

APRIL 1980 \$1.50

Popular Science®

The **What's New** magazine

CAR-CARE NEWS

Finish protectors •
Electronic-ignition
checkout • Corrosion-
resistance systems •
Federal tire standards •
Tuning for max mileage



Wrong- way wings

give new agility to
supersonic planes



Café 7 classy coffee

Café 7 will impress the most sophisticated tastes. Just add 1½ oz. of Seagram's 7 to a cup of your favorite coffee. Add sugar to taste and top with whipped cream. Now that's classy coffee. Enjoy our quality in moderation.

Seagram's 7 Crown
Where quality drinks begin.



NEW PRODUCT

Sports Radar^{T.M.}



Here's how an exciting new micro-electronic breakthrough will make your children heroes and improve your tennis game.

Just point the gun and read the results.

When Roger started pitching for his little league team, he was just another player. And his arm was no better than anybody else's.

Two months later a small miracle took place. Roger was the best pitcher on the team and had a fast ball that was the most powerful in his league—and all thanks to his father.

Roger's success came from a radar gun—the same type device used by police to catch speeding motorists.

SCRAMBLED EGGS

The minute Roger's father was able to clock his son's pitching speed, Roger was subconsciously given a daily challenge of pitching harder and faster to beat his previous speed. The more he practiced, the better he got.

Roger's father paid \$2,000 for the radar gun. But in his upper class neighborhood, it wasn't too unusual for a father to spend that kind of money to help his son.

SPEEDING CITATION

A large manufacturer of radar-type security devices saw what Roger's father had done and felt that there was a definite need to produce a low cost radar unit designed exclusively for the sports market.

The company, Solfan Systems, developed the Sports Radar gun—a major breakthrough in projectile speed detection as well as electronic radar circuitry.

Using the doppler effect of radar and phased-lock-loop circuits, Solfan has developed the Sports Radar gun that compares to even the most sophisticated of police radar units that cost \$2,000.

OVERLAND EXPRESS

The Sports Radar gun is held in your hand and pointed toward the pitcher. You turn it on, press the ready button, and point the gun. The gun will ignore the moving arm of the pitcher but will lock in on the moving ball. The radar unit would then follow the ball for approximately ten milliseconds and the built in computer measures and computes the speed and flashes the reading on the display. The gun registers the speed to the exact mileage within one-half miles per hour.

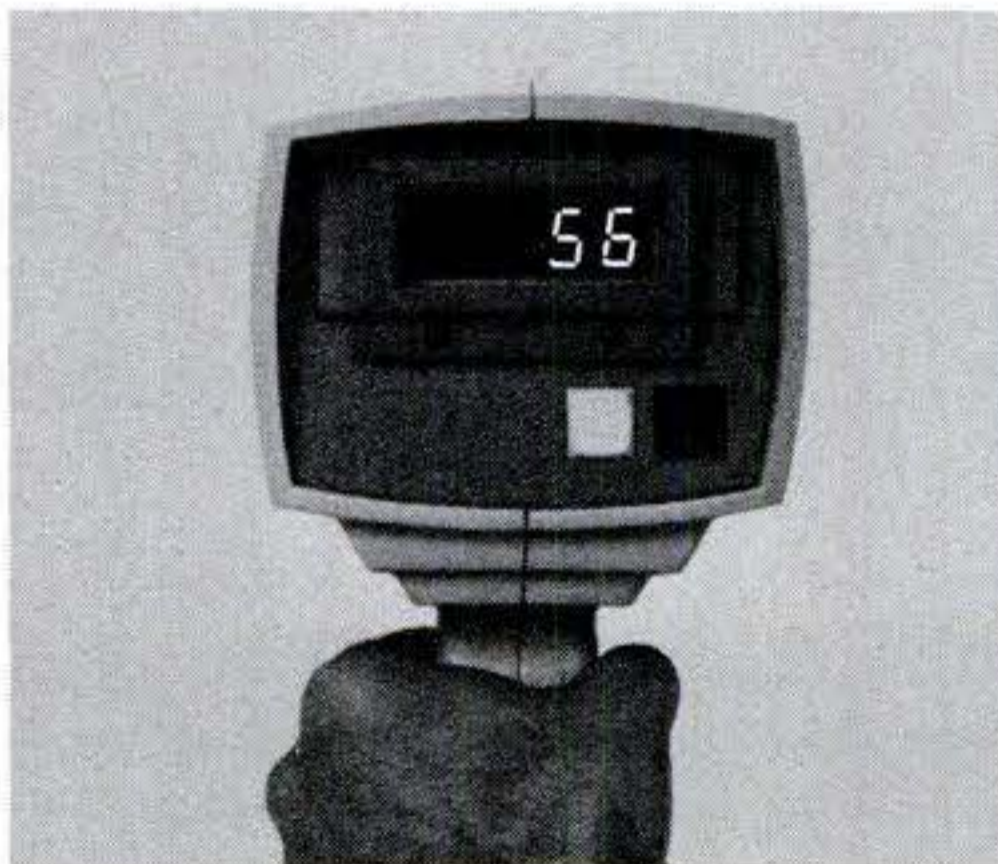
The gun can be mounted on a tripod so that the person taking the measurements can also catch the ball.

In tennis, the speed of the serve can be measured by aiming the gun at the person serving. You can also use the unit by yourself by setting the unit on a tripod and measuring the speed from behind.

WORKING AND PLAYING

Aside from its extreme accuracy and advanced electronics, the unit is priced to meet the budget of every sports-minded athlete or parent. It's only \$149.95 complete.

You can measure the speed of baseballs, soccer balls, tennis balls, golf balls, hockey pucks, downhill skiers, radio controlled model airplanes or anything that moves—even automobiles.



The speed is flashed on the large LED display and is shown in miles per hour.

The unit accepts two commercially available 6-volt lantern batteries which you can purchase locally or from JS&A for only \$2 each. The batteries will last for weeks with normal use.

SUCCESS AND GOOD THINGS

The unit comes in a sports blue color and weighs 38.4 ounces, exclusive of batteries. It's rugged, well built and designed to endure the typical use and abuse it would normally receive.

We urge you to test this exciting new product during our 30-day free trial. Order the Sports Radar gun. When you receive it, measure your child's pitching speed. Test it on your own tennis serve. See how knowing your speed will actually improve it as you try to out perform your previous record fast pitch or serve. Then decide if the Sports Radar gun doesn't make a very exciting addition to your sports equipment.

ONE FOR THE MONEY

If you are not convinced that the Sports Radar gun is something that you'll use constantly to help improve your game, return it for a prompt and courteous refund, including your \$3.50 postage and handling. You can't lose—and chances are your son will at least have the most popular new product in the neighborhood.

To order one for your test, simply send your check for \$149.95 plus \$3.50 for postage and handling to JS&A Group, Inc., at the address shown below. (Illinois residents please add 5% sales tax.) Credit card buyers may call our toll-free number below. If you wish to buy a set of two six-volt batteries, simply add \$4.00 to your order.

We'll then send your unit, the batteries (if you order them from us), a 90-day limited warranty and complete easy-to-understand instructions.

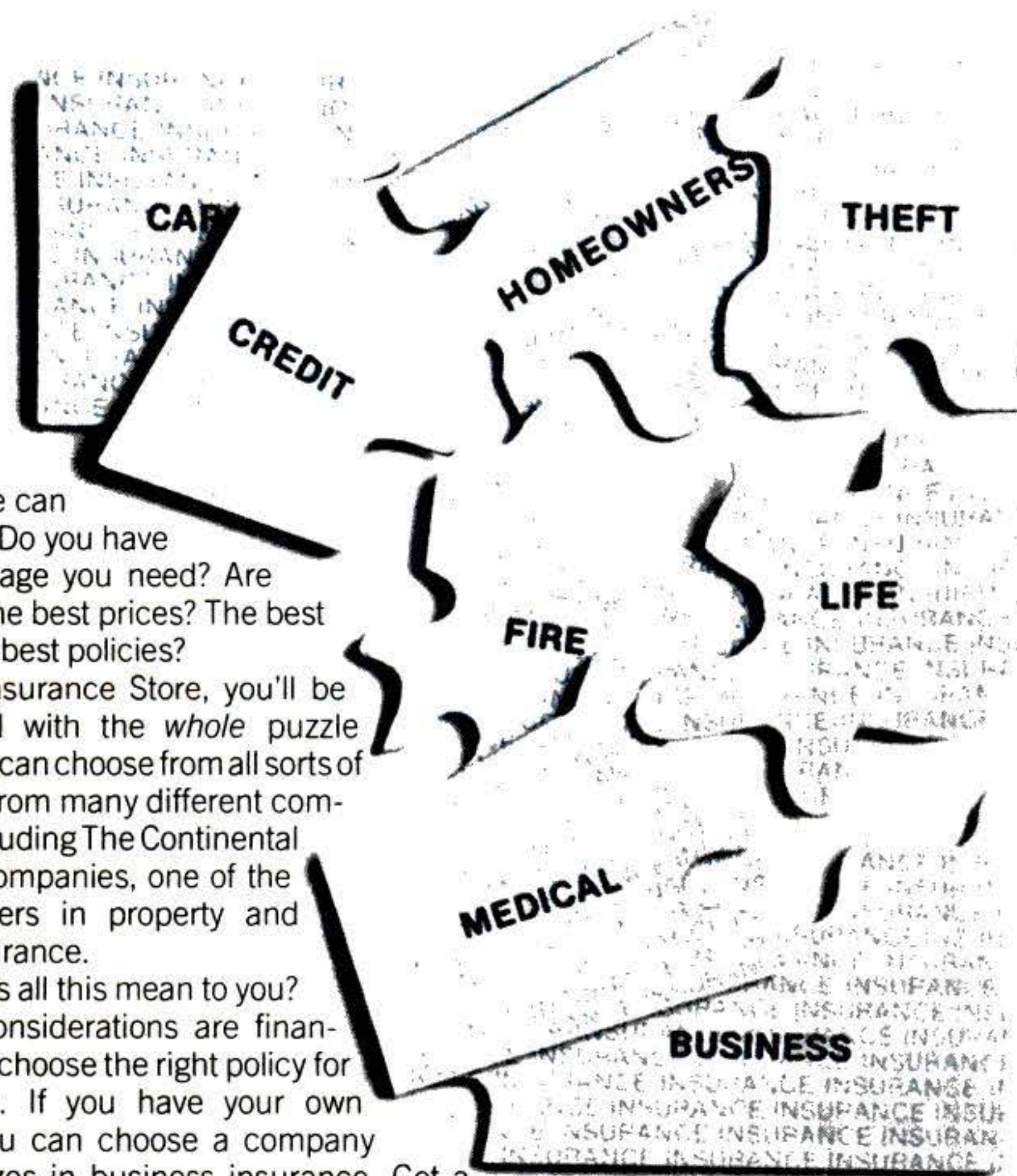
Radar electronics for the sports enthusiast is now a reality. Watch your game improve by ordering your Sports Radar gun at no obligation, today.

JS&A PRODUCTS
THAT THINK[®]

Dept. PS One JS&A Plaza
Northbrook, Ill. 60062 (312) 564-7000
Call TOLL-FREE 800 323-6400
In Illinois Call (312) 564-7000

© JS&A Group, Inc., 1979

GET THE COMPLETE PICTURE. IT'S EASIER AT THE INSURANCE STORE.



Insurance can be puzzling. Do you have all the coverage you need? Are you getting the best prices? The best service? The best policies?

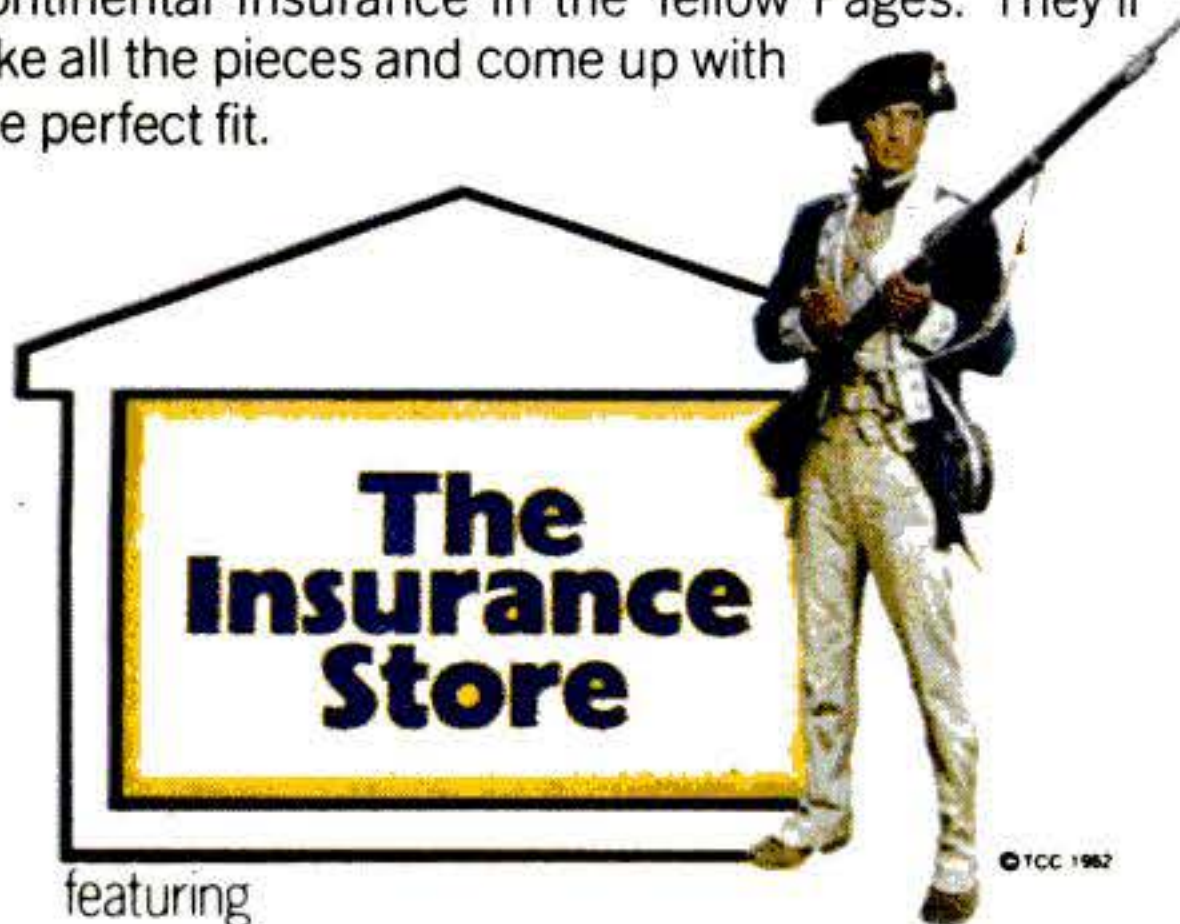
At The Insurance Store, you'll be able to deal with the *whole* puzzle because you can choose from all sorts of insurance. From many different companies—including The Continental Insurance Companies, one of the world's leaders in property and casualty insurance.

What does all this mean to you?

If your considerations are financial, you can choose the right policy for your budget. If you have your own business, you can choose a company that specializes in business insurance. Got a boat? Choose the right boat policy. A plane? Choose your aviation insurance. Plus a whole range of policies for your home, life, car. It's all under one roof, sold to you by an independent agent.

You can't get that at State Farm because they sell only State Farm insurance. Same thing at an Allstate desk, or any other one-company operation.

So if you're looking for an easy way to solve the insurance puzzle, just call any agent listed under Continental Insurance in the Yellow Pages. They'll take all the pieces and come up with the perfect fit.



featuring

Continental Insurance

From The Continental Insurance Companies, subsidiaries of The Continental Corporation

Popular Science

Editor-in-Chief Hubert P. Lockett
Editor C. P. Gilmore
Executive Editor Everett H. Ortner
Art Director W. David Houser
Copy Chief David D. Vigren

GROUP EDITORS

Arthur Fisher *Science & Engineering*
Herbert Shuldiner *Consumer Information*
Alfred W. Lees *Reader Activities*

SENIOR EDITORS

Jim Dunne *Automotive*
John Free *Technology*
William J. Hawkins *Electronics*
E. F. Lindsley *Engineering*
Richard L. Stepler *Home & Shop*

ASSOCIATE EDITORS

Paul Bolon, Ray Hill, Edwin C. Jacobs (*Automotive*),
Susan Renner-Smith, V. Elairfe Smay

Copy Editors: Alice Garrard, Daniel J. Ruby

Art Editors: John F. Crowley, Richard J. Meyer

Art Associate: Hugo Salhuana

West Coast Editor: Jim Schefter

Southeast Editor: Evan Powell

European Editor: David Scott

Editorial Assistants: Jane M. Kleintob (Chief),

Harriet Brown, Eleanor Freebern,

Kathleen Murphy Lord, Edward Moslander

Senior Production Manager: Henry W. Kazmirowski

Business Manager: Anna Dallas

ADDRESS EDITORIAL MAIL to

Popular Science Editorial Dept.
380 Madison Ave., New York, N.Y. 10017

We cannot be responsible for loss of unsolicited queries, manuscripts, or photos. They will not be returned unless accompanied by return postage. We welcome readers' comments, but regret that the volume of mail does not permit us to answer each letter individually.

CONSULTING EDITORS

Jim Schefter, *Space*

Edwin A. Link, *Oceans*

Jan P. Norbye, *Automobiles*

A. J. Hand, *Photography*

Smokey Yunick, *Auto Mechanics*

Jackson Hand, *Home Improvement*

Robert Gannon, *Adventure*

Phil McCafferty, *Projects*

R. J. De Cristoforo, *Tools & Techniques*

Richard Day, *Home & Shop*

Ben Kocivar, *Flying*

Paul Wahl, *Guns*

Robert Black, *Boating*

F. X. WILKINSON *Vice-President, Publisher*

FRANK MARSHALL *Advertising Manager*

MILTON J. NORCROSS *Circulation Manager*

Published monthly by
TIMES MIRROR MAGAZINES, INC.,
380 Madison Avenue, New York, N.Y. 10017
A Times Mirror Company

ISSN 0161-7370

MATTHEW T. BIRMINGHAM JR.

Chairman of the Board

JOHN A. SCOTT *President*

GORDON B. HALL JR. *Senior V.P.*

ARTHUR H. LOOMIS, *Vice President*

HUBERT P. LUCKETT *Editorial Director*

ADELE BOWERS *V.P. Book Division*

PETER CALVO *V.P. Production*

ROBERT D. COLE *V.P. Circulation*

THOMAS J. GARRISON *Treasurer*

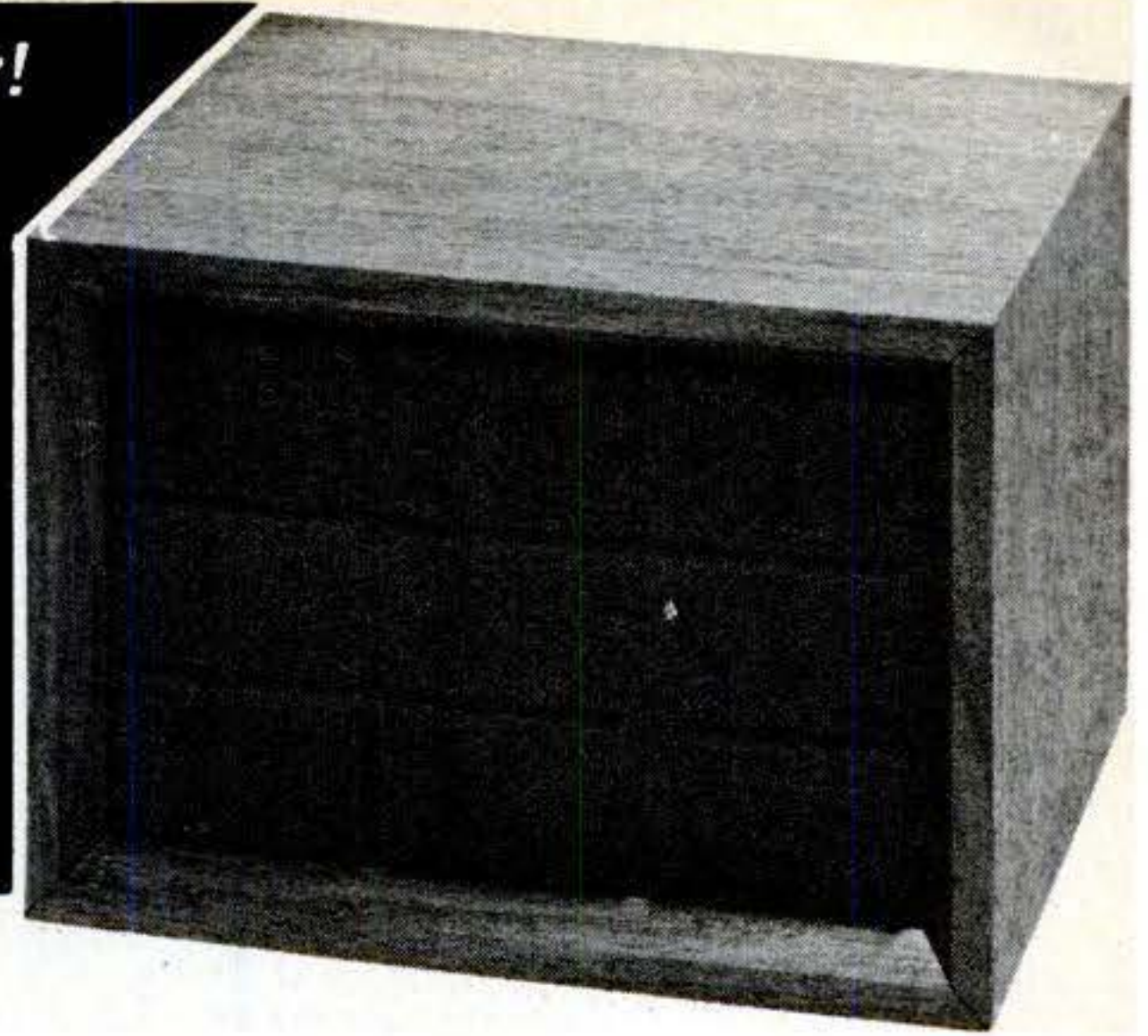
Not Just Another Limited Area Motion Detector!

guardex™

Protects Every Square Inch Of Your Building

Turns On Lights Automatically

Powerful Electronic Siren



Low Cost Computerized Burglar Alarm System Home - Office - Business

The Guardex 8000 Alarm System is walnut grained and disguised to look like a small stereo speaker (6³/₄" x 9³/₄" x 8") and weighs less than 6¹/₂ pounds.

NO INSTALLATION

Just plug the Guardex 8000 alarm system in, make several simple control adjustments to suit your particular building and it works! There are no other wires to run. This totally self-contained burglar alarm can completely seal off every square inch of the surface of your building. It protects doors, windows, and what most alarms miss... your roof, walls and floors.

HOW CAN ONE SMALL COMPUTER PROTECT MY WHOLE BUILDING?

Guardex 8000 Alarm System works on the principle of audio discrimination. This, put simply, is the process of electronically separating normal everyday sounds, such as voices, telephones, etc. from break-in type noises such as breaking glass, prying metal, or forcing a door open. The Guardex 8000 protects one story homes and offices up to 2000 square feet and open commercial buildings up to 10,000 square feet. The Guardex 9300 with wireless remote sensor capability is available for multi-story homes and offices or single story with more than 2000 square feet. Call the factory for more detailed information.

URNS ON LIGHTS AUTOMATICALLY

When the first break-in type sound is detected, the system will instantly turn on lights, radio, or other electronic equipment that you have plugged into the back of the alarm. These lights or other equipment will remain on for a period of five minutes, then automatically turn off.

POWERFUL ELECTRONIC SIREN

The Guardex 8000 alarm is equipped with a loud built-in siren. If during the five minute period the lights or other electronic equipment has been activated, a second break-in sound is detected, (it can be only a second or two after the first break-in sound) the built-in siren will start blasting for 90 seconds. At the end of approximately 90 seconds the siren will shut off and the alarm listens again. If another break-in sound is heard, the siren will come on for another 90 seconds. If no other break-in sound is detected, the siren will stay off and at the end of the five minute period the lights will shut off and the alarm instantly resets.



The rear control panel contains two standard AC plug receptacles for a table lamp, spot lights, radio, etc.; terminals for connecting optional outside siren and back-up battery (not included); entry delay time control and sensitivity control.

EXIT AND ENTRY DELAY

The Guardex 8000 alarm has a built-in exit delay allowing you approximately one minute to lock up and leave the building before the alarm is armed. When you enter your building you may find that just your normal entering sounds activate the siren. You may delay it from starting for up to 30 seconds by turning up the siren entry delay control.

BATTERY BACK-UP

Burglars rarely cut power. However, to give you total protection from a burglar and possible power failure, our alarm has provisions for a battery back-up. (Batteries not included). 12 volt lantern batteries are available at most hardware stores.

THE BURGLARY PROBLEM

The F.B.I. statistics show that at the present rate, one out of every four Americans are going to be burglarized. That is not a very pleasant fact, but it is true. You have a greater chance of being burglarized than being a victim of a fire or automobile accident. The time is now to help protect yourself and your valuables with a Guardex 8000 alarm system.

OUTSIDE SIREN

The Guardex 8000 alarm is equipped with a loud, built-in siren, but if you desire an additional siren to mount outside or in an area away from the main alarm, they are available with 50 feet of wire for \$24.95. (Connecting terminals are provided on the back of the alarm).

30 DAY NO RISK TRIAL

This is your opportunity to purchase an alarm system directly from the factory for only \$199.95. Try it in your home or business for thirty days without risking one cent. Put our Guardex 8000 alarm to your own test. See for yourself! It will protect every window and door from break-in. If you are not completely satisfied, return the alarm within 30 days for a complete refund. To order your Guardex 8000 alarm, CALL TOLL FREE to charge your credit card or send your check to Guardian Electronics, Inc. in the amount of \$199.95. If you want the optional outside siren, add \$24.94. (California residents add 6% sales tax.)

(If you require more information, call during California business hours, Monday - Friday)



Dealer Inquiries Invited

CALL TOLL FREE
(800) 423-5499 Ext. 80

California residents:
(213) 889-1414 collect.

GE GUARDIAN ELECTRONICS, INC.

31133 Via Colinas, Dept. PS.

Westlake Village, Calif. 91361

Copyrighted material

Popular Science

APRIL 1980
Founded in 1872/Vol. 216, No. 4

MONTHLY®

The **What's New** magazine

HIGHLIGHTS OF THIS ISSUE

Wrong-way wings for supersonic planes

They may look strange, but front-swept wings give better agility, control. PAGE 72

A liberated house that lives off sun and earth

This mobile, self-contained dwelling unites dozens of energy ideas PAGE 84

Car-care news: special section

Grading tires . . . fighting rust . . . tuning for max mpg . . . more. STARTS PAGE 109

Meteorites—how science reads them

Preserved in Antarctic ice, they're a bonanza from distant space and time. PAGE 78

Shuttle setbacks challenge engineers' ingenuity

Compared with getting the Orbiter flying, going to the moon was easy. PAGE 20

COVER PAINTING BY CRAIG KAVAFES

CARS AND DRIVING

PS car test: full-size cars for a big family or a heavy load	38
Big little auto for '81: Chrysler's K-car	88
How road materials affect tire-tread life	140
1980 BMW's	165

ENERGY NEWS

Energy adventure: concentrating collectors in Albuquerque	32
New, energy-saving heat-pump water heater	49
The liberated house rolls anywhere, lives off sun and earth.	84

SPACE AND AVIATION

Shuttle setbacks challenge engineers' ingenuity	20
Wrong-way wings aid agility of supersonic planes	72
Meteorites—how science reads them for clues to solar-system birth	78

NEW TECHNOLOGY

Hydrobus, gyrobus use brake-generated energy	76
--	----

CAR-CARE NEWS: SPECIAL SECTION

Car sparkle: PS guide to waxes, sealants, and cleaners	111
You can trouble-shoot your car's electronic ignition	116
How commercially applied sprays fight car rust	121
At last, federal standards for grading tire quality	125
Tune your car for max mpg	132

OUTDOOR RECREATION

Utility hauling? Do it with your boat trailer	104
Landsailer for the '80's	106
25-mph prairie schooner	108
Gas-operated pistol	148
Make an I/O flushing adapter	189

What's New DIGEST

Largest infrared telescope	94
Super blades	95
Weather bird	96
What's new in boating	97
What's new in tools	98
What's new in home improvement	99
What's new for your car	100
What's new in electronics	101

HOME AND YARD

Pruning a problem branch	10
Make a file for your negatives	61
Stepped-floors contemporary home	83
Vises that grip your work better	91
Rigid asphalt roofing: Corrugated panels need no underlayment	102

NEW PRODUCTS AND INVENTIONS

Motion converter—one-way power from two-way input	58
Giant muffler for jet engines	61
Gas grill that beats the grease	64

REGULAR FEATURES

PS readers talk back	8
Science newsfront	15
Through the viewfinder	62
New ideas from the inventors	67
Detroit report	68
PS/What's news	71
Taking care of your car	142
Motorcycling	144
Wordless workshop	154
Shop talk	156
Housepower clinic	162
"Say, Smokey—"	176
PS readers' product information	185

EDITORIAL OFFICES 380 Madison Avenue, New York, N.Y. 10017

Published monthly by TIMES MIRROR MAGAZINES, INC., 380 Madison Avenue, New York, N.Y. 10017

SUBSCRIPTION SERVICE (Only mail regarding subscriptions should be sent to Boulder, Colo., address below). *New or Renewal Orders:* Send to: Popular Science Subscription Department, Boulder, Colo. 80302. One year \$9.94, 2 years \$15, 3 years \$20 in U.S. and its possessions. One year \$13.94, 2 years \$20, 3 years \$28 in Canada and elsewhere. Single copy \$1.50. *Subscription orders processed electronically. All subscription adjustments:* Write to Robert Harlan, Popular Science, P. O. Box 2871, Boulder, Colo. 80302. For change of address allow eight weeks; please give both old and new addresses. Notices of undelivered copies (Form 3579) to Mr. Harlan. Controlled-circulation postage paid at Effing-

ham and Salem, Ill. Publication number 493730. Popular Science is entered as second-class matter at the P.O. Dept., Canada. Microfilm editions are available from University Microfilms, Ann Arbor, Mich. 48106. ADVERTISING OFFICES New York: 380 Madison Ave. (10017), Tel. 212-687-3000; Chicago: 875 N. Michigan Ave. (60611), Tel. 312-337-7717; Detroit: 19075 W. 10 Mile Rd., Southfield, Mich. (48075), Tel. 313-352-8333; Los Angeles (Pacific West Coast): 3550 Wilshire Blvd., Suite 908 (90005). Tel. 213-380-1936. *Mechanics and Handicraft* ® Popular Science ® Copyright © 1980 by Times Mirror Magazines, Inc. All rights reserved. Printed in U.S.A.

INCREDIBLE CASSETTE OFFER!



a \$5 LCD digital WATCH

Try 10 DAK high energy cassettes risk free for only \$2.19 each and get a beautiful \$69 value LCD digital watch for only \$5.

It's your choice. Think about the kind of music you like. You don't want to think about cassettes jamming, loss of high frequency response or tape hiss.

DAK manufactures a cassette that you can really forget about. Great sound, and no problems. And, for only \$5 we hope you will think a lot about your new LCD digital quartz watch.

YOUR TIME IS PRECIOUS

Imagine yourself just finishing recording the second side of a 90 minute cassette and horrors, the cassette jams. Tape is wound around the capstan, your recorder may be damaged and you've just wasted 90 minutes of your time and perhaps lost a great recording off FM.

Enter DAK. We manufacture over one million units of cassette tape each month in our North Hollywood factory. Many of our tapes are used for high speed duplication where they are recorded at speeds up to 8 times normal. This is the ultimate stress for cassettes and causes more failures than any other use.

MOLYSULFIDE

We developed polyester slip sheets with raised spring loaded ridges to guide each layer of tape as it winds. We coat them with a unique formulation of Graphite and a new chemical, molysulfide.

Molysulfide reduces friction several times better than graphite and allows the tape to move more freely within the cassette. The molysulfide is tougher and makes the liner more resistant to wear. Evidently 3M and TDK were hot on our heels, because they have now also come out with new liners.

Hi frequency protection! Tape is basically plastic, and as it moves within the cassette friction causes the build up of static electricity, much as rubbing a balloon against your hair, or scuffing your shoes on a carpet in dry weather.

Static electricity within the cassette is drastically reduced by the low friction of the molysulfide so that its tendency to erase very high frequencies is drastically reduced. A very important consideration for often played tapes.

MAXELL IS BETTER

Yes, honestly, if you own a \$1000 cassette deck like a Nakamichi, the frequency responses of Maxell UDXL or TDK SA are superior and you just might be able to hear the difference.

DAK ML has a frequency response that is flat from 40cps to 14,500cps

±3db Virtually all cassette recorders priced under \$600 are flat ±3db from 40cps to about 12,500cps, so we have over 2000cps to spare, and you'll probably never notice the difference.

No apology. We feel that we have equaled or exceeded the mechanical reliability of virtually all cassettes and offer one of the best frequency responses in the industry. Maxell UDXL is truly the Rolls Royce of the industry, and DAK is comparable to the 100% US made Cadillac or Corvette!

Price DAK manufactures the tape we sell. You avoid paying the wholesaler and retailer profits. While Maxell UDXL 90s may sell for \$3.50 to \$4.50 each at retail, DAK ML90s sell factory direct to you for only \$2.19 each complete with deluxe boxes and index insert cards.



A \$5 LCD WATCH?

Of course not! This is an incredible offer. Countless stores throughout the country sell LCD quartz crystal watches like this for up to \$69.

This beautifully styled slim silvertone watch is loaded with features. LCD means that the time in hours and minutes always shows without having to push buttons. Push the button once, and you'll see the date in months and days, and push the button again and the watch shows seconds.

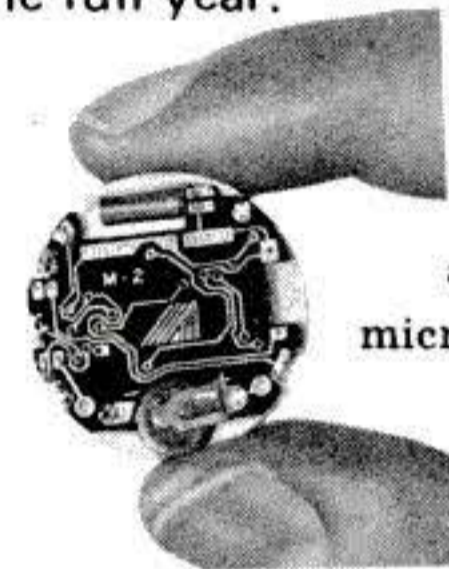
Night light. Usually only found in the most expensive watches. Simply push a button and the entire time section lights up for convenient night viewing.

Quartz crystal accuracy means constant time within 1 minute per month. Crystals use little electricity, so the battery should last up to a year, and may be easily changed by any jeweler.

Stainless steel band for long life and

comfort. No cheap imitation, a first rate locking adjustable band.

It's guaranteed. This fine watch comes with a manufacturer's limited warranty for one full year.



a rugged micro-computer

DAK TAKES A RISK

Obviously giving away quality watches is not going to make DAK rich. Even giving away cheap watches wouldn't help. We are betting that you will buy our cassettes again, and we are putting our money where our mouth is!

Customers like you are very valuable in the form of future business. We anticipate receiving over 6000 orders and 4500 repeat customers from this advertisement to add to our list of over 57,000 actives.

TRY DAK ML90 CASSETTES FREE

Try these high energy cassettes on your own recorder without obligation for 30 days. If you aren't 100% satisfied for any reason, simply return the tapes and the watch to DAK for a full refund.

To order your 10 DAK ML 90 minute high energy cassettes at \$2.19 each and the \$69 value watch with your credit card, simply call the toll free number below, or send your check for \$21.90 plus \$5 for the watch and \$3 for postage and handling for each group of 10 cassettes and each watch to DAK. (Calif. residents add 6% sales tax)

DAK unconditionally guarantees all DAK cassettes for one year against any defects in material or workmanship.

Why not order an extra group of 10 DAK ML90 cassettes for yourself or a friend? We will add one free ML90 cassette to each 10 you buy and of course you can buy one \$69 value watch for \$5 with each group you buy.

© DAK Industries, Inc., 1979



Call TOLL-FREE(800) 423-2636
In California Call(213) 984-1559
10845 Vanowen St., North Hollywood, CA 91605

Why did Bob Larkin buy the KZ440LTD with its 58mpg?

Because Bob always believes in going the distance.

When Bob swung a leg over the KZ440 LTD and settled down into the high-step, dual-density cruising seat, he knew he was on a winner. The pullback bars seemed to reach for his hands. And a tap on the electric starter brought the call of the road from dual mega-

phone mufflers. Who could resist? Its 443cc overhead cam engine with constant-velocity Mikuni carbs delivered plenty of torque, so he could accelerate quickly and cruise effortlessly. Bob liked the fact that it was Kawasaki-reliable. And he appreciated the advantages



of a silent cam chain with automatic tensioner. After all, there are better things to do on campus than to spend your free time working on a motorcycle.

When it came to handling, the KZ440 LTD exceeded his expectations. Precision-damped front forks and needle bearing swingarm gave him a real feeling of control and security. So did the drilled front disc brake. The fat rear tire provided lots of traction, and Bob sat down low with the center of gravity right under him. Riding it was a breeze — and sheer pleasure with a close friend on the back seat.

When you stop by your Kawasaki dealer to see the slick looking KZ440 LTD, be sure to see both the chain drive and belt drive models. You might even take a

look at the new KZ250 LTD. It's a little smaller, but it's got some big numbers going for it. For openers, how's 80.2* mpg grab you?



Kawasaki

Don't let the good times pass you by.



This One



9XXY-NKG-6KE8

Copyrighted material

PS READERS TALK BACK

Address letters for this column to: Readers Talk Back, 380 Madison Ave., New York, N.Y. 10017. Because of the large volume of mail, we are unable to acknowledge unpublished letters.

Meter or metre?

Your article by Pam Humphreys, "If Building Goes Metric" [Feb.], was excellent. It explained in a clear manner some of the interface problems that would confront builders and homeowners if we switch. The use of the millimetre for just about all length measurements will be good. Fractions and decimal points will just about be eliminated—what carpenter can split a millimetre with a saw?

One negative comment, however: I'm sure that if Miss Humphreys is from Canada, she did not use the *-er* spelling for metre and litre as you did. All other English-speaking countries spell these words with *-re* endings. This is the spelling recommended by the U.S. Metric Association and most U.S. technical organizations.

A meter is a measuring instrument. A metre is a unit of length. A nice distinction. Don't try to Americanize the spelling and start to deviate from an otherwise pure and standard system.

R.E. Meyers, P.E.
Pacifica, Calif.

U.S. Government agencies, most U.S. professional associations, such as SAE, and most reference books published in the U.S. use the -er endings. The U.S. Metric Association, Inc., strongly advocates the international English-language spelling -re.

For the present, PS follows the National Bureau of Standards style book, which stipulates the -er spelling.

3000+ mpg—and counting

The "1403-mpg car" in your January issue poses the question, "Next time—2000 mpg?" The answer appears on page 94 of the same issue: a picture of the present mileage champ, 2281.9 mpg, a three-wheeled vehicle built by a group of Daimler-Benz apprentices.

The British and German competitions, both sponsored by the Shell Oil Co., preceded the International Fuel Saving Competition for Cars and Special Vehicles held

in Switzerland. At this subsequent contest, the Daimler-Benz broke its own record, getting the equivalent of 3020 mpg.

Leo Levine, General Manager, PR Mercedes-Benz of North America, Inc.
Montvale, N.J.

What is the big deal about Shell's mileage contest for streamlined mopeds? It would seem more useful to encourage development of a high-mileage vehicle that could be used on the road.

Greg Laden, Albany, N.Y.

Railroad safety

Your article on "Railroad Safety" [Jan.] is very informative and well done, but the inset photo of the coupler with elongated knuckles (page 69) should be rotated 90 degrees to the right so that the air hose is hanging down.

I work for the Burlington Northern Railway in Canada, and in view of this it is reassuring to see that something is being done to protect lives and property from derailments.

K. A. Mitchell, Vancouver, B.C., Canada

Misplaced French Division

While reading "Saturn!" in the January issue I found a discrepancy I hope you can explain. The text (page 93) says the "French Division" occurs between the C and D rings of the planet, but the illustration shows it between the B and C rings.

John H. Wolf, Cincinnati, Ohio

The illustration is correct.

Double-shell houses

Your recent article on the "Double-Shell Solar House" [Dec. '79] was of particular interest to us, for we are building such a house in the Sierra Nevada Mountains near Lake Tahoe.

Tom Smith acted as our consultant. Our floor plan is an improvement over that of the Smith house. Ours is similar to the Leone house in that our stairs are in the solarium space. This design saves space. Further, we did not follow the Smith ceil-

ing-roof design. Our upper-floor ceiling is flat, giving us a large attic space. The functioning of this feature—and of the entire house—remains to be evaluated.

I should like to offer our house for monitoring and evaluation by Ralph Jones.

Robert L. Main, Citrus Heights, Calif.

In his article, author Ron Dans does not address a serious question: How will this structure behave when subjected to a fire? Fire, heat, smoke, and toxic gases travel in the same manner (convection, conduction, and radiation) as does the heat we seek to capture and conserve. It appears that a fire in the double-shell house could easily surround the occupants with heat, smoke, and fire, cutting off their escape. Using the open area for living space as pictured or for a passage for electric wiring further increases the hazard.

Safety equipment such as automatic fire and smoke dampers, along with a smoke-detection system, should be part of these houses.

Michael V. Zlogar, Amherst, Mass.

Heat reflector—disputed savings

The Viking heat reflector, shown in December's "What's New in Home Improvement," is claimed to "reduce heat loss through exterior walls by 80 percent." I found that hard to believe, so I did some rough calculations.

If the heat reflector were installed on an uninsulated wall (the best case for savings) it would reduce heat loss through conduction by only 11 percent. This reduction occurs only in the wall area covered by the 32-by-40-inch panel. The reduction in radiation heat loss involves a complicated analysis, but even without making that, it can be reasoned that less than half of the radiant energy emitted by the radiator will even fall on the reflector.

Eben Fodor, Mechanical Engineer
Institute for Local Self-Reliance
Washington, D.C.

R. L. Stepler replies: "According to Viking, about 25 percent of the heat given off by a radiator is lost through an uninsulated outside wall. If the wall is insulated, the loss is about 17 percent. Placing the Viking Heat Reflector between the wall and the radiator cuts these losses, not total losses, by 80 percent, says Viking."

Correction: In January's "Alternate Energy Answers," the wrong address was given for architect Malcolm Wells. To order his 88-page paperback, *Underground Designs*, send \$6 to the architect at P.O. Box 1149, Brewster, Mass. 02631. We apologize to readers whose letters have been delayed or returned.

POPULAR SCIENCE READER SERVICE Check below to report a change of address. Or to get more mail. Or less mail.

Name		
Address		
City	State	Zip Code

It helps if you attach your address label (or copy your name and address exactly as they appear on your label) in the space above.

- MOVING NOTICE. Put your old address at left, your new one at right. (Please give us six weeks' notice.)
- UNLISTING SERVICE. Check here if you don't want to receive mail from advertisers who use the POPULAR SCIENCE list. (Be sure to attach your label at left.)
- LISTING SERVICE. Check here if you're not a subscriber but want to receive mail from advertisers who use the POPULAR SCIENCE list. (Be sure to fill in your name and address at right.)

Name		
Address		
City	State	Zip Code

POPULAR SCIENCE, P.O. Box 2871,
Boulder, Colo. 80302.



Right to the finish, its Canadian spirit stands out from the ordinary. What keeps the flavor coming? Super lightness. Superb taste. If that's where you'd like to head, set your course for Lord Calvert Canadian.

The unique spirit of Canada:
We bottled it.



Rain Dance[®] lasts longer than any other leading car wax.

Water beading proves it.
DuPont guarantees it.

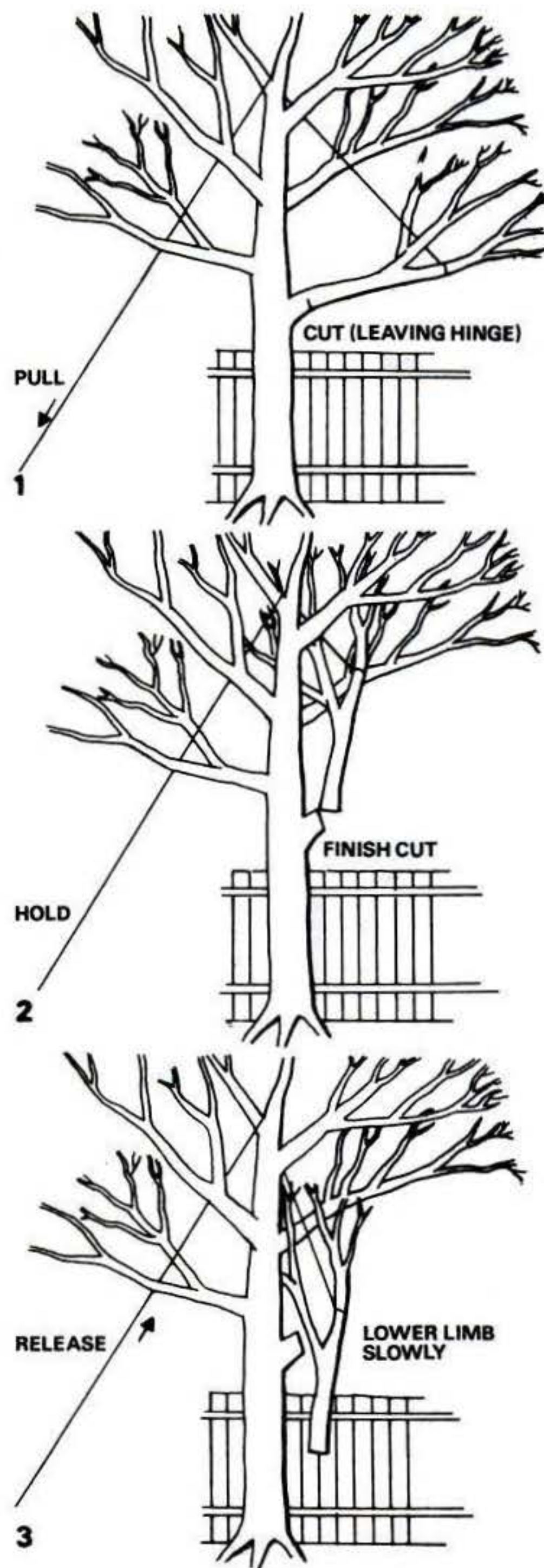
Rain Dance[®] is guaranteed to shine longer, to bead water longer, to last longer. It's the car wax with the watertight guarantee.

America's #1 Premium Wax



GUARANTEE: "RAIN DANCE" is guaranteed to keep on beading and shining longer than the leading liquid or paste waxes. If not completely satisfied, return unused portion to B-4233, DuPont Company, Wilmington, DE 19898, for full refund of actual purchase price and postage.

Pruning a problem branch



Lopping off a long, over-hanging branch doesn't have to be a job for a professional. Two people can do it with my method.

Pass a strong rope through a central point high in the tree. Tie one end around the branch to be cut (diagram 1), the other to a car bumper or winch.

While one person pulls steadily on the rope, the other cuts most of the way through the branch from its underside. When the branch is upright (diagram 2), cut the remaining section. Slowly lower the branch to the ground (diagram 3).—*John Haller*

DO-IT-YOURSELF SIDING!

Examples Of The Types Of Homes Which Can Be Covered With Home-Kits.



You can re-side your home yourself with one of our nationally advertised aluminum, vinyl or steel siding HOME-KITS... and then make as much as \$1000 per order by selling HOME-KITS to your friends and neighbors. Here's how it works. If you own a home which needs siding, you can become a part-time (or full-time) siding dealer for Aluminum Industries, America's largest mail-order siding distributor. To be eligible for a FREE dealership, you must apply one of our kits to your own home. Of course, you'll buy your kit at our wholesale dealer's cost, which is about 1/3 below the national average applied siding cost. Then, when your friends and neighbors see how beautiful your home is, you'll find it quite easy to sell them a HOME-KIT for their own homes. If you choose, you can make even more money by applying the kit for them.

Our HOME-KITS are composed of the finest aluminum, vinyl, or steel siding available, and once you've installed a kit on your home, you'll have the confidence to sell them. You'll be able to talk first-hand about how great these kits really are.

All materials necessary for a durable and professional looking job are included in our HOME-KITS. In addition to the siding panels themselves, you'll receive all of the accessories for the finishing touches... such as window trim, door trim and pre-shaped corner moldings... we even include the proper nails.

HOME-KITS are available in 14 sizes and in 22 colors. And your first kit comes with professional siding applicator's tools at no additional charge. Fill in the coupon below, or call us toll free at 1-800-643-9904 for a FREE ALUMINUM INDUSTRIES DEALERSHIP.

QUESTIONS AND ANSWERS ABOUT HOME-KITS

WHAT IS A HOME-KIT?

A HOME-KIT is a complete kit of either aluminum, steel, or vinyl siding for covering a frame home. The dealer's first kit consists of all the siding, accessories, and tools for covering a certain size home. HOME-KITS come in 14 different sizes. Complete installation instructions are included.

IS IT HARD TO APPLY ALUMINUM, STEEL, OR VINYL SIDING?

No. If you can drive a nail and cut on a straight line with tin snips, you can apply siding. Our instructions are very easy to follow.

WHAT ARE THE PRICES OF HOME-KITS?

Our wholesale dealer prices are about 1/3 the national applied price. If you would like to become one of our part-time dealers (or a full-time dealer) just fill out the coupon and mail it to us or call us toll-free at 1-800-643-9904. We will send you our CONFIDENTIAL DEALER'S MANUAL AND WHOLESALE PRICE LIST. We will not bother you with a personal visit. No salesman will call on you.

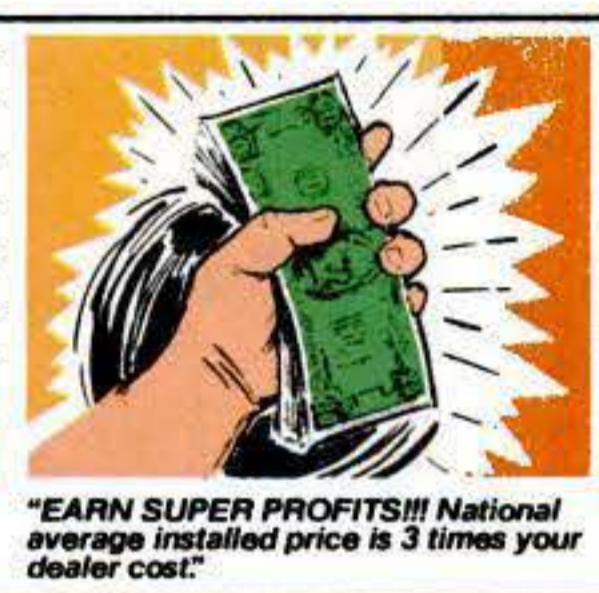
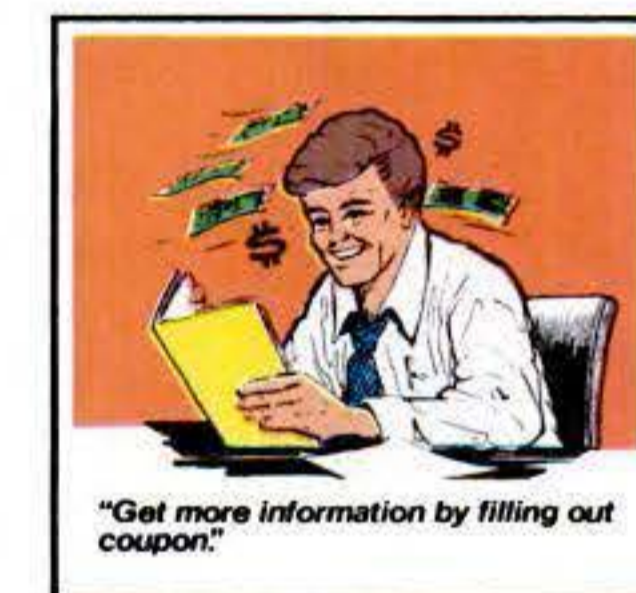
WHAT DO I HAVE TO DO TO BECOME A DEALER?

We require all our dealers to apply one HOME-KIT to their own home to qualify for a dealership.

You can work as a part-time or full-time siding dealer. Most of our dealers are part-time workers... they use the HOME-KIT as a method of supplementing their regular income.

CAN I BUY MY FIRST HOME-KIT ON TIME PAYMENTS?

Yes indeed... in fact most of our dealers buy their first HOME-KIT on either an FHA Home Improvement Loan Plan or with our special \$7.00 per week plan with no interest and no carrying charges.



HOW MUCH WILL I SAVE BY BUYING HOME-KITS?

Our HOME-KITS are priced to our dealers at about \$2,000.00 less than the national average applied price. You will be amazed at how inexpensively you will be able to buy a complete siding kit, including all accessories and all tools.

HOW DO I GET A DEALERSHIP?

If you own a home which is suitable for the application of siding, your first step is to mail in the coupon or call us toll-free at 1-800-643-9904. If we have an opening in your county for a part-time or a full-time dealer, we will let you know. There is no charge for a dealership except in the purchase of your first HOME-KIT. You are under no obligation by mailing the attached application.

WHAT WILL I GET WHEN I CALL OR MAIL IN MY DEALER APPLICATION COUPON?

We will promptly mail to you a CONFIDENTIAL DEALER'S MANUAL AND WHOLESALE PRICE LIST and free samples of the various types of siding we distribute. You will also receive a certificate that will tentatively "hold" a dealership for you in your county, if one is still available.

EARN UP TO \$1000 PER SALE



ALUMINUM INDUSTRIES OF ARKANSAS

300 Phillips Rd. North Little Rock, AR 72117

APPLICATION FOR DEALERSHIP Dept. [PS-40]

WITHOUT OBLIGATION, please mail me all of the materials mentioned above including my FREE 48-page CONFIDENTIAL DEALER'S MANUAL AND WHOLESALE PRICE LIST, DEALERSHIP, AND SAMPLES. I own a home which needs to be re-sided and I understand that I must purchase a HOME-KIT for my home before I can sell them to the public. NOTE: No salesman will knock on your door, we distribute exclusively by mail.

My name is: (please print) _____

I would like to be considered for a: Part-time Full-time dealership

STREET ADDRESS: _____

(The above address must be that of your home which you are considering re-siding.)

CITY _____ STATE _____ ZIP _____

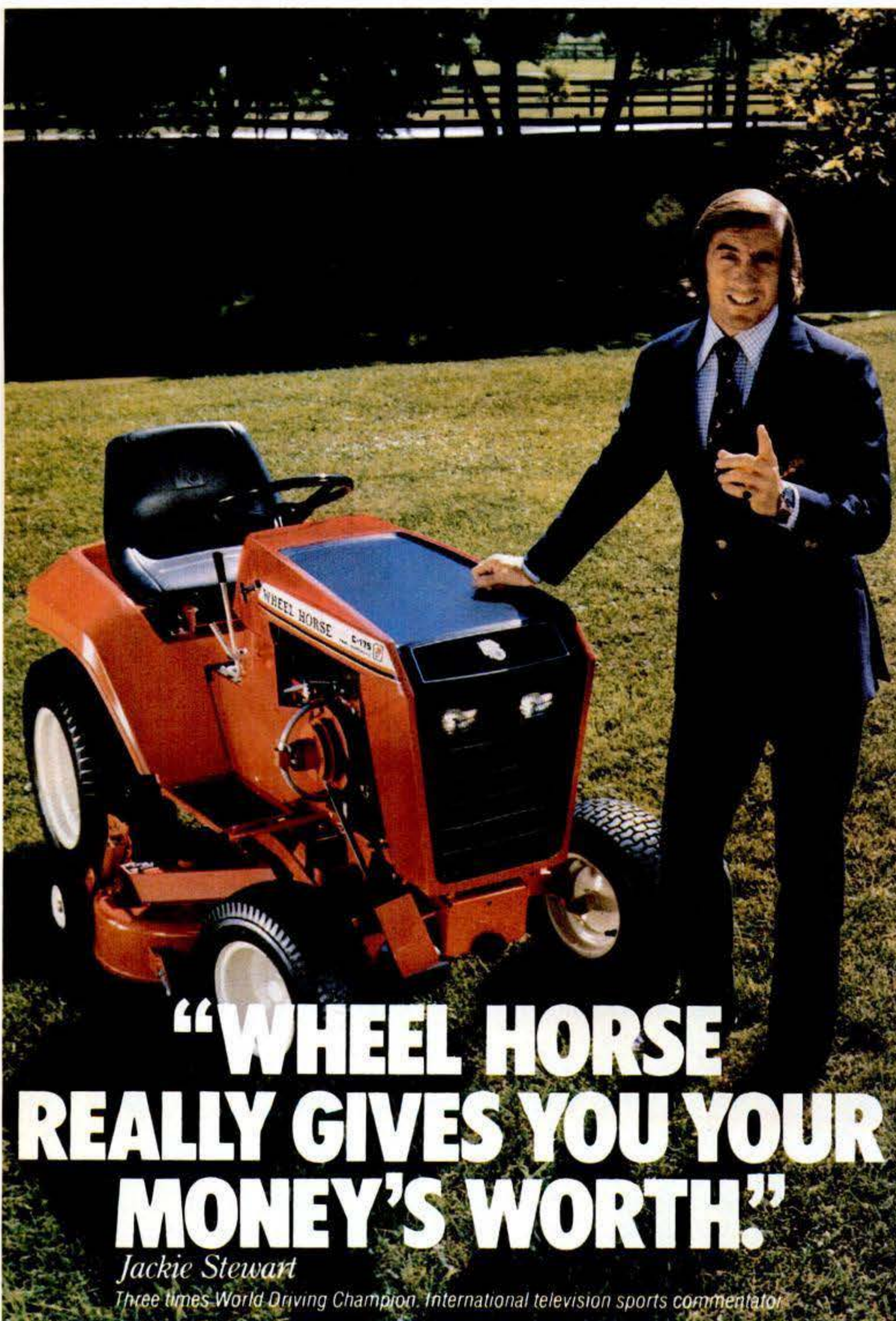
COUNTY _____

My phone number is: _____

SIGNATURE _____ DATE _____

Mail Coupon or Call Toll-Free 1-800-643-9904.

Copyrighted material



**“WHEEL HORSE
REALLY GIVES YOU YOUR
MONEY’S WORTH.”**

Jackie Stewart

Three times World Driving Champion, International television sports commentator

“There’s practically nothing you can’t do on one of these solidly engineered machines.

“Of course, a Wheel Horse will do quite an efficient job mowing the grass. But that’s only the beginning. You can also sweep, aerate, roll or landscape your lawn with a Wheel Horse. Remove snow. Even till your garden.

“Wheel Horse lawn and garden tractors are dependable and hardworking as well as versatile. With quality engineering details that put it way in front of the competition. An excellent value, really.

“And, believe me, value is something a Scotsman like me can appreciate. I think you will, too.”

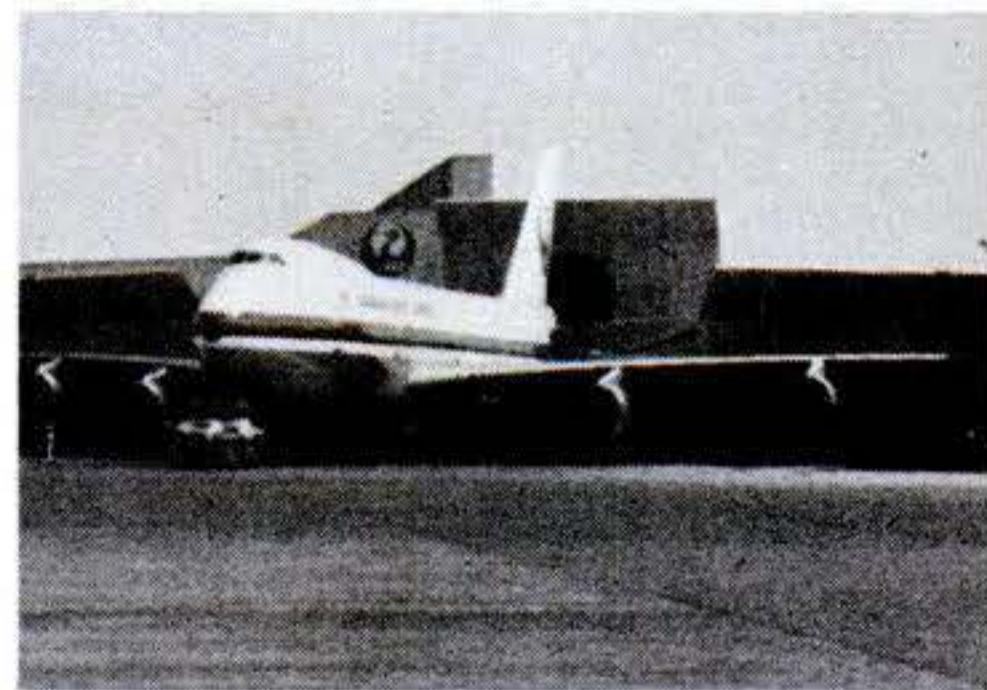
**“YOU CAN
DO IT ALL ON A**



Wheel Horse.”

515 West Ireland Road • South Bend, IN 46614

Giant muffler for jet engines



Backed up to the baffles of a noise-control system, a jet awaits an engine check. The system keeps jet noise from disturbing neighbors of Tokyo’s new airport.



Five separate mufflers (two on far right are hidden by the center screen) smother jet whine. The unit’s corn-cob-pipe shape serves to funnel excess noise upward.

Japan has the world’s toughest set of airport noise restrictions. To comply, the new Tokyo International Airport has imposed a ban on night flights. But Japan Airlines’ fleet must still undergo routine inspection and maintenance. And that means gunning the big jet engines, often for prolonged periods.

To stifle the resulting roar, the airline has installed a giant jet-engine muffler system. It’s so effective that engine checkout tests can be run all night.

The system features huge baffle mufflers that fit behind the engines of a plane backed up to the unit. The baffles not only blanket the noise but also redirect upward any noise the muffler doesn’t smother.

As a result, jet roar is reduced by 20 dB at 700 meters. This means that noise from engine tests falls well below the 60-dB maximum level Japan mandates for all points outside the airport borders.

The Swiss-designed system (there’s a similar one at Zurich Airport) has five mufflers. The center one is positioned high and back from the others (see photo) to match the high center engine on the tail of the DC-10. The four other mufflers are placed lower to accommodate the underwing engines of the 747’s and those on the DC-8’s.

—Ben Kocivar

The U.S. was founded by a group of individuals who rebelled against the oppressive policies of King George in England. Today, this same spirit of independence, a uniquely American phenomenon, underlies a growing displeasure with government tax and spending policies. This viewpoint is a healthy sign. Our society can remain the freest and most prosperous in the world if government power is held in check by us, the citizens who make up the country. Recent passage of laws (such as Proposition 13) are an indication of a growing wave of protest against wasted tax dollars. The effort is getting stronger and more vehement every day.

The largest tax each one of us pays is Federal Income Tax. Yet, the largest corporations and the wealthiest individuals often pay the least amount of tax. According to an article in a leading newsletter, 17 huge corporations paid no federal income tax in a recent year, although they had a world-wide income of \$2.5 billion. Numerous tax loopholes were used. The list includes United States Steel, Bethlehem Steel, Armco Steel, General Dynamics, Singer, Phelps Dodge, American Airlines, Philadelphia Electric and The Chase Manhattan Corporation. The burden caused by these non-taxpayers must be assumed by "somebody." "Somebody" is always the wage earner. There is, therefore, a major inequity under the law which favors the wealthy and, most especially, corporations. In America today we have what could be called a "Corporate Society."

Some individuals have become so upset with these startling inequities, they have stopped paying taxes and have in many cases even ceased to file tax returns. This approach, however, is fraught with danger and has resulted in stiff fines or prison sentences when the government locates and prosecutes the courageous individuals.

You Can Become Part of "The Corporate Society"

Rather than break the law and suffer serious consequences, there is a safer and more viable alternative. You can use the same type of smart thinking as those who own and control great wealth. The big corporations are not necessarily immoral. However, they do get the best advice available on tax matters.

You, as an individual, can now use all the tax loopholes for your own self interest. Thus, you legally gain the advantages yourself as do the huge corporations. Rather than break the law, you can use it to your advantage. Perhaps the best way to accomplish this, as well as reduce your tax burden is through incorporation, the legal form of tax rebellion.

Surprisingly enough, the government encourages incorporation with a number

Wage Your Own Personal Tax Revolt

Like the early pioneers who started this country, many people are rebelling against the near confiscatory taxation at all levels of government. The federal government consumes the taxpayer's cash at the rate of over \$800,000 per minute, and the amount that is wasted is scandalous. The citizens are mad as hell and they're not going to take it any more.

There is but one answer left!

of favorable laws, especially in the area of taxation. In fact, it is rare to find a successful individual who is not incorporated. Incorporation is favored by nearly all millionaires. It is one of the causes of wealth, not its effect. Think about it. Can you think of a single wealthy individual who doesn't own and control his own corporation? It is rare indeed. Let's face it, the first step toward achieving the American Dream in our corporate society is probably incorporation.

To add even more impetus to the idea of starting your own corporation, passage of the recent Revenue Act makes incorporation the ultimate tax shelter. This act and the earlier ones close the door to practically all other tax shelters and loopholes. The tax rate on corporations (especially smaller ones) has been substantially reduced, to as low as 17%.

Favorable laws such as the investment tax credit are most helpful when buying equipment. Even if you incur losses in one year you can deduct those losses over several profitable years.

More Advantages...

You can set up a corporate medical plan wherein you deduct from your taxes every dollar spent on medical and dental care, drugs, and health insurance for yourself and your family. You can also get tax deductible group life insurance even if the "group" consists of only one person.

It is important to note that potential tax savings are not the only reason to incorporate. Another chief value is that it limits your liability to the assets of the corporation in the event of a lawsuit. If you do business as an individual or partnership, you can be sued personally,

"Over and over again courts have said that there is nothing sinister in so arranging one's affairs as to keep taxes as low as possible. Everybody does so, rich or poor; and all do right, for nobody owes any public duty to pay more than the law demands; taxes are enforced exactions, not voluntary contributions. To demand more in the name of morals is mere cant."

Judge Learned Hand

which could put your house and other assets in jeopardy

You can put more money (25% and more of income) into your corporation pension plan. This is more than a traditional "Keogh" plan which has a maximum contribution of \$7,500 a year, or even an I.R.A., where the maximum that can be sheltered under special circumstances is only \$1,750.

In these times of growing inflation and periodic ups and downs of the economy, your own corporation is probably the only way that you may maintain control over your economic destiny. And you can often benefit from incorporation without leaving your present job. More about that in a moment.

You Can Incorporate Simply, Easily and Inexpensively.

Up until now, throughout the majority of history, incorporation had one major drawback: high legal fees. Lawyers today charge stiff fees, up to \$2,500 for incorporation. The truth is that you can easily incorporate yourself for under \$50. A remarkably easy and inexpensive method of incorporating is contained in a book called *How To Form Your Own Corporation Without A Lawyer For Under \$50*. It comes complete with all the tear-out forms required to start your own corporation... minutes... bylaws... everything you will ever need. The author, Ted Nicholas, has helped thousands of people start their own corporations and has saved them millions of dollars in the process — and many millions more in taxes.

It is very easy, and we will show you how. We'd like to send you a copy of *How To Form Your Own Corporation Without A Lawyer For Under \$50* for a free thirty-day trial — without risk or obligation on your part. If, for any reason, you're dissatisfied, simply return it for a full refund of your purchase price. We'll also send you a free bonus: The Income Plan — an astounding report that tells you exactly how to turn your present career into a tax-sheltered corporation. The Income Plan — a \$9.95 value — is yours to keep *absolutely free*, even if you decide to return the incorporating system.

To receive your copy of *How To Form Your Own Corporation Without A Lawyer For Under \$50*, write your name and address on a piece of paper along with the words "Corporation Book & Bonus" and send it with your check or money order for \$14.95 to Enterprise Publishing Co., 501 Beneficial Building, Dept. PO-04C, Wilmington, Delaware 19801. Send for the system now. Let us help you wage your own personal tax revolt. Important note: The full price of the book is tax deductible. Act Now!



Satisfaction, Camel Filters style.

Some men taste it all: Rich warm flavor. Smooth even taste. Solid satisfaction.

Only from the Camel Filters blend of Turkish and domestic tobaccos.

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

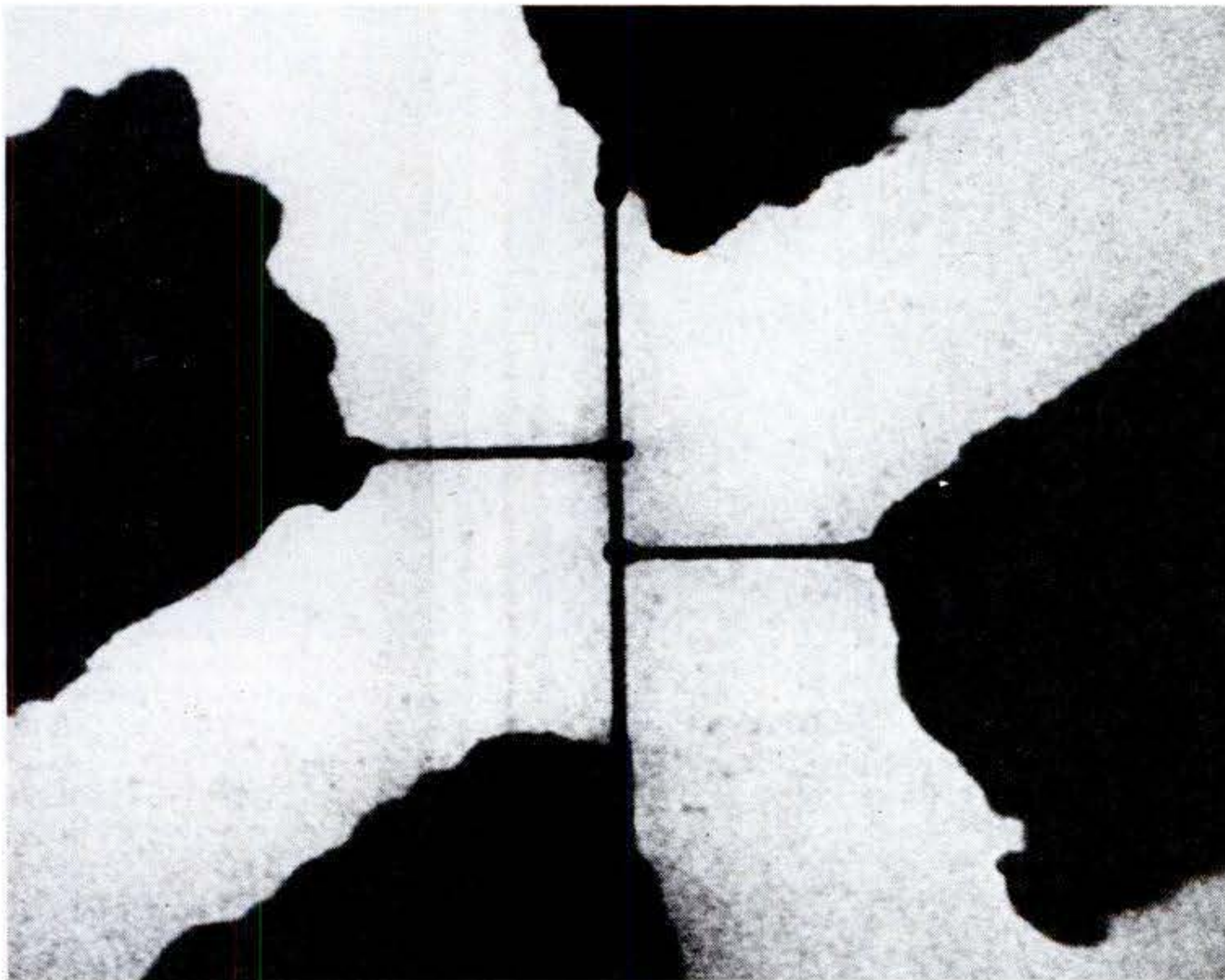
20 CIGARETTES
CAMEL
FILTERS



Famous Cam

SCIENCE NEWSFRONT

By ARTHUR FISHER



World's smallest what?

I haven't checked, but somehow I don't think the Guinness Book of Records has this one. Scientists at the IBM Thomas J. Watson Research Center claim they have made the world's smallest experimental circuit elements. Called nanobridges (from the prefix meaning "billionth"), the devices rely on thin-film strips of superconducting niobium metal that have dimensions only 100–200 times the diameter of an atom, far smaller than the wispiest of human nerve fibers. For example, the three fine lines in the four-terminal circuit configuration shown in the photo are only 50 nanometers (billionths of a meter) wide and 30 nanometers thick. The longest line is 1000 nanometers, the shortest, 600. The long line serves as a superconducting bridge, or weak link, between the pads of superconducting niobium thin films. The short lines act to probe voltage along the longer line. The circuit element is being used to investigate the Josephson effect, in which apparently anomalous electrical phenomena occur in superconducting materials under certain circumstances. Josephson-effect devices have applications in ultrasensitive measuring devices, as well as in computer circuitry.

IBM researchers speculate that a large-scale Josephson computer, based on existing technology, could fit into a box half the size of a basketball, which in turn

would be placed inside a cryostat. It would have three times as much memory as IBM's existing large computers, and would execute 20 times as many instructions per second.

Wisdom from woodpeckers

A team of investigators headed by Philip R. A. May at the UCLA School of Medicine has finished a study of woodpeckers that may help save human lives and reduce paralyzing injuries. Why, they wondered, are woodpeckers able to drill merrily away without the brain injury that one would expect from repeated sharp blows to the head, blows of an intensity that renders other birds and small animals unconscious? To find out, they used high-speed movies and computer-assisted analysis. The answer: The woodpecker's immunity seems to reside in the almost straight approach of the head and the absence of any rotation about the neck as the head approaches the tree. Moreover, the bird has a minimum of space around its brain, and very powerful head and neck muscles. These findings suggest that helmets worn for impact protection—in sports and for bike and cycle riders, for example—should be light and thick, with padding in two form-fitting layers: an inner spongy layer to absorb the energy of impact, and a hard outer layer to distribute it evenly. In addition, a restraint that cuts whiplash and rotary motion to a minimum is required. The

high collars of earlier military uniforms and the head-to-chest sheathing of medieval armor probably served this kind of protective function, the investigators suggest. What to do if you are unprotected and face imminent injury? Tighten the neck muscles and hold the neck flexed in a chin-down position.

A woolly-mammoth story

Using a brand-new dating technique, scientists at the University of Rochester have established the age of a baby woolly mammoth found deep-frozen in Siberia in 1977. The Rochester researchers, who collaborated with teams from the University of Toronto, the General Ionex Corp., and the U.S. Geological Survey, were headed by Harry Gove, who helped develop the new technique. It relies on an accelerator to enable physicists to count carbon-14 atoms directly, as opposed to traditional methods of measuring carbon-14 decay [PS, Nov. '79]. Turns out that the four-foot-high, four-foot-long animal, age six months at death, had been buried in the Siberian tundra for about 27,000 years.

Flying coffin

A happy William Yates, age 19, celebrates his victory in the first Lucas Battery Vehicle Contest, a competition for electric, home-built minicars sponsored by Lucas Industries Limited of England in conjunction with Great Britain's Institution of Mechanical Engineers. Prize money for first place was 1000 pounds sterling. Like the other 51 entries, Yates's car—dubbed the "flying coffin"—was powered only by two ordinary Lucas car batteries. Winning speed for the 41.61-mile event was a galloping 20.81 mph, all of it while flat on his stomach with his nose a bare three inches from the roadway. Yates describes his motor and drive system as "top secret."



Close encounter with a comet

Although a proposed rendezvous with Halley's Comet in 1985 has not yet been

Continued

Advance Dual Time Alarm Chronograph



Thinnest Dual Time Alarm Chronograph Available For Under \$100

\$39.95

Quartz quality, new ultra-thin design and fantastic features are the best words to describe this exciting new chronograph. The thin design of case and bracelet is a perfect match for the multitude of uses that make this world timer the best watch value on the market today... anywhere.

See what you get for only \$39.95

- **24 Hour Alarm** — Pleasant but effective alarm can be preset for any minute of the day or night. Constantly read indicator lets you know when the alarm is set.
- **Snooze Feature** — At the push of a button, you can snooze for 5 more minutes before the alarm resounds.
- **Dual Time** — Set this world timer for your home time and the time of any other city in the world... at the touch of a button. An easily read indicator lets you know which time you're viewing. Shows hour, minute, and running seconds in both time zones.



24 hours, 59 min., 59.9 sec.

Continuously Shows:

- Hours, minutes, seconds
- Day of the week indicator
- AM/PM indicator
- Alarm indicator

- **Full 24 Hour Chronograph** — With 1/10 sec. precision, add time and lap time. Add time lets you time everything from a telephone call to a trip — up to 24 full hours. Lap time lets you time each component within an event.



- **Month And Date** at the push of a button

Tuesday, December 25



- **COMPARE THINNESS** — Thinnest Dual Time Alarm Chronograph available for this low price

Brand	Price	Thickness
Seiko	\$250	10.5mm
Citizen	\$255	11.0mm
Texas Instruments	\$125	12.0mm
Advance Dual Time	\$ 39.95	9.5mm

- **Handsome Styling** — Crafted, quality stainless steel back and bracelet. Optional goldtone model now available with 3 micron quality gold plating at \$44.95.
- **Unconditionally Guaranteed** — For one full year against defective parts and workmanship. 15 day return option if not completely satisfied. Return for prompt refund.

Easy To Order. Just call our toll free number below or fill in the convenient order form. Comes in attractive gift box. Order yours today!

MEDIA MARKETING, INC.

10155-9 Plano Road, Dallas, TX 75238

- Yes! Please send me _____ Dual Time Alarm Chronograph(s) with unconditional guarantee at \$39.95, plus \$2.50 postage, insurance and handling. Texas residents add 5% sales tax.
- Silvertone Goldtone \$44.95

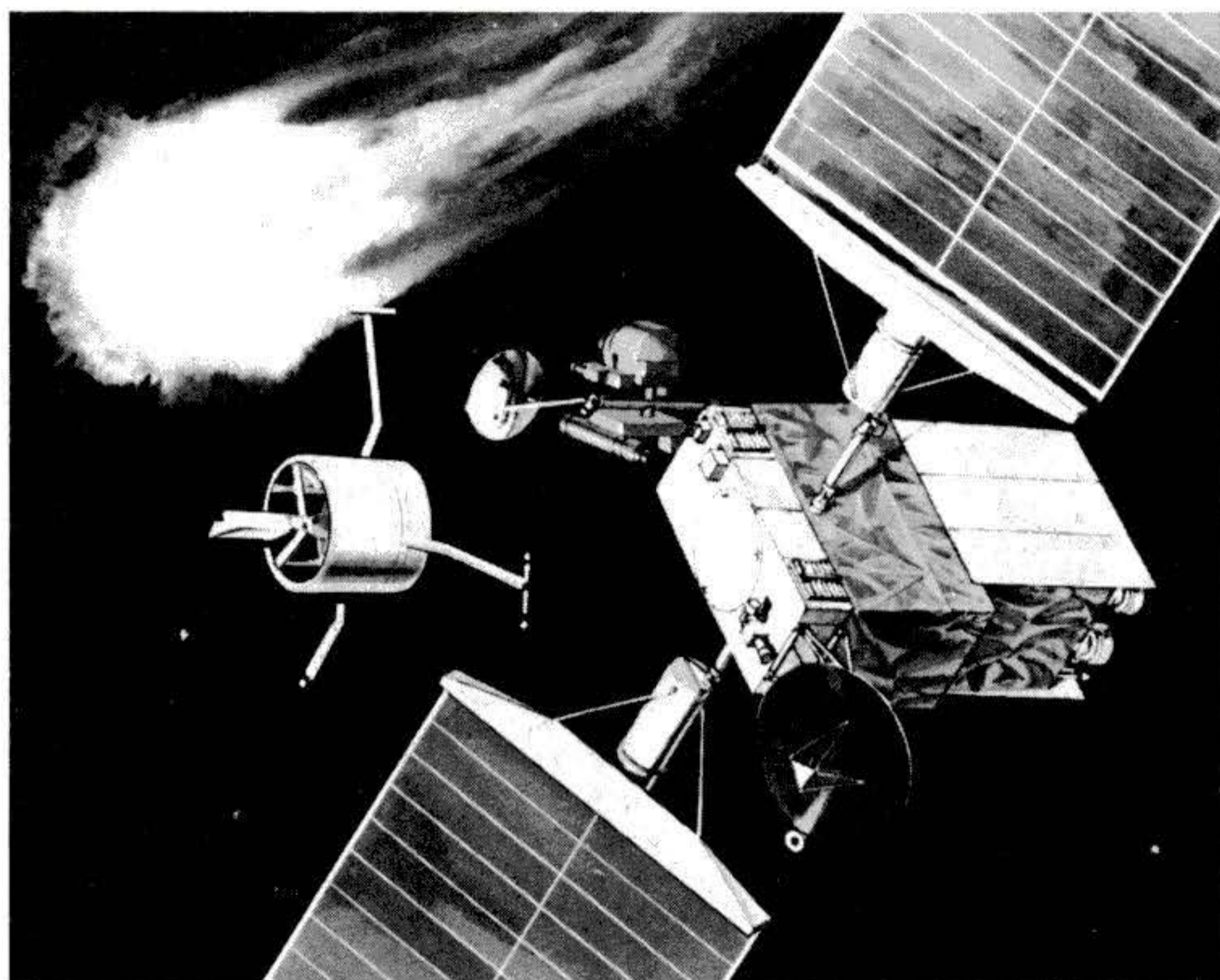
Name _____
 Address _____
 City _____
 State _____ Zip _____

Check or money order enclosed
 For even faster service, charge to:
 Master Charge/Visa Expires _____
 Account # _____

Signature _____
ORDER TOLL FREE 1-800-527-7066
In Texas Call 1-214-349-3120 ©MMI 1979

Science newsfront

[Continued]



approved (and may not be, given the mood of Congress), NASA and the European Space Agency are asking scientists to propose experiments for the mission. Reason: Early designation of the experiments and their principal investigators is imperative if the space project is to go on schedule when and if approval is forthcoming.

Actually, the mission is a two-comet encounter. The spacecraft, pictured above, will be launched in July 1985 by a Space Shuttle. It will use ion (solar electric) propulsion engines (a first in deep space) to reach Halley's Comet, some 120 million kilometers (75 million miles) from Earth, in November 1985. (Halley will make its next once-in-every-76-year visit to the solar system in the winter of 1985-1986, so the next opportunity for a flyby would be in 2061.) At the time of encounter, the craft will spew out an instrumented probe that will plunge into the comet's head, passing within only 1500 kilometers (930 miles) of the nucleus, or core, of the head, where the deep-frozen original matter of the comet is concentrated. Information gathered by the probe, by remote sensing as well as actual sampling of dust and gases, will be relayed to Earth via the mother craft.

After the Halley encounter, the craft will head for Tempel 2, smaller and belonging to a different category of comet from Halley. The spacecraft should, if all goes well, accompany Tempel 2 for a year, close enough to the nucleus (50 kilometers, or 30 miles) to obtain high-resolution photos from on-board cameras, and other measurements of value. The cameras may be able to spot objects as small as a baseball on the surface of the nucleus. Data obtained from Halley and Tempel 2 will help planetologists understand the origins of comets, and possibly of the solar system itself.

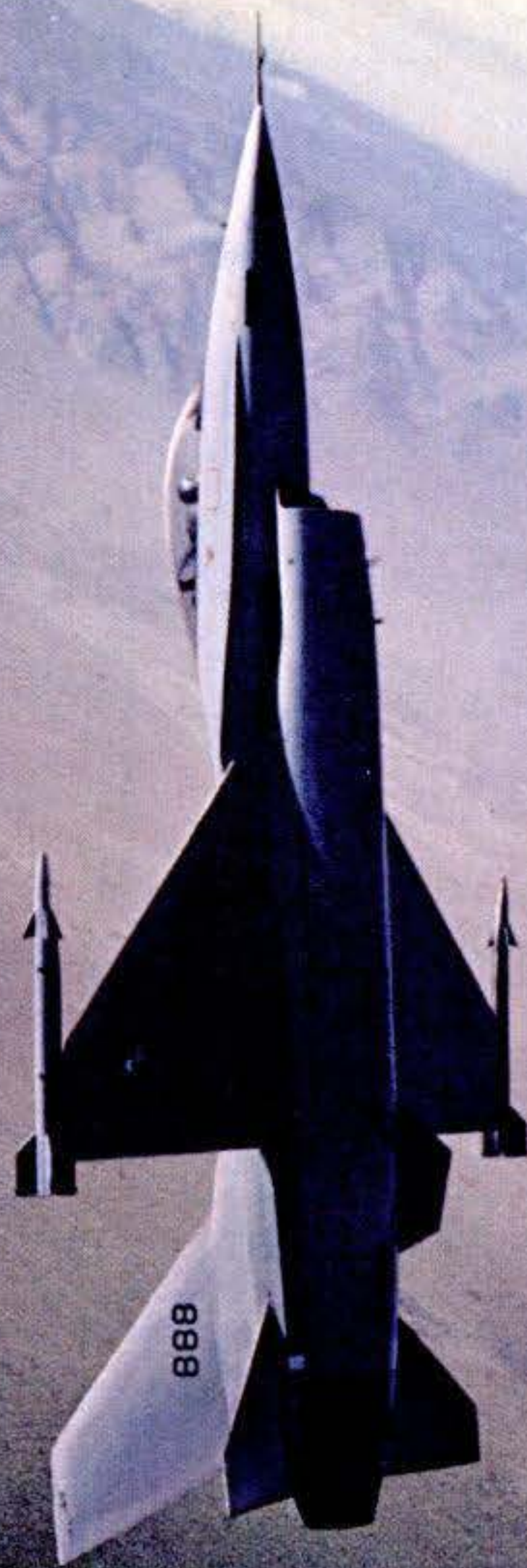
If it flies, the international mission will have a combined scientific payload that will be shared by scientists the world over. NASA will manage the launch, the rendezvous spacecraft system, and mission operations through the Jet Propulsion Laboratory in Pasadena, Calif. The European Space Agency, a consortium of 11 nations, will be responsible for the Halley probe system.

Land boom

Southern California has entered an intense land boom. Not the one that keeps boosting house prices, but an honest-to-goodness increase in the area of its land surface! The phenomenon, which is proceeding rapidly, was detected by measurements carried out independently by the U.S. Geological Survey and by NASA. To give one example, it has added a quarter of an acre of land to the Palmdale area in a six-month period. Because it adds strain to an already strained part of the Earth's crust, the expansion may have grim implications. Dr. Barry Raleigh of the Geological Survey says that if the present pattern of straining persists, it is likely to lead to a large earthquake on the San Andreas fault much sooner than previously predicted.

Earth's slowdown

An extra second—the leap second—was added to the last minute of the last day of the decade, in continuation of a timekeeping artifice that began in 1972 [PS, Mar. '73]. Leap seconds are commanded by the International Bureau of Time in Paris whenever solar time deviates by more than 9/10 of a second from the time kept by laboratory standard atomic clocks. The adjustments are needed because Earth's spin is slowing. 5



MOVE UP TO THE AIR FORCE EXPERIENCE.

You need experience to get ahead . . .
but Air Force Experience goes beyond.

It's professional excellence.

In training or on the job.

Top performance is a way of life.

Be the best.

Find out about Air Force Experience.

See your Air Force Recruiter —
for yourself and your country. Mail in the
attached card. Or call toll free
800-523-5000 (in PA: 800-362-5696).

A GREAT WAY OF LIFE
AIR FORCE

Shuttle setbacks

challenge engineers' ingenuity

Some vexing problems must be solved if this space plane is not to be a dodo

By JIM SCHEFTER

The behemoth in black and white, a brickyard with wings, stands pointed at the Florida sky. Workers throng in and around it, checking its tiled surface, testing its extraordinarily complex systems, fixing this and adjusting that as they attempt to make every doubt disappear.

But some doubts remain.

This is the Space Shuttle, already several years behind schedule, more than \$3 billion over budget, 9000 pounds overweight, and still tied to Earth.

Its problems have now spread throughout the aerospace industry,

sending payload planners scrambling to revise their launch schedules or find other ways to get satellites into space. NASA itself has delayed its Galileo mission to Jupiter and is rescheduling launch timing of communications and other satellites.

What's wrong?

To find out, I spent more than a month digging into the Space Shuttle Orbiter and its problems. I visited aerospace plants where the Orbiter, or parts of it, was designed and built, and NASA centers where its troubles are being analyzed. I talked with a score of experts who generally agreed on what is troubling the Shuttle and what is necessary to fix it.

One conclusion quickly became obvious: The Orbiter is the most cantankerously advanced machine ever conceived. It makes flying to the moon seem easy.

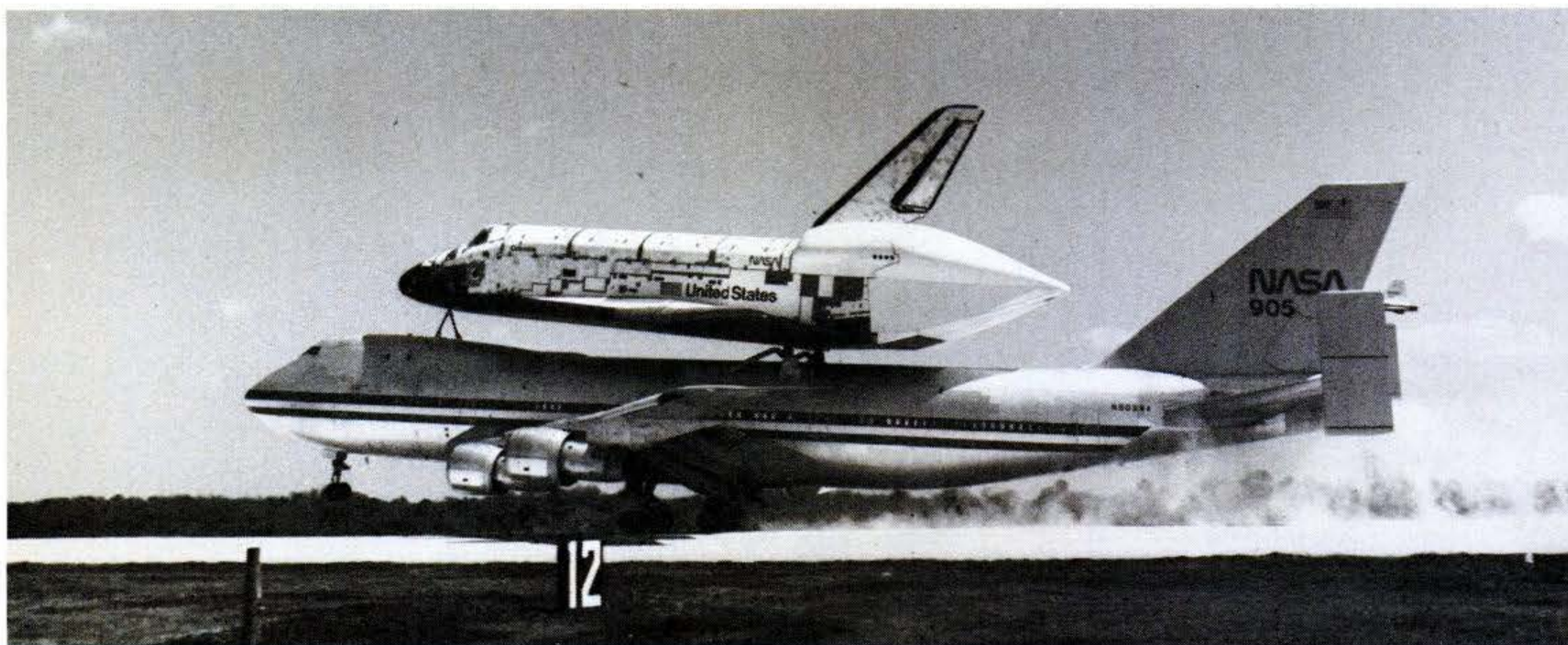
On close examination, it has to be that way. The Space Shuttle is a three-in-one transportation system. It takes off as a rocket, performs its mission as a manned spacecraft, then becomes an airplane for landing back on Earth [PS, Aug. 79]. With a minimum of repair and refurbishment, it has to be ready to do it all over again. One hundred times.

No blank check

No one expected to design and build a Shuttle without running into difficult and surprising problems. NASA's whole philosophy of space flight assumes that problems will sprout where least expected.

It also assumes that enough money will be available for fixes. But that hasn't always been true for the Shuttle—NASA's budget has been sharply

Continued



Riding piggyback aboard a 747 jet transport, the Shuttle Orbiter journeyed last March from Edwards Air Force Base,

Calif., to Kennedy Space Flight Center, Fla. The seemingly uneventful trip did appalling damage. Flight-caused vibrations

loosened the tiles that compose the Shuttle's reentry heat shield. Thousands of tiles had to be tested and replaced.



**MODEL P34A -
ULTIMATE RECREATIONAL
FRIDGE AND
FOOD WARMER** **\$189.00**
(in Canada \$199.00)

The same size, color, weight and capacity as the P34 but includes food warming features, fully adjustable temperature control and low battery warning indicator.

The P34A is our top of the line portable. It heats, it refrigerates and with specially designed electronic circuit control (patent applied for) it allows you to dial a complete range of temperatures from very cold to very warm. You wine buffs will find it indispensable to chill up to 1 doz. wine bottles at just the right temperature. Low battery indicator warns you when you need a recharge and the sensing circuits efficiently control your power consumption to save on battery drain. This is our best-of-the-line, recreational fridge and food warmer with all the bells and whistles for the discerning buyer who demands quality, size and complete versatility. Use from a cigarette lighter receptacle or plugged into house current with our optional 110 volt adaptor.

Travellin' Fridges

FROM ONLY \$129.

Space age breakthrough creates a new line of Koolatron electronic portable refrigerators and food warmers.

You're nicely away on your long-awaited vacation, camping trip or long weekend with the family. You're comfortably cruising in your car, van or rec. vehicle along a busy interstate with few rest stops or restaurants. You guessed it... the kids want to stop for a snack. But your Koolatron P34 or P34A is full of sandwiches, cold pop, fried chicken... home made, fresh and cold. The family helps themselves and you've saved valuable vacation time and another expensive restaurant bill.

You're a commuter, a salesman or a trucker and you spend many hours in your vehicle daily. Now with your amazing Koolatron P10 plugged in beside you, you open the lid and instantly fresh food and drinks are at your fingertips. Just for the price of a good cooler and one or two seasons of buying ice, (or about 10 family restaurant meals), all the marvels of home refrigeration are available electronically. An amazing space-age miracle... the thermo-electric solid state module... makes these portable refrigerators possible.

These amazing heat pumps have not only gone to the moon, but have provided the breakthrough for Koolatron's portable fridge revolution.

THOUSANDS IN USE

Koolatron now has tens of thousands of electronic fridges in use worldwide using these same powerful solid state modules. Built to take it, two of these electronic modules are encased in tough, plastic insulated chests that are designed to be rugged and trouble-free. Non-rusting hinges and latches prevent corrosion in salt water environments. And with only one moving part (a small 12 volt fan) Koolatron's portables seldom see a service depot. Now you can enjoy Koolatron's whole family of electronic portable refrigerators and food warmers that eliminate costly ice and provide "home refrigeration" convenience at sane and sensible prices.

Koolatron's P10 not only makes a great car fridge but at a flick of a switch lets you bring home your favorite fast foods "piping hot". Comes with a 9 ft. power cord that just plugs into your cigarette lighter. Amazingly easy to operate... one switch selects hot or cold. A second switch allows you to refrigerate normally or select maximum cold. With your engine off, you can operate for up to 6 hours and still start your engine. "A low battery" indicator warns you when it's time to recharge. With the power off, your P10 keeps everything hot or cold for many hours in its well insulated case.

With our optional 110 volt adaptor you'll also find endless uses wherever house current is available... at your cottage... as a bar fridge... in your motel room for a midnight snack and drink... as a small office fridge... or beside your pool. Use as an auxiliary home fridge when you're having a party.

**MODEL P34 -
RECREATIONAL
FRIDGE** **\$169.00**
(in Canada \$179.00)



Holds over 40 lbs. of food and beverages or 48 pop cans. Refrigerates in air temperatures up to 95°F. Rugged ABS case in sand beige color with dark brown non-corroding latches and handle. Large 34 litre capacity (1.2 cu. ft.) weighs 17 lbs. empty. Ext. 21" L x 16" H x 16" W. Int. 16" L x 12" H x 11 1/2" W. Operates on 12 volts DC with supplied power cord or with optional 12VDC/110VAC power adaptor.

The P34 is the full-size member of the Koolatron family of portable electronic fridges. It is designed especially for the serious traveler and outdoorsman and will refrigerate more than 3 times the contents of the P10. As a hunter, camper, boater, you'll be amazed at the capacity and convenience. Fits into any boat, van or camper or back seat of your car. Plugs into your cigarette lighter receptacle and refrigerates over 40 lbs. of food (no space wasted by ice), yet it draws no more power than the P10. With our optional 110 volt adaptor, you'll find endless uses as a bar fridge, cottage fridge, office fridge. Your P34 has all the advantages of the P10 without the heating cycle or low battery indicator but with all the capacity needed by the outdoorsman.

**MODEL P10 -
CAR FRIDGE
& FOOD WARMER** **\$129.00**
(in Canada \$139.00)



Holds approx. 17, 12 oz. pop cans - refrigerates in air temps. up to 95°F. Also keeps hot foods hot (150°F) at the flick of a switch. Deep rich blue Polypro plastic case. Ext. 16" L x 11" H x 11 1/2" W. Int. 11 1/2" L x 8" H x 8" W. with 10 litre capacity (0.4 cu. ft.) weighs 10 lbs. empty. Operates from supplied 12 volt power cord in vehicles or with optional 12VDC/110VAC power adaptor.

ORDER TODAY WITHOUT OBLIGATION!

Simply complete the attached order form or phone collect and we'll rush you your portable on our no risk 21 day trial offer. Each unit comes with complete instructions and a written 1 year warranty. In the unlikely event you ever need service, we have major service centres in New York, Arizona and Canada. When you receive your Koolatron, use it constantly for 3 full weeks without risk.

If you ordered our optional 110 volt adaptor, plug it in, then use your portable immediately as a bar fridge or around the patio or pool. Next plug the fridge into your car or RV. Take your family out for a weekend trip. Enjoy fresh home-cooked food as you thumb your nose at those expensive restaurant stops. If after you've thoroughly tested it, you don't agree that your Koolatron represents a major breakthrough that will save you time, money and bother for years to come, send it back for a full refund. You can't lose... we guarantee it.

So be among the thousands to discover that the ice age is over. Don't waste another dollar on ice... order your Koolatron with no obligation today!

For rush delivery phone your order in collect to:

0-705-737-0842

Koolatron Industries Limited
56 Harvester Ave., Batavia, New York 14020
230 Bayview Drive, Barrie, Ontario, Canada
Or use this handy order coupon.

Koolatron Dept. 1096
Industries Limited

56 Harvester Avenue, Batavia, New York 14020
Canada: 230 Bayview Drive, Barrie, Ontario L4N 4Y8
Send me with full refund privileges.

___ Koolatron P10 at \$129.00 (\$139.00 in Canada)
___ Koolatron P34 at \$169.00 (\$179.00 in Canada)
___ Koolatron P34A at \$189.00 (\$199.00 in Canada)

___ Koolatron 110V adaptor at \$29.95 (\$34.95 in Canada)
Please add \$8.00 for handling and delivery per unit.
No charge for shipping adaptor if ordered with unit.
Add \$3.00 for shipping adaptor only.
(N.Y., Ont. and Quebec residents add sales tax).

I understand that I may return any item undamaged within 21 days and receive a full refund if I am not satisfied.

I enclose my check or money order for

\$ _____ or please charge it to my
 Visa Mastercharge American Express

Account Number _____

Expiry Date _____

Signature _____
(necessary to send merchandise)

NAME _____

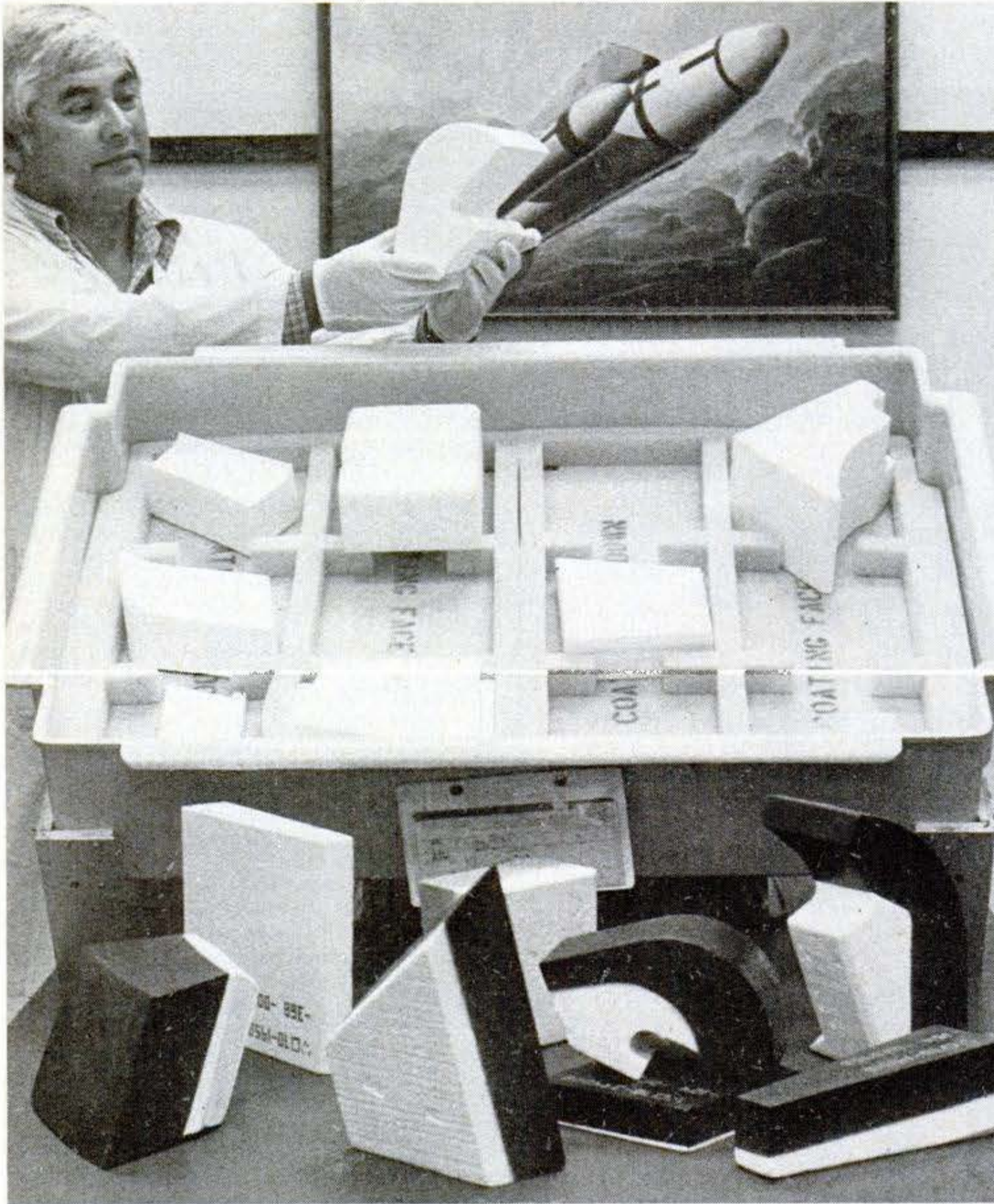
ADDRESS _____

CITY _____ STATE _____

ZIP CODE _____ PHONE _____

Shuttle setbacks

[Continued]



One-of-a-kind heat-resistant tiles are each assigned to a specific spot on the Shuttle's body—and each must be carefully milled on the underside to match the con-

tours of that spot. Thus, none of the 31,000 silica tiles that cover the Shuttle are exactly alike. Black layer on tiles in the foreground is a protective glaze.

restricted during the past few years.

The Shuttle originally was scheduled for launch in 1978. When even 1979 became impossible, concern surfaced rapidly. When the delays affected launch schedules for military surveillance satellites, NASA began getting more money.

Now it's beginning to pay off. Most Shuttle problems have been resolved. But four of them, selected by the experts I interviewed, were real demons to fix:

- The Thermal Protection System, a state-of-the-art advance to allow an airplane to survive reentry heating, turned into a bricklayer's nightmare.

- The main rocket engines repeatedly failed during testing.

- Onboard computer software became so complicated that it strained the industry to find enough qualified programmers to do the job.

- The Orbiter's internal structure was too weak. It could have broken in half during normal reentry.

In each case, NASA and its aerospace contractors tackled the troubles with innovation and hard work. The result now is a Space Shuttle that could reach orbit later this year or early next year. Is it safe?

"I'd fly it," said Rockwell engineer Bob Olsen, who spent more than a year on the Thermal Protection System's problems.

He probably won't get the chance. But astronauts John Young and Bob Crippen, tabbed to be first to fly the Shuttle, will have their lives on the line when the thermal system faces its ultimate test.

The system is composed of more than 31,000 fragile, ceramic-like tiles bonded to the Orbiter's belly, nose, wings, and control surfaces. And the slightest failure could mean disaster.

"The system doesn't have much margin designed in," NASA engineer Tom Moser admitted. "In fact, it's designed not to lose one tile."

What would happen if one small tile ripped off during the intense heating and turbulence of reentry? Temperatures up to 2300 degrees F would eat into the Orbiter's aluminum skin. Other tiles would be weakened as well, Moser said, and would begin peeling away. Total destruction would follow.

These vital tiles are made of a fascinating material developed by Lockheed. Nearly pure silica fibers, the tiles start out as a soft white cube that is 97 percent air and weighs just nine pounds per cubic foot. A heavier version for surfaces that will be subjected to the worst pressures weighs 22 pounds per cubic foot and was developed at NASA's Ames Research Center.

The material can't be handled roughly. Without a surface glaze, it could be pulverized in the fist of a child. And the tiles can't be installed as you'd tile a patio or shower stall.

"It's not like going down to the hardware store for a box of tiles," Rockwell's Olsen told me. "Every tile is different."

Each tile must adhere snugly and smoothly. But some Orbiter surfaces are smooth and flat, while others are curved and bent, even in S-type sweeps. So all 31,000 tiles had to be cut to individual specifications. After being cut and shaped into sections, many no bigger than your hand, each tile had to be glazed for stiffness. Black glaze was used for high-temperature areas such as the belly, while white glaze protects less exposed surfaces.

Painstaking work

The glaze was applied on five sides, leaving the bottom soft and powdery. Then arrays of tiles, ranging from two or three to enough to cover a desk top, were glued to a felt "strain isolation pad" that would be glued—by hand—to exactly the right place on Orbiter's thin aluminum skin.

The glue used is nothing unusual. It's a silicone-type sealant, not too different from the stuff you can buy for household use. (Incidentally, the household-type silicone sealants originally were developed for the space program.)

The real nightmare began with installation. Every tile had to be aligned perfectly on all sides, with gaps held

Continued

Taste country fresh Salem



**Light mountain breezes.
Clear, rippling waters. And
country fresh Salem menthol.
That's satisfaction.**

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

KING: 16 mg. "tar", 1.1 mg. nicotine, 100's: 20 mg. "tar",
1.4 mg. nicotine, av. per cigarette, FTC Report DEC. '79.

Some things just naturally go together.



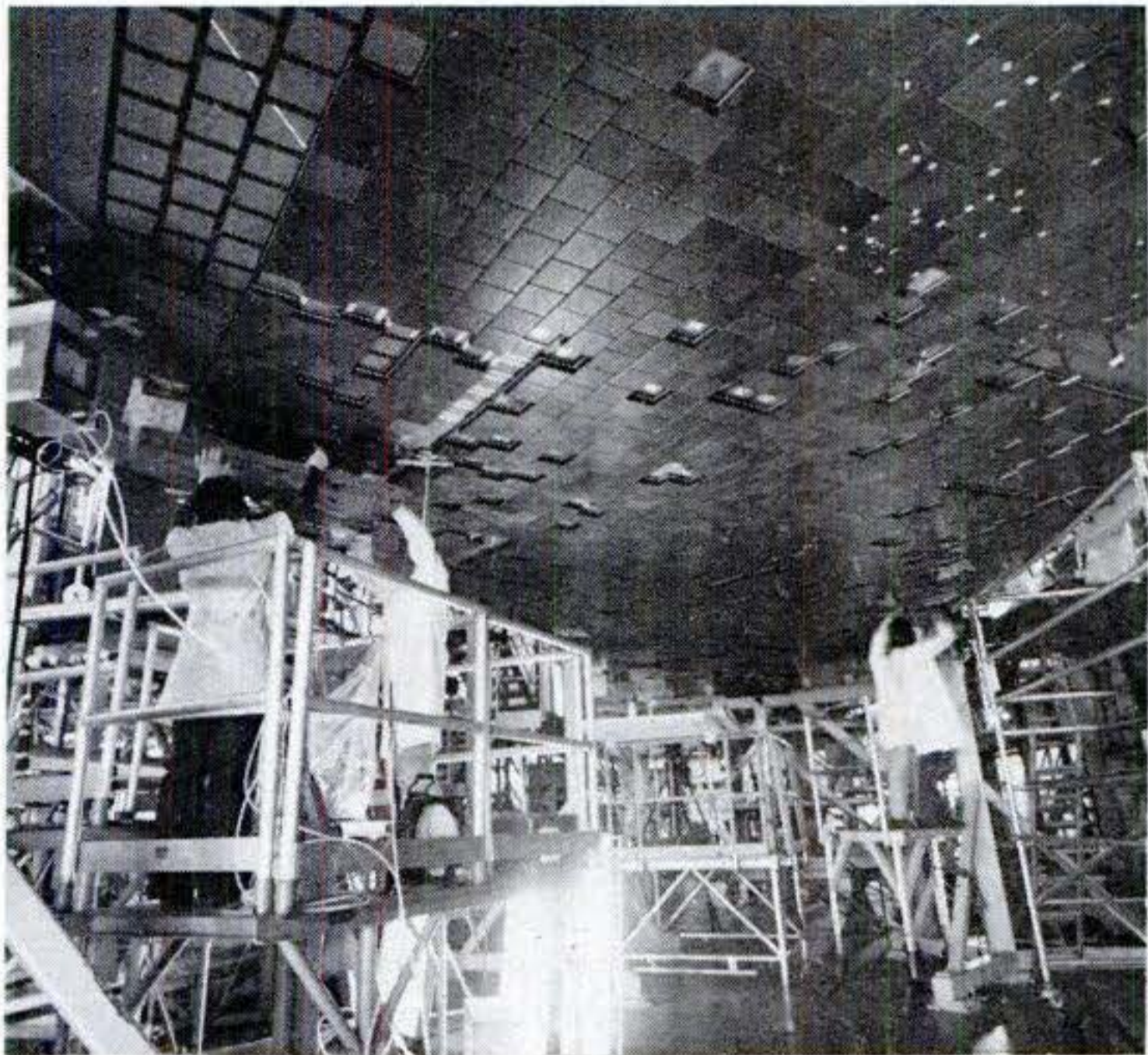
Seagram's V.O.
The symbol of imported luxury. Bottled in Canada.
Enjoy our quality in moderation.

Canadian whisky. A blend of Canada's finest whiskies. 6 years old. 86.8 Proof. Seagram Distillers Co., N.Y.C.

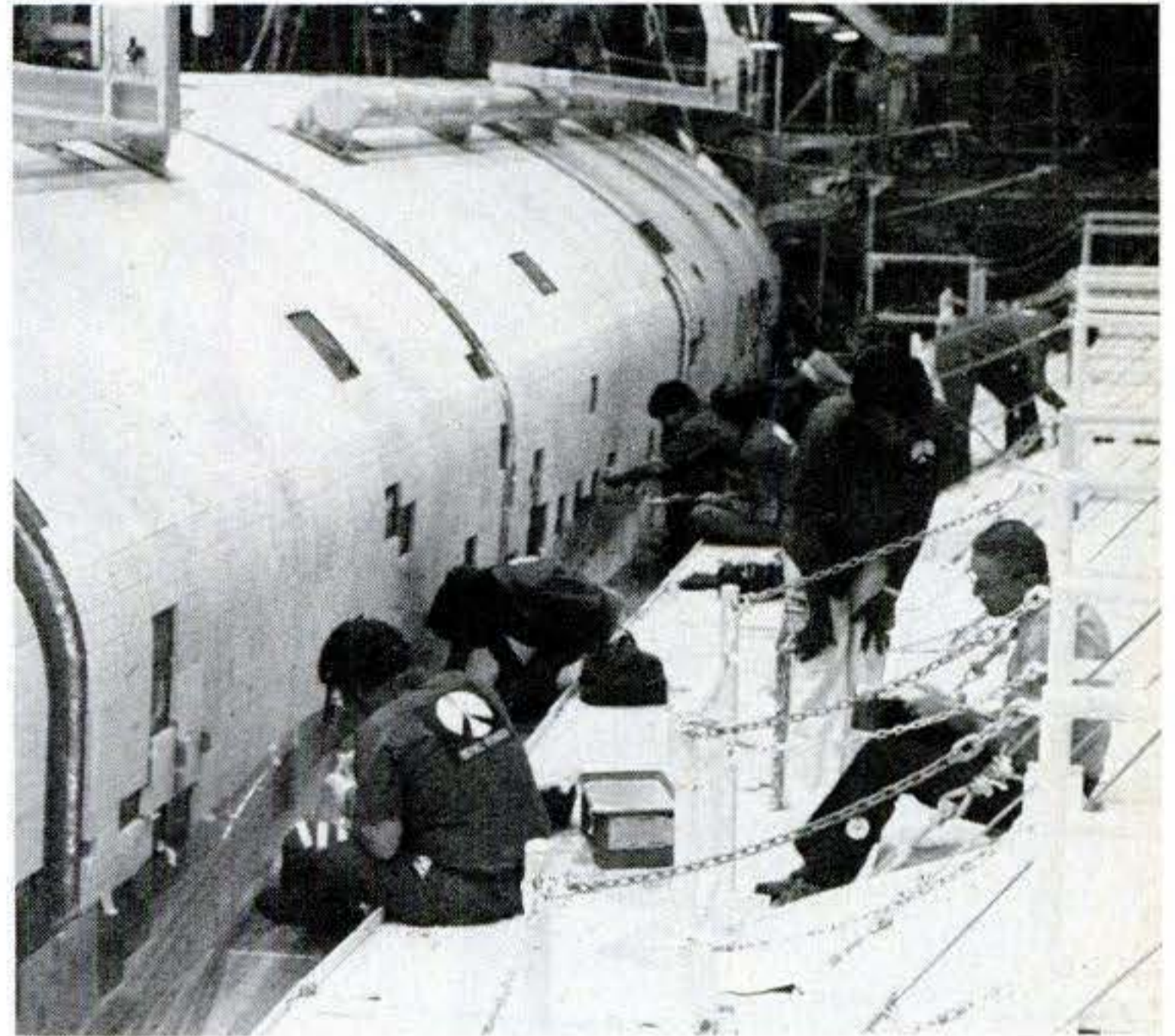
Copyrighted material

Shuttle setbacks

[Continued]



Workers carefully apply and test heat-resistant black tiles to Shuttle's belly (above) and white tiles to its flanks (right). Though this arduous task was uncompleted at press time, other Shuttle



problems were close to resolution. In December, the Orbiter underwent a successful mock flight in which ground-based computers tested the responses of the onboard computer systems.

to 0.002–0.003 inch. And the final surface had to be so smooth that no aerodynamic turbulence would be generated.

But instead of starting from a central point and working outward, the NASA/Rockwell plan called for spotting arrays around the fuselage, checkerboard-fashion, then coming back to fill in the gaps. That only made things worse as installers struggled to insert close-out tiles while perfectly joining arrays.

It was slow going and added significantly to the time it takes to build an Orbiter. In a good week, only about 600 tiles could be installed. Most weeks weren't good.

"We were kind of naive," said Don Whitman of Rockwell's Space Division in Downey, Calif. "It seemed like a simple thing to do, but it was a tough learning curve."

Then tiles began falling off.

When NASA ferried the Orbiter Columbia from California to Florida atop its Boeing 747 transport, the little deflections and vibrations in the Shuttle's skin loosened the bonding. Dozens of tiles popped loose.

So, in late 1979, Rockwell faced the enormous task of pull-testing every tile already installed, more than 20,000 at that point. An easy, two-psi pull test had been planned anyway. But now, each tile was pulled to at least six psi, some to more, while being monitored with sensitive acoustic devices.

"We were listening for the failing of fibers between the tile and strain

isolation pad," Olsen explained.

If a tile flunked the test, it was removed. Its soft bottom was densified with a liquid silica that soaks in about one-tenth of an inch. Then it was rebonded to the felt pad. It all took time.

"We'd have come on this problem a lot earlier if we'd planned our program a little better," Ron Kubicki, former Orbiter engineering manager at Johnson Space Center, said. "If you leave any chance for error, you'll get it."

Tougher tiles

But the innovative work that went into perfecting the tiles has led to even more advanced materials that will be used on later Orbiters now being built. With weight a strong consideration (the current "lightweight" tiles still account for about 20,000 pounds), Dr. Howard Goldstein and his co-workers at Ames have come up with a lighter, much stronger material needing no glazing. Called Fibrous Refractory Composite Insulation, the stuff is a mixture of two recently developed materials. It's 20 percent Nextel, an alumino-borosilicate fiber from the 3M Company, and 80 percent Microquartz, a nearly pure silicate produced by Johns-Manville.

Goldstein and the other materials experts at Ames have perfected ways to blend the mixtures to produce high-strength tiles with none of the current fragility problems. The version likely to be used on the Shuttle weighs 12 pounds per cubic foot, but is 50 per-

cent stronger than the strongest tiles now used. The material can be machined easily, and will even hold screws. It also sticks tight with silicone-based glue.

"And it's totally thermal-shock resistant," Goldstein said. "You can take it out of a 2300-degree oven and drop it in water with no effect."

Some of the new tiles will be on the second Orbiter to reach space. By the third Orbiter, all high-temperature black tiles will be replaced by the new tiles. The low-temperature white tiles also may be replaced, but by a blanket of quartz cloth also developed at Ames. This flexible blanket, now getting intense testing, eliminates virtually all of the installation problems caused by the current tiles. It's also cheaper: \$100 per square foot of blanket versus \$4000 per square foot of tile.

Reluctant rockets

If thermal protection has been the Shuttle's worst problem, its main rocket engines, using hydrogen and oxygen for fuel, have been the most visible. They've blown apart during tests, shut down prematurely, suffered bearing failures and destructive internal combustion, had welds break, and lost critical components in dramatic incidents.

One explosion and fire, in July 1979, so badly damaged the rocket stand at the National Space Technology Laboratories that testing was delayed nearly four months. When it re-

Continued

**Sunpak
is ready
when you are**
thanks to 2-Second Recycle*
and Instant Readout



SUNPAK INSTANT READOUT shows only the actual lens opening in use. So you get **perfect, automatic** flash anywhere from 19 inches to 26 feet. That means perfect pictures of parties, graduations and sports without ever having to puzzle out complicated exposure scales. Light weight, fits all cameras, uses standard batteries and is surprisingly low in cost. Available now, wherever good cameras are sold.

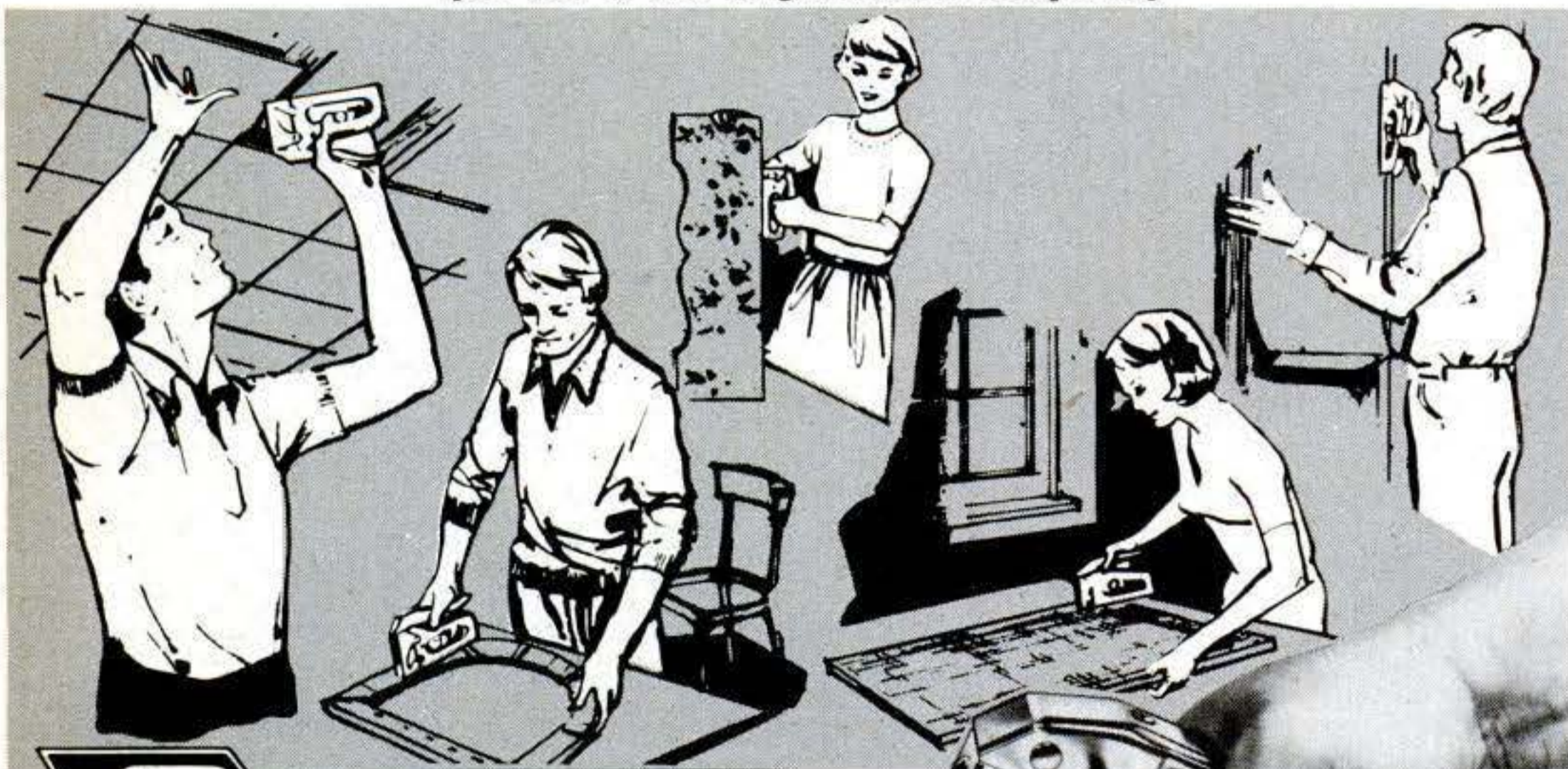
**SUNPAK[®]
AUTO 221**



*With freshly charged AA Nicad batteries.

Sunpak Division, Berkey Marketing Companies Box 1102, Woodside, N.Y. 11377
 ■ 1011 Chestnut St., Burbank, Ca. 91506 ■ In Canada: Sunpak Corporation of Canada, Inc., Ontario

You don't have to be a professional..
 (to be a do-it-yourself expert)



ARROW[®]
 HEAVY DUTY
STAPLE GUN

SHOOTS A STAPLE
 WHEREVER YOU'D DRIVE A NAIL!
faster .. better .. cheaper ...

Whether you're installing insulation . . . re-upholstering a chair . . . repairing a screen . . . covering a cornice . . . securing an antenna wire — there's no faster, easier or more efficient way to get the job done than with a one-hand operated Arrow automatic staple gun.

Arrow Staple Guns come in a variety of models,

At all leading Hardware, Home Center & Discount Department Stores Everywhere.

ARROW FASTENER COMPANY, INC., 271 Mayhill Street, Saddle Brook, N. J. 07662

Shuttle setbacks

[Continued]

sumed in November, a three-engine cluster fired only nine seconds before a turbopump problem triggered a shutdown. That, in turn, ruptured hydrogen lines and started another fire.

At that point, with the Shuttle already about 20 months late, preliminary flight certification on the Space Shuttle Main Engine was less than 80 percent complete.

"This engine is pushing the state of the art," Rocketdyne's Jerry Johnson told me at the Canoga Park, Calif., plant where it is built. "When you want high thrust in a small package, you add complexity."

For instance, to get its 375,000 pounds of thrust, the engine has a higher chamber pressure (3000 psi) and higher expansion ratio (77) than any rocket engine ever built. The big J-2 engine used in the Saturn booster's upper stages had a chamber pressure of just 700 psi and its ratio between combustion-chamber opening and nozzle was 27. And the J-2 didn't have to survive for mission after mission of prolonged use.

Power pumps

Prime elements in the Shuttle engine's performance, and source of major headaches, are the high-pressure fuel turbopumps. These pumps are smaller than, but four times as powerful as, Apollo rocket pumps.

"You get that power by concentrating on precision," Johnson said. "Everything has to be perfect."

When it isn't, there are failures.

So far, Rocketdyne has redesigned valves and seals, strengthened internal components, even added parts not in the original design. With all this effort, it was still a turbopump problem that led to last November's damaging fire.

Several problems centered on bearing failures. In one case, an engine was damaged when a turbopump bearing overheated and shattered. Since the bearing was cooled by a flow of liquid hydrogen, a real mystery developed.

Then engineers discovered the culprit, Johnson said. The supercold liquid hydrogen was spinning into a vortex, leaving the bearing to overheat in the whirlpool's central hole. A small paddle inserted into the feed line broke up the vortex and put the cooling back where it belonged.

Another bearing failed when high-pressure hydrogen, used as fuel, began spinning through the piping instead of flowing smoothly. The erratic sloshing caused high-frequency vibra-

Continued

POLICE RADAR MEETS ITS MATCH.

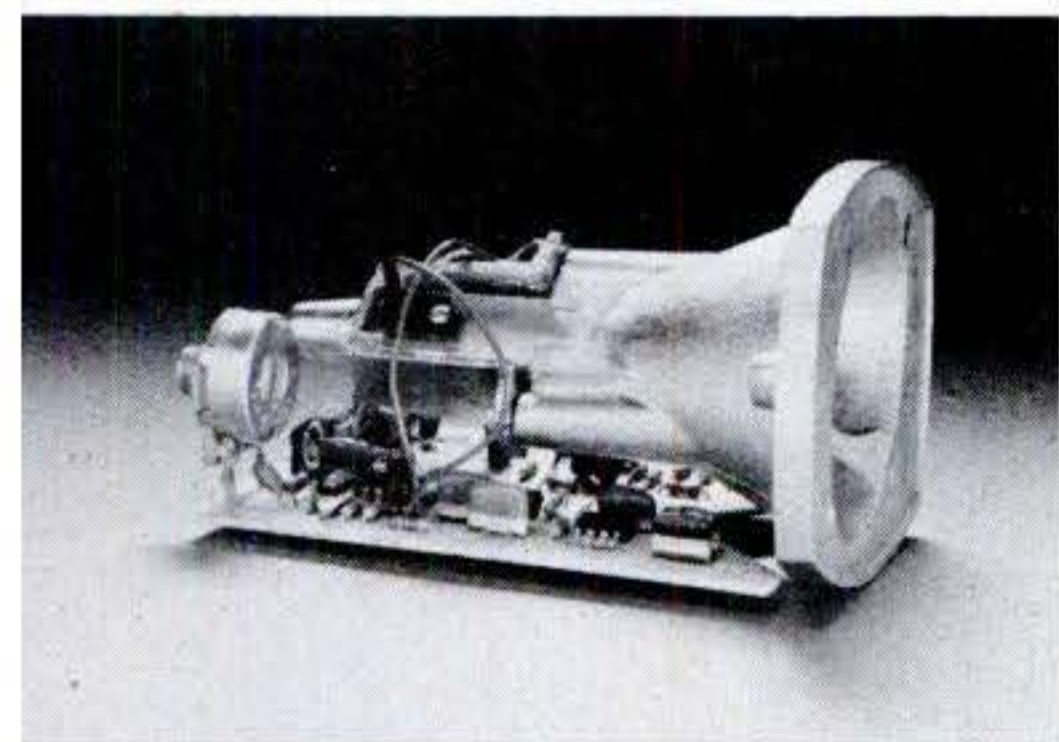


You can't buy a better radar detector for \$95 than the GUL Micro Scan. Developed by B.E.L. Laboratories after 10 years of research, the GUL Micro Scan has repeatedly proven its superior signal sensitivity. In separate tests conducted by Canadian Tire Corporation and *Motor Consumer Report*, it demonstrated a detection distance significantly greater (on both X and K bands) than its top three competitors—the Fuzzbuster XK, the Whistler XK and the XK Snooper.

That was only the beginning.

Plenty of advance warning.

In two recent issues (January and February, 1980) *CB Magazine* revealed an unprecedented comparison showdown involving 12 leading detectors—



Large elliptical horn antenna detects radar from all sides, even when approaching hills and curves.

some with prices as high as \$200.

Monitoring straight line detection, the GUL's 9,029 foot range topped the list.

Signals of .01 millionths of a volt are

sufficient to trigger the GUL's scanning alert system (ranging from 9.445 to 24.445 GHz). It successfully detects all police radar—including the new KR-11 short pulse.

What's more, the GUL has a nondirectional antenna; its large elliptical horn pulls in signals from front, side and rear. This 360° detection field maximizes sensitivity, providing you with valuable warnings—even when approaching hills and curves. *CB Magazine's* comparison bears this out: In a K band test for around-the-curve sensitivity, the GUL's detection range was double that of the Fuzzbuster and Super Snooper. And nearly three times greater than the highly regarded Whistler. On X band pickup from the side and from behind, it was found to be the most effective detector in the dozen.

Doesn't cry "wolf."

The most common problem among radar detectors is the failure to screen out false signals, such as signals from taxis and ham radios, as well as hospital microwaves.

But the GUL shows no sign of falsing when exposed to radio signals of any kind. Its sophisticated circuitry is completely shielded by a diecast and extruded aluminum case which protects

the input terminals from stray signals (the most common cause of false alarms). The aluminum provides lightness, along with durability not found in plastic casings.

A double warning system.

Both a tone and light come on in the presence of radar, and remain on until radar is gone. You're never lulled into a false sense of security by a tone that sounds once and then goes off. You control the tone with a front-mounted on/off switch.

In addition, the GUL uses an internal voltage regulator, commutating filter, and synchronous detector to reduce power consumption to a minimum. This also provides a more stable gain setting. And its gain control knob lets you optimize sensitivity for different city and country conditions.

Quick installation.

The compact GUL measures only 4" x 3" x 4½". It weighs just 20 oz. Its case is finished in glare-free matte black, and comes with bracket in place.

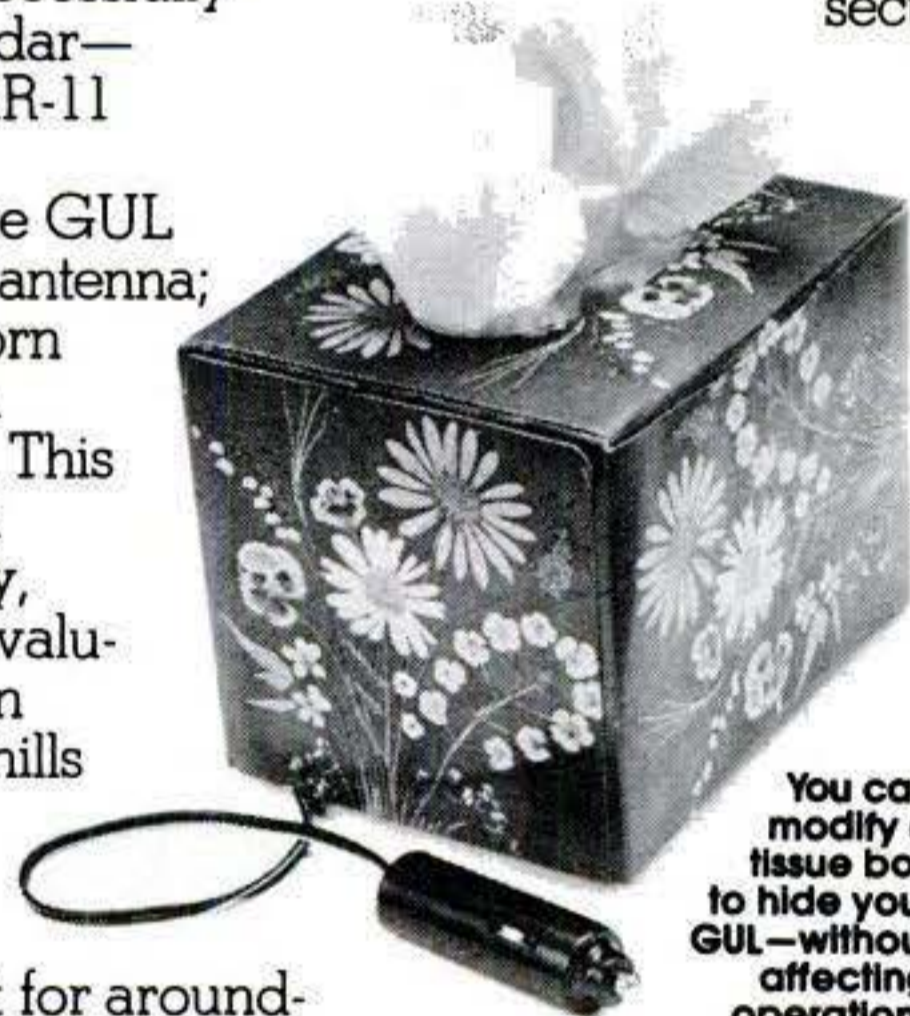
To mount, simply fasten the adhesive Velcro pad to the top of your dashboard; a matching Velcro foot (on bracket) keeps the unit securely anchored. This

Velcro mounting allows for easy removal in seconds to prevent theft (the unit is even small enough to be stowed in any glove compartment). To supply power, simply plug it into your cigarette lighter.

Try it yourself.

Order the GUL Micro Scan today. Road test it for yourself. If you don't find it to be the finest electronic counter-intelligence you can own, return it within two weeks

for a courteous refund. The Sharper Image guarantees your satisfaction. Comes with complete instructions and 120 day warranty.



You can modify a tissue box to hide your GUL—without affecting operation.

ORDER NOW TOLL-FREE.

Please order product #131. Credit card holders may use our toll-free number below. Or send check for \$95 plus \$2.50 delivery. In California, add \$6.17 sales tax.

800 227-3436

In California 800 622-0733

THE SHARPER IMAGE™

260 California St., Dept. BB— 051
San Francisco, CA 94111
(415) 788-8880

©1980 The Sharper Image

Shuttle setbacks

[Continued]

tions that destroyed the bearing. Rocketdyne remedied that problem by stiffening the bearing to make it more resistant to vibrations.

And there were literally dozens of other problems, both with the turbo-pumps and with other parts of the engine. Some of the trouble goes back to money. NASA opted for a less-expensive program of testing whole engines rather than individual components. The result was too often extensive damage when something failed.

That's what happened last November. The original failure was traced to a secondary seal in the oxygen-fuel turbopump. The seal allowed oxygen into an internal cavity where it couldn't escape. Pressure soared and the automatic monitoring system shut down the engine and its two mates almost instantly.

"There was little or no damage from the seal failure," Johnson said.

But one engine was damaged beyond immediate repair by what happened next. The inner lining of the Shuttle engine's bell-shape lower unit, or nozzle, is cooled by liquid hydrogen flowing down through scores of small pipes. The sudden shock of engine shutdown was too much for the cooling system. A weld broke (see photo), pure hydrogen spewed out, and an intense fire engulfed the engine. It was put out very quickly, but not before the engine had suffered major damage.

Rocketdyne already had planned a modification to forestall exactly that

sort of thing. But it came too late to salvage the November trial and added another five-week delay to engine testing.

Command computer

Virtually every Shuttle problem, every new test result, and every design change feeds back into the Orbiter's incredible software package, the central program that directs the craft's five onboard computers. The system is so advanced that the astronauts have direct control over only two functions—lowering the landing gear and stepping on the brakes after touchdown.

Everything else can be done by computer.

But that means that the programming must take into account every factor, even the most insignificant, that can affect Orbiter operations. It means reprogramming pieces of the software every time a test result comes in that's different from the original specifications.

And that happens constantly.

One of the latest revisions came only after combined testing of all three main engines began. In the original plan, the computers started the three engines simultaneously for lift-off from the launch pad. When they did, bulkhead pressures soared dangerously.

"It was like exploding three stacks of dynamite under there," said Bill Madden of IBM's Federal System Division in Houston. "We had to rewrite

the program to start the engines at 40-millisecond intervals."

That kind of precision timing is typical of what it takes to program the Orbiter's computers. It takes more computer instructions to get the Orbiter safely through reentry than it took to get Apollo home from the moon.

More than 600,000 lines of computer code have been written and are stored on tapes carried aboard the Orbiter. Most of the work was done by IBM, which at one time had more than 400 highly skilled programmers on the job.

This massive computer program literally runs everything aboard the Orbiter. It handles guidance and navigation, propulsion, attitude control, lift-off, landing, and on through a seemingly endless list.

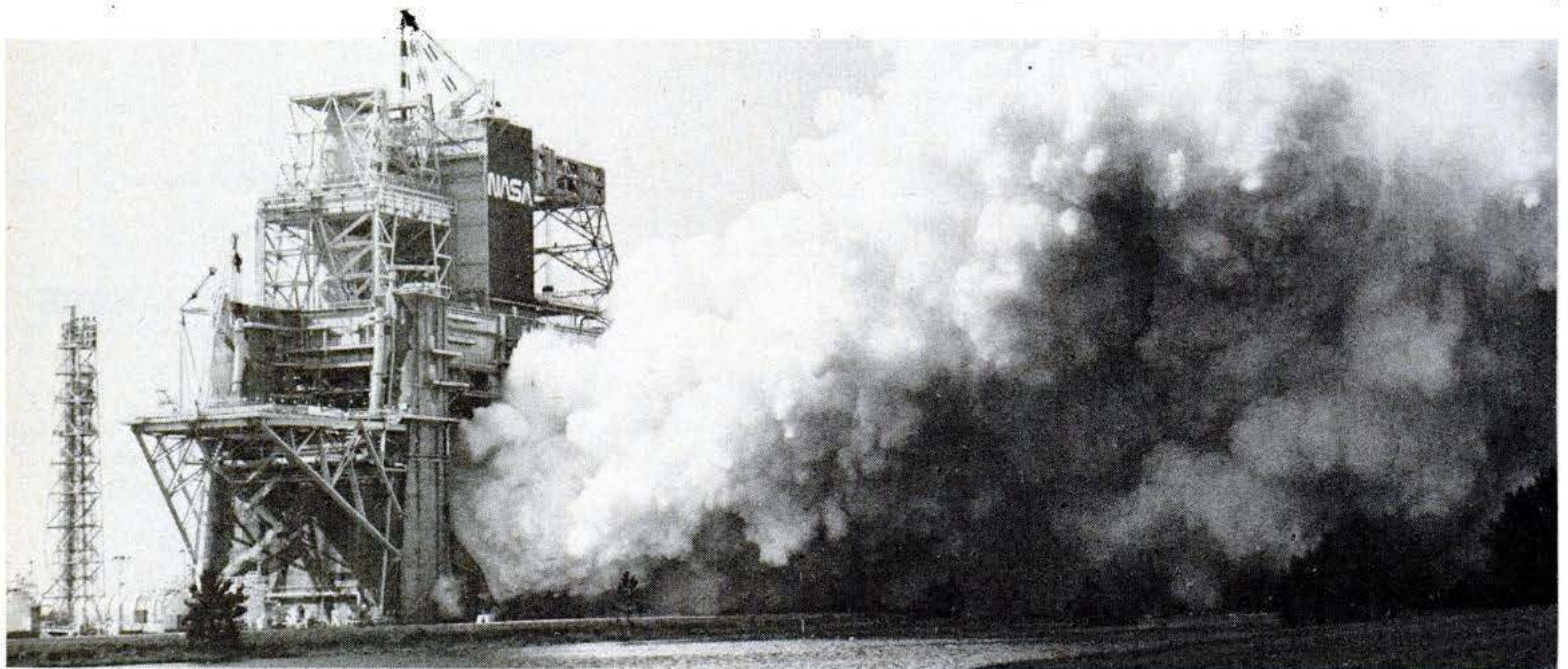
"The software is the nervous system of the thing," Dr. Ken Cox, who manages software development at Johnson Space Center, told me. "That's what makes it work."

And that's why the computer program is never quite ready.

"We're continually finding out things about the hardware that hadn't been considered before," Madden said.

For instance, testing of the small reaction-control jets that shift the Orbiter's attitude in space turned up the fact that a minimum blip of the thruster lasts about 160 milliseconds. It doesn't sound important, except

Continued



Smoke billows from Shuttle main engines after a premature shutdown during tests. Scheduled to fire for 510 seconds, the

three-engine cluster lasted only nine seconds before a malfunction cut it off—causing a damaging engine fire (see text). By

late 1979, the same engines had successfully fired for 540 seconds—more than enough to get the Shuttle into orbit.

Before you spend any money for a new wagon, see what Oldsmobile's had built for you.

zinc-rich layer of primer. One slam of the doors will help tell you... Olds Wagons are built.

They're also very economical. They offer impressive mileage and range estimates. The EPA estimates below are for our available diesel V8.

These wagons also have Oldsmobile luxury through and through. Power steering, power brakes, automatic transmission and rich upholstery are but four of many standard features. And available options include nearly everything you would expect from a luxurious car. After all, these are the Oldsmobiles of station wagons.

See your Olds dealer. Compare price, mileage, engine choices, resale, luxury. Compare everything you want in a station wagon.

We think you'll be very satisfied with the station wagon Oldsmobile's had built for you.

These are two of our 1980 Cruisers, the mid-size Cutlass Cruiser Brougham on the left and the full-size Custom Cruiser on the right. If you're looking for a wagon that'll give you solid value and loads of utility, you're looking in the right direction.

These are Oldsmobiles. You know they're solidly built. The ride is tuned to give you a quiet smoothness you might not expect from a station wagon. Corrosion is combated with galvanized metals, plastisol, aluminum-impregnated wax under-coatings and a



Cutlass Cruiser Diesel

22	400	34	618
EPA Est. MPG	EPA Est. Range	Hwy. Est.	Hwy. Range

Custom Cruiser Diesel

21	462	31	682
EPA Est. MPG	EPA Est. Range	Hwy. Est.	Hwy. Range



WE'VE HAD ONE BUILT FOR YOU.

Remember: The boxed EPA estimates are for comparison to other cars. Your mileage and range depend on your speed, weather and trip length; your actual highway mileage and range will probably be less than the highway estimates. Driving range estimates are obtained by multiplying the EPA and highway estimates by the standard fuel tank capacity rating of 18.2 gallons for Cutlass Cruiser—22.0 for Custom Cruiser. DIESELS NOT CURRENTLY AVAILABLE IN CALIFORNIA. Oldsmobiles are equipped with GM-built engines produced by various divisions. See your dealer for details.

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

©1980 B & W TObacco CO



The Vantage Point

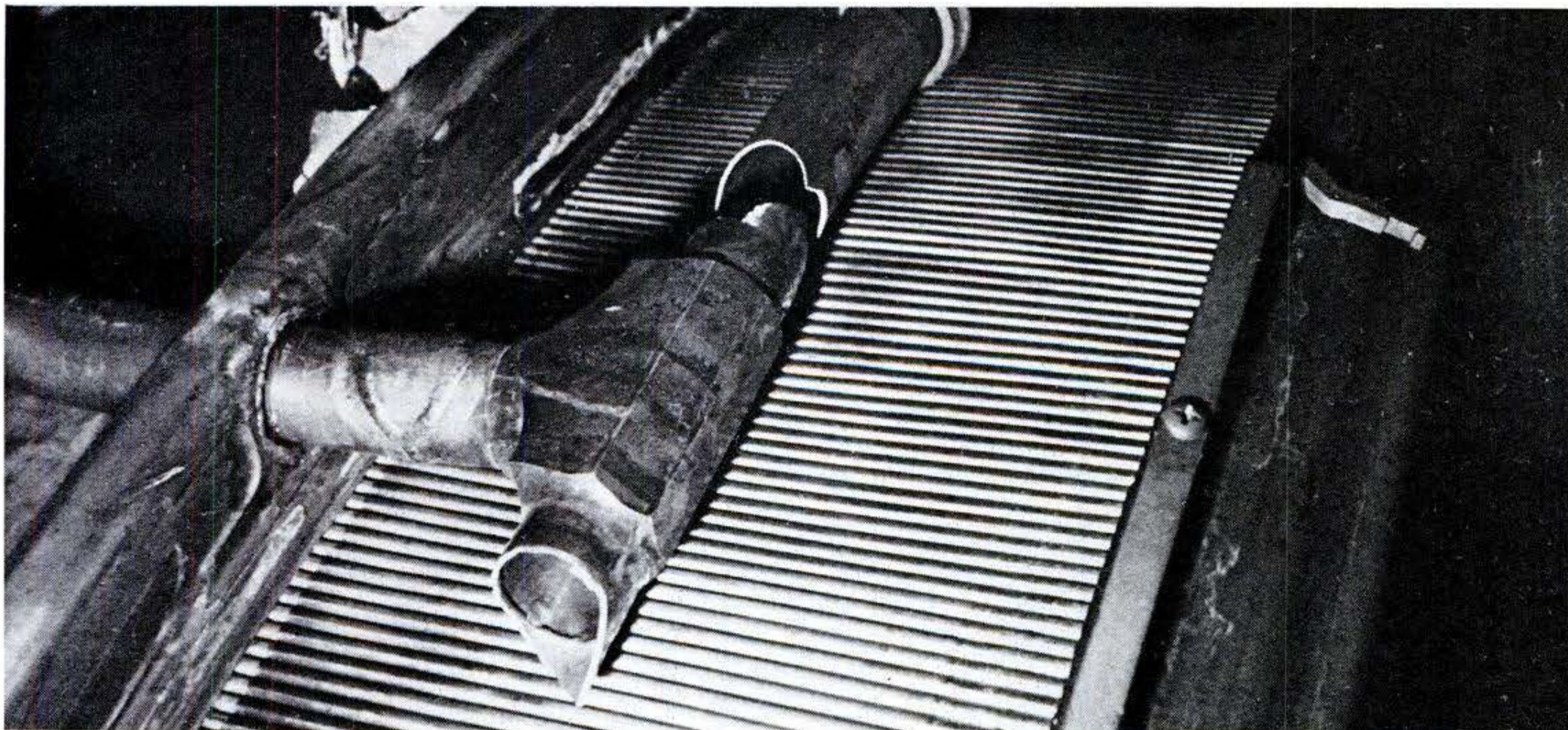
Where great taste and low tar meet



FILTER 100's: 10 mg. "tar", 0.8 mg. nicotine, FILTER, MENTHOL: 11 mg. "tar", 0.8 mg. nicotine, av. per cigarette, FTC Report MAY '78.

Shuttle setbacks

[Continued]



Broken pipe is part of collection system for Shuttle engine's hydrogen coolant. The T-shape pipe funnels used coolant to

the combustion chamber where it aids firing. When welds bordering the T broke, the engine didn't get enough hydrogen,

and so ran oxygen-rich during shutdown. Result: a serious fire. Weld failures have been traced to use of wrong welding rod.

that the programming called for even quicker blips. A rewrite became necessary.

Just the simple act of firing one of those thrusters requires major computer intervention. Here's a vastly simplified version of what happens when an astronaut wants to change which way the Orbiter's nose is pointing.

A digital signal from the astronaut's rotational hand controller actuates the computer, which then checks back with three transducers in the hand controller. If the signal is verified (still "on"), the middle-value transducer signal becomes a command to the computer to pitch, roll, or yaw the ship.

Now the program races through a series of questions. Which reaction control pod should be fired? (Any one of four could do the job.) Which pod was fired last? (Select them in order to help spread around the wear-and-tear.) Now which jet in that pod is needed? (Pick the proper one for the movement required.)

Finally, the best jet is selected and a firing command goes out from the computer. The whole sequence takes 16 hundredths of a second.

Now the program asks whether or not the thruster actually fired. If it didn't, a new 0.16-second sequence to fire another thruster begins. The computer makes a note of thruster failure and eliminates that jet from future consideration.

That's just one small activity. There are thousands like it that keep an Orbiter working.

"The program is so extensive that nobody can know every detail," said Rockwell's Dr. John Peller. "No computer program ever had to work for a rocket, a spacecraft, an entry vehicle, and an airplane."

By mid-winter of 1979-80, programmers still struggled with rewrites to get the Shuttle flying.

"When the aerodynamics change, we go back and rewrite software specifications to make it right," Cox said. "When the structure guys have a problem, they strengthen a strut. But it adds weight and it ripples in to our stuff."

Hazardous poundage

Weight gain affects more than the computer program, Shuttle engineers discovered. Using the latest data, including every design change so far performed, they unearthed a frightening fact.

"We have an understrength condition," Jim Johnson of Rockwell said. "Our new flight-load data, combined with temperature data, show that at some trajectories, this overloads the airplane."

"It would break."

The news sent tremors through the astronaut office in Houston and had NASA and Rockwell teams scampering to find a way to fix their weakened ship. The problem, Johnson said, developed slowly throughout the past few years.

The Orbiter was designed to perform a 2.5-G maneuver during landing. But then it put on weight. That added stress. Heat loads went up a lit-

tle. That reduced body strength.

Most of the problem was in the Orbiter's mid-fuselage, just where it's hardest to reach. That area already was filled with wire bundles, black boxes, pipes, tubes, and insulation. And the required fix called for installing clips and stiffeners on a large number of T-shape struts that give strength to the ship's skin.

It would be at least a month's work, maybe more. And of course, it would all ripple back into the computer program.

Similar stiffening was needed on a number of wing struts. But since workers could simply walk inside the empty wing and do the modification quickly, there was little impact on the schedule.

But instead of building the Orbiter's strength back up to a 2.5-G tolerance, the added fortifications will give the present craft a tolerance of only 2.0-2.2 G, Johnson said.

"It's a classic problem in airplane design," Johnson explained. "We designed for a set of loads generated four years ago and now we've learned more about them."

The new data already are being applied to other Orbiters being built. Their T-struts are being machined a little thicker to bring the G-loading back up to 2.5 G. But in the meantime, it's just one more problem that helps drive up costs and further delay schedules.

For this first of a new breed of spaceship, that's now a familiar story. Until the Orbiter flies, that part of the story won't end.

ES

ADVENTURES IN ALTERNATE ENERGY

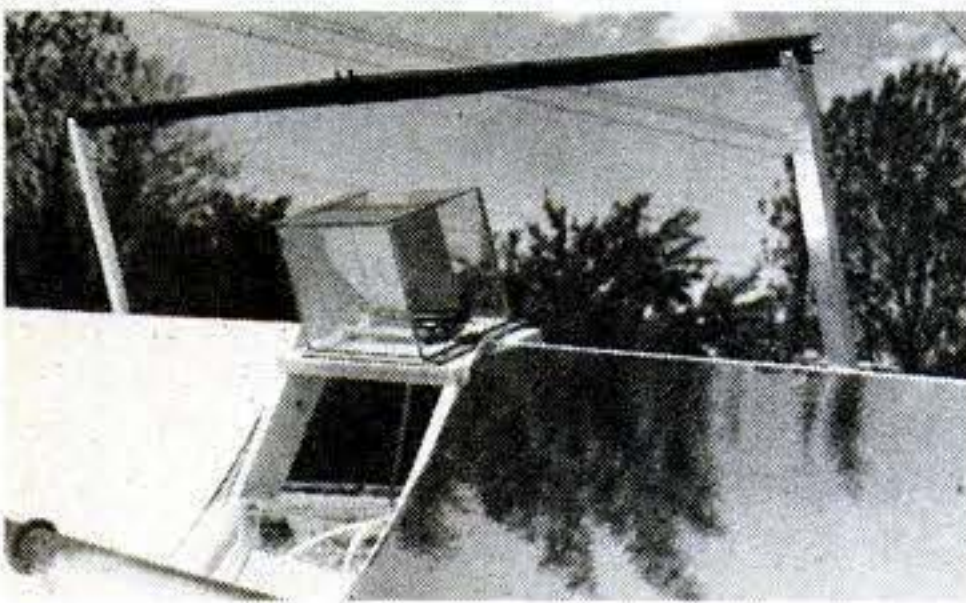
A bimonthly sampling of projects PS readers have devised to conserve or replace fossil fuels

In Albuquerque concentrating collectors put out 120°F water

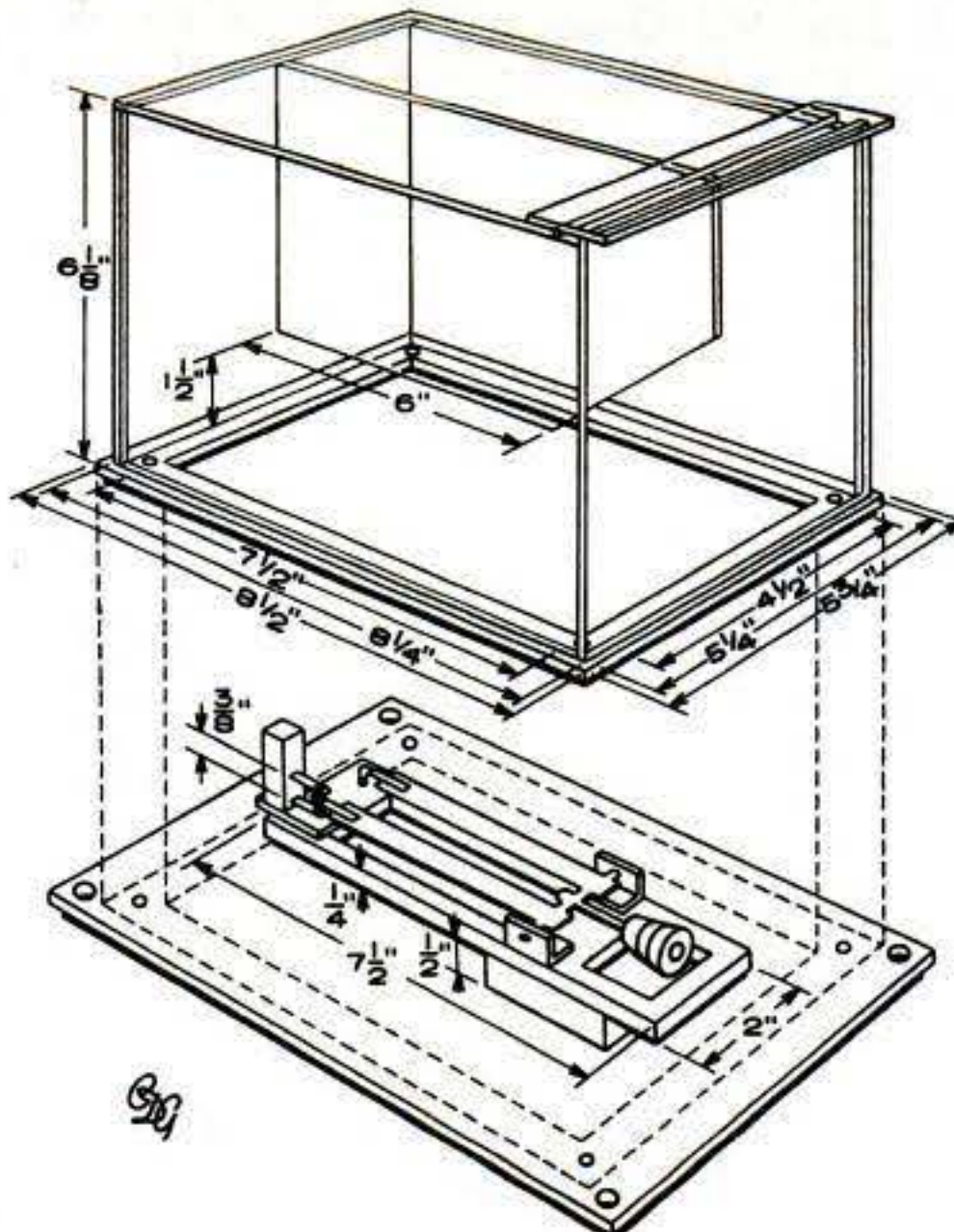


Solar do-it-yourselfer Robert Stromberg, head of Sandia Labs' Solar Technology Liaison Div., is shown above with his home-built concentrating solar collectors.

Plywood ribs support the 55-square-foot parabolic-trough-type collector. Wood-framed supports are mounted on flat roof of Stromberg's home.



Tracking-sensor assembly: The black bar casts shadow on bimetal strips in glass box, which actuate a motor to keep the shadow centered (also see drawing).



By **RICHARD STEPLER**

There's no denying the popularity of the solar hot-water heater as a favorite project among alternate-energy do-it-yourselfers. Since "Adventures in Alternate Energy" began five years ago in the April 1975 issue of *POPULAR SCIENCE*, we've received countless entries from readers who have devised their own solar hot-water systems.

We kicked off coverage in the May '76 issue with "Five Solar Water Heaters You Can Build." Other systems were featured in this series in Sept. and Dec. '76; May and Dec. '77; April, June, July, and Sept. '78; and most recently in the January '79 issue.

For the most part, the readers' systems we've reported on used flat-plate solar collectors to absorb the sun's energy. But at least one PS reader thinks that concentrating collectors are a better choice for heating domestic water. He is Robert P. Stromberg, head of Sandia Laboratories' Solar Technology Liaison Division. Stromberg has designed and built a solar concentrating system that supplies most of the hot-water needs for his home in Albuquerque, N.M.

"Concentrating solar collectors are more efficient when the weather is cold or the sun angle is low in the morning and evening," says Stromberg, "because the area losing energy is a small pipe instead of a large-area flat surface." Stromberg believes that concentrating systems have not been popular among do-it-yourselfers because "many people think the need to continuously move the concentrator to point it toward the sun will make it unreliable and too costly."

Stromberg's solar concentrator system, he claims, is easy to build, uses reliable parts, and costs no more than solar water-heating systems with flat-plate collectors. Stromberg's complete system actually cost \$512.36.

He cites an example as proof of the solar concentrating system's better performance: "At noon on a bright day, when the sun is delivering 1000 watts per square meter, my collector performs about as well as a good flat-plate system and collects about 60 percent of the energy it receives. But as the sun's angle changes in the morning and evening, especially in the winter, the concentrating collector is much more efficient. In winter, when the sun's strength is reduced to half, my collector is still 40 percent efficient, while a good flat-plate collector is down to about 23 percent. The flat plate quits completely at about 350 watts, but my system continues to deliver 120-degree-F water down to about 180 watts.

Continued

Copyrighted material



We wouldn't trust this job to anything but a Crescent.[®]

If I strip these nuts, it'll probably cost more for the plumber to fix what I did, than to fix what went wrong.

That's why we won't trust this job to anything but a Crescent adjustable wrench and Crescent adjustable pliers.

My Crescent wrench adjusts to snug down tight on any size nut or bolt, so there's less chance for slipping.

And my Crescent pliers have "locking grooves" so I can adjust them for small, medium, or large size pipes or connections.

But be careful. Not every adjustable wrench or pliers is a Crescent. You'll find

Crescent products where they keep all the quality tools from Cooper the Toolmaker: the Cooper Tool Center in your local store.

Look for Cooper next time you need tools you can depend on.



Boker • Crescent • Lufkin • Nicholson • Weller • Wiss • Xcelite
Friends you can trust...from Cooper the Toolmaker.

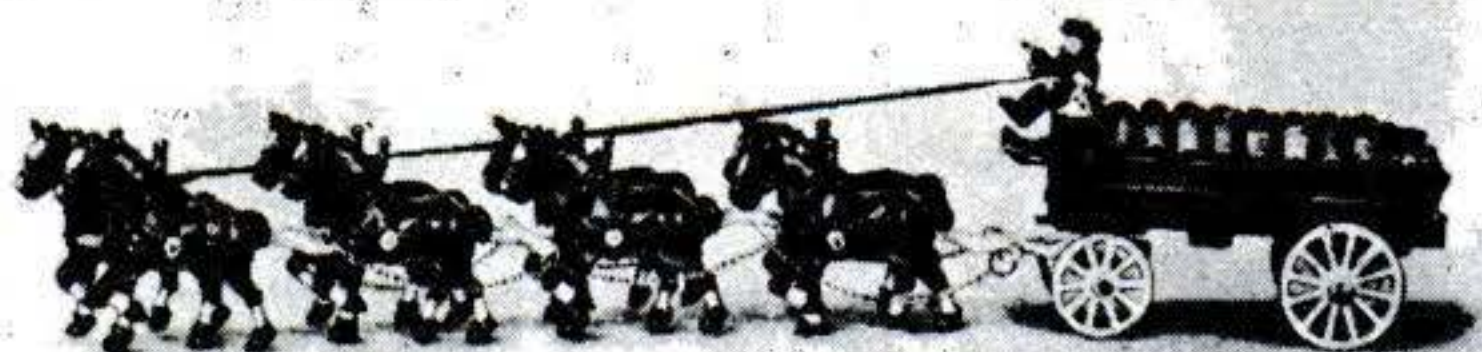


OUR FAMOUS CLYDESDALE'S ON PARADE

ORDER

BY

MAIL!



Our authentic cast iron Beer Wagon is a classic replica/investment for the collector. 8 chunky cast iron Clydesdale horses pull a vividly hand-painted wagon with 27 individual wood barrels. Complete with drivers, reins and dog. 31" overall. Weighs 14 lbs. Looks striking on a Bar, Mantlepiece or Television set. Makes a perfect gift. Although similar wagons sell for \$70-\$80 in gift shops, our price is \$32.95 ea. plus please add \$3.00 for shpg. Mass. residents please add 5% sales tax.

... SPECIAL PREMIUM OFFER ...

Mention this ad with your order and we will send you FREE a set of BUDWEISER salt and pepper shakers. Send your check to: (If Master Charge or Visa, card No. & exp. date)

HIGHLANDER HOUSE Dept. PS1 70 Main St. (617) 665-3581
MELROSE, MASS. 02176

Concentrating collectors

[Continued]

"Some people argue that a concentrating collector uses only the beam from the sun," continues Stromberg, "and that flat-plate systems also use the scattered or diffuse energy from the bright sky. A greenhouse or passive-solar home can use this energy, but hot-water systems simply don't work unless there is visible sun." So, concludes Stromberg, the argument doesn't apply to hot-water systems that must produce a fairly high temperature.

Construction of the system is relatively simple, reports Stromberg. Plywood ribs support the parabolic trough; they're attached to a frame that pivots on standard pipe fittings. Stromberg attached sheet metal to the ribs to form the trough, then covered that with an aluminized acrylic plastic film to produce a highly reflective surface. The absorber tube, positioned at the focal point of the trough, is one-inch-diameter iron pipe painted black.

Stromberg's driving and tracking systems are ingenious: "An automobile power window turns a piece of threaded rod, moving a nut to drive the trough into position," he explains. "Pieces of bimetal, placed in a protective glass box, are arranged so the sun's rays heat two pieces on opposite sides of a shading device, and actuate the motor to keep the trough pointed toward the sun." The motor runs one-fiftieth of the time, reports Stromberg, consuming about one watt.

A circulating pump and a differential thermostat were Stromberg's major purchased parts. He reports that the system has performed well since completion in April 1978: "The troughs have an effective area of 55 square feet and produce 60 gallons of 110-to-120-degree-F water on a clear Albuquerque day most of the year, dropping to 30 to 40 gallons in mid-winter."

Robert Stromberg will answer readers' questions if accompanied by a stamped, self-addressed envelope. A detailed set of plans is available for \$6.50 from Stromberg Enterprises, 1029 California St. S.E., Albuquerque, N.M. 87108. PS

Your idea may bring you \$200

Every other month, we present a project developed by a PS reader and pay the inventor \$200. To enter, send us black-and-white glossies (one photo should show you demonstrating the device), plus a description and sketches. Include your name, address, and social-security number. No material can be returned unless you enclose a stamped, self-addressed envelope.

Since space won't permit us to present projects in detail, we'll expect inventors to answer any reasonable query from readers, if it's accompanied by a stamped envelope.

Mail entries to Energy Adventure, POPULAR SCIENCE, 380 Madison Ave., New York, N.Y. 10017.

BRING ON YOUR TOUGH JOBS



Mow 3 acres in an hour. Plow 8" deep. Front load 1/2-ton bucket loads into a pick-up. Till, cultivate, bulldoze, blow snow...get your tough jobs done fast!

Power King's dependable cast iron engine provides high-torque workpower. Rugged, all-gear drive delivers nearly 100% of engine power to big, ground-gripping drive wheels...squeezes more work out of every drop of fuel. Ground clearance up to 19" lets you cultivate tall crops and work in rough ground.

Get American-made Power King in 12, 14, 16 and 18 hp models and over 20 man-sized attachments. See your Power King Dealer for a test drive or write for free catalog.

POWER KING

ONE TOUGH TRACTOR

ENGINEERING PRODUCTS CO., INC. 1005-A-4 ANOKA AVE., WAUKESHA, WI 53186

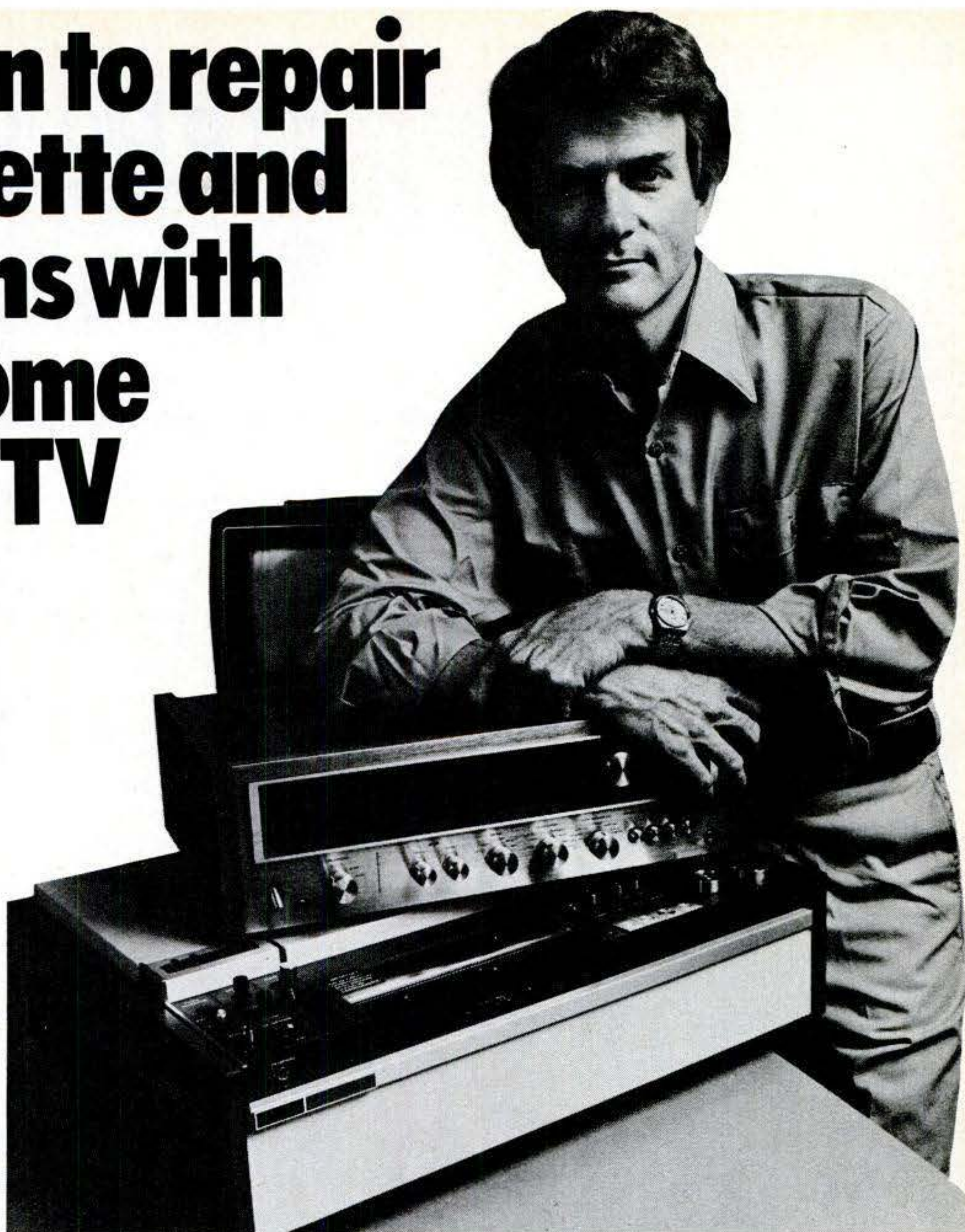
C-71

NOW! Learn to repair video cassette and disc systems with NRI's at-home training in TV and Audio Servicing.

Keep up with opportunity by keeping up with the state of the art. Learn to service and repair color TV, audio systems, video cassette and disc systems with NRI training. Prepare for extra income, a new career, even a full- or part-time business of your own.

Learn at Home in Your Spare Time

You learn right at home, at your convenience, without quitting your job or going to night school. NRI "bite-size" lessons make learning easier...NRI "hands-on" training gives you practical bench experience as you progress. You not only get theory, you actually build and test electronic circuits, a complete audio system, even a color TV.



Build Color TV with Computer Programming

As part of your training in NRI's Master Course, you assemble and keep NRI's exclusive, designed-for-learning 25" (diagonal) color TV, the only one complete with built-in computer tuning that lets you program an entire evening's entertainment. As you build it, you introduce and correct electronic faults, gain understanding and practical experience.

You also construct a solid-state stereo amplifier and tuner, complete with speakers. You even assemble professional test instruments, so you know what makes them tick, too. You build a transistorized volt-ohm meter... a CMOS digital frequency counter... integrated circuit TV pattern generator... even a solid-state triggered-sweep 5" oscilloscope. You use them in your course, keep them for actual TV and audio servicing work.

Free Catalog... No Salesman Will Call

Send today for the 100-page catalog that shows all the lessons, all the equipment and training material you get. The catalog will show you other NRI opportunity fields like the new course in Microcomputers & Microprocessors, Complete Communications, and more. With the addition of video cassette and disc systems, television has taken on an exciting new dimension. NRI training can put you right in the center of that dimension.

If card has been removed, write to:



NRI Schools
McGraw-Hill Continuing
Education Center
3939 Wisconsin Avenue
Washington, D.C. 20016

For a big family or a heavy load: full-size cars

PS ratings— test report in a nutshell

The ratings are based on test results and measurements. Results should be read with the understanding that they reflect tests only on our sample cars. An excellent rating is 5 points; very good, 4; good, 3; fair, 2; poor, 1; very poor, 0.

	Buick LeSabre	Chevrolet Caprice	Ford LTD	Plymouth Gran Fury	Pontiac Bonneville
Acceleration	5	5	5	5	3
Braking	3	3	2(4*)	3	2
Handling	5	3	3	3	3
Maneuverability	5	4	4	4	4
Ride comfort	5	5	5	5	5
Quietness	3	3	4	2	3
Roominess	4	4	4	4	4
Visibility	2	2	2	3	2
Entry/exit ease	5	4	5	3	4
(EPA economy)	2	2	2	2	4

*With transmission in third gear

By **JIM DUNNE** and **ED JACOBS**
PHOTOGRAPHS BY GREG SHARKO

Fuel-efficient cars are getting all of the headlines these days, and you seldom hear about anything else. While it might seem that full-size cars have just about become extinct, that's not the case. Plenty of people are still buying them—many because they need a big car. They might have a big family or need to tow a boat or recreational trailer. Maybe they car-pool or have a job that requires carrying bulky literature and samples.

This month, we tested five repre-

sentative models, with a cross section of available engines and transmissions: Chevrolet Caprice, Buick LeSabre, Ford LTD, Plymouth Gran Fury, and Pontiac Bonneville. Along the way, we found a potentially dangerous design flaw in the Ford's transmission and a serious assembly-line oversight on the Chevrolet, but we also found markedly improved fuel economy, performance, and handling throughout.

Ford LTD

Ford's most significant engineering development this year has been its

Continued



Improved fuel economy and more interior space mark contemporary full-size cars (clockwise from foreground): Buick LeSabre, Plymouth Gran Fury, Pontiac Bonneville, Chevrolet Caprice, and Ford LTD.

Ion Fountain™

**YOUR ULTIMATE AIR FRESHENING/
IONIZING SYSTEM. TOP QUALITY.
LOW PRICE. STATE OF THE ART.**



Breakthrough. The new Ion Fountain™ is in a class by itself. This negative ion generator gives you power to saturate your home or office with billions of refreshing ions. Without fans or any moving parts it puts out a pleasant breeze. A pure flow of ions pours from the top like water from a fountain, filling your room. The result? Your air feels like fresh ocean air—pure, crisp, and wonderfully charged.

The price? **Only \$79.95.** That's a price breakthrough because no other company can offer you a unit with higher ion output or better quality than the Ion Fountain™, even at triple our price.

HOW CAN WE DO IT?

Six years of experience helps. Plus a lot of ingenuity, aggressive research and a personal commitment to give our customers the best we can.

UTP Ion Research Center is a branch of our educational publishing company. And our commitment in publishing to give birth to new ideas and methods that enrich humanity is part of the Ion Research Center too. We're in business to serve you and your environmental needs.

WHAT ARE IONS?

Ions are electrically charged atoms in the air with either a positive or negative charge. The sun and cosmic rays as well as lightning and fast-moving water (like waterfalls, surf) generate trillions of negative ions every day. The more negatively ionized the air, the fresher and more alive it is. Air pollution, artificially controlled climates (with air conditioning and heating) and electronic equipment all produce excess positive ions, depriving the air of these small negative air ions and creating dead "stuffy" air.

WHAT'S THE SOLUTION?

Our rapid-growth technology, which sometimes takes its toll on the quality of our air, has also come up with the solution. Following Nature's model of the thunderstorm which uses a high electrical charge to purify, revitalize and stimulate the air, the UTP Air Energizer has been developed imitating this process. Both the thunderstorm and the Air Energizer fill the air with negative ions, restoring the natural electrical balance to the polluted, energy-depleted air. But the Ion Fountain can be used indoors in the home, office, workshop, laboratory, etc., keeping a fresh supply of ionized oxygen available night and day. This new breakthrough in fresh air control is not a cover-up

which masks or deodorizes. The unit actually removes the dust, smoke, bacteria and pollen particles from the air by attaching ions to them and causing them to sink to the earth where they can be vacuumed up rather than inhaled. At the same time ions electrically stimulate the energy-stripped air.

YOUR CHOICE OF TWO TOP-QUALITY UNITS!

There's only one unit that's better than the Ion Fountain. That's our own Executive System Four™. It sells for \$159. It has an even higher ion output. Plus! Our special **Dial-An-Ion** feature allows you to adjust the ion output anywhere from low to high. Not everyone knows that the need for ions varies. A large smoky room will require higher output than a small room. And some people want fewer ions while sleeping than while working. The new Executive System Four is our answer to this need for output flexibility.

FACTS YOU NEED TO KNOW The Ion Fountain™—System Five

Ion density: 430,000 ions per cm³/sec. at 1 meter. 1.55 million ions per cm³ at 50 cms.
Use: Large room or office—9000 cu. ft.
Warranty: 1 year
Output voltage: 15KV
Ozone: Less than 2 parts per billion
Dimensions: 5 3/8" x 4 1/4" x 2 3/8"

Executive System Four™

Ion density: Low to maximum of 540,000 ions per cm³ at 1 meter. 1.6 x 10⁶ ions per cm³ at 50 cms.
Output voltage: 15KV
Ozone: Less than 2 parts per billion
Dimensions: 11" x 5" x 4"
Use: Large room or office 10,000 cu. ft.
Warranty: 1 year

If the Executive System Four is better, why did we bring out the Ion Fountain? Not everybody is willing to pay \$159 for an air ionizing unit, no matter how good it is. Just like not everyone drives Rolls Royces. Most drive less expensive cars. The Executive System Four is for the person who wants the

absolute best quality and doesn't mind paying a little extra to get it. If you want highest ion output, flexibility, and a beautiful oak paneled case, buy the Executive System Four.

If you want something at half the price of the Executive System Four, but still better than any other units costing up to \$250, buy the Ion Fountain.

HOW TO GET ONE

To place your order now just send a check for \$79.95 plus \$3 shipping for the Ion Fountain. Or send \$159 plus \$4 shipping for the Executive System Four. Tell us your full street address as we cannot ship to Post Office boxes. (California residents add 6% sales tax.)

Our unit is dependable and trouble-free, but if by rare chance any problems occur our service-by-mail center sends off your unit within 24 hours of receipt or sends a replacement so you are not without fresh air and can enjoy your dust-free environment. And each Air Energizer is backed by a full one-year limited warranty.

HOW TO GET ONE FAST

Credit card holders can call our toll-free number below. Order a unit now and if you are not satisfied with its effects within 10 days simply return it for a full cash refund. Order your Air Energizer today.

UTP

Read "The Golden Egg"

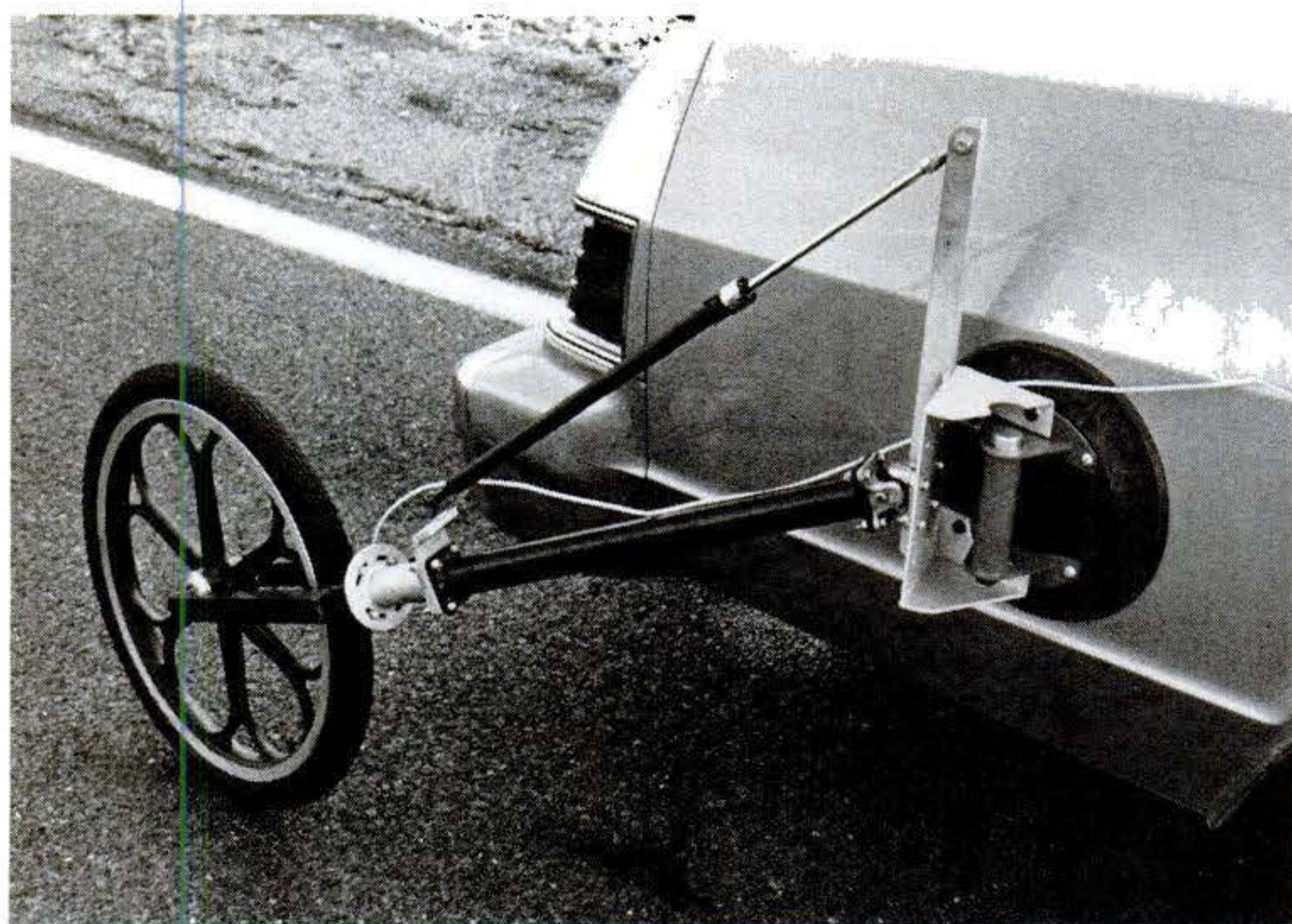
University of the Trees Press
ION RESEARCH CENTER, Dept. PS4
Box 644 BOULDER CREEK, CA 95006
Call Toll-Free . . . 800-538-0750
In California call (408) 338-6663
Send check or use your Master Charge, Visa or American Express card.

DETECT YOUR IONS

This simple but accurate detector instantly gives you a reading of ion intensity.

The Econometer . . . (Pen Size) . . . \$7.50
[If ordering separately include \$2.00 for shipping.]

SURVIVAL! Spirulina is a new wonder food supplement higher in protein than any other natural source. Very high in other nutrients too. Find out how you can be a commissioned representative of the Light Force Family and distribute Spirulina in either bulk or as special vitamin supplements. Generous commissions and opportunities available. **Phone or write for your free information. (408) 338-9436.** Please do not use the toll-free number for information.



Large suction-cup mount holds distance-measuring fifth wheel to the sides

new four-speed Automatic Overdrive Transmission. It's a remarkably flexible unit that allows smaller engines to provide performance as good or better than last year's, while simultaneously giving sizable increases in fuel economy. We have been favorably impressed with it since Ford introduced it last fall [PS, Aug. '79] and throughout our long-term test of the redesigned Thunderbird [PS, Jan. '80]. In the course of the present test, however, we uncovered what we feel is potentially a dangerous problem:

During our normal brake-testing sequence (a time-consuming but essential segment of the PS testing program), we discovered that, in a high-speed panic stop in fourth gear, if the rear brakes were locked quickly, the engine stalled. This caused immediate loss of power-steering assist and, if the power brakes were pumped, almost immediate loss of their power assist. The result: a car that was difficult to steer and stop. In one test, the stopping distance was lengthened by 55 feet. (We determined this by repeating the test in third gear moments after discovering the problem.)

The problem is dependent on several factors: First, it happens only in cars with the automatic overdrive transmission. Second, it occurs only in fourth gear. Third, it happens only at speeds above approximately 40 mph. Fourth, our experience indicates that it occurs only when all of those conditions have been met *and* the rear brakes are both solidly locked almost immediately after initiating braking. If lockup is delayed, or if one rear

of cars whose faired-in bumpers prevent strapping the wheel to the rear bumper.

wheel doesn't lock, the engine doesn't stall.

The drive-train coupling arrangement of the AOT seems to be the culprit. As we reported in Aug. '79, in third gear, power flows from the engine to the transmission 40 percent through the torque converter (the usual coupling device in automatic transmissions) and 60 through direct, mechanical connection. That arrangement allows the torque converter to slip when the car or drive shaft and rear wheels stop, so the engine doesn't stall. In fourth gear, however, the engine-transmission coupling is 100 percent mechanical, and allows no slippage. The transmission's centrifugally operated governor is designed to disconnect the linkup when road speed falls below 35 mph, to allow the slippage that will bar stalling. If the rear wheels are solidly locked up too quickly, there isn't time for the governor to disconnect before the engine stalls. And there is no backup system. (Lockup torque converters on Chrysler products use the same disconnect system as Ford, but we noted no stalling in Chrysler cars under similar circumstances. Lockup converters on GM cars have two disconnect systems—one from manifold vacuum, and the other electrical, in conjunction with the brake-light switch.)

We advised both Ford and the National Highway Traffic Safety Administration of our findings and asked both to investigate. We also secured other AOT-equipped cars to see if we experienced similar results. We did.

Later, Frank Abar, Ford manager of design on the AOT transmission,

told Jim Dunne that during development AOT-equipped cars were tested on ice specifically to check for this effect, and the problem did not occur. In later conversations, Stuart M. Frey, chief vehicle engineer with Ford of North America, stated that, following our letter, he had tried several AOT-equipped cars and had experienced what we described about 60 percent of the time. At the same time, Thomas J. Feaheny, vice-president of car engineering for Ford of North America, told PS: "We consider it a driver irritant. We do not consider it a safety-related item." But he added that '81 models will have a fix for this. Feaheny also said that Ford had received no consumer complaints on the matter.

Aside from the major problem we have described, we found the LTD to be a good car, and would have no reservations about a non-AOT-equipped LTD, or one with a modified transmission.

The full-size Fords were resized last year, two years after the GM big cars, but that time wasn't wasted from a chassis standpoint. The LTD was the shortest car in this group, yet the roomiest, with no loss of comfort or interior quietness. With just the base suspension, it gave about the best combined ride and handling in the group. It also offered a commanding view of the road and an excellent driving position.

The steering, ride, and on-the-road handling were good, and markedly superior to the Caprice. We found the interior spacious, comfortable, and exceptionally quiet at highway speeds, with little or no wind noise. LTD has the biggest and most usable trunk in the group, with a deep well for tall items, and shares the highest towing rating with the LeSabre. We wouldn't have second thoughts about towing a 6000-lb. load with the LTD, although we would with the LeSabre. In addition, among the gasoline-powered cars, it delivered the best economy at 45 mph, and second-best at 55.

Chevrolet Caprice

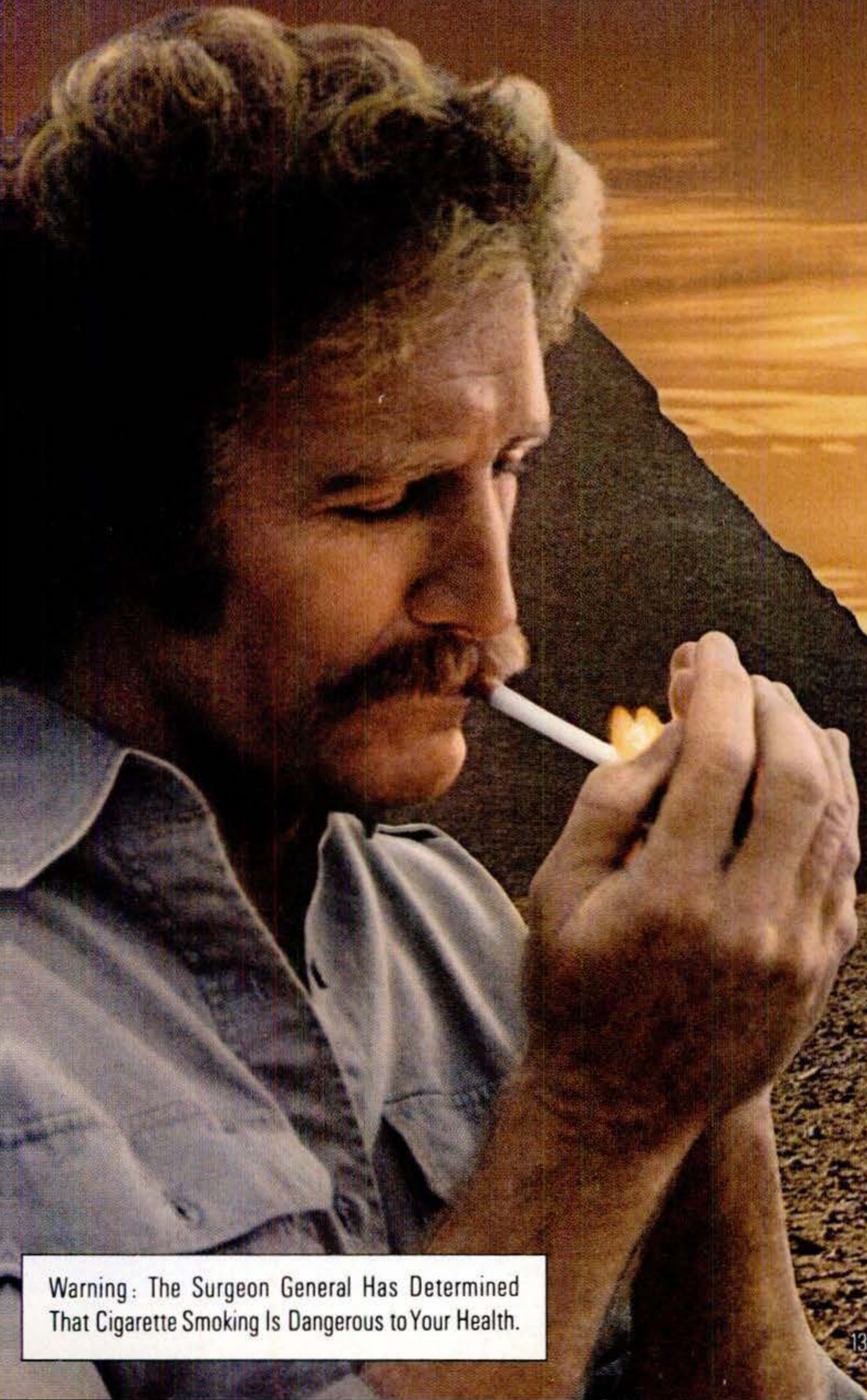
Prior to our track testing of the Caprice, PS Consumer Information Group Editor Herb Shuldiner noticed that the car was getting harder to steer. So we sent the car in for a check-up. Service personnel found that a pinch bolt for one of the steering tie rods was never tightened at the factory, and the tie rod was slowly unscrewing as the car was driven. Ultimately, it could have separated, and steering control would have been lost, although probably not before steering became so hard that almost anyone would have become concerned about

Continued

Discover satisfaction. Camel Lights.

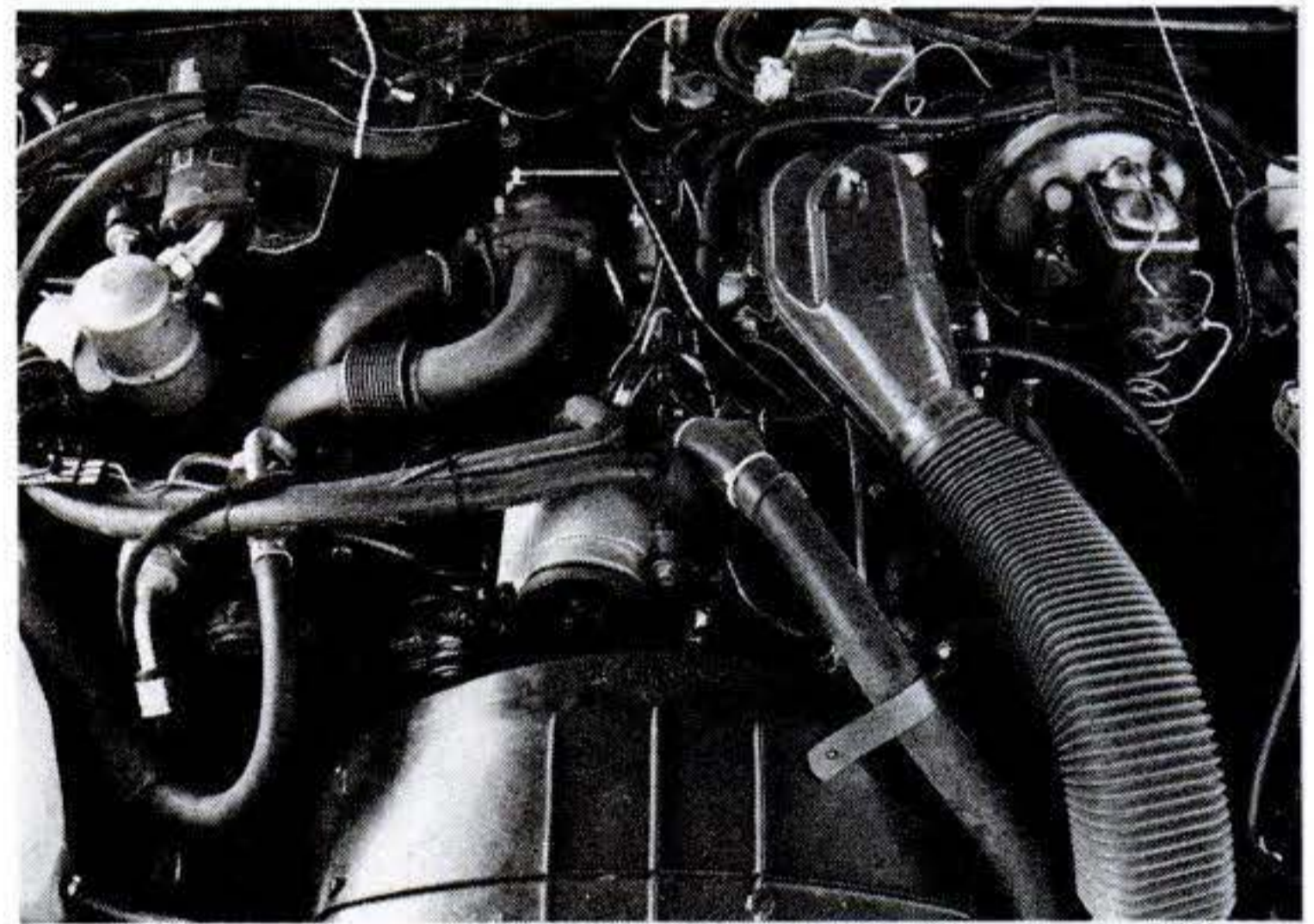
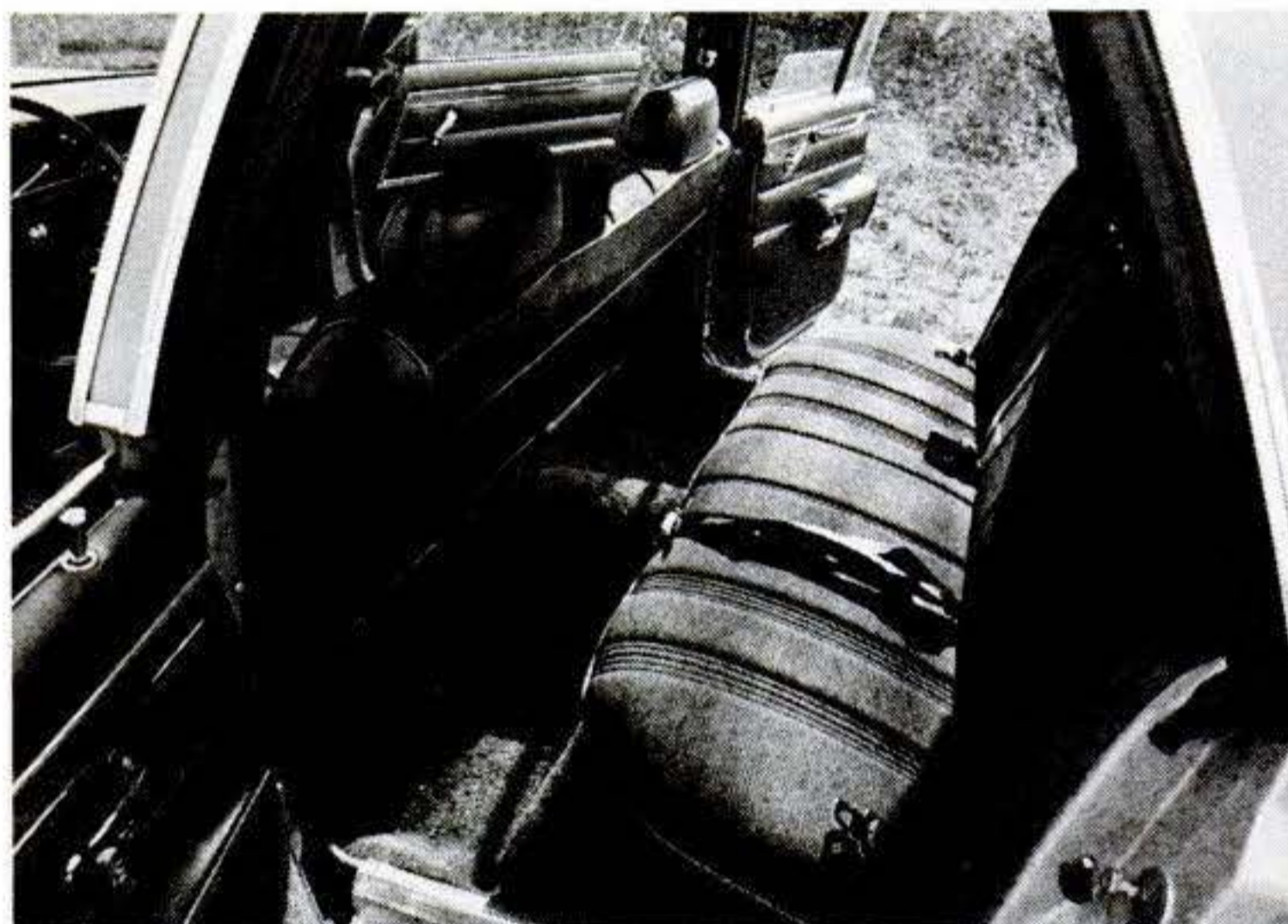
The Camel World of satisfaction comes to low tar smoking.

This is where it all started. Camel quality, now in a rich tasting Camel blend for smooth, low tar smoking. Camel Lights brings the solution to taste in low tar.



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

LIGHTS: 10 mg. "tar", 0.9 mg. nicotine, LIGHTS 100's: 13 mg. "tar", 1.1 mg. nicotine, av. per cigarette, FTC Report DEC. '79.



Gran Fury's spacious trunk (top left) is second largest in the group, although not quite as deep as might be expected. The front-seat room of all cars in our test group is very good, as author Dunne demonstrates in Caprice (top right). Rear-seat spa-

ciousness was close to that of the front seats, as seen in Gran Fury (bottom left). Familiar underhood snake's nest of turbocharged GM V6 (bottom right) makes LeSabre's routine maintenance tough, but is one price of a small, powerful engine.

it and had it checked by a mechanic.

As did its GM sisters in this test, the Caprice received some significant aerodynamic changes to its sheet metal for 1980. Under the skin, though, the GM cars all have still basically the same chassis introduced in 1977.

Ours was one of a group of about 20 identical cars built for a press demonstration of full-size economy, with drive-train components chosen solely for maximum economy. Without knowing we had begun a program of on-the-road economy testing, Chevrolet sent us one of these leftovers, which was obviously tuned to the last gnat's eyelash for economy because it pinged on the slightest upgrade. Aided by a lockup torque converter, the Caprice delivered the best gasoline-powered economy at 55 mph, and second-best in the other two speed categories.

For the first time in a long while, we received a large Chevrolet without the top-of-the-line F41 handling package, and were able to evaluate the car against some competitors' base sus-

pensions. While the car was a bit quicker in handling and maneuverability than the LTD on the track, its road manners weren't nearly as good. The steering was vague and imprecise, and the car was susceptible to both bump- and roll-steer (steering changes from hitting a bump, or the body rolling in a turn). It also wandered and required more attention than should have been necessary. And all of this came after the steering defect was corrected and the alignment adjusted.

The interior of our Caprice was luxurious, roomy, and comfortable. Like some of the others, it was so well equipped and upholstered that it might have successfully competed with some Cadillacs and Lincolns.

Buick LeSabre

The LeSabre Sport Coupe is a different kind of big car, one whose styling and performance lean decidedly toward sportiness. The car's striking appearance results partially from its being the longest, lowest, and narrowest

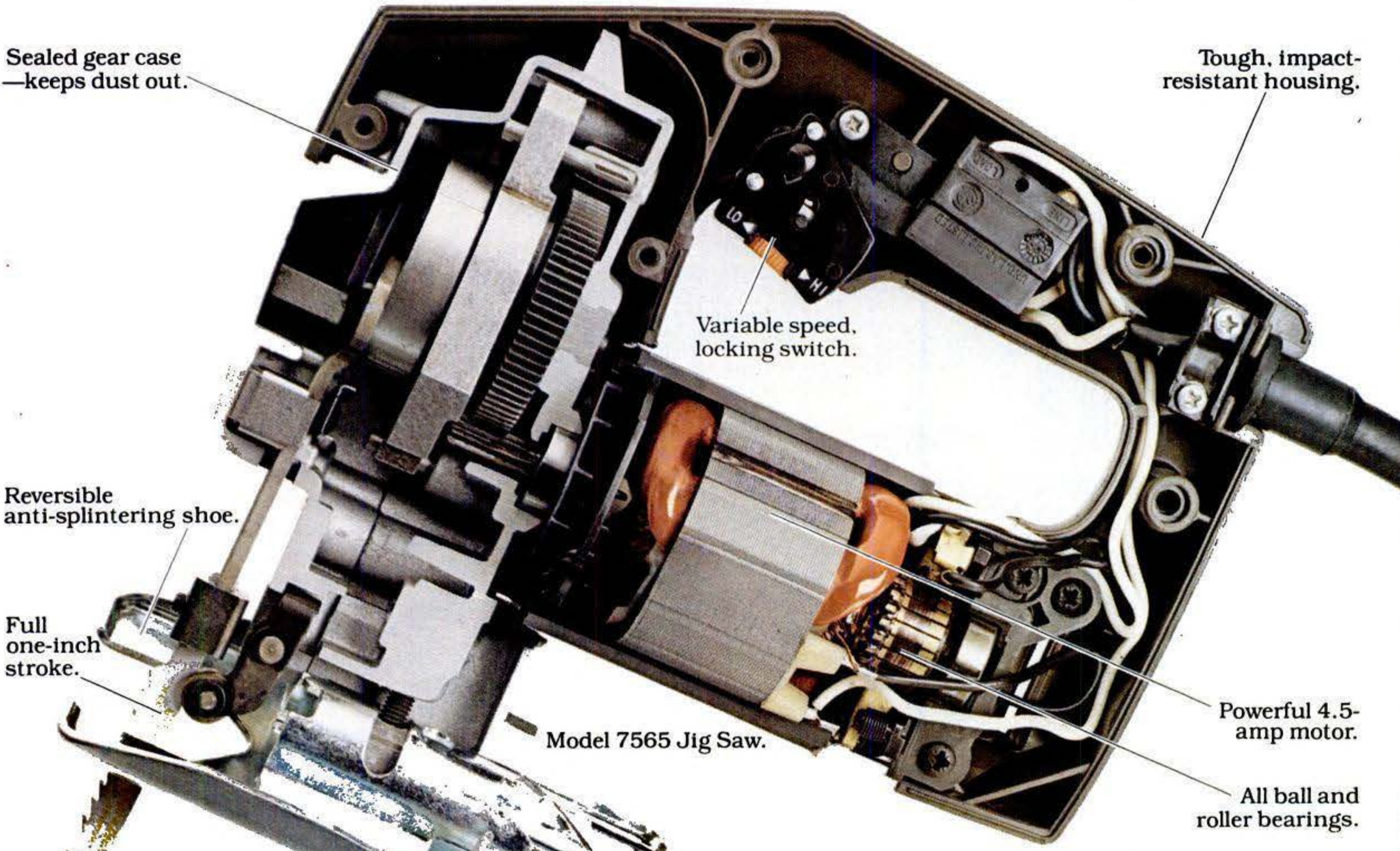
of the three General Motors B-body cars in the group.

Ours had the smallest and most exotic engine in the test, a turbocharged 231-cu.-in. V6. Although it produces the most horsepower and torque, both are developed at engine speeds too high to be of much help to a car this heavy. Performance was only fair. The LeSabre was the slowest gasoline-powered car in the group, and our on-the-road economy testing produced poor results. In addition, we experienced even more pinging than in previous cars with this engine. While LeSabre shares the highest towing capacity of the group (6000 lbs.) with the LTD, we'd have second thoughts about trying to tow anything that heavy with the turbo engine. That's not a knock against the engine; it's just that we don't think it's best suited to towing heavy loads with a car this heavy. (This engine is not available in California at present.)

Although the engine left a bit to be desired, ride and handling were very

Continued

OUR TRADE TOOLS HAVE THE GUTS TO KEEP ON GOING.



Sealed gear case —keeps dust out.

Tough, impact-resistant housing.

Variable speed, locking switch.

Reversible anti-splintering shoe.

Full one-inch stroke.

Model 7565 Jig Saw.

Powerful 4.5-amp motor.

All ball and roller bearings.

If you depend on your tools for a living, you need Black & Decker's Trade Tools. They're built tough from the inside out. Every single part, from the most powerful motor to the smallest bearing, is carefully engineered to keep working day in and day out. Even if you're hard on them, the Trade Tools are tough enough to take it. We know, because we torture-test them. We drop them, freeze them, heat them to extreme temperatures. We abuse them more than you probably ever will. And every one of our Trade Tools has to stand up to that kind of torture or we won't sell it.

And besides all that toughness and durability, you'll find our Trade Tools have just about every feature you'd ever want. Like a one-inch, counterbalanced stroke on our Cut Saw for faster cutting and longer blade life. Or on our two-speed Belt Sander, a motor mounted between the pulleys to help stop rocking and gouging. Or hardened helical steel gears on our vertically adjusting Circular Saws for fast, smooth, clean cutting. Plus powerful motors, 10-foot cords, tough, impact-resistant housings and much, much more.

So if you're someone who can't earn a living without gutsy, reliable power tools, stop in at your Black & Decker dealer and take a good, hard look at our Trade Tools.



B&D **Black & Decker.**
Trade Tools

Copyrighted material



LTD's unusual shift quadrant markings: Overdrive range is available in the "OD" position, but it's locked out in "3" for hill climbing and around-town driving.

good. The car's special handling package produced the best handling and maneuverability of the group.

Inside, comfort was good, and the interior well appointed. Like the other GM cars in this test, the LeSabre had climate-control heating and air conditioning, but with Buick's exclusive touch-sensitive control panel, which is a nice improvement over fiddling with the usual levers. Just a couple of quick pokes at the panel is all that's needed to set things up the way you want them. And it takes less of your attention from the road, which is very important if you're driving alone.

Plymouth Gran Fury

This car is the new entry in the field. Plymouth had been without a full-size car since 1977, so a big Plymouth was designed from the new-for-1979 Chrysler Corp. R-body, which is now shared with the Newport, the

Gentle finger pressure on touch-sensitive control panel is all that's needed to set LeSabre's electronically regulated climate-control heater/air conditioner.

St. Regis, and the New Yorker.

Our car had a fairly basic interior, so it didn't rival any of the other cars in the group in this respect, but it was comfortable and roomy, with a good driving position. We found plenty of room for six adults, and the best visibility in the group. Following current Chrysler practice, there is no identification inside the car (except the corporation's familiar five-pointed star), since the same dash is used in all three divisions' cars. Unfortunately, its deeply recessed instruments are rather difficult for some people to read.

Like its Chrysler sisters, Gran Fury has torsion-bar suspension up front, where the other companies use coil springs. Chrysler's optional "Open Road" handling package was installed on our test car, and it seemed effective. The car rode well and performed respectably in our handling and maneuverability tests, cornering very flatly and predictably.

Our Gran Fury was equipped with a 318-cu.-in. V8, and was the longest, widest, and second-heaviest in the group. Despite that, it was fastest in the zero-to-60 mph runs, and delivered the best gasoline economy at 35 mph. Its towing capacity is only 500 lbs. lower than the top cars—a minor difference. Its base price, though, is from \$270 to \$1600 less than the others, and that makes it a real bargain.

Pontiac Bonneville Brougham

This is the first year that Pontiac has offered a diesel engine. Of course,

EPA fuel mileage (mpg)

	Buick LeSabre	Chevrolet Caprice	Ford LTD	Plymouth Gran Fury	Pontiac Bonneville
Highway	23	25	27	23	34
City	16	17	16	15	22
Calif. city	*	14	16	16	**

Observed fuel mileage

(steady-state mpg)

	Buick LeSabre	Chevrolet Caprice	Ford LTD	Plymouth Gran Fury	Pontiac Bonneville
35 mph	20.7	23.3	23.2	24.2	35.3
45 mph	18.3	23.3	23.9	22.3	30.1
55 mph	16.2	21.6	20.5	19.4	27.5

*V6 Turbo not available in California

**Diesel not available in California

its engine is really the Oldsmobile diesel currently being used by several GM divisions. The important point, however, is that it means big fuel-economy jumps for cars in which it's installed. As you'd expect, since it was the lone diesel in the group, the Bonneville easily swept all three of our economy categories by wide margins. (Unfortunately, GM diesels are not available in California at this writing.)

There are some trade-offs to be considered, however. First, although the engine is equipped with the remarkable GM quick-start system, it is extremely slow to warm up in cold weather. You can drive the car away immediately with no hesitation or smoking, but it will be a long time before you get any heat from the heater. Second, while the engine is only fairly noisy when warm, it's very noisy when cold. Fortunately, Pontiac has made great progress in isolating the objectionable diesel noise and vibration from the passenger compartment.

The Pontiac was the heaviest car in the group, and, having the least power and torque, its performance was less than exciting. It was slowest in acceleration (by a lot), but handling and maneuverability were quite respectable. One minor flaw was that the lockup torque converter occasionally engaged a bit harshly.

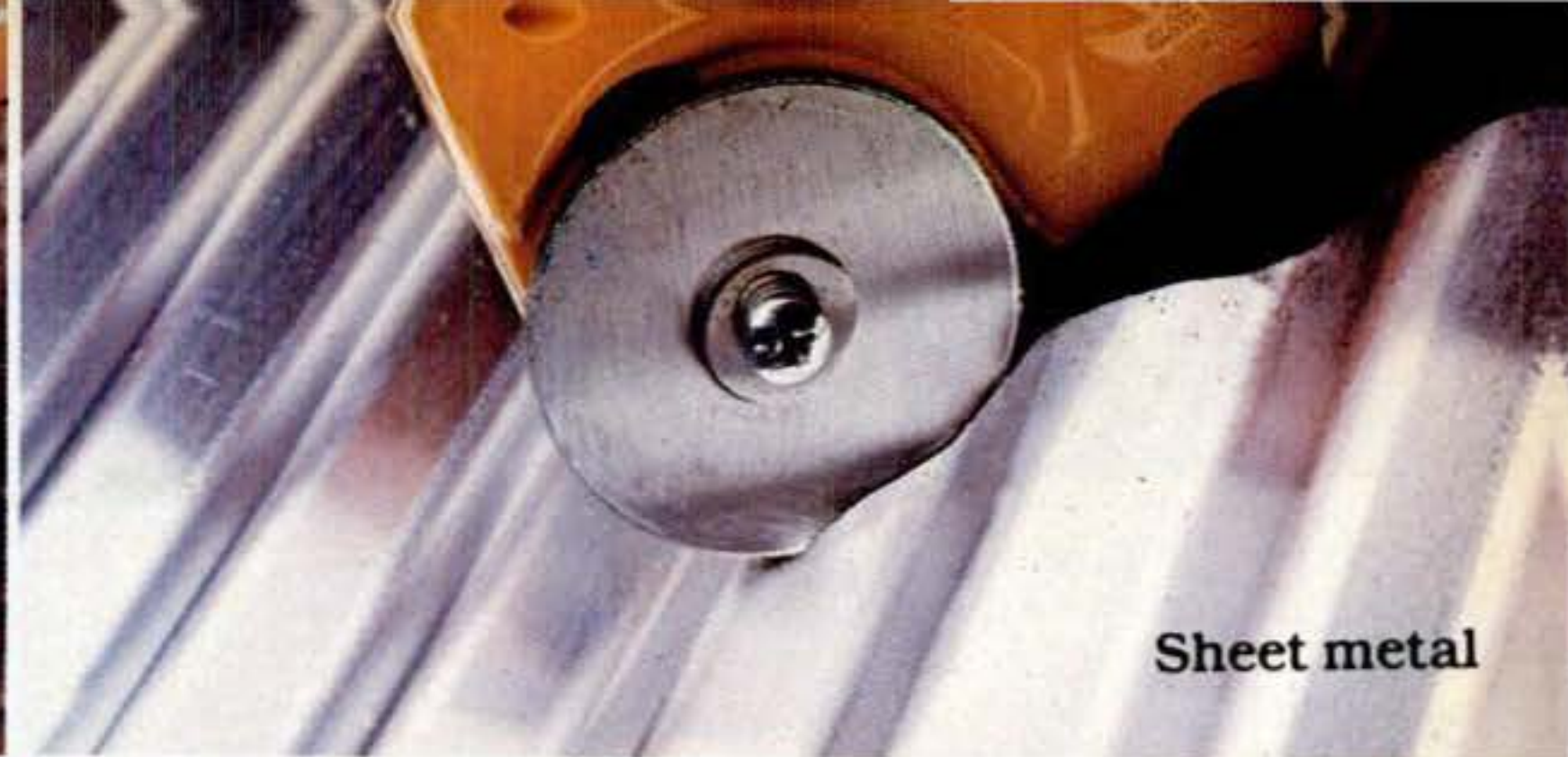
Our Bonneville was the most lavish inside and was extremely comfortable, with plush velour and soft padding. It had a good driving position and offered reasonably good forward vision.

A diesel-equipped Pontiac, like the other full-size GM cars offering the option, could be a very economical proposition for people who need a big car. About the only thing a big car usually does that this one can't do is towing—it's not recommended. Other than that, if you don't mind a noisy engine and losing a bit of acceleration, it's fine.

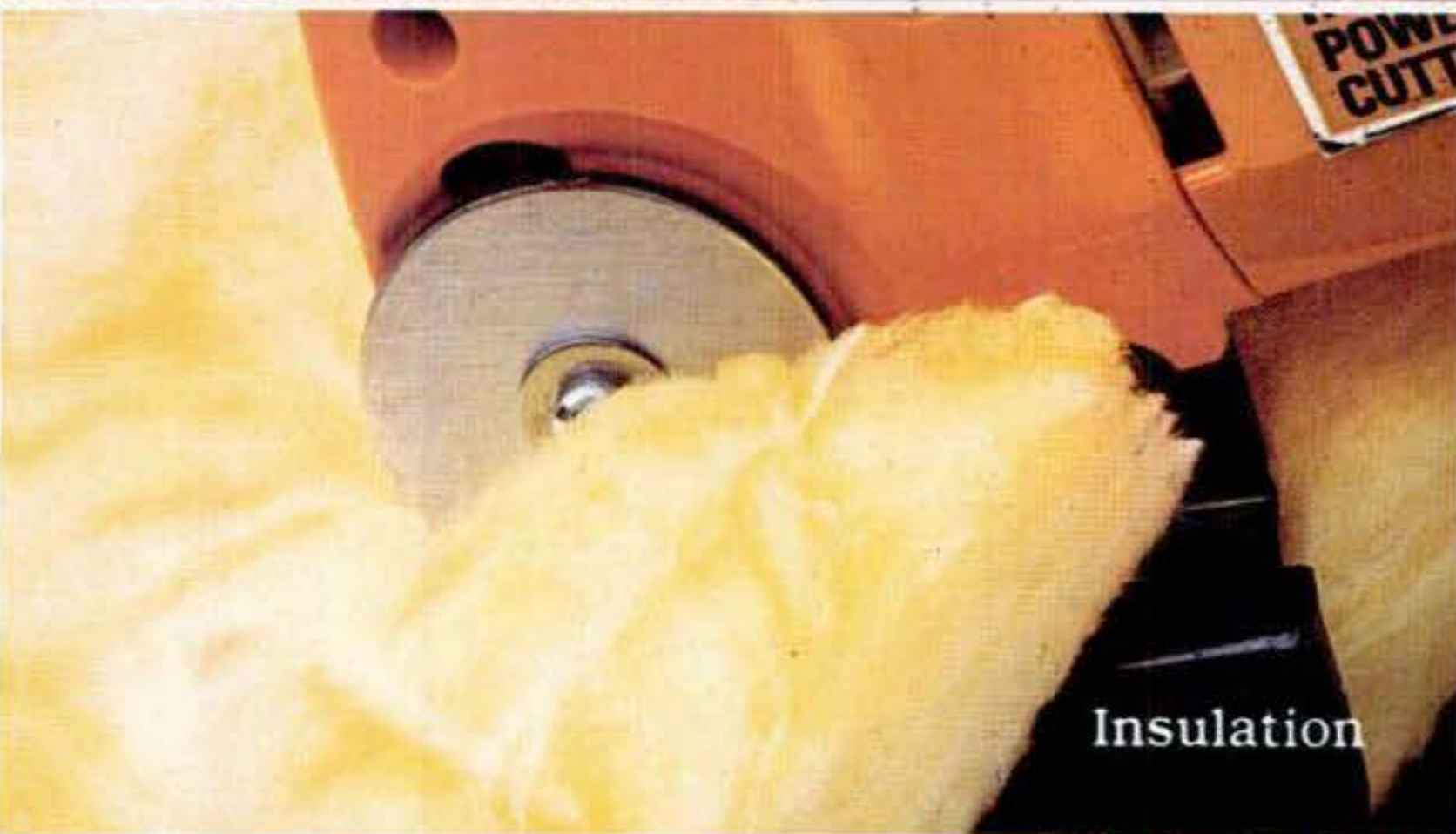
For specs and test results, see page 46



Carpet



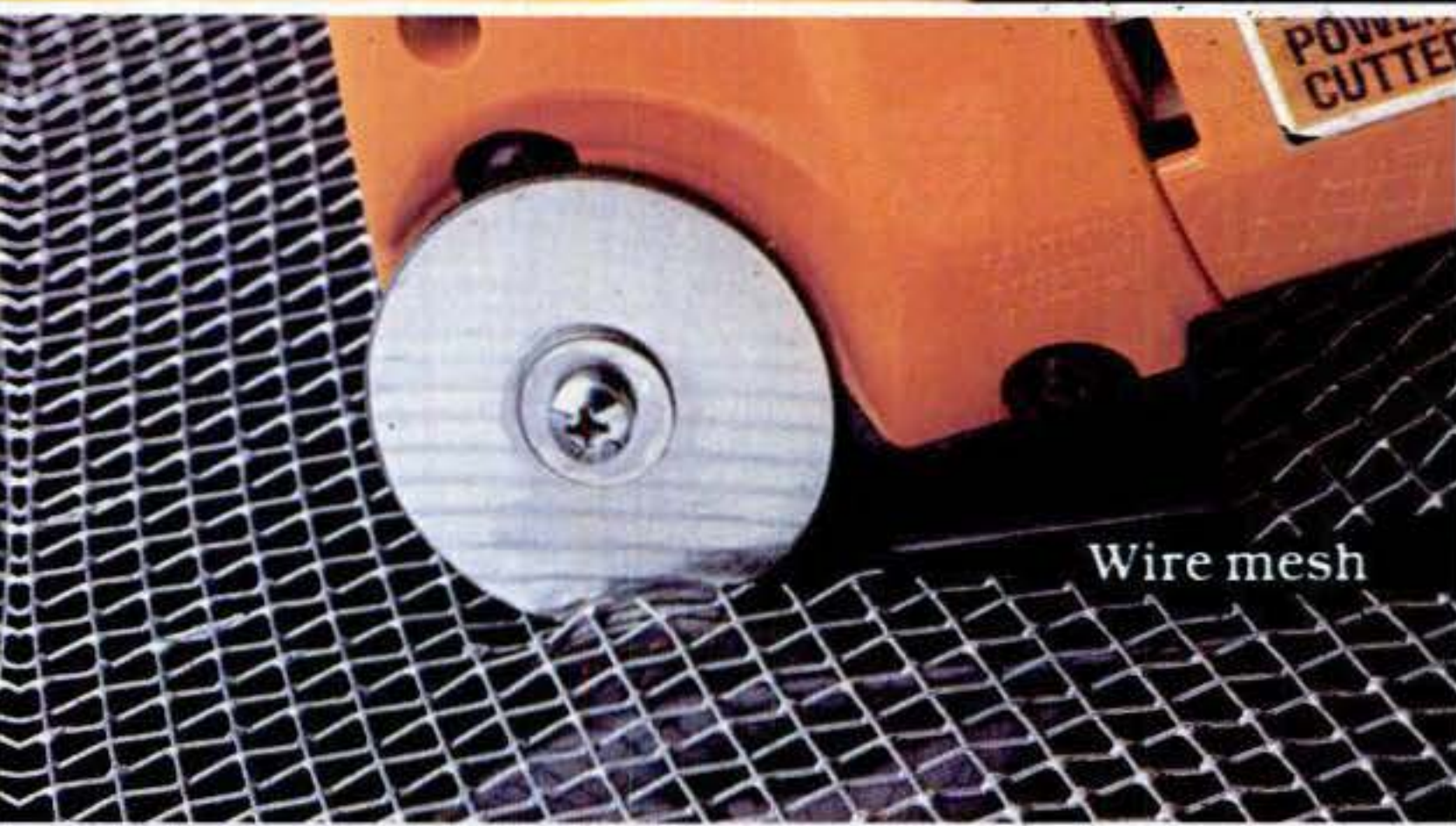
Sheet metal



Insulation



Linoleum



Wire mesh



Canvas

INTRODUCING AN EASY WAY TO HANDLE TOUGH CUTTING JOBS.

When you have a big, tough cutting job, you need a big, tough cutting tool. Introducing Black & Decker's new Rotary Power Cutter.

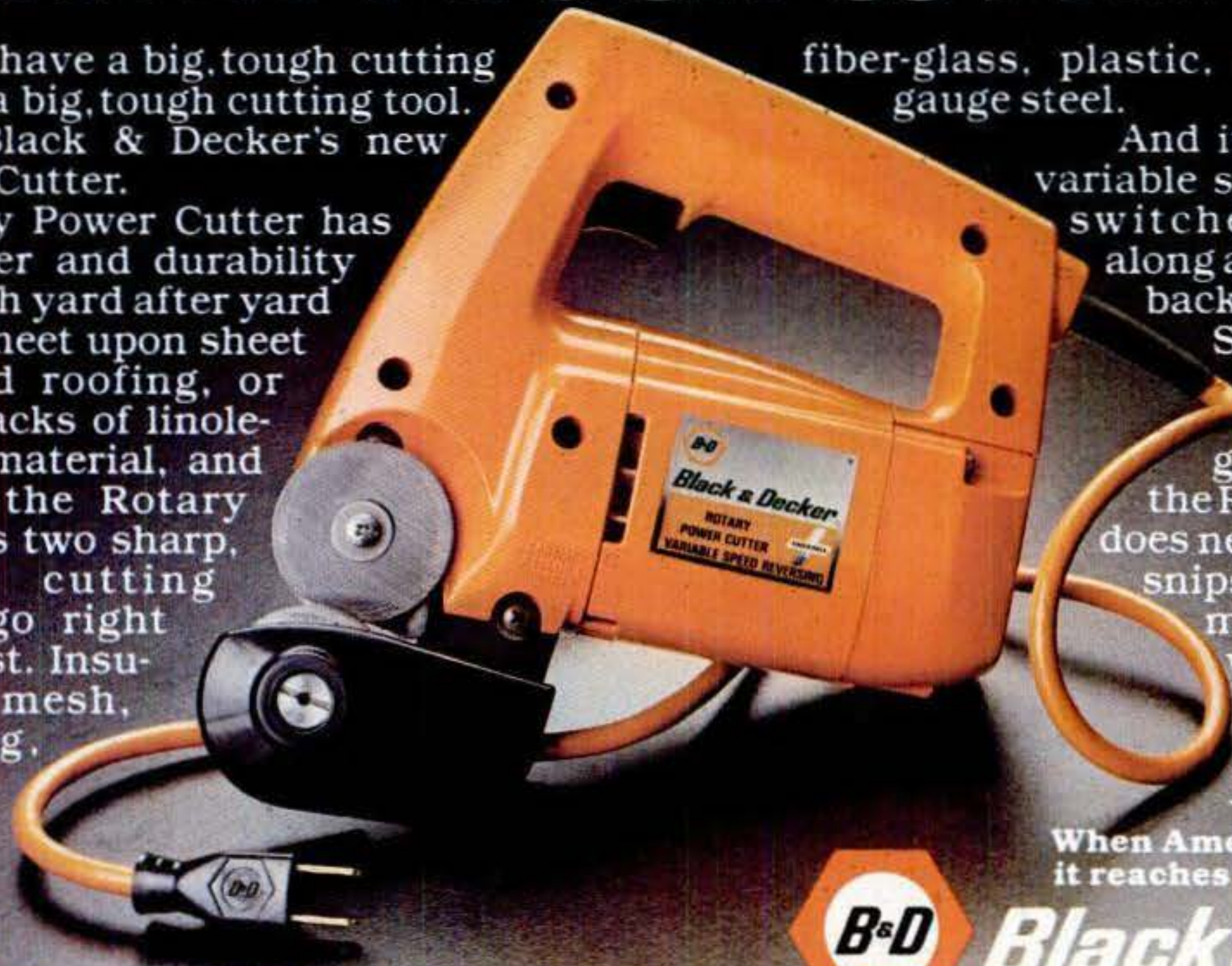
The Rotary Power Cutter has the horsepower and durability to slice through yard after yard of carpet, or sheet upon sheet of corrugated roofing, or stacks and stacks of linoleum. Name a material, and chances are the Rotary Power Cutter's two sharp, self-feeding cutting wheels can go right through it, fast. Insulation, wire mesh, asphalt roofing, heavy canvas,

fiber-glass, plastic, rubber, even 24-gauge steel.

And it's equipped with variable speed and reversing switches that let you cut along at your own pace, or back out of a tight spot.

So every cut comes out clean and precise with no jagged edges. In short, the Rotary Power Cutter does nearly everything tin snips, knives, and other manual cutting tools will do—only faster and easier and without doing a job on your hands.

When America has a job to do, it reaches for Black & Decker.



Black & Decker

ANNOUNCING THE FIRST ELECTRIC VEHICLE CATALOG

Here, in one catalog, you can find a wide selection of the specialized parts needed to build or convert an electric vehicle.

- Batteries
- Motors
- Test Equipment
- Instruments
- Cables
- Fuses
- Connectors
- Accessories
- And Much More

In addition, the catalog includes a number of technical articles on building and converting EV's, including diagrams and pictures.

Send \$2.00 to
The Electric Vehicle Catalog



Department EV 4

FLIGHT SYSTEMS

P.O. Box 25

Mechanicsburg, Pa. 17055

VISA / MASTERCARD
ACCEPTED FOR PARTS ORDERS

Buick LeSabre, Chevrolet Caprice, Ford LTD, Plymouth Gran Fury, and Pontiac Bonneville —dimensions, specs, and test results

DIMENSIONS (inches)	Buick LeSabre	Chevrolet Caprice	Ford LTD	Plymouth Gran Fury	Pontiac Bonneville
Wheelbase	116.0	116.0	114.3	118.5	116.0
Overall length	216.0	212.1	209.0	220.2	214.3
Overall height	52.9	55.9	54.5	54.5	56.7
Overall width	74.6	75.3	77.5	77.6	76.4
Track, F/R	61.7/60.7	61.8/60.8	62.2/62.0	61.9/62.0	61.7/60.7
Ground clearance	7.2	7.2	6.06	8.3	7.1
Front head room	38.9	39.2	37.9	38.2	39.4
Front hip room	60.9	55.0	61.2	57.4	55.0
Front leg room	42.2	42.2	42.1	42.3	42.2
Rear head room	38.4	38.0	37.2	37.4	38.2
Rear hip room	58.0	55.3	58.0	57.4	55.3
Rear leg room (min.)	38.3	39.1	40.5	38.3	39.0
Rear knee room (min.)	0.7	3.6	4.0	2.4	3.5
Couple distance	33.2	34.7	35.1	35.0	34.7
SPECIFICATIONS					
Engine type	V6 turbo	V8	V8	V8	V8 diesel
Displacement (cu. in./L)	231/3.8	305/5.0	351/5.8	318/5.3	350/5.7
Compression ratio	8.0:1	8.6:1	8.3:1	8.5:1	22.5:1
Carburetion	4-bbl.	4-bbl.	2-bbl.	2-bbl.	F.I.
Net hp @ rpm	170 @ 4000	155 @ 4000	140 @ 3400	120 @ 3600	105 @ 3200
Net torque @ rpm	265 @ 2400	240 @ 1600	265 @ 2000	245 @ 1600	205 @ 1600
Transmission	Three-speed automatic	Three-speed automatic	Four-speed overdrive automatic	Three-speed automatic	Three-speed automatic
Axle ratio	2.73:1	2.56:1	2.73:1	2.73:1	2.73:1
Tire make	Goodyear	Uniroyal	General	Goodyear	B.F. Goodrich
Tire type	Polysteel radial	Steel-belted radial	Steel II radial	Polysteel radial	Steel-belted radial
Tire size	P225/70R15	P215/75R15	P225/75R14	P225/70R15	P215/75R15
Steering	Recirculating ball, power	Recirculating ball, power	Recirculating ball, power	Recirculating ball, power	Recirculating ball, power
Overall steering ratio	16.45:1	18.0:1	16.4:1	18.8:1	18.0:1
Turns, lock to lock	3.37	3.16	3.4	3.5	3.16
Turn diameter (ft.)	38.8	38.8	39.2	42.4	38.8
Front suspension	Independent, unequal-length A-arms, coil springs	Independent, unequal-length A-arms, coil springs	Independent, unequal-length A-arms, coil springs	Independent, non-parallel control arms, torsion bars	Independent, unequal-length A-arms, coil springs
Rear suspension	Solid axle, Salisbury with four links, coil springs	Solid axle, Salisbury with four links, coil springs	Solid axle, four links, coil springs	Solid axle, parallel longitudinal leaf springs	Solid axle, Salisbury with four links, coil springs
Front stabilizer-bar diameter (in.)	1.1	None	None	1.12	None
Rear stabilizer-bar diameter (in.)	0.87	None	None	0.75	None
Trailer towing (max. lbs.)	6000	5000	6000	5500	Not recommended
Trailer tongue weight (max. lbs.)	750	500	750	600	Not recommended
Brakes	Disc/drum, power	Disc/drum, power	Disc/drum, power	Disc/drum, power	Disc/drum, power
Brake swept area (sq. in.)	344.0	329.0	385.0	375.0	362.0
Fuel tank (gal.)	25.0	25.0	19.0	21.0	25.0
Trunk space (cu. ft.)	20.8	20.9	22.4	21.3	20.3
Liftover height (in.)	32.0	31.7	29.2	27.9	32.2
Curb weight (lbs.)	3569	3548	3721	3745	3747
F/R weight distribution (%)	54/46	55/45	56/44	55/45	55/45
Basic price	\$7782	\$6709	\$6549	\$6280	\$7884
Price as tested	\$11,212	\$10,471	\$8524	\$7926	\$12,578
Major options on test car	Power seats \$358, power windows \$149, vinyl top \$213, rear defroster \$109, A/C \$647, level control \$145, cruise control \$118, AM/FM stereo \$195	Power seat \$179, power door locks \$135, power windows \$221, rear defroster \$109, A/C \$738, two-tone paint \$128, cruise control \$118, 305 V8 \$295, AM/FM stereo \$276, cloth upholstery \$437	Temperature control \$669, rear defroster \$103, AM/FM stereo \$421, power seats \$335, cruise control \$116, luxury group \$693	AM/FM stereo \$209, 318 V8 \$233, open-road package \$269, wide tires \$186	Diesel 350 V8 \$915, sunroof \$981, wire wheel covers \$126, AM/FM stereo \$349, power seats \$348, power door locks \$135, rear defroster \$109, cruise control \$118, A/C \$647, vinyl top \$155
TEST RESULTS					
Acceleration (sec.)					
0-60 mph	13.3	13.0*	12.8*	12.7	17.2
25-70 mph	15.8	13.2*	14.1*	14.2	19.3
Brake test (cool) 60-0 mph					
Stopping distance (ft.)	132*	147*	165*	159	139
Pedal pressure (lbs.)	75	110	65	100	60
Disc temperature (° F)	148	145	165	142	105
Brake test (hot) 60-0 mph					
Stopping distance (ft.)	153	167*	183*/128*†	163	186
Pedal pressure (lbs.)	115	105	115	95	55
Disc temperature (° F)	450	440	545	530	575
Interior noise @ 60 mph (dBA)	66	65	64	69	68
Handling test (mph)	68.0	61.0	59.0	61.2	59.0*
Maneuverability test (mph)	27.8	26.9	26.6	27.1	27.0*
TEST CONDITIONS: Ambient temperature, 34° F; relative humidity, 75 percent; barometric pressure, 29.7 inches Hg					
*Measured manually					
†With transmission in third gear					

DO-IT-YOURSELF FINE GRANDFATHER CLOCK KITS

STARTING UNDER

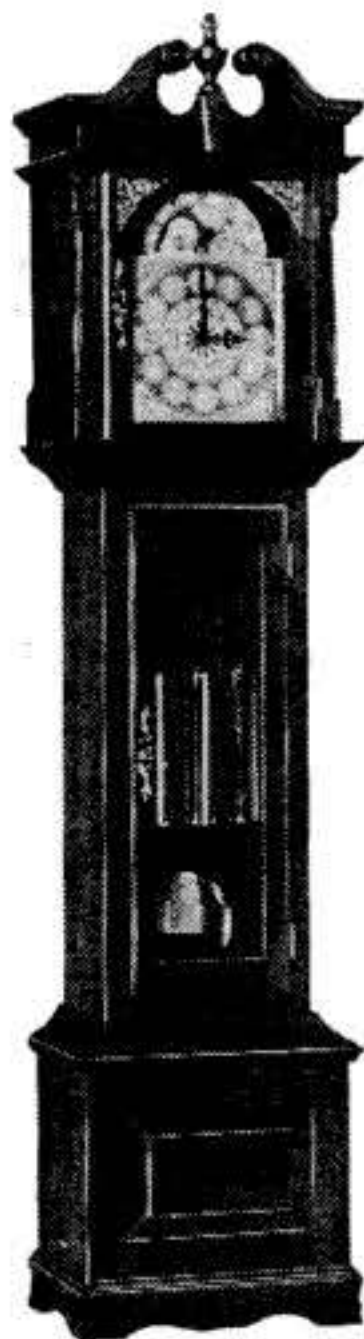
\$225

(including movement and dial)

- Factory direct prices
- Heirloom quality
- Solid 3/4" hardwoods: black walnut, cherry, mahogany, oak
- Easy to assemble, parts pre-cut
- Solid brass West German chiming movements
- Money back guarantee
- Prompt shipment

MASTER CHARGE and BANKAMERICARD/VISA ACCEPTED

Write for FREE color catalog

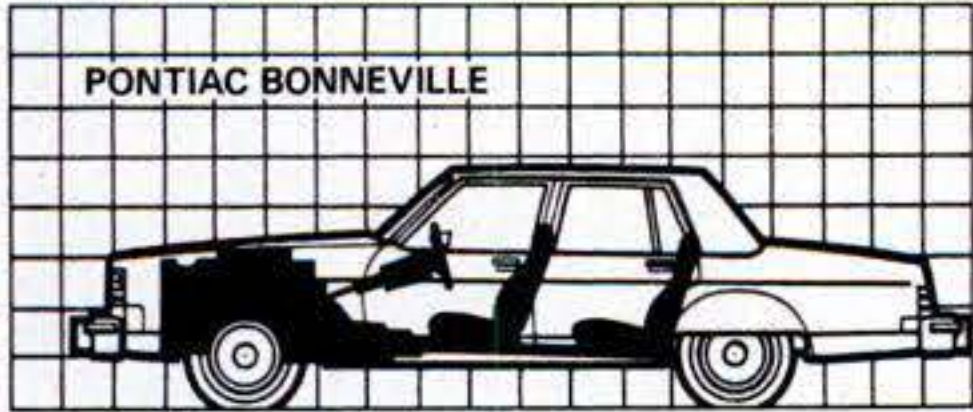
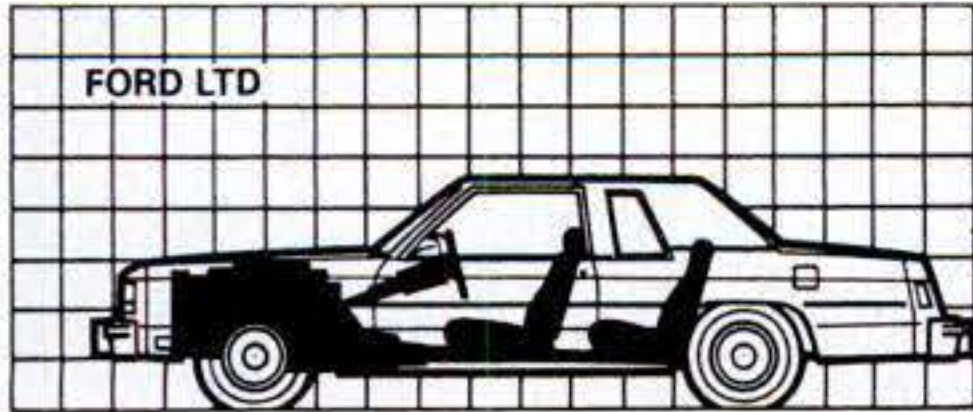
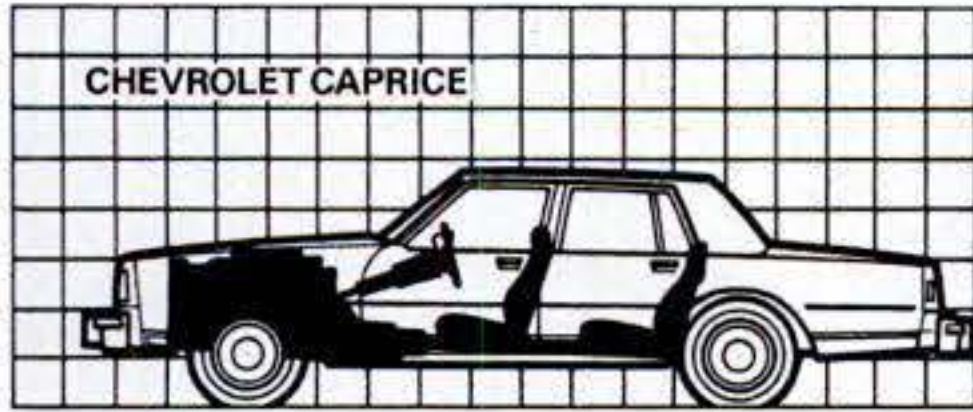
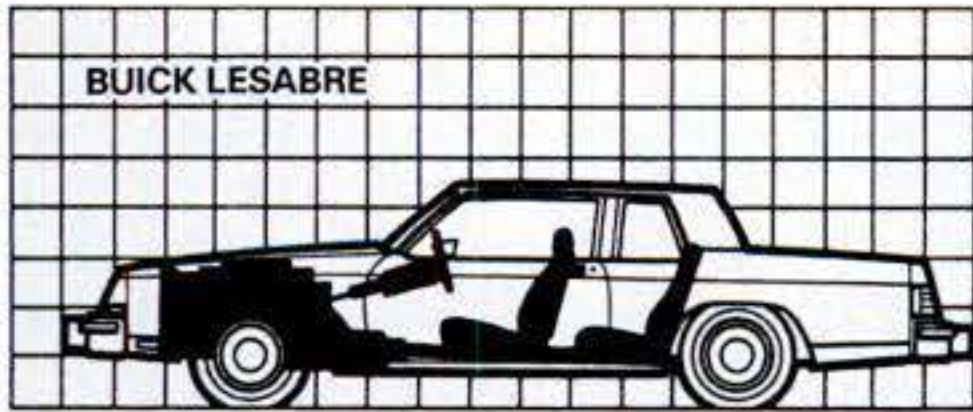


**EMPEROR®
CLOCK COMPANY**
WORLD'S LARGEST MANUFACTURER
OF GRANDFATHER CLOCKS

Dept. 427 Emperor Industrial Park
Fairhope, Alabama 36532

Performance comparison with selected 1980 and earlier models

	Mpg (city driving)	Acceleration 0-60 mph (sec.)	Brakes 60-0 mph (hot) (ft.)	Handling (mph)	Maneuverability (mph)	Noise @ 60 Mph (dBA)
1979 Chevrolet Caprice V8	16	11.3	148	60.0	26.0	64
1979 Ford LTD V8	14	13.9	148	58.2	25.3	66
1979 Chrysler Newport V8	14	13.9	154	58.2	25.7	70
1980 Pontiac Grand Prix V6	20	15.7	162	58.2	26.4	67
1980 Ford Thunderbird V8	17	11.9	147	62.4	29.1	69
1980 Chrysler Cordoba V8	17	16.5	150	58.2	27.2	68



PS serviceability ratings

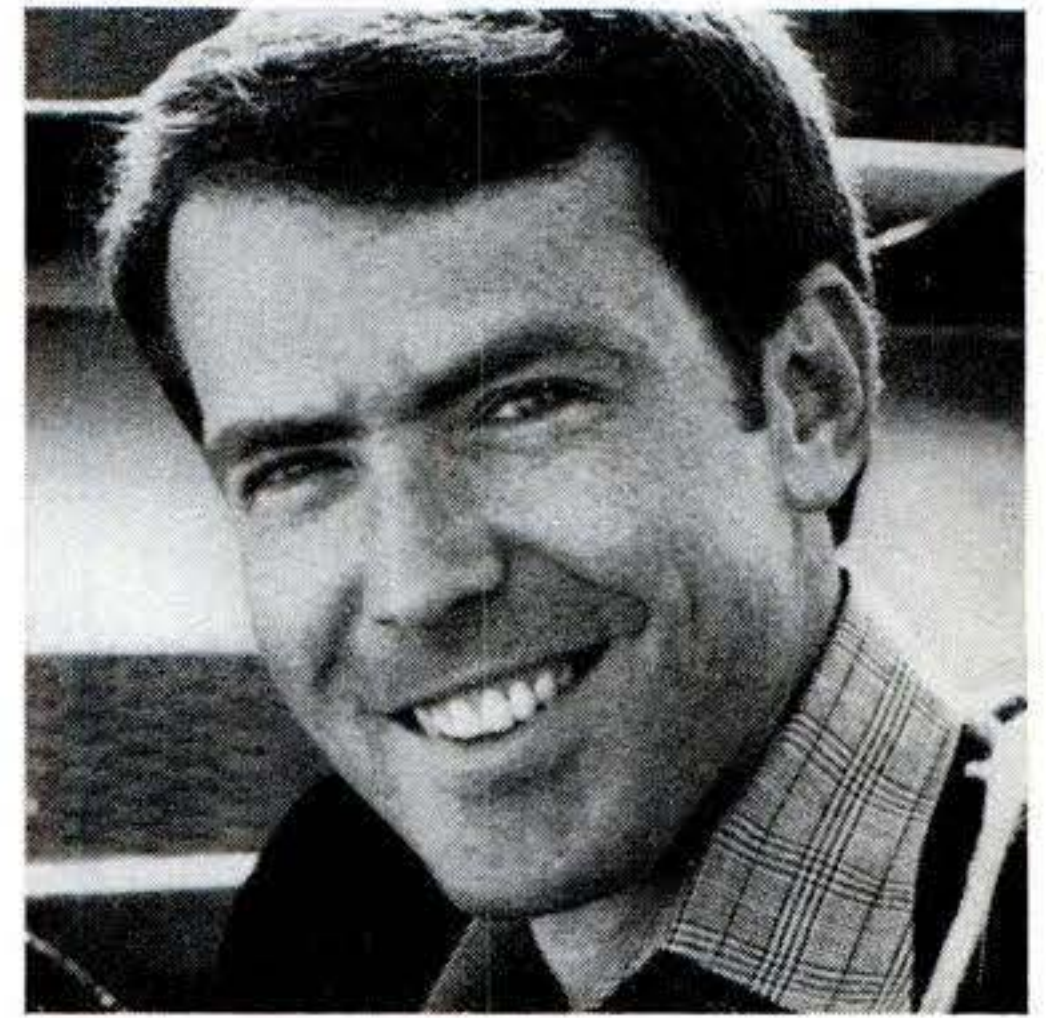
How easy is it to service these cars? To give you an approximation of how difficult it is for a typical person to perform various service operations, we examine each test vehicle. The numbers mean: 1, very difficult; 2, difficult; 3, average degree of difficulty; 4, easy; 5, very easy.

	LeSabre	Caprice	LTD	Gran Fury	Bonneville
Checking fluid levels:					
Battery	5	5	5	4	5
Master cylinder	4	4	4	4	4
Windshield washer	5	4	5	5	5
Engine oil	2	3	3	5	3
Coolant	5	4	5	5	5
Checking the engine:					
Spark plugs	1	2	4	5	n.
Distributor	2	2	4	2	n.
Carb adjustment	*	*	3	3	F.1
Oil filter	2	3	3	3	3
Oil fill	3	3	3	3	3
Replacing hoses:					
Upper radiator hose	3	4	4	5	4
Lower radiator hose	2	3	3	3	3
Heater hoses	3	4	3	4	4
Changing bulbs:					
Headlights	3	3	3	3	3
Taillights	2	2	4	2	2
Front running lights	3	3	3	3	2
Front parking lights	2	3	2	3	2
Front directionals	2	3	2	3	2
Rear directionals	2	2	4	2	2
Rear running lights	2	3	3	2	2
Checking fuses	2	3	2	2	3
Spare-tire accessibility	2	2	2	2	2
Changing belts	3	3	4	3	3
*Sealed					

Greg Wessel, how long do you want your car to last?

"I've been asking myself that question for the past 10 years. See, this '68 Camaro is kind of special to me. It was the first new car I ever owned, a red convertible, no less. And before we got married, I'd drive back and forth across the mountains to Reno every weekend to visit Karen—whether it was snowing, sleeting or whatever. The car never let me down! Even now it does a lot of rough driving 'cause it's the car we use when we go skiing.

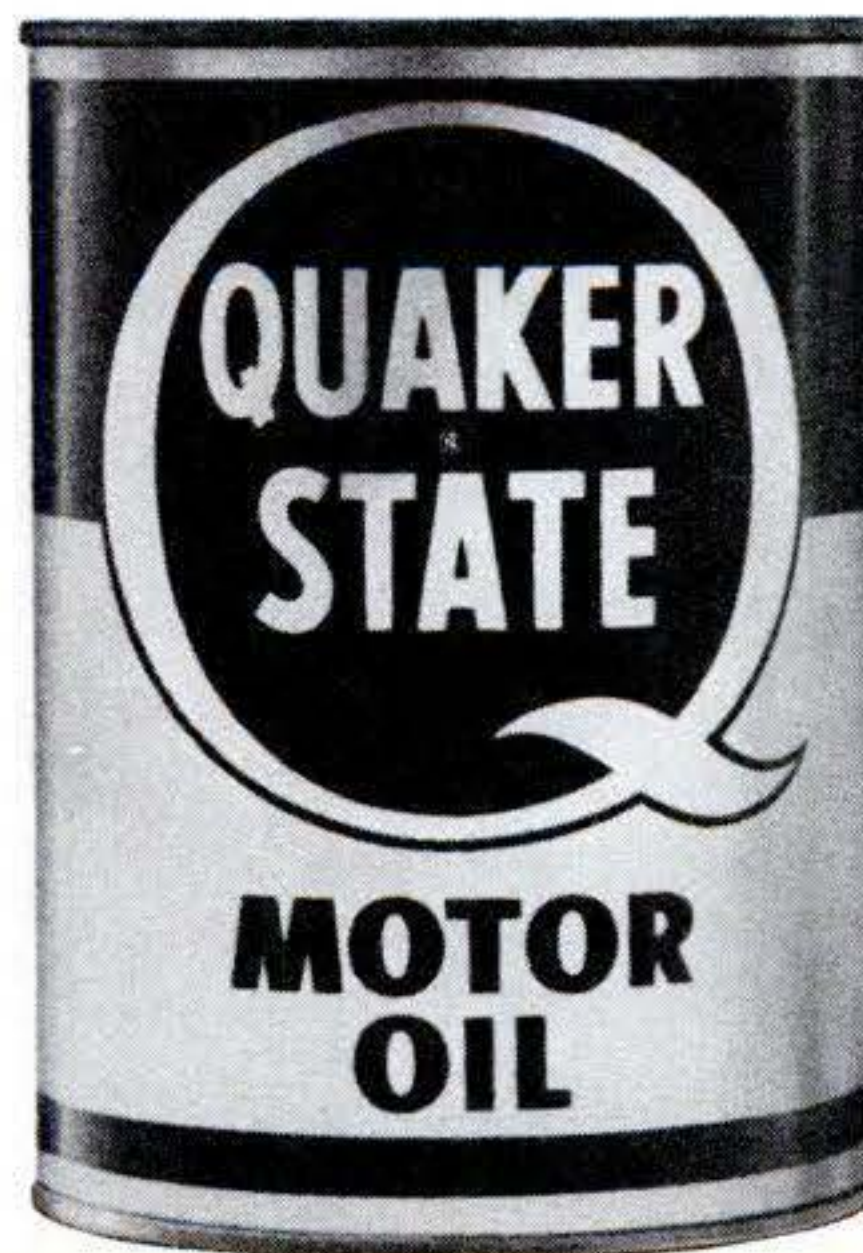
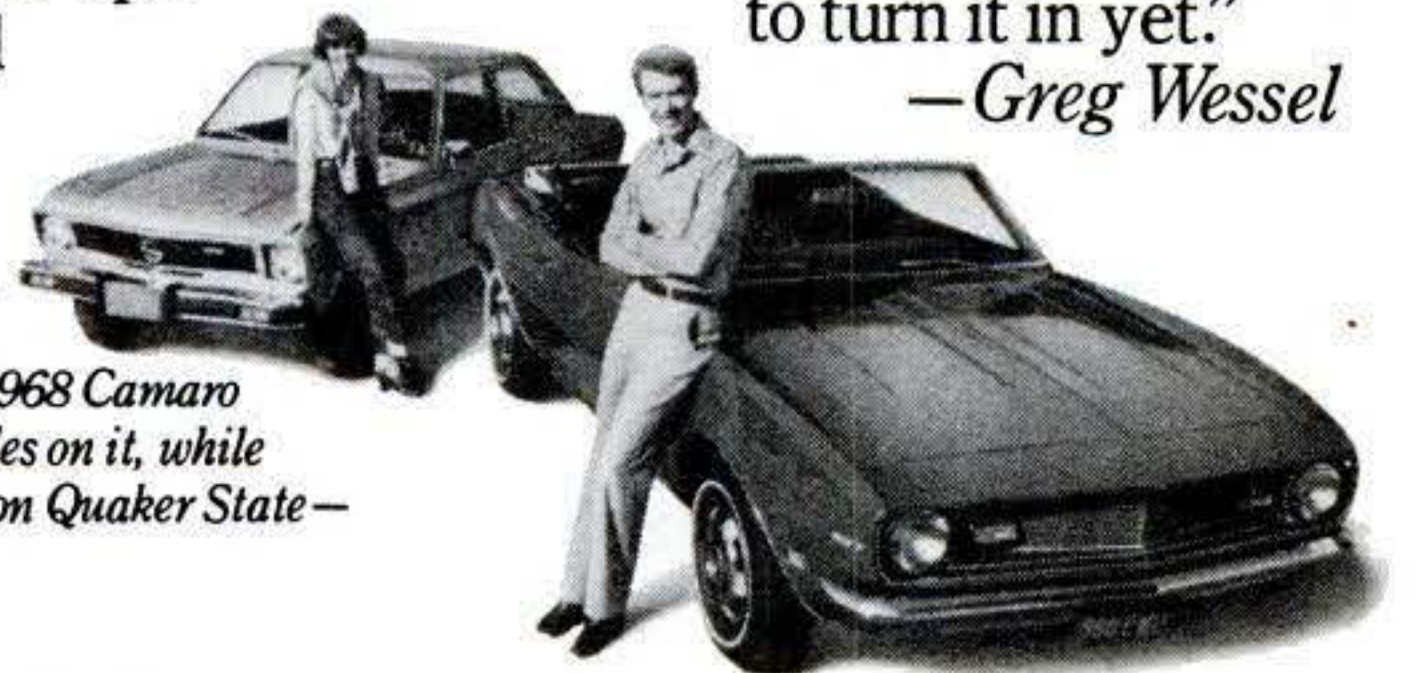
"Of course I take good care of it. I do all my own mechanical work at regular intervals, including tune-ups and oil changes. And I always use Quaker



State Motor Oil. I've been so satisfied with the results that I put Quaker State in our new 'second' car right from the start. I hope it'll last as long as the convertible has, although I know it's a hard act to follow. I've got well over 100 thousand miles on the old car now, but I'm still not making plans to turn it in yet."

—Greg Wessel

Greg and Karen Wessel, Foster City, California. They're still enjoying their 1968 Camaro with over 100 thousand miles on it, while 'breaking in' their '75 Opel on Quaker State—63 thousand miles worth.



Helps cars last.

Keep our neighborhoods clean. Take your used oil to a collection center.

*Fast
Salem Lights*



Refreshing light menthol.
Low tar.
Satisfying taste.
The best selling low tar menthol.
Salem Lights.



The Best Of The Lights

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

10 mg. "tar", 0.8 mg. nicotine av. per cigarette, FTC Report MAY

Copyrighted material

New, energy-saving heat-pump water heater

This easily installed device cuts heating costs by more than half

By EVAN POWELL

That stippled-aluminum box you see in the photos below may be one of the most significant developments yet in home energy conservation. Inside its unglamorous shell is a small heat pump designed to heat water for household use.

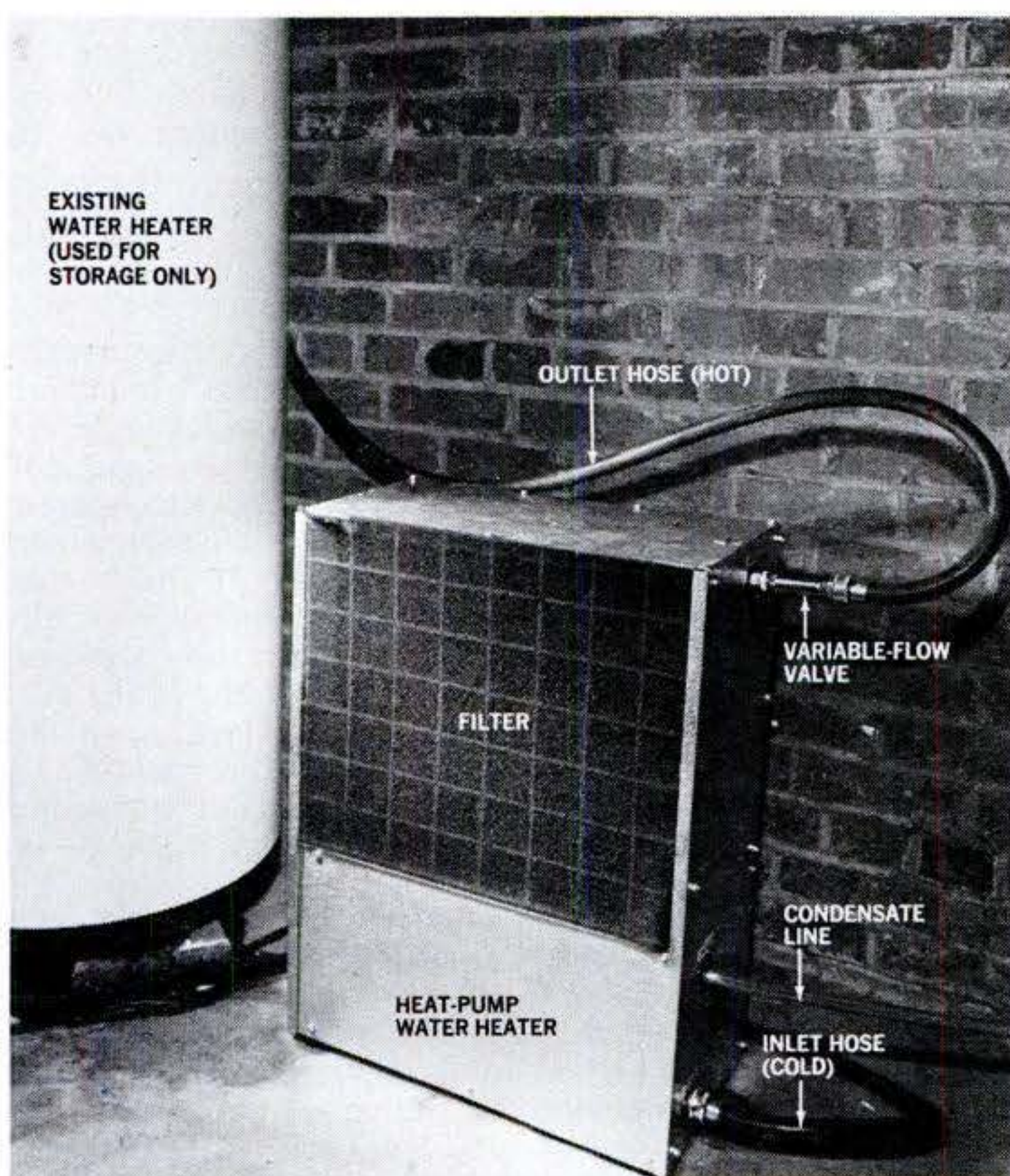
The Efficiency II heat-pump water

heater, made by E-Tech, Inc., of Atlanta, heats water at the rate of 13,000 Btu per hour, equivalent to the output of a 3800-watt high-recovery resistance heating element. But it consumes only 1230 watts of electricity—less than one-third as much as a resistance element would use.

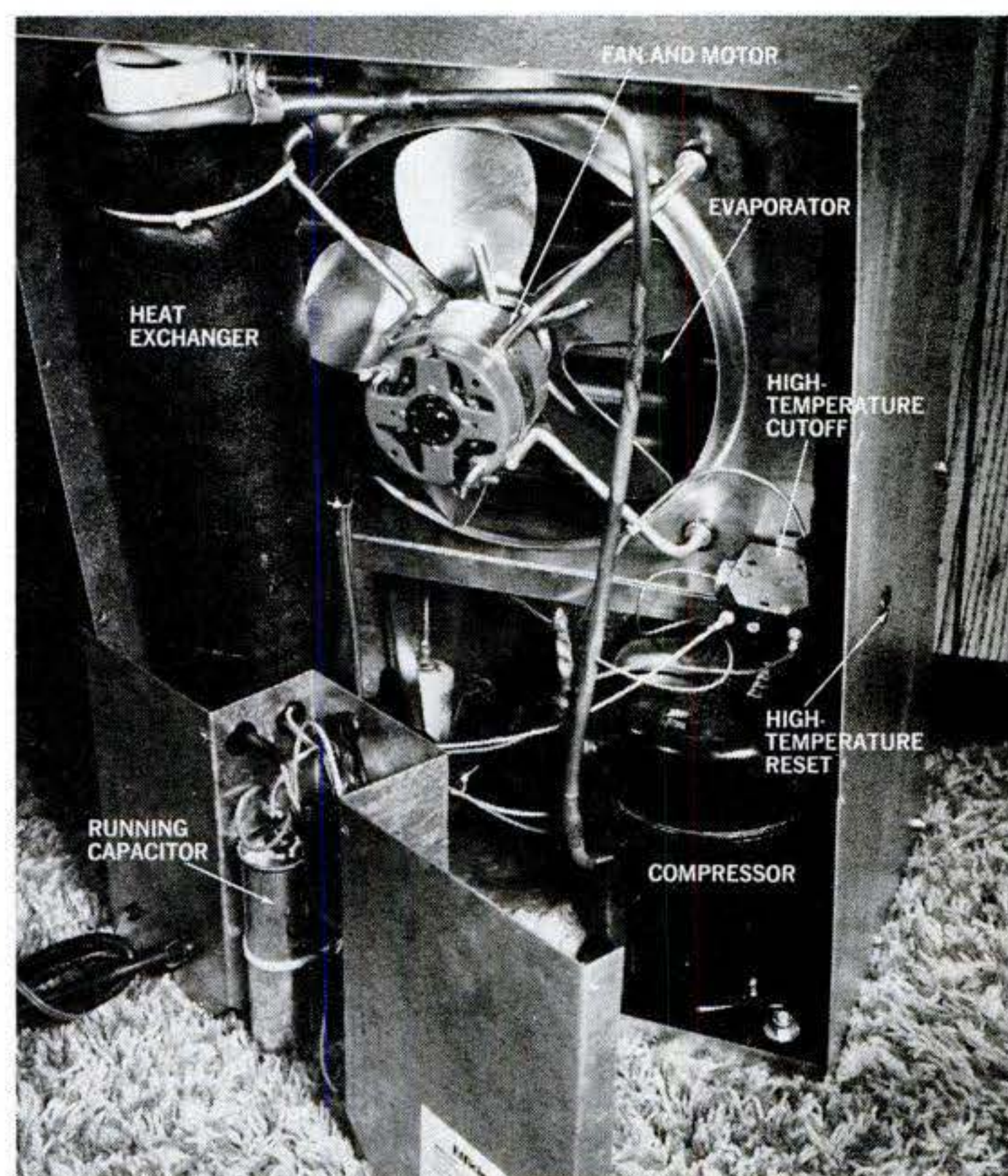
Heat-pump water heaters are not new; in fact, they appeared as early as the 1950's. But a powerful coalition of bargain-basement electric rates and shaky technology soon conspired to drive them from the market. Now, with electricity at luxury prices and

heat-pump technology well-established, the concept has been revived. In December 1978, we reported on one promising new heat-pump water heater being developed by Energy Utilization Systems under a subcontract with Oak Ridge National Laboratory for the Department of Energy. One hundred of these units are now being field-tested. The E-Tech Efficiency II is already commercially available. I installed one last fall, used it, and compared its energy consumption with that of a conventional electric heater (see box, "Keeping

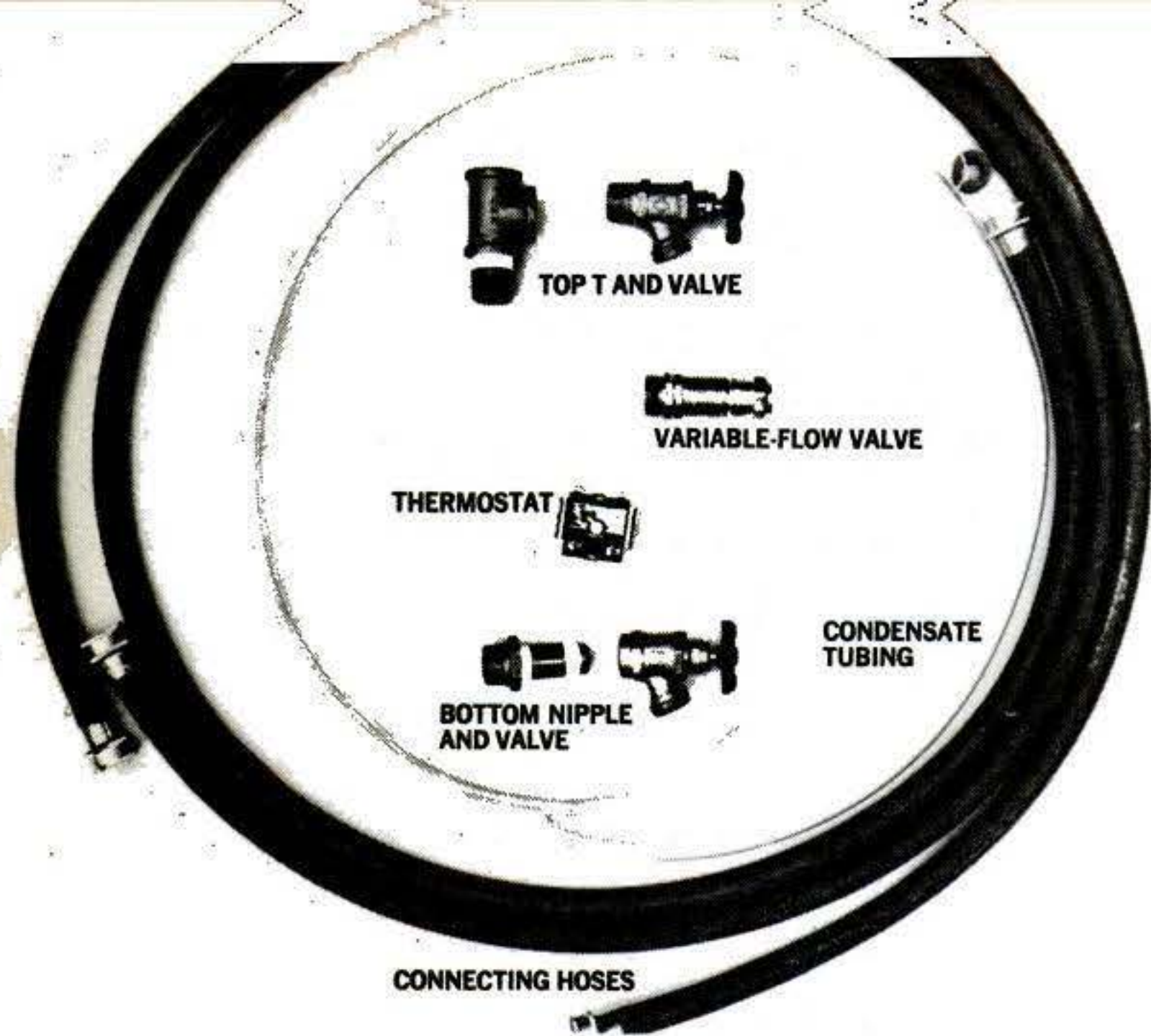
Continued



E-Tech heat-pump water heater connects to conventional electric water heater, which serves as a storage tank only. Company plans to market a unit with its own storage tank in the future.



Components are easily reached for inspection or service with rear panel removed. High-temperature cutoff prevents system damage if water flow stops. Pump must be reset after cutoff.



Installation kit includes all fittings and connections for normal installation. The pressure-temperature relief valve on existing tank must be replaced with a new one if sensing element is too short to extend into tank after adding a new T-fitting.

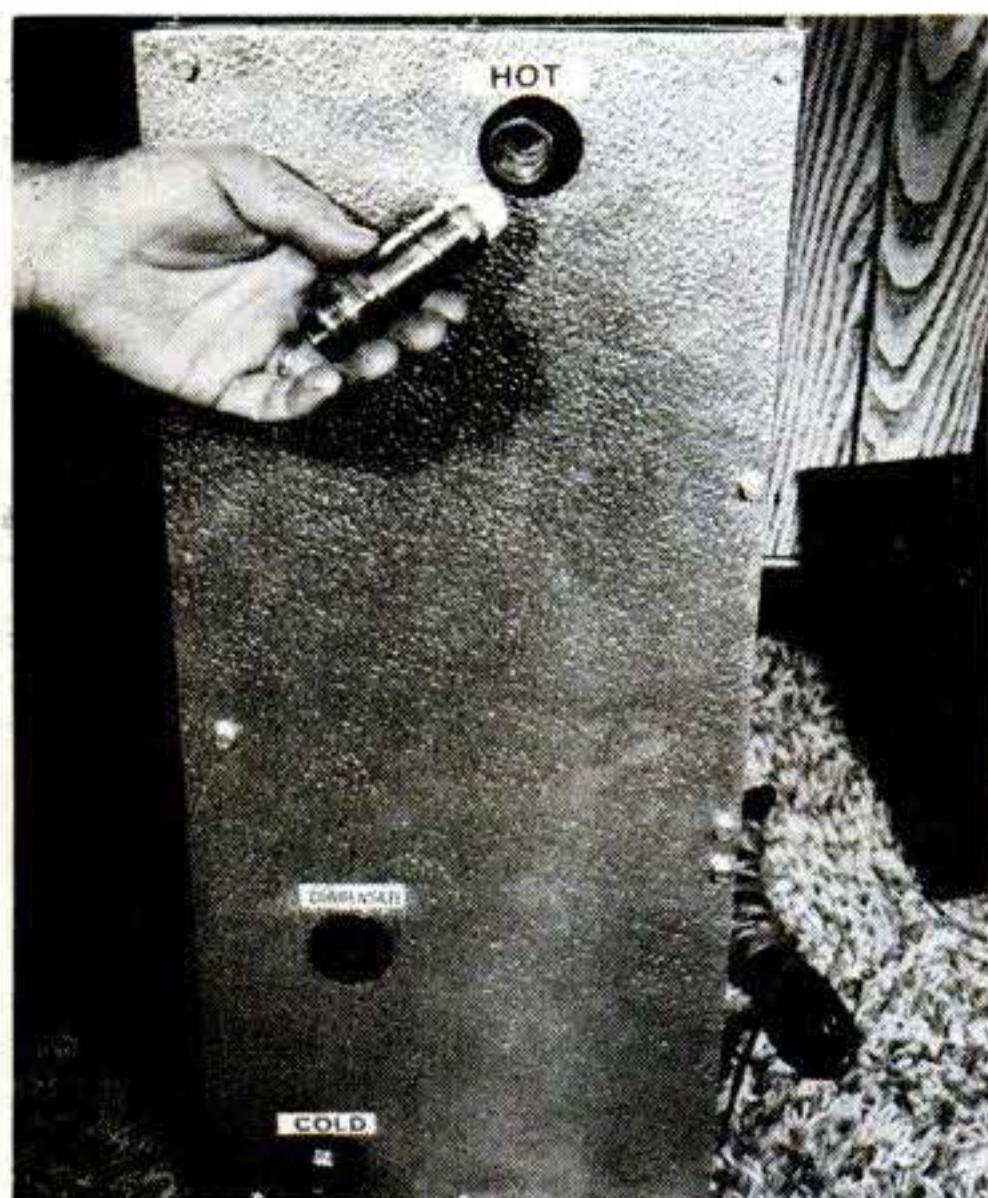
Score on Power Usage"). I was impressed with the savings.

Under many conditions, a heat pump will use less electricity to provide a given amount of heat—whether for space or water heating—than will an electric-resistance heater because it uses standard refrigeration techniques to absorb from the surroundings some of the heat needed to do the job (see box, "How the Heat Pump Water Heater Works.") An electric-resistance element converts electricity to heat on a one-to-one basis: For each Btu of electric energy used you get out one Btu of heat energy. Engineers call this ratio of heat output to energy input the coefficient of performance (COP). With resistance heat, the COP is always 1.0. But a heat pump can have a higher COP because it uses electricity not to create heat, but to augment the heat it absorbs and pump that heat to another location. Under ideal conditions—68° F air temperature and 70° F inlet water temperature—E-Tech's heat-pump water heater will operate with a COP of 3.1. As air and inlet water temperatures go down, so does the COP. But the potential for saving is high, particularly since heating water uses more energy than any other household job except space heating.

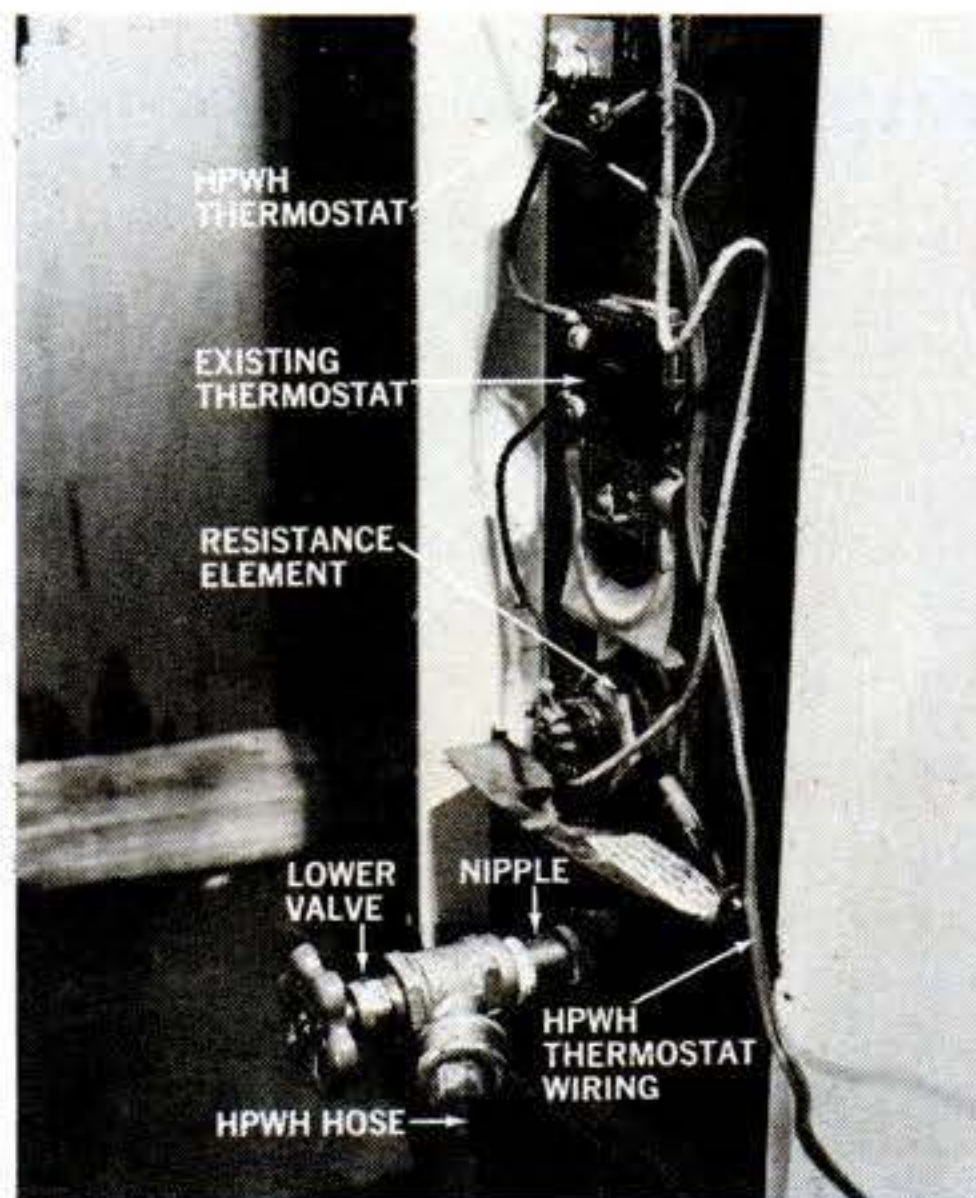
Solar savings—without the cost

Most experts agree that water heating is the most practical application for solar energy, but even a basic solar water heater is expensive and difficult to install. Most good solar systems could not surpass the performance I've realized with the Efficiency II heat-pump water heater, which can be

Continued

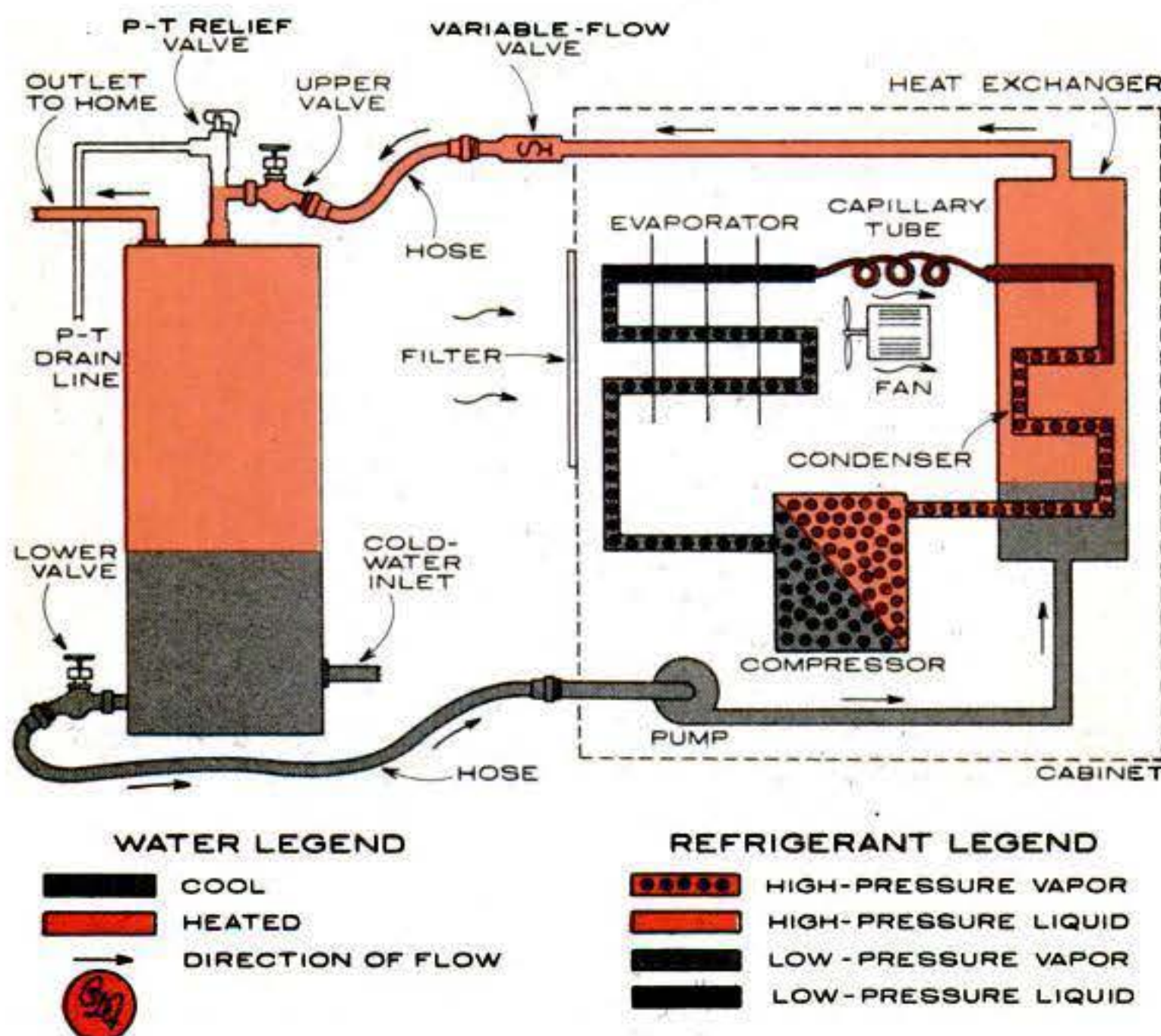


Variable-flow control valve in the hot-water outlet maintains 120° minimum water temperature by reducing the flow rate as necessary. Small amounts of hot water are available even if tank is cold.



Lower boiler drain on existing water heater is replaced with nipple and valve. New thermostat, installed above old one, has low-voltage circuit (24 VAC). Unit is available in 115- and 230-volt models.

How the energy-saving heat-pump water heater works



Two separate plumbing circuits—a nonreversing refrigerant circuit and a water circuit—are used by the Efficiency II to absorb heat from the ambient air and release it into the water. In the refrigerant circuit, a fan draws room air across the evaporator coil. The interior of the evaporator coil is a low-pressure area, and the heat in the air causes the refrigerant (a fluid selected for its low boiling point) to vaporize, absorbing heat. The heat-laden vapor then goes to the compressor, where its temperature is further increased. The hot refrigerant vapor enters the condenser coil under high pressure. As heat is given off to the cooler surrounding water in the heat exchanger, the heat loss causes the refrigerant vapor to condense into a liquid. The liquid flows through the capillary tube, a tiny orifice that acts as a metering device, and back into the evaporator coil, where the cycle repeats itself.

In the water-flow circuit, a small pump circulates water from the bottom of the storage tank, through the heat exchanger in the Efficiency II, and returns it to the top of the storage tank.

The operation of the unit is controlled by a thermostat, which causes the compressor and pump to run when temperatures in the storage tank fall below the stat setting.

A variable-flow valve regulates the water flow rate to keep output temperatures at around 120° F. The positive-displacement recirculating pump tends to keep temperatures relatively consistent from top to bottom in the storage tank; a variation of 30–40 degrees can occur with conventional water heaters.



WHY OUR MACHINES KEEP ON GOING AFTER OTHERS STOP HERE.

As many machines half their age are heading for junkyards around the country, there are 25-year-old Gravely two-wheelers still on the job.

And quite a few '67 four-wheel garden tractors, the first ones we made.

Now, we can't guarantee that kind of future for every Gravely product we make, but we can tell you this:

On Gravely riding tractors, you'll find things you won't find on other lawn and garden tractors.

An all-gear direct drive through the transmission to the attachments.

So there are no belts to slip, break or wear out.

We use cast iron on the engine, transmission housing and the pivoting front axle.

The rear mounted engine is bolted directly to the transmission housing.

We use precision-cut gears, which operate in an oil bath for less friction and a longer life.

*The Gravely Convertible.
Cast-iron engine and transmission housing.*

*Our 8183-T Riding Tractor.
Twin cylinder power and smoothness.
All-gear direct drive.*

The same kind of thinking goes into our two-wheel tractors.

As for mowers, we're not sure how long they'll last. Because we've only made them for two years.

But we expect them to last a long, long time.

Because we don't build them any other way.

For more details, write Gravely, 448 Gravely Lane, Clemmons, North Carolina 27012.

Or look up the Gravely dealer nearest you in the Yellow Pages.

Either way you'll find one simple idea behind all our products.

We don't take shortcuts in workmanship.

Because that usually means taking shortcuts to the junkyard.

GRAVELY

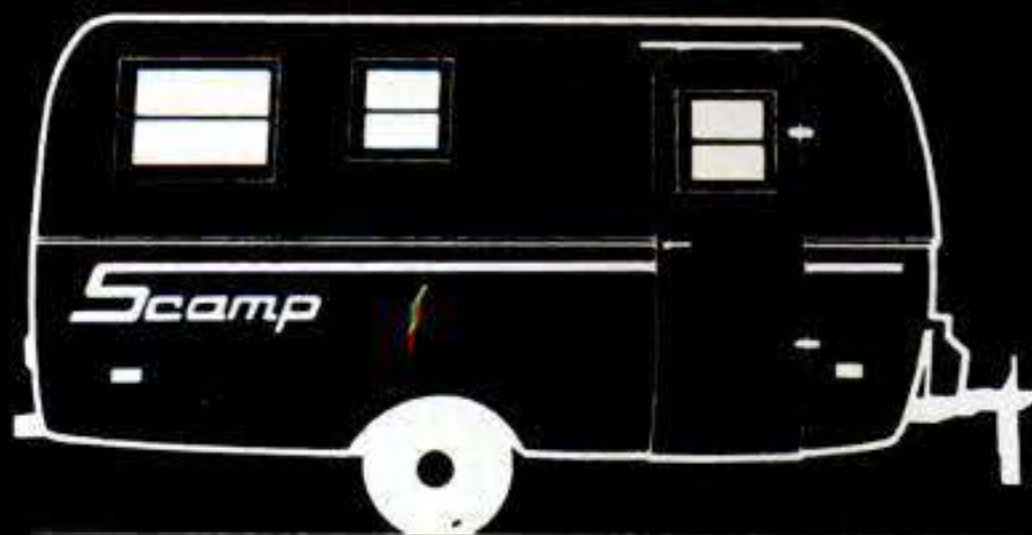


Our 22" dual control mower features separate controls for blade and drive.

*Our 1130-E Riding Mower.
Three-speed all gear transaxle,
unitized steel frame.*

Scamp

The ultimate traveling companion... aerodynamically clean, easy-to-pull, practically maintenance-free... why sacrifice comfort for economy when you can have both? Let scamp be your home on wheels!



Want to know more?

Send us \$2.00 and your return address and we'll mail you our latest brochure!

Or Call Toll Free 1-800-346-4962

We're EVELAND'S
Department PS - 480
Box 2
Backus, Minnesota 56435

85 lb. hitch weight, 950 lb. gross weight, 110V AC, 12V DC, patented undercarriage, all fiberglass, unitized body meets all state and federal regulations.

Read this Ad next time you're drowsy and dragged out at three in the afternoon.

More and more research shows ion-deficient air is a major cause of drowsiness

That invigorating feeling you get from a walk in the mountains is the work of electrically charged air particles called negative ions.

Negative ions are nature's air cleaners, removing polluted particles from the atmosphere.

In the city - and in offices, homes and cars, the natural negative/positive ion balance breaks down, leaving you with far too many energy-sapping positive ions to breathe.

The resulting drowsiness causes reduced productivity in your home or office. And, in your car, where ion deficiency is even greater, it is not exaggerating to say that the atmosphere can be downright dangerous.

How ion deficiency affects you

While we don't yet know all we want to about the effects of ions, we do know this much.

Air conditioning, central heating and pollution strip beneficial negative ions from the atmosphere. This helps to explain why so many office workers and housewives complain of the blahs in mid afternoon. Breathing bad air is bad news.

The same thing applies to your car. Only more so. Compare your car's ion balance (about 80 to 100 negative ions per cubic centimeter) to that of fresh mountain air (1,000 to 5,000 negative ions per cubic centimeter.)

No wonder drivers become sluggish and irritable. This atmosphere is not only unhealthy. It's dangerous. Especially when you consider that ion-deficient air slows reflexes by as much as 20%.

More negative ions mean more energy and alertness

Wherever ionizers have been tried, they have changed things for the better.

People have reported greater energy, better health and increased productivity.

An ionizer replaces the negative ions killed by metals, man-made materials, air conditioning and central heating. It restores the natural balance of the air, making it fresh and easy to breathe. At the same time, an ionizer radically reduces airborne dust, pollution, bacteria and pollen. And almost completely eliminates stale odors like tobacco smoke. Naturally.

You feel better and more alert. So think what it can do for you if you have allergies.

Why you should choose Bionaire ionizers over any other models

Many ionizers on the market emit ozone or other harmful gases. With Bionaire, all you get is a pure, invigorating stream of negative ions.

Another frequent problem is TV,

BIONAIRE 300
CAR UNIT 1" x 4" x 3-1/2"



CB and radio interference. You'll get no static with a Bionaire unit. It just quietly does its job.

The Bionaire 100A for your office or home

This unobtrusive, decorator-designed unit ionizes an area of approximately 250 sq. ft.

It comes complete with unique output monitor indicators, omnidirectional emission, and a full one-year warranty.

The Bionaire 300. Consider it a safety device for your car

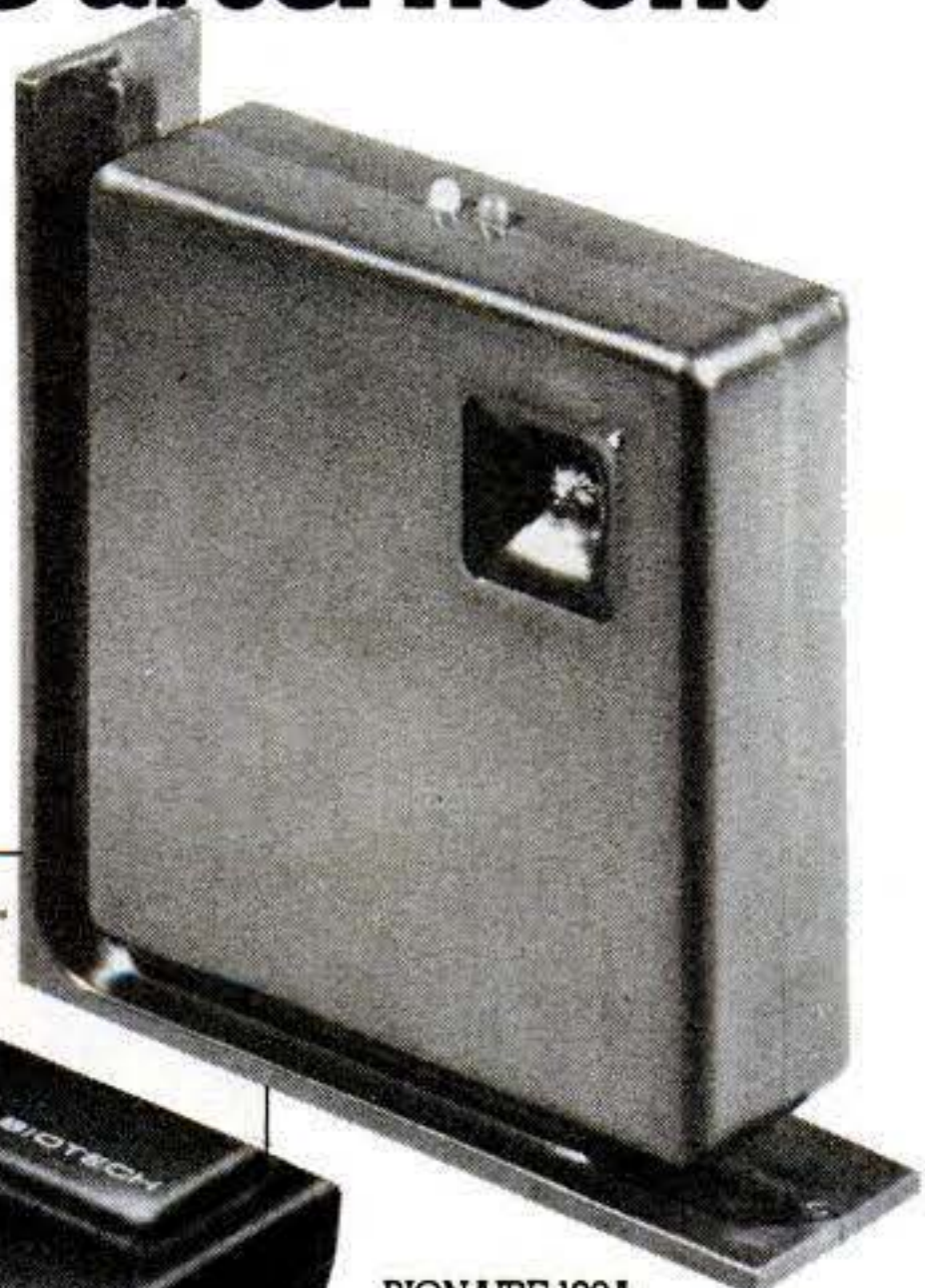
As mentioned, ion-deficient air slows reflexes by as much as 20%.

This can mean all the difference between avoiding a dangerous situation, and running right into it.

The compact Bionaire 300, (1" x 4" x 3-1/2") weighs only 4 ozs., sits on the dash without obstructing your view, and will keep you calm and alert through those endless rush-hour drives.

It's easy to install, has a multi-point ion source, and emits the highest ion output of any self-contained unit of its size. It also has a full one-year warranty.

Each Bionaire unit keeps the air in an 8 ft. radius around it charged



BIONAIRE 100A
HOME/OFFICE UNIT 2-1/2" x 6" x 6"

with at least 10,000 negative ions per cubic centimeter.

Would you like to know more?

If you'd like to read the latest scientific facts about ions, and learn more about these exceptional Bionaire units, we'll be glad to send you some very interesting literature including an article from P.379, December Playboy. Just mail us the coupon below.

Or do you know enough already?

Credit card holders: If you're convinced of the benefits Bionaire can bring you, order your home or car unit by calling 416-363-8704 collect. (Available in Canada).

B-V Distributors

P.O. Box 510, Grand Island, New York 14072, Dept. 112

At no obligation, please send me free, the full scientific facts on:

- Bionaire 300 (Car unit)
 Bionaire 100A (Home/office unit)

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP CODE _____
Dealer Enquiries Invited

Heat-pump water heater

[Continued]

bought at a fraction of the cost and installed in just a few hours.

A study sponsored by the Department of Energy and conducted by Oak Ridge National Laboratory reached similar conclusions. The abstract of the report states: "Model results suggest that heat pump water heaters are likely to offer much larger energy and economic benefits than will solar systems, even with tax credits. This is because heat pumps provide about the same saving in electricity (about half) at a much lower capital cost (\$700-\$2000) than do solar systems."

E-Tech, like Oak Ridge, estimates overall savings to be around 50 percent. My preliminary tests indicate that figure is conservative. Furthermore, the retail price is lower than the projections used in the Oak Ridge evaluation: The E-Tech production unit is \$549 FOB Atlanta. A typical family of four may realize a saving of as much as \$150 a year compared with a conventional electric water heater, indicating a payback period of less than four years.

At this point, the Efficiency II may sound like a partial solution to everyone's high electric bill—and it may be. But there's more to the story, and you should weigh the requirements and characteristics of the device against its merits before deciding if it's for you.

Demands of Efficiency II

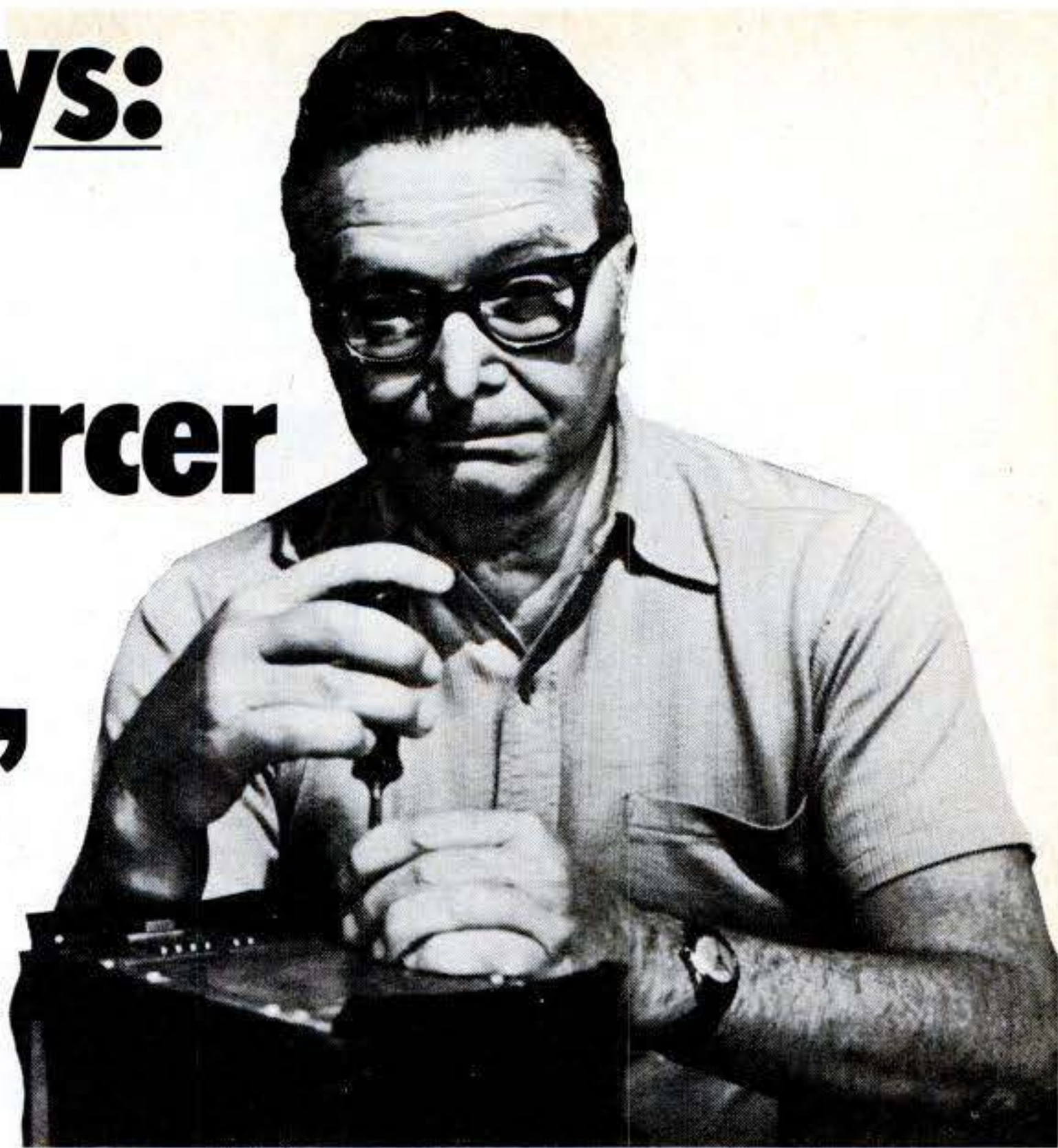
First, consider the space requirements. The box measures 14 by 18 by 26 inches and weighs about 85 pounds. The do-it-yourself installation kit pictured here allows a distance of several feet from the existing water heater, but the unit can be "hard-plumbed" with insulated pipes for permanent connection or for locating it more remotely.

Unlike space-heating heat pumps, with an outdoor evaporator coil and an indoor condenser coil, the Efficiency II is a one-piece device that must be located inside, where the temperature never falls below 45° F. At colder temperatures, frost would form on the evaporator coil. In very mild climates, it could be installed in an unheated space, but not in most parts of the country.

Since the unit works by removing some heat from the surrounding air and transferring it to the water, you should ask yourself where this heat comes from during winter months. If it's from a gas or oil furnace, you're okay in terms of cost per Btu. If that

Continued

Henry Morgan says: "Good appliance repairmen are scarcer than doctors who make house calls."



Did you know that there are over a billion appliances in use in the United States today? And three repairmen. At least that's the way it seems when one of mine goes on the blink. With more than two dozen electrical gadgets in my house going snap, crackle and pop, I finally got tired of trying to locate a guy with enough ambition to take my money and I decided to learn how to make the repairs myself.

When a well-aged comic like me decides to go back to school, you can bet the family jewels it won't be back at P.S. 93. I'm going to learn at home, or not at all. So I sent away for NRI's home study course in Appliance Servicing...and I took the course.

With a mechanical aptitude slightly below that of King Kong, I needed a course that started at the beginning and didn't move ahead too fast. Well, NRI did just that. They started with electricity — what it is and what it does — and went from there. You proceed at your own rate of speed. Whip through it if you want to, or take your time. What counts is the fact that you learn, in a way that it sticks with you.

You learn two things: how to repair appliances — from food processors and microwave ovens to refrigeration and air conditioning equipment — and how to get started in your own appliance business. That can mean money for you either way. If NRI can turn old ten thumbs Morgan into a reasonable facsimile of a repairman, think what they could do for you!

NRI's no fly-by-night outfit. They've been training people for more than sixty-five years...and they've had over a million students. It's the oldest and largest home study school in the field of electronics and electricity, so they know it better than anyone else around.

The NRI course is really easy to understand...with lots of pictures to show you what they're talking about. They even send you the tools you need at no extra cost. Depending on which level of training you select, you'll get professional hand tools, test meters, and demonstration equipment that lets you see the circuits you've been reading about.

In just a few months, you'll be fixing your own appliances like I do. Then, you can start earning spare-time money fixing them for your friends and neighbors. Before you know it, you can have your own full-time business and be independent.

Take my advice and mail the postage-paid card for a free catalog describing the courses, tools, and lessons in detail. Even if you don't know which end of a screwdriver is the handle, they can give you real professional training that'll help you break into the appliance repair field. It's one of the few things I've ever sent for that was even better than they said it would be. The NRI catalog is free and there's no obligation. No one will knock at your door or bug you at home. NRI doesn't use salesmen. They don't need them.

Take it from Henry Morgan, the appliance repair field could sure use some good men. Now. If somebody else beat you to the postcard, write to NRI at the address below.

Henry Morgan

Or look into these other growth fields

Small Engine Repair

The man who can service power mowers, garden tractors, chain saws, tillers, outboards, motorcycles and other small engines has plenty of opportunity open to him. NRI training includes tools, even a 3 1/2 HP engine to learn on. Basic or advanced courses. Check postcard for free catalog.

Auto Repair and Servicing

A good mechanic can work just about any place he wants to. NRI "hands-on" training covers what you need to know for a fast start in this high-demand field. Includes professional tools and instruments for learning and earning. Approved by Richard Petty, NRI Automotive Consultant. Check card for free catalog.

Air Conditioning, Refrigeration, Heating with Solar Technology

Learn residential and commercial servicing with practical training that includes lessons on solar heating and heat pumps. Complete with professional tools. Master Course includes optional training at York Institute resident school at no extra charge. Two courses to choose from. Check card for free catalog.

If card has been removed, write to:



NRI Schools
McGraw-Hill Continuing
Education Center
3939 Wisconsin Ave.
Washington, D.C. 20016

MORE CHEVY WAYS TO TOW.

1980 CHEVY TRUCKS. Chevy's got the rugged towing truck for you. With trailer towing capacities up to 13,000 lbs. when properly equipped. That's one reason Chevy sold more trucks in the 1979 model year than anybody. Big load to tow? Get a Chevy truck with new Chevrolet Three-Year Perforation-From-Corrosion Limited Warranty. See your Chevy dealer for details. Ask about leasing, too.

84.1%	87.2%	87.5%	93.6%	93.9%	96.1%	96.7%	99.2%	99.9%
'69	'70	'71	'72	'73	'74	'75	'76	'77

A TOUGH RECORD TO BEAT. 94.8% of Chevy Light, Medium, Heavy-Duty trucks and commercial vans in the ten most recent years recorded were still on the job. (Based on R. L. Polk & Co. model year registrations through July 1, 1978. 1979 statistics not available at time of printing.)



See your Chevy dealer today and get your '80 Chevy Recreation and Trailering Guide.

CHEVY TRUCKS

Heat-pump water heater

[Continued]

heat is coming from electric resistance units, however, you'd be gaining nothing by using the heat pump. On the other hand, if you're making use of waste heat (from a dryer vent, for instance, or from furnace-jacket losses), or if you locate the unit in a room warmed by a wood stove fueled with free firewood, you may reduce your water-heating costs by a significant amount.

In summer months, the cooling and dehumidification effect of the heat-pump water heater are beneficial. I noticed that my entire basement was free of damp and musty odors during the weeks the heat pump was in operation. But a condensate drain line must be provided to dispose of the moisture the heat pump removes from the air. If the unit is installed at a level below the house drains, a condensate pump will be required. Also, the Efficiency II's filter should be cleaned about once a month, depending on location.

The machine is not silent; there's a one-horsepower compressor and a recirculating pump inside that box, and it sounds very much like a window air conditioner. Located on a basement floor or in a crawl space, this should present no problem. But E-Tech also suggests hanging it from the ceiling or floor joists; there, harmonic vibrations may be propagated through the flooring. I would suggest avoiding this installation unless you are a heavy sleeper.

Installing it yourself

The only tools you'll need are a few screwdrivers, pliers, and a couple of pipe wrenches. The installation kit is complete even to the Teflon tape for the pipe threads.

The first step is to shut off power to your existing water heater, then drain the tank by attaching a hose to the boiler drain at the bottom and opening hot-water faucets in the house. As soon as the tank starts draining, you can install the top fitting. Remove the pressure-temperature relief valve and install the furnished T-fitting, nipple, and hand valve in the same opening. All modern pressure-temperature relief valves should have a handle that can be lifted for flushing. If yours doesn't, if the valve is more than five years old, or if the sensing element is too short, I would recommend replacing it with a new one.

Once the heater has drained, the old boiler drain at the bottom of the tank is removed and replaced by a long nipple and the new boiler drain.

Keeping score on power



Kilowatt-hour meters recorded the power consumption of the Efficiency II and a conventional electric-resistance heater. The heaters alternated weekly duty cycles. Here are the results:

Week	HPWH (kWh)	Conventional (kWh)
1	75	—
2	—	186
3	63	—
4	—	231
5	113	—
6	—	226
7	109	—
8	—	211
9	125	—
10	—	280
Total	485	1134

Duke Power Co. furnished and calibrated the two meters, and subsequently tested an Efficiency II in its Charlotte, N.C., laboratory. Initial testing indicates the unit has excellent recovery characteristics. Testing at 68° F ambient air temperature and 70° F water inlet temperature, hot water was drawn from a 50-gallon storage tank at the rate of three gallons per minute. At the factory thermostat setting, initial outlet temperature was 132° F. After eight gallons had been used it dropped to 130° F. After 50 gallons the water was still at 118° F.—E.P.

The next step is to screw the variable-flow control valve into the unit's hot-water outlet and then connect the shorter of the two hoses provided between the bottom valve of the storage tank and the unit's cold-water inlet.

Electrical connections are simple: Connect the supplied thermostat to the low-voltage wire that extends from the Efficiency II, remove the cover panel from the storage tank, and mount the new stat in good thermal contact with the tank just above the present bottom thermostat. The only deficiency I found with this entire system is the mounting of the new stat. E-Tech recommends using insulation to hold it in place, but I made a special bracket from an insulated wire loop, which I wedged under the two sides of the opening.

Next, clear plastic tubing is connected to the condensate outlet and run to a suitable drain or condensate pump.

Before connecting the hose from the hot outlet to the valve on the T-fitting at the relief valve, the unit should be purged of air by opening the bottom valve all the way and then plugging in the unit. After it runs for a few mo-

ments, the flow-control valve will open and allow the pump to force all air from the system. When the water runs clear, unplug the unit, connect the hose, then open both valves completely. Wait 10 minutes, plug in the heat pump water heater, and the installation is done.

Solid guarantee

E-Tech (3570 American Dr., Atlanta, Ga. 30341) offers a six-month, no-risk, money-back guarantee if you are not satisfied with the Efficiency II for any reason. And for five years the company will replace or repair any defective part. If you can't install the part yourself, it will repair, without charge, units returned to the factory, or an authorized dealer will make the necessary repair for only the cost of transportation.

At a time when boasts about the energy savings of many devices are greatly exaggerated, it's refreshing to find one that surpasses company claims. With a heat-pump water heater, you'll have no conspicuous array of solar collectors to announce to the world that you're saving energy, but you'll know you are when the electric bill arrives. E

Motion converter

— one-way power from two-way input

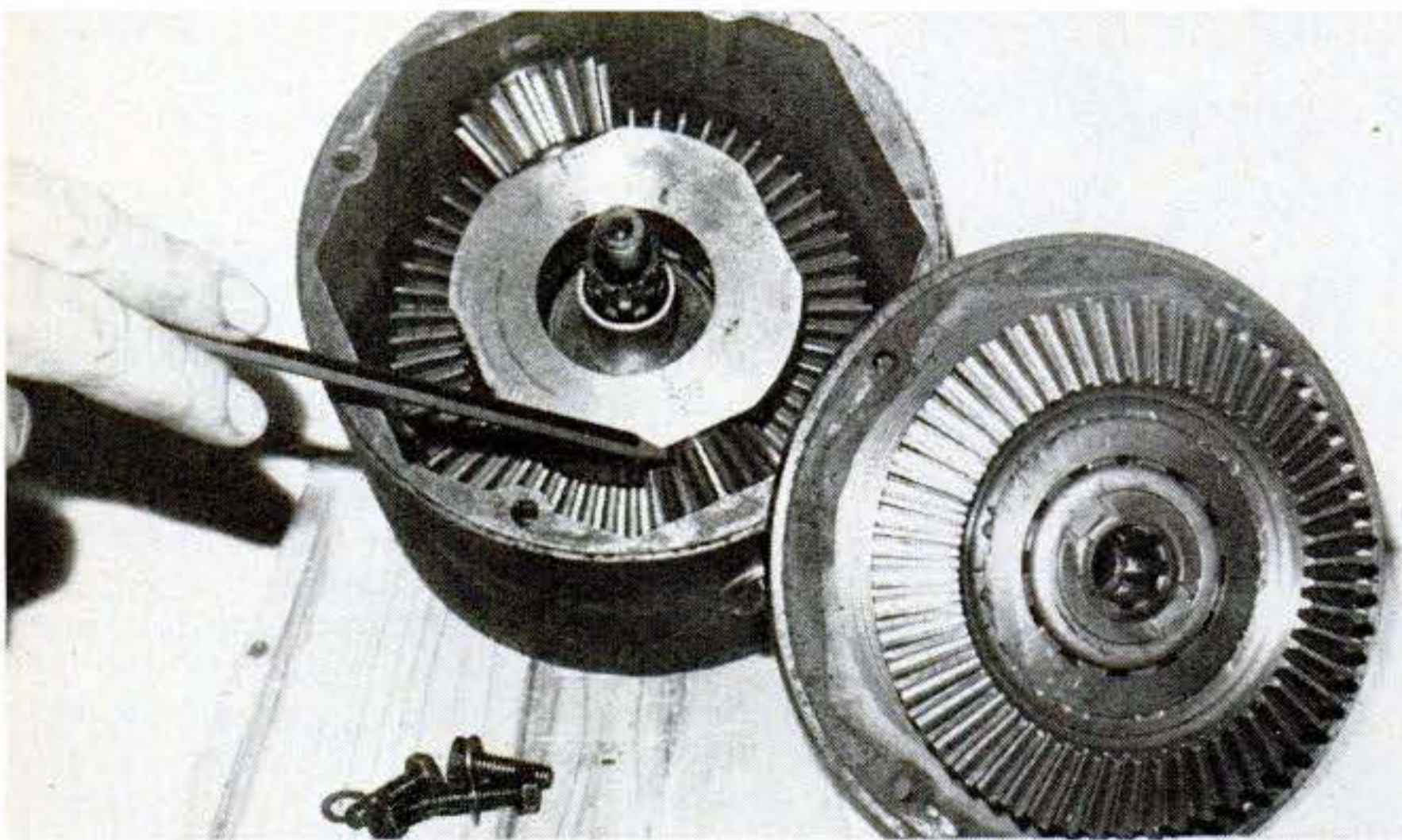
By E. F. LINDSLEY

One big problem with some of those energy sources such as wave power, stream-flow power, and some types of wind power is that they're limited to short up-and-down or back-and-forth motions. The power is there, but instead of rotating in one direction so you can drive a generator handily, the motion is more like that of a handle on a bumper jack.

A new drive device, invented by Musgrave Schoeman and Herbert Warmington and patented by Staw Engines, Ltd. (3 Nesbitt Rd., Pine-town, Natal 3600, South Africa), appears to offer a solution. Accepting full or partial rotation in either direction at one end, it delivers full rotation, single direction at the output shaft. If you put in wagging power from a stubby-tailed dog at one end, it would come out as rotating power at the other.

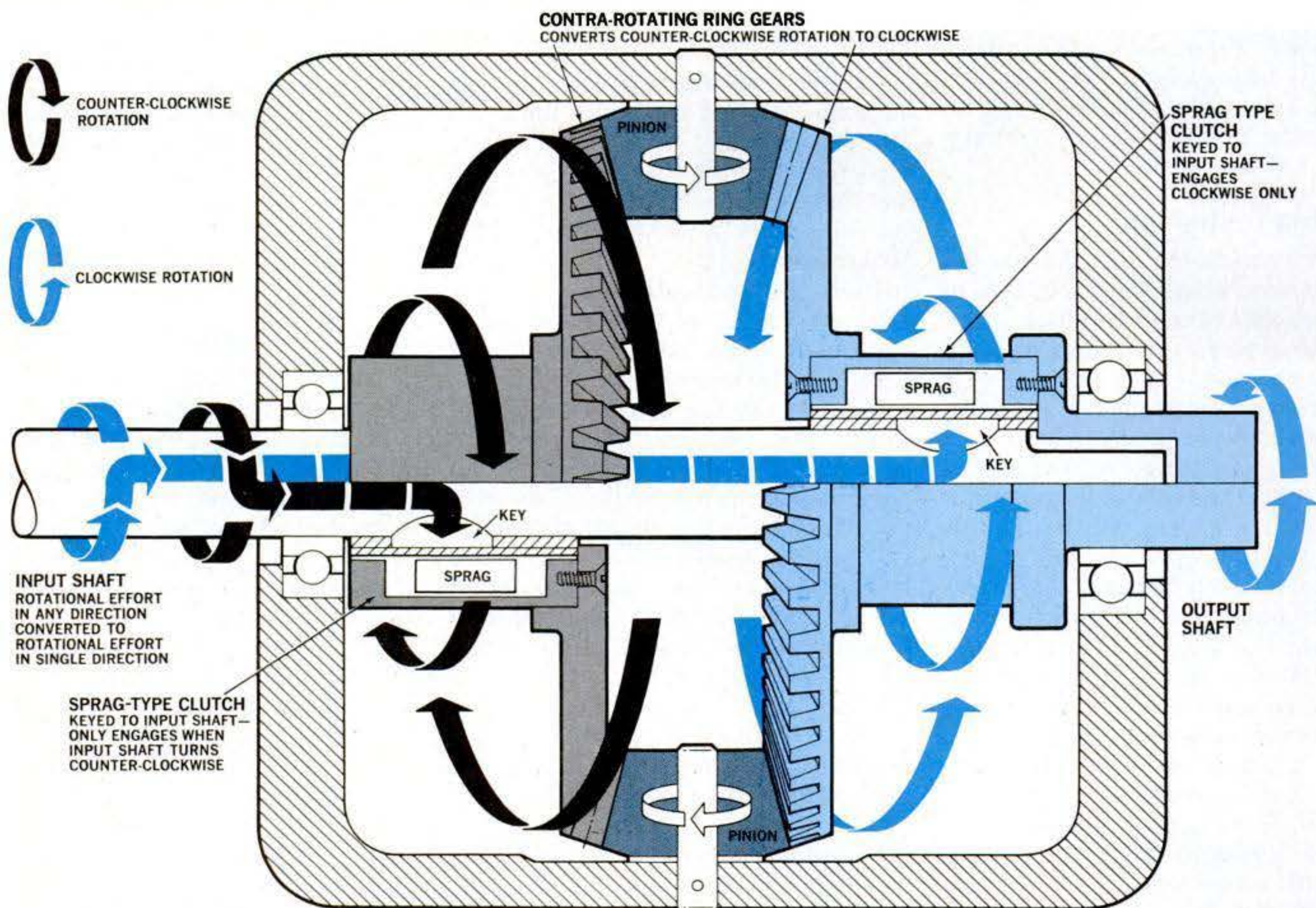
The secret is a pair of Form-Sprag overrunning clutches that lock up when turned in one direction and free-wheel when turned in the opposite direction. As shown in the drawing below, these, in turn, rotate two ring gears that have two pinions in between.

Future use of the device could mean a very simple and direct connection between an alternate-energy device and the workload. P. 51



Two opposing ring gears and intermediate pinions straighten out back-and-forth

oscillating power to make rotating power. It's a simple but rugged design.



Input shaft extends through converter and drives two sprag clutches, counterclockwise at left, clockwise at right. Motion in either direction from input rotates one or the other ring gear, and

in turn the pinions drive the freewheeling gear of the moment. Output shaft is fixed to the right-side ring gear. Result: The output shaft turns in one direction, despite the input source.

A man in an orange jacket is climbing a ladder on the side of a boat. The boat is green and white, and is on the water. The background shows a blue sky with clouds and a rocky coastline.

No compromise

**Winston Lights didn't compromise
on great taste to get low tar.
Why should I?**

**Winston Lights taste good
like a light cigarette should.**

LIGHTS: 13 mg. "tar", 0.9 mg. nicotine, LIGHT 100's: 13 mg. "tar",
1.0 mg. nicotine, av. per cigarette, FTC Report MAY '78.

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



POWER TO CAMP OUT OR SHIP OUT.

When you're in the great outdoors, you never want to get in a position you're powerless to control. And that's where Honda comes in.

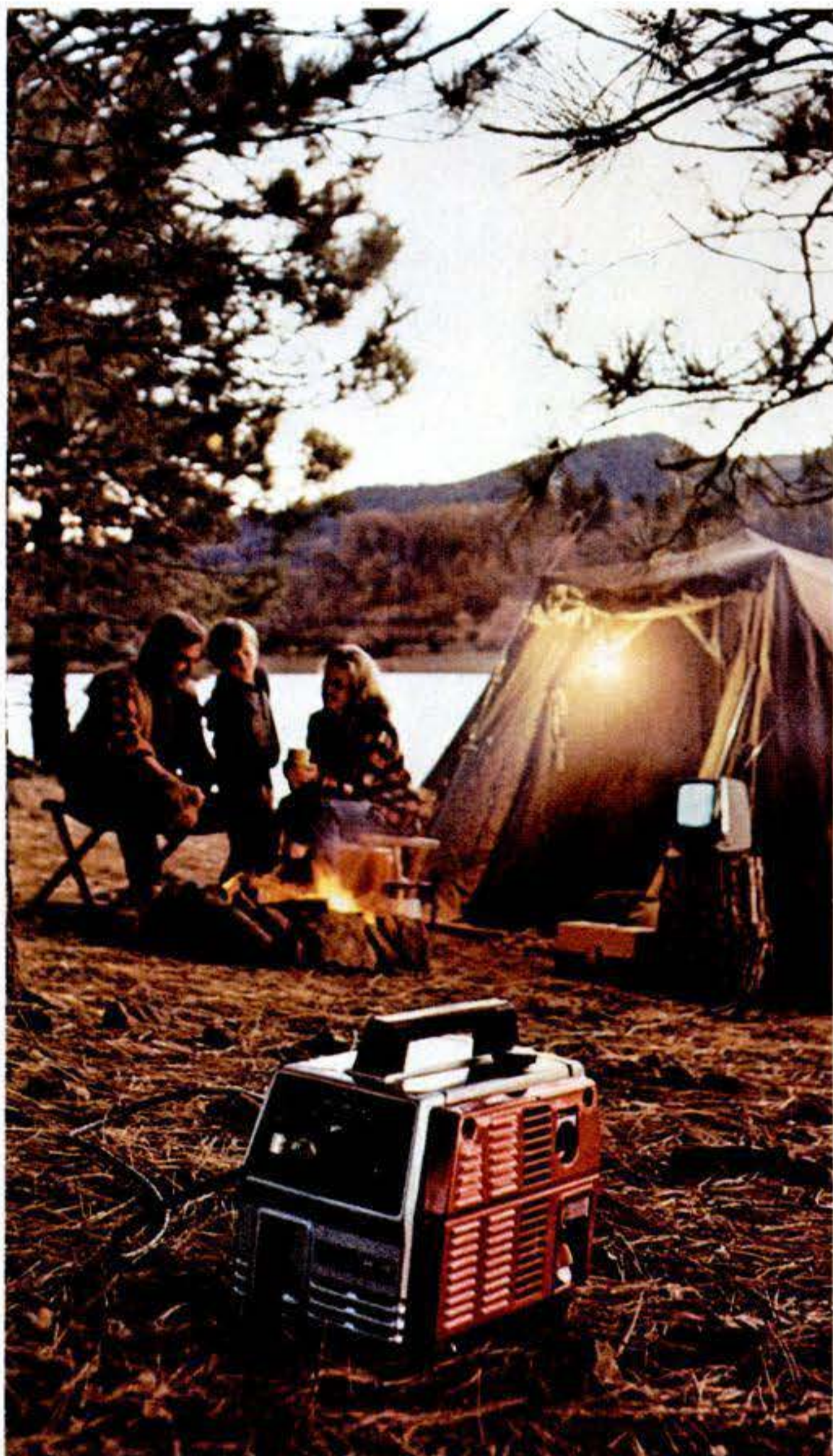
PORTABLE POWER.

The new EM-500 portable generator is the ideal companion for campers and hunters. It gives you a maximum 500 watts of power in a lightweight 40 lb. package about the size of a portable TV.

Whether you need to power your camping accessories, charge your RV battery or just warm-up under an electric blanket, the EM-500 does it quietly and economically—about 4 hours on a tankful of gas.

It's great for small power tools, barbecue motors and electric fans, too. And it can really light-up a camp site.

In addition to the EM-500, Honda has a full line of portable generators from 400 to 4,500 watts.



NAUTICAL POWER.

Honda has power for boaters and fishermen, too. A line of 4-stroke outboard engines that come in 7.5 and 9.9-hp models, both with short or long shaft.

Honda's 4-stroke design means quiet operation. Quick response and powerful acceleration. Maximum fuel economy—over three hours on a tankful of fuel under full throttle.

Smoother operation. And less pollution because there's less oil and smoke discharge.

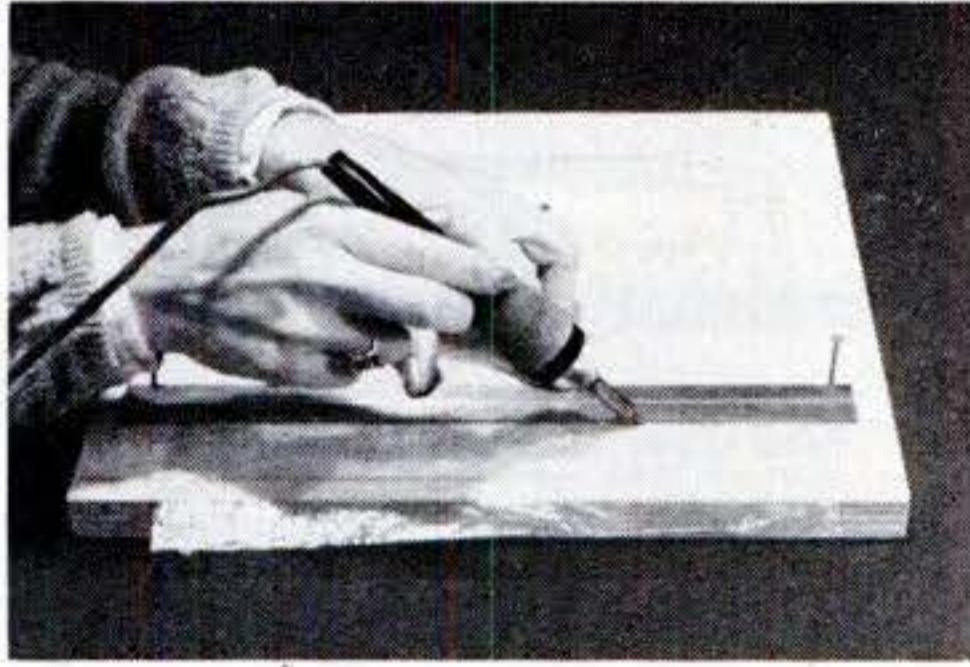
These engines are ideal for trolling. They have the power to keep from drifting at low RPM's without fouling the plugs.

Before you head out on your next trip, let your nearby Honda dealer tell you about Honda power. Just look in the Yellow Pages or call toll-free 800-648-5311 (Operator 99).

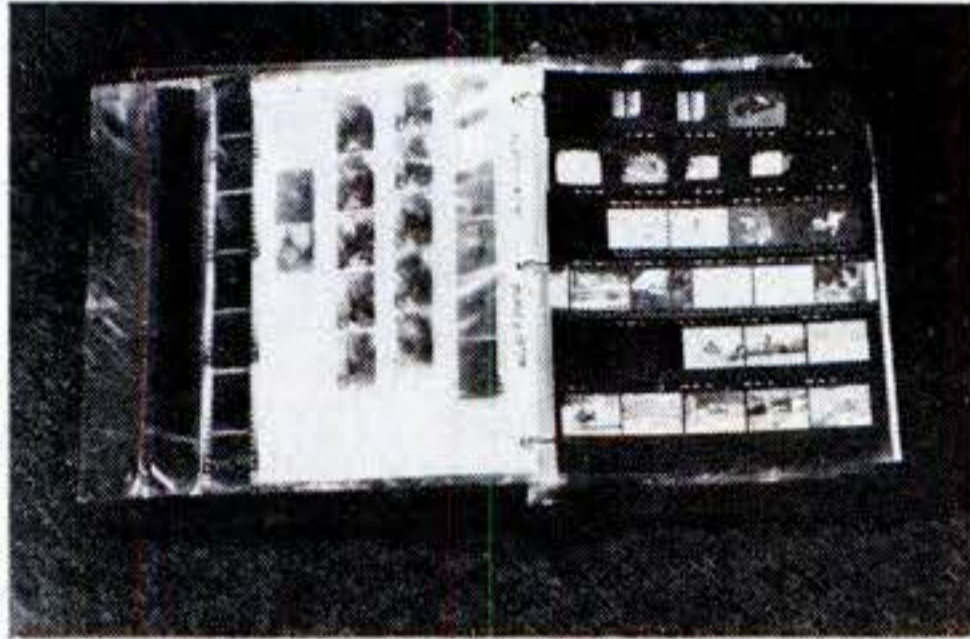
IT'S A HONDA



Make a file for your negatives



Using a wood-burning tool, follow metal rule to fuse the sides of plastic bag.



Clear plastic lets you see your negatives without having to remove them—and they are easy to find and keep.

If you've ever wished there were an inexpensive way to keep your negatives filed, here's a system you can make yourself. All you need is one 13"-by-13" piece of plywood, a wood-burning kit, a metal rule, two nails, a knife, and a box of zip-lock freezer storage bags (about 10½" by 11").

Step 1: Draw line A ½" in from one edge of the plywood; then draw line B 2" in from the same edge. (For sizes other than 35 mm, lines must be adjusted to negative size.)

Step 2: Place the front edge of the rule along line B, away from line A. Drive one nail into the plywood about ½" in from one edge of the rule; repeat with the other nail.

Step 3: Remove the rule and place a freezer bag on the plywood between the nails with its bottom edge along line A. Replace the rule tightly on top of the bag. Using the rounded tip of the wood-burning tool, carefully draw the tool along the edge of the rule (top photo)—too fast, and the sides of the bag won't fuse; too slow, and you'll melt the bag.

Step 4: Slide the bag forward so the fused line is over line A. Repeat Step 3 until you have reached the end of the bag.

Step 5: With the rule and knife, cut a ⅛" strip off each side of the bag. You can file the negatives in a standard three-ring binder for easy access.—
Robert S. Stevens

THE TIGER THAT STANDS STILL WHEN YOU LET GO.

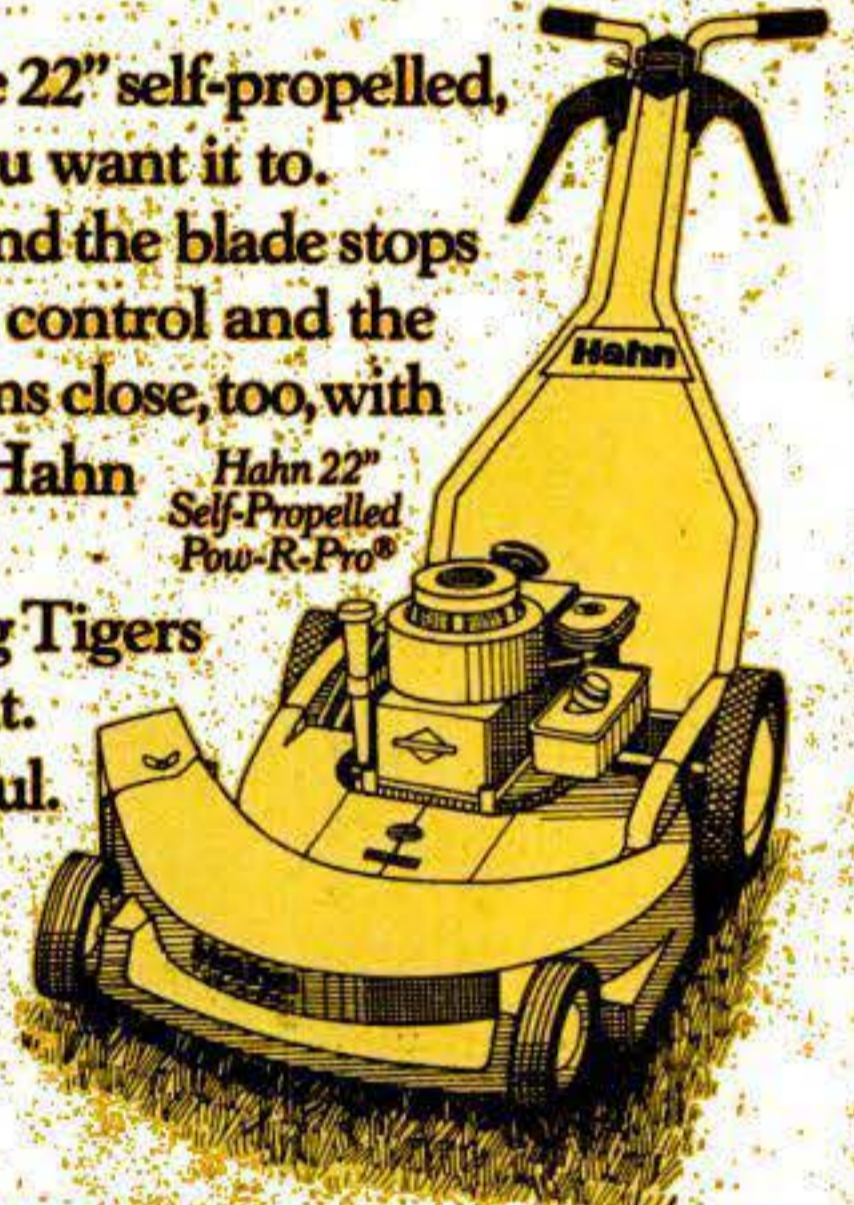
Hahn designed this maneuverable 22" self-propelled, dual-control mower to stop when you want it to.

Release the BladeMaster control and the blade stops in seconds. Release the DriveMaster control and the wheel drive disengages. This Tiger trims close, too, with a low profile front and the exclusive Hahn trimmer notch on the left side.

If you have tall grass, Hahn riding Tigers and lawnmowers can really go after it. And leave your lawn looking beautiful.



HAHN TIGERS
Tough Mowers For Tall Grass



Hahn 22" Self-Propelled Pow-R-Pro®

Hahn Outdoor Products, P.O. Box 5005, Clemmons, NC 27012

HOW TO MAKE THE LADDER BUY OF A LIFETIME.

Compare the following features:

Approved by UL and OSHA

Meets consumer safety requirements of American Nat. Standards Inst.

Full 3 inch side rail construction.

Double rivets for double strength.

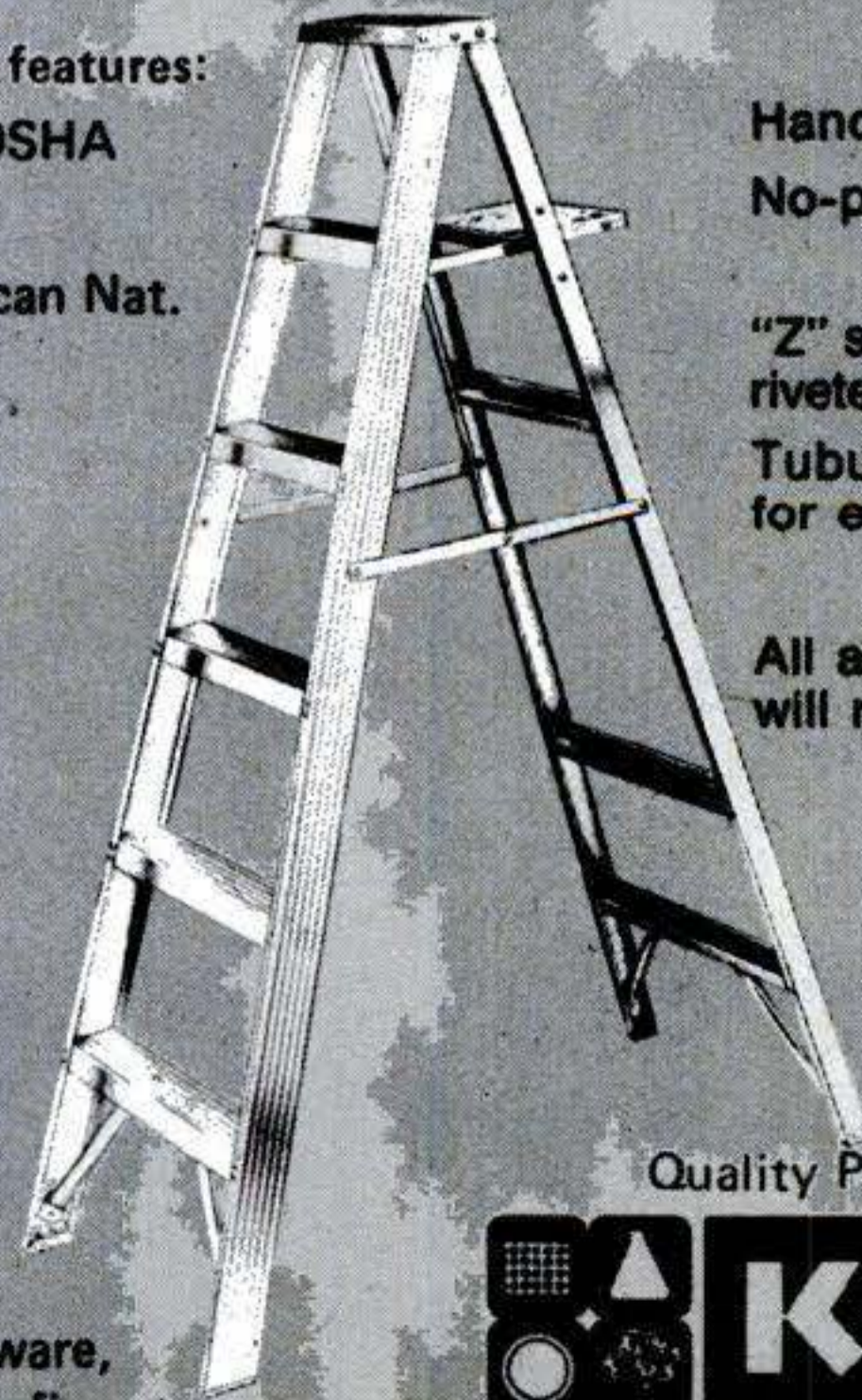
Extruded slip resistant steps.

Vinyl feet that grip.

Handy tool caddy.
No-pinch spreader bars.

"Z" shaped back brace riveted front and back—
Tubular braces for extra protection.

All aluminum will not rust or rot.



Quality Products Since 1950.



Available at most hardware, home centers and other fine stores.

Panasonic Portable Light Scope

When you depend on
an eye for detail



*Suggested
retail price
\$24.95

The powerful Panasonic Light Scope FF-393E lets you make brilliant observations . . . every time, anywhere. It's the ideal tool for students, engineers, collectors, jewelers, chemists, hobbyists, printers, textile inspectors . . . and other sticklers for detail. For the professional perfectionist, it's hand-held technology at a pocket sized price.* It features:

- 30-power magnification
- blue light filter
- thumbwheel lens focus
- battery operation (operates on 2 "AA" size batteries, not included)
- compact — 5½" total length
- automatic shut off when folded
- carrying pouch

For more information about Panasonic portable light scopes, fill out and mail us this coupon.

Panasonic Company,
Battery Dept.
P.O. Box 1500
Secaucus, NJ 07094

I would like more information
about Panasonic light scopes.

Name _____

Firm _____

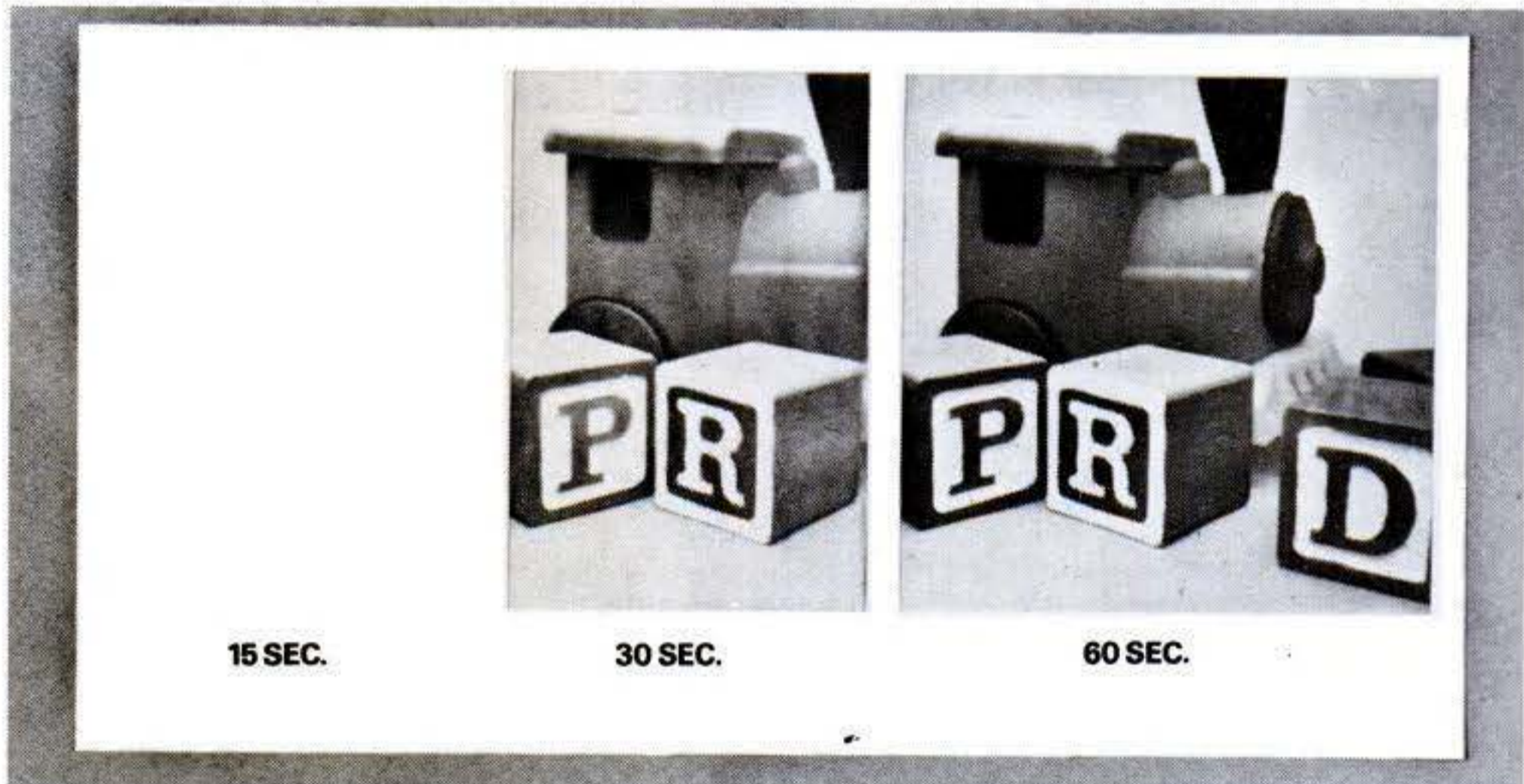
Address _____

City State/Zip _____

Phone _____

THROUGH THE VIEWFINDER

By EVERETT H. ORTNER



One-minute pictures

If you live in Florida and have a camera that uses Polaroid SX-70 film, you may already have had a chance to use the astonishing new Time-Zero Supercolor film. The film, introduced in Florida in January, will be available throughout the U.S. in 1980. "Time-Zero" is only a slight exaggeration; it's actually one-minute film: 10–15 seconds for the first traces of the picture to show up, 30 seconds to turn into a picture, a minute for the picture to look finished (although it keeps changing subtly for a long time after that before the chemical reactions halt). And "Supercolor" is also only a slight exaggeration; the colors are vivid and accurate.

I particularly liked the color quality of the new film when used with Polaroid's own flash unit, the Polatronic, designed for use with the auto-focusing SX-70 and Pronto OneStep cameras. (The nonfocusing OneStep uses a Polaroid Q-Light.) Both are shown below. Polaroid Corp. has done little in the way of publicizing these electronic flash units. Why? And why hasn't the company built an electronic



flash into its units, as Kodak has? Is Polaroid saving you for something else—like the "unique light source and revolutionary battery" rumors say Polaroid will introduce this year, along with a small, lightweight instant camera? Perhaps. In the meantime, \$49.95 will buy a Polatronic unit and \$29.95 a Q-Light. For somewhat less, you can buy other flash units designed to meet Polaroid specifications and work with the cameras' complex electronic systems. If you have a sonar-focusing Polaroid camera, make sure the flash you buy will work with it.

Frozen assets

"Every time the silver price climbs a dollar an ounce, it adds \$50 million to our operating costs," Colby Chandler, president of Eastman Kodak, told a group of market analysts last fall. That's why film and photographic-paper prices have soared.

Hoarding against inflation is usually not a good idea, but if you do have a large stock of film and/or photo paper on hand, at today's prices it's more important than ever to protect it against deterioration. Professionals often keep it in the freezer. The cold slows down chemical action to the point where the material will last a long, long time without apparent change. Even in a standard refrigerator compartment, at say 40 deg. F, I have found that photographic material can be held long beyond the manufacturer's expiration date. I have, for example, used both Kodachrome and Ektachrome, stored at about 40 deg. F, as much as two years after their expiration dates. Black-and-white film can be held much longer.

Centennials

By coincidence, two giants of the photo-

graphic industry, Britain's Ilford and America's Eastman Kodak, got their start at very close to the same time a century ago, and doing very much the same thing: manufacturing photographic dry plates.

Alfred Hugh Harman, a photographer, needed for his enterprise a site close to London with a clean, dust-free atmosphere, and found it (in 1879) in the village of Ilford. There, with two men, three boys, and his wife to help out in busy times, Harman launched the company that was to become Ilford Limited, maker of high-quality photographic materials.

At about the same time—in April 1880—George Eastman, a bank clerk who had become infatuated with photography and spent the previous three years cooking photographic emulsions on the kitchen stove, leased the third floor of a building on State Street in Rochester, N.Y., and also started to manufacture dry plates. Eastman's big discovery was a way to automate production—for which he received patents in 1879 in England and 1880 in the U.S.

Rumors (again!) have it that the Eastman Kodak Co. is cooking up something tremendous on its kitchen stove to celebrate the centennial, and it might just happen about the time you read this issue.

Snapshots

- Are the flash shots with your automatic 35-mm camera sometimes badly overexposed? A commercial photofinisher reports that he sees a lot of such overexposed flash pictures—and he has an explanation. They're caused by the users leaving the camera in the automatic mode when shooting with flash. "Picture the result," he says. "You're shooting in dim nursery light. The electric eye calls for an f/1.8 setting, while you're shooting from three feet away with a flash with a guide number of 64 with ASA 100 film (128 with ASA 400 film). That's a lot of stops overexposed!" The electronics of the most modern cameras automatically puts them in flash mode, but cameras made a few years ago don't have that feature. It's something to watch out for.

- Photographers who are proud of their slides often tend to get bigger and bigger screens on which to project them, or even to fill a whole wall. Can a screen be too big? Yes, says one audio-visual expert. Here's a reasonable formula to use: "Except for the most detailed scenic slides, audiences may be uncomfortable being closer than a distance equal to twice the height of the image." If your screen is six feet high, your audience should not be closer than 12 feet away. If your living room doesn't permit that distance, maybe you should restrict the size of your projected image.

- What are photocards? They're five-by-eight cards with a picture on one side by former *Life* photographer Yale Joel and an explanation on the other side of how he took the picture. They come 15 to a deck, and each deck covers a specific subject: children, travels, pets, and so on for 20 categories. A good idea? Yes... but. The pictures vary in interest (for my taste), and the explanations tend to be very general. P.S.

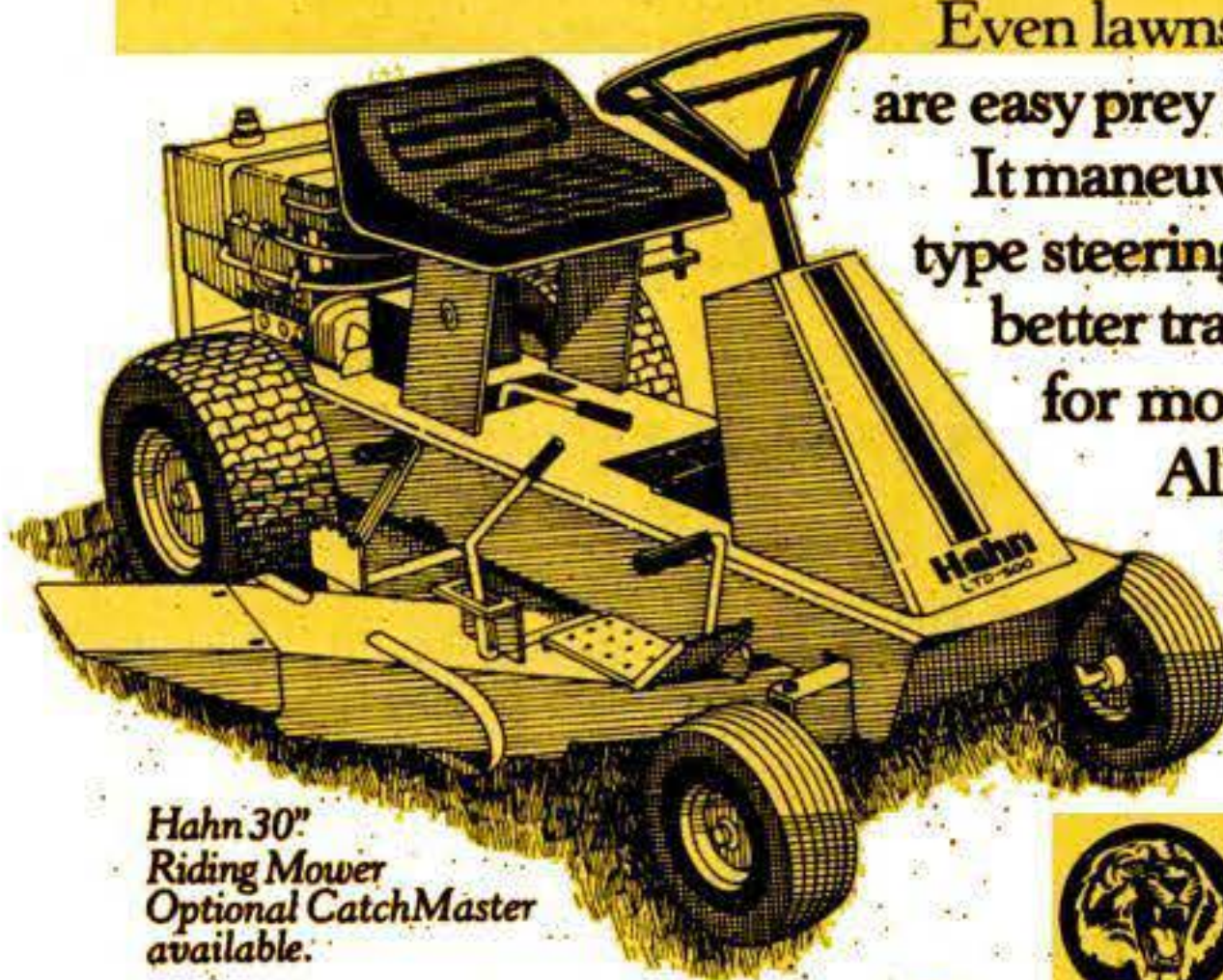
THE TIGER THAT THRIVES IN TALL, TOUGH GRASS.

Even lawns that look like tiny jungles are easy prey for the Tiger.

It maneuvers easily, with automotive-type steering. There's a rear engine for better traction. A floating front axle for mowing on uneven terrain.

All-gear, 3-speed transaxle has a 2-year limited warranty.

Let a riding Tiger or lawnmower turn your tall grass into a beautiful lawn.



Hahn 30" Riding Mower
Optional CatchMaster available.



HAHN TIGERS
Tough Mowers For Tall Grass

Hahn Outdoor Products, P.O. Box 5005, Clemmons, NC 27012

WHEN YOU THINK PERSONAL COMPUTERS THINK OHIO SCIENTIFIC

OHIO SCIENTIFIC
1333 SOUTH CHILLICOTHE ROAD
AURORA, OH 44202 • (216) 831-5600

For literature and the name of your local dealer, CALL
1-800-321-6850 TOLL FREE.

A WORK TRUCK NEEDS A WORK TIRE



FIRESTONE STEELTEX RADIALS WORK.

Firestone Steeltex Radials for light trucks give you the long mileage, smooth ride, good traction and gas saving of a steel belted radial *plus* the hard nosed toughness of a real truck tire.

We built the Steeltex Radial to work. That's why the steel cord in Steeltex Radial belts is the same cord we use in the Firestone Transteel XR4s that roll on the 18 wheelers.

And that's why we build two of them. The regular Steeltex Radial and, for extra drive wheel traction, the Steeltex Radial Town & Country.



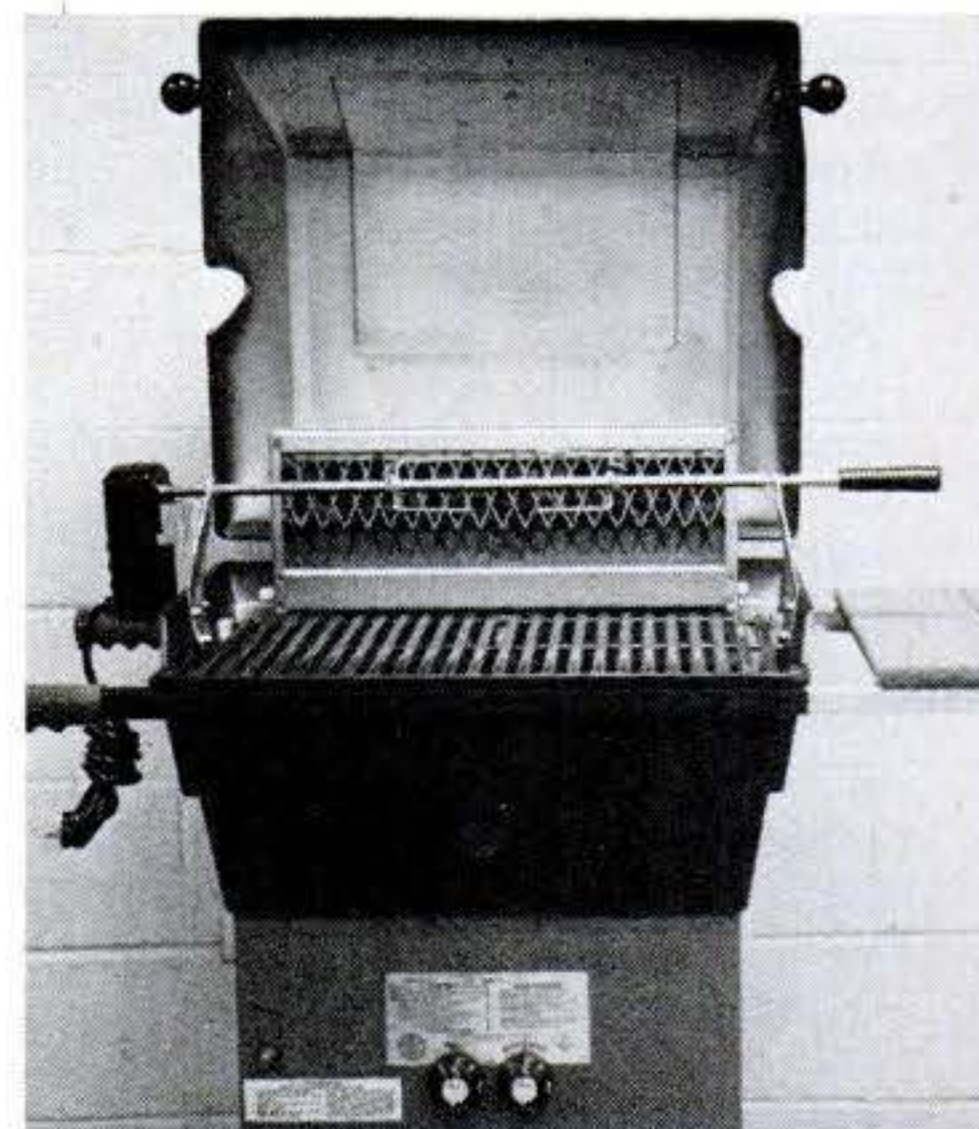
Firestone

STEELTEX RADIALS

Working Tires For Working Trucks

Remember, the safety of any tire depends on wear, load, proper inflation and driving conditions.

Gas grill that beats the grease problem



At last! A barbecue grill with a difference. That's my happy conclusion after taste-testing several dishes cooked in Ducane's innovative outdoor cooker. The Rotis-A-Grate outdoor gas grill has several unique features:

- A vertical "coal" rack with a separate burner for rotisserie cooking. A pan of your favorite basting placed under the meat adds flavor as well as collecting the drippings. With no fire underneath there are no bothersome flare-ups.

- A grill of inverted U-shape sections. These porcelain-covered steel sections trap more heat than other designs, the manufacturer claims, and this halves fuel consumption and shortens cooking time.

- Top-ported burners. Other manufacturers make side-ported burners, often with baffles above the ports to prevent dripping grease from clogging the ports. But the Ducane has no baffles. It has no grease can to collect excess from the grill. A unique coal grate prevents drippings from reaching the burners.

Ducane advises preheating the grill on "high" for 10-15 minutes and then turning the burner to "medium low" before cooking. In my own testing, I found that to be good advice. There is some flare-up (and some is desirable to create "charcoal" flavor), but it's much less than other grills.

The Ducane grill is in the upper-middle price range. I tested a Model 3000, which retails for \$349. For that price you get a grill that is decidedly advanced: It gets the drippings into the gravy, not the fire. For more information write Ducane Corp., 800 Dutch Square Blvd., Columbia, S.C. 29210.—Evan Powell



ENDED AT LAST. MAN'S 400-YEAR STRUGGLE TO MAKE A WATCH THIS SMART, THIS THIN.

Timekeepers first appeared on people's wrists shortly after the development of the mainspring; approximately 1540.

The geniuses of invention have worked to trim the size and bulk of the wristwatch, ever since.

Last year, in fact, Seiko set a record for slenderness with a 2.5 millimeter quartz watch; it sold for \$5000. Yet for this unearthly sum, its owners could learn only the hours and the minutes of the day. Not a stitch more.

History has been made again. Now with an electronic liquid crystal quartz timepiece that approaches the thinness—but greatly exceeds the talent of Seiko's pride.

Its name is Xernus (pronounced *zer' nus*). And The Sharper Image brings it to you through the mail at the highly tempting price of just \$89.

Normal time mode. Continuous display of hours, minutes, seconds, day of week. With alarm indicator.

Date at the flick of a button. Shown in large, crisp digits. Automatic end-of-month adjustment.

24-hour alarm. Speed setting to the exact minute, AM or PM. High-volume electronic beep, auto reset.

Precision stopwatch. 12-hour timing to 1/10 second. Laps, 1-2 finishes, time-outs.

Easy night reading. Face light illuminates display on command.

Nobody else in America offers Xernus; if and when they do, it will most certainly be priced at \$150 or more.

The world's slimmest solar alarm chronograph.

How trim is this brainy piece of jewelry—that gives you the time with ± 15 seconds a month accuracy, the day and date, an alarm, a stopwatch and a solar-assisted battery—squeezed into a wafer?

Precisely 4.95 millimeters from the top of its mineral glass crystal to the back of its solid stainless steel case. (Xernus functions are further described in the face diagrams, below.)

Before you pick up your phone, we invite you to compare the thinness of Xernus to the world's remaining crop of solar alarm chronographs.

Seiko, an undisputed leader, sells a comparably talented timepiece for \$250; it measures 10.5 millimeters from top to bottom.

In the Under-\$150-League, competition for slenderness in alarm chronographs is even more dismal. Texas Instruments' is 12.0 millimeters thick; the Advance, 9.5 millimeters. And these are some of the thinnest.

Craftsmanship that's rare at even \$150 more.

Both case and bracelet of Xernus are machined from solid stainless steel, not plated base metal or "silvertone" (a material that pits and peels, often after only a few weeks of light use).

Once again, the face isn't scratch-prone plastic, but rock-hard tempered mineral glass.

And the manufacturer of Xernus is one of the few who dare to even mention water-resistance. Better yet, they guarantee your Xernus against water damage to 60 feet below the surface. (They're conservative; it has proven to survive in 90.)

Other Xernus distinctions? Mirrored face plating; a highly difficult technique that's just now beginning to

frame the displays on only the most costly digitals. A tightly meshed, smoothly polished bracelet that doesn't pull at skin or hair. Recessed function buttons that stay out of your way.

This unusual timekeeper is available to you in two different models: all Stainless or Gold (with a rich 5 microns worth over stainless). Incidentally, that's real gold, not "goldtone".

Xernus comes with full instructions, service-by-mail, if needed, a one-year manufacturer's guarantee against defects, and its battery in place. (Sensitive to sunlight or even dim roomlight, Xernus solar cells will keep this micro-thin battery working for up to 2 years. Replacements are available at most jewelers.)

And best of all, you have the chance to see a Xernus perform right on your wrist—before making your final commitment.

Keep it for two weeks. Wear it in water. And if for any reason you decide not to be a Xernus owner, simply send it back (in new condition, please). And The Sharper Image will return your entire investment without question. Including the delivery charge.

Time is of the essence. We can only guarantee the continuation of this introductory price through April 31, 1980. So order now.

ORDER TOLL FREE.

Credit card holders may use our toll-free number. Or send check for \$89 for Stainless, \$99 for Gold (in CA, add \$5.34 and \$5.94 sales tax, respectively). Plus \$2.50 delivery. Ask for product #942 (Stainless), or #943 (Gold). For our 40 page color catalog, write address below.

800 227-3436
In California 800 622-0733

THE SHARPER IMAGE™
260 California St., Dept. XT-051
San Francisco, CA 94111 (415) 788-8880

Ford Fiesta. It received a seven-flag salute.

The car that wowed Europe is winning the hearts of America.

Ford Fiesta. The little front wheel drive car that comes from Germany. Applauded all over



Germany 1976
Car that Makes the Best Sense — *Mot*

Europe by the experts for its engineering, design and overall performance. It was voted the most significant import of the year in 1978 by readers of *Car and Driver*. And when you understand how beautifully Fiesta performs, you'll understand why it continues to get rave notices.



Finland 1976
Car of the Year — *Tuulilasi*

Front wheel drive.



Denmark 1976
Car of the Year — *Morgen Posten*

Through rain, ice, sleet, hail and snow, Fiesta's remarkable front wheel drive traction will help you keep your appointed



Italy 1977
Most Successful Foreign Car — *Motor*

True German efficiency.

Americans love Fiesta's manners. It prefers sipping to guzzling. Just consider these EPA mileage figures.

26

EPA
EST.
MPG

38

HWY.
EST.
MPG

Now compare these estimates to other German imports. Actual mileage may differ depending on speed, weather and trip length. California estimates will be lower. Actual highway mileage will probably be lower.



Yugoslavia 1977
Car of the Year — *Automotive Writers*

A masterpiece of European engineering.

Fiesta is assembled by Ford in Germany. And its European engineering makes it feel right at home on streets and highways of America. It's quick, nimble and maneuverable.



Spain 1977
Car of the Year — *Criterion*

Ford Fiesta is sold and serviced by over 5,000 authorized Ford Dealers across America. There's even an Extended Service Plan available, providing longer protection over your car's basic warranty. So test-drive a Fiesta today. You'll discover why it's won international acclaim.



Great Britain 1978
Design Council Award

FORD FIESTA

FORD DIVISION



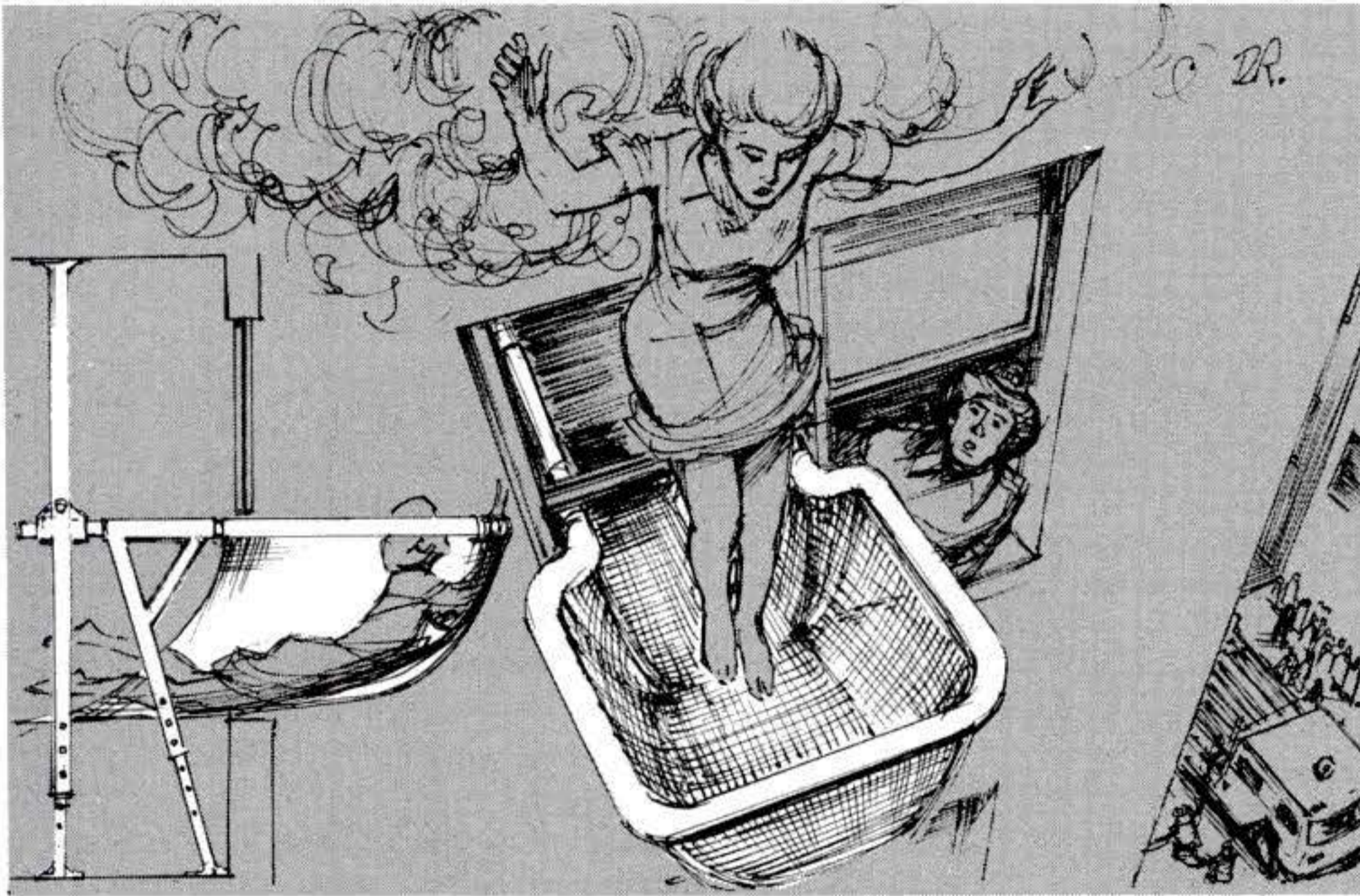
Fiesta. Wundercar from Germany.



Fiesta 3-Door Sport

NEW IDEAS FROM THE INVENTORS

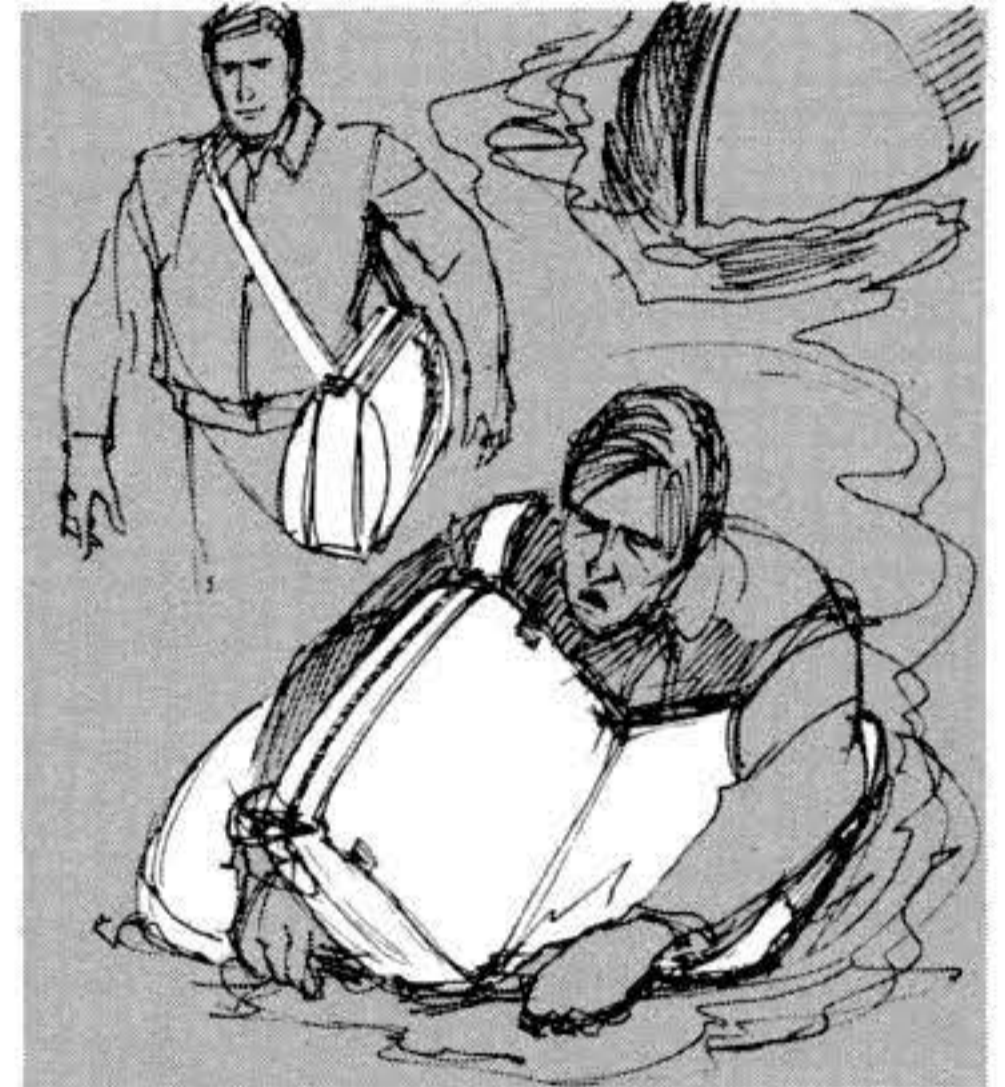
ILLUSTRATIONS BY DANA RASMUSSEN



High-rise windows position and secure fire-rescue nets

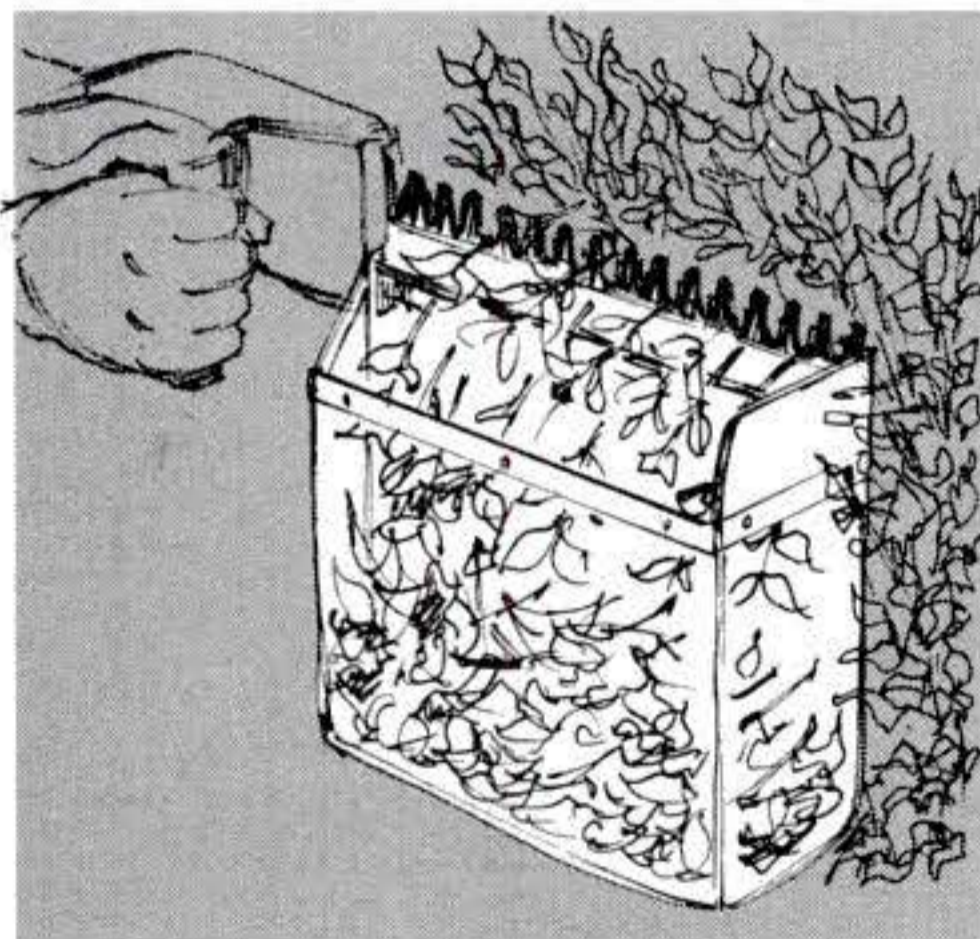
Fire victims trapped above the reach of rescue ladders and too high for a reasonable chance at jumping safely into a ground net might be saved by nets secured in windows a floor or two down (and almost always in a direct vertical

line). These easy-to-carry, cushioned net frames would quickly lock onto extendable, cross-braced, floor-to-ceiling supports. The scooped construction of the net inside its frame would quickly guide a jumper through the window to safety.



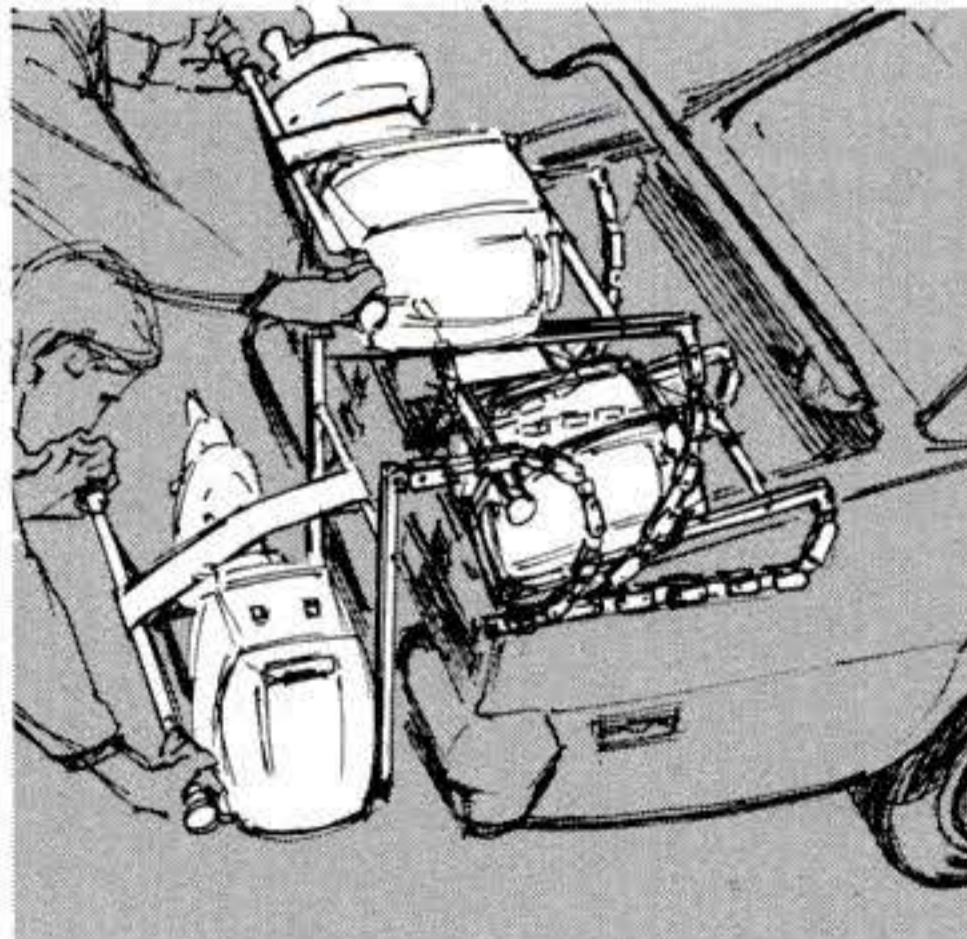
Tote bag doubles as float

Similar to an ordinary flight bag, this tote's two foam-filled, flip-open side panels would buoy you for a considerable time if you accidentally went overboard. The conventional shoulder strap would cinch in around your waist in a way that would let you reach the zip pockets and emergency stores, such as flares or flashlight, you might pack in it. The outer panels would be made of fluorescent fabric.



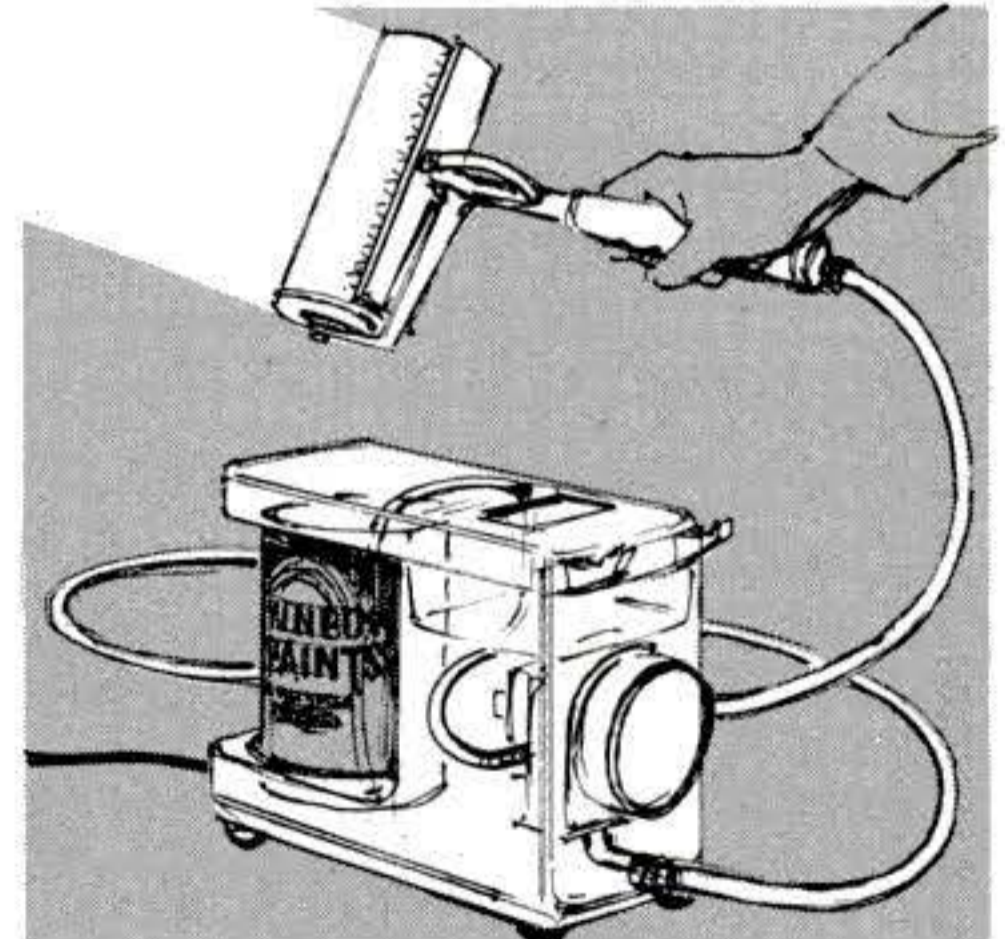
Bag catches hedge clippings

This squared, rigid frame secured to the blade of a powered hedge trimmer would hold a flexible bag alongside the blade assembly. There it would catch the small, often thorny clippings as you worked upward, over the top, or along the curve or taper of a bush. A plate at the outboard end of the frame would help to deflect cuttings into the collection bag.



Lifter frame loads car trunk

Tied onto this collapsing frame, heavy objects would lift more easily in and out of a car trunk. A section of flexible channel links would fold flat onto the trunk floor or bend outward when lifted. Brackets at one end of the link section would fasten to the trunk interior, at the other end to a handled, tubular frame to which you'd tie objects to be stowed or lifted.



Wheeled carrier pumps paint

A painter might cover surfaces faster and easier with fewer unwanted drips if paint flowed up to his roller. A pump in this wheeled carriage would draw paint from a standard can and deliver it to a curved manifold that would spread it evenly along the roller's surface as he worked. A power cord would extend from or roll back into the base as he moved along.

The following patents have been issued on these inventions: **Window rescue net**—No. 4,066,144 to J. F. Valerio Jr., Bridgeport, Pa.; **Clipping catcher**—No. 4,071,951 to T. A. Burns, Fort Wayne, Ind.; **Lift frame**—No. 4,073,395 to C. H. Clement, Phoenix, Ariz.; **Tote-bag float**—No. 4,157,134 to C. Stoll, Monsey, N.Y.; **Wheeled paint pump**—No. 4,072,429

to R. T. Terzian, Chicago, Ill. and D. A. Brand, Naperville, Ill. Copies of patents may be ordered, by number, from the Commissioner of Patents and Trademarks, Washington, D.C. 20231, at 50 cents each. To write to an inventor, if address above is insufficient, address him by name and patent number in care of the Commissioner.

DETROIT REPORT

By JIM DUNNE

A flood of fours

After years of hesitation and false starts, Detroit auto makers will soon jump wholeheartedly into the four-cylinder-engine fray. Chrysler will start things off by introducing a new 2.2-liter four this fall in the Plymouth and Dodge K-body compacts (see "Chrysler K-car" story in this issue). Chevrolet will build a 2.8-liter four-cylinder for the 1982 J-cars it will introduce in early 1981 to replace the Monza. Ford will introduce two engines, a 1.3-liter unit and a 1.6, both for the forthcoming Escort/Lynx subcompact replacement for the Pinto/Bobcat. (Look for an Escort/Lynx engineering story in a future issue.) The 1.3-liter engine will give Ford the only domestic car with a highway mileage rating above 40 mpg.

Small diesels coming

General Motors, which offers America's only V8 car diesel, will get two small diesel engines from Japan in the future. Both will be supplied by Isuzu, which is partly owned by GM. They will be four-cylinder types of 1.8-liter and 2.0-liter displacement, intended for the Chevette and the 1982 J-cars. While GM has a big lead in diesel-engine production, and Ford has dropped development of a large automotive diesel, both Ford and American Motors are expected to buy small four-cylinder diesels from foreign makers in the near future, too.

Buick's last V8

Buick cast its last V8 engine block last Nov. 30, and is now producing only V6's. Buick made more than 13.5 million V8's over 27 years. The division began building V6's in 1962, and now offers a number of versions that are used on all Buick lines, as well as other GM models. The V8's will continue to be offered in 1980 models until the supply runs out.

Air bags lose to belts

Federal law requires "passive restraints" (air bags or automatic seat belts) on new cars starting with 1982 full-size models, then on smaller cars in succeeding years. Air bags are now out of favor in Detroit, and the auto companies are gearing up to put automatic seat belts in their 1982-model full-size cars. They're cheaper to build, and do not have the liabilities that air bags do. So, on models seating two up front, driver and passenger will be protected by automatic seat belts. On models with seating for three in front, an air bag

will still be needed for center and right-side passengers.

Two-seat commuter cars

The two-passenger sedan will become commonplace in the late 1980's, claims Ford vice-president John Betti, as the price and availability of gasoline worsen. He isn't talking about sports cars, though; he means commuter cars that will get 50 mpg and more. The average car now carries only one or two passengers for most of its life, so the switch to the smaller capacity should cause little change in driving habits.

Big Monarch/Granada change

Ford will build the Monarch/Granada on the Fairmont/Zephyr chassis next year, which means a duplication of models during the 1981 model run. The Monarch/Granada versions will have a smaller wheelbase (105 in.) than they had in '80, and will be about three inches shorter. But they'll have more passenger and luggage space. To set the new cars apart from the Fairmont/Zephyr, new sheet metal and grilles, plus more expensive trim, will be used.

Face lift for GM intermediates

General Motors' plans for 1981 center around low-price personal-luxury models—Monte Carlo, Grand Prix, Cutlass Supreme, and Regal. As a group, these cars are the biggest sellers at GM, and the company is committed to keeping their popularity high. This "A-Special" series is a derivative of the A-body intermediates (Malibu, LeMans, Cutlass, and Century) introduced in 1978. The cars have now reached middle age, as things are figured in Detroit, and are due for a major face lift. Next year they'll get new sheet metal with a sleeker profile, including a lower, longer hood line, higher rear deck, and a more vertical rear window. Most of the basic engineering, however, will be carried over from current models. Weights will be cut 100–200 pounds per car, mostly through the use of aluminum and plastic parts instead of steel.

GM frames disappearing

GM plans to build its midsize Malibu, LeMans, Cutlass, and Century models without separate frames when the lines are changed for the 1982 model year. Instead, the cars will have mini-frames, with a steel understructure up front and a unitized body from the cowl rearward. The change is intended to lighten the cars and

make them more fuel-efficient. The problem with mini-frames is the same one found in unit bodies—added noise in the passenger compartment because of no separation of frame and body. The change is predictable, however; only the biggest, most expensive cars now offer separate body-and-frame construction, once found on virtually every car made in this country. The switchover began more than 20 years ago, and now affects all but a handful of models.

Chrysler's future

While General Motors and Ford are planning to spend between \$2 billion and \$5 billion a year for the next five years, Chrysler has had to borrow more than \$1 billion just to stay in business. The massive spending by its bigger competitors will provide them with a continuing stream of smaller cars, as well as new engines, drive lines, and suspensions. If Chrysler is to compete, it will have to come up with even more money for the same types of projects, and prospects look dim. At best, say some insiders, Chrysler will have an excellent lineup of compacts and subcompacts, but its bigger car lines will probably be dropped.

Hybrid cars

The hybrid car offers the most promise in electric-propulsion design, according to Detroit insiders. Batteries would run the car at low speeds, and would be recharged from a plug-in source or from the on-board gasoline-engine-powered generator. Should battery power run down, the gasoline engine would be the backup. At higher speeds, the low-horsepower gasoline engine would be used. Regenerative-braking battery charging and dual-power techniques will also likely be used. (All the components of this system are contained in General Electric's experimental hybrid car, scheduled to be delivered to the Department of Energy in two years.)

X-car delays

Buyers of GM's ultra-successful X-body cars are being shunted to high-priced, V6-equipped models because the wait for lower-priced, four-cylinder types is six months to a year. So dealers are trying to get buyers to order the more expensive models. Meanwhile, GM is working three plants overtime to keep up with demand, and officials are disappointed that more buyers aren't asking for the higher-profit V6 engine.

How much profit per car?

In an unusually candid report, Chrysler has detailed just how much an auto company makes on a new-car sale. For full-size models, it's \$1500; compacts, \$1300; subcompacts, \$700. In a special luxury car like Cadillac's 1979 Seville, Chrysler claims the profit is a whopping \$5400 per sale. The catch is that companies have to build enough of each car to pass the break-even point—usually 50,000 units per model year. E3

People write to



Have a question about motor oil? Lubricants? Engines? Ask the Pennzoil experts...

Ashes To Ashes. My new garden tractor requires the use of a low ash engine oil with an API rating of SE/CD. What is meant by a low ash oil?

D.L., Doylestown, PA

The ash is the amount of noncombustible residue in a motor oil. Lubricants with high ash content will allow deposits to build up on pistons and cylinder walls which can cause run-on and plug fouling and eventual damage. Many of today's engines require an oil with an ash content of less than 1.0%. All Pennzoil Z-7 and Multi-Duty motor oils do contain less than 1.0% ash.



Keepin' Its Cool. I drive a 1979 Chevrolet Caprice with a 350 cubic inch engine. I recently drained a quart of coolant out of the radiator, since I wanted to add water pump lubricant. I didn't take off the radiator cap at that time. The next morning, when the radiator was cool, I took off the radiator cap to add the water pump lubricant, and discovered that the coolant level hadn't gone down one bit. What do you think happened?

R.H., Houston, Texas

Your Caprice engine is equipped with a coolant overflow reservoir. The fluid level in the cooling system is regulated by expansion and contraction as you operate the engine. Therefore, the radiator will be full because coolant expands into the overflow as the engine heats and is drained back into the cooling system when the engine cools. This automatically keeps up the level in the radiator.

How Much To Mix? My chain saw requires either its own brand of oil mixed at a ratio of 40 to 1, or a good SAE 40 two-cycle oil mixed at a ratio of 20 to 1. I purchased a quart of Pennzoil 50 to 1 two-cycle oil and mixed it at a 20 to 1 ratio, as advised by the manufacturer of

the chain saw. It ran fine for almost an hour, but since then it acts as if a plug is fouled, and it has been hard to start, especially after warm-up. Would you recommend I use the Pennzoil at a 40 to 1 ratio?

R.A.B., Weirton, West Virginia

The Pennzoil multi-use 50 to 1 2-cycle oil should be mixed at a 40 to 1 ratio. This is a special pre-diluted 2-cycle oil, and is not the same as an SAE 40 2-cycle oil which would be mixed at a 20 to 1 ratio. It appears the plug has fouled as a result of improper mixture.

True Believer. I've used Pennzoil for as long as I can remember in my '64 Olds Cutlass. It purrs like a kitten, has 80,000 miles on it—and I've had no problems at all. How long can an engine last? I'd like to keep this one a lot longer!

D.M., Bronx, New York

While it is impossible to name a definite mileage figure, it is obvious that with proper lubrication practices and the use of a superior product, like Pennzoil 10W-40, your engine will last quite a long time—doubtless in excess of 100,000 miles.



Up In The Attic. I have a 30-inch diameter fan up in my attic which is used to exhaust warm air. What type of grease would you recommend for lubrication of the bearings which support the shaft and fan blade?

T.A., Columbus, Ohio

We'd recommend a lithium base grease for your attic exhaust fan. Lithium soap base greases are waterproof and will withstand high temperatures and pressures. We'd suggest you use Pennzoil 705 which is a multi-purpose lithium base grease. Since this product is rec-

ommended for most bearing service, you can also use it as a chassis and wheel bearing lubricant in your automobiles.

Sealed With A Kiss. The seal next to the engine in my 80 cc bike started leaking last year. I just recently fixed the seal. When I went riding at high speeds the engine just cut off and refused to start again until I worked the throttle. I changed the 2-cycle oil and the motorcycle was fine for 2 or 3 weeks. However, the seal is once again leaking. What do you suggest?

A.B., Mosinee, Wisconsin

You probably have an air leak into the crankcase. Crankshaft seals must be perfect to insure proper sealing. A good vacuum must be created in the crankcase in order to have a 2-cycle engine run properly. Fuel from the carburetor and oil from the injector must be drawn by vacuum into a perfectly sealed crankcase where turbulence mixes the fuel and lubricant and it is forced up into the cylinders when the piston creates compression in the crankcase on its downward stroke. If there is any leakage, the engine will not run properly and at higher speeds will actually cut off. We suggest you have an experienced mechanic check your engine.

WE'RE OPEN TO QUESTIONS about motor oils, lubricants, engines. But, you can tell us a few things, too. Maybe you have discovered something interesting about motor oils or lubricants. Or you have a special reason for being a Pennzoil fan. We would like to hear from you. Write to: Pennzoil Company, Research Department, P. O. Box 808, Oil City, Pennsylvania 16301. Note: sorry no pictures or material can be returned. Letters chosen for publication are subject to revision necessary for publication requirements.

Quality Products For Over 90 Years



ask for it!

A close-up photograph of a man with a mustache wearing a white cowboy hat and a brown leather jacket. He is holding a lit cigarette in his mouth and another in his hand. The background is a blurred natural setting.

Come to where the flavor is.



Marlboro Red or
Longhorn 100's—
you get a lot to like.

Kings: 17 mg "tar," 1.0 mg nicotine—
100's: 18 mg "tar," 1.1 mg nicotine av. per cigarette, FTC Report May '78

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

Copyrighted material

PS | What's News

New ideas surface every so often in the history of technology that seem contrary to common sense. A few of these "crazy" ideas survive to dominate future technology and become the common sense of the following generation. To the man stretching fabric over spruce spars of a WWI biplane, the idea of an all-metal plane was ridiculous. To the pilot who learned to fly behind a spinning propeller, the idea of an oversize blowtorch pushing a plane through the air was unthinkable.

The wrong-way wings on the plane in our cover painting may be another such idea. Like earlier revolutions in aircraft design, it is the result of no single invention, but a coming together of developing technologies in disciplines far removed from aviation to meet new challenges in aircraft design. Research in chemistry that gave us the incredibly strong composite materials now emerging from the laboratories may provide the strength and light weight needed to resist the greater loads this design imposes on wing structures.

Whether the forward-swept wing is a watershed development or another of the many promising ideas that didn't pan out, no one will know until more design work and full-scale testing are done. If it does prove to be the way to go, you can tell your grandchildren you read about it first in Ben Kocivar's article that begins on page 72.

\$25 million boost for solar cells

The strange devices of Stanford Ovshinsky [PS, Apr '78] got real encouragement recently when the Atlantic Richfield Co. agreed to pay Energy Conversion Devices, Inc., Ovshinsky's company, \$25 million over the next three years to accelerate development of the amorphous semiconductor devices he invented. Ovshinsky has claimed that within five years he could make photovoltaic cells using amorphous semiconductors that could produce electricity at an amortized cost of five cents per kilowatt-hour. Last year Arco agreed to pay \$3.3 million ["PS/What's News," Aug '79] for limited rights to ECD's work. Based on progress to date, Arco decided to invest another \$25 million. A large part of the money will be used to build a pilot plant for manufacturing solar cells at ECD's home base in Troy, Mich. As far as we know, Arco's commitment is the largest single private invest-

ment ever made in solar energy. To put its possible importance into a current context, see the item below.

Largest solar-cell plant

An array of 97,000 silicon solar cells is now delivering electric power for a radar installation 60 miles east of San Diego. It is the world's largest photovoltaic power station—a 60-kW system that supplements a diesel power plant supplying electricity for the Mt. Laguna radar station operated by the military. During the day, it is expected to deliver about 10 percent of the installation's total power requirements. This would save about 11,500 gallons of diesel fuel per year.

The Department of Energy put up most of the \$1.6 million cost of the solar power station. The project is part of a joint Department of Defense/DOE solar research and demonstration program. Cost of the silicon photovoltaic-cell system was about \$8 per peak watt with cells bought at 1977 prices—down from about \$30 per peak watt in 1975 [PS, May '76]. DOE hopes to see the price drop to 70¢ per peak watt by 1986. At such a price, electricity generated directly by the sun would be cost-competitive with conventional sources for some kinds of applications.

If Ovshinsky is right, many will have to revise their thinking about the economics of solar power.

Link between two worlds

Two Viking landers now sitting on Mars have been transmitting information and pictures back to Earth since 1976 [SNF, Oct. '76]. Although these weekly bursts of information about Martian weather, Marsquakes, and pictures of the terrain no longer make newspaper headlines, the data are invaluable for scientific research. However, that link between the two worlds may end when money is no longer available to finance receiving, processing, and analyzing reports from Viking. As a graphic demonstration to Washington officials of the immense public interest in the space program, the San Francisco section of the American Astronautical Society (AAS) has established a special Viking Fund. Contributions will be presented to NASA to finance the link into the 1980's. Those wishing to participate in this do-it-yourself space program may send their

tax-deductible contributions to: The Viking Fund, Box 7205, Menlo Park, Calif. 94025.

SolaRoll honored

The low-cost, roll-on solar collector extruded from synthetic rubber we told you about in June 1979 was selected as one of seven inventions sponsored by the Energy-Related Inventions Program of the DOE at the 8th Annual World's Fair for Technology Exchange in Atlanta. SolaRoll is the first and only solar invention to earn this distinction.

Briefly noted

- The scissors-wing aircraft built for NASA [PS, Oct. '72] has successfully completed its first two test flights. The research aircraft uses a pivoting-wing concept that studies indicate could lower fuel consumption of future high-speed transport planes. At lower speeds, the wing is oriented perpendicular to the fuselage for better low-speed flight characteristics with less noise. For high-speed flight, the wing would be pivoted to form angles up to 60 degrees with the fuselage to decrease drag.

- In-situ recovery of hydrocarbons from oil shale and tar sands using radio-frequency electric fields is being tested on oil shales in Uintah County, Utah. Vaguely resembling, in principle, a giant microwave oven, the experimental process develops heat throughout large quantities of oil shale to produce liquid and gaseous hydrocarbons in place without requiring mining. If successful, the process would open up vast U.S. reserves of shale oil for economic production.

- A new additive for unleaded gasoline to improve octane rating has been announced by officials of Sun Oil Company. It is said to eliminate knock and after-run in many late-model cars. The company is now field-testing the product in Southern Florida. If field tests are successful, the product will be made available to the entire oil industry.

Hubert P. Lueckelt

Editor-in-Chief

Wrong-way wings

aid maneuverability of supersonic planes

New materials are putting new life in an old concept: forward-swept wings

By **BEN KOCIVAR**

BETHPAGE, N.Y.

At Grumman Aerospace Corporation's sprawling plant on Long Island,

I stood inside the low-speed wind tunnel looking at what seemed to be a flying aberration: a model airplane with its wings stuck on backward.

The seven-foot wings of the radio-controlled balsa model were swept sharply forward, like the outstretched arms of Superman. The plane appeared designed to fly in reverse. For free-flight tests, a 2½-hp glow-plug

model-plane engine in its fuselage drives a ducted propeller that shoves air out the tail much like a jet engine—and shoves the plane in the conventional direction. This is no supersonic machine, of course, but if its strange forward-swept wings live up to their promise, the little model may forecast a new generation of high-

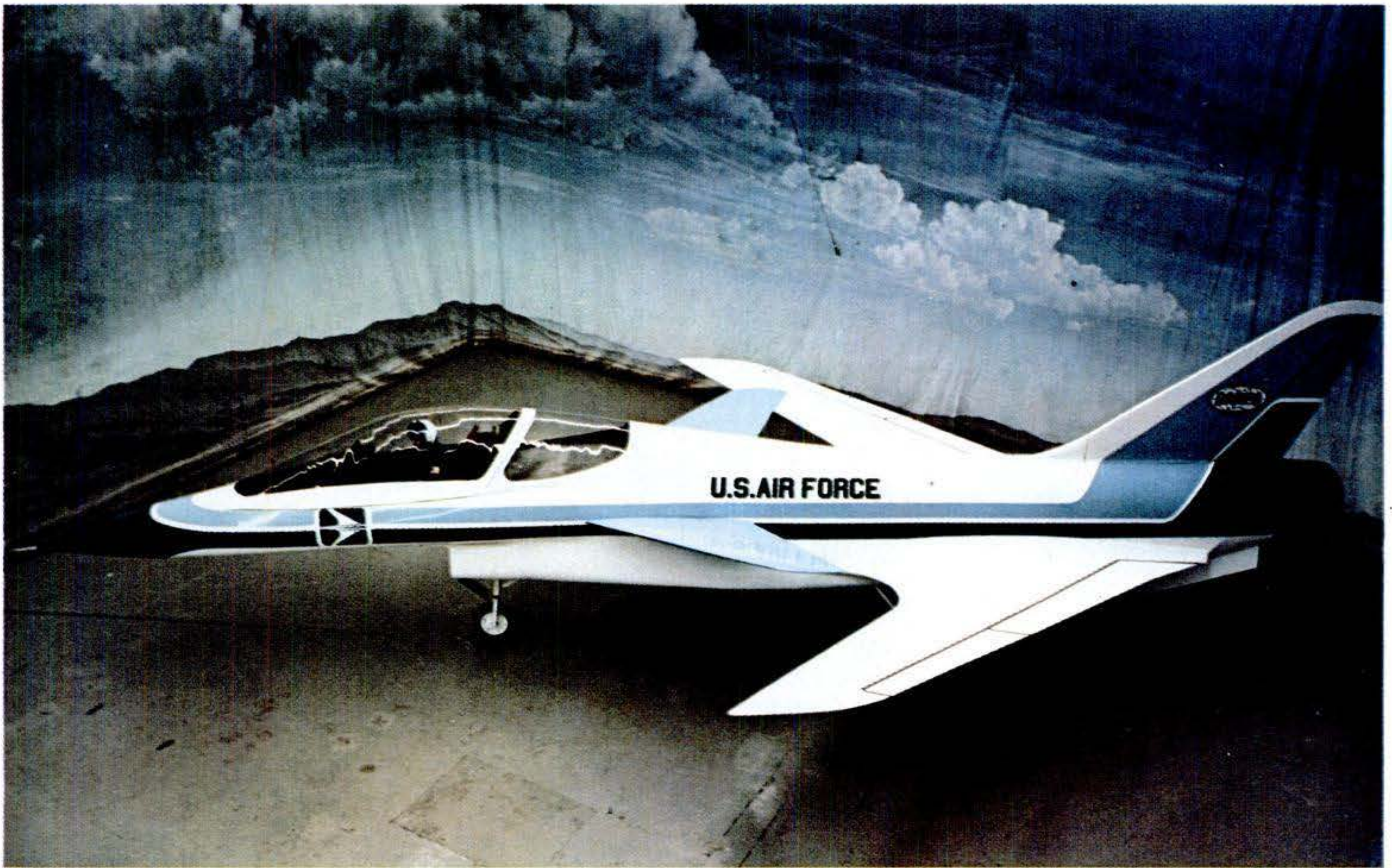
Continued



Forward-swept-wing design proposed by General Dynamics would use existing fuselage, elevator, rudder, and engine of

new F-16 fighter, already in production, and attach forward-swept wings in place of aft-swept wings. Such an approach

could quickly provide a manned flying test-bed to give data that could help determine design of composite wing.



Rockwell's full-scale Styrofoam mock-up author Kocivar saw at Paris Air Show looks very real. Large aft-swept canard

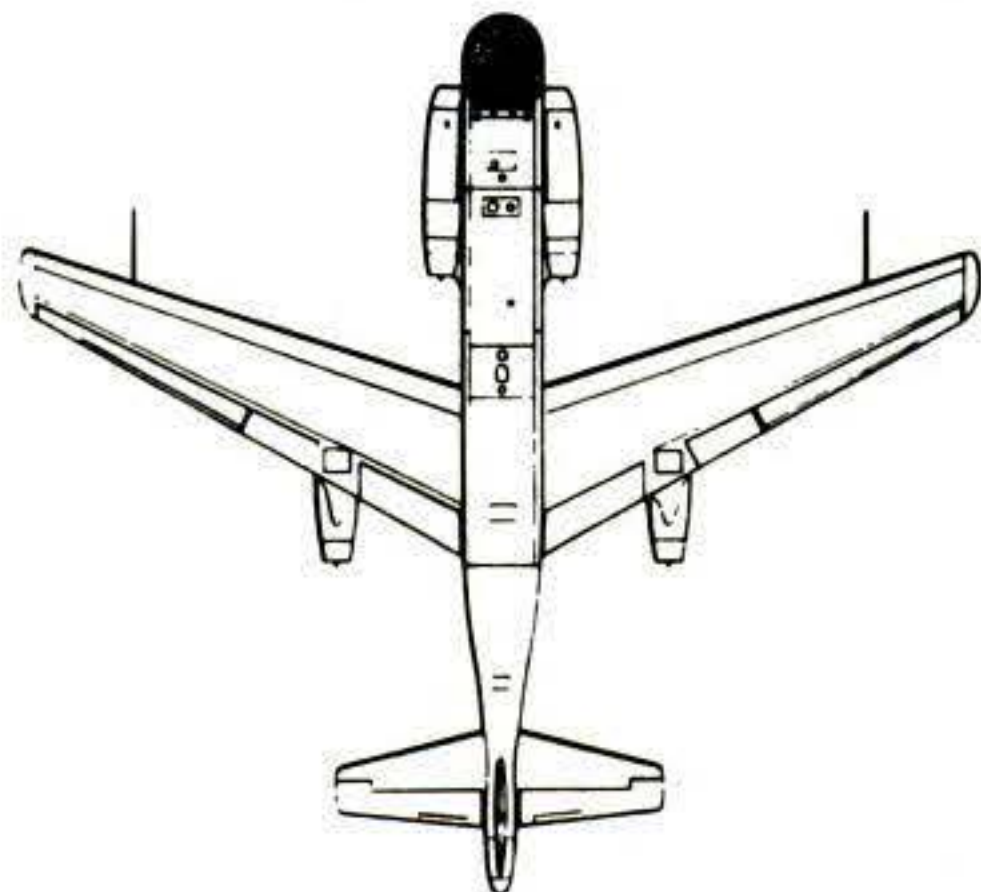
shares weight with forward-swept main wing and provides some trim control, but Rockwell design gets most longitudinal

control from trailing edge of main wing, which has ailerons outboard and elevons inboard. Canard moves as a unit.



Balsa-wood, radio-controlled model (above) of the Grumman design (see cover) was built as an inexpensive test vehicle to prove the computer program used to design the forward-swept wing and canard. The flying model tested the longitudinal stability of the design at about 1/100 the cost of a tunnel test program. The model could be made to stall, but refused to spin. Later, a model underwent supersonic wind-tunnel tests (up to Mach 1.5). Right: Col. Norris J. Krone Jr., manager of DARPA's forward-swept-wing program, displays planforms of the three models at his Arlington, Va., office. While some aerodynamic benefits of the concept were long known, Krone's study of advanced composite structures convinced the Air Force and NASA that a forward-swept wing could be made lightweight enough to capitalize on those benefits at transonic speeds (600-1000 mph).





Junkers JU-287 four-engine jet bomber (drawing above), flown by Germans in 1944, had 15-degree forward wing sweep, conventional tail, and jet engines mounted under wings and along fuselage. The forward-swept wings provided good control at low speeds, and their placement allowed more room in the fuselage. At top: Inside Grumman's wind tunnel, Glenn Spacht (left), deputy director, and Robert Roemer (center), program director, explain the working controls of the radio-controlled model to author Kocivar. Its wings have a 30-degree sweep.

speed, high-performance aircraft.

Robert Roemer, Grumman's forward-swept-wing program manager, and Glenn Spacht, his deputy, summarized the prime merits of the design: greater maneuverability and control—essential characteristics for many of tomorrow's military and even civilian planes.

Currently, forward-swept-wing research is aimed at designing an improved fighter plane. The program is directed by the Defense Advanced Research Projects Agency (DARPA), a special unit of the Department of Defense chartered to develop high-risk technologies with potentially high benefits. On forward sweep, DARPA, with the assistance of the Air Force and NASA, is sponsoring design work and testing by three aircraft companies: Grumman, Rockwell International, and General Dynamics.

Advantages of forward sweep

Tomorrow's fighter planes may need more than speed. They may need agility for close air-to-air combat and to dippy-doodle out of the path of anti-aircraft missiles they spot. Agility

A forward-swept-wing fighter could weigh 20

and aerodynamic control will be required so that pilots can dip and slip among the rocks and rills to elude enemy radar. Speed alone, then, does not make the forward-swept wing a look of the future. A combination of speed, agility, and low-speed flying qualities does.

Col. Norris Krone, a veteran Air Force pilot, leads the DARPA program on forward sweep. He became intrigued with the concept while working on a Ph.D. thesis in aeronautical engineering at the University of Maryland in 1972. I talked to him in his Arlington, Va., office.

"The models, wind-tunnel tests, and computer analysis we are supporting will let us design a demonstrator aircraft with confidence. We may get to a man-carrying version as early as 1982," he told me. About \$4 million has gone into research so far. A pilot-rated demonstrator could cost \$40 to \$100 million more.

If the military program is successful, the forward-swept wing could also change the look of private planes and airliners. Such planes would have greater range, slower stall speeds, spin resistance, slow-speed control for easier landings and takeoffs, and, because of design geometry, more cabin space.

Why it's better

What makes the forward sweep intrinsically better? "Sweeping a wing" Glenn Spacht explains, "reduces the shock wave—the cause of drag (low performance)—as the plane approaches the speed of sound. In comparing wings with the same 45-degree sweep—one forward, the other back—tests reveal that the shock from the forward-swept wing is more highly angled and therefore weaker than the one on the aft-swept wing (see diagram). That spells less drag and greater maneuverability, especially in the critical transonic region, from 600 to 1000 mph."

Spacht also explained why the forward-swept wing gives better stall characteristics and more lateral control at slow speeds. "On conventional straight wings," he said, "the wingtips are designed with a built-in downward twist. This gives them a lower angle of attack than the root of the wing, which helps maintain lateral control because it makes the center of the wing stall and lose lift before the wingtip. So while the plane may dip down, it does not roll. The disadvantage is that this wing twist increases the aerodynamic drag at cruise and high speeds, limiting speed and range.

"The problem is increased in an aft-swept wing. The air hits the wing at the root first. Air starts moving up even before the wind actually hits the wing. Since the tips are farther back, the apparent wind is already moving upward when it reaches the wingtip. This increases the angle of attack there, and the wingtip stalls earlier than the root, causing abrupt loss of lift and a sudden pitch up. The plane may even roll out of control.

"With the forward-swept wing, the wingtip is ahead. It is the root that has the higher induced angle of attack and would tend to stall first. That would also mean a sharp pitch up, since lift would be lost at the rear of the plane. To avoid this, a slight upward tilt is built into the wingtips. This tends to distribute lift equally over the entire wing. The result is better lateral control, because the plane simply drops down straight ahead, builds up speed, and regains lift. And because the wingtip is only very slightly twisted, the plane suffers little drag penalty at high speeds."

Old concept in new clothing

The idea of using forward-swept wings goes back to World War II. In 1944 the Germans built and tested a Junkers JU-287 four-engine jet bomber (see diagram) with a forward sweep of 15 degrees. The wings were attached at the rear of the plane, which left more room inside. The increased space, not high performance, was the reason for the forward sweep. The test plane was damaged by Allied bombers and later captured by the Russians.

In the '60's, members of the same German design team built the HFB-300 Hansa business jet with similar forward-swept wings. I flew in one of these a few years ago. I have also flown in a Swedish two-seat Saab MF-115 and a German powered glider; both have wings with slight forward sweep. But none of these planes was designed for high speed.

The advantage of forward sweep for transonic and supersonic flight has been known for some time, but until recently, technical problems made such planes impractical. For high-speed flight, the wings must be swept much more than 15 degrees forward. Some designs propose as much as 70 degrees of sweep. Wings with such pronounced forward sweep would encounter terrific stresses in flight.

Here's why: When a plane maneuvers (increases the angle of attack and thus the wing loading), the wing bends (see diagram). On a typical aft-swept wing, the wingtip twists down; that reduces its angle of attack rela-

percent less than one of comparable performance with aft-swept wings

tive to the air flow, and hence reduces the load. But on a forward-swept wing the opposite happens. As the air load increases, and the wing bends, the wingtip bends up more, increasing the angle of attack and load. "It's very similar to what you experience when you stick your hand out your car window at 60 mph," explains Spacht. "If your hand is slightly tilted upward, the wind pushes your arm back. Try that at 300 mph and your whole arm would be ripped off." The same thing can happen with an airplane wing. Aerodynamicists call it aeroelastic structural divergence. Put simply, it means the wing breaks.

"So we must make the forward-swept wing stronger," explains Col. Krone. "We can do this with metal, but it adds so much weight that it overcomes the advantage of having the forward sweep."

Composites

"But there are answers to the dilemma," continues Krone. They begin not with aerodynamics, but with those new aerospace materials, the composites (see "Super-Strong Graphite," PS, Apr. '75). It was Col. Krone's thesis on the ability of composites to resist divergence that revived interest in forward-swept wings for high-speed craft. Composite materials such as boron fiber and graphite in a plastic matrix can make a nonmetallic wing a good 30 percent lighter than a wing of the same strength using conventional metal design. Result: The wings can be lighter, stronger, smaller, and cheaper. According to Rockwell, a forward-swept-wing fighter could weigh about 20 percent less on takeoff than one of comparable performance with an aft-swept wing.

Furthermore, engineers can optimize the structure of the wing by varying the orientation and thickness of the carbon plies to help distribute the load properly over the whole wing, thus controlling its twist. They call the process aeroelastic tailoring.

Different design approaches

As the pictures show, the three companies have designed quite different planes for the forward-swept-wing competition. The General Dynamics proposal would modify an existing F-16 by putting on a new wing. This approach has obvious cost advantages for early research of composite wing structures.

Both the Grumman and Rockwell designs, however, go further toward capitalizing on the potential benefits of forward sweep. Grumman's design combines the nose of an F-5 Northrop

fighter with the engine, a GE 404, used in the F-18.

Rockwell, under its former name, North American Aircraft, actually had plans drawn up for a forward-swept-wing version of its famous P-51 Mustang propeller-driven fighter shortly after World War II, but the plane was not built. Rockwell has built a full-scale mock-up of its current proposal (see photo).

Both the Rockwell and Grumman designs use canards, but they are placed differently relative to the wing.

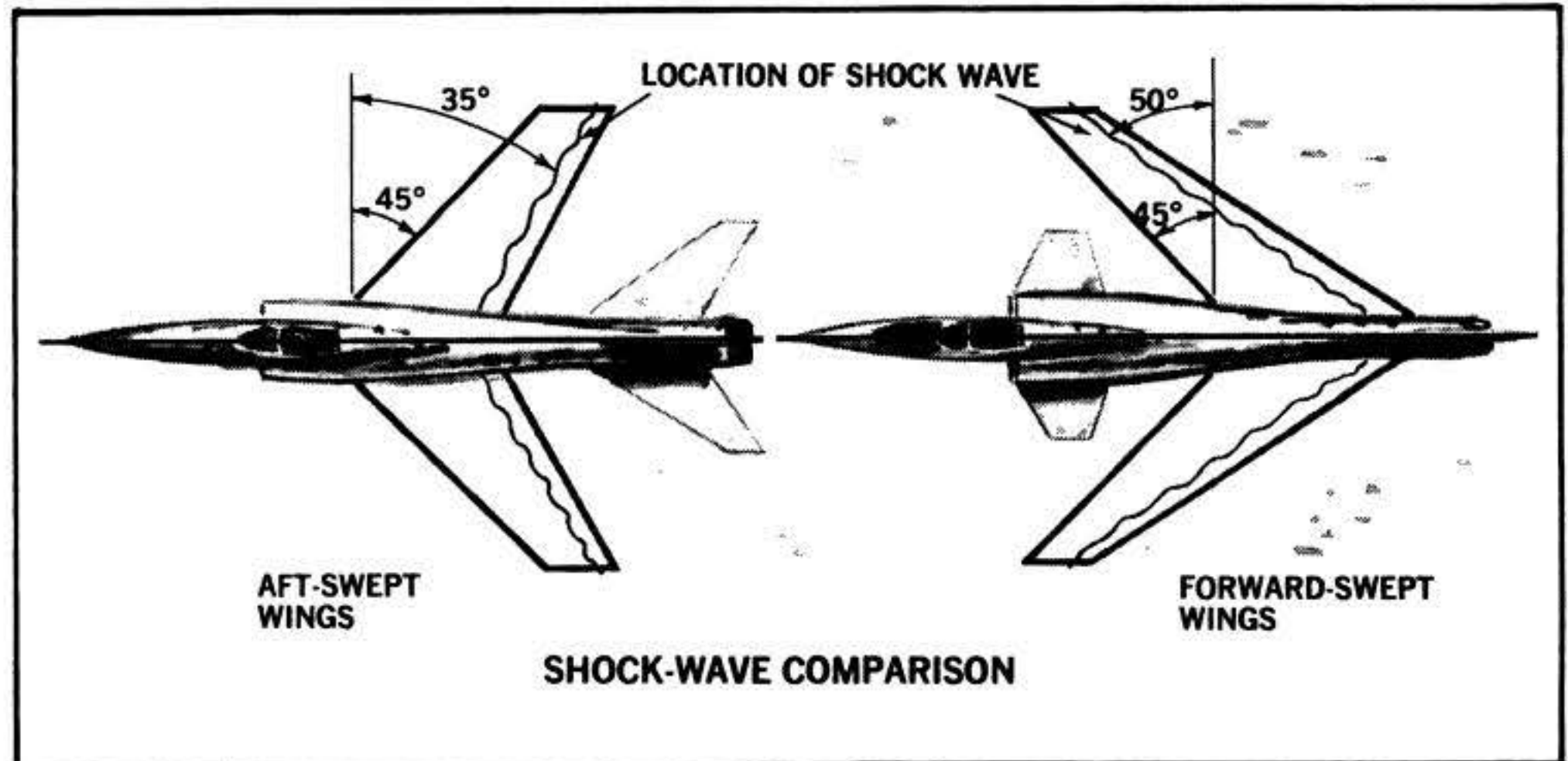
Mike Robinson, Rockwell program

manager, told me the Rockwell concept is derived from its HIMAT (Highly Maneuverable Advanced Technology) plane, an unmanned research plane being developed for NASA. It puts the canard well above the main wing, so that its wake won't interfere with the main wing.

In the Grumman design, the canard and main wing are in line. "Our canard and wing interact to help each other," says Spacht.

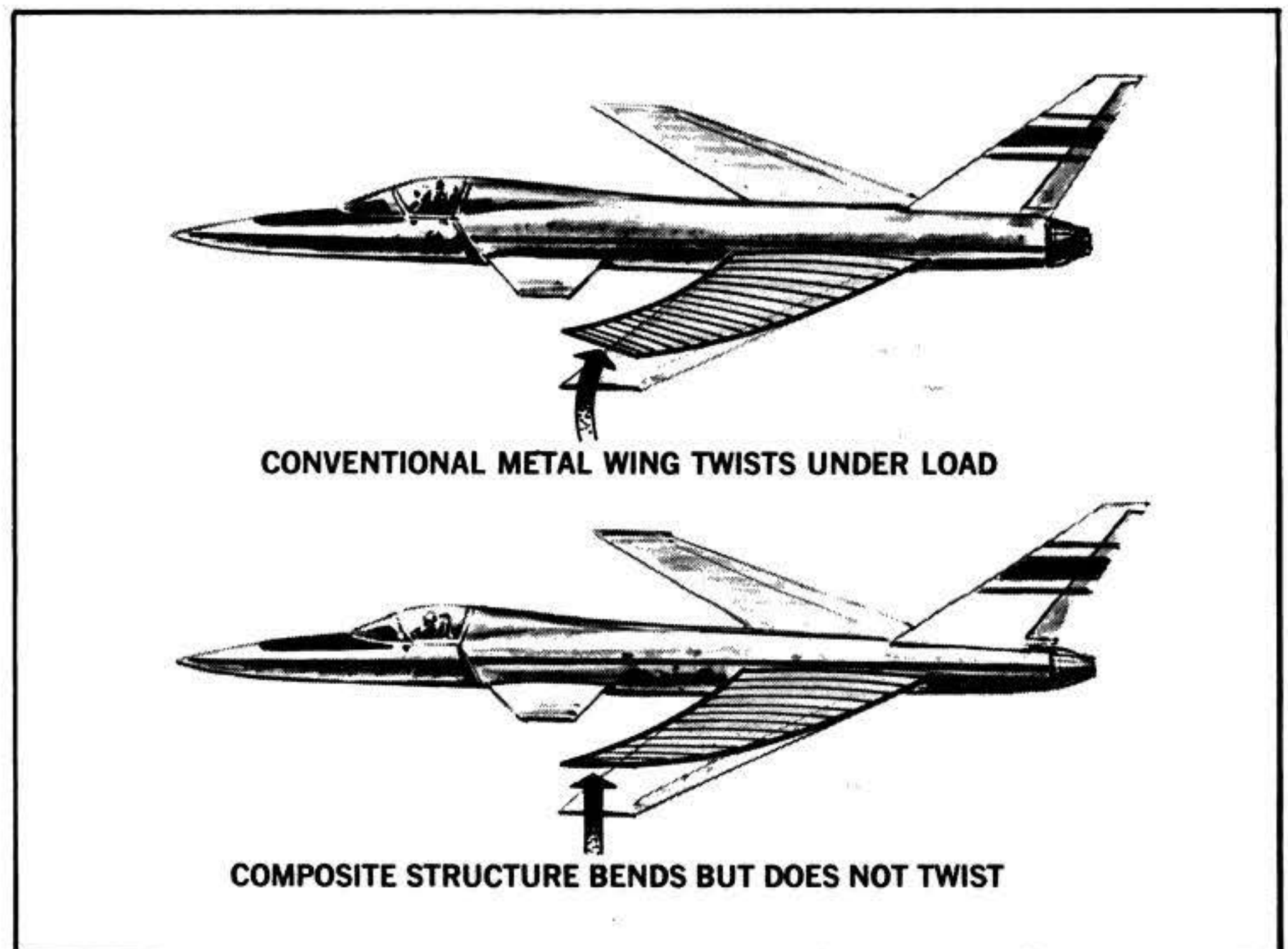
Here's how: When the airplane is pulling up or in a tight turn and thus

[Continued on page 160]



Shock wave on forward-swept wing is weaker than on aft-swept wing of equal sweep. Diagram shows why. Vertical lines represent base from which sweep angles

are measured; wavy lines show position of shock wave. Strength of shock is weaker as its angle is greater; forward sweep creates greater angle, as shown.



Wingtips twist up (top drawing) when forward-swept-wing planes fly at high speeds or execute extreme fighting maneuvers involving high G-loads. This increases the angle of attack of the wingtips, increasing the load on them, and makes the tips bend up even more. End result

can be wing divergence (failure). By using lightweight composites tailored to spread the G-load properly, the wings can be designed to bend (lower drawing) in order to distribute the load optimally over the entire wing. This keeps wing from twisting, and possible structural divergence.

Hydrobus, gyrobus

use brake-generated energy

Soaring fuel costs prompt German bus makers to refine regenerative braking

By DAVID SCOTT

HAMBURG, GERMANY

At the recent International Transport Exposition here, I looked over hardware designed to capture and store the tremendous kinetic energy usually wasted as heat when buses are braked in city traffic. Germany's two largest bus manufacturers estimate that this stored energy, used to accelerate buses to normal cruise speed after stops, could cut fuel consumption by one-quarter.

This energy-storage technique, known as regenerative braking, is an

old idea that so far has been impractical. But dwindling oil supplies, soaring prices, and new emphasis on public transportation have created a real urgency to make it work. For example, Berlin's 2500-bus fleet, at eight mpg, consumes 30,000 gallons of fuel each day. A 25 percent saving could provide enough precious oil each year to heat thousands of homes or run 7000 cars.

M.A.N. of Munich is developing a so-called hydrobus concept, involving hydraulic pressure as the storage medium, and a gyrobus system with flywheel energy storage [PS, Jan. '80]. Mercedes-Benz is also working on a gyrobus design.

Hydraulic storage

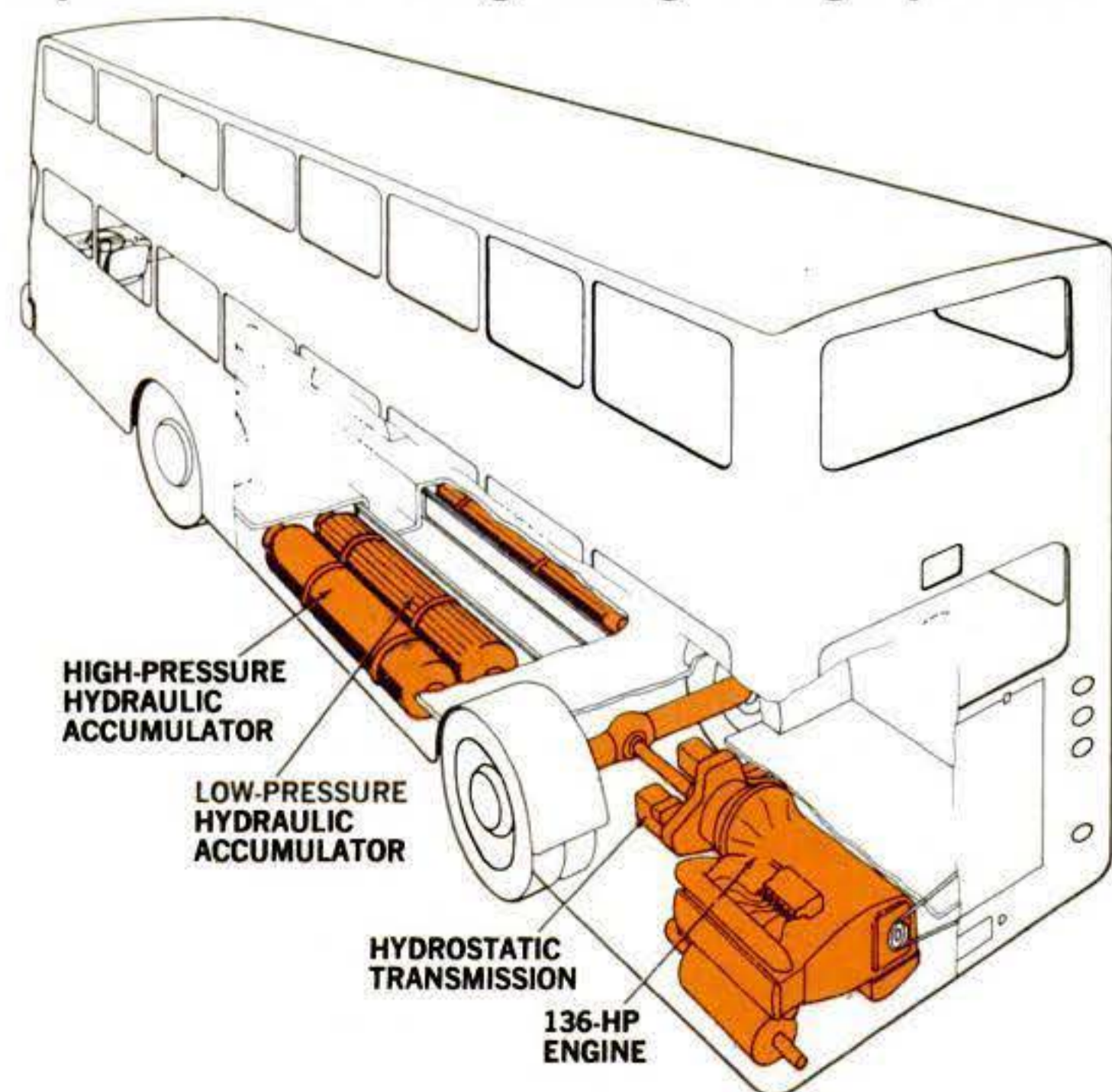
M.A.N.'s hydrobus regenerative-braking design involves a stepless hy-

drostatic transmission between wheels and engine instead of the usual mechanical gearbox. While the bus is cruising, the engine drives the axle through the transmission and hydraulic motors. These are variable-displacement swash-plate motors, enabling the speed and torque ratio between engine and wheels to be varied like a conventional transmission.

"When braking, the engine is automatically decoupled," explained Faust Hagin of M.A.N. Special gearing transfers the axle connection from the motor to the pump. This pump, driven by the bus wheels, then sends oil into large hydraulic cylinders, creating a load on the wheels that slows the bus.

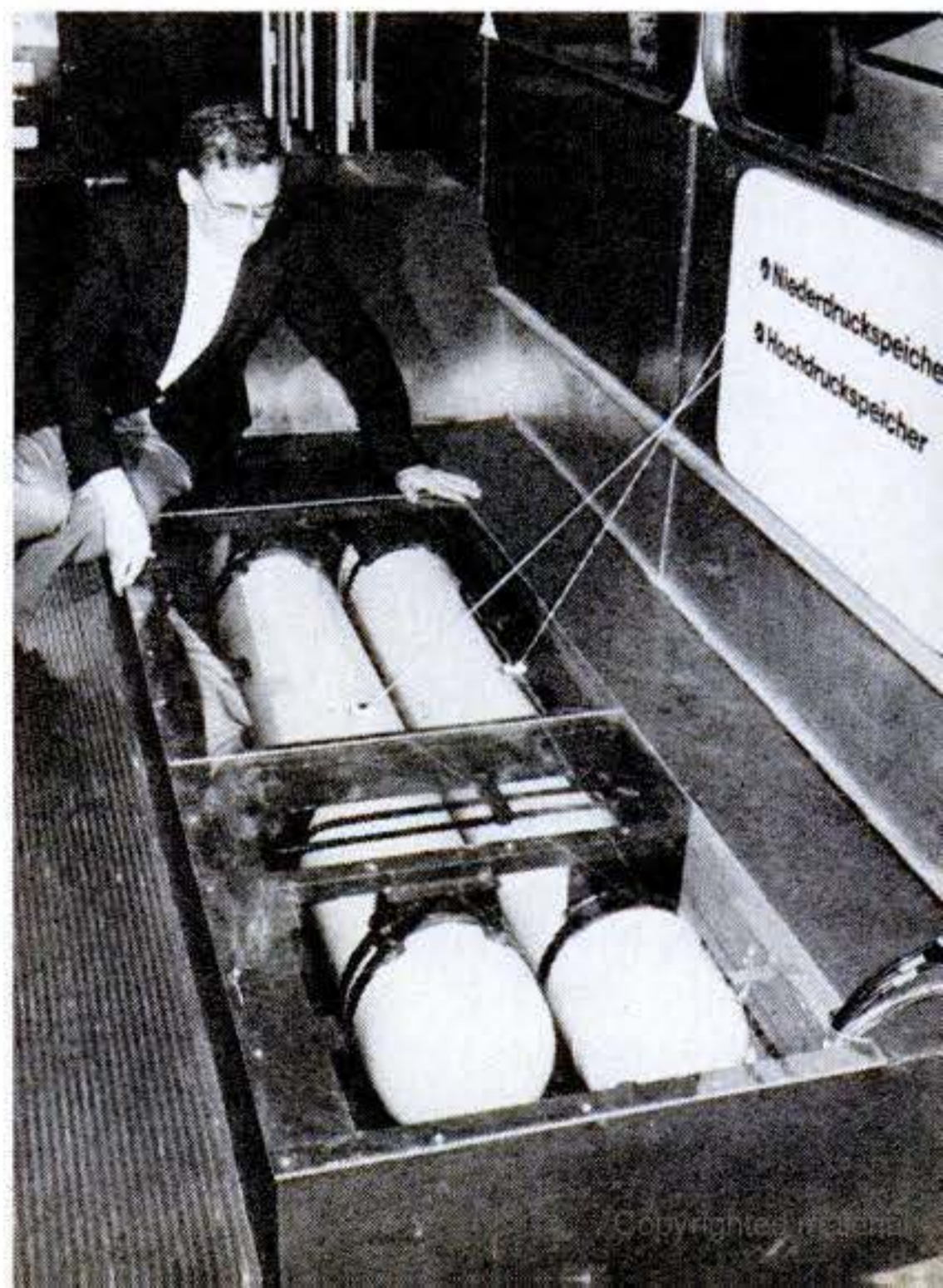
Cylinder-fluid pressure reaches an enormous 4751 psi, created by nitrogen gas sealed in a balloon-like com-

Hydrobus: Braking charges high-pressure cylinders

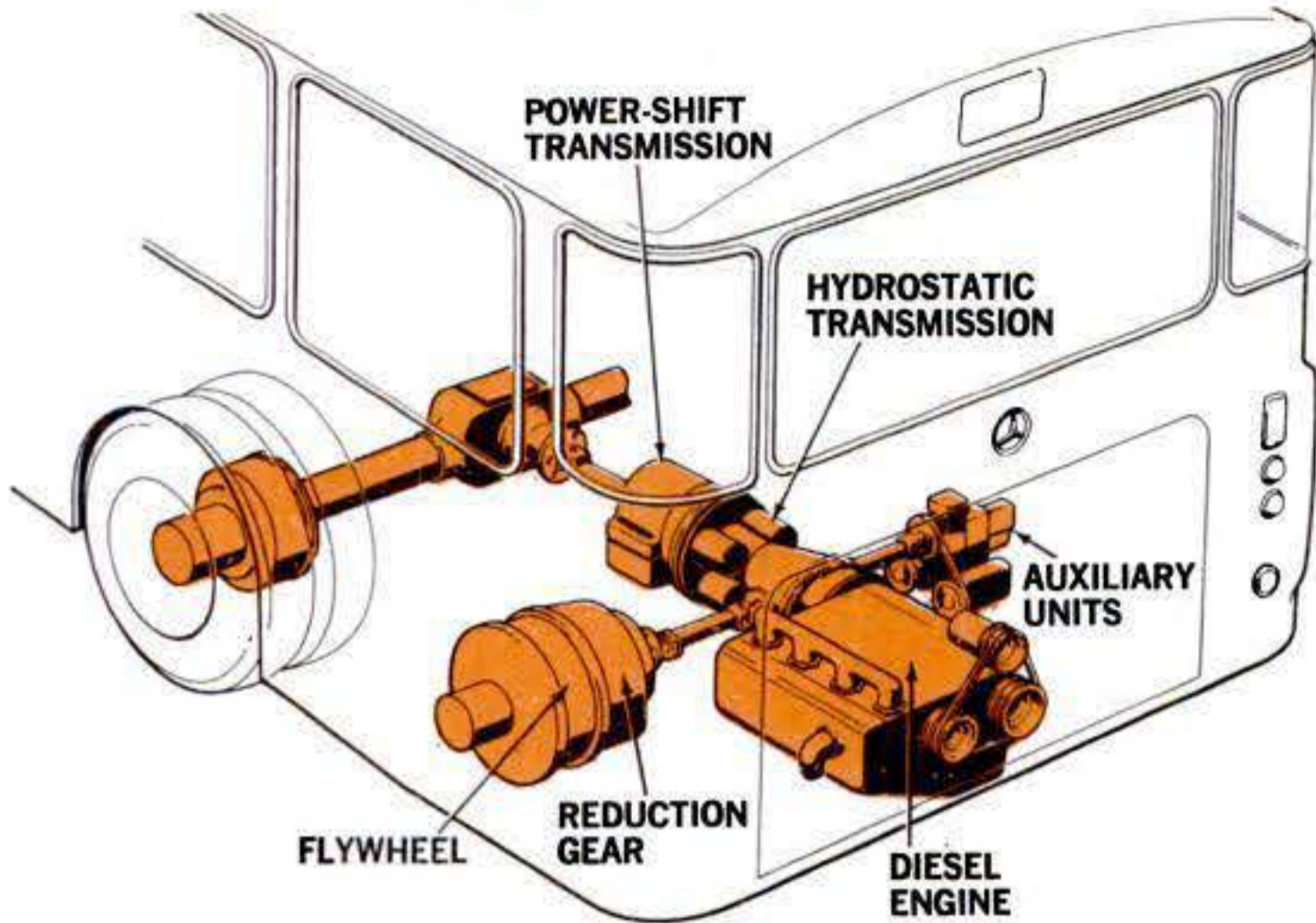


Double-deck hydrobus will capture braking energy. During braking, engine and hydrostatic transmission are disconnected from axle. Spinning axle drives hydraulic motors that charge high-pressure accumulators. Oil operates motors to accelerate bus, then flows into storage cylinders.

Storage cylinders fit under passenger seats. Total 830-lb. weight is partially offset by smaller diesel that can be used for same acceleration results.



Gyrobus: energy from a flywheel



Sixteen-ton gyrobus developed by Mercedes-Benz has steel flywheel revved up to high rpm by rear axle during braking. After a stop, flywheel energy, instead of the engine, is used to accelerate bus. Firm is also building a 3.7-ton, 17-passenger gyrobus with 65-hp diesel. Larger bus requires only 136-hp motor.

pression bag. To accelerate the bus from a stop, fluid is released from the cylinders to the hydraulic motor, which drives the wheels.

"Hydraulic power alone is enough to accelerate the bus from rest to 30 mph," Hagin said. "Then the engine takes over and drives the pump and motor until the next stop." During acceleration, oil from the high-pressure reservoir flows through the motor to a pair of low-pressure cylinders for use in the next braking cycle.

In addition to fuel saving and reduced noise and emissions, the hydraulic system sharply reduces brake-line wear. The friction brakes, always available for emergencies, would be applied just before a complete stop. Also, since the engine is needed only to overcome wind and rolling resistance at cruise speeds, a smaller, more economical version can be used. M.A.N. plans to build some 80 buses by 1982 for Berlin route testing. These double-deckers will have a four-cylinder, 136-hp diesel instead of the standard six-cylinder, 200-hp unit. The first experimental bus is already under test at the Munich factory of M.A.N.

A microcomputer controls the transmission's braking, acceleration, and cruise functions. The regulation includes the infinitely variable ratio changes needed to match power demand with running economy. The electronic brain also handles the delicate balance between reservoir-to-motor and engine-to-pump drive at changeover points.

Flywheel storage

M.A.N.'s gyrobus is similar in principle to the hydrobus, but recovers braking energy by revving up a flywheel. "Its advantage," says Hagin,

"is a greater maximum storage capacity—1.5 kilowatt-hours, against 0.33 kWh for the hydraulics."

That means a longer run without using the engine. The flywheel alone could power a bus on some short stretches between stops. Aside from additional fuel saving, this would minimize exhaust fumes in tunnels and underpasses.

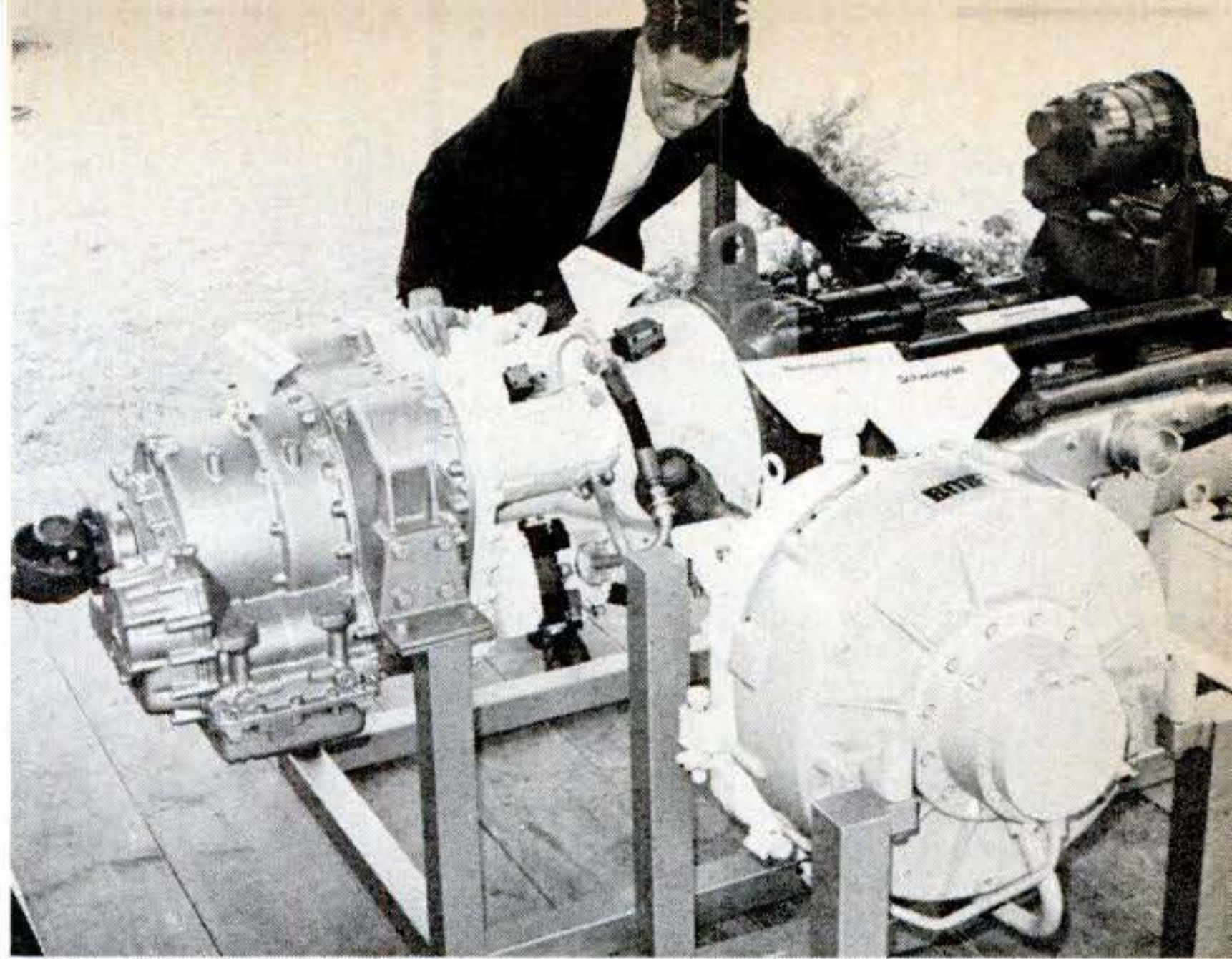
But the snag is the complex controls and couplings needed to combine flywheel and engine drive. A high-speed flywheel slows down as it speeds up the bus, and the opposite occurs in braking. This calls for a pretty crafty power-transmission system to get the most from each situation. Bosch, another German firm, is working on the complex electronic controls needed for the job.

Individual gyrobus components have been tested, and will soon go into an experimental vehicle. A 20-inch flywheel runs at 12,000 rpm in a vacuum casing. The flywheel is indirectly coupled to the engine through a compound differential and two-speed planetary gearing.

The transmission has a pair of rotary hydraulic units that double as variable-displacement pumps and motors. They provide infinitely variable ratio changes, as in the hydrobus, and also simplify a power split to the back axle.

This split combines direct mechanical engine drive with hydraulic drive from the flywheel. As long as the flywheel retains useful kinetic energy, there's a steady 30-mph combined propulsion. Power sharing is gradually changed until the wheel's share drops to 25 percent. The engine then takes over entirely.

"Getting the complete system to work as intended will be a tricky busi-



Gyrobus transmission is checked over by PS European editor David Scott at German transportation exposition. A vacuum-chamber drum in the foreground contains a steel flywheel that stores braking energy. The flywheel spins at up to 12,000 rpm. First Mercedes-Benz gyrobus is slated for track tests this year.

ness," Hagin admits. A harmonious blend of mechanics, hydraulics, and electronics is involved. Two unknowns: how gyroscopic action will affect bus handling, and the potential safety hazard of the whirling mass in an accident.

M.A.N.'s steel flywheel is a hefty 230 pounds. But a steel-rimmed, carbon-fiber wheel weighing only 53 pounds is planned. Running at 28,000 rpm, it should have the same storage capacity as the solid-metal wheel.

Mercedes-Benz is concentrating on building only a gyrobus. "We're in friendly competition with M.A.N., and going our separate ways," says Christian Bader, research head. But the two firms share ideas for flywheels and electronic controls.

The Mercedes system has a different link between flywheel and axle. Its flywheel and reduction gearing is followed by a friction clutch that drives four hydraulic pump/motors. This provides stepless ratio changes to match flywheel speed to bus power demands. The pump/motors also regulate energy feedback during braking. They're followed by a three-speed automatic gearbox with no torque converter.

Hit the brakes and the flywheel revs up as the bus slows. The wound-up wheel returns its stored energy to the axle via the hydraulic circuit as the bus accelerates. When flywheel rpm drop from 12,000 to about 8500, the engine is reengaged to share the load. The flywheel is disconnected below a certain rpm.

These buses will be costly compared to conventional machines, but as oil prices climb their fuel economy could make them economical. (Sheik Yamani of Saudi Arabia has already predicted the \$10 gallon.)

Meteorites

— how science reads them for new clues to the birth of the solar system

These “poor man’s space probes” enable scientists to explore space at comparatively low cost

By **STEPHEN P. MARAN**
DRAWINGS BY RAY PIOCH

Dr. Maran is senior staff scientist of the Laboratory for Astronomy and Solar Physics at NASA’s Goddard Space Flight Center in Greenbelt, Md. He often writes on astronomical topics.

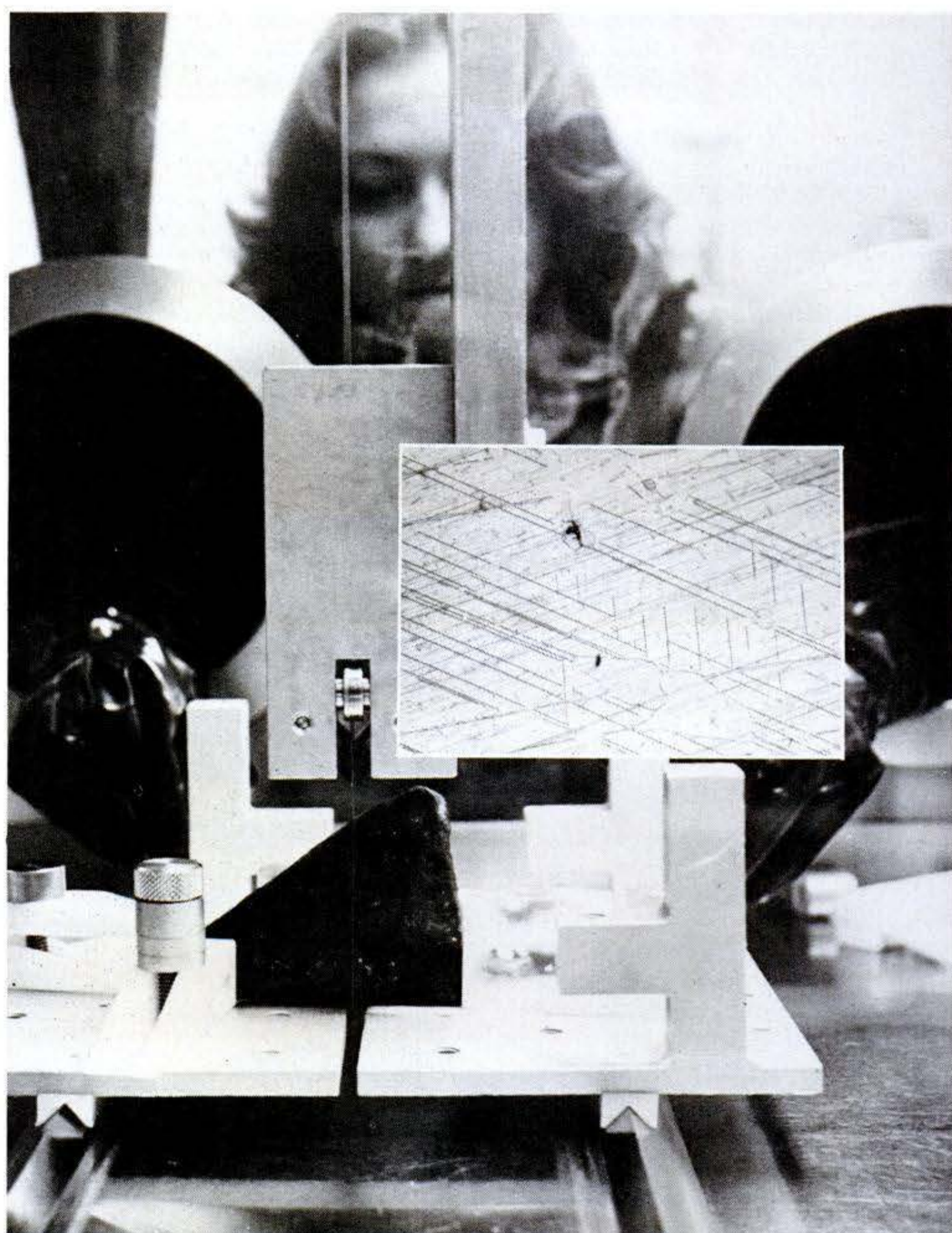
A helicopter hovers over a bare expanse of blue ice in Antarctica. Howling, hurricane-force winds had earlier scoured away most of the snow cover. As the red Navy helicopter descends, geologist William Cassidy points excitedly at something unusual on the ice below.

Sprinkled over the surface, like raisins on a pudding, are small black rocks. Moments later, Cassidy and his team emerge into numbing cold, equipped to “mine” what are actually meteorites. Normally, finds of these visitors from space are rare. But unique geographical and weather processes in Antarctica (see drawing) have funneled and concentrated them into certain regions.

Cassidy and his colleagues collect the lumps of stone and metal almost as though they harbor a deadly Andromeda strain. Teflon-gloved hands slip the meteorites into sterile Teflon bags. Later, packed in dry ice, they’re shipped to the Johnson Space Center in Houston for handling in germ-free containers, just like the Apollo moon rocks.

Why such extraordinary measures to collect and protect a few chunks of rock?

Meteorites provide geologists,



Glove-box cabinet filled with nitrogen at NASA–Johnson Space Center provides sterile environment for geologist to slice Antarctic meteorite with a band saw. UCLA microphotograph (inset) shows

tiny portion of another meteorite sliced, polished, and etched. Heavy diagonal lines, often paired, are Neumann lines, crystalline disturbances produced by the shock of a meteoroid collision in space.



Two large black meteorites sit on polar ice near the Allan Hills in Antarctica. Inset

to NASA photo shows a combination centimeter scale and numbering device used

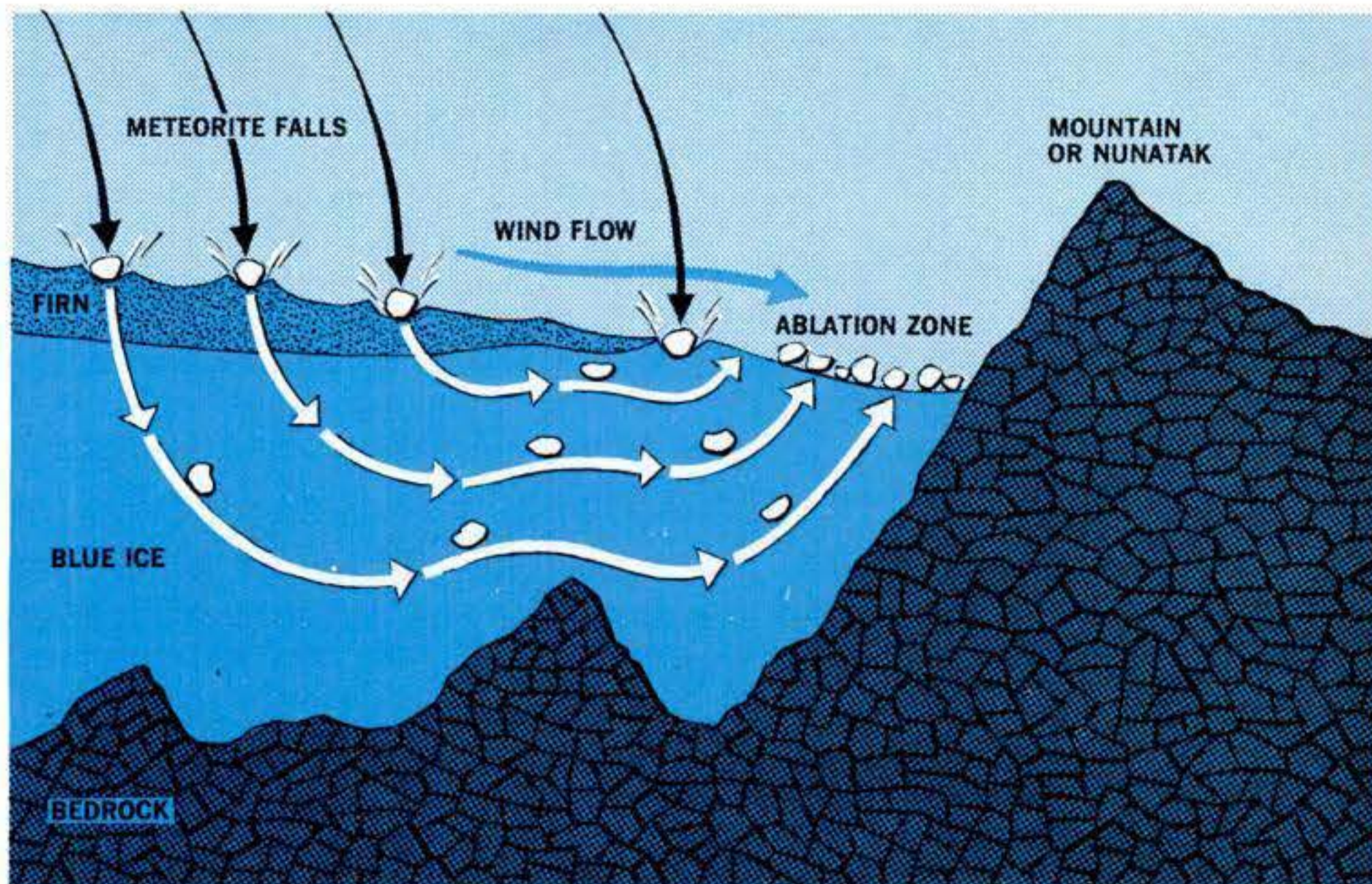
to record meteorite in photo before collection by contamination-free techniques.

chemists, biologists, and astronomers with a unique opportunity to explore extraterrestrial conditions at little cost. Indeed, meteorites have been called "poor man's space probes." Where in space do they come from? In Canada, automated scanners photograph meteor tracks. Careful analysis of such photos from two or more cameras can not only pinpoint an impact zone, helping meteorite hunters in their never-ending search, but also trace the meteorites to their point of origin. There are now orbits known for three meteorites found on the earth; each passes through that rocky zone of flying fragments called the asteroid belt, which lies between the orbits of planets Mars and Jupiter.

(Incidentally, even though experts sometimes misuse the terms, a *meteor* is a "shooting star" or streak of light produced as a *meteoroid* rushes through the atmosphere. Once the rock hits the ground, it is then called a *meteorite*.)

Continued

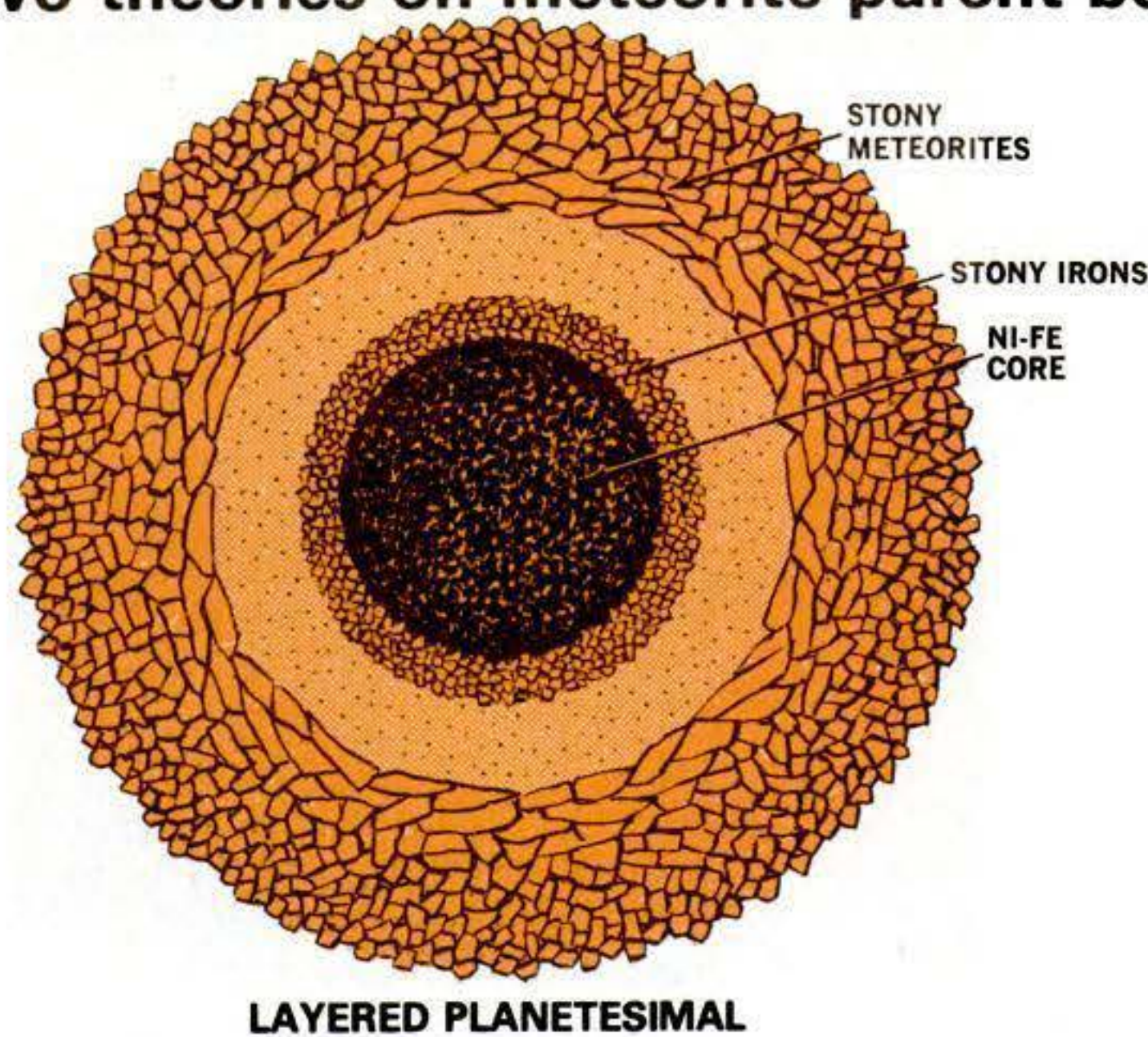
Nature's way of concentrating meteorites



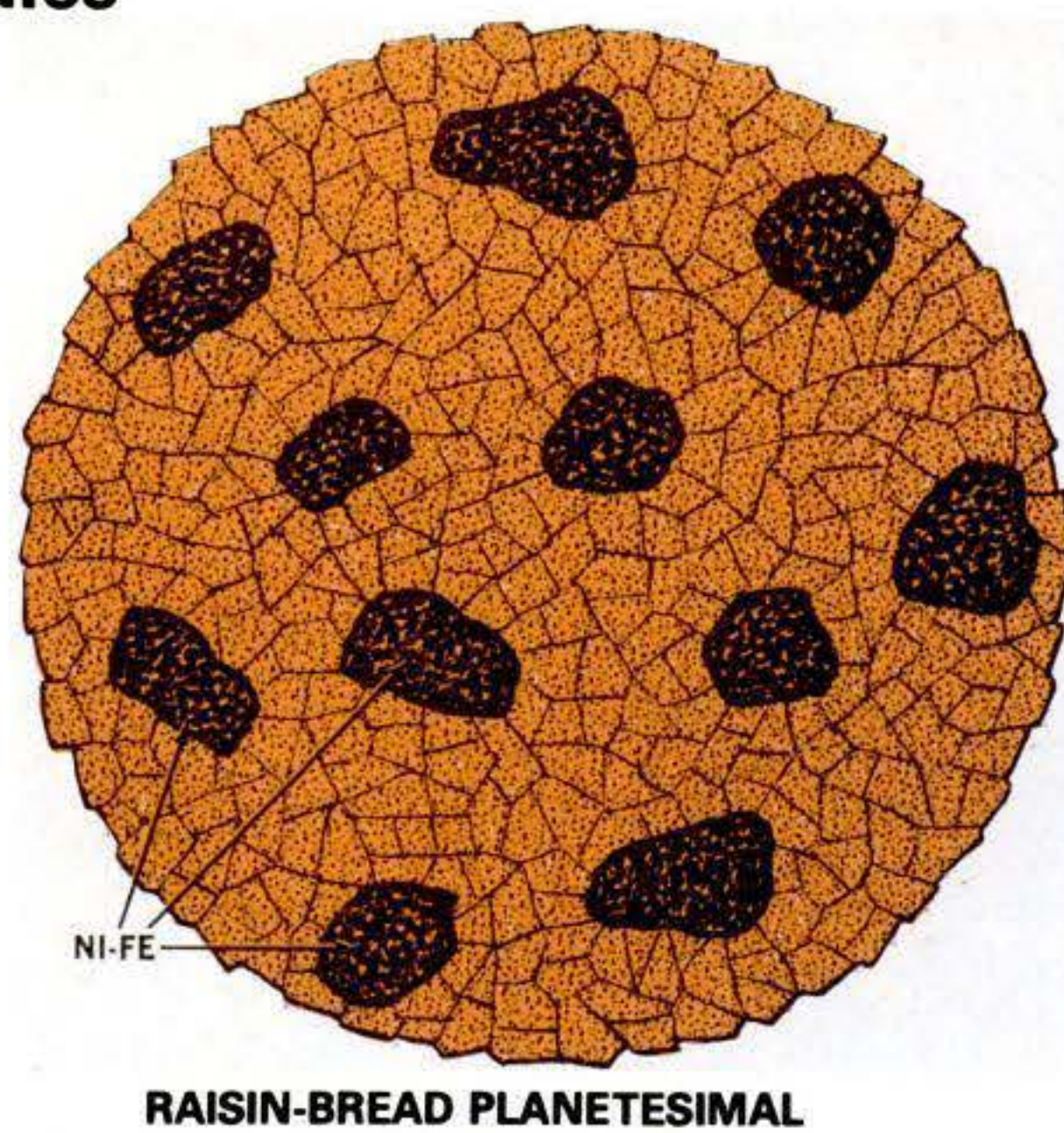
Like a giant frozen conveyor belt, the Antarctic ice cap collects falling meteorites and carries them to mountains or smaller land masses (nunataks). Mountains stop

ice, which then rises and is worn away (ablated) by high winds, leaving meteorites on the surface. The glacial snow cover (firn) cushions impact of falls.

Two theories on meteorite parent bodies



LAYERED PLANETESIMAL



RAISIN-BREAD PLANETESIMAL

Planetesimal parent body, broken up by collisions in space, may have had layers and dense core that could account for me-

eteorite types found on Earth. At one time, body was molten, creating nickel-iron (Ni-Fe) core. According to raisin-bread theory,

iron meteorites may have been dispersed throughout the interior of rocky parent, like raisins in a loaf of bread.



Three-ton meteorite discovered by California prospectors in 1976 is second-largest American find. It's at Smithsonian Institution, its disposition contested.

Using intricate methods of chemical analysis, and combining them with other sophisticated techniques such as cosmic-ray and radioisotope dating, meteorite specialists have been able to learn much and speculate more about the physical and chemical conditions under which the objects in their scientific treasure trove were formed. They now believe many mete-

orites originally formed inside larger, ancient, rocky parent bodies, and can tell, from laboratory analysis, not only when this formation occurred, but when the meteorites were chipped off in collisions, and when the fragments fell to Earth.

Key to astral secrets

Because they reveal so much, and because most meteorites are some 4.6 billion years old—the presumed age of the sun and planets—they are, in effect, a kind of astronomical Rosetta Stone. They may provide us with the key to decoding the history, perhaps the birth of, the solar system, and even help us understand the origin of life itself.

Of all the meteorites ever found on Earth, the most potentially interesting are the ones from Antarctica. One reason is obvious: Until 1969, many decades of tedious endeavor had resulted in a mere 2600 meteorites being collected throughout the world. Yet between 1969 and 1979, more than 1600 were collected from the Antarctic by Japanese and United States expeditions. The sheer number of available samples represents a scientific bonanza.

But there is another, more important reason. Many Antarctic specimens are, for all practical purposes, uncontaminated by organic and other terrestrial chemicals. Thus they preserve an unsullied record of their origins. This is especially important for biochemists analyzing the meteorites for amino acids and other organic chemicals that are the building blocks of the complex molecules—such as proteins—necessary for life as we

know it. That is the reason for the very finicky treatment given the Antarctic meteorites by geologist Cassidy and his colleagues.

Cassidy, a University of Pittsburgh professor who leads the Antarctic explorers, explains that meteorites do not fall on Antarctica more frequently than other locations. But instead of being lost at sea or resting broken and unrecognized on land, Antarctic meteorites are cushioned by snow cover when they fall.

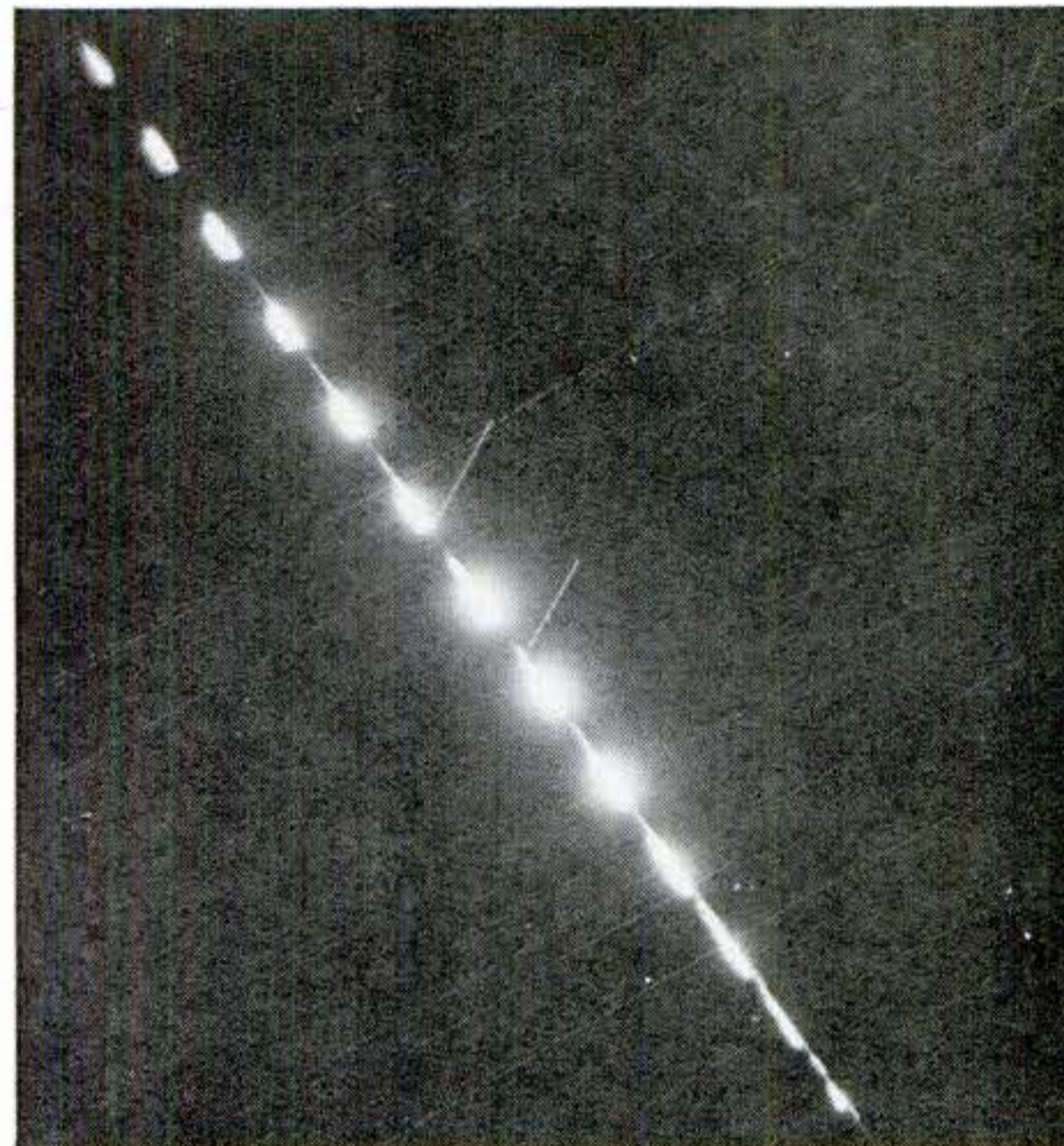
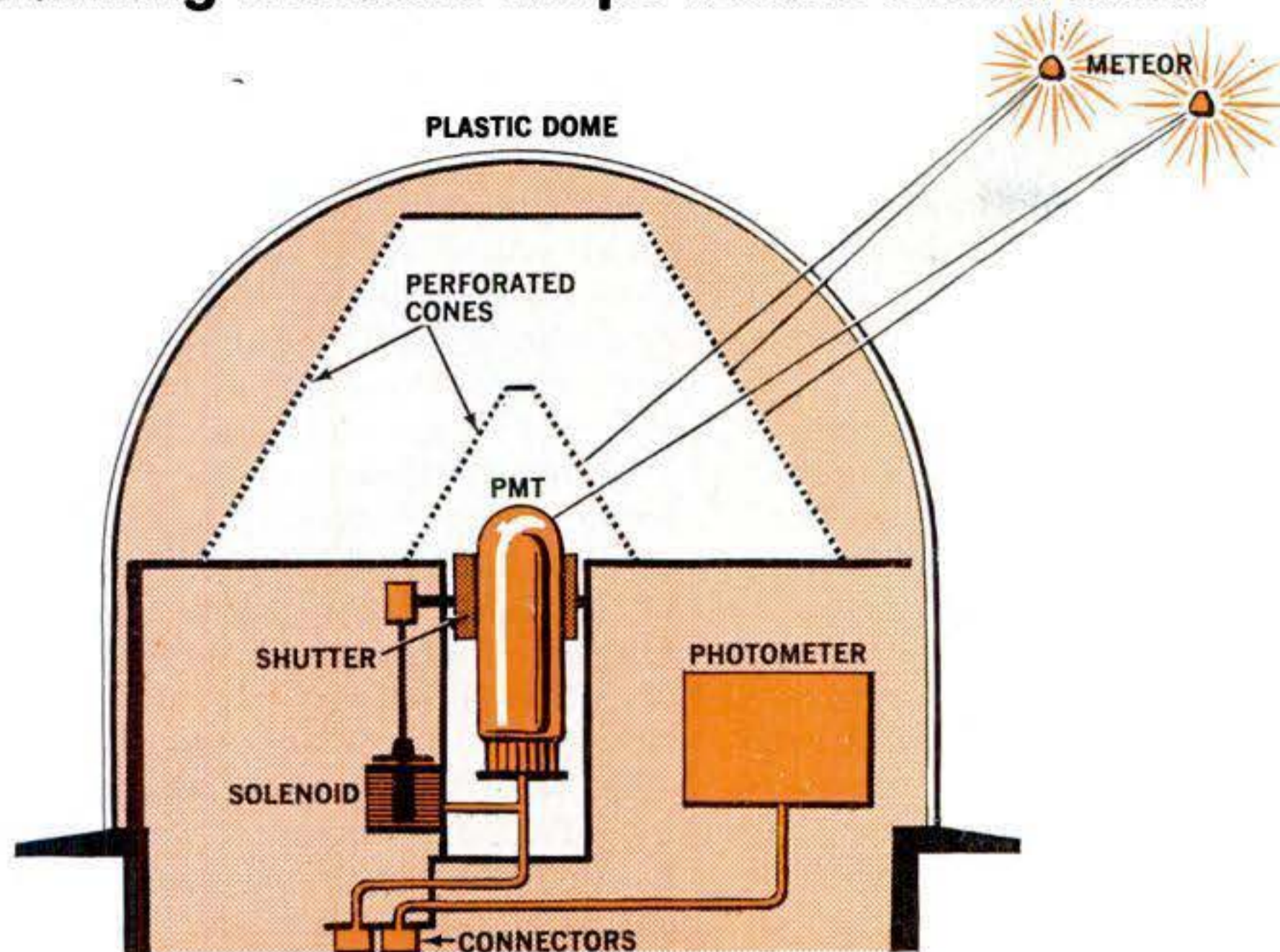
Later, the snow turns to ice and preserves the meteorites. Antarctic weather conditions and glacial flow combine to protect meteorites, transport them across the polar continent, accumulate them in certain locations, and even uncover the buried stones for easy collection atop the ice.

At the University of Maryland's Laboratory for Chemical Evolution, its director, Dr. Cyril Ponnampereuma, told me why the Antarctic meteorites are important in studies on the origin of life. Organic molecules—possible precursors of life—had been found in a few previous meteorites, notably an Australian specimen that fell in 1969.

Dr. Ponnampereuma explained that some of the molecules in the Australian specimen were almost surely extraterrestrial. They included certain amino acids that do not occur naturally on Earth. Some of the molecules found, however, were types that do occur in living organisms on Earth.

The two kinds are distinguishable by their structure. In his office, Dr. Ponnampereuma showed me colored ball-and-stick models that illustrate some of the types of amino acids.

Filming meteors helps locate crash sites



Patrol-camera network established by Canada's National Research Council automatically captures meteors on film and

helps pinpoint impact sites. Light penetrating both perforated cones in basketball-size dome produces an alternating

signal from photomultiplier tube (PMT), which advances film. Breaks in exposure (right) aid timing rate of fall.

Those on Earth, from which proteins and larger complex molecules of living matter are made, are called L-isomers: In a solution, they cause the plane of a polarized light beam to rotate to the left. On the other hand, so-called abiological amino acids, made by a chemist, are random mixtures of both L- and D-isomers, with roughly half of each. D-isomers are chemically identical except that they rotate polarized light waves to the right. Were the Earthlike molecules from outer space, or did they stem from contamination by human handling or contact with the ground after the meteorite landed? If these L-isomers were indeed extraterrestrial, it would mean that some of the mechanisms proposed for the hypothetical genesis of life in space were at least possible.

Pre-life proof

It was impossible to answer this vital question for the Australian meteorites. But with the Antarctic meteorites, the uncertainty was eliminated. The clean ice-sheet environment and careful handling by Cassidy's explorers minimized contamination. Ponnampuruma told me that the first Antarctic specimen his group tested was startling.

"The amazing thing was that we examined the outside and inside of the meteorite and the distribution of amino acids was the same," he said. Contamination would surely have affected the outside layer more than the inner parts of the meteorite. "The meteorite was *not* organically contaminated on the Earth," Dr. Ponnampuruma said. "From the point of view of organic chemistry, it's as though we

brought it back from the asteroid belt."

The presence of both kinds of isomers in the Antarctic meteorites thus proves that at least some of the building blocks of life do exist in space, that some part of a mechanism for the chemical evolution of life has occurred elsewhere in the solar system. But, Dr. Ponnampuruma points out, there is no reason to think these amino acids are the residue of life forms on another world. To make large molecules, the building blocks must be all of the same type; otherwise, they will not fit together. "It would be a case of putting the left foot in the right shoe," he explained. "You can't build really large macromolecules that way." On Earth, L-isomers fill the building-block role. Elsewhere, D-isomers might do the job. Life does not need both types.

Meteorites contain so few amino acids, though, the polarized-light test doesn't work. Rama Kotra, preparing his Ph.D. thesis on Antarctic meteorites, showed me the ultrasensitive equipment used at the Maryland lab to detect organic molecules. The key component in this gas-liquid chromatography method is a compact coil (see photo) made with a long one-millimeter-thick glass tube.

A patented, ultraviscous liquid coats the inner walls of this coiled tube. The liquid sample prepared from a meteorite is injected along with helium gas at one end of the coil. Some molecules in the liquid forced through the tube have a low affinity to the sticky coating and emerge at the other end in a few minutes. Other molecules with a high affinity take hours to get

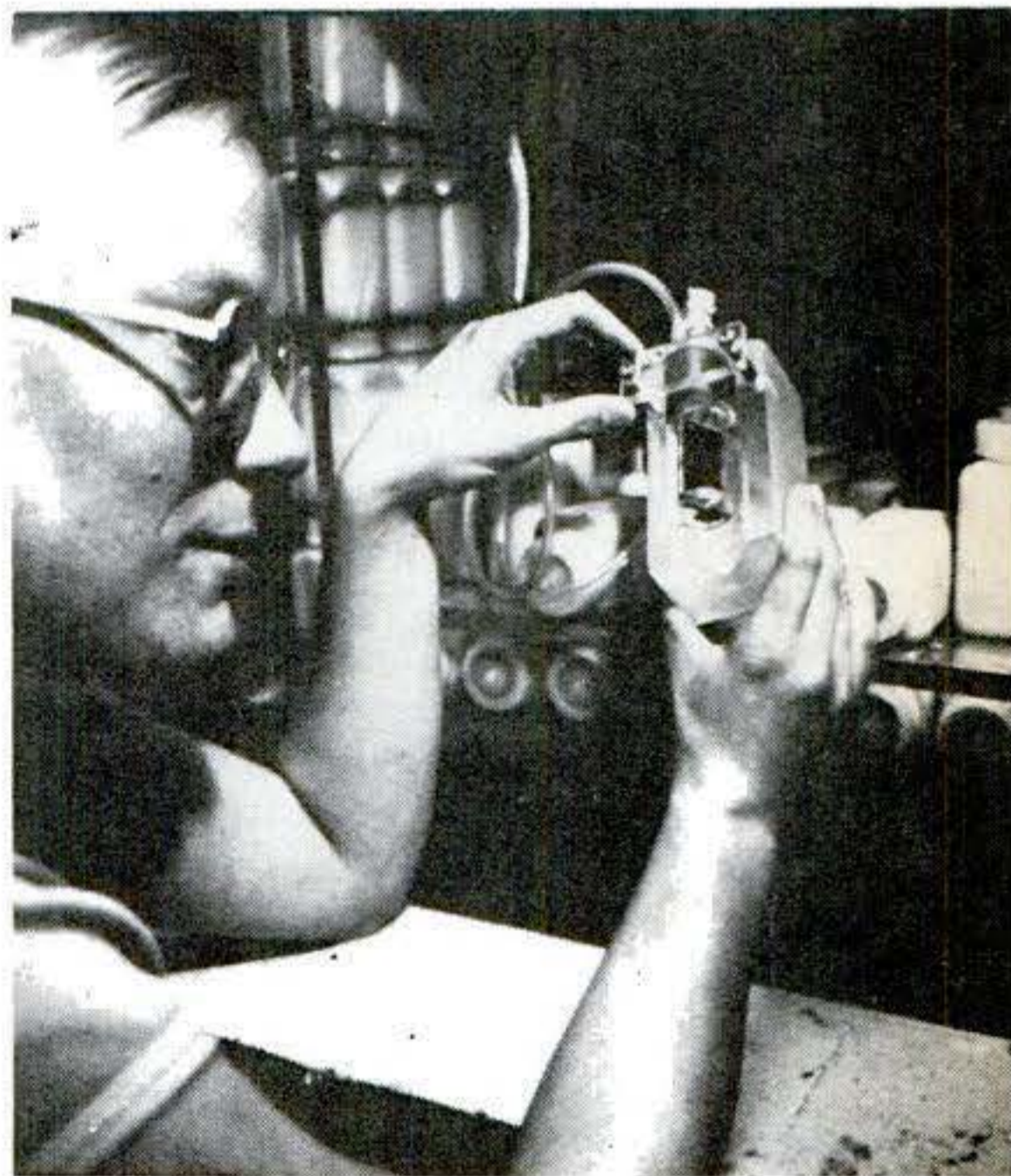
through the ultra-narrow passage.

As each substance emerges from the chromatography tube, it is burned and ionized in a hydrogen flame. The resulting electrically charged particles are detected and recorded as a blip on a chart along with the time. Now the molecules can be identified, since the tube is calibrated by passing known amino acids through it and noting the passage time.

Cosmic dating

Laboratory studies of meteorites also reveal when they formed in the

Continued



Special Geiger counter used by UCSD research chemist measures very low radioactivity in meteorites caused by cosmic-ray bombardment. Device is operated within lead and pure-mercury shields to prevent terrestrial-radiation exposure.



Coiled tube is the heart of apparatus used to detect amino acids in Antarctic meteorites (see text). Gas-liquid chromatography tube is operated inside an oven to maintain a precise temperature.

parent bodies, when they broke away from the parents, and even when they fell on the Earth.

The age of a meteorite, defined as the time since melting occurred in its parent body, is found by measuring radioactive isotopes and the elements produced through radioactive decay. Uranium-235, for example, decays through a long chain of intermediate elements to yield daughter isotopes of lead (Pb-207) and helium (He-4).

This process has a half-life of 710 million years, which means that after that much time one-half of the U-235 has been transformed. In twice that time, only one-fourth of the U-235 remains, and so on. Comparing amounts of initial and daughter isotopes in meteorites reveals their ages. Most turn out to be about 4.6 billion years old.

How long ago a meteorite broke off from its parent body is estimated from cosmic-ray exposure age. In space, a meteoroid is exposed to cosmic rays—high-energy nuclear particles that penetrate rocks to depths of a foot or more. These impacts change some nuclei in the meteorite to isotopes of the noble gases helium, neon, and argon. The longer the exposure, the more gas atoms produced and trapped in the stone. Measuring the numbers of gas atoms tells how long ago a meteorite lost the shielding overlying matter in its parent body.

Results range from 20,000 to over a half-billion years. Significantly, the measured cosmic-ray exposure ages of meteorites are not spread uniformly over this range. Instead, they tend to cluster around certain values, notably five, seven, and 20 million years. This suggests that many meteorites that fell on the Earth resulted from collisions among particular parent bodies five, seven, and 20 million years ago, probably in the asteroid belt.

A meteorite's terrestrial age—the time since it struck the Earth—can also be deduced from its exposure to cosmic rays in space. After separation from its parent body and before striking Earth, a meteoroid is continually bombarded by cosmic rays. This produces the noble gases mentioned and also some short-lived radioactive isotopes.

One of these isotopes is carbon-14, which has a half-life of only 5760 years. The short-lived C-14 dies out in the meteorite once the stone has fallen and is shielded from cosmic rays by our atmosphere. Measuring C-14 radioactivity in meteorites recovered just after they fall provides a reference for terrestrial-age measurements. Stones that have just fallen have higher radioactivity than meteorites that fell long ago.

Several research groups that measured four meteorites from Antarctica's Allan Hills area estimated that three of them fell between 30,000 and 300,000 years ago. One has a terrestrial age of 1.5 million years, indicating the Antarctic ice sheet is at least this old.

Metallurgical studies of meteorites reveal the heating and cooling histories of their parent bodies in space. Nickel-iron meteorites must have been molten at temperatures over 1000 deg. C to have formed. When sliced and polished, these specimens often showed the Widmanstätten pattern. This is a cross-sectional view of the meteorite's metal-crystal structure, formed by the nickel-iron alloys kamacite and taenite.

Seen edge on, the alloys appear as thin plates or bands in the Widmanstätten pattern. For a given mix of nickel and iron, faster cooling results in thinner kamacite plates in the metal-crystal structure. Thus, measuring the thickness of kamacite bands is one technique researchers use to estimate the cooling rate within a meteorite's parent body. And the cooling rate is a clue both to the size of the parent body and to the heat source within it.

Parent-body theories

Researchers use data from both radioactive dating and mineralogy/metallurgy to decode the history of meteorites and the solar system. One of the major, and still unresolved problems, is this: Why are there different kinds of meteorites, with different compositions? One theory suggests that the different types come from different layers of parent bodies called planetesimals.

An ardent spokesman for the planetesimal theory is Dr. David Morrison, an enthusiastic young University of Hawaii astronomer. He is observing

asteroids to learn how they relate to meteorite parent bodies.

"We have to distinguish *primitive* versus *evolved* meteorites," he said. Morrison classifies as primitive those meteorites that contain chondrules—small, round, rocky lumps. The primitive meteorites, he believes, never had parent bodies, but instead condensed from the same nebulous material that formed the solar system.

Evolved meteorites, Morrison says, come from parent bodies 500 kilometers or more in diameter. These parent bodies, or planetesimals, broke up long ago. Meteorites thus evolved are samples of planetary interiors. At one time, according to Morrison, the planetesimal interiors were hot and molten. Thus, as happened inside the Earth, heavy substances such as nickel and iron sank, and they formed a metallic core. Just above the core was a layer of mixed iron and stone, while lighter rock floated above like slag in a blast furnace. Heat, pressure, and chemical reactions "evolved" the original materials into new substances.

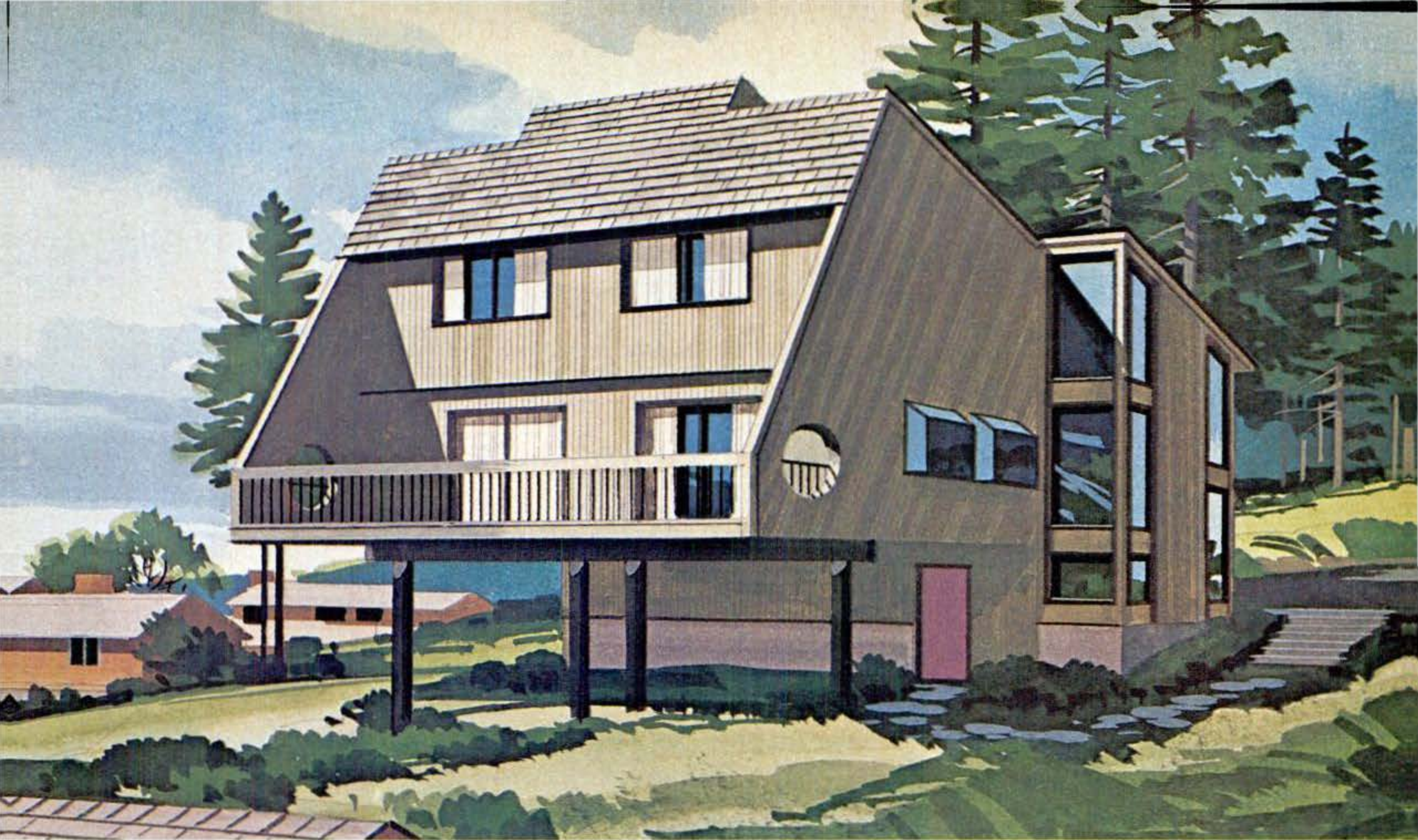
Layers or raisins

According to Morrison, the various kinds of evolved meteorites may be fragments from different planetesimal layers. The "irons," or virtually pure nickel-iron meteorites, are therefore chunks from parent-body solid cores. Stony-iron meteorites originated in the boundary layer between the core and the outer rocky regions. Stony meteorites come from the outer regions.

Like a finished jigsaw puzzle, the planetesimal theory assembles many pieces of evidence into a logical picture. But not every piece fits. Some researchers believe Morrison's primitive meteorites may actually be chips from the outer crusts of parent bodies. Other astronomers prefer the "raisin bread" theory, which suggests that different kinds of material were distributed more or less randomly throughout a parent body, like raisins in a loaf, and that the breakup of the parent body thus gave rise to different meteorite types. This "raisin bread" theory (see diagram) seems more flexible in accommodating the evidence gathered thus far because "raisins" at different depths in the parent "loaf" are subject to different pressures and other conditions. Hence, it is easy to explain more kinds of meteorites with this theory. But there is no preponderance of evidence either way.

Radioisotope dating and metallurgical analysis of meteorites suggest that parent-body interiors melted, then cooled and solidified within the first half-billion years after the solar

[Continued on page 172]



PS leisure-home plan

Stepped-floors contemporary

lifts you for a better view

By AL LEES

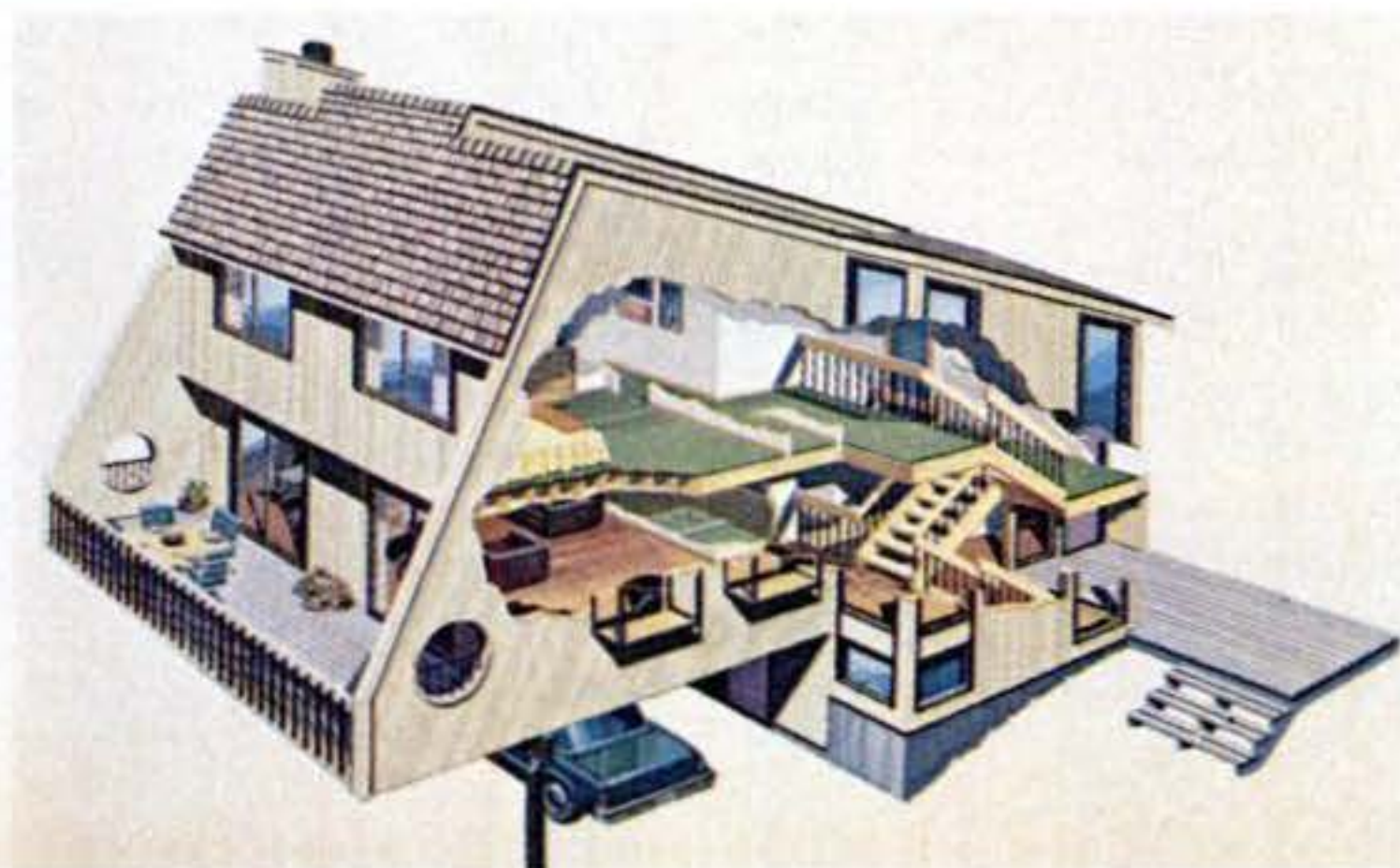
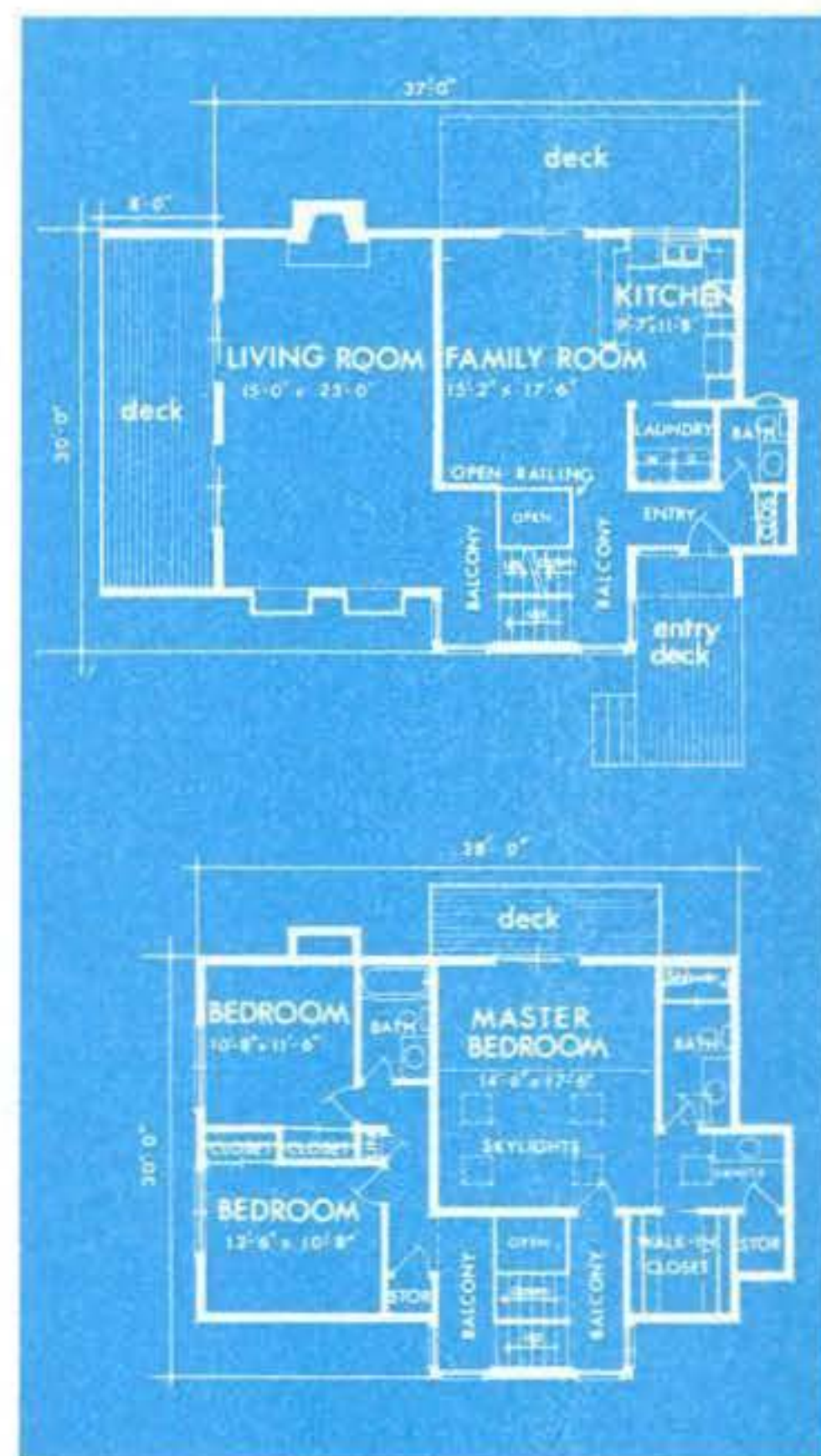
The clever way this house is stacked nearly doubles the square footage of the ground area it requires (only 1350 sq. ft.). As a bonus, you get a sheltered carport, spacious enough for three vehicles. And the structure calls for only a minimal foundation.

The stacking also provides spatial variety indoors, as well as privacy zoning. And it lifts the view-framing windows high enough to minimize any nearby obstructions (such as the

roof in the left foreground, above).

The design is a triumph for natural lighting. Except for the blank north wall (to the right in the floor plans and prominent in the rendering below right), generous windows welcome the sun into every room. Note the height-of-the-house glazing that illuminates the open stair tower, with its inner light shaft. A pair of bays creates delightful window seats in the living room, which also boasts big sliders for access to its shielded deck. All this is

[Continued on page 174]



The liberated house

— no hookups — it rolls anywhere and lives off the sun and earth

An ingenious structure integrates many energy-conserving technologies

By **EVERETT H. ORTNER**
PHOTOS BY THE AUTHOR AND
KRISTEN PETERSON

Was this the American home of the future—this cross between a submarine and a World War II Quonset hut, this metal half-sausage afloat on a sea of mud?

Probably not. My hosts, its designer-builders, Ted Bakewell III and Michael E. Jantzen, had other objectives in mind for their Autonomous Dwelling Vehicle—even though it may well unite more house-of-the-future conservation concepts, technologies, and materials that have ever been brought together in one structure. Their goal was to build a trailerable structure that would:

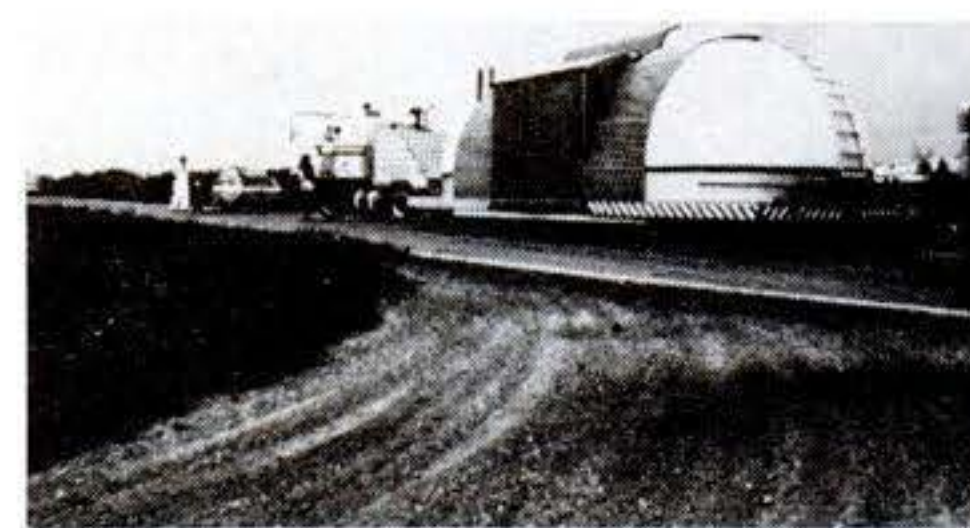
- First, be a mobile home, light and small enough to be towed long distances over the road, or be carried by helicopter, or even be floated on water.

- Second, be independent of utility hookups—electricity, gas, water, and sewage—and of fossil fuels.

- Third, be mass-producible at a cost competitive with luxury travelers of comparable size.

It would be just the thing that Ted Bakewell, 33, an executive with Bakewell Corp., a giant St. Louis real-estate development company, would like to park outside one of his new developments without concern for water or sewers—and in places where such hookups might not even be available.

It's the kind of thing that Michael



Autonomous Dwelling Vehicle—its builders' name—began life as a chassis cannibalized from an office trailer. On this they erected a shell made primarily from aluminized-steel members designed for silo tops. Ridged pieces interlock to form a

watertight roof. Insulation (top right photo) is sprayed-on polyurethane foam, followed by sprayed-on fireproofing. Lower photo shows structure being towed from its building site in Carlyle, Ill., to its present site near St. Louis, Mo.

E. Jantzen, 31, a conservationist and designer, specializes in: "alternatives to alternatives." Jantzen's own house, 64 miles away in Carlyle, Ill., is an expression of his absorption in the problems of conserving fossil fuels through the use of solar and wind energy (it appeared in the "What's New" section of *POPULAR SCIENCE* in June 1979); and the Autonomous Dwelling Vehicle was born in an apple orchard next to his house. Actually, says

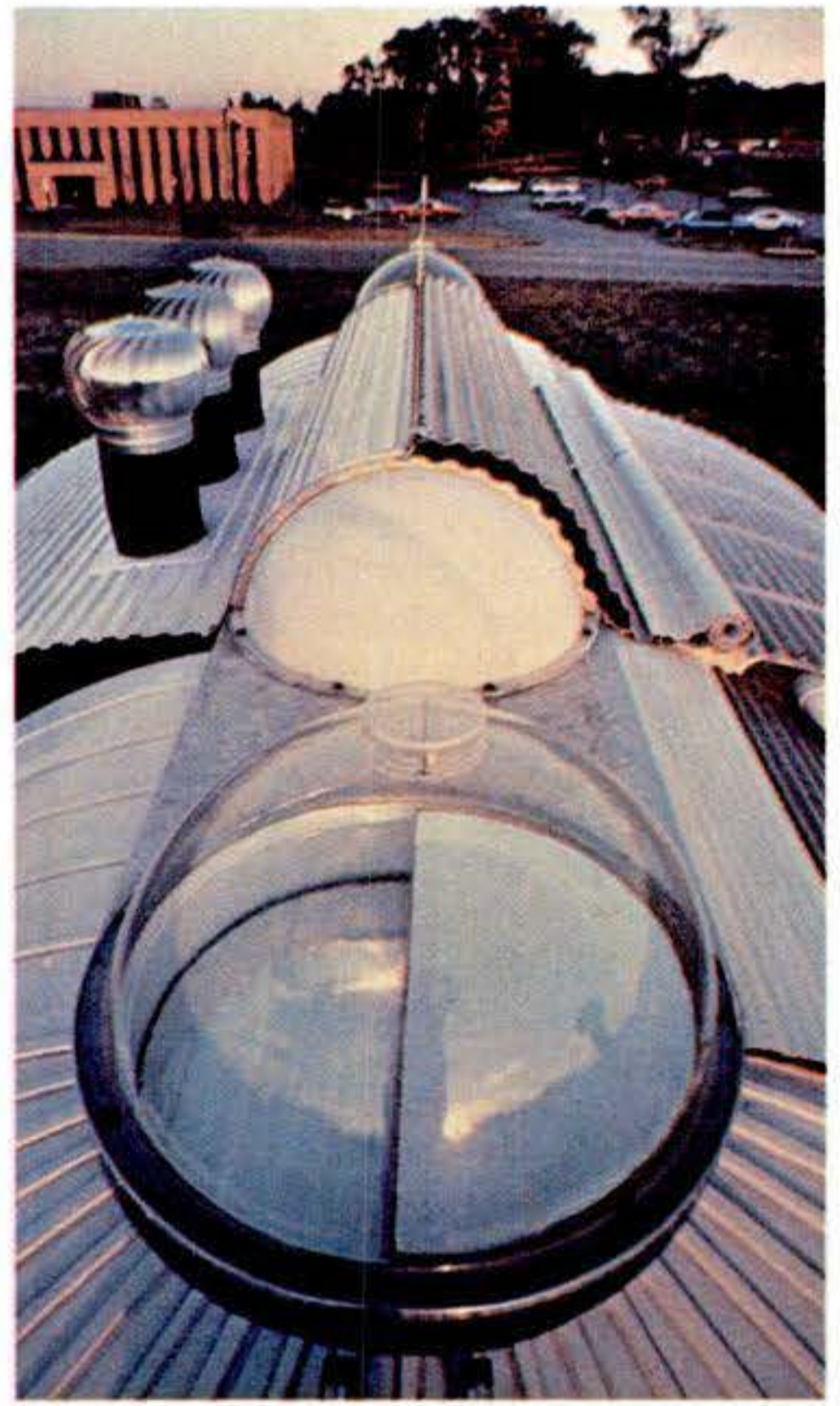
Bakewell, "Michael's house is the mother ship of the Autonomous Dwelling Vehicle."

Silo shell

"Let's look at the external features first," says Bakewell, leading the way through the large muddy field in the center of a Bakewell office park. "The shell, for example."

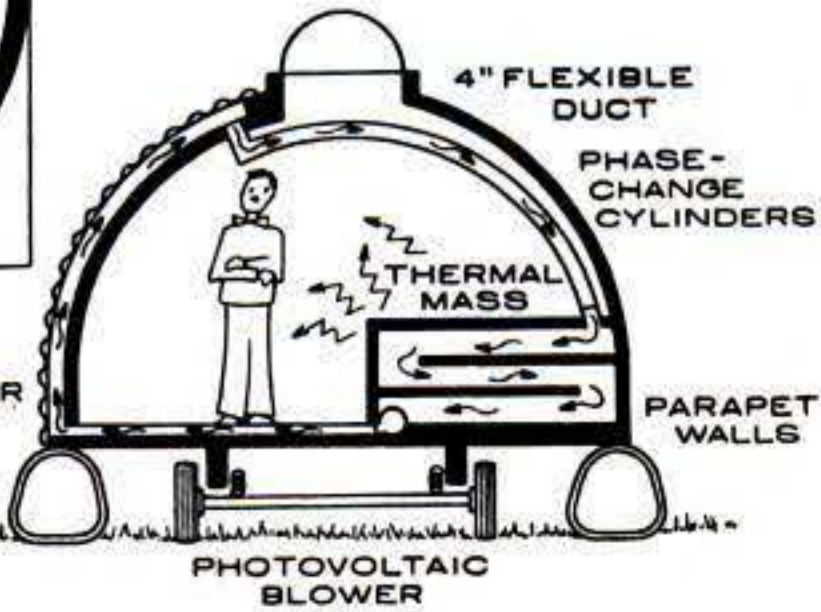
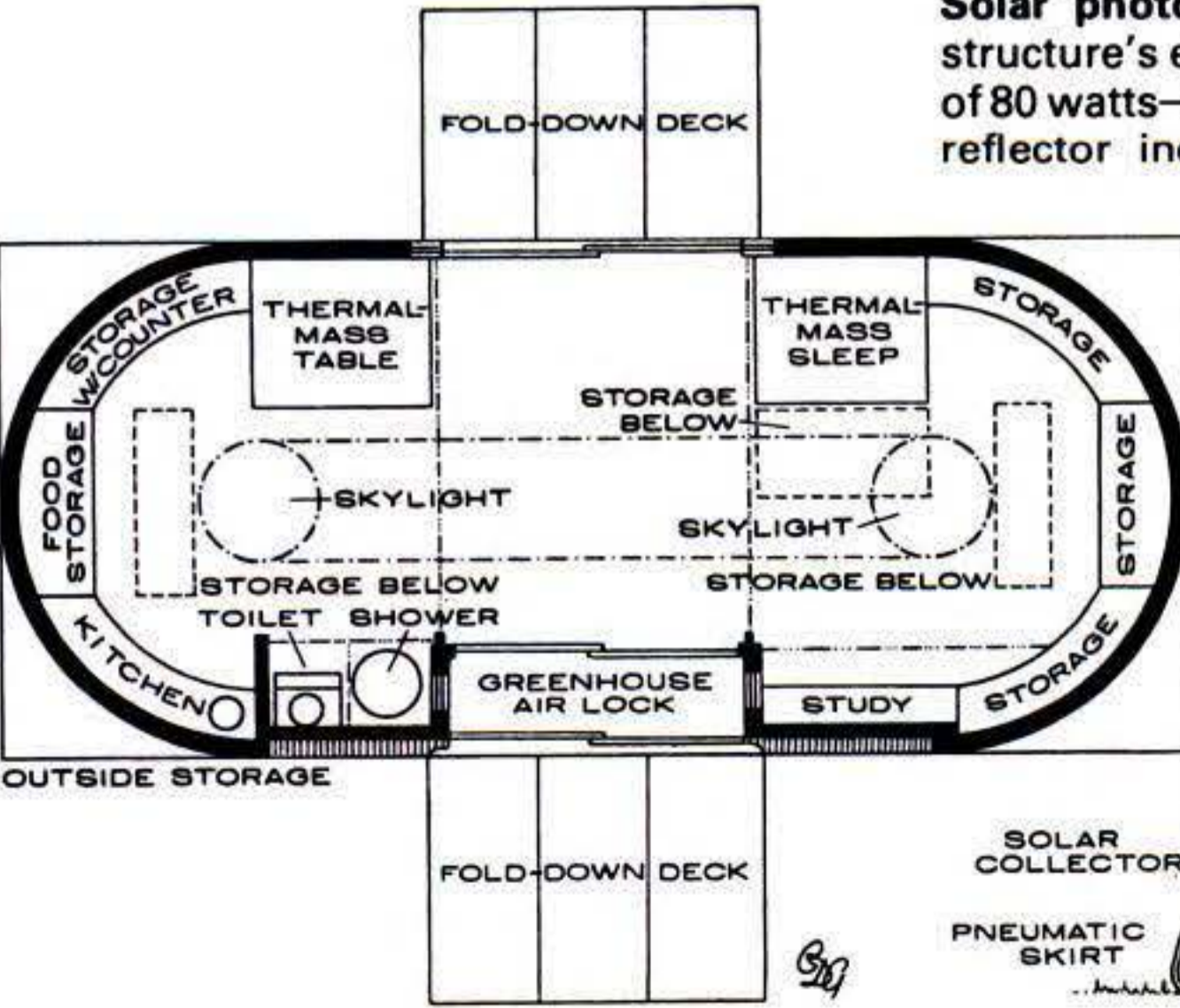
The interlocking, aluminized-steel

Continued



Solar photovoltaic panel (above) supplies structure's electrical needs, with peak output of 80 watts—when the sun is out. At noon, the reflector increases output. Large areas of sides function as solar collectors; they're painted black and covered by translucent fiberglass panels. Diagram below shows flow of heated air.

Designer-builders of Autonomous Dwelling Vehicle—Michael E. Jantzen and Ted Bakewell III—are shown in top photo standing on one of structure's two side decks. For travel, the decks fold up out of the way. Visible behind Jantzen and Bakewell, inside vehicle, is Insulating Shade, rolled down for cold weather. Rooftop view above shows warm-weather look. Stovepipe in top photo has been replaced by turbine ventilator, making three in all for ventilation (there are only two tiny windows). Skylights cover roof openings at each end; these would normally be used for entry to silo. They not only admit light, but are vented to permit hot air to exit in summer. Shelves beneath skylight bubbles are designed to hold trays for food dehydration. In center, corrugated fiberglass covers pipes that carry heat-exchange fluid for water-heating system.



Interior view shows sleeping area (foreground), sitting area, and dining area. The two ducts carry hot air from solar collector outside to heat-storage chambers under bed and dining surface. Disc at top is insulating plug that covers skylight.

sections that form the rounded ends of the vehicle are normally used for silo tops. The center section would normally be used to join twin silos. "They're very thin sheets, fabricated with a ridge in each panel, so they easily slide together, interlocking, for a totally watertight seal," Bakewell says.

The silos are made by Intercontinental Domes, in Plainfield, Ill. "The people from Intercontinental came out here, and they were quite surprised to see what had happened to their domes," says Bakewell. "Since then, they've hired Jantzen to see what other things we could do with them."

Gutters on both sides of the vehicle capture rainwater. A tube carries the water to a tank, a flexible vinyl bladder that sits on the ground under the frame. Freezing doesn't bother the bladder; it expands or compresses without damage, and it can be emptied and stowed for travel. "In a 15-minute rain, we can capture as much as 55 gallons," Jantzen says. Bakewell adds: "But we can't depend on the rain for all our needs. So we have a water-recycling and purification capability on board. Even the rainwater is filtered before it's used, to remove the dirt washed off the building as well as some of the pollutants in the air."

Little clusters of black half-cylinders stand on the decks fore and aft of the domes. They're light and strong,



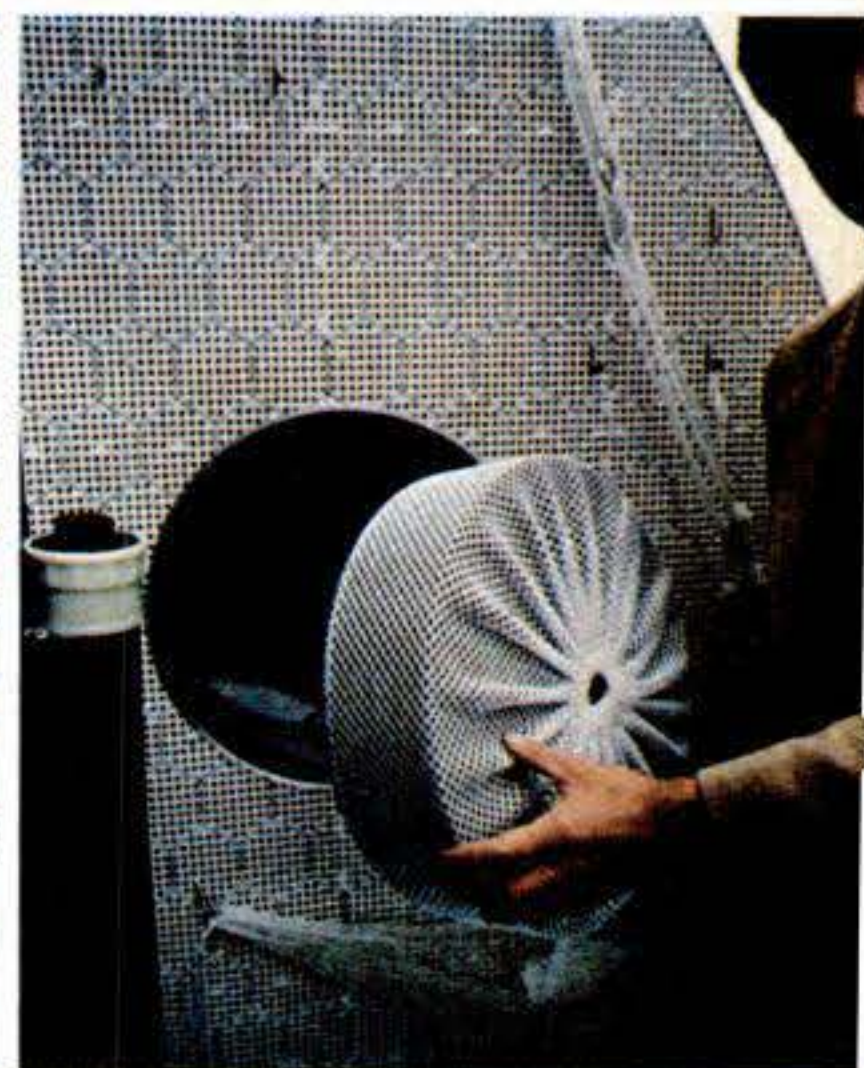
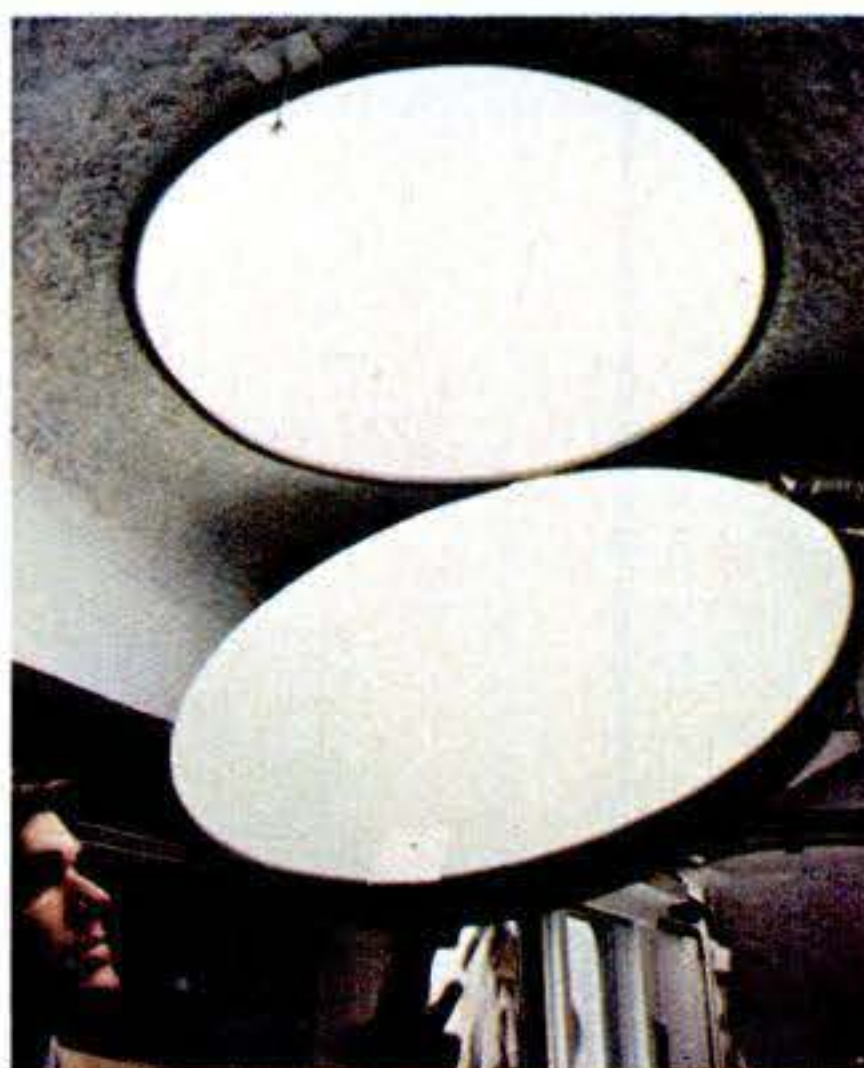
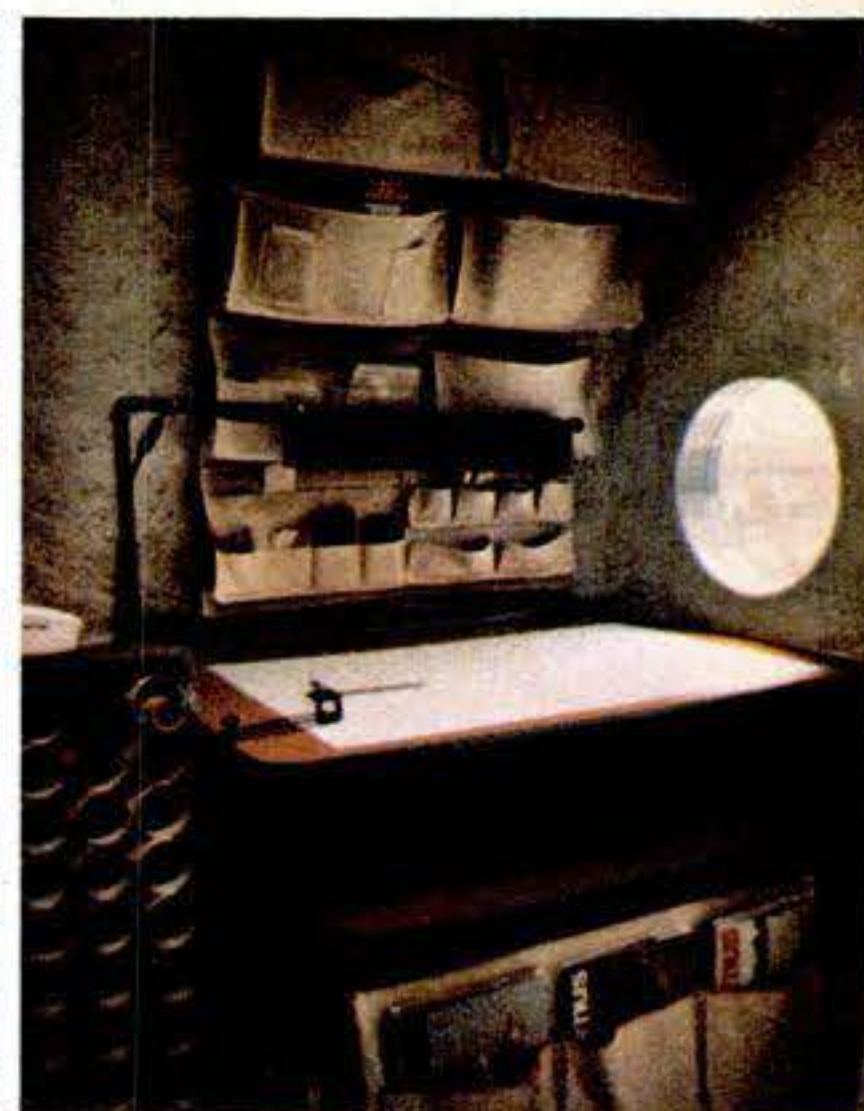
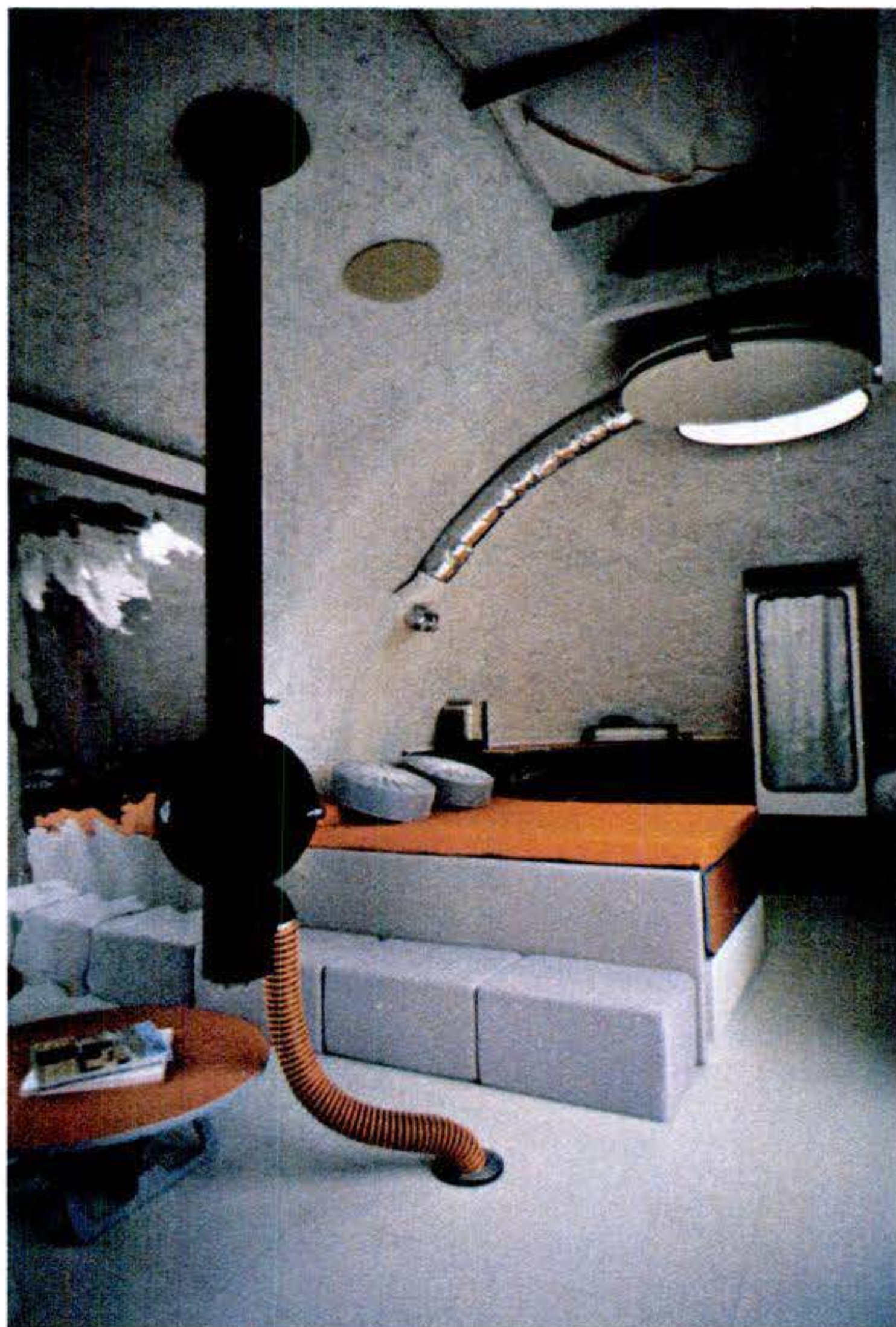
In bath and food-service area, clever design and new technologies meet



Dining area seats up to six with two drop leaves. Chairs fold out for sitting, or back against table, secured by pins. Under table are heat-storage rods (see text); heat is released through vents at bottom. Refrigerator (second photo) uses both outside air (winter) and solid-state thermionic device. Plastic strips let Bakewell see inside without letting cold spill out. Bakewell cooks on

alcohol (renewable fuel) stove. For drinking, he maintains a separate, hand-pump-operated, potable-water system, which feeds into sink. Shower curtain, pulled up as shown for use, collapses to floor. Toilet is Clivus Multrum (waterless waste-composting type). Waste paper and wood are held (right photo) for burning in incinerator, below hot-water tank, when sun heat fails.

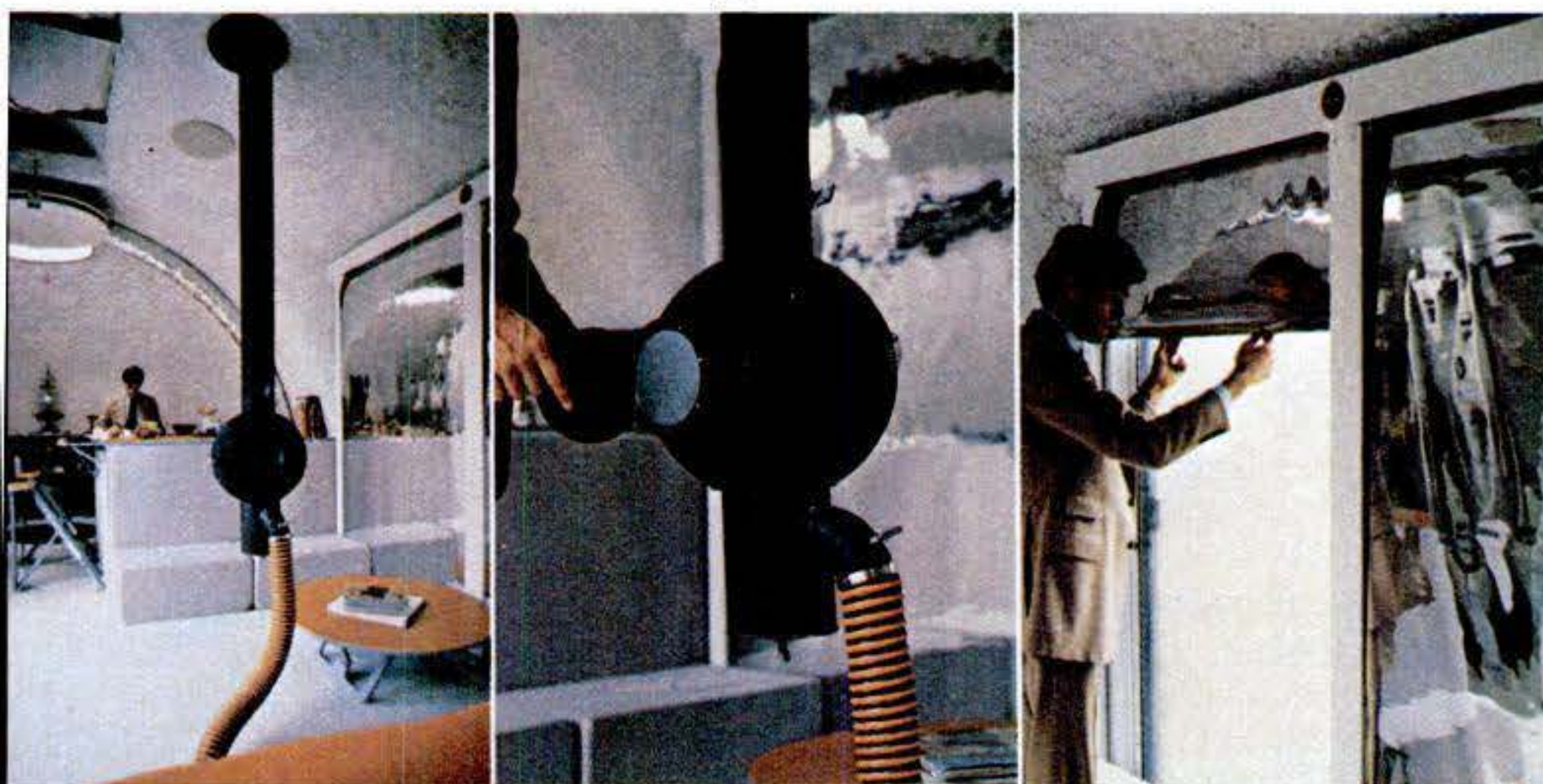
The rear: storage, and a bed over a heat-storage chamber



View toward rear shows wood stove (see below for details), coffee table, foam-plastic cube seats, bed, and personal storage area in rear. Bed has a drop-leaf extender for six-foot-two Bakewell. Steel-conduit frames support formica-covered counters. Drawers are industrial storage bins. Hanging "closet" has curtain closure, saving weight and hardware. Behind bed are 12-volt, aircraft-type reading lights. Stereo system, also 12-volt, as is everything in dwelling, is rec-vehicle type.

Under-bed compartment holds heat-storage cylinders containing phase-change material (it liquefies when hot). Bed and table storage volumes are the same. At lower left, Bakewell lowers hinged insulating plug for skylight; it's used on winter nights. Office area (top right) has drawing table, canvas-storage-pocket system, bench with storage capacity. Daylight comes through the port to right of table. Port's cold-weather plug (lower right) doubles as a decorative pillow for the bed.

A homemade stove to give heat, and a shade to conserve it



Homemade wood stove—"almost airtight," says Jantzen—is for backup heating if sun energy fails. It's 13 inches in diameter, with six-inch opening, screened to hold in sparks, yet permit viewing of fire. The ball, made from a Freon gas can-

ister, can be rotated. Air is drawn in from beneath structure. Fired up, "it heats the entire space in just a few minutes," Bakewell claims. At right, Bakewell rolls up Insulating Shades (featured in PS, Jan. 1979) that cover doors leading to deck.

and eventually they will be hinged, to open and provide an outside storage capacity. "These containers are normally used for sump pumps," Jantzen says, "you know, sump-pump liners."

Two bubble skylights, set in the centers of the silo domes, admit light and (in summer) air to the vehicle. They serve, too, by means of shelves that support trays, as food dehydrators. "They also help to ventilate the vehicle by a thermo-chimney effect," Jantzen says, "pulling the lower air out by heating the bubble."

Turbine ventilators—three in summer, two the rest of the year—also pull out hot air. The turbines are large for the space, to assure maximum ventilation. There are vents in the ends of the structure, making for "tremendous cross-ventilation," says Bakewell, even with the doors closed for

[\[Continued on page 166\]](#)

Big little auto for '81: Chrysler's K-car

By JIM DUNNE

The fate of Chrysler Corp. may ride on the fortunes of a new model line it will introduce this fall. With these front-drive cars, Chrysler hopes to build on the solid success of its Omni/Horizon line. Code-named the K-car, its 1981 models that will replace Aspen/Volare in Chrysler's lineup offer many of the engineering features of today's most advanced compacts. The K-car will be built in three body styles—two-door, four-door, and station-wagon—under the Plymouth and Dodge brands.

Here are the major engineering details:

- Standard engine will be a new 2.2-liter (135 cu. in.) Chrysler-built, Chrysler-designed four.

- Drive line follows the now familiar transverse engine layout.

- Compared to Aspen, the wheel-base will be cut by more than a foot, while overall length will be almost 2½ feet shorter.

- Curb weight will be reduced a startling 1000 pounds, on average.

- The car is rated to carry six passengers.

Most important, fuel economy is expected to be 25 to 30 percent better than Aspen's, with 39 mpg highway economy predicted. City driving could easily top 20 mpg.

No coincidence

Styling of the new line is consistent with the modern "three box" concept that divides the body into the engine section, passenger section, and trunk section. Similar in appearance to the GM X-body models, the Chrysler K-line is within an inch of the GM line in length and height. It's no coincidence that both car lines are front drive and use small, four-cylinder engines as



Two-door K-body

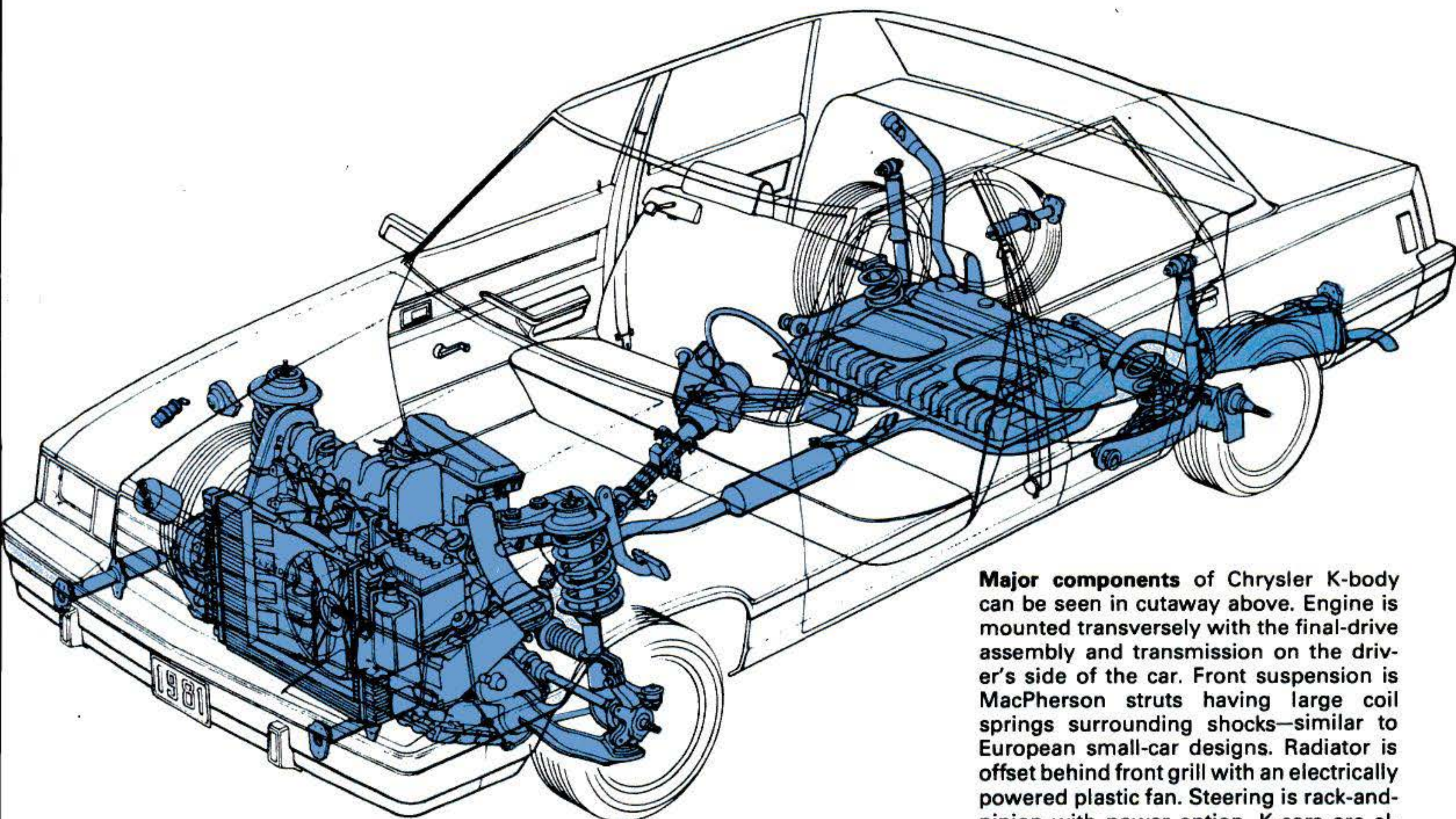
(above) still maintains the sedan image of the Volare/Aspen although it is considerably smaller in overall length compared with its predecessors. There are three K-body versions for 1981; four-door is not shown. The station wagon will be a four-door model with a hatch-opening rear door.



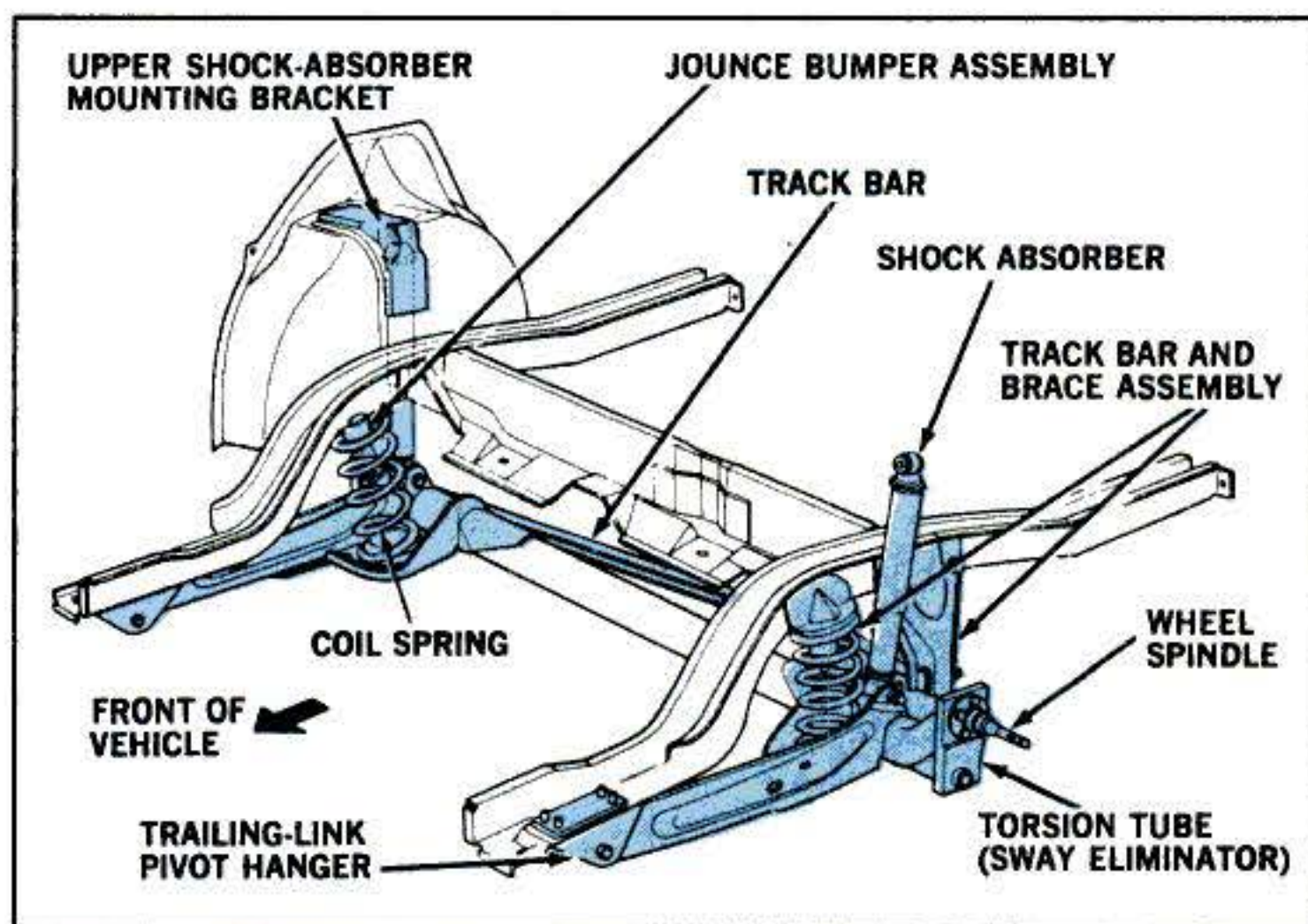
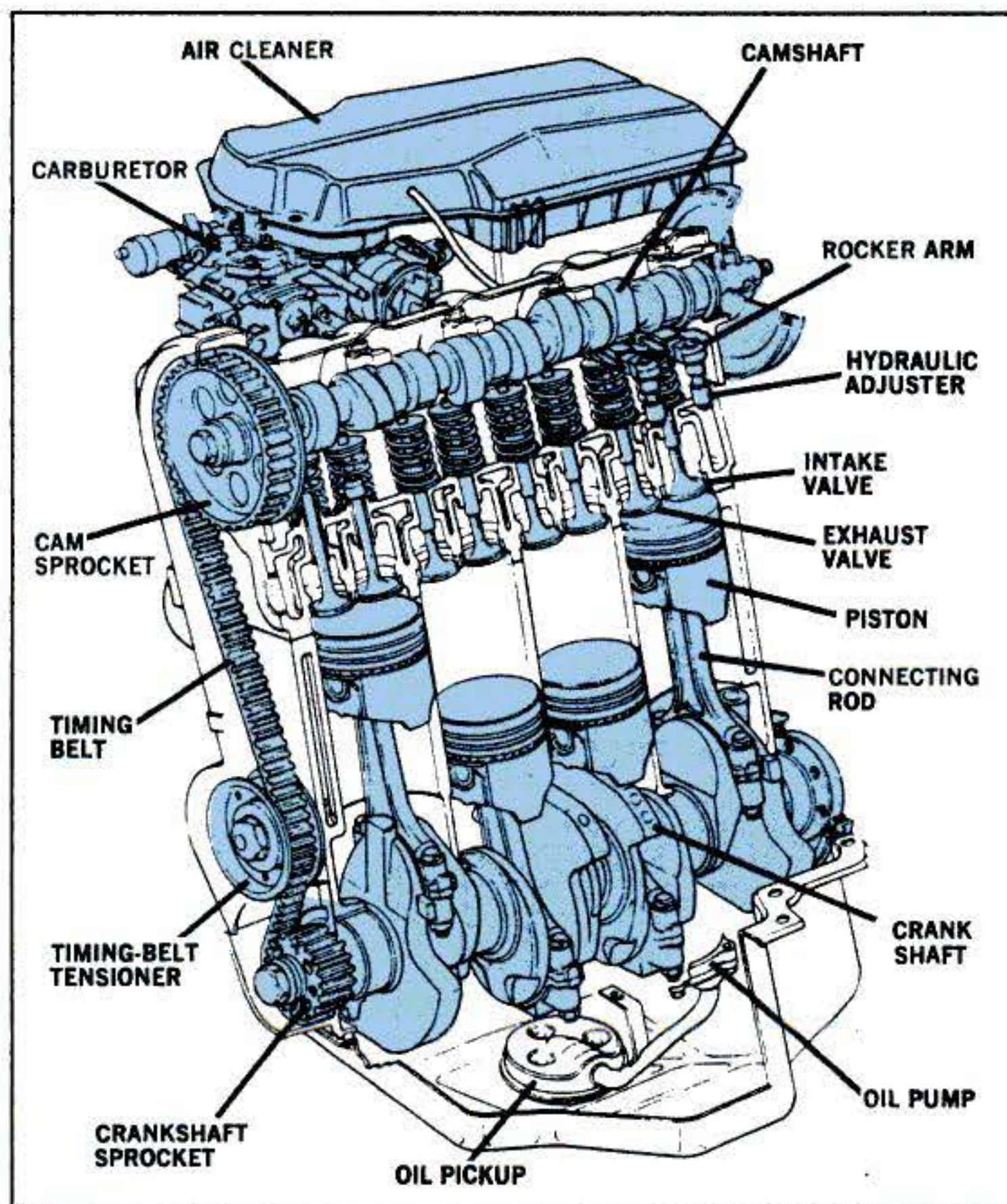
the standard power plant. That's the direction of compact-car design in the foreseeable future.

Though no major feature of the K-car is innovative, some interesting techniques are used in the engine and suspension systems. The four-cylinder engine is the first new Chrysler-designed and Chrysler-manufactured engine since the 225-cu.-in. Slant Six was introduced 20 years ago. The new

engine has an iron block but an aluminum head, keeping weight as low as possible while still providing the rigidity and lower cost of the more common metal. "Our three main objectives were light weight, good fuel economy, and emissions control," reports Jack J. Cornell, the program manager for the engine. "Also, we wanted to keep it as short as possible, to fit easily between the suspension



Major components of Chrysler K-body can be seen in cutaway above. Engine is mounted transversely with the final-drive assembly and transmission on the driver's side of the car. Front suspension is MacPherson struts having large coil springs surrounding shocks—similar to European small-car designs. Radiator is offset behind front grill with an electrically powered plastic fan. Steering is rack-and-pinion with power option. K-cars are almost 1000 pounds lighter and will achieve 25–30 percent better mileage than 1980 Volare/Aspen, which they are replacing.



The rear suspension uses coil springs and a flexing beam axle. Beam is U-section that drops down between wheels to provide more clearance in the trunk and rear seat area.

Four-cylinder, 2.2 liter, overhead camshaft engine will be standard for all K-cars in 1981. To fit transversely under the hood, cylinder walls have been reduced and crankshaft seals mounted flush. Valves have newly designed hydraulic adjusters that give smooth performance, eliminate periodic adjustment.

towers. So the distance between cylinder bores was reduced and the crankshaft seals fitted flush, taking a minimum of space."

Total weight of the engine is 212 pounds, which is about half the weight of a 1978 Slant Six. By using an aluminum engine head, 25 pounds was cut from the total. The engine's valve system has hydraulic "mini-lash" adjusters that promote quiet valve oper-

ation and eliminate the need for periodic valve adjustment. Adjusters use engine-oil pressure to exert a constant balancing pressure on the rocker arms.

Engine size is important for performance and fuel economy. In the K-car, the 2.2-liter displacement was carefully chosen to provide acceptable levels of both. (By comparison, the Horizon engine—made by Volkswagen—is

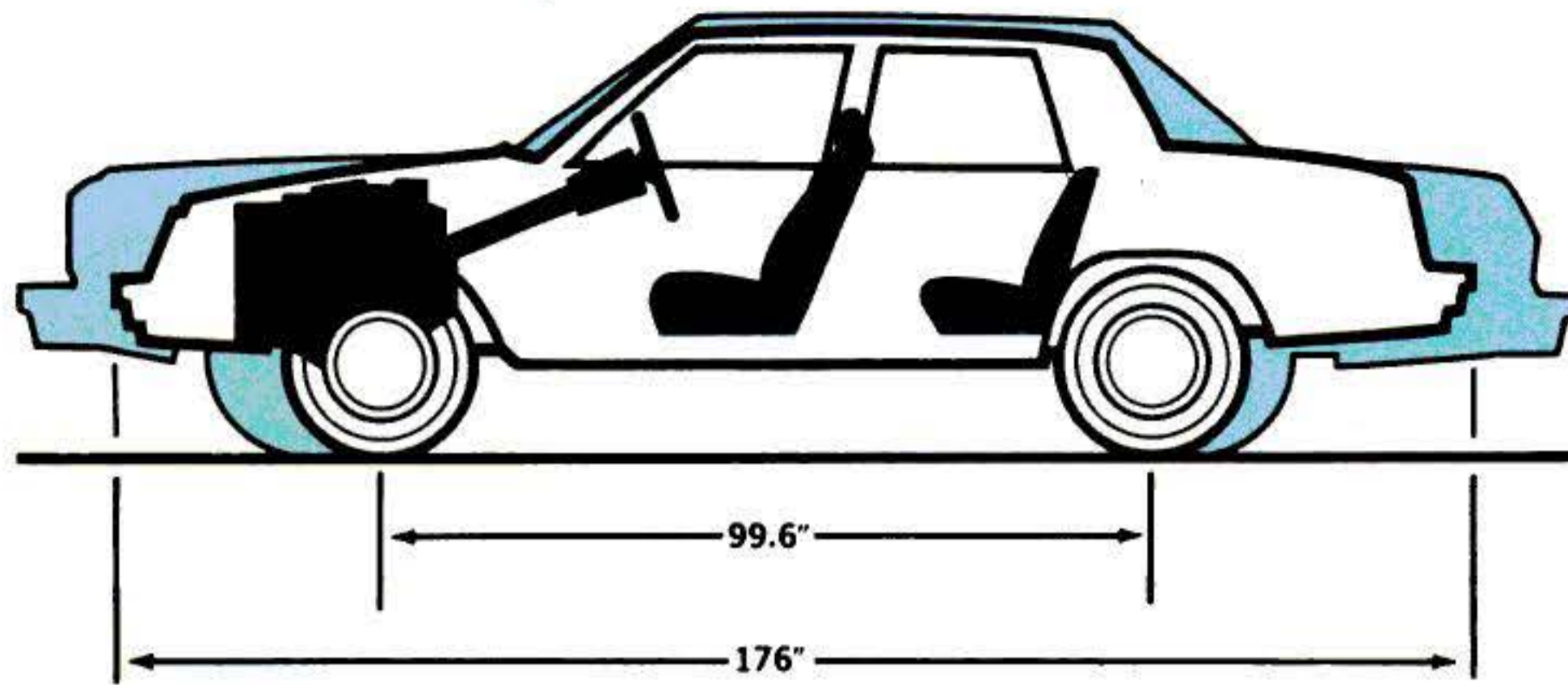
1.7 liters, and the GM X-car engine is 2.5 liters.)

"It's our first four since 1932," Cornell points out. "But it should become a workhorse for us in the future, since we are committed to building 60 percent of our cars with four-cylinder engines by 1985."

An optional 2.6-liter engine will be available. It is a Mitsubishi product

Continued

How 4-door K-body and '80 Volare/Aspen compare



K-body (white) is shown superimposed on its predecessor, Volare. Wheelbase reduction of 13 inches and overall length

reduction of 30 inches has resulted in the loss of only about an inch in each dimension of passenger space and one cubic

foot of luggage space—and, of course, there's no bothersome hump underfoot from the transmission and drive shaft.

that features that firm's famous "silent-shaft" counterbalancing system. The bigger engine is offered for those buyers who want additional performance or more power for optional equipment such as air conditioning. The 2.6-liter engine is already standard in other Chrysler cars.

The drive train is a standard trans-axle setup. The transversely mounted engine has a mechanical connection to the drive axle. Transmission choices include a four-speed manual and three-speed automatic for the 2.2-liter engine; the automatic is the only transmission available with the 2.6-liter engine. Shift levers for the automatic and manual are mounted on the floor, though the automatic can be ordered with a steering-column lever instead.

Smoothing the ride

Front suspension is an unremarkable strut type that works well with front-drive cars. The rear suspension has coil springs, too, but these are used in conjunction with trailing arms and a flexing beam axle. In addition, a track bar and torsion tube are built into the suspension, all designed for light weight and small size, but with excellent ride and handling qualities, as well.

Steering is rack and pinion, with a power assist offered as an extra-cost option.

Brakes are the now-traditional disc/drum type. However, the brake circuits are balanced diagonally so that in the event of a failure to one of the twin brake systems, the car will still be controllable—steerable—when brakes are applied. Diagonal braking systems have been used on European cars for a number of years as part of basic safety packages.

The K-body electrical system is equipped with Chrysler's latest devices for emission control, fuel economy, and reliable operation. They include electronic ignition and electron-

ic control of the spark timing, a feedback carburetor system, and Chrysler's Hall-effect distributor.

A cooling-fan system similar to that used on other front-drive cars is employed, and includes an electric fan motor and a cross-flow radiator that is offset from the center of the grille. The fan is thermostatically controlled to operate only when needed. Fan blades are made of lightweight polypropylene plastic.

Changes outside and in

Special attention was paid to corrosion resistance in the unitized body. One-side or both-side galvanized steel is used on major body parts, including the quarter panels, door outers, roof rails, quarter-panel inners, rocker panels, front fenders, and the cowl area. In addition, anticorrosion primer is added to smaller pieces. On prototype cars, the bumpers are plastic-covered and noncorroding.

Other body changes affect quality as well as efficiency of assembly. All door glass is framed; door hinges are welded to both the body pillars and the doors; major body parts such as floor pan, front-end sheet metal, and deck lids are common to both the two-door and four-door sedan.

Inside, the instrument panel has a simple, straightforward appearance. The speedometer and fuel gauge are the major instruments, while warning lights are provided for most other important car functions. The parking brake is foot-pedal operated and located to the left of the brake (or clutch) pedal.

Chrysler claims six-passenger capacity for the K-car and, in those models equipped with bench front seats, six seat belts are provided. However, optional seat packages offering front twin bucket seats reduce carrying capacity to five. Actually, only four passengers can ride in good comfort; more would be a crowd.

Fixed rear windows on four-door

	1981 K-cars	1980 Volare- Aspen
Base engine	2.2-liter 4 (135 cu. in.)	3.7-liter 6 (225 cu. in.)
Optional engine	2.6-liter 4	5.2-liter V8
Passenger capacity	6	6
Curb weight (lbs.)	2232	3258
Luggage capacity (cu. ft.)	15	16.4
0-60 acceleration (sec.)	14.2*	16
Fuel economy—EPA city/highway mpg	22/38*	17/23
Overall length (in.)	176	204.3
Overall height (in.)	53	54.8
Overall width (in.)	68	72.8
Wheelbase (in.)	99.6	112.7
Headroom, front (in.)	39.2	38.5
Headroom, rear (in.)	37.5	35.0
Legroom, front (in.)	42.3	42.2
Legroom, rear (in.)	37.4	35.0

*Estimated

models and station wagons repeat a mistake that GM made with its intermediate-size cars. The fixed windows restrict air flow for rear-seat passengers, a subject of considerable complaint for GM's line. We expect that Chrysler will get the same reaction to this unpopular space- and cost-saving design.

Three levels of trim will be offered in both the Plymouth and Dodge lines. The premium trim will include 16-ounce cut-pile carpeting on floors and the bottom third of the doors. Extensive use of plastic is found inside, especially on the rocker sills, and as trim around the windshield and rear window.

Station-wagon models will be similar to the Aspen/Volare wagon in layout with two seats, four doors, and a hatch opening at the rear. The wagons are of a size to compete against the Ford Fairmont and the GM intermediates—Malibu, etc.—but are significantly smaller on the outside and provide major gains in fuel economy over those models.

Market position

Chrysler plans to sell the new K-models at a level between the Horizon/Omni and the LeBaron/Diplomat. There, they will compete in price directly with the GM X-body cars and Ford's Fairmont Zephyr.

A Chrysler statement describes the K-models as "smaller, more fuel-efficient cars with performance, interior comfort, optional-equipment offerings, exterior/interior upgrades, and noise levels equal or superior to the Plymouth Volare and Dodge Aspen that they replace."

It should be noted that in Chrysler's recent successful petition for federal loan guarantees amounting to \$1.5 billion, the K-car line was instrumental in the legislators' decision in favor of the corporation. The cars look like winners, and that point was widely recognized. □

VICES

that grip your work better



Craftsmanship and safety can be improved with a quality vise

By A. J. HAND

PHOTOS BY THE AUTHOR

Craftsmanship demands a quality woodworking vise. Without a firm grip on your work, it's difficult to perform even the simplest operations. There's just no way you can saw, drill, or plane accurately when you are chasing a board up and down your bench.

More than accuracy is at stake. Unsecured work is a leading cause of shop injuries. Think back to all the times you have hurt yourself in the shop. It was probably the hand holding the work that got cut. If the work had been in a vise, the injury would not have happened.

Most hardware stores stock good metalworking vises and a variety of light-duty, utility wood vises, but not much more. What better vises do you need and where can you find them?

The first vise you should own is a woodworker's vise that you can screw firmly and permanently to your bench. A vise of this type is not cheap—usually \$60 or more—so you may be tempted to cut corners. Don't do it. Look for a vise with jaws at least seven inches wide and with a maxi-

mum opening of at least eight inches. To let you hold work larger than eight inches, the vise should have a sliding dog you can use in conjunction with bench stops (see photos).

If you do a lot of work you will appreciate fast-action jaws. These let you slide the vise open or shut, then secure it with a turn of the handle. It's a lot faster than cranking the jaws in and out.

If you want extra-large capacity, consider making your own vise from

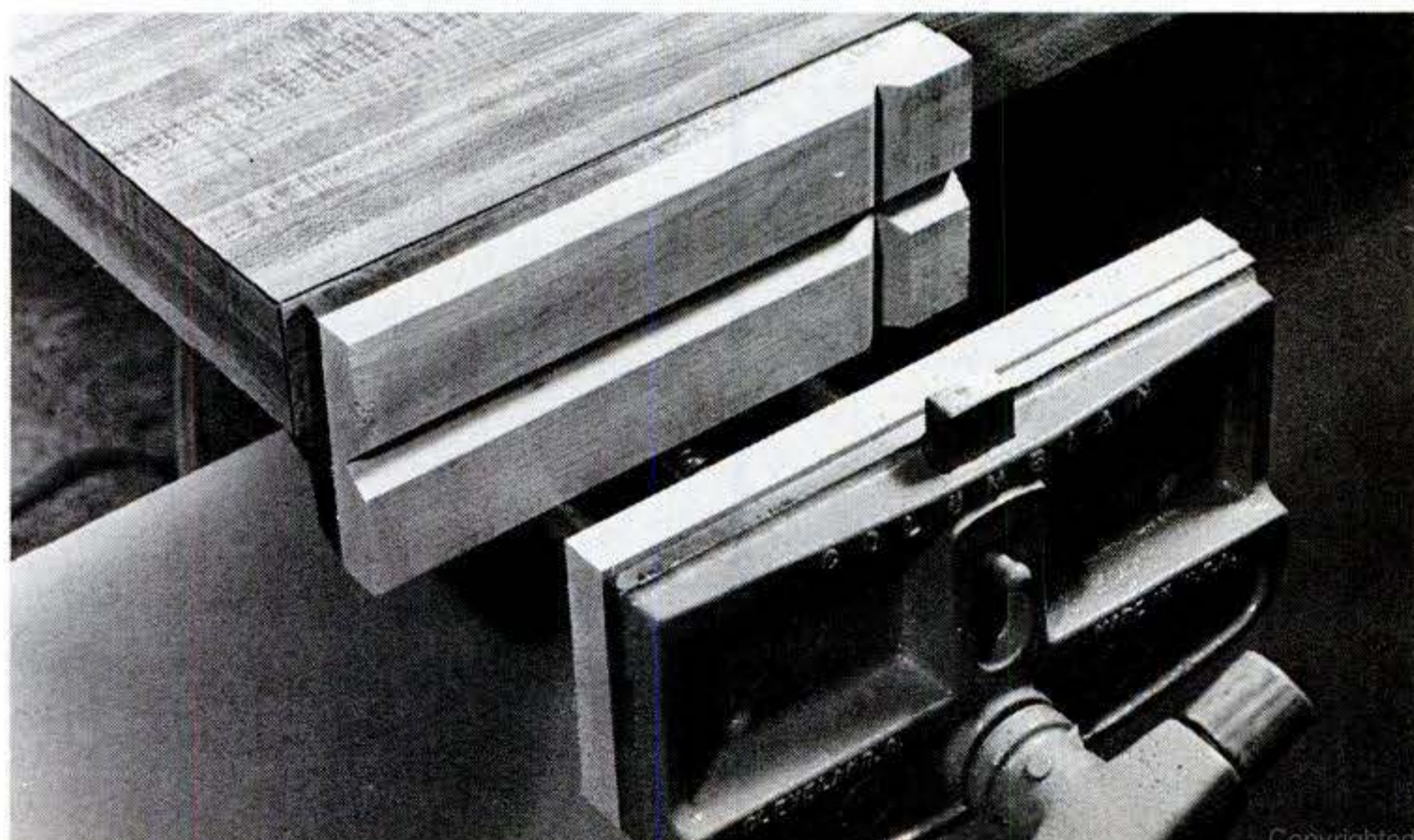
Woodworker's vise like this Columbian is the workhorse in most shops. It has fast-action jaws and sliding dog. Jaws are padded with one-inch pine, secured by author with double-face carpet tape. V-grooves

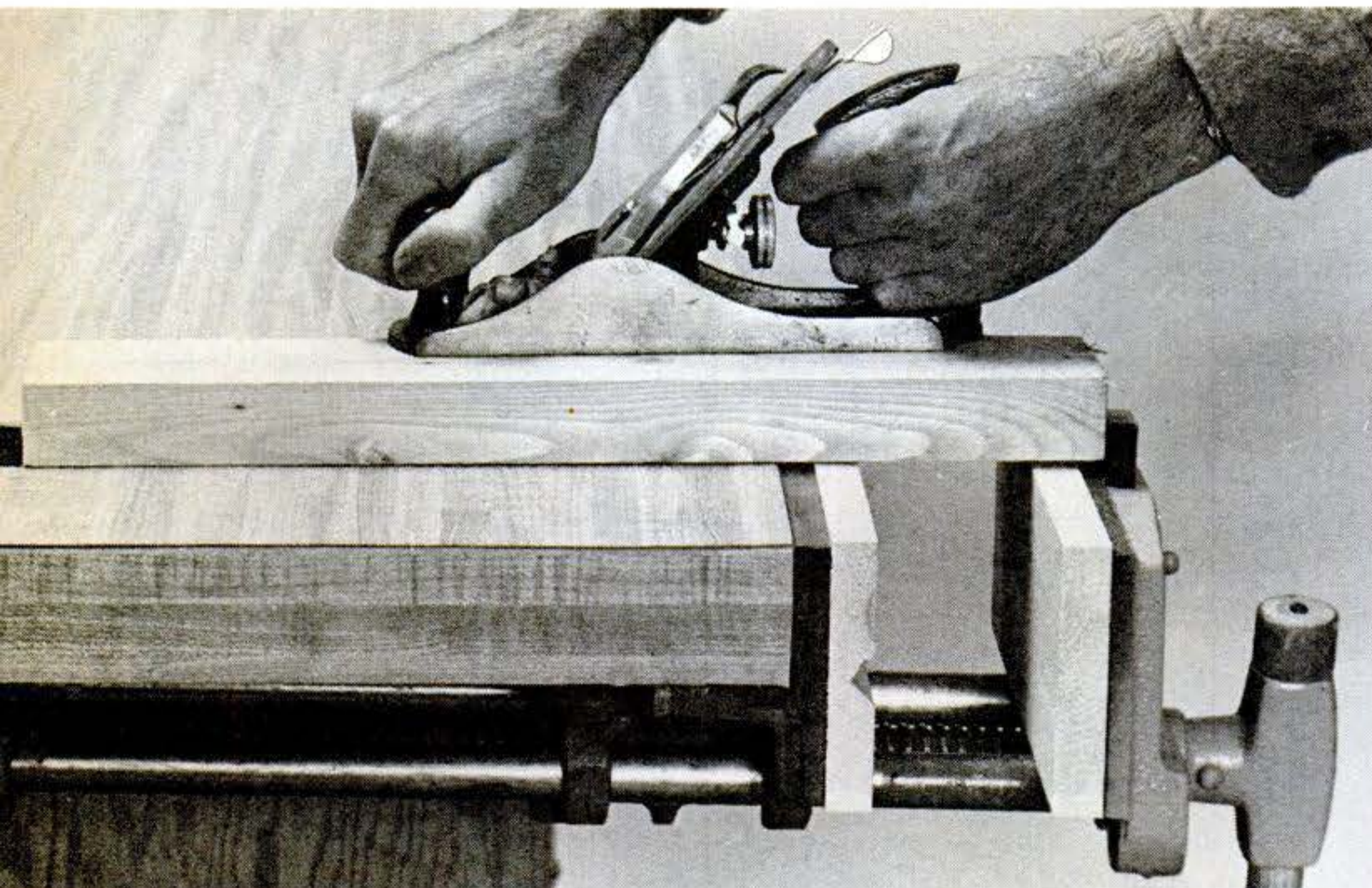
special hardware. Vise hardware varies, but with the simplest types, about all you do is add a set of wooden jaws and mount the finished vise on your bench. Building your own won't save much money because the hardware is heavy-duty and well made. But building your own will give you capacity that's hard to find in a finished vise.

A woodworking vise isn't much good for metalwork, so if you work with metal as well as wood, your sec-

Continued

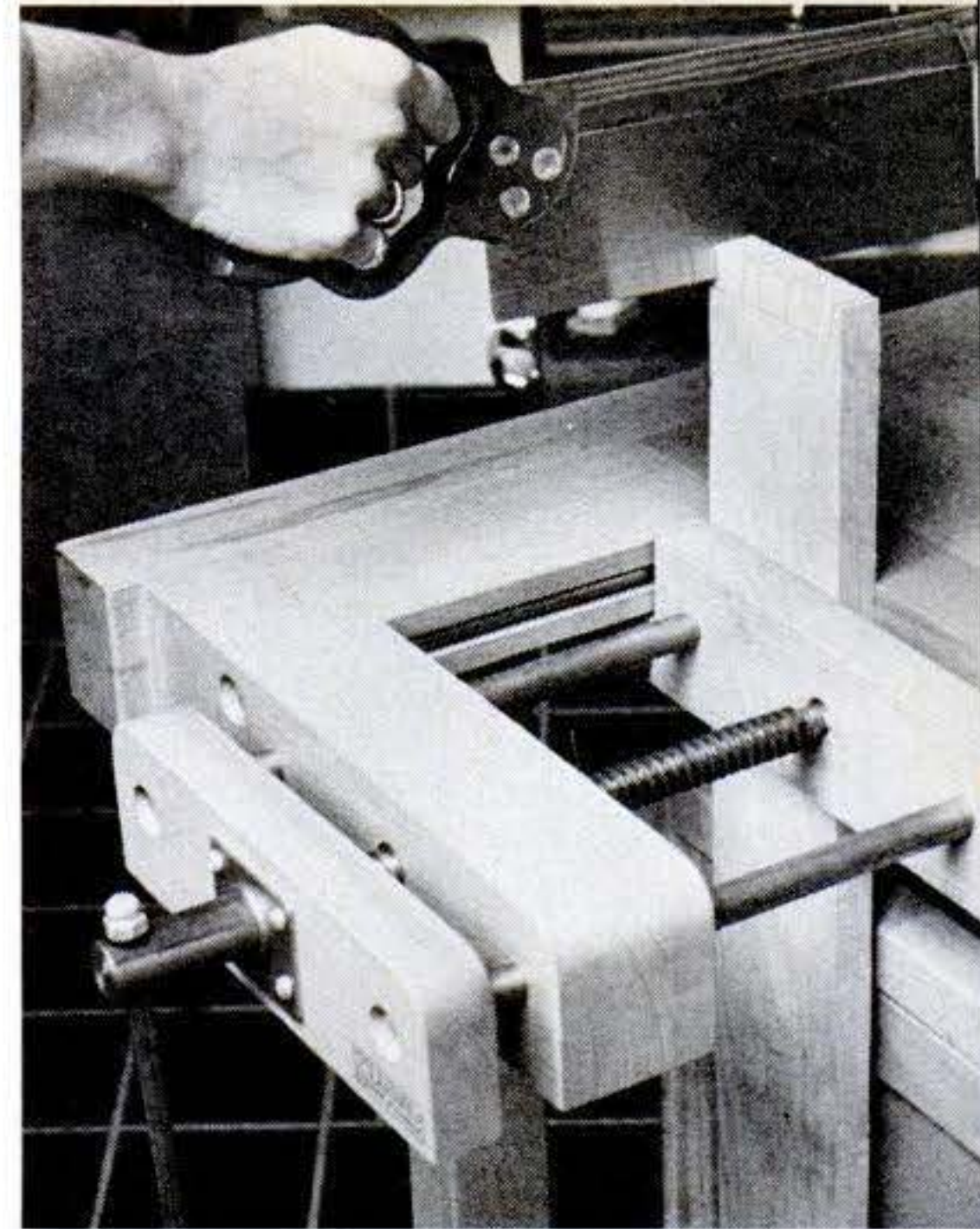
cut into one pad help grip cylindrical stock. Hardware stores and catalog tool outlets sell it or similar vises by Record. Prices start at around \$60, depending on size and the quality of the hardware.





Sliding dog on moving jaw can be used in conjunction with bench stops to secure large work (above). This stop is a three-inch length of one-inch dowel fitted with a square hardwood head. Dowel slips into holes drilled in bench top. One face of the

square head is padded with leather to protect softwood, others are left unpadded for gripping hardwoods. Vertical-hold shoulder vise (above, right) is only available built into European-type workbenches. It's designed with no hardware

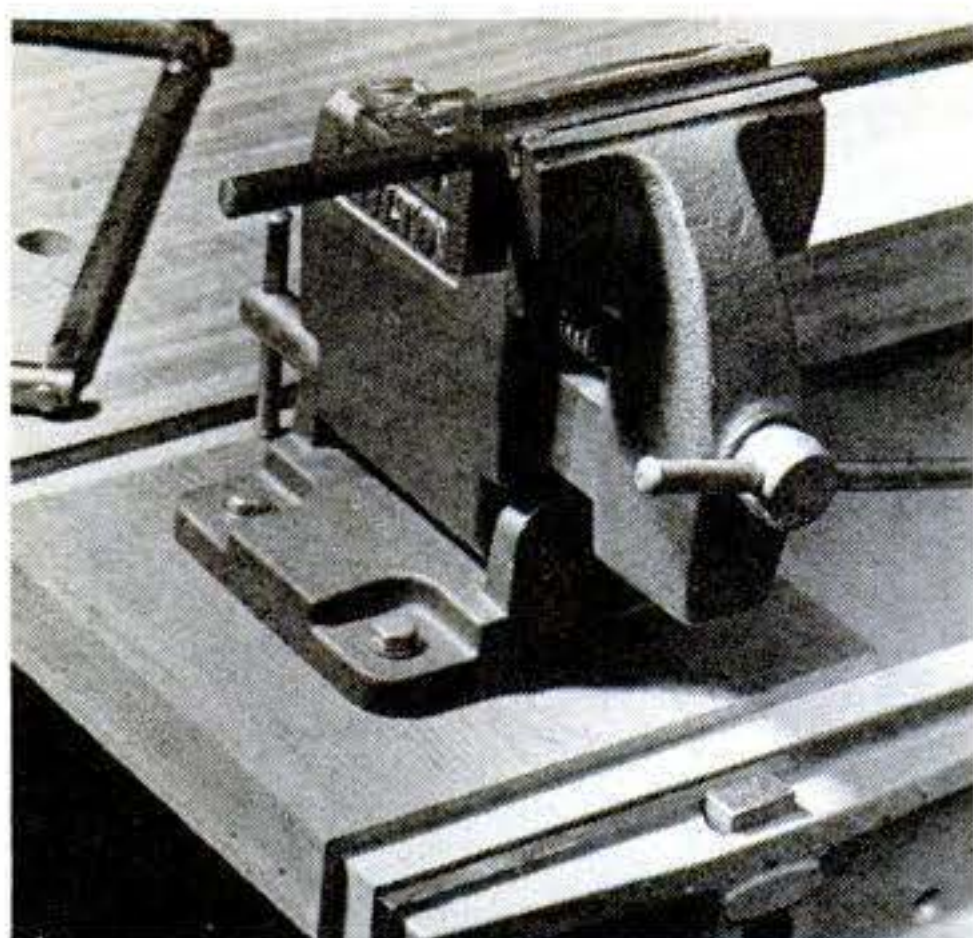


between the jaws so you can grip vertical work—large panels, doors—without interference. This bench is a Lervard from Fine Tool Shop. Other benches with built-in vises include Black & Decker Workmates and similar tools from Sears.

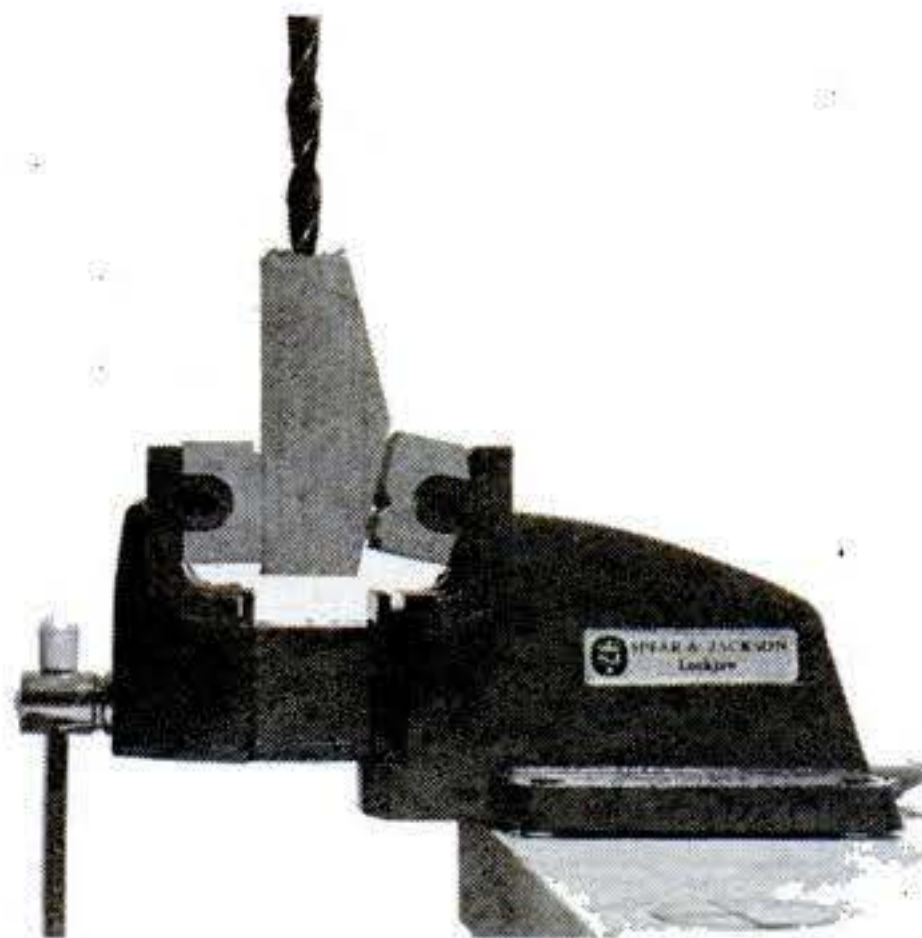


Vise hardware like this lets you build your own bench vises. Shown here is hardware from front vise (left) and end vise (right) of

the type used in European benches. Hardware is not cheap, but has great capacity and durability.



Mechanic's vise bolted to a 2×6 base can be held in a woodworking vise when needed, and stored out of the way at other times. This is better than relying on the insecure clamp-type bases supplied with some metalworking vises.

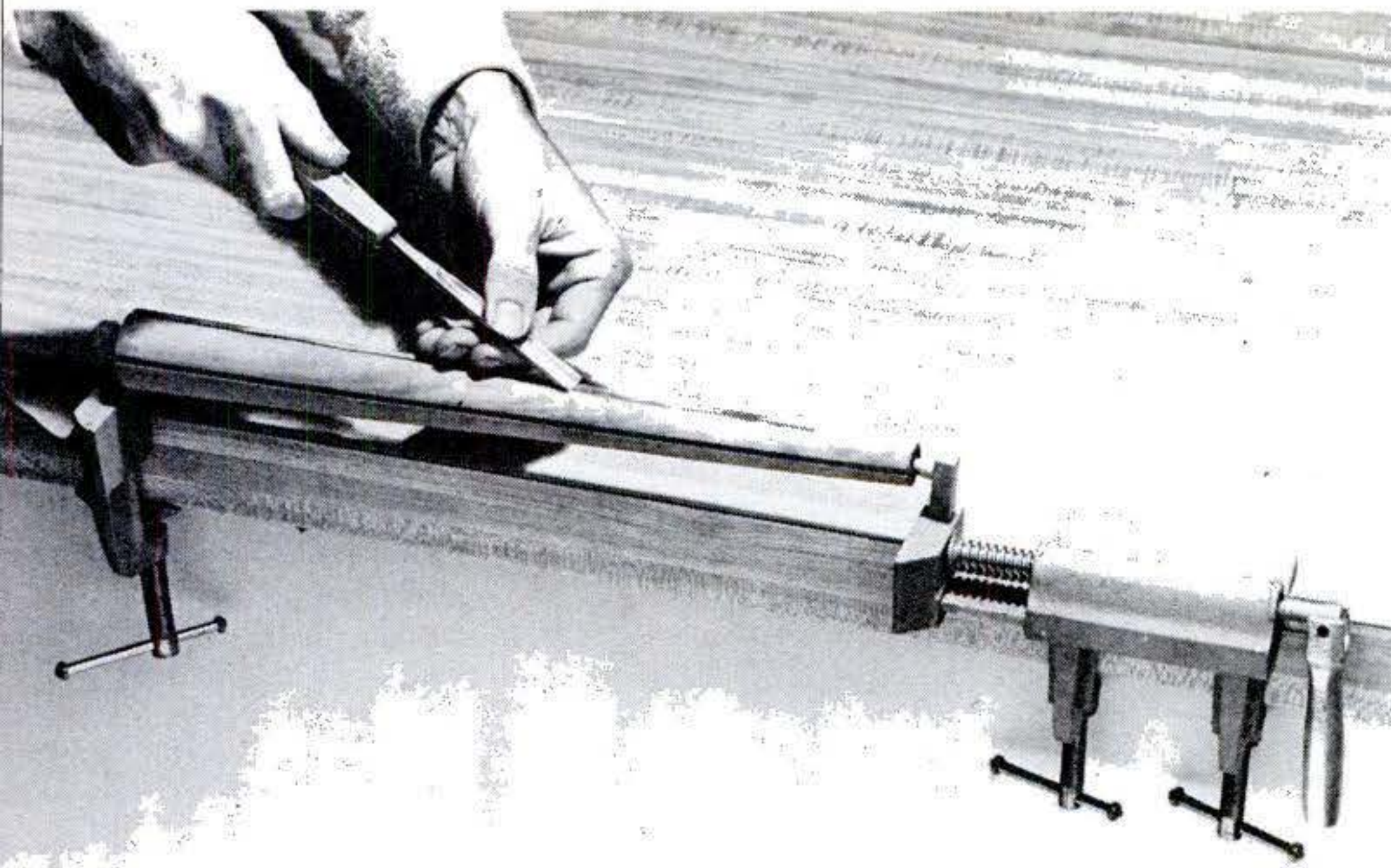


Lockjaw vise has pivoting inner jaw that can rock to conform to the work. It comes with metal jaws and rubber-padded jaws, plus vacuum base. It can also be bolted down and has an optional clamp base. It's from the Fine Tool Shop.

and vise should be a sturdy mechanic's vise. Many of these have optional padded jaws that let them double as small woodworking vises.

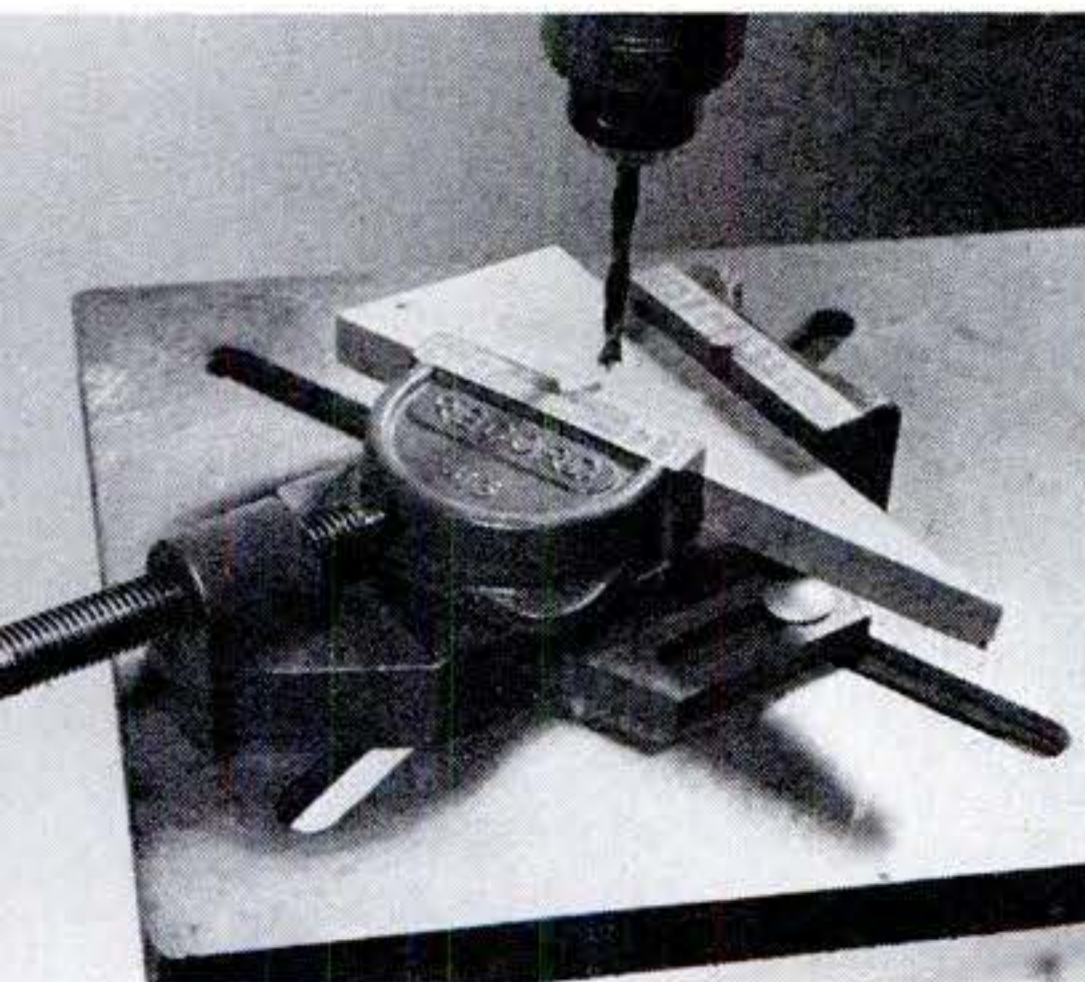
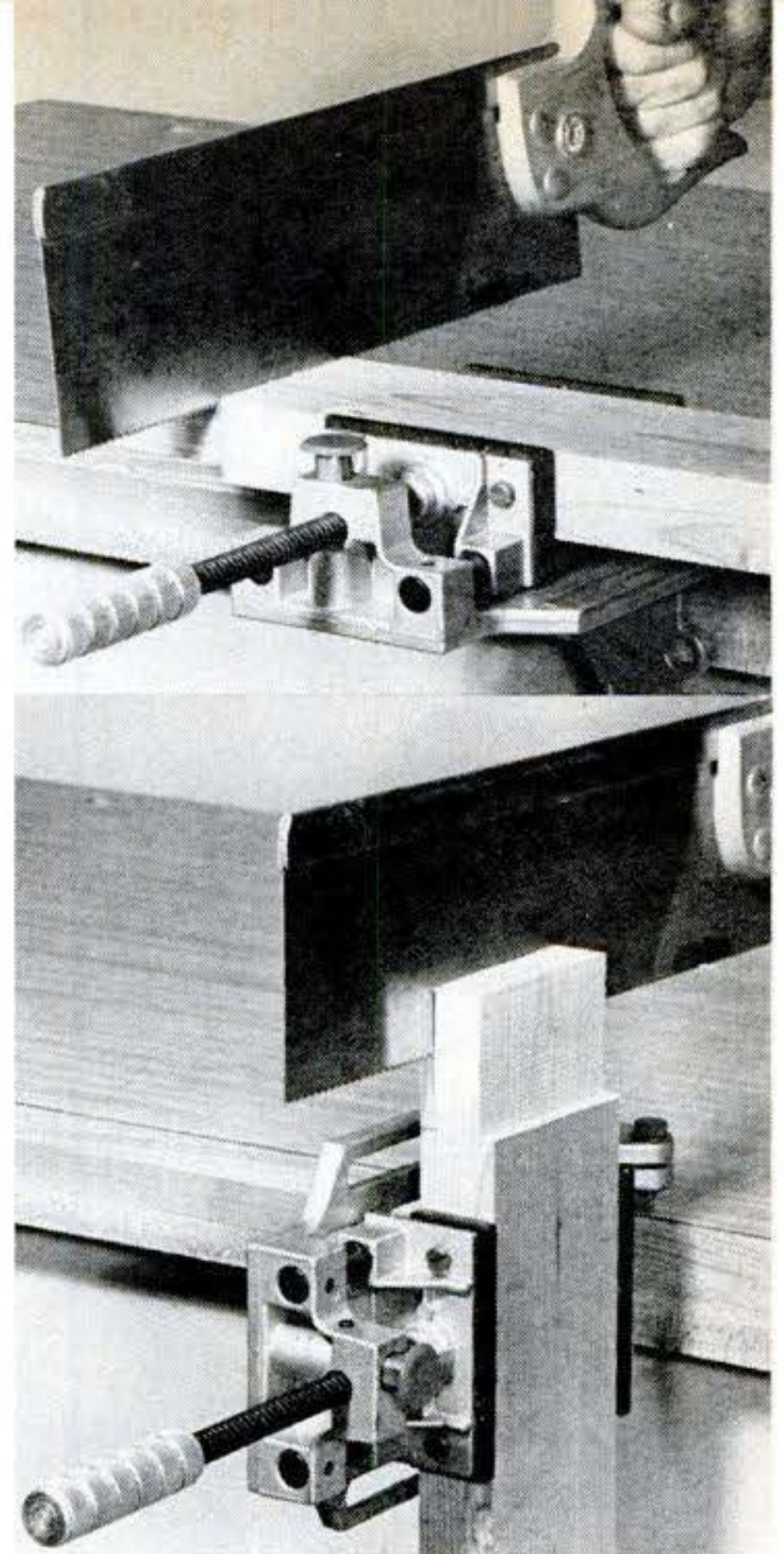
You'll also need a metal vise to work on your own tools and metal hardware. Since a metalworking vise sticks up above the top of the bench, it often gets in the way when you want to work on something large, such as a door. For this reason, I don't mount my mechanic's vise permanently. Instead, I've bolted it to a piece of 2×6 that I can clamp in my woodworking vise whenever I want to work with metal. At other times I store the vise out of the way. You can also buy vises with clamp-type bases that make for fast mounting and disassembly, but the clamps rarely hold the vise as securely as I'd like. Result? The vise moves around, your work suffers, and your bench gets chewed up.

The two basic vises for working on wood and metal are the only ones required in many shops. But they are far from the only types. If your shop has a drill press, it also needs a drill-press vise. Electronics buffs and model makers will get good service from a small swivel-head vise such as the PanaVise. Woodcarvers will want a carver's screw. Frame makers will gladly pay over \$125 for a tool like Stanley's Miter Machine. Others may drop \$500 for a European workbench, in part to gain the advantages of its vertical-hold shoulder vise. So, if you are having trouble coming to grips with your work, there's probably a vise on these pages to solve your problems. **P5**

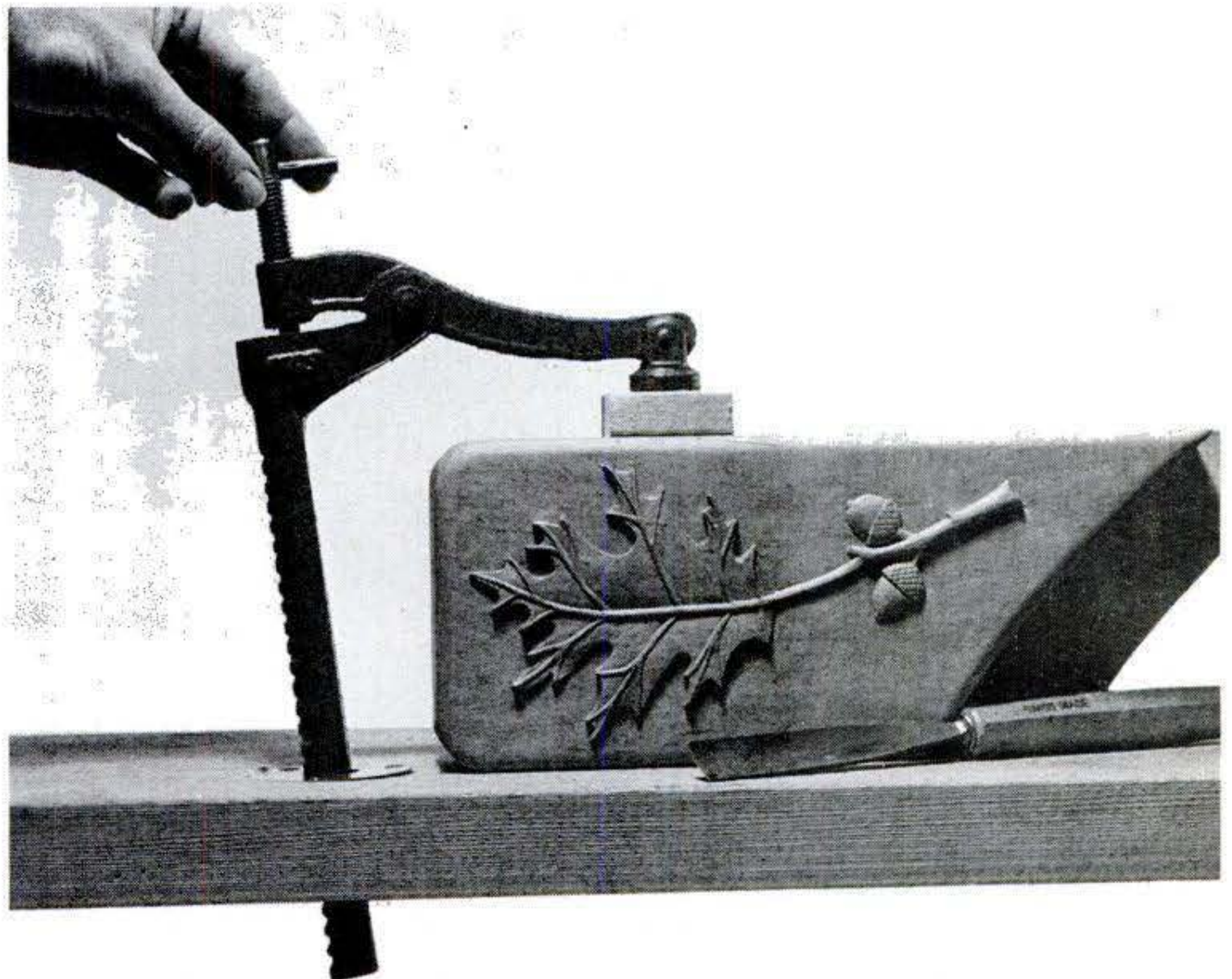


Way Out vise comes in two pieces that mount along edge of bench to hold work of almost any length. Jaws have removable centers for holding turned work, as shown here. Similar but more elaborate vise is made by Zyliss.

Three-position vise can hold work vertically and horizontally as shown at right, and at a 45-degree angle. It has fast-action jaws and it also serves as a drill-press vise. Most catalog outlets, including Sears, stock it.



Drill-press vise is a necessity for accurate drilling. This Record has pivoting jaw, comes in three sizes. For super-accurate work, \$250 will buy drill-press vises with tolerances down to 0.001 inch.



Bench holdfast has toothed leg that is gripped by mounting plate set into bench top. Slide it up or down to fit work, then tighten. It stores out of the way between jobs. Most tool catalogs stock bench holdfasts in at least two sizes.

Carver's screw fits through a pre-drilled hole in the bench. Its wood-screw threads self-tap into the base of workpiece. Giant wing nut then tightens to hold work firmly against bench top without obstruction.

Vises: where to get them

Most hardware stores stock good metalworking vises and a variety of light-duty utility vises, but from there the selection can get surprisingly slim. Many do not even have quality woodworking vises. If you can't find what you want locally, the catalog sources listed below should have what you want.

Brookstone Co., 127 Vose Farm Rd., Peterborough NH 03458; **Constantine's**, 2050 Eastchester Rd., Bronx NY 10461 (good selection); **Fine Tool Shop**, Carriage Hill, Westport CT 06880 (vises and benches); **Garrett Wade**, 302 5th Ave., N.Y. NY 10001 (vises and benches); **Leichtung, Inc.**, 4944 Commerce Pkwy., Cleveland OH 44128 (vises and benches); **Sears, Roebuck and Co.**, Sears Tower, Chicago IL 60684 (ask for special tool catalog); **Silvo Hardware Co.**, 107-109 Walnut St., Philadelphia PA 19106 (good selection and prices); **Woodcraft Supply Corp.**, 313 Montvale Ave., Woburn MA 01888 (good selection including plans for benches built with vise hardware).



What's New

A PICTURE ROUNDUP OF NEW PRODUCTS AND DEVELOPMENTS

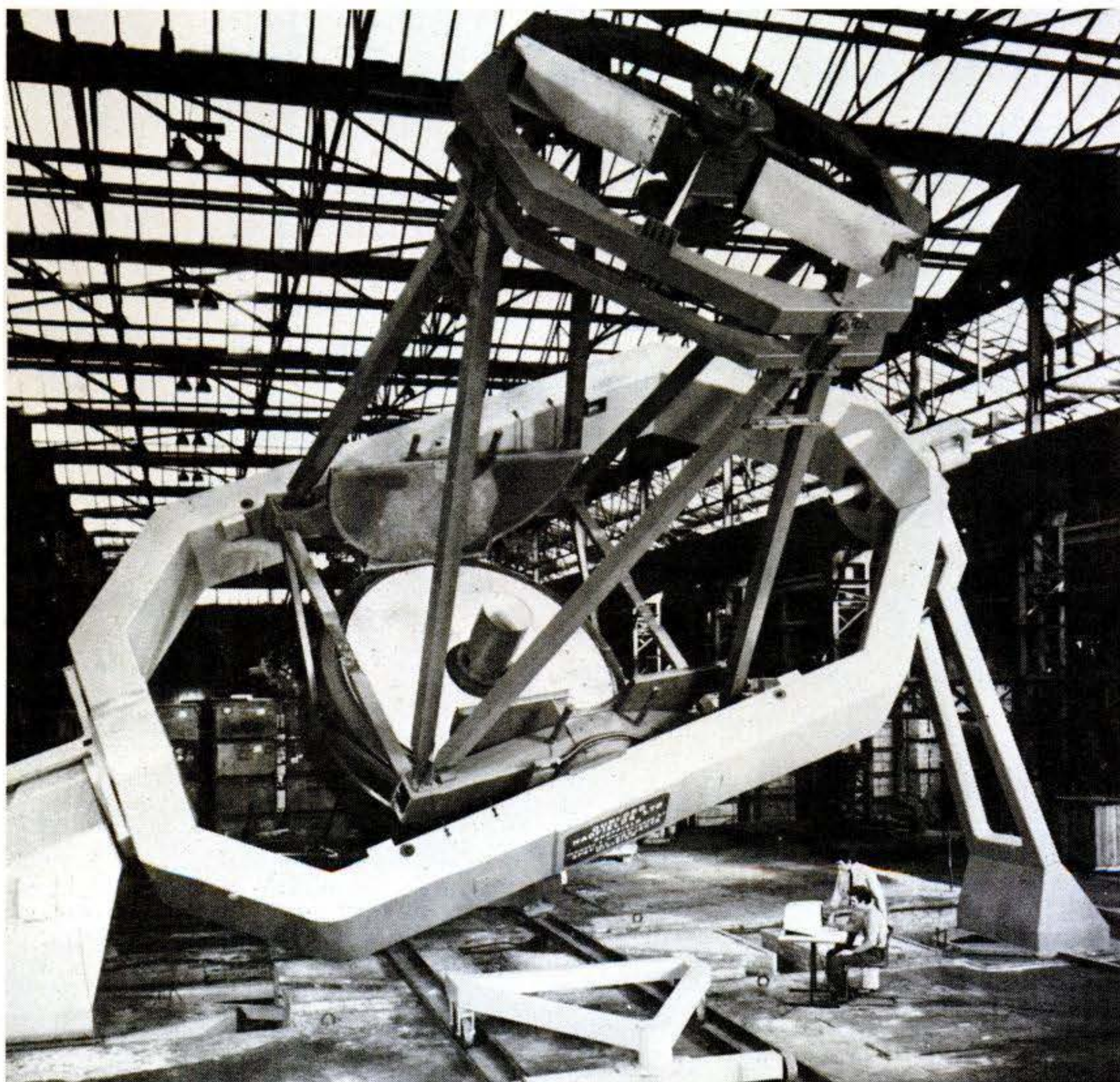


Light fence

Fiber-optic cable, strung with barbed wire, aids security. Glass cables, immune to bridging, carry coded light signals that sound an alarm and pinpoint a cut. Branglea Ltd., Nero House, The Cricket Green, Hartley Wintney, Basingstoke, Hampshire, England.

Infrared telescope

The world's largest infrared telescope, with a 12-ft. primary mirror, was recently installed atop Hawaii's 13,000-ft. Mauna Kea. The device, shown under final factory tests in Scotland, detects heat radiation from planets, invisible galaxies, and quasars.



Wind turbine

Grumman's Windstream 33 has a 33-ft. rotor that aligns itself downwind. It generates 15 kW of electricity in a 24-mph wind. The Ronkonkoma, N.Y., firm and the DOE are testing a new design for possible use for farms, factories, and small businesses.



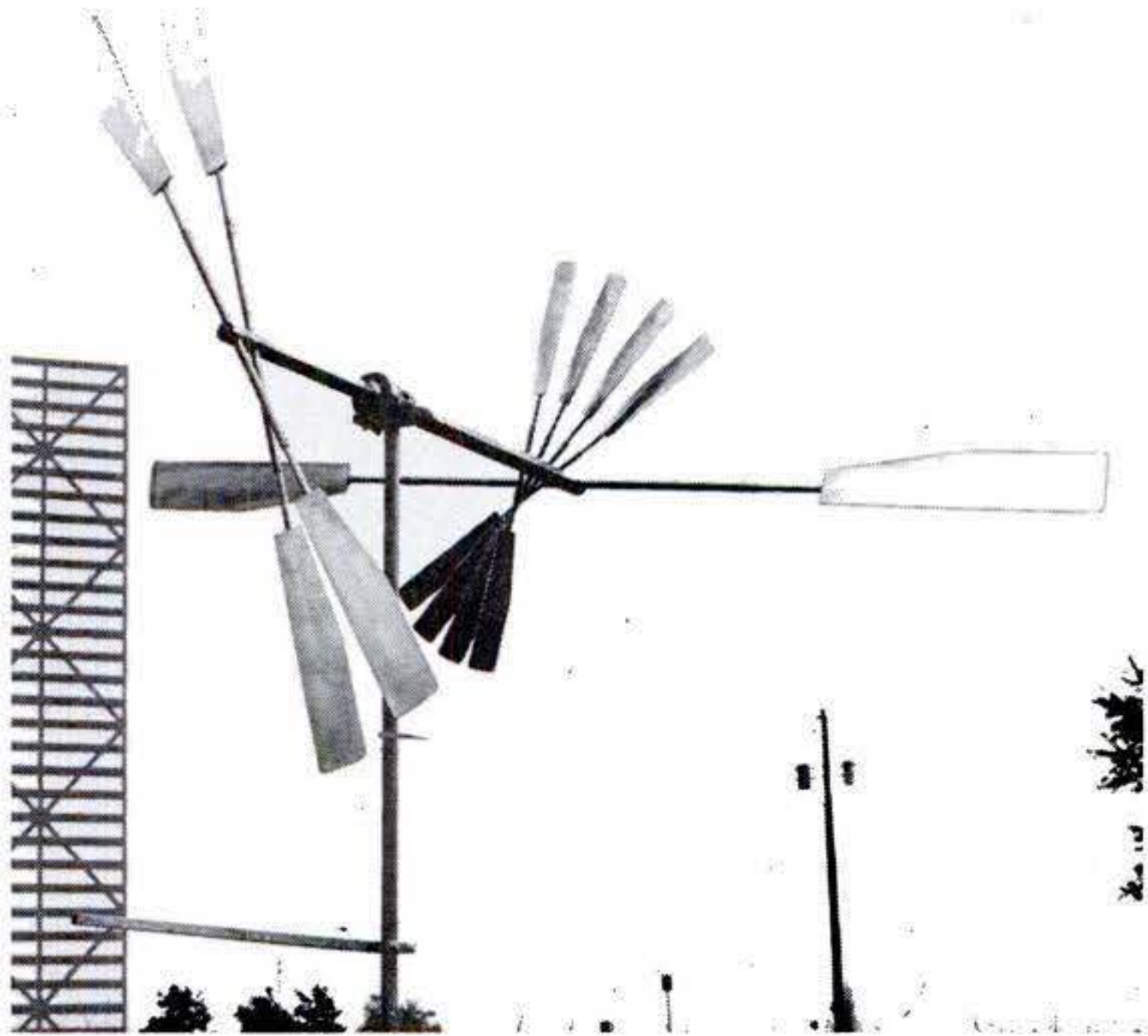
Skid tester

A fifth wheel rigged to this Saab 900 hatchback helps test friction and skid hazards on airport runways. The test wheel, linked to a computer, provides precise checks on rolling resistance, braking distance, and aquaplaning risks. Data can improve safety for jets.

Unsinkable lifeboat

A large, inflatable ring rims the 34.5-ft. rigid hull of the unsinkable Medina 35 lifeboat. Two 212-hp inboard diesels give a 150-mile range at 26 knots. Royal National Lifeboat Institution, 21 Ebury St., London SW1W 0LD, England.





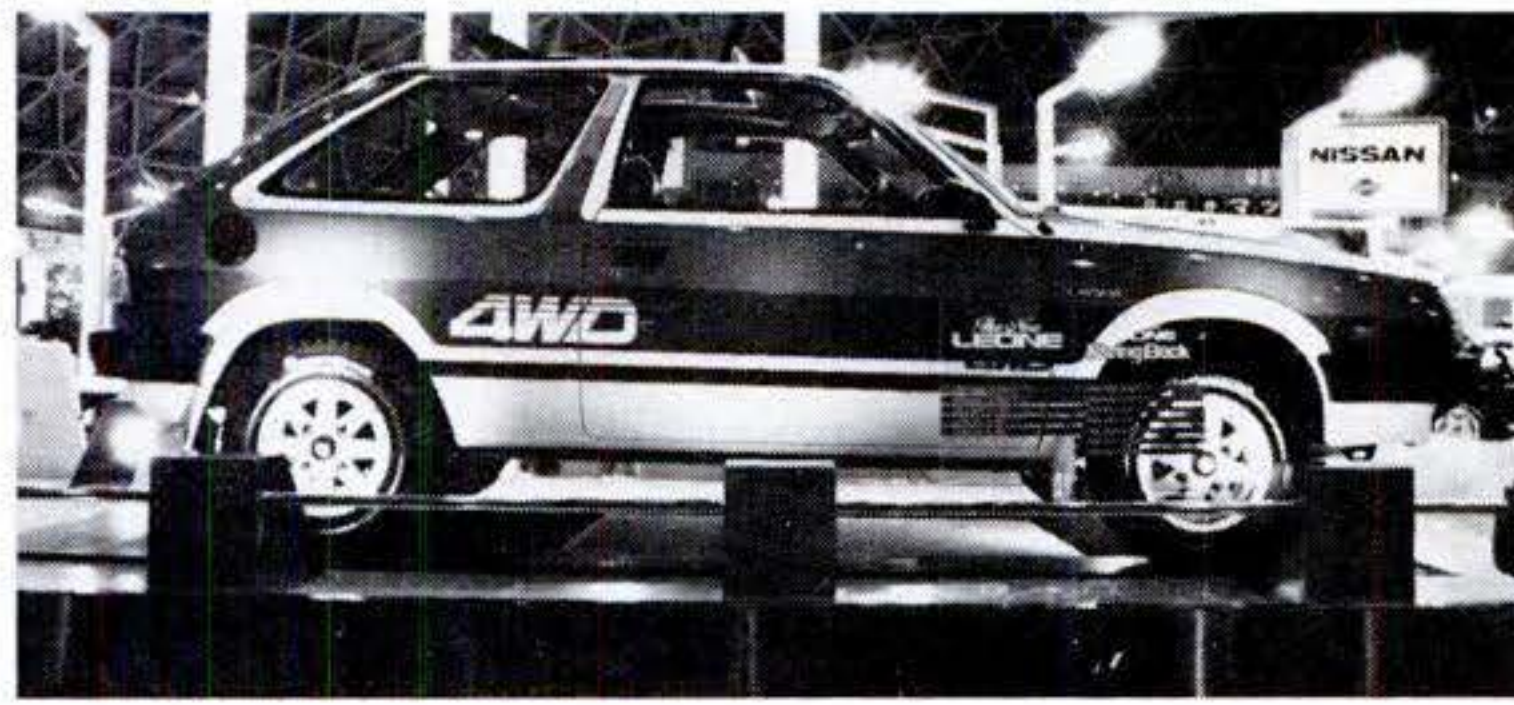
Super blades

Windstar is one of the first windmills made under license from William Allison ["Allison's Wind Engine," PS, Mar.]. Three models, up to 24 ft. in diameter, are available. Pawl Invention Corp., Box 151, Walled Lake, Mich. 48088.



Fiat Panda

Fiat has added the Panda to its low-end line, giving the Italian firm 10 basic models. The Panda is an 11-ft.-long hatchback with front-wheel drive and a transverse engine. The 45-hp, 903-cc, water-cooled engine gives 38 mpg at a steady 55 mph. It's not available in the U.S.



Subaru 4WD

Subaru's three-door hatchback Leone, unveiled at Tokyo's International Auto Show, is a sporty addition to the new generation of four-wheel-drive vehicles. The deluxe version costs about \$5500. A skid plate protects the transmission for rough off-road traveling.

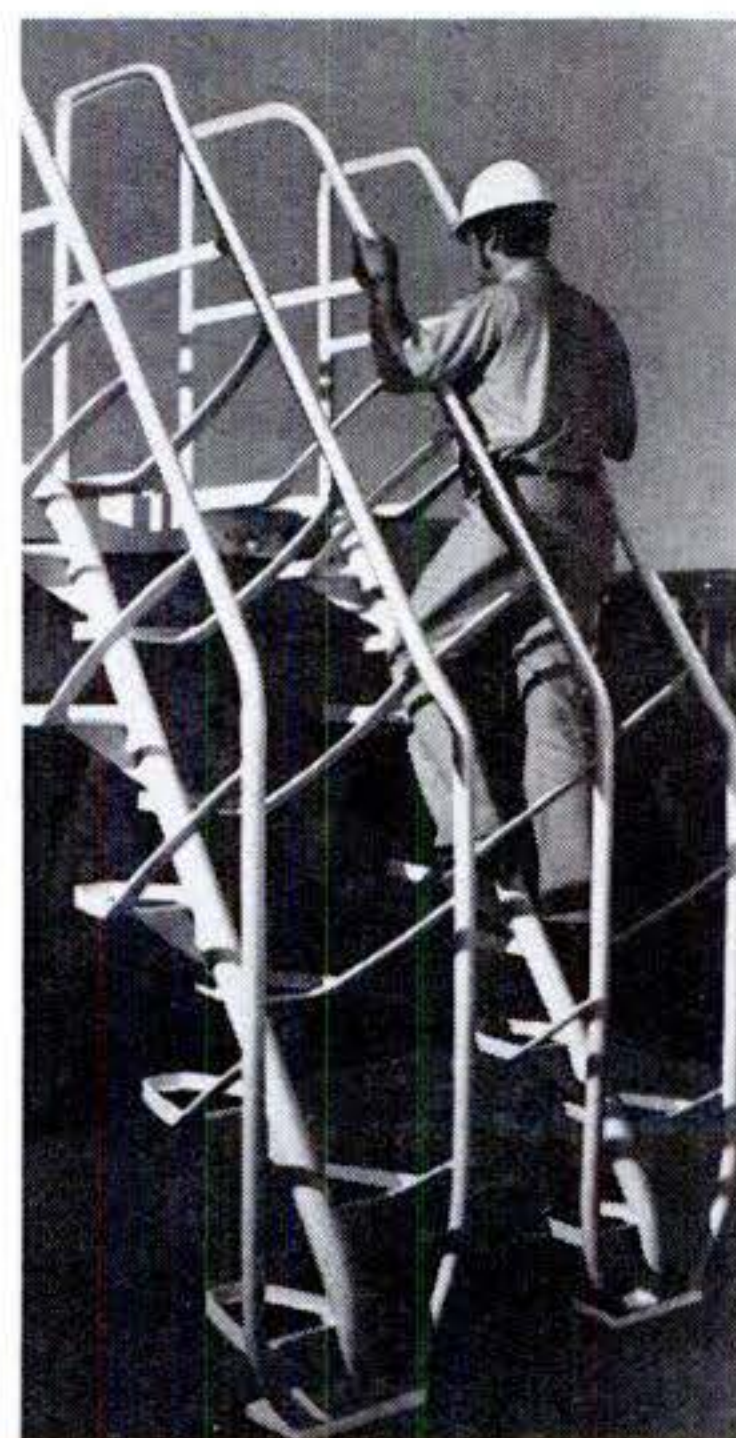
Plastic wheel

Higher speed with less effort—that's one benefit of its new plastic bicycle wheel, according to Montedison SpA, Milan, Italy. It is 30 percent lighter than metal types that need costly assembly. One-piece injection molding takes only 60 seconds.



Wing-tank winglets

Winglets atop tip tanks of Israel Aircraft Industries' Westwind 2 executive jet offer a new look in aerodynamic efficiency. Reduced drag boosts fuel economy. The plane, with a 3000-mile range, is an updated design of Rockwell's Jet Commander, made in the 1960's.

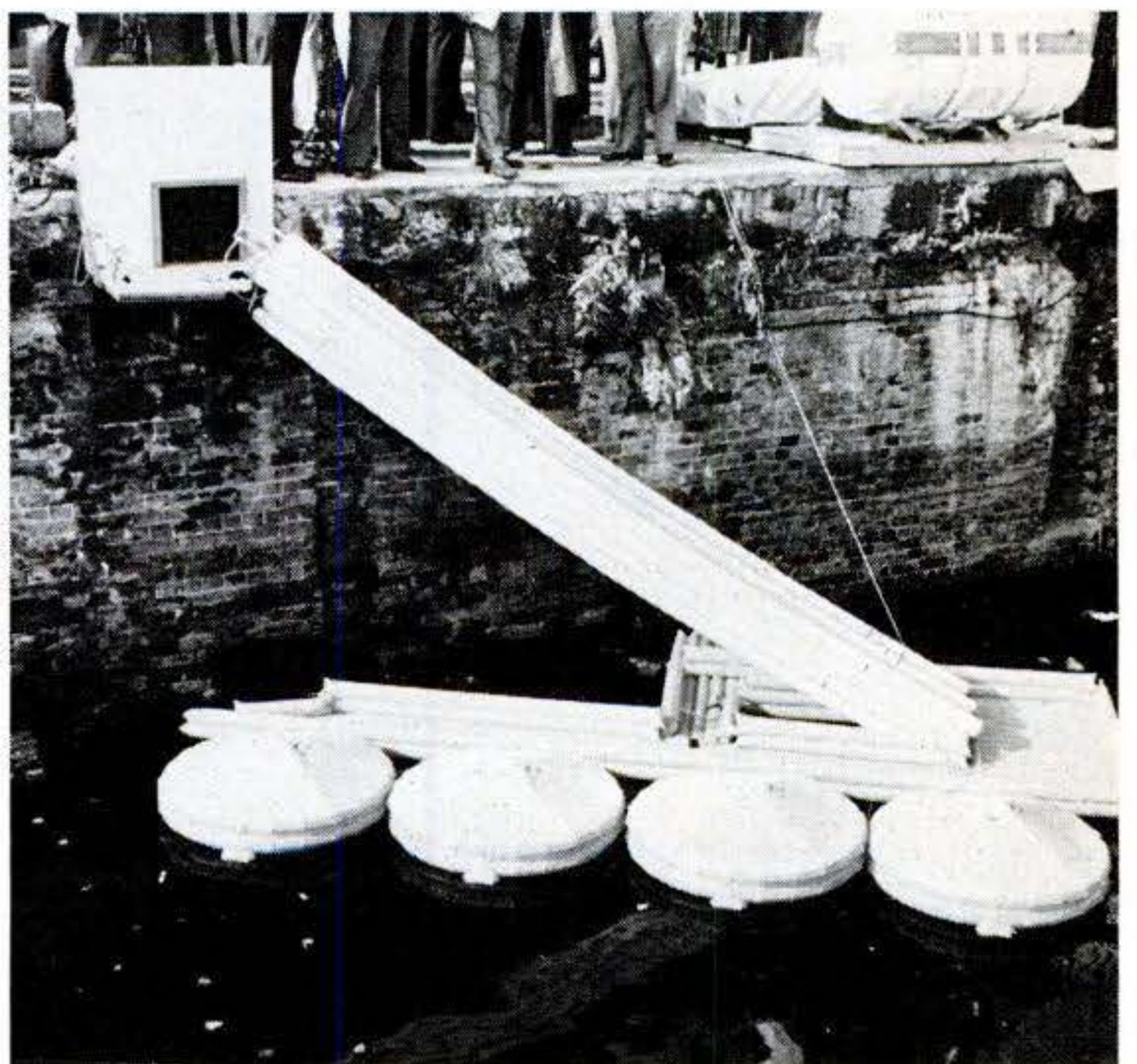


Steep stairs

Installing steep-angled stairs? The Lapeyre Stair—alternating half treads attached to a central beam—provides the walk-up and descent ease of conventional stairs but at a much steeper angle, says Laitram Machinery, Inc., New Orleans, La. 70150.

Escape chute

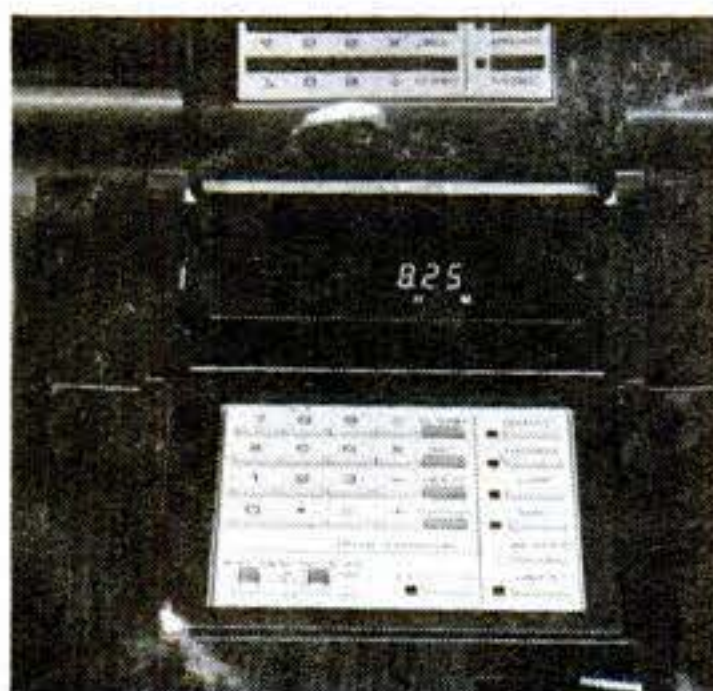
Twin tracks in this inflatable escape chute can help English Channel ferry-boat passengers escape quickly. Eight 42-person life rafts, tied to the platform for easy boarding, also jettison when a line is pulled. Maker: RFD Inflatables Ltd., Surrey, England.



What's New

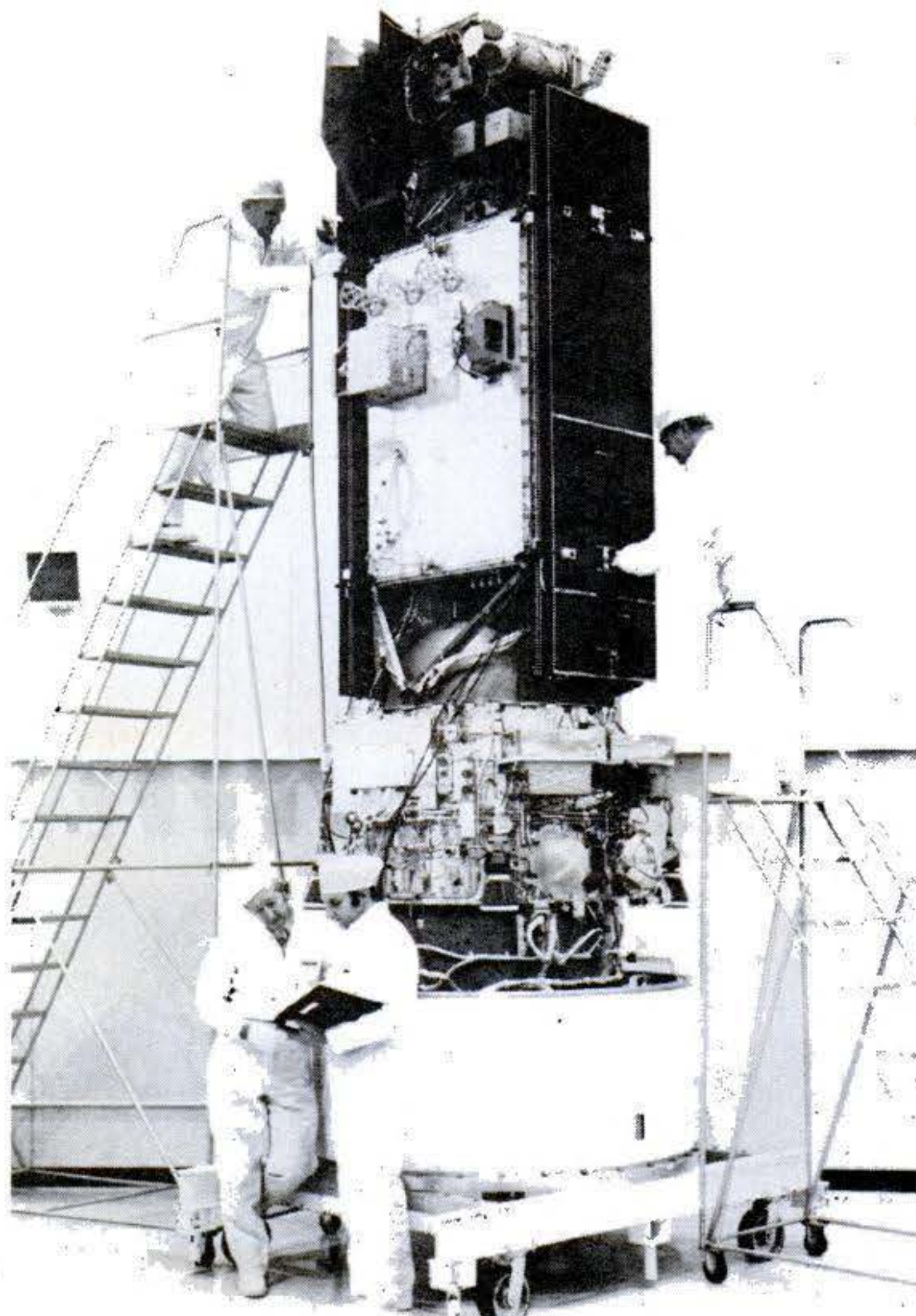
Weather bird

Though only 18 inches longer than current Air Force weather satellites, this RCA-built bird carries 100 extra pounds of sensing equipment. It can "see" in infrared, provide cloud-cover data, and give a sky-to-ground, vertical weather profile of an area.



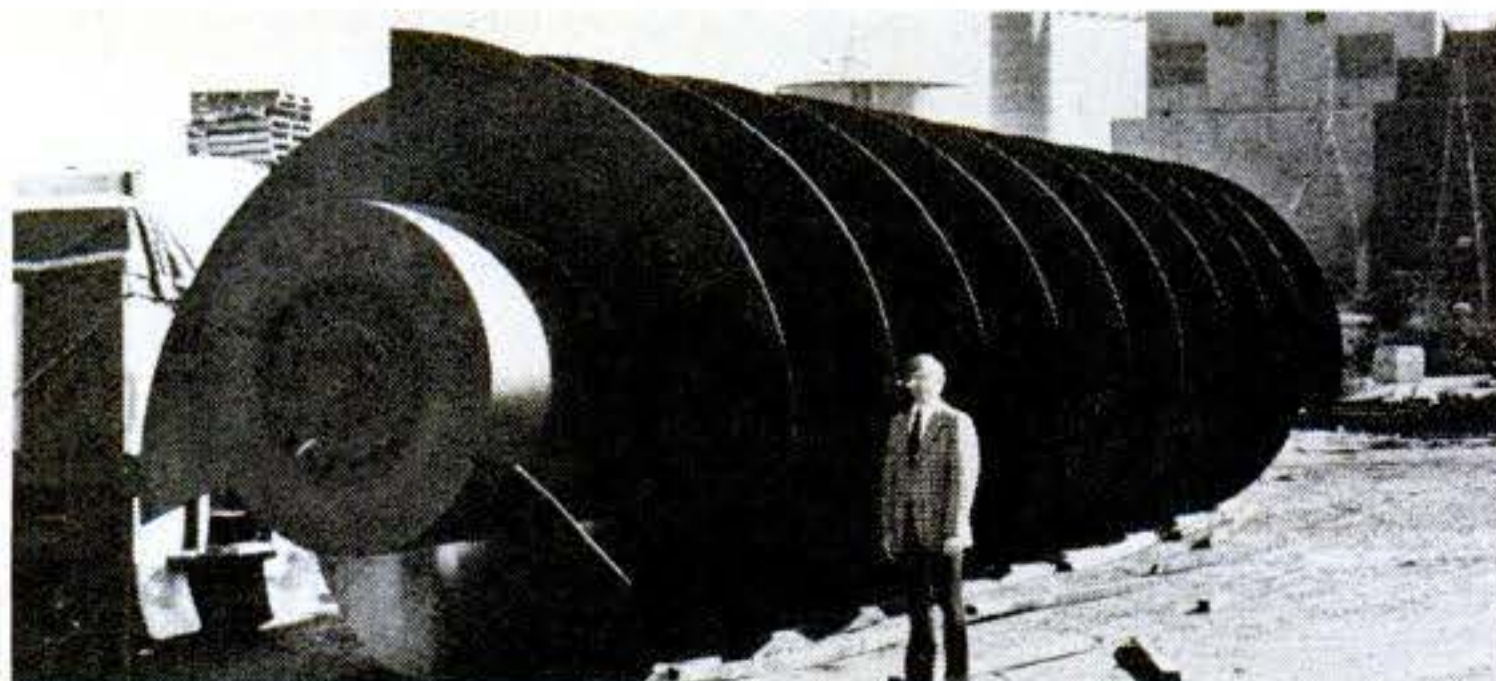
Dashboard brain

A copilot might be needed to get the most from this new auto computer. It displays trip navigation data, works a time alarm, and acts as a calculator. The dashboard computer is standard on Nissan's Cedric car, Japan's Cadillac analog, which may be available here in a year or two.



Stable chopper

A movable tail—dubbed a stabilator—below the rear rotor of the Hughes YAH-6 research copter reduces pilot workload. The stabilator pivots automatically to keep the chopper nearly level during ascents, descents, and other times when the craft is prone to flying nose down.



Super screw

The man-dwarfing, 60-ft.-long spiral is a screw pump that rotates at a leisurely 24 rpm—slow enough to handle debris without jamming. Eight of the 12-ft.-dia. pumps, to be installed in Texas City, Tex., can pump out almost 1.5 billion gallons of flood water a day.



Compact engine

The new, air-cooled, two-cylinder engine from Kohler (for heavy-duty power equipment) looks like a twin of the 17-hp version, but delivers 21 hp. To reduce air-intake noise, the heavy-duty KT21 draws combustion air from within the fan housing.

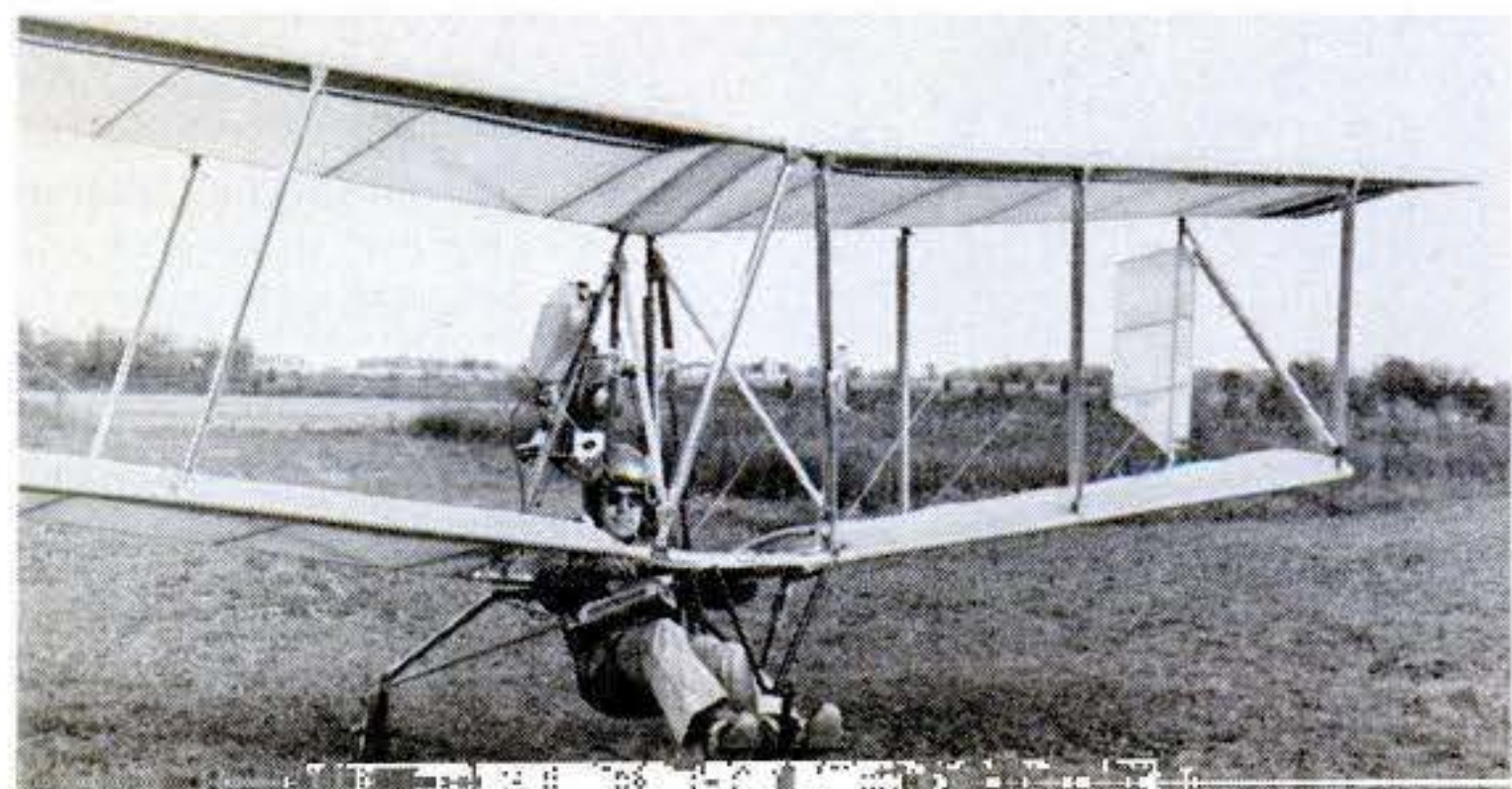


Next year's Datsun?

This Bluebird may bring happiness to variety lovers. Counting transmission options, the Datsun 810 series comes in 44 different versions. A new electronic-fuel-injection 1700-cc engine is one of five power-plant options. The 810 may arrive here in '81.

Glider wheels

Swiveling lightweight wheels make this landing gear valuable for difficult takeoffs and landings in crosswinds. But the wheels leave room for the pilot to foot-launch the craft when conditions are right. UFM Co. (Box 248, Kansasville, Wis. 53139) sells the gear for \$225.



What's New IN BOATING

BY SUSAN RENNER-SMITH

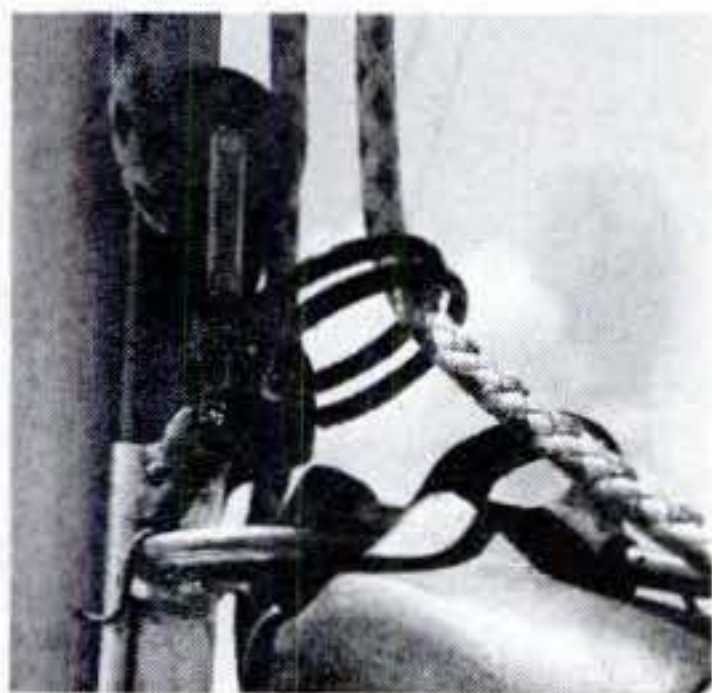
Line cushion

A padded lifeline can be a welcome luxury in choppy seas; a cushioned hiking strap can protect feet from scrapes and cuts. Trans-Pac Inc. (2601 Elliott Ave., Seattle, Wash. 98121) has vinyl-covered foam sleeves for both purposes. A three-ft. Comfort Line is \$14.



Sweat-saving cleat

With rollers for teeth, the new IFL cam cleat smoothly accepts heavily loaded lines—without wrenching the skipper's arms. Release is easy, too, but the cleat holds sheets tight, even in strong winds. Price: \$9-\$14. Pastime Prod., Box 843, Madison Sq. Sta., N.Y., N.Y. 10010.

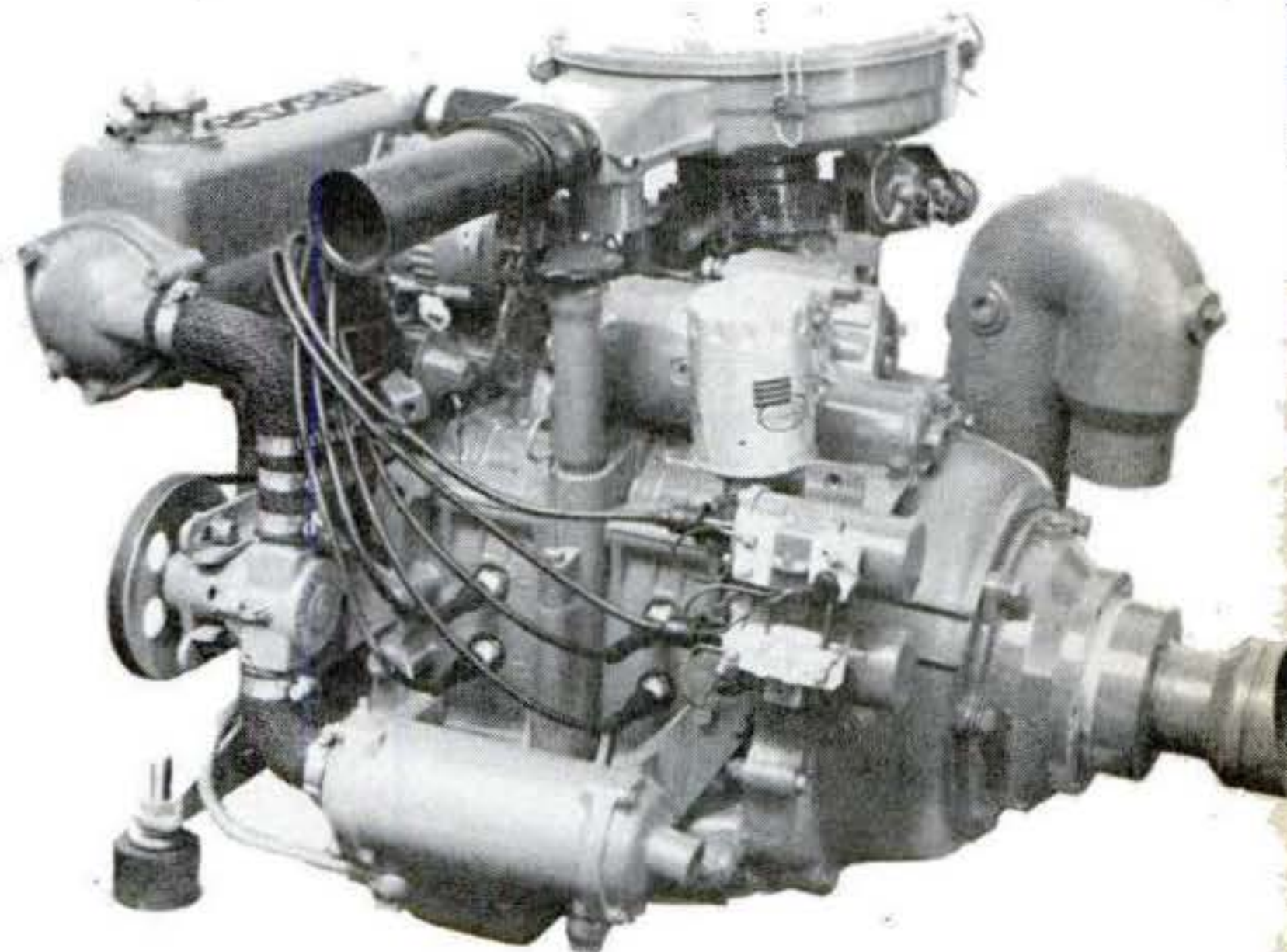


Fast fastener

A tug on the rope and the retaining coil pops open. Then Superloop snaps back into a coil, ready to hold this topping lift, silence the halyard, fasten a sail tie, or secure the life buoy. The polyurethane fastener is \$2 from Sally Marine, Box 208, Solomons, Md. 20688.

Salty Wankel

A sea-going rotary engine, the marine version of the Mazda 13B Wankel engine, delivers 150 hp at 7000 rpm. That's 40 percent more than the same engine gets when mounted in the RX-7 sports car. One reason for the marine version's extra kick: no anti-smog devices. The marine rotary also has modified intake ports, with an additional bridge port that feeds in more air on the induction stroke. The unit is fitted with a special cooling system that has a pump. Plans for marketing the marine Mazda are not yet completed, but sales in Japan are expected to start soon.



Mast climber

Winched up tight against the mast (far left), the Bosun's Ladder lets even single-handed sailors clamber aloft. The set of sturdy ABS plastic steps (left) comes in sizes to fit masts 30 to 50 ft. Marine Trading, Box 429, Royal Oak, Mich. 48068. Price: \$95-\$145.

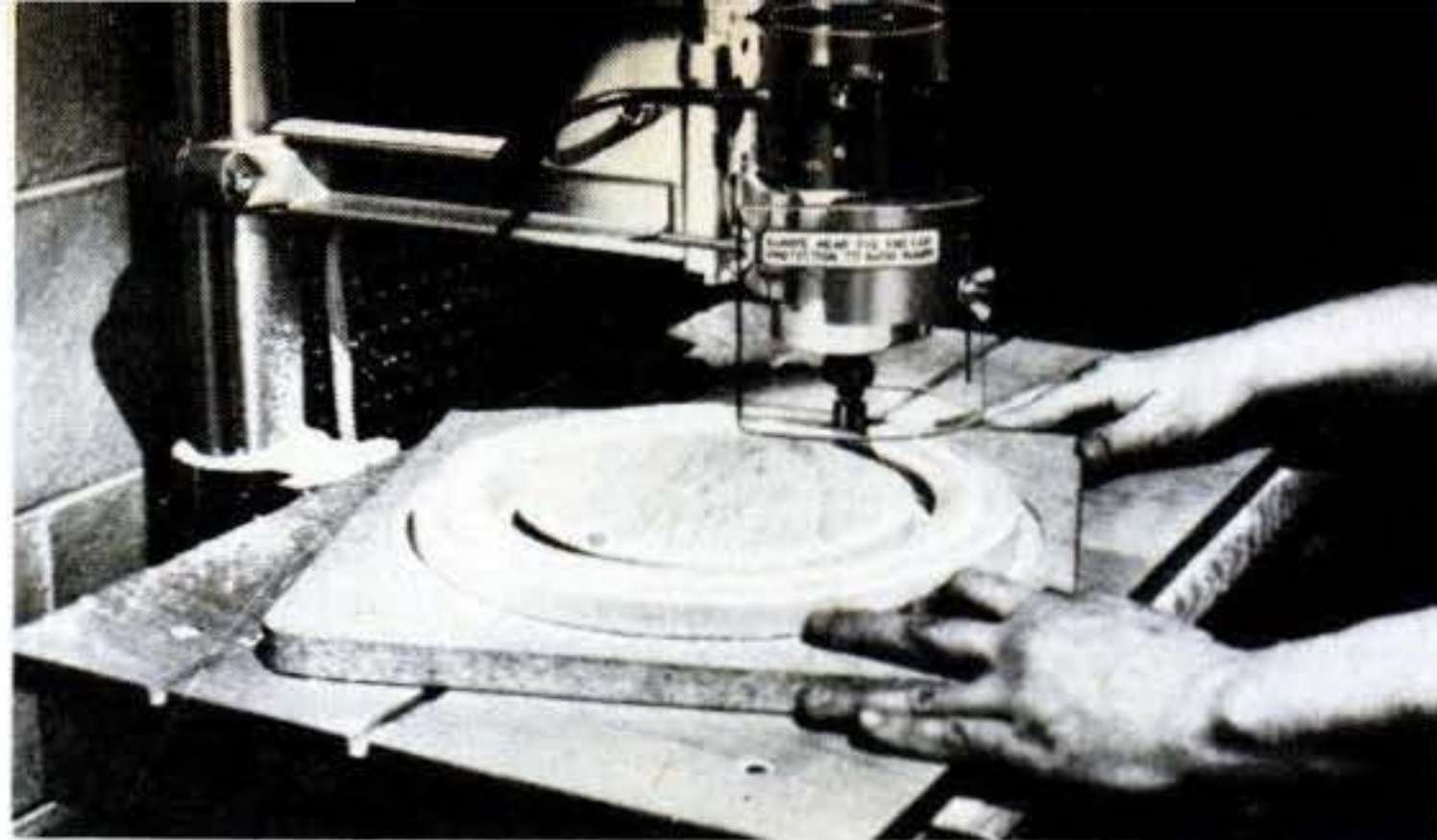
Snug suit

Rain or heavy spray won't penetrate the three-part storm flap that seals this KoolDri jacket. The rain suit's "breathable" nylon-polymer fabric lets perspiration out, while blocking exterior moisture. Price: \$70. Winter Assoc., Box 70, Reinholds, Pa. 17569.



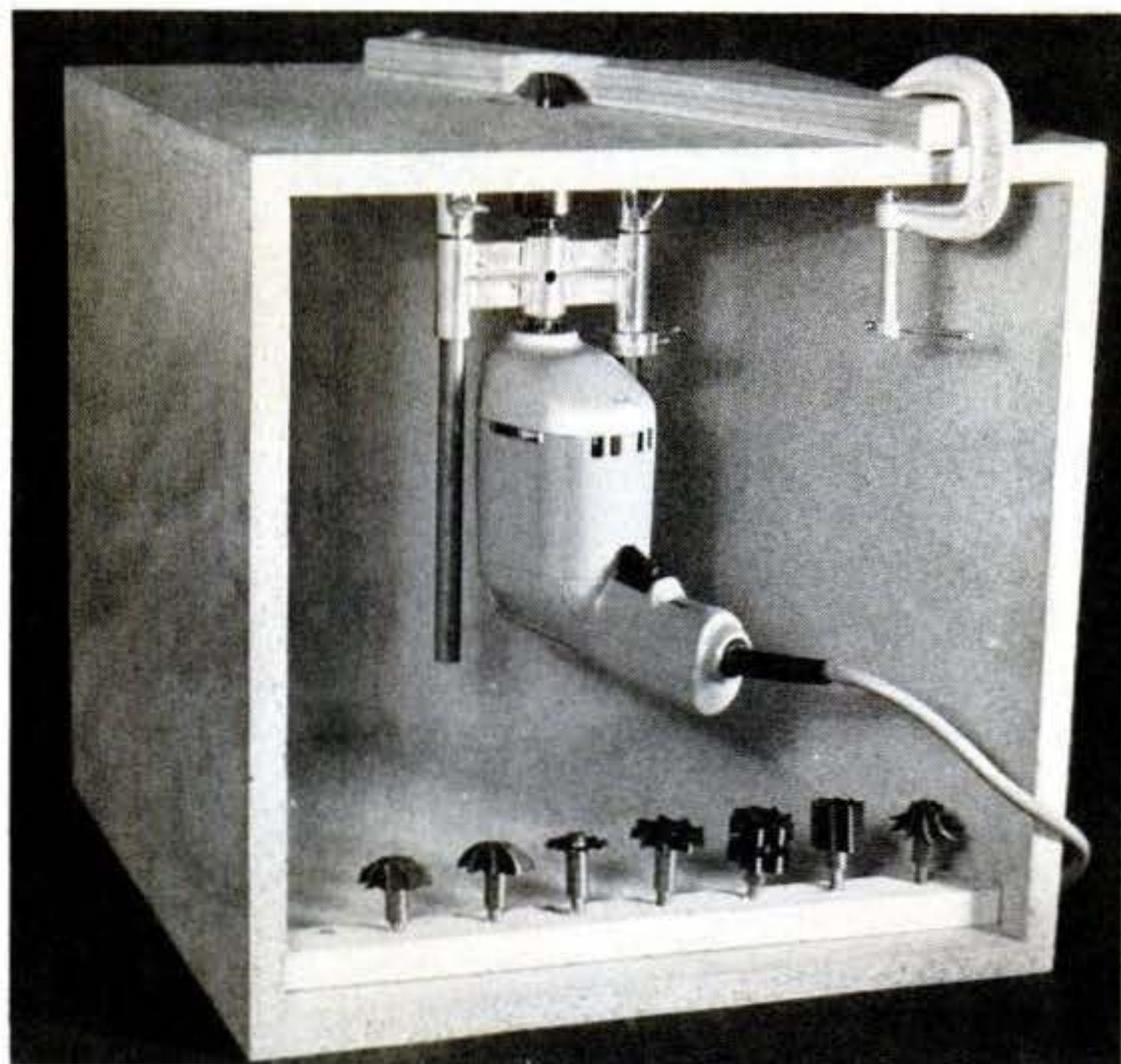
What's New IN TOOLS

BY R. L. STEPLER



Router jig

With your router mounted in Shopsmith's router arm you can accurately shape, mortise, dado, dovetail, and duplicate designs in wood from templates. Price, including table (but not router): \$379. Shopsmith, 750 Center Dr., Vandalia, Ohio 45377.



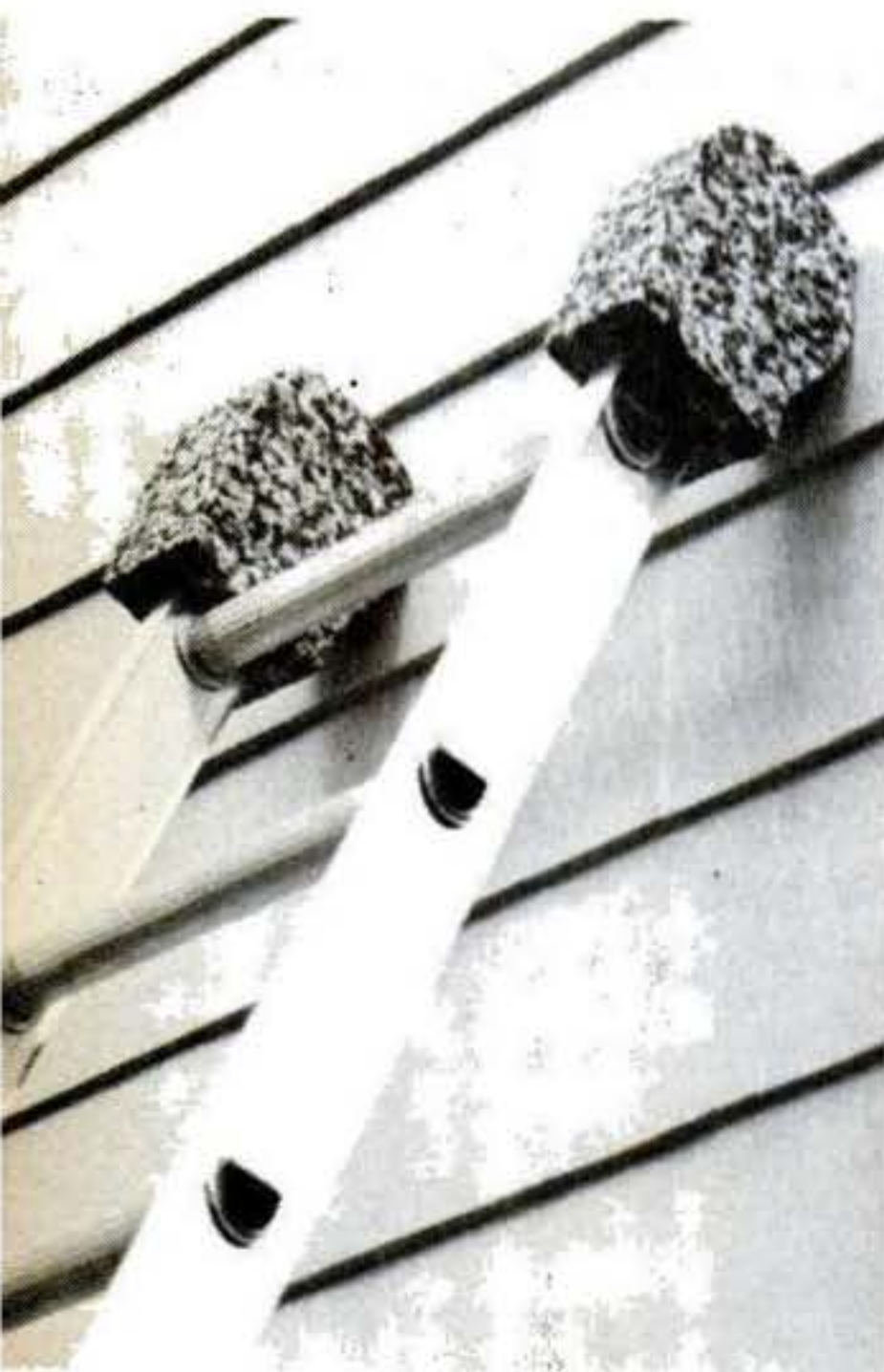
Troweling jig

Aluminum frame's slots control length, width, and thickness of mortar. It's positioned by vertical guides against each previous block in a course. After mortar is applied, jig is removed and block is tapped into place. Brickmate Australia Pty. Ltd., 75 Palm Ave., Sandgate, Queensland 4017, Australia.



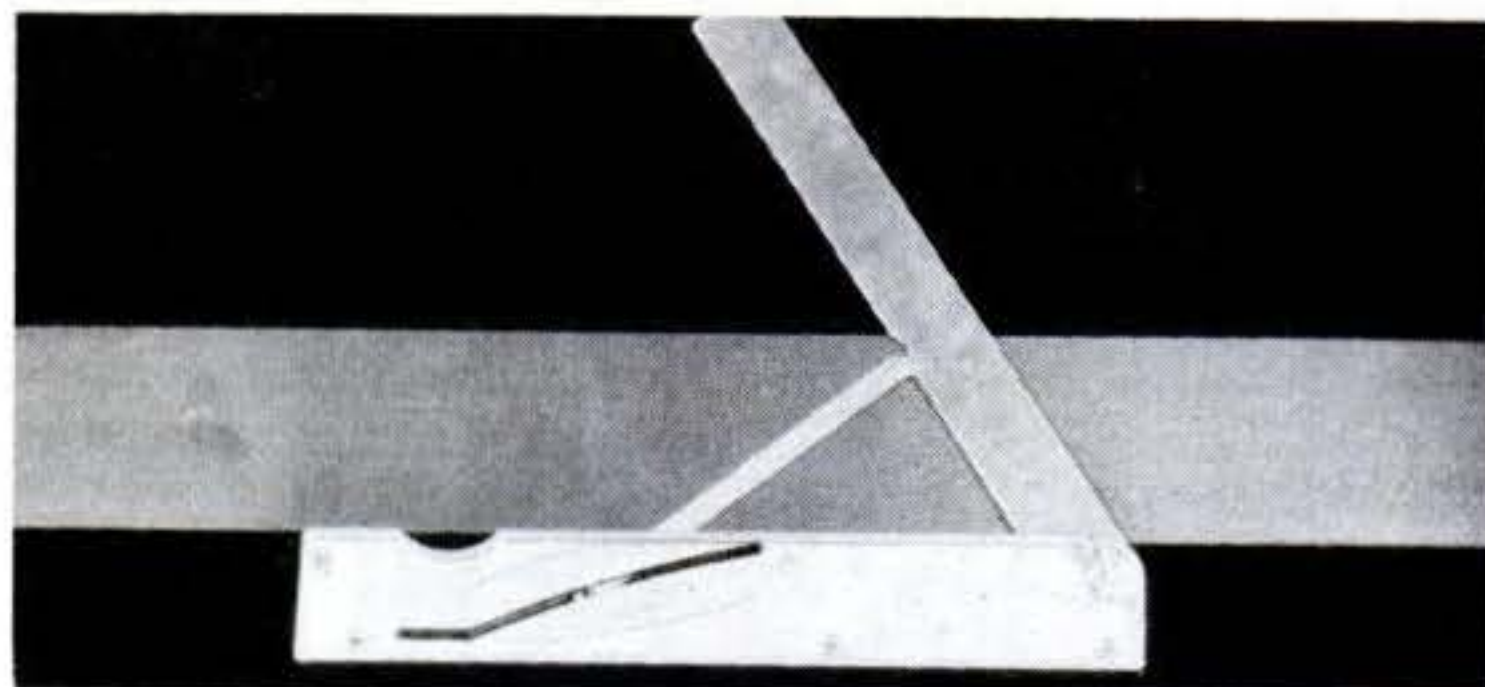
Shaper

Nine different shaper bits, a Portalign drill-guide accessory, plus a box constructed as shown convert your portable electric drill into a shaper. The bits cost from \$3.79 to \$7.95; the Portalign guide is \$19.99. Portalign Tool Corp., Box A-80547, San Diego, Calif. 92138.



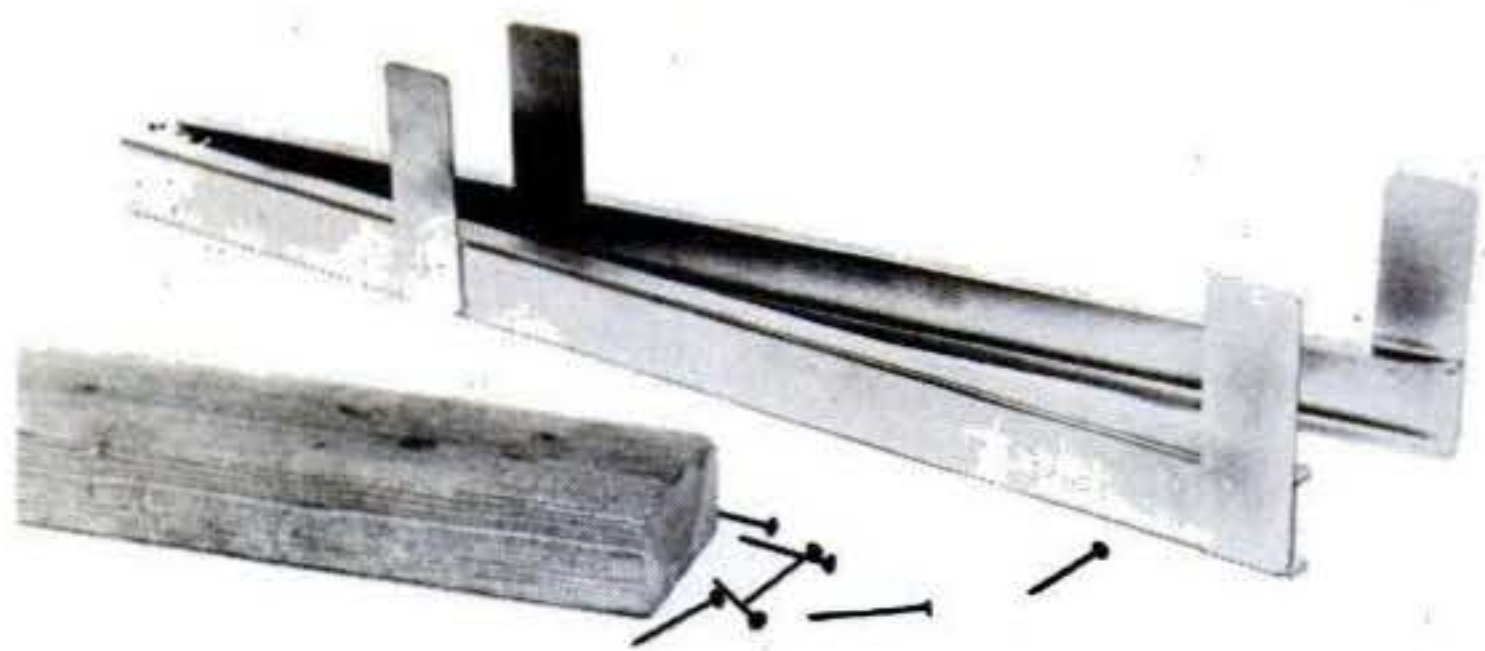
Folding square

Frame-All square can be used as a T, bevel, or framing square, and yet it folds and can be pocketed. The tool features a 10"-long blade and a 12"-long main body. It's \$13.50 from East Sales, 4593 Brooklyn S.E., Grand Rapids, Mich. 49508.



Ladder pads

Foam-rubber Ladder Mates keep extension ladders from denting or scratching painted surfaces, wall coverings, or aluminum, vinyl, and steel siding, claims Nev-R-Mark, Inc. (Box 7-516, West Hartford, Conn. 06107). Price per pair: \$7.95.



Electronic level

Lectra-Level's two light-emitting diodes (LED's) are illuminated when the device is placed on a level surface; only one lights when it's not level. Battery-operated level is \$13.95 from Martronics Corp., 8700 Waukegan Rd., Morton Grove, Ill. 60053.

Framing jig

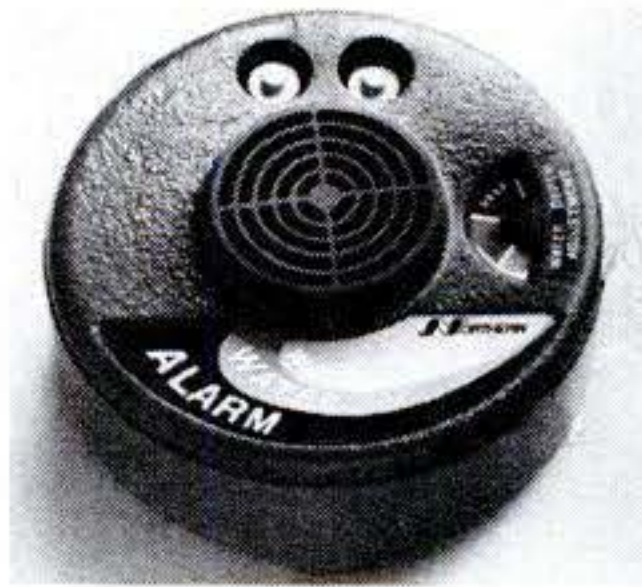
Wall framing is faster with La-Out-Stik, says Maverick Manufacturing Co. (919 Lincoln Ave., Alameda, Calif. 94501). The metal device unfolds to 4'1 1/2" long; flanges are spaced so you can accurately lay out 16" o.c. studs simultaneously on top and bottom plates. Price: \$24.95.



What's New

IN HOME IMPROVEMENT

BY R. L. STEPLER

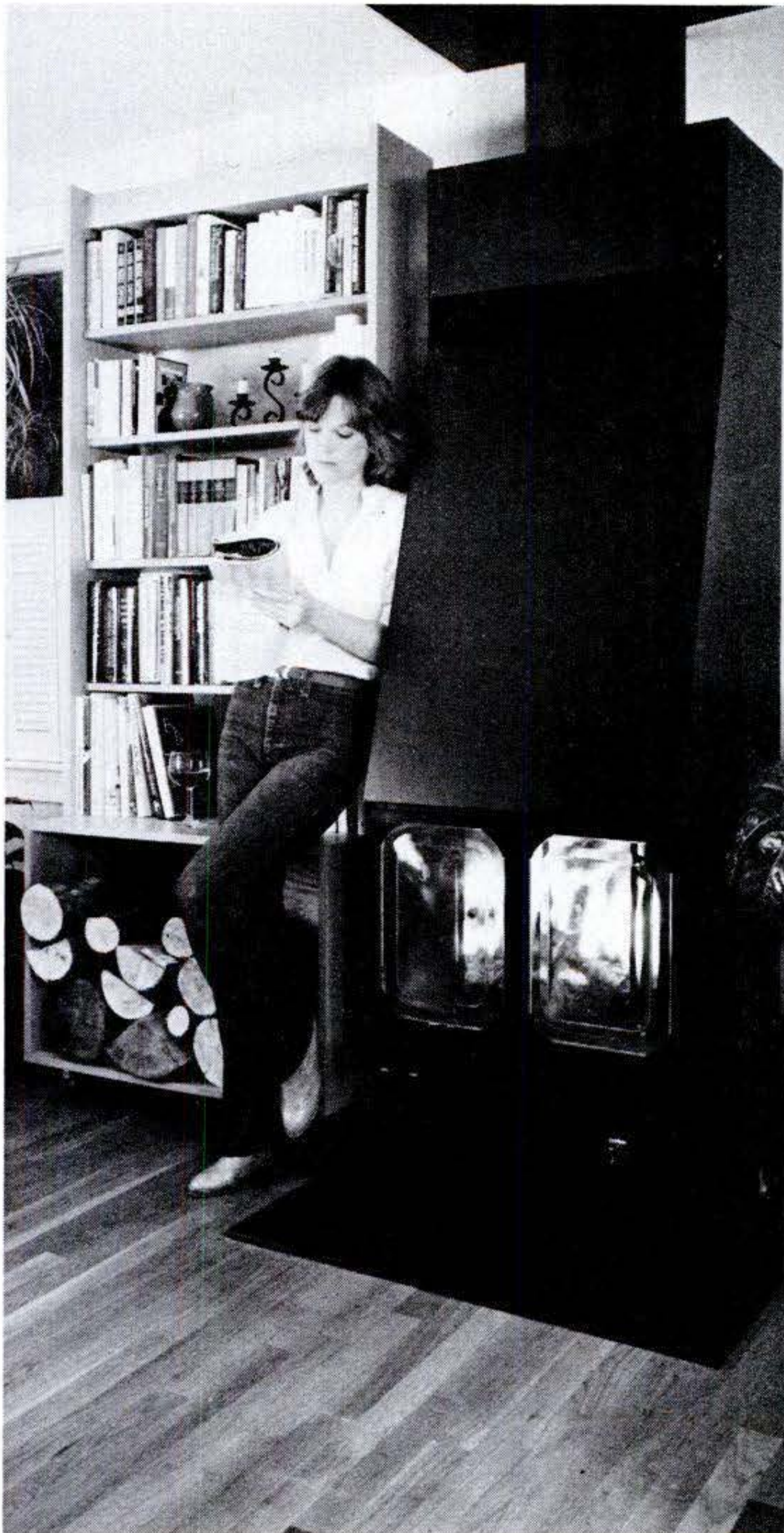


Water alarm

Northern Electric's Water Alarm sounds an 85-dB alert if it senses water in basements, bathrooms, or wherever flooding might occur. You simply place the battery-operated \$29.99 device on the floor; depth gauge lets you set up to a 5/32-in. clearance to prevent false alarms.

Acrylic caulk

UGL says that its AC-88 all-purpose acrylic copolymer caulk will withstand temperature extremes from sub-zero to 350 degrees F without discoloring or becoming brittle. Offered in clear and white, it's claimed to maintain a tight seal under stress and contraction.



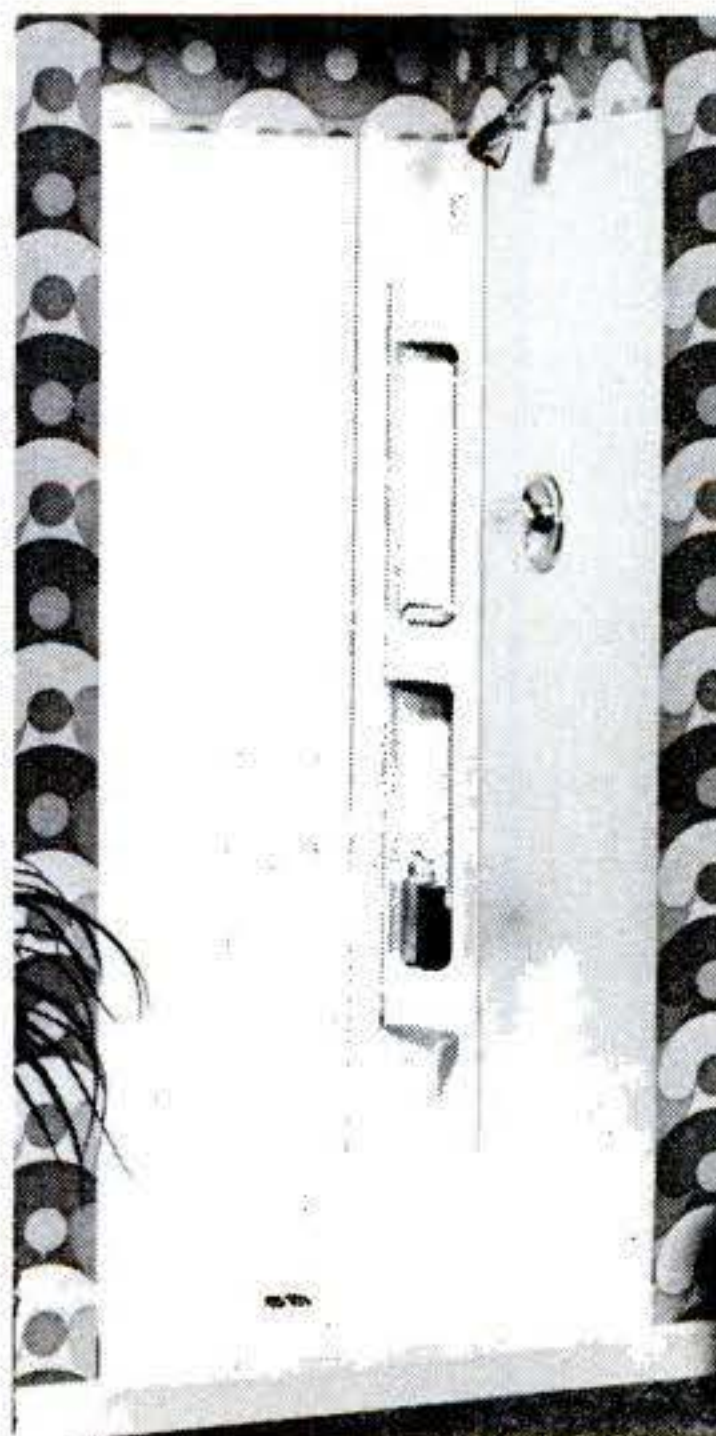
Swedish wood stove/fireplace

The photo's no phony: You can lean on this wood stove and not be burned, even if a fire's been blazing inside for hours. What's more, says Combitherm's maker, the appliance is so well insulated it can be installed within four inches of combustible surfaces. The Swedish import draws combustion air from an inlet at the top of its double flue; flue gases preheat air before it reaches the combustion chamber. A second blower-driven system pulls in room air at the base and exhausts it through louvers near the top of the six-foot-high unit. Price \$2485. Importer: Clivus Multrum USA, 14A Eliot St., Cambridge, Mass. 02138.



Rolls of aluminum

Reynolds now offers its Handyman Coil aluminum rolls in widths from seven to 20 inches to do-it-yourselfers. Typical uses: gutter, downspout, and flashing repair; termite shields; splash guards; bottom liners for garbage cans. It's light, flexible, and easy to cut, says Reynolds.



Shower stall

DIY'ers can go to the shower in style with Showerkit ABS plastic surrounds. The five-piece kit goes over existing tiles or drywall, in three sizes (32" by 32", 36" by 36", and 36" by 48") and three colors (blue, gold, and white). Price range: \$109-\$179. Made by Novi-American (40200 Grand River Ave., Novi, Mich.).

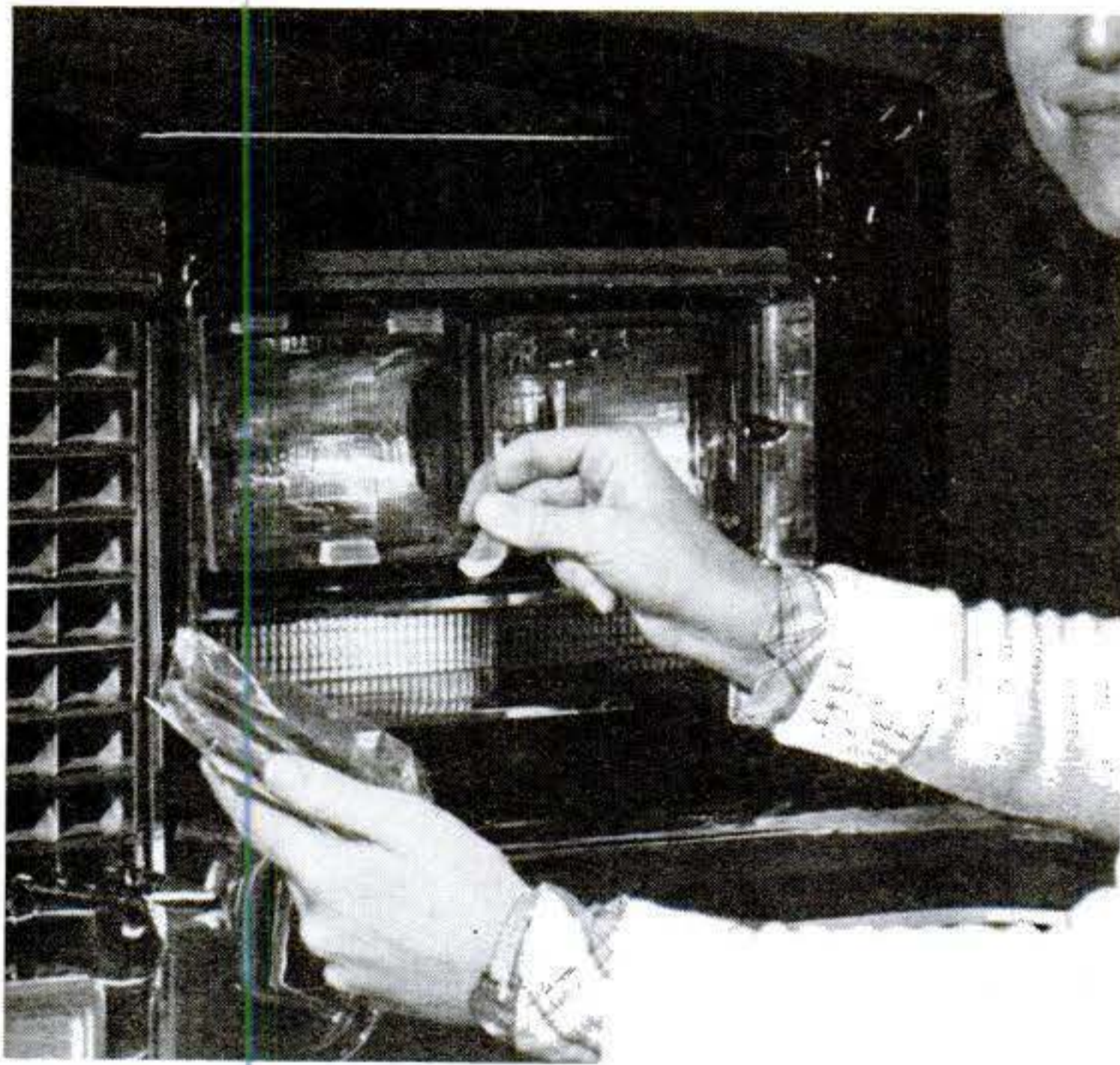
What's New FOR YOUR CAR

BY ED JACOBS



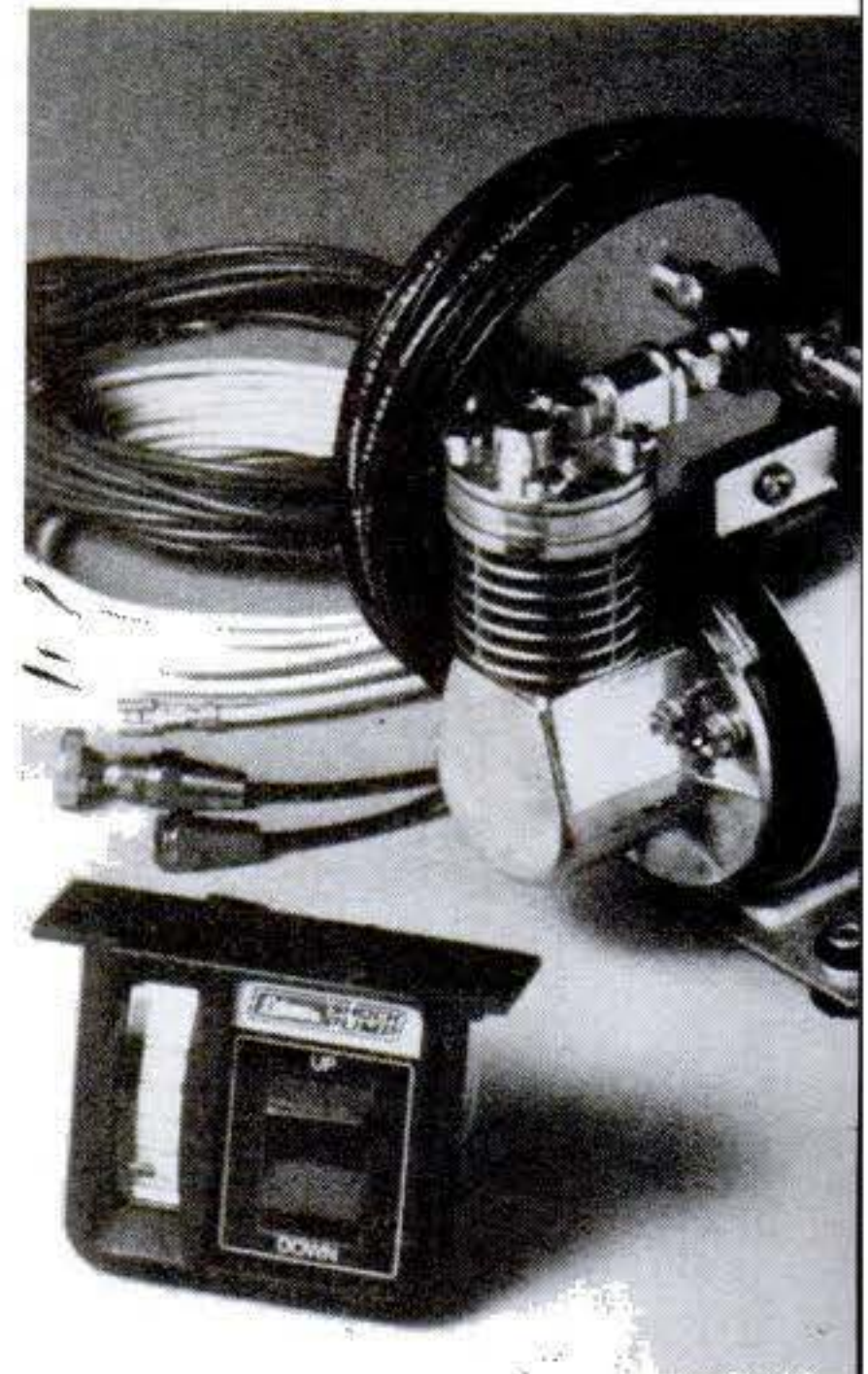
Sun shield

GT Sun Shades are black woven-aluminum screens that mount inside '78-'80 Corvettes to reduce brightness and cut heat buildup, even at low sun angles. Maker: Revline Accessories, 14088 E. Firestone Blvd., Santa Fe Springs, Calif. 90670. Price: \$109.95.



Air-shock pump

The Coleman Shock Pump works with any 12-volt electrical system, and generates up to 175 psi for air-adjustable shocks. The control switch and illuminated pressure gauge mount under your dash; the compressor is mounted remotely. Complete kit costs \$89.95.

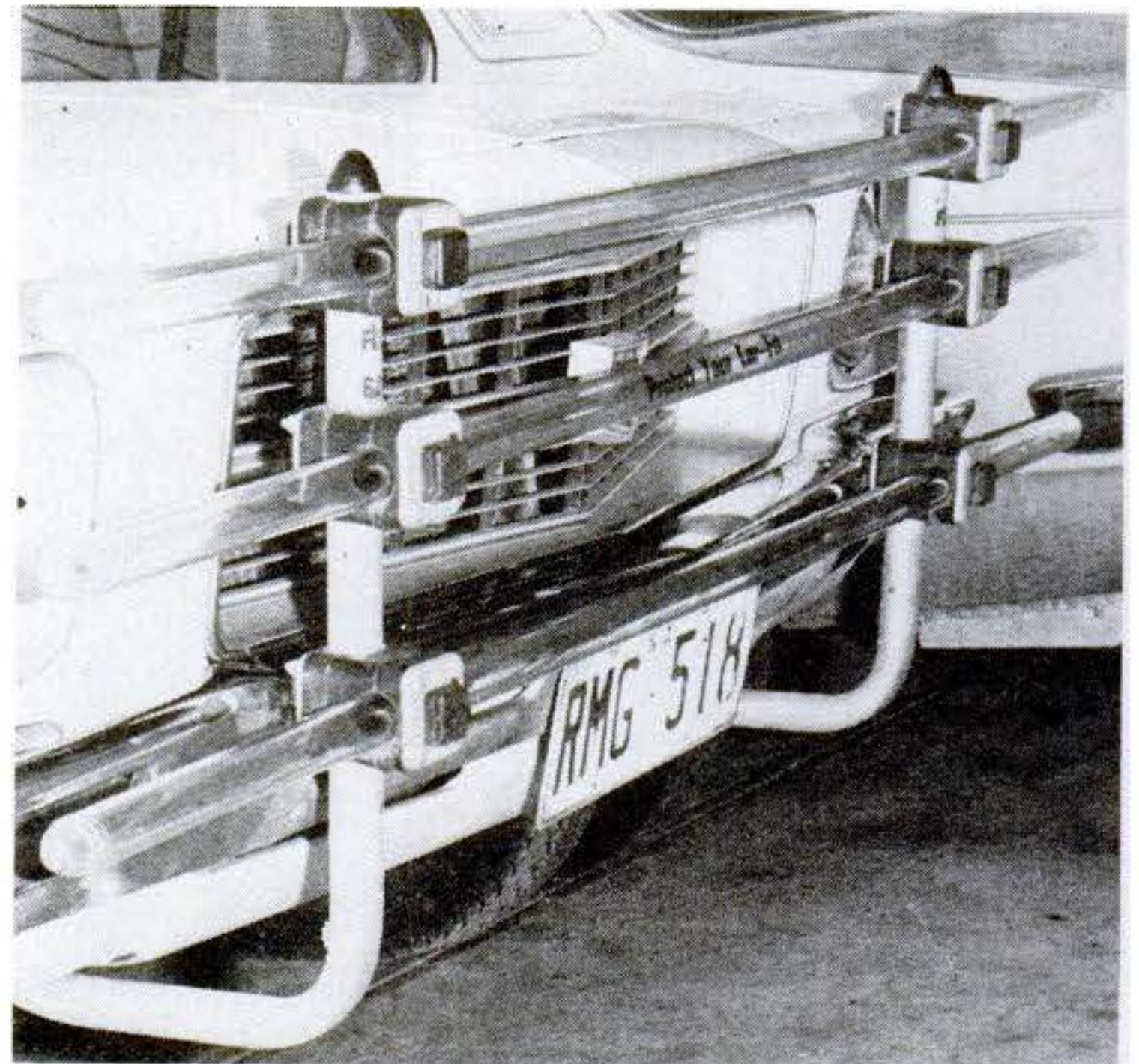


Fog-light converter

Want to convert conventional headlight color to amber? Place a Plexiglas Fog-Lens in front of each. They mount with Velcro strips and cost \$11.45 per set, ppd., from Consumer Products Intl., Box 23572, Nashville, Tenn. 37202.

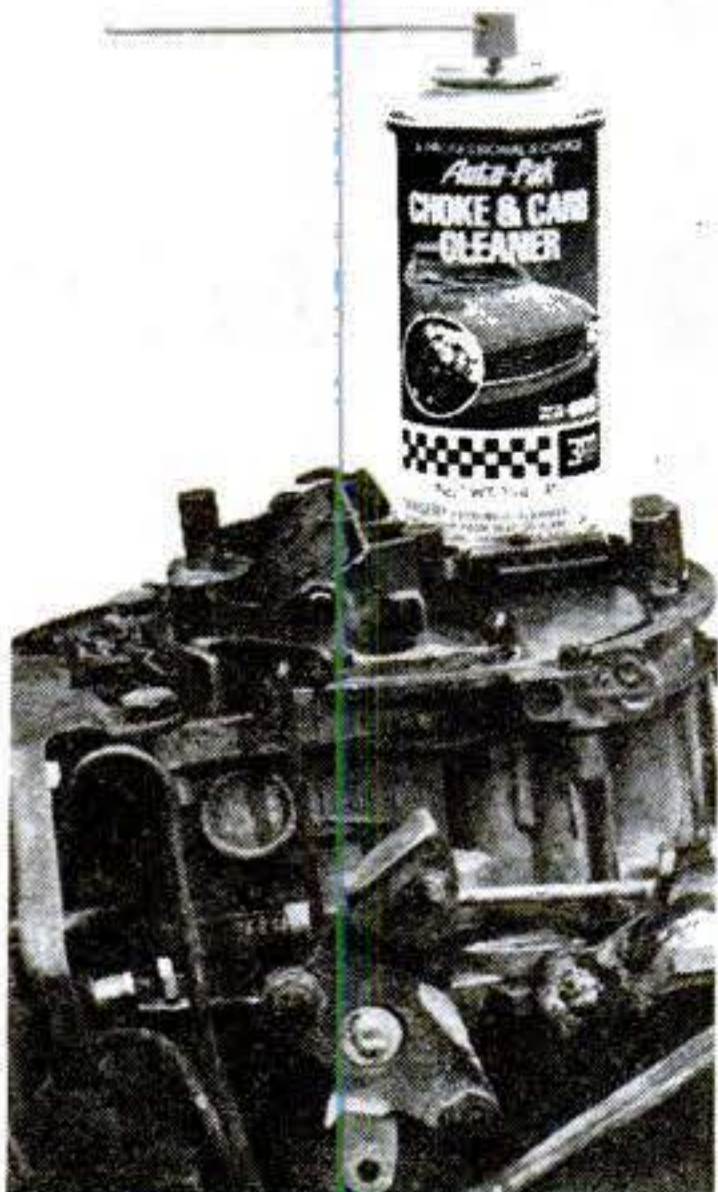
Grille guards

These flexible, clear-plastic bars protect a car's grille and headlights from minor collisions. They're heat-resistant, shatterproof polycarbonate resin, and mount on the front bumper. Maker: Intertrade Pty. Ltd., Box 77, Seaton, S. Australia 5023.



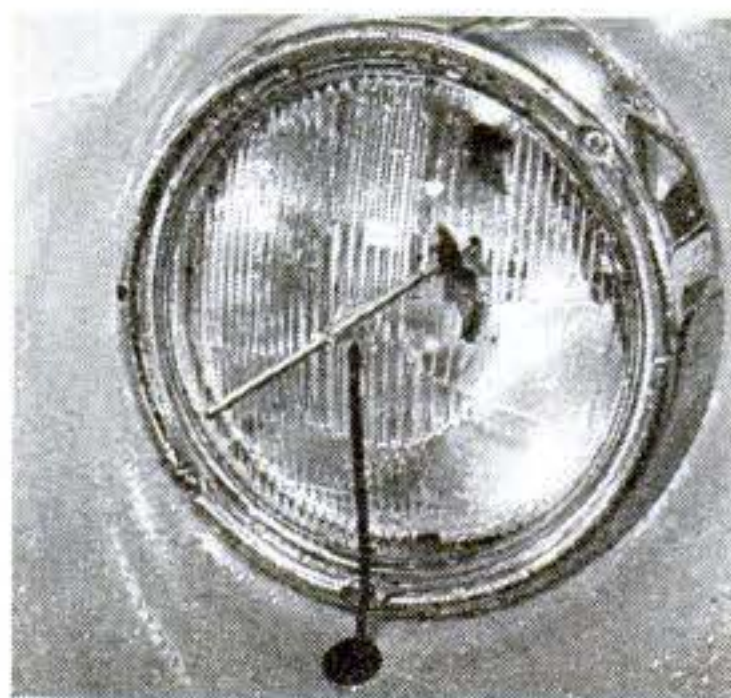
Choke/carb cleaner

Auto-Pak aerosol choke and carburetor cleaner from 3M contains fast-drying solvents to loosen and flush away varnish, gum, and other residues from carburetor parts, linkages, and PCV valves. It's \$1.73 for a six-ounce can.



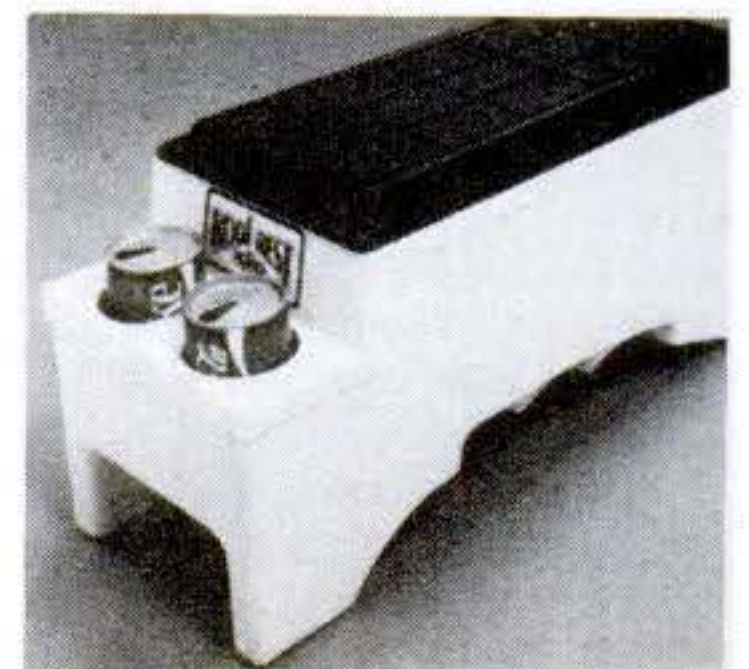
Headlight washer

The base for this headlight washer is cemented to the center of the headlight, and the washer arm is spun by angled jets of pressurized fluid from your car's washer-fluid reservoir. Wolters GmbH, Box 51, 3041 Neuenkirchen 51, Germany.



Seat-top cooler

Igloo's Kool Rest cooler is contoured to fit on the seats of most vehicles. It will hold up to 12 cans inside—plus two outside—and can also be used as a storage compartment. Igloo Corp., Box 19322, Houston, Tex. 77024. Price: \$33.15.



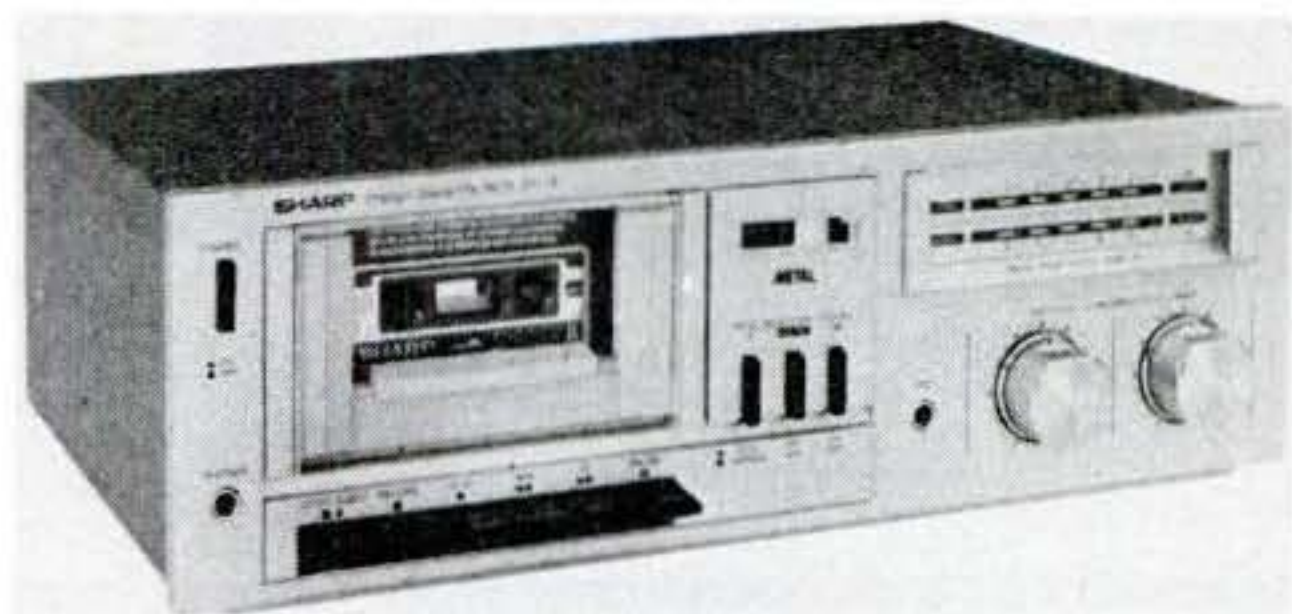
What's New IN ELECTRONICS

BY WILLIAM J. HAWKINS



Smart player

A built-in microprocessor controls all the functions of Optonica's RP-9705 turntable, allowing you to preprogram up to 10 selections in advance. A digital display shows speed or present program instruction. It costs \$950.



Metal player

Here's the usual top-of-the-line cassette deck—metal-tape capability, Dolby, LED level displays, autostop, DC motor drive, 40 Hz to 14 kHz response, and just 0.09 percent wow and flutter. What makes Sharp's RT-10 unusual, however, is its bottom-of-the-line price: \$129.95.



Kit multimeter

Side buttons allow one-hand operation of this Heath 3½-digit multimeter. Designed for field work, it has a built-in calibration system and runs for 200 hours on a single nine-volt battery. The IM-2215 kit, from Heath Co., Benton Harbor, Mich. 49022, is \$94.95.

Hi-fi for joggers

You don't have to jog when listening to stereo music from the Sony Soundabout cassette player—but you could. It's small, lightweight, designed to go anywhere, and produces high-fidelity stereo through its specially built headphones. Price: \$199.95.



Special effects

Tap the remote control and the Quasar VH5155 six-hour VCR plays a tape the way you want it—pause, freeze frame, single-frame advance, or variable speed for slow motion. The recording channel can be changed remotely and the unit programmed up to two weeks in advance.



Pocket computer

Pop in a memory module and this hand-held information center from Quasar will do anything from translating languages to helping you choose a wine. The data is in the modules—nutrition and calorie guides, generic-drug tables, metric conversions, and more.

Rigid asphalt roofing

Corrugated panels need no underlayment

Versatile asphalt panels go up fast, also can be used as siding

By RICHARD STEPLER

Taking on an outdoor building project this year? Whether it's a patio cover, carport, garage, storage shed, or a re-roofing job for your house, you should consider using a relatively new roofing product: 46-inch-wide-by-79-inch-long sheets of corrugated asphalt called Supersheet. The sheet roofing material offers do-it-yourselfers several advantages:

- The large panels go up a lot faster than conventional shingles. It takes 4.5 sheets to cover one roofing "square" (100 square feet).

- It's easier to install—you simply overlap adjoining panels, using one of two methods (see drawings on facing page).

- Because Supersheet is rigid, it requires no plywood underlayment or roofing felt. The panels are nailed directly to purlins (evenly spaced wood strips attached at right angles to rafters).

- It's relatively lightweight: Supersheets with a granular surface weigh 24 pounds each; smooth sheets weigh 18 pounds. (I'll talk more about finishes and available colors later.)

- Supersheet also can be used as siding—for a garage or outdoor storage shed, for example.

According to Supersheet's maker, Onduline, the product consists of a cellulose-fiber sheet that is thoroughly impregnated with asphalt under high heat. While the sheets are still hot, paint is baked on to provide a good bond. Supersheet is guaranteed not to leak for 25 years. Onduline says that

the panels retain their color for several years "except under extreme weather conditions." The company recommends spraying with a high-quality latex exterior paint when repainting becomes necessary.

Accessories available with Supersheet include ridge caps (79 inches long with seven-inch-wide "wings"); 46-by-79-inch translucent fiberglass skylights; closed-cell rubber closure strips (see drawing); ventilators and windows.

You've a choice of two fasteners when you put up Supersheet: Onduline nails with color-coded plastic heads and 2½-inch shanks, or special Woodgrip screws with ⅝-in.-dia. neoprene and steel washers.

Supersheets with a granular surface come in these colors: red, brown, green, black, and white. Smooth-surfaced Supersheets come in silver, red, brown, green, and black.

Putting it up

Supersheets can be nailed or screwed directly to existing metal or shingle roofs. If the roof surface is irregular (or if you want the additional insulating value of a dead air space), the sheets can be installed over wood nailing strips (such as 1x3's).

On new construction, you nail Supersheet to wood purlins. Onduline recommends that purlins be spaced as follows: for ⅓-pitch roofs (four-inch drop per foot) and greater, two feet on center; ½-pitch roofs (two-inch drop per foot), 18 inches on center; and ⅓-pitch roofs (one-inch drop per foot), 12 inches on center. Supersheet is not recommended for flat roofs (roofs with a pitch lower than ⅓). For more installation tips, see photos.

The sheets can be cut with a hand saw or circular saw; use oil or grease

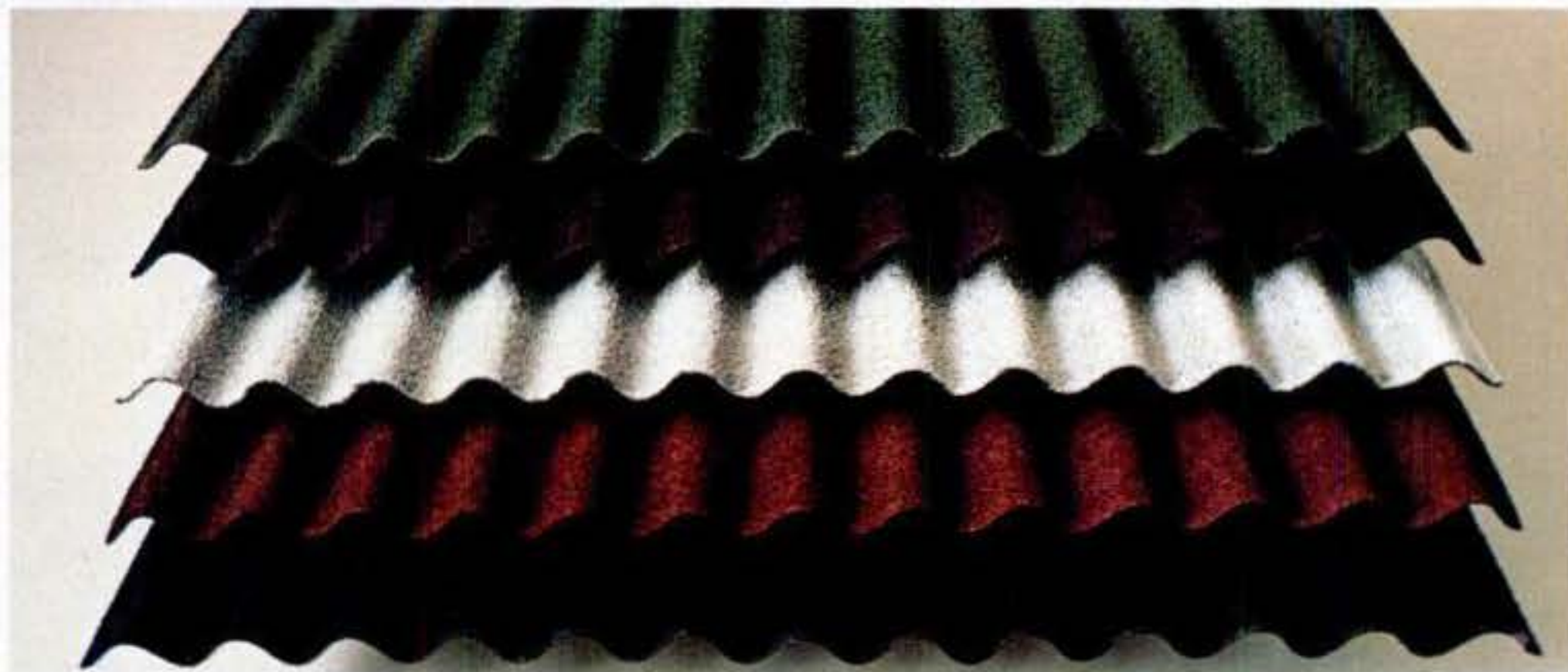


On new construction, Supersheet is nailed to purlins (top). Nail through top of every other corrugation across each purlin in middle of sheets; at end laps, eaves, and ridges, nail through top of every corrugation. Sheets have 13 corrugations—an average of 26 nails per sheet. Supersheet is rigid yet flexible (bottom).

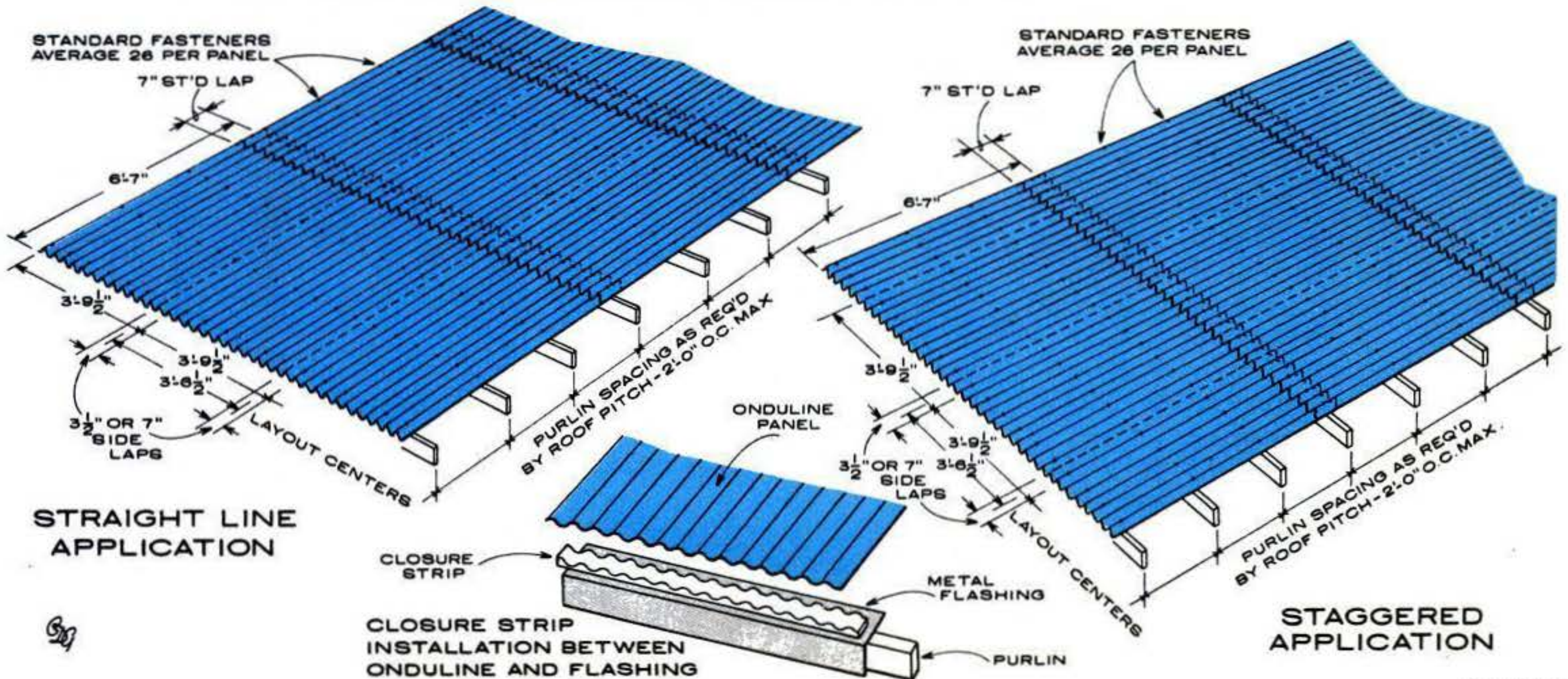
on the blade to prevent asphalt build-up on the teeth.

Cost of the sheets depends on how far they've been shipped from the factory. By calling retail outlets in several regions, I got a price range of \$9.25 to \$15.65 for the granular-surfaced Supersheet, and \$7.50 to \$12.55 for sheets with a smooth surface. Some, but not all, retailers charged more for colors.

To find out where Supersheet is sold in your area, write Onduline U.S.A., Inc., Route 9, Box 195, Fredericksburg, Va. 22401. P5



Brown, Supersheet's newest color, blends with popular earth-tone shingles for patio cover (above). Homeowner saved money since Supersheet needs no plywood underlayment or roofing felt. Full range of colors is shown at left: green, brown, white, red, and black. Onduline recommends two methods for installing the sheet roofing: straight line (below, left) or staggered (below, right). Staggered application (beginning every other row with a half sheet) lets you avoid nailing through four thicknesses at corners. In either, sheets are lapped one corrugation on sides, seven inches at ends.



Utility hauling? Do it with your **boat trailer**

A versatile homemade box turns a trailer into a cargo carrier

By GREG STONE

Having paid \$300 for a boat trailer and hitch, it irked me to see it idle much of the time. I thought of all the chores I could use a trailer for: hauling trash and brush to the dump, gathering seaweed to spread on the garden, or moving an occasional piece of furniture.

Why not have it all? Why not rig the boat trailer so that it could be converted into a utility trailer? I wanted a utility box that would be easily mounted and disassembled, yet be versatile and strong, and have an interior that could be easily cleaned of loose materials such as straw or wood chips.

My trailer is a Highlander T-14 8G, one of the smallest trailers. I normally use it for carrying a pair of Sunfish sailboats that are much lighter than its 800-pound weight limit.

If the box was to be easy to mount and the trailer's use frequently alternated, then mounting should require that none of the rollers for the boats, or other parts of the trailer, be removed each time. I accomplished this by building the floor frame of the utility box with 2×6's that rest on the outside trailer frame. (Thus the width of the trailer frame determined the width of the box.) This raised the bed of the box 5½ inches, clearing the rollers. I do have to lower two padded cradle blocks at the rear of the trailer, but that only requires loosening four nuts. Leaving the rollers in place also provides the means to secure the box to the trailer. The two cross braces not



only support the box floor near the middle, but they straddle a center roller, preventing the box from slipping.

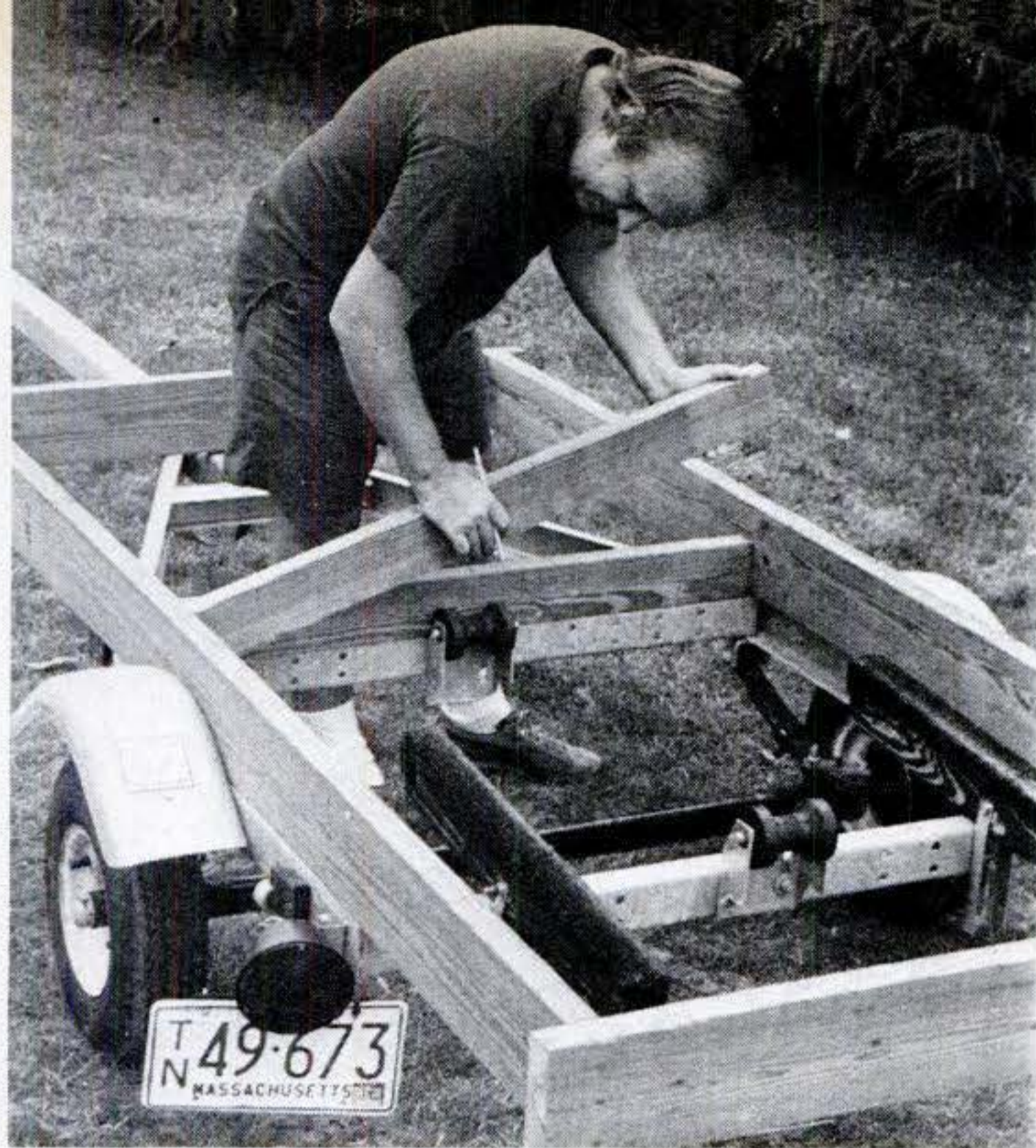
By extending the end 2×6's an inch and a half beyond the sides I was able to tie the upright corner 2×4 posts into both frame members, increasing the stiffness and strength of the posts.

remove loose cargo like this. Sides come off, too, to accommodate wide loads.

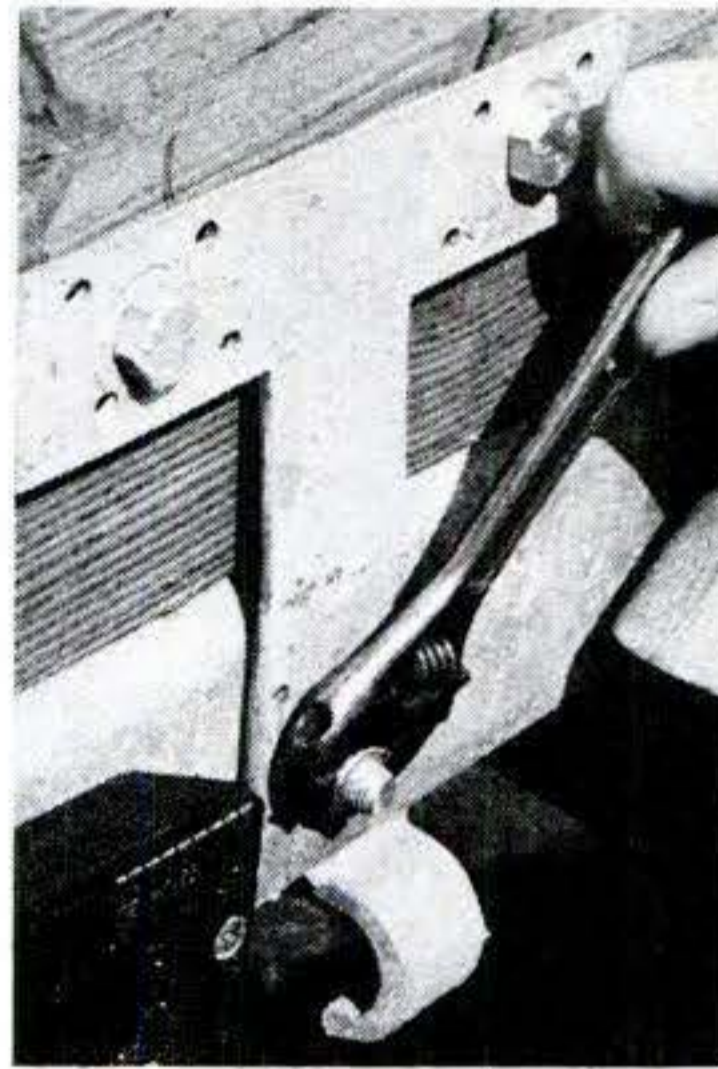
The floor of the box is ¾-inch exterior-grade plywood.

The floor frame is bolted to the trailer with two ½-inch-thick galvanized T's (see photo). For added safety, near the center of the front 2×6 are several long, permanently-mounted bolts that secure a chain that is looped around the tongue of the trailer.

Copyrighted material



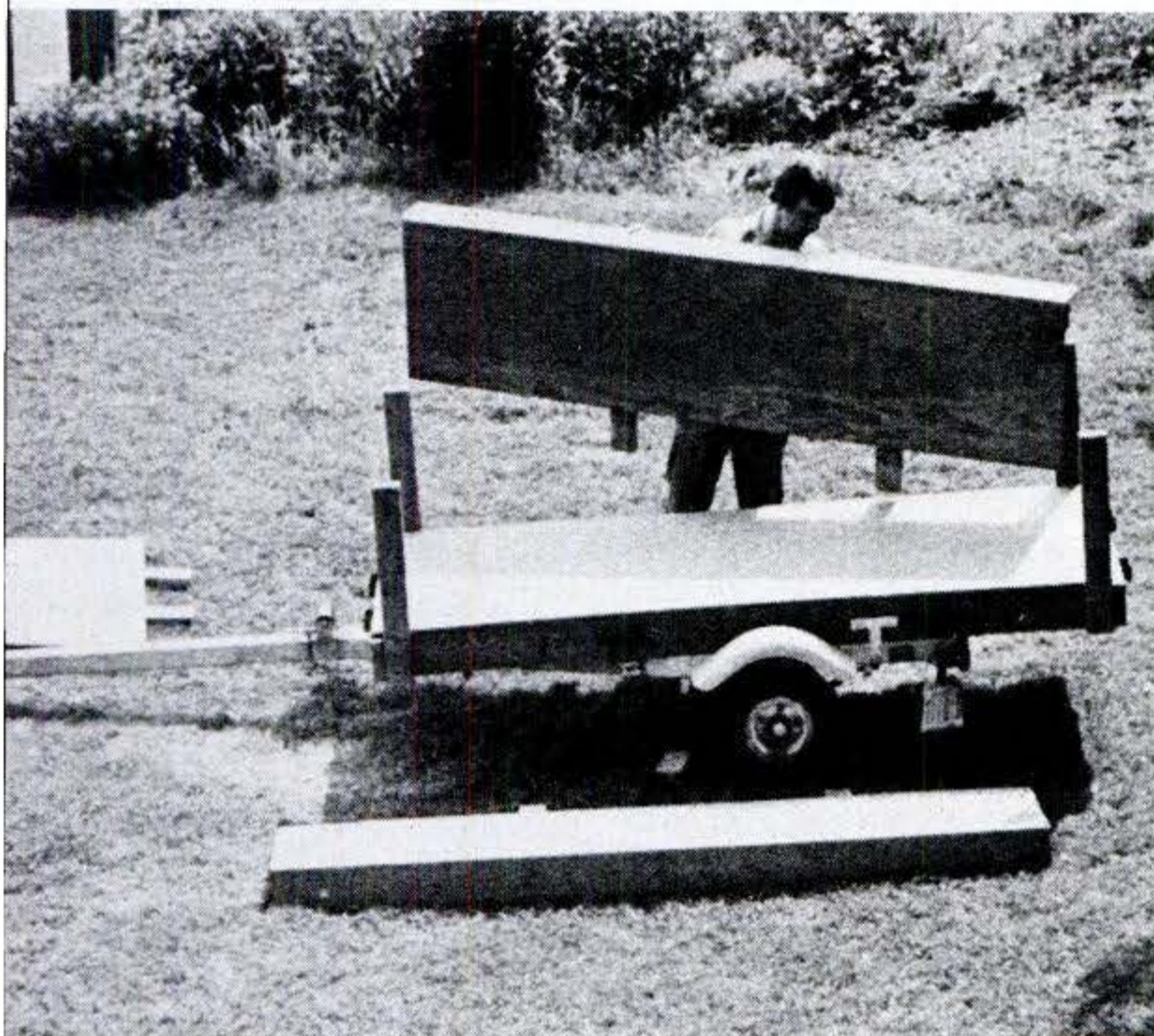
Cross braces fit around trailer's rollers to secure frame to trailer (2×4's are shown here, but 2×6's would support the floor).



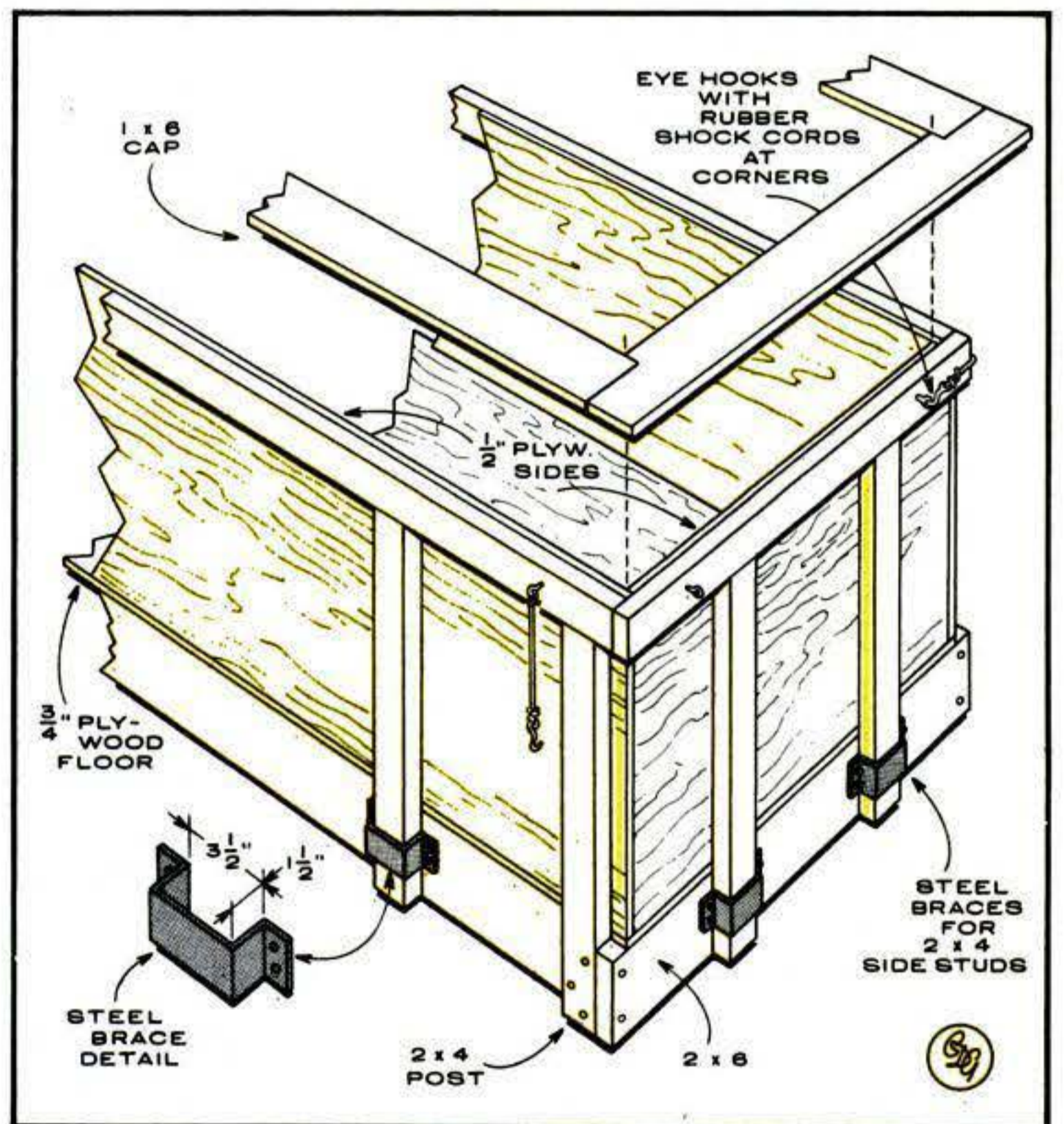
Heavy-gauge galvanized T's are used to bolt the frame of the floor to the trailer body.



Strong safety chain is looped around the trailer tongue and bolted to the frame.



Assembly of box is one-man job, once platform is in place. Sides and ends slip into brackets, shock cords snug up corners.



The sides and ends of the utility box were made with 2×4's and ½-inch plywood (see illustration). A 1×6 cap was added flush with the inside of the plywood.

Because I wanted the utility box to be versatile and easily assembled, I made the sides and ends removable. The vertical 2×4's of the sides extend beyond the ½-in. plywood and slide into heavy steel braces made for me at a welding shop. By using plywood and keeping all the framing on the outside, the interior was made smooth and is easy to clean.

All lumber in the utility trailer is "Outdoor Wood," Kopper's name for its pressure-treated lumber. There's no need to paint it, and the box can sit outdoors for years without mainte-

nance. All nails and other hardware are galvanized or rust-treated. The four corner posts should be bolted to the frame; nails can be used for other joints.

To convert the boat trailer to utility trailer, I just lower the cradle blocks and drop the base onto the trailer, making sure that the center braces straddle a roller. Two bolts go through the metal T's and the chain in front is secured. Then the sides and ends slip in place. It takes only about five minutes, although it is easier with two people.

After using the trailer a few times I made one important addition. I put screw eyes in the 2×4's around the rim and use heavy rubber shock cords at each corner. These additions give

all the strength the box needs.

When you construct your trailer box, be sure to balance the box on the trailer to reduce strain on the hitch. Also, when hauling, distribute the load for balance. Know the weight limits of your hitch and trailer. In my case the hitch will support twice the 800-pound limit of the trailer. Since the box weighs almost 200 pounds, my load limit is 600 pounds.

In these first few months, the box has proven itself well worthwhile: I've used it to pick up wood chips from sawmills, move old furniture, and haul refuse to the dump. I leave the sides off for carrying extra-wide loads and the ends off for extra-long loads. And sometimes the box comes off and the trailer gets used to haul my boats. **E**

Landsailer for the '80's

A second-generation sail car by the designer of our popular Manta

By **PAUL BOLON**

PHOTOS BY PETER STEVENSON

The PS Vector is Peter Stevenson's seventh home-built sail-car design—and his favorite. Eight years ago Stevenson introduced a new concept for a compact land sailer, the PS Manta [PS, March '72], which became the most popular home-built sail car in the country. But the new Vector is lighter, faster, easier to build, and even cheaper than Manta.

Vector has a number of advanced design elements. Sails are 20-mil wo-

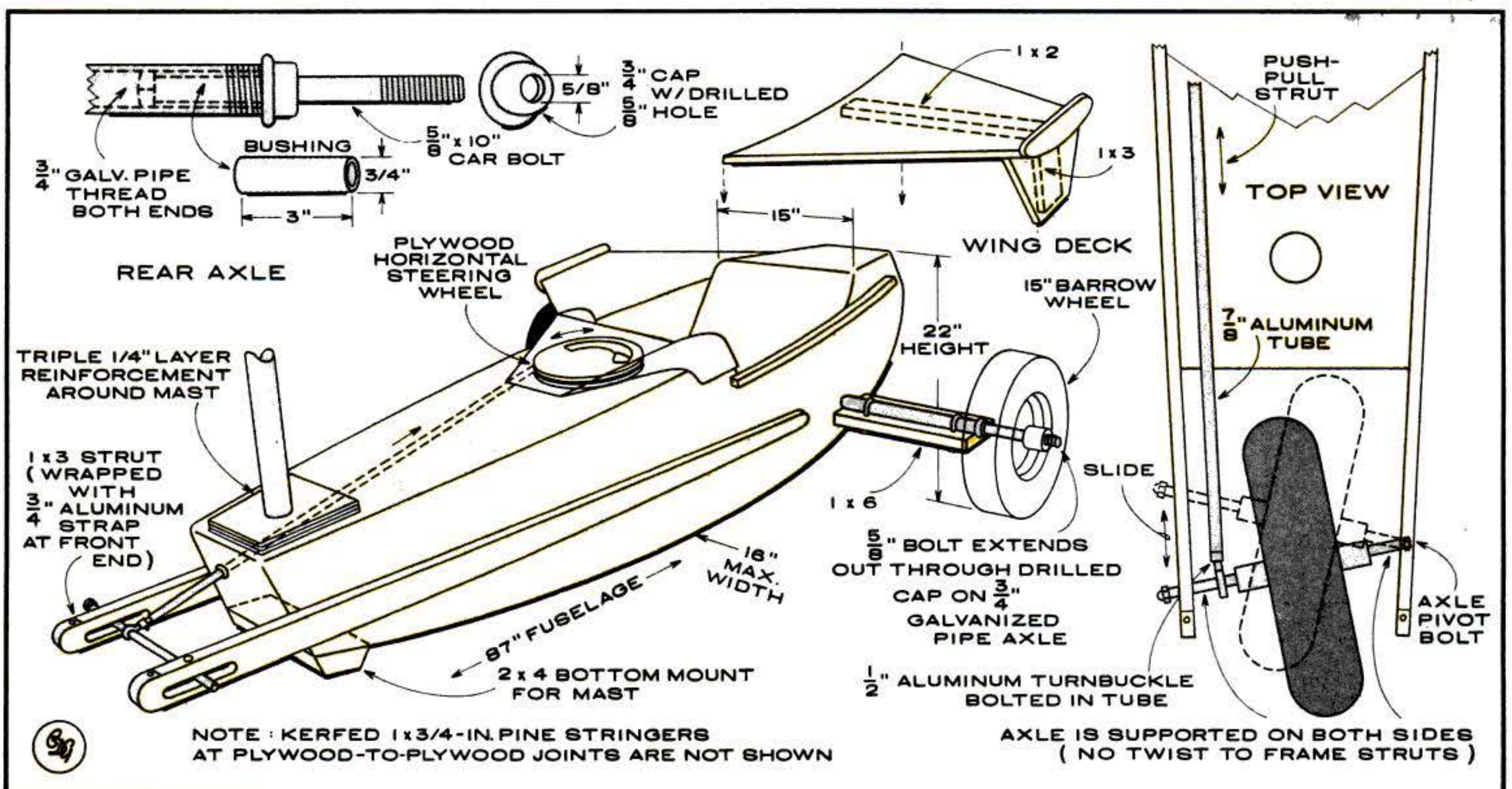
ven polyethylene fabric—the kind used for heavy tarpaulins. Incredibly, the sail requires no stitching or gluing. The fabric is lapped on two edges to accommodate the booms, holes are cut through both sheets at once, and, with holes aligned, high-quality duct tape is applied over each side. It's hard to imagine a quicker, cheaper construction, yet the rig has withstood the roughest racing conditions. The horizontal steering wheel is another new feature, an adaptation from ice boats, with a responsive direct linkage to the front wheel.

The body of Vector, like the Manta, is a stressed-skin construction of 1/4-in. plywood. All materials are standard lumberyard stock: Wheels are 15-in. wheelbarrow replacements; mast and

booms of the lateen rig are two-inch aluminum irrigation pipe; lumber is nominal 1x2, 1x3, and 1x6. Ordinary hand tools are all you need to build Vector. Overall length is 100 inches and sail area is 74 sq. ft. Fully rigged, Vector weighs only 97 pounds.

Its performance comes as no surprise. Vector races against the 20-foot fiberglass specials costing 10 times as much and boasting radial racing tires and disc brakes. Because of its light weight and narrow width, Vector has outstanding acceleration and maneuverability. Like most sail cars, it's easy to learn to control, and is stable even in strong breezes.

Stevenson estimates that a Vector can be built in two or three weekends with materials costing \$200. **P 5**





Vector's acceleration and maneuverability make it fun within the confines of parking lots as well as on longer reaches like abandoned airstrips. Wide tires can negotiate beaches and dunes with hard sand. Wing decks (top) aren't decorative or aerodynamic; they're for hiking out in a strong crosswind or just getting out of the cockpit. Vector is so fast that it's the first sail car for which Stevenson has designed brakes. Its 64-inch width allows easy riding on car or van roof (above). On the ground, Vector takes about five minutes to assemble. Detailed construction plans \$7 from Stevenson Projects, Box 584, Dept. V-36, Del Mar, Calif. 92014.

Copyrighted material

1 sail + 1 trike =
**a 25-mph
prairie
schooner**

By **BEN KOCIVAR**

There are no oceans to conquer out in Kansas, but there's plenty of wind for sailing on land. What do you do when the wind dies? Randy Schlitter of Hays, Kans., has a solution: a sailing tricycle with pedal drive, which he has dubbed the Sailtrike. His RANS Co. (408 Milner, Hays, Kans. 67601) builds both single- and two-seater versions.

"You zip along by wind power on little-trafficked highways, parking lots, hard sand dunes, and unused airport landing strips," Schlitter says. "When the wind drops under 10 mph, you supplement wind power by pedaling." Most people can cruise at 12–15 mph on pedals alone, he says. (Trikes are legal on roads; they're classified as bicycles.)

The 89-lb. one-seater has 30 sq. ft. of sail area. The 120-lb. tandem unit has 47 sq. ft. Trikes can handle winds up to 45 mph with a recommended top vehicle speed of 55 mph. Like ice boats, the machines can sail two to three times faster than the wind speed on a broad reach (wind blowing across the line of travel). Trikes sail up hills, but might need pedal assistance on the steeper ones.

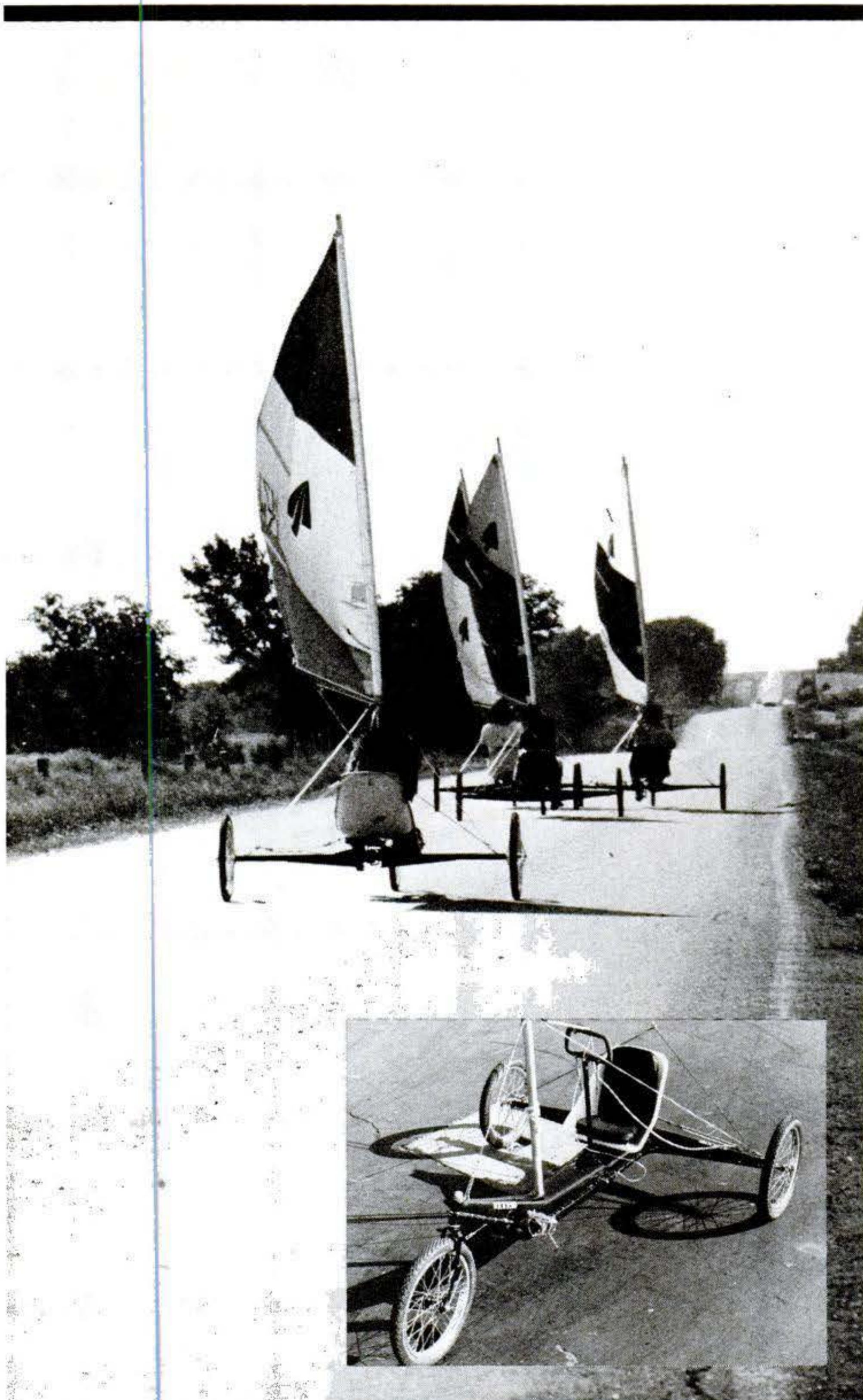
With practically no sideslipping, trikes point to within 20 degrees of the apparent wind direction, Schlitter claims—much better than high-performance sailboats, which can make about 35 degrees. Best performance of the trike is in steady crosswinds.

Interesting longer cross-country trips are on record, too. Leaving Hays, Victor Woodward cruised northwest in high winds, headwinds, and hilly terrain through Nebraska, Iowa, and Minnesota. He reported covering 50–100 miles a day carrying 25 lb. of luggage. A couple in a tandem Sailtrike had only light winds but still managed to cruise from Tulsa, Okla., to Pensacola, Fla., in two weeks. Typically, 10–20 percent of a long trip is unsailable due to weather or terrain.

The trike has a bendy mast that absorbs strong puffs of wind as well as the gusts of passing vehicles. Although the low center of gravity is necessary for stability, it is possible to "fly" the windward wheel the way catamarans "fly a hull."

Trikes are constructed with a tubular steel frame or a fiberglass shell. They have three-speed pedaling, specially designed bucket seats, steering wheels, and coaster braking through the pedals. The trike assembles with only six bolts. Four models are priced from \$565–\$1395.

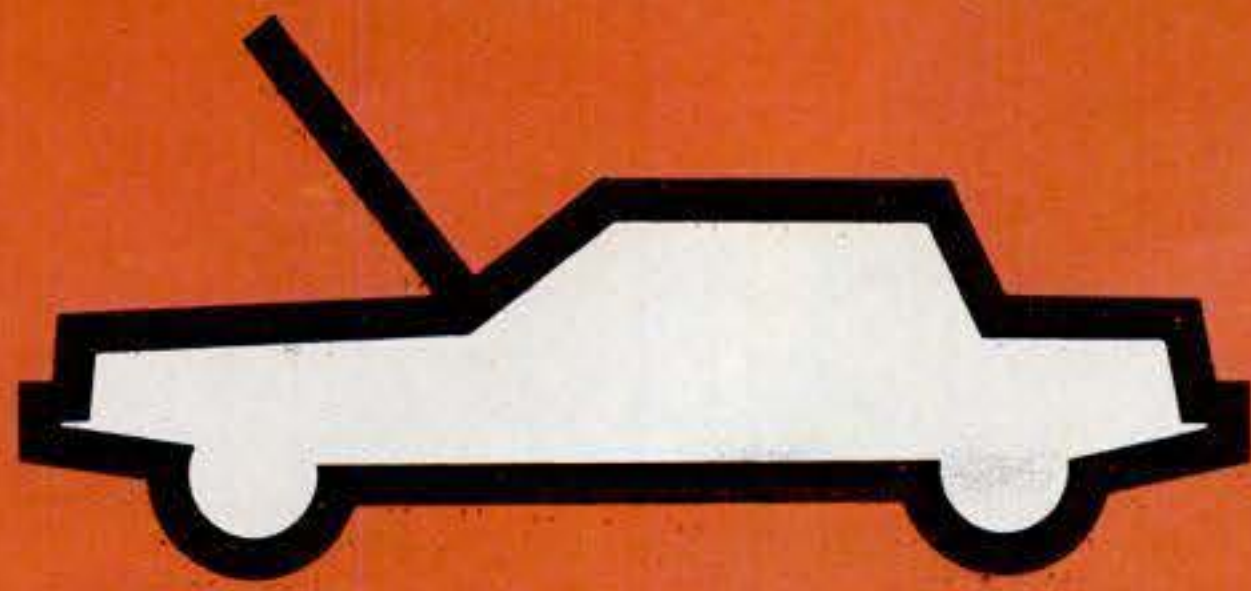
A neat way to save fossil fuel and use wind- and man-power—but mostly the attraction is pure fun. **E**



Sailtrike's exciting performance is due to its light weight and low rolling resistance.

On flat surfaces, Sailtrikes reach 25-mph speeds in only 10-mph cross breezes.

Car Care News



SPECIAL SECTION

- Car sparkle: PS guide to waxes and sealants
- Trouble-shoot your electronic ignition
- Fight car rust
- Grading tire quality: New federal standards
- Tuning for max mileage



SPACE AGE PROTECTION FOR YOUR CAR'S FINISH.
THREE LAYERS DEEP. 24 MONTHS LONG.



THE NEW POLYSHELL™ SYSTEM FROM TURTLE WAX®.

Weather. Pollution. Oxidation.

They all take turns beating the shine off your car's finish. But now the system is on your side—the PolyShell system from Turtle Wax.

An offshoot of space technology and Turtle Wax know-how, the PolyShell system locks three layers of protection between your car's finish and things that can kill it. Bonded

layers of Polymers and Silicones prime, shine and seal the finish.

There's even a Reactivator, which you apply every 6 months to bring the finish up to full shine and full protection for 24 months.

The PolyShell system is easy to apply. You don't need buffers or special tools. All the essentials are included. And it works for all car finishes.

Get the system on your side today. Ask for the PolyShell system from Turtle Wax.



Car sparkle

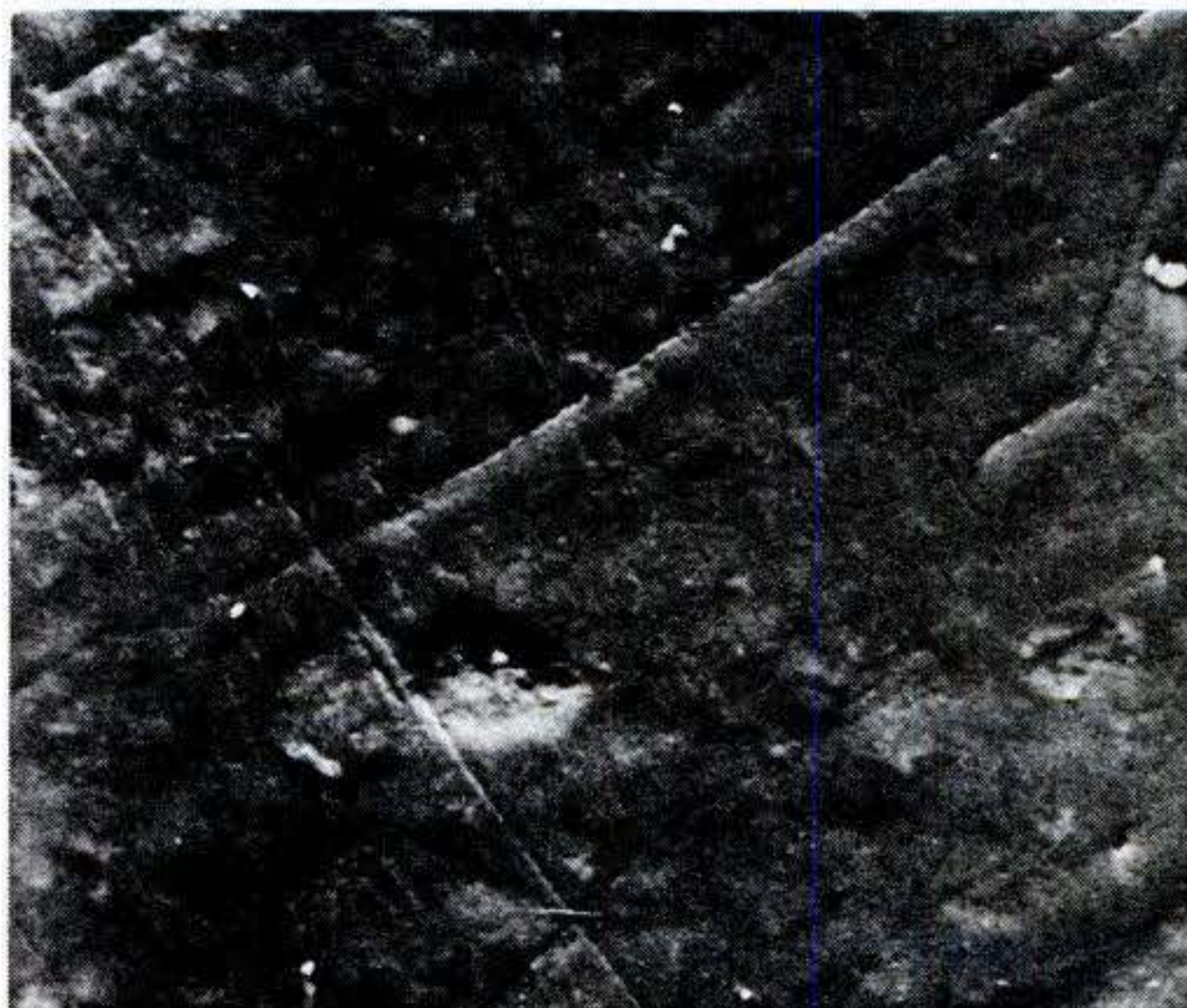
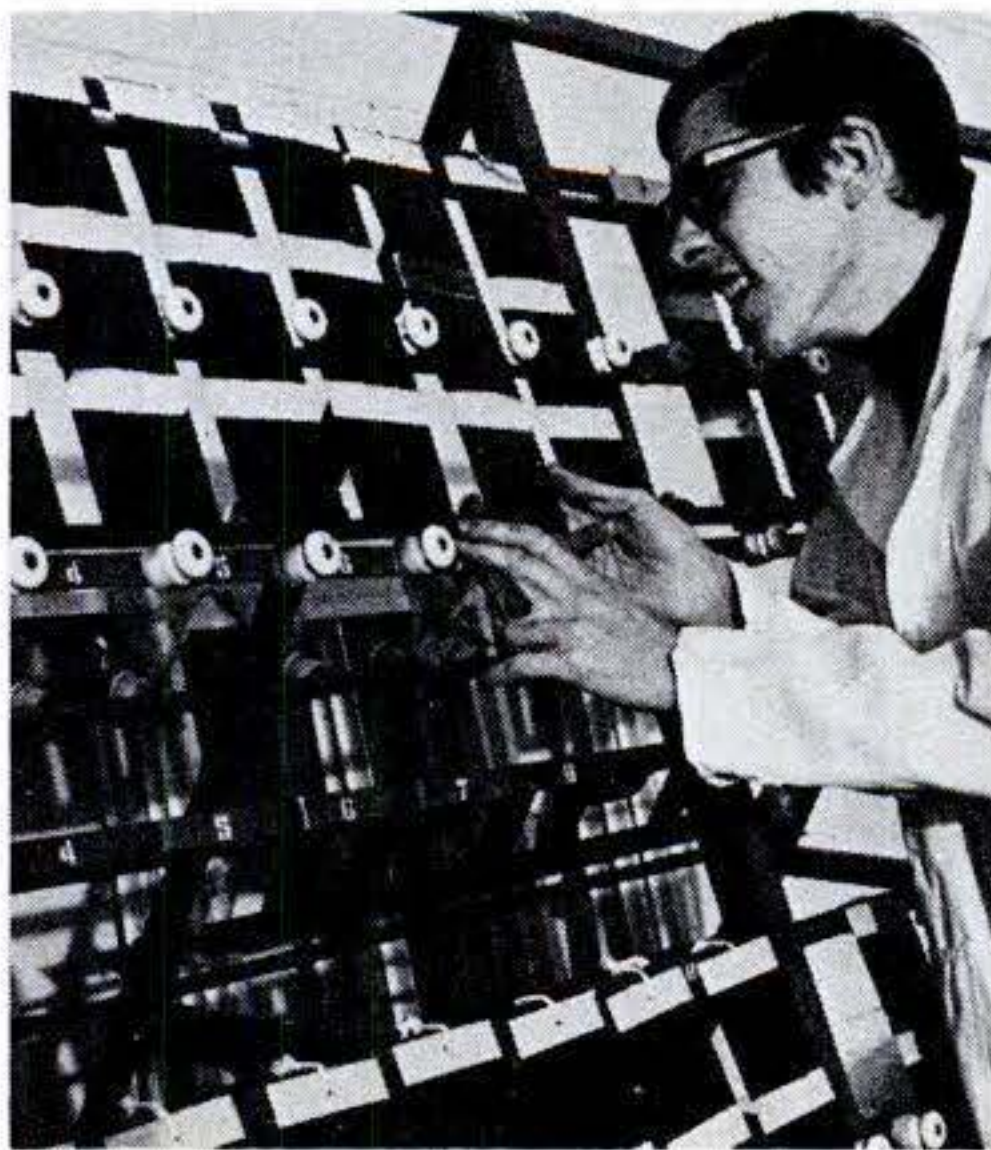
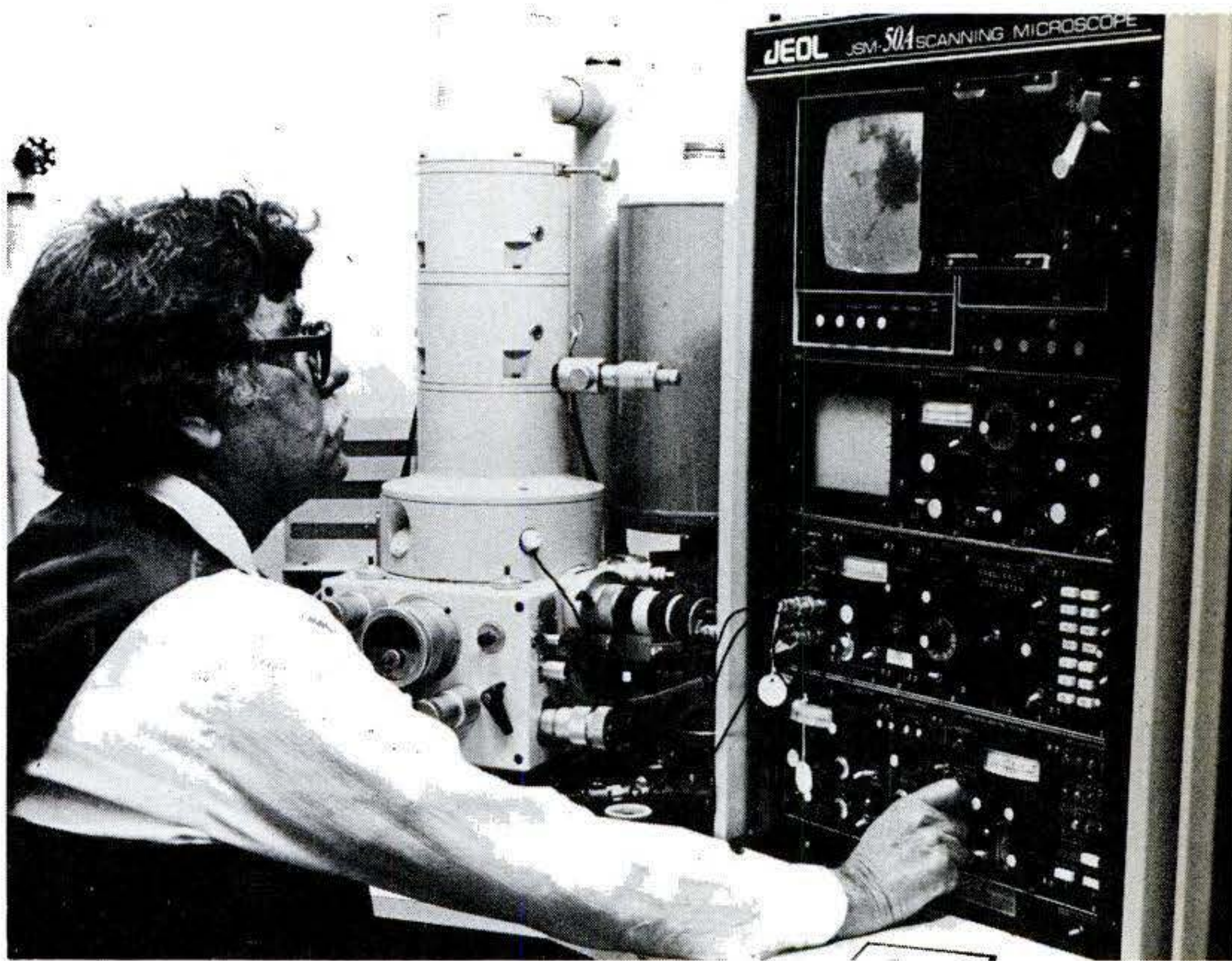
A PS guide to waxes, sealants, and cleaners

By ED JACOBS

Car paints, despite impressive improvements over the past 20 years, still need maintenance to survive the elements and road grime. There's a bewildering array of waxes, cleaners, sealers, and specialized products on the market, some of which are claimed to eliminate routine maintenance. But do they? What can you do to protect your new car's exterior finish? Indeed, *can* you protect it? Are waxes a waste of time and money that could be dispensed with by making a monthly trip to the car wash?

To get the facts, I turned to the auto and chemical companies. From engineers, scientists, coatings experts, and service specialists, I learned some surprising things about finish protection and car waxes. And I got some solid advice on how to take care of new and used cars.

First, understand that the acrylic
Continued



Scanning electron microscope being used by Ford engineer (above) yields high-magnification images of test samples, such as 300x view (left) of sealer/lusterizer-coated finish on a used car. Long-term weathering of new paints, or coating-treated and untreated samples of known paints—as at ECP, Inc.'s laboratories (far left)—can be very revealing. Research by auto makers, paint manufacturers, and chemical companies is constantly in progress.

Copyrighted material

There's something for every car, classic or contemporary

lacquers and enamels now used by all U.S.—and some foreign—makers are far better than those of just a decade or so ago. In fact, they have two or three times the durability and gloss retention of earlier finishes. That's why today's cars look so much better for so much longer.

Products now on the market to maintain or improve car finishes can be broken down into several categories, including the familiar rubbing compounds, polishing compounds, cleaners, cleaner/waxes, and waxes (more detail later). But there is now a new and different kind of product: the sealer/lusterizer. This is usually designed to be professionally applied at a new-car dealership—although several do-it-yourself products are now on the market. The professionally applied products are expensive, costing \$100–\$200 or more. Do-it-yourself products cost from \$6 to \$40.

There is also a host of specialized products to care for other auto parts, such as vinyl and chrome cleaners, fabric treatments, and so on. But paint gets the most attention.

Most people have a couple of goals in mind when it comes to paint. They want to make the car look better, and to protect the finish and make it last longer. But what can the jungle of finish-care products do for your car? And—particularly in view of the huge price differences—which is best for your car? Let's look at each one.

Sealer/lusterizers

This new class of products has been getting most of the publicity lately, partly because of the high price tag on some of them, and partly because of the startling claims made by a number of the manufacturers: "extramolecular action . . . synthetic glass . . . bonds with the paint . . . ultraviolet protective shield."

Essentially, these sealer/lusterizers claim to protect your car's paint and/or eliminate waxing for years. Most have guarantees, some dependent on following a regular maintenance schedule. Some offer only a refund of the purchase price of the product itself, while others have liberal no-mileage or repair-cost limitations. Some guarantees require periodic inspection by the dealer.

There are dozens of sealer/lusterizers on the market, far too many to look at individually. So let's look at three of the bigger companies' products.

Walter Fiveson, president of Polyglycoat World Enterprises, the maker of perhaps the best-known product, says Polyglycoat is "a total lubricant

that penetrates and becomes a permanent part of the paint, slowing down the dehydration process that degrades paint." He also says it deters ultraviolet-ray deterioration. His product carries a three-year warranty against "weather-induced cracking, flaking, deterioration, fading, oxidizing, and loss of gloss," but you must treat the car with Polyglycoat Sealant Cleaner every two or three months in normal use.

Auto Armor Paint Protector is made by ECP, Inc., and carries a three-year paint-protection warranty. According to ECP development chemist Mike Dwyer, Auto Armor "deposits a thin polymeric film on the finish which resists oxidation better than hydrocarbon waxes or the acrylic polymers in the paints themselves." Surface retreatment with renewer is required every six months.

Ted Greenseid, president of Nationwide Ultra-Seal, Inc., says that Ultra-Seal Paint Sealant "prevents the paint from deteriorating from the sun's ultraviolet rays, salt, fog, pollution, and chemical fallout, and also eliminates oxidation." His product carries a three-year transferable warranty, with no mileage or repair-cost limitations; and no maintenance is required.

What's in these sealer/lusterizers? The formulas are secret, of course, but those that do mention ingredients all list silicones—which are also found in many conventional car waxes and polishes (whether or not they're listed on the label).

Many of the dealer-applied sealer/lusterizers specify surface preparation—such as machine buffing with a mildly abrasive compound—prior to application. Some do-it-yourself types specify the equivalent, although not necessarily with a buffing wheel.

Many products require regular washings and surface treatment with "conditioners" or "reactivators." Of these, some that mention ingredients include mild abrasives and silicones.

Do these products do what their makers claim? There is no doubt that they can put a beautiful shine on your car. But there is less evidence to back up the claims that they prolong the life of your car's paint job. We asked for such evidence. Some companies supplied lab reports of various kinds, indicating, for example, that the shine remained brighter with the product in question than with conventional waxes. But we have seen no really convincing lab or experimental evidence to back up the claim that they somehow bond with or become a part

of the paint more effectively than do conventional waxes, or that they prevent the damage ultraviolet light does to your paint. Some manufacturers told us that scientific evidence wasn't that important, that customers' testimonials are all that really matter, since lab tests aren't "real world."

The domestic car manufacturers and major chemical companies I talked to do not share the enthusiasm of the sealer/lusterizer manufacturers, and one company declined to comment on them.

Gene Leithauser, senior engineer in charge of paint and corrosion systems for GM's Fisher Body division, said: "We place them in the same general category as polishes and waxes. They make a nice-looking finish, but we haven't found any polish that preserves a car's finish."

Eric Beynon, technical manager of chemical products for Union Carbide, based his views on long-term, side-by-side comparisons of adjacent sections of cars used daily on the road. He feels that "these products do the same things as regular car waxes and polishes." He also points out that many of them require retreatment at regular intervals, and that, "in effect, you are repolishing the car—regularly; and, if you do that with any good car polish, you'll maintain your car's good looks and appearance."

Norm Price, manager of coatings systems for Chrysler, said: "The widely advertised sealer/lusterizers do nothing to *protect* your finish." He cited long-term, side-by-side exposure tests (like those of GM and other manufacturers) in which identical production-line-painted panels were set out in parts of Florida where the intense sunshine, high humidity, and salt air combine to make a very harsh environment. Treated and untreated samples were regularly checked for effects, and no differences were found.

While the protective value of sealer/lusterizers may be controversial, they certainly deliver outstanding appearance. Whether this striking shine is the result of the materials or of the method of application is hard to tell, though. Many call for surface preparation with a mildly abrasive compound and buffing wheel, which smooths the surface, so there is an immediate improvement in *appearance*.

Continued

No matter what part of your car you want to clean, shine, or dress up, there's a specialized car-care product designed to handle it—for any car from a \$77,600 Rolls-Royce Silver Shadow II to PS Art Director Dave Houser's immaculate 1953 MG-TD.

PHOTO BY GREG SHARKO



Turtle Wax
PolyShell
system

Shines
in Sun

TURTLE
EXTRA

3M
Clean
It Right

Meguiar's
HOT
WAX

Rally

Classic Car Wax

Rally

Polymer
Sealant

mycann
DAVES MG
NEW YORK

465-JYZ

If you want a sealer/lusterizer, but if \$100-\$200+ is more than you care to spend, there are several do-it-yourself products available. Among them are Canarbo Jell, Remo Shine, Polymer Sealant, Gloseal, and Power Gloss. They have just been joined by a three-step PolyShell kit from Turtle Wax—about \$19.95 at Sears.

Waxes instead?

If you're not interested in a sealer/lusterizer for your new car, you're probably considering waxing or polishing with the more traditional products. Although waxes and polishes are often lumped together in a single category, there are actually five different types of products involved. *Rubbing compound* is a highly abrasive paste for removing deep stains and scuff marks, or in rubbing out a new paint job. *Polishing compound* is a milder abrasive paste for lighter stains and blemishes, or for rubbing out spot paint repairs. *Cleaners* are liquids containing still finer abrasives, and are intended for heavy dirt, traffic film, insects, tree sap, and so on. Strictly speaking, these all belong in the polish category. *Cleaner/waxes* are the familiar one-step products that contain both cleaner and wax, and are fine for most jobs. Finally, *waxes* are just that—combinations of several different types of waxes—and may contain silicones. They must be applied on a freshly cleaned surface.

These products can erase that dull, worn look and restore something approaching a showroom shine, but, contrary to what many people think, they do relatively little to extend the life of your car's finish. That's because the ultraviolet radiation in sunlight is the single biggest factor in the normal deterioration of automotive finishes. (Industrial fallout can be worse, in some areas.) Unfortunately, you can do little to protect your car from ultraviolet—except keep it out of the sun.

ECP's Dwyer says, "No film—like a wax or paint sealant—can prevent ultraviolet degradation in paint." Union Carbide's Beynon explains, "Even if you put an ultraviolet absorber in, the layer is so thin that it doesn't do anything for you." (The colored paint on your car is 0.004 in. thick, but a coat of wax would be measured in angstroms, and $1\text{A}=3.937\times 10^{-9}$ in.)

Waxes and polishes don't keep your paint from getting dirty or covered with road grime, but they do make it easier to remove. Frequent washings to remove dirt, road grime, and industrial fallout will help to forestall deterioration. But don't get carried away; overly frequent washing can promote corrosion. Going over the car every few months with a good automotive wax or polish will remove grime and any detergent buildup.

If you think a quick trip to the car wash is the best way to handle washing the car (whether or not you plan to wax it), I've got some more bad news for you: It could be harmful. If the brushes are adjusted for small or mid-size cars, and you own a full-size car, the extra spring pressure on those brushes could mean marks on your paint. In addition, some car-wash detergents could be detrimental, and the solvents in some "hot wax" processes can harm vinyl tops.

It's really best to wash the car yourself, in the shade, using cool water and a specially formulated car-washing product or mild dish soap. Laundry detergents are highly alkaline and can cause chemical reactions, especially with aluminum (among other things, the sparkle in your metallic paint).

If you decide it's time to wax the car, almost any good automotive wax or a cleaner/wax will do fine.

What about a used car? Well, if the finish is in good shape, treat it like a new car. If it's showing some deterioration, try a wax with a high concentration of polishing abrasives. If that

doesn't work, try polishing compound. If everything else fails, use rubbing compound, but it's so abrasive it can easily go right through the paint.

Vinyl cleaners

Paint isn't the only thing you're likely to have on the outside of your car. Vinyl tops require some special precautions. Under normal conditions, the most important thing for your vinyl top is to keep it clean with frequent washings, just like the paint. But don't wax it—ever.

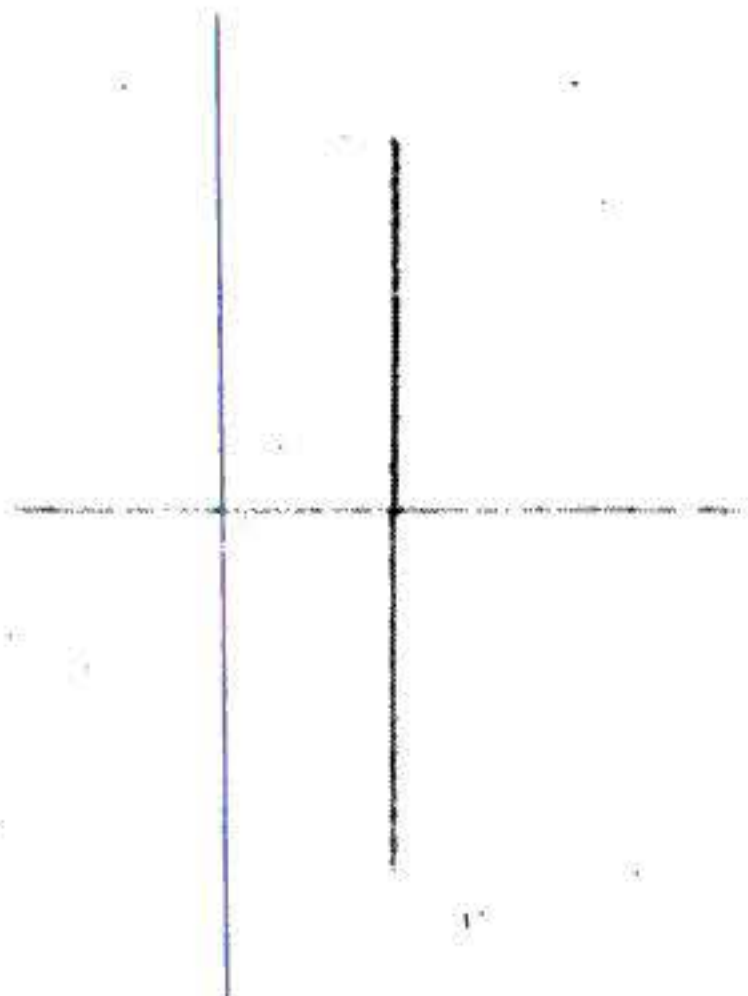
Nearly all car waxes/polishes contain fine abrasives that can damage the thin coating of clear acrylic that covers the vinyl to give it a high gloss and shield it from abrasion and staining. Strip away that coating and you'll begin rapid deterioration. Use only vinyl-compatible cleaners and treatments, and don't go near a vinyl top with household solvents or cleansers.

You'll find a special product for everything else on the car, of course, but be sure to check your owner's manual before you use it. Not everything is what it seems anymore. For instance, much "chrome" trim is now "metalized" plastic. Chrome polish can destroy it in an instant.

The interior of your car also needs some care from time to time. If you've got a vinyl interior, everything said about vinyl tops applies. Incidentally, vinyl, cloth, and leather interiors are extremely resistant to soiling and staining, so the experts I talked to saw no need to treat them with stain repellants or similar products.

Other new products

In addition to those new products already mentioned, there are a number of other new products coming along. Polyglycoat will soon be marketing a liquid cleaner, a wash-and-shine concentrate, and a liquid glaze through J.C. Penny, Sears, and Montgomery Ward—for people who didn't get any Polyglycoat treatment at the dealer. (The company's sealer/lusterizer will not be sold over the counter.) Clean 'N Glaze and Polish 'N Glaze are 3M professional products now being sold to do-it-yourselfers for \$3.85 per pint. Clean 'N Glaze is for appearance-improvement on new cars; Polish 'N Glaze is for used cars. Dura-Glo polymer sealant from J.C. Whitney costs \$19.95 per pint, enough for two cars. Vinyl Guard 100 is said to preserve vinyl, rubber, and leather, and it comes as a complete kit, with cleaner, dressing, scrub brush, and sponge. Classic Gold is a spray-on liquid wax intended for paint and all trim. It comes in a trigger-pump bottle, and is guaranteed to shine for a year. 5



Not touching up scratches, nicks, and chips can promote serious corrosion



damage to paint and underlying metal. These test panels show five years' worth.



If you drive a van, pickup or 4x4, this picture is worth a thousand words.

A few well-chosen words about the new Monro-Magnum®.

As you can plainly see, the new Monro-Magnum® is almost twice as big as the standard one-inch shock on the left. That means Monro-Magnum has a bigger bore. Bigger piston. And almost twice as much oil capacity. Now, draw your own conclusion. Which

shock will give your truck or van a firmer, more stable ride?

Here's an offer that also speaks for itself.

We think that, either on or off the road, no standard shock built measures up to the Monro-Magnum. And we're backing that with this special offer: "If in 60 days you don't agree four Monro-Magnums give you the best ride you've

ever had, Monroe will replace them, no charge, with any comparably priced shocks." Offer extended to October 31, 1980. See your Monroe dealer for details.

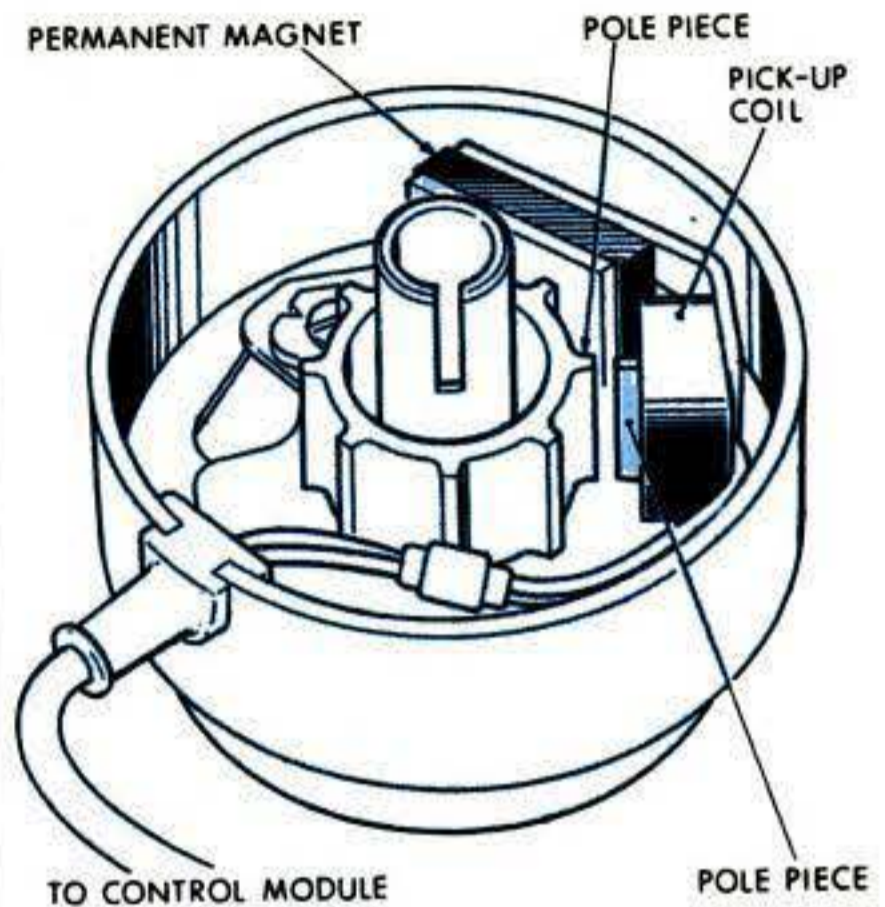
**AMERICA
RIDES
MONROE®**

Monroe Auto Equipment
Division of Tenneco Automotive

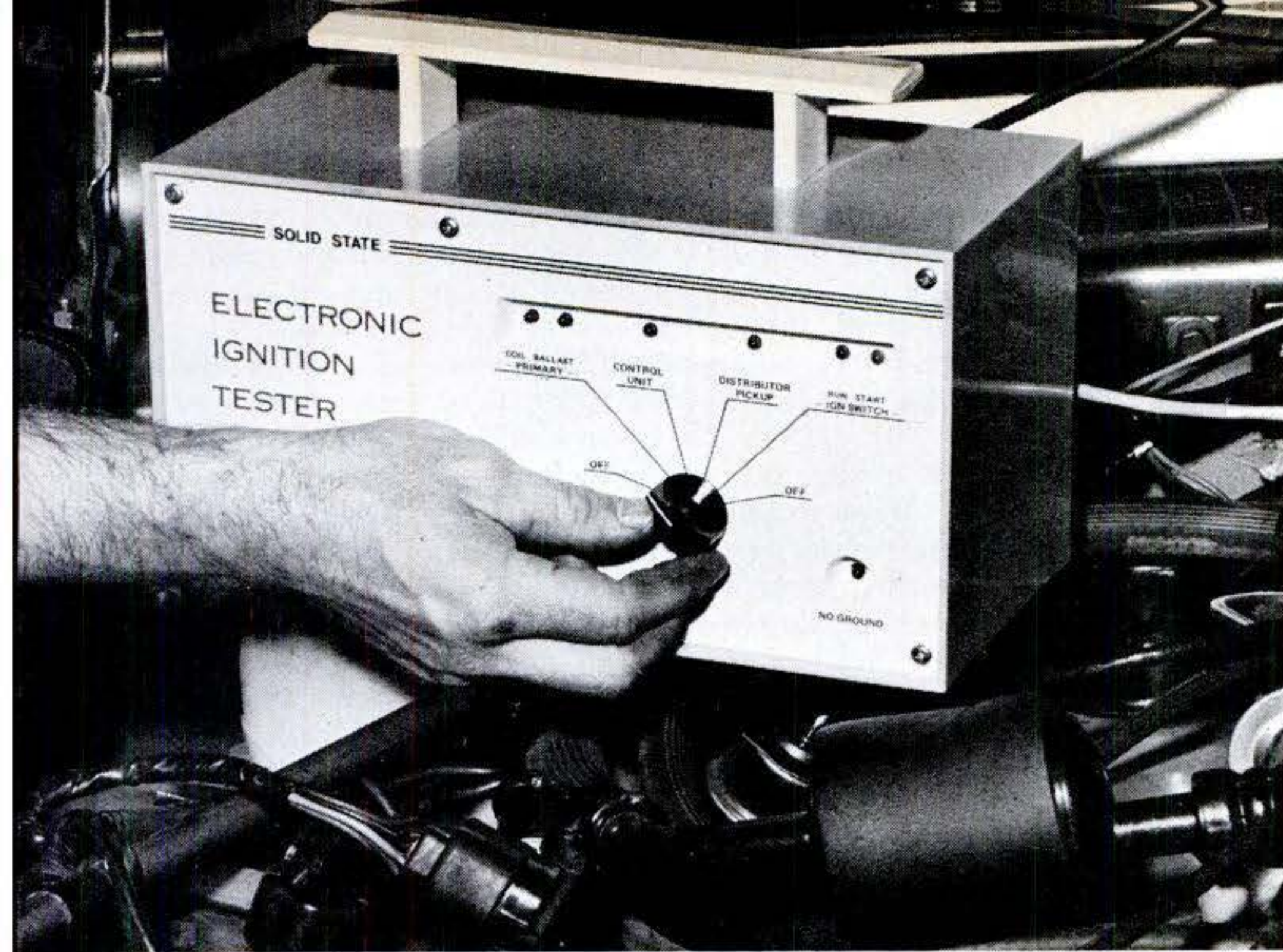
Copyrighted material

Uni-Tester costs \$307 with adapters for five different ignition systems. It's available from jobbers and Mopar dealers. Write to Travis Parr, Chrysler Electronic Products, 102 Wynn Drive, Huntsville, Ala. 35905, for more information.

Inside the distributor

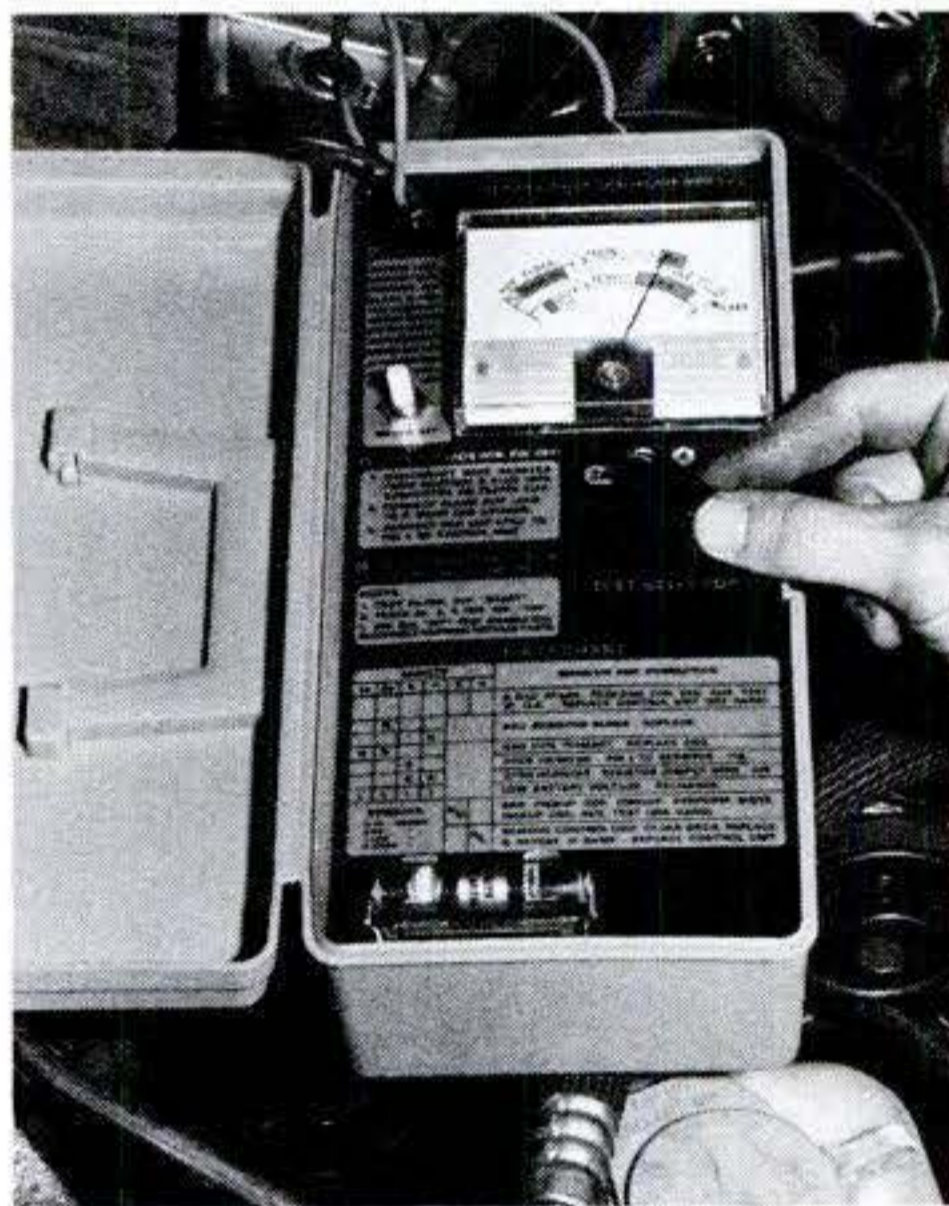
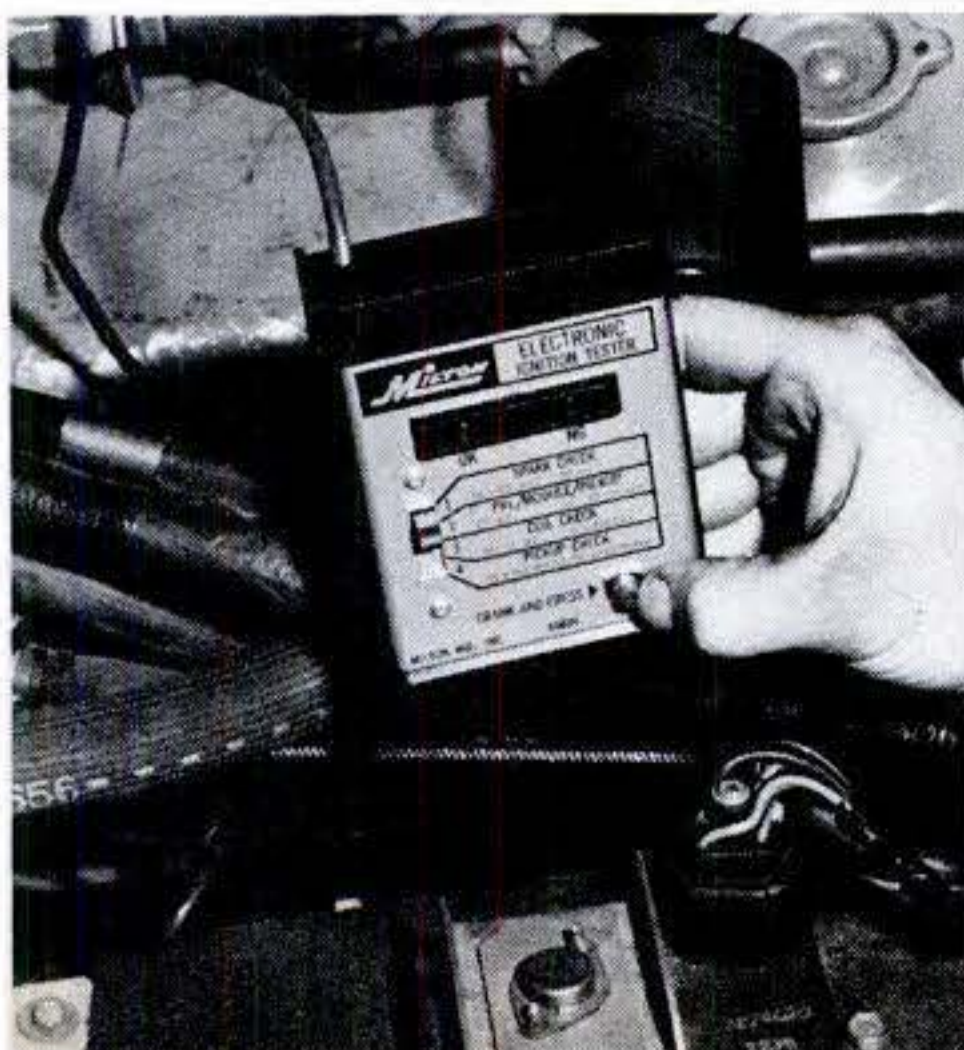


Magnetic signal generator consists of two basic parts—a round gear-like attachment on the distributor shaft (Chrysler calls it a reluctor, GM a timer core, and Ford an armature), and a pickup assembly. The signal generator above is Chrysler's. The pickup consists of a permanent magnet attached to a piece of metal (pole piece) surrounded by a coiled wire (the pickup coil). The coil ends are attached to what Chrysler calls a control unit (GM and Ford call it a module). The coil is insulated from the pole piece. Because of the permanent magnet, there is always a magnetic field around the pickup coil. As the reluctor rotates—which it does when the engine is being cranked or is running—it changes the flux density around the coil, producing alternating current in the pickup coil. As a pole piece from the rotating reluctor aligns with the pickup pole piece, the alternating current in the pickup changes direction. If you looked at a sine wave from the distributor, this would be indicated by the voltage crossing zero as it changes polarity. This change in voltage direction triggers the control unit, which orders its switching transistor to stop the current flow in the primary circuit, thus producing a spark at the spark plug. Voltage generated in the pickup coil is low. In a Ford system, for example, it's one volt for each 100 rpm of the distributor shaft. The control unit on both Chrysler and Ford cars is located on the fender well or firewall. GM puts the module in the distributor (the cap must be off to get at it). The pickup assembly is mounted securely to the breaker plate. When ignition advance is needed, the breaker plate moves. This makes alignment of the pickup tooth and a reluctor tooth occur earlier—so the spark plug fires earlier. Vacuum and the centrifugal advance work in the same way as with breaker-point ignition.



Sears ignition tester (\$49.95) consists of a high- and low-range ohmmeter, voltmeter, and tachometer that are incorporated into one instrument. Adapters are provided for allowing hookup to GM High Energy Ignition distributors.

Milton tester hooks up quickly, has LED lights to indicate "good" or "bad." It's \$40 at jobbers, comes with easy-to-follow instructions. For more information, write Milton Industries, Inc., 4500 West Cortland St., Chicago, Ill. 60639.



WareTech offers three different testers, each designed for a specific system. GM tester is \$100; Ford, \$110; and Chrysler, \$90. Meter indicates "good" or "bad." For more info, write WareTech, 38 Cherry Lane East, Syosset, N.Y. 11791.

Suntune inductive electronic-ignition analyzer CP7671 can check alternator diodes as well as perform standard ignition checks. Made by Sun Electric Corp., it's available in many stores. Suggested retail price is about \$80.



tion tester, of which there are several. They come in many configurations. Sears, for example, sells one for \$49.95. It's a combination voltmeter/ohmmeter/tachometer and comes with an excellent instruction manual for checking out GM, Ford, Chrysler, and AMC.

Some testers have scales with a "good/no-good" zone. If the needle is in the "good" zone, that particular circuit you are checking is okay. If it's not, you either replace the component or check the circuit further. These are basically ohmmeters and voltmeters, but they're designed so that you just make the hookup, then rotate a knob or two, and watch to see if the needle indicates good or bad.

Others eliminate scales and use lights. If the light is red, the compo-

nent or circuit is bad. If it's green, everything's okay.

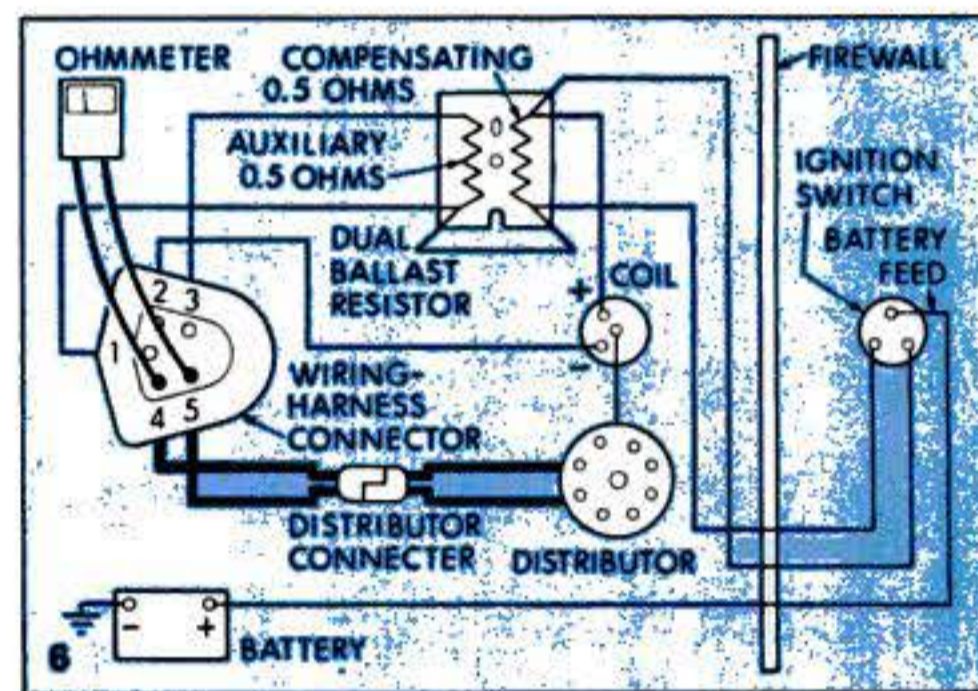
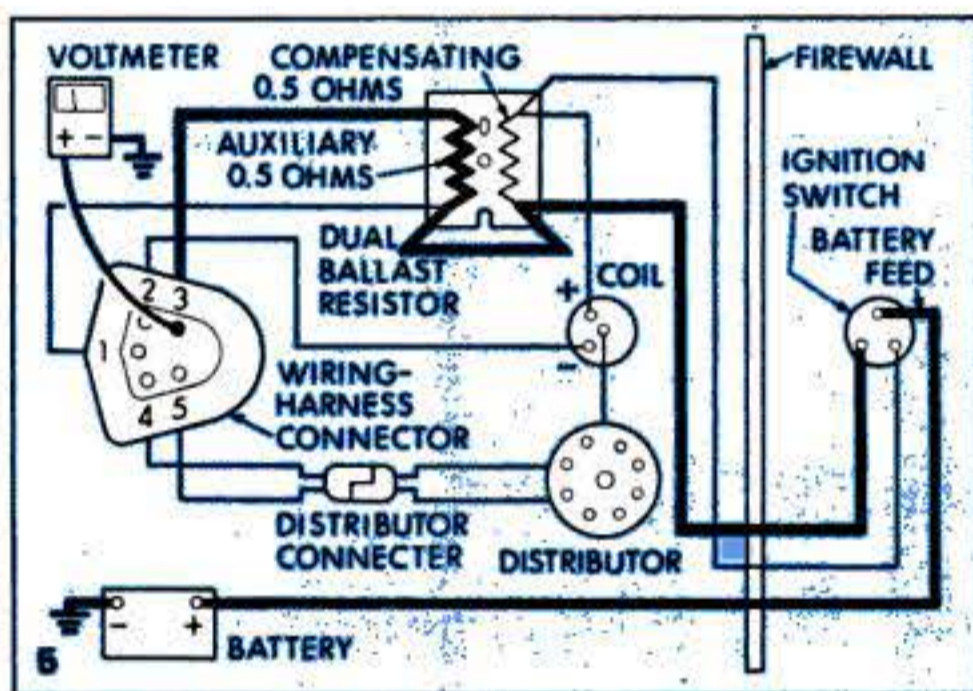
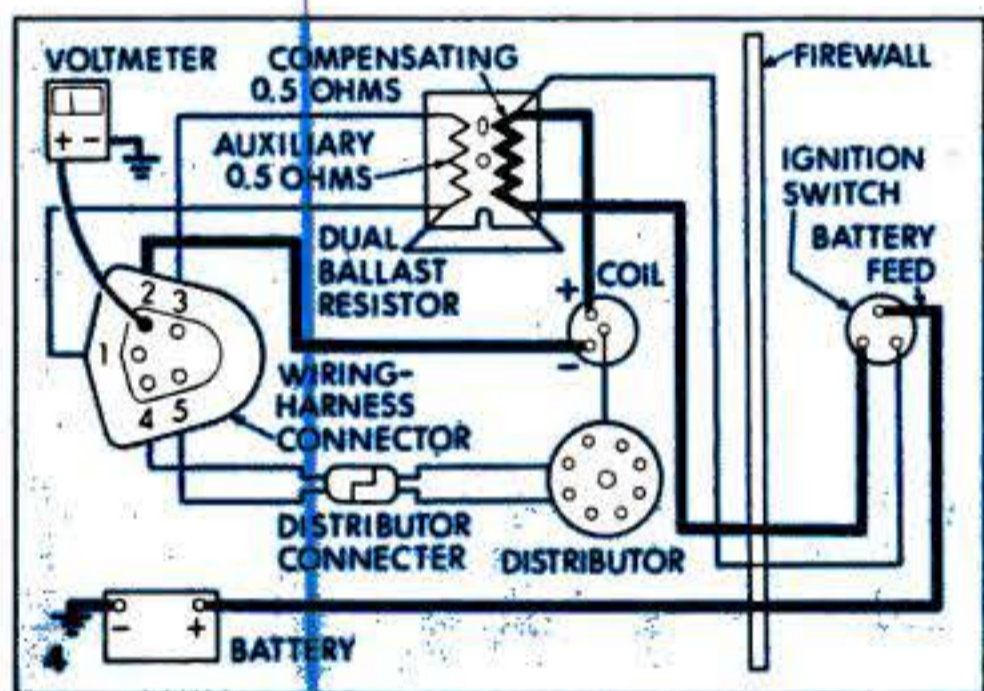
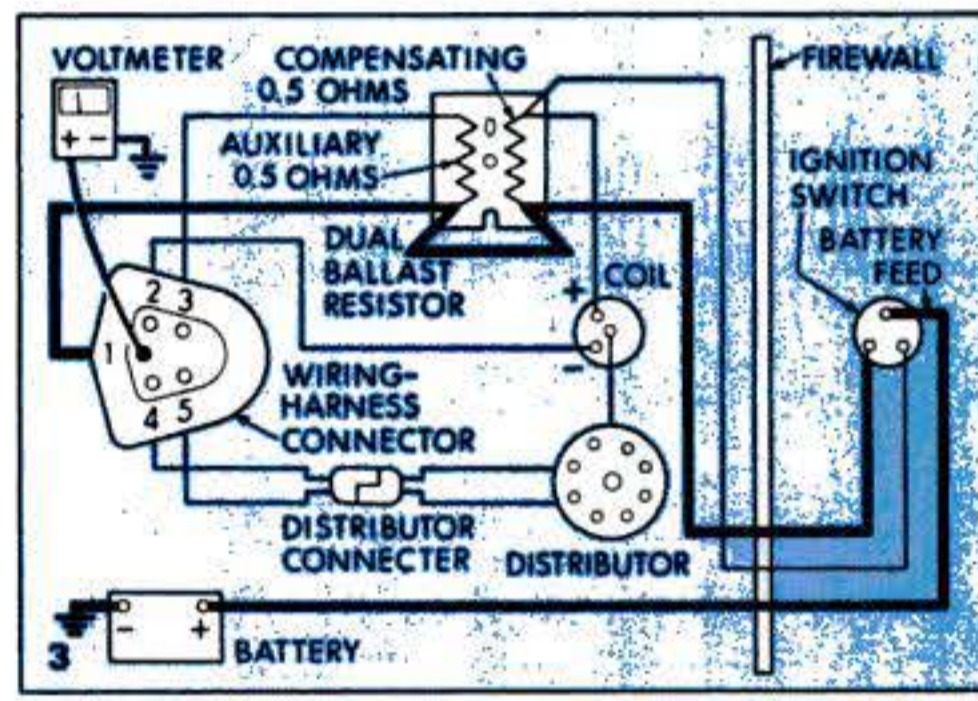
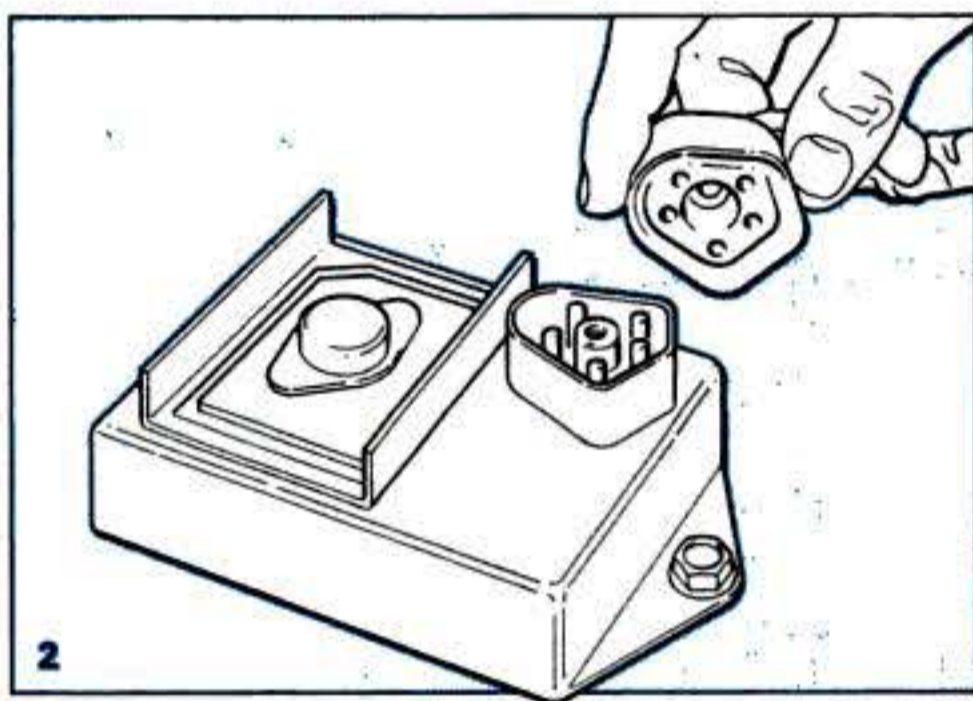
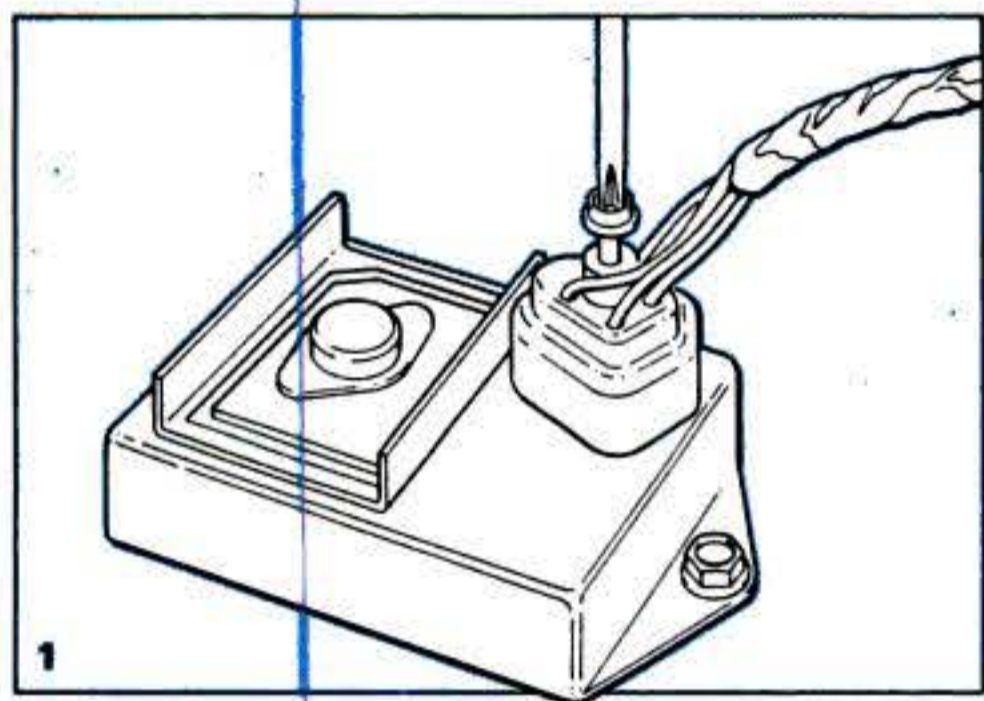
We rounded up a representative sample of the many testers available. The one we liked best is the Uni-Tester, a professional-level instrument available to the do-it-yourselfer. Not surprisingly, it is the most expensive—\$307.

Using the Uni-Tester is very easy. It comes with five adapters so you can hook it in series with the primary circuit in the electronic ignition systems on GM, Ford, Chrysler, AMC, and International vehicles. An excellent instruction booklet tells you how to make the hookups and perform the tests (which consist basically of turning a knob to different positions). Once you're familiar with the procedures you can hook up the Uni-Tester

and check out a system in minutes.

One advantage of this tester is that its circuitry can duplicate actual running conditions. Not only does it determine if the module is properly grounded (very important), it tests the module to make sure all its dwell and switching functions are being correctly performed. With most of the do-it-yourself testers we have seen, or with an ohmmeter and voltmeter, you can check out the circuitry to and from the module and make sure the module is grounded—but you can't actually test its internal components to make sure they're doing their jobs. With the Uni-Tester, if the control module is working right, a green light lights. If it's bad, a red light lights. (A bad module can not be repaired. It will have to be replaced.)

Trouble-shooting with a voltmeter and ohmmeter



Don't trouble-shoot your car's electronic ignition system without first reading and thoroughly understanding the procedures outlined in the shop manual for your car. To give an idea of what is involved, though, these drawings and captions demonstrate the trouble-shooting techniques that would be used on a Chrysler electronic ignition.

If normal diagnostic procedures performed on a rough-running or nonstarting engine isolate the cause to the ignition system, the next step is to check all spark-plug wires for cracks in the insulation, and to make sure they are inserted all the way in the distributor and fit tightly. They should also fit snugly at each spark plug. Don't forget the high-tension lead from the coil to the distributor. It should be pushed in fully at either connection, be free of cracks, and each boot should fit tightly over its tower. Check the distributor cap for cracks, carbon tracking or other damage. Also inspect the rotor: It should not be cracked, and the metal tip and cen-

ter contact should be in good shape. Check the wire that runs between the plus terminal of the ignition coil and the ballast resistor. It should be tightly connected at both ends. (Ford cars, except those sold in California, use a resistor wire instead of a ceramic resistor. GM uses neither a resistor wire nor a ceramic resistor.) Then check battery voltage. Hook the red voltmeter lead to the positive battery post and the black lead to the negative battery post. Battery voltage should be at least 12 volts.

If everything checks out okay so far, then follow the 13 steps sketched above. To remove the wiring harness connector from the control module, first remove the screw that holds the harness connector in place (1), then pull the connector off the module (2). Whenever removing or installing the harness connector to the control unit, the ignition switch should be in the off position. After removal, turn the ignition switch on. Then connect the negative voltmeter lead to a good ground and

the positive voltmeter lead to cavity one in the wiring harness connector (3). The voltmeter should read within one volt of battery voltage. If it does not, check out this circuit. Probably the easiest way to check the circuit is with the voltmeter. Working your way back to the battery from cavity number one, stop at each successive connection and take a voltage reading. When you get a reading that's the same as battery voltage, you know the excessive resistance or broken circuit is somewhere between that connection and cavity number one. Using a visual inspection and a voltmeter, ohmmeter, or test light, work your way back to cavity number one until you find the offending connection, broken wire, etc. Remember: When using an ohmmeter, the wire or component you are checking must be disconnected from any external voltage supply. Otherwise you can get a faulty reading and damage the meter.

Next, connect the positive lead of the voltmeter to the wiring-harness-connec-

The Uni-Tester can also check out a coil. With an ohmmeter and the cheaper do-it-yourself ignition checkers, the most that you can do is check resistance in the primary and secondary windings of the coil, and check that the primary windings aren't shorting out to the coil housing.

Sometimes a coil may pass this test and still be bad. The only way to know for sure is to load-test the coil—which the Uni-Tester can do. It can also bench-test an ignition coil or control module, which means neither has to be on a car to be checked.

What to do?

Probably the best thing is to go with the straight voltmeter and ohmmeter checkout. Many do-it-yourselfers have volt/ohmmeters or a voltmeter

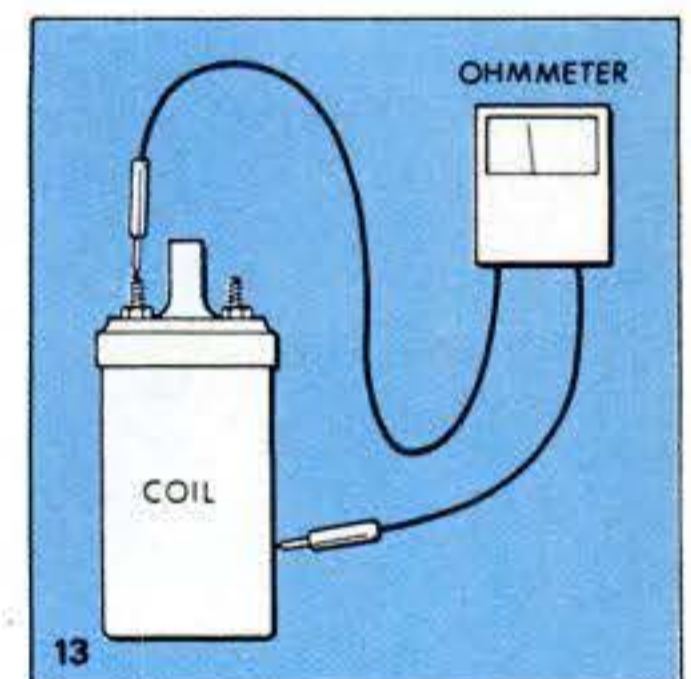
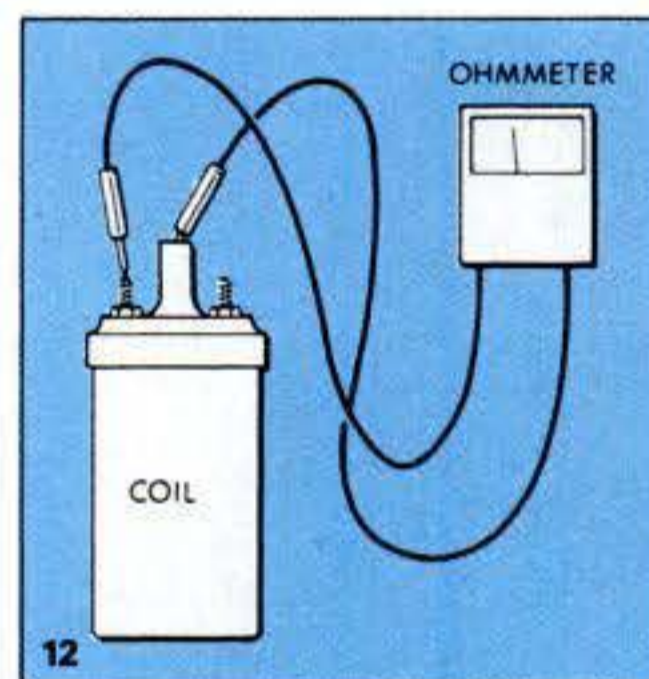
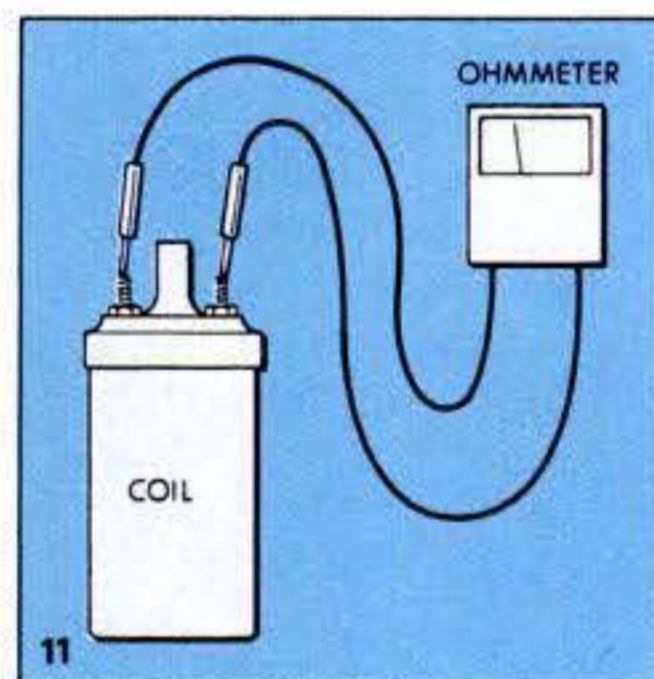
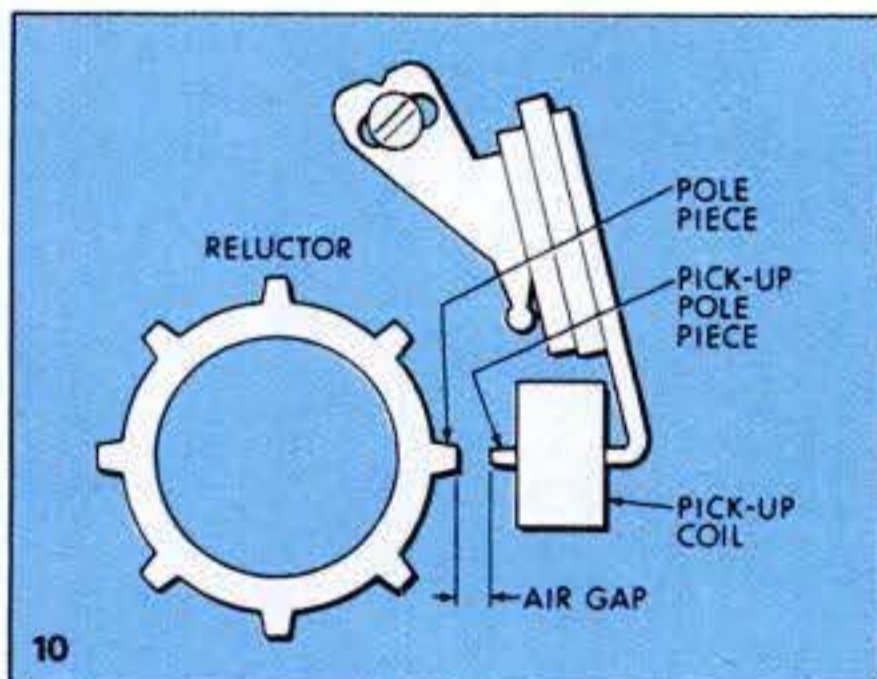
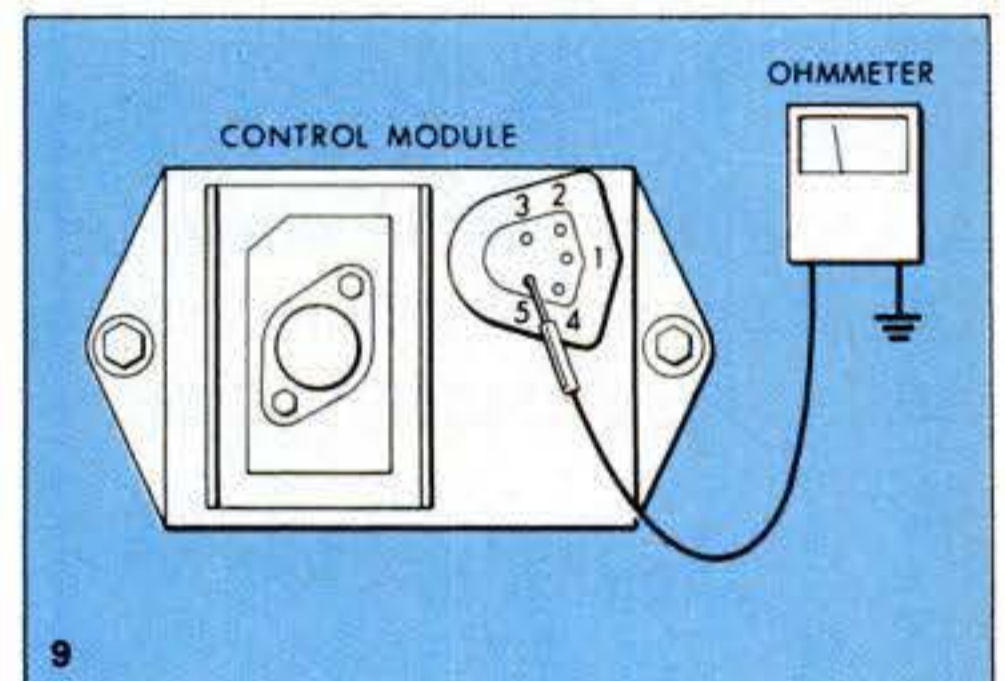
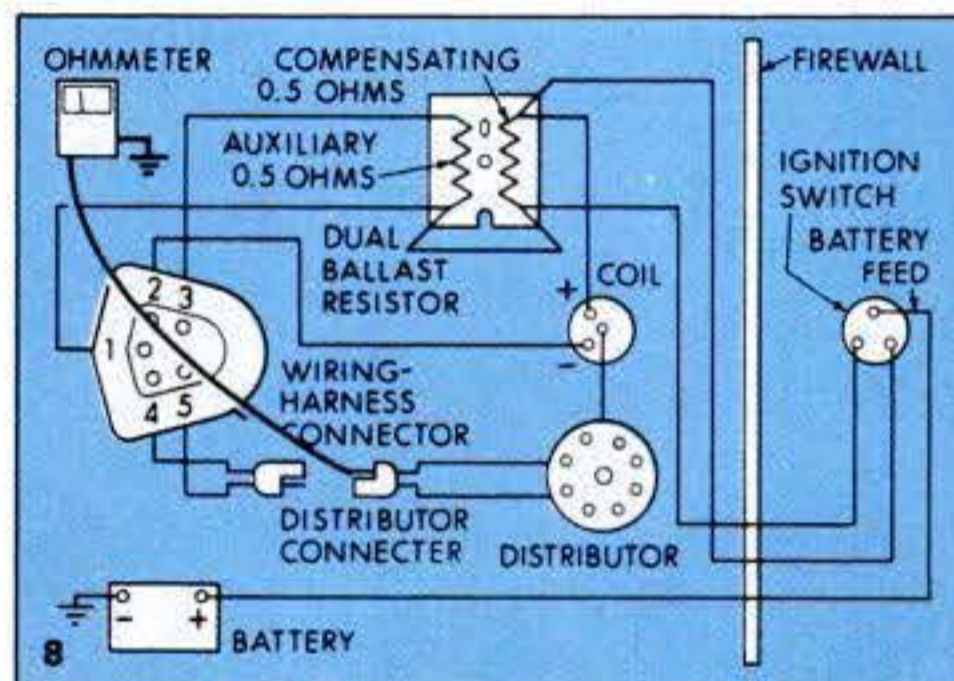
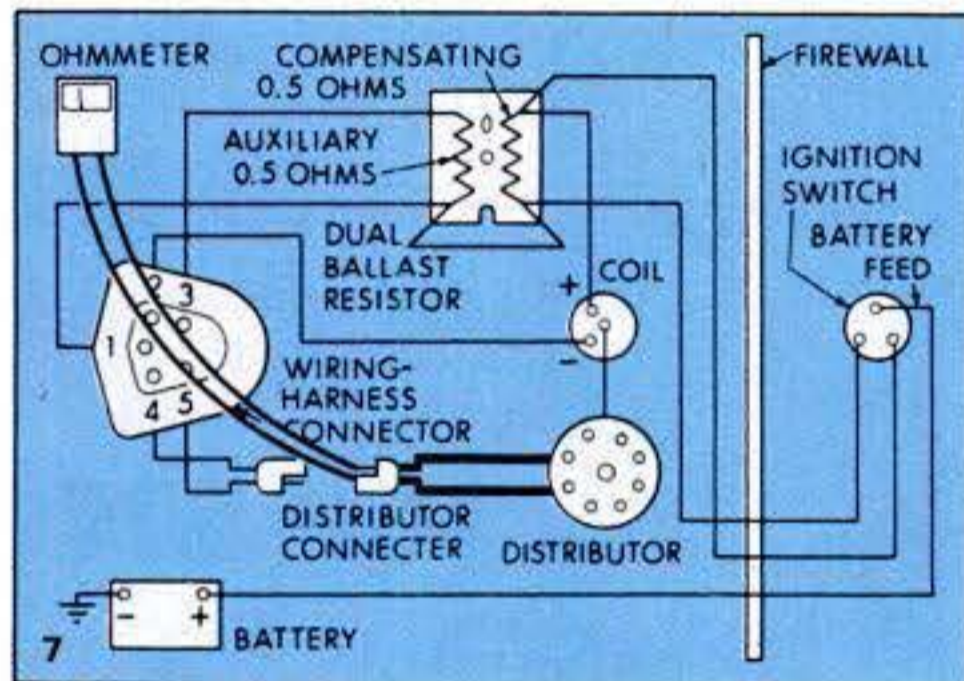
and ohmmeter as separate units anyway. So why buy extra equipment that basically performs VOM functions?

For example, if a tester—even the Uni-Tester—indicates a ballast resistor is bad, is the resistor really bad, or is there a break in the circuit somewhere (loose connection, broken wire, corroded connection, bare wire rubbing against another wire or ground, etc)? The best way to find out for sure is with basic circuit checking using an ohmmeter, voltmeter, or test light.

True, you can't load-test a coil or test the control module in an operational mode, as the Uni-Tester and other professional-level testers can. "But as a practical matter, you really don't have to," Steve Mercaldo says. "If everything checks out with the

voltmeter and ohmmeter, then the problem is either a bad control module or a bad ignition coil. Just remove the coil and module and take them to a garage that can bench-test them. Replace whichever tests bad."

Actually, if the ignition coil checks out okay with an ohmmeter, it's almost a sure bet the control module is bad. If your local dealer will let you buy a control module—and return it if the old one turns out to be good—don't bother to have the coil and control module checked. Otherwise, have both checked. Even though chances are slim that the problem isn't the module, you don't want to buy a new one as a replacement for one that's in perfectly good condition. Not every garage can bench-test both coil and module. 5



tor cavity number two (4). Available voltage here should be within one volt of battery voltage with all the accessories turned off. If it's not, check out that circuit to determine the cause of the excessive resistance.

Then, connect the positive voltmeter lead to the wiring-harness-connector cavity number three (5). Available voltage should be within one volt of battery voltage with all accessories off. If not, check out that circuit to find out where the problem is. If everything checks out okay, turn the ignition switch off and check the pick-up coil.

To check the pickup coil, connect an ohmmeter to wiring-harness-connector cavities four and five (6). The ohmmeter should read between 150 and 900 ohms. If the reading is higher or lower than this, disconnect the dual-lead connector from the distributor and check the resistance at the connector (7). If the reading is not within 150–900 ohms, replace the pickup coil assembly. If it is within spec, the prob-

lem is in the wiring harness that connects the dual-lead connector to the control unit. Connect one ohmmeter lead to a good ground, the other lead to either connection of the dual-lead connector from the pickup coil (8). The ohmmeter should read infinity. If you get a reading, that means there is a connection between the pickup coil and ground, which shouldn't be. Replace the pickup coil.

To check the control unit to make sure it's grounded, connect one ohmmeter lead to a good ground and the other lead to pin number five in the control unit (9). The ohmmeter should read zero, or thereabouts, indicating good continuity between ground and the connector pin. If it shows high resistance, or no continuity, tighten the bolts holding the control unit to the fender or firewall. If proper continuity still doesn't exist, remove the control unit, and use sandpaper to remove any corrosion between the control unit and fender/firewall. Reinstall it. If there's still no continuity, the control unit must be re-

placed. Reconnect the wiring harness connector to the control unit.

Next, check the air gap between a reluctor tooth and pickup pole piece (10). It should be within shop-manual specs. If not, adjust it (with Ford and GM systems the air gap is not adjustable). Finally, check the ignition coil with an ohmmeter. First, connect the two ohmmeter leads to the two primary terminals on the coil (11). The reading should be 1.60–1.79 ohms with a Prestolite coil (no. 2444242). Next, attach one ohmmeter lead to the center tower of the coil and the other to either of the coil's two primary terminals (12). The reading should be 9400–11,700 ohms (shop manual will give the specs for your coil). Then, attach one meter lead to one of the coil's primary terminals and the other lead to the coil's metal housing (13). The reading should be infinity—indicating no short between the primary windings in the coil and metal housing. If everything is okay so far, chances are the problem is the control unit. Replace it.

MOTORCRAFT

DO IT YOURSELF WITH MOTORCRAFT PARTS.

All it takes is you and Motorcraft parts.

And you've got a lot to work with—tune-up parts, batteries, shock absorbers, oil filters, air filters, and much more. Plus a handy step-by-step guide you can send for that will help you do 15 simple repair jobs yourself.

Of course, while you're at it, we encourage you to use Motorcraft parts. Each is built to meet quality performance levels

owner
maintenance
and light
service guide
for do-it-
yourselfers

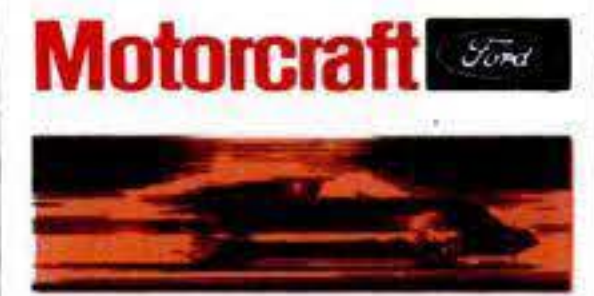


Motorcraft

and is supported by Ford Motor Company engineers. Motorcraft parts are available for most U.S.-built cars as well as many popular imports.

So do it yourself; send for our helpful guide, and use Motorcraft parts... for sure.

Motorcraft
Do-It-Yourself Manual
c/o Helm, Inc.
P.O. Box 5386
Detroit, MI. 48211



...FOR SURE



Please send me your repair manual for just \$1 enclosed. (Michigan residents, add 4% sales tax.)

Name _____

Address _____

City _____ State _____ Zip _____

NOTE: CHECK OR MONEY ORDER ONLY, PLEASE.

How commercially applied sprays fight car rust

Salt and moisture are death on a car. Even washing your car may be bad for it

By JIM DUNNE

A friend was trying to sell his four-year-old Chevette—with no success. His newspaper ad mentioned low mileage, new radials, and an eight-track player. But the first three callers asked just one question.

"Is the car rustproofed?"

When my friend answered "no," the callers lost interest.

Spraying a car's vulnerable underbody with a petroleum-based compound, a Rusty Jones technician seals out corrosion-caus-

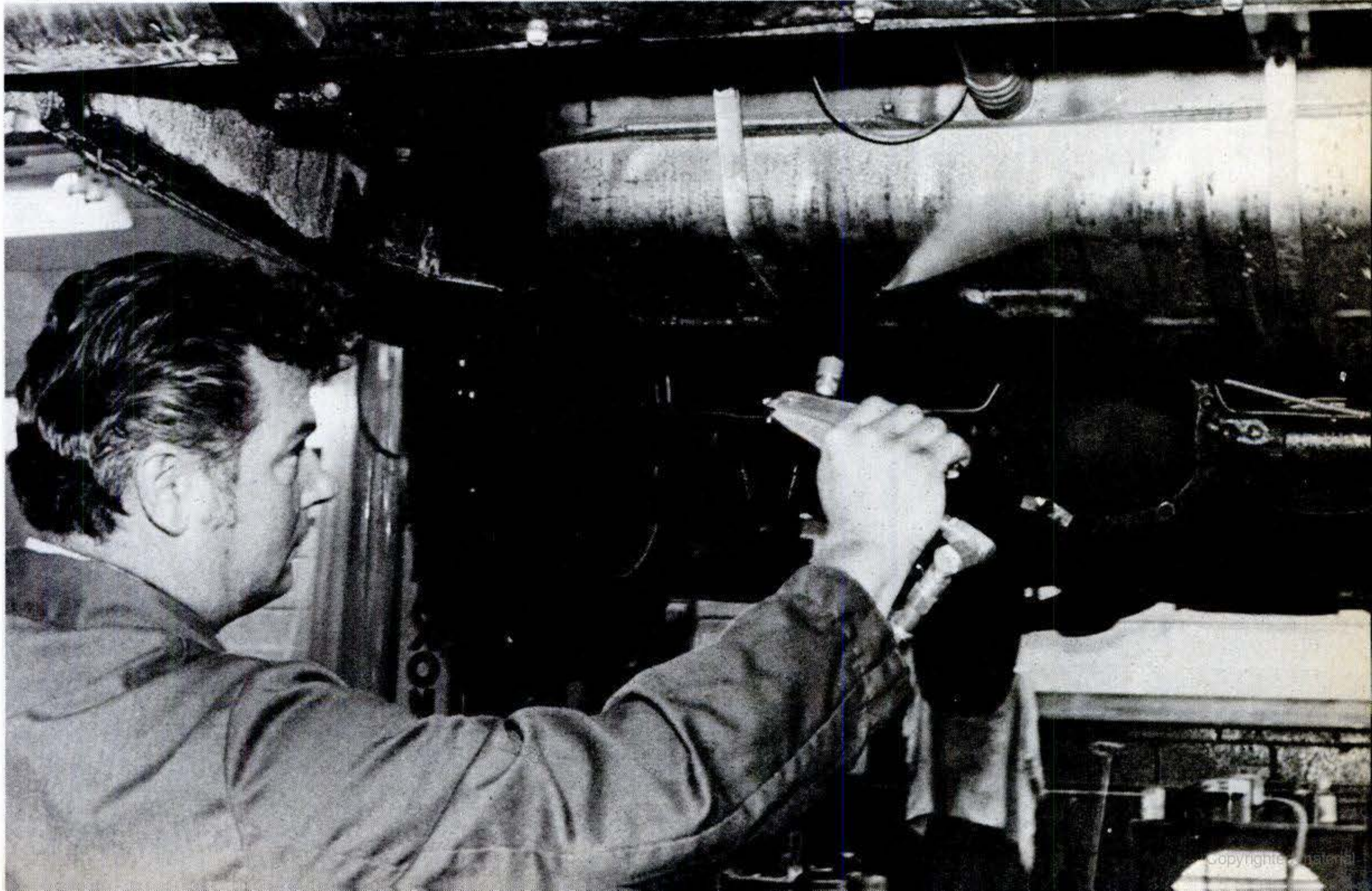
ing air and moisture. Applied under high pressure, compound chemically bonds permanently to metal, says the company.

He eventually sold the car, but the experience taught him the value of rustproofing a new car.

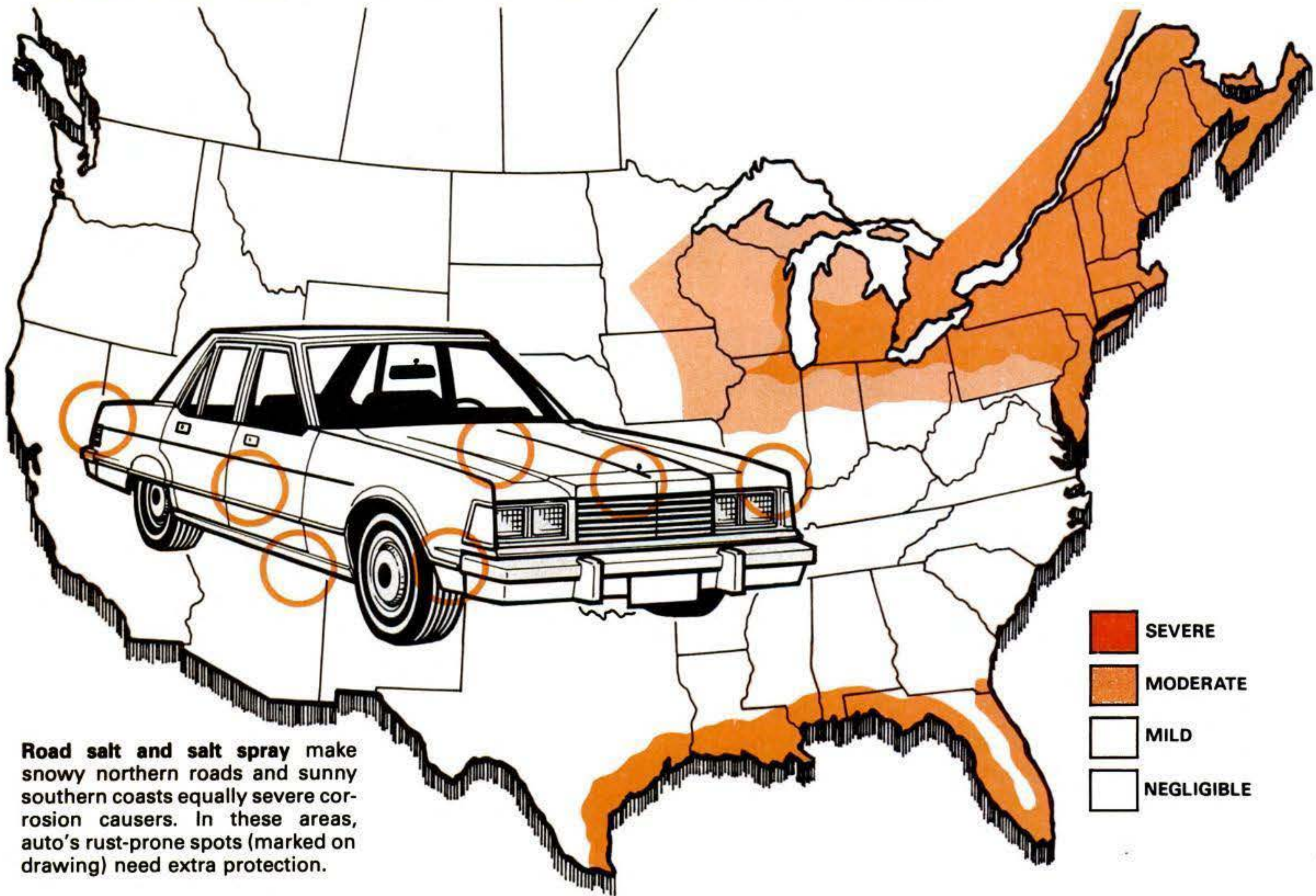
"It will bring anywhere from \$100 to \$300 more at a sale, depending on how it's been cared for," Mike Maltese says. Maltese is general manager of one of the nation's largest auto auctions, APTCO, in Taylor, Mich. He recommends rustproofing any new car that you plan to keep for three or more years.

"When dealers fix a rustproofed car for resale, they're more likely to do a complete job. They know the body is basically sound," he adds.

Maltese's advice is aimed at auto owners in the Detroit *Continued*



"Corrosion corridors" in the United States and southern Canada



Road salt and salt spray make snowy northern roads and sunny southern coasts equally severe corrosion causers. In these areas, auto's rust-prone spots (marked on drawing) need extra protection.

area, but it could just as well apply to anyone living in the nation's "corrosion corridors" (see map) where road salt or ocean spray cost car buyers an estimated \$14 billion each year. In these areas, more and more consumers are driving their new cars directly from the dealer to a rustproofer, such as Ziebart, Tuff-Kote Dinol, Poly-Oleum, Rusty Jones, ECP, Ultra Seal, Polyglycoat, or Classic Rustop. In 1978, 3.6 million people paid up to \$200 to have rust-prone parts of their new cars treated with one of these protective coatings. Should you do the same?

Here are the facts:

- Use of highly corrosive salt on roads is increasing sharply.
- Old rules of protecting your car, like weekly washes and parking in a warm garage, may do more harm than good.
- Despite auto makers' massive investment in rust-resistant body materials, added protection may be necessary.

What makes rust? Its chemical name is ferrous oxide, or a combination of iron and oxygen. In automobiles, rust is caused by a chemical reaction between three main sub-



Drilling holes in a car door (above), then shooting in the rust-proofing compound (right), allows the thick gunk to creep into



hard-to-reach welds and inner crevices. But new window-lift mechanisms, such as GM's tape-controlled one (far right), com-

Copyrighted material

stances: steel, moisture, and oxygen (air). High temperatures speed up the reaction. Adding salt (sodium chloride) accelerates the rusting process even more. Sodium ions create a highly alkaline condition on the car-body surface that actually lifts off the paint. This allows the chloride ions to eat at the bare metal, speeding up the rust process.

Destructive combination

When the weather gets very cold, road crews also add calcium chloride to help the salt work at lower temperatures. This is the chemical that's put on dirt roads in the summer to keep down dust. Calcium chloride picks up moisture and holds it. For a car, this can be devastating.

Snow-belt drivers also know that salt-saturated snow packs under fenders and body corners, attacking out-of-sight places first with such aggressiveness that it can actually damage heavy-gauge-steel frame members. And corrosion problems in the snow belt are increasing rapidly. According to Vladimir Hospadaruk, head of corrosion research for Ford's Scientific Laboratories, the use of salt to melt snow on roadways in the U.S. and Canada has jumped from one million tons per year in the 1950's to 10 million tons today—a tenfold increase.

"This is the major cause of body rust," Hospadaruk points out. "Ten years ago, the increased amount of salt hit us hard. But now we think we have the car well protected."

To prevent rust formations, auto companies seal off bare steel from air and moisture with a coating such as zinc plating or any of a number of spray and dip processes [PS, Jan. '78]. Other rust fighters used by auto companies include vinyl sealers for metal welds, aluminized wax spray, and the use of plastic inner liners for fenders and other under-body parts that can be dented by thrown stones.

For all of these protective steps, major auto companies' rust warranties are good for only three years. After that, you're on your own. (AMC, which pioneered a new rustproofing approach by adopting a Ziebart-approved process on its assembly line, and International Harvester now offer a full five-year warranty on body rust.)

A three-year warranty is not very realistic to the customer, according to E. J. Hartmann, president of Ziebart.

"Our customers will believe a five-year-warranty minimum," Hartmann explains. "People who come in to Ziebart plan to keep their car for four years or longer, and they know rust shows up after the three-year limit."



Complicate the rustproofing job. Door panels must now be removed on many cars, and the window-crank systems must be protected.

"If auto companies stick with the three-year limit," Hartmann adds, "business for us will continue to be pretty good in the near future."

A sticky seal

Rustproofing jobs—at first glance—are pretty much the same. You take your new car to a garage-like center and leave it for a day. Trained technicians spray a gooey, dark substance into the high-corrosion parts of the body (see diagram), especially in fender wells, inside door panels, on rocker panels, inside hood and deck lips, and over most of the underside.

The operation adds about 25 pounds of a petroleum-chemical mixture to the body of the car. The mix contains oxalic acid, a rust dissolver. Its job is to clean the metal of any rust dust. (Even brand-new cars can have a light sprinkling of rust—the minute air and moisture hit a tiny scratch or patch of unprotected steel, rusting starts.) The acid makes sure that the petroleum gunk does not seal in rust that can work beneath the surface, unseen until it pops through the other side of the metal.

The petroleum base is the metal protector. It's essentially the leavings from a barrel of crude oil that cannot be refined any further. It's thick, dark, sticky, and does a good job of covering the metal. Ideally, the base remains pliable for years, never hardens or cracks, and forms excellent protection.

“We buy on appearance. If a four-year-old, rust-proofed car looks better than an untreated one, we'll pay more. Most of the time, it looks better.”

Other ingredients include a solvent to make the petroleum more manageable in the spraying process and a drying agent to remove moisture from the metal as the mixture is applied.

With a good application, applied with an airless spray at a pressure of 960–1200 pounds, the material will get to virtually all exposed parts of the metal and adhere with tenacity. The mixture is applied to a thickness of three to five mils, which is about three times the thickness of the paint on a car.

The cost runs \$150 for smaller cars, over \$200 for big cars, vans, and some trucks. You get a warranty against metal perforation that can vary from five years to the lifetime of your ownership, depending on the type of rustproofing chosen. The warranty takes care of repair and replacement costs.

Most rustproofers use similar materials. A number of chemical and oil companies supply the mixture, with each using essentially the same amounts of petroleum residue and active chemical additive.

Which system should you choose?

It really comes down to the reputation of the individual dealer. How long has he been in business? Does he have satisfied customers you can talk to? Does he honor his warranties? How extensive are the warranties? Also check whether the rustproofing material is applied under high pressure, and whether the dealer removes the inner panels when applying the mixture to the doors.

Note that rustproofing centers treat only new vehicles. While the rust dissolver in the mixture can take care of

Continued



Individual steel panels mounted inside the wheel wells (above) and under the front bumpers are used for field tests—under normal highway conditions—of ECP's Auto Armor rustproofing.

fine new rust, it can't dissolve the flake rust that eventually develops with age. In fact, rustproofing dealers generally don't recommend treating cars that have more than 3000 miles on the odometer.

"Flake rust is like cancer," Roy Nixon, president of Tough-Gard, Inc. (maker of rustproofing compounds), told me. "You can't stop it. You either cut it out and weld in a new piece of metal, or it will continue to spread."

But does it work?

Experience shows that the rustproofed car does show its extra care.

"We buy strictly on appearance," reports Ford used-car manager Clyde Thurston of Redford, Michigan. "Naturally, if a four-year-old rustproofed car looks better than an untreated one, we'll pay more."

"And ninety percent of the time it looks better," Thurston says. "Even on those with rust spots, you can usually grind them off and retouch without pushing right through the metal."

According to George Krausmann, whose eastern-Detroit Ziebart center is one of the biggest in the country, two types of customers dominate the business.

"One is the young couple who plans to keep a car for a long time. They're more conscious about their car and about money. That's a big part of our business.

"Then there is the person who is just meticulous about cars. He wants our protection."

Commercial vehicles make up a big part of Ziebart service, too. Michigan Consolidated Gas, with a fleet of 1900 cars and trucks, rustproofs all new vehicles at a Ziebart center. The utility has done this since the 1960's. "Before that, we had body deterioration as early as the first year," reports Dave Kivlin of Consolidated. "That's very costly. Since we keep our vehicles from five to seven years, rustproofing is routine." Consolidated made an initial study of the economic advantages of rustproofing, but now none is needed. To the company, the advantages are self-evident.

Another utility, Detroit Edison, also routinely rustproofs new vehicles, including vans, cars, and light trucks. And tractor-trailer owners who want their rigs to last 250,000 miles and more are turning to rustproofing.

"They replace engines and transmissions on the big rigs," Krausmann says, "but they don't want to get into replacing bodies. That's too expensive."

Whether your car is rustproofed or not, you should at least try to protect it from corrosion-causing conditions as much as possible. Unfortunately, taking care of your car in the usual ways may be self-defeating, and your conscientious efforts may actually create more corrosion than would otherwise occur.

Rust accelerators

"Get your car washed weekly" is the advice car makers offer to rust-conscious owners. Yet the act of washing the car can add to the corrosion. In most automatic car washes, wash water is recirculated from a reservoir beneath the line. That means your car is washed with the same water that rinsed off the car ahead of you. In the winter, the wash water forms a strong salt solution that is sprayed on each car that goes through the ways. Not only do you get salty water over the paint, but a salt solution is sprayed underneath to settle in all the nooks and crannies where the rust festering takes hold.

Most automatic car washes can't stay in business without recirculating their water. Some car washes do use fresh water all the time—or so they advertise. Search these out and patronize them exclusively to avoid the weekly salt bath.

But given the option of driving with a salt-encrusted car or getting it washed with recycled water, Ford's Hospadaruk says, "Get it washed. Get the dirt off the car, especially underneath. It packs in and acts as a poultice that makes rust even worse."

Temperature change is another rust accelerator. So a warm garage, instead of protecting your car, actually speeds up the rusting process. In fact, it's estimated that regular—daily or nightly—parking of a snow-encrusted car

“Get your car washed weekly” is the advice car makers offer to rust-conscious owners. Yet the act can add to the corrosion”

in a warm garage can accelerate the rusting process by a factor of three. Warm in this case is any temperature above freezing.

The swing to fuel-efficient cars will create more corrosion problems. Because small cars are built for light weight, with less inner paneling and protection from road splash, they may be more susceptible to the ravages of rust. And the inner panels are smaller, more difficult to treat with rust-protection coating.

So should you get your next car rustproofed? If you plan to keep it for three years or more, and if you live in a high-corrosion area, you'll certainly drive a better-looking car. And you'll probably get all your rustproofing costs back when you sell.

Ford's Hospadaruk admits that, despite the best efforts of the auto companies, he, too, would seriously consider having his new car rustproofed if he planned to keep it for four years or more. "Even if only for the peace of mind it would give," he adds. E3

FOR FURTHER INFORMATION

Classic Rustop, 1305 E. Ave. H, Grand Prairie TX 75050; ECP Inc., 1200 Jorie Blvd., Oak Brook IL 60521; Nationwide Ultra Seal, Inc., 84 Sylvester St., Westbury NY 11590; Polyglycoat World Enterprises, 25 N. Broadway, Tarrytown NY 10591; Poly-Oleum Corp., 16135 Harper Ave., Detroit MI 48224; Quaker State Corp., Box 989, Oil City PA 16301; Rusty Jones, Inc., 5757 N. Lincoln Ave., Chicago IL 60659; Tuff-Kote Dinol, Inc., 13650 E. 10 Mile Rd., Warren MI 48089; Ziebart International Corp., 1290 E. Maple Rd., Troy MI 48064.

Grading tire quality

— at last, federal standards reveal the truth about buying tires — or do they?

The U.S. now grades tires for tread-wear life, traction, and heat resistance

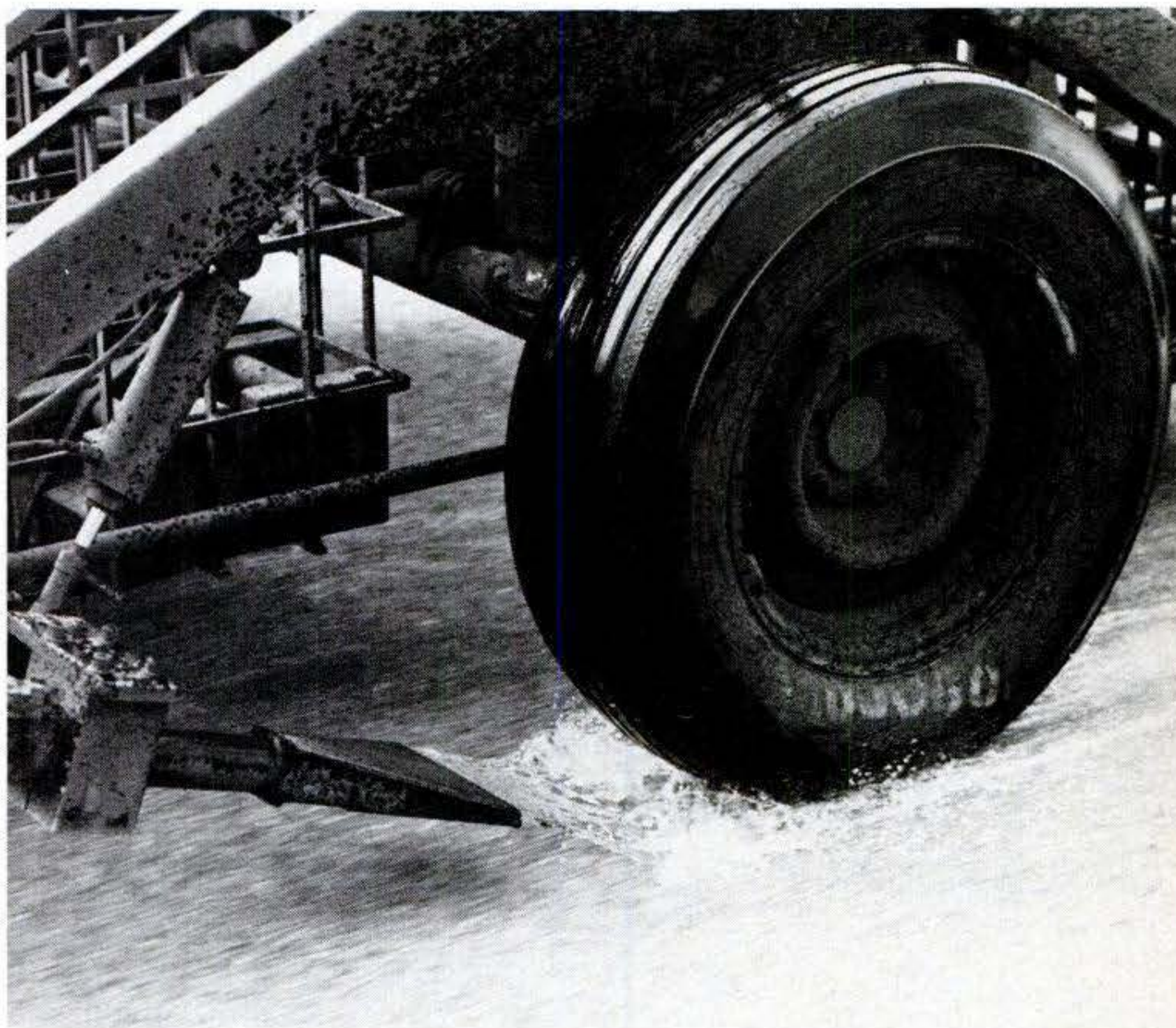
By HERBERT SHULDINER

Recently, I went shopping to replace the bias-belted tires on my 1973 Dart. The tires I looked at in the showrooms had something new since the last time I'd bought some: government-mandated stickers with certified quality information for three categories of performance. What's more, I found that tires of identical quality in different stores sometimes carried \$5 to \$10 price differences. Is this new information finally the magic key to unlock the mysteries created by the bewildering claims rubber makers advertise for the more than 1200 passenger-car tire lines sold in the U.S.?

The federal Uniform Tire Quality Grading Code rates tires for tread-wear life, wet-traction performance, and high-temperature resistance. An executive for a big western tire retailing chain told PS, "It's a real boon to consumers if they know how to use the grading information." A spokesman for the Rubber Manufacturers Assn. claims, however, that quality grading is meaningless because the tests on which it's based are inadequate—and that grade differences are too narrow to reveal quality distinctions.

What's the truth about this new system? Can it help you get more tire for your dollars?

The new quality-grading code is different from the basic safety standards that tires have had to meet for over a decade, and which are still in effect. All passenger-car tires (except snow treads and temporary spares) are now quality graded. When you shop, how-



Traction test for new grading code is done on trailer. Wheel is locked up and

dragged as water is sprayed. Computer measures force needed to stop tire.

ever, you may find some ungraded tires—made before the code took effect. Quality-grading information has been mandatory on all bias-ply tires manufactured since April 1, 1979, and on all bias-belted tires made since Oct. 1, 1979. All radials made from the beginning of this month must carry the grades, which are uniform for all tires, regardless of their construction. Thus a 100 grade for tread wear, for instance, means the same life expectancy in a bias ply as it does in a radial. Let's take a closer look at the grades and how the marks are achieved.

Tread wear

"The average consumer is basically concerned about two things when he buys tires—price and tread life," says Thomas E. Cole, vice-president of the Rubber Manufacturers Assn. tire division.

That's why tread wear is undoubtedly the most important tire-quality grade to car owners. The new system does *not* tell you how many miles you can expect from a given tire. Instead, it ranks tires on an open-ended scale

Continued

starting at 10 and increasing in increments of 10. To arrive at this numerical rating, each tire line is graded after a nine-day test on a 400-mile road network with various surfaces in and around Goodfellow Air Force Base in San Angelo, Tex. The test tires are run on cars against an official "course-monitoring tire" selected by the government. The wear rate for the course-monitoring tire is already known. All conditions are controlled (load, inflation pressure, tire rotation, etc.), and the tires are broken in for 800 miles. "The purpose of the break-in is to allow the tires to reach their equilibrium shape under load," says Dr. F. Cec-

il Brenner, chief of consumer information for the National Highway Traffic Safety Administration. After break-in, the tread depth of the test tire is measured. Then it's run for 6400 miles with average tread-depth measurements plotted on a graph every 800 miles. "The slope of the best straight line that can fit between the data points is the rate of wear," Dr. Brenner says.

This is compared to the wear rate for the course-monitoring tire run at the same time, under the same conditions. If the course-monitoring tire is wearing faster that day, the wear rate for the test tire is then reduced

by the same amount to compensate.

Then, using an official formula, the projected tread-wear life for the tire is obtained and that becomes the grade. A 50-graded tire means that its tread-wear life is half that of a tire graded 100. Most bias-ply tires are graded around 70-80, while the belted tires are mostly between 110-120. The official grades for radials were not available as this issue went to press, but PS learned that some radials have scored grades as high as 400 in testing, and some will probably be assigned grades of over 300. "The points don't stand for any given number of miles," Dr. Brenner says. Retailers who use the grades

Federal quality grades for bias-ply and bias-belted passenger-car tires

Brand	Constr.*	Line	Tread wear	Traction	Temperature resistance	Brand	Constr.*	Line	Tread wear	Traction	Temperature resistance	Brand	Constr.*	Line	Tread wear	Traction	Temperature resistance
Acme	BB	Acme 2+2	120	B	C	Brunswick	B	Premium Poly	100	A	C	Dayton	B	Premium Heavy Duty	80	B	C
Acme	B	Poly Special	80	B	C	Brunswick	B	Sport King	80	A	C	Dayton	BB	Road King Premium	120	B	C
Acme	B	Premium Polyester	80	B	C												
All American	B	Deluxaire	70	B	C	Carlton	B	Cougar SST H78-15	100	B	C	Dayton	BB	Road King Wide 60	170	B	C
All American	BB	Premium 2+2	100	B	C	Carlton	B	Custom 78	70	B	C	Dayton	BB	Road King Wide 70	150	B	C
All American	BB	Sport Trac 60	140	A	B	Carlton	B	Custom Premium WT	90	B	C	Dayton	B	Road Runner 78	80	B	C
All American	BB	Sport Trac 70	130	B	C	Carlton	B	Maxi-Trac Super 60	100	B	C	Dayton	BB	Sport 60	170	B	C
All American	BB	Sport Trac 70 A70-13	120	B	C	Carlton	B	Maxi-Trac Super 70	100	A	C	Dayton	Bb	Sport 70	150	B	C
						Carlton	B	Ultra-Sport	60	A	B	Dayton	B	Sports Premium	80	B	C
Alliance	B	Alliance	70	B	B	Carnegie	BB	Camino 780	120	B	C	Dayton	BB	Super Stag	110	B	C
Allroad	B	78	80	B	C	Carnegie	B	LTR Sports Tyre	80	B	C	Dayton	BB	Sup-R-Tred N78-15	110	B	C
Allroad	BB	780	90	B	C	Carnegie	B	Power Liner	80	B	C	Dayton	B	Thorobred Prem Poly 78	110	B	C
Allroad	B	PC 78	50	B	C	Carnegie	B	Powermaster 78	80	B	C	Dayton	B	Thorobred Premium	90	B	C
Ambassador	BB	Sports 60 WT	210	B	C	Carnegie	B	Prem Poly 78	110	B	C	Dayton	BB	Thorobred Premium 78	120	B	C
Ambassador	BB	Sports 70 WT	170	A	C	Carnegie	BB	Super Track GT60	170	B	C	Dayton	B	Treasury Sport King	80	A	C
Armstrong	BB	Carlton Custom	90	B	C	Carnegie	BB	Super Track GT70	150	B	C	Dayton	BB	Widetrack Super RIBN78-15	110	B	C
Armstrong	B	Coronet II	60	A	C							Dean	B	Fayette P-20	100	B	C
Armstrong	B	Cougar SST H78-15	100	B	C	CBI	B	F/C	80	B	C	Dean	B	Galaxie Four	120	B	C
Armstrong	B	Curbwall G78-15(D)	120	B	C	CBI	B	Flex Ride	80	B	C	Dean	B	Polaris 78	100	B	C
Armstrong	BB	Custom SST Beltedex-L7815	90	B	C	CBI	BB	Heritage	100	A	C	Dean	BB	Star Stream Limited	140	B	C
Armstrong	B	Custom WT 78	90	B	C	CBI	BB	Heritage H78 TOL 78	80	A	C	Dean	BB	Stinger Wide 60	150	B	C
Armstrong	B	Maxi-Trac Super 60	100	A	B	CBI	B	Sportster	70	B	B	Dean	BB	Stinger Wide 70	150	B	C
Armstrong	B	Maxi-Trac Super 70	100	A	B	CBI	B	Style Line	80	A	C						
Armstrong	BB	Pecos Belted	70	B	C	CBI	BB	Style Line 60	130	A	B	Delta	BB	60 Road Max Belted	210	B	C
Armstrong	B	Pride	70	B	C	CBI	B	Super Flex Ride	80	A	C	Delta	BB	70 Road Max Belted	170	A	C
Armstrong	B	Super HPG N78-15	100	B	C	CBI	BB	Wide Flex 70	80	A	C	Delta	B	784	100	B	C
Armstrong	B	Surveyor	90	B	C							Delta	BB	Custom 78S	130	A	C
Armstrong	BB	Surveyor 78	100	B	C	Centennial	B	78	100	A	C	Delta	B	Premium 125	100	B	C
Armstrong	B	Tru-Trac 60	100	A	B	Centennial	BB	78 Belted	110	A	C	Delta	BB	Ranger	90	B	C
Armstrong	B	Tru-Trac 70	100	A	C	Centennial	BB	Belted 60	160	B	B	Delta	B	Road Max II 60	80	B	C
Armstrong	B	Ultra Sport	60	A	B	Centennial	BB	Belted 70	150	A	B	Delta	B	Road Max II 70	80	B	C
Ashland	B	Petroleum Starmaster	80	B	C							Delta	BB	Sports 60	210	B	C
Atlantic Richfield	BB	Award 78 Belted	100	A	C	Concorde	B	LTR Sports	80	B	C	Delta	B	Victorian 478	100	B	C
Atlantic Richfield	BB	Award Mach 60	150	A	C	Concorde	BB	T/P 78 Belted	100	B	C	Delta	BB	Victorian Big Vic	210	B	C
Atlantic Richfield	BB	Award Mach 70	150	A	C	Concorde	B	T/P 78 Polyester	80	B	C	Delta	BB	Victorian Big Vic	170	B	C
Atlantic Richfield	BB	Award Premium Belted	130	A	C	Concorde	B	Trac-Action 50	90	B	B	Delta	BB	Victorian Premium 788	100	B	C
Atlas	B	Cushionaire	80	B	C	Concorde	BB	Trac-Action 60 Belted	130	B	C	Delta	BB	Victorian Sports 60	210	B	C
Atlas	BB	Forty-Two	130	B	C	Concorde	BB	Trac-Action 70 Belted	130	B	C	Delta	B	XP 78	80	B	C
Atlas	BB	Pacesetter	120	B	C	Concorde	B	Turbo Speed 78	80	B	C	Delta	BB	XP 78 Belted	90	B	C
Auto Club	B	78 Poly	80	A	C	Co-op	BB	2+2	130	A	C	Detroit	B	78 Poly	80	A	C
Auto Club	B	Medalist Sport King	80	A	C	Co-op	BB	L7815 6	100	A	C	Detroit	B	Sport King	80	A	C
Auto Club	B	Premium Poly	100	A	C	Co-op	BB	Mach Seventy	150	A	C						
Auto Club	B	Sport King GT	80	A	C	Co-op	BB	Mach Sixty	150	A	C	Diamond	BB	78 Belted	100	A	C
Avalon	B	LTR Sports Tyre	80	B	C	Cooper	B	Cooper MWD	60	B	C	Diamond	B	78 Poly	80	A	C
Avalon	B	Road Runner 50	90	B	B	Cooper	BB	Lifeline Prem 78	140	B	C	Diamond	BB	Mach 60	150	A	C
Avalon	BB	Road Runner 60 Belted	130	B	C	Cooper	B	Poly Mark IV	120	B	C	Diamond	BB	Mach 70	150	A	C
Avalon	BB	Road Runner 70 Belted	130	B	C	Cooper	B	Poly Mark IV	80	B	C	Diamond	BB	Premium Belted	130	A	C
Avalon	B	Roadway 78	80	B	C	Cooper	BB	Pro 60	150	B	C	Diamond	B	Sport King GT	80	A	C
Avalon	B	Treadway 78	80	B	C	Cooper	BB	Pro 70	150	B	C						
Avalon	BB	Treadway 78 Belted	100	B	C	Cooper	B	Sports Master	90	A	C	Doral	B	LTR Sports Tyre	80	B	C
Bedford	B	Air Coach	50	B	C	Cooper	B	Sports Master II	90	A	C	Doral	BB	Strata Poly 78	80	B	C
Bedford	B	Antique	50	B	C	Cooper	B	Sports Master II	50	A	C	Doral	BB	Strata Poly 78 Belted	100	B	C
Bedford	B	Famous Coach	50	B	C	Cooper	B	Trendsetter	100	B	C	Doral	B	Stratastar	80	B	C
Big Boss	-	Big Boss	80	B	C	Cooper	B	Trendsetter	60	B	C	Doral	B	Swinger 50	90	B	C
Big Foot	BB	Big Foot 60	150	B	C	Cooper	B	Untouchable	120	B	C	Doral	BB	Swinger 60 Belted	130	B	C
Big Foot	BB	Big Foot 70	150	B	C	Cooper	B	Untouchable	80	B	C	Doral	BB	Swinger 70 Belted	130	B	C
Big Ride	BB	Big Ride 2+2	110	B	C	Cordovan	BB	Cordylas	110	B	C	Douglas	B	Dynamic Premium	80	B	C
Brunswick	BB	78 Belted	100	A	C	Cornell	B	200	80	B	C	Douglas	B	Trackmaster 50	90	B	B
Brunswick	B	78 Poly	80	A	C	Cornell	BB	Douglas Dyn Prem Belt	100	B	C	Dunlop	B	Gold Cup	90	A	C
Brunswick	BB	Mach 60	150	A	C	Cornell	B	Sports Premium	80	B	C	Dunlop	BB	Gold Seal 78 Sport Belted	110	A	C
Brunswick	BB	Mach 70	150	A	C	Cornell	BB	Track Master T/M 60	130	B	C	Dunlop	B	Gold Seal C60	100	A	C
Brunswick	BB	Premium Belted	130	A	C	Cornell	BB	Track Master T/M 60 Belted	130	B	C	Dunlop	B	Gold Seal Poly Sport 78	100	A	C
						Cornell	BB	Track Master T/M 70 Belted	130	B	C	Dunlop	B	Gold Seal RS Patrol	100	A	C
												Dunlop	BB	GT Qualifier Belted 60	160	B	B
												Dunlop	BB	GT Qualifier Belted 70	150	A	B
						Courier	BB	Belted	70	B	C	Duralon	B	560-15 600-15	90	B	C
						Courier	B	Courier	40	B	C	Duralon	B	78	130	B	C
						Cushion Ride	B	Cushion Ride	80	B	C	Duralon	BB	78 Belted	100	A	C
						Custom	B	Goodrich Custom Longmiler	80	A	C	Duralon	B	78 Poly	80	A	C
												Duralon	B	78 Poly Sport King	80	A	C
						Dayton	B	Deluxe	80	B	C	Duralon	BB	Mach 60	150	A	C
						Dayton	B	Flyer	50	B	C	Duralon	BB	Mach 70	150	A	C
												Duralon	BB	Premium Belted	130	A	C
												Duralon	B	Premium Poly	100	A	C

*Construction: B—bias ply; BB—bias belted

in advertising, however, relate a 100 grade to 30,000 miles of tread wear. Brenner disputes this interpretation. "Tread-wear life has to be taken in relationship to where and how a tire is driven," he says. "Absolute mileage figures vary according to the harshness of road surfaces." (See "How Road Materials Affect Tire Tread Life," this issue.)

The RMA's Tom Cole goes even further in attacking the translation of the grades into mileage figures—or even as a reliable gauge to relative tread life. "All you've got is a standard that rates tires on one course," he says. "And it's an easy course, at

that." Cole claims that 80 percent of the nation's motorists drive under more severe road conditions than those experienced at San Angelo.

"Tread-wear grading holds up in all areas," Dr. Brenner counters. "The better-graded tire gets more wear than a lower-graded tire in all areas, although absolute figures vary according to the harshness of road surfaces."

Traction

The purpose of the wet-traction grade is, really, to keep the tire companies honest when they compound treads for wear. That's because the

heat buildup necessary for good traction helps to wear tires faster. It would be easy for rubber companies to compound a longer-lasting tread if they didn't have to worry about stopping a car on a slippery surface.

Tread grades are (from best to worst) A, B, and C. "We didn't find any tires graded C that are legal for highway use," says Dr. Brenner. It's a good thing, because C doesn't even represent a minimum performance level. The wet-traction ability of a C-graded tire could actually be zero. Here's why:

Traction performance is determined

Continued

Brand	Constr.*	Line	Tread wear	Traction	Temperature resistance	Brand	Constr.*	Line	Tread wear	Traction	Temperature resistance	Brand	Constr.*	Line	Tread wear	Traction	Temperature resistance
Duralon	B	Sport King	80	A	C	Giant	B	Roadmaster 78	60	B	C	Heafner Tire Co.	BB	Regal XL 60	150	A	C
Duralon	B	Sport King GT	80	A	C	Gillette	BB	Ambassador	90	B	C	Heafner Tire Co.	BB	Regal XL 70	150	A	C
El Dorado	BB	Custom Stock 60	150	B	C	Gillette	B	Ambassador	80	B	C	Heafner Tire Co.	B	Regal XL 100	80	A	C
El Dorado	BB	Custom Stock 70	150	B	C	Gillette	BB	Ambassador Sprint 60 Ser	210	B	C	Heafner Tire Co.	BB	Sunbelt 78 Belted	100	B	C
El Dorado	BB	Golden Fury	130	B	C	Gillette	BB	Ambassador Sprint 70 Ser	170	A	C	Hercules	BB	Honcho 60	150	B	C
El Dorado	B	Premium 78 Plus 4	100	B	C	Gillette	B	Golden Bear	100	B	C	Hercules	BB	Honcho 70	150	B	C
El Dorado	B	Rally Sport	90	A	C	Gillette	BB	Golden Bear	130	B	C	Hercules	BB	Honcho 70 H7015	120	B	C
Electra	BB	Electra	110	B	C	Gillette	B	Sport Special	70	B	C	Hercules	B	Premium 478	120	B	C
Emblem	B	Emblem	80	B	C	Gillette	BB	Sprint GT	170	A	C	Hercules	B	Saftipreme 78	100	B	C
Emblem	BB	Ride 78 Belted	110	B	C	Gillette	BB	Sprint GT 60	210	B	C	Hercules	B	Sportspreme	90	A	C
Empco	BB	2+2	120	B	C	Gillette	BB	Sprint GT 70	170	A	C	Hercules	BB	Ultrapreme 78	140	B	C
Empco	B	Poly Special	80	B	C	Gill/Wilson	BB	Gran-Trac G/T 60 Belted	130	B	C	Hillcrest	B	Invader 500	90	B	B
Empco	BB	Power Cat	130	B	C	Gill/Wilson	BB	Gran-Trac G/T 70 Belted	130	B	C	Hillcrest	BB	Invader 600 Belted	130	B	C
Empco	B	Premium Polyester	80	B	C	Gill/Wilson	BB	LTR Glass Belted 78	100	B	C	Hillcrest	BB	Invader 700 Belted	130	B	C
Empco	BB	Solar Belted 78	110	B	C	Global	B	600 Trac Speed G60-14	100	A	A	Hillcrest	B	LTR Sports	80	B	C
Empco	BB	Super Cat 60	140	A	C	Global	B	700 Trac Speed	100	A	A	Hillcrest	BB	Poly Belted 78	100	B	C
Empco	BB	Super Cat 70 14-15	130	A	C	Golden Falcon	B	Golden Falcon	70	B	C	Hillcrest	B	Premium Polyester	80	B	C
Empco	BB	Super Cat 70-13	120	A	C	Goodrich	B	155-13	80	B	C	Hillcrest	B	XKE 400	80	B	C
Fairmont	B	Premium Sportway	100	A	C	Goodrich	BB	All Terrain T/A F	120	B	C	Holiday	BB	Belted	100	B	C
Falcon	BB	N.Y. Belted	110	B	C	Goodrich	BB	Belted GT	130	A	C	Holiday	B	Polyester 78	80	B	C
Falls	B	Allstar	120	B	C	Goodrich	BB	Belted Japan E	90	B	C	Holiday	BB	WT EF714G14-15	130	B	C
Falls	B	Allstar	80	B	C	Goodrich	BB	Belted T/A60	150	A	C	Hood	BB	WT GL614GL6-15	160	B	C
Falls	BB	Avenger	140	B	C	Goodrich	BB	Belted T/A70	150	A	C	Hood	B	78 Belted	100	A	C
Falls	BB	Avenger A-R78-13	130	B	C	Goodrich	B	Custom Longmiler	80	A	C	Hood	B	78 Poly	80	A	C
Falls	BB	Avenger C-L78-15	140	B	C	Goodrich	BB	Silvertown Belted	130	A	C	Hood	BB	Mach 60	150	A	C
Falls	BB	Jet Streak Wide 60	150	B	C	Goodrich	B	Silvertown GT	80	A	C	Hood	BB	Mach 70	150	A	C
Falls	BB	Jet Streak Wide 70	150	B	C	Goodrich	B	Silvertown HT	100	A	C	Hood	BB	Premium Belted	130	A	C
Falls	B	Persuader	100	B	C	Goodyear	BB	Blue Streak Polyglas	130	B	B	Hood	B	Sport King GT	80	A	C
Falls	B	Persuader	60	B	C	Goodyear	B	Cruiser	80	B	C	Imperial Falcon	BB	Imperial Falcon	90	B	C
Farmland	B	100	120	B	C	Goodyear	BB	Cushion Belt Polyglas	100	B	C	Imperial Falcon	B	Imperial Falcon	80	B	C
Firestone	B	Deluxe Champion	80	B	C	Goodyear	BB	Custom Power Cushion	130	B	C	Interstate	BB	Drag Master 60 Belted	130	B	C
Firestone	BB	Deluxe Champion E78-14JAP	70	B	C	Goodyear	B	Mini Custom	80	B	C	Interstate	BB	Drag Master 70 Belted	130	B	C
Firestone	BB	Deluxe Champion L78-15SW	90	B	C	Goodyear	BB	Polyglas GT 60 CWT	160	B	C	Interstate	B	Drag Master 50	90	B	B
Firestone	BB	Deluxe Champion SUP-R Belt	110	B	C	Goodyear	BB	Polyglas GT 70 CWT	160	B	C	Interstate	B	LTR Sports Tyre	80	B	C
Firestone	B	Gran Champion	100	B	C	Goodyear	B	Power Guide	80	B	C	Interstate	BB	Poly Master 78 Belted	100	B	C
Firestone	B	Gran Champion EFG7814G-15	100	B	C	Goodyear	B	Power Streak	70	B	C	Interstate	B	Premium 78 Polyester	80	B	C
Firestone	B	Super Sports	80	B	C	Goodyear	B	Power Streak	80	B	C	Interstate	B	Super 78 Polyester	80	B	C
Fisk	BB	Classic	90	B	C	Goodyear	B	Rally GT	80	B	B	J.C. Penney	BB	EL Tigre 278	130	B	C
Fisk	B	Premier II	80	B	C	Grand Prix	BB	14 & 15 inch	130	A	C	J.C. Penney	BB	Mileagemaker Belted	120	B	C
Fisk	BB	Safety Classic II	90	B	C	Grand Prix	BB	70 13 inch	120	A	C	J.C. Penney	B	Mileagemaker II	80	B	C
Fleetwood	BB	LTD 780	130	B	C	Grand Prix	BB	Power King XP Belted	70	B	C	J.C. Penney	B	Mileagemaker Sport	80	B	C
Fleetwood	B	Marauder 60	110	A	C	Grand Prix	BB	Superwide GT 60	140	A	B	J.C. Penney	BB	Scat Trac Super AFX 60	120	B	C
Fleetwood	B	Marauder 70	90	A	C	Gulf	B	Cruisemaster	80	A	C	J.C. Penney	BB	Scat Trac Super AFX 70	120	B	C
Fleetwood	B	Poly 440	80	B	C	Hallmark	B	150 Poly II	70	B	C	J.C. Penney	B	Treasury 78 Poly	80	A	C
Flex-Ride	B	Flex-Ride	50	B	C	Hallmark	B	200	80	B	C	J.C. Penney	B	Treasury Premium Poly	110	A	C
Formula	BB	Formula I Super Stock 50	140	A	B	Hallmark	BB	275	100	B	C	J.C. Penney	B	Treasury Sport King GT	80	A	C
Formula	BB	Formula I Super Stock 60	100	A	C	Hallmark	B	Sport Comet	80	B	C	Jetson	B	707 Polyester	80	B	C
Formula	BB	Formula I Super Stock 70	80	A	C	Hallmark	B	Super GT 50	90	B	C	Jetson	B	Gemini II Polyester	80	B	C
Gator	B	78 Poly	80	A	C	Hallmark	B	Super GT Sport 60	140	A	B	Jetson	B	LTR Sports Tyre	80	B	C
Gator	B	Premium Poly	100	A	C	Hallmark	BB	Super GT Sport 70	130	B	C	Jetson	B	Revenger 50	90	B	B
Gator	B	Sport King	80	A	C	Hallmark	BB	Super GT Sport A70-13	120	B	C	Jetson	BB	Revenger 60 Belted	130	B	C
General	BB	Belted Jumbo 780	120	B	C	Harvard	B	Premium MCL	90	B	B	Jetson	BB	Revenger 70 Belted	130	B	C
General	B	Bias Jumbo 780	80	B	C	Heafner Tire Co.	BB	Medalist 78 Belted	100	A	C	Jetson	B	Wide Ride 78	80	B	C
General	BB	Grabber 60	130	B	C	Heafner Tire Co.	B	Medalist 78 Poly	80	A	C	Kelly Springfield	B	Benchmark	70	B	C
General	BB	Grabber 70	130	B	C	Heafner Tire Co.	BB	Medalist Mach 60	150	A	C	Kelly Springfield	BB	Citation G/P	130	B	C
General	B	Poly Jet	80	B	C	Heafner Tire Co.	BB	Medalist Mach 70	150	A	C	Kelly Springfield	B	Kelly Springfield	70	B	C
General	B	Sprint II	80	B	C	Heafner Tire Co.	BB	Medalist Premium Belted	130	A	C	Kelly Springfield	B	Roadmark	80	B	C
Giant	B	Cushion Ride	120	B	C	Heafner Tire Co.	B	Medalist Premium Poly	100	A	C	Kelly Springfield	BB	Roadmark Belted	100	B	C
Giant	B	Roadmaster 78	100	B	C	Heafner Tire Co.	B	Regal	80	A	C	Kelly Springfield	BB	Super Charger 60	140	A	B
						Heafner Tire Co.	BB	Regal	100	A	C	Kelly Springfield	BB	Super Charger 70	130	A	C
						Heafner Tire Co.	B	Regal 78 Belted	100	A	C	Kelly Springfield	BB	Super Charger 70 A70-13	120	A	C
						Heafner Tire Co.	BB	Regal HP 780	100	A	C	Kelly Springfield	B	Super Charger	90	B	C
						Heafner Tire Co.	B	Regal HP 780 Belt	130	A	C	K-Mart	B	KM 100	100	B	C
						Heafner Tire Co.	BB	Regal Mach 60	150	A	C	K-Mart	BB	KM 200	110	B	C
						Heafner Tire Co.	BB	Regal Mach 70	150	A	C	K-Mart	B	KM 50	50	B	C
						Heafner Tire Co.	BB	Regal Premium Belted	130	A	C	K-Mart	B	KM 78	80	B	C
						Heafner Tire Co.	B	Regal Sport King	80	A	C	Kumho	B	Sam Yang 560-15	70	B	C
						Heafner Tire Co.	BB	Regal XL 100 Belt	100	A	C	Kumho	B	Sam Yang 615-13	60	B	C

by testing two tires mounted on a special trailer rig on asphalt and concrete skid pads, which are located at Goodfellow AFB.

While the trailer is pulled by a truck over the skid pads, water is sprayed under one wheel that's locked up so that it's being dragged. The other wheel keeps rolling and maintains trailer stability. Meanwhile, instrumentation on the trailer measures the force on the locked wheel.

This is converted by computer into a coefficient of friction. "The higher the coefficient of friction, the greater the tractive ability of the tire for stopping," says Dr. Brenner. A-graded

tires must have a coefficient of friction greater than 0.35 on the concrete surface, and greater than 0.5 on asphalt. B-graded tires must have a coefficient of friction more than 0.26 on concrete, and greater than 0.38 on asphalt. Tires ranked C are below that level.

The tests only record straight-line braking performance on a wet surface. They do not reveal stopping power on dry roads or the cornering ability of tires in turns.

Heat resistance

This grading quality gives some indication about the high-speed capability of tires, and is probably the least

important to most drivers. That's because every tire sold today must be capable of sustained speeds of at least 85 mph. And with the margin of safety most companies put into their tires, it's probable that tires are good for at least 100 mph. If they rate a minimum of 85 mph, they get a C grade. Tires that run without failure at better than 110 mph rate a B; 115 mph or better get an A.

The higher-rated tires run cooler, and although there's no scientific proof, tire engineers believe cooler-running tires have less rolling resistance. That means an A-rated tire may give better gas mileage.

Federal quality grades for bias-ply and bias-belted passenger-car tires (cont.)

Brand	Constr.*	Line	Tread wear	Traction	Temperature resistance
Kumho	B	Sam Yang 645-13	80	B	C
Kumho	B	Sam Yang A78-13-600-13	70	B	C
Laher Spring	BB	Mustang 78 Belted	100	A	C
Laher Spring	BB	Mustang Mach 60	150	A	C
Laher Spring	BB	Mustang Mach 70	150	A	C
Laher Spring	BB	Mustang Premium Belted	130	A	C
Laramie	B	Easy Rider	80	B	C
Laramie	B	Easy Rider 78	80	B	C
Laramie	BB	Equalizer 60 Belted	130	B	C
Laramie	BB	Equalizer 70 Belted	130	B	C
Laramie	B	LTR Sports Tyre	80	B	C
Laramie	B	Performer	90	B	B
Lee	BB	GS 300 Belted	100	B	C
Lee	B	GS-300	80	B	C
Lee	B	LTR Sports	80	B	C
Lee	B	Manhandler 50	90	B	B
Lee	BB	Manhandler 60	130	B	C
Lee	BB	Oxford Invader 600	130	B	C
Lee	BB	Oxford Invader 700	130	B	C
Lee	B	XL 200 & 3000	80	B	C
Lemans	BB	EG7014G70-15	130	B	C
Lemans	BB	GL6014GL60-15	160	B	C
Lexington	B	78 Poly BPT	70	A	B
Lexington	B	78 Poly WPI	70	A	B
Lexington	B	Fayette 78 Poly WPI	70	A	B
M & H	B	Racemaster	140	A	C
Mansfield	B	Harvard Poly 78	70	A	B
Mansfield	B	Polaris Superior WPT	70	A	B
Mansfield	B	Poly Miller	70	A	B
Mansfield	B	Poly Miller II	70	A	B
Mansfield	B	Poly Miller PQ BPT	70	A	B
Mansfield	B	Road Gripper LNT	120	A	A
Mansfield	B	Road Gripper LPT 60	120	A	A
Mansfield	B	Road Gripper LPT 70	120	B	B
McCreary	BB	Road Star 60	130	A	B
McCreary	BB	Road Star 70 (13 inch only)	120	B	C
McCreary	BB	Road Star 70 (14 & 15 inch)	130	B	C
McCreary	B	Scot	70	B	C
McCreary	B	Scot	80	B	C
McCreary	BB	Scot Hawk Belted	130	B	C
McCreary	B	Scot Major	100	B	C
McCreary	B	Scot Major	90	B	C
Medalist	BB	78 Belted	100	A	C
Medalist	B	78 Poly	80	A	C
Medalist	BB	Mach 60	150	A	C
Medalist	BB	Mach 70	150	A	C
Medalist	BB	Premium Belted	130	A	C
Medalist	B	Premium Poly	110	A	C
Medalist	B	Sport King GT	80	A	C
Midwest	BB	Ramus 78 Belted	100	A	C
Midwest	BB	Ramus Mach 60	150	A	C
Midwest	BB	Ramus Mach 70	150	A	C
Midwest	BB	Ramus Premium Belted	130	A	C
Miller	BB	78 Belted	100	A	C
Miller	B	78 Poly & Sport King	80	A	C
Miller	BB	Mach 60	150	A	C
Miller	BB	Mach 70	150	A	C
Miller	BB	Premium Belted	130	A	C
Miller	B	Premium Poly	100	A	C
Mobil	B	Cushion 78 Polyester Cord	80	B	C
Mobil	BB	Premiere Belted	110	B	C
Mohawk	BB	Glas Belt	90	B	C
Mohawk	B	Meteor	70	A	C
*Construction: B—bias ply; BB—bias belted					
Mohawk	B	Meteor	80	B	C
Mohawk	B	Montego Sport	60	A	C
Mohawk	B	Montego Sport	50	B	C
Mohawk	B	Super Mag 60	80	A	C
Mohawk	B	Super Mag 60	110	A	C
Mohawk	B	Super Mag 70	80	A	C
Mohawk	B	Super Mag 70	90	A	C
Mohawk	BB	Ultissino Glasbelt	130	B	C
Monarch	B	200 Poly 78	80	B	C
Monarch	B	LTR Sports Tyre	80	B	C
Monarch	B	Road Hugger 50	90	B	C
Monarch	BB	Road Hugger 60 Belted	130	B	C
Monarch	BB	Road Hugger 70 Belted	130	B	C
Monarch	B	Ultra H78	80	B	C
Monarch	BB	Ultra M78 Belted	100	B	C
Montgomery Ward	BB	Glass Belt	110	B	C
Montgomery Ward	B	Highway Handler I	70	B	C
Montgomery Ward	B	Highway Handler II	70	B	C
Montgomery Ward	B	Poly Sport	80	B	C
Montgomery Ward	B	Poly Sport	40	B	C
Montgomery Ward	BB	Road Guard	130	B	C
Montgomery Ward	BB	Road Tamer Belted	130	B	C
Montgomery Ward	B	Runabout	40	B	C
Montgomery Ward	BB	Runabout Belted	100	B	C
Montgomery Ward	BB	Steel Belt	100	B	C
Montgomery Ward	B	Super Sport 50	70	B	C
Montgomery Ward	BB	Super Sport 60	140	A	B
Montgomery Ward	BB	Super Sport 70	120	B	C
Montgomery Ward	BB	Twin Guard	110	B	C
Montgomery Ward	B	Wide Track Oval 50 Series	70	B	C
Montgomery Ward	B	Wide Track Oval 60 Series	70	B	C
Montgomery Ward	B	Wide Track Oval 70 Series	70	B	C
Multi-Mile	BB	Grand AM 70 13 inch	120	A	C
Multi-Mile	BB	Grand AM Superwide GT 60	140	A	B
Multi-Mile	BB	Grand AM Superwide GT 70	130	A	C
Multi-Mile	BB	Multi-Mile II	110	B	C
Multi-Mile	BB	Power King XP Belted	70	B	C
Multi-Mile	BB	Wide 600	130	B	C
Mustang	B	78 Poly	80	A	C
Mustang	B	Premium Poly	100	A	C
Mustang	B	Sport King	80	A	C
National	B	Air Float Custom	80	B	C
National	BB	Air Float Custom Belted	100	B	C
National	B	F/C	80	B	C
National	BB	XT Chapparell 715	140	A	C
National	B	XT Rene 60	80	B	C
National	B	XT Rene 70	80	B	C
National	B	XT Renegade L70-15	70	A	B
O. K.	B	Premium Polyester	80	B	C
Okamoto	B	Cezan Riken (Japan)	80	B	C
Oxford	BB	Poly Belted 78100	130	B	C
Peerless	BB	Ambassador	90	B	C
Peerless	B	Ambassador	80	B	C
Peerless	BB	Ambassador Sprint 60 Ser	210	B	C
Peerless	BB	Ambassador Sprint 70 Ser	170	A	C
Peerless	B	PI 78	100	B	B
Peerless	BB	PI 78	130	B	C
Peerless	B	Sport Special	70	B	B
Peerless	BB	Sprint GT	170	A	C
Peerless	BB	Sprint GT 60	210	B	C
Peerless	BB	Sprint GT 70	170	A	C
Pep Boys	BB	Cornell 300	90	B	C
Pep Boys	BB	Cornell XWT 60 Belted	130	B	C
Pharis	B	Superior WPT	70	A	B
Phillips	B	66 Custom P/C Poly Sprint	80	B	C
Phillips	BB	66+2	130	B	C
Phillips	B	Poly Special	80	B	C
Pirelli	B	Intermark	70	B	C
Polymile	BB	Polymile	80	B	C
Pos-A-Traction	B	Torque Twister 50	140	A	C
Pos-A-Traction	BB	TT 60	140	A	B
Pos-A-Traction	BB	TT 70	140	A	B
Power Cat	B	Cornell 100 Polyester	80	B	C
Premium	B	HD N78-15	80	B	C
Pro-Trac	BB	60 All Sizes	130	A	B
Pro-Trac	BB	70 13	120	B	C
Pro-Trac	BB	70 14 & 15	130	B	C
Pro-Trac	B	Racing Profile	90	B	B
Prowler	BB	78 Belted	100	A	C
Prowler	B	78 Poly	80	A	C
Prowler	BB	Custom SST	90	B	C
Prowler	BB	Mach 60	150	A	C
Prowler	BB	Mach 70	150	A	C
Prowler	BB	Premium Belted	130	A	C
Prowler	B	Premium Poly	110	A	C
Prowler	B	Sport King GT	80	A	C
Prowler	BB	Prowler II Belted	70	B	C
Ram	B	Cougar SST N78-15	100	B	C
Ram	B	Custom 78	70	B	C
Ram	BB	Custom Belted	70	B	C
Ram	B	Maxi-Trac Super 60	100	A	B
Ram	B	Maxi-Trac Super 70	100	A	B
Ram	B	Premium Poly	90	B	C
Ram	B	Ultra Sport	60	A	B
Ram	B	VR III	80	A	C
Ram	B	VR III 560-15	70	B	B
Ramus	B	78 Poly	80	A	C
Ramus	B	Premium Poly	100	A	C
Ramus	B	Sport King	80	A	C
Regency	B	Regency 30	50	B	C
Regal	BB	78 Belted	100	A	C
Regal	BB	HP 780 Belt	130	A	C
Regal	BB	Mach 60	150	A	C
Regal	BB	Mach 70	150	A	C
Regal	BB	Premium Belted	130	A	C
Regal	BB	XL 100 Belt	100	A	C
Regal	BB	XL 60	150	A	C
Regal	BB	XL 70	150	A	C
Reliable	B	Medalist 78 Poly	80	A	C
Reliable	B	Medalist Jet Speed Poly	80	A	C
Reliable	B	Medalist Premium Poly	100	A	C
Reliable	B	Medalist Sport King	80	A	C
Reliable	B	Spartan 78 Poly	80	A	C
Reliable	B	Spartan Custom 400 Poly	70	A	C
Reliable	B	Spartan Premium Poly	100	A	C
Reliable	B	Spartan Sport King GT	80	A	C
Reliable	B	Vanguard 78 Poly	80	A	C
Reliable	B	Vanguard Jet Speed Poly	80	A	C
Reliable	B	Vanguard Premium Poly	100	A	C
Reliable	B	Vanguard Sport King	80	A	C
Remington	B	Cushion-Aire	100	A	C
Remington	BB	Cushion-Aire Belted	110	A	C
Remington	B	Cushion-Aire Poly 4	100	A	C
Remington	B	Taxi and Flash Cab Taxi	100	B	C
Remington	BB	XT-120 Belted 60 Series	160	B	B
Remington	BB	XT-120 Belted 70 Series	150	A	B
Republic	BB	Road Rebel 60 Belted	130	B	C
Republic	BB	Road Rebel 70 Belted	130	B	C
Republic	BB	Super Ride 78 Belted	100	B	C

So far, the new tire-grading code has had little impact on buying habits of consumers, according to manufacturers and dealers interviewed by PS. Most feel it's too new, and the tire companies have done virtually no publicity on the standards. In fact, I get a definite feeling that the companies would rather that the standards, which they fought fiercely, just disappeared.

Dr. Robert H. Snyder, vice-president of engineering for Uniroyal, says, however, that it's possible some companies might eventually find it profitable to advertise tire grades if they feel it would be a marketing ad-

vantage. He told PS, "I wouldn't be surprised to see the grades used in advertisements, just the way EPA mileage figures are used by car companies today."

One additional development could make tire grading more important in motorists' buying decisions. That's two additional standards now being studied by the EPA and the DOE. The EPA is expected to issue a grading standard for tire noise, while the DOE will probably issue a grading standard for rolling resistance. The latter would be of special interest to increasingly fuel-conscious motorists because lower rolling resistance means better

fuel economy. It would also be of great interest to Detroit because of the immense pressure car makers face in increasing their fleet fuel-economy averages. High grades for low rolling resistance would attract buyers.

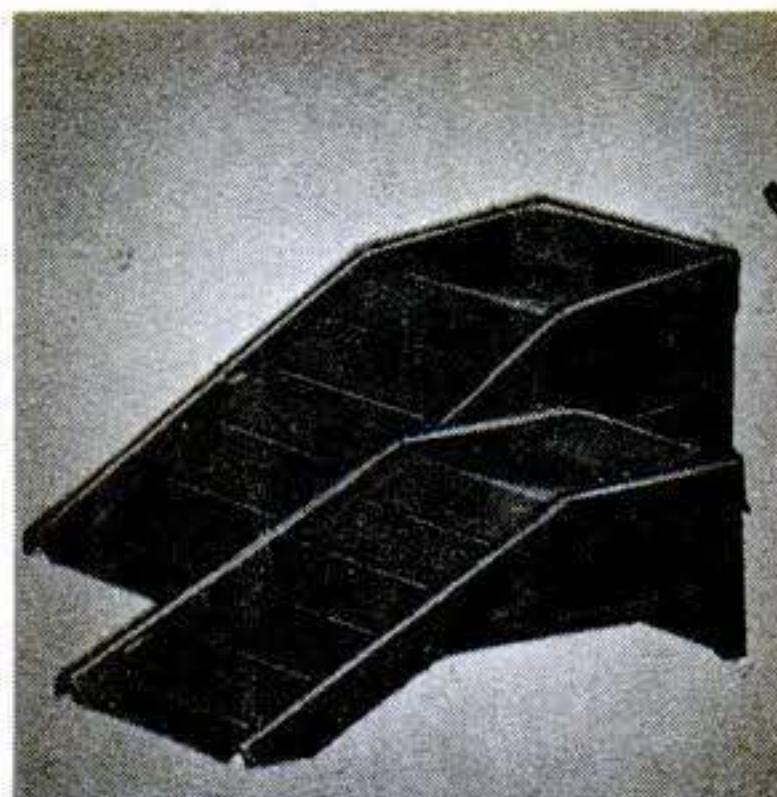
Tire-grading standards don't rank many properties of these tremendously complex products. They do, however, quantify the most important feature a tire buyer looks for—tread-wear life—and two other important performance areas. The grades for tread life, traction, and high-temperature resistance can help comparison shoppers a great deal, in my opinion. I plan to use them from now on. PS

Brand	Constr.*	Line	Tread wear	Traction	Temperature resistance	Brand	Constr.*	Line	Tread wear	Traction	Temperature resistance	Brand	Constr.*	Line	Tread wear	Traction	Temperature resistance
Revere	B	100	100	B	C	Starfire	B	Poly IV	60	B	C	Titan	B	78 Poly	80	A	C
Revere	B	50	100	B	C	Starfire	B	Poly IV	100	B	C	Titan	B	Premium Poly	100	A	C
Revere	B	78	80	B	C	Starfire	B	Poly Sport	50	B	C	Titan	B	Sport King GT	80	A	C
Reynolds	BB	Drag-Rite Seventy	130	B	C	Starfire	B	Poly Sport	90	A	C	Toyo	B	Toyo Tire	80	B	C
Reynolds	BB	Drag-Rite Sixty	130	B	C	Star Tires	B	Deluxe 78	70	B	C	Treasury	BB	78 Belted	100	A	C
Reynolds	B	Poly Special	80	B	C	Star Tires	B	Skytrac 78	80	B	C	Treasury	BB	Mach 60	150	A	C
Reynolds	BB	Premium Polybelt	130	B	C	Star Tires	B	Sport Comet	80	B	C	Treasury	BB	Mach 70	150	A	C
Reynolds	B	Premium Polyester	80	B	C	Star Tires	B	Super Star 50	90	B	C	Treasury	BB	Premium Belted	130	A	C
Reynolds	BB	Sport Belted	130	B	C	Stratton	BB	78 Belted	100	A	C	Triumph	BB	Triumph Belted	90	B	C
Road King	B	Performance 78	80	B	C	Stratton	B	78 Poly	80	A	C	Triumph	B	Triumph Foreign/Compact	80	B	C
Road King	B	Premium Plus 78	110	B	C	Stratton	BB	78 Super Belt	100	A	C	Triumph	B	Triumph Ride	80	B	C
Safemark	BB	Belted 2+2	120	B	C	Stratton	BB	Black Belt 60	150	A	C	TSC Industries	B	Traveller Ultra Ride 300II	70	B	C
Safemark	BB	PE 411	80	B	C	Stratton	BB	Black Belt 70	150	A	C	Union 76	BB	Sports Oval 60	140	A	B
Safemark	BB	Seventy	130	B	C	Stratton	BB	Mach 60	150	A	C	Union 76	BB	Sports Oval 70	120	B	C
Safemark	BB	Sixty	130	B	C	Stratton	BB	Mach 70	150	A	C	Union 76	BB	Super Belt	110	B	C
Safemark	BB	XP-211W	130	B	C	Stratton	B	Medalist 78 Poly	80	A	C	Union 76	B	Three Star	80	B	C
Saftipreme	BB	78 AB7813	110	B	C	Stratton	B	Medalist Premium Poly	100	A	C	Uniroyal	B	Ambassador	100	B	C
Saxon	B	Poly Ride 78	80	B	C	Stratton	B	Medalist Sport King GT	80	A	C	Uniroyal	B	Fastrak A78-113	120	B	B
Saxon	B	Speed Track 50	90	B	B	Stratton	B	Poly IV	80	A	C	Uniroyal	B	Fastrak B78-13	100	B	B
Schenuit	BB	Premium 78	120	B	C	Stratton	BB	Premium Belted	150	A	C	Uniroyal	BB	Fastrak LR B	120	B	C
Schenuit	B	Stallion 780	80	B	C	Stratton	B	Premium Poly	100	A	C	Uniroyal	BB	Fastrak LR C	100	A	C
Sears	B	Allstate Guardsman	50	B	C	Stratton	B	Sport King GT	80	A	C	Uniroyal	BB	Fastrak LR C L78	100	A	C
Sears	BB	Dynaglass Belted 25	100	B	C	Stratton	BB	Supercat 50	90	B	B	Uniroyal	B	Fastrak P15580D13	100	B	C
Sears	BB	Dynaglass Belted 26	100	B	C	Sumitomo	B	Dunlop Grand Speed	80	B	C	Uniroyal	BB	Tiger Paw	90	B	C
Sears	BB	Dynaglass Belted 28	100	B	C	Summit	BB	2+2	120	B	C	Uniroyal	BB	Tiger Paw 60 SS	210	B	C
Sears	B	Dynaply	80	A	C	Summit	BB	Super Trac	130	B	C	Uniroyal	BB	Tiger Paw 70	150	B	C
Sears	B	Dynaply 18	70	B	C	Summit	BB	Super Trac 60	130	B	C	Uniroyal	BB	Tiger Paw Belted	90	B	C
Sears	B	Dynaply 20	70	B	C	Sunbelt	BB	78 Belted	100	B	C	Uniroyal	B	Tiger Paw L78-15	100	B	B
Sears	B	Dynaply 24	80	B	C	Sunbelt	B	78 Polyester	80	B	C	Uniroyal	B	Tiger Paw Nylon	70	B	B
Sears	B	Dynaply 24	80	B	C	Sunbelt	B	Poly 4	80	B	C	Uniroyal	B	Tiger Paw Polyester	80	B	C
Sears	B	Dynasport	60	B	C	Sunbelt	B	Premium	80	B	C	United	B	727 Poly BPT	70	A	B
Sears	B	Guardsman	60	B	C	Sunbelt	B	Special	80	B	C	United	B	727 Poly WPT	70	A	B
Sears	BB	Guardsman Belted	70	B	C	Superior	B	Poly Four	100	B	C	Universal Coop	B	Custom Poly 78	80	A	C
Sears	B	Present Antique	50	B	C	Super Jet	BB	Sport Wide 60	150	B	C	Universal Coop	B	SPD Poly A-D7814	100	B	B
Sears	B	Proposed Antique	50	B	C	Super Jet	BB	Sport Wide 70	150	B	C	Universal Coop	B	SPD Poly F-L7815	100	B	B
Sears	B	Silent Guard	110	B	C	Telstar	B	LTR Sports Tyre	80	B	C	Universal Coop	B	Sport King GT	80	A	C
Sears	BB	Superguard Belted	120	A	C	Telstar	B	Polygrand 78	80	B	C	Vista Custom	B	Custom Poly	80	B	B
Sears	BB	Superwide 60	130	A	B	Telstar	BB	Polygrand 78 Belted	100	B	C	Vista Custom	B	Mainliner	110	B	B
Sears	BB	Superwide 70	110	A	B	Telstar	B	Streaker 50	90	B	B	Vogue	BB	Bias Belted	110	B	C
Sears	B	Superwide XSS60	80	A	C	Telstar	BB	Streaker 60 Belted	130	B	C	Western Auto	B	LPS II	90	B	C
Sears	B	Superwide XSS70	80	A	C	Telstar	BB	Streaker 70 Belted	130	B	C	Western Auto	B	LPS III	90	B	C
Sears	B	Wide White	80	A	C	Telstar	B	XL 500	80	B	C	Western Auto	BB	Macho Belted	110	B	C
Security	BB	Custom Belted	90	B	C	Tire and Battery	BB	APD Cordovan Bonny	90	B	C	Western Auto	B	Sentry	80	B	C
Security	BB	Fast Cat	70	A	C	Tire and Battery	B	Bonneville Superwide 60	90	B	C	Western Auto	BB	Sentry Belted	100	B	C
Seiberling	B	110 78PE	60	B	C	Tire and Battery	B	Bonneville Superwide 70	80	B	C	Western Auto	BB	Wide GT70A73	120	B	C
Seiberling	BB	200	100	B	C	Tire and Battery	B	Cordovan Jet Star	80	B	C	Western Auto	BB	Wide ONEG160	140	B	C
Seiberling	B	200 Polyester	100	B	C	Tire and Battery	B	Grand Poly Broadwax	80	B	C	Western Auto	BB	Wide ONEG170	130	B	C
Seiberling	BB	Allroad 780	90	B	C	Tire and Battery	B	Grand Prix Superwide	90	B	C	White	B	Power Custom 78	80	B	C
Seiberling	B	Ambulance Service	80	B	C	Tire and Battery	BB	GT50	90	B	C	White	B	Safety Custom	110	B	C
Seiberling	BB	Lemans 60	160	B	C	Tire and Battery	B	Multi-Mile 78 Multi-Glass	70	B	C	White	BB	Safety Custom 220	120	B	C
Seiberling	B	Lemans 600-16	50	B	C	Tire and Battery	B	Power King Custom Poly	70	B	C	White	BB	Sportster XWT 60	170	B	C
Seiberling	BB	Lemans 70	130	B	C	Tire and Battery	B	Power King Custom Poly IV	70	B	C	White	BB	Sportster XWT 70	140	B	C
Seiberling	B	Lemans Wide White	60	B	C	Tire and Battery	B	Power King Poly IV	70	B	C	White	BB	Sportster XWT Super 60	170	B	C
Seiberling	BB	Shell Belted 78	120	B	C	Tire and Battery	BB	Power King XP Belted	70	B	C	White	BB	Sportster XWT Super 70	140	B	C
Seiberling	BB	Widetrack Super 60	170	B	C	Tire Brands	B	Challenger 78	80	B	C	Widetrack	BB	Super 60	170	B	C
Seiberling	BB	Widetrack Super 70	150	B	C	Tire Brands	BB	Golden Sonic 78	120	B	C	Widetrack	BB	Super 70	150	B	C
Seiberling	BB	Widetrack Super HP A7815	100	B	C	Tire Brands	B	LTR Sports Tyre	80	B	C	Widetrack	BB	Super HP A7815	100	B	C
Service Custom	B	Service Custom	50	B	C	Tire Brands	BB	Saxon Polyride 78 Belted	100	B	C	Winston	B	60 PE	80	B	C
Shell	BB	Belted 78	120	B	C	Tire Brands	BB	Saxon Speed Track 60	130	B	C	Winston	B	70 PE	80	B	C
Shell	B	Comfort Ride	80	B	C	Tire Brands	BB	Saxon Speed Track 70	130	B	C	Winston	BB	78 Glass Belted	110	B	C
Sonic	B	Golden Sonic 78	110	B	C	Tire Brands	BB	Sonic Maxima 60	150	B	C	Winston	B	F/C	80	B	C
Sonic	B	Golden Sonic HP Sport	90	B	C	Tire Brands	BB	Sonic Maxima 70	150	B	C	Winston	B	PE	80	B	C
Sonic	B	Poly 78	80	B	C	Tire Brands	BB	Sonic Satellite	110	B	C	Zenith	B	Polyester 78	80	B	C
Sport Terrain	BB	Sport Terrain	120	B	C	Tire Factory Warehouse	B	Wind Mark 780 BPT	70	A	B	Zenith	BB	S/S Widetrac	130	B	C
Sport Terrain	B	Super Sports	80	B	C	Tire Factory Warehouse	B	Wind Mark 780 WPT	70	A	B	Zenith	BB	S/S Widetrac	160	B	C



Tune Ups

Hand-held analyzer reads dwell angle, idle, tach, amps, volts, point resistance. 743 **22.99**
Timing light with induction pick-up, xenon tube. 817 . . **32.99**



Mark Fore Car Ramps

A lift for the home mechanic! Rugged 1-pc. steel construction holds 6500 lbs. per set. 11-inch high with wheel well. Pair. R75 **22.99**



CAMPBELL & HAUSFELD Consolaire

Air compressor has twin cylinder pump for constant pressure, hi-volume air. 1-hp. 12-gal. tank. 6.9 cfm @40 **379.00**
psi. VT4100



CAMPBELL & HAUSFELD Airless

Compact sprayer applies a gal. paint in 3 min., indoors or out control for primer and pressure. Has hose & gun. AL2000 **359.00**

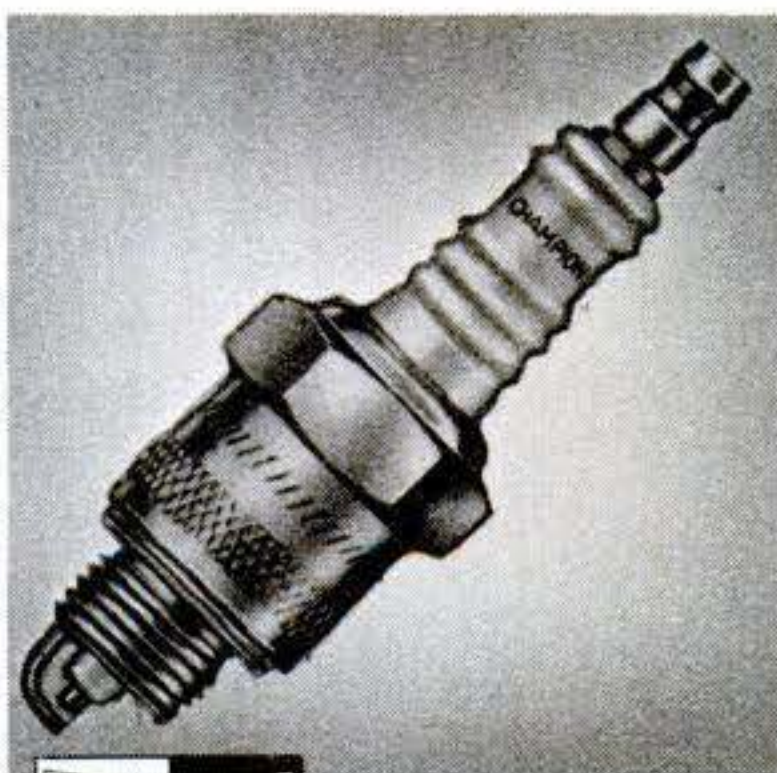


Check our championship CAR CARE



LubriMatic Grease Gun

Up to 10,000 lbs. working pressure to lubricate cars, trucks and machinery quickly and easily. 6" extension pipe. 7090 **6.49**
14-oz. Grease Cartridge. 400 . **79¢**



CHAMPION Spark Plugs

Replace worn plugs yourself. You'll save money, get better gas mileage and a smoother running engine. Regular, each . **79¢**
Resistor-type plugs, each . **99¢**



DURO Body Shop

Complete 11-pc. kit renews car, boat, any vehicle body. Free body repair manual. BSK11 . **7.99**
Auto body filler and patch. Pt. BKK2 **2.49** Qt. BKK3 . . . **4.49**



WD-40 Lubricant

Penetrates instantly to free frozen locks, bolts, other metal parts. Stops rust and corrosion. Shuts out moisture, reduces shorts. 9-oz. **1.29**

QUAKER STATE Motor Oil

Deluxe all-temperature motor oil helps engine run more efficiently. Refined from 1st quality Pennsylvania crude. 10W40. Qt., reg. 1.39, only **99¢**



DU PONT Premium Wax

Highest quality ingredients deliver a clear, haze-free gloss and radiant color. 16-oz. liquid or 14-oz. paste. Your choice, 0100N/0105N **6.88**



turtle wax Hard Shell

Turtle Extra, the extra-hard car wax that goes on extra-easy, gives extra-brilliant protection. 16-oz. liquid or 13-oz. paste. T-1/T-4 Each **4.88**



SIMONIZ Car Wax

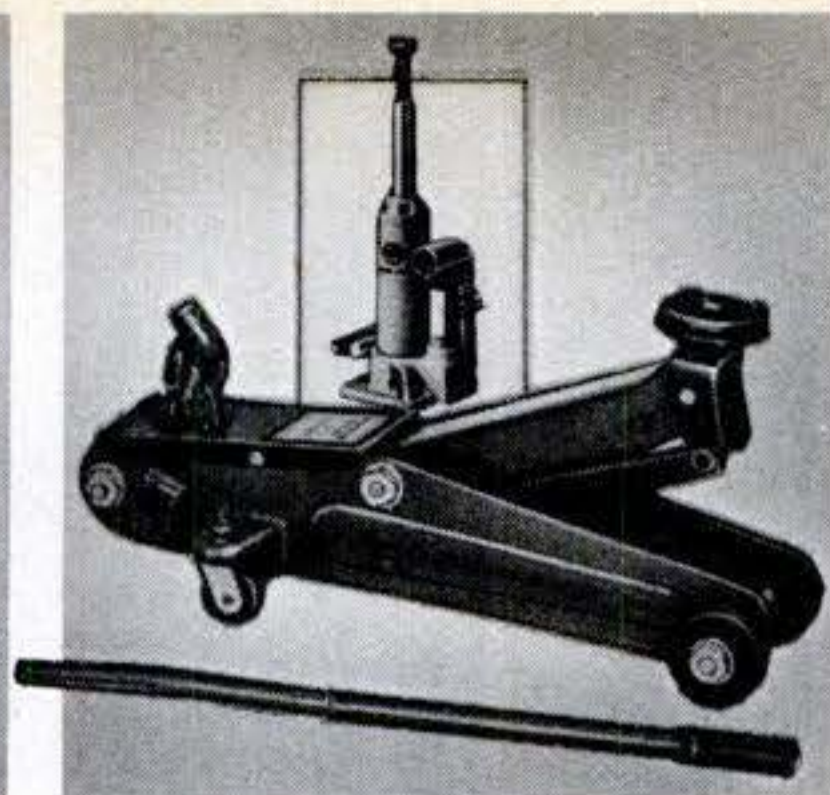
"Shines like the Sun" goes on and buffs off in less than an hour, stays bright week after week. 16-oz. liquid or 14-oz. paste. Ea. **4.88**

COTTER & COMPANY, 100% Member-Owned warehouse distributor serving over 5,000 True Value Hardware Members who own their own stores, set their prices and reserve the right to limit quantities. Be



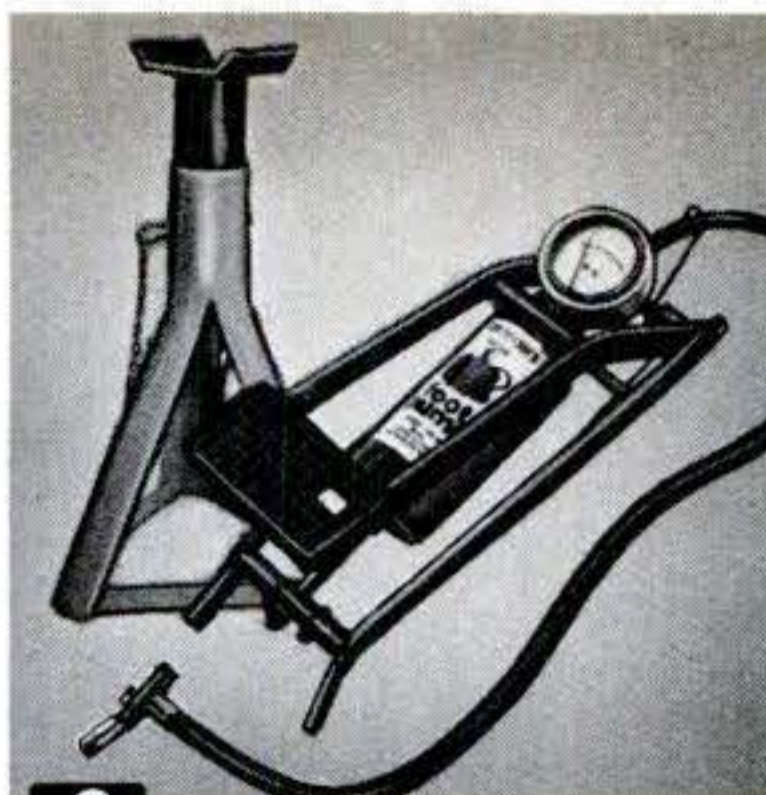
BIG BOY Tire pumps

1-purpose steel pump with 24" hose, thumblock. 5675 **8.98**
 2-pressure pump for air shocks, truck tires. Built-in gauge accurate to 150 psi., 5620 **14.98**



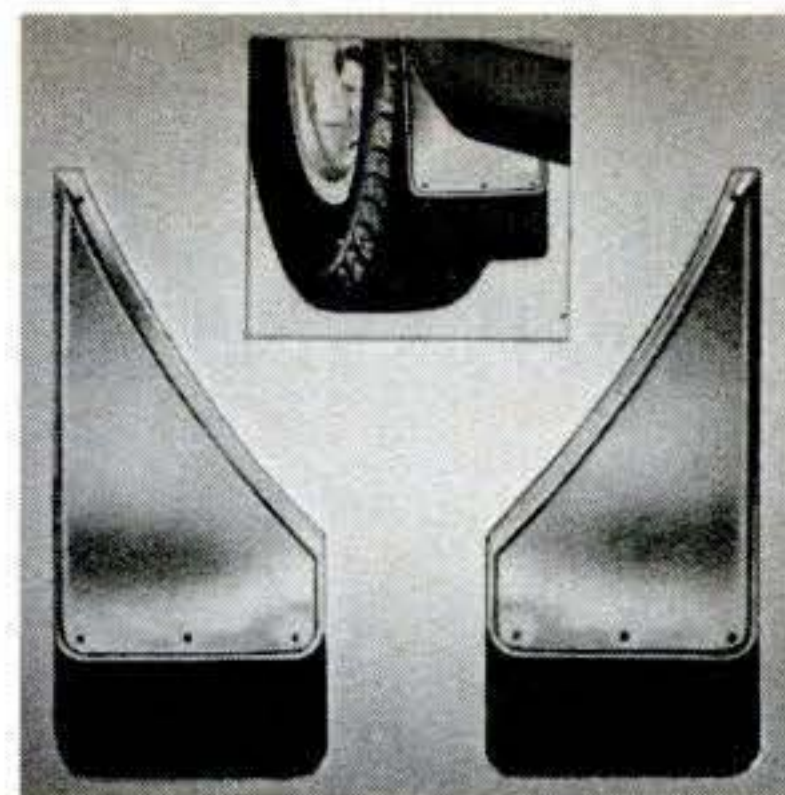
HOLLYWOOD ACCESSORIES Jacks

Heavy-duty 2-ton jack has 50% reserve capacity. 621 **9.99**
 4-ton 623 . **14.99** 6-ton 625 . **19.99**
 Extra-stable 1½-ton service roller floor jack. 649N **69.95**



pathfinder Parts

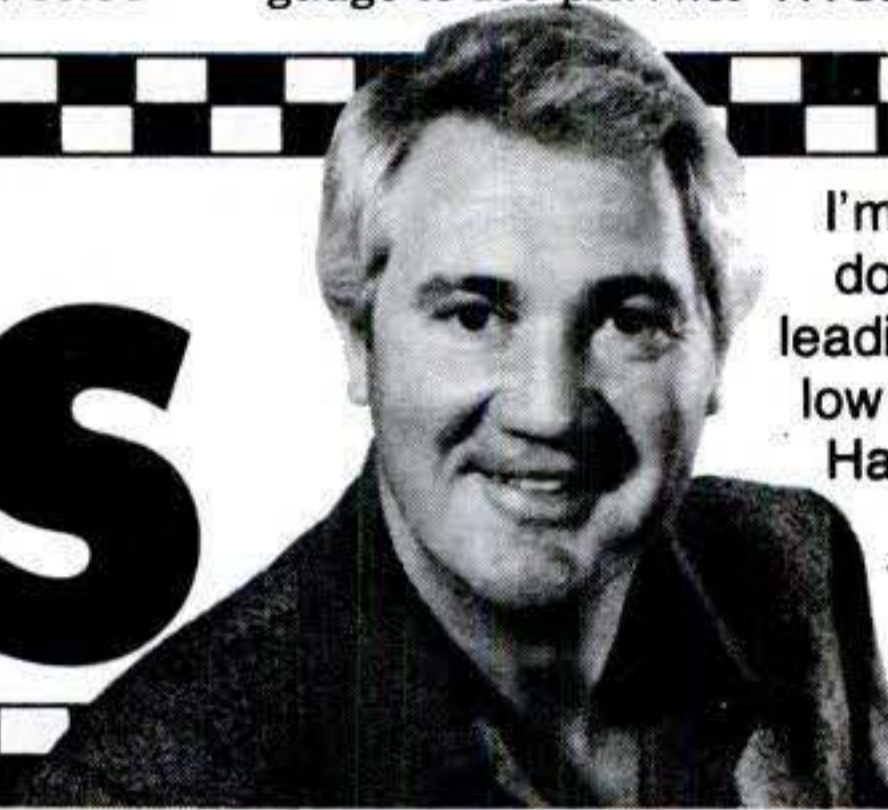
3,000-lb. capacity jack stand extends 12" to 17". 7224 **3.49**
 Heavy-duty tire pump you work with your foot. Has accurate gauge to 100 psi. PW96 . . . **14.99**



Grobaski Splash Guards

Protect car from tar, mud, salt. Stainless steel with heavy rubber flap. Pair. SG13B. **5.99**
 Extra large guards. SG14B. . **5.99**
 Duraflex, blk. or wht. FX7. . **1.09**

line-up of
VALUES

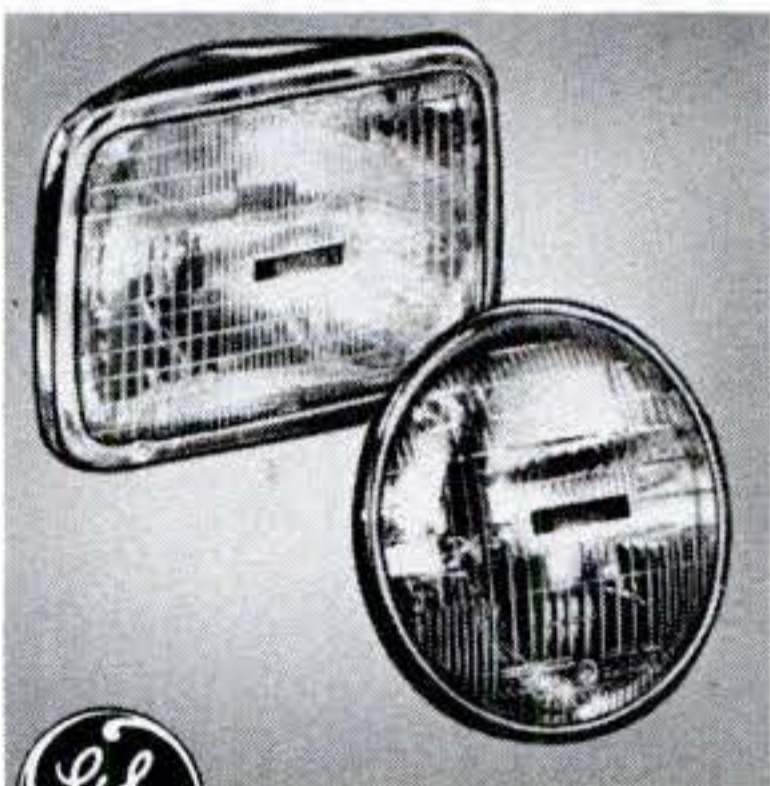


I'm Pat Summerall reminding you that do-it-yourself car care costs less with leading automotive products, at everyday low prices, from your nearby True Value Hardware Store. There are over 5,000 True Value Hardware Stores in 50 states. Look under "Hardware" in the Yellow Pages.



GUNK Engine Brite®
 Just spray on and rinse with water. Self-emulsifying degreaser carries away dirt & grime. From the makers of Liquid Wrench.
 15 ozs. EB-1 **1.49**

STP Engine Savers
 Oil treatment reduces friction and engine wear. Cuts oil use. 15 ozs. Only . . . **1.49**
 Pour-in gas treatment keeps fuel lines clean and free-flowing. 8 ozs. Only **99¢**



GE More Headlight
 New Halogen Power Plus sealed beam headlamps give more light from same watts. Need no adapter. Round or rectangular. Hi-beam, **9.99** Hi-lo beam, **19.99**



KLEENEST Quality Motor Oils Protect Engines
 2-cycle outboard motor oil. Qt. . **1.29** BIA-cert. for hi-hp. Qt. . **1.99**
 4-cycle motor oil for mowers, tractors, motor bikes, generators. Qt. **1.29**
 Bar & Chain oil keeps saws working efficiently. Gal. **4.99** Qt. **1.39**
 Chain Saw Oil keeps clean engine & exhaust, reduces wear. Qt. **1.29**
 General-purpose gear lube for autos, tractors. SAE 80W-90. Qt. **1.69**



ARMOR ALL For Vinyl
 All-weather protection that also beautifies vinyl, rubber, and leather inside and outside your car. Prevents rot, mildew. 4-oz. AALL4 **1.49**



bondo Body Repair
 Jumbo pack includes plastic filler, primer, putty, cream hardener, fiberglass screening, tools & complete instructions. 316 **7.99**



BLUE POLY 1-Step Sealant
 Cleans, shines and seals your car's finish from weather, detergent, tar, salt, dirt. Guaranteed to protect for 24 mos. 16-oz. BP25 **9.99**

icipating True Value Hardware Stores vary in size and merchandising policies, some may not stock all items shown. Prices may vary and are subject to change without notice. Prices expire June 7, 1980.

Tune your car for max mpg

By RAY HILL

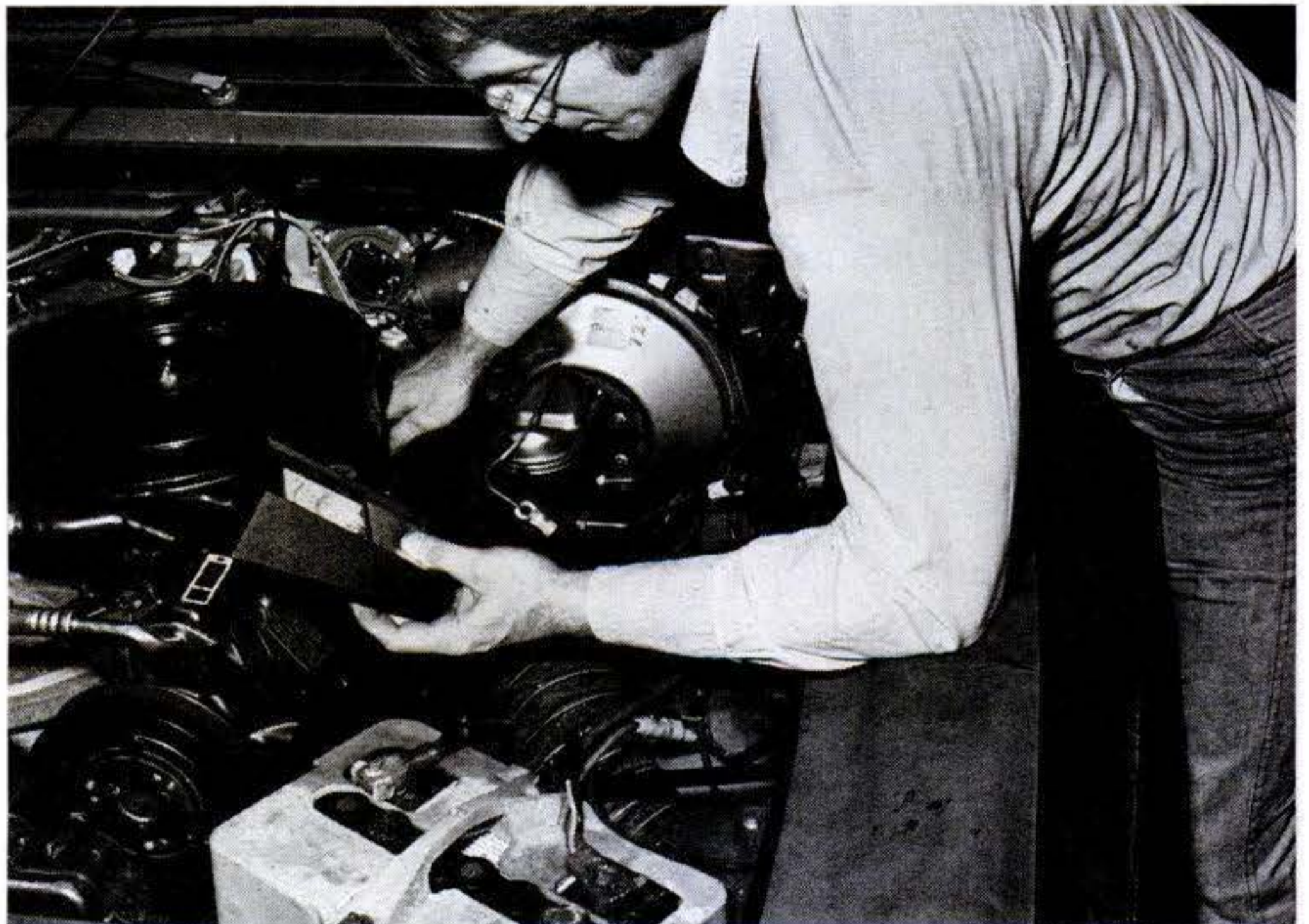
Studies have shown, and any working mechanic can tell you, that many cars on the road have dead or misfiring spark plugs. What's worse, poor plug performance is often only one of several problems under the hood that contribute to decreased mileage and poor drivability. With today's high gas prices, an improperly operating engine can take a big bite out of your paycheck.

If you have a V8 with a dead spark plug, for example, 12½ percent of the gas entering the carburetor leaves the tailpipe without providing any power. You're throwing away two of every 25 gallons of fuel you buy. If you have a four-cylinder with a dead plug, one out of every four gallons of gas you pay for is wasted.

The solution? An engine tuneup at the maker's recommended intervals. With modern electronic-ignition engines, that's in the neighborhood of every 15,000–25,000 miles. You can do the tuneup yourself and save the inconvenience of being without your car. You save labor costs, too. In New York, where I live, a tuneup costs from \$40 to \$190, depending on the engine and where you have the work done.

To do the job right, though, you'll need some special tools. You may have some or all of them already. In addition to basic hand tools, you'll need an oscilloscope, ammeter, voltmeter, ohmmeter, vacuum-gauge/fuel-pump tester, dwell tach, timing light, battery hydrometer, and battery-post-and-terminal brush.

What does tuning a late-model car for maximum mileage and performance consist of? We asked Steve Mercado, a top-notch professional



mechanic. In addition to teaching basic automotive mechanics to future pros, Steve also teaches working mechanics how to use elaborate professional-level diagnostic and test equipment. Here is what he advises.

Tuneup basics

First, dress properly. This means no rings, watch, bracelets, or other jewelry. They can catch on things, and cause severe electrical burns. Accidentally bridge a couple of terminals on a starter solenoid with a metal watch band and tell the world how it feels to have 150 amps burn the imprint of the band into your wrist. No neckties or loose clothing, either. A pair of coveralls will protect clothes from dirt and grease. And wear safety glasses.

Road-test the car. Check engine performance. Does it hesitate, misfire, or

make strange noises? Accelerate smoothly? If there is a problem, you can solve it later.

Use fender covers. They protect the fenders.

Check for engine noises. If an alternator bearing is about to go, it's better to catch it now than on a deserted road some dark night.

Start the engine. Listen for unusual sounds. If you hear any, isolate them with a stethoscope or other listening device.

Use extreme caution when working around moving parts—idler pulley, alternator, or water pump, for example. If your listening device or fingers get caught in a pulley or fan, you can be seriously injured. Ask any careless mechanic with a couple of missing fingers.

Make a visual inspection of the engine compartment. Shut the engine

off. Look for fuel leaks or oil leaks. Check for loose, disconnected, or cracked vacuum hoses.

Check coil output during cranking. (This test is only for cars with a ballast resistor in the primary ignition circuit. GM HEI cars, Dura Spark Fords made for California, and some AMC's, for example, don't have one.)

Remove the coil wire from the distributor cap and hold it as far from other engine or auto parts as possible. Hook up your oscilloscope and set it on display and on the high scale.

Have someone crank the engine and observe the scope. The spike (firing line) on the scope should go up to a minimum of 20 kV. (All oscilloscopes—whether expensive professional models or those available to the do-it-yourselfer—have instruction manuals that explain how to use them, what the scope patterns look like, and what they mean.)

If the spike falls below 20 kV, check the voltage at the primary terminal of the coil while the ignition switch is in the crank position. The voltmeter should show a reading within 0.5 volt of battery cranking voltage (if full battery voltage can't reach the coil during cranking, a weaker spark can result, making the car hard to start).

If voltage is low at the primary terminal, trouble-shoot the primary circuit. Most likely causes are the solenoid, ignition switch, or a wire that's loose, broken, or corroded. If everything checks out okay at the primary-coil terminal, check the coil itself.

Use the right ammeter

Check starter current draw. You'll need a DC ammeter that can read in the 300-amp range. If it's not an inductive ammeter, you'll have to have a battery-post adapter so you can hook it in series with the battery at the battery's negative post.

With an inductive ammeter, attach the pickup to the negative battery cable. If you can't reach the cable—as is

the case on some new Cadillacs, for example—use the positive cable. Be sure you put the inductive clip around all the wires coming from the battery post. If you don't, you won't get an accurate reading.

Remove the coil's high-tension lead from the center of the distributor cap and ground the lead with a jumper wire (one end of the jumper attached to the end of the high-tension lead, and the other end to a good ground). This prevents the car from starting, and ignition-system damage.

GM HEI V8's and V6's have their ignition coils in the top of the distributor cap. On these cars, disconnect the BAT wire at the distributor.

Crank the engine for five to 10 seconds and note the ammeter reading. It should be in the range of 140–225 amps (check your shop manual for the exact spec). If current draw exceeds specs, trouble-shoot further. Some possible causes: bad starter, bad wires or connections in the starter circuit, or a bad battery.

Check battery voltage during cranking. Hook the voltmeter leads across the battery (positive voltmeter lead to positive battery post, negative lead to negative post), and crank the engine for 15 seconds with the coil wire still grounded (or with BAT wire disconnected on HEI V8's and V6's). The voltage reading should not fall below 9.6 volts. If it does, you've got either a battery or charging problem that should be solved.

Check manifold vacuum. Find a vacuum tap at the intake manifold and attach your vacuum gauge to it. With the coil wire still grounded (or BAT wire disconnected), crank the engine for a few seconds.

Manifold vacuum should be somewhere in the two-to-five-inch range as the engine cranks. And the needle should be steady. This indicates there are no major mechanical problems (sticking valves, bad rings, bad timing chain, etc.).

Check the charging system. Reconnect the coil wire to the distributor. Start the engine and run it at 2500–3000 rpm. Read the ammeter (hooked up as before at the battery). You've drawn off current in previous tests, so you want to see the alternator putting current back in. If the alternator is a 55-amp, for example, you would want to see better than half of 55 amps.

If you end up with a low output, check the fan belt. Check the diodes and stator on the scope. If the belt is tight and the diodes and stator are good, the cause of the low output could be bad connections at the alternator, a bad rotor, bad brushes, or other circuitry problems.

Check the diodes and stator. Set the scope to the position for checking the alternator. Run the engine at about 2000 rpm and observe the scope. It should give you a good diode-stator pattern (scope operator's manual will show what a good pattern looks like).

If the diodes and stator are bad, the alternator's output will be lower than it should be, and the alternator must be repaired.

Check idle speed with a tach. If it's not at the maker's recommended spec, adjust it. Otherwise, ignition timing and emissions will be off later on.

Check dwell at idle. On Ford, AMC, and Chrysler cars with electronic ignition, dwell doesn't vary (with the exception of Fords made for California), so if you own one of these cars you won't need to check it. On GM cars with electronic ignition, dwell does vary.

In any electronic-ignition system, dwell is controlled by the control module. Dwell cannot be adjusted on cars with electronic ignition; if it is not within specs, the module must be replaced.

Be sure to check specs closely—on some cars, the shop manual may call for the engine rpm to be above curb

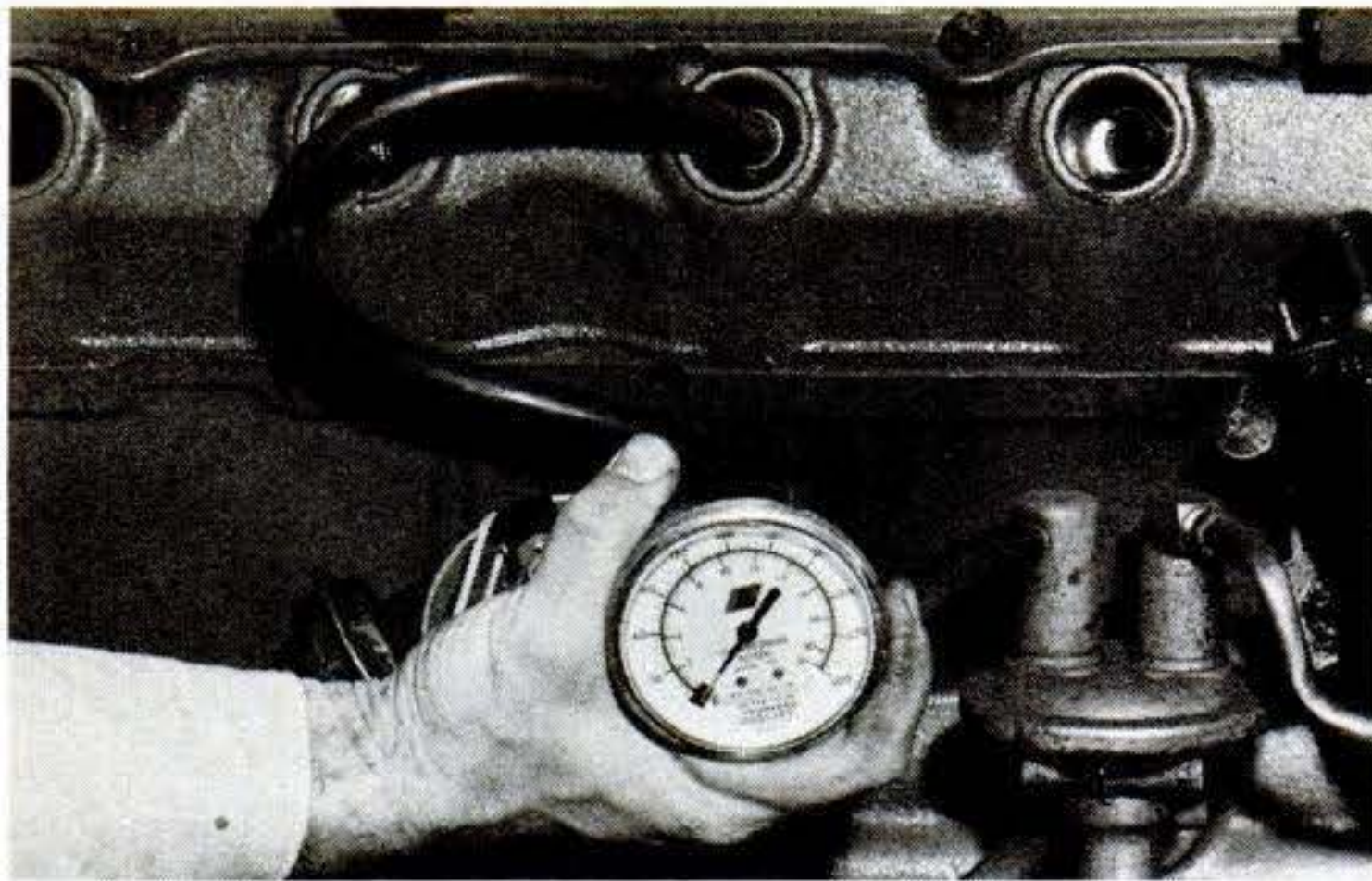
Continued



Professional mechanic Steve Mercaldo at the controls of what a pro might use to tune your car—Sun's 1115 analyzer.



Inductive ammeter with a variable-control carbon pile, such as Sun's VAT 40 shown here, tests charging system.



Compression tester lets you know if your engine, which is basically an air pump, is doing a good job of pumping.



Manifold heat-control valve should move freely when you try to rotate it by hand. Don't touch it when it's hot.

idle when you are checking dwell.

Check ignition timing at the maker's specified rpm. Disconnect the vacuum-advance line where it attaches to the distributor's vacuum-advance chamber. Plug the line with a golf tee. With the engine at the specified rpm, check the timing with your timing light.

On electronic-ignition cars, timing should not change unless it has been set wrong earlier. If timing is off, loosen the distributor hold-down and rotate the distributor until your timing light indicates that the timing is at spec.

Check engine vacuum at the intake manifold with the engine at the maker's specified idle rpm. You should see a reading in the neighborhood of 17–21 inches on the vacuum gauge, with the needle remaining steady. This indicates the engine is in good mechanical condition when it's running. Most cars will pull around 20 inches.

If the carb needs adjusting, the needle will "walk" back and forth on the scale from 17 to 20 inches, for example. If ignition timing is retarded, the reading will be low and steady. If timing is too advanced, the needle will jerk erratically. With a bad valve, it will show a jerk at regular intervals.

Check the PCV system. Make sure the PCV hose is not clogged and the PCV valve is working (even if the valve is working, replace it at each tuneup anyway). A clogged hose should be replaced.

Now is a good time to install the new PCV valve.

Hook up your tach and let the engine idle. Remove the PCV valve and put your thumb over the valve, plugging its hole. Engine speed should drop about 50 rpm.

You can use a vacuum gauge to check the PCV system, too. Tap into intake-manifold vacuum and plug the PCV valve with your thumb. Engine vacuum will rise if the valve and hose

are good, because you have plugged off an air leak to the carb.

Check coil polarity. With the engine running at 1200 rpm, set the oscilloscope on display. The firing line should go up. If it goes down, the coil is either hooked up backward (in which case reversing the hookup to the coil's two primary terminals will solve the problem), you've got the wrong coil for the car (a foreign-car coil with a positive ground installed on an American car with a negative ground, for instance), or the coil was made wrong at the factory.

Proper coil polarity is important. About 40 percent of the coil's potential energy is lost if polarity is reversed.

The firing line

Check spark plugs. With the engine at 1200 rpm and the scope still on display, note the firing line for each plug. It should be in the neighborhood of five to 15 kV, and there shouldn't be more than a three-kV difference between any two plugs.

This shows the voltage required to fire each spark plug. A low reading might mean a grounded plug wire, a fouled plug, or a cracked distributor cap.

An excessively high reading might mean an open plug wire (the spark is not only jumping the gap between the rotor and distributor and the spark-plug gap, but is also jumping a gap in the broken wire). It might also mean a very lean mixture in that cylinder (air doesn't conduct electricity as well as fuel).

Check maximum coil output. Run the engine at 1200 rpm. Remove a spark-plug wire from a plug, and hold it far enough from the plug and ground so it can't fire (with Dura Spark Fords there are certain wires you shouldn't remove when the engine is cranking or running: one and three on in-line fours; three or five on straight sixes; one or four on V6's; one or eight on V8's).

With the scope still on display, observe the firing line. The spike should be at 20 kV or more. On GM HEI systems it should be at 35 kV or more.

If the firing-line spike doesn't reach 20 kV (35 kV with HEI), shut the engine off, then turn the key to the "on" position without starting the engine. With a voltmeter, check voltage to the plus terminal of the coil. It should be around 12 volts on cars without a resistor in the run circuit, and below 12 volts on cars with a resistor in the run circuit (check shop-manual specs).

Visually check the coil's high-tension lead for cracks, making sure it's inserted all the way at both ends, and that the boots fit snugly and aren't cracked. Check the coil with an ohmmeter, and have the coil load-tested.

Check the distributor pickup coil with an ohmmeter (refer to your shop manual).

If all this checks out, you probably have a bad control module (see accompanying story in this issue on checking out your electronic ignition).

Check secondary insulation. With the engine at 1200 rpm and the scope still in the display position, observe the down spike on the scope (except on GM HEI cars—because of their high voltage, this test is meaningless). A down spike means the insulation is okay. Bad insulation would reveal itself as intermittent down spikes or no down spikes.

Check secondary resistance. This test shows whether the secondary circuit (secondary coil windings, high-tension coil lead, rotor, distributor cap, spark-plug wires, and spark plugs) has the proper resistance.

With the engine at 1200 rpm, and the scope set on raster shift, observe the spark line of each cylinder. Each should be nearly horizontal; each line should be the same. If they're different, there's a problem in the secondary circuit. It might be a spark-plug wire, distributor cap, etc. A grounding

Continued



FIRE BRIGADE.

AC Fire Ring Spark Plugs. You can count on AC to come to your rescue to help cut gasoline costs.

If your car's plugs are misfiring, a tune-up with a new set of AC "Fire Ring" Spark Plugs can help improve your car's gas mileage.

Go for the AC hot tip. It heats up fast. Fires hot. Helps resist fouling.

So tune up now with new ACs. They can help save gas. And money.

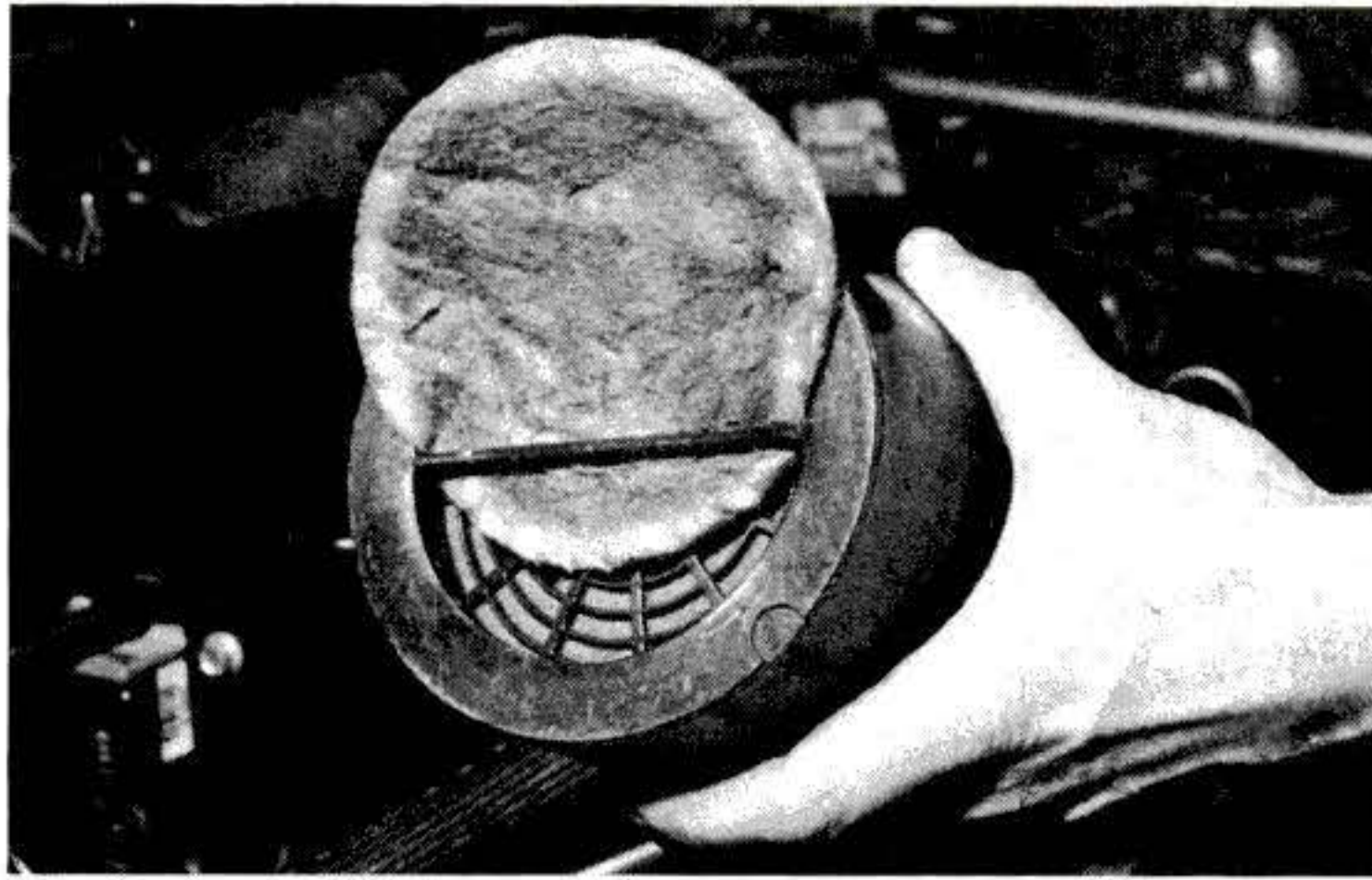
Ask for reliable, quality AC-Delco products wherever you go for parts or service.

AC-Delco Division of General Motors Corporation.

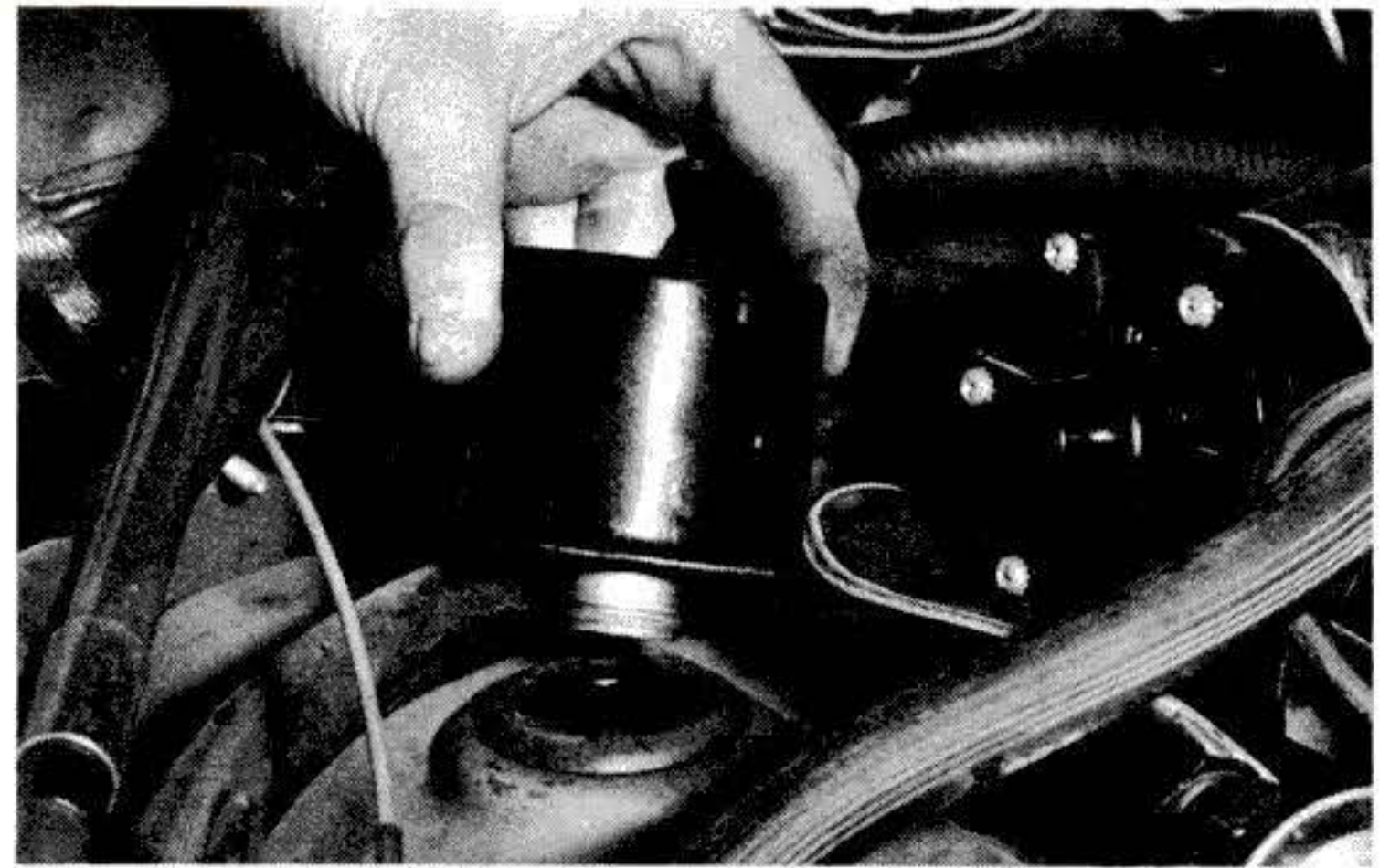
THANKS, AC.



[Continued]



Charcoal canister filter can be reached after you remove the clamp that holds the canister in place.



Crankcase breather filter on Chryslers (above) is in valve cover. On other cars it's in the air-cleaner housing.

test will identify the trouble spot.

Take plug wires off one at a time and ground with a jumper wire. If the spark line for a plug becomes almost horizontal, the problem is in the plug or combustion chamber (such as a too-lean mixture). If the line doesn't become horizontal, pull the plug wire out of the distributor cap, and ground that tower in the distributor with a jumper wire. If the line now becomes horizontal, the problem is in the wire. If it doesn't become horizontal, check the cap and rotor.

When working on Dura Spark Fords, there are certain wires you should not disconnect while the engine is running (as mentioned earlier). To check these wires by the grounding method, first shut the engine off, ground the wire, then start the car again.

Check coil. With the engine at 1200 rpm and the scope set on raster, observe the oscillations of the intermediate section of the scope pattern. You should have three to five oscillations. This shows the coil has enough energy and isn't shorted or open.

Do a power-balance test. With the engine running at idle, remove each spark-plug wire temporarily from its plug, note the rpm drop, then reconnect it. Engine rpm should decrease about the same amount each time, indicating that each cylinder is doing its share of the work. If this doesn't happen, check to find out why.

On the Dura Spark Fords, don't perform the power-balance test by disconnecting individual wires. (See "Trouble-Shooting Quiz," PS, May '79, on how to perform a power-balance test on Fords.)

If your scope is equipped with a cancelling button, use this instead of pulling wires.

Check total timing advance at 2500 rpm (see shop manual specs for your

car). Disconnect the vacuum-advance hose to the distributor and plug it. Be sure the engine is set to maker's recommended idle rpm. Rev the engine up from idle rpm and look at the timing marks with your timing light. They should move, indicating that the mechanical (centrifugal) advance is working.

Run the engine at 2500 rpm and attach the vacuum line to the vacuum-advance unit. Watch the timing marks with the timing light as you're doing this (or have a friend do it). The timing should advance, indicating the vacuum advance is working.

Some cars have Transmission Controlled Spark (some GM's and Fords, for example). These only get vacuum advance when the transmission goes into third gear. On these gears you have to have the rear of the car elevated so the drive wheels can't touch the ground, and have the car running so the transmission goes into third gear (whether it's standard or automatic it must go into high gear). Follow shop-manual instructions with these cars.

Certain cars (Chryslers, for instance) have a time-delay switch that prevents vacuum delay for 15-30 seconds after a certain rpm. It's connected in the vacuum line to the distributor diaphragm.

When you rev these engines up to 2500 rpm, you'll see the timing marks advance 10 degrees or so (this is the mechanical advance). You then wait for the vacuum delay switch to let vacuum to the distributor diaphragm. When this happens, you'll hear the engine rpm increase, and see the timing marks advance some more (check shop-manual specs).

When checking total ignition advance (mechanical and vacuum) at 2500 rpm with your own timing light, you'll have to mark the damper pulley first. With the engine off, make a

chalk mark on the damper pulley where shop-manual specs call for the vacuum advance to be.

Check charging voltage. With a voltmeter hooked across the battery terminals and the engine running at 2500 rpm, voltage should be at the specs called for in your shop manual, generally between 13.5 and 15.5 volts.

If it's not, full-field the alternator to determine if the problem is in the alternator or the regulator (see shop-manual instructions).

Check manifold vacuum. With the engine running at 2500 rpm, a vacuum gauge connected to a manifold-vacuum tap should show a high steady reading—around 21 inches. This shows that the exhaust system is not clogged.

If vacuum begins to drop off, the exhaust system is partially obstructed. Any obstruction must be eliminated.

Battery and belts

Service the battery. Remove the battery cables, negative cable first, and clean the posts and cables with a battery post-and-cable-terminal brush.

Check the battery hold-down for tightness. If the battery is loose, it can decrease battery life by allowing the plates to vibrate excessively.

Check each cell with a hydrometer. You should get a reading of around 1.260.

If you can load-test the battery with a Sun VAT 40 or equivalent, do so. If not, refer to the reading you got earlier when you disabled the ignition and cranked for 15 seconds. If the voltage didn't fall below 9.6 volts, the battery is probably in good shape.

Top off the cells with distilled water. Fill each cell until the fluid level just touches the bottom of the filler neck.

If the battery is dirty, wet it with



PCV valve is in the valve cover. It should fit tightly, both at its hose connection and in the valve-cover grommet.



Vacuum pump is used to check the choke pull-off. A leaking choke pull-off must be replaced. It can't be repaired.

water. Then sprinkle baking soda on it and let it set for a few minutes, and wash the baking soda off with water. This cleans the battery and neutralizes any acid present.

If your car has a sealed battery, such as the Delco Freedom battery, you can't add water or perform a hydrometer test of each individual cell. With the Freedom battery, check the eye in the top of the battery. If it's black, that means it's discharged. If it's green, it's okay. If it's yellow, the battery must be replaced. (Do not try to charge or boost-start it.)

Check and adjust drive belts. Grasp each belt midway between two of its pulleys. You shouldn't have more than 1/2 inch of up-and-down movement. Or you can use a belt-tension gauge. If you use the gauge, set belt tension to shop-manual specs.

Belts should be replaced every two years. This virtually eliminates the possibility of a belt breaking and leaving you stranded. After the engine has been run a week with new belts, retighten the belt tension. New belts loosen as they break in.

Inspect the coolant hoses. They should not be brittle, cracked, or leaking. Hoses should also be replaced every two years.

Check compression. With the engine at operating temperature, loosen each spark plug one turn. Then start the engine, accelerate to 1000 rpm, and shut the engine off. This blows out any debris that may be around the plugs and also cleans the combustion chamber of any carbon that fell in after the plug was loosened.

Remove the plugs. As you do, keep them in order. This way, if there is a problem—one plug oil-fouled, for example—you'll know which cylinder to check later.

Disable the ignition by removing the coil wire from the distributor and

grounding it with a jumper wire (with HEI V6's and V8's, disconnect the BAT wire at the distributor connection).

Hold the throttle wide open. Check compression in each cylinder. A compression gauge that screws into the spark-plug hole is better than the rubber-tipped jobs you hold against the hole.

Crank the engine five or six compression strokes for each cylinder. Note each reading; they should all be within specs. If you've got excessively high or low readings, check further to find out why.

If you get a low reading in a cylinder, put about a teaspoonful of oil in that cylinder through the spark plug hole and take a compression check again. If the reading increases, you've got ring problems. If not, it's a valve problem.

An engine with severe valve or ring problems cannot be tuned successfully. These must be repaired first.

(If you use a remote starter switch to crank the engine, leave the ignition key in the "on" position to prevent possible damage to the ignition system.)

Look at ignition wires

Inspect the coil tower and wires. Check the primary wires going to and from the coil's primary terminals. They should be clean and connected tightly, with no cracks in the insulation. The same goes for the coil's high-tension lead.

Check spark-plug wires with an ohmmeter if they failed earlier on the scope. Remove the distributor cap and the spark-plug wires from the plugs, but leave the wires attached to the distributor cap. Connect one ohmmeter lead to the insert inside the cap and the other lead to the metal terminal inside the wire's spark-plug boot. The ohmmeter should show a reading

that's within the spec called for in the shop manual. If it doesn't, remove the wire from the cap and check only the wire. If the wire is at spec, replace the distributor cap. If the wire is still out of spec, you need a new wire.

Gap and install new spark plugs. Gap the plugs to specs, using a wire gauge. Don't use a flat gauge—it makes accurate gapping harder. Tighten the plugs according to specs.

Service the distributor. Check the inside and outside of the distributor cap visually for cracks, burns, carbon tracking, or corrosion of metal parts. Replace the cap if any are present.

Check the rotor for burns, cracks, or a damaged tip or center contact. Replace the rotor if it's damaged.

Check the pickup coil for looseness, broken wires, excessive corrosion, or metal filings. If the distributor shaft is bent or has bad bushings, it can allow the reluctor/armature/timer core (Chrysler's, Ford's, and GM's terminology, respectively) to hit the pickup pole piece. Because the pickup is permanently magnetized, metal filings will be attracted to it and cause it to perform poorly.

Pickup-coil wires should have tight connections.

Check the reluctor/armature/timer-core teeth. They should not be hitting the pickup. If contact between the reluctor/armature/timer core and pickup has been made, replace both the pickup and the reluctor/armature/timer core. And fix the cause.

Check the breaker plate for looseness. That's the plate the pickup assembly is attached to. It should not be loose.

Grasp the distributor shaft and its top and try to move it back and forth. You shouldn't be able to move it by hand. If you can, it needs new bushings.

Continued

With the rotor on the shaft, rotate the rotor (which moves the shaft) in the direction of its normal rotation. It should move slightly, then spring back when you release it. If it doesn't, determine the cause and fix it. This indicates the mechanical advance is working. A sticking mechanical advance can result in reduced performance and less mpg.

With GM distributors, clean and lubricate the centrifugal-advance pivot pins with a light film of 10W oil.

On Ford and Chrysler distributors, getting at the mechanical advance requires disassembly of the distributor. If the advance is working okay, normal practice is to leave it alone.

Check the vacuum-advance unit with a vacuum pump if it failed the earlier vacuum-advance check. Remove the vacuum line from the advance diaphragm and attach a vacuum pump. Pump up 15 inches of vacuum. The vacuum-advance chamber should hold this without leaking down. If it leaks, replace the chamber.

Change the fuel filter. The filter may be at the carb's fuel inlet or it may be an in-line filter between the fuel pump and the carb inlet.

Be sure to put it in correctly. In-line filters have an arrow indicating direction of fuel flow. With filters that fit at the carb inlet, the open end should always face the fuel line to the carb.

Testing the fuel pump

Check fuel-pump pressure and volume. Remove the fuel line from the fuel pump to the carb at the carb inlet, and attach the fuel-pump gauge (many vacuum gauges available to do-it-yourselfers are combination vacuum and fuel-pump testers). Start the engine and read the gauge. You should have three to five inches of pressure.

Stop the engine, remove the gauge, and hold the end of the fuel line in a container. Crank the engine for 15 seconds. It should deliver a half pint of fuel in that time. Have a fire extinguisher handy while you are working. (The engine should be cold when you do this test. A friend should handle the cranking chores while you direct the fuel into your container. Definitely no smoking while doing this!)

If volume or pressure is bad, remove the fuel line from the gas-tank side of the fuel pump and attach a vacuum gauge. Crank the engine. You should get a reading of 10 inches while the engine cranks. If you do, then there is an obstruction somewhere in the fuel line between its connection to the fuel pump and the fuel tank. The fuel line or the pickup in the gas tank may be clogged.

If you get a low vacuum reading while cranking, the fuel pump is bad and must be replaced. A weak fuel pump can cause decreased engine performance and a marked loss of power at higher rpm. (In rare cases, a worn lobe on the cam that drives the fuel pump can result in the same symptoms.)

Service the air cleaner. Install a new air filter. If the air cleaner has a crankcase breather filter inside it, replace that filter, too. With Chryslers, the crankcase breather filter is in the valve cover instead of the air-cleaner housing.

Check the hot-air door in the snorkel of the air cleaner. You should be able to move it freely.

Make sure the large hose that runs from the hot-air stove around the exhaust manifold to the hot-air door is connected, both at the snorkel and at the exhaust manifold. If it's not connected, it can result in rough running until the engine warms up, wasting precious gas. And if the hot-air door is stuck so that it won't open as the engine warms up, you'll waste gas after the engine is warmed up, as well as get poor engine performance.

With the engine cold, start it, and make a visual check of the hot-air door. It should open to outside air as the engine warms up.

Service the vapor canister. On some canisters there's nothing to service. Others have a filter in the bottom that should be changed periodically. Failure to replace the filter can result in decreased mpg and a gas smell in the passenger compartment.

Check the manifold heat-control valve. During warmup, this valve directs hot exhaust gases through the intake manifold through a separate passage. While the engine warms up, the hot gases help vaporize the fuel. As the engine reaches operating temperature, the exhaust-gas heat is needed less and less, until finally it's not needed at all. At this time, the heat-control valve directs the hot exhaust gases directly out the exhaust system.

For good engine performance and fuel economy, this valve must work. To check it, the engine must be cold; otherwise you'll burn your hand.

You should be able to rotate the valve by hand. If you can't, lubricate both ends of the valve's pivot rod with penetrating oil and tap each end of the rod lightly with a hammer. Don't tap the valve weight; you may bend the rod if you do. Keep repeating the process, applying liberal doses of penetrating oil at each end of the shaft and tapping until the valve is free.

Retorque intake-manifold and carb-mounting bolts to spec. This is impor-

tant because the bolts can loosen, allowing air leaks which can affect engine performance. Be sure to check specs, though. You don't want to over-tighten. The engine should be completely cold when you do this.

Check the choke. Choke linkage should move easily and not bind. The choke plate should move freely throughout its complete range of motion. Use choke cleaner on pivot points if any binding is present on the choke-plate pivots or linkage. Never use oil. It can collect dust and grime and cause binding.

Remove the vacuum hose from the choke kickoff and attach a vacuum pump. Pump up 10 inches of vacuum. The choke kickoff should hold that vacuum without leaking down. If it doesn't, replace the choke kickoff.

The fast-idle cam should move freely. If the engine won't go on fast idle, the engine may start and stall. If it won't go off fast idle, the engine will idle too fast. Hold the throttle half open, close the choke plate by hand, and the fast-idle cam should follow. If it doesn't, find out why (binding parts, misadjustment, etc.).

Check the EGR system. (See the article in PS, June '79.)

Run the engine at idle and at operating temperature. Intake-manifold vacuum should be high and steady.

Accelerate to 2500 rpm and look to see if the EGR valve stem moves (it should). If you can't see the stem, feel with your finger for movement (be careful not to burn your fingers), or use a mirror.

Bring the engine back to idle, and manually move the valve diaphragm. Engine rpm should drop off, and the engine should run rough or die.

If you can't move the valve manually, bring the engine up to 2500-3000 rpm and remove the vacuum line from the valve. Rpm should increase.

If any of these checks fail, troubleshoot the system further according to shop-manual procedures.

Check the AIR pump if your car has one. Follow shop-manual procedures. A quick basic check, though, is to remove the rubber hose from the check valve at the exhaust manifold, accelerate the engine, and feel for air coming out the hose. Now release the accelerator, allowing the engine rpm to drop back to idle. There should be a momentary decrease in air when the throttle is released.

Also inspect the check valve (the hose goes on to this). Apply light pressure with a pencil to see if the valve opens.

This completes the tuneup. Drive over to your local garage and have an infrared check made for emissions and the carb adjusted, if necessary. **5**

THE SEA LEVEL EAGLE IS...



The spectacular American Eagle works on many levels. In rain, through mud, on sand, for fun.

Even towing is smooth sailing with Eagle's automatic 4-wheel drive.

In fact, uphill, downhill, or on the level, Eagle's 4-wheel drive automatically directs power for traction when and where you need it most. So you can enjoy a higher level of confidence that you and your friends will get wherever you're going.



THE SKI LEVEL EAGLE.



On another level, Eagle is ideal for plowing through heavy snow. With the traction of its 4-wheel drive, Eagle can go where others fear to tread.

And Eagle not only gives you the feeling of stability that comes from four wheels working together. It gives you the unique experience of enjoying that feeling in a roomy, smooth riding automobile with independent front suspension. An automobile that's attractive by any standard, on any level. Test drive an American Motors Eagle—2-door, 4-door or wagon model. Or rent one on your next trip. Get to know the beauty of 4-wheel drive.

**THE EAGLE HAS LANDED
...ON ALL FOURS.
AMERICAN MOTORS**

BUYER PROTECTION PLAN[®]

THE BEST PLAN AVAILABLE AT NO EXTRA COST—Because only American Motors covers each part except tires. Even if it just wears out.*

EXCLUSIVE FULL 5-YEAR NO RUST-THRU WARRANTY[™]

—This is proof of the confidence we have in our Ziebart[®] Factory Rust Protection.[†]

FULL 12-MONTH/12,000-MILE WARRANTY—Only American Motors offers this. No extra cost.

LOANER CAR—If we have to keep your car overnight for warranty repairs, you'll get a free loaner car until yours is ready.

*Aluminized exhaust system warranted for 12 months/12,000 miles. Ziebart is a registered trademark of Ziebart International Corporation.

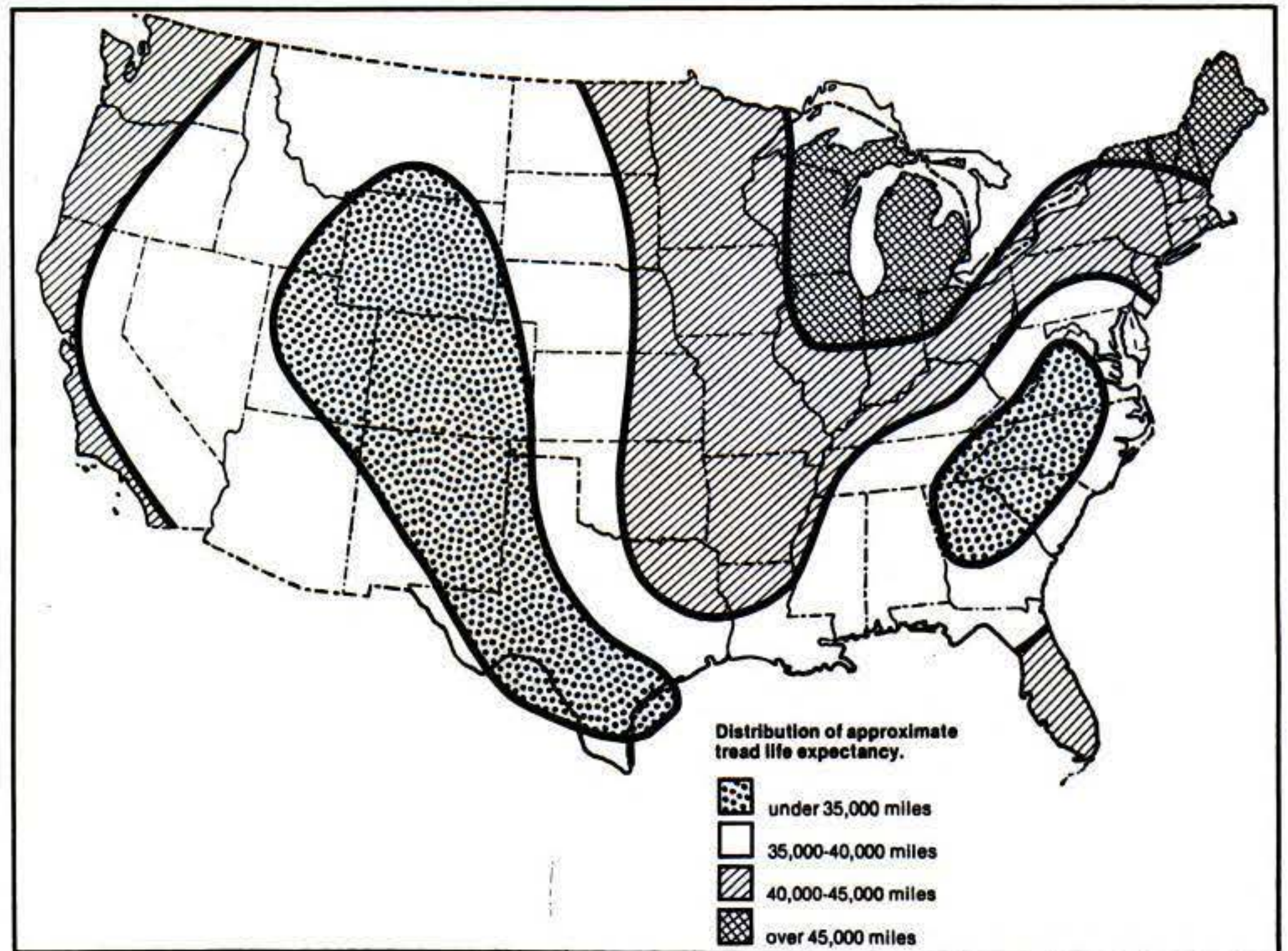
*See your dealer for full warranty and rust-program details.

Copyrighted material

How road materials affect tire-tread life

If you drive in the Northeast or Midwest, you'll probably get up to 46 percent more miles out of your radials than motorists in parts of the South, Southwest, or Rocky Mountain regions. That's what a new study by Dr. Robert Snyder of Uniroyal reveals. Why such marked differences in tire wear?

The most important factor behind these variations in tire-tread life is the material used to make the roads you drive on. Drivers in the Northeast and Midwest get extra tread life because roads there are made of low-abrasive materials such as limestone, says Snyder. Widespread use of coarser materials, such as cracked granite, causes tires to wear faster in other parts of the U.S. (see map). For example, if you live in Milwaukee, you might expect 46,000 miles of wear; in Detroit, up to 47,000. But if you live in Atlanta, you might get only 37,000



miles; in San Antonio, only 33,000; and in Denver, only 32,000.

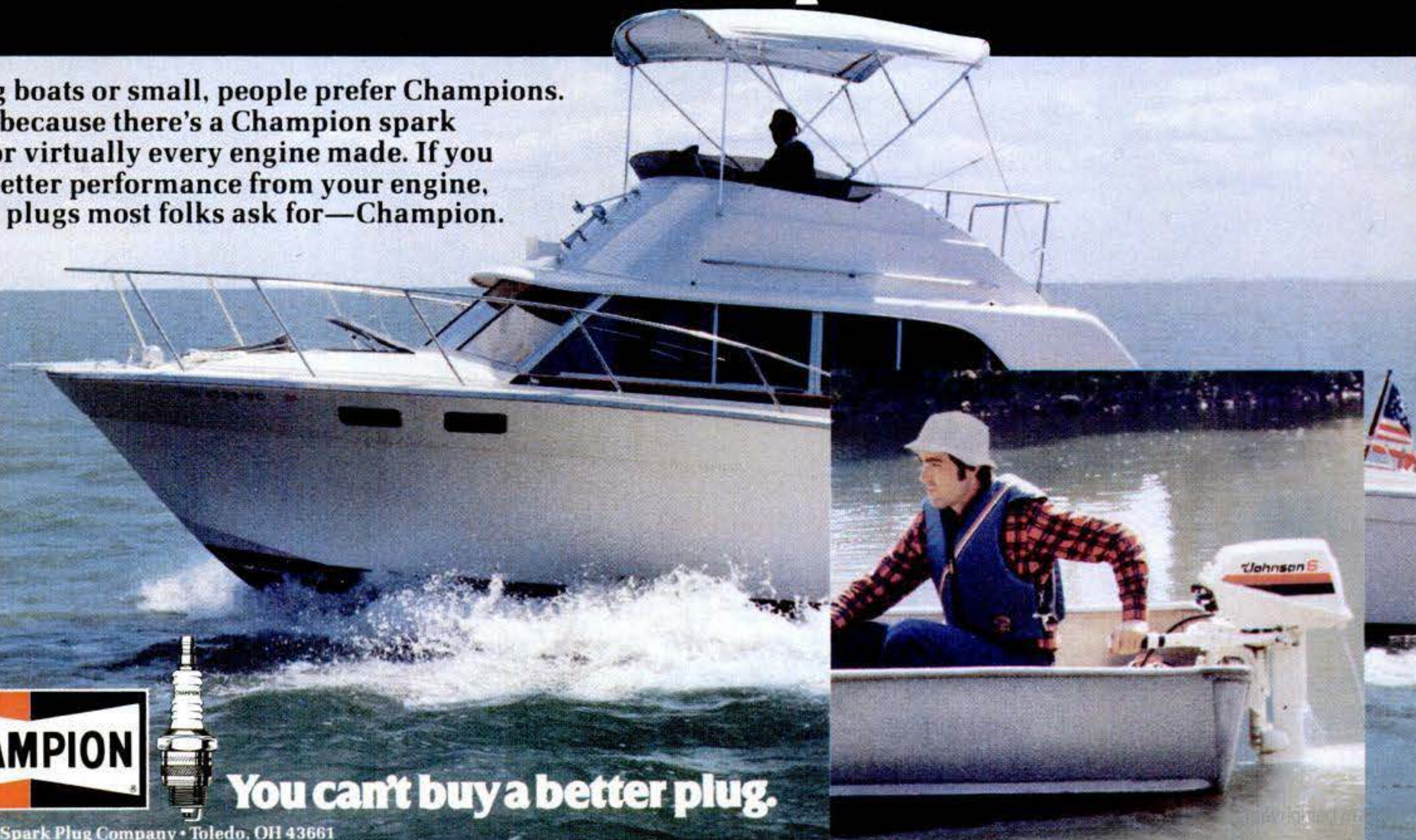
Through their selection of materials, highway builders could improve wear in the low-mileage regions, Snyder says. "Highway engineers use coarse materials in the high-hazard areas to increase safety, but abrasive materials are also used in miles of low-hazard areas where the

contribution to safety is minimal."

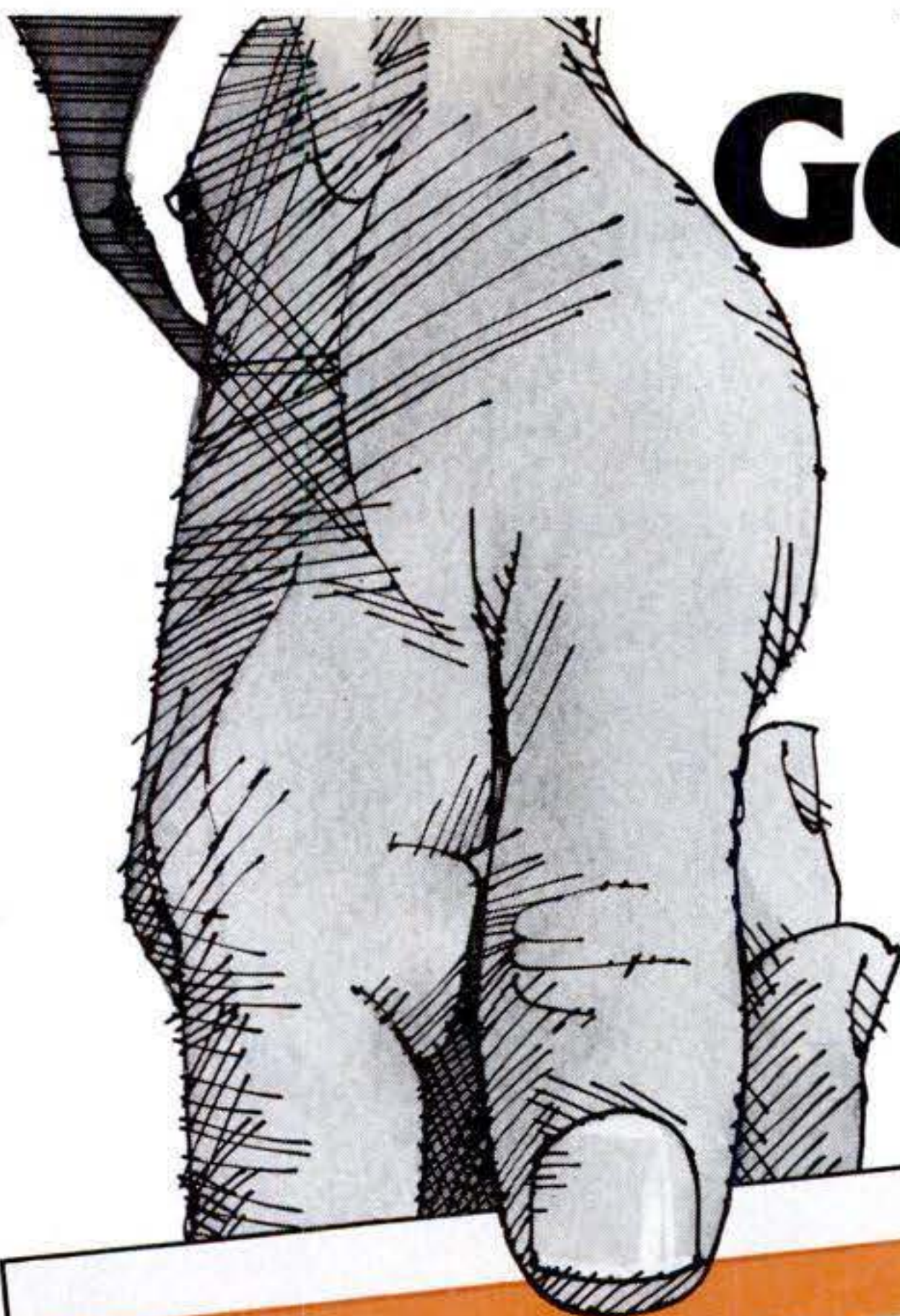
Since the materials used may be chosen primarily because they are the most readily available, it's essential that the motorist do his part to maintain his tires, says Snyder. Keep them properly inflated and rotate them regularly, and you may be able to gain some ground against the tread-robbing roads.—Ed Moslander

People with a lot of pull...or a little... choose Champion.


For big boats or small, people prefer Champions. That's because there's a Champion spark plug for virtually every engine made. If you want better performance from your engine, get the plugs most folks ask for—Champion.



You can't buy a better plug.



Get them now... to save you money and save your engine!



Operating and maintaining your Briggs & Stratton engine

This free engine maintenance and repair booklet — and original equipment replacement parts like those originally built into your Briggs & Stratton engine.

There is great satisfaction — plus welcome savings — in making your Briggs & Stratton engine *consistently* give you high quality performance. And to help you get top performance, we have a booklet for you that will give you helpful tips on engine operation, maintenance and replacement parts installation. It's FREE at your nearby participating Briggs & Stratton Authorized Service Center.

The Briggs & Stratton booklet tells you exactly how to maintain your engine and keep it maintained — with such Briggs & Stratton parts as starter rope grips, head gaskets, fuel tank caps, mufflers. It lists simple but essential special-care steps for the start and finish of a mowing or snow removal season, and for during use. Tips you off on operating your engine with maximum efficiency, safety and results.

Need any of the parts called for in the booklet? Your participating Briggs & Stratton service dealer stocks them, factory-original parts.

He also offers a more detailed Manual for advanced home repairmen. And he can give your engine a major tune-up or overhaul by his own factory-trained experts.

Drop in soon to pick up your free copy of "Operating and Maintaining Your Briggs & Stratton Engine". Inspect the display rack of packaged replacement parts. Or take your Briggs & Stratton powered equipment in for truly professional work. In any case, you'll save time, money, headaches *and* your engine.

Look in the Yellow Pages under "Engines — Gasoline" for the nearest Briggs & Stratton Authorized Service Center at *your* service!



Briggs & Stratton Corporation
Milwaukee, Wisconsin 53201

The quality-assurance trademark
people look for.



FREE Car Stereo Catalog Get Yours Now!

- 84 pages of photos, comments, and the best possible prices on over 200 car stereo products!
- Dimensions charts, fitting charts, and installation "how-to" articles!
- Only published source of accurate and comparative product specifications!
- The finest brands, including Blaupunkt, Clarion, Craig, Concord, Jensen, Marantz, Motorola, Pioneer, Sanyo, and many more!

Send now for your FREE catalog. We'll rush it to you by first class mail, or if you can't wait, call our toll-free WATS line:

800-446-1506

In Virginia call (800) 552-3961

System of The Month

PIONEER

Pioneer's new KE-2002 in-dash AM/FM cassette car stereo featuring electronic tuning and high fidelity specifications and Pioneer TS-168 6 1/4" three-way speakers with exponential horns.



Yes! Send me my FREE copy of the famous CRUTCHFIELD Car Stereo Catalog!

Name _____

Address _____

City _____

State _____ Zip _____

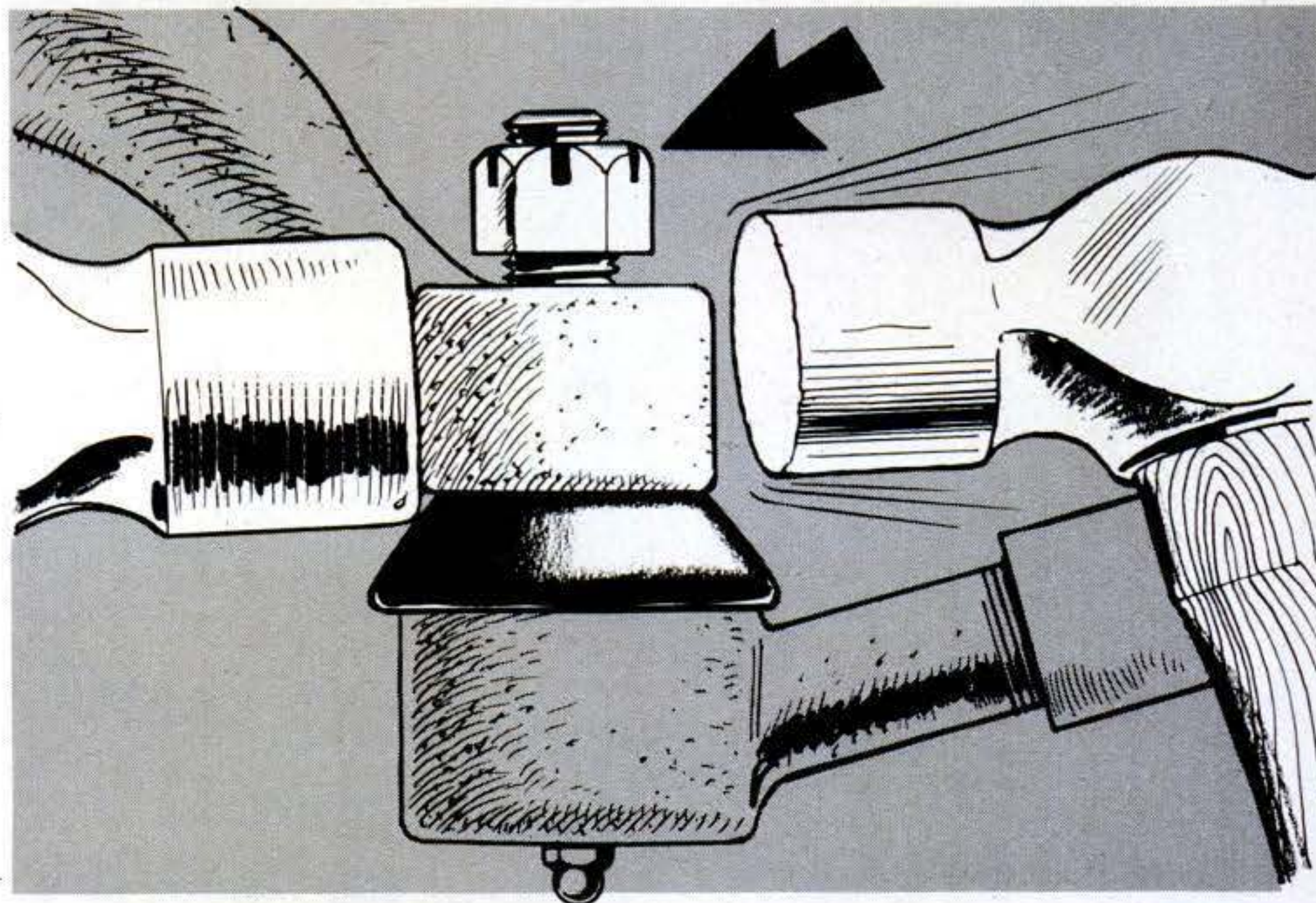
CRUTCHFIELD

1 Crutchfield Park, P.O. Caller 1, Department P
Charlottesville, VA 22906

TAKING CARE OF YOUR CAR

By RAY HILL

Got a useful car tip? Send it (with Social Security No.) to Car Care, Popular Science, 380 Madison Ave., New York, N.Y. 10017. We'll pay you \$25 if we use it. If two or more readers send in the same usable tip, the one with the earliest postmark will be chosen. Sorry, but tips can't be returned.



Removing a ball-joint stud—it's not as hard as you might think

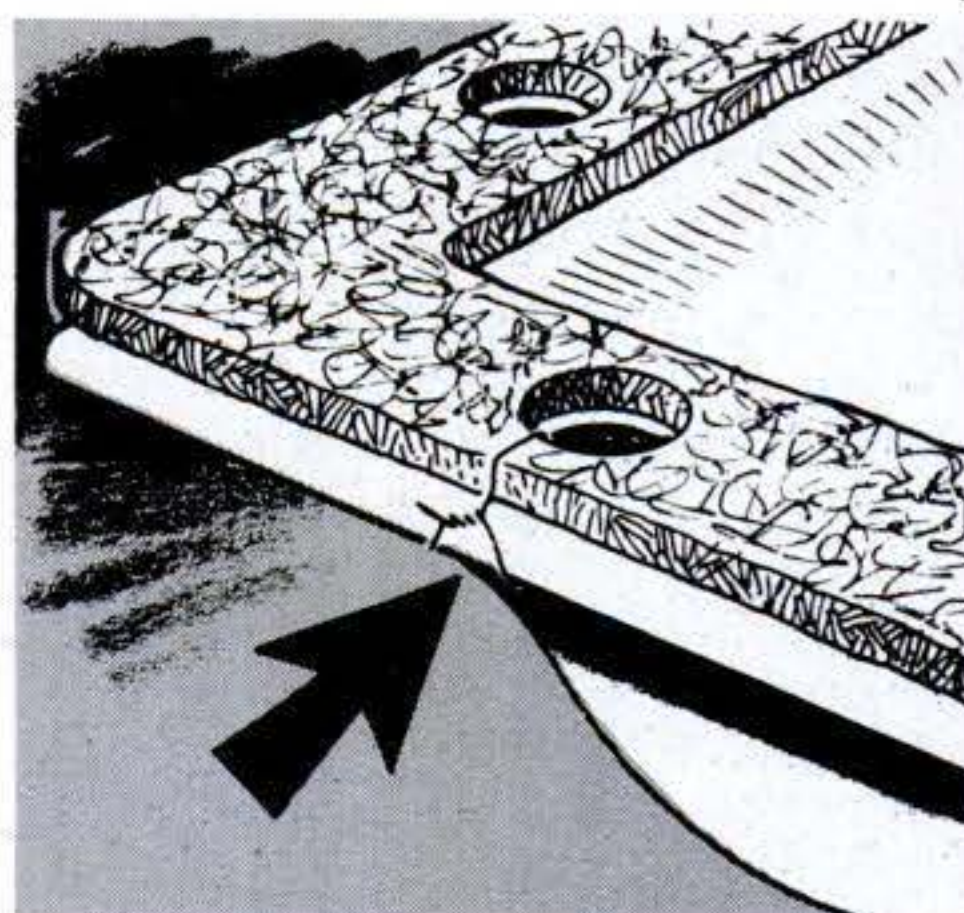
You don't need a special tool to remove a ball-joint stud. Loosen the castellated nut several turns. Now all you need are two heavy ball-peen hammers of equal weight. Hold one against the ball-joint support. Strike the support with the other hammer. Several hard blows should loosen the ball joint. Remove the castellated

nut, and take the stud out of its support. This method is not only relatively easy; it does not damage the rubber grease boot—important if the ball joint is to be reused. Caution: When removing upper or lower ball joints, follow the manufacturer's instructions for compressing springs; otherwise, injury could result.



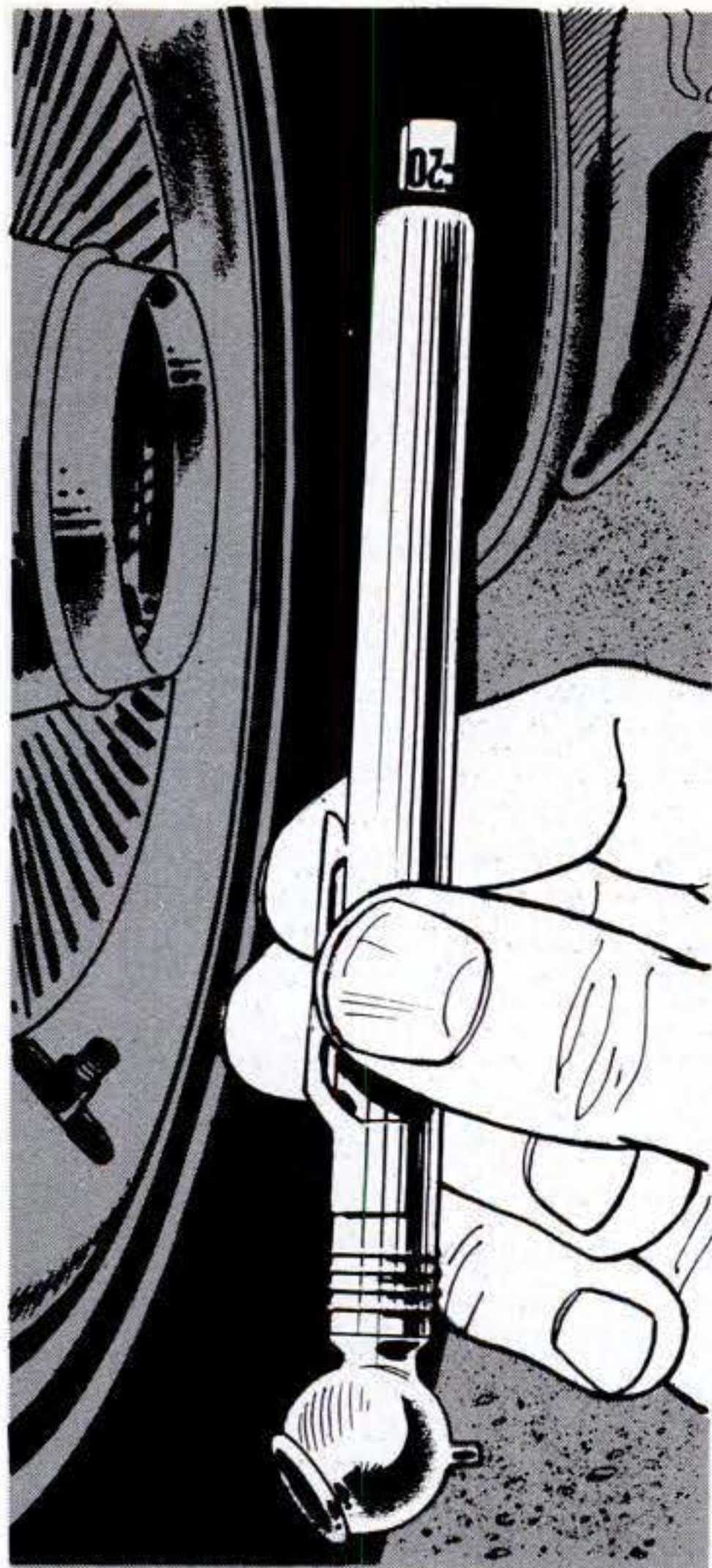
Rough-running engine

Is a loose vacuum hose causing your engine to run rough? Here's a quick way to check: Disconnect each vacuum hose at the intake manifold while the engine is idling. Place a moistened fingertip firmly over the tap to seal it. If the engine abruptly runs smooth, there is a leak in the disconnected vacuum line or its component. If—after trying this procedure on each vacuum line—the engine still runs rough, you can assume the cause is not a leaking line. Search elsewhere for the problem.



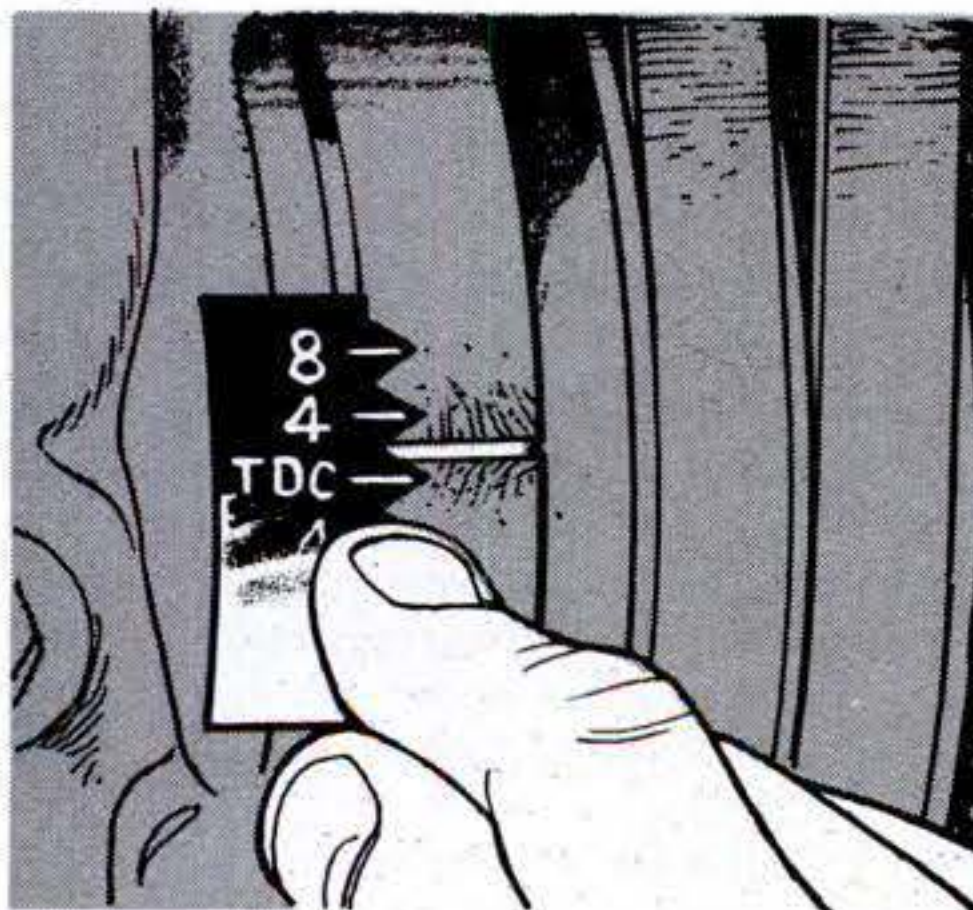
Replacing transmission gasket

When replacing a transmission-pan gasket (as you would when putting in a new filter), how do you hold the new gasket in place as you position the pan and insert the bolts? One way is to take a single strand of wire from multi-strand 18-gauge electrical wire and tie the gasket in place. You can then position the pan easily without the gasket shifting. Because the wire is so fine, it can be left in place and the bolts tightened without causing the gasket to leak transmission fluid.



Rough ride?

If you have a front-wheel-drive car and it gives you a rough ride, the cause may be nothing more than improperly inflated tires. Correct tire pressure is especially important on cars with front-wheel drive. Rear-tire pressure is usually different from front-tire pressure. Follow the specs in your owner's manual.



Seeing timing marks

When checking or adjusting ignition timing, the marks on the timing tab are often hidden by corrosion. A quick way to make them clearly visible is to rub the tab with chalk, then wipe the chalk off with your finger. Chalk will remain in the indented timing marks, making them easy to see. Mark the appropriate number, and chalk the indentation or ball on the damper pulley. Follow the maker's specs on idle speed and plugging the vacuum-advance line (if required) when setting timing.



"The grip is basic for proper control"

Roger Staubach,
Dallas Cowboys

"The grip is basic for proper control"

Tom Watson,
1977 Masters and
British Open Champion

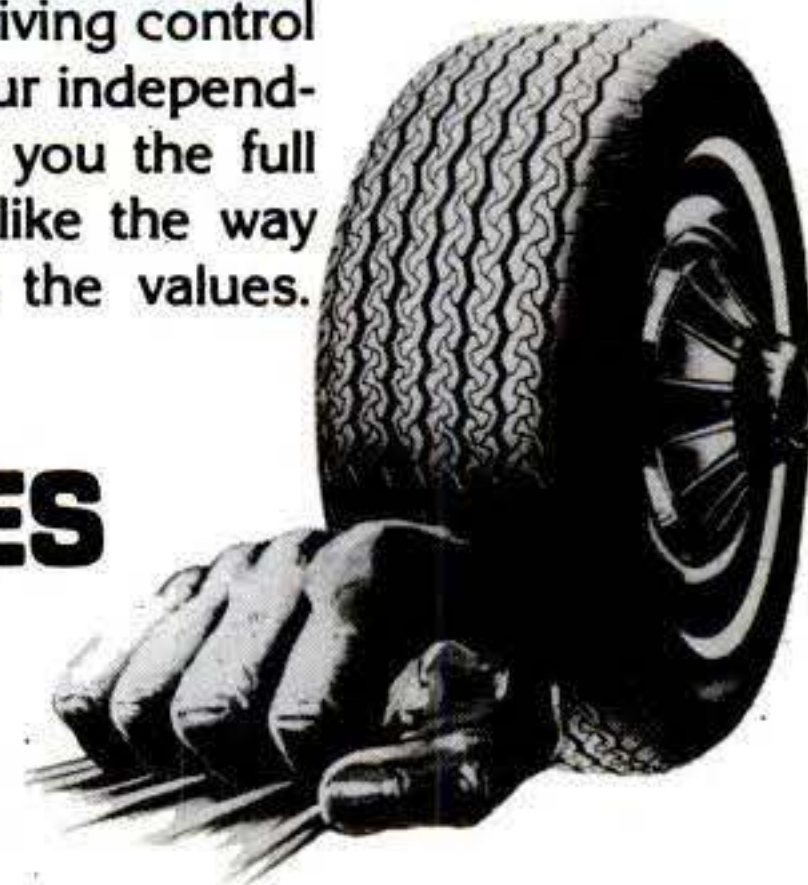
"The grip is basic for proper control"

Armstrong Tires

The way a tire is designed and built determines how well it grips the road. And that is a factor which determines the kind of driving control you get behind the wheel. Why do Roger Staubach and Tom Watson prefer the Armstrong Coronet steel belted radial? They like the way Coronet's road-hugging design gives them a combination of driving control and passenger comfort. Ask your independent Armstrong dealer to show you the full line of Armstrong tires. You'll like the way they perform. And you'll love the values.

ARMSTRONG TIRES
GRIP THE ROAD

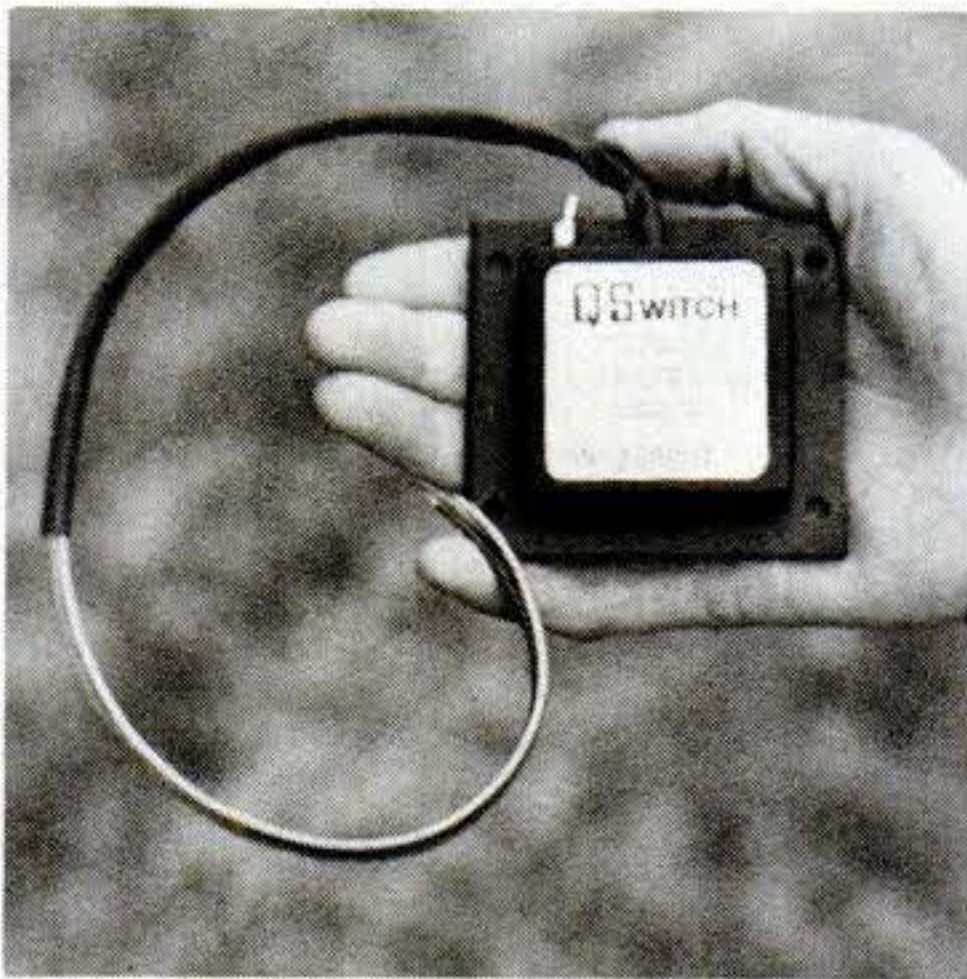
Proper tire inflation is important for longer tire life, better control, safer handling. Check the pressure in your tires every week.



MOTORCYCLING

By RAY HILL

High-beam modulator



A recent Department of Transportation study indicates that a pulsating headlight increases the chances of a motorist seeing an oncoming motorcycle during daylight hours. A device called a Q-switch can be wired into the high-beam circuit, causing the headlight to pulse from dim to bright about four times a second. At night the Q-switch is turned off, allowing the headlight to work normally. Its maker, Doltech, in Charlotte, N.C., claims it increases headlamp life. You can buy it at motorcycle shops for about \$60.

Electronic fuel injection

This year's Kawasaki KZ1000 has no carburetors. In their place is something no other production motorcycle has ever had—electronically controlled fuel injection. Kawasaki calls it KEFI (Kawasaki Electronic Fuel-Injection System).

Sensors monitor engine speed and temperature, and intake air flow and temperature. This information is sent to an electronic control unit. The control unit decides how much fuel is needed and sends an electric signal to the electromagnetic fuel-injection valves. The valves open, injecting the exact amount of fuel needed in front of the intake valves.

Each injector is located in the cylinder head about 1½ inches from the intake-valve face. All four injectors inject simultaneously, once for every 360 degrees of crankshaft rotation. The fuel-injection system is made for Kawasaki by the same Japanese company that makes the fuel-injection components for the Datsun 280 ZX.

Kawasaki says KEFI provides superior cold-start performance. There is virtually no throttle lag or hesitation. And because

the precise amount of fuel is delivered to the engine throughout its speed range, fuel economy is superior to that of an engine with the same power output using conventional carburetion.

Also, Kawasaki says, exhaust emissions are low. Compared to a normally carbureted engine, the KEFI engine can be set up for an optimum combination of performance, drivability, and fuel economy.

KEFI was introduced as we were going to press, and no bikes were available then. We'll be testing one and reporting on it, though, as soon as possible.

Belt replaces chain drive

Also new from the big K this year is a different final-drive system for the KZ 440 LTD. Instead of the conventional roller chain, a toothed belt (made of polyurethane, Kevlar, and nylon) is used.

Kawasaki says it won't slip—large front and rear sprockets allow deep tooth contact over a wide surface. Stretch is supposed to be minimal, only one or two adjustments needed during the life of the belt. It's reported to last as long as a standard roller chain.

Three big advantages, says Kawasaki: It's cleaner (no messy lubing as with chains), quiet running (chains make noise, the belt makes almost none), and smoother shifting (the belt cushions drive-line shock).

We'll be trying a belt-drive 440 soon to see how it lives up to these claims.

8000-mile road test

I've lived with a GS 850 now for the past 12 months and 8000 miles. I've used the machine for such diverse things as going to the local supermarket, commuting to work, and long-distance touring (both solo, and two-up with fairing, saddlebags, and luggage). In all these situations the machine has performed flawlessly. The only maintenance has been routine—adjusting points and timing (this year's model has electronic ignition, so you don't have to do this anymore), a couple of oil changes, and a valve adjustment. If you're looking for a touring/street bike with a drive shaft, good handling, and reliability, you would do well to consider this one.

A spectator's delight

If you live near a stadium that has a supercross event scheduled this year, go see it. Even if you have never ridden a motorcycle and have no intention of doing so, I guarantee that you'll come away in awe.

Continued



Turning into a better craftsman can be as simple as turning the pages of our new catalog.

Look inside and you'll see what we mean.

It's 116 exciting pages filled not just with great tools and specs. But carefully thought-out recommendations from craftsmen who've spent much of their lives making, using and testing the tools. Informative reading on every page, even detailed illustrations — so you'll know how the tools will look and fit in your workshop. After all, shouldn't you know everything about what you're buying.

At Garrett Wade, we know you're not the average craftsman. So why should we give you an average catalog?



Garrett Wade Co., Dept. PS-4-80
302 Fifth Ave., N.Y., N.Y. 10001

- Send me your catalog on hand tools. I have enclosed \$1.
- Send me your catalog on INCA SWISS stationary power tools. Here's \$1 for that as well.

Name _____

Address _____

City _____ State _____ Zip _____

Canadian craftsmen can obtain our Hand Tool catalog only by sending \$1.00 directly to: Lee Valley Tools, P.O. Box 6295, Ottawa, Ontario K2A 1T4.

Learn Glass Etching



Transform your windows, mirrors and everyday glassware into works of art the easy way with the **New ARMOUR ETCH™** GLASS ETCHING METHOD. Complete including supplies, illustrated step-by-step instruction booklet, plus 45 full-size etching patterns.

ONLY \$9.95

(please add \$1.50 per kit postage & handling)

Armour Products, Dept. PS40
Hill St, Midland Park, NJ 07432 • 201/652-8895

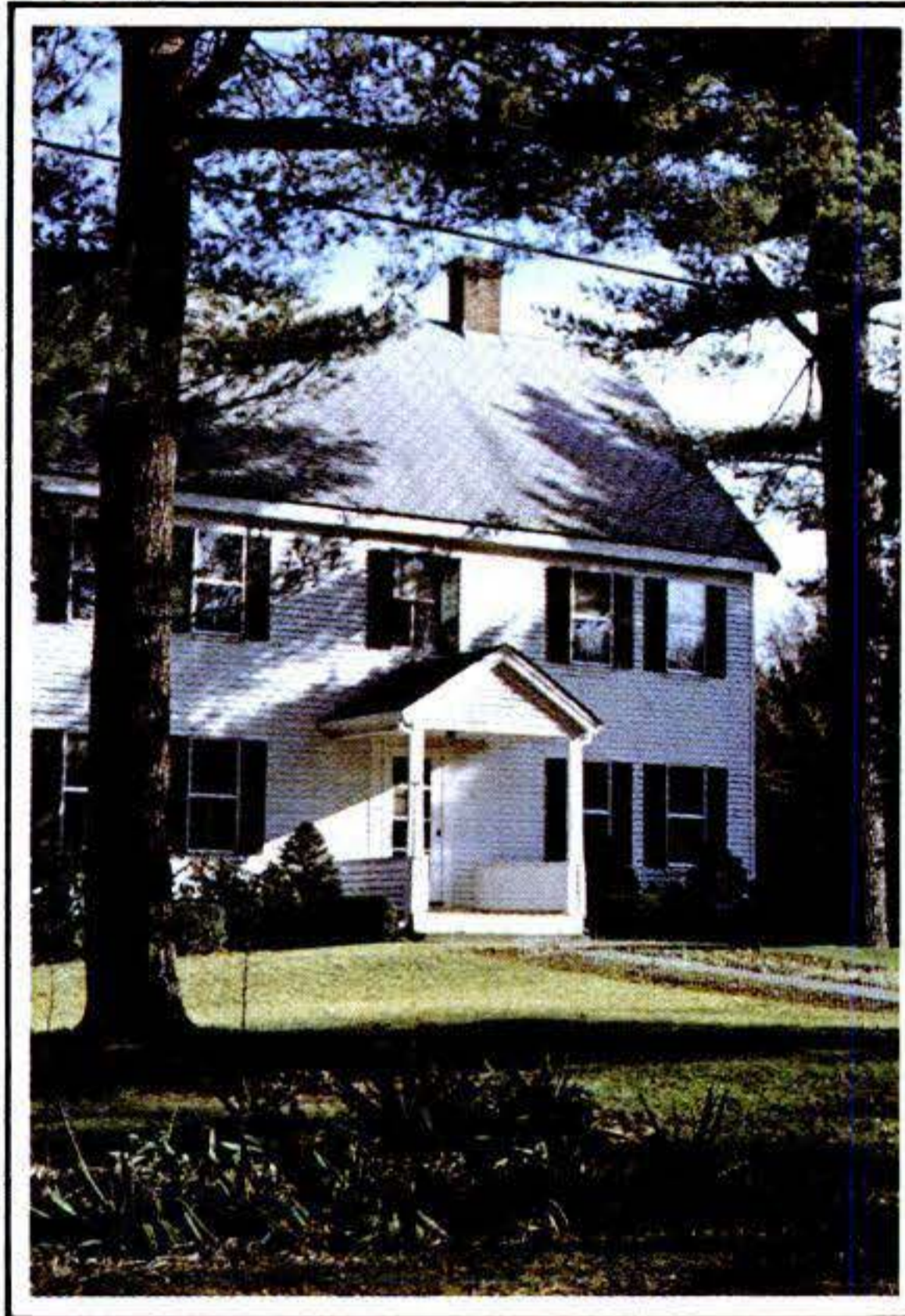
Name _____

Address _____

City _____

State _____ Zip _____

The Bird siding on this house is 8 years old.



Eight years ago it would have cost the family who lives here \$2125 to paint this house. Four years after that it would have cost \$2720. And today, four years after that, it would cost \$3910. That adds up to a total of \$8805* over the last eight years just to keep this house from peeling. But instead, this family spent just \$2890 on Bird solid vinyl siding. Now they're happy to know the siding's already paid for itself 3 times over. And they'll go on saving thousands for the next 32 years because their Bird siding is guaranteed for a total of 40 years.

Today more and more people are making the same decision this family did. It's the kind of dollar-stretching idea that really makes sense in times of inflation. (Have you had a painting estimate lately?) Besides being practical, Bird siding will make your home look great. And it will keep it that way year after year.

OUR SIDING HAS ALL THE APPEAL OF WOOD.

If you like the looks of wood, then you'll definitely like Bird siding. Each panel is squared off on the bottom to look like wood clapboard. And we carry a particular style that's etched with a rugged woodgrain texture. But unlike wood, our siding won't rot, peel, or blister, so it never needs painting.

It's paid for itself 3 times over.

BESIDES MONEY, BIRD SAVES YOU TROUBLE TOO.

Bird siding takes care of itself. There are no cracks to seal, or repairs to make. And to keep it looking fresh and clean, all you have to do is occasionally hose it down. Stubborn smudges are easily removed with a mild detergent. **BIRD IS AS TOUGH AS IT IS BEAUTIFUL.**

Vinyl siding is durable enough to stand up to harsh winds, rain, and snow, season after season.

It will keep your home looking like new, year in year out. And should you ever decide to sell it, that means great resale value! **CHOOSE FROM AN ATTRACTIVE SELECTION OF COLORS AND STYLES.**

Our siding comes in a textured finish, in six handsome colors. And it's available in the classic 4" over 4," the contemporary 8" width, and the V-Groove Vertical. So do something beautiful for your home, and smart for yourself. Put on Bird Solid Vinyl Siding today. For more information and a free estimate, just contact your Bird Siding Dealer. He's in the Yellow Pages.

Bird & Son, inc., E. Walpole, MA 02032
Please send me your revised, color booklet, "Building or remodeling, and how to make the most of your investment." I'm sending 50¢ in payment, and I'm planning to build, remodel with vinyl.

NAME _____
PHONE _____
ADDRESS _____
CITY _____
COUNTY _____
STATE _____ ZIP _____

It pays to invest in Bird.

POPULAR SCIENCE - APRIL 1980



*These figures are based on estimates supplied by a reputable painting contractor who examined the house shown.



“My boys mow 11 lawns a week, not counting our own, so we really depend on our John Deere.”

Lucy Ellis, Dallas, Texas

Eleven lawns a week is a lot of mowing for one lawn mower.

Especially in Dallas, where the lawns are Texas-size and the mowing season runs from March through October.

Nevertheless, the Ellis family's 21-inch self-propelled John Deere has been doing the job for 2 years now, and it's still running as strong as ever.

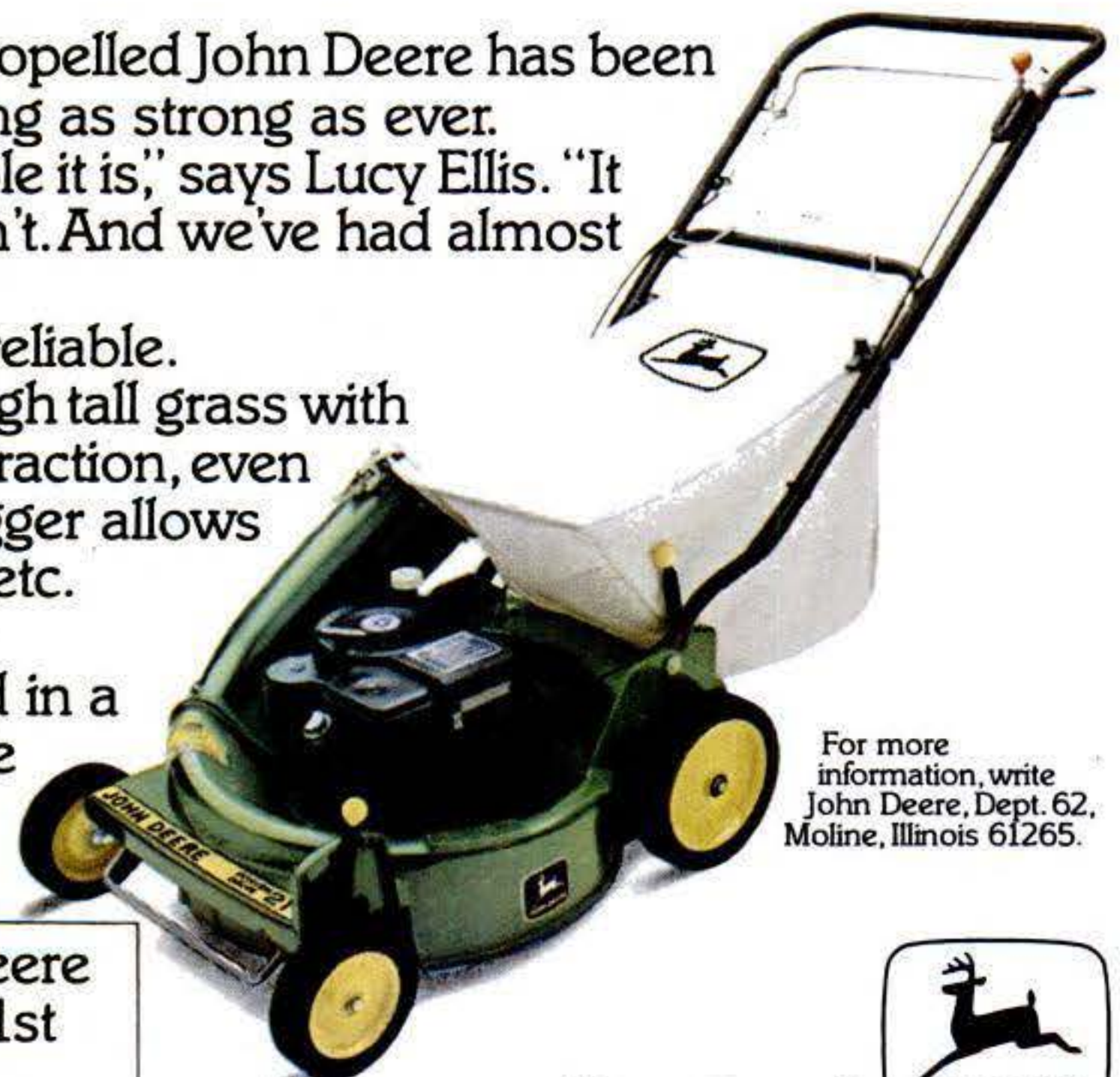
“We've been real pleased with how dependable it is,” says Lucy Ellis. “It always starts right up, which our last mower didn't. And we've had almost no repairs to speak of.”

What's more, it's as easy to operate as it is reliable.

It has a powerful 4-hp engine that zips through tall grass with ease. A rear-wheel gear drive provides superior traction, even on hillsides. And an optional 2½ bushel rear bagger allows for close-in trimming around trees, flower beds, etc.

John Deere 21-inch mowers come in a self-propelled model with an electric-start option and in a push-type model. Push models are also available in 18- and 20-inch cutting widths.

Come in for a demonstration soon.



For more information, write John Deere, Dept. 62, Moline, Illinois 61265.

Down-to-Earth Value. Save \$30. Buy any John Deere 21-inch mower with rear-bagger before May 31st and you save \$30 at a participating dealer.

Nothing runs like a Deere®



Copyrighted material

Motorcycling

[Continued]

Supercross started about eight years ago. A supercross event is staged inside a stadium, in which an off-road course has been constructed. The course is fiendishly difficult; there are bumps, jumps, berms, straightaways. There's also a horde of super-talented athletes on high-powered 250-cc racing bikes, each trying to be the first to the checkered flag. Airborne vehicles, slides, crashes, neck-and-neck competition—it's all there. You'll see riders do things that defy gravity and sanity—all from the comfort of your seat.

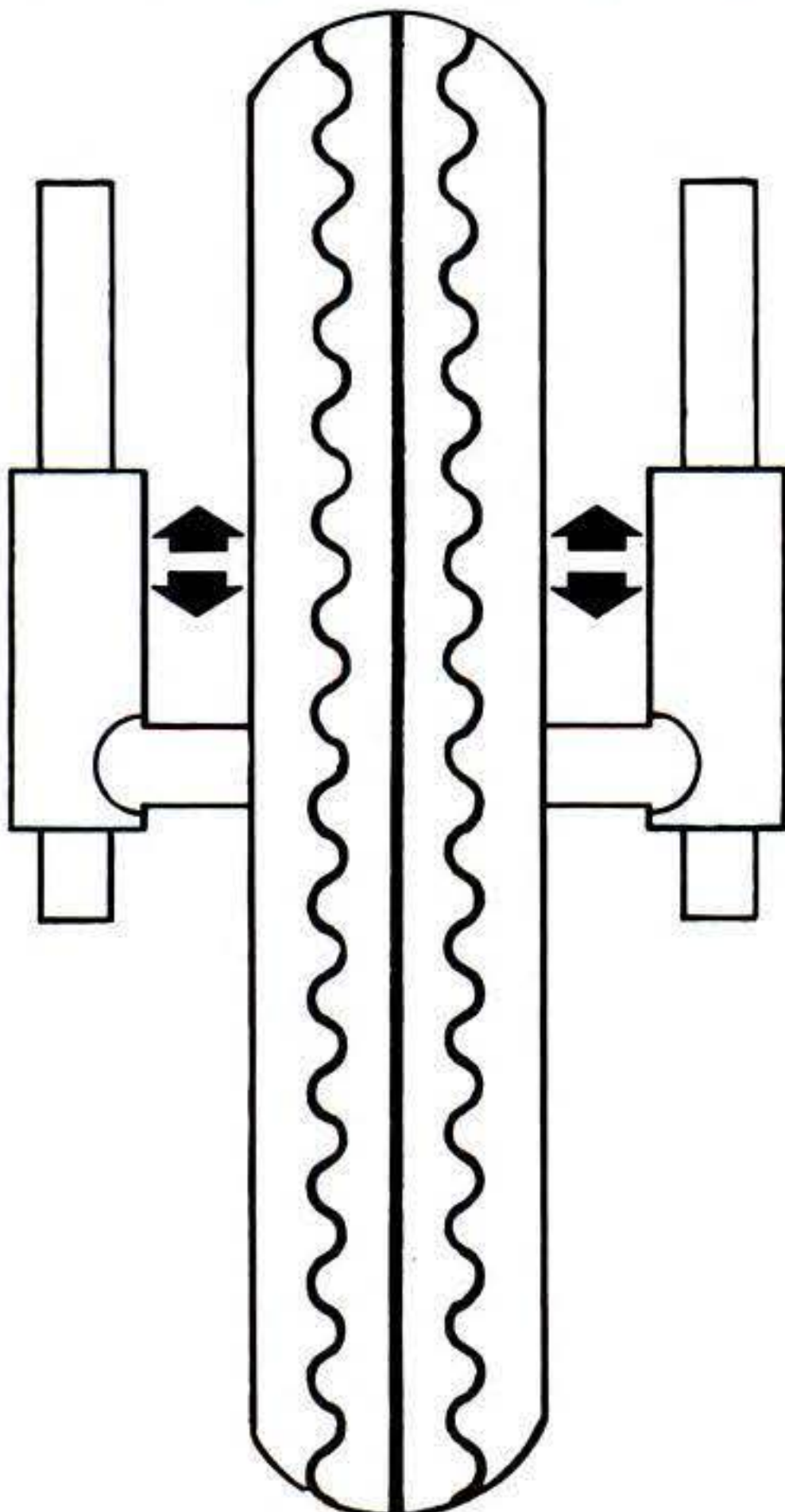
If you live in or near Seattle, Oakland, Atlanta, Daytona, Houston, Pontiac, New Orleans, Kansas City, Anaheim, Los Angeles, or Philadelphia, check with the local stadium for the supercross events held there.

New rear suspension

Engineer and ex-roadracer Ted Henter has patented a unique rear-suspension system. With it, the swing arm becomes a rigid frame member. The rear wheel is mounted between two double-rod hydraulic cylinders. The rods are attached at both ends to the frame, and the cylinders move up and down the rods.

Henter says this has several advantages: It eliminates the swing-arm pivot, so the space can be used for other things. Mufflers, foot pegs, and saddlebags don't have to be designed to allow for swing-arm travel. The bike will not squat during acceleration. And because the cylinders and rods have a slight curve, chain tension stays constant as the wheel moves.

The system has been shown to various manufacturers. Whether it will become a production item remains to be seen. **PS**



AIRE-ALL® For your shop or your car

- Emergency tire filling on road or at home
- Easily filled at your service station or with a home compressor
- Safety tested to 160 P.S.I.
- Carry a refillable compressed air unit with you for any use
- Complete with 48" hose and pressure gauge and standard tire filling fitting



SHIPPED POSTPAID

\$29.95

Safety Blo-Gun

Use with Aire-All® to clean dust, metal filings, etc. Use to clean and blow out air conditioner heat exchangers, etc.

\$3.98



AIRE-ALL®
8200 Blankenship
Houston, Texas 77055

COUPON

Please send me ___ Aire-All kits, each \$29.95

Send ___ Safety Blo-Guns, each \$3.98
Check or money order enclosed in the amount of _____

Please bill by Visa or Master Charge

Account: No. _____

Expiration Date _____

Name _____

Address _____

City _____ State _____ Zip _____

Texas residents include 6% Sales Tax

AIRE-ALL®

8200 Blankenship
Houston, Texas 77055



The WESO Ceramic Tile Stove, a direct descendant of Europe's mighty *kachelofen* tile heaters, combines superb combustion efficiency with an appearance that graces the most tastefully decorated home.

Its hand-glazed ceramic tiles conceal an airtight, cast-iron firechamber that burns both wood and clean, low-sulphur anthracite. A precision thermostat and controlled secondary air intake assure an all-night burn and maximum combustion efficiency.

The WESO warms your rooms so evenly, floor to ceiling, you're barely aware of a heat source. A removable ash pan and shaking grate minimize ash clean-up mess.

And the WESO's sheer beauty will enchant you. Its visible flames, lustrous tiles and iron grillwork make it the focal point of any room setting.

At last. A beautiful way to keep warm.

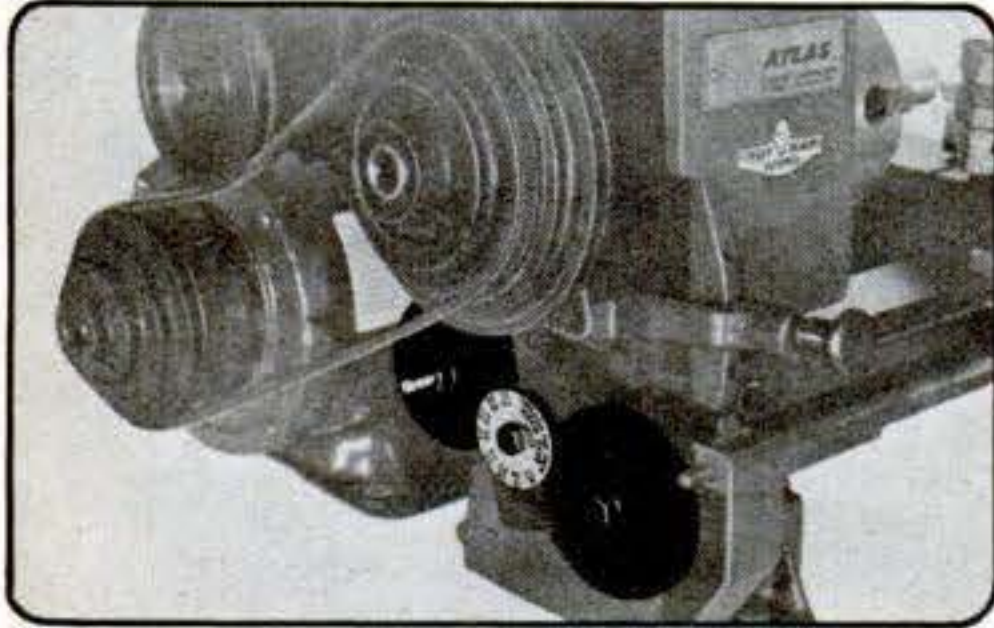
Send \$1 for a portfolio of illustrated brochures, including available tile colors and direct-from-importer price.

Ceramic Radiant Heat

5704 Pleasant Drive, Lochmere, N.H. 03252 • (603) 524-9663

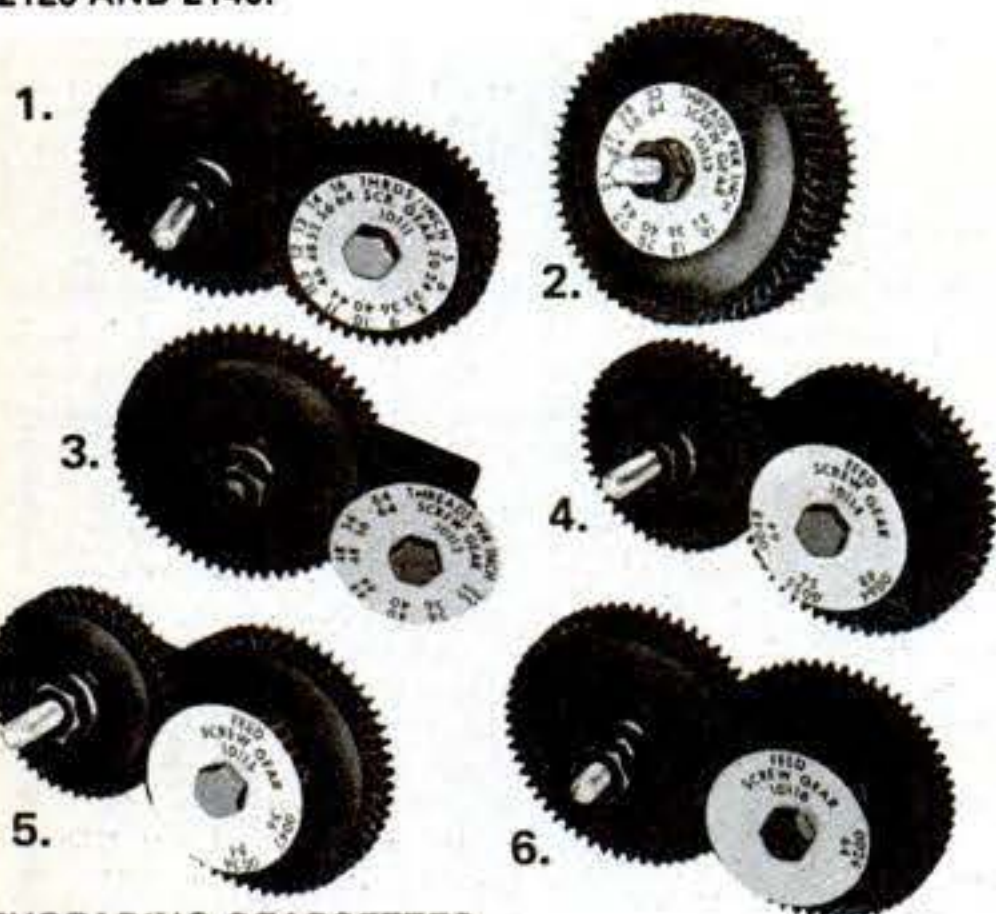
New! Quick Change Gearsettes... from **ATLAS**

Now, you can have the convenience of a quick change device for your new or old Atlas 6-inch lathe at a low cost.



No need to consult a threading chart. Each Gearsette is clearly marked with a circular metal disc that shows you thread range (or feeds) and which corresponding screw gear to use. All set ups require just one screw gear change and one Gearsette. When using the same Gearsette for different threads, you only have to change the screw gear.

Order Atlas Gearsettes separately or as a set. ENGINEERED TO FIT ATLAS LATHE MODELS 10100, 612, 618, 3950 AND SEARS CRAFTSMAN MODELS 2120 AND 2140.



THREADING GEARSETTES

1. No. 10111—For cutting 5, 6, 8, 9, 10, 11, 11½, 12, 13, 14 and 16 threads per inch. \$17.40
2. No. 10112—For cutting 16, 18, 20, 22, 24, 27, 28 and 32 threads per inch. \$8.60
3. No. 10113—For cutting 32, 36, 40, 44, 48, 56 and 64 threads per inch. \$16.70

FEEDING GEARSETTES

4. No. 10114—For carriage feeds of .0064, .0055 and .0048 inches per spindle revolution. \$17.80
5. No. 10115—For carriage feeds of .0042 and .0036 inches per spindle revolution. \$18.20
6. No. 10116—For carriage feed of .0024 inches per spindle revolution. \$18.00
7. No. 10118—Complete set of all 6 Gearsettes. \$89.00

Prices subject to change without notice.

MAIL TO: ATLAS PRESS COMPANY Dept. 220
2019 N. Pitcher, Kalamazoo, MI 49007

Please send me the following Gearsette(s):

- 10111 10112 10113 10114 10115
 10116 10118 Enclosed is my check or money order

for _____ plus shipping (92¢ per Gearsette and \$1.60 for complete set of 6), or charge my order to:

- Visa Mastercharge

Acct. # _____ Exp. Date _____

Name _____

Address _____

City / State / Zip _____

- Send free Atlas Catalog

Michigan residents add 4% sales tax, Indiana residents add 4%.

Available U.S.A. only.

First gas-operated semi-automatic pistol



Stainless-steel Wildey is first auto-loading pistol that does not operate on blowback or recoil principles. Piston (above) is forced back by expanding powder gases, actuating slide, which ejects empty and chambers next round. New Winchester magnum cartridges dwarf standard 9-mm (inset, far right) and 45-cal. rounds (second from left).

Self-loading handguns are usually either blowback- or recoil-operated. The new Wildey is unique—the world's first production-model gas-operated semi-automatic pistol. In the patented Wildey system, a portion of the powder gases is exhausted from the barrel through six ports, where it impinges on the operating piston, driving it rearward to operate the slide and rotary bolt action. An adjustable gas-regulator ring controls the gas flow to accommodate various cartridge loads. With the gas ports completely cut off by the regulator, the Wildey becomes a manually operated handgun.

Winchester-Western has developed two new cartridges especially for the Wildey Auto Pistol: 9-mm Winchester magnum, with the highest velocity of any commercially loaded handgun round, and 45 Winchester magnum, the largest caliber among magnum pistol cartridges.

The ballistics are impressive: 9-mm Winchester magnum loads with 115-grain full-metal-case bullets deliver a muzzle velocity of 1475 fps and muzzle energy of 555 ft-lb. The numbers for the 45 Winchester magnum with 230-grain FMC bullet are 1400 fps and 1000 ft-lb. For \$16.15 you can buy a

box of either fifty 9-mm magnum cartridges or twenty 45 magnum cartridges.

The double-action Wildey Auto Pistol is constructed of stainless steel, and has a fixed barrel, available in your choice of five-, six-, seven-, eight-, or 10-inch lengths. With the six-inch barrel, the Wildey measures 10 inches overall and weighs about 51 ounces.

The 9-mm magnum version holds 15 cartridges in its magazine, while the 45 magnum's capacity is eight rounds. The rear sight is adjustable for windage and elevation, and the ramp front sight is mounted on a ventilated rib. Grips are made of select hardwood, finely checkered.

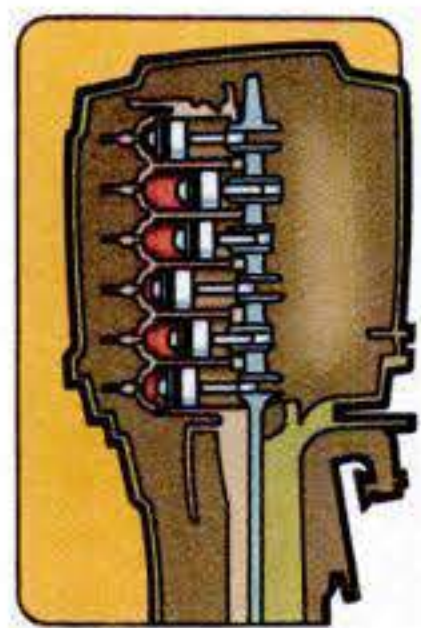
The new Wildey is ideal for big-game hunting and metallic silhouette target shooting, the sports for which it was designed. Recoil levels of the powerful 9-mm magnum and 45 magnum pistols are well below those of revolvers firing 357 magnum and 44 magnum cartridges.

Suggested retail prices for the pistols start at \$389.95. The manufacturer is Wildey Firearms Co., Inc., Box 284, Cold Spring, N.Y. 10516—Paul Wahl

Mercury mid-range outboards.

Engineering leadership means we never stop making them better.

For 1980, Mercury® offers you seven outboards in its mid-range line, from 40-hp to 140-hp. Including three powerful 6-cylinder in-line models.



Cruise, ski, fish, roam or run flat

out—you enjoy a wide choice of versatile mid-range power with Mercury.

The new Mercs are the most corrosion-resistant outboards on the market today, in fresh or salt water. All critical parts are stainless steel or other tough, high-impact corrosion-fighting materials.



And a multi-step metal protection process provides an extra-hard corrosion-resistant paint finish.

The redesigned 40-hp Merc runs quieter than ever, but with more power and better



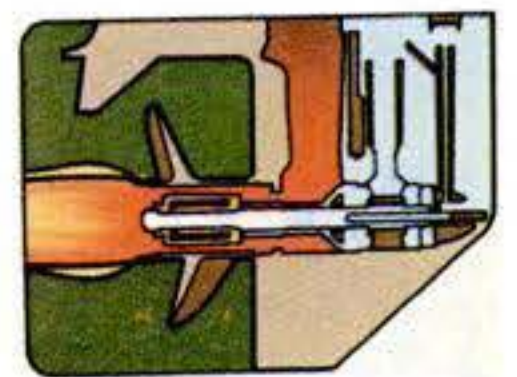
performance. The 70-hp Merc, too, provides more performance with a new, higher rpm range and a new gear ratio.

You get fast starts with Mercury solid state CD ignition. The same ignition that lets a

fisherman troll slow and easy, hour after hour, without fouling the spark plugs.

Fuel-saving fixed jet carburetion provides just the right fuel/air mix.

And every Merc exhausts sound and fumes



underwater through the propeller hub, increasing engine efficiency and resulting in better fuel mileage.

Engineering leadership means we keep changing, improving. Making things stronger, longer-lasting. Tougher, lighter. More efficient, more economical in fuel consumption.

Mercury for 1980. Because we never stop making them better. We've given you just a few of the reasons here. Your Mercury dealer will be happy to give you the full story.

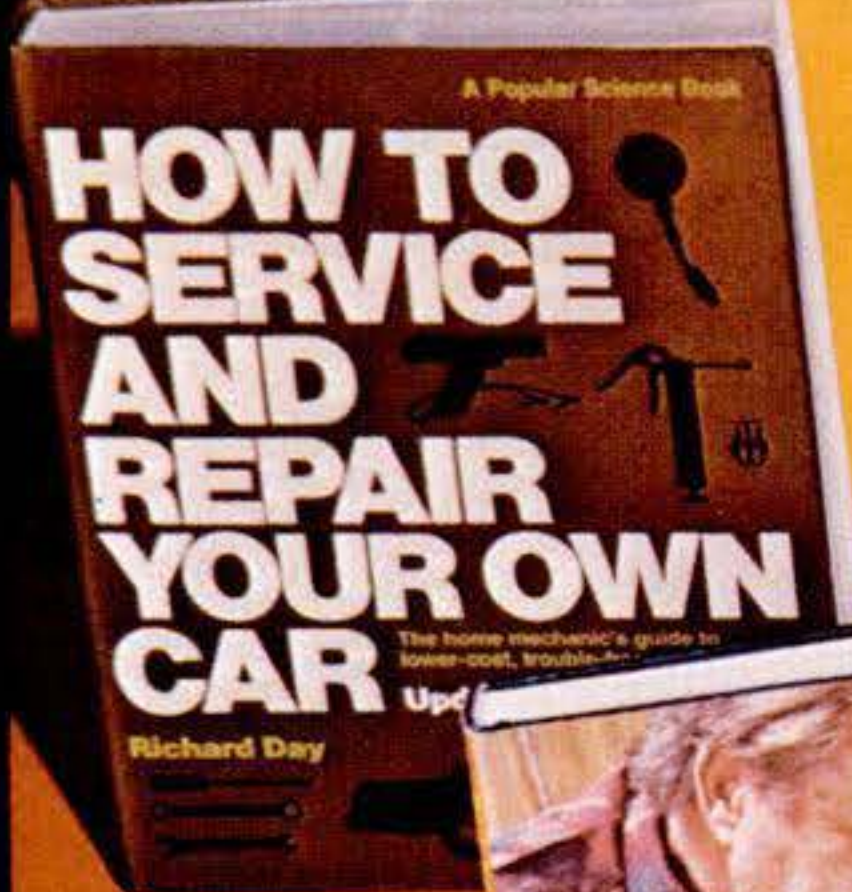
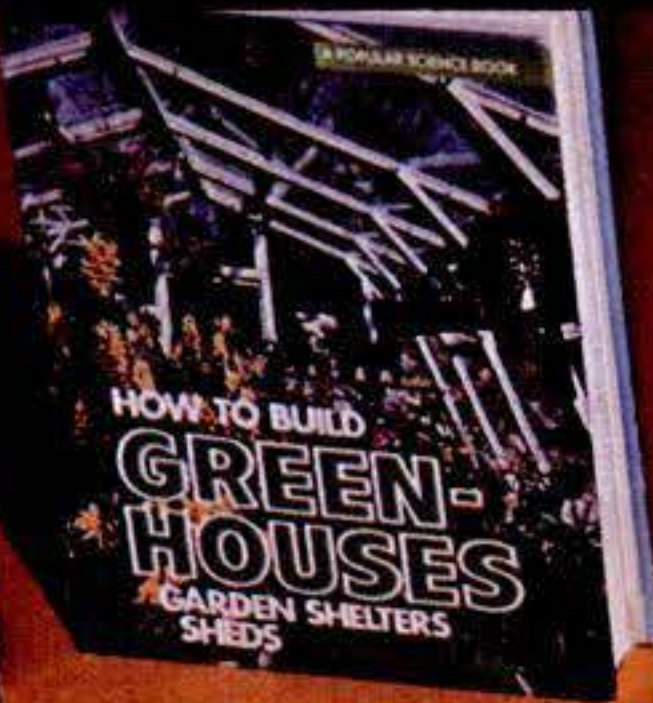
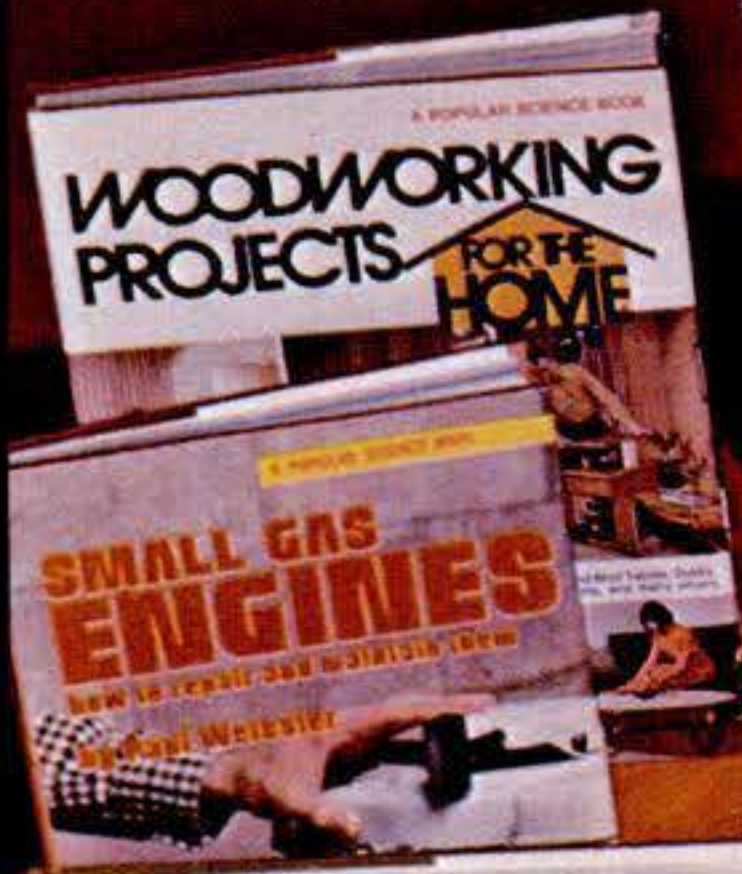
Visit him soon.

**MERCURY
OUTBOARDS**

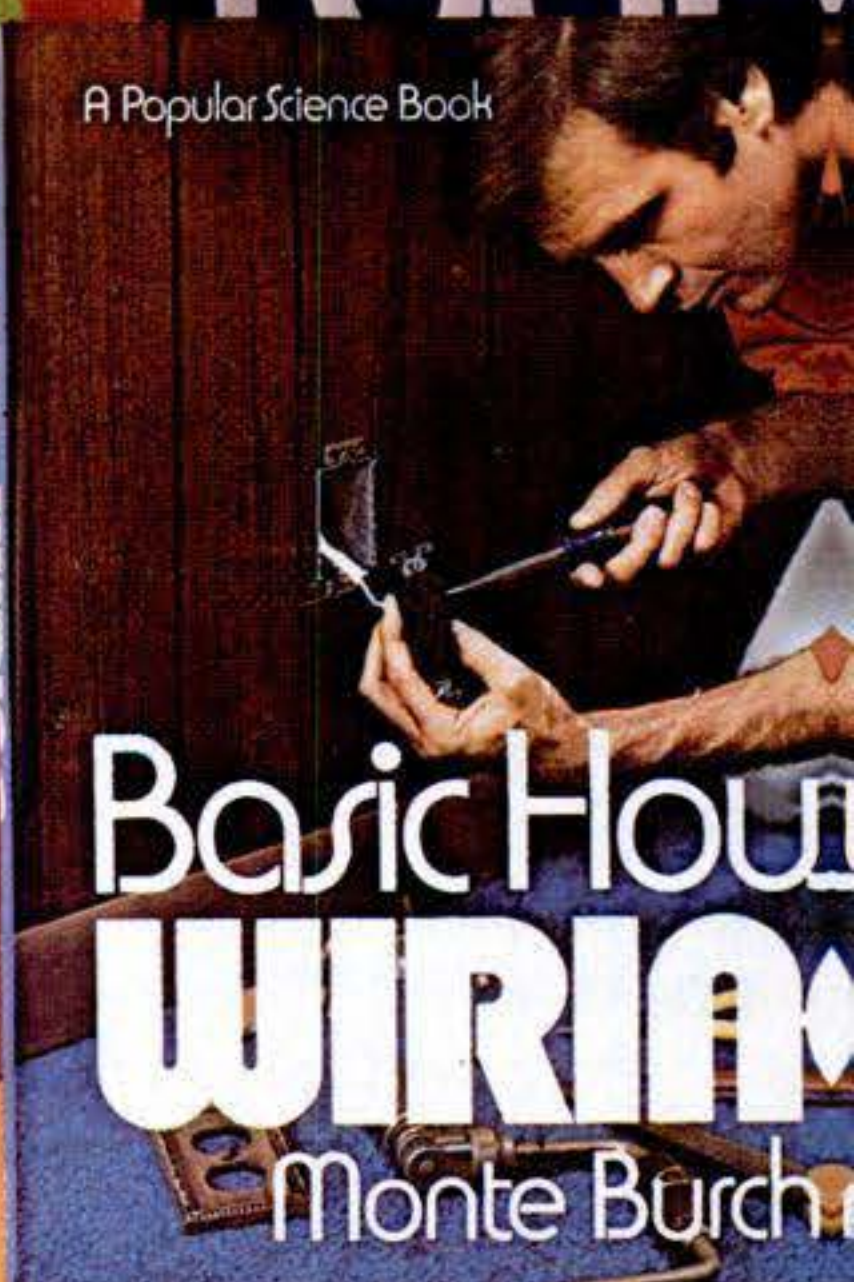
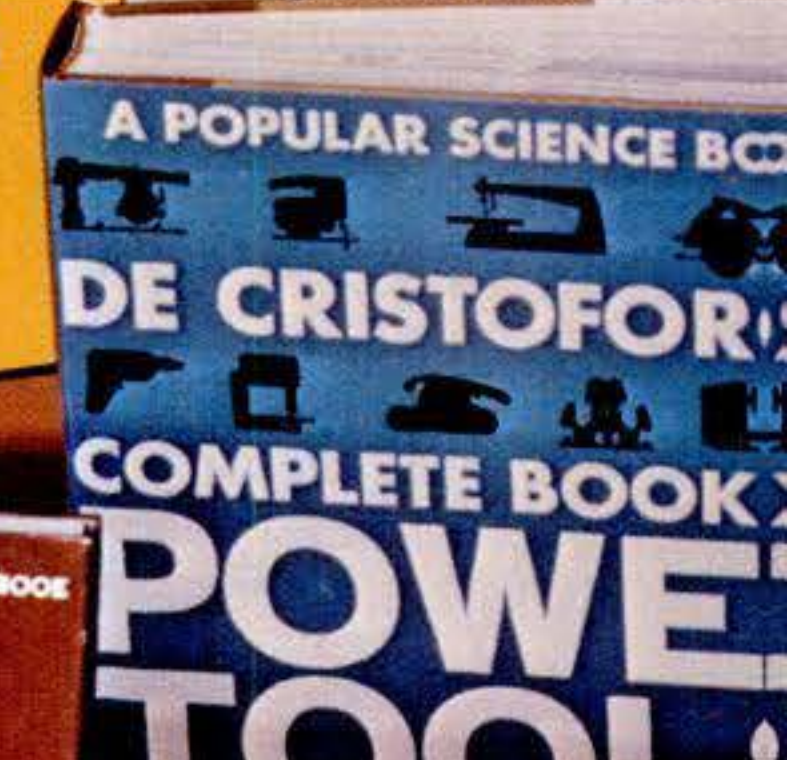
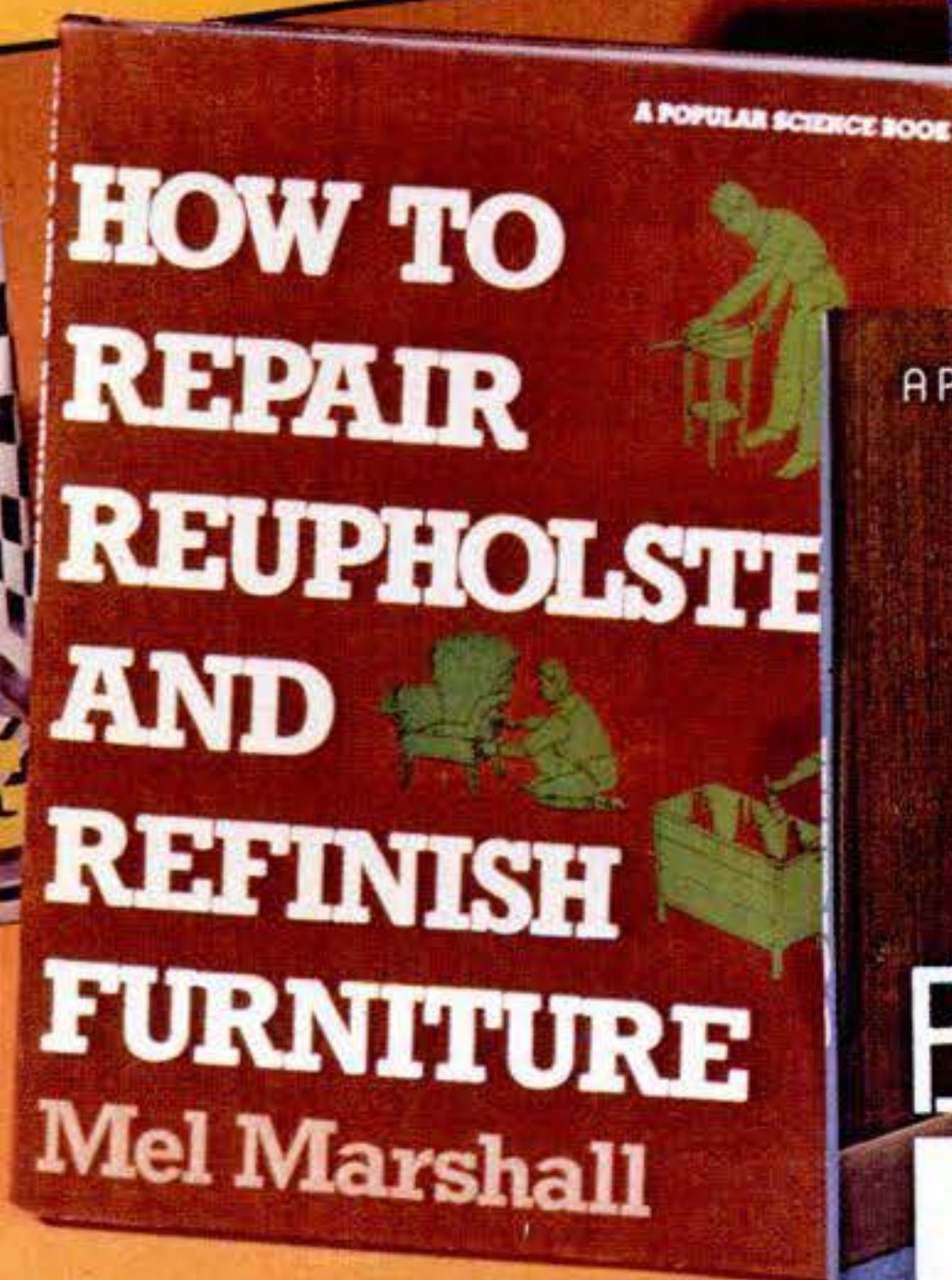
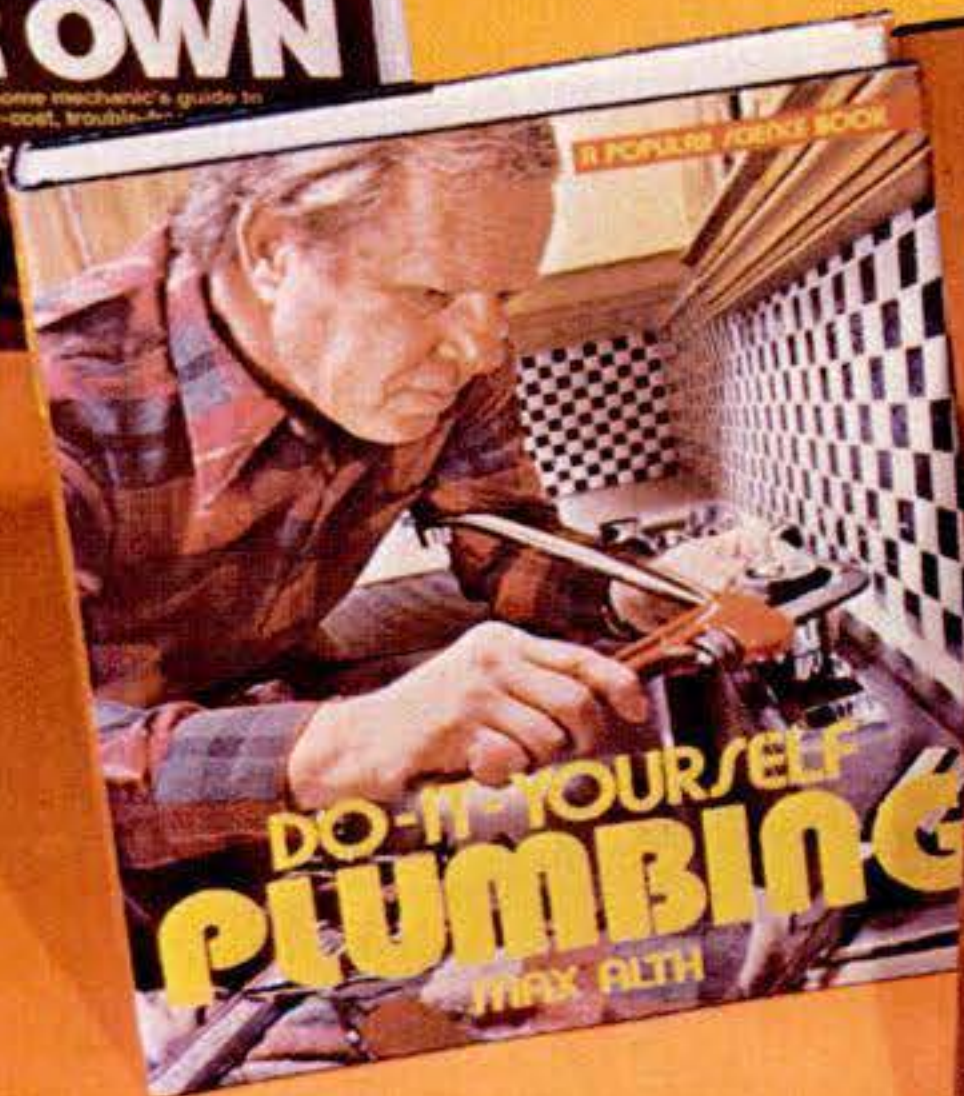
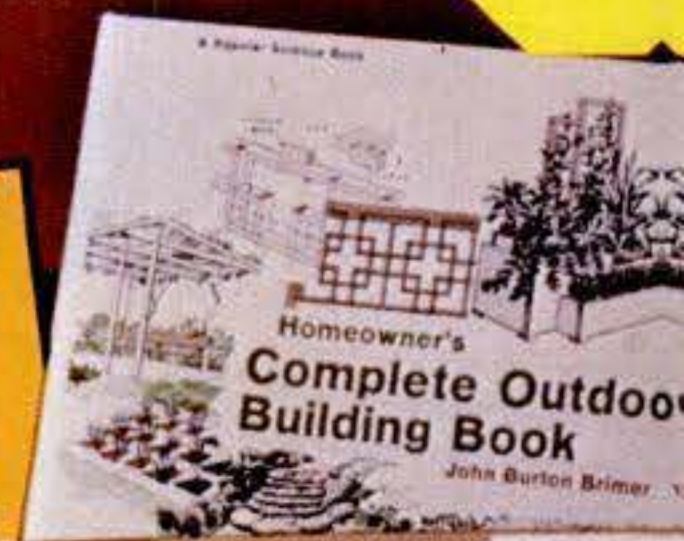
A BRUNSWICK COMPANY

Mercury Marine, Fond du Lac, Wisconsin, Canada, Australia, Belgium

CHOOSE ANY 3



Every Book Here is
a Popular Science Original
Title, Custom-Written*
for Club Members



109. **BASIC HOUSE WIRING** by Monte Burch. Pub. at \$12.50

105. **COMPLETE BOOK OF WOODWORKING** by Rosario Capotosto. Pub. at \$15.95

116. **DE CRISTOFORO'S HOUSEBUILDING ILLUSTRATED** by R.J. De Cristoforo. Pub. at \$16.95

084. **DE CRISTOFORO'S COMPLETE BOOK OF POWER TOOLS** by R.J. De Cristoforo. Pub. at \$14.95

097. **DO-IT-YOURSELF PLUMBING** by Max Alth. Pub. at \$12.95

042. **FORMULAS, METHODS, TIPS AND DATA FOR HOME AND WORKSHOP** by Kenneth Swezey, Revised by Robert Scharff. Pub. at \$15.95

119. **HOME ENERGY HOW-TO** by A.J. Hand. Pub. at \$10.95

058. **HOMEOWNER'S COMPLETE OUTDOOR BUILDING BOOK** by John Burton Brimer. Pub. at \$12.50

118. **HOW TO BUILD GREENHOUSES, GARDEN SHELTERS & SHEDS** by Thomas R. Jones. Pub. at \$11.95

150. **HOW TO REPAIR, REUPHOLSTER AND REFINISH FURNITURE** by Mel Marshall. Pub. at \$13.95

089. **MASONRY AND CONCRETE WORK** by Max x. Pub. at \$14.95

113. **SMALL GAS ENGINES: HOW TO REPAIR AND MAINTAIN THEM** by Paul Weissler. Pub. at \$11.95

101. **WOODWORKING PROJECTS FOR THE HOME** contributors to Popular Science magazine. Pub. at \$12.95

056. **HOW TO SERVICE AND REPAIR YOUR OWN CAR** Richard Day. Pub. at \$14.95

If card is missing write to: **POPULAR SCIENCE BOOK CLUB** P.O. Box 2006, Latham N.Y. 12111

BOOKS FOR ONLY \$2.95

when you join the Popular Science Book Club (retail prices up to \$48.85)

And then keep saving up to 50% on books covering a wide range of do-it-yourself subjects . . . home improvements and repair, housebuilding, appliance repair, home workshops, electronics, how things work, home protection, mathematics, masonry and carpentry, modern technology, science, space and many other popular science subjects. Every month you choose from a selection of up to twenty books and often many more. These include both the Club's custom-written books and the finest new books of all other publishers. And you get all books at substantial discounts.

The Popular Science Book Club regularly offers custom-written books to its members. These are specially commissioned books written by the leading authors in the popular science field on all the subjects of greatest interest to members. Men like Jackson Hand, Rosario Capotosto, R.J. DeCristoforo, Richard Day, more. These books are offered at discount exclusively to Popular Science Book Club members.

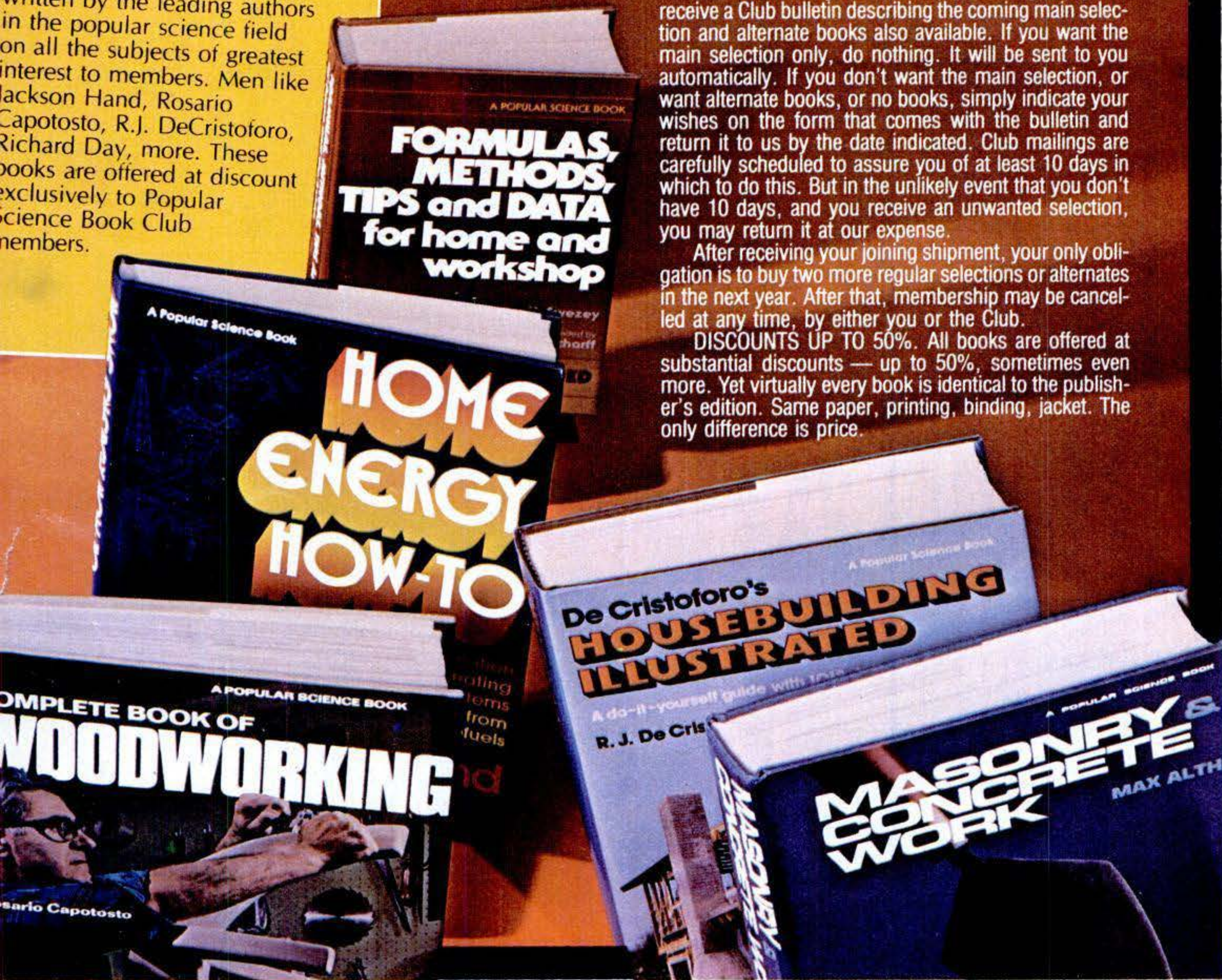
How Popular Science Book Club Works

First, just pick any three of the books listed here (up to \$48.85 worth of books). Indicate your choices on the attached card and mail. Send no money now. We'll bill you later for only \$2.95 plus delivery and handling.

Then about every four weeks (15 times a year), you'll receive a Club bulletin describing the coming main selection and alternate books also available. If you want the main selection only, do nothing. It will be sent to you automatically. If you don't want the main selection, or want alternate books, or no books, simply indicate your wishes on the form that comes with the bulletin and return it to us by the date indicated. Club mailings are carefully scheduled to assure you of at least 10 days in which to do this. But in the unlikely event that you don't have 10 days, and you receive an unwanted selection, you may return it at our expense.

After receiving your joining shipment, your only obligation is to buy two more regular selections or alternates in the next year. After that, membership may be cancelled at any time, by either you or the Club.

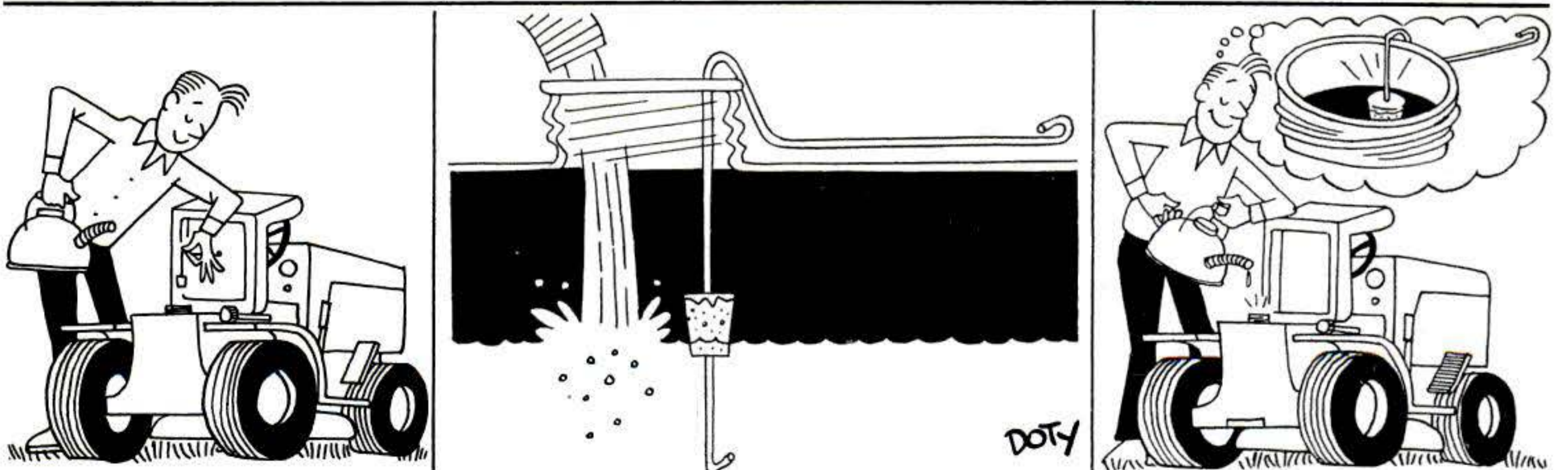
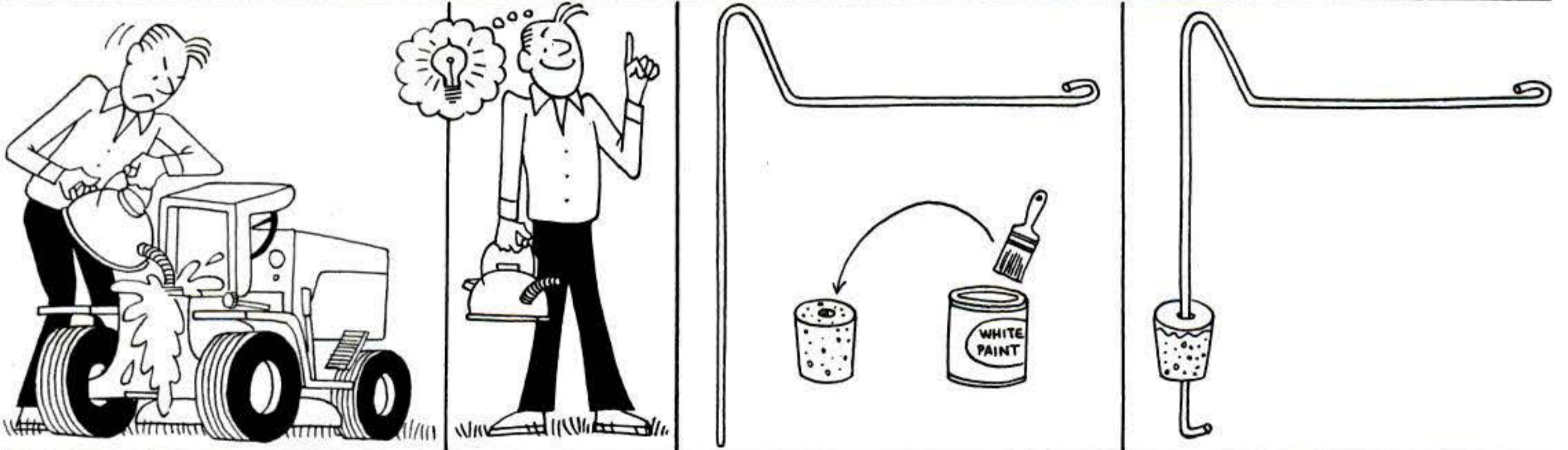
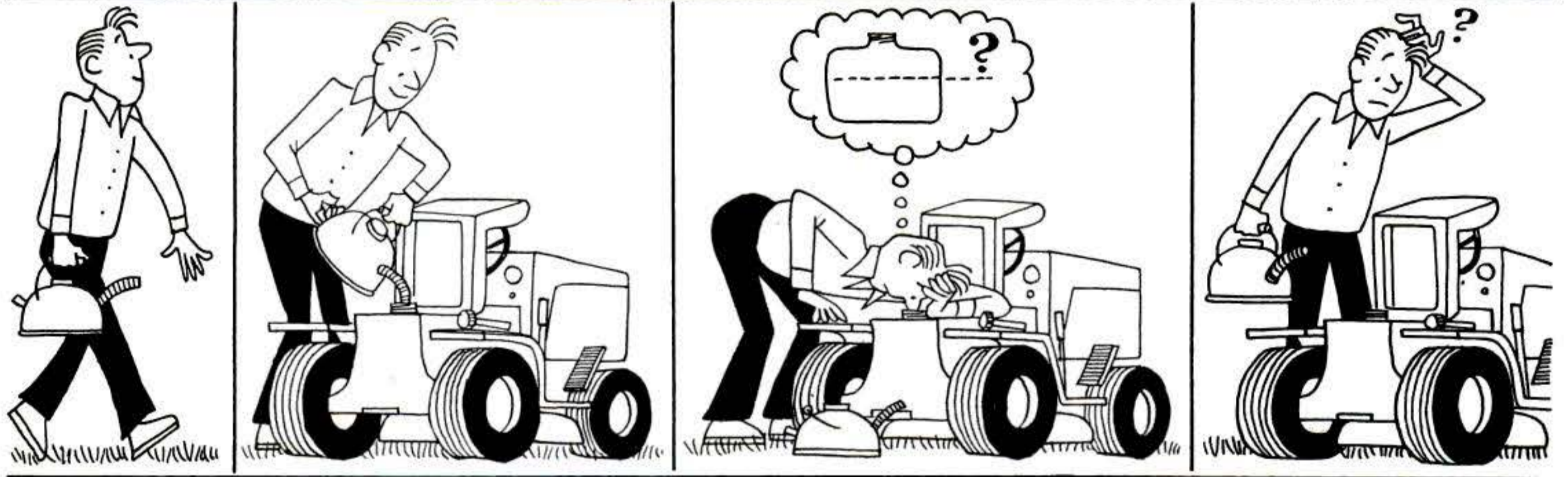
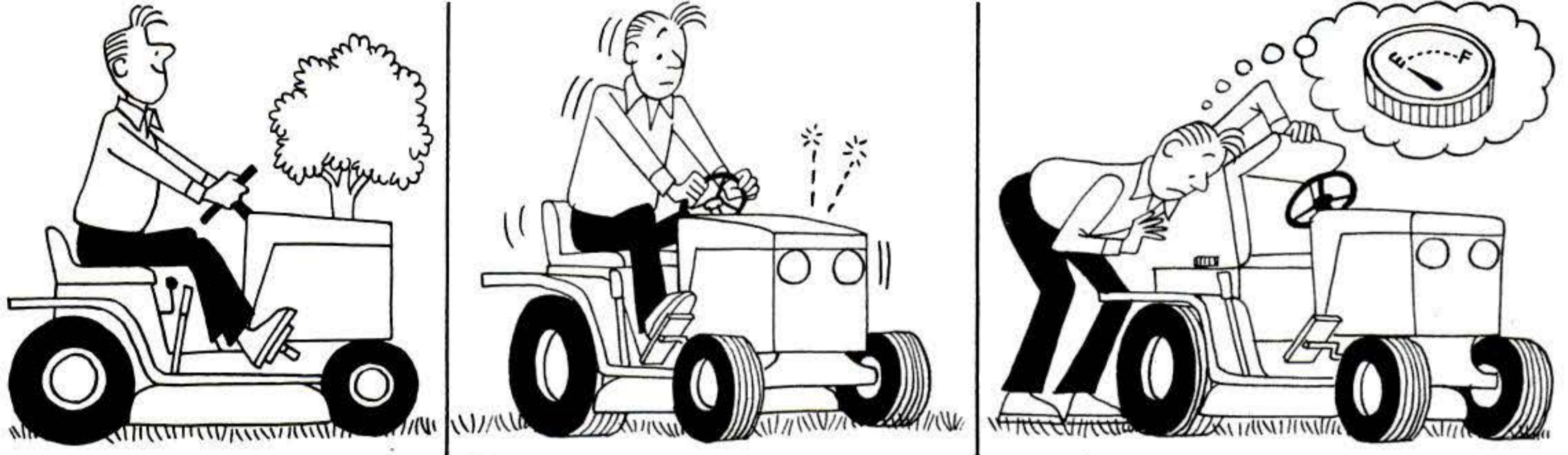
DISCOUNTS UP TO 50%. All books are offered at substantial discounts — up to 50%, sometimes even more. Yet virtually every book is identical to the publisher's edition. Same paper, printing, binding, jacket. The only difference is price.



WORDLESS WORKSHOP

By ROY DOTY

\$50 to Patrick Mullen of Elyria, Ohio, for this idea. Send yours (with Social Security No.) to Wordless, POPULAR SCIENCE, 380 Madison Ave., New York, N.Y. 10017. Only purchased ideas acknowledged.



The SNAPPER versa-tiller.

Optional attachments make it a walking tractor for all-season use.



Furrowing Tool



Gauge Wheel Kit



Wishbone Harrow



Front-Mounted Blade



SNAPPER[®]
Mowers · Tillers · Tractors

Gardening is a pleasure, with rewards by the bushel, when you use a versatile SNAPPER tiller. They're designed to take the "work" out of gardening.

At planting time you can break your soil and prepare an excellent seedbed. When you replace the working tines with lug tires you convert your tiller to a walking tractor which can open furrows for your seed and pull a cultivator. Then you can keep out weeds that steal nutrients from your

crops. Plus it can be used for light dozing and snow removal.

The tines on SNAPPER tillers are unique and long-lasting. They're self-sharpening and designed to work deep rather than travel forward. By adding optional extension tines to any SNAPPER tiller with Hi-Torque Drive you can increase your tilling width from 28" to a whopping 38". See your local SNAPPER dealer, the Yellow Pages or write:

McDonough Power Equipment
McDonough, GA 30253



Any way you cut it...it's a snap with SNAPPER!

Easy! DRILLS WATER WELLS

50...100...200 FEET DEEP
Saves You Hundreds of Dollars!



Did you know that vast quantities of fresh, sparkling clear water lie within 200 feet of the surface of the ground almost everywhere? In the city. In the suburbs. In the country. Pure, tasty water untouched by chemicals or pollutants.

Thousands of home owners are now drilling their own wells from 50 to 200 feet deep! YOU can join them in saying goodbye forever to expensive, chemical-tasting city water! Forget about droughts! Ignore summertime water shortages!

You owe it to yourself to find out more about this practical economical way to provide good, year 'round water for your home and garden.

Write or call today for a big, illustrated brochure and 24-page booklet on how to drill your own well. The big fact filled package will be rushed to you by First Class Mail!

Deeprook Mfg. Co.
Opelika, Alabama 36801

FREE Phone Toll-Free

(800) 821-2280

(Ask for Extension 5058)

Call anytime including Sundays.
OR CLIP COUPON AND MAIL TODAY!

Deeprook Mfg. Co. Dept. PS40
Opelika, Alabama 36801

Please mail your free information kit. I understand there is no obligation.

PRINT NAME _____

ADDRESS _____

CITY _____

STATE _____

ZIP _____

© 1980 Deeprook Mfg. Co.

SHOP TALK

By AL LEES

Brand-new old phone



The What's New magazine has no space for nostalgia, but I was present at the unveiling of this handsome new reproduction of a 1913 phone that's a design classic. Handcrafted in solid oak with antiqued-nickel accents, the phone is the 15th and latest in the Bell System's Design Line (for specialty phones from other sources, see our Jan. '79 issue). Called Country Junction, it's available for around \$165. You can install it yourself.

Although, except for that dial, it's a careful copy of the battery wall phone, its innards are current technology. Interesting sidelight: The only plastic in the phone (the handset cups) proved the hardest to reproduce. It simulates Bakelite, widely used in old phones and radios but not manufactured for some years.

Don't burn—build

Wood as fuel? "This is really only the second-best way of employing wood to save energy," says Prof. David M. Smith of Yale's School of Forestry and Environmental Studies. "The most important way of using wood for energy conservation is as a structural material. At best, *burning* wood only substitutes one Btu from wood for one Btu from oil, gas, or coal. But when we build houses out of wood, we expend only about one Btu for each six Btu that a steel house would require and roughly 25 Btu that an aluminum house would take. The energy requirement for making cement is in the same high range."

On the other hand, Andersen Corp. (the Bayport, Minn., window maker) says build *and* burn. In milling its millions of wood sash and frame parts, Andersen

creates mountains of sawdust and chips. Sure, the company sells a lot of this waste to manufacturers of particleboard—but for only around \$4 a ton. So Andersen prefers to burn as fuel as much of this waste as proves practical. A company spokesman tells me that waste wood provides all the heat for its 43-acre plant—even during a severe Minnesota winter—and there's energy enough to spare for powering much of the machinery. The company figures that, as a fuel, its wood wastes are worth at least \$50 a ton!

Many forest-products companies are energy self-sufficient through the use of wood waste. Some even generate more power than they need, and sell their surplus to local utilities. For example, the Louisiana-Pacific plant in Samoa, Calif., generated 230,000 megawatt hours of power last year—enough to run its factory complex, provide power for a nearby community of 100 homes, and still produce surplus for sale. The 54-mW power plant runs entirely on wood fuel—up to 600 dry tons (or cords) per day.

Cross a metric/inch barrier

Your workshop choice of twist-drill sizes is now virtually infinite. The old standard fractional-inch sizes (in $\frac{1}{64}$ -in. increments) have long been supplemented by drills bearing wire-gauge numbers (e.g., #72, #4) and letters (A to Z). But now all gaps have been bridged by the vast number of metric drills available—some 316 diameters, up to 32.5 mm.

There's no reason why these metric drills shouldn't be used in "inch" projects, and vice versa. This way, you can get—without machining—a close running fit, force fit, tap or clearance hole. But you need an equivalency chart to know exactly which size from which set to use. And a PS reader has just compiled one, listing 504 sizes in diameter sequence. Send \$3 to Clarence J. Marx, Box 23033, Cleveland, Ohio.

Pro tips: dowel joinery

The proprietor of Woody's Wood Shop in Mt. Prospect, Ill., writes:

"Tom Jones' fine article in the October '79 issue will introduce many woodworkers to the use of the dowel. But I question his suggestion that homemade dowel pins be roughened under a rasp and grooved lengthwise with a saw. Rasping a dowel is likely to make it out-of-round, and the lengthwise groove may be the *only* area that will hold any glue.

"Spiral dowels hold much more glue; they're cheap and available. But if you

Continued



Fed

Unfed

Grow more tomatoes without planting more tomatoes.

If you like plump, juicy tomatoes fresh from the garden (and plenty of them), we have a fertilizer for you.

Scotts® Grow Vegetables Fertilizer.

We fed the tomato plant on the left just to show you what Grow Vegetables will do. Just one feeding can actually give you up to twice the yield on each tomato plant.

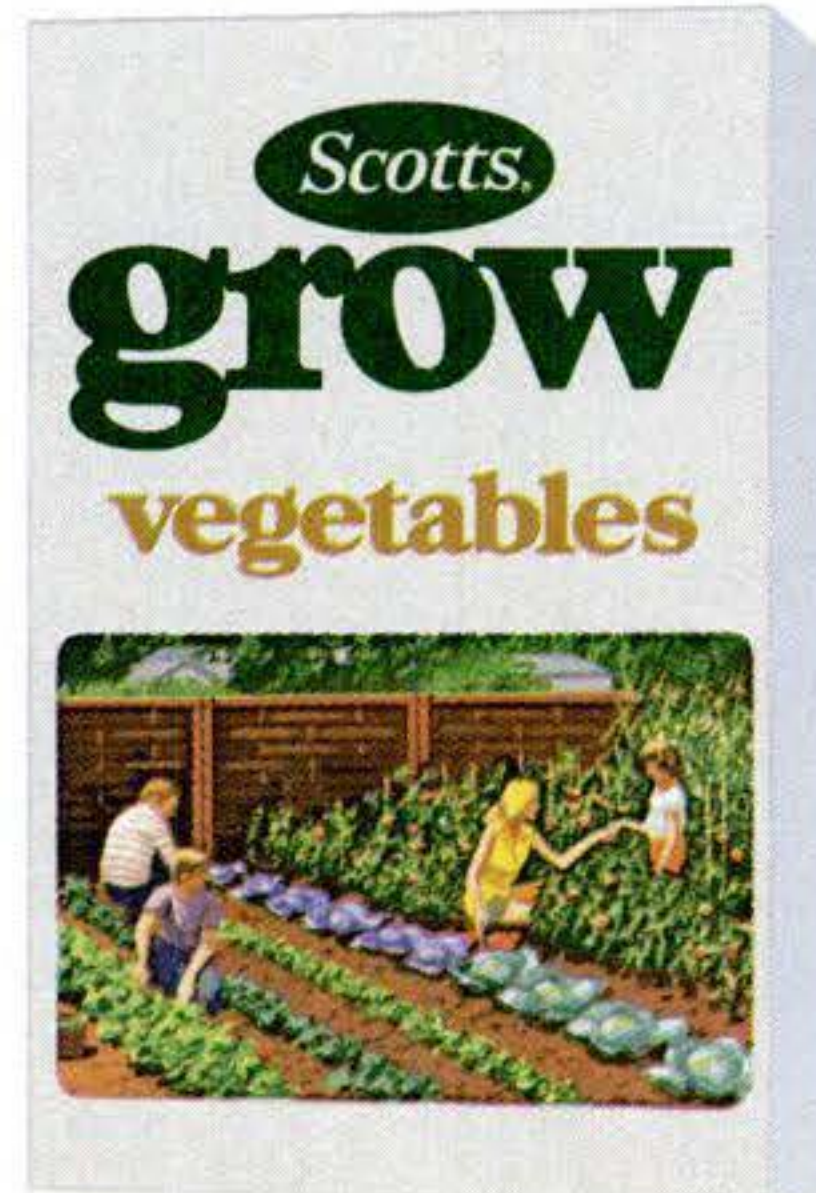
We've tested our formula on all sorts of other vegetables at universities and on our own research farms around the country. Grow Vegetables will give you more beans, more sweet corn, bigger lettuce or whatever, and that's a promise.

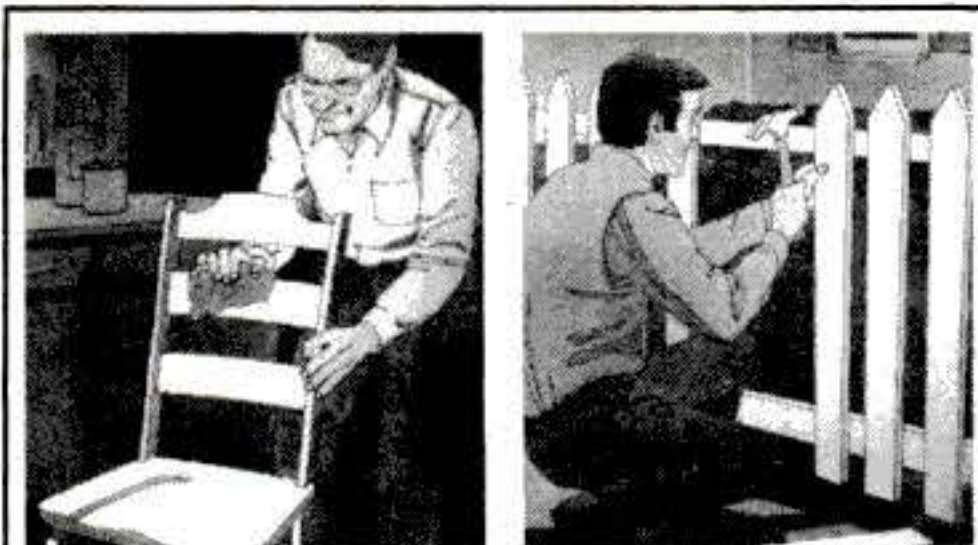
It's just one of our special line of fer-

tilizers we make for everything in your garden. There's Grow Shrubs, Trees and Evergreens, Grow Flowers, Grow Azaleas, Camellias and Rhododendrons and Grow

Transplants.

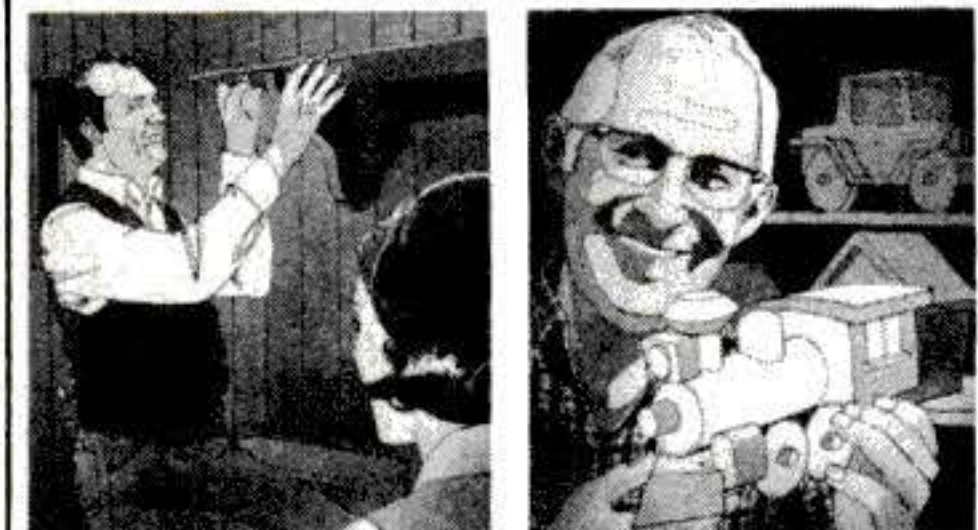
They're all safe for your plants if you just do what it says on the package. And each one offers results that will look just as good to you as all those extra tomatoes up in the picture.





Bill C. — He's been a woodworker for years, for the fun of it. But his work is so professional he could sell everything he makes.

Jerry R. — He's your basic weekend putterer. He's always got a project going to add to the value of his home.



Walt and Mary D. — They found the only way they could afford to improve their home was to do it themselves.

Jack B. — He does it for the fun like Bill C. But he sells his work at fairs and flea markets... at fancy prices.

Which Do-It-Yourself Type Are You?

No matter which type you are, you've probably already learned one important fact. To do the job right, you need more than a couple of hand-held power tools.

You need things like a table saw, drill press, lathe and more. And, if they're individual tools, you need lots of space... and lots of money to afford them all.

But now you can enjoy a complete home workshop at substantial savings — and in less space than a bicycle. That's all the room you need for a Shopsmith MARK V that gives you the five most needed workshop tools — a 10" table saw, a 12" disc sander, a 16½" drill press, a 34" lathe and a horizontal boring machine — all in one compact and economical unit.

Whether you do fine carpentry, just putter around, make vital home repairs, or actually sell your work, the Shopsmith MARK V is for your type of do-it-yourselfer. Send for the FREE facts today. The information is yours at no obligation to you. Just mail in the coupon.



Shopsmith Inc.

Dept. 2169
750 Center Drive
Vandalia, Ohio 45377

Yes! Please mail me your FREE Information Kit on the Shopsmith Mark V. I understand there is no obligation.

Name _____
Address _____
City _____
State _____ Zip _____

NEED THREE PHASE POWER

The "THREEPHASER" allows you to operate three phase motors ¼ thru 7½ horsepower from 220 volt single phase power sources. Rugged — heavy duty — patented unit built to give many years of satisfactory service. Satisfied users worldwide since 1966. Free literature furnished on request. Telephone 305-862-3038.

ONLY \$59⁹⁵

RELIANCE ELECTRIC MANUFACTURING COMPANY INC.
Rte. 2, 1024 W. Lake Brantley, Maitland, Fla. 32751

UNIQUE SPORTS CAR KIT
for VW. Fun, Easy to Build...

Laser 917

Dealerships Available



Elite Enterprises Inc.
Dept. PS4-80
690 E. 3rd St.
Cokato, MN 55321

DUST MASK

STOP INHALING HARMFUL DUSTS AND MISTS

Gov. Apprvd
NIOSH/MSHA



Others don't filter. The MASK passed rigid Gov. tests against pneumoconiosis and fibrosis producing dusts, incl. asbestos and silica. Cool, comfortable, lightweight (¼ oz). Exclusive contour molds snug to face. Folds increase protection and life of mask THOUSANDS IN USE. Send \$1.95 for DUST MASK ppd. to

DEFENSOR COMPANY

15936 Foothill Blvd. San Leandro, CA 94578

SpeakerGuts.

The absolute latest in advanced speaker technology. Wave Aperture Drivers, the Patented Nestroic Woofer System, raw speaker components selected for their excellence. Horns, crossovers, subwoofers, woofers, midranges, horn and dome tweeters. Over 30 in all. Build your own speaker system and we'll provide top quality speakers and design information. Send for FREE 48 page color catalog from the largest, most experienced speaker kit manufacturer in the world. DON'T DELAY. Write today!



Speakerlab
Dept. 189, 735 N. Northlake Way
Seattle, Washington 98103

Own a DIXON ZTR mower and you might never get to use it yourself.



Once the family finds it's *mower fun* on a DIXON, you've lost the mowing job. Maybe forever.

DIXON mowers appeal to all kinds, all ages. A great many operators are under 18 or over 65 and more than half are women; many are farm wives.

Big 42" cut or 30" town lawn size, all have Zero Turning Radius that easily cuts mowing time on many lawns in half. That's Mowbility!

Test drive one today; it might be the last time you get to drive it yourself!

Tell me more about DIXON Zero Turning Radius mowers. Please send a free brochure to:

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

I might like to be a DIXON Dealer; please tell me how:

TELEPHONE _____

DIXON INDUSTRIES, INC.
BOX 494, DEPT. PS-2
COFFEYVILLE, KANSAS 67337
(316) 251-2000

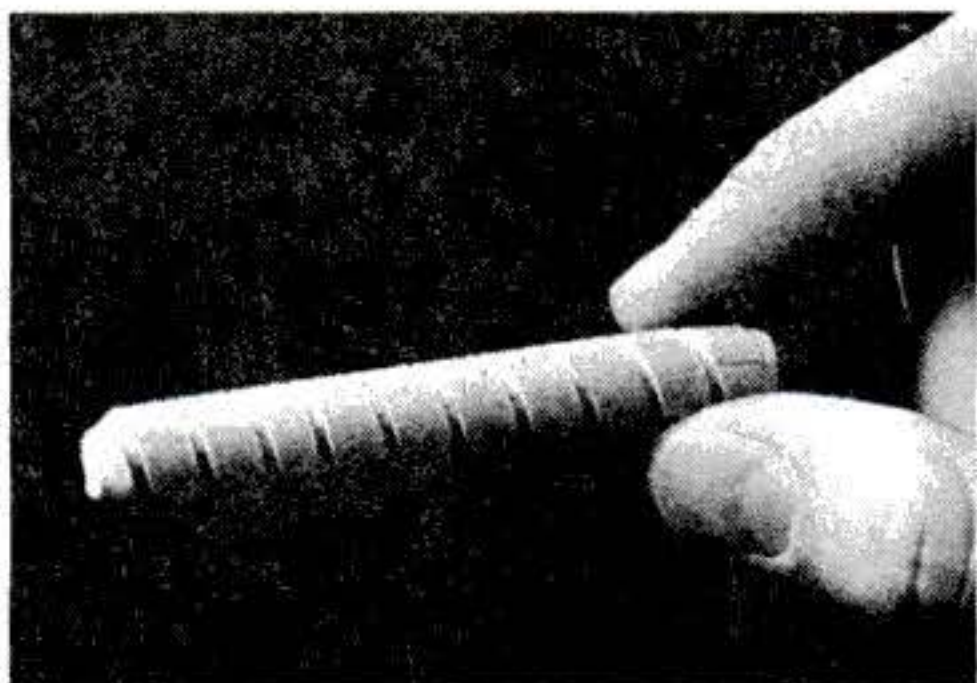
© Dixon Industries, Inc.

SHOP TALK

[Continued]

can't find the diameter you need, they're easily made on your table saw: Set your miter gauge at 70 degrees, raise the blade about 1/32 in. above the table, and rotate the dowel over the running blade, for the effect in the photo. [Cut into pin lengths as the last step; don't spiral short pieces.]

"As for spur bits, they're hard to sharpen accurately. If the spur is even slightly off-center, you'll tear holes in the wood rather than drill them. We stick to twist drills in our shop—but when they're used in wood we sharpen them to a 70-degree angle instead of the usual 55 degrees. That way they won't chatter, pull to one side, or feed too fast." Thanks, Woody.



May's our HI month

Did you expect our spring annual on Home Improvement in this issue? Sorry: In a rescheduling move, this special issue has been shifted to May. We're combining it with the home hardware section that's long been a feature of that month's issue.

Yours for the asking

- Want to prepare for our gradual shift to the metric system? A Metric Consumer Information Kit contains a wallet-sized conversion card and booklets explaining how you can participate in switch-to-metric decisions. Send \$1 (postage/handling) to MCIK-ANMC, 1625 Massachusetts Ave. N.W., Washington, D.C. 20036.

- Dress up your dishwasher with a custom trim kit available from most manufacturers. It's a frame that lets you display posters, fabrics, even coin collections on the front panel, protected by an acrylic sheet. For a free copy of the how-to booklet, write Consumer Information Center, DF, Maytag Co., Newton, Iowa 50208.

- Three new booklets will be of interest to any homeowner who has wood-framed windows—or wants them: The first is an owner's manual with tips on keeping windows and patio doors looking and working like new; the second, "Window Answer Book," tackles the most frequently asked questions about window planning; the third concerns replacement. Free from Andersen Corp., Bayport, Minn. 55003.

- Have you done any arc welding jobs or projects lately, either in school or in your home shop? You may be eligible for awards ranging from \$50 to \$1000 just by submitting a description. For a free brochure and entry form, write James F. Lincoln Arc Welding Foundation, Box 3035, Cleveland, Ohio 44117.

RUUD[®]

Is Air Conditioning

Any place in the country.
Any season of the year.
Ruud is air conditioning
with a record for improving
efficiency of its home
comfort systems. That's
a reason why Ruud is one
of the fastest growing
brand names in air
conditioning. That's a

reason why you should
consider Ruud before you
buy air conditioning for
your home this year. Ask
the Ruud dealer nearest
you how Ruud can help
you save on energy and
still give your family
home comfort year 'round.
Ruud is air conditioning.



Wrong-way wings

[Continued from page 75]

pulling positive G's, the canard is pitched up, at a positive angle of attack. This deflects the airstream behind it downward. When this airstream reaches the main wing, in effect it decreases the angle of attack of the root of the wing and thus reduces the chance of a stall there.

If the plane pitches down, as in an outside loop, and is therefore in a negative-G condition, the canard would be pointed down, at a negative angle of attack. Now it is deflecting the airstream behind it to the top of the main wing, and thus is again reducing the wing's angle of attack and reducing the chance of a stall.

The Grumman canard is a primary flight control—it pivots as a unit.

Neither the Grumman nor the Rockwell main wing has leading-edge slats or wing spoilers. This saves weight and reduces complexity. The Grumman design has full-span flaps that act as both flaps and ailerons. The Rockwell concept has ailerons and elevons.

Designed to be unstable

These fighter concepts, like other high-performance planes, are aerody-

namically unstable—they roll and pitch easily. On conventional planes, the wings tilt slightly (dihedral), and they have larger control surfaces to provide aerodynamic stability so that the plane tends to fly steadily upright and on course, resisting change. Fighters and other supersonic planes, however, have smaller control surfaces to reduce skin-friction drag. Without rapidly reacting automatic stabilization systems, pilots would have to work madly trying to correct every flight wiggle. Electronic controls do the job instead.

The Grumman design, for example, calls for three redundant computers to position the canard, the flaps, and the engine autothrottle to maintain the desired angle of attack. This helps maintain a constant flight position along the glide slope for landing. Such sophisticated electronic control systems are part of all three manufacturers' proposals.

Many forward-swept-wing ideas remain to be explored—among them, variable sweep, as on the F-111 and the F-14. The wings of these planes extend straight for takeoff and landing, then sweep back for high-speed

dash. A variable forward-swept wing would angle forward for fast flight.

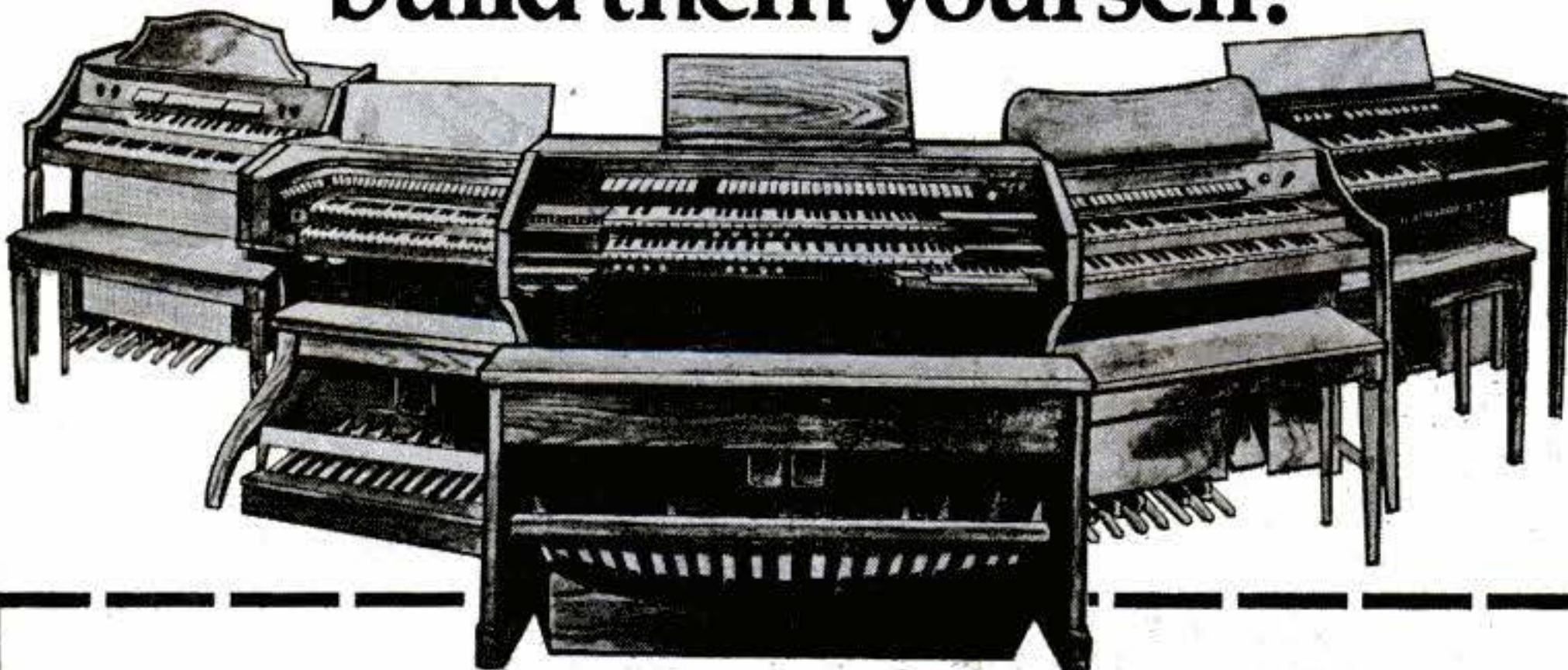
Maneuvering ability might be increased even more by variable-direction exhaust nozzles for the jet engines. The Harrier V/STOL fighter ["Paris Air Show," PS, Dec. '79] uses such jets.

While much research remains to be done, the feasibility studies have shown major advantages for the forward-swept-wing plane. For the same mission, it can be lighter and smaller, would need less engine power, and thus burn less fuel. The cost of planes increases with weight, so it would be cheaper, too.

The concept is not simply a matter of hanging forward-swept wings on any airplane. "The integrated effect of forward sweep with the composite wing needs full-scale testing," Col. Krone cautions. "The concept may not be best for every future design."

The next major step, building a piloted plane, should demonstrate whether the forward-swept wing will change the direction of aircraft design as decisively as did all-metal construction and the jet engine. Some experts predict it will. P 5

**They look expensive.
They sound expensive.
But they're not because you
build them yourself.**



The Magnificent Schober Electronic Organs.

Imagine the pride and joy of owning one of the world's great organs. And for up to 50% less than an instrument of comparable sound and quality. Schober organ kits come in 5 different styles and sizes to fit your musical taste and budget.

Mail this coupon today for free information.

The Schober Organ Corp., Dept. PS-23
43 West 61st Street, New York, N.Y. 10023

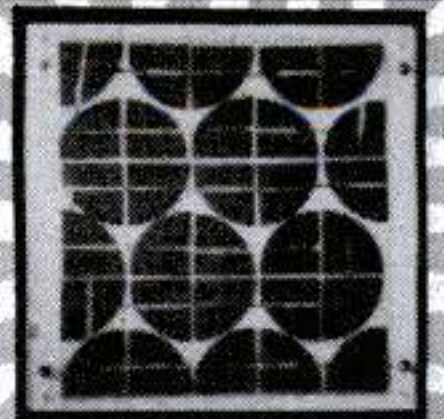
Send me free catalog.

Name _____

Address _____

City _____ State _____ Zip _____

**FREE
ELECTRICITY
FROM
SUNLIGHT
\$99.95**



(12" x 12" x 1/4")

NO MOVING PARTS • NEVER WEARS OUT

**SPACE AGE TECHNOLOGY
is now available from
UNITED ENERGY CORP.**

WORLD LEADERS IN
CONSERVATION AND RENEWABLE
ENERGY PRODUCTS

**UEC SOLAR CELL PANELS
FOR ANY APPLICATION**
Will produce 12 volts, up to .4 AMPS of
electricity generated directly from sunlight.
Solar Cell Panels can easily be inter-
connected to generate any desired
electrical requirement.

**UEC SOLAR CELL PANELS
INSTALLED ON** boats,
cars, trucks, tractors, airplanes, T.V.'s,
radios, tools, power systems, etc.
**Keeps batteries fully charged and helps
extend battery life.**

TO ORDER OR INFORMATION

Credit Card Toll Free Number

(800) 367-2611

UEC 666 Mapunapuna
Honolulu, Hawaii 96819

Copyrighted material

The new chairman of the dashboard. Fuzzbuster Elite.

Make room at the top.
The new Fuzzbuster Elite[®] is here.

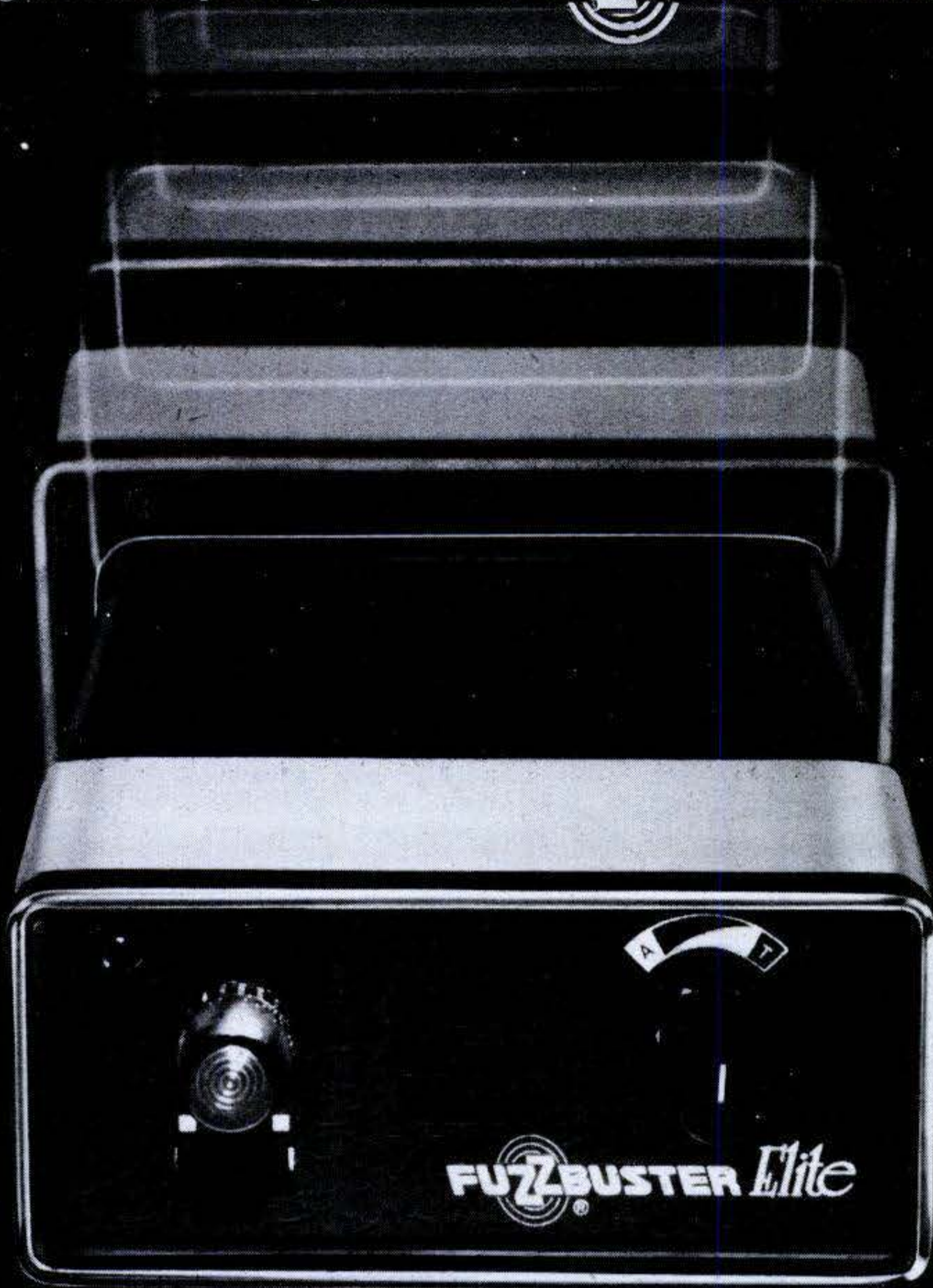
It commands the latest instrumentation and circuitry. Including a power indicator light, automatic sensitivity controls, and a three-position switch to adjust audio and light warning.

But the big story is performance. Fuzzbuster Elite equals or out-performs units costing far more. It picks up all

radar bands, even the "off" frequency signals other radar detectors miss entirely. And it's effective against all types of traffic radar.

Sleek, crafted in metal, and finished in chrome, the Fuzzbuster Elite is the kind of quality product you expect from the leader in radar detectors.

FUZZBUSTER *Elite*



SALE OR USE OF THIS PRODUCT MAY BE CONSIDERED ILLEGAL IN MICHIGAN AND VIRGINIA. © 1980 BY ELECTROLERT, INC.

ELECTROLERT, INCORPORATED

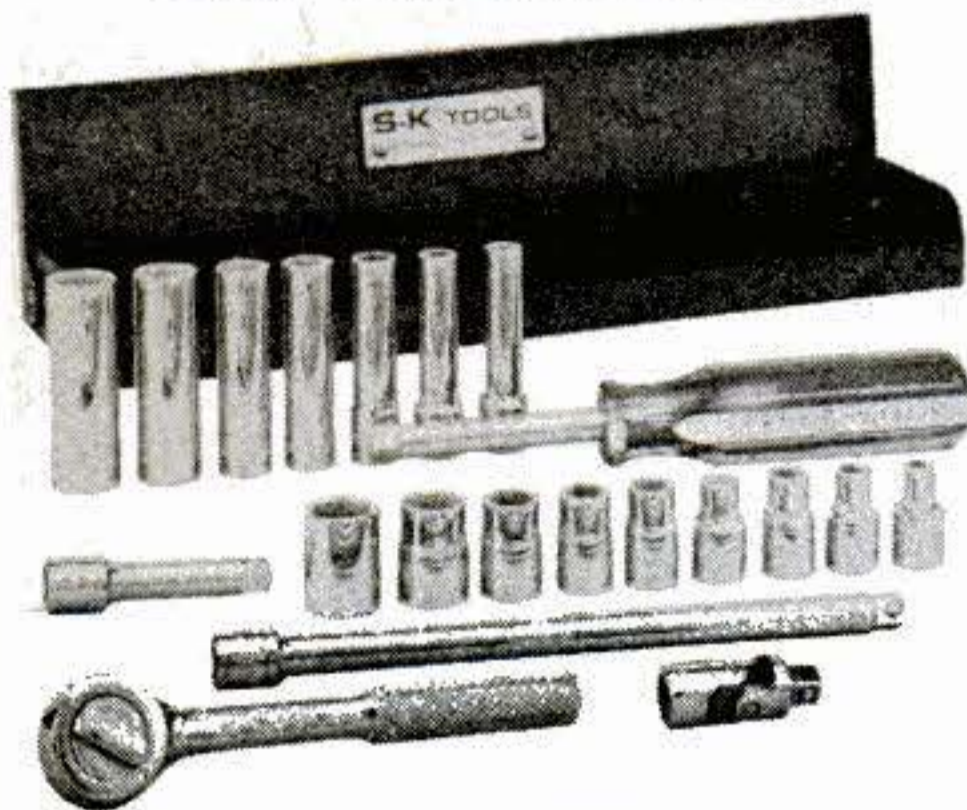
electrolert

4949 SOUTH 25A, TROY, OHIO 45373

Alert to new ideas that work for you.

Copyrighted material

S-K[®] TOOLS VICTORY SPECIALS



SAVE \$35⁰⁸*
Over 50%

S-K 21 pc. 1/4" Dr. Socket Set
#4921-80

Only \$34⁸⁸

**Indy
Winners:**



Rick Mears — driver **Jim McGee — mechanic**
and
American-made S-K Tools

Chief mechanic Jim McGee says,
"I used S-K Tools extensively in
preparing our winning car."

Right now take advantage of fantastic
savings on this and other championship
quality S-K Tools sets. They're available
at auto parts and hardware stores.

CHECK OUR GOLDEN WARRANTY



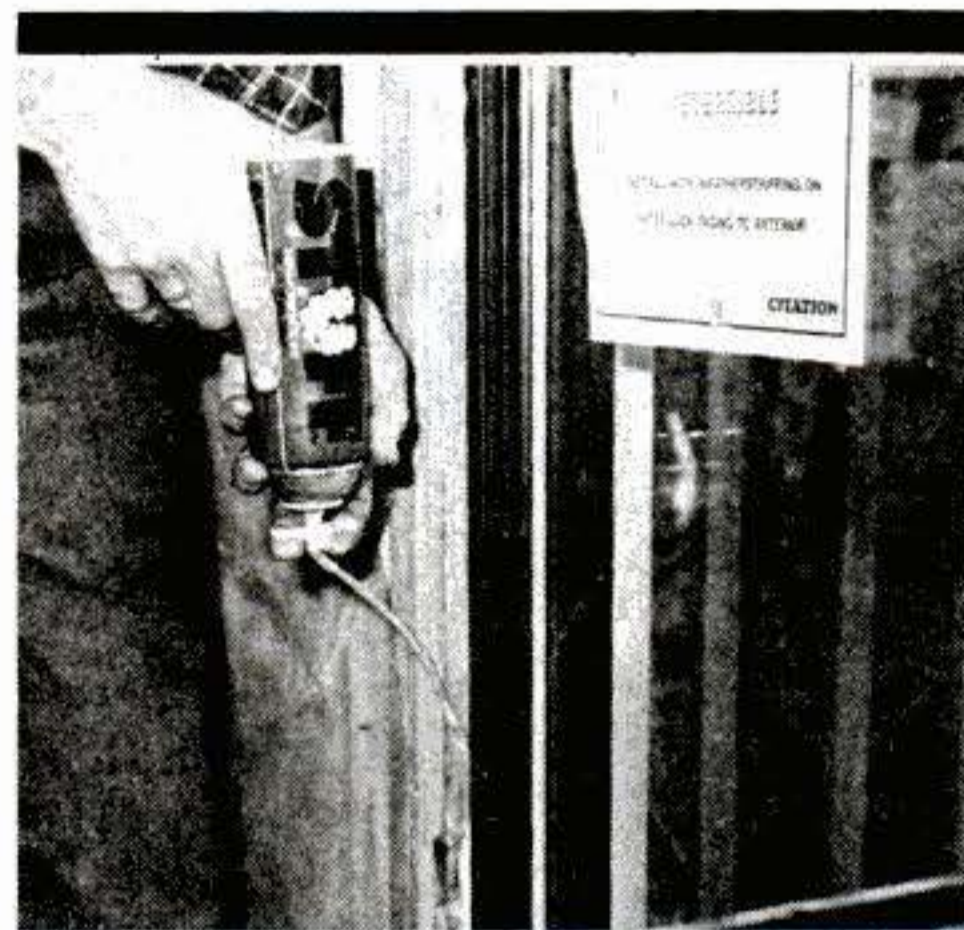
HAND TOOL DIVISION, DRESSER INDUSTRIES, INC.
3201 N. Wolf Rd., Franklin Park, Illinois 60131

Copyright 1980 DRESSER INDUSTRIES, INC.

*Savings are based on suggested user prices of
individual pieces.

HOUSEPOWER CLINIC

By EVAN POWELL



Foam facts

Several letters to "Housepower" from readers in Massachusetts have inquired about the use of aerosol-foam insulation-sealants, which are marketed for sealing voids and gaps around windows and doors, as well as other openings. The question is a pertinent one for Massachusetts homeowners since a statewide ban on urea-formaldehyde foam is now in effect.

As Rich Stepler pointed out in last month's "Shop Talk," the Consumer Products Safety Commission is holding regional hearings on complaints about adverse health effects from formaldehyde gas being released while the material cures. Intensive testing is going on to determine if a tolerable level of formaldehyde exposure exists.

But all "whipped cream" insulating foams are not urea formaldehyde. I recently used Insta-Foam Products' "Great Stuff" single-can aerosol foam to seal around fixed glass in my panelized Chestnut Mountain studio-home. A prior check with the manufacturer (2050 N. Broadway, Joliet, Ill. 60435) revealed that the material contains neither formaldehyde nor fluorocarbons (the propellant is nitrogen).

Nothing I've found does the job of filling large openings like this and other similar foam sealants. The stuff expands to fill gaps as large as three inches with a single application. After curing, you can add more material to fill even larger voids. And I've used it instead of caulking for small cracks. It goes a long way. According to the manufacturer, a 14-ounce can of this particular sealant is equivalent to fifteen 11-ounce tubes of conventional caulking.

I've learned a lot about using foam sealants since I reported on them in January '77. It's best to go light on the application, since it continues to expand for several hours while curing. While you can

scrape it off, it's hard to remove from finished surfaces, and wasteful; better to come back with a second application than try to seal a large void on the first shot. A one-inch depth is all you need to equal three inches of typical wall insulation.

If foam is exposed to sunlight, it should be covered to prevent deterioration. A coat of enamel or latex paint is sufficient. And remember, it's combustible; it should never be exposed to flame or excessive heat. Apply it at room temperature (70-85 deg. F); cold temperatures make it stiff, and slow the curing process. Also, be sure that the material is fresh; the salesperson where you purchase it should be able to interpret the code date on the can. If it's more than a year old, select a fresher material. I encountered a problem with old material that was so thick it would blow the applicator tube from the valve. Besides being a nuisance, it resulted in a sloppy job.

Finish up a partially used can by looking for unsealed openings such as those at points where pipes and electrical cables enter the home and around flashing and other joints. One shot can keep out bugs, rodents, drafts, and moisture. It is good for filling cavities in trees and repairing mortar in masonry work, since it sticks to almost any surface. You can even use it as an adhesive for applying foam panels to concrete and masonry.

Energy labels have arrived

You'll soon be seeing yellow and black "Energy Guide" labels (similar to those we reported about in our May 1979 article) on six types of household appliances—refrigerators, freezers, dishwashers, clothes washers, water heaters, and room air conditioners. Manufacturers of home furnaces must provide an energy fact sheet, instead.

These seven appliances account for 78.2 percent of all energy consumed in American homes. The new label differs somewhat in appearance but little in content from the prototype we showed you earlier. Our two current samples (p. 164) are for a refrigerator-freezer and air conditioner. The first shows estimated annual energy cost; the air conditioner's label shows its EER (energy-efficiency ratio). The most important feature of both types of label is the sliding scale that shows the relationship of the particular model to the highest- and lowest-efficiency models available. Below that is a table showing annual operating costs based on kWh rates (from 2¢ to 12¢) and, in some cases, how much you use the appliance.

Continued

Copyrighted material



Golden Lights® ends every-which-way search for taste.

With 75 low tar products to choose from, over 1 million smokers switched to Golden Lights... often after just one pack.

10 MG. TAR 0.8 MG. NIC.	13 MG. TAR 0.9 MG. NIC.	11 MG. TAR 0.8 MG. NIC.	12 MG. TAR 0.8 MG. NIC.	14 MG. TAR 0.9 MG. NIC.	10 MG. TAR 0.8 MG. NIC.	11 MG. TAR 0.8 MG. NIC.	8 MG. TAR 0.7 MG. NIC.

Golden Lights.
The taste you'll swear by... not at.

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

Source comparative 'tar' and nicotine figures: Either FTC Report May 1978, or FTC Method. Of All Brands Sold: Lowest tar: 0.5 mg. 'tar,' 0.05 mg. nicotine av. per cigarette. Golden Lights: 8 mg. 'tar,' 0.7 mg. nicotine av. per cigarette by FTC Method.

Telephone Listening Device

Record telephone conversations in your office or home. Connects between any cassette or tape recorder and your telephone or telephone LINE. Starts automatically when phone is answered. Records both sides of phone conversation. Stops recorder when phone is hung up. This device is not an answering service.



Each
\$18.95
Qty. Disc. Avail.



Super Powerful Wireless Mic

10 times more powerful than other mics. Transmits up to 1/4 mile to any FM radio. Easy to assemble kit. 15V battery (not incl.)

Call (305) 725-1000 or send \$18.95 + \$1.00 shipping per item to USI Corp., P.O. Box PS-2052, Melbourne, FL 32901. COD's accept. For catalog of transmitters, voice scramblers and other specialty items, enclose \$2.00 to USI Corp.

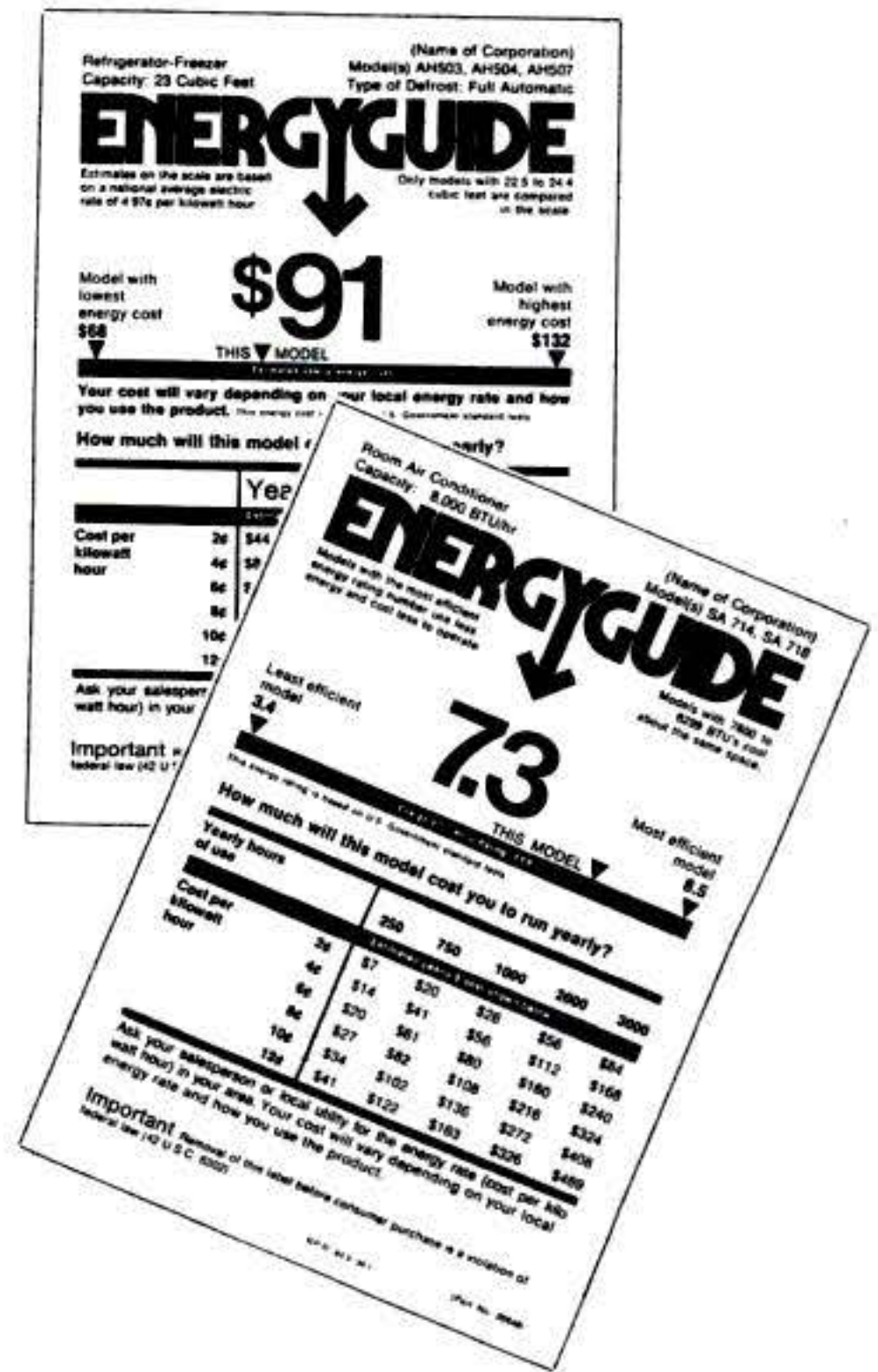


SELF DEFENSE

KUNG-FU • KARATE

Learn unbeatable fighting power
BLACK BELT INSTRUCTORS
NEW HOME STUDY COURSE
CERTIFICATE AWARDED

For details write: **NEW ORIENT KARATE SCHOOL**
Dept. 3D Box 5, Avon, N.J. 07717



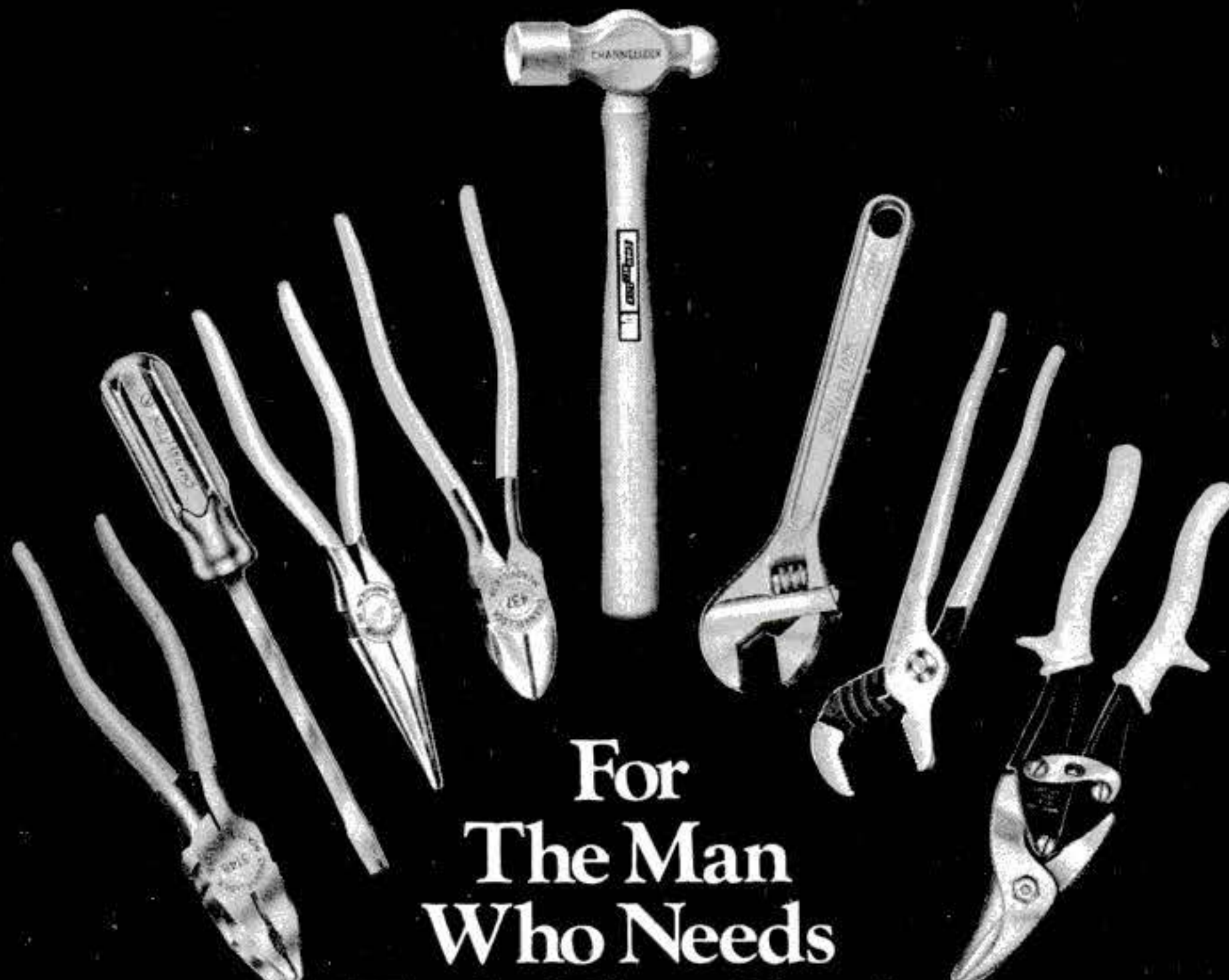
Q&A Energy-saving A/C switch

Two of our Whirlpool air conditioners were factory-equipped with an "Energy Saver" switch to allow the fan motor to cycle with the compressor through the thermostat or to run continuously. In the June 1978 "Housepower" you say continuous air circulation would increase the efficiency of central air-conditioning systems. Which method of operation, continuous or automatic, is most efficient for room air conditioners? Also, is it better to run the fan motor on high or low speed?
Glenn Zagicek, Ganado, Tex.

In the laboratory, cycling the fan motor does save some energy. In the typical home, I'm not so certain. Since no two homes are alike, a lot of variables enter the picture, not the least of which is air infiltration and the amount of insulation. You can probably gain an indication of what is best for you by making your own tests, clocking the running time of the compressor in both modes. This doesn't have to be elaborate, but should be at least an hour in duration and conducted consecutively to reduce temperature variables. At the same time, determine if you're as comfortable with the fan cycling off as you are with continuous operation. Moving air tends to evaporate skin moisture and make you feel cooler. Indeed, with continuous air circulation, you may be just as comfortable with the thermostat set higher. Continuous air circulation also helps prevent stratification—cold air near the floor, warm at the ceiling. Personally, I seem to get the best results with the fan on high and continuous air circulation.

Got a home-equipment problem? Write to Evan Powell/Housepower, Chestnut Mountain, Route 1, Box 322A, Travelers Rest, S.C. 29690, giving appliance make and model number. Unpublished questions cannot be answered by mail.

Copyrighted material



For The Man Who Needs Tools That Don't Take Early Retirement

... tools that stay on the job, year after year. That feel right in your hand, that ease the job. Tools precision made of drop forged, beautifully polished, high grade steel. Tools that give you quality in every detail (at no premium in price). Tools by CHANNELLOCK. Be sure that name is on the tools YOU buy.

CHANNELLOCK

CHANNELLOCK, INC. • Meadville, Pennsylvania 163335

Meet The Rest of The Family. Send For Free Catalog.

1980 BMW's



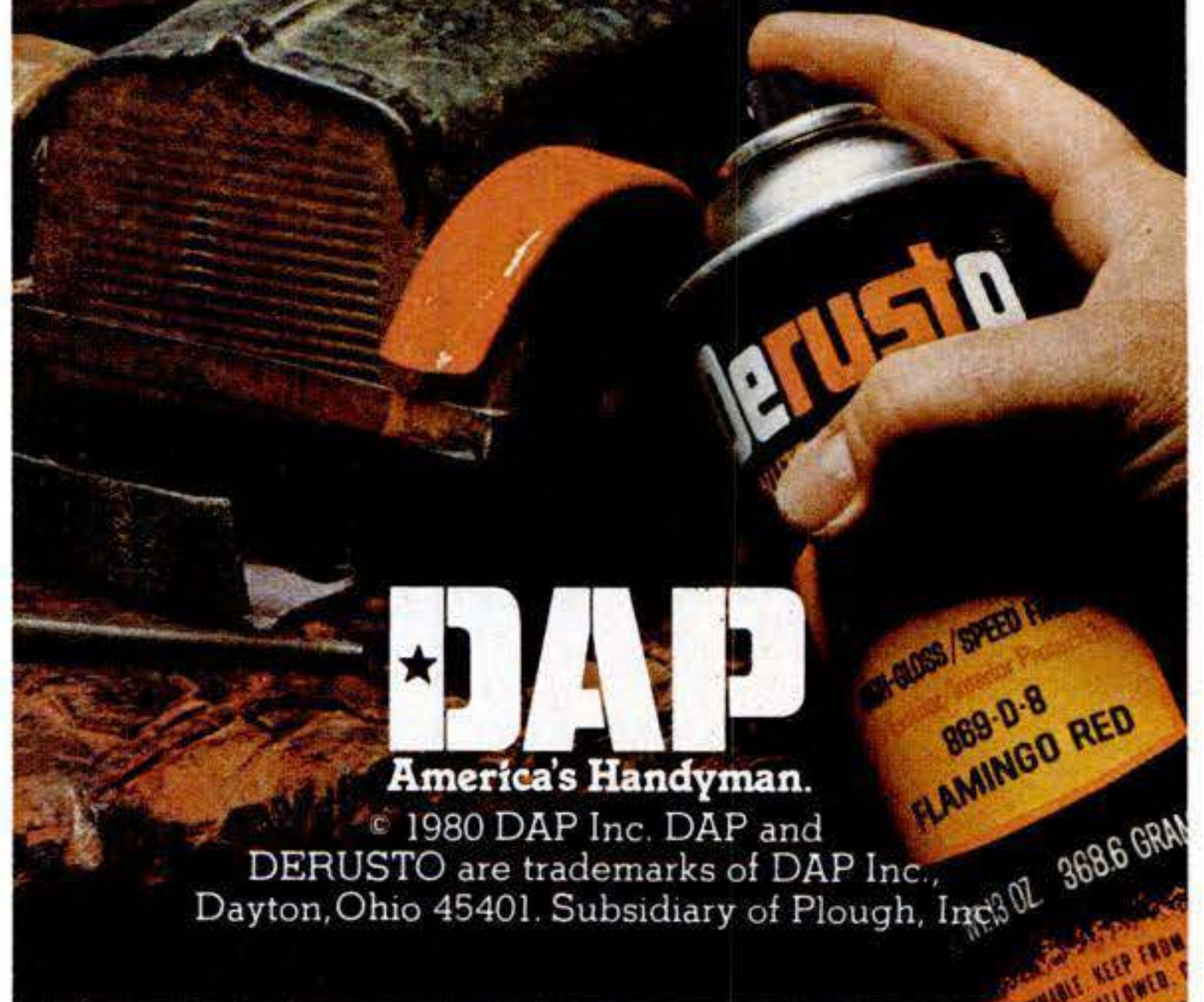
On the outside, the 1980 BMW's seem little changed. The big story is under the skin of these new luxury cars.

BMW's engineering vice-president Hanns Weisbarth says the company decided to meet and exceed increasingly stringent requirements for fuel economy without totally redesigning BMW's lineup. The result is a reengineering effort that improved overall mileage by 30 percent from 1979, yielding a corporate average fuel economy rating of 26 mpg. That's six mpg better than current federal requirements.

The two best-selling models, BMW's 320i (shown above) and 528i, underwent changes that are next to invisible. But the effects are obvious—significantly less fuel con-

FINGER PAINT.

Industrial strength DERUSTO Minute Finish renews rusted surfaces of furniture, toys, tools and decorative iron with each quick-drying coat. Works great on wood, too. Has a built-in rust preventive primer. Comes in 18 beautiful high-gloss colors. And lasts a good long time.



DAP

America's Handyman.

© 1980 DAP Inc. DAP and DERUSTO are trademarks of DAP Inc., Dayton, Ohio 45401. Subsidiary of Plough, Inc.

RING AROUND THE TUB.

Kwik-Seal Tub & Tile Caulk is a handyman's favorite solution to sealing around tubs, sinks and showers. Also grouts and replaces tile, fills cracks and joints in walls, ceilings and wood trim. Dries fast. Stays flexible. Won't yellow. Resists mildew.

DAP

America's Handyman.

KWIK-SEAL
TUB & TILE CAULK
flexible
white

© 1980 DAP Inc. DAP and Kwik-Seal are trademarks of DAP Inc., Dayton, Ohio 45401. Subsidiary of Plough, Inc.

sumption with no performance loss. Among the changes:

- A new 1800-cc engine for the 320i.
- New five-speed overdrive transmissions in both cars.
- Major weight reductions—more than 110 pounds trimmed from the 320i, more than 140 from the 528i.
- Improved Lambda-Sond three-way catalyst systems, also used on the top-of-the-line 633 CSi and 733i models.
- A stiffer suspension in the 528i.
- Aerodynamic changes in the 320i front end.

The biggest mpg improvement, as might be expected, comes in the two-door 320i. With its new transmission, slightly smaller engine, and reduced weight, it's rated at 25 mpg city driving and 36 mpg on the highway, with a combined rating of 29 mpg. That's nearly seven mpg more than in 1979. The 528i is rated at 18 and 30 mph (22 combined). Automatic transmissions reduce the ratings slightly in both models.

Aerodynamic changes in the sporty 320i resulted from wind-tunnel tests, Weisbarth claims. The model now has a new hood, new grille, and new air dam. "But you have to see the old and new side by side," says Weisbarth. "The changes are small, but they make a big difference in aerodynamic drag."

Any differences in handling and performance are strictly on the positive side. In freeway traffic or winding through California mountain roads, the 320i was smooth, fast, and quiet. Its quick acceleration and instant steering response are seemingly better than ever. The 528i also handles better with stiffened suspension, and accelerates slightly faster because of its lower weight. Both models ride so smoothly and quietly that driving is a pleasure under any conditions.

BMW prices are up about nine percent for 1980. Base prices are \$11,465 for the 320i and \$19,565 for the 528i.—
Jim Schefter

FREE HEATHKIT® CATALOG



400 electronic kits:

Stereo components, color TV's, computers, test instruments, electronics educational programs, amateur radio gear — things you've always wanted, now at low kit prices.

Discover the fun of kit building:

It's a great way to relax in your spare time, resulting in beautiful things you'll be proud to have in your home. And it's easy. The famous Heathkit illustrated manuals make it easy for anyone to build reliable craftsman-like kits.

Send today!

It costs nothing to discover the complete line of Heath electronic kits. Don't miss it. Clip and mail the coupon now.

Heathkit

If coupon is missing, write:
Heath Company, Dept. 016-642,
Benton Harbor, MI 49022

Heathkit

Heath Company,
Dept. 016-642,
Benton Harbor, MI 49022

Send my **free** Heathkit Catalog now.
I am not currently receiving your catalog.

Name _____

Address _____

City _____ State _____

CL-730 Zip _____

Liberated house

[Continued from page 87]

security. The third ventilator is replaced by a stovepipe in winter. "Also, that being the highest point on the structure in the winter," Bakewell says, "it is fitted with a branch of the lightning-rod cable, so the chimney becomes a third lightning rod at this time of year." The cable runs to a stout copper rod planted 10 feet in the ground.

Decks, made of aluminum grating, on the two sides of the structure tilt up for travel. "For the highway, we have to trim our width down to 14 feet, and in most states there's a height limitation of 13 feet," Bakewell says. "Before we travel, we unscrew the lightning rods and pull the turbines off and the two top sections of those other chimneys [for the toilet and incinerator]. It trims down to 12 feet, eight inches. In transporting the vehicle from Illinois, we had to go under the lowest bridge in Missouri—13 feet, two inches—and it made it."

Solar features

Next to the entry deck is a solar photovoltaic array, with a reflector below it. With the sun shining, it has a peak output of 80 watts, going to 120 at noon when the reflector comes into use. Four 12-volt marine batteries store the electricity. "It works because we have designed our electrical needs with the most energy-efficient appliances available," Bakewell says. "We have a truly microload demand that is matched to this small solar panel."

The sides of the vehicle are painted black and are covered with corrugated, translucent fiberglass. There is an air space between the metal and the fiberglass. Small, super-efficient blowers (designed to cool electronic equipment in the nose cones of jet aircraft) pull air through the space and into ducts inside that carry the heated air into storage compartments.

Above that is another corrugated-fiberglass area. That's the solar water heater. Beneath the fiberglass are copper pipes through which is pumped a synthetic oil—a heat-exchange material. The copper coils wrap around the water tank below and give up their heat. Jantzen says: "On a sunny day, you can't touch the water—it's so hot."

Now we're coming into the entryway—an area, covered by a transparent roof, that is designed to be a greenhouse for small hydroponic plantings, an occasional cooking area (there is a solar cooker), a sun porch when a hammock is stretched across it, and a mudroom. Floors and walls are cov-

ered with a material called TileDek, designed for swimming-pool decks. On the floor, mud drops through to the subfloor. On the walls, the material serves as a handsome and useful perfbord. The material is also fireproof. Where had they come across it?

Says Jantzen, "It was in your 'What's New' section not too long ago" [WN Home Improvement, Aug. '79].

Then they read POPULAR SCIENCE? "I subscribe," Jantzen says.

"Best magazine going," Bakewell adds.

Heat storage

Inside, two large, shiny, insulated ducts traverse the ceiling, carrying heated air to huge storage chambers under the bed and the dining table. Bakewell raises the cover over the bed compartment to show the tubes—Thermol 81 heat-storage cylinders—piled up in there [PS, March]. "On paper," he says, "calculations show that the material should store enough heat to keep the building at 68 degrees F for 48 hours when it's zero outside—or about five days at 30 degrees outside."

The table and bed are lined with superinsulating isocyanurate boards, a material called Thermax. One board has an R-value of eight. A double thickness with air space gives the heat-storage chamber an R-value of 16. Little doors at the bases open to release heat.

Inside, the structure has been sprayed with two layers of material: a polyurethane foam, 3½–four inches thick, primarily for insulation, followed by a flameproofing and sound-deadening layer of Durafiber, a test material with a half-hour fire rating in addition to some insulating value.

The weight problem, as with everything in a mobile vehicle, has been carefully considered. All the polyurethane foam weighs only 200 pounds. (The metal shell for the whole structure weighs only 556 pounds.)

The fluorescent lights over Bakewell's drawing board were developed for the space program. Their secret: a high-frequency ballast used with a standard fluorescent tube. They have low and high settings.

"At night, on high beam, using only 20 watts, they give at least the equivalent in light of a 100-watt bulb," Bakewell says. "And the low beam, 12 watts, is the equivalent of a 60-watt bulb."

Built-in counters line both ends of the structure, where the curving walls would make it impossible for a person

Continued

HOMELITE® ST 100 GAS-POWERED STRING TRIMMER. At just 7 lbs. 4 ozs., you'll love this baby.

The most advanced gas-powered string trimmer ever made. Lightweight and practical.

Exclusive Idle-Line™ lets out more string simply by squeez-

ing and releasing the trigger.

The 20" cutting path is the widest of any trimmer you can buy.

Self-standing for easier refueling through the unique combination fuel tank/handle.

Powered by a rugged, direct drive, 26.2 cc (1.3 hp.), 2-cycle engine.

Softone™ muffler ensures

quiet operation.

Adjustable handgrip.

Comes fully assembled.

Add the sweeper attachment and switch from trimming to 100-mph power sweeping in seconds . . . no tools needed.

The Homelite string trimmer and sweeper attachment are on sale now through April 26 at over 1,600 K mart stores across the U.S.A.

Power Sweeper Attachment

Cleans leaves, dirt, grass clippings, water and even light snow. You receive a second power tool for just a few dollars more.

\$7.97



SALE PRICE
\$99.88

Homelite® quality at a K mart price. Nice.

Kmart

The Saving Place

Copyright 1980

K mart Corporation

Troy, Michigan 48084

Famous Hothead: Vic Tayback

**"FUEL COSTS REALLY GET ME STEAMED UP,
BUT CARRIER'S HELPING TO SAVE MY ENERGY."**

Rely on The Carrier Round One to help keep your cool.

Carrier has had more experience building reliable air conditioners than any other brand. After all, we invented air conditioning! And Carrier has the largest dealer organization in the world to help you.

Keep your cool efficiently with Carrier. Nobody makes more efficient central air conditioning systems.*

Reliability and efficiency. That's why people look for Carrier when they buy an air conditioner or heat pump. That's why Carrier's number one.

*Current Carrier submissions to the Air-Conditioning and Refrigeration Institute.



Number One
Air Conditioning
Maker



The Carrier Corporation

Carrier

**I KEEP MY COOL
WITH CARRIER**

Liberated house

[Continued]

to stand up. At the dining end, they are used for food service. At the bed end, they cover clothes-storage compartments.

"These are 14-foot domes set on 18-inch parapet walls," Jantzen says. "With the curved outer portion used for storage, you can stand in any part of the Autonomous Vehicle."

Furnishings for living areas

Soft foam-plastic cubes serve for seating in the sitting area—not very comfortable, I thought. An Insulating Shade—the same kind featured in POPULAR SCIENCE in January 1979—covers the large patio doors. Jantzen and Bakewell have had trouble rolling the shade up, but now the manufacturer has a chain mechanism that helps, and they think the problem is solved. For the coldest months, there will also be a one-inch-thick panel to increase the barrier to the cold.

A wood stove, like a black soccer ball over an orange tube, creates a not-unattractive sculpture in the sitting area. Jantzen created the design for his own house.

The last artifact in the sitting area is an ingeniously designed coffee table, made, apparently, from a half panel of plywood. There is a moment of silence when the visitor comments that Jantzen should have submitted the table to the PS plywood-design contest.

"I did," says Jantzen.

"We all thought Mike should have won that one," Bakewell adds.

In the dining area, inventive design abounds. Leaves drop down or snap up to extend the table. Seats drop down to get out of the way. Most of Bakewell's cooking is done on an alcohol stove; he believes in using renewable fuels as much as possible. The refrigerator was designed from scratch. In winter, ducts below bring in cold air, saving electricity. A butterfly valve controls the amount. In summer, a solid-state thermionic device supplies cooling.

The toilet area contains a shower and a Clivus Multrum Bio-Loo, a Swedish waterless toilet that composts human waste odorlessly. The shower resembles a nylon telephone booth. Square hoops support an ingenious curtain arrangement (see photo) sewn together by Jantzen's wife, Ellen. Bakewell economizes on water by using a special nozzle head, developed for distributing chemicals from crop-dusting planes. It is capable of producing a very fine water-conserving mist that is, he says, nonetheless very effective in washing. Or, if he

Continued

SLEEP LIKE YOU'VE ALWAYS DREAMED OF...

On a Siesta Air Bed!

The new improved air bed

Inflates in minutes for luxurious comfort anywhere!

- Camping
- In your Car or Van
- On the Boat
- By the Pool
- In the Guest Room

The sensuous way to sleep

Siesta Air Beds provide you with the relaxing, sensuous sleep of a water bed without the fuss and weight! Their revolutionary Tubular Air Coil System automatically equalizes body weight so you don't "sink" and sides won't pop up. Your whole body gets the firm yet gentle support it needs to wake up feeling alert, rested, restored!

Improved! Lush, denim-like finish

Unlike other air mattresses you may have seen, the Siesta Air Bed is luxuriously covered with a soothing denim-like Rayon that never feels cold or slick. You'll enjoy complete "at-home" comfort even when you camp out on vacation!

Outstanding durability, too

The Siesta Air Bed is unbelievably strong—kids can jump and play on it without wear and tear. It's double-sealed by the manufacturer for long, leak-proof life... Siesta's are really built to take it. So, you can take your Siesta along wherever you go and get the sleep you need.

Like having a guest room on a shelf

No place to put up guests? No problem when you own a Siesta Air Bed! Just inflate it in minutes and provide guests with a luxurious "guest room" anywhere. When they're gone, just deflate it and store it easily on a small shelf! But you may well decide to make your Siesta Air Bed your permanent mattress. No frame or box spring is required—the Siesta is the all-in-one luxury bed for comfort and unprecedented convenience at home or on the road.



Store your Siesta "Guest room" on a shelf when not in use! Inflate it in minutes when guests arrive—or use it every night for a deep, restful sleep.



Sleep FREE for 30 nights!

We invite you to sleep-test a Siesta Air Bed for a full 30 nights before you decide a thing. If not convinced that it gives you the most restful, supportive sleep ever, simply return it for a prompt, complete refund.

Available in a variety of sizes

Whether you order Full, Twin, Queen or King, you'll enjoy the sleep of a lifetime! And don't forget to order the Custom Air Pump specially designed for use with the revolutionary new Siesta Air Bed.

Order Now at these low prices!

A fine mattress has become a very expensive proposition—but not the Siestas! You may own a Twin-size Siesta for just \$59.95, a Full for \$79.95, a Queen for \$99.95 and a King-size for merely \$109.95 plus \$5.95 for shipping and handling—incredible! The Custom Air Pump is just \$29.95.

CAMBRIDGE INTERNATIONAL, Inc.

8700 Waukegan Rd. Morton Grove, IL 60053 (312) 966-5510

Credit Card Customers

Call Toll Free

800-228-5440

(In Neb. 800-642-8777)

24 Hours A Day—7 Days A Week

Clip & Mail To:

Cambridge International, Inc. Dept. P40
8700 Waukegan Road, Morton Grove, IL 60053

Please send me the following Siesta Air Bed(s). I understand that I may return my purchase within 30 days for a full refund.

Twin @ \$59.95 Full @ \$79.95
 Queen @ \$99.95 King @ \$109.95
(Add \$5.95 shipping and handling per bed)

Also send me the high-powered motorized Custom Air Pump @ \$29.95 each. (Ill. residents add 6% sales tax.)

Check or Money Order enclosed
 Charge my Credit Card Account:
 American Express Master Charge Visa
 Diners Club Carte Blanche

Account # _____

Exp. Date _____

Name _____

Address _____

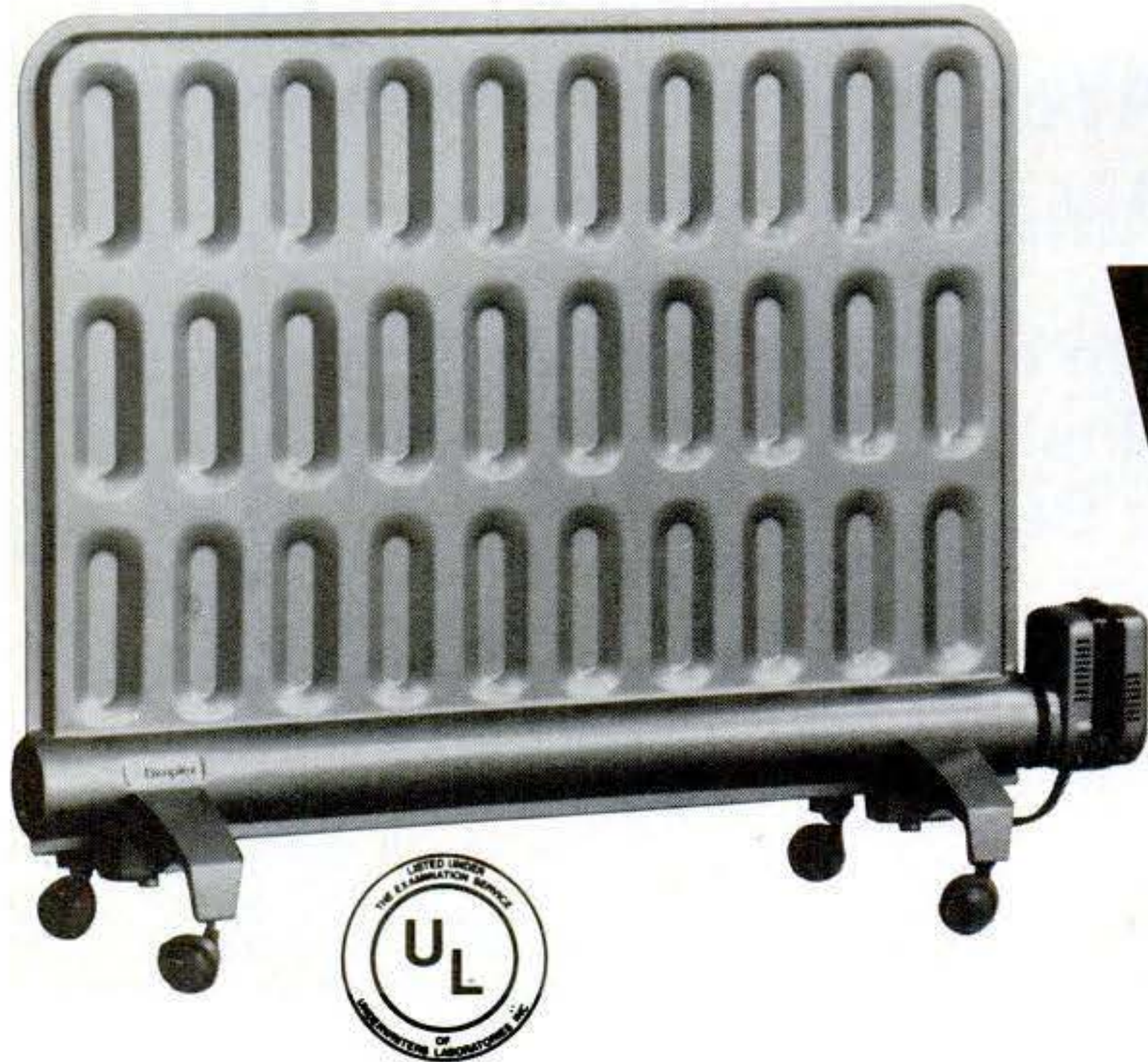
City _____ State _____ Zip _____

Signature _____

© Cambridge International, Inc. 1980

Clean
Efficient
Heating
31½" W by 23¾" H

A NEW PRODUCT



Waffle Warmer

A major, money-saving,
energy-saving heating advance
from England — where fuel costs
are double.

Winter in England? It's like December in San Francisco. Or January 1980 in Chicago. It's that yukky weather that's forever wet, cold and dismal. The kind of climate that makes toasty warmth a glorious haven.

But, in England, toasty warmth is costly. In fact, their average household fuel bill is twice as much as ours. Their electricity alone costs 7¢ a kilowatt hour versus our 4¢ per kilowatt hour. That's why the British Dimplex® firm developed their ultimate, permanent fuel radiator.

A WAFFLE ON WHEELS

The unusual, yet ingenious design provides greater warming surface area and permits an even distribution of heat. Rooms warm faster at far less cost or energy waste than ever imaginable.

CHILD SAFE

The system is completely enclosed. There are no exposed elements and because of the way it warms a room, the temperature of the radiator surface is always safely low. You can actually touch it without scorching yourself.

HOW IT WORKS

There's a science to efficient heating because there are two types of heat involved. To warm a room you must replace *radiant heat*, or heat which is naturally lost through windows or walls. You must also reheat surrounding air, or *convected heat*. Warm air cools down every two hours or so.

The Dimplex's sealed waffle housing is permanently filled with a fine oil. This oil is *never* used up. Never needs replacing. Because of the waffle pattern, the oil is evenly distributed throughout the system. This dispersement spreads the heat evenly and produces equal amounts of radiant and convected heat.

The air you breathe is warm, clean and fresh. There are no gas smells. No fume odors ever. You will never experience that parched atmosphere smell, common to wasteful old-fashioned heaters, or that stuffy feeling of over-heated air. Every one of these unhealthy conditions, from gas odors to stuffiness, means that fuel is being wasted. You are paying for unnecessary energy!

CONSTANT ROOM COMFORT

At the base of the Dimplex is a climate-controlled thermostat. It's automatic. Once the temperature of a room reaches your desired setting, the unit shuts itself off. Since oil is an excellent heat retainer, the Dimplex continues to diffuse warmth into the room, long after power has been switched off. It automatically goes on again when the room temperature falls. Now, you are enjoying maximum comfort and reducing your heating bills at the same time.



STURDY AND PORTABLE

The Dimplex is designed for stability. It weighs 27 pounds and rests on four heavy duty casters. You can move it easily to any part of your home, apartment or office. In addition to the room air-controlled thermostat, there is also a built-in radiator thermostat that acts as an instant cut-off switch, which shuts off the system to prevent overheating. There is never any danger of fire. Most domestic heating systems lack the extra safety precautions of this quality-built, UL listed Dimplex unit.

PLUG-IN LOW COST WARMTH

With its permanent oil heating system, its environment-sensitive thermostat control, and its totally balanced radiant-convected heat diffusion, the Dimplex is entirely new. It is the first meaningful breakthrough in energy-saving, cost efficient, safe heating. Air is clean and warm. There are never any peculiar odors. Wherever you put it — in office, playroom, workroom or apartment — it will save you money.

PLEASE, FOR THE SAKE OF YOUR FAMILY AND YOUR WALLET — TRY IT.

It's a small investment that will let you start saving money and fuel from the

moment you plug it in.

The Dimplex comes ready to plug in. Try it for 10 days. If you are not convinced that it is the perfect answer to low cost, clean, efficient heating, send it back collect to us for a no-questions-asked refund. It is finished in long-lasting gold enamel and is backed by a 90-day limited parts and labor warranty.

CREDIT CARD ORDERS CALL TOLL FREE

800-621-5199

ILLINOIS RESIDENTS: 800-972-5855

24 HOURS—7 DAYS/WEEK

Please send me _____ Dimplex Radiator(s) at \$99.95 plus \$9.95 shipping and insurance.

Illinois residents add 5% sales tax.

Enclosed please find check or money order.

Charge my credit card:

American Express Diner's Club
 Master Charge Carte Blanche
 Bank Americard/VISA

Credit Card No. _____

Master Charge No. _____

Expiration Date _____

Name _____

Address _____

City _____

State _____ Zip _____

Signature _____

PS-04

©Camelot '80

**Camelot
DIRECT**

801 Green Bay Rd., Lake Bluff, IL 60044

DIVISION OF UNITED EDUCATORS, INC.

Liberated house

[Continued]

feels like splurging, he can open it up all the way. Bakewell showers with, basically, recycled water from a gray-water (used wash water) tank, to which he adds, as needed, fresh water taken from the vinyl rainwater bladder.

"We pump gray water into a pressure tank," he says. "Then it's forced through a five-micron filter, then a 0.25-micron filter, then an iodinator. Then it goes into a storage tank. Before it's delivered to a faucet or shower, it goes through a carbon polisher—activated charcoal. We take out the bacteria with the filters, and then we kill the viruses with the iodine."

The gray-water tank, under the kitchen floor, is just above the rainwater tank, which rests on the ground. A pump takes water from the rainwater tank through filters to the gray-water tank.

Next to the toilet area is the opening to the incinerator. Here waste wood and paper are stored. The hot-water tank is built around the incinerator. When sun heat fails, Bakewell burns his waste material and heats his water that way.

What did all this cost? Bakewell es-

timates \$16,500. The cost doesn't include their own time, but it does include all their mistakes. "One thing is important to note," Bakewell says. "This has been a completely private endeavor—no grants, no subsidies—and as such we've been motivated to be a lot more clever with some of our materials and cost savings than if we'd had a huge subsidy to put the whole thing together. We have integrated in one system the state of the art in all the little systems that usually come as individual components.

But here they have been brought together in a workable system that can function in a remote area."

A Japanese architect who visited the Autonomous Dwelling Vehicle saw it as a good mass-production possibility. With floating collars around the units, he thought, they could be grouped to form residential marina colonies in countries with poorly developed utility infrastructures.

But that's in the future. Right now it's probably the most energy-efficient house in the country. **PS**

PRINCIPAL COMPONENTS SUPPLIERS FOR THE AUTONOMOUS-DWELLING VEHICLE

Appropriate Tech Importers, Box 5, El Rito NM: wood-burning water heater; American Excelsior Co., 850 T Ave., Arlington TX 76011: sponge urethane products; Arco Solar, 20544 Plummer Blvd., Chatsworth CA 91311: solar electric modules; Beckson Industrial Products, John St. Ext., Clinton CT 06413: hand pumps; Caruso Sales, Woodland Drive, Chicago IL 60648: Mitsubishi enthalpy exchangers; Clivus Multrum U.S.A. Inc., 14 A Eliot St., Cambridge MA 02138: Bio-Loo composting toilet; Cohn Athletic Supply, 10720 Midwest International Blvd., St. Louis MO 63132: fabrics; Corrosion Products, Inc., 856 Hanley Industrial Ct., St. Louis MO 63144: PVC and polyethylene plumbing components; Heliotrope General, 3733 Kenora Dr., Spring Valley CA 92077: delta-T differential thermostats; Hy-Vac Plastics, 4450 Olive, St. Louis MO 63101: plastic components and industrial storage bins; Insulated Shade Co., Box 282, Branford CT 06405: insulated shades; Intercontinental Domes Ltd., Route 59, Box 181, Plainfield IL 60544: silo components; Iota Engineering, Inc., 1735 Fort Lowell Rd., Tucson AZ 85719: dimmable high-efficiency lamps; March Mfg. Co., 1819 Pickwick Rd., Glenview IL 60005:

solar pumps; MFG, 605 Hanley Industrial Ct., St. Louis MO 63144: styrofoam and gasketing materials; National Cellulose Corp., 12315 Robin Blvd., Houston TX 77045: Durafiber spray fireproofing; Oberjuege Rubber Co., 10950 Cinpage Place, St. Louis MO 63166: rubber hoses and gasketing; Pamotor, 770 Airport Blvd., Burlingame, San Francisco CA 94100: low-wattage DC blowers; Pease Shade Co., 7100 Dixie Hwy., Fairfield OH 45012: exterior collector and greenhouse shades; Pipe Systems, Inc., Energy Storage Div., 1533-D Fenpark, St. Louis MO 65026: Thermal 81® energy-storage rods; Radio Shack, 2617 West 7th St., Fort Worth TX 76107: low-energy auto stereo components; Rubatex, 1460 Ashby Rd., St. Louis MO 63132: rubber products; Stephens Floor Covering, 3132 Watson Rd., St. Louis MO 63105; Thomas Inc., 8135 Forsyth Blvd., St. Louis MO 63105; Universal Plastics, Arthur Industrial Park, Arthur IL 61911: sump-pump-liner containers; Water Equipment Technologies, 4255 Westwind Drive, Palm Beach FL 32014: gray-water recycling equipment.

IF IT LOOKS LIKE JUST ANOTHER HAND GRINDER, LOOK AGAIN.

Do it easier and faster with Dremel. The Moto-Tool does projects that used to take many hours in a fraction of the time. Home repair projects become easier and more enjoyable to handle. Variable speed control (5,000 to 28,000) RPM lets you dial the speed to fit the job. The Dremel Moto-Tool—buy it wherever fine power tools are sold. Dremel, Div. of Emerson Electric Co., 4915-21st St., Racine, Wisconsin 53406.

DREMEL®
MOTO-TOOL®
It shapes, sands, carves,
saws, polishes, sharpens,
drills and a
whole lot more.

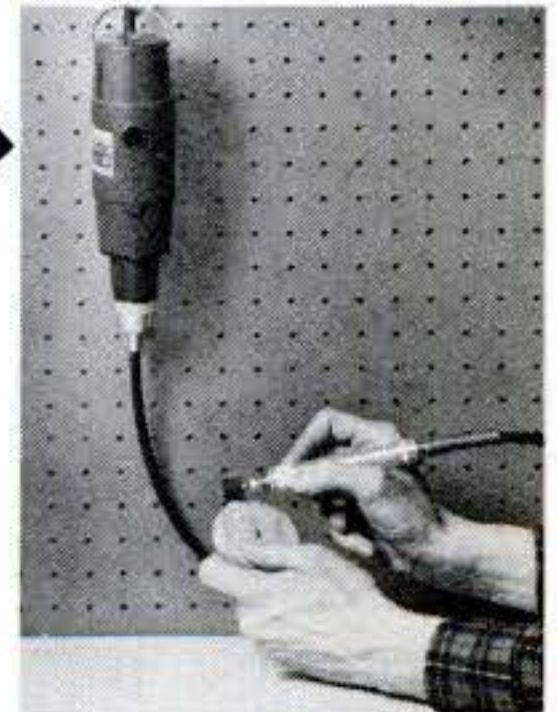


Comes with a large assortment of accessories that make Moto-Tool the most versatile tool in your workshop.

Also available, Model 232 Moto-Flex Tool. Gives finger-tip control for precision work.



Cut floor tile.



Cut tubing or pipe.



Sharpen yard tools.

DREMEL®

SAVE \$120 ON A SEIKO

New Low Prices for 1980!



The Seiko Solar Chronograph Alarm in beautiful gold tone only \$174.95

List price \$295.00

Operates up to 10 years without a battery change. You can set the alarm to sound automatically at the same time every day and there's an hourly signal, too. Plus a precision stopwatch that measures to 1/10th of a second. It even has a battery recharge indicator. Pure elegance — in a compact water-resistant case for the first time.

In Stainless steel only \$149.95.
Save \$100.00 off list price.

Similar Savings on other Seiko Watches:

- Chronograph Alarm\$ 99.95
 - Chronograph Alarm w/Interval
 - Countdown Timer\$124.95
 - Memory Bank Calendar\$118.95
 - New! LCD Calculator w/Alarm\$149.95
 - Digitron Analogue Chronograph\$129.95
 - Melodic Alarm Chronograph\$139.95
- available in goldtone at additional cost

47st. photo

Cameras, Electronics & Video
67 West 47th Street
New York, N.Y. 10036



Master Charge
& Visa accepted

Open Daily & Sundays
(212) 260-4410
[toll-free]

(800) 221-5858
(800) 223-5661

Minimum shipping & handling \$4.50
orders subject to verification & acceptance
free catalogue with clipping of ad

FOR THE MAN WHO HAS EVERYTHING. SOMETHING TO CONTROL IT WITH.



THE BSR SYSTEM X-10™ THE CONTROLLER



Just plug it in (no special wiring is needed), and you can control up to 16 lights and appliances

anywhere in the house by simply pressing a few buttons. And when you can turn on the TV, dim the lights or turn them all off without getting up from your easy chair, you're in control.

For under \$100* the BSR System X-10 Starter Kit comes with a command console and enough modules to control lights and appliances at three locations. So the man who has everything doesn't have to have a lot of money to own one.

*Manufacturer's suggested retail price.
BSR (USA) Ltd., Blauvelt, N.Y. 10913
BSR (Canada) Ltd., Toronto, Ont.



The Controller

EVERYTHING'S UNDER CONTROL. THE BSR SYSTEM X-10.

Meteorites

[Continued from page 82]

system's birth, five billion years ago. This has led to speculation about what melted and cooled the interiors.

Earth's interior was heated originally by radioactive isotopes of potassium, uranium, and thorium. But these elements are not very abundant, and in an object the size of a meteorite parent body could not melt rock and iron. Thus, an unknown energy source had to provide intense heat over a cosmically short period of time.

Supernova genesis

A likely candidate for the unknown energy source came through study of the Allende meteorite, which fell on Mexico in 1969. It contained an excess of magnesium-26, identified as the radioactive-decay product of aluminum-26. This isotope has a half-life of only 720,000 years. Al-26 may have provided the energy to melt the parent bodies, and its radioactivity would have died out soon enough to allow the rapid cooling inferred from meteorites studied in labs.

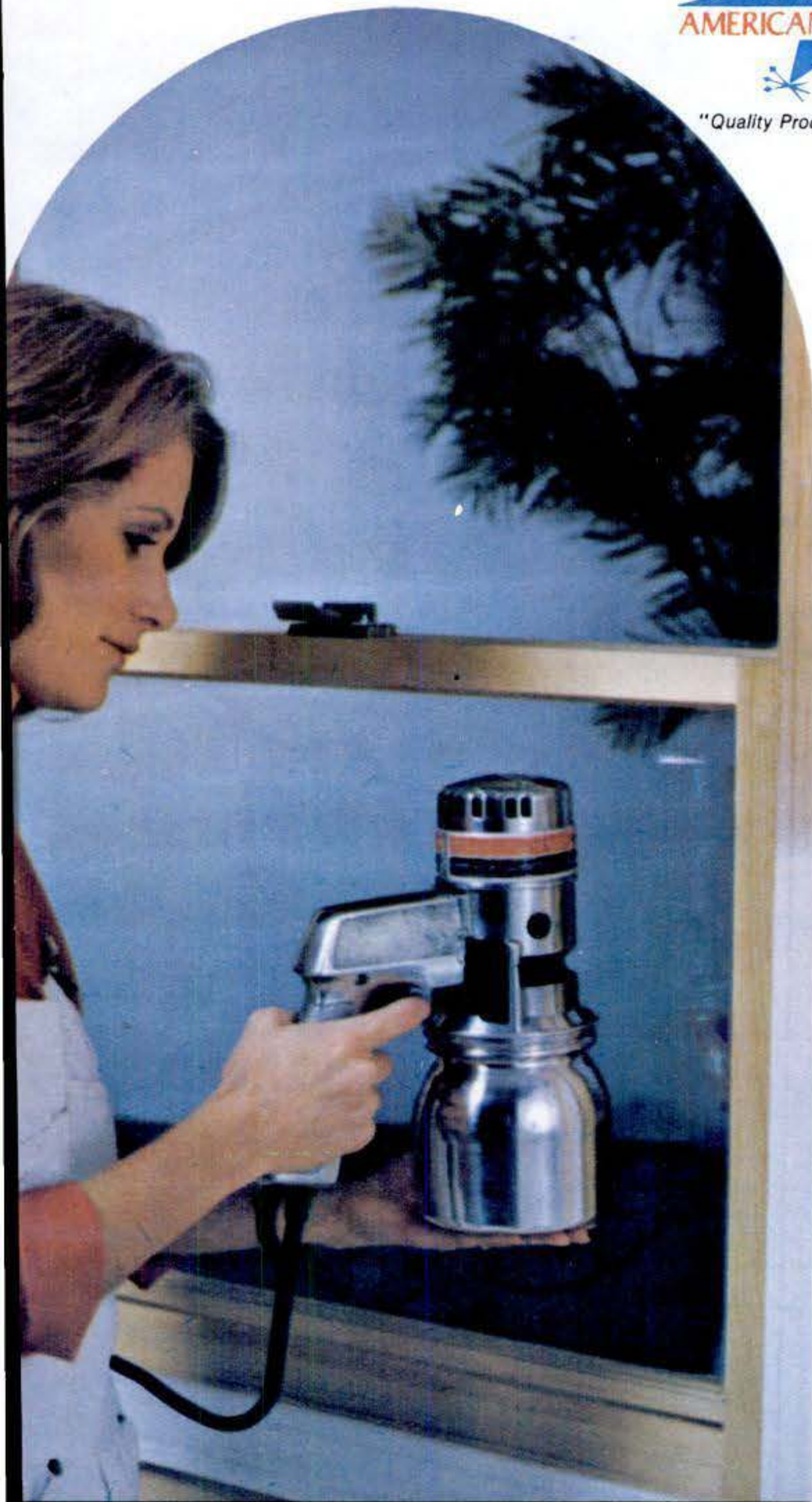
But the short half-life of Al-26 means these atoms could have been present in the solar nebula for no more than a few million years. Also, nuclear theory says rapid nuclear reactions in a supernova, an exploding massive star, is the only likely source for Al-26 in space. Thus, several astrophysicists have speculated that a supernova in our galaxy, relatively close to what is now our solar system, sprayed a whiff of freshly synthesized atoms into the solar nebula, our genesis cloud.

Prof. A. G. W. Cameron of Harvard University, a leading expert on the theory of solar-system formation, has proposed that the condensation of the sun and planets from the solar nebula was triggered by a supernova blast wave. The meteorite studies indicate that the nebula also was enriched by short-lived isotopes from a supernova. The logical conclusion is that the same supernova did both the triggering and the enriching.

Professor Cameron told me, however, that the isotope analyses are still on shaky ground. Lab measurements may be accurate, but are the samples representative of most meteorites? Many more studies and calculations are needed. Fortunately for scientists who need new specimens, the scientific storehouse of our cheapest space probes and most informative time capsules continues to expand. Eventually, meteorites may yield the ultimate answers to the major riddles of the solar system.

THE ORIGINAL ROTARY DISC AIRLESS PAINT GUN

Now with Electronic Controls for Speed, Safety and Versatility! Ideal for home, farm and factory use.



**PAINT A FINE LINE ONLY $\frac{1}{2}$ INCH WIDE
with a minimum of misting . . .**



**OR A FULL $1\frac{1}{2}$ FOOT SWATH
with practically no overspray!**

Easier to use—and safer, better!

ELECTRO ROTARY DISC NO-NOZZLE/LOW PRESSURE AIRLESS **PAIN T GUN**

The first paint gun to give you **REVOLVING DISC ACTION** and **ELECTRONIC CONTROLS** for amazing versatility! Does the work of a **\$300 industrial compressor model!**

Send today for the Revolutionary Electro® Airless Paint Gun—and you'll never want to go back to the old-fashioned method of painting! That's because it is fast, safe, and more efficient than other paint guns you can buy. Only the Electro® Airless Rotary Disc Action Paint Gun gives you precision solid state electronic controlled painting, airless spray action, and the capacity of an industrial paint gun that could cost as much as \$300.

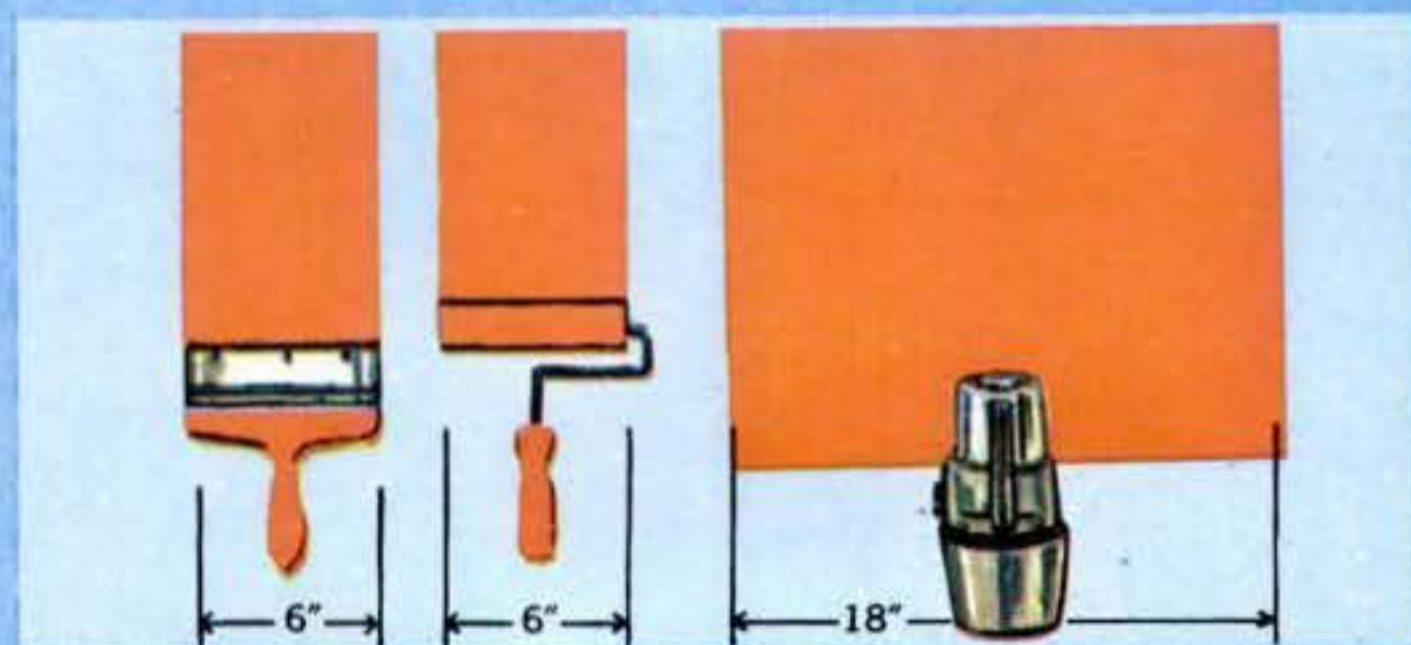
Gives you professional painting capacity for your Home, Farm or Factory!

Save money, time and paint—get professional quality painting whenever and wherever you use the Electro® Airless Paint Gun. With this gun you can cover 100 sq. ft. in just 10 minutes! The unique revolving Disc Action spins paint out so fast you complete the biggest jobs in little time. No bulky compressors, flimsy vibrators, strainers, needles, valves or nozzles . . . it won't clog in action.

It's lightweight and portable . . . only 10" high and made of sturdy-durable aluminum—compact and portable enough to take anywhere there's a really tough paint job.

Low Pressure Design for Safety!

The Electro Airless Paint Gun uses only safe centrifugal action to spin paint out at speeds up to 20,000 RPM. Uses no nozzles—valves—or high pressure build-up to squeeze paint out. As a result you get safe, easy painting, and it eliminates the danger of accidental paint injection possible with high-pressure sprayers.



Covers 300% more area than a 6" brush or roller!

Brushes and rollers can't compare with the Electro® Airless Paint Gun. Whether it's a big job—or tight precision painting—Electro® saves you time and effort.

Solid State Electronic Controls give you Versatility—Speed—Precision

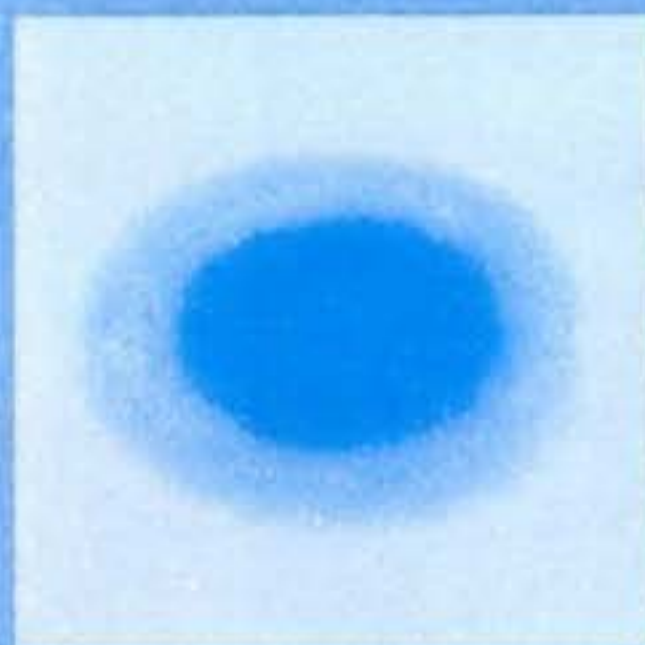
The Electro® Airless Paint Gun puts solid state electronic controls at your fingertips. All you do is pre-select the exact amount of paint you want to deliver and the width of the spray pattern you want—from ½ inch to 1½ feet. Then pull the trigger and paint! Rotary action feeds the paint up and out the gate opening for maximum control of every painting action.

Cover an entire room in just minutes—or perform precision paint jobs like frames, woodwork or furniture. All with a minimum of misting, fogging or overspray.

The Electronic Controls also compensate for varying thicknesses so you can use your Paint Gun for everything from primers to heavy paints—for indoor and garden disinfectants, for waxing floors and woodwork, and dozens of other chores. **Handles latex—oil—water soluble paints—enamel, semi-gloss, flat—light oils. Not for use with lacquer or highly volatile liquids.**

Try it at Our Risk for 14 days—FREE!

Send for your Electro® Airless Rotary Disc Paint Gun today—try it for fourteen days—and if you're not completely satisfied that it gives you the fastest, easiest, best painting results you've ever had from a paint gun, then return the Paint Gun and owe nothing.



Ordinary Paint Gun gives you an oval pattern that's hard to control. Misting, splattering and feathering require drop cloths and masking.



Electro® Airless Paint Gun gives a precise straight line fan-shaped pattern for a minimum of misting and feathering. Lets you paint like a professional.

Yours to use FREE for 2 full weeks!

Mail the order form card today!

For practically any painting job!



Cover All Exterior Walls



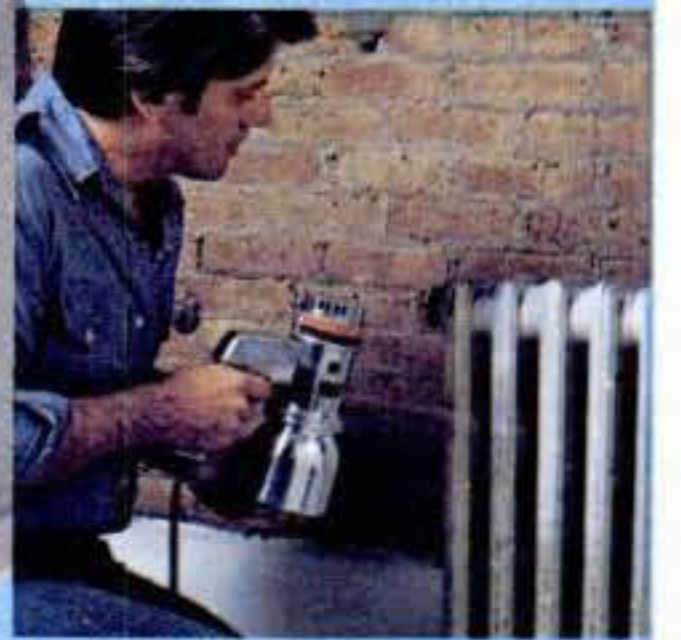
Wax Floors



Disinfect Rooms



Paint Shutters



Paint Radiators and Pipes



Paint Louvered Doors

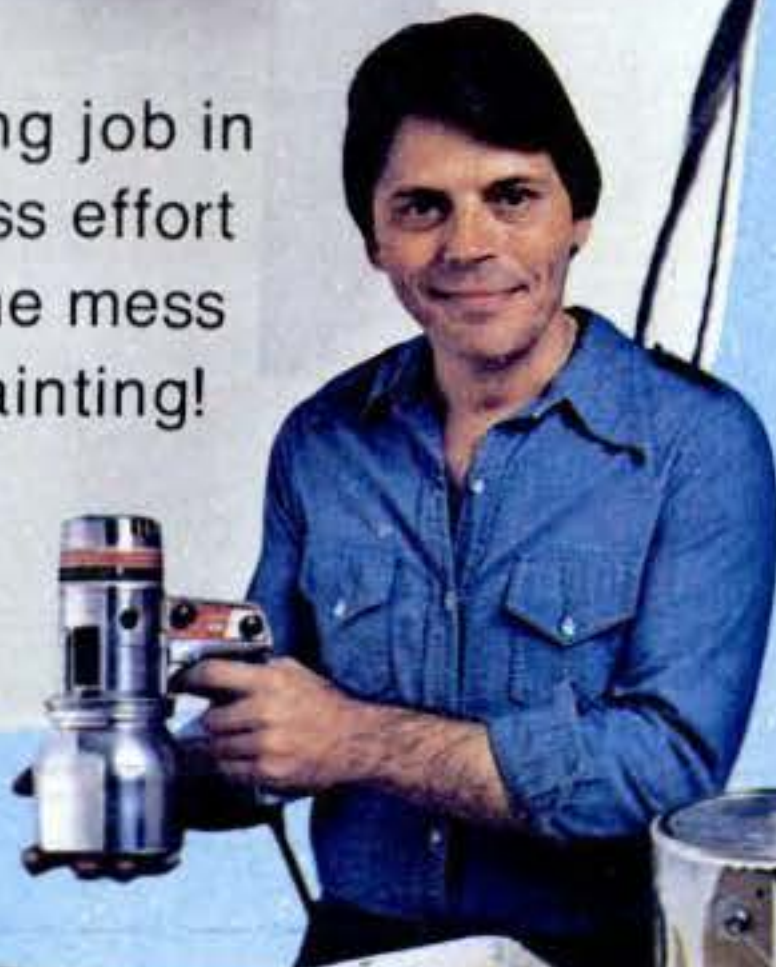


Paint Woodwork



Paint Fences

Do a better painting job in less time...with less effort...and eliminate the mess of conventional painting!



No brush—no roller— no other spray gun gives you the painting performance of the **ELECTRO® ROTARY DISC • NO NOZZLE • LOW PRESSURE • AIRLESS • PAINT GUN**

Compare these unique features and you'll agree—no paint gun can equal the fast, accurate, low pressure, safe painting you get with the Electro® Airless Paint Gun! Try the Electro® Paint Gun on your biggest—or smallest—painting chores and get professional results every time!



Works with almost any liquid!

The Electro® Airless Paint Gun does much more than just paint! It sprays waxes . . . disinfectants . . . polishes . . . even insecticides . . . almost any liquid. It's the most versatile spray gun you can buy. Of course, Electro® Airless always does a great job with paint!



1. New full trigger control! Easy fingertip "on/off" action trigger locks in any position—including closed. Trigger starts motor, activates gate opening. Just set the controls, pull the trigger and start painting!



2. Preset Width Control lets you select spray width from ½ inch to 1½ feet. You can even vary width while painting.



3. Self-Centering Adjustable Gate gives you spraying widths from ½ inch to 1½ feet—from a fine line to a wide swath.



4. Solid State Precision Electronic 2 Speed Control lets you paint as little or as much as you want. Also compensates for paint viscosity.



5. Rugged, Powerful Motor gives you years of dependable use and the spraying capacity to match an industrial paint gun!



6. Snap Open Latches make cleaning and disassembly quick and easy . . . latches snap back to lock your spray gun securely.



7. Twist-On Container holds a full quart of paint or other liquid.



8. Rugged, Lightweight Aluminum Die-cast Housing makes this the perfect "go-anywhere" Paint-Gun. Only 10" high.



9. The Best Airless Paint Gun you can Buy— No-nozzle, adjustable gate and rotary disc action painting means the paint gun operates with almost no pressure—for safe, effortless painting every time.

SPECIAL SALE ON OUR TWO OUTSTANDING SELECTIONS!

the classic hunting knife used by thousands of outdoorsmen, **now on sale**



why pay \$25 for a **folding hunting knife**

when you can own ours for \$6.99 (reg. \$7.99)

- Razor-sharp stainless steel knife folds to fit your pocket
- Solid brass forged body, luxurious rosewood handle inserts!
- Trigger-release safety lock—knife can't fold accidentally in use!

This is the classic folding hunting knife. A full four inches long, with frame and bolsters forged from solid brass. Gleaming, razor-sharp 3" stainless steel blade. Luxurious real rosewood handle inserts to give you a sure grip. And the specially contoured belly makes this the easiest knife to hold, the easiest knife to use we've ever seen!

You'll use it on fishing and hunting trips and even around the house. You'll use it to blaze a trail, cut kindling, whittle tent-pegs, slice through thick rope. It cuts every camp chore quickly down to size.

It's razor sharp. It's beautifully balanced. It's a delight to use. And this classic hunting knife is also

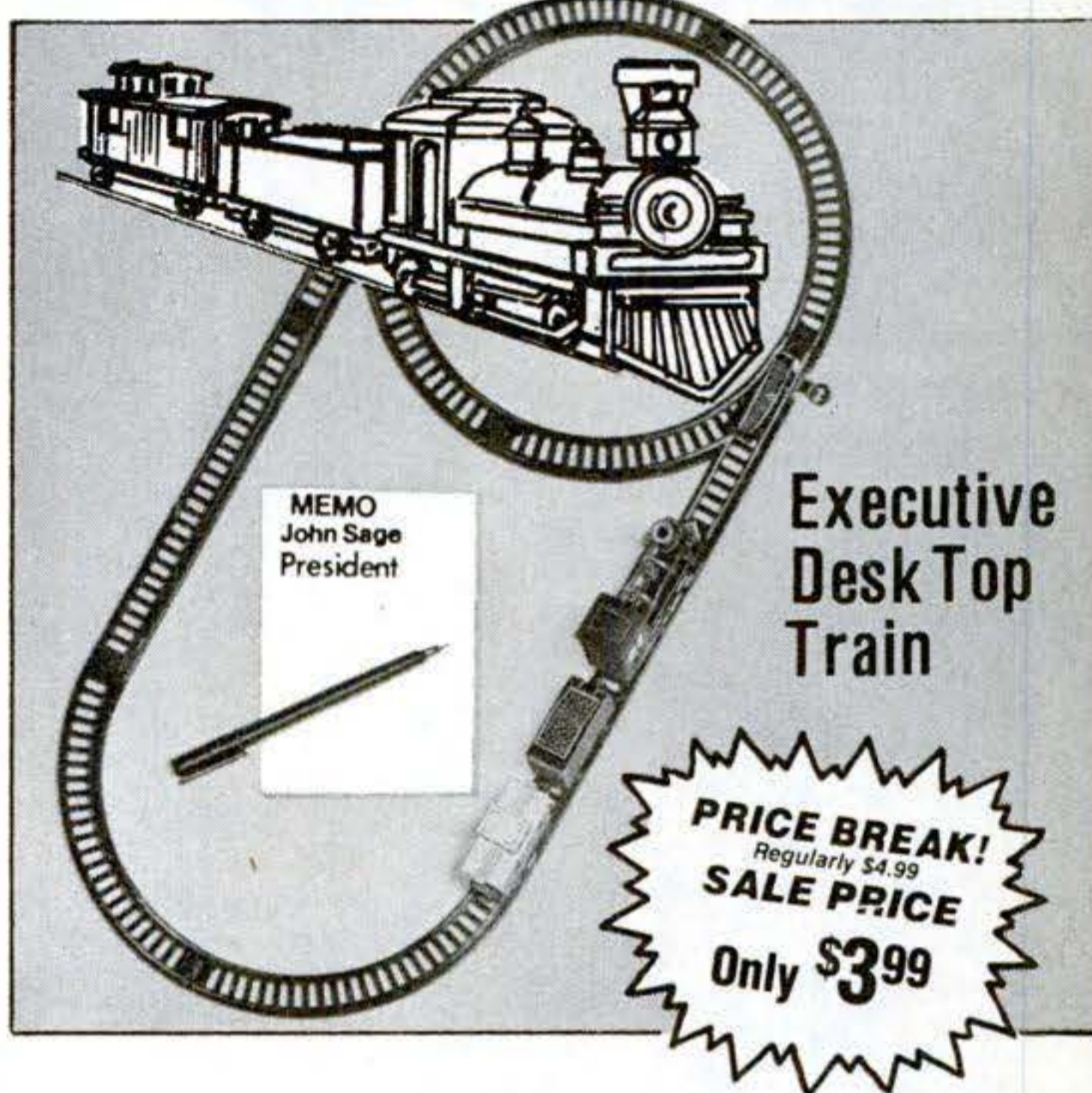
extraordinarily safe. When you open the blade, it locks into position, cannot be closed until you press the trigger-release safety lock.

Thousands of hunters, fishermen, campers, outdoorsmen have paid up to \$25 for a similar folding hunting knife. Now, we offer ours to bargain hunters like you not for our regular \$7.99 price, but for a low \$6.99 sale price. And we'll engrave your initials free in a solid brass plate, to give your knife that personal finishing touch.

Order right now—we may never be able to repeat this extraordinary sale again!

When the Deal Collapses . . . When Your Nerves Are Tight as a Drum . . . Relax!

RUN YOUR OWN RAILROAD!



Let it roar past your "In Basket." Switch the tracks and it will take the express route past your phone. If your desk is cramped, it will even set up in an 11" circle, perfect for your desk drawer.

Our tension-breaking "Executive Electric" packs a lot of pleasant relaxing into a tiny bit of space. But though it's super-compact, it is a complete model train in every way.

You get a 3 1/2" authentically-detailed steam locomotive with tender and bright orange caboose; 6 ft. of 3/4" tracks and two switches. No need for bulky transformers or tangles of wires—this railroad runs for many fun-filled hours on a single penlite battery. Arrange track layout to fit your free desk space—either 2 ft. x 10 1/2" oblong or an 11" circle. The tracks snap together instantly for easy set-up and disassemble just as fast for convenient storage.

Yes, for less than the price of a single round-trip commuter ticket, you can run your own railroad! Order several sets—for yourself, for the kids (you surely won't want to part with your set!). Satisfaction completely guaranteed. Only \$3.99.

spencer L-88 Spencer Bldg., Atlantic City, New Jersey 08411
GIFTS Bringing You Direct Mail Savings For Over 30 years

15-DAY NO-RISK TRIAL OFFER

SPENCER GIFTS, Inc., L-88 Spencer Bldg., Atlantic City, N.J. 08411

- Please send me the Folding Hunting Knife (P-77867) @ only \$6.99 plus 75¢ postage and handling.
- SAVE \$1.50 Order 2 knives for only \$12.98 plus \$1.00 postage and handling.

My initials are _____

I understand that if I am not completely satisfied, I may return it within 15 days for a replacement or a complete refund of the purchase price.

Cost of Folding Hunting Knife(ves) Ordered\$	_____
Add Postage and Handling\$	_____
Add Sales Tax (see chart)\$	_____
I enclose <input type="checkbox"/> check or <input type="checkbox"/> money order for Total\$	_____

Print Name _____

Address _____

City _____ State _____ Zip _____

STATE SALES TAX CHART. Please add to your remittance OK 2%, AR CO IA KS LA ND VT 3%, MO 3 1/8%, NE 3 1/2%, AL AZ FL GA IL IN MI MN NC SC VA WI 4%, NM 3 3/4%, OH 4 1/4%, KY MA MD ME MS NJ SD TX UT 5%, WA 5.2%, CA PA RI TN 6%, CT NY 7%, NYC 8%.

© Spencer Gifts, Inc. 1980

spencer L-87 Spencer Bldg., Atlantic City, N.J. 08411
GIFTS Bringing You Direct Mail Savings For Over 30 years

15-DAY NO-RISK TRIAL OFFER

Spencer Gifts, L-87 Spencer Bldg., Atlantic City, N.J. 08411

- Please send me "Executive Electric" Train(s) #86215 @ \$3.99 each plus 75¢ postage and handling.
- SAVE \$1.00! Order TWO sets for only \$6.99 plus \$1.50 postage and handling.

I understand that if I am not completely satisfied, I may return within 15 days for a complete refund of the purchase price.

Cost of Train set(s) Ordered\$	_____
Add Postage and Handling\$	_____
Add Sales Tax (see chart)\$	_____
I enclose # check or <input type="checkbox"/> money order for Total\$	_____

Print Name _____

Address _____

City _____ State _____ Zip _____

STATE SALES TAX CHART. Please add to your remittance OK 2%, AR CO IA KS LA ND VT 3%, MO 3 1/8%, NE 3 1/2%, AL AZ FL GA IL IN MI MN NC SC VA WI 4%, NM 3 3/4%, OH 4 1/4%, KY MA MD ME MS NJ SD TX UT 5%, WA 5.2%, CA PA RI TN 6%, CT NY 7%, NYC 8%.

© Spencer Gifts, Inc. 1980

Sharpen your chain saw like a pro!



This revolutionary chain saw sharpener grinds a razor sharp edge on any size chain saw using a specially made grinding wheel. All you supply is a 1/4" electric hand drill. The *Pro Sharpener** assures the correct grinding angle and a built-in gauge maintains the proper guide height.

The *Pro Sharpener* produces a ground edge—much sharper than a filed edge. Comes complete with three grinding wheels (enough for up to 30 sharpenings) plus a hand file adapter.

*Patents pending

Pro Sharp Corporation
P.O. Box 11378
Newington, Ct. 06111

Please rush — *Pro Sharpener(s)* at \$12.95 each plus \$1.95 postage and handling per unit (\$3.00 outside U.S.) Send check, money order or Master Charge. No C.O.D.'s.

M.C. # _____ Exp. Date _____
Conn. Residents add 7% sales tax.

Name _____

Address _____

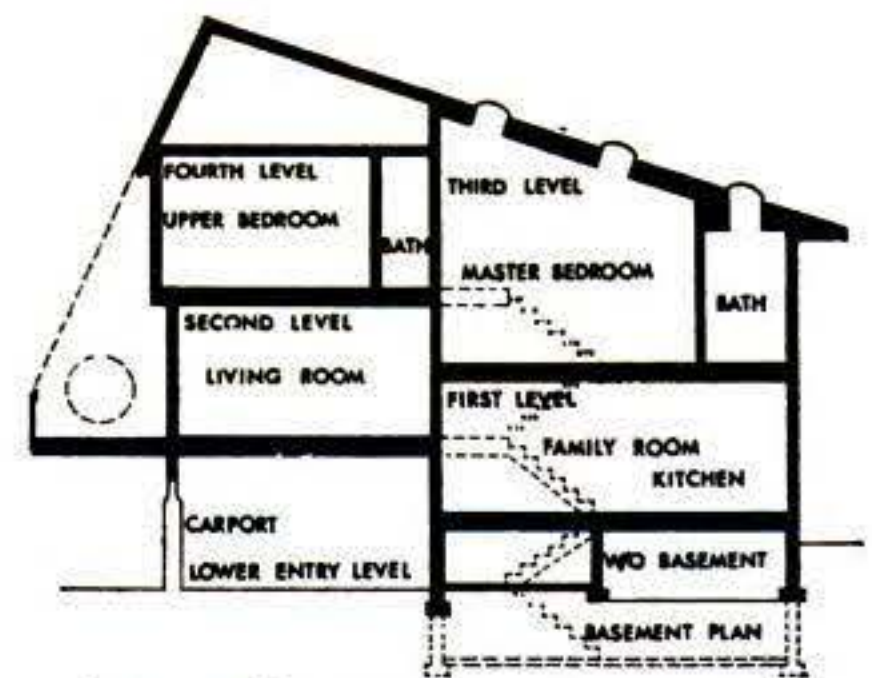
City _____ State _____ Zip _____

Important: To insure correct grinding wheel size
Indicate your Chain Saw Mfg. _____
Saw Model: _____

30 Day Unconditional money back guarantee. PS-48

Stepped-floors contemporary

[Continued from page 83]



Square footage

Lower entry	122
First level	560
Second level	462
Third level	582
Fourth Level	488

Total: 2214

topped with a half-dozen skylights marching down the roof over the master bedroom and windowless upstairs bath with adjacent vanity. (A walk-in closet and storage bay make this area a veritable private suite. Yet step out the door and you have calling access to the entire house through the light shaft.)

Two other bedrooms are a half-flight higher; they share a bath. In addition, a half-bath is tucked downstairs behind the laundry room, just off the main entry hall.

If you enter the house directly from your car, you step up into the kitchen/family-room area, then up again to reach the living room. But if you come in from the entry deck, you're at the first (kitchen) level.

The section sketch above shows how the bottom stair can turn down into an excavated basement, should you need additional storage. The tally shows how each level contributes to the total square footage. (In relating the section sketch to the floor plans, remember that *each* of the latter represents two levels.)

Diagonal boards on the sides and vertical siding on the front and back enhance the bold upward thrust of this design, created for us by Home Building Plan Service in cooperation with Western Wood Products Assn.

Many readers have asked for a complete collection of all homes in this series. A book including every design through February '80 is now in the works.

How to order your plans

One set of professionally drawn plans for the Stepped Floors house is \$95; four sets—for building, financing, and permits—are \$125. Plans will be reversed for \$20; building-materials list is also \$20. Send orders and queries to Home Building Plan Service, 2235 N.E. Sandy Blvd., Portland, Ore. 97232. Specify plan 932-1 (with basement) or 932-1A (without).

LEARN MEAT CUTTING

Train quickly in 8 short weeks at Toledo for a bright future with security in the vital meat business. Big pay, full-time jobs—**HAVE A PROFITABLE MARKET OF YOUR OWN!** Time payment plan available. Diploma given. Job help. Thousands of successful graduates. **OUR 57th YEAR!** Send NOW for a big new illustrated **FREE** catalog. No obligation. G.I. approved. **NATIONAL SCHOOL OF MEAT CUTTING**, No. 71-02-01977, Dept. 51-B, 33 N. Superior, Toledo, Ohio 43604.

THROWING AWAY \$5 per lb.?

Everyone has thrown this little known asset away. It is thrown away in every office, home, and all other buildings. Industries throw tons of it away annually. Only 1 person out of 1,000 save it, the other 999 don't realize its value, and the buyers want it kept that way! Hundreds of millions of dollars worth of it go unclaimed, discarded each year!

We will pay you \$5 per lb. for all of this material that you collect. You should start saving yours, and buy it from other uninformed persons for \$2-\$3 per lb. This is a unknown field that should be started part time. Huge income potential. To receive the complete educational package, remit \$7 + \$3 postage and handling. Money refund within 30 days for any reason. **Double your money back with 1st shipment!**

You will learn what we will pay for over 3,000 scrap items, some worth \$700.00 per ounce. The average price we pay for these scrap items is \$12.45 per lb. Learn where to find them, how to buy them, and how to ship them. If you have our old book, send it back with \$3 and we will send you the new one. Become a buyer, or at least a saver, we need the material and you can use the money.

Poley's Industrial Salvage Co.
Supply Dept. P-16
12389 Minges Rd., Battle Creek, MI 49017

LOUD AND CLEAR.

Read all about the K—the amazing speaker that has the power to reproduce even the lowest bass notes—loud and clear. Features the brilliant cornerhorn design with Speakerlab innovations like Magnar™ damped horn drivers. One of the only kits available for this unique loudspeaker. Read about K's and all the other great Speakerlab speakers and parts in our free catalog.

Speakerlab®
To get yours, write
SPEAKERLAB, Dept. 190
735 N. Northlake Way
Seattle, WA 98103

HIGH FLYING THRILLS!

The amazing rotating airfoil

ROLL-O-KITE

\$5.00 sent each prepaid

The unusual design of this rapidly spinning airfoil causes strong lifting forces in the wind. A GREAT FLYER! Quick, easy to assemble without glue or tools. 17" wide, 7" diameter. COMPLETE KIT includes fittings, instructions, 100 yards of flying string—all handsomely boxed for gift giving.

\$5.00 each, 3 for \$13.50, 10 for \$25.00
Calif. residents add 6% tax

Hawaii, Alaska, Puerto Rico, Mexico, Canada & any USA rush orders, add \$1.50 per order for air shipment. All other countries: minimum order 10 for \$30.00—boxed & shipped by sea, prepaid.

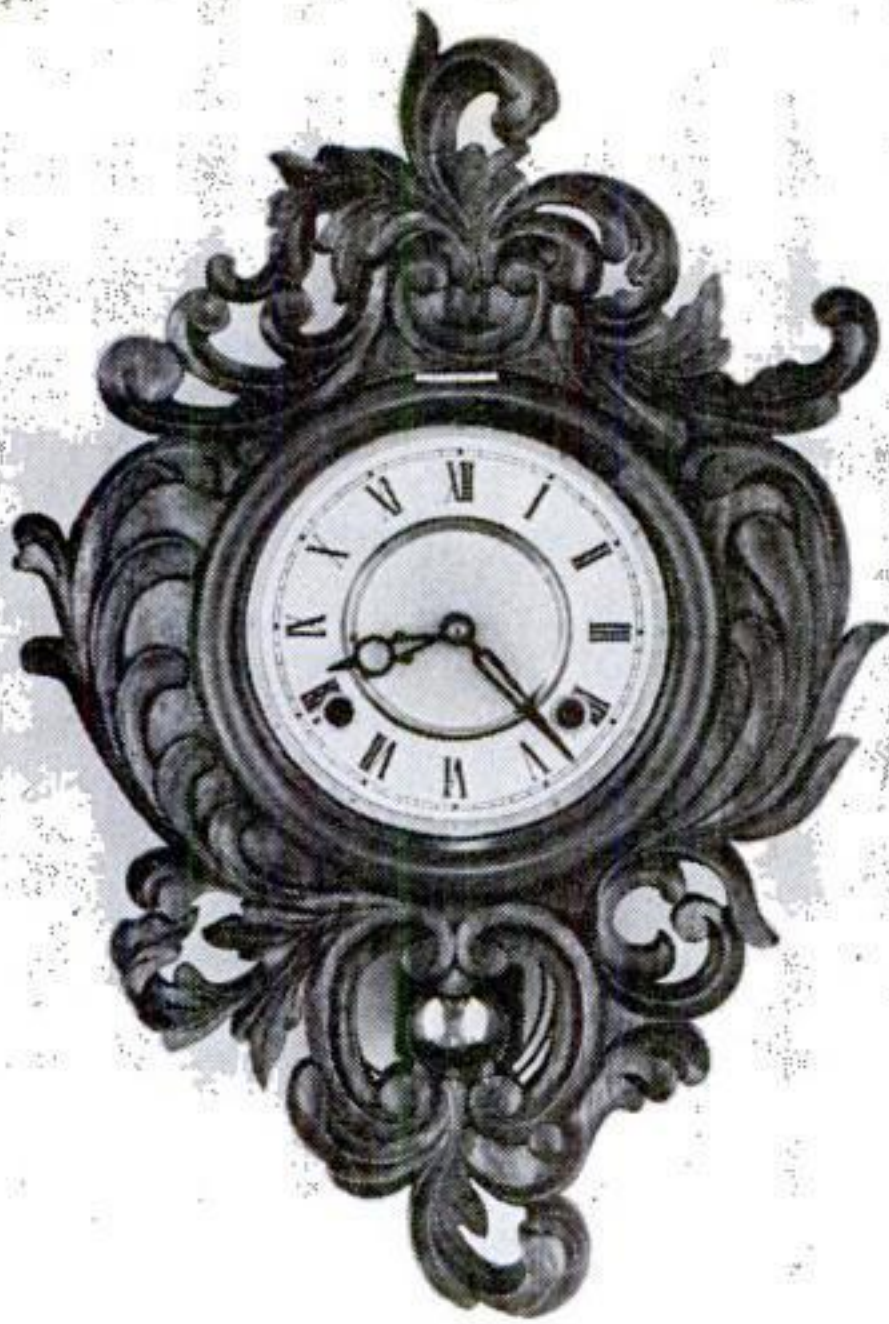
Send check or Money Order to:
RAFCO, Dept. PS-40
3136 Kashiwa St., Torrance, CA 90505

A SUPERB COLLECTION OF Antique Forgeries!

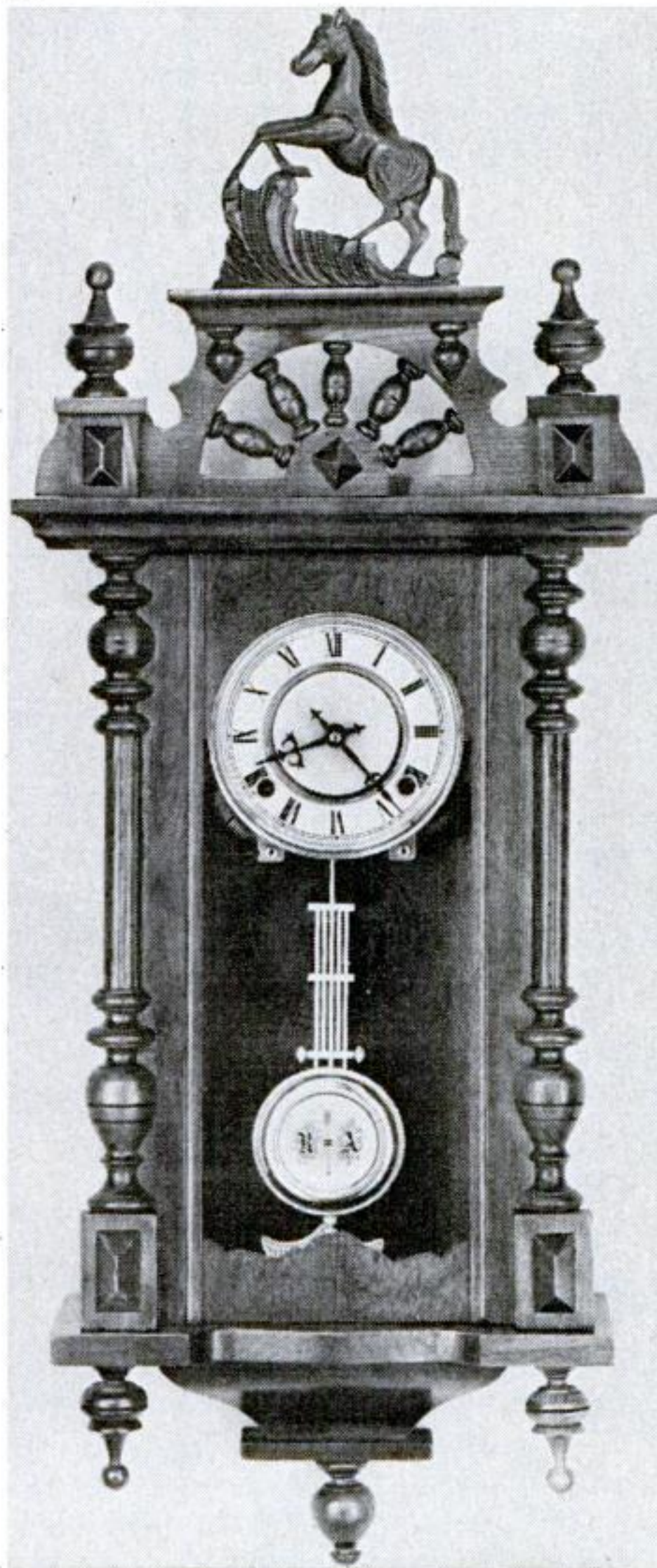
FEATURING ALMOST IMPOSSIBLE-TO-FIND STYLES
...AT A FRACTION OF THE COST OF THE ORIGINALS!

If you enjoy lovely old clocks, and treasure the wonderful warmth and friendly atmosphere they create - then you must collect these marvelous antique re-creations for your very own. These are not ordinary, high-gloss, new-looking reproductions...but, rich, mellow-finished, true-to-life re-creations that look like

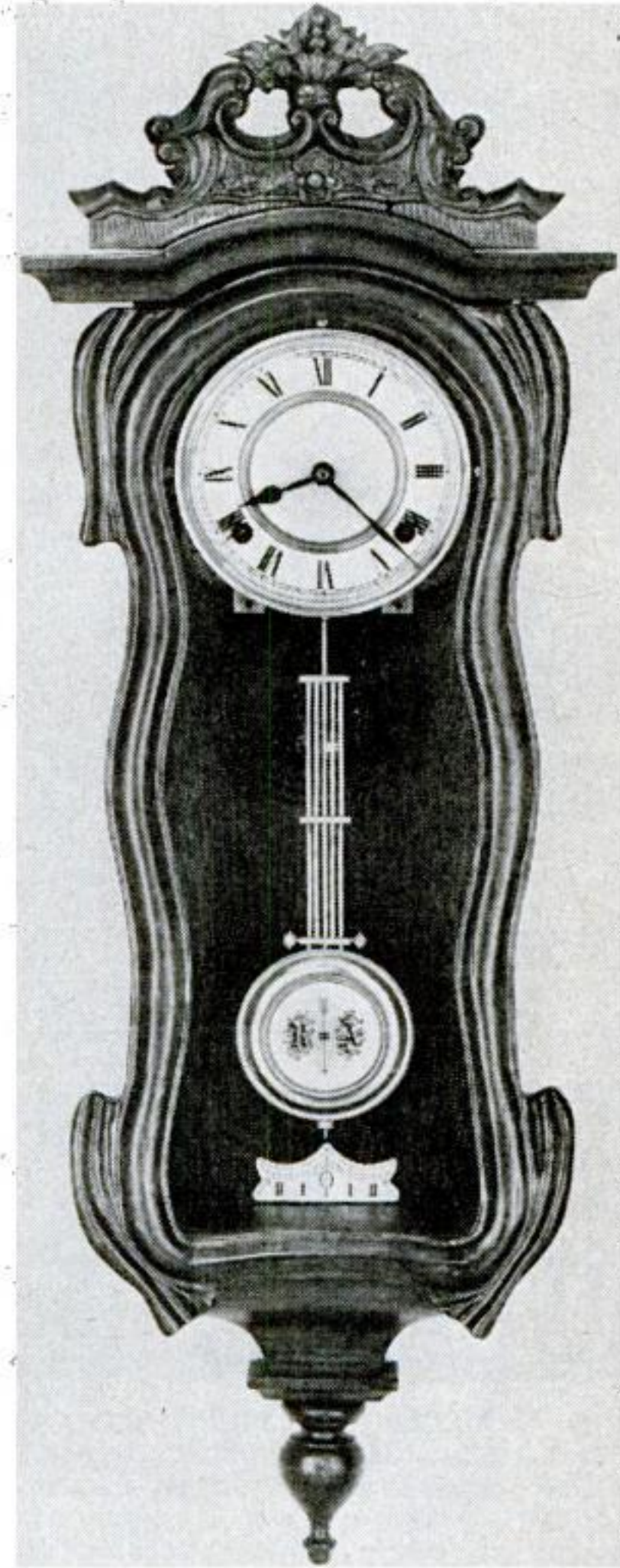
a priceless old antique should. You get all the beauty and charm of a true antique, plus the solid 'carefree' performance of a new clock... all, at a fraction of the cost of the originals. So hurry, supply is limited - order your fabulous forgery today! Guaranteed for one year,



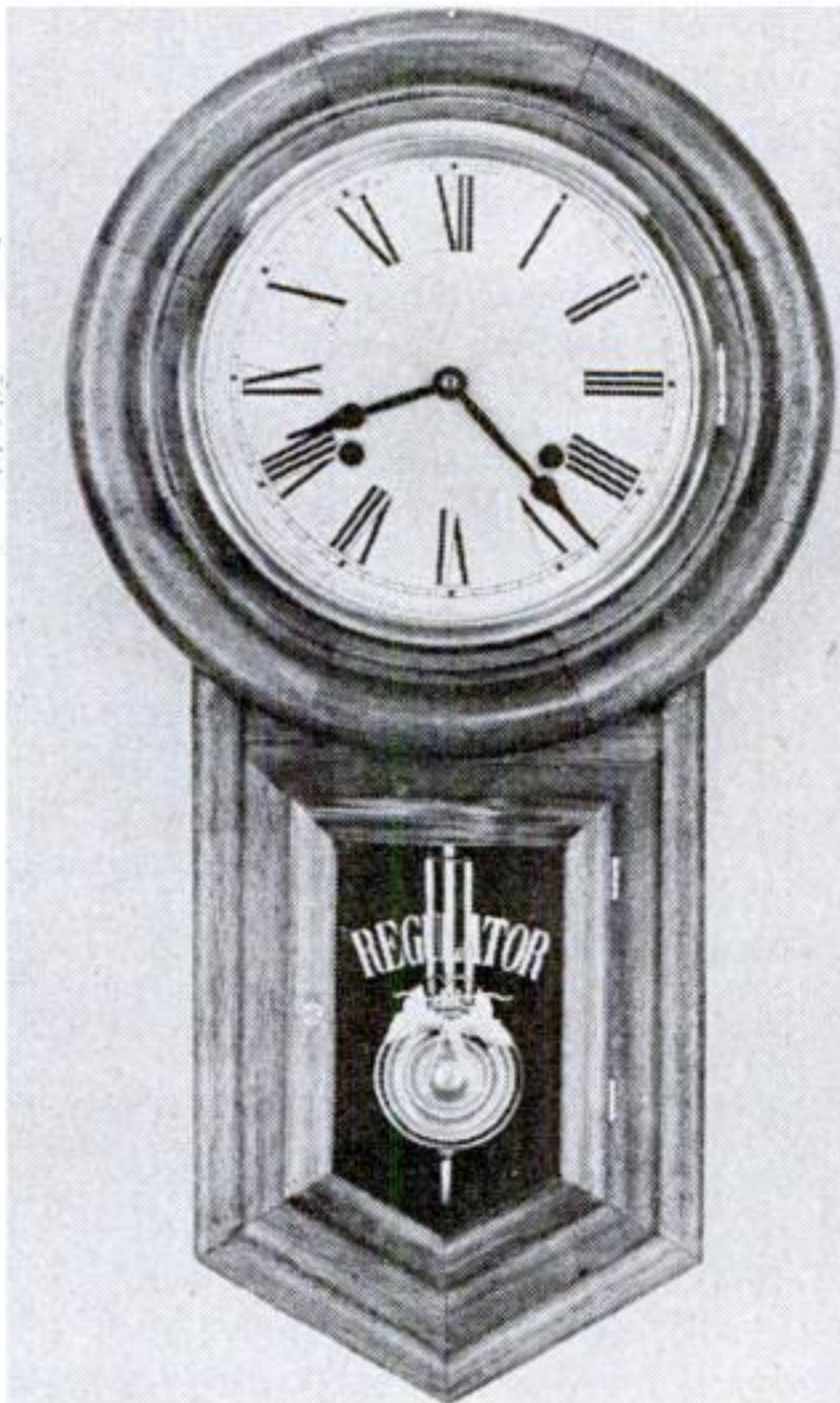
#75 THE FLORAL BOUQUET



#2 THE LIPPINZANER HORSE CLOCK



#47 THE SERPENTINE CLOCK



#12 THE R.T. SCHOOLHOUSE

ABOUT THE CLOCKS!

All the cases are 100% kiln dried solid wood. Sanded, stained, rubbed, and carved by hand. Pendulums are solid brass. Faces, traditional white with brass rims, black roman numerals and hands. The time-tested 8-day, keywind, solid brass movement chimes the hours - and is reproduced from the original Ansonia U.S. Patent of 1882. It features the Graham dead-beat escapement, lantern pinions, traditional 3/4" X 96" X .013" blued steel springs.

#2 THE HORSE CLOCK. Circa; 1880. 36"L X 14 1/2"W X 6"D. Walnut with walnut finish. Large glass door. Glass panels on each side. Only \$110.

#12 THE R.T. SCHOOLHOUSE. Circa; 1880. 22"L X 12"W X 4 1/2"D. Solid oak with oak finish. Round glass door with brass bezel. Gold lettering on lower glass door. Only \$79.95.

#47 THE SERPENTINE. Circa; 1886; 32"L X 11 1/2"W X 5"D. Walnut with dark walnut finish. Hand-carved top. Large glass door. Glass panels on sides. Only \$119.

#75 THE FLORAL BOUQUET. Circa; 1885. 18 1/2"L X 12"W X 4 1/2"D. Hand-carved walnut with walnut finish. Round glass door. Only \$110.

BE CAREFUL AND REMEMBER...

a 'good' antique clock costs 3 to 4 times more than a reproduction. And, like all antiques, almost all the good clocks are in museums or private collections. What's leftover, are in such poor condition or with so much restored - their working ability and antique value are in serious doubt.

© 1980 COTTAGE CLOCKS

Shipped Insured In A Moulded Foam 'Safety' Box!

Use Our Telephone 'Hot-line' For Credit Card Orders!
CALL (516) 673-5552 (9:30 to 4:30 E.S.T.)

COLLECTIBLE CLOCKS

Dept. D6
15 Wall Street
Huntington, N.Y. 11743

#2 HORSE, only \$110. plus \$5.50 ship/hdlg.

#12 R.T. SCHOOLHOUSE, only \$79.95 plus \$5.50 ship/hdlg.

#47 SERPENTINE, only \$119. plus \$5.50 ship/hdlg.

#75 BOUQUET, only \$110. plus \$5.50 ship/hdlg.

SAVE! Buy Any Two Clocks Or More And We Will Pay All Shipping & Handling Charges!

Please rush the clock(s) I have checked, I understand that if I am not completely satisfied, I may return the clock(s) within 1-year for a complete refund or credit.

ENCLOSED IS \$_____ (Check or M.O.)

N.Y. State Residents Add Sales Tax

CHARGE MY: MASTERCHARGE VISA

Card # _____

Exp. Date _____ Bank # _____

Signature _____

Name _____

Address _____ Apt. # _____

City _____

State _____ Zip _____

SO YOU'VE GOT A GREAT NEW IDEA...

Now where do You go from here?

First, we think you need the answers to some important questions:

- What is the best way to protect my idea?
- How do I go about securing a patent, or getting a patent search performed, so I will know my idea is patentable?
- Where can I find a manufacturer?

We have had to answer these, and a lot of other questions the hard way! As individual inventors, we had been burned by "blind alleys" and "marketing" companies. And that is why our group, International Inventors Assoc., was formed.

I.I.A. has prepared a fact-filled guide that will show you how to protect your valuable idea and how to merchandise it! (I.I.A. currently has a worldwide network of over 2,000 manufacturers that we work with).

This guide is available on cassette or in print, and costs \$10.00. Our yearly membership dues are \$35.00, and should you decide to join I.I.A., the cost of our guide will be applied to your first year's dues. Order your I.I.A. Guide today, and get that idea of yours going!

TO: International Inventors Association
719 Dennis / Diboll, Texas 75901

Please send me one copy of your "I.I.A. Guide" for \$10. My payment is enclosed. CASSETTE PRINT

NAME

ADDRESS

CITY STATE ZIP

"PAY" YOURSELF \$1000+ to BUILD THIS NEW 4-WHEEL HAULER

- 16 or 11 H.P. Briggs & Stratton electric start engine • automatic torque converter transmissions
- 500 lbs. payload plus two passengers • dump box 44½" x 40" x 11" • steering wheel, foot pedal controls
- forward and reverse gear • rear dual hydraulic disc brakes

Tough Mark Series Haulers lug 500 lbs. of cargo plus you and a passenger almost anywhere. 16 H.P. opposed Twin-Cylinder or 11 H.P. Synchro-Balanced Briggs & Stratton engine, automatic torque converters (no manual shifting), alternator and electric start. Steering wheel, foot pedal accelerator and brake (rear dual hydraulic disc), forward and reverse gear let you maneuver easily with speeds up to 25 MPH. Dump bed 44½" x 40" x 11" extends to over 4' with tail gate opened. Many accessories.

Build it yourself and SAVE \$1000+. Engine mounts to welded & painted frame. Tires mounted on rims. You bolt parts together and pocket assembly costs. Only simple tools needed. Thousands from eight to 80 have built a Carl Heald Kit.

For more information call 616/849-3400 or write for FREE brochure today:



Heald Hauler Mark 4 Model HH-416 shown with optional headlights and knob tires.

Also 3-wheel models and with steel cab.

Carl Heald, Inc. Dept. PS-04
P.O. Box 1148, Benton Harbor, MI 49022

"SAY, SMOKEY—"

A clinic on cars by Smokey Yunick, America's most famous mechanic

Engine oil in rear end?

I have been using a 10W-40 oil with graphite in my 1978 Olds. It seems to work very well. Would this oil improve my gas mileage if I put it in the differential? I read an article suggesting this.

Warren Waller, Highland, Ill.

Don't do it. No engine oil can stand the pressure of hypoid gears in the rear axle.

Stumbling problem

I have a 1974 Jeep CJ-5 with a 258-cu.-in. engine. It has less than 25,000 miles on it and has performed well with one exception: a distinct tendency to stumble at low engine speeds and during acceleration. I believe the trouble lies with the stock carburetor. Do you think that replacing it would improve performance?

Tom Battle, Santa Maria, Calif.

Put a little more fuel in at off-idle and get a little stronger accelerator-pump shot. Also run the ignition timing at its high limits. That should handle things at normal temperature. Cold start-up might also need longer choke duration and more heat to the carb.

Oil consumption

I purchased a new Thunderbird in 1978 with a 400-c.i.d. engine, and now have about 8500 miles on it.

It uses a quart of oil every 500 miles and I am a little concerned. I went back to the Ford garage to see about getting it fixed and the shop foreman showed me a chart on oil consumption. What it amounts to is, the best I can ever expect from this car is about 700 miles to the quart. From the look on the shop foreman's face, I feel like someone just stuck it to me.

I asked why I wasn't shown this chart before I bought the car. This produced another stupid look. Got any good ideas on the best approach to this problem?

Ron Blank, Havre, Mont.

Yup. Trade it to another dealer for a different make.

Wants more mpg

I have a 1978 Dodge Sportsman Van (6100 GVW) with a 318 V8 and auto transmission (3.21 rear). I use it around town, with an average load being one wife and one ankle-biter. Once a year we load up everything for two weeks, hook up the 19-ft. Sea Ray, and head for the hills of New Hampshire. In town we get 10 mpg and on the highway a max of about 13. On our annual

excursion with the boat we get 10 mpg on the highway (regular gas).

I've been considering a 2.71 rear end to see if I could more nearly compete with my friends who have Chevy 350's and brag about their gas mileage of 15-17 mpg. Is this a good move?

Emmet Venett, Milford, Del.

Chances are, if you drive at the speed limit and conservatively, you will gain—but be prepared to accept less performance.

Wants to store car

I'm currently assigned to a U.S. Navy vessel on the West Coast. In a few months, I will be storing my car for about six months, while the ship is overseas. What should I do before putting the car away? And how should I break it in after a six-month rest?

Robert Morin, San Francisco, Calif.

Oxidation is the big enemy. Static load is also a problem. Fill all liquid containers and seal off all atmospheric vents, including the engine air intake and the exhaust system.

Add a good engine oil through the engine air intake (slow engine speed and run about a pint through at 900 rpm or so—to a point of almost stalling the engine). Relax all belts. Jack up the car and block it up so the weight is off springs and tires. Try for a storage site that's dry and has a moderate temperature.

Remove the battery and arrange for a monthly trickle charge if possible.

Transmission and rear-axle gears will rust because in several weeks lube will drain off the gears above flush level. Your only hope here is to seal the vents and try to have the drive shaft rotated manually 1½ to two turns monthly.

When you return, change oil and fuel and retension belts, and open all vents. Five miles of medium-speed driving should get her back to normal. Keep an eye on rubber-type parts for a while.

Needs high-test gas

I have a 1968 Dodge Dart V8 (318) with 60,000 miles on it. It runs fine but needs premium fuel. It will occasionally run well on super unleaded.

Since premium fuel is hard to find, would you recommend having the timing adjusted for regular fuel?

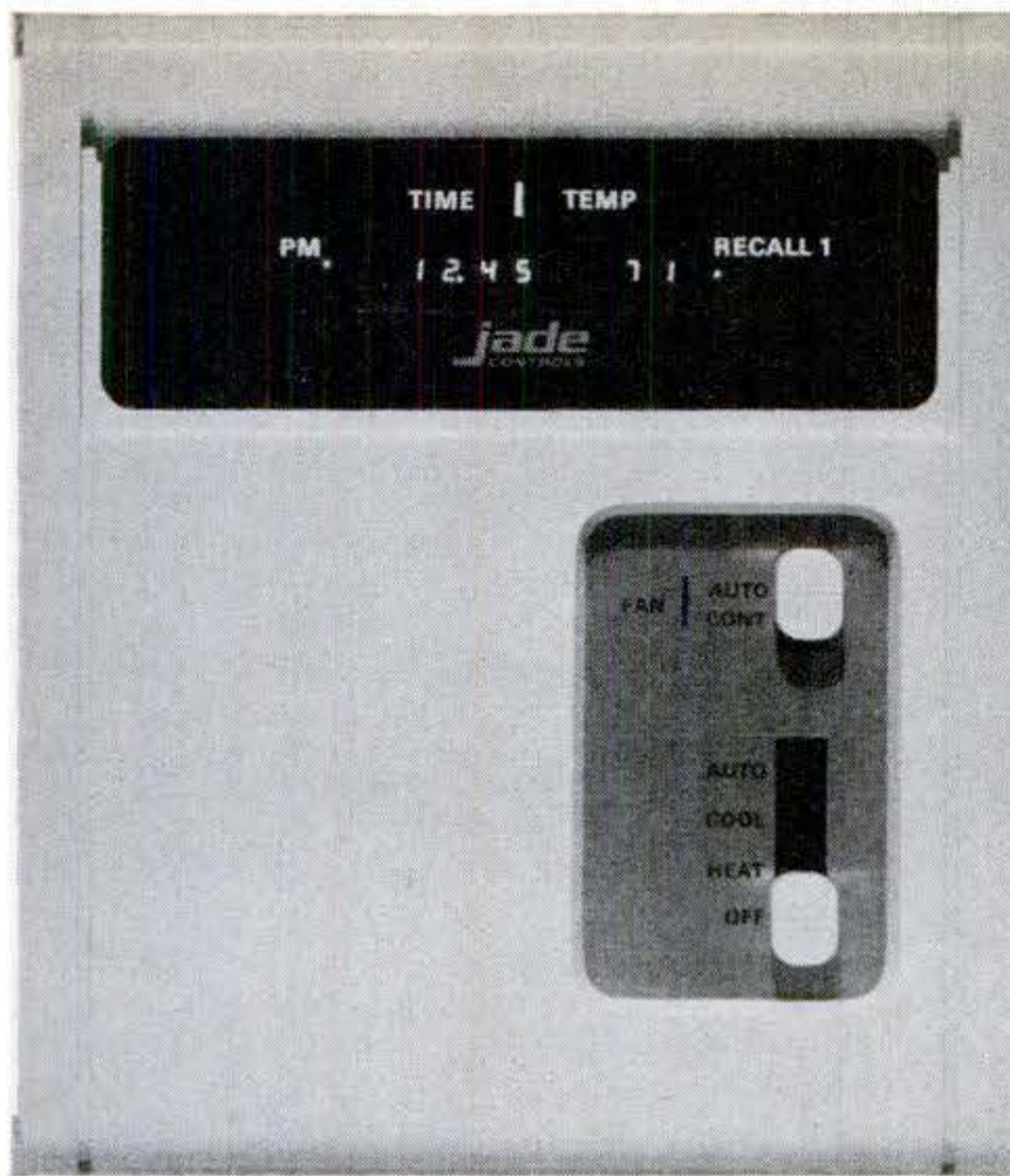
H. L. Buckley, Kensington, Md.

Not much help will come from adjusting the timing. I suggest mixing 75 percent regular leaded and 25 percent high-test unleaded, or use gasohol or water injection.

Continued

Digital Thermostat

Second generation Digital Thermostat breaks the \$100.00 price barrier. Saves you money, both Winter and Summer.



Jade features microprocessor electronics and thermistor accuracy.

If you're like the rest of us, you've been bombarded by talk about energy . . . shortages, crises, conservation and higher costs . . . always higher costs. All of us have been flooded by so many new devices that claim to save energy that it's hard to separate the legitimate ones from the gimmicks. Like you, we're a little skeptical of everything until we try it out.

TUNE YOUR PERSONAL ENVIRONMENT

We have discovered a second generation climate controller for your home that really makes sense. It's the Jade Digital Thermostat . . . and frankly, we're excited about it. It conserves energy. The Jade is easily operated and contains features usually found on much more expensive units. Features like microprocessor electronics, thermistor accuracy and a *continuous* LED display of both time and temperature.

The Jade not only replaces your old bi-metallic thermostat, it does a whole lot more. It lets you go from heat to cool and back again . . . all automatically. The Jade Digital Thermostat lets you control the temperature of your home — to the degree — 24 hours a day . . . minute by minute . . . season by season. It's like tuning your home. You use just the energy you need.

ALL SEASON CONTROL

The Jade Digital Thermostat controls your heat in the winter and your cool in the summer. If you don't use air conditioning Jade makes a model for heating systems only. Unlike all other "set-back" units, you have a wide range of control; from 35°F to 89°F in the heating program and 65°F to 98°F in the cooling program. You can program up to eight temperature changes (four heat/four cool) in a 24 hour day. Here are a couple of typical examples:

Winter Heating

Set Jade to start warming your home about 15 Minutes before you get up. When everyone has cleared out for work or school, Jade will turn down your heat to save energy while your house is empty. If the kids get home before you do, have Jade turn up the heat for them before they get home. When everyone is tucked in at night Jade will again turn down the heat to your favorite setting for sleeping. The next morning it starts all over — all automatically — you set it and forget it.

Summer Cooling

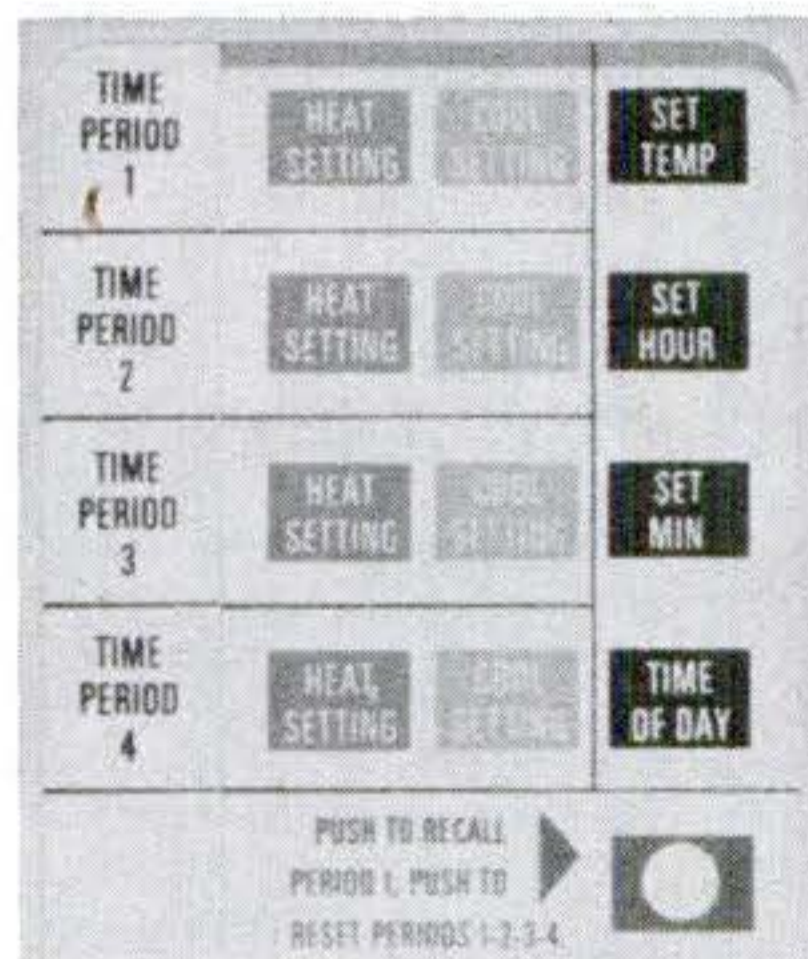
To control your air conditioning you can use the same times or change them to fit your life style — to the minute. Cool your home a little for breakfast, let it get a little warmer while everyone is away and have it cool for you before you get home in the afternoon. You don't have to waste energy by cooling all day long. If you live in a climate that has cool nights you can set your Jade Digital Thermostat to a setting which will keep the air conditioning off during the night.

SPECIAL OCCASIONS BUTTON

Not every day has the same routine. Entertaining and weekends pose different hours. To keep your home comfortable at any time, just push the Recall Button and Jade will keep your environment at the comfortable temperatures you have selected. A light will come on to remind you that you are in the recall program. Just push the Recall Button again and Jade automatically returns to your normal routine. You're in control at all times. This feature is handy for family trips and small businesses closed over the weekend. The Recall Button actually allows more freedom than the fixed programming of the 5 or 7 day thermostats.

PROGRAMMING IS A CINCH

Once you decide which time and temperature settings you want for your home, simply follow the color coded buttons and easy instructions. You can always change one or more settings without disturbing the rest of the program. Check any setting by pressing a button . . . the display will show the time and temperature you programmed into it. When the button is released, current time and temperature are displayed. After programming just close the cover and all the buttons are protected from curious little fingers.



MORE FEATURES

We've mentioned Jade's thermistor accuracy and *continuous* LED display of current time and temperature. Other features make the Jade Digital Thermostat an outstanding buy. If you've programmed both heat and cool settings, you maintain a 5° spread, to keep your heating and air conditioning systems from wasting energy by

competing with each other. If your home experiences a slight power interruption Jade keeps its programming. Even after a sustained power outage your home will stay between 50°F and 98°F. A convenient switch lets you go from automatic Heat/Cool operation to Heat only, Cool only or Off. Another switch allows you to circulate ambient air by running only the fan.

INSTALL YOURSELF . . . IT'S EASY

Just remove your old mechanical thermostat and mount Jade to the wall. We've provided long guide holes and self-tapping screws. Connect your existing wires to your new Jade Digital Thermostat — we show you how with clear instructions. Jade is attractive to apartment dwellers because you can take Jade with you when you move. Also, its off-white color blends with any decor.

TRY IT — NO RISK

Since the Jade Digital Thermostat is manufactured by a company that has 14 years experience in gas control devices, we are confident you will be completely satisfied. Just send your check or money order made out to Applied Energy Products for **\$99.95 (\$90.95 for the Heat only model)** to the address below. We pay shipping charges. Order four or more units and you can take a 10% discount. (Jade is not intended for heat pumps). Colorado residents add 3% for sales tax. Credit card customers call toll free 1-800-525-2694 24 hours a day. In Colorado call collect 1-449-9949 until 6 p.m.

We'll rush your Jade to you. Try it for 30 days and compare it to any other thermostat. If you decide to return it in that period we'll cheerfully refund your money. We also guarantee the Jade Digital Thermostat for one year against defects in parts and workmanship.

Government reports indicate you will recover your purchase price by saving up to 15% on your energy bill, summer and winter. Additionally, you'll qualify for 15% of its costs on your income tax . . . it's like getting back about \$15.00

The Jade Digital Thermostat will take a little frustration out of all that energy news, and with no obligation on your part. Order one today.

Applied Energy Products

DIVISION OF

ZDC Inc.

ENERGY PRODUCTS THAT WORK
2305 North Broadway Boulder, CO 80302

Call toll free 1-800-525-2694
In Colorado call (303) 449-9949

©ZDC, Inc. 1980

Now! A Scientific Way to "SCRUB" the Air Clean!



**"Natures Aire"
makes dust, odor
and pollutants
vanish—leaves
air country fresh**

listed by 

Discover nature's own "secret" for fresh air...

Ever notice how wonderfully fresh and clean the air is after a good thunderstorm? Well, it wasn't the rain that cleansed the air... it was the negative ions generated by the storm. Now you bring that same natural phenomenon into your home, office or car with Natures Aire, the ion generator that works like Mother Nature to cleanse, purify and refresh the air you breathe!

Natures Aire—a controlled "thunderstorm"

That's right! Natures Aire safely and electronically emits negative ions to create the same beneficial balance of ions found in the great outdoors—right in your home. You just plug it in and it silently and immediately begins to sweep unpleasant odors, smoke and pollutants from the air—leaves it refreshed and smelling sweet and country-fresh.

Unlike many similar products...

Natures Aire produces precisely the right balance of ions—25,000/cm³. Much more or less would not have the beneficial effect. In fact, Natures Aire is now the standard by which Underwriters Laboratories measures other negative ion generators. It will be the first ion generator to receive UL.

Proven safe and effective

Yes, Natures Aire's graphite conductive fibers are so safe a baby could chew on them. And Natures Aire sweeps any airborne micron-size pollutants from the air and deposits them in the wall or floor. So effective at eliminating smoke and odors, you'll notice the pleasant difference in just minutes!

Perfect when you entertain

You'll love breathing purified air everyday, but imagine what a great benefit Natures Aire will be when you have parties. No lingering cooking odors to embarrass you—no smoke filled rooms when the guests are gone! Yes, Natures Aire will actually destroy stubborn odors and pollutants—not just cover them up with an artificial "freshener." Lets the whole family breathe easier!

Prove it to yourself for 30 days

You really must experience the remarkable Natures Aire phenomenon for yourself to be absolutely convinced. It's the ion generator that really works. Enjoy Natures Aire in your own home, office or car for 30 full

days—if not thoroughly impressed with this revolutionary air purifier, simply return it and we'll send you a prompt, courteous refund. No questions asked! Immediate Delivery—No Waiting!

Pure air... Pure value!

Imagine! For fresh, pure air every day of your life—you pay just \$79.95. A small investment when it comes to protecting the well-being of your whole family!

Safe enough for a baby....yet effective enough to rid your home of lingering smoke, odors and pollutants. Leaves it wonderfully refreshed and sweet smelling!

 **CAMBRIDGE INTERNATIONAL, Inc.**

8700 Waukegan Rd. Morton Grove, IL 60053 (312) 966-5510

Credit Card Customers

Call Toll Free 24 hours a day

800-228-5440

(In Neb. 800-642-8777)

Clip & Mail to:

Cambridge International, Inc. Dept— P-40
8700 Waukegan Road,
Morton Grove, Illinois 60053

YES! Please rush me _____ (quantity) Natures Aire Ion Generator(s) at just \$79.95 plus \$3.95 for shipping and handling. (Ill. residents add 6% sales tax.) I understand that if I am not absolutely satisfied with my purchase, I may return it within 30 days for a prompt and courteous refund.

OPTION! Send me _____ (quantity) Mountain Aire Ion Generator(s) for my car or van at just \$79.95 plus \$3.95 for shipping and handling.

Check or MO enclosed
 Charge to: American Express Diners Club
 Carte Blanche Master Charge Visa

Account# _____ Exp. Date _____

Name _____

Address _____

City _____ State _____ Zip _____

Signature _____

© Cambridge International, Inc. 1980

"Say, Smokey—"

[Continued]

tion. I don't consider any of these a good thing, but they can help older models. The real problem is too much compression.

About FWD

I would like to know the advantages and disadvantages of front-wheel drive.

I am thinking of buying a Buick and don't know whether to buy an Electra or Riviera. Which one would you buy?

A. W. Drake, Franklin, Va.

After adding up the pluses and minuses, I vote front-wheel drive. It's better in all ways except in a panic stop with one passenger.

Hard starting

I own a '73 Buick Century 350 without air conditioning. Sometimes when I start the car it acts as if the battery is weak. The starter barely turns the engine over. The most serious experience was recently: It would not even crank.

A serviceman came over and attached a mobile generator to my battery, but still no start. He then said that my battery was no good. I asked: If I replaced the battery and the car did not start, would he take the battery back? He said yes. So I told him to go ahead and, sure enough, when he hooked up the new battery the car started easily. I thought I was in the clear, but shortly thereafter I again got the slow cranking when starting. I then checked the battery I had removed from the car and it showed full charge.

Before this last incident I was told it was my starter, so I had that changed—but that didn't help. Then I read that something like this could be due to a faulty coil, so I changed that—with no results. I then cleaned all battery terminals, the ground cable, and the starter connection—and still have the problem.

Louis Cornale, Bronx, N.Y.

Battery cables or the starter solenoid could be the trouble. If you change cables, be sure and get heavy duty. Did you get a heavy-duty battery or the smallest and cheapest? Check the starter for excessive current draw or a bad ground.

Change in stock cars?

I am an avid fan of stock-car racing. I would like to know when the racers are going to begin using the new smaller cars. Also, what size engines will they use?

Glad you asked. In stock-car racing, nothing has happened except some races have been shortened a little and practice has been cut down a little. Seems like a cut-back on engine and car size should be exercised to adjust to our changing times and energy problems. I'd say they are two years late in resizing already.

I see it as V6 engines, particularly Buick's in 2500-lb. cars. And I believe front-wheel drive will be on 95 percent of our cars soon.

Continued

"By thunders of White Silence, overthrown."

— Elizabeth Barrett Browning

White Silence

Major Price Breakthrough

A truly affordable and highly reliable way to protect what you've worked so hard for.

Within the last few years, home and office protection devices have developed into near perfect security systems. You can now leave your apartment for an evening, or your office for a weekend with total peace of mind.

The major breakthrough behind this total security is ultrasonic motion detection. *White Silence*.

Essentially, White Silence is a harmless cone of energy that envelops an area. Any movement within this invisible energy field sends a signal back to the system's computer base to sound a warning.

USED TO SAFEGUARD FACTORIES

Systems incorporating the very same ultrasonic motion detection technology used in our American-made Private Eye, guard many of the nation's plant and factory facilities. Understandably, these units encompass networks of "White Silence" systems and cost hundreds and thousands of dollars.

BUILT AND PRICED FOR PERSONAL APPLICATION

Private Eye White Silence is new. It has been especially designed to protect homes, apartments, offices, basements, cabins, etc.

READY TO PLUG IN

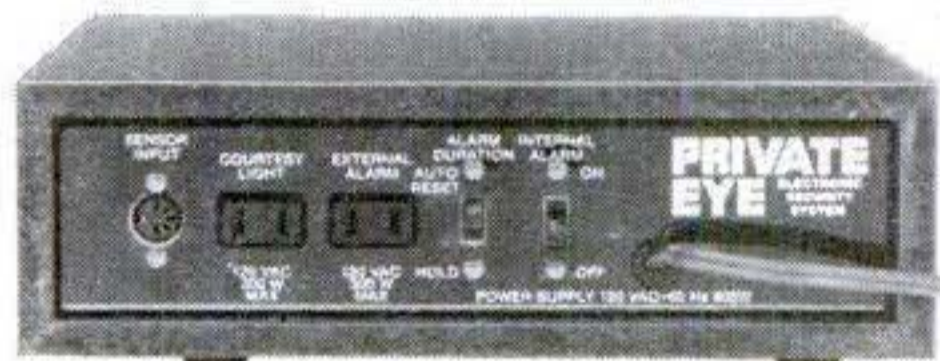
The entire system comes complete. You just plug it into any household 110v AC outlet. You don't need special speakers, horns or proximity to a TV to make it work. Everything, including siren, is built right in.

The computer base of our Private Eye system is housed in a walnut finished cabinet that's just 3" tall x 10 1/4" w x 8 3/4" d. This compact unit is attractive enough to set on a bookshelf, but is equally efficient when hidden out of sight. With this base comes a remote sensor. It is this miniature speaker-looking cabinet only 10 1/4" tall x 3" wide x 2" d that sends out the energy scan. Easy, instant operation. A variable sensitivity control at the back of the computer cabinet lets you adjust the ultrasonic cone to a range of 30 feet by 20 feet across. The remote sensor comes with a 30-foot connecting cord so that it can be placed quite far from the siren base.

TOTAL COVERAGE

Let's assume that at the rear of your home you have a patio door and a second rear entrance from the laundry room. The sensor can be placed to protect an entry hall common to both, so that any intrusion from either door will signal the alarm.

Take a closer look at the control panel. We said that the siren was built into it. That siren emits an 85 decibel ear-piercing alarm 12 seconds after movement is detected. This gives you time to shut off the system upon your return. You can control the sound pattern. Set the Alarm Duration switch to "Auto Reset" and it will blast for up to 4 1/2 minutes, then pause and rearm itself. In other words, if the intruder has been frightened away, the alarm has reset itself to protect against further entry. In the "Hold" position, the alarm blasts continuously.



Notice the courtesy light and the external alarm outlets. You won't find these on many systems costing hundreds of dollars. They are auxiliary features that offer added protection.

You already own the accessories. Plug any lamp into the courtesy light outlet and immediately upon detection of intrusion, the lamp switches on. You can light up the entire area, if you wish. Twelve seconds later, the alarm goes off. And it's loud enough to let your neighbors know something is happening in your place.

If you want added attention, you can plug in a second remote siren or remote light to the External Alarm outlet. This alarm or light can be stationed anywhere. On the roof, outside the front door, in the basement. It will go off simultaneously with the built-in alarm.

The solid state engineering of our White Silence system makes it extraordinarily portable, practical to use anywhere and superbly reliable.

Above all, the new automated technology inherent in this domestically made system lets you enjoy total peace of mind protection at far less than you would ever expect to pay. The complete Private Eye White Silence System, with computer base, built-in siren and remote sensor is only \$94.95.

A RELIABLE, AFFORDABLE SYSTEM

It is a reliable system, a major breakthrough in price, design and trustworthy engineering. But, to prove it, you must use it in your apartment, home or office. Try it. Plug it in. That's all you have to do. Plug in a lamp, if you wish. Then, test

it. You will appreciate the security and comfort it provides. We know you will.

Use it for 10 days at our expense. Let the Private Eye System work for you. Plug it in your office overnight. You will never be concerned about returning to your apartment or home late at night. If you are not convinced that it is an exceptional security system, just return it for a prompt refund.

CREDIT CARD ORDERS CALL TOLL FREE

800-621-5199

ILLINOIS RES: 800-972-5855

24 HOURS—7 DAYS/WEEK

- Please send me _____ Private Eye White Silence System(s) complete with computer base and remote sensor at \$94.95 each, plus \$4.00 packaging and insurance. If not satisfied, I can return it for a prompt refund.

Illinois residents add 5% sales tax. Prices slightly higher beyond continental U.S.

- Enclosed please find check or money order.

- Charge my credit card:
 American Express Diner's Club
 Master Charge Carte Blanche
 Bank Americard/VISA

Credit Card No. _____

Master Charge No. _____

Exp. Date _____

Name _____

Address _____

City _____

State _____ Zip _____

Signature _____

PS-04

©Camelot '80

Camelot
DIRECT

801 Green Bay Rd., Lake Bluff, IL 60044

DIVISION OF UNITED EDUCATORS



GAS TO ELECTRIC CONVERSION KIT

2 bulb fixture duplicates the *charm* and increases the light output of any existing double mantle gaslight. Kit includes on-at-dusk, off-at-dawn photo control, fixture, bulbs, detailed instructions. Approximately 60¢ per month to operate compared to \$5.00 with gas. 115 volt kit \$29.95 postpaid, or safe 12 volt kit, including plug-in transformer, \$39.95. **Dealers and installers inquiries invited.**

YARDLIGHTING SYSTEMS INC.

1039 CHARLES AVE., DEPT. 10 • ST. PAUL, MINN. 55104

DELUXE QUALITY MOVIE VIEWER only \$34.95

8 MM & SUPER 8

COLOR or
BLACK & WHITE



10 DAY MONEY BACK GUARANTEE
Try your Luminavision viewer for 10 full days. If it doesn't completely satisfy all your movie viewing needs, return it to us for a prompt refund of the full purchase price.

- Handles 200' reels of 8MM and Super 8
- Fully portable-Battery operated

Transformer permits operation from household current - Save on batteries only \$4.95

- Adjustable speed-Fast to Stop Action for single frame viewing and editing
- Precision lens-lifelike viewing

Now you can enjoy quality movies in the privacy of your home. "Luminavision" handles up to 200' reels of both 8 MM or super 8 film and gives detailed viewing in both color or black and white. It's battery operated and has a carry handle for complete portability to parties or for sales presentations. Stop action and speed control switches make for excellent single frame viewing or for film editing. This precision made viewer is only \$34.95 plus \$2.50 for postage and handling. (batteries not included) For COD's send a \$5 goodwill deposit and pay postman the balance plus COD charges.

Honor House Prod. Dept. 97VX02
35 Wilbur Street, Lynbrook NY 11563

Gentlemen: Rush me the "Luminavision" viewer on your 10 day money back guarantee.

- I want to save COD charges so I enclose \$34.95 plus \$2.50 for postage and handling
- I enclose \$5 deposit. Rush my order and I will pay Postman the balance plus COD charges
- The transformer I enclose \$4.95.

Name _____
Address _____
City _____ State _____ Zip _____

N.Y. State Res. please add Sales tax.

Glue hold-ups?

**NO WAITING
NO CLAMPING
NO MIXING
NO MESS
WITH HOT GLUE**

**THERMOGRIP®
ELECTRIC
GLUE GUN**

Hot glue sets in seconds. Permanently bonds wood, leather, paper, fabric, tiles. Glue with our hot glue and you'll never let cold glue hold you up again. THERMOGRIP Brand Electric Glue Gun.

**Bostik Consumer
Division** Reading, PA 19605
An **EMHART** Unit



"Say, Smokey—"

[Continued]

Backfiring problem

I have a 1978 Mercury Zephyr with a 2.3-liter engine and four-speed transmission. The car now has 10,500 miles on it. It idles rough, has very uneven deceleration, gets poor gas mileage, and pops and backfires through the exhaust while idling. The dealer has set the timing and adjusted the carburetor several times. The first time, I was told that the carb was out of adjustment. I've heard that some of the 2.3-liter engines develop camshaft problems, and I am wondering if the problems I'm having suggest cam trouble. If not, is the carburetor the culprit?

George Elliott, Greencastle, Pa.

Popping through the exhaust usually is caused by an open exhaust valve when the engine fires. Burned, sticking exhaust valves could be involved. Also a bad cam. Do a cylinder-leakage test. A distributor cap leaking—allowing a plug to fire with an open exhaust valve—could cause this problem, too.

Fix for high-compression engine

I recently inherited a Continental Mark III (460 cu. in.) and find that the super-unleaded fuel is not so super for these high-compression cars.

You have hinted before at the solution: increasing the thickness of the head gaskets to reduce the compression ratio so other fuels could be used. If this is done: (A) What other changes must be made? (B) How much power is lost? (C) What will happen to the gas consumption? (D) What other changes will occur?

Robin Brumley, Toronto, Ont.

(A) Reset your timing, probably two degrees or so slower. (B) Very little. (C) Remains about the same. (D) Little loss in acceleration.

Sulfur smell

I have often noticed a sulfurous "rotten-egg" odor from the exhaust of my 1979 Plymouth Horizon. Is this normal, or is it a sign of some problem in the emission-control system? The engine also has a run-on problem.

Ralph C. Wright, New London, N.H.

Increasing the idle speed should get rid of the odor. The throttle plate needs to close tighter in the engine shutdown mode to stop the run-on problem.

About nitrous oxide

I have heard a lot about nitrous oxide injection. What is it? And how does it work in a car's engine? And how does this give the engine more horsepower? Can this addition be dangerous to the owner of the car if gas leaks into the passenger compartment, or is this possible?

Raymond Mathews, Oakland, Calif.

It's the same as a dentist's laughing gas. Its oxygen concentration is incredible (if

Continued

**PUBLIC NOTICE!
BANKRUPTCY
and Financially
Distressed Merchandise!**

As the nation's largest authorized mail order liquidator of consumer products, we constantly receive big inventories that must be quickly sold at sacrifice prices!

There are many reasons for these closeouts, such as: Last year's models. Discontinued products. Bankruptcy, loan foreclosure, or other serious financial problems. Plant closings. Insurance claim sale, etc., etc.

If you know of any company in a situation that requires them to sell large inventories for immediate cash, call us Toll-Free: 800-328-5082. Only products in perfect operating condition will be considered.

All inventories we liquidate must be priced to sell **BELOW NORMAL DEALER COST!**

MUST LIQUIDATE

AT FAR BELOW DEALER COST!

12-Speed, Heavy-Duty 3/4 hp. DRILL PRESS

FACTORY NEW! PERFECT CONDITION

**Heavy duty, by Milwaukee
Pneumatic® with a 5/8" chuck.**

Great for industrial use or home workshop!

Here's a heavy-duty, 14" drill press at a fantastically low liquidation price that's even less than those little "sissy" models!

This heavy, 160 lb. "brute" has all the power, all the "guts" you need for fast, smooth drilling into steel, cast iron, aluminum, brass, wood, plastic. Head and base are made of strong, fine-grained cast iron. Heavy walled machined column increases rigidity, cuts vibration for smoother operation. Standard NEMA 56 frame.

Oil table swings 360° and tilts 0° to 45°. Precise up and down movement of table with rack and pinion. Recessed light in head gives bright illumination of work. We dropped the price way down low to sell them FAST! Order yours right away!

- Capacitor start 110V motor; grounded receptical 10 Amps.
- All belt pulleys on ball bearings. 5" largest pulley on spindle (high torque).
- Quick release belt tension.
- Chuck is 5/8" No. 3 J.T. Arbor.
- 11" x 17" base; 2-7/8" column diam.
- Height: 40 1/2"; weight: 160 pounds.
- Spindle to table (max.): 15 1/4"
- Spindle to base (max.): 23-5/8"
- 7" from spindle center to column
- 11 1/4" diam. oil table with "T" grooves.

INCLUDES MORSE TAPER!

Reg. Retail: \$695.00

NOW . . . while they last:

\$198

Plus shipping charge



To order, or to ask questions,

Phone Toll-Free: 800-328-5082

Minnesota residents call Collect: (612) 729-2345

C.O.M.B. Co. / Authorized Liquidators
3258 Minnehaha Ave. S. Minneapolis, Minn. 55406

Dept. 191

Please send _____ 12-speed Heavy Duty Drill Press(es) at \$198.00 each. I will pay the shipping charges to driver upon delivery. (Allow 4 to 5 weeks for delivery. If paid with personal check, allow an extra 2 weeks for the check to clear.) **Sorry, NO C.O.D.**

Also send Vise Attachment for \$25.00. (In separate carton; NO shipping charge.)

My check or money order is enclosed.

Charge to my credit card: Mastercharge

VISA

American Express

Acct. No. _____

Expires _____

PLEASE PRINT CLEARLY

Name _____

Address _____

City _____ State _____ ZIP _____



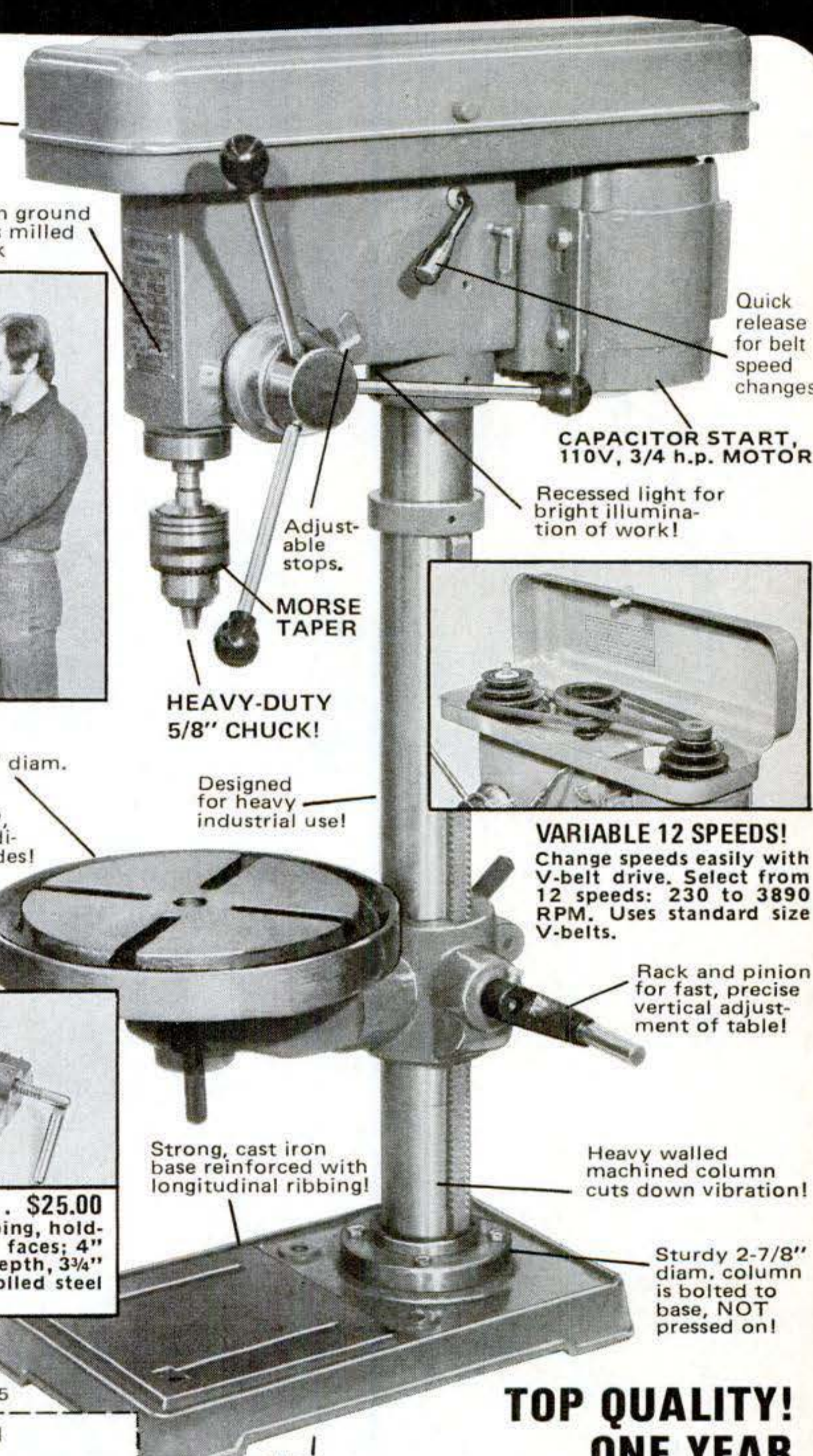
Precision ground quill has milled rear rack

Big 11 1/4" diam. oil table!

Table rotates 360°, tilts 0° to 45°. Indicator scale both sides!



Vise Attachment . . . \$25.00
For maximum clamping, holding power. Steel jaw faces; 4" jaw width, 1 1/4" jaw depth, 3 3/4" jaw opening. Cold rolled steel screw.



Fully enclosed belt guard case for safety!

Quick release for belt speed changes.

CAPACITOR START, 110V, 3/4 h.p. MOTOR!

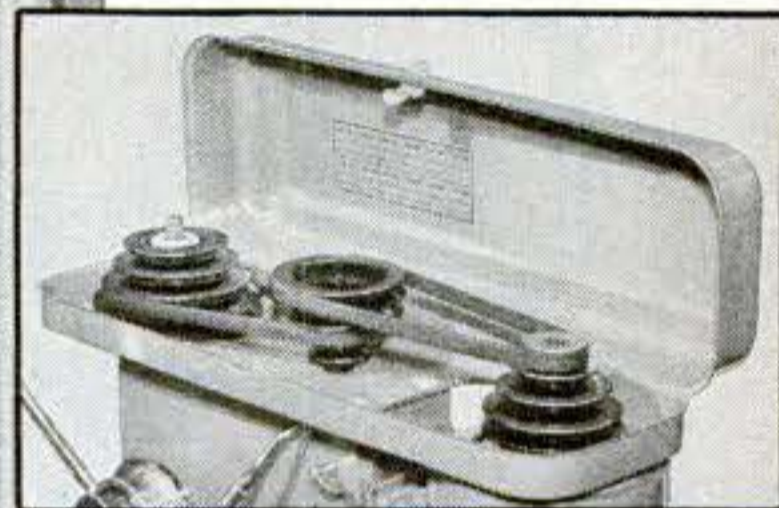
Recessed light for bright illumination of work!

Adjustable stops.

MORSE TAPER

HEAVY-DUTY 5/8" CHUCK!

Designed for heavy industrial use!



VARIABLE 12 SPEEDS!

Change speeds easily with V-belt drive. Select from 12 speeds: 230 to 3890 RPM. Uses standard size V-belts.

Rack and pinion for fast, precise vertical adjustment of table!

Strong, cast iron base reinforced with longitudinal ribbing!

Heavy walled machined column cuts down vibration!

Sturdy 2-7/8" diam. column is bolted to base, NOT pressed on!

A big, 160 lb. heavy-weight!

**TOP QUALITY!
ONE YEAR
PARTS WARRANTY!**

C.O.M.B. Co.

THE NATION'S LARGEST AUTHORIZED MAIL ORDER LIQUIDATOR OF CONSUMER PRODUCTS
3258 MINNEHAHA / MINNEAPOLIS, MN 55406
Phone: 612-729-2345 Toll-Free: 800 328-5082

MOLDS

for making
Ornamental Concrete
Items...



Book about Aluminum
Molds with prices and
production trade secrets
direct from world's larg-
est mold manufacturer.

SEND
\$5.00

CONCRETE MACHINERY COMPANY, INC.

P. O. BOX B99 - HICKORY, N. C. 28601

HYDRAULIC JACK REPAIRS

Earn While You Learn In Your Spare Time



Trained and qualified mechanics needed NOW to service inoperative hydraulic jacks. BIG opportunity for ambitious men. We show you HOW - in your basement or garage to earn spare time cash in an expanding industry. Don't wait, ACT NOW! Get the facts.

Write for folder No. PS4 and free bonus offer.

Hydraulic Jack Repair Manual Co., Inc.

G. P. O. BOX 3 • STATEN ISLAND, N. Y. 10314

Fireplace Beauty PLUS Highest Heat Output & Efficiency



Write: Thermograte Ent. Inc.
Dept. 861-004 P.O. Box 43021
St. Paul MN 55164.

Or CALL TOLL FREE 800-328-0882

"Say, Smokey—"

[Continued]

you add more fuel, it acts like a super-charger). Costs are out of the ballpark. Engine life is shortened relative to the amount used. It's only use is in racing.

Good mpg yesterday

The 1955 and '56 Chevrolets with 265 V8, stick shift, and overdrive were getting mileage in the 20's quite regularly. One friend of mine claimed he got 27 mpg.

Is there any reason car makers can't do even better after 24 years?

L. D. Voyles, Reynoldsburg, Ohio

Those Chevys with light, small engines and no emission controls and 25 percent overdrive got very good mileage. But the trick today is to do it with emission controls, and that's difficult. Just hang on a little while, though; we've finally decided we have an energy problem and now the job will get done.

Burned pistons

My 1975 Datsun B210 just had a complete engine overhaul (including two cylinders bored and sleeved) because of a severe case of burned pistons. I am positive the engine never overheated, at least not to the point where it registered on the temperature gauge (which was checked and works perfectly).

Someone suggested that because the engine has an aluminum head on cast-iron block, it is necessary to tighten the headbolts every 12,000 miles or less because the head gasket might slip and allow water to leak into the cylinders. The owner's manual indicates only that the head gasket should be checked at the first 1000-mile checkup.

Two of my friends have had similar problems with burned pistons in their Datsuns. Could you give any suggestions as to what causes this, so I can avoid its happening again? I'm out almost \$1000 for the engine repair.

Russell Fleming Jr., Milltown, N.J.

I'd be looking for a lean condition or too much spark. Or too much compression for the fuel you are using. I believe your burned pistons are a result of high combustion temperature, not a hot cooling system.

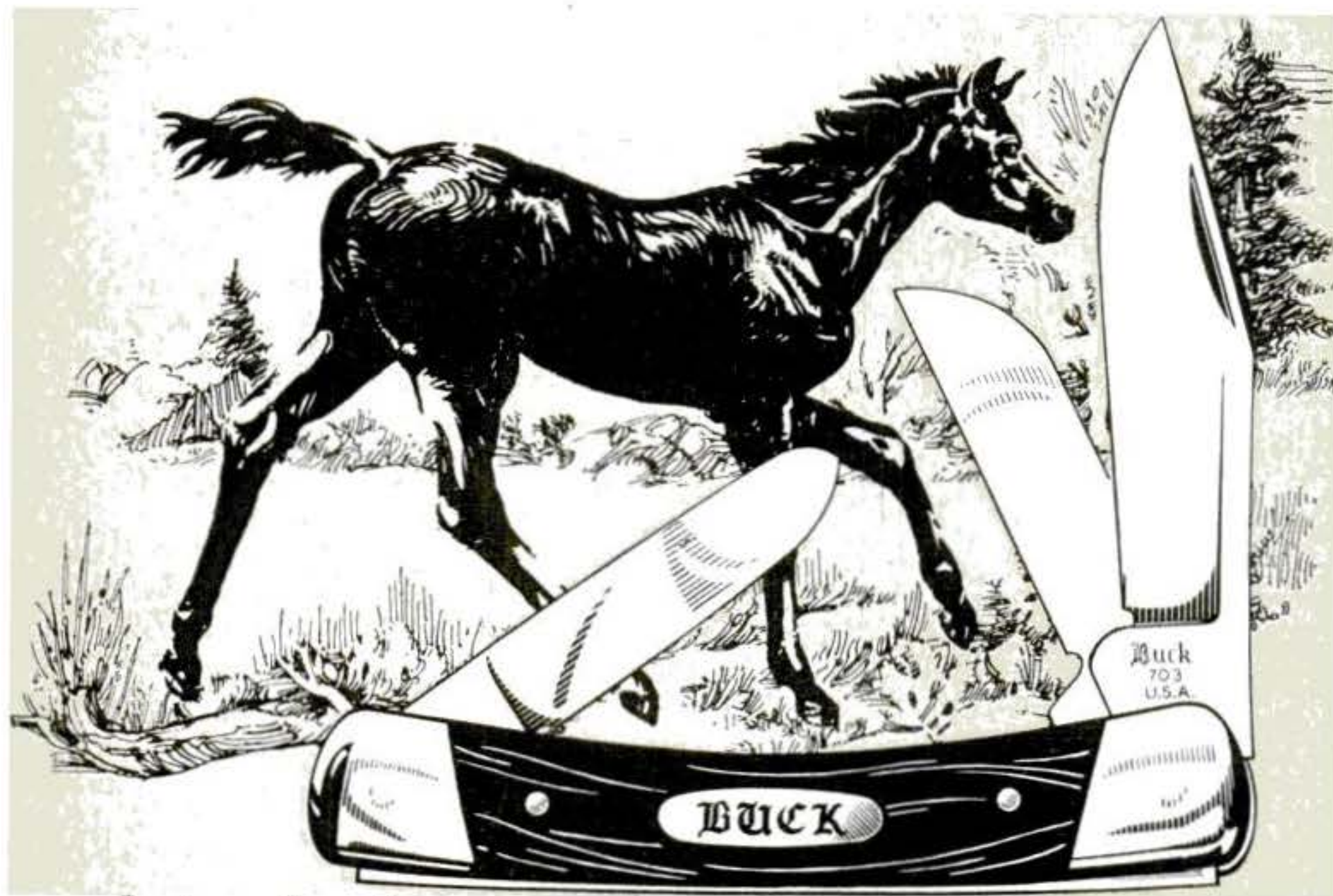
Propane conversion?

Now that gas is sky high, what is the future for propane-car conversions? It seems that there's plenty of propane around. Does the \$900-\$1200 for the job seem indicated?

Leonard Shedler, Seminole, Fla.

Damn good fuel but it costs about 15 percent more to get it from point A to point B. I can't figure out for the life of me where it's all going to come from. Right now, it's less per gallon than gas. But I wonder how long that will last, especially since it's soon bound to be scarce and hard to find. It likes a compression ratio of 10 to 11 to

Continued



Introducing

ACTUAL SIZE

the new Super Knife from Buck

Here's a whole new concept in what a pocket knife should be. Truly a new knife . . . a super knife: *The Colt*.

First in a new line engineered by Buck craftsmen with advantages no other knife today can offer, the *Colt* is stronger, heftier, has more body.

Heavier bolsters are made of stainless steel; liners made of stainless, too. Non-rusting springs. Handle inserts are laminated wood/epoxy for long-lasting wood-grain beauty. Best of all the *Colt's* three

blades are hollow-ground, made of new high-chrome, high-carbon steel.

But these are just words. See Buck's *Colt* (model #703) at your favorite store. You just might consider retiring the old friend in your pocket . . . and make a life-long companion of the new *Colt*!

BUCK KNIVES

Free Booklet *KNIFE KNOW-HOW*, Dept. PS-480, Box 1267, El Cajon, CA 92022

Know your car inside and out.

Know how to fix it... to tune it... to service it... to keep it running right. The TOTAL SERVICE MANUAL for your car will show you how to do everything from a minor adjustment to a major repair.

factory workshop manuals. Each one is carefully rewritten for use by the do-it-yourself car owner. Clear and easy to follow, yet complete and detailed enough even for professional use. You get all the important information plus hundreds of the best pictures, diagrams, and specifications.

TOTAL SERVICE MANUALS are digests of official TOTAL SERVICE MANUALS

SATISFACTION GUARANTEED OR YOUR MONEY BACK



1713	ALFA ROMEO 62-78 for all Giulia, GT & Spider mdls	\$9.95
9641	ALFA ROMEO ALFETTA 73-78	\$9.95
9643	AMC AMBASSADOR 68-74 covers all models	\$9.95
8677	AMC GREMLIN & HORNET 71-77 for all 6 & V8 models	\$9.95
8190	AMC REBEL 67-70 all models plus Matador 71-74	\$8.95
0991	ARROW, PLYMOUTH 76-77 for all models	\$9.95
9404	ASPEN, DODGE 76-78 for all models	\$7.95
7122	AUDI 100 70-77 for all models inc 100L	\$9.95
0664	AUDI 5000 77-79	\$9.95
8749	AUDI FOX 73-79 covers all models	\$17.50
0916	AUSTIN AMERICA 68-71 covers all models inc 1100, 1300	\$9.95
1203	AUSTIN HEALEY 100/6, 3000 56-68 for all models	\$9.95
0752	AUSTIN MARINA 71-75 sedan and GT models	\$9.95
0379	BARRACUDA & 'CUDA 65-72 all 6 & V8 models	\$7.95
8154	BLAZER, CHEVY 67-79 all mdls plus Suburban & GMC Jimmy	\$9.95
1007	BMW 1600 66-73 covers all models	\$9.95
1042	BMW 2000, 2002 66-76 covers all mdls inc CA, CS, TI	\$9.95
9813	BMW 320 75-79 covers all models	\$9.95
9760	BMW 2500, 2800, 3.0 all mdls inc Bavaria & CS	\$10.95
0883	BOBCAT, MERCURY 76-79 covers all models	\$7.95
0504	BRONCO, FORD 66-77 all 2 & 4 whl drive models	\$7.95
0011	BUICK 66-68 factory shop manual... must give year	\$17.95
0025	BUICK 71-79 shop manual... must give year. No 72-73	\$17.95
0727	CADILLAC 68-74 all models except El Dorado	\$9.95
8678	CAMARO 67-78 covers all 6 & V8 models	\$9.95
9557	CAPRI 70-76 for all 2000, 2600, 2800 mdls	\$9.95
0875	CAPRI II 77-78 covers all models	\$9.95
0379	CHALLENGER 70-72 covers all 6 and V8 mdls	\$7.95
8331	CHARGER 67-70 for all models inc 500 & R/T	\$7.95
8212	CHARGER 71-75 covers all models	\$7.95
0383	CHEVELLE 64-77 inc Malibu, Monte Carlo, El Camino	\$7.95
0838	CHEVETTE 76-78 covers all models	\$9.95
1038	CHEVROLET 29-40 covers all 6-cyl models	\$15.00
0888	CHEVROLET 49-54 reprint of factory shop manual	\$16.00
0051	CHEVROLET 55 or 57 reprint factory manual, give year	\$19.95
8407	CHEVROLET 56 supplement to 55 manual	\$9.95
0870	CHEVROLET 68-77 for all full size models	\$7.95
8187	CHEVY II 62-68 covers all 4, 6 & V8 models	\$8.95
0779	CHEVY LUV 72-77 covers all models	\$9.95
1661	CHEVY PICK-UPS 67-78 all models & GMC	\$9.95
1662	CHEVY VANS 67-78 for all models & GMC	\$9.95
1145	CHRYSLER 55-71 all inc Newport, 300, New Yorker	\$9.95
0020	CHRYSLER 72-79 factory manual... must give year	\$22.95
9588	CITROEN ID, DS 67-75 covers all DS19, 20, 21 mdls	\$9.95
8539	CITROEN SM reprint of factory service manual	\$19.95
8264	COLT, DODGE 71-77 covers all models	\$9.95
9422	COMET 60-65 covers all models	\$7.95
8211	COMET 70-77 covers all models	\$7.95
8212	CORONET, DODGE 71-75 covers all models	\$7.95
0477	CORVAIR 60-69 covers all models	\$9.95
0478	CORVETTE 57-65 covers all 283 & 327 models	\$9.95
9481	CORVETTE 66-79 covers all 327, 350, 427, 454 models	\$9.95
1756	CRICKET, PLYMOUTH 70-73 also covers Hillman Avenger	\$9.95
9440	DART & DEMON 65-67 covers all models	\$7.95
8188	DART & DEMON 68-76 covers all models	\$7.95
1657	DATSUN F10 76-78 covers all models	\$9.95
1164	DATSUN 200SX 77-79 covers all models	\$9.95
8065	DATSUN 1200, B210 68-78 covers all models	\$9.95
8127	DATSUN 240Z, 260Z, 280Z 70-78 covers all models	\$9.95
1551	DATSUN 510 68-73 covers all sdn & wagon mdls	\$9.95
1074	DATSUN 510 78-79 covers all models	\$9.95
9583	DATSUN 610 68-77 covers all models	\$9.95
0935	DATSUN 710 73-76 covers all models	\$9.95
8271	DATSUN 810 77-78 for all models	\$9.95
1258	DATSUN 311 1600/2000 SPL & SRL sports car mdls	\$10.95
9297	DATSUN PICK-UP 68-77 covers all 521 & 620 models	\$9.95
1145	DODGE 55-71 all inc Coronet, Monaco, Polara	\$9.95
0871	DODGE 72-77 for all Monaco & Polara models	\$7.95
1259	DODGE OMNI 78-79 covers all models	\$9.95
8208	DODGE RAMCHARGER 74-75 covers all models	\$7.95
8564	DODGE PICK-UP 65-75 service/maintain all 2-whl drive	\$7.50
8371	DODGE PICK-UP 65-78 4-whl drive service/maintain all	\$7.50

8203	DODGE VANS 67-70 all 100, 200, 300 mdls & Plymouth	\$7.95
8310	DODGE VANS 71-77 covers all 6 & V8 mdls inc Plymouth	\$9.95
8192	DUSTER 70-76 for all models inc. Scamp	\$7.95
8189	FAIRLANE, FORD 62-70 covers all models	\$7.95
9422	FALCON 60-64 covers all models inc Mercury Comet	\$7.95
9874	FALCON, FORD 64-70 covers all 6-cyl models	\$7.95
0480	FALCON, FORD V8 65-71 covers all V8 models	\$7.95
9776	FIAT 124 67-77 all inc sdn, sta wgn, TC, spcl	\$9.95
0844	FIAT 124 SPORT 78-78 all coupe & convertible models	\$9.95
9640	FIAT 128 72-79 for all models inc SL & Rally	\$9.95
8742	FIAT 131 75-77 covers all Mirafiori models	\$9.95
1201	FIAT 850 64-74 all sedan, coupe & spider mdls	\$9.95
0399	FIAT X1/9 73-77	\$9.95
1073	FIESTA, FORD 77-79 for all models	\$9.95
0675	FIREBIRD covers all models—67-74	\$7.95
1149	FORD 55-67 all inc Galaxie, LTD, Custom & wagons	\$9.95
0872	FORD 68-77 inc Galaxie, LTD, Custom, XL & wgn	\$7.95
9369	FORD COURIER 72-77 covers all models imported	\$9.95
0451	FORD PICK-UP 69-79 covers all models	\$9.95
8204	FORD VANS 66-68 covers all models	\$7.95
0453	FORD VANS 69-79 covers all 6 & V8 models	\$9.95
9436	GRANADA, FORD 75-77 covers all models	\$7.95
0644	HONDA 360, 600, 67-75 for all models inc "Z"	\$9.95
0885	HONDA ACCORD 77-78 covers all CVCC models	\$9.95
8694	HONDA CIVIC, 73-79 covers all models inc CVCC	\$9.95
8206	INTERNATIONAL SCOUT 67-73 800, A, B, H mdls	\$7.95
8565	INTERNATIONAL 62-78 tune/maintain Scout, wagon, pick-up	\$7.95
1207	JAGUAR XK120, 140, 150 48-61 also Mk 7, 8, 9	\$9.95
1206	JAGUAR 55-69 sedan mdls 2.4, 3.4, 3.8, 240, 340	\$9.95
1043	JAGUAR E-TYPE 61-72 covers all 6-cylinder models	\$9.95
9612	JAGUAR E-TYPE V12 71-74 covers all models	\$9.95
9399	JAGUAR XJ6 68-78 covers all models	\$9.95
9617	JAGUAR XJ12 72-77 for all models inc Daimler	\$9.95
9769	JEEP 50-65 for 4 & 6 cyl station	\$15.95
8207	JEEP 66-79 for all Cherokee, Commando & Wagoneer mdls	\$7.95
9805	JEEP WAGONEER J-series with 230 ohc eng.	\$15.95
9806	JEEP UNIVERSAL CJ-2, CJ-3 reprint factory manual	\$15.95
0509	JEEP CJ-5, CJ-6, CJ-7, 55-79	\$7.95
8856	JEEP FC150, 170 covers all front cab models	\$15.95
8739	JENSEN-HEALEY reprint of factory manual	\$19.95
1254	LANDROVER 59-77 covers 2, 2A, 3 gas & diesel models	\$9.95
1149	LINCOLN 55-70 covers all models	\$9.95
9773	LINCOLN 71-77 all models inc Versailles	\$9.95
0481	MAVERICK 69-71 6 cyl, 170, 200, 250 cu. in. eng.	\$7.95
8211	MAVERICK 72-77 covers all models	\$7.95
1550	MAZDA GLC 77-78 covers all models	\$9.95
0370	MAZDA RX2 70-75 covers sedan & coupe mdls	\$9.95
0371	MAZDA RX-3, 700 70-74 covers all models	\$9.95
0444	MAZDA 71-78 includes RX4 and Cosmo models	\$7.95
0880	MAZDA PICK-UP 72-75 B-1600 & rotary eng. mdls.	\$7.95
0593	MAZDA 808, 818 72-78 covers all models	\$9.95
0573	MAZDA 1500, 1800 67-74 covers all models	\$9.95
1009	MERCEDES-BENZ 190 59-68, B, C & 200 models	\$9.95
0781	MERCEDES-BENZ 190SL reprint of owner's manual	\$7.95
1746	MERCEDES-BENZ 220 59-65 covers all mdls	\$9.95
9483	MERCEDES-BENZ 220 68-72 mdls except Diesel	\$9.95
1747	MERCEDES-BENZ 230 63-68 inc. 230S & SL	\$9.95
1748	MERCEDES-BENZ 250 65-68 covers all models	\$9.95
9484	MERCEDES-BENZ 250 69-72 covers all models	\$9.95
9485	MERCEDES-BENZ 280 68-72 covers all models	\$9.95
0416	MERCEDES-BENZ 68-73 inc 280, 300 & 350, 450 V8 mdls	\$8.95
8439	MERCEDES-BENZ 74-79 Covers all models inc Diesels	\$9.95
1149	MERCURY 55-70 covers all models	\$9.95
9773	MERCURY 71-77 for all models inc Cougar	\$9.95
1105	MG TA, TB, TC, TD, TF 36-55	\$9.95
1098	MG MIDGET 58-78 covers all models	\$9.95
1106	MGA, MGB 55-68 covers all models inc twin cam	\$9.95
1720	MGB, MGBGT 69-79 all roadster & coupe models	\$9.95
8396	MGC reprint of factory manual	\$19.95
0917	MINI 59-78 covers all models inc Mini-Cooper	\$9.95
9436	MONARCH, MERCURY 75-77 for all models	\$7.95
0050	MONZA, CHEVROLET 77-79 factory manual... give car year	\$12.95

1109	MORGAN 36-77 covers all 4-cyl models	\$9.95
8395	MUSTANG 65-73 covers all 6-cylinder models	\$9.95
0479	MUSTANG V8 65-73 covers all models	\$9.95
8272	MUSTANG II 74-78 covers all 4, V6, & V8 models	\$9.95
8187	NOVA 69-79 covers all 4, 6 & V8 models	\$8.95
7107	OLDS CUTLASS 70-77 covers all inc 442 models	\$7.95
0002	OLDS 68, 71, 74 factory shop manual... must give year	\$10.95
0008	OLDS 75-79 factory shop manual... must give year	\$16.95
1724	OPEL KADETT 62-73 1000, 1100, 1200 models	\$9.95
1752	OPEL KADETT 67-73, 1500, 1700, 1900 mdls	\$9.95
8273	OPEL 66-79 for all models inc 1900 Manta & Isuzu	\$9.95
9589	OPEL GT 68-73 covers all 1900 models	\$9.95
9872	PEUGEOT 304 70-77 covers all models	\$9.95
1546	PEUGEOT 404 60-75 covers all models	\$9.95
0876	PEUGEOT 504 68-74 includes diesel models	\$7.95
7124	PEUGEOT 504 68-78 for all gasoline models	\$9.95
0883	PINTO 70-79 covers all models inc Mercury Bobcat	\$7.95
1145	PLYMOUTH 55-71 all inc Belvedere, Fury, Satellite	\$9.95
0874	PLYMOUTH 72-76 Fury, VIP, Gran, Suburban mdls	\$7.95
1660	PLYMOUTH HORIZON 78-79 covers all models	\$9.95
0030	PONTIAC 69-75 factory manual, all models, give year	\$17.95
0489	PONTIAC TEMPEST 68-73 all mdls inc GTO, Le Mans	\$7.95
1650	PORSCHE 356 57-65 covers A, B & C models	\$9.95
1591	PORSCHE 911 64-73 covers all models	\$9.95
8173	PORSCHE 911 74-77 includes N, S, Targa, Carrera	\$9.95
1590	PORSCHE 912 65-69 with 1582cc engine	\$9.95
9834	PORSCHE 914 70-76 all models inc 914/6	\$9.95
0993	PORSCHE 924 76-78	\$9.95
8208	RAMCHARGER, TRAILDUSTER 74-75 all models	\$7.95
0372	RENAULT 5 72-78 for all models inc Le Car	\$9.95
1224	RENAULT 8, 10 62-72 covers all models inc 1100	\$9.95
9429	RENAULT 12 69-79 covers all models inc auto trans	\$9.95
0645	RENAULT 15, 17 71-78 all mdls inc TL, TS	\$9.95
1554	RENAULT 16 65-78 covers all models	\$9.95
0395	ROADRUNNER & SATELLITE 68-73 all models	\$7.95
1121	ROVER 2000 63-75 for all models inc 2200	\$9.95
9493	SAAB 95, 96 66-76 covers all V4 models	\$9.95
0750	SAAB 99 69-76 covers all models inc fuel injection	\$9.95
8440	SAAB 67-79 covers all models inc Sonnet	\$9.95
1098	SPRITE 58-71 covers all Mk 1, 2, 3 & 4 models	\$9.95
8058	SUBARU 70-77 covers all models	\$9.95
0853	SUNBEAM ALPINE 55-65 Mk1, 2, 3, 4 & Rapier	\$9.95
0845	SUNBEAM TIGER reprint of factory shop manual	\$19.95
0489	TEMPEST, GTO, LE MANS 68-73 all models	\$7.95
9773	THUNDERBIRD 71-77 covers all models	\$9.95
8189	TORINO 68-75 all models inc Elite, Ranchero	\$7.95
0912	TOYOTA CELICA 70-77 covers all models imported	\$9.95
0829	TOYOTA CELICA 78-79	\$9.95
7127	TOYOTA COROLLA 68-74 for all models	\$9.95
9812	TOYOTA COROLLA 75-78 all models plus 5-spd trans	\$9.95
1738	TOYOTA CORONA 65-68 covers 4-cyl 1500 models	\$9.95
0926	TOYOTA CORONA 69-73 for all 4-cyl models inc MK II	\$9.95
0886	TOYOTA CORONA 74-77 covers all 4-cyl models	\$9.95
0754	TOYOTA CORONA Mk 2 72-76 for all 6 cylinder models	\$9.95
0647	TOYOTA HI-LUX 68-77 covers all pick-up models	\$9.95
8524	TOYOTA LAND CRUISER 66-77 covers all models	\$9.95
0687	TRIUMPH STAG 70-77	\$9.95
1200	TRIUMPH SPITFIRE 69-78 covers all models	\$9.95
1016	TRIUMPH GT6 62-74 for all models plus Vitesse	\$9.95
1225	TRIUMPH TR2, TR3, 52-62 covers all models	\$9.95
1231	TRIUMPH TR4 61-67 covers all models	\$9.95
1015	TRIUMPH TR5, TR6, 67-76 all models inc TR250	\$9.95
8693	TRIUMPH TR7 75-79	\$9.95
0384	VALIANT 63-67 covers all 6 & V8 models	\$7.95
8192	VALIANT 68-76 all mdls inc Scamp, Signette	\$7.95
0567	VEGA 72-73 all 140 CID & GT 140 CID models	\$7.95
0884	VEGA 74-77 covers all models	\$7.95
9404	VOLARE, PLYMOUTH 76-78 for all models	\$7.95
1227	VOLKSWAGEN BEETLE 54-67 for all mdls inc K-G	\$9.95
0140	VOLKSWAGEN BEETLE 68-77 covers all models inc K-G	\$9.95
6010	VOLKSWAGEN RABBIT, SCIROCCO 74-79 all mdls inc Diesel	\$16.95
1547	VOLKSWAGEN BUS 54-67 all camper, van, transporter mdls	\$9.95
7130	VOLKSWAGEN BUS 68-78 all camper, van, transporter mdls	\$9.95
9582	VOLKSWAGEN TYPE 3 62-73 for squareback, fastback	\$9.95
9639	VOLKSWAGEN 411 68-73 covers all E, L, LE models	\$9.95
9778	VOLKSWAGEN 412 71-74 covers all models	\$9.95
8748	VOLKSWAGEN DASHER 74-78 covers all models	\$14.95
9444	VOLVO P1800 60-73 all models inc E & ES	\$9.95
1722	VOLVO 122 61-70 for all models inc GT	\$9.95
1754	VOLVO 142, 144, 145 66-74 for all models inc S & E	\$9.95
9558	VOLVO 164 68-75 for all models inc fuel injection	\$9.95
3729	VOLVO 242, 244, 245 74-78 for all inc fuel inj models	\$9.95
8311	VOLVO 262, 264, 265 75-78 all models inc fuel injection	\$9.95

GENERAL INTEREST BOOKS

1264	CHILTON AUTO REPAIR 73-80 for all American cars	\$16.95
0743	CHILTON AUTO REPAIR 72-79 for all American cars	\$14.95
1775	CHILTON AUTO REPAIR 68-75 Reg. \$12.95, Special	\$6.95
1763	CHILTON AUTO REPAIR 54-63 for all American cars	\$17.95
8561	CHILTON TRUCK REPAIR MAN 61-71 for all 1/2-2 1/2 ton mdls	\$19.95
9700	CHILTON IMPORT CAR MANUAL 73-79 for ALL pop imports	\$18.95
7125	AUTO AIR CONDITIONING... service & repair all	\$6.95
8726	TRANSISTOR IGNITION SYSTEMS covers them all	\$5.95
1067	MORE MILES-PER-DOLLAR GUIDE How to do it right	\$5.95
9622	HOW TO TUNE YOUR CAR good for all cars	\$5.95
8030	POWER TUNING your car, truck, van or RV	\$5.95
8859	GM DIAGNOSIS & REPAIR MANUAL 70-80 for all GM cars	\$9.95
1712	BASIC AUTO REPAIR MANUAL a must for any car	\$5.95
1707	BASIC BODYWORK & PAINTING	\$4.95
1711	BASIC CARBURETORS & FUEL SYSTEMS	\$4.95
1706	BASIC CHASSIS, SUSPENSIONS, BRAKES	\$4.95
0791	BASIC ENGINE HOTRODING	\$4.95
1708	BASIC IGNITION & ELECTRICAL SYSTEMS	\$4.95
0680	BASIC AUTO TROUBLESHOOTING for all cars	\$4.95
8359	BRAKE SERVICE GUIDE for repairing all types & makes	\$5.95
3759	ELECTRONIC FUEL INJ MAN 70-77 for all imported cars	\$9.95
2438	FUEL INJECTION MANUAL 70-78 all systems... 630 pages	\$29.50
9411	HOLLEY carbs, all 2 & 4 bbl, tune & rebuild	\$5.95
9652	ROCHESTER carbs, all inc 4MV Quadrajel	\$9.95
9666	SOLEX CARBURETORS all 1 & 2 barrel downdraft	\$2.95
6354	SU CARBURETORS tune & rebuild all to 1976	\$6.50
9423	STROMBERG CD CARBS tune/rebuild all to 1976	\$6.50
0734	WEBER DCOE overhaul manual	\$4.95
1153	WEBER CARBURETORS theory & design	\$3.95
9803	WEBER CARBURETORS tuning & rebuilding all	\$3.95



This VET Did It – and YOU Can Do It Too!

"War injuries left me badly handicapped, but now I'm a financial success as a Locksmith, thanks to your training. Besides, the work is fascinating. If I can do it anybody can." — Glen Johnson, Larned, Kan.

Make Up to \$10 an Hour—even while learning!

Train FAST at Home!

Be a LOCKSMITH!

If you enjoy fixing things, you're a "natural" to make hundreds of EXTRA DOLLARS a year in the fascinating business of Locksmithing. Rising crime has increased demand for service a thousandfold. Yet there's only one Locksmith for every 17,000 people!

COLLECT CASH PROFITS ALMOST AT ONCE!

You're "in business" ready to make \$5 to \$10 an hour a few days after you begin Belsaw's shortcut training. Easy, illustrated lessons complete with ALL practice equipment PLUS

- ALL TOOLS YOURS TO KEEP
- KEY MACHINE YOURS TO KEEP
- EXPERT PERSONAL ASSISTANCE
- BUSINESS-BUILDING HELP

enable you to get your share of this always-profitable business. Hundreds we've trained are doing it. So can YOU.

MAIL COUPON to discover how Locksmithing can keep the extra money coming in during spare time—or in your own full-time business. Ideal for retirement—good jobs, too.

BELSAW INSTITUTE, 111A Field Bldg.
Kansas City, Mo. 64111
Accredited Member NHSC.



FREE

N. Hunt, Wilmington, Del.—"I make \$50 a week extra."

R. Davis, St. Louis, Mo.—"I cleared \$110 last Saturday."

Ed Boyle, Pittsburgh, Pa.—"My business going at top speed. I'm moving to bigger quarters."

MAIL THIS COUPON • NO SALESMAN WILL CALL

BELSAW INSTITUTE, 111A Field Bldg.
Kansas City, Mo. 64111

Rush **FREE** book, "Keys to your Future."

Name _____

Address _____

City _____ State _____ Zip _____



THIS DO-ALL PRO KEY MACHINE YOURS TO KEEP!

Can add \$25 to \$40 a week to your income... and doesn't cost you a penny extra!



FINANCING NO PROBLEM!

Have you been priced out of today's housing market?

Miles Homes could be the answer!

If you have the ambition and desire to build your own home, then the Miles Plan could be for you. **THE MILES HOME OWNERSHIP PLAN IS UNIQUE.** Your desire and dedication are more important than ready cash — start now to build the home of your dreams... the Miles Way.

- Liberal credit — Low monthly payments while building.
- Foundation assistance.
- Land may not have to be fully paid for.

- Pre-cut materials, blueprints, step-by-step instructions.
- 36 months to build.
- There is a representative near you. Phone: (612) 588-9700.

Miles has nearly 30 years experience helping over 15,000 families to build their own home. Send coupon today to see how Miles can help you.

Send me your **FREE** Great Homes Idea Book
MILES HOMES, Dept. MPSO-0410
4500 Lyndale Ave. N., Minneapolis, MN 55412

Name _____

Address _____

City _____ State _____ Zip _____

County _____

Phone () _____

I plan to do all or part of the work
 \$1.00 enclosed for priority handling

Miles Homes

12 Insilco A Division of Insilco Corporation

"Say, Smokey—"

[Continued]

one. It increases engine life and burns clean. It's easy to carburete, but a little tough to get going in cold weather. It's subject to a big change in character from area to area.

Pressure drop

I have a 1979 high-performance Trans Am that runs fine. The engine has a high-pressure oil pump (60+ psi).

I recently switched to Mobil 1 and have noted a significant decrease in oil pressure, especially when the engine is hot. At idle, the pressure never drops below the 20-psi mark on the gauge, but at high rpm the maximum oil pressure seems to be about 50–55 psi, compared to 62+ psi before I switched to Mobil 1. Throughout the intervening rpm range the pressure seems to be about 10–15 psi less than it was previously. Is this lower pressure satisfactory? Or should I go back to natural oil? I do my share of high-rpm driving.

Tom Lajcik, Thousand Oaks, Calif.

I wouldn't use Mobil 1 for racing. It's too light, for one thing. But if you have 10 pounds of oil pressure for every 1000 rpm when the engine is hot, you're in good shape.

Hard starting

I have an Oldsmobile with a 455-cu.-in. engine. After I drive it 20 or 30 minutes and shut it off, then attempt to restart it, the engine will not turn over—although the lights are bright and the battery appears to be good. Then after about a 15-minute rest, it spins over and starts—possibly because it cools off. I asked the Olds dealer here and he said there was no remedy, so I wrote Oldsmobile. They didn't offer any help, but told me to contact the local dealer. If I put a jumper on the battery, it will turn over and start.

Robert E. King, South Bend, Ind.

A heavy-duty starter is the biggest help. Then a heavier battery and heavier battery cables will put you on Broadway.

On water injection

I would like your comments on the usefulness of a water-injection system. Will this reliably eliminate engine knock?

Glenn Wenger, Santa Clara, Calif.

If it has a use, it's probably to reduce detonation. Now, a combination of water and alcohol may work to an advantage in some applications.

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**, 380 Madison Ave., New York, N.Y. 10017. Questions cannot be answered by mail.

Booklets, catalogs, and folders listed below provide reliable information, illustrations, and specifications to help you in planning the purchase of a variety of products or services offered by these dependable companies. The convenient order form will save you time and postage.

401 The Facts About Stereo Loudspeakers Altec Lansing's Model 14 brochure disproves the myths by informing the buyer of the facts that are important to know before buying quality speakers. Free

402 Learn Glass Etching You don't have to be an artist to get professional results in accentuating your mirrors, windows, and glasses—with Armour's etching method. Free

403 Black & Decker Tools & Accessories This new, 92-page color catalog shows complete selection of handy power and trade tools, as well as accessories, to use indoors or outdoors. \$1

404 Browning Sporting Arms Catalog One hundred fifty color pages detail the finest in sporting arms and accessories, including knives, boots and clothing, rifles, archery and fishing tackle, and golf equipment. Free

405 Saving Energy Doesn't Have To Be Expensive Booklet describes how Chimgard magnetically attaches to flue pipes and surfaces to read temperatures and determine energy loss. Also includes Condar products that recover energy waste. Free

406 Lawn & Garden Maintenance John Deere offers over 50 attachments for lawn and garden tractors, and equipment for grounds landscaping and gardening—all shown in folder. Free

407 Take the Drudgery Out of Mowing Brochure explains how to cut time in half with a Dixon ZTR Riding Mower. Two-hand levers control all the action. Free

408 Styrofoam Insulation Energy effectiveness and efficiency of styrofoam in new and existing homes are shown in leaflet from Dow Chemical. It includes an illustrated demonstration of actual fuel-saving cost to consumers. Free

409 Creative Woodworking Projects This new, 250-page soft-cover book, now available from Dremel, offers more than 150 projects with easy-to-follow directions. \$6.95

410 Attention Audio Enthusiasts! Booklet features series of versatile sound and speaker control systems to accommodate dubbing, fading, recording, playback, mixing, and monitoring of any sound system, from Zaino. Free

411 Outdoor Footgear Pamphlet from Dunham illustrates complete line of comfortably styled, waterproof hiking, hunting, and work boots. Free

412 Spray Away Car Scars Seven easy steps to touch-up your car are given in pamphlet from Dupli-Color Products. Free

413 Metal & Woodworking Tools Catalog displays dozens of reasonably priced tools for craftsmen, from Fine Tool Shop. Free

414 Beautify Metal Surfaces Flecto offers advice on how to protect metal surfaces—colorfully—from rust and corrosion, in its new brochure. Free

415 Motor-Home Insurance Buyer's guide provides specialized, practical information for today's motor-home owner, from Foremost Insurance Co. Free

416 Lawn & Garden Equipment Gravely's colorful catalog shows two- and four-wheel tractors, and attachments for lawn care, snow removal, and gardening. Free

417 Herman Boots & Shoes Leaflet offers a cross-section of styles, including insulated, waterproof, and handsewn groups of hiking, casual, or uniform shoes and boots crafted for comfort and durability. Free

418 Energy-Control Products Intermatic's catalog covers a wide range of time switches and photoelectric controls that help conserve electricity by automatically adjusting the flow of energy as needed. 50¢

419 15% Better Gas Mileage, Flex-a-Lite Brochure, describes how Electra-Fan, a thermostat-controlled cooling fan, can improve your car's performance and increase power. Free

420 Ondine Shower Heads Pamphlet contains a colorful selection of smooth, durable shower heads, with a choice of spray settings at your fingertips, from full-cone shower to pulsating massage. 25¢

421 Eliminate Glare of High-Intensity Lights Optronics explains a newly patented BlueEye Beam process that eliminates glare associated with hand-held spotlights and driving fog lights in informative leaflet. Free

422 The Window Fixer Repair and weather-strip your windows; make them fit and move easily; stop drafts and rattles; and save on the high cost of fuel. Quaker City brochure tells you how. Free

423 Kitchen Cabinets Booklet features wide range of styles and colors of cabinets, along with accessories becoming to any kitchen atmosphere, from Riviera Kitchens. Free

424 Lock In Security Twenty-page catalog from Schlage Lock offers various types of locks and security recommendations, as well as installation information. 25¢

425 Success With Trees & Shrubs Information and illustrations aid the gardener with advice on planting, staking, fertilizing, pruning, and care of shrubs and trees, from O. M. Scott. Free

426 Antenna Test Results Shakespeare publishes the results of the 1979 test between an ordinary metal base-station antenna and Shakespeare's Big Stick base antenna. Free

427 Chain Saws Booklet features the full line and specifications of Stihl's chain saws and commercial and industrial products. Free

428 Baths & Shower Stalls Illustrated brochure pictures a variety of baths in Mediterranean, traditional, contemporary, jungle, and nautical designs, from Tub-Master. Free

429 Paneling Installation Instructions contain 20 pages of tips to decorate existing rooms or cover new walls with paneling, from Weyerhaeuser. Free

430 Play Olympic Golf Whispering Palms Golf and Country Club offers a new playing-range concept for you to sharpen your shot-making. Free

FILL IN COUPON AND MAIL TODAY

POPULAR SCIENCE P.O. Box 2748, Clinton, Iowa 52735

Note: Popular Science Iowa address is for Product Information only. Subscription inquiries should be directed to the address at the foot of the table-of-contents page.

Please send the items checked below. I am enclosing 30¢ handling charge (any number of items) plus amount required for priced items.

- | | | | | | |
|----------------------------------|-------------------------------------|------------------------------|----------------------------------|----------------------------------|------------------------------|
| <input type="checkbox"/> 401 | <input type="checkbox"/> 406 | <input type="checkbox"/> 411 | <input type="checkbox"/> 416 | <input type="checkbox"/> 421 | <input type="checkbox"/> 426 |
| <input type="checkbox"/> 402 | <input type="checkbox"/> 407 | <input type="checkbox"/> 412 | <input type="checkbox"/> 417 | <input type="checkbox"/> 422 | <input type="checkbox"/> 427 |
| <input type="checkbox"/> 403 \$1 | <input type="checkbox"/> 408 | <input type="checkbox"/> 413 | <input type="checkbox"/> 418 50¢ | <input type="checkbox"/> 423 | <input type="checkbox"/> 428 |
| <input type="checkbox"/> 404 | <input type="checkbox"/> 409 \$6.95 | <input type="checkbox"/> 414 | <input type="checkbox"/> 419 | <input type="checkbox"/> 424 25¢ | <input type="checkbox"/> 429 |
| <input type="checkbox"/> 405 | <input type="checkbox"/> 410 | <input type="checkbox"/> 415 | <input type="checkbox"/> 420 25¢ | <input type="checkbox"/> 425 | <input type="checkbox"/> 430 |

Name (please print) _____

Address _____ City & State _____ Zip _____

Please send cash, check, or money order made out to Popular Science. No stamps or foreign currency. Allow approximately six weeks delivery.

THIS COUPON EXPIRES JUNE 31, 1980

I AM ENCLOSING

\$ _____ for priced items

.30 for handling

\$ _____ TOTAL REMITTANCE

POPULAR SCIENCE APRIL 1980

Shoppers' Showcase

A selection of products and services for Popular Science readers available direct by mail. Enjoy the fun and convenience of mail order shopping. Please order directly

from the advertiser. For advertising rates for this section, write Harry Fleischman, Popular Science, 380 Madison Avenue, New York, N.Y. 10017.

BELSAW ONE MAN SAWMILL

NOW! BEAT Inflation and HIGH Lumberyard Prices!
No need to stop your important projects.

Take this portable mill right to the trees—turn out smooth, true lumber every time—no experience needed. Saw your own logs or lumber for others and make excellent spare-time income—no crew needed. Use any power—tractor PTO, diesel, electric. Time payments may be arranged. Send for FREE details—mail coupon below or postcard TODAY! No Obligation and No Salesman Will Call.

World Famous Since 1928

BELSAW MACHINERY Co., 3158 Field Bldg., Kansas City, Mo. 64111

Name _____ (Please Print)
Address _____
City-State _____ Zip _____

RUSH COUPON TODAY!

RICKA DUO-WHEEL CONVERSION KIT AND FIBERGLASS FENDERS

New wide tire adapters & fenders to fit most mini-1/2, 3/4 & 1 ton trucks. Simple bolt on installation. Increases traction, tire capacity & life.

The ultimate in safety protection for your family.

RICKA MFG. DEPT. RPS-4
Pequot Lakes, MN 56472

VISA MASTERCARD

BASEMENT TOILET

Flushes up to existing sewer or septic tank by powerful, self-contained pump operated by normal water pressure. No digging up floors. Clog resistant, easily installed. Make basement into game room, den, apartment with private bath. Write for free literature. Dealer inquiries invited.

ROSS MFG. Dept J-26, Box 10947, Houston, Texas 77018

WE DARE YOU TO COMPARE!
WESTWOOD OFFERS YOU MORE...
SAVE 20-50% OVER COMPARABLE FINISHED CLOCKS

YOUR SELECTION OF:
CLOCKS
17 MODELS TO CHOOSE FROM
MOVEMENTS
20 DIFFERENT MOVEMENTS AND DIALS
OPTIONS
BEVELED GLASS - HANDCARVING
OAK OR CHERRY SOLIDS - RARE BURLS

EASY-TO-ASSEMBLE
PRE-CUT KITS

ONLY THE FINEST QUALITY

Send \$1.00 NOW for Color Catalog

WESTWOOD CLOCKS 'N' KITS
Uncompromised in quality
Dept. 003A
3210 Airport Way
Long Beach, Ca 90806
(213) 595-4981

ALCOHOL FUEL!

"MANUAL FOR THE HOME AND FARM PRODUCTION OF ALCOHOL FUELS"

by S. W. Mathewson

"Written by an expert in clear, understandable language, this comprehensive modern manual contains everything you need to know to produce cheap, efficient fuel from almost any agricultural material."

Chapters on: U. S. GOVERNMENT REGULATIONS, FUEL THEORY, MODIFYING ENGINES TO BURN PURE ALCOHOL, GASOHOL, WATER INJECTION, ECONOMIC CONSIDERATIONS, MALTING, MASHING, FERMENTATION, DISTILLATION, and MUCH, MUCH more . . . practical, down to earth plans for mashing and fermentation equipment from 55 gallon drums . . . plans for an efficient, high volume still and reflux column from common hardware and plumbing items . . . PLUS special plans for a continuous feed SOLAR still!

\$12.95 postpaid

J. A. DIAZ PUBLICATIONS
Box 709, Los Banos, Ca. 93635
C.O.D. orders accepted.
Money back if not satisfied.

GARAGE DOOR OPENERS

HELPMATE

- Radio Controlled
- Buy Factory Direct and Save
- Thousands In Use • Free Brochure
- Easy Homeowner Installation
- Immediate Shipment by UPS or PP

HELPMATE Equipment Co. Dept. PS-480 Baroda, MI 49101



AT DEALERS OR ORDER DIRECT POSTAGE PAID

WS-1 STANDARD MODEL	\$5.00
FS-1 COMPACT FOLDING MODEL	\$7.00
S9 SLINGSHOT WITHOUT WRIST-BRACE	\$4.00
RR-1 REPLACEMENT BANDS & LEATHER POUCH	\$2.00
SA50 500 ROUNDS 1/2" DIA. AMMO. ONLY USA	\$6.00
NO C.O.D.S./ FOR AIR POST., FOREIGN ORDERS ADD PER ITEM	\$2.00

TRUMARK SLINGSHOTS: P.O. BOX 1517 S, BOULDER, CO. 80306

BREW YOUR OWN FUEL

BROWN'S ALCOHOL MOTOR FUEL COOKBOOK

Contains step-by-step procedures for the making and using alcohol as a motor fuel. How to build your own home still, how to modify your car's carburetor to run on alcohol & other engine modification to get up to 100 miles per gallon, & much more. Loaded with large clear photo's, you'll be amazed at how easy it really is. Don't hesitate order your copy today! Book No. 300 \$9.95 postpaid

DESERT PUBLICATIONS
DEPT. PS - CORNVILLE, ARIZONA 86325

The Air Bed®
Original Velveteen

A Revolutionary Sleeping Experience

\$49.95
from

The lightweight Air Bed offers a revolutionary sleeping experience. Gently, but firmly supports you with 100% air. Features air coil construction with multiple controlled air chambers that hold your body evenly and independently.

Turns any room into a guest room. The ideal portable bed for holiday and vacation visitors...and it stores easily. Take it camping, in your van, on your boat, in your summer home; sunbathe and float on it!

Available in twin, double, queen and king sizes. Inflates in minutes with most air pumps or cannister vacuum. (High-power air pump available—optional.) Made of sturdy 20 gauge poly vinyl, cleans with soap and water. Repair kit and pump adapter included.

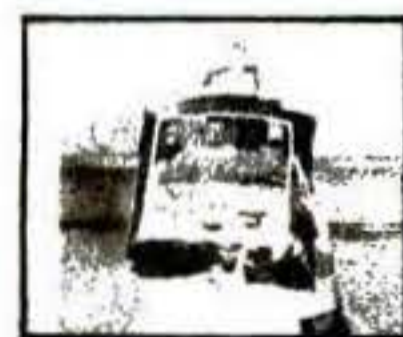
Don't be misled by imitations. Insist on the original, red velveteen The Air Bed. 10-day Free Trial. If not satisfied, return it within 10 days for refund. Order now!

CREDITCARD ORDERS **800-648-5600** Nevada Residents Call: 800-992-5710
CALL TOLL FREE: OPERATOR NO. 48, 24 HOURS A DAY, 7 DAYS A WEEK
790 Maple Lane, Bensenville, Illinois 60106

Contemporary Marketing, Inc.



Air Coil Construction



Stores Easily on Shelf

Please send me the following AIR BED(S):

<input type="checkbox"/> Twin Size (Item 2339)	\$49.95
<input type="checkbox"/> Double Size (Item 2354)	\$69.95
<input type="checkbox"/> Queen Size (Item 2360)	\$79.95
<input type="checkbox"/> King Size (Item 2374)	\$99.95

Add \$4.95 per bed for shipping and insurance.

AC Air Pump (Item 0004) \$29.95
 DC Pump-12 volts-(Item 0005) \$29.95

Illinois Residents include 5 1/4 % sales tax.

Check/M.O. Enclosed Charge My Credit Card:

Master Charge American Express Carte Blanche
 Visa Diners Club

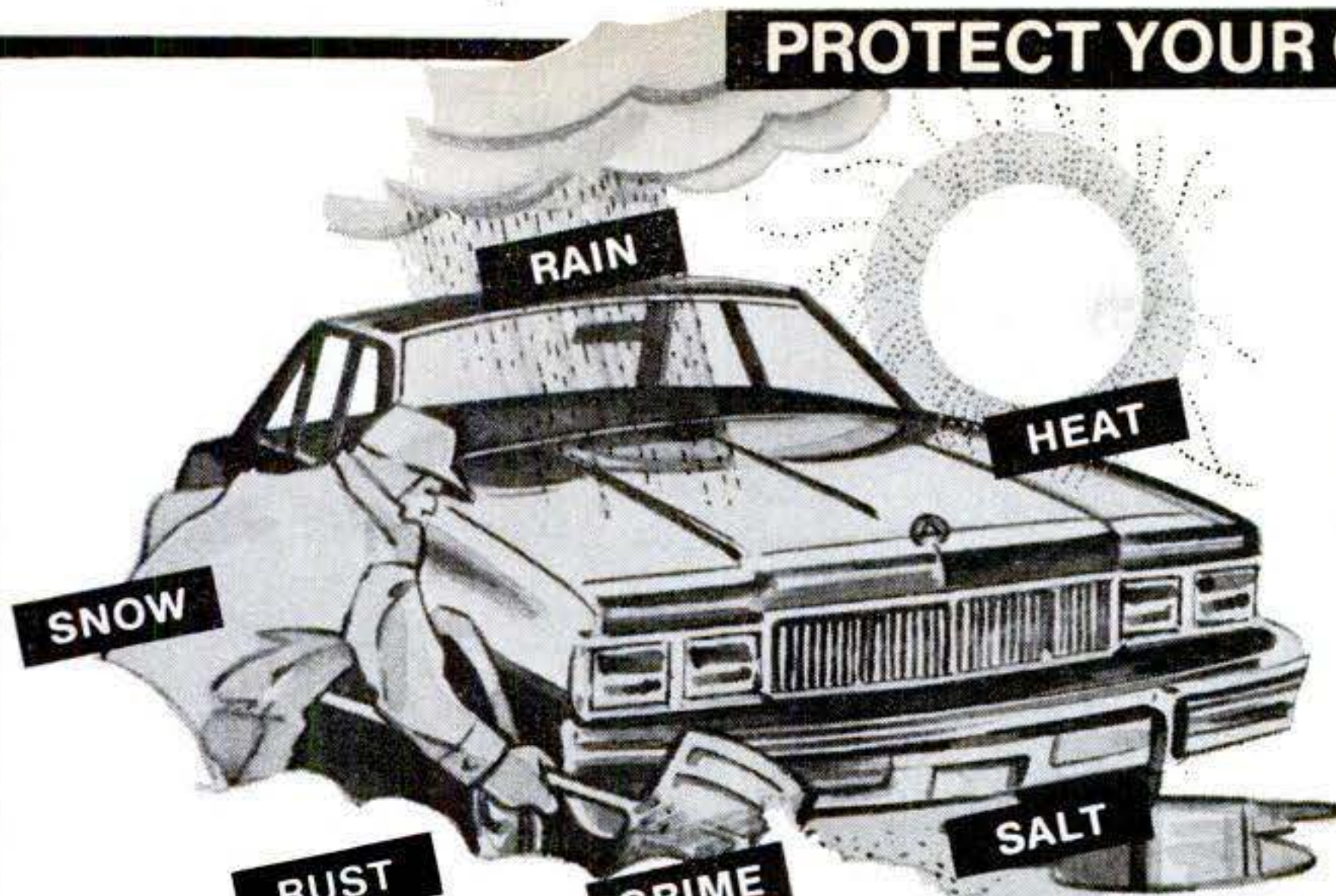
Card No. _____ Exp. Date _____

Name _____
Address _____
City _____
State _____ Zip _____
Signature _____

Contemporary Marketing, Inc.
790 Maple Lane, Bensenville, IL 60106
Dept. PSMD-091 © CMI1980251

PROTECT YOUR CAR FROM THE ELEMENTS

FIRST TIME AVAILABLE
TO THE PUBLIC



ORIGINAL PLASTIC COATING
GLO-SHIELD™
MAKES WAXES AND POLISHES
OBSOLETE

AS SEEN ON TV

Plastic Coat Your Car In Less Than 1 Hour FOR ONLY \$9⁹⁵

NEW CAR DEALERS CHARGE UP TO \$200

POLYMER ACRYLIC ACTUALLY RESURFACES AND RESEALS IN ONE SIMPLE STEP. GIVES YOUR CAR "SHOWROOM" BRILLIANCE THAT LASTS THREE YEARS—GUARANTEED!

Now at last you can put an end to corrosion, chalking, rusting, dulling, and pitting of your car's finish. GLO-SHIELD can protect your car's finish and restore it, too! You can bring back that new car look in less than 1 hour with hardly any effort at all! Too good to be true? Not with GLO-SHIELD, the miracle polymer plastic sealant that's guaranteed to protect and/or restore your car's finish for three years. Yes! you can revitalize and restore dull oxidized finishes...just wipe on—wipe off. Do away with compounding...dead paint is chemically removed. Just wipe on—wipe off. GLO-SHIELD removes old waxes, tar, stains, tree sap, road film, dirt, bird deposits, grime, grease, gasoline streaks, rusting, even tarnish. GLO-SHIELD deposits a plastic film that fuses to the surface and fills the pores to give your car a hard, high lustre, mirror-like finish. Just wipe on—wipe off.

NOTHING LIKE ANYTHING YOU'VE EVER USED BEFORE
Don't confuse this product with any wax or polish. GLO-SHIELD is a clear, transparent liquid, when, after it strips old wax and grime away, actually deposits a film that's very similar to the acrylic lacquer your car was originally painted with. And it works even if your car was painted with enamel. Acrylic sticks to anything... but nothing sticks to acrylic! Not tree sap, not

road salt, not grime or dirt, not even bird droppings, grease, gasoline — not even paint.

- THIS IS AN ACRYLIC PRODUCT DO NOT CONFUSE WITH IMITATIONS!
- NO RUBBING! NO BUFFING!
- CLEANS, COMPOUNDS, POLISHES, SEALS!
- USE ON ANY PAINT FINISH!
- FAST, ONE STEP WIPE-ON, WIPE-OFF!

And, GLO-SHIELD's protective coating that you apply in under one hour lasts three years. All you have to do to keep the finish beautiful is a light hosing...even a light rain, and road dirt, salt and grime roll right off, and dries streak free. GLO-SHIELD is detergent proof, contains no abrasives, invisible, non-yellowing, peelproof and crystal clear.

Here's an added plus. GLO-SHIELD works its magic on all painted and plated surfaces...chrome bumpers, mag wheels, appliances, motorcycles, fiberglass boats formica, marine hardware, brass, plexiglass, stainless steel, aluminum, etc.

So put an end to laborious waxing and polishing...get GLO-SHIELD the one step, wipe on—wipe off refinisher that gives your car a three year finish...free from dirt, grime, smudges. Order yours today!

Enough for 2 average cars. \$9.95 (less than \$5 per car). Fleet owners: write on letterhead for quantity prices.

3 YEAR GUARANTEE
If, after using GLO-SHIELD, you are not delighted, return the unused portion anytime up to three years, for a pro-rata product refund

CONSUMER NOTICE!

Beware of cheap imitations and the scare tactics of High Price Sealants —**ONLY GLO-SHIELD** is made with **ACRYLICS**. The same **ACRYLIC** that's on your car's original paint.

(Glo-Shield is a one step operation—you don't need so-called professionals to put it on for hundreds of dollars) You do it yourself easily—in less than an hour.

BEFORE YOU BUY—LOOK AT THE LABEL

Only Glo-Shield Contains Acrylics
Not a wax—Not a Polymer-Silicone Polish **But an Acrylic Sealer**—that protects and shines...guaranteed for 3 years. Don't be switched—it's your money.

CREDIT CARD PURCHASE—CALL TOLL FREE 24 HOUR SERVICE: **800-453-2444**

SATISFACTION GUARANTEED OR MONEY BACK

GLO-SHIELD, Dept. 1453
10-10 44th Ave., P.O. Box 1464
Long Island City, NY 11101

Please send me GLO-SHIELD. I understand that if I am not delighted in every way, I can return the unused portion for a pro-rata refund, exclusive of postage and handling.

- One bottle only \$9.95 plus \$1 shipping.
 - SAVE: Two bottles only \$18 plus \$1 shipping.
- Enclosed is \$_____ or charge my
 BankAmericard MasterCard
 MC Bank # _____ Exp date _____

Acct.# _____
Name _____
Address _____
City _____
State _____ Zip _____

N.Y. RESIDENTS ADD SALES TAX

ACCEPTED AND PROVEN FOR AIRPLANES AND BOATS

After extensive testing GLO-SHIELD has been accepted and used by America's leading aircraft manufacturers and leading boat builders. Desert sunshine labs report amazing results from testing (reports available on request). GLO-SHIELD has been shown to be especially effective while operating in a salt water environment and highly recommended by boat centers for use on all boats, including fiberglass.

© 1979 MEDIA MKTG.

YOU CAN MAKE BADGES QUICKLY, EASILY, INEXPENSIVELY



**PROMOTE
IDENTIFY
RAISE FUNDS
MAKE MONEY**

This is the original \$17.95 badgemaker. BADGE-A-MINIT is now in use by thousands of businesses, schools, clubs and individuals throughout the United States and Europe. A unique, patented system of color coded dies and a hand die press allows you to create colorful pin-back badges and buttons. BADGE-A-MINIT is so portable, so complete that you can make badges, anywhere, anytime, in any quantity.

Send today for FREE expanded color catalog showing America's foremost badgemaking systems and accessories.

Basic system as illustrated, contains sturdy, hand die press, color coded, BUT-N-LOK dies, parts for twelve pin-back badges, and fully illustrated instructions. It's only \$17.95 and is the ideal introduction to the fun and profitable world of badge and button making! All BADGE-A-MINIT systems are unconditionally guaranteed.

**SEND FOR
FREE
COLOR CATALOG**

BADGE-A-MINIT, Ltd., Dept. PS-40 Box 618, Civic Industrial Park, La Salle, IL 61301

I WANT TO MAKE BADGES. Rush me the basic BADGE-A-MINIT system. I'm enclosing \$17.95 plus \$1.75 shipping.

My personal check or money order is enclosed.

Use my charge card

VISA Mastercharge American Express

Credit Card # _____

Inter Bank # (MC) _____

Exp. Date _____

Signature _____

YES, SEND ME the BADGE-A-MINIT catalog. FREE!

(Ill. residents add \$1.25 sales tax.)

Name _____

Address _____

City _____

State _____

Zip _____

UNCONDITIONAL MONEY BACK GUARANTEE

**SAVE
BIG!**

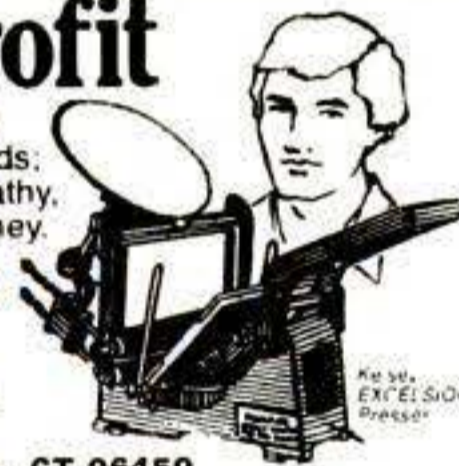


Great traction, power. Build your own 16 hp. tractor. Factory direct savings. Field proven. 30 attachments — mower, snowblower, garden tools. 12-pg. Catalog — 50¢; build-it-yourself Plans — \$7.00 (refunded on any purchase). **Struck Corp.**, Dept. PS40T Cedarburg, Wis. 53012

Print For Profit

Cards; stationery; envelopes; advertising; labels; tickets; QSL cards; announcements; greeting, sympathy, prayer cards; tags, etc. Save money. **Own a Printing Business.** We supply everything direct from factory. Easy instructions. Also raised printing like engraving. Have home shop. Add to income. Send 25¢ for catalog.

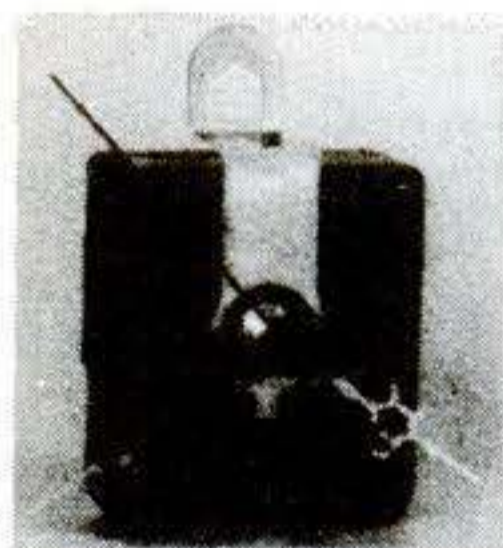
Kelsey Presses, 80-CD Meriden, CT 06450



**FOR SPEEDIER DELIVERY
PLEASE USE YOUR
ZIP CODE**

QUARTZ BATTERY CLOCK MOVEMENTS

**LARGEST
SELECTION
at the Lowest
Prices Ever From KLOCKIT**



PR QUARTZ SERIES

PR #202 - for dials up to 1/4" thick.

PR #203 - for dials up to 7/8" thick.

PRICES:

1 Mvt. \$8.75.

5 Mvts. \$8.00 ea.

10 Mvts. \$7.50 ea.

FREE Hour & Minute Hand!

Second hand S-300 - .35c ea.

- Pendulums!
- Decorative Dials!
- New "Mini-Quartz"
- Numerals!
- Chime Movements!
- Wt. Shells!

Add: Shipping & Handling!

1 unit \$1.50, 5 units, \$2.00

PHONE ORDERS WELCOME!



SAVE with #154

American made 4-jewel Battery Clock Movement

Free Hr. & Min. hand

LOW PRICES:

1 Mvt. \$7.95

5 Mvts. \$5.85 ea.

10 Mvts. \$5.40 ea.

For dials up to 1/4" thick long shaft available - at slight extra cost, shipping extra.

For complete QUARTZ series send for a Free Catalog.

Write KLOCKIT, Dept. PS80, P.O. Box 629, Lake Geneva, WI 53147

or Call: [414] 248-1150 [For 1st class catalog delivery - send 50c]

MAKE POWER ALCOHOL FUEL

We have a very large selection of reasonably-priced alcohol books, slide sets, Still-construction Plans, Hydrometers & Test Kits, Enzymes and other supplies.

Our new catalog also features Methane, Solar, Wood, Wind, Electric cars and many other topics.

Our Introductory ALCOHOL FUEL PACKET contains a 192-page Still Building Book, another booklet on Basic Fermentation & Testing Methods, our new catalog, Government Permit Information, Test Kit Literature, and much, much more. Price is \$8.50 per packet. (Foreign orders = \$10)

The catalog alone is available for \$1 (Foreign = \$2).

**MICRO-TEC
LABORATORIES, INC.**
Rt 2 Box 19
Dept. PS - 4
Logan, Iowa 51546



Member: National Gasohol Commission

Build this beautiful Dome Home by yourself!

The least expensive, most energy-efficient home available.



Monterey Domes' geodesic shell package can be easily assembled by one or two people in a few days with ordinary household tools. Our unique, patented system is a dramatic breakthrough—makes home construction a snap. No skills necessary.

Your Monterey Dome home costs significantly less to build than a conventional home, yet meets or surpasses all building codes. It will also save you up to 50% or more on heating and cooling costs. Prices start at \$3795. Many home packages are available ranging from 700 to 4,500 square feet.



MONTEREY DOMES

Dept. 224 P.O. Box 5621 • Riverside, CA 92517

Send for our all-new color Catalog and Plans Book—96 fact-filled pages of exciting, affordable homes. Write today!

Please rush me your new 96 page full color Catalog and Plans Book. I am enclosing \$4.00.
 Also send me the Monterey Domes Assembly Manual for an additional \$5.00.

NAME _____

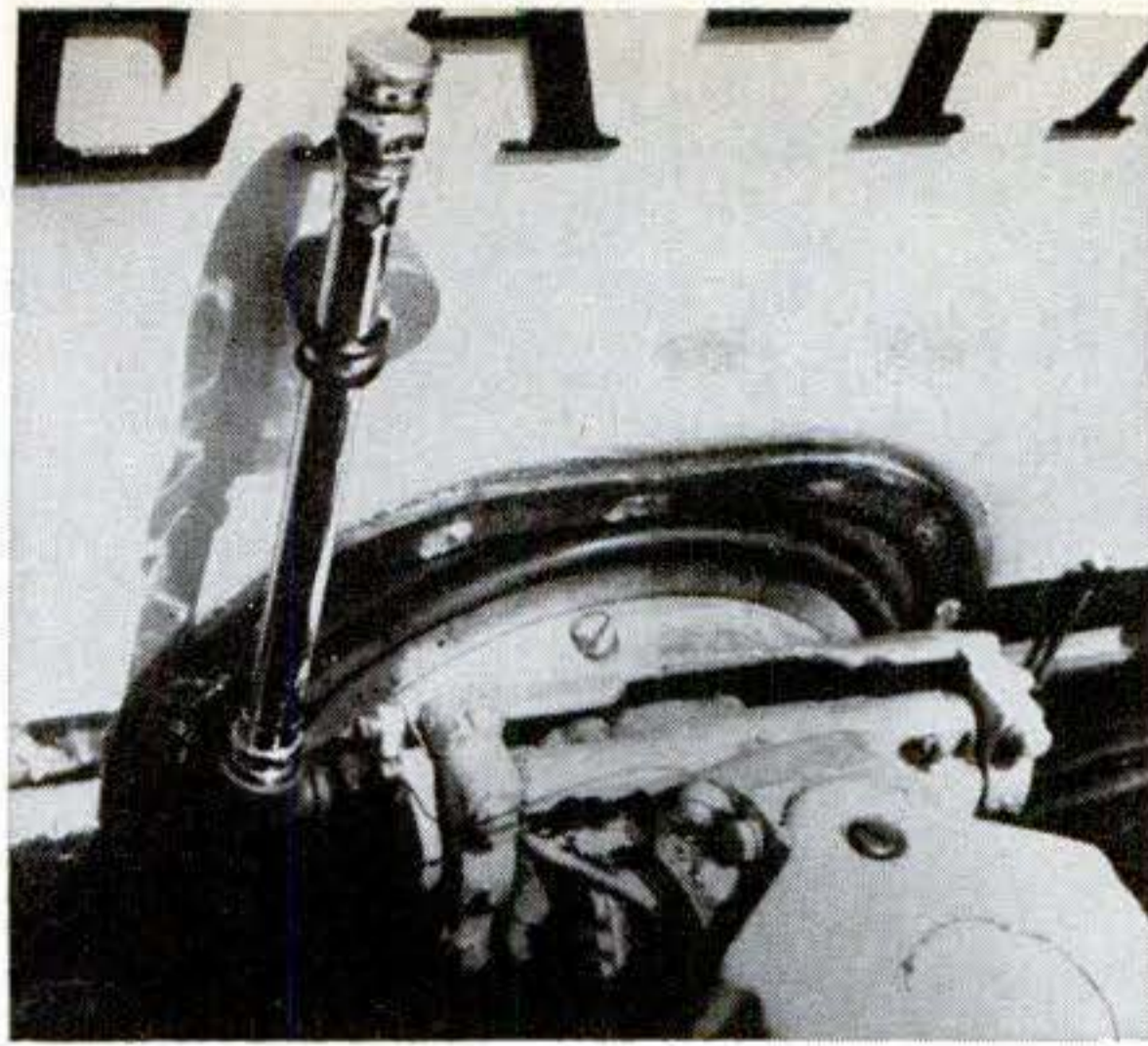
ADDRESS _____

CITY, STATE, ZIP _____

Mail To: Monterey Domes, Dept. 224
P.O. Box 5621, Riverside, CA 92517

Simple-to-make stern-drive flushing adapter

Chrome pipe projecting upward is an easy-to-make flushing adapter for an OMC stern-drive engine. To use, simply remove the end cap and insert a hose.



If your boat is permanently moored in a salt-water marina, as mine is, flushing the stern-drive engine can become a major and sometimes dangerous project—especially since the flushing attachments are located well down on the transom. My solution? A transom-mounted flushing device that you can build for under \$50. With this simple add-on, you can easily hook up the flushing hose without leaving your boat.

The device is designed to work with the OMC out-of-water flushing adapter (see diagram below). This comes as a simple kit that installs in minutes.

For the flushing extension, you need the parts shown. Get the cable clamp and teak standoff at a marine-supply store, and the rest at a plumbing-supply house. Make sure that the ends of the pipe are cut off straight.

Once you have assembled and in-

stalled the flushing extension, start the engine and check for major leaks in the device. If you find one, retighten the fittings or add thread compound. If the end cap at the top leaks, add hose washers.

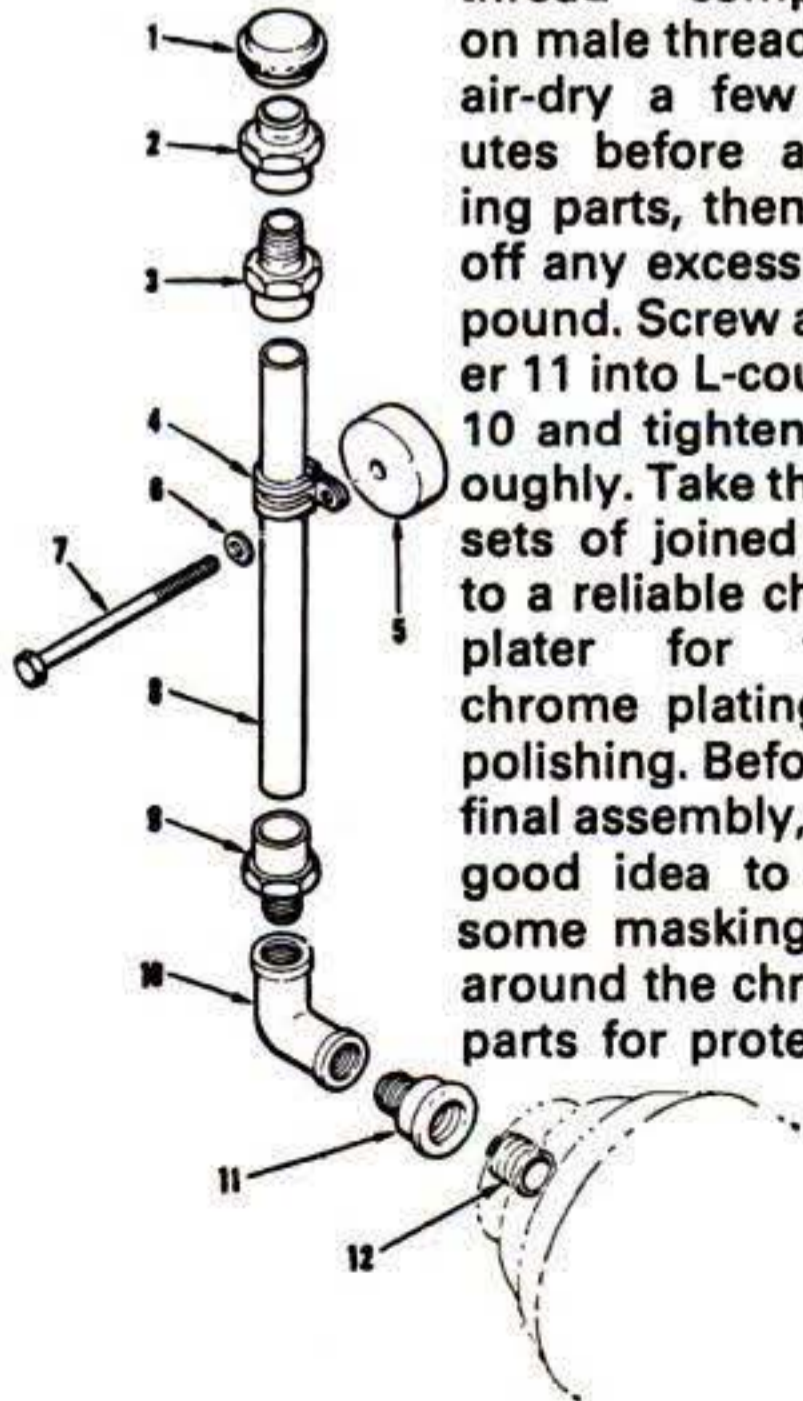
To flush the engine, remove the end cap, connect a garden hose to the threaded pipe, and turn on the water. After flushing, don't forget to replace the end cap—and always make sure it's in place before you use the boat.

—Ralph Landers

Parts list for diagram below: (1) End cap with internal hose thread; (2) 3/4 NPT to 1-in. hose thread adapter; (3) 3/4 NPT male thread fitting; (4) No. 12 cable clamp with 1/4-in. screw hole; (5) Teak standoff with 1/4-in. center hole; (6) 1/4-in. stainless-steel flat washer; (7) 1/4-in. stainless-steel, 5-in.-long RH bolt; (8) 10-in.-long, 3/4-in. ID, 7/8-in. OD copper pipe; (9) 3/4 NPT male fitting; (10) L-coupling, 7/8-in. ID, 1-in. OD internal NPT; (11) Male 3/4 NPT to 1-in. female hose thread adapter; (12) 1-in. male hose thread fitting (part of stern-drive flushing adapter). Not shown—1/4 stainless-steel nut; lockwasher and flat washer with 1/4-in. hole; silicon rubber compound; Form-a-gasket no. 2 thread compound.

To assemble the flushing adapter, first attach fittings 3 and 9 to pipe 8, using silver solder only. Grind down any burrs, then mount hose adapter 2 to fitting atop pipe. When joining these and other parts, use

thread compound on male threads. Let air-dry a few minutes before attaching parts, then wipe off any excess compound. Screw adapter 11 into L-coupling 10 and tighten thoroughly. Take the two sets of joined parts to a reliable chrome plater for triple-chrome plating and polishing. Before the final assembly, it is a good idea to wrap some masking tape around the chromed parts for protection.



Then remove and discard the end cap and chain from the OMC adapter 12, but save the rubber washers. Thoroughly clean the threads of this fitting, put thread compound on them, and screw the chromed adapter and L-coupling (10 and 11) onto this fitting. Before tightening, make sure the L-coupling points upward. If not, back it off a half turn. Next, apply thread compound to fitting 9, then screw it and attached pipe into the L-coupling. Tighten thoroughly. Attach clamp 4 to pipe and slide the clamp about one-half the way down. Hold it against transom and mark position of clamp hole. Check that the inside of the transom is clear of equipment and wires near that mark. Next drill a series of progressively larger holes through the transom until you get a hole that's 1/4-inch in diameter. Apply silicone rubber to the transom side of the teak standoff 5, and slide bolt with washer into transom. Have a helper inside the boat add a flat washer, lockwasher, and nut to bolt. Tighten thoroughly. Immediately wipe excess silicone compound off transom. Insert the rubber washers from OMC end cap into your new chromed end cap and screw onto pipe. Finger-tighten only—never use pliers.

Professional car care in one easy kit.

Star Luster has put together a kit of our most-used products. With step-by-step instructions. So you can give your own car, truck, R.V. or boat professional care. It's the finest reconditioning kit you can buy. It's easy-to-use. It's complete—everything you see here:

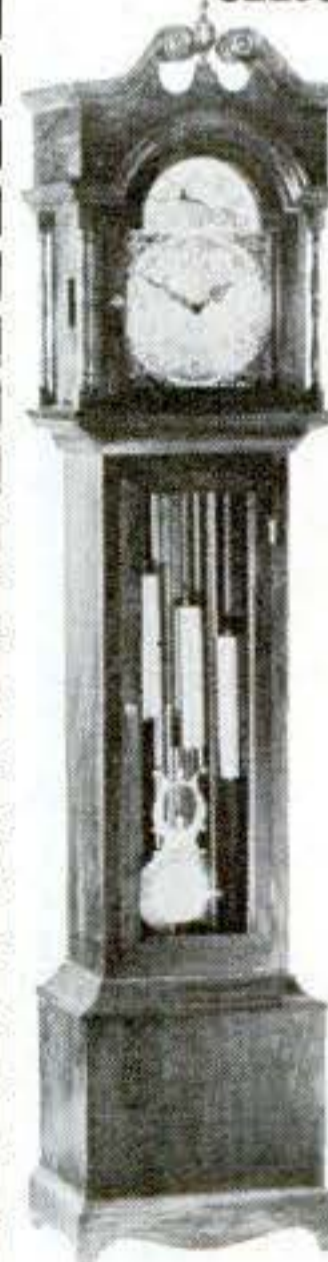


Ask for it where you buy automotive supplies. Or send \$14.95 (includes immediate shipping) to:

Star Luster,
181 West Marshall,
Ferndale, MI 48220.

star luster

Every time it chimes you'll remember that you built it.



There is a great personal pride in owning a Mason & Sullivan heirloom quality clock.

Build your own from plans or easy-to-assemble kits for all levels of skill. The finest hand-matched hardwoods, solid 3/4" in walnut, oak, cherry or Honduras mahogany. Precision imported movements and chimes. Solid brass dials. Choose from Grandfather, Grandmother, wall, desk, mantle and more. A Mason & Sullivan clock. Yours for the making, at a price you can afford.

Send for our new 32 page catalog today.



Please send me your color catalog of top quality antique reproduction clocks I can build. I enclose \$1.00 for catalog.

Name _____

Address _____

City/State _____ Zip _____

Mason & Sullivan Co.

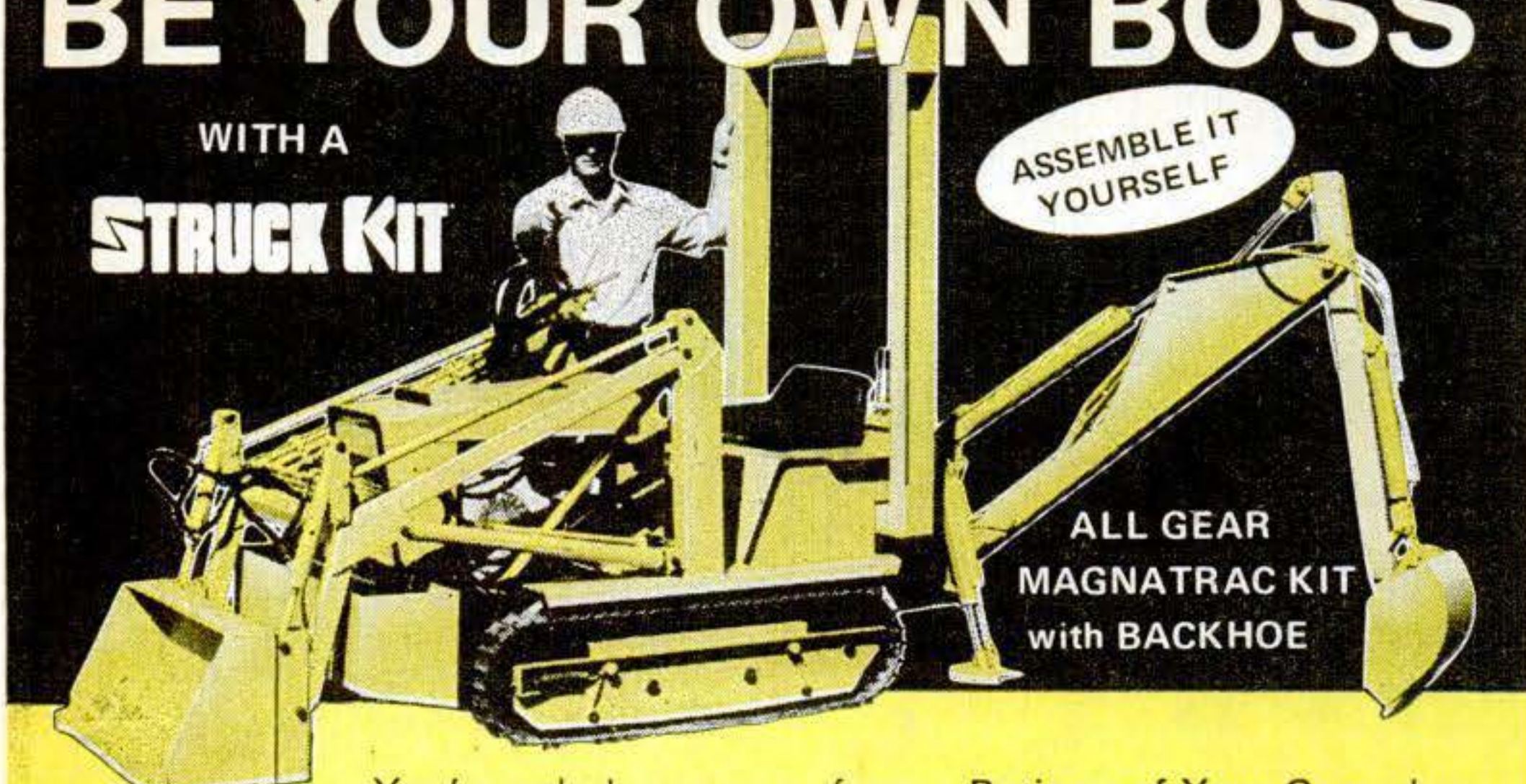
Dept. 1318 Osterville, MA 02655

BE YOUR OWN BOSS

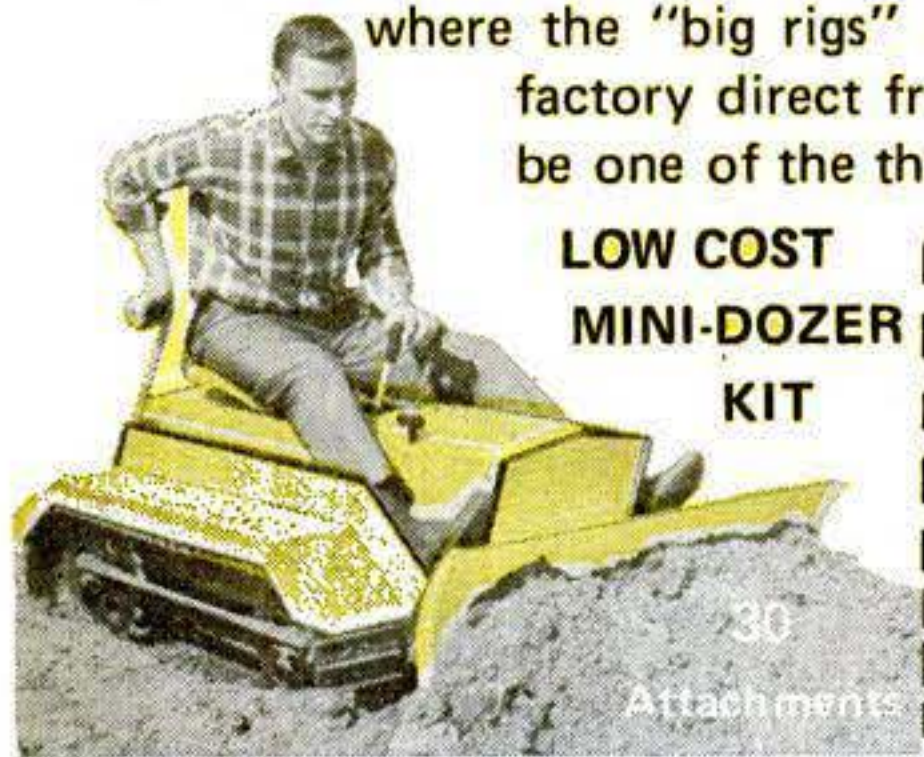
WITH A
STRUCK KIT

ASSEMBLE IT
YOURSELF

ALL GEAR
MAGNATRAC KIT
with BACKHOE



You're only hours away from a Business of Your Own when you start to assemble your Struck-Kit Tractor. Once assembled (a weekend project), your Struck Tractor will allow you to turn your spare hours into Cash! Over 30 attachments allow you to tackle almost any "compact-size" construction, landscaping or gardening job. You'll be able to get in places where the "big rigs" can't and then charge your own price! Buy factory direct from the leader in the small crawler field and be one of the thousands of satisfied customers. Send now to:



LOW COST
MINI-DOZER
KIT

STRUCK KIT, Dept. PS40 Cedarburg, Wis. 53012

- Catalog showing Struck Tractor Kit construction & uses (specify Magnatrak or Mini-Dozer) - \$.75. Both catalogs - \$.75.
- Plans for fabricating Struck Tractor (specify Magnatrak or Mini-Dozer) from local materials - \$7.00. Both plans - \$10.00. (Refunded on any purchase.)

Name _____
Address _____
City, State, Zip _____

(Dealer Inquiries Invited)

THE GREAT HOOK-UP

Combination Hitch Plate/Step & Bumper Guard

Rugged, attractive, versatile — fits most U.S. made 1974 and newer...

- VANS
- PICKUPS
- 4WD's

(Vehicles must be equipped with standard factory bumpers)

Easy do-it-yourself installation. No welding or alterations. All mounting hardware included.

Solid steel construction. Custom good looks. Won't interfere with oversize fuel tanks or spare tire carriers.

10 DAY MONEY BACK GUARANTEE



Avionic Structures, Inc.
1429 N. State College Blvd.
Anaheim, California 92806



COMBO II SAE Class II Rating

3500 lb. load capacity

\$89.95*



COMBO III SAE Class III Rating

7500 lb. load capacity

\$129.95*

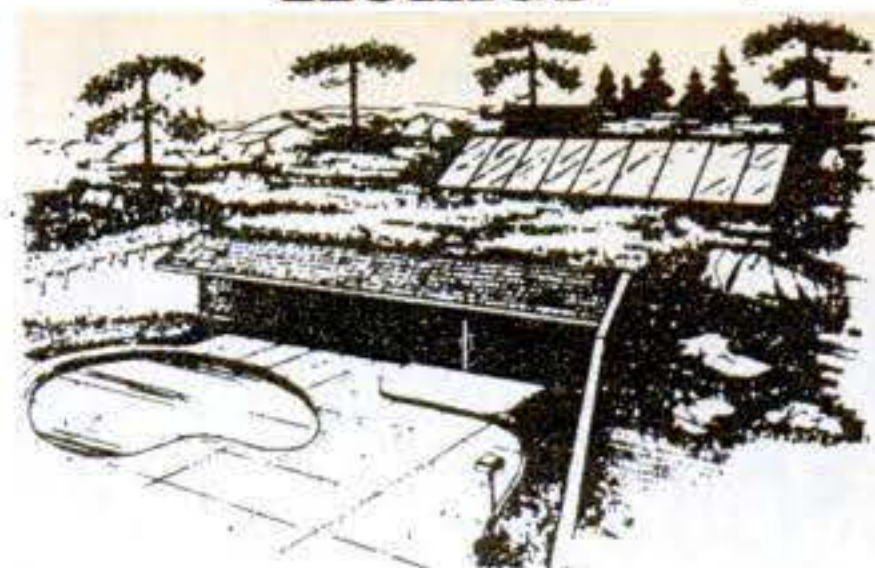
*FOB Factory

ORDER TOLL FREE **1-800-854-6903**

or call for more information

(In California call collect: (714) 772-9950)

Homes



- The Primer To Earth Sheltered Living** — 24 Page Booklet gives basic information on underground homes — advantages, site selection, planning, financing, building tips, construction and landscaping. \$3.00 ppd.
- Plans For The Future** — 44 Page Book features full color renditions of 25 different underground home designs, plus floor plans. Blueprints available. \$6.95 ppd. Order Today! Satisfaction Guaranteed.

Underground Homes • Dept. PS4
700 Masonic Bldg. • Portsmouth, OH 45882

Vacu-Stack™ acts like an . . .
“Automatic Chimney Sweep”
for Woodburners!



- Reduces creosote build up
- Keeps rain and snow out
- Adapters available for any flue
- Durable stainless steel
- Full money-back guarantee

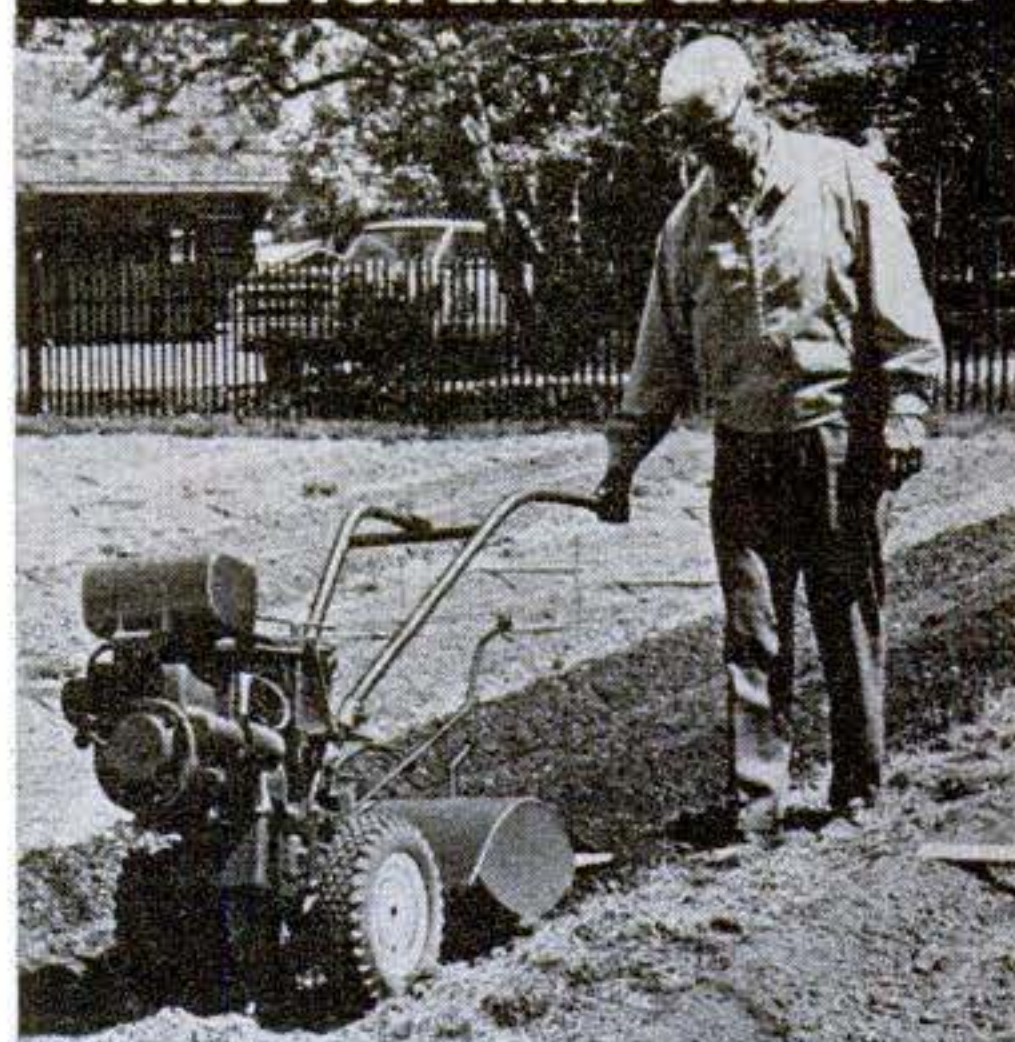
Dealer inquiries invited
(617) 695-7000

Send: Stove Brand, Pipe Size and Inside Flue Dimensions for Free quotation and brochure.

Mastercharge and Visa welcome.

IMPROVED CONSUMER PRODUCTS, INC.
Box 1264-PS4, Attleboro Falls, MA 02763

NOW COMES IN 2 SIZES:
PONY FOR SMALL GARDENS,
HORSE FOR LARGE GARDENS.



JUST ONE HAND!

So easy to handle you guide it with just one hand. And now the Troy-Bilt Roto Tiller-Power Composter is yours in 14½" and 20" tilling widths. For complete details, prices, off-season discounts, send coupon below for free booklet.

Troy-Bilt, 102nd St. & 9th Ave., Troy, N.Y. 12180

Troy-Bilt Roto Tiller-Power Composters, Dept. A-152
102nd St. & 9th Ave., Troy, N.Y. 12180

Please send the whole exciting story of Troy-Bilt® Roto Tiller-Power Composters, including prices, specifications and off-season savings.

Mr. _____ (Please Print Clearly)

Mrs. _____

Miss _____

Address _____

City _____ State _____ Zip _____

FREE

BOOKLET How to Build a more Powerful Body

Develop your body to its fullest potential!

Not everyone can develop massive muscularity as shown here. Of course, there are some who can exceed it. But it is important that you know that everyone can develop to his maximum potential! With bodybuilding, you can get into shape. Really into shape! With the right amount of effort, you might even make the girls notice you with admiration and make a few guys turn their heads in envy.

Besides looking better, when you get into shape, chances are you are going to feel better and have much more energy. That's how much bodybuilding can do for you. All you have to do is follow our program three times a week. And each bodybuilding session can probably be completed in the time it would take you to drive to a commercial spa and back. What's more, you can follow our program in the privacy of your own home.

Get a sexy, trim and muscular waist!

Ask any girl what the biggest turn-off is in a guy's appearance. Chances are, she'll say FAT. However, with the proper combination of bodybuilding and diet, you can get rid of excess fat and flab. You'll see miracles performed on your waistline!

Want to do better in sports?

It's a fact! With all other factors the same, the stronger guy almost always out-performs the underdeveloped, weaker guy. This is the reason most coaches put their athletes on a strength building program. And for you, this is where the Universal Bodybuilding program comes in. Because not only can it help you get into shape, it can improve and increase your strength as well!

So, why let yourself deteriorate?

Face it. Unless you do something about it, your body will eventually become out of shape. Participating in sports will help, but as you get older, it is difficult to remain as active as you would like to. However, unlike most other sports, bodybuilding is a sport that you can continue at almost any age. In fact, there are bodybuilders who are in their 30's and 40's who are more muscular than most Olympic champions! With progressive bodybuilding, you get results you can see and feel!

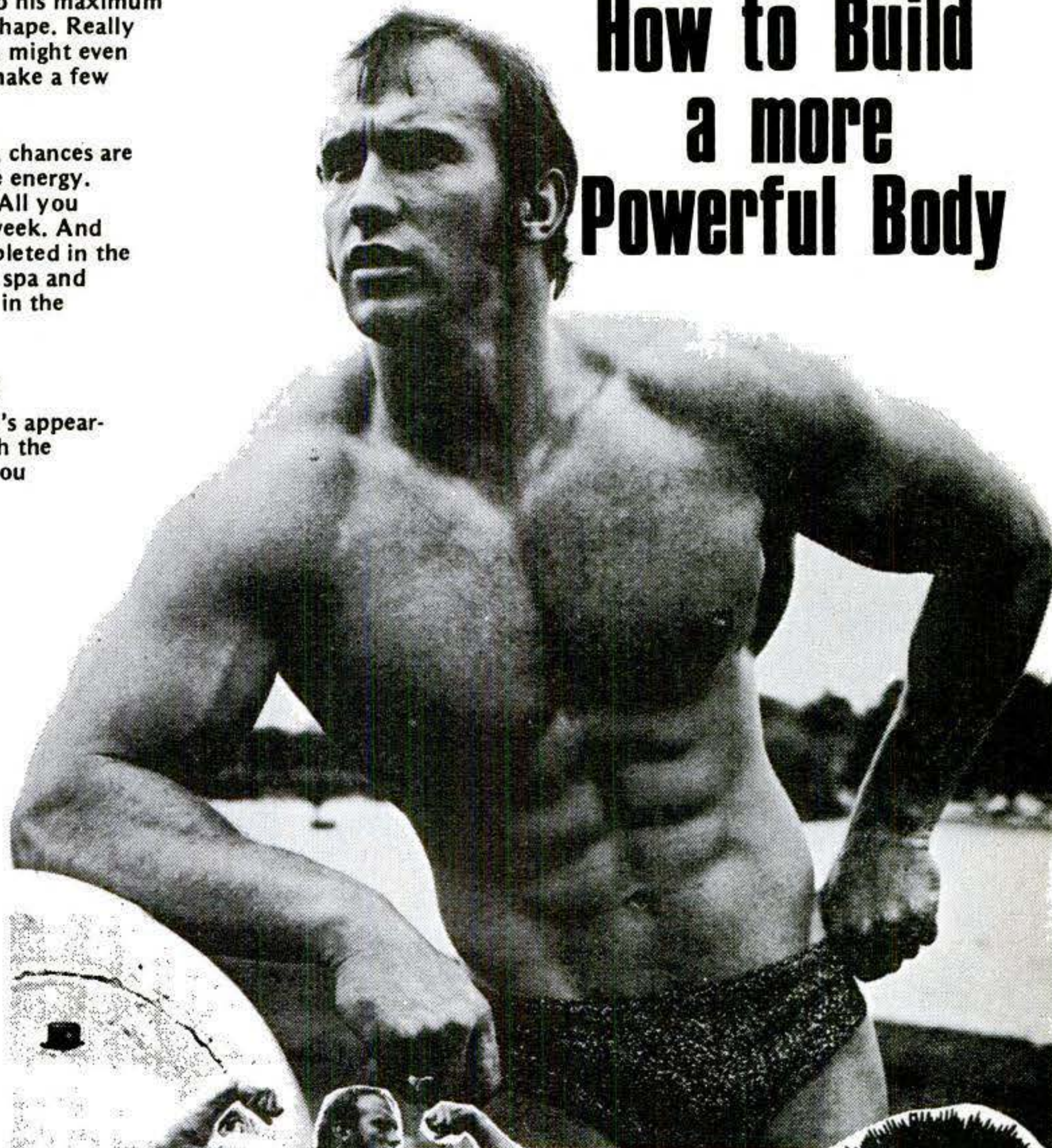
Also, don't forget the psychological benefits of exercise. As you get into the habit of exercising, you'll have an increased awareness of self, and being more in touch with your body!

Only for the healthy!

Before embarking on this bodybuilding program, or any other new physical endeavor, be sure to check with your physician for his okay. A bodybuilding course such as this specializes in developing the body to its maximum potential and should only be attempted by those in good health.

Like more info?

If you're 17 years of age or older we'll be glad to send you a colorful booklet. Absolutely free! Simply send us your name, address and zip code.



FREE!

UNIVERSAL BODYBUILDING
Dept.-21
Box 6694
Detroit, Michigan 48240

Dear Universal:

You bet I want to build a more Powerful Body. Rush me that FREE Booklet!!!

Name _____

Address _____

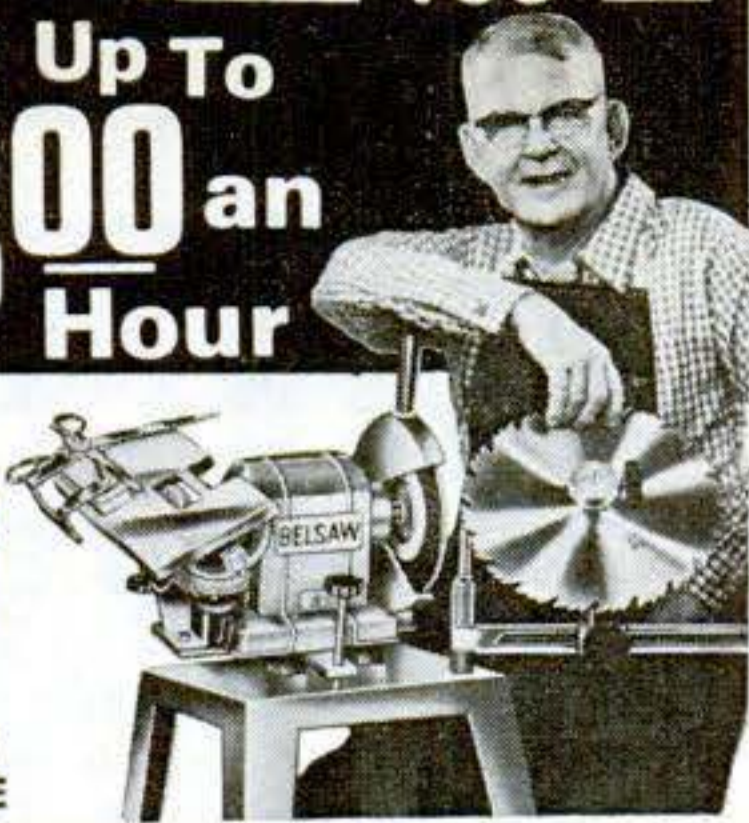
City _____ State _____ Zip _____

MAIL TODAY!



Let Belsaw prove YOU can
Earn Up To
\$800 an
Hour

In
YOUR
OWN
SPARE
TIME or
FULLTIME



SHARPENING BUSINESS!

On our
30-DAY
FREE
TRIAL
OFFER

You risk nothing by accepting this offer to see how easily you can turn your spare time into big Cash Profits with your own Complete Sharpening Shop. No selling... no previous experience needed. Our famous Sharp-All and show-how instruction set you up to make \$200, \$500, \$700 a month CASH sharpening Saws, Knives, Scissors, Lawnmowers, Shop and Garden Tools... all cutting edges.



LIFETIME SECURITY
 with YOUR OWN BUSINESS

FREE BOOK!
 Gives Full Details

Send for all the facts! Our Free Book tells how to start a profitable, lifetime home sharpening business, how we help you grow, how we'll finance you.

Send for FREE details - mail coupon below or postcard TODAY!
BELSAW SHARP-ALL CO., 701A Field Bldg. Kansas City, Mo. 64111

No Obligation... No Salesman Will Call

YES, **BELSAW, 701A Field Bldg., Kansas City, Mo. 64111** please send me the **FREE BOOK** that gives full details.

Name _____ Please Print
 Address _____
 City-State _____ Zip _____

BEST BUY!

EASY-TO-ASSEMBLE KIT

ONLY **\$375** F.O.B.

For 3'6" diam. Other diam. from 4' to 6' at comparable savings. All diam. adjust to floor-to-floor hts. of 8'1/2" to 9'6".



©The Iron Shop 1977

People who've looked everywhere tell us there isn't another spiral stair around that touches our combination of price and quality of materials and workmanship. We believe it!

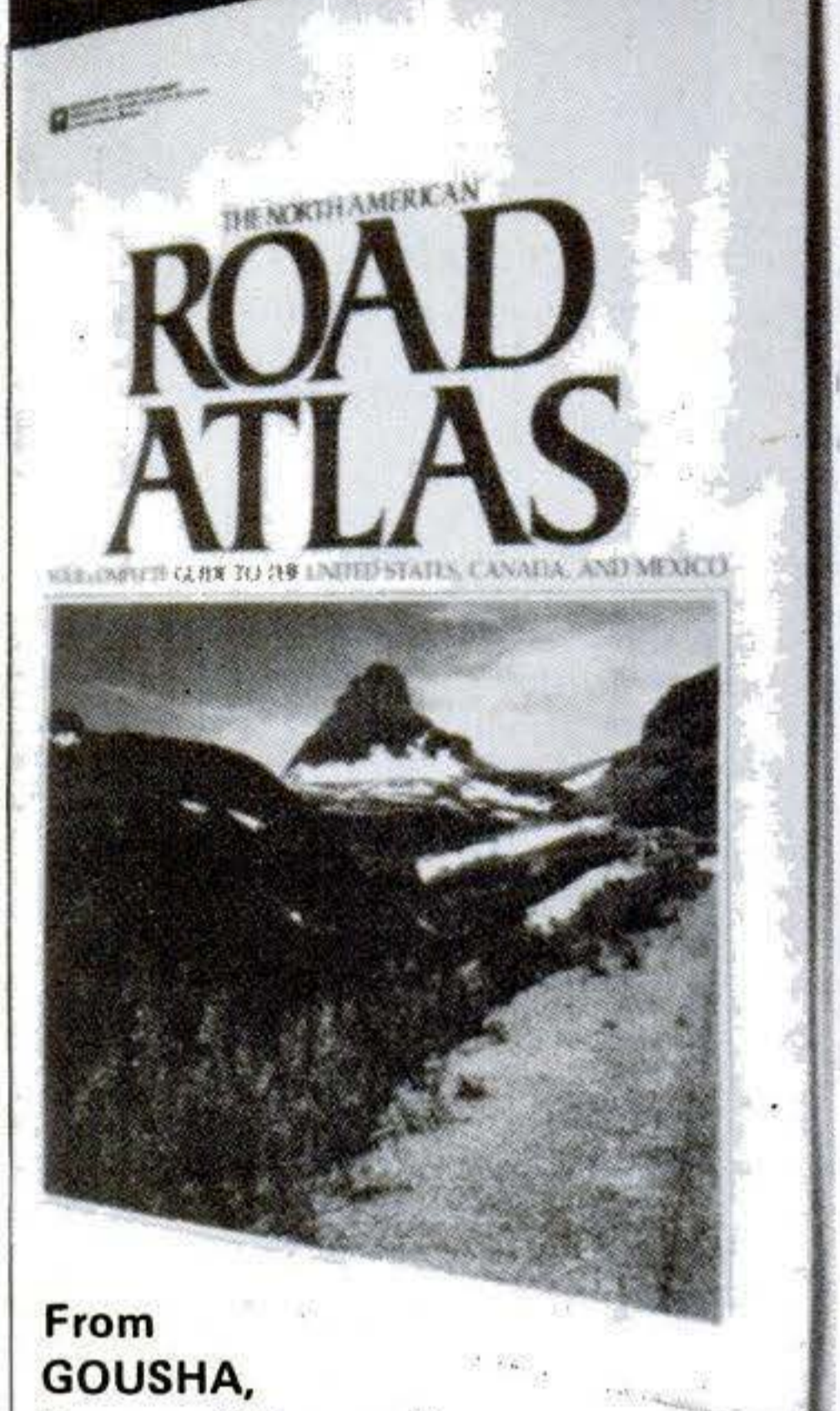
CALL OR WRITE FOR FREE BROCHURE:

To: The Iron Shop, Dept. 53B, Box 128, 400 Reed Road, Broomall, Pa 19008 Our Tel: (215) 544-7100.

Name _____
 Street _____
 City _____ State _____ Zip _____
 We accept Master Charge and VISA.

THE IRON SHOP
 MANUFACTURERS

YOUR PERFECT TRAVELING COMPANION!



From **GOUSHA**, for over 50 years the nation's foremost road map publisher

A must for every driver, the new edition is the most comprehensive road atlas Gousha has ever published. Users report it superior to any they've ever used.

- Large 10x14" full color pages
- Indexed, detailed maps of the 50 states, Canadian provinces & Mexico
- Individual maps of 212 cities
- 18 National Parks, Recreation Areas
- Transcontinental mileage chart
- Scenic sites, and much more

Only \$3.95 + \$1 per copy shipping & handling. Residents of CA, CO, FL, IL, NY, PA, VA, VT, WI add appropriate sales tax. Quantity prices available. **ORDER YOUR ATLAS TODAY!**

Popular Science Road Atlas - Dept. 480
 P.O. Box 5115, Grand Central Station
 New York, NY 10017

Enclosed is check for \$ _____
 Please send me _____ copies of the new NORTH AMERICAN ROAD ATLAS at \$3.95 + \$1 shipping & handling each.

NAME (Print) _____
 ADDRESS _____
 CITY _____
 STATE _____ ZIP _____

Res. of CA, CO, FL, IL, NY, PA, VA, VT, WI add appropriate sales tax.

Your
CONSERVE ENERGY

Electrify your Bike...



PEDALPOWER-Exciting new powerful electric drive for bikes. Tames tough hills. Be independent. Shop when you want. Fits all bikes and adult trikes. Easy to use and install. Beat high gas prices. Recharges overnight at home. Travel 100 miles for a dime.

Get your exercise without strain. Pedal easily with motor engaged to help improve your health. Visit friends. Travel to work or ride for fun. Starts without pedaling. Noiseless, non-polluting. Virtually maintenance-free operation!

Thousands in use today by senior citizens, students, housewives, workers, handicapped and professionals. Call today or write for free booklet with complete details on PEDALPOWER motors, Take-Apart Electric Bikes and Adult Electric Tricycles.

Call Toll Free
800-257-7955*

For this **FREE BOOKLET** & Special Offer or Write:



General Engines Co.
 5777 Mantua Blvd.
 Sewell, NJ 08080



* In AK, HI, NJ call collect (609) 468-0270

Order-by-mail from Airborne... Save up to 90% on government surplus and other bargains

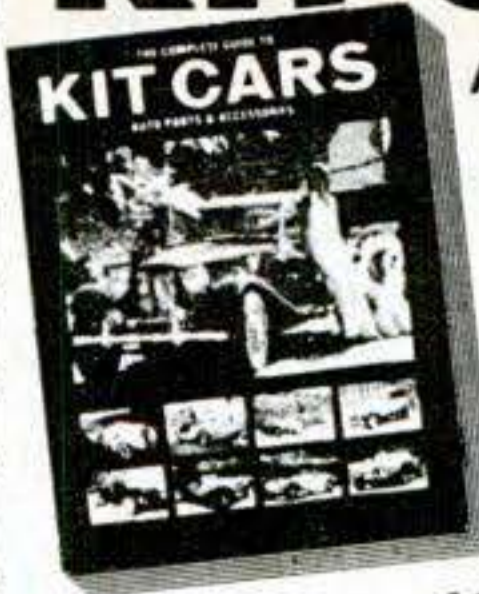
★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★
PERMANENT MAGNET MOTOR
 Reversible. Hi torque. 1 HP. 48 VDC @ 4800 RPM. Linear tube. 1/4 HP. 12 VDC @ 1200 RPM. 3/4" keyed shaft. 9 1/2" L x 4 1/2" Dia. Also use as generator. Shpg. Wt. 15 lbs. NEW. Reg. \$108. Now \$47.50. (Stk #4279).
 Price FOB Culver City, CA. 50% deposit for COD. Send cash, check or money order. Calif. res. must add sales tax. Master Charge & Visa accepted.
 ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★



AIRBORNE SALES CO. Dept. PS80, Box 2727
 8501 Steller Drive, Culver City, CA 90230
 Name: _____
 Address: _____
 City: _____
 State: _____ Zip: _____



KIT CARS



Annual Buyer's Guide
 160 Pages
 Over 500 Photos



ASSEMBLE & DRIVE YOUR OWN FULL-SIZE SPORTS CAR

Beat the gas crisis in style! Giant fact-filled Buyer's Guide reveals over 110 full-size kit-built autos. Discover everything from 40 mpg roadsters to economical gull-wing GT's, energy saving electrics and more. You'll save thousands! This Supercatalog is packed full of Photos • Prices • Comparisons • How-to's • Tech Data • In-depth articles and more.
 FREE! Order today and receive valuable Newsletter of used kit car bargains.

★ 14 Day Money Back Guarantee ★



AUTO LOGIC, INC. \$7 Postpaid
 P.O. Box 2073, Dept. C1 \$10 Rush 1st Class
 Wilmington, DE 19899 \$11 Foreign Air Mail
 Bill to my: Master Charge VISA

_____ Exp. Date _____
 Name _____ (print)
 Address _____
 City _____ State _____ Zip _____

Order TOLL-FREE by phone. Master Charge or VISA REQUIRED!
 (800) 331-1000 Day or Night.
 (918) 664-8300 in Okla. call collect.

Virtually Invisible Hook Up Wire Laminated in Pressure Sensitive Tape

HIDES UNSIGHTLY WIRES FOR TV, AM, FM ANTENNAS, STEREO SPEAKERS, PHONES, BURGLAR ALARMS, ETC.

Practically invisible hook up wires laminated into crystal clear pressure sensitive tape is a decorator's dream. End unsightly cords of stereo speakers, intercom, alarms systems, toys, other low voltage applications. Use as indoor

AM, FM, TV antenna for superior reception. Paint applies harmlessly over tape without reception loss. 100-foot roll only \$8.98 + 85¢ postage & handling or 2 rolls for just \$16.98 + \$1 post. & hdlg.

Res. of CA, CO, FL, IL, NY, PA, VA, VT, WI add applicable sales tax.



TV-AM & FM RADIOS ANTENNAS



STEREOS SPEAKERS



INTERCOMS ALARMS

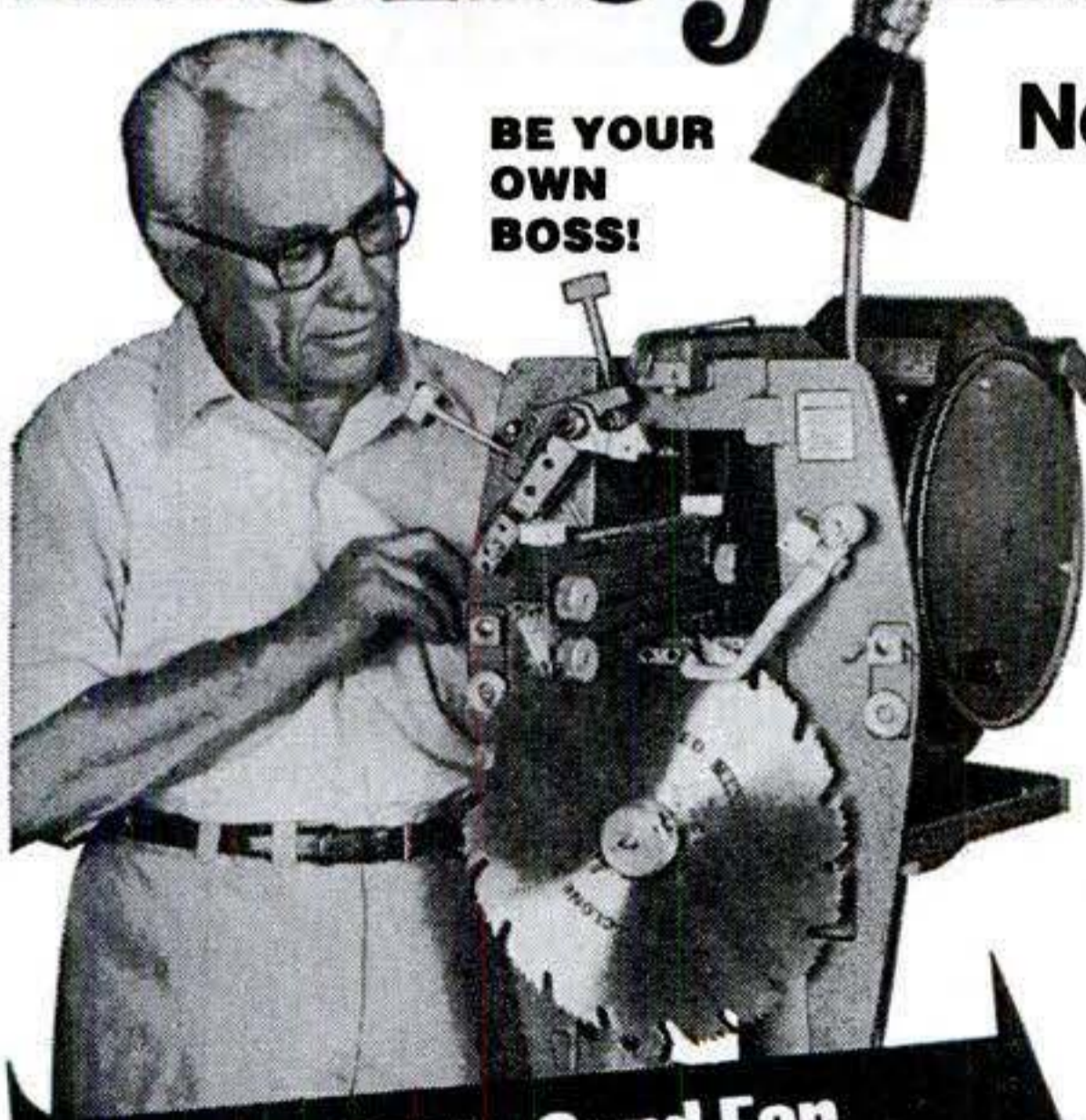


PAINT WILL COVER

Order from **POPULAR SCIENCE HIDE-A-WIRE**
 Dept. 480, P.O. Box 5220, Grand Central Station, New York, NY 10017.

For A Sparetime or Full Time Business, There's Good

Money In Sharpening



BE YOUR OWN BOSS!

Now you can cash in on the huge demand for SHARPENING SAWS and TOOLS.

EARN \$5 to \$8 An Hour Sparetime

All over America, in small towns and big cities, people just like yourself are earning big money in the saw sharpening business. Industry, home handymen, professional carpenters all need their equipment sharpened. It's a business that's growing every year.

Foley will help you finance you and show you how to start and maintain a profitable sharpening business of your own. There's no huge inventory to carry. You can set up in your garage, basement or spare room... wherever there's electricity. You can start earning profits as soon as you receive your equipment.

FREE BOOKLET
 This booklet tells how to start your own sharpening business; how to operate it profitably; who your potential customers are; and what kind of money you can make.

Send your name and address to:
Foley Manufacturing Company
 3227 Foley Building
 Minneapolis, Minn. 55418



Send For Free Booklet

CLIP OUT AND MAIL THIS COUPON TODAY - OR CALL TOLL FREE 1-800-328-7140
 (Except Hawaii or Alaska)

... RUSH COUPON TODAY!
 Get FREE Book with facts and full details



MANUFACTURING CO.
 3227 Foley Bldg., Minneapolis, Minn. 55418

Please send me the free booklet "Opportunities In A Sharpening Business Of Your Own."

Name _____
 Address _____
 City _____ State _____
 Zip Code _____ My Phone _____

Learn Yacht Design

We have produced more yacht designers than any other school and we have been doing this for 50 years. At the same time we have also shown thousands of yachtsmen like yourself the satisfaction and sense of accomplishment to be gained in this rewarding study. And we do it all by correspondence.

- Accredited Member of the National Home Study Council.
 - Approved by the Connecticut Commissioner of Education.
 - Approved training for eligible veterans and service personnel.
 - A not-for-profit affiliate of Nat'l Marine Manufacturers Association.
 - SEND FOR FREE CATALOG.
- WESTLAWN SCHOOL OF YACHT DESIGN
P.O. Box 779-J, Stamford, Connecticut 06904

BE A CHIMNEY SWEEP

Your Own Business: A chimney sweep can clean a chimney with the August West® System in one hour. Nationally, the average charge is \$40.00.

A Growing Need:

The energy crisis has resulted in a dramatic increase in wood burning. Wood smoke deposits flammable creosote in chimneys. Regular cleaning is necessary to prevent fire damage.

The August West® System:

More sweeps use it than any other method in the country.

Send for our free booklet, or call TOLL FREE any time and ask for "The August West Story."

800-648-5311

(In Nevada (800) 992-5710)

August West Systems, Inc.
Box 603 - Dept. QMP
Westport, CT 06880



LONG PLAY 10 HOUR TAPE RECORDER

Top quality AC-DC cassette recorder, modified to provide 5 continuous hours of recording and playback of true fidelity, distortion-free sound on each side of cassette for a total of 10 hours. Unit has many special built-in features. cassette supplied.
NOW ONLY 125.00*



PHONE RECORDING ADAPTER

Record incoming and outgoing calls automatically with this all solid state unit connected to your telephone jack and tape recorder. Starts recording when phone is lifted. Stops when you hang up, making a permanent record. APPROVED Easily installed. No monthly charges. **\$24.50***



VOX VOICE ACTIVATED CONTROL SWITCH

Solid state. Self contained. Excellent adjustable sensitivity. Voices or other sounds activate recorder. Uses recorder mike or remote mike. 2 1/4 x 1 3/4 x 3/4" **\$24.95***



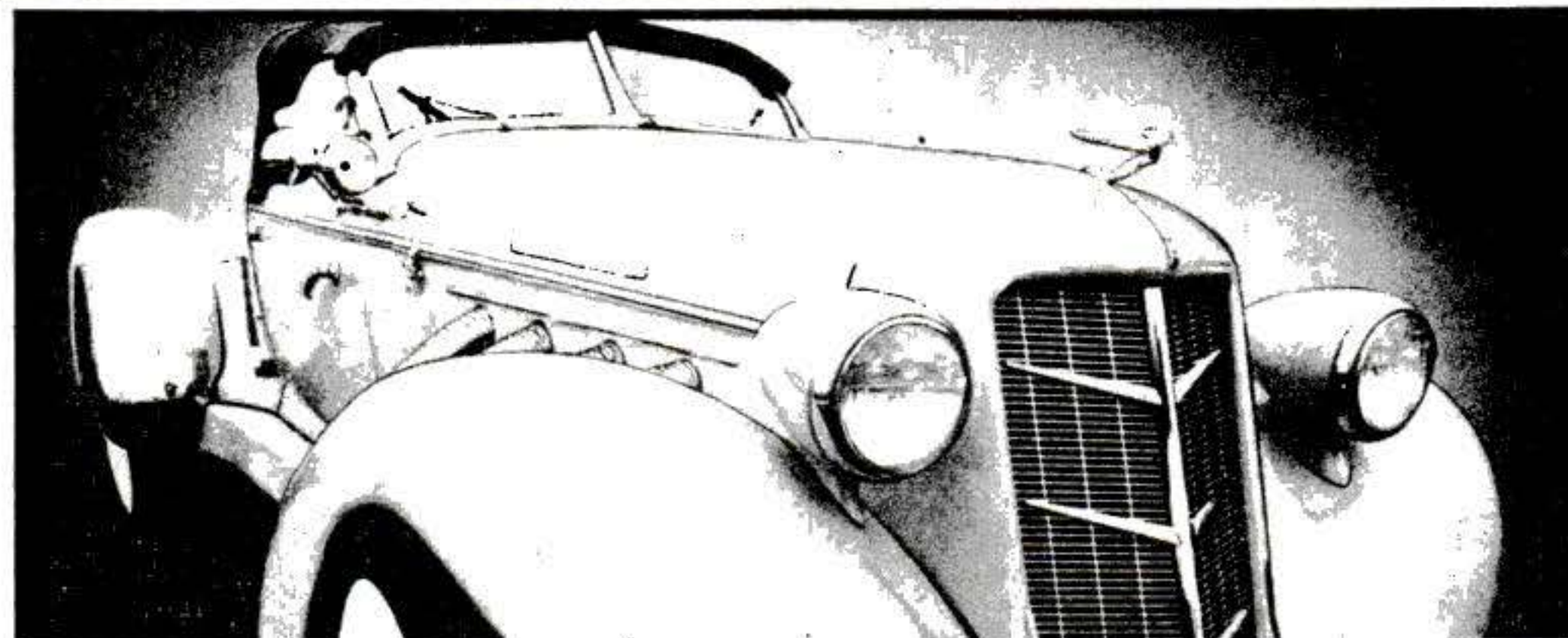
MICRO MINI MIKE™ WIRELESS MICROPHONE

Among world's smallest, solid state, self contained WIRELESS MIKE. Mercury Bat. furn. Picks up most sounds and transmits without wires up to 300 ft. thru FM Radio. Tuneable. Use as mike, ampf., alarm & alert system, baby sitter, hot line, etc. 2-1/4 x 3/4 x 1/2" **\$24.95***



Phone Call Adapter, VOX, MIKE, (* plus \$1.00 ea. ship. & hdlg.), 10 hr. Recorder (* plus \$4.00 ship. & hdlg.). Calif. res. add tax. Mail Order, VISA, M/C, cod's o.k., quan. dis. avail. Money back guar. Free data.

AMC SALES, Dept. C 9335 Lubec St., Box 928
Downey, CA 90241, Phone (213) 869-8519



DON'T WAX YOUR CAR EVER AGAIN!

Chemists Develop New Glaze Finish

A new discovery in the chemical industry **now makes car wax obsolete!** CHEM-GLAZE is actually a liquid, hard-curing resin system, that will flow into the very pores, harden, and completely seal against the paint-destroying elements of the atmosphere.

Until now, CHEM-GLAZE was used strictly by foreign import dealers to protect costly custom paint finishes. It is also used on the body shells of race cars to cut wind resistance, and to give that "super-glossy" appearance.

As temperatures change, wax warms on your car. As wax softens, it acts like a magnet to attract, and collect dirt in the paint. By applying more wax, you actually "grind" dirt into paint pores. Whether you wax or not, when dirt gets into the pores of paint, it causes the glossy finish of your car to fade, and **promotes paint rot.** Merely pour liquid CHEM-GLAZE on a rag, wipe it on your car, then wipe it off. The liquid easily flows into the pores of the paint, brings dirt to the surface, and, within one hour, hardens, or "cures" into paint pores.

CHEM-GLAZE is a unique blend of costly polymer resins, that will actually stop and remove oxidation on a car that is not new. Also, extensive salt spray tests in Florida prove that the CHEM-GLAZE laminating effect will put an impenetrable "glaze" that will last 2-3 years on new paint.

We guarantee CHEM-GLAZE to be fully tested **100% safe and effective.** If you find, after using CHEM-GLAZE, that anything we say about this unique product is untrue, **return unused portion for a full refund!** (minus shipping charges).

Invest \$14.95 today for a 16 oz. bottle of CHEM-GLAZE, enough to treat three cars. These pennies can make you dollars in resale value of a big investment — **your car!**

Call Our 24 Hour "Hot Line" for Instant Processing.
1-800-521-8108 — Mich. Residents — (313) 525-7747

To: TRU-KEM CORPORATION

P.O. Box 2324, Livonia, Michigan 48150

- Please rush one 16 oz. bottle of CHEM-GLAZE @14.95 (plus \$2 shipping and handling)
- SAVE \$5.00! Rush 2 bottles @24.95 (plus \$2 shipping and handling)

- Check or Money Order enclosed
- Charge my Credit Card
- BankAmericard/Visa
- Master Charge, Interbank No. _____

Credit Card No. _____ Exp. Date _____

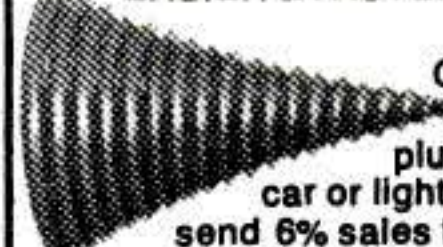
Name _____

Address _____

City/State/Zip _____

THE BOSS LOG SPLITTER!

Splits EASIER & FASTER!



Only \$49.95 plus \$5 p. & h. for adaptable cone, or \$99.95 plus \$8 ready-to-attach to hub of car or light truck (specify vehicle). Pa. — send 6% sales tax. Free info—send stamped self addressed envelope. Good Products, Route 3 Box 88-A PS, Kutztown, Pa. 19530

If You Need **RUBBER STAMPS** Super Quick

Anytime Day or Nite

CALL Toll Free 1-800-547-8678

SAVE YOUR GAS... let YOUR mail do the shopping

Rockwell Speed-Bloc Sander— Palm grip design for one hand use. Thumb control switch, offset pad for 4 way flush sanding, 12,000 OPM. 100% Ball Bearing, 5/64" Orbit. Direct Motor to pad design. Pad size 4 1/2" x 4 1/2". Add \$2.00 for shipping. Reg. \$69.99. 4496(330)-R7 \$53.98

SILVO (BRAND NAME) TOOL CATALOG

THOUSANDS OF EXCITING TOOL VALUES: Stanley, Wen, Speedy-Sprayers, Milwaukee, Rockwell, Dremel, Skill, Nicholson, Disson, Millers Falls, Hellos, Wellsaw, Plumb, Kennedy, Huot, Ridgid, Crescent, Vise-Grip, Audel Books, Unimat, Wiss, Channel-lock, General, Pony Clamps and many Nationally Advertised brands of tools and supplies. We ship Coast to Coast at prices hard to beat. Send \$1.00 for our big SILVO TOOL CATALOG today.

SILVO HARDWARE CO.
2205 Richmond St., Dept. PS0-4, Phila., Pa. 19125

LENAIR WASTE OIL HEATER

For Shop, Garage, Warehouse and Farm

Waste Oil Worth 80¢ per gallon as a heating fuel.

Pay Yourself not the fuel companies. Heat with any type of waste oil. LENAIR Waste Oil Heaters are a smart investment. Models 75,000 and 130,000 BTU Forced Air. **PROVEN * SMOKELESS ODORLESS**

WRITE
LENAIR INDUSTRIES INC.
P.O. BOX 1017-D
JANESVILLE, WI 53545
DEALER INQUIRIES WELCOME

Lock Blade TIGER KNIFE
7 1/2" Overall Length

Rugged Stainless Steel Blade that locks into open position. Safety folding finger guard. Razor sharp hand-hollow ground blade. A Superb Folding Hunting Knife

Model: K-4-T **\$3.95 Each**

WESTBURY SALES CO.
P.O. Box 434 Westbury, New York 11590 Dept. L-4-PS

Also — **ConSuntrator™** PLANS FOR

Plans & Kits For:
Killowind™ Windmills
Heat, Electric Light & Power
Plants High Mileage Cars & Trucks Water
Wheels & Turbines Free Information From
GOODMAN ASSOCIATES, 4 BERRYVILLE PIKE SUMMIT POINT, WEST VA. 25446

SOLAR HEATER



From Scandinavia, where cars have to last ...prices start at \$25,000!

Rust Biox Your Car!

A safe easy way to completely rid your car of body-killing rust...With the world's first biodegradable, 100% organic, guaranteed rust-treatment system!

The professional-quality bodyshop treatment you apply yourself:

- Spray it on...rinse it off
- Requires little if any rubbing
- Amazing biochemical, enzyme action completely eats away all rust, tarnish and corrosion!
- 100% non-toxic; No poisonous acids (Will not harm metals, paint, plastics, rubber, wood, clothing, ceramics or people!)
- Important rust-arresting benefits for a long term cure
- Adds years of "New Car" life to your automotive investment
- Unconditionally Guaranteed or your money back

Finally, an inexpensive alternative to "Planned Obsolescence" For years we American car owners have accepted short life spans for our vehicles. We've watched helplessly as their shiny bodies and chrome trim suffered all too soon from corrosion, and those destructive, ugly rust spots got bigger and bigger, eating right through the metal in a few months. Until now our choices haven't been easy: Spend a fortune at the body shop, or trade it in and start the process all over again, much to Detroit's delight.

Rust-Biox...A New Miracle, "No-Hassle" Automobile-Body-Saver! Rust and corrosion are inevitable "metal-diseases" (helped along by winter weather, road and ocean salt, and rainy seasons) that sooner or later will affect your vehicle, boat, plane, etc. Like human ailments, the **critical factor for a full recovery is early detection, and a prompt, effective cure.** Once you discover that first spot of rust on your car, a quick easy Rust-Biox treatment can mean the difference whether your car's body (and/or engine parts) will survive this "killer" problem or not.

Now there is no excuse for any car to be prematurely ruined by this costly "Auto-Epidemic"...

Simple to use. Just spray it on and rinse it off a short time later! Rust-Biox generally requires no rubbing or labor of any kind. It works selectively, completely destroying rust and tarnish, without harming metals, paint, plastics, rubber, wood, textiles, ceramics, or people. Other products (conventional rust removers and converters, etc.), are usually dangerous poisonous acids that can destroy almost anything...including your skin, as well as your car's metal, paint, etc.

Non-Polluting Rust-Biox is so safe you can apply it with your bare hands and since it is not an acid, it can be sprayed for easy, quick application. After spraying, wait the required time (15 minutes to 2 hours normally, depending upon the degree of rust and air temperature), then merely rinse it off with water. The thorough rust-eating enzymes do the dirty work for you!

Important - unique "Rust-Arresting" powers! Our research shows that after most conventional rust removers are used, rust begins again almost immediately, within 10 seconds after use! However Rust-Biox has been professionally designed to give you a full 24-48 hours of guaranteed rust-free protection, allowing plenty of time to seal or touch-up paint the treated area. Thus, **early detection followed by a Rust-Biox treatment, followed by a sealer or touch-up paint completely**

guarantees you a permanent rust-free solution that no other product can offer. This popular European product can literally provide you a car with no rust damage to depreciate its value and shorten its life.

Hundreds of other household and industrial uses...

Rust-Biox completely removes rust, tarnish and oxides from iron, steel, copper, brass, chrome, and aluminum - safely! Use it on bikes, boats, antiques, screens, tools (also removes concrete mortar), baths, basins, plumbing systems, stove burners, frying pans, even for coffee stains on dishes. You'll use Rust-Biox in dozens of places you'd never dream of using the acid-based products. In the Industrial sector Rust-Biox usage is booming, particularly in pollution-sensitive and health-related industries such as food-processing, medical, etc.

Concern for the environment in Scandinavia is a way of life, and Americans are becoming equally aware. Biodegradable, 100% Organic Rust-Biox can be rinsed down the drain without harm to plumbing systems, and it poses no "poison threat" when stored in the home. And most importantly, Rust-Biox encourages us all to preserve what we have, rather than allowing our costly automobiles to waste away from needless rusting. **It is now easier to maintain your car rather than replace it, even if you can afford to do so.**

We dare you!

Try Rust-Biox on any rust you can find, no matter how severe, and return the balance within 30 days for an unconditional, no-questions-asked refund if you're not 100% satisfied.

Call Toll Free for Instant Processing: 1-800-235-6945, or if busy 1-800-235-6951. Calif. res. please call: 805-966-7187. Or send coupon:

Please ship immediately the following order for new Rust-Biox. If not completely satisfied I can return the unused portion within 30 days of receipt for a full refund of the purchase price (less shipping & insurance).

- Please send _____ 16 oz. bottles of Rust-Biox (with deluxe spray top for easy application) @ only \$14.95 (plus \$2 shipping and insurance) ea.
- SPECIAL INTRODUCTORY GALLON REFILL OFFER. SAVE ALMOST \$70! 8-16 oz. bottles of Rust-Biox in one gallon container for \$49.95! (no spray cap). To introduce and distribute Rust-Biox in volume we are temporarily making this highly economical one gallon offer. Please send _____ one gallon containers of Rust-Biox @ \$49.95 (plus \$4.95 shipping and insurance) ea. The standard 30 day trial offer described above still applies.
- Check or Money Order enclosed (CA res. add 6% sales tax).
- Charge my credit card number below.
- BankAmericard/Visa Master Charge (interbank no. _____)
- American Express Diners Club Carte Blanche

Credit Card No. _____

Exp. Date _____

Name _____

Address _____

City/State/Zip _____

Copyright Starshine Inc., 1980

STARSHINE GROUP

PRODUCTS THAT MAKE THINGS LAST LONGER®

924 Anacapa St., Dept. RB280, Santa Barbara, CA 93101

NOW! Get in on the PROFITS in

SMALL ENGINE REPAIR!



Start your own money making business!

Work part time, full time - right at home - we help you every step of the way.

No doubt about it...as a small engine pro, you can cash in on the huge demand for qualified men in one of America's fastest growing industries. You'll be able to command top hourly rates of from \$10.00 to \$15.00 per hour - and that's just for labor. A simple tune-up earns as much as \$17.50 for less than an hours work, and parts, engines and accessories will add even more to the profits.

Plenty of business waiting for qualified men.

46,000,000 Small Engines Are In Use Today!

That's the official count from the Engine Service Assn., and one-million new engines are being built each month. With fully accredited Belsaw training, you can soon have the skill and knowledge to make top money servicing these engines. People will seek you out and pay you well to service their lawnmowers, tillers, edgers, power rakes, garden tractors, chain saws, minibikes, snowmobiles, generators, go-carts, paint sprayers, snowblowers...the list is almost endless.



Professional Tools And Equipment PLUS 4 HP Clinton Engine...

...All Yours To Keep - ...All At No Extra Cost!

NO EXPERIENCE NECESSARY!

You don't need to be a 'born mechanic' or have any prior experience. You can master this profitable trade right at home in your sparetime. Lessons are fully illustrated...so clear you can't go wrong, and with our famous 'learn-by-doing' method you get practical 'hands-on' experience. We also show you how to get business, what to charge, where to get supplies wholesale...all the inside tricks of the trade you need to assure success right from the start.

Send for FREE Facts - Do it TODAY!

NO Obligation - NO Salesman Calls!

You risk nothing by accepting this offer to see how easily you can learn the skills you need to increase your income in a high-profit business of your own. Just fill in and mail coupon below (or send postcard with name and address) to receive full information by return mail.

RUSH COUPON TODAY

BELSAW INSTITUTE
531A FIELD BUILDING
KANSAS CITY, MO 64111



FREE BOOKLET!

Send for your copy today!

BELSAW INSTITUTE
531A FIELD BUILDING
KANSAS CITY, MO 64111

Accredited Member National Home Study Council

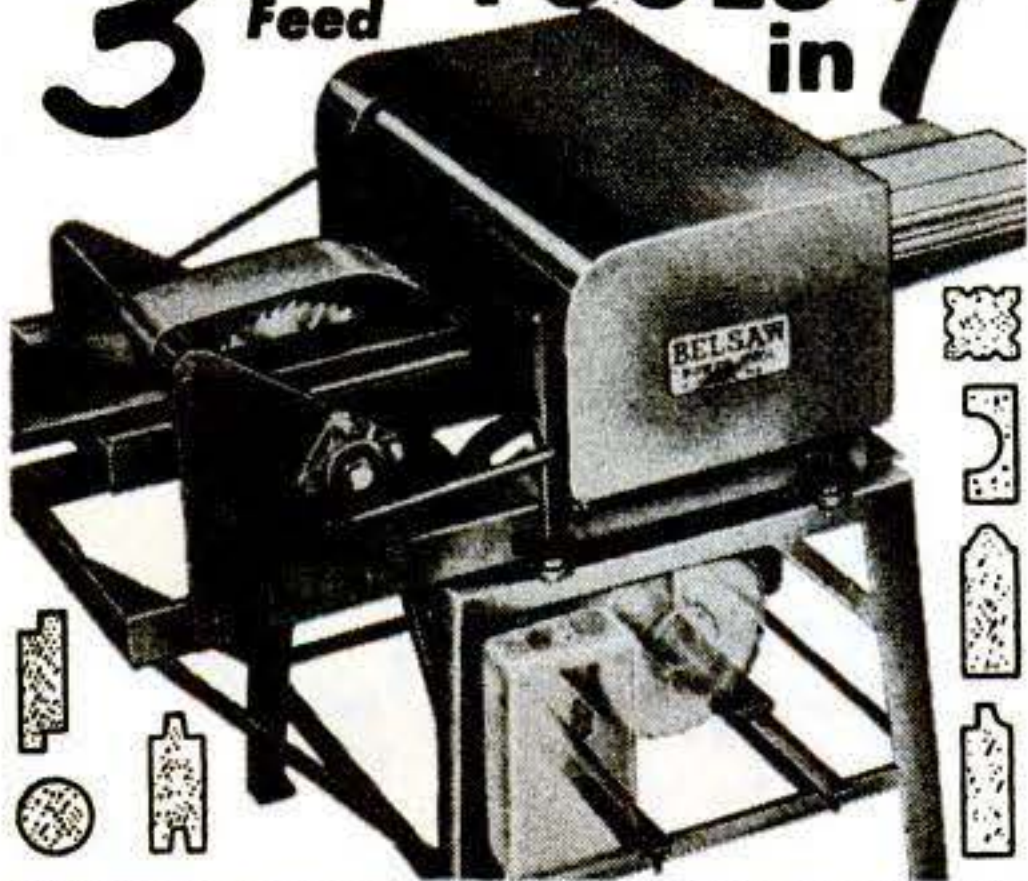


YES, please send me the FREE booklet that gives full details about starting my own business in Small Engine Repair. I understand there is No Obligation and that No Salesman will call on me.

NAME _____
ADDRESS _____
CITY _____
STATE _____ ZIP _____

Planer Molder Saw

3 Power Feed **TOOLS** in **1**



Now you can use this ONE power-feed shop to turn rough lumber into moldings, trim, flooring, furniture —ALL popular patterns. RIP-PLANE-MOLD . . . separately or all at once with a single motor. Low Cost . . . You can own this power tool for only \$50 down.

30-Day FREE Trial! SEND FOR
NO OBLIGATION—NO SALESMAN WILL CALL
RUSH COUPON BLSAW POWER TOOLS CO.
TODAY! 921A Field Bldg.
 Kansas City, Mo. 64111

BELSAW POWER TOOLS
 921A Field Bldg., Kansas City, Mo. 64111

YES Please send me complete facts about PLANER—MOLDER—SAW and details about 30-day trial offer.

Name _____
 Address _____
 City _____
 State _____ Zip _____



TIMBER KIT Perfect for solar post & beam home. 14 contemporary or country home designs. Do-it-yourself kits from \$16,835 + shipping. Send \$1.00 with coupon for brochure.

TIMBER KIT P.O. Box 704 Amherst, MA 01002

Name _____
 Address _____
 Phone _____ Lot Location _____

Now Fake Out The Crooks As You

Banish Burglars, Thwart Thieves Crush Crooks and Fight Felons

With the world's TRICKIEST, SLYEST 'Burglar Alarm System'

Felony Fighter™

Only \$9.98



Fool the felons and protect your home with this replica of an expensive burglar alarm system. Just place the ingenious alarm terminal at each of your doors and switch on the alarm light. That's all there is to it. There's virtually no way a burglar can know that the activator control panel is not a high-priced complete alarm system. The glowing red light, steel switch plate and realistic engineering look to any crook like expensive alarm systems costing \$1,000 and more.

SATISFACTION GUARANTEED

If our ever-vigilant, new thief-thwarter doesn't scare the bejabbers out of any second-story man, or if you're not completely satisfied in every way, merely send the Burglar Alarm System back to us for full refund, no questions asked. At the low price of only \$9.98 you can afford to have one at each door. You can't afford not to! Supplies are limited. Order today!

FREE BONUS

Order within 10 days and we will include "official" window decals for extra protection. Each decal pictures a fierce guard dog and the words: "PROTECTED BY ELECTRONIC BURGLAR ALARM SYSTEM."

Security Window Decals



Popular Science-Felony Fighter Dept. 480
 P.O. Box 5220 Grand Central Station
 New York, N.Y. 10017

Popular Science-Felony Fighter Dept. 480
 P.O. Box 5220 Grand Central Station
 New York, N.Y. 10017

I don't want my home unguarded another minute. Rush the new Felony Fighter™ at only \$9.98 each (plus 75¢ to cover postage and handling) under your full satisfaction or money back guarantee. Also include my FREE Security Decals.

SAVE! Order two Alarms, one for each door, at only \$8.98 each (plus 75¢).

Enclosed is \$ _____

Charge My Credit Card Visa Master Charge

Card No _____ Exp. Date _____

Print Name _____

Address _____

City _____

Add applicable sales tax in CA, CO, FL, IL, NY, PA, VA, VT, WI.

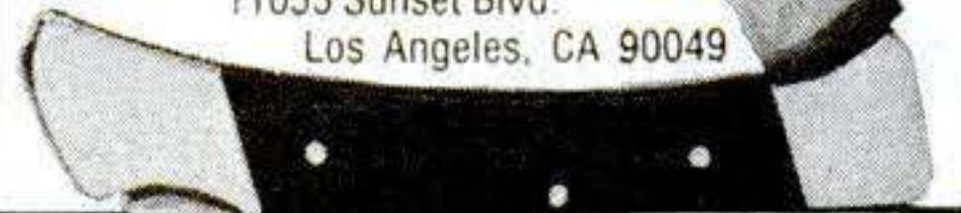
Custom Quality FOLDING SPORTSMAN'S KNIFE

An outdoor Pocket Knife with features worth four times the price.

- HANDMADE STYLING**
- Solid Brass Bolster & Lining
 - Rosewood Handle
 - Sharp Surgical Steel Safety-Locking Blade

A pocketable 4" size (7-1/4" open)

EGBERT CO., Dept. PS4
 11055 Sunset Blvd.
 Los Angeles, CA 90049



Only \$4.50 plus 50¢ postage & handling
 Add \$2 for Genuine Leather Holster

NOW AVAILABLE

Gazebo Study Plan Book



Custom Design your own Gazebo!

The unique Gazebo Study Plan Book enables you to Custom Design your own Gazebo or select one from 23 beautiful designs featuring 5 Classic Styles. And it's only \$4.50, plus 75¢ postage and handling; allow 3-4 weeks for delivery, or \$1.30 for First Class. Complete plans are also available.

SUN DESIGNS

P.O. Box 157 Dept. 20
 Delafield, WI 53018

START MAKING CHEAP "HOMEMADE FUEL."
STOP WASTING MONEY ON GAS.

Step-by-step instructions how to:

- convert your car's engine to operate on alcohol.
- produce your own cheap "Homemade Fuel."

Send only \$10.80 for the "Homemade Fuel" Book.

SEGO ENERGY

Box 1290B Palisade, Colorado 81526

Eyeglasses. Save up to 50%.

Send for free catalog — all lenses — all styles. As low as \$14.95 complete. Your prescription, or your present lenses duplicated. Money back guarantee. Now you can afford extra pairs.



Est. 1959

Prism Optical, Inc., Dept. PS40
10992 N.W. 7th Ave., N. Miami, FL 33168



TRAILER FOR THE 80's — Burro Travel Trailer kit sleeps four. Under 1,000 lbs. Fiberglass. Ready to tow. Finished interior only. Write Burro PS-4, 14143 - 21st Avenue North, Plymouth, MN 55441. For full color catalog send \$2.00 to cover postage and handling. *Dealers Wanted.*

Clock Components



Clock Movements: Battery, Quartz, Electric, Urgos Grandmother, Grandfather, Westminster & Triple Chime, 8 Day Key Winds & Westminster, Bim Bams, Barometers, Metal, Bezel, Paper dials, Hands, Brass & Plastic Numbers & Markers. Hundreds of Items. Quantity Prices. Send \$1.00 for 60 Page Catalog. Refunded on \$10.00 Order.

NEWPORT ENTERPRISES, INC. DEPT C
2313 W. Burbank Blvd., Burbank, Calif. 91506

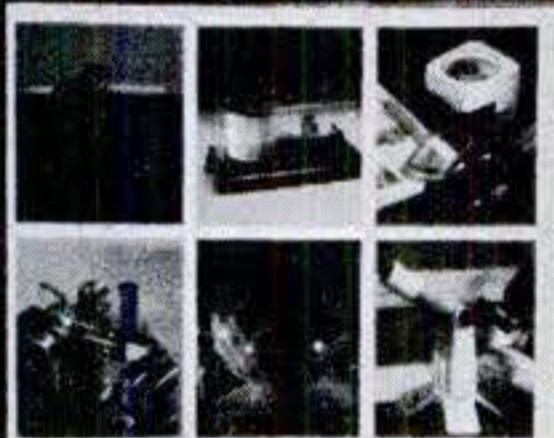
HOME SECURITY MANUAL

BURGLARIES ARE SKYROCKETING! Over 2 MILLION homes & farms are burglarized every year! Most of our daily habits actually make a thief's break-in job a breeze! Your home, farm or apartment may be **INVITING** a theft! Protect you and your family! Save money on security costs! Chapters on: Securing outer premises, Doors & Windows, External lighting, Apartment security, Proper lock selection, Home inspection program, Identifying valuables and much more!



COMPLETE SECURITY MANUAL: \$6.95.
GLENVALE PRODUCTS Dept MH
Box 358 Station D Toronto, Ontario M6P 3J9

Free! Edmund Scientific Catalog



Edmund Scientific Catalog



Explore Astronomy, Biofeedback, Optics, Lasers, Magnets, Weather, Magnifiers, Microscopes, Photography... Over 4,000 Fascinating Products in Our **FREE** 100 page color Catalog! Send for your **FREE** Edmund Scientific Catalog, Today!
38 Years Of Service!

Yes! Rush me your **FREE** catalog!

Name _____

Address _____

City _____

State _____ Zip _____

Clip and Mail Coupon Today to:
Edmund Scientific Co., Dept. 2020 N-08
Edscorp Bldg., Barrington, N.J. 08007

No. 156 ©1980 Edmund Scientific Co.

75 MPG!

**TOP SPEED OF 90 MPH!
1,125 MILES OF DRIVING
(from a 15-gallon fuel tank)!**

That's the kind of high-mileage, fuel-pinching performance you can get — right now — with the amazing **HYBRID ELECTRIC CAR!** What's more... *you can build it yourself!*

HOW IT WORKS

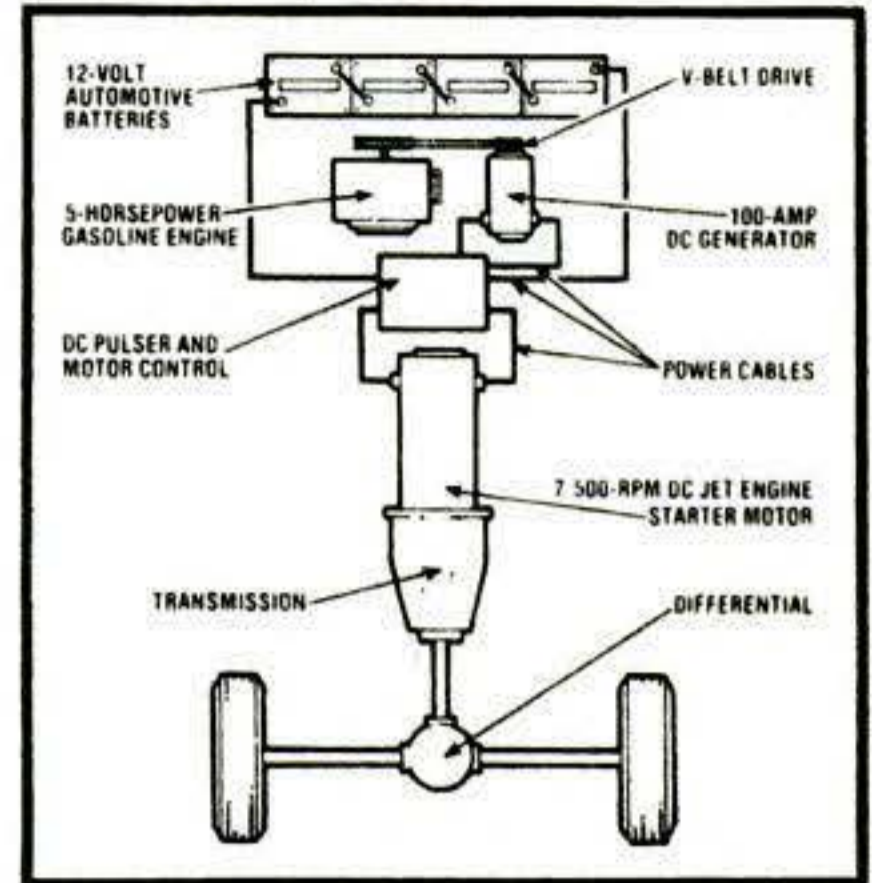
All you do is take your existing car (or buy a used body) and replace its original power plant with a small gas-powered lawn mower engine. (That's right, a lawn mower engine!) This engine drives a generator which, in turn, supplies the vehicle's drive motor with electricity allowing you to travel at speeds up to 50 MPH.

When more power is needed, four automobile batteries — hooked up in series and fed by a 100-amp generator — give you plenty of kick for passing, climbing hills, and for running at higher speeds (up to 90 MPH)... and to help save normally wasted energy, a regenerative braking circuit automatically converts the drive motor into a generator that feeds and charges the batteries *while the vehicle is decelerating!*

Your total cost — by buying your own parts and building it yourself — is under \$1500. Your first year's benefits alone — in fuel savings *and* in hassle-free driving — will more than pay for the car!

GET ON YOUR WAY TO HIGH-MILEAGE MOTORING... NOW!

THE MOTHER EARTH NEWS® — the national magazine long recognized as a leader in alternative energy — offers you a detailed, step-by-step set of plans for making the **HYBRID ELECTRIC CAR.** The complete package includes the plans, bill of materials, and list of suppliers. The plans sell for \$15.00 and come with a no-risk guarantee. To order simply fill in the coupon below and mail it — along with your payment — to: **MOTHER'S PLANS, Dept. SP-4, P.O. Box A, East Flat Rock, North Carolina 28726.**



The layout of the new drive system.

Enclosed is \$15.00

Please send me the **HYBRID ELECTRIC CAR** plans. I understand that I have 10 days to examine the plans, and if I decide not to use them, I can return them for a full refund.

Ship To:

NAME _____ ADDRESS _____

CITY _____ STATE _____ ZIP _____

CHARGE IT TO MY MASTER CHARGE OR VISA CARD

NAME _____ ACCOUNT NO. _____ EXPIRATION DATE _____

MASTER CHARGE INTERBANK NO. _____ SIGNATURE _____

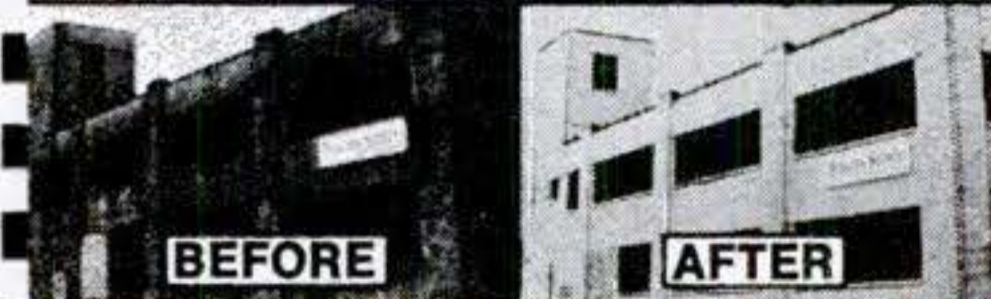
Add \$1.00 if you wish to have your plans sent first class.

North Carolina residents add 4% sales tax.

MOTHER'S PLANS, DEPT. SP-4, P.O. BOX A, EAST FLAT ROCK, NORTH CAROLINA 28726

BUILDING CLEANING

Chemicals & Equipment



**CLEAN • Brick • Stone
• Aluminum Siding
Instantly, Safely, Low Cost**

Spray-on, rinse-off method.

Factory training provided.

Send for **FREE** booklet,

complete details.

Write or call (216) 292-4727

National Surface Cleaning Corp.

4959 Commerce Parkway PS-4

Cleveland, OH 44128

SEND
for
FREE
BOOK

Save Gas-Add Power



Look at these features!
Gas Mileage increased 10-30%
Power increased, 10-20%
Increased torque through
RPM range

It's here! A new Japanese product from Sekon which gives you a solution to High Torque, High Power, and Less Fuel, simultaneously!

SWARUP is a static mixer which partially rotates the fuel-air mixture in the manifold in different directions.

Prevents overheating
Rotation-smooth and steady
Less carbon deposit
Easy starting
Less pollution
Prolongs engine life
Plus!

A lifetime guarantee
A 60-day money back guarantee

SEKON SEKON INTERNATIONAL

**SEKON INT'L CORP.
OF AMERICA**

2210 Wilshire Blvd.
Suite 577 PS
Santa Monica, CA 90403
(213) 393-9791



One barrel carb.....\$38.95
Two barrel carb.....\$48.95
Four barrel carb.....\$68.95

World Wide Patent Pending
Distributors and Dealers needed



Protect your car at home and work, rain or shine; but beware, all car covers are not the same...

Prevent "PREMATURE DEPRECIATION" because of oxidation and fading due to unnecessary exposure to rain, ice, snow, sun or salt.

Shelter your car

from Mother Nature's ruinous ways with custom-fitted, Starshine Auto Shelters*!

Complete exterior and interior protection — in less than 1 minute! Starshine Auto Shelter's* improved and superior new fabric totally shields your vehicle from nature's single most damaging element...the *SUN*. Direct exposure will oxidize your paint, bake dirt and grime into the finish and fade the color. Plus, ultraviolet rays magnified by the windshield glass will cause your car's dashboard and other interior upholstery to crack, split, and fade as well. A Starshine Auto Shelter* will prevent all of these value-robbing losses from occurring. If used regularly, your Auto Shelter* will keep your car looking new, inside and out, for years to come.

Starshine Auto Shelter*...a revolutionary breakthrough in protective car cover fabrics. It is a remarkably improved blend of space-age textiles and natural fibers custom designed and manufactured to fit and thoroughly shield every automobile, truck, van or cycle — foreign or domestic. Each cover is individually tailored to fit your make of car as opposed to lesser quality, bulky "universal"

type cover-alls. Auto Shelter's* tight fit insures complete protection against high winds, and snow or rain will not get trapped underneath.

Water-resistant — not waterproof. Here's why: A "waterproof" cover traps moisture under the cover. This vaporized water can cause clouding of paint when the temperature is raised (from hot sunlight) and air circulation is eliminated by the cover. A beautiful finish can be ruined in a matter of hours. Taking this important factor into account, Starshine Auto Shelters* are purposely made to be effectively water and mildew resistant — a smart balance between potentially damaging "waterproof" covers and flimsy 100% cotton covers that quickly absorb most liquids, offering minimal protection. Starshine Auto Shelters* are also fully washable and wrinkle resistant.

In addition to eliminating unattractive oxidation and fading, your Auto Shelter* will protect your vehicle from the harmful effects of smog, industrial pollutants, sea and road salt, dust, sand, rain, snow, ice, sleet, tree sap, bird droppings, tar, etc. With the higher cost of new autos today it makes sense to protect your investment from these harmful elements.

■ No snow or ice-scraping this winter ■ Clean windows stay that way ■ Reduced chances of engine freeze-ups and dead batteries ■ Reduced maintenance, washing, painting, etc. ■ Minimized threat of vandalism and theft ■ Protection for your exterior shine, your interior upholstery, and your financial investment. ■ Free storage bag included ■ Special 2 Year Limited Warranty against tearing, fraying or losing its shape or water repellency!

Try a Starshine Auto Shelter* on your vehicle — at no obligation... Return it for a full refund within two weeks if not satisfied!

To Order Call Toll Free for Instant Processing: 1-800-235-6945, or if busy 1-800-235-6951. Calif Res. please call: 805-966-7187. Or send coupon:

Please send the following Starshine Auto Shelters* as priced below: (Please include \$3.95 shipping and handling per cover). If 2 or more are ordered, please take our special 5% quantity discount.

If not 100% satisfied I can return the Auto Shelter* (undamaged) within 2 weeks for a quick refund of purchase price (less shipping cost).

Quantity	Make	Year	Model	Body Style	Price
----------	------	------	-------	------------	-------

- Check if your vehicle has an external antenna.
 - Check or Money Order enclosed (CA res. add 6% sales tax).
 - Charge my credit card number below.
 - BankAmericard/Visa Master Charge (Interbank No. _____)
 - American Express Diners Club Carte Blanche
- Credit Card No. _____ Exp. Date _____

Name _____
Address _____
City/State/Zip _____

*Trademark Copyright Starshine Inc., 1980

STARSHINE GROUP
PRODUCTS THAT MAKE THINGS LAST LONGER®
924 Anacapa St., Dept. AS296, Santa Barbara, CA 93101

Only \$49.95 for these cars:

- | | | |
|------------------|------------------|------------------|
| Alfa Spyder | Fiat 850 124 | MG. Midget. MGA. |
| Austin Healey | Spyder 500 | MGB-GT. MGS. |
| Sprite | 1100 1200 1500 | MGC Convertible |
| Datsun 1600-2000 | Convertible | Morgan 2 Seat |
| Convertible | Honda 600 Coupe | Triumph Spitfire |
| | Lotus Elan Elite | TR2 TR3 TR3A |
| | to 1971 | |

Only \$59.95 for these cars:

- | | | |
|--------------------|--------------------|--------------|
| Alfa-Romeo Cpe | Datsun 1200 | Mustang II |
| Arrow | Datsun B210 | Omni |
| Astre | Datsun F10 | Opel |
| Audi | DKW | Pacer |
| Austin | English Ford | Pinto |
| Austin-Healey | Fairmont | Porsche |
| Beetle | Falcon | Rabbit |
| BMW | Fiat Excl 850 124 | Renault |
| Bobcat | Spyder, 500 | Saab |
| Capri | 1100, 1200 1500 | Scirocco |
| Celica | Convertible | Simca |
| Chevette | Fiesta | Skyhawk |
| Cobra | Fox | Starfire |
| Colt | Gremlin | Subaru |
| Corolla | Hillman-Minx | Sunbeam |
| Corona | Horizon | Sunbird |
| Cortina | Isotta | Tiger |
| Corvair | Jensen | Triumph exc |
| Cricket | Karmann Ghia | Spitfire TR2 |
| Crosley | Lotus exc | TR3 TR3A |
| Daimler | Elan Elite to 1971 | Vauxhall |
| Datsun 240Z, 260Z | Mazda | Volksvaagen |
| Datsun 280Z, 280ZX | Morris-Minor | Zephvr |
| | Mustang | |

Only \$69.95 for these cars:

- | | | |
|-----------------|--------------------|---------------|
| Accord | Datsun 810 | Mercedes-Benz |
| Alfa-Romeo Sdn | Datsun 200SX | Mercury |
| American Motors | DeSoto | Model A |
| Apollo | Dodge | Model T |
| Aspen | Dusenberq | Monarch |
| Aston Martin | El Camino | Monte Carlo |
| Auburn | Essex | Nash |
| Avanti | Excalibur | Oldsmobile |
| Bentley | Fairlane | Omega |
| Bricklin | Ferrari | Packard |
| Buick | Firebird | Pantera |
| Cadillac | Ford | Peugeot |
| Camaro | Frazier | Pierce-Arrow |
| Checker | Granada | Plymouth |
| Chevellie | Henry J | Pontiac |
| Chevrolet | Hudson | Rambler |
| Chrysler | Hupmobile | Ranchero |
| Citroen | Jaguar | Rolls Royce |
| Civic | Jensen Interceptor | Rover |
| Cord | Jeep* | Seville |
| Cordoba | Kaiser | Skylark |
| Corvette | Lamborghini | Studebaker |
| Cougar | Lancia | Thing |
| Crown | Landcruiser | Thunderbird |
| Cutlass | La Salle | Torino |
| Dasher | Le Baron | Toronado |
| Datsun | Lincoln | Versailles |
| all 2 + 2 | Mangusta | Volare |
| Z-cars | Maserati | Volvo |
| | Maverick | |

\$69.95 for any other American or imported car.

\$79.95 for any pickup or van (1 ton or less).

\$49.95 for any size motorcycle. (specify if windshield)

INVENTORY ADJUSTMENT SPECIAL!

PILOT'S GLASSES AT UNBELIEVABLE PRICES!

ONLY \$6.95 

- Impact Resistant
- Handcrafted
- Polished Glass Lenses
- Hardened Metal Frames
- Money Back Guarantee

To order, send check or money order (include \$1.00 for postage and handling) to U.S. Optics, Dept. 308, P.O. Box 14206 Atlanta, GA 30324. (Please specify gold or silver frames.) SPECIAL: Order now and get TWO PAIR for \$13 plus one dollar handling charge.

FREE! During this limited offer. Deluxe velour lined protective case. A \$3.00 value.

LIMITED OFFER FROM U.S. OPTICS

Holds Flashlight! Frees Your Hands.



Headgear is made of reinforced denim, adjustable to your head size. Holds any regular flashlight using C or D size batteries. \$7.95 each postage paid. (Flashlight not included). **TO ORDER:** Send check or money order payable to J.M. & D Products Co., Box 387, Verdugo City, CA 91046. (Calif. residents add 6% sales tax.)

Money Back Guaranteed.

OFFER EXPIRES MAY 31

Hardened Steel. For filing, drilling, milling, carving, routing any metal or wood. Cutting edges from 1/4" to 1", all shanks 1/4". Brand new in air-tight G.I. packs.



32-Tool Set, G.I. cost \$275 now ... \$22.00
14-Tool Set, G.I. cost \$114 now ... \$16.00
Save Even More, Both Sets now ... \$33.00
Two \$33 Sets (Limited Time) \$52.00
100% Guaranteed. Add \$2.50 for shipping
Texas orders add 5% tax. Export orders add \$3.
U.S. SURPLUS CENTER, Dept. 501
715 Camden, San Antonio, Texas 78215

FIND BURIED TREASURE



Powerful electronic detector finds buried gold, silver coins, etc. Write or call for free catalog.

Phone day - night (713) 682-2728
REICO, Dept. DD63

BOX 10839, HOUSTON, TEX. 77018

STAINED GLASS



Send 50¢ for fascinating catalog of kits, tools, ideas, books, and supplies.

BIG STARTER KIT
Only \$16.95 ppd.

WHITTEMORE, Box 2065DE, HANOVER, MASS. 02339

Portable Steam Cleaner
Steam in 60 seconds



CLEAN: Engines, Air Filters, Lawn Mowers. 3 year guarantee on fire box, coils. Uses liquid soap, propane fired. Weight 120 lbs. Auxiliary pump required on low water pressure.

WEDCO MFG. INC., Dept. S-8,
Scott Lane • Box D, Jackson, WY. 83001

PROTECT YOUR CASH AND VALUABLES AGAINST THEFT!

Now—Get low cost protection for cash, jewelry, passports, sentimental items and other valuables with the new WALL-IT. It's a patented, clever home hideaway that'll give you peace of mind, because once installed, it looks like any ordinary electrical outlet in your home, apartment, office, even your boat or motor home.

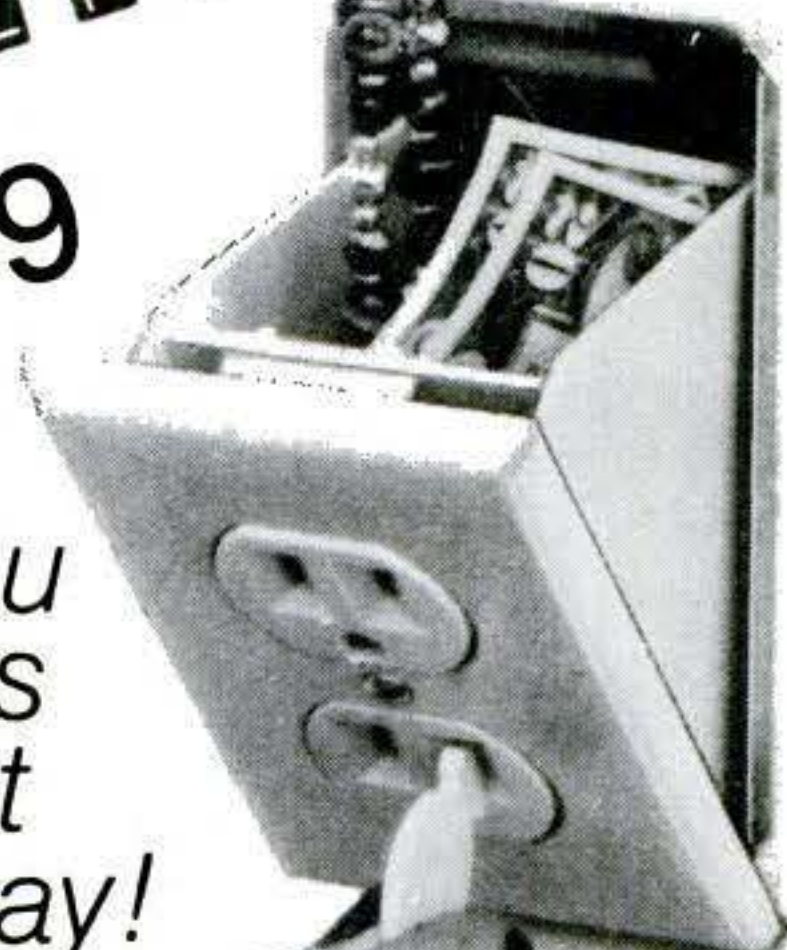
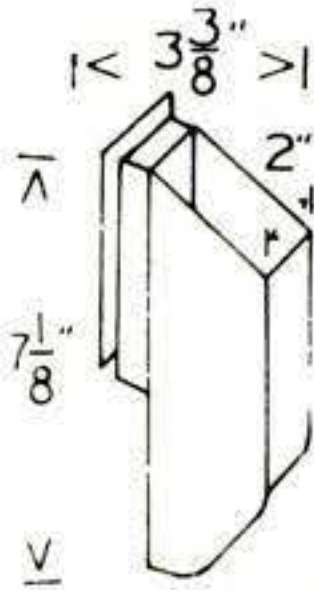
There's a special key to lock and unlock it...and only you know it's a secret, protective hideaway for your valuables. Yet your possessions are always near when you want them.

WALL-IT can be installed easily in most walls in less than 15 minutes with the complete installation kit and detailed instructions included. (Kit includes a template, switch plate, even a saw.)

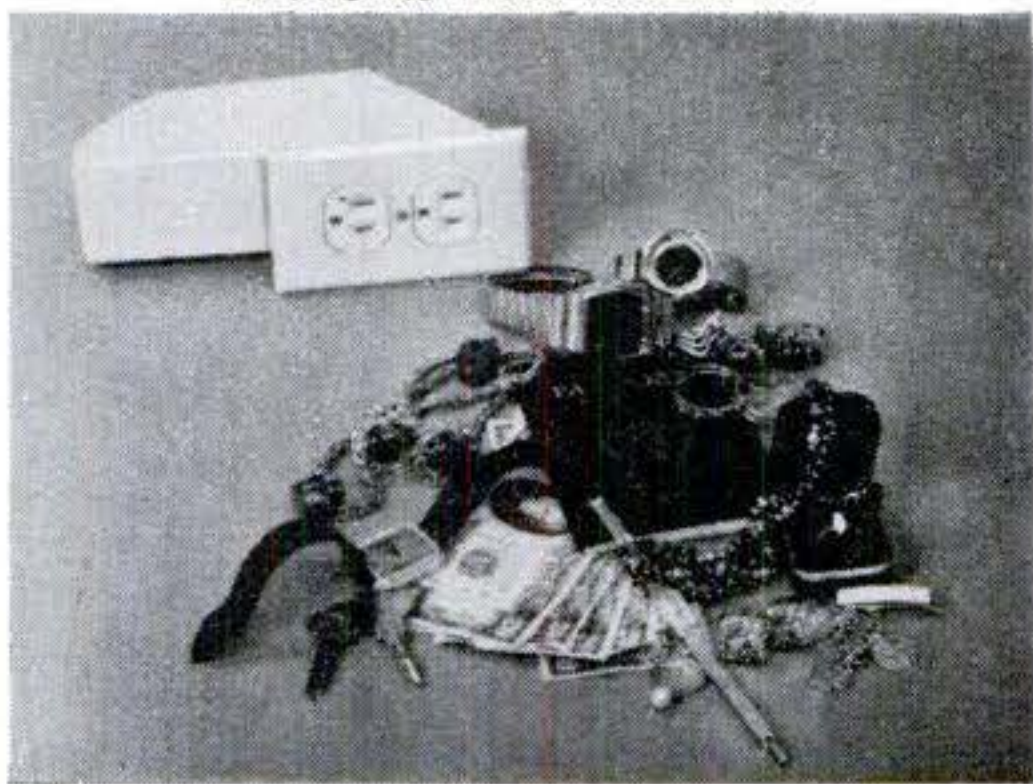
Act now to give your home added security against burglars and intruders. Order your WALL-IT today by mailing the coupon below. For faster service, Visa and Master Charge customers can call TOLL-FREE anytime 1-800-835-2246. You'll probably want several. You *save* by ordering 3 or more).

new WALL-IT™
U.S. PAT. # 3,999,493
only \$14.99

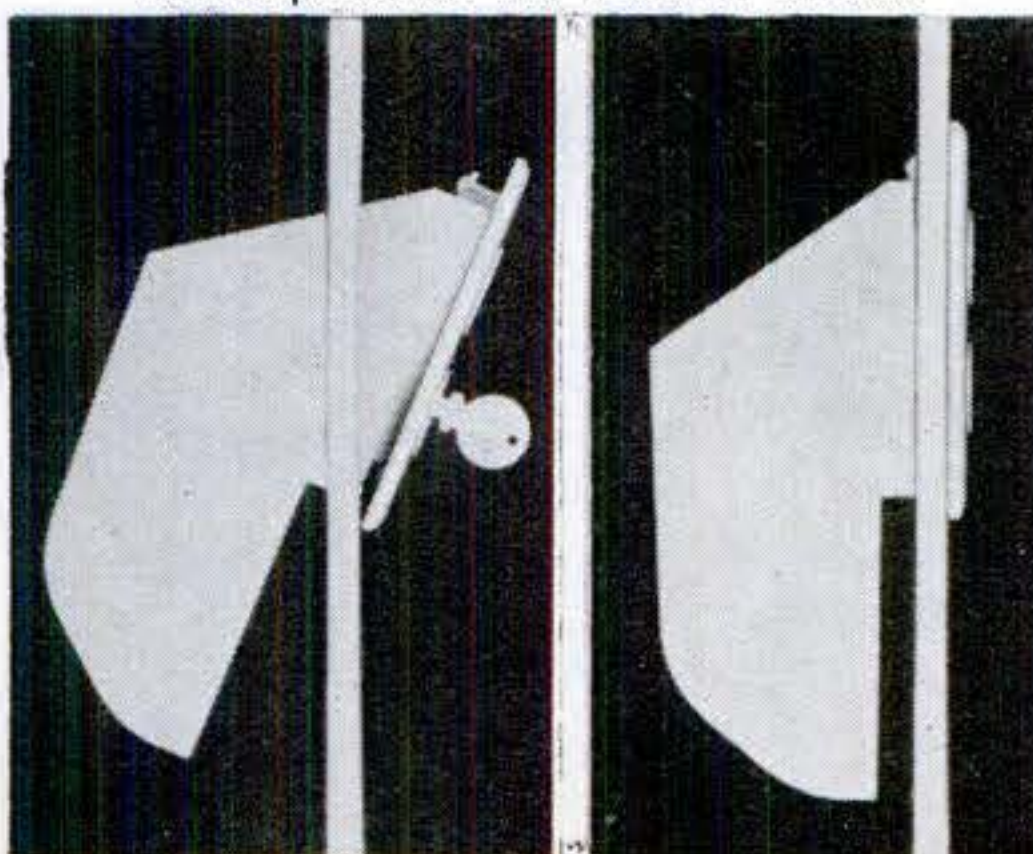
Only you know it's a secret hideaway!



All this fits in a WALL-IT



Actual photo of WALL-IT in wall



OPEN

CLOSED

WALL-IT defies detection — looks just like an ordinary electrical outlet. You can use the switch plate provided or any standard switch plate to match your others.

HOW TO ORDER YOUR WALL-IT: Enclose check with coupon or charge to your Visa or Master Charge. WALL-IT is just \$14.99 each + \$1.50 each postage & handling. **SAVE!!!** If you order 3 or more WALL-ITs at \$14.99 each, we pay postage! Residents of following states add applicable sales tax: CA, CO, FL, IL, NY, PA, VA, VT, WI.

VISA & MASTER CHARGE CUSTOMERS: For Fast Service, Call TOLL-FREE anytime 1-800-835-2246. (In Kansas, 1-800-362-2421.)

POPULAR SCIENCE • WALL-IT

Dept. 480

P.O. Box 5220, Grand Central Station, New York, NY 10017

Please send me _____ WALL-IT(s) @ \$14.99 each + \$1.50 each postage & handling.

(SAVE! Order 3 or more WALL-ITs @ \$14.99 each and we pay postage!)
Add applicable sales tax in CA, CO, FL, IL, NY, PA, VA, VT, WI.

Check enclosed for \$ _____
Charge Visa Master Charge

ACCOUNT # _____

Master Charge Interbank # _____ EXP. DATE _____

Signature _____

Name (Print) _____

Address _____

City _____ State _____ Zip _____

Celestron®

C90 TELEPHOTO



C90 PHOTO OF TIGER AT 30 FEET



C14 SATURN PHOTO



C90 TELESCOPE

For the photographer, astronomer, naturalist, educator, or casual observer—Celestron has established a new standard in superb telescopes and telephoto lenses at affordable prices (from \$245). All feature large observatory type mirror/lens optics folded into a compact, lightweight, portable telescope or telephoto lens. Close-up detail borders on the fabulous from celestial subjects light years away, to ships, planes, flowers, wildlife or people. Here is truly an instrument that allows you to view or photograph the world around you.

Free 4-page brochure or send \$2.00 for 32-page full color catalog on how to select and use a Celestron telescope or telephoto.

Celestron International
2835 Columbia St., Box 3578-3
Torrance, Calif. 90503, U.S.A.
Telephone: (213) 328-9560

Dealer Inquiries invited.



C8 Telescope

SAVE UP TO 85% GOV'T SURPLUS and NEW EQUIP'T



ENERGY BOOSTER CENTRIFUGAL BLOWER
200 CFM, 115-VAC
\$13.95 Normal Retail Over \$40.00

• (ITEM #16-922) - Boost efficiency of woodburning stoves or heaters, circulate heat in solar systems, use for dozens of air conditioning, air intake, ventilating applications. Useful for forced draft, cooling, drying, etc.
• 200 CFM, 115-VAC, 2.2-amp. motor, thermally protected. Dynamically balanced 6" diam. rotor. Intake 3" diam., rectangular discharge 3" x 3-1/4". Overall 8-1/4" x 8-1/4" x 7-1/4". Shpg. wt. 8 lbs.

BIG, Equip. Catalog



Send 50¢ Coin or Stamps
SURPLUS CENTER
LOWEST PRICES ON
WEED SPRAYING CABLE
GEAR MOTORS WINCHES
SPEED REDUCERS PUMPS
COMPRESSORS TELEPHONES
POWER PLANTS BINOCULARS
HYDRAULICS ELECTRONICS
SURVEYING INST'S HOSE
WELDERS MANY OTHERS

SURPLUS CENTER PS-040 Lincoln, Nebraska Zip Code 68501

• NON-POLLUTING • NO DEAFENING NOISE • MAINTENANCE-FREE • INSTANT START

Quiet Power

12 VOLT Chain Saw

- Runs off battery in your car or truck.
- Can cut a pickup load of wood. still leaves plenty of juice to start vehicle.
- Famous super-tough Oregon bar & chain.
- Approved for Highway Department use.
- Sold and used around the world.

Call toll free: 800-547-9906 Ext. 141
Or write: Tensen Co., Dept. 141, 304 S. E. 2nd, Portland, Oregon 97214

• TOUGH, BUT NOT TOO HEAVY FOR LADIES • NO FIRE DANGER • NEEDS NO GASOLINE

..... GREAT OUTDOOR FUN.

SEARCH ELECTRONICALLY FOR ... gold, silver, coins and relics with White's Electronics mineral/metal detectors. Pays for itself. U.S. Patented.

For your nearest dealer and free catalog
CALL TOLL FREE
1-800-547-6911

White's Electronics, Inc. Dept. PB-O
Sweet Home, OR 97386

CHECK IT OUT!
There are more opportunities, products and services offered in the "Classified Opportunity Mart," immediately following this section. You may find just what you've been looking for.

Kirsten

FREE COLOR CATALOG

Send for our free color catalog showing all of the Kirsten pipes, accessories and tobaccos.

KIRSTEN PIPE CO. INC.
P.O. Box 70526, Seattle, WA 98107
Dept. G

SAVE YOUR GAS... let YOUR mail do the shopping

CLASSIFIED

OPPORTUNITY MART

1 AUTOMOBILES

AUTOMOTIVE TECHNICAL WRITER Wanted for Specialty Magazine (British Cars). Contact: Editor, 310 Franklin Street, #384, Boston, MA 02110.

SAVE MONEY Buying A Car - Avoid Lemons! Detailed Instructions for locating mechanical & structural defects, prepared by Certified Mechanic. Send \$2.00: W. Coupe, Dept. PS, P. O. Box 74, Blossvale, NY 13308.

CUT DRIVING COSTS. Yearly record of your gas, MPG, repairs, more. Pocket size vinyl holder. \$4.00 plus \$1.00 postage. **FREE** Car Care Tips. **TYMETTE**, 4842 West Ainslie, Chicago, IL 60630.

ANTI-THEFT SECRET SWITCH, effective. Plans \$2.50. Build for \$5.00. Box 19082, San Diego, CA 92119.

VOLKSWAGEN BUG OWNERS. New Product Prevents **DANGEROUS FRONT SEAT FAILURE** in **REAR-END COLLISIONS.** Details \$1.00. Refundable. Mastercraft Industries, Drawer 410, Ridge, NY 11961.

LEGAL Alcohol Fuel 45c/Gallon! Solar/Conventional still plans. Mash formulae. Operate car, home. \$10.00—RDA, Box 873, Concord, NC 28025.

LECTRICKAR — Convert VW's, Fiats to Electric 50 MPH. Plans \$25.00. Information \$1.00. Robert Bucy, Box 28794, Dallas, TX 75228.

MIRACLE CARBURETOR Vaporizes Gas 100+ MPG. Drawings, Details \$10.00. Money Back Guarantee. Carbu, Route 1A, Hitchcock, SD 57348.

PROPANE/GASOLINE DUAL-FUEL AUTO! Conversion plans and instructions. Parts sources. Only \$10.00! RDA, Box 873, Concord, NC 28025.

CORVAIR PARTS - 4500 Parts, 280 Page Catalog, \$3.25. Clark's **CORVAIR** Parts, Inc., Shelburne Falls, MA 01370.

PROTECT YOUR CAR FROM BEING STOLEN FOR LESS THAN \$20. Easily installed in minutes. Guaranteed. Can't be stolen even with key. Completely hidden. Unique. Safe and Durable. Details Free. Write now: Asmann Enterprises, Box 2135, Dept. E, Great Neck, NY 11022.

WATER ALCOHOL INJECTOR Inexpensive, Easily Built. Plans \$5.00. Arndt, 2906 47th, Des Moines, IA 50310.

GAS GADGETS DO THEY WORK OR NOT? Which ones do as advertised, which ones are **RIP-OFFS.** Receive your copy "GASAVERS" Newsletter Before you buy one! Plus Product Evaluations on those that work. Send \$2.00 to: Fuel-Expanders P.O. Box 17711, Irvine, CA 92715.

GASOHOL FOR ALL! Homemaking Guide, plus Alcohol Manual. Special, \$2.00. Alcosag, 5133 Fairhill, Philadelphia, PA 19120.

KILLSWITCH frustrates thieves, protects your car. Three different plans including digital code type. Easy to build. \$3.50. Aerostar Systems, Dept. PS1, 22713 Ventura Blvd., Suite F, Woodland Hills, CA 91364.

ALCOHOL — Complete Mash Recipes, Still plans and detailed do it yourself information on converting your auto to run on both alcohol or gasoline. Send \$5.00 to: Alcohol, P. O. Box 907, Los Banos, CA 93635.

THE MILEAGE SHOP PRESENTS: **ONE** Stop Shopping for All Your Mileage Needs. Send \$2.95 today for our latest catalog to: **THE MILEAGE SHOP, INC.**, P. O. Box 4185-PS, Hayward, CA 94540.

ALCOHOL FUEL LEGALLY. Run car or furnace, 30c gallon. Plans, instructions \$3.00 (Refundable). Geans, Box 98-S, Payson, UT 84651.

GAS GUZZLING CAR? Self-Help Manual - \$3.99 (Refundable). XA Automotive, 113 Tupelo, Ft. Walton, FL 32548.

TEFLON Engine Treatment. Guaranteed. Free Literature. **DISCOUNT** Price. S & S Supply Co., P.O. Box 41046, Indianapolis, IN 46241.

IHC Light truck owners - "Cornbinders United" a monthly newsletter of articles, access to parts and vehicles, service tips to keep that IHC on the road. \$12/yr. J. Borghorst, P.O. Box 925, Redway, CA 95560.

TRUE or False? 50 MPG carburetors. Box 206-8, Berea, KY 40403.

GASOLINE MILEAGE INCREASED DRAMATICALLY! Details **FREE!** Technical, Box 12191C, Norfolk, VA 23502. Toll free recording. 1-800-446-8289.

CLASSIFIED ADS \$5.50 per word, per insertion. Minimum 10 words. Payment with order, or charge to your Visa or Master Charge. First word in bold capital letters, rest of ad upper & lower case. Other bold cap words, \$1 per word extra. Bold headline or white space, \$22 per line. **DISPLAY-CLASSIFIED \$300** per inch, per month. Advertisers using a P.O. Box number must furnish complete name and street address for our records.

CLOSING DATE for June issue (on Sale May 15) is March 28. Send orders to Mary C. Ansbro, Classified Adv. Mgr., Popular Science, 380 Madison Avenue, New York, NY 10017.

BUYING A New Car? Save Money by having the Facts First. Send \$4.00 For Exact Dealer Cost Quote. List Make, Model. **CARS**, Box 262, Rt. 1, Port Hope, MI 48468.

WASH AND WAX your car 50 times for just \$6.95. Super industrial concentrate leaves vehicle cleaned, polished in minutes. Guaranteed! North American Chemical Industries, P.O. Box 668, Port Jefferson, NY 11778.

FREE. Car Care Tips. SASE. Tymette, 4842 Ainslie, Chicago, IL 60630.

PROPANE Conversion, cars, trucks - Return to gasoline anytime while driving. Uses ordinary refillable cylinders. No engine modifications. **COMPLETELY PROVEN, TESTED - THIS SYSTEM WORKS!** Uses inexpensive **LOCALLY** available components. Build system yourself, for as little as \$50, in approximately two days with ordinary hand tools. Satisfaction **ABSOLUTELY GUARANTEED** or money **IMMEDIATELY** refunded. For plans, drawings, **RUSHED First Class, send \$10.00.** Fleming Engineering, Dept. PS8, Remsen, NY 13438

1A ELECTRIC VEHICLES

75 MPG!
Amazing Build-It-Yourself Hybrid Electric Car can travel at 90 MPH... Takes less than 40 hours to build... and costs just \$1500! Complete Plans (including schematics materials list and components sources) are available from **THE MOTHER EARTH NEWS.** Send Check or Money Order for \$15 to:
MOTHER'S PLANS
Dept. SP4C, P.O. Box A
East Flat Rock, NC 28726

2 AUTO SUPPLIES & EQUIPMENT

FREE Oil for your Car. Guaranteed. Easy. \$2.00. Oil, Box 218669, Houston, TX 77218.

AT 55 M.P.H. compute travel time with this highly simplified method. Over 99% accurate. Glove compartment card with method and 37 examples. Send \$1.98 check or money order to: Foremost Consultants, P.O. Box 3004, Lafayette, LA 70503.

FREE OIL and More. Auto Reports Show How. Five for \$2.95. Details, SASE, P & J, 17 Marion, Phoenixville, PA 19460.

FORGOTTEN LIGHTS - battery rundown, towing charges, embarrassment. Prevent!!! "Light Alarm" warns you! Easily installed. Year Warranty. \$9.95. Enrichco 3S4, 1023 Fairlawn, Duncanville, TX 75116.

ALTERNATORS/STARTERS. Factory rebuilt, guaranteed, some \$19.95. Send \$3.75 for application catalogue. Southwest, Box 9133, Wyoming, MI 49509.

AUTOMOTIVE Tools & Equipment Nationally Advertised Brands at Discounted Prices for Mechanics. Send Stamped Envelope for Current Specials. Associated Distributors, 401 Augusta Street, Cincinnati, OH 45202.

ALCOHOL fuel, legally, cheaply made on kitchen stove! Instructions. \$3.00. Mailway, Box 24949-ED4, Nashville, TN 37202.

SAVE GASOLINE!! Professional reveals retuning secrets. Details — Posco, GS4, Box 300, LaGrangeville, NY 12540.

ALTERNATOR Generator Rebuilding Book. Details: Hedelund Engineering, 7505 Barkentine, Las Vegas, NV 89128.

3 AUTO TRAILERS & CAMPERS

R-V KITS — PLANS — PATTERNS — Campers — Trailers — Fifth Wheels — Vans — Covers — Motorhome. Simple construction. Save! R-V Kits/Equipment catalog \$1.00. **GLEN-L R-V's**, 9152-PS Rosecrans, Bellflower, CA 90706.

5 AVIATION

ONE-MAN JET HELICOPTER — Easy, inexpensive to build! Detailed plans, drawings—\$7.00. **HELICOPTER EXPERIMENTER'S HANDBOOK**—\$4.00. Both—\$10.00. Helicopters, Box 3053-A, Redondo Beach, CA 90277.

HELICOPTER KITS: Gasoline and Jet Powered from \$495.00. Information \$2.00. BW Rotor, Towanda, KS 67144.

BOOMERANGS - INCREDIBLE RETURN! Exciting sport. Order Free catalog — Amazing designs! BoomerangMan, 312 Park, Monroe, LA 71201.

Fly your own
MINI-HELICOPTER, SPORT PLANES, Motorized and Regular HANGGLIDERS

Complete Kits, Easy to Assemble or Detailed Plans. 1, 2 & 4 Seat Aircraft

MANY TYPES



SEND TO:
LIGHT FLIGHT DIRECTORY
Dept. C • P.O. Box 19828 • Houston, Texas 77024

CATALOG \$3.00

NEW!



JET ENGINE

REVOLUTIONARY NEW JET ENGINE, PUSH-BUTTON starting, 100% THROTTLEABLE POWER. All who see it MARVEL at its POWER and SIMPLICITY. 5 MODELS, 5 to 130 lbs THRUST. VERY LOW S.F.C. and WEIGHT. ASSEMBLED JETS, KITS and PLANS AVAILABLE. INVESTIGATE! SEND \$7.50 FOR COMPLETE INFO. TODAY

- POWER your Glider, Small Plane, Ice-Sled, Boat, Go-Kart Test Stand, Etc.
- "EASY-TO-BUILD" CONSTRUCTION PLANS: 15-LB. THRUST JET-WT: 5-Lbs. PLANS... \$12.00 40-LB. THRUST \$18.00 ★ 80-LB... \$19.95

For Complete INFORMATION Package: 130... \$24.95 including GS-2 Technical Handbook (Illustrated), Graphs, Curves, Comparisons with other Jets, and a Book on Uses Information Brochures & Catalogs. Plus Four 8x10's Photos

EMG ENGINEERING CO.
18518-G SO. BROADWAY, GARDENA, CAL. 90248

WEEDHOPPER—ULTIMATE FUN MACHINE!



No licenses required on plane or pilot; 40 hour construction time; complete kit \$2695; carries 220 lb up to 50 mph! Send \$5.00 for info-pak to:

WEEDHOPPER OF UTAH, INC.
Dept. PS4, Box 2253, Ogden, UT 84404

5A HOVERCRAFT

HOVERCRAFT Plans. Catalog \$1.00. Universal Hovercraft, Box 281, Cordova, IL 61242.

AERO-CAR Amazing Hovercraft built easily with ordinary tools. Lawnmower engine powered. Carries one man plus. Flies over land/snow/water. Complete plans and booklet. \$8.95. Aero-Projects, Box 5118PS, Clinton, NJ 08809.

6 ASTRONAUTICS

ANTIGRAVITY Propulsion Device. Free Brochure. RDA, Box 873-N, Concord, NC 28025.

ANTIGRAVITY SPACECRAFT - Build your own. Data, schematics, diagrams. 200 Pages, 8x10 mimeo, including 20 patents. Guaranteed. \$30 ppd. **ALTERNATIVE ENERGY SYSTEMS**, Box 132-A, Eureka Springs, AR 72632.

7 BOATS, INBOARD & OUTBOARD MOTORS

POWER Anchor Winch, 12 Volt. Build it for less than \$30.00. Plans \$5.00. Box 42, Temagami, Ont., Canada POH 2H0.

KEVLAR 49 Fabrics, Price list and info, send to: Hi-Pro-Form Fabrics Inc., 962 Devon Drive, Newark, DE 19711.

PATENTED SKATE, SKI, SURF SAIL \$71.45. Free brochure. Windfin Co., Box 65, Middleton, WI 53562.

GAS SAVER DORY SKIFFS
FREE Plan "Gloucester Gull" Rowing Dory With Brochure/Photos 50 Plans 15/45 Ft. Power & Sail Only \$2.00. Air Mail \$3.00. Texas Dory, Box 720, Galveston, TX 77553.

EVINRUDE 1979 Bargains... all sizes... \$1.00 handling... Scott-McCulloch parts... Electra Marine, 610 Merrick Road, Lynbrook, NY 11563.

BOATKITS - PLANS - PATTERNS - FRAMEKITS - 300 modern designs in plywood - fiberglass - steel - complete - instructions. **POWERBOATS** - inboards - outboards - cruisers - sportfishers - runabouts - hydroplanes. **SAILBOATS** - prams - daysailers - trailersailers - motorsailers. **KAYAK** - Canoes - Complete line fiberglass builders materials - Catalogue - \$1.00 (with Boatbuilding Guide - \$2.00). **CLARKCRAFT** - 16-S Aquilane, Tonawanda, NY 14150.

CANOE Pontoons — Virtually Tip-proof. Complete plans \$5.00. P.O. Box 7780, Pittsburgh, PA 15215.

BOAT KITS—22 Trailerable models — **POWER** and **SAIL** - 16' - 30'. Molded fiberglass hulls and decks come factory assembled - you install factory supplied interior. Save half factory-built cost. No experience required. **FREE** Catalog. Luger, Dept. AC-80, 3800 West Highway 13, Burnsville, MN 55337. (612) 890-3000.

BOAT PLANS — FRAME KITS — PATTERNS — HUGE 140-page catalog! Powerboats — Sailboats — Outboards — Jets — Rowboats — Houseboats — Runabouts — Dorries — Workboats — Racing Boats — In plywood — Cold Molded — Wood/Epoxy — Fiberglass — 8' to 49'. Lowest cost, highest quality for 27 years. Easy, proven methods include instructions especially for amateurs. No lofting! **"BOAT-BUILDING SUPPLIES"** — Fastenings — Fiberglass — Resins — Glues — Equipment — Spars — Books — Boat Trailer Plans. Send \$2.00 for catalog plus **FREE "BOATBUILDING SUPPLIES"** brochure. **"INBOARD MARINE HARDWARE"** catalog also \$2.00. **GLEN-L Marine** 9152 Rosecrans, Dept. SP Bellflower, CA 90706

11 DO-IT-YOURSELF

WOODBURNING RADIAL STEAM TURBINE Generates Electricity! Easy Construction! Compact! Complete Plans: \$6.00. Glenvale, Box 358H Station D, Toronto Ontario M6P 3J9.

BIKE FIXIN' will teach your kids bike maintenance. \$3.00/Book, Box 36-PS, Ludington, MI 49431.

BLUEPRINTS/KITS \$1 (refundable) for **SAMPLE** blueprint (planter) & listing (10) **UNIQUE** wood product designs. **CONIFER** Corp., Dept. PS-1, Box 598, Oconomowoc, WI 53066.

MAKE Beautiful Ship's Wheel and Bottle Lamps From Simple Materials, Plans \$4.00. Hall, 177 Maple Grove Dr. Pittsfield, MA 01201.

LIGHTNING! A fear worse than death. **PROTECT YOUR FAMILY NOW.** Information \$3.98: Lightning S-6, P. O. Box 9141, Denver, CO 80209.

BENCHSAW, With Accurate rip-fence, uses B&D Workmate and circular saw. Easy plans plus instructions, \$5.00. Babin, Box 16, Site 18, RR5, Fredericton, N.B., Canada E3B 4X6.

SPEAKERS, Unique, Dramatic, High Performance, Low Cost. Take No Living Space. Plans \$3.00. Speakers, 1119 Medlin St., J-8, Smyrna, GA 30080.

RADIATION DETECTOR. Make your own - easy, safe, cheap. Plans \$5.00 to: "Fallout", Box 192, Montague, Mich. 49437, 3 to 4 weeks.

CONVERT Auto to Hydrogen operation! Generate hydrogen fuel. Plans and Instructions - \$10.00. RDA, P.O. Box 873, Concord, NC 28025.

DULCINERS \$66, Kits \$27. Brochure. Here Inc. 29 Southeast Main, #S, Minneapolis, MN 55414.

GIANT SCREEN T.V. Projection System. Kit \$19.95. Plans \$3.00. Boykin Electronics, Box 6203, Biloxi, MS 39532.

327 HOME Energy Savers—\$3.27. PSA, 2646 Cheltenham, Toledo, OH 43606.

SOLAR Water Distiller. Pure water, Easy and Economical to build. Money back guarantee. Complete plans \$4.95. Harvest House, P.O. Box 6430 Station A, Daytona Beach, FL 32022.

UNIQUE Lofted bed plans. All Plywood. Sturdy, Beautiful, \$5.00. B. Pratt, 1101 Myrtle, Sturgis, MI 49091.

SOLAR TRACKER - Solid State - Plans \$5.00. **ACCRI SERVICES**, Box 147, St. Gabriel, LA 70776.

125 WAYS TO IMPROVE YOUR GAS MILEAGE! Latest Tips & Techniques On How To Increase Gas Mileage **15% to 35%**. Instructions \$9.95 - Money Back Guarantee. Fuel Expanders, P.O. Box 17711, Irvine, CA 92715.

SATELLITE Television - information on building or buying your own earth station. Send \$3.00. Satellite Television, RD 3, Box 140, Oxford, NY 13830.

EASILY Build **TRUE WEATHER BAROMETER** from material in your home. Instructions \$2.00. Barometer, Box 869, Racine, WI 53403.

PIG Roaster Plans, use scrap oil tank. Charcoal or gas fired. Fun or Profit. \$10.00. B. Pratt, 1101 Myrtle, Sturgis, MI 49091.

ELECTROPLATING, Complete Textbook. All Metals. Electroplate Metallic/Nonmetallic Items, \$9.95, Details Free. Tropic, Box 95P, Palm Bay, FL 32905.

TUNE UP LAWNMOWERS — No Special Tools Needed. \$2.50. Power Mower Service, 10544 North Second Street, Loves Park, IL 61111.

RECLAIM SILVER from photographic sources. How to process, where to sell. \$10. MetalTek, Box 27, Toney, AL 35773.

BEAUTIFUL, sturdy wooden lawn furniture from standard materials. Three complete plans \$7.50. B. C. Woodcrafters L, 156 Thelma Dr., Battle Creek, MI 49017.

LEVEL EXACTLY LONG DISTANCES. One to over 200 Feet... Lawns... Gardens... Patios... Foundations... Excavations... **AROUND CORNERS!**... Easy, New Product... \$19.95... \$3.50 shipping... Free Brochure. Cox Associates, 1372 Seville-apps 2, Bountiful, UT 84010.

PROJECTION TV... convert your TV to project 7 Foot picture... Results equal to \$2,500 projector... Total cost less than \$20.00. **PLANS & LENS** \$16.00. Illustrated information **FREE**. Macrocoma g, Washington Crossin, PA 18977.

SKI, JOG to STEREO CASSETTE. Complete Plans \$3.50. Mecco, Box 8674, White Bear Lake, MN 55110.

Wind/Methane Solar/Fuel Cells

Enjoy free heat & power. Send for energy Encyclopedia. Complete list of Mfg., cost, specifications, on most alternate sources of energy - Plus Catalog of Plans available for do-it-yourselfers. —\$4.00
Energy Service
14A Hughey St., Nashua, NH 03060

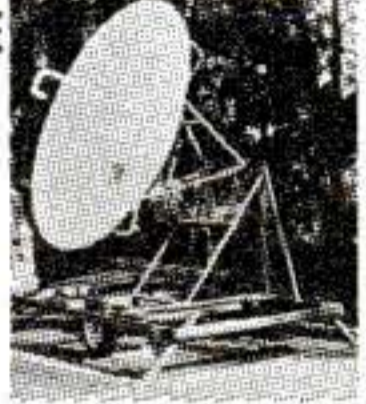
ATTENTION - COMPUTER CHESS OWNERS NOW AVAILABLE - MANUAL READOUT FORMS. AVOID POSITION ERRORS.

Register a manual readout of all moves. Form size: 6"x9" - 100 entry's per. 200 game pad inserted in a **QUALITY** Brown Vinyl Folder Printed in **GOLD** Stamping—(Pad refills Available). No Game is complete without a Record. Price: **\$6.95**, add \$1 for postage/handling. (NYS residents add sales tax)

NORTHERN HOUSE, INC
10 Ridgedale Circle, Tonawanda, NY 14150

SATELLITE TV FOR THE HOME

Our receiver lets you get over 75 channels of television directly from earth-orbiting cable TV satellites: **HBO, Showtime, super stations, sports and movies** from around the world.



Sick of Network TV?

Buy Complete or Build our kit and save!
Our 24-channel receiver provides "studio quality" TV reception. Easy to install! Ultra low power consumption! Brilliant color! Works anywhere! FCC licensing no longer required. Order today!

Complete details covered in our Home Earth Station manual. Send \$7.95 today (refundable against any purchase), or call:
24-hour C.O.D. Hotline
(305) 869-4283
SPACECOAST RESEARCH
Dept. Q, P.O. Box 442, Altamonte Springs, FL 32701

SCIENTIFIC SYSTEMS INC.

Now at last offers in kit or completed form such unique products as: **Nighttime vision devices, super sensitive directional mikes, low and high powered lasers, micro-mini-voice transmitters, ultra sonic devices, super high voltage generators, intrusion and sensing devices, scientific personal protection items, and many other hard to find products.** Send \$1.00 for catalog: **SCIENTIFIC SYSTEMS INC. Dept. S1, Box 716 Amherst, NH 03031**

PUMP

DRAIN • IRRIGATE CIRCULATE • SPRAY
Heavy-duty rustproof ball-bearing pump. Stainless shaft. 1 HP 1200GPH 60' high or 3000 GPH 25' well. 5200GPH max. 1 1/4" in. 1" out. Belt or direct drive. Use 1/4 HP or larger. Money back guarantee. Add \$2 postage & handling \$19.95
LABAWCO Box 35, Belle Mead, N.J. 08502



LASERS UNLIMITED

- **CONSTRUCTION PLANS** — with all parts sources
 - Ruby Laser Ray Gun \$15.00
 - 40W Burning CW CO₂ Laser 15.00
 - Argon Multi-color Laser 10.00
 - Dye Tunable Color Laser 10.00
 - Helium Neon Visible Red Laser 7.00
 - Solid State Laser Rifle 8.00
 - 100 KW Nitrogen UV Laser 7.00
 - Beginners Pocket Visible Laser 7.00
 - Laser Light Show Plans 9.00
- **COMPLETE ITEMIZED LIST** of all laser companies with addresses, phone numbers, spec sheets 6.00
- **LISTING OF BOOKS, LASER COURSES, DATA SHEETS, INFO PACKS, NEW DEVELOPMENTS, GOV'T INFO WEAPONS, etc.** 5.00

LASERS UNLIMITED
Dept. L1, Box 716
Amherst, NH 03031

GREAT SAUSAGE RECIPES AND MEAT CURING

227 page illustrated book explains sausage making plus home curing and smoking of meat, fowl and fish. Over 100 recipes. Free equipment and supply catalog has more information. TO GET YOURS, SEND TO:
The SAUSAGE MAKER Dept. AC-4
1067 Grant St., Bflo, N.Y. 14207

FANTASTIC SCIENCE PLANS

- Low-Cost/One-man Hovercraft..... \$7.00
- Solid-State Laser..... 6.00
- Easy-to-Build Jet Engine..... 6.00
- Stereo-controlled Laser Show..... 8.00
- Methane Fuel Generator..... 10.00
- Convert Auto to Hydrogen/Methane. . 8.00
- Generate Hydrogen Fuel..... 10.00
- Electronic Robot..... 9.00
- Visible-Red He-Ne Laser..... 6.00
- Radiation Survey Meter..... 5.00
- MHDElectrical Generator..... 5.00
- 25KV Tesla Coil..... 5.00

EXCLUSIVE MONEY-BACK GUARANTEE
CATALOG..... \$1.00

RESEARCH & DEVELOPMENT
Route 2, Box 322-A
Kannapolis, N. C. 28081

12 HOME CRAFTSMAN

ROLLTOP BREADBOX. Full size plans and instructions. Send \$5.00 to: Copper Adze; Box 1279; Grand Rapids, MI 49501.

OVER 50 PATTERNS! Profitable Wooden Gifts, Novelties. Plus "Shop Secrets." Only \$4.00. Accents (S-4), Box 262, Danvers, MA 01923.

END TABLES. Under \$10.00. You Build. Plans \$3.00. Unlimited Marketing, Box 463, Hobart, IN 46342.

CYPRESS & Cedar wood clocks, tables & other wood products. Details, \$2.50, kits & finished. The Windmill, 13102 N. Neb. Tampa, FL 33612.

"GETTING Started in Stained Glass" 50c. Whittemore, Box 2065X, Hanover, MA 02339.

1600 CATALOGS listed and described. Sources for everything imaginable, \$3.00. **MASTERLOG**, Box 879 Fairfax, CA 94930.

CHAIRSEAT CANING INSTRUCTIONS - \$2.00. Bilell, Box 43092, Cincinnati, OH 45243.

12A FOR THE HOME

SAVE \$200 - Repair Your Leaking Wet Basement Yourself. Send \$3.98 for Illustrated Instructions. D. Mertens, 929 Walck Rd., N. Tonawanda, NY 14120.

ALUMINUM WIRING IN YOUR HOME? WORRIED? Latest information and recommendations. Please send \$4.00. **TECHNICAL DYNAMICS**, Dept. C, 725 North Riverside Drive, Crownsville, MD 21032.

SELL Your Own Home! (Save Thousand!) Guide \$3.95. Box 825, Bonita, CA 92002.

Virtually Invisible Hook Up Wire Laminated in Pressure Sensitive Tape HIDES UNSIGHTLY WIRES FOR TV, AM, FM ANTENNAS, STEREO SPEAKERS, PHONES, BURGLAR ALARMS, ETC. Practically invisible hook up wires laminated into crystal clear pressure sensitive tape is a decorator's dream. End unsightly cords of stereo speakers, intercom, alarms systems, toys, other low voltage applications. Use as indoor AM, FM, TV antenna for superior reception. Paint applies harmlessly over tape without reception loss. 100-foot roll only \$8.98 + 85¢ postage & handling or 2 rolls for just \$16.98 + \$1 post. & hdlg. Res. of CA, CO, FL, IL, NY, PA, VA, VT, WI add applicable sales tax. Order from **POPULAR SCIENCE HIDE-A-WIRE** Dept. 480-C P.O. Box 5220 Grand Central Station New York, NY 10017

12B MOBILE HOME OWNERS

MOBILE Home Owners, Save your life, install your fire sprinkler system now. Details, \$3.00. The Windmill, 13102 N. Neb. Tampa, FL 33612.

13 TOOLS & MACHINERY

4" METAL Cutting Lathe \$72.65. Taig, 15048 Proctor, Industry, CA 91746.

WOODWORKING, CARPENTER, DRY-WALL tools. Up to 50% savings. 1980 Catalogue \$1.00. S.I. Industries, D-PS480, Box 29802, Dallas, TX 75229.

WEEKEND MONEYMAKER. Atlas 12-inch Lathe has 16 speeds, quick change gear box, Made in USA. For more information, write: Atlas Press Co., Dept. 2C, 2019 N. Pitcher, Kalamazoo, MI 49007.

BANDSAW BLADES. Any Size. Free Pricelist. Bandsaws, 8921hy49, Sonora, CA 95370.

MACHINEX — Unimat — Maximat — Sherline Lathes, Mills. Catalog \$1.00 Shop Supplies \$1.00. Campbell, 142 Barclay, Springfield, OH 45505.

BANDSAW BLADES, Carbide Tippe Saws, Any size. Free Literature. Kin Saw, 6541-C Tidewater Drive, Norfolk VA 23509.

SMALL FOUNDRY Furnace, Supplies: Free Literature. Pyramid Products Dept. M, 3736 South 7th Avenue, Phoenix, AZ 85041.

14 ENGINES & MOTORS

MOTOR HOLDER

Puts firm base under end mounted motor 5-1/16 to 6-11/16 diameter. Postpaid U.S. Prices—Aluminum \$3.25 ea., 2 for \$5.50 3 for \$7.25 - 6 for \$13.00. For all Steel add \$2.25 each mount
E. Walstedt Co.
11801 92nd Ave. N. Osseo, MN 55369

15 HOME REPAIRS, REMODELING

AQUATAPOXY Seals Underwater Patch leaky basements, pipes, bath tiles pools. Repair Boats In The Water. Works on Metal, Wood, Concrete, Fiberglass. Wet or Dry. 4 oz. package \$6.95 pp Satisfaction Guaranteed. Dealer inquiries invited. Allen Enterprises, 400 North Michigan, Chicago, IL 60611.

15A ENERGY SAVING

\$50 AND UP UNDERGROUND HOUSES. \$6.95 postpaid. The Logical Place, Box 882, Tullahoma, TN 37384

FREE INSULATION! Available everywhere. Sources and illustrated installation guide, \$5.00. **REX**, Box 307 Rouseville, PA 16344.

WINDMILLS of Plastic Gallon Jug Generate Electricity for House. Plan \$4.00. Windmill Electric Car, Engine Drives to Work Free, Plans \$3.00. Hadley, 2100 3rd Ave., Seattle, WA 98121

SAVE Hundreds of Dollars on Gas and Electric. Easy with Home Energy Planner and Calculator, \$7.95. Energy Planners, D/100, Box 609, Brea, CA 92621.

SOLAR Catalog, Bargains, \$5.00 Refundable. Gould, Box 5457, Titusville, FL 32780.

INSTALLATION-operation wood stove costs experience. Immediate savings. \$ to: JRM, 10023 SE 27, Bellevue, WA 98004.

HOME ENERGY CONSERVATION Booklet - \$5.95. R. Hughes, 222 Yates Mt. Prospect, IL 60056.

"RUSSIAN FIREPLACE MASONRY WOODSTOVE." Safest, Cheapest, Highest Efficiency System for your "Wood Coal" dollar. Complete Plans and Building Techniques. **DON'T GO METAL.** Send \$9.98 to: Frederick Brandt, Main Street Milbridge, ME 04658.

UNIQUE ENERGY Saving Storm Windows. Variable "R" Value. Easy Assembly. Plans \$5.00. JBE, P.O. Box 284 Lake Zurich, IL 60047.

THE EARTH SHELTERED HOME PERFECTED! Above ground beauty retained. Details and plans brochure \$3.00. Evolutionary Homes, Box 16654 Raytown, MO 64133.

EARTH SHELTER DIGEST — magazine devoted solely to earth sheltered housing. Contains articles, photos and plans for various types of underground homes. Sample copy \$3.00 **WECO PUBLISHING**, 479 West 7th St. Paul, MN 55102.

POOLS - SOLAR HEATED - Build Yourself. Plans \$5.00. Cook Enterprise Smithville Road, Hanna City, IL 61536

REDUCE Home Heating Costs. Send \$1.85 for Heat Pump Facts, Parklaw Technical Information Services, P. O. Box 363, Washington Grove, MD 20886

EARTH SHELTERED HOME PLANS. **THIRTY-Three** Plans to Choose from Energy Saving and Fallout Protection. Mail \$2.50 to: **EARTH SHELTERED HOME PLANS.**, Wiseman Holdings Ltd RR2, Qualicum Beach, B.C., Canada V0R 2T0.

SOLAR POOL HEATER - Build your own for \$2.00/sq.ft. Plans \$4.50 **BRES**, 90 Old Concord Road, Fletcher NC 28732.

FIREPLACES — Improve Energy Efficiency, **LOWER HEATING BILLS** — "How-To" information, manufacturer addresses, etc. \$4.30. Komar-Chisier, Box 276, Burke, VA 22015.

SLOW DOWN YOUR ELECTRIC METER. It's perfectly legal. Details \$5.00 Arnesco, Box 1061-PS, Woodland Hill CA 91365.

GET LATEST UNDERGROUND HOMES INFORMATION! Two new books, manual, blueprints. Free color brochure! Underground Homes, 700 Masonic Building, Dept. PS-3C, Portsmouth, OH 45662.

SOLAR GREENHOUSE - home addition reduces food and heat, substantial early savings. Detailed plans and information. \$8.50. Homestead Drafting, t. 1, Box 193, Buena Vista, TN 38318.

5B ALTERNATE ENERGY

SAVE MONEY - Heat Complete House with FIREPLACE. For information and details Send \$8.50 to: J And J Energy Consultants, 470 Cornwall Street, Hartford, CT 06112.

SOLAR HEATED AIR - Practical, simple, inexpensive, add-on (over-layment) system. Designed for homes with southern exposed roofs, forced air systems, and space for heat storage. Complete specifications, material list, cost data, drawings, installation and operating instructions. \$15. Alltech-Sundial, 1408 Mt. Vista Drive, Knoxville, TN 37920.

METHANE Generator Plans, \$10.00. **ALCOHOL Production Plans**, \$6.00. Phone, Box 212, Hiawatha, IA 52233.

SOLAR WATER HEATER. Complete plans and Step By Step Instructions. Send \$5.00 to: Heater, P. O. Box 40502, Charlotte, NC 28224.

AMAZING Forced-Air Wood Heater. Supplement Your Furnace or use alone. Write: Box 3, Rockton, IL 61072.

ENERGY INTEGRATION - Book on Alcohol, Methane, Electricity, & Solar systems for homestead energy production. \$2.00. ALEnSy, Rt. 2, Box 43, San Marcos, TX 78666.

AIR SOLAR Collectors. Easily Built with ORDINARY Materials. Plans \$3.00. Bronstein, 9026 Autoville Drive, College Park, MD 20740.

SOLAR System's hot water and complete home heating systems. Ideal for the home handyman. So simple you don't believe it. Manual with drawings \$4.75, free quotes. Allied Power Products, 1708 East Innes Street, Salisbury, NC 28144.

SOLAR POWER & WIND GENERATORS. National Company Guarantees Lowest Cost, Latest Technology. Send \$3.00 for Quarterly Distributor Publication. Gregory Hamilton, Box 989-S, Sun Valley, CA 91352.

SOLAR - Special Manual for sizing and installing. **SAVE** - Do it yourself! Send \$5.00. Your Sun Company, 2562 Bond Avenue, Drexel Hill, PA 19026.

HYDROGEN - Electrolysis Generator Plans, \$10.00. L. Spicer, Lineville, IA 0147.

FREE Home Lighting. No Cost Electricity. Further Details: James West, P.O. Box 1635, Pompano, FL 33060.

WIND POWER BLADES 9' DIAMETER, 3-Blade with Hub and Shaft: \$125. Begins producing in 10 mph, 3/4 HP in 17, 2 HP in 25 mph wind. Johnston Manufacturing, 412 W. Terra, Palmdale, CA 93550.

REDUCE OR ELIMINATE ELECTRIC BILLS. For the cost of a quality automobile. It's possible with DAKOTA WIND electricity. Details \$5.00. Dealerships also. Kirchner, 131 Beaver, Colorado Springs, CO 80906.

CONFUSED - ABOUT SUN ANGLES? You can duplicate solar shadows on models! Observe changes for various times of day or year! Only \$3 brings fold-up solar angle indicator and booklet! Rydberg Associates, Dept. PS-1, P. O. Box 23, Sterling, CT 06377.

HOW TO BE YOUR OWN POWER COMPANY with solar, water, wind, even utilities power revolutionary 12 volt home system. Operates 120VAC appliances too. Goodbye blackouts. Fully illustrated three book set **The Wilderness Home Powersystem**, \$14.95 (US) Ppd. (foreign add \$5.) 15 day return privilege. Allow 4 weeks.

JCE Inc.
P.O. Box 732-P
(44850 Highway 101 N.)
Laytonville, Ca., 95454
Visa/MC Okay (707) 984-6186

SAVONIUS WINDMILL SYSTEM Build from simple parts & generate up to 2000 Watts of Electricity! Ideal for homes, farms, cottages! Offers high efficiency, even in low windspeed areas! Simple, Economical construction! COMPLETE PLANS include electrical circuit.

ENCYCLOPEDIA OF HOME ENERGY Includes the LATEST CONCEPTS in the generation of HEAT & POWER using **HOMEMADE SYSTEMS**. Chapters on power from the Sun, Wind, Wood, Water and several alternatives to gasoline in vehicles. COMPLETE MANUAL with list of plans available. \$6.95 each, both for \$9.95.

GLENVALE PRODUCTS Dept PS4
Box 358 Station D, Toronto, Ontario M6P 3J9

KALWALL'S SOLAR HEATING CATALOG
Full line of solar heating components, including Sun-Lite® glazing and tubes. Order all materials from one source. Send \$2.00 for catalog.
Solar Components
Dept. P, P.O. Box 237
Manchester, NH 03105

ENERGY BOOKS
AT LAST! All significant books on SOLAR energy AVAILABLE BY MAIL. Also WOOD heating. WIND & WATER power, METHANE and more. Send for 3rd edition catalog with book descriptions and conversion tables. US \$1.00 REFUNDABLE. ENERGY BOOKSTORES, Dept. PS-58, 14922 Hawk Dr., Palmdale, CA 93550.

16 PLANS, BLUEPRINTS

WORLD Famous Plans, Hexa-Pent Dome \$20. Pumpkin Seed Sail Boat \$15. Redwood Canoe \$5.95. Trailboat \$5.95. More in the Catalog \$2.00. Pond Brook Products, Box 301, Franklin Lakes, NJ 07417.

17 BURGLAR/FIRE ALARMS

MAGNETIC LOCK - NO KEYHOLE. Stops crooks cold. Just \$7.95. Freeman Enterprises, Dept. 480PS, P.O. Box 226, Fallston, MD 21047.

FINALLY, A Complete SECURITY HANDBOOK! All Types Locks, Safes, Alarms, Residential and Commercial, explained. Protect Yourself, Family, Valuables, Business - Order Today! Only \$7.95 for this invaluable manual! Chain Lock, Box 344482, Dallas, TX 75234.

FINEST equipment! Save! Catalog, Decal, 50c, Refundable! AAS, 186C Oxmoor Road, Birmingham, AL 35209.

EVERY HOME IS A TARGET FOR CRIME. SELL PROTECTION FOR \$3.00!

WARNING
PROTECTED BY
ELECTRONIC
ALARM SYSTEM

WE'LL SEND YOU 1,000 STICKERS FOR \$35. - AND ONE FREE ALARM

Burglars see this warning sticker on windows, doors and leave. The psychology behind the sticker deters the burglar and sells these bright yellow/green self-adhesive vinyl stickers to people who cannot afford alarms. Once you show them, everyone will buy. Sell to homes, shops, security companies, factories, businesses, flea markets, mail order, premium users. Make up to 600% profit! \$3 will bring you details and 12 big (1 3/4 x 3 3/8) labels; or start making money right away and order 48 for \$5. 144 for \$9.60; 1,000 for \$35 and 1 Free Alarm (at this price, if you resell labels 12 for \$3.00, your profit is \$209.00 on a \$35.00 investment.) Counter displays avail. Write now.

RIDGEWOOD HOUSE
P.O. Box 5, Dept. PS0-1, Ridgewood, NY 11385

19 MOTION PICTURES

SUPER 8, Videocassettes and 16mm full length features and digest films in color and black/white. Rock movies, Jack Nicholson, Sherlock Holmes, Bogart, Selznick, hundreds of titles. Free illustrated catalog. Niles, Box 1576-PS, South Bend, IN 46634.

Video from the film folks? You betcha!

If you're a new customer at Blackhawk Films we want to make sure that you know that we're a whole lot more than just "old-time movies". Like video cassettes for example.

From classic to contemporary (but nothing X-rated), we're your one source of fine home entertainment programs, whether you view them on a video cassette player or projector. Write today for our video catalog or film catalog. Please specify video or film and include \$1.00 for each.

Blackhawk
Dept. 5143 • 1235 W. 5th St.
Davenport, Iowa 52808

21 HOBBIES/COLLECTIONS

PEWTER - Child's Goblet - Handcrafted - Collectible. Send \$17.00. Pewter, P. O. Box #772-PS, Natick, MA 01760.

COLLECT Military Medals. List 50c. Vernon. Box 387PS, Baldwin, NY 11510.

22 JEWELRY

CONVERT Your Junk Silver and Silver into Valuable Jewelry or Ingots. Complete instructions \$3.00. Smelting, 180 Blanche, Troy, MI 48098.

AMAZING JEWELRY CLEANER, \$3.75 per Jar. Commodities America, 230 Elm Street, Oil City, PA 16301.

22A WOODCARVING

CARVING Wood and Tools. Listing \$1.00 Refundable with order. Mac and Mac Mahogany, 1720 Regene, Westland, MI 48185.

23 MINERALS & PRECIOUS STONES

AUTOMATIC Goldpanner. Pan Gold The Easy Way. Goldhound, 4078 Lincoln Blvd., Marina del Rey, CA 90291. (213) 822-2252.

GOLD: \$10.00. S. Babich, P. O. Box 874, Rosemead, CA 91770.

GOLD - Find it yourself! New Mechanical Panner. Fast! Easy to use! Build Yourself. Plans \$5.00, CWB, 4150 E. Iowa 409, Denver, CO 80222.

GOLD SLUCE plans, instructions - easy to make, operate. \$4.00. Snyder, Box 113, Irvine, Alberta, Canada TOJ 1V0.

GOLDI Field Guide for Locating, Panning, Sluicing, Extracting. Includes Sluicibox Plans, Maps. \$5.00. Placerlode, Box 13326, Kanata, Ontario K2K 1X5.

24 ANTIQUES, RELICS & INDIAN GOODS

ARROWHEADS \$7.50 Dozen. Artifacts List 25c. C. Secrist, Deerfield, MO 64741.

25 FORMULAS, PLANS

NICAD Battery Charger, universal, easily built, under five dollars. Plans \$3.00. Nicad, P. O. Box 6884, Birmingham, AL 35210.

NEW MONEYMAKING FORMULAS! CATALOG - \$1.00 - Refundable! Innowel, Box 201, Custer, WA 98240.

20,000 MONEYMAKING FORMULAS! CATALOG - \$2.00 - REFUNDABLE! GWA6, Box 193, Brookfield, WI 53005.

HENLEY'S
20th Century Book of 10,000 Recipes, Formulas & Processes (Latest Edition)

Here is a wealth of practical, accurate and clear information and instruction that can save you thousands, or make you a fortune! Housewives, manufacturers, farmers, handymen, home experimenters, electricians, chemists, people in every walk of life, refer to Henley's daily. In this gold-mine of a book, you too will find formulas and recipes for almost everything used in the home, farm, workshop or industry. Discover the trade secrets of thousands of commercial products—learn new money-savings and exciting way of doing things. As indispensable as a dictionary. Satisfaction guaranteed. 900 pages hard cover-cloth binding. Only \$10.95 plus \$1.45 postage & handling. Dealer's Inquiries Invited

EMBASSY SALES Dept. PS-39
Box 67, East Elmhurst, N.Y. 11369

26 SCIENCE & CHEMISTRY

COMPLETE Catalog 50c. Surplus Lists, Laboratory Sales, Box 161-B, Brighton, MA 02135.

NEGATIVE ION GENERATORS. (Fascinating details - \$1.00.) Golden Enterprises, Box 1282-PS, Glendale, AZ 85311.

NEW 200-page 1980 catalog listing thousands of chemicals, glassware and lab equipment. Send \$2.00 to: Merrell Scientific, 1665 Buffalo Road, Rochester, NY 14624.

N.A.S.A. Technical Reports inventions and technology you can use, \$2 to: NASA Information, P.O. Box 24441, Lexington, KY 40524.

EVERYTHING For Chemistry Experimenters! Catalogue \$1.00. Starr Scientific, Manitowoc, WI 54220.

ECONOMICALLY Priced—Apparatus, Chemicals. Discount Catalogue-\$1.00. Hagenow Laboratories, Manitowoc, WI 54220.

CHEMICALS, Apparatus. Lowest prices Anywhere. Free Catalog, Avatar, P. O. Box 213, St. Charles, MO 63301.

CHEMICALS apparatus, project books, wide selection, Catalog \$1.00. Send to: Pioneer Industries, 14A Hughey Street, Nashua, NH 03060.

A MOVIE IN YOUR POCKET AWARD-WINNING PANGAEA FLIP BOOK. Flip the pages and see the ancient world break apart to form the present continents. Send \$2 to: MIYP, Inc., P. O. Box, Green's Farms, CT 06436.

AMAZING ELECTRONIC PRODUCTS

LASERS SUPER POWERED, BURNING, CUTTING, RIFLE, PISTOL, POCKET - SEE IN DARK - SHOTGUN DIRECTIONAL MIKE - UNSCRAMBLERS - GIANT TESLA - STUNWAND - TV DISRUPTER - ENERGY PRODUCING, SURVEILLANCE, DETECTION, ELECTRIFYING, CHEMICAL, ULTRASONIC, CB, AERO, AUTO AND MECH DEVICES, HUNDREDS MORE - ALL NEW PLUS INFO UNLIMITED PARTS SERVICE.

INFORMATION unlimited.
CATALOG \$1 Dept. PS, Box 716, Amherst, NH 03031

*****LASER & SCIENCE PLANS*****
FIVE LASER PLANS - \$9.
ALL ABOUT LASERS COURSE - \$10.
RUBY LASER COURSE & PLAN - \$10.
HOW TO FABRICATE LASERS - \$5.
INFRARED LASER PISTOL - \$8.
WELDING-BURNING LASER - \$9.
LASER WARS SABER/PISTOL - \$5.
"LASERAMA" LASER SHOW - \$19.
LASER AIMED 22 RIFLE - \$9.
WOOD CARVING LASER - \$10.
"WILD IDEAS" CATALOG - \$2.
SO-LASER, Laser Experts
"PS480", Box 1015
Claremont, CA 91711

27 PLASTICS

CASTOLITE Liquid Plastics. Crystal clear, colors. For casting, embedding, coating, fiberglassing; in industry, laboratories, craft work. Reproduce your designs with our mold materials. Profitable. Illustrated Catalog \$1.00. Castolite, Dept. 80D/PS, Box 391, Woodstock, IL 60098.

29 LOG CABIN & HOME BUILDING

BABY BARN Plans, materials list, and detailed instructions 6' x 8', 8' x 10', or 10' x 12'. \$5.00. Barns, P.O. Box 41, Nackawic, N.B., Canada E0H 1P0.

UNDERGROUND Housing Organization. \$12.00 Membership Brings Monthly Updates, Information, Plans, Kintyre, Box 233, Pemberton, B.C., Canada V0N 2L0.

"DOME HOMES." Beautiful, economical, designs, easily constructed. Send \$5.95 for price list and brochures for prefabricated kits, or do-it-yourself blueprints. **STOR-CON LTD.**, P.O. Box 4, Rome, NY 13440.

BARN HOME PLANS - Catalog \$1.00. Family Corner, Box 501, Little Rock, AR 72203.

CABIN KITS

- Broad Top "A"
- Little "A"

Top Quality. Low Cost
Easy to Build

Brochure \$3.00

KITWOOD • BOX 12552
FORT WORTH, TEXAS 76116

30 GARDEN SUPPLIES & EQUIPMENT

LOSING seeds to birds? Automatically save seeds. \$5.00. Save, 1285 S. Kingston, Chandler, AZ 85224.

31 NURSERY STOCK

GROW GINSENG! \$50 pound. Have seeds, roots. Goldenseal. Information. Collins, Viola, IA 52350.

32 REAL ESTATE

MONEY MAKING SECRETS OF REAL ESTATE - HUGE PROFITS. Information \$5.00. Mr. Neese, 13724 Bluegrove, Bellflower, CA 90706.

BIG . . . NEW . . . FREE . . . SUMMER CATALOG! Over 2,700 Top Values Coast to Coast! **UNITED FARM AGENCY**, 612-PS West 47th, Kansas City, MO 64112.

OFFICIAL USA/CANADIAN DIRECTORIES!! \$1.25/Acre. Complete Agricultural, Commercial, Residential, Waterfrontage Listings, Homesteading Availabilities Information. \$2.00—National Center: US/Canadian Lands, Hewitt-SA, WI 54441. (Copyright 1980).

CALIFORNIA. Acreage. Lots. \$20 down. \$20 monthly. 11546 Valerio, North Hollywood 91605.

BUILDER'S SURPLUS ACREAGE, LOTS. California, Oregon, Arizona, Florida. \$125. down, Paul Lacher, 3900 Victory Blvd., Burbank, CA 91505.

HOUSE Buyers - Save 50%. Send \$5. F.B.B., Box 134, Mesick, MI 49668.

GOVERNMENT LANDS - from \$7.50 Acre! "Buyer's Guide" . . . plus nationwide listings - \$2.00. Surplus Lands, Box 19107-FD, Washington, DC 20036.

OWN CANADIAN LAND FROM \$47 ACRE— Choice properties across Canada. Low monthly payments. Cottage, hunting, fishing and investment. Twelve month exchange privilege. Six month money back guarantee. **CATALOGUE \$1.00.** Write: Canadian Estate Land, Dept. 22C, 286 Lawrence Ave. West, Toronto, Canada M5M 3A8.


FREE! Big Spring Catalog! Over 5,400 country properties described, pictured! Land, Farms, Homes, Businesses, Recreation, Retirement buys! Selected best thruout the U.S. Over 700 offices, 43 states All Across America! Yours **FREE** from the World's Largest! **STROUT REALTY, Inc.,** 7 S. Dearborn, Dept. 5810, Chicago, IL 60603.

HISTORIC Western Town, beautiful Southern Utah. Hunt, fish, camp year-round. Huge valley rimmed by mountains. Lots \$695 full price, \$10 down. Complete information \$1. Southwest, Box 37-S, Beryl, UT 84714

LIQUIDATING Florida Land 75'x125' Lots for Homes or Mobile Homes. Lake Access, Lake Weir, Ocala Area, as low as \$1995.00. Only \$39 down and \$38.49 for 63 months. Interest 8 3/4%. Total price \$2424.87. Lake Weir, Phone Free: 1-800-521-4996 or Write: 1424 NW First Ave. - H, Ocala, FL 32670.

10-20 ACRES in fabulous Northern IDAHO. Choice land in beautiful timbered settings. In the heart of lake, hunting & recreation country. Reasonably priced. Terms. Parcels with domestic water and power available. A unique opportunity for country living at its best. Write for free information:

NATIONAL ASSOCIATED PROPERTIES

 Dept. NC, 1121 Sherman Coeur d'Alene, ID 83814 (208/664-8161)


34 CAMPING EQUIPMENT & TENTS

FREE Catalog. Everything for Camping. Campmor, Box 407P, Bogota, NJ 07603.

35 AQUARIUM SUPPLIES

LIVE SEA HORSES \$3.98

Kit includes 4 adults & up to 30 ponies from pregnant male, marine salt, food, live plant, live snail & instructions. Above kit with Custom Aquarium, sea horse tree, seashells, coral, silica sand + 2 ghost shrimp \$7.95. **Large Deluxe Aquarium** with all custom kit accessories & 10 adult sea horses (2 preg. males - up to 60 sea horses) \$12.95. *Kits sent ppd Live delivery guaranteed. via air mail*



See Horses Inc., Dept. PS 40, Box 1477, Coral Gables, FL 33134

38 BIRDS & ANIMALS

FREE! "How to Raise Game Birds" for fun & profit. Source for incubators, feeders, hatching eggs, books, Marsh Farms, Box 7-DD, Garden Grove, CA 92642.

39 EARTHWORMS, CRICKETS, FROGS

FREE Literature—We Teach You To Raise, Sell Fishworms, Crickets, 12-inch African Worms, Carter Farm-12, Plains, GA 31780.

42 FIELD GLASSES, TELESCOPES

CELESTRON — Discount Prices - Astronomical, Spotting, Telephoto Lenses, More. Free Catalog. Atlantic Optics-P, 1302 Niantic Terrace, West Palm Beach, FL 33411. (305) 793-9465.

FREE Catalogue! Thousands War surplus optical bargains. Lenses, Prisms, Telescopes, Binoculars, etc. Jaegers, 691G Merrick Road, Lynbrook, NY 11563.

43 GOV'T. SURPLUS

OFFICIAL USA DIRECTORY! Jeeps \$37.22! 400,000 Listings! Your Immediate Area! **UNEQUALLED!** \$2.00 (INCLUDES G-LANDS, G-LOTTERIES, INFOGUIDES!) US/Great Lakes Federal Depository, B-807SK, Marshfield, WI 54449. (COPYRIGHT 1980)

SURPLUS JEEPS - \$19.30! CARS - \$13.50! 650,000 ITEMS! GOVERNMENT SURPLUS - MOST COMPREHENSIVE DIRECTORY AVAILABLE TELLS HOW, WHERE TO BUY - YOUR AREA - \$2 - MONEY BACK GUARANTEE. "GOVERNMENT INFORMATION SERVICES," DEPARTMENT A-4, BOX 99249, SAN FRANCISCO, CA 94109.

FREE! DIRECTORY Information - Importers' Listings, **SAMPLES.** Enclose Commercial Stamps Self-Addressed Envelope, Lenner's - 337B, Brooklyn, New York 11224.

JEEPS \$52.40, Airplanes \$75.01, typewriters \$6.70, Boats \$7.50, direct from Government Directory and Surplus Catalog \$1.00. (Refundable). Midwest Surplus, Box 401-PS, Dayton, OH 45401.

GOVERNMENT Surplus. Buy your Area, How, Where, Send \$2.00. **SURPLUS, 615-PS HEADQUARTERS BUILDING,** Washington, DC 20036.

1980 SURPLUS Army, Navy store 64 page illustrated catalog. Send \$1.00. Ruvel, 3037 North Clark, Dept. M4, Chicago, IL 60657.

"GOVERNMENT SURPLUS Directory." Buy 250,000 items (including jeeps) . . . low as 2c on dollar! Most complete information available - \$2.00. **SURPLUS DISPOSAL, 19107-FD, WASHINGTON, DC 20036.**

JEEPS, Trucks, From \$52.40. Boats, Airplanes, Automobiles, Motorcycles, Typewriters, Tools, Clothing Sports, Camping, Photographic, Electronic Equipment. . . 300,000 Amazing Bargains Direct From Government Nationwide. . . Low as 2c on Dollar! Surplus Catalog and Sales Directory \$2.00 (Refundable). Surplus, Box 954-PPS, Muskegon, MI 49443.

JEEPS - \$18.88. 675,000 Items! Buy In Your Area! How! Where! "Moneyback GUARANTEED" 1980 Government **SURPLUS** Directory" including: "Buy **G-LANDS**" - "G-Oil/G-Gas **LOTTERIES**," \$2.00. **GSURPLUS, Box 2009-E, Syracuse, NY 13220.**

45 BODY-BUILDING, SELF-DEFENSE COURSE

POWERFUL Muscles Fast! Guaranteed! Free Information. American Powerhouse, Box 667, Minneapolis, MN 55440.

46 PROFITABLE OCCUPATIONS

START YOUR OWN BUSINESS small investment, low overhead, minimum time, great income potential \$2.00 Details: Box 43, Iberia, OH 43325.

STOP FLAT ROOF PROBLEMS on Commercial, Industrial, Mobile Homes. Install Acrylic Fiberglass Roofs. White Finish Saves Energy. Free Dealership. \$10.00 for Sample Kit, Information, Refunded First Order. Money orders only. Polar Seal, Route 8, Box 273, Huntington, IN 46750

FREE Catalog. Repair Air Conditioning, refrigeration. Tools, supplies, full instructions. Doolin, 2016 Canton, Dallas, TX 75201.

STUDIO Home Knitting Machines are a profitable hobby. Credit available. Send \$1 for information to: Studio, Box PS-46017, Seattle, WA 98146.

GOLD & SILVER Scrap (GET RICH!) Buy Cheap - Sell at Huge Profits! Guide \$4.95 Includes Prospecting! (We Buy Scrap.) Tomlinson Gold Co., Box 825, Bonita, CA 92002.

SURPRISE Everybody. Become Notary Public now. We guide you, free. We sell notary needs. Raise your image, job value, income. Assistance nationwide. Brochure: Gulf, 234 Club-B, San Antonio, TX 78201.

MECHANICALLY INCLINED INDIVIDUALS

Assemble electronic devices in your home. Knowledge or experience not necessary. Get started in spare time. Above average profits. \$300-\$600/wk. possible. Sales handled by others. No investment - Write for free details.

ELECTRONIC DEVELOPMENT LAB Box 1560G, Pinellas Park, FL 33565

47 BOOKS & MAGAZINES

"ALIAS THE-CREDIT-CARD-KID" is the **TRUE** humorous biography of the biggest credit-card manipulator of them all. Read how he beat the system for a million bucks. Only \$4.95. Reiny Publications, P.O. Box 1541, Brandon, FL 33511.

SKYVISION—The monthly magazine of home satellite television reception. 12 monthly issues only \$12. Send to: Skyvision, P.O. Box 10017, Chicago, IL 60610.

"HOW to Write to Oriental Ladies." \$6.00. Cherry Blossoms, Honokaa, HI 96727.

THE COAL PRIMER — Basic handbook on coal industry. \$7.00. The Coal Primer, P.O. Box 9764, Little Rock, AR 72219.

GOOD News Bibles — Today's Version. Information - \$2.00. Bridges, Box 4413-P, Hollywood, FL 33023.

JOGGER'S Journal: Record Book for the Jogger - \$5.00. Leduc, 104 A South, Cowansville, Que. J2K 2X2.

ASTROLOGICAL Booklet plus cards (readings) - \$5.00. 3633 West Mauna Loa, Phoenix, AZ 85023.

FREE magazine featuring 500 books . . . natural health, gardening, other interesting subjects. Provoker Press, St. Catharines-505, Ontario L2R 7C9.

BEAT ACCOUNTANTS! How to know in just a second the total of **ANY** fifteen different numbers when you know just one number! Read: "Your Majesty . . . What's Going On?!" Unbelievable secrets. Send \$1.99 to: Champollion, Dept. A24, P. O. Box 808, Union City, NJ 07087.

FREE List - Over 350 Titles Informational Books. Clanon Associates, Brewerton, NY 13029.

CLOCK and Watch repairing books (including digital watches). Free catalog. North American, Box 77-BQA, Fox River Grove, IL 60021.

READY REFERENCE

SAVE your copies of Popular Science neatly with handsome, rugged file cases and binders. Dark blue with Popular Science logo, holds a year's issues. **FILE CASES:** \$4.95 each, 3 for \$14 or 6 for \$24. **BINDERS:** \$6.50 each or 3 for \$18.75; 6 for \$36. Canada & Foreign add \$1 per case or binder extra. Send check or money order to Jesse Jones Box Corp., P. O. Box 5120, Philadelphia, PA 19141.

49 JOKES & NOVELTIES

FREE—World's Leading Novelty Catalog. 1600 Jokes, Tricks, Science, Sports, Hobbies, Johnson-Smith, C-11, Mt. Clemens, MI 48043.

50 MAGIC TRICKS, PUZZLES, ETC.

MAGICIANS! Free Trick with Super Magic Catalog - 50c. Sun Magic PS, 10 Forest St., So. Burlington, VT 05401.

FREE! \$2.00 trick, huge catalog, all 50c. Abracadabra-SP, Scotch Plains, NJ 07076.

51 COINS & CURRENCY

INEXPENSIVE Quality Foreign Coins. Write: Paul C. Welz, 421 Balboa Street, Dept. PS, San Francisco CA 94118.

HONG KONG DOLLAR Only 10c. Uncirculated cupronickel dollar. Limit One. (Adults Only.) Plus price lists. Littleton Coins, KH-2, Littleton, NH 03561.

UNBELIEVABLE, 100 UNCIRCULATED coins from **100 COUNTRIES** only \$12.99. Entreprises, Box 275, Coteau Landing, Quebec, Canada, J0P 1C0.

1978 UNCIRCULATED EISENHOWER DOLLAR - \$2.50. Coin City, Box 28743, St. Louis, MO 63141.

LOOK - Fascinating Foreign Coins. Three for 25c. Godwill Coins, 44 Thunderbird, Putnam, IL 61560.

3 OLD Liberty Head Nickels Only \$1.00. Issued before 1913. Limit 1 Set. (Adults Only.) Plus price lists. Littleton Coins, HL-2, Littleton, NH 03561.

BUYING SILVER COINS

Dimes, Quarters, Halves, Silver Dollars. U.S. 1964 and before \$15.00 per dollar. Kennedy halves 1965 through 1970 \$5.00 per dollar. Canadian silver 1966 and before \$10.50 per dollar. Canadian silver 1967 and 1968 \$6.00 per dollar. Send registered mail or insured mail

J. E. Smith

P.O. Box 588

Jeannette, Penna. 15644

52 STAMP COLLECTING

MICKEY MOUSE, Donald Duck, Minnie Mouse, Pluto, Goofy. **CARIBBEAN NEW ISSUE!** Only 10c when requesting approvals. State age. Douglas Cook, Dept. PS-8, Las Vegas, NV 89119.

UNITED NATIONS 3 Complete Mint Sets 25c. Approvals. Cornetta, POB 1509-P, Lake Placid, FL 33852.

PENNY Approvals! Regardless Catalogue! Kloster, 4164—52nd Street, San Diego, CA 92105.

50 DIFFERENT Old U.S. between 1861 and 1939 \$1.00. Ed Roush, 423 Shepard, Mansfield, OH 44907.

FIFTY Free Stamps With Approvals. J&D Stamps, Box 747, Melbourne Beach, FL 32951.

OLD U.S. Stamps on approval. Chester, Box 15414-R, Philadelphia, PA 19149.

MAKE money collecting, trading and selling stamps. Learn why price of stamps will skyrocket soon. Report \$3.00. World Mail Order Products Co., P.O. Box 910, Bronx, NY 10451.

1000 WORLDWIDE PLUS BONUS, s.a.s.e., \$2.00. Arno, Box 446, Elmhurst, IL 60126.

U.S. 100 DIFFERENT 10c approvals. Stamps, Box 385-S, Midlothian, VA 23113.

FREE Surprise collection sent with approvals. Jay, 1784 Union, San Francisco 94123.

PENNY Approvals. Regardless Catalogue. Zamora, 1 Mendez Liciaga, San Sebastian, Puerto Rico 00755.

TOPS! 100 Popular Poland Stamps (All Different) Only 25c. Mystic, Dept. PS2, Camden, NY 13316.

16 DIFFERENT U.S. Airmail stamps worth over \$1.00. Only 10c. (Adults Only.) Limit One Set. Wonderful lists included. Littleton Stamps, AH-2, Littleton, NH 03561.

100 DIFFERENT Fascinating Turkey Stamps, Only 25c. (Adults Only.) Goliath, Y-2, Bethlehem, NH 03574.

WOW! 125 Different plus Mystery Gift 10c. Approvals. Fayette Stamps, Dept. WA, Fayetteville, NY 13066.

FREE! 107 Different, Triangles, Topicals, etc. Approvals, Jayto Company, Manlius, NY 13104.

FREE Worldwide packet. Penny approvals. Froelich, Box 412-B, Morton Grove, IL 60053.

50 YEARS Old, fifteen different United States, over fifty years old 25c with approvals. Jaxon, Box C11, New Rochelle, NY 10804.

54 RADIO, TELEVISION

36c TUBES. Radio & TV! Free Color Catalog. Cornell, 4217S University, San Diego, CA 92105.

POLICE Scanners, Crystals, Radar Detectors. HPR, Box 19224, Denver, CO 80219.

FREE Educational Electronics Catalog. Edukits Workshop, Department 799-A, Hewlett, NY 11557.

54A CB RADIO

INCREASE CB RANGE — Legally! Free Information. "SKIPPER", Box 130-C4, Paradise, CA 95969.

CATALOG OF UNUSUAL CB ITEMS! Modifications, repairs, range boosters. \$1 (refundable). CB City, Box 1030-P, Woodland Hills, CA 91365.

55 ELECTRONICS, STEREO, HI-FI

FREE - 60 Top Brand Batteries. Details \$4.00. Chris Eric, Box 8264, Hollywood, FL 33024.

FREE ELECTRONIC KIT CATALOG
accom, 14805 NE 40th, PS-4, Red-
ond, WA 98052.

6 RECORDS, TAPES, etc.

OLDIES - 45's Original Hits. Catalog
1.00. C&S Record Sales, Box 197-B,
ampsville, NY 13163.

OLD Radio Programs on Cassette
apes. Send 15c Stamp for Catalog. Box
6365-P. St. Louis, MO 63125.

RECORDS - TAPES! Discounts to
3% on all labels; no purchase obligations;
newsletter; discount dividend certifi-
cates; 100% guarantees. Free details.
Discount Music Club, 650 Main Street,
ept. 4-0480, New Rochelle, NY 10801.

COLLECTOR'S ITEM never sold in
ores anywhere. **GLEN CAMPBELL'S**
ery first stereo album. On 8-track or
assette. Only \$6.95 ppd. Buckhorn
ales Company, Box 8835, Houston, TX
7009.

7 MUSICAL INSTRUMENTS

MUSICAL SAW - If you can whistle,
ou can play the Saw. Produced since
921. Details-Free "Sawing News of
e World." Mussehl-Westphal, 130PS
outh 4th Street, Delavan, WI 53115.

GUITAR, Banjo, Violin, Mandolin
aking Materials, Accessories, Books,
lano Tuning Kits. Catalog 50c. Interna-
tional Luthiers Supply, Box 15444,
ulsa, OK 74112.

INTERNATIONAL Catalog valuable to
akers, repairers of stringed instru-
ments. Imported woods, parts, accesso-
es, kits. Fine German-made violins, vi-
as, cellos, basses and bows. Send 25c
or catalog. Credit certificate worth
1.25 enclosed with catalog. Interna-
onal Violin Company, Dept. AR, 4026
Belvedere Ave., Baltimore, MD
1215.

LEARN GUITAR . . . Cassette Tape,
ooklet, Courses . . . Hear Instructions
. . . Hear Music . . . Play along band
\$12.95 . . . \$2.50 shipping
ree brochure. Cox Associates, 1372
eville-apps 3, Bountiful, UT 84010.

SAVE ON ACCORDIONS

40 Models! Famous Makes!
SAVE! Direct from Importer.
Models for students, teach-
ers, professionals. Standard
or Electronic. Terms. Trades
welcome. Home Trial. Hohner
Button models too. FREE
catalog and Importer prices.
ACCORDION CORPORATION
5535 (PX) Belmont Avenue, Chicago, Ill. 60641

8 SONG WRITERS

POEMS - SONGS WANTED. Free Pub-
lishing/Promotions. Broadway Music,
Box 7438-PS, Sarasota, FL 33578.

POEMS set to music, Nashville Music
Productions, Box 40001-PS, Nashville,
TN 37204.

9 IMPORT-EXPORT

2500 "FAST Selling" Products. Free
Brochures! Ballico, Box 91309-X4,
Cleveland, OH 44101.

10 BUSINESS OPPORTUNITIES

GOV'T CONTRACTS. How to bid. In-
ormation \$3.50. Jr. Stapper, 12401
railing Oaks, San Antonio, TX 78233.

GOLD MINE FROM YOUR TALENTS.
Free Information. Yortal, Box 460-PS,
Fairview, OR 97024.

FREE PACKET! Describes 19 Over-
ooked Fortunes. Take 'em! TRSC, Box
32, Union City, MI 49094.

MAKE MONEY sponsoring your own
Arts & Crafts festival or Saturday
Market! For complete information on
inancing, vendors, booths, advertising,
ncorporation, etc. send \$12.95 to:
Wood Visions, P.O. Box 1051, Alta
Loma, CA 91701.

PAY TV. As popular as jukeboxes in
offee shops, restaurants & many other
ocations. Ideal low cost, low risk busi-
ness now available in kit form. For
FREE INFORMATION write: **ELDORADO**
PRODUCTS, 3645 Inglewood Ave. #3,
Redondo Beach, CA 90278.

SELL SUCCESS - Beat Inflation.
Guaranteed Effective. 7 New Easy
Steps. Sales Dynamics, Department 1B,
Jamestown, NY 14701.

WE MANUFACTURE QUALITY SOLAR
collectors, storage tanks, and shutters,
and would like to help others get started
in same. Ideal small business. Invest-
ment required. Send \$1.00 to Sunset
Solar Construction, Rt. 3, Box 50A,
Stevensville, MT 59870.

NEW TAX LOOPHOLES Discovered.
Everyone eligible. Free facts. ULC, P.O.
Box 359-00, Clarkston, GA 30021.

REPAIR HYDRAULIC JACKS—Free
details. Hydraulic Parts Supply, Dept. S,
Box 4157, Brownsville, TX 78520.

MAKE More Money by mail. HACO,
Box 846, Nashua, NH 03061.

SYNTHETIC OIL DEALERS Needed.
Exciting Products & Opportunities.
Make More Spare Time Than in Present
Business or Job. Collect (316) 686-
0441.

FREE Inflation-Beater Book "2042
Unique, Proven Enterprises." Fabulous
"Little Knowns." Work Home! Hay-
lings-E, Carlsbad, CA 92008.

\$92.00 FROM Square Foot Plywood
(Huge Demand). Revealing Proof 25c
(Refundable). Woodwins, Bridgewater,
MA 02324.

ABANDONED INDUSTRIAL SILVER—
take it! Details: Silver, Box 548, Wood-
ville, TX 75979.

VENDING Machine. No selling. Routes
earn amazing profits. Big Catalogue
Free. Parkway Corporation, 1930PSB
Greenspring Drive, Timonium, Maryland
21093.

PLASTERCRAFT — Profitable Home
Business. Over 1,000 molds available.
Details: Lynnette, 6251R Mentor Park,
Mentor, OH 44060.

LEARN Sewing Machine Repairing.
Men, Women, Lucrative profits. Gresslin
Correspondence School, Box 927, Spen-
cer, IA 51301.

SELLING KNAPP SHOES IS EASY.
Highest cash commissions immediately.
Enjoy a steady income with satisfied
repeat customers. Your own hours. No
investment. Free sales kit. Knapp Shoes.
K-611 Knapp Centre, Brockton, MA
02401.

EASY CASH! Sell opportunity books!
Free distributorship! Allen, 5711-J
Graves, Encino, CA 91316.

\$534.00 WEEKLY working three hours
daily at home. \$356.00 weekly working
two hours daily. \$178.00 weekly work-
ing one hour. Start immediately. Paid
daily (advance) - \$106.80, \$71.20, or
\$35.60. Written Earnings Guarantee.
Free Bulletin/Application. FAS, Postal
Unit 13703-B, San Antonio, TX 78213.

\$50,000/YEAR distributing bacterio-
static water purifiers. (Details - \$1.00.)
SAFEWATER, Box 39195, Phoenix, AZ
85069.

LOTTERIES Agents Worldwide Want-
ed. Box 35699, Vancouver, B.C., Canada
V6M 4G9.

FREE DETAILS ON HIGH PROFIT
MAIL Order Book Business. Vantage,
Box 224-PS, Hyde Park, MA 02136.

\$30,000 MONTHLY, oil lease firm,
legal lottery operated by mail. Details
\$3. JT, Box 7798, Waco, TX 76710.

"ADS 'N' ANSWERS" has current
Business & Moneymaking Opportunities
classified answers. We answered 'em all
for you. Send long, self addressed,
stamped envelope: Consumer Assistance
Corp., Dept. A-C, Box 13102, St. Pe-
tersburg, FL 33733.

MAILORDER: Free Instruction Book-
let . . . Free Directory Dropship Manu-
facturers. Clifco, Box 7519-p4, Alexan-
dria, VA 22307.

MAKE \$100,000 using your own sav-
ings account with \$20 per week. Meth-
ods revealed by attorney. Free Facts.
Write, DSC Enterprise, Box 15242,
Dept. PS-1, Honolulu, HI 96815.

MECHANICALLY Inclined? Be your
own boss. Own your own shop. Send
\$1.00 to: Empire Automotive Services,
241 21st Street, Ogden, UT 84401.

FIREWOOD = ENERGY = PROFIT
Wood lot operator tells how to develop
and operate energy business full or part
time. Good profits plus tax advantage.
Send \$5.00: Forest Fuels of Virginia,
Box 432, Blacksburg, VA 24060.

\$58.90 DAILY PAY. \$353.88 WEEK-
LY. Homework. Immediate Income.
Earnings guarantee certificate. Free
report/Application. AAHIP, Unit 29309-
A, Medcensta, TX 78229.

PIANO Tuning learned quickly at
home! Free information. Empire School,
Box 450327. Miami 33145.

FREE Mailorder Dropship Business
Journal! Mailer's World, Box 1355-P,
Sioux Falls, SD 57101.

MANUFACTURER NEEDS MAN To
Assemble Product at home and supply
national sales crews, full or part time.
Should desire business of their own.
Five-figure income potential. S.K.R.C.
Manufacturers, River Bend Plantation,
Broadway, NC 27505.

MAILORDER \$1,000.00 Possible
Monthly Selling Information. Free De-
tails: AR Enterprises, Box 92-S, Bronx,
NY 10465.

EARN BIG FEES
EASY - Fascinating Opportunity. Be-
come Money Broker. Own hours. No ex-
perience. Proven success formula. Free
Report: DFC, Dept. 11-P-4, 1145 Res-
ervoir Avenue, Cranston, RI 02920.

OIL - How To Get In The Oil Busi-
ness Treatise \$5.00. OIL, Box 2441,
Monroe, LA 71207.

MAILORDER Opportunity. Start prof-
itable home business without experience
or capital. Information free. Mail Order
Associates, Dept. 547, Montvale, NJ
07645.

MAKE Durable Building Plastic Easily.
Waterproof, Fireproof, Economical. Bays
Laboratory, 2086 - 2075 Drive, Cedar-
edge, CO 81413.

LOCK KEYING SIMPLIFIED. 18"x24"
Illustrated Instructions. \$6.00. Barch
Enterprises, P. O. Box 17440, San
Diego, CA 92117.

DEPENDABLE Continuing Income
Possible - not millions operating small
businesses. Minimum investment. De-
tails: Evergreen, P. O. Box 46, Elkhorn,
WI 53121.

MECHANICALLY inclined individuals
desiring High Weekly Profits operating
Small Manufacturing business Without
Investment write: Businesses, 92-P
Brighton 11th, Brooklyn, NY 11235.

PIANO Tuning quickly learned with
home study course. Diploma granted.
American Tuning School, 17050 Telfer
Drive, Morgan Hill, CA 95037.

BEAT the Races! Free Booklet! "Un-
limited Lifetime Income from Thorough-
breds - Harness". Elias, Box 47-G,
Brooklyn, NY 11219.

I MADE \$40,000.00 Year by Mail-or-
der! Helped others make money! Details
25c. Torrey, Box 318FF, Ypsilanti, MI
48197.

PHOTOSTAMP Agents Wanted! Make
Big Money from Home Mailorder. Free
Samples & Information: Postermatic-C8,
East Providence, RI 02914.

NEW Luxury Car Without Cost! Free
Details. Codex-B, Box 6073, Toledo,
OH 43614. (419) 865-5657.

MILLIONS in Mail! Free Secrets.
Transworld-11, Box 6226, Toledo, OH
43614.

BELTS And Buckles. Complete Line
Fast Sellers, including Westerns, Truck-
ers, Motorcycles, Wildlife, etc. Big Prof-
its. Complete dealer set up. Free Cata-
log. Anchor, Box 3958-BPS, North
Providence, RI 02911.

JEWELRY SALES CAN MAKE YOU
RICH! Full or Spare Time. Starter kit
\$1.00 (Refundable). Nasco, 310-BQB
Lincoln Avenue, Fox River Grove, IL
60021.

SELL SENSATIONAL LOW-COST
BURGLAR ALARM. Lightning seller. Ex-
ceptional margin. Samples for trial.
Northwest Electric, Ave. 2127, Mitchell,
SD 57301.

TAKE Catalog Orders. We dropship
2500 Best-selling specialty products.
Lowest below-wholesale prices. Imme-
diate delivery. Spectacular home busi-
ness opportunity. Free Book. SMC, 6061
De Soto Ave., Dept. 28-88, Woodland
Hills, CA 91365.

IMPORT-EXPORT opportunity, prof-
itable world-wide, mail order business
from home, without capital. We ship
plan for no risk examination. Experience
unnecessary. Free Report, Mellinger
Dept. C2694, Woodland Hills, CA 91367.

WE Pay \$1 Each Photo Done! \$12.50/
Hour. Easy! Write: Free Report, #PS-4,
3110 Fulton, Sacramento, CA 95821.

BIG Profits In becoming a supplier to
major industry through electroplating
small parts and metalizing non-metals.
Write for free particulars: Mason,
Room MC-3-JC, 1512 Jarvis, Chicago,
IL 60626.

HOW TO MAKE \$4,850 MONTHLY!
Guaranteed or \$1,000 refund! Executive
type business. Free Bonus! Write im-
mediately: Treasure, Morroson, CO
80465.

MAKE 2 TO 3 TIMES YOUR COST ON
HUNDREDS OF PRODUCTS - Gift
items, novelties, toys, carded merchand-
ise - 1001 others. For free details
write: Norman A. Patterson Enterprises,
Box 7564, Baltimore, MD 21207.

\$1200.00 MONTHLY CORRECTING
STUDENTS' LESSONS at home! Spare
time. Start immediately. No experience
required. Free report. Send self-ad-
dressed stamped envelope. Horizon, Box
1685-WBCB, Las Vegas, NV 89101.

\$100,000 YEAR running backpacking
camp. Information free. Ficker's, Box
432-PS, Oroville, WA 98844.

MAILORDER. Get The Truth. Write:
Balgenorth, Dept. PS, Box 10476, St.
Petersburg, FL 33733.

BECOME Tax Consultant - Our stu-
dents earn \$1,000-\$3,000 every tax
season preparing returns evenings. State
approved. National Tax School, Monsey,
IDM, NY 10952.

MAKE \$2,000.00 Monthly Spare
Time. Unique proven enterprise. No
selling. No capital to start. Free bro-
chure. Kashbuilder, Box 1132-PK, In-
dianapolis, IN 46225.

GET RICH! Secret law smashes
debts—Brings cash and credit. Details
free! Wealthkit, Box 350-S, Billings,
NY 12510.

AMAZING! \$265,000.00 annually
with classified ads. Proof \$1 (refund-
able). Year, 2320 Glenmore Terrace,
Rockville, MD 20850.

PLASTERCRAFT! Moneymaker! Excel-
lent Home Business! Mailway, Box
24949 EF4, Nashville, TN 37202.

EARN \$25/HOUR window cleaning.
Free details. Rainbow, Box 14533-PS4,
Spokane, WA 99214.

BIG PROFITS ELECTRONIC ASSEMBLY BUSINESS

Start home, spare time. Investment, knowledge or
experience unnecessary. BIG DEMAND assembling
electronic devices. Sales handled by
professionals. Unusual business opportunity.

FREE: Complete illustrated literature
BARTA, Box 248-SD
Walnut Creek, Calif. 94597

BUMPER STICKER PRINTING DEVICE

Simple, Cheap, Portable. Any Message in
Minutes. Send for FREE DETAILS.
BUMPER—PRESS
P.O. Box 22791 (LL)
Tampa, Fla. 33622

61 MONEYMAKING OPPORTUNITIES

LEARN The Secrets of Repairing Junk
Batteries. "Fabulous Profits", small in-
vestment. Apex Engineering, 5454 Bolsa
Road, Atascadero, CA 93422.

NEW Discovery in Battery Recondi-
tioning Means "Big Profits Fast." Elec-
toan, 7415 Gable Drive, Little Rock, AR
72205.

\$48.65 DAILY Starting next week.
No mailorder swindle or stuffing en-
velopes ripoff! For information mail 15c
poststamp: Sbiapox, Drawer 4099, Val-
ley Village, CA 91607.

TURN SPARE TIME INTO BIG
EARNINGS with investment! Hundreds
of National Companies seek men and
women for part-time, spare-time, week-
end work. Their offers are detailed in 5
issues of Opportunity Magazine and
they're yours free! Write: Opportunity,
Dept. 475, 6 N. Michigan, Chicago
60602.

\$60.00 PER HOUR LIFETIME INCOME IMMEDIATELY. Write: Williams, 10626A South Budlong, Los Angeles, CA 90044.

FEDERAL OIL LEASES, How To Compete with the Oil Barons in obtaining \$1 yearly per acre drilling rights. \$5. **OIL RIGHTS,** P.O. Box 645-B, Bronxville, NY 10708.

GOLD from rivers and streams. Details 25c. Seekay Chemical, 210 Fifth Ave., New York, NY 10010.

MAKE 25+ % from mutual funds. Free details. Thurman Smith, 213 Commonwealth 9E, Boston, MA 02116.

BIG MONEY! Interested? Free Disclosure. Febré-M, Box 6073, Toledo, OH 43614. (419) 865-5657.

MAILORDER SUCCESS! Interested? Free Expose. TWP-M, Box 6226, Toledo, OH 43614.

LET Me show you how you can have your own Rubber Stamp Business Free! Write: Roberts, Room RC-3-JC, 1512 Jarvis, Chicago, IL 60626.

\$350.00 WEEKLY! Home Program! Day, 104-P East Third, Salem, MO 65560.

ERASE DEBTS with little-known law: **CREATE** wealth! **FREE** report. Blueprints, S4, Box 100, La Grangeville, NY 12540.

SOLVE YOUR MONEY WORRIES FOREVER! Flood your mailbox with \$3500 weekly! Nothing like this anywhere! Free Proof — Free \$20 Bonus! Write Immediately! Treasure - PQ3, Morrison, CO 80465.

MAKE TOP MONEY IN STAINED GLASS

Learn at home in your spare time. Program includes your book of completely illustrated lessons — all professional tools, many interesting projects and more. All this is included in our self-study program. Every thing needed to start you on your way to success. — **FREE INFO** REGINA CAREERS LTD.—Pub. Dept. **PSG-40** 33 E. Main St., Round Lake Park, IL 60073

62 EMPLOYMENT INFORMATION

TRUTH FROM AUSTRALIA—JOBS, Incomes, Tourism—Latest Facts Book. \$4.00 bills to: Infoton, POBOX F-91, Forestville 2087, Australia.

GET A BETTER JOB! Write a Better Resume. Step-by-Step Instructional Booklet. Concise, Simple, Detailed. \$3.00: John Bute, Box 562(G), New York, NY 10013.

JOBS OVERSEAS (including Alaska). Free Details. Global Employment, Box 808-PS, National City, CA 92050.

JOURNEYMAN CREDENTIALS GRANTED LEGITIMATE! Write: National Craftsman Union, 210 Fifth Avenue, Suite 1102, New York, NY 10010.

OVERSEAS . . . \$15,000-\$50,000 +. Free Information! Employment, Box 29217-FD, Indianapolis, IN 46229.

AUSTRALIA — New Zealand! Big pay! 75,000 jobs. Free transportation. Employer listings \$2.00. Plus information 68 countries. Austco, Box 4116-F, Hayward, CA 94540.

62A HELP WANTED

PARTTIME piece work, Webster, America's foremost dictionary company needs home workers to update local mailing lists. All ages, experience unnecessary. Send name, address, phone number to Webster, 175 Fifth Ave., Suite 1101-CN-7, New York, NY 10010.

63 SPECIAL SERVICES

INFORMATION On Anything. Ferguson Research Specialists, 60-15 Woodside Avenue, Woodside, NY 11377.

66 AGENTS WANTED

EARN Extra Spending Money! Write orders for your friends and family and earn \$250/Month or more. Sell quality Mason Shoes. Absolutely no investment. Write: Mason Shoes, K-526, Chippewa Falls, WI 54729.

CANADA'S Newest Money Game. Details: Seajay Enterprises, Box 624A, Station F, Toronto, Ontario, Canada M4Y 2L8.

67 SALESPERSONS—DISTRIBUTORS WANTED

EARN BIG COMMISSIONS WORK FULL OR PART TIME!

Show big **FREE SALES KIT** featuring complete line low priced business printing and ad specialties to business people. Build profitable repeat business. Start now.

NATIONAL PRESS, INC.
DEPT. 038
NORTH CHICAGO, IL 60064

69 CONTESTS

NEVER WON ANYTHING? Anyone Can Win Sweepstakes Contests! **FREE** Details. Lawrence Enterprises, 475 W. Shaw, PS-480, Fresno, CA 93704.

71 ARTS & CRAFTS

NATIONAL ART FAIR LIST LISTS 2000 Art & Craft Fairs where you can sell your crafts. Published Quarterly - \$10.00 for one year's subscription: National Art Fair List, 300-PS South 5th Ave., Minneapolis, MN 55415.

NEW 1980 LEATHERCRAFT CATALOG! 100 Pages of Over 2100 Genuine Leather Kits, Tools, Supplies. Easy Way To Make Extra Money in Your Spare Time. Send 50c for postage and handling to: Tandy Leather Company, P. O. Box 791, Dept. PSC4, Ft. Worth, TX 76101.

ATTENTION HOBBYISTS! 50 Different Patterns for making Plaques for Tole, Decoupage, etc. \$5.95 postpaid. L. Baker, Perkins, OK 74059.

72 EDUCATION & INSTRUCTION

COMMERCIAL Art Calligraphy. Personal Corrections. Yenny, Box 1181-L, Piqua, OH 45356.

FOR the inexperienced Man or woman who has to speak publicly occasionally. Send for these helpful rules. \$2.98. Box 4322, St. Louis, MO 63123.

ELIMINATE fuel costs - Go sailing. Teach yourself how. For complete instructions send \$5.00 to: Frank Collins, P. O. Box 35, West Hill, Ontario, Canada. M1E 4R4.

LEARN PHOTOGRAPHY! Camera and Darkroom skills. \$3.50 brings Introductory Lesson. Fotomasters. Box 174, Farmingdale, NY 11735.

DRIVER HABIT-CHECK. Used to improve driver skills by more motor fleets than any other system. Send \$1.00 to: Drivers, Box 165, Grosse Ile, MI 48138.

PLAY PIANO . . . Professional "Secrets" revealed. CPI, Box 1022, Placentia, CA 92670.

MEDICAL ELECTRONICS TECHNICIAN. Join the medical team. Troubleshoot EKG's, EEG's, Ultrasound, etc. Learn a prestigious profession at home. University REM-S, PO Box 9622, Fresno, CA 93793.

50 BASIC COMPUTER PROGRAMS, including simulations, statistics, heuristics, graphics. Send \$7.98 to: T. J. O'Malley, 426 Park Ave., Dunkirk, NY 14048.

EARN Extension Degrees in Homeopathy, Radionics, Botanic Medicine, Naturopathy, Philosophy, Psychology, etc. School Founded 1961. Prospectus \$1.00. Airmailed. Secretary PA/PS, Brantridge Forest School, Highfield, Daneshill, Sussex, England RH17 7EX.

LEARN GAS TURBINES! Correspondence course covering all systems, maintenance, theory, operation. Established 1957. Valuable diploma awarded! **AMERICAN JET SCHOOL,** Department PS-1, Darby, MT 59829.

LEARN Dowsing, Radionics, Radiesthesia and E.S.P. Subjects. Free Illustrated Catalog. Courses and Equipment. (Airmailed \$2.00.) Established 30 Years: Bruce Copen, Highfield, Daneshill, Sussex, England RH17 7EX.

COLLEGE Students! Improve your grades. Send \$1.00 for 356-page, collegiate research papers catalog, 10,250 available. Research Assistance, Box 25918-Q, Los Angeles, CA 90025. (213) 477-8226.

MEMORY, Sleep Learning. Free Publication. DLP, Box 487, Anaheim, CA 92805.

BRITISH DEGREES, Diplomas, Doctorates. Obtain yours now from London, England. Commerce Philosophy Sciences, Divinity, Medicine. Over 40 subjects. Free prospectus (Airmail \$1.00 Refundable). College Registrar, Dept. 1030, BCM-Collegiate, London WCIV 6XX, England.

UNIVERSITY DEGREES! No Classes, Fast, Economical. Accredited, **FREE** Revealing Details. Success, Box 13151-S4, Columbus, OH 43213.

EARN HIGH SCHOOL DIPLOMA AT HOME FAST! State Registered. Lowest tuition available. Individual counseling. Credits awarded for job experience and previous courses. Free school ring. Call free: 1-800-327-8103. Cambridge Academy (PS-4), 409 E. Osceola, Stuart, FL 33494.

MAJORS, MINORS, SEVENTHS . . . and all 144 most used pop music **CHORDS.** Learn **INSTANT KEYBOARD RECALL,** find them all. **AUDIO CASSETTE** instruction, printed materials. Seen on 100 **PUBLIC TELEVISION** stations. \$11.95. Dr. John Fryman, Box 9802 #131-PS4, Austin, TX 78766.

BOOKKEEPING for your small business. Save hundreds. Learn basic, everyday bookkeeping yourself. Full, easy instructions. \$10.00 to Domain Investments, 6361 Buchanan Ave., Niagara Falls, Ontario, Canada L2G 3V9.

PHOTOGRAPHIC TECHNIQUES simplified to increase your skills - \$2.00. Milone, Box 4154, Miami, FL 33169.

IMPROVE JOB/SALARY—Learn Electronic Blueprint Reading—Free Details!!! Blueprints, 7131 Owensmouth, Suite B58, Canoga Park, CA 91303.

ACCREDITED, Government recognized degrees in 18 months under \$400. Rush \$5.00. Holmes, Box 3131, Commerce, TX 75428.

DEGREES, Thesis Method. Brochure, \$1. North, Box 3388, Tulsa, OK 74101.

FREE Lifetime Ordination. Become Chaplain, Missionary Evangelist, Bishop. Box 744-PS, McKeesport, PA 15134.

ELECTRONICS CAREER TRAINING By Mail. G.I. Bill, FCC License, Color TV, Broadcasting, Engineering. **FREE** School Catalog, School Rep will try to call. Write Cleveland Institute of Electronics, Inc. (CIE), Dept. WPS-58, 1776 East 17th Street, Cleveland, OH 44114.

COMPLETE YOUR DEGREE REQUIREMENTS VIA INDEPENDENT STUDY WITHOUT Class Attendance. Resident faculty ready to assist you. Degree programs in Business, Engineering, Education, Social Sciences. Kensington University, 512 East Wilson Avenue, Box 2036, Glendale, CA 91209. Dept. 728.

BARTENDING — Bar Management Home Study. Bartending Training, 3843-G San Fernando Road, Glendale, CA 91204.

ELECTRONICS Degree (BSET) by correspondence. Grantham College, 2500 La Cienega, Los Angeles, CA 90034.

LEARN WHILE ASLEEP! Astonishing New Method! Strange Catalog Free! Autosuggestion, Box 24-A, Olympia, WA 98507.

WELDING TRAINING. Basic and Advanced for Major Processes — Arc (Stick), MIG, TIG, Gas, Pipe all processes. A non-profit school. Accredited member NATTS. Approved Ohio 70-12-0064 HT. Write for school bulletin and course schedule. **HOBART SCHOOL OF WELDING TECHNOLOGY,** Box 80, Troy, OH 45373.

UNIVERSITY DEGREES BY MAIL! Bachelors, Masters, PH.D.s . . . Free revealing details. Counseling, Box 389-PS4, Tustin, CA 92680.

STUTTER?

BREAK THAT HABIT NOW! Learn Fluent, Normal speech. Easy self-study corrects stammer or stutter habit. Amazing results by correspondence since 1935! Speech Pathologists certified by Florida Commissioner of Education. Money refundable if not helped. Free details. Write today: Emery Institute, Box 867-PS4, Winter Park, Fla. 32790.

INSTANT MEMORY

The new way to remember
A short, simple method of acquiring a powerful memory. No memorization, no keywords. Release your photographic memory. Learn "how" you remember, "why" you forget. Discover your natural ability to recall everything. Send for free information to:
INSTITUTE of ADVANCED THINKING
859PS ViaLaPaz, Pacific Palisades, CA 90272

73 CARTOONING, SIGN PAINTING

LEARN Sign Painting—Free Catalogue. Kaufmann Supply, Centertown MO 65023.

MODERN Cartooning Taught by Mail Write for Free Brochure. Cartoonorama Box 263-AL, Branford, CT 06405.

CARTOON for money!!! Free Book Success, Box 885B, Dearborn, MI 48121.

LEARN Cartooning. Fun or profit. Cartooning, Box 7069A, Colorado Springs CO 80933.

76 DETECTIVES

DETECTIVE Profession, easy home study; free tie-tack or lapel pin, certificate, future. Professional Investigators Training School, Dept. CB, P.O. Box 1890, San Pedro, CA 90733.

FINGERPRINTING - exciting scientific career. Home study course teaches everything. Certificate on completion. Many openings; prepare now. Professional Investigators Training School Dept. FP, P.O. Box 1980, San Pedro, CA 90733.

BE A PRIVATE INVESTIGATOR **LEARN** our trade secrets. No gimmicks. My brochure shows you how simple it is. I guarantee you it's easier than you think. We make \$200 per day plus expenses. Send \$3 to: Private Investigators, P. O. Box 551, Wood Dale IL 60191.

77 LOANS BY MAIL

IMMEDIATE Loans and Outright Grants to individuals refused elsewhere 98% Accepted! Associates, Box 98-P3 Brooklyn, NY 11235.

BORROW FROM HOME **ANY** amount, any purpose, within 30 days. Competitive rates. Also, you can earn unlimited income as our Money Agent. No experience - own hours. National Company to assist every way possible. No Gimmicks! Free Details! Financial, Dept. 11-C-4, 1145 Reservoir Avenue, Cranston, RI 02920.

QUICK \$CASH\$ Signature Loans Write: NAA, 507 - PS Fifth Ave., New York 10017.

BORROW \$25,000 "overnight." Any purpose. Keep indefinitely! Write: Success Research, Box 29263-FD, Indianapolis, IN 46229.

78 WINEMAKING

WINE From Grocery Store Materials For Recipe send \$5.00 to: Obenaus Famous Wine, 117 Peterson Road, N Muskegon, MI 49445.

FREE ENCYCLOPEDIA WINEMAKING BEERMaking, supplies, equipment, ingredients. Vynox Industries, Box S7498, Rochester, NY 14615.

BREW Delicious Continental Beer and Save. Free Catalog and Recipes. Bachanalia, Box 1-PS, Dartmouth, MA 02714.

WINE/Beer Making Catalog - \$1.00 refundable. 1845 S. 19th, Springfield IL 62303.

MOONSHINE MANUAL, plus Gasohol Guide. Both only \$2.00. Gourmay, 5133 Fairhill, Philadelphia, PA 19120.

WINEMAKERS—BEERMakers Free Catalog. Fast Service. Large Selection. Kraus, Box 7850-N, Independence, MO 64053.

WINEMAKERS — Beermakers. Free Catalog. Equipment Supplies. Continental. Box 68016-PS, Indianapolis, IN 46268.

WINEMAKERS - Beermakers: Free Illustrated catalog of supplies. Semplex P.O. Box 12276H, Minneapolis, MN 55412.

BEER — Winemaking Supplies. 42 Imported Malts. Catalog. Wine Hobby, P.O. Box 1866, Allentown, PA 18105.

BEERMAKERS, Winemakers, Free Catalog, Recipe, Finest Ingredients, Equipment, Service, SPI, Box 784-S, Chapel Hill, NC 27514.

99 BUY IT WHOLESALE

REPLACEMENT PARTS for Chainsaw, Motorcycle, Snowmobile, Small Engines. Wholesale prices. 48 hour shipment. Free Catalog. Manufacturer's Supply, Box 157PS, Dorchester, WI 54425.

400,000 BARGAINS Below Wholesale! Many Free! Liquidations... Closeouts! Job Lots... Single Samples. Free Details. Worldwide Bargainhunters, Box 30-B, Holland, MI 49423.

100 ADVERTISING AGENCIES & SERVICES

EXPERT Assistance for mailorder, advertisers. Ratebook leading newspapers, magazines \$1.00. Chicago Advertising Agency, 28-ES Jackson, Chicago 60604.

103 RUBBER STAMPS & OFFICE SUPPLIES

RUBBER Stamps for business, professional or personal use. Three Lines \$5.75 plus ink pad. Wright-PS, 11531 Loomis, Chicago, IL 60643.

RUBBER Stamp Catalog \$1.00, Returnable. Business Cards. Youngers Stamp Shop, Princeton, IA 52768.

RUBBER Stamps. Free Catalog. Jackson's, Brownsville Rd. G-100, Mt. Vernon, IL 62864.

105 PRINTING & RUBBER STAMP OUTFITS

PRINT YOUR OWN — Printing Presses. Type, Supplies Direct From Factory. Send 25c for Catalog and Samples to: Kelsey Company, DS, Meriden, CT 06450.

SIMPLE-X RUBBER STAMP PRESSES. Hydraulic Operated. Electrically Heated. Sizes 5"x8", 8"x12", 10"x15". Starting Outfits. Order for Presses. Supplies Shipped Day Received. Send \$2.00 for Catalog and Brochure. Custom Manufacturers, Box 211-PS, Springfield, MO 65801.

106 RAZOR BLADES, SHAVERS

FOR ELECTRIC SHAVERS. Amazing Liquid Sharpener & Lube Now Available. INJECT-AN-EDGE sharpening compound sharpens any electric shaver — single or multiple head, rotary or conventional. Simply apply, run shaver 1 minute & blades turn sharp like magic. Comes with separate Inject-A-Lube. Also sharpens electric hedge trimmers & carving knives. Only \$5.98 each "Edge & Lube" Kit & \$1 post. & hdlg. 2 kits or \$9.98 & \$1.50 post. & hdlg. Res. of CA, CO, FL, IL, NY, PA, VA, VT, WI add applicable sales tax. Order from Popular Science Inject-An-Edge, Dept. 180-C, P. O. Box 5220, Grand Central, New York, NY 10017.

108 OLD GOLD, JEWELRY WANTED

GOLD - Silver - Platinum Wanted. For free information write: Wilmore, 445 S. Glassell, Orange, CA 92666.

HIGHEST CASH for Gold, Jewelry, Gold Teeth, Rings, Diamonds, Watches, Silver, Platinum, Mail Articles Today. Free gift with information. Chicago Gold & Precious Metals, 6 E. Monroe, Dept. 857, Chicago 60603.

BUYING Gold - Silver! Free Details! Reliance, 50-PS4 Margin, Salem, MA 01970.

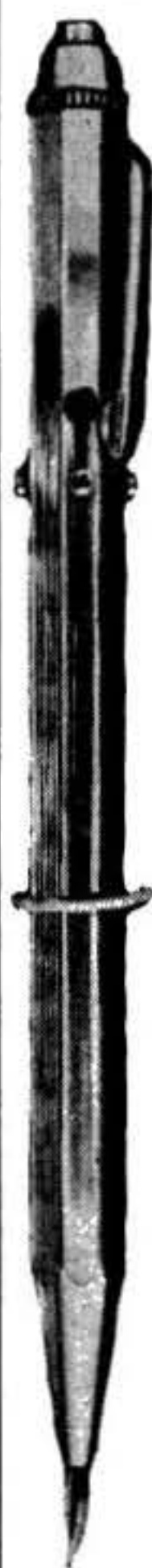
109 WATCHES, CLOCKS— SALES & SERVICE

WATCH and Clock Repairing Books, Tools, Materials. Free Catalogs. North American, Box 77-BQ, Fox River Grove, IL 60021.

110 GIFTS

FREE! EXCITING New Gift Catalogs! IL Gift House, 3618-ps South Francisco, Chicago, IL 60632.

GREAT GIFT IDEA A HANDFUL OF INSTRUMENTS!



Give 5-in-one, and then some... Selecto 5 Plus! A multi-purpose chrome-finished retractable instrument in the form of a pen.

Features:

- Solid tungsten-carbide tipped precision engraving tool. Etches on glass, metal, plastic, etc., to identify your valuables.

- Sharp double-ground knife blade for clippings, trimming, paste-ups and more.

- Retractable, adjustable lead pencil.

- Blue ball point pen.

- Powerful magnet at top of instrument.

PLUS, red writing pen to be interchanged with engraver! PLUS 4 Pen refills! A gift that is one of a kind. Attractively boxed.

Only \$17.95 each + \$2 insured shipping & handling. Visa & Master Charge accepted (give full account number & exp. date). Res. of CA, CO, FL, IL, NY, PA, VA, VT, WI add applicable sales tax.

POPULAR SCIENCE SELECTO 5 PLUS

P. O. Box 5115-AP, Grand Central Station, New York, NY 10017.

91 OF INTEREST TO ALL

AUTOMOTIVE CONSUMERS — This 50 page guide tells where to get swift action on any auto complaint, Government, Media, and Industry sources. \$2.45 to Guide, P.O. Box 23291, L'Enfant Plaza, Washington, DC 20024.

25 HEALTHFUL, Delicious Whole Wheat Recipes. \$2.50. Box 35A RFD, Coalville, UT 84017.

SAVE your driving dollars with detailed mileage comparisons. Send \$5.00 to: Driving, Box 817, Manchester, MO 63011.

92 MODELS—SHIPS, CARS, PLANES, ROCKETS

STEAM ENGINES — Handcrafted in Brass. Brochure 50c. Havelock-Engine Works, Box 223, Parkville, NY 12768.

BUILD museum-quality ship models, gun models, dollhouse room settings. 1980 Model Catalog features complete kits, fittings, plans, construction materials, tools, "How-To" books. 88 pages. Only \$1.00. James Bliss & Company, Dept. PS, Route 128, Dedham, MA 02026.

94 FOR INVENTORS

NONPROFIT foundation helps inventors. Widest range of services. Free recording forms. Free evaluation. Affiliated Inventors Foundation, 501-A Iowa, Colorado Springs, CO 80909.

PATENT ATTORNEY—Serves Inventors By Mail. Box 405, Medfield, MA 02052.

PATENT IT ECONOMICALLY! Free details. N. Rainer, 2008 Fondulac Rd., Richmond, VA 23229.

IDEAS, inventions, new products needed by innovative manufacturers. Marketing assistance available to individuals, tinkerers, universities, companies with feasible concepts. Write for Kit-PS, IMI, 701 Smithfield Street, Pittsburgh, PA 15222.

NEW! "Patenting Your Invention Yourself." \$29.95. Patent Attorney, 7400-PS Benjamin Franklin Station, Washington, DC 20044.

CHEAP PROTECTION for your ideas. Inventor's Logbook. Verification format, permanent binding; moneyback guarantee. \$14.95. JorJan, Box 405PS, Ellensburg, WA 98926.

REGISTERED PATENT ATTORNEY. Applications and Searches. Mail Service. Free Preliminary Review. Box 392, Millwood, NY 10546.

INVENTORS - Patent Your Invention. Free Initial Consultation. We are registered by the U.S. Government. Victor J. Evans & Co., 4637 Eastern Ave. N.E., Washington, DC 20018. Since 1898.

95 INVENTORS WANTED

INVENTORS: Free information on offering your invention for sale. Kessler Sales Corporation, C-74-IW, Fremont, OH 43420.

WE BUY inventions, ideas. Quick reply. Send general description. No secrets. Hill, P O Box 312, Syracuse, NY 13209.

MANUFACTURER SEEKING INVENTIONS. ADVANTEK INTERNATIONAL, 1100 17th NW., WASHINGTON, DC 20036.

INVENTIONS WANTED

FREE CONSULTATION • NO IDEA TOO SMALL Disclosure registration. Potential cash or royalties from manufacturers seeking new ideas. For free information on how to register your ideas. Call or Write

American Inventors Corp.

59 Interstate Dr. Dept PS
West Springfield, MA 01089 (413) 737-5376
A Fee Based Marketing Company

97 GOOD EATING

SMOKE Houses - Plans plus Recipes of European Sausages, Meats, Curing and Smoking. \$6.00 U.S. J.H.M. 6536 W. Gunnison, Chicago, IL 60656.

100 WANTED TO BUY

QUICKSILVER, platinum, silver, gold! Ores analyzed. Mercury Terminal, Norwood, MA 02062.

102 TREASURE FINDERS, METAL DETECTORS

GOLD — Get with Drywasher. Book with Plans \$20.00. S. Alford, Rt. 1, Roosevelt, MN 56673.

GOLD-TEST! For any rock or ore will prove if gold is present. Instructions \$6.95. Geological Explorations, Jacksboro, TX 76056.

FIND old coins, jewelry, gold nuggets. New patented revolutionary device. Free catalog. Gardiner, 4729L N. 7th Ave., Phoenix, AZ 85013.

BURIED TREASURE

Locate from a LONG DISTANCE with Ultra-Sensitive DIRECTIONAL Locator SEND FOR FREE INFORMATIVE BROCHURE RESEARCH PRODUCTS BOX 13441-H TAMPA, FLORIDA 33611

104 VACATIONS, RESORTS, TRAVEL

YOUR PERFECT TRAVEL COMPANION

The North American Road Atlas from Gousha, for over 50 years the nation's foremost road map publisher. Beautiful, full-color, 128-page easy-to-read atlas covers U.S., Canada & Mexico. Even includes maps of 212 cities. Major parks, historic sites & points of interest clearly marked. Mileage charts, too. You'll find it the best road atlas you ever owned. Order directly from Popular Science for just \$3.95 + \$1 postage & handling. (Residents of CA, CO, FL, IL, NY, PA, VA, VT & WI, please add applicable sales tax.) Popular Science Road Atlas, P. O. Box 5115-AP Grand Central, New York, NY 10017. Quantity prices (50 or more) on request.

105 MISCELLANEOUS

PROBLEMS SOLVED. \$100.00. Payment on satisfaction. The Psychic, Box 711, Nantucket, MA 02554.

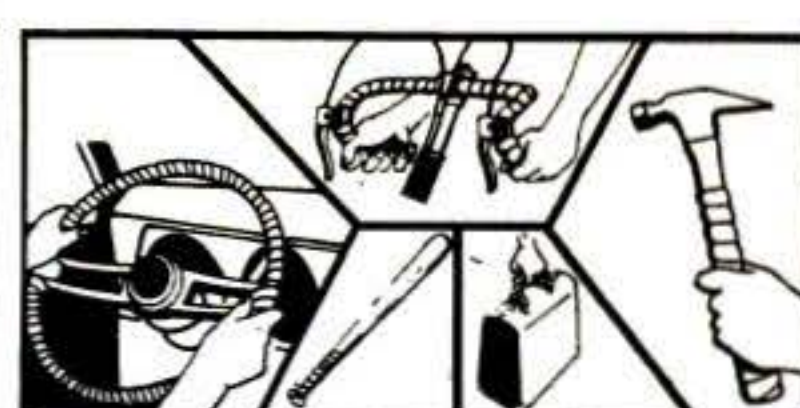
AMAZING Magnet. North Pole each end. 2"x3/16" Alnico rod \$2.99. Dorad Magnet, P.O. Box 1204, Indianapolis, IN 46206.

ORNAMENTAL Iron designs. Book of 1600 beautiful practical designs for railings, columns, etc. Free literature. Cunningham, 3881 South 3200 West-P.O. Box 2005-S, Salt Lake City, UT 84120.

IDENTIFICATION Card Catalog, Free. Nipcos, 303 East Main, Barstow, CA 92311.

FREE BOOK. Prophet Elijah Coming Before Christ. Megiddo Mission, Dept. 58, 481 Thurston Road, Rochester, NY 14819.

PROFITS in the Stock Market. Facts and proven method. Send \$4.95 to H. Messler, P.O. Box 123, Montgomeryville, PA 18936.



AMAZING NEW CUSHION GRIP TAPE EATS UP VIBRATION OF TOOLS, MACHINERY, SPORTING EQUIPMENT!

Vibration virtually disappears with miracle cushion-grip tape on hand tools, bicycles, all types of rackets, bats—hundreds of sporting uses. Laboratory-developed to imitate softness of human hand. Washable & weather resistant. Black. Only \$4.95 (+ 75¢ post. & hdlg.) per 14 ft. roll, \$3.95 ea. (+ \$1 post. & hdlg.) 2 or more rolls. Res. of CA, CO, FL, IL, NY, PA, VA, VT, WI add appropriate sales tax.

POPULAR SCIENCE CUSHION TAPE

Dept. 480, P.O. Box 5220
Grand Central
New York, NY 10017

106 PERSONAL

MONEY Management Letter "After Taxes" — \$2.25. P.O. Box 875, Griffin, GA 30224.

INVESTIGATORS. Latest Electronic Aids. Write: Clifton, Box 220-F, Miami, FL 33168.

TOTAL Mind Power (How to use the other 90% of your mind). Free Booklet. Total Mind Power Institute #18, Larkspur, CA 94939.

LINT PICKER REMOVES Lint and Hair from Clothes. Quick, Easy, Disposable. 20/\$5.00. FJW, P.O. Box 119, Pennsauken, NJ 08110.

ASTROLOGY Personanalysis - \$12.00. \$20.00 for Two, plus chart comparisons. Send date, exact time of birth. Astroanalysis, P.O. Box 854, Pisgah Forest, NC 28768.

A COMING Whirlwind to sweep this earth! Free Information! Write: Harvest, PS, Jefferson City, MO 65102.

BE Ordained Minister - \$10.00 Donation. Perform Marriages, etc. Legal Credentials, World Church, Route 2, Goodlettsville, TN 37072.

COLLEGE DIPLOMAS WITHOUT CLASSES. Accredited Degrees by Mail. Free Details. EACS, Box 33428, Seattle, WA 98133.

UNIVERSITY DEGREES BY MAIL. Legal, Fast, inexpensive. Free revealing details, Counseling, Box 389-SP4, Tustin, CA 92680.

CERTIFICATES, Documents (all kinds) Guaranteed! Authentic!! Catalogue 25c: LTD Documents, Box 3910-A9, New Hyde Park, NY 11040.

DATING SECRETS! Would you like to know? SST, 6903B New Utrecht Avenue, Brooklyn, NY 11228.

ADVANCED TITLES/DEGREES Ministers, Honorary Doctorates, other Services available. Omnidenominational. Free Details. Acquarian Church, 432-PS PCH, Hermosa Beach, CA 90254.

FREE HEARING AID CATALOG - Save 1/2 by Mail! Write: "MONEYSAVERS", 9530-PS4 Langdon, Sepulveda, CA 91343, Not sold in California.

106A HAIR CARE

STEP By Step Professional Method to Hairstyling. Easy to Read Instructions and Illustrations Will Have You Cutting Like A Professional. Send \$14.95 to: Marilungo Industries, P. O. Box 22012, Cleveland, OH 44122.

107 HEARING AIDS

HUGE SAVINGS. Eliminate dealer markup. Free Trial, Batteries wholesale. Terms Arranged. Lloyds-PSC, Rockford, IL 61104.

HEARING AIDS 1/2 PRICE CATALOG FREE!

SUPER SAVINGS! Newest. Finest. All types. Buy DIRECT & save up to HALF! No salesmen. Sold by AIR MAIL on HOME TRIAL. FREE Catalog. Write: MONEYSAVERS, Dept. PS-4D, 9530 Langdon Ave., Sepulveda, Cal. 91343
Not sold in California.

Subscriptions cut to \$2.97! mind-boggling announcement

Publisher slashes price to
celebrate Tenth Anniversary

By **R. GINZBURG**

NEW YORK

Moneysworth, the monthly magazine, has stunned the publishing world by announcing an offer of full-year subscriptions for \$2.97. This is as little as some magazines charge for a single issue.

"We're doing this to celebrate our Tenth Anniversary," a spokesman said, "and to solidify Moneysworth's position as America's Number One Biggest Magazine Bargain. Ever since it began publication in 1970, Moneysworth has consistently lowered subscription rates, while other periodicals have raised theirs. We started out at \$10 a year and now are offering Tenth Anniversary Special Subscriptions at *THE UNREAL PRICE OF ONLY \$2.97!*"

Moneysworth, which tells how to get the most for your money and the most out of life, is read by an estimated 5,000,000. Its chief competitors are Consumer Reports, which sells for \$12 a year, and Money magazine, for \$14.95.

How to place your order

Readers of this magazine who wish to take advantage of this unparalleled offer should send their name and address with \$2.97 to: Tenth Anniversary Special Subscriptions, Moneysworth, General Post Office Box 7777, New York, NY 10001.

Typical of the savvy, wallet-fattening articles Moneysworth prints are these:

Recession-Proof Jobs

Cars that Are Stingiest with Gas

Earn Top Interest on Your Savings

Canada's FREE Land Giveaway

How to Cope with Dunning Letters

How to Qualify for Food Stamps

The Long and Short of Hair Transplants

How to Collect Social Security from the

U.S. and Canada—BOTH

Are Hay Fever Shots Pointless?

Mercedes' New "Lifetime" Car

States with Best Unemployment Pay

How to Avoid Alimony

The Kinds of Cars Mechanics Own

How to Stop Snoring

Prosperity in Alaska

How to Hold On to Your Auto Insurance

Landing an Executive Job After 40

How to Turn Boxtops into Gold

Contact Lenses that CURE Poor Vision

Happiness Is a Hick Town

A Gourmet's Guide to Free Cookbooks

How to Reduce Exorbitant Doctor Bills

Air Travel at 50% Off

Today's Soldiers Command High Pay

Low-Cost Insurance for Non-Smokers

Mattresses to Turn Handsprings Over

How to Save 20% on Your Food Bill

Scholar Dollars for the Middle Class

Where Retirement \$\$ Goes Farthest

The "Yurt": Incredible \$350 House

How to Get 7 Bestsellers for Price of 1

Ski Areas Without Steep Prices

How to Burn Wood Efficiently as Fuel

Resumes that Get Jobs

How to Travel and Get Paid for It

Fifteen Fabulous Free Maps

Don't Sneeze at This Cold Remedy

How to Get a Low-Cost Divorce

Starting a Retirement Business

The World's 100 Best Free Calendars

The Only Diet that Really Works

Sailboats that Are Real Winners

Getting a Job as a Forest Ranger

The Amazing New Two-Engine Car

As you can see, Moneysworth is an easy-to-follow instruction manual for building a better life.

Each day, its editors are inundated with ecstatic testimonials like these:

• "You're not going to believe this, but I have parlayed \$146 into \$90,000 due to your informative article on how to break into real estate. How can I ever express my gratitude sufficiently?"
—H. Pinrose; Montgomery, Iowa.

• "Your advice on Social Security resulted in a \$3,135 lump-sum cash payment to my wife and \$171 monthly pension. The best investment I ever made was my subscription to Moneysworth."
—Dr. Herman Hortop; La Grange, Ill.

• "Your tip on flying to Europe via the Middle East saved me \$450. You've made me a subscriber for life."
—Chas. B. Fager, M.D.; Harrisburg, Pa.

• "Your article on high interest paid by foreign banks has enabled me to retire in style. I cannot thank you enough."
—E. Svenson; Fallbrook, Cal.

• "Your news reports on investments have brought me, in just months, \$12,996 profit, tripling my money. You can bet I shall be a Moneysworth subscriber for life."
—L. Gray; Ypsilanti, Mich.

• "Your article 'Inaccurate Billing by the Phone Company' led me to discover four years of overcharges. I got a \$1,593 refund!"
—A. DiRienzo; Bristol, Pa.

• "Your article 'How to Avoid Paying an Exorbitant Doctor Bill' saved me \$65. Here's my subscription extension."
—C. Wagner; Yorktown Heights, N.Y.

“This Tenth Anniversary Special Subscription Offer is highly recommended to the readers of this magazine”

• "Thanks to your article 'How to Buy a New Car for \$125 over DEALER's Cost,' I just bought a Chevy at a saving that I conservatively estimate at \$350."
—Rudy L. Grange; Anita, Iowa.

• "Moneysworth is aptly named. To paraphrase Churchill, never have so many paid so little for so much."
—Dave Alpern; Pittsburgh, Pa.

To take advantage

To take advantage of this *GIVEAWAY* offer, readers of this magazine should send their name and address with \$2.97 to: Tenth Anniversary Special Subscriptions, Moneysworth, General Post Office Box 7777, New York, NY 10001.

(Note: There is a limit to the number of years that may be ordered under this special rate. No subscription may exceed three years—at \$8.91.)

If ever a publication was accurately named, it's Moneysworth. This offer is highly recommended.



The first new truck of the 80's...

TOUGH NEW 1980 FORD

with the best gas mileage rating of any American-built standard pickup.*

Ford totally redesigned its pickups to help meet the fuel needs of the 80's: **19** MPG EPA estimate, 29 MPG highway estimate* No other American-built standard pickup has ever achieved such a mileage rating. Plus Ford has the longest estimated range of any 1980 pickup.

Tough '80 Fords give you more payload capacity than last year's models with comparable GVWR's. An all-new cab. Exclusive Twin-I-Beam front suspension. Aerodynamic styling. And more.

See all the new 1980 pickups at your Ford Dealer. New 4x4's with Twin-Traction Beam independent front suspension. Rugged new Six-Wheeler. Roomy new SuperCab.



All-new cab interior. More leg room than last year. New instrument panel. New anti-theft features like locking steering column, inside hood release. New options include AM/FM stereo with 8-track or cassette player, underhood tool box.

BEST GAS MILEAGE RATING
of any American-built
standard pickup

19 EPA
EST. MPG* **29** EST.
HWY. MPG*

Standard 4.9L (300 CID) Six with optional overdrive transmission.

LONGEST RANGE

722 **1,102**
EST. MILES HWY. MILES

Std. 72L (19-gal.) tank plus opt. 72L (19-gal.) auxiliary tank (on LWB Style-sides only). Total: 144L (38 gals.).

*EPA estimates. Compare these estimates with others. Your mileage and range may differ depending on speed, distance and weather. Actual highway mileage and range will probably be less than estimated. California estimates lower. Diesels and car-trucks excluded.

**America's best-selling truck line
for the 3rd straight year.**

(Based on 1979 retail deliveries)



FORD

FORD DIVISION



Copyrighted material

Rich Lights

from Viceroy



The rich low 'tar.'

There's never been a low 'tar' with richer taste.

Only 9mg 'tar'

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

9 mg. "tar", 0.8 mg. nicotine av. per cigarette by FTC method.