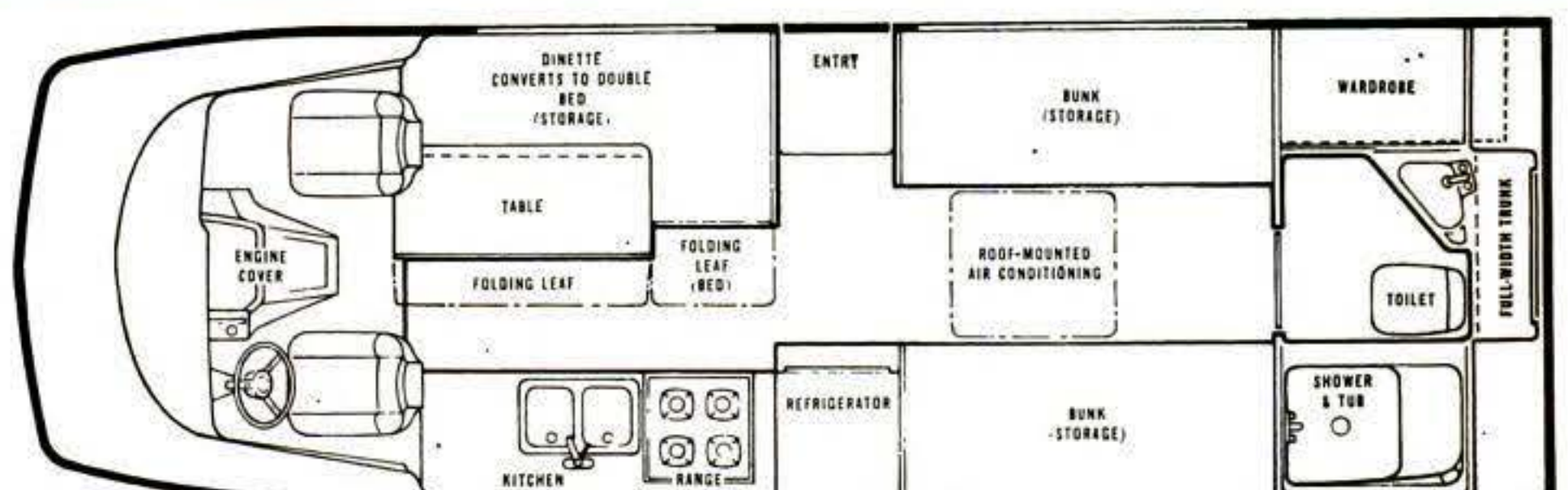
**Superior 2000** is a new 20-footer that has an all-steel frame. Its \$9,500 price tag makes it one of lowest in industry.



**Apollo** is a sturdy 25-footer with steel frame and fiberglass body. It offers big kitchen and spacious bath, including tub.



**Rectrans Discoverer 25** is the startling new design pacesetter in motor-home industry. Note the wedge-shaped front end and squared-off rear. There's less room in the cockpit (center), but PS Detroit Editor Jim Dunne says it helps driving—less body roll in the driver's seat and controls within easier reach. Floor plan (right) provides plenty of room for a big family to play and sleep. Dinette (above, right) becomes a double bunk. Stove, sink, and refrigerator are opposite dinette.





Amerigo molded-fiberglass trailer is one of the first of a new breed of lightweight, low-profile rigs that make towing lots easier.



Colorful interior of Amerigo blends with modern exterior. Space suits small family.



Tongue weight is light enough for one man to lift it and latch onto ball hitch.



Low seven-foot height makes Amerigo easier to tow with standard car in head winds.

## TRAVEL TRAILERS: They're bigger, smaller, and the fifth wheel is in

Rolite folding trailer has been given a face-lifting this season. A motor raises the roof at the touch of a button.

Roomy interior of Rolite offers most of the features of larger trailers, plus low-profile towing when you break camp.





**Fifth-wheel trailers** like this Cree Travois 266 are exciting the RV industry. Everything is king-size about the fifth-wheelers. This

one, 26½ feet long, must be towed by pickup. Despite jumbo size, fifth-wheel method makes towing safer at highway speeds.

By **HERBERT SHULDINER**

**W**ant a bigger and more luxurious trailer this year? Most of the new trailers are. Want a smaller, easier-to-tow trailer? There are some that fill that bill, too.

But the big news this spring is the fifth-wheel trailer. I counted more than a dozen makes at the recent RVI show in Louisville, Ky. These are big jobs, and you can tow them only with pickups equipped with special fifth-wheel hitches.

Like most of the quarter-million or so trailers that will be built this year, they're designed for the outdoorsman who wants to take everything with him. It's not lots of kids the trailer makers are thinking of; it's lots of possessions.

**Short hauls—long stays.** That's why it's not surprising to find fifth-wheelers designed for pickups. So what if most pickups only carry three? Those three people are going to be darn comfortable when they get settled in at their campsite.

One big reason for this phenomenon is that many trailer owners aren't interested in towing their rigs over great distances. They tow their trailers a short way and park them for the summer. Some are even anchored permanently in one campsite from season to season—becoming smaller, less costly mobile homes.

But the new small campers are an interesting exception to the bigger-is-better trend. They boast smart new designs and a no-frills look. At least three feet shorter than the most popular 19-22-foot lengths, the smaller rigs provide adequate nonluxury living space.

One of these new trailers is the

Amerigo F-16, made by Gardner, Inc., of Bristol, Ind., a Kampgrounds of America subsidiary. I recently took an Amerigo out to the Surf and Stream KOA campground in Toms River, N. J., to see what it's like.

The Amerigo is a sleek, molded-fiberglass rig with a low profile. It's easy to tow when you're on the highway, and it's low enough to store in most garages when you're at home.

The makers seem to recognize that campers spend most of their time outdoors, so the Amerigo provides just enough space for four persons to eat and sleep comfortably. There are also generous storage bins and necessary appliances such as stove, sink, and cooler (or refrigerator). You can also get an optional heater, portable toilet, and 12v current converter. And there are large picture windows for looking out at the scenery.

Best of all, I liked Amerigo's light weight and easy towing. It's light

enough so that you can lift the trailer's tongue and hitch the coupler without jacking it up. With a hitch weight of 145 pounds, it can be towed by virtually any compact car. Overall weight is about 1,500 pounds.

**Efficient comfort.** Another low-profile trailer that packs a lot of convenience in a small package is Apeco's Small World. Shaped more like a cruiser than a camper, it features a foldout rear porch. This enlarges the living area sufficiently to sleep two persons in addition to the normal four. The mini trailer also has a dinette that seats six, a galley, and small shower-toilet.

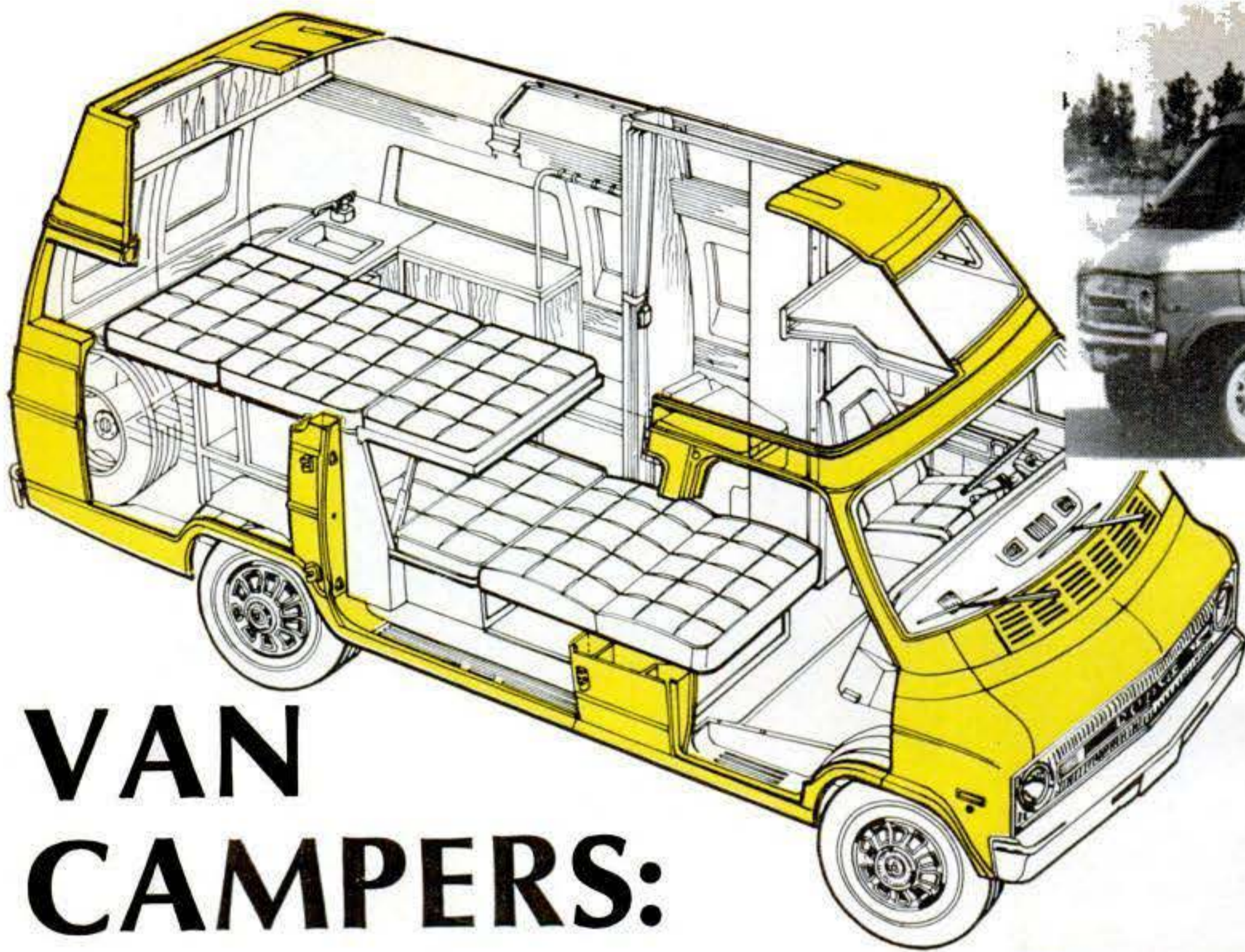
Small World, also, is light enough to be towed by compact cars.

While most new trailer models this year tend to be big and heavy, the new Small World and Amerigo point the way to another trend that seems ideal for people who want their comfort in small packages. **ES**



**Apeco Small World** is a slick-looking new trailer with a pull-out rear porch that gives

you an extra bedroom. Low-profile rig can be stored in many regular-size garages.



Windowed penthouse is feature of '72 Corey Cruiser above and in cutaway at left. Two beds sleep four, fold into benches for wagon-type errands. Specs, prices from any Dodge dealer.

# VAN CAMPERS: Competition for station wagons?

By AL LEES / PS Home Workshop Editor

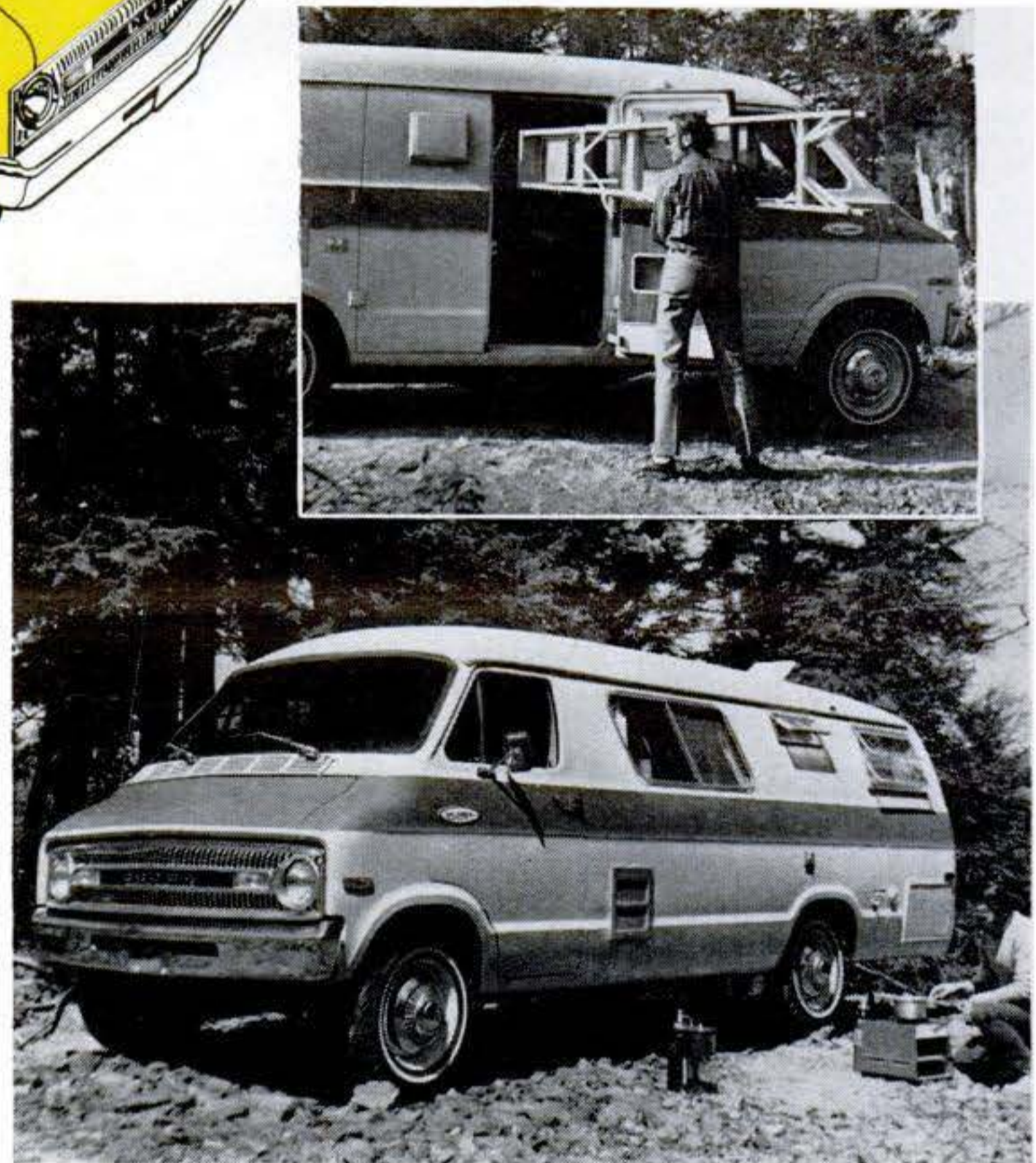
**H**ungry for the space a wagon offers for hauling supplies and bussing cub scouts? Why not buy a vehicle that'll serve those purposes *and* give you a camper as a bonus? Whether you call it a van conversion or compact motor home, this type of RV is worth considering as your family's second car.

To test the theory, I borrowed an Xplorer 224 from Frank Industries (Box 70, Brown City, Mich. 48416) and subjected it to about the most grueling dual-use test you could devise for a self-contained. I drove it deep into mountain wilderness, far from electricity or plumbing, and lived in it for 10 days while I erected a garage-workshop [featured in Jan. issue, page 97].

**Cozy cabin for two.** Except for trips out for ladders, wall panels, and other materials I'd otherwise have needed a truck to haul, the Xplorer served as a cabin for two—and a cozy one it proved to be through long, wet nights. There are two gas heaters built in; the wall furnace is located so you can reach out to light it before you roll out of bed on chill mornings. The separate water heater must be lighted from outside.

Unlike the cutaway Cruiser above, the Xplorer sports a permanent bedroom: The whole rear section is a double bed. This would also serve as a spacious playroom for the kids on

Still closer to wagon is Model 224 Xplorer Motor Home chosen by author to test for dual use as wilderness camper (right) and hauler (inset). Instead of raising the roof, this model drops the floor. It also extends body of longest Dodge van, yet can be parked in standard two-car garage.



rainy days in camp. For additional sleeping, there's the conventional dinette conversion.

Like the Cruiser, the Xplorer boasts an enclosed bathroom. As you might guess, such a "room" in a compact van turns out to be a giggle. You step up into it from the traffic well of the Xplorer's dropped floor, entering at a crouch. You reach a blind hand back and pull the door shut as you seat yourself. Whatever your business—brushing your teeth at the tiny molded-fiberglass basin, combing your hair at the mirror above, or even more basic matters—you conduct it from that seat. The shower is a spray-head on a metal hose. Just don't take your towel in with you.

Everything's diminutive in a van (they're not designed for pro football players) right down to the mini ice cubes I made one evening in the Nor-cold refrigerator—running down the

auxiliary battery to the point where I had to take a drive to charge it up again.

**Ready-made bed is a bonus.** I couldn't help comparing the Xplorer's livability to that of the Ford Mini-Home I tested [PS, March '70]. The Ford's rear galley was handier, with better food storage (Xplorer's floor plan is more conventional, here; the galley is split by the side entrance). But having to convert a dinette for sleeping every night was a nuisance compared to Xplorer's ready-made rear bed. And that capsule bathroom *was* usable. (Since my MiniHome didn't have one, it didn't qualify as a self-contained.)

But the main advantage—especially if you plan dual use—is the Xplorer's low profile. Being able to drive it through a standard seven-foot garage door means you can park it under cover, just like a wagon. PS



**Coachmen Lamplighter** is 11-foot slide-in with choice of eight complete interiors.



**Amerigo camper** uses camping-trailer design for extra sleep space: Bunk pops out

of rear end, folds back for traveling. Camper has full galley and sanitary facilities.

# PICKUP CAMPERS: New ideas stir new interest

By A. J. HAND

The phoenix of the RV scene today is the pickup camper. A few years ago, the experts classified it as an endangered species—on the verge of extinction. But last year the pickup camper was second only to travel trailers in popularity among RV buyers. Some 135,000 were sold.

Why won't the pickup camper die? Because both the campers and the pickups that carry them get better every year. As the campers lean more toward built-in conveniences and self-containment, the truck makers have come up with camper specials that do a safer, easier, more comfortable job of carrying those slide-ins.

Chevrolet, Ford, Dodge, International, Jeep, and GMC have increased the GVW on their camper specials so you won't compromise your safety when you hook on a camper. Special cooling systems, tires to match the increased GVWs, and better brakes [see this month's Norbye/Dunne Report] also help.

**Convenience features?** Easy-to-remove tailgates; sliding rear windows for conversation with the kids in back

without intercoms; optional generators to power luxury items like air conditioners.

Convinced of the enduring popularity of pickup campers, many camper makers are offering revamped models this year. And there are some completely new campers, too.

I recently got a chance to try one of the newest: the Diamond. This new lightweight is the latest design from Bud Coons, the man who gained fame in the RV world five years ago with the precedent-breaking fiberglass Goldline.

I picked up a new 11-foot Diamond, mounted on a Ford F-250 pickup, in Des Moines and took it on a trip through Central Iowa.

The Diamond's light weight (1,720 pounds empty) impressed me right off the bat. The rig rode almost as well with the camper as it did without it at normal highway speeds. The slight extra lean on curves and pitch on straightaways are well within the comfort level. Of course if you overload the high cabinets inside the camper with heavy gear, you could affect the center of gravity and produce some handling problems. I was traveling light.

The ceiling was comfortably high. I could move my six-foot-four-inch height around without bumping my head, and I never got the cramped feeling I've experienced in some campers. The bunks were a full-size treat, too. I could stretch out completely—with room to spare.

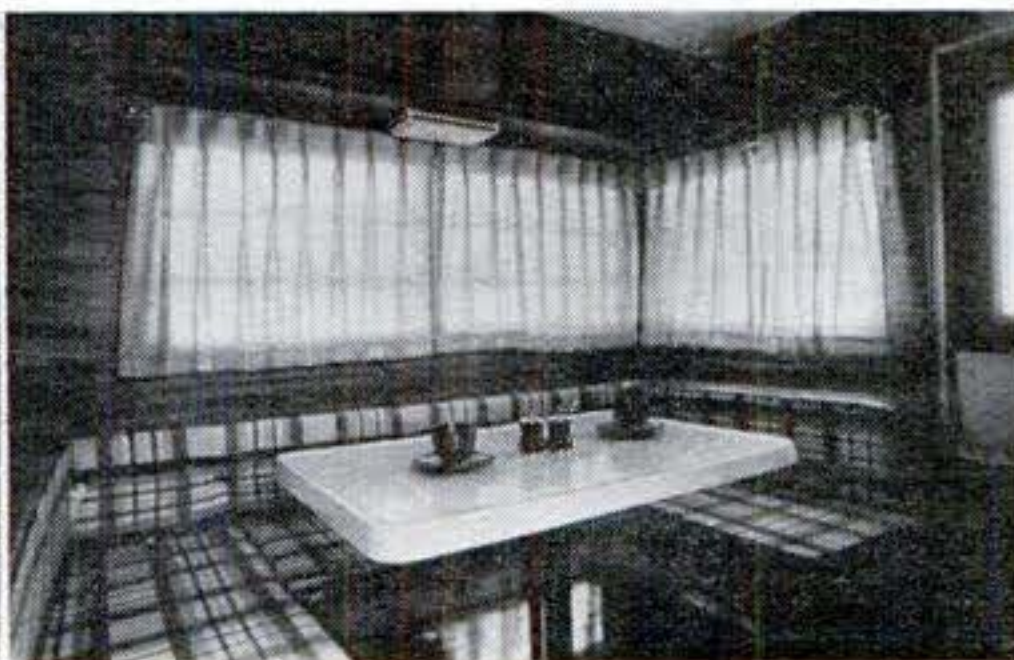
**Any problems?** Getting the little gas heater started was a chore. Instructions are in small type, set in an out-of-the-way spot inside the heater—just about impossible to read without a flashlight. Once the heater was lit, though, the Diamond stayed warm overnight with no problems—the camper's fully insulated, even under the floor.

All told, the Diamond is an easy rig to live with—good-looking inside and out, roomy, comfortable, convenient, and light in weight.

It's a good example of what makers can do with a supposedly dying species. My first suggestion for next year's improvements: adequate information on weights. With few exceptions, when you go shopping today you won't get many facts on how much a rig weighs, or what happens to it when you load it up. And this leaves too much room for trouble. **RE**



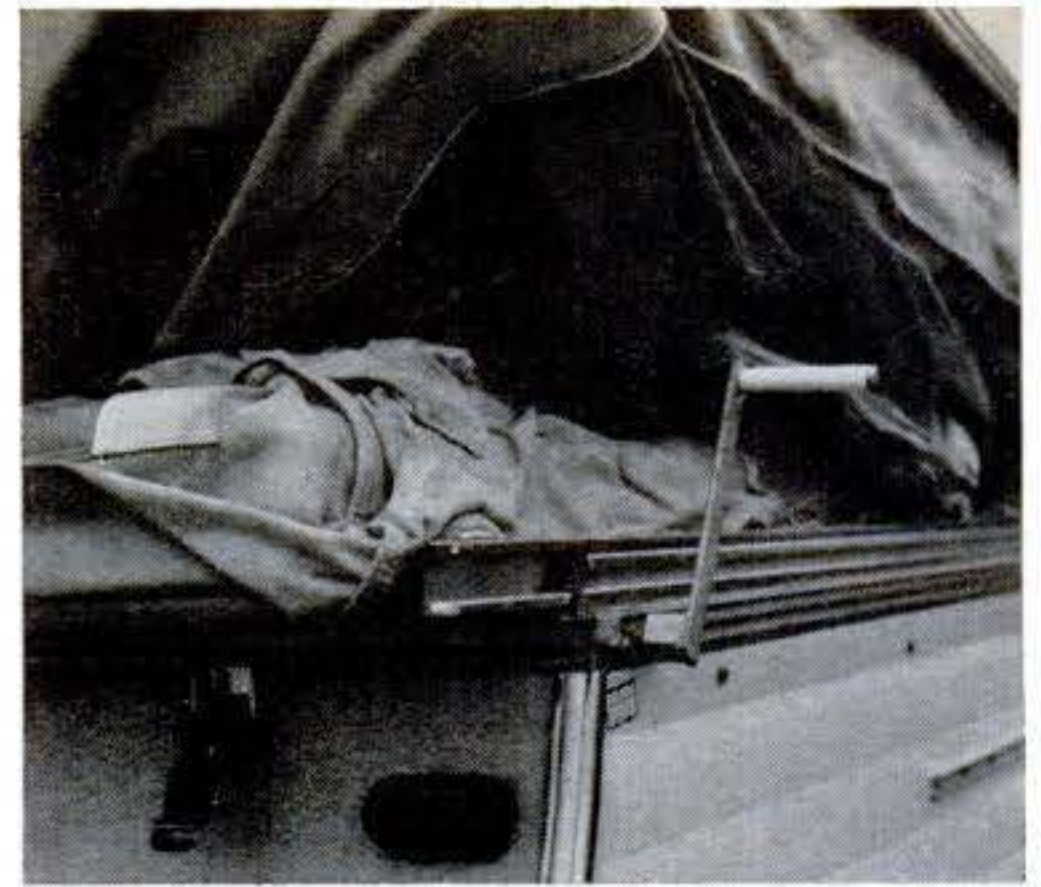
**Diamond 11-foot camper** is a new, ultra-light model. It features an oak-paneled in-



terior and complete galley. Camper sleeps four, six with optional fold-down bunk.



**Corsair 10-foot camper** has a short hang-over, to make for better handling.



**Keep channels clear** on sliding mechanism of tent trailer when cranking up. You don't have to lubricate tracks, but make sure they're kept clean. Inspect screen and canvas for damage with trailer open.

**Wash and wax** the outside of your RV to begin your spring check. It will make your rig look new again, and give you an opportunity to check the body closely for cracks, scrapes, and missing fasteners.

# Get Your Camper Ready

**Do these spring chores on your RV and you'll save headaches on vacation**

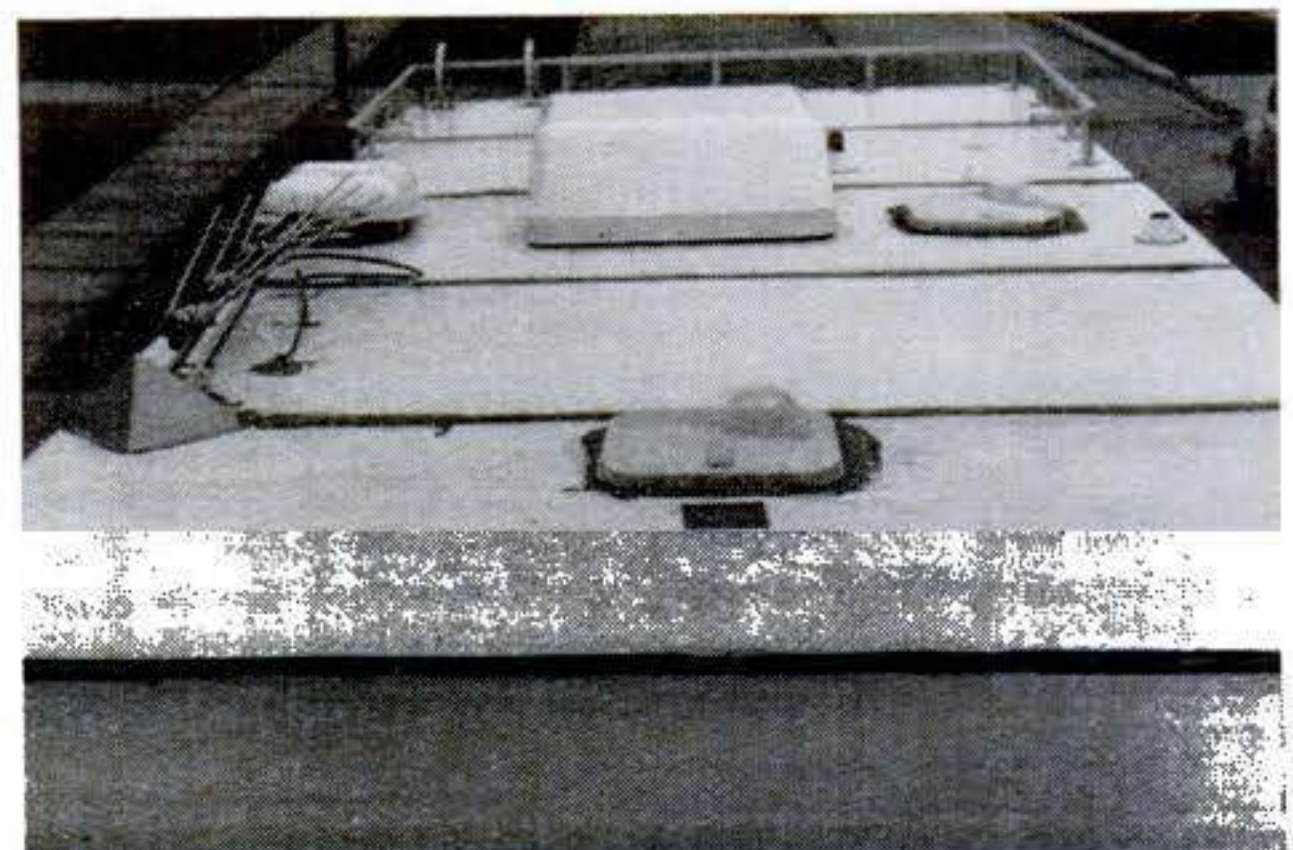
By JERRY COPELAND

It's time to get your RV ready for a vacation trip or the weekend outings you've been waiting for all winter. Whether you're going on a long or short trip, check your equipment *before* you leave. It's no vacation when you break down in a remote camping area.

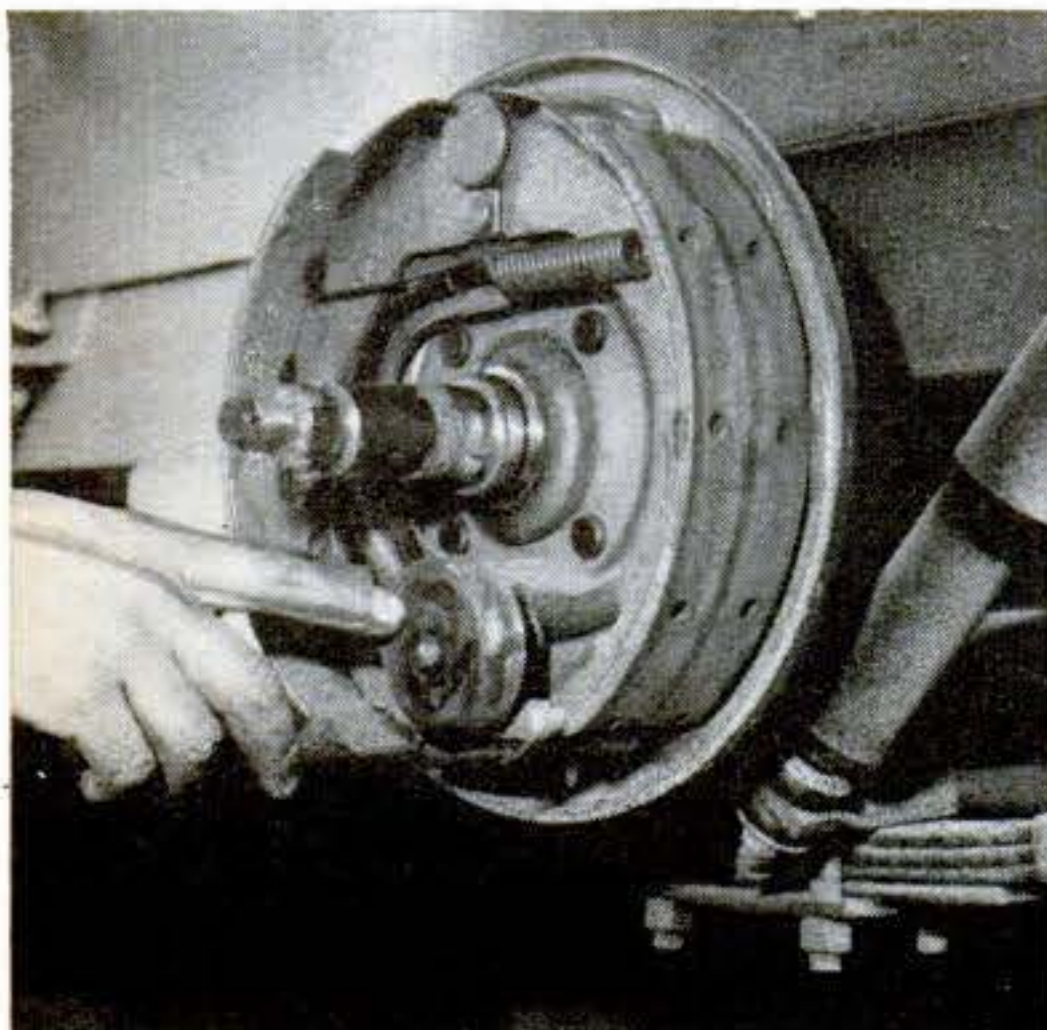
Start your spring prep with a good cleaning inside and out. It'll give you a chance to get rid of the junk you've accumulated since last season.

Begin with the general RV checklist that applies to either motor homes, pickup campers, travel trailers, or tent trailers. Finish with the list that matches your vehicle.

Motor-home owners should find pertinent steps for checking [\[Continued on page 138\]](#)



**Look over the roof of your RV** carefully. Check for cracks and splits in the metal seams and around all flashings or appliances. A new layer of roof coating should be added periodically to prevent leaks.



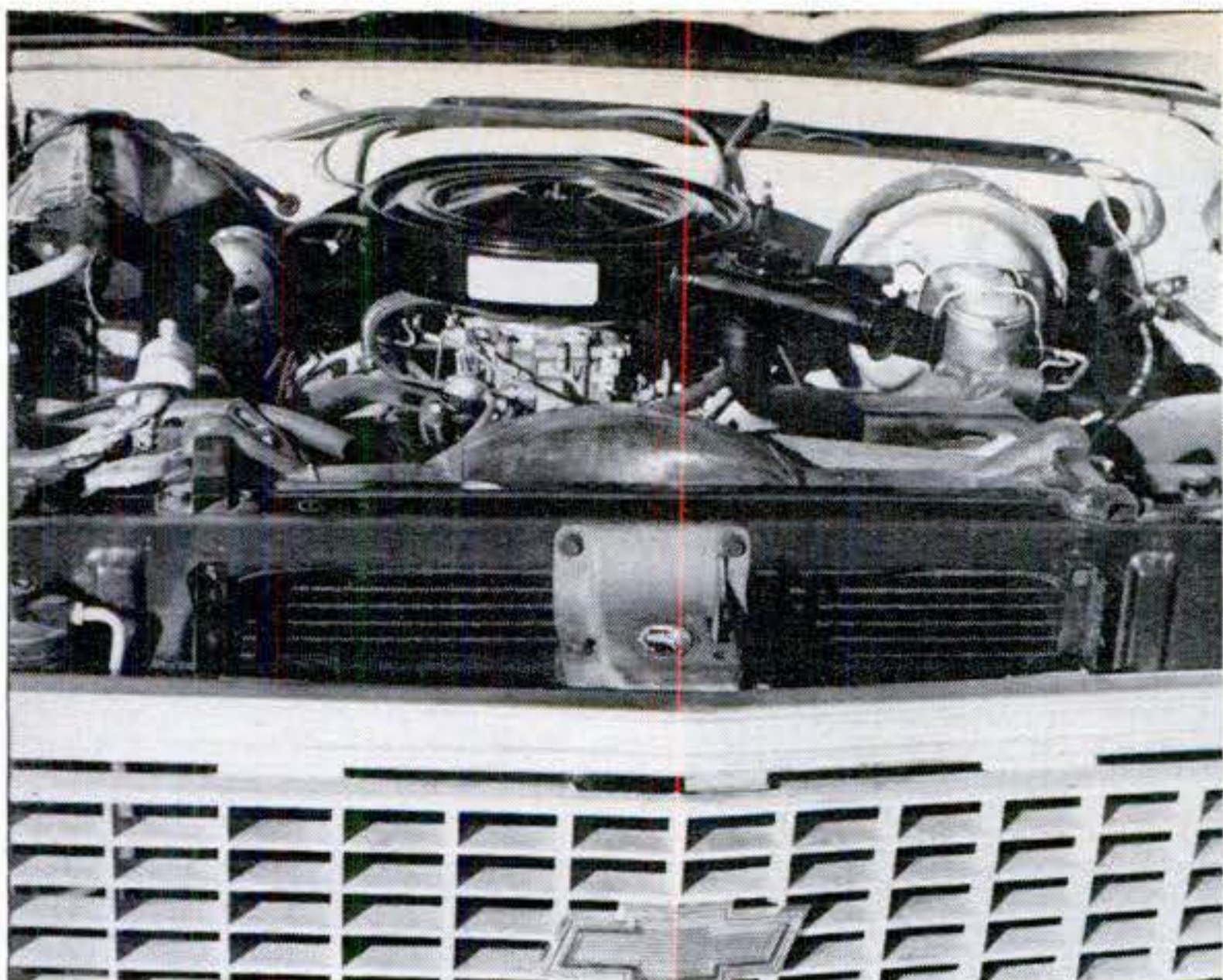
**Remove trailer hubs and wheels** for inspection. If grease has been sprayed around inside of brake shoes, you have leaky seals or too much grease from last repacking. Replace brake magnets or shoes if worn.



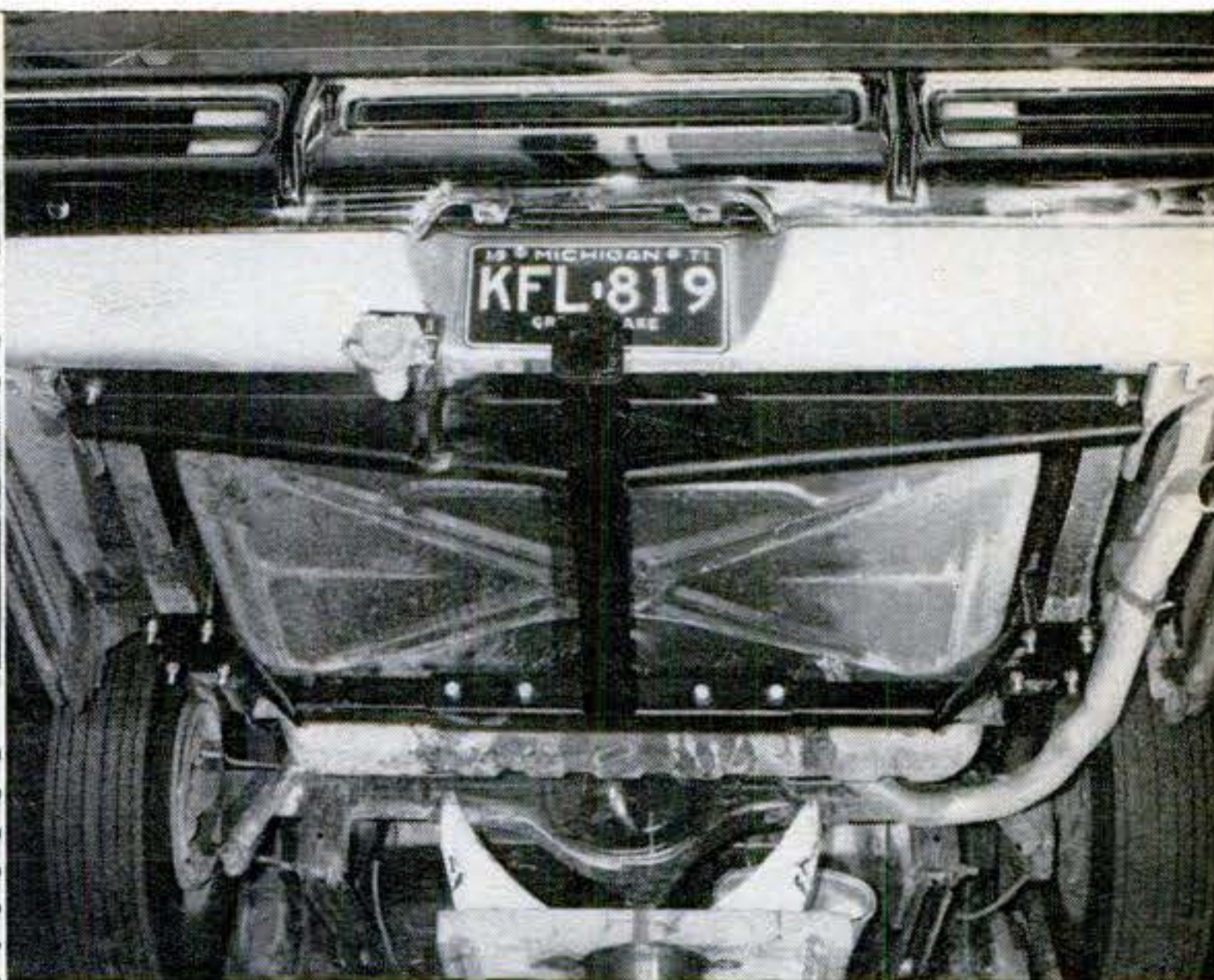
**You can't pay too much attention** to your RV's tires and wheels. Make sure you tighten the lugs and keep the tires inflated to proper poundage. Buy a pressure gauge and use it before and during each trip.



**Pour water and tank-cleaner solution** into holding tank through toilet. Do this when traveling if possible—movement of water will aid cleaning. Let stand for one to three hours before recirculating.

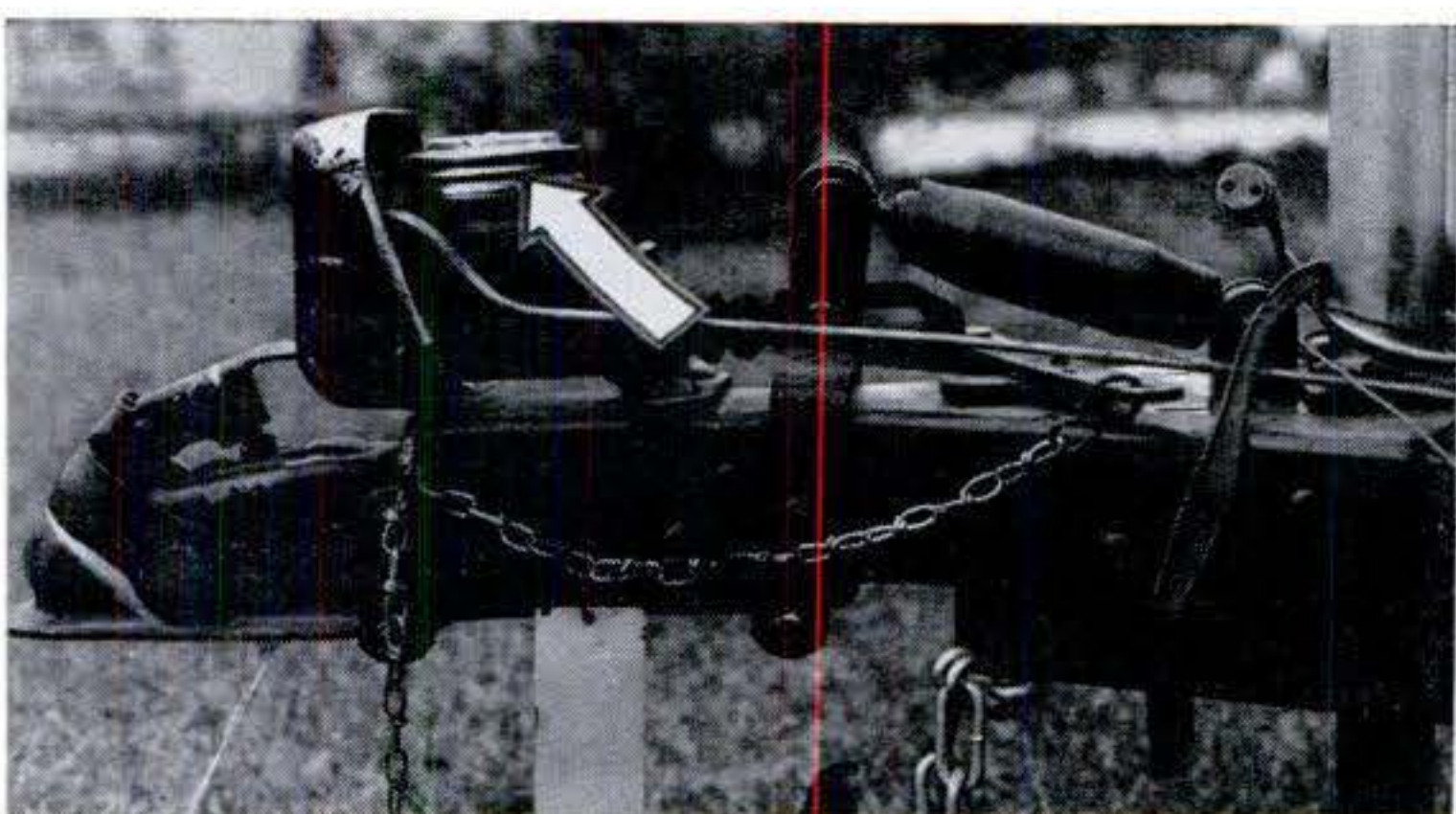


**Don't neglect usual engine maintenance**, especially if you're towing a trailer. Check cooling system—pour water in radiator, brush insects from core. Replace cracked radiator hoses. Start each towing trip with clean motor oil and transmission fluid.



**Check for proper hitch attachment** underneath the tow vehicle. It's a good idea to elevate the car—you can inspect for cracks in the welding. Inspect and tighten nuts. Paint platform and complete hitch with metallic paint to rustproof.

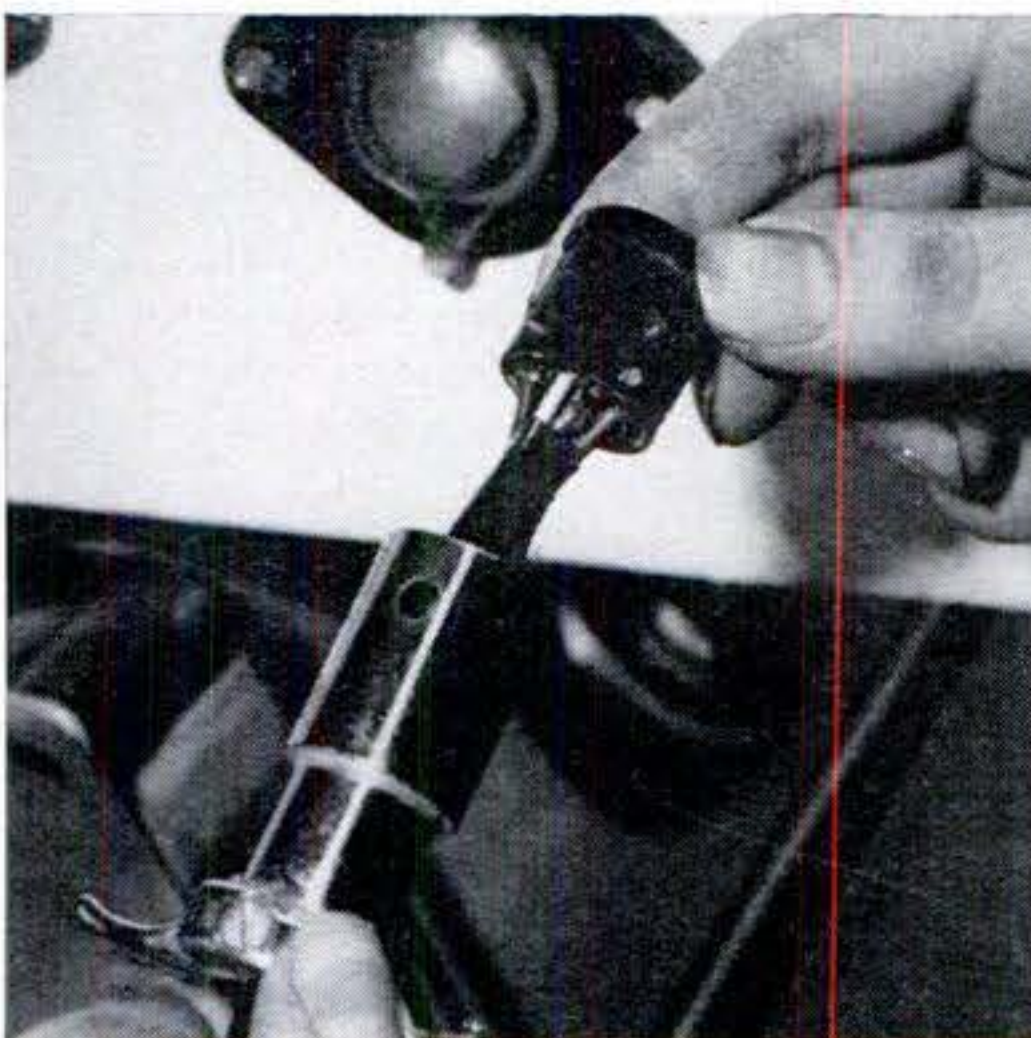
## for Summer Fun



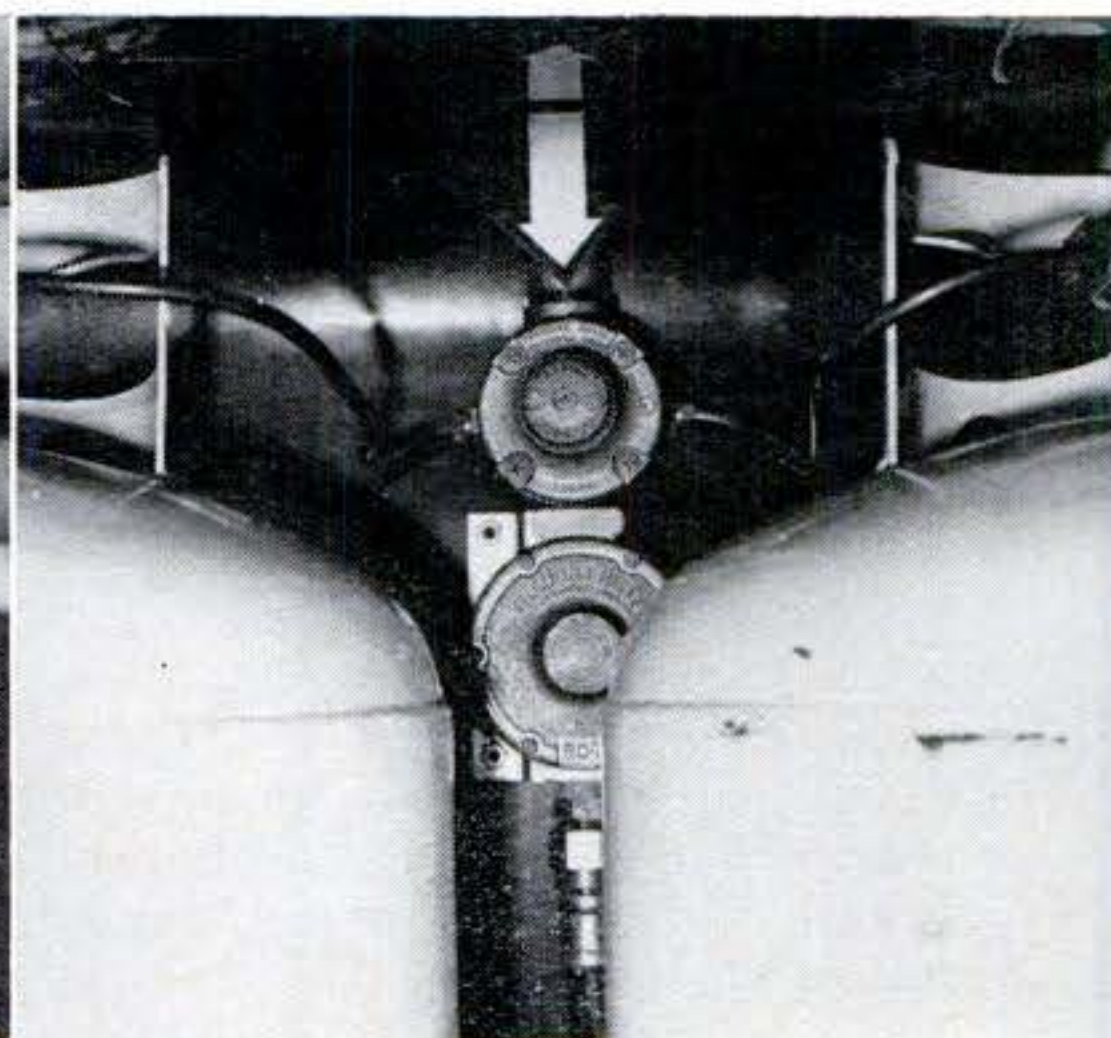
**To inspect trailer brakes**, start at hitch and finish at wheels. Fill fluid reservoir on hitch (arrow), and inspect metal brake lines for leaks and missing fasteners. Then remove wheel and check carefully the condition of the lining and drum.



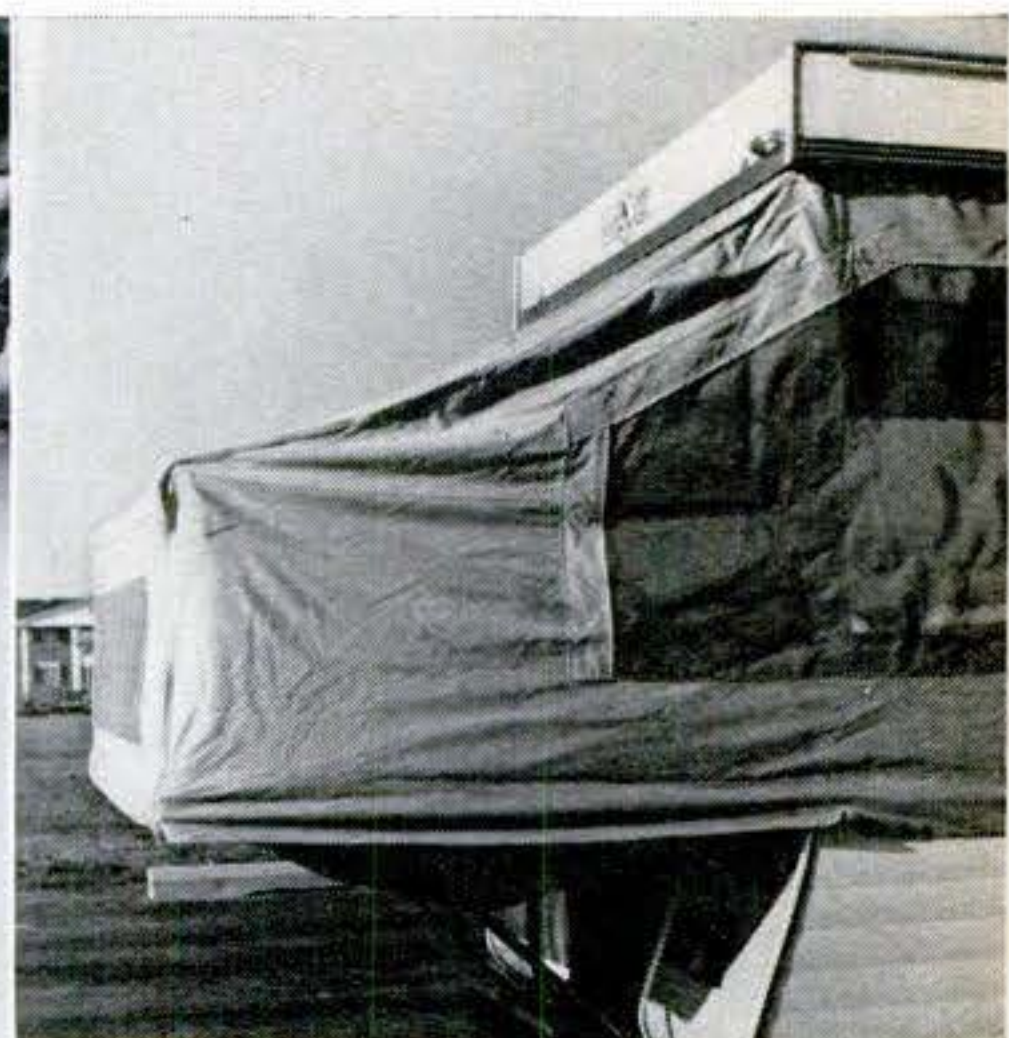
**Attach safety chains** to trailer A frame. Smear petroleum jelly on ball of hitch and on sway-control friction points. This reduces noise when under way and stops rust. Do not use an automobile lubricant for this—it's not suitable for the job.



**Test turn signals**, stoplights, and running lights. Make sure that sockets are properly grounded. If whole system fails, inspect wires, connections, and pigtail and plug that feed juice to the trailer or camper.



**Snug the fittings on LP-gas connections** using a wrench on each side of connection to avoid twisting the copper lines. You can use an automatic changeover regulator (arrow) to check for leaks.



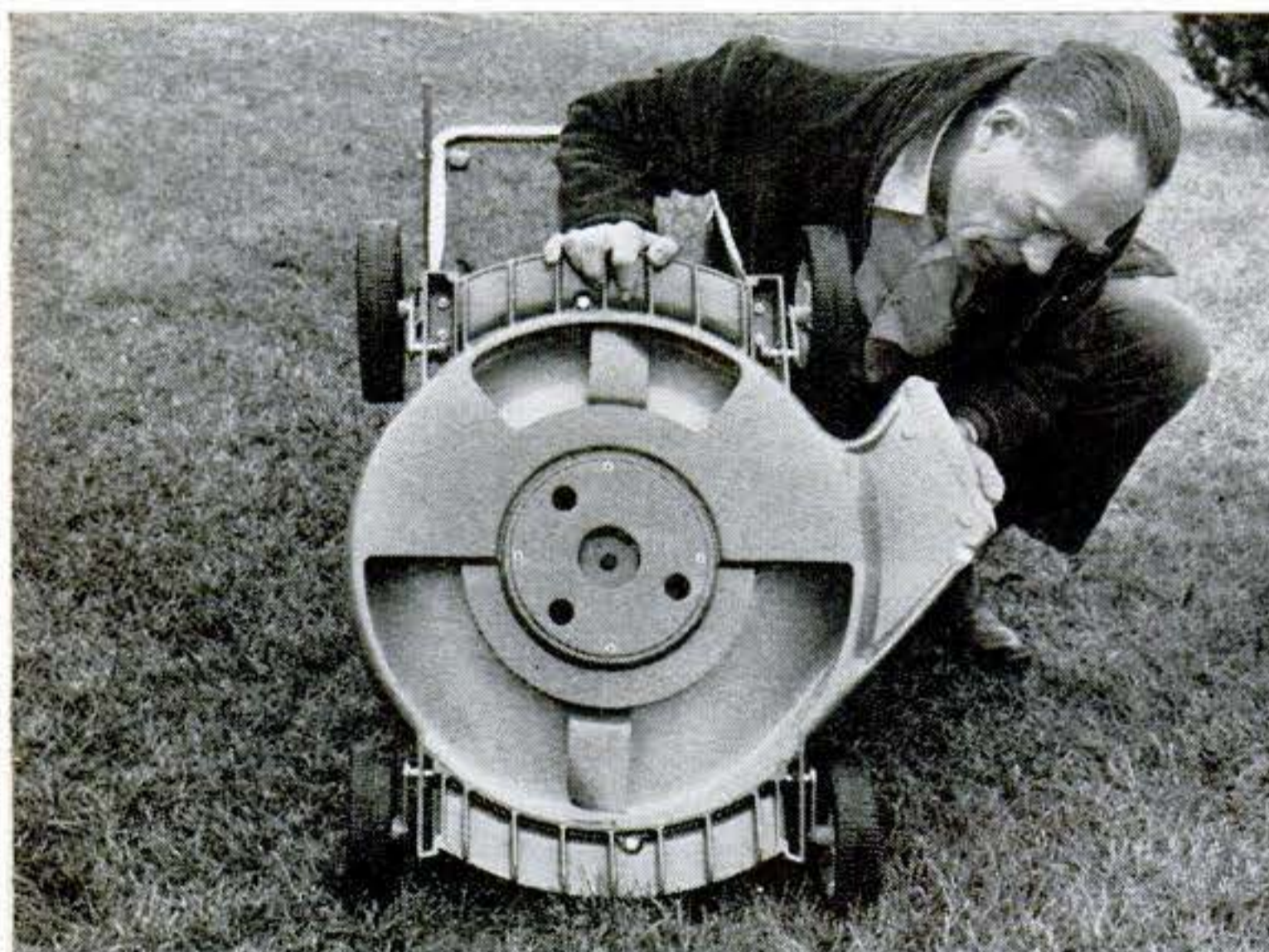
**Take a thorough look** at canvas and window screening on tent trailers. Try to spot rubs on canvas before they develop into large rips. Test canvas for strength. If too old, it will leak and tear easily.



**Gilson rider** gate-shifts for no-error control, lets you shift without clutch or blockout. It cuts 30-inch swath with eight hp.



**Gravely's new workhorse mower** has an eight-speed, all-gear transmission, instant reverse, and high deck clearance.



**Montgomery Ward's supersafe walk-behind** is the best-shielded mower on the market. It's an ideal choice for family use.



**Bolens control panel** on walk-behind lets you operate throttle and clutch while you keep your eyes on the ground ahead.

# The '72 MOWERS: Better

**Shop carefully this year and you'll come up with a mower ahead of its time**

By E. F. LINDSLEY / PS Midwest Editor

**B**uy a '73 mower in '72? You can if you're sharp-eyed. Changes aimed at meeting the 1973 industry safety code have come so thick and fast that right now some mower makers are apparently in full compliance. This, even though at the time of writing the standards are still undergoing a certain amount of nitpicking engineering review.

Be wary, however. The unknowledgeable shopper may be sold a mower design practically unchanged from 1960, particularly if he shops the bargain basements. Some makes that stress equaling or exceeding next

year's standards are Simplicity, Toro, J. C. Penney, Lawn Boy, John Deere, Bolens. Doubtless there are others.

A good way to avoid buying an unsafe antique is to know what to look for in controls. It's a fair bet that a mower with full-compliance controls will also have been safety-engineered throughout. Tip-offs:

- Solid, man-sized, easy-to-grip levers and handles.
- Labels that clearly spell out the purpose and direction of control movement.
- Controls that move forward or upward to move mower forward or increase speed.
- Controls that move downward or rearward to reverse or slow mower.
- Lift controls that move forward to lower, backward to raise.

If you can read a wall calendar at three feet without glasses, you should be able to read the control labels. Fine type, or labels positioned so you must stoop, twist, or cant your head,

or put on reading glasses, just don't make it. An excellent example of well placed, full-compliance controls is Arien's handsome new Emperor.

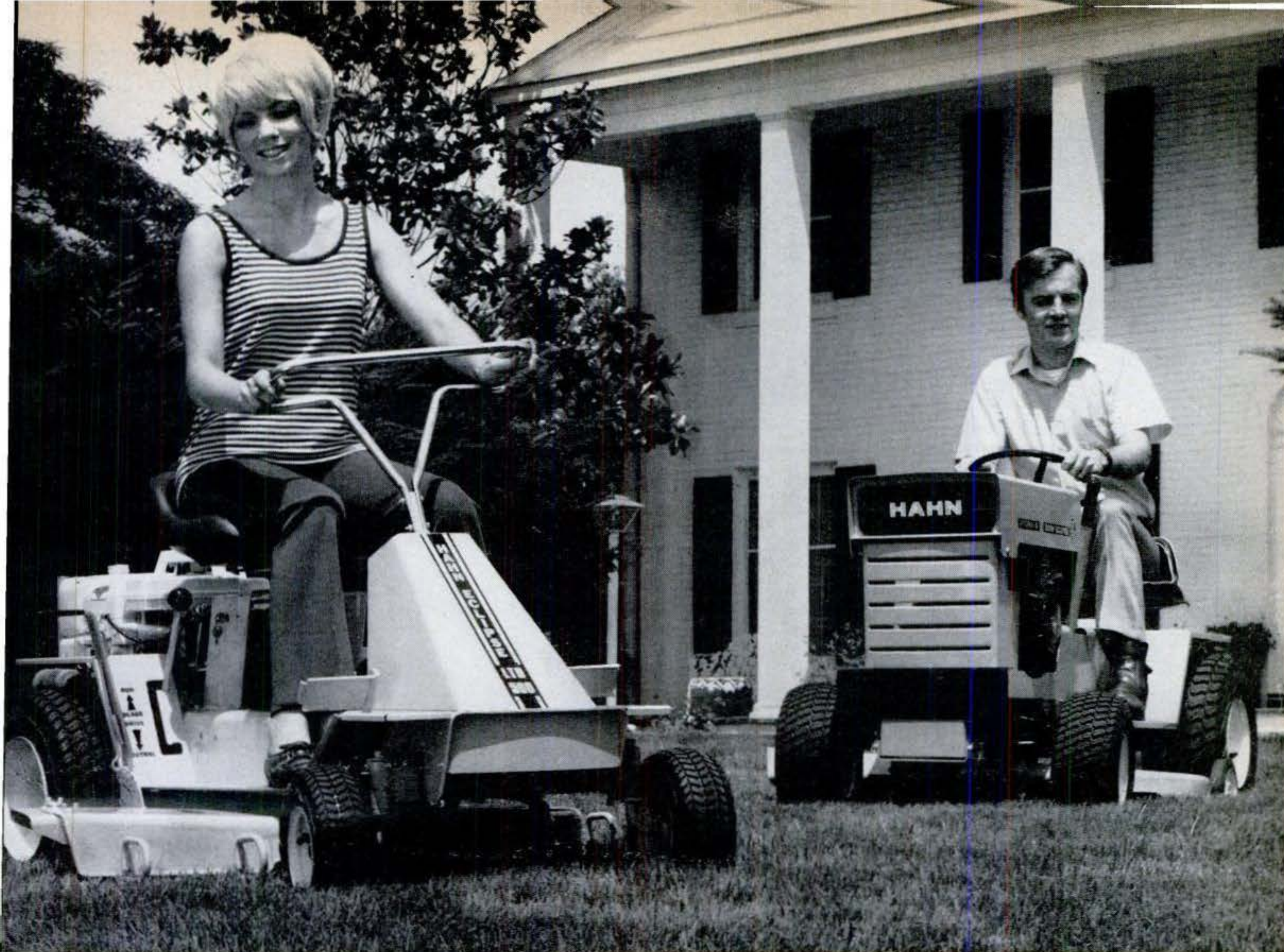
**How important are controls?** Where your safety is concerned, probably more than you realize. Tipovers, rollbacks, runaways, and collisions can all be caused by poor controls. These are obvious examples of control-caused accidents, but sometimes control problems can get you through the back door.

For example, a cutter deck with limited lift control may hang up when cutting shallow ditches or depressions. Harried users are prone to tug at the underedge of the deck and encounter the whirling blades, or try to push or lift the tractor while the wheels are spinning in gear.

Here a mower like the Gravely 816, able to lift the deck nearly six inches, could prevent an accident.

Only recently have mower makers realized that many lawns are any-





Hahn rider and tractor stand out as examples of mowers with solid controls and good control labeling. Steering on the rider

is among the best that is available, and both mowers ride on large tires for better traction and less wear on your lawn.

## Controls for Safety

thing but level. Many have slopes, hillsides, or even retaining walls, dropoffs, and landfill grades that are precarious, especially for riders and tractors with awkward controls.

Some mowers that work well on flat lawns can be deadly on hillsides when shifting from forward to reverse unless the brakes are available manually and positively in the neutral mode. If, during the shift, a rider or tractor rolls backward, then is caught by the clutch as the gears engage, there's a good chance of front-end flipup or engine stall and perhaps a fast roll into trouble.

If you have a sloping yard, insist on trying the mower on your own ground. Don't be overly reassured by so-called automatic clutch/brakes. These are usually spring-applied, tend to fail after a season or two, and you don't know they're missing until you're on the roller coaster.

I like separate clutch and brake pedals, easily operated by separate

feet but at the same time. Mower makers may argue that the instinct of automobile-conditioned drivers is to yank one foot from the gas and apply it to the brake. They overlook the equally common practice, for maneuvering in tight spots or taking off from a hillside stop, of having one foot on the gas and the other on the brake for inching control. Most mowers place you "horse fashion" astride the beast, and when both brake and clutch are on the same side you can't cross over the idle foot.

**Safety in the clutch.** During your on-site test, check the clutch action. Most riders and light tractors will have either gear or friction-disk transmissions and belt-tightener clutches. Before you buy, try inching the mower in forward and reverse, full throttle, and in all speeds. If the clutch grabs and the mower leaps, continue shopping. Don't let the salesman tell you it will "wear in." The idler geometry is wrong and it

won't improve. One accident caused by a grabby clutch may be one too many.

Removal and replacement of blades for the frequent sharpening needed by most rotaries can be difficult and

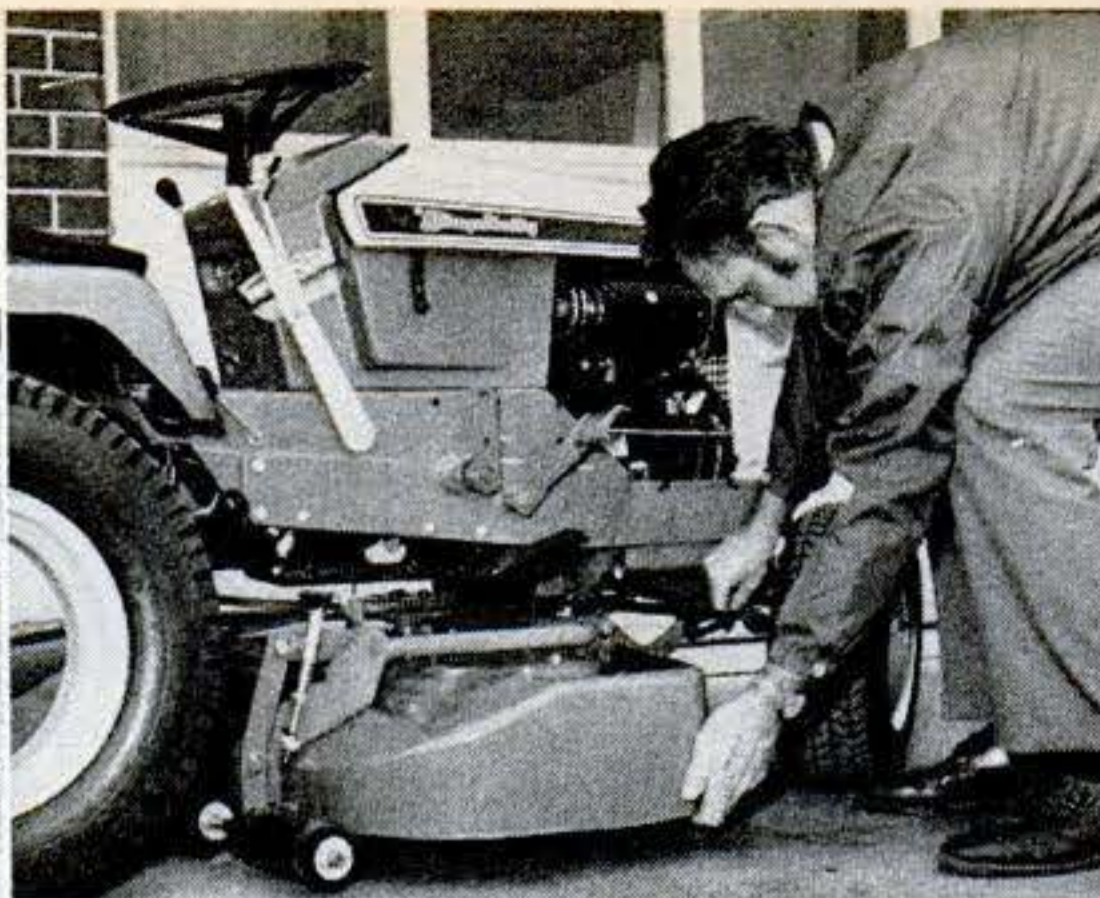
*Continued*

Jacobsen Javelin Mark II has easy-to-reach controls and automatic, variable-speed, forward/reverse drive via single foot pedal.





**Penncraft mowers** from J. C. Penny feature large, easy-to-reach controls and a safety interlock that prevents in-gear starting.



**Simplicity cable lift** suspends deck at balance point so you can float the mounting holes into alignment without tugging.



**Snapper Comet** has excellent deck mount, positive controls, and solid construction details including a tubular-type frame.



**Toro's top-of-the-line** walk-behind has a new, safer bagging system featuring a rear-opening bag. Model above, a 19-incher, is the Guardian.



**Black & Decker electric** mower is double-insulated to eliminate shock hazard. Other safety plusses: instant stop, and no restarting problems.



**Homelite's new tractors** have a control panel designed for easy visibility and use. Famous for its chain saws, Homelite is new in mower field.



**Sears rear-engine rider** is an all-new model with seven hp, 26-inch cut, safety discharge chute, single-pedal foot control of both clutch and brake.

dangerous. Rear-stand riders that tip up are great. Hahn Eclipse features this capability and claims the vertical posture is suitable even for extended storage.

For big tractors, where deck removal is the rule, Simplicity shows some well-thought-out deck-mount engineering. One flip of a tension release frees you from the usual wrestling match with the drive belt; even better, the cable-type lift is attached at the deck center of gravity. To insert the pins is easy; you just dangle, or float, the deck on the lift while you align the holes.

The safer decks can be accurately and easily adjusted for cutting height on the go. Try before you buy hydraulic-type lifts. Most are "either/or" and lack precise intermediate adjustments between full up and full down. To adjust their cutting positions, you must stop and re-rig gauge wheels, stops, or rollers. A really practical deck lift lets you select instantly the height you want from a series of clearly marked positive positions. Many manual, and some electric, lifts

do this, and do it while on the go, too.

**Safety through electricity.** Electrical power take-off clutches, used by Jacobson and others, are quick operating and less troublesome than belt tighteners. Unfortunately, few makers see the logic in fitting them with massive handles since a simple toggle switch—just like the one for the headlights—is all that's needed electrically. I've made a fast flick at a PTO switch many times, usually in an emergency, only to find that I've turned the headlights on or off and the PTO has, by now, chewed up what I didn't want chewed up.

A new and promising electrically operated clutch/brake on some Montgomery Ward mowers pulls the whirling blades to a halt in three seconds or less. The device is reportedly "fail safe" even if battery power fails. This could set a trend, in light of proposed federal safety regulations.

The appeal of electric operation is not limited to controls. John Deere's Electric 90 battery-powered rider has proven both successful and popular. Now, to supplement their larger Elec-

trak tractor, GE is introducing an eight- and a 10-hp. series. Blessed with the typical high torque of electrics, these are capable of snow and ground-engaging work as well as mowing. The word is that the price is "right," about \$700.

Electrics, rider or walk-behind, have safety features hard to duplicate with engine power. Black & Decker points out that users are mentally conditioned to turning off electrical gadgets to adjust them. Free of fret about restarting, one just flips the switch.

Controls are just as vital on walk-behinds as riders, maybe more so, because the user tends to be less protected and more intimately involved. Bending to grope for a clutch on a self-propelled diverts your eyes from the mower path. Attending to engine or mower-mounted throttle and clutch controls invites the intrusion of toes under the mower deck. For an excellent example of control placement, look at the upper panel on the Bolens 22-inch self-propelled. There's a full display of clutch and throttle.



Massey-Ferguson six-horse rider has neat controls, fiberglass upper deck. Side car holds five bushels of grass or leaves.



Lawn Boy 26-inch compact is a nimble and sturdy rider for small lawns. It has five-horse engine, two speeds forward, reverse.



GE has a new, lower-priced addition to its line of electric tractors. The E8M is around \$700, 36-inch mower not included.



Allis-Chalmers Scamper gives great visibility in tight spots, maneuvers nicely. Despite small size, it has eight-hp engine for big jobs.



Sleekly styled Ariens encloses all mechanisms for looks and safety. Eight horses driving through six forward speeds cuts large lawns down to size. Controls, including separate clutch and brake, are easy to see and use. The Emperor II shown here has a built-in rear stand for easier servicing.



International Cadet 75 has side or rear discharge, two blades in floating deck that adjust on the go. Body is lightweight, rustproof fiberglass.

**Safety in the bag.** Some users couldn't care less about bagging cuttings; and some mowers, such as Bolen's Orbit-Air, intentionally operate as mulchers without discharge chutes. But if collecting grass or leaves is your bag, look for bagging arrangements that:

- Remove and attach without tricky hardware, rubber bands, or strings. If you have to stoop, squat, or get near the chute, look farther.

- Do not make the mower tipsy when full of heavy cuttings.

- Hold enough grass.

- Convert from bag to nonbag mode with full safety-chute deflection in both, and without having to change chute or outlet parts.

The latest mowers have swing-up chute deflectors that pop back into fully safe position automatically when you remove the bag. As for capacity, Snapper offers a whopping six-bushel rear catcher for their rider; and Massey-Ferguson's side cars hold five bushels. Jacobsen's rig on walk-behinds swings up for clearance in tight spots, or, again, Snapper has a be-

tween-the-handle mount for the bag.

Regardless of whether you're shopping for a walker, rider, or tractor mower, look for the new safety features in four broad areas:

- Deck and cutter sturdy for projectile containment, and shielded against dangerous throw-outs.

- Starting, stopping, clutch, lift, brake standardized and labeled.

- Protection against moving or hot parts.

- Service safety for easy, safe deck

**John Deere Electric 90** cuts 1½ acres on a battery charge. Author found it very safe and easy to drive, even on hillsides.



and blade access or removal without pinched fingers, lifting, or precarious positioning.

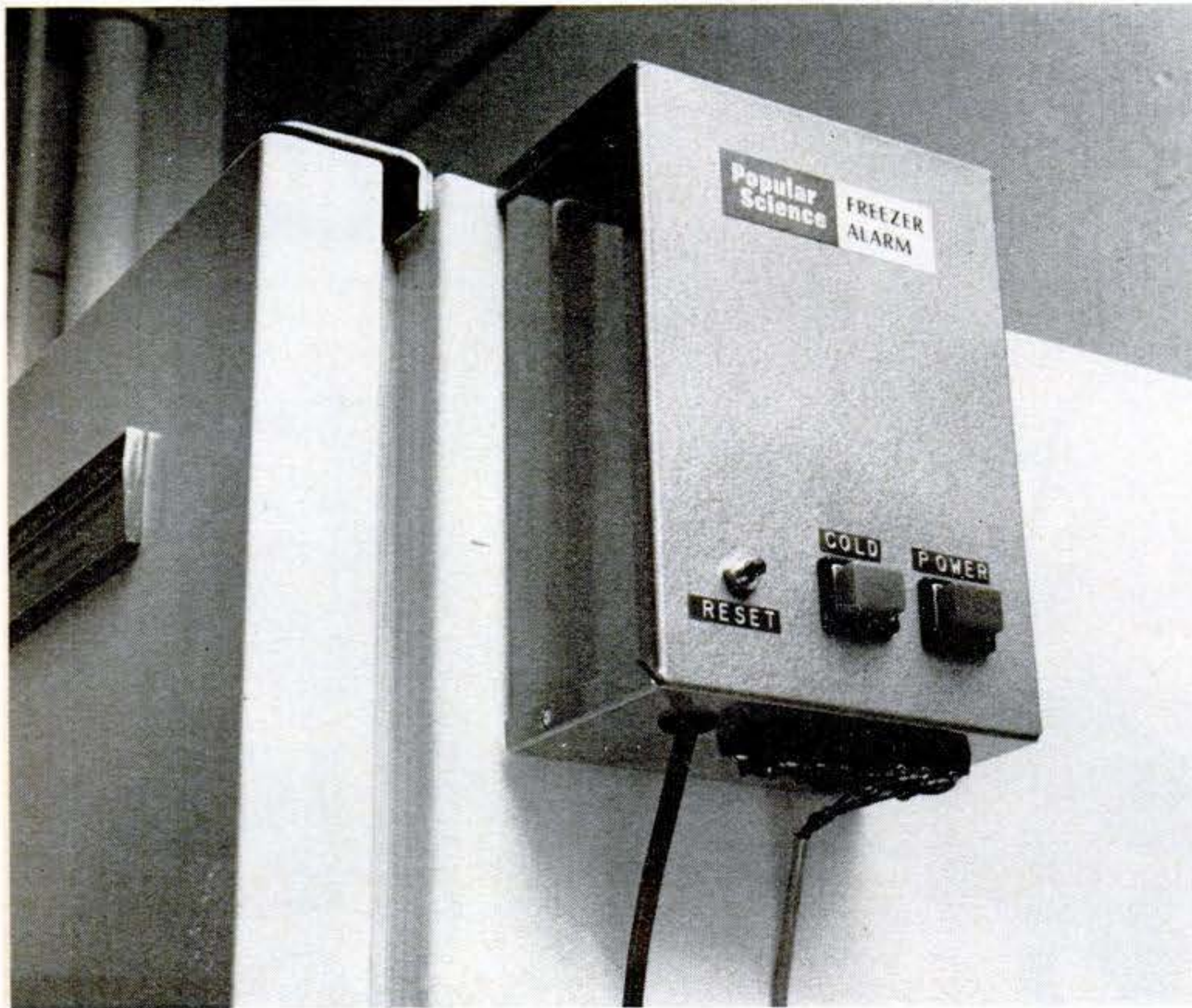
If the mower you're looking at doesn't show positive evidence of attention to these areas, it is not worth buying. Above all, try before you buy. No mower is perfect for every kind of lawn, but some are better than others. Take the time to find the one that's best for you and your lawn. You'll find it if you shop carefully. [E]

**AMF's 21-inch walk-behind** has two-speed front drive, rear toe guard, integral cast deck and drive housing, safe Flexor blade.



# Keep Your Cool—with

Why risk the trouble and expense of food spoilage? This remote



By RONALD M. BENREY

**T**alk about frozen assets! You've got plenty if you have a freezer full of frozen food down in your cellar. Think of the dollar loss if your freezer failed one unhappy day, and you wound up with a couple of hundred pounds of ready-to-eat beef.

Unhappily, most modern freezers don't have any warning system to signal failure—with the exception of a door-mounted pilot light that merely shows the unit is plugged in.

This easy-to-build gadget goes a giant step further: Its buzzer sounds off upstairs (or anywhere in your home) if the freezer's internal temperature exceeds a preset upper limit or if power to the freezer is cut off. It gives you a positive warning of danger in ample time to take corrective action. If you can't get the freezer fixed, you can probably get dry ice to keep the chest cold, or else move the food to a locker.

**How it works.** The gadget senses the temperature inside your freezer with a high-precision thermistor probe. The probe contains two thermistors wired together. Each is a temperature-sensitive chunk of semiconductor material—its electrical re-

sistance drops as its temperature rises.

Together with a pair of precision resistors, the thermistors form a network whose resistance is precisely related to temperature. This network is connected to the gate electrode of a silicon-controlled rectifier, so that the SCR triggers when the probe temperature (and, hence, its resistance) reaches a specific point.

The SCR is an electronic switch. When it is triggered, relay K1 closes and locks on, activating the upstairs buzzer circuit.

The buzzer is also activated if relay K2 is *deactivated*. This relay is wired across the power line, and warns of a power failure in the line powering the freezer.

The buzzer circuit is battery powered so that a power failure won't interrupt the warning signal. The four pen-cell alkaline batteries will sound the buzzer for more than 12 hours continuously. So you're safe even if you're away some hours.

An on/off switch on the buzzer box lets you silence the buzzer once you've heard it; a pushbutton switch lets you test the buzzer and batteries.

Note that relay K1 in the main chassis will remain activated even if the probe temperature drops back to normal. You must reset the alarm

circuit each time it trips by pressing pushbutton S1.

**Building it.** A piece of perforated phenolic chassis board holds most of the components. Use push-in terminals as wiring and soldering points. Be careful not to overheat resistors R1 and R2 and the SCR when you solder their leads.

The thermistor probe consists of a tiny glass bead equipped with three color-coded leads. Shorten the leads to about 1½" long, and solder them to one end of a 10' length of three-conductor cable.

Use small pieces of plastic electrical tape to prevent short circuits between adjacent probe leads.

Finally, slip a length of ¼"-diameter "shrink-fit" plastic tubing over the connections, and heat with a rapidly moving candle flame. The tubing will shrink tight around the connections and form a stiff protective sleeve. Only the upper half of the thermistor probe should protrude past the tubing.

**Find the right spot.** The Dept. of Agriculture recommends that, for safe and satisfactory frozen storage of most foods, the *warmest* spot in a freezer be no warmer than 0 degrees F. Modern freezers are often colder.

Using a freezer thermometer, survey the temperature zones inside your freezer. You are searching for a zone that:

- Has an air temperature about midway between the highest and lowest inside the freezer, *and*
- Doesn't soar in temperature when the door or lid is opened for under a minute.

In an upright freezer, you'll probably find this point about one-third up from the bottom, toward the rear wall. In a chest freezer, any point about half-way down will probably meet the requirements.

**Mount the probe.** Once you've found this zone, check with your freezer dealer or manufacturer to find out which walls of the freezer *don't* contain coils or mechanism. Drill the smallest possible hole that will accommodate the probe cable, and run the cable through. Tape the probe to a nearby shelf element, or fashion a simple bracket and mount the probe on a wall surface. Be sure to position the probe so that someone dropping food packages into the freezer won't smash the glass tip.

Finally, seal the holes through the wall with silicone sealant.

# This Homemade Freezer Alarm

alarm sounds if your freezer is ever in trouble

You will calibrate the device according to the normal temperature of the zone where you have located the probe. The circuit responds to a 10-degree-F rise in temperature. Thus, if the normal temperature of the zone is -10 degrees F, you will calibrate the device to trigger at a temperature of 0.

In most freezers, you'll receive a failure warning before the warmest temperature has gone over 15 degrees.

Note also that the alarm will trigger a few minutes after someone accidentally leaves the door open. This is a kind of bonus feature.

**Calibration.** It's a simple procedure: Consult the resistance chart and select the specific resistor value that matches the zone temperature. Buy a precision (one-percent-tolerance) resistor of this value.

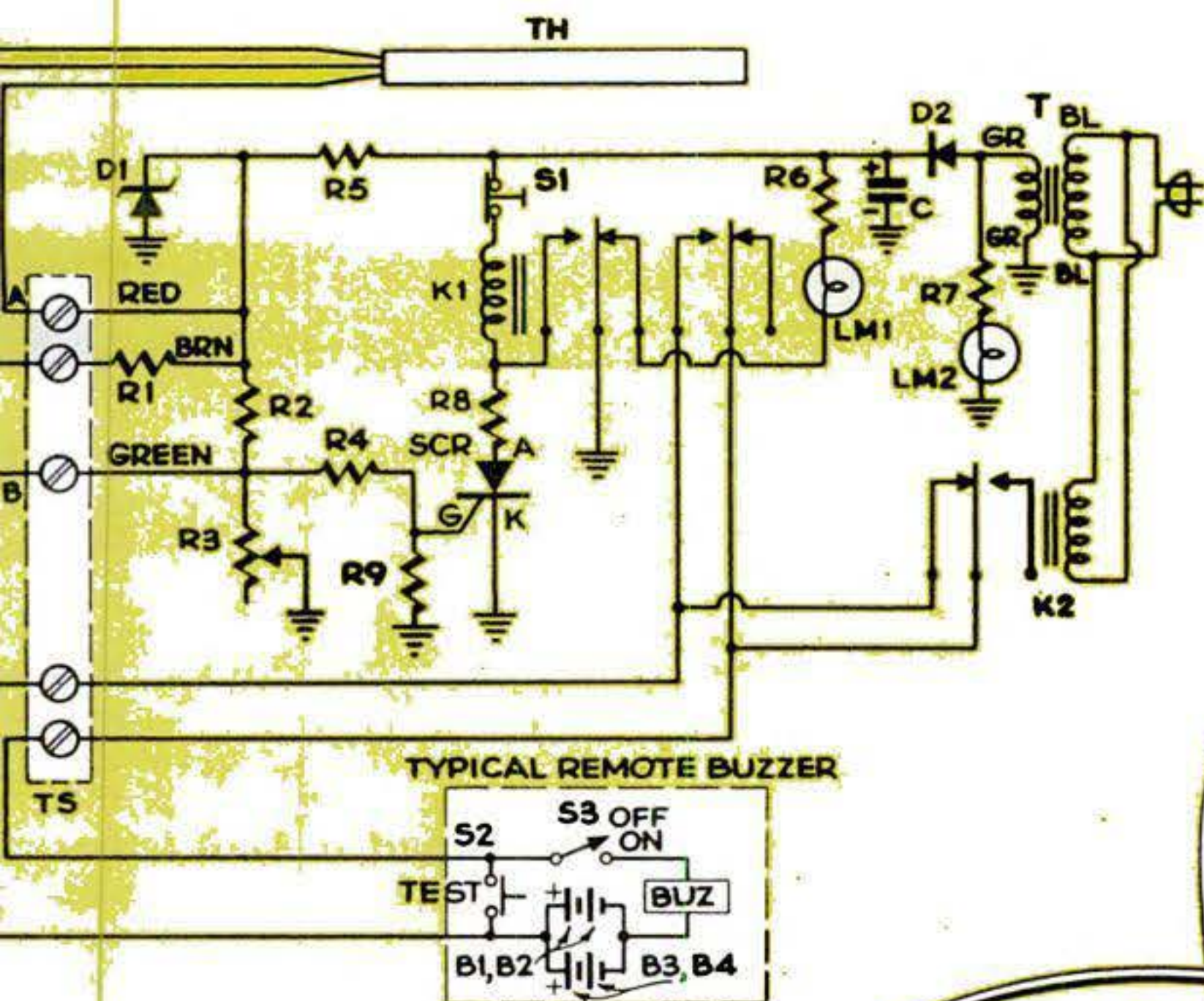
Connect the resistor across points A and B (the two outer terminals that will hold the probe-cable leads). Turn R3 to the minimum setting (full counterclockwise) and plug in the power cord.

Very carefully, and very slowly, turn R3. Stop at the exact point the SCR triggers and the relay pulls in. This is a critical adjustment, so take

your time. Repeat the procedure (being sure to press S1 to reset the circuit) several times, until you are sure R3 is set to precisely the point—not higher or lower—that trips the SCR.

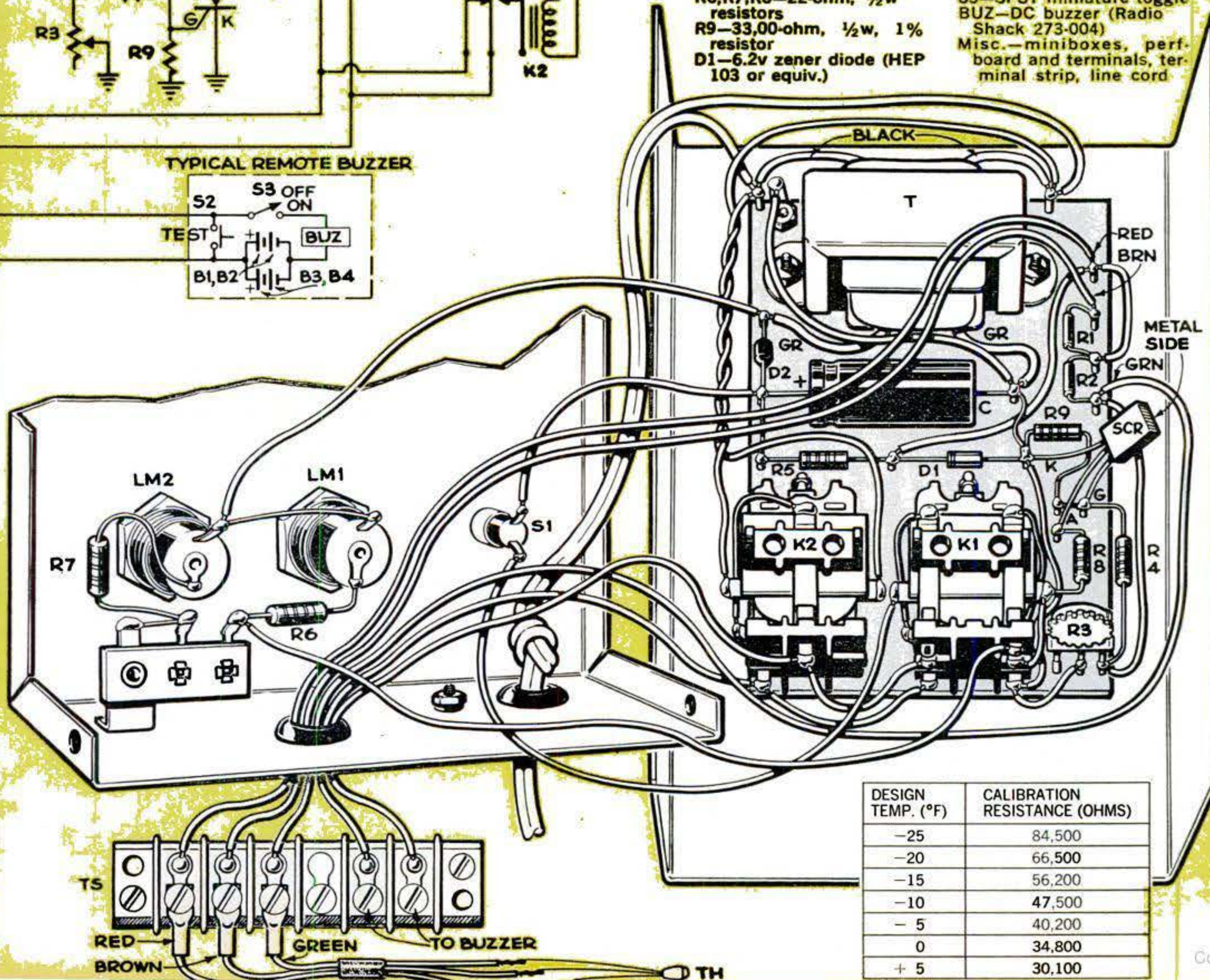
Finally, disconnect the calibration resistor and attach the color-coded probe leads to the terminal strip. Connect the buzzer box to the main chassis using two-conductor cable, and place it in some central area in your home.

Your freezer alarm is now ready to detect any problems—and to keep all your worries on ice. PS



## PARTS LIST

- C—1,000-mfd, 15v electrolytic capacitor
- Th—thermistor probe, Yellow-Springs Instrument #44203 (Allied Electronic 997-3002)
- R1—35,250-ohm resistor (supp. with thermistor)
- R2—18,700-ohm resistor (supp. with thermistor)
- R3—5,000-ohm potentiometer
- R4—100,000-ohm, 1/2w resistor
- R5—68-ohm, 1/2w resistor
- R6, R7, R8—22-ohm, 1/2w resistors
- R9—33,00-ohm, 1/2w, 1% resistor
- D1—6.2v zener diode (HEP 103 or equiv.)
- D2—1N2070 (or similar) silicon rectifier
- SCR—silicon-controlled rectifier (Radio Shack 276-1079)
- T—6.3v @ 2A transformer (Stancor P-6465)
- K1—DPDT, 6vDC relay (P&B KA11DY)
- K2—SPDT, 120vAC relay (P&B KA5AY)
- LM1, LM2—panel-mount sockets with #47 lamps
- S1—normally closed PB
- S2—normally open PB
- S3—SPST miniature toggle
- BUZ—DC buzzer (Radio Shack 273-004)
- Misc.—miniboxes, perf-board and terminals, terminal strip, line cord



DESIGN TEMP. (°F)	CALIBRATION RESISTANCE (OHMS)
-25	84,500
-20	66,500
-15	56,200
-10	47,500
-5	40,200
0	34,800
+5	30,100



Belt sander is your most useful power sanding tool. On wide surfaces make overlapping passes along full length of work. Never

sand across grain, never lower tool onto work until belt is moving. Use only the weight of the sander for working pressure.

## Sanding Secrets of a Pro

**Sandpaper your way to a super finish—it's simple if you know the secrets**

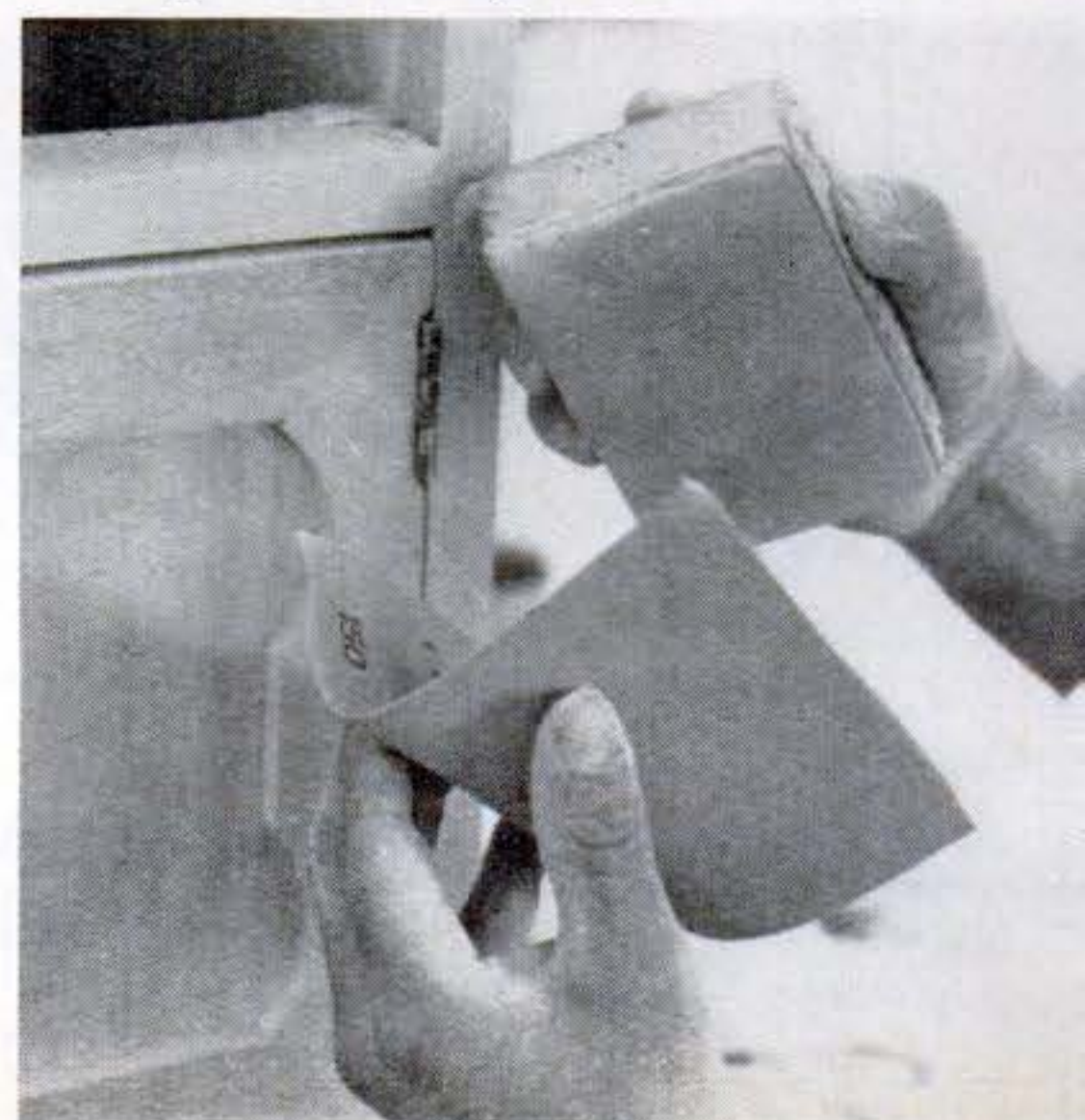
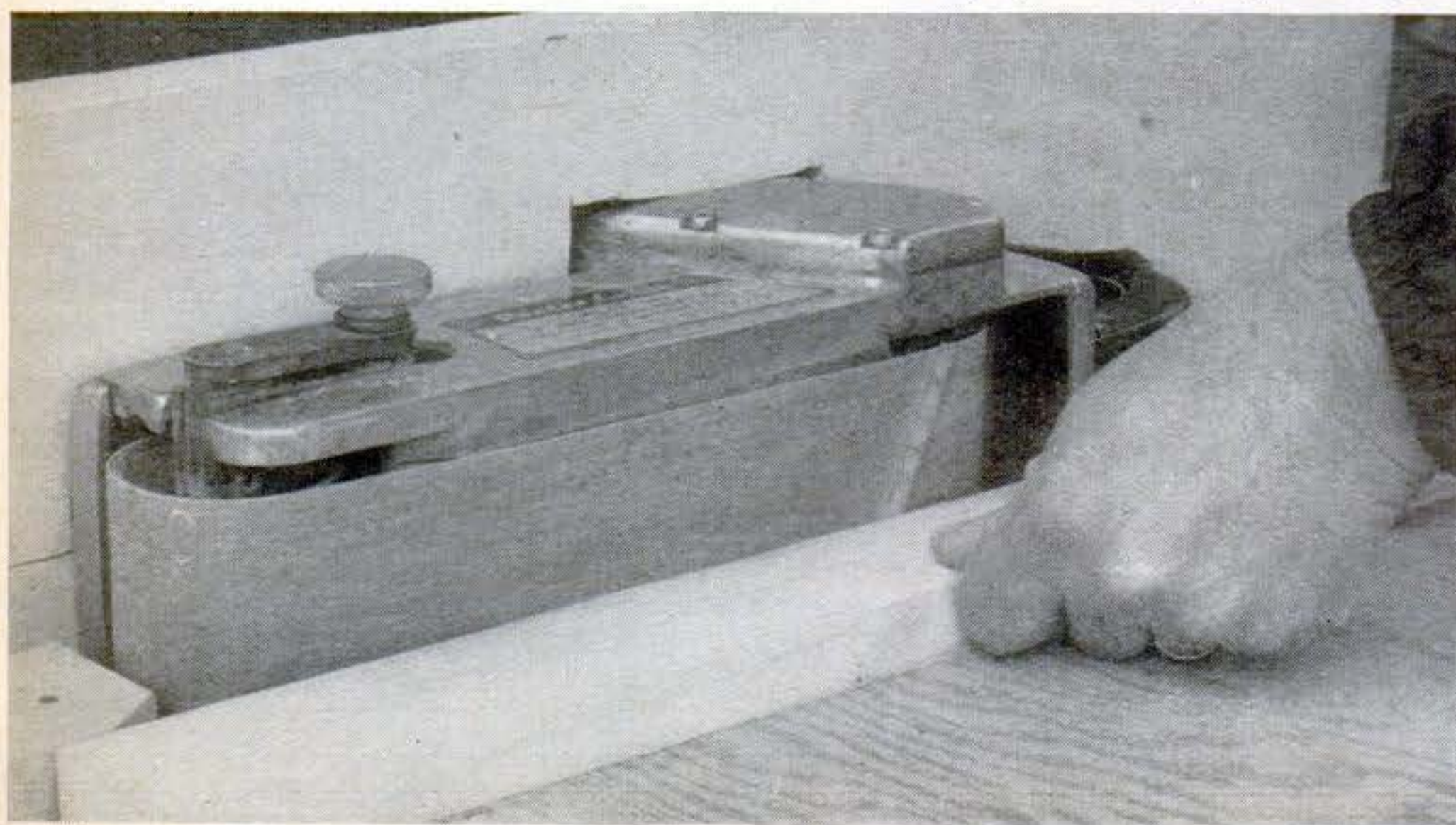
By HERBERT CONNELLY

**A** few weeks ago it was just a pile of rough boards. Today it's a table—and YOU made it. As you pry the lid off a can of stain you look at your work and congratulate yourself on its professional quality.

Minutes later you're wiping off the excess and your heart sinks. The finish is blotchy—dark here, almost white there. Unsightly streaks run across the grain. The deep warm glow of color you'd expected isn't there.

**An edge sander** is what you get when you mount portable belt sander on its side in a frame. Setup gives clean, square edges.

**Felt-padded sanding block**—key to fine finish sanding. Use the block after all machine sanding is finished—just before stain.



## Finishing flaws and how to avoid them

Herbert Connelly speaks from long experience in the wood-products industry. He's worked as a research chemist, production man, plant manager, speaker, and writer. Today he heads a South Carolina wood-products consulting firm.—*The Editors*

What went wrong? It isn't the stain; it's your sanding. Sanding is the key to a fine finish. Skimp in this department and your work will never look professional.

There are five major defects that can ruin the final finish on wood—and careful sanding can eliminate them all: (1) mottled, uneven color; (2) small light patches; (3) cross-grain scratches; (4) light edges and corners; (5) muddy overall color. Let's take a look at these defects and see how to eliminate them.

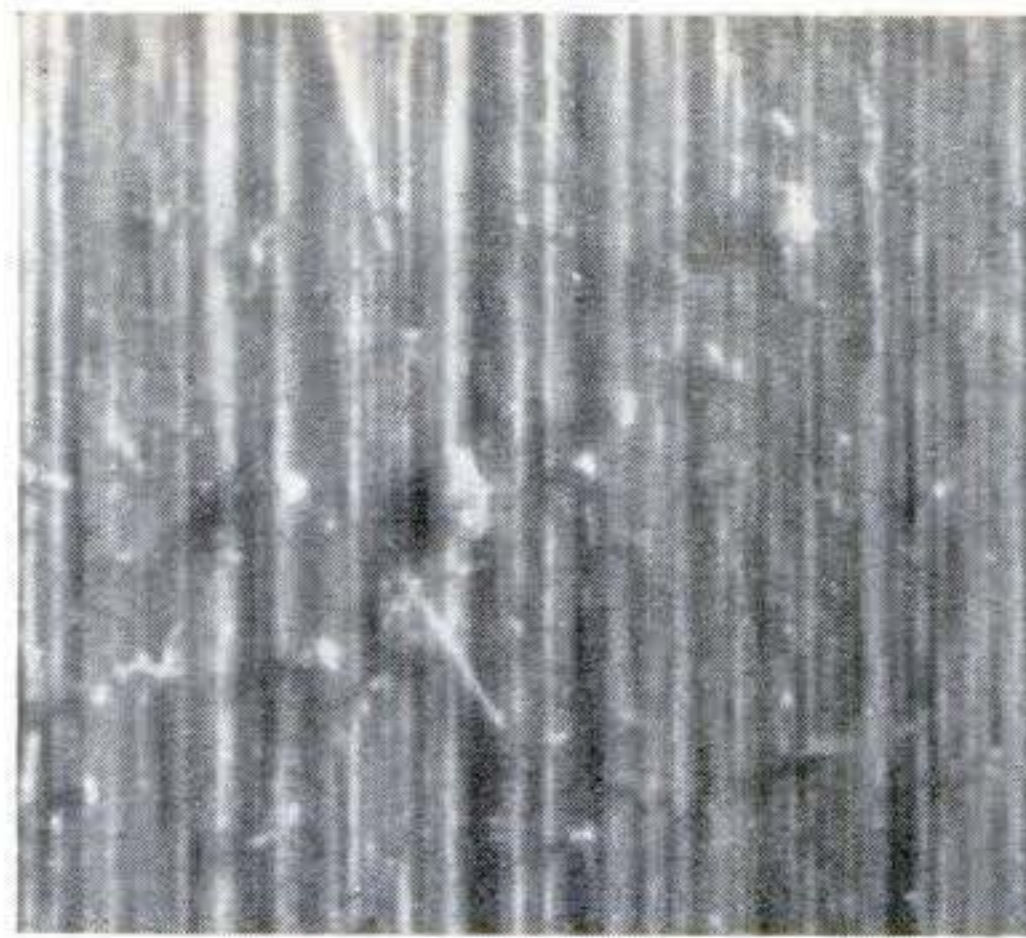
**Mottled, uneven color.** A major cause of this problem is failure to remove jointer and planer marks. These defects show up like an old washboard after finishing.

Planer and shaper-knife marks can be corrected only by removing wood. To do this with the least labor, sand with several grit sizes starting with 60-mesh garnet abrasive for fast stock removal. After the ridges have been leveled, progress to the finer abrasive sizes. Progression should be made in steps not exceeding two grit sizes in any one step. Here's why:

The cutting action of abrasive grains can be described as the removal of wood fibers by tiny chisels, leaving ridges and furrows which must be reduced with finer and finer grits if a truly professional job is wanted. Leap more than two grain sizes and the first sanding leaves deep, stain-absorbing cuts—that can't be removed by the final sanding. When you apply the stain, these cuts soak up more color than the rest of the wood. Result? A blotchy, streaked finish.

Blotching and streaking also can be traced to the kind of abrasive mineral used. For the home shop you'll be using either aluminum oxide or garnet. Both grits work well when new and sharp. But aluminum oxide grains grow progressively round and dull with use, removing less and less wood with each pass of the sander. The rounded grains become friction points producing heat on a belt sander that I have measured in excess of 400 degrees F. When transmitted to wood fibers, heat above 360 degrees causes the lignin (nature's glue) to flow in the cell walls, forming microscopic burnished or burnt areas on the surface. These areas are poor stain ab-

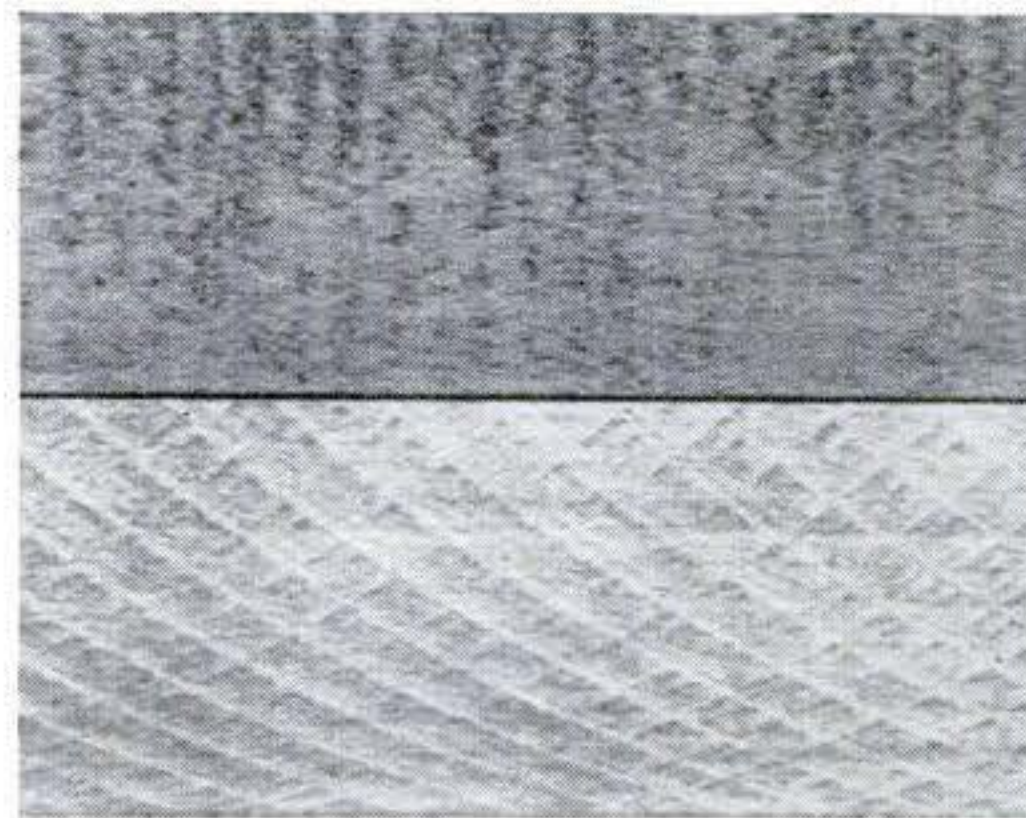
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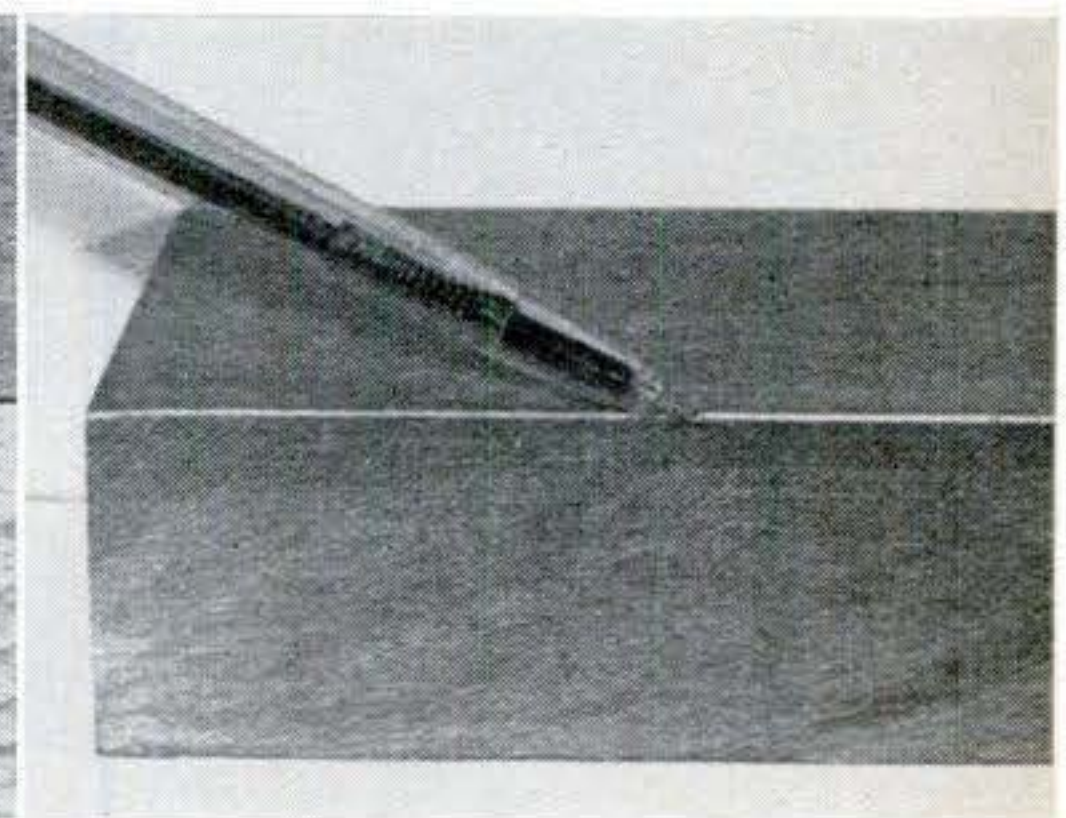
Ultra-closeup photo of hard maple sanded with an aluminum-oxide belt shows deep scratching and countless raised wood fibers.



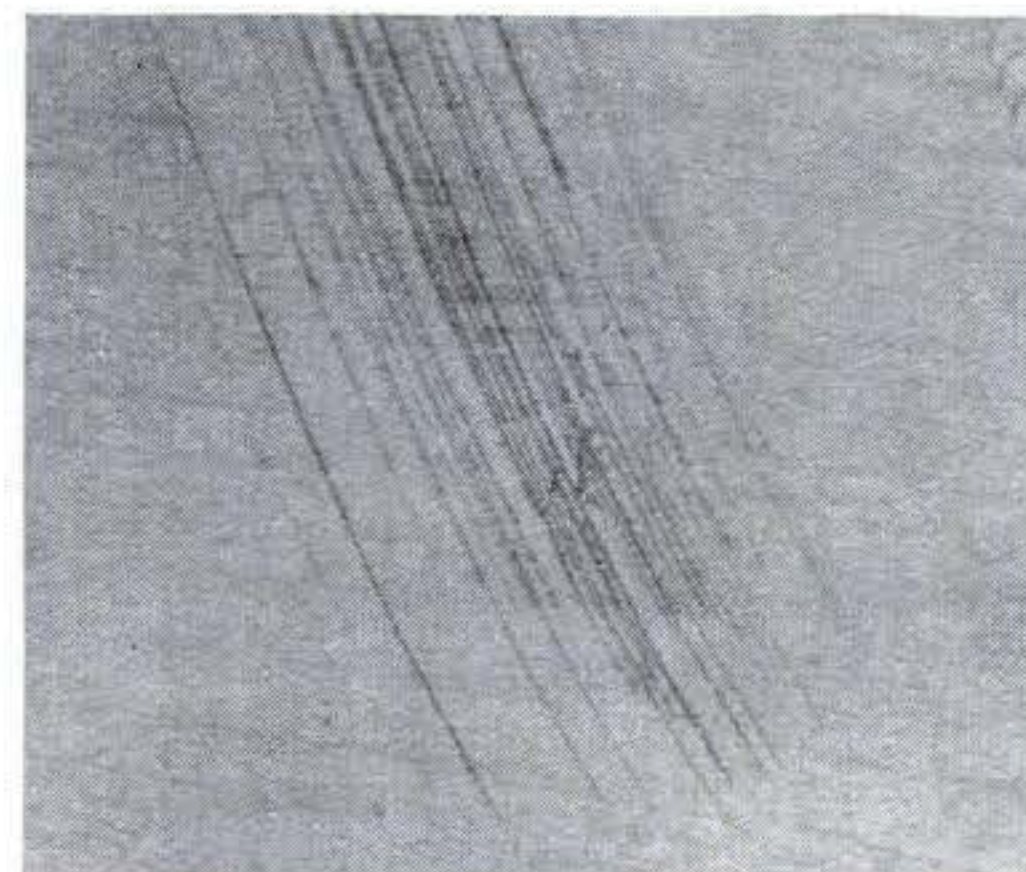
Garnet belt in the sander gives much smoother surface than aluminum oxide. Surface is easy to fine-sand before finishing.



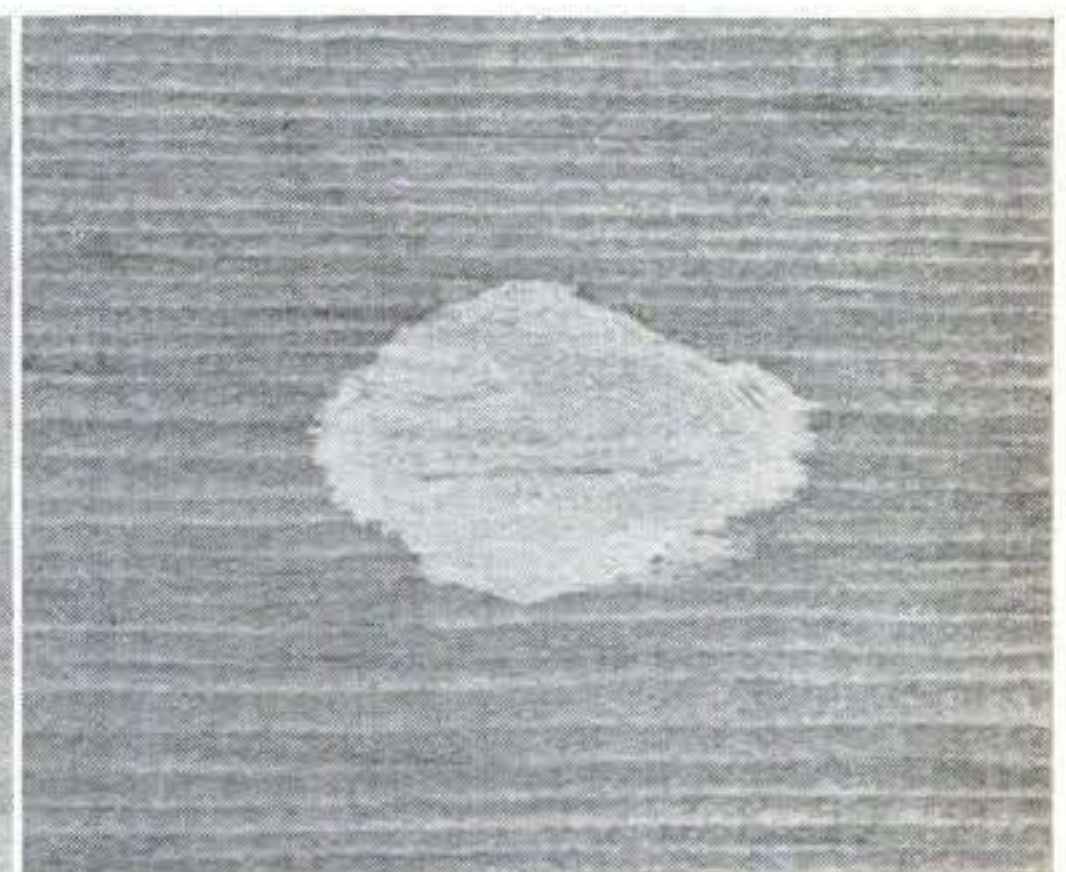
Recognize these two eyesores from your own work? On the top block—jointer marks; on bottom block—saw marks. Sand out!



White edge is created when you sand sealer over stain coat, then cut through sharp edge. Round the edges slightly before staining.



Cross-grain sanding—even an accidental scuff—makes marks like these, and they're hard to remove. Never sand across grain.



Glue spots are hard to see—until you put on the stain. All spots must be removed by careful sanding before you apply finish.

### Recommended grit schedules for common shop woods

Type of sanding	Mineral	Oak Ash	Pecan Hickory Walnut Maple Cherry	Poplar Pine	Mahogany
rough	garnet	60	60	80	80
2nd sand	garnet	80	80	100	100
3rd sand	garnet	100	120	120	150
polish	garnet	120	150 or 180	120	180

# The New Chain Saws: Should

The lightweights sometimes sub for portable circular saws in heavy cutting jobs



Sears lightweight Beaver has fitted case to keep out dirt and provide storage for the wrenches and accessories you need.

A quiet revolution has taken place in chain saws. If you haven't rented, borrowed, or shopped for a saw in the last year or two, you may not have noticed:

- New smaller, lighter, amazingly powerful models.
- Lower prices that make ownership easy.
- Automatic chain oiling on some models, optional on others.
- Compression releases for really easy starting on many models.

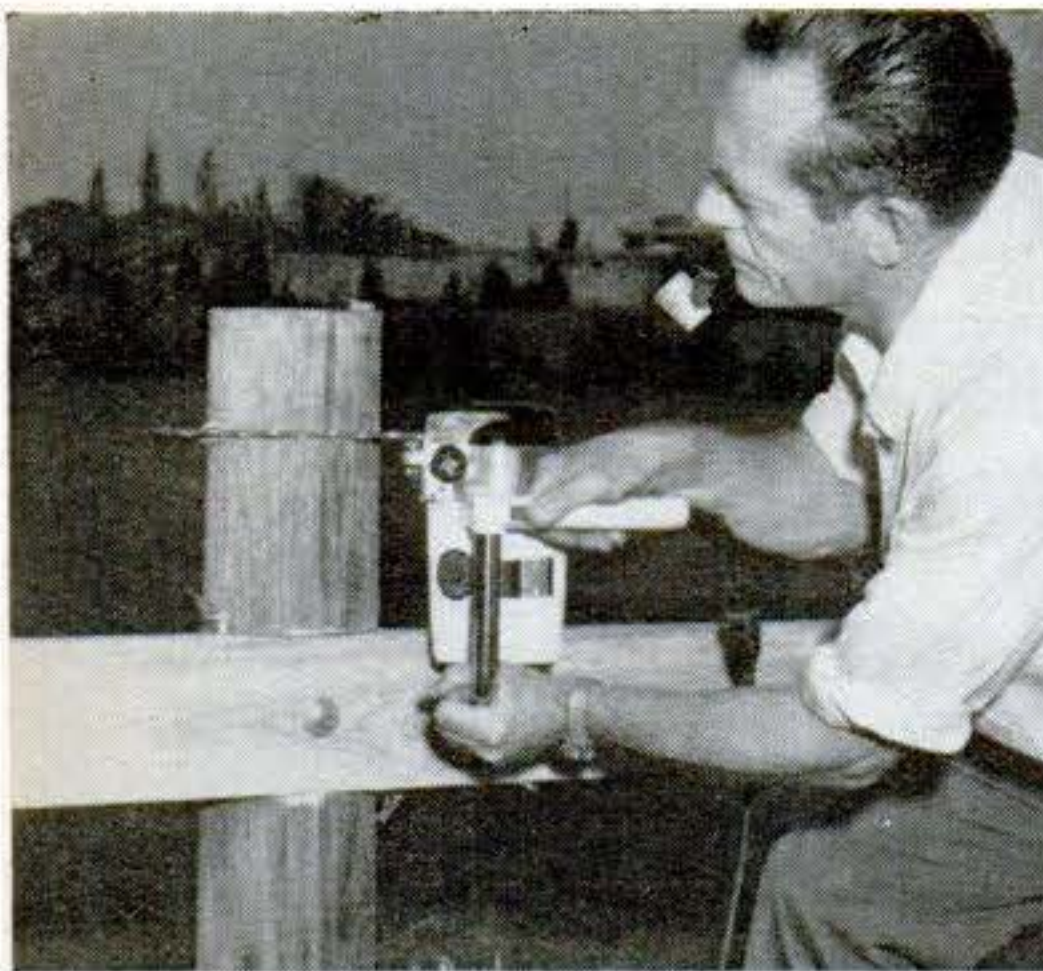
These are not mini-saws with mini engines—the kind with price-tags as low as \$89.50. The saws we mean are blocked in, roughly, by cubic displacements ranging from 2.1 to 3.1 inches; prices from \$129.50 (Poulan) to about \$179 (quite a few). Blade bar lengths are normally 12 or 14 inches. Weight is important, but may be given for engine only, without bar and chain. Think under 10 pounds and you're in the ball park. A few, a pound or so heavier, are in the same market. I weighed the following, complete with bar and chain:

Skil 1610 Auto. Oil .....	7 lbs. 12 oz.
John Deere "8" .....	7 lbs. 15 oz.
Pioneer Holiday II .....	11 lbs. 15 oz.
Wards TMC 24000A .....	8 lbs.
Skil Elect. 1600 .....	9 lbs. 8 oz.
Stihl 020AV .....	10 lbs. 7 oz.
McCulloch Mini-Mac 6 .....	8 lbs. 1 oz.
Homelite EZ Super Auto. ..	12 lbs. 8 oz.
Allis Chalmers 75 .....	9 lbs. 11 oz.
Sears Beaver .....	9 lbs. 10 oz.

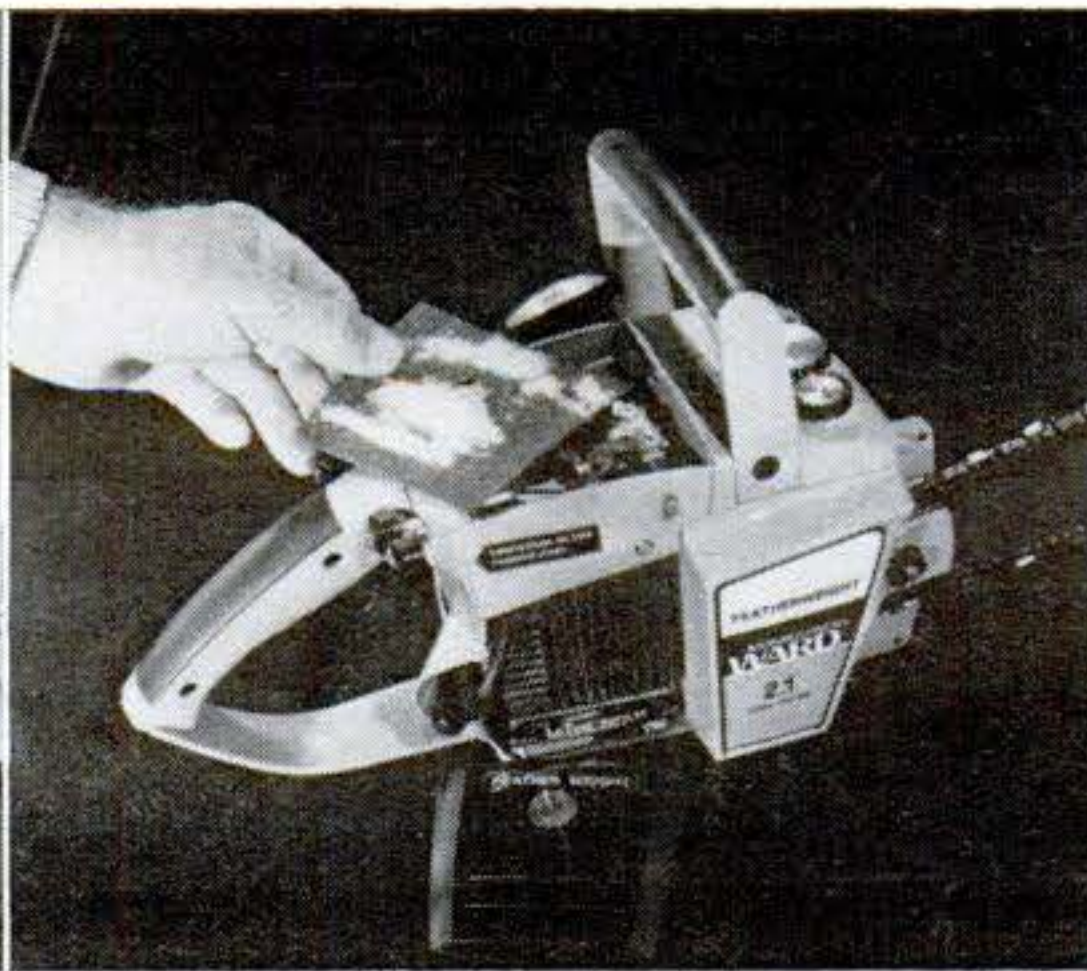
All had a 12-inch bar except the Pioneer and Sears, both with 14-inch, and Homelite with 16 inch bar.

Any of these saws can fell trees to 20 inches in diameter. But, even if you rented a larger saw for the big felling and cutting, we'll bet you'd still use one of the smaller saws for limbing and cutting to firewood length. Their size and weight make them handier.

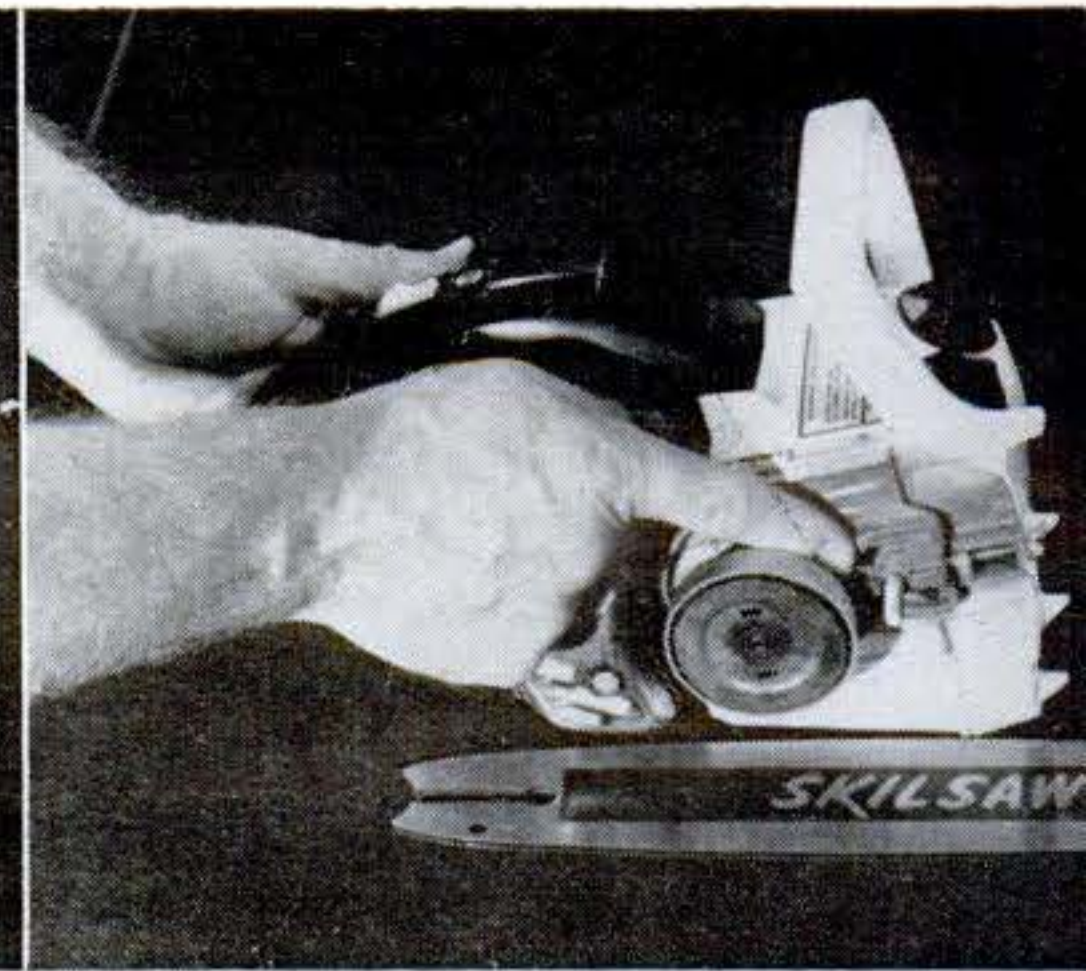
Hang one on your shop wall. You'll reach for it almost as often as for an electric drill. The narrow, keen cutting chains let you cut posts, planks, and heavy boards cleanly and to the line without the chewing and shattering you might expect from big chains. And you'll probably feel safer and



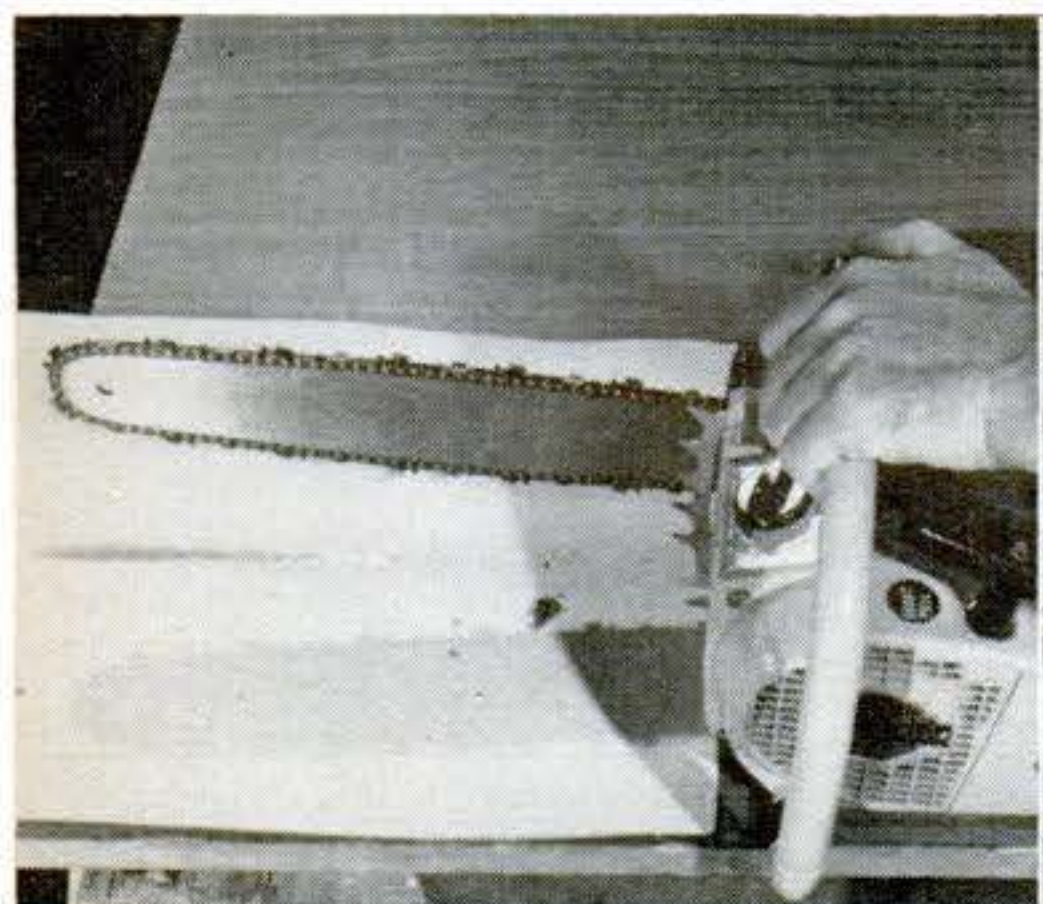
An electric chain saw can be as handy as an electric drill. In fact, all chain saws can be used for rough building cuts.



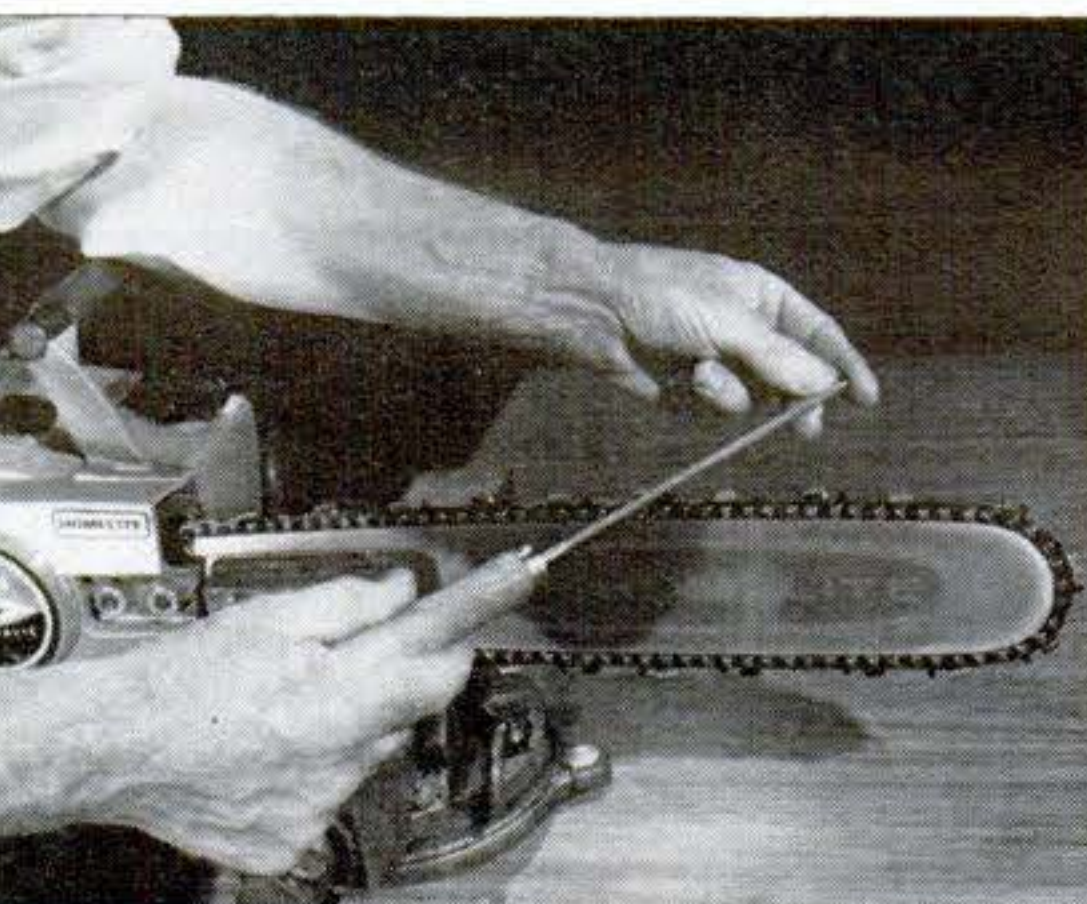
Cleaning air filter every time you use a saw is a good rule. New Montgomery Ward saw has both automatic and manual oiling.



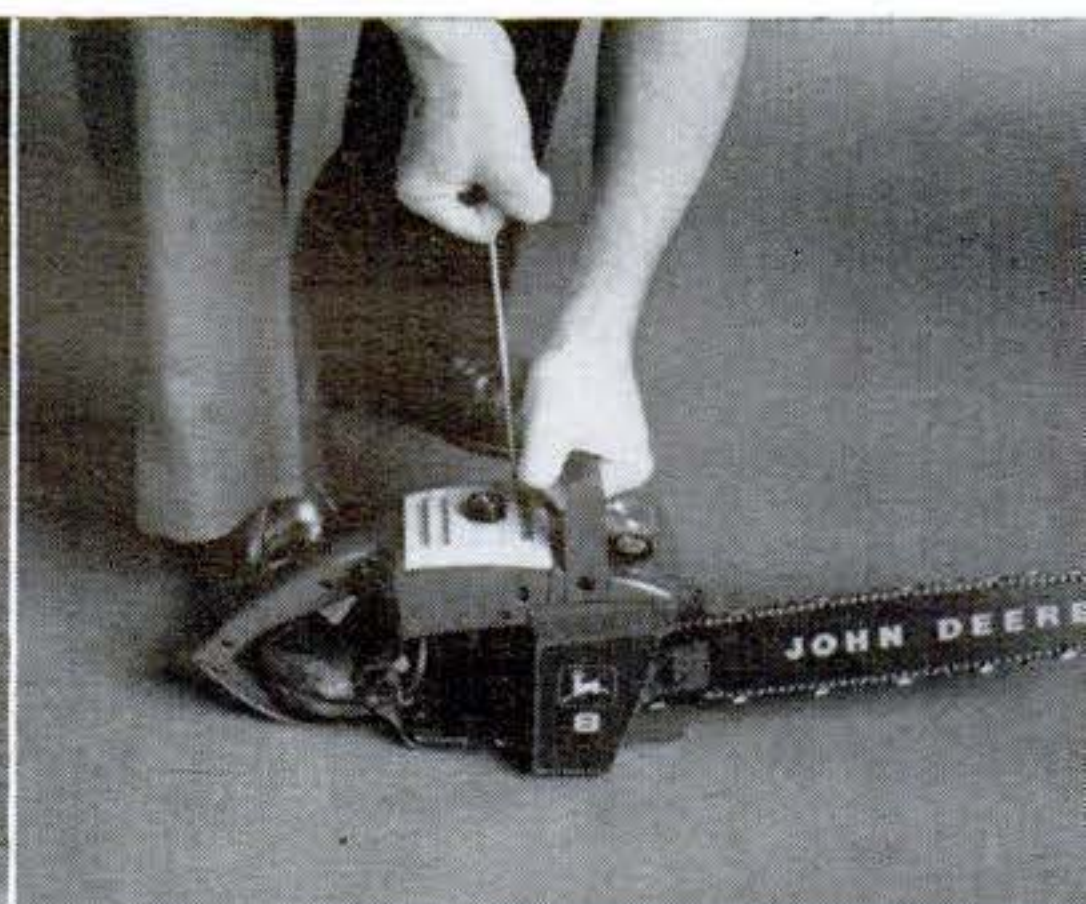
Be sure to keep oil flowing to chain. Finger points to oil discharging from the port as Skilsaw manual oiler is pumped.



Oil spray on sheet of white cardboard indicates that everything's fine with the automatic oiler on the Stihl 020 above.



Keep it sharp. Learning to do it yourself pays off. Correct angle for holding file is demonstrated on Homelite lightweight.



Safest starting method if your saw has a foot strap, as does this John Deere, is demonstrated by author in the photo above.



# You Buy or Rent?

By E. F. LINDSLEY / PS Midwest Editor

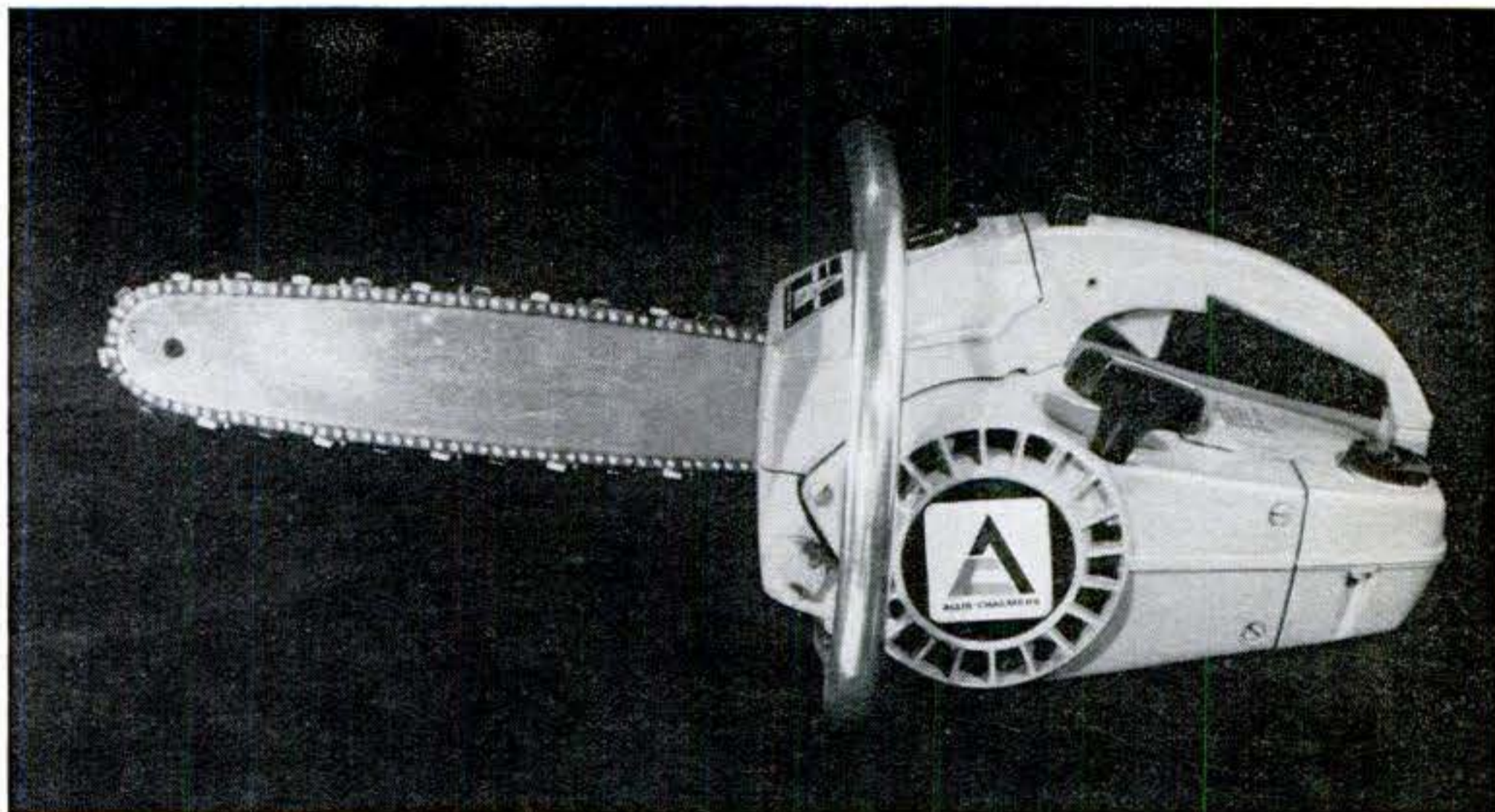
more sure of yourself using a small chain saw in this type of work than if you try to muscle a hand-held circular saw beyond its range.

For real convenience try an electric chain saw like the 9½-pound Skil 1600. Electricians are great for trimming up in trees where trying to hang on to life and limb and pulling a starter rope are not compatible sports. They work just as well on a rooftop, or at ground level, on construction projects.

**Buying vs. renting?** It's hard to put dollar values on the convenience of ownership, less physical exertion, firewood often free for the cutting, and the well-being of your trees after consistent judicious pruning and removal of dead wood. We checked local rental rates and found:

- Most agencies rent out only the medium-size and larger saws.
- Rates range from \$12 to \$17.50 per day, or, about \$3 per hour.
- Not all rentals include fuel and oil. Expect 65 cents a gallon for fuel mix; 85 a gallon for chain oil.
- Most of the rental saws looked beat up; on some the chains were worn.
- Add the bother of searching for a rental saw and the time and miles to pick up and return it.

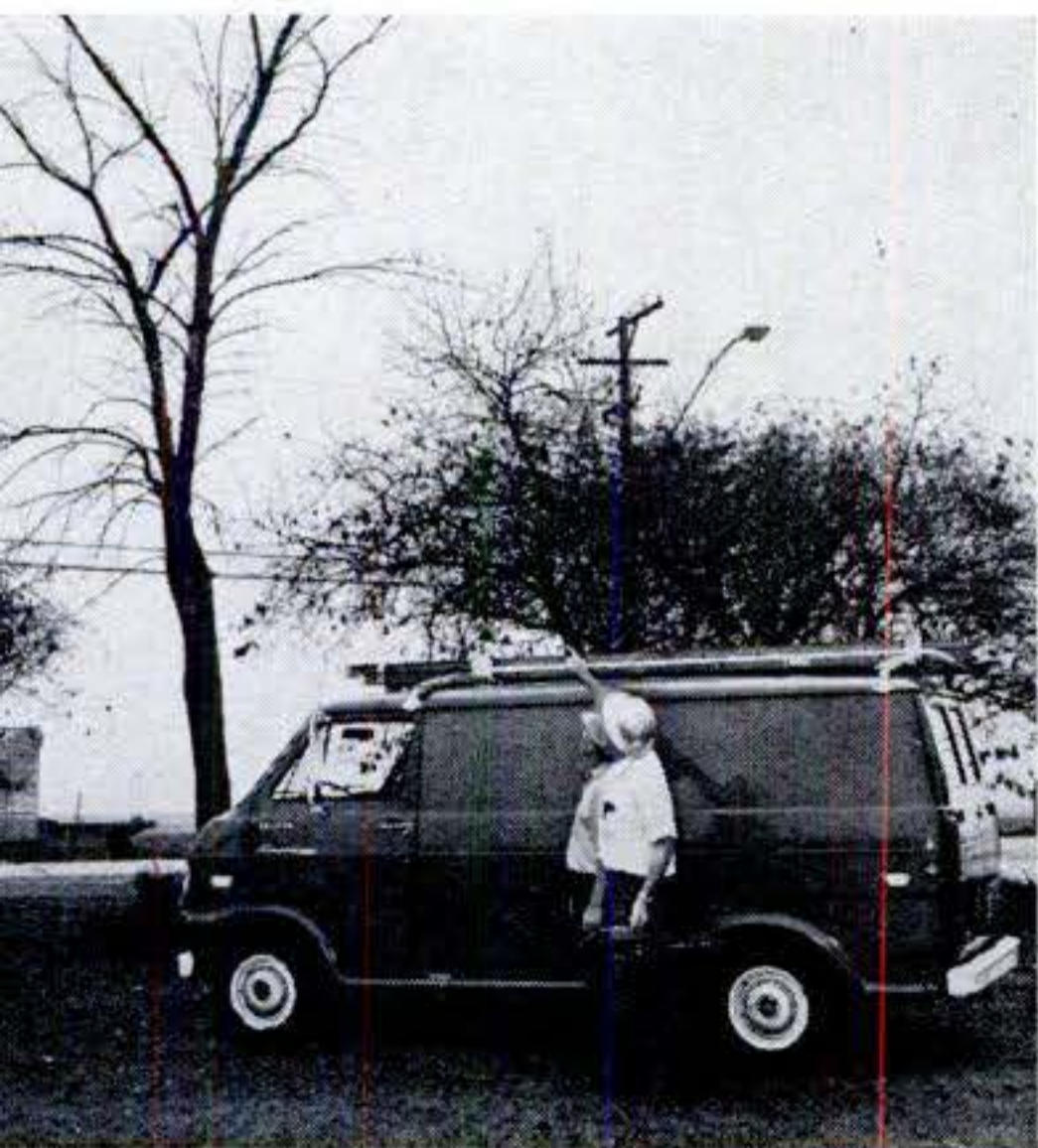
**Our conclusion:** If you need a big saw for big work, buy a smaller saw and rent the big one for an hour or two. Thus, for those rare big jobs, you'd spend a \$6 minimum rental fee for a few hours, and have your own saw to use for cutting felled wood to fireplace length, plus all the other jobs. Pay \$170 for a saw, use it for 10 years, and your yearly cost about equals one day's rental. P 5



**Compact and rugged**, new Allis Chalmers 75 has a 2.1-cu.-in. engine, spark-arresting muffler. Complete with 12-inch bar as above, it weighs nine pounds, 11 ounces.



**Firewood stacks up fast** and effortlessly when you use a lightweight saw like this Pioneer Holiday II. If you have fireplace, firewood savings can soon pay for saw.



**Look out for wires** before felling a tree. If in doubt about clearing wires, better consult utility company about doing job.



**McCulloch Mini-Mac 6**, a pioneer lightweight, rests above on an example of its handiwork: making clean and splinter-free cuts. Automatic oiler is an option. The small saws are especially useful for bucking wood; that is, cutting it up.

# SAIL HO on the parking lots! Speedy Sailcars Take Off in the West

By PETER STEVENSON

When people see this little sailcar for the first time, they all react the same: They smile and scratch their heads. The smile comes as they watch the little plywood craft scoot around at surprising speeds with a fascinating lack of noise. The head-scratching comes from not being able to quite place the thing. It looks like a sailboat from one angle, yet from another it looks more like a speedboat or maybe a race car—or even an ATV.

One thing it doesn't look like is a

typical sailcar. Sailcars are wide structures that look like iceboats on casters. My little Manta takes a different tack.

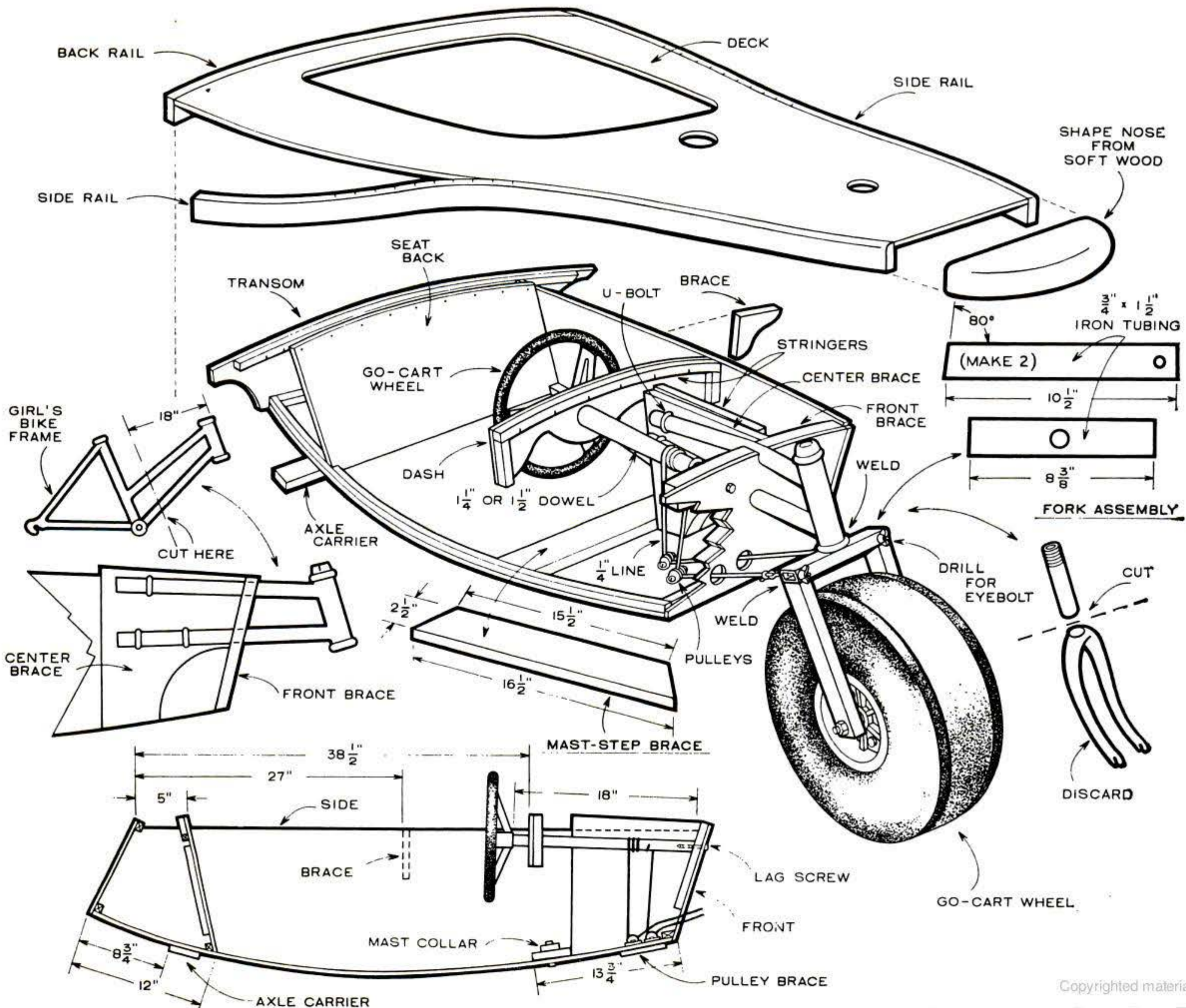
**Light and narrow.** She's light enough to deliver performance in light breezes, yet strong enough to take the stress of gusty days. The secret lies in the monocoque stressed-skin plywood construction, which provides an amazing amount of rigidity at a minimum of weight and material cost.

Instead of strapping the pilot in the center and hoping that a wide track will keep things upright, the Manta allows its skipper to move all

over the deck and keep it balanced in the hairiest of gusts. Thus, the Manta is narrow enough to ride in a station wagon or on top of a car.

Because it's narrow, it can also be short and maintain exciting race-car handling. And being small, it gives a greater feeling of speed, and permits several of the racers to tear through a tight turn without running over each other's wheels. Several Mantas can provide a great afternoon of sport on an average-sized parking lot.

The Manta has a sail plan adapted to normal wind speeds—the breezes  
*Continued*





AMERICAN PLYWOOD ASSN.

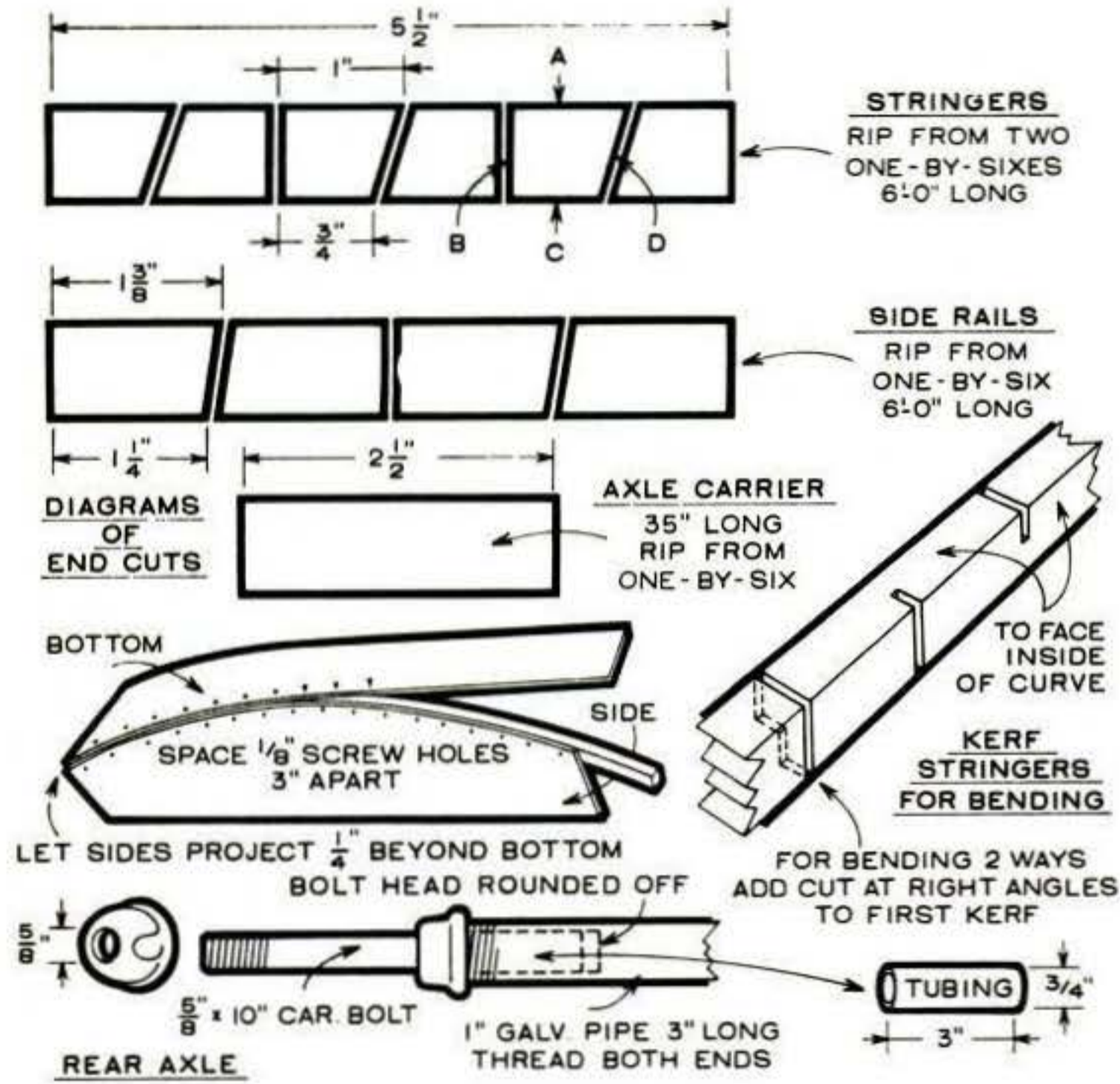
Perhaps you've not yet seen a sailcar race. But we predict that you will. Peter Stevenson has crossed race car and fast sailboat to create a fun thing that stops Southern California traffic every time he sails it.—The Editors



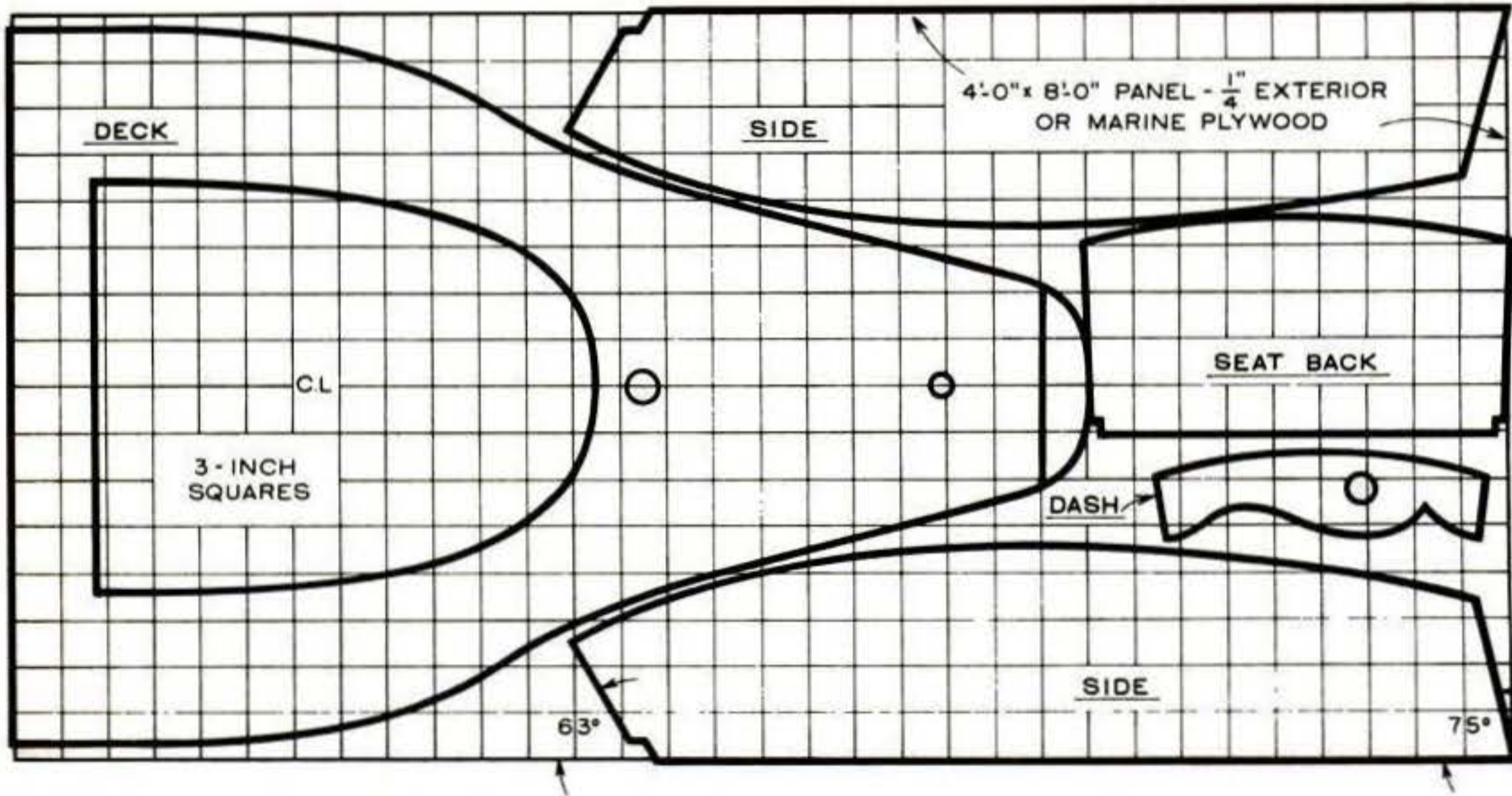
that you can find on most weekends. The sail is larger than the one on the traditional sailcar rig. This results in a lower top speed, but better performance in typical breezes.

Although top speed is reduced, you can count on traveling at roughly twice the speed of the wind in the Manta. At around 30 knots, most sailors are ready to ease the main-

sheet a little to cool things off a bit. The mast acts as a natural roll bar. If you do happen to be sitting on the lines and dump the car over, it skids  
*[Continued on page 132]*

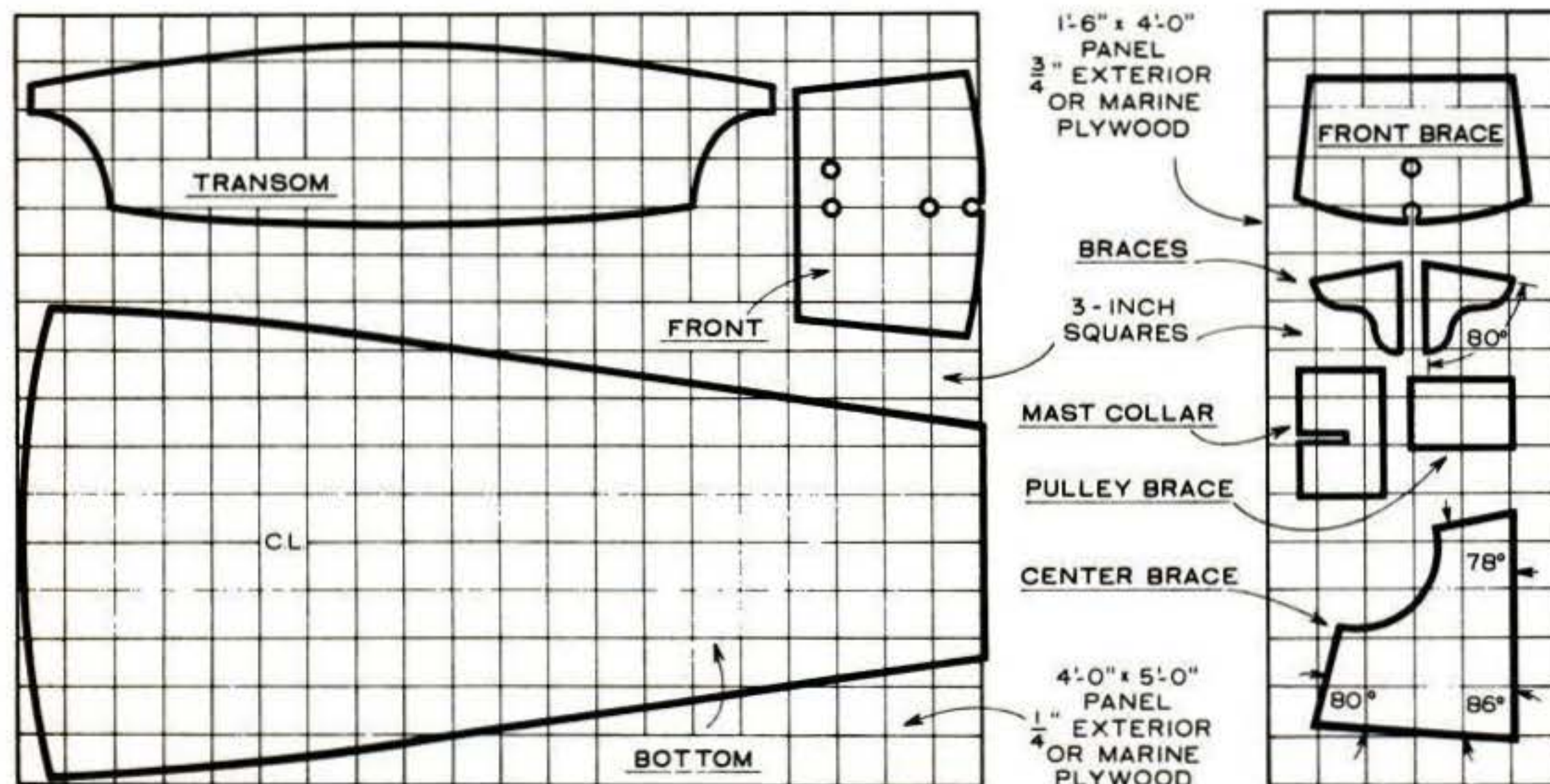


Briggs Cunningham takes Manta's helm in the parking lot of his automotive museum at Costa Mesa, Calif. Winner of the world-famous America's Cup races and long-time campaigner at Le Mans, Cunningham combined his talents for sailing and car racing to show Peter Stevenson good tricks on sailing the Manta.



**Construction summary:** Sailcar body is 1/4" DFPA plywood framed on straight-grained strips, kerfed for bending, and stiffened where needed with 3/4" plywood. Part of steering gear comes from junked bike frame, wheels from go-cart. Sail rig can be ready-made.

### Large-Scale Plans Are Available



For your convenience in building the Manta, plans are available in a larger scale than it's possible to present on this page. Included are plans for building an inexpensive sail rig using aluminum tubing and sheet polyethylene. Full step-by-step instructions for the entire project are included. For Sailcar Plans No. 5534, send \$3.95 (check or money order) to Popular Science Plans Division, 355 Lexington Ave., New York, N.Y. 10017.

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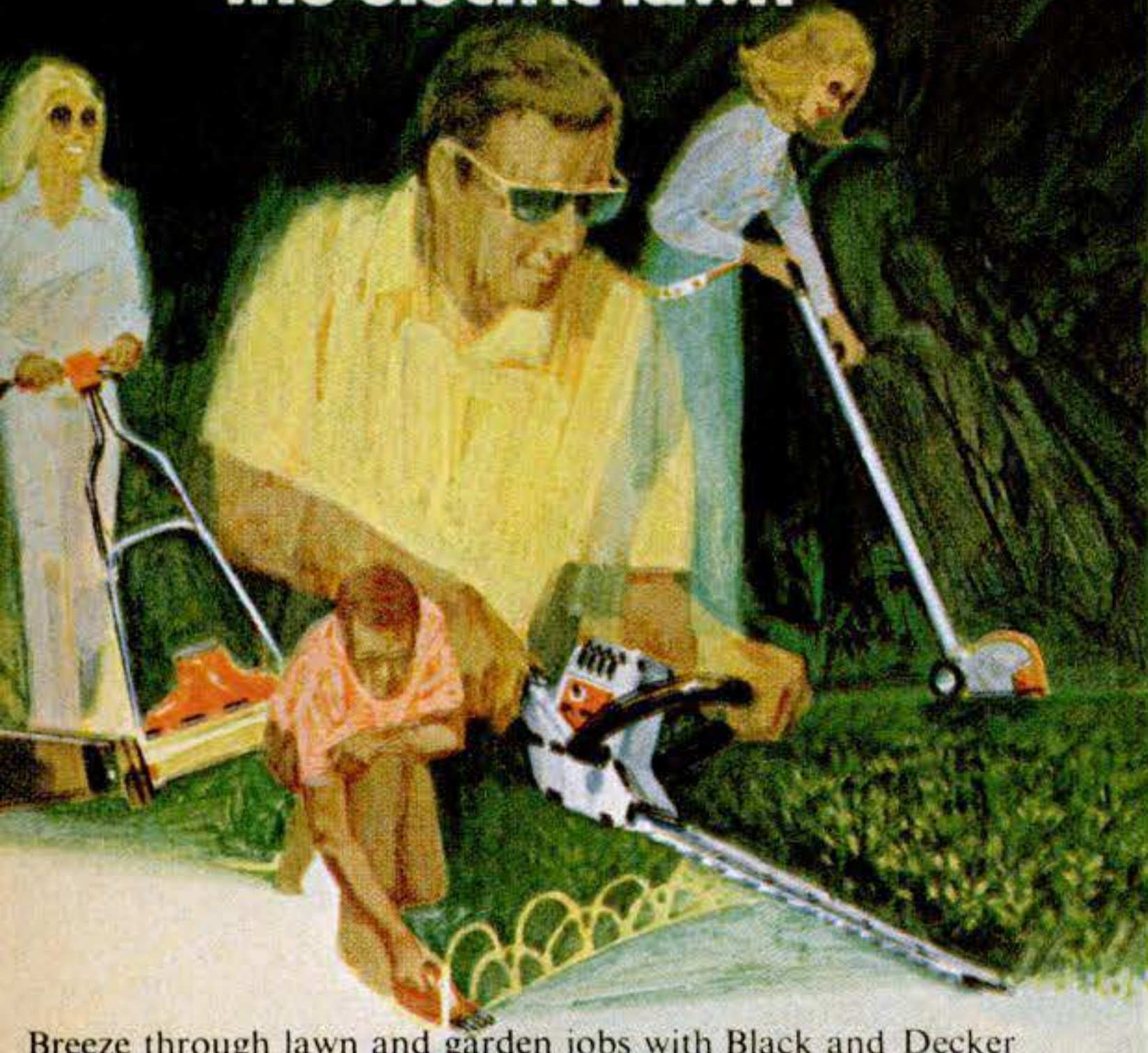
dealers will loan you a car. Free.

Finally, you get a name and toll-free number to call in Detroit if you have a problem. And you'll get action, not a runaround.

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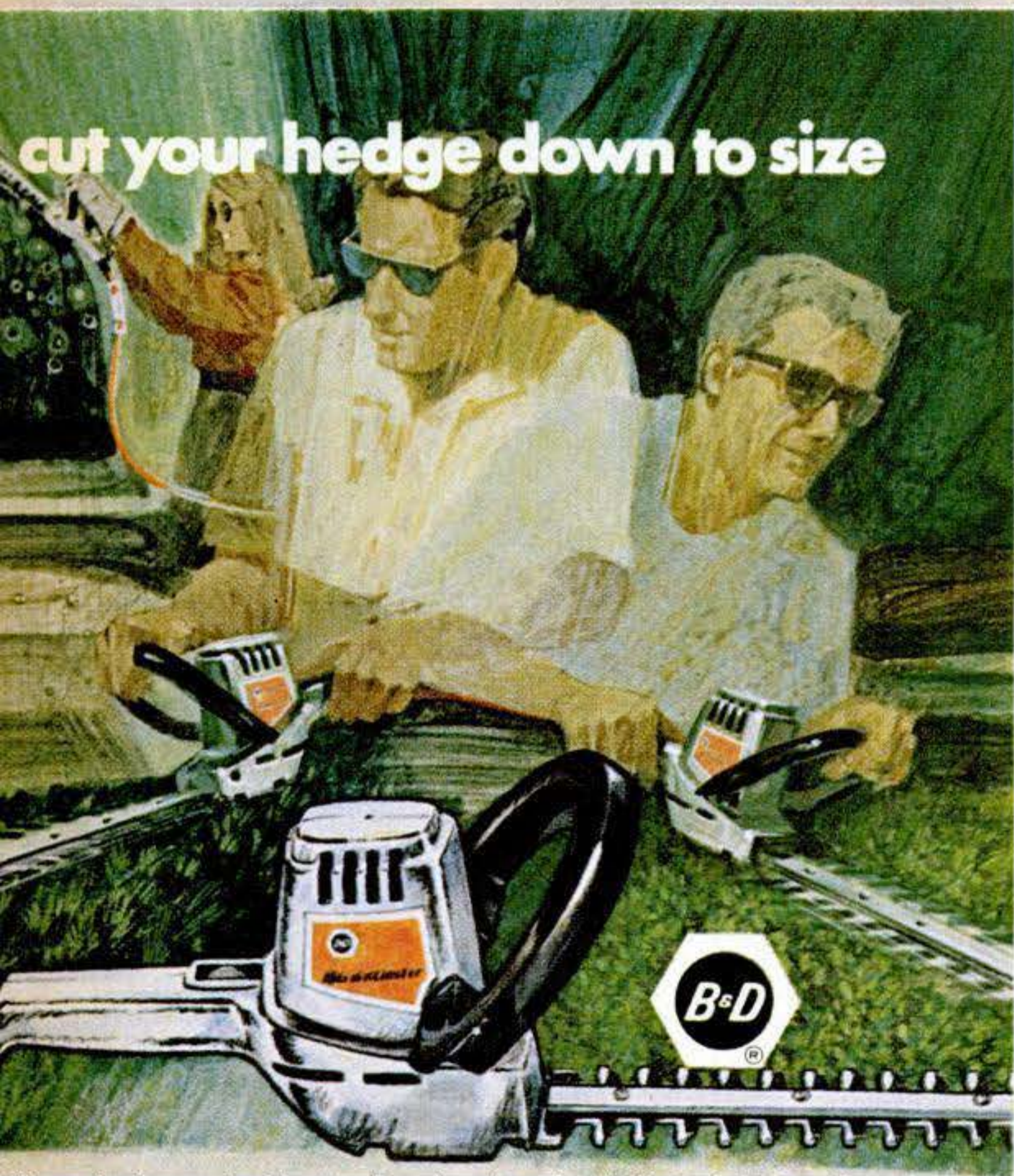
Which is probably why people who've never bought a car from us before are buying one now.

# the electric lawn



Breeze through lawn and garden jobs with Black and Decker electric helpers. Clean running, light weight, and easy to use, they keep everything trim from the ground up . . . and keep trimming for years. There's a mower, hedge trimmer, lawn edger, or grass trimmer in just the size to fit your job at your dealer's now. Stop in and heft it soon.

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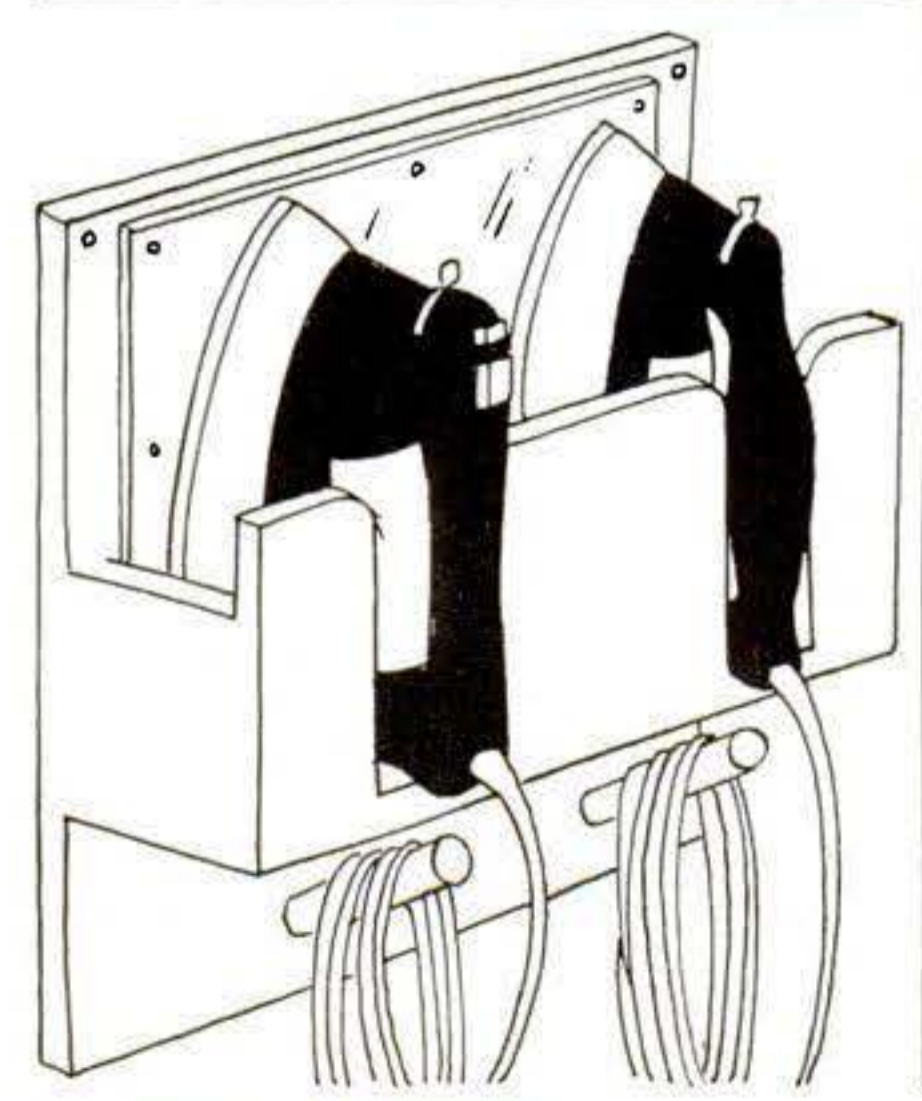
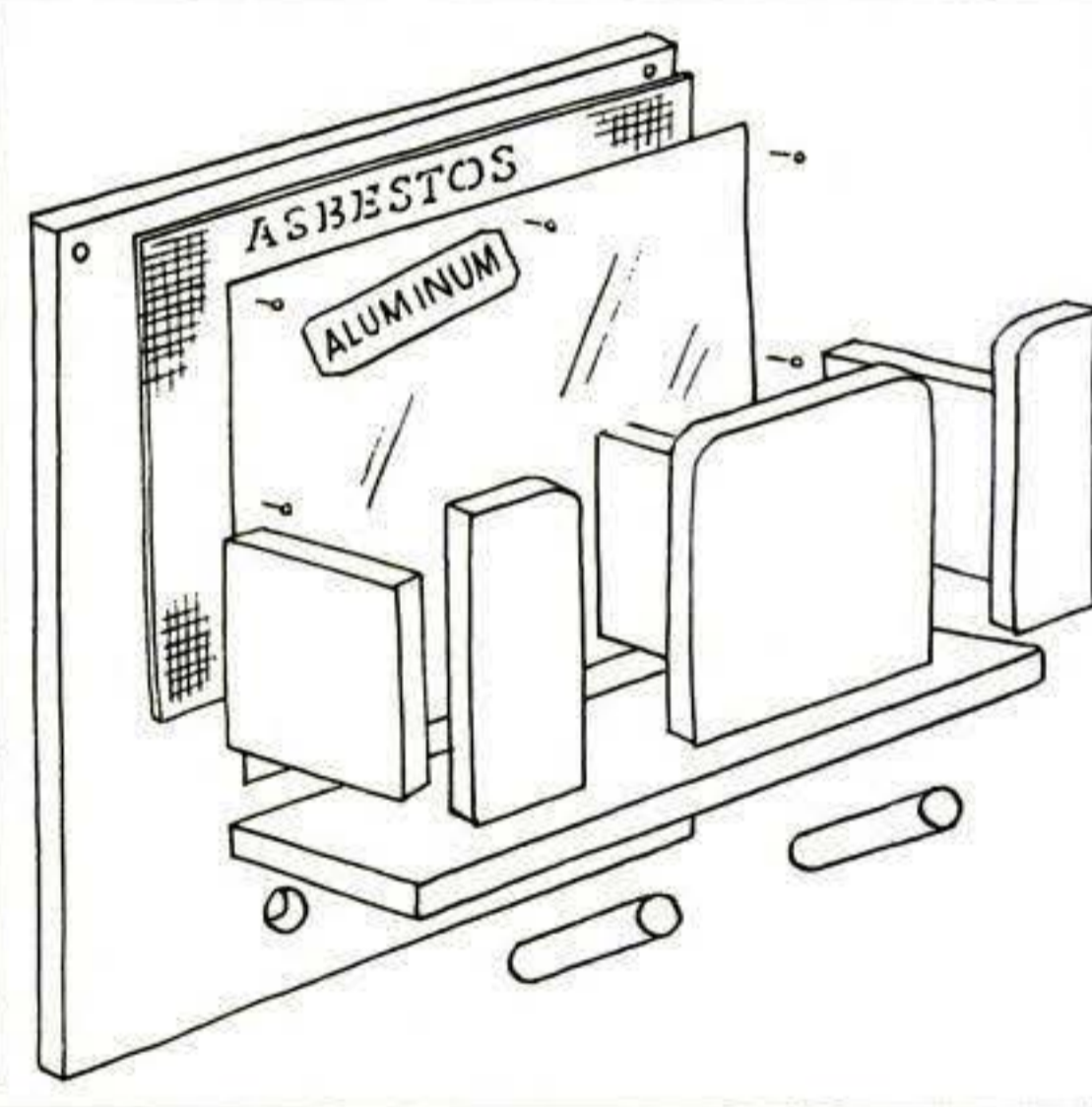
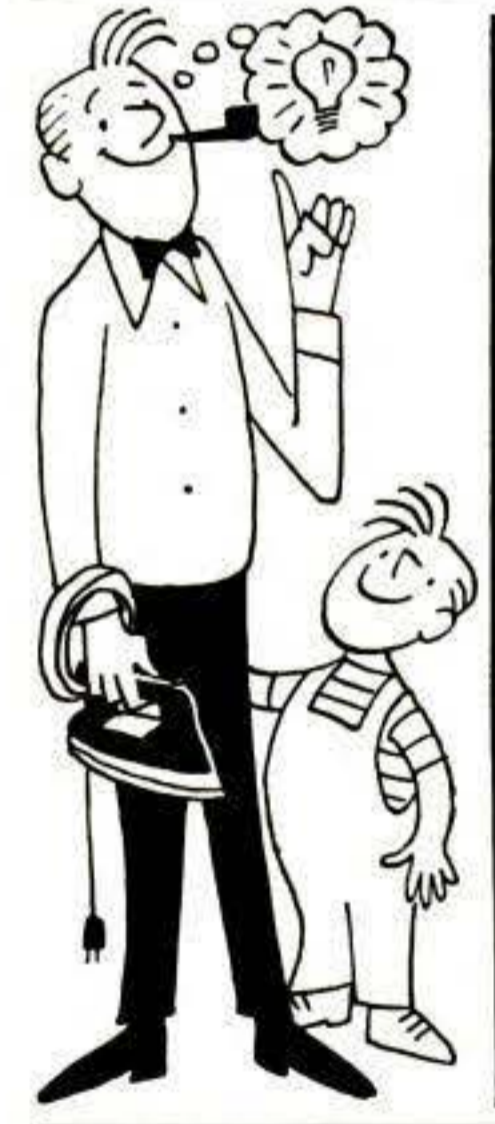
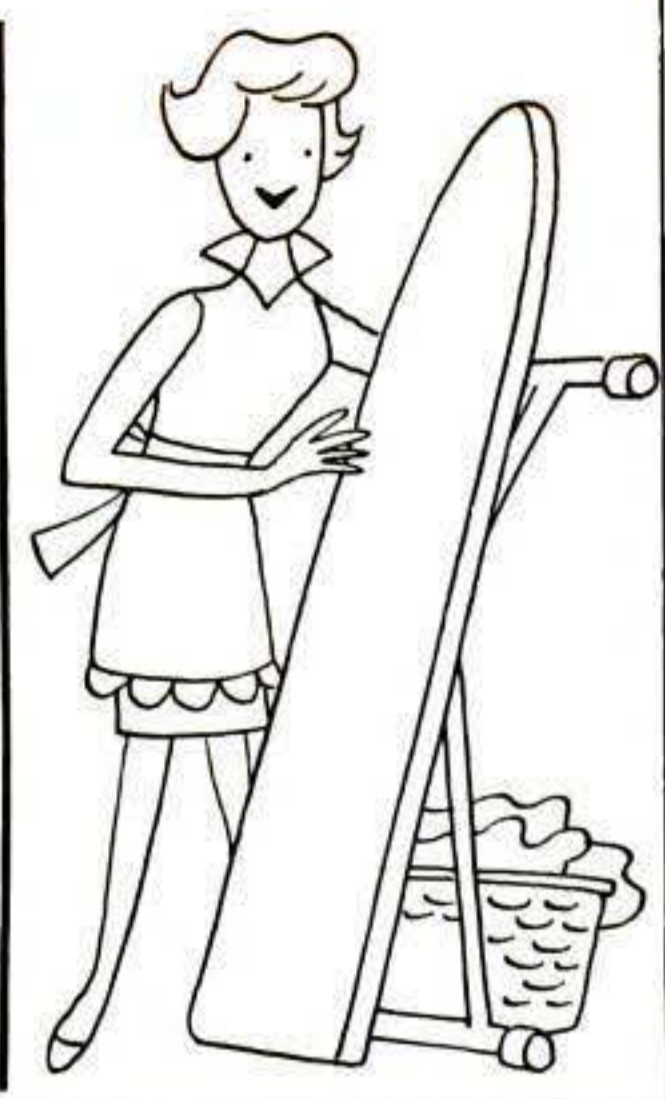
# cut your hedge down to size

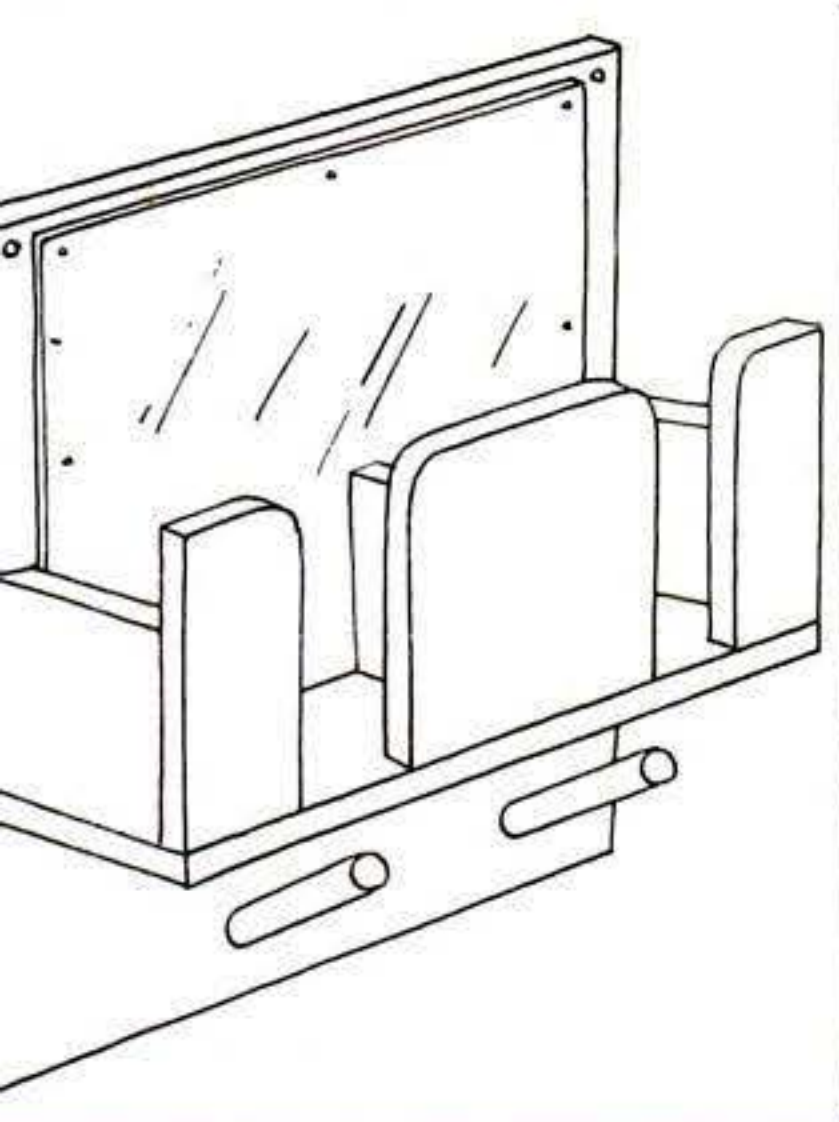
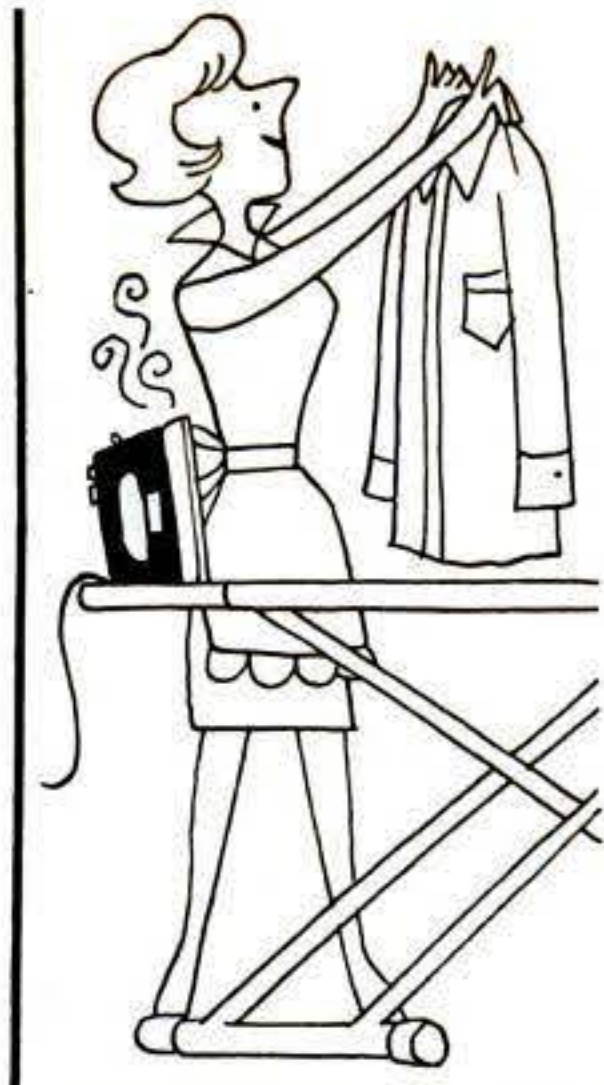
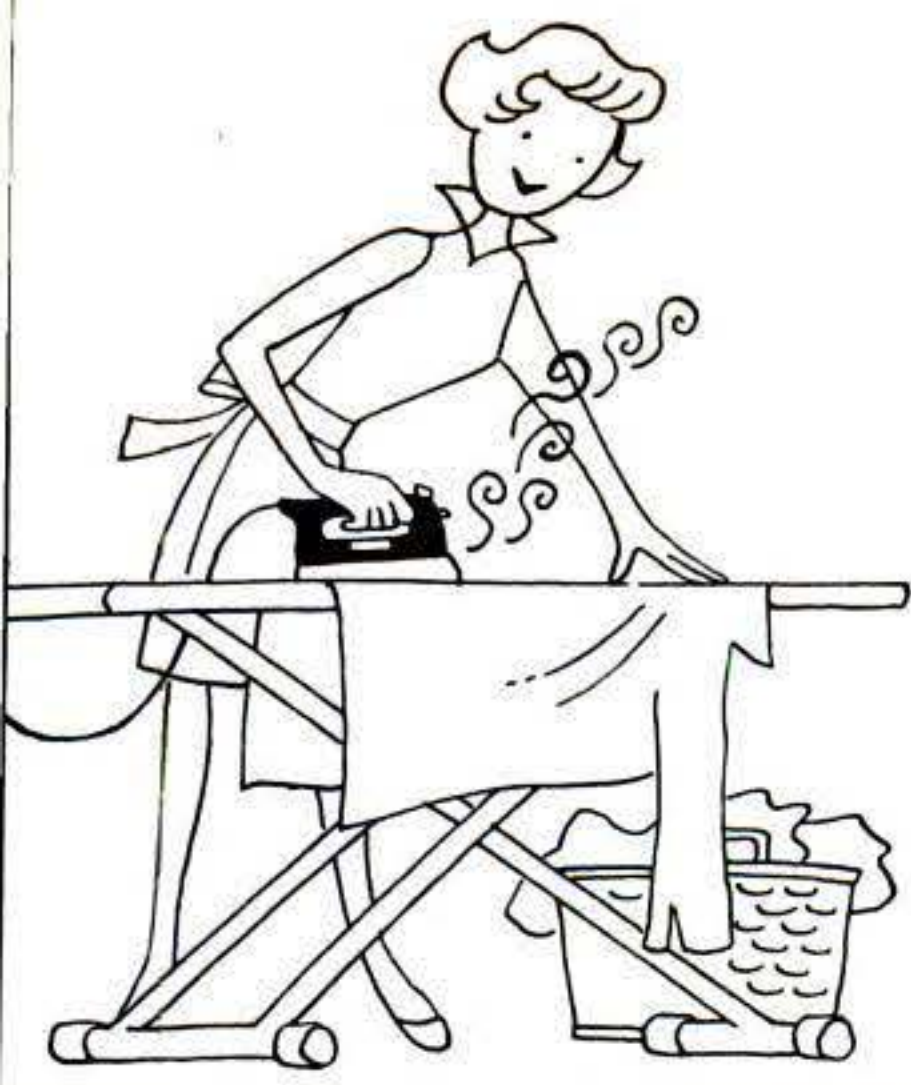
Keep hedges, shrubs, and bushes in trim with B & D's 16" Deluxe Double Edge Hedge Trimmer. Extra-long double-edge blade speeds work, while the wrap-around handle gives easy, accurate handling. Powered to also prune small branches, ornamentals, etc. 8120 \$29.99. Tough vinyl 50' extension cord U3327 \$8.99.

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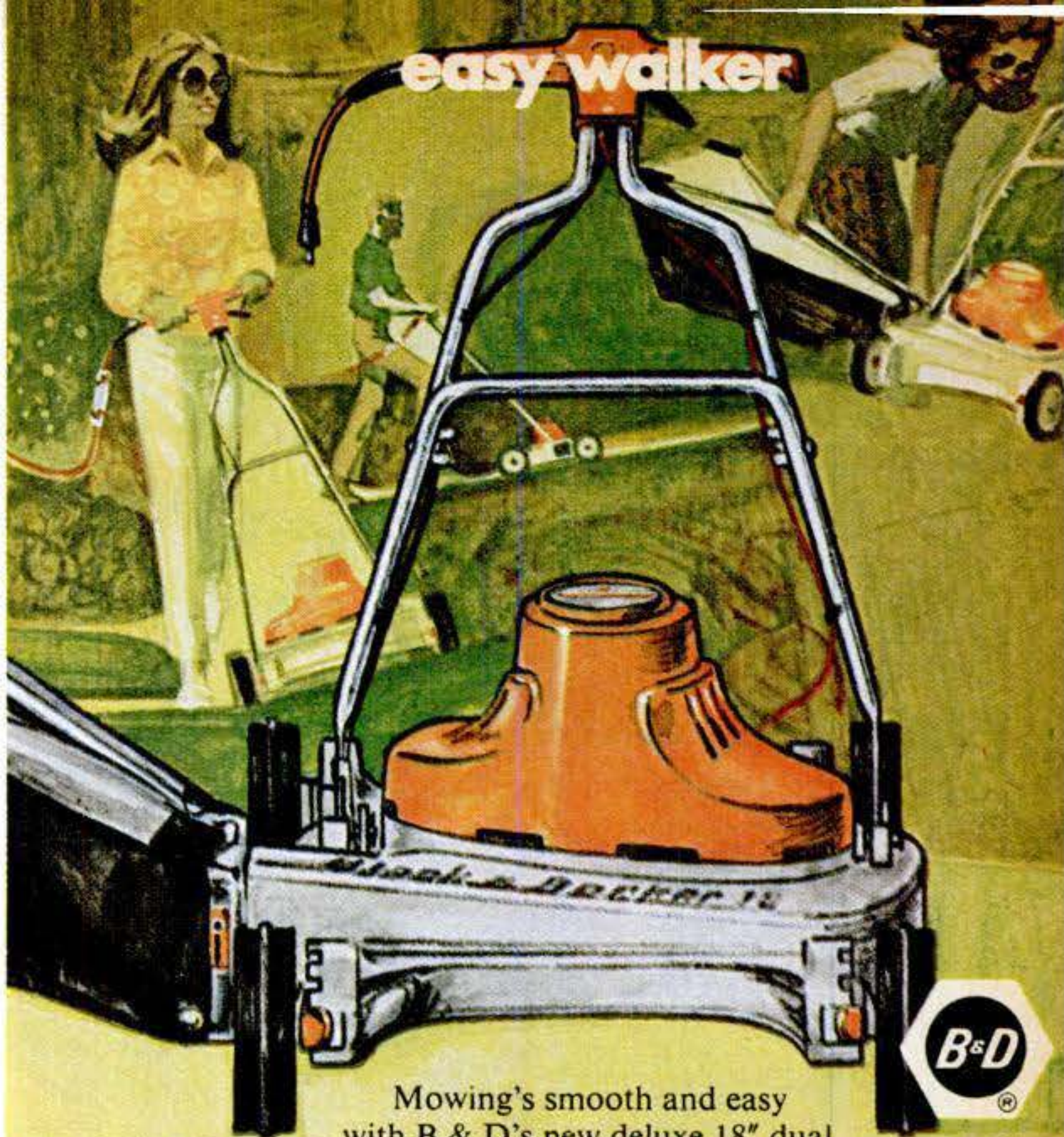
# Wordless Workshop

By ROY DOTY



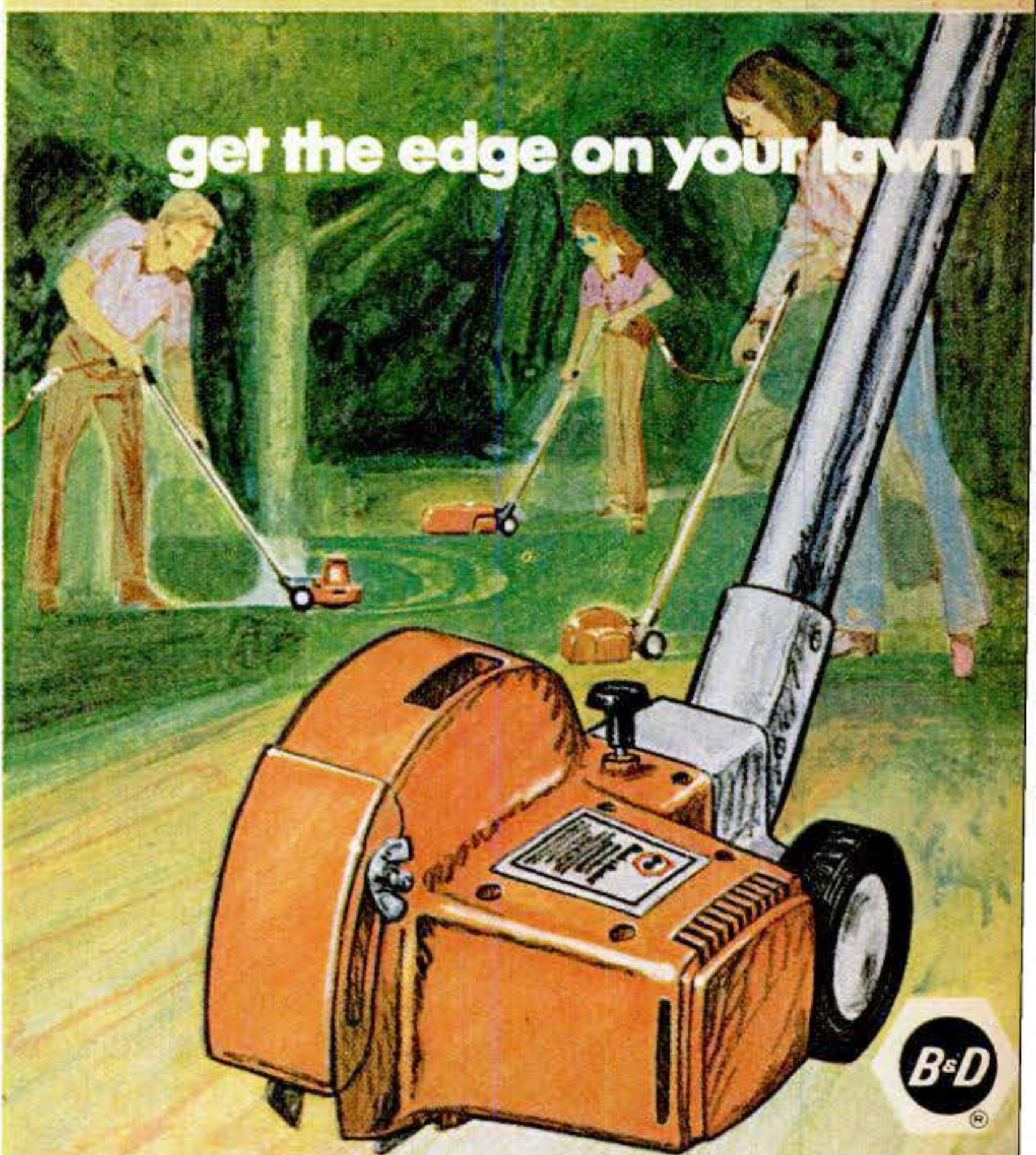


Doty



Mowing's smooth and easy with B & D's new deluxe 18" dual blade mower. Compact housing and clean running electric motor make light work. Flip-over handle ends turning mower around. Quick-adjust wheels. Includes easy-to-empty grass catcher. Double insulated for safety. #8021 \$89.99. High visibility orange 100' extension cord U3328 \$13.95.

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8220 \$34.99. Optional debris catcher helps eliminate cleanup. U3345 \$5.95.

**expect the best from Black & Decker**



## PS Tests Five Camping Trailers for Your Small Car

[Continued from page 97]



**Gremlin had no trouble** pulling Scotty at highway speeds, but the height and width of the trailer hurt driver vision to rear.



**Sprite trailer tongue**, hitched to Vega, stays level without equalizing hitch. This trailer also blocks driver vision to the rear.



**Apache Eagle, a low tent camper**, does not hinder vision through Pinto's rear-view mirror—a big driving advantage.



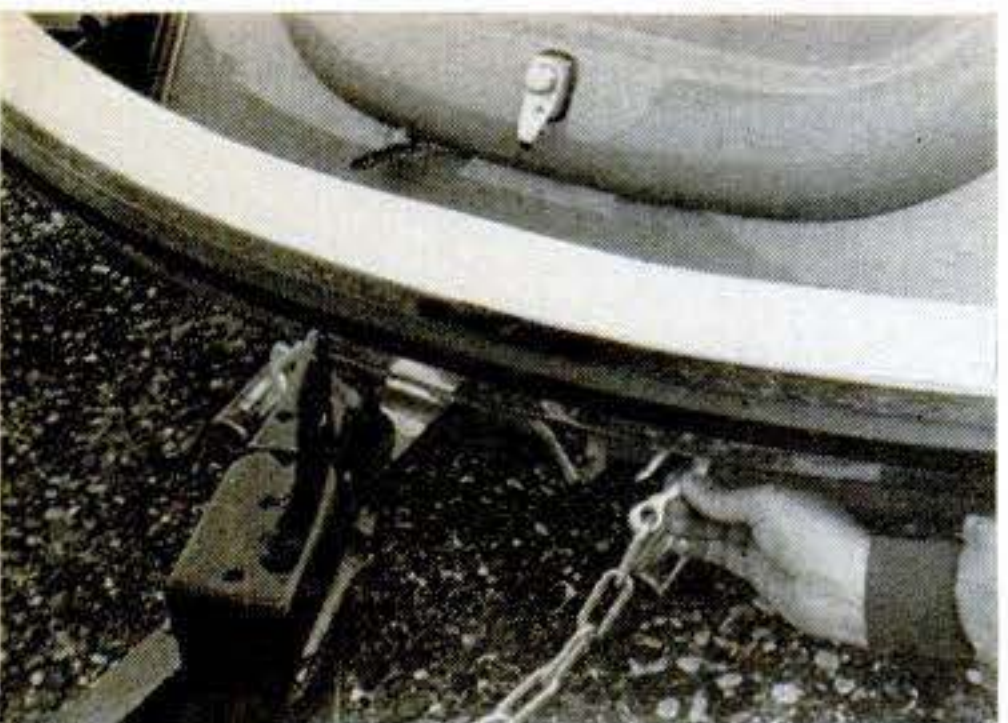
**Mastercraft Compact** was lowest of trailers we tested. Just 41 inches high, it's considerably lower than Super Beetle.



**Starcraft/Starlite** was biggest tent camper in group. Opened, it had most living area, but it was convenient to tow.



**Mini Camper** above was not tested by us, but fills bill as small camper for towing by a small car. Hitch weight is 35 pounds.



**Frame-mounted ball hitch** on VW was typical of hookup used to pull small trailers. Equalizing hitches were not recommended.



**Appleby's Sundowner II** is another camping trailer well suited to towing with mini-

cars. It weighs 440 pounds, is only 38 inches high when folded for towing.

### The campers—how they compare

	HEIGHT (in.)	WIDTH (in.)	LENGTH	WEIGHT (lbs.)	HITCH WEIGHT (lbs.)	PRICE
Mastercraft Compact .....	41	48	9 ft. 9 in.	600	45	\$719
Apache Eagle .....	47½	62	10 ft. 4 in.	710	35	795
Starcraft Starlite .....	54	83	12 ft. 4 in.	995	145	1,075
Sprite Mark III 400 .....	81¾	78¼	13 ft. 6 in.	1,064	100	1,595*
Scotty Sportsman 13 .....	83	76	13 ft.	975	210	975

\*As equipped — basic price \$1,295

to the hitch mounting. Our first results confirm that the bumper clamp-on hitch should not be used to tow camping trailers on the highway.

The PS team recommends that the heavy Starlite be purchased with optional braking, for use with small cars. And this advice should be followed when matching trailers of similar weight to any mini-car.

**Safe stopping.** The desirability of heavy trailers—about 1,000 pounds or more—having their own brakes is dramatically demonstrated in the Vega/Sprite results. The stopping distance with this trailer (with its own brakes) was about a foot more than for the Vega alone—although with slightly more pedal pressure.

**Handling.** As you might expect, our team found, during lane-change tests, that high-speed maneuverability diminishes as trailer size and weight increase. The cars pulling the lighter

trailers were only slightly slower going through this test than without trailers. The heavy trailers lost stability in severe maneuvers at high speed, displaying a tendency to lift the inside wheel and jackknife. Our team concluded that the rigs have limited evasive ability in an emergency situation.

Each trailer was tested in combination with only one car. The object of our test was not to make individual product comparisons, but to obtain general results from representative combinations. Wide differences in test results (see below) are easily accounted for by differences in trailer weights, and the presence or absence of trailer brakes.

The objective Norbye/Dunne tests bore out the subjective feelings of this writer and PS staffers Ray Hill and Doug Garr, who drove the rigs under a variety of street and superhighway

### The tests—what they show

	BRAKE TEST (with cool brakes)				LANE-CHANGE TEST	
	Distance w/o trailer	Distance with trailer	Pedal pressure w/o trailer	Pedal pressure with trailer	Max. average speed w/o trailer	Max. average speed with trailer
VW/Compact .....	.114 ft. 2 in.	161 ft.	100 lbs.	120 lbs.	58.2 mph	53.0 mph
Vega/Sprite .....	.135 ft. 9 in.	136 ft. 10 in.	130 lbs.	150 lbs.	60 mph	42.5 mph
Gremlin/Scotty .....	.108 ft. 2 in.	168 ft. 8 in.	80 lbs.	90-100 lbs.	60 mph	45.9 mph
Pinto/Starlite .....	.109 ft. 5 in.	200 ft. 3 in.	115 lbs.	150 lbs.	61.2 mph	43.6 mph
Colt/Eagle .....	.155 ft. 10 in.	195 ft.	120 lbs.	120 lbs.	60 mph	47.2 mph



## Small-Car Camping Trailers

[Continued]

conditions. Our rigs were stable when passed by big trucks or buses, and had fair to very good resistance to leeward sway. The very low Apache Eagle and Mastercraft units had the additional advantage of being lower than the tow cars, so headwinds were no problem with them. The larger trailers were more troublesome under windy conditions.

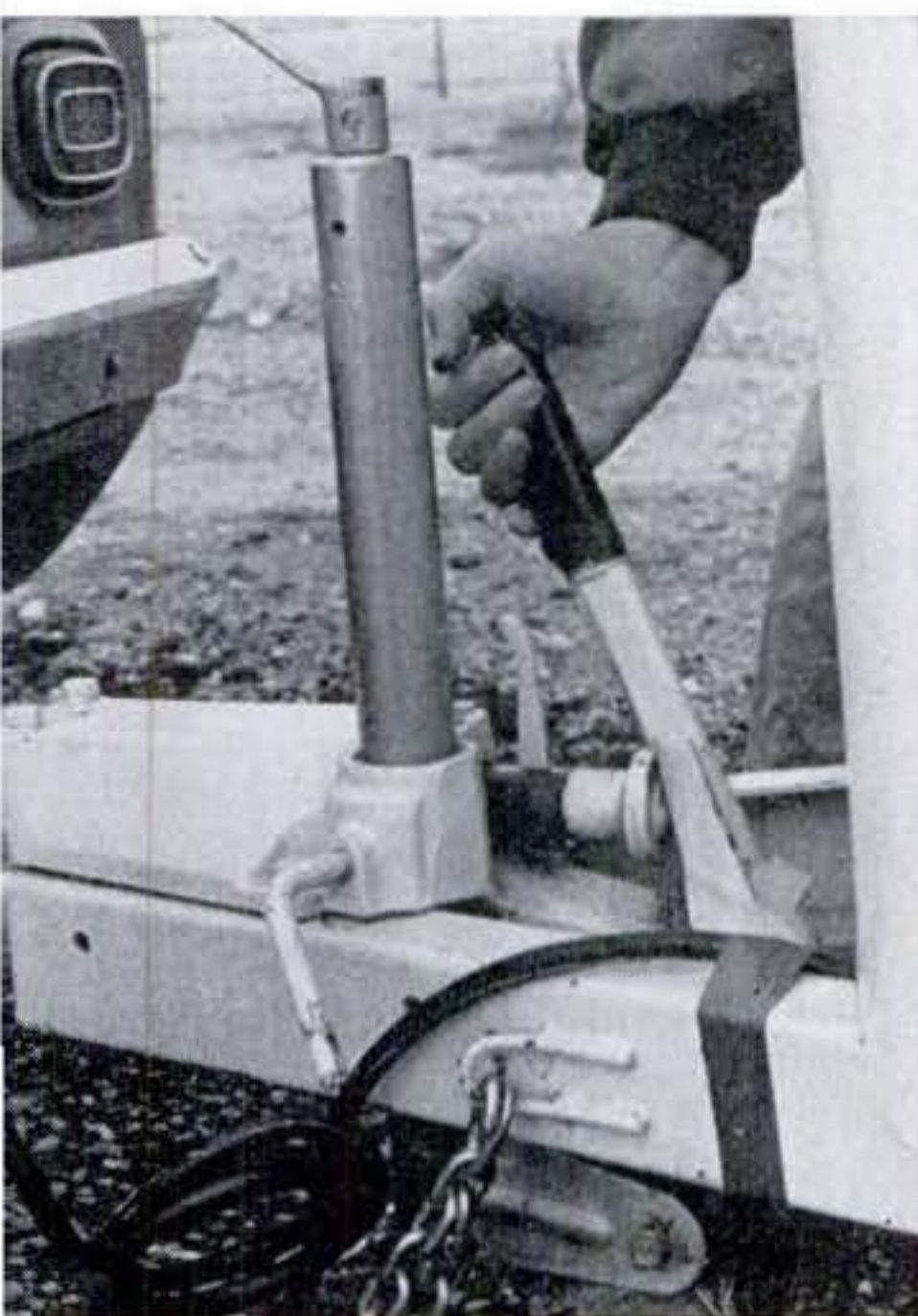
The tradeoffs are similar to those for selecting campers for standard-size cars. The more compact the camper, the easier it is to see the road behind you and the easier to tow.

**On the inside.** The comforts of the small campers are as impressive as their towability. All sleep four.

The smaller tent campers have simple interiors with simple furnishings: the Eagle offers only a dinette and no double bunks. The Compact has a two-burner stove, sink, and icebox. The Starlite, with its larger "box," has a somewhat larger living area than the other tent campers.

The travel trailers, with dinettes, bunks, and refrigerators, are more like tiny cabins, and give a greater feeling of permanence. And they can be equipped with heaters—while tent campers cannot. But a good portable heater can warm up a tent camper.

How practical are the small campers? You certainly won't get the "living room" comfort of huge, plush trailers. But if you're looking for an adequate portable shelter for a small family, they'll fill the bill nicely. And the fact that they can be towed with acceptable safety by a subcompact should make them welcome to outdoorsmen who think small. **25**



White mini travel trailer has a very effective brake package, plus a parking brake situated with lever, as shown above.



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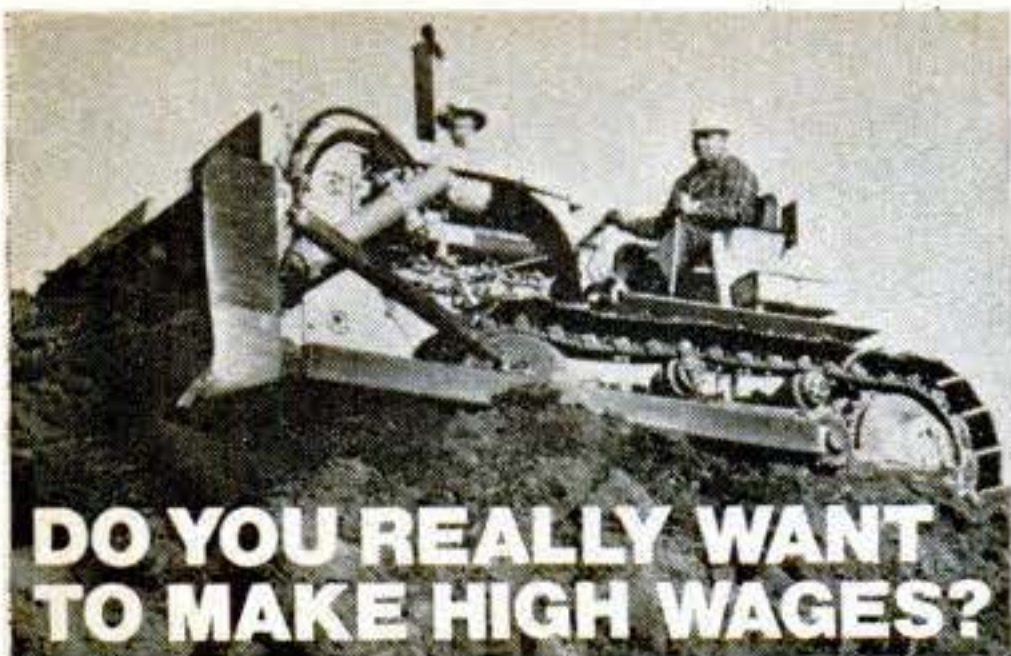
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# SHOP TALK

By ROBERT P. STEVENSON

## How to figure how much house paint you need

In a recent survey of do-it-yourself house painters conducted by Sapolin Paints, Inc., more than 80 percent admitted they were uncertain about how much to buy. So the old estimating rules bear repeating. Determine the square feet to be painted by multiplying the length of each wall by the height from the foundation to eaves. Deduct nothing for windows, doors, and gables. For a finish coat on a previously painted and well prepared surface, divide the total square footage by 500 (or the coverage figure given on the paint can). For the prime coat, divide by 400. Sash and frame of a window can be figured at about 35 sq. ft. Multiply this figure by the number of windows, divide the total by 550, and you'll have the approximate gallonage of trim paint to buy. Gutters and spouts? Just use the running length as your square-feet total.

## Tips on servicing butane lighters

When a butane lighter needs repairs, your best bet is to return it to the manufacturer. The Japan Trade Center sends word that it is willing to help if your lighter was made in Japan and you don't know the name of the maker. Get in touch with the Japan Trade Center, 437 Fifth Avenue, New York, N.Y. 10016. In refilling a lighter, use fuel produced by the same company that made the lighter, if at all possible.

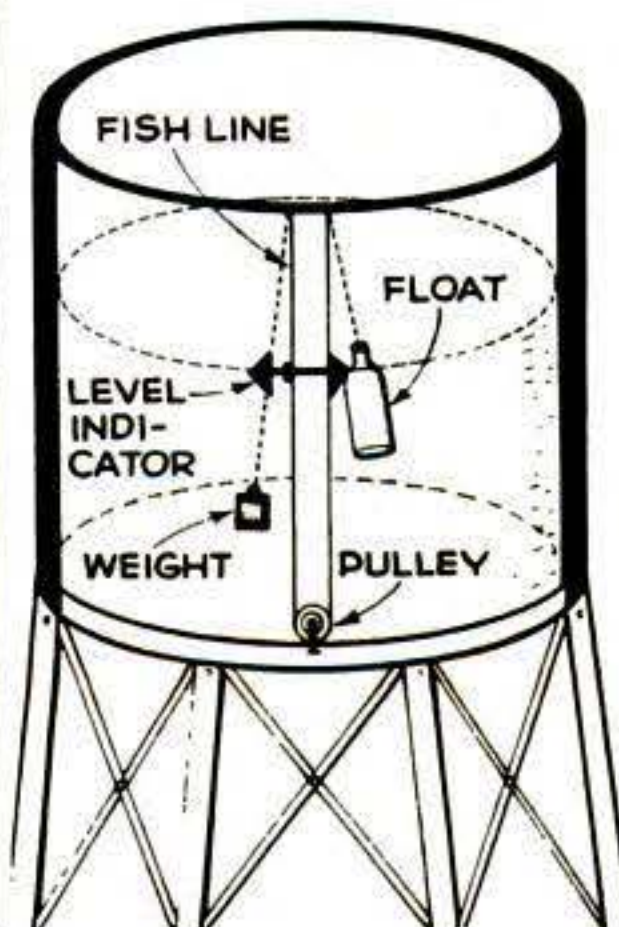
## Brief reports about various products

Do your plans include use of outdoor latex or alkyd paints? St. Joe Minerals Corp. urges that you buy those containing zinc oxide. In prolonged tests, the company found that exterior paints with zinc oxide have better tint retention, longer life, and reduced mildew . . . Edmund Scientific Co., Barrington, N.J. 08007, is offering an unusual adhesive—fish glue, for bonding wood, rubber, glass, paper, cork, felt, and metal. Made from the skin of codfish, it has had wide use in industry. One property: If it dries too soon, remoisten with water, and it has immediate tack. Two four-ounce squeeze bottles are priced at \$2 postpaid . . . Rohm and Haas is offering two new cements for use with its Plexiglas. Check them out wherever the plastic is sold . . . A color guide available at most Sears stores shows how to paint danger spots in your home.

## Where to find small mechanical parts

Mechanics, design engineers, hobbyists, experimenters, and others interested in the mechanical fields can find a wealth of good reading in a 516-page catalog I've just seen—*Stock Drive Products, a handbook of commercial drive components*. Specs are given for a great variety of hard-to-find small mechanical parts—gears, chain and belt drives, couplings, speed reducers, bearings, etc. A 171-page section gives tables and other information that enables you to make good use of the parts. The catalog costs \$1.49 (deductible with first order) from Stock Drive Products, 55 S. Denton Ave., New Hyde Park, N.Y. 11040.

## Good tricks you may want to remember



Perhaps you'll never need to keep track of the water level in an overhead storage tank. But some people do—like T. I. Topacro, who lives in Quezon City, in the Philippines. He does it as shown in the drawing. The floating bottle pulls the indicator up and down as the water level changes. Neat, huh? . . . Suppose your last soldering-gun tip burned through, all the stores were closed, your neighbor had no spare tips, and you just had to use the gun. Lane Sander, Yakima, Wash., sent me an emergency tip he bent up from a five-inch piece of 10-gauge wire. Worked fine, he says. Looks good, too. . . . Al Lindsley, our editor who lives in the cold regions of the upper Midwest, tells me a trick for starting a stubborn one-lunger in cold weather. Remove spark plug, heat it with a torch or in the flame of a gas range while holding with pliers, turn it back in quickly, and pull rope. For stubborn cases, have someone squirt an ether jet into the plug hole first. Fast teamwork will pay off.

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**Boating**

### Safety push stick

I found this easy-to-build push stick a lot safer than using my fingers on a jointer or circular saw. To make one, use a No. 5 plane handle and bolt, and a 3/4"-by-2"-by-8" piece of scrap hardwood. Cut a 3/8"-by-1 5/8"-by-8" rabbet and fit with a tapered dovetail heel. Drill a pilot hole small enough so that the bolt taps into the hardwood. A No. 9 bit will do the job. Glue the whole thing together with epoxy.

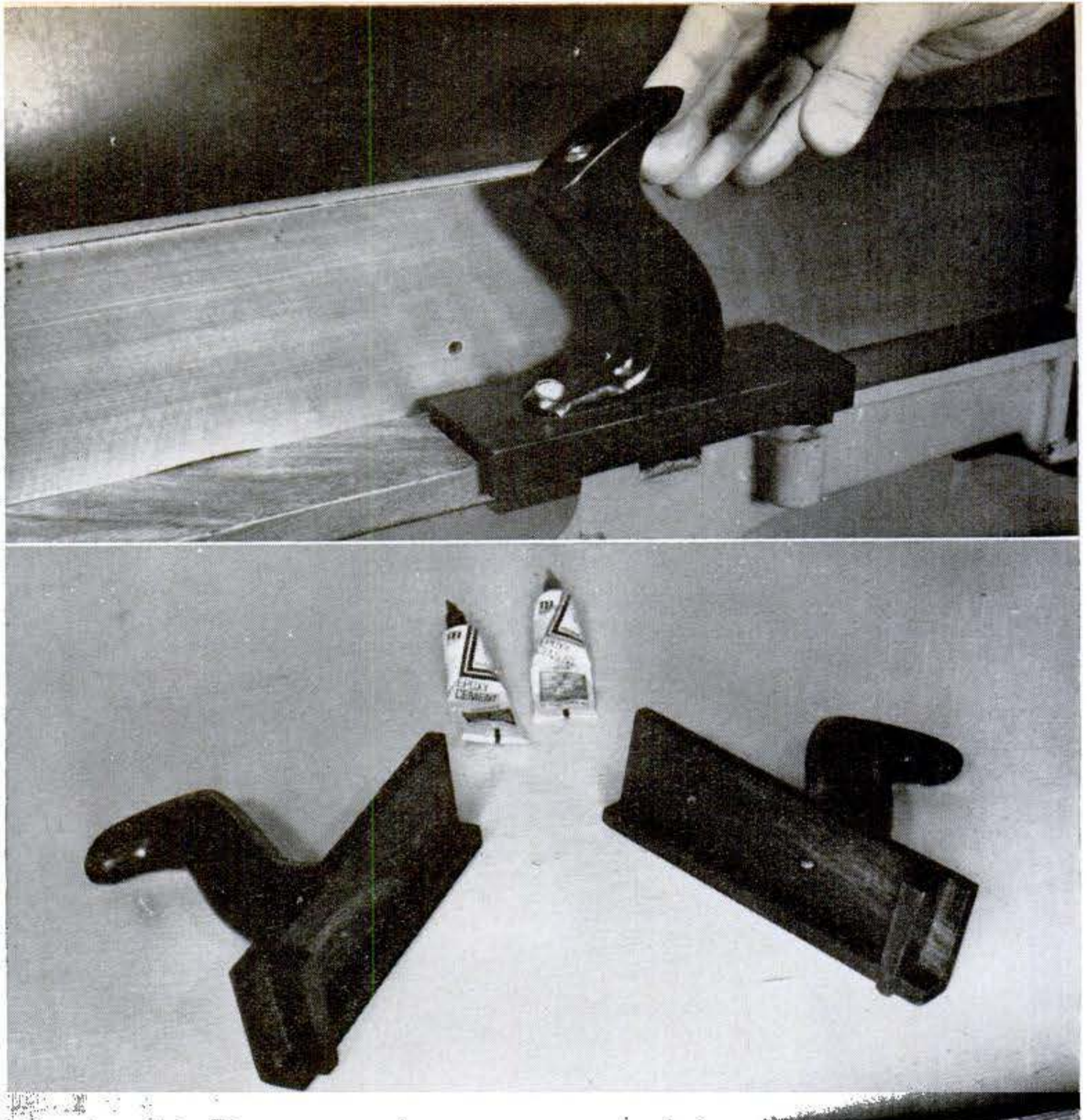
The finished handle distributes forward, sideward, and downward pressure evenly. The bottom photo shows two push sticks—constructed for left-handed and right-handed use.

DAVID WARREN, Crystal Lake, Ill.

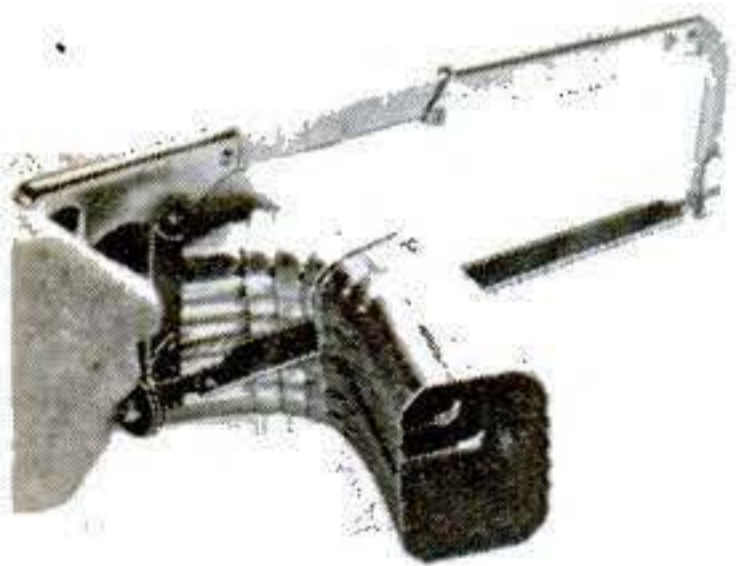
### Nonslip vise jaws

I used to have a problem when using pieces of angle iron to temporarily enlarge the surface area of my vise jaws: The irons would part company with the jaws. So I tried sandwiching a thin layer of modeling clay between the two. It keeps the irons firmly in place and leaves no mess to clean up.

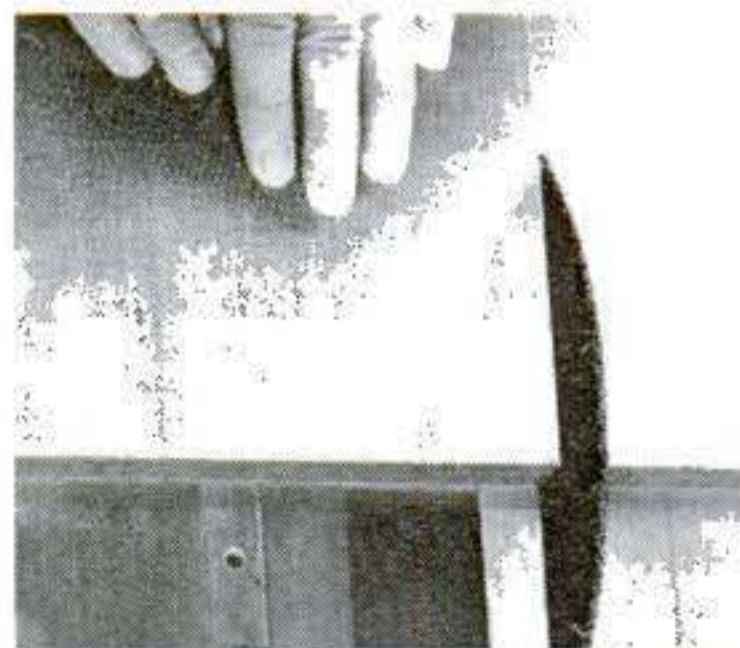
J. BALDWIN, Los Gatos, Calif.



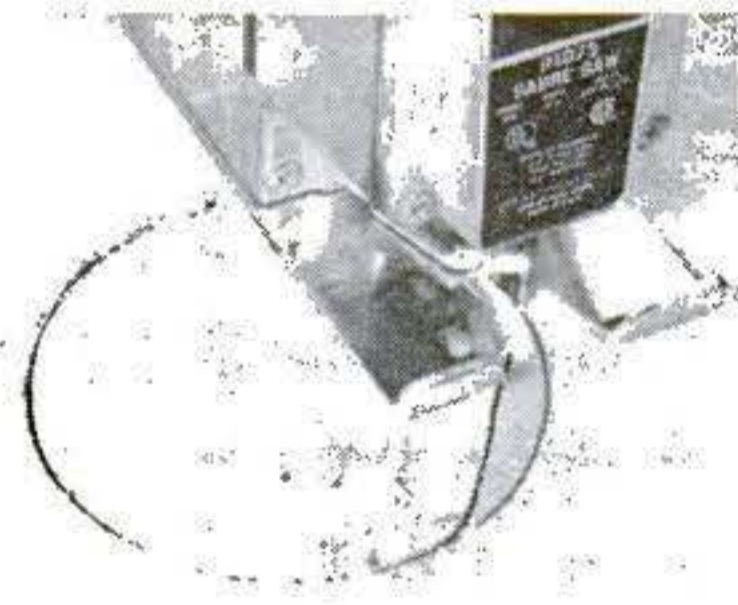
## Remington "Grit-Edge" Saw Blades Have No Teeth. They're Something Else!



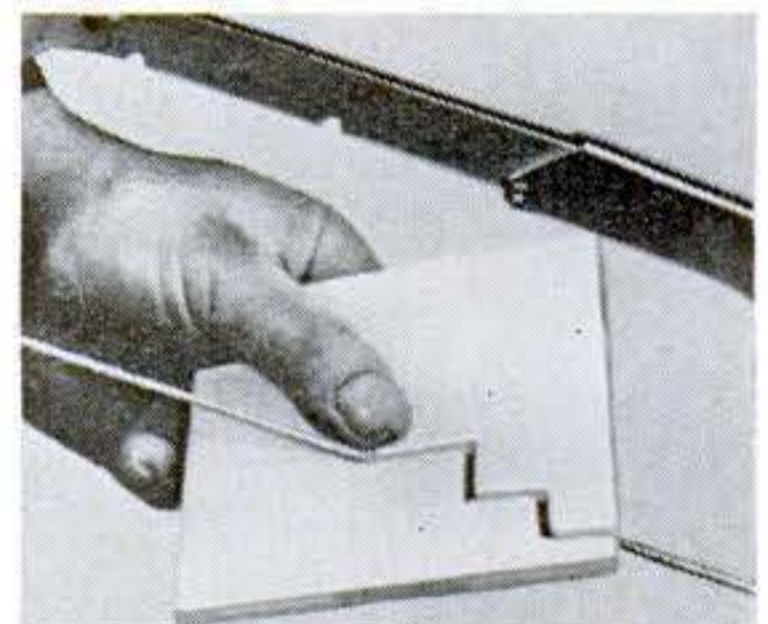
**Hacksaw Blade.** New! Virtually unbreakable. Makes thin, straight cuts. No need to protect the edge when you carry it in your toolbox.



**Circular Saw Blades.** New! No need to change blades when you change materials. Come in 6 1/2", 7", 8" and 10" diameters, to fit most saws.



**Saber Saw Blades.** Universal 1/4" shank saws, coarse grit for fast cuts, fine grit for smoother cuts. Make plunge cuts in tile, cut small circles. Also available in 4" and 6", 1/2" shank.



**Rod Saw.** Thin, round blade cuts in any direction. Ideal for contour cutting. Reversible for extended life. Ten-inch length fits standard hacksaws.



That's right, "GRIT-EDGE" blades have no ordinary saw teeth to snag, break or dull. Instead, an exclusive process permanently bonds tiny tungsten carbide particles to each blade. "GRIT-EDGE" blades are inherently safer than blades with conventional teeth. "GRIT-EDGE" blades cut almost everything, including things ordinary blades can't touch. They're designed to cut extremely hard or abrasive material. And they last up to ten times longer.

They can cut glass, cement-asbestos, tile, fiber glass and the hardest metals; make smoother cuts in veneers and laminates; help you do jobs you couldn't try before.

In fact, a low-cost "GRIT-EDGE" blade can do jobs that used to take expensive industrial cutting tools. See the "GRIT-EDGE" blades at your local hardware dealer's now.

**Remington® DU PONT**

"Remington" and "GRIT-EDGE" are trademarks of Remington Arms Company, Inc. The Du Pont oval is a trademark of E. I. du Pont de Nemours & Co. (Inc.). Made in U. S. A., U. S. Patent 3,023,490. Applications Pending.

## Sanding Secrets of a Pro

[Continued from page 115]

sorbers. Brush on stain and the burnished spots remain light. Unburnished areas turn darker.

Garnet, on the other hand, is self-sharpening. It won't become dull with use, won't cause burnishing and the accompanying finishing defects.

**Small light patches.** These glaring defects are caused by glue spots on the wood. This usually results from squeeze-outs during the assembly operation. If the stain is applied without first removing the dried glue film, the spots stand out objectionably because the stain will not penetrate the wood fibers beneath.

A small amount of food coloring added to the glue mixture will make the dried glue visible and guide your eyes when sanding. A color that closely matches the wood stain to be used will blend with the finish if you miss a spot in the final sanding.

**Cross-grain scratches.** You have to remove these. They soak up stain like a sponge and always appear several shades darker than the rest of your finish. Follow the first commandment of professional sanding: "Thou shalt not sand across the grain." It's a mistaken idea that the first sanding with coarse grits can, in the interest of fast

stock removal, cross the grain. A second and third sanding will seldom remove deep cross-grain cuts.

In the interest of preventing cross-grain sanding, I do not recommend using an orbital sander. This portable tool sands with an oval motion that leaves cross-grain oval cuts (often called "fisheyes") that are objectionably visible when finished.

A felt-padded sanding block is an indispensable tool for hand sanding. Make one by forming a wooden block 3" by 4" by 2" to fit the hand comfortably. To the 3"-by-4" face, glue 1/8" soft woven felt, using Elmer's glue or contact cement.

The felt provides a cushion for sandpaper, compensating for the minute grain-pattern variations as well as providing a traction surface to hold the paper firmly.

**White corners.** Fail to ease sharp corners before finishing and you'll probably produce this defect. When you sand the sealer over the stain coat you cut through the stain on sharp corners, leaving a line that's the color of raw wood. Remedy? Hand-sand all corners to a small radius with the felt padded block just before staining. Then when you sand the sealer

you will not cut through the stain.

**Muddy overall color.** Even a well-sanded project can turn muddy when stained. Unless you begin finishing soon after your final sanding you'll have this problem: Wood soaks up moisture from the air, and tiny wood fibers rise above the surface like whiskers. These whiskers soak up more than their share of stain. Covering the surface of your project like a blanket, they obscure the deep glow of the wood beneath—and the result is muddy color. So if you can't begin staining after your final hand sanding, go over the work with fine paper on your felt block just before you *do* start staining.

That's it. To sum up:

- Sand with the coarsest grit first, progressing to the finest in steps not exceeding two grit sizes.
- Stroke with the grain—always.
- Use a felt-padded block for clean-up and hand sanding.
- Stop often to check the work.
- Add dye to assembly glue to make it easy to detect and remove.
- After assembly and just prior to finishing, hand-block sand with 180 or 220 finishing paper to remove raised grain and sharp corners. **PS**

# A sweet swingin' low chariot for roamin' countrymen.

## Tri-Sport

Free-wheeling, three-wheeling Tri-Sport. Super fun; super safe. Optional ski makes you a snow goer. Five great Tri-Sport models; five low prices. Engines from 3 hp. to 12 hp. For a free full-color brochure telling the whole Tri-Sport story, write today to:

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## Motor Homes: Live It Up in Luxury—or Modestly

[Continued from page 101]



**Condor four-wheel-drive motor home** brings first rough-road capability to this class of RV. It's built on Ford chassis; Napco 4WD unit is installed by Ford.

built job can run you (are you ready?) up to \$250,000.

Winnebago makes about 45 percent of all motor homes, and they build them exclusively on Dodge chassis. In fact, Dodge chassis serve as the platform for most units, with Ford and Chevrolet following.

For the walls and ceilings of its bodies, Winnebago uses sandwich construction: outer aluminum skin, wood-paneling interior, foam in between.

But a number of Winnebago's competitors employ steel-cage framing to support walls and roofs. Some even have heavy-gauge-steel roll bars for added roll-over protection. Both Winnebago and its steel-using competitors claim superiority for their systems. But no one has done any roll-over testing of motor homes to determine whether either system offers greater protection.

While PS could not test the structural qualities, we were able to test the liveability and driving/handling qualities of several representative motor homes. Here are our reports:

**Ortner:** I drove two motor homes recently—a Kayot 2600 and a Winnebago D-18 Brave—selected for special reasons. The Kayot rolls on a new International chassis designed specifically for motor homes. The Winnebago is a new vehicle designed to sell at the price of a luxury car: \$6,795.

My wife and I, with my nephew, put 1,500 miles on the Kayot through the Midwest. The vehicle cruised stably and comfortably at 60-65 mph. Top speed, 73 mph, was less stable.

The Kayot handled very well indeed on the road, even though it's the size of a small bus; and all three of us drove it with confidence. Visibility is generally excellent. Maneuverability was surprisingly good—although there is little speed reserve

for passing on turnpikes. Gas mileage: 6.86 mpg.

Inside, the Kayot is luxury all the way. But details were sometimes disappointing: Noisy water pump. An almost impossibly awkward oil-filler tube. Switches for housekeeping functions scattered and in odd places. Poor-quality window locks.

The Winnebago D-18 took us on a pleasant tour of New England. At 18 feet (six feet shorter than the Kayot 2600), and with a 104-inch wheelbase, it is more maneuverable. The Dodge chassis and 212-hp engine gave us speeds comparable to the Kayot's, although, I thought, with less road stability. Our gas mileage was 7.3 mpg. The quality of the detailing and fittings was poor. Mattresses tended to come loose, window locks looked insecure, hardware was disappointing. Still, the D-18 offers tremendous value for the price.

**Dunne:** The Discoverer may well be worth its \$14,000-19,000 price, if you value fine styling, good aerodynamic characteristics, well-finished interiors, and uncommonly good directional stability on the highway.

I found all these extras in the Discoverer on a recent trip with my family through northern Michigan. I also found some design drawbacks.

The Discoverer 25 uses a standard Dodge truck chassis. Its directional stability is excellent. Speeds of 70-75 mph were common, and on secondary paved roads 65 mph is safe. The unit responds well to the steering wheel, does not lean excessively, and returns nimbly to the right lane.

The Discoverer's aerodynamic styling cuts down on wind resistance and improves fuel economy. I logged 7.6 mpg during normal use, which included extended periods of running the auxiliary generator. Rectrans offers a Chrysler 413-cu.-in. V8 in the 25, which has all the power you need.

Most impressive is the quiet ride. At 70 mph, the radio is easily heard, and at lower speeds the sound level approaches that of most sedans.

But what really sets the Discoverer apart from other motor homes is styling. The wedge-shaped front end, plus squared-off rear, stand out in the motor-home field—and are aerodynamically effective.

I found some drawbacks, too. Discoverer's brakes and acceleration were not up to the sedan standards you might expect in large units of this type. Zero-to-60-mph times were around 18 seconds, which is better than some small import cars.

But stopping distances from 60 mph after a series of severe warm-up

stops were over 260 feet, well beyond the maximum of any passenger car similarly tested. This is traceable to the fade characteristics of brakes on the Dodge chassis—something to remember particularly in hilly country. When cold, the brakes showed no fade, and stopping distances were closer to those of passenger cars.

**Davis:** I drove one of the most interesting new RVs—the Condor II four-wheel-drive motor home, which brings rough-road capability to camping rigs. A 25-footer, it's built on a Ford M-500-series truck chassis, powered by a 390-cu.-in. V8, with three-speed automatic transmission.

The four-wheel-drive units are made by Napco. To transfer into, or out of, 4WD, you just hit one of the dash-mounted solenoid switches. Although set up for off-road driving, the Condor II is a smooth rider. Even slamming through a gully isn't what you'd expect. Chances are you'd spill a few drops of coffee.

And home comforts abound, from complete kitchen to complete bathroom to complete climate control. Add that to good driving control and great visibility—and you have a brand-new way to travel off the beaten path. PS

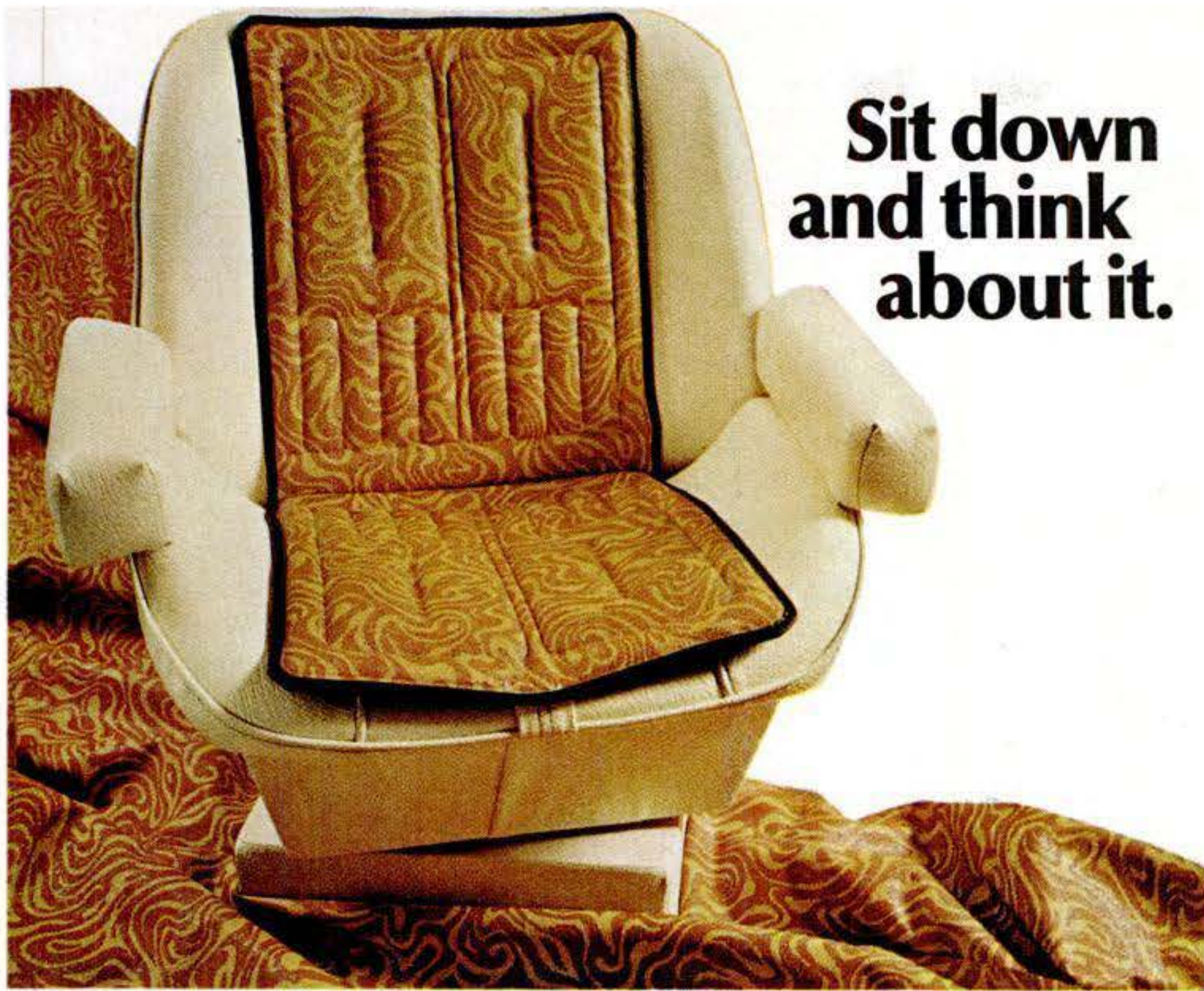
### Most beautiful camper on the road



That's how many persons have described our bubble-top camper, with redwood-siding walls. The Tourineer camper grew out of a practical need. An architect designed it after failing to find what he wanted among campers he could buy. The first plans were for the Ford Ranchero only. Now they have been adapted to suit about any vehicle on the road. Tourineer builders are a proud breed, and some of them are already talking about a nationwide rally. The plans include mail-order sources for parts you'll probably want to buy. Each set of plans is \$14.95. When ordering, be sure to choose the set that suits the vehicle you own. Send check or money order to Popular Science Plans Div., 355 Lexington Ave., New York, N.Y. 10017.

- Ranchero, from 1968 to '72: Plan 5508
- El Camino, from 1969 to '72: Plan 5535
- Sprite, for 1971 and '72: Plan 5536
- Half-ton Pickups (Dodge, Ford, Chevy), 1968 on: Plan 5537

# All boats are not created equal.



**Sit down  
and think  
about it.**

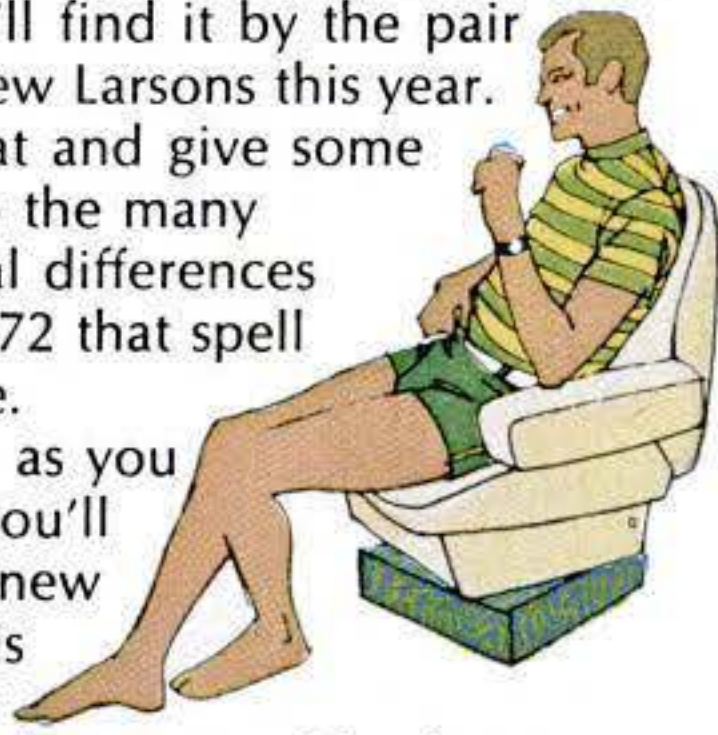
Your Larson dealer has this superb seat waiting for you on his showroom floor. You'll find it by the pair in many new Larsons this year. Have a seat and give some thought to the many exceptional differences in Larson '72 that spell extra value.

As soon as you sit down you'll know this new boat seat is unlike any

other. The bottom and back are contoured and cushioned to fit yours.

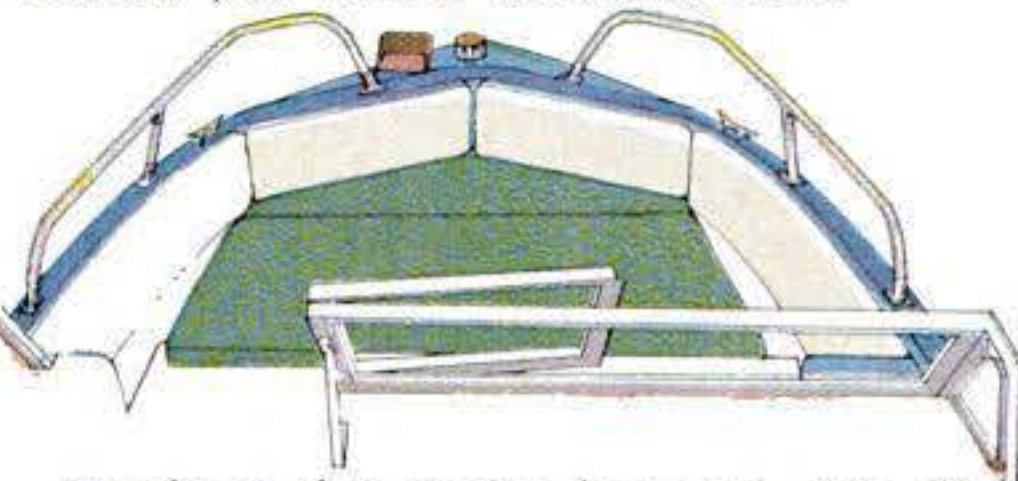
And when you lift the levers under the arms, the back reclines. Your mate can swing around to talk comfortably with you

while facing the stern. You can swing toward her. Yet you're still within comfortable reach of the wheel and all other controls.



The 18 ft. Shark Stern Drive model has a wrap-around control panel. And every '72 Larson has padded dash and padded coaming.

Reach up now to the top of the windshield frame and pull yourself up. Sturdy, isn't it. If you've tried that on others, you'll feel the difference.



Look at the space forward. It's all flat and cushioned. You can stretch

out in any direction. Or you can stow one section of cushions to convert the forward area to conventional seating. And there's a well for stowage or ice under the middle cushion. The new left side walk-thru makes it easy to get to the forward deck without disturbing the driver.

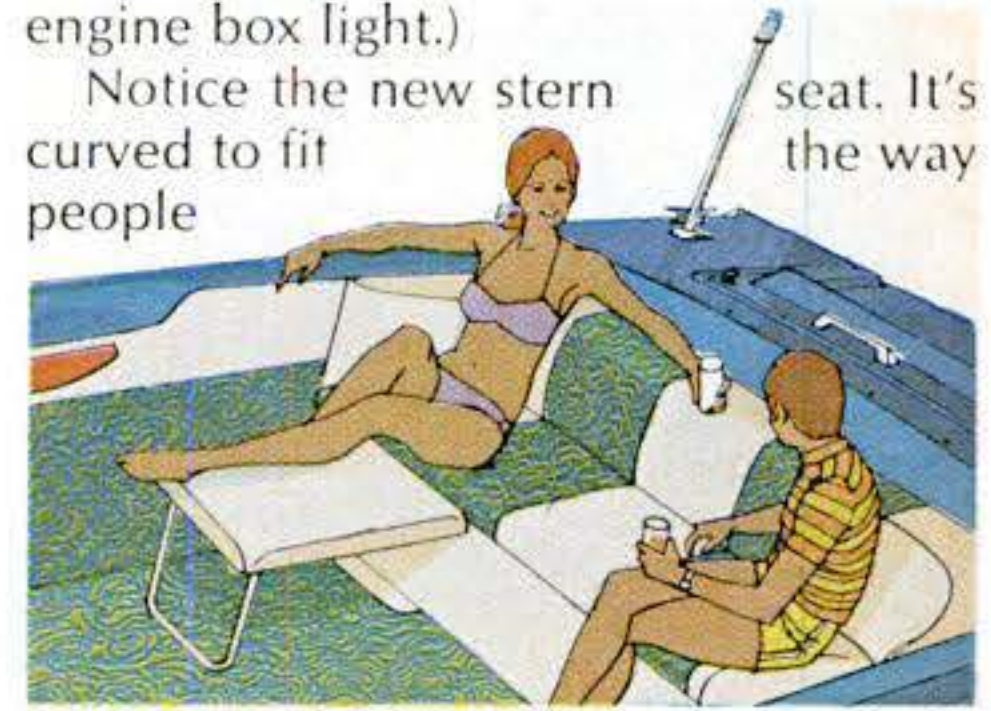
There's even a locking beverage bar to hold glasses and bottles secure.



We've thought of some other simple things, too. Like molding non-skid step areas on gunwales, and at the bow on Shark models.

And a very functional but unobtrusive bow light that has the big advantage of providing more step area for beach boarding. (Speaking of lights, every '72 Larson has an interior courtesy light; all Stern Drives have an engine box light.)

Notice the new stern seat. It's curved to fit the way people



like to sit. By the way, the tables double as footrests for forward or stern seats. They stow neatly on the side panels when they're not in use.

There are many more innovations your Larson dealer would like to show you. All in the category of "value added by engineering for people."

During Larson's 58 years of boat-building, more people have bought Larson than any other brand of runabout. This year's innovations add to the value that's been so traditional.

Larson's differences make boating more fun and give you more value for your boating dollar. Your Larson dealer hopes you'll make your own comparison.



**All American Boats for '72**

Larson Boat Division, Larson Industries, Inc., Little Falls, Minnesota 56345







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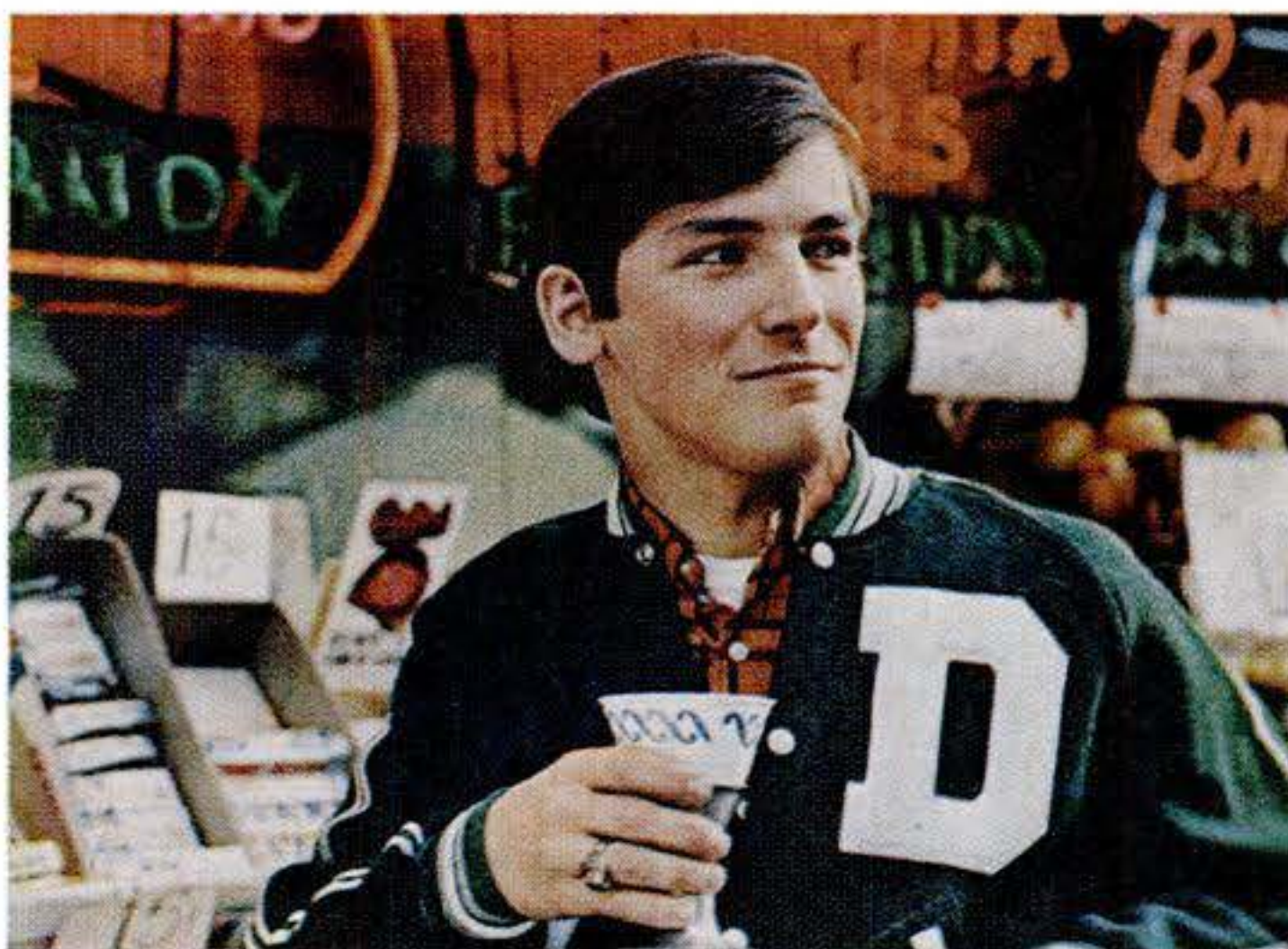
You normally attend weekend meetings once a month at local Reserve headquarters. And you go to camp for two weeks each summer.

The Reserve pays you for this. The Reserve pays in other ways, too.

For instance, we'll pay your way through one of our schools so you can learn one of 300 job skills, depending upon the specific skill requirements of your local unit.

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Tell me more about how the  
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PS 3-72

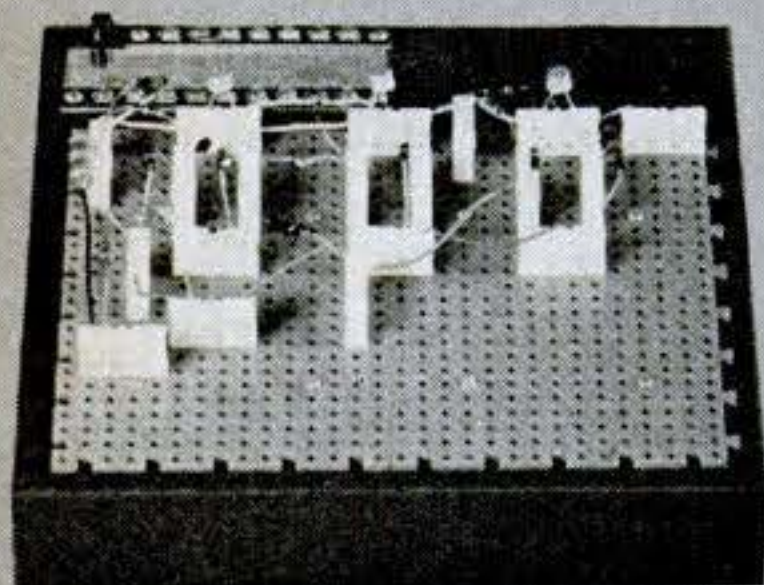
**The Army Reserve.  
It pays to go to meetings.**

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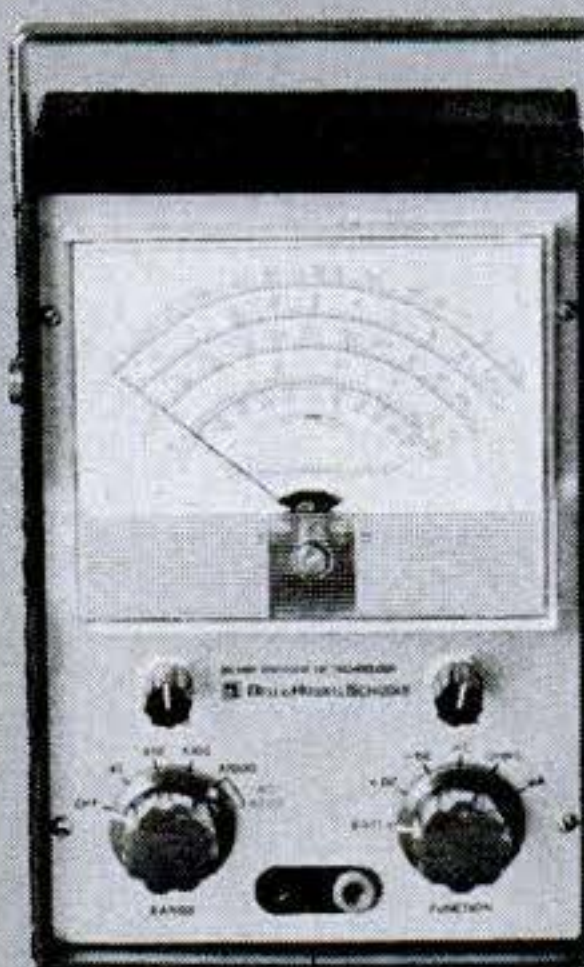
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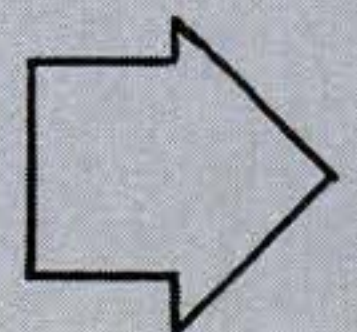


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**INCLUDES—**  
Transistorized Meter . . . a multimeter for current, voltage and resistance measurements registered on a large, easily-read dial.

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As you follow the simple, step-by-step assembly procedures, you become thoroughly familiar with the most advanced solid-state TV circuitry. And as you build this kit you'll prepare yourself for a profitable Color TV service business of your own—either full or part time.

## Why Color TV pays better.

Today, Color TV is the big seller. As Color Television goes completely solid-state, the man who has mastered this type of circuitry will be in demand. Obviously, this is where the money is going to be made.

This new Bell & Howell Schools program will also give you an in-depth knowledge of the basics as well as TV circuit theory and analysis. You'll get the theory and practical experience you need to handle radios, hi-fis, stereos, and tape recorders.

You will also receive three precision quality instrument kits which you assemble and keep. These are highly sensitive professional instruments which you'll use constantly.

**EXCLUSIVE ELECTRO-LAB®  
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This unique at-home laboratory comes to you in 16 shipments and includes a remarkably instructive *design console*. You can rapidly "breadboard" a great variety of circuits without soldering. The *Oscilloscope* offers 3-way jacks to handle test leads, wires, plugs. Images on screen are bright, sharp. Your *Transistorized Meter* is fully portable, features a sensitive, 4-inch, jewel-bearing d'Arsonval meter movement. It's a multimeter for current, voltage and resistance measurements.

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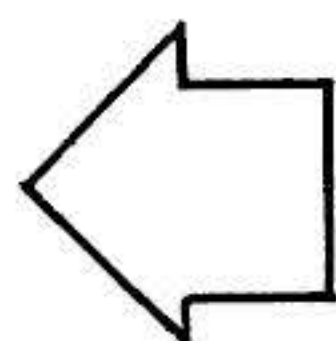


ONE OF THE

**BELL & HOWELL SCHOOLS**

(TV kit is not available in Canada)

321



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## Get Your Camper Ready for Summer Fun

[Continued from page 106]

their complete unit covered in the general list following:

### General RV checklist

**Exterior:** Inspect roof coating around flashings, vents, and seams for cracks and splits that can cause leaks. Renew coating where necessary.

Paint frame, undercarriage, and entrance steps to avoid rust. Use caulking gun to stop leaks around doors and windows. Repair torn screens.

**Running gear:** Repack wheel bearings every 5,000 miles for travel trailers, every 2,000 for tent trailers. Replace questionable grease seals. Don't overpack. Inspect wheels, tires, and brakes. Replace wheels if lug holes are worn, or if split from overloading. Replace worn brake linings.

**LP gas system:** Snug connections, check for leaks in gas lines with soapy water. Adjust air vent on range if flame is yellow (it should turn blue).

**Plumbing system:** Empty holding tank, then close shutoff valve to clean. Pour a gallon of water and two ounces of tank cleaner through toilet. Let it stand for one to three hours; then drain. For recirculating toilets, use three or four gallons of water with two ounces of cleaner per gallon. Use

the same solution to clean holding tank. Check slide valve for smooth operation and leaks. Pour water through sinks to make sure traps are clear.

**Water system:** Make sure fill cap is airtight. Replace cap if gauge shows no pressure. Clear supply tank with a half pound of baking soda in water. Let stand 24 hours, and drain.

**Hot-water heater:** Close drain valve and fill tank by opening hot-water faucet inside RV as supply tank is being filled. Light and heat to temperature to be sure valves don't leak. Replace faulty washers.

**Electrical system:** Replace power cord if cracked or clogged. Use only three-wire extension cords. Replace blown fuses and burned-out bulbs. Check turn signals, stoplights, clearance lights.

**Engine area:** Perform all normal maintenance on radiator and battery. Be sure engine is properly tuned and oil and filter changed.

### Travel-trailer checklist

**Hitch:** Elevate tow vehicle and inspect hitch attachment. Tighten all bolts, check for cracked welds. Paint platform to impede rust. Check coupler jack and safety chains.

**Breakaway switch:** If switch assembly uses a self-contained battery, replace it each season. Pull pin, then try to pull trailer to see if brakes work. Be sure coupler-pin lock is equipped with padlock. If equalizer bars bend excessively when hitching up, check rating to be sure bar capacity is matched to tongue load. Check antisway device.

**Safety skids:** Check for rust. If trailer doesn't have skids, install them. They're invaluable if a tire fails.

### Tent-trailer checklist

**Lift mechanism:** Clean tracks by brushing or with an air hose. Paste wax makes sliding easier.

**Canvas:** Repair tears with patches or a chemical sealant. Repair screens.

### Pickup-camper checklist

**Jacks or camper lifts:** Check brackets that mount jacks to camper for tightness, jacks for smooth operation.

**Cab-to-cowl shock absorbers:** Check mounting brackets at both camper and truck cowl. Usual wear is on cowl. If necessary, relocate brackets to side of cowl.

**Hold-downs:** If stake-pocket hold-downs are used, inspect for visible sign of twisting. Replace rusted chains or turnbuckles. P 5

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**EXTRA MONEY BUSINESS**  
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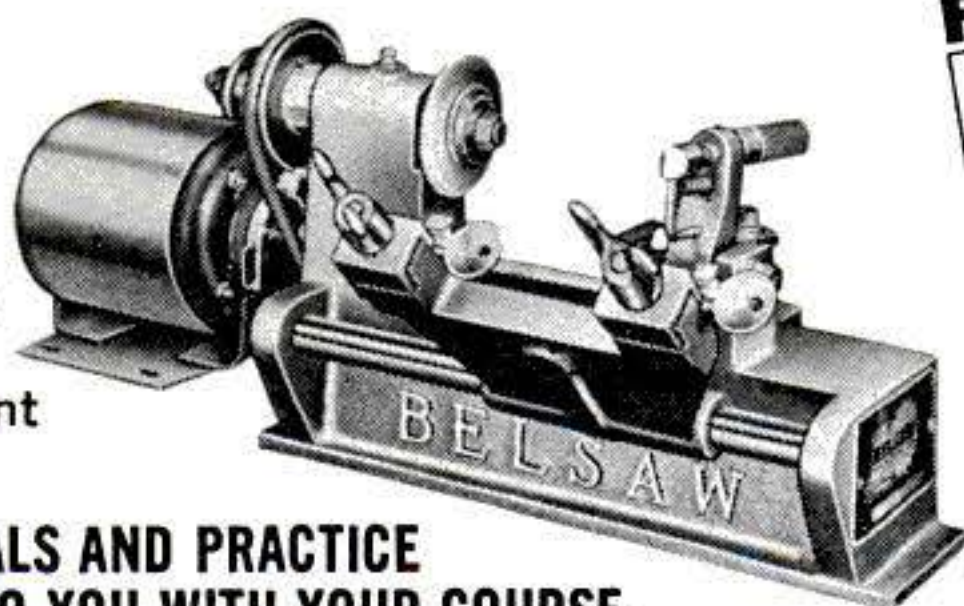
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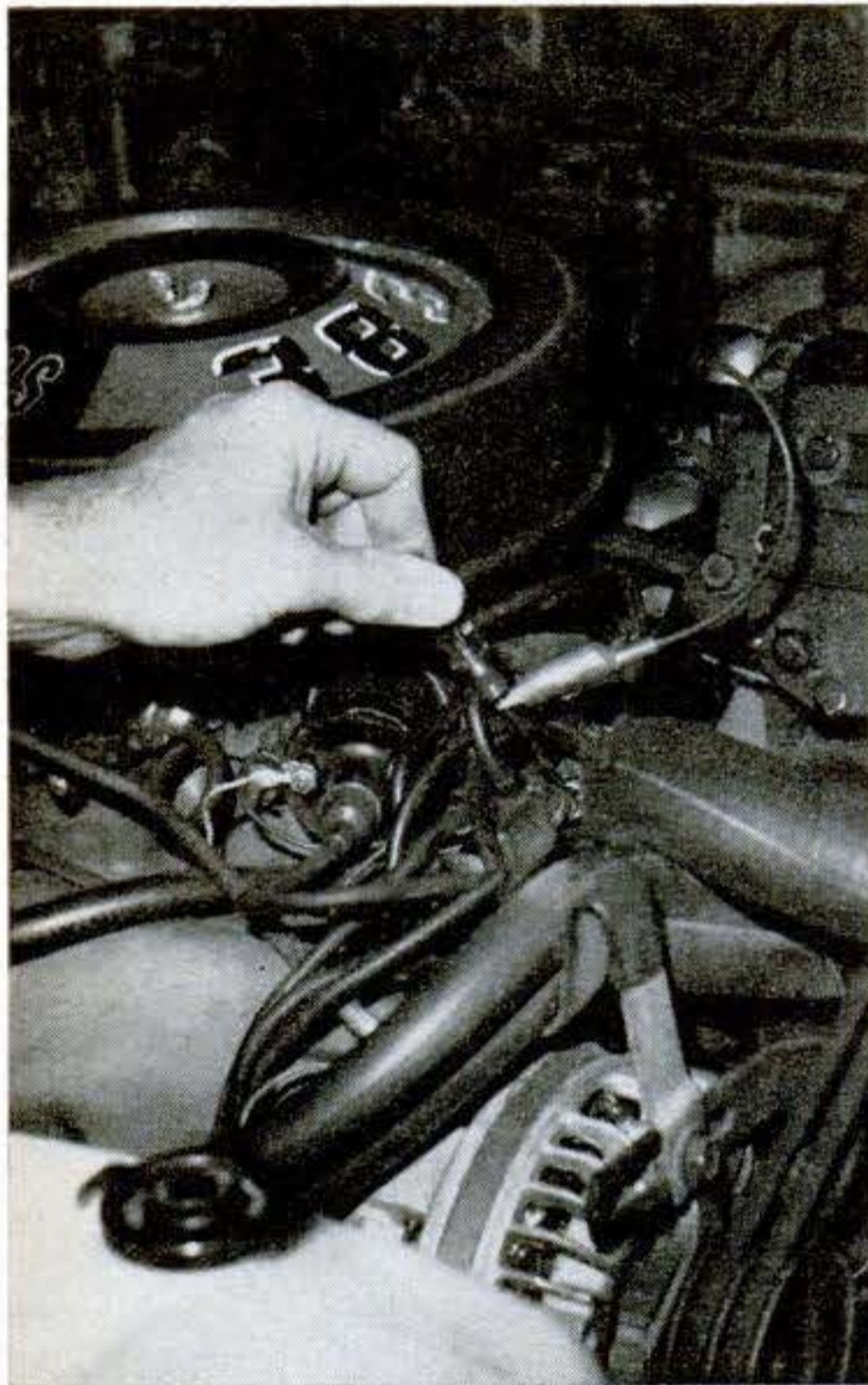
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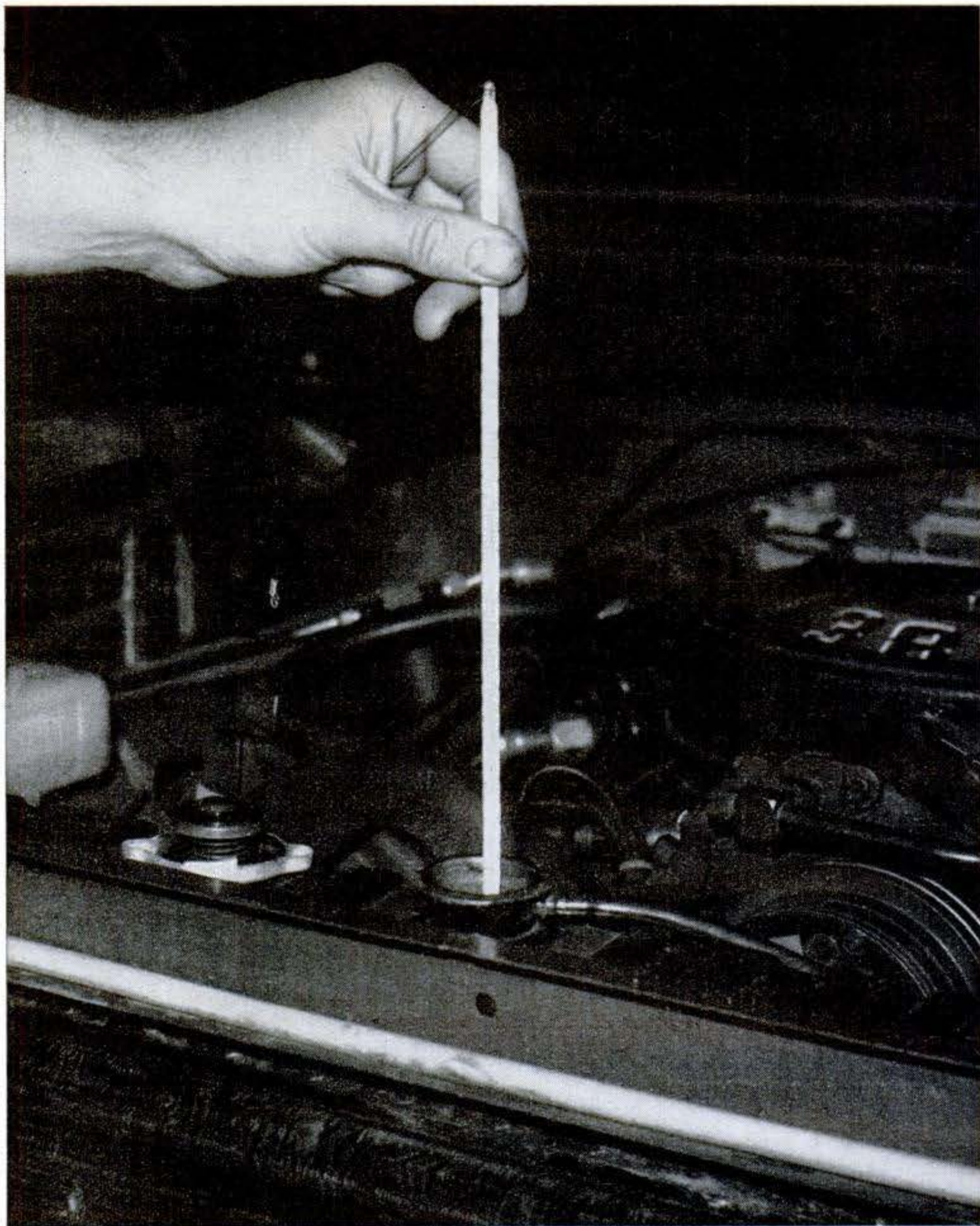
# Taking Care of Your Car

## Good hints others have used

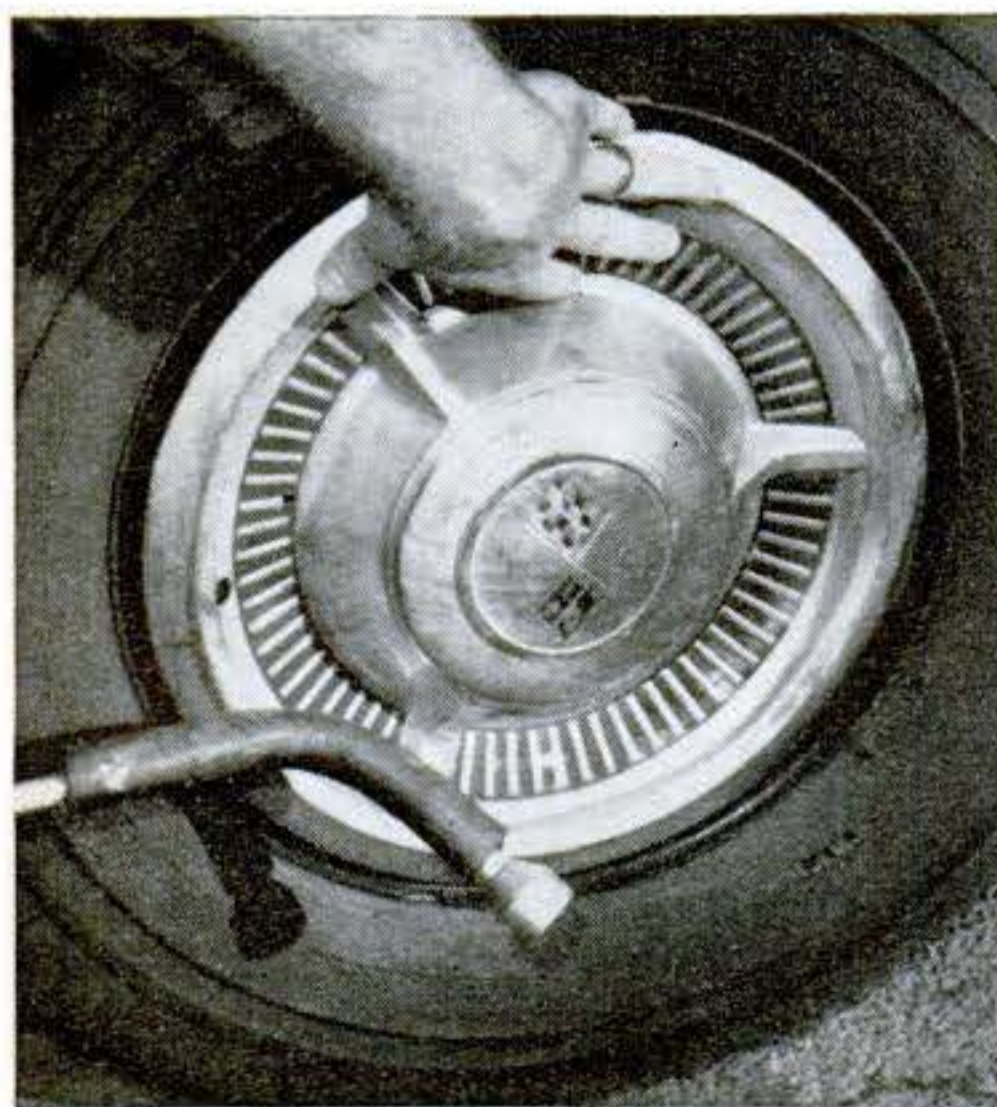
Got a car tip? We pay \$25 for each one accepted. Send it to Car Care, Popular Science, 355 Lexington Ave., New York, N.Y. 10017. None are returnable.



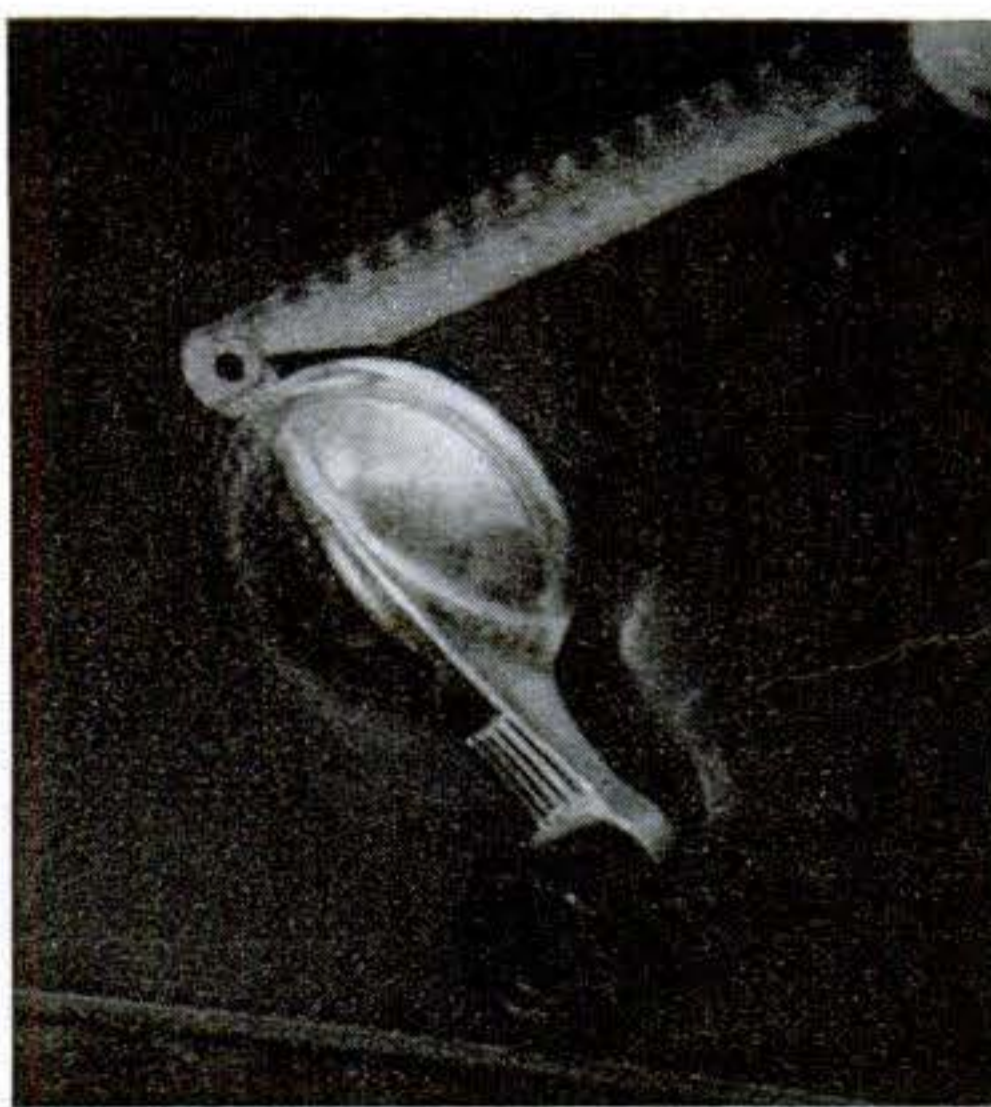
**Shorting out cylinders** on an engine with an exhaust-recirculation system is not a reliable diagnostic procedure—because the unburned mixture is recirculated to other cylinders. The engine may speed up, slow down, or not change speed at all.



**Here's an easy way to check your radiator thermostat:** With the engine at operating temperature, fill the radiator to 1¼" below the filler neck. Let the engine idle and insert a good thermometer in the radiator so that the bulb will sense the temperature of the coolant coming from below the baffle in the top tank. If the coolant stabilizes at no lower than approximately eight degrees below the thermostat's rated opening temperature, the thermostat is satisfactory, and doesn't need replacing.



**Tap wheel covers back on** with a lug wrench? Sure. First, slip a piece of heater hose over the end of the wrench. Then you can pound that old wheel cover solidly back in place, without fear of adding any unsightly dents or scratches.



**Removing a door handle's spring clip** can be difficult if you don't use the proper tools. A cheap tool can be made quickly by filing a notch in the end of an old hacksaw blade. The notched blade will easily slip behind the handle and pull the clip off.



**Noisy speedometer cable** and jerky speed needle? Here's a fix. Remove the cable and coil it in a small jar. Spray it thoroughly with silicone, and reinstall. Now the cable will be quiet, and the speedometer needle will stay steady.

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## Laser Weapons—How Close

*[Continued from page 66]*

and weapon are motionless on quiet days. And the new high-powered lasers have shot down the old notion that it would never be possible to build enough power into a unit small enough to be a practical weapon.

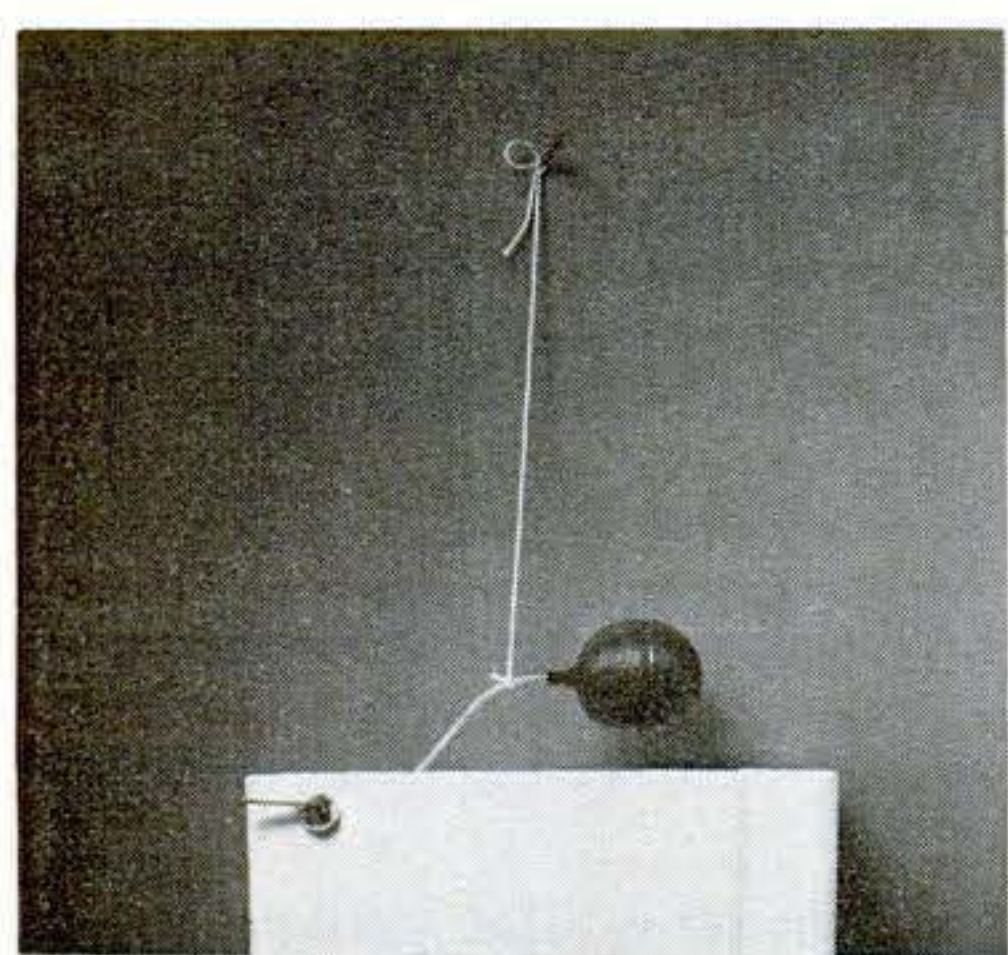
But there are still many questions. How quickly can a thermal weapon of given energy density destroy a target? In some instances, it may take longer than a bullet or a cannon shell, but may still be worth the price.

How susceptible is military hardware? Researchers must find out. Then they can figure how much laser power it will take to destroy or damage various kinds of equipment. The Air Force is looking at the impact of laser radiation on jet-aircraft engine fuels, turbine-engine blades, fuel cells, weapons fuses, high explosives and materials of all kinds. In one experiment, the Pyroceram nose cone of a standard tactical missile fractured into countless pieces after one square centimeter of its surface was blasted for a half second by a laser delivering only one kilowatt.

Laser test ranges. To expand these investigations, the Air Force put into operation at an isolated spot in the Manzano mountain range within 25 miles of Albuquerque the first of three laser-weapons-firing test ranges each to be operated by one of the three services. There, high-energy lasers located on one side of a barren scrub-pocked valley are fired at two simulated targets across the valley. The laser and target locations are chosen to insure beam paths at different heights. At the Manzano range not too far from where the first atomic bomb was exploded outside Alamogordo, the Air Force expects to isolate and analyze the effects on the optical path of airborne particles, air turbulence, and ground interactions.

Historically, every weapon has produced a counterweapon. Laser thermal weapons may be no exception. Mirrored surfaces that reflect incident light are an obvious—but not necessarily practical—answer. Highly reflecting surfaces on aircraft would compromise the vehicle's aerodynamic qualities. Tank surfaces can be made reflective, but quickly they would be pitted with sand and dust during normal military operations, ruining their reflective properties. Artificially generated plasmas and water vapor may offer other solutions now under study.

The imminence of laser weapons is difficult to predict because tough engineering—not scientific—problems still have to be solved. But odds are they'll be in our future soon.

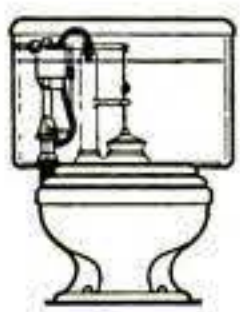


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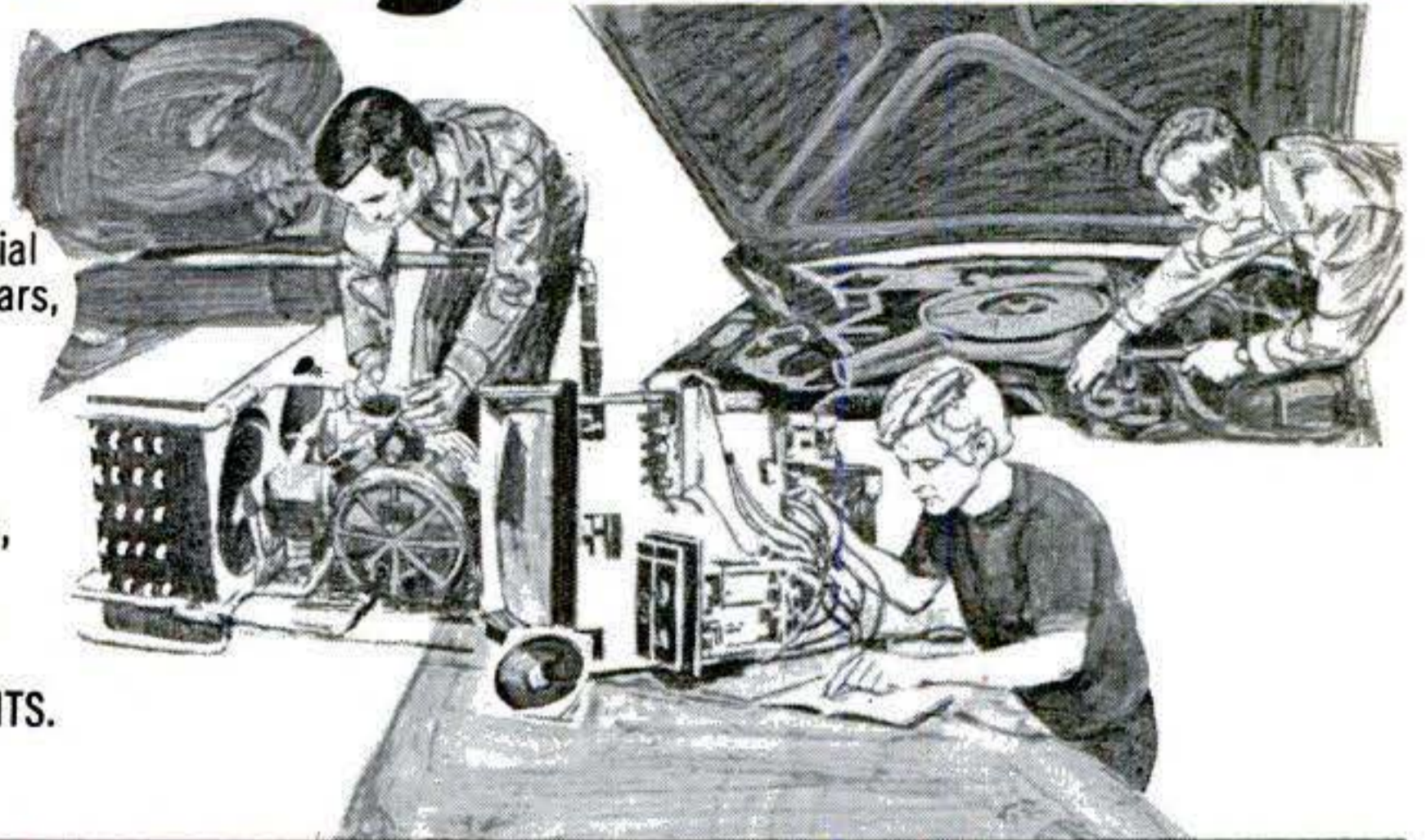
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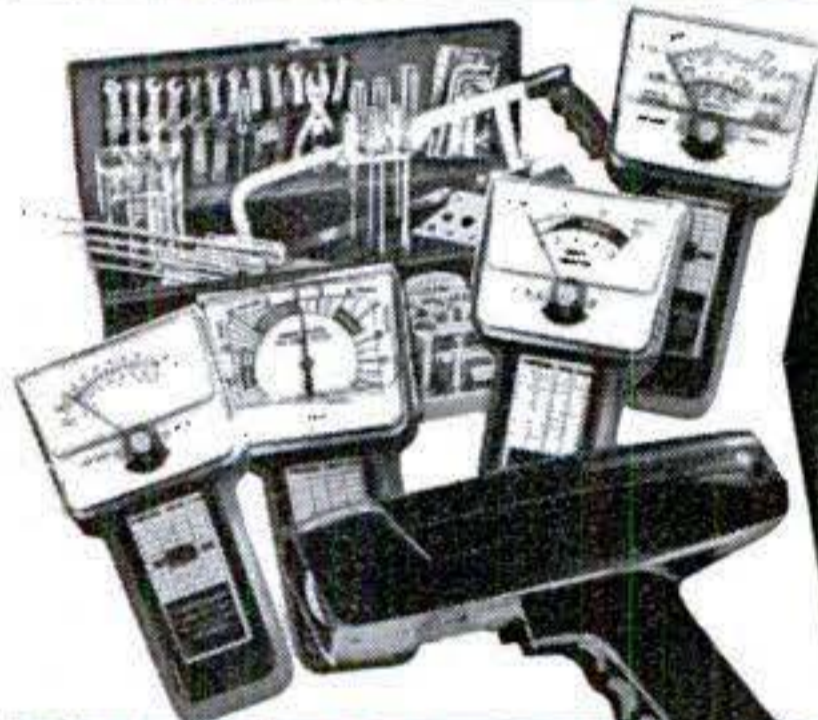
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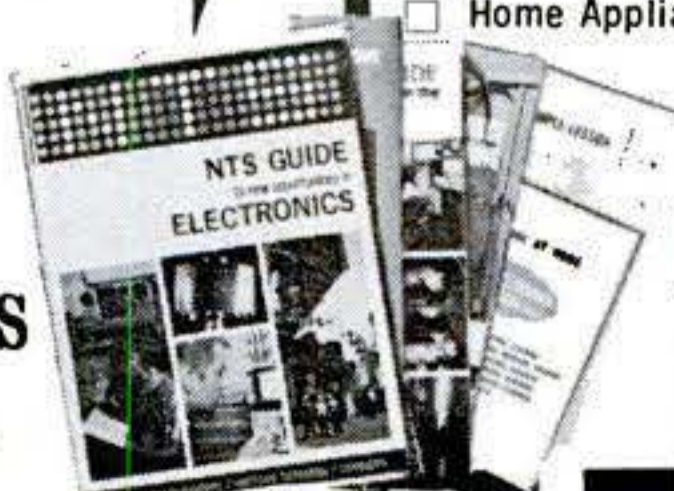
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## Apollo 16—Exploring the Lunar Highlands

[Continued from page 81]

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transmitter that provides precise  
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the data to Earth.

Another important ALSEP experi-  
ment is the Lunar Surface Magnetom-  
eter. It will determine the presence,  
strength, and orientation of a mag-  
netic field at the landing site, and  
monitor possible variations. The sen-  
sor consists of three so-called flux-gate  
magnetometers, one at the end of  
three orthogonal booms aligned at  
right angles to one another. Each  
boom-mounted sensor can be rotated  
by small, automatically programed  
electric motors to perform a survey  
of any magnetic field encountered.

**Lunar heat loss.** The ALSEP Heat  
Flow Experiment, like its Apollo 15  
predecessor, will determine the rate  
of heat loss from the lunar interior.  
Using the Apollo Lunar Surface Drill  
an astronaut will first drill two holes  
down 10 feet [see PS, Dec. '71].

Two probes, each about four feet in  
length, are inserted into each of the  
holes. The probes are equipped with a  
number of ring sensors that measure  
the temperature of the hole wall at  
their respective depths. The tempera-  
ture increase as depth increases [PS,  
Jan. '72] is a measure of the contin-  
uous heat loss from the moon's interior  
to its surface.

One lunar surface experiment not  
attached to ALSEP is the Solar Wind  
Composition Experiment. This is  
simply a piece of aluminum/platinum  
foil unfurled like a sail facing the sun.  
Small patches of the foil consist of two  
and three sheets.

The idea is to trap noble gases  
(helium, argon, krypton) and other  
particles which make up the solar  
wind. By better understanding this  
wind, scientists hope to resolve sev-  
eral competing theories on the origin  
of chemical elements, the birth of the  
solar system, and the history of  
Earth's atmosphere.

**Spotting cosmic rays.** An experi-  
ment unique to Apollo 16 involves a  
detector consisting of four small plas-  
tic, glass, and mineral panels. This  
detector array will be attached to the  
lunar module during the trip to the  
moon, and returned to Earth for  
analysis. When cosmic rays pass  
through the detector materials, they  
leave distinctive tracks that become  
visible with chemical etching. Sci-  
entists may be able to determine the  
age and chemical composition of cos-  
mic-ray particles originating in deep  
space and the sun.

Probably the most important activ-  
ity on the lunar surface will again be  
collecting geology samples. Their

usefulness depends on the precisio  
with which location, orientation, an  
circumstances of each find are doc  
mented by the astronauts.

Taped narration of even minor a  
tivities during land traverses, an  
ample use of hand cameras, will grea  
ly help in sorting out the sample  
Special soil tests, where the astr  
nauts dig small trenches and test th  
bearing strength of the lunar soil, wi  
also help determine the geological  
characteristics of the landing site.

**Science in lunar orbit.** Apollo 16  
like the 15 mission, will have a sizabl  
portion of its lunar-science program  
conducted from orbit. Again, one ba  
in the service module has been vacat  
ed for the sole use of scientific equip  
ment. This SIM bay (for Scientific  
Instrument Module) accommodates  
among other things:

- A 24-inch-focal-length panoram  
ic camera to obtain—from the 60  
nautical-mile orbit—stereoscopic pic  
tures of lunar surface details with a  
resolution of three to six feet. The  
camera is suspended in a gimbal sys  
tem that tilts fore and aft to provide  
stereo coverage as well as no-blur  
forward-motion compensation.

- A mapping camera with a three-  
inch cartographic lens to obtain high-  
quality metric photographs.

- A laser altimeter which, in one  
of several operational modes, can de-  
termine the precise elevation of the  
area being photographed.

- An X-ray fluorescence experi-  
ment using three gas-filled proportio-  
nal counter-detectors that continuously  
scan the fluorescent X-ray flux from  
the lunar surface. This fluorescence  
is generated by impinging X rays  
from the sun, and its "signature"  
varies with the chemical composition  
of the lunar surface material. The ex-  
periment thus provides information  
on the distribution of the major rock  
forming elements on the moon.

- A separate subsatellite that wil  
remain in lunar orbit for several years  
One of the most interesting tasks of  
this subsatellite is to survey the far  
field of the Earth's magnetopause.

Many satellite flights have shown  
that the Van Allen Radiation Belt  
while appearing "as advertised" in the  
direction toward the sun, is actually  
blown out on the opposite side by the  
solar wind into a "geomagnetic tail."  
Particle and electrostatic detectors  
will help provide a clue to the shape  
of the magnetopause.

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## They're Not Just Toys Anymore—Kites Go Scientific

[Continued from page 94]

Ray Holland claims his Sky Sail design, which looks something like a Scott Sled without the center vent, can lift as much for its weight as any heavier-than-air lifting system.

**The parafoil.** Conceived by Domina Jalbert of Boca Raton, Fla., this is the most fascinating kite design I know. It's like an airplane wing with the leading edge left open. Jalbert got the basic idea while flying one day in his Beech Bonanza and thinking about how the wing worked.

In the air, Jalbert's parafoil looks like a flying mattress. But on close examination, you can see it's a wing-shaped fabric with individual longitudinal cells between each rib. Rigging and paneling along the bottom of each rib hold the bottom section flat. The upper section takes an airfoil shape because of wind pressure. To keep sections from collapsing in gusts or side shifts, Jalbert designed slots to keep the air from escaping too fast.

Once aloft, the parafoil has startling lift, and it's a very tough bird. As a result, big models are used in weather-making research in the Rockies. They carry large loads of instruments and seeding materials into extremely turbulent weather that might wreck planes, gliders, or helicopters trying to do the same job.

Jalbert questions the general opinion that March is the kite month. "This may be true when the winds are between eight and 15 mph. Above or below this, it is quite questionable. The velocity into which an average kite can be flown is highly dependent on the type and design of the kite. For example, a Scott Sled will fly in very light winds, while a French war kite requires high winds. For each kite, there is a minimum and maximum wind velocity at which pleasant operation can be performed. The very low wind can be as frustrating as the too high wind."

At what angle should a kite be rigged for best performance? "My experience is, when suspended from the bridle junction, a kite should have an angle of 30 to 35 degrees. This means that this type rig on a kite will fly well at angles of 60 to 70 degrees to the vertical, which is good for any kite-flying. Now the higher the angle of flight, the less pull there is on the flying line, because past 60 or 70 degrees the angle of attack becomes negative, and the kite will gently settle back to normal flying position. Rigging a kite at 45 degrees will produce maximum pull or drag."

**Should a kite have a tail?** Jalbert likes a plain kite with a long, light,

waving tail that offers lots of air friction to counterbalance the dynamic pressure of the kite surface. The higher the winds, the more dynamic force; therefore, more tail is required. It is the friction of the air that gives stability. A short, heavy tail simply acts as a pendulum and makes the kite fly erratically.

How about the tailless kite? Jalbert points out that all of the successful ones have a built-in fin. The fin acts as a lateral stabilizer, like the rudder on a plane. Adding a long tail to the normally tailless kite helps it fly in higher-than-normal winds.

Jalbert points out that any kite is purely dependent on the plane surface area for dynamic force. A kite that is wider than it is long (high aspect ratio) has more difficulty maintaining lateral stability if it is the keel type. On the other hand, without a keel a longer tail is needed.

"An extra-long tail may cause the kite to go into a series of downward loops. In this case, just quickly release the flying line and the kite will go back to flying upward."

The most exciting use for the parafoil design is for parachutes. Lift-to-drag ratios of three to one and better have been demonstrated for specific designs. This is a rather steep glide compared to a regular rigid glider, but considerably better than normal parachutes. It means better control of landing sites for cargo drops and parachutists. A review of parafoil applications by Notre Dame, Air Force, and Navy researchers concluded that controlled cargo delivery at drop speeds of up to 130 knots could be accomplished with weights up to 2,000 pounds.

All this points to some rather wild future demonstrations of load, altitude, and strong-wind capabilities.

P. R. Lawson, of the department of mechanical engineering at the University of Waterloo in Ontario, told me of his research with Jalbert kites. He used gasoline-engine winches to tether and control the kites up to heights of 3,000 feet. Instruments carried aloft transmitted radio signals to the ground providing temperature, pressure, and relative-humidity changes at varying heights. The meteorological data was then used in conjunction with smoke-plume observations at a major thermal generating station for an air-pollution research program being carried out at the University of Waterloo.

The kite size was seven-by-six feet and lifted instrument packages in ground winds of from five to 45 mph. Once, during a 45-mph wind, the

winch failed. It took eight men several hours to pull the kite down by hand.

These kites have been flown both over land and from ships on Lake Huron using a 400-pound-test nylon braided line.

Lawson feels the advantages of the Jalbert design are that it has no rigid parts, is easily transported, and is safe in event of a crash. It is also extremely powerful for its size. Its disadvantage is a tendency to dive under gusty-wind conditions.

Most of Jalbert's designs have been for special scientific uses and cost several hundred dollars. But his recently marketed miniature model, the Kytfoil—about 27 inches by 36 inches—is available for \$7.98 for the kite alone, or \$10.95 with snaps, drogue, and 500 feet of 36-pound test nylon and instructions. Order from Jalbert Aerology Laboratory, 170 NW 20th St., Boca Raton, Fla. 33432.

**Inflatables.** Finally, there is a funny new kite I found as a breakfast-food premium. It is called the Puffer and is one of the few inflatable designs around. It's distributed by Creative Marketing of Chicago, Ill. Made of thin plastic, the Puffer is blown up to an elongated pear shape, 42 inches long, 30 wide, and 12 thick. The grommet for attaching the string is already in place. It is light and goes up almost as though it had helium inside. It is truly an advanced design.

The kinds of fun you can have with kites seem endless. Altitude records are constantly being challenged. The most recent one was set by 10 Gary, Ind., high-school students, who put up 19 Gayla deltas (Gayla Kites, P.O. Box 10800, Houston, Tex. 77018) in June 1969 to a record 35,530 feet.

Endurance is another challenging area: An unofficial record of 37 hours, 17 minutes was set at Sarasota, Fla., in Jan. 1971. And Roger Williams (R.I.) College students kept a kite up 35½ hours last April in a contest sponsored by Bermuda.

With new scientific uses for kites cropping up, is there a major upswing of interest in the sport of kiting? Definitely. Last year, according to one authoritative estimate, more than 35 million kites were sold, and countless more were home-built.

If you want to learn more about kiting developments, one of the best ways is by joining the American Kitefliers Association, P.O. Box 1511, Silver City, New Mex. 88061. Membership is \$3 and includes a bulletin called *Kite Tails*, which keeps members updated on new kites, kites, and kiting methods. Have fun! ■

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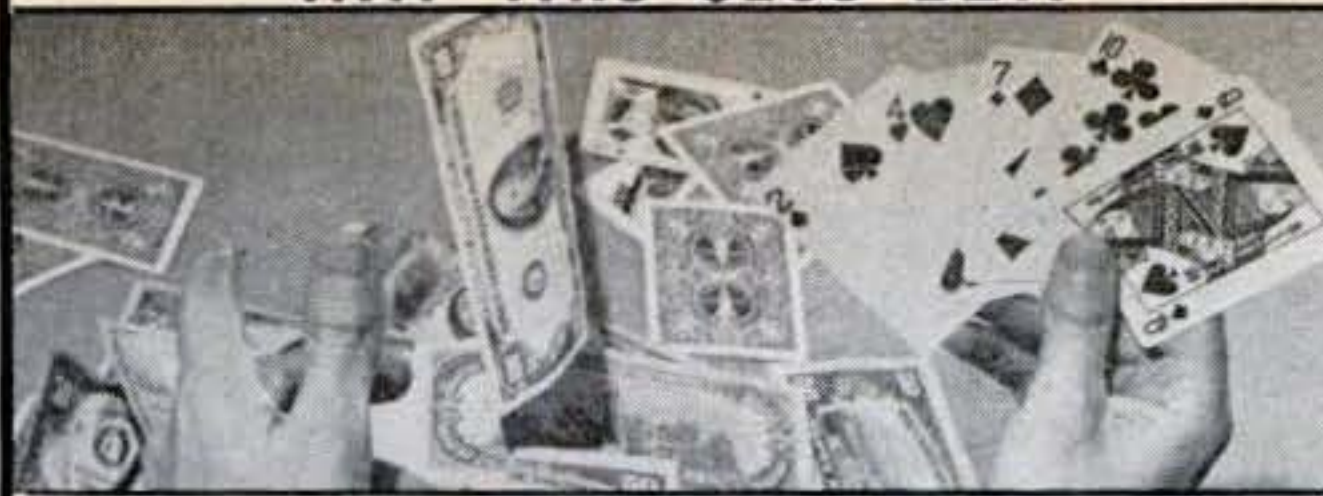
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## Man-Powered Planes Get a New Lift

[Continued from page 69]

versity's Keith Sherwin answers: "At the present state of the art, it is rather like the Wright brothers attempting to fly the Atlantic in 1903."

Dr. Sherwin, whose recent book, *Man Powered Flight*, has become the bible in its field, is no ivory-tower theoretician. Currently, he is making taxiing trials of Liverpuffin, the sports skycycle he and his students designed and built.

**Hopeful Leonardos.** Since contenders are still being built, it's obvious that Sherwin's gloomy opinion of the chances of winning the Kremer Prize is not held universally. However, a study of the problems tends to support his view.

The figure-8 course is about two miles. To obtain long-range capability, with the minimal power available, designers of planes for the Kremer Competition typically have produced monster birds that are ultra-lightweight and very fragile, with tremendous wingspans. The span of the 145-pound Toucan two-seater is 123 feet—that's 15 feet longer than a 45-ton Boeing 727's spread!

This type of man-powered plane, because of very low wing-loadings and high-aspect-ratio wings, is especially sensitive to wind. Generally unsafe to fly in even a three- to five-mph breeze, these aircraft need dead calm for successful flight. And they are so delicate that one was disabled when someone stepped on it.

Controlling and pedaling one of these super-skycycles is tricky. Imagine how hairy things could get on 180-degree turns at something like 18 mph, with the tip of a 120-foot wing close to the ground.

The longest muscle flight on record is 993 yards, made May 2, 1962, by John Wimpenny in Puffin I, one of the best man-powered planes ever flown. It was a straight-line flight only one-fourth of the distance around the Kremer course with its two 180-degree turns. Nevertheless, Wimpenny, an expert pilot in top physical condition, landed in a state of exhaustion.

To take advantage of power-saving ground effect (the cushioning effect of the layer of air between plane and ground), man-powered aircraft fly very low, usually about three feet or so off the ground.

Another reason for low-level flight is that it takes 70 percent more power at a typical six-inch-per-second rate of climb to zoom than to fly level. That means more gut-busting labor for the already heavily taxed skycyclist to meet the Kremer requirement that the plane cross both start and

finish lines at 10 feet. It's tough.

**Bucking the odds.** All this adds up to the conclusion that the Kremer Competition is too tough for both men and machines. But despite the heavy odds against their success, at least four man-powered aircraft teams claim they're going to give it a try.

The Weybridge, which made its maiden flight of 50 yards last fall, and the Toucan, soon to begin flight trials, were designed expressly for the Kremer Competition. Builders of the Flycycle and Ottawa [PS, Jan. '71] say that's their goal, too. Reportedly, the Flycycle is expected to fly this year. The Ottawa's first flight is still at least a year away.

Except for the single-place Weybridge plane, these aircraft will have two-man crews: a skilled pilot and a highly trained athlete. Thus, the pilot can devote himself primarily to controlling the aircraft, with his power contribution secondary, while his teammate concentrates on delivering horsepower. The two-man crew eliminates the problem of finding a combination pilot-athlete (the Weybridge group found one).

In the Flycycle, the "slave" in the back seat is provided with hand cranks as well as foot pedals. He will use the cranks to supply extra power for takeoff, climbing, etc.

Whether or not one of these planes wins the Kremer Prize, they're probably the last of the large man-powered aircraft. This fragile species is really due for extinction. It's too difficult to design, build, fly, and maintain—with the Kremer Prize their only reason for being. Very few groups can muster the resources and dedication to sustain such a project.

For example, some 10,000 man-hours went into the Weybridge plane.

**Breed of the future.** Man-powered aircraft will be smaller, simpler, sturdier, and cheaper than those built to date. A skycycle, perhaps similar to the Malliga and Liverpuffin but with a wingspan of about 50 feet, would be ideal for sports flying and an excellent student project.

An average man could take such a pedal-plane on a muscle-powered flight of 100 or 200 yards, a few feet off the ground. Like the Malliga skycycle, it might be tow-launched for higher and longer flights.

Hang-gliding enthusiasts report that a hang-glider with a drive system and propeller—intended to double normal glide distances—is being designed and should be ready in about a year. Farther in the future is a self-launching sailplane with a pedal driven propeller. PS

## New Skyscraper Champ

[Continued from page 74]

SOM architects felt that city air pollution and dirt would do less harm to dark aluminum than to a light-colored metal. More than 16,000 panes of bronze-tinted-glass windows complete the outer wall, along with a series of metal louvers that enclose mechanical floors.

**Second to the Pentagon.** When the Sears Tower is completed, it will provide some 4.4 million square feet of gross floor space. The space is equivalent to 101 acres, or 16 Chicago city blocks. That's more than any other private office building in the world, and is topped only by the Pentagon, which contains 6.5 million gross square feet. Each tower of the World Center has 4.37 million square feet of gross space.

Some 16,500 persons will work in the tower, including about 7,000 Sears employees. The giant retailer will occupy the first 50 floors of the skyscraper, with the rest rented to commercial tenants.

Workers and visitors to the huge building will be sped to offices with the aid of an ultramodern system of elevators and escalators. It would take you about 90 seconds to get from the lower level to the 102nd floor, including one transfer.

There will be 102 high-speed elevators, including 14 double-deck cabs. The 5,000-pound double-deck cabs will speed up to 25 passengers to the sky-lobby floors at 1,600 feet per minute, but they are spacious enough to prevent giving you a jammed-in feeling at that capacity. The single cabs will serve intermediate floors. Going to the 103rd-floor observation deck will be two express elevators, which will travel at 1,800 feet per minute.

**Escalators for the lobbies.** Transportation to the first three floors is provided by escalators. Other escalators will serve the sky-lobby floors, which are located at the 33-34 floor level and the 66-67 floor level.

One other noteworthy bit of trailblazing by the Sears building's designers is in making it the first all-sprinklered skyscraper. A fire in such a huge building could be a terrible disaster, so the architects have provided for a complete system.

You won't have to work in the building to enjoy it. It will house restaurants, boutiques, and many other attractions. It will also have an observation tower on the 103rd floor from which you can enjoy spectacular views of the Midwest's greatest city.

When can you visit this man-made wonder? In about two years. PS

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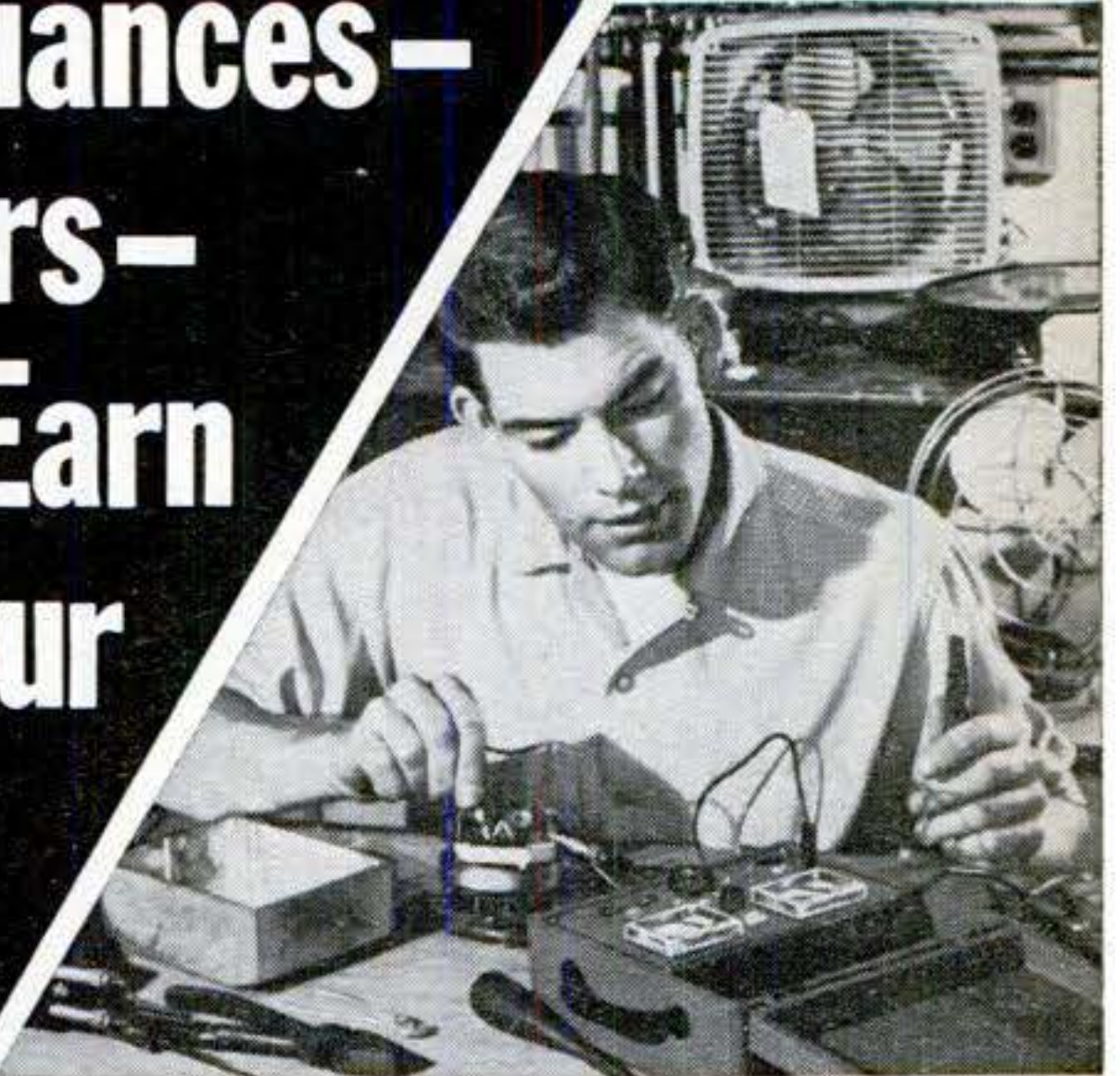
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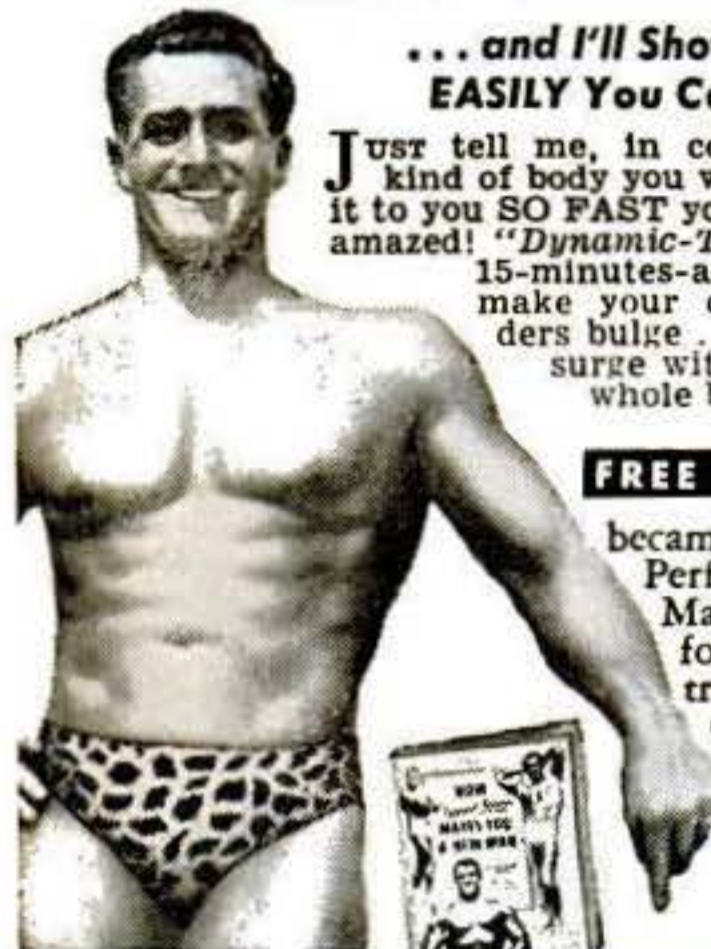
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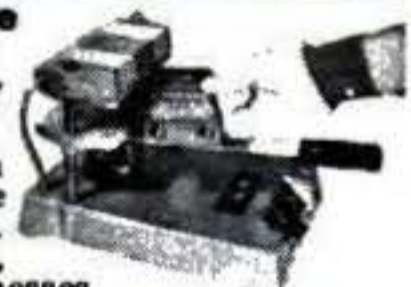
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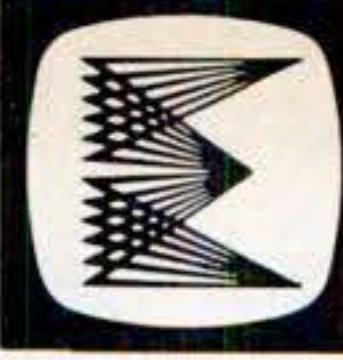
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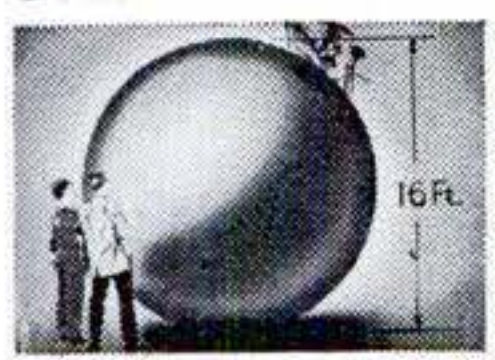
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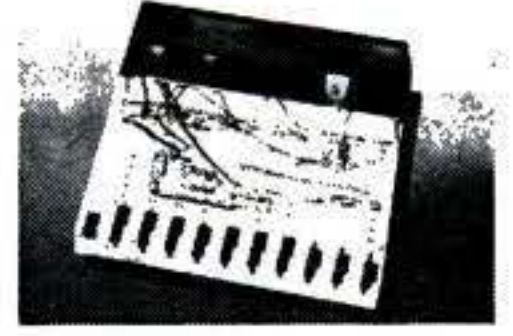


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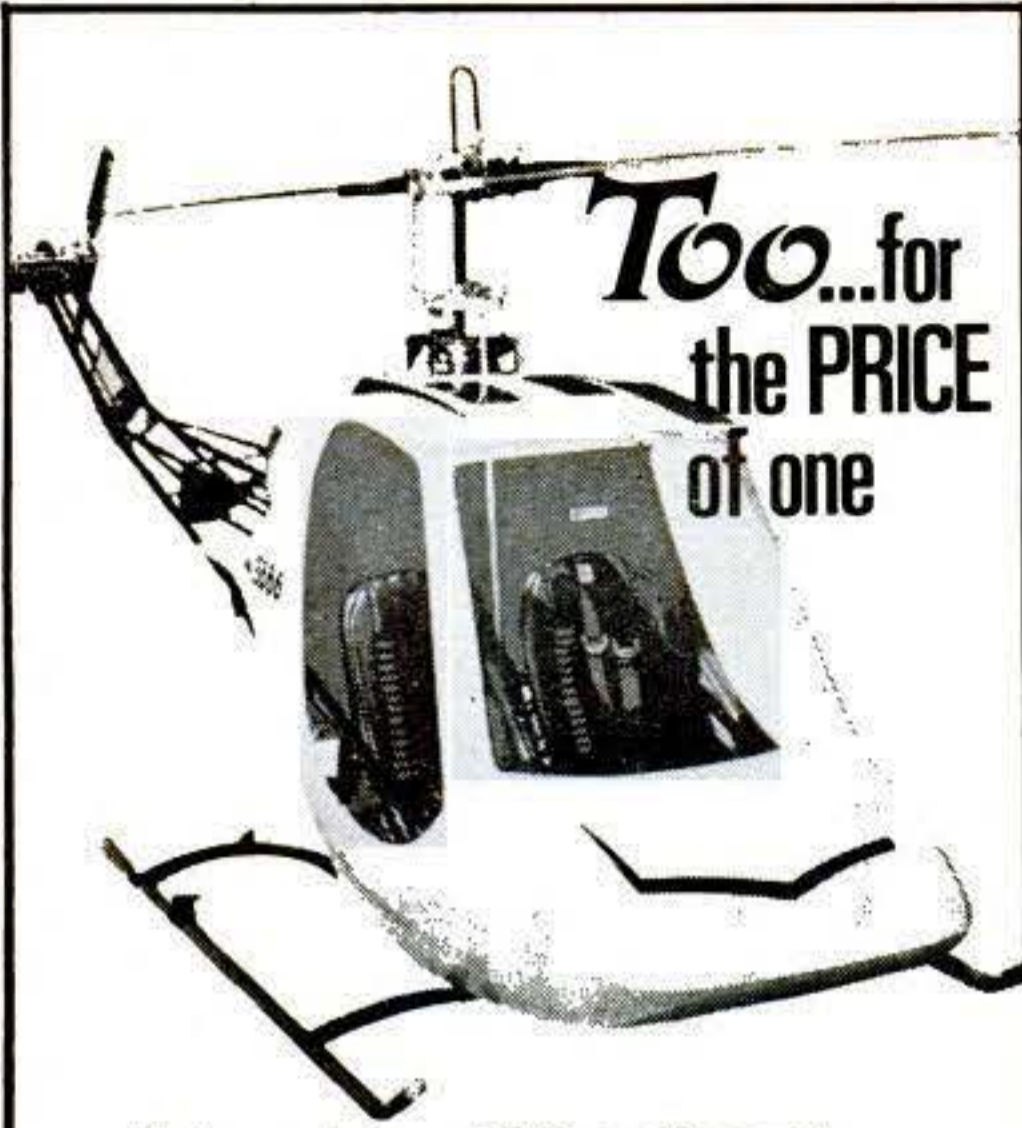
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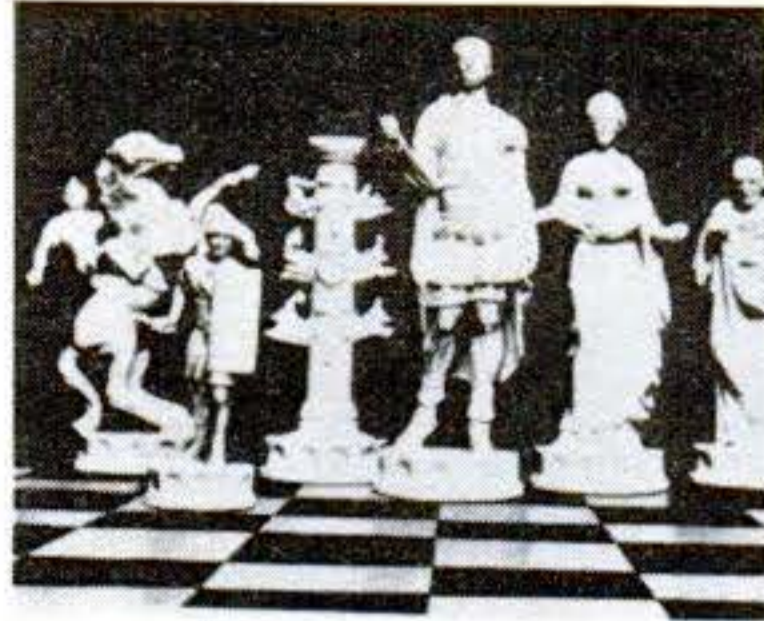
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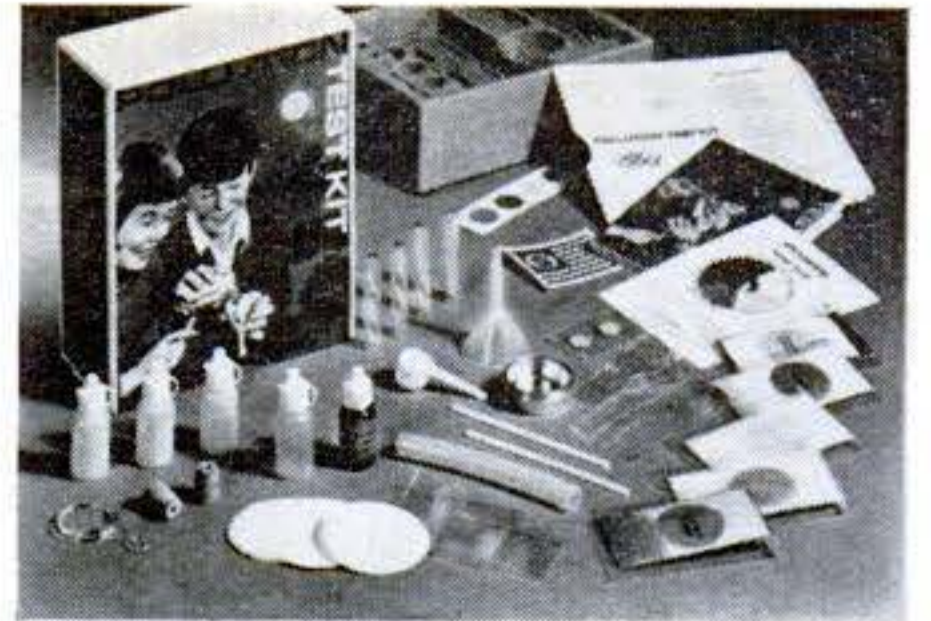
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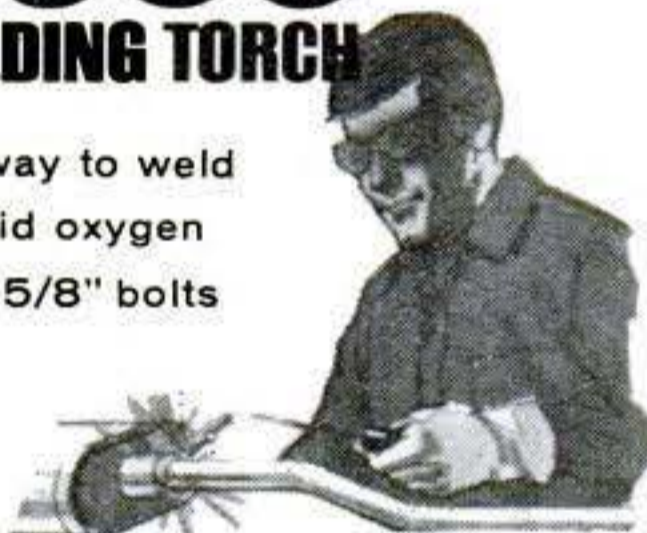
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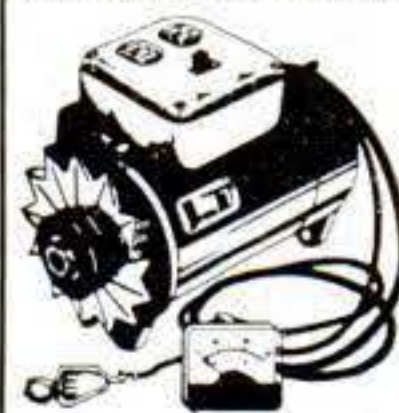
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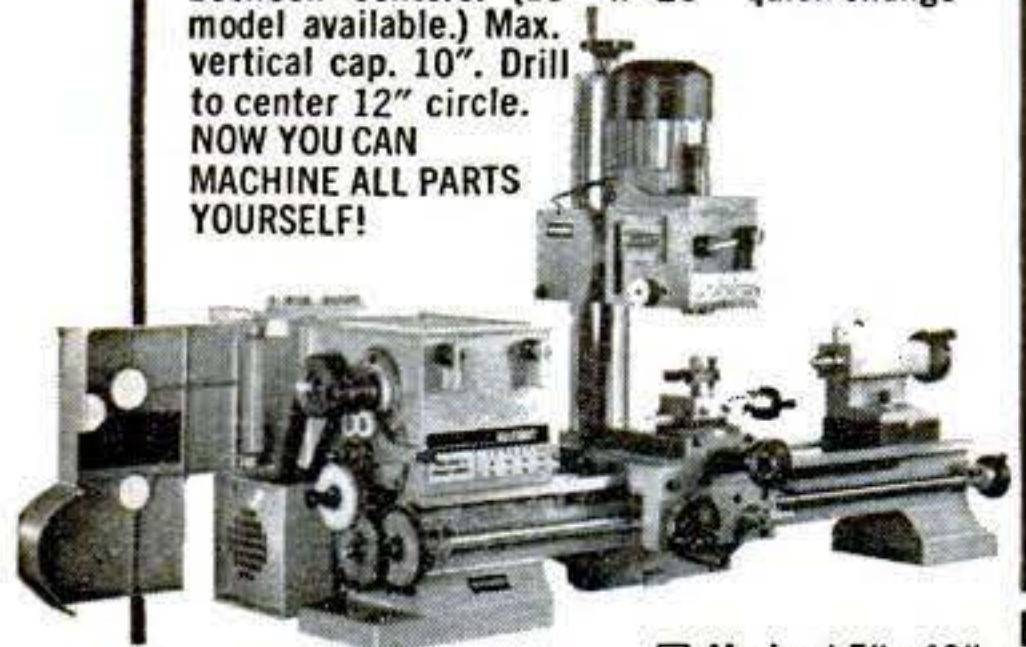
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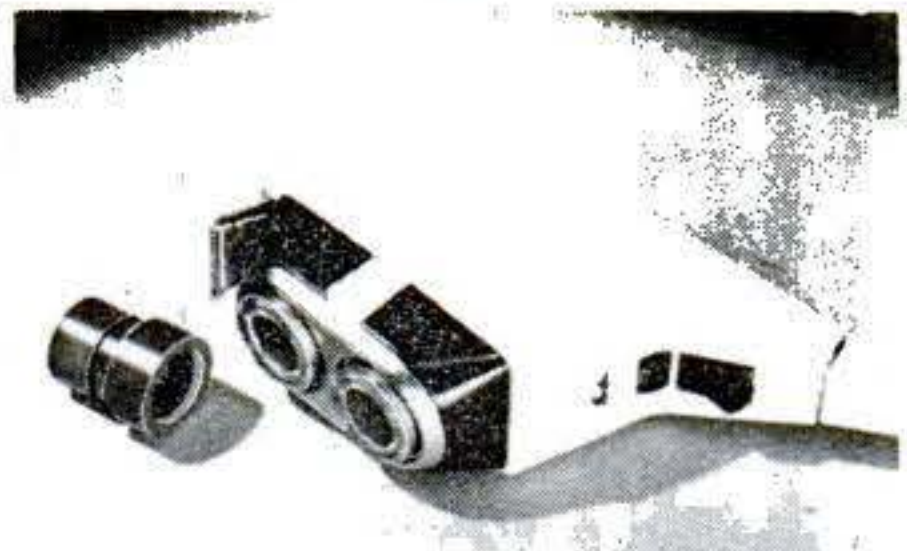


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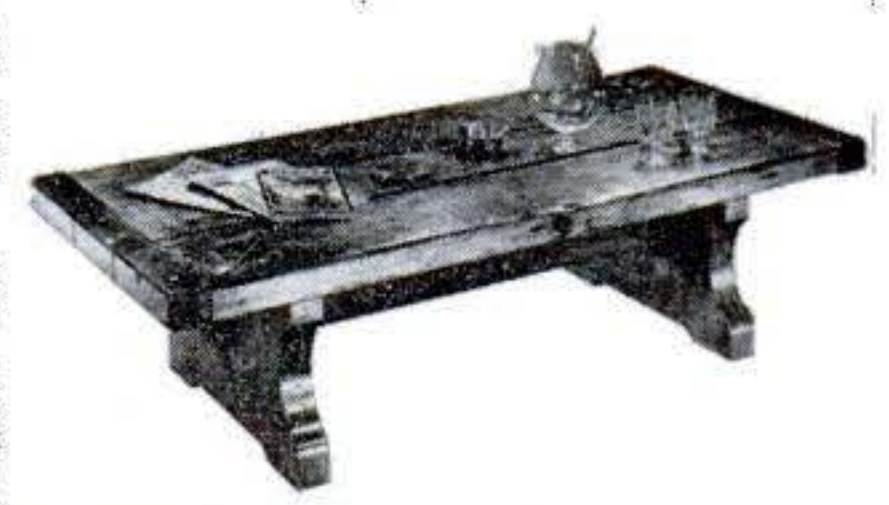
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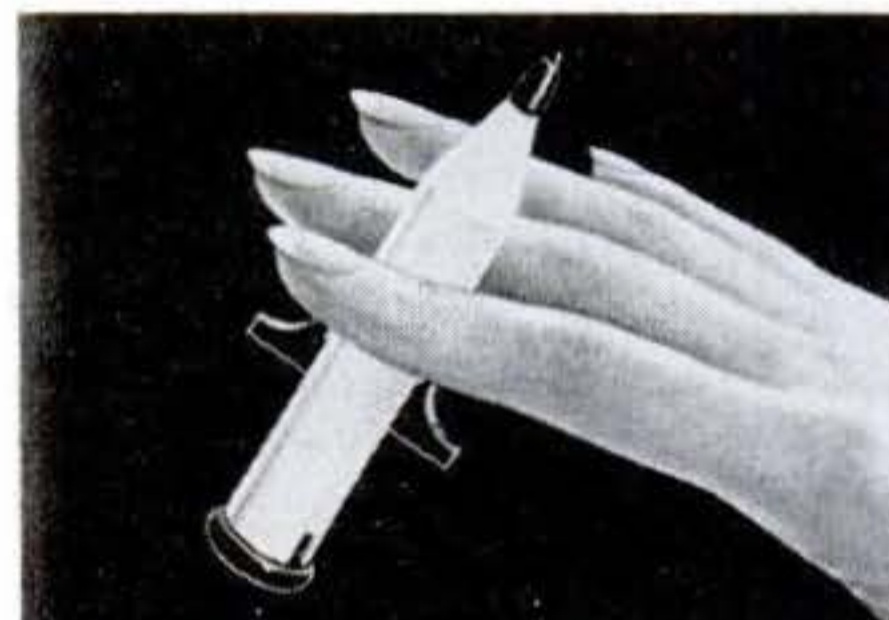
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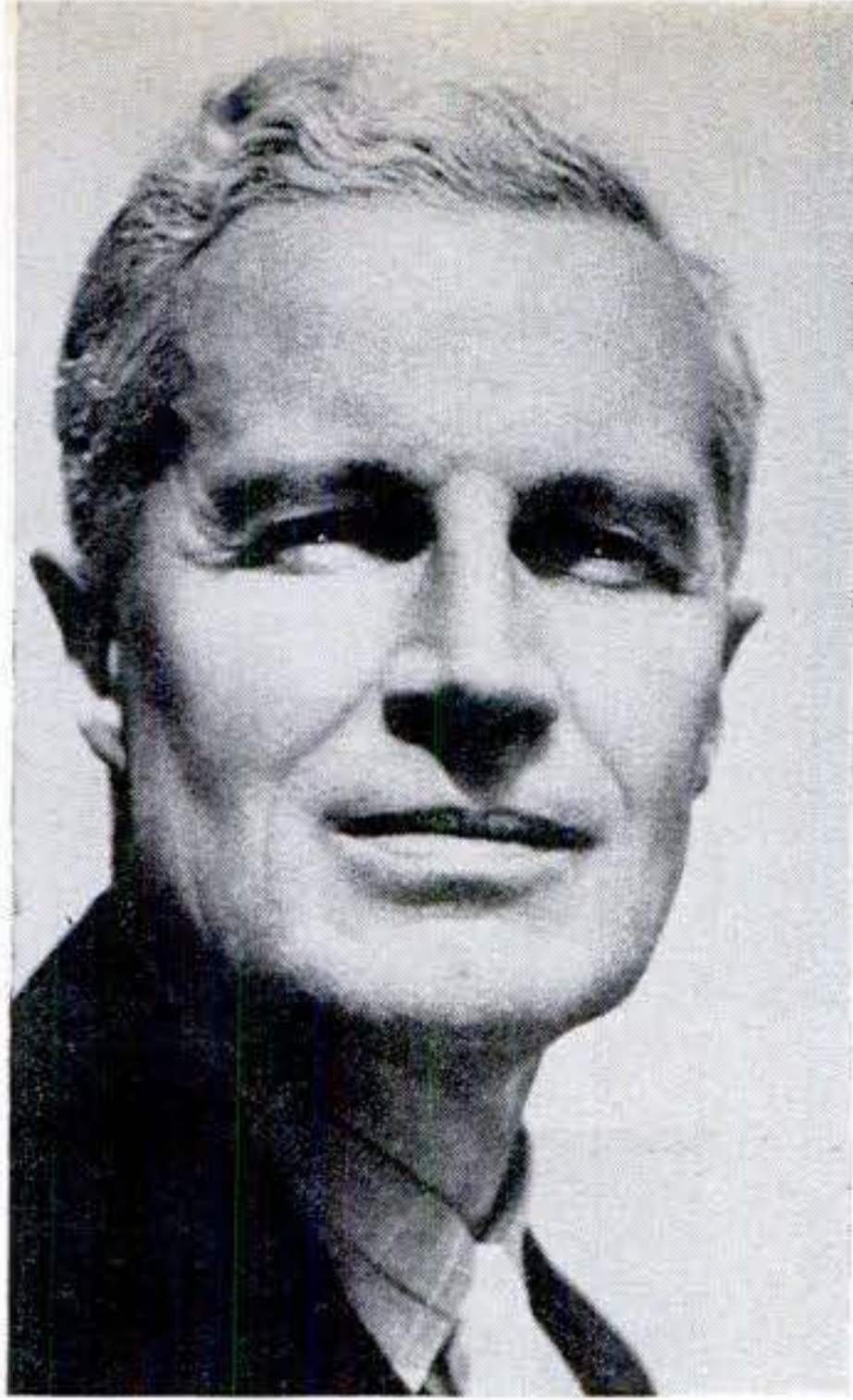
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summer home, my Cadillacs, my winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things, of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish!* And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned!* I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

## I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to

gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

## A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows." It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own." It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

## Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and

ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

In this message I'm not going to try to tell you the entire story. There is not enough space on this page. And, I am not going to ask you to spend a penny now to learn the secret. I'll send you all the information, free. If you are interested in becoming independent, in becoming your own boss, in knowing the sweet fruits of success as I know them, send me your name. That's all. Just your name. I won't ask you for a penny. I'll send you all the information about one of the most fascinating businesses you can imagine. With these facts, you will make your own investigation. You will check up on conditions in your neighborhood. You will weigh and analyze the whole proposition. Then, and then only, if you decide to take the next step, I'll allow you to invest \$15.00. And even then, if you decide that your fifteen dollars has been badly invested I'll return it to you. Don't hesitate to send your name. I have no salesmen. I will merely write you a long letter and send you complete facts about the business I have found to be so successful. After that, you make the decisions.

## Does Happiness Hang on Your Decision?

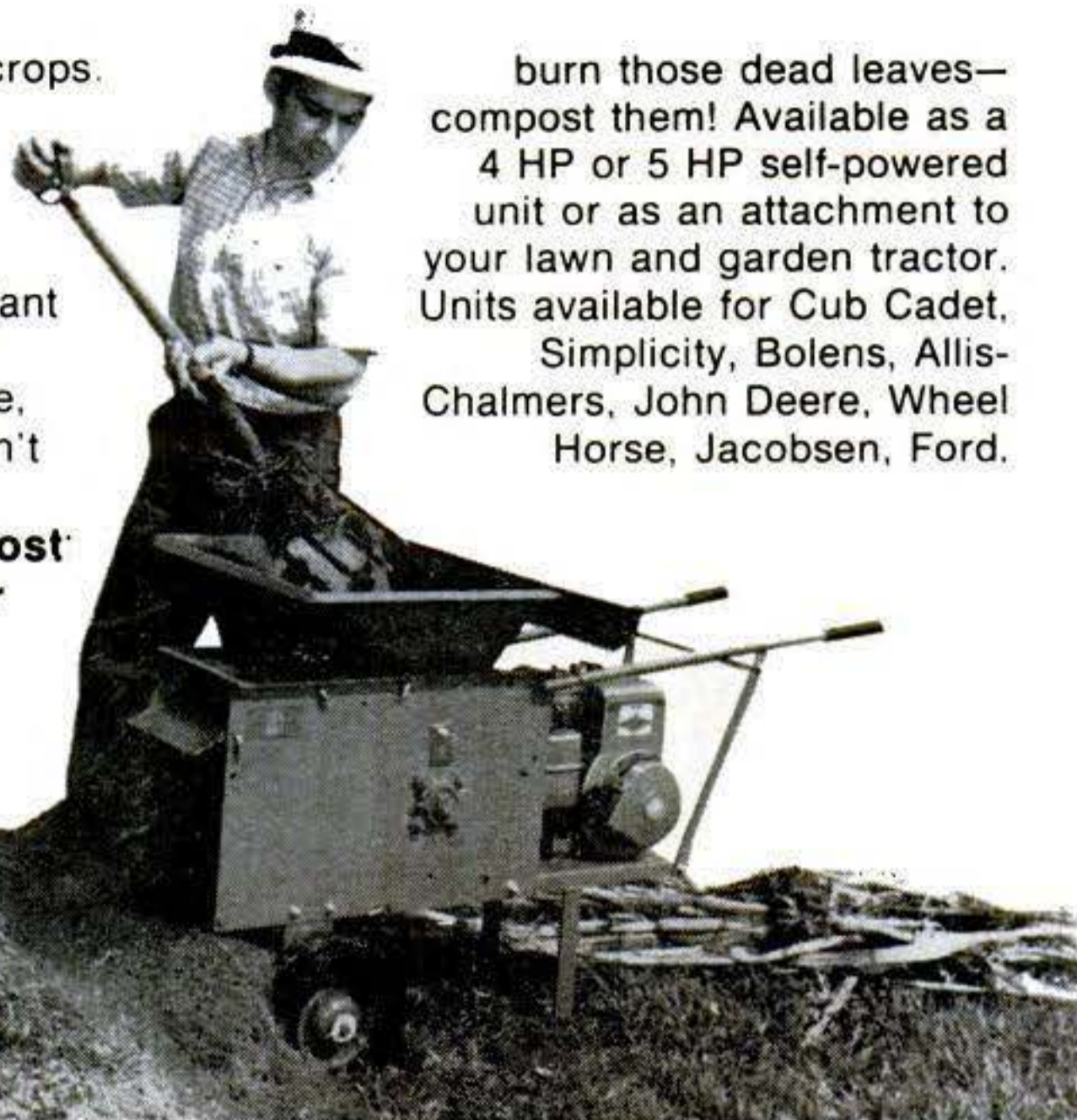
Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name now. What I send you may convince you of the truth of this proverb. And what I send you will not cost a penny, now or at any other time.

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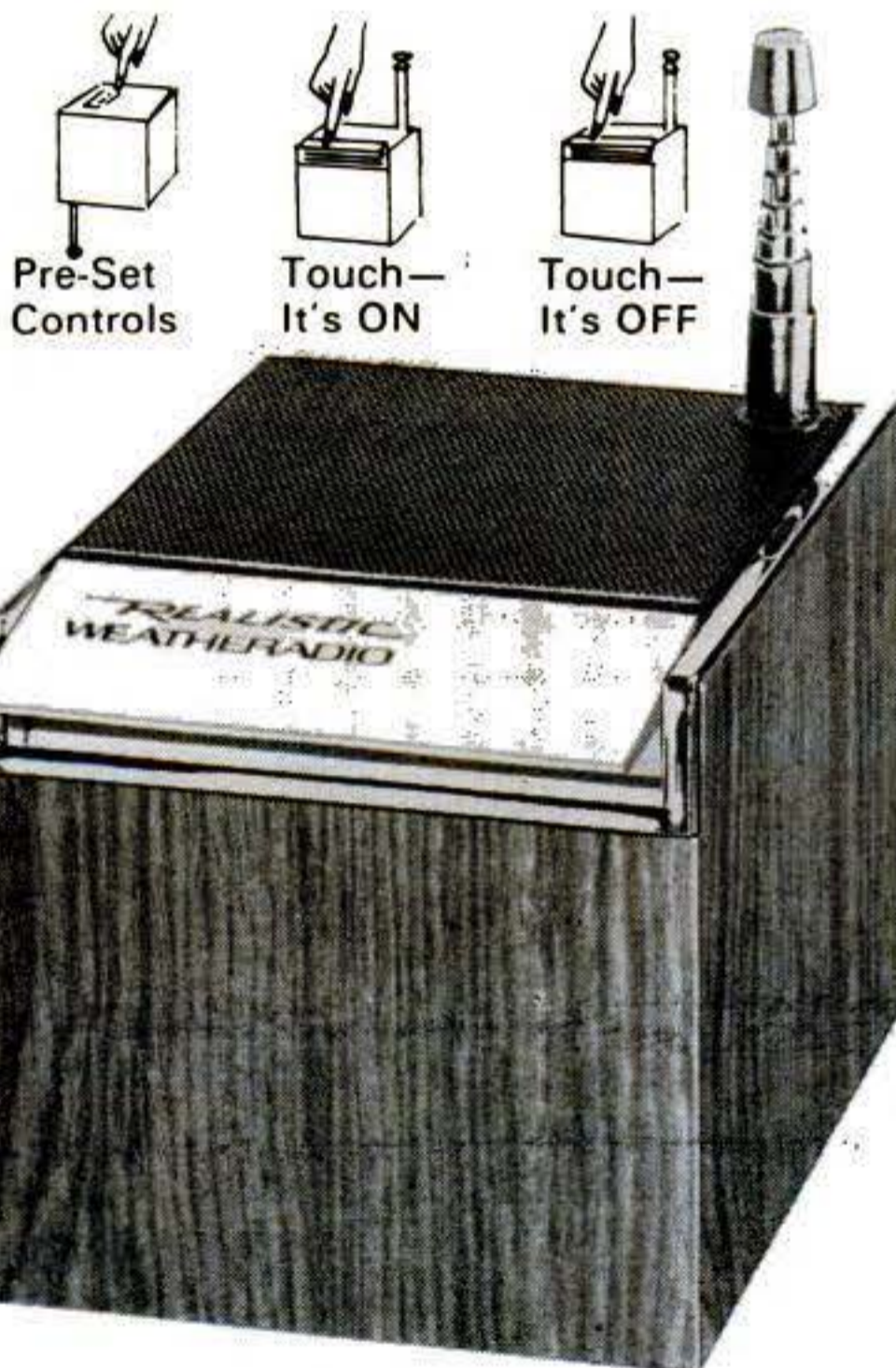
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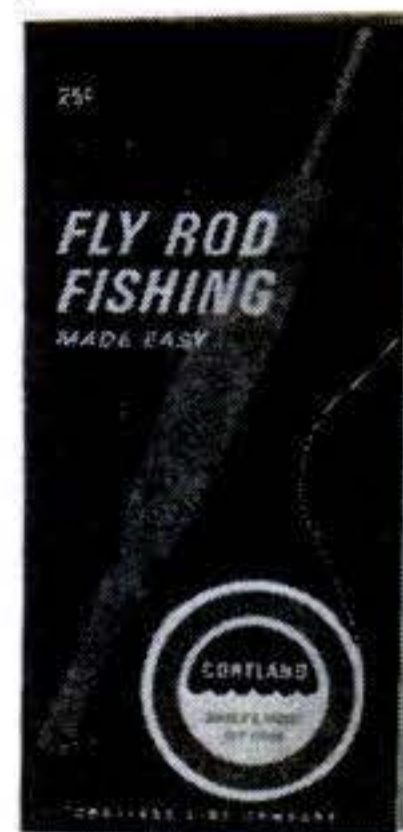
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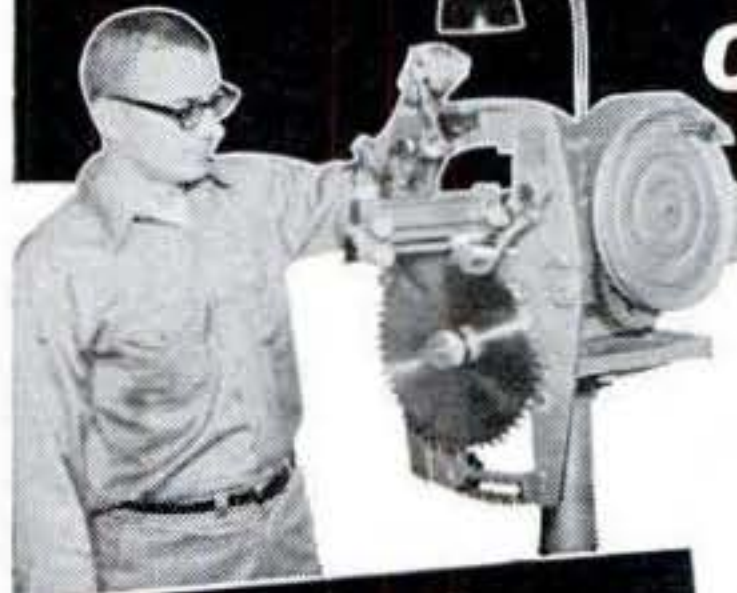
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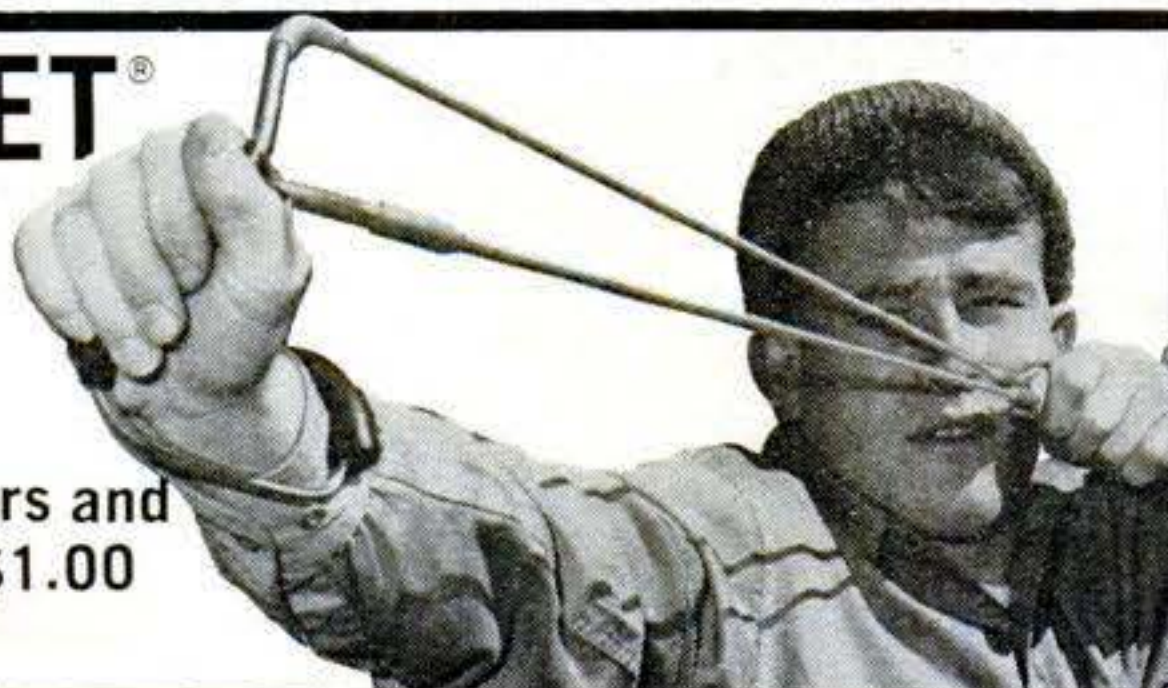
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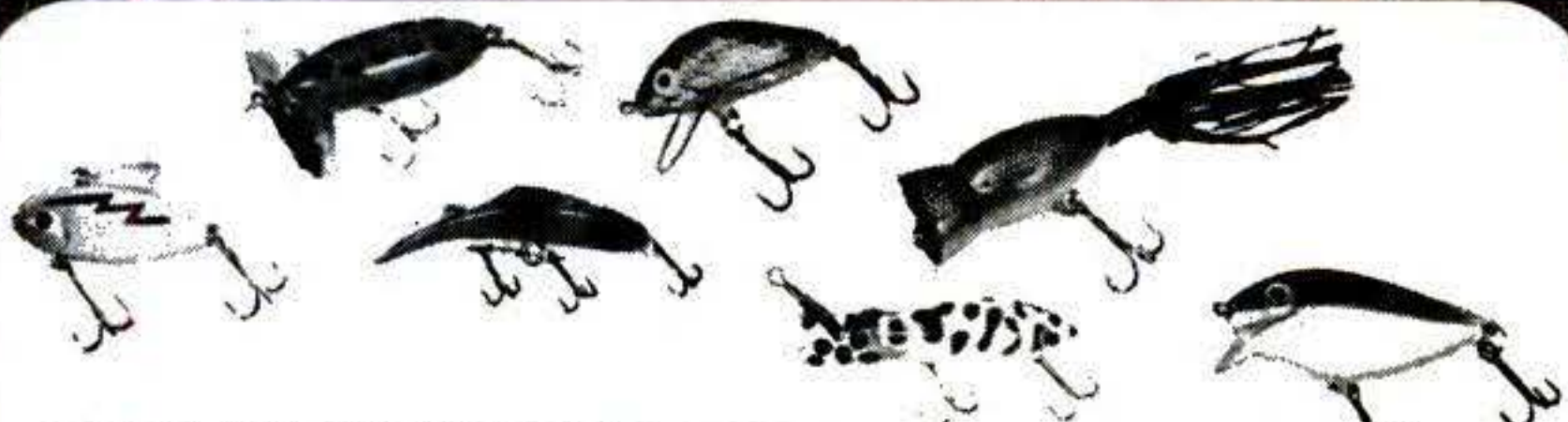
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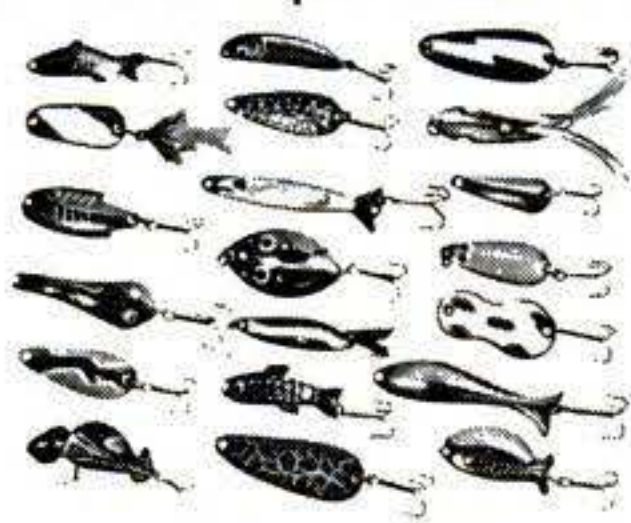
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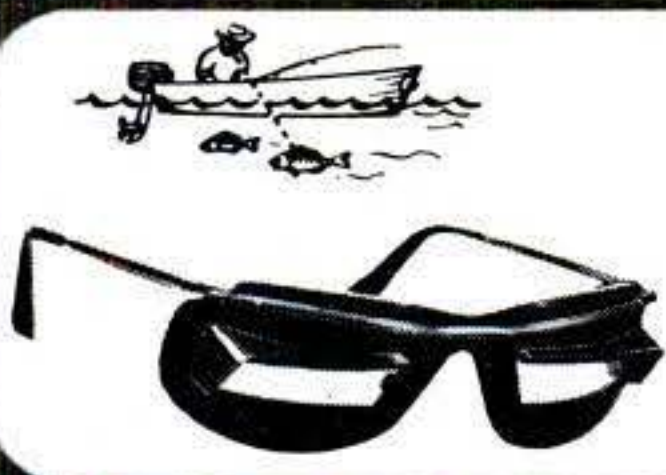
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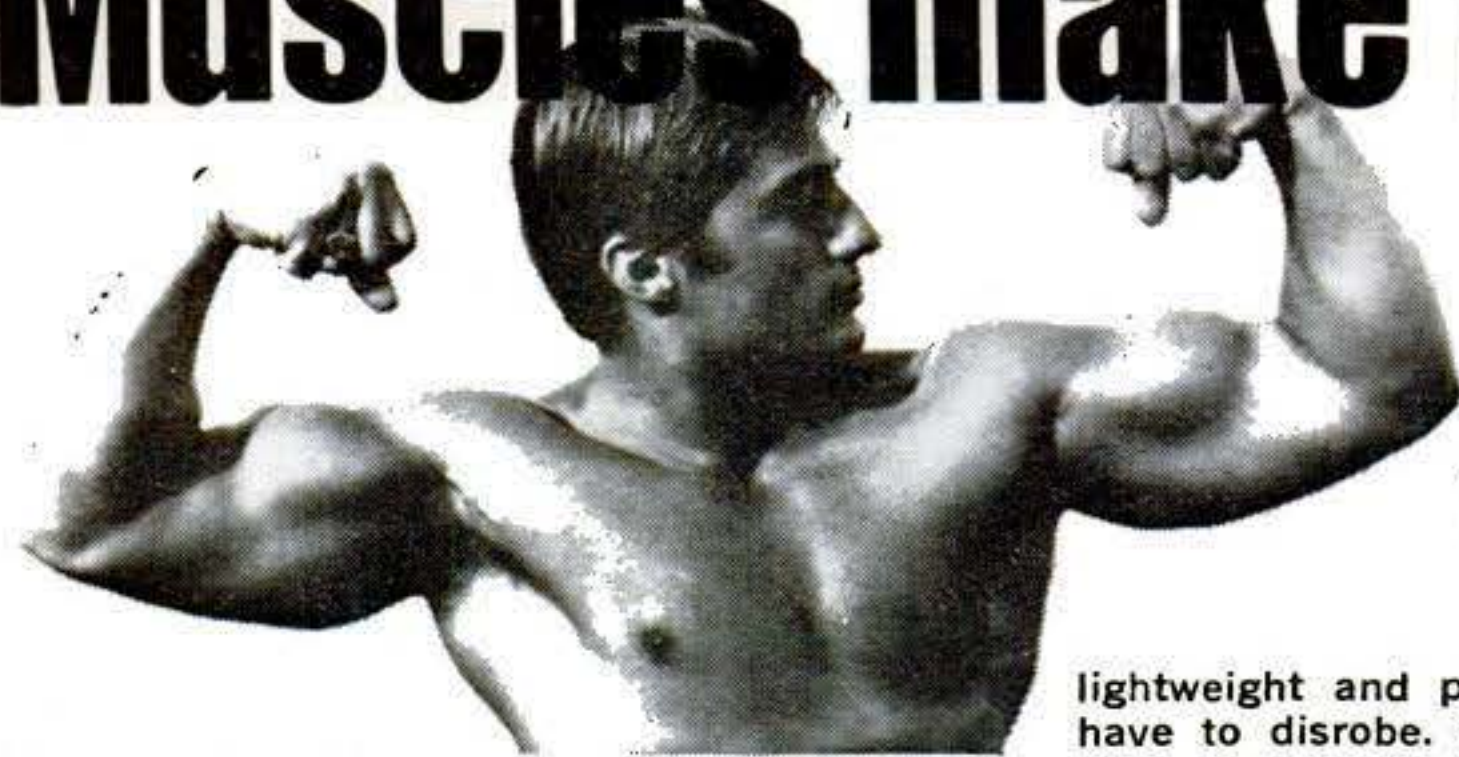
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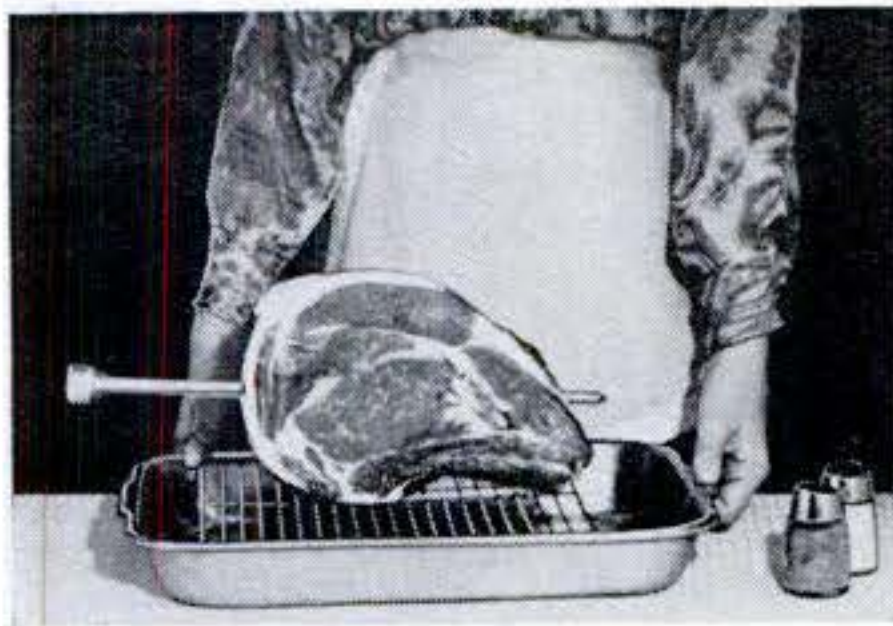


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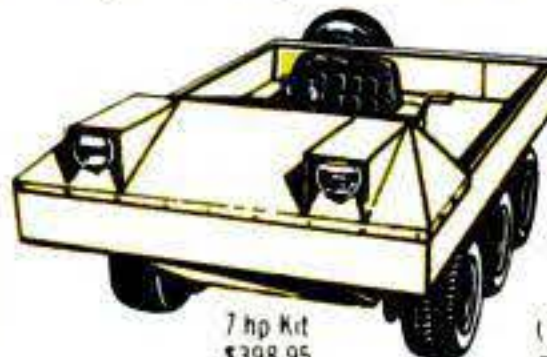
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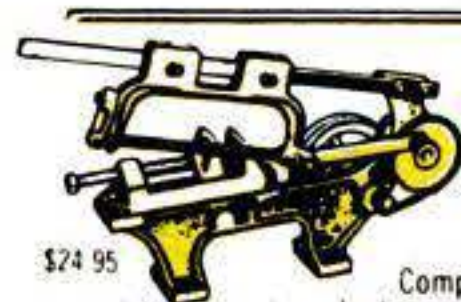
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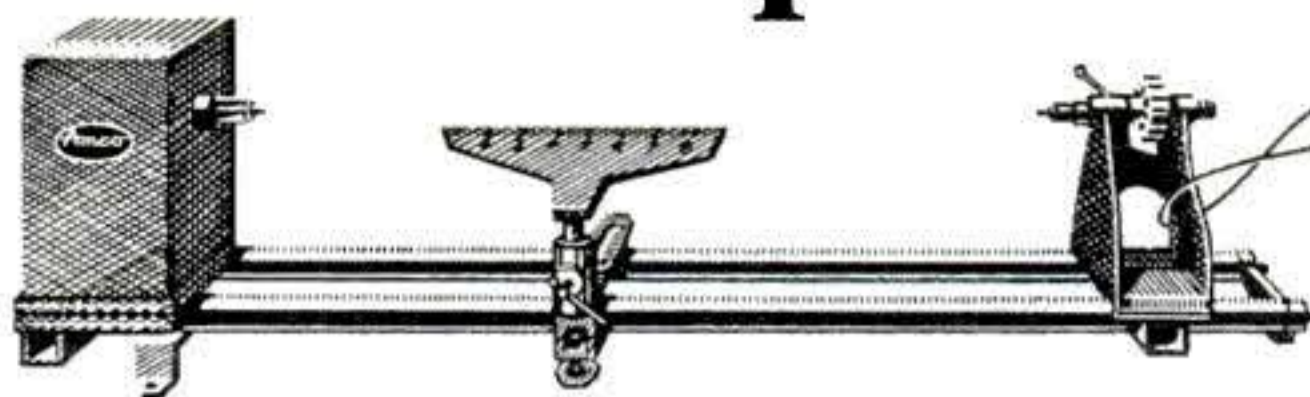
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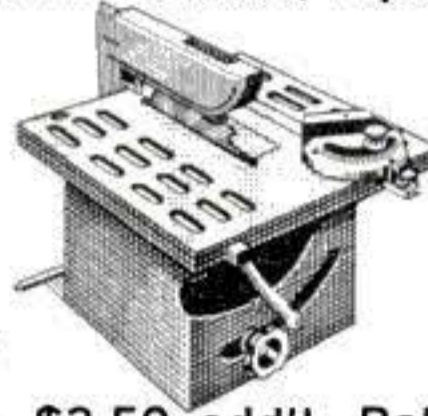
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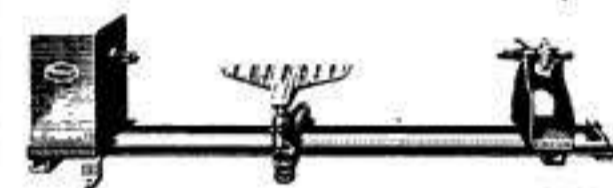
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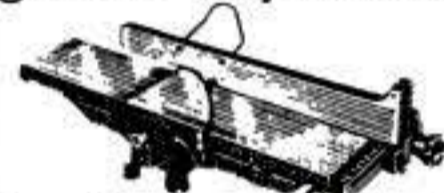
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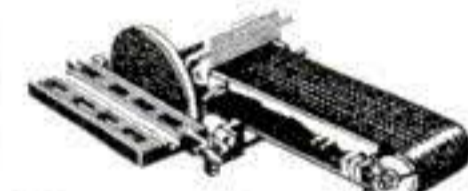
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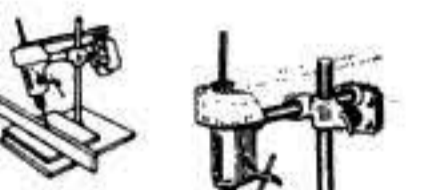
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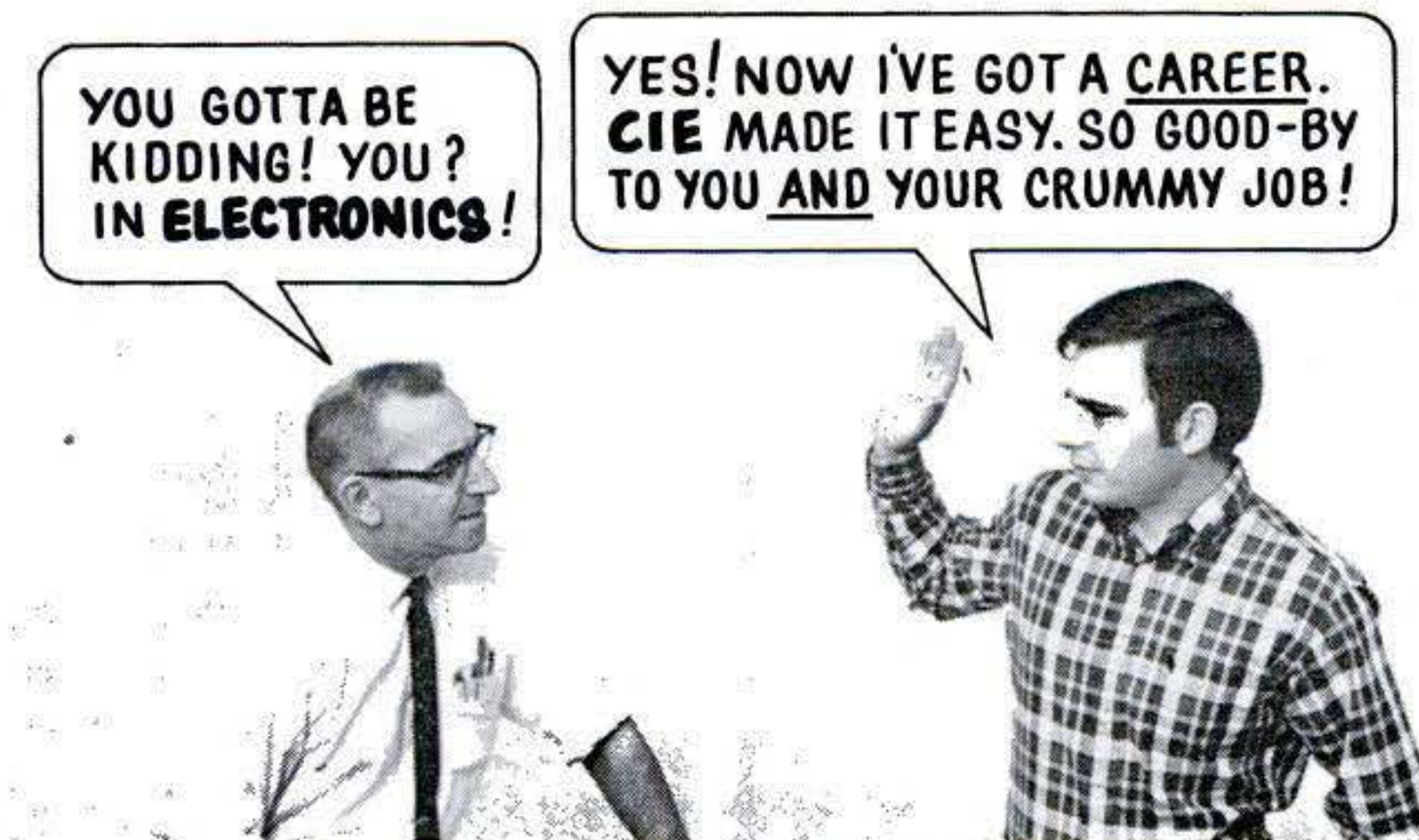
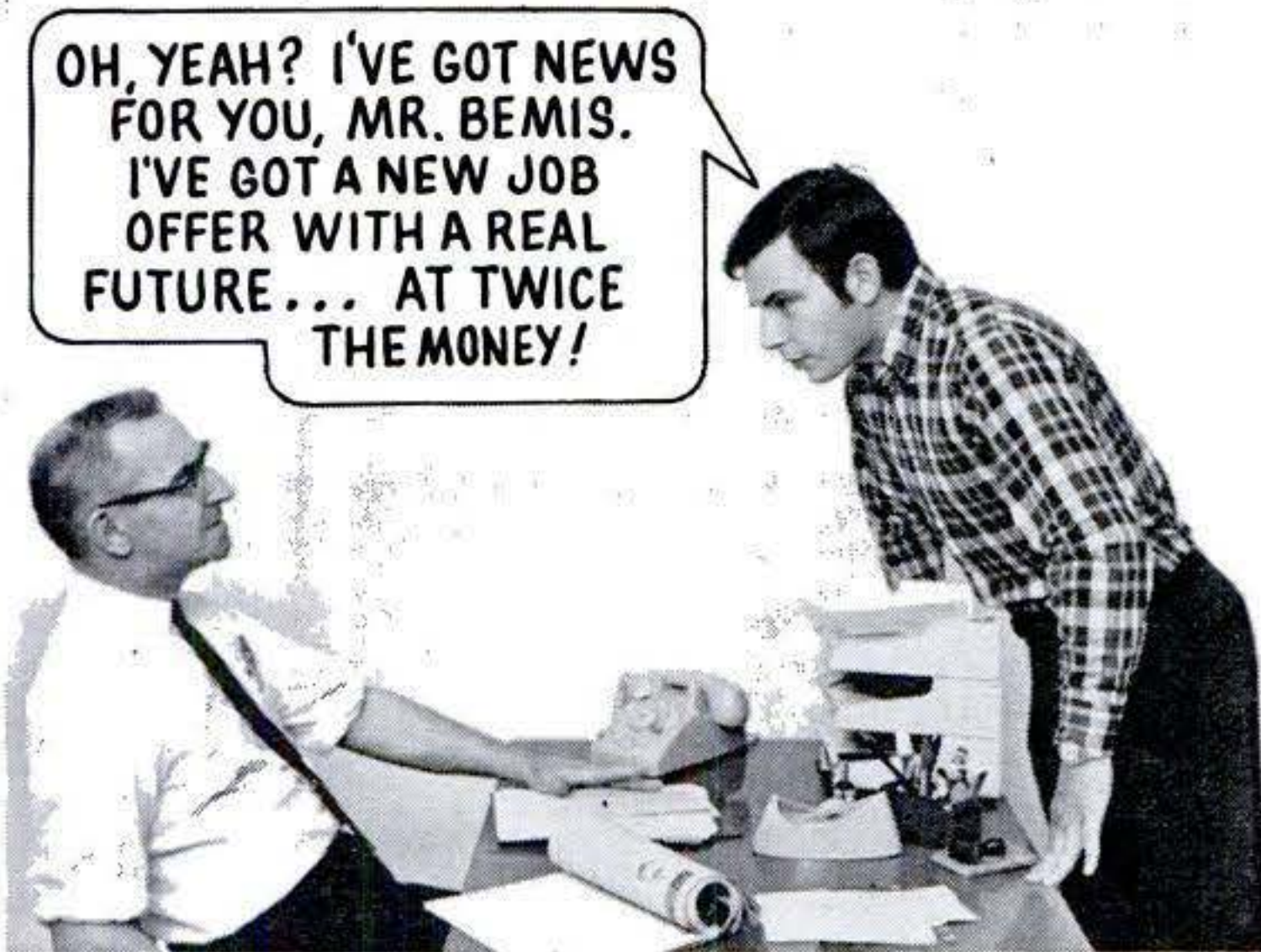
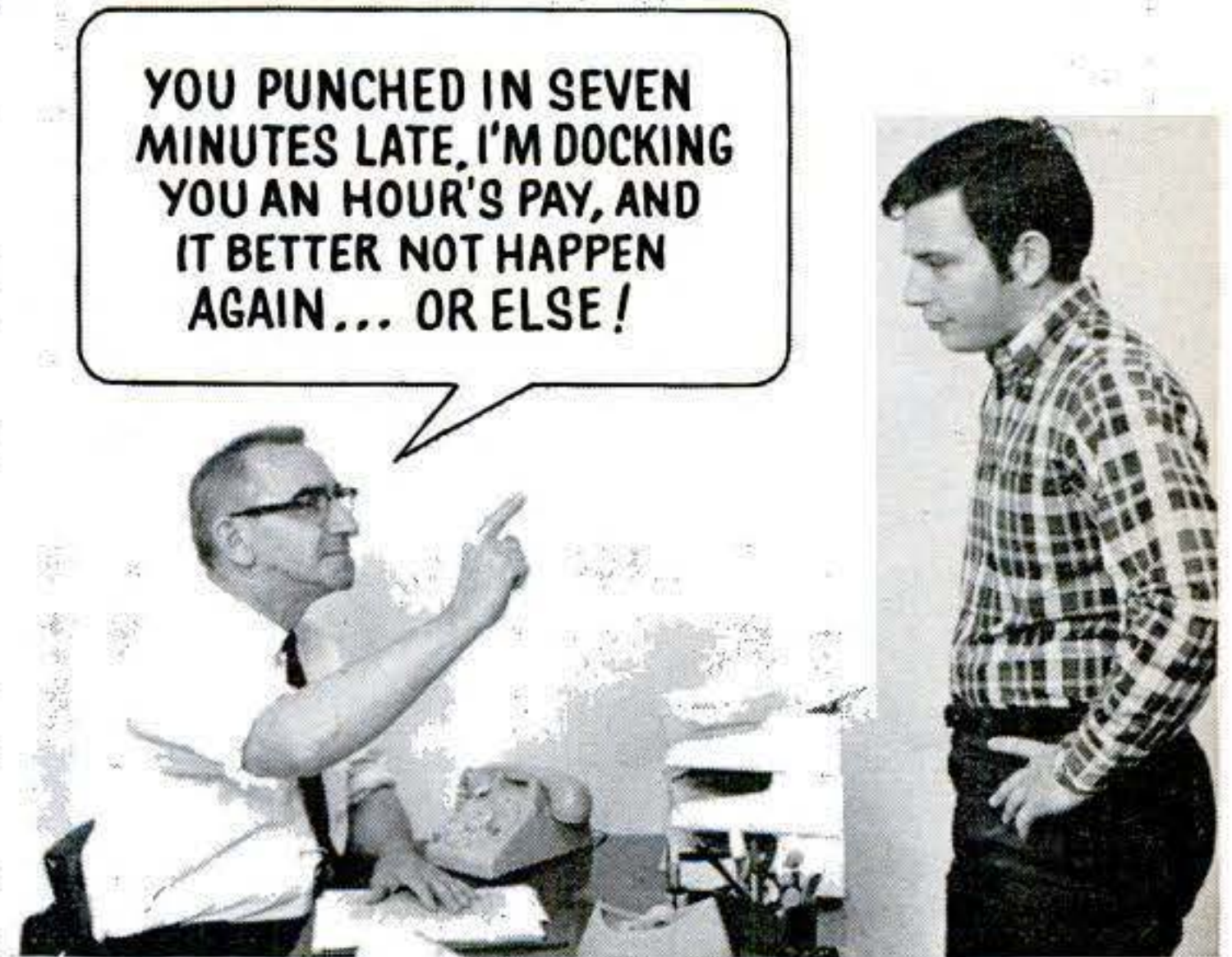
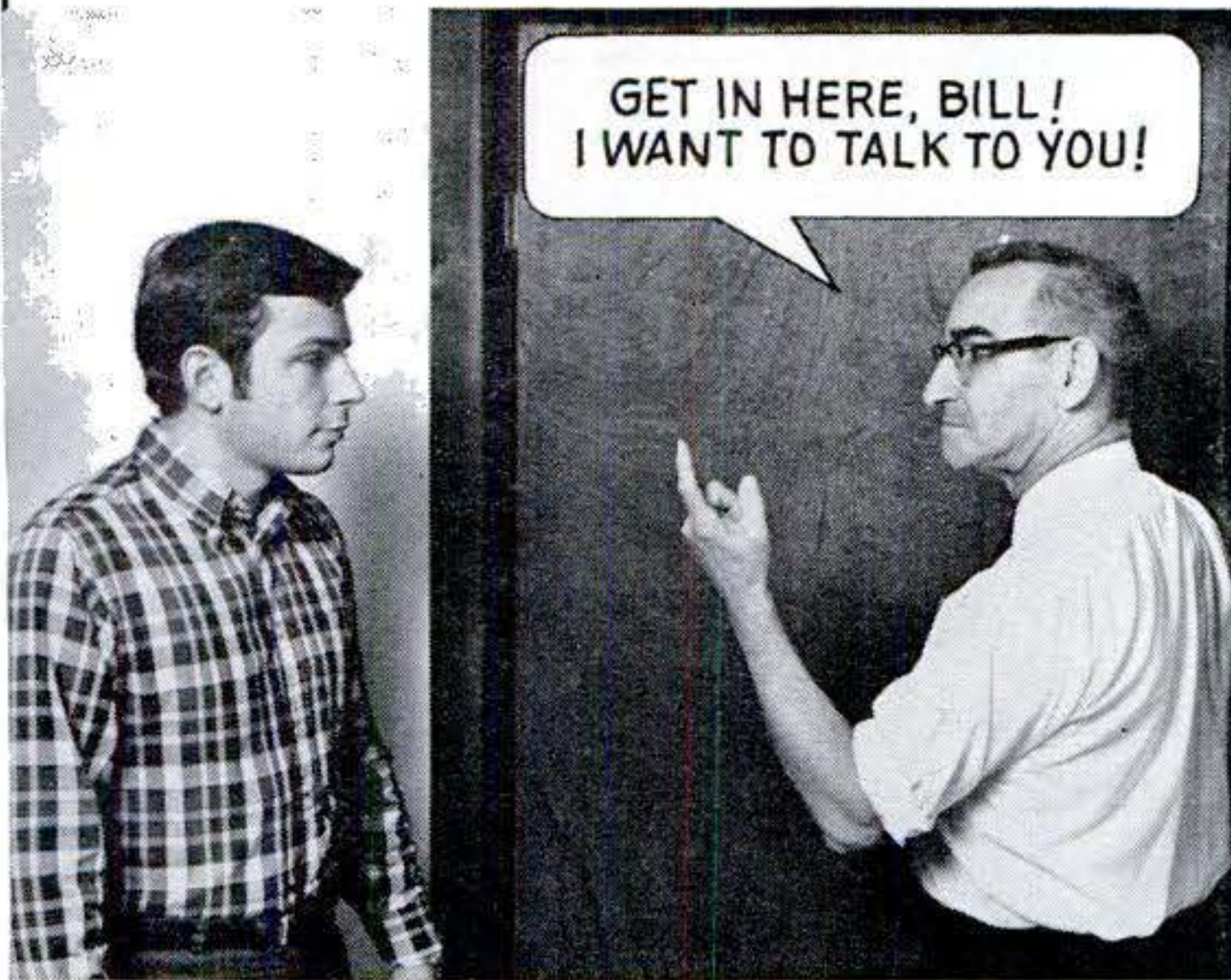
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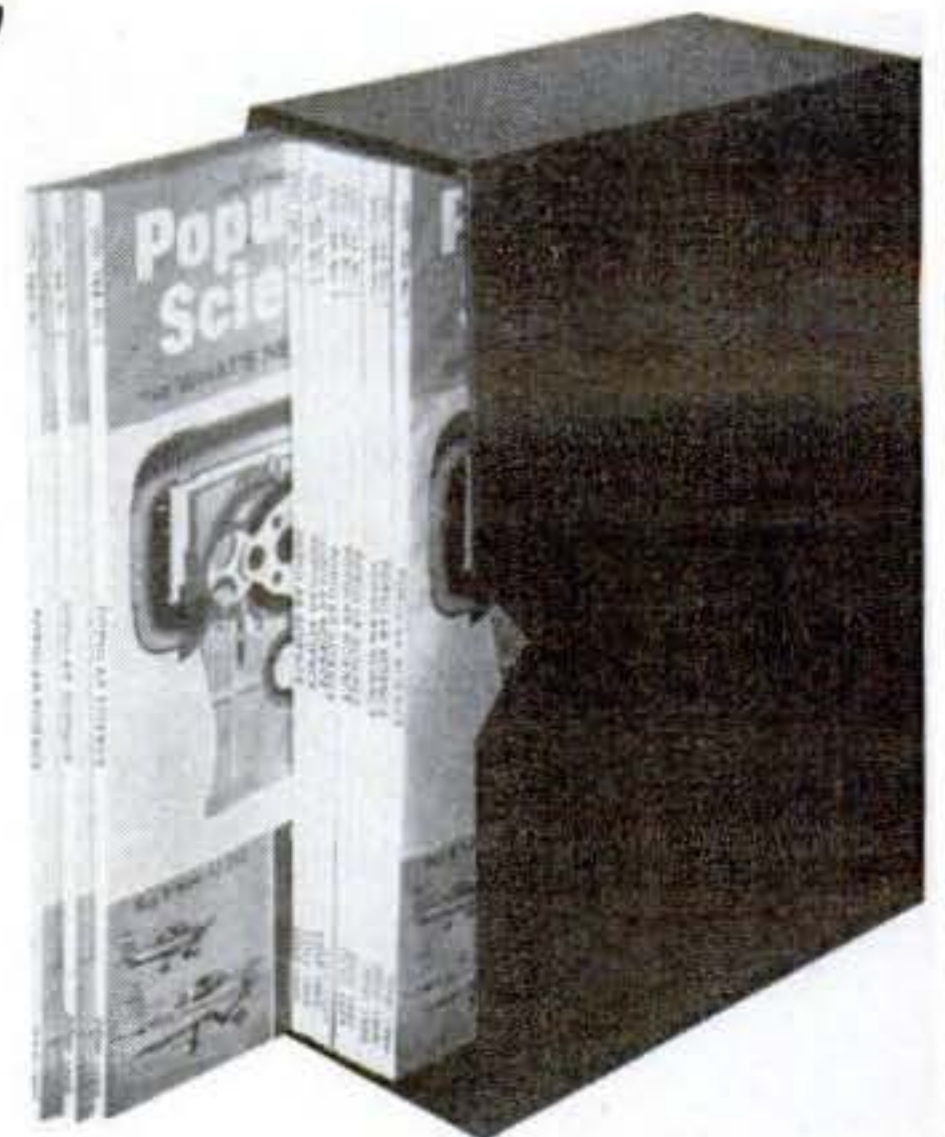
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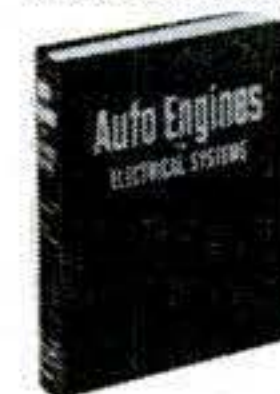
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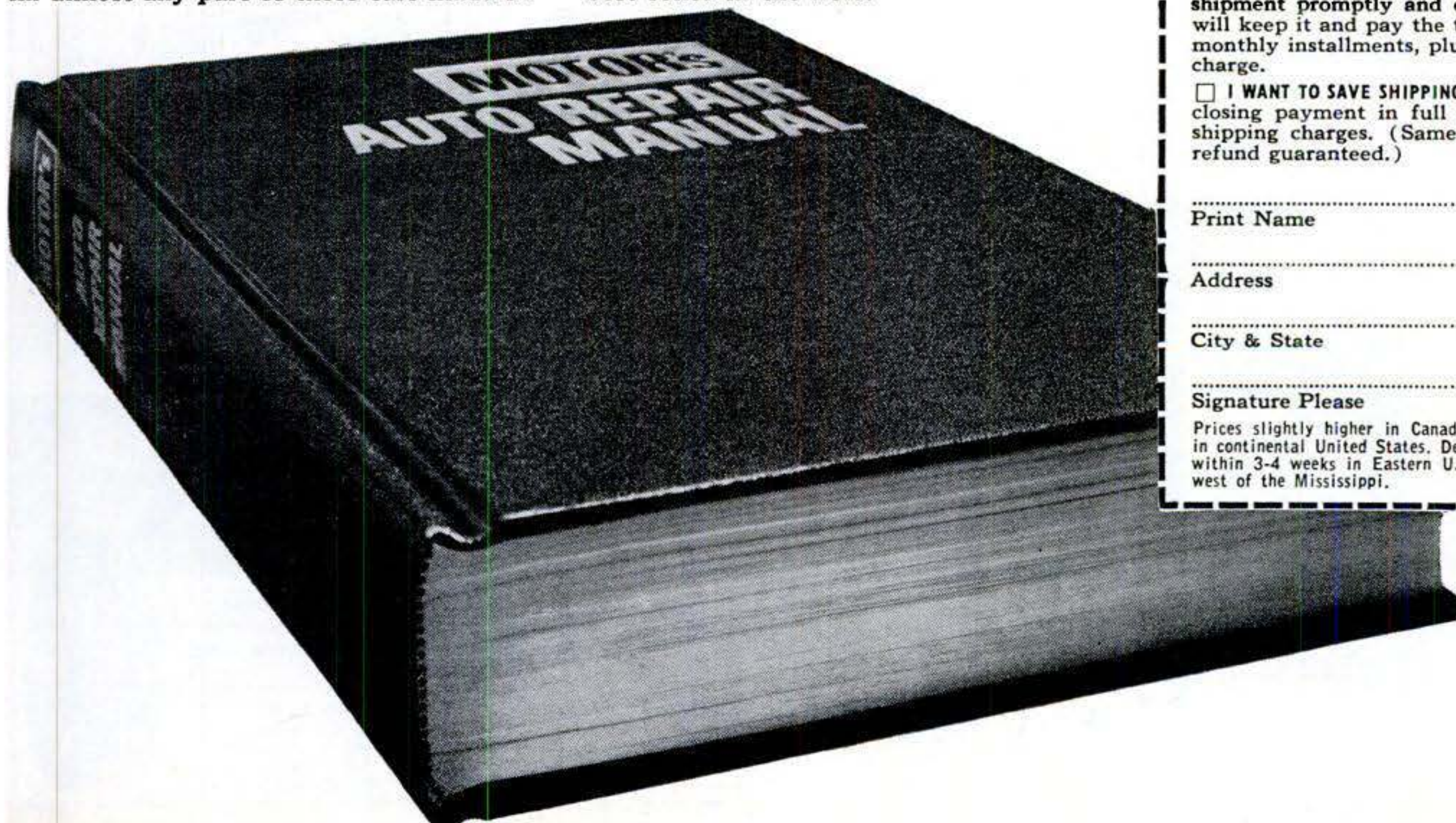
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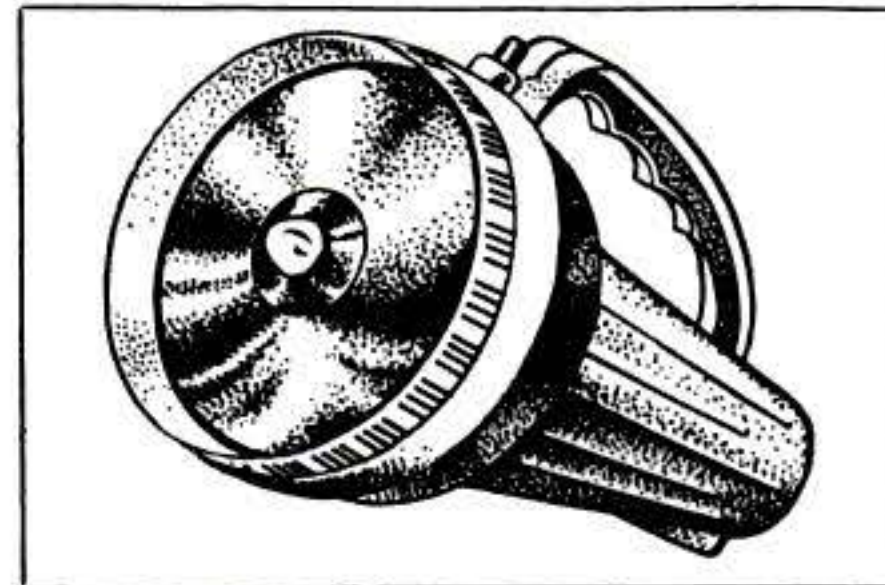
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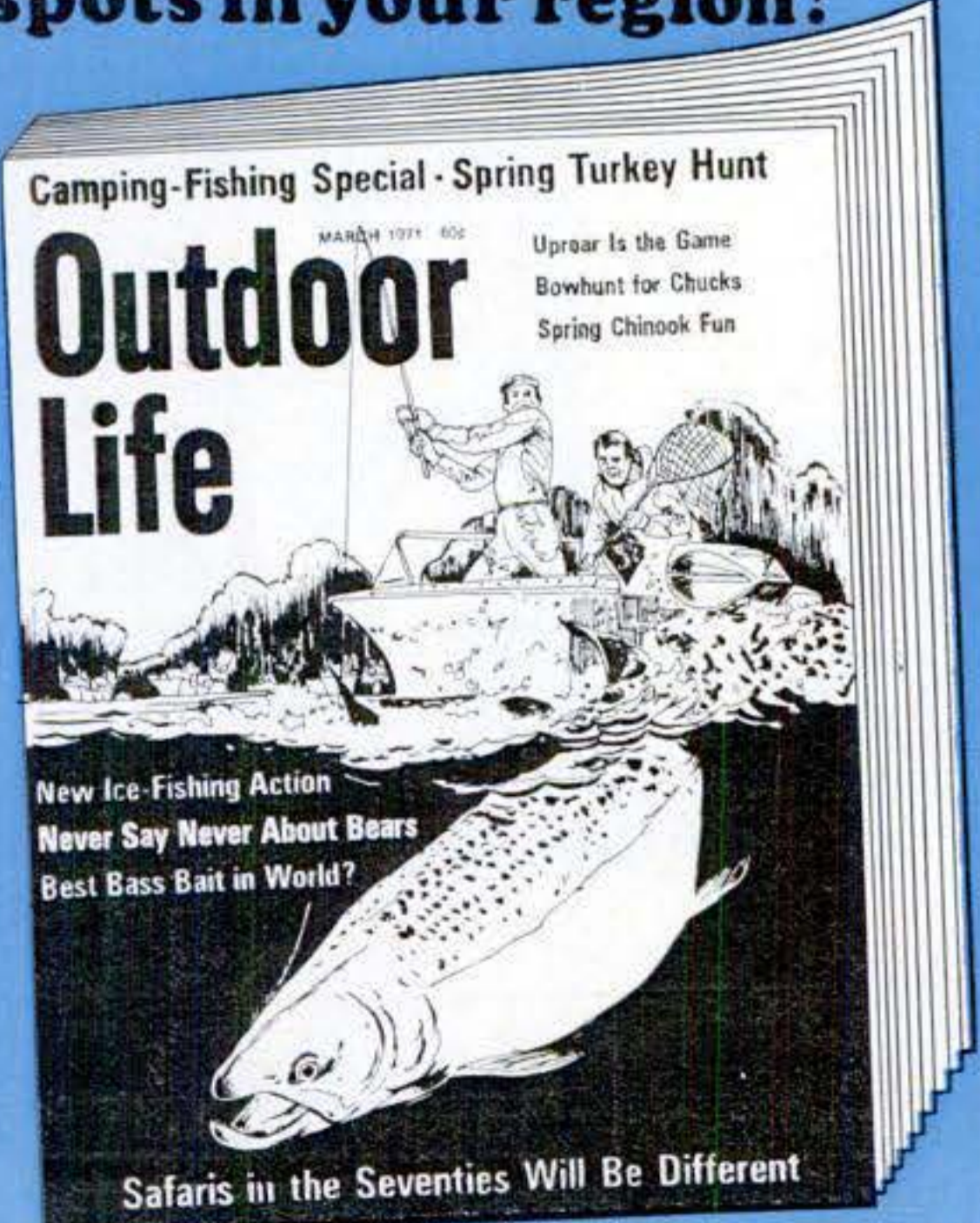
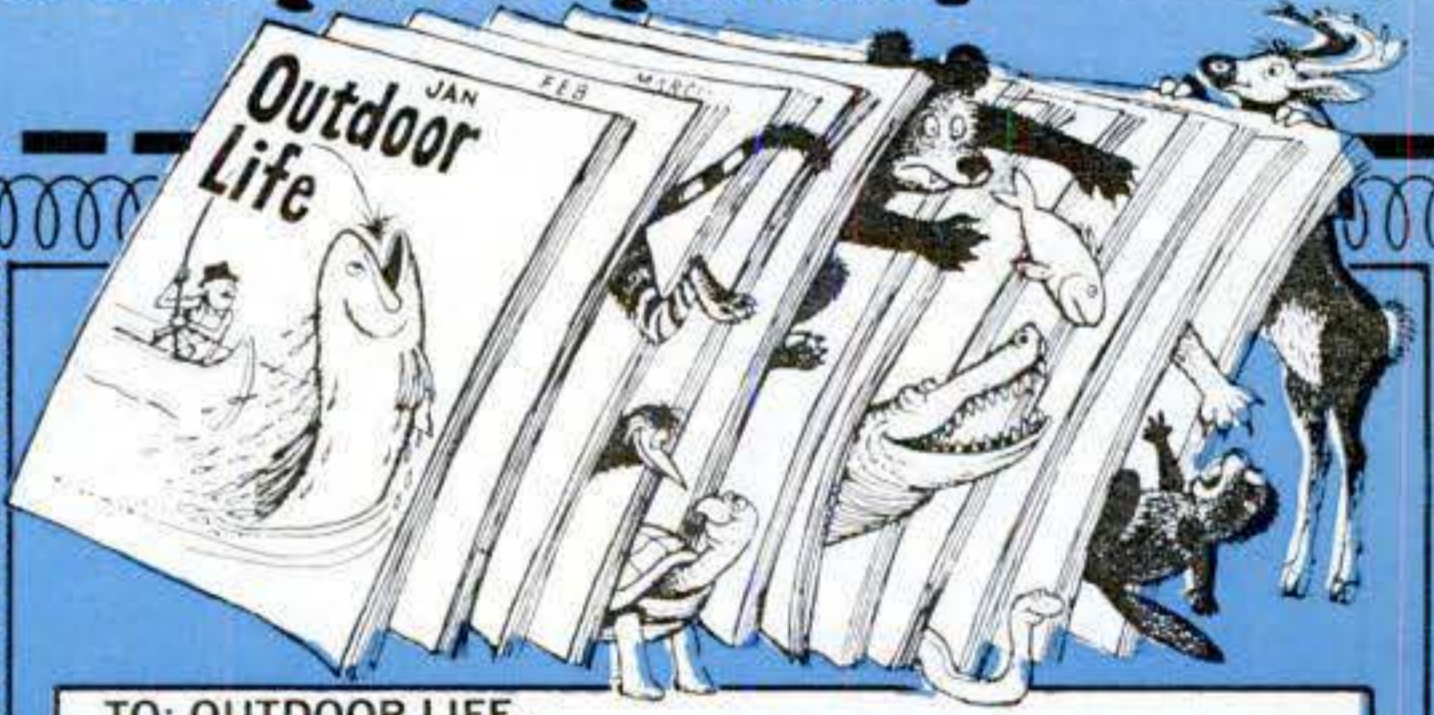
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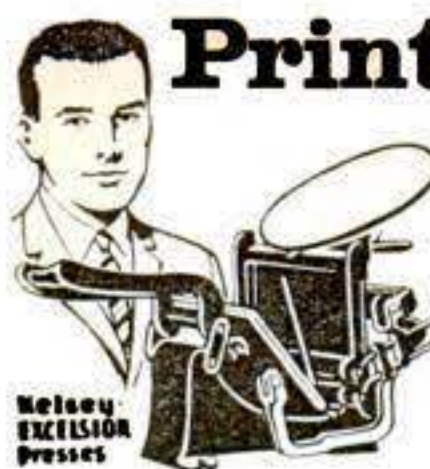
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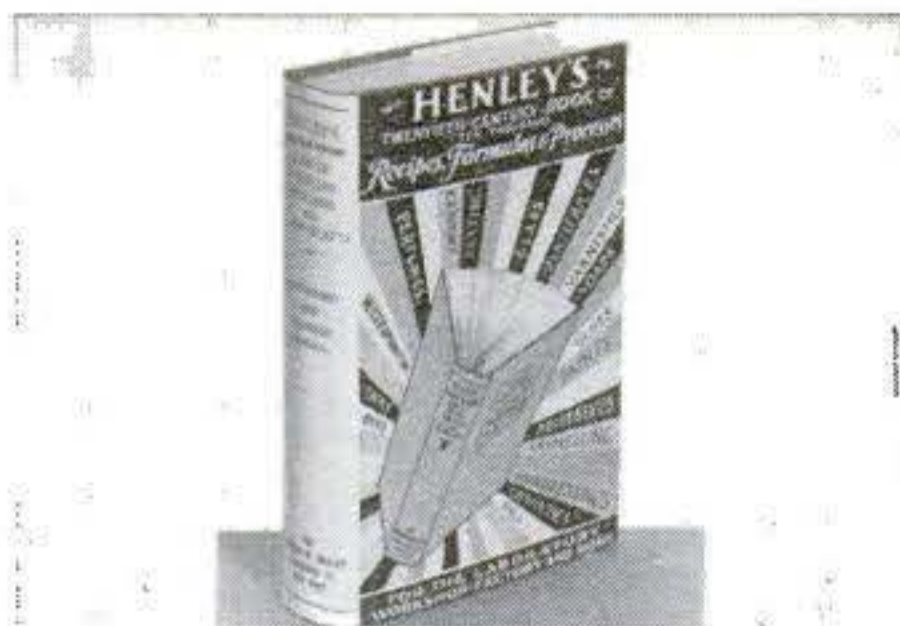
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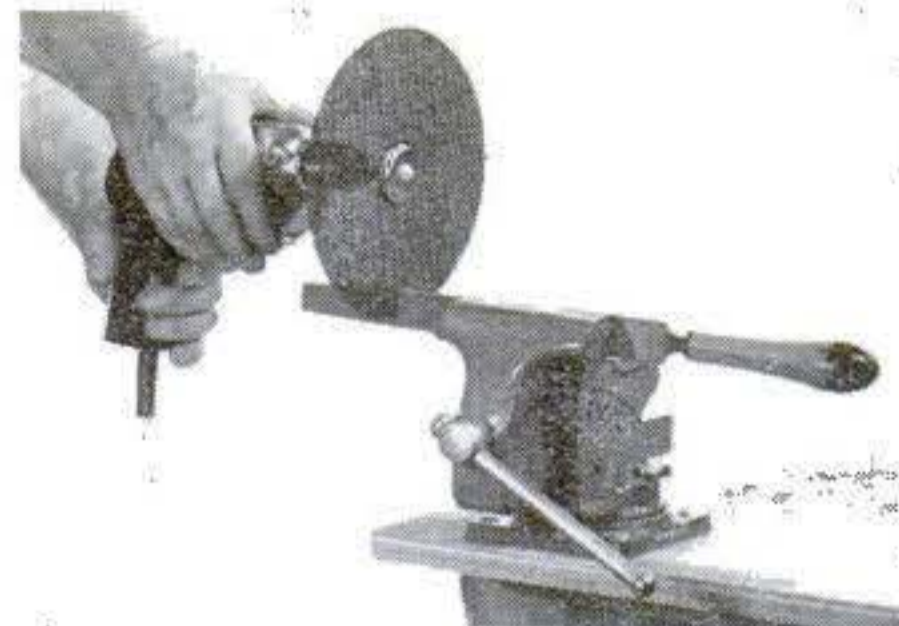
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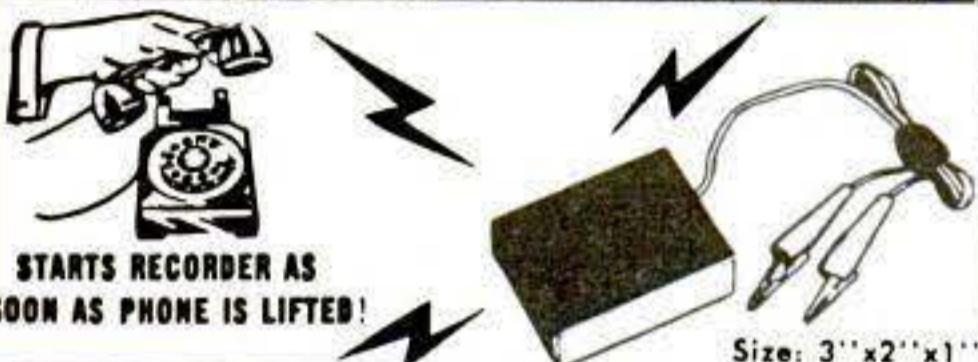


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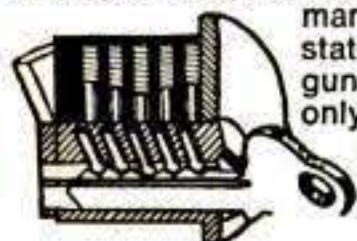
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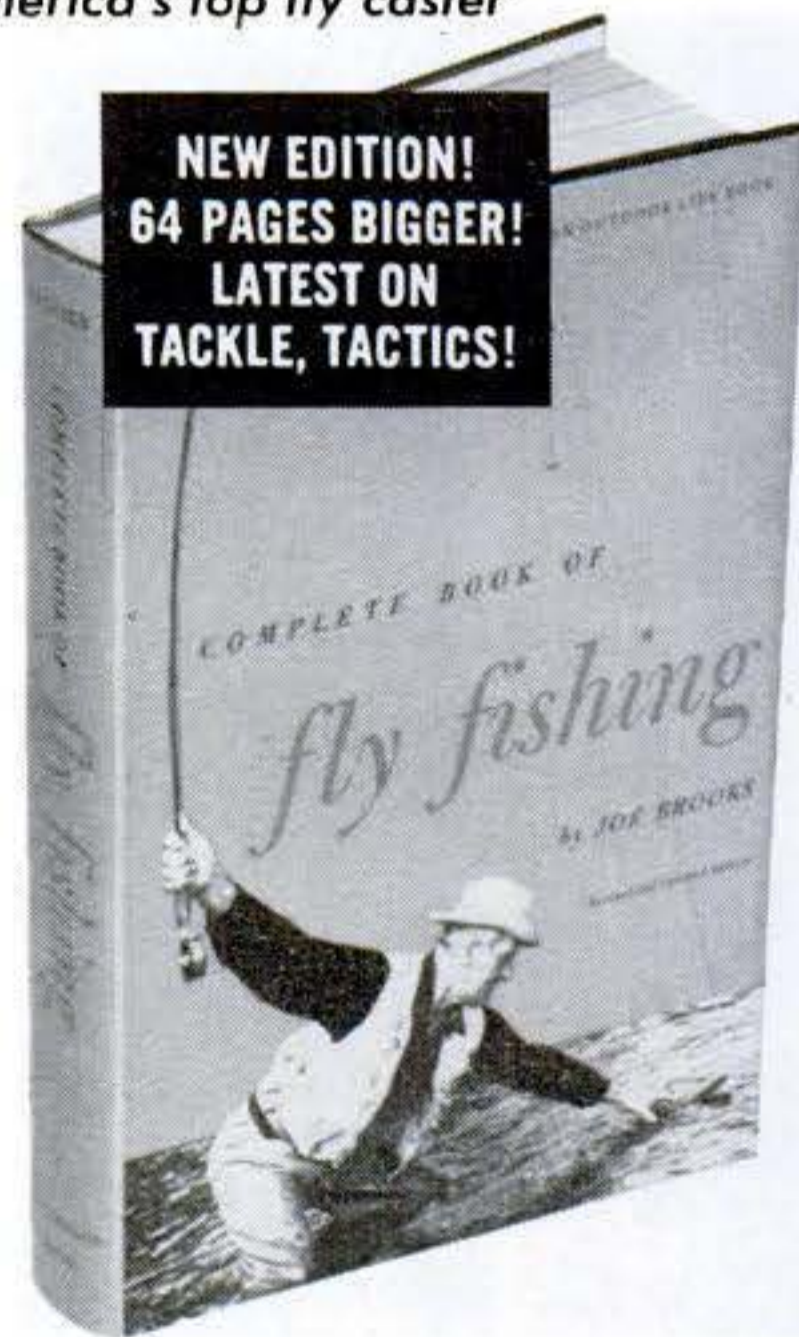
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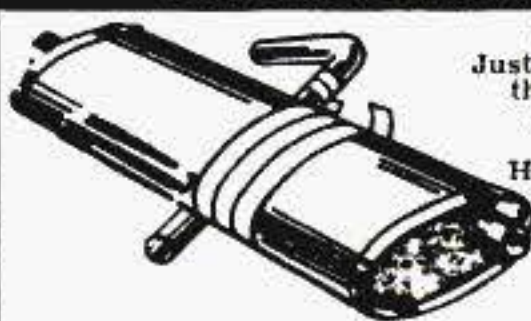
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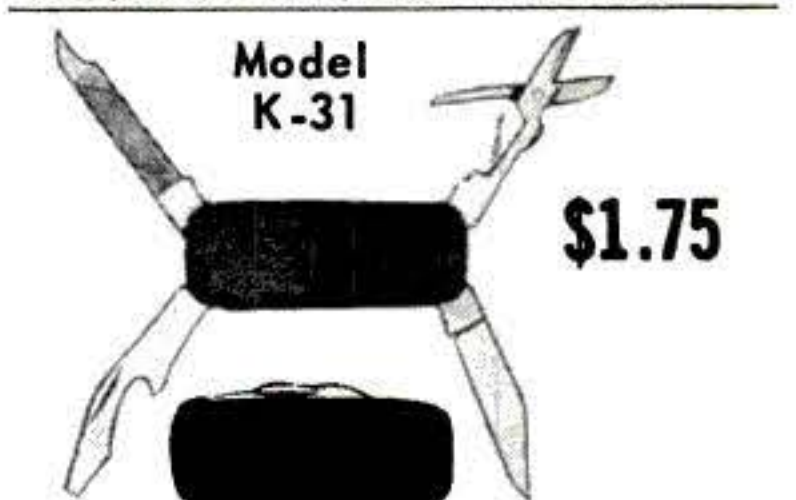
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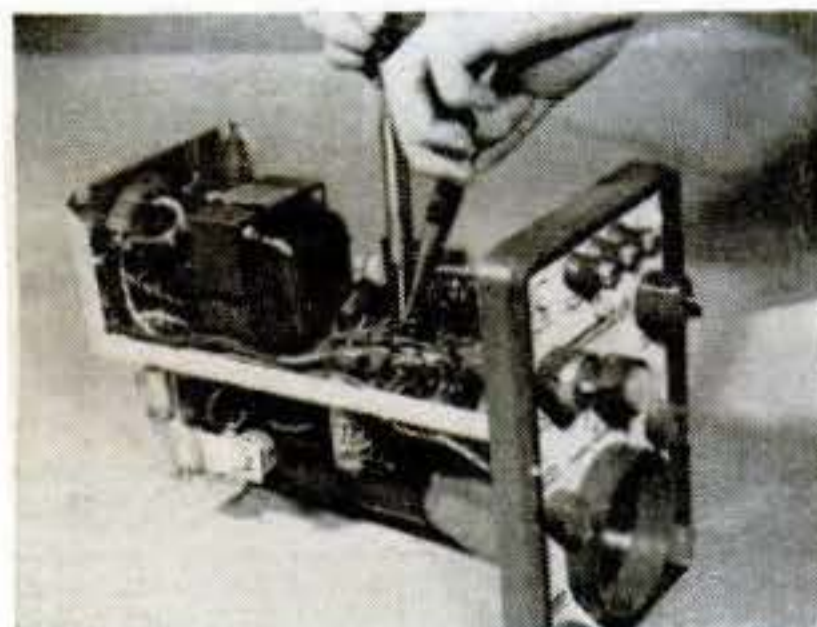
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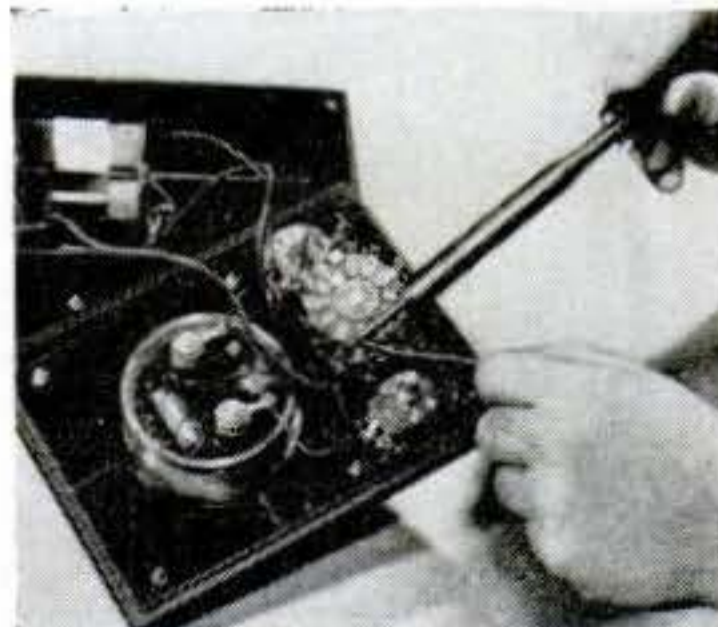
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You don't ski down a mountain  
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The fun is in how you get there.

The pleasure of motion under  
control.

Mustang drivers understand  
that. If all they wanted was to  
get from here to there, they'd be  
driving something else. Not a  
Ford Mustang.

With independent front sus-  
pension and an anti-sway bar to  
give you good control, good road  
handling.

With bucket seats to position  
you comfortably behind the  
wheel.

With a cockpit design and floor  
mounted shift that give you a  
beautiful feeling the instant  
you're inside.

There are five sporty Mustang  
models: Hardtop, SportsRoof,  
Convertible, Mach 1, Grandé. And  
a selection of five engines, three  
transmissions. What it takes to  
make driving a beautiful  
experience is what Ford  
puts into Mustang.



1972 Mustang Grandé, shown with optional white sidewall tires.

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