

NOVEMBER 1970

50 CENTS

Popular Science

THE *What's New* MAGAZINE

WARRANTIES—

What Are They Worth to You?

PLUS:

How Our New Warranty Law
Would Protect You

By Sen. Warren G. Magnuson

YOUR PERSONAL MEDITATOR

What It Is
How It Works
How to Make It

New No-Maintenance BATTERY FOR YOUR CAR

SPECIAL SECTION ON HOME ENTERTAINMENT

New Trends in
Sight and Sound Systems
Revolution in
Stereo Headphones
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Automatic Turntables
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Tape Systems
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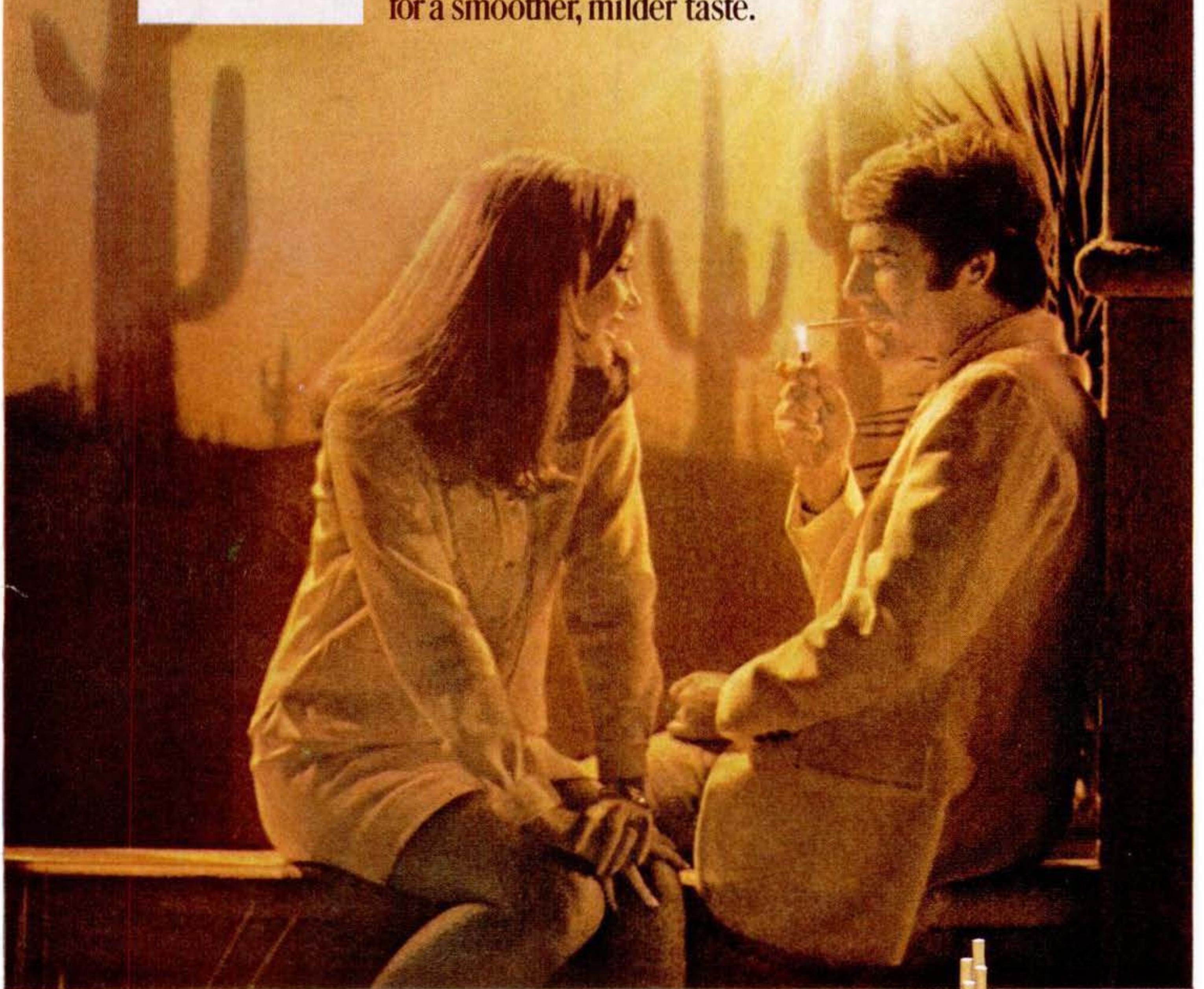
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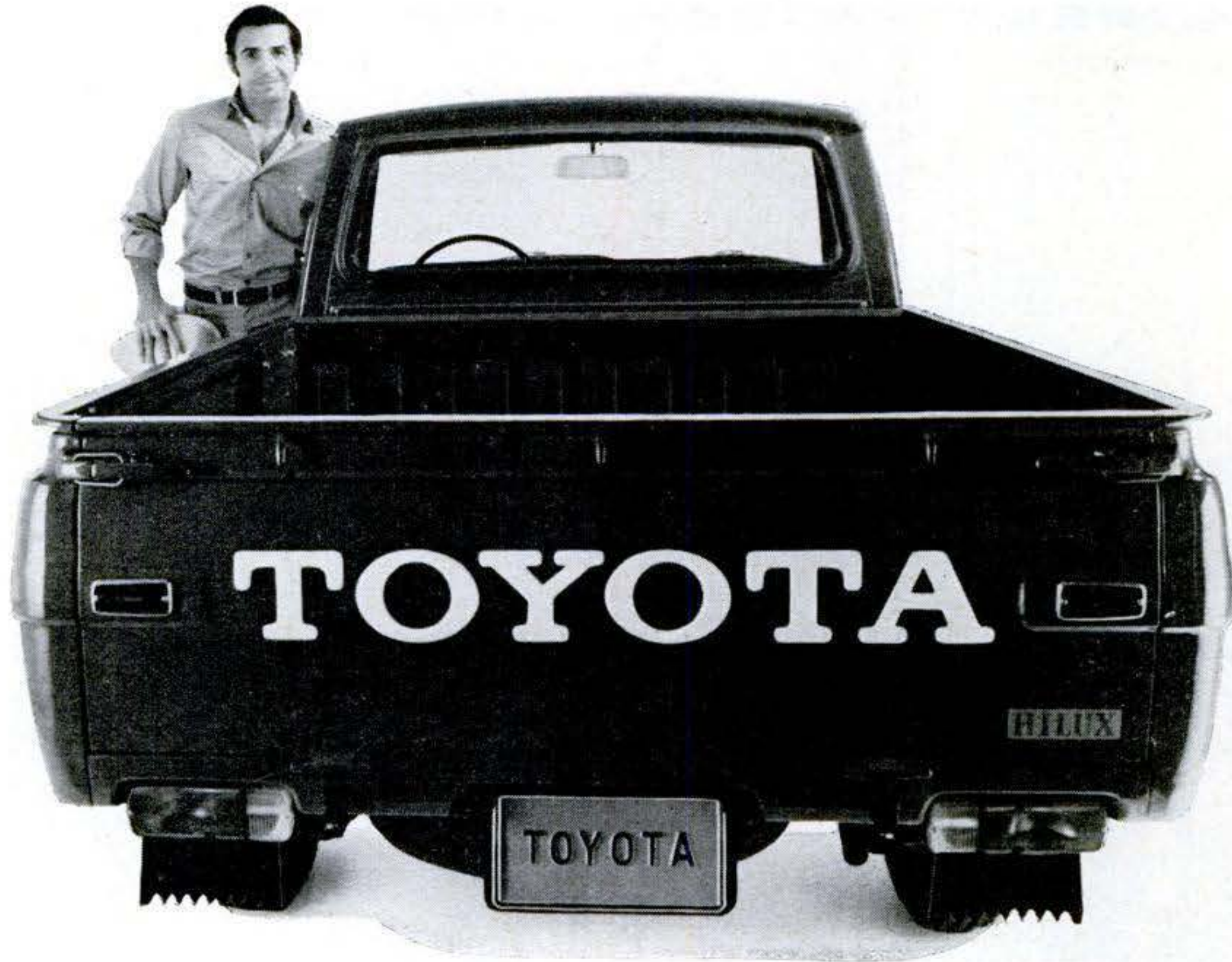
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The Toyota Half-Ton is a smaller truck than you're used to. Inside the bed measures approximately 72.8" x 56.3".

But it is all truck. And if it's all the truck you really need, it's worth looking into.



*Manufacturer's suggested retail price: \$1948. Dealer preparations, freight, taxes and any additional equipment extra. Toyota Motor Sales, U.S.A., Inc., 2055 West 190th Street, Torrance, California 90501.

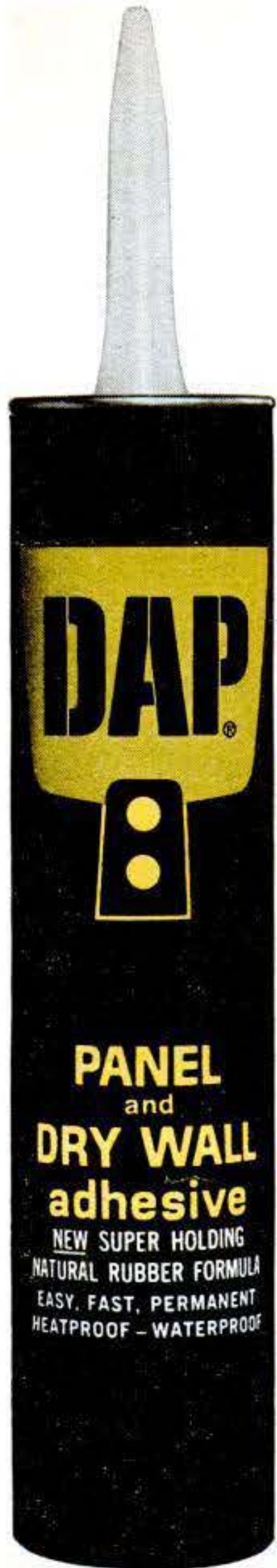
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Warranties—What Are They Worth to You? PAGE 55

PS surveyed America's major producers of consumer products, found some warranty improvement. But there's still need for important reforms.

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How Science Will Foil the Skyjackers PAGE 58

The air piracy epidemic can be stopped with new techniques + technology.

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Take in this ultralight fun car. Unique in design—but tops in mobility.

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Striking new "personal communicator" is easy to build from plywood pentagons.

COVER PHOTO BY JIM DAVIS

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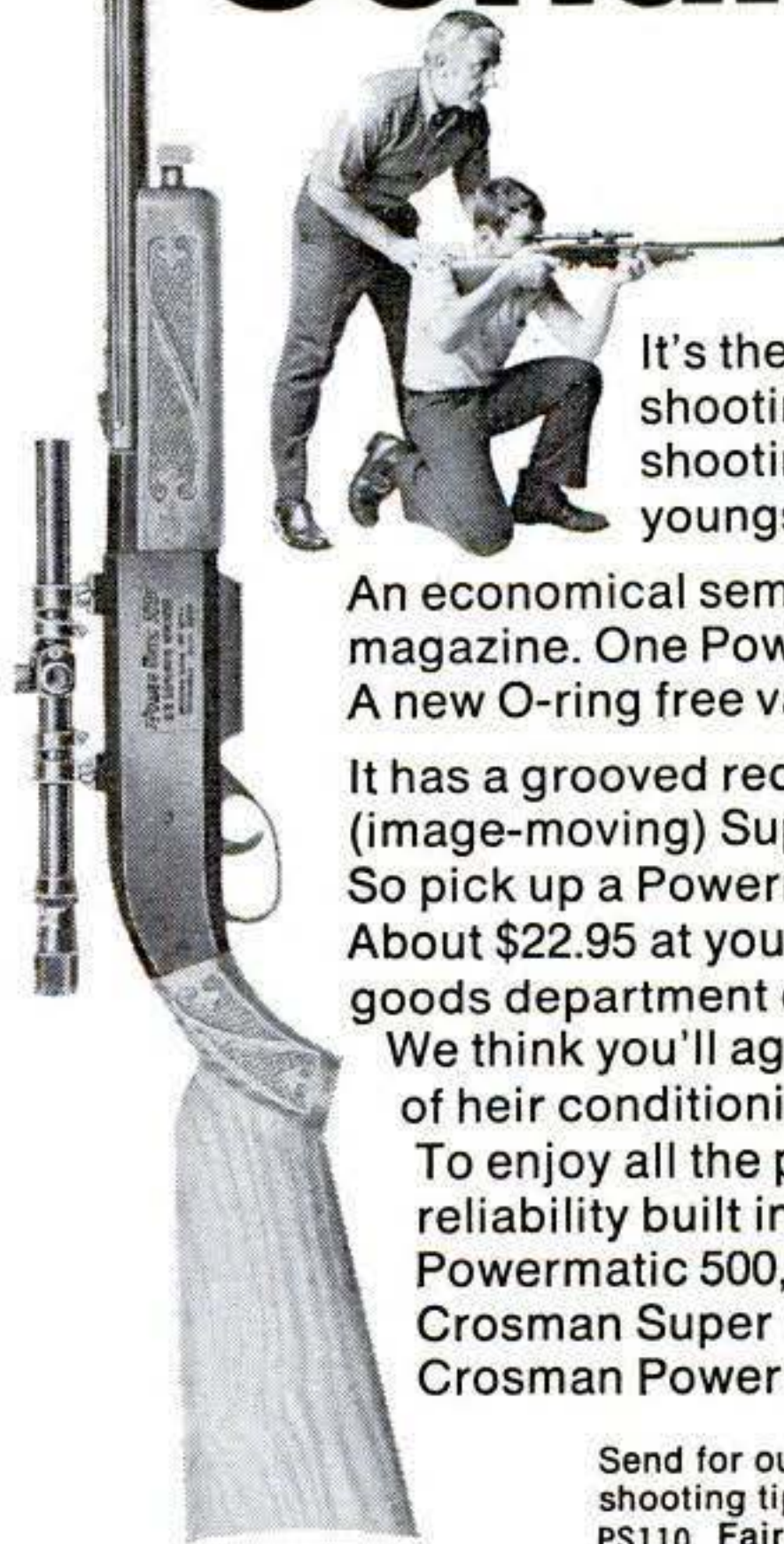
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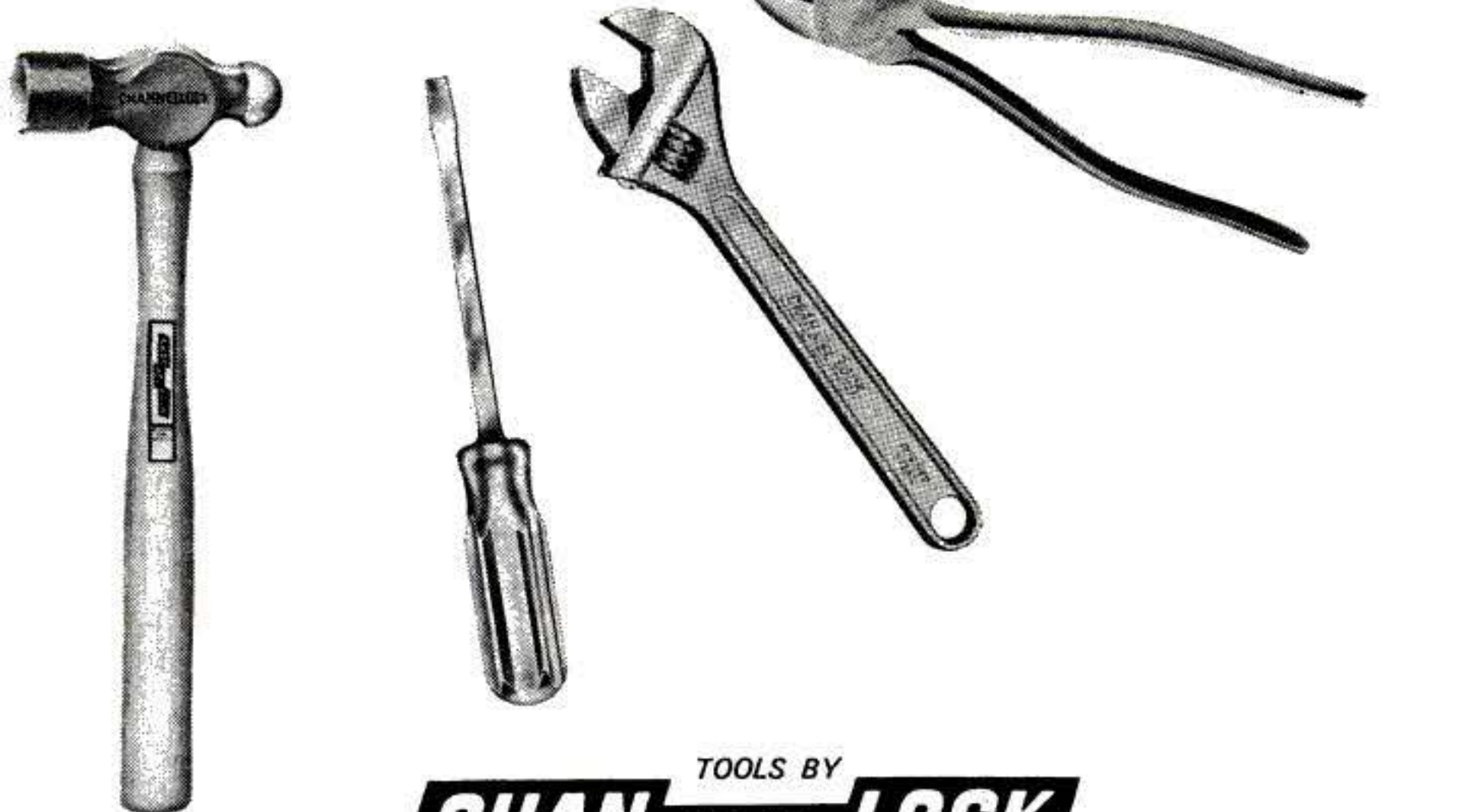
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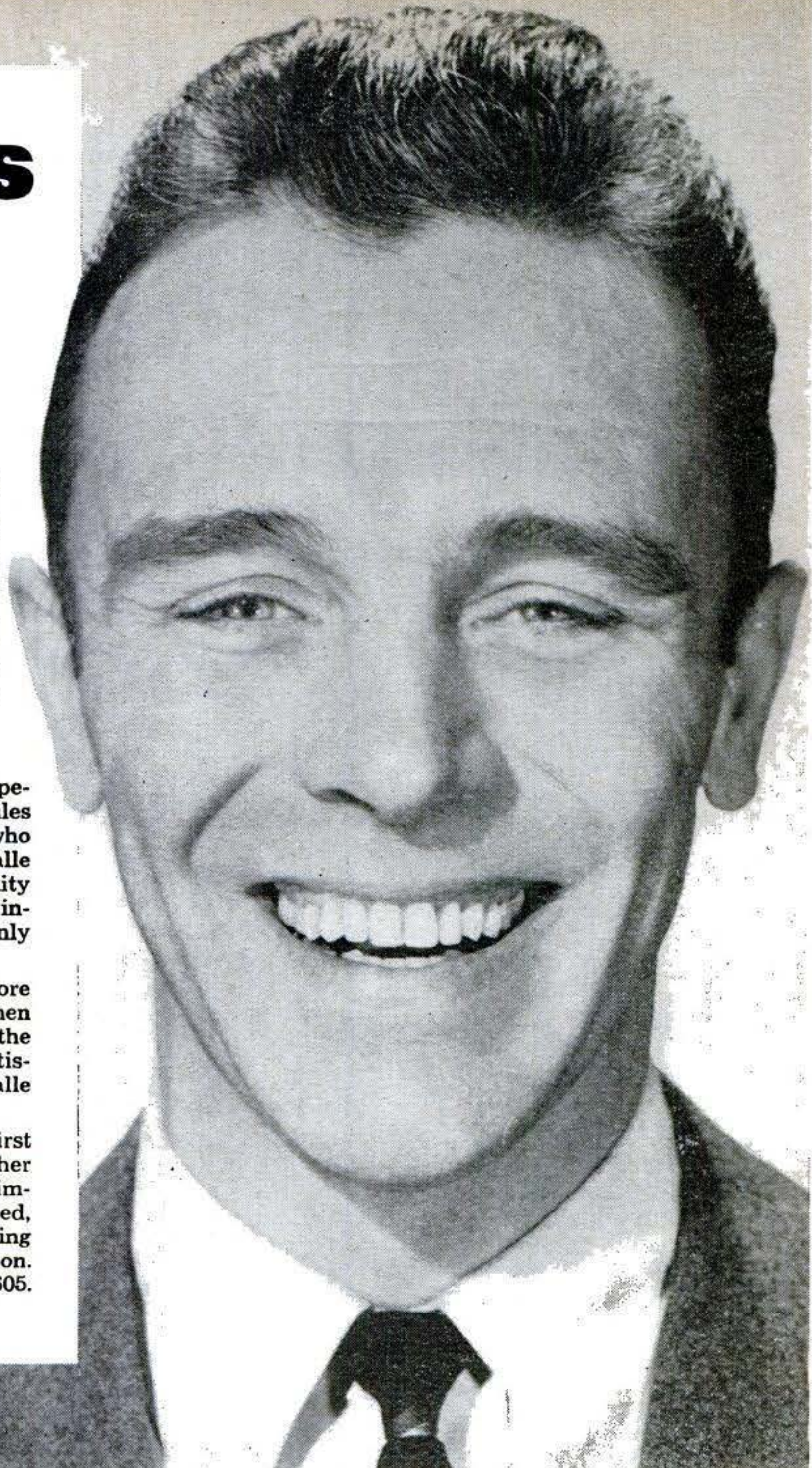
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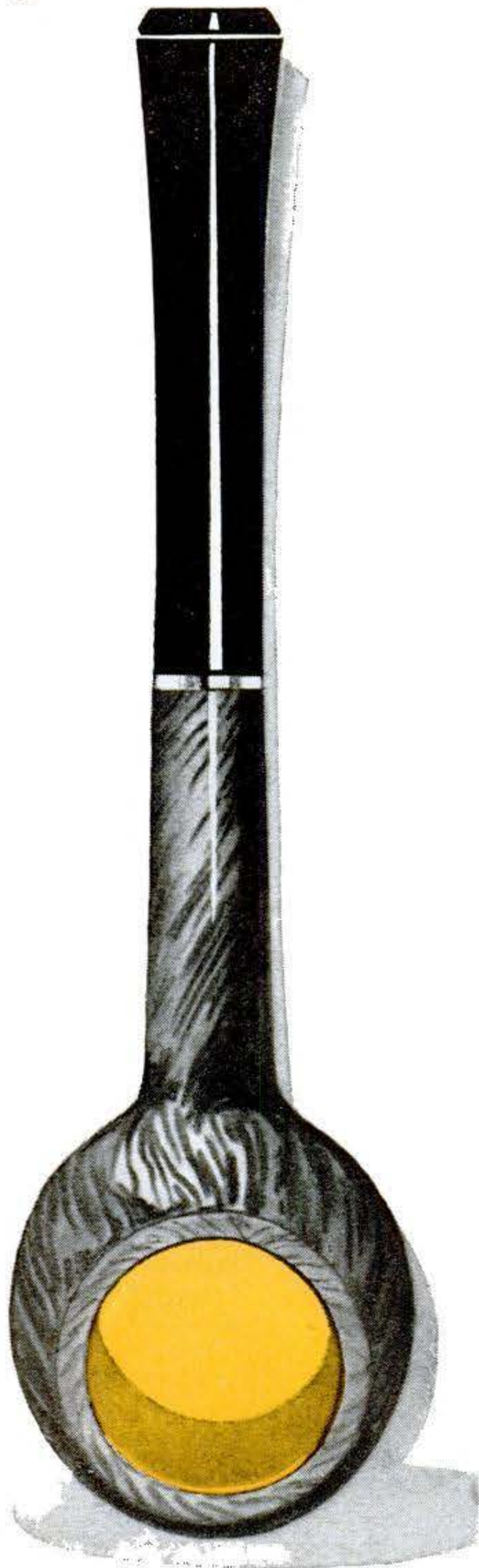
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Poor gas mileage bothers them

I have owned six Chevy Suburbans, all with stick shifts and six-cylinder engines. In 1957, I towed a 30-foot trailer to California and averaged 25 mpg. Recently I traveled 1,700 miles in a '69 Chevy Suburban with no trailer, and averaged 17.5 mpg. I'm told it is the anti-smog device that uses the extra gas—and that the device doesn't do the job. Otherwise, why should I use all this extra gas? I paid good money for the device and if it isn't practical do I have to keep on supporting it?

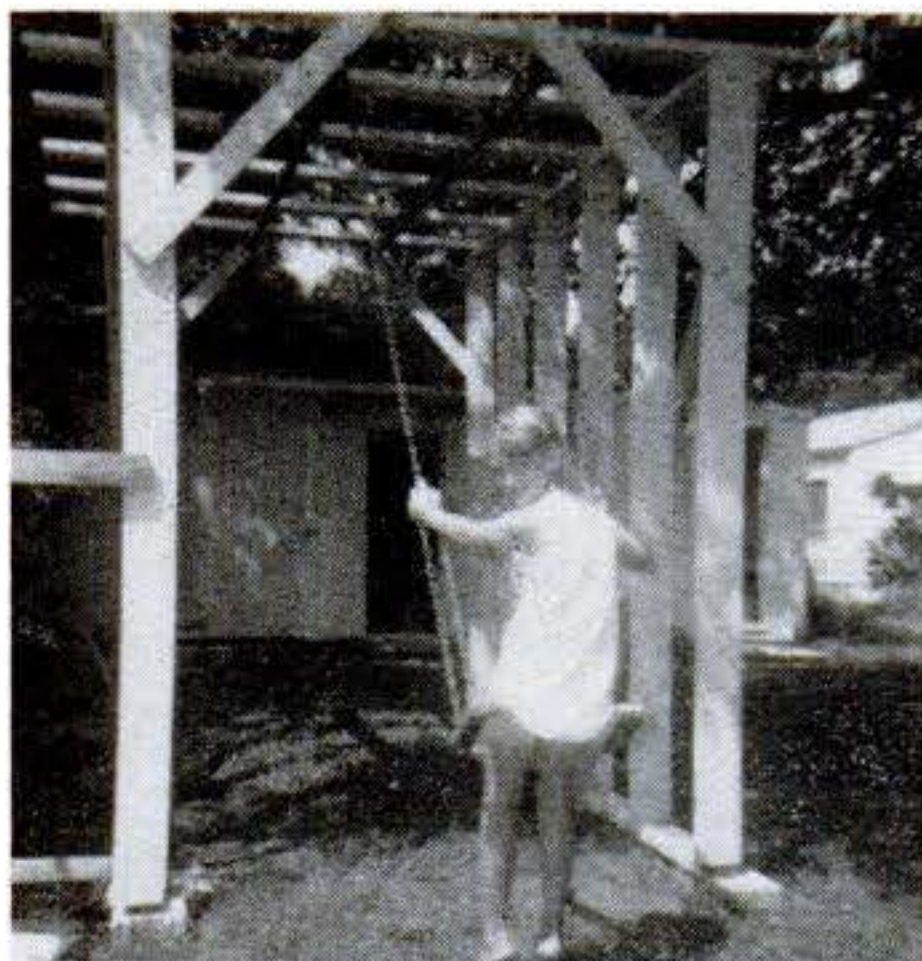
SPRAGUE W. BAILEY, Woodbury, Vt.

. . . Research needs to be done quickly on the number-one malady of all American cars—poor gas mileage with its accompanying hazard of high emission and cost. I'm not asking for 50 mpg, but would be delighted to get 17-20 mpg consistently. The high-power, low-mileage kick is the most impractical idea ever to come along for cars.

CRAIG R. BROUGHER, Prairie Village, Kans.



Swinging project



Thought your readers might like to see the zoom swing I built from plans given in "Build a Zoom Swing" (June).

PETER NILSEN
North Miami, Fla.

Mini-sauna voltage

You say the electrical requirements for the mini-sauna's door is 17,000 watts ("Tuck a Mini-Sauna Into a Corner . . . or a Closet," Sept.). Shouldn't that be 1,700 watts?

R. FRASER, New York City

Right you are.

Shotgun article on target

I heartily congratulate you on "What's The Right Shotgun for You?" (Sept.). PS should have more articles of this type for outdoorsmen.

JIM GRAND,
Philadelphia, Pa.



Observation gap

Your "International Inventor's Showcase" (July) shows Marco Marraccini's ingenious, but complex, up-and-down bicycle-pedaling device that overcomes the dead spot at the end of the pedal stroke. Another solution to this problem has been in use for many years. That's the simple toe-clip, snugged down over a sneaker or combined with a slotted shoe cleat, which locks the foot into the pedal.

Once locked in, you get 360-degree endless power by setting up a spinning motion, while using your gearshift to keep pedal effort at an acceptable level. This solution is a product of professional racing technology. The nation that produces the ultimate in this kind of light-metal precision engineering is Signor Marraccini's Italy. Even in the U.S., you can see people with toe-clips and cleats running their Campagnolo-gear bicycles around the parks on warm days. Is there no window in Signor Marraccini's workshop?

A. J. BUDRYS, Chicago, Ill.

Roving camper's complaint

The report that a reservation system is to be applied to National Park camping sites ("Recreation Roundup," June) would be the most asinine solution any moron ever conceived. The great majority of campers will find the reservation will prove to be an unjust restraint. Few campers have a planned itinerary. Most are explorers and many spend the season roaming around the States.

California and Oregon have reservation systems which offer a doubtful advantage to a small number of campers with planned vacations. It operates in reverse for most people.

E. J. STEPHENSON,
Santa Rosa, Calif.



Looking for cast lead sheet?

In the box with your article "New Ideas for Noise Control at Home" (Sept.) you state that a cast lead sheet called Sheald, made in Canada, "will

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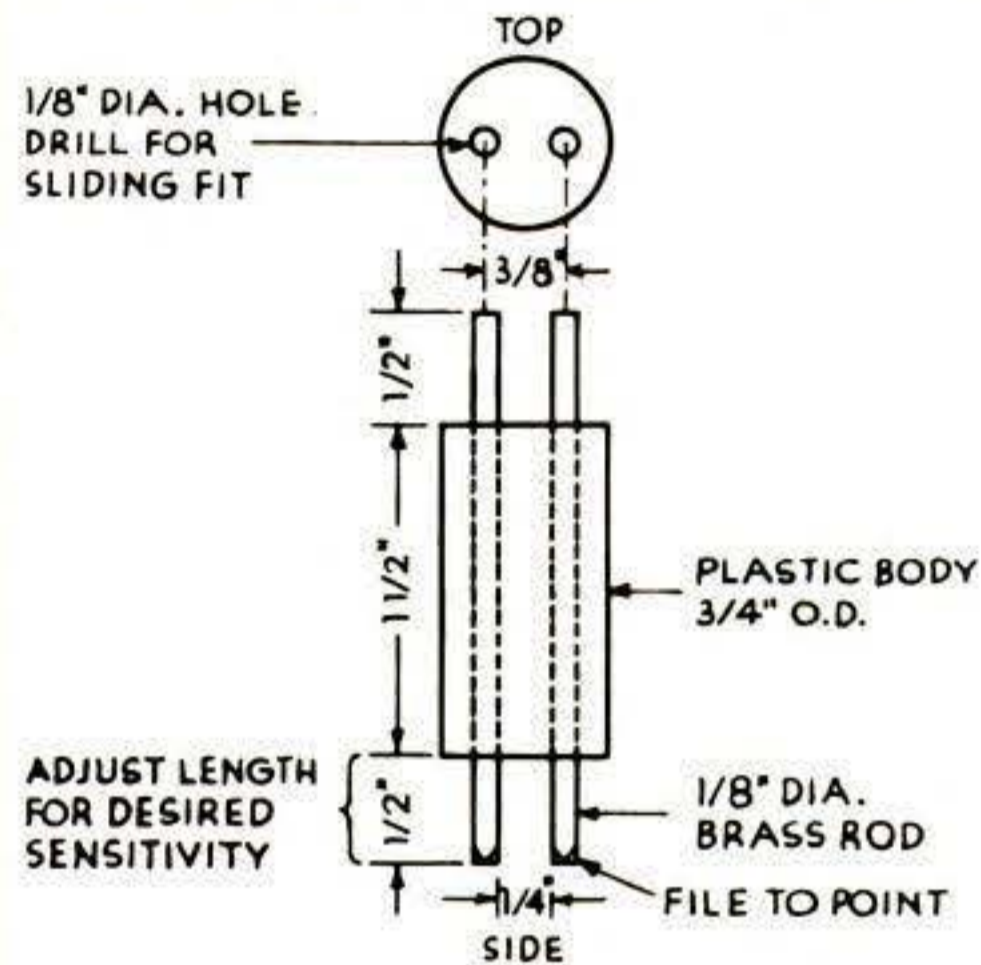
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JIM ANDERSON, Essexville, Mich.

Converting the water tester

Could the instrument described in "Build Your Own Portable Water Tester" (Sept.) be used to check moisture content in the ground or in foundry sand?

C. H. HUBACHEK, No. Branford, Conn.



Author Paul Emerson says that for testing moisture in ground, a solid probe with pointed electrodes should be used with the portable water tester. The proper design is shown above. Electrode length can be adjusted to get the desired sensitivity, then be glued in place.

Super flywheel

I noted some flaws in the design of the "Super Flywheel to Power Zero-Emission Car" (Aug.) that should be pointed out. The flywheel is rotating at a speed comparable to a jet aircraft engine. Pilots are never seated on the plane of rotation of turbine or compressor blades, because if the turbine should throw a blade, it would go through the whole aircraft like butter. You show bus passengers and driver in the same plane of rotation as the flywheel. What if the flywheel should break loose or a piece break off? At 27,000 rpm there wouldn't be much left of the occupants.

Even though the flywheel has a long way to go, it would be an ingenious power source in space.

D. W. SCHROLL, Fairborn, Ohio



The flywheel's designer points out that it is made up of many stressed strands rather than a single piece. This should result in a relatively progressive failure, rather than an instant one, as when the flywheel is made in a single piece.

... How can this wheel deliver 17.5 hp for two hours? If it could, you would have perpetual motion with a big margin of surplus power. I calculate the mini-car would require 17.5 hp on level

roads. Granting 100 percent overall efficiency, and assuming the 222-pound wheel has the equivalent of its mass centered at 10-inch radius at which 23,700 rpm is 2,069 fps, then acceleration would require 0 to a peak of 37 hp, or an average of 18.5 hp for 24 minutes.

E. I. MCGEE, Conneaut, Ohio

The designer says his flywheel would require only 4.48 hp, cruising at 55 mph—not 17.5 hp.

... It seems the cordless drill would be very difficult to handle and use, due to the effect of the gyroscopic precession from the flywheel.

GREGORY L. WHITE, Athens, Ala.

The flywheel's gyro effect could be expected to give such a tool quite a different "feel" from a standard one. Whether this would be a hindrance would have to be demonstrated.

Shatter-resistant glasses

A colleague has brought me to task for using the term "shatterproof" in regard to glass lenses when writing "Making Glasses Fit Your Job" (Aug.). "Shatterproof" was probably an inaccurate description of tempered glass lenses because they will break under severe impact. "Shatter-resistant" would have been more accurate.

JACK RUNNINGER, O.D., Rome, Ga.

Where to find it

I took a fancy to the "Marble-Topped Table You Can Build" (May) and decided to try it. But I'm having trouble finding the brass ferrules for the bottom of the legs. Can you tell me where to find them?

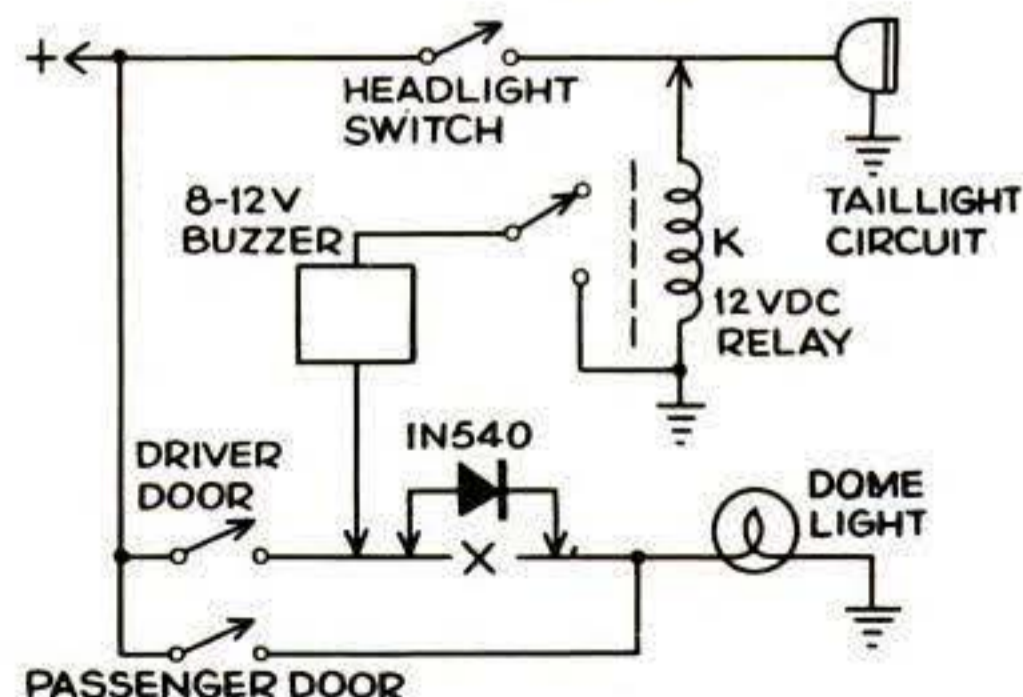
RICHARD TAYLOR, Elmhurst, N. Y.

Author Frank Greenwald says you can get the four 1" sockets from Craftsman Wood Service, 2727 Mary St., Chicago, Ill. 60608 for \$4.95 postpaid.

Ford owners take note

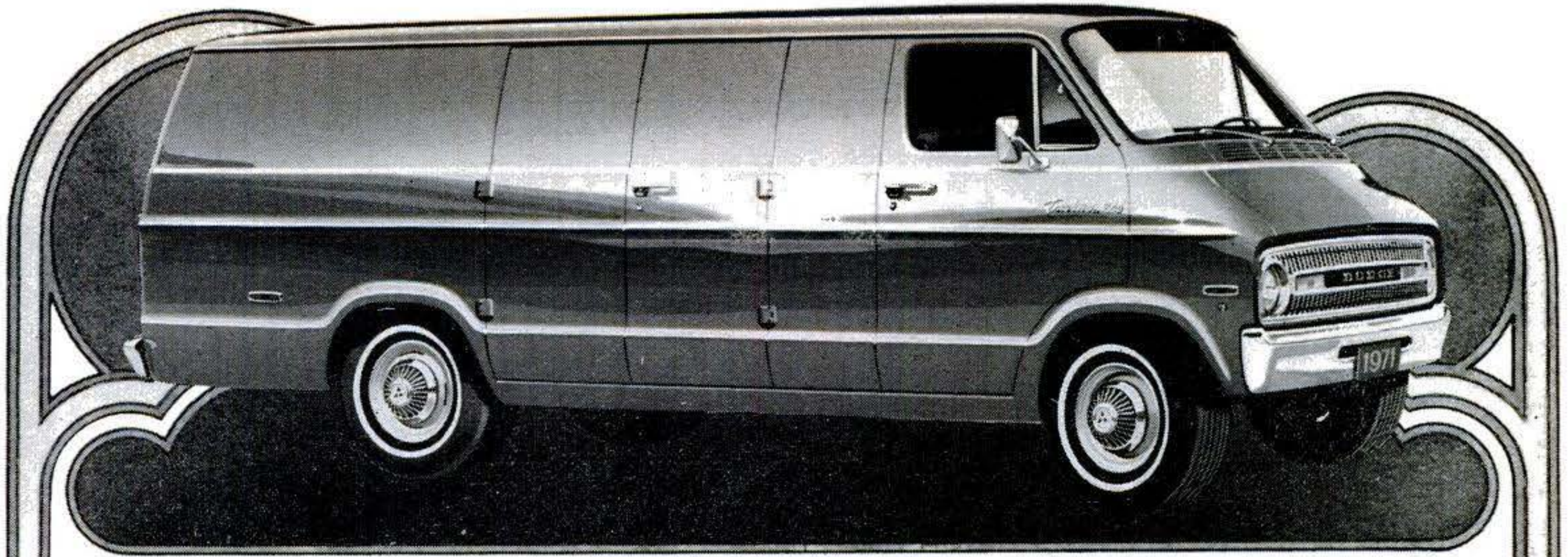
The taillight-circuit warning buzzer described by Sid Claire in "Two Automatic Reminders to Keep Yourself on the Ball" (Sept.) will not work in Fords. Ford has two wires to the door-jamb switch rather than one as most other cars have.

G. F. FREESEK, Charlestown, S.C.


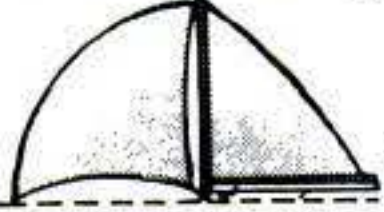





Right you are, but the schematic above will do the job for Ford owners.

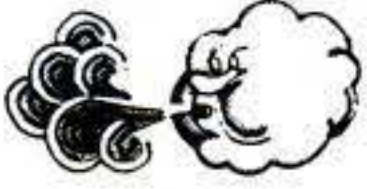
Want to get something off your chest? Write "Readers Talk Back," Popular Science, 355 Lexington Ave. New York, N.Y. 10017.



THE NEW DODGE MAXIVAN TRADESMAN

will carry a 12-foot sailboat , plus its mast , a living room-size roll of carpeting , a snooker table , or a full-size alligator , under cover, and still give you all 31

features the other **Dodge Strong Box** models do.

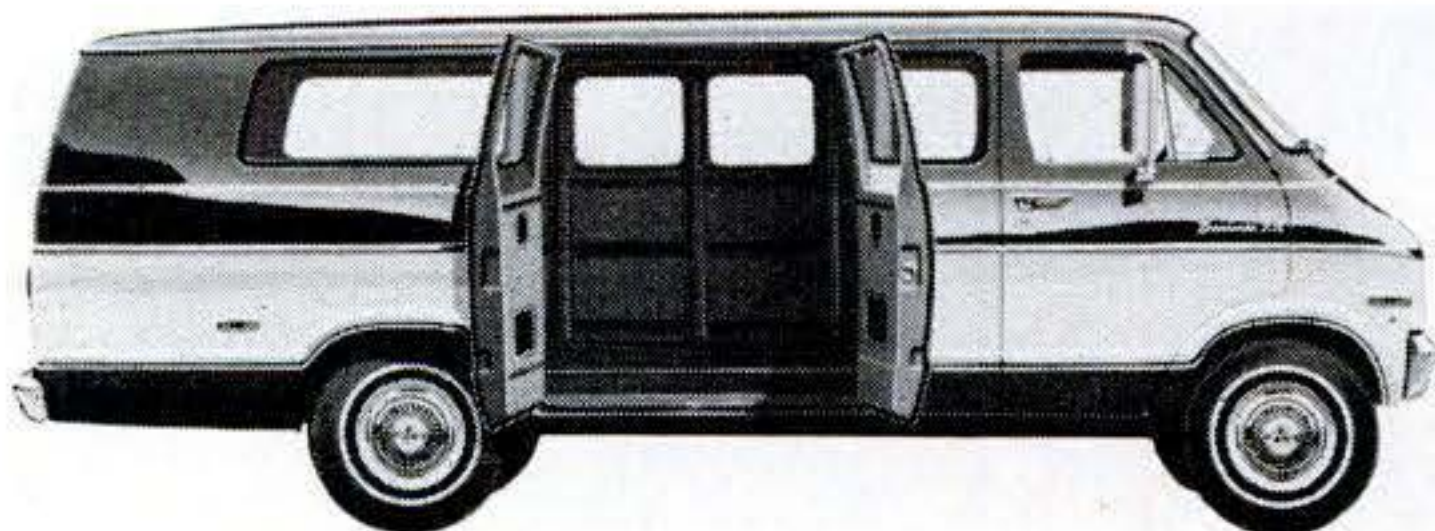
There's only one way to get power steering  and Fresh Air air conditioning  in a compact

van, and that is to buy a Dodge. Go ahead, call it the **world's**  **biggest compact van.**

Because that's what the Dodge Maxivan is.

Open its doors and say, "ah!"

At your Dodge Dealer's.



NEW DODGE MAXIVAN STRONG BOX

Dodge Trucks  **CHRYSLER**
MOTORS CORPORATION

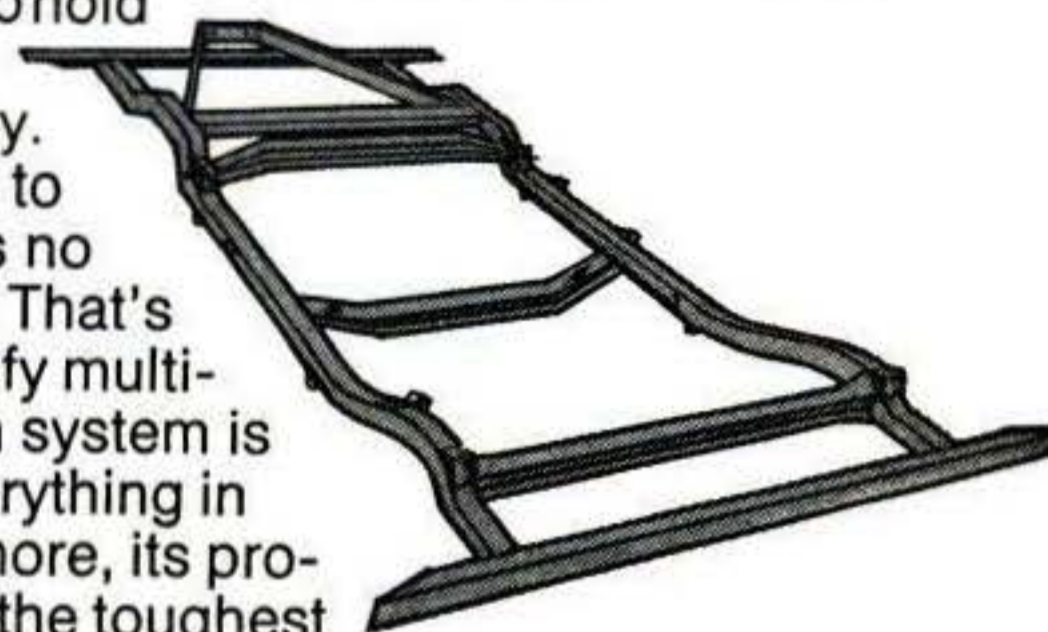
**This stubborn runt
holds its ground anywhere.
It's got Jeep guts.**



The original Jeep Universal— the world's most imitated 4-wheel drive vehicle.

You expect short guys to have more guts. Meet the shortest of them all. The Jeep Universal. It's got the guts to hold on, even in the roughest country.

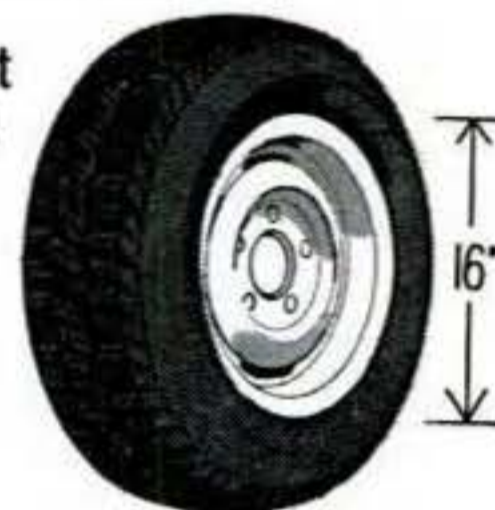
And the guts to take you places no one else dares. That's because its beefy multi-leaf suspension system is built to take everything in stride. What's more, its protective frame is the toughest we've ever made—thick enough to make sure you get out in one piece.



The Universal is a no-compromise off-road performer. That's why competing vehicles eat its dust.

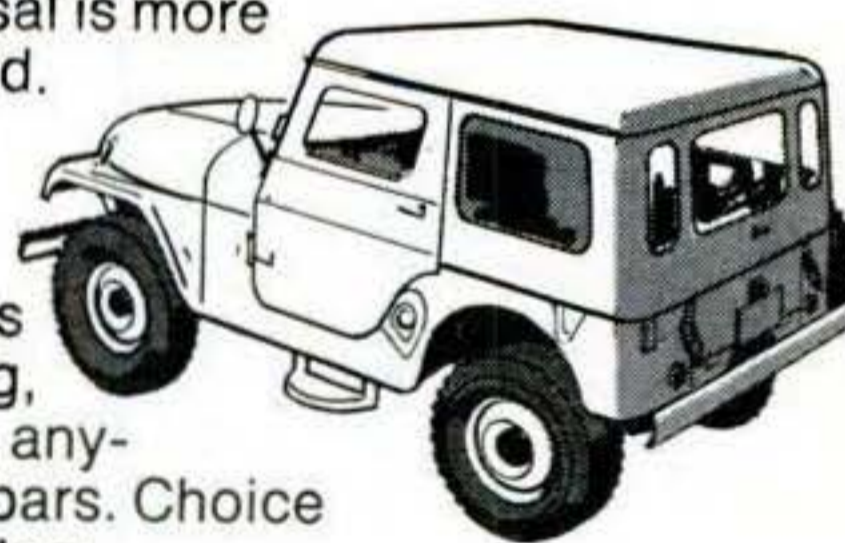
Want proof? It's taken most of the biggest off-road events—the Riverside 4WD Grand Prix, Baja 500, Mint 400.

And this off-road vehicle comes equipped with special jumbo-size wheels—a full 16 inches. So you won't bog down in potholes that stop others. And you'll float over sand dunes and out of gulches.



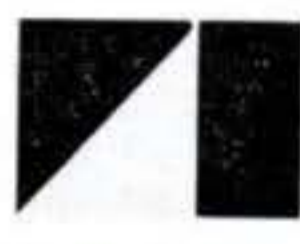
But the Universal is more than a glory hound. It's built for hard work, too.

Comes with one of the longest lists of pushing, pulling, winching options anywhere. Even roll-bars. Choice of fabric or metal top.



Don't be afraid. Drive it into the ground. Jeep guts can take it.

**The toughest
4-letter word on wheels.**

 **Jeep**

Products from American Motors

Science Newsfront

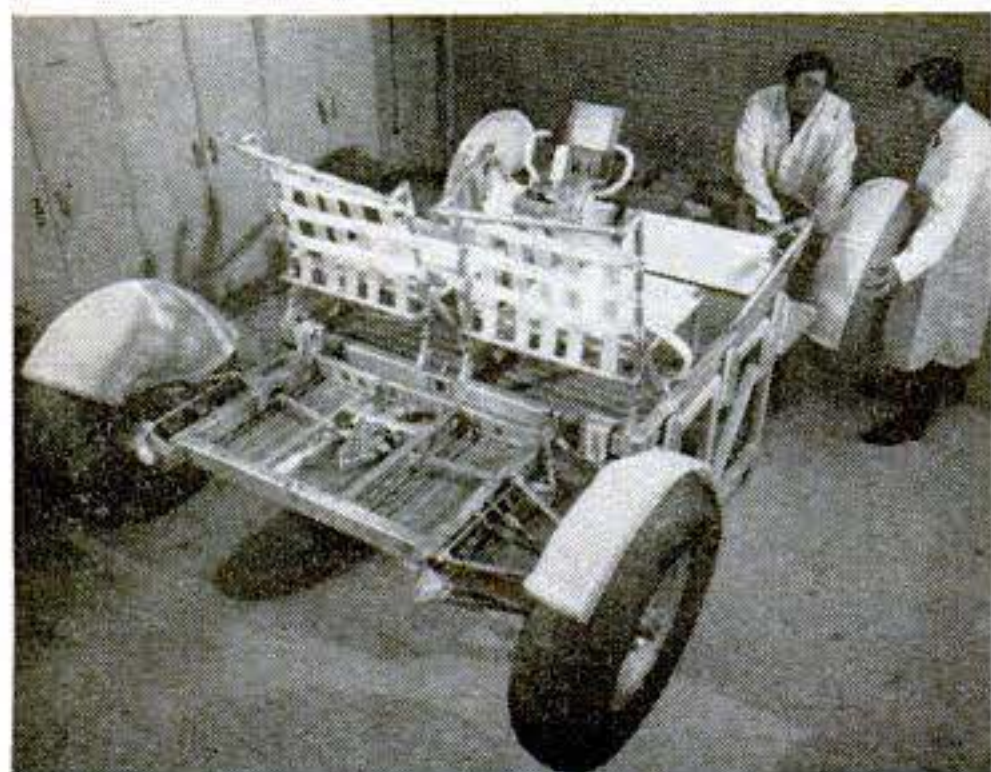
Last-minute news
and notes to keep you
up-to-date

By ARTHUR FISHER

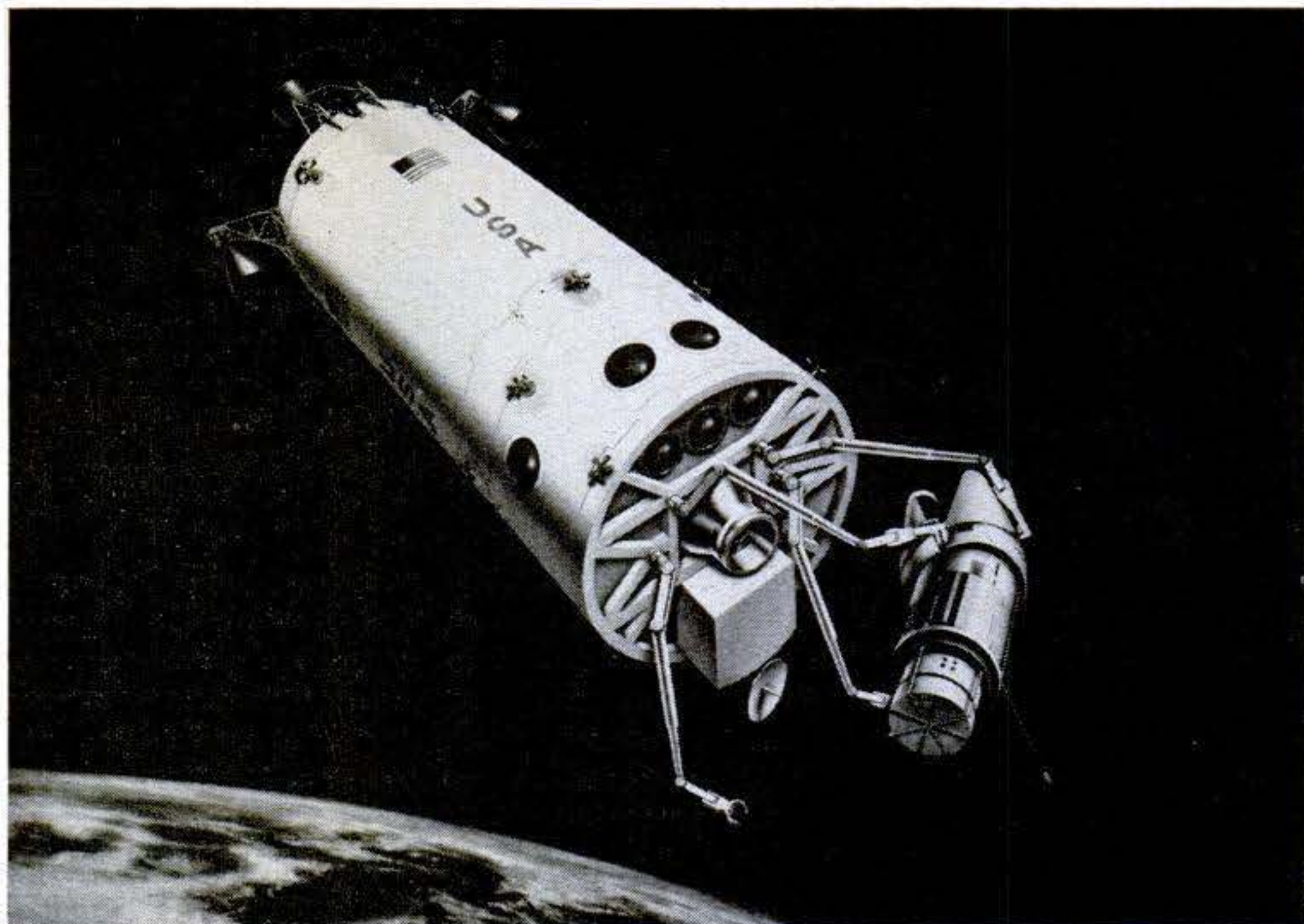
NASA fights auto pollution

The big guns of aerospace technology are being enlisted in the battle against the major source of air pollution in this country—automobile exhaust. The mission: to reduce the one-quarter to one-half ton of carbon monoxide and hydrocarbons each car spews into the atmosphere in a year, as a result of incomplete fuel combustion. The battle plan: Develop a thermal reactor that would replace the standard exhaust manifold and serve as an afterburner. But such a reactor must withstand temperatures occasionally exceeding 2,000 degrees F, thermal shock from cold starts, and jarring vibrations—all problems routinely encountered in space exploration. That's why the National Air Pollution Control Administration has asked NASA's Lewis Research Center to help develop new materials and designs for thermal reactors. Engineers at Lewis are using a V8 engine hitched to a number of experimental reactors. They have learned that the temperature inside must reach a minimum of 1,400 degrees F to clean up exhaust products. Next will come studies to develop iron-chromium-aluminum alloys as reactor materials, and eventually a ceramic core that can withstand shock.

Shaking up the Lunar Rover



Vibration testing of Boeing's Lunar Roving Vehicle is under way. Seen here on a large electromechanical vibrator, a test version of the moon explorer will



Space tug will be do-anything craft of the future

A workhorse for the space age in the 1980s is in the works at Lockheed Missiles & Space Co. Called the orbit-to-orbit shuttle, or space tug, it would perform such missions as repairing orbiting satellites (shown above) and meeting the reusable space shuttle-to-be to transfer its payloads to higher, hard-to-reach orbits or trajectories.

be buffeted and jiggled to simulate the stresses of a Saturn V launch and actual operation on the lunar surface. The first of four Lunar Rovers is scheduled to be carried on a forthcoming Apollo mission. It will be nestled in a cargo bay at the bottom of the coming Apollo Lunar Module.

Shock waves break records

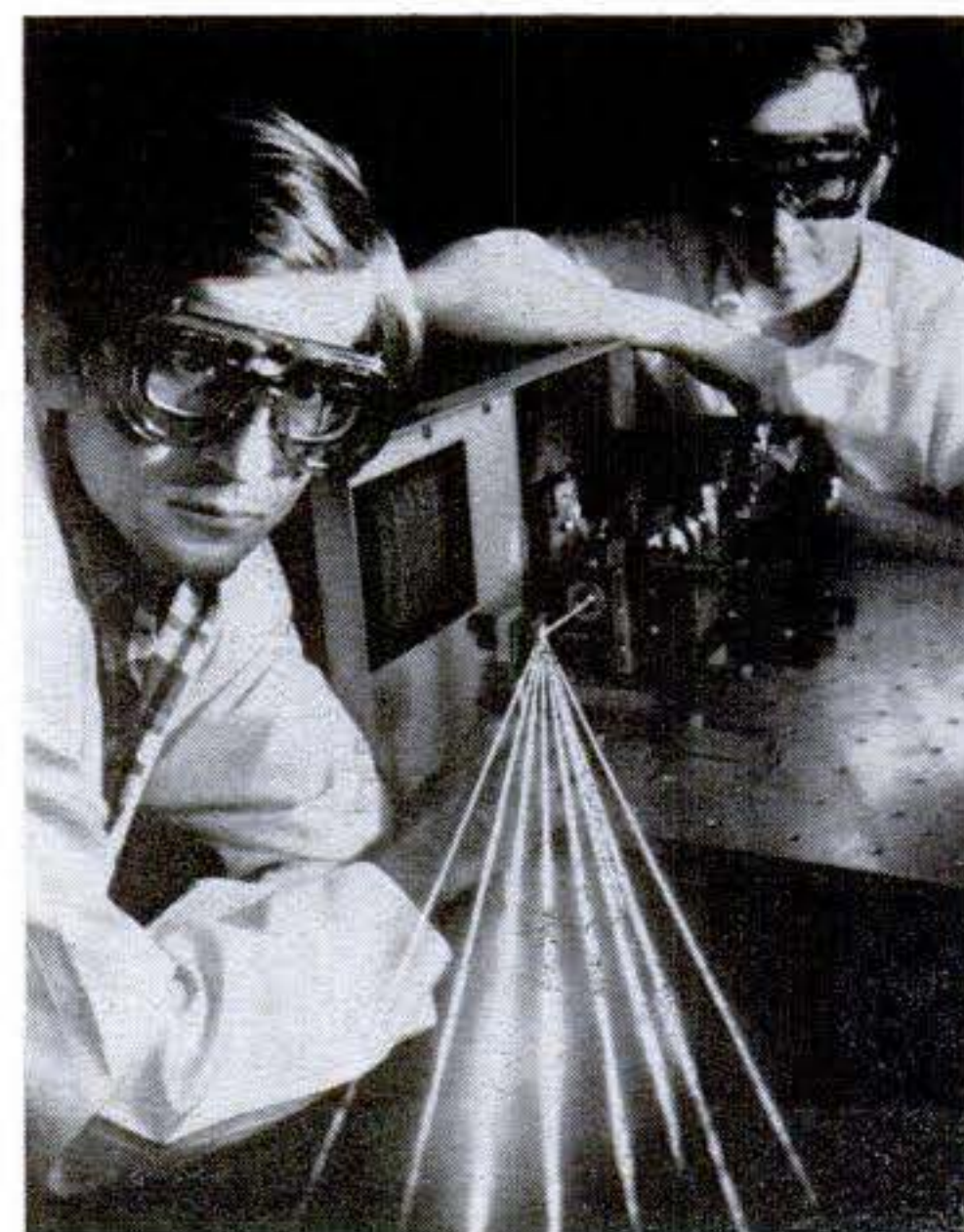
The fastest and most powerful shock waves ever produced by man have been generated at the Columbia University School of Engineering and Applied Science, as part of continuing research into ways to control hydrogen fusion. The waves flashed down a special, 10-foot-long metal tube at six million miles an hour—some 3,000 times faster than the speed of sound, and 10 times faster than any shock waves previously created. The tube was filled with deuterium—a hydrogen isotope. The waves, driven by a two-million-ampere jolt of electricity, heated the deuterium gas to more than 10 million degrees, enough to release neutrons and fuse its atoms into helium nuclei, actually the very essence of the fusion process.

Ink jets copy photos

A new technique developed at Sweden's Lund Institute of Technology can make a nonphotographic high-quality copy of a picture on ordinary paper in just 40 seconds. It relies on writing with a thin jet of ink forced at high pressure through a nozzle. The jet draws a line on the moving recording paper. When 500 volts is applied to the nozzle, the jet instantly changes to a spray, and the line is interrupted (the spray droplets can be masked from the paper by a diaphragm). Thus the intensity of the line can be modulated by

the voltage. The reproducing device actually scans the original optically and converts its information into electric signals, which then regulate the copying procedure to suit.

New wide-range laser



A new laser at Bell Laboratories, dubbed the "exciplex" for "excited-state complex," can emit light in a range of colors from near ultraviolet to yellow—almost half the visible spectrum. The frequency desired can be selected by "tuning" the organic dye material that actually lases. Although other tunable dye lasers exist, this one has a tuning range four times greater than any previous single dye type—a very important advance for researchers who are investigating the interaction of light with matter and need to tailor the frequency of laser beams to specific requirements.

Continued

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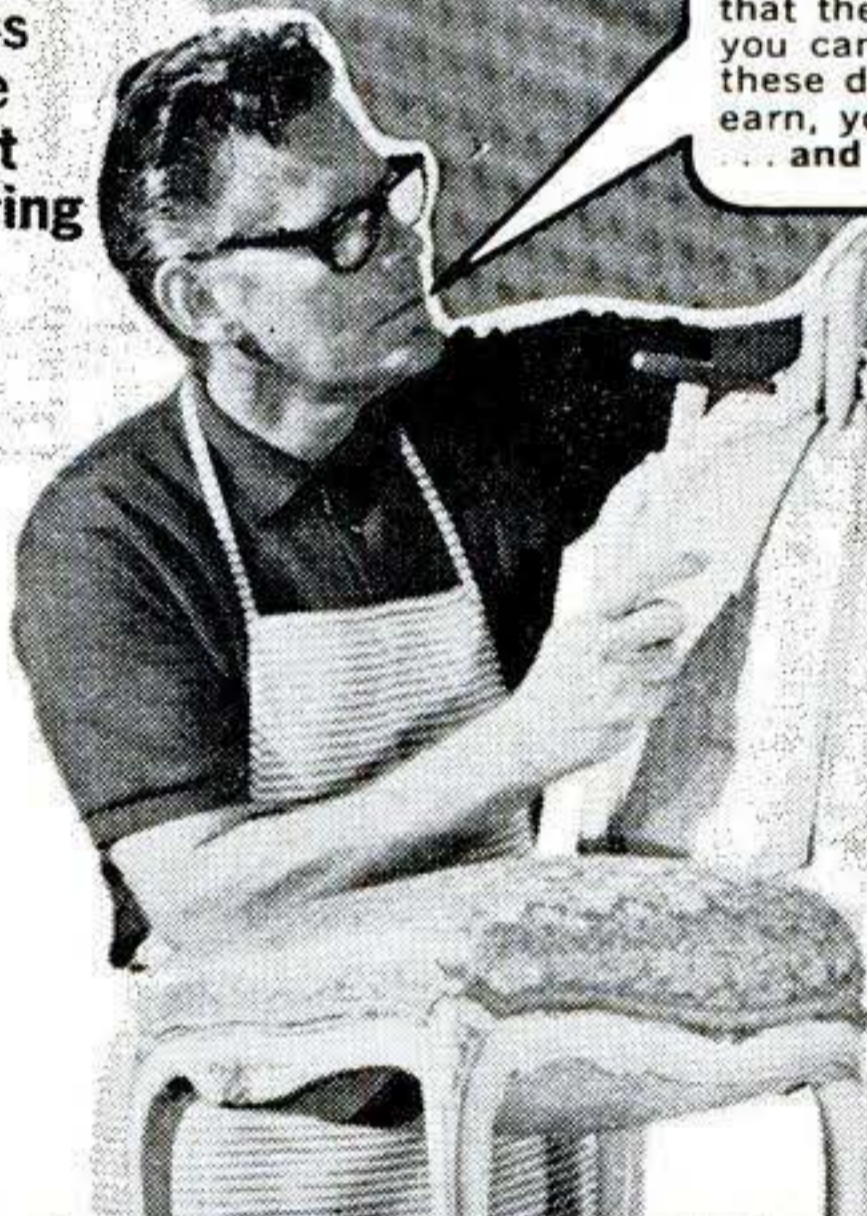
Start learning now. At home, or in the garage, in your spare time — no outside classes to attend. If you can tie a knot and drive a tack, you can learn this business, quickly, easily. You start learning the basics **right away** through the proven MUI Home Training Plan. And before you're barely into it, you can start doing the simple upholstery jobs that are all around you waiting to be done. Chairs, cushions, seats, footstools. Even before MUI students finish their training, people start bringing upholstery jobs to them, and remember—the world is full of furniture that needs fixing and re-upholstering and more is wearing out all the time!

AS YOU LEARN, YOU JUST SLIP INTO THE IMMENSE FLOW OF UPHOLSTERY WORK! Think of all there is! . . . Sofas, lounging chairs finished in beautiful fabrics, which MUI tells you how to get at the right price — even leather and all the new vinyls. And then you have built-ins and breakfast nooks, boats, trailers and all the millions of automobiles in America. Yes, you learn all this and more! When we finish teaching you, (in your own home in your spare time) and when you get our California state approved diploma, you know this business . . . as a real professional! You will then have one of the most fantastic moneymaking skills in America built into your head and hands! No one can ever take this skill away from you . . . and no one can ever fire you, because you're the boss of a business that you can take with you . . . You can make big money from then on . . . any time, anyplace you want to put out your shingle!

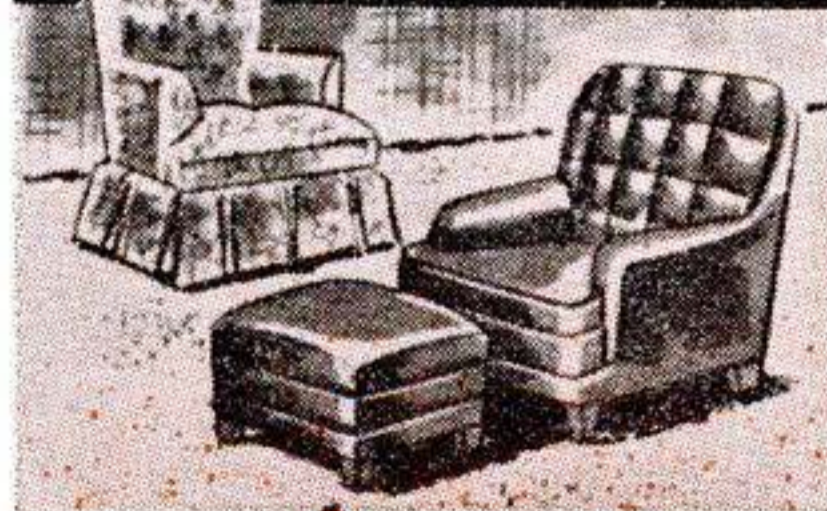
When you read the papers you see there's a strike here, a lockout there. Detroit lays off 150,000 men. A plant is shut down and moved out of state. A new automated machine eliminates 5,000 jobs. They talk about dislocated workers and try to do something about it. What pays the bills if you get caught up in one of these situations? When you know upholstery, life gets very simple and lots of fun. It's simple because where there are people, there are upholstery jobs and lots of them. It's fun because life is fun when the bills are paid and there's money in the bank, even enough to buy those things you've always wanted for yourself.

MUI IS APPROVED BY THE CALIFORNIA SUPER-INTENDENT OF PUBLIC INSTRUCTION AND IS AUTHORIZED TO ISSUE A DIPLOMA IN UPHOLSTERY.

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Yes, many MUI graduates make better than \$10 an hour turning old wornout furniture into bright new decorator pieces! Stack it up against what you're doing now! Are you making \$150 a week? \$200? \$250? Do you put in long hours of dull work, with small raises? Is that the way you want to spend the rest of your life? Just imagine, you can make \$150, \$200, \$250 upholstery just one chair or sofa these days! And if you're the kind of person who likes to work and earn, you can sometimes finish a job like this in a day. That's pay, . . . and it beats what most college graduates make!

WORK THE HOURS YOU LIKE TO WORK!!

If you favor a regular 35 hours a week, upholstery lets you do it and make a really fine living. On the other hand, if you're really ambitious and want to work 60 or 70 hours a week, you are starting to talk about some big, big money! The important thing is that the choice is yours, not somebody else's! (Not like when you're working for someone else.) Many students of retirement age just do a few pieces now and then just to keep things nice and comfortable.

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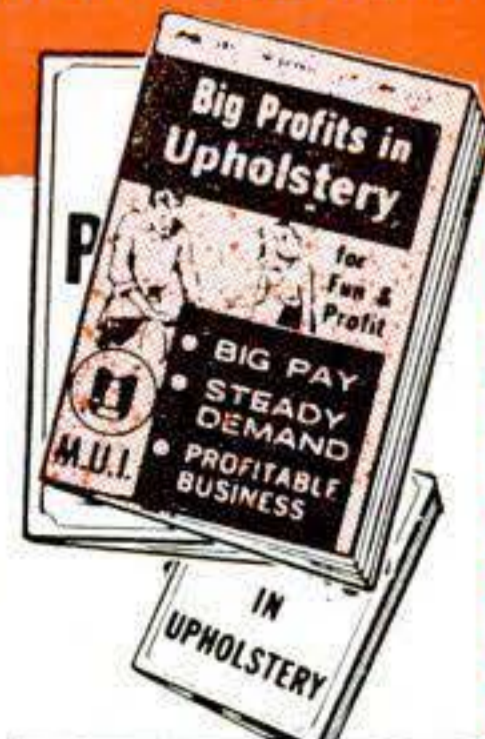
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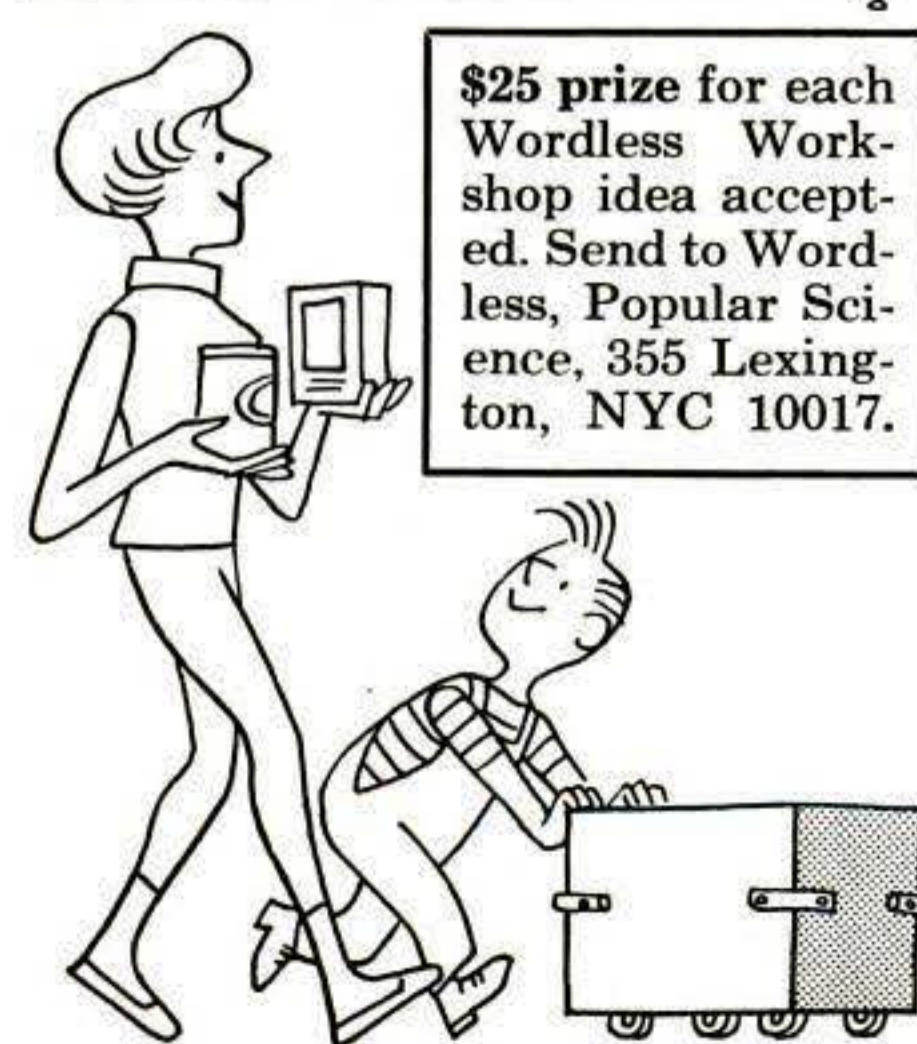
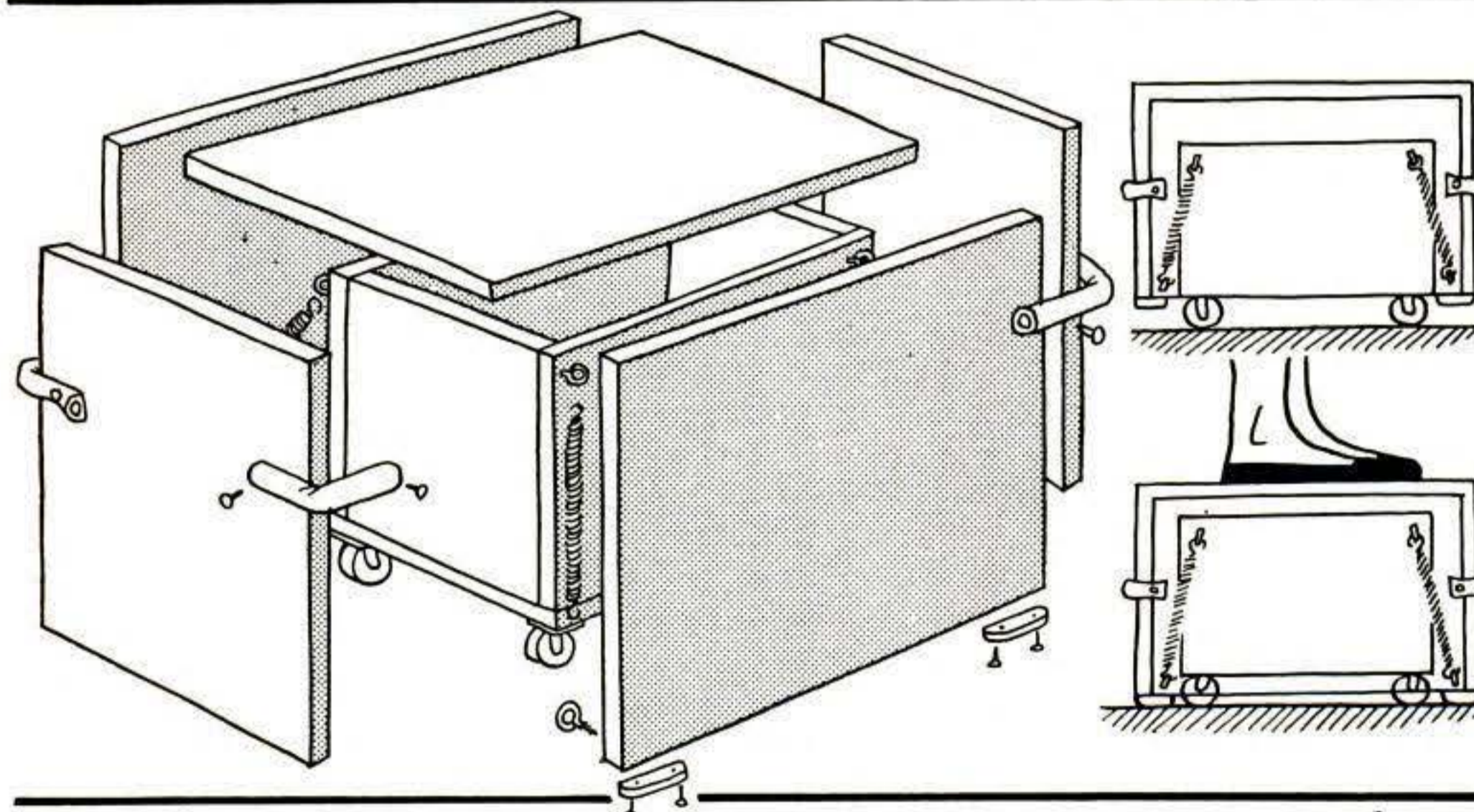
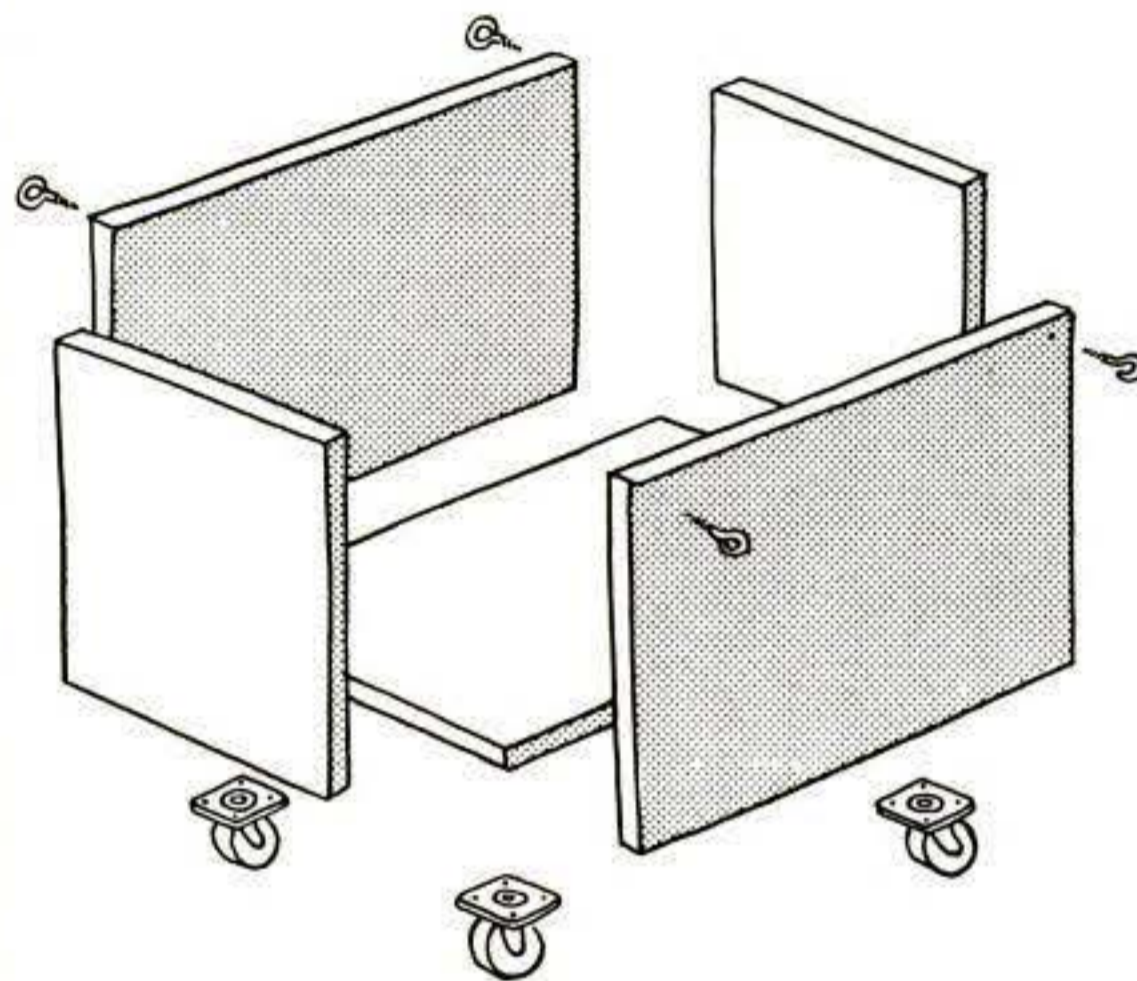
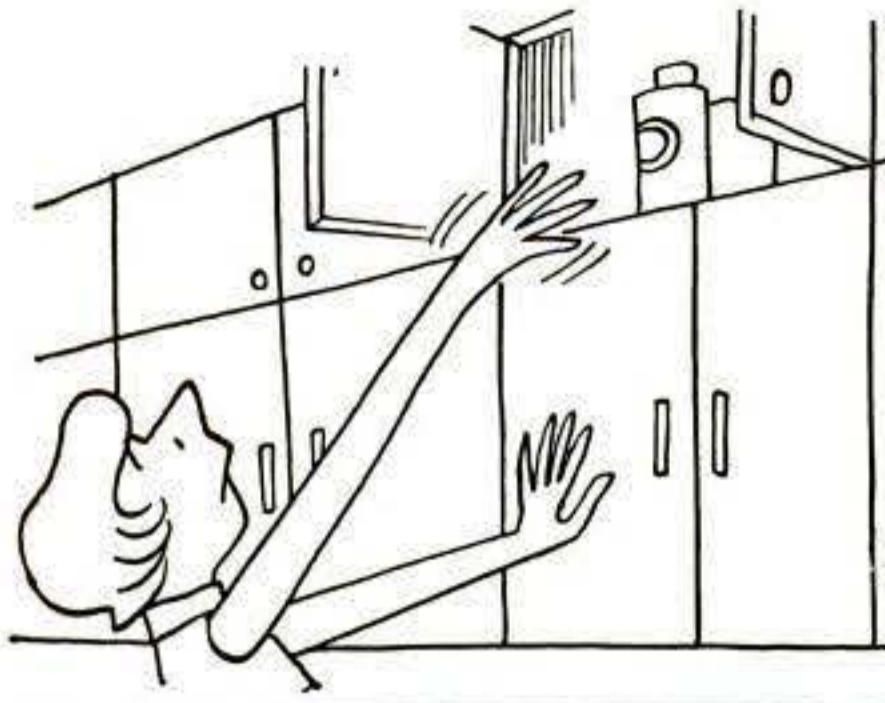
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By ROY DOTY



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Science Newsfront

[Continued]

Tiny laser works on batteries



The rectangular chip you see almost lost on the face of a penny is a full-blown, infrared, continuous laser—the first of its kind. Made from a crystal of semiconductor materials, it can operate from a dry-cell battery at room temperatures, and needs no cooling. Thus a whole unit with power supply might take up no more room than a pocket flashlight. Scientists at Bell Laboratories, where the mini-laser was developed, say it will run for years and will cost mere dollars to produce. This laser, or one like it, will probably see duty in the not-too-distant future in communications systems. A single laser beam can carry many thousands of electronic signals, including phone, radio, and TV communications.

Salting the oceans with gold

The U.S. Government is dumping gold into the oceans. No, it's not a gigantic boondoggle, but a joint effort of the AEC and the Army Corps of Engineers to study the effects of ocean currents on coastline erosion and sediment flow. The researchers dump sand tagged with minute amounts of radioactive isotopes of gold in coastal waters a short distance offshore. Then underwater radiation detectors can trace its movement out to sea up to 1,500 feet and parallel to the coastline more than 3,000 feet. Only a quart of the glittery sand is needed to investigate an area of more than 500,000 square feet of water-borne sediments. The dispersal can be monitored for a week before dilution and the radioactive decay make the gold undetectable.

Fort to get honorable discharge

The Departments of Defense and Health, Education and Welfare are reported to be planning to convert the super-secret Ft. Detrick, Md., facility into a civil lab—possibly for critical medical and environmental research. Ft. Detrick has been a center for research in chemical and biological warfare.

Shaves time.



This is the shave cream to use for that dreaded morning rush hour shave (when you shave faster than you should—without giving the lather enough time to really soak in).

Why? Because it heats up right under your nose. And takes less time to soften tough whiskers than ordinary cold shave cream. Making it entirely possible for you to get a close, comfortable shave in the morning. And still catch the 7:47.

The Hot One—when you shave too fast for comfort.

Pontiac's New Battery— You'll Never Need to Fill It

It's sealed—
for a long life of
maintenance-free
service

By JIM DUNNE
PS Detroit Editor

Pontiac's new no-maintenance battery is probably the most important improvement in power sources since Charles F. Kettering first installed a battery in a car to run his self-starter, back in 1911.

Pontiac offers the new battery, made by Delco, as standard equipment on the 1971 Grand Prix SJ models, and makes it available as an option on its 455-cu.-in.-engine cars.

Probably the most astounding aspect of this new battery is that it is refill-free. In fact, you couldn't refill this battery with water even if you tried. The only openings in the battery cover are vent slits at the top of the case, which permit charging gas to escape. Everything else is sealed.

Since the battery can't run low on water, it can't be damaged by water loss. The result is that the new battery will produce electrical energy and take full recharges for duration of its design life. You can neglect the battery and expect top service for as long as you'd get from a well-maintained conventional battery.

Out with the antimony. Delco engineers say the key difference between the new battery and conventional designs is the absence of antimony in the lead plates. Up to now about a half pound of this element—a white metal—has been used in all batteries to stiffen the lead plates. Lead alone isn't rigid enough to keep its form both during the manufacturing process and during the life of the battery.

But the addition of antimony brings a penalty: Water is lost during the chemical reactions that occur when the battery is charging and discharging. And as water is depleted, it must be replaced. Otherwise the battery will no longer take a charge, will quickly lose all power, and may even suffer permanent damage.

Delco removed the antimony and replaced it with calcium to eliminate the water-loss problem. While the calcium alloy is not as stiff as the antimony alloy, a new manufacturing process was worked out to overcome the softness, and polypropylene envelopes were built into the battery to support the lead plates. These envelopes replace the two-plate separators in conventional batteries.

Rapid progress. More substantial changes have been made in battery design in the past five years than in the previous 25, according to Delco. Apart from the refill-free feature, two other changes appear in the new battery. First is the new corrosion-preventing, side battery terminal. Through-the-wall connectors, a recent improvement that eliminated the terminal posts on the top of batteries, lead to the side terminal placement. Second is a thin-wall case that permits more power to be squeezed into the standard battery size, or permits a smaller battery to deliver the same power as a larger conventional design.

Pontiac officials are doubly pleased with the no-maintenance feature, since it will allow placing the battery anywhere in the car—under a fender or in the trunk, for example.

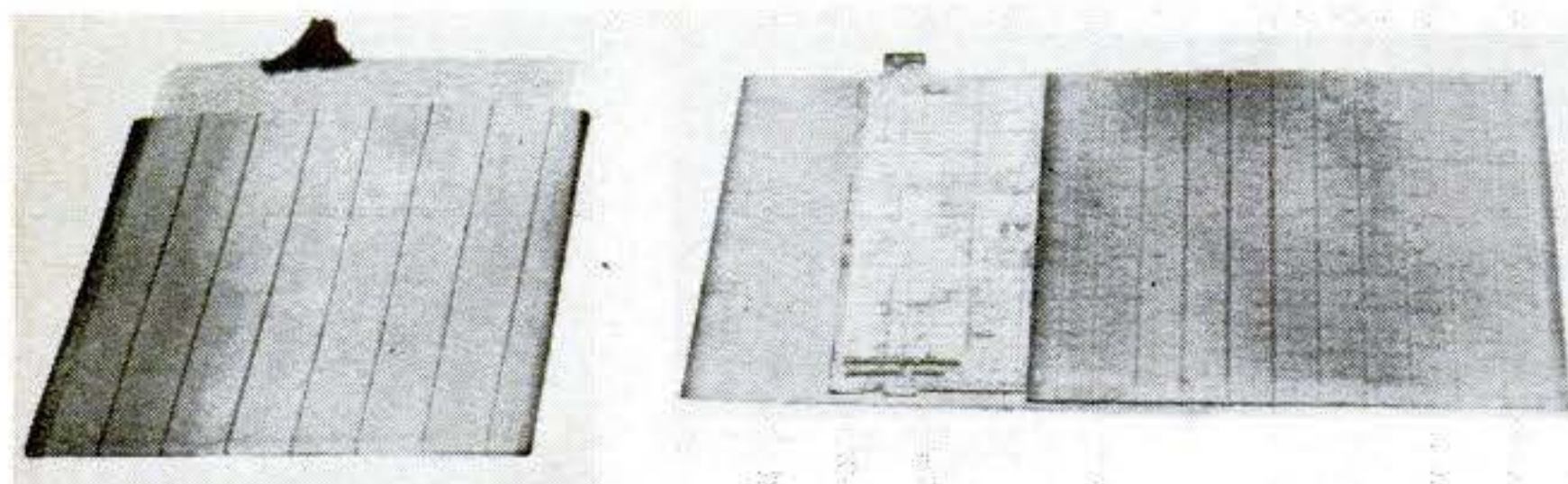
Delco says the calcium substitute can be used in all types of batteries. It will be used in more Delco sizes in the future as machines are switched to the new design. But for this year, production is limited to about 10,000. Price will be close to other first-line batteries. **ES**



No filler caps? That's right. Terminals? They're built into the side of the casing.



Polypropylene case walls and cell partitions of new battery (left) are much thinner than those of conventional battery. Result? More power in less space.



Edges of soft lead plate in new battery (left) are protected by a plastic envelope. Two-piece protectors in old batteries left edges open to damage.

TOM McCAHILL SAYS:

“There’s no mystery to making money if you can repair these things”

The greatest detectives in history would be hard pressed to track down somebody to fix a bum toaster or dishwasher these days. It’s funny: you have no trouble finding any number of so-called experts who’ll fix a leaky pipe or a home run through the picture window. But electrical appliance repairmen are still as scarce as hippies in bathtubs.

If you’re lucky enough to get a repairman to come from across town, he’ll eventually have your bum dishwasher humming again like bees at a picnic. He’ll also present you with an oversized bill. That’s where the picnic ends.

If you’re in the market for more money you don’t need to be a super-sleuth to find it. Look for clues in your own hacienda. If you’re typical, you own a couple dozen appliances, counting your wife’s hair dryer, power tools and usual plug-ins like air conditioners, toasters, refrigerators, freezers, fry pans, and on and on. A lot of men like yourself have built rewarding full-time businesses after starting part-time earning \$5 and more an hour fixing broken appliances. Others have found full-time jobs as Service Technicians. And when you hit Social Security years, think how great it would be to pick up a little extra cash doing as much Appliance Repair as you cared to do.

The Appliance Division of the National Radio Institute in Washington, D.C., has a great low-cost, home-study course covering every type of Appliance repair in detail — from toasters and irons to air conditioners, refrigeration equipment and one-lung gas engines. There’s a section on farm and commercial appliances, too, if you’re interested in a big payoff, for when appliances go kaput, they’re as useful as moose antlers on a mouse.

To get technical know-how, NRI starts you with



basic principles of electricity. You can gain experience through actual practice, using an Appliance Tester included in the low cost of training. It’s the same kind of tester a professional would use while charging you six bucks an hour. With the tester and a few basic hand tools, you can be repairing Appliances long before you finish the course. All you need for a shop is a corner of your basement or a card table left up between poker games.

You’ll be amazed at how easy NRI has made this course. Lessons are bite-size and loaded with photos and drawings so you see how each appliance comes apart — and goes together again. Men who felt they were as handy as icemen in the Arctic have nothing but praise for this great training.

The coupon below will get you a free NRI catalog with all the facts. From there on it’s up to you. No salesman is going to bother you. Do yourself a favor and mail the coupon today . . . tomorrow morning, for sure.

Tom McCahill

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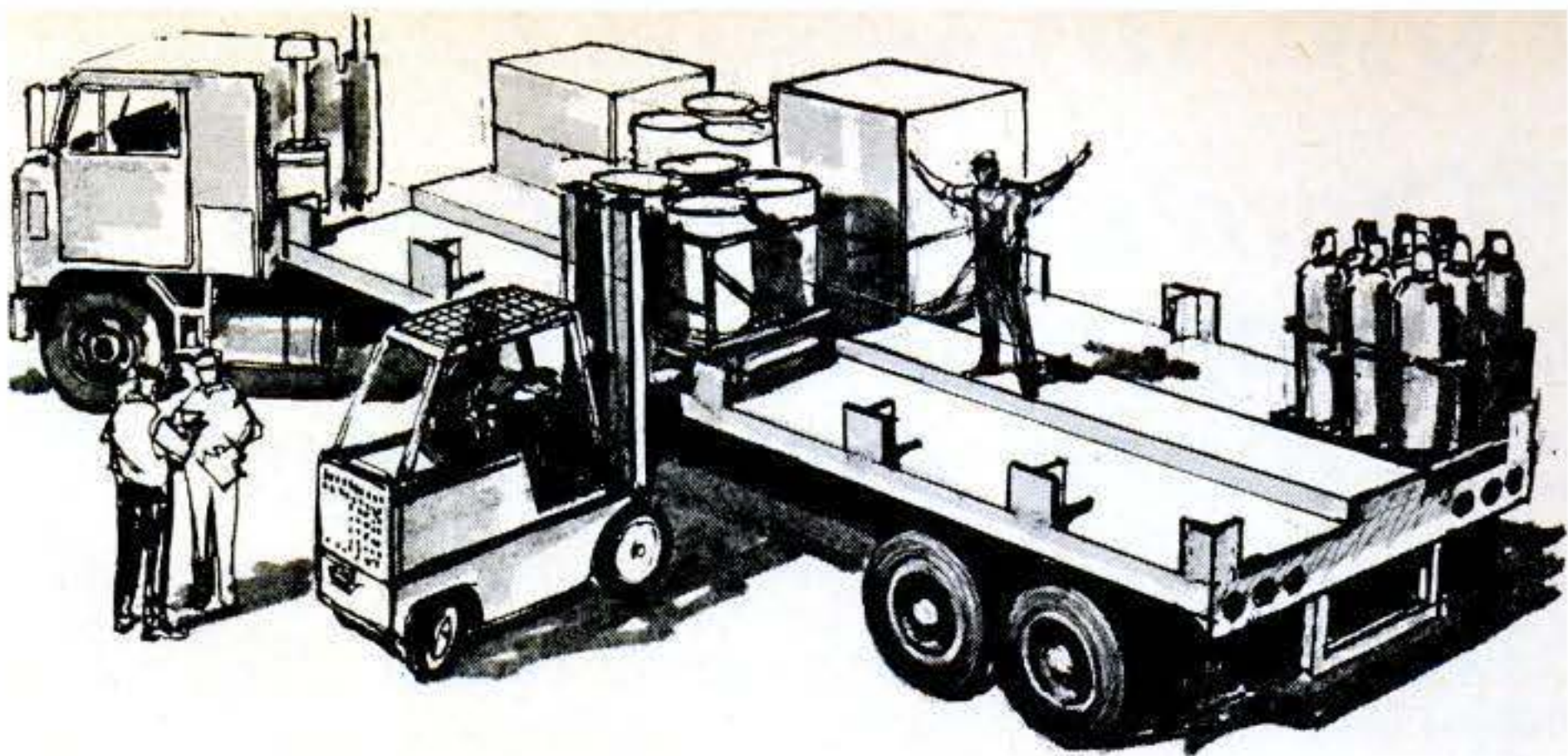
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New Ideas from the Inventors

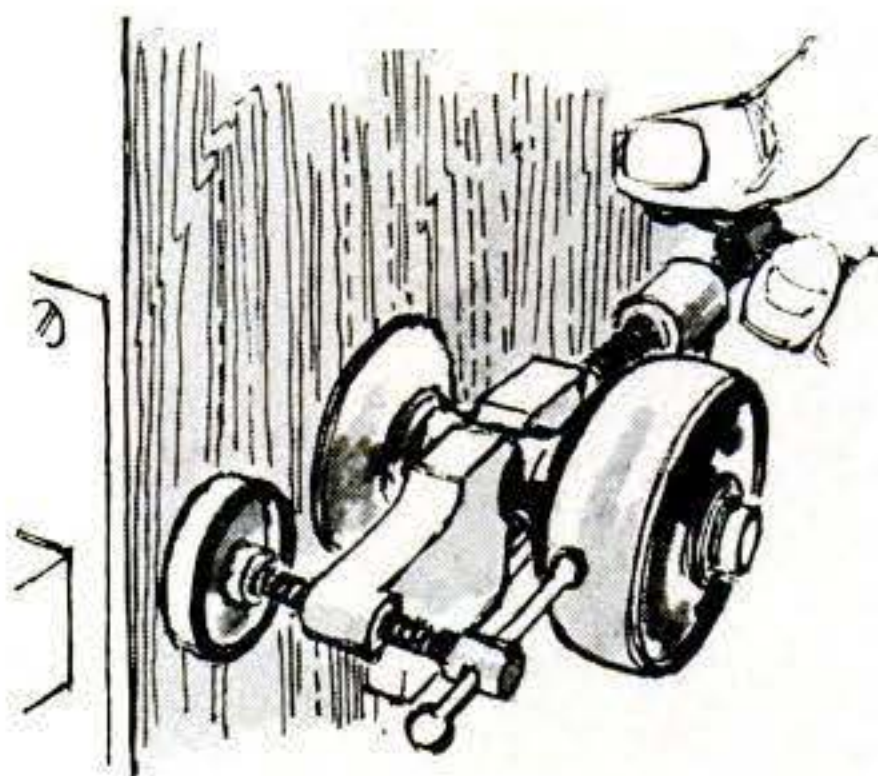
ILLUSTRATIONS BY DANA RASMUSSEN



Truck assembles palleted loads. Heavy, hard-to-handle products could be loaded and transported more easily, according to this recent patent, if they could be locked onto specially constructed pallets at the point of production, then fork-lifted into fitted slots on either side of an aisled, flat-bed truck. At the destination, pallets would be delivered singly or in groups.



Camper tire forms table. Held by hinged arms against the back wall of a camper, this spare-tire carrier would swing down and out to form a self-supporting base for a picnic or work table. Rear mounting should keep the tire cleaner—and handier—than the usual under-the-floor storage well.



Portable clamp locks knob. Even if he could pick a lock—or had a key—an intruder couldn't force entry through a door whose knob was locked against turning by this clamp. Fitted and tightened without tools, the portable lock would secure most doors and could be used with ease at home or away.



Vehicle headrest stows trash. A tip-out, lift-out receptacle fitted into the back of a headrest would provide more refuse space than usual without affecting the rest's utility or comfort. It could substitute for most passenger-car headrests or it could be used on bus or train seats.



Broom wipes shoes. Pressing the base of this long-handled brush against the floor would turn the bristles upward to clean mud or snow from the soles of your shoes. (A small extension brush would clean the sides.) Raising the handle would let the bristles turn down so you could use the brush as a broom. In either position a stop would prevent movement.



Jacks offset ladder. Individually adjustable clamp-on brackets would let you block your ladder solidly regardless of the shape or slope of the wall against which you're working. Similar clamps could support a platform for you and your tools. The cushioned tips of the support would limit the area of ladder-to-wall contact and minimize surface or paint damage.

The following patents have been issued on these inventions: **Pallet trucks**—No. 3,451,573 to W. Josephian, Oakland, Calif.; **Tire table**—No. 3,448,904 to K. D. Sahr, Phoenix, Ariz.; **Knob clamp**—No. 3,458,228 to R. A. White, Overland, Mo.; **Headrest receptacle**—No. 3,449,011 to R. Edwards and G. Gielow, Mansfield, Ohio; **Shoe broom**—No. 3,451,092 to A. Szopo, New

Brunswick, N.J.; **Ladder jack**—No. 3,459,277 to E. Frederick, Allis, Wisc. Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington, D. C. 20231, at 50 cents each. To write to an inventor, if the address above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.

Taste too hot to handle?



Come all
the way
up to
KOOL

By PAUL WAHL

A thief prowling a darkened warehouse pauses and draws nervously on a cigarette. Blocks away, his image flares brilliantly on a TV monitor. A security guard seated behind a panel of monitors summons police, then watches the intruder's progress through the building.

Concealed low-light-level television (LLTV) cameras make the "show" possible, amplifying light too faint for the human eye into studio-like views on a TV receiver. But industrial and police surveillance is only one of the widening range of applications for these supersensitive devices. A few of them are:

- Better navigation of ships and aircraft on dark, overcast nights.
- Study of deep-sea life without the disturbance of bright lights.
- More spectacular lunar and deep space views (LLTV has already been used on Apollo flights).
- Broadcast coverage of outdoor events under poor lighting conditions.

Until recently, the closest TV cameras could come to seeing in the dark was a twilight (or barroom) illumination level. The screen image is usually degraded, with poor resolution. Today's LLLTV cameras can "see" in starlight or operate in blazing sunlight. (Compared with twilight, direct sunlight is 10,000 times brighter and starlight is 1/10,000 as bright.) Picture quality is usually quite good.

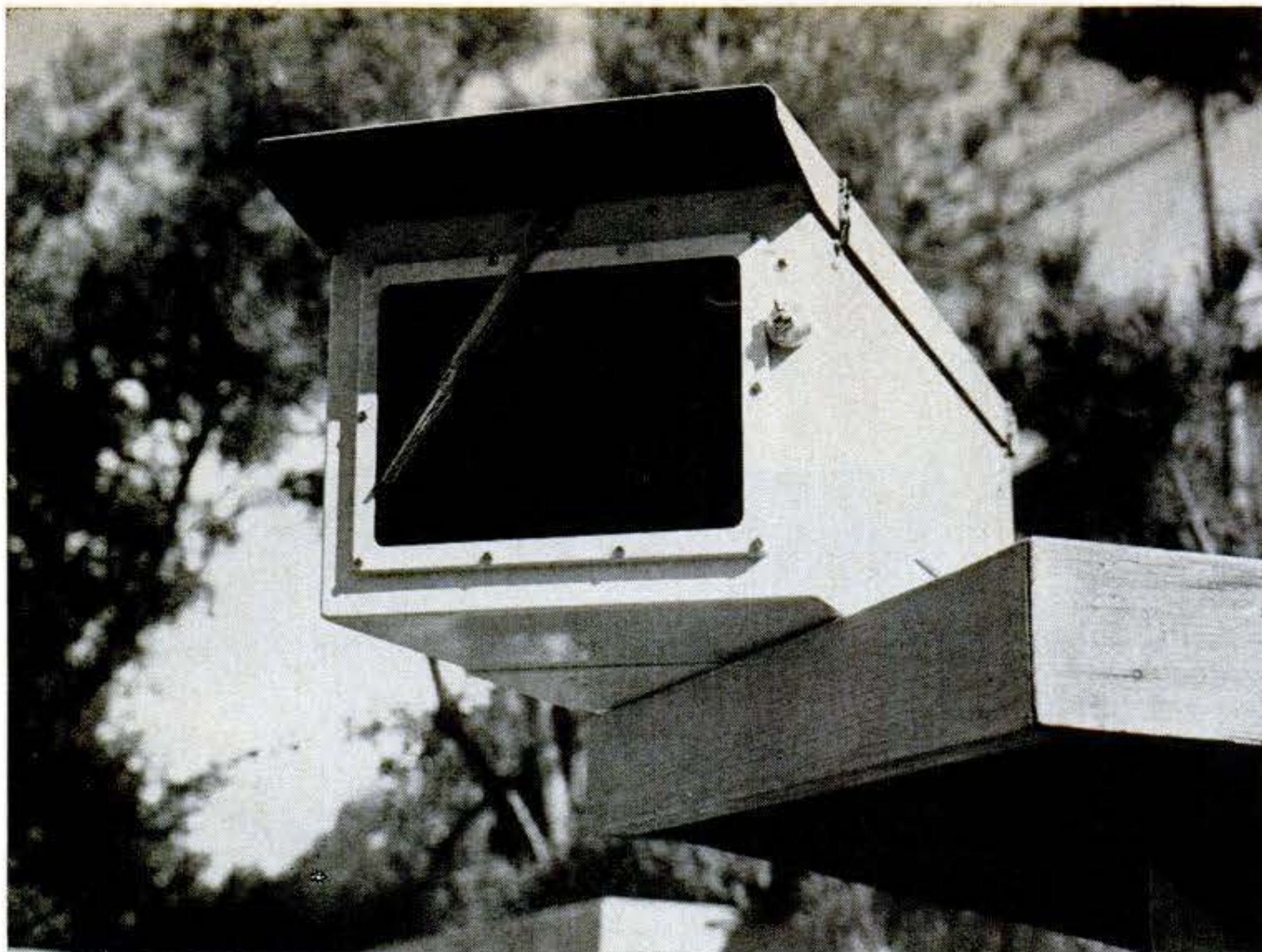
Inside the Orthicon. Before seeing how LLLTV cameras work, let's look at an early Orthicon camera used in TV studios.

In Orthicon tubes, light from the camera lens is focused on a photoconductive target, a thin chemically coated glass sheet that emits electrons when light strikes it. Individual chemical particles shed electrons according to the light level they receive; in effect, they become microscopic capacitors, since their missing electrons make them positively charged. Light and dark areas of the scene, then, become "etched" on the target as positively charged particles.

To turn this pattern into a useful electronic signal, a narrow beam from an electron gun sweeps back and forth on the rear of the target. As electrons from the beam neutralize positive charges, a small current flows from a lead connected to the target. This current fluctuates according to the electrons needed to "fill up" positively charged particles, and becomes the camera's video output signal.

Avalanching electrons. When Westinghouse engineers sat down to design a TV camera for the Apollo program, one of the obstacles was the strong

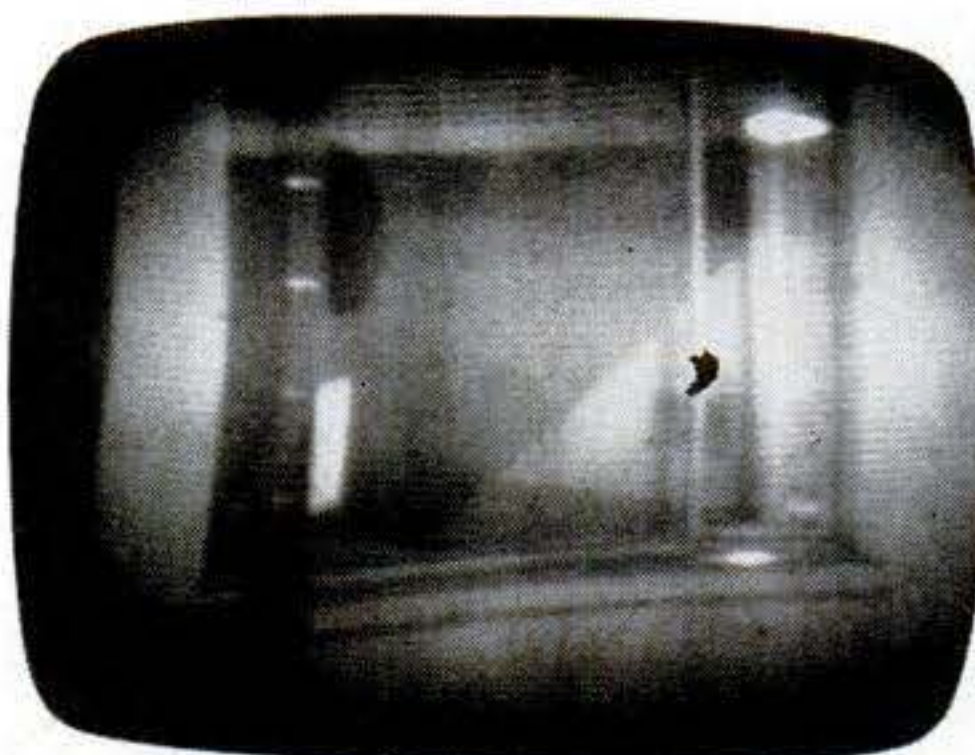
Continued



A protective housing for the low-light surveillance camera tested in Olean, N.Y., has a windshield wiper and washer, and sun shield. This Sylvania camera has a zoom lens.



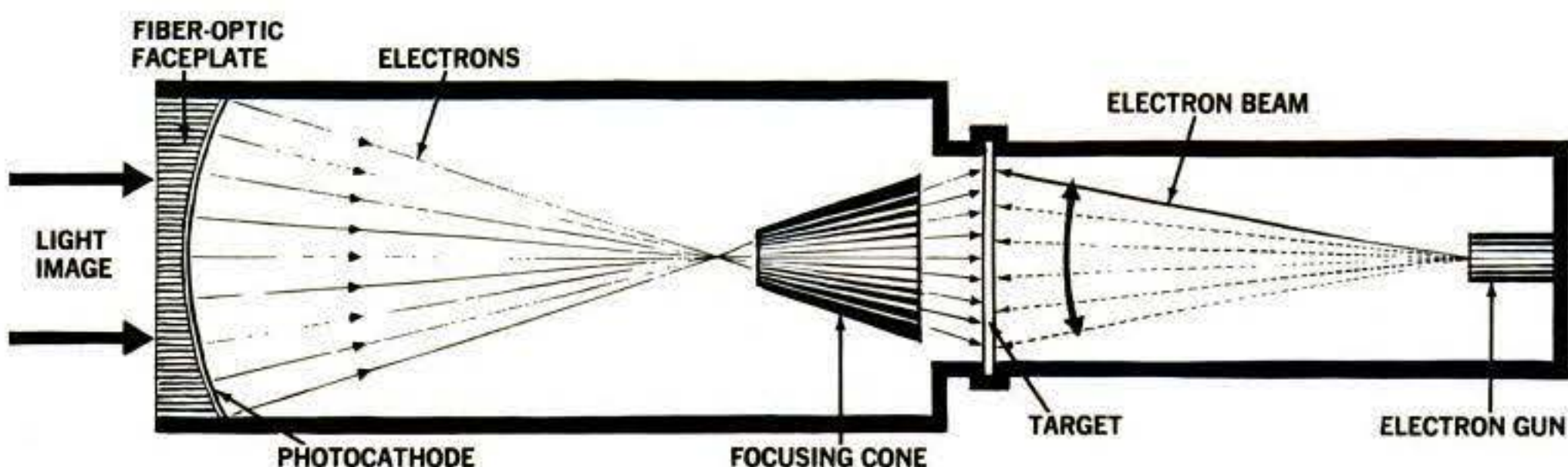
Wide-angle night view of business district from camera above is fed to a monitor



A zoom view clearly shows details in a room darkened to the eye.

Amazing See-in-the-Dark TV Cameras

New supersensitive image tubes turn night into day with solid-state targets and techniques borrowed from "starlight scopes"



Camera tube developed for Apollo program is finding many uses elsewhere. Light passing through the fiber-optic faceplate knocks electrons loose from the photocathode coat-

ing. Accelerated by about 7,000 volts, the electrons strike a special target, generating many more electrons. This creates a stronger output when a beam sweeps the target.

totally

New Cheyenne. Other pickups just went out of style.

CHEYENNE

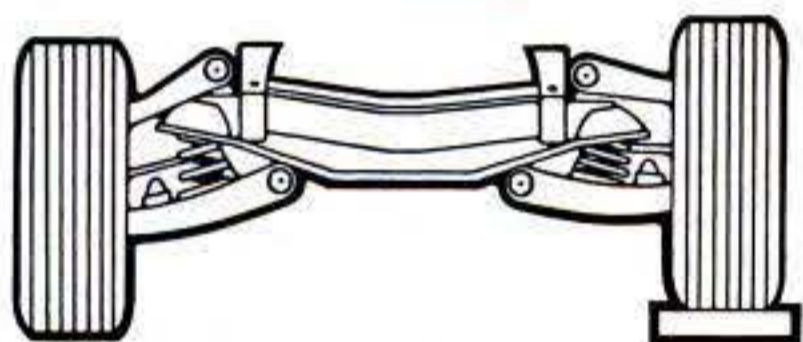
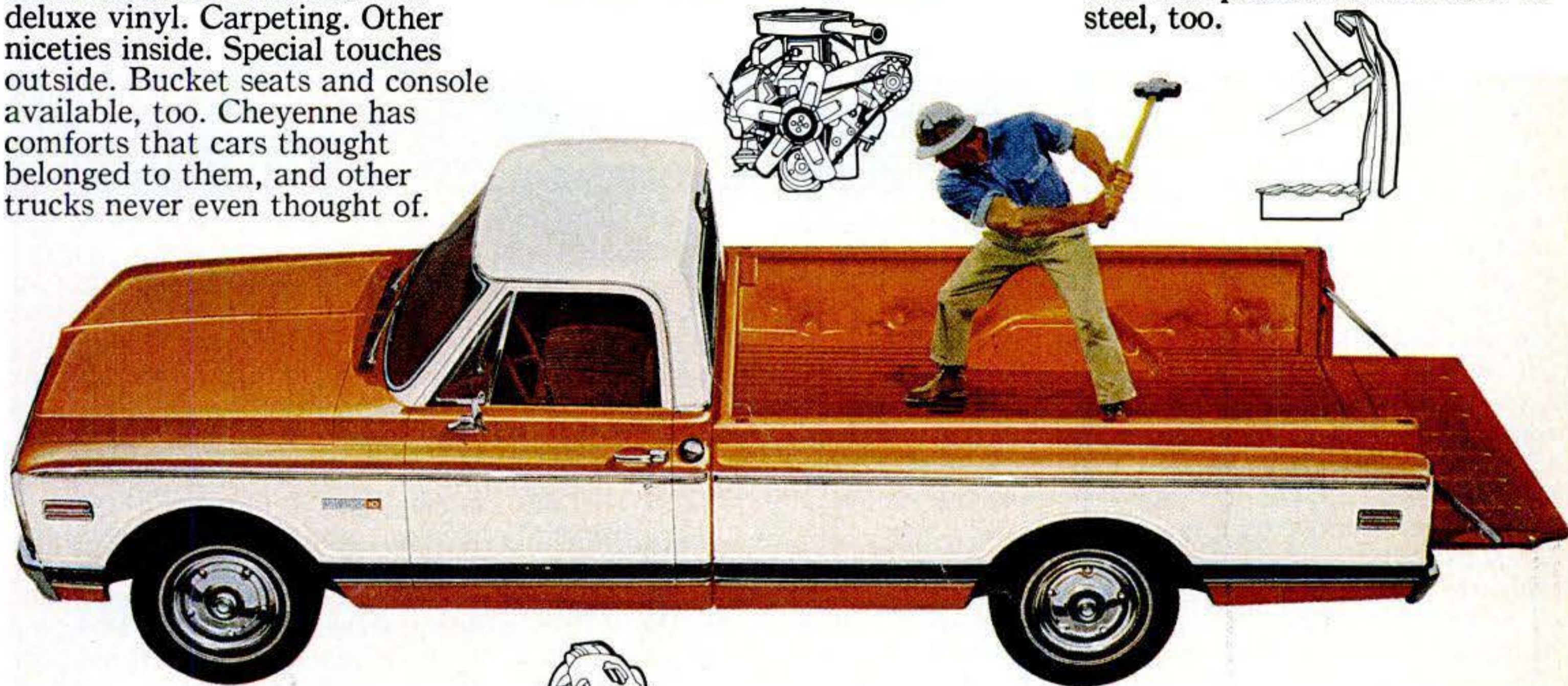
It's our new top-of-the-line pickup. Cheyenne offers a deep foam-cushioned bench seat in deluxe vinyl. Carpeting. Other niceties inside. Special touches outside. Bucket seats and console available, too. Cheyenne has comforts that cars thought belonged to them, and other trucks never even thought of.

**Most V8 power.
Biggest standard 6.**

No other pickup can top Chevy's V8 power availability. Up to 400 cubic inches. They don't come any bigger than Chevy's standard 250 Six, either. Three other engines, besides, for you to choose among. They all get along just great on regular, or new no-lead or low-lead gasolines.

Durable double wall cab and box.

We double-wall our wide Fleetside cargo box top to bottom, not halfway like some pickups. So dings inside don't show outside. (Note our sledgehammer test below.) Our cab roof, cowl, body sills and rear wall panels are two walls of steel, too.



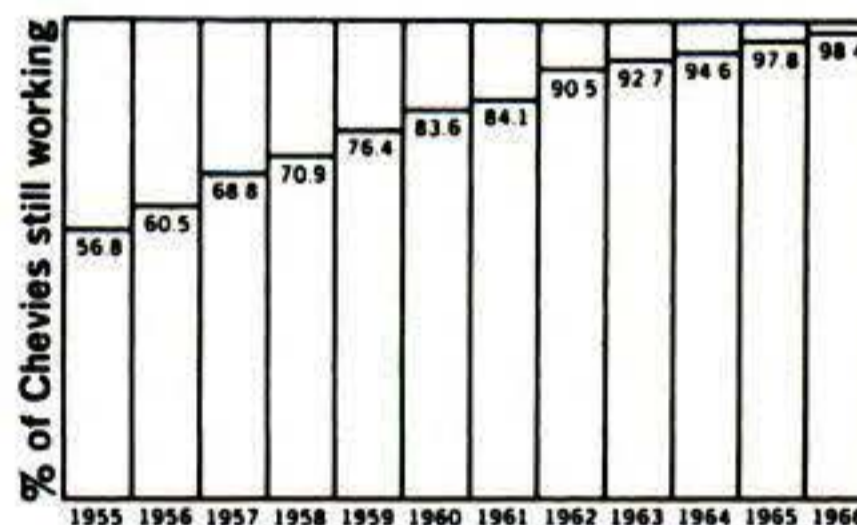
Super Suspension rides smoother.

It's fully independent up front with big coil springs to keep road shock from passing back and forth between the wheels. Or up to the cab and box. In the rear, coil or leaf springs are available—tailored to the loads you carry. So you ride smooth, even when the road isn't. Super Suspension: better because it's proved on more jobs than any other kind.



New fade-resistant disc brakes standard.

You won't find disc brakes standard on most other pickups. You get better fade-resistance, longer brake life. Power assist is standard, too, on ¾- and 1-ton models. And new finned rear brakes on ½-ton models complete Chevy's advanced brake system.



Chevy trucks work longer. Here's proof.

Official figures, based on R. L. Polk & Co. statistics, show how Chevies outlast other trucks. Going back as far as 1955, for example, over 56% of the Chevies of that model year are still on the job. No competitive make has as many as half of its '55 models still working.



tougher.

71 Chevy trucks are here.

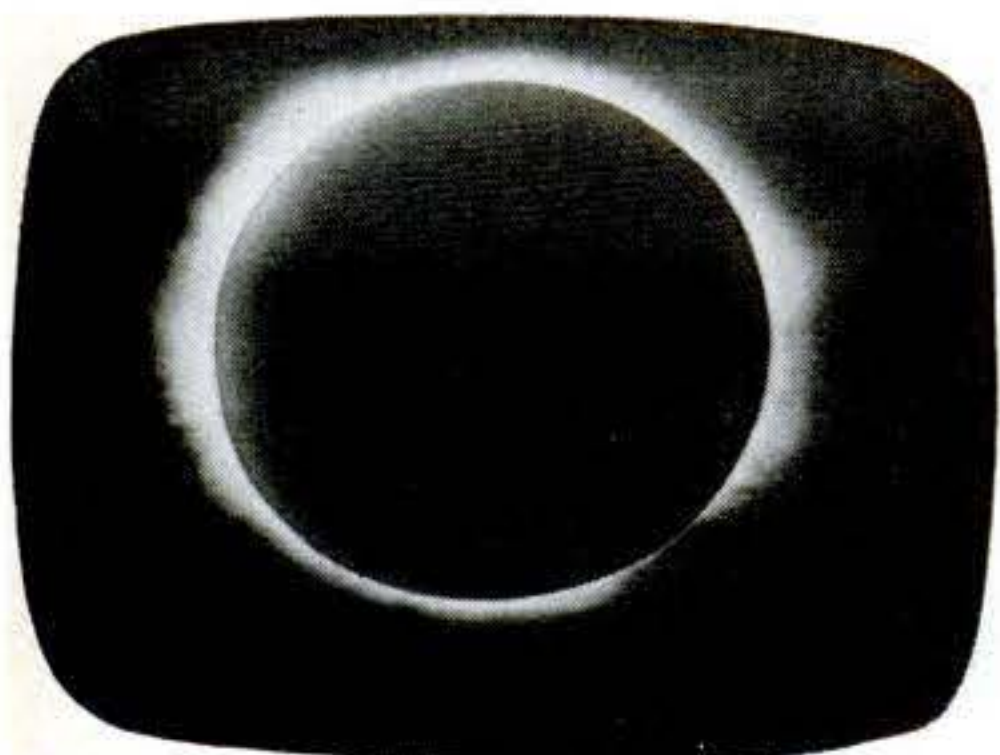


An intense light that duplicates the brightness of the sun will not harm this color TV space camera made by RCA. The camera has a silicon intensifier tube, whose semiconductor target protects it from sunlight and helps magnify faint light 150,000 times. Foil cover minimizes temperature extremes.

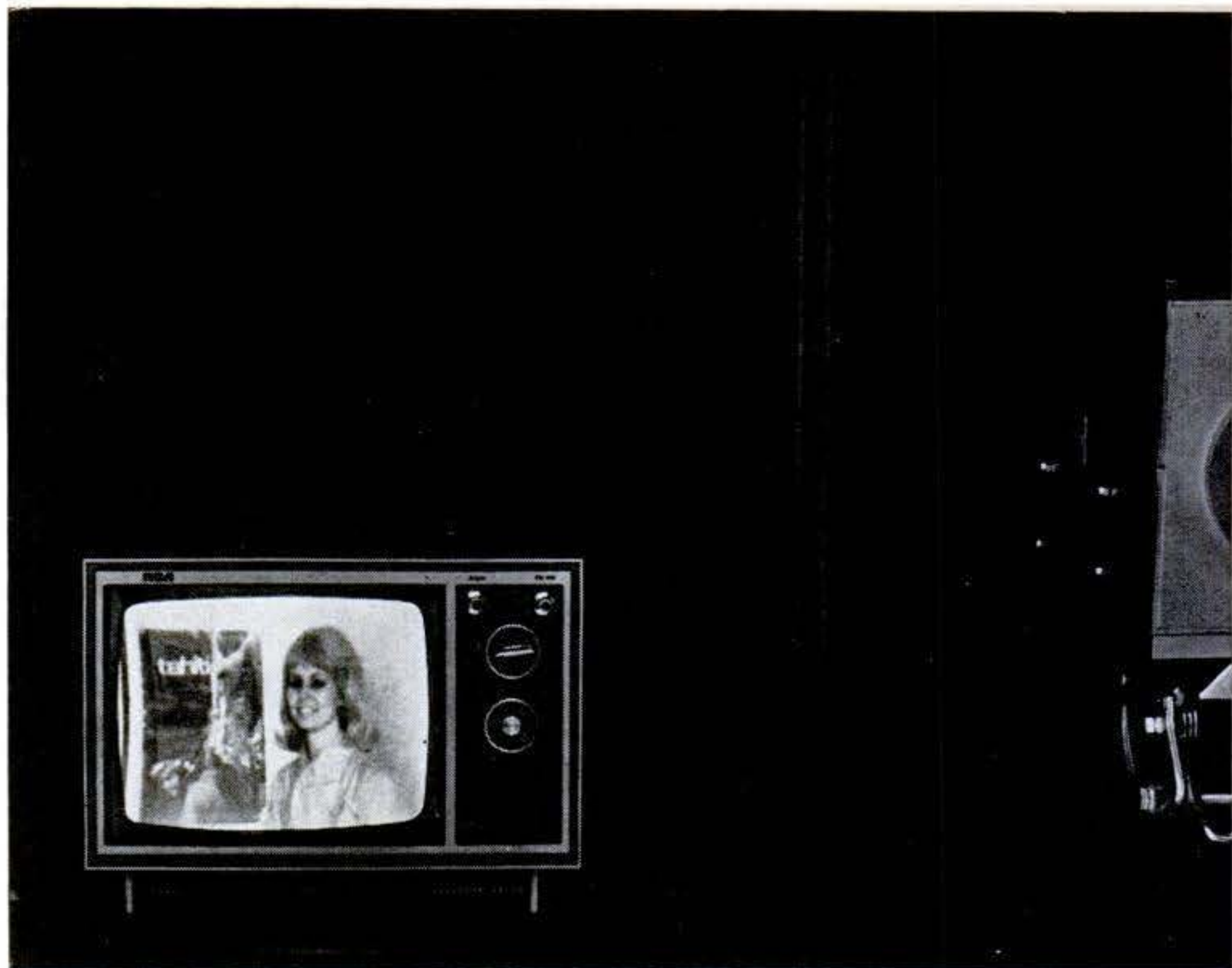
light necessary for good pictures (especially color), coupled with the limited power on a spacecraft. To get around this, they developed an extraordinarily sensitive camera tube that needs very little light to deliver a good image. The technique used to achieve this sensitivity, secondary electron conduction, gives the device its name—the SEC tube. Here's how it works:

Light from the camera lens falls on a fiber-optic faceplate. This concave plate reduces image distortion and is made with thousands of parallel optical fibers—each is 12 times thinner than a human hair. The coated rear surface of the plate is a photocathode that emits electrons when light falls on it.

These electrons, accelerated by a high voltage, crash into a thin aluminum-foil target whose rear surface is coated with a fluffy layer of potassium



Spectacular solar-eclipse views on network television were provided by cameras equipped with a new image tube that has a solid-state target immune to intense light.



Supersensitive silicon intensifier tube provides a bright, clear picture of the model when studio illumination is the equivalent

chloride. Each electron from the photocathode smashing through the foil causes an avalanche effect of secondary electrons in the chemical layer. These additional electrons make the positive-charge pattern on the target 100 times stronger. The electron beam sweeping over the target then generates a strong video signal.

Recently, after an Apollo-12 SEC tube was damaged by intense sunlight burning part of the target, Westinghouse developed a burn-resistant SEC tube. The target is protected by a heat-conducting copper-wire mesh.

SEC tubes are also suitable for a variety of earthbound applications. One manufacturer of color TV cameras uses three SEC tubes in a conventional color-camera arrangement: The camera can easily use the relatively low light levels suitable for monochrome cameras. This means a savings in electricity, since fewer lights decrease the air conditioning required in the studio.

Image intensifiers. A few years ago the Army revealed details of the classified "Starlight Scopes" used on night missions in Vietnam. These telescopic devices greatly amplify light, so troops can spot the enemy on the blackest overcast night. The addition of the image intensifiers used in military scopes to ordinary TV-camera tubes gives them a low-light capability.

In image intensifiers, light passes through a fiber-optic faceplate and strikes a photocathode (like the SEC tube). The freed electrons, acceler-

ated by about 15,000 volts, plow into a phosphor screen on the surface of another fiber-optic plate. The phosphor glows and the light it produces, about 50 times brighter than the incoming light, is funneled through the fiber optics into a conventional camera tube.

Two or three of these image intensifiers placed in series will boost light levels as much as 2,500 times (50 x 50) or 125,000 times (50 x 50 x 50). Sylvania's Model 200 LLTV surveillance camera uses a two-stage intensifier with a special vidicon-type sensor. Like most LLLTV units, this version has an automatic light-level and gain control to maintain a constant video level as light varies from starlight to sunlight.

Solid-state versions. A revolutionary type of low-light image tube was recently developed by RCA. Called the silicon intensifier tube (SIT), in some respects it is similar to the SEC tube. Instead of striking a coated aluminum target, though, electrons accelerated from the photocathode smash into a semiconductor target. Using integrated-circuit manufacturing techniques, some 600,000 diodes are formed on a nickel-size silicon wafer.

Due to a low voltage across the diodes, each one becomes a minute storage capacitor. When high-speed electrons strike one side of the diode target, a semiconductor type of avalanche takes place. Consequently, when the electron beam sweeps the

of starlight. That's 1/10,000,000 as bright as daylight. The new RCA tube will be available for commercial use in a few years.

Continued

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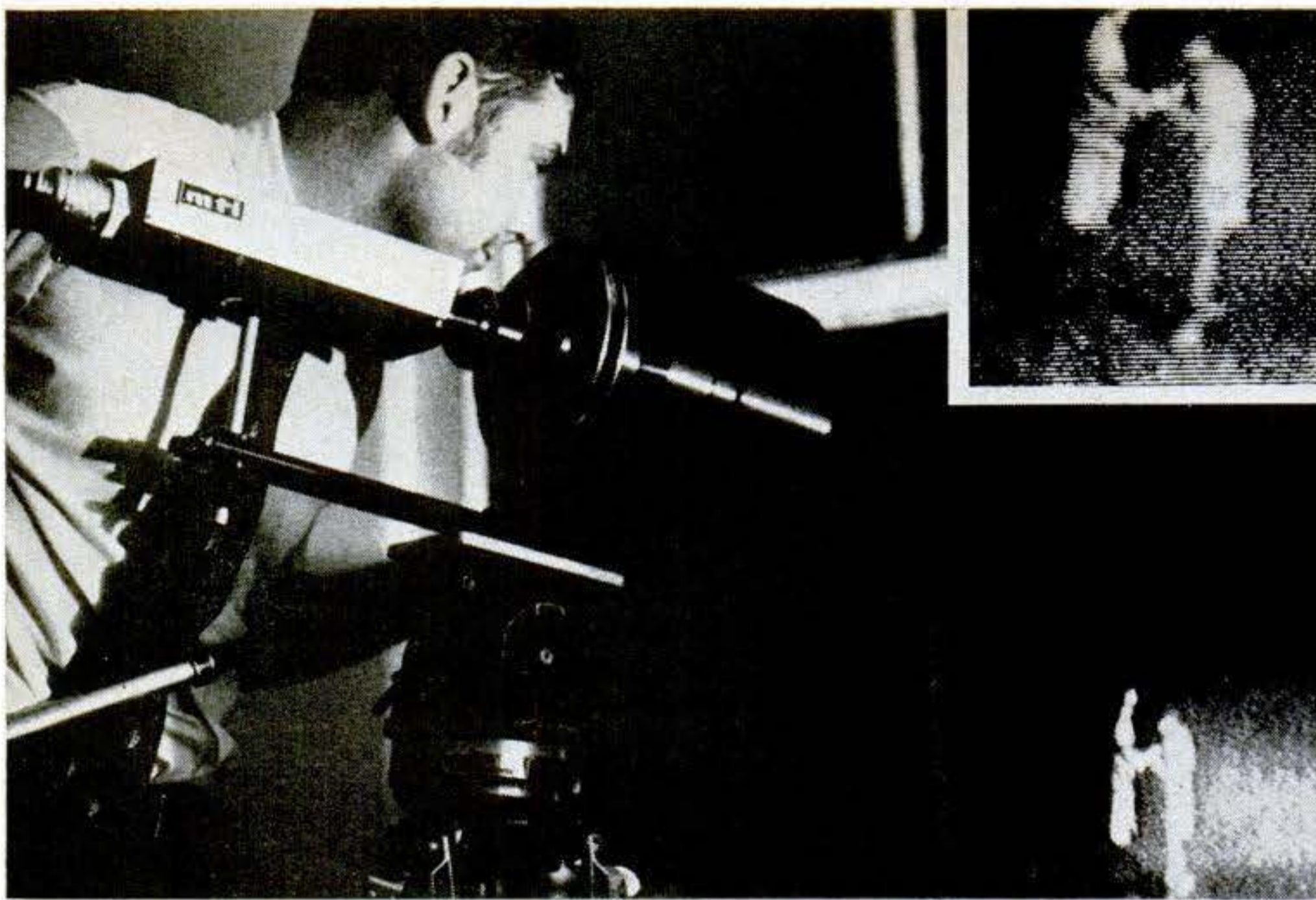
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A simulated narcotics sale 400 yards away is picked up by a Tivicon camera at night

and through the rain. The transaction area (inset) is illuminated with infrared light.

rear of the silicon target, more electrons are required to recharge the diode capacitors, and a strong video signal is developed.

An important feature of the SIT is its burn-proof silicon target. The SIT can be pointed directly at the sun without damage. Its brightness magnification of 150,000 is the highest ever achieved in a TV camera tube. Illumination equivalent to a 100-watt lamp at two miles is enough to produce a clear, bright TV picture.

For the moment, RCA is aiming SIT sales at specialized government and industrial markets. However, by 1973 they expect the tube will be

ready for commercial markets such as color TV broadcasting.

Moon-to-earth blastoff. RCA's silicon intensifier tube is the heart of a new color TV space camera built for NASA. Designed for use by astronauts on the moon, it can transmit color pictures under lunar light ranging from the dimness of sunrise to the brilliance of high noon. The image will not smear when the camera is panned quickly across bright objects. The rugged camera weighs only 10 pounds and measures 4-by-6½-by-16½ inches. Its ability to withstand temperatures from -250 to +250 degrees F will enable astronauts to leave



A prototype low-light-level TV camera is shown with the silicon intensifier tube that amplifies incoming light. The tube is similar in size to conventional vidicons.

it behind for moon-to-earth telecasts of the Lunar Module blastoff from the surface.

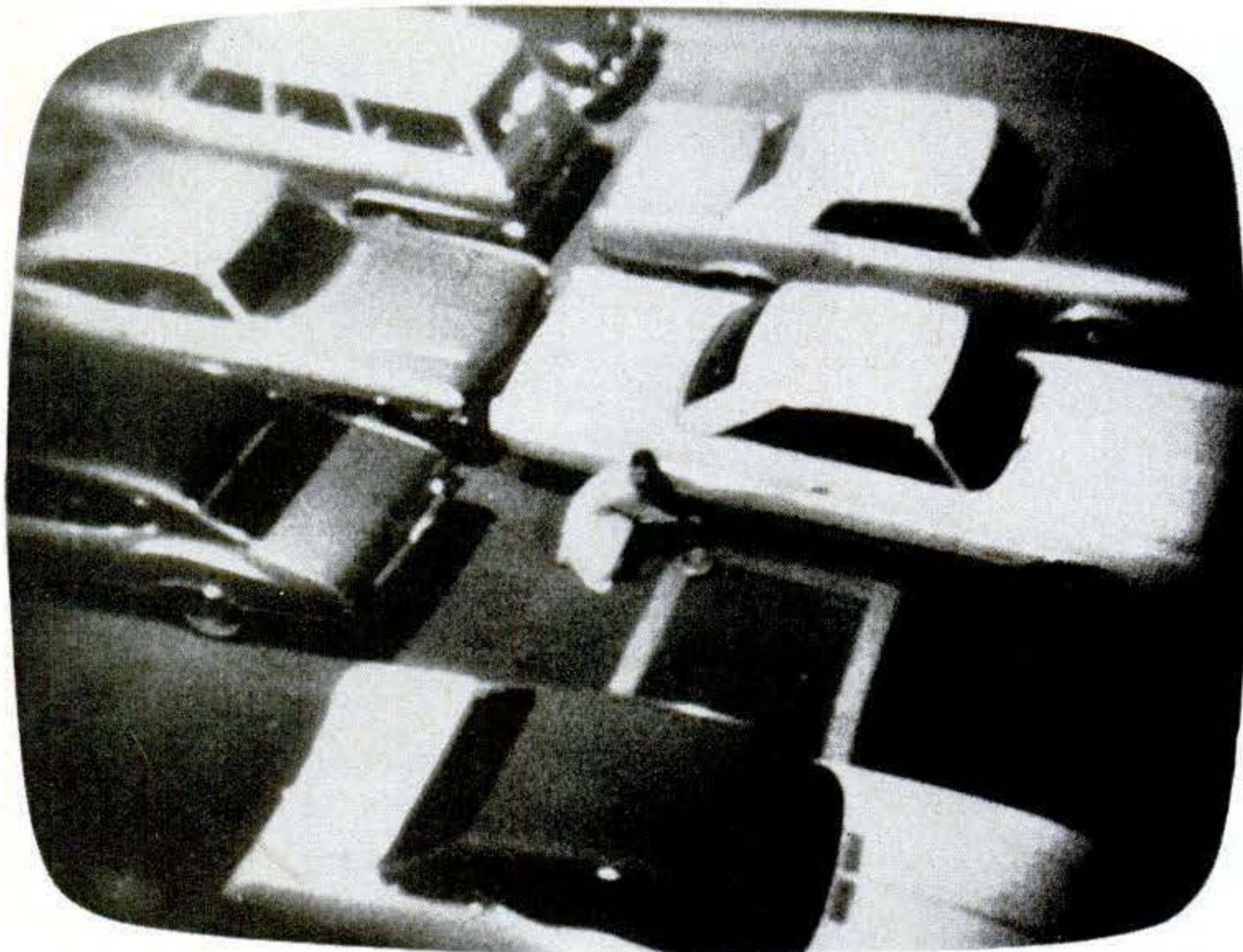
Tivicon is Texas Instruments' new infrared-sensitive vidicon image tube that also uses a silicon-diode array as a target. Some 750,000 light-sensitive diodes (each 0.0002 inch in diameter) are on a silicon slice the size of a 25-cent piece. Unlike the low-light tubes described, the Tivicon does not use a photocathode. The lens image is focused directly on the diodes. This makes Tivicons less sensitive, but lowers their cost (\$750 in off-the-line production quantities).

Infrared sensitive. But the Tivicon is still 10 times as sensitive as ordinary tubes under the same type of visible light. The Tivicon really "shines" under infrared illumination, where the human eye and conventional TV image tubes are blind. A thimble-size solid-state source of infrared light can invisibly light a 300-sq.-ft. area intensely enough for a Tivicon-equipped camera to deliver an image that looks like the same scene in daylight.

Like the SIT, the Tivicon's diode target cannot be "burned" by exposure to the most intense light. This was demonstrated last March 7 when millions of TV viewers were given a spectacular view of the total solar eclipse by a Tivicon-equipped camera.

Tivicons can withstand severe environments that would damage ordinary camera tubes or degrade their image quality. Resolution for Tivicons approaches 900 lines, easily exceeding broadcast resolution requirements.

Already an industry with a growing multimillion-dollar market annually, LLLTV systems have a luminous future.



Parking-lot scene on a TV monitor shows a thief at work in moonlight. The clear view

is possible due to a secondary electron conduction (SEC) tube in the TV camera.

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Maintenance Mechanic
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Industrial Engineering
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Tool Design

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Secretary, Medical
Secretary, Professional
Shorthand
Stenographic
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General Electronics
Indust. Electronics Tech.
Radio Telephone License
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Other (tell us)

1K765K

"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.



We haven't been able to get satisfactory answers from anybody concerning the effects of high-altitude driving on carburetor function. Like—it's the assumption that at part throttle a normal engine consumes about 9,500 gallons of atmosphere-pressure venturi area of the line, and at full throttle about 7,500 gallons of air per gallon of gas. Looking at the main float bowl we see atmospheric pressure pushing fuel into the below-atmosphere-pressure venturi area of the carburetor throat. The question is, if no adjustments are made, what's the effect on air/gas ratios when that same engine is running on a mountain top in lowered atmospheric pressure? Will the engine consume a less dense air at a faster rate, and the gas rate of flow remain constant? Or, will the decreased air pressure atop the gasoline chamber force less gas into the less-vacuumized venturi area? In particular, will that engine be running at perhaps 10,000 gallons of air per gallon of gas, or perhaps 7,000 gallons of air? Put another way—if an engine is rated at and produces 100 hp at sea level, will it rate lower at high altitude? Your answer will be greatly appreciated.

BILL THOMPSON, Milwaukee, Wis.

As altitude increases, a fixed-jet atmospheric-vented carburetor will present the engine with a richer condition. And the higher you go the less horsepower your engine will produce. Reason is that compression pressure drops with rising altitude. Assuming temperature and other correctional factors are equal, a cubic foot of air at sea level would be more than one cubic foot at 5,000 feet.

We own a '68 Ford Falcon and '68 Ford wagon, but my questions concern all cars. The manufacturers list tire pressures; are they an average value—or are they absolute? If the former, should tire pressures be raised for high-speed driving? How about for snow and ice? Should the rear tires be inflated more than front ones when carrying a load?

BOB LITTLE, Springfield, Va.

Recommended tire pressures have, as a rule, been very thoroughly investigated—but they're calculated on average driving, loading, and road conditions. For high-speed driving and/or above-average loads, tire pressures should be a little higher. Without heat and friction to-

gether, a tire would not wear; so the correct pressure would be that which causes the least heat while the tires are doing the job demanded of them. I can't give you the exact pressures for your expected driving conditions, but the people who made your tires can if you give them the facts.

Can you help settle an argument? My friend says you cannot have a supercharged fuel-injected engine, but I say you can. After all, big truck diesels are fuel-injected and turbocharged! Who's right?

JOHN BERGER, Ladysmith, B.C.

All I can say is that Al Unser sure won the hell out of the 1970 Indy Race with an engine like the one your friend says won't work!

The 327-cu. in 300-hp V8 in my '66 Corvette will not idle after initial start-up in cold or wet weather. It starts fine and runs smoothly for about five minutes, then it chokes out if I attempt to idle it. It gradually works itself out in city driving. When the roughness abates, a lack of "dashpot effect" can be noticed until the problem completely clears. The problem occurs only when the engine hasn't been run for eight to 10 hours, and the roughness is always accompanied by a strong smell of raw fuel. The manual choke may be opened or closed without any help. The car doesn't have any power accessories. I have had the ignition and timing checked, with new plugs, condenser, rotor, distributor cap, and new capacitor-discharge ignition added. Carb is a Holley 4160 four-barrel. When I try to step-accelerate, it sputters, bogs, chokes, etc., and once in a while backfires. Help!

W. A. LEVIJOKI, Flushing, Mich.

The basic problem is that after five minutes of running the engine starts running over-rich. You can control the mix up to a point with the manual choke, but after five minutes the manifold should be warm enough from the heat riser to run off from choke, and normally. At this point, somehow the engine gets too rich, so it looks like a carb problem. Next time you have this problem, remove the air cleaner immediately and look down into the carburetor. See if there is any ice—it's not beyond possibility. Otherwise, go to a good tune-up shop and have it checked

under the cold and damp conditions that are giving you trouble. The answer could be a high fuel level, a power-valve problem, or trouble in the idling circuit.

Recently a friend disconnected the transmission vacuum advance on his '70 Chevy. This made the transmission shift smoother, improved gas mileage some, and gave a slight improvement to performance. I tried it on my '70 Pontiac. I had to turn down the idle screw about 1½ turns, and set the mixture jets a turn leaner. Result: much smoother idle and transmission shift, plus smoother acceleration. I haven't checked gas mileage yet, but it should be better around town. Please let me know if this will affect the engine or performance. Also, why wouldn't it make for less pollution?

R. T. HOTZCLAW, Savannah, Ga.

I'm against maneuvers such as you describe. Sometimes engineers miss the boat, but I think not this time. All of those controls were developed from the results of a year or more of testing, and I doubt that people in the field can do much better. I think what you've accomplished is to advance the timing, and your smog production is probably well up.

I have a '69 Buick Skylark with only 10,000 miles on it. At 6,000 miles the battery went completely dead. Buick replaced it and said that it was due to a faulty voltage regulator. Now, at 10,000, it has gone dead again. Everything this time checks out okay—voltage regulator, alternator, no shorts, etc. What do you think is the cause?

SOL LEVIN, Brooklyn, N. Y.

Three main causes of premature battery failure that come to mind are: undercharge, overcharge, and low fluid level. I believe your problem could be lack of charge from short runs with many accessories pulling current, which would keep the battery in constant low condition. If this is so, there are three possible cures: a larger-capacity battery, an alternator with higher output at low speed, or just cut down on the accessory use and treat the car to some runs on the highway.

The front disk-brake pads on my '65 Ambassador wagon have been wearing out in less than 5,000 miles ever since the master cylinder was overhauled. I think the problem is residual pressure on those pads after each brake application (as evidenced by rapid accumulation of gray-black powder) and my inability to force fluid back up into the master cylinder when replacing pads. I feel that possibly the wrong kit was used, or that the tube seat installed did not contain the bleed port needed to avoid this condition. What do you suggest?

G. L. BECKER, Santa Cruz, Calif.

Disk brakes do not need a residual pressure system, since they have no retraction spring and only move a short distance. In comparison, drum brakes have quite a bit of travel and have healthy springs to pull them away from the drums. Retraction in disk brakes is usually accomplished by rotor run-out.

THE CITY SPARK PLUG THE HIGHWAY SPARK PLUG

WHICH ONE DO YOU NEED?

Spark plugs installed by automobile manufacturers are designed to suit normal driving conditions.

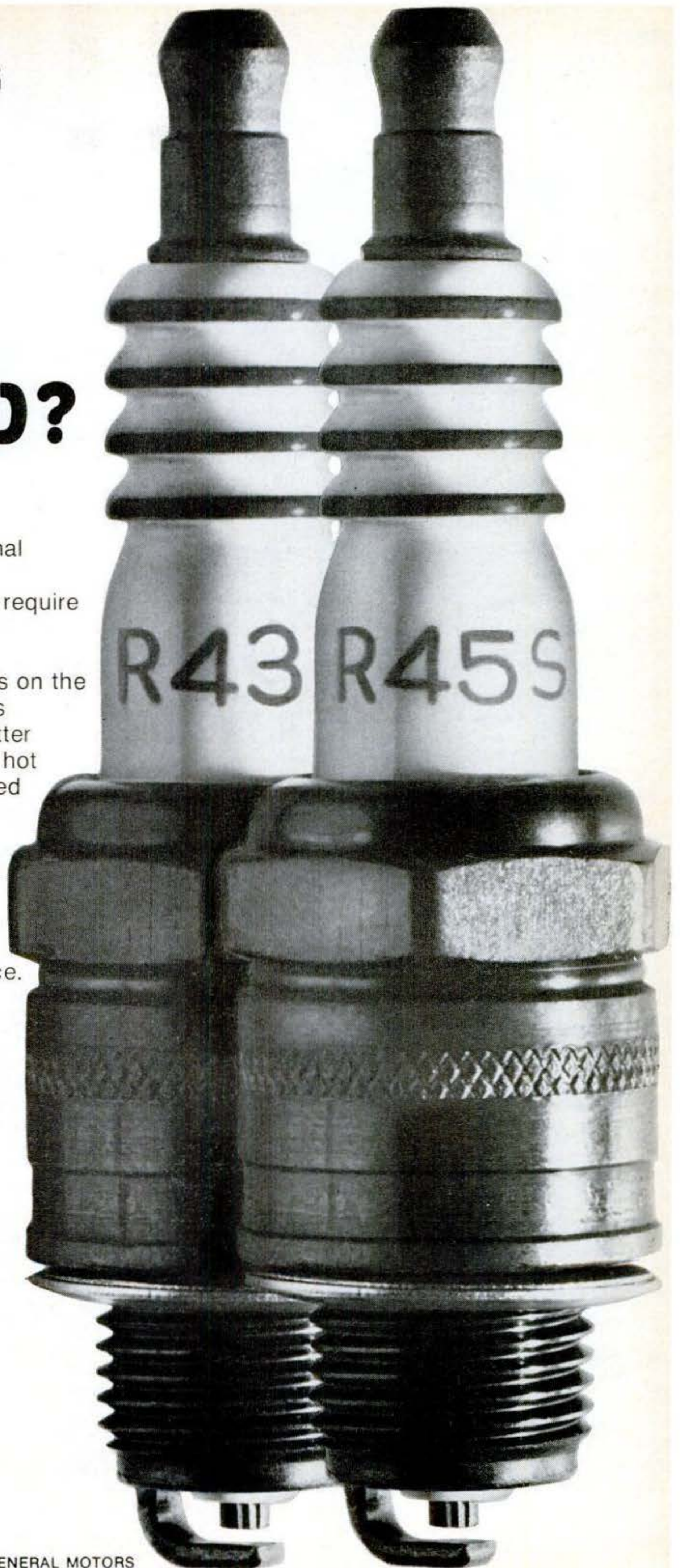
But some kinds of driving you do may require a cooler or hotter spark plug for best continuous performance.

For example, if most of your mileage is on the highway, a spark plug one or two ranges "cooler" than normal might give you better performance. A spark plug that runs too hot could lead to pre-ignition and high-speed missing.

But if most of your driving is stop-and-go in the city with extended idling periods, you may need a "hotter" heat range. A spark plug that runs too cool may not burn off fouling deposits . . . results in poor economy and performance.

How do you know what's best for your kind of driving? Check what the factory recommends as a mid-range spark plug and go from there . . . one step up or down in heat range at a time.

And when you're installing a fresh set of spark plugs . . . make sure you get the best . . . AC Fire-Ring Spark Plugs. They'll deliver peak power and economy longer . . . because they're engineered to meet your driving needs.

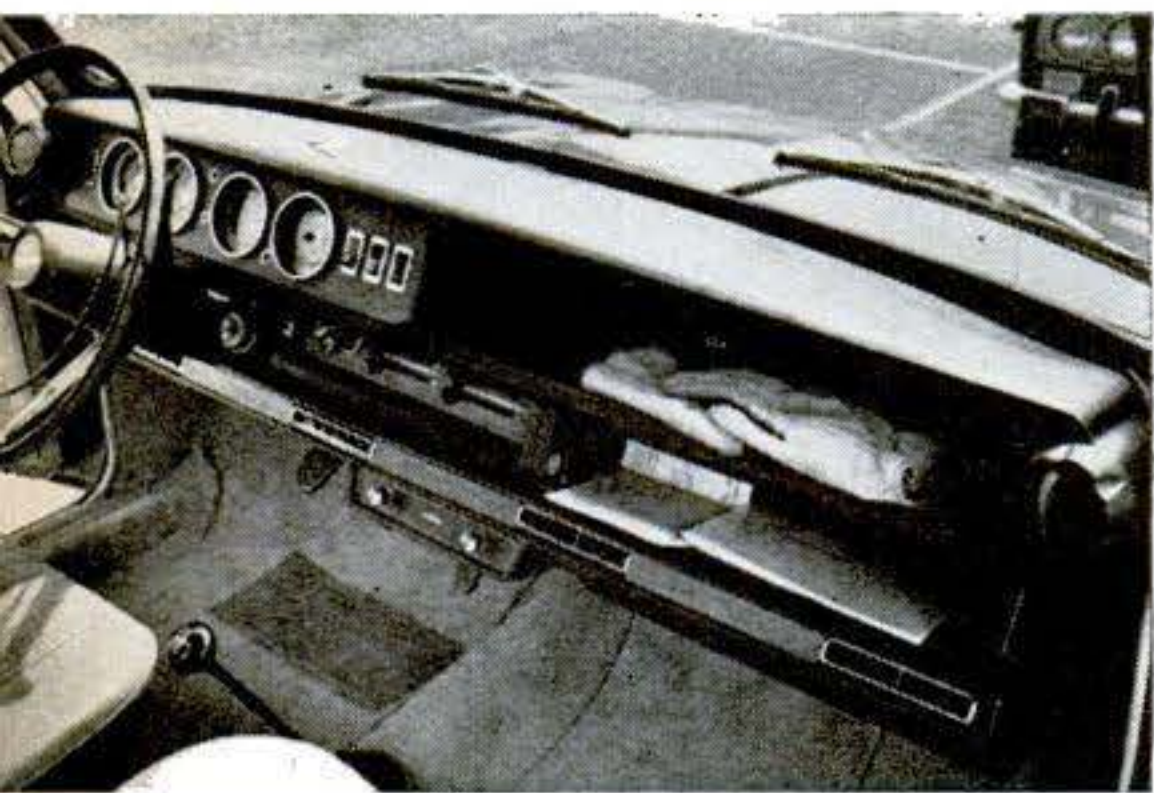


AC SPARK PLUG DIVISION OF GENERAL MOTORS



In see-through pose, with all doors wide open, are (clockwise from left) Simca 1204, Fiat 124 S, Datsun 510, and Toyota Corona.

PHOTOS BY ORLANDO GUERRA



The Small Car Detroit Doesn't Make: 4 DOORS, 4 SEATS, 4 CYLINDERS

These subcompact family cars from Europe and Japan surprise you with their roominess, comfort, performance, and economy

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

Well, you've seen the Pinto and the Vega, and you've probably gotten used to the Gremlin—Detroit's small cars, sized and priced to compete head-on with the most successful subcompact imports. They're fine little family cars, but none is available as a four-door sedan. For that you have to look to imports.

Four of them tested by PS closely match the Vega in price. Two are Japanese (Datsun and Toyota), one is French (Simca, built by Chrysler-France), and one is Italian (Fiat). All are backed by big sales and service organizations in this country.

The Japanese cars are available with three-speed automatic transmissions. The European ones come only

with four-speed manual gearboxes—though Fiat will soon make the French-built three-speed General Motors automatic transmission optional on the 124 S. It's the same transmission you find in the Opel (Buick's import).

All have enough power to run an A/C system (optional) without significant loss of performance, and the neat, compact installations do not severely hamper service accessibility. The tested Simca and Toyota carried A/C—keep that in mind when you look at acceleration test results.

The Toyota Corona is a brand-new design, and the most expensive of the four, but priced lower than the Mark II (still in production). The Datsun

Continued

View from up front shows Simca's two-level shelf (top photo) instead of glove box. High-level fresh-air vents are at each end of dash. Datsun (second from top) has a particularly well-padded look and high-level vents at both sides. Fiat (following) has central upper-level vents plus vent windows in the front doors. Glove-box lid is hinged on top. Toyota (bottom) has vent holes in the dash and unusually well-marked controls. Fuse box is under dash, on the right. All cars have adequate instrumentation.



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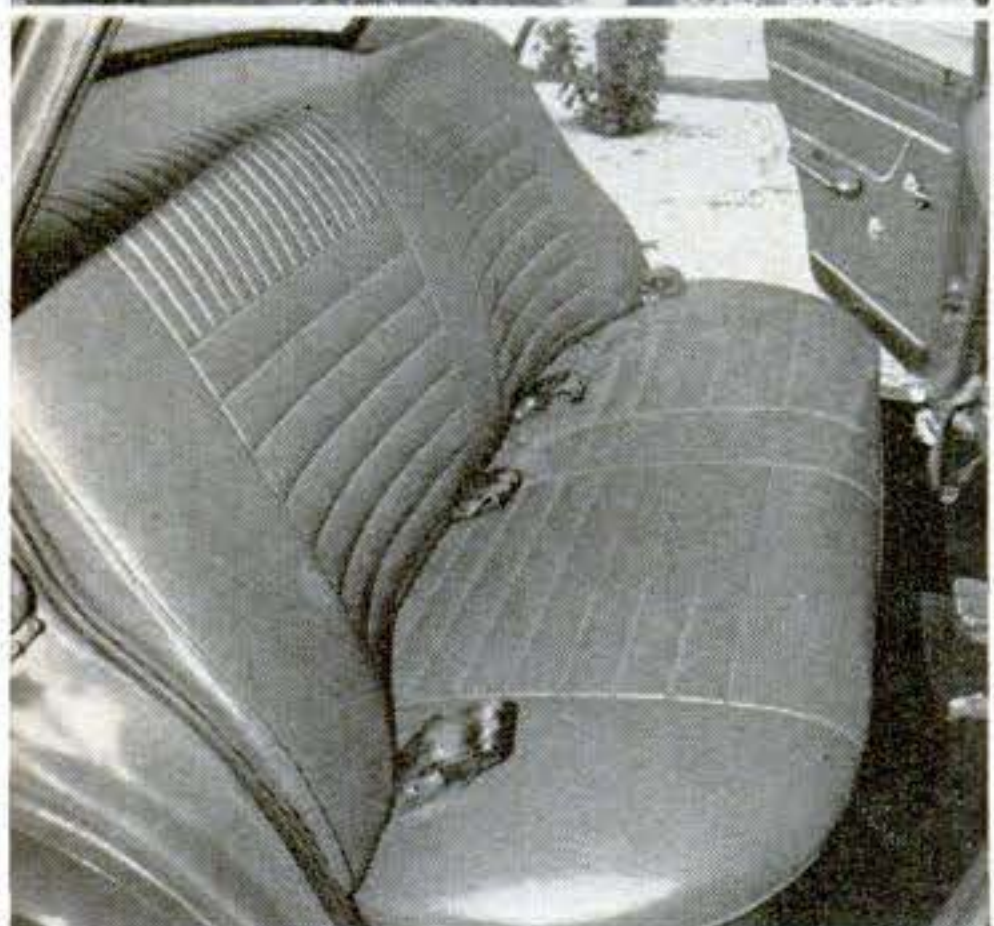
And let it snow.

ATLAS WEATHERGARD

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Extremely versatile back seat and trunk give the Simca the carrying capacity of a station wagon. The trunk lid is hinged at roof level, and the rear seat folds down to make a flat loading platform.



510 dates from 1967, as does the Simca 1204. The original Fiat 124 appeared in 1966, and the 124 S was added in 1968 and has now replaced the basic 124 in the U.S. market.

All will probably continue in production for some years to come. All have unit-construction bodies.

The Fiat and Toyota are conventionally built, with front engines and rear drive through beam axles. The Datsun has front engine/rear-wheel drive, but all-independent suspension. The Simca differs with front-wheel drive and all-independent suspension. Special utility features give its rear compartment a multitude of configurations and uses.

All four cars have front bucket seats of almost chair height, with good support and reclining backrests. Like most imports, all have inside

Fiat's plush interior, with high-quality, comfortable seats (left), promises ease on long trips. The front-seat backs recline. Rear seat gains extra width, for the wheel housings do not intrude. This car could almost qualify as five-seater.

hood-release knobs. On the Fiat and the Simca, hoods are front-hinged.

All are practical and handy city cars—easy to park, easy to get in and out of—with good visibility. They'll give you fair-to-excellent gas mileage, yet are able to cruise at top legal speed without too much noise. Our test-result figures show how greatly they differ in braking, handling, acceleration, and fuel economy. And there are other differences:

Datsun—easy to drive. Its strong pull at all speeds, and lack of engine noise at low rpm are impressive. At the top end it gets harsh. There's excellent seating for four, even with rear seat width cut down by intruding wheel housings. Steering is quick and light. The parking brake—an umbrella-handle type—is under the dash, at right of the steering column. The car has a hand throttle and automatic choke.

Separate lap and shoulder belts allow use of the lap belt alone. Underhood accessibility is great. Standing in one spot, you can reach coil, distributor, oil filter, plugs, battery, and fuses. Our handling tests showed that the car needs wider tires, preferably radials, for the rear end gets twitchy in emergency maneuvers. Wider tires probably would also help brake performance, as the biggest problem was rear wheel locking and loss of overall stability.

The Datsun gives a pleasant ride on all road surfaces, probably due to the all-independent suspension. Despite rather loud chassis rumble on rough roads, and more road noise at all speeds, on all roads, than the other cars, the Datsun gives an impression of great toughness and stamina. It kept running faultlessly throughout our test program.

Fiat stands out. The seats are a bit more luxurious, the controls smoother and more refined, and standard equipment includes radial tires and power disk brakes on all four wheels, with a weight-sensitive proportioning valve to prevent rear wheel locking.

Continued



Fiat trunk is long and deep, holds 14 cubic feet of useful space, with 31-inch liftover height. Fuel tank is in right fender.



Datsun trunk has wide flat floor, holds 12.5 cubic feet, with 33-inch liftover. Tank and spare wheel are under trunk floor.



Toyota trunk holds 10.9 cubic feet, with 32.5-inch liftover. Tools store at right, spare wheel in slanting position at left.

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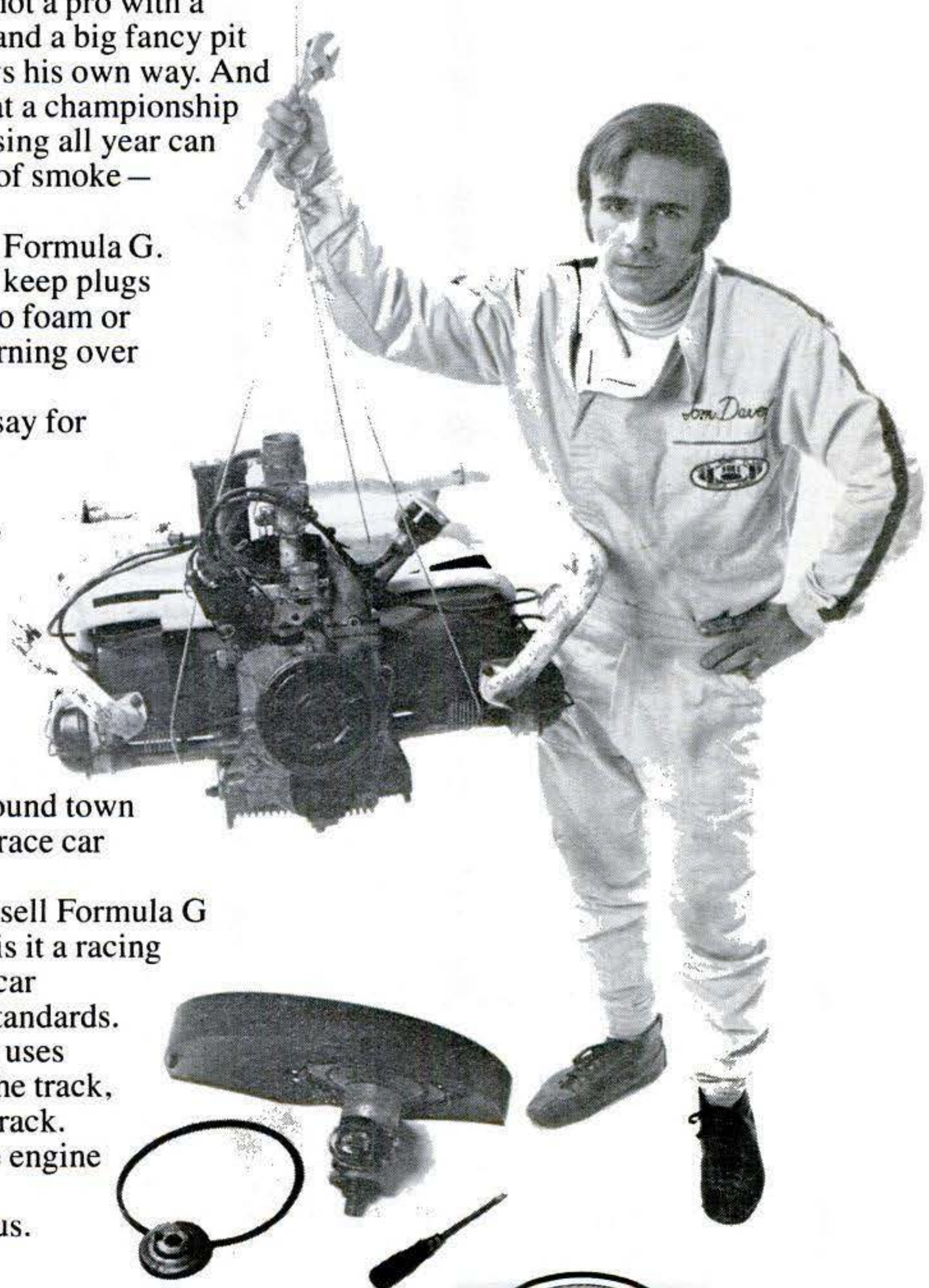
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CONVENIENT PAYMENT PLAN



Toyota and Datsun (right) have overhead-cam engines. Both can claim first-class ser-

vice accessibility. Installation job for Toyota's air conditioner is very neat.



Simca spare wheel is stored out of the way, and removal requires tools. Job is difficult and tends to get clothes dirty.



Datsun fuse box is located under the hood (right rear corner), and is labeled in two languages: English and Spanish.

The interior is airy and bright, with big windows and unmatched visibility. There are assist straps above all doors except the driver's. Belt and harness are integrated but overly complicated. Head restraints are adjustable.

The hand brake is a pull-up stick between the front seats. The wiper switch is perfectly placed at right of the steering column, but the high-beam switch can be mistaken for the turn-signal stalk. Choke is manual (there is also a hand throttle). The glove box is large, and there are storage bins in the kick panels.

The trunk is enormous. We managed to fill it with a seven-hp outboard motor, a six-gallon gas tank, three life

preservers, an anchor, and a tackle box—and still closed the lid.

The ride is firm, almost sporty, but not harsh. The all-coil suspension and radial-ply tires cushion road shocks from bumps, ripples, or potholes with equal ease. Steering is very quick, with racing-car precision, and not hard. Nor does it loosen up as speeds go up, but remains tight and accurate whether you're backing into a parking spot or rounding a turnpike curve at 70 mph.

It was no surprise that the Fiat, only car with four-wheel disks, had the shortest stopping distance, but we were astonished when it proved faster in acceleration from standstill than cars with larger and more powerful engines. In the handling tests it could be challenged only by the Simca. Service accessibility? Excellent, except for the oil filter. The cooling system is sealed.

Simca—soft and plushy. Cloud-nine seats, but a less roomy interior than in the Fiat. It has the best-looking, most comprehensive instrument panel, but no lockable glove box. The nearly flat floor makes for more comfortable seating; and the folding rear seat and top-hinged back door give you station-wagon versatility and storage possibilities not found in the other sedans. The ride is firm; and with stabilizer bars front and rear, the Simca takes all turns absolutely flat.

The steering is great—light and precise, giving the same response regardless of speed. But the gearshift has an ill-defined gate; you could get the 'wrong gear by mistake. The hand brake is floor-mounted, the choke manual. While the air conditioner has a fully integrated appearance, the heater controls were bewildering in their complexity. The one-piece seat belts were easy to use, with dual ad-

Continued

If you're planning to tow anything with any other '71, you could kill it by '72.

A car—even a car with a heavy-duty towing package—is still a car. Not a tow vehicle. So any time you're running a car ahead of a heavy load, you're running the high-priced risk of tearing its heart out.

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Plus the one thing no other wagon can give you: the ability to tow up to 10,000 pounds.

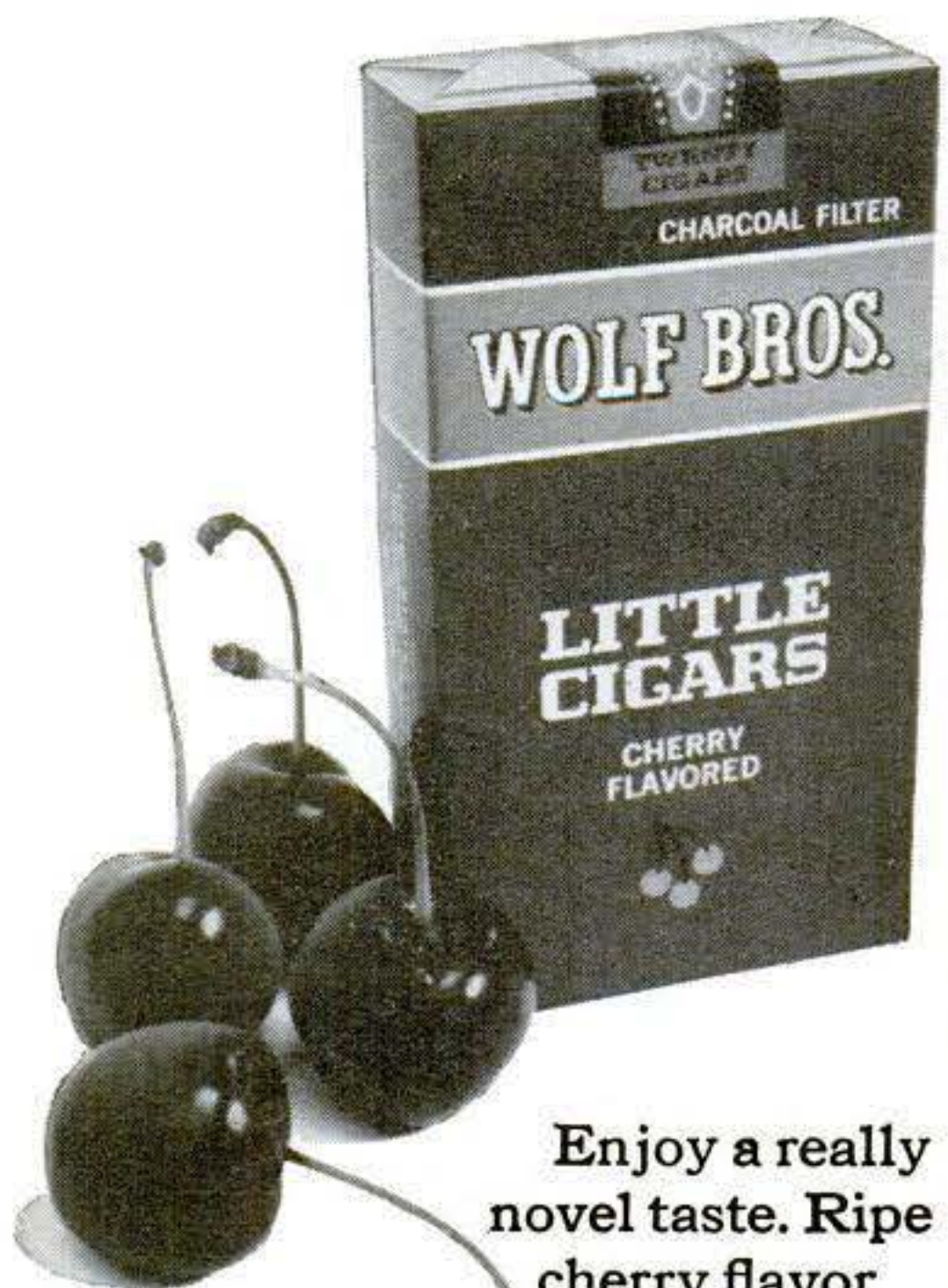
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Lane change: Simca (top) proved remarkably surefooted—it has front-wheel drive—and stayed level at all times. Toyota was slowest, due to body roll and tire slip.



Fiat had shortest stopping distance, braked beautifully straight, and had no trace of rear wheel-locking problems.



Datsun slewed to a stop from 60, fade-free but bothered by rear wheel locking, side pull. Distance: over 225 feet.

NOISE-LEVEL TEST RESULTS

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 an enormous difference.

	Datsun	Fiat	Simca	Toyota
30 mph smooth road	68 dbA	67 dbA	73 dbA	66 dbA
60 mph smooth road	77 dbA	79 dbA	80 dbA	76 dbA
30 mph rough road	77 dbA	76 dbA	78 dbA	76 dbA

adjustment for lap and shoulder straps, but locking in the same place.

Like the Fiat, Simca's radial tires and sealed cooling system are standard. Unlike the Fiat, under-hood accessibility is poor. Plugs and distributor are well hidden and the oil filter is in a particularly bad position. The spare tire is under the trunk floor, accessible only from below. Having a smaller engine, the Simca trails on acceleration, but gave best gas mileage.

Toyota—the quietest—The noise-level test results tell the story. This car gives the best highway ride and, surprisingly, the best off-road ride. The body is tight and rattle-free. The Toyota impresses you at once with its obvious quality. There's fine seating for four. Lap belts are separate from shoulder belts, which need exact adjustment to keep from pulling up on the lap belt. Door handles and lock buttons are a new type, hard to get used to, but perhaps superior. There are assist bars above the right-front and both rear doors. A pull-out hand brake with umbrella handle sticks out from the dash at right of the steering column. The Toyota has automatic choke. The engine is easily accessible for service. The air conditioner makes it a little hard to get to the oil dipstick and the front plug.

In the handling tests the Toyota steering was hard (though it loosens up at speed), and the tires ran with high slip angles, which held speed down. Due to soft springs there is some roll on hard turns, though the car is stable enough, with firm understeer in most situations. Fuel economy may look poor, but that's partly accounted for by the A/C.

Conclusions

Dunne: The Fiat gives me the exact combination of space and comfort, per-

Continued

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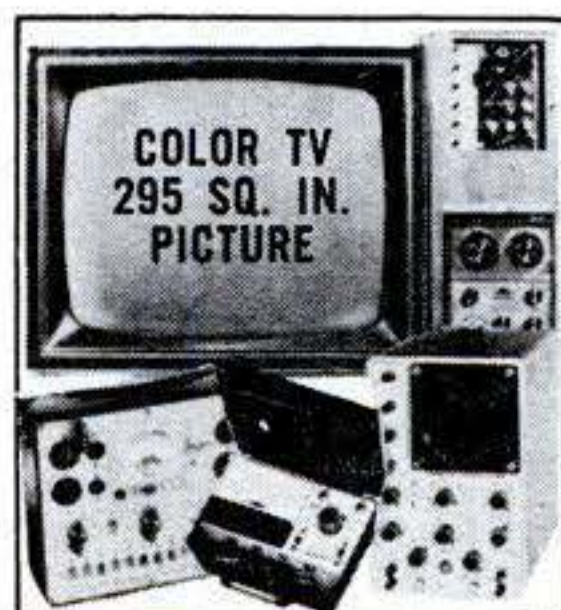
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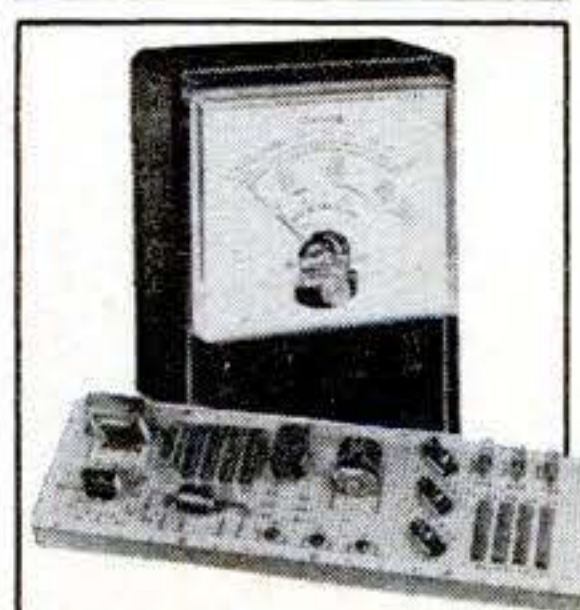
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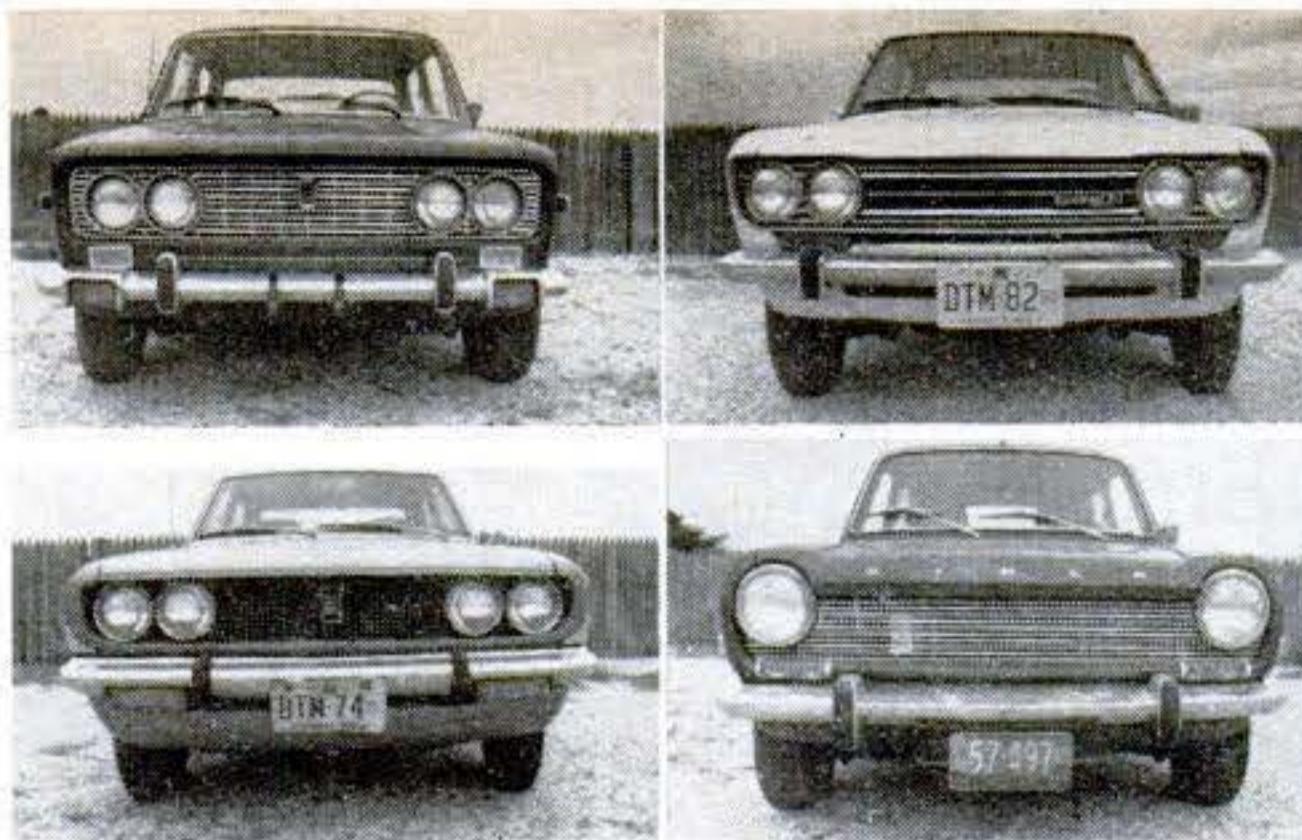
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Head-on view: At top are Fiat 124 S and Datsun. Below are Toyota and—only car with single headlights—Simca.

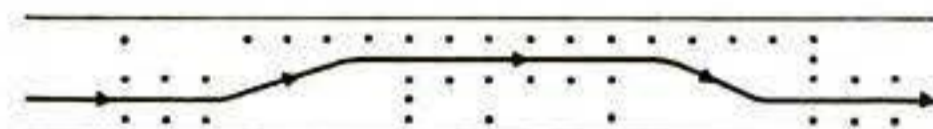
formance and economy steering and braking, that I look for in a car.

Norbye: I couldn't agree more. But I'd add that the Fiat also offers something special in both driving enjoyment and safety. The body was developed to leave survival space for the occupants in any type of accident—head-on collision, oblique-angle crash, rollover, and side impact. That's a big plus.

How PS tests cars—and what the tests show

Brake test shows a car's ability to stop on a straight line from 60 mph, without locking any wheels, after 10 stops from 60 at one-minute intervals with 1/2g deceleration (normal quick stop). Final stop is made in a 12-foot-wide lane and stopping distance is measured. Excessive pedal pressure indicates fading brakes. Excessive distance indicates fade, locking, or both.

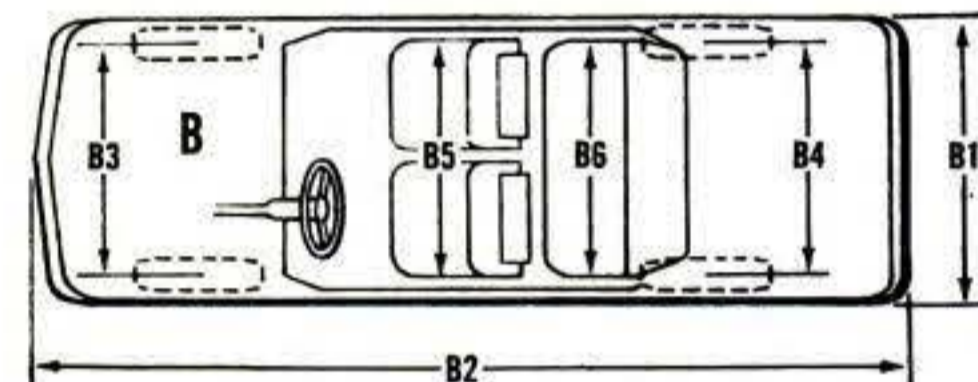
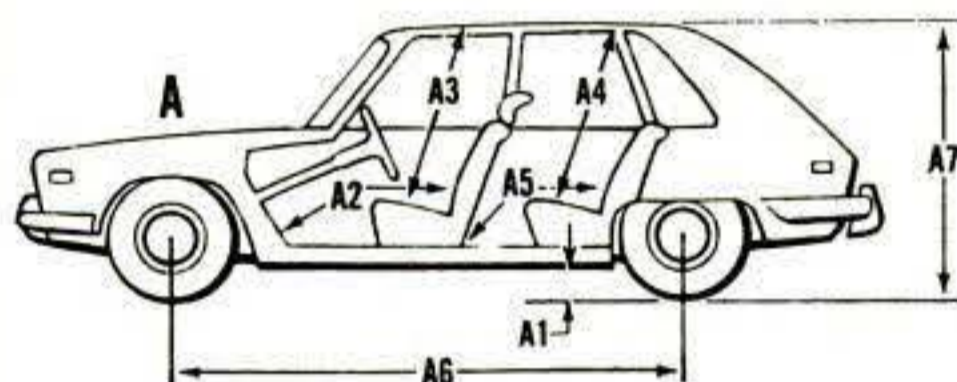
Acceleration test at 0-60 mph shows a car's ability to reach cruising speed from standstill. The 0-80 mph test shows its high-speed power reserve; 25-70 mph test simulates a highway merging situation. Cars with automatic transmission are tested in DRIVE.



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 sneaking a car as fast as possible through pylons 48 feet apart. In both handling tests, times clocked by two stopwatches are converted to mph.

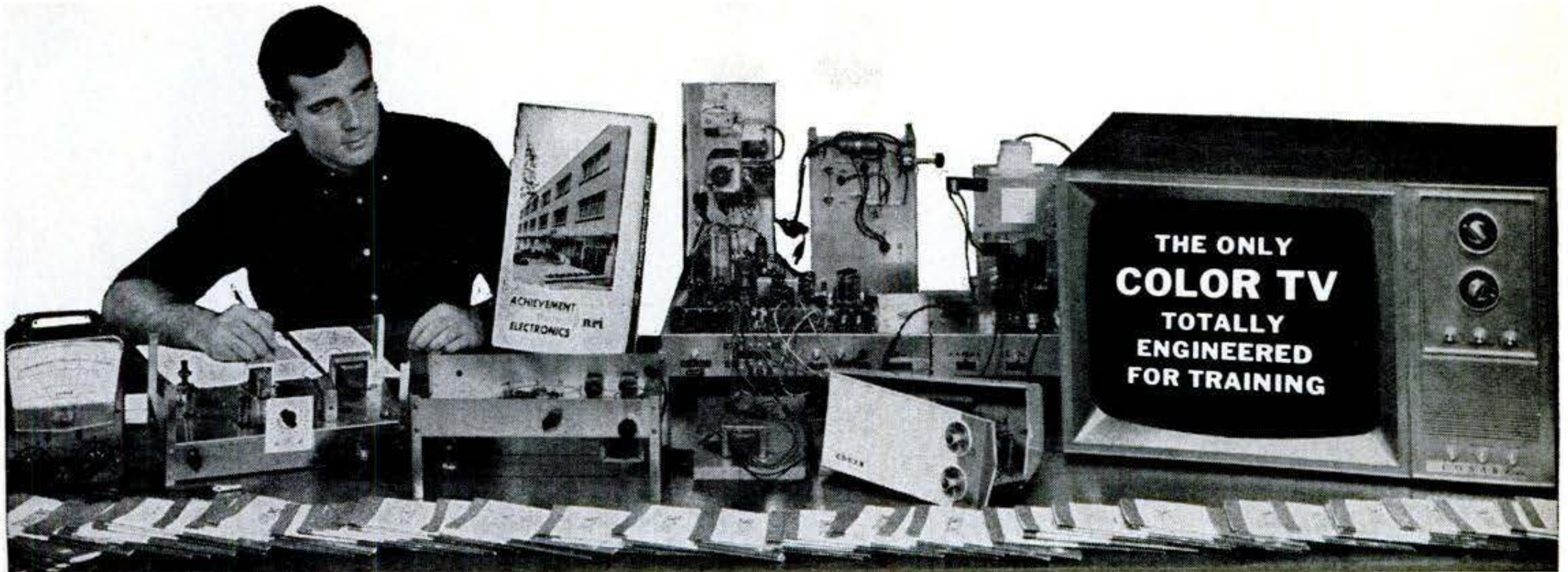


DIMENSIONS (inches)	DATSUN 510	FIAT 124 S	SIMCA 1204	TOYOTA Corona
A1 Ground clearance	6.9	6.5	6.0	7.1
A2 Front leg room (max.)	43.0	41.25	43.0	41.0
A3 Front head room	36.0	36.0	35.0	35.5
A4 Rear head room	33.5	34.0	35.0	33.5
A5 Rear leg room (min.)	37.0	39.0	35.25	38.0
A6 Wheelbase	95.3	95.25	99.2	95.7
A7 Height	55.5	53.75	55.7	55.1
B1 Width	61.4	64.0	62.5	61.8
B2 Length	162.2	158.75	155.3	166.9
B3 Front track	50.4	52.4	53.8	51.2
B4 Rear track	50.4	51.2	52.6	50.0
B5 Front hip room	48.0	51.0	49.0	48.0
B6 Rear hip room	45.5	55.0	48.5	38.5

SPECIFICATIONS	DATSUN 510	FIAT 124 S	SIMCA 1204	TOYOTA Corona
Engine type	SOHC 4-in-line	OHV 4-in-line	OHV 4-in-line	SOHC 4-in-line
Bore x stroke	3.30 x 2.90 in.	3.156 x 2.81 in.	2.91 x 2.76 in.	3.39 x 3.15 in.
Displacement	97.3 cu. in.	87.75 cu. in.	73.4 cu. in.	113.4 cu. in.
Compression ratio	8.5:1	9.0:1	8.7:1	9.0:1
Carburetion	One 2-barrel	One 2-barrel	One 2-barrel	One 2-barrel
Power @ rpm	96 @ 5,600	76 @ 5,400	62 @ 5,800	108 @ 5,500
Torque (lb.-ft.) @ rpm	99.8 @ 3,600	81 @ 3,300	65 @ 3,400	117 @ 3,600
Transmission	4-speed manual	4-speed manual	4-speed manual	4-speed manual
Axle ratio	3.90:1	4.10:1	3.94:1	3.90:1
Tires	Toyo E-41	Pirelli Cinturato	Fire-tone Sport 200	Dunlop C-41
Tire size	5.60-13	155 SR 13	145 SR 13	6.00-13
Turning diameter	31.4 ft.	35.0 ft.	35.6 ft.	31.5 ft.
Turns, lock to lock	3.2	2.7	3.25	3.0
Brakes	Disk/drum	All disk	Disk/drum	Disk/drum
Fuel tank	12.1 gal.	10.3 gal.	11.0 gal.	13.2 gal.
Curb weight	2,094 lbs.	2,085 lbs.	2,103 lbs.	2,170 lbs.

TEST RESULTS	DATSUN 510	FIAT 124 S	SIMCA 1204	TOYOTA Corona
Acceleration 0-60 mph	16.2 sec.	15.4 sec.	19.6 sec.	16.6 sec.
Acceleration 0-80 mph	32.6 sec.	31.3 sec.	40.0 sec.	31.9 sec.
Acceleration 25-70 mph	16.8 sec.	17.5 sec.	26.4 sec.	17.6 sec.
Braking distance 60-0 mph	225 ft., 10 in.	150 ft., 7 in.	164 ft., 4 in.	166 ft., 9 in.
Brake pedal pressure	160 lbs.	200 lbs.	160 lbs.	140 lbs.
Max. speed—lane change	53.0 mph	59.5 mph.	56.3 mph	49.8 mph
Max. speed—traffic weave	26.0 mph	26.7 mph	26.4 mph	24.7 mph
Average fuel mileage	23.6 mpg	24.4 mpg	26.0 mpg	19.8 mpg
Price (basic)	\$2,035	\$2,015	\$1,960	\$2,060
Price (as tested)	\$2,112	\$2,101	\$2,372	\$2,481

You get more for your money from NRI



BUILD • TEST • EXPLORE All this is yours — from Achievement Kit, to solid state Radio, to training-engineered Color TV set — when you enroll for NRI's TV-Radio Servicing course. Other courses equally complete. Unique training methods, "bite-size" texts, many personal services have made NRI the leader in its field for over 50 years.

NRI Programmed Equipment Gives You Priceless Confidence, Makes Learning TV-Radio, Electronics Fast and Fascinating

NRI pioneered the idea of supplying home-study students with custom designed training kits to give practical on-the-job experience as you learn. Today, NRI's "3-Dimensional" training can't be equalled. You get more value — from the exclusive Achievement Kit sent the day you enroll, to "bite-size" texts and custom training equipment. Learning TV-Radio, Electronics or Communications at home is easy, exciting, the NRI simplified, dramatized way.

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Regardless of your educational background, you can learn the Electronics field of your choice the practical NRI way. The NRI color catalog, sent to you free and without obligation, tells you how you can qualify quickly to be a part of the fast growing Electronic Age; about engineering jobs in business, industry, broadcasting, government, now offered to men without college degrees. It will open your eyes to the great number of success opportunities available right now in the high-pay world of TV-Radio Servicing, Broadcasting-Communications and Industrial-Military Electronics. With NRI technical training, you can take your choice of a wide variety of career

openings or have a business of your own. And if you choose one of five NRI courses that include FCC License preparation, you must earn your FCC License or NRI refunds your tuition!

MAKE \$5 TO \$7 AN HOUR EXTRA IN SPARE TIME STARTING SOON

Tens of thousands of NRI graduates are proof it is practical to train at home in your spare time. Keep your present job while preparing for a better one, and earn \$5 to \$7 an hour extra in spare time while you train, fixing sets for friends and neighbors. NRI shows you how. Equipment you build and keep becomes useful in your work.

STEP UP TO BETTER PAY, A BRIGHTER FUTURE

NRI can help you, but the decision to act must come from you. Decide now to move ahead . . . mail the postage-free card today for your FREE NRI color catalog. No obligation. No salesman will call. NATIONAL RADIO INSTITUTE, Electronics Division, Washington, D.C. 20016.

APPROVED UNDER GI BILL

If you served since January 31, 1955, or are in service, check GI line on postage-free card or in coupon.

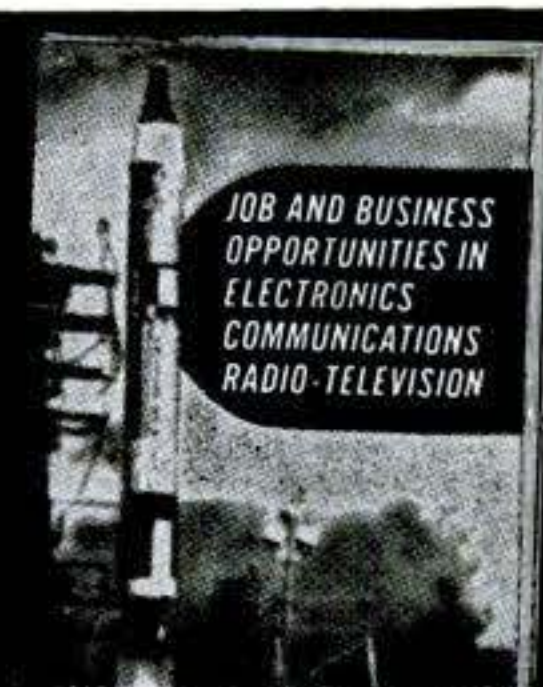
CASH IN ON THE BOOM IN COLOR TELEVISION



The NRI TV-Radio Servicing course includes your choice of black and white or color TV training equipment. Color TV needs thousands of trained men to keep pace with millions of sets being sold every year. NRI prepares you quickly. Cash in on the boom.

Mail insert card for
**your FREE NRI
color CATALOG**

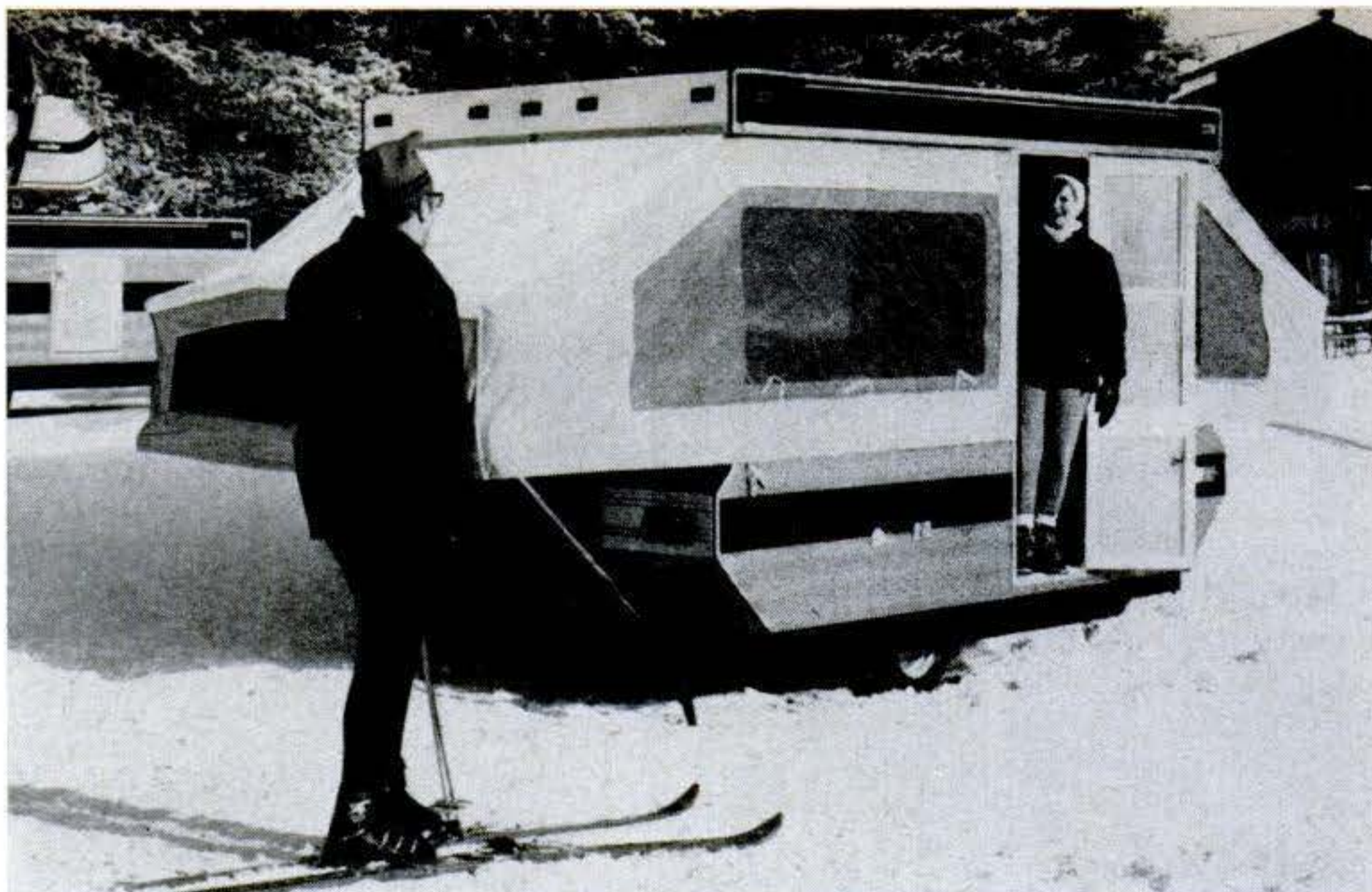
No salesman will call



Recreation Roundup

...on the move with PS

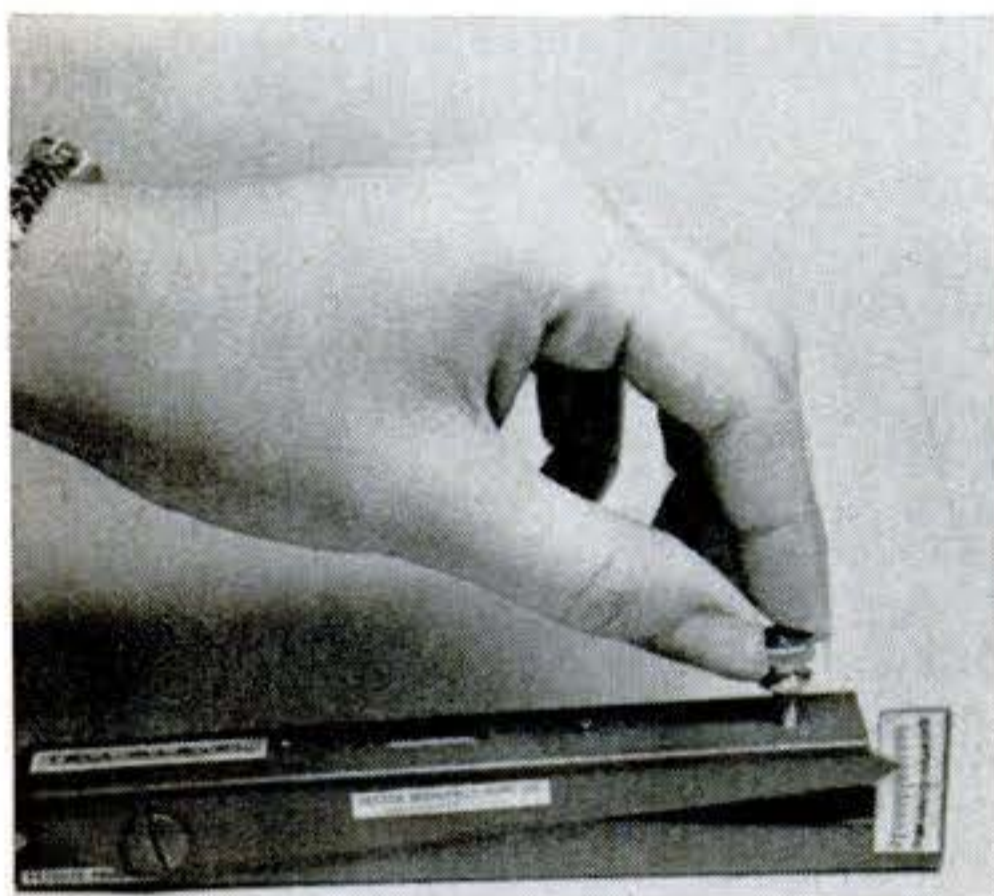
By HERBERT SHULDINER



Four-season camper is hot item for winter sportsmen

The new Conwed 220 is designed for use around the calendar. It has a forced-air heating system that will keep you cosy and warm, even in zero weather. The camper has sleeping space for as many as seven, and there's a complete kitchen. It's built by Conwed Campers, Route One, Rice Lake, Wis. 54868.

Device puts campers on the level



You're looking at the Tell-A-Level. It tells you the actual distance you'll have to jack up your camper to level it. The work-saving device can be used with trailers of any length. It's made by the Yetter Mfg. Co., Colchester, Ill.

Great idea for the slower paced

The Federal Highway Administration and the state of Virginia are presenting to outdoorsmen a "fringe benefit" in the construction of I-66 through Arlington County. Hiking and biking trails will be added to the fringe of the highway—fenced off to protect cyclists, walkers, and motorists from accidents. Seems like a fine idea to take care of outdoorsmen who like to look while they travel.

Things to write for

The National Coal Assn. will send you a list of campgrounds on strip-mine lands which have been opened to the public. Write the Association at the Coal Building, 1130 17th St. N.W., Washington, D.C. 20036.

Updated volumes of the *Snowmobile Trail Atlas* (for Michigan, Minnesota, Wisconsin, and New York) are now available from Rockford Map Publishers, Inc., 4525 Forest View Ave., Rockford, Ill. 61108. They're \$1.95 each.

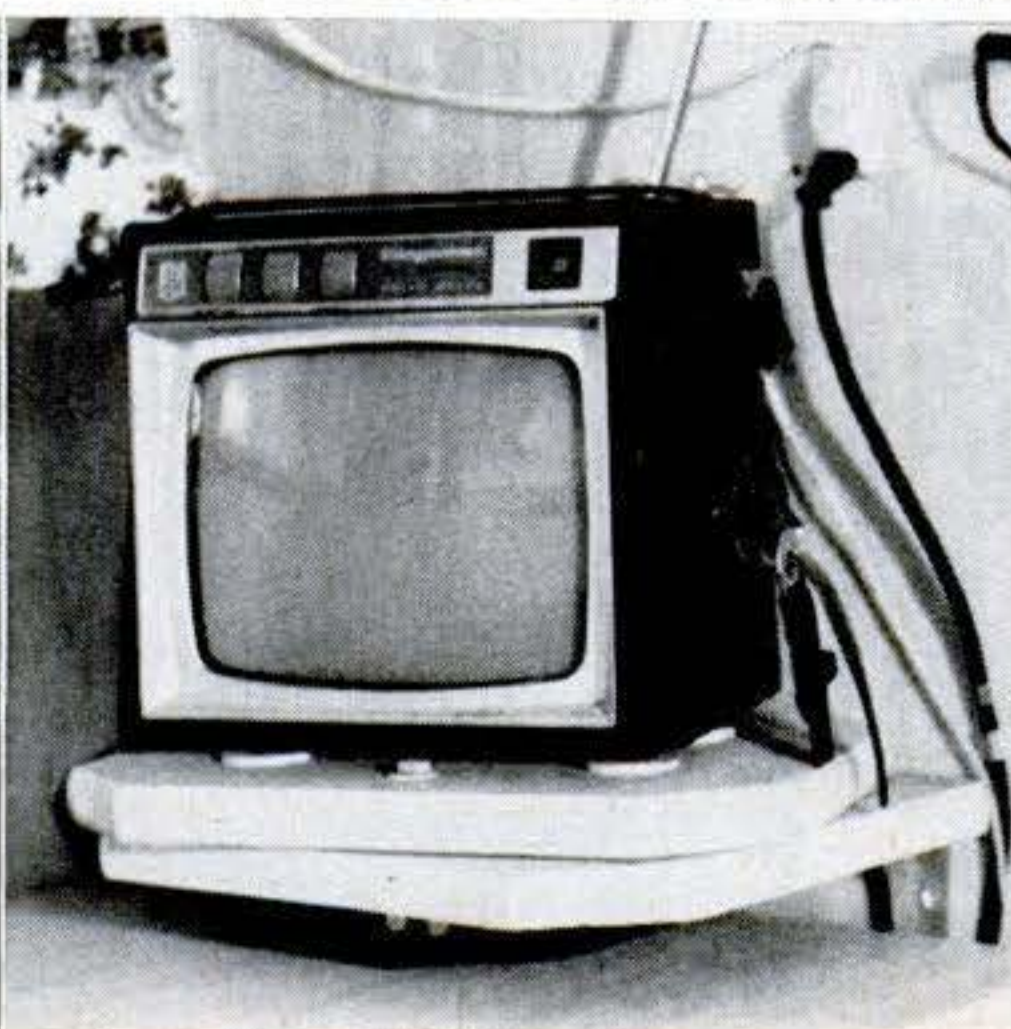
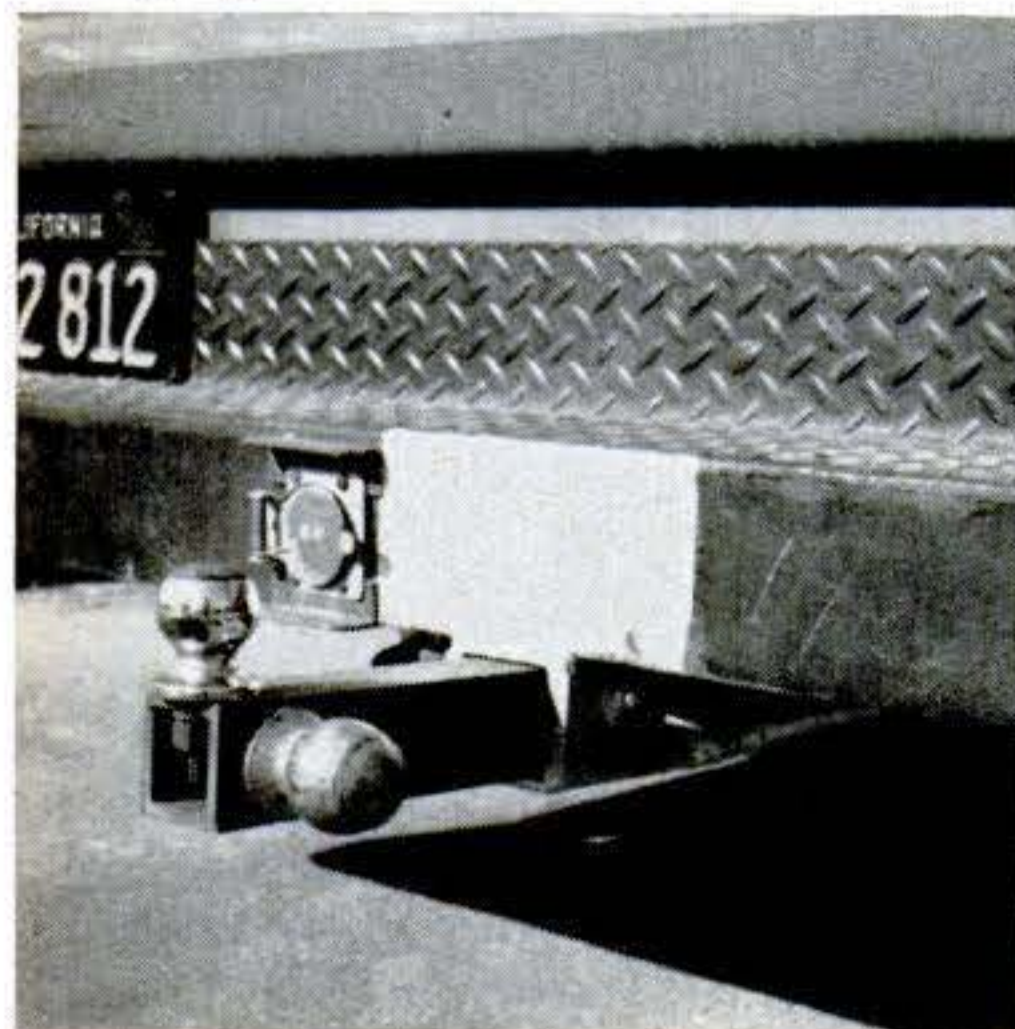
An ingenious gadget for travelers—the

Dist-O-Map—may intrigue you. It dials the mileage between U.S. cities and shows the best routes, coast to coast. You rotate a disk between the front and back of a page to get desired mileage. The seven disk-shaped maps are spirally bound, and handling the book is a lot easier than the usual wrestling bout with a flat road map. You can get one from the House of Bilmar, 1200 Hutton Rd., Farmington, N.M. 87401, for \$3.25.

Off-season tire care

If you haven't already done so, now is a good time to "winterize" your camper tires. The Tire Industry Safety Council advises that tires may be left on the trailer, but they should be off the ground, and their inflation pressure reduced to 10 pounds. The Council also suggests that your tires "should be replaced if the tread is worn to $\frac{1}{16}$ -in. or less in two or more adjacent grooves, or—in late-model tires—to the level of the tread-wear indicators molded into the bottom of the tread grooves."

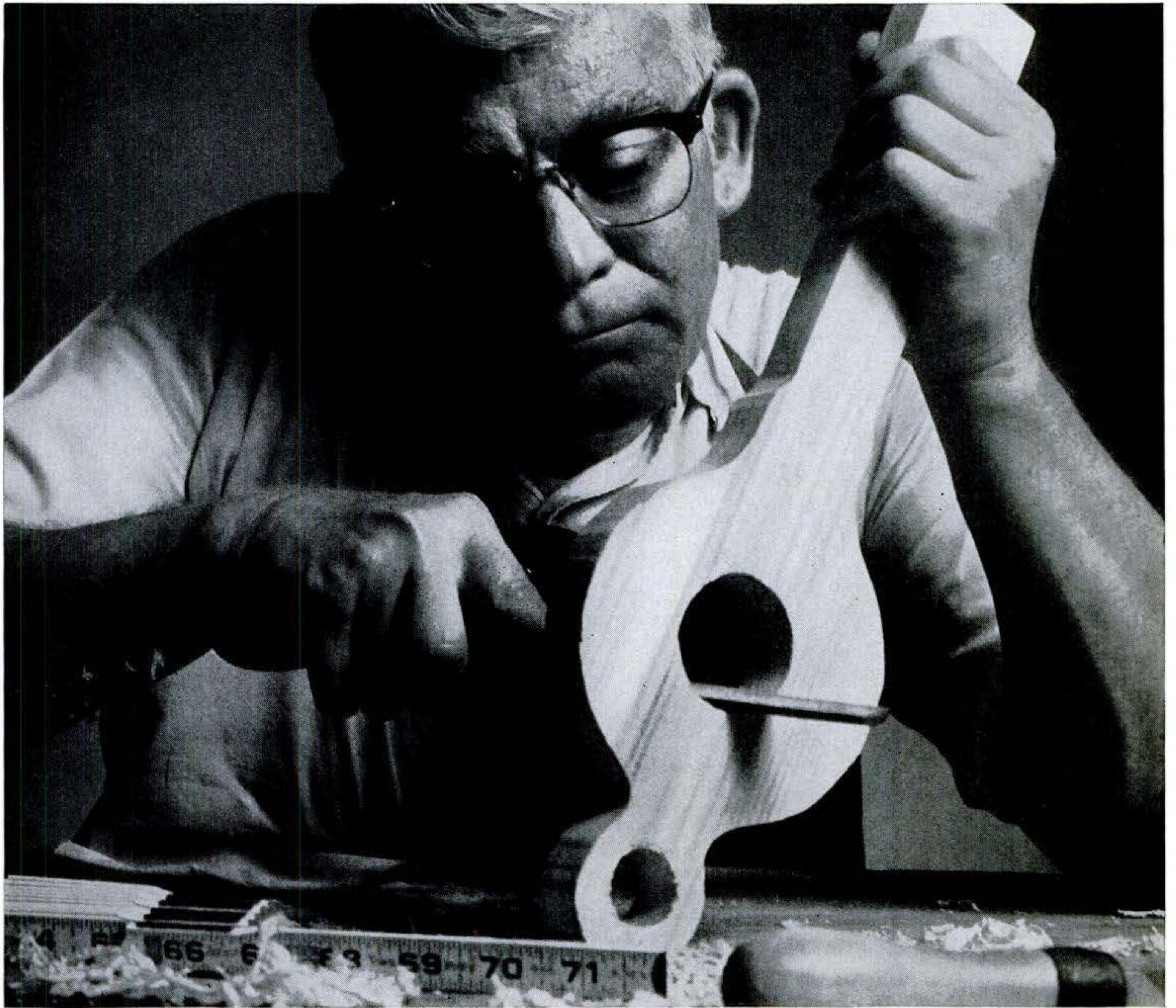
Two projects a camper owner can tackle over the winter: one for work, and another for play



Reader W. C. Miles of Redlands, Calif., owner of two towed vehicles, sends along a clever idea for handling the problem of changing ball hitches of two different sizes: Make a double-duty hitch as at far left. A quarter-turn brings the second ball into use.

The other photo shows an idea for a firmly based TV swivel for campers devised by D. C. Edwards. Both the shelf and swivel are made of $\frac{3}{4}$ -in. board covered with $\frac{1}{8}$ -in. pre-finished veneer matching the camper interior. The swivel shelf is cut slightly smaller and four wood washers placed to hold the TV legs. A bolt through both shelves forms the center spindle. A leather belt cut in two and fastened to the swivel shelf with screws anchors the set.

Old Crow begins with men who love to work with their hands.

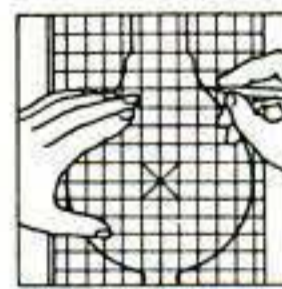


George Donehoo is Old Crow's Master Distiller. He is the one man who knows *all* the secrets that give our country Bourbon its special character.

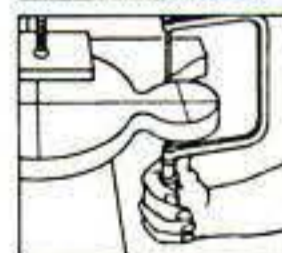
The first scientific way of distilling Bourbon was invented by Dr. James Crow back in 1835. But giving our Bourbon a handcrafted taste is still an art.

"Most of the people at Old Crow never *stop* working with their hands," says Donehoo. "Come evening, you'll find them working on their own projects."

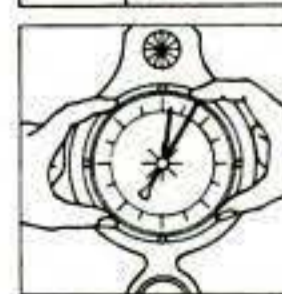
George Donehoo calls on the same craftsmanship making this barometer as he does running our distillery. For a set of the plans, write: Old Crow, Box 531, Frankfort, Kentucky 40601.



Trace barometer pattern on a good piece of mahogany.



Saw outside the lines. Make holes for instruments with drill and coping saw.



Fine sand. Stain. Insert instruments. And now it's getting on toward Old Crow time.



Old Crow
Handcrafted Bourbon

KENTUCKY STRAIGHT BOURBON WHISKEY. 86 PROOF
DISTILLED AND BOTTLED BY THE FAMOUS OLD CROW DISTILLERY CO., FRANKFORT, KY.

Detroit Report...

CHRYSLER'S R429 MINICAR will be built in a two-door version only. Chrysler is debating right now whether to build a station wagon in addition to the sedan, but leans toward the single body style, at least for production startup late next year. Unlike Ford, which dropped the Cortina when the Pinto came out, Chrysler plans to keep selling the Colt and Cricket imports after the R429 appears. Chrysler will let the market demand for each car decide its fate.

Traffic deaths will most certainly go up in the coming year despite any safety measures the government may take, says one of Detroit's top auto safety men. He blames the boom in sales of smaller cars for the predicted increase. According to this expert, a recent New York State study shows that chances of serious injury or death—in an accident—are three-to-one greater in cars of 2,000 pounds than in 4,800-pound standard-size cars. Small cars are simply more vulnerable—a selling point for big cars that Detroit judiciously avoids.

You'll see an end to the high cost and annoyance of those low-speed, chain-reaction accidents. New bumpers that can withstand a five-mph barrier crash without damage are coming. Look for General Motors to switch all their bumpers to this five-mph capability next fall. Ford, Chrysler, and American Motors are working hard on the problem, too. Biggest hangup so far is getting the bumper on one car to meet the bumper on the next. With nosedive and rear-end lift during braking, bumpers must cover a lot of space. Bumper standards are being written now to cover this problem. Final designs will be shock-absorbing bumpers that will cushion impact and retract up to six inches without hitting sheet metal, then automatically return to original position. All bumper facings will probably be rubber-covered.

Ford predicts that small cars will take 30 percent of the market in 1971, with most of the added sales stolen from the standard-size part of the market. Sales of standard cars have been falling for the past 10 years. Right now they are taking about 40 percent of the market, their lowest share in history. As sales of small cars grow, this share will continue to fall, since both the intermediates and sporty cars are expected to continue selling at present levels. What is the future of the standard car? Look for some model lines—especially in the medium-price range—to be dropped in coming years. Look for the low-priced standards to become even more luxurious. Finally, look for more expensive luxury cars, with price tags breaking through the \$10,000 level.

Oldsmobile continues to search for a combination that will be a big seller in Olds' traditionally high end of the small-

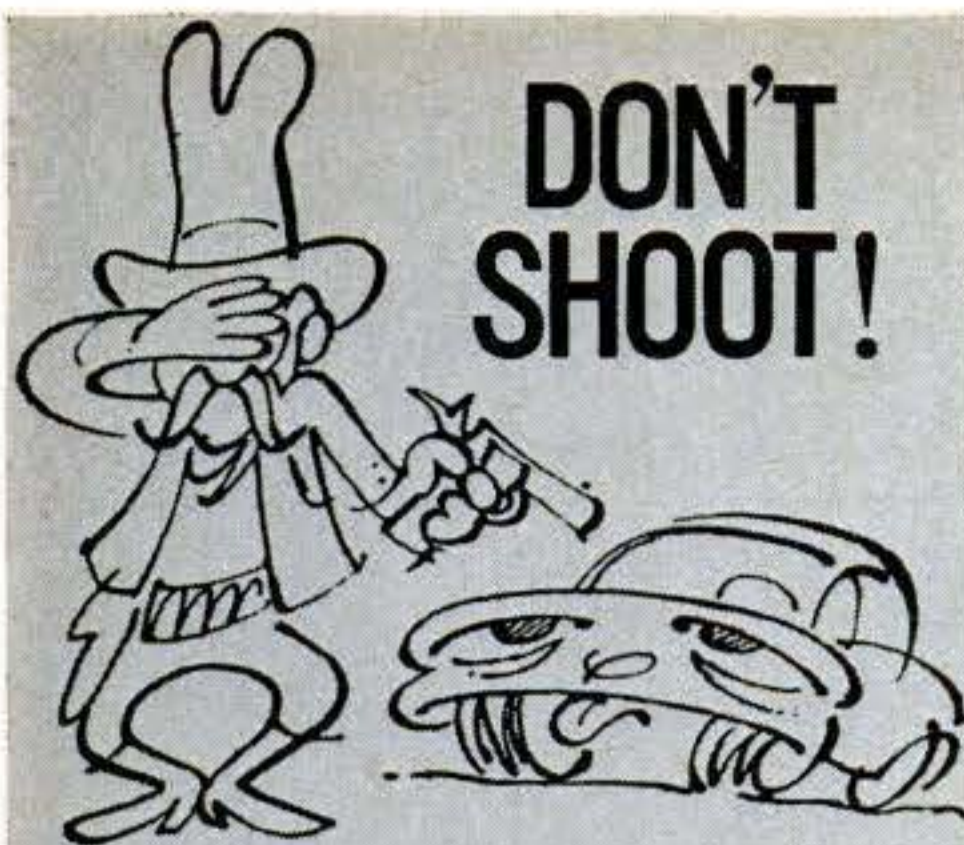
car market. Olds planners are nearly stumped in coming up with a car that will compete in the economy market, yet still carry Olds' higher price tag. One result: The division has just about given up on building a sedan, and instead turns its attention to two-seat sports models. One suggestion is a two-seater made from a cut-down Camaro chassis. This kind of vehicle would be unique in General Motors, yet still use body and suspension parts now in production. The earliest that this sports car could be ready for production would be for the 1972 model year.

Pontiac planners have second thoughts about "Cirrus" as a name for their new 1970½ compact car. Although widely known as a type of cloud, Cirrus has some dictionary meanings that are not the kind of thing you want to call a car. Also, Cirrus sounds very close to a Yiddish word that means "trouble." Pontiac has a special role for the name "Poncho." Poncho was boosted as a name for this car, but ruled out for now: Pontiac still had hopes of getting its version of the Vega within two years, and naming it Poncho. Last-minute decisions, however, may drop Cirrus and use Poncho for the 1970½ compact.

Chevrolet engineers tried every combination of engine placement possible when designing the Vega. That's one reason why the final Vega engine was made in complete reverse of earlier prototypes. One early layout had a rear engine placed in fore-aft position with an integral transaxle. With the engine in this position, the carburetor was on the driver side, just where it should be for best connection to the accelerator. But when the front-engine layout was adopted, the carburetor was on the wrong side. As a result, intake and exhaust manifolds, carburetor, engine porting and spark plugs all had to be reversed. It is interesting that Ford was also developing a rear-engine design for its Pinto at precisely the same time, then made the change to front engine midway in the program.



Detroit Editor



DON'T SHOOT!

TRY CASITE Tune-Up



If your car stalls, coughs, sputters — don't shoot, sell it or give in to the expense of a mechanical tune-up without trying Casite Tune-Up first. The problem could simply be a little dirt in the wrong place — easily cleaned by Casite Tune-Up. Casite Tune-Up frees sticky valves and rings, cleans dirty carburetors and PCV valves, dissolves and flushes away gum and varnish deep inside the engine to restore full pep and power, makes your car run smoother and start easier. No risk... Results guaranteed or your money back double!

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Heavy duty, depth-type—traps dirt other filters miss. The proof is on the dipstick.

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Want to know how to rustproof your tools? Keep your concrete driveway from cracking in the winter? Purify water? Metallize baby shoes? Preserve fence posts? Repair stucco? Make fabrics flame resistant? Make prints without negatives? Make a great cleaner for grimy handyman hands?

JUST ASK THIS BOOK!

Here are over 700 pages of formulas, tips, shortcuts and ideas to make all your home and workshop jobs easier, more professional—and to save you money, too!

Yes, if you ever do jobs around home yourself, you *need* this book. It is by far the most comprehensive encyclopedia of how-to information ever put together. It covers an almost unbelievably wide range of home and workshop subjects. And much of the information you get here is extremely hard to find anywhere else.

FORMULAS

You get formulas on all kinds of do-it-yourself projects. For example: oil paint for concrete floors, coloring metals with chemicals, lifetime photo prints, invisible inks, cold putty, septic tank chemicals, mildew control, fire-resistant paints, mosquito repellents. And there are hundreds more.

METHODS

You get methods for sealing plaster walls, buffing hardware, removing rust from tools, coloring fireplace flames, making saddle soap, antiquing copper, reinforcing concrete, cleaning household metals, making paraffin fire-starters, mixing custom colors. And there are hundreds more.

MONEY-SAVING IDEAS

In addition, the book tells you how to use inexpensive household chemicals to do a thousand and one jobs around your home and shop. Salt, for example, is good for removing ink stains, patching plaster, killing weeds, cleaning brass, lengthening the life of cut flowers and boiling eggs without cracking.

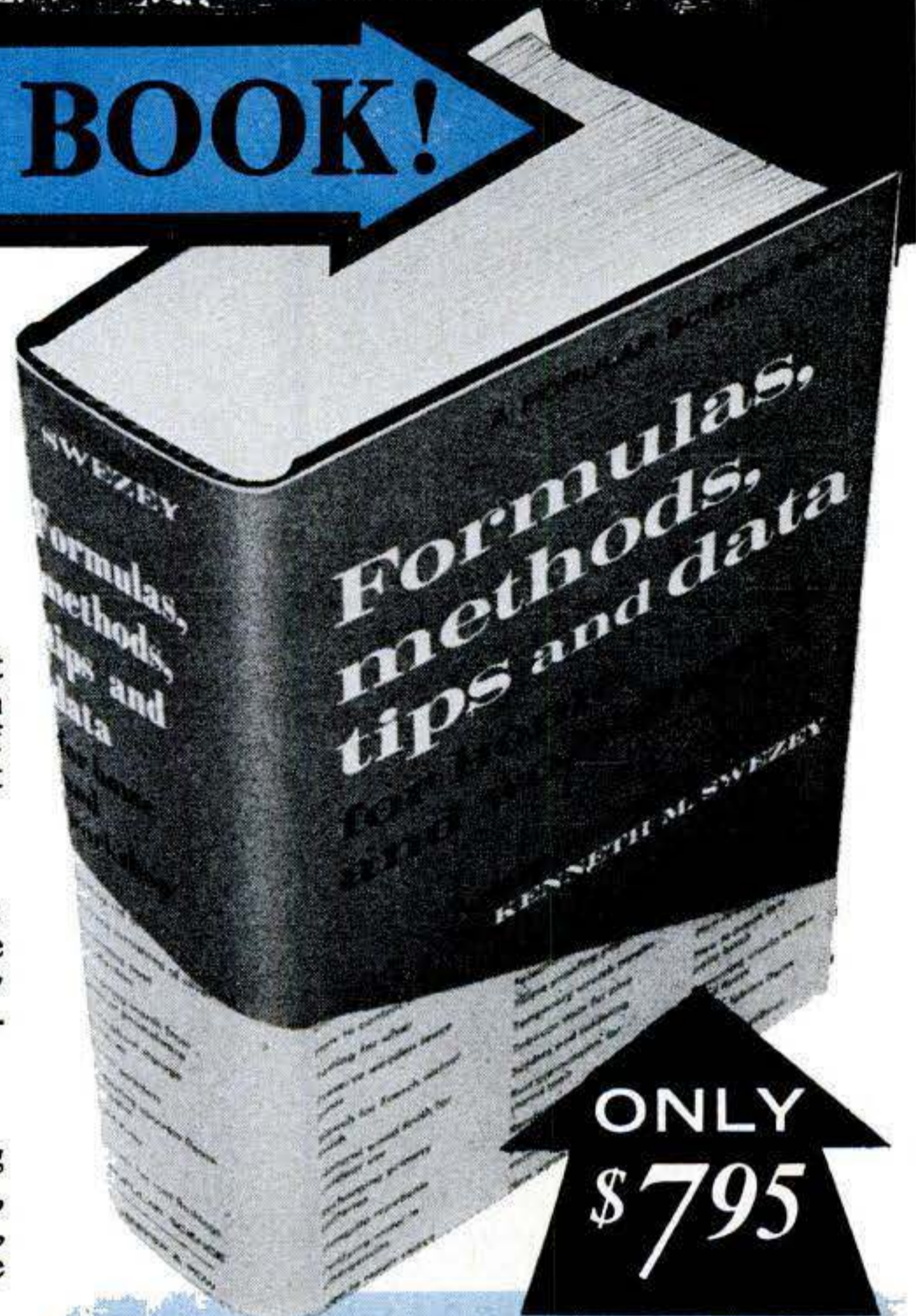
All the what-to-do and how-to-do-it information in this book is on a *professional level*. The author, Kenneth Swezey, is a long-time contributor to *Popular Science Monthly*, has written for *Life* and other magazines, and his articles and experiments have been used by such people as John Kieran (radio and TV encyclopedist) and Lenox Lohr of the Chicago Museum of Science and Industry. *He has even been praised by Albert Einstein.*

TABLES OF INFORMATION

There's even more to help you in this book! Over 75 valuable tables of information. For example: grinding wheel speeds, tap drill sizes, tables of freezing mixtures, lathe cutting speeds, hack-saw blade selector, copper wire sizes. And there are dozens more.

And, you won't be bored if you read this book for fun. You get some unusual and exotic formulas (yet every one of these is practical and workable, too). How to make paint out of cottage cheese. How to make soap that floats. How to change the color of flowers. In fact, almost everything except a formula for changing base metals into gold. (But you do find out how to test for gold and silver.)

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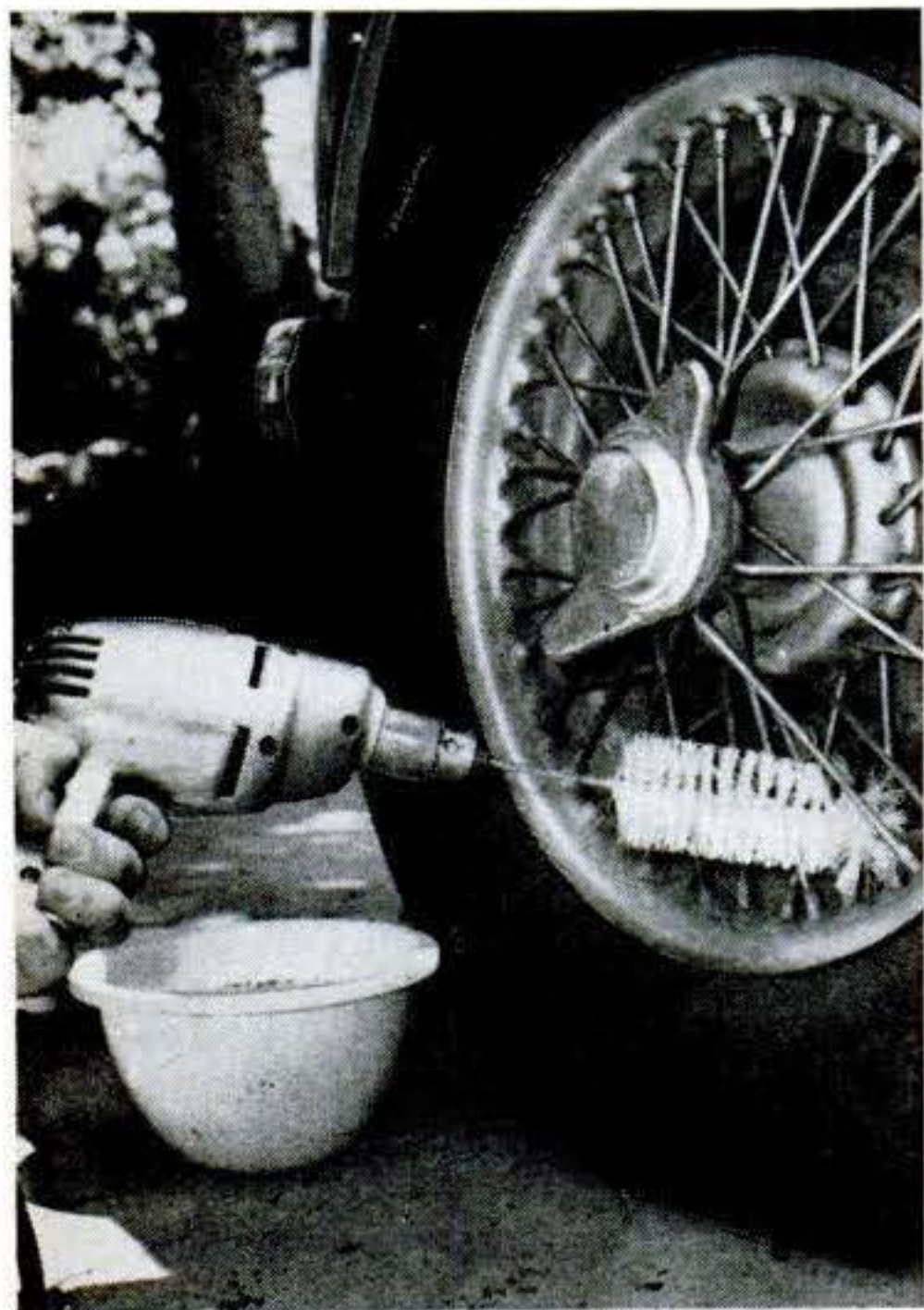
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Money back in 10 days if not completely satisfied.

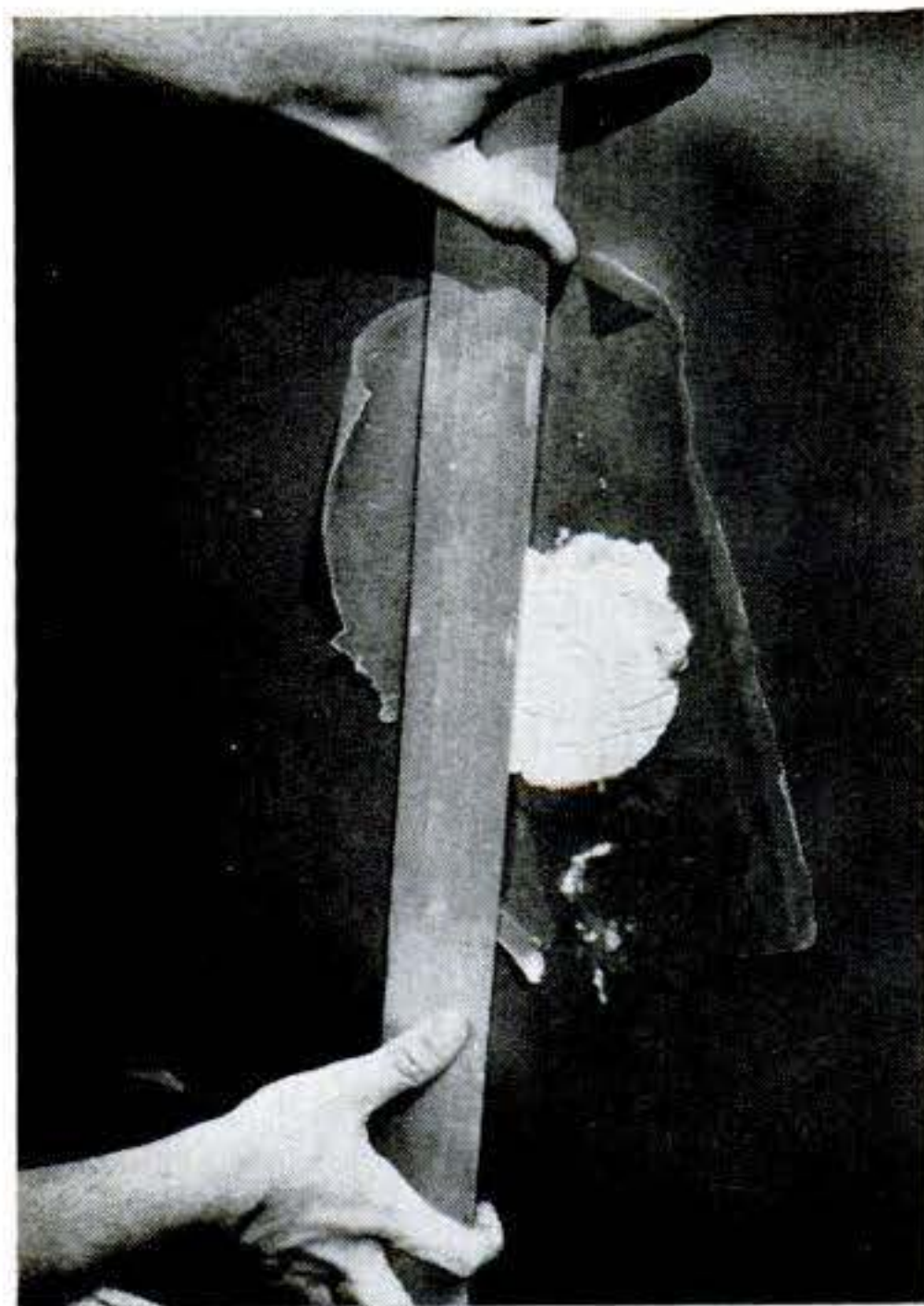
Taking Care of Your Car

Good hints others have used

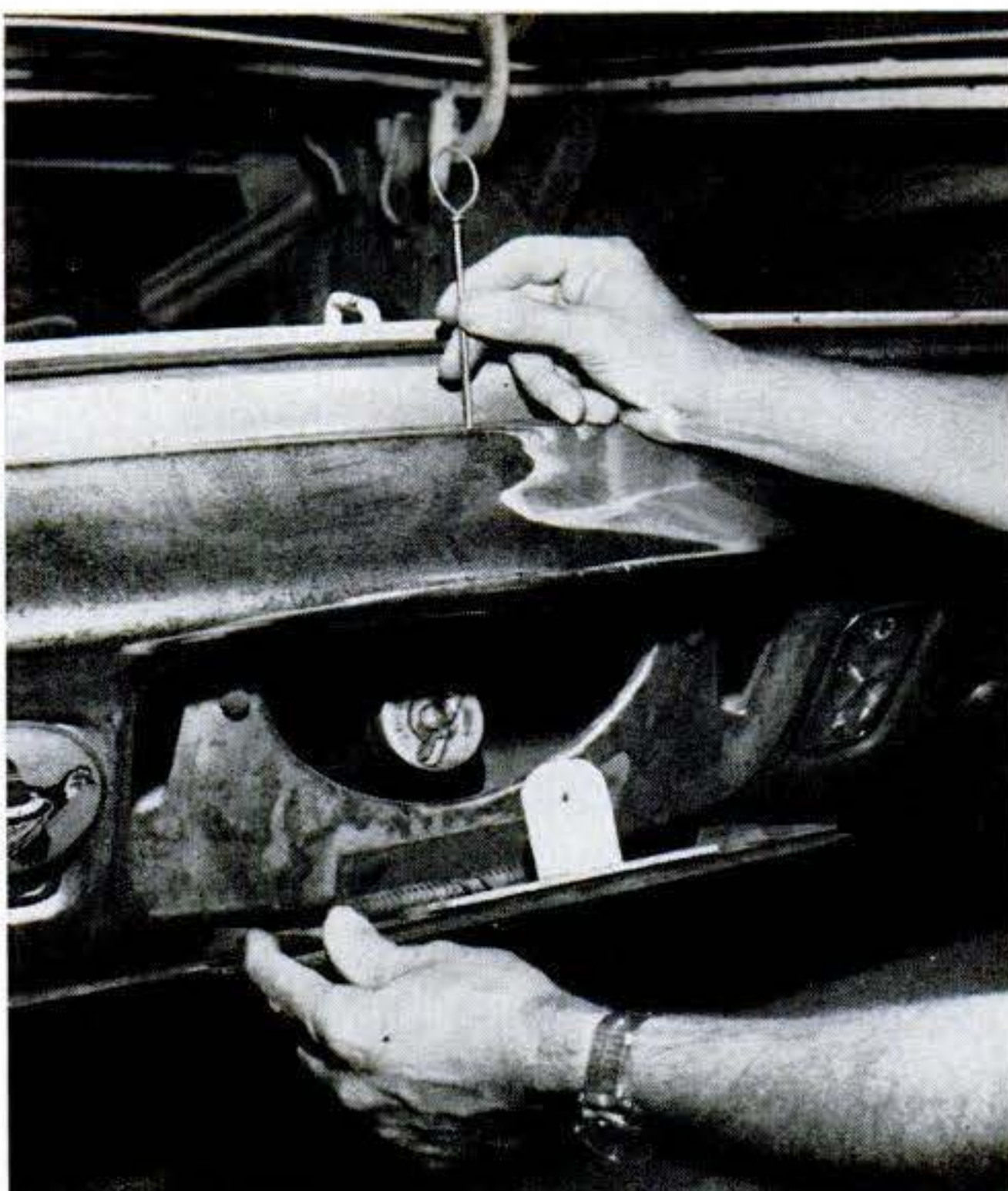
Got a car tip? We pay \$25 for each one accepted. Send it to Car Care, POPULAR SCIENCE, 355 Lexington Ave., New York, N.Y. 10017. None are returnable.



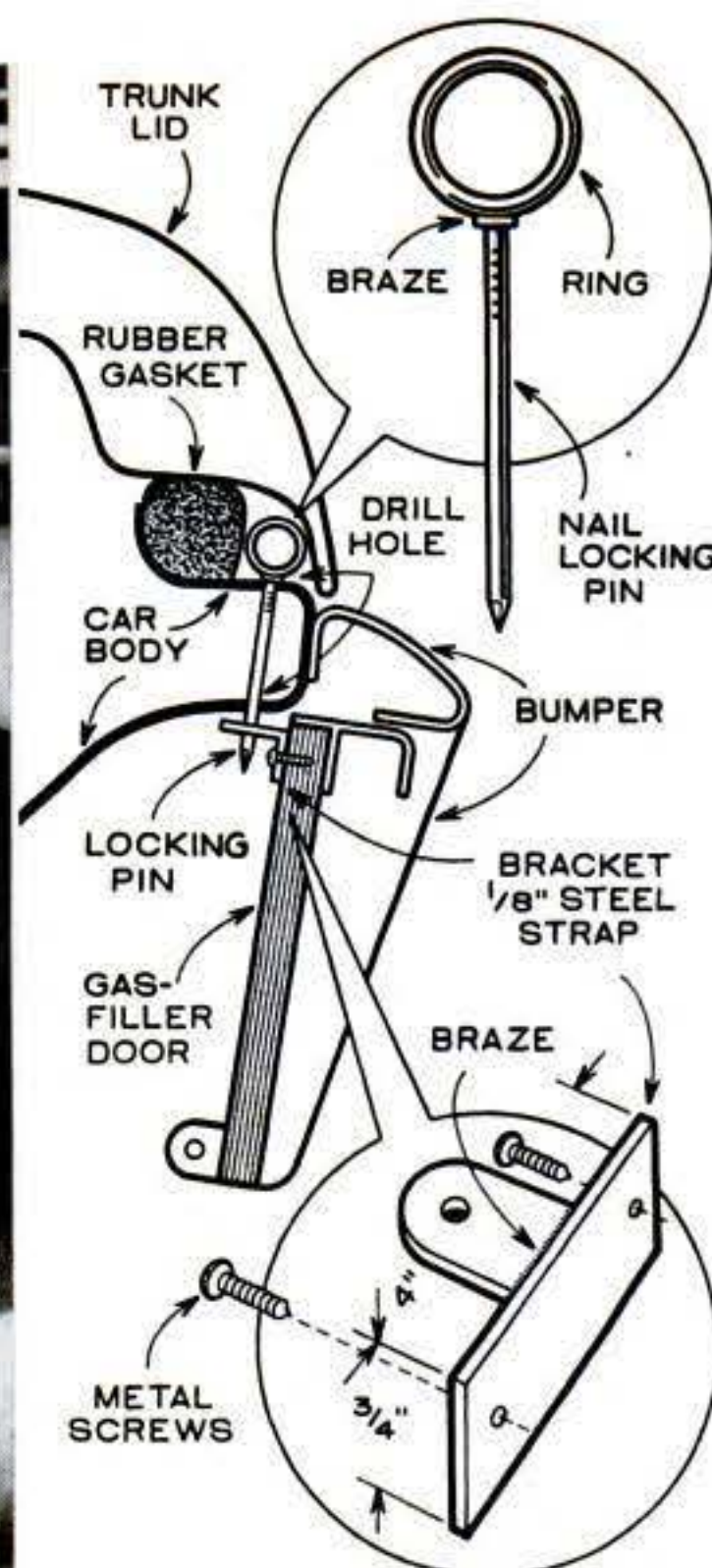
To clean your wire wheels, shoot the wheel with detergent or Gunk first, then clean with a bottle brush, shortened and inserted in a small electric drill. Wash with clear water and the wheels look like new.



When applying body filler to extensive body damage on the sides of doors and fenders, try covering the filler with a sheet of wax paper and then smoothing it with a straightedge until it begins to harden.



Suspect someone is making off with your gasoline? Gas-filler doors on late-model Ford cars (and others with the filler cap hidden by a hinged license plate) can easily be made tamperproof with the addition of a steel pin and bracket as shown above. The pin, hidden by the trunk lid, locks the plate in closed position. As long as the trunk is locked, the gas-filler door cannot be opened without using a pry bar.



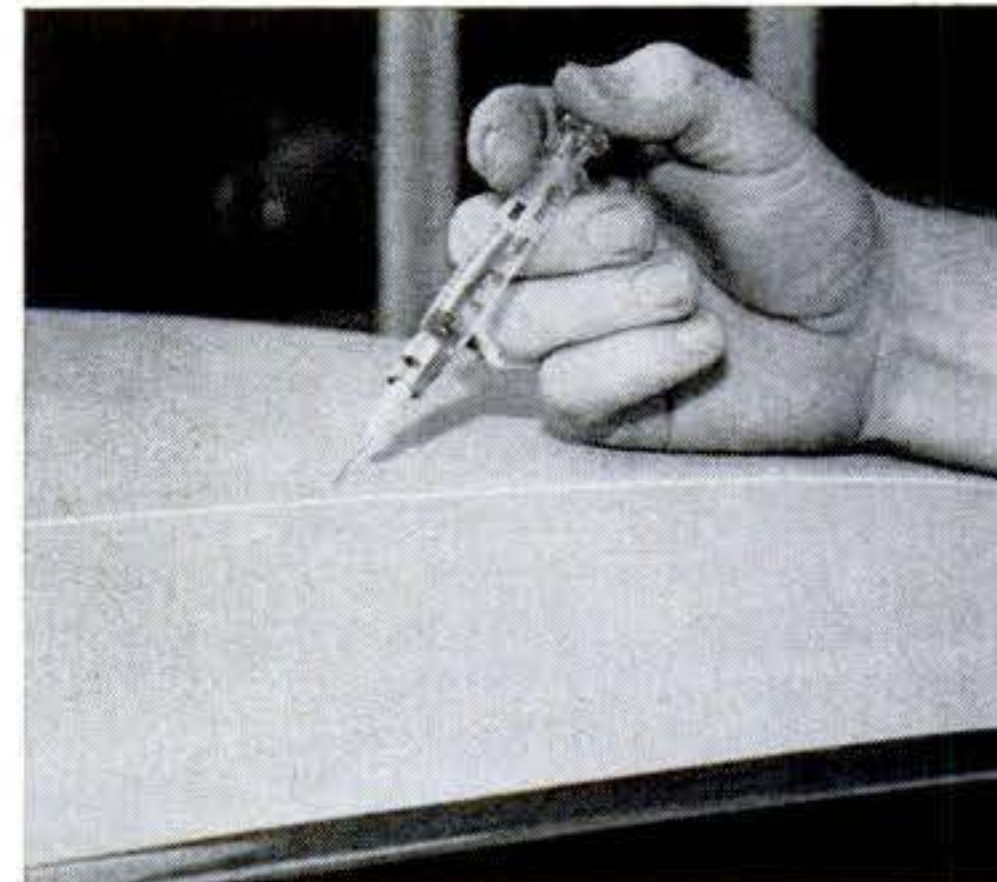
You can use a curved brake-adjusting tool to remove door handles, chrome molding, and molding snaps if you don't have the proper tool for each job. You'll find that this substitute works almost as well.



Better replacement bulb: Next time you burn out a 1034 combination brake-and-stoptight bulb, replace it with a 1157. Most shops now stock it. You'll find that the 1157 lasts longer, may even cost less.



Floor mats creeping up on the pedals? Snapfastener kits sell reasonably at most hardware stores. Install the snaps on the floor and mat, and those writhing mats will never wriggle under your feet again!



Bubbles in your vinyl auto top? Purchase a small syringe tube at your local drugstore, puncture the offending bubble, fill the void with vinyl-top cement, and your troubles should be about over.



**If you think “rapping” is something you do on a door,
maybe Roi-Tan’s new flavors aren’t for you.**

But if your idea of “rapping” is honest talk and getting into someone’s head, maybe you’ll give Roi-Tan flavors an audience, too.

Because they’re into the same kind of honesty. Like honest taste. And an aroma that tells it like it is. There are now four Roi-Tan Tips. New cherry, menthol, and aromatic. And regular.

They’re mild in taste but heavy in satisfaction. And wherever your tastes are at in flavors, one of ours will satisfy one of yours.

So get Roi-Tan Tips. And instead of knocking on some door, you’ll get to where someone’s really at.

What could be a better reason to smoke one?



Choose it because it works like a truck, rides like a car

...or for many other good reasons.

Ford's Twin-I-Beam suspension is one reason. But there are many more. We call them better ideas. For instance:

Biggest cab of any pickup.

Combined headroom, legroom, shoulder room and seat height dimensions exceed those of any other pickup cab.

Only Ford has Twin-I-Beam independent front suspension.

Wheels step over bumps independently to smooth the ride.

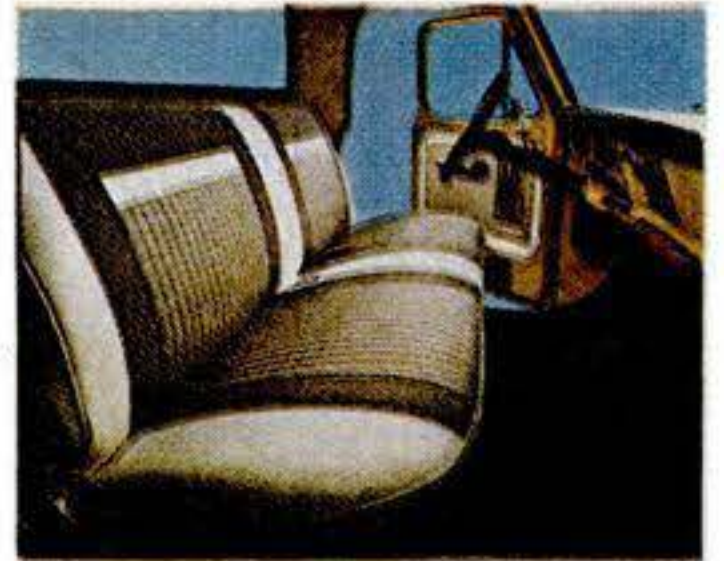


Levellest, quietest ride of them all.

Virtually no nosedive on braking, less side-sway on curves. Independent tests proved Ford is quieter than all other leading pickup makes.

Most luxurious.

Choose from four levels of luxury . . . all the way up to the unique Ford Ranger XLT, most luxurious pickup ever built. Distinctive good taste marks the XLT: wood-tone accents, thick-pile carpeting, deep-cushioned seats upholstered in pleated cloth and vinyl, plus luxury options like AM/FM stereo and air conditioning.

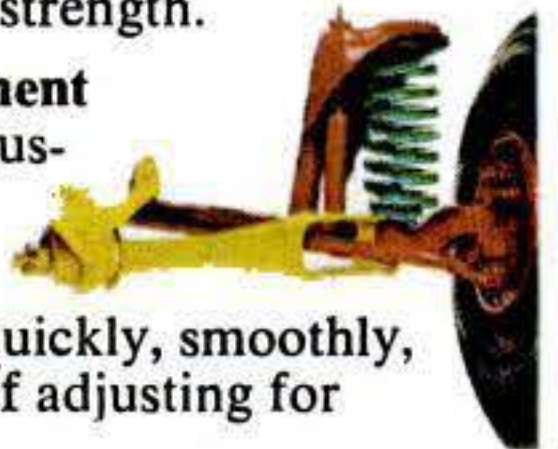


I-beam front axles.

A Ford exclusive. Both axles are drop-forged I-beam design. Everybody's *big* trucks use I-beam front axle design for greater strength.

Radius rods help hold alignment

better than any other front suspension system. Only Ford pickups offer radius rods.



Self-energizing brakes stop quickly, smoothly, with little pedal pressure. Self adjusting for lower service costs.

Welded, instead of bolted, pickup box stays strong, resists working loose, means greater quietness, less chance of rust.

Leaf-type rear springs, like all big trucks use, for better stability. Exclusive Flex-O-Matic rear suspension, standard on F-250 and with heavy-duty springs on F-100, keeps the ride smooth, with or without a load.



Make sure your next pickup includes the better ideas you get only from Ford. See your Ford Dealer for the pickup that works like a truck, rides like a car.



FORD PICKUPS



A better idea for safety: Buckle up.

WARRANTIES

What are they worth to you?

To find out, we surveyed America's major producers of consumer products. Result? Consumer pressure is making some warranties better, but there's still plenty of room for improvement

By HERBERT SHULDINER

If the words "warranty" and "guarantee" confuse you, don't be ashamed to admit it. The way these synonyms are used today by manufacturers and sellers of the things you buy, they can mean a valuable assurance of product reliability and satisfaction or they can be empty of any meaning whatever. And that's why consumer groups, state and federal agencies, and Congress are all spurring important reforms in warranty protection for the products you buy.

Some of these reforms have already begun to show up in revamped warranties that spell out more clearly the extent of your insurance, and that increase the protection you get. A survey, just completed by POPULAR SCIENCE, of leading companies who manufacture, distribute, or sell big-ticket products shows that buyers of color TV sets and auto tires are the principal beneficiaries of these better warranties. For example:

- One TV manufacturer now pays dealers to repair color sets under warranty.
- Over-the-counter exchanges of defective radios, recorders, and phonographs have been instituted by two companies.
- An electronics giant has offered its customers a money-back-guarantee trial period to evaluate its color TV sets.
- Two important rubber companies have liberalized exchange procedures for defective tires.
- Several important appliance and power-equipment manufacturers have new programs to make parts and service under warranty more available to customers.
- A growing number of firms are simplifying warranty language so it can be more readily understood by the average consumer.

Despite these few bright spots, the PS survey on warranty services revealed these ominous facts:

- Free-service protection is being cut back at a time when products are becoming more trouble-free for longer periods. For example, the 5-year/50,000-mile automotive power-train warranty is disappearing.

[Continued]

How Our New Warranty Law Would

By SENATOR
WARREN G. MAGNUSON

Senator Magnuson is co-sponsor, with Senator Frank E. Moss, of the Consumer Products Warranty and Guaranty Act, currently awaiting action by the House and the President



"Guaranteed for 10 Years" reads the bold-faced type on the warranty that accompanies the new piano for your living room. So you tuck it away in a safe place, confident that you'll have no worries if the instrument quits working. But are you in for a surprise the first time the instrument hits a sour note; and you retrieve the warranty card!

The fine print tells you to bring the piano to the factory if you want to have it repaired. And to add insult to injury,

the legal beagles who drafted the warranty have chosen words that don't even promise the piano is fit to do the job you bought it for.

But if the Magnuson-Moss Warranty and Guaranty Bill, which the Senate passed earlier this year, becomes law, the warranty game will have to be played by different rules. Such products as automobiles, major appliances, tires, luggage, clothing, and many other products are covered. No longer will manufacturers and sellers of consumer products be able to give glowing promises in the bold print of the warranty and then blithely snatch them away with the foggy fine print.

This legislation would end such confusing and misleading practices. It will require clear statements as to what you can reasonably expect from warranties covering all the products you normally use. Suppliers guaranteeing these products will be required to use "full" or "partial" labels on their warranties on all products that cost \$5 or more. If the price is less than \$5, the manufacturer won't have to affix these labels, but his warranty must not be composed in a way that could mislead you.

Such clearcut labels would let you seek protection against a defective product by shopping for a "full" guarantee,

WARRANTIES—What are they worth to you?

[Continued]

- Allowances are inadequate for consumer inconvenience caused by malfunctioning products. Nobody repays your cab fares when your car goes back to the dealer for warranty work.

- Consumers who purchase products that don't work because of manufacturing defects are additionally burdened with shipping or other expenses in order to obtain adequate repairs or adjustments.

- Rarely can you get your money back, or even receive an exchange, if you purchase a big-ticket item that turns out to be a lemon. If you get stuck with a chronically malfunctioning product, chances are that most manufacturers will do no more than keep taking it back for service—unless it becomes economically advantageous for them to do otherwise.

- Consumers are often taken advantage of by dealers when they attempt to have defective or malfunctioning products repaired under warranty. Many tire dealers, for instance, will tack on an unauthorized service charge for labor involved in replacing a defective tire.

- Consumers are not guaranteed a minimum amount of use from a product, and rarely receive warranty extensions for down time. Mrs. Virginia Knauer, special assistant to the President for consumer affairs, told the

Senate Consumer Subcommittee, headed by Sen. Frank E. Moss, of a man who owned a refrigerator which apparently spent more time in the shop being repaired than in his home.

"When the man came to pick it up," she says, "the repairman said 'Oh that is going to cost you money. Your warranty is over.'" The refrigerator had been in use for less than half the time covered by the three-year warranty. Mrs. Knauer's office interceded with the president of the company and the warranty period was extended for a year and a half.

- A large number of disclaimers, still used in warranties, tend to deceive consumers into thinking they have more protection than they actually have. Mrs. Knauer told the Senate subcommittee that "the fine-print trick, in actuality, can nullify the essence of a guarantee. As it has been said, "the bold print giveth and the fine print taketh away."

- Many guarantees give free replacement parts, but charge for installing them. A 25-cent part will be given to you without cost, but with a \$5 or \$10 labor charge tacked on.

- Some products, like campers, snowmobiles, or automobiles, carry multiple warranties. Tires, batteries, and engines may all be guaranteed by separate companies. This can confuse the owner of the vehicle when trying to get warranty service on various components.

A substantial segment of industry is attempting to do away with these warranty abuses. One of the biggest

warranty innovations was made recently by RCA. They now pay dealers to repair defective TV sets under warranty. That means your repairman can't lose money putting your set in shape no matter how long it takes him.

What's more, you don't have to go to any designated repair shops. You can have it done by any recognized service agency you choose—RCA or otherwise, and the bill is paid directly to the repairman.

RCA has also established an over-the-counter exchange service for radios, tape recorders, and hi-fi sets that may become defective within 90 days after purchase.

Magnavox has instituted a similar exchange program for replacing defective table radios, recorders, and portable phonographs.

GE has introduced another highly innovative warranty. It offers a "30-day money-back" guarantee of consumer satisfaction on its color TV sets. If you don't like the way the set performs during the first 30 days you can return it and get your money back. The money-back guarantee is not available in New York, New Jersey, or Connecticut, however.

Breakthrough in tire guarantees.

Goodyear and Uniroyal have abolished, for the first 20 percent of tread life, the usual prorated method of charging for the replacement of defective tires. Previously, when defective tires were replaced, you paid part of the costs—for the tread life used.

Protect You

or warranty. (There is no difference between a warranty and a guarantee).

The "full" guarantee would entitle you to free repair or replacement within a reasonable time should the product quit working. And the company that backs the product won't be able to impose any unreasonable requirements upon you when you ask them to make good on their warranty—require you, for example, to bring the piano to their factory in order to get it fixed.

At the same time, you'll be able to tell easily when you're not getting this protection. We're not going to make manufacturers give full guarantees if they don't choose to do so. The "partial" and "full" labels are designed to help you readily differentiate between full-insurance protection and something less than complete protection against defect or malfunction.

Another important aspect of the new consumer protection is a provision which prohibits anyone giving a warranty from disclaiming in any way the fitness of the product to do the job for which it was intended. A piano will have to make music.

What happens if people giving warranties don't play the game under the new rules? The Federal Trade Commission

and the Justice Department are empowered to take action against such individuals. In addition, you, the consumer, receive the means to help yourself. If the supplier of a product doesn't do what he has promised in his warranty, you can afford to go to court. Any consumer who successfully proves his case in court will recover reasonable attorney's fees (based upon actual time spent by the attorney, not upon the size of the settlement) and other costs connected with the suit.

It will cost a company that doesn't live up to its warranty or service-contract obligations. When the warranty legislation is finally law, any recalcitrant auto dealer or manufacturer failing to repair a new car with peeling paint, or brakes that pull to the left, may find himself having to tell a judge why he failed to do what was promised in his warranty. After talking to the judge, the dealer or manufacturer will think twice about doing a sloppy job, or not doing anything at all, the next time someone brings a car in for warranty repairs.

As you can see, this protection is not radical. The new standards merely set up some sensible rules for playing the warranty game—rules designed to let you know what you're getting, so that you can make wise consumer choices. And importantly, it gives you the means to enforce warranty rights when they are breached. I only hope that the House acts on the Senate-passed Magnuson-Moss bill so that American consumers will finally have a chance of playing—and winning—the warranty game.

Both companies now replace a tire without charge if it fails in the first 20 percent of its tread life because of a manufacturing defect.

At the same time, Goodyear has discontinued any allowances for tires with only 1/16 inch of tread remaining. Goodyear considers that such tires have given their full tread life and should be replaced for safety's sake.

Other companies are setting up new programs to make it easier for their customers to obtain parts and service. John Deere now includes tires and tubes in its own warranties. Deere did this because it found that although the rubber products were warranted by the manufacturer, few tire dealers stocked lawn and garden tire sizes.

Where to get your products serviced when you're hopping around? One company has come up with a unique solution. A "world" warranty has been created for Nikon cameras.

And there's also an effort on the part of some firms to accept responsibility for extra expenses you incur when their products fail. Volkswagen recently started reimbursing its customers for towing costs necessitated by breakdowns following malfunctioning of parts under warranty.

Simplifying the language

Perhaps most important, a small but influential group of firms has simplified the language of its warranties, so that the average consumer can better understand exactly how much pro-

tection he is getting with his purchase. These firms include giants like Sears and Montgomery Ward, whose marketing practices have a wide impact on the nation's buying habits.

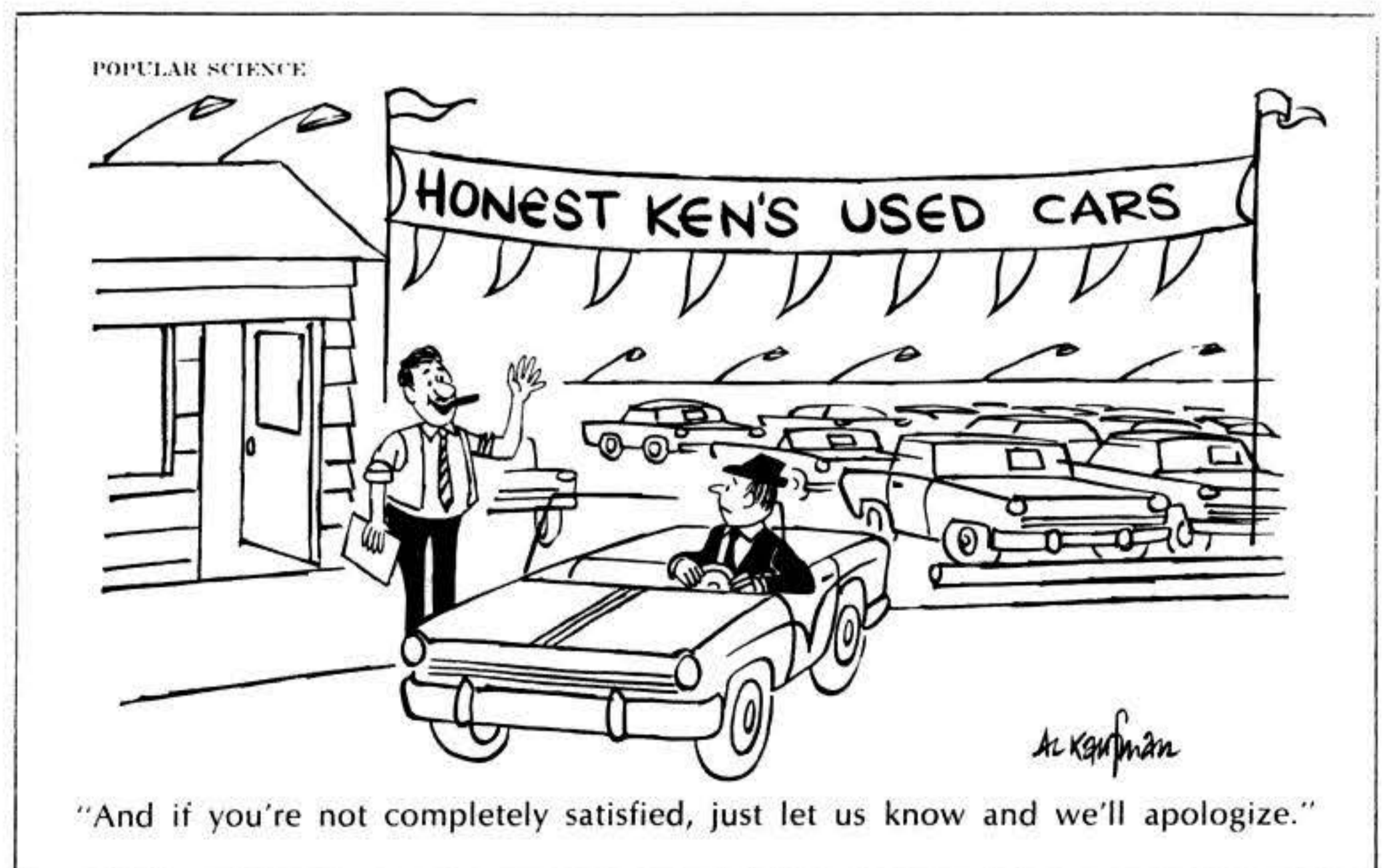
One example Sears president Arthur M. Wood gave PS was the warranty on a dishwasher. The old one took up most of a page. The new one is just six simple lines. And this simple warranty becomes part of the pitch Sears salesmen make. Wood feels that Sears service is an important part of its success in selling. "After all we're in competition with a great many distributors," he says. "We think it wise to tell the customer just how far Sears goes."

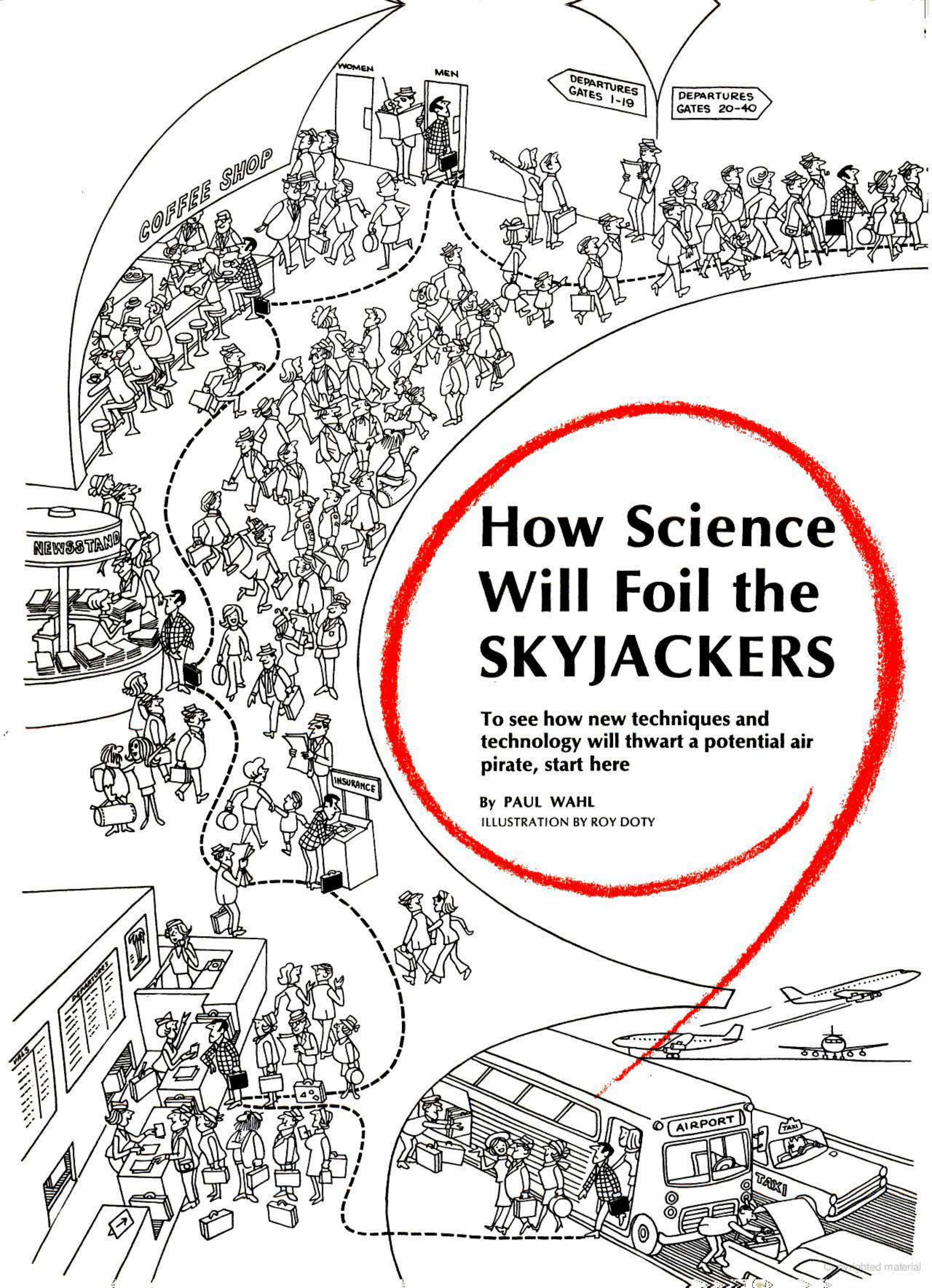
The language barrier is perhaps the biggest obstacle you run into in trying to understand warranties. A cheap watch recently purchased by a PS editor was accompanied by a gold-colored "guarantee." Its provisions: If the watch failed, he could return it with \$2 and the maker would bill him for repair charges. If he thought that cost too high, they would return the watch with "free" replacement parts so he could fix it himself.

Contrast this with the warranty that accompanies an AR amplifier.

"Guarantee: The workmanship and performance in normal use of the AR amplifiers are guaranteed for two years from date of purchase. This guaran-

[Continued on page 134]





How Science Will Foil the SKYJACKERS

To see how new techniques and technology will thwart a potential air pirate, start here

By PAUL WAHL

ILLUSTRATION BY ROY DOTY

Ninety-seven passengers showed up for the flight, but 96 were on the Miami-bound plane when it took off from a New York airport one recent evening. Left at the gate, in the custody of two deputy U.S. marshals, was a gun-toting traveler. They nailed him after the loaded .38 revolver in his shoulder holster triggered a new weapons detector—one of the ingenious countermeasures devised by science to keep in-flight crime from getting off the ground.

Since 1968, when it became epidemic, the chronic disease of air piracy has grown into a worldwide problem of frightening proportions. Being aboard a plane shanghaied to Havana by an individual with a grudge is bad enough; being held hostage by terrorists who skyjack your plane as a form of political blackmail, as in the recent spate of Mideast incidents, is far worse.

The only real defense now at hand is the anti-hijacking system developed last year by a special task force of the Federal Aviation Administration and currently used by several U.S. airlines. How can it stop a potential air pirate before he can board the plane? The technique is illustrated on these pages.

The personal approach. This anti-hijacking system relies heavily on behavioral screening of passengers. Psychological studies by the FAA's Office of Aviation Medicine show that skyjackers have certain behavior patterns, readily spottable with simple techniques. Since general awareness of these behavior-detection procedures might ruin the system's effectiveness, the details are closely guarded.

New Orleans International Airport was the first at which all commercial flights were screened for potential air pirates. Specially trained observers, posted in various parts of the terminal or circulating in the crowd, watch passengers for signs of skyjacker behavior. When a suspicious character is spotted and reported, airport offi-

cers ask him to walk through one of 13 weapons-detection stations.

If he is carrying a mass of ferrous metal that could be a concealed weapon, a blue light flashes and a dial indicator jumps. The suspect is then interviewed and asked to identify himself and produce the metallic object. Should he refuse to cooperate at any point, he is denied boarding privileges. Deputy U.S. marshals make a personal search of the suspect and arrest him if he is armed.

Some airlines, at other airports, use the FAA anti-hijacking system on a limited basis (not all flights are covered), with a slightly different weapons-screening procedure. At the boarding gate, all passengers for a given flight must walk single file through a weapons-detection station. If a passenger, previously spotted as fitting the skyjacker behavioral pattern, also triggers the weapons detector, he is detained.

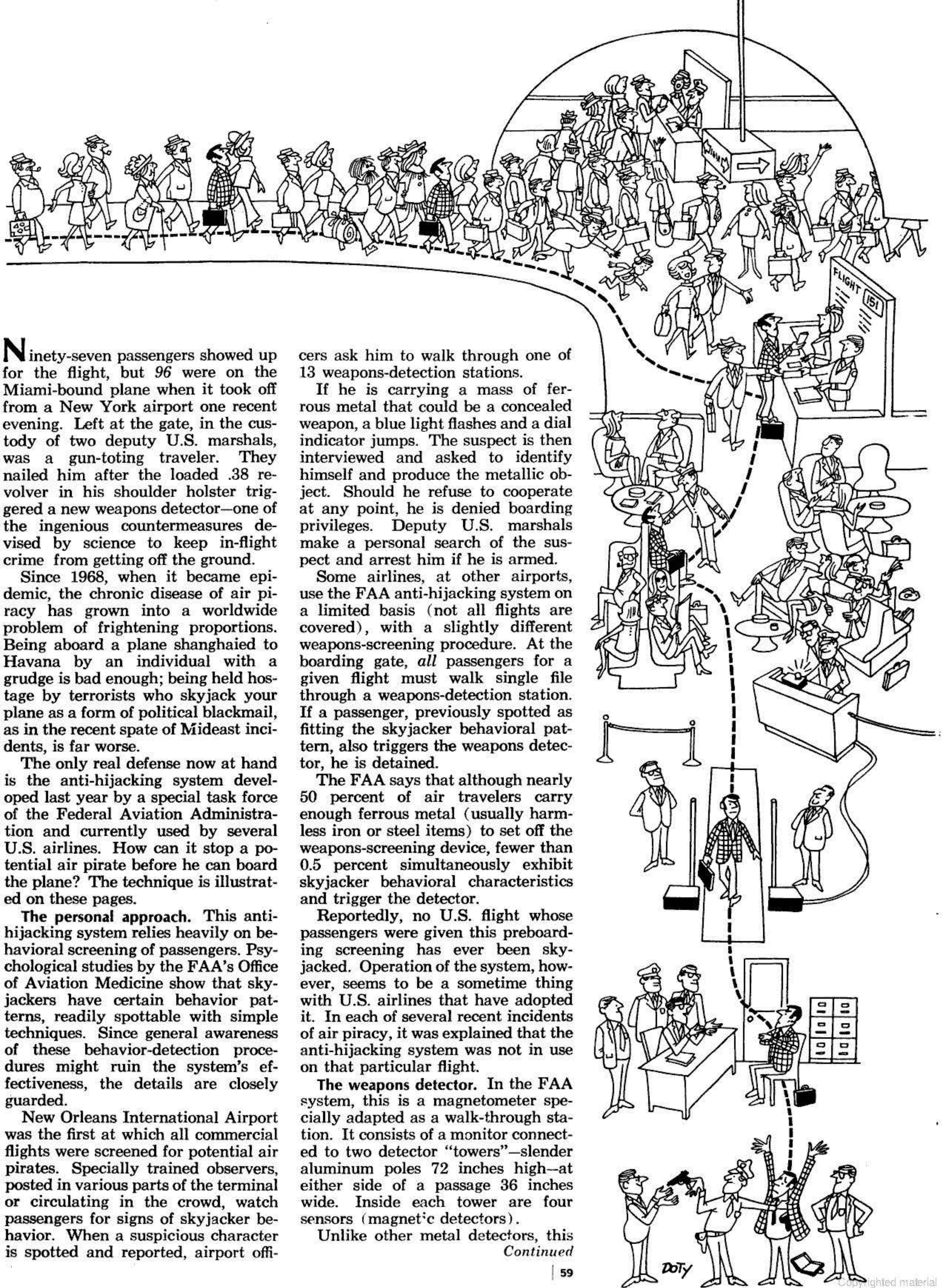
The FAA says that although nearly 50 percent of air travelers carry enough ferrous metal (usually harmless iron or steel items) to set off the weapons-screening device, fewer than 0.5 percent simultaneously exhibit skyjacker behavioral characteristics and trigger the detector.

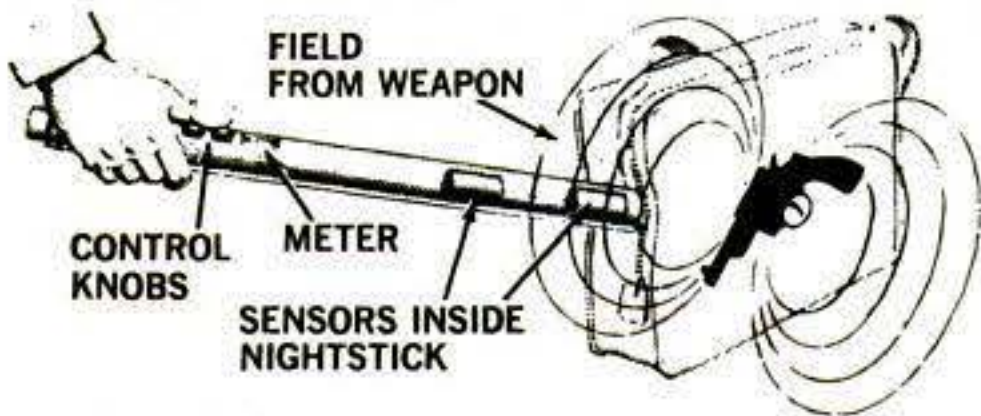
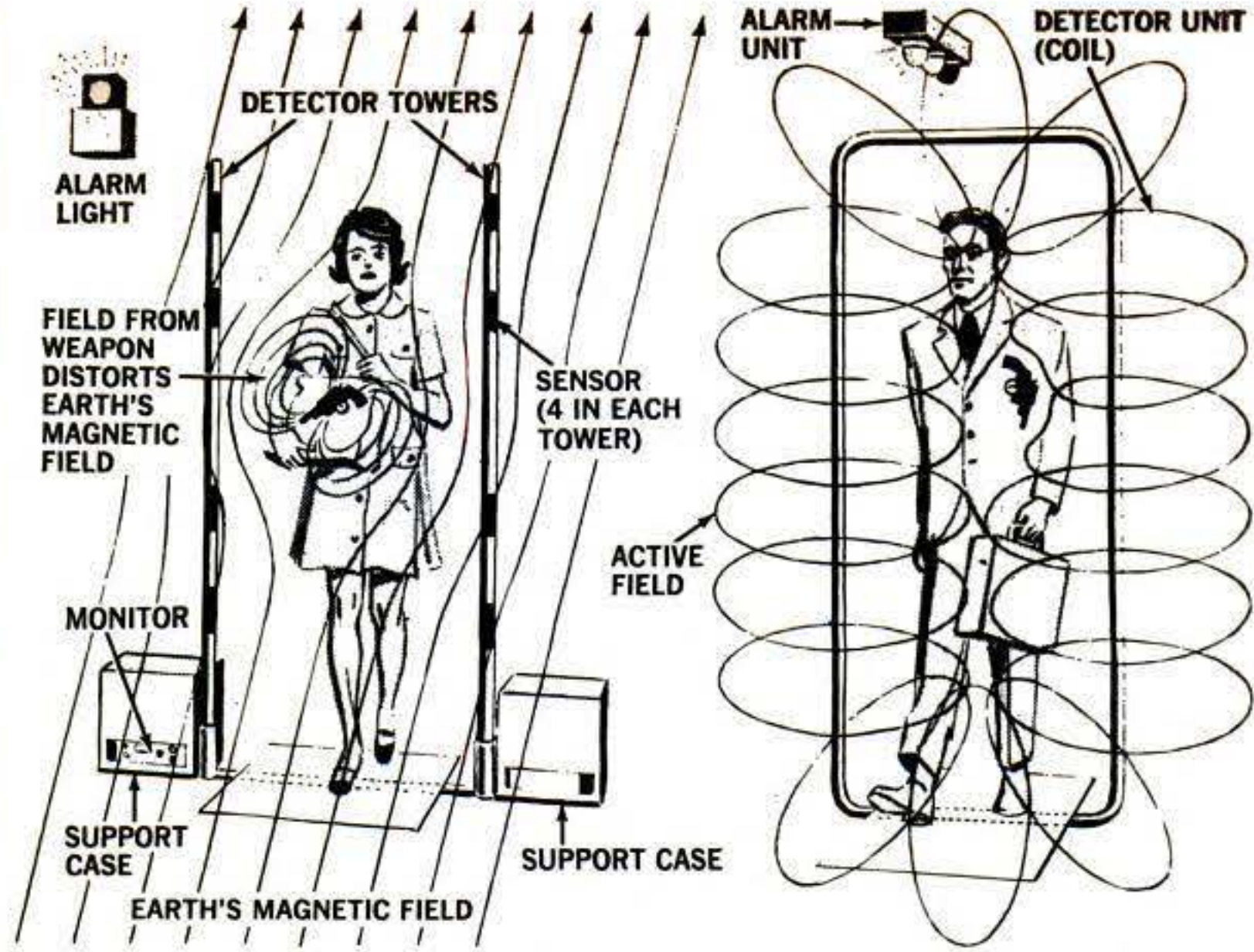
Reportedly, no U.S. flight whose passengers were given this preboarding screening has ever been skyjacked. Operation of the system, however, seems to be a sometime thing with U.S. airlines that have adopted it. In each of several recent incidents of air piracy, it was explained that the anti-hijacking system was not in use on that particular flight.

The weapons detector. In the FAA system, this is a magnetometer specially adapted as a walk-through station. It consists of a monitor connected to two detector "towers"—slender aluminum poles 72 inches high—at either side of a passage 36 inches wide. Inside each tower are four sensors (magnetic detectors).

Unlike other metal detectors, this

Continued





Disturbances in earth's magnetic field are sensed by magnetometer (above, left) when weapon passes between its detector towers (center). Nightstick magnetometer (below,

left) can pinpoint weapon's location. Active-field metal detector (above, right) creates its own magnetic field and signals when a weapon carried through disturbs it.

magnetometer is a passive device—it generates no energy of its own. Any iron or steel object between the towers creates disturbances in the earth's magnetic field, which, together with the field radiating from the ferrous mass, are sensed by the detectors and transmitted to the monitor control. Signals amplified by the monitor power supply drive a meter read-out and trigger an alarm circuit to flash a blue light.

The magnetometer is fine-tuned to detect weapon-size masses of ferrous metal. It cannot, however, discriminate between a concealed weapon and an innocent iron or steel item of like mass.

Infinetics Inc., of Wilmington, Del., makes the Friskem Walk-Thru Station, the magnetometer weapons detector selected for the FAA anti-hijacking system. It sells for less than \$1,000. Recently, the Schonstedt Instrument Co., Reston, Va., started marketing a similar magnetic detection device, the Searcher.

All-metal detectors. In Japan, they're installing a home-grown weapon detector, the Densok Magnetic Eye, at airline boarding gates. First used by Japan Air Lines at Tokyo International Airport last July, it is an active-field all-metals detector. Passengers walk through a rectangular pipe frame—39 by 94 inches—that is actually a coil creating a weak electromagnetic field. If any metal object of a size within the system's sensitivity range is carried through, it will vary the inductance of the detector coil and trigger the alarm unit.

Mounted on the ceiling above the detector, the alarm unit has three red lights like the stop signals on a car.

One lamp lit indicates a knife; two lamps, a pistol; three lamps, a large firearm such as a shotgun. In each case, of course, it might be some other metal object of equal size.

A product of the Densoku Measuring Instrument Works, Tokyo, the Densok Magnetic Eye costs \$1,200 in Japan.

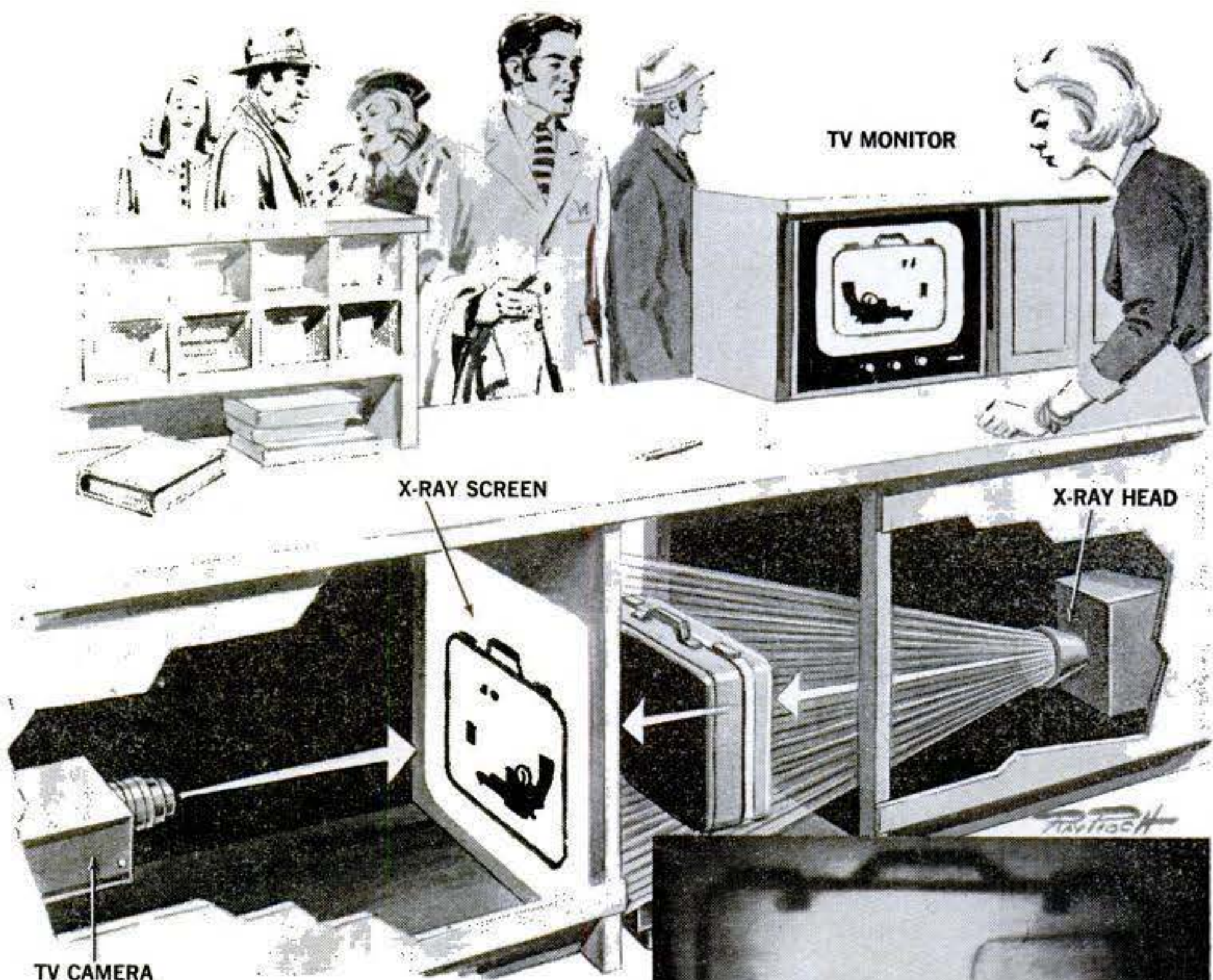
The British-designed Diver anti-hijack system—like the Densok, an active-field all-metal detector—has

the most elaborate signal array of any weapons-screening device now made.

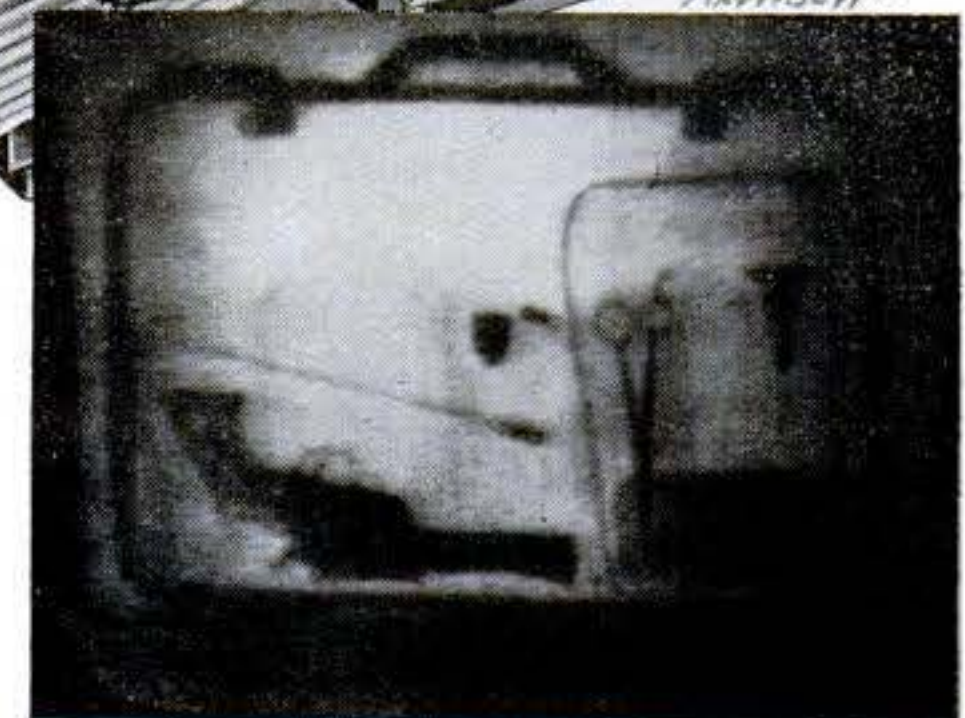
Its two detection pillars, six feet high and 33 inches apart, flank the departure gate. Any metal object brought into its magnetic field is measured by the detection pillars, whose signal is converted by the amplifier into a meter reading and visual/audio alarm.

Location of the metal object on a

[Continued on page 123]



Short-pulse X-ray system for screening of baggage uses tiny dose of radiation—exposure is 50 billionths of a second—to produce an X-ray image of bag's contents on fluoroscope-type screen. This image is viewed by a TV camera and displayed on a monitor screen for inspection. System will not fog or damage film in your luggage.



How New Weather Satellites Will Give You More Reliable Forecasts

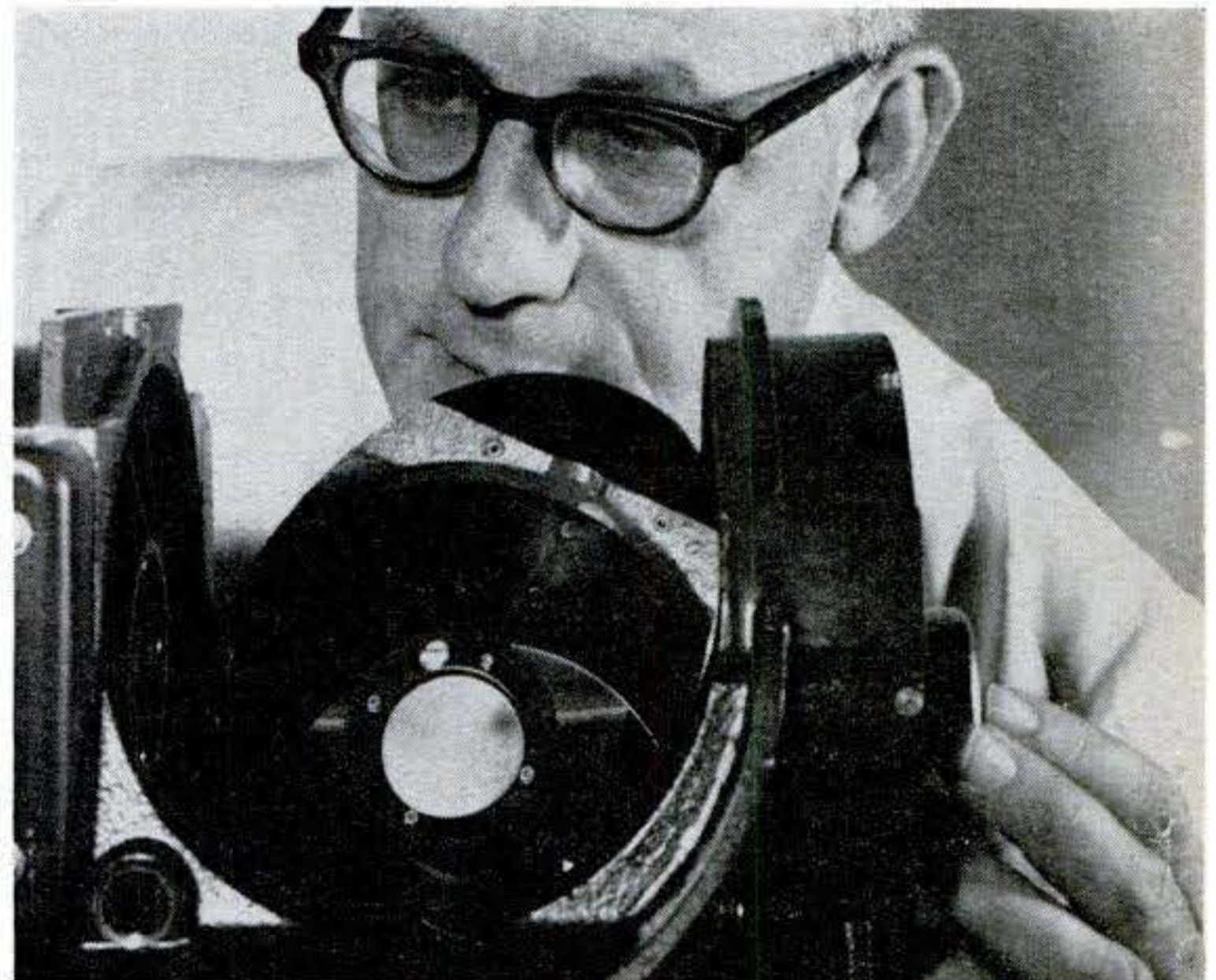
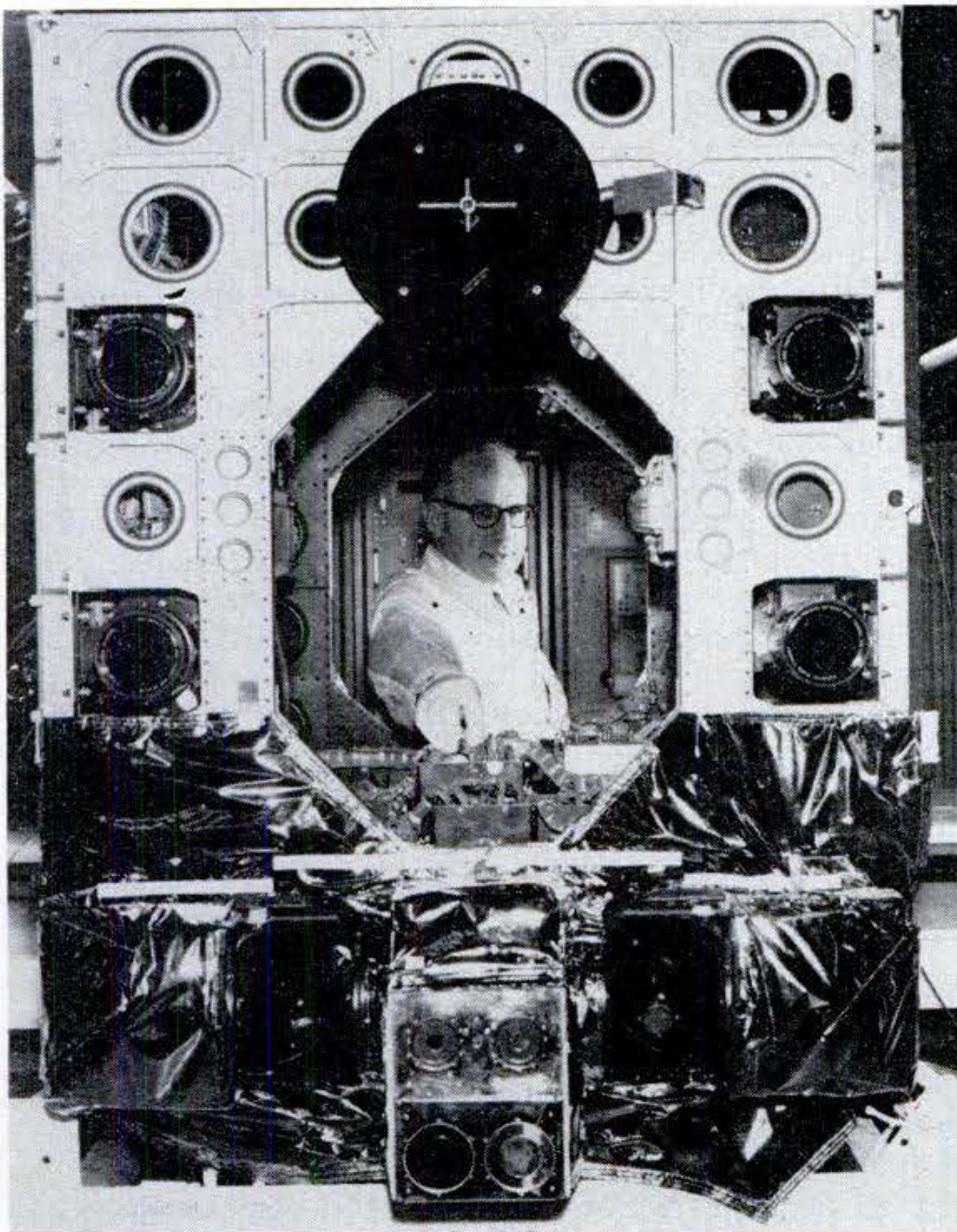
By DR. WERNHER von BRAUN
NASA Deputy Associate Administrator
PS Consulting Editor on Space

The new operational ITOS "second-generation" system promises better and longer-range predictions—and soon you'll be able to plan a good-weather vacation two weeks in advance



Ten years have elapsed since TIROS-1, our first weather satellite, opened a new era in meteorology. In less than another 10 years, weather satellites will tell you whether you will have a rainy vacation if you leave two weeks from now.

Since April 1, 1960, 23 meteorological satellites have returned more than a million pictures of the earth's cloud cover, and a wealth of other data for weather forecasting and research. During those 10 years, weather satellites



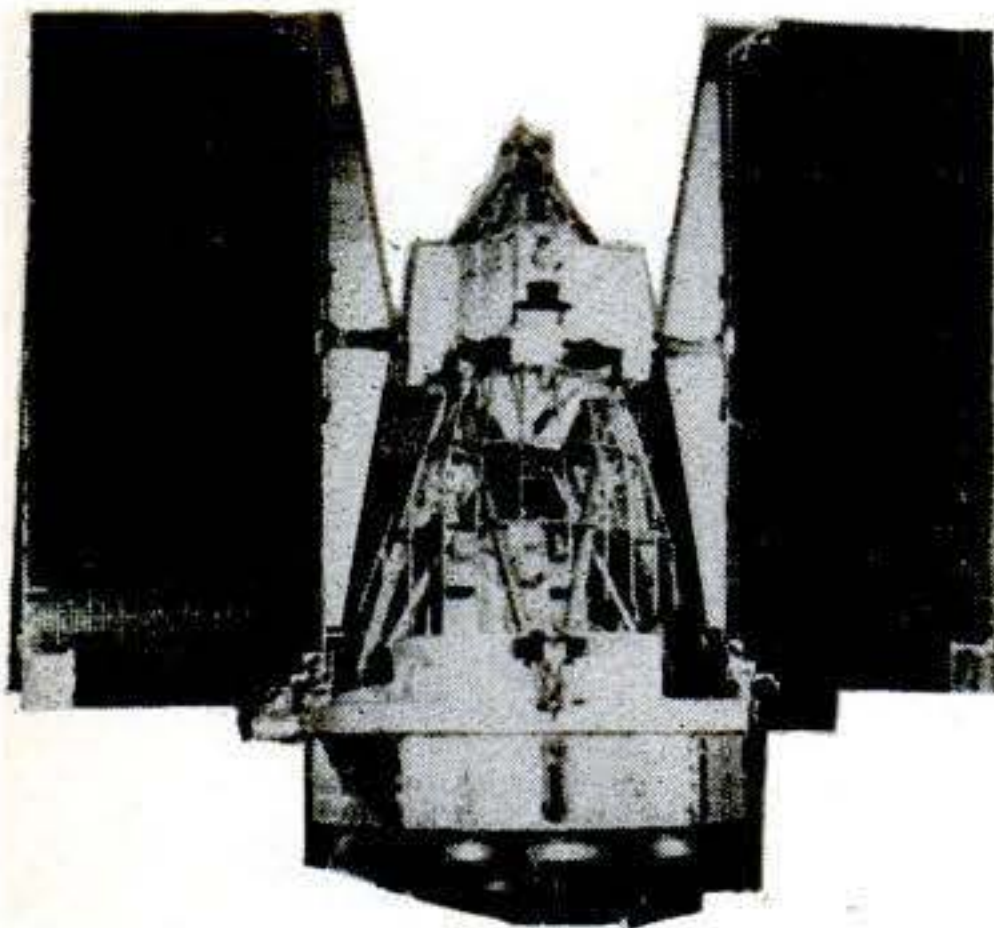
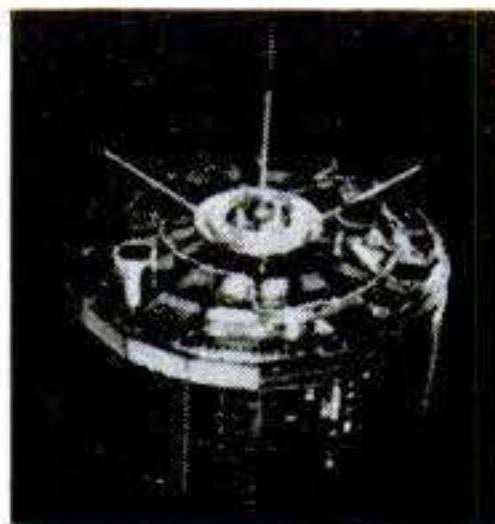
Newest weather satellite is boxlike, RCA-built ITOS-1. It views earth's clouds by day with four TV cameras (at left and right of opening); by night, with two scanning infrared radiometers (on each side of flat-plate radiometer at center of bottom), like one seen close-up in top view at right. Flywheel, in view at lower right, helps keep the camera-studded side of ITOS-1 facing earth.



In total darkness, Hurricane Celia of 1970 (the white mass near lower center) is spotted off Texas coast by ITOS-1 satellite.

Ten Years of Weather Satellites

Hatbox-shaped TIROS-1 of 1960, first of our weather satellites, was experimental version.



Nimbus type of 1964 and later has tested advanced sensing and TV equipment for our operational systems of weather satellites.



ITOS satellite of 1970 is a prototype of ESSA's new fleet of Improved TIROS Operational Satellites for weather watching.

have saved countless lives through early hurricane warnings. They have helped airline pilots circumnavigate storm fronts over oceans and thinly populated areas. They have aided shipping by revealing ice conditions in northern passages and in bays and estuaries. And still better satellite weather forecasting is on the way.

Not only will this aid your personal planning; it will be worth money. An accurate five-day forecast probably would save between \$2½ and \$5½ billion yearly in the U.S. alone, and perhaps \$15 billion for the entire world. Most of the savings would be in agriculture, the construction industry, and government operations such as flood control and water management of hydroelectric lakes. Since the capital investment for a good global weather-forecasting system should be less than a half-billion dollars, the payoff is impressive.

How weather satellites began

First orbital pictures of the earth's cloud cover, crude but encouraging, were obtained by Explorer 7—a 92-pound wheel-shaped satellite developed for NASA by the Army Ballistic Missile Agency, and orbited by a three-stage Juno-2 rocket in October 1959.

TIROS-1 was designed to get down to serious work in weather observation. It was the first of a spectacularly successful TIROS family of 10. "TIROS" stands for Television Infrared Observation Satellite—and, from TIROS-2 on, all carried infrared sensors to measure heat radiated by the earth's surface, in addition to their TV cameras.

In 1963, TIROS-8 was the first to use a new camera system—the Automatic Picture Transmission (APT) system—whose cloud pictures could be received by small inexpensive ground stations.

TIROS-9 of 1965 introduced another radical improvement. Earlier TIROS spacecraft could observe only about 20 percent of the earth's surface in one day. Their sensors and TV equipment looked out through the base of the wheel-shaped, spin-stabilized spacecraft, and pointed away from the earth much of the time. Even when they could view the earth, they seldom looked straight down; to interpret data meaningfully, coordinates had to be transformed.

Instead, TIROS-9 carried its two cameras in the wheel's rim, 180 degrees apart. Orbiting on its side, it rolled around the earth like a wheel, pointing first one camera and then the other at the earth. Its polar orbit, putting the sun behind the cameras viewing sunlit earth, constantly shifted westward due to the earth's rotation.

Thus TIROS-9 could photograph the entire sunlit surface of the earth each day.

The time for weather satellites to "go operational" had clearly come.

First operational system

On Feb. 3, 1966, ESSA-1 went into orbit. ESSA stands for the Department of Commerce's Environmental Science Services Administration, then newly created, with which the U.S. Weather Bureau had been consolidated. Now that NASA had demonstrated the feasibility of real-time meteorological observations from orbit, ESSA assumed the role of putting that new capability to work.

Since ESSA took over, no major storm on earth has gone undetected. Warnings based on satellite data have averted innumerable deaths, injuries, and losses of property. In one dramatic instance in 1968, ESSA-6 was credited with saving the Mexican cities of Gomez Palacios and Torreon when its weather pictures, from a height of about 900 miles, helped Mexican authorities manage a reservoir that threatened to break its dam and inundate the two cities.

Under ESSA's aegis, the Automatic Picture Transmission system has become so popular that 510 APT ground receivers are now in operation in more than 50 countries. At international airports they serve for the weather briefing of transoceanic-flight crews. The Air Force has found the satellite pictures helpful to detect local breaks in bad weather, for otherwise-impossible ground-support operations.

NASA tests refinements

While TIROS satellites evolved into the operational ESSA system, NASA experimented with more-advanced sensing and TV systems. These went aboard non-spinning Nimbus spacecraft—easily three times as heavy as the TIROS/ESSA satellites, but offering the advantage of a stable earth-looking platform.

Nimbus 1, launched in August 1964, carried an Advanced Vidicon Camera System (AVCS)—which, along with the popular APT system, soon became standard equipment in ESSA satellites—and a High-Resolution Infrared Instrument that made night cloud photography possible.

Besides a nuclear power source to recharge its chemical batteries, Nimbus 3 tested two new instruments—a Satellite Infrared Spectrometer and an Infrared Interferometer Spectrometer. Together, these measured temperature and atmospheric pressure at various levels in the atmosphere. The soundings closely matched measurements from airplanes at low altitudes, and appeared even more accurate

than balloon-radiosonde measurements at high altitudes. Since a single satellite can cover all regions of the globe and transmit its readings at once to weather-data centers, this new measuring method can be considered a major advance.

Relaying unmanned network's data

Weather satellites' usefulness would be enhanced if, besides making direct observations, they could collect and relay information from unmanned ground stations, buoys anchored or drifting at sea, and balloons drifting through the air. On radio command from the satellite as it rose above the local horizon, the stations below would transmit data recorded during the preceding hours. The exact position of drifting stations would be determined by the satellite. Feasibility of this idea was successfully demonstrated by Nimbus spacecraft with a system called IRLS (Interrogation, Recording, and Locations System).

NASA's multi-mission Applications Technology Satellites 1 and 3, hovering stationary in synchronous orbit more than 22,000 miles above the earth, carried out other experiments to improve meteorology from space. ATS-1, orbited above the Pacific in December 1966, photographed the earth's whole disk every 20 minutes with its Spin Scan Cloud Camera. A sequence of these views, put together, yielded a short movie that dramatically displayed the changing cloud pattern on the earth below.

ATS-3, in November 1967, carried a Spin Scan Cloud Camera for color pictures into orbit above Latin America. From this location, in a joint ESSA-NASA experiment, it continuously photographed the earth at times of high tornado probability. One of its pictures was taken at almost the same time (April 19, 1968, 3:13 p.m. CST) that a tornado struck the town of Greenwood, Ark.—killing 14 persons, injuring 270, and causing extensive damage. The tragic event led to a thorough after-the-fact analysis to study what triggered this and other tornadoes. ESSA experts now are optimistic that a time will come when satellite pictures will enable them to predict a tornado and its path.

Newest operational satellites

Last January the first of a fleet of ESSA's second-generation weather satellites went into 900-mile-high orbit. ITOS-1 (for Improved TIROS Operational Satellite) incorporates the latest refinements in sensors and television equipment.

Four-foot-high, 682-pound ITOS-1 has a "wingspread" of 14 feet with its three solar panels unfurled for 500

watts of power. A flywheel and electronic circuitry provide a precision attitude-control system replacing TIROS spin stabilization.

ITOS-1 has two wide-angle high-resolution AVCS cameras, two APTs, and two scanning infrared radiometers for nighttime cloud pictures. It also carries a novel flat-plate radiometer, which can tell whether a particular part of the earth is absorbing more heat than it loses—an important piece of information for long-range forecasts. A solar-proton monitor can predict solar flares that may be hazardous to manned space flights or may interfere with radio on earth.

Long-range weather forecasts

Reliable long-range weather forecasting will take more than a continuous survey of the atmosphere from orbit. To forecast, we must better understand the underlying mechanisms that make the weather. The most important single factor is the interaction between the atmosphere and oceans. Seventy percent of the globe is covered by water, which is pumped about by the earth's rotation in great "rivers" like the Gulf Stream and the Humboldt Current.

We need to know more about the complex energy balance involved as water from this dynamic ocean system evaporates, forms clouds, is borne inland by the wind, and returns in rivers to the seas.

An international program called GARP (Global Atmospheric Research Project), which NASA and ESSA support, has been established to throw light on these fundamentals. A U.S. contribution to it has been a \$23 million, three-month Barbados Oceanographic and Meteorological Experiment (Bomex) in the western Atlantic off Barbados [PS, Aug. '69].

Fast high-capacity electronic digital computers make it possible, too, to "model" weather situations on a computer. If we could set up the physical laws governing weather in a computer, and it was fast enough to stay ahead of the weather, we should know at any time what weather to expect.

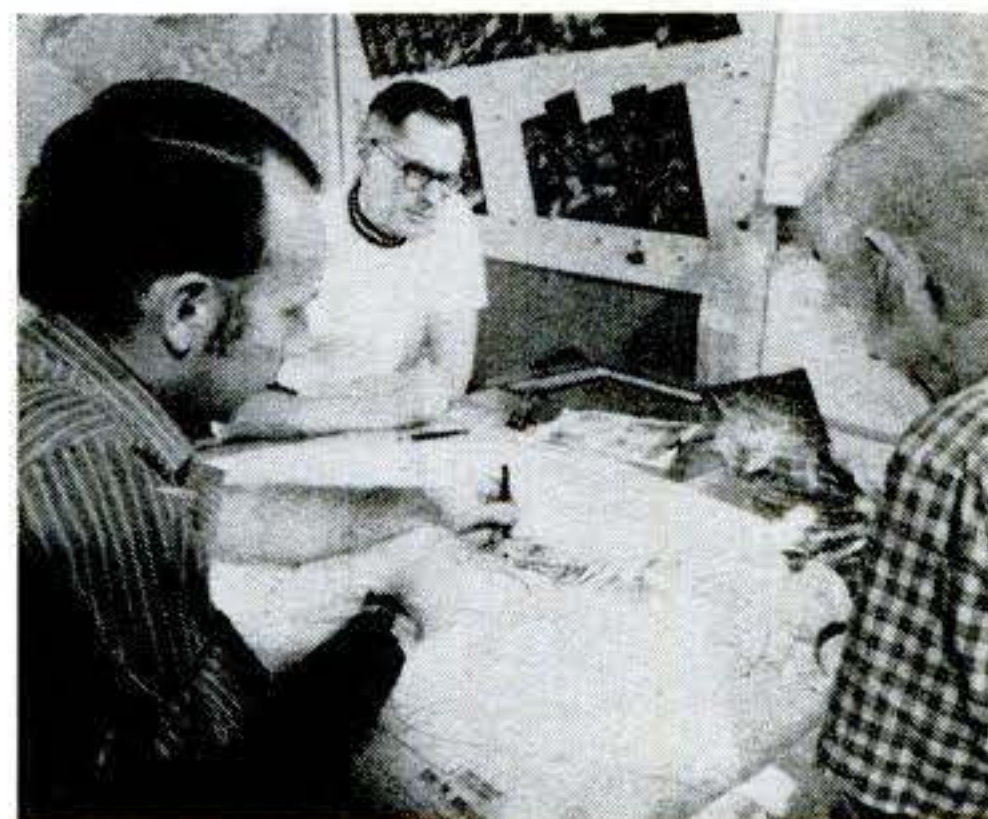
Today, while we know the general equations, we do not know many of the numerical figures we would have to feed into the computer. But if we combine a continuous global satellite survey of the atmosphere with an advanced computer-modeling technique, and continuously update the computer with real-time factual weather information, we are bound to get ahead of the game.

It is safe to predict that a reliable five-day weather forecast, and even a respectable 14-day forecast, will be available 10 years from now. **ES**

Turning Satellite Photos into Weather Forecasts



Weather photo is received by radio at the Suitland, Md., facility of the Environmental Science Services Administration (ESSA).



Tracing frontal systems with the aid of satellite photos, ESSA technicians at Suitland plot the world's weather on charts.



Hurricane-warning centers are alerted to late developments by meteorologist on phone with maps and photos at Suitland.



TV brings you timely forecasts of local, national, and world weather based on data from weather satellites orbiting earth.

The QUIET ONE: An



High torque from electric motor takes the Attex and author up a steep slope with ease.

The prototype looks almost exactly like a standard gasoline-powered Attex.

By E. F. LINDSLEY / PS Midwest Editor

If you've always thought of ATVs as snarling monsters breathing out oily blue fumes, wait until you've seen the latest electric model of the Attex. You'll have to see it—you won't hear it until it swooshes by with a low whine of motor and gears.

Strangely enough, it was originally intended as an industrial model to crawl over flat factory rooftops on maintenance patrols. But get it out on rolling terrain, and this 36-volt quiet one can master a 45-degree slope with ease. In fact, it may well claim a wider place than expected in the sports field.

Try it and you'll find you can stop it dead, halfway up a slope, then take off up the hill again with an easy squeeze of the throttle. This is the kind of move that's tough for engine-powered ATVs—they need revs for power. But the series-wound electric motor in the Attex puts out massive torque from a dead stall.

Driving the Attex electric is like



A quick kick and your bike is started.

At Last: A Kick Starter for Minibikes

You're out on a trail one bright, sunny day, bombing up a steep hill, and your minibike suddenly quits. You give a mighty yank on the rope starter, there's a grinding sound, and you're left with a couple of feet of rope and a little rubber handle in your hand.

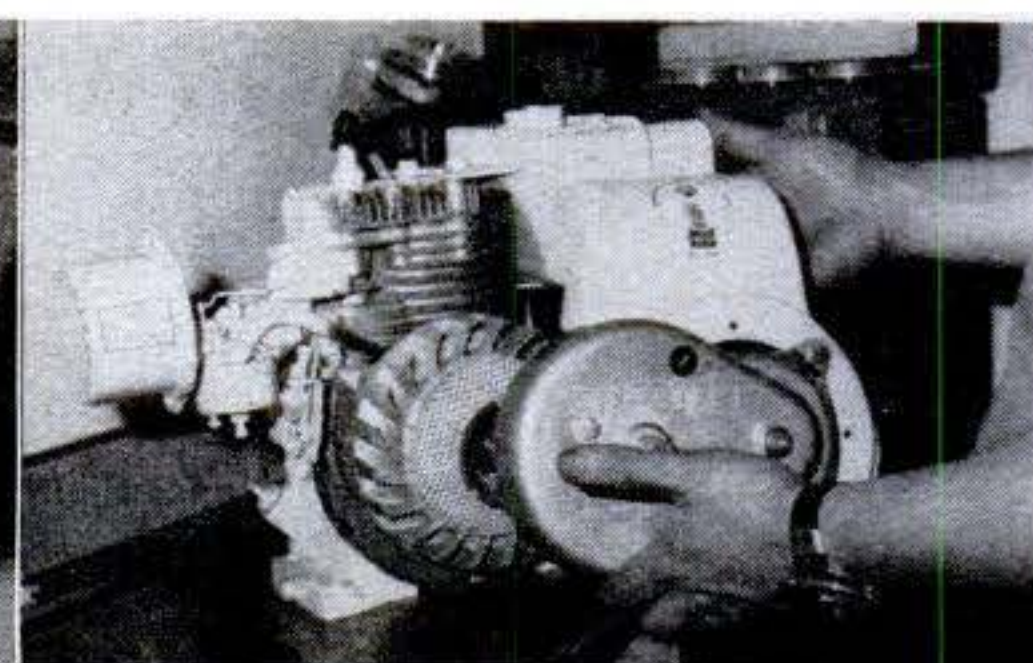
You can do away with rope-start problems like that in 20 minutes or so. How? Bolt on the new Kik-Start by Hegar 4 Products, Portland, Ore. It's a small kick starter that replaces the rope starter, and it fits over the cool-

ing shroud on the Tecumseh engines so common on minibikes.

It goes on like this: Remove the cooling shroud and hand starter from the engine. Some starters come off easily—just remove a few screws—but on other models you'll have to drill out rivets.

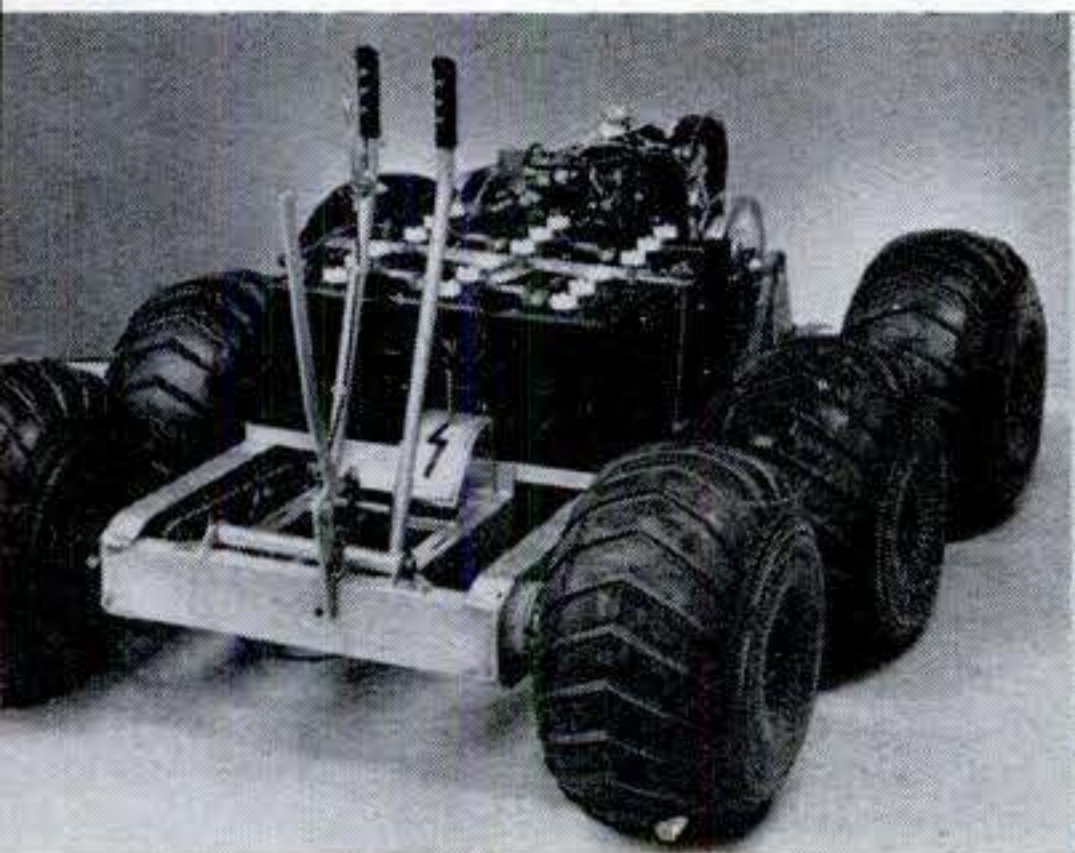
Then enlarge the holes in the shroud to take the bolts that will fasten it to the Kik-Start. Use a drill or a file, but be careful—the metal is quite soft. Bolt the kick starter and the shroud together tightly, and attach the unit to the engine. Make sure the starter and flywheel are aligned before you complete the final tightening.

When everything's in place, adjust the kick arm to the angle that suits you best, give it a light kick, and you're off—no more sore tempers or pulling arms.—Jim Davis



Enlarge the holes in cooling shroud to take the Kik-Start's mounting bolts. Bolt together shroud and starter and fasten them in place over the flywheel. The whole operation takes you only 20 or 30 minutes.

ATV That Runs Off Batteries



With body lifted off, you see the welded aluminum frame and cluster of golf-cart batteries that gives the ATV its quiet go.

driving its gasoline kin, except . . . You don't have to fool around starting it; the noise level is blessedly low; delicate steering and creeping tactics are easier; and top speed is somewhat lower.

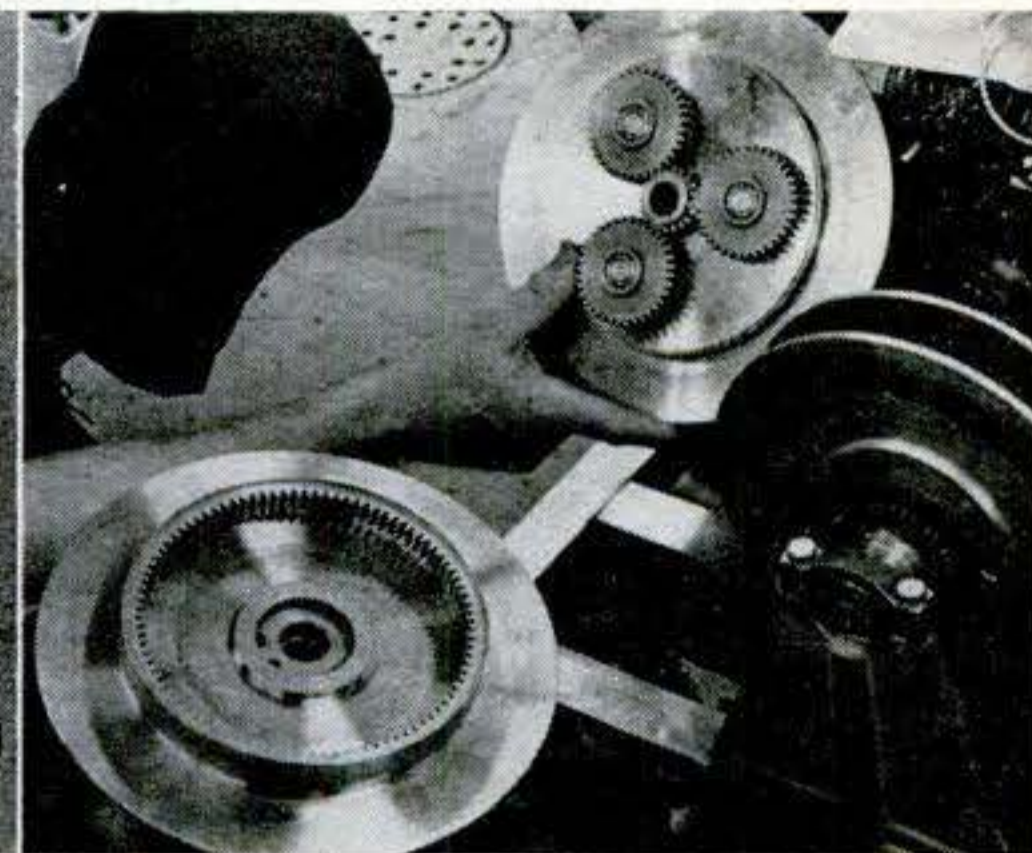
There is no intent to make this electric a racing machine, but it should attract outdoorsmen interested in moving quietly without disturbing neighbors (furred, feathered, or two-legged)—or the environment.



Motor, controls, and batteries are revealed on raising hinged seat. Batteries add over 400 pounds to the vehicle's weight.

Powering the 36-volt GE motor are six 12-volt lead-acid golf-cart batteries. Their life under severe testing has proved to be about four hours; three of the four continuous work hours, with no real chance for battery recovery. To hold down the weight—the Attex scales in at 795 pounds with batteries—there is no battery charger built in.

The Attex electrical controls are simple mechanical switches. Motor



Planetary transmission (shown disassembled) is like that Attex uses in their gas-powered vehicles. It's simple and tough.

starting uses wire coil resistances with stepping contacts. It seems predictable that further refinement will see the introduction of modern solid-state controls, though the switches worked well on the prototype.

The ATV Mfg. Co. (Pittsburgh, Pa.) expects the Attex electric to be available for industrial use early next year. With a windshield and top, headlights, taillight, and spotlight, it will be price-tagged around \$3,000.

The Camper Van with More Room in the Rear

Even with every inch of space utilized, van campers have not been able to squeeze in a permanent bath. Now, for '71, Dodge will offer a camper built on their 127-inch Maxi-Van chassis—18 inches longer than their standard van. And those 18 inches make room for that missing bath, and more. In addition to a shower and toilet, you'll be getting more overhead storage in the galley, a wider closet, larger dinette/bedroom, and space for a water heater.

Extra space isn't the only news with the new Family Wagon Royale. It has options—factory A/C, front disk brakes, automatic speed control, AM/FM stereo radio—never before available on a van. Power steering, power brakes, and automatic transmission, available on last year's models, will of course be on the option list again this year.

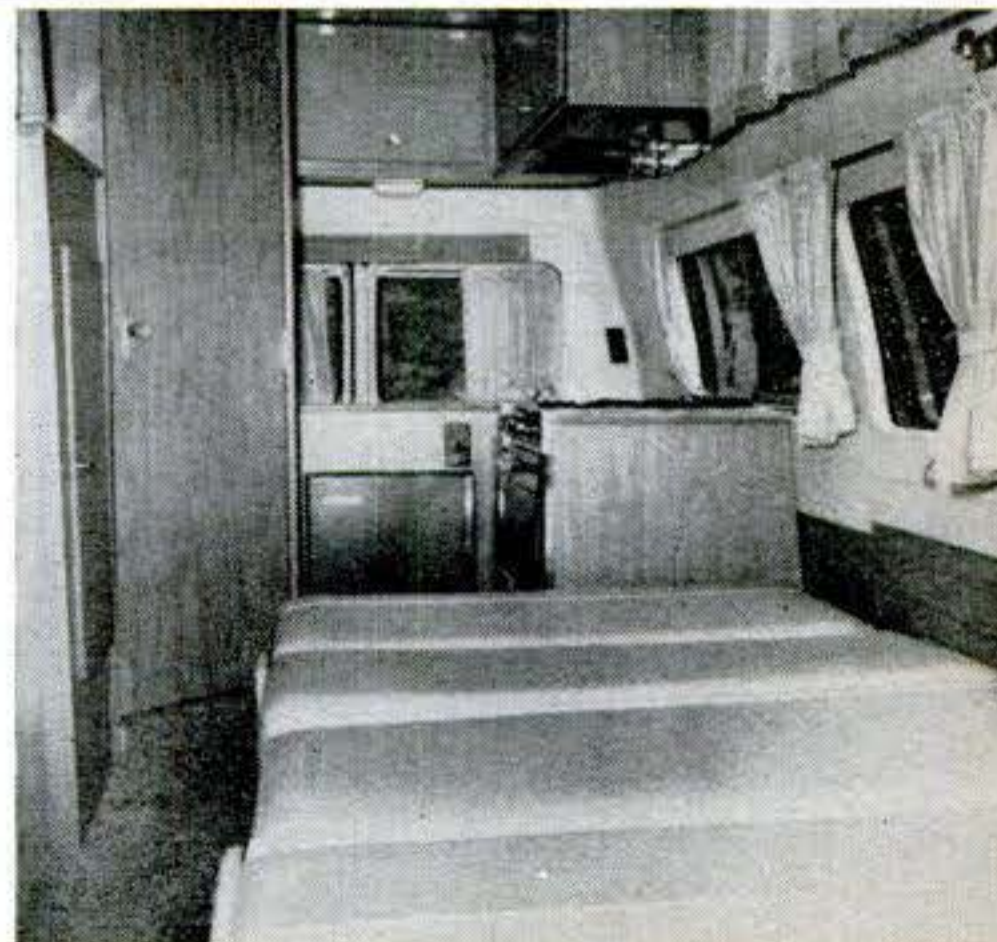
Skiers and snowmobilers will be interested in the new furnace that turns the Maxi-Van into a warm winter

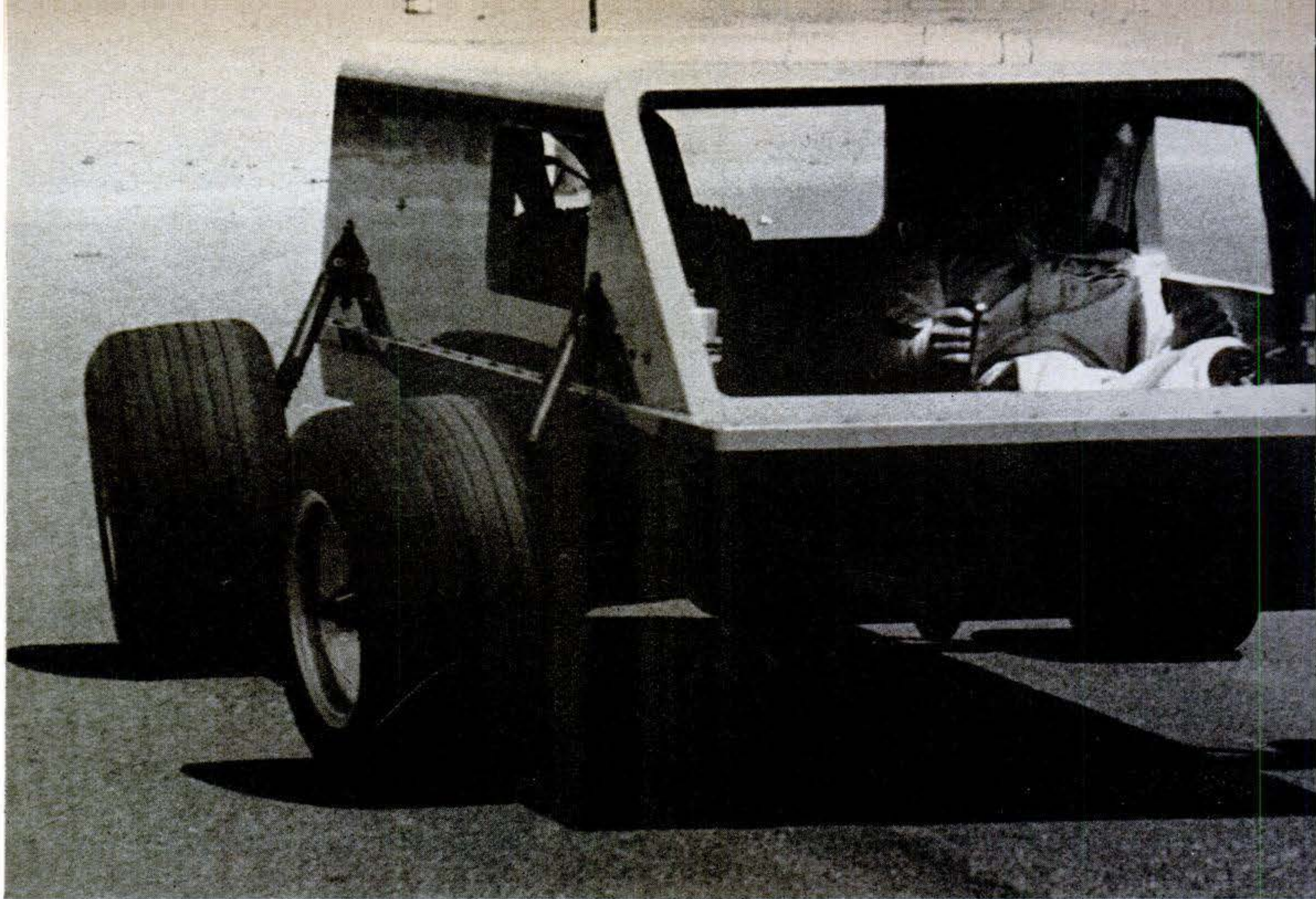


Vista top gives the new camper walk-through headroom from front to rear. Front-mounted engine and 18-inch extra space at rear make the Family Wagon Royale most spacious van camper on the market.

headquarters for fun. And big families will like the special trailer-towing package: It lets you tow a camp trailer for extra sleeping space when the sun goes down.

Travco Corp., Warren, Mich., has been converting Dodge vans into campers for several years. They'll be building this one, too. It's sold by Dodge dealers.—Jerry Copeland





Cornering attitude of Box when race-track tested is flat, no lean or pitch—but all wheels adopt curious camber angles, and rear

“The Box”—All Wheels Steer

Look at this ultralight on-and-off-road vehicle that hits new highs in mobility

By JIM DAVIS / PS West Coast Editor

Racing car? Economy car? Dune buggy? Off-road vehicle? The answer, every time, is yes; the Box is all of these. It began life as a multipurpose car suitable for street, track, and off-road use; but because it has a fully watertight body, it even converts to an amphibian when paddles are fixed to the wheels.

The designers, Dan Hanebrink and Matt Van Leeuwen of Costa Mesa, Calif., aimed for aircraft lightness. They also had their own ideas on just about everything in the chassis department.

A radical departure. The Box is far from the norm. But when you analyze it, you see the thoughtful reasoning and the simplicity behind the design: four-wheel drive as well as four-wheel

steering; power by a rear-mounted motorcycle engine, and belt drive to transmit the power. With the two-stroke, 500cc, 60-hp Kawasaki engine, the Box will top 100 mph and do the standing quarter-mile in 13.5 seconds at 95-mph terminal speed! A four-stroke LaVerda engine is now being tested.

From the engine, power is transmitted to the rear differential via a pulley. Suspension is an independent swing-axle affair, front and rear. It utilizes a hydropneumatic nitrogen-oil system, with separate reservoirs for each wheel. Over rough terrain this system really proves itself, taking the bumps out of ruts and gullies, and making off-road driving almost comfortable.

There is no separate frame. The body structure is what holds the parts together. The body is made in two sections, a top and bottom, bolted together. The Box is a two-seater. You step into it through a single front door, which also serves as the windshield.

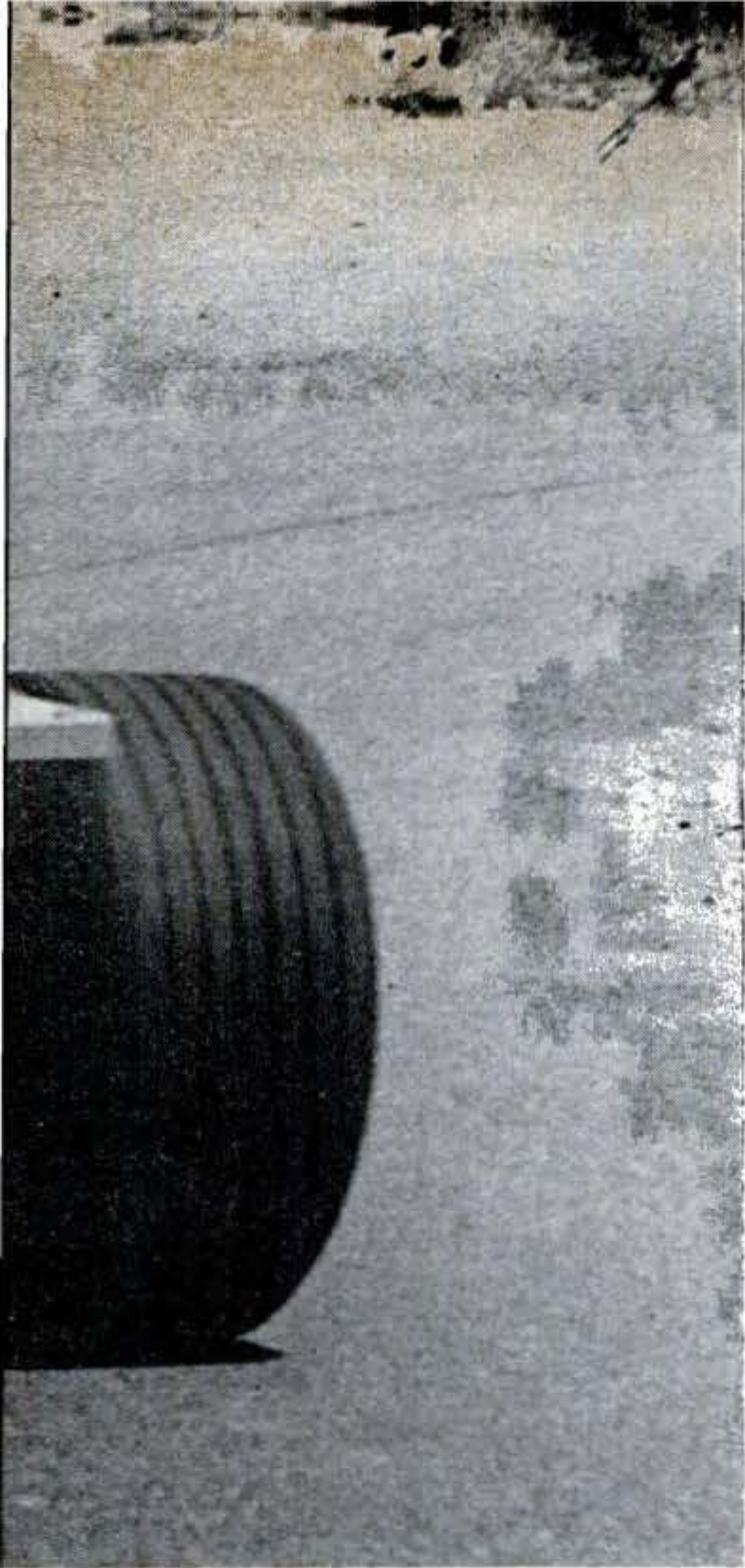
The Box is made of balsa wood (the ultralight stuff you build model

planes of) and fiberglass (the kind used in big aircraft). The balsa, end-cut into small pieces, is fitted between layers of the fiberglass.

Although aircraft fiberglass is harder to work and requires more attention to detail, it gives greater strength. Using this balsa/glass sandwich construction made it possible to strengthen points exposed to the greatest stress—such as suspension mountings—without beefing up areas that don't need it.

Controls for the Box. They're simple—borrowed from motorcycle components. Gear-changing is managed with the right hand, and so is the clutch control. The left hand controls the throttle by a twist-grip arrangement, as used on motorcycles. Brakes are applied simply by pushing the throttle grip forward.

You steer with your feet. It sounds weird, but really isn't. It's like the steering on those soap-box carts you had as a kid. When you pushed with your right foot, the cart turned left. When you pushed with the left, you turned right. But in the Box, instead of pushing directly on the axle, you



wheels show a pronounced steering angle!

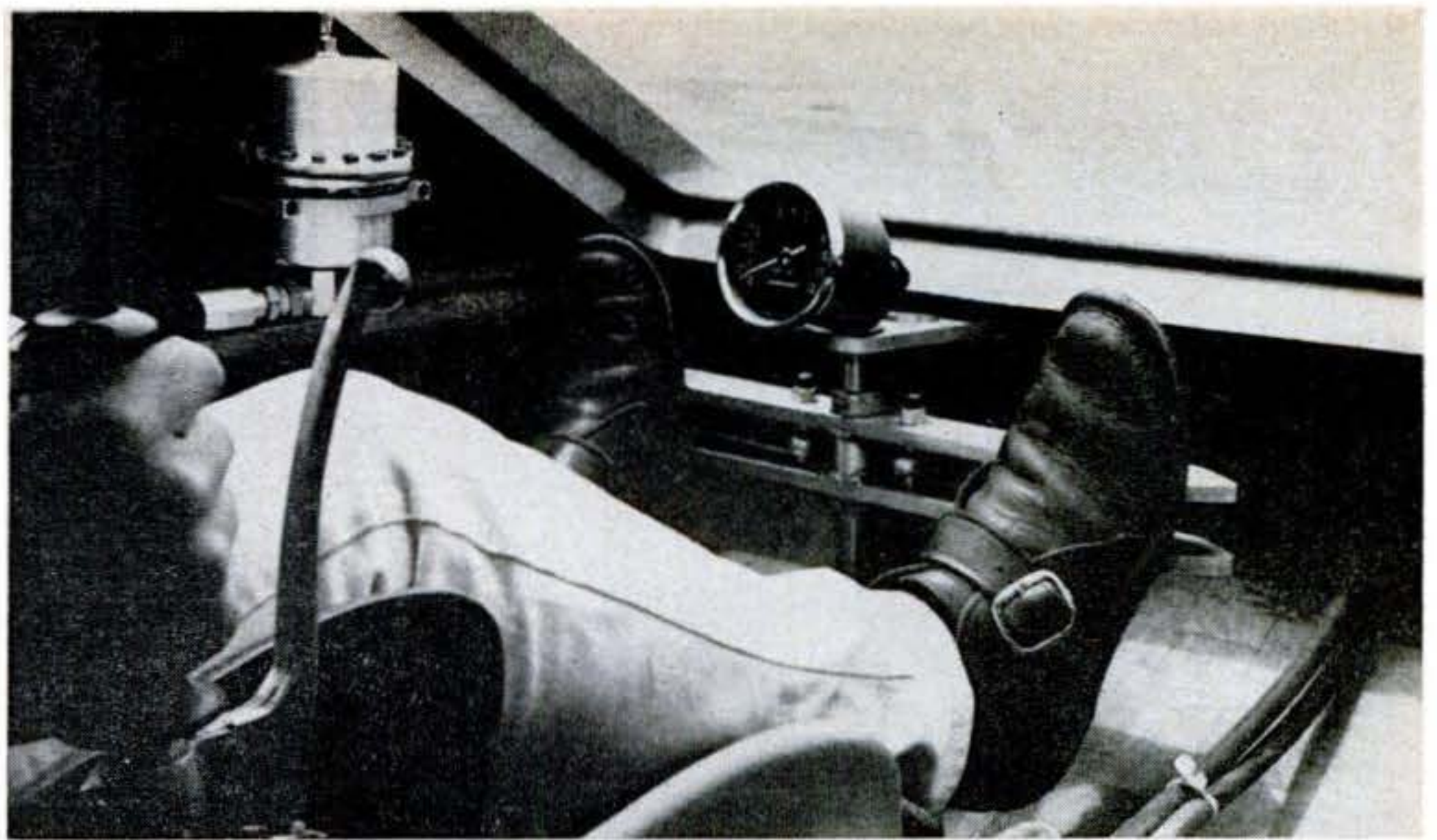
and Drive

are operating a hydraulic four-wheel steering system. The surprising thing to the designers was that it proved easier to make than a conventional two-wheel mechanical steering gear and linkage.

When can you buy? Plans call for about half a dozen of the Boxes to be built by the end of the year. A team of them will be entered in the Mexican 1000 off-road race this winter. They'll still be experimental. After that, start watching for yours. **DS**

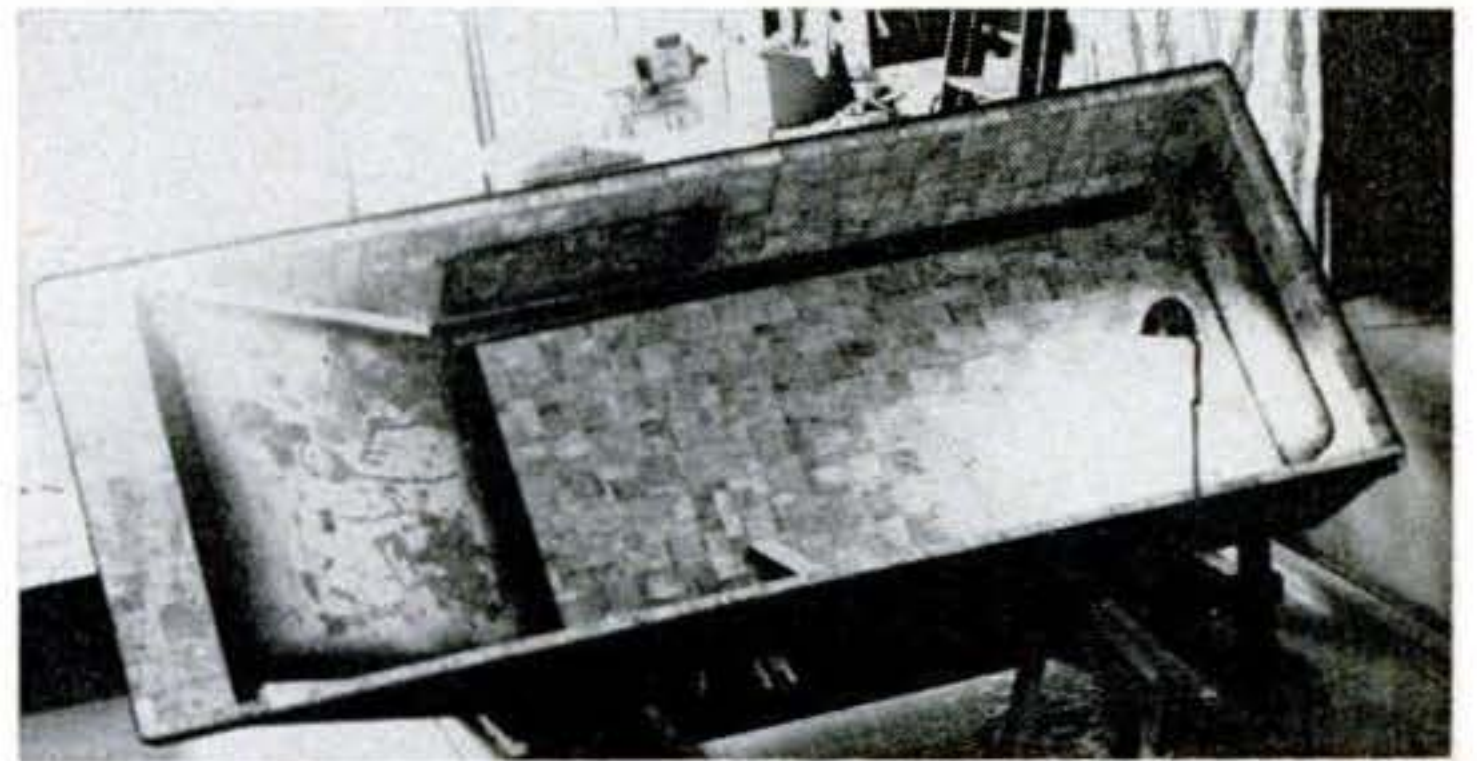
"THE BOX" SCORE

Wheelbase	77 in.
Track (front and rear)	68 in.
Overall length	144 in.
Overall width	80 in.
(w/tires)	
Overall height	40 in.
Ground clearance	8 in.
Steering	Closed-loop hydraulic
Suspension	Swing axles front and rear, with hydro-pneumatic struts
Wheels	13 x 10
Tires	5.75/12.80-13
Dry weight	700 pounds
Transmission	Uniroyal belt drive
Engine	3-cyl. Kawasaki 500 or 2-cyl. La Verda 750.

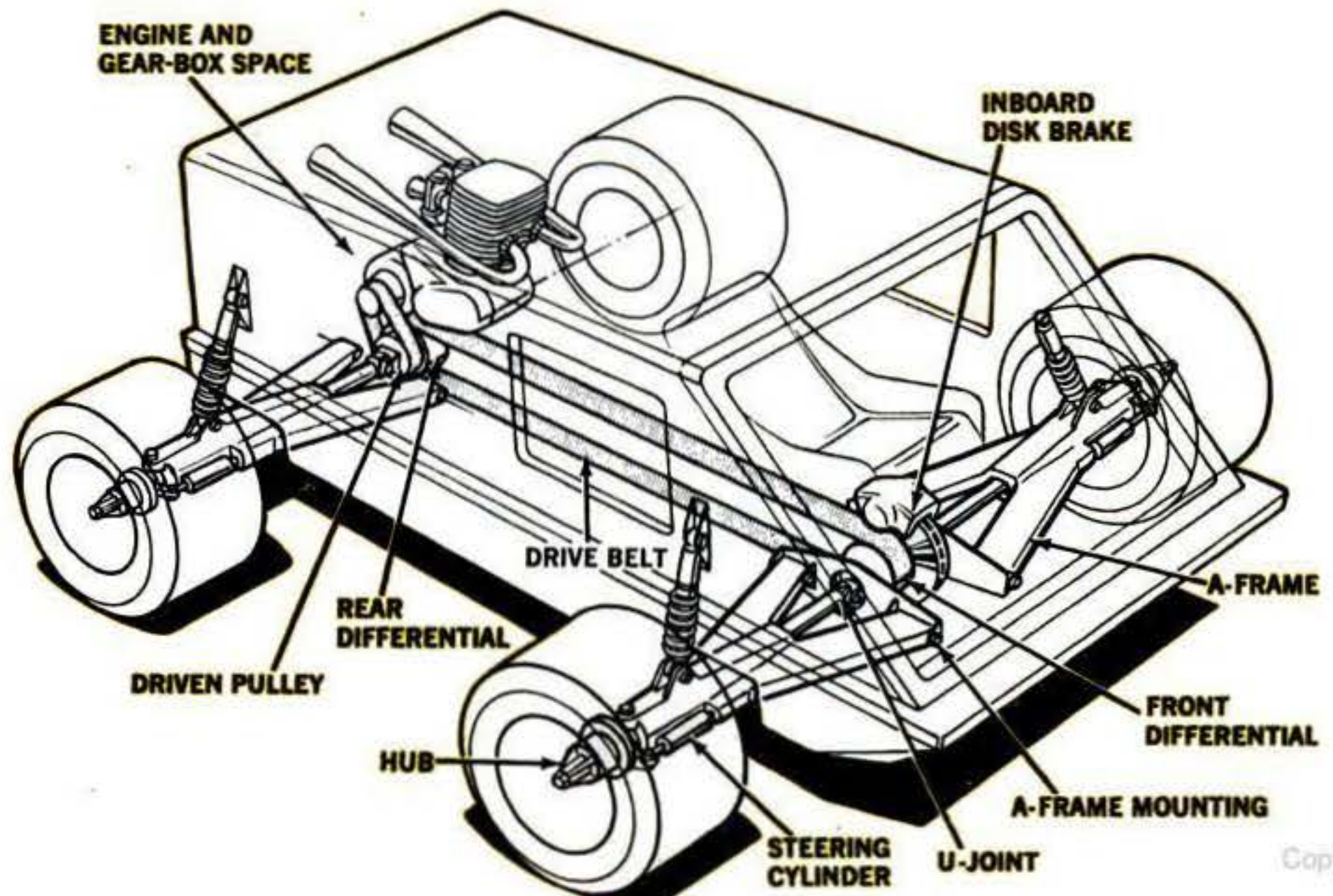
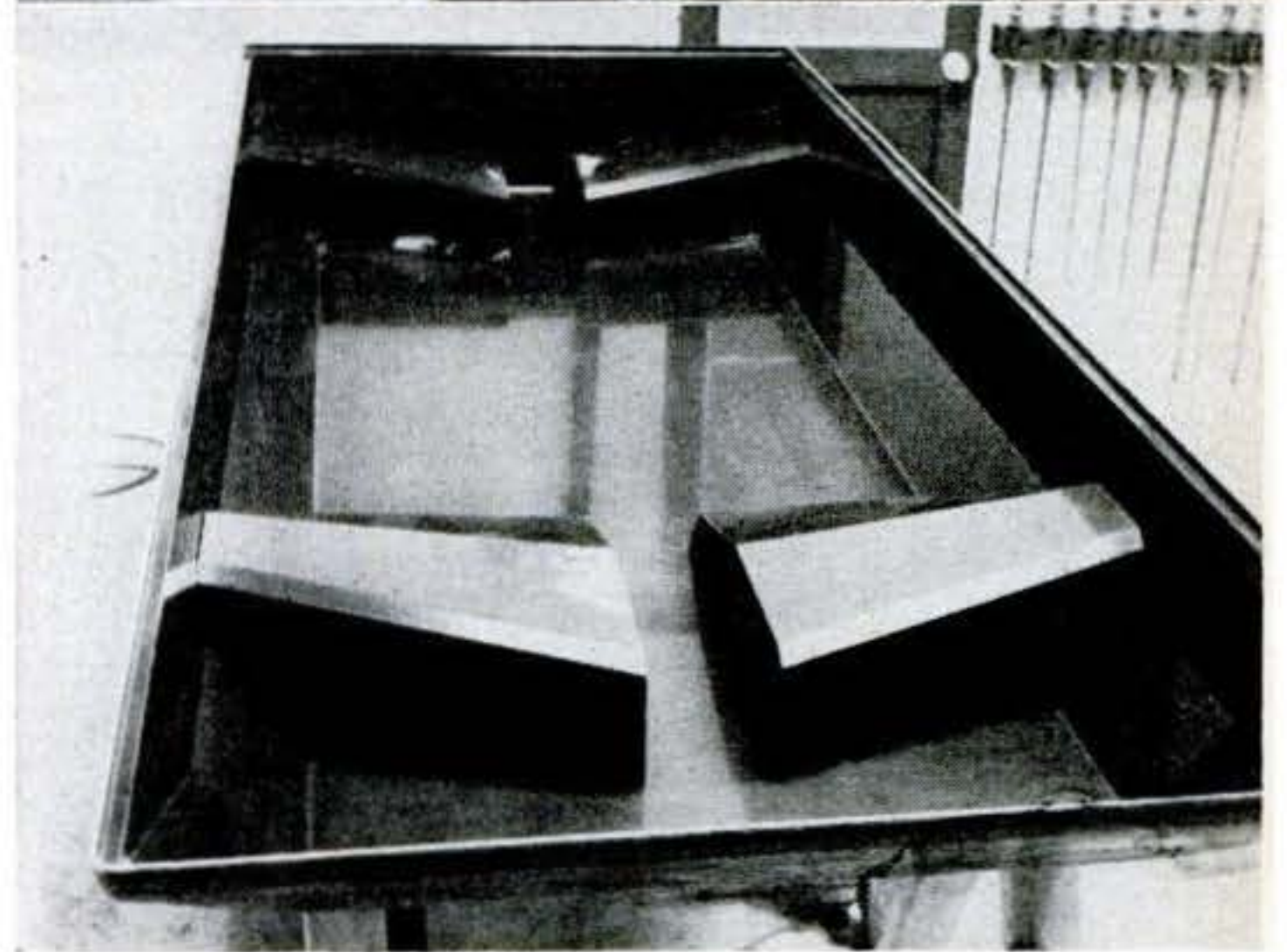


You steer with your feet, use hand controls of motorcycle type for throttle, clutch, gear- box. Driving the Box, Davis discovered, is no stranger than anything else about it.

Top section is made of end-cut pieces of balsa wood sandwiched between fiberglass and molded. Door (which holds windshield) and windows are cut out after molding.



Fiberglass bottom mold shows great tightness of the supporting structure with total lack of seams, joints, or bonds. The raised areas in the floor pan form the covers for the suspension control arms. Sketch below clarifies transmission and suspension principles, and shows the unique disk brake that is mounted inboard.

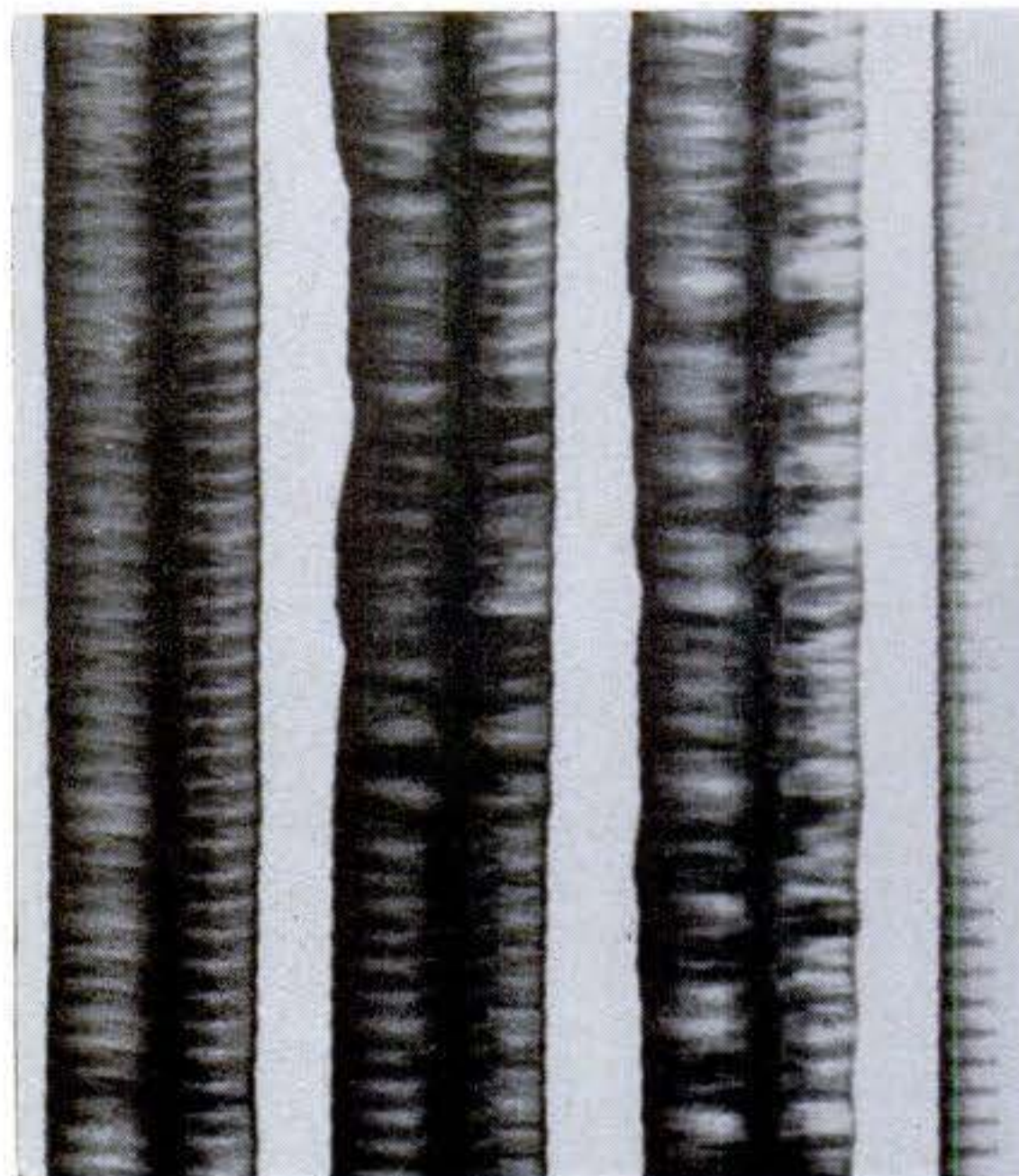


New Trends



New four-channel disc and playback system from the Victor Co., of Japan, uses decoder (left) to unscramble matrixed channels.

Closeup of the four-channel disc shows grooves with unmodulated (left) and modulated high-frequency carrier signals.



By **ROBERT BERKOVITZ**
Acoustic Research, Inc.

If you follow the claims made for home entertainment products, you get the impression that the tide of electronic progress sweeps into shore each fall and never recedes, with breakthroughs as thick as seaweed.

But how much do any of these developments really affect the way you'll be listening to music and watching TV? What are the *important* trends in home entertainment equipment? In my view, three current de-

velopments will have a great impact on your home sight and sound system:

- The revolution in tapes and tape units, including special noise-reducing circuits and equipment.
- Four-channel sound systems, including the possibility of a four-channel phonograph record.
- Video tape-cartridge recorders and playback systems.

The Tape Revolution. A few years ago, reel-to-reel prerecorded tapes had reached the point of presenting a genuine challenge to the disc record from a fidelity standpoint. To the home recordist who could turn to FM

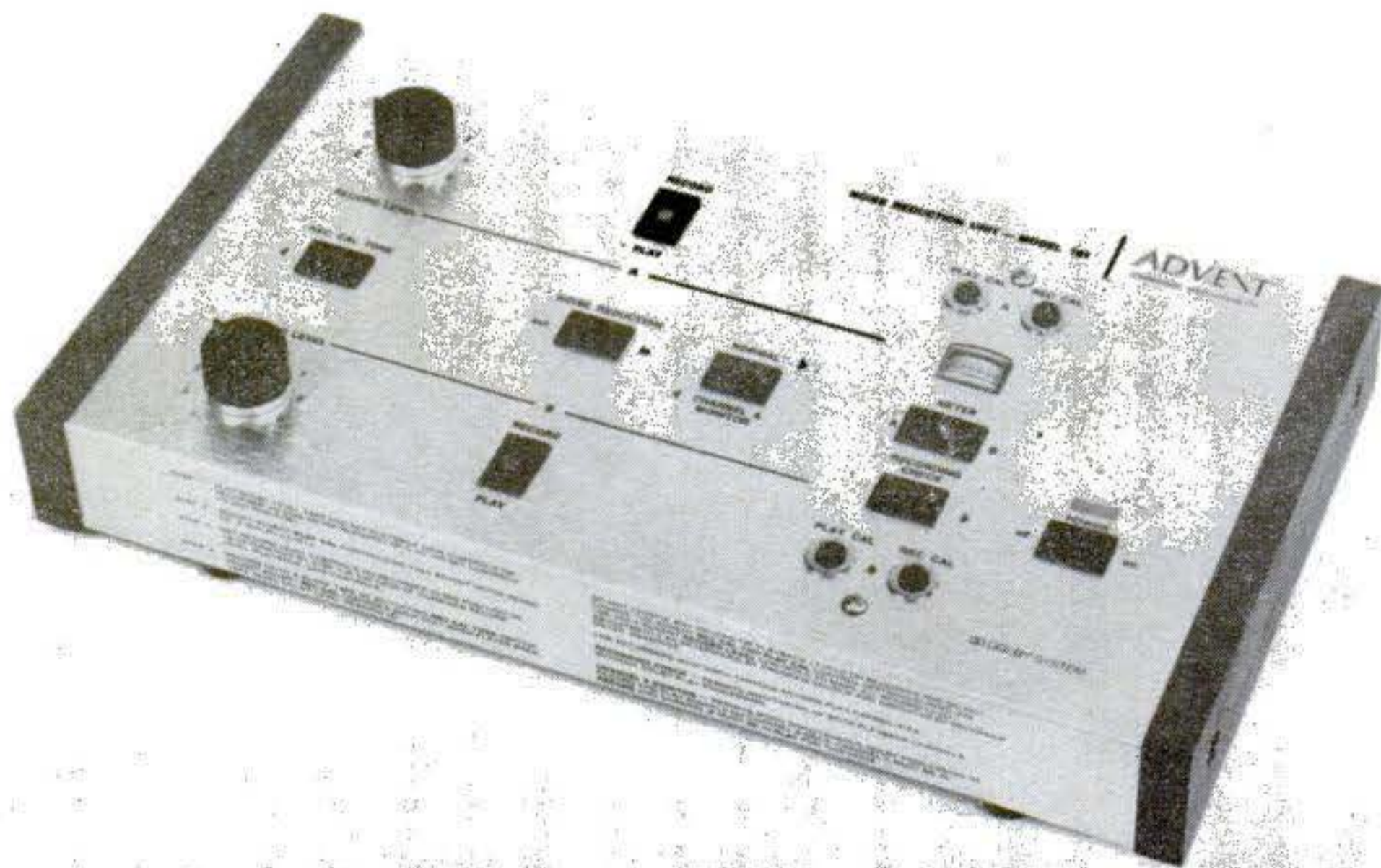
broadcasts for a wealth of musical source material, such developments as the cross-field head and low-noise tape put home tape-recording units like the Tandberg and Revox into the professional league even at amateur speeds.

Yet, most listeners were never "turned on" by tape until cartridge and cassette packaging became available, despite the admittedly modest performance of these systems when compared with reel-to-reel machines of comparable cost.

The answer lies not only in the convenience of the cassette and cartridge formats—especially for portable and automotive use—but in the fact that they make popular music on tape economically feasible, a fact of staggering importance when it is realized that approximately 95 percent of recorded music sales are of popular music! Records cost about 20 to 25 cents to manufacture (not counting performers' payments, advertising costs, etc.) and play for as long as an hour.

Tape has a factory price of about 10 cents per hundred feet. Thus, an hour of quarter-track stereo at 7½ ips starts with a raw-tape cost of more than a dollar. The sales appeal of the cassette is that it is convenient to use, attractive to handle, acceptable (as is AM radio from pocket transistor sets) in sound quality to a large part of the buying population. And it is nearly competitive in price with disc recordings.

As listeners who have been keeping



Dolby unit by Advent reduces noise of recordings, but only when made and played

back through unit. System works by boosting, then reducing low-strength signals.

What to expect next? Better tape units, portable TV recorders, and—maybe—four-channel discs

in Sight and Sound Systems

an ear on cassette releases know, these recordings have some way to go before catching up with the disc record in quality. Here, the areas of possible improvement are not numerous, since research has pushed development of the basic elements—tape-record and play heads and the tape itself—very near a practical limit of performance.

As one scientist I talked to at BASF, a major magnetic-tape manufacturer, put it: "We now fight for every tiny fraction of a db of signal-to-noise ratio by refining, polishing, or milling a bit better than we did in the past. But the big breakthrough—one that will solve more problems than it causes—remains to be found."

Where will the tape revolution lead? Nothing about the system forbids accurate tape motion; the newest machines are already considerably improved beyond yesterday's "high-fidelity" cassette recorders, and it is likely that economical ways to stabilize tape motion will be found.

Special, premium tapes (TDK and BASF's Chrome are the most frequently mentioned) appear capable of better performance in machines with proper equalization and bias—which may not be optimum for playback of regular cassettes—but at substantially higher tape costs.

Consequently, the home listener, having paid for an expensively engineered cassette recorder, and using expensive tape, may find that he has barely achieved the fidelity available on records with his present system. Moreover, it must be remembered that each of these improvements also extends the quality of higher-speed, open-reel tape recorders. [For a less-skeptical view of cassette quality, see the article following.]

To this listener's ears, the critical question that will decide the outcome of the tape revolution from a high-fidelity standpoint will be tape-mechanism improvement. The home listener may then be able to fully reap the benefit of a truly major tape-recording development: Dolby noise-reduction circuitry.

Dolby noise-reduction systems. If low-speed tape systems are expected ever to meet high-fidelity standards, surely one major reason is the Dolby "B Parameter" noise-reduction system. First introduced by KLH in amateur tape recorders several years ago, the Dolby system is now licensed to numerous tape-recorder manufac-

turers in this country, Japan, and Europe.

You can purchase a recorder with the system already built in, or you can buy the system as a separate unit usable for recording and playing special "stretched" tapes, as the Dolby-processed recordings are called.

The effect of the system on the sheer listenability of cassettes is remarkable, to say the least. Owners of high-quality open-reel recorders, moreover, will find that they are capable, with separate B-Type units like those made by Advent, of obtaining performance at 3¾ ips that will give 15-ips professional machines a run for their money.

Long-range prospects for the Dolby system appear good and, by the time this appears in print, at least one major duplicator of prerecorded tapes may be releasing "stretched" cassettes and cartridges. Based on the marked improvement the Dolby B system provides, it seems reasonable to expect that it will be adopted as a standard by all makers of tape recorders in a matter of a few years.

Four-channel record and play. Two-channel stereo can come remarkably close to duplicating the sound of live performers when accurate speaker systems are used in the demonstration. However, reproducing the sound of the concert hall—as opposed to trying to create this sound artificially—requires more information to be brought to the listener's ears than two straight audio channels can carry.

Marvin Camras, of the Illinois Institute of Technology, has made and demonstrated 12-channel recordings. Inspired by Camras' experiments, I, myself, and others at Acoustic Research carried out further work that appears to have catalyzed the current interest in commercial four-channel systems.

PS readers with tape recorders that record and play stereo simultaneously can investigate some of the interesting possibilities of four-channel reproduction. This can be done even if you don't own four-channel tapes, if you are able to use an extra stereo amplifier and a pair of speaker systems. All that is necessary is to play a stereo record or an FM broadcast through the regular system, while recording and playing back the same program through another pair of speaker systems at the *back* or *sides* of the room.

[Continued on page 132]



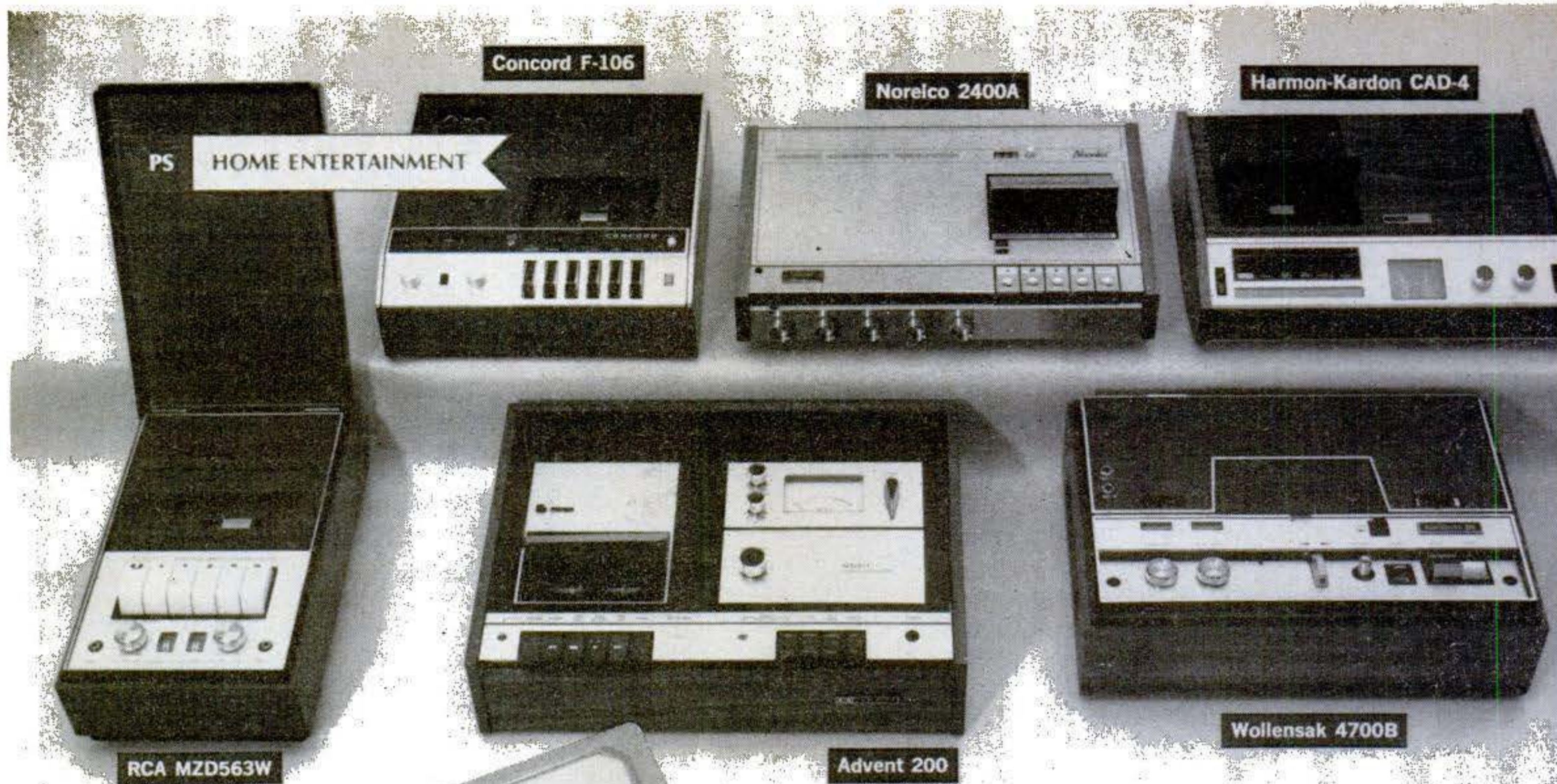
Late entry in cartridge-TV sweepstakes is Instavision. The Ampex portable records off a matching camera or from color or B&W TV set; works on AC and batteries.



Plastic cartridge for Instavision uses standard video tape of half-inch width.



Instavision plays back cartridge in color or B&W over TV, for 30 or 60 minutes.



Some of the new cassette decks tested included features that make high-quality audio from the new tapes (left) possible.

Cassette Tape

special noise-suppressor circuits—sounded almost as good as open-reel tape played at 7½ ips (inches per second). Even decks without the special circuitry sounded good enough for very enjoyable listening. Finicky ears may find that in frequency response and background hiss most cassette decks are still a notch below the best sound obtainable from records or reel tape.

Six hours of music in a shirt pocket

Even so, cassettes have a lot going for them that no other music medium can match. They're compact. You can carry six hours of music in your shirt pocket. They don't wear out, don't get scratched. No tape to thread, no tone arm to fiddle with. You can make your own cassette recordings off the air, from your friends' records, or "live" with a mike. Or you can buy almost any type of music on prerecorded cassettes. Also, the price tag is attractive. You can buy a good deck from about \$90 on up. All this combines to make cassette decks just about the hottest item in audio these days.

The technical upgrading of cassette machines also stems from several linked factors:

- New line-powered drive motors and transport mechanisms to move the tape smoothly and without chugging. This eliminates the fluttery sound that still bugs many of the battery-powered portables.

- New playback/record heads to achieve better frequency response—even at the snail speed of cassette tape (1⅞ ips compared to 7½ ips of standard reel tape).

- Radically new kinds of recording tape, specially designed for cassettes, allowing the tape to carry a better signal despite slow speed and narrow track width.

- A new type of noise-cancelling circuit called a Dolby, used in some of the fancier decks.

Let's look briefly at each of these design factors: *Better mechanics.* This concerns the "transport"—the

New tapes and tape heads, beefed-up mechanics, and the Dolby noise reducer give cassette decks quality sound

By HANS FANTEL PHOTOS BY ORLANDO GUERRA

A new breed of tape recorders is sounding off. Cassette decks are fast becoming the most popular add-on item for stereo systems. Unlike familiar portable cassette recorders, these decks are designed as plug-in units for your stereo system, and their performance can be called high-fidelity without winking an eye. Some of the newest cassette decks have been upgraded to the point where they offer serious competition to records and open-reel tape as a basic music medium for the home.

This raises several questions: Just how good is the sound? What advantage do cassettes offer in comparison with records or reel tape? And why do cassettes now reach high-fidelity performance standards when they couldn't before?

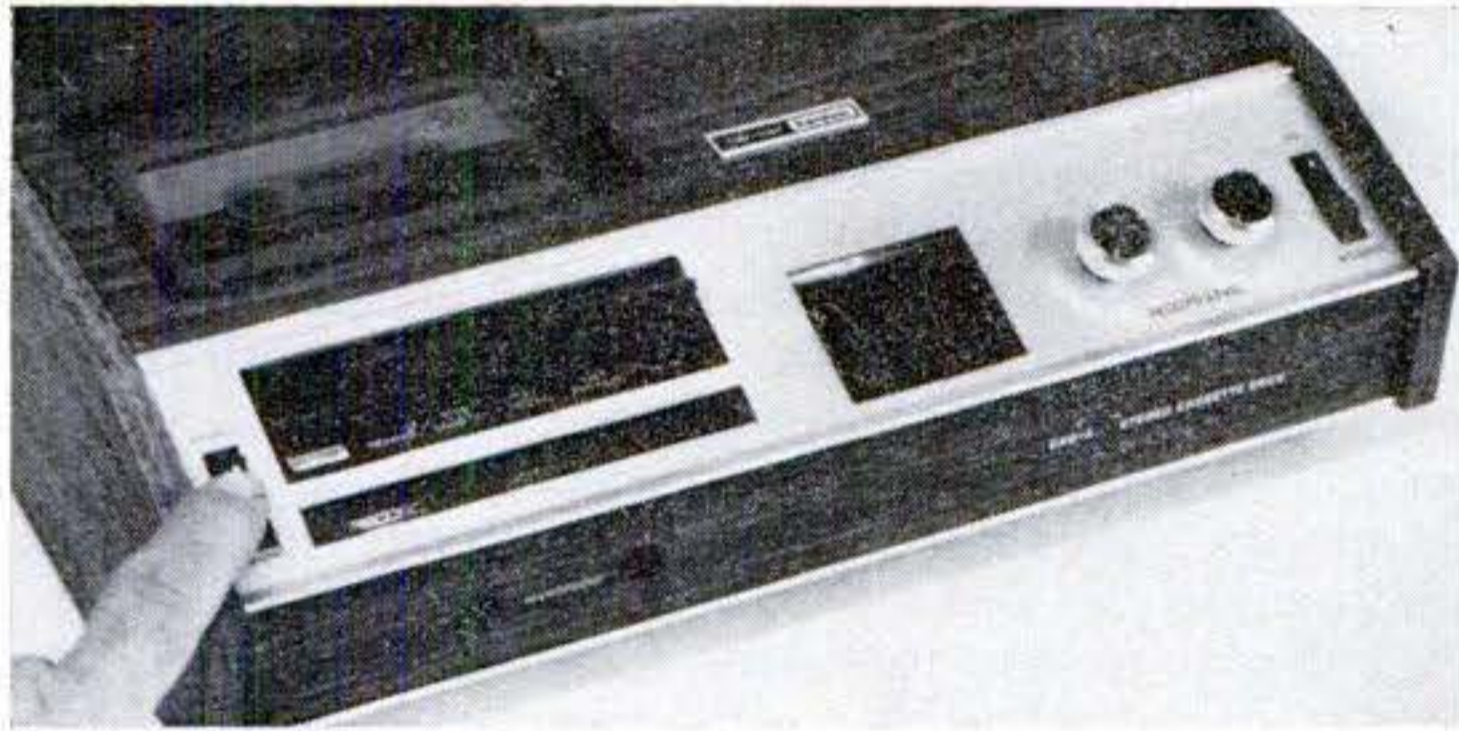
To find the answers, I checked a sampling of the new cassette decks. The best decks—those equipped with



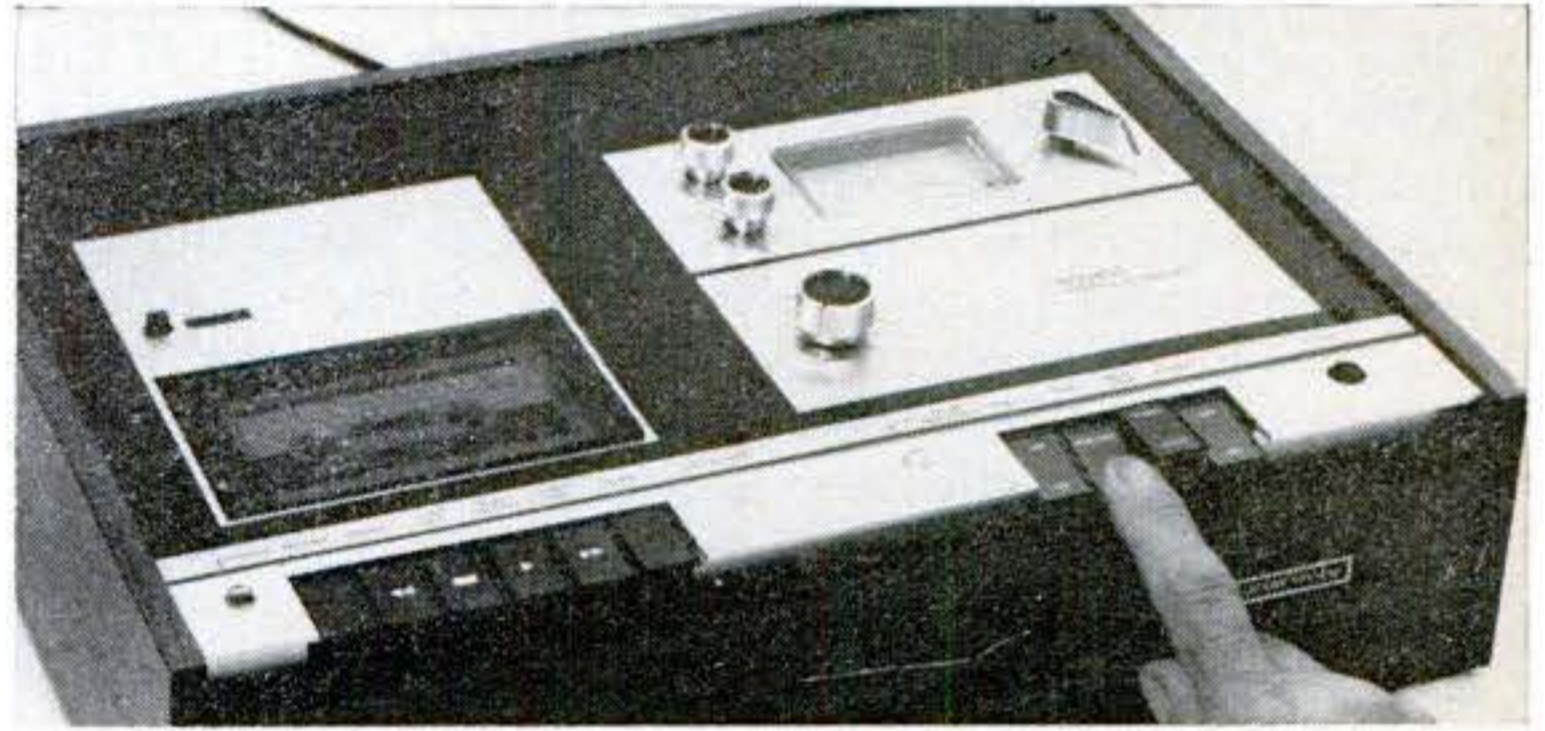
Plugging a deck into your hi-fi system will give tapes better speakers and amplifiers than most cassette recorders can offer.



A bias select switch included on the Concord F-106 lets you increase the tape bias level for the new high-density tapes.



Overmodulation light flickers on in this Harman-Kardon CAD-4 when the recording level is high enough to cause distortion.



Side-by-side switches for Dolby noise reduction and chromium dioxide tape bias in Advent's Model 200 bring top fidelity.

Systems: Now They're Hi-Fi

motor and the parts that turn the hubs of the cassette and guide the tape past the record/playback head. Until recently, no high-quality transports existed. Most were designed for portable use where fidelity didn't really matter. The majority of portables aimed at sound no better than that of a portable radio.

A year or so ago, a new quality standard was set. Harman-Kardon, a company with an adventurous engineering philosophy, introduced the first deck to be used with high-grade stereo systems. They used a precision motor with servo speed control, a hefty flywheel, and specified precision tolerances for other mechanical parts, such as pulleys and drive capstan.

This type of mechanical design would not have been feasible in a lightweight portable. But in a deck for home use, size and weight limitations did not apply. The unit still was compact—hardly bigger than a cigar box—but it performed with a speed constancy close to that of a standard tape recorder. It proved that quality performance was possible with cassettes and set the pace for the whole industry.

Better heads. The most important single part in a cassette deck (or any other tape machine) is the recording and playback head. The head "writes" the magnetic signal on the tape and "reads" it from the tape. The smaller the head gap in which the magnetic field develops, the better the frequency response. A narrow-gap head is like a sharply pointed pencil: You can write finer details with it. Or, putting it in audio terms, the narrower gap can write or read the finer waveforms of high frequencies.

But small head gaps mean precision tolerances, and these are hard to maintain in mass production. Thanks to recently improved manufacturing and quality-control methods, it is now possible to make precision heads at reasonable cost. With a gap width of 50 to 80 microinch (millionths of an inch), cassette decks now promise you

frequency response to about 12 kHz or more—enough for lively, natural sound.

Improved tape. At the same time heads were upgraded, tape itself was improved. The early cassettes had tape with fairly rough oxide grain. This hampered the magnetic "writing." Recording on rough-grained tape is like writing on a pebbly surface. Fine lines just don't show. You need broader strokes to make legible marks. So, to take advantage of the finer magnetic signals created by narrow-gap heads, you need fine-grain tape.

Narrow tracks are a problem

Grain structure is more critical in cassettes than in open-reel tape. For one thing, the tape travels more slowly. Also, the tape strip is only 1/7 inch wide—less than half the width of reel tape. With four sound tracks on the tape (two stereo tracks in each direction) this leaves only a 0.024-inch width for each track. Add up slow speed and narrow track and you see why cassettes have a special problem: A lot of signal has to be crammed into very little tape space. That's why special tape types had to be developed to hold more information (both in frequency range and loudness level) in smaller areas of magnetic material.

The pioneer in this field is a company known by the initials TDK. Their cassettes use a patented ferrite grain whose particles differ from ordinary iron oxide. On most ordinary tapes the magnetic particles are deposited in a random pattern, like bricks dumped in a heap. By contrast, the TDK ferrite arranges itself on the tape like bricks laid up face-to-face in a wall. That way, up to eight times more magnetic particles can be crammed into a given area of tape. This compensates for the slower speed and narrower track width in cassettes, bringing performance almost up to par with open-reel tape running three times as fast.

Continued

Fine-grain tapes lower background noise and give you better highs,

My tests showed that TDK cassettes provide a noticeable performance margin—better highs and less hiss. But the better sound comes at a higher price. A TDK cassette with one hour playing time sells at discount stores for \$2.99, compared with about \$2 for other quality brands. Whether the margin in sound is worth the difference in price is something you have to decide.

Other companies, of course, are catching up fast. A brand also known by its initials—BASF—has fine-grain iron oxide with a remarkably quiet background. And Norelco, Scotch, Ampex, and Sony also use special low-noise tape formulations in their products.

Stronger high-frequency bias

For optimum results with special tapes like TDK and BASF, the recording bias should be boosted above standard level. The bias is a high-frequency signal automatically applied to the tape in recording to make the tape more responsive to the audio signal. Some tape decks have a special bias selector to let you choose the optimum bias for the kind of cassette you prefer. Most now have the bias fixed for the new low-noise tape formulations. My tests show that you get good results on these decks with any cassette, even without a special bias selector.

Some of the less expensive house-brand cassettes (like those offered by Allied Radio or Lafayette) give good results in more casual recording applications. They may lack the sparkle of the top brands, but they're fine for background music, voice letters, and other uses where top fidelity is not required. But stay away from the lowest-cost off-brand cassettes. Their mechanical parts—internal tape hubs, guides, etc.—are not always aligned properly and may cause jamming. This could overload and dam-

age the motor in your deck. Besides, the tape grain itself may be too rough and act as a grinding compound on the record/playback head, messing up that precision edge on its narrow gap. Some "cheapie" cassettes also shed oxide particles that foul the head gap.

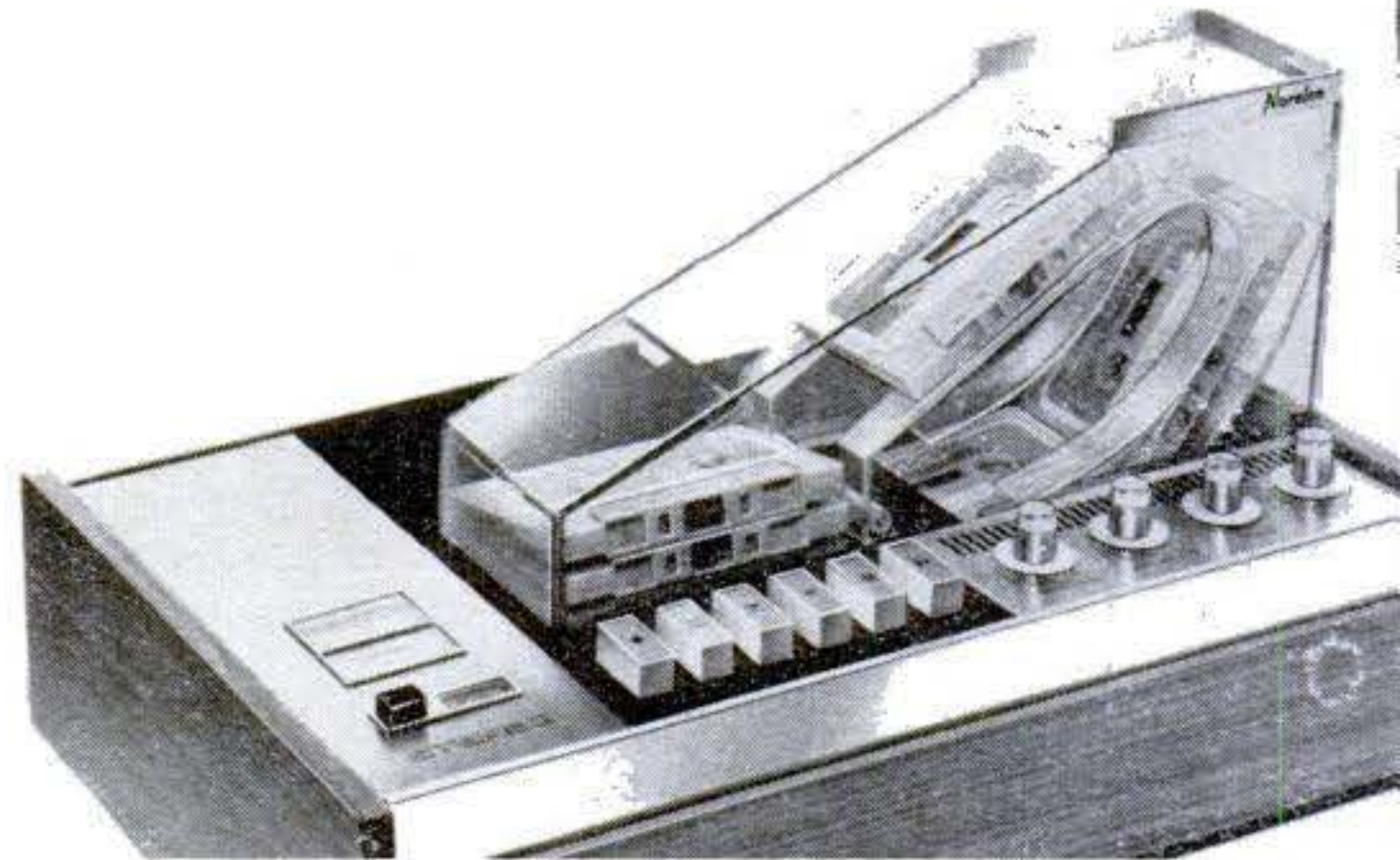
Another hitch with "cheapies" is tape width. Because the tape is so narrow, the slightest variation in width causes the tracks to waver up and down in front of the heads, making the signal fade or drop out completely at certain points. Quality cassettes maintain a width tolerance of two-thousandths of an inch. Most off-brands are slit from sheets more sloppily. So if you're recording a one-shot—an event or interview that won't be repeated—don't take a chance on losing your signal because of uneven tape width.

One way to tell a precision-made cassette from less reliable ones is to look at the four corners. Most quality cassettes are put together with small screws, which permits precise alignment of their parts. Cheaper products are usually welded together. This works out all right in most cases, but the chances of being stuck with a dud are generally greater in welded cassettes. Most quality brands are guaranteed by the manufacturer against all malfunction.

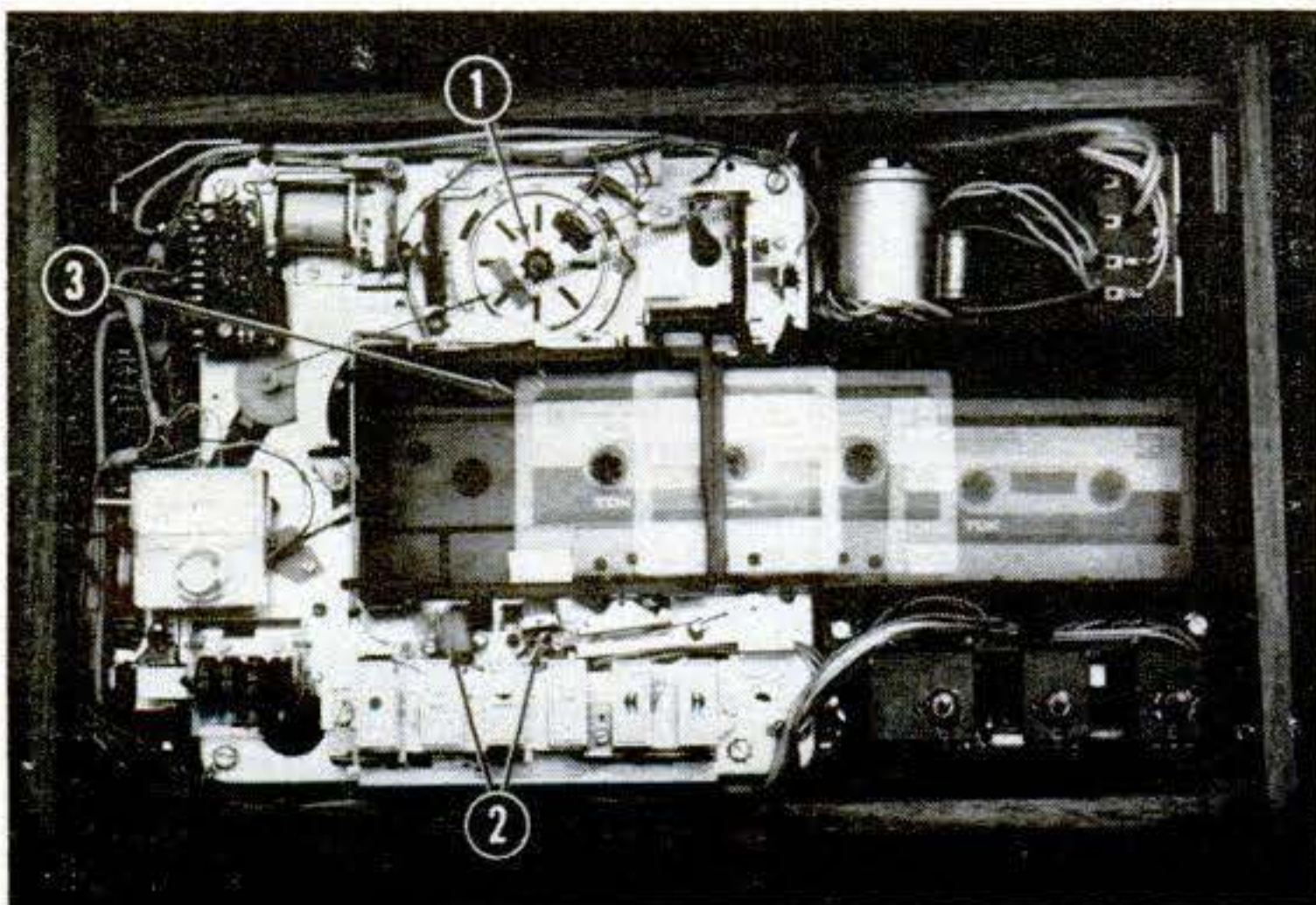
Crolyn tape. As this goes to press, an entirely new type of cassette has been announced which does not use iron particles, but chromium dioxide, as its basic magnetic material. Commercially known as Crolyn, these cassettes give even better frequency response, quieter background, and wider range between levels of softness and loudness than the most advanced ferrite tapes. The hitch is that Crolyn cassettes (just introduced by Advocate and BASF) require different electrical adjust-



Fast, simple loading feature of changers, and a wide choice of musical selections accounts for their growing popularity.



Here's a \$20 snap-on circulator (Norelco's CC6) that flips cassettes over for 12 hours of nonstop, no-repeat music playback.



Triple exposure shows movement of a rejected cassette into Norelco storage compartment after heads and capstan retract.

CASSETTE CHANGERS Are

If you dislike changing cassettes periodically, there's a growing list of automatic changers to do the job for you. They let you stack up to 12 hours of continuous musical entertainment, so you can really relax.

The first changer was introduced by Norelco about three years ago, and versions using the same mechanism are now sold by Bell & Howell and Ampex. Recent entries to the field are from Panasonic and Denon (Nippon Columbia). Early next year Benjamin will bring out an eight-cassette changer and a 24-cassette, carousel-tray model. Panasonic has a 20-cassette changer now

Dolby noise reduction boosts the signal-to-noise ratio 10 to 15 db

ments of the recorder circuits than other kinds of tape. So far only a few decks, including Advent's Model 200 and Harman-Kardon's Model CAD-5, feature a switch to let you choose between proper settings for Crolyn and iron-based tape.

At the time my tests were made, Crolyn was not yet available to consumers. But we heard an experimental demonstration of the new Advocate Crolyn cassette now selling for \$3.99 for an hour's run. The result was impressive. A high-quality 7½-ips reel tape was dubbed to the cassette on an Advent deck. Then the dub and the original were compared by switching back and forth for A-B listening tests. You could hear a difference—but just barely.

The Dolby. This is the most radical innovation to hit the cassette field this year. A special circuit to reduce background noise, it's named after Ray Dolby, the engineer who invented and patented it. At present, Advent, Fisher, and Harman-Kardon are marketing cassette decks with built-in Dolby circuits.

Solving the tape-hiss problem

Background hiss has been a persistent problem in cassettes. The track is so narrow, the speed so slow, that you can't record a strong signal without overloading the tape. To reduce distortion, the signal has to be kept weak. In playback, therefore, it takes high amplification to get enough volume, and this brings up the background noise along with the music.

Ray Dolby just about licks this problem with a circuit that does the following things: In recording, it passes all signals above a certain strength without altering them in any way. But signals below a certain strength are boost-

ed by about 10 to 15 db, depending on their frequency.

In playback, the process is turned around. Boosted signals get chopped down the identical amount they were stressed in recording, so you hear them at their natural loudness level. Yet at the same time, the Dolby cuts down the background hiss (never boosted in the first place) by the same amount along with the pre-boosted signal. Add it all up and you come out with a 10- to 15-db improvement in signal-to-noise ratio.

Dolby-equipped decks now run about \$100 more than a good non-Dolby deck. Advent, for example, pegs its 200 model at \$260, Harman-Kardon's CAD-5 sells for \$229.95, and Fisher's RC-80 carries a tag of \$199.95. (Vivitar Electronics' V2 will soon be available at \$220.)

Is the Dolby worth the extra cost? *If you are a perfectionist, if your stereo system is good enough to really show the difference, and if you insist on cassette performance comparable to open-reel tape—the answer is yes.* If not, you can get good performance from a non-Dolby deck and save yourself a hunk of cash.

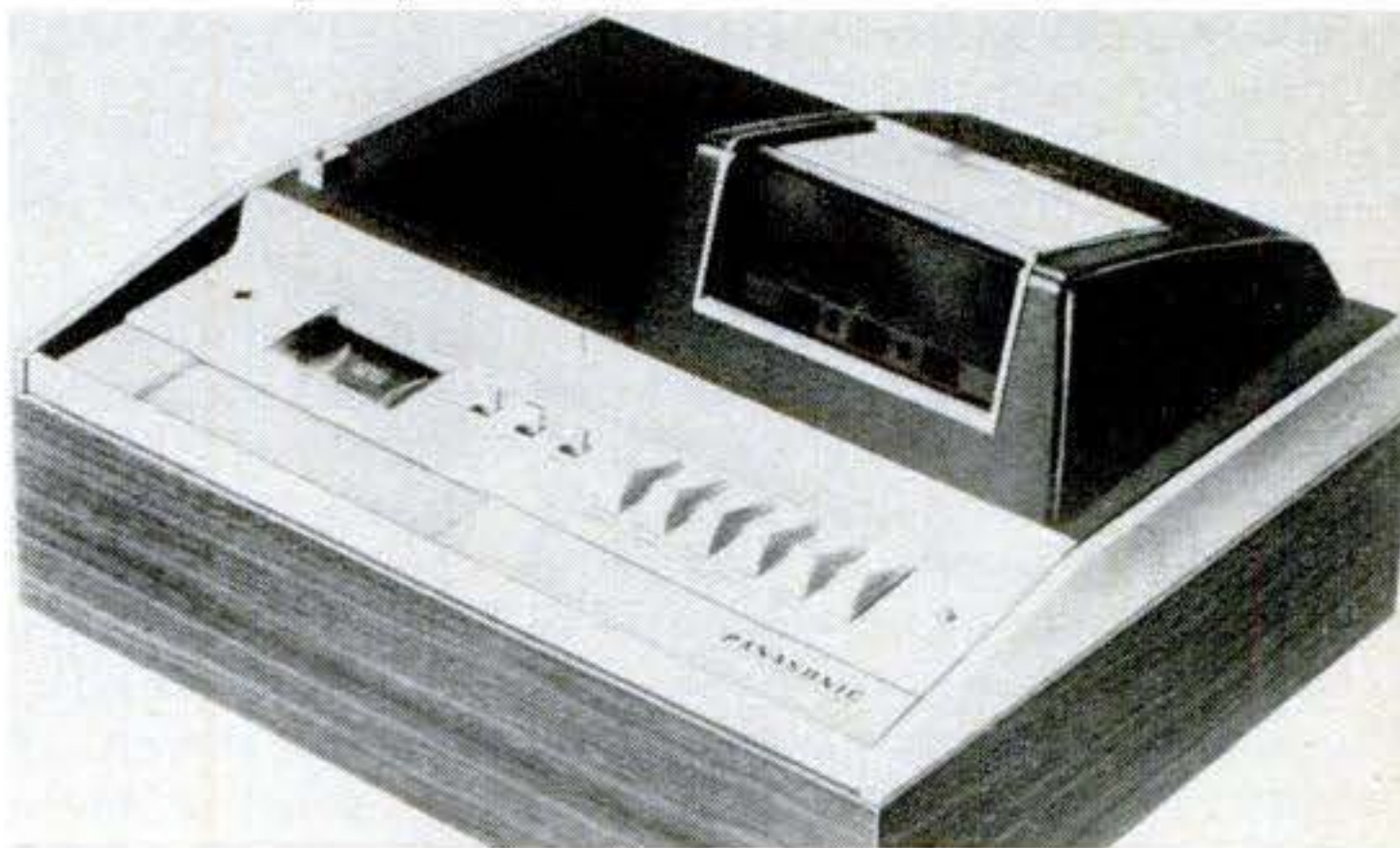
Among the non-Dolby decks we tried, we were particularly impressed by the low wow and flutter of the Wollensak Model 4700B, which made even long-held piano chords and organ tones sound solid and steady without a trace of waver. We also got excellent results from Harman-Kardon's CAD-4, which features a special warning light that flashes on whenever the signal gets strong enough to overload the tape.

Among the other decks providing very fine performance were the Concord F-106, the very similar Panasonic RS-156US, the Sony TC-125, the Allied Model 1125, and Lafayette's RK-510. Prices in this group range

[Continued on page 130]



New slide-tray technique for changing cassettes is found on Denon's Cassematic 12. A ratchet advances tray to the right.



This Panasonic Manchester model handles six cassettes, has two VU meters, and a switch for non-Dolby noise suppression.

Coming Up Fast

in the works that will have an automatic-reverse feature.

Norelco's design accepts up to six cassettes, one stacked on top of the other, in a cassette holder. (That's six hours of continuous play with C120 cassettes.) When the bottom cassette is completed, the cassette takeup reel stops and a small microswitch, which has been opening and closing periodically, closes.

This causes a multivibrator circuit to energize a switch, starting the change cycle. First, a hinged plate (1 in photo, left) holding the motor, capstan, play and rewind spindles swings down so the cassette can slide free. The play and erase heads (2) also move away from the cassette. Next, a small catch (3) in a groove beneath the cassette pops up. As a string slides the catch to the right,

the bottom cassette is pulled into a storage compartment. The next cassette drops down, a feeler contact senses its presence, and the hinged plate and heads move into place.

Cycle time? About 10 seconds. Heart of the changer mechanism is a large, toothed control gear—much like those in record changers. A synchronous motor drives the control gear and the play/rewind spindles.

Denon's changer permits easy access to cassettes. Twelve cassettes may be stacked vertically like books on the tray. They are lowered through a slot to make contact with the heads. The changer senses the end of play somewhat like the Norelco design, and the cassette is returned to the tray. A spring-loaded stepping switch then advances the tray to the next cassette. Denon's changer deck costs \$250; the Ampex, Panasonic, and Norelco units go for \$230.—John R. Free

The '71 TVs— Color 'Em Natural



Color TV screens have changed their shape from the round (19-inch-diagonal) tube below to the currently popular 23-inch diagonal (left), to the 25-inch rectangular tubes (above) in some top-of-the-line '71 models.

Look for new color-control circuits . . . pushbutton tuning . . . square-corner tubes

By RONALD M. BENREY

Your new 1971 color TV will show you a better picture than any you've seen until now. And it will probably need less service during its lifetime. It's all due to a group of 1971 innovative improvements in picture tubes, solid-state circuitry, UHF tuners, and even warranties.

To get the story on what's new, I surveyed the whole field, and talked to key engineering executives at four major color-TV manufacturers: Nathan Aaron of Zenith, Clyde Hoyt of RCA, Jerry Martin of Magnavox, Dick Kraft of Motorola. And I lived with an advance-model '71 color set for several weeks. So what's new?

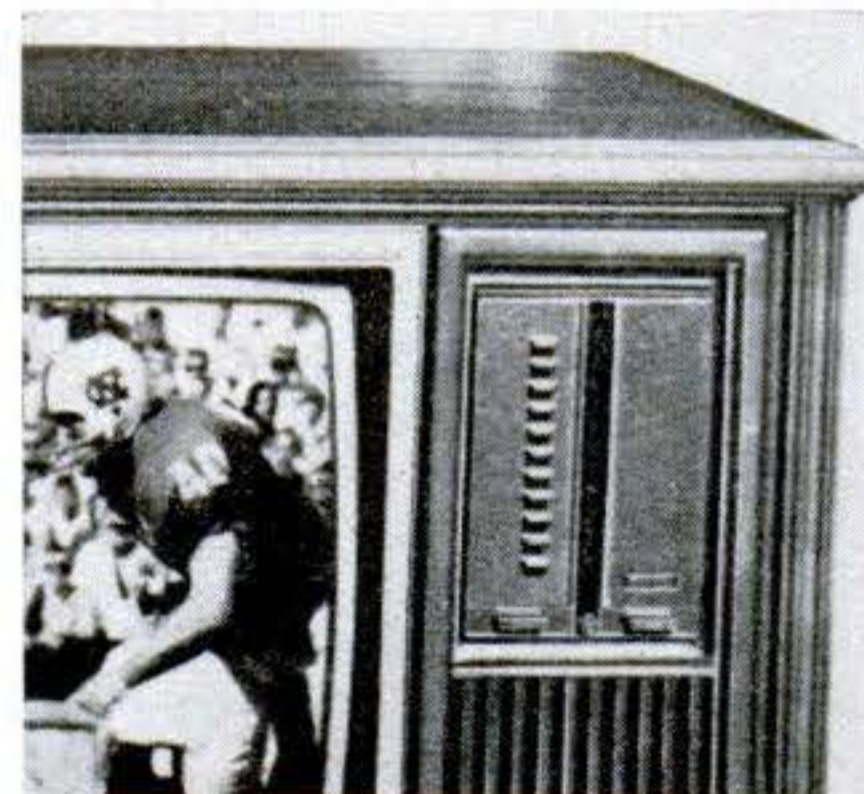
Picture tubes. The three new screen sizes offered by almost every American set maker—19-inch, 21-inch, and 25-inch—come to you in a brand-new screen *shape*. Corners are squared off more, the faceplate is flatter, and the "aspect ratio" (the ratio of horizontal to vertical measurements) is an ideal 4:3—like TV stations broadcast.

These minor changes make a big difference; for the 315-sq.-in. picture on the 25-inch test set seemed much bigger to my eye than the 295-sq.-in. image of my own 23-inch television set.

I agree with Magnavox's Martin: "Most viewers prefer the new screen shape because of its more modern look. It's like viewing a movie rather than watching a picture on the end of a light bulb."

Will the new tubes make conventional rectangular models obsolete? Apparently not for a while. Because of the substantially higher cost to the buyer of a model with the new tubes, there's bound to be a place for both new and conventional tubes in television sets.

More superbrights. Last year, RCA and Zenith introduced superbright picture tubes [PS, Oct. '69]. This



Pushbutton electronic tuning in Sylvania's color model lets you instantly tune one of 11 preselected channels from 2 to 83.

year, similar designs are available from nearly all manufacturers. They achieve brilliant pictures through the use of brighter phosphors, tighter control of the electron beams inside the tube, and the blackening of the blank areas surrounding the phosphor dots on the screen. This latter technique prevents reflected light from washing out the image and reducing picture contrast.

Specifying the superbright tube can add \$50 to the price of your new set. But after many hours of side-by-side viewing tests, I would say that the superbright tube is worth the investment. The colors you see are much more vivid, and screen whites are absolutely dazzling.

Shallow picture tubes. RCA has a new 18-inch solid-state portable that has a shallow picture tube: It's 4½ inches shallower than the conventional 18-inchers. Inside, the electron beams sweep back and forth across a wide 110-degree angle, rather than the usual 90 degrees. Thus, the tube's funnel can be steeper-sided and shorter than conventional tubes.

How about shallow big-screen

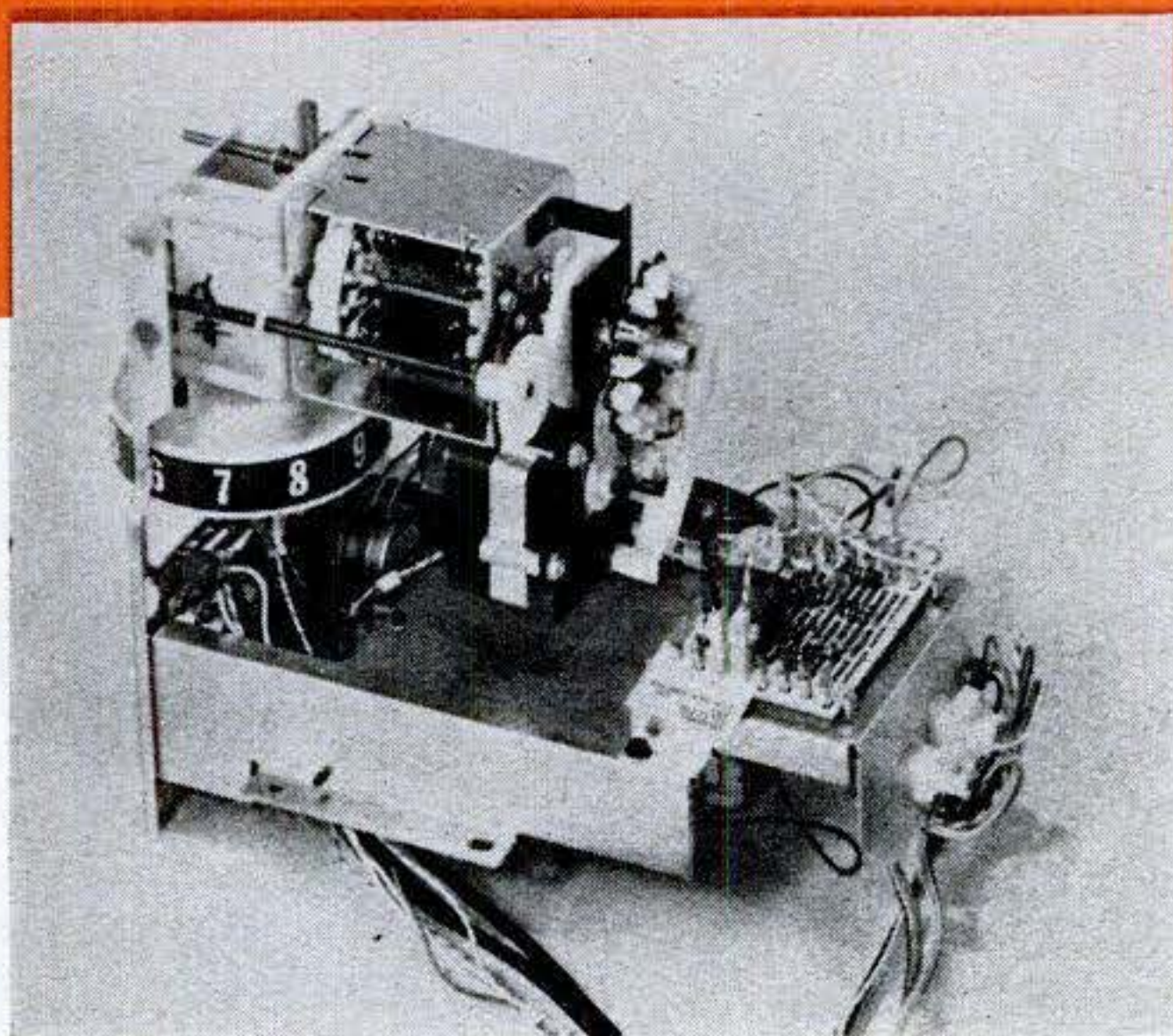
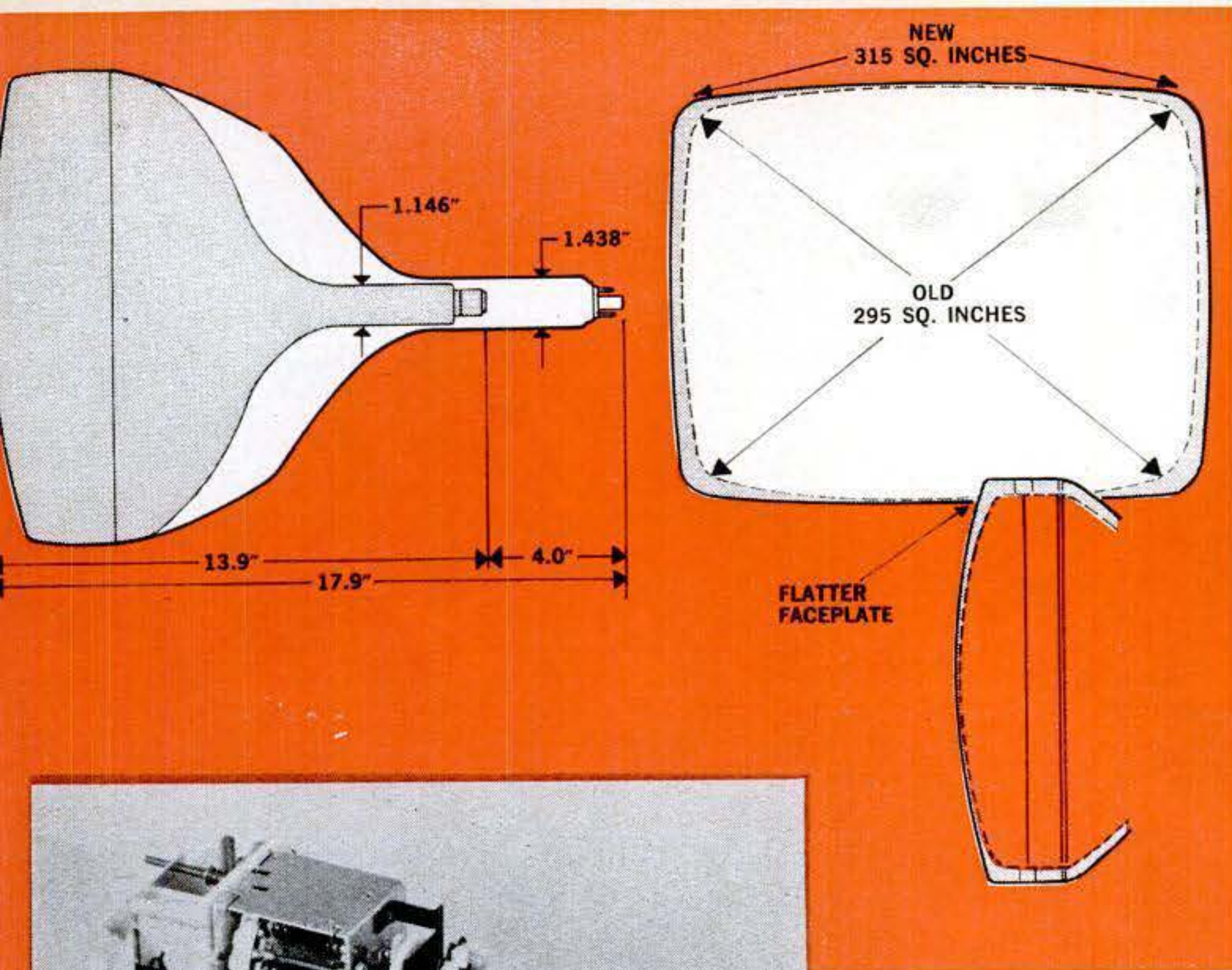
tubes? They should come along soon. "It's a matter of priority," says RCA's Clyde Hoyt.

Automatic color correction. Magnavox is back with the automatic tint-control circuit they introduced last year [PS, Sept. '69]. It keeps flesh tones accurate by assuming that any color on the screen that is close to flesh tone *must be* flesh tone, and it automatically turns it into a perfect flesh tone. The principle is that if the flesh tones are okay, the viewer will be happy.

Several other makers have adopted a simpler technique for '71. They have added a few components and an on/off switch that enables the viewer to slightly "desensitize" the color-decoding circuits. The effect is that most color-signal shifts away from correct flesh tones (usually caused by color-signal differences between different cameras and different TV stations) don't affect the picture you see.

Possible distortion? Both systems do tend to distort screen colors to some degree.

"As an engineer," says Aaron, "I have mixed emotions about the de-



Picture tubes in some 18-inch sets are four inches shorter (above, left). New square-corner tubes (right) are flatter and won't "lose" part of picture at edges.

Electronic tuning systems, like this four-varactor unit from Zenith, eliminate mechanical-contact wear.

vice. If perfect color signals are transmitted by the station, it can only hurt the color reproduction on the screen. But, if the signal isn't perfect, it can be a great convenience."

Possible color distortion is the price that you pay for not having to twiddle the tint-control knob each time you change channels.

Solid-state circuitry. For '71, five American makers (Motorola, RCA, Sylvania, Zenith, and Heathkit) and four Japanese firms (Sony, Panasonic, Hitachi, and Toshiba) offer all solid-state color TVs. The bandwagon started rolling by Motorola in 1968 has a lot of new passengers aboard.

"By 1973 there should be universal use of solid-state components in color TV sets," says Motorola's Kraft. The trend seems clear: All solid-state chassis are appearing as top-of-the-line models, while lower-cost sets use "hybrid" circuits (mixtures of tubes and transistors). "Because of costs," Martin points out, "hybrid chassis will be with us for a long time."

Why hybrid sets? The problem with the all solid-state chassis is the steep price of semiconductor compo-

nents that can handle the high power levels found in some stages. A practical solution is to use lower-cost tubes in these stages, and reserve transistors for the "small-signal" tasks in the chassis. That's how a hybrid chassis is born.

"Today's all solid-state chassis offer superior performance because they contain circuit extras. They're more elaborate than lower-cost hybrid and tube-type sets," says Hoyt.

The growing use of solid-state components in color TV has introduced a trio of exciting new gadgets. Two of these can be found this year in both hybrid and all-solid-state chassis from several manufacturers.

Integrated circuits. These are tiny chips of silicon—each about the size of this letter "o"—that contain a complete circuit of transistors, resistors, and diodes.

One point to keep in mind when you see the advertising: Because of the nature of ICs, construction of relatively simple circuit functions may require that an IC contain dozens of components. Thus, an IC that is touted as the "equivalent of 24 trans-

istors, 12 diodes, and 20 resistors" may do the same job as a one-tube conventional circuit.

Voltage multipliers. Here you have a device made up of an array of high-voltage diodes and capacitors, packed into a protective module, that simplifies the design of the high-voltage supply that powers the picture tube. It accepts relatively low-voltage pulses (six to 8,000 volts) and transforms them into a 25,000-volt DC output voltage.

The advantages: Less stringent requirements on other power-supply parts, since they work at lower voltages; and the elimination of two potential sources of X-ray radiation—the high-voltage rectifier and regulator tubes. Zenith, RCA, and Sylvania are using the device in some of their models.

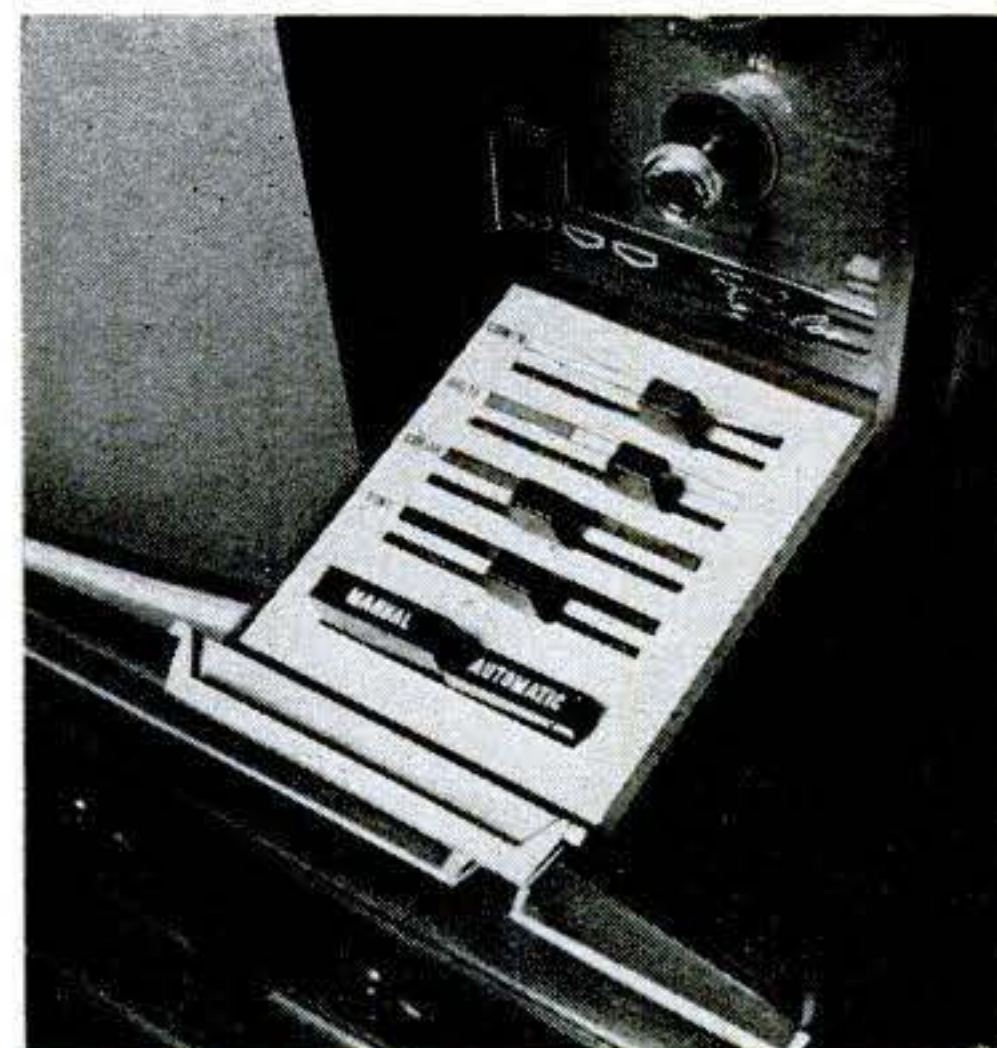
Ceramic modules. These were developed by RCA for their 18-inch solid-state portable (and are destined for use on other chassis). "They represent a technology in between integrated circuits and conventional chassis wiring," according to Hoyt.

Each module consists of a small piece of ceramic wafer upon which is deposited a network of thin-film "strips" that serve as interconnecting wires (and occasionally as resistors and capacitors). Other components—such as transistors and large-value capacitors—are mounted at appropriate points along the strips to create a circuit. Then the entire unit is encapsulated inside a protective coating. The advantages are lower cost and greater reliability.

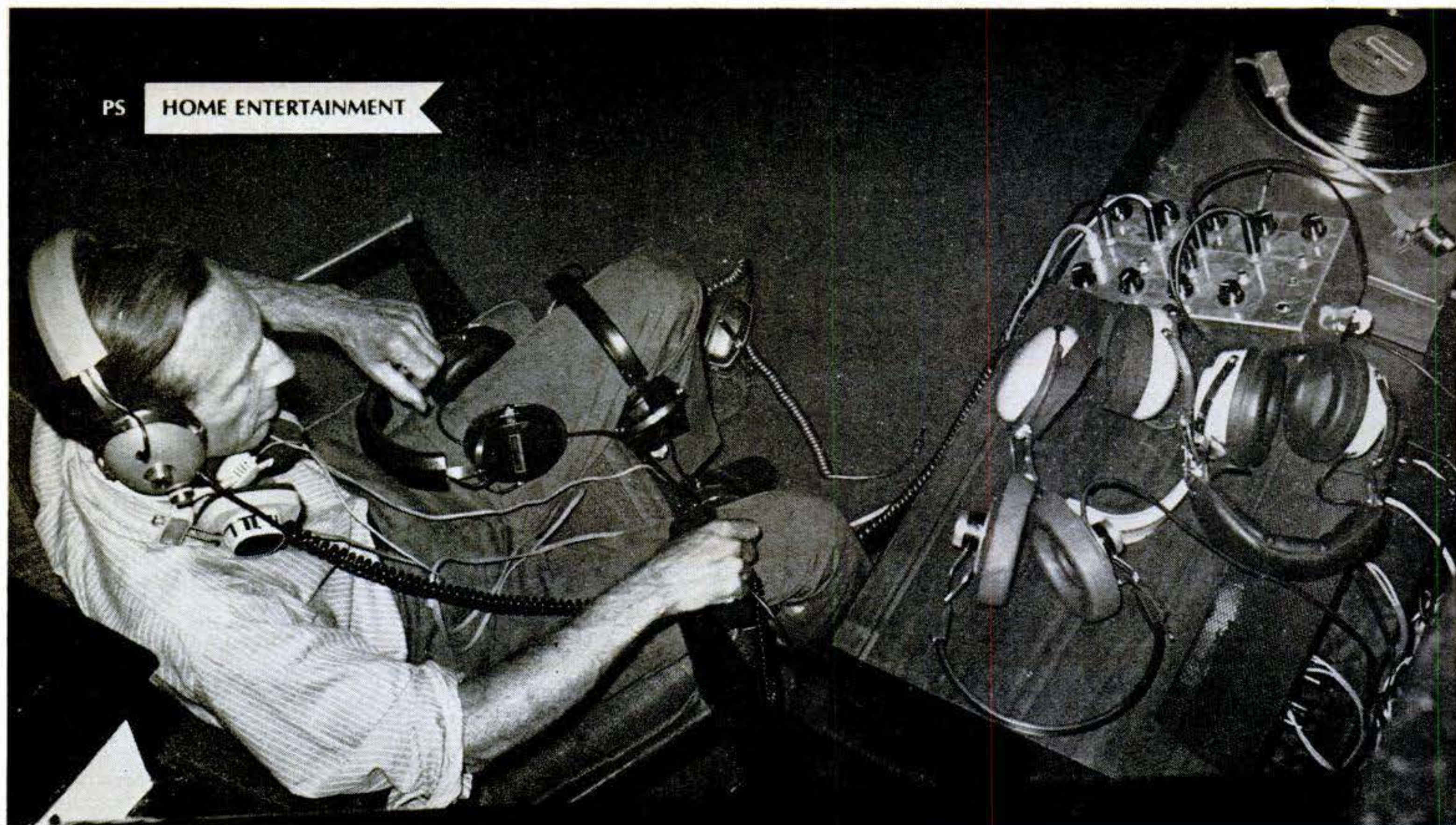
However, so far no company will stick out its neck and claim greater reliability for its solid-state chassis until it has really hard evidence to back up that claim.

If you read the advertisements carefully, you'll see that what they

[\[Continued on page 131\]](#)



Automatic color switch on this GE console model keeps flesh tones adjusted when cameras change or you switch channels. Many of '71 models have similar features.



To make quick comparisons among some 20 headphone sets tested for PS, the author built the 10-position outlet box that's shown above.

Join the Revolution in STEREO

Today's phones can outperform many speakers and put you in a noise-free world of superstereo acoustics

By R. S. LANIER

Stereo headphones are being bought more and more as new technology improves their fidelity. I have just spent more than a week listening carefully to about 20 models selected from the current crop. What I discovered was surprising: Some phones now equal the fidelity of the best loudspeakers—a few perhaps even top the speakers.

The most amazed man to hear this new level of quality in phones would be an old audio hand who just came back, say, from 15 years on the upper Amazon. When he left, phones were still generally scorned for entertainment purposes, as they had been since about 1924. That's when relatively inexpensive loudspeakers and the amplifiers to drive them began to appear. For some 35 years headphones were strictly functional, doing a job for aviators, telephone operators, radio hams, and military communicators, but not for people like you and me, listening for entertainment.

Shutting out noise pollution. Following the introduction of stereo records in 1958, phones started a comeback that now has put them in the audio glamor class. Defense against rapidly rising noise pollution is reason enough for buying a set of phones. Beethoven, for example, is likely to be on a collision course with the Rolling Stones in today's homes, where the variety and power of *wanted* sounds are out of hand, not to mention the proliferation of plain noise.

A lot of people have discovered that phones keep the sounds they want in and the sounds they don't want out. They provide undisturbed and undisturbing listening in close quarters or late at night.

Noise lowers fidelity. The phone user's intimate contact with the music and the sometimes strange superstereo acoustics that phones produce are listening experiences that have created a host of enthusiasts. The sharp reduction of interfering noise can, by itself, greatly improve the listening experience. Noise is more than an annoyance: It can reduce the effective frequency response of a sound system by masking very low and very high tones.

An important factor responsible for the growing popularity of phones is fidelity, the trueness of individual sounds. The industry is now acting widely on a long-known fact: High performance is more easily designed into phones than into speakers. Phones handle only a small fraction of the power speakers must put out to fill a room with sound. Phones are free of the many distortions and variations imposed on loudspeaker performance by room acoustics. Phones cover the whole range of tones, from lowest bass to highest treble, more easily than speakers do.

Phones versus speakers. Right here, though, a disclaimer is needed. Nothing in this article is intended to say, even indirectly, that speakers are through and that phones are the wave of the future. It seems obvious that we will always want speakers—and they too, as it happens, are better than ever. Phones simply fulfill a different set of needs and desires.

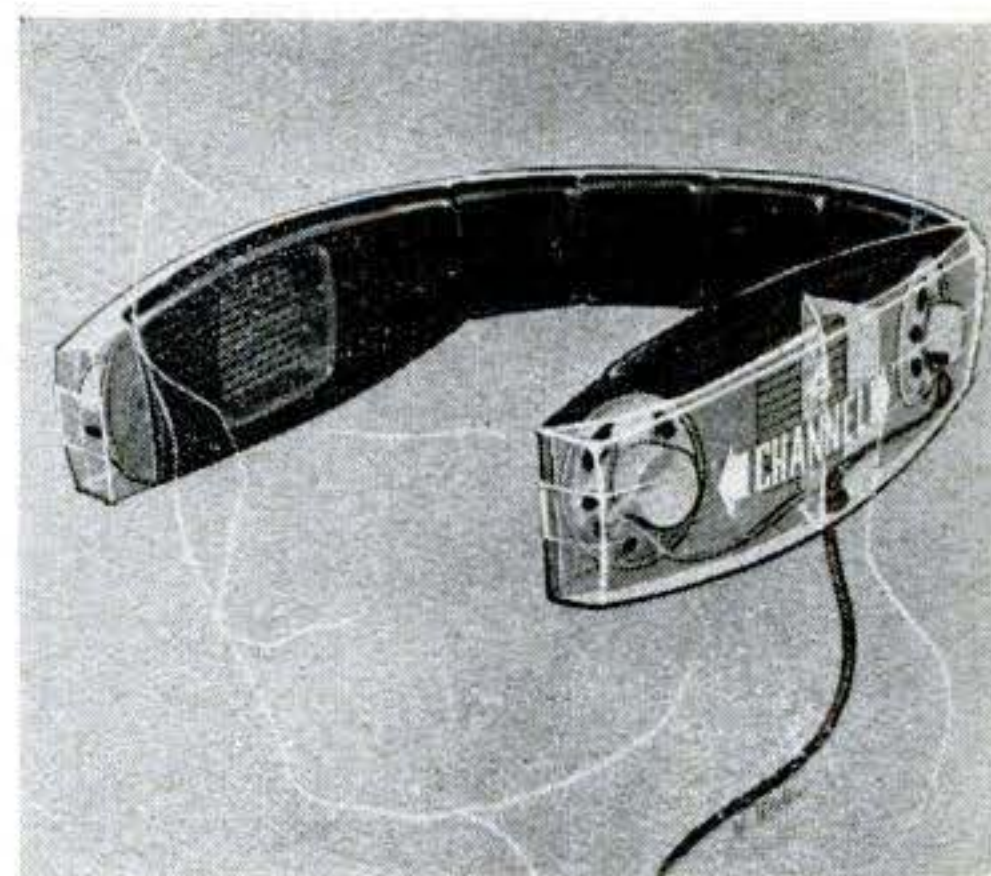
To make quick and reasonably valid comparisons among the phones, I built a 10-position outlet box. Each position has its own volume control so that all phones plugged into it can be brought to the same loudness level,



Sound-transparent sponge rubber makes these Fisher HP-100s more comfortable.

A separate high-voltage energizing unit comes with Koss ESP-9 electrostatic phones.

Four-Channel Headphones?



That's right—according to inventor Jon Fixler of Philadelphia, it's no Chinese-box trick. His patented scheme (production units are not available) ties headphones to the very latest in hi-fi trends. The dynamic sound transducers (two per ear) are separated by an angled double baffle at the center opening over the ear. Reports say it's possible to locate front and rear audio sources accurately. Audio buffs will undoubtedly await further development of four-channel headphones with real interest.

HEADPHONES

which is essential to make fair or reliable comparisons.

I listened to the same recorded passages on each set of phones. Included were a wide spectrum of loud and soft orchestra music and some high-quality voice material—very telling for distortion and frequency balance. In some cases I used a test record with warbled frequency tones to double-check my impressions from the music and voice material. I also noted the comparative comfort of each set of phones.

Here are highlights of the findings:

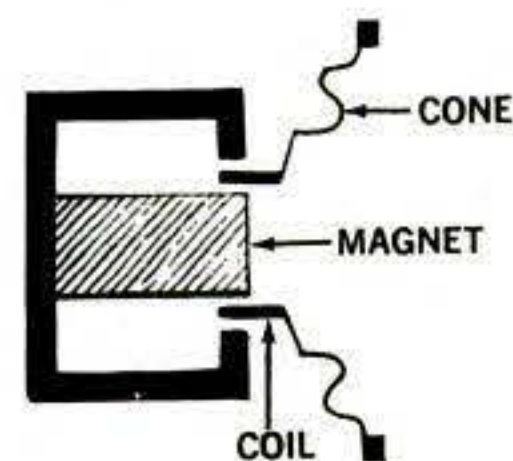
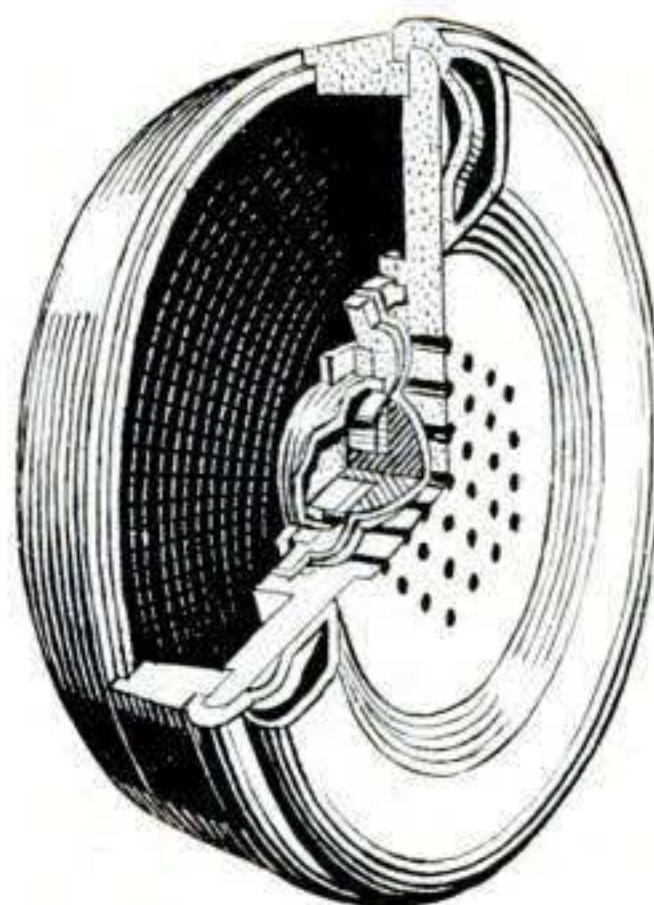
The new electrostatics. I listened to three brands of electrostatic headphones: Koss, Stanton (on the market next spring), and Stax. These phones use the same principle as electrostatic loudspeakers to transform electrical signals into acoustic (sound) signals. That principle is the attraction and repulsion between members carrying high electric voltages. (See description at right.) An electrostatic diaphragm can be extremely thin and light, and is pushed and pulled equally at every point on its surface. This produces extremely pure, extended highs. On the other hand, strong lows are hard to get in an electrostatic design because the diaphragm can't move far without hitting the back plate, which must be close for high efficiency. Another disadvantage: The electrostatic must have a high initial voltage across diaphragm and plate, a polarizing voltage which takes some extra electronics to produce.

Bass problem solved. The Koss ESP-9, the most elaborate and expensive model tested, did have great purity of sound throughout the tonal range, but was a bit low in the treble for my taste. Turning up the treble control on the amplifier *slightly* produced a balance I liked and overall sound of the best, superspeaker quality. The bass was solid, too, indicating that particular problem of

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

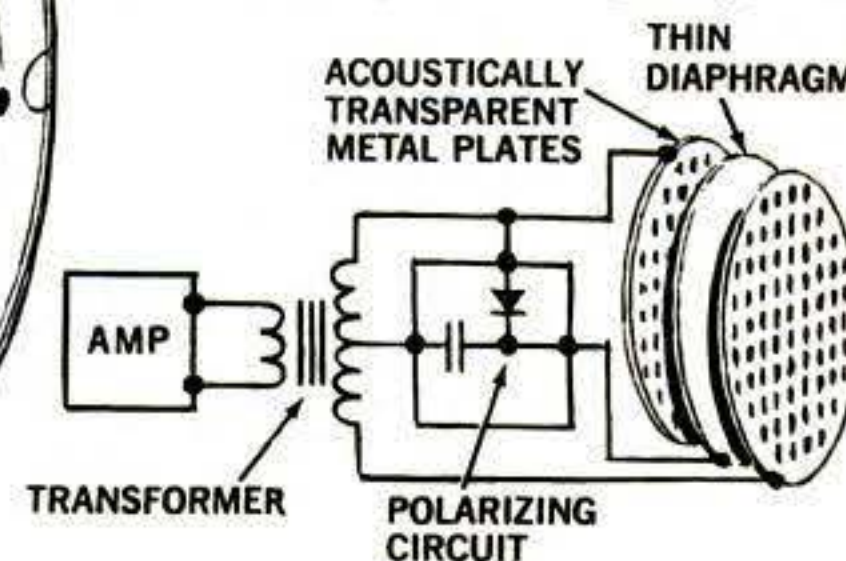
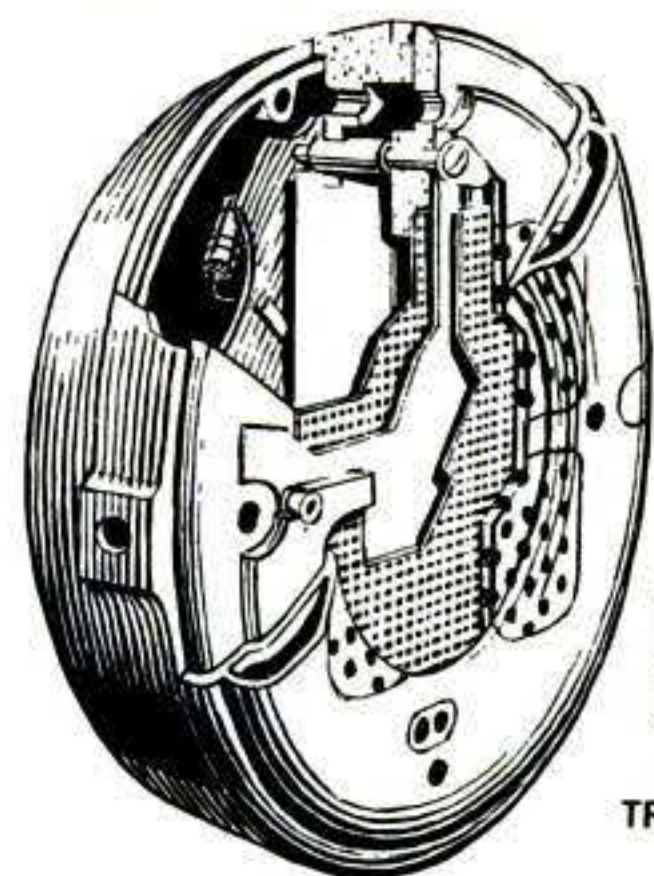
HOW DYNAMIC PHONES WORK

Most of the headphones on the market are the dynamic type. A miniature loudspeaker cone or diaphragm is fixed to one side of a voice coil wound with relatively heavy copper wire. The voice coil is suspended in a magnetic field produced by a permanent magnet. An audio signal current from an amplifier passes through the coil, generating a magnetic field. The opposing fields cause the movement of the coil, which also moves the diaphragm.

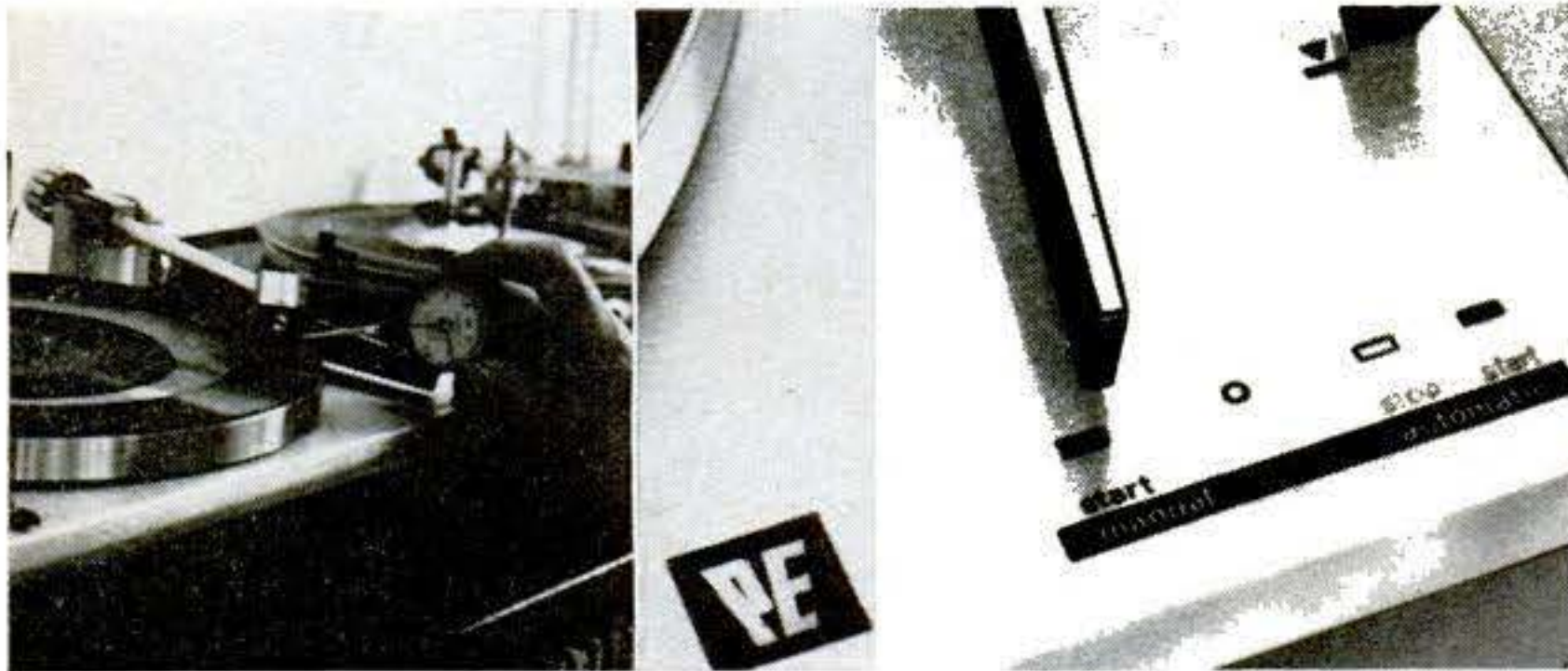


HOW ELECTROSTATIC PHONES WORK

Instead of a magnetic field, electrostatic phones use the high-voltage electrostatic field between two acoustically transparent metal plates. The moving diaphragm, an extremely thin membrane with a conductive coating, is attracted and repelled by the metal plates as the audio signal varies the high voltage between them. In Koss headphones, a three-volt audio input signal might be boosted to a harmless (low-current) 500 volts by the energizing circuit.



Try the New Generation of



Comparing stylus-pressure readings on built-in gauges with a calibrated gauge (left) is one of the tests that the author performed. At right, the PE 2040's one-lever control is checked.

Latest models offer smooth handling—plus the precision today's cartridges require

By R. S. LANIER

If you want your record playing *easy*, with a full complement of mechanical refinements and adjustments at your fingertips to accommodate today's super-delicate stereo pickups, try one of the newest top-grade automatic turntables.

I've just tested a batch of the available top-of-the-line machines and judged about six of them the finest record-turning units ever produced. They are pretty expensive, running from about \$130 to a cool \$225, without bases; but they do just about everything imaginable to take the kinks out of what is basically an awkward operation.

You can choose among these units on the basis of "feel" and the particular features you like. Several of the makers, including Dual, Garrard, PE,

and Miracord, also make models at lower prices. Judging from the "best" model in each line, I would say the others are worth investigating if you want to spend less money.

Automatic or manual. We are a long way from the days when there was *one* reasonably decent record changer: "Automatic turntable" and "record changer" are now synonymous. In those days changers were scorned by the audio buff, who wouldn't think of taking a record from its jacket without a "precision manual," or one-at-a-time, turntable to play it on.

That path to audio status is now totally a thing of the past: Fidelity belongs just as much to automatics as to manuals. Mechanically the new automatics are light-years from a machine I can recall: Its arm ground in from one side to grab the record in a pincer grip, then literally threw it onto a reject pile. After a few encounters with that arm, records were *permanent* rejects.

Changers, or automatic turntables, have, of course, been a lot better than that for some time. What's new is the extent to which the designers have incorporated mechanical refinements, and the number of top-level brands.

They had to improve. Part of the reason is that they *had* to get a lot better to handle today's vastly improved cartridges. Also, there's the intense competitiveness in the audio industry. And part just might be the demonstration of total convenience by tape-cassette manufacturers. The disc is still the major home entertainer in audio, but the cassette is within hollering distance, certain to keep disc-equipment makers on their toes.

Here is a rundown of the dazzling refinements on the new machines:

Motors. A smooth-running motor

that operates precisely on speed is essential for playing records at today's highest fidelity levels. The *induction* motor, used on several of the machines, has a strong starting torque for fast acceleration, but tends to slow down a bit with increasing loads. The *synchronous* motor, on the other hand, has an average speed tied precisely to the power frequency, but tends to bounce a bit around that speed, like a weight on a very tight spring.

In all the machines I checked, the motors, whether induction or synchronous, are of such high quality that smooth, on-speed drive is assured. One manufacturer, Garrard, uses a combination synchronous-induction motor.

Drive systems. A similar emphasis on quality exists with respect to the two main methods of coupling motors to turntables: the belt and the idler wheel. A belt can help isolate motor vibration from the turntable, but it may have a built-in tendency to "swing."

The rubber idler wheel, driven by the motor shaft and pressing against the inside of the turntable rim, is the simplest drive system and is used on practically every inexpensive turntable and automatic today. It can be crude indeed, but on the tables I checked using the idler-wheel system, it has obviously been greatly refined, as have the belt systems.

No audible distortion. The overall result of the refinement in motors and drive systems is that the tables play records without introducing audible flutter, wow, or rumble, the major distortions that a table can impose on music. Flutter and wow come from periodic changes in turntable speed, and must be smaller than about 1/10 of one percent to be inaudible under all conditions. Rumble is the low-

New PS Test Record

We've updated the Project-3 Popular Science Test Record [PS, Feb. '68]. We've added to the package a second, free, seven-inch blank (unrecorded) disc so you can adjust anti-skating controls as described in this article. The test bands on the main test record provide all you need to check out your hi-fi system. You can have both discs for only \$2.98. Send check or money order to: Stereo Test Record, Project 3, 1270 Ave. of the Americas, New York City 10020.

Automatic Turntables



Vertical-tracking-angle adjustment knob on the PE 2040 rotates to keep the angle constant in a stack of up to eight records.

An elapsed-time stylus-wear indicator, just to the left of the pushbutton console, is one of many features on the Miracord 770H.

Elaborate gimbal suspension system on the Dual 1219 is raised or lowered for best tracking angle on a single disc or stack.

pitched noise that comes from vibration, present in any machine with rotating parts. It, too, has been kept to very low levels.

Smooth record handling. Records are handled gently but very surely with comparatively foolproof "finger" systems, small projections that move in and out of the center spindle to release the records. Controls are much better than they used to be: easier to use and, generally speaking, jamproof—whether they are pushbuttons, piano keys, levers, or dials.

The trend toward several interlocking controls, which peaked several years ago, has declined. Pushing a single button, key, or lever now generally sets a machine off on a complete cycle. I liked especially the "feel" of using the Dual 1219, the Lesa PRF, PE 2040, and Garrard SL95B.

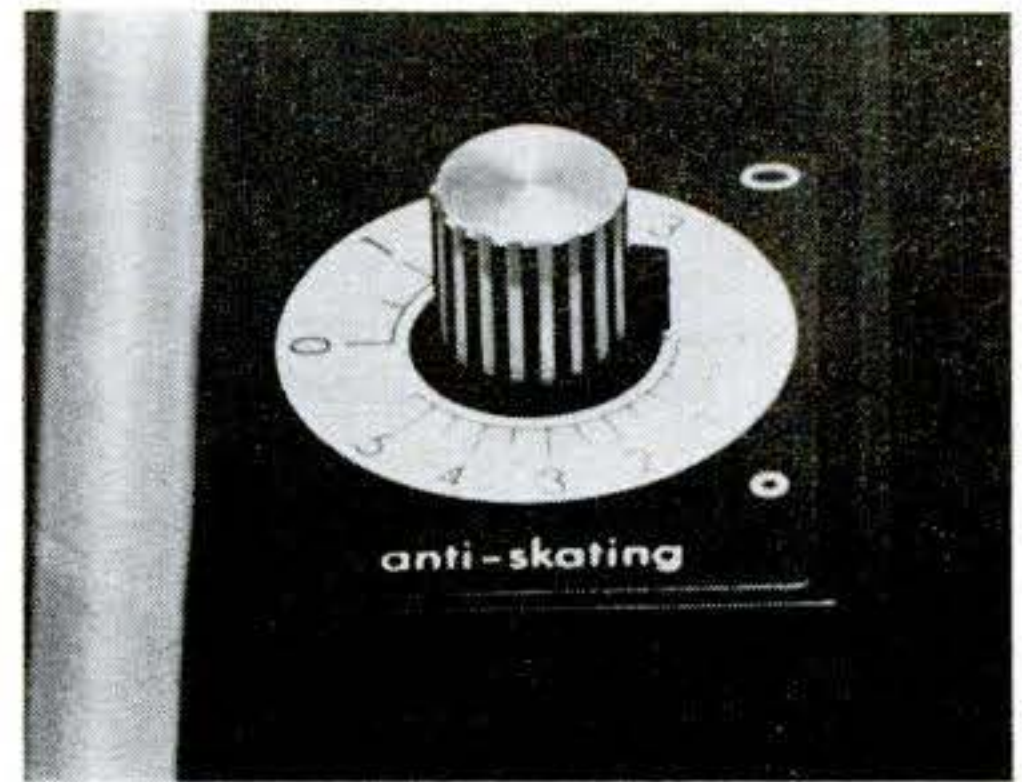
Easy shift to manual operation. In the early days of changers, it was tricky to play one record at a time. Since the serious music listener may frequently want to play a single rec-

ord, he shouldn't have to, for example, hold his hand over the table until the pickup drops into it, then move it to the lead groove, as preparation.

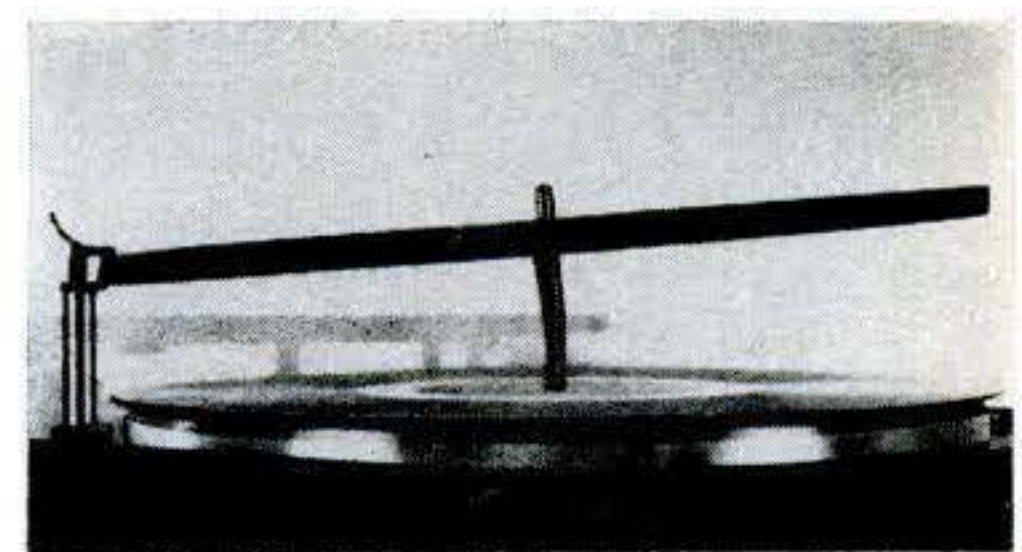
The machines I checked confirm that cumbersome manual operation is gone forever. Going manual generally means simply operating a control that says "manual." Several can be operated two ways: either with the arm completely free, so you put the stylus on the record by hand, or with the machine putting the stylus on the single record.

Cueing controls. This is another nearly universal feature I like. Pull a short lever projecting upward from the panel, and the pickup lifts up from the record. Push the lever back again, and the pickup drops as gently as a snowflake back to exactly where it was. Or you can slide the arm, with the cue control in the up position, over to another spot on the record and lower it there.

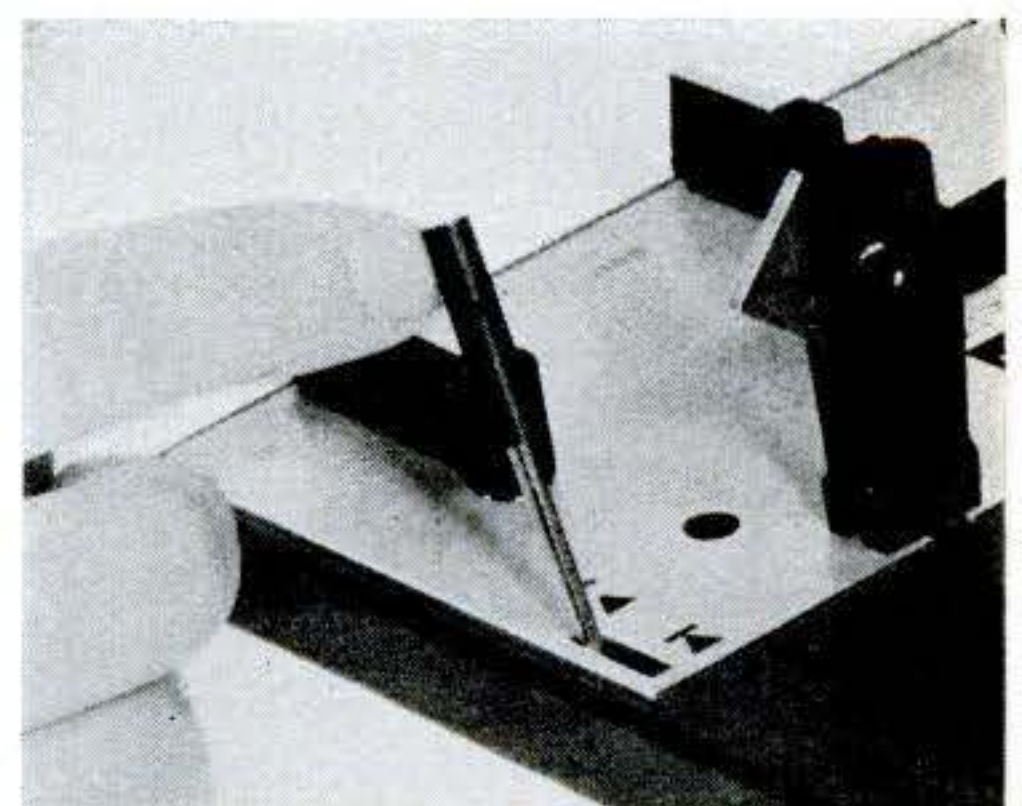
The cueing control gives you the [\[Continued on page 138\]](#)



Markings near the anti-skating dial on the Dual 1219 turntable identify different scales for styli with elliptical and conical shapes.



Two-point record support is featured on Garrard's top-line models. Most changers use a removable inverted-umbrella spindle.



Cueing controls, standard on top-line changers, let you raise and lower tone arm without touching it. This is Dual's 1219.

TOP-OF-THE-LINE AUTOMATIC CHANGERS

	SPEEDS	FINE-SPEED ADJ.	CALIBRATED TRACKING-FORCE ADJ.	ANTISKATE ADJ.	DRIVE	CALIBRATED VERTICAL-ANGLE ADJ.	CUE LEVER	STROBE ON PLATTER	MOTOR	PRICE (less base and pickup)
Dual 1219	33, 45, 78	✓	✓	✓	Idler		✓		Synch.	\$175.00
Garrard SL95	33, 45, 78		✓	✓	Idler		✓		Synch-Induct.	\$129.50
PE 2040	33, 45, 78	✓	✓	✓	Idler	✓	✓		Induction	\$145.00
Pioneer PL-A25	33, 45		✓		Belt		✓		Two Motors	\$129.95
Lesa PRF-6	33, 45, 78	✓	✓	✓	Idler		✓	✓	Induction	\$179.95
Miracord 770H	33, 45	✓	✓	✓	Idler	✓	✓	✓	Hys. Synch.	\$225.00
Sherwood SEL-100	33, 45		✓	✓	Belt		✓		(Two) Induct.	*\$149.50
VM 1555	33, 45		✓	✓	Belt		✓		(Two) Induct.	*\$220.00

*(with base and pickup)

PERSONAL-USE REPORTS:

Four-Channel System You Can Buy

It's been only about a year since the hi-fi industry began talking seriously about four-channel stereo. But you can already buy a quadriphonic system that's about as easy to use as a regular stereo rig.

Wollensak's Model 6154 quad-playback/stereo-record deck is exactly the same size as their two-channel Model 6150. And the Scott 499 four-by-35-watt amplifier is about as big as an old, tube-type stereo receiver. The quad deck costs \$500 and the amplifier is \$600.

The tape-motion controls were a favorite feature on the Wollensak—they're the best I've ever used on any machine without all-relay pushbutton operation. I especially liked the pause control, built into the start button—you can't forget to unlock it, because it releases when you push the start button again.

All connections except those for microphone and headphone are recessed into one side of the 6154. These include outputs for all four channels and two pairs of inputs for the front two channels. One pair of these in-



Two speaker pairs used with this amplifier and tape deck give a quadriphonic setup.

puts is for the normal connections to your stereo system; it disconnects automatically when you plug in the mikes. The other pair, labeled "Mixing Inputs," is live all the time, so you can use the inputs to record voice over music, to do sound-on-sound, to add echo, or to create other effects.

Performance was good at all three speeds, though response was naturally limited at $1\frac{7}{8}$ ips.

Four separate amplifiers. The Scott 499 amplifier, aside from its four VU meters, also looks rather conventional. Most of its controls are just what you'd expect on a standard stereo amp. But there are *two* input selectors, *four* front-panel mike inputs, and *four* controls for bass and treble. There's an extra balance control for front/rear. And the mode switch has two mono and two stereo positions, plus one for "quadrant" sound.

The controls basically define the amplifier: In the quadrant mode, you can play four-channel music in one



All the controls you need to balance four speakers are on Scott's new 499 amplifier.

room (from any input) or separate two-channel programs in two different rooms (though with some crosstalk). In the other modes, you can play two-channel stereo or monophonic sound from either the front or back input pairs through two or four speakers.

The VU meters are more of a help than I had expected in balancing the four channels, though not in watching record levels. (The output to the meters comes after the volume control, while the tape output comes before it.) I would have liked the meters switchable for both uses.

Sound was good, and the 499's 35 watts per channel was sufficient to drive my speakers (AR-3as in front, AR-2ax speakers in back) comfortably. Vanguard Records (71 West 23 St., New York, N.Y. 10011) sells four-channel tapes for \$15, and Project 3 (1270 Ave. of the Americas, New York, N.Y. 10020) has tapes at a similar price.—Ivan Berger

Tape Deck with Built-In Dolby



Using part of a professional noise-reducer circuit, the KLH 41 sharply lowers tape hiss.

About two or three years ago, the Dolby noise-reduction process created a small revolution in professional recording. Its effect—the reduction of noise in recording and dubbing—was large. Its price—\$2,000 per two-channel stereo unit—was, by professional standards, reasonably small. Now a modified version of the Dolby system is available for home use. And the first consumer product with a Dolby circuit, the KLH 41 tape deck, costs only \$230.

The home-modified noise-reduction circuit featured in the KLH reduces only high-frequency noise (tape hiss) instead of attacking noise of all frequencies as the professional units do. But hiss is the biggest noise problem in home tape recording, especially at the lower speeds.

With the KLH 41, this problem is solved so well that you can use $3\frac{3}{4}$ inches per second as your "normal" speed for high-fidelity recording, and make really usable background-music

and speech tapes at $1\frac{7}{8}$ ips. The $3\frac{3}{4}$ speed can halve your tape costs and double tape playing time if you now use $7\frac{1}{2}$ ips.

To get these advantages, though, the Dolby system must be used in both record and playback. Dolby-recorded tapes played on conventional machines will sound shrill, and conventional tapes will lack high frequencies when played through the Dolby circuit. But a switch on the KLH lets you play non-Dolbyized prerecorded tapes conventionally and record tapes without the Dolby process to play on other machines.

There's an interlock built into the tape transport control that prevents your breaking tape by going directly into play mode from fast forward or rewind. And a control on the back lets you match the KLH's output level to that of all your other sound sources. But most important is that switch marked "Dolby System." It works.—Ivan Berger

Stylus Timer Saves Your Records

Elapsed-time meter can warn you of stylus wear through a "sample" of the hi-fi cartridge output

By THOMAS R. SEAR

How long have you been using the stylus in your hi-fi cartridge? If you've exceeded the recommended playing time, a worn stylus tip may be scrap-

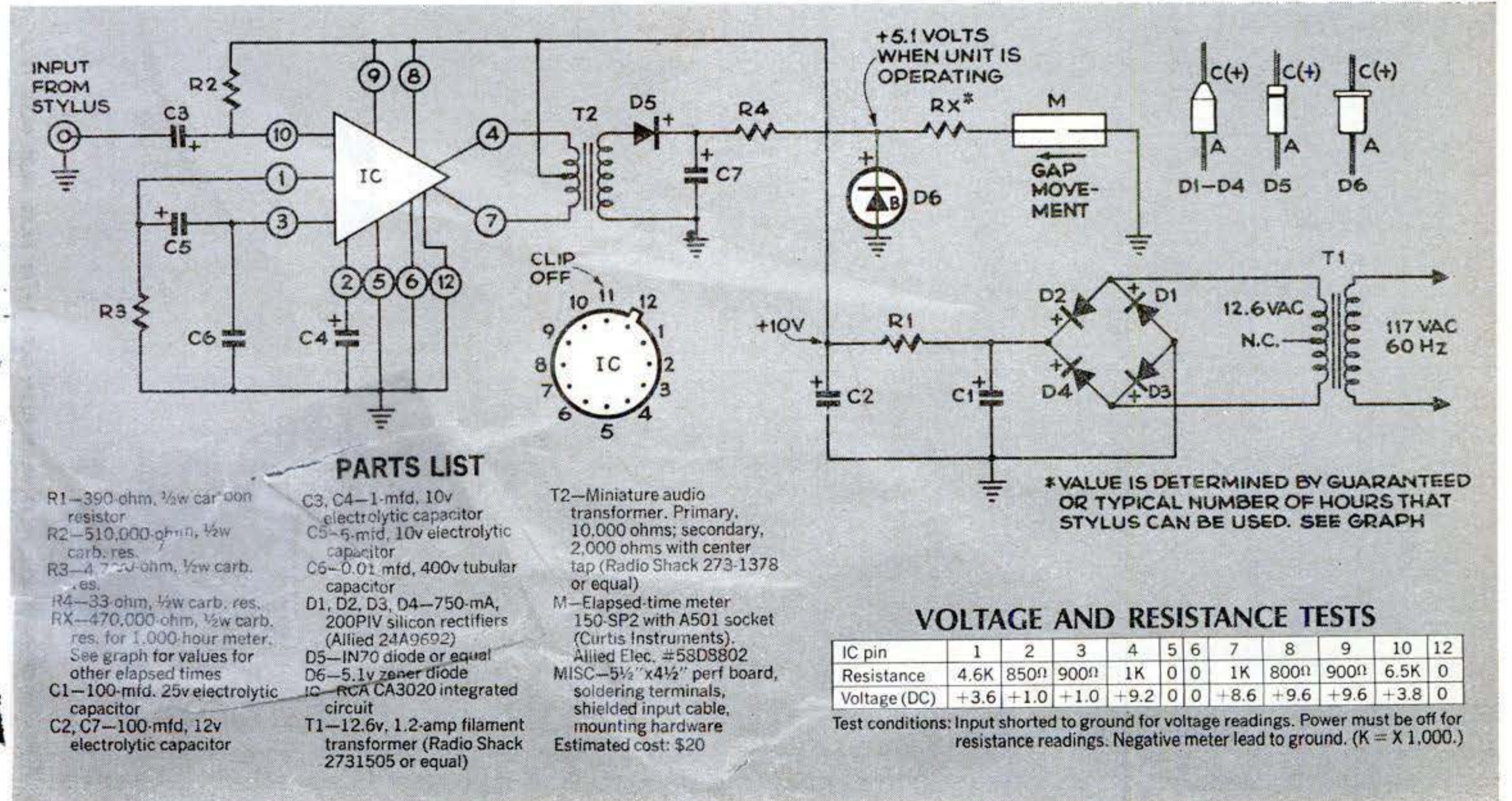
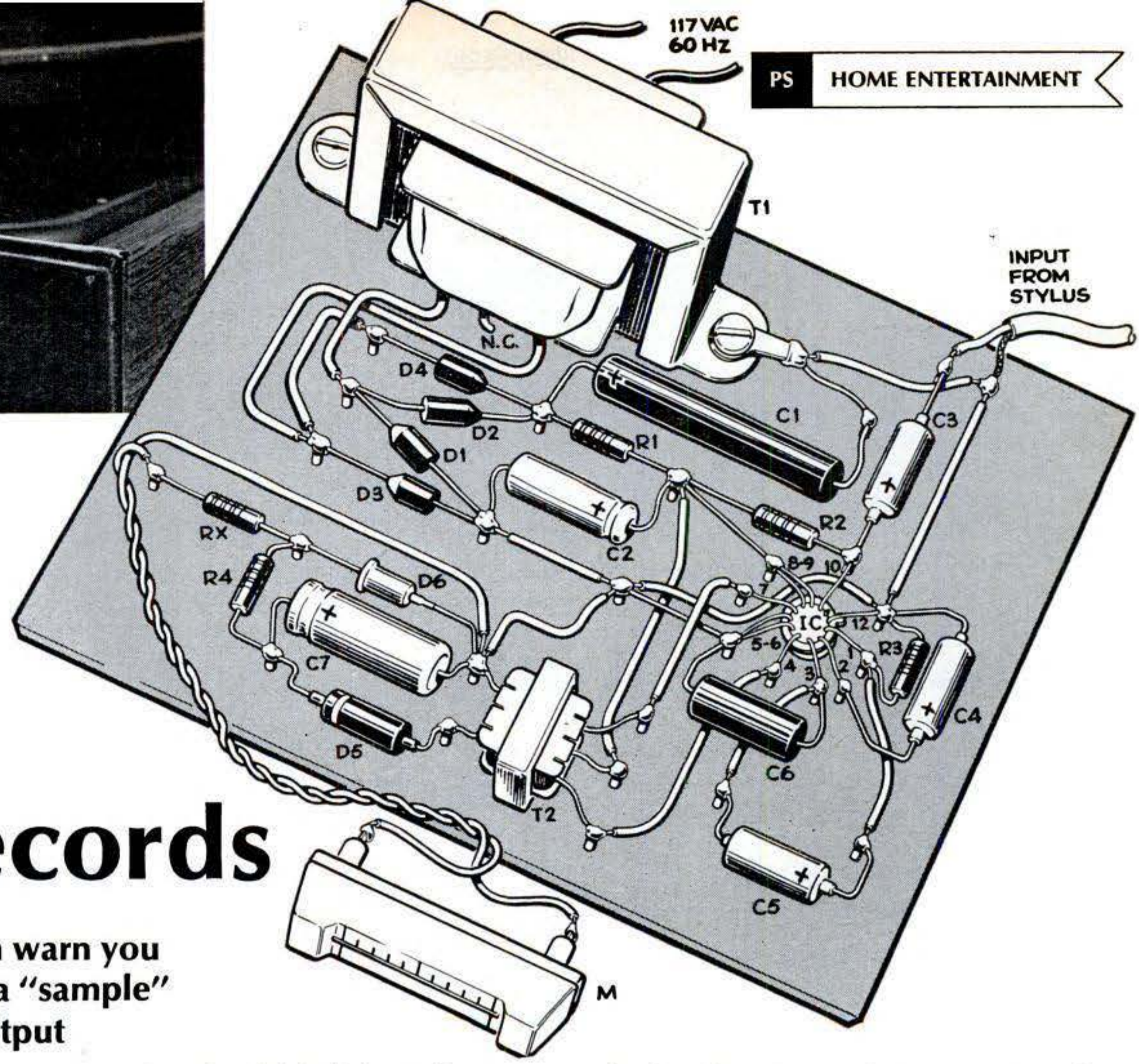
ing the "highs" from the grooves of your valuable records.

Here's an electronic timer that monitors the output of a cartridge. Like the units on the newest, high-priced automatic turntables, it lets you know how long the stylus has been used. When the recommended stylus-play-

ing time approaches, you can replace it or check its condition.

The stylus timer "samples" the output from your cartridge (one channel, if it's stereo) without loading the signal and affecting the sound. The cartridge signal is amplified and used to

[Continued on page 126]



PARTS LIST

- R1—390-ohm, 1/2w carb. res.
- R2—510,000-ohm, 1/2w carb. res.
- R3—4,700-ohm, 1/2w carb. res.
- R4—33-ohm, 1/2w carb. res.
- RX—470,000-ohm, 1/2w carb. res. for 1,000-hour meter. See graph for values for other elapsed times
- C1—100-mfd. 25v electrolytic capacitor
- C2, C7—100-mfd, 12v electrolytic capacitor
- C3, C4—1-mfd, 10v electrolytic capacitor
- C5—5-mfd, 10v electrolytic capacitor
- C6—0.01 mfd, 400v tubular capacitor
- D1, D2, D3, D4—750-mA, 200PIV silicon rectifiers (Allied 24A9692)
- D5—IN70 diode or equal
- D6—5.1v zener diode
- IC—RCA CA3020 integrated circuit
- T1—12.6v, 1.2-amp filament transformer (Radio Shack 2731505 or equal)

- T2—Miniature audio transformer. Primary, 10,000 ohms; secondary, 2,000 ohms with center tap (Radio Shack 273-1378 or equal)
 - M—Elapsed-time meter 150-SP2 with A501 socket (Curtis Instruments), Allied Elec. #58D8802
 - MISC—5 1/2" x 4 1/2" perf board, soldering terminals, shielded input cable, mounting hardware
- Estimated cost: \$20

*VALUE IS DETERMINED BY GUARANTEED OR TYPICAL NUMBER OF HOURS THAT STYLUS CAN BE USED. SEE GRAPH

VOLTAGE AND RESISTANCE TESTS

IC pin	1	2	3	4	5	6	7	8	9	10	12
Resistance	4.6K	850Ω	900Ω	1K	0	0	1K	800Ω	900Ω	6.5K	0
Voltage (DC)	+3.6	+1.0	+1.0	+9.2	0	0	+8.6	+9.6	+9.6	+3.8	0

Test conditions: Input shorted to ground for voltage readings. Power must be off for resistance readings. Negative meter lead to ground. (K = X 1,000.)



Imperial with Sure-Brake stops in straight line (left), 40 percent shorter than Imperial without Sure-Brake (right), which slowed

4-Wheel Antilock Brakes Give You Sure Stops on

Chrysler's Sure-Brake cuts stopping distances, keeps the car straight on slippery roads

By JIM DUNNE / PS Detroit Editor

When you buy one of those ultra-safe new cars they'll be building five years from now, you can bet on one thing: It will have an antiskid braking system that works on all four wheels.

Chrysler Corporation took a big step toward that day when it built the 1971 Imperial with its optional Sure-

Brake, the first four-wheel antiskid system built on a U.S. production car.

Other car makers will be watching Chrysler's Sure-Brake experience closely while they rush their own versions through development stages. Meanwhile, drivers of the new Imperials equipped with Sure-Brake will benefit from all these advantages that go with the computer-controlled braking system:

- Firm, steady stops—even when driving on glare ice
- Up to 40 percent shorter stopping distances (on slippery surfaces)
- End of wheel lockup
- Vastly improved stability and

control of a car during panic stops.

Sure-Brake was developed by Chrysler in cooperation with Bendix Corporation. The system has three main parts: an electronic control box, a speed sensor in each wheel, and brake-pressure modulators. When a driver hits the brakes hard enough to lock the car wheels, these parts act to keep the wheels turning with optimum braking pressure. And when the wheels keep turning, the car stays under control.

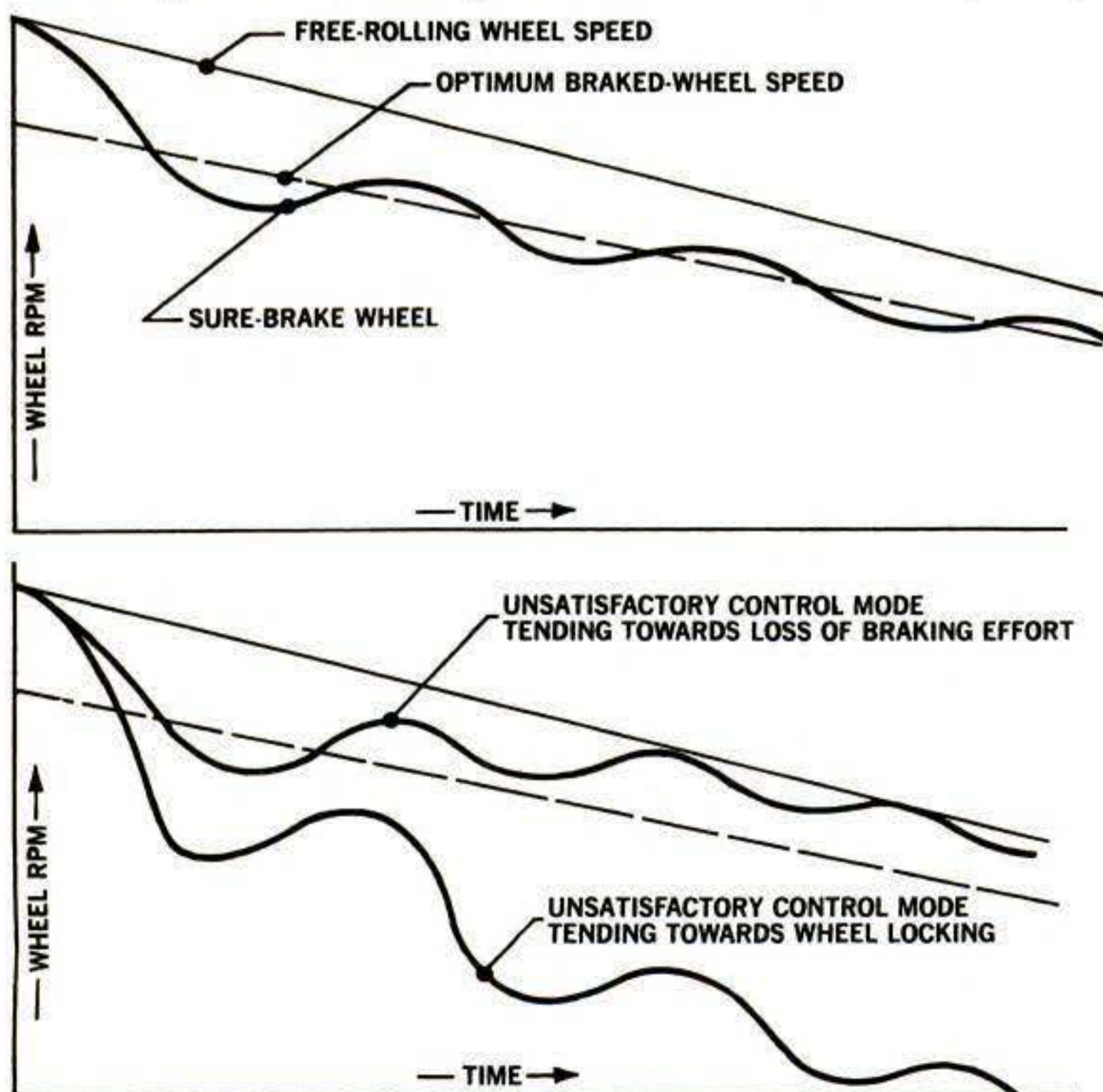
Here's how each of the parts works:

Sure-Brake's brain. This is an electronic computer that monitors the speed of each wheel, signals the mod-

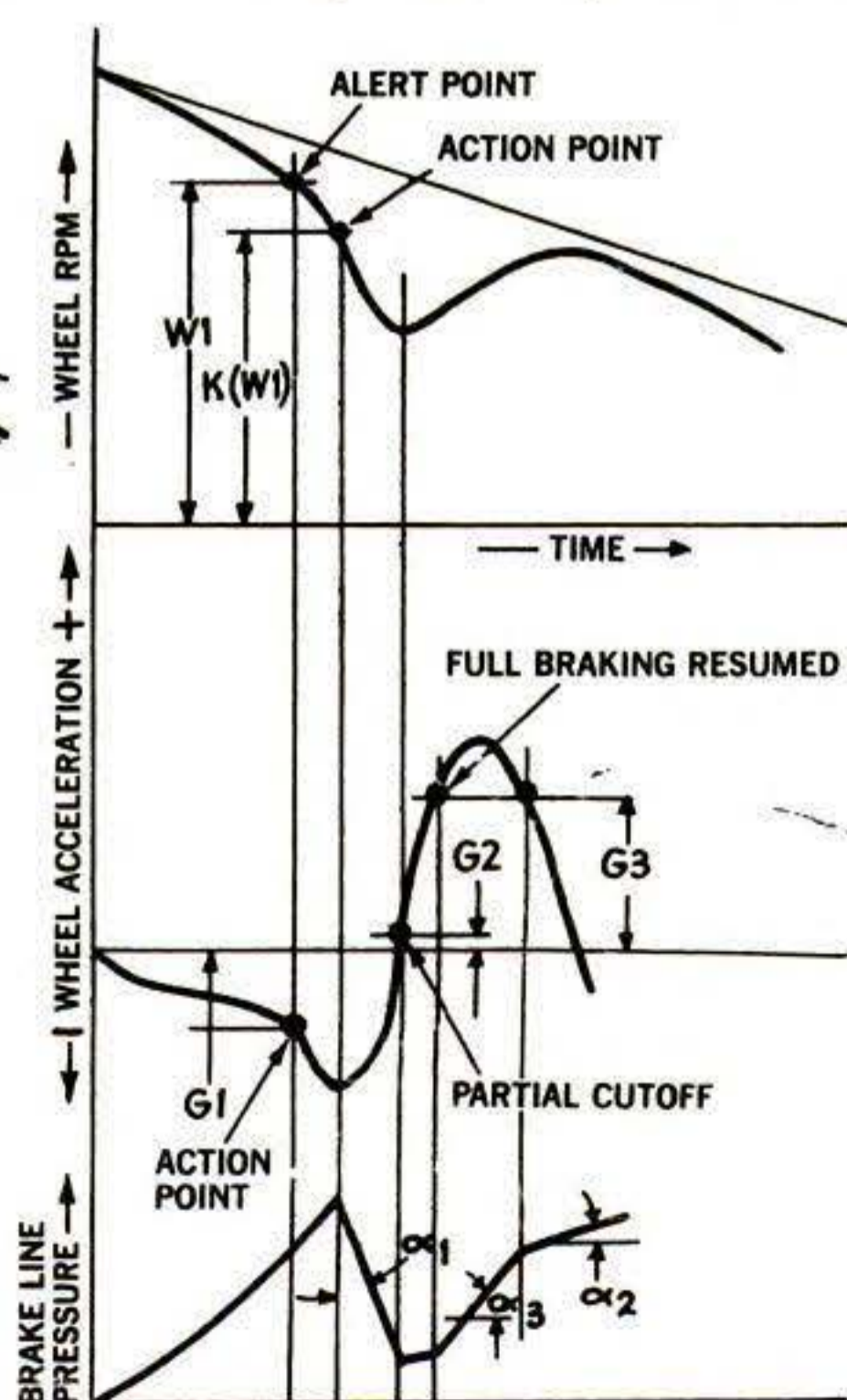
ulators to start working, and keeps check on all parts of the system to make sure they are in working condition. Its logic system is made up of solid-state components that together take up about as much room as a cigar box. Chrysler's unit is stored under the hood.

Modulators regulate the brake line pressure, and operate between the master cylinder and the wheels. Chrysler's A. L. Turner, who is manager of Sure-Brake, describes the modulators as essentially "a power-brake cylinder in reverse."

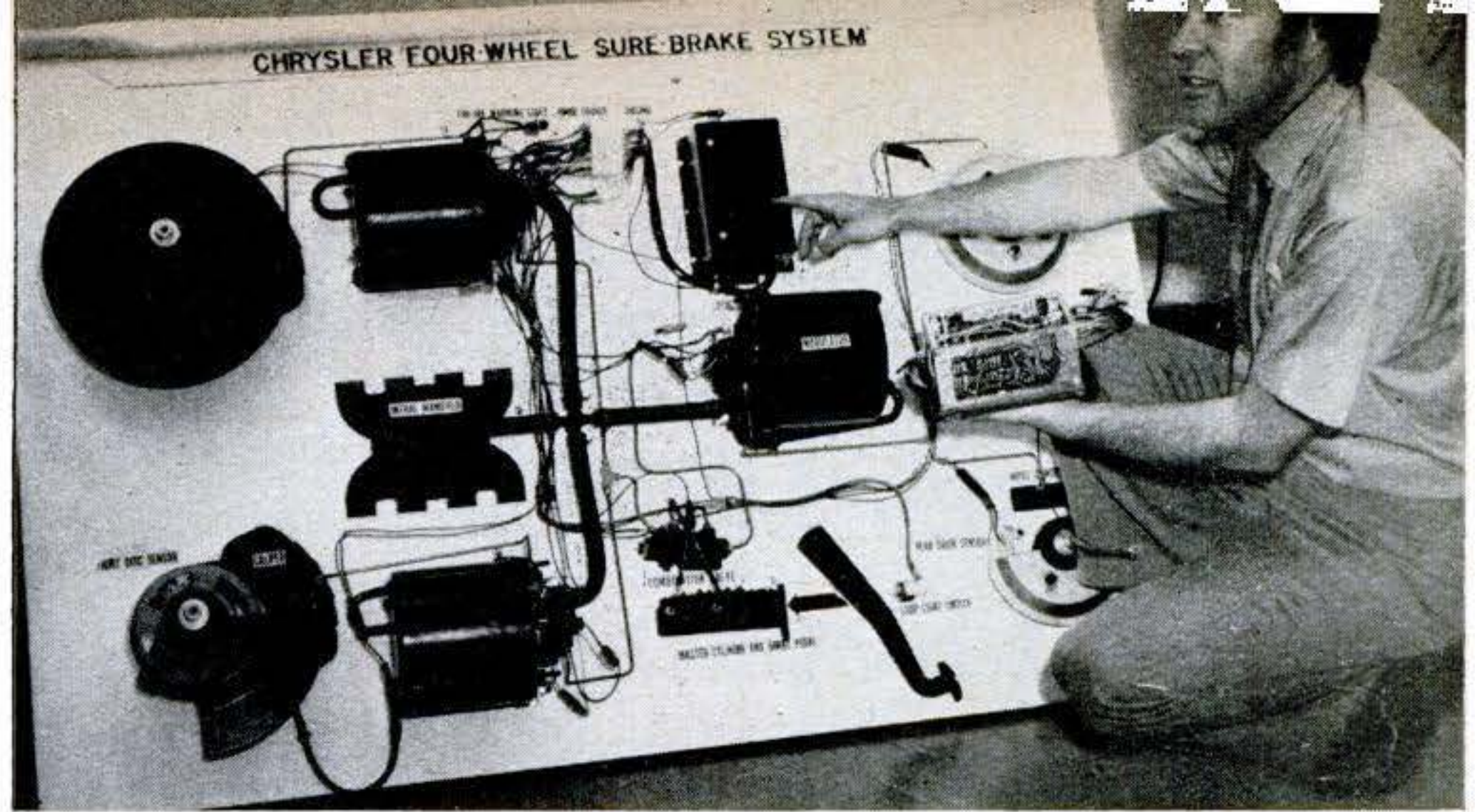
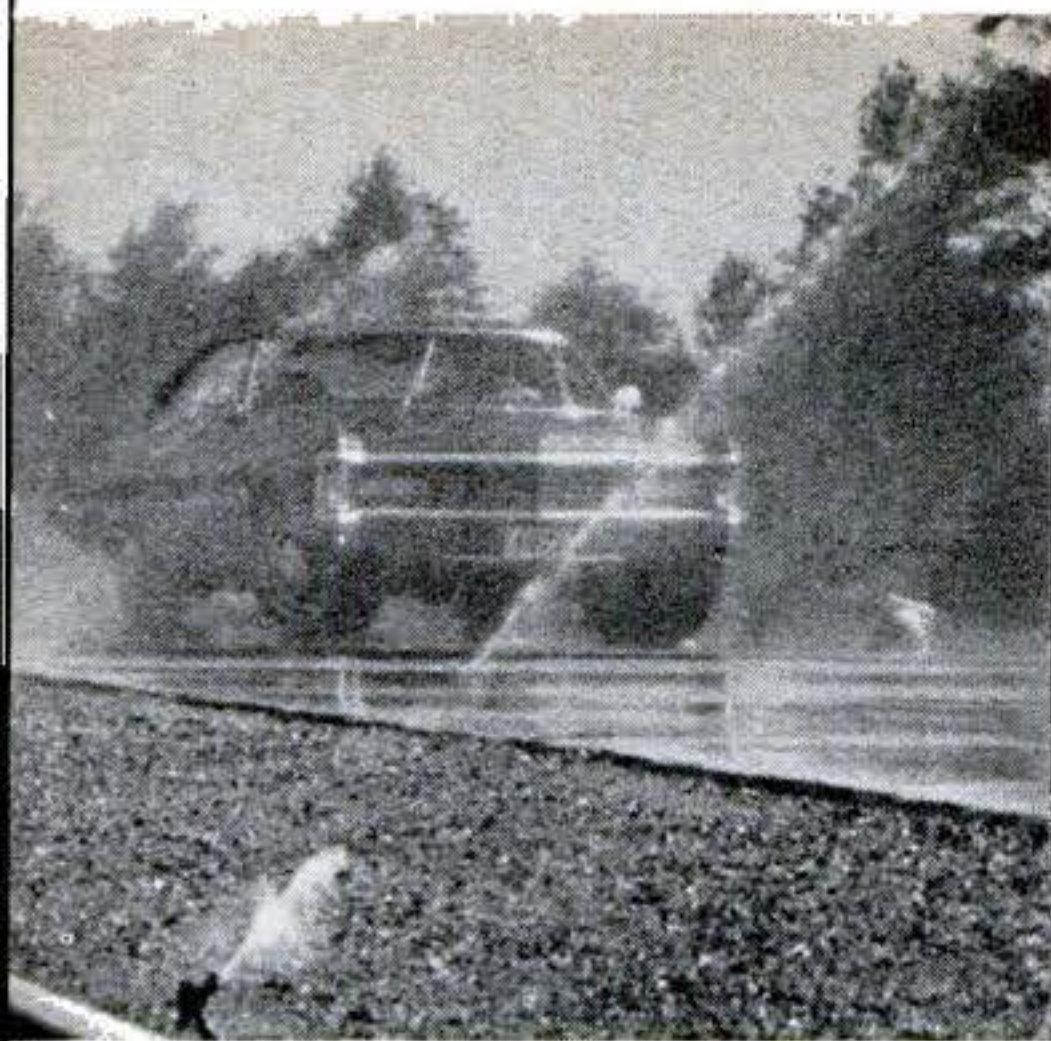
"They pull on the hydraulic system instead of pushing," Turner explains. "The



Best braking is obtained with 15 percent slip (top). Less slip, or more, can lock wheels or lead to loss of braking effect.



During one cycle: wheel speed (top), acceleration (center), and line pressure.



to a stop after knocking down pylons.

Chrysler's Al Turner points to the computer and holds another with its cover off.

Glare Ice

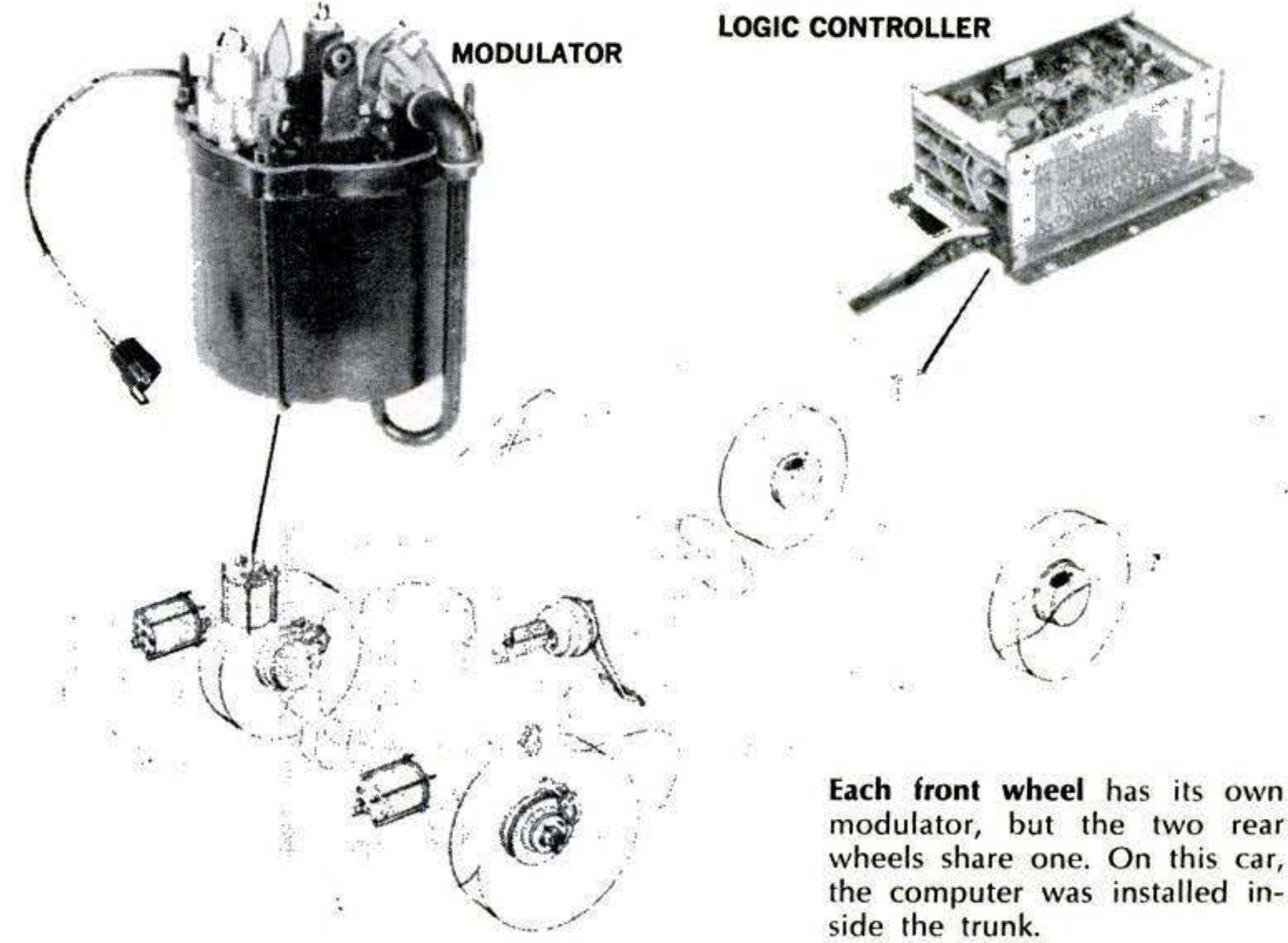
modulator can is a vacuum canister that operates cutoff and relief valves to stop the pressure going to the wheel cylinders."

The modulators mimic the action of an expert driver pumping the brakes to keep the wheels from locking up—only better. They apply the brakes up to six times per second. Each modulator weighs about 16 pounds. There are three in all, one each for the front wheels, and one serving both rear wheels, all located under the hood.

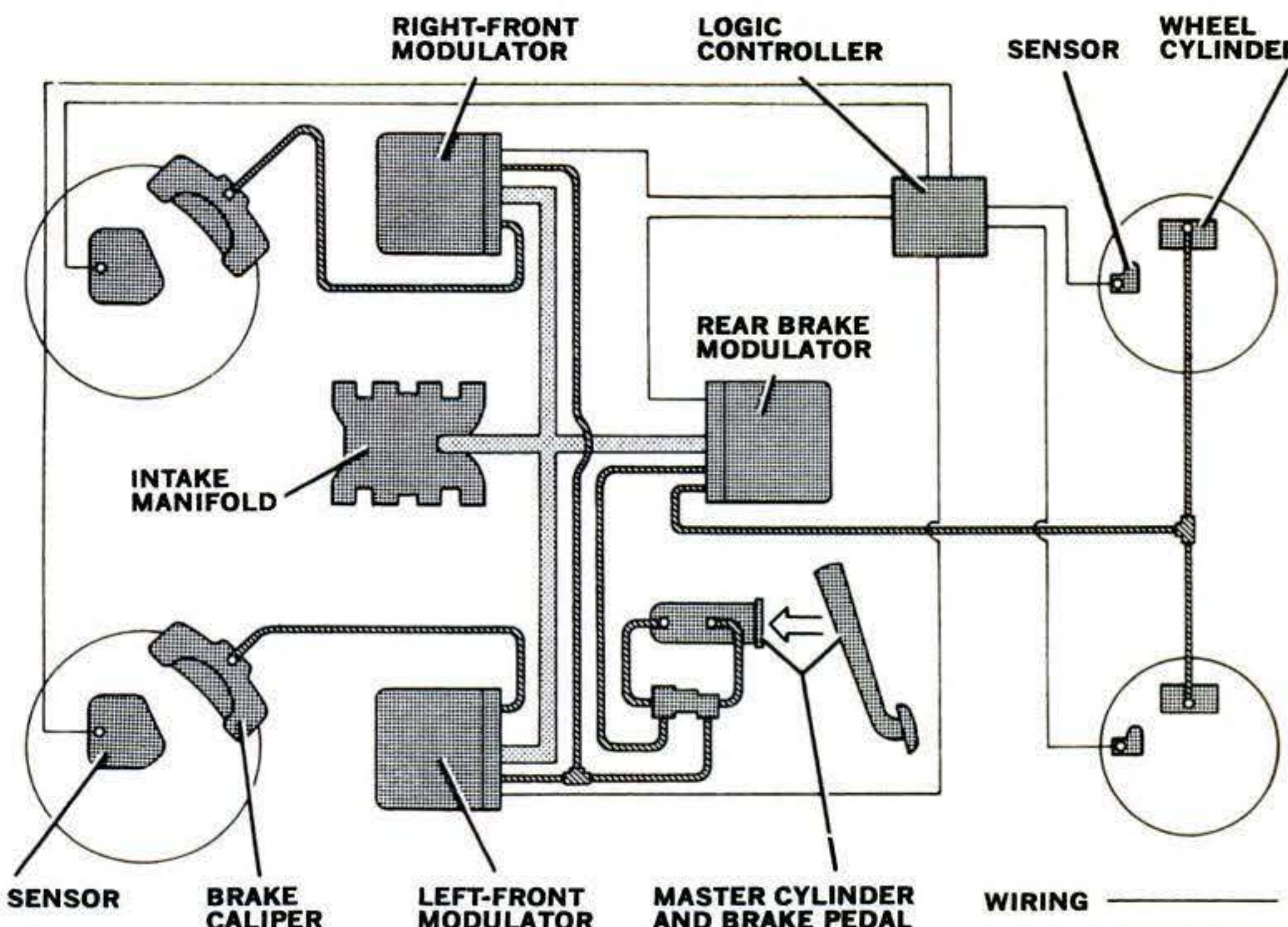
Sensors are the third key part. They measure the speed of each wheel, and send that information to the computer. The sensors themselves are little more than magnetic coils with three prongs sticking out of one end. These prongs line up with the teeth of a tone wheel that turns with the same speed as the road wheel. When lined up with the prongs, the teeth complete a magnetic field and an electrical impulse is created. As the tone wheel turns, the teeth come out of alignment and break the magnetic field, setting up a sine-wave type of electrical current. The peaks of this sine wave are counted and recorded by the computer. With diminishing frequency—which means the wheel is slowing down—in excess of 15 percent, the computer decides the wheels are about to lock up, and the Sure-Brake modulators go into action.

Chrysler's choice of 15 percent maximum wheel slowdown is critical. If the wheels move too slowly in relation to car speed, they start to lock up. Too fast, braking is not at its most efficient. Fifteen percent was chosen as the best average.

Two-speed braking rate. This is a [\[Continued on page 133\]](#)



Each front wheel has its own modulator, but the two rear wheels share one. On this car, the computer was installed inside the trunk.



Sure-Brake antilock system is most sophisticated yet devised, but it's complex and costly. Future versions may be miniaturized.

Do-Anything RANGE ROVER Cruises Like a Sedan, Clammers Like a Goat



Cresting a hilltop at full bore, the Range Rover gets airborne but lands softly on its long-travel coil springs. At left, its off-road mobility is demonstrated on the hills of Cornwall in convincing fashion—in "high" range!



Here's a four-wheel-drive wagon with a boulevard ride, sports-car handling, and cross-country go

By DAVID SCOTT / PS European Editor

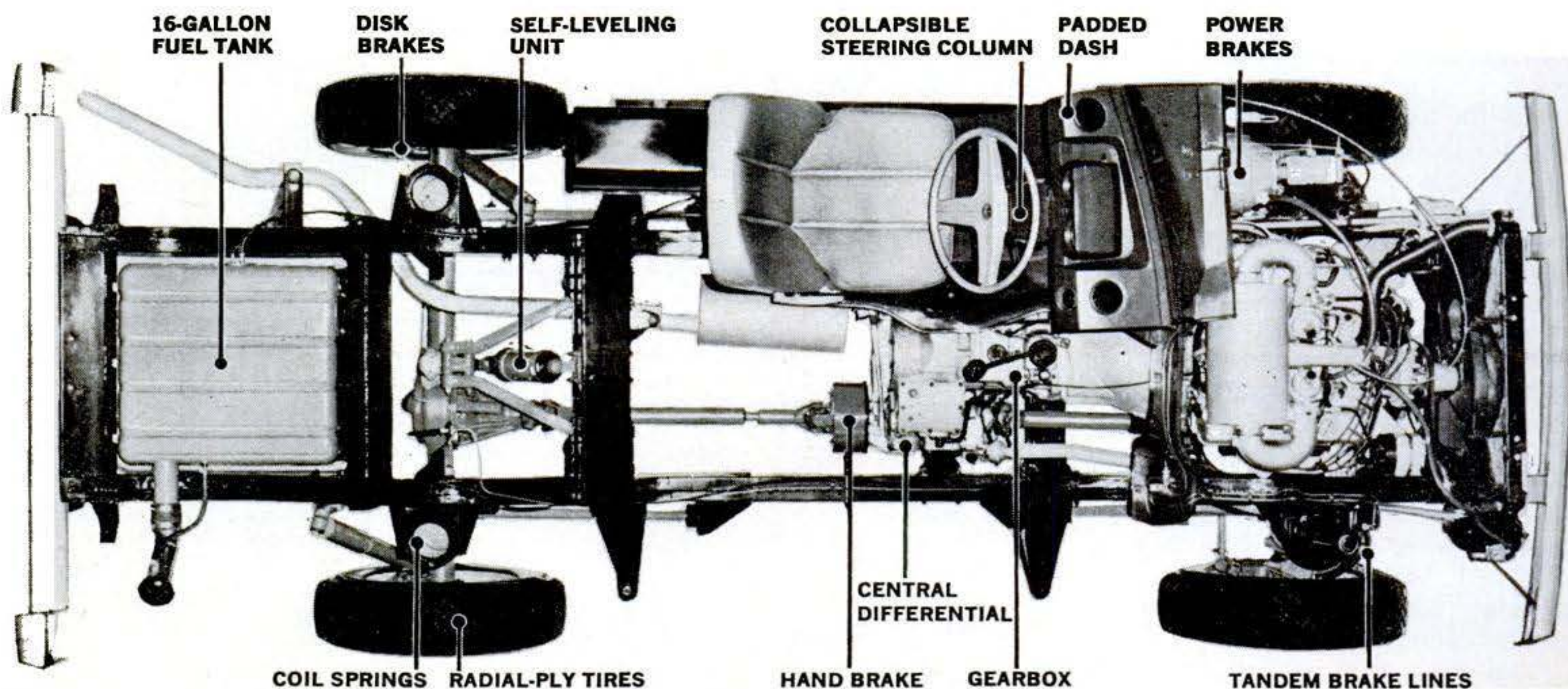
Here at last is the Rover that car buffs have been waiting for. The Range Rover could be the answer to the basic problems with the cars we now have. Our passenger cars depend pretty much on good roads. They're easily stopped by snow and ice, minor floods, mud and sand. And our off-

road vehicles just aren't suitable for highway driving.

Tires wear out because front and rear wheels are driven at the same speed, and the drive train is subject to extra stress when the wheels protest. Range Rover's answer is a limited-slip differential between the front and rear drive shafts, similar in principle to the central differential in the Ferguson system [PS, Nov. '69]. Four-wheel drive is permanently engaged, but the front wheels are free to overrun the rear wheels. For very rough conditions, the central differential is lockable. A pneumatic actuator pulls a sleeve that's splined to the differential forward to engage the front output shaft.

In a 200-mile drive around the highways, twisty lanes, and rugged coastline of Cornwall, at the western tip of England, I marveled at the Range Rover's comfort, speed, handling, and go-anywhere capability. On the open road you get relaxed cruising at 70, although there's a bit of gear whine from all those cogs. On an unused airfield I did 0-60 mph in 15.1 seconds, 0-80 in 29.5, and hit a top speed of 96 mph.

Four-wheel power disk brakes give sustained braking power. Soft coil springs all around give a cushioned ride on all surfaces. Rear suspension includes a hydraulic self-leveling unit that pumps itself up or down on bumps to maintain constant body height and suspension travel, regardless of the load aboard. **PS**



Wheelbase is 100 inches, ground clearance is 7½ under differentials and 12½ beneath the body. Load capacity is 1,200 pounds.

A Grass Trimmer with the Power in the Handle

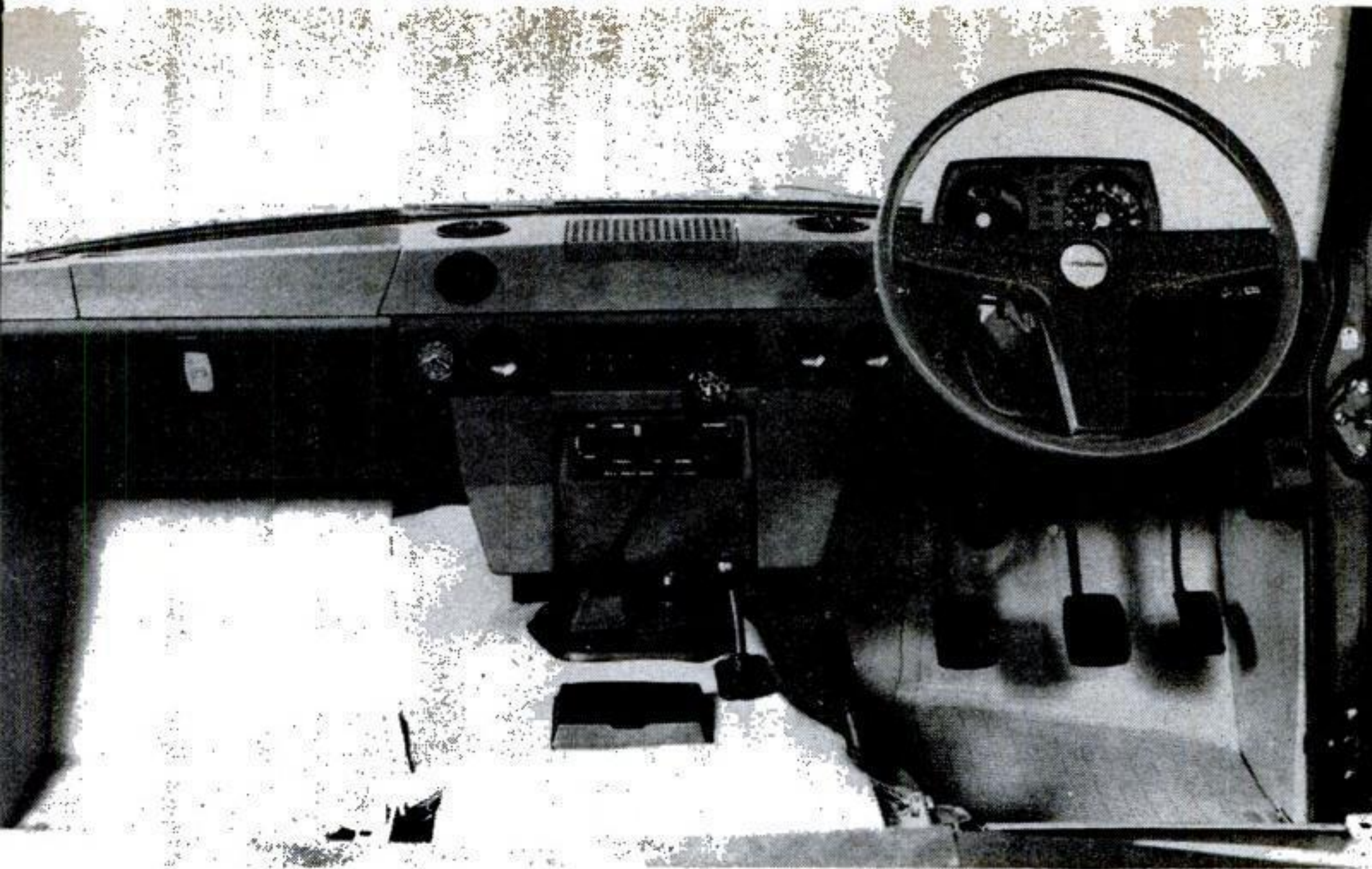
You've just finished mowing the lawn. Now what do you do about those fringe areas—around buildings, trees, plantings—that your mower can't get at? If you're not fond of stooping and squeezing, Toro's new self-contained electric trimmer may be your answer.

Originally a plug-in accessory for the company's riding mowers, this whirling-blade trimmer became a walk-around tool with the addition of a lightweight, rechargeable battery. The unit comes complete with ni-cad battery and plug-in recharger.

In my tests of the tool, which approximated normal domestic use, battery and charger did an excellent job. Overnight recharge provides enough power for at least half an hour's operation. In fact, during these tests the battery never ran down.

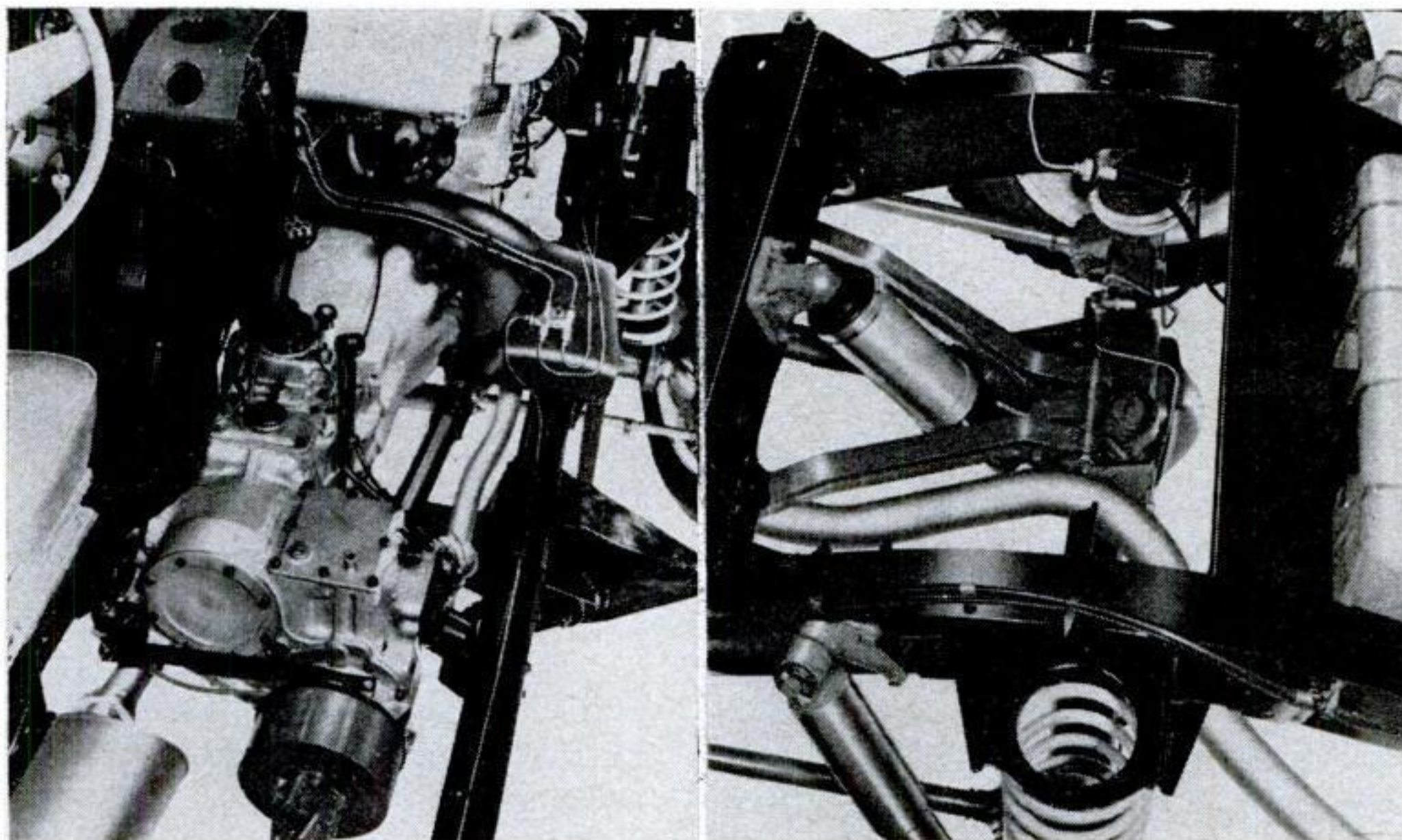
The long handle was well balanced by the battery mounted at the grip end, so total weight of about five pounds was no problem. I found that successful results depended somewhat on technique. A jabbing thrust at tall grass did not work as well as a gentle swinging sweep.

The thin 3" blades are easily replaced. At 12 volts, of course, there is no shock hazard, and any injury beyond minor cuts seems unlikely. Suggested retail price is \$44.95. --*E. F. Lindsley*



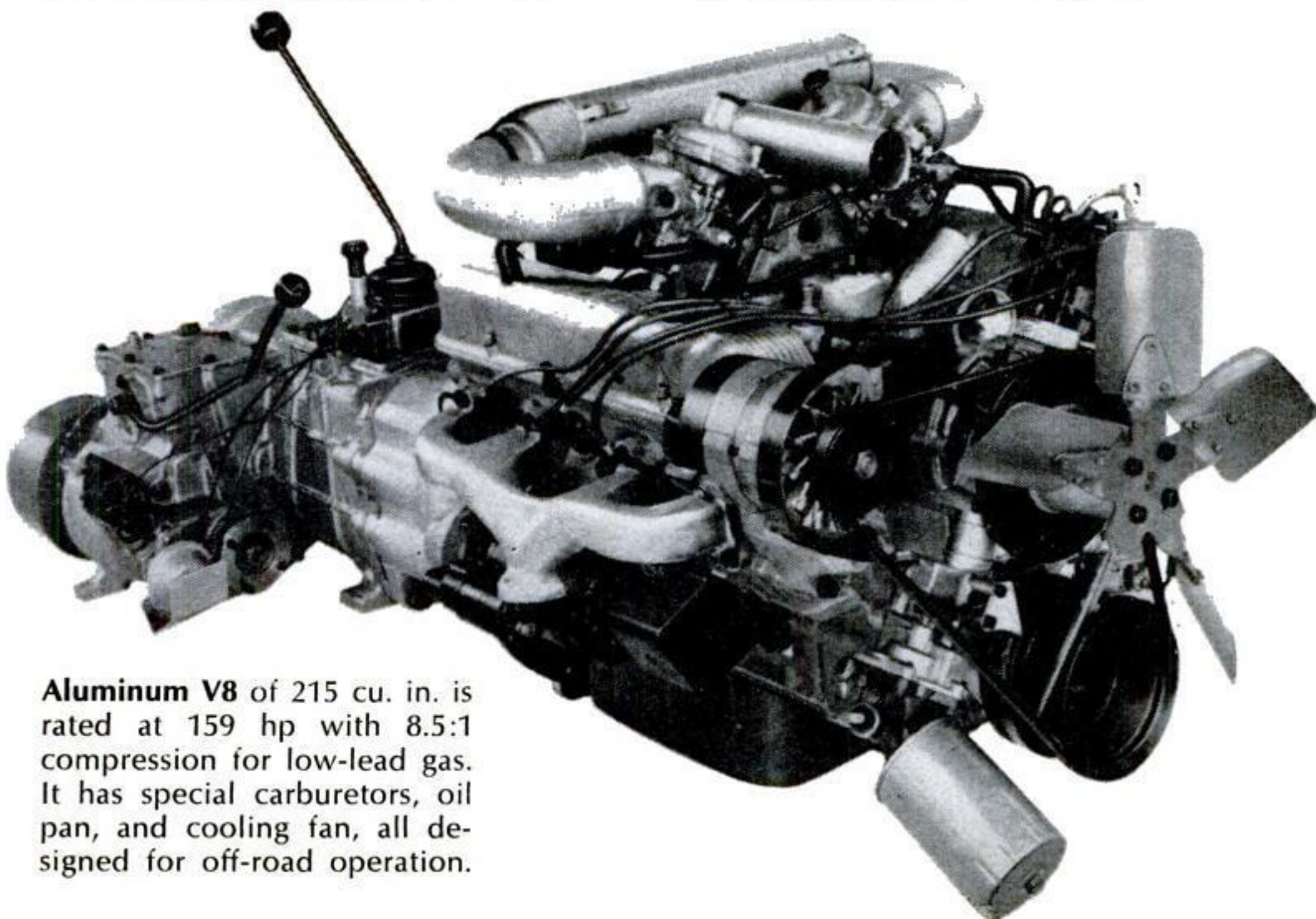
Longest lever operates the four-speed transmission. At its base is the switch for the central differential lock. The short lever

gives high and low range in the transfer case. At its right is the hand brake, which works on the rear propeller shaft.



Drive-line center consists of four-speed gearbox, dual-ratio transfer case, and central differential. Parking brake is behind.

Self-leveling rear-suspension strut works on centrally located A-bracket. Coil springs are placed outboard of the frame.



Aluminum V8 of 215 cu. in. is rated at 159 hp with 8.5:1 compression for low-lead gas. It has special carburetors, oil pan, and cooling fan, all designed for off-road operation.



Balanced trimmer is just right for free-whisking assault on fringe grass. But the blade won't cut tougher growths.

Our New B-1 Bomber— High, Low, Fast, and Slow

This big swing-wing bird is designed with a unique combination of talents

By **BEN KOCIVAR**
PS Consulting Editor, Flying

To swing or not to swing, that was the question. In the competition for the new B-1 manned bomber, the answers were the same. All three giant aerospace companies presented swing-wing designs.

The winner? North American Rockwell, voted by the Air Force best and cheapest over entries by Boeing and General Dynamics. (The latter two also hedged their bets with fixed-wing designs, which are cheaper.) General Electric will make the engines for the B-1.

Cost? If over 200 are made, the flyaway price can come to \$25 million per plane with all gear installed, but not including ground-support and training equipment. (Present plans call for five "bare-bones" prototype planes, with only enough electronics aboard to enable them to fly, plus two for testing.)

That's a big hunk of bread even for a plane about the size of a 707. It's as much as a C-5 cargo plane (which weighs three times as much as the B-1) and 10 times as much as a Minuteman.

As you might expect, there's lots of honest military security blanketing detailed information on the hot new bomber. Down at the Pentagon, they rather walk on eggs when you ask for details. But that still leaves lots of interesting answers to some of my questions.

The new supersonic bomber will not be in operation until seven or eight years from now—if all goes according to plan. First flight is scheduled for the summer of 1974, and complete testing will run through December, 1977. It's a big program with 11,000 subcontractors in 48 states.

Why the swing-wing design? That puzzled me most. The supersonic transport program started with a swing-wing design won by Boeing and, after a couple of years, changed

to a fixed-wing plane which is still years from flying.

The F-111 swing-wingers have had structure and weight problems and are still not out of the woods. The multimissioned planes designed as fighters and bombers for the Air Force and Navy are just getting back to flying status; they've been grounded since last December for inspection and fatigue tests because of a series of crashes. The Navy versions have been dropped in favor of a new Grumman swing-wing design—the F-14. Some problems there, too.

I talked with Air Force and North American officials connected with the B-1 program, and to a number of other manufacturers involved in swing-wing designs. Here is what I learned about the plane.

It's a multimission bomber. Its crew: two pilots and two navigator-systems officers, seated in one escape capsule. The B-1 is designed to fly supersonically for short distances at about 1,500 mph, but will do most of its flying at about 500 mph. It will be able to fly at 50,000-foot altitude, do a supersonic dash, and fly low subsonically—its mixed-mission flight profile—for more than 6,000 miles without aerial refueling. But its main mission is to be able to fly low, below 1,000 feet and under enemy radar detection, at about 550 mph.

It will weigh about 375,000 pounds, two thirds of a B-52's weight, yet will carry twice the B-52's payload. With nuclear weapons at high altitude, it will travel as far as a B-52, more than 10,000 miles, without refueling. But it will be less vulnerable and less visible on radar than the B-52 at low altitudes.

There, its primary mission will be to carry as many as 24 SRAMs (short-range attack missiles) to hit such targets as SAM (surface to air missile) sites. The SRAM has inertial guidance and can be fired at short ranges against radars detected by passive radiation-detection systems aboard the bomber.

Like the F-111, the B-1 will be able to take off fully loaded from short fields—even rough fields in an emergency. This means it can operate from 5,000- to 7,000-foot runways; I was told the B-1 could use airports not

open to the F-111. It is even possible that it could fly from many super-highways. This, plus its ability to get off quickly, provides tremendous dispersal capacity and safety in a surprise attack. Any enemy will find the planes more difficult to pinpoint in advance than our fixed rocket bases.

In flight, the B-1 performance will match that of the KC-135 jet tanker, the military version of the Boeing 707, so no new refueling tankers will be needed. The KC-135 was ordered to match the flying ability of the B-52 bomber and the fast jet fighters that could not slow down enough to be refueled by the old prop-driven KC-97.

The B-1 will have ground-mapping radar, making runways as well as other things visible from the air without ground assistance, and thus able to land in bad weather, even pea-soup fog. It will carry decoy missiles and defensive missiles to protect itself against enemy attack.

Swinging versatility. To meet all this variety of flight, distance, speed, and load ability, the competitors agreed on the swing-wing or variable-geometry wing. Moved straight out, it provides greatest lift for slow flight, and for takeoff and landing with big loads from short fields. Swept back, it enables the B-1 to fly at more than twice the speed of sound.

Sound like the same arguments as for the F-111? They are.

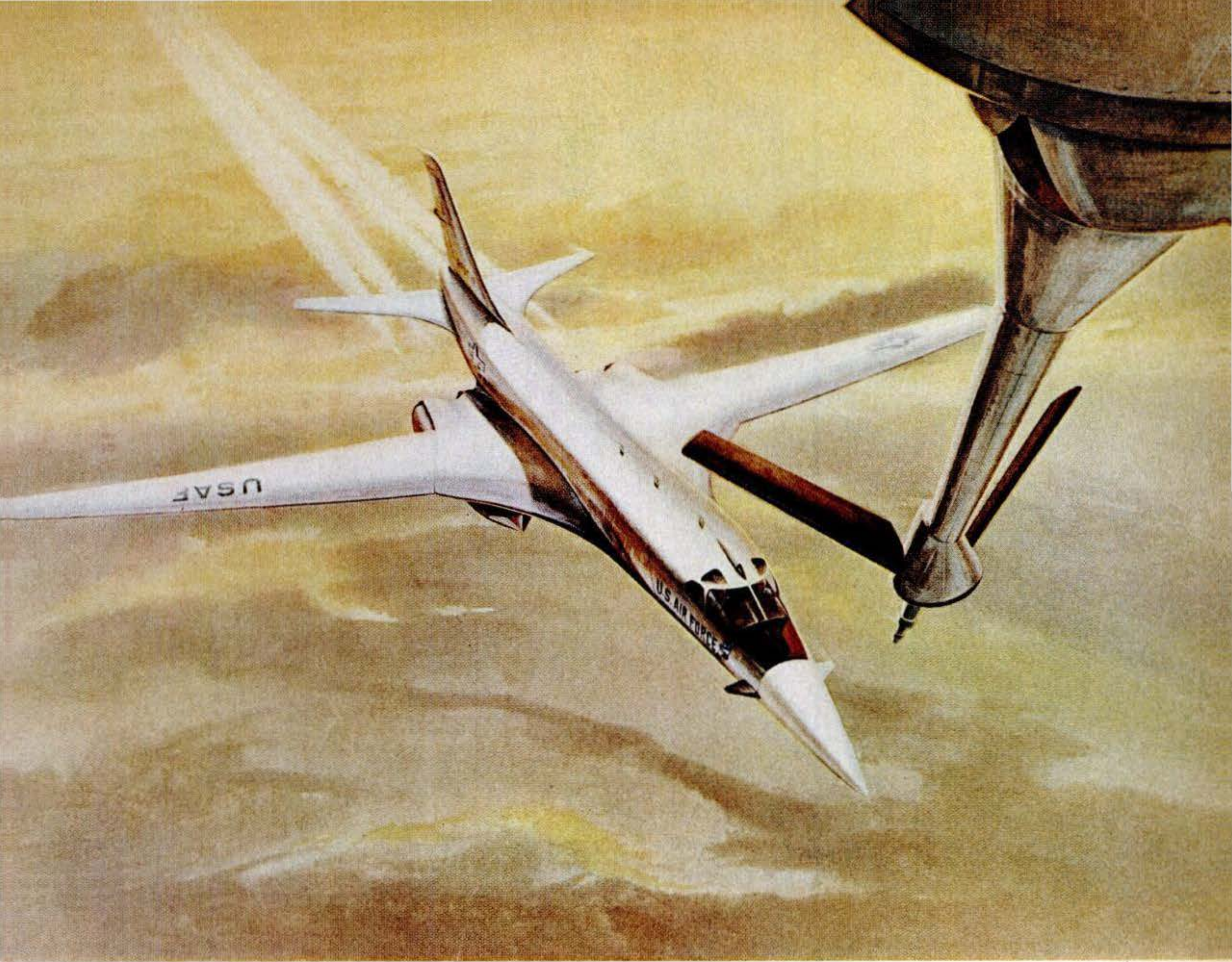
"How about the wing problems that the F-111 has had?" I asked. "Won't you run into the same thing?"

The answer was a definite "No." The F-111, I was told, used D6AC tool steel for its wings. This material turned out to be not strong enough. It had advantages: It allowed thinner and more streamlined wing joints, and cost less than titanium. But it was like tool steel in that even a small crack could rupture rapidly and was difficult to inspect.

The B-1 will use new methodology for fracture mechanics. Of the prototypes ordered, one will be used for static testing, one for fatigue testing. The F-111 had simultaneous testing and production. The B-1 will undergo development work before production starts.

What about the abandonment of the

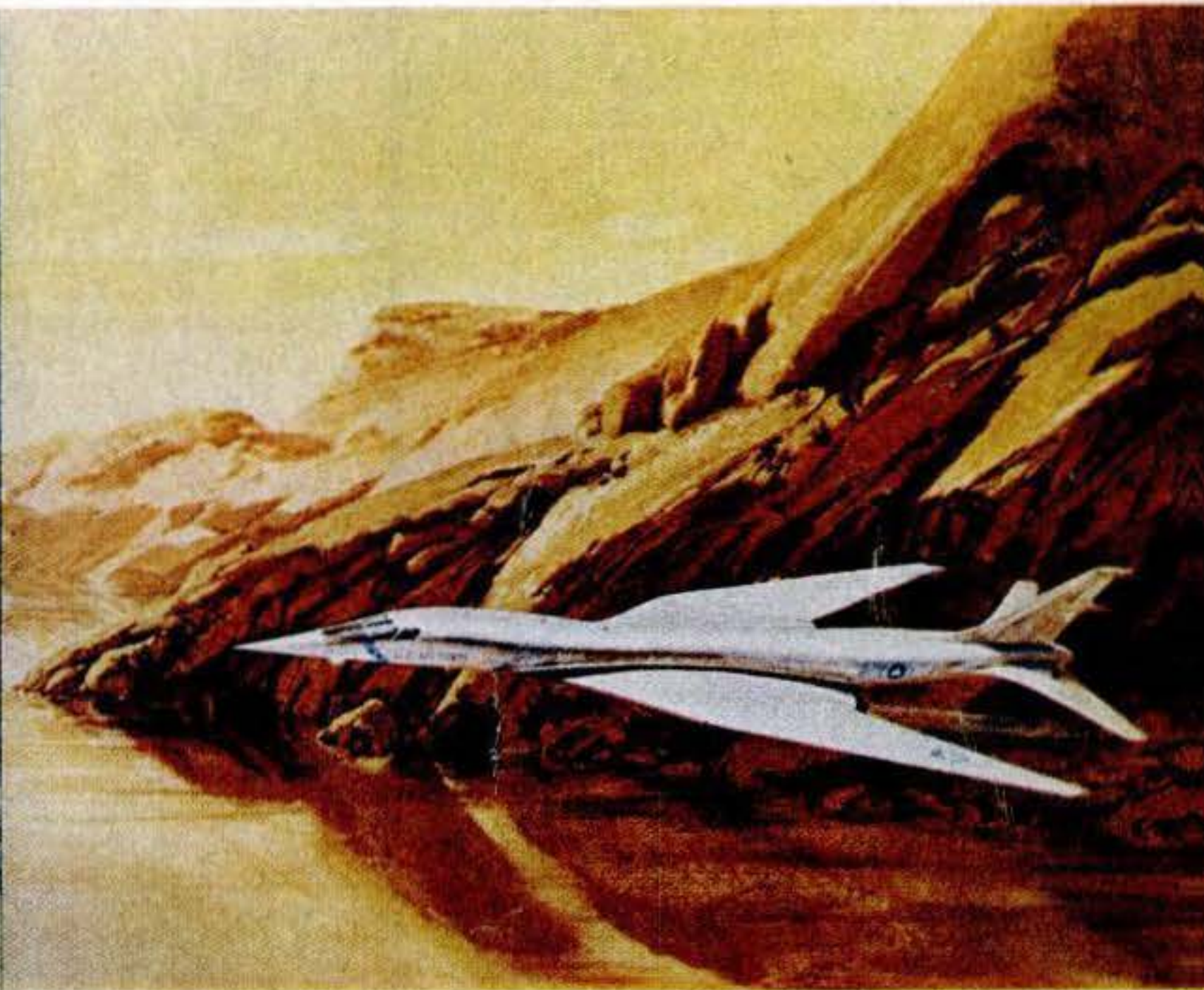
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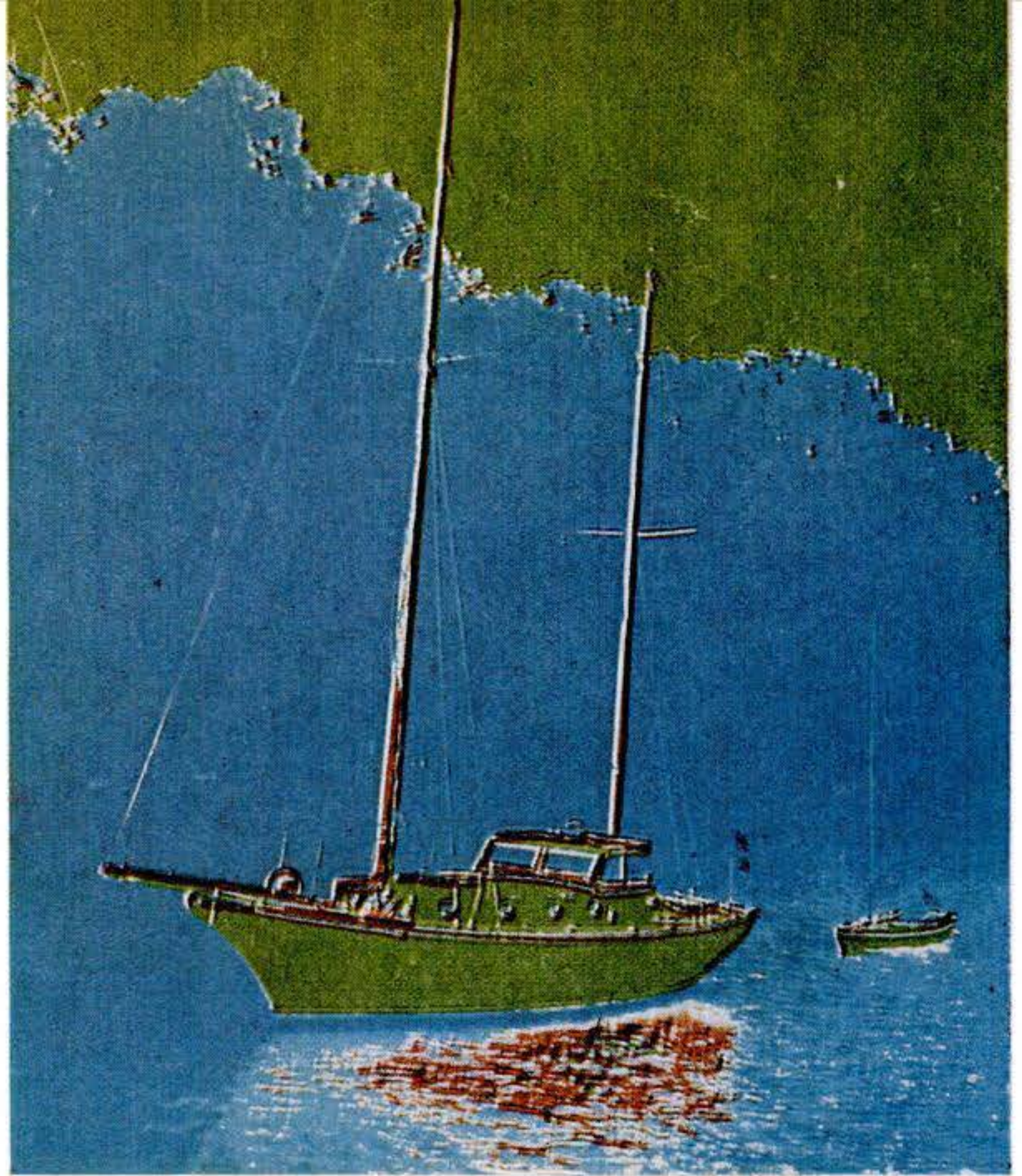
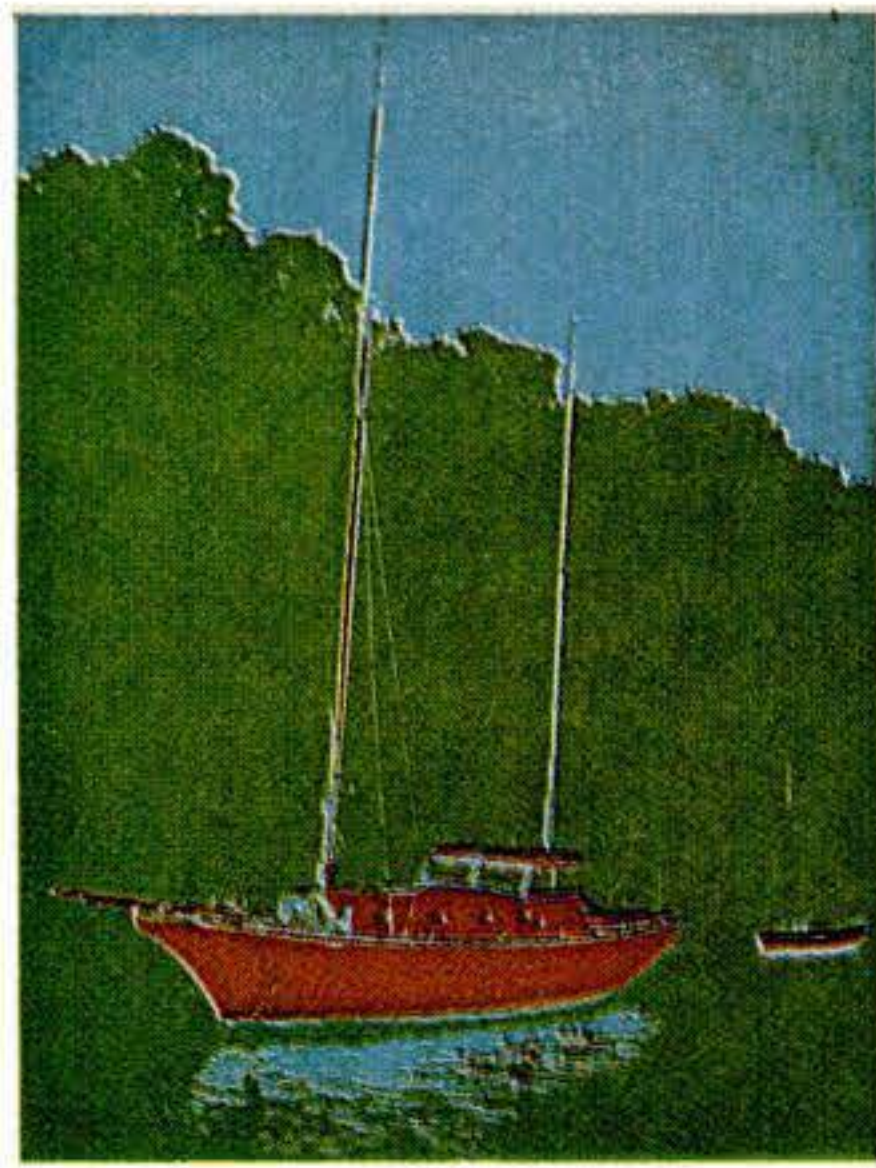
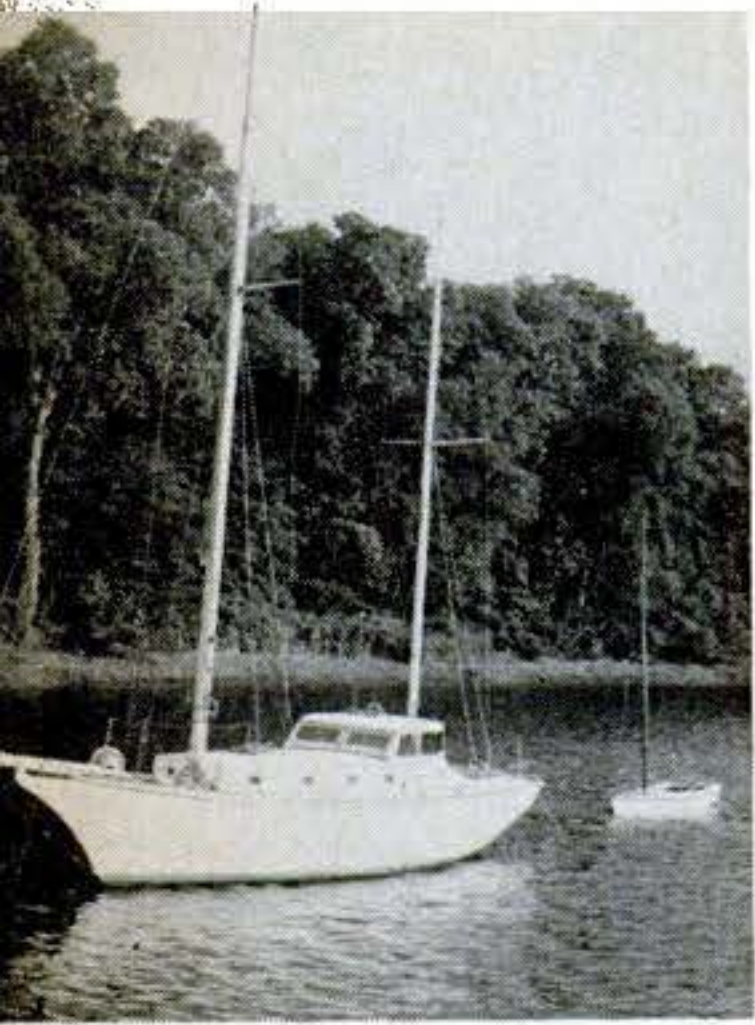
B-1 refuels from a conventional KC-135 jet tanker (military version of the Boeing 707), which positions its fuel probe with controllable wings. Here, B-1's wings are held straight out for slow flight. Note small canard stub wings in front of the cockpit. They smooth out bumpy-air ride.



Underbelly view of B-1 shows position of four engines in two separate pods under fixed inner portion of variable sweep-wing. Bumps on rudder house sensors for electronic countermeasures.



Flying low through valleys, B-1 dashes at just under the speed of sound, using terrain-following radar for automatic flight below area that's reachable by defense radars guiding SAM missiles.



Color Key lets you pick the colors in your final product. The small color sandwich (center, above) and the larger one beside it were both made from the black-and-white negative that produced the monochrome print at far left. You can buy Color Key at graphic-arts supply stores. Get the rainbow pack (25 10-by-12 sheets in assorted colors for \$17.90) and a quart of developer (\$2.25). That's enough to make hundreds of sandwiches in 35mm and Instamatic size, or about 50 sandwiches in 120 and 220 roll-film sizes.

Turn Your Snapshots into

By A. J. HAND PHOTOS BY THE AUTHOR

How would you like to be able to "paint" bright, bold, colorful poster pictures with your camera? It's easy. You can do it with your usual film—any size, color or black and white—and 3M Color Key.

Color Key is a clear plastic film that is coated with an emulsion in a wide variety of colors. When it is exposed to light, the emulsion hardens. You use the film with Color Key developer,

an organic solvent. Wipe the solvent over unexposed Color Key and all the color comes off. Wipe it over fully exposed Color Key and nothing at all happens.

But place one of your negatives or slides on a piece of Color Key—blue, let's say—and shine a bright light through your original onto the Color Key, and here's what happens:

The emulsion under the clearest parts of your original hardens, the rest stays soft. Development washes away the soft portions, but the light-hardened portions remain. So you

get a high-contrast rendition of your original in clear and blue.

Use a longer exposure time and more Color Key emulsion will harden. You get another high-contrast rendition, but the detail in it will be different. And that's the secret of making your own poster art.

You just expose your original on different colored sheets of Color Key, varying the exposure times for each sheet. Then take the different Color Key copies, and laminate them together into the most eye-catching sandwich you ever made. **PS**

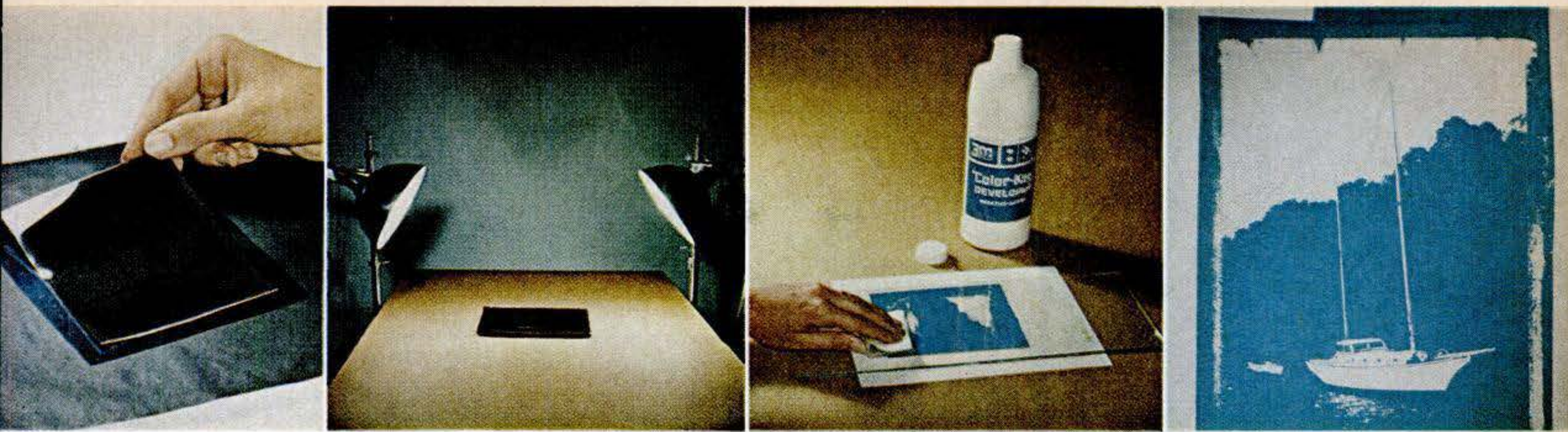
Let your imagination run wild — transform a slide into a striking color sandwich

Removed from its mount, slide on opposite page was contact-printed on red Color Key for three minutes. Exposure left a broad shadow (clear area) on the girl's cheek.

Same slide exposed for five minutes on a scrap of orange Color Key has eliminated shadow on the girl's cheek, and broadened the highlight band running across her hair.

Orange layer is not used in the sandwich. Rather, it is contact-printed on blue Color Key for two minutes. Result? An exact reversal of the orange layer in blue.





The three easy steps to color from a black-and-white negative

Cut a piece of Color Key to size of your original. Lay it, emulsion (dull side) down on black paper that comes with the film. Then cover with a sheet of glass to assure good contact between Color Key and original. Use any size film; we used a negative from four-by-five Polaroid positive/negative here

Set up two photofloods at either side—about 18 inches from the glass—and make your exposure. Vary the time according to the effect you want and the density of the original negative. Two to five minutes is a good starting point. Intense light is required to expose Color Key, so you can work under normal room light—you need no darkroom or special safety light for this job.

After exposure, remove the Color Key from beneath the glass and place it with the coated side up on a smooth surface. Wait for a few seconds, and then pour on a capful of the Color Key developer. Let the developer spread for a few seconds, then wipe carefully with cotton balls or soft paper toweling, until all of the soft emulsion has been removed completely.

Rinse the developed film in water and blot dry with a lint-free material. Now experiment. Make another exposure for a different time on a different color. Or combine this layer with the original and print them both together onto a sheet of another color. You'll be surprised at effects you'll get.

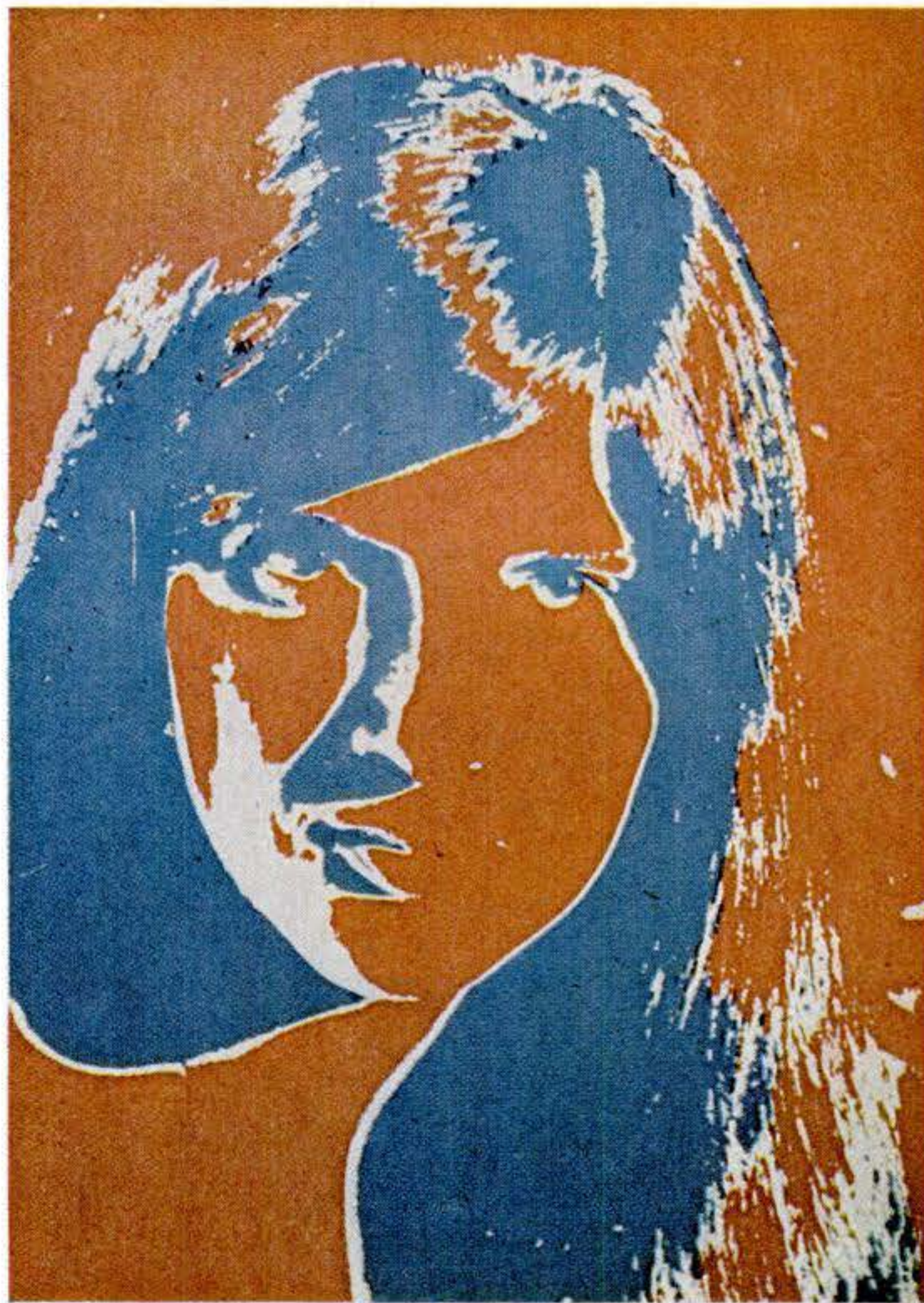
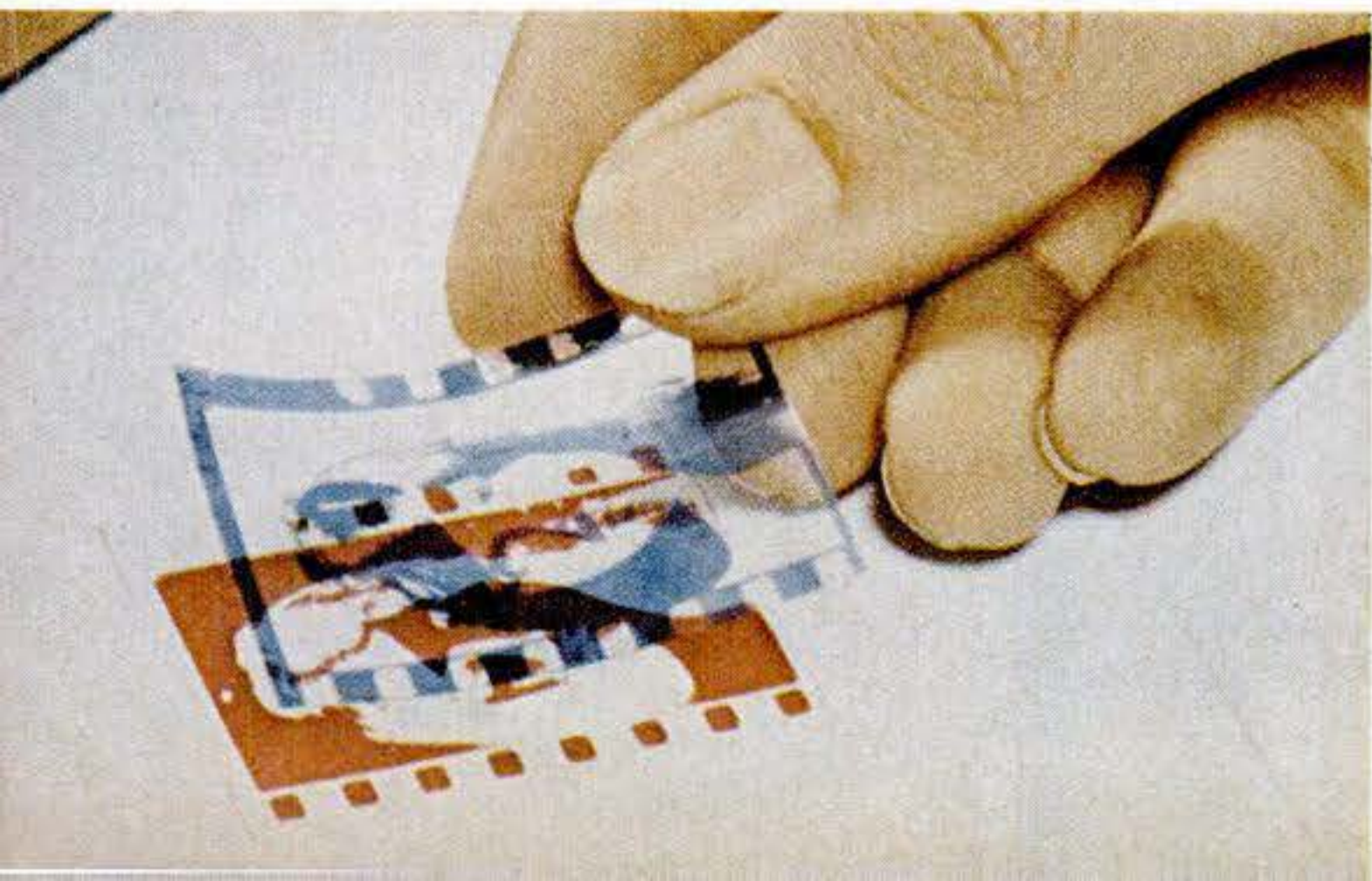
Poster Art with Color Key



Original slide at left produced Color Key sandwich at right in about 10 minutes. The striking result can be projected like any ordinary slide, or sent to a good custom color lab to be made into a color print. Good trick: Group together many small sandwiches like this on a plain window, and you turn it into a way-out stained glass.

Here's how to do it

Last step: The red and blue layers are placed in register (the images of the sprocket holes guide alignment) and taped at the edges. Sandwich is then placed in a new mount and is ready for projection. Glass slide mounts keep the sandwich pressed flat.



Three

Sheet plastic, Pop rivets, and walnut are a natural team for the clean look of today

By A. J. HAND
PHOTOS BY ORLANDO GUERRA

A lot of today's modern designs owe their visual impact to the combination of the natural, earthy look of wood, with the clean, clinical look of plastic and metal. Here are three designs that make the most of the combination. Deep, rich tones of walnut key perfectly with the color of bronze Plexiglas while the gleam of shiny rivets provides just the right metallic accent.

As a bonus, the rivets make the assembly of all three accessories a simple pop-together procedure. Industrial designer Gary Gerber, who created these accessories, achieved the pop-together capability by using Pop rivets in a new and unusual way.

In normal riveting routine, the rivet passes all the way through two thin pieces being joined. When you squeeze the riveting tool, the end of the rivet mushrooms up tightly against the rear piece.

In these projects, however, plastic is fastened to walnut so thick the rivets don't pass through it. So when you squeeze the tool the rivet expands *into the sides of the hole*. You get a neat strong bond—*instantly*.

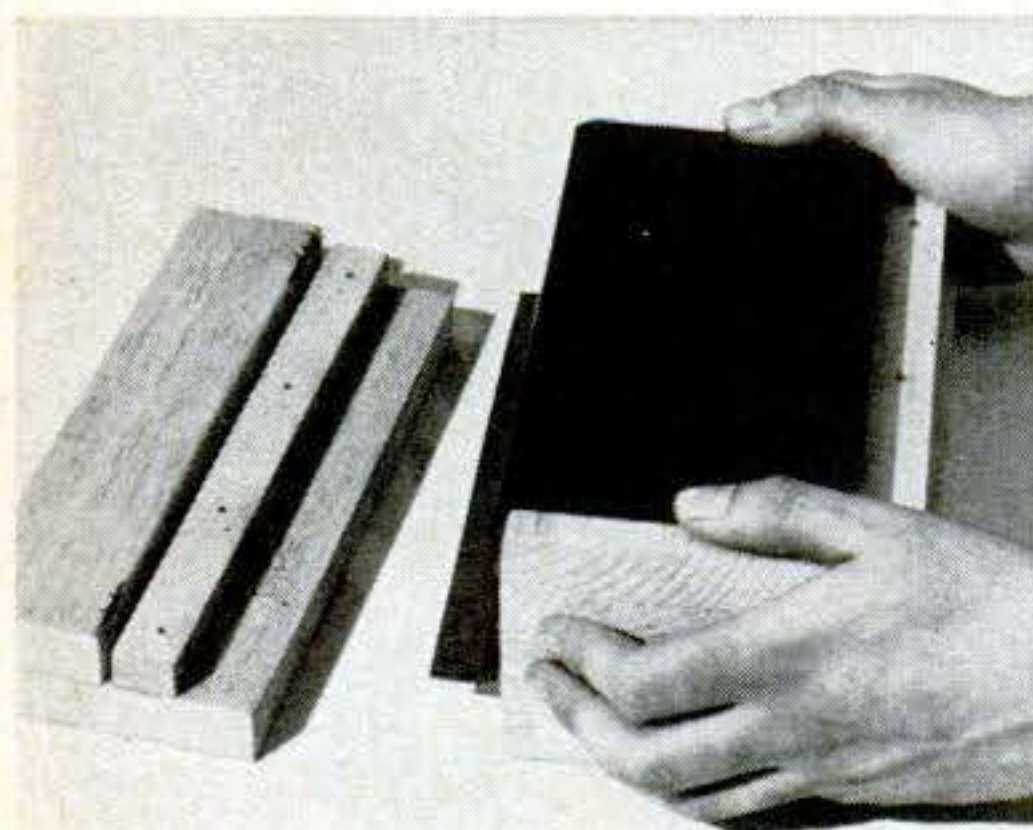
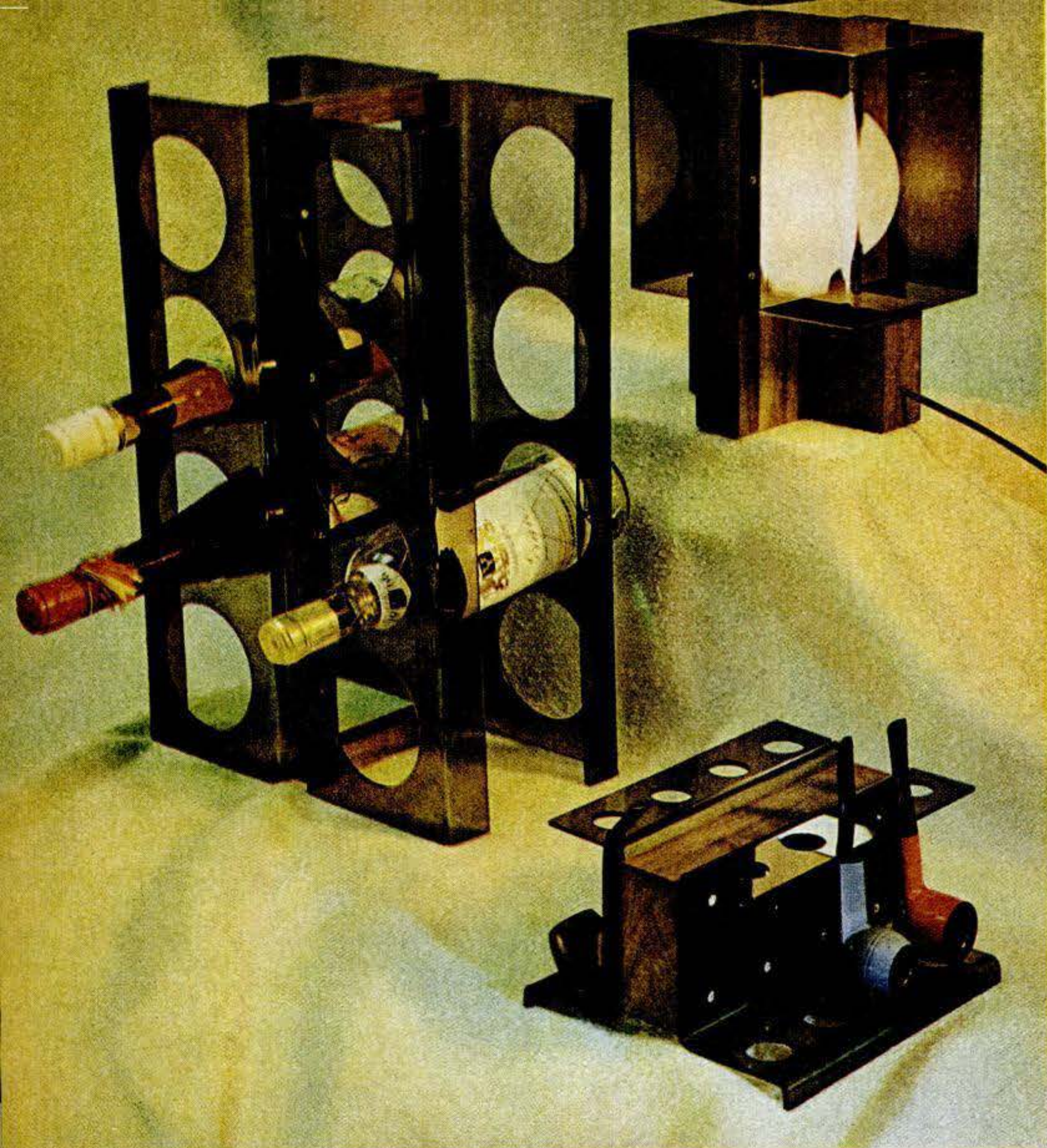
All three accessories are built using the same techniques. Start by assembling the wooden parts, using white glue and clamps. Drill all the rivet holes. Then sand the wood smooth, knocking off the sharp corners and cleaning up burrs around holes.

Finish the wood before you mount the plastic. A penetrating finish such as Deep Finish Firzite or DuPont Penetrating Resin Finish will give the wood a deep-grained look.

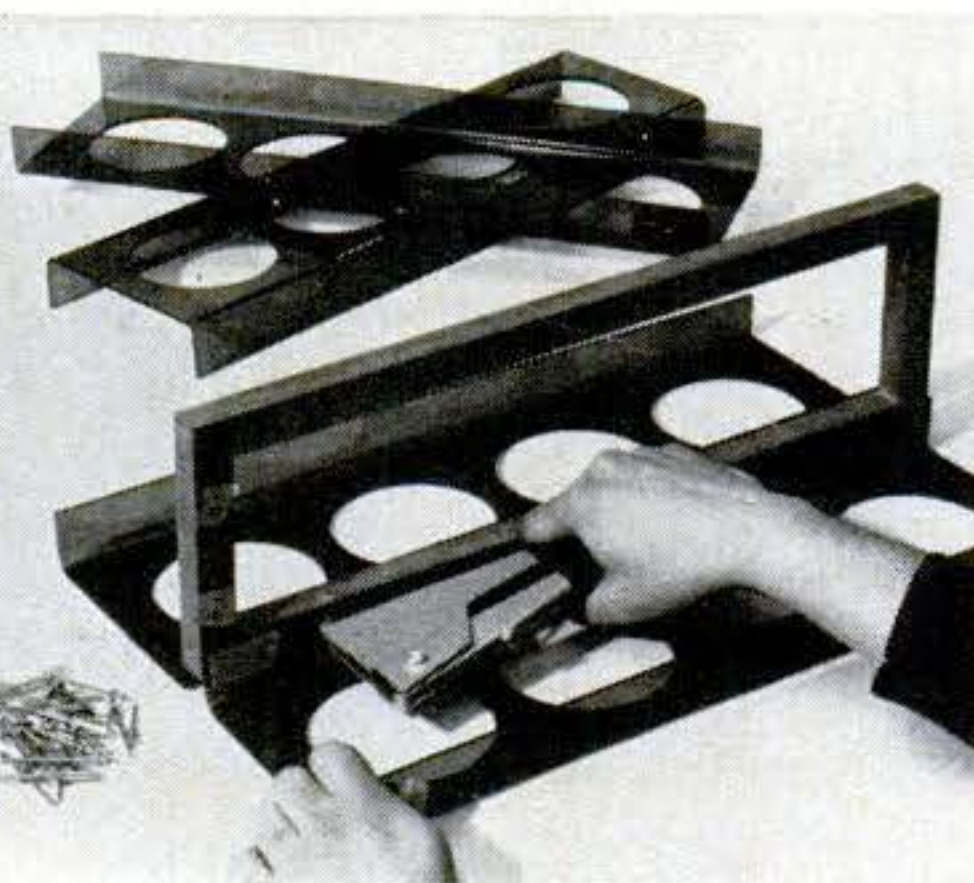
The plastic. You can get the sheet plastic—Rohm & Haas Plexiglas—at most building-supply stores. It comes in a variety of colors and thicknesses. The color's up to you—Gerber used bronze—but get the $\frac{1}{8}$ " thickness.

Do your cutting with a fine-toothed handsaw, or with a plywood blade on a table saw. Note that the plastic for the lamp and the pipe rack is cut and bent slightly oversize, then trimmed

[Continued on page 141]



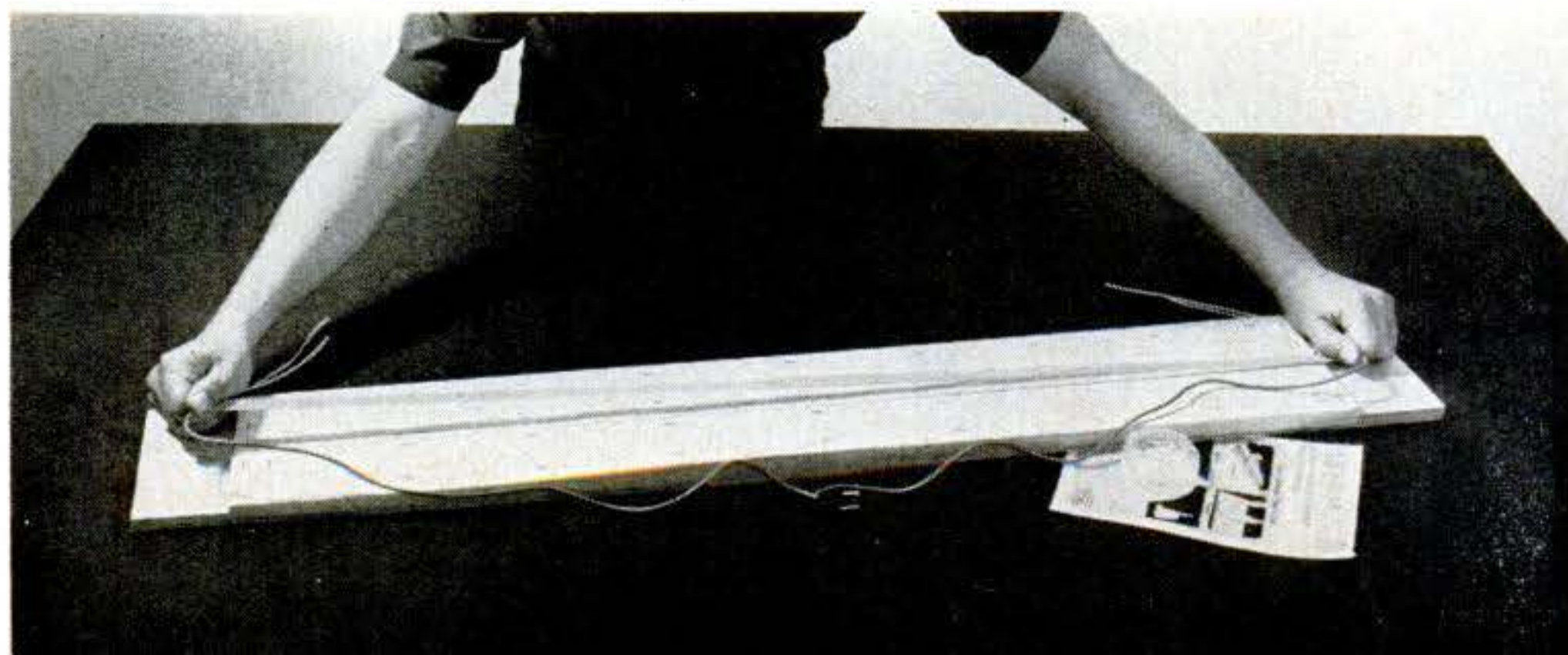
Jigs make accurate bends easy: Slip hot plastic into jig, gently bend to shape and hold until cool. Remove protective paper from plastic just before you apply heat.



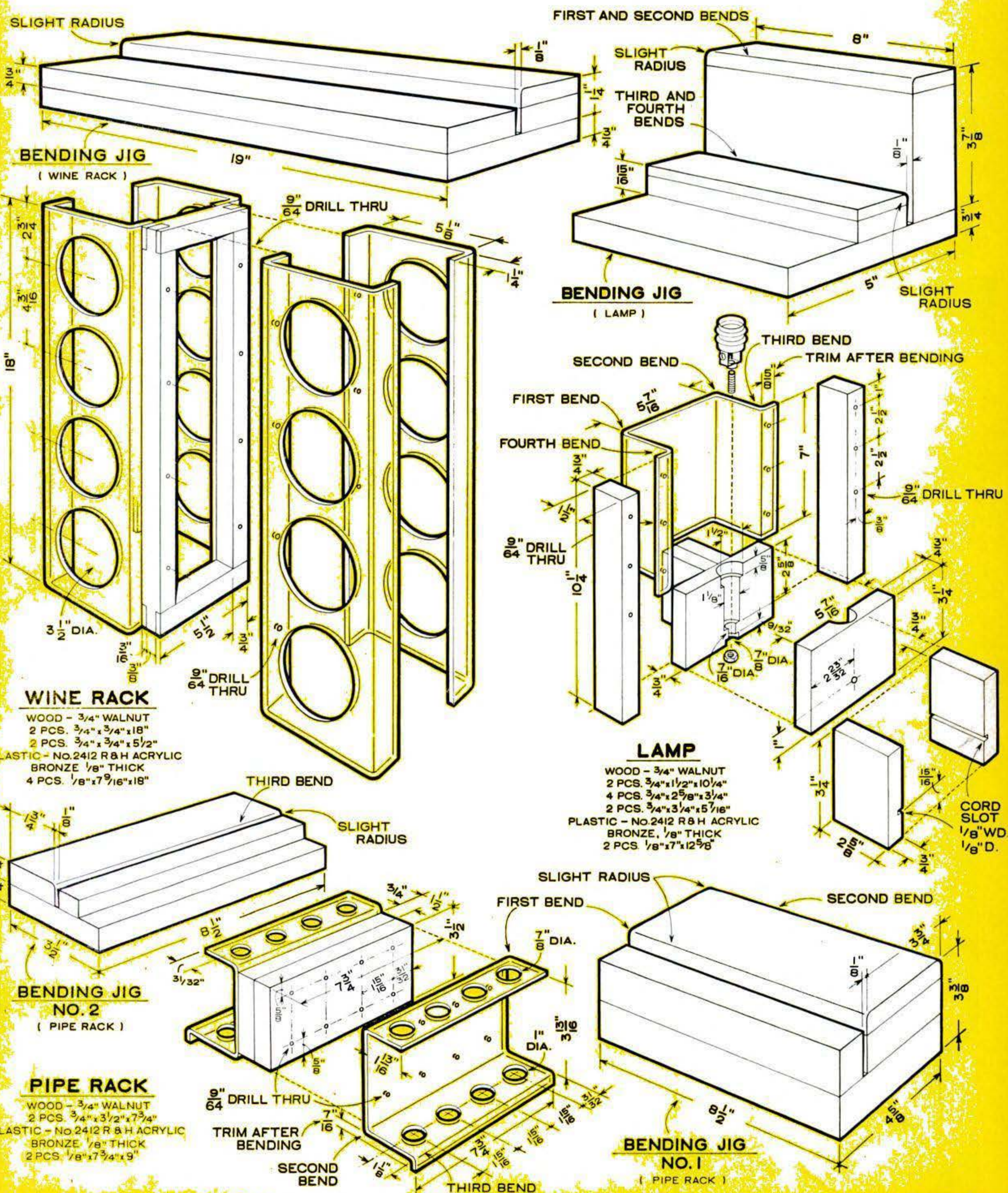
Rivets let you pop the accessories together in minutes—no clamping or waiting for glue to dry. Use USM's $\frac{1}{8}$ " aluminum A-44 pop rivets. Steel ones may crack out.

Strip heater softens Plexiglas for bending. Make it with the new Briskeat heating ele-

ment sold for this purpose. Plans for building the heater come with the element.



Pop-Together Home Accessories



BENDING JIG (WINE RACK)

FIRST AND SECOND BENDS

BENDING JIG (LAMP)

WINE RACK

- WOOD - 3/4" WALNUT
- 2 PCS. 3/4" x 3/4" x 18"
- 2 PCS. 3/4" x 3/4" x 5 1/2"
- PLASTIC - NO. 2412 R & H ACRYLIC BRONZE, 1/8" THICK
- 4 PCS. 1/8" x 7 9/16" x 18"

LAMP

- WOOD - 3/4" WALNUT
- 2 PCS. 3/4" x 1 1/2" x 10 1/4"
- 4 PCS. 3/4" x 2 5/8" x 3/4"
- 2 PCS. 3/4" x 3/4" x 5 7/16"
- PLASTIC - NO. 2412 R & H ACRYLIC BRONZE, 1/8" THICK
- 2 PCS. 1/8" x 7" x 12 5/8"

BENDING JIG NO. 2 (PIPE RACK)

PIPE RACK

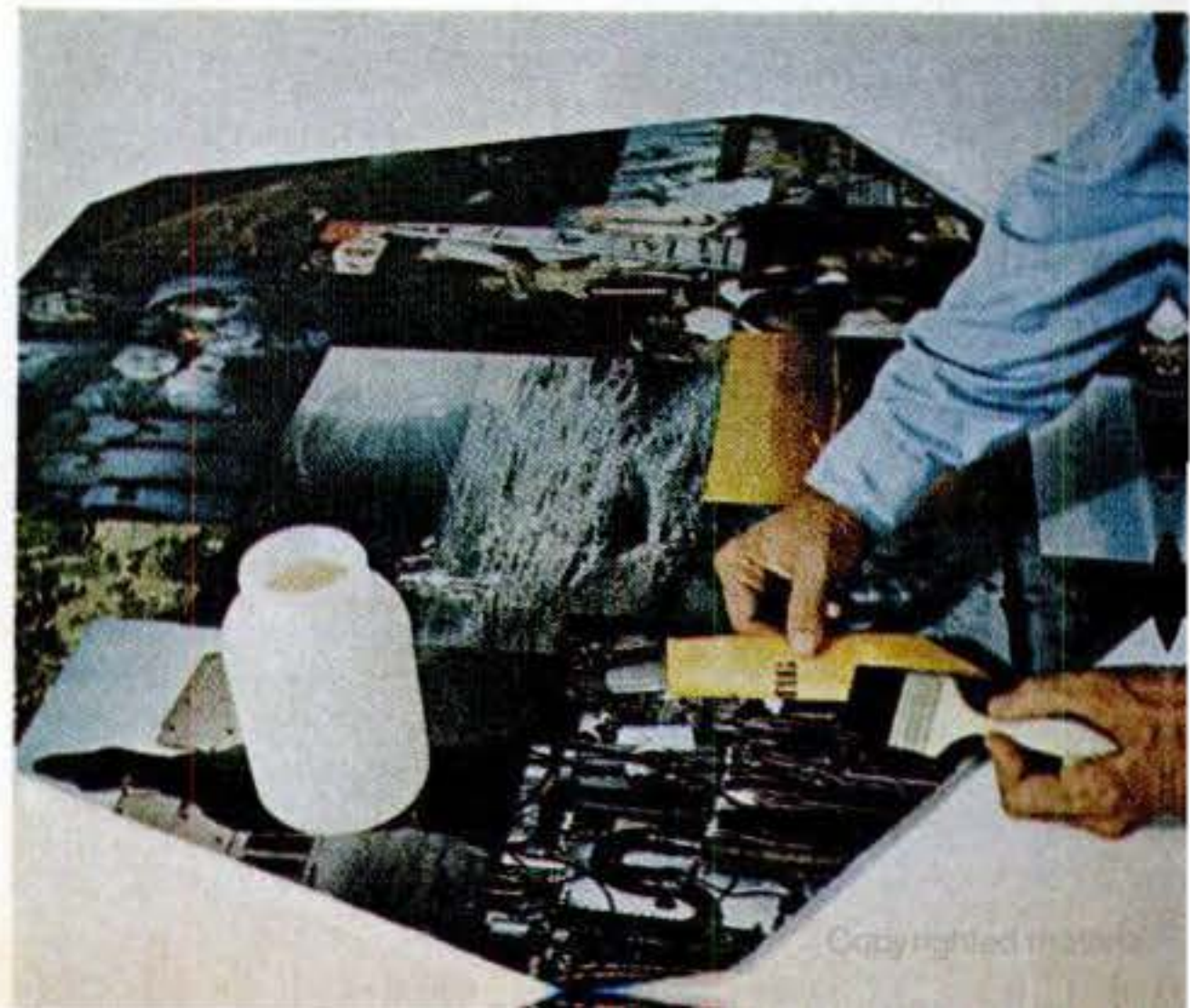
- WOOD - 3/4" WALNUT
- 2 PCS. 3/4" x 3 1/2" x 7 3/4"
- PLASTIC - NO. 2412 R & H ACRYLIC BRONZE, 1/8" THICK
- 2 PCS. 1/8" x 7 3/4" x 9"

BENDING JIG NO. 1 (PIPE RACK)



'Bye for now, says the man of the house as he retreats into think tank. Though it dominates a room, it can be quickly disassembled. At left, Isaacs contemplates interior collage.

Interior face of each pentagon is covered with magazine photos chosen for response they stimulate in you. Apply them, overlapped, by brushing thick wallpaper paste on back of moistened page.



Escape from the pressures of modern life . . .
Relax in contemplation after building

Your Very Own Meditator

By KEN ISAACS
PS Design Consultant

"I want to be alone." When Greta Garbo made her often-quoted remark, years ago, it may have had a deeper meaning than escape from pursuing newsmen. Everybody occasionally wants to be alone. We all need privacy to renew ourselves for the fast pace of modern living. As old as mankind, this inner need is today more urgent than ever before.

Mohandas Gandhi was perhaps this century's outstanding exponent of aloneness—of personal meditation. Gandhi's inspiration came in part from our own Henry David Thoreau, who fled to the natural solitude of Walden Pond. And Thoreau was a real soul brother of our western man of the mountains, naturalist John Muir.

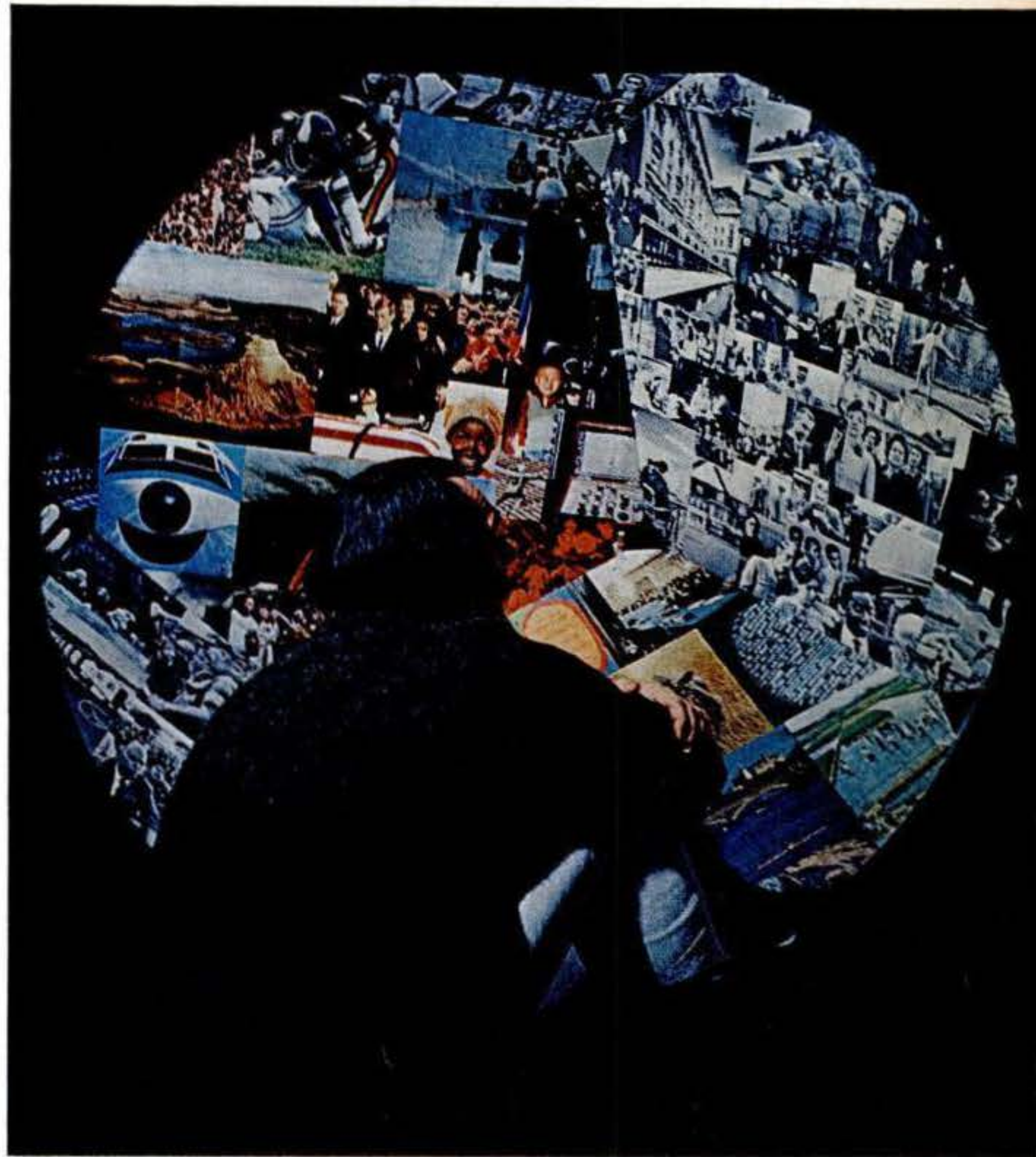
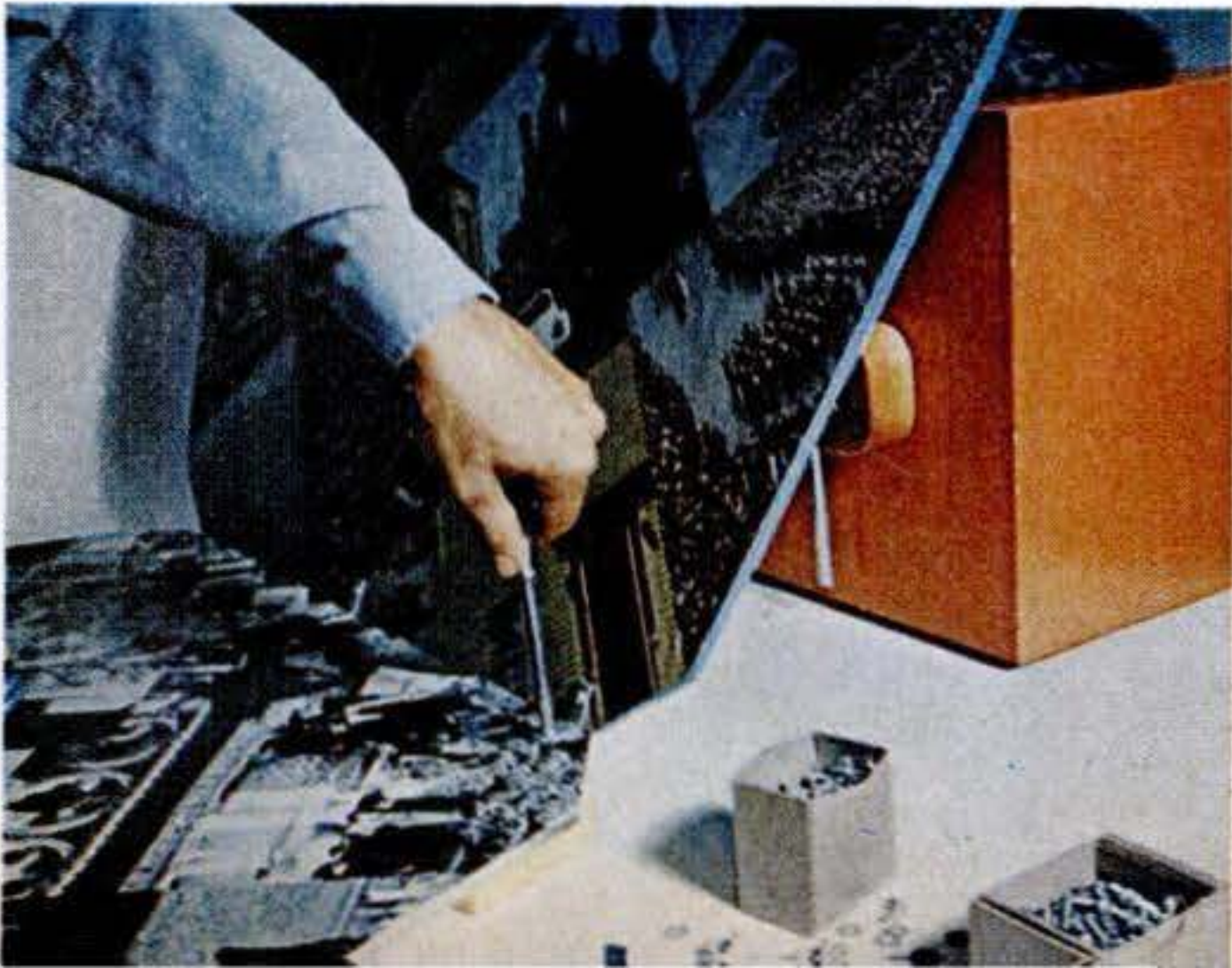
But perhaps the best expression of this inner need—the one that moved me to design the POPULAR SCIENCE Meditator—comes from the cultural historian and critic, Lewis Mumford. In his book, *The Conduct of Life*, Mumford speculates that, ideally, each of us has two lives: our public life of daily activity—earning a living, raising a family—plus a private life created within our thoughts as we examine and evaluate our actions.

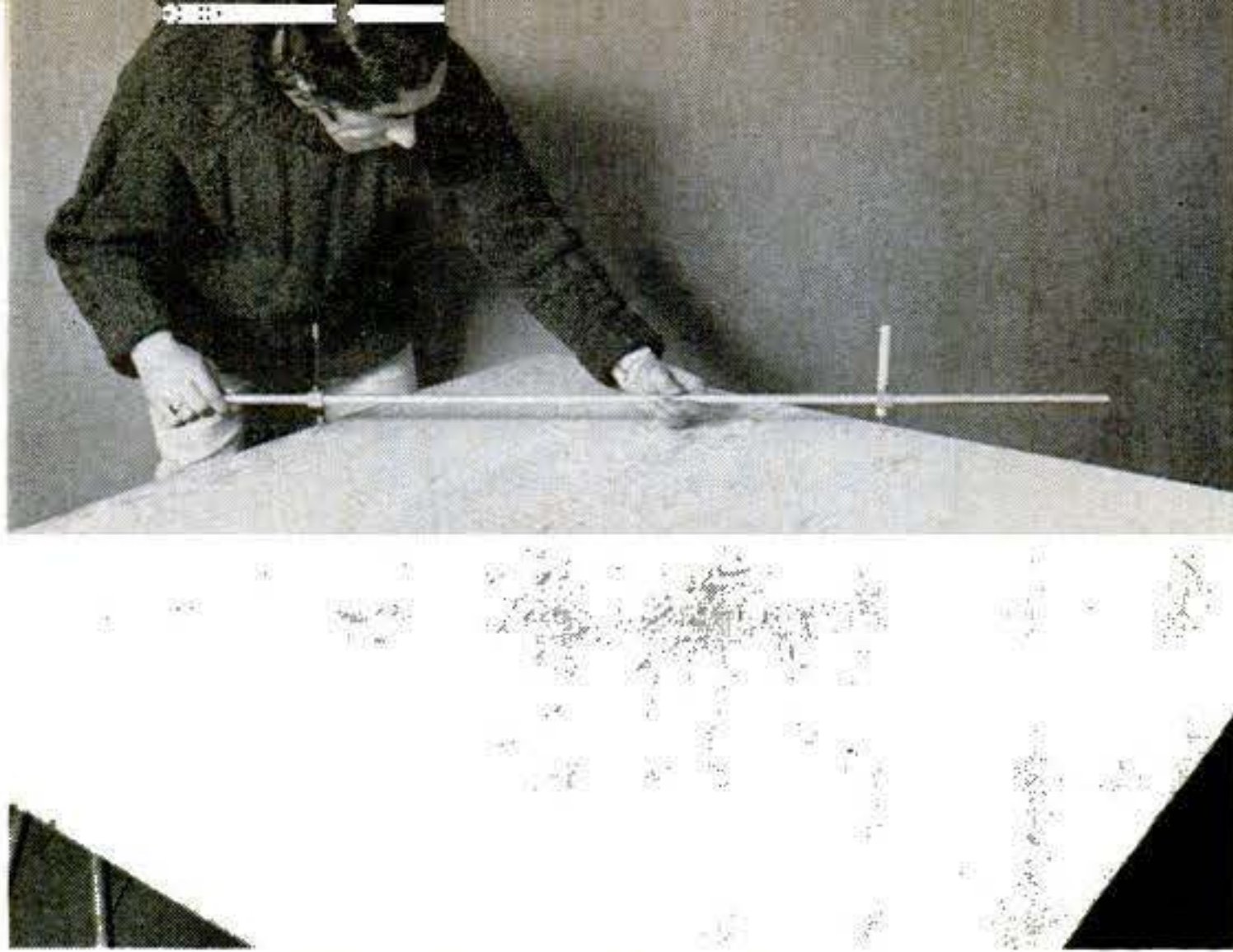
It is Mumford's contention that if each of us fully realized that every minute of our lives that "escapes reflection" is gone forever, we'd make provision for that "second life"—provision that would encourage us to slow down and follow up our day-to-day pursuits with regular meditation.

Mumford actually anticipated my Meditator design when he called for a *form* that would give this second life shape: a specific time and place for contemplative withdrawal—preferably even a special structure devoted to the purpose. Inspired by this idea, I designed my Meditator.

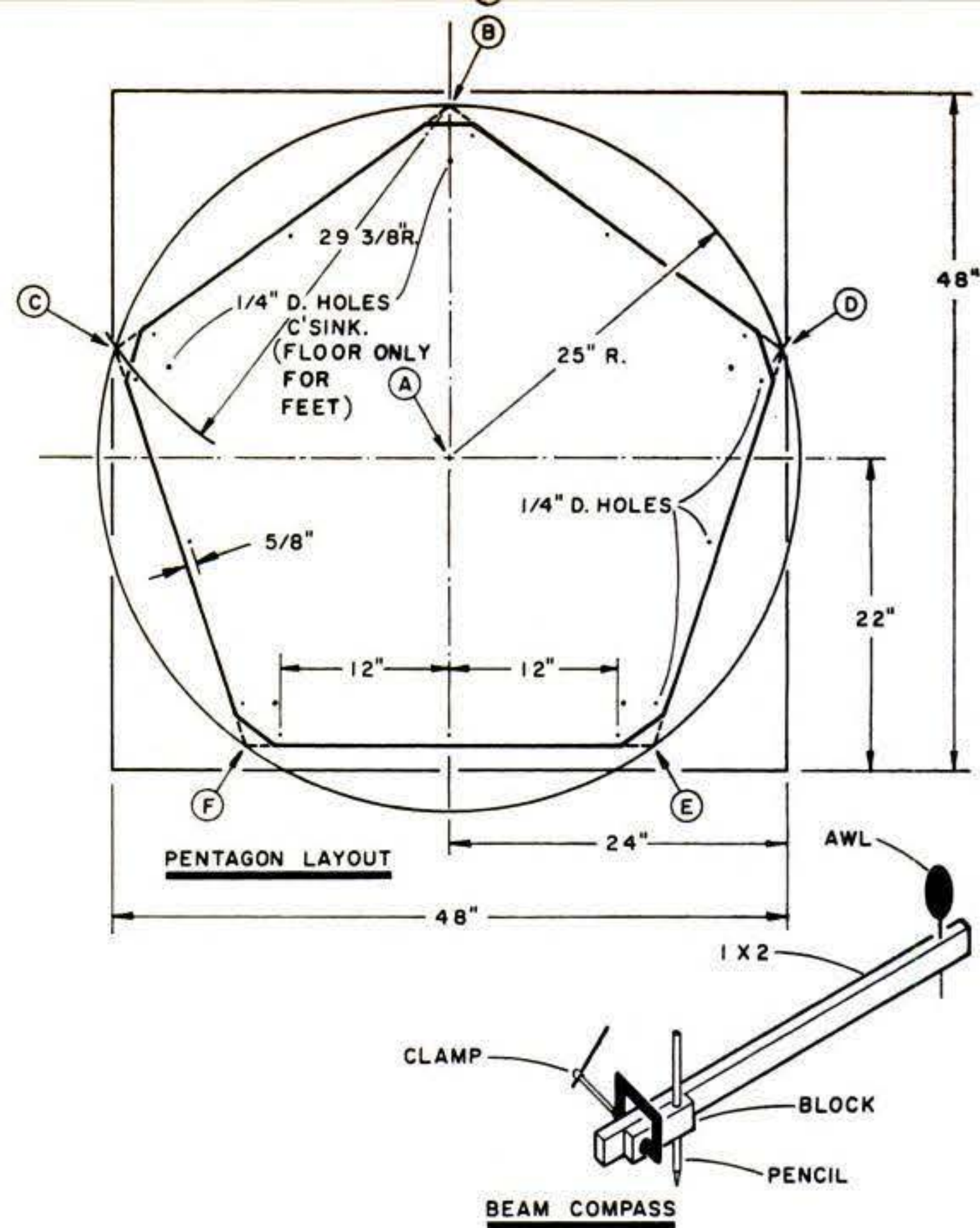
This project was conceived to make it easier for

Assemble the pentagons with common corner angles spread to 117 degrees with vise and pliers. Machine screws pass through predrilled panels into washer and wingnut. To join at floor line, prop lower panels at proper angle (right).





How to lay out the pentagons: Cut each of the 4'-by-8' plywood panels into 4' squares, as above; prepare your layout carefully, since all edges must be equal for assembly of dodecahedron. Use a beam compass—either the commercial type above or homemade version sketched at right (drill tight-fit hole near one end of 34" 1-by-2 for the awl; drill block for pencil and clamp to other end so distance between points of awl and pencil is exactly 25"). Mark off vertical and horizontal centerlines on plywood square, locating horizontal 22" from bottom edge. Using centerpoint A, scribe circle (note that pencil goes off three edges). Reset compass for 29 $\frac{3}{8}$ ", set point at B and strike arcs right and left, intersecting circle at C and D as above. Using same setting, move point to C and mark off F. Move point to D and mark off E. As check, set point at E to see if arcs cross at F. Join points with straightedge and cut out first pentagon with fine-tooth saw. True edges with fine wood rasp and finish with sandpaper on a block (hold rasp and block at 90 degrees to face of panel). Use this pentagon as template for layout of other 11. Just mark points on



plywood squares and connect with straightedge. Note that a small triangle (with 3 $\frac{1}{2}$ " base) is nipped off at each corner. Cut 12"-radius hole at center of one pentagon to serve as access door.

all of us to satisfy our need for occasional moments of private contemplation. Enter the Meditator and surround yourself with the graphics which cover its walls, and something begins to happen to you almost at once.

It's difficult to predict, but you may find the sensation akin to that mystical communion with nature that you experience when alone in a forest—or the sense of peace you feel in an empty cathedral. Or you may develop sudden insights as you study the

picture-fragments of your world—and be swept by the conviction that you're "getting it all together" at last.

Far back into history. For the design of the Meditator, I've gone to the ancient Greeks and borrowed one of the polyhedrons they first visualized—the 12-sided dodecahedron, each face of which is a perfect pentagon. The Pythagoreans called it the "atomic building block of the Universe."

Although the structure is simple to build, the secret of its effectiveness lies in the preparation of those graph-

ics inside. You create them from pictures cut from popular magazines—pictures of any subjects you wish, but pictures to which you have a strong response. The random assemblage of such pictures is a technique I developed some years ago and which *Look* magazine christened "pholage"—a word coined from "photo" and "collage" (an art work pasted up from scraps).

The point of a pholage is to confront the viewer with immediate ac-

[\[Continued on page 134\]](#)

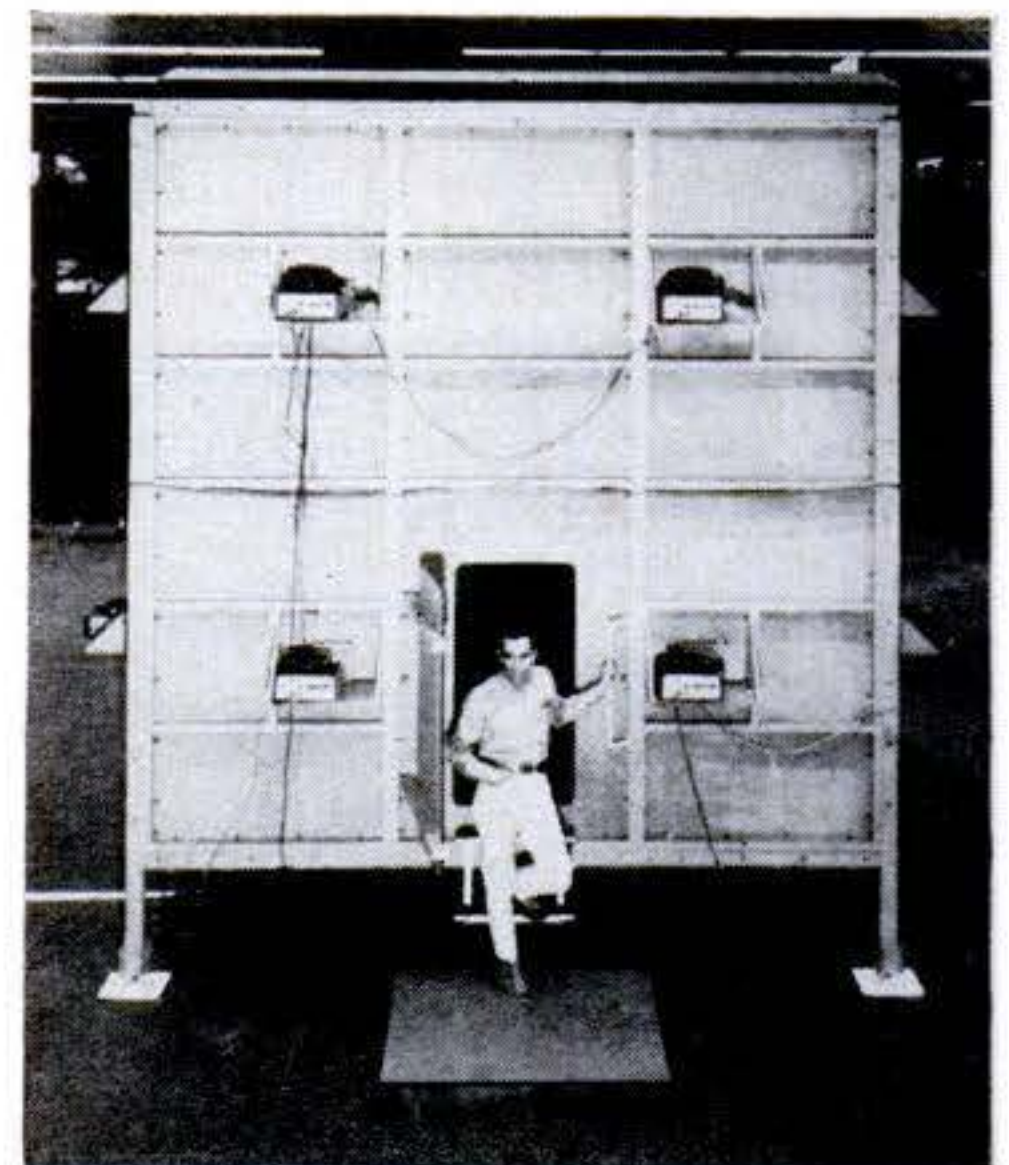
Author Ken Isaacs pioneered the concept of contemplation structures

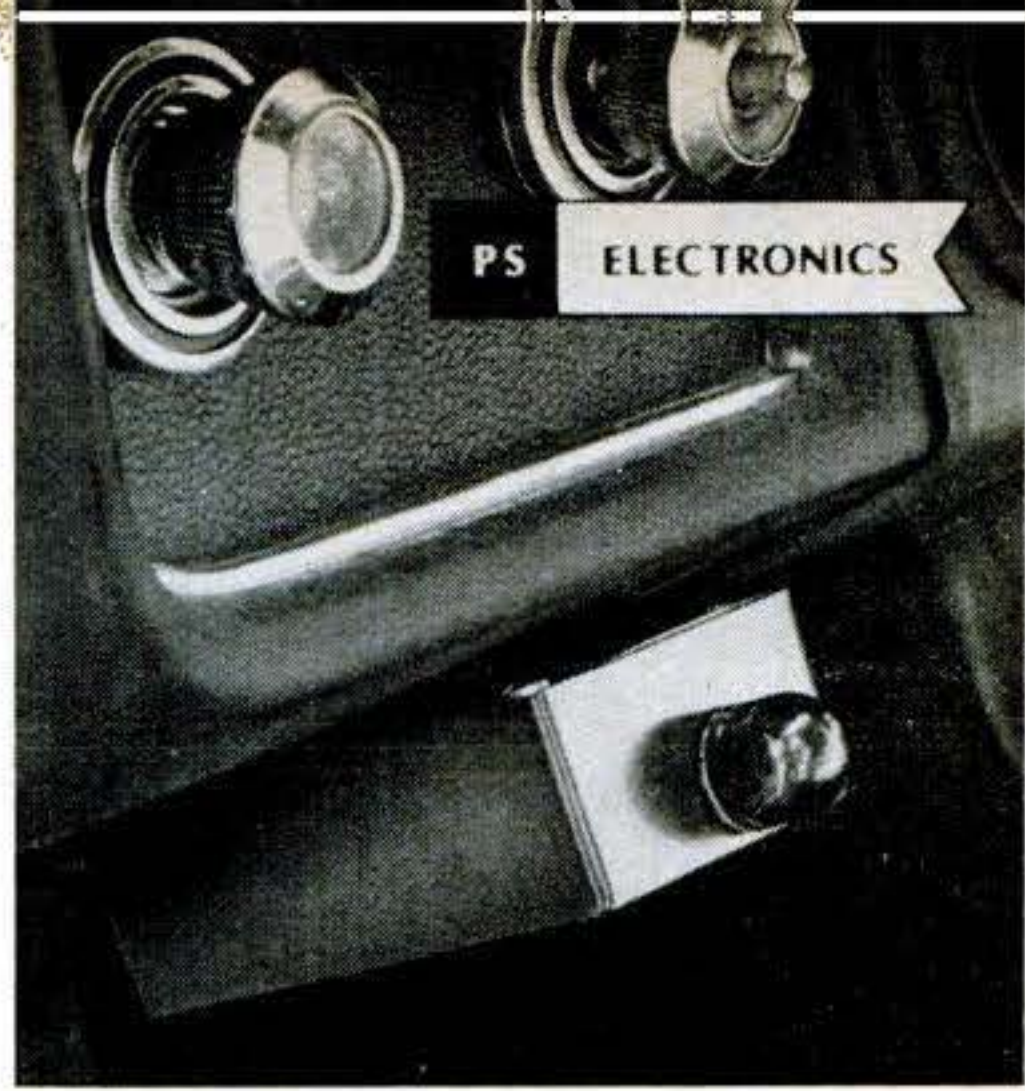
From all the publicity on study carrels and retreat structures in the past year, it's easy to suppose the concept is brand new. A leading New York museum gave over all its space to 16 Contemplation Environments and people flocked to the show, padding shoelessly from structure to structure. The museum developed the exhibit because many artists and architects were independently seeking solutions to modern man's need for solitude and mental rejuvenation.

Other museums across the country have introduced similar concepts, inviting artists to create rooms or

snug one-man "crawl-ins" conducive to undistracted meditation.

But PS Design Consultant Ken Isaacs has been working with such environments for over a decade. When we introduced him to PS readers in March, 1968, we included the photo at right, showing the Knowledge Box Isaacs created at IIT in the early 60s. The related images on the inner walls of this 12-foot cube came from 24 synchronized, outside projectors. The PS Meditator is a natural outgrowth of the Knowledge Box, and the latest application of Isaacs' Matrix Idea.





FILL 'ER UP! The Blinker Says So

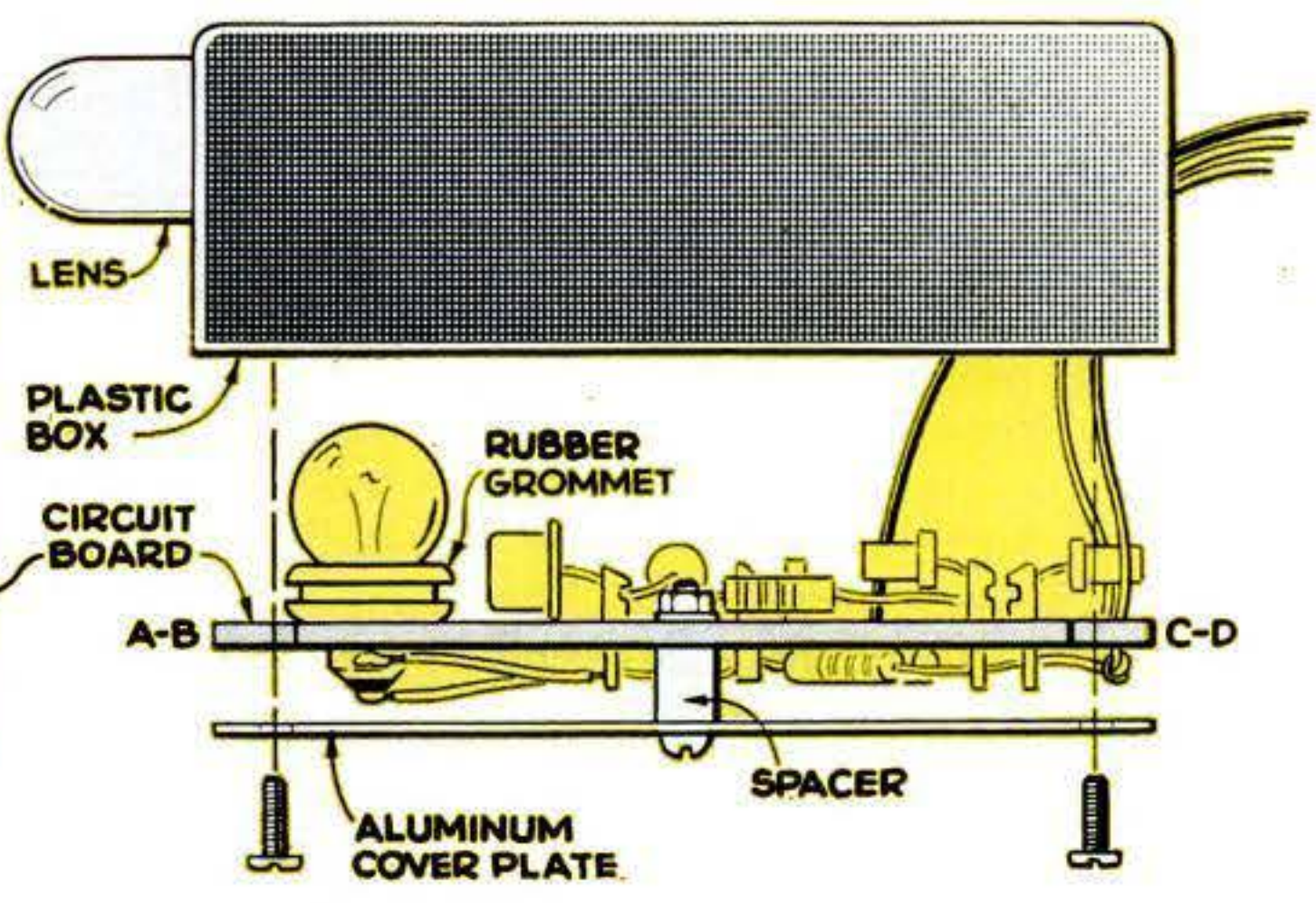
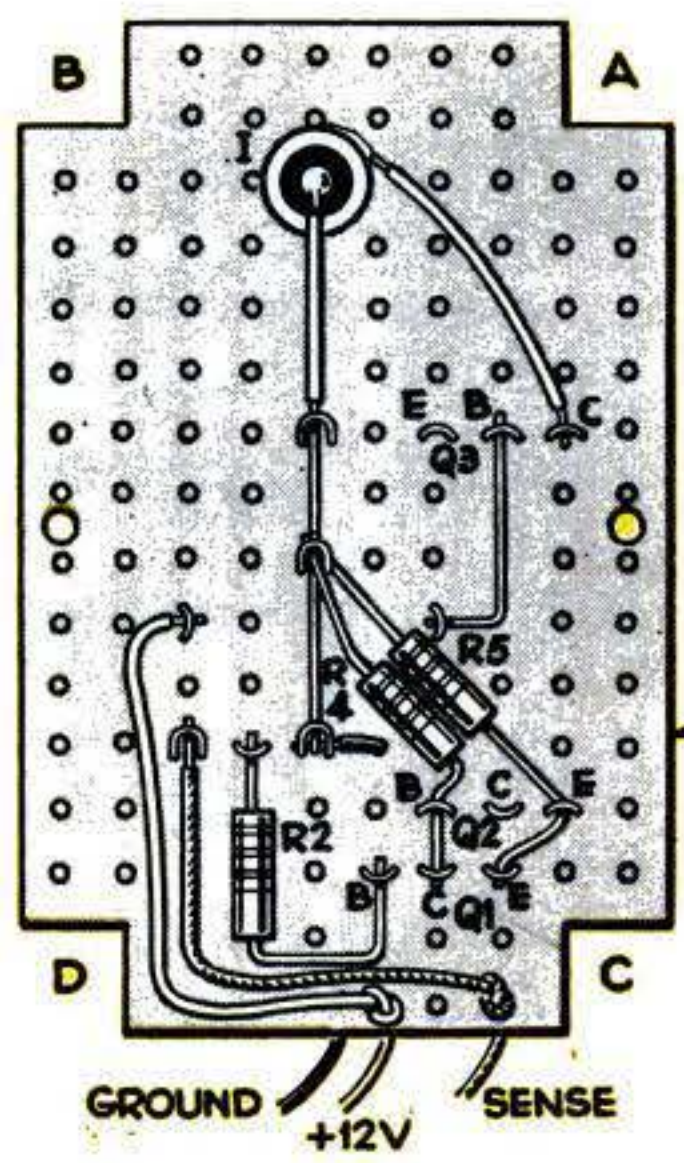
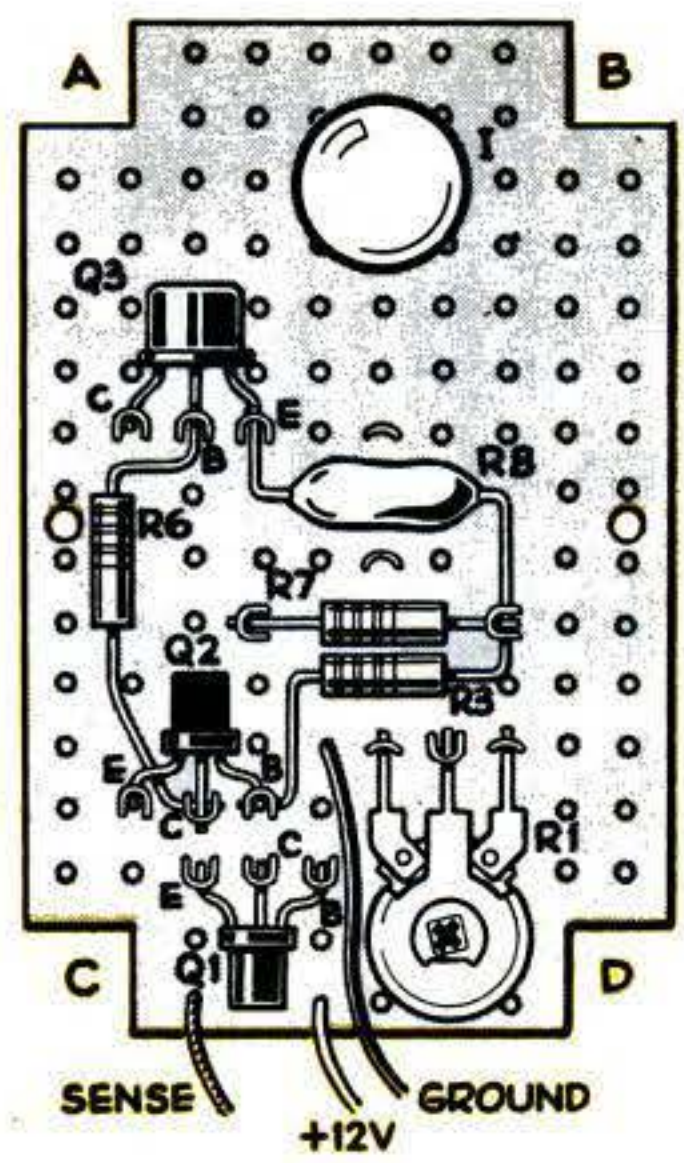
Now owners of GM cars can build a low-fuel indicator like the one previously described for other makes

By RUDOLF F. GRAF and GEORGE J. WHALEN

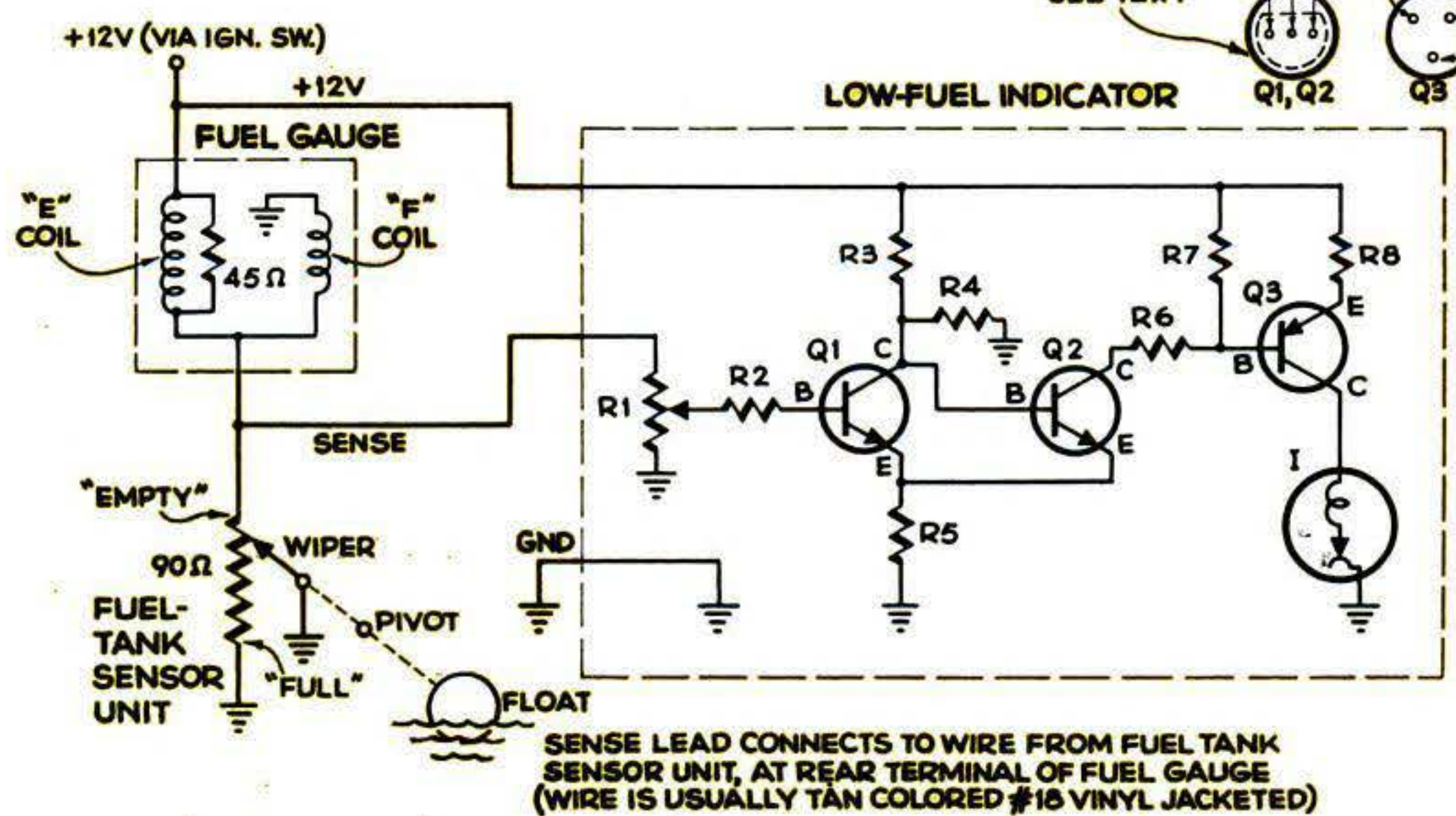
The newest automobile on the road unfortunately still has motoring's oldest problem: the empty fuel tank. If you're one of those blithely unaware of a fuel gauge, we have here a more obvious way of nudging you to a stop at the next fill-up station. It's a gentle reminder—a warning light you make yourself—that may save you from a long walk. Our low-fuel indicator is for GM cars only. [For a similar simple and inexpensive device for Ford, Chrysler,

American Motors, and many foreign cars, see PS, Apr. '70.] No changes are called for in your car's wiring, and the fuel gauge works as usual. Unlike the other automobile manufacturers that employ a bimetallic fuel-gauging system, GM uses an electromagnetic one. This so-called "air-core" gauge contains two coils of fine enameled wire on either side of a small round permanent magnet which is connected to the EMPTY/FULL pointer. The two coils are connected

in series between ground and the positive side of the battery, and across each is a shunting resistor. Across the coil which pulls the pointer toward the EMPTY margin is a 45-ohm resistor, while the FULL coil is in parallel with a 90-ohm float-operated variable resistor. This, of course, is the heart of the system, which changes its resistance in proportion to the amount of fuel that is in your gasoline tank. *[Continued on page 121]*



- PARTS LIST**
- R1—5,000-ohm, 1/2w variable resistor
 - R2, R6—2,700-ohm, 1/2w carbon resistor
 - R3, R7—10,000-ohm, 1/2w carbon resistor
 - R4—4,700-ohm, 1/2w carbon resistor
 - R5—120-ohm, 1/2w carbon resistor
 - R8—1-ohm, 1w carbon resistor
 - Q1, Q2—Sprague 2N2923 or equiv.
 - Q3—Motorola HEP 242 or equiv.
 - LM—#257 self-flashing bulb with red tint (Inventive Electronics, Wykagyl Station, N.Y. 10804; \$1 pp. for 2)
 - Misc.—Minibox 1 1/8" x 2 1/8" x 3 1/4", perfboard, 2 spacers 1/4", grommet 1/2" o.d., red lens cover (opt.)



What to Do When Your Motorcycle Conks Out

By JIM DAVIS / PS West Coast Editor

You're riding along down a dark country road when the engine of your new motorcycle begins to pop and then quits dead. You find you're out of gas. There's no reserve fuel because you neglected to turn off the reserve tap the last time you filled up. There isn't a gas station for miles.

With your flashlight, you see a bit of gas in the tank bottom. But how to get it to the carburetor?


Try this: Leave both taps on, roll the front wheel up on a curb or rock, and shake the bike back and forth. The gasoline will run to the back of the tank, down the fuel line, and into the carburetor.

Start the engine, get into high gear quickly, keep your speed low, and with luck you'll make it to the nearest source of gas.

This is just one example of what imagination and common sense can do to get you home in an emergency. There are many other emergency fixes. Did you know, for example, that a paper clip can be subbed for a faulty distributor rotor? Did you know that the little hand pump that comes with many new motorcycles will transfer gas into your tank?

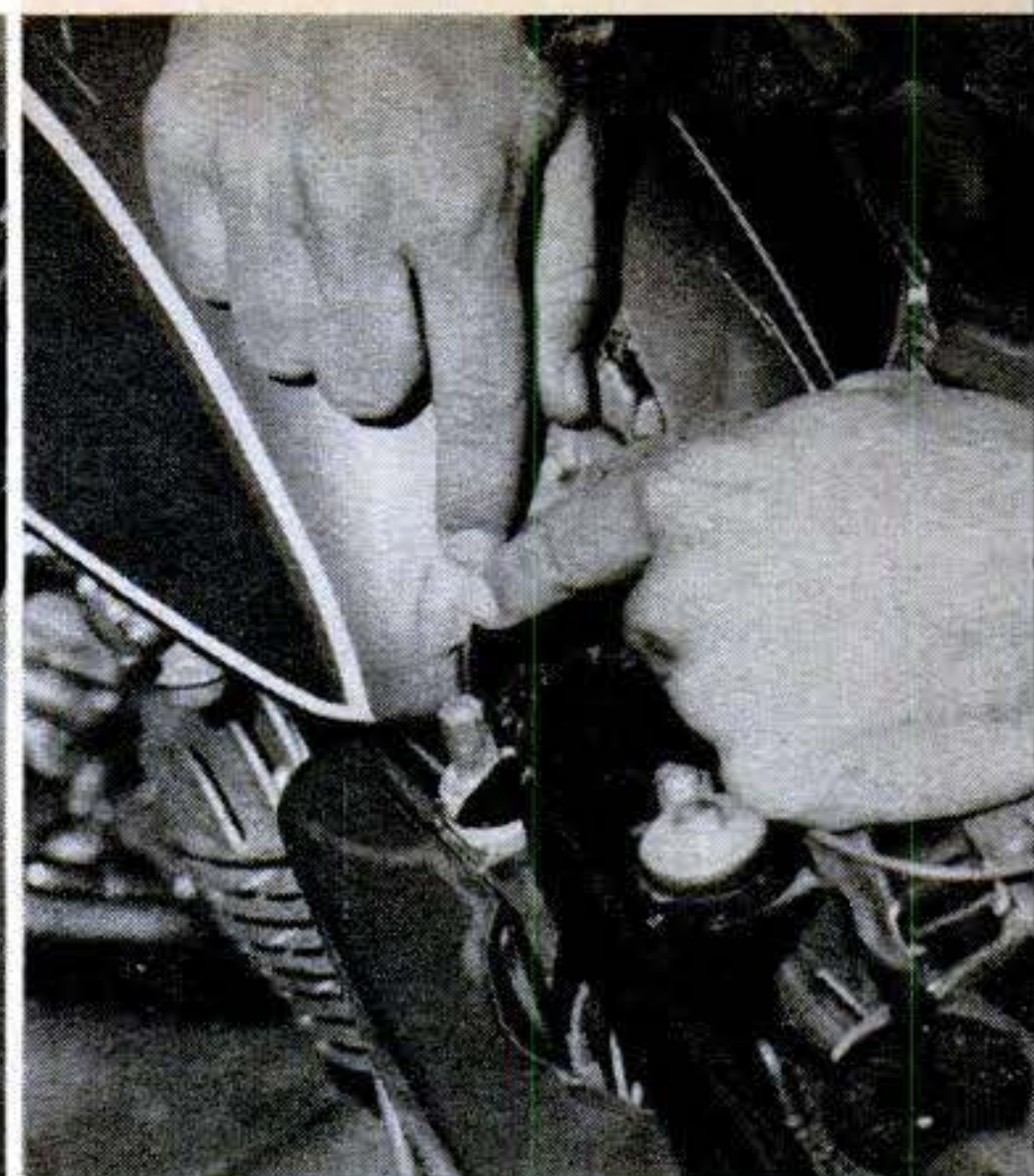
Use your imagination! In many cases, one or two standard flashlight batteries will supply enough electricity to start a disabled battery-ignition bike. A coil that goes bad is trouble, but it's possible to decrease your spark-plug gap, and the faulty coil will give you a few more miles.

If you're stuck without a fuse, tinfoil from a cigarette package wrapped around the old fuse will work for a while. When you've let the battery water get too low, pour in some water and let it sit for a couple of hours. The battery should build up enough juice to get you started. A broken taillight lens may attract a policeman—but not if you coat the bulb with lipstick or nail polish.

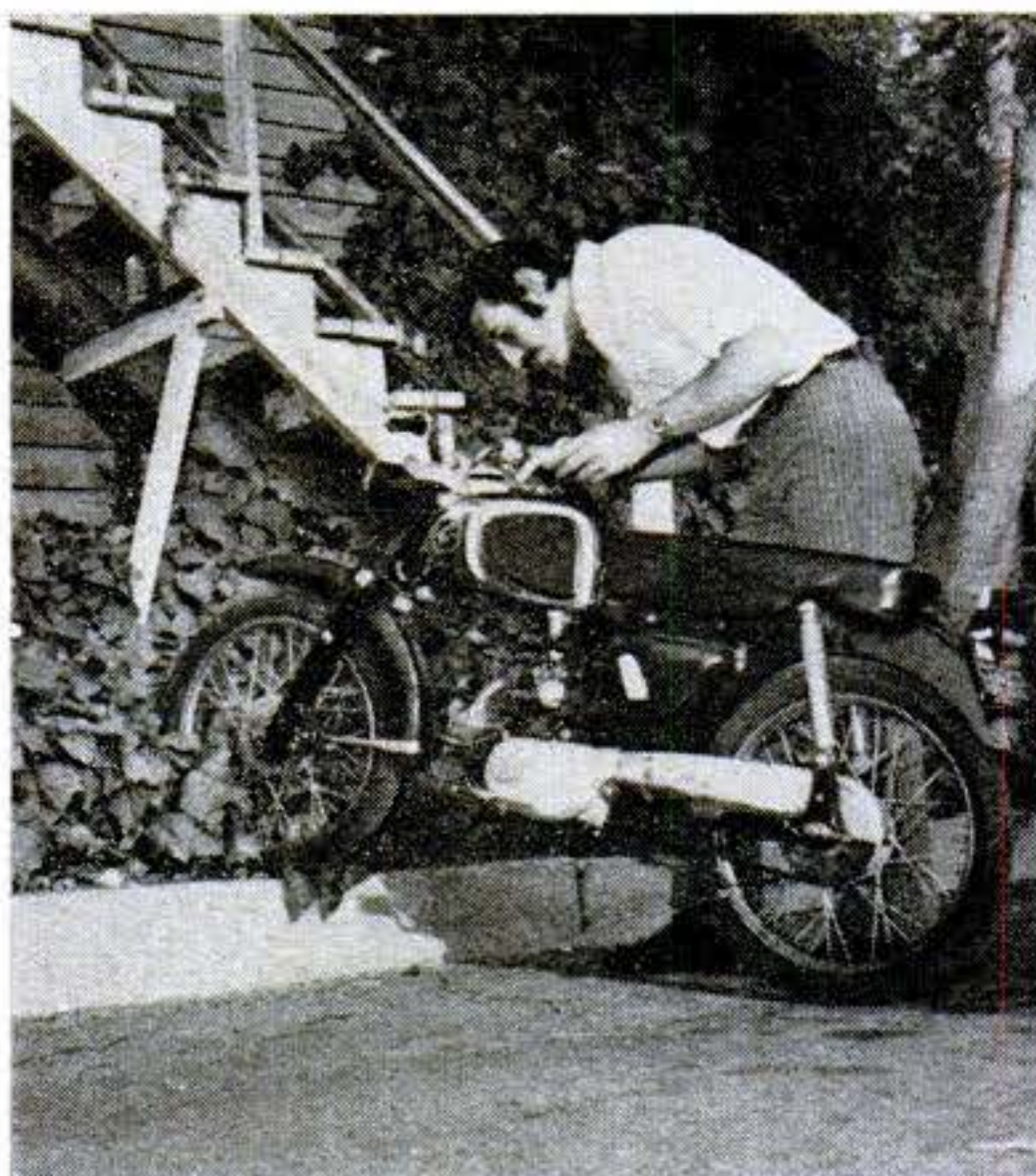
Every year, motorcycles become a little more reliable. Perhaps some day they'll never need any repair. Until then, think out your problem and you'll probably get home. 



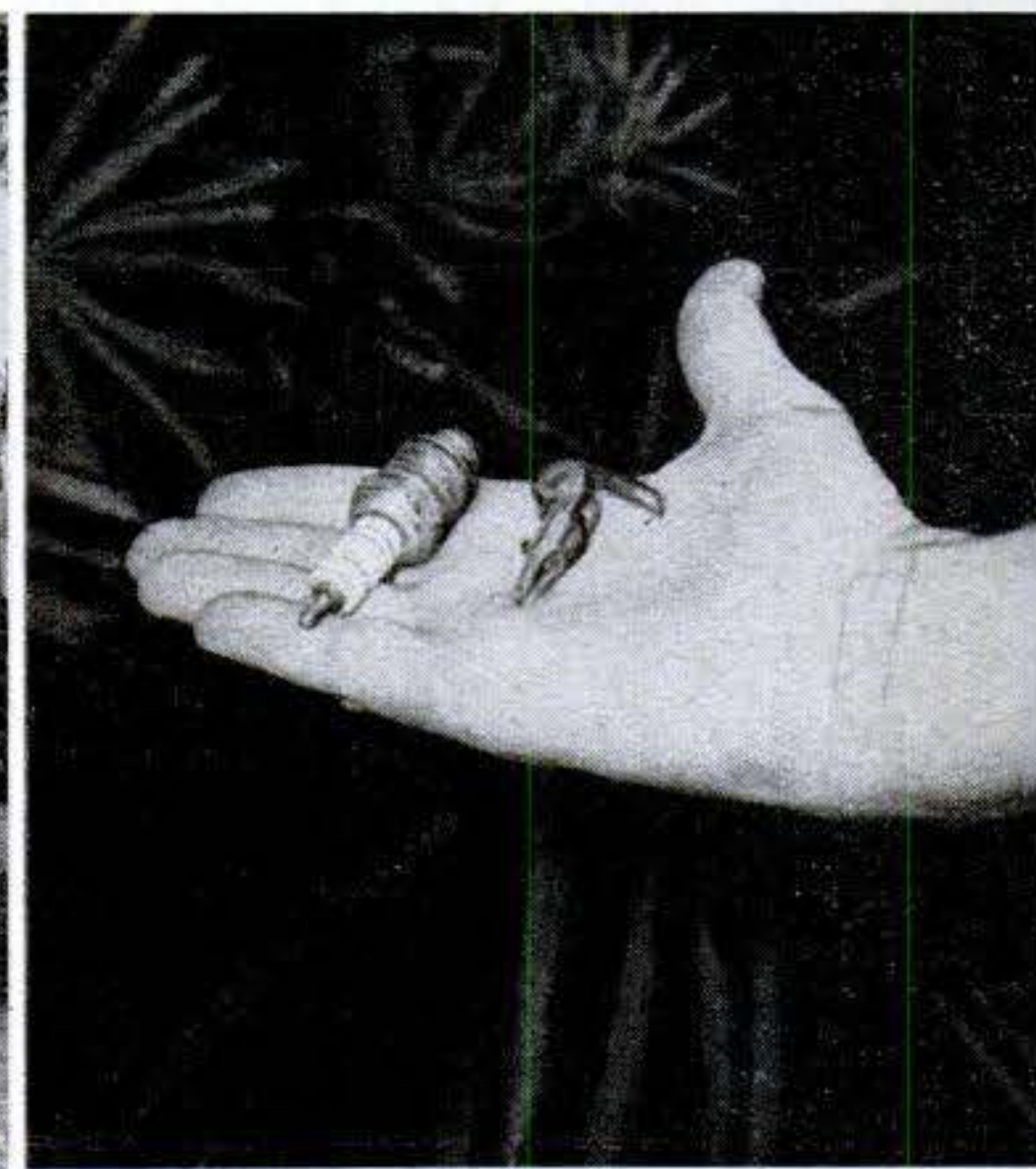
A fouled plug can be cleared by holding the cap $\frac{1}{8}$ -inch from the electrode. With luck, the voltage buildup will fire the plug and clear it out so you can get home.



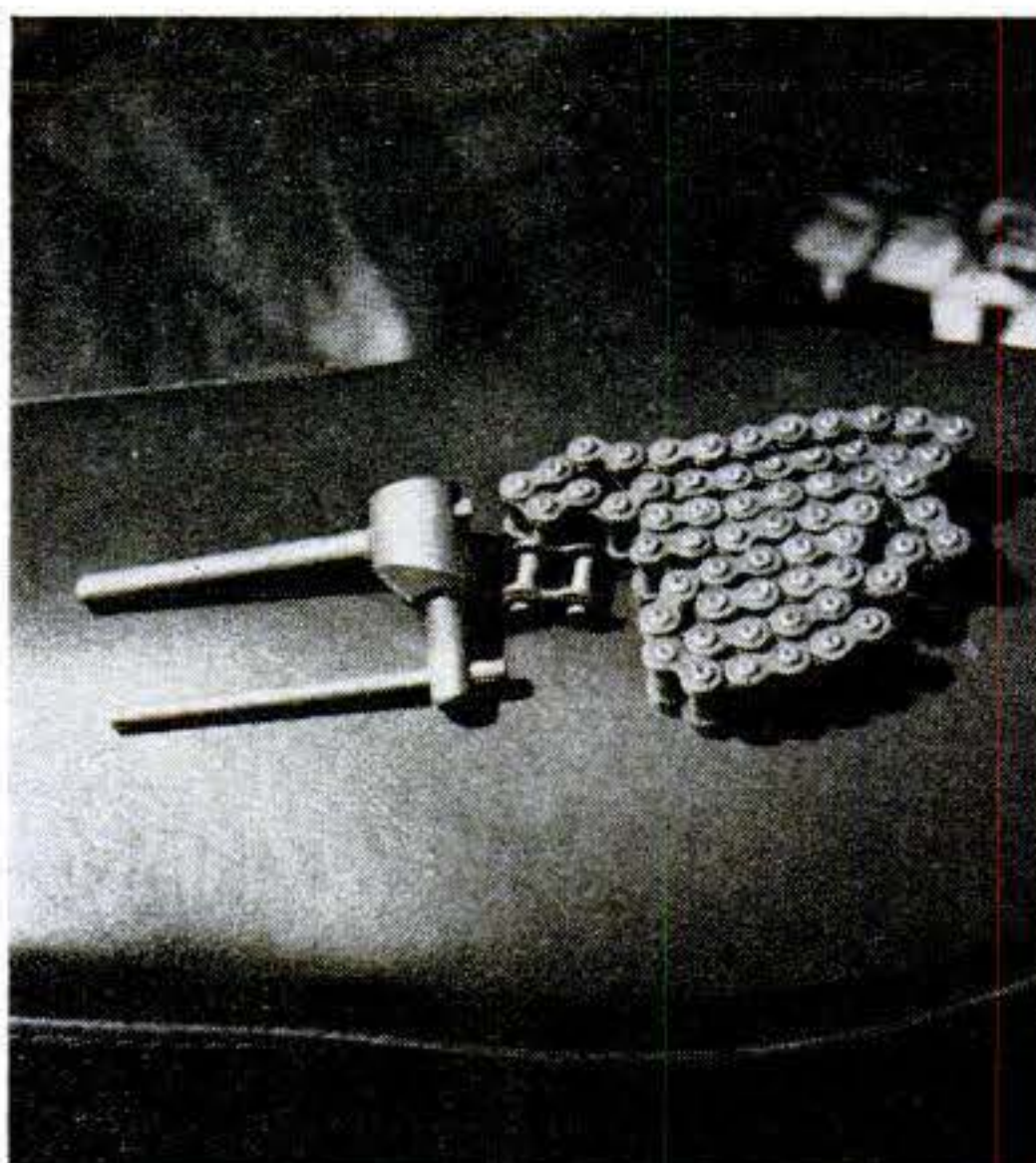
Putting chewed gum over a gas-tank leak isn't farfetched. It's certainly not a permanent repair, but when you're deep in the woods it may get you back to camp.



Out of gas? Maybe not. There's usually a tiny bit in the bottom of the tank. To get it down to the carburetor, put the front wheel up on curb and rock the bike.



Ignition parts are not easily repaired by the roadside. So why not take along extras in your tool kit—a spark plug, a condenser, and a new set of points as a starter?



For touring with your motorcycle, a chain breaker, a master link, and a spare length of chain are an absolute must. Your total investment shouldn't come to much over \$6.



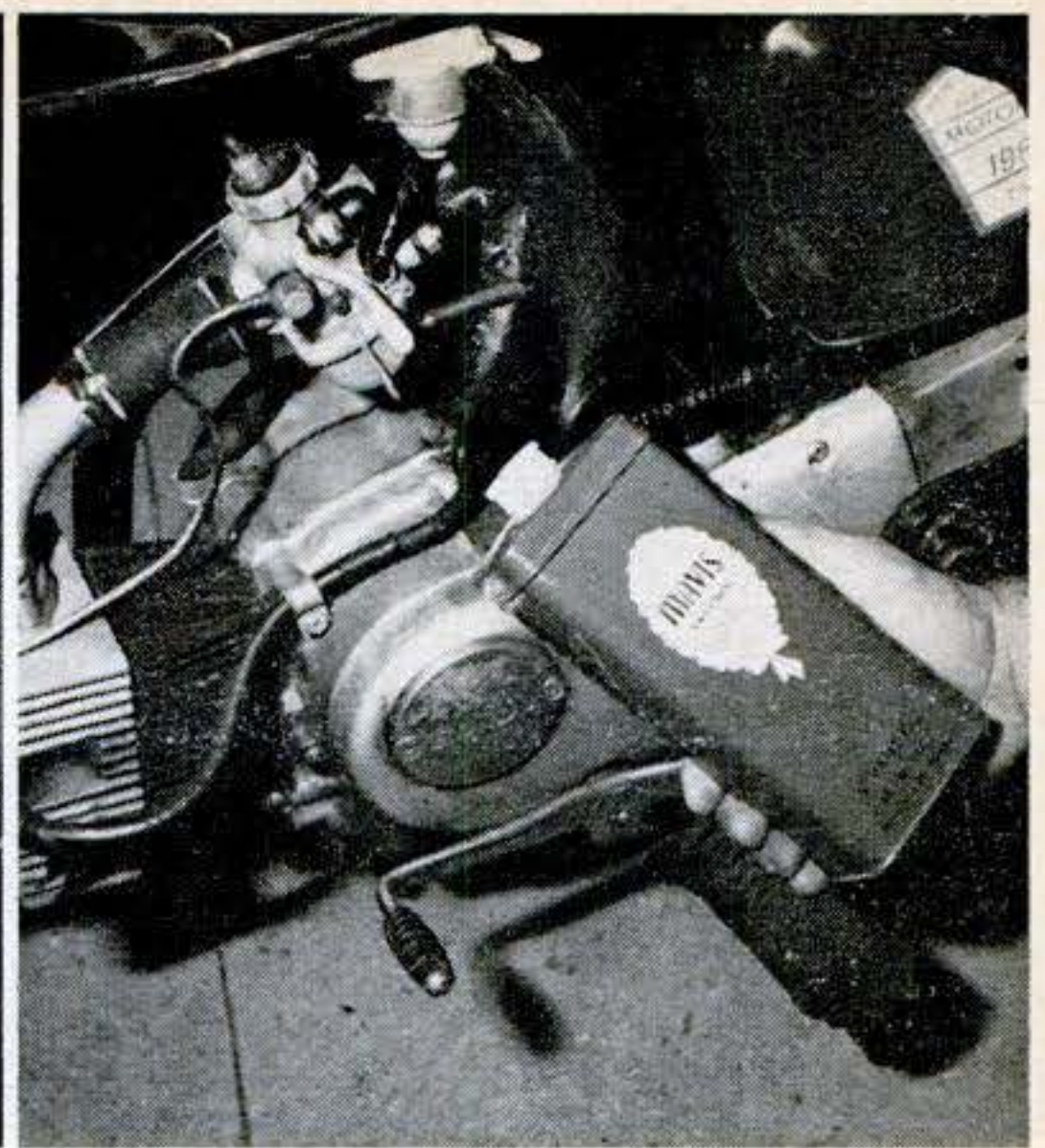
Carry a spare clutch and throttle cable. Follow the routing of the old cable and tape both cables together so you're ready to install the new one when the old one breaks.



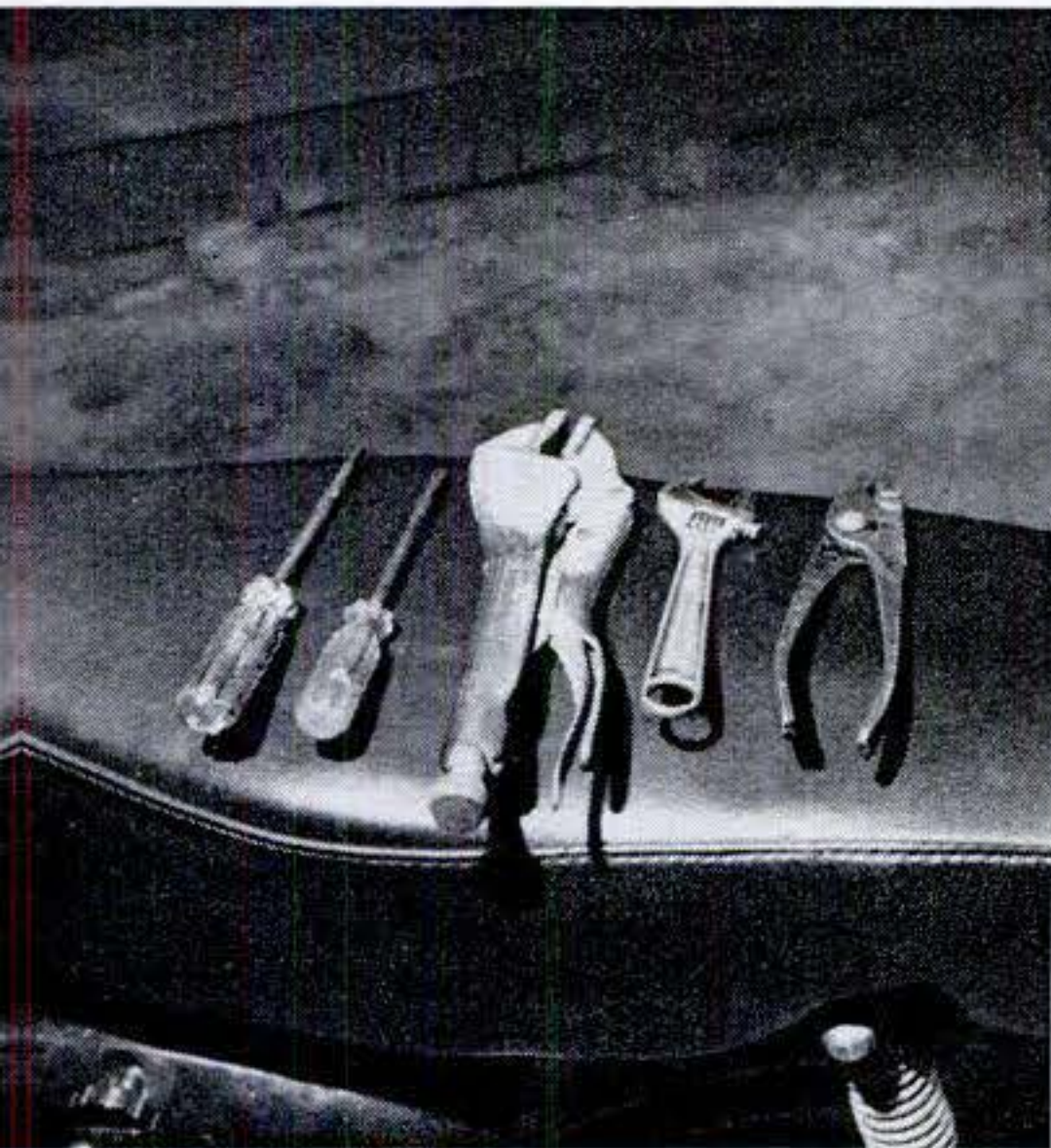
Grounded at night by a burned-out headlight bulb? Keep a replacement inside the cowl of the headlight. There's also space here for an extra fuse and a stoplight bulb.



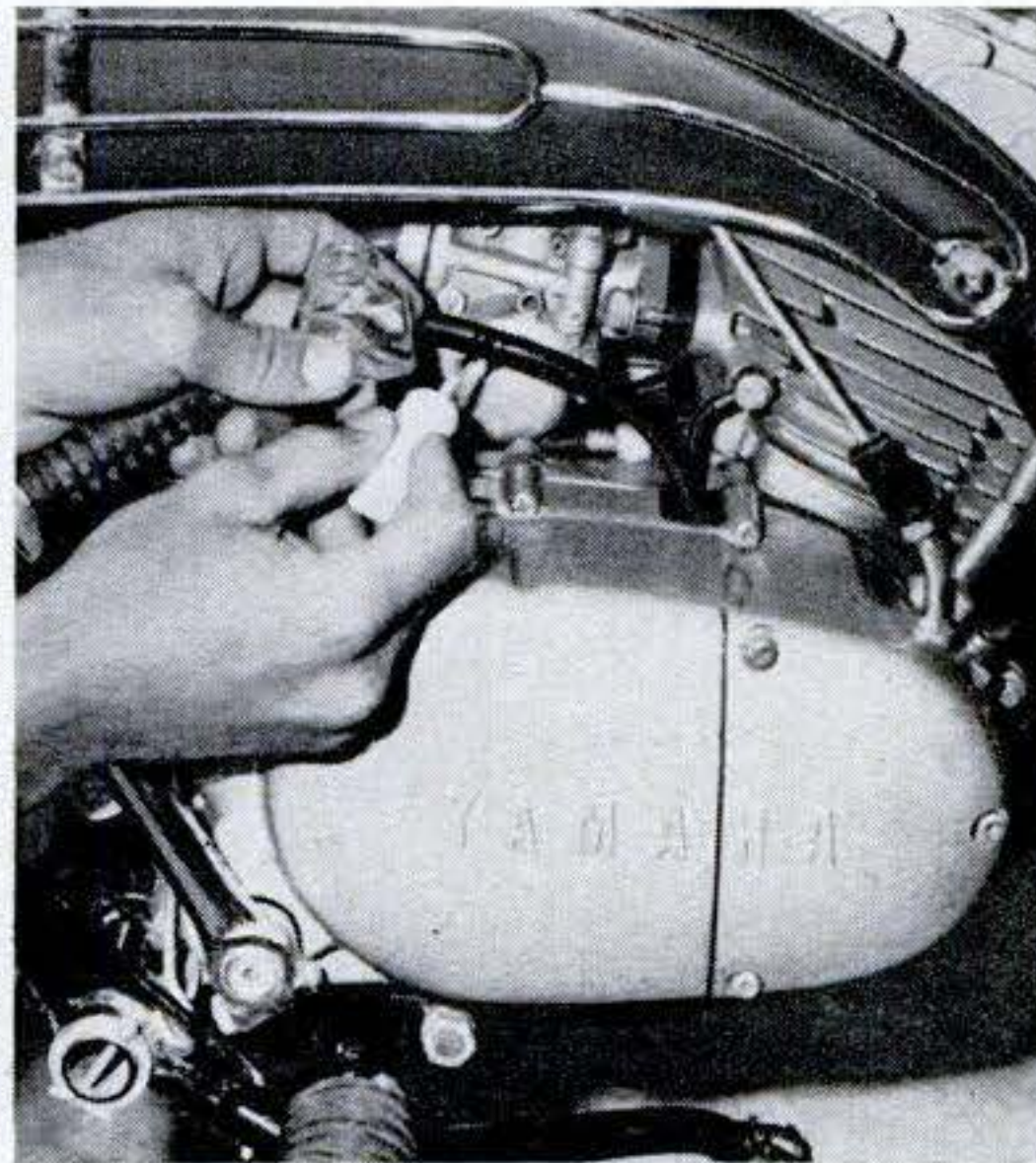
Most motorcycle carburetors aren't very complicated, but they can be if you've never taken one apart. Before starting that next trip, find out what makes your carb tick.



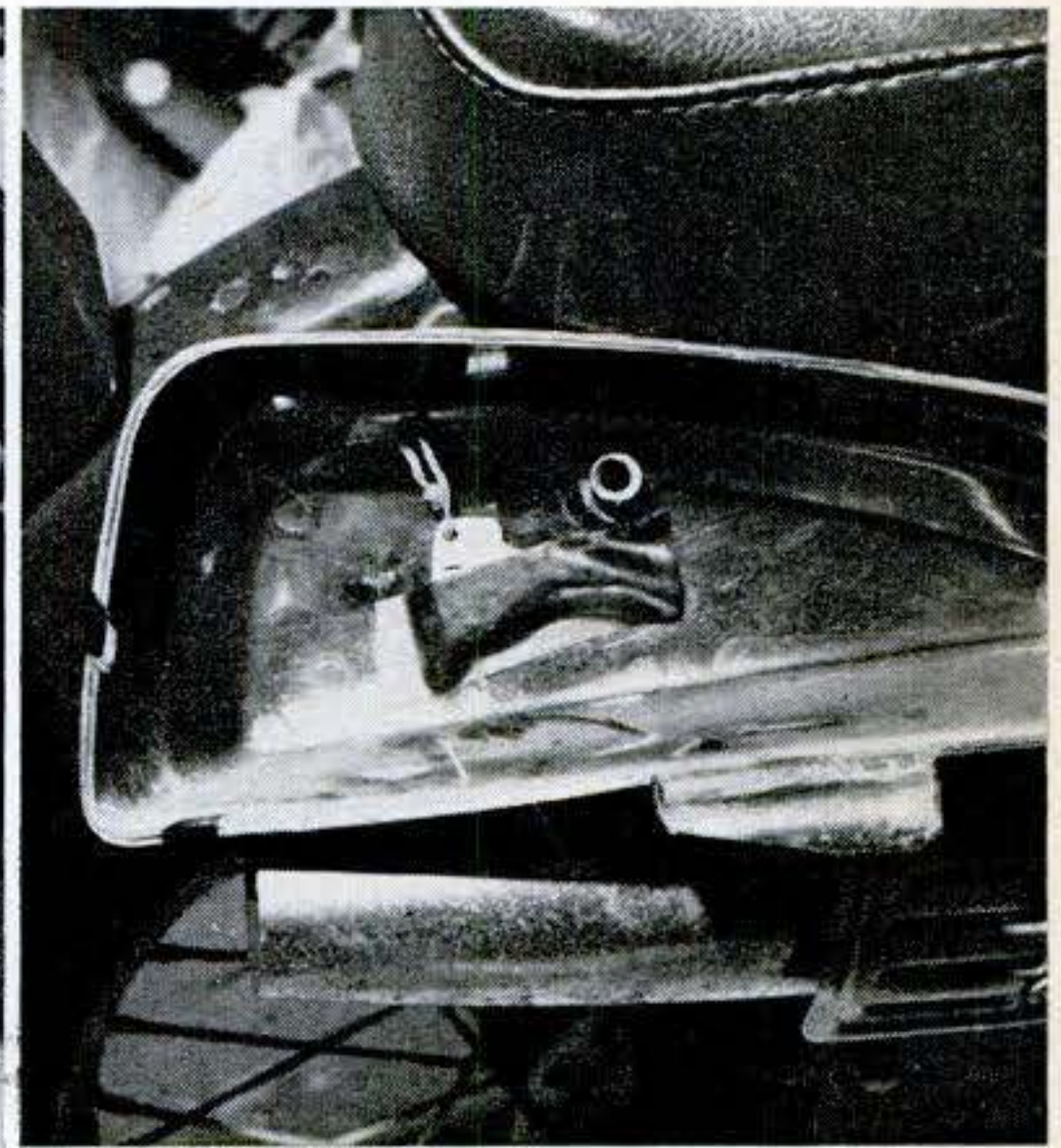
A slipping clutch can sometimes be temporarily cured by placing common talcum powder between the plates. The trick will get you to where you can make repairs.



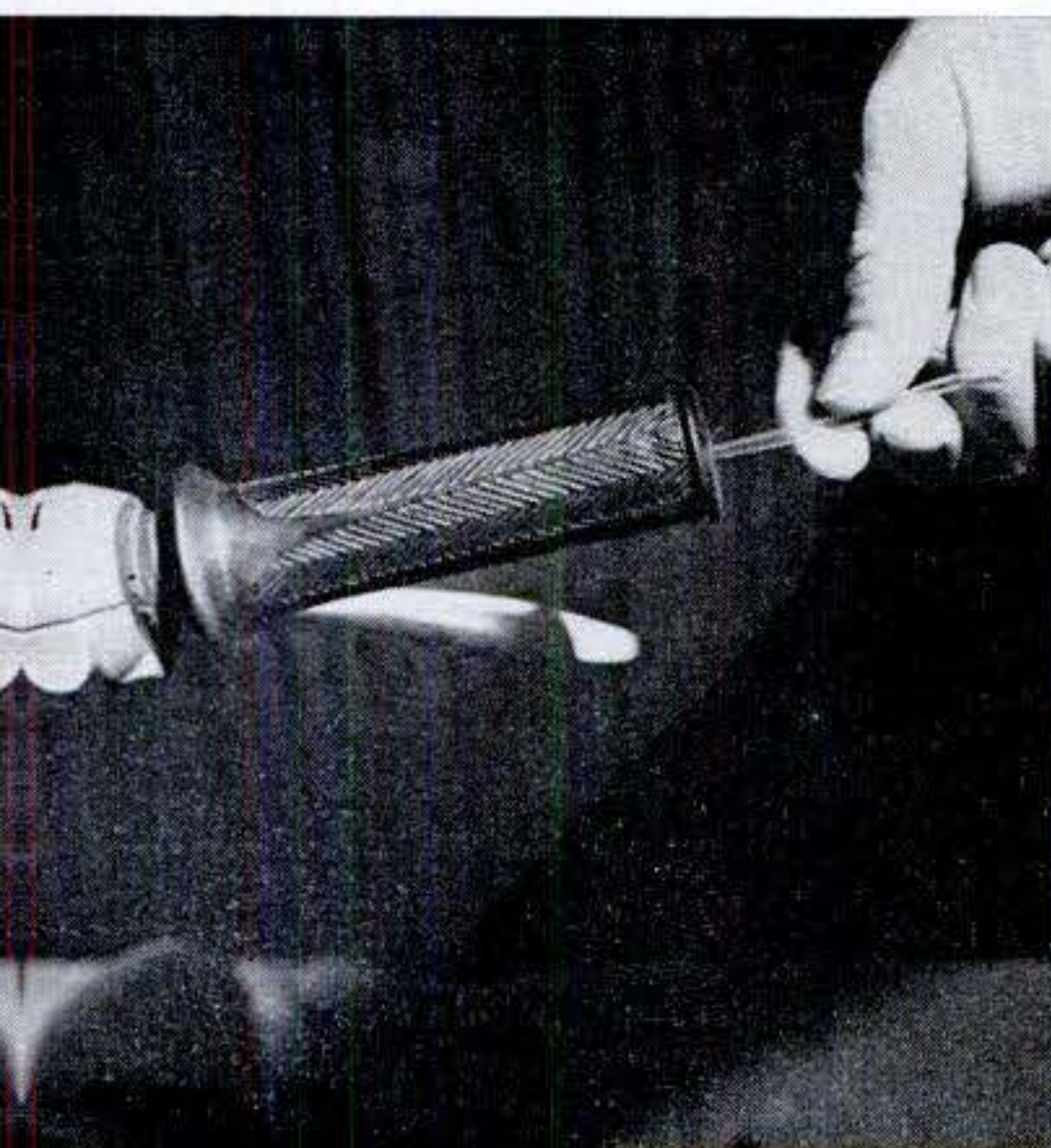
Motorcycle toolboxes should carry a maximum of important tools. Vise grips make an excellent emergency shift, brake, or clutch lever if the original is lost or broken.



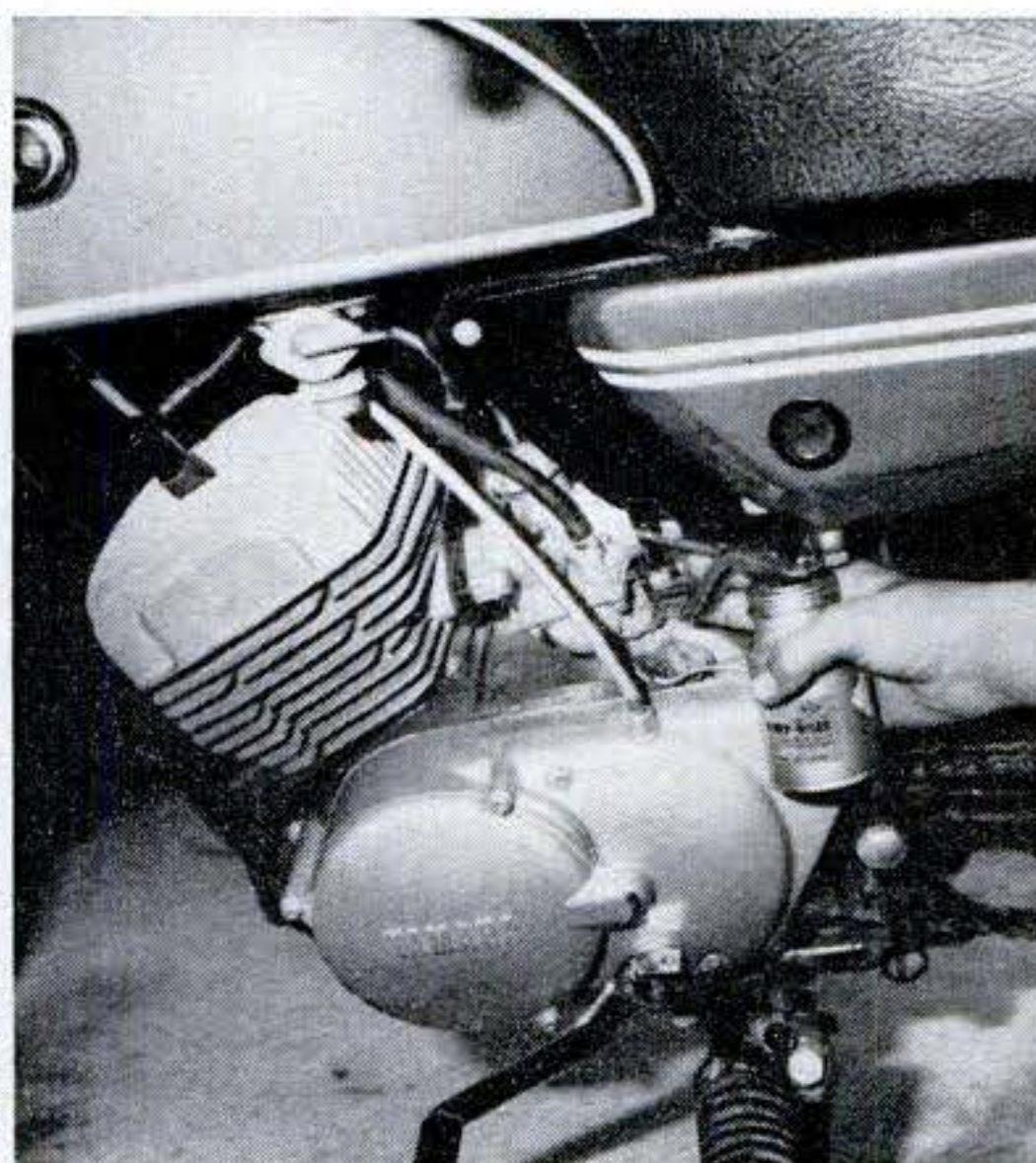
An ignition line with an electrical leak can sometimes be repaired by painting with nail polish or thick, flexible paint. Chances are the fix will get you back to your base.



Lose that ignition key and your motorcycle instantly becomes as useful as a large hunk of granite. Why not tape a spare inside the toolbox cover or the headlight cowl?



Get gasoline from another vehicle in an emergency. Siphon it out with a length of small plastic tubing carried inside one of the handlebars for just such an occasion.



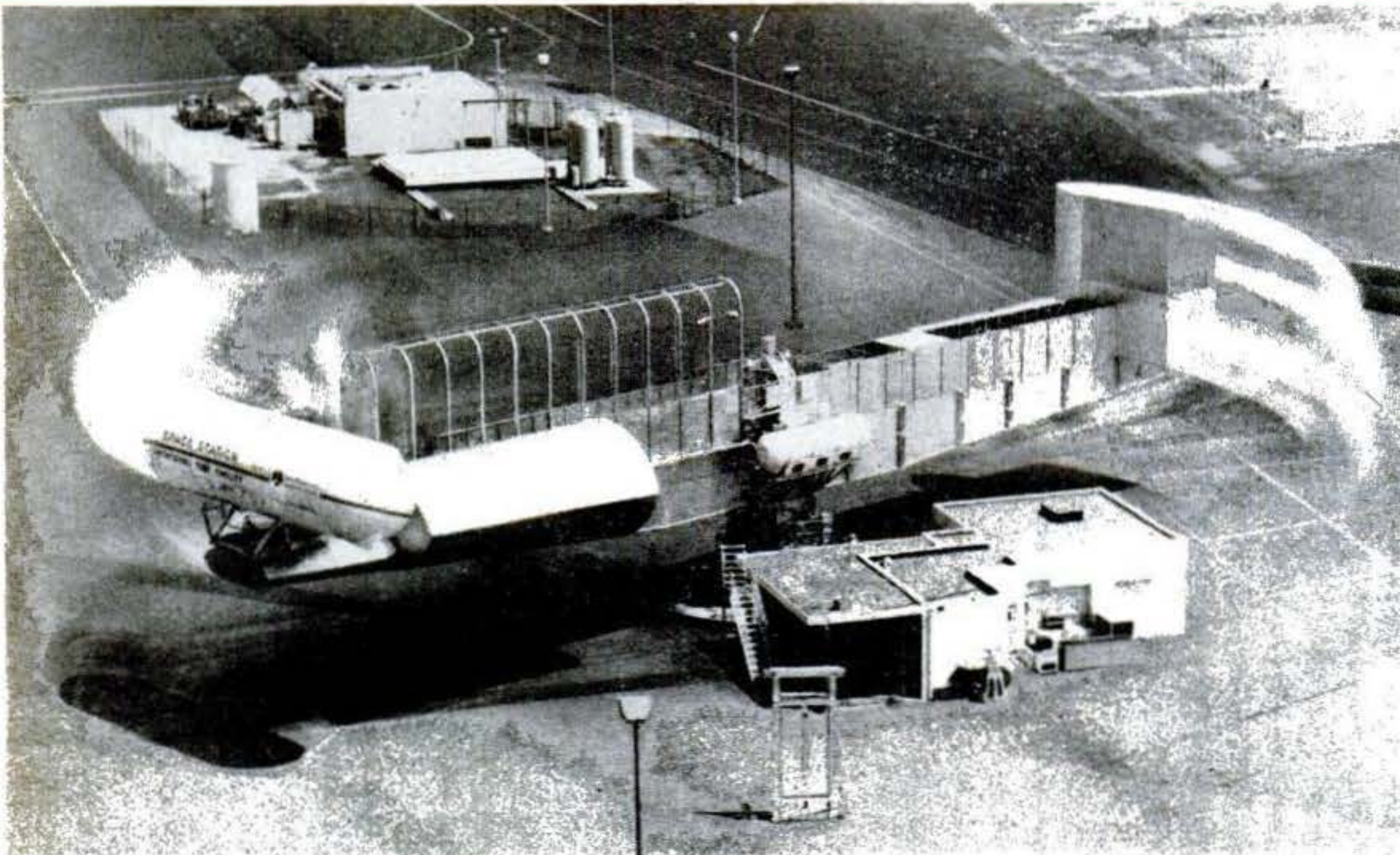
A seized engine can often be made to run long enough to get to the nearest garage. Allow it to cool completely, then squirt oil into the carb intake as you start the engine.



If baffles blow out of your muffler, you're likely to get a ticket. As a substitute, insert a large piece of coarse steel wool inside muffler to cut down noise level.

What's New

A PICTURE ROUNDUP OF NEW PRODUCTS AND DEVELOPMENTS



▲ Giant spinner simulates artificial gravity

All aboard for a week-long spin! Groups of four space engineers will spend up to seven days at a time as test crewmen inside the gondola at left, to provide information for construction of the earth-orbiting space station planned for the 1970s. Counterweight at the opposite end of the beam helps spin the rig at a constant speed, which creates an artificial gravity like that of a rotating station in space. The giant spinner is at North American Rockwell's Space Division just outside Downey, Calif.

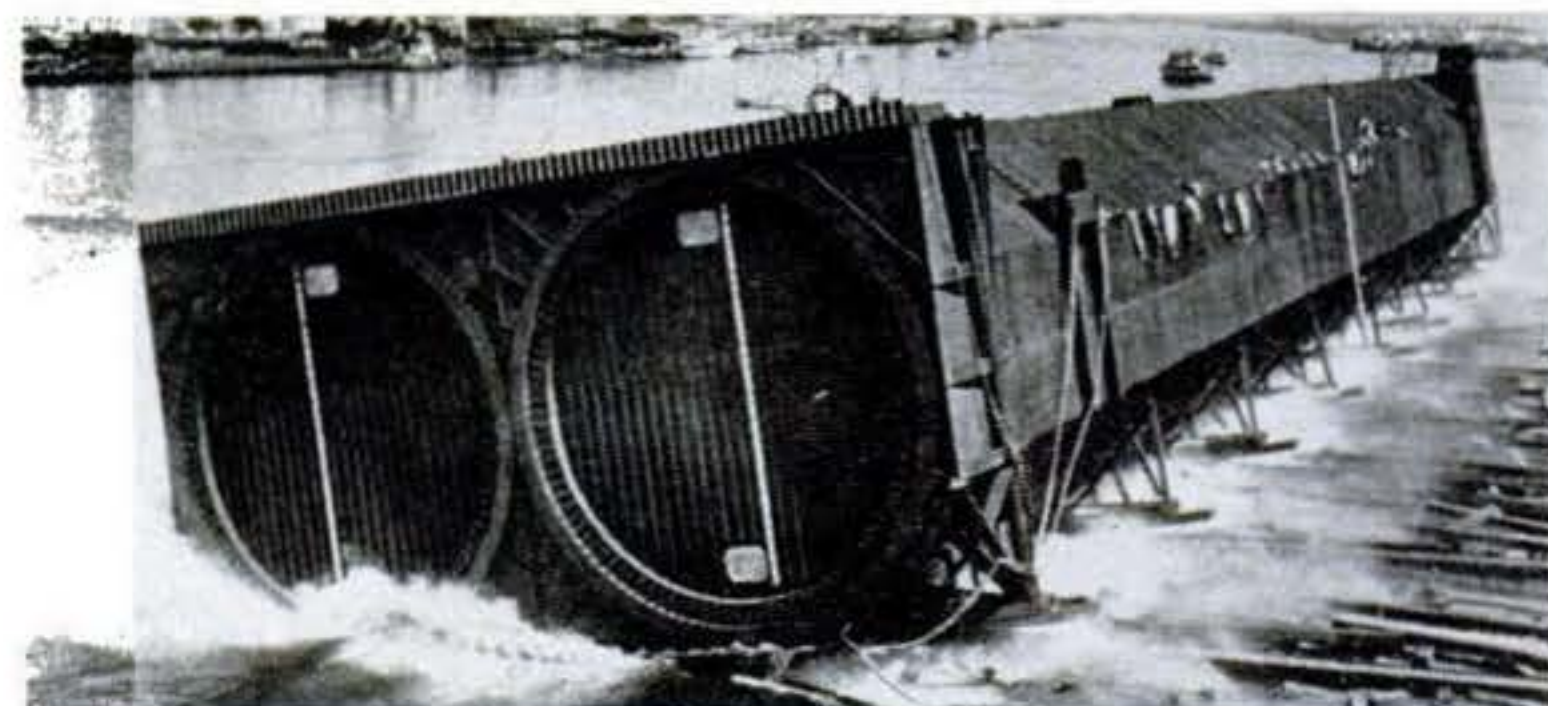


▲ Reflective student

This West German lad will trek to school in greater safety, these dark winter mornings, thanks to that specially-designed school bag. It's made of bright yellow plastic, studded with reflecting buttons and buckles to help drivers spot him easily.

▶ Vest toasts your torso

This battery-powered vest should warm the heart of any outdoorsman. It's made of plastic-coated aluminum foil sewn into perforated fire-retardant fabric. Six heating pads are fed by cadmium batteries in breast pockets. John Bloch, a participant in Alcoa's 1970 student design program, designed it.



◀ Arctic twister

An ATV for Alaska? Have a look at Lockheed's Twister, whipping over an ice ridge 200 miles north of the Arctic Circle. It's already completed trials elsewhere in the U.S., over desert sand and through marshes and dense forests. Both yoked bodies have independent four-wheel drive.

▲ Launching a tunnel

Sliding down the way of the Alabama Shipbuilding Company is a huge steel shell for a four-lane highway under the Mobile River. Made of three million pounds of Armco steel, this is the first of seven sections for the half-mile tunnel that will be floated to the site and sunk.



▲ Electronic backpack won't let you get lost

It's called a position locator, and Westinghouse makes it for the Army. The locator automatically computes the distance and direction traveled by a wandering soldier on patrol, who then determines his location by reading map coordinates on a counting meter and comparing them with grid lines on a military map. The system consists of a 14-pound backpack computer plus boot antennas (top right) and a display/control unit (lower right). The antennas count and measure each step by an exchange of electronic signals fed to the backpack, which contains a compass device. The system can also be used in forestry work, in exploration, or for preliminary mapping.



◀ This spear fights fire

The old gag about fire axes doing more damage than the fire they're used against may soon be obsolete. This Badberg Piercing Firefighter has a sharp nozzle that can be thrust through roofs, ceilings, and partitions to put smothering fog exactly where it's needed.

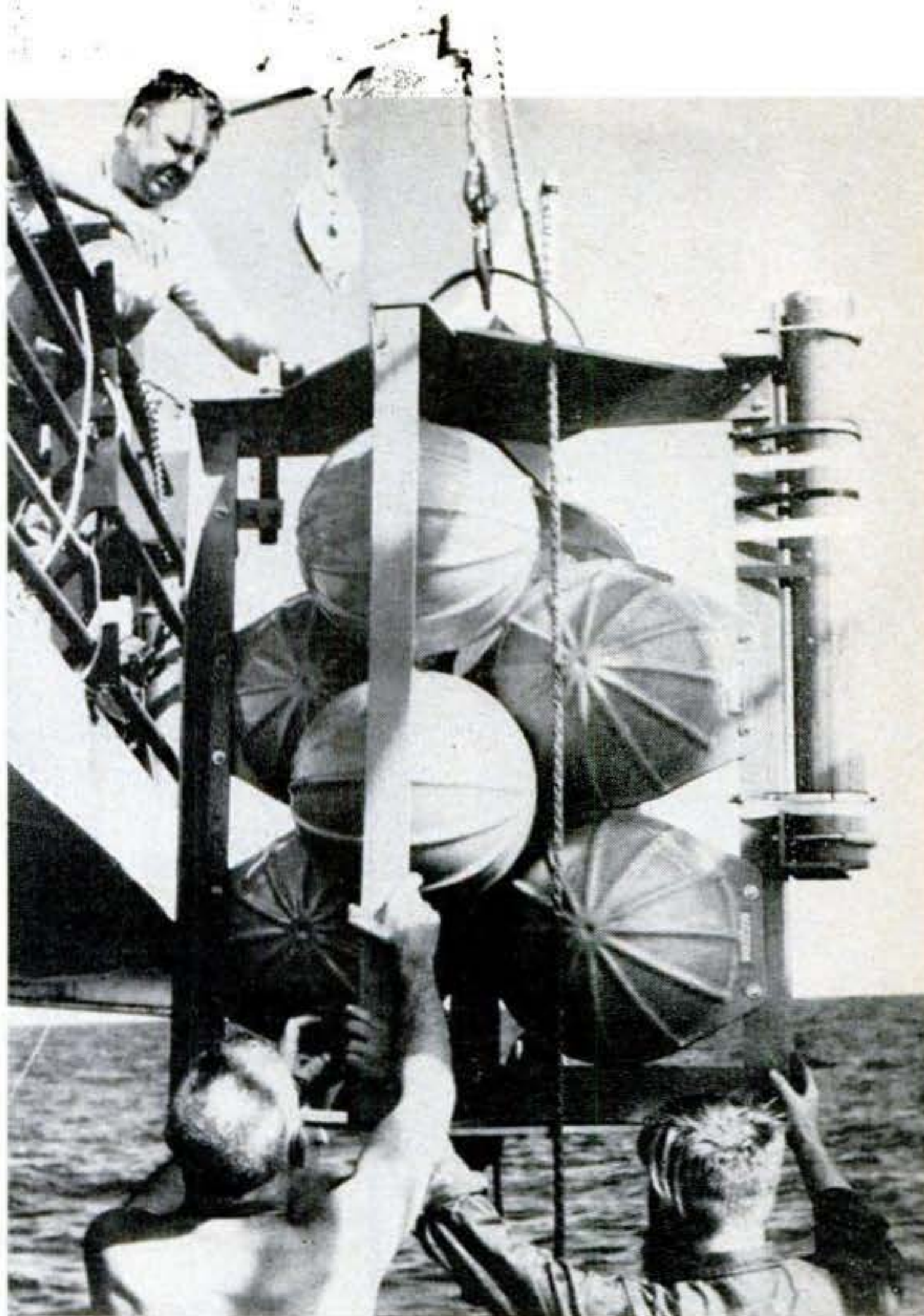


▲ And now: from Prague

The Czechs enter the international sports coupe scene with this prototype built by the Motor Vehicle Research Institute. The fiberglass body features a fastback window hinged as a trunk lid. Beneath the trunk, an inclined 69-inch Skoda engine delivers 75 hp through a four-speed transaxle. Top speed: 110.

Carnival of safety ▶

Disabled on a dark road? In England you can guide traffic past by festooning this string of lights along your car. Clipped to the battery, a fluorescent yellow cable provides five bulbs in red PVC sleeves. You sling a matching pair (and a battery pack) over your shoulder. Festive, what?



▲ Sink the bubbles to study deep currents ▲

Scientists at Woods Hole Oceanographic Institution in Massachusetts are here lowering into the sea a modular buoy system of eight 16-inch plastic-cased glass spheres bolted into a fiberglass framework. Four such assemblies were dropped to 4,500 meters for two-month periods to study the countercurrent fluctuations of the Gulf Stream. The amount of buoyancy can be altered by merely adding or removing spheres—made by Corning Glass and called CABLEMATE floats—and these can be used again and again.



What's New



▲ Cricket and Colt join the Chrysler lineup

Chrysler's response to increasing sales of imports in the U.S.? If you can't lick 'em, join 'em. The little four-door above is the new Plymouth Cricket, made by Chrysler in England. Its four-cylinder overhead-cam engine gets 69 horses out of 91 inches, drives with a standard four-speed floor stick. Below it is the Dodge Colt station wagon. The Colts are made by Japan's Mitsubishi Heavy Industries in hardtop and sedan models as well as the wagon.

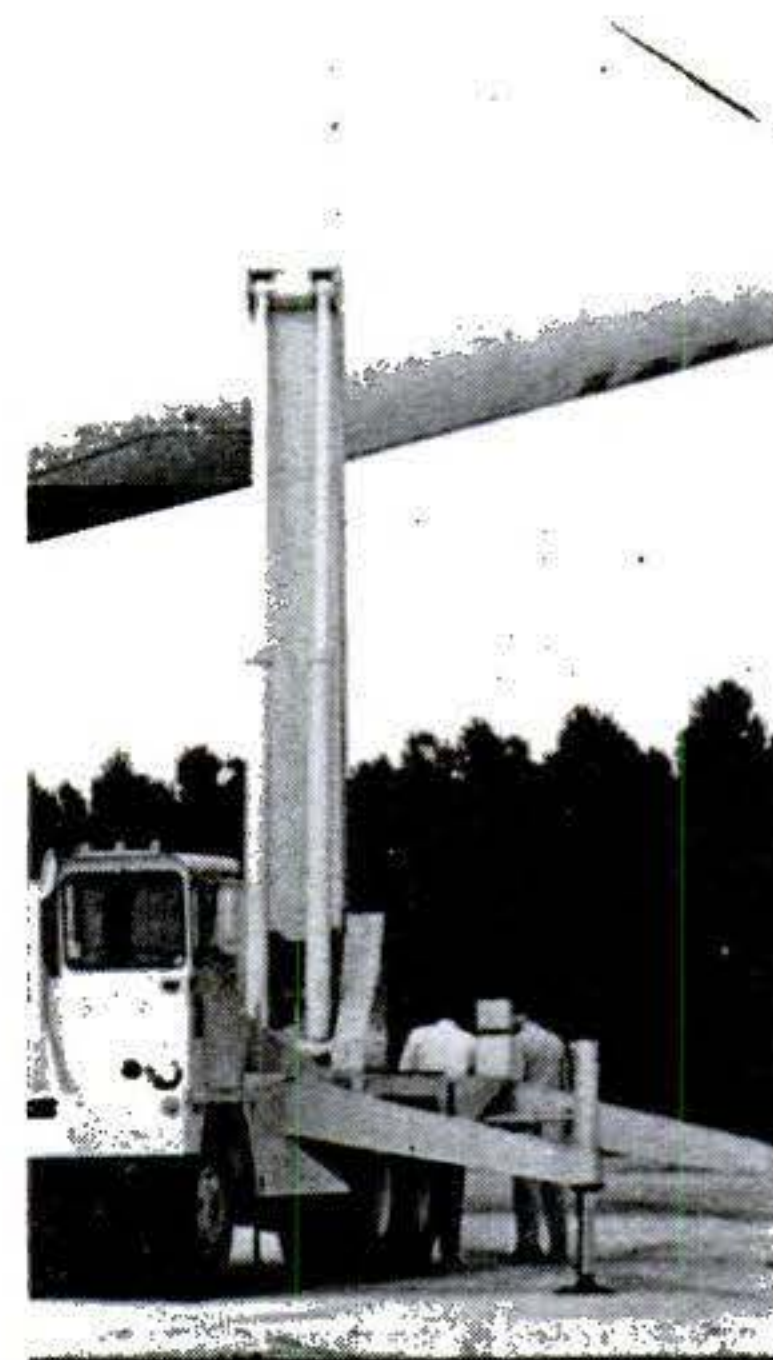


◀ Copter plants a tower

What's the quickest way to plant a five-ton, 135-foot power-line tower in the middle of a swamp? The Virginia Electric Company used a Sikorsky Skycrane and placed 48 of the towers in an average of only 20 minutes each, including transportation from the assembly area.

Top of the tail ▶

It's a long way to the ground for men working on the tail of the new C-5 Galaxy. To get workers 65 feet up to the top of the tail, the plane's builders—Lockheed-Georgia—use a hydraulic lift with special stabilizing arms. The giant plane will be flown on cargo missions by the Military Airlift Command.

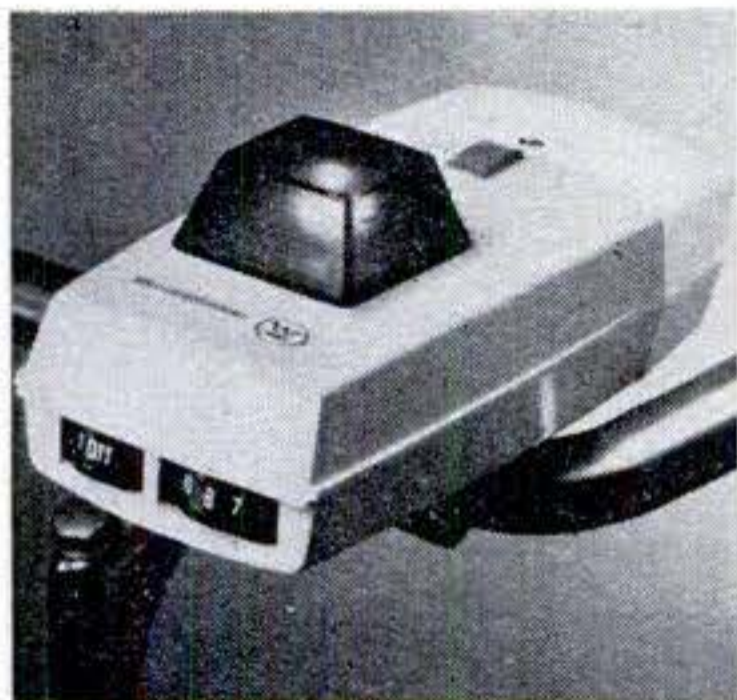


◀ Strap-on hydrofoils for inflatable boats

One way to increase the speed of an inflatable boat is to install a set of hydrofoils. These Swedish foils raise the speed of a 13-footer to 26 mph and cut fuel consumption 40 percent. Other advantages of the foils? Automatic leveling of the craft no matter how passengers and cargo are distributed, plus instant, strap-on mounting. Designed for inflatables, the hydrofoils will boost performance of any flat-bottomed boat by cutting friction.

What's New IN ELECTRONICS

Up/down speakers for all-around sound ➤
 "Dual-dimension" stereo is what Zenith calls the sound produced by its new speaker-system design, included in the Quadrille modular sound system. In each speaker system, a treble horn fires upward and a woofer downward into deflector cones. This setup, the manufacturer claims, results in more even dispersion of sound and full stereo separation throughout the listening room. The Quadrille features a four-speed automatic record changer and an AM/FM/stereo FM tuner. The whole three-piece system, complete with dust cover, sells for \$299.95.



▲ Cycle with a beat
 It's safety first with Westinghouse's new bike radio: An amber flashing light on top warns approaching vehicles and a focused headlight lights the road ahead. The solid-state AM radio, housed in a weather-protected case, can be tuned without taking the cyclist's attention from the road. \$12.95.

Sing-along receiver ➤
 Kenwood's KR-6160 AM/FM stereo receiver features its own dynamic microphone for mike mixing in any mode. The powerful amplifier will drive three pairs of speakers and boasts an equally generous assortment of inputs and controls. The unit sells for \$379.95. An optional walnut cabinet is \$19.95.

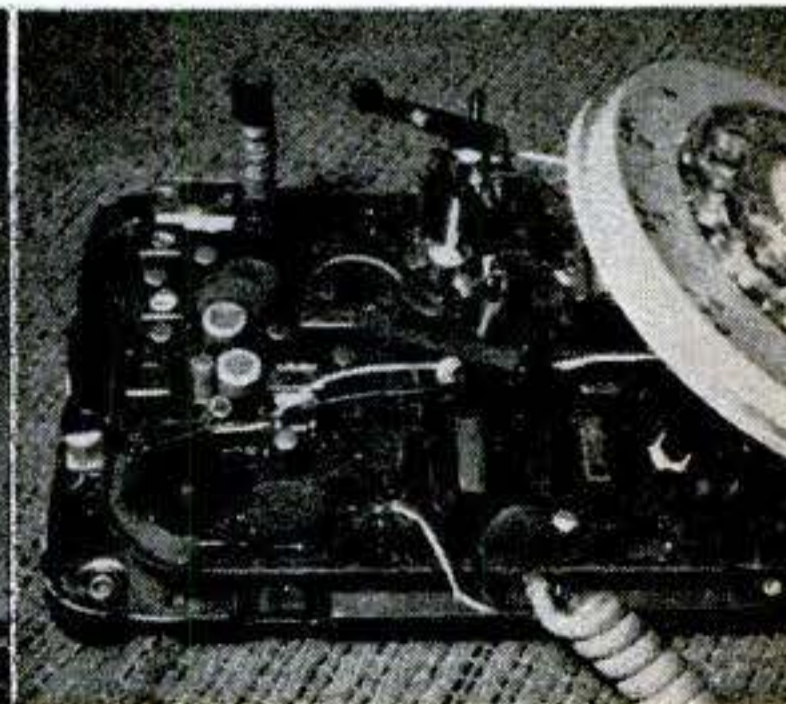
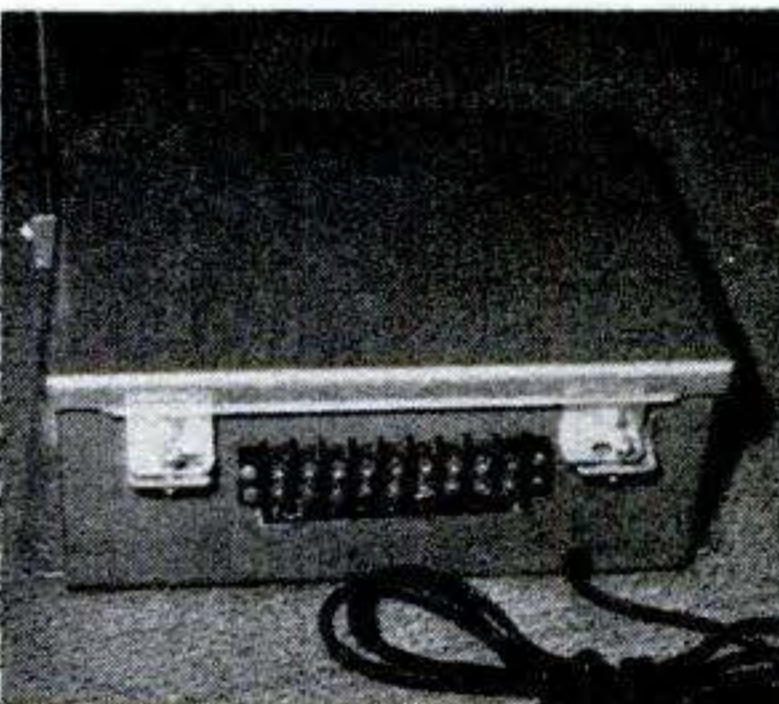


▲ Big-console sound
 This new clock radio from Arvin delivers console-like sound from two Velvet Voice speakers. Wake up to AM/FM music or let the slumber switch lull you to sleep with up to 60 minutes' worth. The buzzer alarm and repeat-a-call alarm should wake even the soundest sleeper. Price: \$59.95.

Desk-top calculator ➤
 Here's a handy item to keep at your fingertips. Despite the simplicity of the keyboard, this 12-digit calculator can perform all the basic functions and, in addition, multiply with a constant and carry forward a grand total. It's \$349 from Casio Enterprises, Long Island City, N.Y. 11101.



Cordless phone ➤
 Shown in its recharging tray (immediate right), the Satellite Phone communicates via radio to a transponder (center), which is connected to the phone line. Transmitter and receiver built into a phone (far right) make it cordless. It's \$395 with charger from Keltner Research, 2126 S. Kalamath, Denver, Colo. 80223.

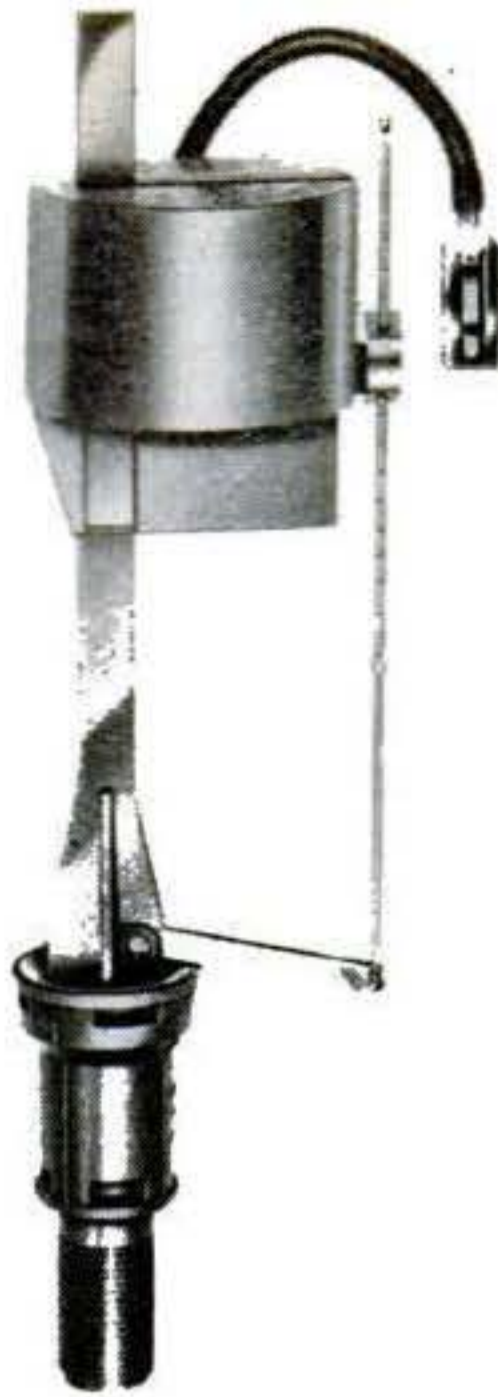


What's New IN HOME IMPROVEMENT

Bet you can't guess →

It's an improved ball cock, designed to replace the present float-arm flush system in your toilet tank. The inverted plastic cup slides on a plastic post and is connected to the valve by rod and lever. It's corrosion-resistant and boasts positive shut-off, quiet action.

From Fluidmaster, 1800 Via Burton, Anaheim, Calif.



▲ Dial a rainstorm

The Body Toner shower head sets three tiny turbine jets whirling to break up flow into a rhythmic pattern of separate drops. Adjusting handle offers a range of spray settings from dense patter to vigorous down-pour. By Sherman Mfg. of Battle Creek, it sells for \$19.95.



← Icy reception

Entertain a lot? Run out of cubes? No party can exhaust what this compact automatic ice maker supplies—up to 45 pounds a day. Just 34½" tall, it will slide under a counter. Commercial system removes minerals to produce clear ¾" cubes. As an added touch, Frigidaire includes that cute little scoop for handy serving.

Simple frame-up ▲

Each Frame-All kit contains four plastic strips and corners that snap into a 24"-by-36" frame, complete with picture and wall hangers. But strips can be trimmed to any smaller size with cutting tool and guide included. Not sold locally? Write to Allen Field Co., 10 E. 22 St., New York, N.Y. 10010.



← Rolling refuse

It's a roll-about rack for two garbage cans that collapses for storage (inset). But you can put it to more festive use as a patio butler, with one can filled with ice for beer and pop, the other ready for refuse. Racks, made by MACC Ind., are about \$12.50 at department stores.

RUB'N'GLUE™



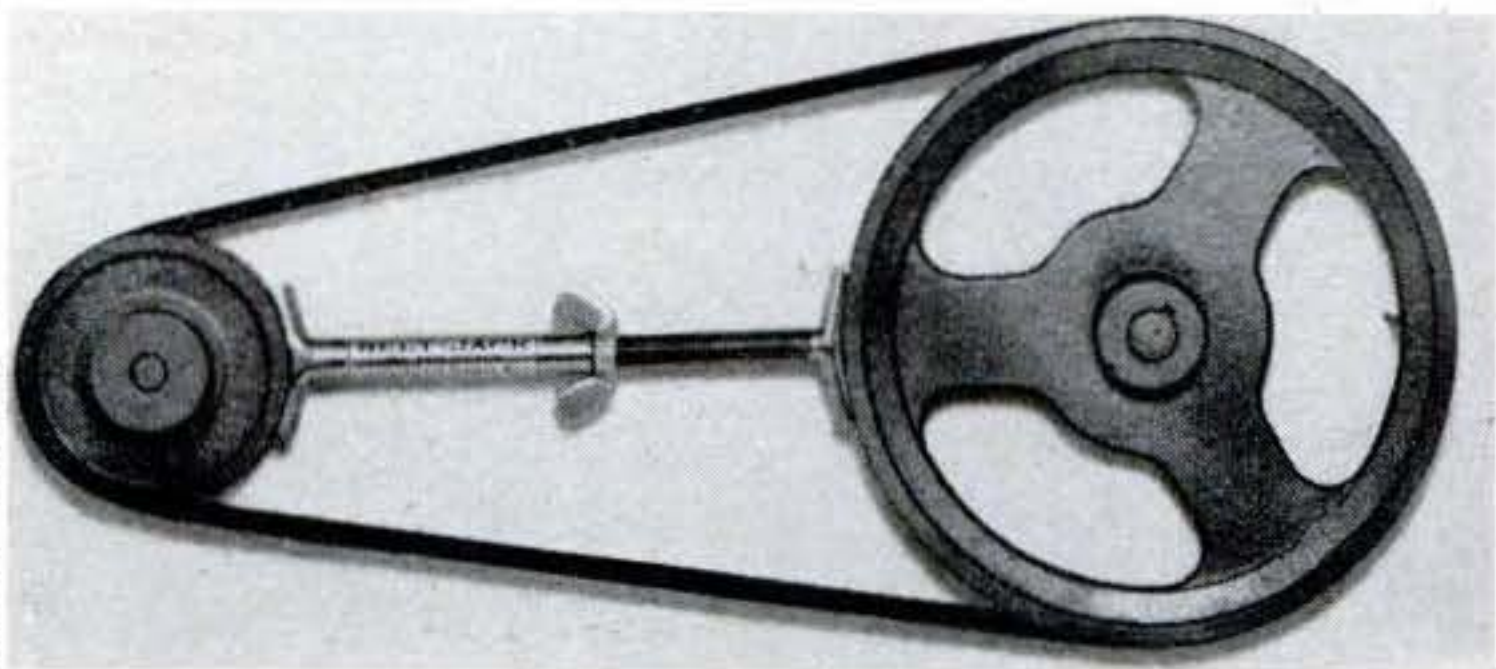
Pasting crayon ▲

A no-mess paper glue for home and school, developed by U.S. Plywood, is intended for such projects as scrap books and photo albums, and can be carried in a pocket for many uses. You rub the glue end on the back of the paper, press paper in place with plastic cap. It's 39 cents at stores all over.

What's New IN TOOLS

Cordless power handle ➤

Tiny tools in tight spots can be powered by this rechargeable powerpack from Jensen Tools, 4117 N. 44th St., Phoenix 85018. Priced under \$45, the 8½-ounce comes with a plug-in charger. Power takeoffs at both ends give choice of rotation direction. Accessory chuck takes drills, grinders.



▲ Tighten your belt

Those curved feet pressed against the two pulleys are self-centering in the sheaves. The Belt-Jack eliminates crow-bars, screwdrivers, bruised knuckles, and belts damaged from forcing. It's \$8.95 from H. Custer Co., 30635 Helmandale Dr., Franklin, Mich. 48025.

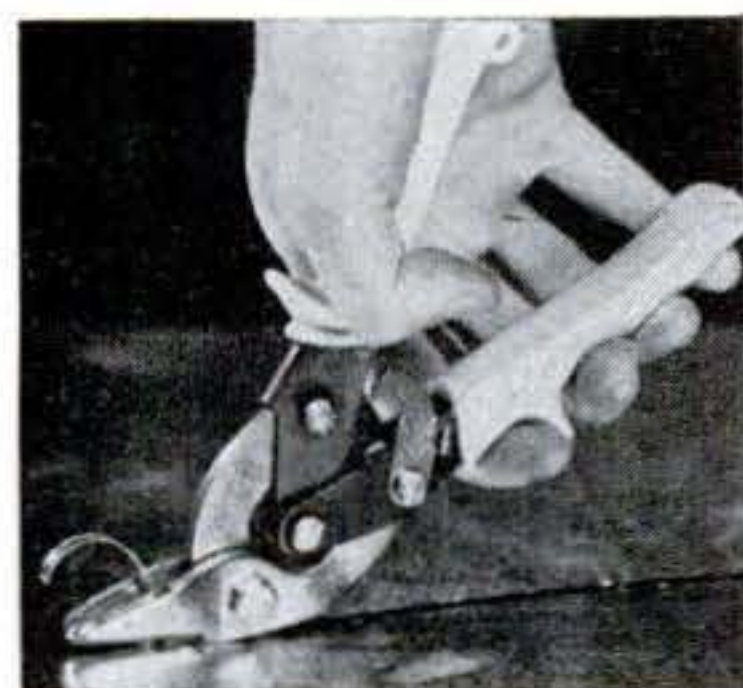
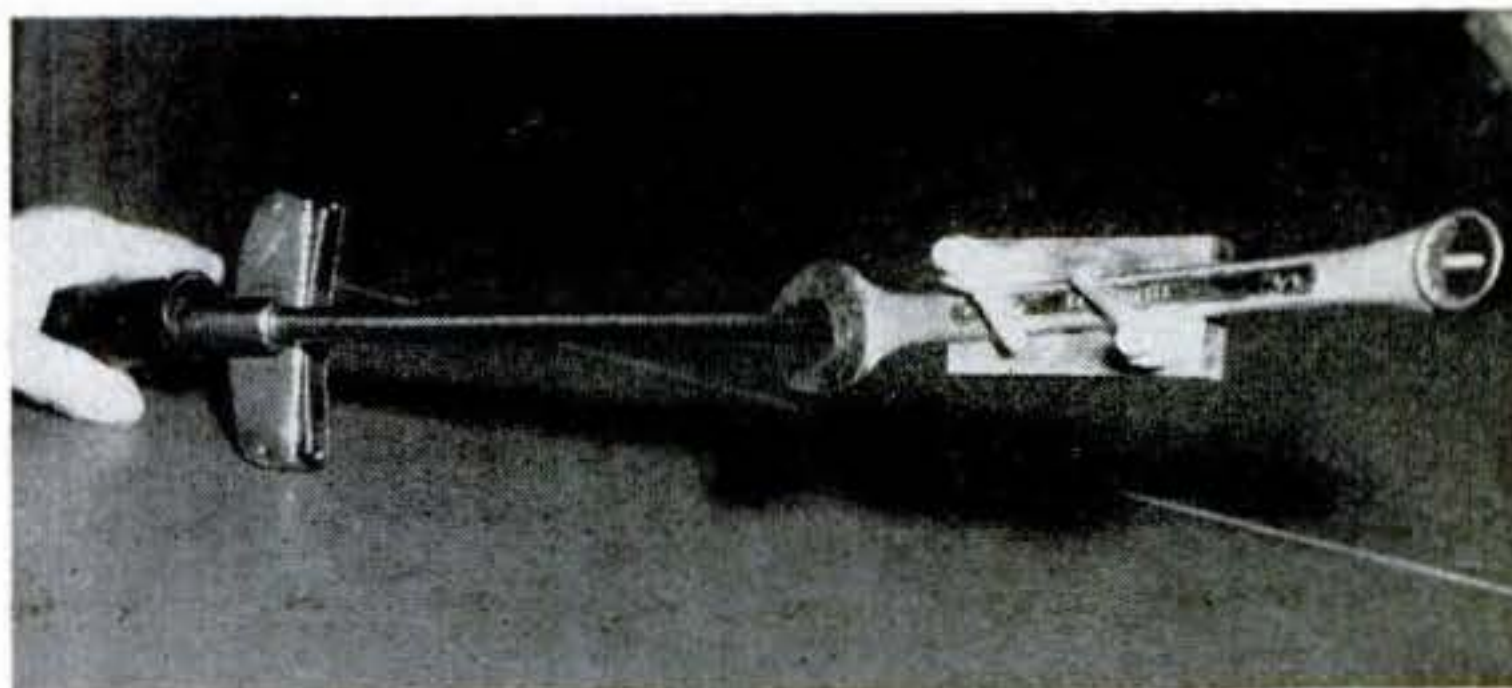


▲ Hammer holster

You'll be quick on the draw with this steel holder that keeps your hammer on your hip. Threaded onto your apron cord or belt, it holds the tool for ready-to-use grasping, but leaves both hands free. It's \$1 postpaid from Corvel Co., Box 507, Geneva, Ill. 60134.

Torque adapter ➤

Clamped to the shaft of your favorite wrench (box or open), this adapter takes the guesswork out of critical tightening of hard-to-reach bolts. Meant for the home mechanic who does some motor work, but not enough to invest in a whole set of adapters, it's \$5.65 postpaid from Newberg Sales, St. James, Minn. 56081.



▲ Snip for all seasons

They're called M-41R pipe-and-duct snips, but they'll cut vinyl tile and flat sheet metal without distortion. Compound action makes for easy cutting, offset handles spare your fingers from cuts and bruises. J. Wiss of Newark makes them to retail at \$7.50.



▲ Prop for wide eaves

This standoff/shelf combination attaches to any wood or metal extension ladder and adjusts to position you for contortion-free painting of various-width overhangs. Retracted, it returns the ladder to normal use. It's under \$10 from Wokasch Co., 14909 E. Belcourt Dr., Whittier, Calif. 90604.



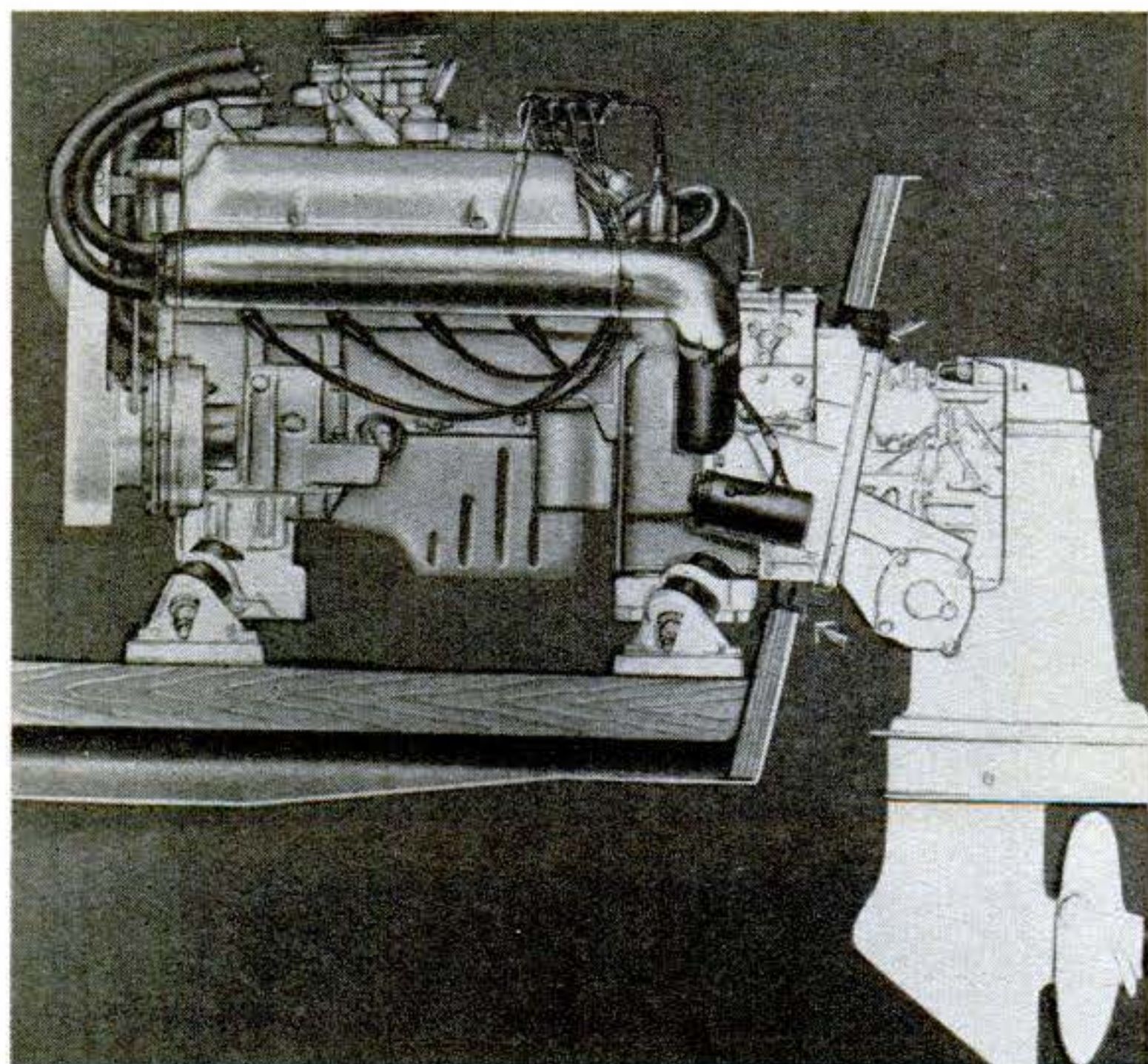
▲ Dual-indicating caliper has metric scales

This direct-reading caliper for linear measurements up to 15 centimeters (both outside and inside) replaces three instruments needed previously. Long curved legs reach over obstructions to measure thickness of sections as far as 10 centimeters from the edge of a flat object. Lock the pointer at any reading and the caliper becomes a fixed gauge. It's made of heavy-gauge steel stampings finished on all edges and chrome plated. The list price is \$22.50 f.o.b. from Indicating Caliper Co., Box 51, Oak Park, Ill. 60301.

What's New IN BOATING

Super sloop →

Here's a 21-foot, four-berth fiberglass sloop designed with a retractable keel for easy trailering and launching. The Santana 21 sells for \$3,100, complete with rigging, sails, carpeting, and a heavy-duty trailer. She's from W. D. Schock Co., 3502 Greenville St., Santa Ana, Calif. 92704.



← Rubber muffers

What's the key to the quiet, vibration-free operation of OMC's line of five new stern drives? Rubber. The drawing at left shows rubber motor mounts that isolate engine vibrations from the hull. A rubber seal surrounds the drive housing where it passes through an oversize hole in the transom.

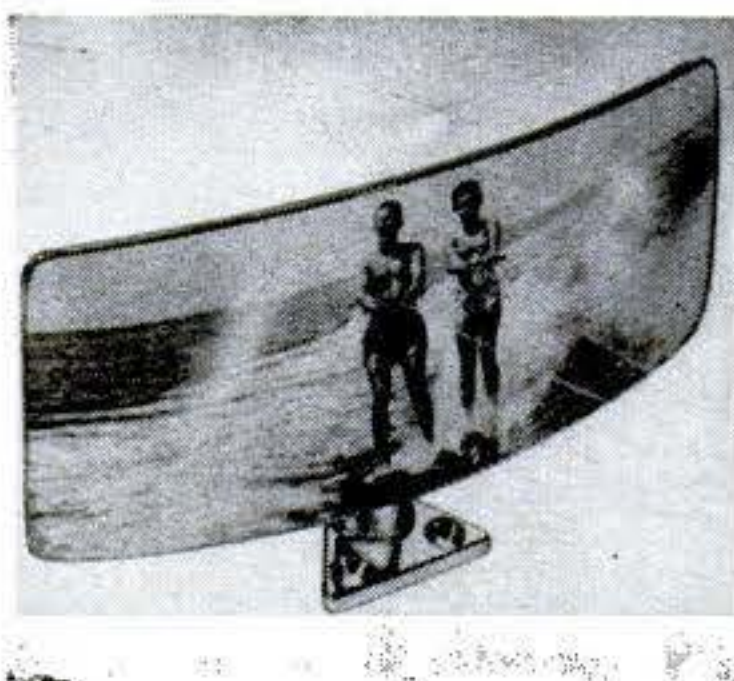
Bail by battery ↗

Want to move water the fast and easy way? The Utility Battery Pump and a 12-volt car battery make a 500-gallon-per-hour team that can lift water 20 feet from its source, or push it even higher—to 50 feet. It's from the Simer Pump Co., 207 Humboldt Ave. North, Minneapolis, Minn. 55405. Price: \$39.95.



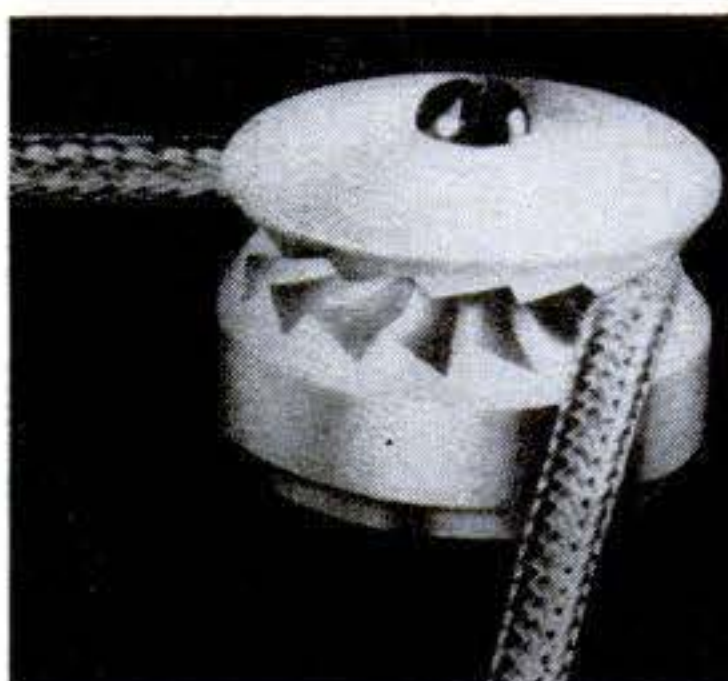
↗ Pint-size paddle

Keep one of these midget 10-ounce paddles on board your boat and you'll be prepared when the motor gives out. It's good for keeping your crew in line, too. The bright-yellow polyethylene Poly Paddle is \$2.98 from Borse Plastic Products, 7400 Quincy, Hinsdale, Ill. 60521.



↗ Skier scanner

Use your boat for waterskiing? This mirror lets you watch skiers behind you no matter how far outside the wake they wander: It covers 180 degrees. The shatterproof mirror comes in two versions: one for deck mounting at \$7.95, one for windshield mounting at \$8.95. They're from Attwood Corp., Box A, Lowell, Mich. 49331.



↗ One-way pulley

Pull a line in through the Jam Winch—it works like a pulley. But if the line starts to slip back out, special teeth take over, gripping the line just like a cleat. Price? \$6.95 for a Jam Winch to handle 3/16- to 3/8-inch rope. Products Research, 6731 15th Ave. N., St. Petersburg, Fla. 33710.



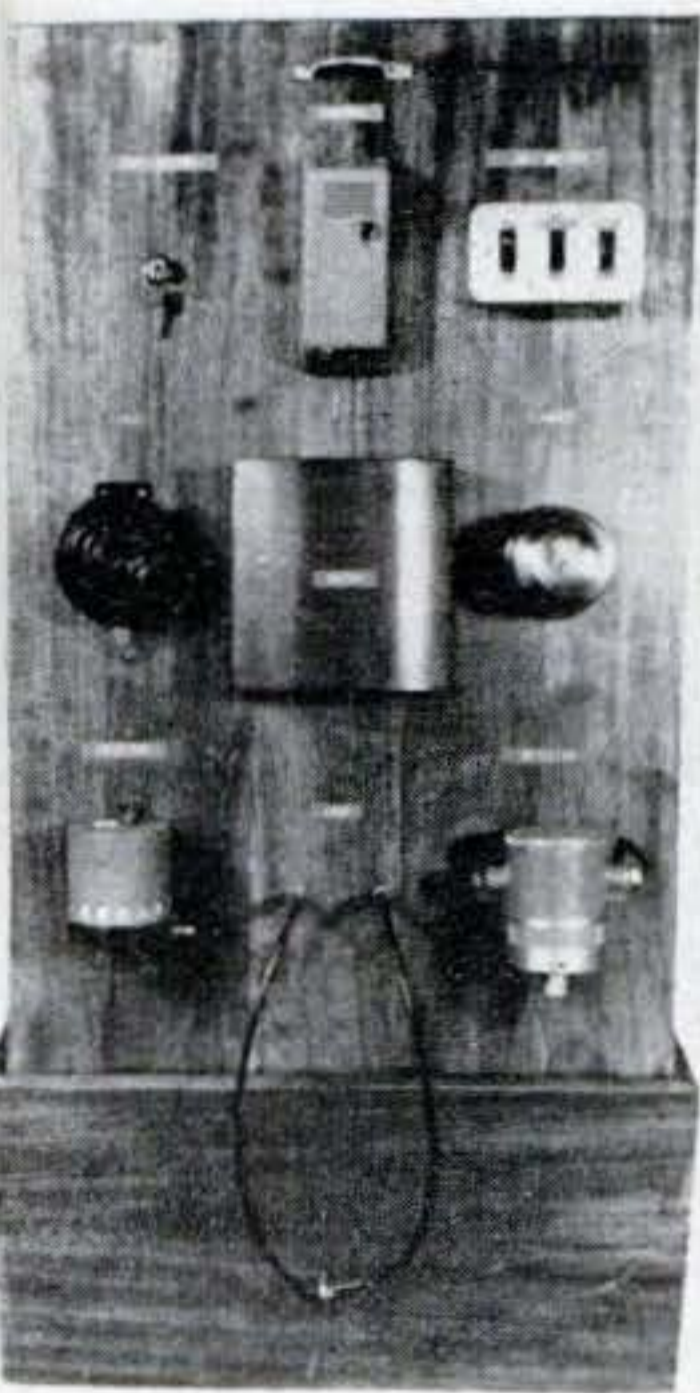
↗ Hook & paddle

Aluminum and plastic combine to make this combination paddle/boathook a lightweight, permanent-finish, crackproof boon to boaters. Woolsey's new line of Drake paddle/hooks runs from five to eight feet, and starts at \$5.25. Available at marine dealers everywhere.

What's New FOR YOUR CAR



Bilge minder
Solid-state circuitry in the Electronic Bilge Control means there are no contacts to corrode, no moving parts to jam. Twin sensing rods detect bilge water, turn on the pump, and keep it running until the level drops below the ends of the rods. It's \$24.95 from C.E.W. Electronics, Box 65, Hastings-on-Hudson, N.Y.

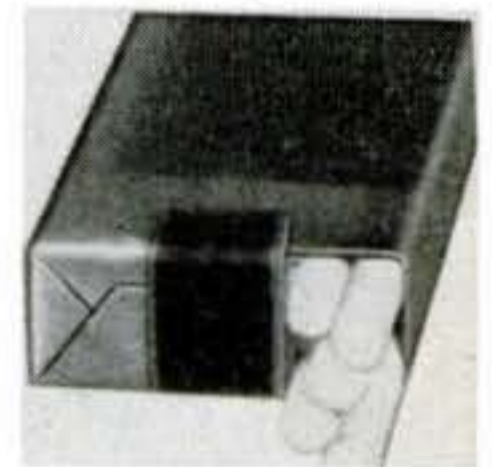


Marine watchdog
If anything is about to go wrong aboard your boat, this British alarm system should let you know. It signals gas and fuel leaks, warns of attempted theft or tampering, and even tells you if the boat is riding below her usual level in the water. The Sea Alarm is made by Scout Alarms Ltd., London.

Economy car wash →
Hook a JET-X sprayer to your hose, fill it with JET-X Suds and wash your car with a high-pressure fan of water. It's great for garage floors, for windows, and—with special JET-X Pet Shampoo—for dogs and horses too. Sprayer-and-suds set is \$6.95 from JET-X, 2550 W. 2nd Ave., Denver, Colo. 80219.



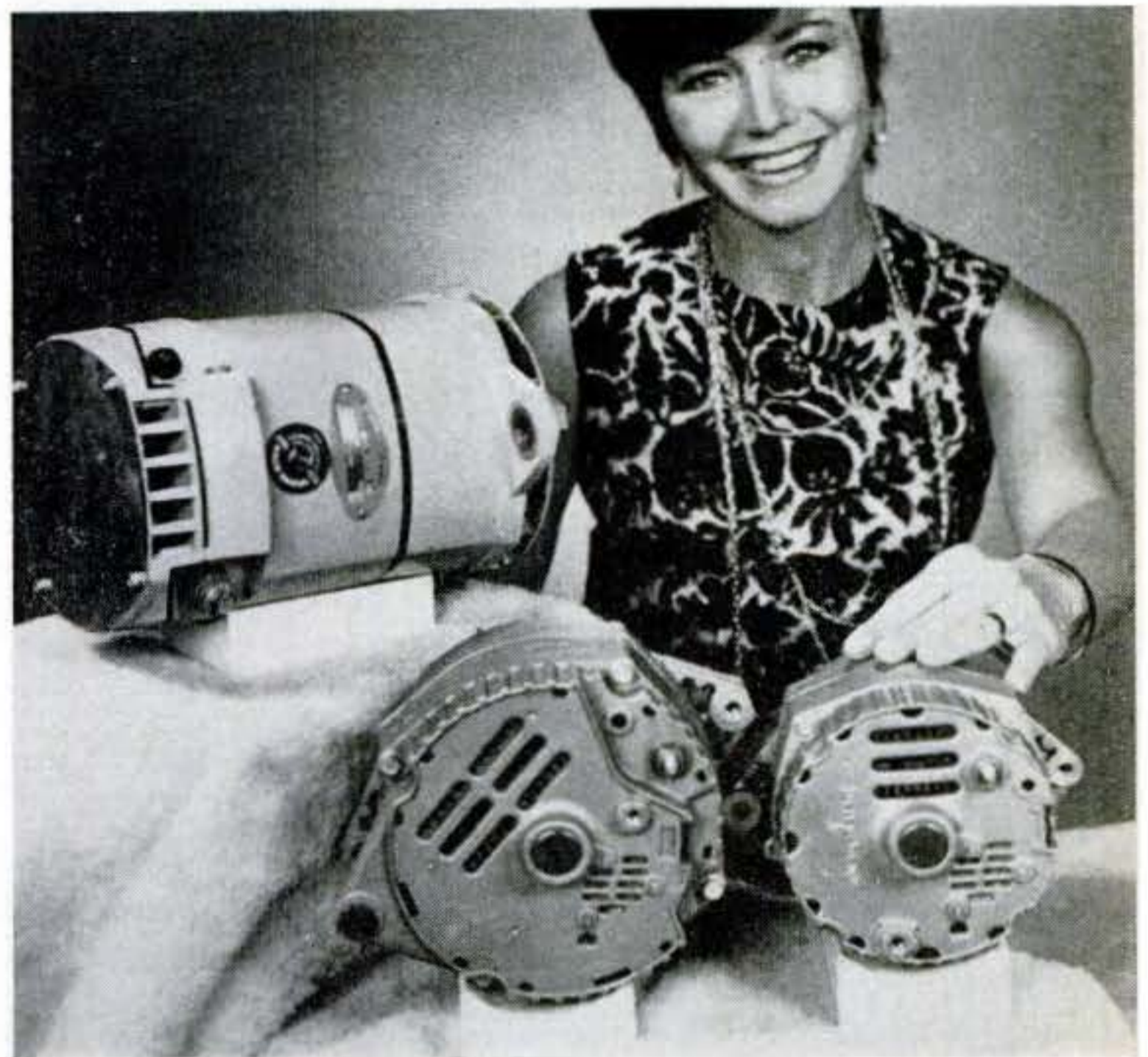
Converter for your car →
How do you get FM radio in your car without an FM radio? With this tiny FM converter. It picks up FM signals, converts them to AM, and plays them through your regular car radio. The AT-6000 is made by Boman Astrosonix, 9426 Stewart & Gray Road, Downey, Calif. 90241.



One-piece power →
GM is combining generator and voltage regulator in one compact package for many of their new cars and trucks. Result: lower cost, greater reliability, and saved space under the hood. At right are three of the new units, including the one to be used in the new Vega 2300 (under the girl's hand).



Ice chaser ↑
Tired of the winter morning ritual of chipping ice and snow off your windshield? Osrow's Blast-Off infrared heat gun plugs into your cigarette lighter and does the job without effort in seconds. It's \$8 from Starlight Sales, Box 868, Dept. PS, Livingston, Ala.



Stop, thief! →
This little device foils—and embarrasses—car thieves. It lets them drive your car a few yards, but then stalls it for good, out in the open where they won't be able to strip it for parts. It's \$4.95 from Warnax Ent., Box 2066, Ventnor, N.J. 08406.



SPANISH-STYLE TILE

Here's a rewarding project: Floor tiles set in grout make a handsome, durable surface

By R. J. De CRISTOFORO

There's always demand for heavy Spanish-style furniture like this coffee table. An interior decorator keeps an eye on everything that comes out of my shop. When she made a good offer for the table, I figured others might like to know about it, too.

It's a pretty straightforward project. The tiles, a full $\frac{1}{2}$ " thick, are made for floors. All wood parts of the original are pine. You can substitute a hardwood if you prefer, but I think the pine and a walnut finish give the right feeling for this sort of project. Besides, pine is easy to work.

The tile base is a used solid-core door. To get the heavy look in the legs and stretcher, I wanted a full 2" stock. So I checked lumberyards to uncover a 14' length of 2-by-12 pine in the rough. I have a planer to work with, but there isn't so much smoothing involved that you can't do it with a belt sander.

Have the tiles on hand—enough to cover about 13 or 14 sq. ft.—before you start. Since these are an important feature of the table, spend some time looking for and selecting them. Avoid conventional tiles; you don't want to end up with something that looks like part of a kitchen counter set on legs. Spanish styles are good; so are handmade Mexican varieties. Generally, tile made for floors is better for this kind of project than those designed for counter use.

Lay the tiles out. Use pieces of $\frac{1}{4}$ " or $\frac{3}{8}$ " plywood as spacers so you can determine the overall size of your table. It's not likely you'll hit the exact size shown in the drawings; on the other hand, since tile modules don't vary too much, you shouldn't be far off. An inch or two in width and length—one way or the other—won't be critical. This procedure will determine the size of the base on which you place the tiles. Have the tile dealer cut the tiles as necessary—or do it yourself with an abrasive wheel on a grinder.

Cut pieces for the leg assemblies to overall size and form the notches for the splines. Don't be tempted to make the splines a tight fit; a *slip* fit is better since it provides room for glue to bond everything together.

Make all *inside* pattern cuts on the leg pieces, but do not shape the outside edges of the vertical pieces. Finish this up *after* you have glued and clamped the pieces together. Pattern cuts can be made on a bandsaw or a jigsaw, or even with a saber saw; but be sure, after cutting, to smooth all edges on a drum sander. This is very important for the shaping cuts that come later.

Now make the stretcher. Cut it to overall size, and lay out the straight lines shown in the drawing. This will diagram a wide, shallow chevron. On these lines, lay out the pattern using the same template employed on the legs. At this point, you can do the shaping on the stretcher and the leg assemblies. If you lack a shaper or a portable router or necessary drill-press accessories, you can do the shaping by simply rounding off with a file and sandpaper.

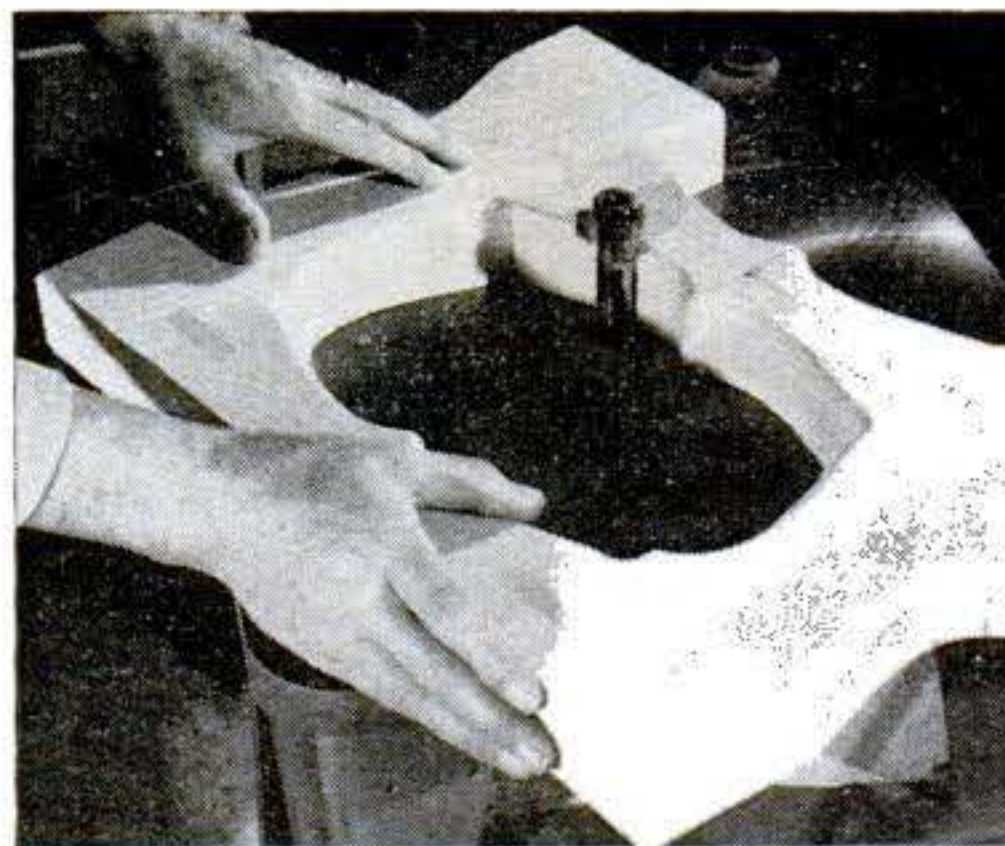
Drill the lag-screw hole in the legs and assemble temporarily to the stretcher. Place the assembled pedestal on the underside of the tile base and mark lag-screw points. Drill and counterbore for all lag screws. Make the assembly by applying glue to all

mating surfaces before driving the screws.

I made the frame for the top from $\frac{3}{4}$ " pine, shaped on the outside top and bottom edges with the same cutter used on the legs and stretcher. You can substitute a fancy molding. The width of the frame pieces should equal the thickness of the tile base, plus the thickness of the tile, plus about $\frac{1}{16}$ " allowance for the mastic. After the top frame is glued and nailed in place, you can lay the tile.

Use a regular tile mastic. Apply according to the directions on the container. I found it best to place the perimeter tiles first and then those between, using the same plywood spacers I cut when doing the original layout. When you place the tiles, swivel them a bit to get good contact with the mastic. Let the mastic set overnight before doing the grouting.

Use a grout that is grayish in tone and has sand in it—not the velvety material used on kitchen tile. Add water slowly and mix thoroughly until you have a very plastic mixture. It should "pour" like a very thick salad dressing. Work it over the tiles with a small trowel or piece of wood, but be



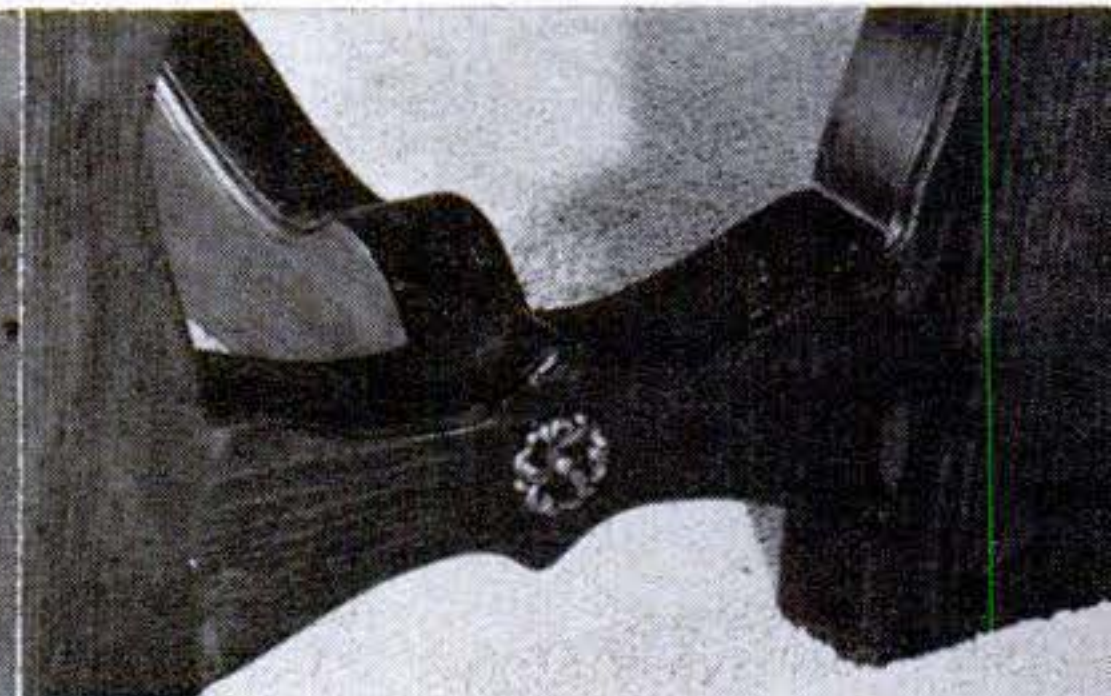
1 Edge shaping should be done after the leg assemblies are put together and sanded well. The author used the bead section of bead-and-cove cutter for this. You may prefer some different shape at edge.



2 Shape edge of stretcher in the same way as the legs. Since material is the same thickness, no change is needed in cutter setting. Be sure to work with a shaper guard, removed here to photograph work.



4 Use three lag screws through top into each leg, one down through each vertical piece and one between. After trial assembly, remove screws, counterbore for the heads, apply glue before final assembly.



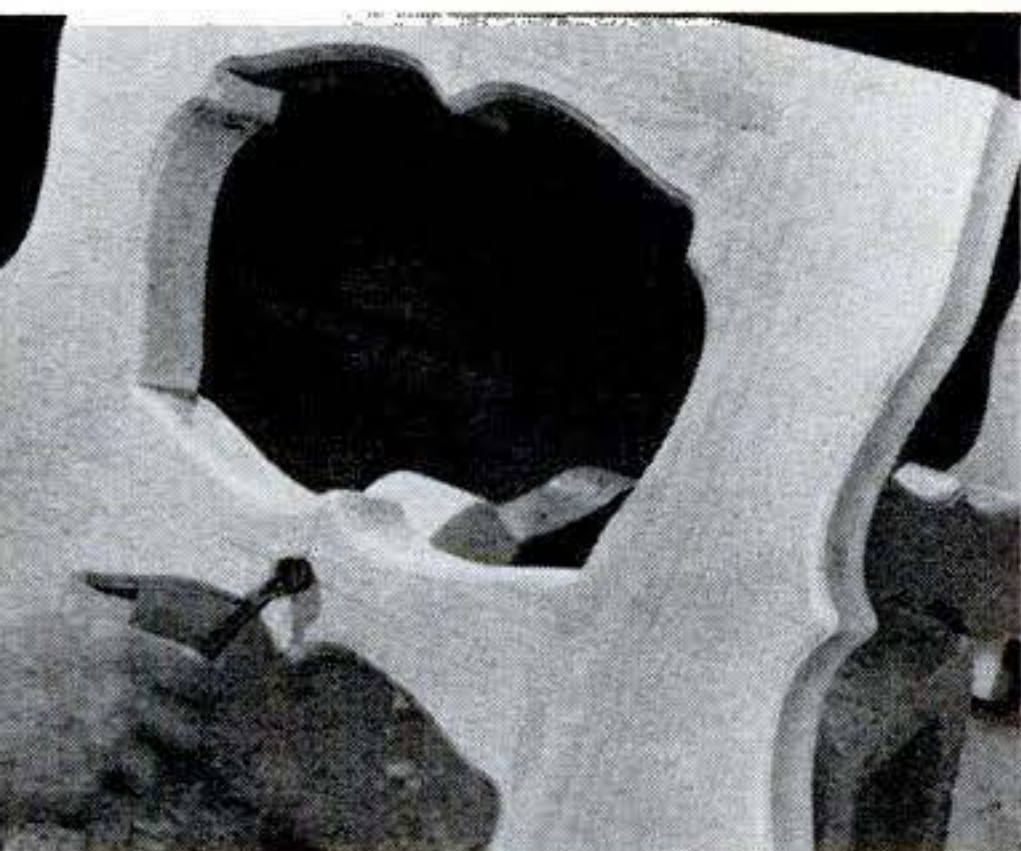
5 Use an escutcheon to conceal the head of the leg-to-stretcher lag screw. You can buy a Mexican- or Spanish-style nail from a hardware store, or modify a drawer pull by sawing off post and drilling holes.

TABLE

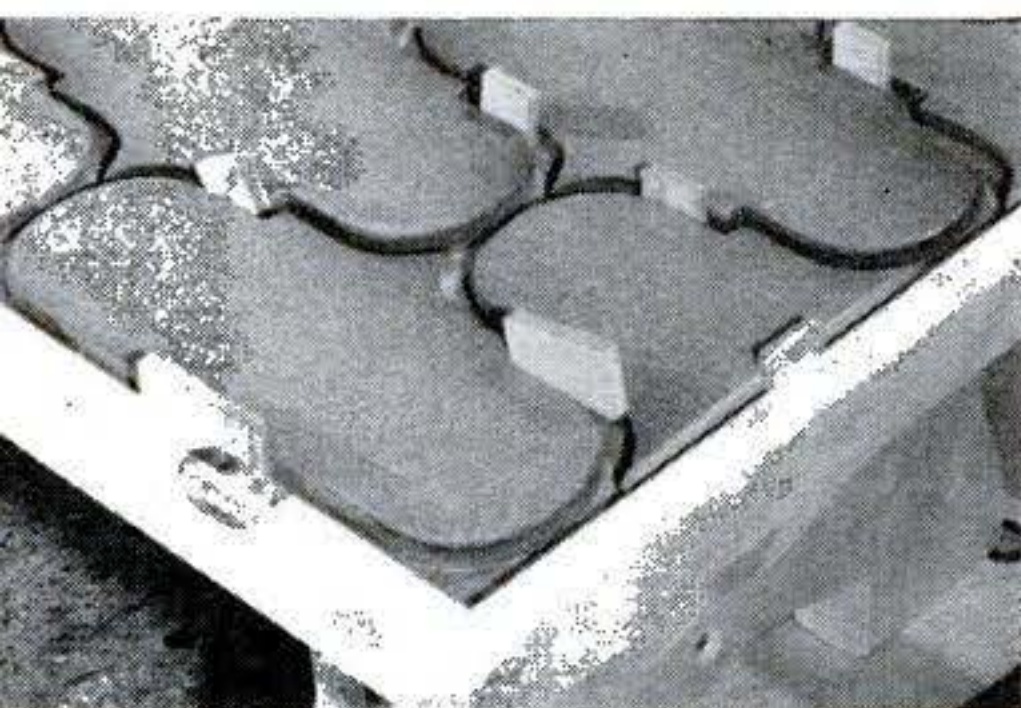
sure to fill all the joints completely. After it has set a while, wipe off the excess with a piece of old, rough towel. Check to be sure all joints are full. Repeat the wiping process with a damp cloth until the joints are smooth and the tiles are clean. Allow to set until the grout is dry. Then you can finish with a regular tile-and-grout sealer.

Finishing the wood. Use a dark, filler-type walnut stain, applying it generously by brush and then wiping after about 30 minutes. After drying, rub it with steel wool, wipe clean and apply two or three coats of satin-finish Varathane. Let each application dry thoroughly and smooth down with a fine steel wool before doing the next coat. Rub the last coat with steel wool, wipe clean, and then finish with a couple of applications of hard paste wax. The tile top will also take the wax application.

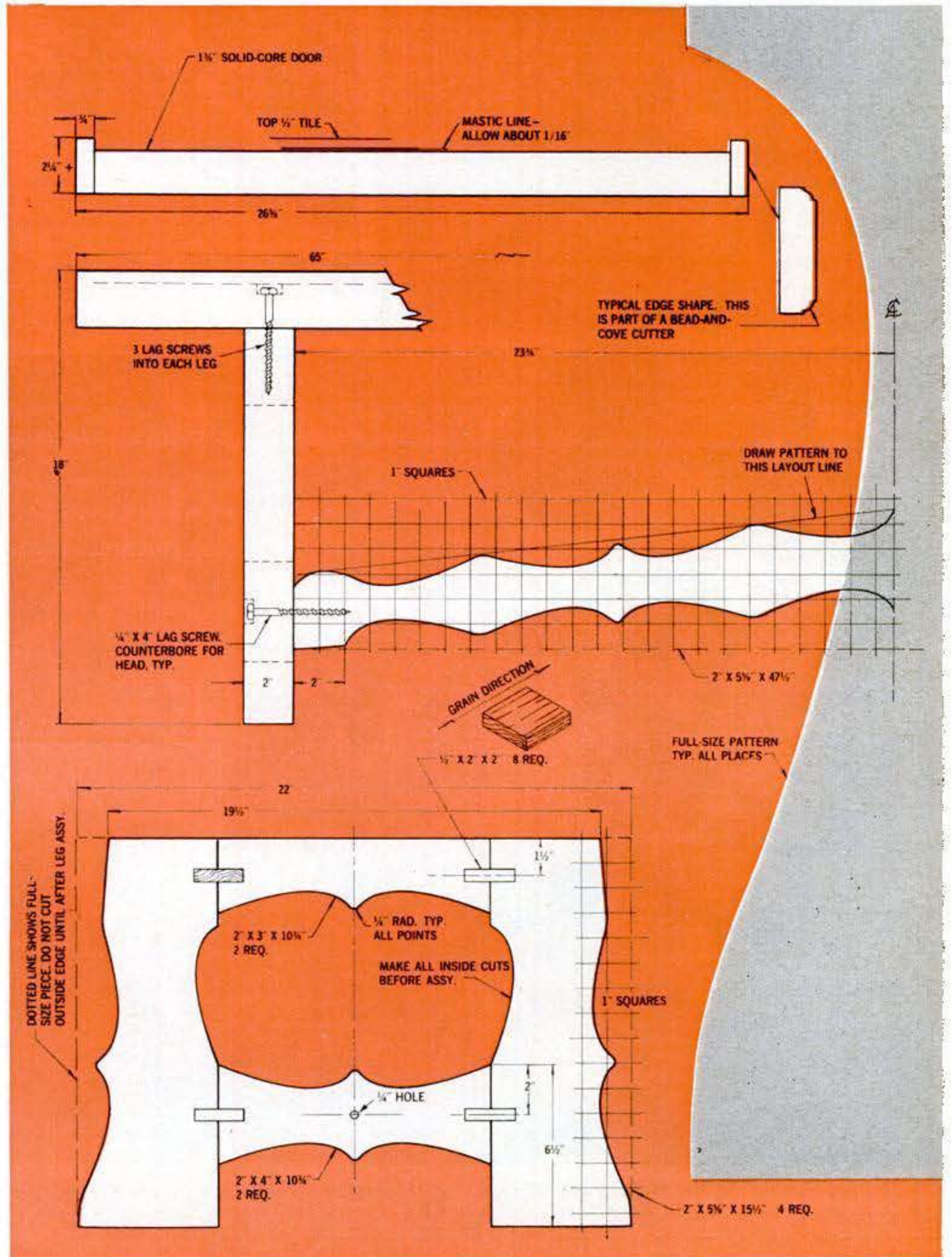
One hint before you go to buy the tile: Luck and persistent checking over of what's available can save you money. Keep an eye out for good seconds, or tag-ends at close-out prices. And remember—broken tiles can be used at table edges. **P 5**



3 Lag screw is driven through the leg assembly into end of stretcher. Be sure to make a trial assembly before you do the final one—a good rule to follow in all sorts of home-shop construction.



6 Plywood spacers help place the tiles as you want them. Note the grout joint between the perimeter tiles and the frame. Be sure to use the plywood spacers to determine table-top size and to set tiles.



A Good Twist

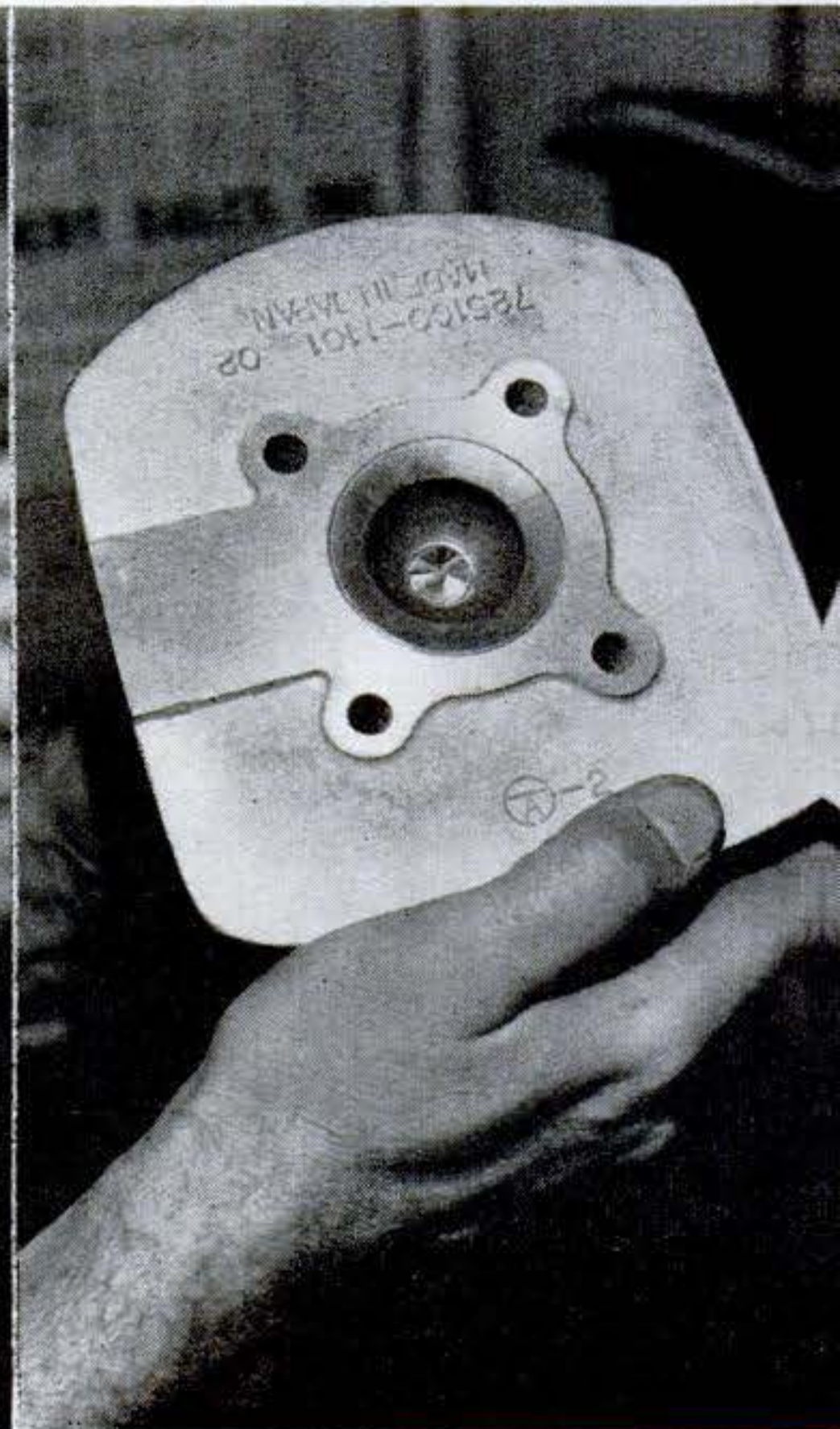
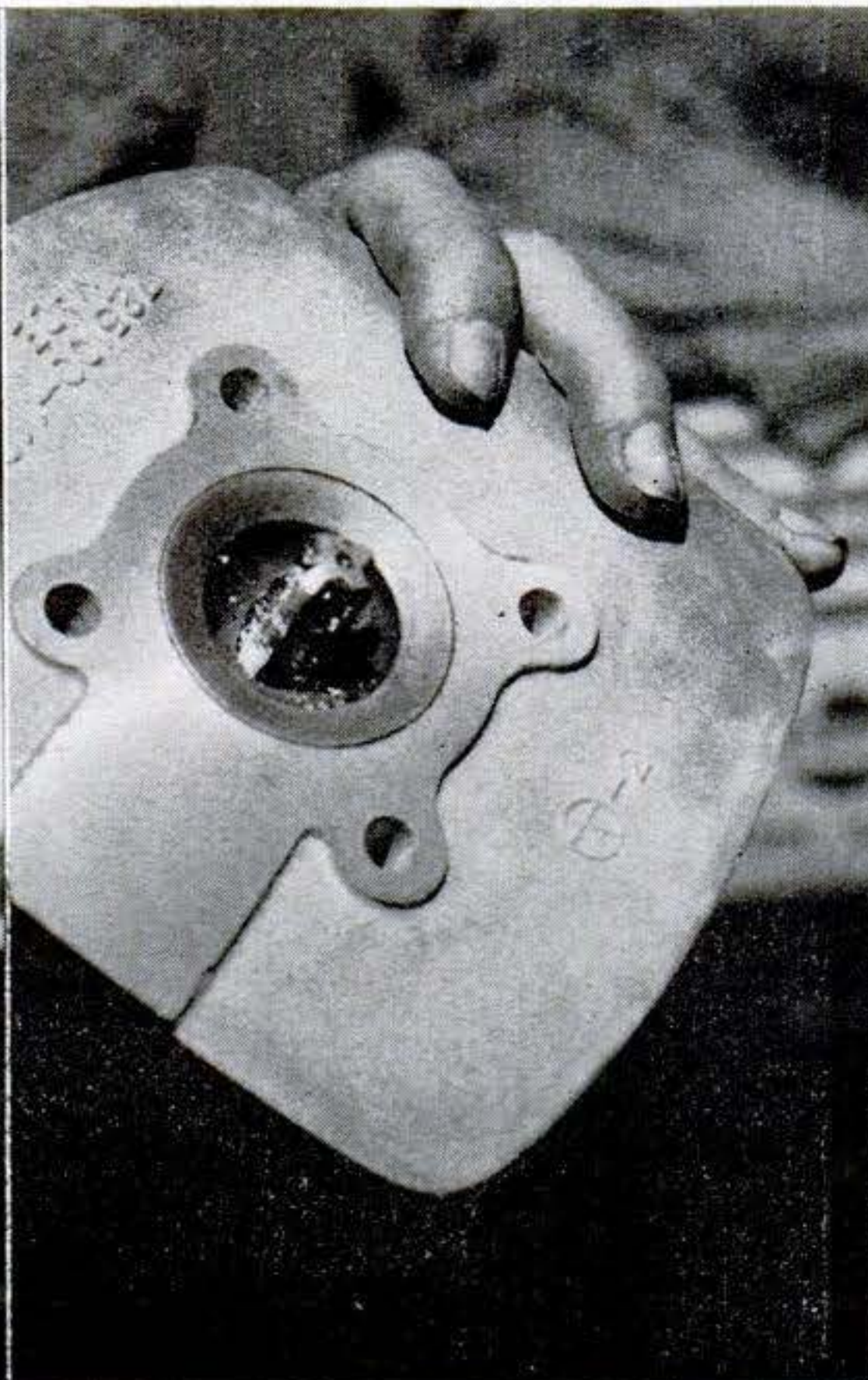
You can rescue any expensive cylinder head by inserting a Heli-Coil, the machinist's real friend. Just follow the steps outlined in photos below

By JIM DAVIS



1 Heart of the entire Heli-Coil system is the tool that inserts the new threads. This comes as part of the kit you buy.

2 Clean out old threads, and then cut new ones. This tap does the job of thread cutting.



5 The protrusion on the Heli-Coil matches a notch in the center of the insertion tool so you can screw it into new hole.

6 Oversize threads are cut in the cylinder head for the Heli-Coil to lock onto. A special tap to do this job comes with kit.

7 Take care not to snap off the Heli-Coil while you are screwing it into place. It's shown here snug in place.

for STRIPPED THREADS

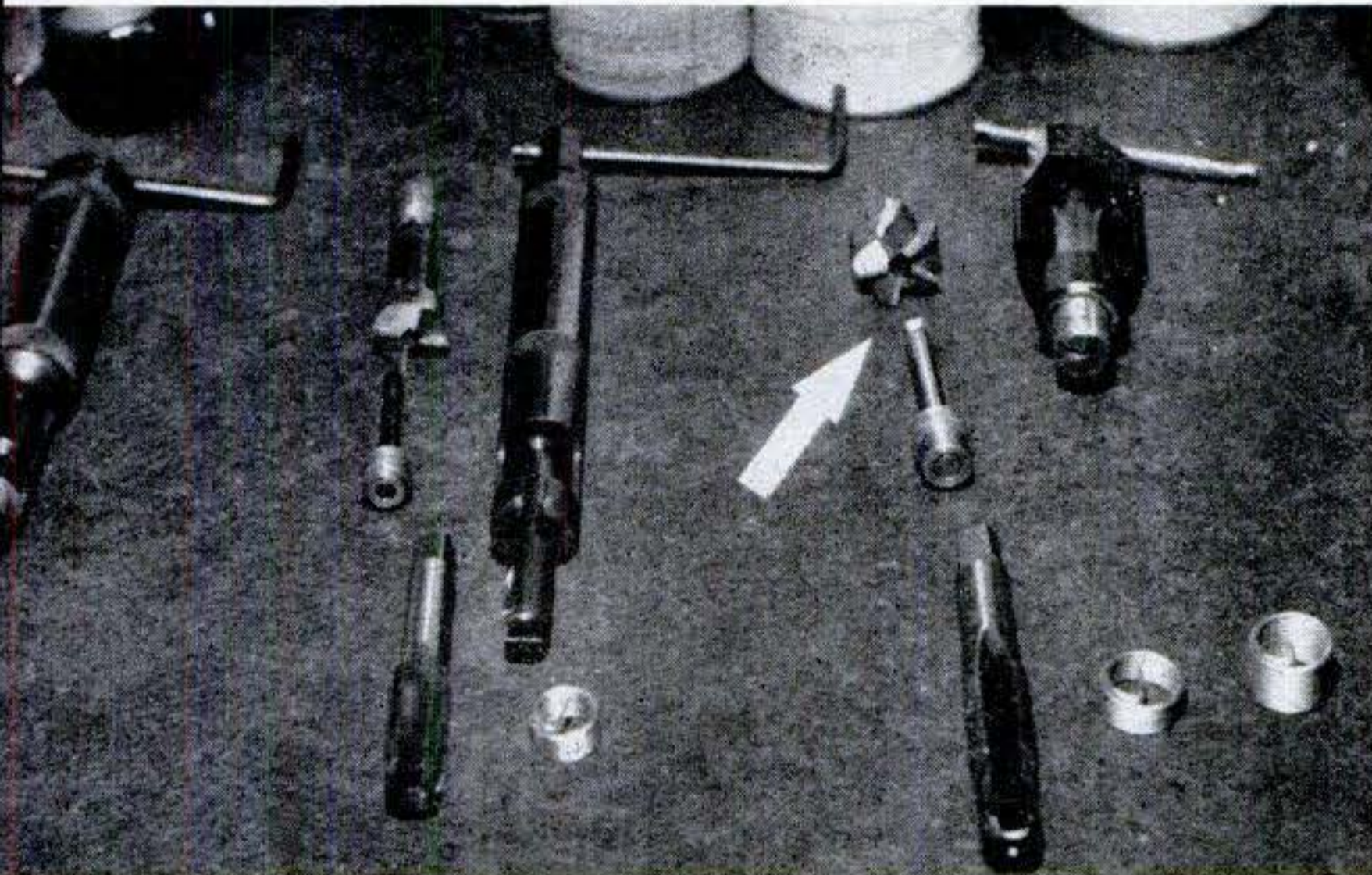
When was the last time you gave just one more twist with that big adjustable wrench on a car or other repair job, and encountered that sickening feeling as the threads stripped out? Chances are, you threw the damaged part in the nearest trash can, and then purchased another one. Did you know you were throwing money

away? Those stripped threads could have been saved with a small object called a Heli-Coil.

Heli-Coils have been around for years, and have pretty well gained the title of "The Machinist's Friend." The photos here show good examples of what they can do. Many motorcycle cylinder heads are soft alumi-

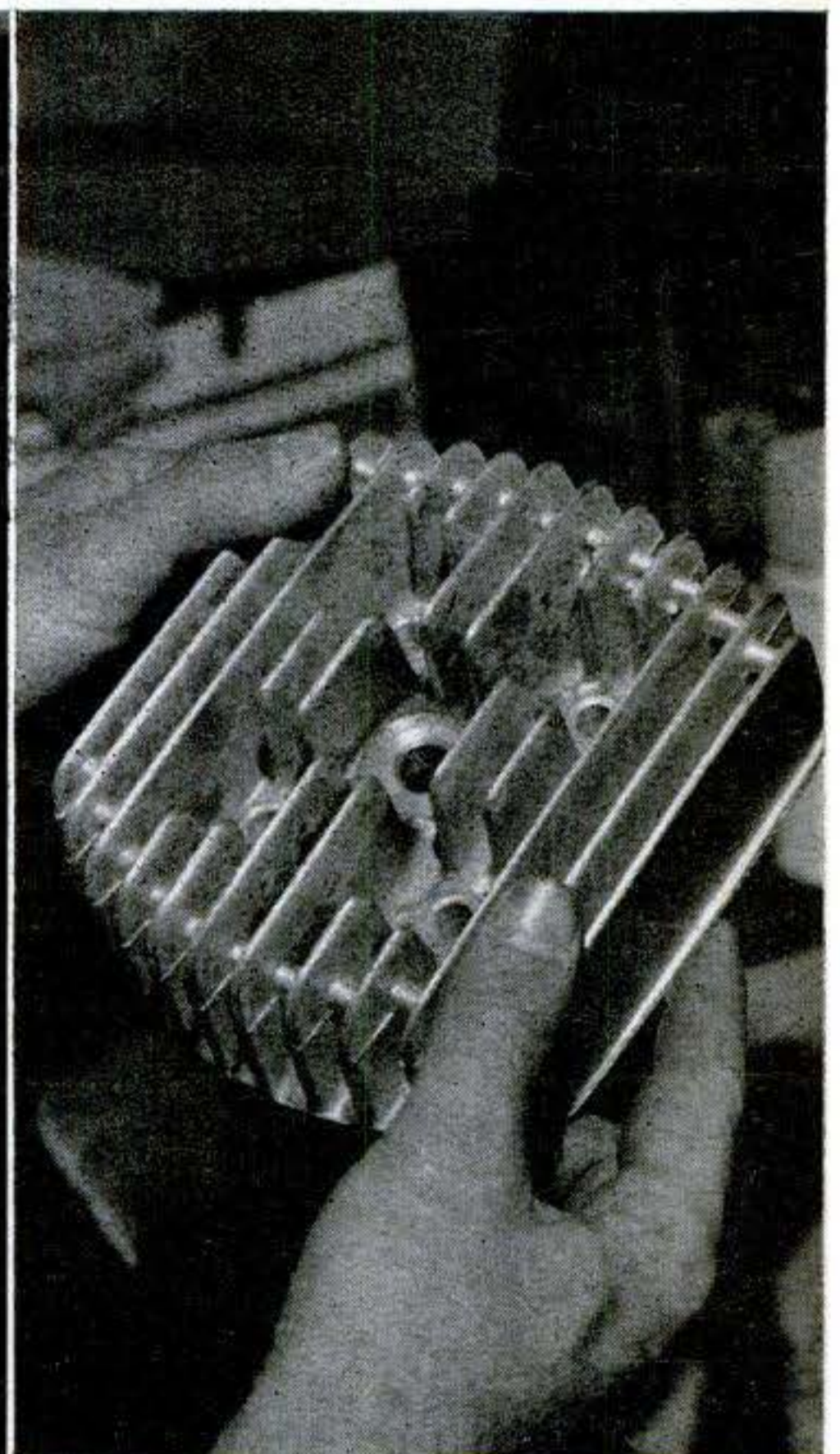
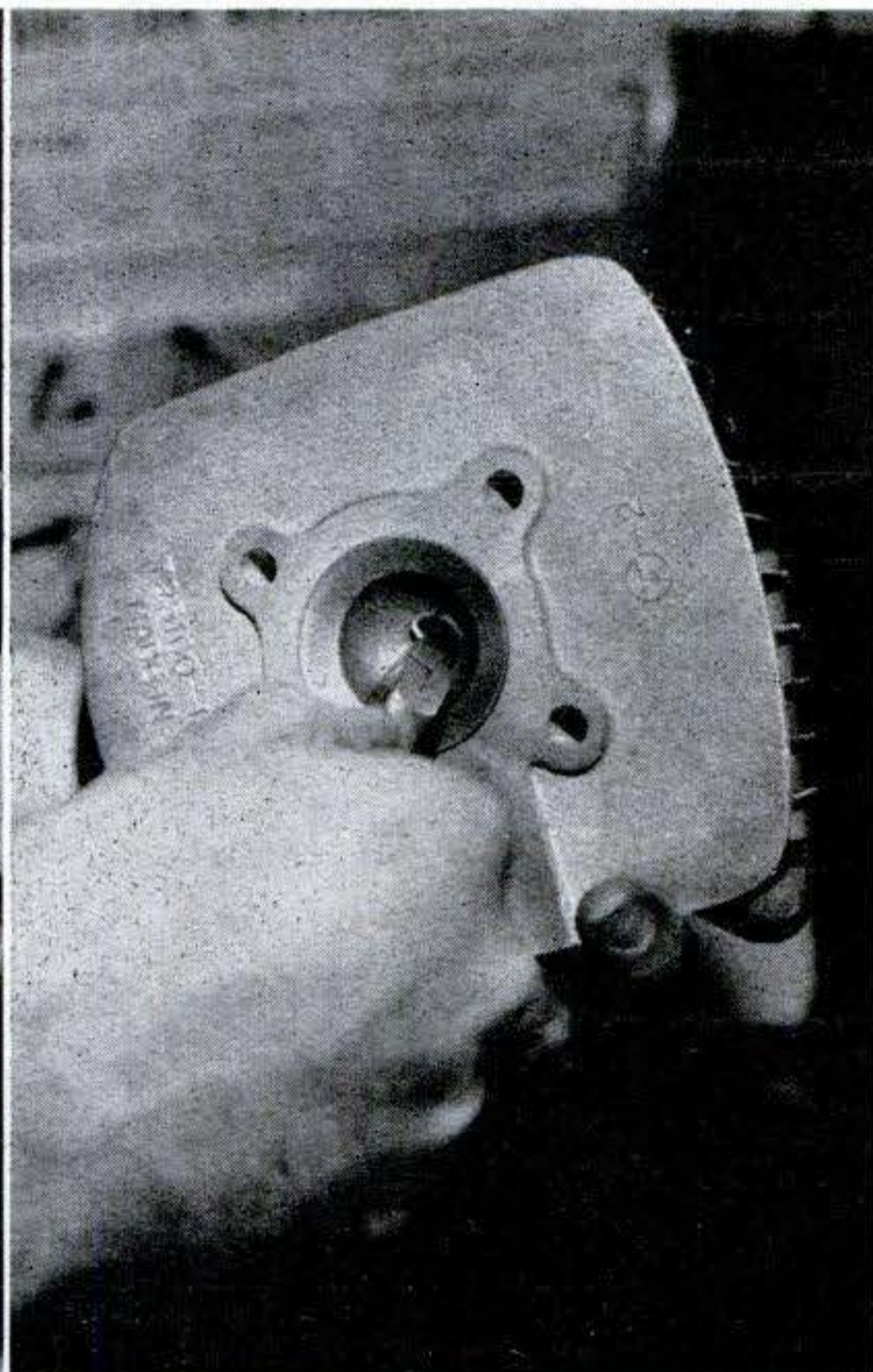
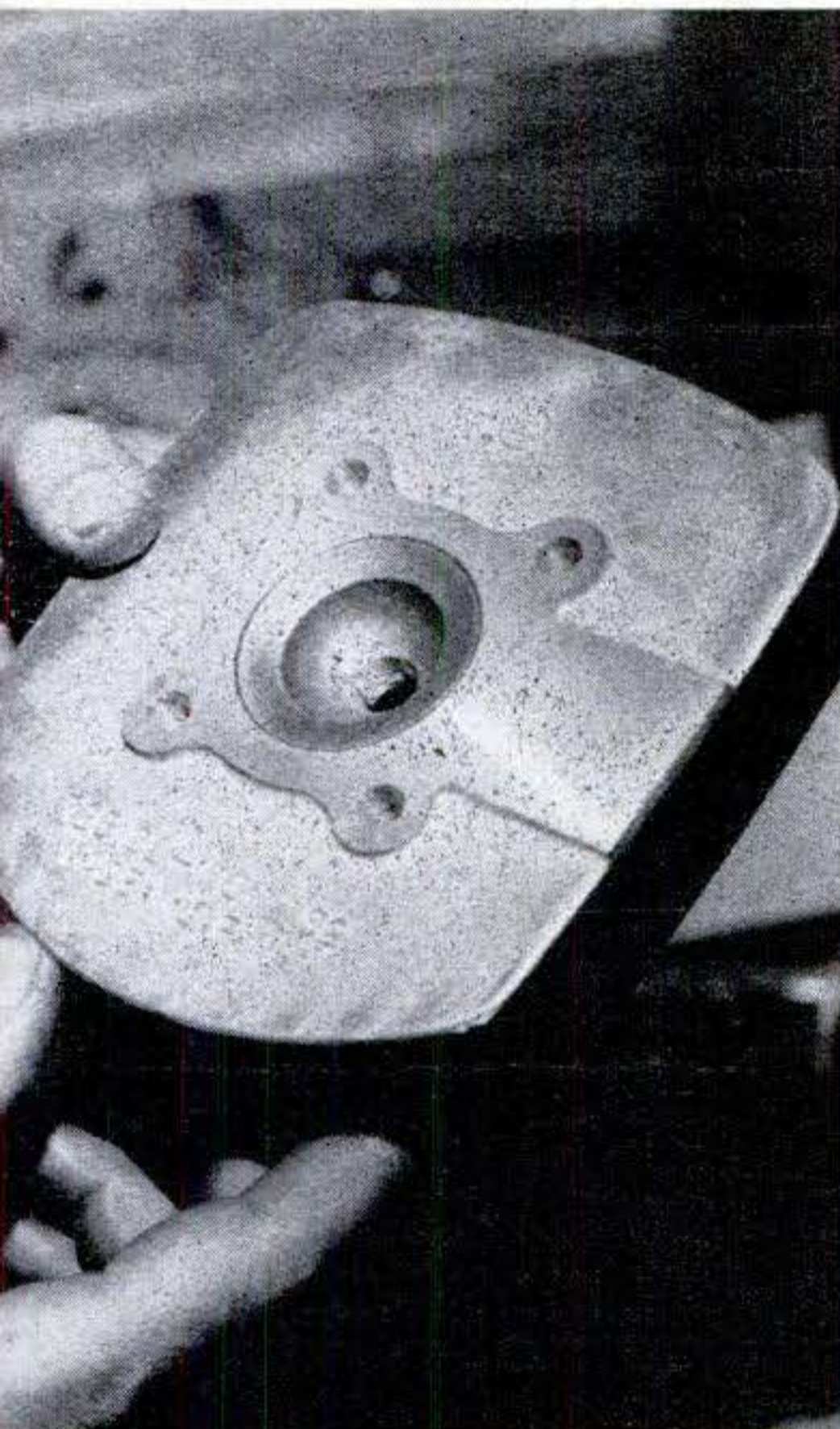
num alloy, and threads are easily stripped when a spark plug is screwed in too tight. To throw away a casting like this isn't financially feasible. Next best thing is to repair it with a Heli-Coil. The repair will be stronger than the original threads.

The job isn't difficult to do. The series of photos shows you how.



3 Heli-Coils come in all sizes, and it takes different tools to install each size. The tools shown by the arrow are used for beveling the top of a cylinder head so a spark plug will seat without leaking.

4 Heli-Coil is slipped on the insertion shaft, as shown. It is then screwed into the base of the tool. Be sure that all parts are clean and lightly lubricated.



8 Once the tool is pulled out, you'll find the insertion tit intact, leaving new threads in place. The tit has to be removed.

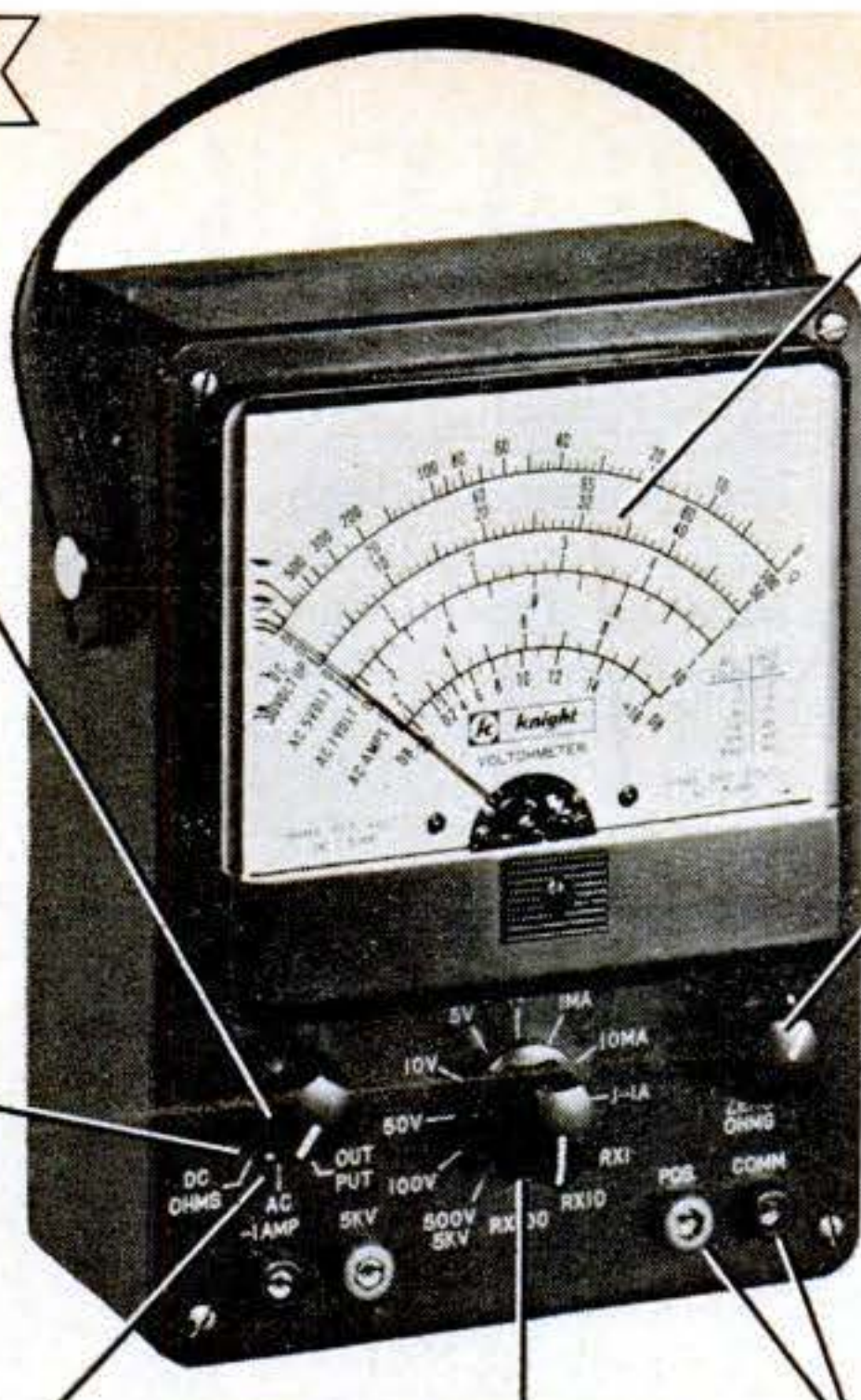
9 The tit is notched at the removable point, so you should have no problem snapping it off with a pair of pliers.

10 Here's the finished product—actually better than new, the threads can be stripped only by badly mistreating them.

DC voltage: Function switch is set to find amount of voltage at direct current (DC) sources, such as battery. Set range switch to position that includes the voltage you would expect.

Resistance (ohms): Small battery in VOM sends current through unit you're testing; meter shows opposition current meets, in ohms. Voltage is kept from circuit to avoid meter damage.

AC voltage: Set switch here to find amount of voltage at alternating current (AC) sources, such as wall outlet. Select the test range as before.



Calibrated scales correspond to various settings of range switch. Voltage readings increase, left to right, while resistance readings decrease similarly.

Zero ohms: Adjust with probes touching until pointer is at zero on ohms scale. Insures precise amount of current flow through resistance tested.

Range switch puts various values of resistance into the circuit. Select highest scale if you don't know what voltage level to expect in tested appliance.

Input jacks: Put red probe in positive jack and black probe in common (COMM. or NEG.) one. In DC tests, "polarity" of these probes is critical.



First place to check is outlet where major appliance—such as this window air conditioner—plugs in. Blown fuse? A house call by service technician to replace it would cost price of a good VOM.

The Meter That Doctors Home Appliances

You need a VOM to diagnose your car's electrical system, too. Here's how to buy and use this essential tool

By EVAN POWELL

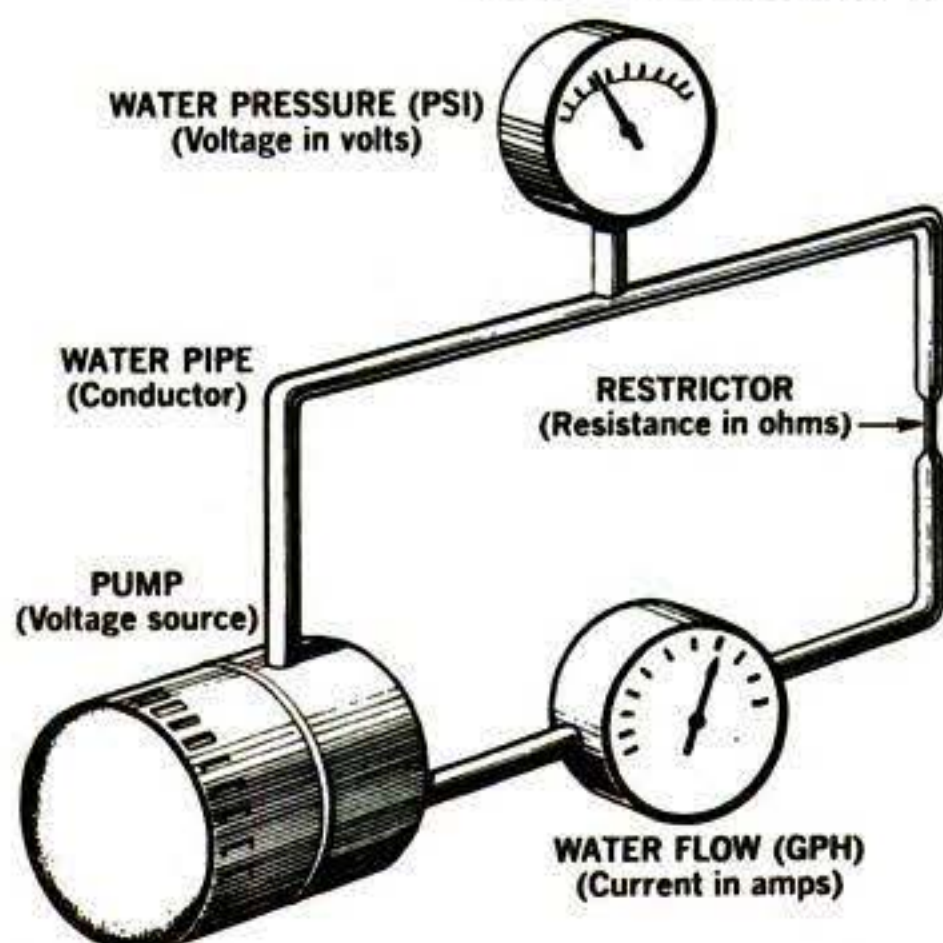
A surprising response to our recent series on home appliance repair was a flood of demands: "Tell us how to use that VOM you mention."

To quote from a typical letter: "It's all very well to tell us to make a continuity test of an appliance cord with a volt-ohm milliammeter—but how

do you buy and use one? And I suspect that there are more sophisticated tests that could be made with a VOM on cars, radios, and appliances that could save me many dollars—if I just knew what to touch with the probes and how to read the scales."

[Continued on page 115]

Once you learn what electricity is, you can measure it



Everything around us is made up of electricity. All atoms consist of positively charged protons in a nucleus with negatively charged electrons orbiting outside. Electrons in the outermost orbits are less attracted to the nucleus, and by "bumping" these "free electrons" from atom to atom, we cause electron flow. This chain reaction is like pushing a marble into one end of a tube already filled with marbles, expelling another from the opposite end.

The atomic structure of any substance determines whether it will permit easy electron flow or not. Materials with large numbers of free electrons (aluminum, copper), are "conductors." Those with only a

few (plastic, glass) are "insulators." **Voltage** is the pressure, or force, which bumps electrons through a conductor. Your VOM measures this pressure in units of volts.

Current is the volume, or flow rate, of electrons, measured in amps.

Resistance is the restriction of electron flow. Insulators have high resistance, conductors have low. Lowering the resistance in a circuit permits greater current flow for a given voltage. Your VOM measures resistance in units of ohms.

Most people find electrical flow puzzling because they can't see it. But if you visualize these factors in terms of like factors in a water system (left), it all becomes clear.

Everybody needs a little elbow room!



No place to work?
You need a little elbow room.
A den or office or sewing room.
Family outgrowing your bedrooms?
You need extra sleeping area.
Kitchen too small to eat in?
You need a dinette or breakfast nook.
You could look for a bigger house,
or add onto your present one.
But there's an even easier way
to get the elbow room you need.



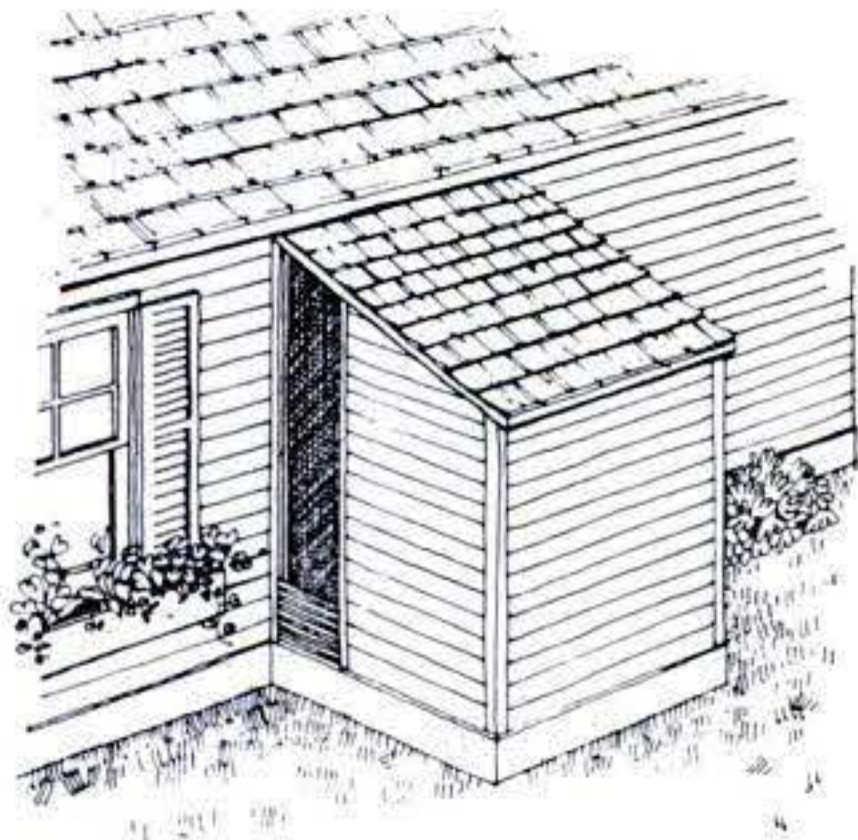
A do-it-yourself
remodeling project from
Western Wood Products Association



AND HERE IT IS!

the little Elbow Room!

You can build the Elbow Room—everything from floor to roof—for less than \$600.* This is a simple do-it-yourself project.



Ideal size

The Elbow Room measures 6' x 8'. An ideal size for an expansion of a bedroom—big enough to hold bunks or a double bed comfortably, leaving the former bed space for play and study. An ideal size for den or sewing room. A dinette or breakfast nook.

*Materials only.



Easy to build

What does it take to build the Elbow Room? A simple plan, Western Wood, and a little elbow grease. Your lumber dealer who handles Western Wood can supply you with the plans, and all the materials you need. The total package will cost you less than \$600*. And, of course, it will include siding and roofing to match or to compliment your present home.



No hidden costs

The Elbow Room won't overload an adequate heating system. It's big enough to be functional. Small enough to fit on your home without a burden.

If you're handy with tools, there's no reason why you can't have the extra room you need. You don't have to buy a bigger house, or get involved with a long-term remodeling loan. If you need a little elbow room, build a Little Elbow Room!

Send for idea plans or see your lumber dealer.

Get idea plans and materials for the architect-designed Elbow Room from your nearby lumber dealer. Or send the coupon and 25¢ for full color booklet, including complete idea plans. The idea booklet shows what can be done with the Elbow Room inside, and how beautifully it will go with your home outside.

- Send me the full color "Elbow Room Idea Booklet," including Elbow Room idea plans. Enclosed is 25¢ (check, cash or money order, please).
- Please send me information on other remodeling ideas and projects.

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Western Woods include knotty and clear grades of Douglas Fir, Ponderosa Pine, Western Red Cedar, Incense Cedar, Western Hemlock, White Fir, Engelmann Spruce, Western Larch, Lodgepole Pine, Idaho White Pine and Sugar Pine. One of a series presented by members of the American Wood Council.

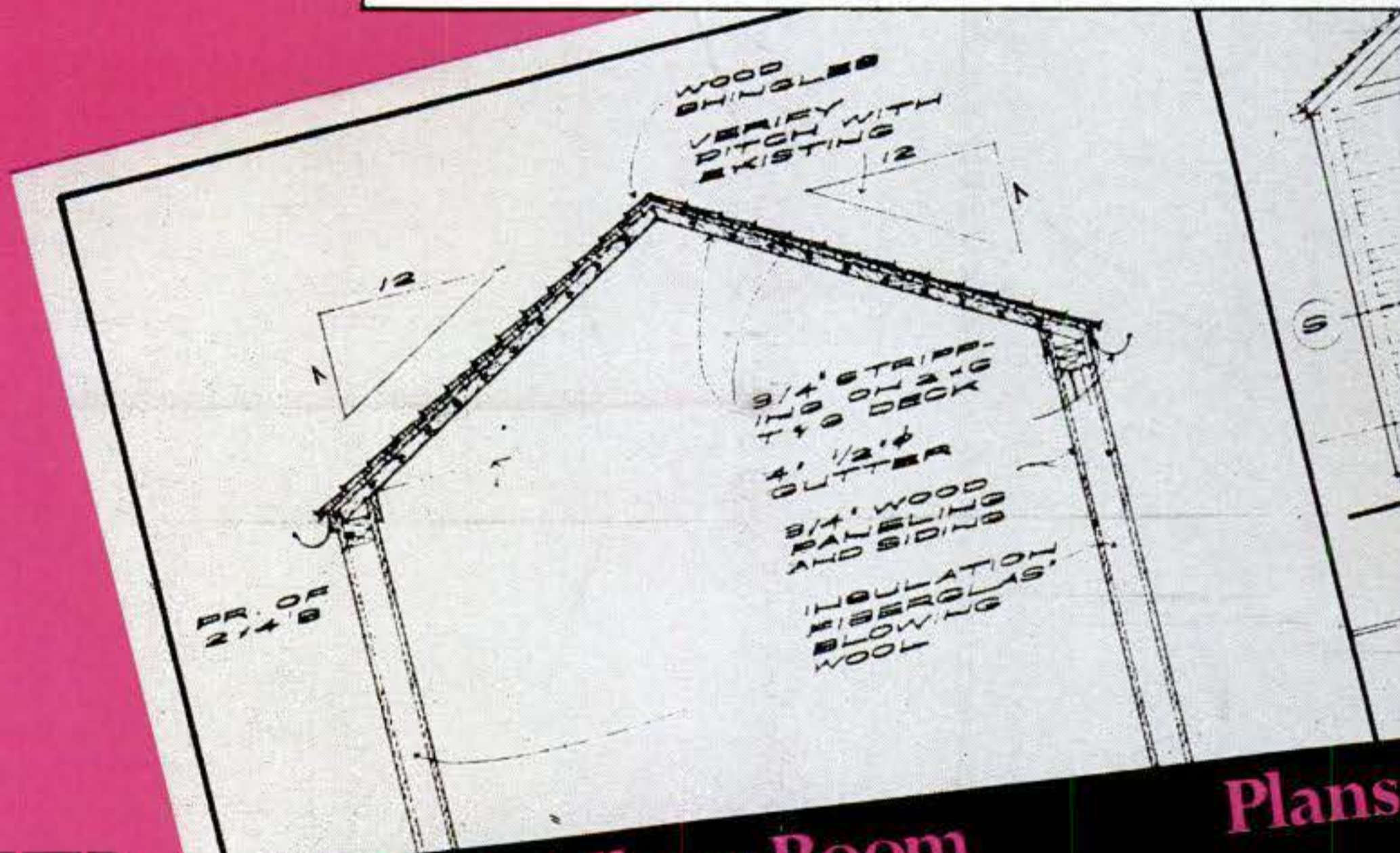
New Softwood Lumber Sizes

Product Standard 20-70 promulgated by the U. S. Department of Commerce and now in effect establishes a relationship between unseasoned and dry lumber sizes. Minimum standard surfaced sizes at time of manufacture for both unseasoned and dry dimension lumber are shown below. Board sizes are not shown, but their widths are the same as for dimension sizes, with a 3/4" thickness for dry and a 25/32" thickness for unseasoned boards. The previous thickness for boards was 25/32".

PRODUCT CLASSIFICATION (Nominal Size)	OLD SIZES (Dry or Unseasoned)	NEW SIZES	
		Unseasoned*	Dry*
2 x 4	1 5/8 x 3 5/8	1 9/16 x 3 9/16	1 1/2 x 3 1/2
2 x 6	1 5/8 x 5 1/2	1 9/16 x 5 5/8	1 1/2 x 5 1/2
2 x 8	1 5/8 x 7 1/2	1 9/16 x 7 1/2	1 1/2 x 7 1/4
2 x 10	1 5/8 x 9 1/2	1 9/16 x 9 1/2	1 1/2 x 9 1/4
2 x 12	1 5/8 x 11 1/2	1 9/16 x 11 1/2	1 1/2 x 11 1/4

The dry thicknesses of nominal 3" and 4" lumber are 2 1/2" and 3 1/2". Unseasoned thicknesses are 2 9/16" and 3 9/16". Widths for these thicknesses are the same as shown above.* Product Standard 20-70 defines dry lumber as being 19% or less in moisture content and unseasoned lumber as being over 19% moisture content. The size of lumber changes approximately 1% for each 4% change in moisture content. Lumber stabilizes at approximately 15% moisture content under normal use conditions.

All changes required by the new standard have been incorporated in WWP's 1970 Grading Rules for Western Lumber.



A little Elbow Room



Plans

Basic plan with roof and window alternates. Use as a bunk room, sewing room, office-den or whatever kind of "elbow room" you need.

This reader is so right—in fact, the VOM has become as essential to home maintenance as a portable drill. Those of us who work in electrical and automotive fields take this test meter so for granted that we're surprised to find the average homeowner is unfamiliar with it and most likely thinks he'd have to be an electronics buff to use one. Not true. The VOM is a simple measuring tool that should be standard equipment in every home.

What's ailing that toaster you tucked away months ago? Is that dead brake light getting 12 volts—or is there an almost invisible break in the lamp filament? When the vacuum cleaner gives out, is there something wrong with the motor, or just a break in the line cord? Whenever an electrical malfunction occurs, you need a VOM to pinpoint the cause.

Voltage basics. A volt-ohmmeter does two jobs: It measures the voltage across an electrical circuit, and it measures resistance within a circuit. (Actually, most VOMs have a third function—indicating current flow on a milliammeter—but you'll rarely need this for electrical-appliance repair.)

There are two types of voltage measurements, and you must set your VOM switch and place the two test probes accordingly. One type is the voltage present at ordinary household outlets: alternating current (AC). Current—as explained in the box on the previous page—means electrons are flowing in the circuit. When you throw a switch to light a lamp or run a motor, the electrons flow alternately in one direction, then reverse, and move in the opposite direction—120 times each second, completing 60 cycles. When you measure AC voltage, therefore, it doesn't make any difference which probe you put where; current is moving both ways in both probes.

But direct-current (DC) voltages—such as you get from batteries—require care in probe placement. You'll note that a VOM's jacks are labeled POS. or + for *positive*, NEG. or — or COMM. for *negative*. The last is an abbreviation for *common*, and in DC circuits it's a "shared" point for all negative leads. In most cars, for example, the negative battery terminal is "grounded" to the car chassis. The common point for all negative connections in the car's electrical circuit is, then, the chassis.

Electron flow in a DC circuit is always from the negative terminal (which has an excess of electrons) to the positive terminal. The positive terminal attracts electrons, creating a one-way flow.

Failure to get the positive (red) probe of your VOM on the positive terminal of a DC circuit will cause

the meter needle to "peg" against a stop on the left, instead of sweeping to the right. If the voltage is high, this can damage the meter.

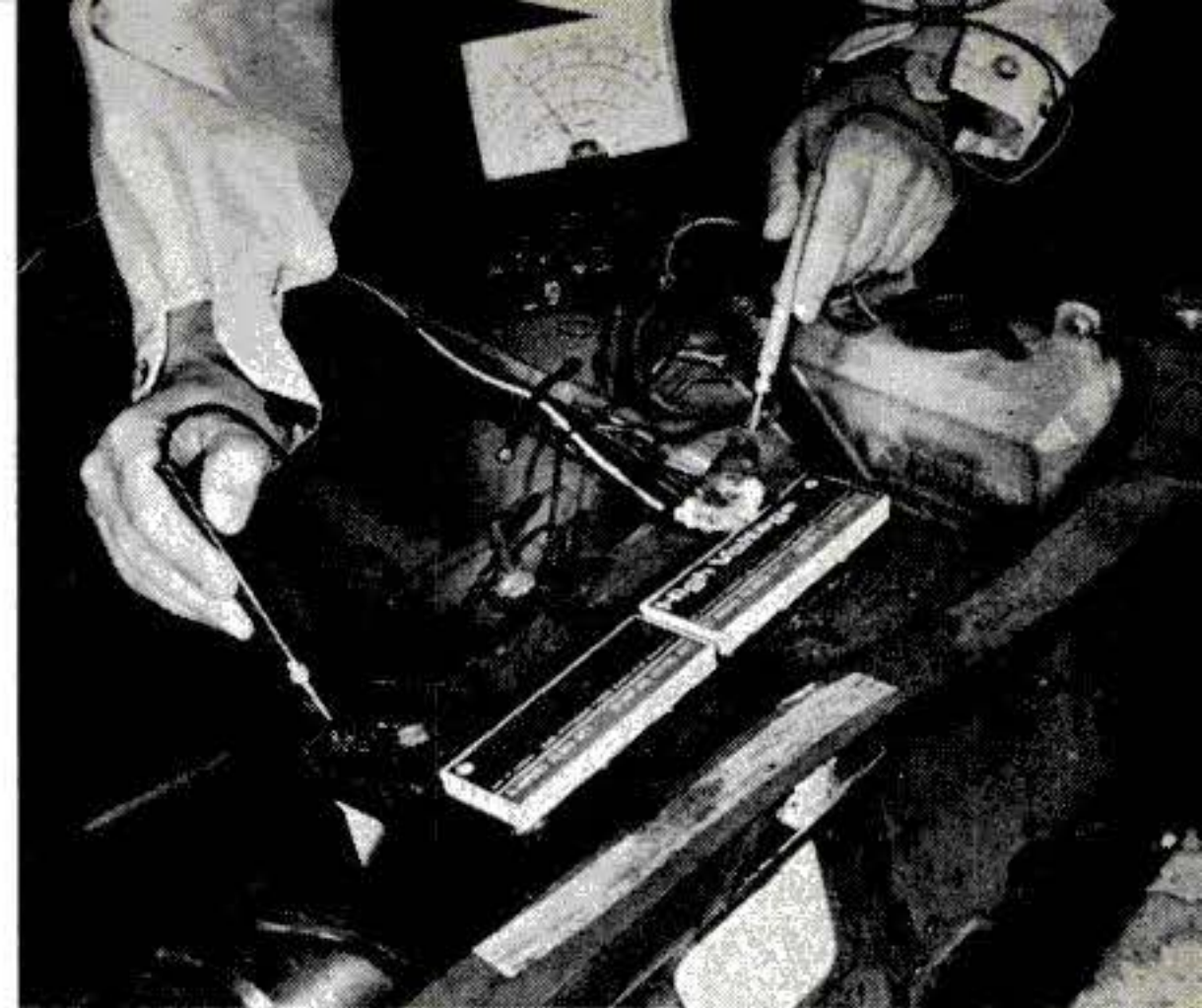
Resistance measurements. The VOM has a small built-in battery that feeds a current through whatever you touch the probes to, once you set the meter for resistance tests. Since the amount of this current is known, the meter can be calibrated to register how much opposition it encounters in the circuit you're measuring.

When you place the probes at opposite ends of a piece of copper wire, the current from the VOM battery will encounter little resistance. But when you place them at the ends of the graphite from a mechanical pencil, the current meets a higher resistance. You see these results as low and high readings on the VOM scale. (A short circuit offers zero resistance—unlimited current flow.)

And auto maintenance? For troubleshooting your car's wiring, nothing beats a VOM. It will diagnose circuit problems, pinpointing which circuits are live, dead, open or shorted. It lets you check bulbs (switch to low-ohm scale, zero meter, and touch one probe to bulb's base, other to its contact; if filament is burned out, scale will show infinite resistance). It lets you test fuses (set and zero meter as for bulbs, then touch probes to ends of removed fuse; if fuse is good, needle shows zero resistance).

You can also find resistance under load in the starting-motor circuit, test the car clock and the panel gauges, and make various tuning checks in the ignition system.

How to buy a VOM. Once you grasp these basics, you can buy a VOM with confidence that you'll be able to use it with ease. And just consider: You'll



In this DC voltage test, battery terminals indicated 11 volts when engine was cranked, but cable terminals showed only six volts. Cleaning corroded terminals restored power.

pay for the meter with what you save the first time you *don't* have to call in a service technician because you're able to track down and repair the trouble yourself.

How much will a VOM cost? There are several pocket-size meters selling for under \$5, but these lack some features you'll probably find useful. However, if you'll be using the meter only on rare occasions, a \$5 model might suffice.

Better meters are in the \$10-\$20 range. Both Lafayette and Radio Shack stores offer a good \$18 VOM (models 99-5071 and 22-049, respectively). Eico VOMs, available from Allied Radio and elsewhere, range from \$13 up. The pocket type shown in use on the next page is Model 30A4, 30,000 ohms/volt. It's \$20. Eico also offers a line of assemble-it-yourself kits.

Knight kits (from Allied) range from \$12 to \$40. The one shown on the first page of this article was built

Continued

Both types of tests are easy with the VOM

Resistance tests to check part that's removed from a circuit . . . to check for a ground . . . to check equipment with power supply disconnected:

- Plug test leads into meter jacks.
- Set function switch on RX1.
- Zero meter (see caption next page).
- Disconnect equipment from power, remove one lead from test part.
- Touch test probes to terminals of part, read resistance in ohms. If needle movement is slight, switch to higher scale (caption, next page).

How to interpret reading

No needle movement on any scale indicates part is open. A reading between terminals and body or case of part indicates a short to ground. Replace part in either case.

Voltage test to check a part that's hooked into an operating circuit:

- Plug test leads into meter jacks.
- Set function switch to lowest voltage range above reading you expect. Use AC range for line voltage, DC ranges for batteries.
- Locate suspected part. Clip test probe to one terminal (*which* terminal is critical in DC tests only).
- Turn circuit on.
- Touch other probe to opposite terminal, read proper scale.

How to interpret reading

Proper voltage across the terminals pinpoints trouble within the part itself. No voltage indicates trouble is not in the tested part but elsewhere in the circuit.

from a \$17 kit. It's model KG-645A, 5,000 ohms/volt, with eight calibrated scales and four-foot test leads.

Of course, you can spend much more. Several manufacturers (RCA,

Simpson, Triplett, etc.) offer a range from \$45 up; a few run over \$150.

But you've no need for an expensive VOM. There's little practical difference in accuracy between meters

above \$10. Features to look for include a large, legible scale and rugged construction. But keep in mind that even the most expensive instruments won't take much abuse. A rotary switch for selecting the function of the meter is more convenient than plug-in jacks and more durable than the pushbuttons on some models.

Once you've made your choice, learning to use your meter is pretty standard for all makes.

What's continuity? Remember that all the elements in an electrical circuit—the components and the wiring that connects them—must be continuous for the circuit to function. Current won't flow properly across a gap. The circuit may be interrupted intentionally (by opening a switch) or due to a failure (blown fuse, broken wire).

When a part of a circuit doesn't work, chances are that voltage isn't reaching that part (as when a motor's fuse is blown) or the part itself doesn't have continuity (as when a motor winding wire is broken). With a VOM you can quickly test for the presence of voltage at the terminals of a component and/or the resistance within the component to pin down the problem.

The secret of electrical diagnosis is: simplify. Complex circuits are composed of many simple ones. Concentrate your efforts on the part of the circuit that could produce the symptoms you've detected.

Caution: High Voltage. Never forget that you're working with voltages that can be dangerous. Follow the "one-hand rule" whenever possible to assure you don't absent-mindedly touch a live circuit with one hand while providing a path for current flow by touching something else. Hold the free probe (assuming you've clipped the other one onto the circuit) in one hand while keeping your other hand behind you or in your pocket.

Most VOMs come with probes attached to the leads. It's a good idea to remove the black probe and attach a small, insulated alligator clip to the lead, instead. With this clipped to a circuit terminal, it's easy to hold the other probe in one hand.

Heavy-duty residential circuits (for big air conditioners, ranges) should read 230 volts across the two outer terminals and 115 volts from the middle (neutral) terminal to either outer terminal.

Handle with care. Don't treat your VOM roughly. Keep the face and jacks clean; oil and dirt can insulate and give you false readings. Always check the position of the rotary switch before using the meter; and when the meter isn't in use, place this switch in highest DC voltage position. **ES**

How to use the VOM for appliance testing



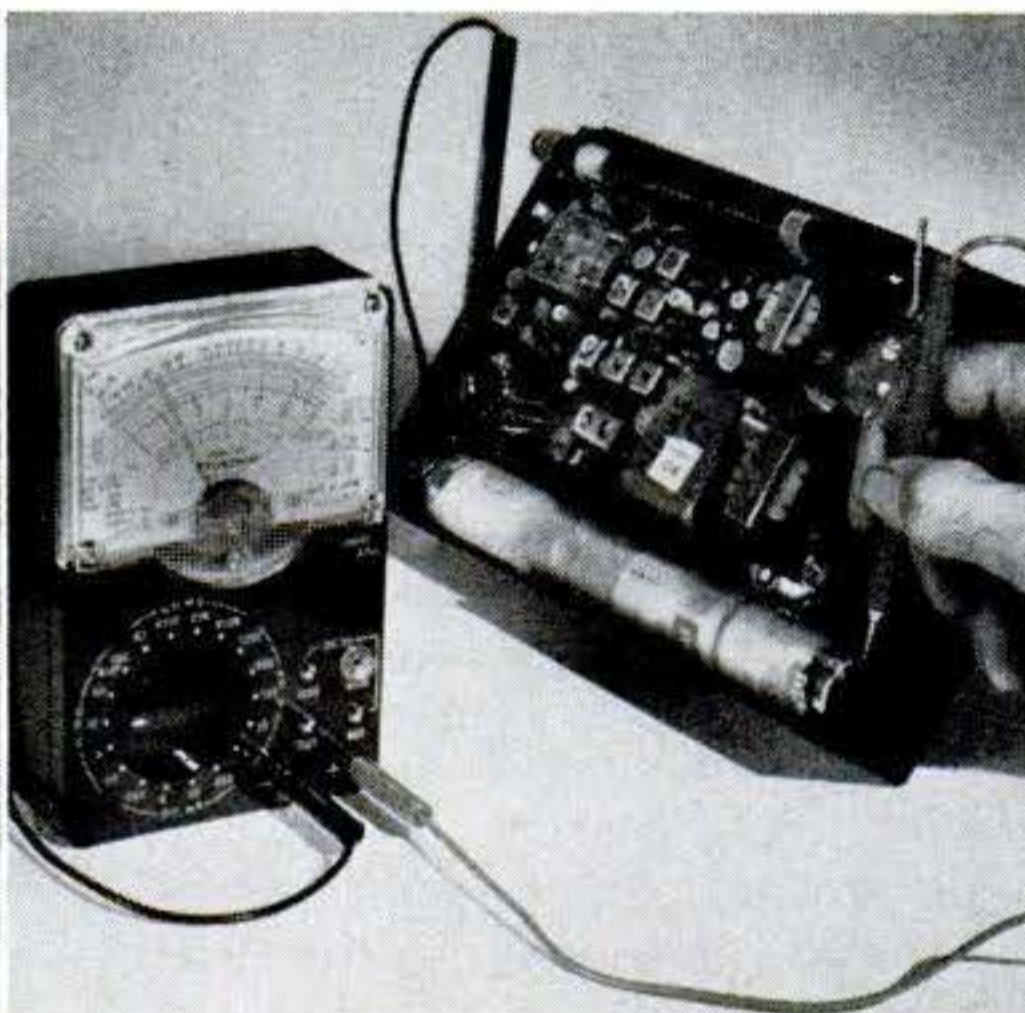
Zeroing meter is first step in using VOM for resistance measurements. Clip or hold test probes together and turn the "Zero Ohms" or "Ohms Adjust" knob until needle rests on zero. Zero meter each time you measure resistance or switch to different ohms scale; this insures precise amount of current from VOM's battery is flowing in meter circuit—and through resistance you test—by compensating for changes in battery voltage and various resistance scales. If meter won't zero, its battery may need replacing.



Resistance measurements tell you whether circuit has continuity (is unbroken) and what its resistance is, in ohms. Generally, you set switch multiplier on RX1 and read meter scale directly; that is, reading of 15 means 15 ohms. If switch were on RX10, 15 reading would mean 150 ohms; if set on RX100, it would mean 1,500 ohms. Always disconnect equipment from power source before resistance tests and discharge capacitors in circuit since they can store voltage. Farther needle sweeps right, less resistance.



AC voltage tests can be made by clipping negative lead to either wire in circuit without worrying about polarity (see text). Set meter on an AC range above the line voltage. For appliances with heating elements, such as this toaster, you should get reading of full line voltage with unit off; voltage will drop momentarily as unit is turned on to heat up. To check if switch is bad, test voltage across it in open and closed positions: Open, you should read full voltage; any reading when closed means trouble.



DC voltage tests require proper placement of probes in circuit according to polarity—that is, negative and positive terminals. Unless you know how high voltage will be, set meter to highest DC scale. Clip black probe to negative terminal, touch red one to positive. Above, VOM is used to check combined voltage of four cells in portable radio. When making resistance tests of a car's electrical system, disconnect positive terminal of battery. Meter in these photos is Eico model 30A4, described in text.



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In top condition, the human body can generate as much as 14 horse-power! Can you? If you're like most men you're not in good enough shape. But you can be! Regardless of your age, weight, or present physical prowess, you can tune your body to peak performance by following the scientific fitness program in the **FITNESS AND MEDICAL GUIDE**.

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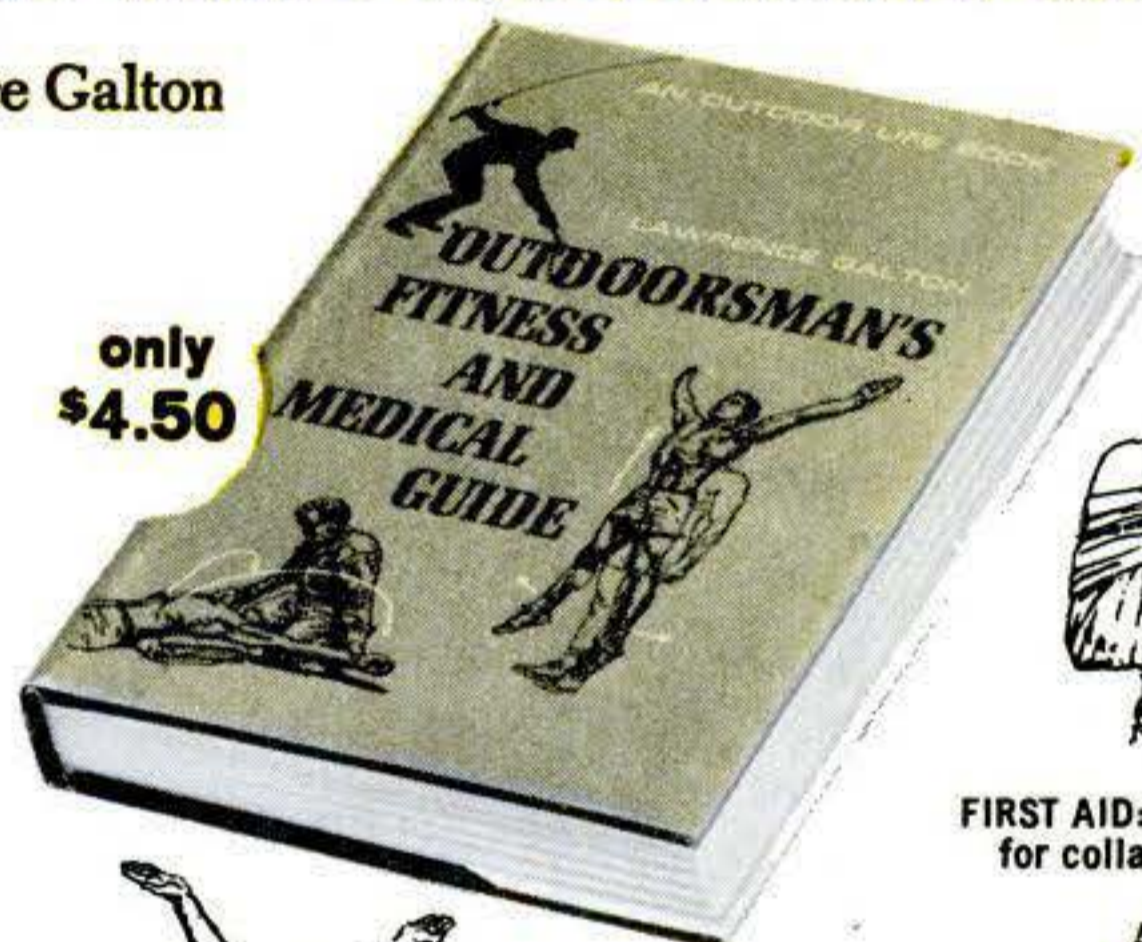
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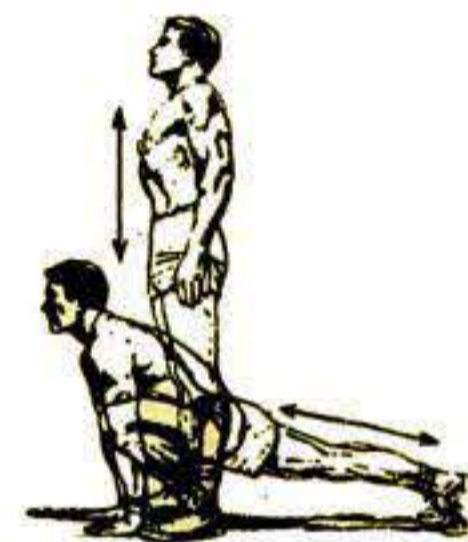
Yes, **OUTDOORSMAN'S FITNESS AND MEDICAL GUIDE** is *the* book that will tune you up to an amazing new high! You'll *feel* the difference and you'll *see* the difference in improved wind, agility, stamina and coordination. The illustrations and medical facts alone are worth the price of the book. Why not put this all-round guide to work for you starting today.



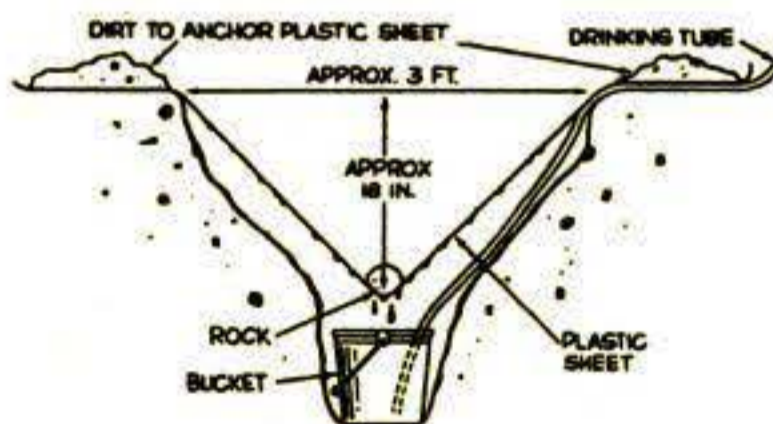
FIRST AID: Correct bandage for collarbone fracture.



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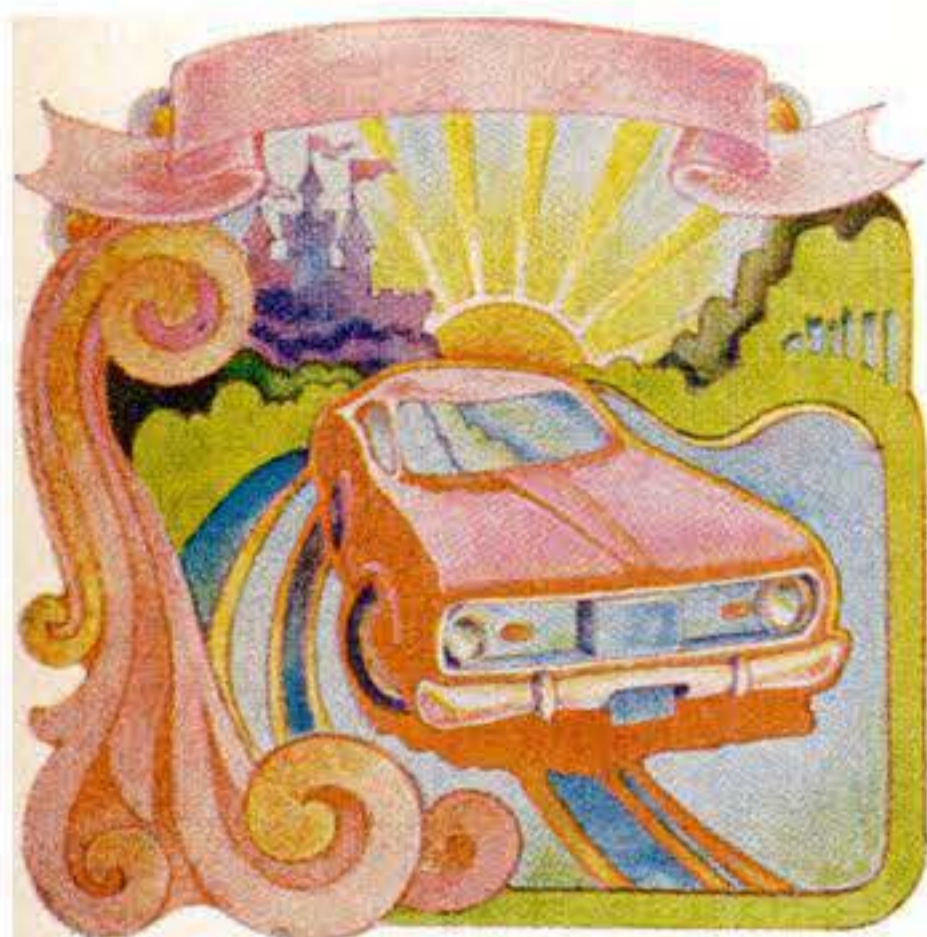
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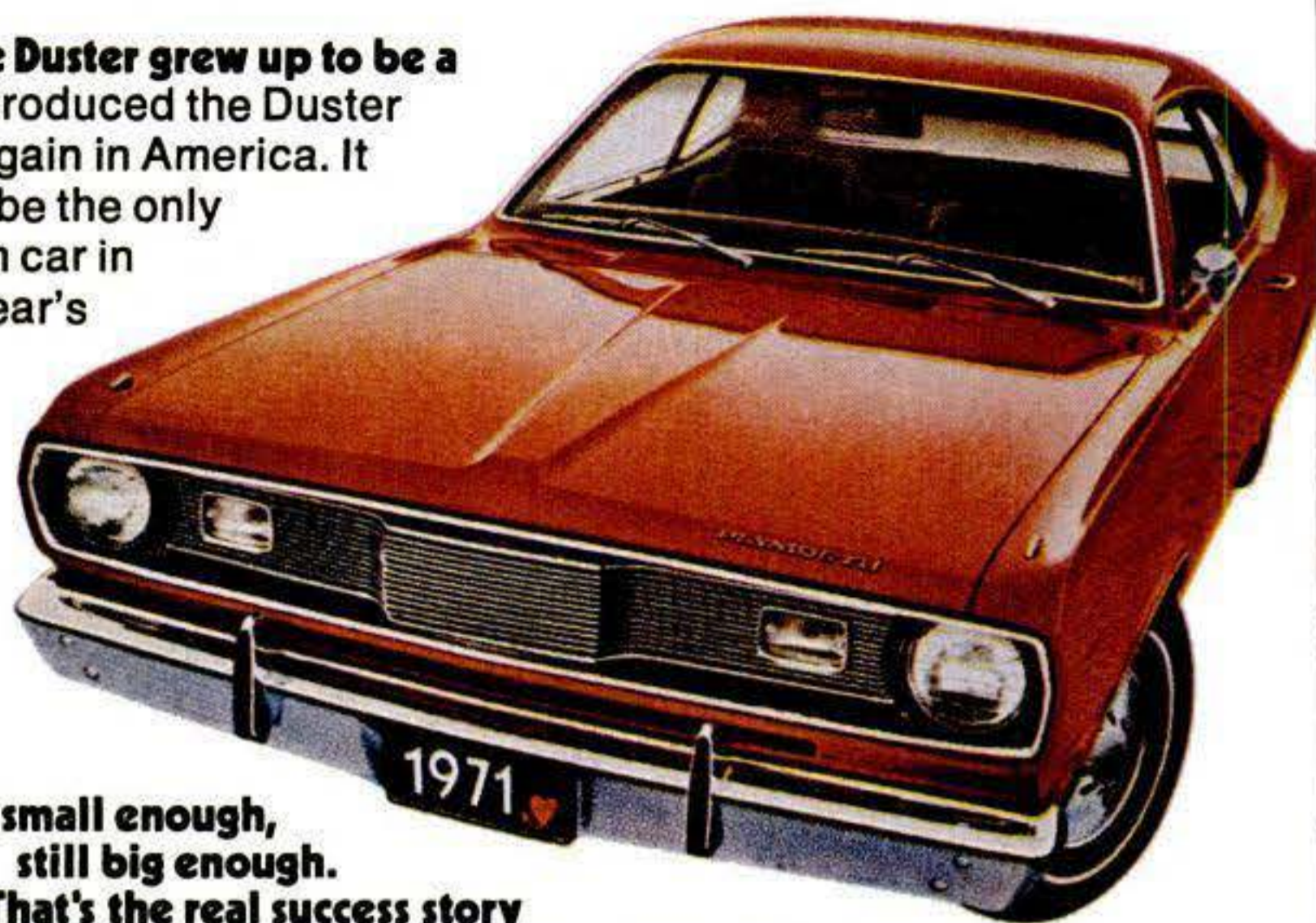
MONEY BACK GUARANTEE

Announcing the 1971 Duster.



This is the story of how little Duster grew up to be a wonderful success. We first introduced the Duster as the best transportation bargain in America. It still is. And we built Duster to be the only small-enough-but-big-enough car in America. And it still is. This year's sales of our Duster/Valiant line are up over 200% from last year's sales figures!

And now, we present the 1971 Duster. Still small enough. Still big enough.



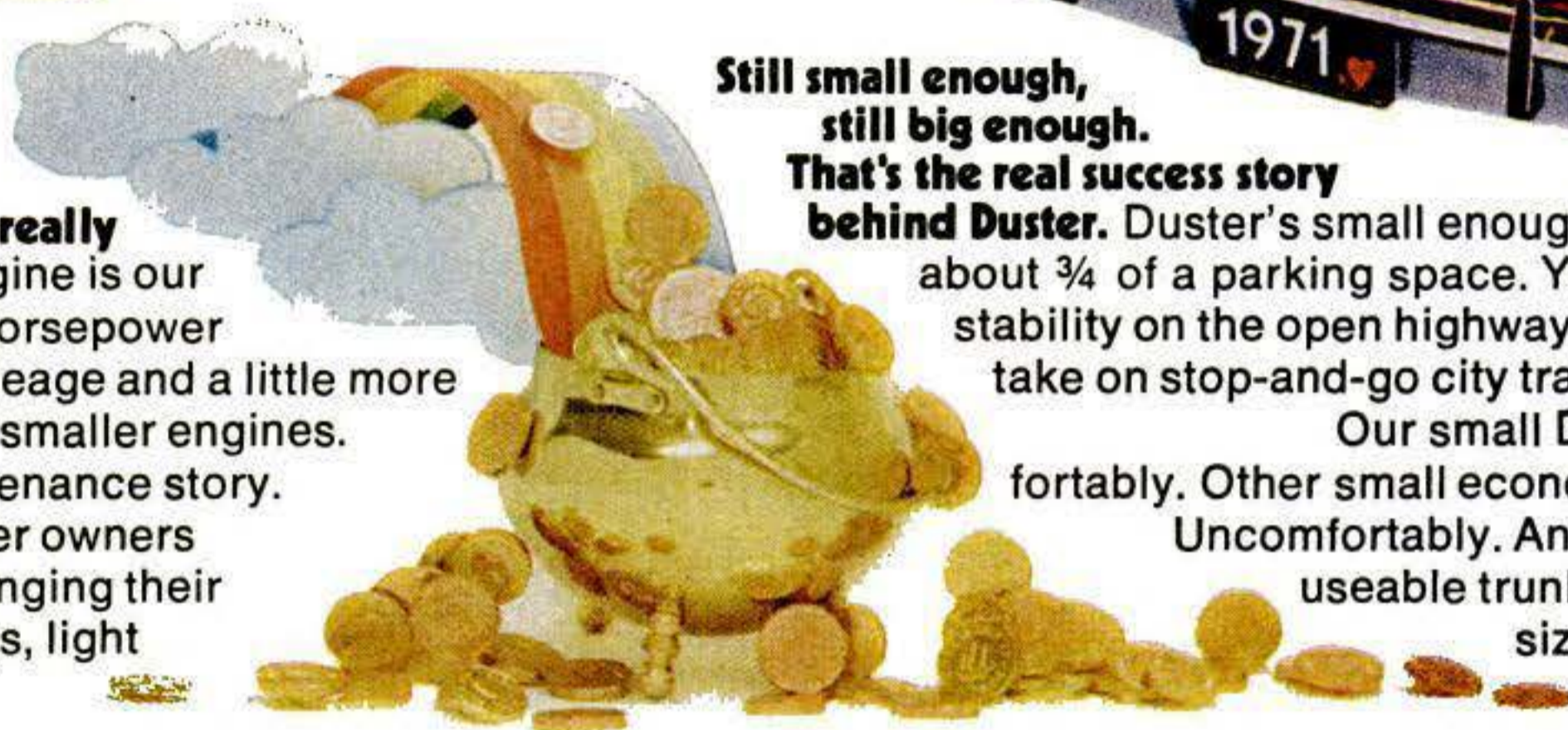
The tale of Duster's gas economy and low maintenance bills. Or, how to succeed at savings without really trying. Duster's standard engine is our rugged 198 cubic inch, 125 horsepower Six. It gives you great gas mileage and a little more power than other small cars' smaller engines.

And then there's the maintenance story. We've made it easy for Duster owners who want to save money changing their own oil, replacing spark plugs, light bulbs, fuses, etc. etc.

Still small enough, still big enough. That's the real success story behind Duster. Duster's small enough to slip into

about $\frac{3}{4}$ of a parking space. Yet it's big enough to give you stability on the open highway. In other words, it can easily take on stop-and-go city traffic as well as freeway traffic.

Our small Duster seats five adults. Comfortably. Other small economy cars seat five adults, too. Uncomfortably. And Duster has 15 cubic feet of useable trunk space. Or about three good size suitcases more space than most sub-compacts.



Our New B-1 Bomber—High, Low, Fast, and Slow

[Continued from page 86]

swing-wing design for our commercial supersonic transport?

Whippet vs. ferret. This was an economic rather than a performance or safety problem. The SST and the B-1 are different animals, even though both must fly at more than twice the speed of sound. The SST, incidentally, will be bigger, and faster by about 300 mph. Its imperative—to carry passengers profitably—changes the position of landing gear and engines. Also, it is designed to cruise long distances at high-altitude supersonic speeds.

The requirement for the B-1 is the ability to loiter on station and, if necessary, make a supersonic dash to penetrate a defensive border, then drop down low and fly close to the ground at just under the speed of sound. The B-1 does not have low-altitude supersonic-dash capability. Times change: Until two years ago, a final low-altitude supersonic capability was considered vital.

The canard. The low-altitude requirement can mean terribly bumpy riding, not only because of air turbulence but because the B-1 will have to fly up and down hills and mountains. To make this ride smoother

and more tolerable for the crew, the B-1 has a small forward wing, a canard, that automatically changes its angle to make the flight less choppy.

One of the experts I interviewed was Warren Swanson, now B-1 program manager for North American Rockwell and previously general manager of the company's B-70 program. The B-70 had also been a supersonic bomber design, but was abandoned as such and became a high-speed research plane.

He explained that the B-70, which also had a canard wing up front, was a "point" design, made to cruise only at Mach 3 (2,000 mph) at high altitude. The B-1, on the other hand, is of "flexible" design for operation at both high and low altitudes. The B-70 was also a "variable-geometry" plane, even though the wings did not swing back and forth. Giant movable wing tips took up almost a third of the wing. They moved straight out for takeoff (or landing) and then dropped down to reduce lift and drag for high-speed flight. When the tips were down, they gave a rudder-like effect; as a result, the tail rudder could be smaller to provide less drag.

But it was the B-70's single-point

concept that probably kept it from further development. Russian defenses against high-altitude supersonic bombers improved and forced development of a new, low-level penetration concept. According to some authoritative sources, low-level penetration at high subsonic speeds (under 700 mph) provides almost as much survivability as supersonic dashes at low altitude, and uses far less fuel; hence, possible range increases.

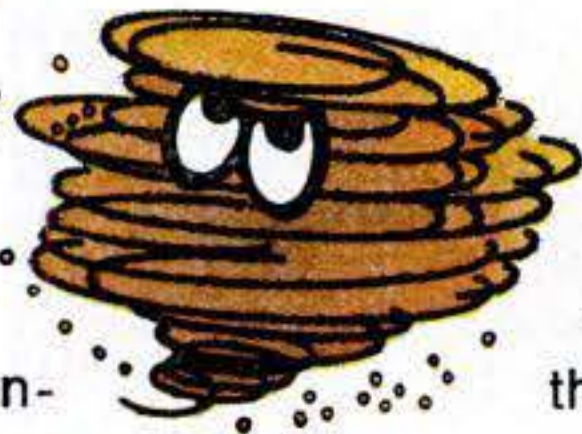
Instruments galore. On-board computers and inertial navigation systems will enable the B-1 to take off and fly an entire mission with the crew monitoring. The avionics package, still to be worked out, will use some items developed for the bomber version of the F-111. It will include radar for air-to-air and air-to-ground defensive and offensive weapons, infrared and electro-optical sensors, terrain-following radar, and map-matching for bomb-damage assessment.

Though not officially released, the word is that all three competitors took a different approach to build the same bomber.

• Boeing put the engines in the rear, mounted on the fuselage in the

A success story.

Part of Duster's success lies in range of options. Duster has over 50 different options you can choose from. That's part of its charm. You can add power brakes, or a tachometer, or Chrysler Corporation's exclusive Stereo Cassette Tape Player (you can record with it—right from the radio), or bucket seats, air conditioning, tinted glass, power windows, or more.

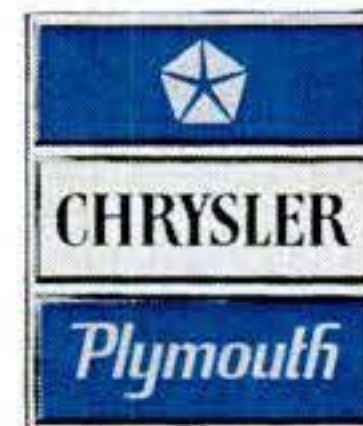


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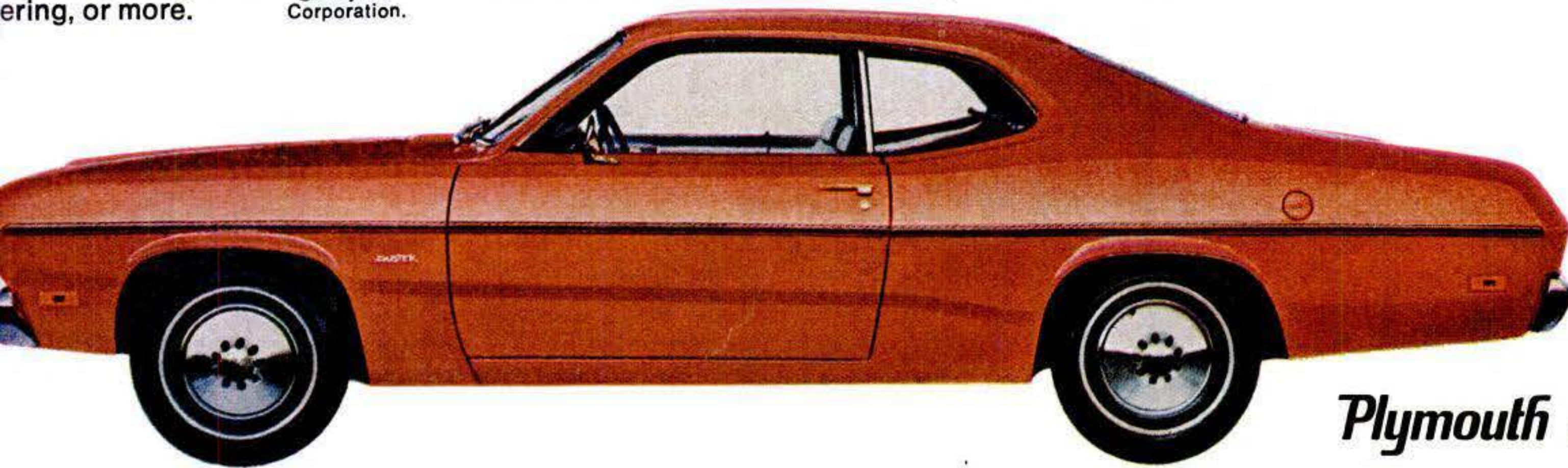


Duster's been very successful at winning friends and influencing people. The reason is simple: Duster is the car for the times. The kind of car people will be turning to in the Seventies. Over 175,000 car buyers thought so last year. And we expect more of the same kind of success in 1971. Duster. Built and engineered with extra care.

The '71 Duster comes through with a whole lot of success for you.



Coming Through.



Plymouth CHRYSLER MOTOR CORPORATION

Our New B-1 Bomber—High, Low, Fast, and Slow

[Continued]

same manner as on the 727 airliner.

- General Dynamics mounted their B-1 engines under the swing-wing, on swivel pylons to keep them pointed dead ahead as the wings were moved back and forth. This same method is used to carry the missiles mounted under the wings of their F-111.

- North American mounted its engines under the fixed position of the wing, near the fuselage, with intakes ahead of the leading edge of the wing. (The four GE engines, incidentally, will have a thrust of about 30,000 pounds each. The design is an offshoot of the engines developed for the B-70 and the C5A.)

Passing the word. There's a lot of data exchange between builders of high-performance planes, leading to greater efficiency and safety. The small canard wing that helps smooth the B-1's ride can do the same job for commercial airliners and, says Warren Swanson, it could be retro-fitted on existing craft. In encounters with severe clear air turbulence, it would add safety because it works automatically and reduces stress on the wings.

Data on the pivot point of the Boeing swing-wing supersonic transport design was used for the B-1. There

were also lessons learned from the B-70—even from the rocket-powered X-15, on which Swanson also worked. Actuators developed for the X-15 to operate at high temperatures of 250 to 700 degrees F will also be used in the B-1.

Also, North American is looking at the control system of Boeing's SST. In an opposite swap, they have provided transonic flight data from the B-70, which flew at Mach 3, to British and French engineers working on transonic problems for the Mach-2 Concorde transport. Swanson reports they are still not able to predict accurately speed data between Mach 0.95 and Mach 1.4, just below and above the speed of sound.

In researching the B-1, I ran across one prediction that is nothing less than a blockbuster, if it turns out to be true. It was denied by both Air Force and North American officials. But my source was so well placed—an extremely knowing, experienced, and responsible authority, closely involved with the supersonic transport program—I cannot ignore it.

He told me that even though the B-1 program had been five years in study before the decision was made to

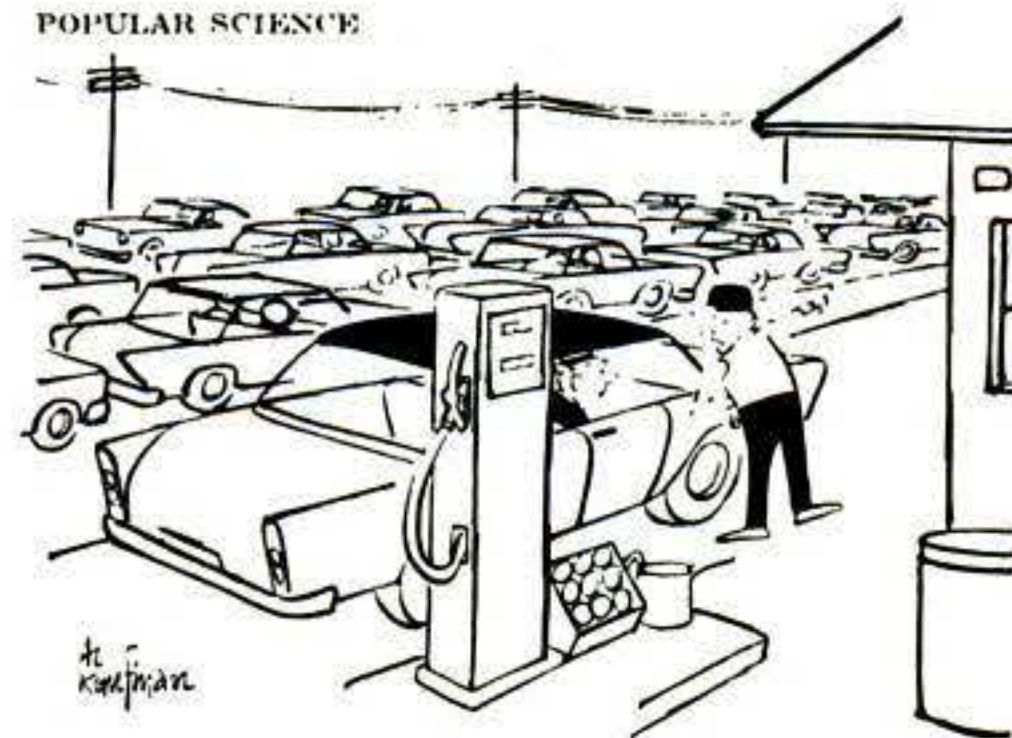
go ahead with the swing-wing, he considered it entirely possible that, like the Boeing supersonic transport, the B-1 design might be radically changed—even to the extent that a fixed-wing design might emerge, and the swing-wing idea be shelved again. If this happens, we will have once more come full circle.

The more things change, the more they stay the same!

Only faster.

P.S.

POPULAR SCIENCE



"Monmouth Road? Yessir, just crawl along this highway for six miles until you reach a big jam at the circle. Inch your way into the right-hand lane. Then, bumper-to-bumper for another two miles until you see the sign."



Typical chemical tools you might stock on your garage shelves. You may find others that work just as well for your purposes

Chemical Tools for Home Car Care

By RICHARD DAY

An automotive tool is designed to perform a certain task, right? Nothing says it has to look like a wrench or a screwdriver. It could just as well be a blob, a liquid, or a powder, as long as it does its job. Well, here's a list of 24 chemical tools—blobs, liquids, and powders—all just as useful as wrenches or screwdrivers at times.

This isn't a list of oil additives, appearance products, or maintenance chemicals like brake fluid. It's a selection of special-duty lubricants, cleaners, cements, sealers, and other products that take a lot of the work out of caring for your car.

Most are made by several manufacturers and are easy to find at auto parts dealers, chain stores, service stations, and hardware stores. At the bottom of the list are sources for some of the harder-to-get products.

When you shop for chemical tools you'll notice that some come in many forms. The cheapest is bulk, but it's the least convenient to use. Aerosol

CHEMICAL TOOLS: WHAT TO GET, HOW TO USE IT

	FORMS AVAILABLE	BEST USES	HOW TO USE
Motor oil	Applicator cans, bulk	General lubrication of heavy moving parts, distributors, generators	Squirt on, work in, wipe off excess. Use 20-wt. for most jobs
Light machine oil	Applicator cans, aerosol sprays, drop-oilers, bulk	General lubrication of light moving parts, small motors, clocks. Rust-protection of metal	Apply, work in, wipe off excess. For rust-protection, spray on lightly, wipe to spread
Penetrating oil	Applicator cans, aerosol sprays, drop-oilers, tubes, bulk	Freeing rusted parts. General light lubricant for clocks, etc.	Squirt onto part, tap to work in. Wait, then loosen. Repeat if necessary
White grease ¹	Tubes, aerosol applicators, bulk	Lubing of metal-to-metal moving parts such as hinges, bearings, slides, latches, linkages, cables, etc. Protects against corrosion	Apply between moving parts, wipe off excess if exposed. Wipe on a thin coat for corrosion-protection. Won't dry out or wash away
Stainless stick lube ²	Applicator sticks	Lubricating door latches and strikers. Stainless to clothing	Rub stick over contacting parts to leave a film of lubricant between them
Moisture-displacing penetrating lubricant	Aerosol spray	Varied uses as a penetrating lube for parts that are wet. Excellent winter lock lube. Cleaning moving parts. Rust-preventive for tools. Drying wet ignition systems	Shake, spray on parts. For wet ignitions, spray on distributor cap, coil, wiring, and spark plugs, and start engine
Liquid locknut ³	Tubes	Turns threaded fasteners into vibrationproof locked fittings. Can be removed when desired	Clean parts, apply a drop to threads. Assemble and tighten. Works in one hour
Hand-protector	Jars	Protects hands and arms from soiling by paint, grease, oil	Rub on until it disappears. To remove, wipe off excess dirt, and wash. Lasts 3-4 hours
Hand-cleaner	Cans, tubes, wall applicators	Removes dirt, grease, oil, tar, gasket cement, rubber cement, and other material from hands	Apply a little to hands, work in thoroughly to loosen soil. Wipe dry, or rinse hands in water and dry
Degreaser	Applicator cans, aerosol sprays	Removes grease, oil, and grime from engines, concrete paving, etc.	Scrape off heavy deposits. Spray liberally onto warm engine, let soak, hose off. Repeat if necessary
Gasket cement	Applicator bottles, cans, tubes, aerosol sprays	Engine repair. Comes in hardening, nonhardening, adhesive types; latter two most useful	Apply to cleaned mating surfaces according to directions. Assemble parts and fasten together
Trim cement	Tubes, applicator cans	Fastens weather strip, fabric, and insulation to metal. Mends convertible tops. Seals hoses	Put cement onto both cleaned surfaces, press and hold together for a few minutes
Rubber lubricant ⁴	Applicator cans	Lubricates rubber suspension parts, helps change tires. Cleans rubber, vinyl, and leather	Squirt onto cleaned rubber fittings to lube. To clean, apply, rub into lather, wipe or flush off
Belt lubricant	Tubes, aerosol sprays	Stops fan, generator, other belts from slipping. Quiets belts	Apply carefully to inside edges of moving belt
Powdered-graphite lubricant	Applicator cans, squeeze bottles	Lubes locks, heat-riser valves, wheel lug nuts. Greaseless, oilless, hot- and cold-proof	Apply to parts with a squeeze. Work parts to distribute
Silicone rubber	Applicator tubes	Seals windshield, firewall leaks. Beefs up shrunken weather strip	With applicator tip, run a bead under lip of rubber windshield molding or along weather strip. Let cure
Silicone lubricant	Aerosol sprays, tubes	Dry lubricant for sliding contacts such as window channels. Quiets squeaky door weather strips. Retards corrosion of battery terminals. Greaseless, stainless, colorless. Not affected by solvents	Spray a light film onto clean, dry surface. Work moving parts. Re-spray if necessary. White coating indicates too-heavy application; brush off excess
Carburetor, automatic-choke, PCV-valve cleaner	Applicator cans, aerosol sprays, bulk	Cleans fuel and other deposits from carburetor, automatic choke, smog valve	For best results, use the specific product. Apply according to directions on the container, work parts. PCV valve should be removed
Naval jelly	Plastic bottles	Removes rust from trim, tools, wherever found. No scraping, sanding, or wire-brushing	Brush or wipe liberally onto rusted, oil-free parts. Wait, rinse off with water
Starting fluid	Aerosol sprays	Aids in starting engines as cold as 55 below zero	Spray into carb throat while engine cranks. Avoid accumulations in engine
Ignition sealer	Aerosol sprays, applicator bottles	Waterproofs ignition system, protects chrome trim from corrosion	Spray a fine mist onto cleaned surfaces, let dry
Gas and oil leak-sealer ⁵	Applicator sticks	Seals gasoline and oil leaks from the outside without draining	Rub stick vigorously over leak to stop it. Apply more material for better seal
Exhaust-system sealer ⁶	Tubes	Seals joints and repairs in exhaust pipes, mufflers, tailpipes	Apply thin layer to inch of joint inside and outside. Insert pipe, install clamp
Speedometer-cable lubricant	Dispenser containers	Lubricates speedometer cables and housings	Connect to detached housing near speedometer, let lube flow into housing

Where to find hard-to-get items: 1) Lubriplate, Fiske Bros. Refining Co., 129 Lockwood St., Newark, N.J. 07105. 2) Door-Ease, American Grease Stick Co., Muskegon, Mich. 49443. 3) Nut Lock, Loctite Corp., Newington, Conn. 06111. 4) Ru-Glyde, American Grease Stick Co., Muskegon, Mich. 49443. 5) J. C. Whitney & Co., 1917 Archer Ave., Chicago, Ill. 60606. (Catalog #15-1008). 6) Acousti/Seal, Walker Mfg. Co., 1201 Michigan Blvd., Racine, Wis. 53402.

sprays—the easiest to use—cost the most. So you'll have to balance cost against convenience.

Many of these tools have good uses around the home as well as in the

garage. It's a good idea to round out the list to 25 items with a 2½-pound dry-powder chemical fire extinguisher, your most important chemical tool of them all.

The Blinker Says to Fill 'Er Up!

[Continued from page 95]

As the gas level goes down, the floating wiper arm of the variable resistor lowers its resistance, forcing more current to pass through the EMPTY coil pulling the pointer to E. Filling the tank increases the resistance, allowing the 45-ohm shunting resistor to force more current through the FULL coil.

Sensing the fuel level. Since the voltage from the fuel-tank sensor varies with the amount of fuel that's in the tank, all we need is a voltage-sensitive switch to activate a warning indicator at a predetermined point. This is readily accomplished by the use of a Schmitt trigger made up of Q1 and Q2.

When the wiper arm of the float-actuated resistor is at the FULL end of its winding, a relatively positive voltage is present on the base of Q1 from the sense wire. This allows Q1 to go to an ON state, which in turn cuts Q2 off. Q3, a power transistor acting as a buffer between Q2 and LM to supply the required current, is also biased off by R7, keeping LM from illuminating.

As the wiper arm of the fuel-tank sensor begins to move toward the EMPTY side, the voltage on the base

of Q1 becomes more negative. At a certain voltage level, which is adjustable by R1, Q1 will no longer be able to conduct and will cut off. This will allow Q2 to conduct, turning on Q3 and illuminating LM. A bimetallic strip built inside the lamp assembly will then open and close, causing LM to flash out its unforgiving prophecy.

Making your blinker. Mount the components on a piece of perforated board as shown and you will be able to fit the entire package neatly into a 1 1/8"-by- 2 1/8"-by-3 1/4" plastic box. Use 1/4" spacers to prevent the components from shorting to the aluminum lid, as well as electrical tape against the lid as an added precaution. A rubber grommet is perfect for shimming up the bulb high enough to prevent its base from bottoming against the cover.

If you do not use the red-tinted flashing bulb specified in the parts list, glue a colored lens, preferably a red one, to the box above the bulb. This will insure a good eye-catching indication.

One special note about Q1 and Q2 that we should also mention: The Sprague 2N2923 uses a different pin configuration than normal (see the

drawing). If a substitute transistor is used, you must, of course, make the necessary changes on the layout to keep the connections of the emitter-base collector the same as those shown on the schematic.

Mount and connect. Locate the indicator box somewhere in your field of view, but make sure that you do not place it where it may hinder your driving. On the steering column or under the dash is usually a good spot to mount the box.

Connect the three respective wires to ground, ignition plus, and the fuel gauge where it joins the sender cable from the fuel-tank sensor. Finding a particular wire under the dash can sometimes be tedious, but perseverance and a good flashlight will eventually lead you to it. A manual for your car, of course, can be helpful, but is not a must.

Completing the installation requires only the setting of R1 for triggering at some low level of fuel somewhere between needy and desperate. Once it has been set, forget it. It will take care of itself—and you. Fill up the tank and you may never see your gas reminder lit again—until you need it. E3

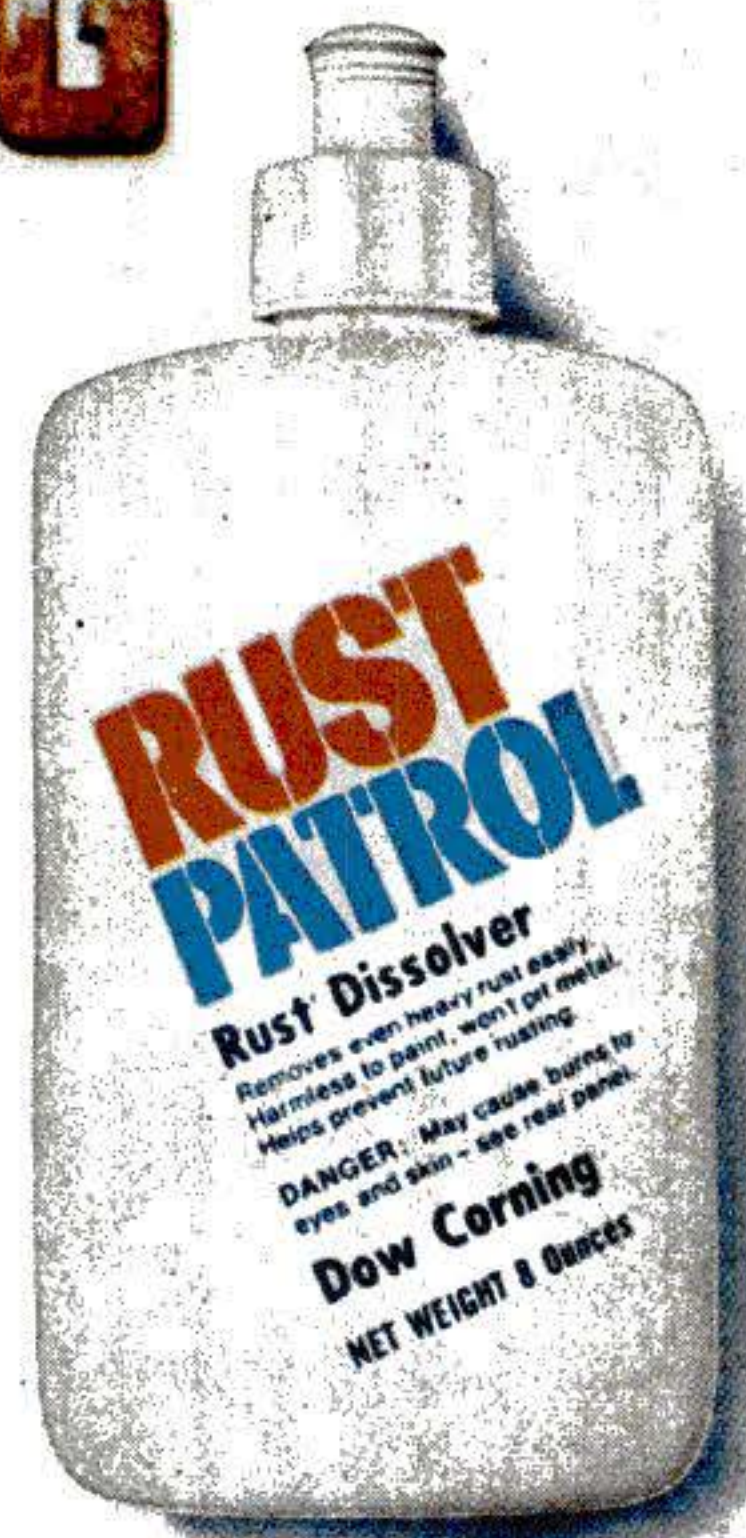
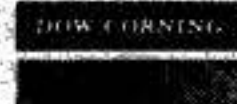
LIBERATE AMERICA FROM CREEPING RUST

Meet Rust Patrol. A new and devastatingly effective rust remover. It's ruthless. Digs down deep for rust and dissolves it completely. But it's selective, too. So it won't remove paint or pit metal. Even works on chrome and aluminum.

Rust Patrol™ rust dissolver comes complete with a free applicator brush. So it's easy to apply. (It even sticks to vertical surfaces.) And when it's done the job, you just wash the rust away—no scraping, no sanding.

Get yourself some Rust Patrol. Nobody wants America to go rusty.

DOW CORNING





First, we made them last. Then, we made them fast.

The faster a snowmobile goes, the *stronger* it needs to be. But the stronger you make it, the heavier it gets and the slower it goes.

The easy way out is to make it light *first*. Then make it as tough as you can, under the circumstances.

Here, at Evinrude, we did it the other way around. *First* we made our snowmobiles *tough*. Then we concentrated on making them fast.

Choosing this longer, slower route to performance turned out to be the smartest move we could have made.

Our stronger, tougher designs forced us to compensate for weight with *efficiency*. And this led to a whole series of improvements. New high-torque horizontal engines with loop-charged fueling and power-tuned exhausts. Better track designs using new, longer lasting track materials. New torque-sensing drives — efficient over a far wider range of speed and load conditions. Tough new suspensions that soak up shocks like the "Knee-action" on your automobile.

Result: Our big new two-passenger

luxury snowmobiles are now the equal in performance of stripped-down one-man machines that lack nearly all their luxury features.

And our new high-performance Bobcat models are fast on the flats, strong on the hills, and built tough enough for the wild country — a most unusual combination.

Our competitors will think we got our performance the hard way. Our customers will be glad we did.

Write for catalog. Evinrude Motors, 4004 N. 27th St., Milwaukee, Wis. 53216

EVINRUDE SNOWMOBILES

Div. of Outboard Marine Corporation



An empty parking lot in a state forest can offer a handy, plowed spot to set up your snowmobile lodges, the PS reporters discovered.

Turn Your Camper into a SNOWMOBILE LODGE

Why mothball your RV over winter? It's a fine shelter for snowmobile families

By **ERIK H. ARCTANDER** and **HERBERT SHULDINER**

Heads turned as our campers pulled into a parking lot of the Pittsfield State Forest. Spring was still around the corner. Snow covered the ground and the temperature was ideally frigid for snowmobiling. But campers?

Well, we had an idea that campers and snowmobiles did indeed mix. We had set out to test our theory that a camper could serve well as a fine warm-up lodge or as guaranteed overnight accommodations in freezing weather. To try out our theory, we had selected two different types of camper vehicles—a self-powered El Dorado chassis mount, and a unique trailer, called the Trans-Por-Teer,

which has a built-in port for carrying recreational vehicles.

We towed a Polaris Mustang and an Arctic Cat Panther on a regular trailer hitched to the El Dorado. We loaded an Evinrude Skeeter and a Polaris Playmate into the open port of the Trans-Por-Teer and hitched that to a Ford 350 pickup.

When we got to our parking-lot

campsite, the kids—all seven of them—and our wives popped into the “lodges” to change into snowmobile togs while the two of us unloaded the snowmobiles. Then we were off for a ride through the marked trails of the forest.

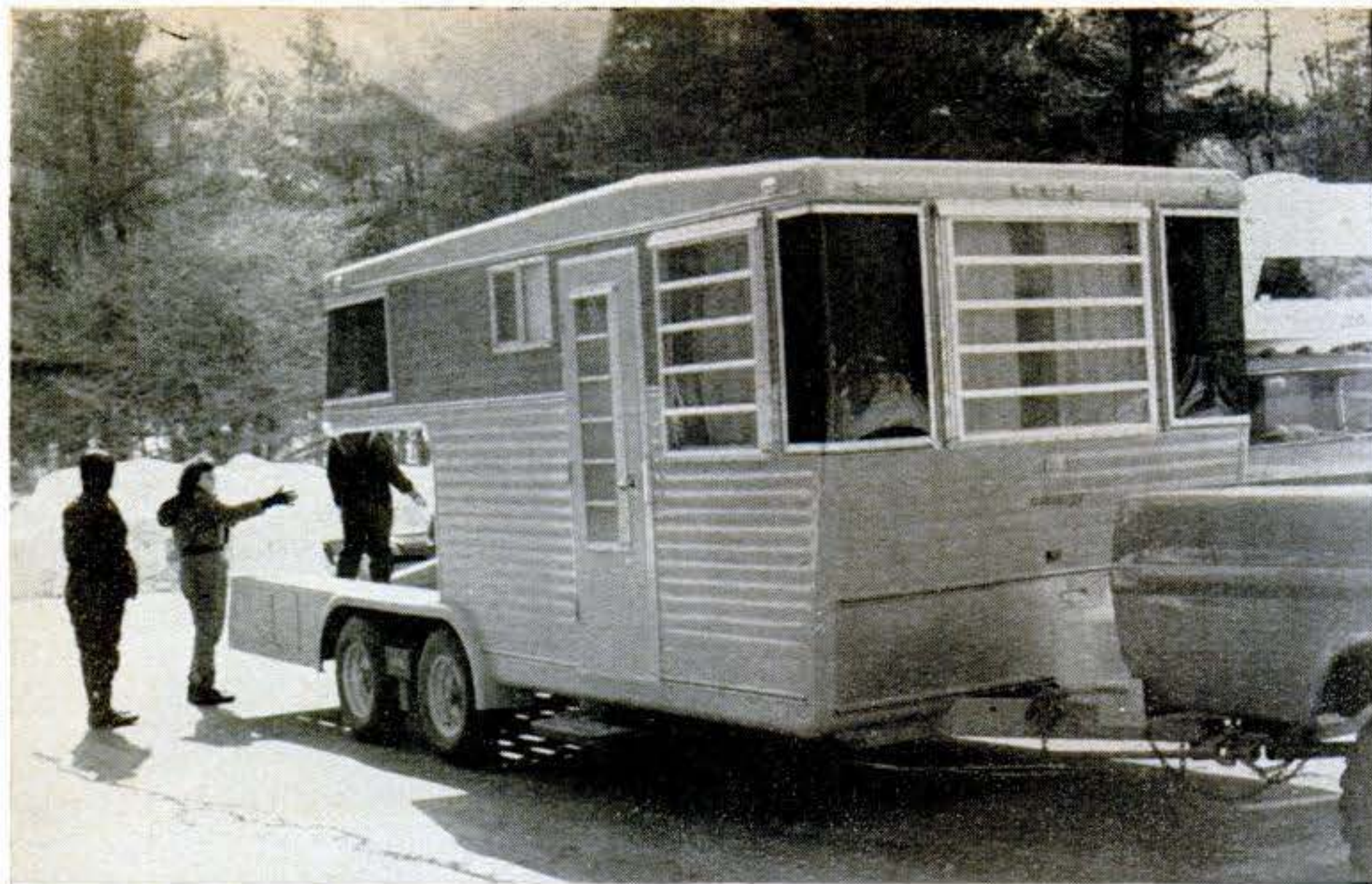
After a couple of hours on our snowmobiles, the afternoon sun was fast

Continued



El Dorado van is a huge camper mounted on a truck chassis. It has a walk-through

opening from the camper body to the cab and, inside, is as luxurious as a motor home.



Trans-Por-Teer is unique—it's a trailer with a built-in port for transporting a fun ve-

hicle. It can carry two snowmobiles, or take your boat aboard come summer.



Ramps slide out for handy loading on the Trans-Por-Teer. Fitting this Evinrude Skeeter and Polaris Playmate snugly into the parking port proved to be relatively easy.



It's a real gasser for kids rarin' to go. The five or six gallons Dad is slurping into the tank will keep their rig running for a whole day of fun in the snow.



Well-marked trails like this made for happy days in Pittsfield State Forest, Mass. After

fun on trails, snowmobilers head back to warmth of their "lodge" and a hot drink.

disappearing and a chill began to set in. So we headed back to our warm lodges for hot drinks and a rest in real comfort.

The kids piled into the chassis mount and the mamas and the papas found peace in the trailer. A handy stove soon had hot water bubbling for coffee and tea. What's more, we could peel off our bulky snowmobile suits and heavy boots and sit in shirt-sleeve comfort to enjoy our coffee break.

That night some of the Arctander family prepared to bed down in the El Dorado. They would carry out the second part of the experiment, while the rest of us spent the night in a motel.

The El Dorado. Sleeping in the big van proved "just great." The chassis mount had everything but a working shower and toilet. For the night we parked it beside the home of Dan Post, a Polaris snowmobile dealer who lives adjacent to the forest. And Dan's place provided those necessary facilities. But aside from having to trek a few hundred feet to a toilet in zero weather, the overnight accommodation was downright luxurious.

For year-round use, you'd probably want to winterize your camper's plumbing facilities and be completely self-sufficient.

The van's propane-fueled heater was effective, but failed to distribute the heat evenly through the camper. Its location, in a narrow hallway toward the front of the van, left the rear dining area a bit colder than might be ideal for some people. Up front, it was much warmer, especially in the bunk over the cab. Luckily, a roof vent there could be opened part way to keep you from getting uncomfortably hot.

The second night, all six Arctanders slept in the five-bunk van—one on the floor in a sleeping bag with a built-in mattress for warmth.

Walls and floor inside the cabinets were uninsulated, so every time you opened a door, a blast of cold air blew in. You'll need complete insulation if you plan to use your camper in sub-zero temperatures.

One pleasant surprise was the way the big van handled on snowy and icy roads. Its powerful V8 engine, automatic transmission, and dual rear wheels took the huge vehicle anywhere, even up the extremely steep and icy hill on which the Post home sits.

The Trans-Por-Teer. The trailer was an ideal warm-up lodge (we never used it as a sleeper). The really great thing about this camper is the built-in cargo space for snowmobiles. You could also use it for carrying a dune buggy, an ATV, a boat, or as many as six trail bikes.

Continued



Merc. Flattens hills.

Pick a hill. Any hill. Hit the throttle and aim for the sun . . . Merc outclimbs 'em all!

Mercury really lays it on the snow this year, with a big, wide, surefooted track . . . plus our own exclusive super-climbing tread that sets up the snow for maximum bite.

Whatever kind of action you're after, you'll find a new Merc built right, priced right (2 brand-new bullets—the 30-hp Lightning and the 25-hp Rocket—designed to outmaneuver anything in their class—a sharp, new 20-hp Merc 200 and the luxurious 25-hp Merc 250).

Get your choice now at your Mercury Snowmobile dealer—the man who services what he sells. He's in the Yellow Pages, easy to find. Get with him today—and get something going for yourself this winter!

Mercury Snowmobiles—from the makers of the world's most dependable outboards.

Kiekhaefer Mercury/Division of Brunswick Corp./
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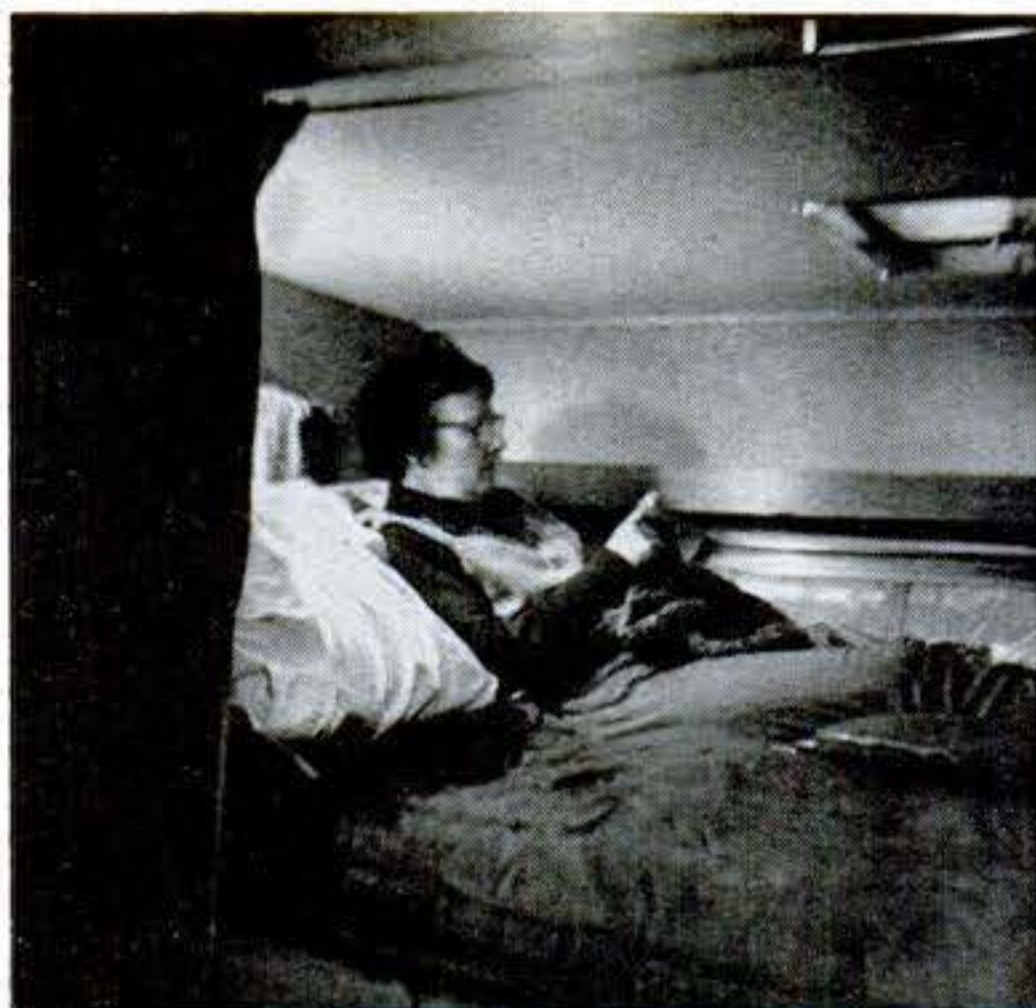


MERCURY

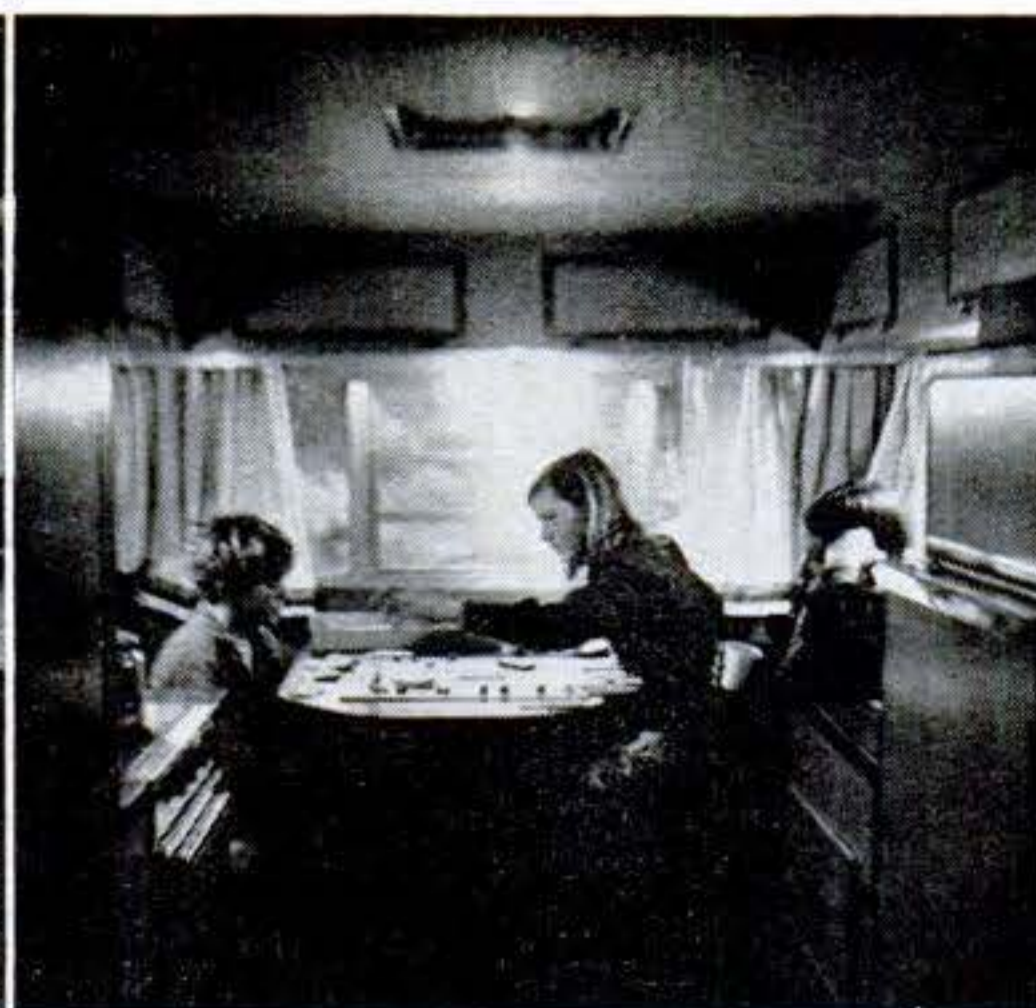
*Spend a minute on a Merc
and leave the others behind.*

For more information write Snowmobiles, Dept. 411, Kiekhaefer Mercury, Fond du Lac, Wis. 54935.

Copyrighted material



Relaxing in top bunk of El Dorado van, Rosemary Arctander eases tired muscles. It proved to be warmest spot in camper.



Dinette serves as a gameroom in El Dorado for (left to right) Lance, Bergit, and Kris Arctander as they ponder the next moves.



Coffee-break time, and Rosemary visits Julie and Herb Shuldiner in second "lodge," the Trans-Por-Teer trailer.



Outdoor barbecue in the snow is hot stuff to warm up and fill up adults and kids alike.

There are bunks for four and a roomy dining area. It also has its own shower and toilet, and plenty of storage and closet space.

The Trans-Por-Teer was kept good and warm by a heater with 11,000-Btu output, and its plumbing is above the floor so it will not freeze up in winter.

Happy experiment. At the end of our two-day trial, the 11 members of our party came up with a unanimous verdict: It's a darn good idea to take your lodge with you when you go off snowmobiling. And, of course, it will work just as well for a family that's mad about weekend skiing.

In the snow belt, there aren't many parks that are set up to accommodate camping vehicles during the winter. But as long as the roads are plowed and the parking lots are cleared, it's quite feasible to drive in.

From the envious looks of other snowmobilers huddled up in their cars with heaters going to keep warm, there's no doubt that our setup was superior. Try it and—with year-round use—get your money's worth out of your camper.

P 5



Nothing like a snapshot to permanently record a weekend of fun. With a camper you combine healthy outdoor winter exercise with the comforts of home when the moon rises over the snow.



Getting a lesson before takeoff, Erik Arctander (at right) learns from Ray Gagnon (seated) and Dan Post (behind rig) how to get a Wankel-powered snowmobile idling at the right speed.



Out here, a Cat is man's best friend.

Out here is a challenge. Out here is a long trail with steep hills, long sideslopes, bumps, dips, soft powder snow turns, stretches of glaze. Out here on a long day you need a friend like your Arctic Cat. Because Arctic Cat gives you an extra margin of maneuverability with its forward-mounted engine and its extra wide skis that tilt into turns. And because Arctic Cat's

patented torsion spring slide rail suspension gives you a ride that stays comfortable all day long.

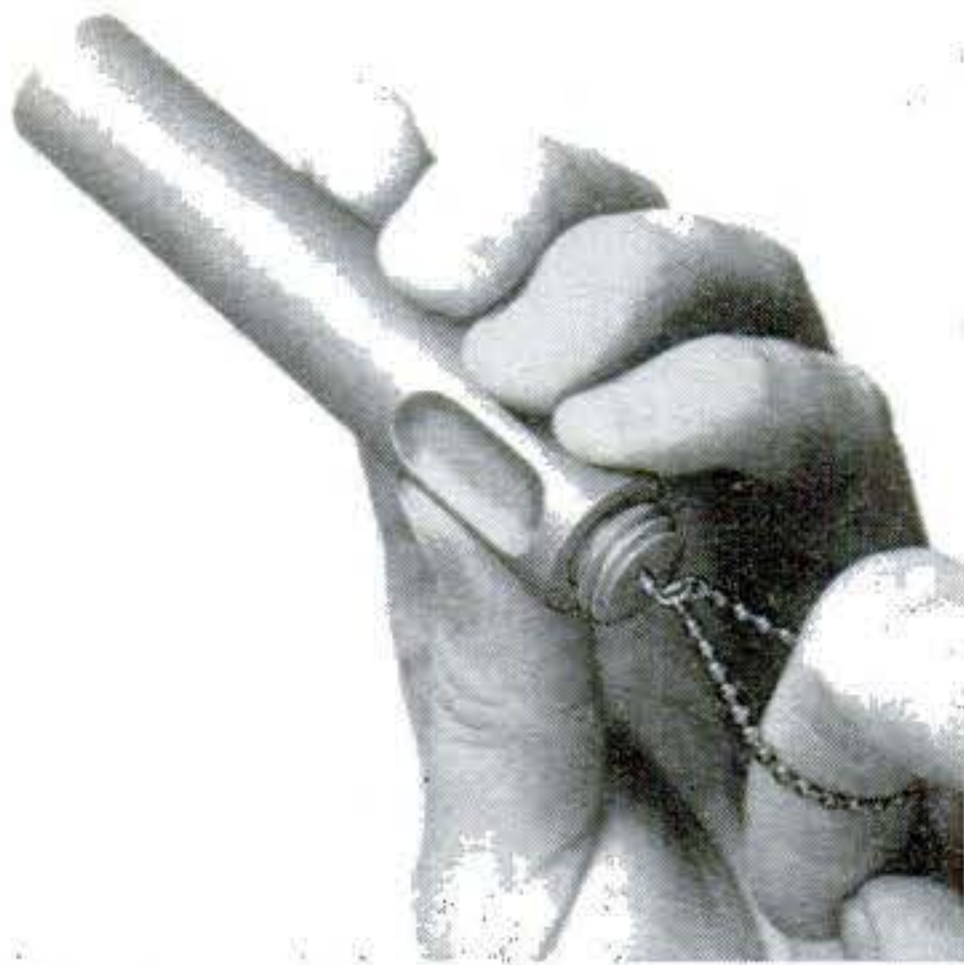
For the long run, when it comes to smooth, stable ride and dependable performance, an Arctic Cat is man's best friend. So visit your nearby dealer now. There are four exciting new '71 Arctic Cats who are anxious to meet you.

ARCTIC CAT

this
is the
year
of
the
Cat

For Cold-Weather Sportsmen

This new gear for outdoorsmen adds safety as well as convenience to your fun in the snow



Survival Signal is a one-ounce launcher/flare that works even in high winds. Its bright red signal is visible day or night. Pack of three is \$5.95 from Leisure Industries, 105-10 Metropolitan Ave., Forest Hills, N.Y.

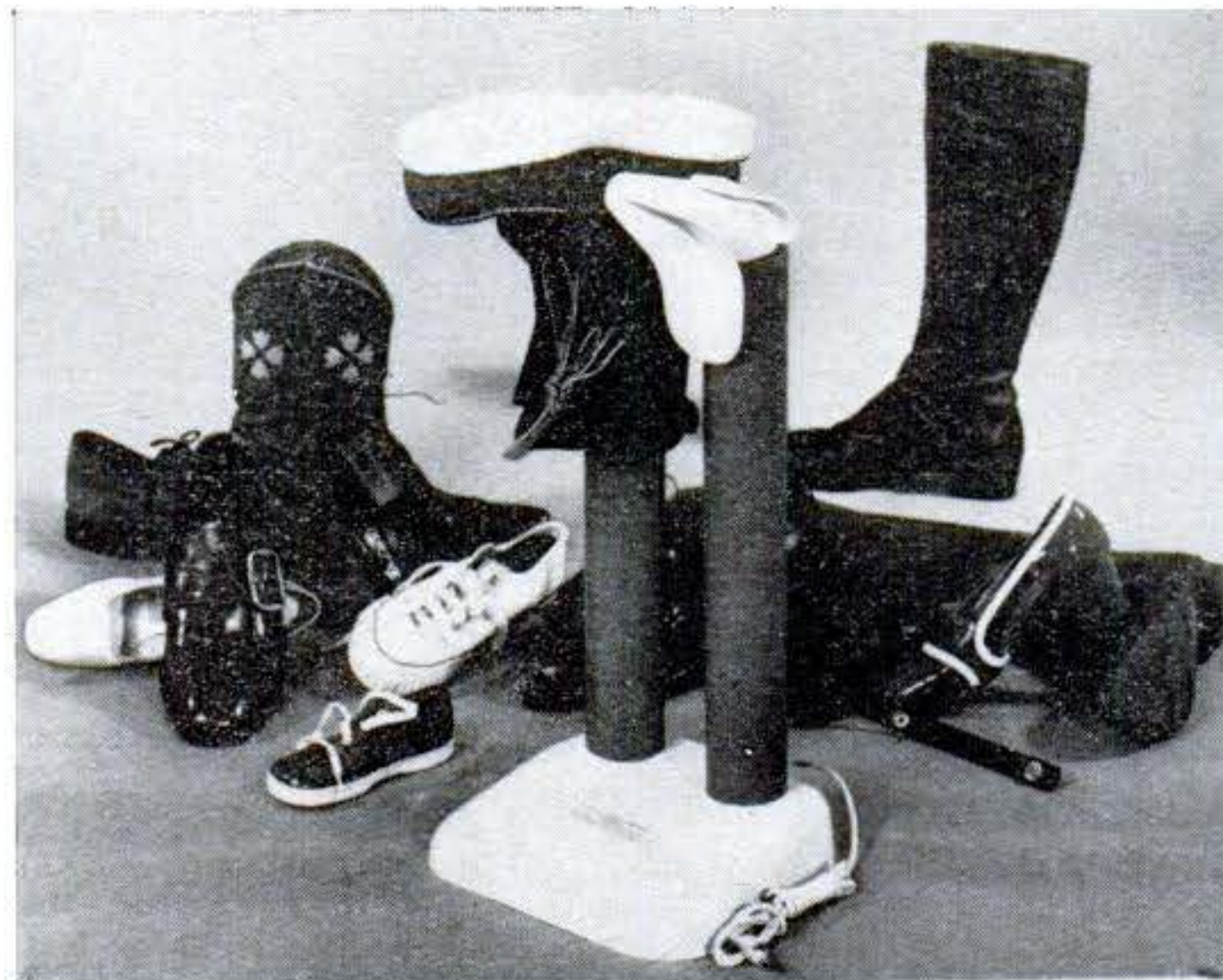


Snow-plow attachment with 54" spring-loaded hydraulic blade fits all-season vehicles made by Ridge Runner, 1625 Wash-

ington St. N.E., Minneapolis 55413. Blade attaches with three quick-disconnect pins, adjusts to remove deep snow in layers.



Reflectorized jump suits let snowmobilers be seen at night. The suits—cold-tested to 30 below—weigh under two pounds, have leg zippers, detachable hood. Thermorama, 2303 Wycliff, St. Paul, Minn. makes them.



Electric dryer heat-dries boots and shoes overnight—with no damage to leather, rubber, or plastic. Two 25-watt heaters in base can be left plugged in all day. It's \$20 from Peet Electric, 130 S. Fifth St., St. Maries, Idaho 83861.



Sportsman's folding saw has Swedish-steel blade with raker teeth that zip through large logs. For carrying, blade folds into 15" handle. It's \$3.95 from Gloy's, 10 Lewis St., Greenwich, Conn.



Safety equipment for snowmobilers, recommended by Sno-Jet, includes: extra drive belt, spark plugs, wrench set, first-aid kit, collapsible snowshoes, freeze-dried food, nylon rope, poncho.

If you've waited this long to buy a snowmobile,

Skee-Horse Wide-Trac. The one that finally put it all together. **Speed?** The two cylinder 437 cc engine turns out 30 big horses. And the new Super-Torque transmission with over-drive makes good use of all 30! You'll get quicker low end response and more effortless speed at the top. Skee-Horse is quick and fast. **Style?** Just take a look. From the slick hideaway headlight to the contoured seat back, this one has eye appeal. Notice the new padded steering bars. Shaped grips. The rally instrument console.* And the new seat that sits as good as it looks.

Performance? Reverse and neutral lock-out are standard. They are unavailable on most other machines. The new deep tread 20" molded track is seamless. And our patented drive system eliminates sprocket holes. So you get longer track life and much better grab for climbing, cornering and side-hill traversing. The Wide-Trac starts with a key or the new "Mitt Grip" manual starting. Either way, you'll get twin coil ignition, compression relief and a fuel injection primer for simple, sure starts. **Quality?** Everywhere you look. The disappearing headlight

is a sealed beam. The bumpers are real—they'll take some bumps. The seamless fuel tank has a big six gallon capacity. Did we mention the caliper disc brakes and full length underseat storage? The engine is completely enclosed. So is noise, dirt and ugliness. The new Skee-Horse Wide-Trac is the way snowmobiling ought to be—but never was 'til now. And it's just one of seven models awaiting your inspection at your Johnson Skee-Horse dealer. Stop in and storm out. Or write for a free brochure to Johnson Motors, Waukegan, Illinois 60085, Dept. PS-S711.

here's your reward.



Johnson

FIRST IN DEPENDABILITY Division Outboard Marine Corporation

* Speedometer and tach are accessories.

Snowmobiles Put the Zip in Ice Fishing

Here's how to scoot to where the big ones are biting—plus tips on how to hook them

By CHARLES R. MEYER



Cutting a hole is easier with an ice auger. This one folds in half for travel.



Electronic helpers are boon: Fish flasher—such as Vexilar Sound Off Sonar on ice, left—helps locate schools. Zonar electronic thermometer (held) helps choose depth.



Dressed for cold in one-piece thermal coverall by RefrigiWare, Dick Marsh of Canadian Waters, Inc., has just caught a northern pike on an ingenious airplane jig.

Fishing through the ice was once a sport that demanded large expenditures of muscle power and stamina—until the advent of the snowmobile. Now sportsmen who balk at snowshoes, heavy backpacks, and high fur collars have joined in. Wearing a one-piece thermal coverall to check the cold, the determined angler astride an arctic machine will find hinterland lakes within easy reach.

Ice fishing is extraordinarily productive on a fish-per-hour basis, especially in waters where bluegills and yellow perch are abundant. Veteran ice fishermen bring home strings of northern pike, trout, walleyes, crappies, bass, catfish, and carp.

There's no sense in using conventional tackle. The punishment the equipment must take is too severe. On a recent voyage to Thomas Lake in northern Minnesota's Superior National Forest, we employed 24- to 36-inch metal or fiberglass rods with reel seat and a single guide plus the tiptop. The reels were standard bait-casting variety without level winds. Lines were 12- to 15-pound monofilament or 18-pound Dacron.

Tips on jigging. For this method, all you need is a stick with a scalloped handle on which you wind your line, and a single eye or tip guide. Depth at which your lure lies is of paramount importance, and can be determined by the number of turns unwound or retrieved off the bottom.

Let's say you've discovered a school of perch or smelt at 50 feet. Fairly small, needle-sharp hooks with a shiny-surfaced one-oz. sinker (to produce a flashing action when jigged) will bring them in. A single perch eye used as bait on a small hook is productive without requiring frequent replacement. For smelt, try a strip or slab cut from the tail section of another of the same species.

Experienced hands at deep-water

jigging take the majority of their fish without actually feeling them bite. Instead, they employ a jig-and-snatch technique consisting of alternately jigging the bait slightly, then jerking it upward. Proper jigging intervals become intuitive with practice.

A portable fish flasher is virtually a necessity for locating schooling species. The new Vexilar Sound Off Sonar, Ray Jefferson No. 5005 Fish Flasher, or Lowrance Fish Lo-K-To are typical lightweight machines on the market.

When you're seeking out a certain spot or depth, brush away snow cover until you get down to clear ice without excessive air bubbles. Wet the surface (carry a small bottle of antifreeze for this purpose). With the transducer face of your flasher on the wet spot you'll get a clear bottom signal and be able to spot fish.

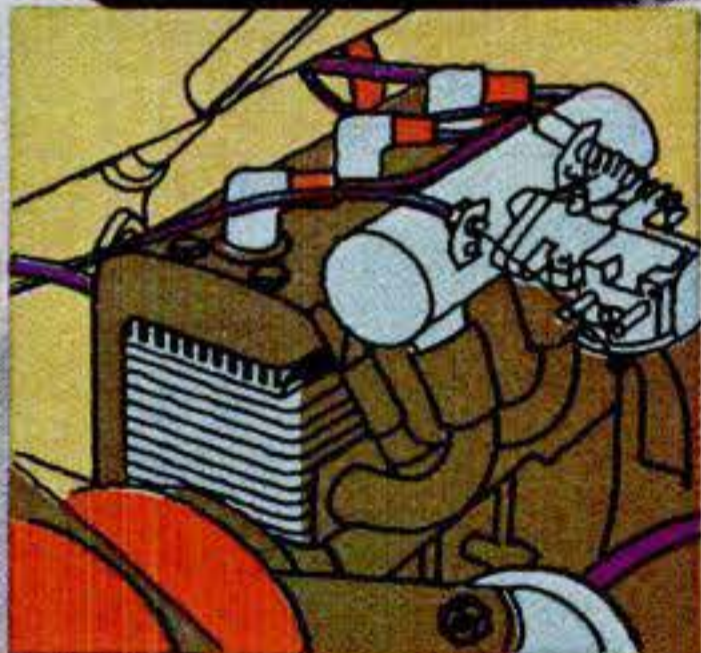
Electronic thermometer. Winter or summer, most fresh-water fish remain at a temperature where they're comfortable and feed is easy to find. Try using a remote electronic thermometer which reads down to 60 feet. Compact, handheld, it will run all season on a single C battery. You simply set the pointer dial for the temperature you're seeking, then unreel a weighted probe until the meter needle indicates the preferred zone has been reached. You then read the depth from the calibrated wire.

For cutting holes, I favor the Worth-Mustad ice auger, which folds in half for travel. Its blade, instead of being curved, forms a cutting arc with five angled straight edges. This makes cutting easier and also lets you hone the blade yourself. Make holes eight to 10 inches in diameter; round all edges to prevent snags.

You'll find that this equipment can produce a rewarding catch. And your snowmobile makes it easy to get everything there and back.

WE GAVE IT 3 CYLINDERS.

WE CALL IT THE HUSKIER SPRINT.



The new 399 and 440 cc Husky Sprint engines are designed to run smoother, start faster, and last longer than any other snowmobile engine.

Until now, the only other 3-cylinder snowmobile engine available was an all-out, full-house racing engine. Great for daredevils and mechanics. But definitely not for the majority.

Now Bolens offers the only 3-cylinder engines designed for all-around snowmobiling. Designed for plenty of power without being souped into unreliability. In fact, the Huskier Sprint engines develop their muscle with less strain than 2-cylinder

engines of the same size. Nice to know when you're unleashing your Sprint away from civilization.

If your taste (or budget) calls for something only slightly tame, Bolens has 8 other Husky Sprints to choose from. In 3 frame sizes, 3 track widths, and with a host of optional goodies. And electric starters are free on all model 295, 340, 399 and 440 Sprints. Take hold of one at your Bolens dealer...and watch the snow fly this winter.

The Bolens Husky Team . . . compact tractors • walking and riding mowers • tillers • snow blowers



BOLENS

BOLENS DIVISION, FMC CORPORATION, PORT WASHINGTON, WISCONSIN



Twin Mercurys head down-sun towards the mainland after a day's exploring. In the background, the open expanse of Georgian Bay.

Visit Your Summer Haunts in Winter



Steering cautiously, author moves along edge of narrow channel marked by Pointe

au Baril Lighthouse. Between him and the lighthouse . . . a thin layer of rotten ice.

You'll snowmobile your way to a new appreciation of your favorite vacationland

By JACKSON HAND
PHOTOS BY A. J. HAND

Four hard hours north of Toronto you swing off the Trans-Canada Highway at a wide spot in the road called Pointe au Baril, set your boat in the water, gas up at Jerry Evoy's dockside Shell pump, and head out the channel through the 30,000 islands of Georgian Bay. I've done it every July for 30 years. Last February I decided to do it in the winter. Things were a little different.

We gassed up at Jerry's, but instead of outboards it was a pair of Mercury 25 snowmobiles. We took off through three inches of last night's powder on a heavy crust.

Five minutes later I was lost—dead lost in a territory where, in July and August, I know every island, every shoal.

I had learned lesson No. 1. Visit your summer retreat in the dead of winter,



It's a long walk home.

Two cycle engines can be tricky little creatures. You've got to know them inside and out before you can start building dependable snowmobiles. We served our apprenticeship making championship motorcycles. And we learned a lot.

We developed Autolube so you don't have to premix gas and oil. Oil goes in its own separate tank. Then, depending on your speed and the load you're carrying, the right amount of oil is automatically pumped into your engine. It gives

SL 292 is our single cylinder economy model. It has all the features of its bigger brothers. And a very small price tag.



you cleaner, smoother running. And spark plugs last longer.

Other innovations too. Like 5-port power to help the engine use fuel more efficiently. A chassis that's unit-constructed and automatically welded just like a car's. Double-sealed, lifetime lubricated bogie wheels.

Heavy-duty disc brake. **Five new snowmobiles.** From a 292 to a 433 twin. They all work on a round-trip basis.

YAMAHA
It's a better machine



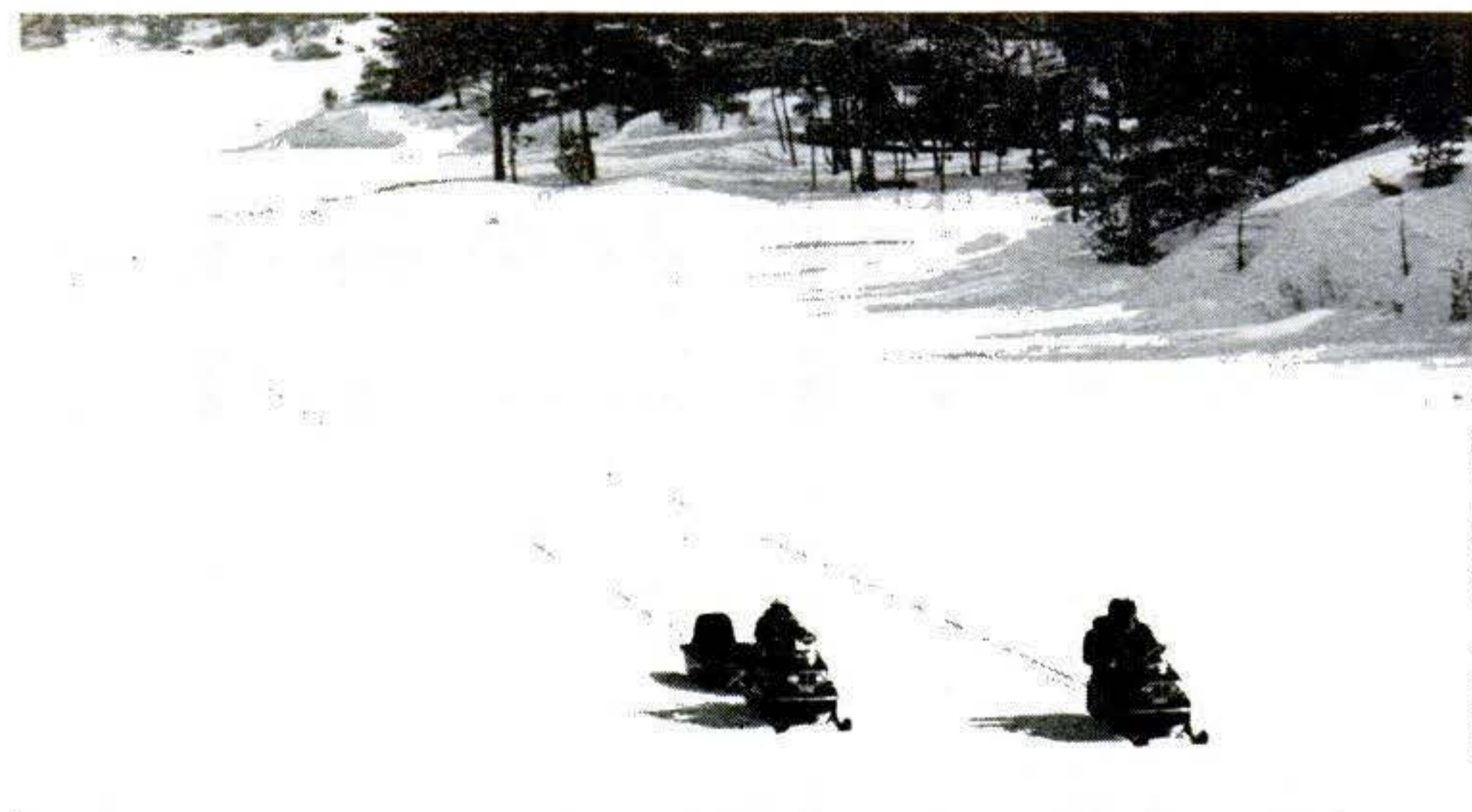
Jerry Evoy fills fuel cans with gasoline from his dockside pump and special snowmobile oil, formulated to mix in subzero weather. Pete Marks waits for a fill up.



Leaning his machine into a turn, Merc's Don Johnson heads through the bush. This is where Hand lost his bearings in country he's known for more than 30 years.



A glazed drive belt gets replaced before starting out on a trip to the lighthouse. A shot of winter grease in the squeeze pulley bearing put quick end to the glazing.



Two Mercs make straight tracks across fresh snow covering the ice, approaching author's cottage. In summer, adjacent bay is a favorite spot of pike fishermen.

and someone has spirited away the landmarks. I was to learn more lessons before the trip was over.

For years I've dreamed of a wintertime visit to my summer place, but it wasn't until the snowmobile became a dependable means of transportation that the dream gained a glimmer of practicality.

I called Pete Marks, a young friend who is finishing his doctor's thesis on plant ecology, and who had done some research on our island. He said, "You bet I'd like to see it in the winter."

Bob Hanson at Mercury headquarters provided the key to the whole trip: two of their 25-horse machines, and an experienced snowmobiler named Don Johnson, service manager for Mercury's distributor in Toronto.

American Airlines set us down in Toronto, where Don, a trailer full of snowmobiles, and a station wagon full of cold-weather gear were waiting. Four hours later we were at Jerry Evoy's dock.

"Be sure to follow the old tracks out the channel," Jerry warned. "I'll be right behind you."

About half a mile out, the track veered away from the main boat channel, and into the woods. I took my thumb off the gas.

Jerry quickly pulled up beside me. "How come we don't stick to the channel?" I asked.

And here came lesson No. 2. "The water moves back and forth through the narrows," Jerry said. "You don't dare risk the ice. So we go overland quite a bit. Better let me lead the way."

And that's how I got lost. For the next 10 minutes we ran those two Mercurys through a madman's delight of a wintertime roller coaster. Abruptly we emerged from the rocks and woods and I ran my eye along the shoreline in both directions. Nothing looked familiar.

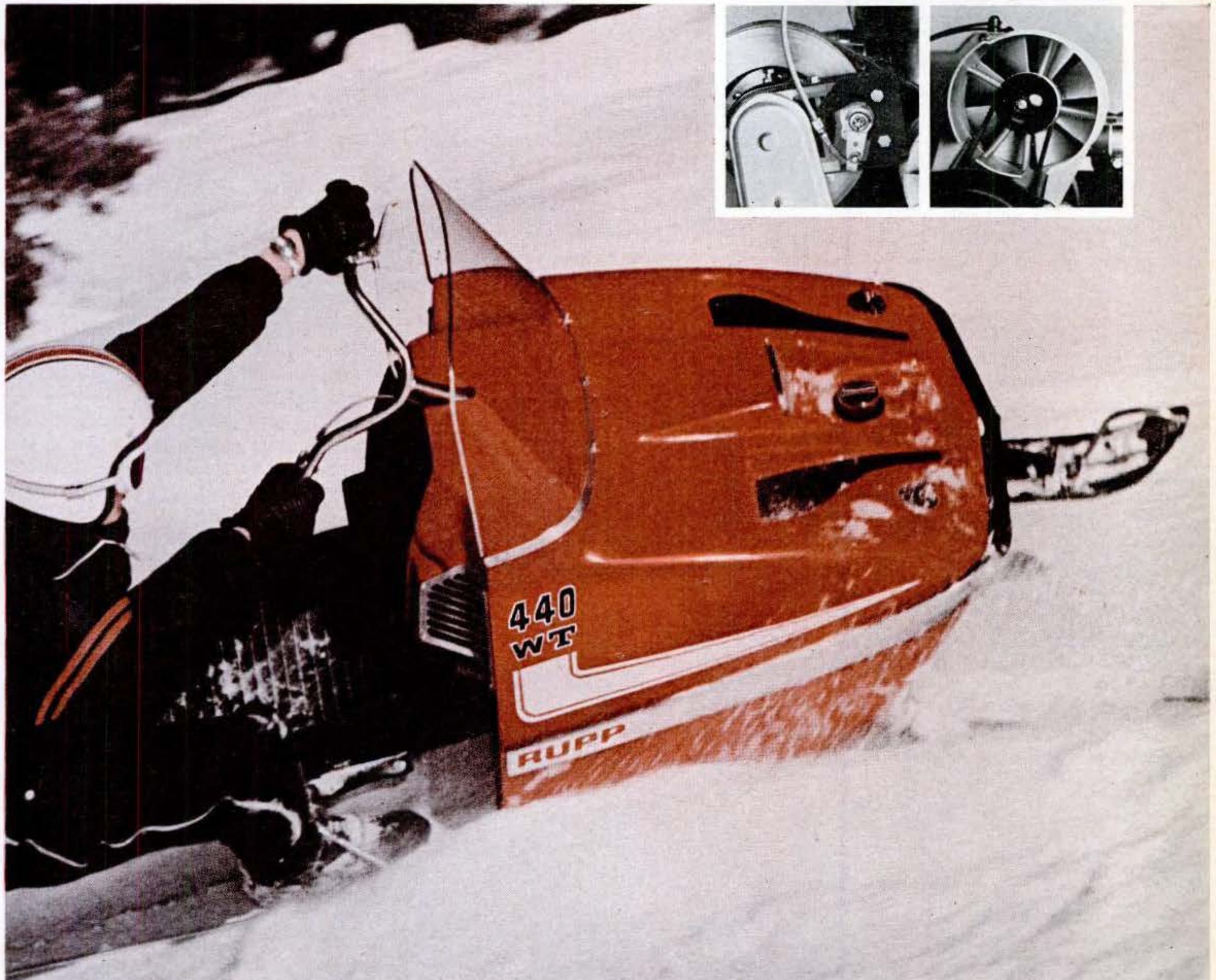
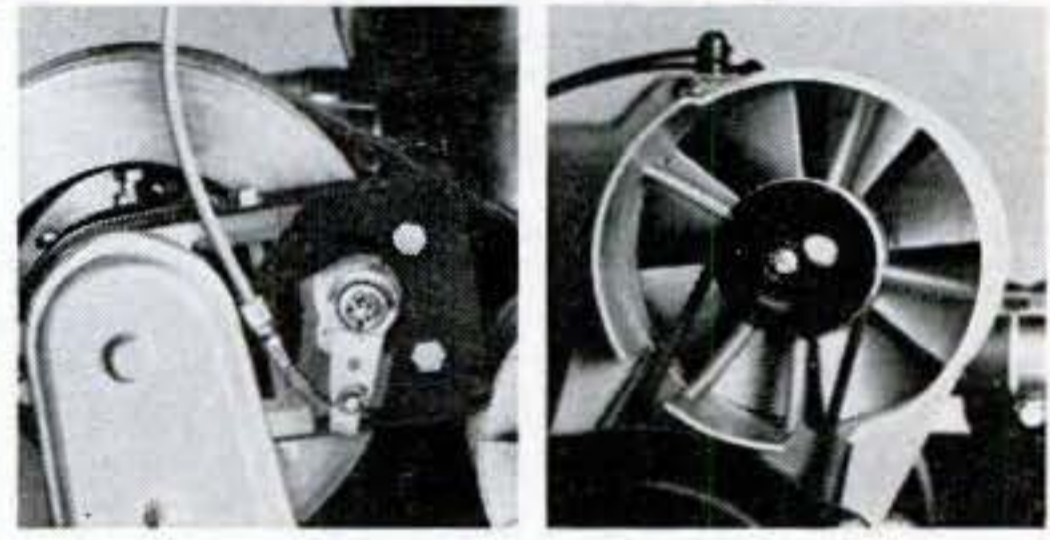
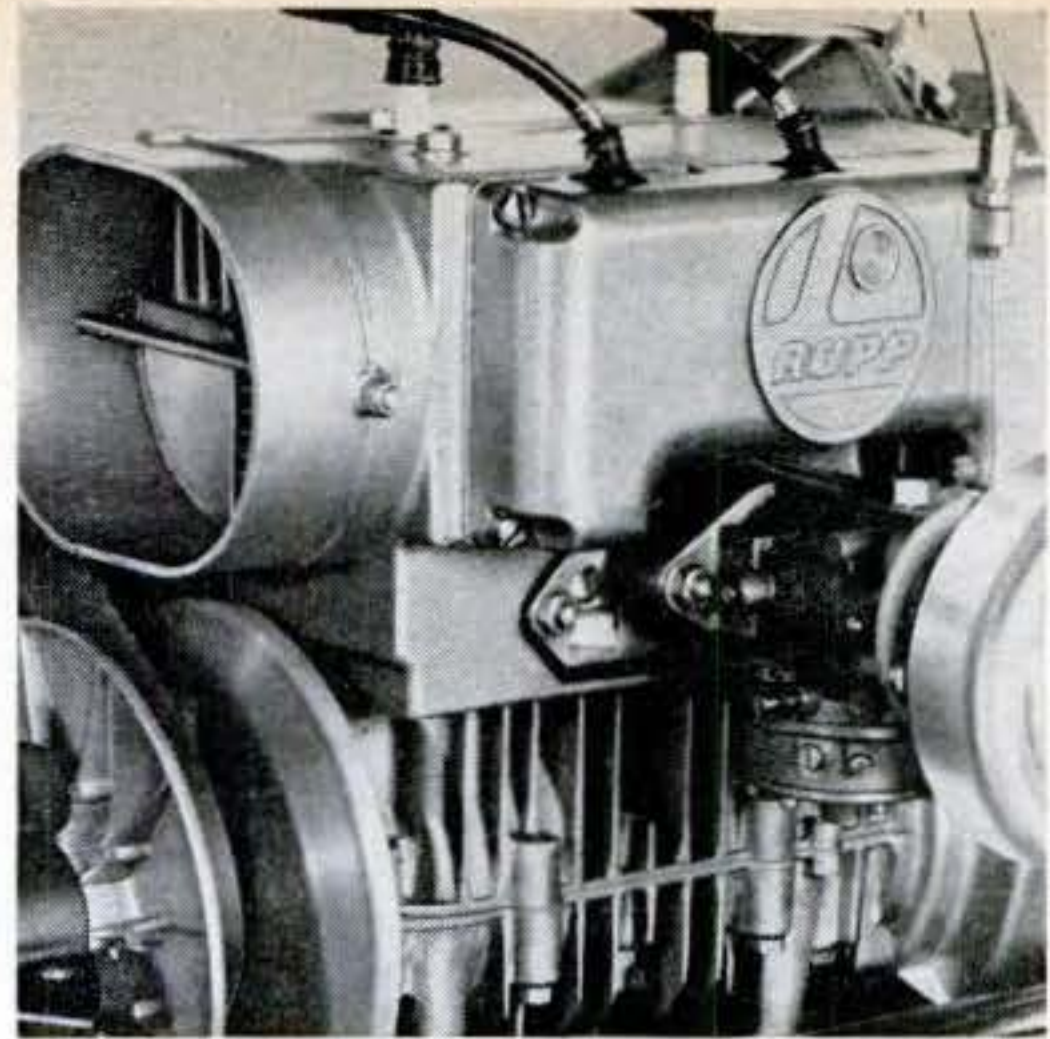
Four feet of snow has the effect, visually, of raising the water level four feet. Islands look smaller. Bodies of water look bigger. Inlets you are familiar with disappear. It wasn't until we'd traveled another 10 minutes that I knew where I was. I saw the rock that marks the entrance to what we call Our Bay. I gunned out across the bay, swung out in front of the diving tower, next to the dock, shut off the engine, and started up the path to the cottage.

Here's Lesson No. 3. Take along snowshoes if you expect to move around much off snowmobiles when you're in real snowmobile country. Without them, I never did get up the path. I rolled back down, mounted the Merc and found a place where the machine would climb the rocks.

Up at the cottage I laid a fire in the

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engines... if you ever need it.



When you buy a Rupp Ram-Air 440 powered Snowmobile you're in for a winter full of fun. And, you're *in* the capable hands of your Rupp dealer. He's qualified to service these new Rupp engines, if you ever need it. Just show your Rupp Owner's Registration Card and you'll be back in the fun fast. See and ride a Rupp at your dealer this week. Compare it to any other snowmobile. You'll see it's more economical for you to own and operate.



Rupp Industries, Inc., Mansfield, Ohio 44903





Breaking through ice in narrow channel, Don's Merc almost went to the bottom.

With Ray and Pete helping, he pulled it free before it broke through completely.

fireplace. I got a flickery blaze going, but my original plan to stay the night seemed to make less sense all the time.

The flames didn't even jiggle a thermometer reading 15. And by four o'clock we were headed back to the mainland. There, we met Ray Holl and his wife Phyl, who run a fishing camp called Silverwood Lodge. They half expected us anyway, having heard from Jerry that we were headed into Pointe au Baril. They had a couple of rooms warmed up, and we watched the Canadiens and the St. Louis Blues play hockey on—ah, wilderness!—color TV.

The next morning I was awakened by the roar of a snowmobile outside my window. Don was monkeying

with one of the Mercs. I got dressed and went out.

"Trouble?"

"No—just checking things out while we're in here where a man can get warm between chores," he said, and then I got more instruction.

Lesson No. 4. Always check out a snowmobile before taking it on long-distance frigid-weather treks where it might be unretrievable.

Before he finished his check-out that morning, Don had replaced a glazed drive belt. Other checks he made:

Carburetor adjustment. "Always be sure not to keep the mixture too lean when you are hauling hard," he said. "Or you may burn out something."



Level blanket of snow covers the iced-in bay in winter. Here, approaching a

narrows, Pete rises on one knee to look for gray snow—the tipoff to thin ice.

Plugs. Keep them clean and gapped. Points should last a season or more, but if you are heading into bad country, change them.

Lube and tighten. Oil and grease everything; put a wrench and screwdriver on everything.

"Always carry spare parts and tools when you go out," Don warned, "but try to make sure you never need to use them."

When we took off that morning, Ray Holl decided to come along. Jerry's son, Kirk, borrowed one of Ray's machines. And Bill Ellis, the local propane gas dealer, joined the fun.

Jerry and Bill Ellis led. Ray and Kirk brought up the rear. We hit out the channel, hugging the shore line, took to the woods to "portage" around Brignall Banks narrows, and zoomed out on the flat. As usual, there was a rendezvous, making sure everyone made it over the rough.

Kirk didn't show. We waited a few minutes, then Jerry backtracked through the bush. Pretty soon he came back, with Kirk riding piggyback. Kirk's machine had broken down.

Lesson No. 5. Never ignore the common sense of the buddy system.

We headed out to the edge of the 30,000 Islands for a look at the deserted lighthouse.

On the way back through Hemlock Channel, Jerry swung us off the channel where it is the narrowest and into the Back Channel. I gunned up beside him to protest. I wanted to see my favorite bass hole in winter.

"Okay," said Jerry, "but you walk ahead and feel it out."

I moved gingerly into the narrows, hugging one wall. When I got through I turned and waved a heavy-mittened "Come on" to Pete and Don.

They zipped their Mercs into the narrows full speed—and instantly both machines were stock-still, their tracks churning in water. They leaped off and dragged the lead machine forward. Jerry and Kirk, Bill and Ray sped up and snaked the second machine out before it could slip back into the hole chewed through the ice.

All the way back to the mainland I didn't look at Jerry and he didn't look at me. Both of us had heard, the night before, the news of a man running a narrow channel into Sturgeon Bay—by himself—right down the middle—into a patch of open water. They fished him out in the morning.

There was excitement, bewilderment, enjoyment in our trip into the midwinter northland wilderness. There was also Lesson No. 6:

You get hooked. This summer, we're insulating our cottage on Georgian Bay, and we're putting in a floor furnace. Next winter, come Christmas vacation time . . .

come snow...



Coming or going, you can't beat an Ariens Arrow snowmobile. It outclasses them all! Look up your Ariens dealer (you can track 'em down in the Yellow Pages) and test drive the dependable one. Comfort, style and power are combined to bring you pleasure without problems. Add up these Ariens features: smooth-running bogie wheel suspension system, rubber and nylon reinforced track, synchronized arctic-dynamic skis and super-tough thermoplastic hood. They make sense . . . mean quality. Come on now — go Ariens.

Ariens Arrow snowmobiles are made in ten different models with engines from 277cc to 437cc, 15" or 19" tracks. All feature dual air scoops and twin sealed beam headlights. Some available with slide rail suspension and electric starting.



a cut above the rest

ARIENS COMPANY • 655 West Ryan Street • Brillion, Wisconsin



Ariens Arrow 400L snowmobile with 19" wide track and 399cc, twin cylinder Kohler engine.



Ariens 7 H.P. Sno-Thru with four speeds forward and reverse. Clears a 24" path.

You asked for it, and here it is —



New Generation Sno-Pony Snowmobile!



Super-light—blasts off faster, turns quicker, climbs better, stops faster than heavy old generation snowmobiles!

We know what you want because you told us. And we built it. A light-weight snowmobile with high performance and rugged dependability. Super-light New Generation Sno-Pony hasn't one ounce of surplus weight to hinder quick maneuverability. Won't bog down like heavy old generation snowmobiles. Can be lifted into a "go" position by women and children under the roughest snow conditions. Nimble—handles like a sports car. Great on the trail. A sure-footed hill climber. Sno-Pony is also a new concept in all terrain vehicles. The industry's first true convertible (pictured above). A fast, highly maneuverable, all terrain vehicle which converts to a high performance snowmobile in one hour's time! Outstanding price-value relationship. Sno-Pony is affordable to the point where your family can own more than one. Test drive the model of your choice now and you'll want to own it for the rest of your life!

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How Science Will Foil the Skyjackers

[Continued from page 60]

subject's person is indicated by a flashing red signal light (there are four) at the appropriate level on one of the detection pillars and by illumination of the corresponding area of a human figure outlined on an adjacent screen. In addition, an alarm sounds. These simultaneous signals are triggered at a predetermined level of calibration for a weapon-size metal object.

Diver Detection Devices Ltd., Griff Clara/Nuneaton, Warwickshire, England, prices the system at upwards of \$2,500.

Since the Densok and Diver weapons-screening devices are sensitive to nonferrous as well as ferrous metals, it would seem that its false-alarm rate may be even higher than that of the magnetometer, which detects only steel (the usual weapon metal) and iron. Neither the active-field metal detector nor the passive magnetometer can tell a weapon from a piece of harmless hardware of the same size. There is, however, a new detection system that doesn't share this shortcoming.

The X-ray eye. In Mahwah, N.J., at the Philips Broadcast Equipment Corp., I was given a preview demonstration of their short-pulse X-ray detection system.

An ordinary overnight bag was packed with clothing, a shaving kit, a book—and a revolver. The bag was shoved into the slot of a mock-up airline check-in counter, a button was pushed, and an X-ray image of the

bag and its contents instantly appeared on a TV monitor screen. The picture was remarkably sharp and clear—there was no mistaking the revolver. Results with other luggage containing a simulated dynamite bomb were equally impressive.

Here's how this short-pulse X-ray technique works: The weak momentary image on a fluoroscope-type screen is viewed by a TV camera having a light-boosting image intensifier (similar to those in the Army's night-vision Starlight Scope) ahead of the camera tube. Electronic switching is used to trigger the recording of one TV frame on a video recorder during the period of peak image level. The stored frame is then viewed directly on a TV monitor.

Exposure time is 50 nanoseconds (50 billionths of a second) and the radiation required to produce these images is approximately 0.2 milliroentgen. This is harmlessly small—well below the level of radiation you receive daily from naturally occurring sources in the environment. Incidentally, unlike conventional X ray, this short-pulse, extremely low-dosage X ray will not damage photographic film.

The image appears on the screen within a second after the system is activated, and lasts 10 to 15 minutes unless erased sooner. Time from erasure to installation of the next frame is less than one second.

Because the system has such low X-ray emission, costly and cumbersome shielding isn't needed, and it can be adapted to a variety of installations.

Although the prototype is a baggage-screening device—a most practical application, especially in conjunction with a conveyor system—Philips' short-pulse X-ray detector could safely and effectively screen air passengers in a walk-through weapons-detection station.

For example, with metal detectors on all gates, those who triggered this first stage of the preboarding screening process could be diverted past a short-pulse X-ray unit for a quick, positive search. With this system, security officers would actually be able to see a concealed weapon or explosive device.

Research toward production of more effective deterrents continues on a wide scale, especially in the area of explosives detection. While no details have as yet been released, one of the more promising systems is said to be a neutron activator that is now under development by North American Rockwell.

"Bomb sniffers." Also under consideration are chemosensing devices able to monitor for the presence of extremely small concentrations of vapor characteristic of certain materials. Some explosives continually emit such vapors.

A chemosensor device has been constructed that cyclically samples air for the vapor of ethylene glycol dinitrate (EGDN)—which is characteristic of dynamite and technical nitroglycerine—and register its presence. An experimental bomb sniffer of this type reportedly has already been tried out by El Al, Israel's national airline.

Further research in chromatography and olfactronics may even provide a weapons detector capable of reacting to the characteristic vapors of gunpowder and its residues, bullet lubricant, gun oil, powder solvent, and similar substances present in a concealed firearm.

Perhaps the detective capabilities of the human nose should be considered, too. In Tashkent, the Russians employ a woman whose superb olfactory sense sniffs out passengers smuggling hashish. How about doing that with explosives?

Gunfights while airborne. Work on foiling skyjackers and bombers has focused on stopping the perpetrator on the ground. What about the even knottier and more controversial problem of defense while aloft?

Under review are such ideas as the secure (bulletproof and invasion-proof) cockpit and the use of armed guards and/or armed flight crews. (The United States is now stationing government agents aboard planes on some flights.)

One misconception needs correcting: Although the hazards of a gunfight aloft to passengers and crew are very real and serious, there is virtually no danger that a stray bullet might destroy the aircraft, should it penetrate the fuselage, by explosive decompression of the pressurized cabin at high altitude. According to Boeing engineers, one of their airliners can sustain a hole as large as a cabin window (10 by 14 inches in a 747) without exceeding the capacity of the pressurization system to compensate. Chances of a bullet severing a vital control linkage are remote, and, even if it did, all essential systems are well backstopped.

Obviously, the best place to stop the skyjacker is at the gate, not simply here, but everywhere. The hardware to do the job exists. Can any nation along the air lanes afford not to put it to use? P.S.



When a gun-toter walks through this British anti-hijacking device, made by Diver, it alerts three ways: A red light flashes, an alarm goes off, and a human figure on an adjacent screen lights up to indicate the weapon's location in clothing or baggage.

The Revolution in Stereo Headphones

[Continued from page 77]

electrostatics has been solved in this unit. Altogether, the ESP-9 seemed the truest reproducer of sound I have heard. It is fairly heavy but quite comfortable. One disadvantage, besides the price of about \$150, is a sizable separate unit, holding the electronics for the polarizing voltage, that must be connected to your amplifier or receiver.

The Koss ESP-6 has the extra electronics built into the phones themselves and is therefore somewhat heavier than the ESP-9. Again, the sound generally had the great purity characteristic of electrostatic designs. Very occasionally, though, there was a fluttery sound added to the music, suggestive of some form of overload.

Superb dynamic phones. The best dynamic phones I heard prove again that the *principle* of an electroacoustic design is often less important than the refinement of the particular design. Dynamics work on the same principle as does the ordinary cone loudspeaker.

Five of the dynamics produced sound of extremely high quality and in some cases had smoother bass than very good loudspeakers. They were, in no particular order: Fisher HP-100, Koss Pro-4AA, AKG-60, Sennheiser HD-414, Uher MBK-64. A number of other sets were very good, and by the standards of two or three years ago would have been in a top category.

The Fisher and Sennheiser are unusual on several counts. They are similar, using the same dynamic driving unit (made by Sennheiser in Germany). Both make use of a new idea in ear pads, a solid slab of a remarkable new sponge rubber that rests against the whole ear. The sound comes through millions of tiny tubular passages in the rubber.

This sound-transparent rubber is finding many uses in acoustics. For example, it's an excellent windscreen for microphones: It lets sound through but reduces wind effects.

More comfortable phones. Having a large pad against the ear distributes the pressure of the phones and raises the comfort index. A few other effects of the system: The outside world is not cut off as much as with "circumaural" designs that completely encircle the ear and rest tightly on the head. The lowest bass would tend to be weakened somewhat with this design, since strongest low bass results from a tight coupling of the phone to the ear.

This effect, however, has obviously been offset in the two models by an increase in bass response of the driver. The low bass is *there*; if the listener

wants it a little stronger, he turns up the bass control on his amplifier slightly.

How they sounded. The Fisher was extraordinary in its openness and the clarity of the middles and highs. This is partly because the mid-highs seem to be up a bit, for a strong "presence" effect; but the high-highs are there too. The set is very light, very easy to wear.

The Sennheiser to my ears had a little less "presence," but still gave a completely satisfying high treble and extremely smooth sound over the whole range. With this high level of performance, the Sennheiser takes the best-buy tag among the phones I heard. The retail price is \$29.

The Koss Pro-4AA was a third splendid performer, extraordinarily smooth and free of distortion over a very wide range. Low bass seemed a little more solid than in the other two, probably in part because the Pro-4AA does fit tightly on the head. But the set is quite comfortable, with fluid-filled cushions that adjust exactly to the head. This is sound you can listen to happily for hours. It does represent the state of the art, the top grade in performance for speakers or phones.

Use your tone controls. The Uher MBK-64, to my ears, made the same grade, but with a slightly different sound: a bit heavier in bass. A very small adjustment of the tone controls could bring the phones to about the same tonal balance.

One small warning: Even with the remarkable advances in headphone technology, not every current set is a delight. There are some bad ones. Interestingly enough, none I've heard has obtrusive distortion (muddying of the sound); the faults are almost always unbalanced response, with the sound muffled by weakness in the highs, thin from weakness in the lows, or tinny, honky, or scratchy because of peaks at certain frequencies.

Set your standards high. What it all means is that when you select a set of stereo phones you can set your standards very high. Listen to the best speaker you can use for comparison, reproducing the same material you'll hear on the phones. Or listen to one or two of the models discussed here, which should give you some perspective in judging others you try. Compare phones by listening to the same material, played on the same system, with the same loudness. You'll soon know what you want in phone sound.

Using stereo phones is, by and large, simple. Almost universal on today's amplifiers and receivers is a jack for plugging in a set of stereo

headphones. If you have the jack, and want to use only one set of phones at a time, you're all set.

There is one slight awkwardness: The industry has apparently not succeeded in standardizing channel assignments. If your phones are marked "left" and "right," as many are, you may find the left-channel sounds are fed to the right phone, and vice versa. It's only a question of turning the phones around on your head, of course. Listen to some recorded material in which you know what's left and what's right to find the proper way of wearing the phones.

Plugging in without a jack. If you have no phone jack, or if you want to use more than one set of phones at a time, you need some way to connect the phones to the output of your amplifier or receiver. A set of phones can handle only a small part of the power put out by the average home amplifier. A high-wattage burst of sound fed directly to the phones probably means a burst of phones, too.

There are a number of outlet boxes on the market that connect to the output of an amplifier and interpose a control between amplifier and phones. It's a good practice to set this control, and leave it, in a position that makes the loudness at your ears the same as that from the loudspeakers at any given main-volume-control setting. This protects your ears as well as the phones. Outlet boxes for one, two, or more sets of phones sell from about \$5 to \$30.

Watch the ground wires. There is a warning for the user of an outlet box. Some amplifiers can't stand having the two ground wires from the outlet box (which are connected together), misconnected to the amplifier in such a way that the high side of one channel is connected directly to the ground side of the other channel. I've blown up one channel of a receiver by just this mistake. Be sure the polarity of each connection between outlet box and receiver is correct. PS

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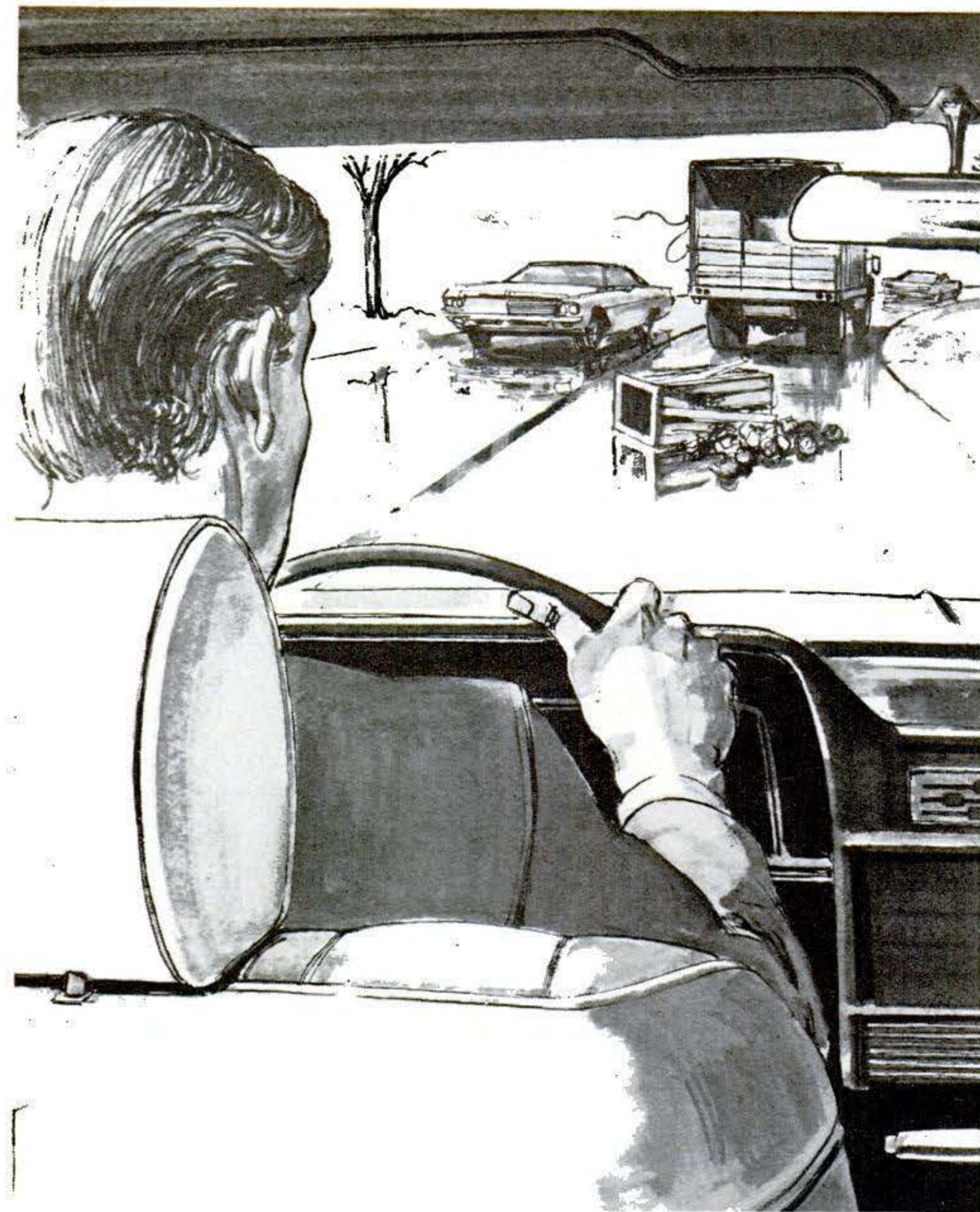
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2PS 11-70



THE SKILLFUL DRIVER

If You Must Swerve on Ice...

Winter driving is different. You double the normal following distance between yourself and the truck in front because the road is icy, and you want to be on the safe side. A crate falls off the truck. You want to avoid hitting it—but how? There's enough room on the right, but you may skid in maneuvering abruptly. Try to ease the car over to the right shoulder by very gradual steering-wheel movement. If the front wheels grip, the rear wheels may skid to the left, threatening to put the crate into your left door. Countersteer, so as to keep the front wheels pointing right down the road. Stay off the brake, no matter what else is going on. Ease back on the gas, but don't get off completely. With manual transmission, disengage the clutch. Suppose you've cleared the crate, but now the tail swings out toward the shoulder. Keep countersteering. The fishtailing motion will gradually diminish and the car will regain directional stability.

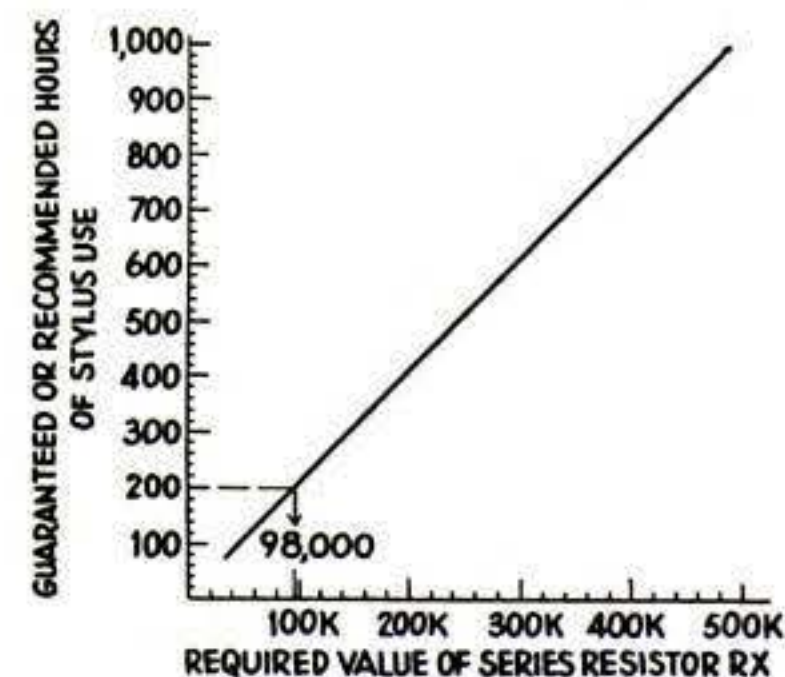
Stylus Timer Saves Your Records

[Continued from page 81]

drive a small elapsed-time meter.

Circuit operation. A stable 10 volts DC to power the stylus-timer circuit is obtained by rectifying and filtering the 12.6-volt output of transformer T1. A wide-band, high-gain integrated circuit amplifier presents a very high impedance to the cartridge input as an emitter follower at pin 10.

How to find Rx for your cartridge



By controlling the amount of current passing through the elapsed-time meter with series resistor Rx, you can "adjust" the meter to measure elapsed time from two to 10,000 hours. First determine the recommended hours of use for your stylus. (If it's not mentioned in the literature supplied with your cartridge by the maker, check with a supplier of the replacement stylus.) Find the stylus-use time on the left column of the graph and draw a line straight out to the sloping line. Now draw a line down to the series resistor scale. In the 200-hour stylus example, the value of Rx should be 98,000 ohms. The nearest standard resistor value of 100,000 ohms is satisfactory. Use series or parallel resistors to get the exact value.

The push-pull output of IC at pins 4 and 7 is boosted further by stepup transformer T2 and applied to detector circuit D5-C7. The value of C7 keeps the detector output fairly constant. The detector output is applied across voltage divider R4-D6. Zener diode D6 provides a constant DC signal for the meter when program material is present.

Assembly and calibration. The 4½"-by-5½" perfboard circuit can be easily mounted beneath most turntables and changers. The input leads to T1 are connected to the turntable power switch or motor terminals. (Before permanently mounting, make sure T1 induces no hum in your cartridge.)

The value of series resistor Rx determines the rate at which current flows through elapsed-time meter M. Use the graph to select the right re-

"Even with extra asbestos and a firewall, our Autolite battery took an awful roasting during our Lime Rock win. We're tougher on batteries. But you're tougher on yours."—Parnelli Jones

Parnelli Jones believes a top driver ought to know almost as much about race-car systems as the top mechanics. So when Parnelli talks, you listen carefully.

"In our Trans-Am Mustang, I stuck the Autolite battery up under the right instrument

cowl. Despite the heat shield my feet get really hot. And that battery gets hotter—maybe 200 degrees—because it's higher up, and it's not ventilated. So you can figure on a lot of evaporation in 2½ hours of roasting."

That's no problem for Autolite batteries. Their Star-Ful reservoir has up to three times more water above the plates—to deliver full power, despite evaporation.

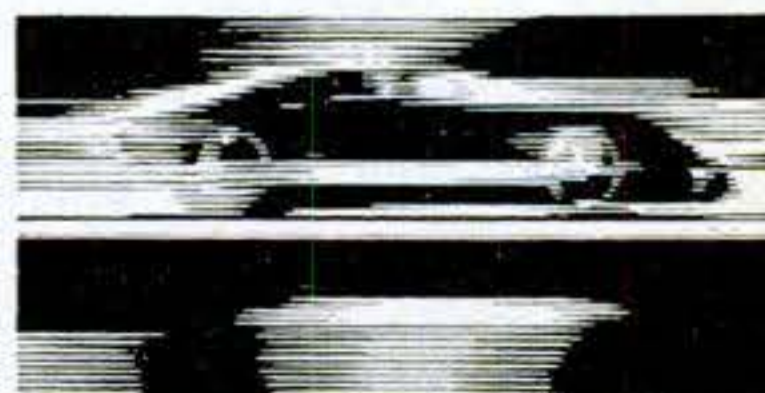
"Racing's tough on batteries. You're tougher. We'll change batteries almost every race. You stick with yours for 10, 20, 30 thousand miles and never care a bit about dirt and salt and moisture collecting on top of it, and making a nice path for electric leaks that can stop a battery cold."

With Autolite, you can forget electric leakage. The one-piece construction virtually eliminates self-discharging across the battery top.

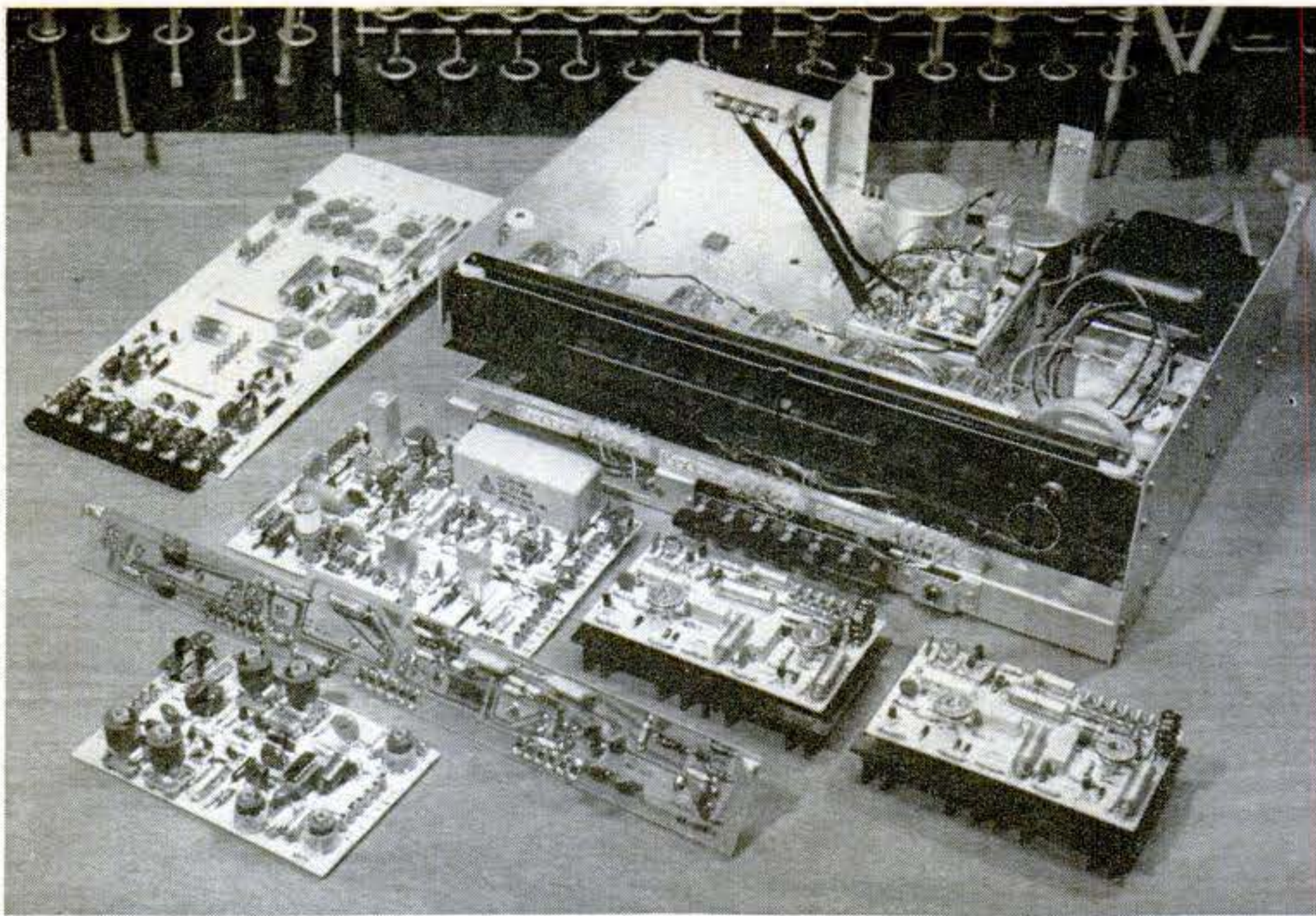
Next time, get an Autolite battery. It passes the toughest test in racing. And the toughest test there is. Your kind of driving.



Autolite 



We pass the toughest test.



Each of the eight circuit boards is built from its own kit. The tuner comes assembled.

PERSONAL-USE REPORT

All-In-One Stereo Receiver Kit Features Plug-In Modules

The Heathkit AR-29 is a superb stereo receiver, but it must share that distinction with a number of other fine receivers. It is unique, though, in the value it offers the man who enjoys putting together and maintaining his own equipment. The overall performance is so nearly faultless, there's no point in lauding each separate aspect.

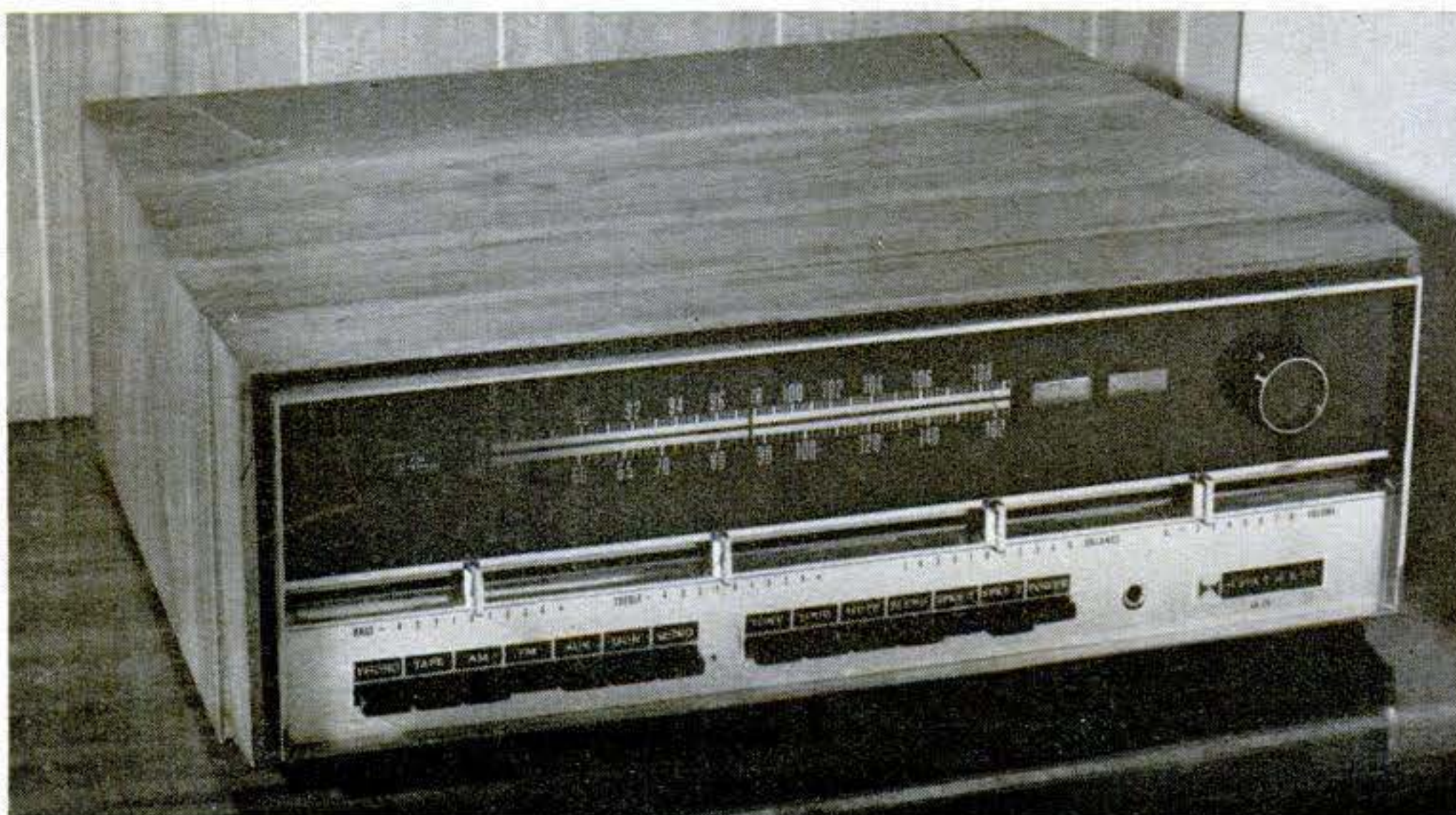
It took me about 35 hours to put the kit together. It uses plug-in modules for the various parts of the receiver and you complete each of the eight separate circuit boards before you proceed to the next.

When all the circuit boards are completed, you install them in the chassis one at a time and test them,

using the meter that comes with the kit. Testing instructions are very detailed and will be invaluable later if you ever have trouble with the set. Faults are readily isolated, and the offending circuit board can be unplugged from the chassis without disturbing the remainder.

The modern panel features a blackout dial. Volume, bass and treble tone, and channel balance are controlled by sliders that move in a horizontal line rather than the usual rotating knob. The various functions are selected by pushbutton switches.

The AR-29 is sold as a kit only for \$285 (a hardwood cabinet is \$19.95 extra) from Heath Co., Benton Harbor, Mich.—*Hubert P. Luckett*



FM-AM AR-29 has flywheel tuning, and it has two meters to assist in accurate tuning.

Stylus Timer Saves Records

[Continued]

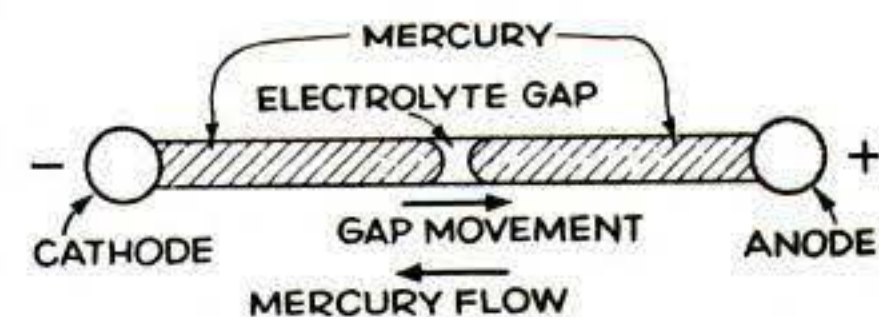
sistance value for your cartridge.

When the gap in M reaches one end of the tube, the meter can be reset about two hours or you can reverse the meter leads. If the gap is not positioned at the zero reference point, connect the meter in series with a 1.5-volt battery and a 390-ohm resistor. The gap will move toward the positive battery terminal; connect the positive terminal to the meter terminal nearest the gap. Don't try to hurry the process by using more voltage or a low value of resistance.

Test before mounting. Apply line voltage to power-supply transformer T1. Then connect the positive probe of a DC voltmeter (set to read about six volts) to the junction of R4-R5-D6; connect the negative probe to ground—the other side of D6. You can provide the minute AC voltage necessary to drive the meter, simply touch the input lead with your finger. The voltmeter should indicate a constant voltage of about 5.1. When you short the input wire to the ground shield of the input cable, this reading should be less than 0.5 volts DC. Mount the perfboard if you obtain these readings.

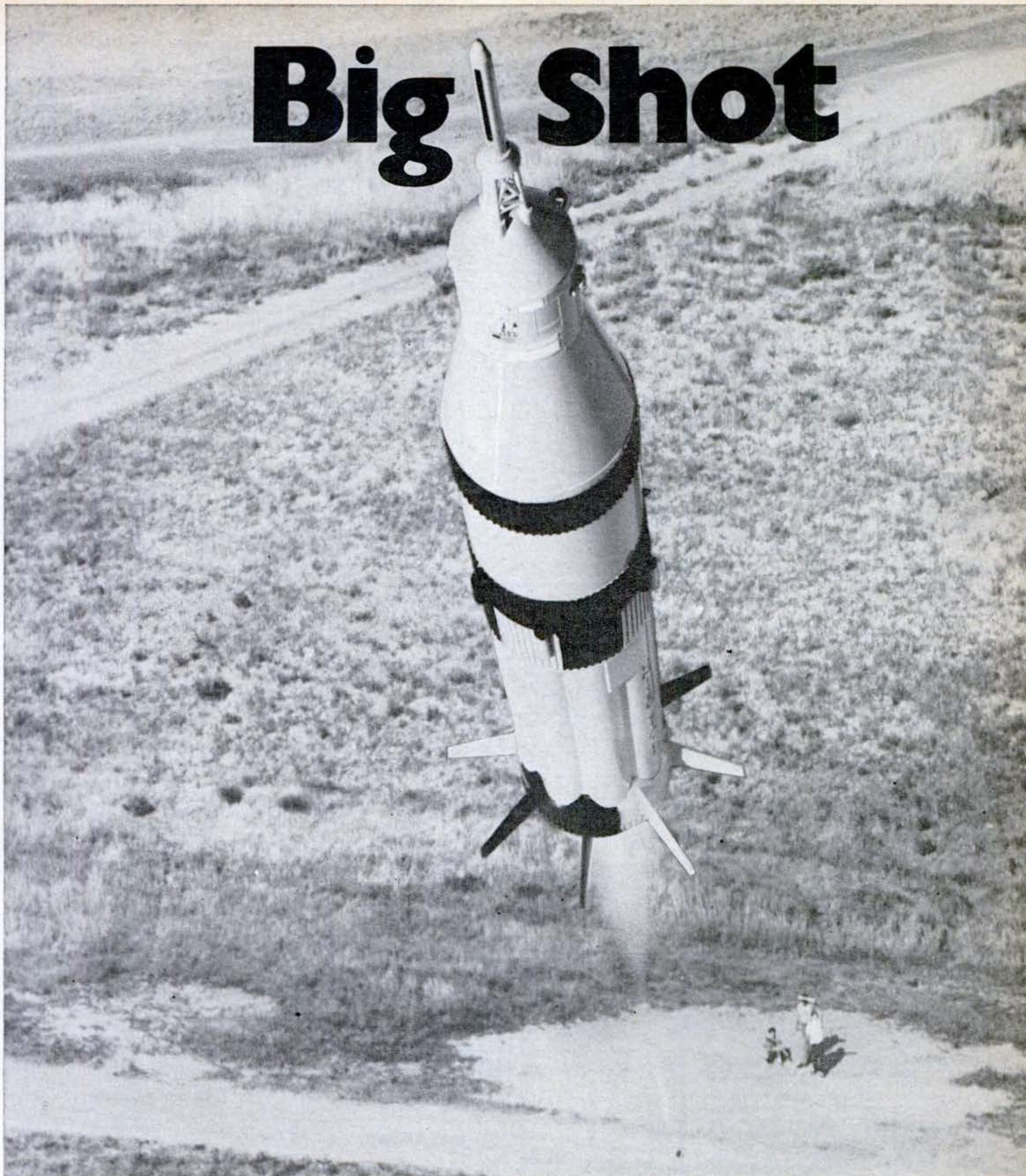
If it doesn't work. Unless the circuit operates as described above, something is wrong. Make sure you've installed the diodes and electrolytic capacitors with their polarities correct. Check the wiring of the IC very closely. Use the table to verify the resistance and voltage on each IC pin. If the readings you get are similar to those in the table, the circuit is wired properly, and it still doesn't work, the integrated circuit may be bad.

How elapsed-time meter works



The elapsed-time meter is a precision-bore glass tube filled with two columns of mercury separated by a small amount of liquid electrolyte. When current passes through the meter, mercury slowly moves from the positive column to the negative column through the electrolyte. The electrolyte gap, then, appears to move toward the positive side of the meter. The transfer of mercury from one column to the other is exactly proportional to the current through the meter.

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Hi-Fi Cassette Tape Systems

[Continued from page 73]

from about \$90 to \$110, with the higher-priced models usually having more solid construction and extra operating features. Other makes in this range include entries by Ampex, Aiwa, Craig, RCA, TEAC, and Toshiba.

Aside from these plug-in decks, you can also get cassette systems with built-in amplifiers feeding their own speakers. Also available are so-called casseivers—all-in-one units featuring a stereo receiver with a built-in cassette deck. Most audio fans, however, may prefer separate decks because this allows them to update and interchange components separately.

Try a listening session. The best way to check out a particular model is to take one of your favorite records to the shop and ask the dealer to let you dub the disc on the cassette deck you're considering. As a rule, the dubbed sound won't be quite as crisp and lively as the original, but you can judge the quality of the cassette machine by how close it gets to the sound of the record.

At the same time, you will get the feel of the controls. The control layout will differ from model to model, and some may seem more convenient to you than others. The only way to tell is to get your hands on them.

Another test you might try is to switch the deck into the play position without inserting a cartridge. Then turn the volume control on the deck all the way up. You will hear a rushing noise from the speakers generated by the deck's motor and circuitry. The lower this noise is, the better the deck.

If and when two-channel stereo is expanded into a commercially popular four-channel setup (with front and rear speakers), the cassette may be the logical medium on which to record four discrete channels. An experimental system of this type has been demonstrated by Norelco. PS



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"Watch your language. I spotted a portable tape recorder on the seat next to him."

'71 TVs—Color 'Em Natural

[Continued from page 75]

proclaim is "solid-state reliability." They don't promise that solid-state television sets are more reliable than tube-built sets; they simply state that, in general, solid-state components are reliable.

Longer warranties. Apparently they are right about long-term reliability: Two makers, Motorola and RCA, offer full one-year warranties on both parts and labor with their solid-state chassis, instead of the conventional 90 days on parts alone.

This seems part of a general upgrading of warranty benefits: This year several makers have expanded the 90-day parts-only warranty to 90 days on both parts and labor.

New UHF tuners. The Federal Communications Commission has formulated a new requirement for next year's TVs: They must tune a UHF channel as easily as a VHF channel.

This "equality" ruling has spurred the development of a number of clever tuning mechanisms, some of which are available on '71 sets. All of them use varactors, tiny diodes that act like electrically controlled variable capacitors. The varactors are used in the tuned circuits that lock onto specific channels:

- Motorola: Blank channels on the VHF selector knob can be set to any UHF station in your area.

- Philco-Ford: In addition to the

usual VHF tuning knob there are six pushbuttons that control the varactor UHF tuner. Each button can be set to any UHF channel.

- Sylvania: No more tuning knob! Pushbuttons instead. The electronic varactor tuner pulls in both VHF and UHF. Each of the 11 station-selector buttons can be set to receive any VHF or UHF channel.

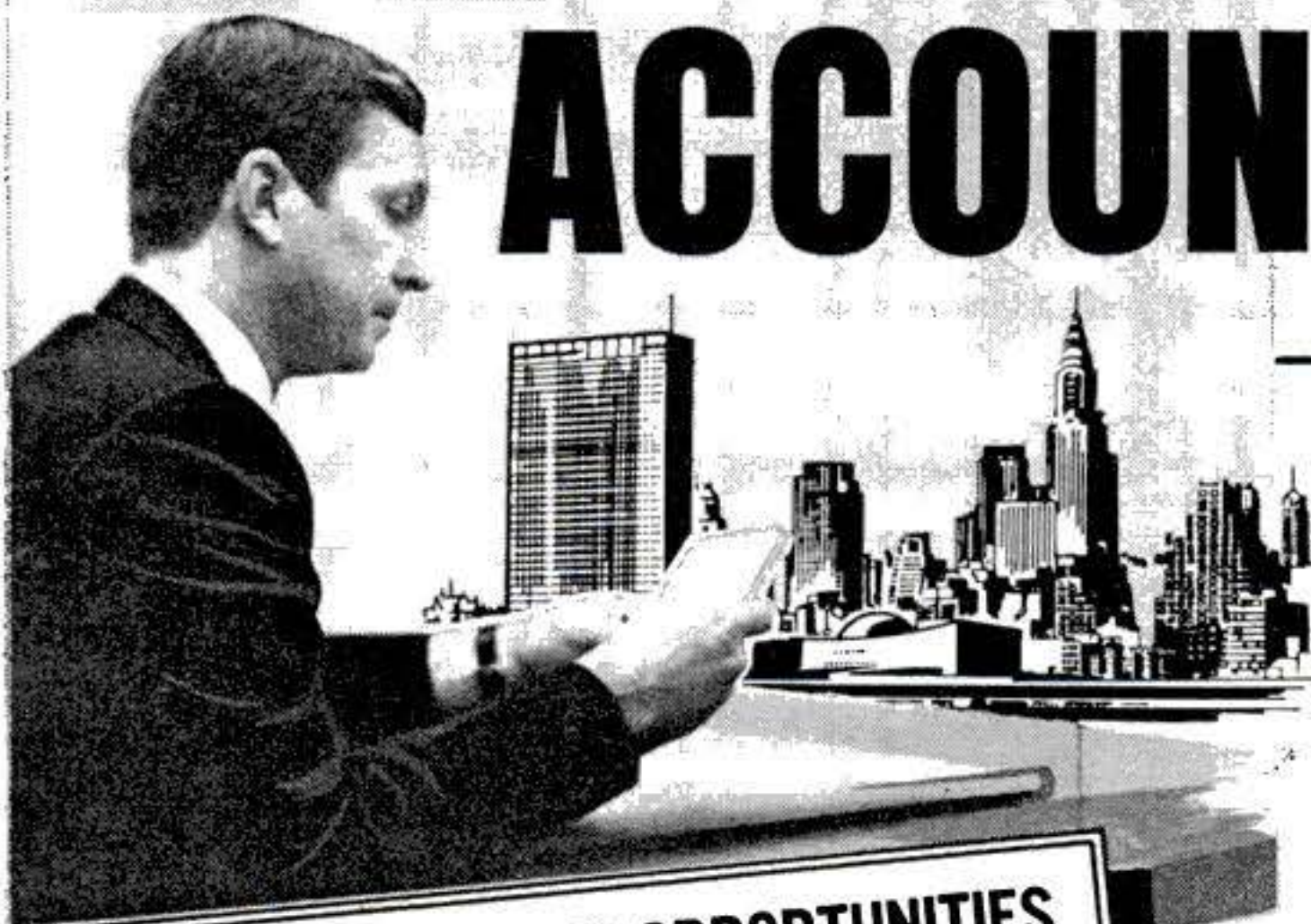
- Zenith: Also a single-varactor tuner for VHF and UHF—but this one is controlled by the familiar channel-selector knob. Any of the positions can be set to receive any UHF or VHF station.

All in all, 1971 should be a great year for viewing. P 5

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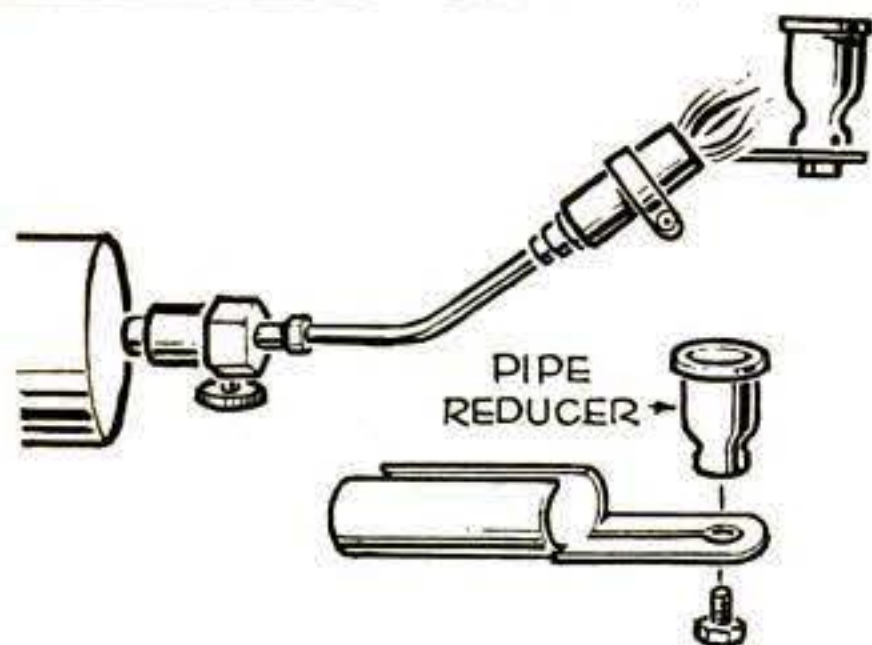
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Torch holds solder pot

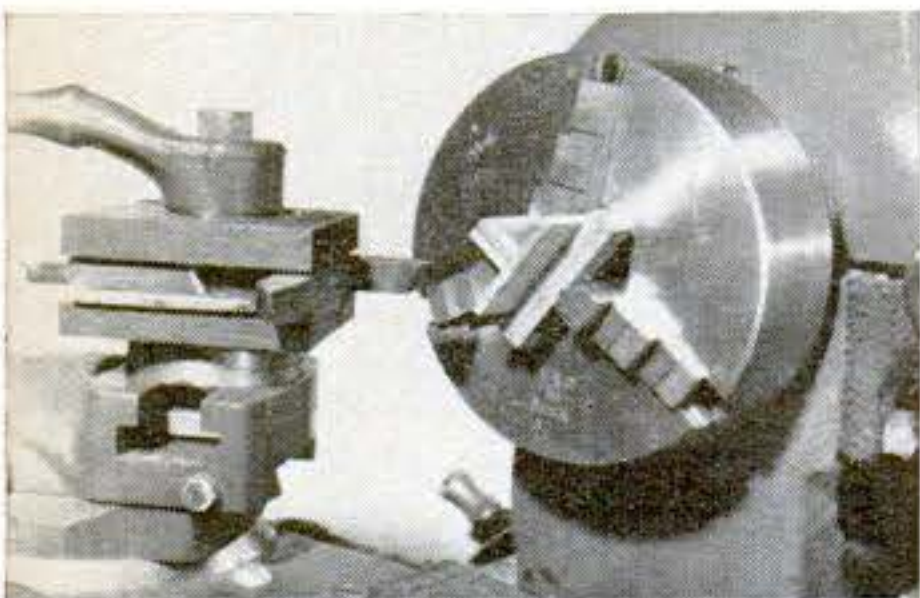
A small solder pot can be attached to a propane torch for such jobs as tinning wire or casting small fishing sinkers. Slit a piece of $\frac{1}{2}$ " metal tubing lengthwise, then cut it away as indicated in the drawing. Flatten the tab and drill near the end. Ream the threads from a small pipe-reducing coupling and bolt it to the tab. Fasten to the torch end with a hose clamp.

PETER LEGON, Malden, Mass.

Freeing a sticky cable

When a flexible cable sticks and oiling it doesn't seem to help, a penetrating oil will often do the trick. Let a few drops run into the cable, from both ends if possible, and work the mechanism a few times.

VICTOR LAMOY, Upper Jay, N.Y.



Squaring angle stock

When it's important to square off short pieces of angle stock accurately, it can be done quickly—two at a time—in a lathe. Cut to approximate length. Mount two in a three-jaw chuck, with two jaws holding them together, and the third jaw bearing against a backing piece. Take a facing cut at moderate speed. Then reverse the pieces, keeping the machined ends flush. Finish the other ends to exact length.

WALLACE KEY, Los Angeles, Calif.

New Trends in Sight and Sound Systems

[Continued from page 69]

Because the recording is heard just a fraction of a second after you hear the original program from the front speakers, an "echo" occurs. When adjusted to the proper volume, this produces a startling sensation of space. The effect works best on choral or organ recordings made in a hall or church that has plenty of natural reverberations of its own. It is also most natural at the higher tape speeds—say $7\frac{1}{2}$ or 15 ips.

The problem with four channels is that nobody has come up with a practical way of putting all of them on a disc record that can be played by owners of monophonic and two-channel stereo equipment. Instead, a number of compromise systems have been proposed by some engineers, each of which requires some form of adapter or "decoder" for playback. [Victor of Japan has announced the "true four-channel record" shown here. It requires a decoder, but can be played with a conventional cartridge as long as it reproduces to 45,000 Hz.]

The easy way, in terms of today's technical capability, is to put the four channels side by side on tape (as in the Vanguard releases already available). This gives you full separation, low distortion, full frequency response, and the reliability that comes with simplicity.

What can four-channel systems provide, whenever they arrive? Hopefully, something better than the simple-minded ping-pong effects heard at some quadrasonic demonstrations. For one thing, the ideal acoustic setting can be provided for music, a setting that transcends the limitations of architecture.

At Cambridge, Mass., Bolt, Beranek and Newman, Inc., a research and development consulting firm famed for its acoustical work, has a 12-channel simulation system now in use. It is already bringing science closer to an understanding of the exact correspondence between concert-hall acoustics and the listening sensation.

The BBN system uses analog computer techniques to generate a precise pattern of reverberation from chosen directions to match the "sound" of any concert hall that can be described. These techniques, applied to four-channel recording, could produce synthetic auditorium acoustics with all the tastefulness and clarity of the best concert halls for any recording company wishing to use the technique. The system could even be used to transform many two-channel stereo recordings into convincing "four-channel" versions.

In any case, four-channel sound, if it becomes a widespread commercial recording practice, is strictly add-on from the home listener's viewpoint. In view of the extremely limited amount of material available for playback, it is probably best to wait before "adding on."

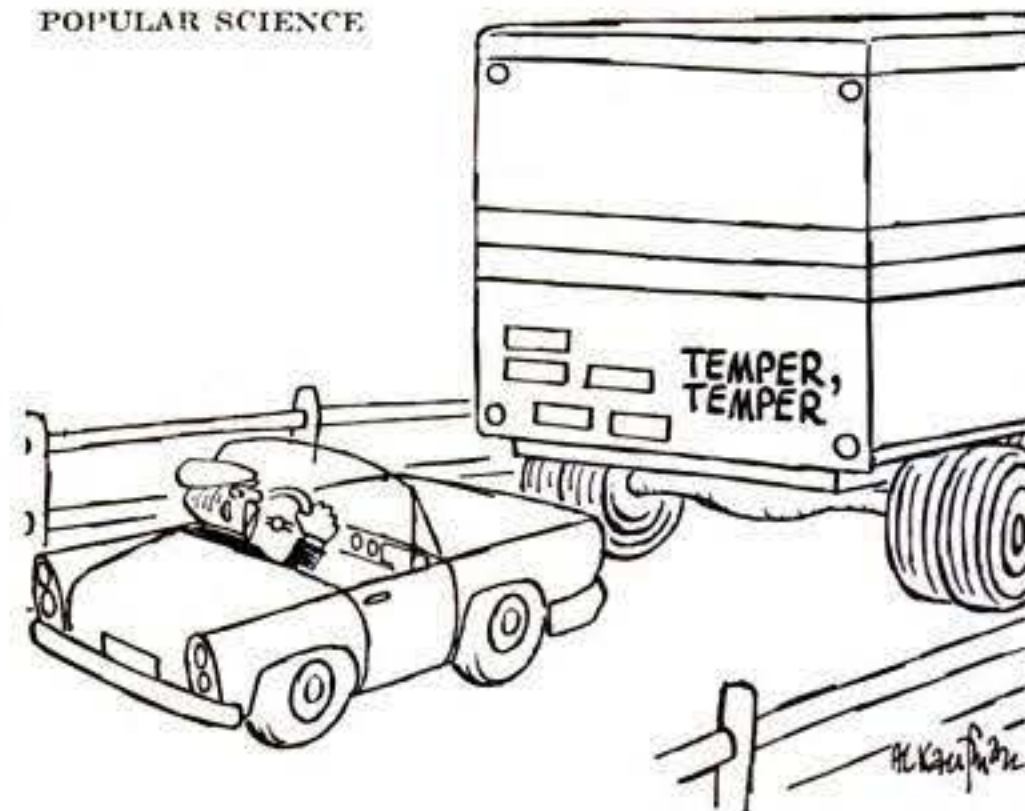
Video cartridge players. There is no doubt that there is currently a bandwagon in packaged video entertainment that can be replayed over your home TV set via a player. But you can hardly be blamed if you don't know whether to jump aboard. You may be confused over the fact that some systems, like the CBS EVR, and RCA Selectavision, are strictly playback systems, whereas others, like the Sony, Avco Cartrivision, and Ampex Instavision, lend themselves to recording from TV as well as playback. Further, some systems come with video cameras, for home—or outdoor—moviemaking.

Into the uncertainty surrounding the probably surviving system there has recently been tossed the European Teldec disc—a special record capable of being stamped out like ordinary records, but also able to record and play signals out into the MHz range, good enough to put TV on a disc.

The major hope of the video packagers is to develop a market for video purchase (or rental to keep costs down). This market would be similar to that for books and movies, which, like video programs, are almost always one-time exposures to their audience members. As a substitute for today's run-of-the-mill TV diet, video cartridges could offer viewers just the programming *they* want (an uncut movie, for example) without depriving the vast TV audience of its free staples.

But at the moment, it would appear that straight magnetic recording systems, like those of Ampex, Sony, and Philips, are more likely to survive as basic home systems than those which can only play—if the Teldec disc doesn't upset the apple cart. PS

POPULAR SCIENCE



4-Wheel Antilock Brakes

[Continued from page 83]

new wrinkle, exclusive in the Chrysler system. One braking rate is for stopping on a surface with a high coefficient of friction, the other for stopping on slippery surfaces. A tiny mercury switch in the computer senses the kind of surface the car is rolling on by checking the deceleration rate. If this rate is above 0.5 g, the Sure-Brake system works slower; the modulators cycle down to two pulses per second, just as your braking would do on dry-pavement skids. If the deceleration rate is below 0.5 g, the Sure-Brake works faster, cycling up to six pulses per second. The faster cycling fulfills the need for faster pumping of the brakes on slick pavement.

This two-speed braking rate is critical in cutting stopping distances to a minimum, since the coefficient of friction varies widely, depending on the type of road surface you drive. Here are some average figures:

Coefficient of friction:	
Concrete	0.8
Blacktop	0.7
Wet concrete	0.65
Gravel	0.55
Wet blacktop	0.35
Jennite	0.2

The '71 Imperial's system is set up to keep both rear wheels turning when you brake. The wheel that may be on slicker pavement will not lock up but will keep rolling with a minimum of braking force. This is done to maintain car stability. This way, the rear will not swing around out of control when one wheel is on dry, and the other on a stretch of slick pavement.

What makes Chrysler's Sure-Brake different from Ford and General Motors antiskid systems? Simply the fact that Sure-Brake works on all four wheels—front as well as rear—whereas Ford and GM designs affect the rear wheels only.

Ford's Kelsey-Hayes system, available on Thunderbird and Lincoln cars, works on the rear wheels only. GM's Delco-Moraine front-wheel system is used on the front-wheel-drive Tornado and Eldorado. A four-wheel system on the special English Ford Zephyr converted by Ferguson [PS, Nov. '69] does not include a two-speed braking rate, as Chrysler's system does.

The clear advantage to Chrysler is that the driver can steer the car while

the brakes are jammed on in panic stops. Since the front wheels continue to roll, the steering is not impaired. With the front wheels locked, as could happen with other antiskid systems, the car just skids straight ahead and can't be steered in order to avoid an accident.

Is Sure-Brake fail-safe? Yes, says Chrysler. If a malfunction occurs, the system will turn itself off, a light will go on to signal the driver, and the brakes will operate normally. But Chrysler is still keeping a close eye on the complicated safety system. Sure-Brake is purposely offered only on the low-volume Imperial, for which fewer service people are needed for maintenance. Also, Chrysler is using the low volume as a test of public acceptance, to see how interested buyers are in the \$400-plus system. Safety can be expensive.

As for repairs, Turner revealed that parts will be replaced, not repaired, if they should fail. And you don't have to wait until the failure occurs while you're driving. The unit can be checked for defects simply by plugging it into a wiring harness in the trunk! P 5

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Your Very Own Meditator

[Continued from page 94]

cess to a far greater variety of visual "information" than he could obtain by leafing through a magazine, page by page. Many experiments have proven my theory that such a confrontation expands the consciousness. The viewer begins to see unique relationships between seemingly isolated incidents.

The experience can be eye-opening; no two people respond the same way to an identical pholage—and no two people will assemble duplicate collages from identical materials.

The fun, then, in making your personal Meditator, is double: First you create 11 pholages (only the access panel is left bare), then discover the unexpected cross-referencing when you wrap yourself in the assembled panels. Beyond that, you'll be able to compare responses with your friends. And when you feel you've exhausted the potential of a given assembly, it's easy to paste new pictures over the old.

I think you'll be surprised by the new perspectives you'll get toward the world about you, and your own part in it. I'll soon be taking the Meditator with me (knocked down, it fits into a station wagon or sedan) on a college lecture tour as part of my demonstration of design technique. Teachers who have had an advance look at the



Light interior with reflector flood on a pivot arm of $\frac{3}{8}$ "-dia. aluminum rod inserted in 2-by-4 block bolted to one of lower panels.

Meditator feel that—with changeable panels—it could be utilized in schools as a teaching environment. [Editor's note: College groups interested in booking Isaacs to speak should write him in care of Popular Science.]

A breeze to build. When you go to the lumber yard for the $\frac{3}{8}$ " plywood, see if they'll saw the 4-by-8 panels in half for you. Four-foot squares are easier to handle.

After you've cut all the pentagons as illustrated, clamp them into two groups of six and lay out the $\frac{1}{4}$ " holes along the edges. To bore these holes accurately, it's best to use an

accessory stand with your portable drill. The distance from the edge should match the holes in the corner angles you buy. Spread one of the angles to an accurate 117 degrees, checking with a protractor, then use it as a template for the other 89.

Give all wood parts a coat of enamel undercoat. When this is dry and smoothed with fine sandpaper, apply a good semigloss enamel finish to the outside faces and all edges. For a decorative effect, paint adjacent panels contrasting colors and paint the feet to match or contrast.

Applying the pholage. Once you've gathered your magazine photos, you may want to experiment with one of the spray adhesives now on the market—although they're expensive. My own method is simple, and results in a nice flat adhesion to the undercoated plywood.

Mix nonstaining cellulose wallpaper paste slightly heavier than recommended. Put clean water in a flat pan and pull each picture through it before applying paste liberally to the back with a soft brush and a light touch. Use the same brush to put paste on the panel where the picture will be located. The panel should be leaning against the wall in a nearly vertical position when you take the picture by the two top corners and place it.

Occasionally ink will run and a clipping must be discarded, but if you keep that light touch I mentioned, this won't be frequent. You'll find that the two paste-coated surfaces attract each other so a picture almost places itself. Avoid major wrinkles, but don't try to shift clippings much once they adhere.

You may be dismayed at the puckered look of just-applied pictures, but they'll flatten overnight. The purpose of the wetting is to allow the paper to shrink to the panel. Experiment on a scrap of plywood to gain confidence and proficiency before tackling the big pentagons.

Assemble with the hardware (all wingnuts go outside) and you're ready to crawl in for meditation. You'll quickly understand what Garbo meant and why Mumford championed the second life of contemplation. **PS**

MATERIALS LIST

- 6 panels 4'-by-8' fir plywood, $\frac{3}{8}$ " thick, good both sides
- 6 2-by-4-by-3 $\frac{1}{2}$ " pine blocks (feet)
- 1 2-by-4-by-7" pine block (lamp)
- 24" $\frac{3}{8}$ "-dia. aluminum rod (lamp)
- 1 socket w/clamp, wire and plug
- 1 ball joint for $\frac{3}{8}$ " rod
- 1 75w reflector flood bulb
- 90 1" corner angles
- 180 10-24 r.h. machine screws $\frac{3}{4}$ " long
- 180 10-24 wingnuts, w/washers
- 6 $\frac{1}{4}$ "x1 $\frac{1}{2}$ " f.h. machine screws, w/nuts
- 2 $\frac{1}{4}$ "x2 $\frac{1}{2}$ " hex-hd. bolts (lamp block)

What Are Warranties Worth?

[Continued from page 57]

tee covers parts, repair labor, and freight costs to and from the factory or nearest authorized service station. New packaging, if needed, is also free."

Is a clearly written guarantee of performance satisfaction impossible to give? Mrs. Virginia Knauer told the Senate Consumer Subcommittee that it isn't. She pointed to the Maytag guarantee on appliances—considered to be a model of responsiveness to its customers' needs. "The fact that this kind of warranty and product information can be written and adhered to should help to dispel the unreasonable fears that many [other companies] have concerning the aims of this Committee," she told Senator Moss.

However, warranty procedures such as those pioneered by Maytag are exceptions rather than commonplace. In fact, Mrs. Knauer commented that "industry self-regulation has not yet shown itself to be fully adequate to eliminate the problem. Some legislation seems necessary in order to insure the elimination of warranty abuses." Mrs. Knauer says consumers have four basic concerns here:

- Fair representation in advertising prior to sale.
- Clearness, completeness, and accuracy of the terminology of the guarantee or warranty itself.
- The adequacy and fairness of the guarantee.
- The guarantor's actual performance in a reasonable manner of the obligations stated in the warranty.

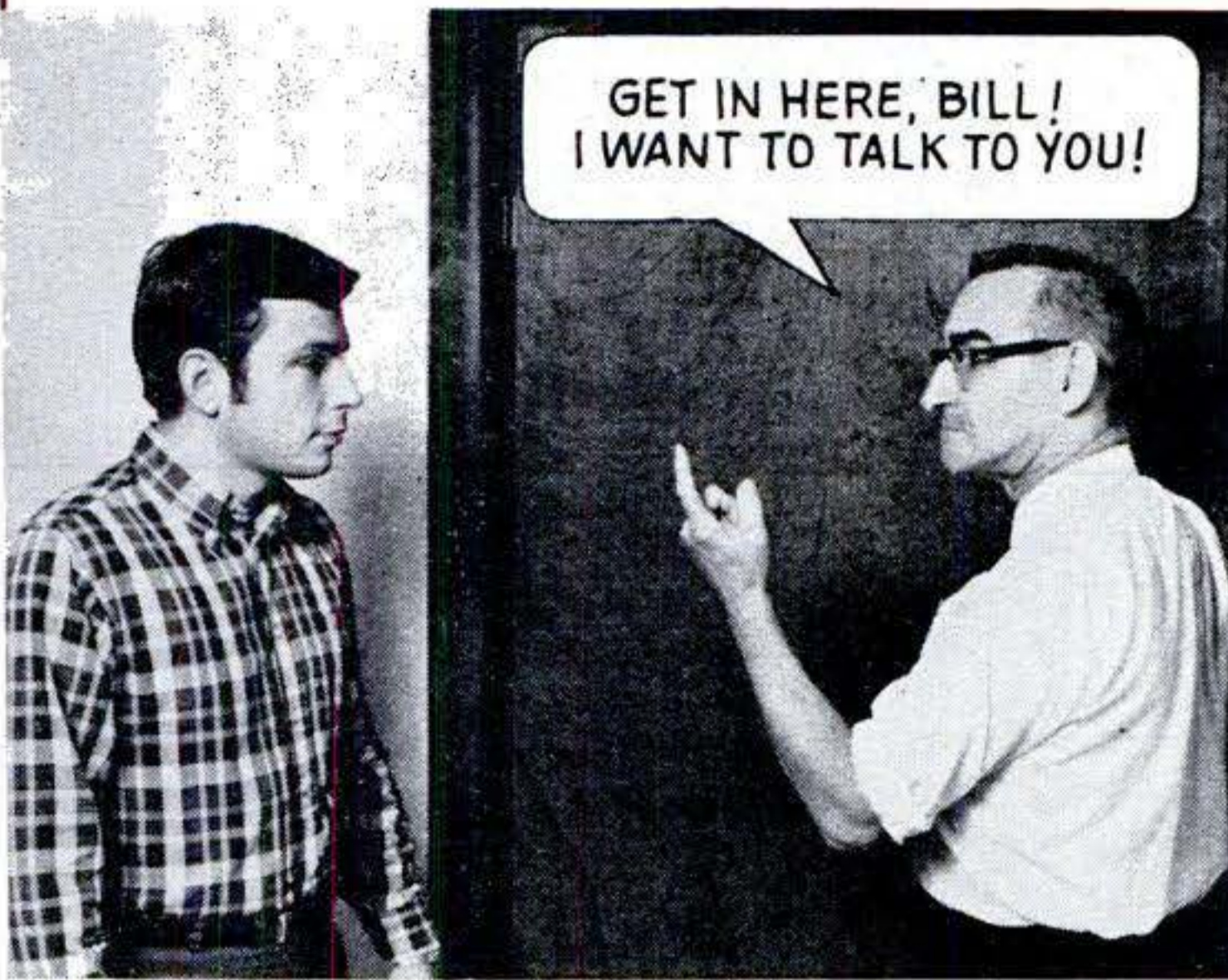
Is legislation really necessary?

In analyzing replies PS received from firms that responded to the warranty survey, there emerges a conviction that they want to be fair to the consumer. But at the same time, there is a reluctance to spell out in their warranties the lengths to which they will go to satisfy their customers.

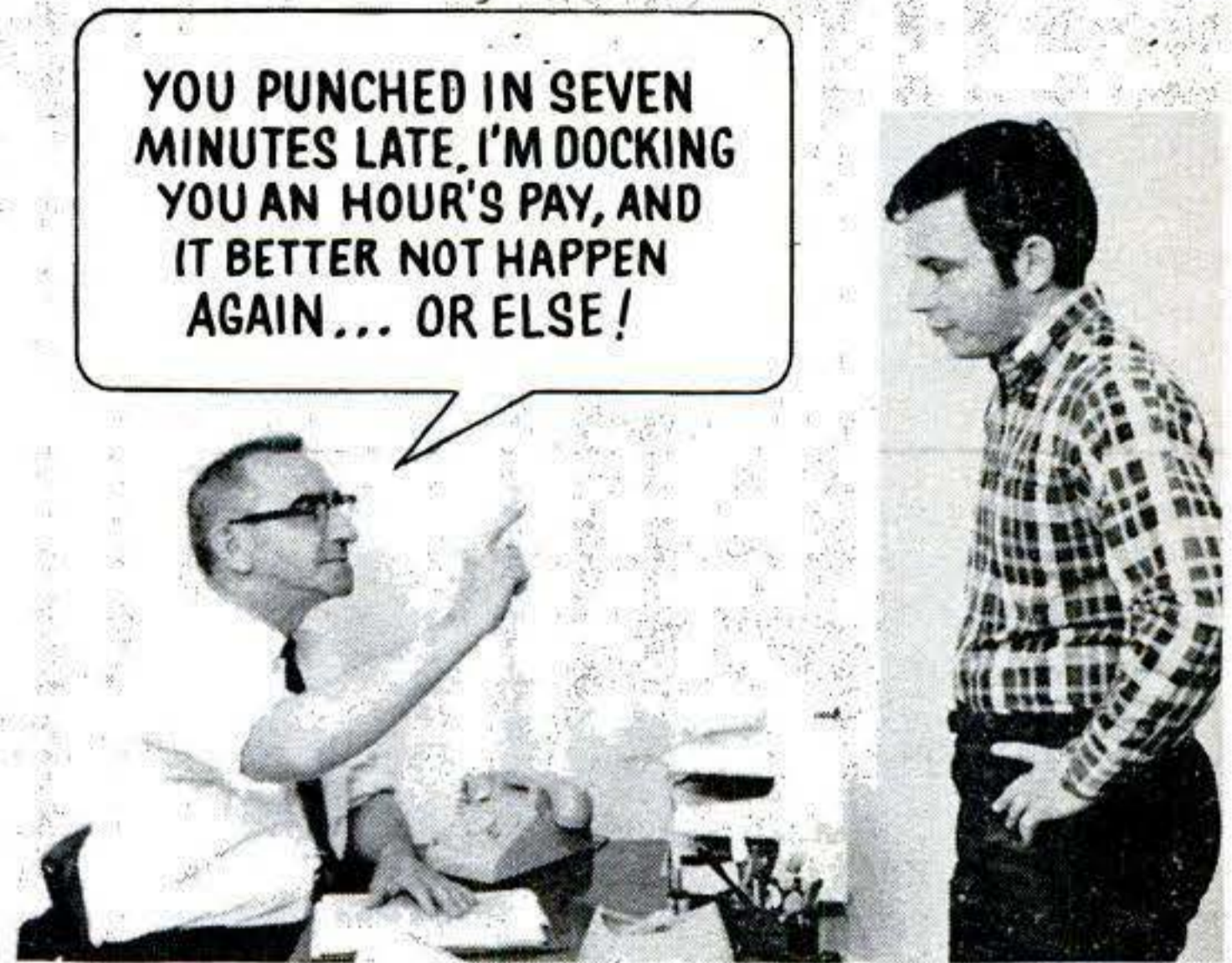
The result is that the purchaser is left without really effective means of obtaining the service which might be necessary to get satisfactory use of an expensive product.

The Magnuson-Moss bill, if it is enacted by the House and signed by the President—and its backers admit to only a 50-50 chance that it will happen this year—would end many of the inadequacies of today's warranties. It would not establish compulsory guarantees. It would, however, force guarantees to say exactly what you are entitled to in the way of service and parts. And this could enable you to shop in confidence for the kind of service and performance guarantee you might want. **PS**

The day Bill told off his boss



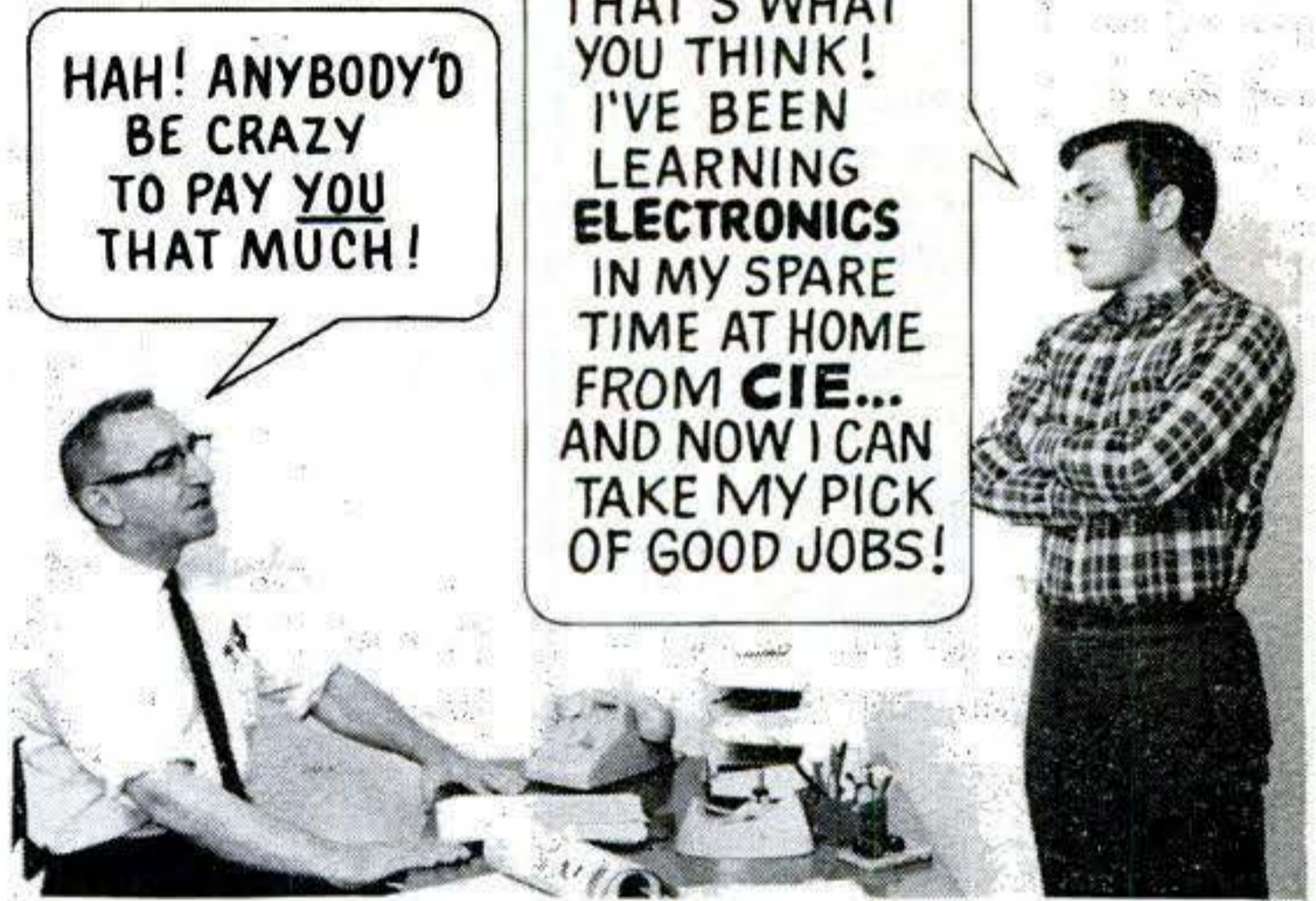
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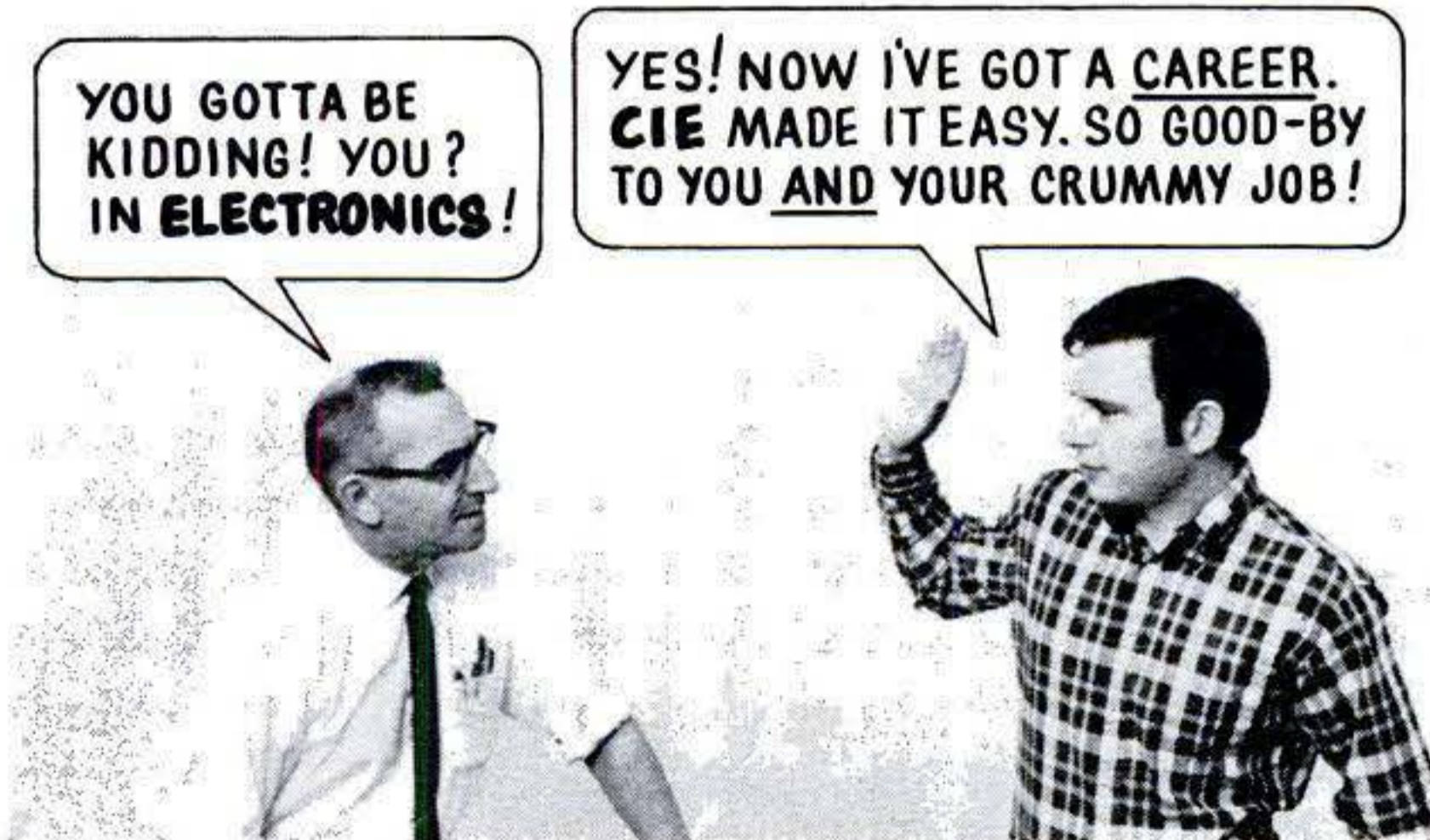


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PS-53

The New Automatic Turntables

[Continued from page 79]

dexterity necessary to handle today's very light, very delicate pickups and arms. It's difficult with the unaided hand to put the stylus down on the record without an inadvertent jab or swipe that can scratch the records. The cueing control lets you: (1) start the record in the outside groove, (2) interrupt play and go back again where you left off, and (3) take quick samples across a record until you find something you want—all smoothly and painlessly.

Tracking force adjustment. Nearly all the tables have calibrated adjusting devices, and for good reason: Tracking force—the downward force on the stylus—has to be set precisely with today's pickups. Even one or two grams too little or too much (too little is usually more harmful) can cause a sharp increase in distortion and record wear. With a separate stylus-force gauge—a readily available device—you can set the force, measure, reset, and remeasure until it's right.

Obviously if you can simply turn a dial to the value you want, you are far ahead on convenience, speed, and, potentially, on accuracy. That's just how it's done on today's automatic turntables. Moreover, the markings

were accurate enough for the purpose on all the machines I checked.

Initial arm balancing. For this kind of high-accuracy dial setting of tracking force, the time-honored method of adding a little forward weight to the arm is not good enough. On these machines a more refined method is used: The arm is first balanced horizontally, then tracking force is added from a delicate spring, usually coiled around or near the arm pivot.

Since cartridges are generally chosen by the buyer, and the various makes vary in weight, there must be some way of balancing out the pickup to balance the arm initially. On all the machines this is done with an adjustable counterweight on the rear of the arm.

After installing the pickup, you set the tracking-force dial to zero; then you adjust the counterweight until the arm floats in a horizontal position. Finally, you turn the tracking-force dial to the value the pickup requires.

This is more complicated than the old sliding-weight method, but it is far superior in ease and accuracy. Having the arm balanced forward and back has another advantage: It reduces any tendency for the arm to

push sidewise if the turntable is not exactly level.

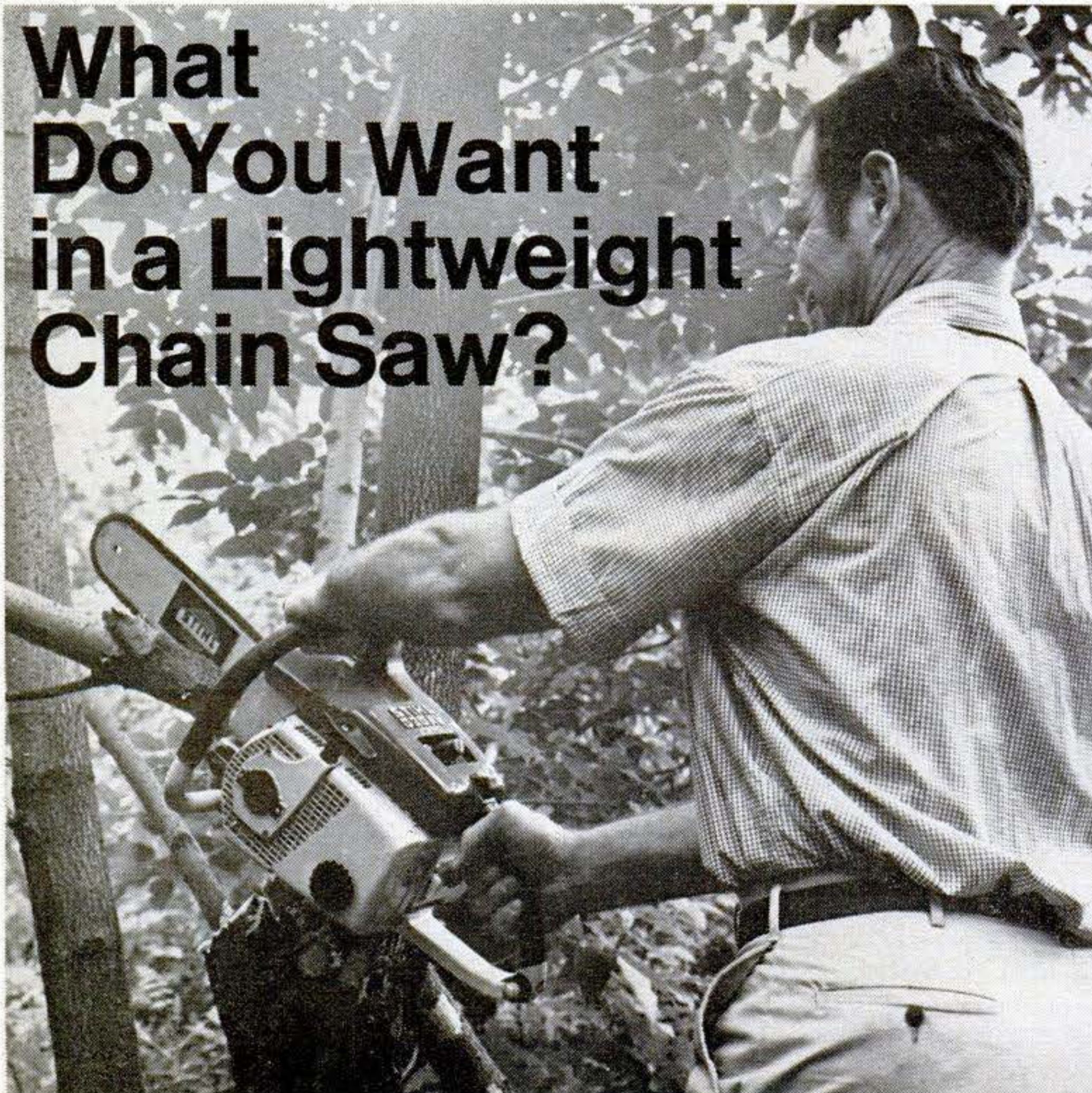
Fine control of speed. In their eagerness to give the buyer a basketful of features, the makers have not only invented new ones but reached back for some good old ones. A welcome case in point is the vernier speed control. A very few turntables have for many years included controls that let you adjust the turntable speed a few percent up or down.

You can get the speed, and thus the pitch of the music, right on the nose. This is essential if you want to play a musical instrument along with your phonograph; even a neophyte on a musical instrument can hear, and be distressed by, a difference in pitch from even one percent or less of speed error.

Vernier speed controls have blossomed this year among the top-of-the-line turntables.

Anti-skating adjustment. Here is an adjustment that becomes important only when you are tracking at around one gram, and only on the most advanced systems. The "skating force" is a component of the force from the friction on the stylus tip. It pushes the arm toward the center of the turn-

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The New Automatic Turntables

[Continued]

table, and arises from the bent-head geometry of modern arms. The anti-skating force is an opposing force applied, from a spring or weight, to balance out horizontal forces on the arm and thus prevent an unbalanced, off-center performance by the pickup—a possible source of distortion.

There have been arguments in the industry for some years about the importance of anti-skating adjustments. Probably most professionals would agree that distortion from skating force is extremely small. It is certainly inaudible, except possibly when tracking at very low forces, with super-delicate pickups.

Nevertheless, it's reassuring to know that this kind of distortion, small as it is, can be sharply reduced. You can get it approximately right by putting the stylus down on an ungrooved section of record and setting the anti-skating dial so that the tip does not slide horizontally as the record turns. This is not exactly right, since the friction is different on a flat section of record from that with the stylus in a groove.

Features, features, features. Some pleasant or even useful extravagances: A photocell on the VM "sees" when

the arm has completed a record and initiates the change cycle (other machines do the same thing with sensitive "feelers"). A center spindle on the PE lowers the record toward the turntable, rather than just dropping it. Feelers on the PE keep the arm from dropping if there is no record on the turntable.

A time accumulator on the Miracord tells you how many hours your stylus has put in playing records. This is a very rough guide to stylus life, but useful for checking stylus wear under a microscope.

Various methods are used for adjusting the vertical angle of the cartridge so the stylus comes very close to the standard 15-degree angle to the record, no matter how many records are on the turntable. This is another adjustment intended to minimize a form of distortion already so small it is probably buried under other components of the reproduced sound.

Choosing the one for you. Any of the tables listed in the chart will do a superb job. If you want to spend less, or try another make, two or three simple tests will give you a pretty good line on overall quality.

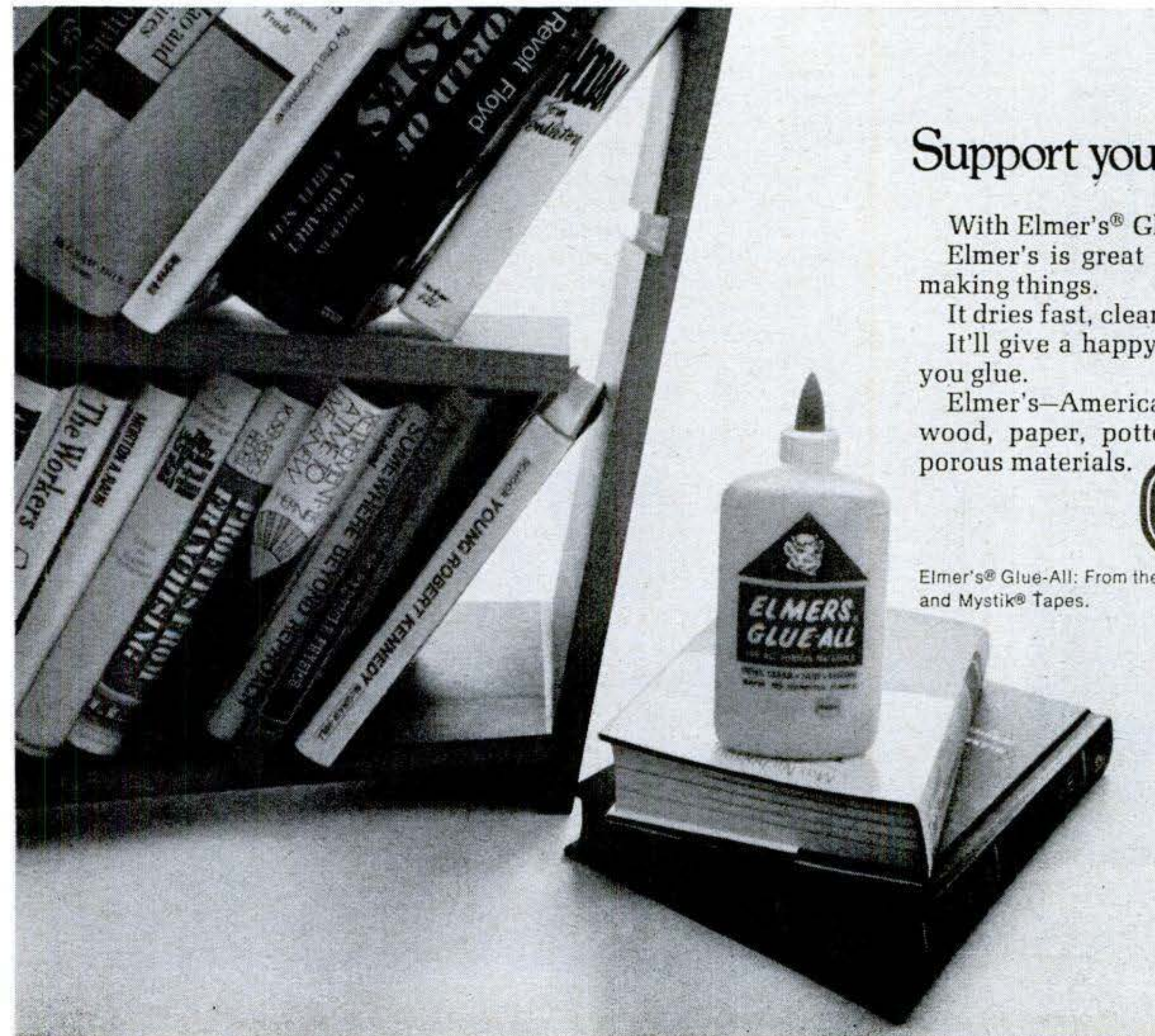
Of course, put a stack of records

on and watch the machine handle them. Go through every operation—starting, stopping, rejecting, repeating, etc. Are the controls foolproof and easy to understand? How easy is manual operation? Does the machine have the features you want?

Check for flutter. For fidelity, first put on a record of slow piano music, which brings out flutter and wow better than any other music. Is there any over-the-waves effect in pitch, or a watery quality in long-held piano notes? This test is vital because flutter is rampant in the inexpensive changers used on small portables and console machines. You might find piano music unplayable.

For rumble, first set the volume *and bass controls* carefully at *normal listening levels*. Then go back to the opening groove, before the music starts, or use the "quiet" grooves on a test record. How obtrusive is low-pitched noise? A tiny amount won't hurt, but it shouldn't be strong enough to mix in with the music.

Finally, buy the best table you can afford. You can get fabulous turntable refinements today, and the more refinement you buy, the better you'll like it over the long haul. **PS**



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SHOP TALK

By ROBERT P. STEVENSON

New glues make sniffing impossible—well, almost

Those of us "over 30" will never quite be able to understand a phenomenon of recent years—glue sniffing by grade schoolers. Yet it continues as a real problem. You should be happy to hear, therefore, that one major glue manufacturer has taken positive steps to combat the practice. The Testor Corp., Rockford, Ill., now adds oil of mustard (allyl isothiocyanate) to its model cements. When a hobbyist attempts to sniff one of these, the mustard gives such a severe jolt to his eyes and nasal passages that he is discouraged from continuing. Anyone using the glue for its intended purpose doesn't notice the additive, and the product's adhesive qualities are not affected. Testor offers the formula free to other manufacturers who want to use it. Other deterrent additives are also being sought. Government authorities have applauded the move.

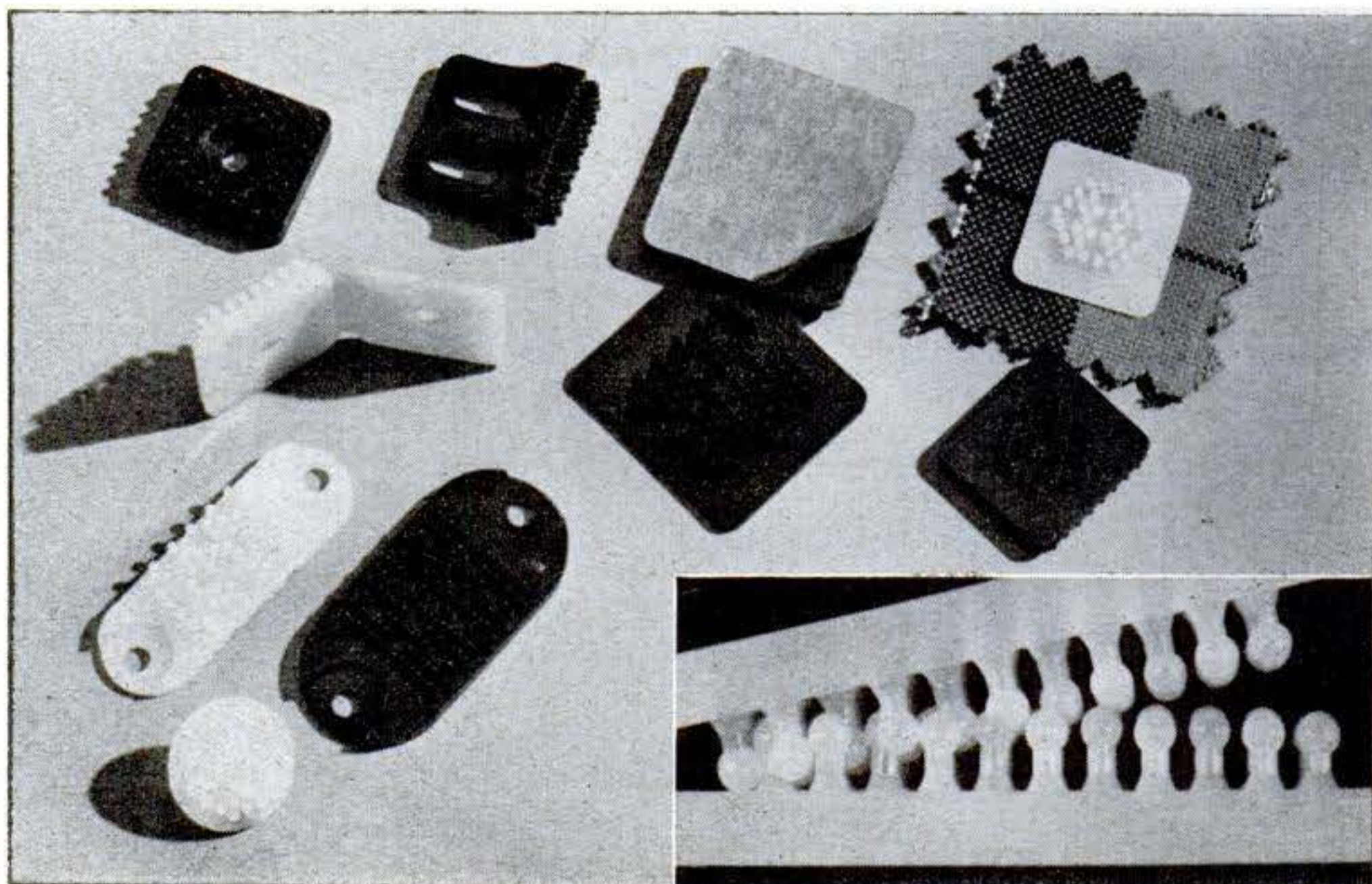
Information dials offer help for home improvements

What do you know about door styles? Are you trying to cope with a moisture-condensation problem in your home? You can find help in both cases from new information dials available free from Ponderosa Pine Woodwork, 39 S. LaSalle St., Chicago, Ill. 60603. The door selector helps you choose a style suited to the decor of your home. The other wheel suggests what windows to use to avoid condensation damage.

3M offers a design kit of interlocking fasteners

Do you have or know about a design problem whose solution may depend on, or be helped by, a special type of fastener? The 3M Company suspects that quite a few of us may occasionally find ourselves in that fix. The company is offering a design kit of more than 100 nylon and acetal Hedlok fasteners for \$15. The black or white fasteners consist of mating parts that interlock when their multiple stems or "heads" are snapped together (inset photo below), yet pull apart easily when you want them to. The company introduced Hedlok fasteners in 1967, and industries now use them in various manufactured products. The design kit includes 18 different shapes, sizes, and types—some are seen below. The fasteners attach with screws, bolts, or rivets. Some have an adhesive backing, and some have tabs that press into a metal opening. The fasteners are not available in retail stores, but this may come later.

One retail possibility: a blister pack of kitchen-cabinet door fasteners. I have used them on cabinet doors—and find they work well. The kit and further information can be obtained from Hedlok 220-8E, 3M Company, 3M Center, St. Paul, Minn. 55101.



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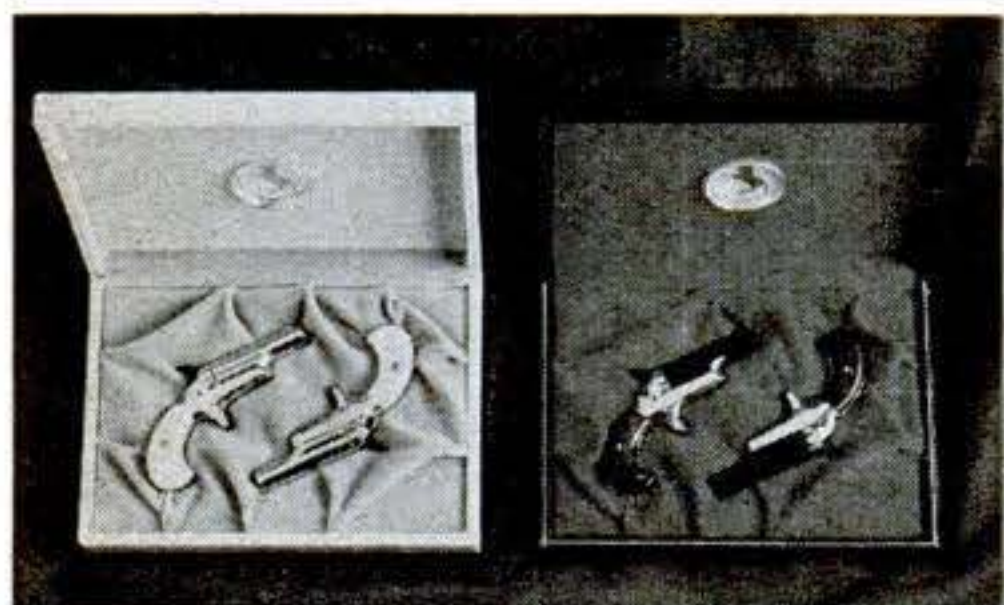
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Three Pop-Together Designs

[Continued from page 90]

to finished size. This helps you get a clean bend near the edges of the plastic.

Cut and sand the holes—in the pipe and wine racks—before you do the bending. For a smooth sanding job on the pipe-rack holes, wrap sandpaper around a 3/4" dowel. Use a frozen-juice can for the wine rack. Work down to a number 400 wet-or-dry paper. Then polish with a rag and automobile polishing compound.

Use the same polishing and sanding schedule to clean up the edges of the Plexiglas. But remember you'll have to do some of the edgework—on the lamp and pipe rack—after the plastic is bent and trimmed to its finished dimensions.

Bending the plastic. To soften the plastic for bending you'll have to make a strip heater. This is easy; a new heating element—the Briskeat RH-36—made just for bending Plexiglas is now on the market. You can get it where you buy your Plexiglas; price is around \$8. Instructions for building the heater come with the element.

Make simple jigs from white pine as shown to simplify bending. Note that the strips of wood that hold the plastic while you bend it are not as high as the mandrels. If you make the retaining strips too high they'll mar the hot Plexiglas during the bending operation.

Measure the plastic carefully to determine where you should apply the heat for a bend. Mark the bend point with a felt-tip pen.

Apply the plastic to the heat, the outside of the bend down (toward the heating element). Now keep an eye on the strip of plastic just over the heat. When the shiny surface begins to distort, remove the sheet and make the bend. Don't wait too long or you'll get too much heat, with bubbles in the plastic and a wrinkly bend.

Once the plastic is bent, trim off the excess and sand and polish any rough spots. Then drill the holes for the rivets, using the holes already cut in the wood as guides.

Wire, then pop together. If you're making the lamp, now is the time to wire it up. Thread the wire in through the base and on out the top. Connect the socket, pull it down into its seat, and tighten up the nut. Put a switch in the line if you like.

Now you're set to pop the projects together. Use aluminum rivets—steel tends to crack the plastic. Gerber recommends USM's 1/8" A-44 Pop rivets. Put a rivet in the tool, insert it through the plastic and into the wood. A steady squeeze will set it. P 5

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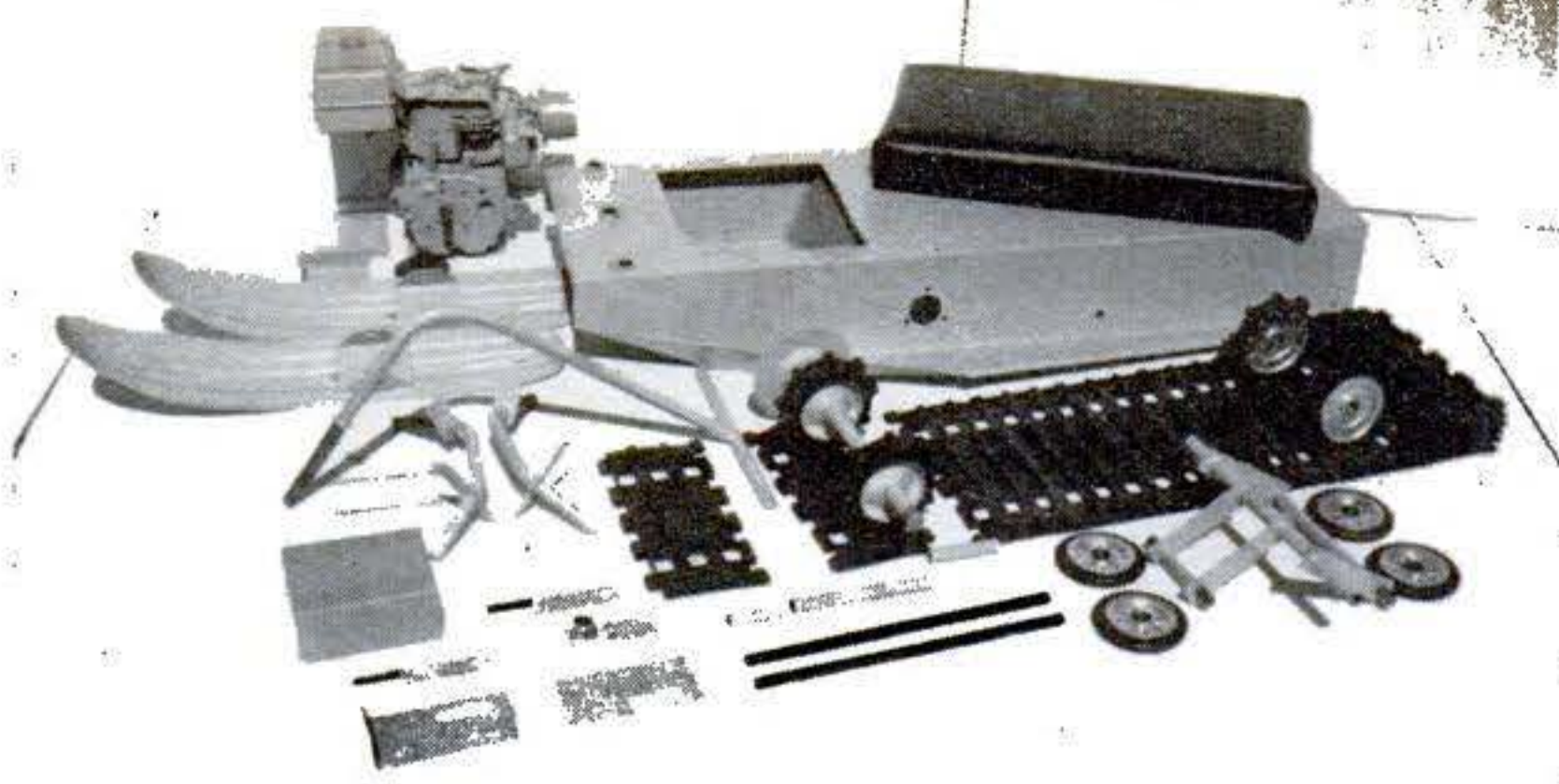
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For SNOWMOBILERS: Now There's a \$300 Kit

By E. F. LINDSLEY
PS Midwest Editor

A snowmobile you assemble yourself for \$298? Yup. It's the Snow-Skoot, designed by C. F. Struck, inventor of the Mini-Dozer and the Beep. Though not as potent—or expensive—as big commercial jobs, you and the kids could have a ball with this cutey.

The design is simple, but rugged. Basic parts are all ready to bolt to the one-piece 18-ga. steel chassis. Assembly takes about two hours.

The seven-hp, four-stroke Tecumseh engine nests in a submerged pocket of 14- and 10-ga. steel welded into the main body. This gets the center of gravity down low. Power is delivered through a heavy-duty centrif-

ugal clutch with sintered shoes. From there, the drive is à la minibike, through a No. 40 roller chain to the track's forward sprockets. A brake operated by the left handlebar grip snugs a band on a four-inch drum. This lets you hold the brake while pulling the starter rope with your right hand.

Top speed is about 20 mph, but for up-hill-down-dale suburban rambles, Snow-Skoot's plenty lively. It's not a cross-country rig; it's meant for local fun use, like a mini-bike.

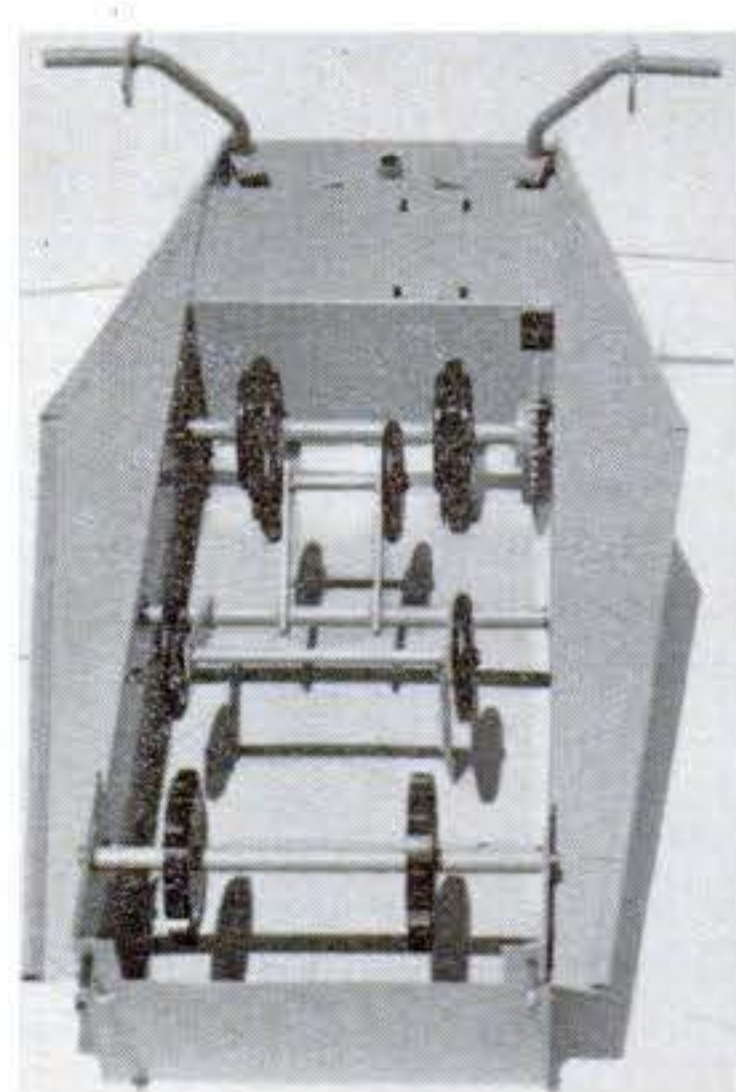
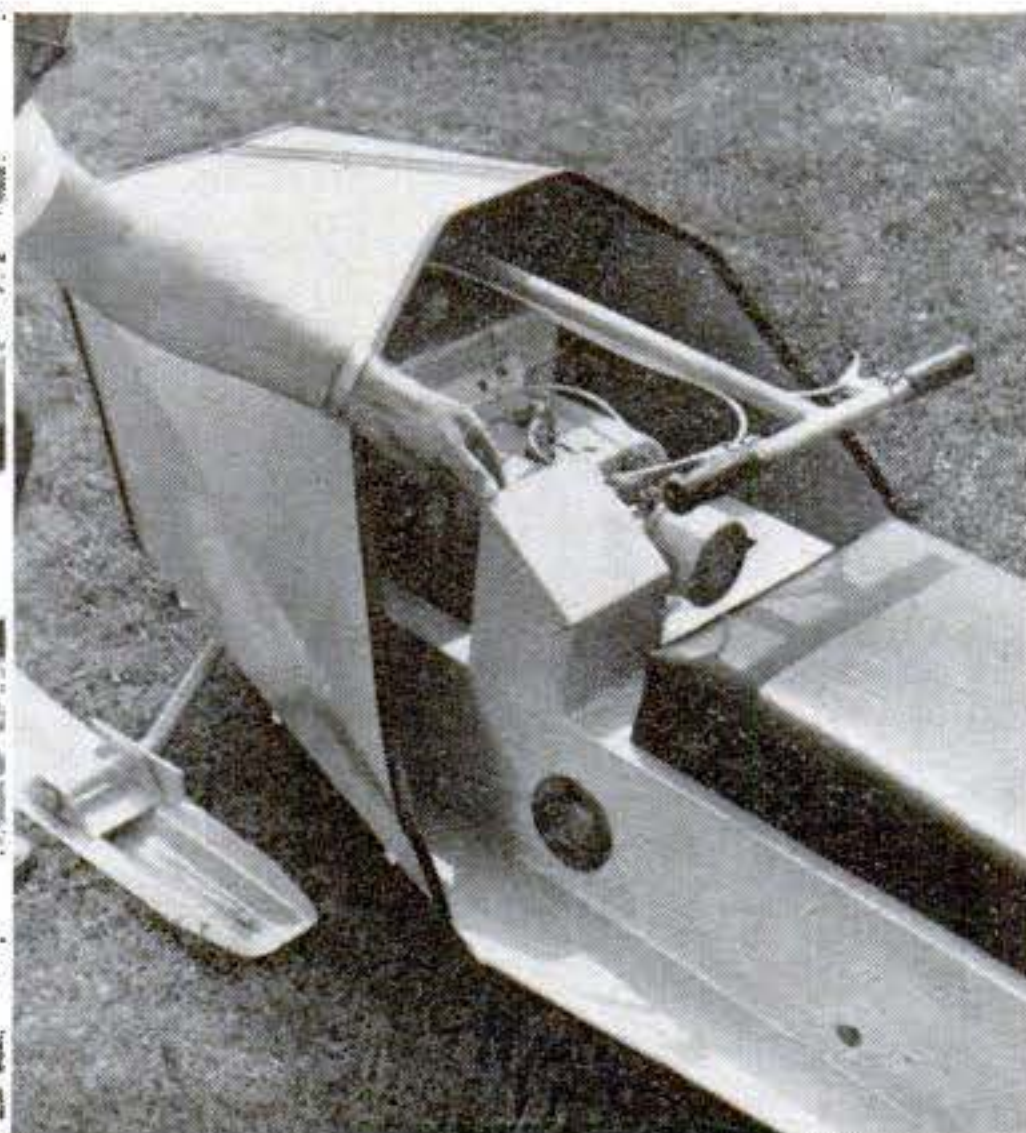
An alternator and lights are optional. Before ordering a kit, check your state's lighting requirements. And you may need to certify a sound-level reading. Without the muffler shroud and hood, this machine, at 3,600 rpm and a distance of 50 feet, checks out at 74 db (A scale), so it's

no screamer by snowmobile standards.

You can forget about a trailer. The skis can be yanked off by pulling a pair of pins, and the light, 180-pound rig then fits into almost any car trunk or wagon.

Ski contact area is 242, track area 360 square inches—a total of 602. Surface loading, empty, is thus about 0.3 pound per square inch. The 15-by-72-inch track of molded urethane is put together with steel pins, so track sections are easily replaced. Bogey wheels on a walking beam give center track support.

If the Snow-Skoot looks a bit Spartan to you, you can cook up your own fantasies. The C. F. Struck Corp. (Cedarburg, Wis. 53012) offers plans for it for \$5. But just as it stands, this little snow skimmer has a character that's really quite winning. **PS**



Skis and steering are simple, solid. Sentry clips at pivots allow removal of skis to fit rig in car trunk. Weight is liftable: 180 lbs.

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Track's drive sprockets and bogey system are mounted with chassis inverted. Track tighteners pull the back sprockets rearward.

Shoppers'



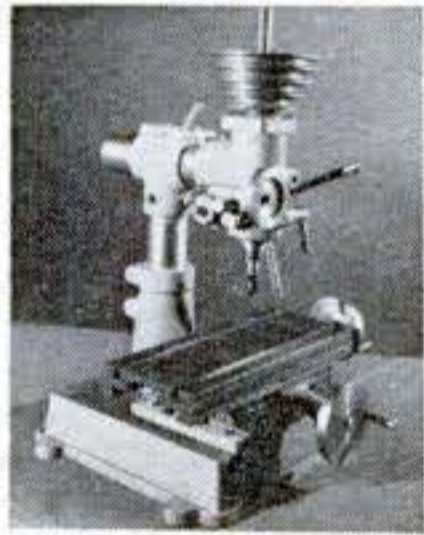
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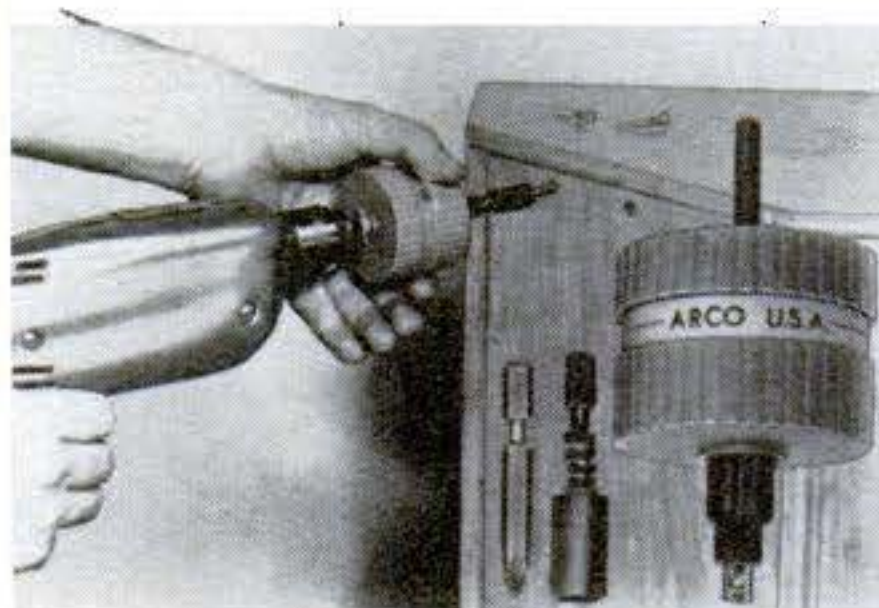
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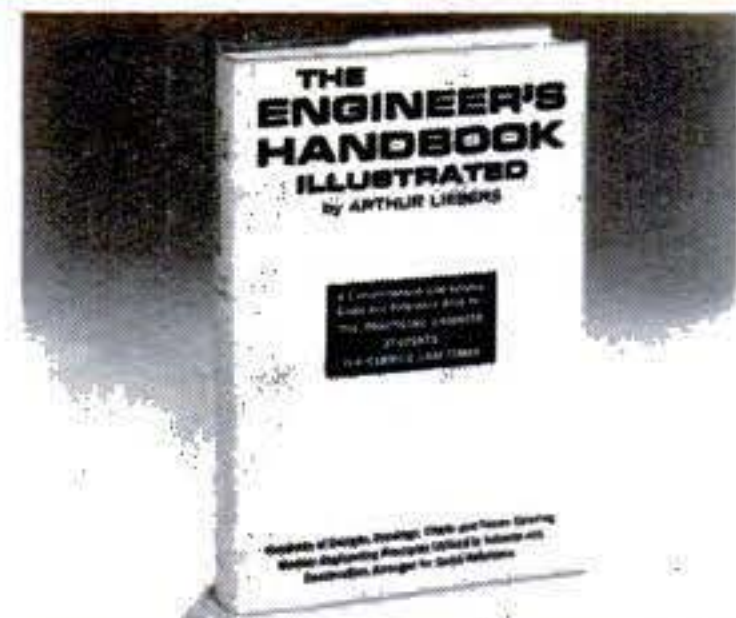
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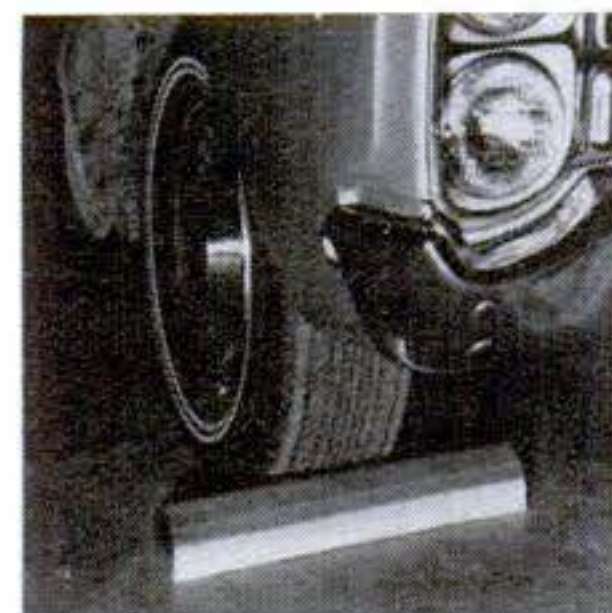
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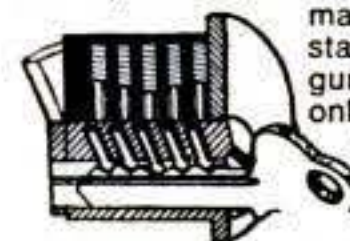
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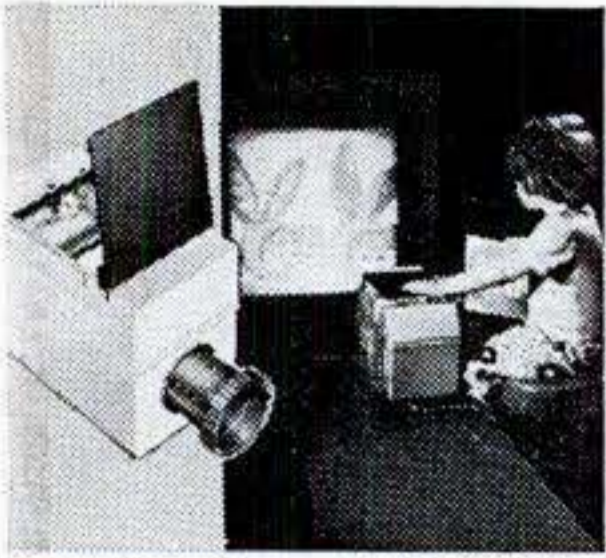
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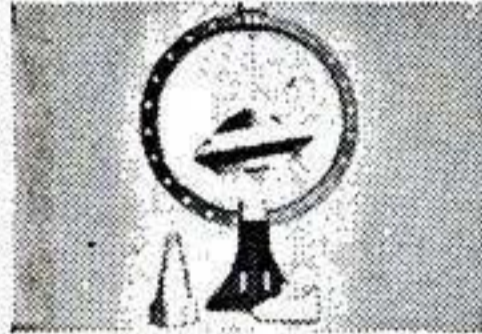
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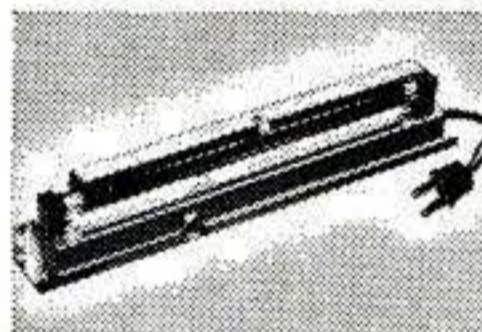
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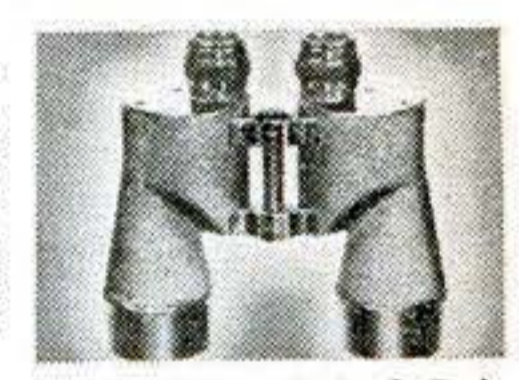
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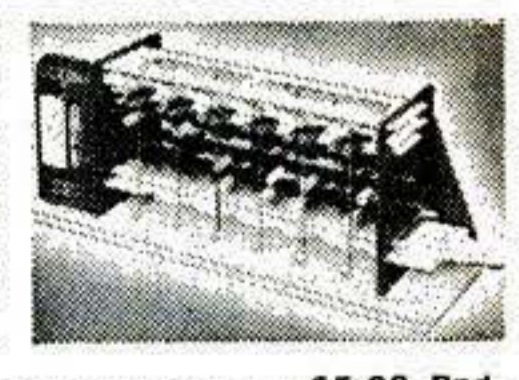
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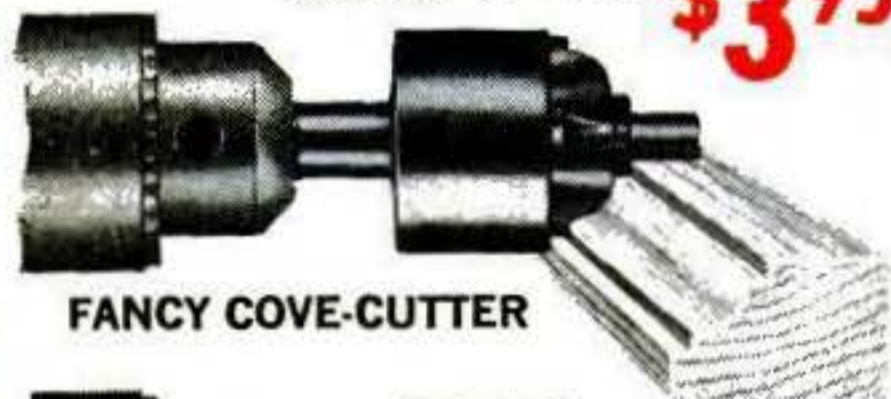
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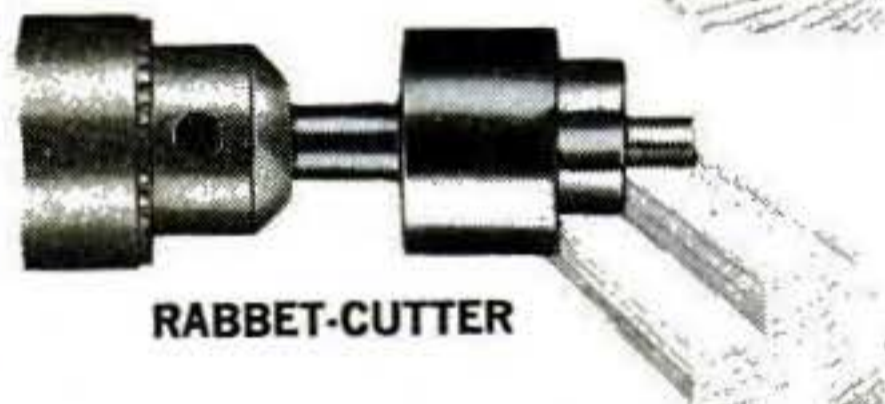
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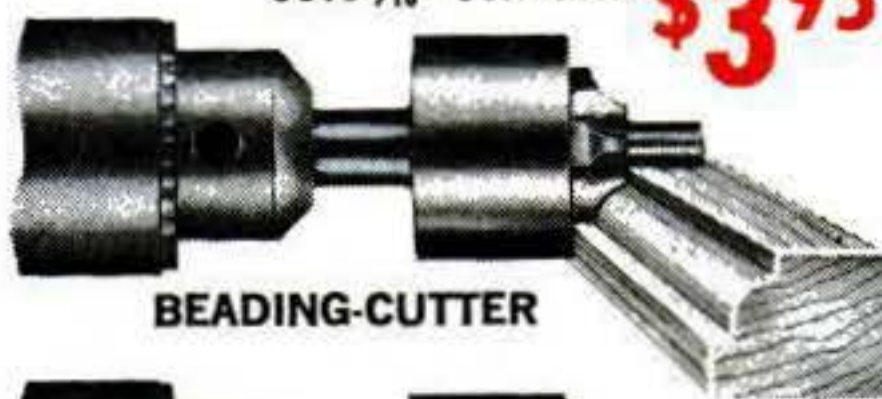
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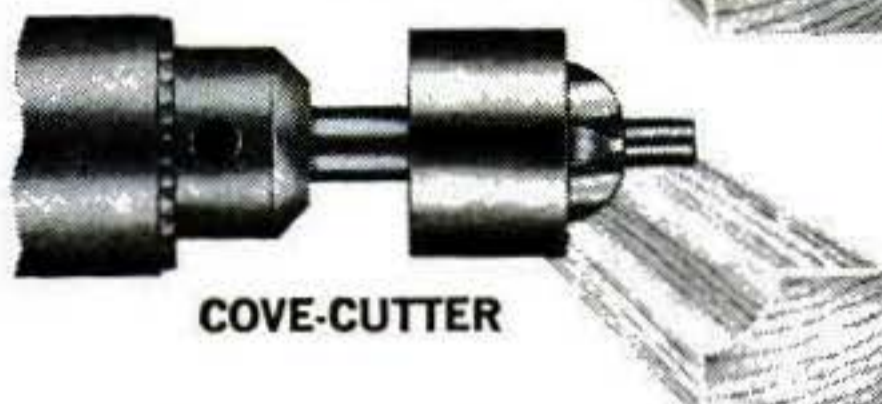
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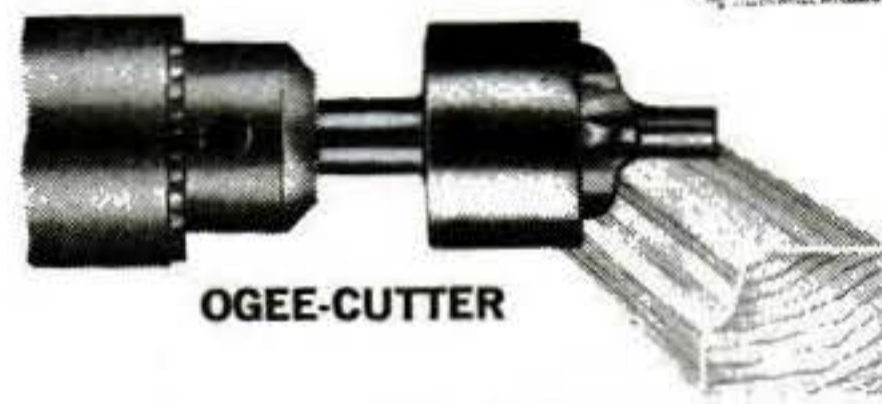
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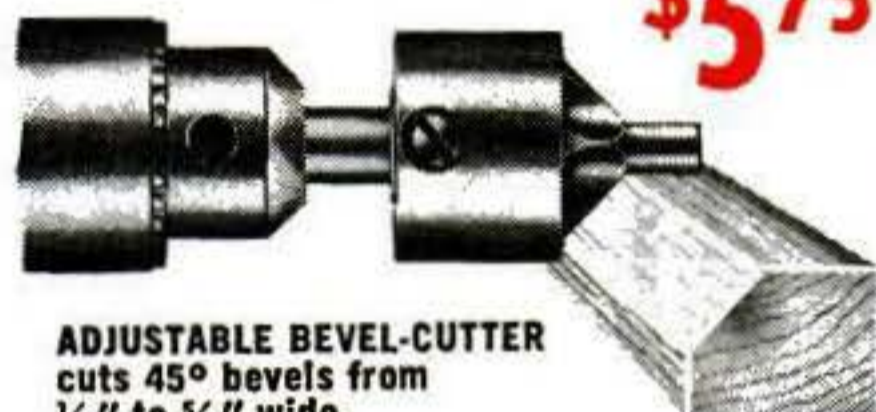
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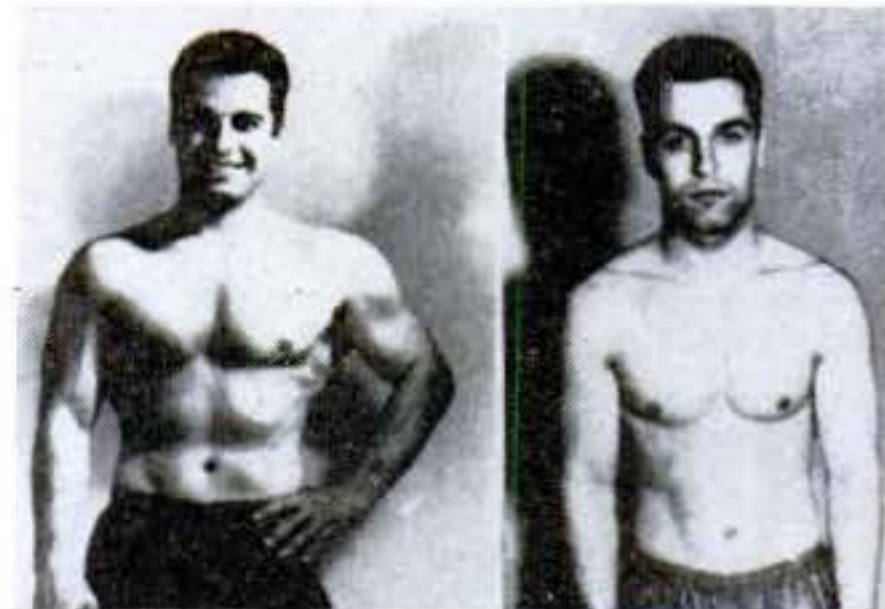
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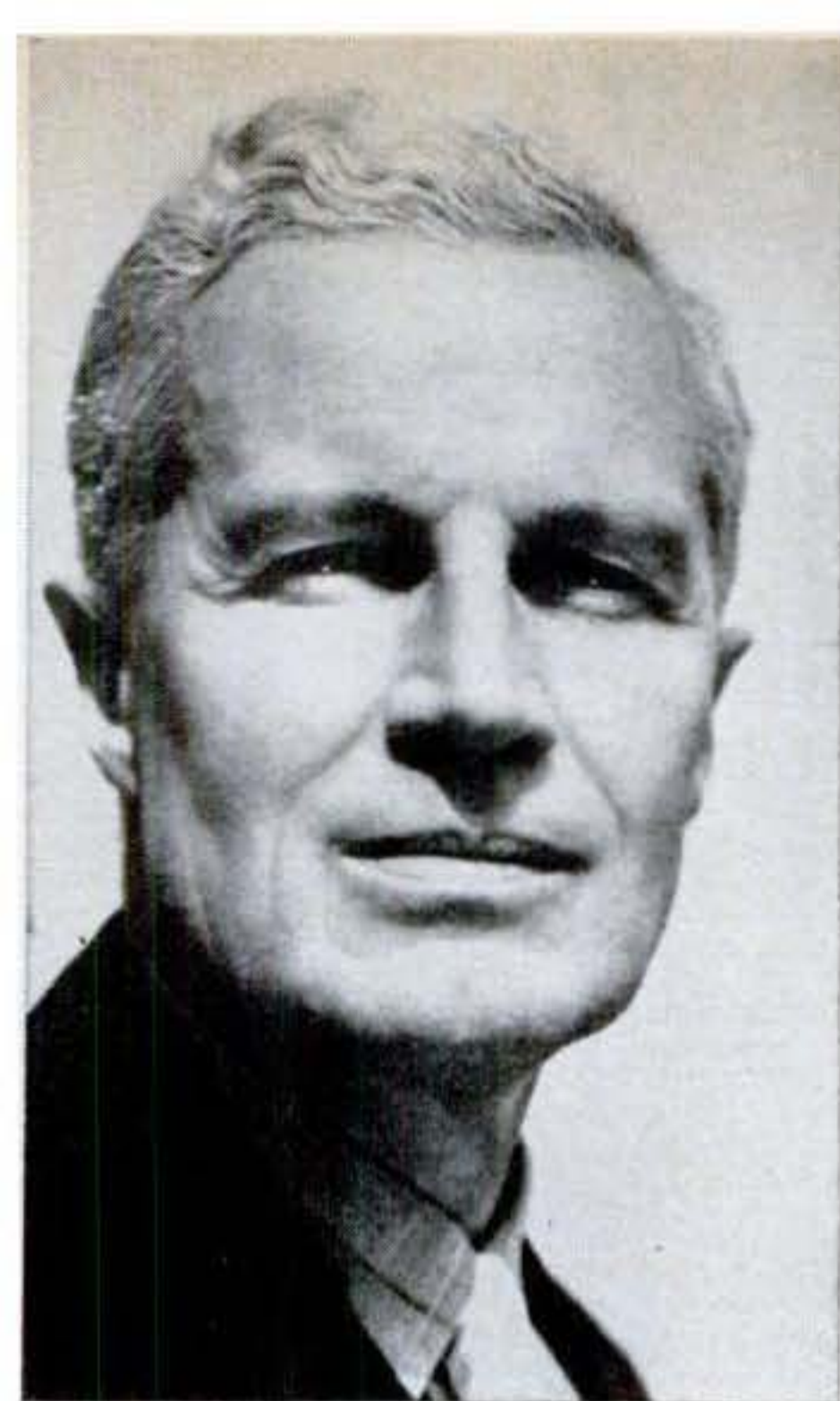
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summer home, my Cadillacs, my winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied 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.

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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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NOVEMBER 1970 | 147

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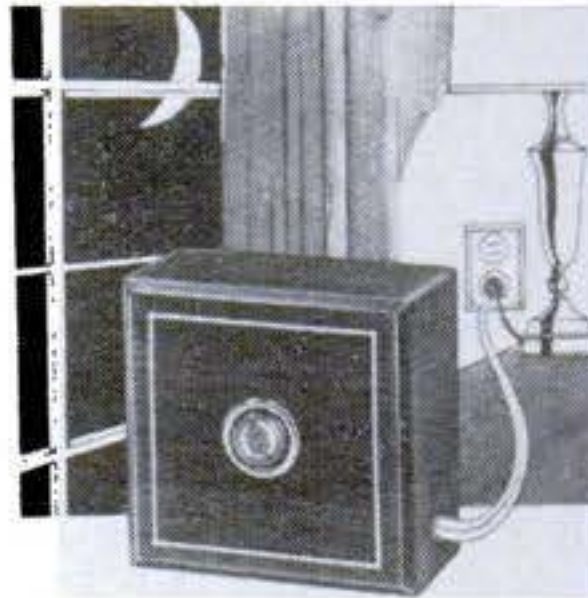
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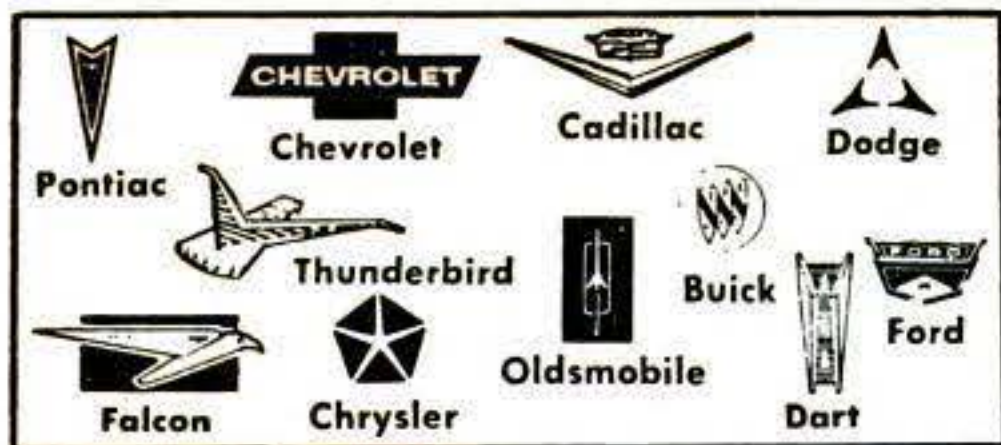
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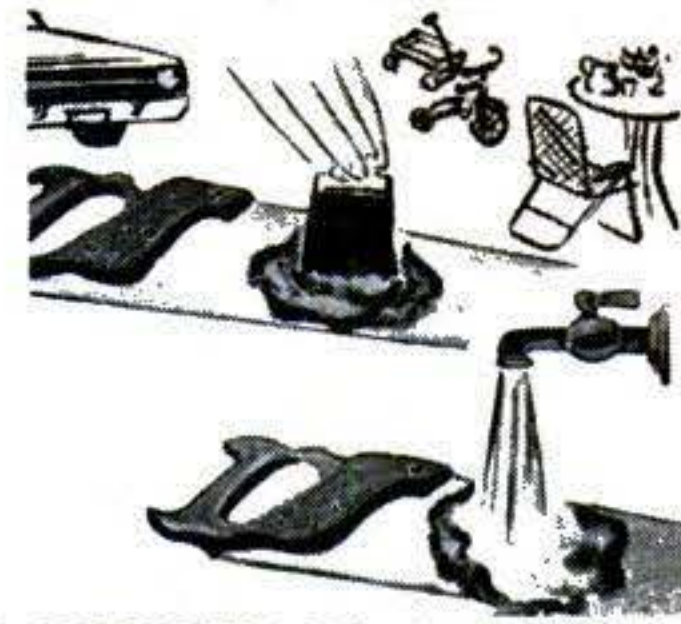
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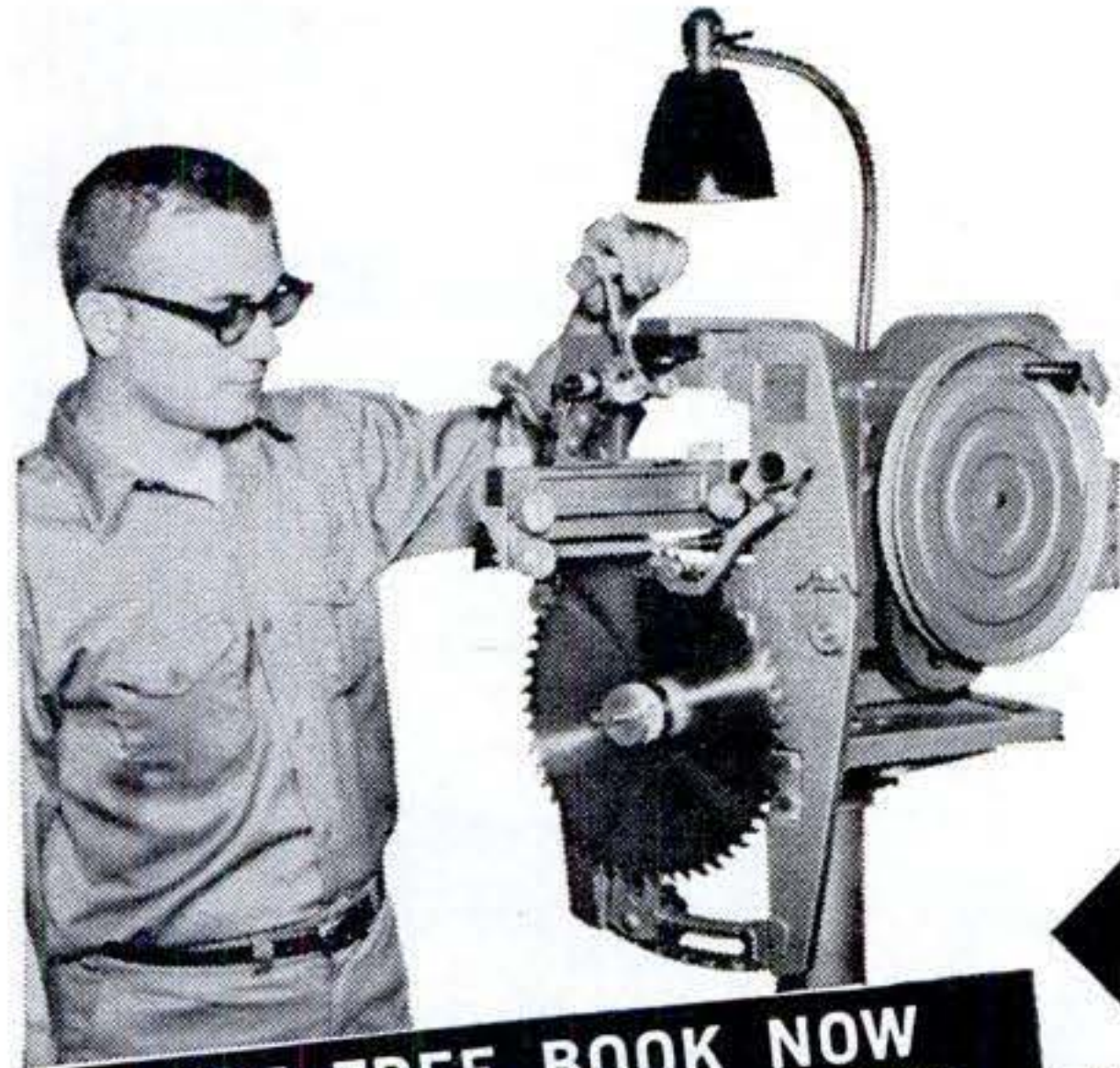
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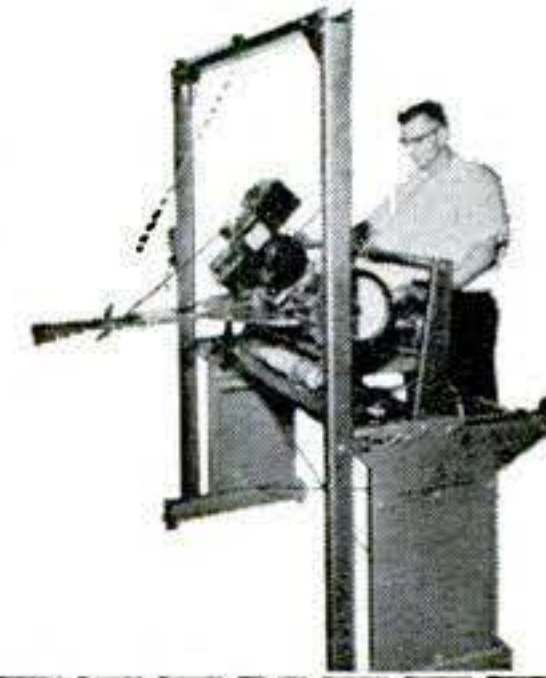
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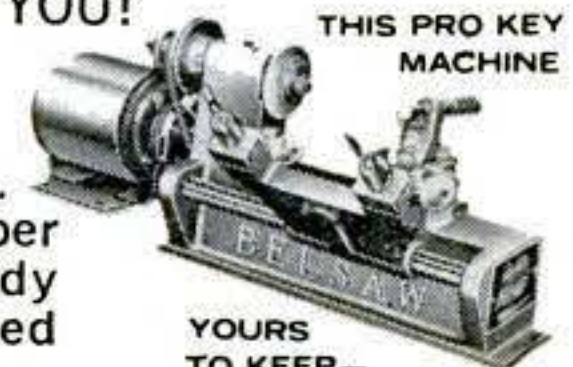
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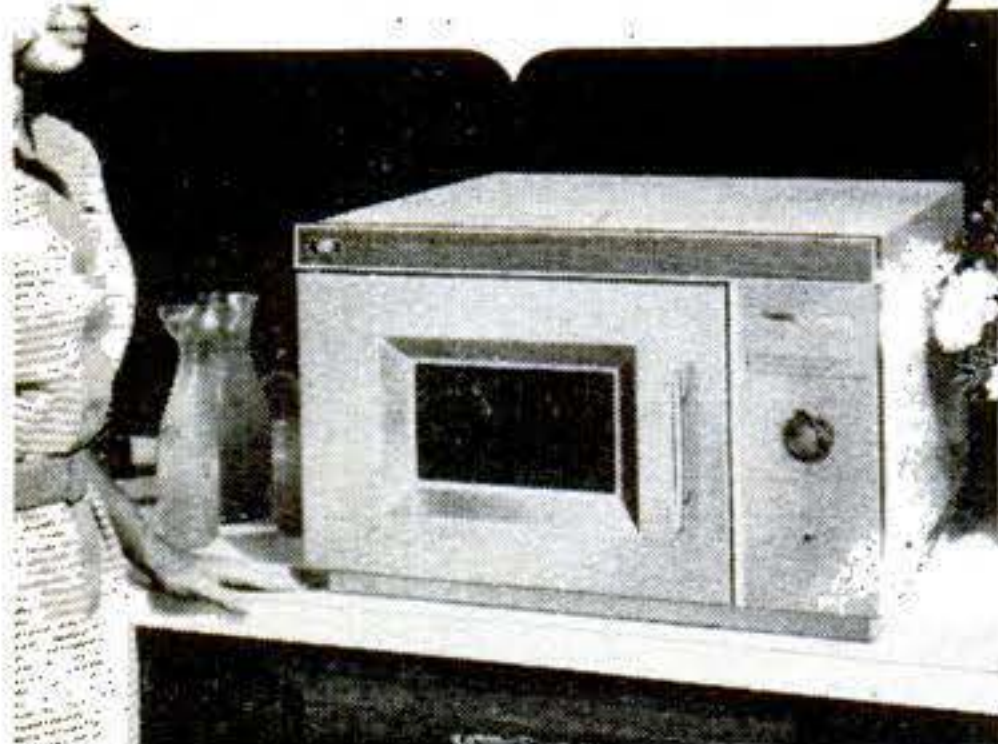
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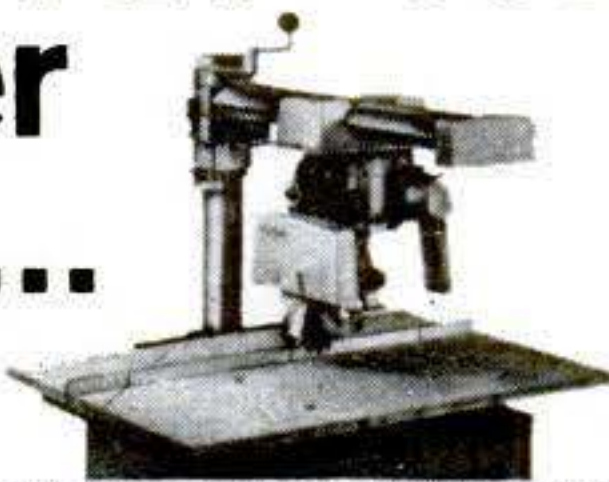
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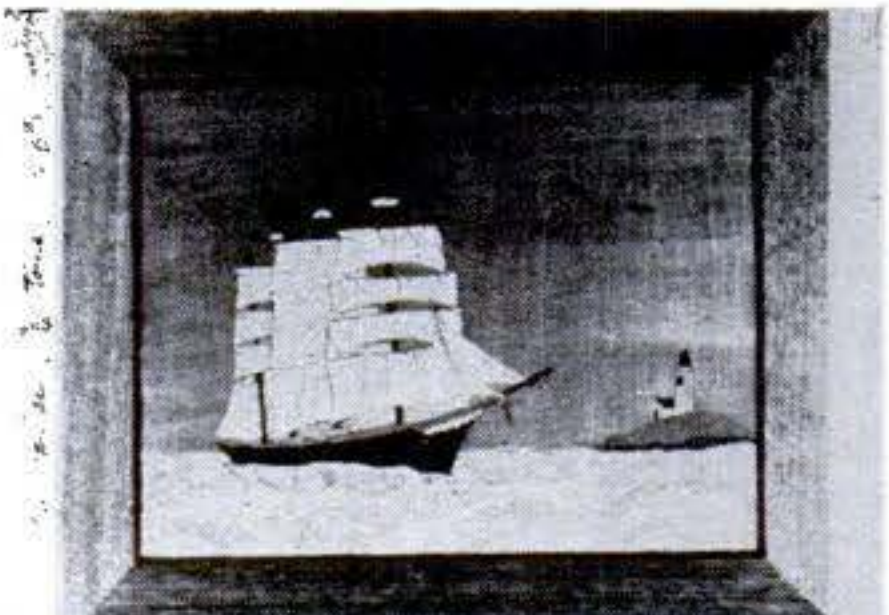
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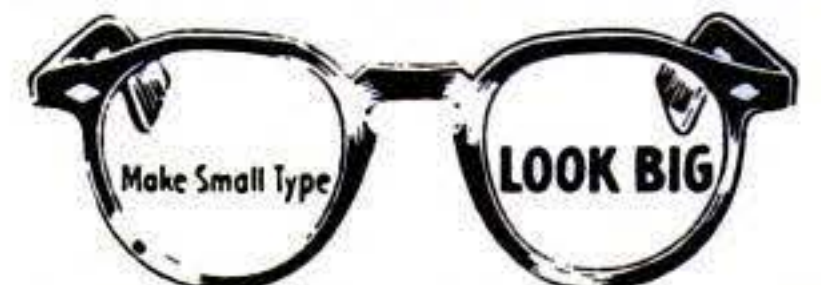


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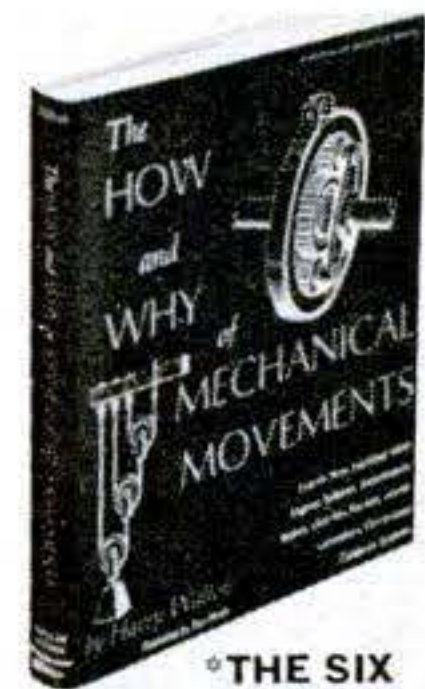
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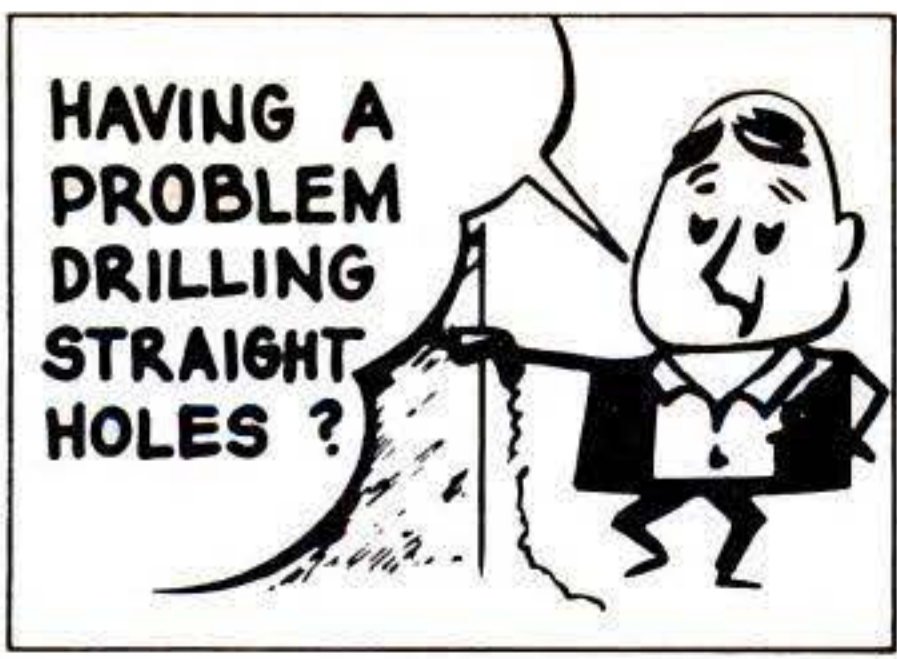
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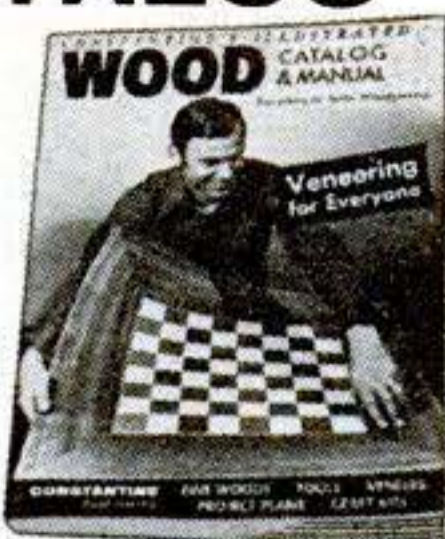
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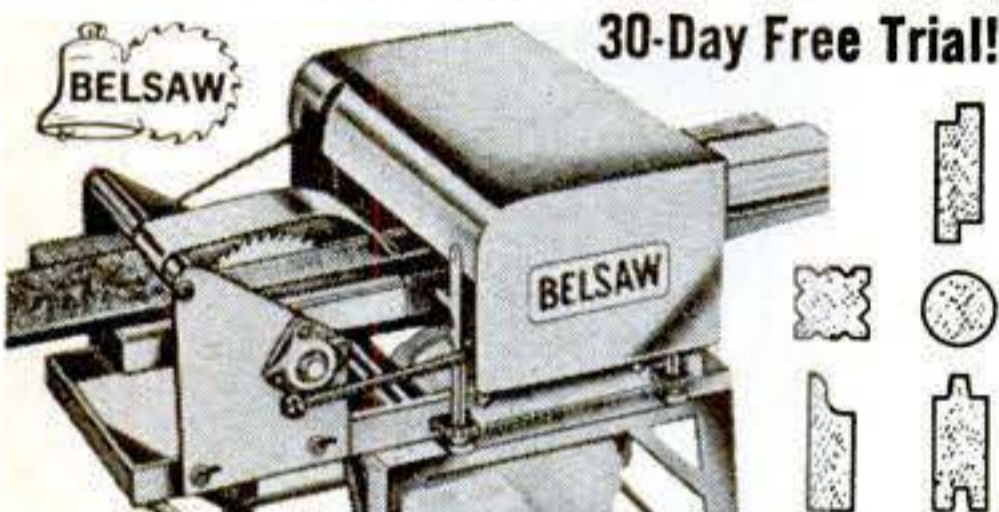
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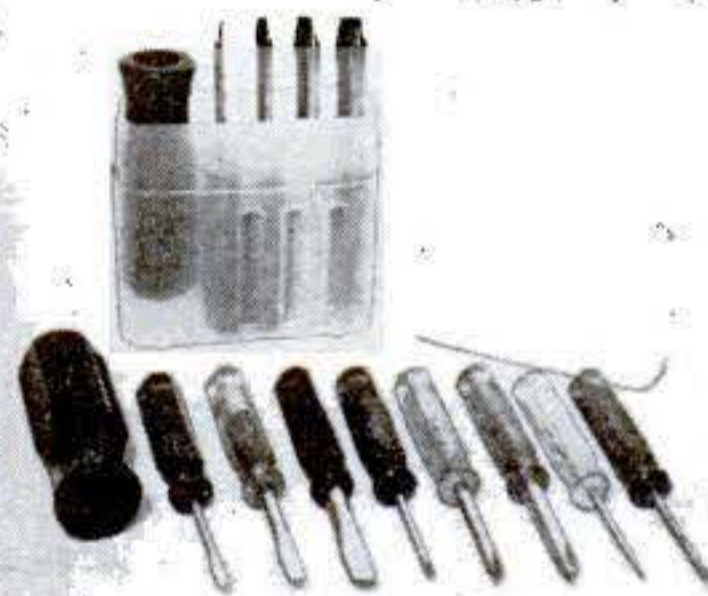
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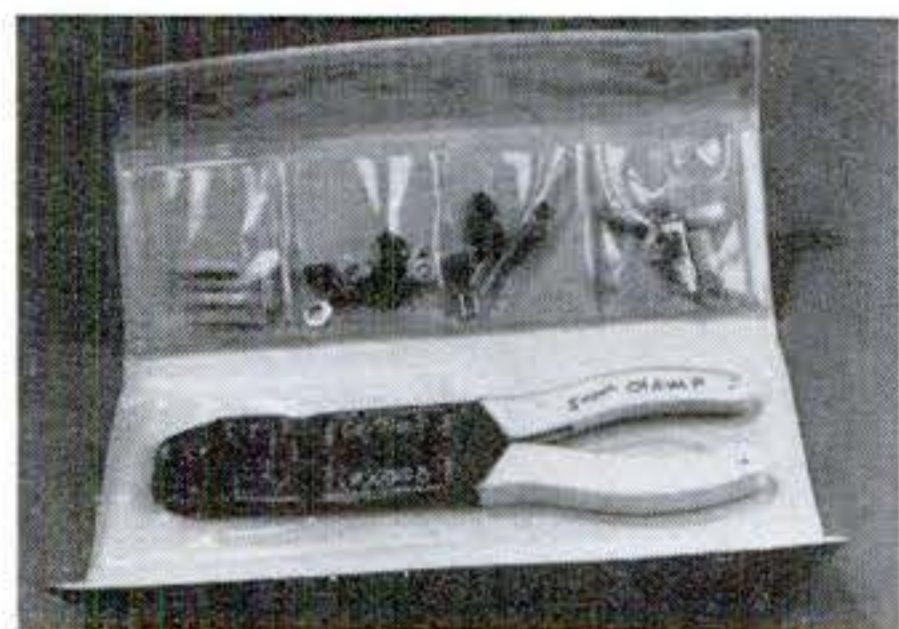
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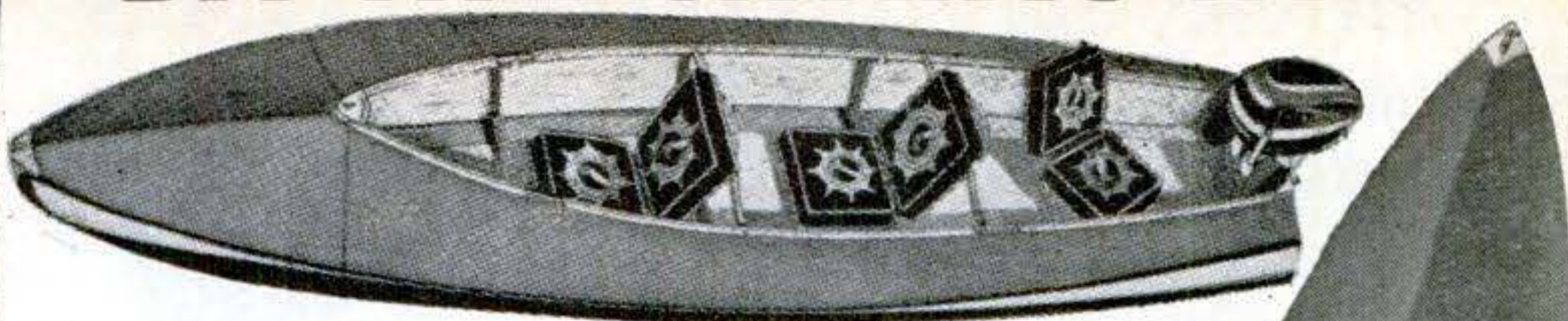


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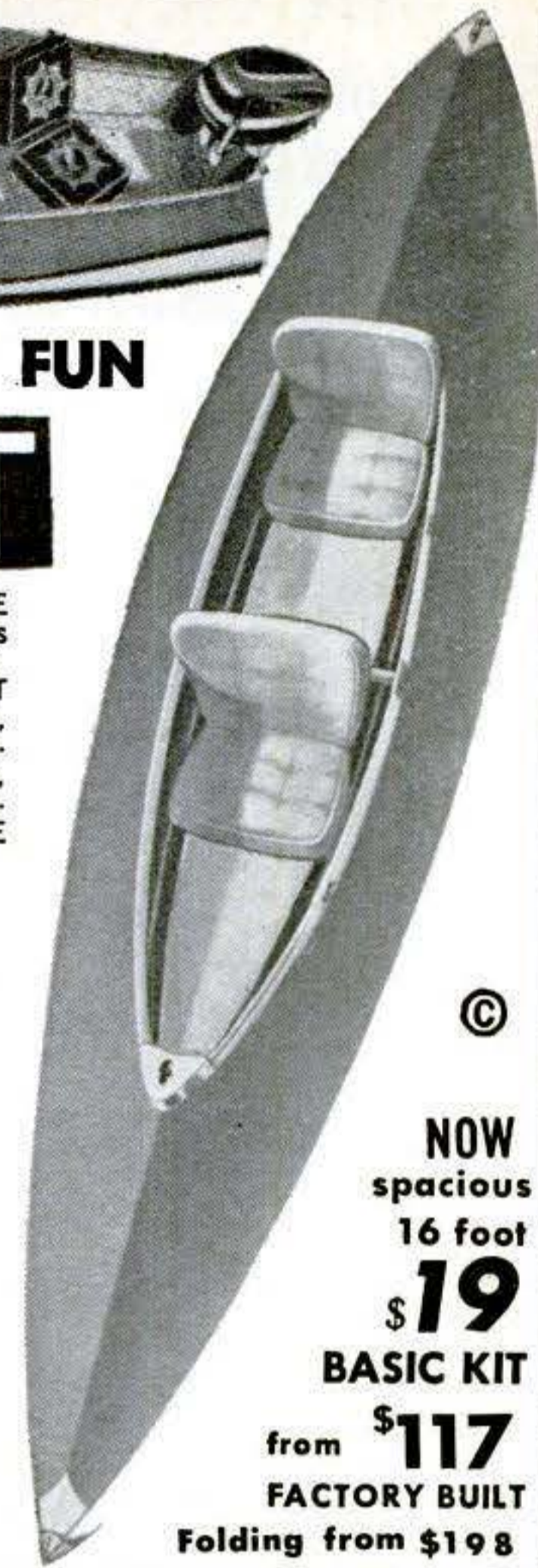
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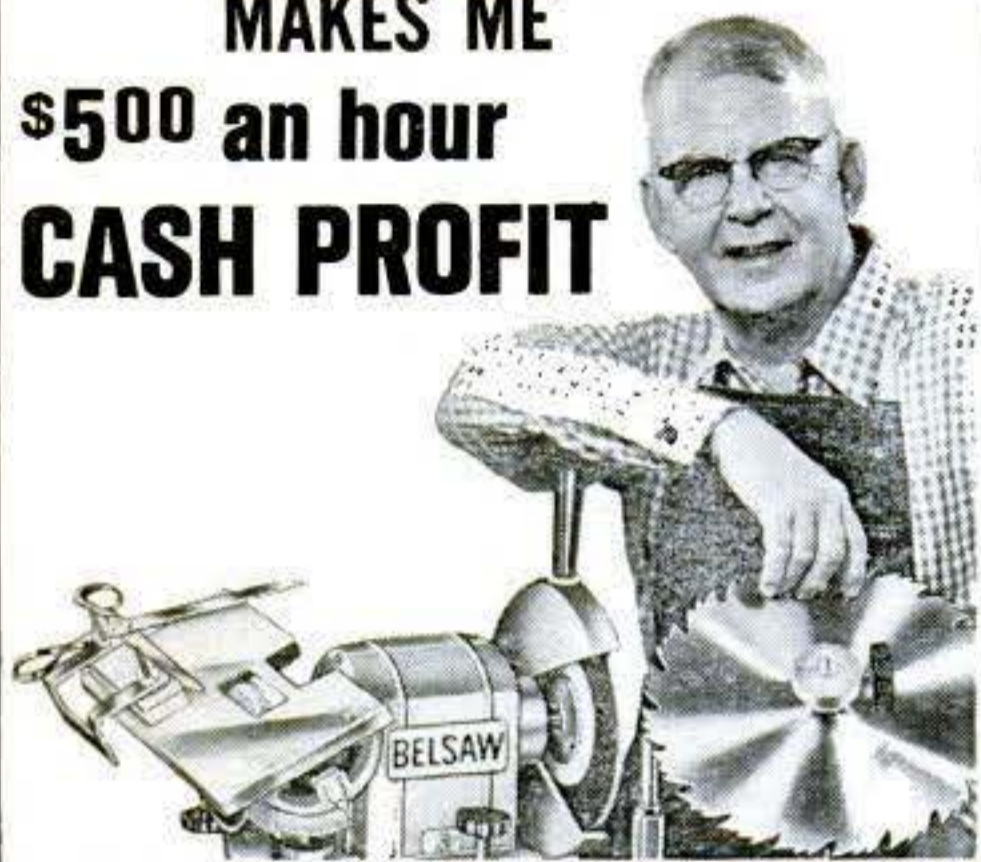


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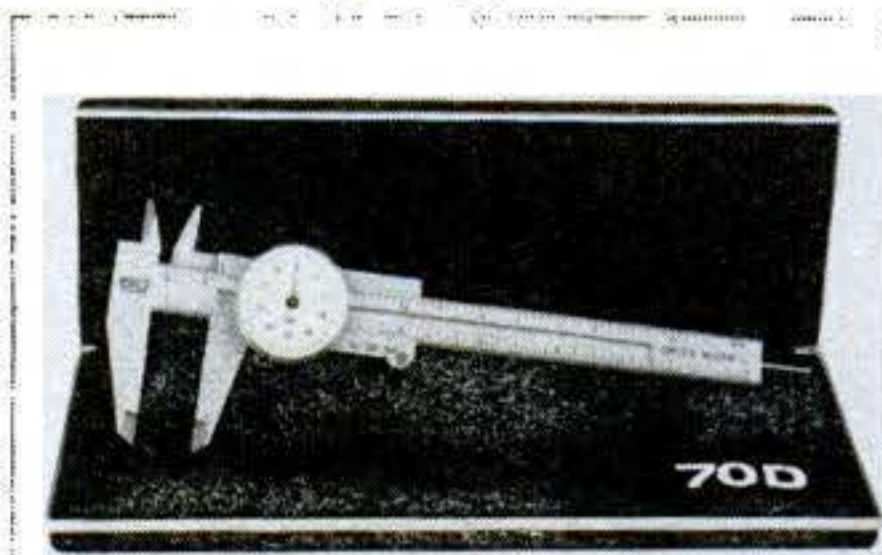
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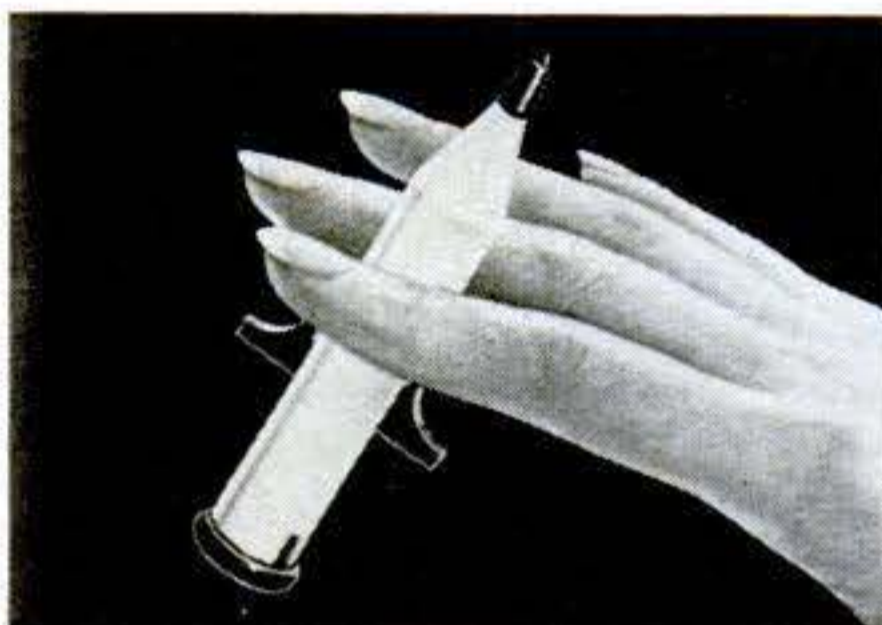
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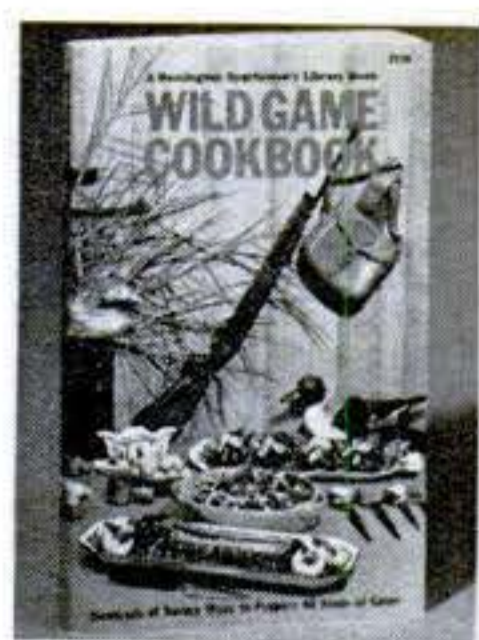
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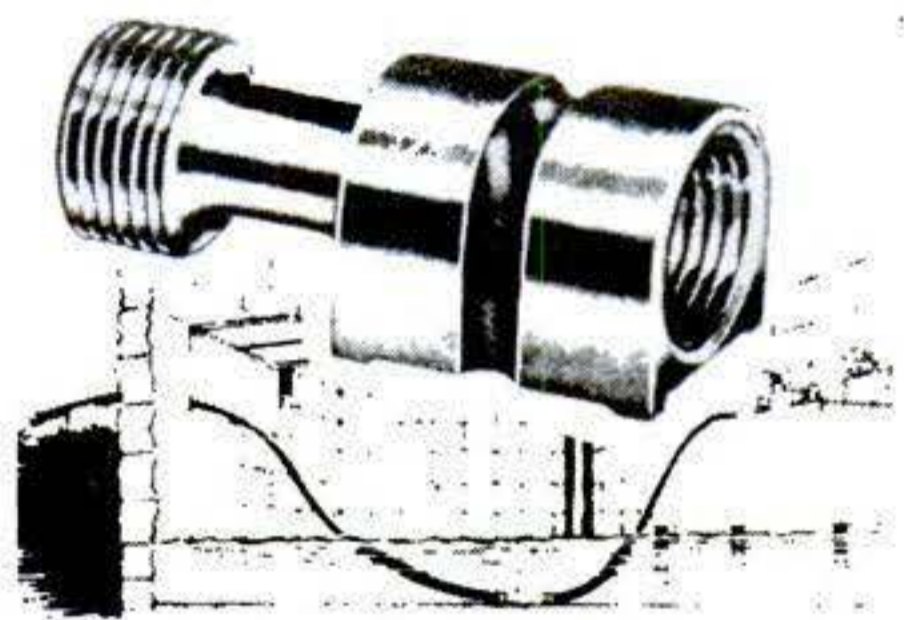
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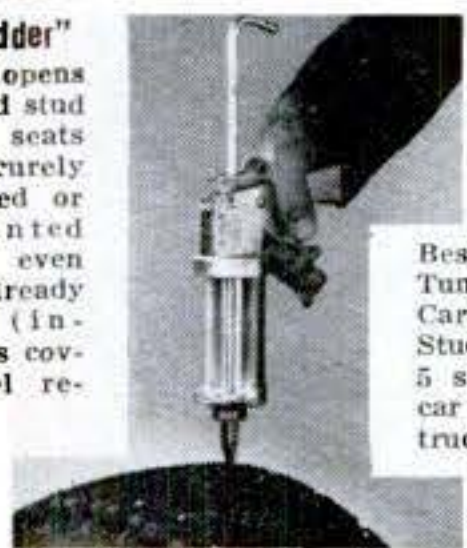
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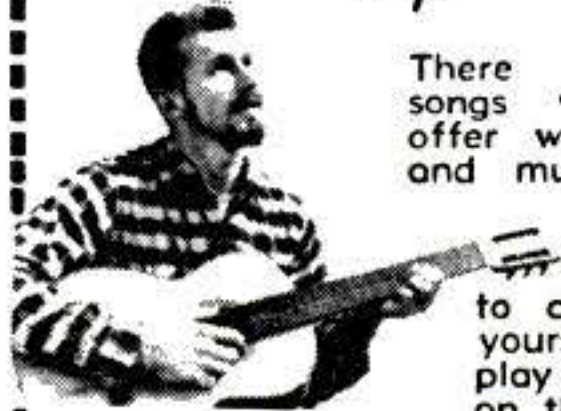
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WHISKEY, beer, winemaking, instructions \$1.00. 5410 Brighton, Ft. Wayne, Ind.

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106 PERSONAL

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PUBLISH Own Poetry Books. 100, \$25.00. 25c for complete information, sample, Henricks, P.O. Box 2127, Birmingham, Alabama 35301.

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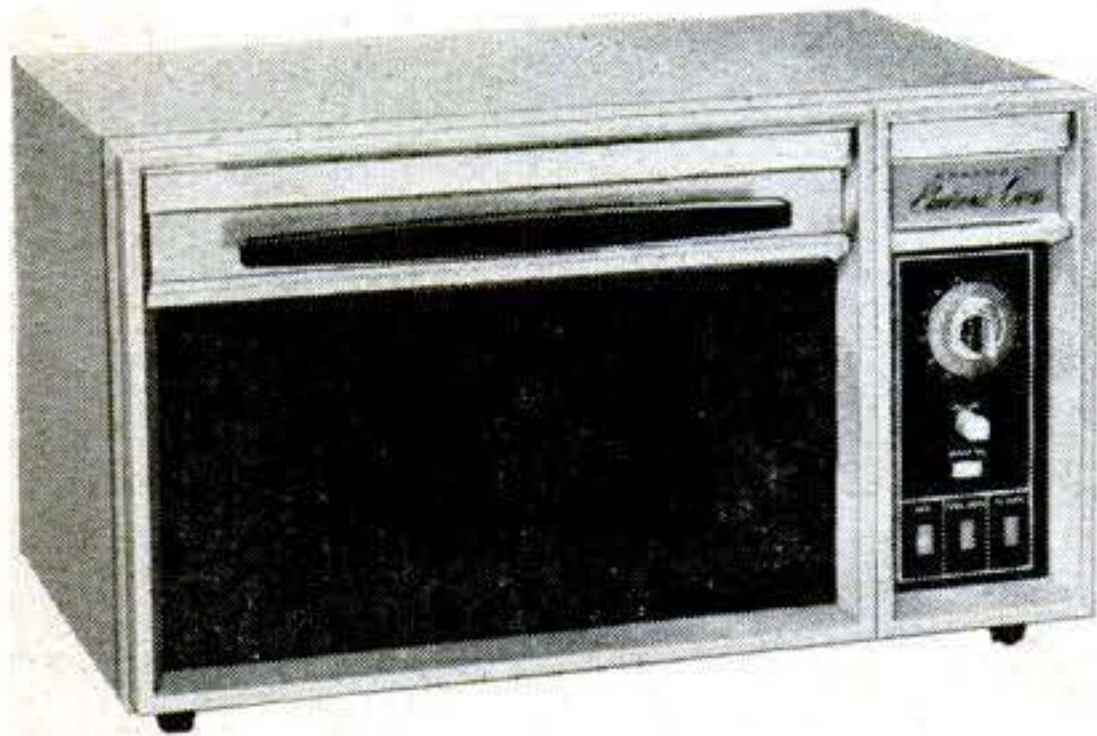
BALDING? Read "Hair Styling And Proper Care of Hair and Scalp". Copyright 1970. \$1.00. Books D3, R3 Box 49, Plaistow, New Hampshire 03865.

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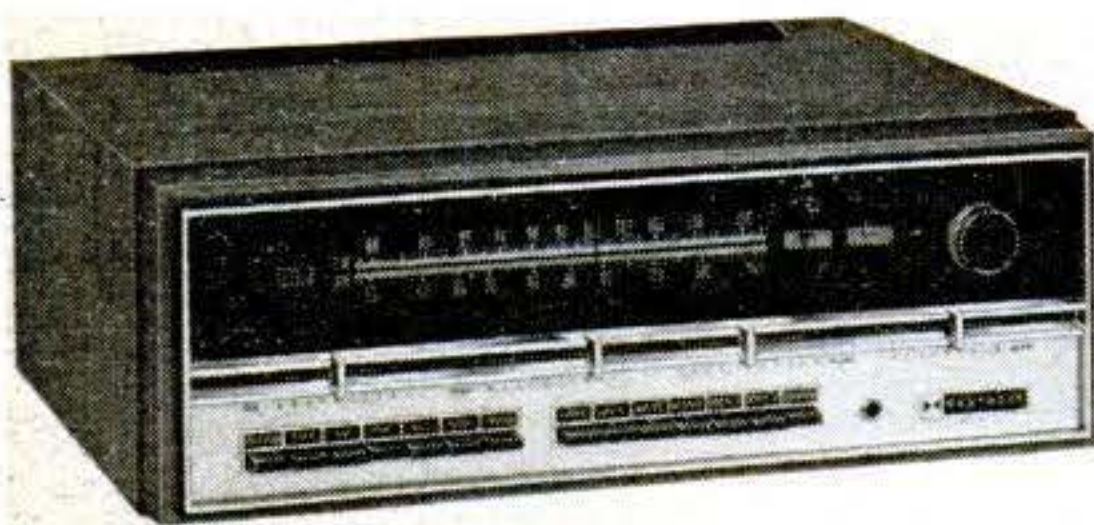
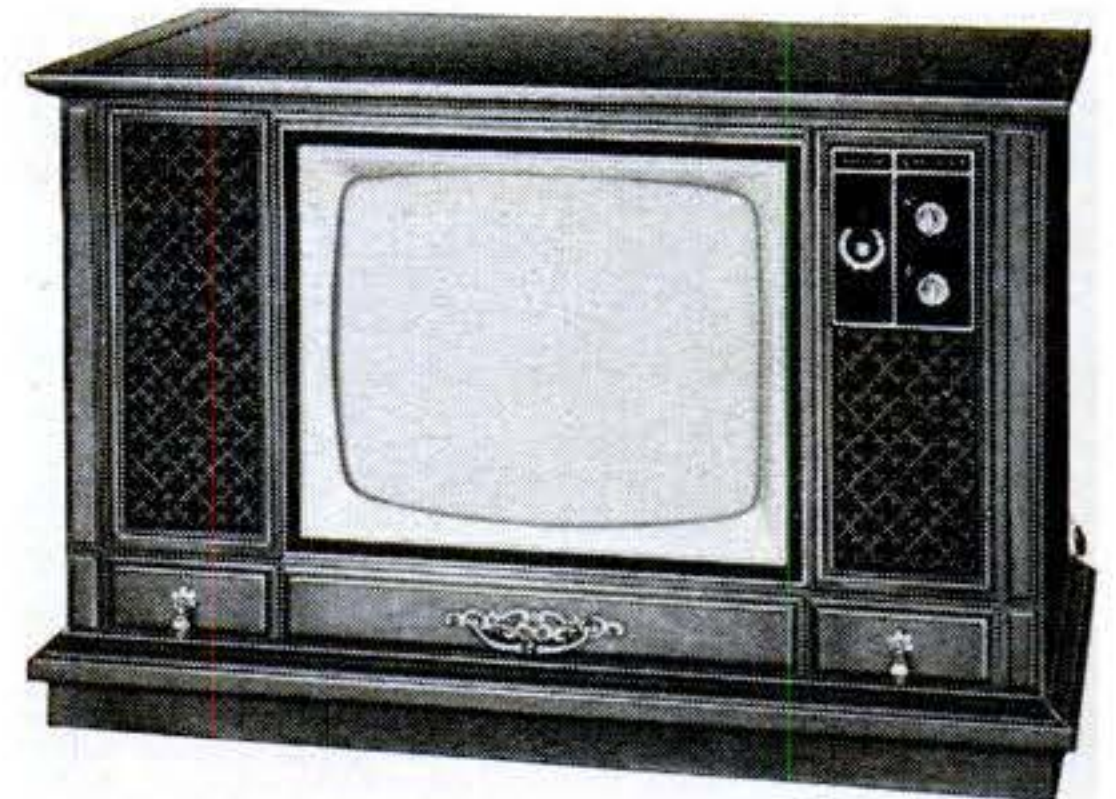


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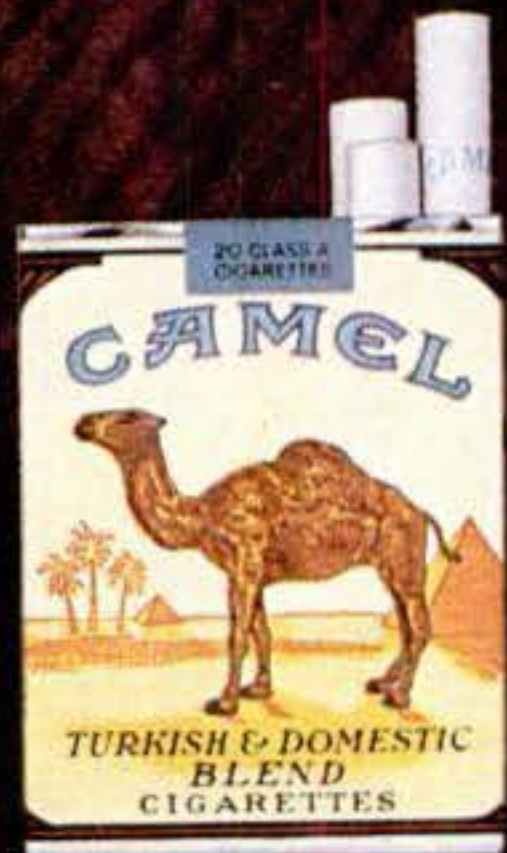
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