

SEPTEMBER 1980 \$1.25

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# Popular Mechanics

**PM's CUSTOM PHOENIX:**  
How to turn your stock  
car into a show car

**COMPLETE PLANS:**  
Kids' art desk  
that never  
runs out  
of paper

**BEST HOME  
TELESOPES**

**2,000,000-MILE REPORT**

**VW RABBIT:**  
Owners say U.S.  
model is better  
than Germany's

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**NOW: Fireplace booster  
for a home solar-heat  
system...and much more!**

**'81 CARS: FIRST LOOK**  
■ AMC's 4wd 'Eaglets'  
and Renault R18i  
■ Dodge Aries  
■ Plymouth Reliant



## SKY-HOOK TAKEOFF

**Dramatic new concept  
for launching fighters**



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Kings, 9 mg. "tar", 0.8 mg. nicotine av. per cigarette by FTC method;  
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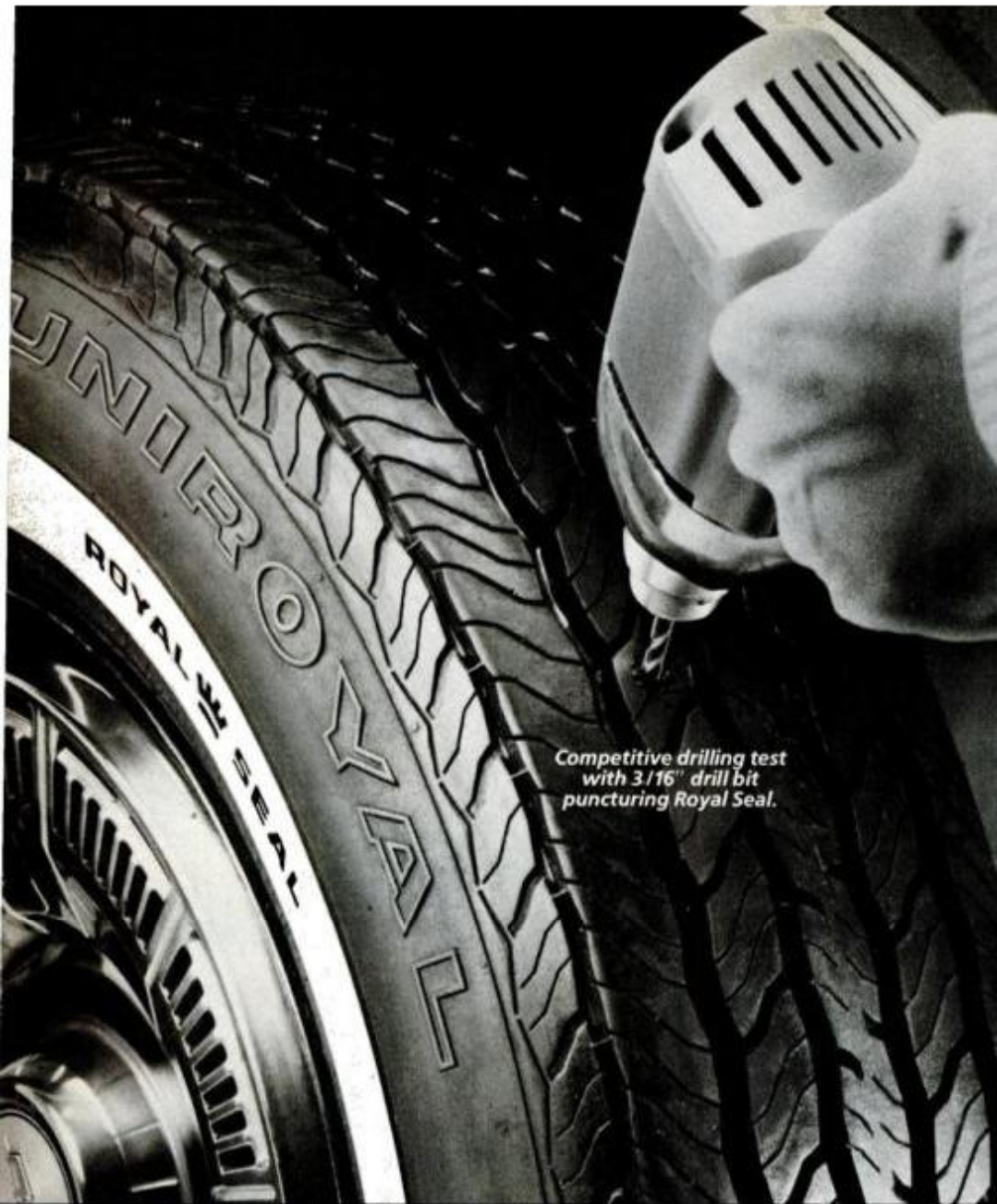
Kings & 100's

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





Competitive drilling test with 3/16" drill bit puncturing Royal Seal.

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After 15 minutes. Flat.

GOODRICH  
After 15 minutes. Flat.

MICHELIN  
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When you're looking for the right tire, remember the test that proved Uniroyal best. When you compare us for quality or compare us for price...you'll buy the tire that won't leave you flat. Royal Seal.

This One



17QU-AGZ-6Y10

**WHEN YOU COMPARE, YOU WANT UNIROYAL THERE.**

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The Royal Seal is available at Cadillac, Chevrolet, Buick, Pontiac, Oldsmobile, Ford and Lincoln-Mercury and Uniroyal dealers.



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EVEN THE SKY SEEMS TO SAY  
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**JOHNNIE WALKER RED**  
THE RIGHT SCOTCH WHEN ALL IS SAID AND DONE.



Минимум алкоголя и максимум вкуса





### On the cover

After years of expensive aeronautical research, the secret for an operational fighter with full vertical takeoff capability may be the simple insertion of a workaday helicopter—plus a cable launch/retrieve system—as the vertical propulsion factor. Read about this new concept beginning on page 104 in this issue.

—PM painting by Ed Valigursky

# Popular Mechanics

SEPTEMBER 1980

CONTENTS

VOLUME 154 NUMBER 3

INTERNATIONAL EDITIONS: CARIBBEAN, ITALY, MEXICO, SOUTHERN HEMISPHERE

## Special features:

### First look at the '81 cars

How the fight to stem the import tide will shape up; plus, inside look at Plymouth Reliant and Dodge Aries; driving AMC's Eaglets and Renault R18i.

**75**

### Annual Home Energy Guide

Special 36-page section includes tips on wood burning to upgrade fireplace efficiency, newest solar-heat designs, best energy-saving ideas from PM readers and lots more.

**115**

### PM's custom Phoenix

How selection and installation of options turned a stock Pontiac into an eye-catching custom car.

**94**

### Satellite TV at home

Antenna kits let you pull in worldwide signals right now.

**112**

### PM Owners Report

After 2 million miles, VW Rabbit owners say domestic hare is their dish.

**92**

### Automobiles and bikes

- 12 Imports and Motorsports
- 20 Detroit Listening Post
- 28 The PM Garage
- 35 Saturday Mechanic: Repairing GM's High Energy Ignition system
- 42 Car Clinic
- 75 Detroit '81: Beginning of the end of foreign domination?
- 76 Chrysler's special K formula for success
- 78 PM looks under the hoods of the new Chryslers
- 80 Driving the new AMC Eagles and the Renault R18i
- 92 PM Owners Report: VW Rabbit
- 94 PM's customized Pontiac shows how to turn your stock car into a show car
- 108 Plug in or fill up?

### Home and yard

- 22 Painless way to use a shovel
- 30 Homeowners' Clinic
- 64 PM looks at auxiliary heater
- 66 Appliance Clinic
- 102 Create an unusual room with strips of wood

### Electronics, radio and TV

- 8 PM Electronics Monitor
- 63 PM previews the Heathkit GR-4000 projection TV
- 90 Today's telephones: Too smart to just ring!
- 110 Look before you build
- 112 Now: Receive home TV directly from satellites

### Aviation

- 104 Up, up and away

### Photography

- 170 Photo hints

### Every month

- 6 Letters
- 14 Notes from the Editor
- 69 PM Briefs

### '81 HOME ENERGY GUIDE

- 115 Cover
- 117 A fireplace boiler helps the sun heat this new house
- 120 Where to go for solar help
- 122 The art of burning wood to get more heat
- 128 Install a fireplace insert and keep more heat in your house
- 130 5 ways to get more heat from a furnace
- 138 6 new products to save energy
- 145 Energy-saving tricks
- 150 Heat pump for cold climates

### Shop and crafts

- 15, 23, 168 Hints from readers
- 27 PM Workbench
- 50 PM looks at Spitfire propane torch
- 60 New Now for home and shop
- 98 Build the art desk that never runs out of drawing paper
- 100 PM's portable lectern goes with the speaker
- 101 PM looks at a compact bandsaw
- 114 Workshop Minicourse: Portable circular saw
- 190 How to avoid the 6 most common hand-tool mistakes

### Science and engineering

- 52 Science Worldwide
- 82 See more of the sky than ever with these sensational 'scopes
- 104 Tech Front Lines
- 106 Bowl power
- 155 How to tap the energy under your back yard

### Boating and outdoors

- 32 New Now: Boating
- 46 New Now: Camping
- 48 All Outdoors
- 86 New add-ons to go off-road in style

### Worth writing for

Looking for more ideas and information? See page 144.

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# LETTERS TO THE EDITOR

## A cut above

The article *Hand Mowers: Keep Your Lawn and Yourself in Shape* (Mar. '80, page 146) reminded me of an old mower that had been stored away since 1957. Thanks to your advice, it looks and works as good as or better than new. I think I have found a new hobby: buying old, rusty mowers at auctions and garage sales for next to nothing and then selling the reconditioned mower for a nice profit.

ORLO C. BURCH  
OLD FORGE, N.Y.

## Alive and, well. . . .

Congratulations for what is probably the most asinine, immature and insensitive title I have ever seen in a major magazine: *World War II in the Air Is Alive and Well* (June '80, page 96). The title was stupid and not deserving of a publication of PM's worth.

C.W. JOHNSON  
STUDIO CITY, CALIF.

## Table fable

In the July '79 issue, you featured complete plans for a classic oak dining table (*Build a Classic Oaken Table*, page 92). The table in the accompanying photo was made as a first project by a 17-year-old high school



Larry Zimmerman's table, from PM plans.

senior, Larry Zimmerman. The grading and work are superior.

MRS. LYLE ZIMMERMAN  
STERLING, ILL.

*Looking at the photo, we agree. Thanks for sharing it with us.*

## Corrective vision

In the June issue in the caption on page 97, you identify "A flight of four P-51 fighters . . ." that are shown on page 96. As an ex-Marine Corps pilot of some vintage, I'll bet that those are SNJs, or AT-6s as the Air Force called them.

PETER G. JOHNSON  
PARK RIDGE, ILL.

*Pilot Johnson's eyes are still fit. Those are AT-6 trainers, as other PM readers noticed. The planes had immediately followed a flight of Mustangs into the field; the photographer mislabeled the frames.*


## A lot of rot

On page 167 of the March issue (*Protect Against Rot and Insects With Pressure-Treated Wood*), the wording under "When you go to buy" should read: "Pieces designated LP-2

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YOU NEW OILS  
HAVE A RIGHT TO STAND TALL!  
LOOK SHARP! YOU'RE RATED "SF."  
THE HIGHEST RATING GIVEN  
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D.M. DILBECK  
TIMBER PRODUCTS INSPECTION INC.  
CONYERS, GA.

### Nothing new under the sun

Everyone seems to be talking about solar energy, but it looks like PM has been publishing information on solar water heaters for some time. As early as May, 1930, you ran a story on how to build a thermosiphon solar water heater (*Water Heater for Sunny Climes*, page 875). Perhaps this will jog a few memories.

RALPH J. LEWIS  
KENILWORTH, ILL.

*PM has been and always will be committed to making the latest technology accessible to readers.*

### Let the sun shine in

I have essentially the same solar hot-water system as that on page 84 in the June issue (*Don't Get Burned By Solar Rip-offs*). It works fine, but I learned the hard way that there had better be a one-way check valve between pump and collector. The system will thermosiphon at night and radiate away collected energy

unless just such a valve is installed.

ED VERPLOEGH  
CORRALES, N.M.

I was very disappointed by the totally negative slant of the article. I felt it left the impression that the people in the industry are not to be trusted. We need much more said about the positive aspects of solar. Bad news travels faster than good. So how about some articles on the good side of this industry?

MICHAEL H. JUNG  
PORTAGE, WIS.

The solar rip-off article is illustrated with an inferior system. Water in the preheat tank should be in series with the conventional hot-water tank: the coil should be in the solar-collector loop.

W.A. BERGLUND  
BYRON, MINN.

*The system we showed would not necessarily thermosiphon, but the check-valve idea is good. The article did not have a negative slant; we specifically stated that a good solar system can save 80 percent of fuel bills. It would be irresponsible, however, to ignore obvious shortcomings of the*

industry. PM has been writing about solar-energy systems since at least 1930.

*As for the "inferiority" of the system we illustrated, it was taken almost completely from a Department of Housing and Urban Development publication. It was not intended as a blueprint but rather as an example. Solar systems differ widely in many aspects of their design. One correction: Abraham M. Genen's correct title is Senior Consumer Fraud Representative for the state of New York.*

### He's grateful

Just a belated thank you for the hundreds of dollars you have saved me through the answers in *Car Clinic*. On at least two occasions, your reference to a manufacturer's bulletin has given my dealer the accurate information needed to handle the problem.

W.H. BRUNNER  
ST. PAUL, MINN.

### Correction

The address for the Minibat ultralight aircraft (*How the New Homebuilt Ultralights Take Shape*, July '80, page 80) is GLA Inc., 841 Winslow Court, Muskegon, Mich. 49441.

**Motorcraft** Ford

**Single Weight SAE-30 Motor Oil** 1 qt. (0.946L)

**Premium 20W-40 Motor Oil** 1 qt. (0.946L)

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GEE, I'M JUST A 30 WEIGHT, AND I'M RATED "SF" TOO!

**Motorcraft** Ford

**...FOR SURE**

GASOLINE ENGINE OIL



# PM ELECTRONICS MONITOR

## Electronics—all that's new!

I stood at one end of an aisle so long that there was almost an horizon effect. On either side of me blared the very latest stereo equipment, wattage drowned out by the milling sounds of more than 50,000 people within the vast hall where the Chicago Consumer Electronics Show (CES) met this summer.

More than 1500 exhibitors were showing their 1981 lines of consumer electronics to retailers and the press.

## The beat goes on

The audio exhibits were nothing short of fantastic in sound, quality and technological achievement. This will be one of stereo's best years, judging by the equipment.

Sony introduced a new line of frequency-synthesized, digital receivers whose technological innards were enhanced with some magnificent exterior styling. Also shown at the Sony booth was a new series of portable stereo components—small, take-along receiver/amplifier and preamp in their own little carrying rack.

Kenwood introduced its *Star Tracer* receiver, a beautiful set. Unlike most digital receivers whose numbers only can be tuned to certain frequencies, the *Star Tracer* can be tuned throughout the FM range with a normal tuning knob. As you tune, the digital numbers seem to fly by.

Take-alongs keep getting tinier. Technidyne's *Hip-Pocket Stereo* is a tiny cassette player and headphone combo that can be taken everywhere. Sony's *Walkman* cassette player is a similar concept. Both show that stereo is no longer a sit-and-enjoy venture but is now completely mobile.

## Booming down the highway

And, speaking of mobile, the world of autosound is roaring along with no red lights in sight. This was one of the largest exhibit areas, with many manufacturers and new products.

The newest items in autosound are the rack-mounted component sets that just about everyone seemed to be offering this year. Glittering design features make these units look more like jewels than the mean, mobile hi-fi machines that they really are.

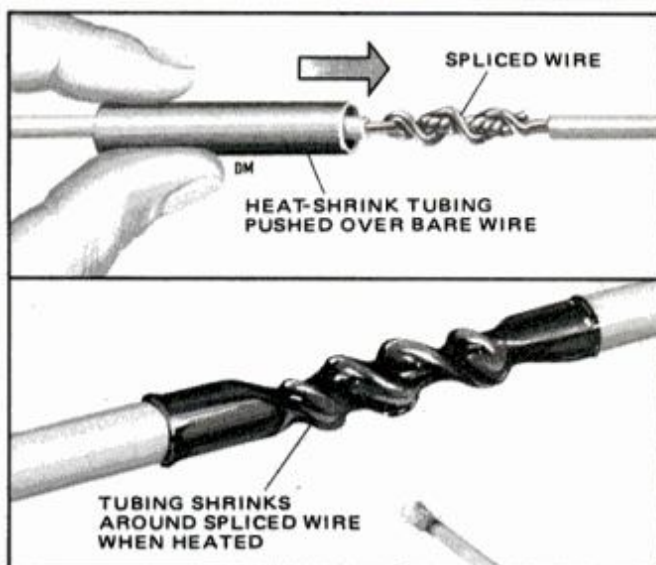
We liked Sparkomatic's little equalizer that used an illuminated green line to show the exact "shape"

## Protecting a splice

Have you ever soldered two wires together and wondered how to protect the bare splice?

Try heat-shrink tubing. It couldn't be simpler to use. Just slip it over the splice. Then heat it with a match, and it shrinks in a tight, insulating bond all around the splice.

It's available at most electronics stores in varying diameters (and is a stock item at Radio Shack). Try it on your next project or repair.



of the sound curve even as you realigned the frequencies. Pace-Altus came through with a delightful 70-watt, seven-band, amplifier-and-equalizer combination complete with LED power lights and a fader control.

Clarion showed its much-touted and impressive Magi-Tune system, which it claims offers the best FM reception in a car. It looked (and sounded) good to us and we'll have a full report in a later issue.

## Toys do more than beep

We would have played more with *Milton* from Milton-Bradley, but the long line of people waiting to be insulted by this talking wonder discouraged us! Other talking toys were in evidence, such as the new *Speak and Read* series from venerable Texas Instruments.

Displays, too, have gotten crazy and wild—no more tiny dots of light dimly lit. Mego's *Toss-up* is a handheld game featuring a cute juggler whose arms you control—try not to drop the eggs! Kenner's new *Football* has a fully animated player figure who can throw a pass, punt and tackle.

Chess games are now the next best thing to a real partner. Fidelity's new line of *Chess Challengers* offers not only a voice but a board that senses how you move the pieces and lights to show you where the computer moves; no more keyboard input.

And *Boris*, from Applied Concepts, has grown a hand—yep, a little claw moves the chess pieces, and he, too, has an automatically sensing board.

## Here, there, everywhere

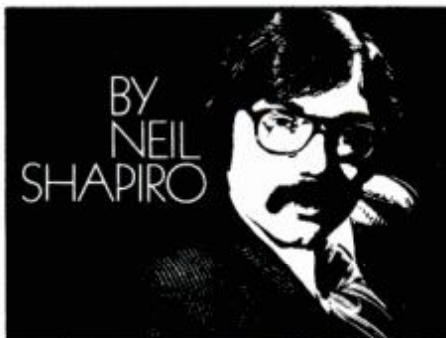
Panasonic unveiled its new handheld computer, as did Sinclair and Nixdorf. All are impressive and we will have a feature story very soon. Size is coming down—and price? The Sinclair machine is scheduled to sell for \$200.

Quasar showed a new, three-gun and rear-screen projection TV that should give RCA's widescreen some competition. Hitachi showed a new six-hour programmable Video Cassette Recorder controlled by a microprocessor and smaller than any competing unit.

Technics showed a new turntable that is so automated that it can even be used vertically.

BSR released *The Timer*, a new control center for its popular line of remote-controlled outlets. Add this to an existing BSR remote system and you will be able to completely program and automate every appliance that you currently have in your house.

This CES showed everyone that the world of electronics is a growing, expanding and popular one. Stay with us as we continue to bring it home to you. **PM**





# IF RISING FUEL COSTS MAKE YOU BLUE, THINK PINK.

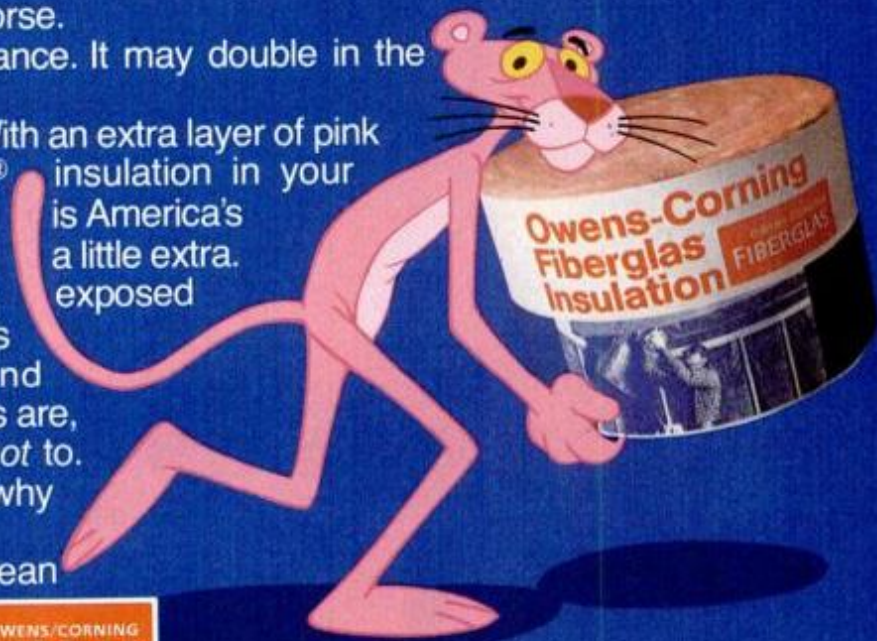
Cheer up, things could get worse.

The cost of fuel, for instance. It may double in the next ten years.\*

But you can fight back. With an extra layer of pink Owens-Corning *Fiberglas*<sup>®</sup> insulation in your attic. Pink Owens-Corning is America's best-selling insulation. Add a little extra.

Insulate your attic, walls exposed to heat and cold, and floors over unheated garages and crawl spaces. The way things are, it could be more expensive *not* to.

Savings vary. Find out why in the sellers fact sheet on R-values. Higher R-values mean greater insulating power.



\* Source: Data Resources, Inc.



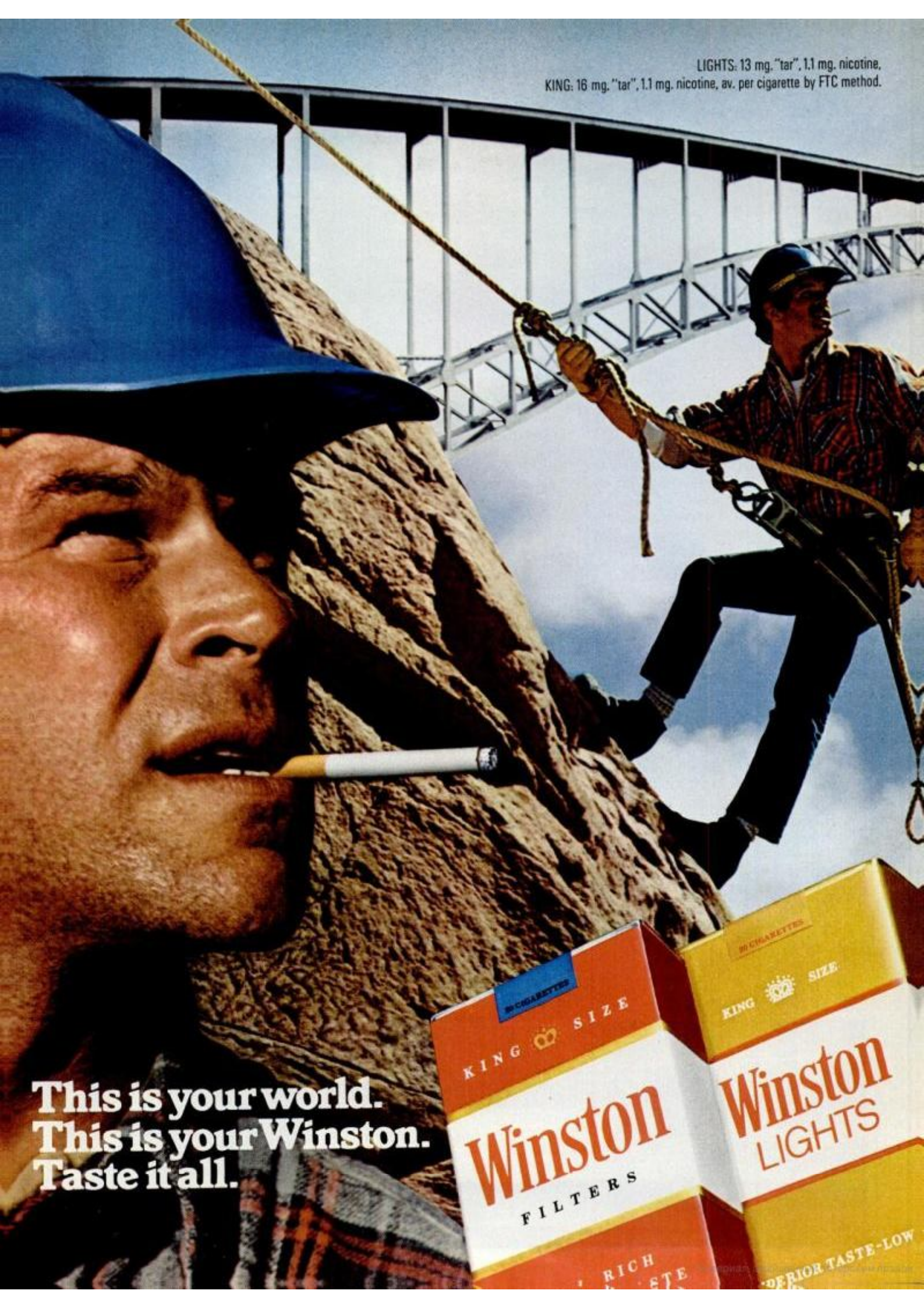
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**Nobody does it better.**

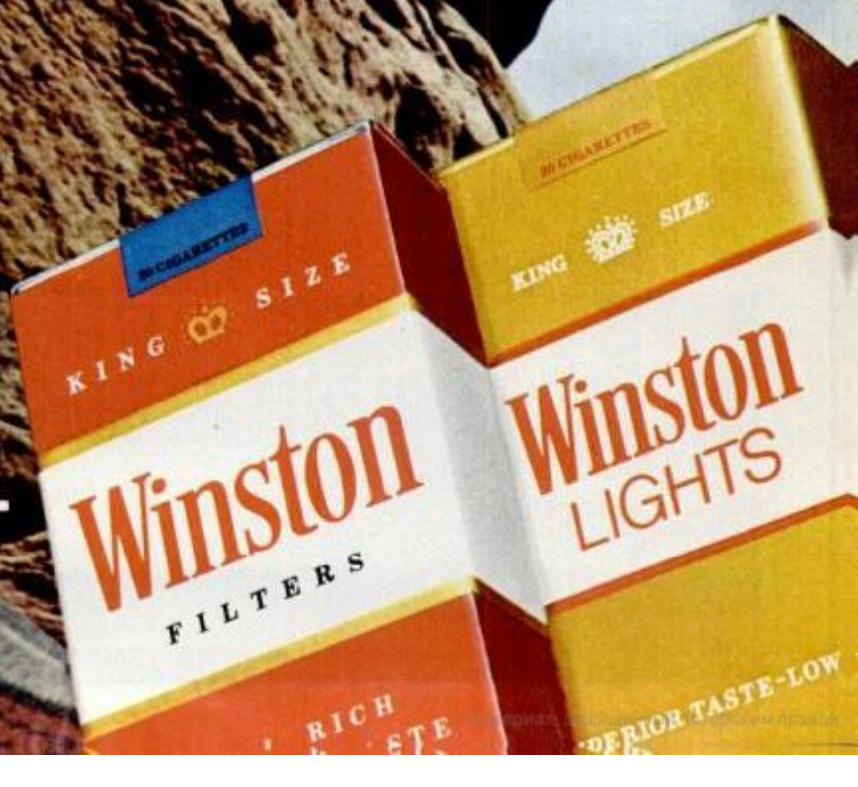
**Winston**



LIGHTS: 13 mg. "tar", 1.1 mg. nicotine,  
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**This is your world.  
This is your Winston.  
Taste it all.**





# IMPORTS & MOTORSPORTS

## New GLC gets fwd



Right-hand drive, required fender mirrors are on Japanese-market GLC.

It's still a GLC, but is it still a "great little car"? First photo of Mazda's all-new, front-wheel-drive GLC model shows crisp styling, but what's it like to drive? We won't know until next month when the *Firsthand Report* of our GLC test drive in Japan is



GLC transverse Four drives front wheels.

scheduled to appear. The three-door hatchback (above) and five-door hatchback will go on sale here next month. The GLC for '81 is a wedge-shaped econocar unlike the original GLC introduced in 1977 (see *Driving Mazda's New Piston Packin' GLC*, page 197, Mar. '77)

The complete redo abandons the long driveshaft and goes to transverse front engine with fwd. The Four displaces 1.5 liters and will take the car 10 percent farther than



Seats fold flat for impromptu camping.

the current rear-drive model. If you want to drive a steady 37.5 mph, you'll get 59 mpg, according to the Japanese equivalent of the EPA. The new GLC, built on a 93-inch wheelbase, will, I'm sure, be found very appealing by an increasingly sophisticated U.S. car buyer.

Already, Mazda plans followup notchback models.

## Cookin' on all five

It's nice, every now and then, to get away for a few miles. I headed out of town earlier this summer with Audi's new five-cylinder 4000 and didn't return until 500 miles later. The escapade ran the odometer on the metallic-green two-door with air conditioner and automatic transmission from 1000 to an even 1500 miles, scarcely broken in. Two fill-ups of 11.3 and 13.7 gallons made the arithmetic easy, and my trip log shows that the 4000's fuel consumption rate for the week of swift, com-



Clean machine is five-cylinder Audi 4000.

fortable driving came to 20 mpg, on the nose. To me, that was on the low side, but considering that 1) the engine is still breaking in; 2) the transmission is automatic; 3) the air conditioner was on a lot; 4) I wasn't driving for all-out economy; and that, 5) I was enjoying the performance boost from the big Five under the hood, the 20-mpg figure isn't all bad. The EPA figures are 20 city and

28 highway; 23 combined. Owners of four-cylinder 4000s with four-speed transmissions got 25.5 in town and 31.6 on trips in our *PM Owners Report* (page 120, Mar. '80).

## 1000-cc car

This Energy Conservation Vehicle (ECV) from BL Ltd. in England ran a constant 30 mph and got 100 mpg, but that was on an imperial gallon: With the U.S. gallon, the bantam-weight gets only 80 mpg. It owes its



ECV won't be ready 'til gas hits \$7/gal.

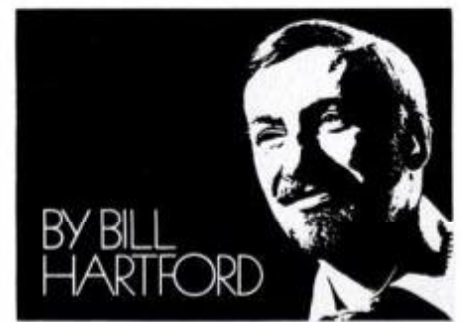
fuel efficiency to an aluminum chassis, plastic body and aluminum-alloy Three. Jaguar Rover Triumph would love a bunch to sell right now, but it'll be years before the four-seater could be in production.

## 1000-cc bike



V-Twin gets 86 hp from one liter.

This Hesketh V-Twin should make some noise when it reaches volume production early in '81. The one-liter, high-performance machine is the first new British motorcycle in years. The bike uses a unique coaxial chain layout to keep the chain under constant tension for better power to the rear wheel. It's strictly a machine for high rollers and should be capable of wicked wheelies. **PM**







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## NOTES FROM THE EDITOR

John A. Sillitto

**W**hen the year's crop of new cars is announced each fall, we know that you PM readers are just as interested in a look under each hood as you are in admiring the shiny new sheet metal on the outside.

You are the most enthusiastic do-it-yourself car owners in the country. That's why, for the past few years, we've had an expert "Saturday

Mechanic" look at all the new cars and let you know how easy or difficult they'll be for you to service. He's Paul Weissler, who begins his scrutiny of the '81 cars on page 78.

Paul is a graduate of an automotive trade school and at one time made his living as an auto mechanic, so the underside of a car holds no mysteries for him. He has been contributing to PM since 1963, and has been a member of the Society of Automotive Engineers since 1964.



Paul Weissler (facing camera) gets a first look under the hood with the expert guidance of Detroit engineers.

**Keeping a car in good shape** is by no means the limit to the skills of PM readers. You are also the people who repair gutters and downspouts, make fine furniture in your workshops, put together personal computers, build kit boats and add rooms and decks to your homes. There's a healthy supply of self-reliance in your makeup. You want to know *how* things work and you want to *make* them work.

Long ago, you discovered the secret of getting a job done competently and honestly when you didn't have time yourself: You let it be known that you know how things should work when they're done right.

And have you noticed that when you can make things work, you're the one person in the neighborhood whom everyone consults for advice? You're the kind of person whom futurist Alvin Toffler cites in his new book, *The Third Wave*.

An article adapted from the book and printed in the *New York Times Magazine* carried this title: *A New Kind of Man in the Making*. In it, Toffler talked about a new ethic: "Having plenty of money still carries prestige. But other characteristics gain importance. Among these are self-reliance, the ability to adapt and survive under difficult conditions, and the ability to do things with one's own hands—whether to build a fence, to cook a great meal, to make one's own clothes or to restore an antique chest."

Well, we're not at all surprised to find that our readers—good, old-fashioned do-it-yourselfers—have become recognized as the wave of the future.

We think you've got it all together right now, so we've started a publicity campaign to tell the world about you. We use the words *New Achiever* to describe the guy who can make things work and who lives better because he can. We think you'll recognize yourself when you see it.

PM



## HINTS FROM READERS

### Disposable brush



Make a disposable brush from scrap materials and use it for spreading glue and for minor paint touch-ups. Pound end of small bamboo stick until fibers separate.—*Walter E. Burton*

### Substitute edging clamp



If you are in need of a three-way edging clamp, try using a C-clamp and wedge as shown in the photo above. It will work every time.

—*Frank H. Day*

### Lever-jaw pliers aid hammer



You can remove a headless nail by gripping it in the claws of a hammer and clamping a lever-jaw pliers onto the nail, close to hammer claws. Roll hammer head to complete pull.—*Ken Patterson*

### Aid for boring metal

An ink bottle filled with pure turpentine and a small watercolor brush kept near my bench drill press are handy aids, especially when boring metal. I simply dab on some of the turps from time to time during the operation. It acts as a lubricant and keeps the bits from overheating.

—*Harvey Muller*

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for you to learn BASIC high level language programming and assembly language programming.

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The NTS/Rockwell AIM 65 Microcomputer (#2) is included in our Microprocessor Technology Course. It's a single board unit featuring an on-board 20 column alphanumeric printer with 20 character display. This 6502-based unit also has 4K RAM memory, expandable, 8K monitor ROM and 8K advanced BASIC interpreter on ROM.

And in NTS's Master Course in Electronics and Industrial Technology, you'll work with the NTS/KIM-1 Microcomputer (#3). This unit features a 6 digit LED display with an on-board 24 key hexadecimal calculator-type keyboard. It's a 6502-based microcomputer with 1K of RAM memory, expandable.



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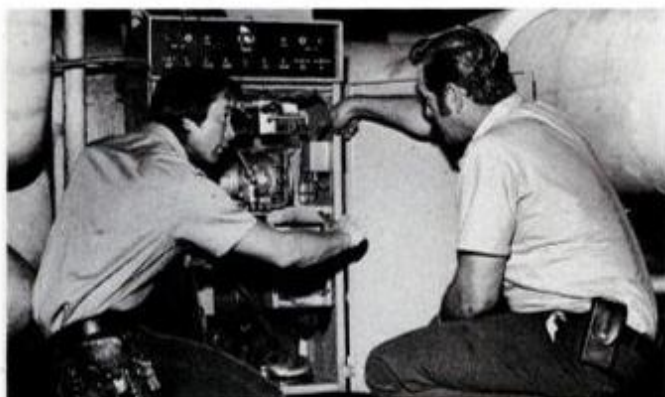


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# DETROIT LISTENING POST

## Industry plans changing fast

Remember the chart we gave you back in April (*Detroit Listening Post*, page 32) outlining Detroit's new-car plans for the next five years? Well, that was before the bottom dropped out this year, and many of those well-laid plans are fast being altered, or even scrapped.

High interest rates, fuel prices, inflation, recession, and political and economic uncertainty have cut deeply into American car sales, particularly of the large and intermediate models. Detroit has entered into near-panic planning.

No designer or engineer can be sure of what you and I are going to be interested in buying in the next few years, and as Ford Motor Co. chairman Philip Caldwell said recently, "One of the hazards of this industry is that the lead times are long, the investments are high and the bets are not easily changed once they're in place."

The \$64 billion question is not whether to build more and better small, fuel-efficient, compact and subcompact models—those are already coming this month, with more on the way as fast as they can be developed, plants shifted and component pipelines placed. The problem is what to do with those larger cars that have been such a glut on the 1980 market.

The wife of a doctor friend of my parents told me in 1974 that she had to buy a smaller car because she was worried about the price and availability of fuel. She asked my advice, and I gave it. Then she went out and traded in her big, gas-guzzling 1974 four-door Cadillac for... a 1975 two-door Cadillac! That was her idea of a smaller car, and a lot of people like her are still going to want the sort of big, soft, comfortable automobiles that they've grown used to—or will they?

Remember when the '73-'74 fuel crisis was over? People went right back to buying large and intermediate-size cars, and the domestic makers had to offer rebates on their small automobiles for a while just to get rid of them.

Until recently, at least, Detroit decision makers have been expecting the same thing to happen this time. That's why they've been planning to keep those larger models around and spending billions to downsize them a bit more and make them con-

siderably more efficient. Now fuel is plentiful again, but prices continue to rise, and who knows when the next crisis will come along? The crystal ball gets cloudier almost daily. Here's one scenario of what may happen:

## General Motors

The '81½ subcompact fwd J-car Monza/Sunbird replacements will arrive as scheduled next May. Buick and Olds will get their classier versions a year later, and (surprise!) Cadillac Div. is rushing its own luxury "J" version to market, also for '82½. The J-bodies are a bit smaller and shorter than GM's X-cars, weighing in at around 2400 pounds, and powered by a new 1.8-liter four-cylinder engine—including the baby Caddie.

The 1982 models (fall '81 intro) include the smaller Camaro/Firebird (still rear-drive) as planned, but from there on things begin to get scrambled. Only the two-door intermediate A-cars (Malibu, LeMans) will go front-drive, leaving the four-doors and wagons with their current conventional platforms, along with the A-special (Monte Carlo, Grand Prix, Cutlass Supreme and Regal) personal coupes. This indicates that a lot of name switching will take place on these cars to differentiate the new front-drives from the older A-bodies.

Why not switch all at the same time? GM can't put enough fwd engine and transaxle production capacity in working order by then, we hear.

The mid-engine, two-seat Pontiac sport coupe (which may get the old GTO name) has been approved and could reach production by mid-'82. There will also be new, smaller Chevy and GMC trucks for '82, plus some diesel engines smaller than the current V8s, probably both a V6 and a four-cylinder.

For '83 comes the smaller Corvette sports car, but most important are the downsized (again) and fwd full-size models. But will they spend the massive bucks for such a major redo of their largest cars (again) if the market for such vehicles continues to evaporate? My guess is they'll end up scrapping most of the big cars and wind up doing some high-bucks Buicks, Olds and Caddies in much smaller volumes than originally planned, perhaps on the al-

ready existing (and excellent) fully independent, fwd E-car (Eldorado, Toronado, Riviera) platform.

Also look for a fwd Chevette replacement by '84 and something smaller sooner—probably a two-seater, and possibly with a three-cylinder gas engine first and optional electric power by '85.

## Ford and Chrysler

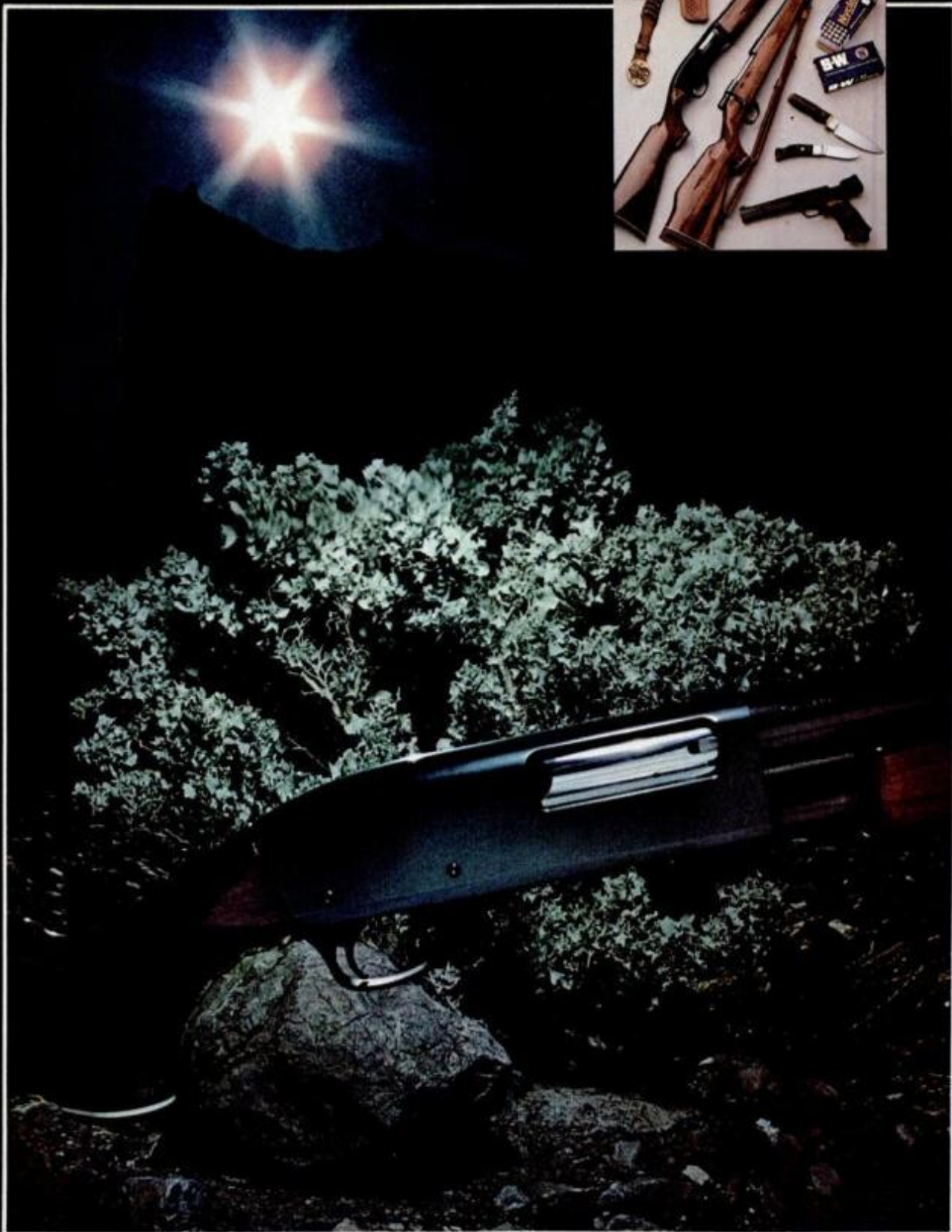
Ford's sporty coupe versions of the Escort/Lynx (called Ford EXP and Mercury LN-7) are due for spring, and a five-door hatchback sedan is set for next fall, plus slightly larger Fairmont/Zephyr replacements on a stretched Escort/Lynx platform at the same time. But what will Ford do with the rest? The T-Bird/XR-7 personal coupes will certainly get a restyle (to get rid of their chunky, gas-guzzler looks) and a slight size and weight reduction by '83, but front-drive or rear? Don't be surprised to see both those and the Mustang/Capri become spinoffs of that '82 fwd Fairmont/Zephyr.

Also, don't be shocked to see the Ford and Mercury full-size entries go away in the next couple of years, leaving the luxury Lincolns as larger, plusher versions of this year's rear-drive Granada/Cougar. (Versailles is already going that route next year.) The billions thus saved could be channeled into the mini-compacts that will surely be needed by a demanding public well before mid-decade.

Chrysler already has stopped producing its full-size cars, and I doubt whether they'll ever be revived. Instead, Chrysler will spend what money it has on future versions of the L- (Omni/Horizon) and K-body fwd platforms, including a chopped-L mini and stretched-K replacements for the current crop of intermediates. **PM**







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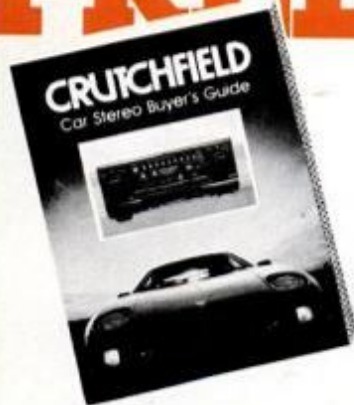


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# The painless way to use a shovel

**W**hether your next digging project is preparing a garden patch, filling in a low spot or excavating for a footing, you can benefit by checking out these tips on how to handle a shovel properly. Using a shovel as suggested, you will be able to complete the job without blistered hands and aching back. If your life is a sedentary one, remember to take it slow.



This Rocket shovel (\$17) by True Temper has a rolled edge where your foot applies force. The lip spreads pressure over a wider area of your foot. Even with this design aid, however, you should wear sturdy, hard-soled shoes when you dig.



**1** When you put the shovel into the soil, about 20 in. from the vertical line of your body, the blade should approximately parallel the hip of your pressure leg. In this posture, you get maximum use of your body weight without twisting a hip or losing balance. Handle will be about 10 in. in front of you, hands comfortably placed.



**2** When you lift a shovel of dirt, the hand nearest the blade supports the load and acts as a fulcrum. The other hand gives a downward push, which raises the blade. Shovels with long handles provide good leverage and require less effort.



**3** Rest the shovel handle against the inside of your forward, pressure leg. Support the shovel with your fulcrum hand. Your fulcrum arm should lie across your flexed knee while your other arm provides a counterbalancing push. In this manner, the load will be carried comfortably by your leg and not by your back or arms. You'll be able to work longer in the garden and have less back fatigue later.



**4** Rise up slightly while your arm remains on your leg. You can lift the load with little strain. Turn your wrists to dump the load. Then repeat the cycle.



## HINTS FROM READERS

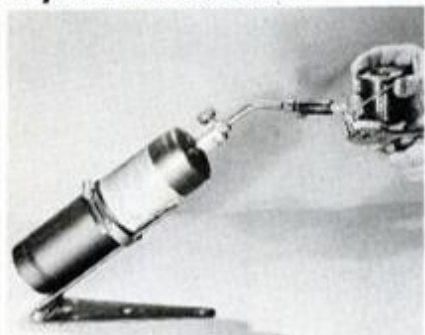
### Storing lathe accessories



Protect a lathe accessory from dust and chips by storing it in a plastic bread bag, preferably one with a see-through panel. Be sure the part is dry before storing it. In humid areas, it is helpful to enclose a drying agent such as silica gel; tightly seal the bag.

—Walter E. Burton

### Adjustable torch stand



A large strap hinge having tight hinge action and a large hose clamp combine to make an adjustable stand for a propane torch. Using this setup, both of your hands are free for other jobs. Hammer pin head to tighten hinge action.—Ken Patterson

### Garbage-bag shop apron

After forgetting the smock that I wear at an evening machine-shop class, I tried to think of an easily obtainable substitute. A large-size plastic garbage bag with neck and arm holes cut out did a fine job of protecting my street clothes.—Colgan C. Curlett

### Renewing a chamois

To renew a chamois, gently agitate it for 15 minutes in a bucket of warm water containing a teaspoon of olive oil. The chamois will become soft and pliable again.—Lane Olinghouse

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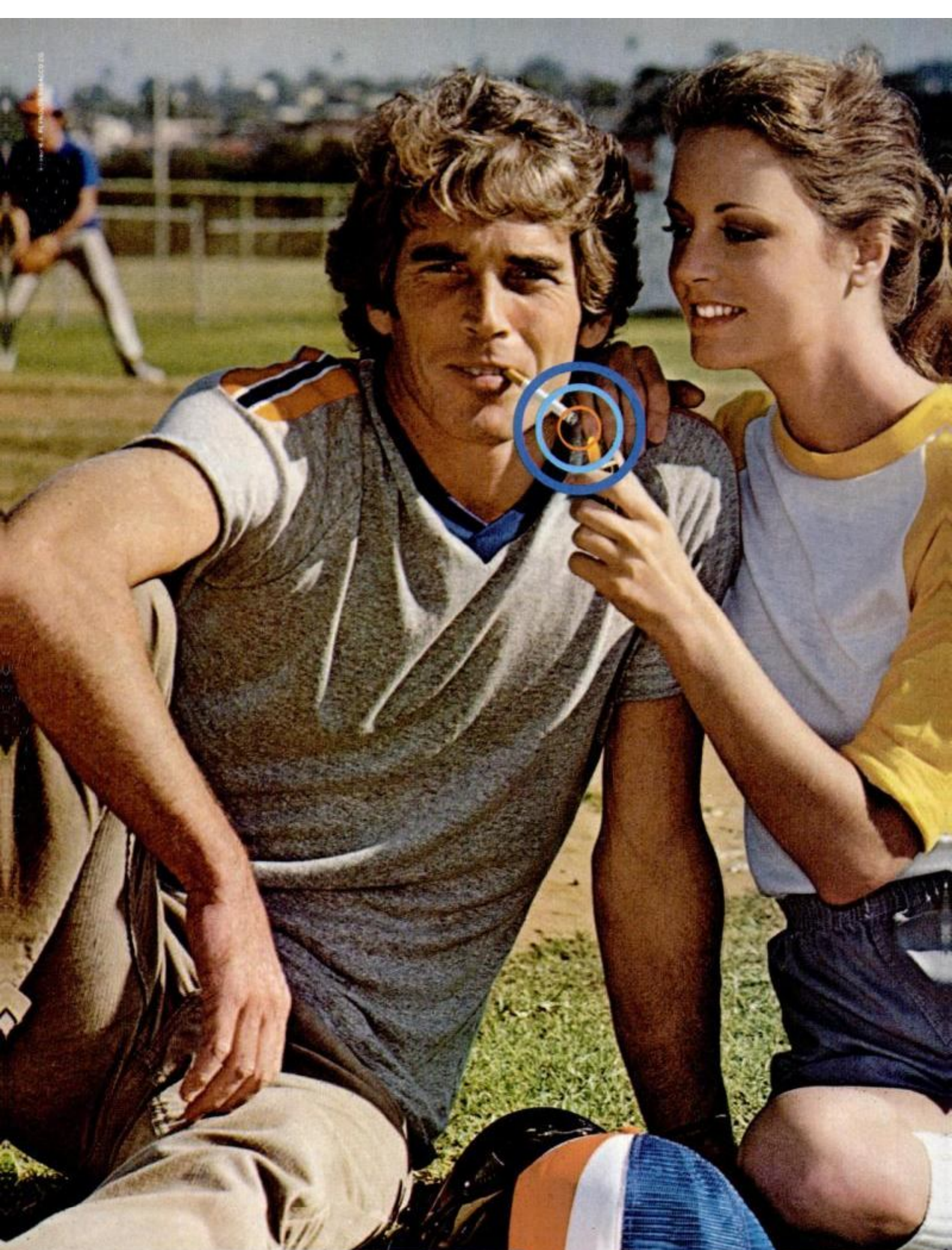
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A free razor on Gillette TRAC II® 5-packs? That's some offer. It's a \$3.00 value, and a perfect opportunity to save on the smooth, close comfort of the TRAC II® system. Naturally our offer is good only while supplies last. Which in this case could mean there's no tomorrow.

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## WHY MOTOR OILS THAT HELD UP IN YESTERDAY'S CARS BREAK DOWN IN TODAY'S.



Twenty-five years ago, it didn't make a big difference what motor oil you used.

Most of those old V-8 engines ran at a mere 20% of their capacity, producing relatively low temperatures and making few, if any, critical demands on a motor oil.

But today's smaller cars are a lot tougher on an oil. They do the same work as bigger cars but with two – even four – less cylinders. So their engines often have to run at 80% capacity, creating brutally hot temperatures.

All this can break down an oil's viscosity. That's why smaller cars need Castrol. Castrol's special viscosity modifier prevents it from breaking down,

even in today's higher revving, hotter running engines.

To demonstrate Castrol's ability to withstand this intense heat and pressure, engine tests were conducted by an independent lab. And even after the equivalent of 2,000 miles, Castrol still didn't break down.

So if you drive one of today's demanding smaller cars, make sure you use Castrol – the motor oil that keeps up with the times.



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# PM WORKBENCH

PM EXAMINES PRODUCTS AND SERVICES

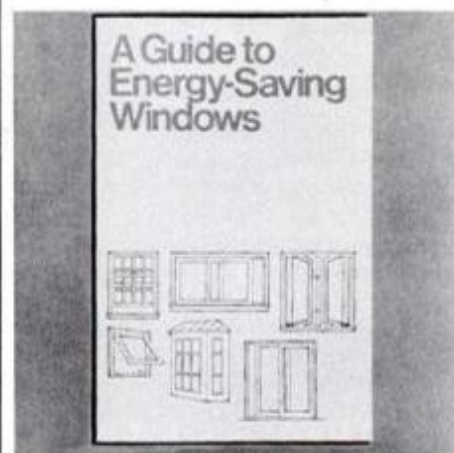
## A pair of handy booklets

There is a surprising amount of helpful do-it-yourself literature available for little or no cost. Here are two items that you may be interested in sending for:

*Installing Your New Subatop Countertop Is Easy as 1...2...3* is free from Suba Manufacturing Inc., Building 116, Benicia Industrial Park., Benicia, Calif. 94510 (include self-addressed, stamped envelope). The pamphlet tells how to install



Manufacturer's instructions are handy for all do-it-yourself countertop installers.



This 16-page booklet answers questions owners most often ask about windows.

preformed countertops on the market.

*A Guide to Energy-Saving Windows* is free from National Woodwork Manufacturers Assn., c/o Sumner Rider and Associates, 355 Lexington Ave., New York, N.Y. 10017. This 16-page booklet answers many of the questions asked about windows regarding condensation, fuel savings and the like.—H.W.

## Two new paints

I recently tried the new Rust-O-Crylic coating on an old aluminum screen door and I liked using the stuff. It dries fast and cleanup is with soap and water. The paint is an effective rust inhibitor and can be used on problem surfaces like masonry and galvanized steel. The paint is available in 10 colors from the Rustoleum Corp., 11 Hawthorn



New paint labeled Rust-O-Crylic is priced at \$2.50 per half pint and \$6.30 per quart. Write manufacturer for the nearest dealer.



USG's latex floor enamel is priced at \$17.65 per gallon and is sold at home centers.

Parkway, Vernon Hills, Ill. 60061.

I haven't used Grand Prize latex floor enamel yet, but plan to soon. Maker claims it can be scrubbed and is quick-drying—two desirable features in a floor paint. It's from United States Gypsum Co., 101 South Wacker Dr., Chicago, Ill. 60606.—J.P.

## Solid-oak chair kits

These solid-oak chairs come in knockdown kit form and assemble in minutes. Patented fastener called Nut-Lok, placed at 10 vital joints, makes chairs as rigid as possible. They're easy to assemble and com-



Handsome chairs were finished by tester with two coats of satin-finish varnish.



fortable. All hardware is included, but finishing materials are not. The CC-22 chair is \$35.30; rocker is \$42.30, plus shipping. Write to Bud-off Outdoor Furniture, Box 530, Monticello, N.Y. 12701.—H.W.

If you've come across a new product with some special features, let us know about it. Write to PM Workbench, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.



# THE PM GARAGE

## CAPSULE REPORTS ON NEW AUTO PRODUCTS

### Diesel compression gauge

It's about time: a diesel compression gauge for passenger cars at a weekend mechanic's price of \$47 list. The gauge has a hose and a quick-release coupling; you can buy adapters for General Motors (\$11), VW or Mercedes (\$16) or even Cummins (\$20). It's by S&G Tool-Aid Corp., 43 East Alpine St., Newark, N.J. 07114 and sold only through auto-parts stores.

The gauge reads to 1000 p.s.i., well above 400-600 p.s.i. of the typical diesel, a range that makes the gas-engine gauge unsuitable.

We tried the gauge on a Pontiac with the GM diesel, and found it easy to use. Remove a glow plug and thread the adapter into a glow-plug socket. Just push on the hose and coupling, disconnect the fuel-flow solenoid on the injection pump, and



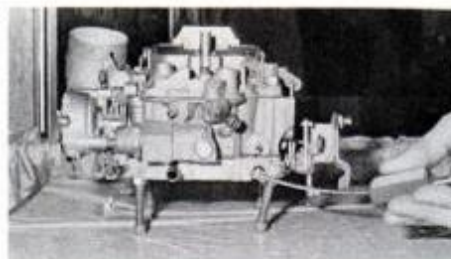
Thexton gauge has adapters for all makes of diesel engines; reads up to 1000 p.s.i.

crank the engine to get the reading. The gauge has a pressure release just below the dial so you can discharge pressure and retest without having to remove it.—Paul Weissler

### Mixture-adjusting tool

Detroit started plugging the idle-mixture screw in 1979 to make it tamper-resistant. Unfortunately, plugging the screw doesn't always eliminate the need to reach it. To get at the adjusting screw, you have to shove a punch into the plug and pry it out.

But getting out the plug is only half the problem. The recessed location of the mixture screws on 1979-80 GM carburetors makes reaching them a struggle. The solution is a \$5 tool with a flexible shaft and differently shaped ends; it can be routed under obstructions. One end is a 4.5-mm hex and the other is like a flattened circle so that you can handle



Flexible shaft lets you route the mixture tool under the obstructions to save time.

either of the two mixture-screw heads that GM uses.

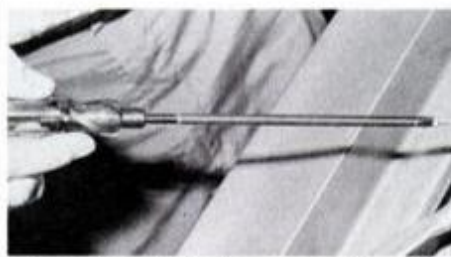
A special knob on the shaft slides to either end, where it holds in position while you make the adjustment. The tool, sold only through auto-parts dealers, is made by Thexton Manufacturing Co., Box 35008, Minneapolis, Minn. 55435.—Paul Weissler.

### Screw-holding screwdriver

There are several tools designed to hold screws so you can start them in tight quarters. All those I've used have had some flaw, such as having poor retention, being inconvenient to turn or difficult to remove when I was done. Many weren't even screwdrivers. So I had to change to a screwdriver to complete the tightening.

One type of screwdriver I just encountered is as close to perfect as I've seen. Just push down on the handle and a mini-tang in the blade turns and locks on the screw, and it stays locked on without keeping the pressure on.

Insert the screw and tighten it



Magic Tip's blade has a mini-tang that locks onto screw, stays on without fuss.

down, as you would with any screwdriver; then just pull on the handle to get it off.

Called Magic Tip, the screwdriver is available in popular blade widths ( $\frac{1}{8}$ ,  $\frac{3}{16}$  and  $\frac{1}{4}$  inch) and various lengths. Prices are in the \$8 range. The screwdrivers are made by an outfit called Hunter, which I'd never

heard of before. Hunter, however, was bought by K-D Tools of Lancaster, Pa., a leading maker of specialty tools.

So you will soon be able to get them in any of the thousands of auto-parts stores that carry K-D.—Paul Weissler

### Buying an inexpensive floor jack

Suddenly, there's a spate of inexpensive,  $1\frac{1}{2}$ -ton hydraulic floor jacks on the market. I've bought several brands lately, the most recent being a superbargain, \$38.95 model from Grand Auto (made in Taiwan by Dingwei Machinery Co. Ltd.).

I have learned what to look for when shopping, and I pass this information along here:

First, be sure the hydraulic floor jack you buy has pivoting rear wheels. Nonpivoting rear wheels make it hard to position and useless for moving a disabled vehicle.

Second, does the pad and its mounting structure (the fixed or swiveling plate that carries the weight of the vehicle) look sturdy enough to withstand an off-center



Grand Auto's \$38.95 bargain model has the pivoting rear wheels for easy positioning.

load? Jack pads have been known to break because of poor design and weak welds.

Third, if it's the type of jack with a handle that twists to release the hydraulic valve, check the universal joint at the bottom of the handle. I've had this U-joint break twice on a Key-Bar jack I purchased about a year ago.

Finally, be sure the jack comes with a decent warranty, not only for the reasons cited above, but because leaks can develop within the first year of use. A 90-day warranty isn't enough.

Prices range from about \$40 to \$150, and you'll find such jacks at most chain auto stores.—M.L.



# Beauty that's more than skin deep.



Architect: Wendell Lovett, FAIA, Seattle, Washington

Olympic Oil Stain. Not only does it bring out the natural beauty of wood, but it keeps it looking beautiful. Year after year.

The secret to lasting beauty lies in Olympic's rich linseed oil and natural woodtone pigments. Together, they penetrate the wood to preserve beauty, in even the harshest conditions.

See all 66 colors at your Olympic Dealer. He's listed in the Yellow Pages. Or write Olympic, Dept. C., P.O. Box 1497, Bellevue, WA 98009.

**Penetrates to  
protect wood  
beautifully.**



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# HOMEOWNERS' CLINIC

## QUESTIONS ANSWERED

### Heating a vacant house

*This November I am going to Florida for about five months. With the high cost of utilities, my heating man told me to drain my hot-water baseboard heating system. My plumber said this would be bad for the pipes, furniture and walls. My utility company said to set the temperature at 55° F. What do you say?—Charles Manfro, Kingston, N.Y.*

Some time ago I wrote an article *How to Close Up Your Vacation Home* (page 94, Sept. '73). Definitely of the close-it-completely school, I advocate draining all water and closing down the heating system.

A power failure in an unattended house for only one night can lead to broken pipes and split radiators in subfreezing weather. Your heating man can show you how to drain the system so you can do it yourself next time.

Shut off the domestic water at the main and drain the system fully, leaving all valves open. Drain the toilet-bowl tank and pour two cups of permanent antifreeze in the bowl. Put one cup of antifreeze in each trap, including the tub and shower traps.

Job down each step on paper as you go. In the spring, merely reverse the procedure to reopen your house.

### Painting aluminum siding

*I'm about to paint my aluminum siding. What preparations must I take? What type paint must I use?—Tom Johnson, Burlington, N.J.*

Aluminum siding has a built-in cleansing action called chalking. According to a spokesman for Reynolds Aluminum, chalking span varies from geographical region to region. The theory is that after the siding has chalked, rains will wash it and the dirt away. Then the cycle repeats.

You can use a good-quality exterior latex paint on aluminum siding. In addition, PPG Industries, 1 Gateway Center, Pittsburgh, Pa. 15222, has recently developed an exterior finish designed expressly for aluminum and steel siding called *Metal Siding Refinish* (see *PM Workbench*, page 37, July '80).

First wash the aluminum with this solution: 1/3 cup detergent (Tide), 2/3 cup sodium phosphate (Soilax), 1 quart Clorox and 3 quarts water. Apply solution with a sponge

and hose off. Don't use abrasives and avoid contact with the solution.

### Hot water recirculating

Several questions were raised by the gravity-recirculating water system ("Recirculating Hot Water," *Homeowners Clinic*, page 34, Mar. '80). William T. Eliot of Santa Ana, Calif., wrote: "Here in California, many of us don't have basements. Therefore, our hot-water outlet is higher than our faucet (in my case, it's 30 ft. away). How would we Westerners recirculate our hot water?"

Louis J. Karg of Seneca, Pa., asked where to get a circulating pump. His faucet is also a long distance from his heater.

Any plumbing-supply house will carry a domestic water-circulating pump such as the Bronze Booster (photo, below) by ITT Fluid Han-



**Bronze Booster, made by ITT Fluid Handling Div., recirculates your domestic hot water.**

dling Div., 8200 North Austin Ave., Morton Grove, Ill. 60053. Be sure to specify "with bronze body," as a domestic water system introduces fresh water, which can corrode an iron-body pump.

When a circulating pump is used, it must be controlled by an aquastat (usually at the farthest end of the line), which may be set at about 100° F. If the temperature drops below 100° F., the pump will start; water will circulate until it reaches 100° F.,

*Do you have a home maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in this column. For more home repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send order(s) to PM, Dept. HCG, Box 1014, New York, N.Y. 10019.*

which stops the pump. If installing such a pump is beyond your skills as a do-it-yourselfer, have a licensed plumber do it.

### More on clogged toilets

Several readers sent us ingenious solutions for removing objects from toilets (see "Toilet Trouble," *Homeowners' Clinic*, page 61, Dec. '79). One good idea came from: Walter L. Jones of Sandpoint, Ohio; Harry Alley Jr. of Butte, Mont.; Terry Cole of Lake George, N.Y., and several others. Although their methods vary slightly, the principle is the same.

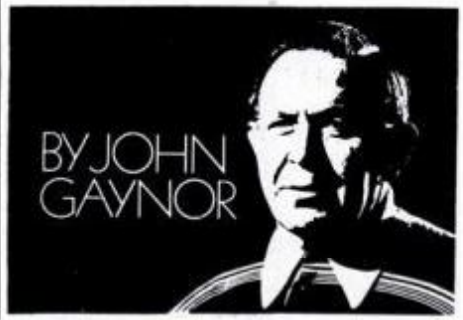
Remove the bowl, take it outdoors and place it on its side. Tie a small piece of cloth on the end of some string, or simply knot the end. Then, using either air or water pressure, force the string through from the bottom of the bowl. (You may have to shake the bowl a bit to get the string past the obstruction.) Once the string emerges at the top of the bowl, tie a washcloth to the string at the bowl base. Then pull the washcloth through the bowl. The cloth should dislodge the object.

### Homeowner bug equipment

*We seem to get all the bugs: ants, roaches, you name it. We also have problems with professional exterminators who forget their monthly visits. Is there equipment available for the homeowner to do the job himself?—E.D. Unger, Spencer, W. Va.*

When it comes to debugging, there are myriad devices for a homeowner. A pump-action handle on a plastic bottle will cost about \$1.50. For \$25 or so, you can buy a galvanized pump-up pressure tank with a spray nozzle. Supermarkets sell spray cans of bug repellent; this with termite treatment is my choice.

A reliable exterminator will know the most bug-prone areas of your house. However, if you do your own spraying, read all instructions. Also, wear goggles and gloves. **PM**



BY JOHN GAVNOR





## “Somebody who was scared to death of refinishing, refinished this beautiful table.”

Homer Formby, 3rd generation restorer and refinisher.

And she did it in a matter of hours! Without a mess, struggle, or night course.

Go ahead and say “impossible.” That’s what this lady said.

And honestly, before my simple yet revolutionary refinishing system, it was impossible. But thousands have learned that refinishing doesn’t have to be a terrible chore—thanks to Formby Products.

Now, I’ve put together an Introduction to Refinishing Kit. It lets the new refinisher get started immediately on a rewarding project.

### Don’t strip. It’s immoral.

For years, the only way the non-professional could refinish, was by stripping. But stripping is a disaster.

More than a mess, stripping actually destroys the finish you want to restore. By taking your piece down to the bare wood, you remove the patina—the beautiful glow that’s created over time.

In no time you can destroy 50 years worth of beautiful aging.

### The Formby Formula.

The center of my system is Formby’s Furniture Refinisher. It does not strip, so it does not raise the grain and make for tedious sanding.

Instead, it dissolves the old finish. Without any elbow grease you’ll watch the old, discolored varnish, lacquer and shellac melt away. Along with any cracking or checking in the finish.

You’re actually reaching back in time to the original finish, by dissolving years of accumulated gunk. (Packed in the kit you’ll find my steel wool refinishing pads to work with.)

To protect your piece after refinishing, I put Tung Oil varnish into my kit.

Ordinary varnish is brushed on top, so it sits on top. Formby’s Tung Oil varnish is hand-rubbed into the wood. It brings out the patina and highlights the grain.

### Refinishing without fear.

My refinishing products are used by professionals, antique dealers and museums.

Now, with my new kit, even more people can get started on refinishing the Formby way.

If I sound like a refinishing missionary, it’s because I am. Refinishing is fun and fills you with pride. Refinishing saves money because you can rescue furniture that’s been discarded in your attic or basement.

So if you’ve never refinished, now’s the time. Because there’s no feeling in the world like doing something with your own two hands.

Formby’s is a registered trademark of Formby’s Inc.



# Formby's®

No one knows wood as good.

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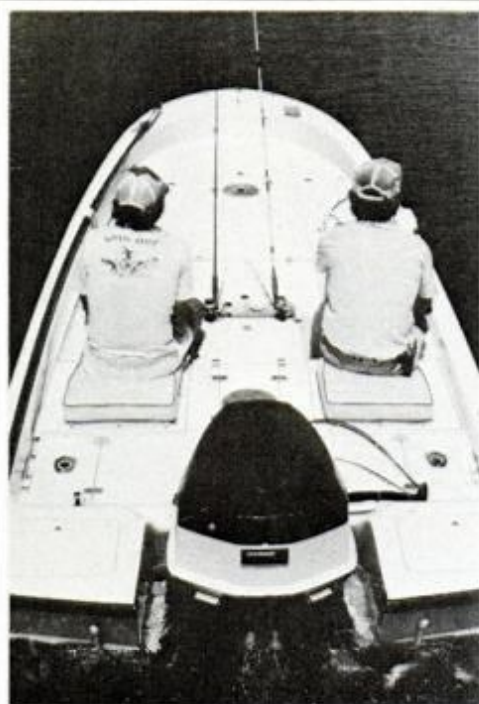
Formby's products are available at better paint, hardware, home centers and department stores.



# NEW NOW



# BOATING



## Convertible chaser

A Mako-18 Back Country Boat for the flats, this clever fishing platform from Mako Marine in Miami converts from a level load of storage compartments, fish wells, live bait boxes and tackle containers to a completely unobstructed deck for casting and poling thin water.

When it's under way, two under-cushioned hatches in the flush deck of the 18-footer can be hinged back to provide comfortable seating and foot wells. Sockets for pedestal seats are also provided, and the hull can handle up to 140 hp.

## Depth finder can show and tell

Digital readouts down to 600 feet are nothing new for a modern depth finder, but the TDS-1 Talking Depth Sounder from Paragon Electronics, Bellevue, Wash., tells the depth as well, in a speaking voice, and says "too deep" when the depth gets beyond its range. Synthesized voice recordings are stored on a silicon chip which is smaller than a shirt button, and a microprocessor matches them to the readouts.

The \$995 unit will also be available in French, Spanish, German and Arabic.

## A deck craft turns into a bass boat



No matter how it looks, the Riviera Cruiser B-12, from Columbia City, Ind., is called a bass boat. Mounted on two 16-foot aluminum pontoons, it weighs 530 pounds and probably has the widest beam of any bass boat around—6 feet. It's rated for 35-hp motors, and is reported to tow easily.

Optional equipment includes captain's chairs and a convertible navy top.

## Tower helps display boat's electronics

Offshore utility craft are often rigged with the latest in communications, navigating and fish-finding gear. Seasquirt's Big Hooker, from VIP Industries, Fort Lauderdale, Fla., uses an overhead tower over the control console to mount additional units within view of the helmsman. Raytheon instruments shown on the tower include an automatic direction finder, Loran C, and synthesized VHF radio with 55 transmitting channels. On the console are a straight-line white-line recorder and a rotary-flasher depth finder.



## A seated introduction to water skiing

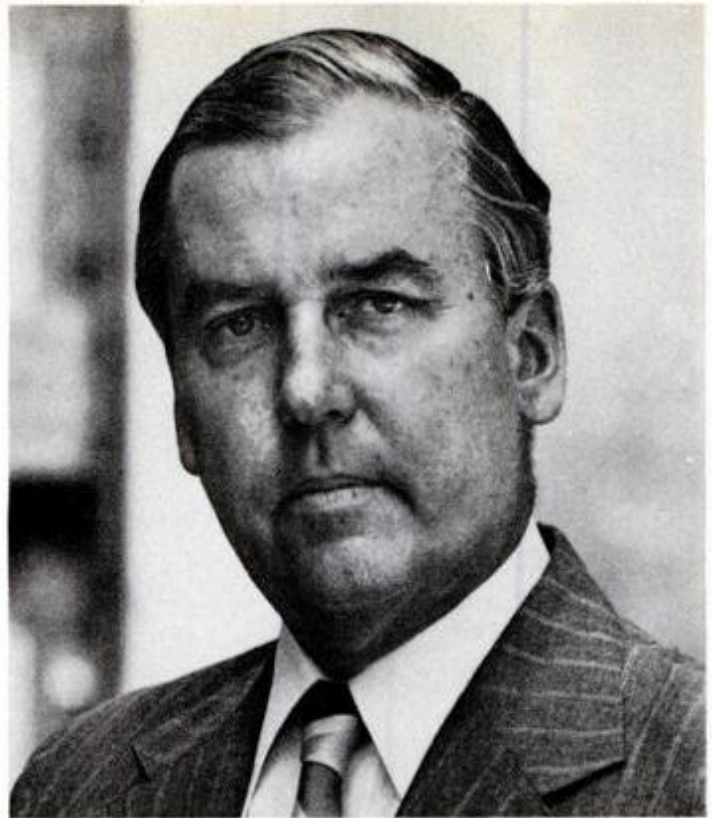
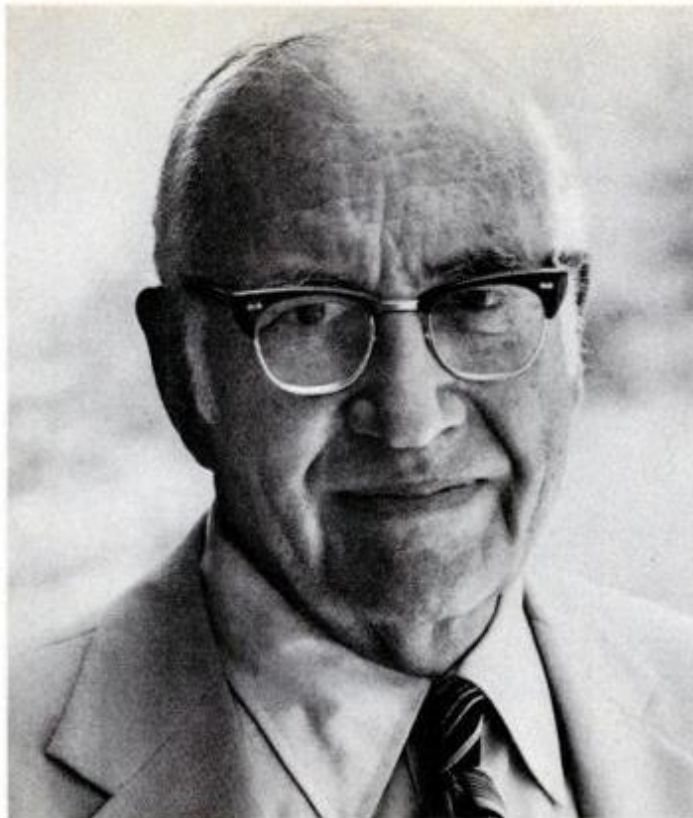


Designed for water sledding at the end of a tow rope, the Hydro Slide also is claimed to provide an easy introduction to water skiing.

Beach and deep-water starts are possible, as well as slalom runs, wake jumps, flips, slides and halfway or 360° turns. It's also been used as a trainer for barefoot skiing, all for \$100. The Hydro Slide is from Portugal & Co., Fontana, Calif.







## One of these drivers had a head-on collision and walked away without a scratch.

"I'm Dr. Arnold Arms, the man on the left. In 1975, I drove one of the American cars equipped with air bag restraint systems being tested in this country. At 6 p.m. on October 7, I left my office to make a house call and never made it. I had a head-on collision with a city bus. I was travelling at about 25 miles an hour.

"I recall very well what happened. The air bag filled in front of the steering wheel and deflated right away. I could see I was alive. I could see that I had no broken bones. To my surprise, I didn't even have a headache or whiplash injury. I was able to walk away from the crash." Arnold V. Arms, M.D., Kansas City, MO

In 1979, 25 million auto accidents occurred in the U.S. Millions of drivers and passengers were injured; 27,000 of them died. The cost of hospital and medical treatment for auto injuries was astronomical. And with inflation continuing to spiral, these costs continue to soar.

Many deaths and injuries could be prevented if people would use seat belts and shoulder harnesses, which are standard equipment in all new cars. Unfortunately, fewer than 20% of all automobile occupants use their seat belts.

A federal standard requires that all full-size 1982-model cars automatically protect front seat occupants from serious injury in crashes up to 30 mph.

The auto industry has proven technology to meet these new federal requirements. Safety belts that automatically restrain you is one approach. The air bag restraint system is another.

Extensive testing has proven that air bags can absorb the impact forces in head-on and front-angle crashes, with a cushioning effect that dramatically reduces serious injury. Research has shown that air bag protection can reduce the frequency of head, face, neck and torso injuries by as much as 40%. And the cost is less than many car stereo systems.

Air bag protection is automatic. No initiative is needed from the occupant. However, manual lap belts will still be provided for those who desire additional protection in other than front-angle crashes.

If there are fewer injuries, there will be less medical, hospital and legal expenses. And we will be better able to keep the cost of your auto insurance at a reasonable, affordable level.

### Here's what we're doing to control costs:

- Working through the Insurance Institute for Highway Safety to make cars more crash resistant and highways safer.
- Lowering premiums for cars with air bag or automatic seat belt restraint systems.
- Asking for stricter enforcement of the 55 mph speed limit.
- Encouraging increased use of safety belts.

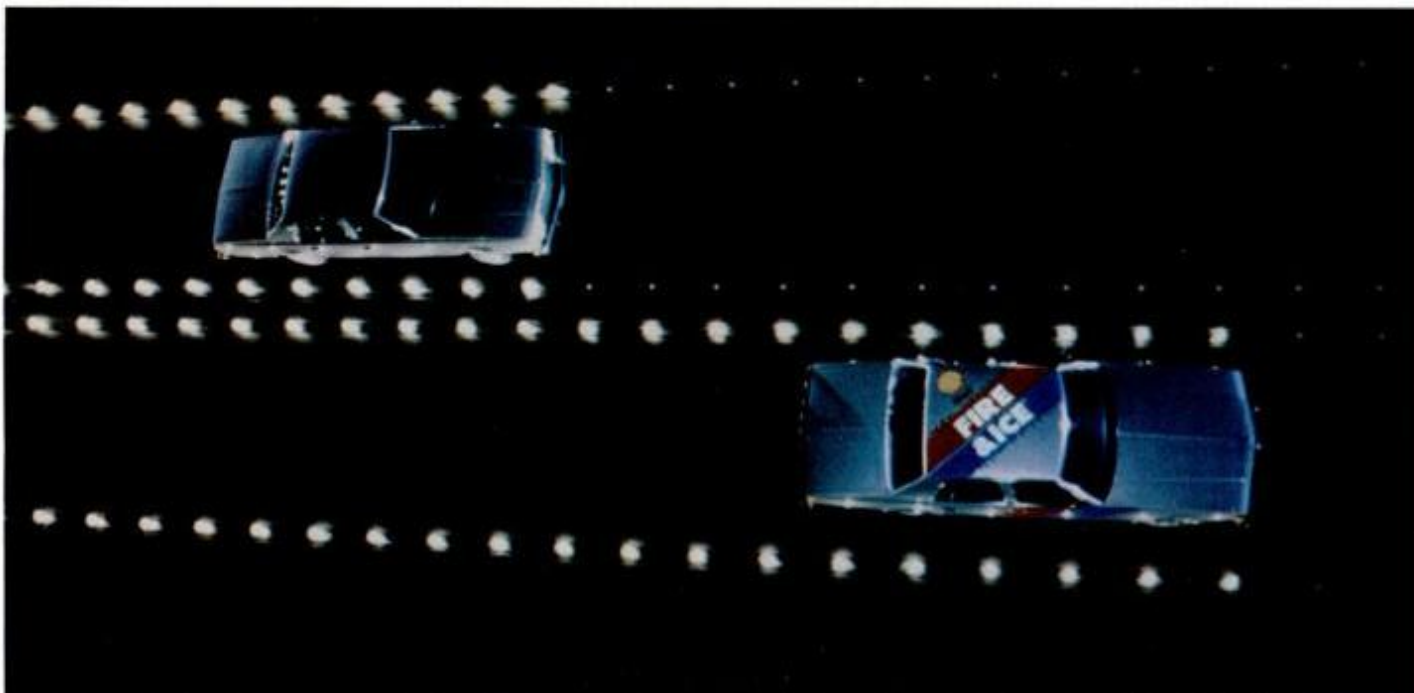
### Here's what you can do:

- Use your seat belt regularly.
- Work in your community to make sure speed laws are enforced.
- Don't drink if you're going to drive.

## Affordable insurance is our business...and yours.

This message is presented by the American Insurance Association, 85 John Street, New York, New York 10038.





Improved Shell Fire & Ice<sup>®</sup> 10W-40 Motor Oil was compared to old formula Shell Fire & Ice for gasoline mileage. Here's what happened.

## Shell Fire & Ice beats Shell Fire & Ice

Shell Fire & Ice first became famous as a protection motor oil. A television commercial seen since early 1979 dramatically showed that Shell Fire & Ice 10W-40 Motor Oil protected a car's engine.

1979



A car frozen in ice starts on the first try using Shell Fire & Ice Motor Oil.



The same car, 36 hours later, using the same Shell Fire & Ice Motor Oil tows a 30-ton crane through desert heat with no engine damage.

But what about gasoline mileage?

Since that television commercial was made, Shell Fire & Ice was

reformulated to improve gasoline mileage — and to do this without sacrificing engine protection.

It's one thing to say a product is improved, another thing to prove it. Shell proved it. How?

Using several different cars under carefully controlled laboratory conditions, we compared the improved Shell Fire & Ice formula to old Shell Fire & Ice.

The results: The cars we tested averaged 17.3 mpg; but with improved Shell Fire & Ice, the cars averaged one-third of a mile farther on every gallon of gas.

### A new TV commercial

With an improved product, it seemed fitting to make a new commercial to dramatize the improvement. So we did.



Two 1980 Chevrolet Caprices get last-minute checks before the television cameras roll.

After all, one-third of a mile is one-third of a mile. It's a distance



Ground-level tracer lights dramatize the extra distance test cars averaged using improved Shell Fire & Ice.

longer than five football fields. It could be the difference between making the next freeway exit or running out of gas. And we're talking per gallon not per tankful.

### Try it in your car

At Shell, we believe in making good products — then making them better. Try Shell Fire & Ice 10W-40 Motor Oil in your car. It's the motor oil that first became famous for protection — then went out and beat itself in mileage tests.

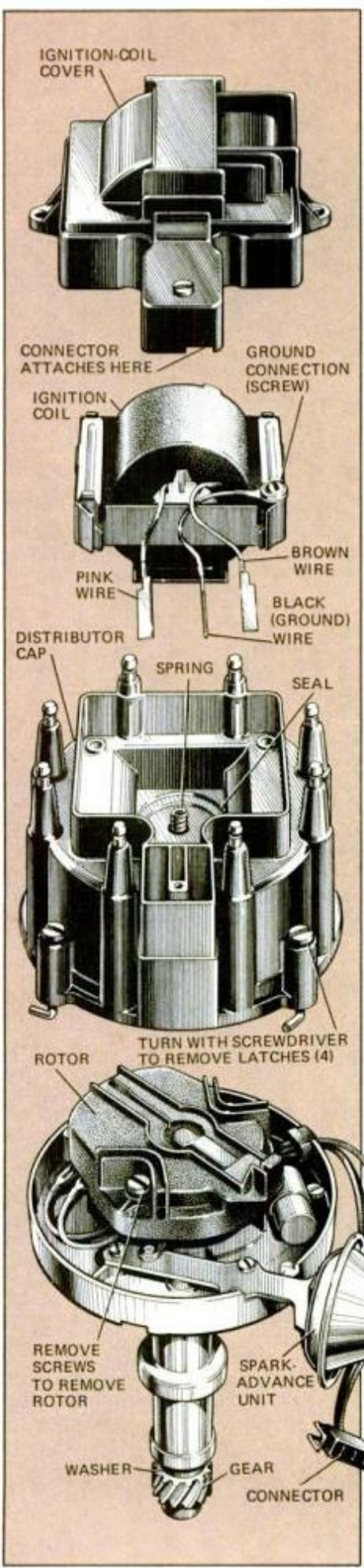




# Repairing the General Motors High Energy Ignition system

Once you know these goof-proof procedures, it'll be a snap to find and fix your HEI problems.

by Mort Schultz



It's been five years since General Motors began installing High Energy Ignition (HEI) in cars. (A limited number of 1974 GM models also possess HEI.) HEI is GM's term for its electronic ignition system.

Although HEI and electronic ignition systems used by other manufacturers are reliable, things happen after five years that cause performance to suffer. Therefore, knowing how to test the system to uncover faults and being able to make repairs will save you money. For example, replacing a defective pickup coil (often called the pole piece) yourself costs about \$20, while having a GM dealer do it for you costs about \$60.

## Signs of trouble

Trouble in the HEI system usually reveals itself in one of the following ways:

- The engine backfires and fails to start.
- The engine starts, but runs roughly at idle and low speed, and/or misfires at high speed.
- The engine cranks briskly, ruling out a battery-starter problem, but fails to start.

If the engine backfires and doesn't start, the distributor cap may be defective. Remove the cap from the distributor and inspect it for visible cracks, carbon tracks which indicate cracks that are hard to see, and worn or burned terminals. Replace a damaged cap.

Backfire may also be the sign of a wet ignition system. Dry the inside of the distributor cap with a clean

cloth. See that sparkplug cables are in good condition.

Rough running, if related to the HEI distributor, is probably being caused by an improperly functioning spark-advance unit or pickup coil. We discuss testing these components below. However, rough running is usually caused by fouled or damaged sparkplugs, bad sparkplug cables or incorrectly adjusted ignition timing.

Starting failure, although the engine cranks briskly, may be caused by a bad distributor cap. It may also result from a defective rotor. Unscrew the rotor from the distributor and check it for cracks. See that the metal contact tip isn't burned and has strong tension as you press on it. Replace a defective rotor.

If the distributor cap and rotor pass inspection, the reason the engine won't start may be a malfunction inside the HEI distributor. The way you test the system in your car depends on the system you have.

## Types of HEI systems

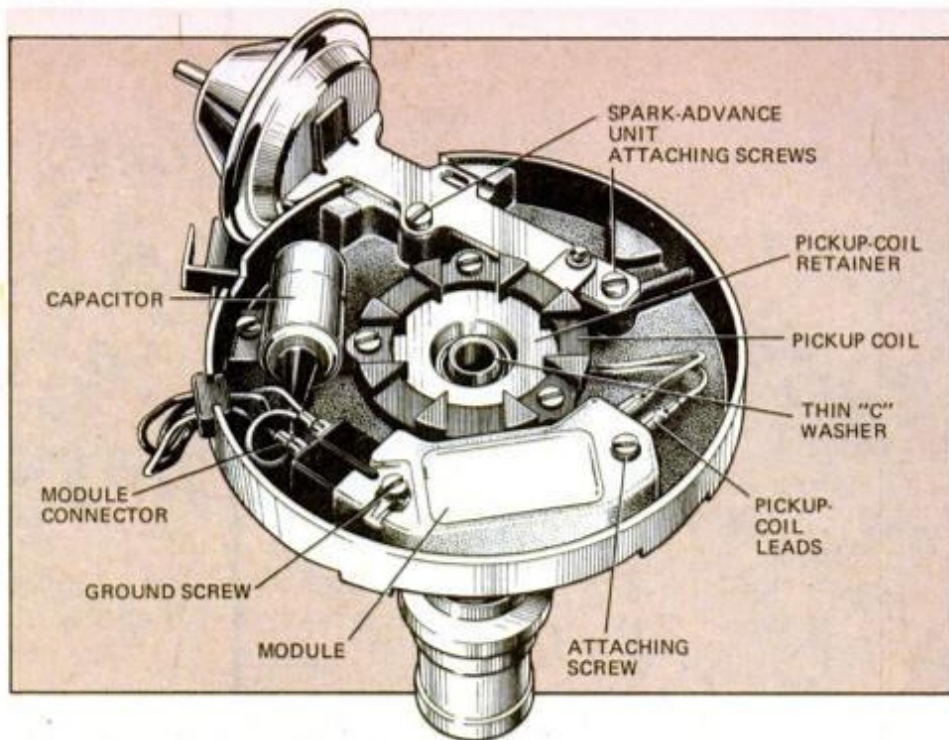
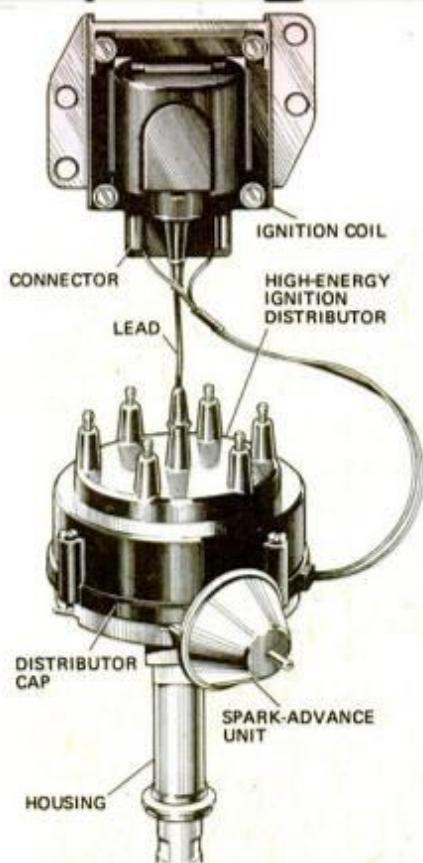
There are two variations of the HEI system. HEI distributors of cars with V6 and V8 engines from 1975 to the present, and four-cylinder and in-line six-cylinder engines from 1978 to the present, have the ignition coil inside the distributor.

HEI distributors of cars with four-cylinder and in-line six-cylinder engines produced in 1975, 1976 and 1977 have all parts, except the ignition coil, inside the distributor. The ignition coil (not to be confused with the pickup coil, or pole piece, mounted inside the distributor) is mounted externally.

Having components housed inside the distributor sets the HEI system apart from electronic-ignition sys-

General Motors' high energy ignition system for V8 engines incorporates the ignition coil inside the distributor cap.





The HEI system for six-cylinder engines (left) mounts the ignition coil outside the distributor cap. To test spark advance for V8 unit (above) you attach vacuum pump and then check for movement of the vacuum-advance unit's shaft.

tems used by other manufacturers. Other systems have the ignition coil and electronic control unit, or module, as independent components mounted separately from the distributor.

### Testing the one-piece distributor

To determine if the HEI system in your car is preventing engine starting, and you have a system where the ignition coil is inside the distributor, do the following:

1. See that all wires and cables are tightly connected at the distributor and at sparkplugs.

2. Use a voltmeter to determine bat-

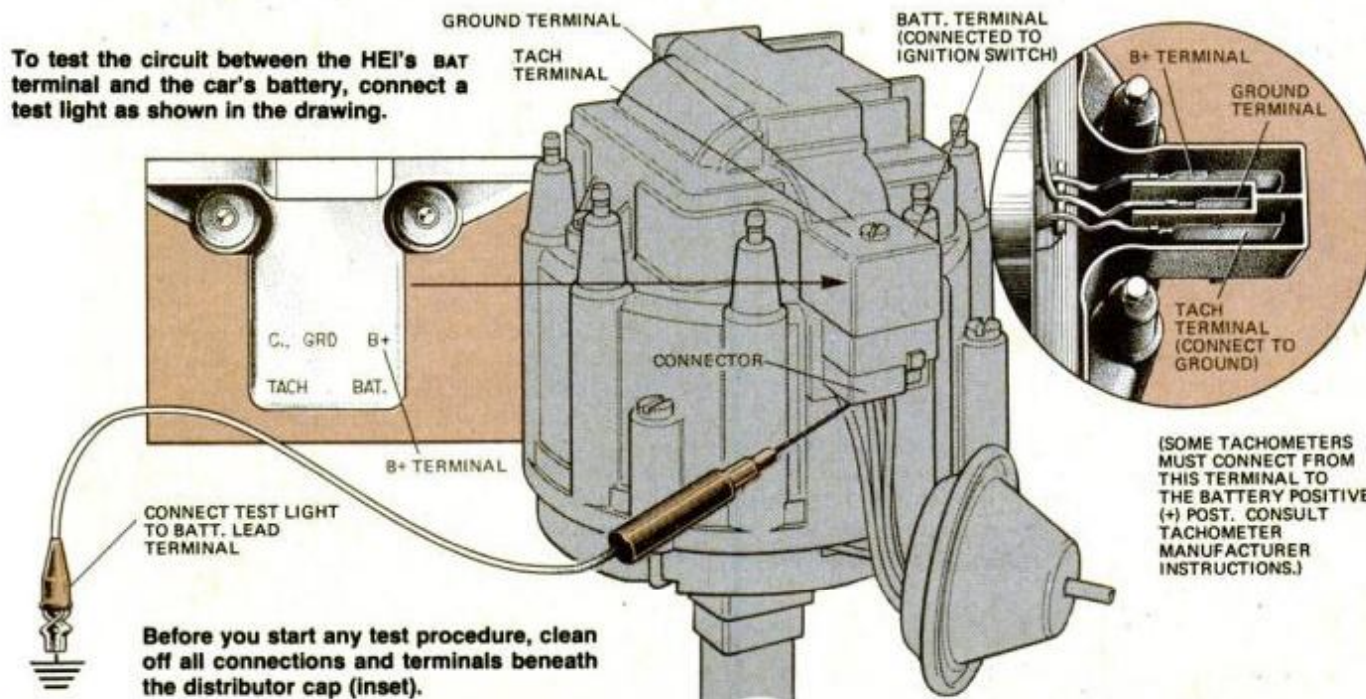
tery cranking voltage. It should be a minimum of 9 volts. If not, charge the battery and check the cranking voltage again. Voltage must be at least 9 volts to do the test.

3. Connect the positive (+) lead of a voltmeter or a 12-volt test light to the distributor BAT lead terminal, and connect the voltmeter or test light negative (-) lead to a ground on the engine. The place where you attach the negative lead must be clean and dry to assure a good ground connection. Turn on the ignition switch.

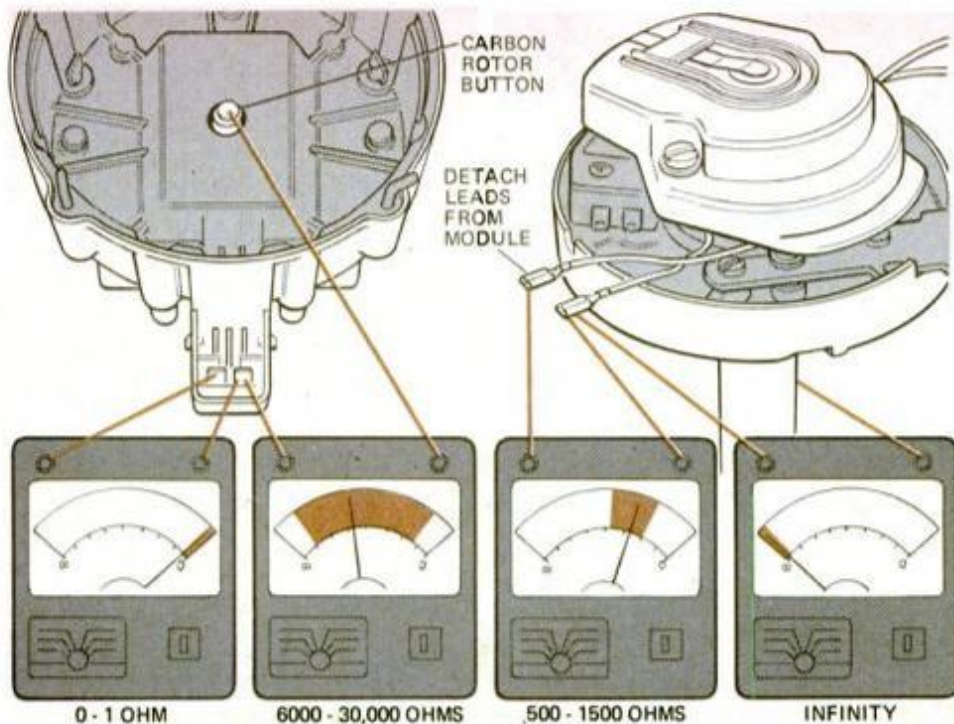
Result: If the voltmeter or test light doesn't record any voltage, the circuit between the distributor BAT

terminal and battery is open. Check all connections and wires. If the voltmeter or test light records battery voltage, turn off the ignition switch, disconnect the voltmeter or test light and proceed to the next step.

4. Using insulated sparkplug cable pliers, remove a cable from one of the sparkplugs. Insert a screwdriver in the sparkplug boot so the tip of the screwdriver makes contact with the cable terminal. Holding the sparkplug boot with insulated sparkplug cable pliers so you won't get a shock, place the shank of the screwdriver about 1/2 inch from a ground on the







To test ignition coil, make the connections shown above left. To test the pickup coil connect the meter as shown on the right. Readings must be in the indicated range.

engine. Have someone crank the engine momentarily.

**Result:** If an intense spark jumps the gap between the screwdriver and ground, turn your attention to another part of the engine, such as the fuel system, that could prevent starting. The HEI system is okay. On the other hand, if there is no spark, or a weak spark, reconnect the sparkplug cable and proceed to the next step.

**5. Release the four latches holding the distributor cap to the distributor.** Lift the cap straight up. If you slant it, the carbon rotor button in the top of the cap may break off.

**6. Inspect the distributor cap and rotor for damage, as explained above.** Assuming both are in good shape, disconnect the connector from the distributor cap. Turn the cap upside down and attach an ohmmeter across the BAT terminal and TACH terminal. Place the ohmmeter on the XI scale.

**Result:** If the ohmmeter reading is 0 to 1 ohm, showing continuity, proceed to Step 7. If the ohmmeter reading is more than 1 ohm, replace the ignition coil as follows:

■ Remove the three screws holding the ignition coil cover to the distributor cap.

■ Remove the four screws holding the ignition coil to the distributor cap. The front righthand screw, as you face the coil wires, serves as the ground connection.

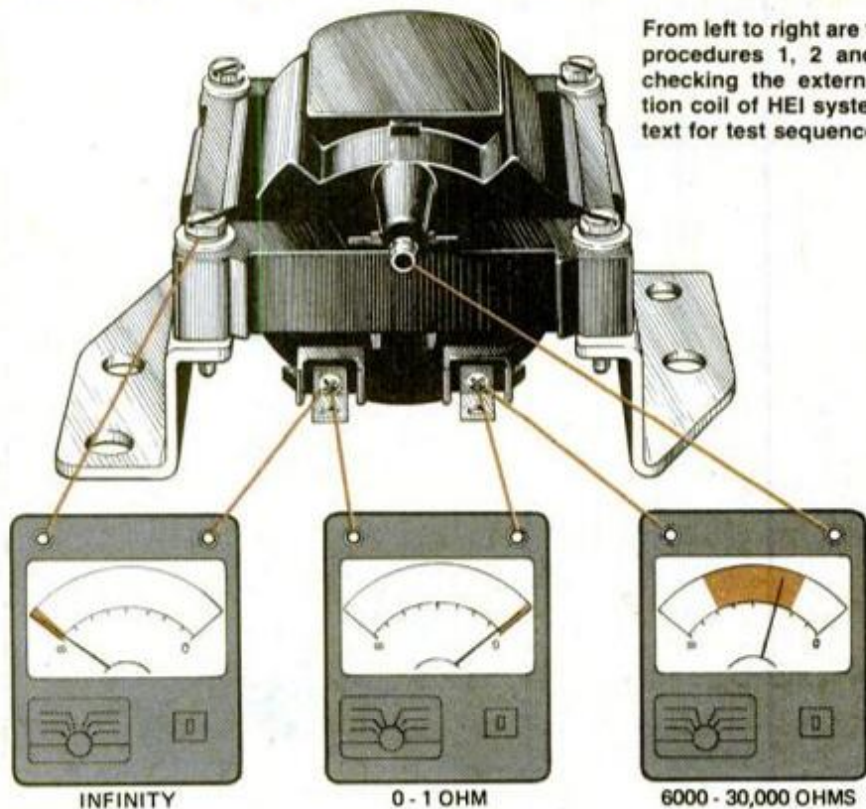
■ Disconnect the coil wires from the connector in the distributor cap and gently pull them from the cap. Use tweezers to prevent damage to the

wires, which are rather fragile.

■ Remove the coil.

■ Put a new coil in the distributor cap, and push coil wires into the connector in the cap. Position the black wire, which is the ground wire, in the center. Place the brown wire next to the spark-advance unit. Put the pink wire farthest from the spark-advance unit.

■ Install the screws that hold the ignition coil to the distributor cap. Connect the black wire under the



screw serving as the ground before tightening the screw.

**7. Attach an ohmmeter across the BAT and ground terminals.** Set the ohmmeter to the X1000 scale.

**Result:** If the ohmmeter scale shows a reading of less than 6000 ohms or more than 30,000 ohms at both points, replace the ignition coil. If the ohmmeter scale shows a reading other than 6000-30,000 ohms at one point or neither point, the ignition coil is okay.

**8. Disconnect the vacuum hose from the spark-advance unit.** Check the hose to make sure it isn't cracked. Replace a bad hose.

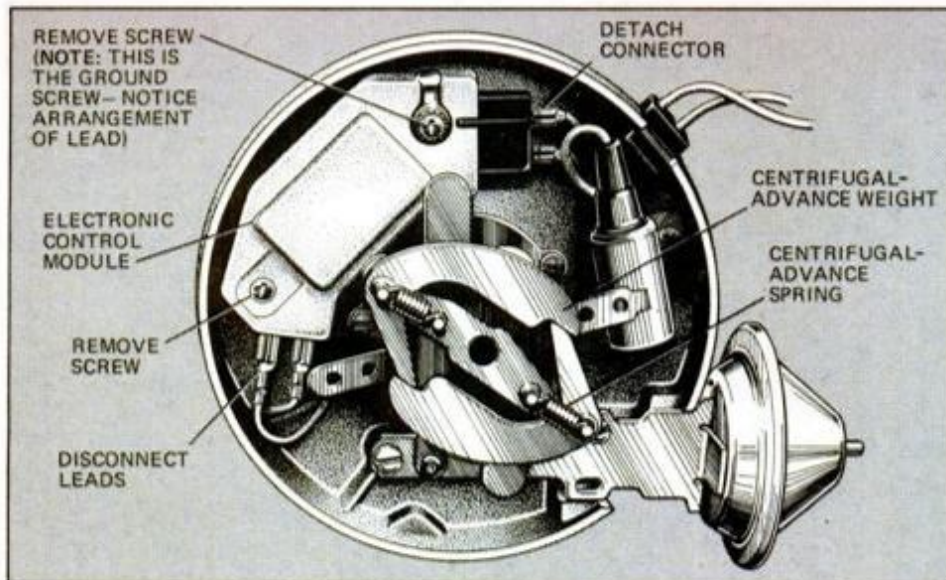
Connect a hand-vacuum pump to the spark advance. Apply vacuum while watching the pickup coil. The spark advance is connected by a link to the pickup coil.

**Result:** If the pickup coil doesn't rotate, the diaphragm inside the spark-advance unit is defective. Replace the spark-advance unit by detaching the link from the pickup coil and unscrewing the unit from the distributor housing. If the coil moves as vacuum is applied, proceed to the next step.

**9. Disconnect the two pickup-coil leads from the control module, and connect an ohmmeter across one lead and a good ground.** The distributor shaft is a good ground. Use needle-nose pliers so you won't damage wires by pulling them. It's important to make note of which wire attaches to which connection. Set the ohmmeter to the X1000 scale. Apply vacuum to the spark-advance unit

From left to right are the test procedures 1, 2 and 3 for checking the external ignition coil of HEI system. See text for test sequences.





When working on the interior of distributor, be certain that you don't touch leads or connectors with your fingers. Use needle-nose pliers and tweezers.

to get the pickup coil to rotate through its entire range of travel.

**Result:** If the ohmmeter shows other than an infinity reading, replace the pickup coil as follows:

■ Remove the distributor from the engine, but before doing so mark the position of the rotor. Place an awl across the rotor so it extends to an adjacent point on the firewall or engine.

Make a mark on the firewall or engine. When the distributor is returned to the engine, line up the rotor and mark this to insure correct timing of the distributor.

■ Lay the distributor on the workbench and support the gear end on a block of wood. Scribe a mark from the distributor gear to the distributor shaft.

When you have put the gear back on the shaft, line up the marks.

■ Drive out the roll pin that is securing the gear to the shaft and remove gear.

■ Now, pull the distributor shaft from the distributor housing.

■ Remove the centrifugal advance springs, weight retainer and advance weights.

■ Remove the thin retainer ("C" washer) on top of the pickup coil and remove the coil. There isn't any need for you to remove the three screws that hold the assembly together.

■ Install a new pickup coil and replace the distributor by reversing this procedure. If you see a felt wick on the distributor shaft, put two or three drops of motor oil on the wick before installing the coil. In attaching wires, make sure they are connected to their correct terminals on the electronic module.

**10. Connect an ohmmeter across both pickup-coil leads.** Apply vacuum to the spark-advance unit to get

the pickup coil to rotate through its entire range of travel. Watch the ohmmeter scale.

**Result:** If the ohmmeter scale at any point shows a reading of less than 500 ohms or more than 1500 ohms, replace the pickup coil.

**11. If the cause of the starting or rough running problem still hasn't been uncovered,** the electronic-control module may be to blame. Testing the module requires a special instrument available at GM service shops. If the module has to be replaced, disconnect wires and unscrew it from the distributor.

### Installing a new module

When installing a new module, be sure an electrically conductive grease is applied to the metal face at the underside of the module and to the module seat that is in the distributor.

This grease, which prevents corrosion and allows the module to cool, usually comes with a new module. If it doesn't, use General Electric Di-

electric Heat Transfer Compound G642, Dow-Corning Heat Sink Compound 341 or Dow-Corning 5 Compound.

If you should have a problem getting grease from a Delco parts or GM dealer, check with a company that sells electronic parts.

### Testing the external ignition coil

If your GM car has an HEI system that features an external ignition coil, all procedures are done in the same way, except for testing the ignition coil.

In order to do this, proceed as follows:

■ Connect an ohmmeter to test procedure No. 1, as shown at the bottom of page 37.

You must set the ohmmeter on the X1000 scale.

**Result:** If the ohmmeter scale does not show an infinity reading, replace the ignition coil by disconnecting the coil-to-distributor cable and unbolting the coil.

■ Now, connect the ohmmeter to test procedure No. 2. Set the ohmmeter on the X1 scale.

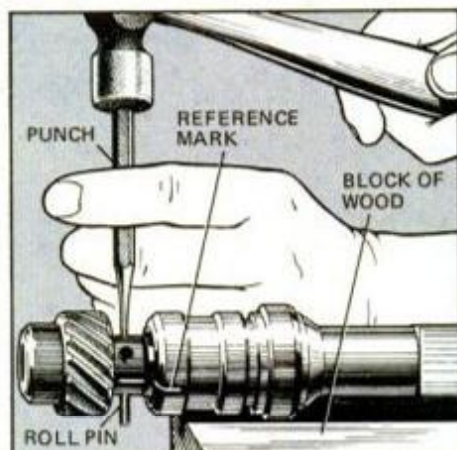
**Result:** If the ohmmeter scale does not show a reading of 0 to 1 ohm, you'll find it necessary to replace the ignition coil.

■ Finally, connect the ohmmeter to test procedure No. 3. Set ohmmeter scale on the X1000 scale.

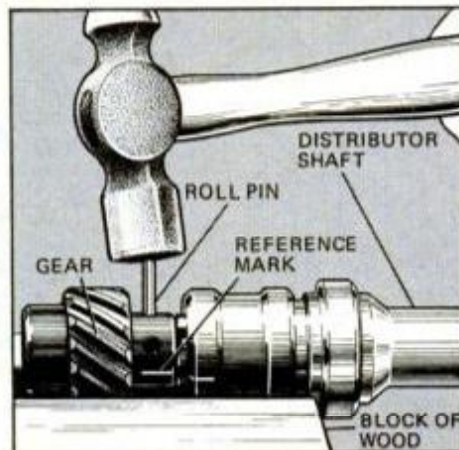
**Result:** If the ohmmeter scale reads more than 30,000 ohms or less than 6000 ohms, replace the ignition coil.

You may wonder why we've not mentioned the capacitor inside the HEI distributor. This component doesn't have anything to do with ignition. It is used for radio noise suppression.

After working on the HEI distributor, be sure that you take the time necessary to adjust ignition timing to the proper specification for your automobile. **PM**



To drive out roll pin, rest the shaft on a block of wood and tap pin with a punch.



To install roll pin, support the shaft and gear on soft wood and tap in gently.



Richard Petty says,

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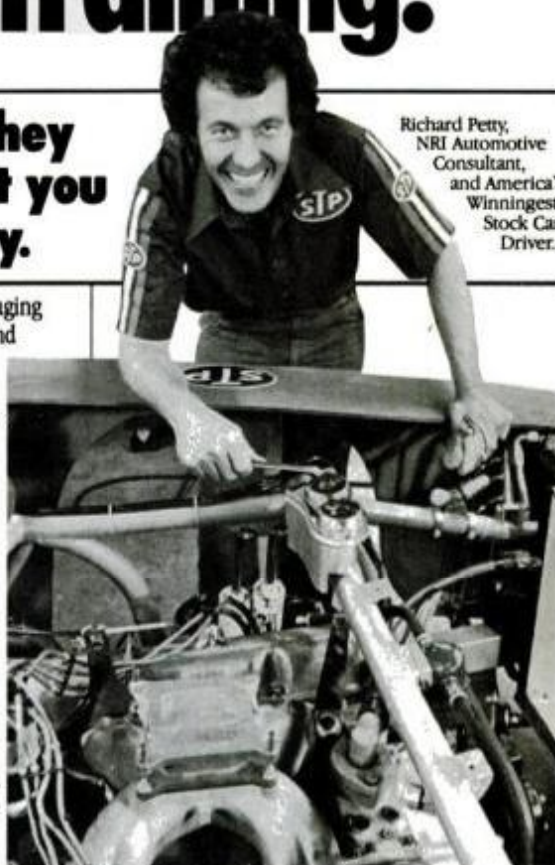


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covering foreign cars, running or managing a business, body and framework, etc. And you get the master instrument for the master mechanic, the Heath ignition analyzer oscilloscope. Built by one of the most respected names in electronics, it lets you "see" the motor at work, even tune up high performance and racing engines.

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# CAR CLINIC

## SOLUTIONS FOR MECHANICAL HEADACHES

BY MORT SCHULTZ



### Off the scuff

Recently, I had to have new pistons, rings and connecting rods installed in the 2.3-liter engine of my 1975 Ford Mustang II. This was done at 50,000 miles and cost \$700. Two pistons had scuff marks running up and down their sides. In fact, the mechanic described the condition as "piston scuff."

The mechanic told me the cause of the problem was the inability of connecting rods to splash adequate lubricating oil onto upper cylinder walls, and that he had to install a newly designed connecting rod. Additionally, I read an article which stated that some Ford models had defects that cause piston scuff. Do you think my car falls into this category? If so, is there anything I can do to get reimbursed for repairs?—Matthew P. Kinutis, Manchester, Mo.

Piston scuff is likely to strike 1974-77 Mustangs, Pintos, Bobcats and Capris equipped with the 2.3-liter engine, so your car is in this category. In addition, piston scuff also affects 1975-77 Mavericks, Granadas, Comets and Monarchs equipped with 200- and 250-cu.-in. engines. In May 1977, Ford issued service bulletins to dealers describing what has to be done to solve the problem. The service bulletins also establish ground rules concerning warranty provisions.

Service bulletin 134, article 1834, issued May 9, 1977, covers cars with 2.3-liter engines; service bulletin 135, article 1854, issued May 24, 1977, deals with 200- and 250-cu.-in. engines. They substantiate what the mechanic told you. They state:

"Piston scuff noise may be alleviated with the installation of new connecting rods and bearings, assuring proper piston fit to the cylinder bore upon replacement. The improved connecting rod and bearing provide an oil-squirt hole for increased lubrication to the cylinder wall. Replace all connecting rods and rod bearings using the new parts."

According to the service bulletins,

this repair is "reimbursable under the provisions of the warranty." However, this is amended to apply to an "extended policy." It is this "extended policy" provision, which has been referred to as a "secret warranty," that caused the Federal Trade Commission to bring suit against Ford Motor Co. To make this long story short, Ford had been reimbursing some car owners for repairing piston scuff, while other people were not being reimbursed.

To find out what the present policy is and where you fit in, Matthew, I asked Ford. I was told that the policy has three main provisions, as follows:

1. Ford will repair, free of charge, those engines covered by the piston-scuff warranty policy. This warranty is for 36 months or 36,000 miles, whichever occurs first.
2. If an owner has paid to repair the engine of a car that falls within the 36-month or 36,000-mile interval, Ford will provide reimbursement as long as repairs can be documented.
3. Ford will consider complaints of owners whose cars exhibit piston scuff that exceeds the 36-month or 36,000-mile interval. If an engine

has piston-scuff noise, or if repairs were made after the car exceeded the 36-month/36,000-mile interval, the owner should talk to a dealer and to the Ford district office for his area. District offices are listed in the owner's manual.

By the way, warranty provisions covering piston scuff apply to all owners of the cars involved—those people who buy cars used, as well as those who purchased their cars brand-new.

### Mumbo jumbo

I have a 1978 motor home on a Dodge chassis equipped with a 440-cu.-in. engine. At 8000 miles, the engine started knocking at speeds above 45 mph. Knocking becomes louder as speed and mileage increase. The Chrysler field representative claims, "The noise is normal and is due to a buildup of tolerances in the valve train." Do you think this is possible?—Al Badalamento, Warren, Mich.

To tell the truth, Al, I don't know, because I can't figure out what the Chrysler representative is saying. It sounds like double talk, so let's start with basics.

Is this a spark knock? It could be, if ignition timing isn't set exactly to the specification on the vehicle emission-control label. Furthermore, distributor damage, including damage to the spark advance, will cause spark knock.

Engines in motor homes are particularly susceptible to carbon buildup, because the average motor home is kept idle for comparatively long periods. Carbon buildup causes preignition, which produces knocking.

I would investigate this possibility. You might pour chemical carbon

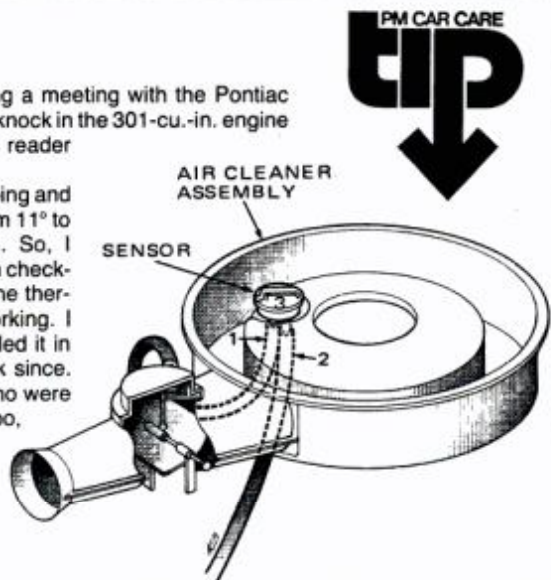
(Please turn to page 44)

### Making sense

"Repeated trips to the dealer, including a meeting with the Pontiac zone people, failed to resolve a severe knock in the 301-cu.-in. engine of my 1978 Pontiac Bonneville," says reader Tom Rosenkranz of Milwaukee.

"They insisted it was normal engine ping and kept retarding the timing all the way from 11° to 5° Before Top Dead Center (BTDC). So, I spent \$10 for a shop manual and began checking the car myself. I finally found that the thermostatic air cleaner (TAC) wasn't working. I purchased a new sensor for \$9, installed it in 10 minutes and haven't had the knock since. I've shared this with several owners who were having the same trouble, and they, too, found their TACs not working. Hope it helps Car Clinic readers."

You can count on it, Tom. It's a good tip to keep in mind for all cars having thermostatic air cleaners.







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3 mg. "tar," 0.4 mg. nicotine av. per cigarette, FTC Report Jan. 1980.

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## CAR CLINIC

(Continued from page 42)

solvent into the engine to determine if it affects knocking. You can purchase solvent at an auto parts store.

If none of this helps, get the Chrysler field office back on the phone and ask them to send another representative—this time one who talks with a straight tongue.

### Ignoring facts

*Not long ago, I read in PM that the 1977 Chevrolet Monte Carlo has been recalled to repair a defect that could cause the rear axle to break. I called the Kansas City customer service department of GM, and the man said he knew nothing about this. Please comment. I own one of these cars.—Mrs. D. Gillespie, Pleasant Hill, Mo.*

I'll comment, okay. Bah! Quote this guy chapter and verse, Mrs. Gillespie. The manufacturer recall campaign number is 77C26. The National Highway Traffic Safety Administration (NHTSA) number is 78V-138. The date NHTSA notified the company that the recall was necessary is June 6, 1978. The recall involves 265,068 1977 Chevrolet Monte Carlos and Malibus, Pontiac Le-

Mans and Gran Prix, Oldsmobile Cutlasses, and Buick Centurys and Regals. The reason for the recall is the possibility of a flaw in the metal of the rear axle shaft. As a result, the shaft could break, allowing the tire and wheel assembly to separate from the car. The repair procedure is to inspect the shaft and replace the axle, if necessary.

### A guy named Joe

*Have you heard of any widespread front-end noise problems with the GM X-body cars? When I make a hard turn with my 1980 Pontiac Phoenix, there is a loud metallic clunk. The dealer lubricated the area, but it didn't help. Now he says the noise is characteristic of the vehicle.—Ralph Del Vecchio, Howard Beach, N.Y.*

If front-end noise is characteristic of this vehicle, it's news to me. It's also news to one of the most knowledgeable X-body technicians—a guy who works for Pontiac (the company, not a dealer).

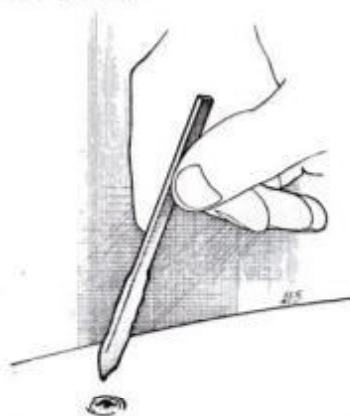
According to Joe (not his real name), the noise is probably coming from the rack-and-pinion steering. Steering may be overriding the stops and going to the end of its travel.

## Chip off the old block



Chips in car-body paint, which can eventually work themselves into rust spots, can be easily repaired if you follow this procedure:

- Clean the damaged area thoroughly, using a wax remover. Allow the spot to dry.
- Dip the end of a wood matchstick in paint that has been well stirred. Dab a few drops on the spot. Then, let the paint dry.
- When the paint has dried, use an auto-body polish to treat the area, if the paint on your car is enamel. If the paint is lacquer, first rub the spot gently with auto-body compound and then polish it.



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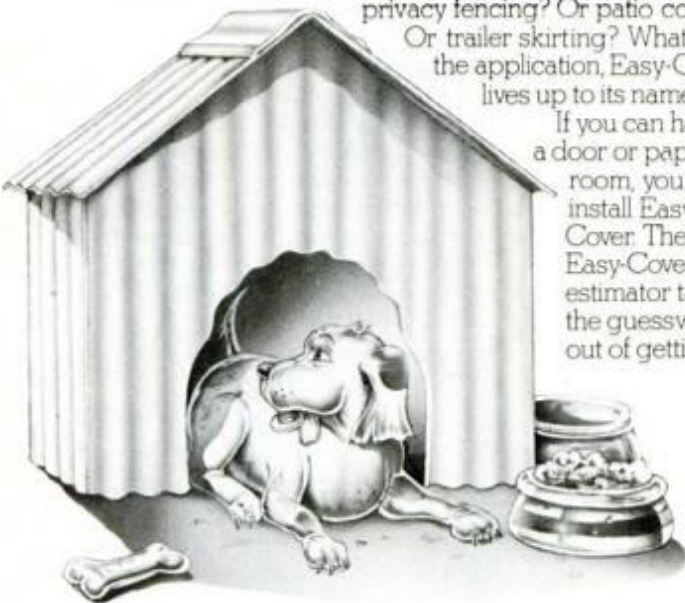
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"The dealer," says Joe, "should find out what's happening by lifting the car and looking as the steering wheel is moved from one extreme to the other. If this is too complicated for him to do, your *Car Clinic* reader should take the car to another GM dealer or call the GM zone office."

That's good advice, Ralph.

## So what's new?

*My parents own a 1980 Chevrolet Citation that gets its kicks by blowing fuses.*

*The fuse that it always blows controls the horn, dome light and seat-belt buzzer. We've taken the car to the dealer, but he says all we can do is keep installing new fuses. This gets quite expensive, because those fuses are the new rectangular kind. What should we do?—Rod Meyer, Burt, Iowa*

Get yourself another dealer. Your parents should not have to live with this problem. Fuses blow, normally, because there's a short in the circuit.

This means that each section of a circuit protected by the fuse has to be checked with a continuity tester to find the cause of the problem. To do this, you need the wiring diagram for your car. This procedure for lo-

cating the cause of a blown fuse has been the same since auto fuses were developed. The procedure hasn't changed just because the fuse is in the new X-body model.

I would start by checking the horn circuit. There's more chance of a horn wire being pinched and shorting out in the steering column than of dome-light and seat-belt buzzer wires being affected. The steering wheel has to come off to test the horn circuit. This is no big deal. The steering column setup in the X-body is pretty much the same as the steering column used in GM cars since 1969.

I've said it before, and I'll probably say it again and again: If one dealer can't help you, then find another one.

You're not locked into the dealer from whom you bought the car. If you can't find a dealer who can solve the problem, call the GM zone office.

## GOT A PROBLEM WITH YOUR CAR?

Just ask Mort about it. Send your question to the *Car Clinic*, *Popular Mechanics*, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems that are of general interest will be published in the column.

## Safety and service tips

■ If you are the owner of a 1980 Datsun 310 that was manufactured between October and December 1979, your car has been recalled so that repairs can be made on the transmission main shaft locknut.

There's a chance that the nut may work loose, which would cause the transmission to become inoperable.

■ An Audi 5000 that must have its power-steering fluid replenished often, or is hard to steer, may need to have repair kit No. 431498020A installed. You can ask your dealer to check on this possibility by having him refer to repair manual supplement No. 17 (12/79).

■ Do you have a 1980 Chrysler Corp. car with a 225-cu.-in. engine, a one-barrel carburetor and an automatic transmission that takes a long time to start when it's cold and/or has engine sag on a cold driveway?

Here's a possible solution to the problem: Have part No. 4240063 (driveability package) installed according to service bulletin No. 14-06-80.

■ Take a close look at the heater return hose of your 1980 AMC Spirit, Concord or AMX with airconditioning.

There may be some chafing present on the left rear corner of the compressor. If this is the case, you should tie the hose back so it clears the compressor. **PM**



# NEW NOW



# CAMPING

## Trailered tent-cottage



The European tenting look has come to camping trailers. The new Conway Cottage Camper opens from a compact tent-trailer into a 200-square-foot unit that sleeps seven, but can fit nine into enclosed double bedrooms. For storage, the 540-pound rig can tip up on its side (below). When it is towed, the 3½-foot height doesn't block rear vision, has minimum wind resistance and opens at the end for picnics (below left). It sets up in 20 minutes; the price is \$2500 from Conway Trailers, C.R.6, Elkhart, Ind. 46514.



## Get a wider look at the wide open spaces



Oversize picture windows, 35×108 inches on the driver's side and 35×50 on the passenger's, are big features of a new Limited Edition van from Coachmen Industries. The deeply tinted windows are made of Lexan. Other custom additions include mag wheels, running boards, fog lights, power roof vent, four recliner chairs with map lights, couch and pedestal table, overhead-console tape system and polished chrome spare tire cover.

## Safer storage

To secure a gun in an RV, camp or home, the Istec Gun Mount can use any heavy-duty padlock to fit through a trigger guard stud.

The unit mounts quickly, prevents tampering by children or intruders and allows easy access. The cost is \$15.95 postpaid from Istec Security Mounts, 55 Knolls Crescent, Riverdale, N.Y. 10463.



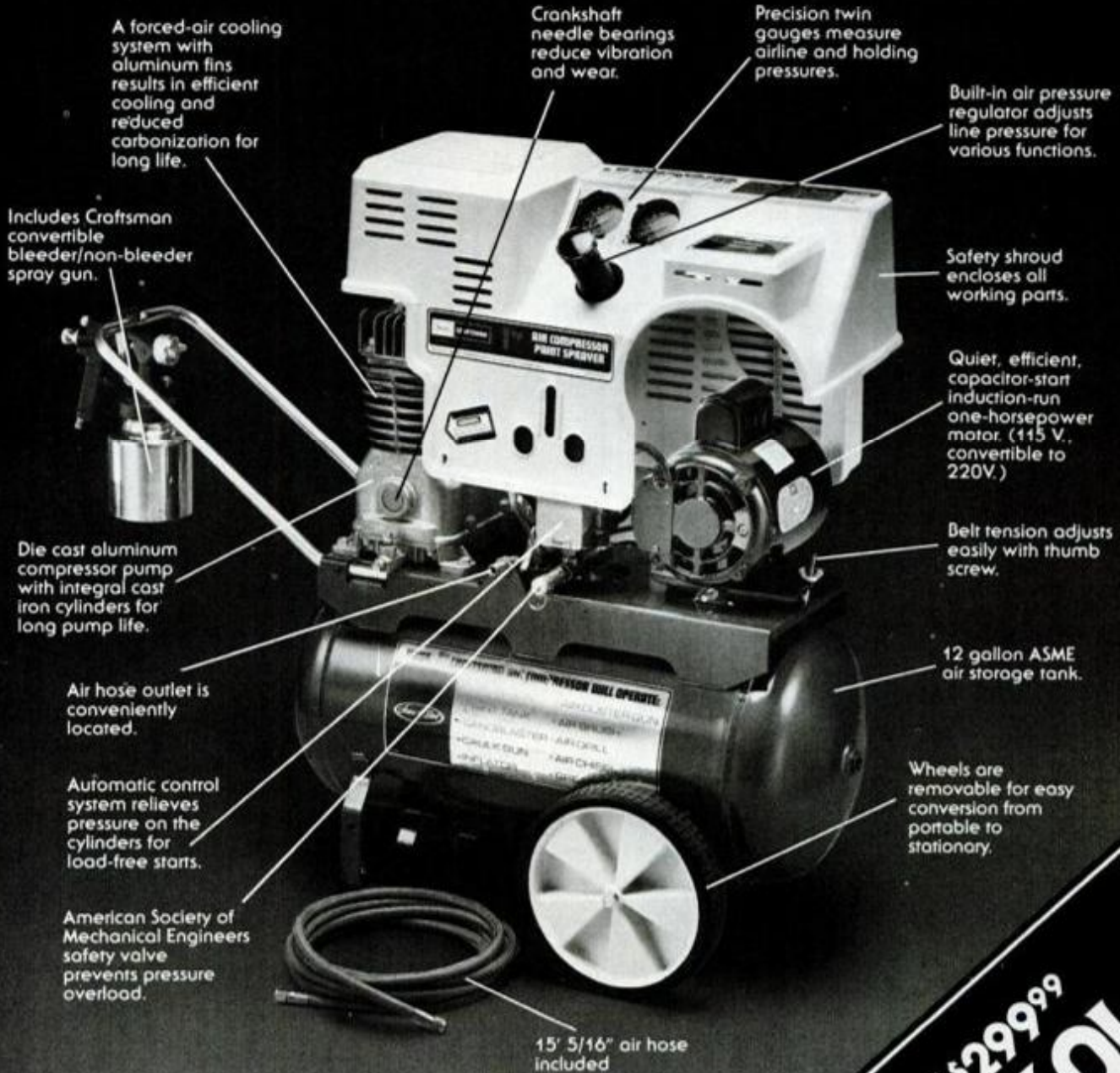
## Custom fifth-wheel trailer tow



Towing in style is offered with a special toter unit from Holiday Rambler, Wakarusa, Ind. Designed to match the fifth-wheel travel trailer behind it, the unit is built on a 158-inch Ford chassis with 11,000 GVWR. The gas-tank capacity of 170 gallons allows a range of approximately 1200 miles before refueling. Originally designed for delivery of trailers to dealers, the toter has a cab fitted with an optional flip sofa that can be used as an additional sleeper. Also optional is LP gas as an alternate fuel source for the transporter.



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# ALL OUTDOORS

## National hunting and fishing

Every year in September—this time it's Saturday, the 27th—outdoorsmen have the chance to demonstrate the skills that go with the pleasures of fishing, shooting, camping, backpacking, archery, boating, climbing, bird-watching, nature photography, orienteering, RV travel and the multitude of activities that make up outdoor sports.

Demonstrations, instruction and displays will be offered around the country—check local sports clubs, shopping centers and outdoor equipment stores for when and where the action will be. Most active of all conservationists are outdoorsmen, the ones who pay the fees and taxes that support ecology programs and wildlife management. The annual National Hunting and Fishing Day is a chance to show what our outdoor tradition is all about.

## New shooter

Just introduced by Charter Arms is a multipurpose mini-cousin of its .22-caliber Explorer AR-7. That's the handy camping and survival automatic-loading rifle that comes apart to fit into the stock for a watertight package that can even float. The new Explorer II pistol is also versatile and swaps barrels from an



A pistol version of Charter Arms' AR-7 survival rifle, the new Explorer II will come with interchangeable barrels.

8- or 10-inch for targets and varminting, to a 6-inch tube for easy packing. The clip will hold eight rounds, while a loaded spare may be stored in the grip as well. Another option will include a mount for a scope.

Just like the 2½-pound AR-7 rifle, this kid-cousin Explorer II pistol disassembles for even more compact portage. It is a light 20 ounces, has an adjustable rear sight and sells for \$99.

## Break strength

While all fishing line is sold on the basis of the amount of pull it can resist before it comes apart, a lot of factors between the fisherman and the fish can influence how well it works and how long it lasts. Some cheap line will get brittle or take a permanent curl after sitting on a spool or reel too long. Others are affected by temperature, sunlight's ultraviolet rays, stretch, abrasion,



Breaking strength for wet and dry, new and abraded Du Pont Stren fishing lines get tested as McKeown, Tattersall watch.

and chemicals in the water, the bilge and the air.

Recently, Du Pont changed the formulation of its Stren monofilament line. We toured its research and development labs to look at testing procedures and check their claim that New Stren has found a better way to fight off rough rocks, barnacles and sand, worn rod guides and fatigue from constant use. With Bill Tattersall and other engineers, we watched while competitive brands were analyzed on machines that would dazzle a crime lab. Line was tested worn-down, wet and dry; subjected to abrasion devices and stress-tested on machines like the Instron shown. In the lab, at least, the new line showed marked improvement. Now we'll try a fish.

## How to—where to

This fall 27 states will require the use of steel instead of lead shot for the waterfowl hunting season. Ducks and geese eat spent lead shot and two million have been dying each year from lead poisoning. Steel shot will come in 10, 12 and 20 gauge for the four flyways affected.

From Bantam paperbacks, *Great Cooking Outdoors*, by Gale and Bev-

erly Holsman, is the newest and best of guides to what and how to eat in style at your campsite. Techniques and recipes are a bonus.

And, in this America's Cup challenge year, the best of inside explanations and descriptions is in the book, *America's Cup Fever*, by premier skipper-writer Bob Bavier and worth its \$14.95 price.

## Sport snapshots

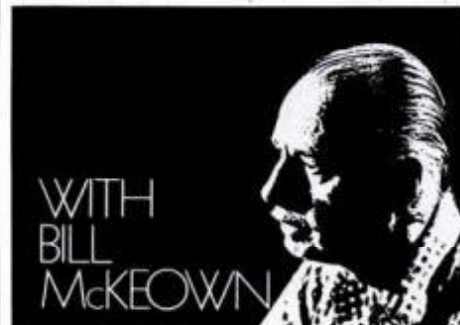
In our continuing search for the best outdoor camera, the latest contender is a new weatherproof HD-S Fujica. Unlike the Minolta Weathermatic-A, it uses 35-mm film. Unlike the Nikons, it has automatic exposure and a built-in strobe flash. Though it isn't designed for skin diving, the HD-S can take water sports afloat and dusty work ashore as well. To clean it off, just rinse it.

At about \$265, it is not inexpensive, but it is light and compact, will fit in a pocket or backpack, and should keep shooting (at from 1/8 to 1/500) through years of rugged going.



All-weather photography is possible with HD-S Fujica 35-mm auto-exposure camera with built-in flash. It's rain- and dustproof.

Fortunately, it has that bonus for the solo sportsman—a built-in self-timer. Right now, the Fujica HD-S is available primarily through top sporting goods mail-order sources like Easy Winters in Seattle and L.L. Bean in Freeport, Me. For other outlets, drop a note to Fuji Film, 350 Fifth Ave., New York, N.Y. 10001. **PM**







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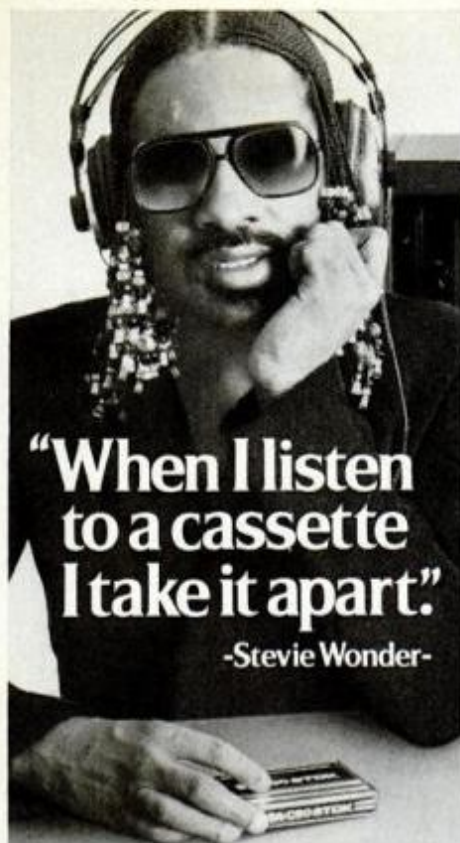
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05		





**"When I listen  
to a cassette  
I take it apart."**

**-Stevie Wonder-**

Stevie's reputation as a perfectionist is well known. Before he takes a cassette home, it must deliver big studio sound. The kind of sound he can't take apart.

The cassette Stevie likes most is the high bias TDK SA. TDK SA has a startling musical memory. You'll hear the full timbre of the human voice. The vibrant dynamic energy of strings. The blast and bluster of rock. No nuance is beyond its range. No instrument is forgotten.

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\*In the unlikely event that any TDK cassette ever fails to perform due to a defect in materials or workmanship, simply return it to your local dealer or to TDK for a free replacement.

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## PM LOOKS AT SPITFIRE PROPANE TORCH



Spitfire kit No. 408-01 includes propane tank, pressure regulator, large and small torch, flame spreader, heat shield, spark lighter, 50/50 solder, aluminum rod, bronze and stainless-steel brazing rods, fluxes, brush and orifice wrench.



When you turn on the regulator knob completely and ignite the torch, it produces a dark blue flame, which is advantageous for all brazing and soldering operations. You can swivel the tip 360° for easy and safe aiming at the workpiece.

**A**ccording to its maker, the Spitfire propane torch delivers more heat than conventional propane torches. After using the torch, I can say this is not an overstatement.

Without the need for auxiliary oxygen pellets, I was able to do light brazing of iron, stainless steel and aluminum with the Spitfire. I also tried it out sweating copper plumbing. It did the job without having to drain the system.

A design feature called Swirl Combustion gives the Spitfire its advantage. Here's how it works: The torch head has an automatic pressure regulator that is simply opened all the way. (I didn't have to fuss with adjusting the gas flow.) A jet-pump venturi sucks in the correct amount of air for proper combustion. Then a helical flameholder in the flame tube starts the gas/air mixture spinning. Combustion begins and the hot gases expand, generating a high-velocity swirl.

The swirling gas spins the heavier gases to the outside edge. These gases act as an insulator, keeping the heat in the flame as it's directed onto the target. The design results in a very stable flame, which is extremely effective at heating.

In situations where the heat needed to be dispersed rather than directed at one point, I attached the flame-spreader accessory. It was helpful, for example, when heating floor tiles for cutting.

In addition to the kit accessories shown, a *deluxe kit* includes a small tip for light work and a heat shield for working near combustible surfaces.—Rosario Capotosto



You can mend a loose connection in copper plumbing without having to fully drain the system. However, it is necessary to turn off the water in the line upstream from the point where the repair will be made. Also open a downstream valve so that building pressure—from water boiling at the joint—can be relieved.



Using flame-spreader accessory, asphalt tiles are gently heated on their underside. Heat makes them slightly pliant so they conform to the contour of the floor.

### SPECIFICATIONS—SPITFIRE TORCH

Kit: All-metal repair kit, No. 408-01, which includes all the parts shown in the top, left photo, plus an instruction manual

Price:\$40

Manufacturer: Wingaersheek Inc., 2 Dearborn Rd., Peabody, Mass. 01960



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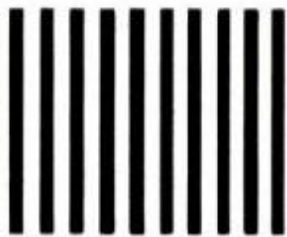
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# SCIENCE WORLDWIDE

## Harnessing volcano power

The recent clouds of ashes over Mount St. Helens have something of a silver lining, some U.S. and Canadian scientists believe.

Eruptions of the volcano suggest that the Cascade Range, a line of mountains including Mount St. Helens, is a promising source of geothermal energy. Exploratory drilling at Mount Hood and Canada's Mount Garibaldi, two other peaks in the range, revealed large underground temperature increases that might be used to produce turbine-driving steam.

Dr. Wendell A. Duffield, a volcano expert with the U.S. Geological Survey, said the flow of molten rock through the earth's crust at Mount St. Helens provided evidence that "unusually high temperatures may be expected at exploitable, shallow depths." Explosions at Mount St. Helens occurred when molten rock welled up under the surface and boiled underground water. The resulting steam blasted a large crater in the summit area of the volcano.

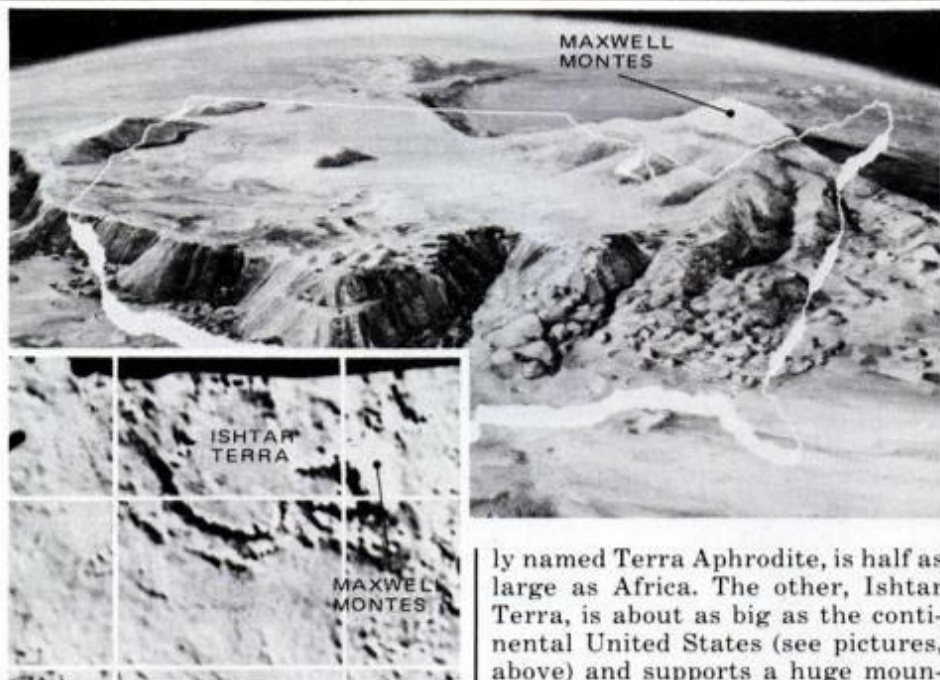
Currently, The Geysers, near San Francisco, is the only site in the United States where geothermal energy is generating electricity commercially. The facility has the capacity to produce enough power from subterranean heat for a city of about 700,000 people.

## Mind over motion sickness

The volunteer in the spinning chair below is taking a lesson in preventing nausea and dizziness as part of a National Aeronautics and Space Administration program to help astronauts overcome "space sickness."



Dr. Cowings (background) monitors subject during motion-sickness research.



Radar provides picture (above) of Venus's topography. Artist's conception (top) compares Ishtar Terra size to United States.

Researcher Patricia Cowings whirls subjects around in a specially wired chair while monitoring signs like heart rate, skin color and perspiration. Spin rate begins at 6 rpm and increases slowly to a maximum near the rotational speed of a long-playing record (33 rpm).

Subjects can stop spinning whenever they want; on average, subjects without training make it to about 10 rpm before feeling too sick to go on.

But biofeedback and self-suggestion training significantly increase tolerance to the spinning in 85 percent of her subjects, Dr. Cowings told us from Ames Research Center.

What settles stomachs? Sitting still, focusing attention on sensations in the hands, relaxing, breathing easily. Using these and other techniques, at least 40 percent of her subjects learn to suppress symptoms completely.

## Venus's hidden continents

Radar aboard NASA's Pioneer Venus spacecraft has penetrated the thick clouds covering Venus, revealing continent-size land masses, deep valleys and mountains as high as Everest.

The radar data displayed two rugged highland regions rising above flat plains that cover 60 percent of the planet's surface. One, tentative-

ly named Terra Aphrodite, is half as large as Africa. The other, Ishtar Terra, is about as big as the continental United States (see pictures, above) and supports a huge mountain, Maxwell Montes, to the east.

The steep slopes of the 35,300-foot mountain (higher than 29,000-foot Mount Everest) are peppered with rocks and boulders.

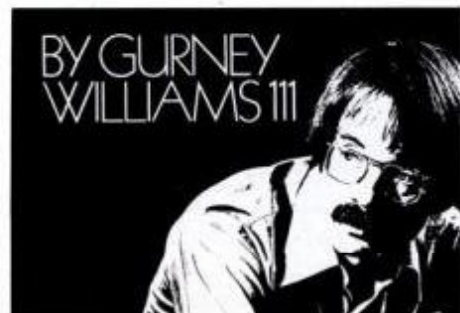
Previous probes to Venus provided evidence of hellish surface conditions, with temperatures of hundreds of degrees Fahrenheit in a dense, carbon-dioxide-rich atmosphere.

## Stalking an old killer

Just a decade ago, doctors offered no hope for adults with acute leukemia, a virulent disease in organs manufacturing white blood cells. Recently, for the first time, some researchers using advanced medical technology have begun to report the almost unthinkable: *survivors*.

A few patients treated with drugs alone have lived for five years. And at a California medical center, Dr. Karl Blume and colleagues report that 14 of 33 patients in a test program have survived up to 35 months after treatment involving drugs, radiation and bone-marrow transplants.

PM



BY GURNEY WILLIAMS III



ON SALE: AUG. 31-SEPT. 13

# Don't buy an ordinary storm door unless you expect an ordinary winter.

## Look at the features of these Sears Storm Doors:

**Foam plastic core for years of strength.**

The core is inside a 1 1/4" thick, sturdy aluminum frame and double kick panel.



**Draft-tight seal helps stop the shivers.**

The bottom extender is triple weather-stripped.



Stop winter drafts from coming through your patio doors.

**SAVE \$30 on Sears Insulating Patio Storm Doors.**

Installs over existing patio doors to create an insulating barrier. #3817. Available in 5', 6', or 8' x 80" sizes.

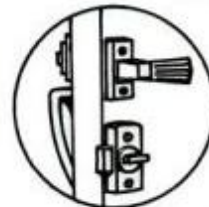


**ENERGY TAX CREDIT** applies to storm doors installed in a principal residence built before April 20, 1977. The credit allowed is 15% of the first \$2,000 spent on qualifying products.



**Double weatherstripping shuts out heat loss.**

Also helps prevent cold drafts. Helps you save energy. Interchangeable glass and screen inserts are weather-stripped, too.



**Keylock and inside dead-bolt help frustrate unwelcome visitors.**

Adds to your home's security and to your peace of mind.

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SAVE \$30 Now \$119**



**Crossbuck Style #2280**

**SAVE \$30  
Now \$139**

These doors available in either 32" x 80" or 36" x 80" sizes.

Other styles at similar savings. And you can use your Sears Credit Card.

These are the minimum savings nationally. Regular prices vary in some markets.

Available at most Sears retail stores. Prices and dates may vary in Alaska and Hawaii.

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per cigarette, FTC Report Dec.79.





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Marlboro Red—you get a lot to like.



ON SALE  
AUGUST 25  
THRU SEPTEMBER 27

# Stumped? Get a Homelite Chain Saw at a K mart price.

To do a good job, you've got to have good equipment, and there's no better equipment for tree felling and firewood cutting than these sale-priced, top quality chain saws from Homelite, the chain saw king.

Try the Homelite XL 12-inch gas saw, a tough lightweight that cuts logs up to 20 inches in diameter. It features fingertip controls for easy handling and an all-weather ignition. **\$108.88**

Save gas with the double-insulated Homelite XEL electric saw. It has a push-button oiler, built-in chain tensioning device and a rubber-coated, full radius handlebar to reduce vibration. **\$51.88.**

Or go to the top of the line with the Homelite Super 2 14-inch gas saw. The Super 2 is the chain saw for every job, whether it's trimming branches, turning logs into firewood, or cutting down those big trees. It features a twin-trigger dual control throttle system and an automatic oiler for longer chain life . . . and it weighs in at just over 7 pounds, so you're always in complete control. **\$144.88**

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**DETROIT**  
**'81**

# Beginning of the end of foreign domination?

Armed with brand-new world cars, Detroit finally seems ready to do serious battle against the inroads by the imports.

by Tony Assenza AUTO EDITOR

**T**he 1981 model year will probably go down as the most significant in the history of America's domestic car manufacturers—the one that determined the fate of this country's biggest industry, which employs, directly or indirectly, one out of six American workers.

Last May, the import share of the new-car market hit 35 percent nationwide (in California and Washington, 45 percent is the norm). General Motors captures about 60 percent of what's left.

The reason for the big slump is obvious. Fearing increased fuel shortages and costs, you no longer want what Detroit is building. Your letters to PM bemoaning the sad state of the American auto industry ask why Detroit can't build a car that can compete with the foreign makes.

The fact is that the average car buyer never wanted a small, economical car. Even after danger signals first appeared in 1974, Detroit was selling all



**AMC EAGLE KAMBACK**

See page 80

the big cars it could build. Those who blame GM, Ford and Chrysler for their shortsightedness must realize that it was we who demanded longer and wider cars. Horsepower wars through the early '70s were a market response to public demand. If GM had built X-cars in '71 while the others were still stuffing 400-cu.-in. engines into 4500-pound cars, it would have committed showroom suicide.

Those days are over. The big V8 will soon become a museum piece. Already speculators are beginning to stockpile them. In a few years, even a junked wedge may well be worth as much as the original price of the car from which it came.

If the X-car success indicates what's in store for other domestic makers, prospects for their recovery look good. Since April 1979, GM has sold more than a million X-cars. Plants making them are working double shifts and weekends, and still the supply can barely meet the demand.

In a few months Chrysler hopes to be in the same position with its K-cars—Aries and Reliant—not so much as competition for the GM equivalents, but as an alternative for the traditional full-size Chrysler buyer who wants more mileage without losing too much room or comfort. To make sure that the K-car buyer gets his money's worth, Chrysler claims to have developed a rigorous quality control equaling that of the imports.

American Motors will enter the '81 market with the French-built R18i because it doesn't have the money to build an economy car from scratch. It was either make the deal with Renault or go under. At the same time, AMC has two down-sized Eagles, the Kamback and SX/4, set to battle Subaru's four-wheelers and the numerous imported front-wheel-drive econocars. After these three models have been established, AMC will produce a Renault/AMC-designed economy car that will carry the AMC badge. While this may not be driving the imports back to the shores, it certainly is making



**DODGE ARIES**

See page 76

the best of a bad situation.

Next month in PM we'll show you what Ford has up its sleeve. It's a front-wheel-drive, 45-mpg car called the Escort. The Mercury version will be known as the Lynx. With the appearance of that car, the domestic versus import battle lines will be clearly delineated.

By October, the showrooms of each domestic carmaker will be stocked with the kinds of cars the American public has been screaming for. For those of us who love cars, 1981 will be the year in which we'll see the climax of a classic no-holds-barred battle of the titans in the automobile industry. It will be interesting to see who picks up most of the marbles.

Turn the page for the beginning of the 1981 model year.



**RENAULT R18i**

See page 80

PM



# Chrysler's special K formula for success

On the proving grounds, the K-cars showed muscle and agility. But, will they do as well in the showrooms? We think they might.

by Moss Miller



The Reliant wagon has the same 99.6-inch wheelbase as do the sedans.

At speed, the Reliant blocks out road noise and wind roar. Although small, it has the solid feel of bigger cars.



The die is finally cast and Chrysler Corp. has its fingers crossed that its K-cars—Plymouth Reliant and Dodge Aries—will be the vehicles to reverse the company's sagging fortunes. Due to all the pre-introduction publicity involving the government loan guarantee, the K-cars have been among the most anxiously awaited cars of the last 10 years. With so much riding on the success of these cars, Chrysler has gone to great lengths to make sure that they are lovingly put together and all the pieces fit as they should. (See *Detroit Listening Post*, page 26, Aug. '80.)

We tested four prototypes at Chrysler's Chelsea Proving Grounds: three two-door sedans and a four-door wagon. A four-door sedan will be offered in the near future but, for the moment, no hatchback variants are in the works.

The Reliant and Aries employ the formal, boxy styling first seen on this year's downsized Cordoba

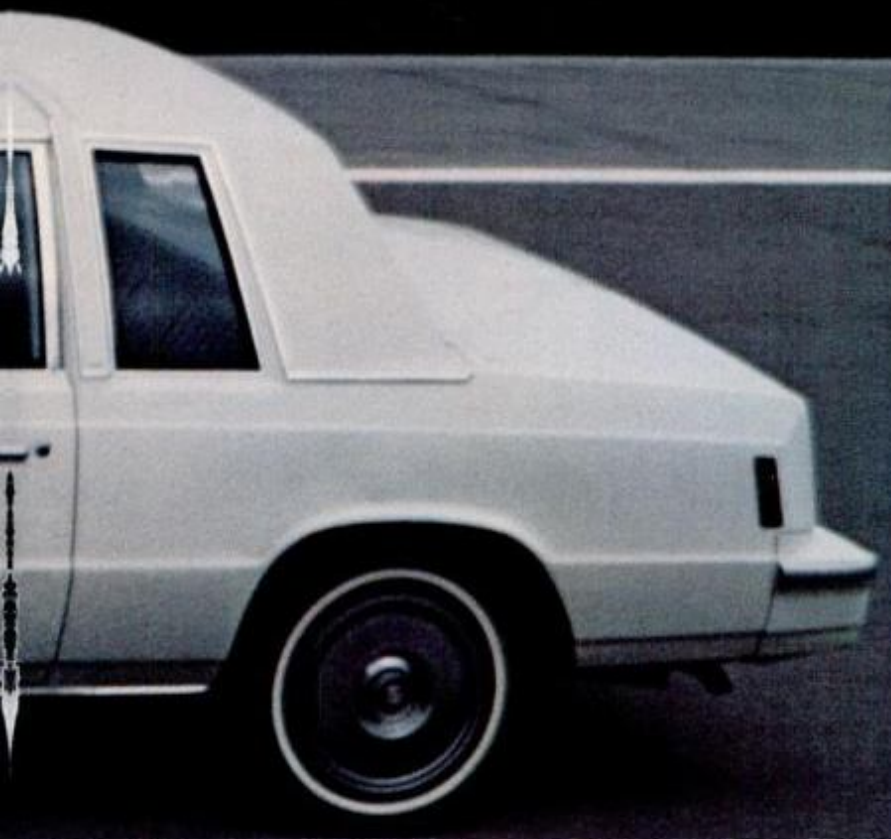




The 2.2-liter American-built Four (top left) is standard. The only optional engine is the 2.6-liter Japanese-built Four.

Interior (left) provides good legroom and excellent visibility. Even on bumpy terrain, the Reliant tracked well, responded quickly.

*(Text continues on page 151)*



The new Chrysler has McPherson-strut front suspension.



At the rear is an independent flex-arm suspension.





# PM looks under the hoods of the new Chryslers

by Paul Weissler

**C**an a Saturday mechanic find happiness with a transverse-mounted, computer-controlled engine that doesn't even have an on-board diagnostic system to help out?

It would seem not, but the Plymouth Reliant and Dodge Aries should be exceptions. The latest entries in the front-drive, compact-car sweepstakes have the most serviceable engine-compartment layout to date. And although the computer doesn't have the self-test features of the General Motors and Ford electronic brains, it doesn't have to control as many items. So it can be checked manually almost as easily.

Our evaluation car was equipped with the standard Chrysler-built 2.2-liter, belt-driven, overhead-camshaft engine. It was loaded with power steering and brakes, automatic transmission, airconditioning, even cruise control. Yet the routine service items and many of the not-so-routine items all were accessible.

Except for the airconditioning belt, which is adjusted at an idler pulley accessible only from underneath, you can handle all the belts from the top of the engine compartment. The belt that drives the alternator and the water pump is tensioned by a stud-type adjuster that

is similar to that used on the Ford power-steering pump for so many years.

One reason the belt adjustments are so accessible is that one of the belt-driven accessories is in an unusual location: It's the air pump and it's at the transaxle end of the engine rather than the usual passenger-side, "front" end. The air pump is bolted to the cylinder head and is driven off the back of the overhead camshaft. To change a belt, you must pull the air pump, but the mounting bolts are very accessible. Chrysler was hoping to use extra-long mounting bolts so that you could just loosen them, move the pump away and slip the new belt into place. However, this seemingly simple modification would take a lot more change than just bolt length. So it looks like the pull-the-pump procedure will stay for a while.

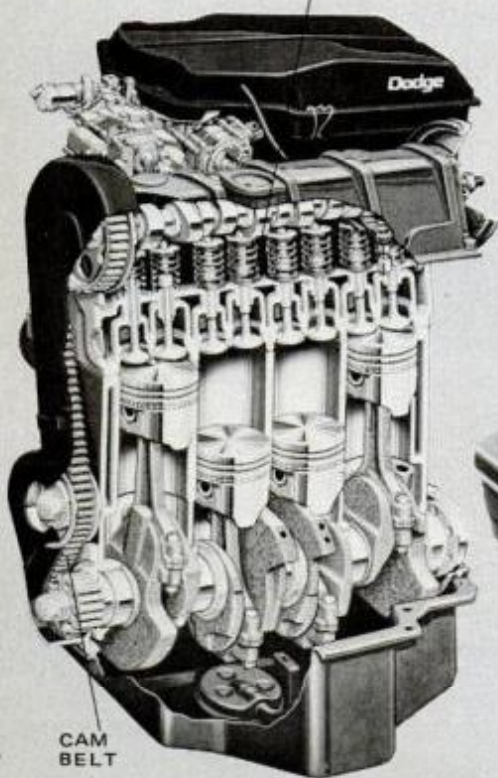
## Cooling system

Cooling system of the Reliant/Aries may be far and away the best for ease of service of any transverse-engine car. The radiator drain cock can be reached from the top of the engine compartment. Both radiator hoses are accessible, and the thermostat housing is at the top center

*(Please turn to page 171)*

## CHRYSLER-BUILT 2.2-LITER FOUR

OVERHEAD CAMSHAFT



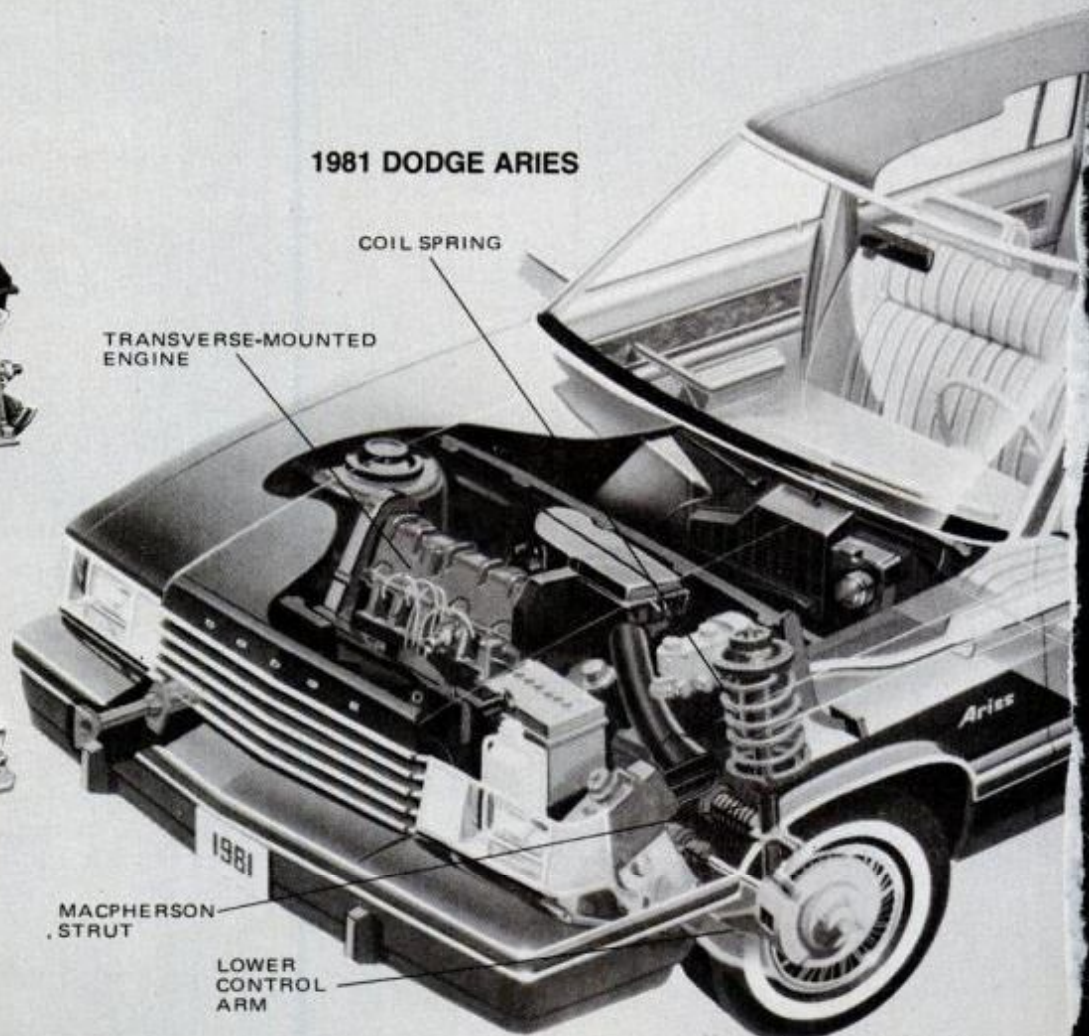
## 1981 DODGE ARIES

COIL SPRING

TRANSVERSE-MOUNTED ENGINE

MACPHERSON STRUT

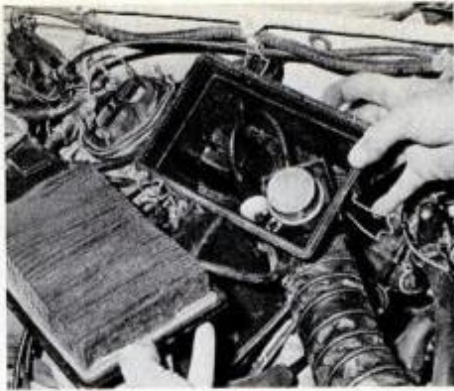
LOWER CONTROL ARM







The sparkplugs face toward the front of the car, making their removal very easy. They are not obstructed by any plumbing.



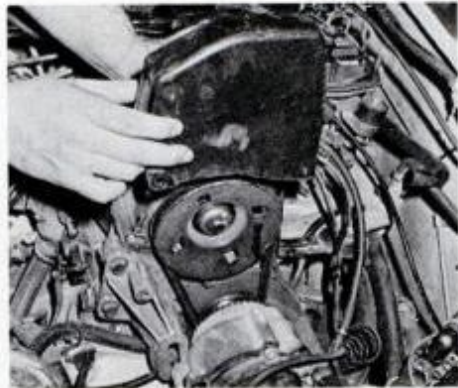
The thermostatic air-cleaner diaphragm is located inside the air-cleaner housing, which is unusual but is still accessible.



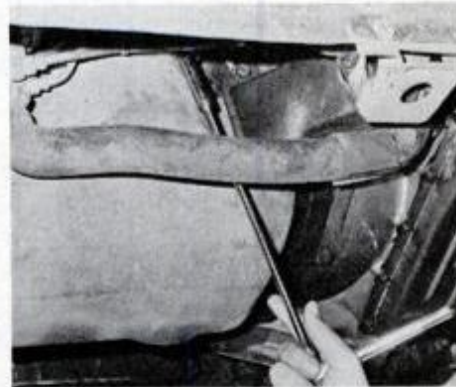
From left are antideseling relay, starter relay, voltage regulator and radiator-fan relay (on airconditioned cars).



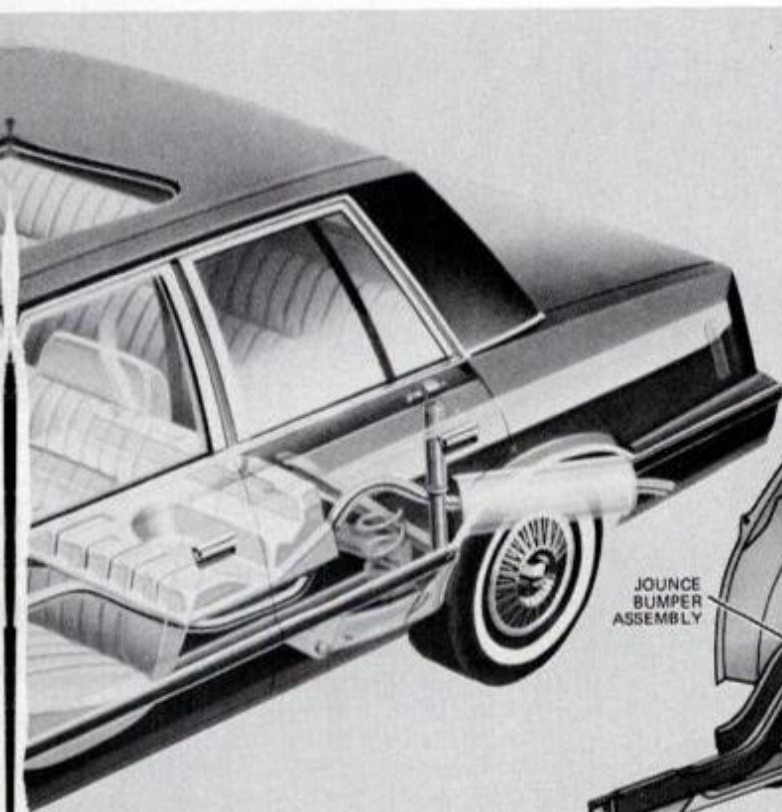
To take up the slack on the fan belt, the air-pump retaining bolts must be loosened; they are short but are easy to reach.



Unlike that on most cars, the belt guard is plastic, which means it will never distort or dent the way the metal one can.

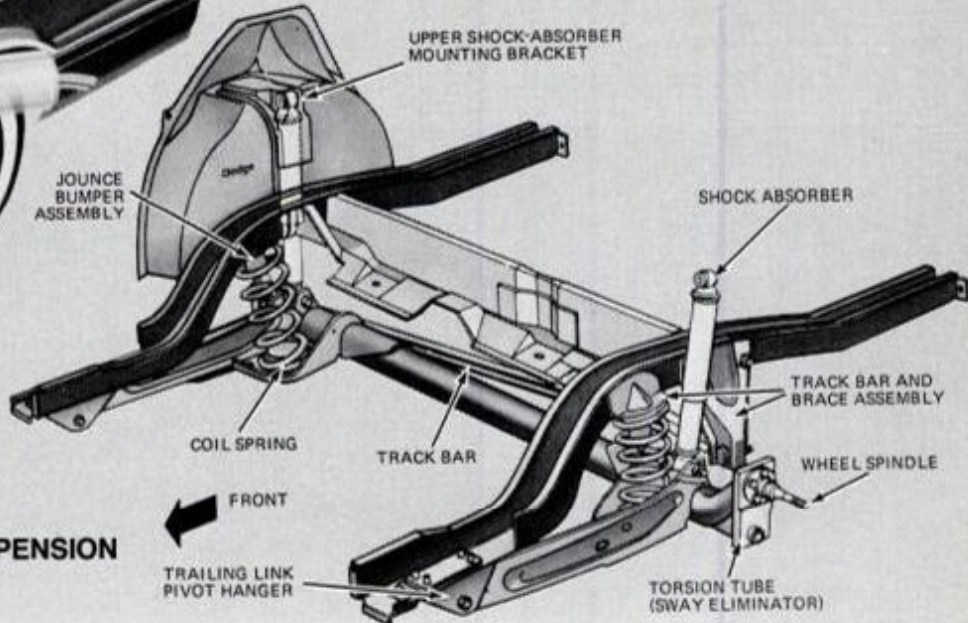


The engine's oilpan is removed easily from underneath the car. It uses RTV silicone for sealing rather than a formed gasket.



The 2.2-liter, American-built Four (shown at far left) has a belt-driven overhead cam. The valve train is activated by low-maintenance, hydraulic lash adjusters. The Aries' front suspension (center) uses a MacPherson strut design with an offset, top-mounted coil spring. The rear suspension (below) is a solid-tube type equipped with coil springs.

### ARIES/RELIANT REAR SUSPENSION







The NP 119 full-time-drive transfer case is used by all three AMC Eagles. While the SX/4 (below) isn't meant to be an off-road vehicle, it demonstrated excellent traction and agility on a muddy test track.



# Driving the new AMC Eagles

## FIRSTHAND REPORT

by Gary Witzenburg and Moss Miller



One of the biggest sales successes for American Motors Corp. began at the introduction of the Concord-based Eagle (see *Driving American Motors' Four-Wheel-Drive Eagle*, page 92, Sept. '79). Sales took off quickly and remained relatively stable even after the car market went sour last spring. AMC, wanting to

make the most of a good thing, has expanded the 4x4 Eagle line for 1981. There are now two subcompact Eagles in the AMC nest, the

SX/4 and Kamback. Both are derived from the Spirit, the sporty AMC vehicle that was introduced in 1979.

The SX/4 has a hatchback roofline, while the Kamback retains the familiar mini-wagon look of the old Gremlin, but with a much larger rear window for better visibility. The wheelbase on both models is 97.2 inches, about a foot shorter than the original Eagle. Length is a very compact 166.6 inches, much shorter than the larger Eagle at 183.1 inches. Only in width are the baby Eagles comparable to the larger sibling: at 73 inches they are .7 inch wider than the original.

Also new for 1981 is the Pontiac-  
*(Please turn to page 178)*





The Eagle Kamback (top) looks very much like the old Gremlin. The front suspension has a total travel of 6.2 inches and the rear suspension has 9.4 inches of travel. To prevent damage in case you bottom out, the transfer case is protected by a skid plate. Interior options include full instrumentation, tilt steering wheel and split folding rear seats. Other options include automatic load-leveling shocks and tow package.

## *and the Renault R18i*



The Renault R18i is equipped with a 1.6-liter, fuel-injected, four-cylinder engine, coupled to a standard four-speed manual gearbox. The sharp-looking and comfortable interior can be trimmed in vinyl or cloth.





Photo: R. Provin and B. Wallis



Amateur shot of galaxy (lower photo) rivals observatory's (top).



Photo: Leo Henz

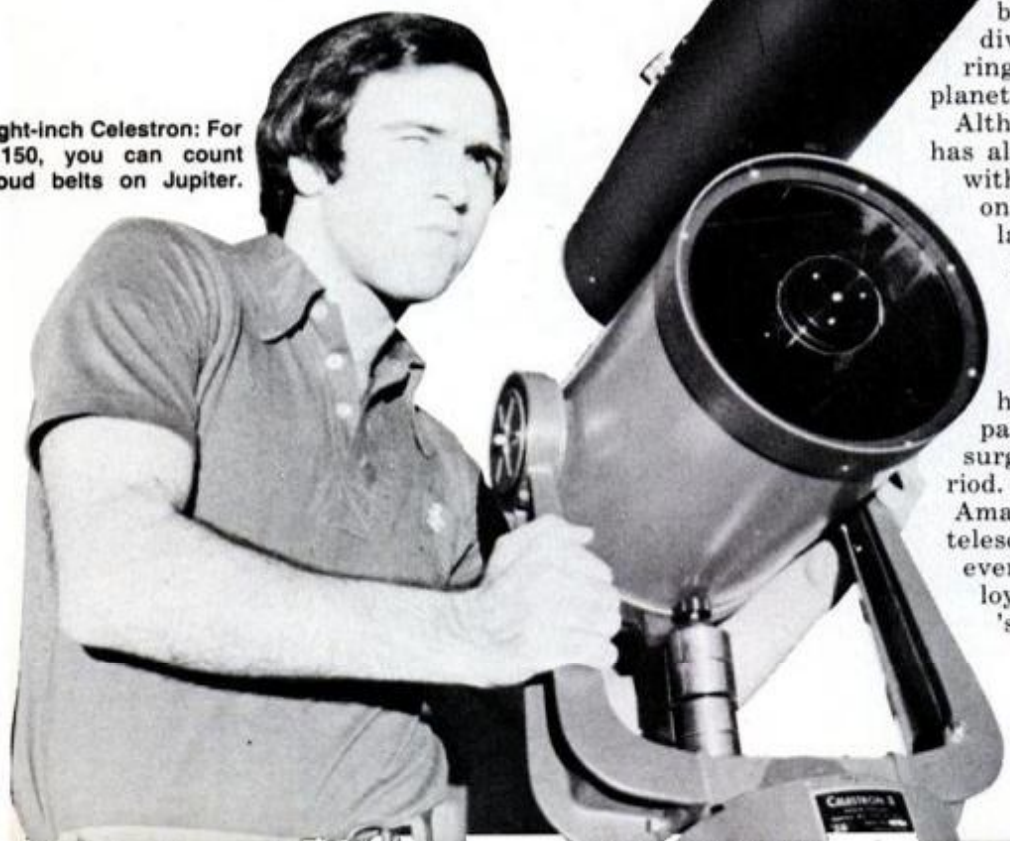
Nebula is about as clear in amateur's photo as pro shot (left).

# See more of the sky than ever with these sensational 'scopes

For the price of a good stereo set you can get observatory-quality views in your own back yard.

by Terence Dickinson

Eight-inch Celestron: For \$1150, you can count cloud belts on Jupiter.



**N**ot long ago, large telescopes were special-order, high-ticket items. No longer. Thanks to price cuts resulting from mass production, today you can get observatory-quality views of the universe from your back yard for the price of a typical home stereo set.

Using these new-generation commercial telescopes, I have detected craters on the moon the size of a large football stadium. I've traced subtle ripples only tens of feet high on the floors of the lunar plains—views corresponding to what you would see out the window of a spacecraft only a few hundred miles above the lunar surface. Turning these

'scopes to Jupiter, I've seen the giant planet's colorfully banded "surface" of clouds in magnificent detail. I've counted 12 cloud belts and seen wisps and swirls within them of yellow, salmon, gray, blue and brown. I've picked up divisions between Saturn's rings and their shadows on the planet's surface.

Although this celestial showcase has always been there for anyone with access to a good telescope, only recently have amateurs in large numbers been able to enjoy—and often photograph—the view. The reason is that prices of American-made gear haven't risen as fast as inflation. In general, prices have about doubled over the past 20 years—well below the surge of inflation in the same period.

Amateurs are getting a lot more telescope for their dollar today, even as Teflon and aluminum alloys have reduced the weight of 'scope components. Machines

Photos at right: 1, Leo Henz; 2, 3 and 6, James Rouse; 4, M. Dowling; 5, Alfred Lilje.





#### A gallery of amateurs' work

**1** Trifid Nebula, 8-inch 'scope, 60-minute exposure on high-speed Ektachrome.

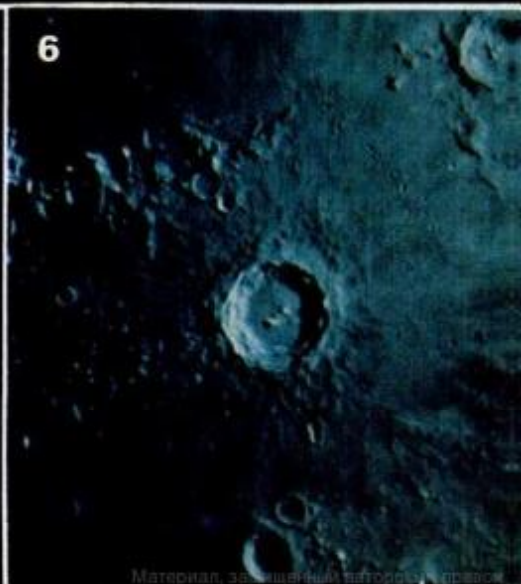
**2** Jupiter, 8-inch 'scope, 5 seconds on high-speed Ektachrome.

**3** Saturn, 8-inch 'scope, 5 seconds on high-speed Ektachrome.

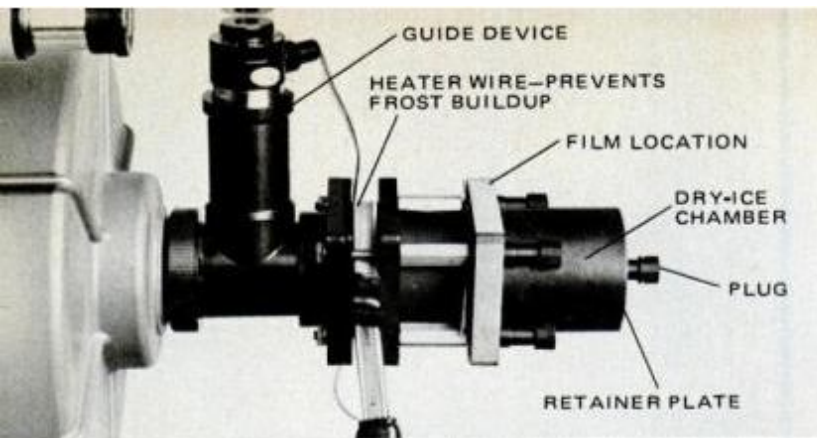
**4** Solar eclipse, 6-inch 'scope, 1/60th second on Ektachrome 200.

**5** Lunar eclipse, 12-inch 'scope, 16 seconds on Ektachrome 400.

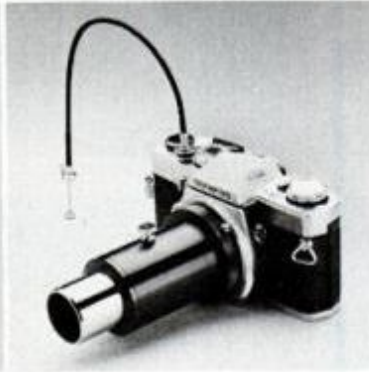
**6** Copernicus crater, 8-inch 'scope, 1/60th second on high-speed Ektachrome.







For photographing sky, gear ranges from simple adapter (right) to higher-tech chilling equipment to increase light grasp of film (above). Schmidt camera (far right) picks up sharp detail in wide area of sky. Framing 'scope shows area; a 6-inch guidescope aims and tracks the object.



## WHERE YOU CAN SEE WHAT THE PROS SEE

**M**any of the greatest observatories in the United States are now holding "public night" or "night visiting hours" so you can see what professional astronomers see through the world's largest telescopes.

What's it like to visit an observatory? First, it has to be done at night if you want to look through the great 'scopes, except for the few solar ones. Second, you're likely to feel as cold as a cryogenic corpse, especially at the high-altitude observatories. No observatory can be heated when it's in use, because rising heat waves in the air above it would cause distortion. For your visit, dress as if you were going to be outdoors the entire time.

The length of time you can spend at the eyepiece depends on how many other visitors are waiting, and, sometimes, on your resistance to the cold. When there are many visitors, each 'scope may be kept at the same focus and aimed at the same object all evening. When visitors are few, you can observe various objects at different levels of magnification.

### Telephone or write first

There are probably more than a hundred U.S. observatories that the public can use occasionally. If you're not near one listed below, try the nearest university's astronomy or physics department. Telephoning or writing before your visit is advisable, since visitor nights may be changed because of weather, and the number of visitors may be limited.

**Mauna Kea Observatory**, 177 Makaala St., Hilo, Hawaii 96720; (808) 935-3371. The 88-inch reflector of the University of Hawaii is available on open-house nights, held monthly around the time of the full moon. Four-wheel-drive vehicles (rare in Hilo) are required to make the steep ascent to the 13,800-foot observatory; there are blizzards in winter. Astronomers at this telescope observed a rare event, a volcanic explosion on

lo, one of the moons of Jupiter, on June 11, 1979. A 30-mile-wide crater opened up, exposing an ocean of hot sulfur under the crust.

**Chabot Observatory**, 4917 Mountain Blvd., Oakland, Calif. 94619. Every Friday and Saturday night, two to five large telescopes are available to the public, including a 20-inch refractor. There is a small admission charge.

**Griffith Observatory**, 2800 East Observatory Rd., Los Angeles, Calif. 90027; (213) 664-1191. A 12- and a 9½-inch refractor are available for free public viewing every clear evening, except Mondays after Labor Day. During the daytime you may use the solar telescope.

**Kitt Peak National Observatory**, Tucson, Ariz. 85726; (607) 795-8266. Kitt Peak is 52 miles southeast of Tucson, and has 15 major telescopes. Open free to the public, 10:00 a.m. to 4:00 p.m. daily, except Tuesdays and Christmas.

**McDonald Observatory**, Visitors' Center, Box 1337, Fort Davis, Tex. 79734. Offers night viewing, through an 82-inch reflector on the last Wednesday of every month, and a short film and lecture.

**Dearborn Observatory**, Northwestern University, Evanston, Ill. 60201; (312) 492-7651. From April through Oct. 28, there's visiting every Friday evening, 9:00 to 11:00, to look through an 18½-inch reflector.

**Warner and Swasey Observatory**, Case Western Reserve University, 1975 Taylor Rd., East Cleveland, Ohio 44112; (216) 451-5624. Public visiting is scheduled two nights each month in the school year. Hear a lecture and look through a 9½-inch reflector.

**Allegheny Observatory**, University of Pittsburgh, Pittsburgh, Pa. 15214; (412) 321-2400. Open to visitors every night except Sundays, Apr. 1 through October, using a 13-inch reflector.

**McCormick Observatory**, University of Vir-

ginia, Charlottesville, Va. 22903; (804) 295-7141. Admission is free the first and third Friday of each month and attractions include a film, lecture and viewing through a 26-inch refractor. Fan Mountain Station, 16 miles south of the campus, has a 40-inch and a 32-inch reflector. There's an open-house weekend in October. Write for tickets.

**U.S. Naval Observatory**, Superintendent, U.S. Naval Observatory, 34th and Massachusetts Ave. N.W., Washington, D.C. 20390. The public is allowed to view the sky through a 24-inch reflector and a 26-inch refractor, and to see a film and exhibits, two to three nights each month. Obtain the list of visiting nights from the superintendent and reserve by mail well in advance. Security is tight because the Vice President's residence is on the grounds.

**Columbia University**, Observatory is on the roof of the Pupin Building, Broadway at 120th St., New York, N.Y. 10027; (212) 280-3278. Public nights at the 12-inch reflector are the first and third Fridays of every month, weather and astronomy exams permitting.

**Harvard-Smithsonian Center for Astrophysics**, 60 Garden St., Cambridge, Mass. 02138; (617) 495-7461. Two 9-inch reflectors are available on two Friday evenings in spring and two in fall; write for dates and free tickets. Open the third Thursday of every month.

**Laines Observatory**, Maria Mitchell Assn., Nantucket Island, Mass. 02554. Open to the public Wednesday evenings, 9:00 to 10:00 in August, 8:00 to 9:00 in September and October.

**U.S. Observatories: A Directory and Travel Guide**, by H.T. Kirby-Smith, describes major observatories in detail. It catalogs hundreds of others by states, giving travel advice and information on accommodations and camping, where feasible. Published by Van Nostrand Reinhold, it's \$6.95 in paperback and \$11.95 in cloth.—Robert Scott Milne



have replaced hand grinding of mirrors. In most new 'scopes costing more than \$300, electric motors running at constant speed turn worm gears connecting with spur gears to keep 'scopes precisely aimed at targets as the earth revolves. Almost all the new models come with high-quality finderscopes—miniature telescopes mounted parallel to the main 'scope to help find targets easily.

Not long ago, lenses were designed by trial and error, or by theory and some back-of-the-envelope calculations. Today, computers analyze the way light passes through different lens systems. New programs help designers come up with optimum thickness, spacing and type of glass for a sparkling view.

New filters maintain the view under challenging conditions. Light-pollution-rejection filters, for instance, cut through man-made glare to show details of nebulous clouds of gas and dust thousands of light years away. Solar filters offer safe viewing of sunspots, and narrow-band-pass solar filters let you probe the colossal eruptions that surge over the surface of our star.

The most recent innovation is a computer system that automatically points your telescope toward any of 200 objects whose positions it holds in its memory. Or you can punch in up to 25 new positions for targets such as comets. (The device costs \$1200 from Roger Tuthill, Box 1086 PM, 11 Tanglewood Lane, Mountainside, N.J. 07092.)

### You can rival the pros

The notion that professional astronomers using the largest observatory telescopes automatically have the best views of celestial objects is generally false, for two reasons. First, the big 'scopes used for frontier research are neither designed for nor intended for visual use. Sophisticated electronic, photographic and spectroscopic detectors are placed at the focus, rather than the fallible human eye.

Second, the larger the telescope, the more likely it is to be affected by a phenomenon known to astronomers as "seeing." Seeing refers to the unsteadiness of the image of a celestial object seen through the telescope.

The astronomer is in the position of a deep-sea diver looking up toward the sky: The view is interrupted by waves. For land-based telescopes peering through a "sea" of air, the intensity of turbulence varies, depending on winds, temperature differences and the size of the telescope. Large telescopes have to

## 'Scopes for amateurs



Off-the-shelf 'scopes available to amateurs today include (clockwise, from upper left): 3½-inch Questar (\$1680) with carrying case; 10-inch Meade Newtonian (\$1285); 8-

inch Dynamax (\$750); 4-inch Quantum 4 (\$1395); 8-inch Edmund Newtonian reflector (\$799). Prices include basic 'scope and mounting; accessories are extra.

penetrate through more air than smaller ones. For instance, a telescope with a main mirror or lens 8 inches in diameter looks through a column of air 8 inches wide and about 10 miles high—the nominal thickness of the turbulent layers of Earth's atmosphere. Smaller telescopes have a smaller column to contend with; telescopes 4 inches in aperture and less can generally look "between" ripples in the atmosphere. Images in these 'scopes are usually relatively steady. Large telescopes are also plagued by "cool-down time"—the interval, usually shortly after sundown, during which the optics are changing temperature and their optical figure is distorted.

These factors explain why the new generation of widely popular telescopes is in the 4- to 12-inch range—the ideal size for portability, good light-collecting ability, and image resolution.

### Prices: \$300 to sky-high

The least expensive type of telescope per inch of aperture is the Newtonian reflector. Light enters the open tube and passes virtually unobstructed to the bottom, where a

highly reflective parabolic mirror reflects the light back up to the top of the tube. There, a smaller mirror set at a 45° angle bounces the converging beam out the side of the tube where it is focused by a magnifying eyepiece.

A 6-inch Newtonian reflector is typically priced from \$300 to \$600; an 8-inch, \$400 to \$900; a 10-inch, \$700 to \$1200; and a 12-inch runs \$1000 and up. The 10-inch models are about the limit for portability.

Unlike the Newtonian reflectors, which have been widely used by amateur astronomers for decades, the Schmidt-Cassegrain system is a relative newcomer—a child of the technological advances of the 1970s.

Schmidt-Cassegrains have a main mirror at the base of the tube similar to the Newtonian, but instead of having the converging light beam deflected out the side of the tube, it is reflected directly back through a hole at the center of the main mirror. This provides a convenient focus at the rear of the instrument. A corrector lens at the front of the tube (which also holds the secondary mirror) gives the Schmidt-Casse-

*(Please turn to page 154)*



# New add-ons to go off-road

Bumper-mounted winch and extra lights are among the aftermarket add-ons that can increase range of action.



A carload of extras—from grille guards, Zelmat lights, heavy-duty springs and shocks, to racing cams and tire brackets—comes with this Scout II by Tuff-Terrain.



Built-in or bolted-on, these new options for RVs will mean better boondock driving.

by Bob Behme

**T**hough sales of family cars and RVs have slowed, interest in personal pickups and off-road rigs is still cooking. Present choices include a lineup of full-size American-made pickups from Chevrolet, Dodge, Ford and GMC, smaller domestic vehicles from Volkswagen and International Harvester, still smaller imports from Datsun, Mazda, Subaru and Toyota, and two crossbreeds: Ford's Courier and Chevy's Luv.

Four-wheel drives offer a selection of regulars from Chevy, Datsun,



# in style



Pickups like Toyota (above left) and Ford (right) are more versatile, with or without four-wheel drive, with roll-bar-mounted Warn auxiliary lights, grille guards, bumper winches.



Four-wheel Jeeping through a mudhole after a flash flood is safer with front winch and extra high-intensity lights available.



Swimming isn't standard for most off-road vehicles, but some of the new hubs come with grease fittings to keep out water.



Ten bonus lights for this Ford Bronco may be more than most 4wds need, but high-low options can pierce fog, dust dark byways.



To prevent axle bending and housing breakage when you jump for joy, stress bars and cable axle trusses can be mounted.

For driving along a dusty trail after sunset, you need high-intensity lights.



Some manufacturers now supply a good assortment of original equipment options—grille brush guard, high and low lights and roll bar—as does Datsun for its 4x4 pickup truck.





Ford, GMC, Jeep and Toyota plus a new and booming category, the off-road car—rigs designed to be at home in the back country as easily as on the highway. This year, the remarkable American Motors Eagle and the popular Subaru are joined by the "Eaglets" (see page 80).

And now the marketplace offers a selection of special equipment for these rigs, gear that can customize and protect a vehicle precisely to your specifications. Much is available from vehicle dealers and specialty shops, together with mail-order houses. Off-road experts like Baja pioneer Dick Cepek in Southgate and winning racer Sherman Balch of Tuff-Terrain in Hayward, sell custom items through their own California firms. Rough Country, El Cajon, Off-Road Distributors, Lemon Grove and Rainbow in Marina del Mar, are suppliers in the same state. Then there is Bushmaster in St. Louis, J.C. Whitney in Chicago, and, of course, many more.

### Ready-mades

Luxury and macho vehicles are offered by nearly every builder of pickups and 4wds as factory-fitted rigs with a choice of luxury or rugged country extras. Jeep's Laredo may be the luxury winner with its tooled leather upholstery and special paints. And for the rugged image, several vehicle makers have pulled out all stops. Scout, for example, offers accent kits with a special hood design, wide wheels, roof rack, protective fender extenders and rally sports bumpers. What else can you add? Here are some aftermarket ideas.

### Bolt-ons

Fuel tanks and carriers make sense. A number of firms, including Travel Accessories and Southern California RV Products in the West plus several VW dealers in the East, offer auxiliary tanks and larger replacements. Either way, capacities can top 50 gallons. Rainbow has replacement tanks up to 47 gallons for Chevy vans, Blazer and GMC's Jimmy. Tuff-Terrain, specializing in Scout accessories, has a 32-gallon replacement for Scout, Scout II, Terra and Traveller. A less expensive solution is a bolt-on fuel-can carrier. Dick Cepek, Kayline, Tuff-Terrain and others offer models. A good version mounts on the rear of most four-wheel drives and holds both spare tire and fuel can.

Engine accessories, from chromed goodies to skid plates and customizing accessories, improve appearance, performance or both. Headers are an early choice. They help collect



Rigged for rugged racing, vehicle may have out-of-sight modifications on shocks, springs and cam by Balch's Tuff-Terrain.



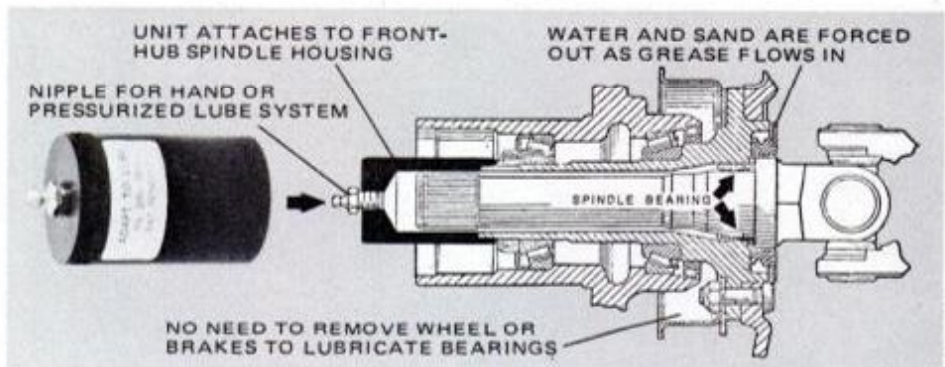
Roll bar can help prevent injuries if rig flips, but makers give no guarantee and prefer names like "grand prix bar."



A fuel savings of as much as 2 mpg is claimed for the Econ-O-Miler replacement tailgate by Oriole, Blooming Prairie, Minn.



Compacts and full-size pickups and 4wds can be fitted with combination brush and grille guard with winch kits by Warn.



Spindle bearings battered by off-road grit can survive with Adapt-to-Lube from R&T Enterprises. It allows easy addition of grease to front bearings to force out mud.

exhaust gases, reduce back pressures, improve performance. Some are even available for vehicles with airconditioning. Tuff-Terrain makes a set for Scout; Modern Motors has designs for a variety of vehicles, and Rainbow has a dual kit.

Body accessories range from such subtle improvements as decals to radical changes like large windows. Special windows are generally added at the factory, but can also be installed at home. Guardian offers a selection from bay windows for vans to sliding rear windows for pickups. Moon and sunroofs are available from many sources, but it's usually wise to let an expert install them.

Grab rails bolt to the pickup bed, improve appearance and utility, add cargo space and can be used as tie-downs. Several manufacturers offer matching roll bars that also serve as mounting bars for custom lighting. Special tie-downs, in spring-loaded

retractable T-bars and hooks, are available from Sears, Montgomery Ward, J.C. Penney and others, and may be the single most useful item you can buy.

If you own a four-wheel drive and live in snow country, look at snow plows. Models are available from a number of dealers, and a good one will not only keep your property clean, but can be used to earn extra money.

Winches, for back country, can pull your rig free from mudholes, over impassable boulders and through deep streams, an insurance policy worth considering. Although there are manual types, the common choice is electric. Warn is a leading brand and Koenig (Texas Metal) and Superwinch are popular. Vic Hickey makes a rugged version that mounts out of sight beneath the vehicle.

A 100-foot length of  $\frac{5}{16}$ -inch winch cable is basic, and you should carry a





On- and off-landers in the snow belt can push drifts and pad their bankrolls by using a 4wd like this Scout that sports a properly mounted snow-plow attachment.



A lockable storage compartment from Jeep dealers for their CJ models mounts at the rear. A hidden winch is also available.



Mexico's rugged Baja 1000 off-road race has helped develop many add-ons. The Scout Terra was first diesel to finish.



Heavy-duty hauling jobs are easier for a rig with off-road capabilities. Chevy's '80 Suburban has locking hubs for its 4wd.



A fabric top called a Sun Bonnet is sold by Jeep dealers. Other options are new wheel-house pads, sunroof for Wagoneer.



Front-end improvements with lights, grille guard and truss rod under the transfer case to prevent axle bend dress up Scout.



With a winch, the off-roader can pull his rig or a friend out of trouble. This Warn winch mounts a handy remote-control switch.

length of chain with two hooks, protector straps (to minimize scarring of trees and rocks) and a nylon rope or strap to help pull out vehicles from tough places. Warn supplies a "winching kit" that includes most of these items.

Suspension equipment helps ease the ride, and if you drive where trails are difficult, you need all the suspension help you can get. Consider rugged shock absorbers with Freon or nitrogen cells to keep the hydraulic fluid from aerating. Bilstein uses pressurized nitrogen. Mickey Thompson offers a 55-mm design with a variety of valvings for every use from street to off-road racing. Rough Country, Gabriel and Heco have similar products.

Sway bars can be mounted to control excessive lean, front and rear. Overload springs will handle heavy loads, and steering stabilizers are useful to control the front wheel

shimmy and wobble that can come with large tires and wheels.

Auxiliary lighting is basic for back country. Consider round spot and floodlights for general driving and rectangular versions for foggy nights. For the road, you'll probably mount one or two rectangular lights on the bumper to give the headlights a boost and cut through fog and haze. Off-road, add special light above your line of vision. Glare caused by dust from other vehicles is a problem, and lights should be mounted so the driver doesn't look through the beam until it's beyond the glare area, about 100 feet ahead. Lights should be positioned so the driver's vision is above the lower light and below those on top. Top lights, often mounted to the roll bar, add depth perception.

Fog lights should be mounted low. The trick is not to try to penetrate haze, but to look beneath it. Tests

indicate that clear lenses are more effective than amber, with white glass about 16 percent brighter than amber.

You can choose from a number of quality makers. Warn recently introduced an excellent line that includes floods and spots for highway and off-road use. KC HiLites, popular with racers, have a complete selection, including super-bright quartz-iodine models. Bosch, Cibie and Zelmat are excellent, and most catalog houses offer a range of designs.

When installing custom lighting, use large gauge wire to avoid overheating. Most experts now swear by a new 14-gauge wire that has substantially less resistance than copper.

Is that all you can add on? Hardly. These are just examples of selections that are limited only by your checkbook.

PM





# Today's telephones: Too smart to just ring!

Now they remember, have cordless extensions and many other surprising features. Computerized integrated circuits, used in more and more communications applications, provide the brains behind the beeps.

by Marc Stern

Phones like Universal Security's "Intelliphone" (left) are really miniature computers that can recall and redial numbers. Answering machines like Radio Shack's Tad-31 (below) let you collect your calls from a remote phone.

**T**he inevitable marriage between the tiny integrated circuit (IC) and the telephone has only really gained force in the last couple of years, but that union has spawned a whole new generation of phone equipment.

Computer technology has even invaded the telephone answerer arena. Many modern answerers are now equipped with voice-actuated capability, which allows the caller to give a complete message for as long as that message takes. These new units will record for the length of the tape, if necessary, rather than just allowing 20 or 30 seconds for each message.

Answerers used to be just tape recorders attached to telephones, but today they have become sophisticated

instruments. You can call them with a pocket pager from any phone booth and receive your messages; or you can tell the machine to reset itself.

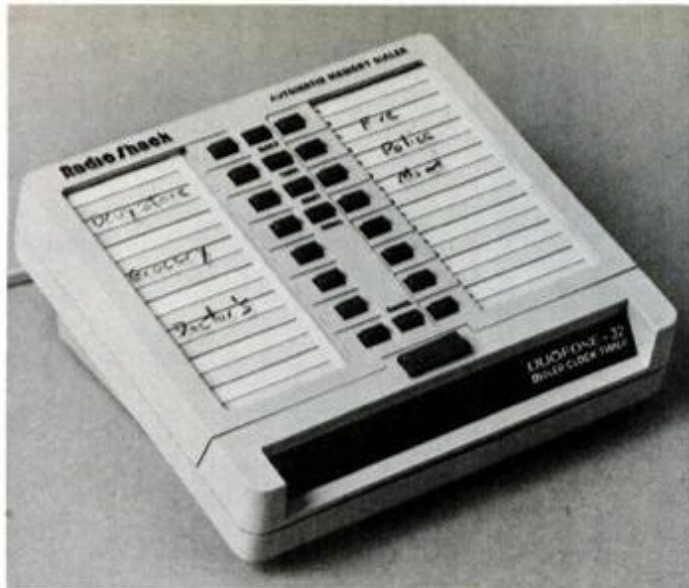
#### Answerers show versatility

Some will now take cassettes, rather than just using an internal tape loop, and this increases their capacity further. Most will accept more than one taped message and will tell the user how many calls have been placed.

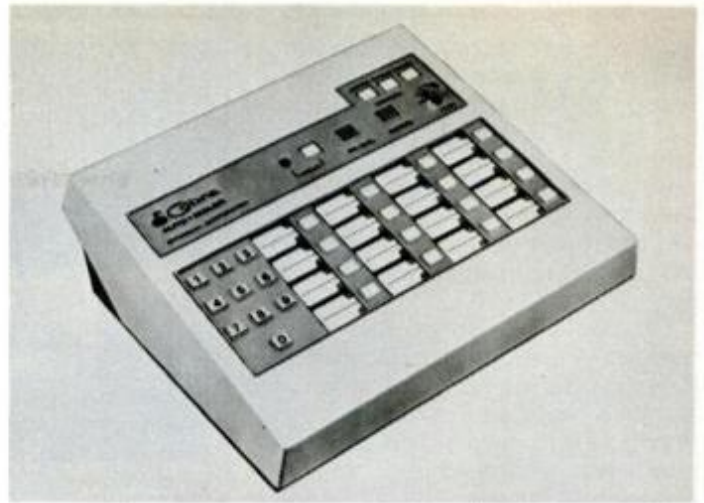
Some of them, like the Radio Shack Tad-30, will allow you to record two-way conversations with the required beep.

Nowhere more than in telephone dialers have the in-





Memory dialers store phone numbers for recall at the push of a button. Radio Shack's Duofone-32 (above) stores 12 numbers. Cobra's memory dialer (upper right) holds 24, lets you dial manually. EMP's machine (lower right) takes 32 entries.



egrated-circuit chip and microprocessor technology made themselves felt. These units accept anywhere from 10 to 60 or more telephone numbers, which you can then call out at the touch of a button. They all have different features. Some are combined with telephones, some are separate keyboards and some are dial units which take over for a rotary dial phone.

Programming is easy. You dial a number, tell the microprocessor you want to enter the number into the memory and then determine which memory. Most memories will accept up to 16 digits so you can store long-distance numbers. And, thanks to microprocessor technology, some of them have two or more memory storage areas.

Some of the more interesting features include clocks, calendars and calculators. Some will also keep dialing a number until told to stop, and most have last-number-called redial capacity.

Some of them even allow hands-off dialing and include speakers, so you can tell if a call has gone through and you have to pick up the receiver.

Then there are the phones which combine both memory dialing and the telephone into one unit. Their chief advantage is as a space-saver. They are offered by a

variety of companies, but one of them, Radio Shack's Duofone-16, even includes an amplifier for hands-off conversations. Ma Bell also offers a combination Touch-A-Matic phone.

Dial memories work with microprocessors and let you store phone numbers. The Radio Shack version stores 16 and the phone company's unit stores 15 or so.

#### Dial with one button

One of the chief attractions of these combo dialers is that they offer one-button telephone dialing. Since they also run off the telephone-line current, they require no external power, although most offer battery backups in case the phone lines go dead. This is so the memory won't be drained of the numbers you've put in.

Some of the independent dialers, like the Webcor Dial-A-Tron and Hi-Tek Autotouch, can turn a rotary phone into a Touch-Tone phone because they use auxiliary keyboards to program the numbers. They bypass the old rotary dial.

Telephone amplifiers have also come a long way. They're trimmer, dressier and fit in with most office or

*(Please turn to page 160)*



Phones with memory and redial capability, as well as auto repeat, are represented here by Radio Shack's Duofone-19 (left) and Superphone's Model 7900 (above).



**W**hen we ran our first Volkswagen Rabbit Owners Report back in November 1975, the car was brand-new, and you had to pay all of \$2999 to own one!

So what else has changed in five years? We wanted to know, so we queried 1000 owners of nondiesel 1980 Rabbits. Some of their answers surprised us.

For one thing, there's that nagging question of workmanship. Rabbits built in Pennsylvania can't possibly be as good as those produced in Wolfsburg, right? Wrong. Fact is, more owners praised the quality and workmanship of their 1980 Pennsy-built Bunnies than did buyers of Rabbits produced in Wolfsburg back in '75.

Nearly 84 percent of our respondents rated 1980 U.S. workmanship *good to excellent*, whereas only 71.8 percent felt



Rabbits come in three trim levels, this being "L" model with bright grille bars.

## PM OWNERS REPORT: VOLKSWAGEN RABBIT

that way in 1975 about German Rabbits.

Another surprise came in comparing answers to: "Have you had any mechanical problems?" In 1975, 70.5 percent of our sampling said, "Yes." In 1980, that figure dropped to only 42.0 percent.

It's quite true that the first-year Rabbits had more than their share of bugs. Carburetor problems topped the list at 23.2 percent, and a new carburetor cost a couple of hundred bucks back then—a real shocker for people who'd been sold on the Rabbit's *economy*.

Most of today's Rabbits still come with carburetors, but carburetor ills accounted for exactly half as many complaints as in '75: 11.6 percent in 1980 versus 23.2 in 1975. (The larger 1.6-liter Rabbit engine uses fuel injection which, according to our

survey, gives relatively little trouble.)

Dealer service has also risen in owner estimation. Back in '75, only 54.2 percent gave dealer service a *good to excellent* rating. For 1980, that tally jumped to 63.2 percent—nearly 10 points.

And today's owners rate their Rabbits more comfortable than the 1975 model.

So what we seem to have here is a car that's basically quite similar to its forebear, yet is put together better, with fewer trouble spots, a more capable service network and greater comfort.

What, then, *hasn't* changed? The most noticeable similarity is fuel economy. The '80 model, according to our survey, gets 0.2 miles per gallon more than the 1975 model, both in town and on the highway. That's so close it's almost imperceptible.

Economy topped the list of reasons people bought Rabbits, and it also headed their list of the car's best-liked features. All but a handful of owners expressed satisfaction with the Rabbit's fuel mileage, but several went beyond that in pointing out the car's overall economy.

A Florida computer maintenance writer, for example, explained, "I consider the Rabbit's engineering dollar value its true economy; that is, it's the best engineering I could get for my dollar."

A California conservation specialist told us, "The quality is the economy, but I didn't want to economize on either spa-

BY MICHAEL LAMM WEST COAST EDITOR

## Surprise! Our survey shows U.S.-built Rabbits are made better than the German ones!

Some owners would like hatch to open at bumper level for easier loading.

Space-saving independent rear suspension makes for more fuel and luggage capacity.





sciousness or comfort in my choice."

An Idaho social worker: "The Rabbit cost more initially, yet seems to be a better machine, and it does get good mileage."

And an Illinois cashier: "Economy in a car like this goes farther than good mileage."

"It's the Rabbit's sturdiness, excellent workmanship, logical engineering, good performance and high resale value that make this a true 'econobox' in the best sense of the word."

Moving now to more general areas of praise, here's a cross section of owner comments:

"Handles very well on snow and ice. VW instruction manual makes maintenance and upkeep easy. The car seems sturdy and well balanced."—Colorado nurse.

"My wife and I wanted a comfortable, economical car for long trips. We were both delighted to find the Rabbit so quiet on the highway. The childproof locks on the rear doors have been an added plus with our 2- and 4-year-old children. The car is fast, with an excellent air conditioner and large cargo area, and it's fun to drive."—self-employed Floridian.

"The car has a very pleasant ride over rough roads, and the maneuverability of the rack-and-pinion steering has helped me avoid plenty of potential wrecks."—South Carolina computer key operator.



Huge luggage area holds 15 cu. ft. with the rear seat up, 22.6 cu. ft. with it down.

"It's a high-quality auto that's economical and dependable. For a subcompact, I consider it a safe car, as well. Mine was involved in a major collision, yet my injuries were minor. The Rabbit survived, too."—Illinois cost accountant.

"The Rabbit does many things very well and is certainly superbly  
*(Please turn to page 188)*

## Rabbit rundown

Volkswagen introduced the Rabbit in this country in 1975. Changes since then have been minor.

All 1980 Rabbits sold in this country are assembled in Westmoreland County, Pa. Body styles include two- and four-door hatchback sedans, a convertible and a pickup.

Rabbit sedans come in three levels of appointment.

The basic Rabbit is currently available only as a two-door, with black interior and choice of three exterior colors. Next up is the Rabbit "C," offered in both two- and four-door bodies, with choice of leatherette or ribbed velour upholstery and more colors. Finally, there's the "L" Rabbit, with still more luxurious trim, front ventipanes and passive restraint belts.

The Rabbit offers a carbureted 1.5-liter, 62-hp, ohc Four as its standard 49-states powerplant. VW's California engine (optional elsewhere) is a 1.6-liter, fuel-injected version that delivers 76 hp. The 1.6 is mandatory with VW's optional automatic transmission. All Rabbits have front-wheel drive and offer a choice of four- and five-speed manual gearboxes.

In 1977, VW added the Rabbit diesel engine as a \$525 option. The diesel has captured the EPA's economy championship three years in a row now, topping 56 mpg in its latest tests.

For a look at driving impressions of the Rabbit diesel, see *Firsthand Report: Driving the Diesel Rabbit* (page 82, July '77).

## A NATIONWIDE SURVEY BASED ON 1,927,858 OWNER-DRIVEN MILES

Front ventipanes are standard in "L" Rabbits, optional on the "C."



Rabbit shares its basic unitized body with Scirocco, convertible and pickup.



Full instrumentation is optional in "C" and "L" models, includes tach and clock. VW engines lie crosswise, come in 1.5- and 1.6-liter sizes, have aluminum heads, cast-iron blocks. Our survey showed only a .5-mpg difference between the 1.5 and 1.6.

Rabbits come with aluminum radiators, front-wheel drive and choice of three engines, including diesel.

PM photos: Robert J. Lamm



# PM'S CUSTOMIZED PONTIAC SHOWS TURN YOUR STOCK CAR

A few accessories and some pinstripes can transform your car's personality—and yours.

by Tony Assenza AUTO EDITOR



Aluminum die-cast speaker housings are solid as a rock, distortion-free, even at maximum volume.



Two-tone paint job and Phoenix lettering set car apart from the crowd. Mag wheels complete the custom look.

PM photos: George Ancona

**D**riving fun! Some people thought it was all over when the last of the big-block V8s were made and when gasoline prices went through the roof. We were told the love affair with cars was over and all we had to look forward to were more and more look-alike boxes, which, although fuel-efficient, had all the flair of a packing crate.

Well, let's have a round of boos and hisses to the prophets of doom and gloom and let's send OPEC a big raspberry because fun cars are still with us. And the fact they are now fuel-efficient

makes owning them a lot more affordable.

To make our point that fun and fuel efficiency aren't mutually exclusive, we decided to take a box-stock Pontiac Phoenix and turn it into the envy of any hard-core hot-rodder. And we didn't use magic or custom-built equipment to do it. We took basic off-the-shelf items that are available anywhere and selected the pieces that we thought would best enhance the car's basic nature.

For starters, we removed the stock seats and



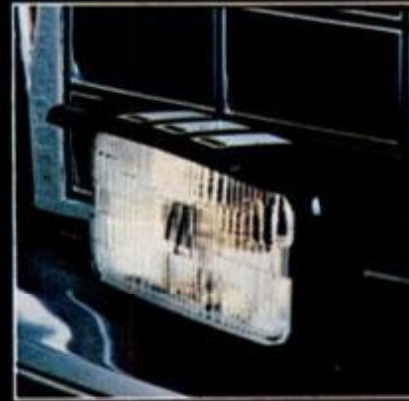
# HOW YOU CAN... INTO A SHOW CAR

Scheel custom seats are far better looking and far more comfortable than even the expensive factory bucket options. Panasonic's slick Cockpit stereo mounts to the headliner for that 747 look. It features FM radio and cassette tape, built-in equalizer, individual spotlights and a whopping 60 watts per channel.



Zemco ZT-3 driving computer is mounted by Velcro strips to dash, gives instant and average mpg, instant and average mph and miles-to-empty.

CB and police-band scanner (below, left) are stacked and mounted below the dash. Custom wheels are lighter and better looking than stock wheels. Special lugs are used to prevent theft. Auxiliary lights are mounted on top of the bumper. Flip-up lens shield prevents stone damage.







The letters are first drawn freehand on a sheet of paper (left) and then are transferred to the body panel using a roller and talcum powder. A contrasting color is sprayed on with an airbrush in order to give the letters weight and density.



Pinstripes are painted freehand, using the masking tape only as a guide. The pros use a special pinstriping brush called a dagger to do this.

replaced them with a pair of Scheel seats. This was to provide more comfort and support for the two front occupants. The Scheel seats have large thigh and side bolsters that keep you put under hard cornering, whereas the stock ones were flat up and down.

Taking out the old seats and putting in the new ones took less than an hour. The only tools needed were a ratchet and a half-inch socket.

The stock seats are anchored to the floor pan by four studs. To take out the seats, you remove the four nuts which hold the seat rails to the studs and lift out the entire seat, rails and all.

The Scheel seats are different from the stock ones in that they have a separate subframe. You install the subframe first, by slipping the four subframe tangs over the studs and screwing it down, using the same nuts that held the stock seat. Once the subframe is installed, the seat, with its attached rails, is bolted onto the subframe.

Before you bolt in the seat, however, you should first determine how high you want it to be. The Scheel seat height can be adjusted by using any of three bolt holes in the rail

tang. We found that the highest setting, which is the lowest hole in the tang, would accommodate the majority of adults.

In the looks department, the Scheel seats far outshine the stock ones. They transform the cockpit's appearance from fairly unexciting to one that would look at home in a Ferrari.

### On-board computer

When auto computers first came out a few years ago most people considered them nothing more than expensive playthings. Our experience finds that they're much more than

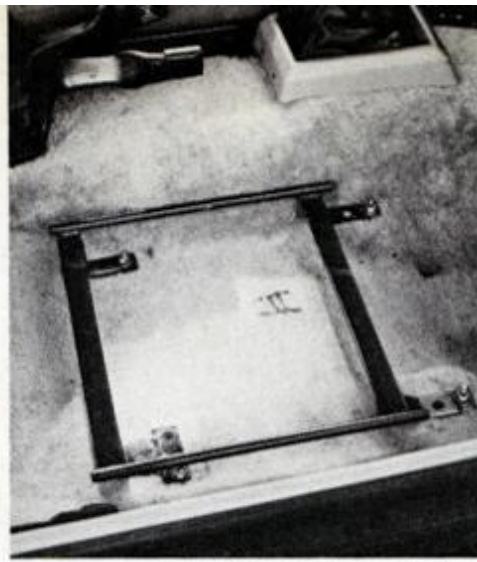
that. While they are fun to play with, computers can be used like any of the other gauges in your car. By keeping track of mileage and fuel consumption, a computer can tip you off that something is wrong with the car.

If, for instance, you were getting a consistent 27 mpg and the computer

Computer's fuel-flow sensor (below) is mounted between the fuel pump and carburetor. Alarm system's motion-detector box (right) screws to the inner fender.







Subframe for replacement seats uses same studs as stock seats (right). New seat is then bolted to the subframe (left). It takes less than an hour to do the whole job.

suddenly starts giving you a reading of 24 or 25 mpg, it's a good indication that the car has gone slightly out of tune. By keeping track of mileage the old way (by odometer reading computed by hand against fuel consumption), that 2 or 3 mpg might go undetected through odometer error, a small error in the fuel gauge, tank top-off or even a false odometer reading due to tire wear or improperly inflated tires. With a computer on board, these factors are accounted for and automatically adjusted.

The computer we chose for the Phoenix is the ZT-3 Driving Computer made by Zemco. It incorporates 28 functions, including average and instantaneous miles per gallon, average speed and current road speed, miles-to-empty and many others. Not surprisingly, the function we used most often was average mpg and instantaneous mpg.

As you might expect, installing the computer was nowhere near as easy as installing the seats. The job involves installing the fuel-flow sensor, the speed sensor and the brain box, and running wires through the fire wall into the display terminal mounted on the dash.

The fuel-flow sensor is installed in the fuel line between the fuel pump and the carburetor. This requires cutting out a section of the fuel line with a small pipe cutter and attaching the sensor with two pieces of neoprene hose. Although we used the smallest pipe cutter available, working it in the tight confines of the Phoenix's engine room was a real chore.

The speed sensor, on the other hand, went in with no trouble. This

To run wires through fire wall (far right), push them through grommet with a rod. Relay for auxiliary lights must be mounted with tabs facing downward (right).

sensor works on the Hall-effect principle of magnetic induction. There are four small magnets which are mounted on the left front driveshaft, arranged an equal distance from each other around the shaft. A pickup coil is mounted to a bracket above the magnets with a recommended clearance of  $\frac{3}{8}$  inch between the magnets and the coil.

The coil receives a pulse from each magnet as it passes and feeds that information to the computer. With this setup, the computer is accurate to within a few inches per mile.

In the Phoenix installation, mounting the speed sensor was a simple matter of removing the left

wheel and attaching the magnets to the driveshaft. Mounting the coil was even easier.

The bracket that holds the coil is attached directly to the transaxle case. This is made easy because an existing transaxle bolt is directly in line with the driveshaft. All you need to do is remove the bolt, slip it through the bracket and screw the bolt back in place. It's as if the transaxle and the speed sensor were made for each other.

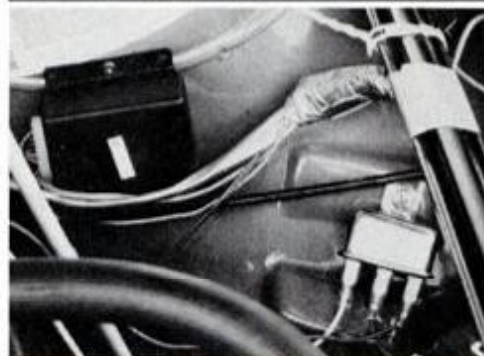
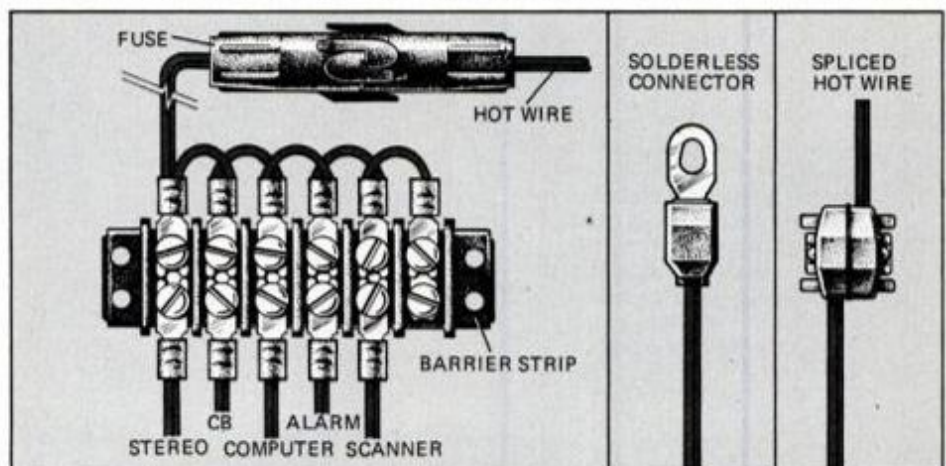
The rest of the installation requires running wires from the speed sensor and fuel-flow sensor to the brain box, and then from the box to the display terminal. When it came to running the bundle of wires from the brain box through the firewall, we got a neat tip from ace mechanic Gerry Moringiello. He advises that the wires should be crimped onto a stiff metal rod and pushed through the grommet on the fire wall. This eliminates the need to drill extra holes through the metal. It also keeps the added wiring neat, because it follows the same route as the car's wiring harness.

#### The ear buster

One of the nice things about having a really super sound system in your car is that it doesn't penalize your gas mileage. Unlike adding a wild camshaft or a big carburetor, a good sound system is a pleasure you

*(Please turn to page 173)*

Use a barrier strip with a connection for each accessory and fuse each accessory individually. Solderless connectors and splicing clips help to make the job easier.





# Build the art desk that never runs out of drawing paper

It's sleek, easy to build and will be your child's favorite for years.



This good-looking, contemporary desk boasts a built-in paper holder which lets children roll out a clean sheet (and safely tear off the old one) whenever they want. There is storage for other supplies beneath the lift-up drawing board, as well as inside the handsome, rollabout chair.

**A** good desk, especially an art desk, should keep clutter at bay and supplies at hand. This desk, designed by David Stiles, does both admirably well: It functions as a drawing table, while providing compact storage and a paper holder all rolled into one. The desk surface is an ample 16x24 in. Scissors, ruler, brushes, crayons—whatever is frequently in use—can be kept in the bin at the head of the desk. A narrower trough at the foot of the drawing surface is designed to hold jars

of poster paint and prevent spills. Supplies not in use can be stored in the desk under the hinged drawing board. Even the matching chair provides storage for small items under its seat.

All surfaces are either covered with high-pressure plastic laminate,



The contemporary chair and desk designs are from *Easy-to-Make Children's Furniture* by David Stiles. The book is published by Pantheon Books, a division of Random House Inc. and is \$7.95 at book stores.

PM photos: Harry Hartman.



such as Formica, painted with high-gloss enamel or coated with polyurethane varnish to make cleanup a snap. You can also substitute the enamel paint for laminated surfaces, if desired.

### Materials you will need

The only parts of the desk not made of plywood are the stand—which is of pine—and the desk top hinge, made with a 1/2-in.-dia. dowel. Careful cutting will allow you to get all of the plywood pieces for the desk from a 1/2 x 48 x 48-in. sheet of A-C fir or birch veneer solid-core plywood. For the stand, you will need a 4-ft. length of 1 1/8 x 7 1/2-in. pine and a 4-ft. length of 1 1/2 x 3 1/2-in. pine. You may substitute 5/4-in. stock (actually 1 1/8-in. thick) for the desk feet if you would prefer a lighter look. In addition, a 3/4 x 8 x 24 1/2-in. stretcher is re-



Most art and stationery stores sell cheap drawing paper in rolls. The 16-lb. bond poster-paper roll we used is 18 in. wide and 25 yds. long. It costs about \$2.65.

quired to complete the stand.

The rollabout storage chair can be made completely of plywood and two 1-in.-dia. dowels. We used 3/4-in. birch plywood in the prototype because the edges were to be given a clear finish. If you intend to paint

the sides and edges, you can save money by using fir plywood.

### How to cut plywood

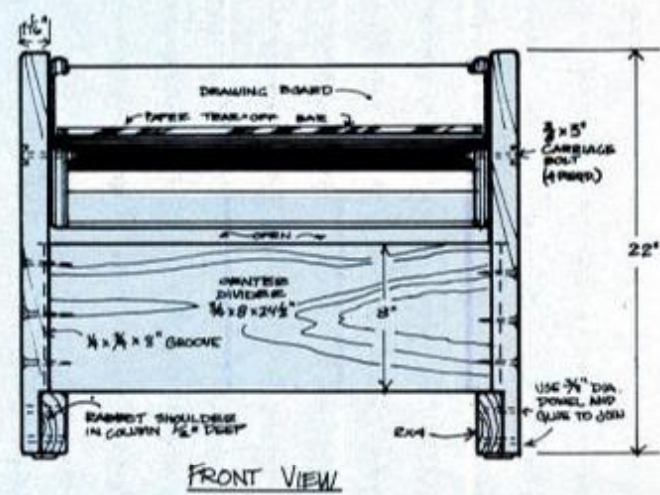
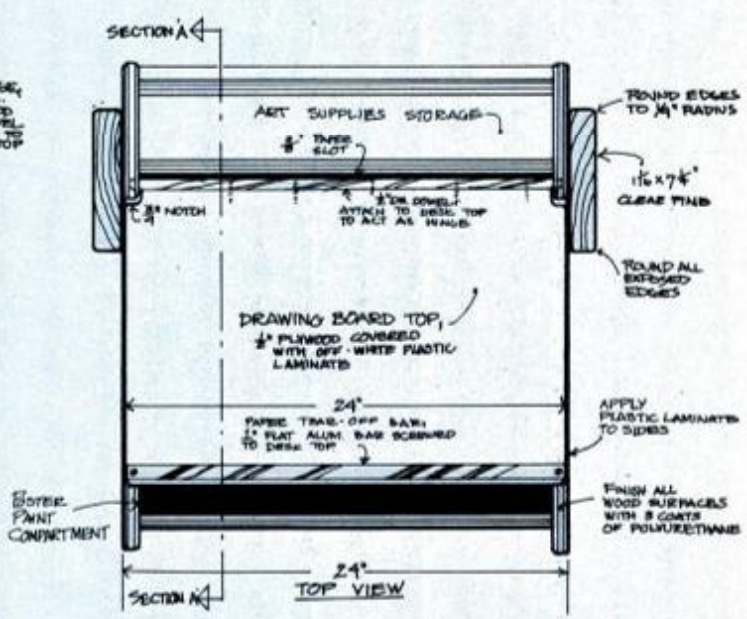
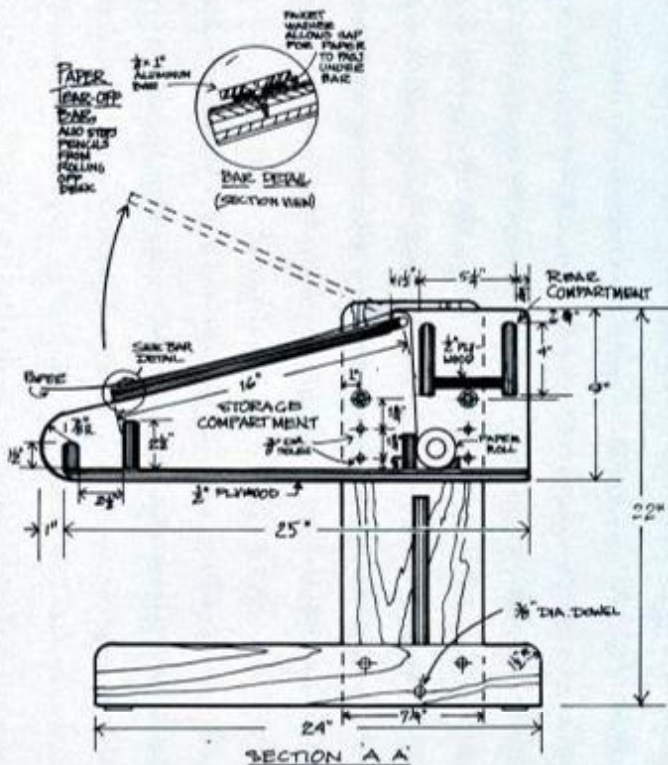
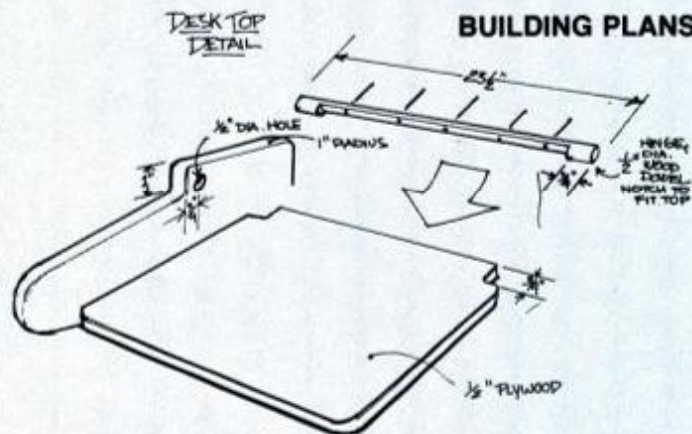
To cut the plywood pieces without getting unsightly splintering along the edges, use a sharp plywood blade in your circular saw (table, radial-arm or portable). Install a fine-toothed blade in your sabre saw to cut the curves. To assure splinter-free edges you can apply masking tape over the cutting line. For most cuts it isn't necessary to be so fussy—rounding the edges removes minor splintering. Use wood filler to cover voids in the plywood edges. Sand all filled areas perfectly smooth when dry.

### Applying plastic laminate

Plastic laminate on both the drawing board and the desk seat makes a

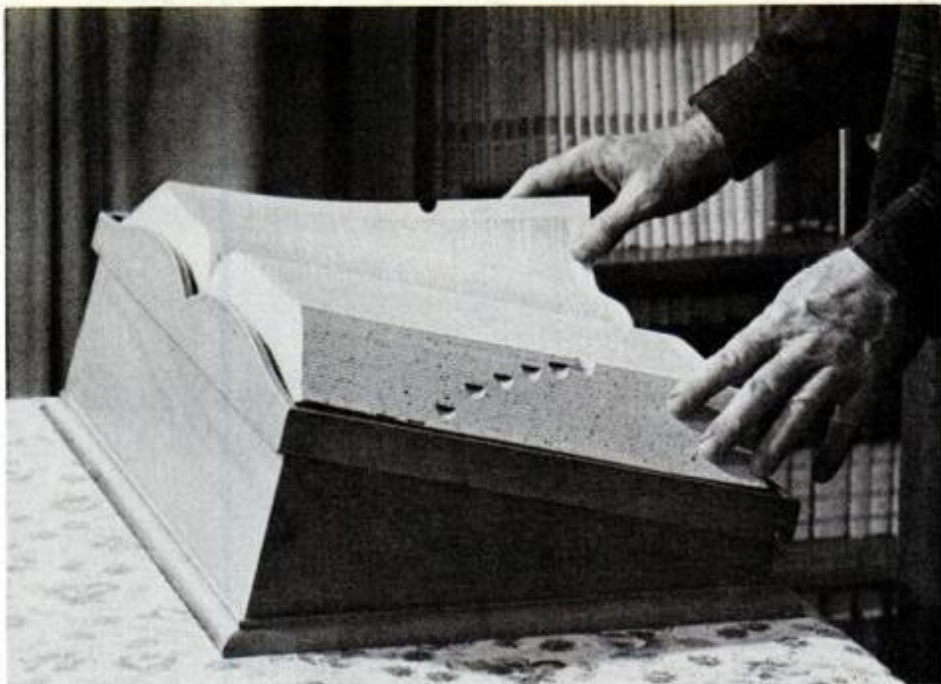
(Please turn to page 166)

## BUILDING PLANS FOR THE ART DESK





# PM's portable lectern goes with the speaker



This easy-to-build lectern doubles as a stand for dictionary, atlas or other heavy book.

**B**ig, floppy dictionaries, atlases and encyclopedias, as well as sheaves of lecture notes, are a nuisance to handle. This lectern, light enough to carry to speaking engagements, is a handsome solution.

Begin making the lectern by cutting sides (B) to the dimensions given in the materials list. Then cut the back (C) and the front (D) to identical lengths. Make 45° bevels at all ends (B, C and D) and groove the base together, checking for square.

Next, install predrilled blocks (H) for mounting the top (A). Install top with screws from the underside. Sand surfaces until smooth.

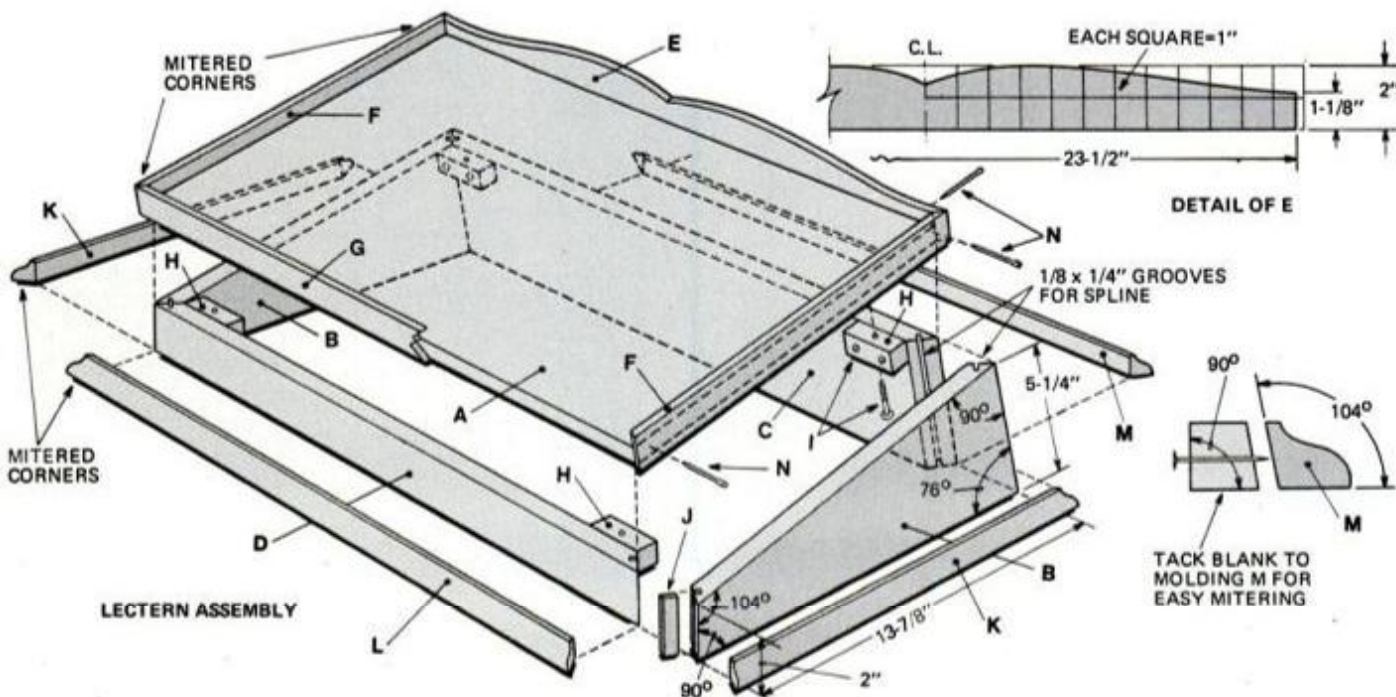
Use ready-made molding for trimming the lectern, or make your own. The shop-made molding is cheaper and will match better. For the top

pieces (E, F and G), resaw solid stock to obtain suitable 1/4-in.-thick strips. For the bottom molding (K and L), shape both edges of a 3/4-in. board with a 3/4-in. radius, rounding-over bit, or use a Roman ogee bit. Then, rip strips to separate them from board. Molding (M) can be made in the same manner, but should be ripped free at a 14° angle. Rip a blank strip at the same time to hold beveled molding true for mitering. (See detail, below.)

Use glue and finishing nails to fasten moldings. Give the stand a final sanding and finish with oil or varnish, as desired. Finally, glue felt to bottom to protect furniture surfaces.—G.S. Wing

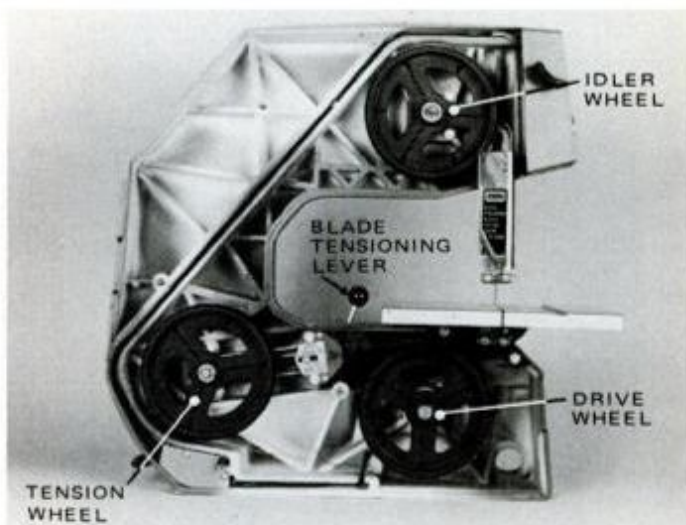
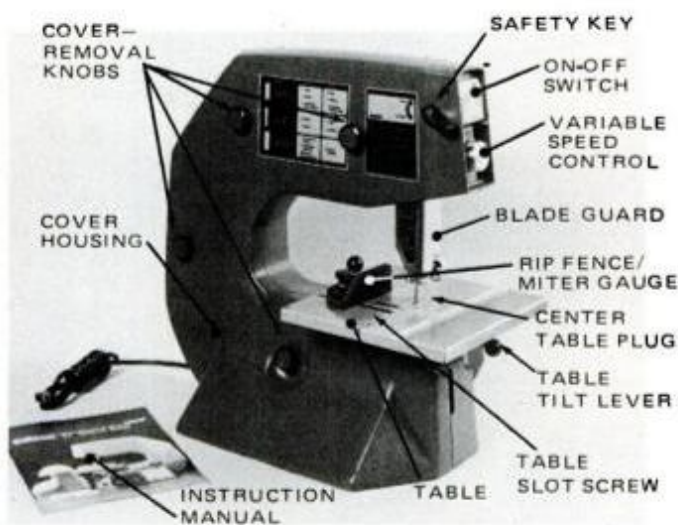
## MATERIALS LIST—PORTABLE LECTERN

Key	No.	Size and description (use)
A	1	3/4 x 13 x 23" Philippine mahogany plywood (top)
B	2	3/4 x 5 1/4 x 13 3/4" overall Philippine mahogany plywood (sides)
C	1	3/4 x 5 1/4 x 23" overall Philippine mahogany plywood (back)
D	1	3/4 x 27 1/4 x 23" overall Philippine mahogany plywood (front)
E	1	1/4 x 2 x 23 1/2" Philippine mahogany (back trim)
F	2	1/4 x 1 1/4 x 13 1/2" Philippine mahogany (side trim)
G	1	1/4 x 1 1/4 x 23 1/2" Philippine mahogany (front trim)
H	4	3/4 x 3/4 x 2" pine (blocking)
I	12	No. 6 x 1 1/4" fh screws
J	4	1/2 x 1/4 x length to suit, pine (spline)
K	2	3/4 x 3/4 x 15 1/4" Philippine mahogany (bottom-side molding)
L	1	3/4 x 3/4 x 24 1/2" Philippine mahogany (bottom-front molding)
M	1	3/4 x 3/4 x 24 1/2" Philippine mahogany cut at 14° angle as shown (bottom-back molding)
N	as reqd.	3/4" brads





# PM LOOKS AT A COMPACT BANDSAW



Benchtop bandsaw is more compact than most 10-in.-throat models; blade rides around three small wheels instead of two large ones.

**S**everal features make this saw stand out. First, it is small and light enough to be classed as portable. A three-wheel setup allows the design to be short and squat. Unlike several models I've tried, it isn't top-heavy.

The housing is made of a structural foam plastic. It's extremely tough, according to the manufacturer's tests, and helps to keep the saw's cost reasonable. The internal rib pattern was designed by a computer and adds to the material's strength. (For its innovative use of plastic, the saw won first place in a contest sponsored by *Plastics World* magazine.)

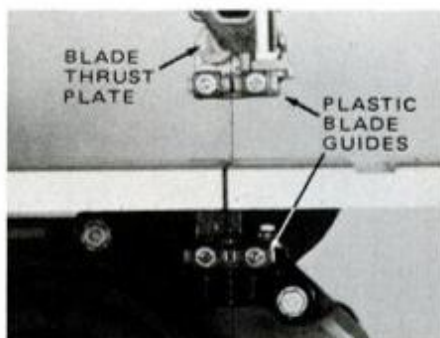
In addition, a variable-speed motor control built into the housing permits cutting at fast speeds for wood and slow speeds for nonferrous metal. Other wood- and metal-cutting bandsaws I've tried require step-down pulley and belt setups. Turning a control knob is a lot easier.

Another good feature is the quick-release blade-tensioning lever. If it's locked, a preset tension

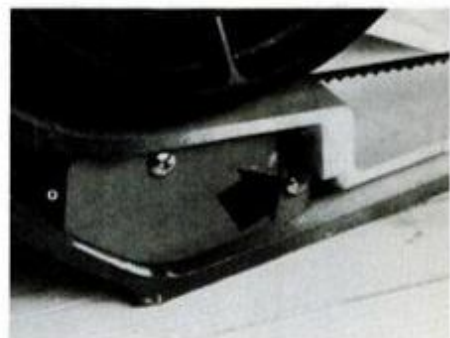
is maintained. When it's unlocked, blade tension is released. Other than normal tension, settings can be made by adjusting a wheel.

Maintaining the unit is fairly simple, since the bearings are lifetime-lubricated. Rubber tires on the three wheels and plastic blade guides are easily replaced if worn.

An opening for a vacuum-cleaner hose is provided in the housing of the saw to permit you to clean out dust and small wood chips as they are generated. Changing brushes is a simple operation, despite the maker's recommendation that it be done by a trained technician.—*J.P.*



With housing removed, blade guides and thrust plate adjust easily. Manufacturer recommends guides lightly touch blade.



Housing interlock switch (arrow) avoids accidental turn-on when housing cover is removed for adjustment, blade change.



Miter gauge doesn't pass under guard unless it's raised. Manufacturer reports that this has been corrected on new models.



For resawing and ripping, miter gauge also functions as fence. It's fixed to table with screw at one of three locations.

## SPECIFICATIONS—COMPACT BANDSAW

Model: No. T 676016-A  
Throat: 10 in.  
Cutting-depth capacity: 4 in.  
Weight: 25 lbs.  
Electric: 120 v.a.c., 60 Hz, 3 amps., double-insulated  
Unitized gear motor: develops a 1/2-hp peak  
Speeds: 480 to 1200 ft. per minute  
Price: \$150; UL listed  
Blade accessories: 1/8-in., 6-tooth general purpose; 1/8-in., 6-tooth scrolling; 1/8-in., 14-tooth general purpose metal cutting  
Manufacturer: Portable Appliance & Tool Group, McGraw-Edison Co., 1801 N. Stadium Blvd., Columbia, Mo. 65201





While this handsome coffee table can be sized to fit the space you plan to put it in, construction method remains the same. After cutting parts and test-assembling without glue, unit is disassembled and painted before final assembly. Lattice on walls is affixed with glue and brads.



# Create an unusual room with strips of wood

Installing lattice strips over a painted wall is one quick way to give a room a new feeling. And, if you can apply strips to one or more pieces of furniture at the same time, you will give the room a custom look that is sure to draw admiring glances and comments.

In the room on the facing page, strips of 1½-in.-wide lattice are applied diagonally to the wall at 45° angles. The vertical and horizontal strips that box in the diagonals simplify the installation considerably.

The coffee table is a shop project that requires one sheet of ½-in. plywood and about a weekend of your time. You can use interior-grade, A-D plywood for the table and not worry about the edges because they will be covered with lattice.

## Building the table

All four sides are exactly the same size. Cut these pieces first when building the table; then carefully stack them to make sure they are identical. If there is any variance of parts, clamp them together and use a block plane and/or belt sander with coarse-grit belt to make them all the same length and width.

On the D side of the plywood, install the glue cleats at one end of each side as shown—set back ½ in. to receive the joining side. The cleats can be fastened using either 1¼-in. ringed nails or 1-in. flathead screws (turned into countersunk holes.) If you opt for the nails, use your diagonal cutter to nip off the tip of each nail before driving (or the points will come through the plywood). Next, install the cleats upon which the top will rest. With sides completed, the case can be assembled. Use glue and screws at each corner as shown in the section drawing below. When all four sides are assembled, check with a square to make certain corners are exactly 90°. Before the glue has a chance to dry, measure for, and cut, the

With carefully placed lattice, you can create an elegant look. And with our plans, you can make a matching coffee table.

top piece. Install the top using glue and flathead screws in deep countersunk holes. If you have cut the top perfectly square and with a neat fit, it will hold the case square while the glue dries. When dry, the screw holes on top can be filled with wood filler and sanded smooth.

Lay out the lattice and cut all strips and assemble without glue to check for layout and fit. When satisfied, remove the lattice and apply a finish before final assembly.

For a proper finish, sand all sur-

faces of the table with a belt sander; first use an 80-grit paper, then 120-grit. Dust off and apply a coat of a pigmented shellac, such as Bin. Repeat the steps for the lattice.

Next, sand all painted surfaces lightly with 150-grit abrasive paper; dust and wipe with a tack cloth. Apply the finish color of your choice to the table and white semi-gloss paint to the lattice. Allow paint to dry overnight and assemble the unit.

Lattice for the walls should also be painted before application. It can be secured to the wall using flathead wood screws into wall studs or white glue and 6d finishing nails. No matter which fastener you use, be sure to predrill holes to avoid splitting. **PM**

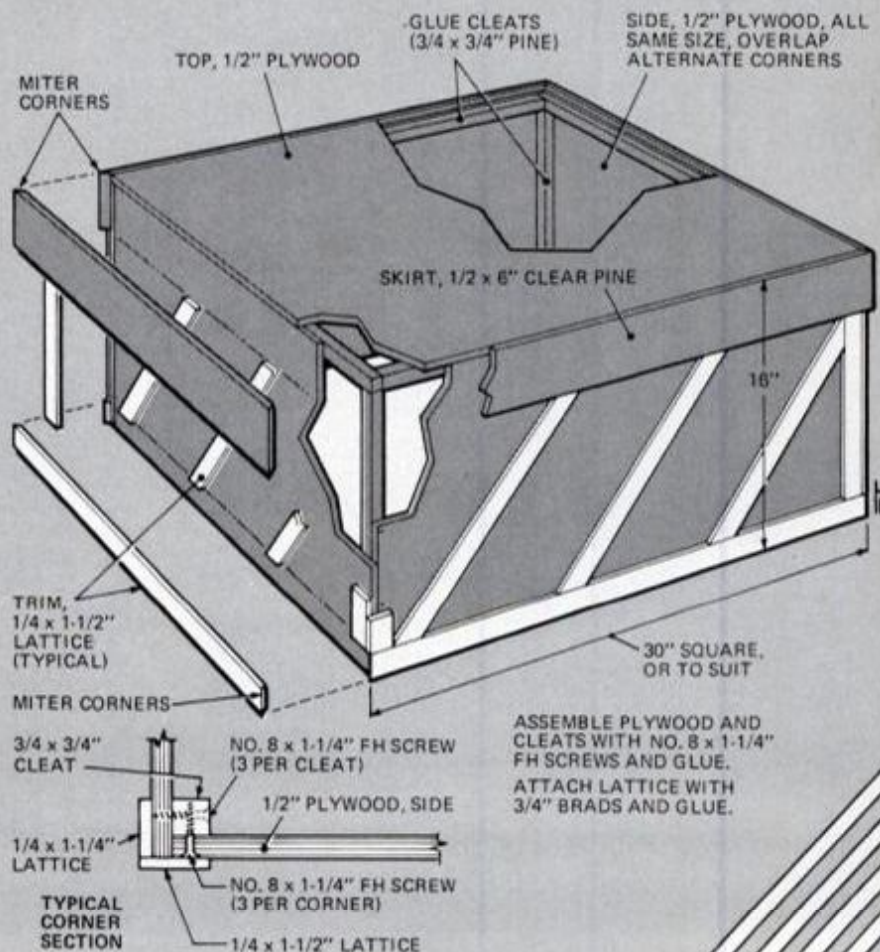


Photo courtesy of Western Wood Products Assn.



## AVIATION

### Up, up and away

Our cover illustration this month and the one below anticipate, perhaps by some years, an event that would have great significance to the military: The reliable takeoff of a fully loaded, fully capable supersonic attack/fighter aircraft from land or sea with zero ground roll.

In the decades since World War II, perhaps no single avenue of military-oriented aeronautical research has involved so much effort and money with so little practical result as has VTOL (vertical takeoff and landing). From the "pogo-stick" fighter which stood on its tail through "flying bedstead" platforms to

pivoting wing-and/or-engine systems, these efforts have yielded only one operational aircraft—the British-designed AV-8 Harrier (photos, opposite page).

### Ski-jump takeoff

The Harrier's vectored thrust propulsion system, while proven, permits vertical takeoffs only when the aircraft carries just half its normal load of fuel and ordnance, sacrificing combat radius and mission capability. Operating within roughly the same parameters in which Jimmy Doolittle got his B-25s off for Tokyo, the naval (Sea Harrier) version can come off fully loaded from the new pocket aircraft carrier's 490-foot flight deck. And the celebrated ski-jump ramp (see photo) gets a partly loaded Harrier on its way after a relatively short takeoff roll with engines pointed partially

downward. Off the ramp, the plane goes through a brief but, for the pilot, eternal period of "ballistic flight," during which the engines' thrust is vectored—smartly—aft.

Yet, during 30 years of VTOL research, while exotic, expensive fixed-wing aircraft were developed to behave more like helicopters, the temporary use of an existing helicopter as a VTOL powerplant for an existing conventional aircraft apparently got no serious consideration.

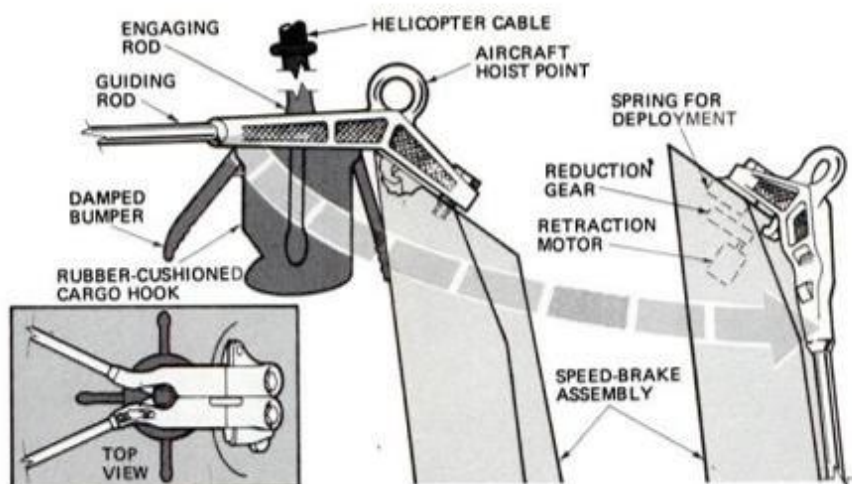
Until 1979, that is, when a 27-year-old aeronautical engineer named William R. McDonnell drew up a "Flying Catapult" proposal and showed it to the National Aeronautics and Space Administration and the Navy for review. McDonnell, son of McDonnell Douglas Corp. president Sanford N. McDonnell, based his idea on rigid-boom-type air-re-



"Flying catapult" concept would use helicopter's lift as the vertical component for a VTOL-capable supersonic

fighter. For the Navy, it would give even small combat vessels the added punch of launching attack aircraft.





**Retractable trap assembly mounted on speed brake locks under any load. Pilot flies cable into locking lugs with deft throttle and aileron control.**

fueling technology. He projected a system to maneuver the boom from a cargo-capable helicopter into a lifting point built onto a jet fighter aircraft. The copter would then lift the plane, accelerate it to flying speed and release it for normal flight. The system could also be used to retrieve the aircraft at low flying speed and subsequently land it vertically. Total ground—or deck—space needed? Only the same as for parking.

### Cable replaced boom

NASA's initial review and Navy comments indicated to McDonnell that he had unnecessarily complicated the idea by using a rigid boom. He has since redesigned the system using a flexible cable with a rubber-cushioned

cargo hook as the "stop." It is the projected operational version of this apparatus that you see published here for the first time.

A front-line supersonic fighter aircraft like the F-18 (which PM chose for the hypothetical illustration) would have a vertically extended speed brake incorporating the cable-trapping mechanism. With the brake extended in slow flight or prior to takeoff, the trap would be positioned to engage the rod-stiffened lower part of the cable.

The cargo hook is rubber-encased and has spring-loaded bumper arms. The trap has fork-like guide rods to help the fighter pilot fly the cable into place. (Actually it happens behind him, and he uses his rear-view mirror for the "final approach" in the

landing phase.) The trap will not release the cable while there is a substantial load on it from the aircraft. During takeoff, the pilot would exert back pressure on the stick as flying speed is reached, increasing the plane's angle of attack until its weight is on its own wings. The cable would then be released by retracting the trap arms (see diagram).

### Technological challenges

Some questions remain to be answered in a test of the system McDonnell hopes to perform soon, using a Navy T-2 trainer and a Sikorsky CH-54 ("Flying Crane") helicopter. Disabled aircraft lifted by helicopters in Vietnam were often found unstable, "porpoising" dangerously in tow. The rotor downwash of the copter, moving aft as speed picks up, could affect the tail surfaces, causing the nose to pitch up. Finally, the dynamics of the airborne hookup need additional analysis to assure that no difficulties will occur.

McDonnell, a rated helicopter pilot and flight-test engineer on the F-18 evaluation program at the Navy's Patuxent River, Md., facility, believes the Flying Catapult can be perfected with existing technology, saving perhaps billions in further research.

Even as just a backup system for carrier operations, providing emergency retrieval for disabled aircraft too "sick" to try an arrested landing, it could save both planes and lives. **PM**



**Jump-takeoff ramp lets Harrier add fuel, ordnance for a STOL mission.**



**Ski-jump gets plane up where it flies, momentarily, without lift—like a rock.**



## ENERGY

### Bowl power

At first glance Crosbyton is no different from the other quiet hamlets that dot U.S. 82 in flat, dry, windy West Texas. But if you turn off the main road at the town square and head south into the open plain, you'll find a silvery bowl as big as a house,

**PM visits Crosbyton, Tex.** tipped on edge in the middle of a cotton field.

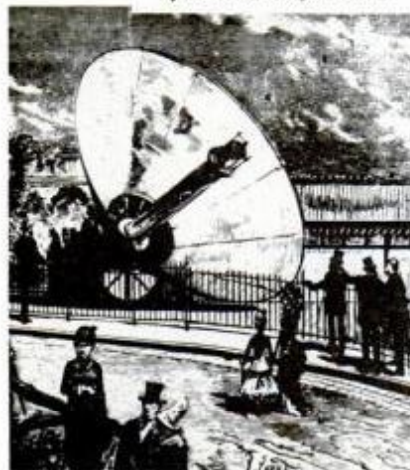
The 65-foot-diameter bowl got there through the dogged efforts of the small farming community (pop. 2700) which plans to use the bowl and others like it to catch solar energy. The parabolic collector is the prototype for a system designed to supply a third of Crosbyton's electric power.

### 19th-century solar

The concept behind the Crosbyton bowl isn't new. More than a century ago, the Frenchman Augustin Mouchot displayed similar bowls to trap sunlight for heat to boil water, cook food, distill alcohol—and even to run a refrigeration device. Mouchot's mirrored bowls moved on pivots to track the sun. The idea survives in heliostat designs using motorized mirrors to bounce sun rays onto a fixed boiler tower.

The Crosbyton bowl is different in that the mirror sits still. The boiler, a tube carrying water,

From *A Golden Thread*, © 1980 by Ken Butt and John Perlin



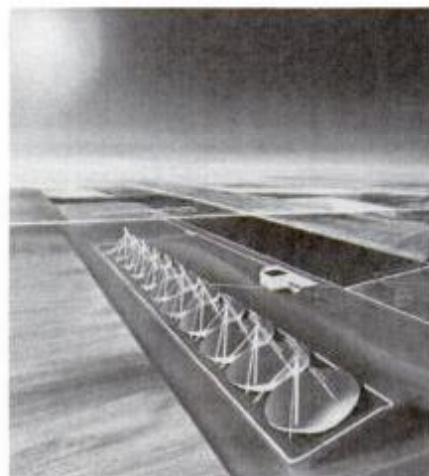
Mouchot's bowl cooked and cooled.



A 65-foot-diameter bowl focuses sun to heat water-filled tube at focus.



The boiler moves above 430 mirrors.



Goal: 10 bowls, millions of watts.

moves to keep up with the changing focus as the sun passes overhead. The central advantage over Mouchot's concept is savings: It costs less to move the boiler than the whole bowl heating it. So say the Crosbyton bowl builders, who faced a formidable challenge in convincing Washington.

The search for funding began years ago with futile appeals to the U.S. Energy Research and Development Administration (ERDA, now the Department of Energy). Undaunted, Crosbyton officials spent \$20,000 over two and a half years traveling to Washington, D.C., to seek government funding. Their effort worked. Since late January, the bowl has consistently produced 1000-pounds-per-square-inch steam, sufficient to operate a commercial turbine and produce a peak of 40 kilowatts. "We've

spent less than \$5 million," said program director Dr. John Reichert, "and we've done everything we said we would do."

### Following the focus

The success is based on simplicity: Steam is generated and consistently maintained by keeping the boiler at the hottest spot in the bowl. The movable receiver is an 18-foot tube 6 inches in diameter, wrapped with two ¼-inch-diameter flow tubes. Water cycles through the tubes, heated to a blinding white 1000° F. When the sun is obscured by clouds, a memory drive insures the receiver will be in optimum position when the light returns.

Reichert readily concedes that the device is not as efficient as the heliostat system because a portion of the bowl is shadowed early and late in the day. Nor does he



## Sit-com solar

Will Laverne or Shirley or Mork or Mindy convert to solar power this TV year? Stay tuned. They might.

Representatives from the U.S. Department of Energy, the non-profit Solar Lobby and the White House have been nudging television producers to mention solar in their fall scripts. In Los Angeles, the Washington visitors did an energy audit on Lou Grant's fictional house (suggesting that his fictional bedroom air conditioner needed shading) and made a standing offer to solarize Archie Bunker's place.

The effort paid off. A spokesman for Garry Marshall, executive producer of *Mork and Mindy*, *Laverne and Shirley* and *Happy Days*, told us there will be a reference or two to solar on the air this fall. "Garry's sympathetic," the spokesman said, which means Laverne isn't far behind. **FM**

promise the plant will save Crosbyton money at today's energy costs. "There's no free lunch in this business," he said. But if the prototype continues to work well, the next step is to build a 200-foot-diameter bowl, then nine more—enough bowls for 5 megawatts of electricity.

"The good news is for the nation," Reichart said. "If we can get roughly 30 percent of our energy from the sun, that means there's more fossil fuel that can be used elsewhere." **FM**

## Earth as energy bank

Like squirrels burying nuts for the winter, industry and utilities are looking to store energy underground to supply them when the need is greatest.

In systems under development at Battelle Pacific Northwest Labs, salt domes, aquifers (water-bearing rocks) or caverns would hold compressed air or hot water for peak-demand periods.

### The air bank

The compressed-air energy storage (CAES) system comprises a manifold of mined storage caverns, a heat-storage cavern, and a pressure-compensation system. During low-demand periods, a utility would pump air underground.

The air would heat up so much

under compression that it would threaten to fracture the manifold. So on its way into storage, the air would pass through crushed rock, giving up its heat. From the heat-storage cavern, the air enters the manifold, displacing water to the surface.

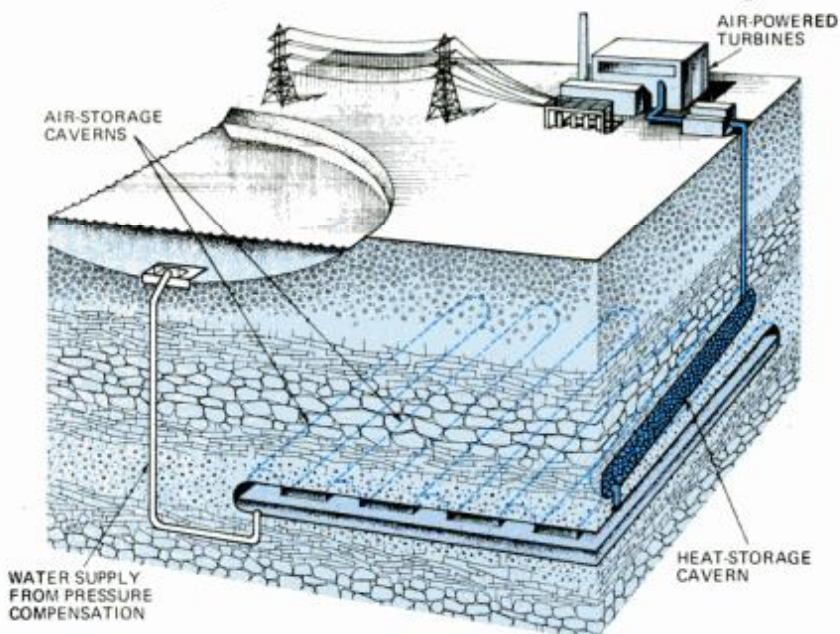
When the demand is highest, air would stream back through the crushed rock and regain enough heat to run turbines properly. As the air is used up, surface water flows down to take its place, keeping underground pressure constant.

A second system, seasonal thermal energy storage (STES), would bank energy longer.

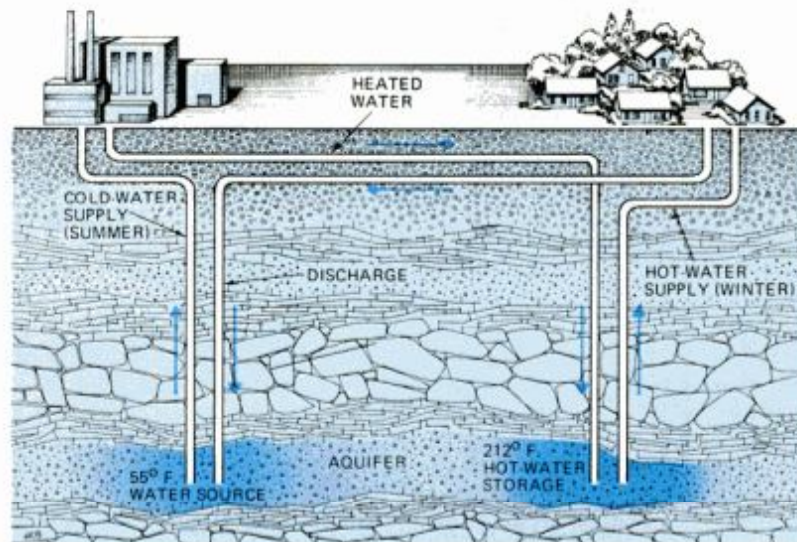
In warm weather, 55° F. water

is pumped from an aquifer to a source of waste heat, like a factory. Now near 212° F., the water courses down to another part of the aquifer hundreds of feet away, where it remains hot. In winter, nearby buildings draw out the water and use its heat. Cooled to 65° F., the water is discharged back to its original well.

The success of an 18-month-old CAES operation near Hamburg, Germany, gives researchers confidence in the concept. That facility stores compressed air in salt domes instead of rock caverns. But more research is needed to see if squirreling energy in earth causes geological or environmental damage. **FM**



Compressed air releases heat to crushed rock on way to storage area, regains heat before powering turbines. Water maintains constant pressure.



Cold water picks up industrial waste heat, is pumped back underground. In winter, hot water heats buildings, cools down, and flows back to source.



## AUTOMOTIVE

### Plug in or fill up?

In the ever-accelerating search for maximum fuel economy and alternative sources of energy there seems to be no shortage of clever ideas for accomplishing those aims. One of the latest entries in the high-mileage auto competition comes from General Electric, which has announced it has been granted \$8 million to conduct a 30-month hybrid vehicle project. The grant came from the U.S. Department of Energy to enable GE to build a pair of cars that will use 55 percent less petroleum than a conventional car of similar size.

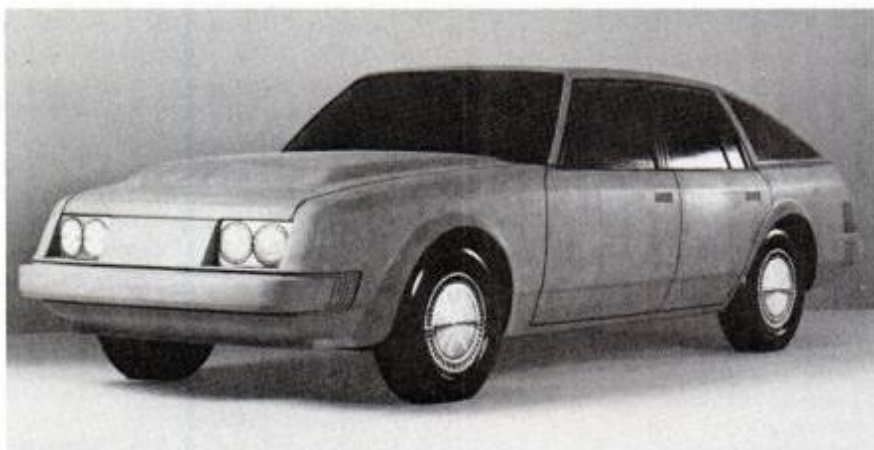
In this case, the vehicle will be a four-door, five-passenger sedan weighing in at 3950 pounds. The propulsion units will be a 30-hp electric engine running in parallel with an 80-hp gasoline engine. The electric engine will be used to propel the car from 0-30, after which the gas engine will take over for highway cruising.

The conventional lead-acid batteries planned for the hybrid will be recharged by regenerative braking, by running the gas engine while the car is cruising or by plugging into a home outlet.

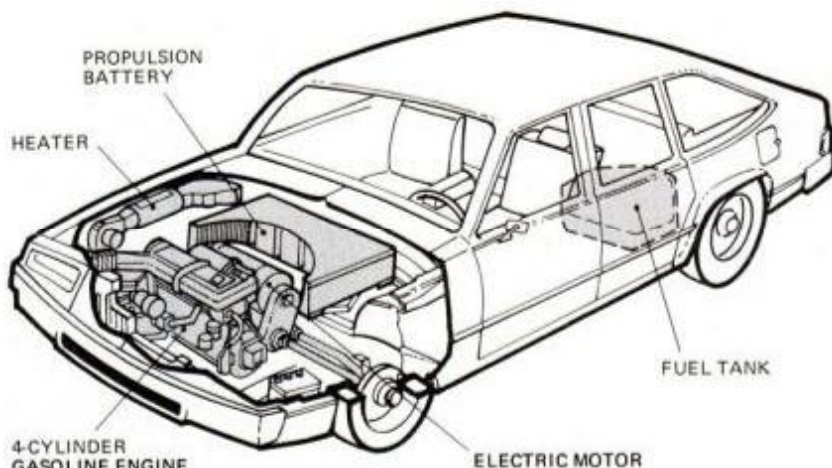
The design parameters call for acceleration from 0-50 in 12 seconds, and the hybrid should provide the looks, performance and handling characteristics of conventional vehicles that will be marketed in the mid-1980s.

### Where's the gain?

While this entire project may sound impressive coming from GE, one wonders whether this is really a step in the right direction. A quick analysis of GE's figures puts the idea in perspective. A typical 3950-pound five-passenger sedan such as a Ford Thunderbird will yield fuel mileage of around 20 mpg. If the GE project will improve the figure on that type of car by 50 percent, that would put the mileage at around 30 mpg—good but not startling. There are already plenty of cars on the road that will



Still in the mock-up stage, GE's hybrid vehicle will carry five passengers.



Gasoline engine, electric motor and battery pack are all in the engine bay.

seat five and yield 30+ mpg. It would seem that for \$8 million, GE is inventing something which anyone could walk in and buy off the showroom floor.

### G+W's electric

Coming on the heels of GE's announcement is perhaps a more significant one from Gulf + Western. The news from G+W is an all-electric car with a range of 200 miles per charge, and a battery life of 100,000 miles.

The real breakthrough is the type of battery used to power the vehicle. Unlike conventional lead-acid batteries, the G+W battery pack uses a pump to circulate the electrolyte over graphite plates. The electrolyte is a solution of water, zinc and chlorine.

The drawbacks of using lead-acid batteries in electric cars have been their short life cycle, limited range and possible damage during deep discharge or overcharge. Zinc-chloride batter-

ies, on the other hand, don't suffer from the same problems. They can be fully discharged without damage, they can't be overcharged and have a life cycle similar to that of an internal-combustion engine. Another positive factor: the zinc-chloride battery pack is completely sealed and will never need maintenance or service.

If this invention lives up to its expectations you could be driving one as early as 1985.

### Cracking heavy oil

A new petroleum-refining process offers the hope of extending our national fuel supply, and Ashland Oil, the developer, is pinning a bundle of hopes on it.

Anyone involved with petroleum refining will tell you the best oils to use for gasoline are the so-called "sweet oils" from North Africa and the Middle East. They are low in sulfur and



## Super fungus

Thanks to a fungus which ate Army uniforms in New Guinea during World War II, we now have a shortcut for producing fuel alcohol from garbage. During the war the U.S. Army's Natick Research and Development Command discovered that a fungus called *Trichoderma Veridei* produced pure glucose as a byproduct of its ingestion of uniforms. After the first oil crisis this hungry little beast was taken off the shelf, where it had languished for 30 years, and was put to work making glucose, the raw material for ethyl alcohol. Natick Research has recently developed a super fungus called *Trichoderma Reesii* which produces glucose from garbage much faster than the original *Veridei*. According to Leo Spano, project director at Natick, *Trichoderma* could bring the cost of producing ethyl alcohol down to about 75 cents per gallon in three years.

can be cracked easily to make gasoline. Essentially, the molecules are lighter.

However, there's another kind of oil on the market, residual oil—the heavier oil from the bottom of a well—which contains metals and is high in sulfur. Now, residual is considered fuel fit only for powerplants and boilers.

The key problem with residual is the presence of two metals, nickel and vanadium. Current refining practice involves using catalysts to get the most gasoline (and other products) from crude oil. Unfortunately, nickel and vanadium deactivate the catalyst.

But by using high heat, pressure and a crystallized, silica-alumina microspherical zeolite catalyst and a still-unnamed Ashland process, the company says it could deactivate the nickel and vanadium and let the catalyst work to produce gasoline.

### The Ashland secret?

Checks with scientists at Penn State showed that the only two practical ways of deactivating the metals are "oxidizing" (burning) them to make petroleum coke, or absorption. Ashland engineers told us the company had discarded coking as well as hydrolizing (exposing the

metals to hydrogen) as too expensive. So, it looks as if the Ashland process involves absorption.

Ashland calls its technique Reduced Crude Conversion and, as Orin E. Atkins, chairman and chief executive of the corporation, told the New York Society of Security Analysts: "This Ashland process permits us to take heavy oil from refined crude and convert it to gasoline, light distillates and other higher-value specialty products. We anticipate a yield of more than 70 percent gasoline, which should give us a total net margin improvement of \$8 to \$12 a barrel.

"In addition to the ability to upgrade heavy oil to gasoline, the process permits us to produce the same yield of gasoline with 20 percent less crude oil, or, alternatively to process more of the heavy crude oil."

This process can work well with heavy oil from any source, oil shale, heavy residual or tar sands.

### The real significance

But what does this mean? Look at the availability of oil around the world. The quality sweet lights are not available, and the prime crudes of North Africa and Arabia have premiums which may put the cost up near \$40 a barrel.

Much of the remaining oil has a high specific gravity. It's thick. A lot of it comes from Venezuela and contains sulfur and the heavy metals.

With current technology, roughly 50 percent of this oil can be turned into gasoline, leaving the remaining heavy oil fit only for furnaces. But using the new process, this oil is recoverable. So it can brighten the overall energy picture for transportation.

It can help our national oil supply, and it's a big step toward energy independence. Residual makes up the bulk of our national reserves; it's also the cheapest on the market. Armed with the ability to make the same amount from less crude, and assuming a stable demand (demand has actually been dropping), we should be able to keep gasoline at the pumps just a little longer.

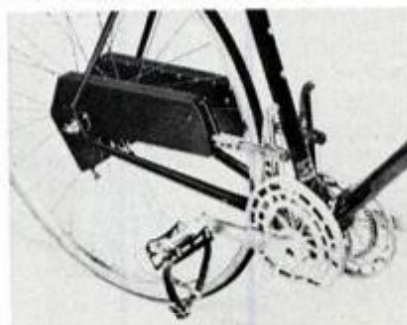
It could be a revolutionary development. At least, Ashland hopes so.

PM

## PRODUCTS

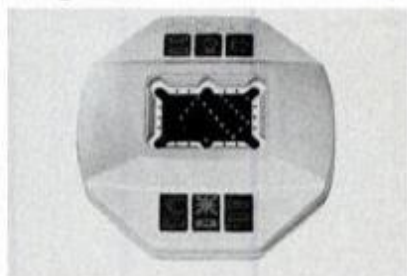
### Cam-drive cycle

The BioCam bicycle (Is This the Bicycle of the Future?, page 28, March '79) is now in production. The 50-speed cam drive has a wider gearing range and reportedly eases pedaling. Three models cost \$1900, \$1500 or \$1200 for stripped-down version; from Facet Cycle, Tulsa, Okla.



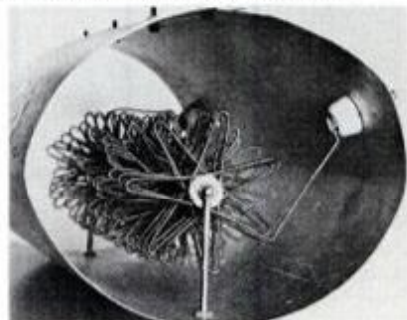
### Follow a bouncing ball

Parker Brothers' Bank Shot, a sophisticated home electronic toy, offers three pool games that feature cushion bounces and "English."



### Elementary

The "porcupine" clothes dryer heating element from the Kanthal Corp., Bethel, Conn. costs some 25 percent less to make than its helical predecessor. It's said to permit more efficient heat transfer without hot spots.



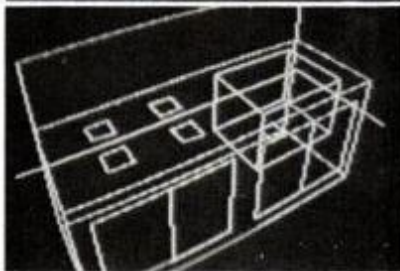
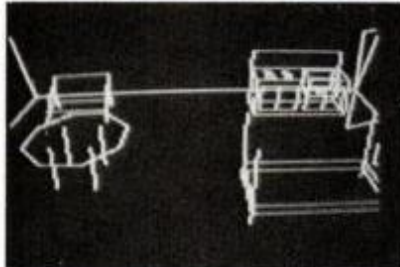


## ELECTRONICS

### Look before you build

Computer graphics systems can turn workaday technical drawings into exciting full-dimension views, helping designers and builders see projects from many angles and distances. But the view provided by electronic wizardry has been costly.

Now, a comparatively inexpensive program allows you to see potential shop projects from any perspective—before you build. At about \$1000 for the Apple II computer and another \$45 for the program, the new system may not be an impulse buy. But the price beats the \$35,000 tickets on similar systems a few years ago. Apple World from U.S.A. Software (750 Third Ave., New York, N.Y. 10017) is easy to use: Once a shape is entered into memory, the computer can rotate the original, zoom in or back away to change the scene—instantly on a television screen.



Here's a house you can visit even though it exists only in the computer's memory. Program lets you fly over the rooms, or look in the stove.



We entered the specs for a backgammon board from our May '77 issue (upper right) to show how program lets you view projects before you build them.

On this page we illustrate how a backgammon-board drawing published in our May, '77 issue (page 110) can, using the Apple World program, be seen from different angles and apparent distances. Never before has such sophisticated design capability been available to small studios or home shops.

### Tech artists on call

If you build small projects or design anything from footstools to airplanes, a program like this is better than having a staff of technical artists on call.

Suppose you want to make a design change—perhaps modifying the shape of the handles on a magazine rack. Sure, you can imagine what it would look like to some extent. But with this program you can actually see what the changes will do to the rest of the design—look at your project from all sides, close up or from a room's distance away.

A displayed image can be as simple or complex as you want. For instance, you can start with a view of a house from orbit, fall to an airplane's level, land on the roof, drop through the ceiling, walk around the living room and finally crawl right into the stove for a Hansel and Gretel finale. No

more moving cardboard pieces around to design a room; move the furniture right on the screen.

### How it's done

Line drawings such as the backgammon board are the simplest to enter. The program uses what are called "Cartesian Coordinates," a three-dimensional system of plotting points. Just as in high-school algebra, the X and Y axes define a point's horizontal and vertical distance from center. Cartesian systems add a Z axis which defines the point's depth into or out of the two-dimensional plane.

Two points, of course, define a line, so adding points gradually will give you the lines of the drawing. Each line must be entered, even those hidden from certain angles of view. The computer will rotate and redraw each line on your command, but has to hold all the lines in its memory. You still have to be fairly good at interpreting draftsman-style drawings to program a shape.

Some shapes are harder to enter than others. Curves are the most difficult; you have to define many points to get a smooth line. Shapes such as goblets (deformed cylinders) can be automatically produced by a subprogram.



## Wave good night

The "Circadian Clock" from Wave-master not only wakes you without sounding an alarm, it puts you to sleep as well, if you're a person who goes to sleep when you hear tom-toms thrumming under your bed.

The device (\$250 from E.D.D.E. Inc., 17351 Murphy, Irvine, Calif. 92714) resembles a clock radio. But there's no radio. When you punch instructions into the sophisticated circuitry, the clock drives two vibrators under your mattress. The frequency changes to match wakeful or sleeping brain-wave patterns.

Only two of four PM editors and wives who tried the clock fell into programmed slumber, although all were awakened by pleasant thumping in the morning. In one case, resonant vibrations were set up in objects around the room. The extraneous rattles moved from windows to doors to bedposts as frequency declined, leaving an editor wide-eyed with fascination and his wife asleep. **PM**

For what it does, Apple World is unsurpassed. It does have one drawback: You can rotate a house by hitting the right key with your finger, but you cannot link Apple World to a larger program to give cartoon-like animations.

Here is where a program called A2-3D from Sublogic (Box V, Savoy, Ill. 61874; \$55) could come in handy. Similar to Apple World, it is also designed for the Apple computer.

The A2-3D program, however, can be used to animate moving pictures in other programs. You could design a landscape that would move past you as if you were driving a car and then use the moving landscape within a larger race-car game. This program is more complex than Apple World: It requires more keyboarding during the initial setup stages.

So, if you want just to move shapes around and examine them, try the Apple World system. But if you want to add some breathtaking animation to a larger program, the Sublogic system is the way to go. **PM**

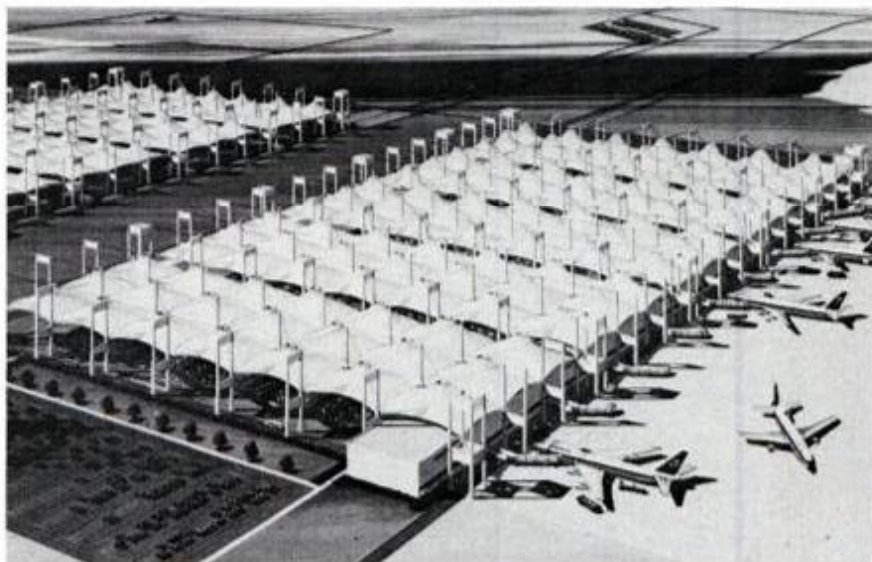
Editor: Gurney Williams III

Contributors: Tony Assenza, Mitch Lobrovich, Robin C. Nelson, Joseph R. Provey, Tom Sahagian, Neil L. Shapiro

## ARCHITECTURE

### Tent terminal

In 1982, when more than 750,000 Moslems land at Saudi Arabia's New Jeddah International Airport to begin the holy pilgrimage called the "Haj," their first stop will be a 105-acre terminal shaded from the sun by tent-like structures made from Owens-Corning's Fiberglas. This fabric has a life expectancy of more than 20 years and is coated with Teflon to make it virtually maintenance-free.



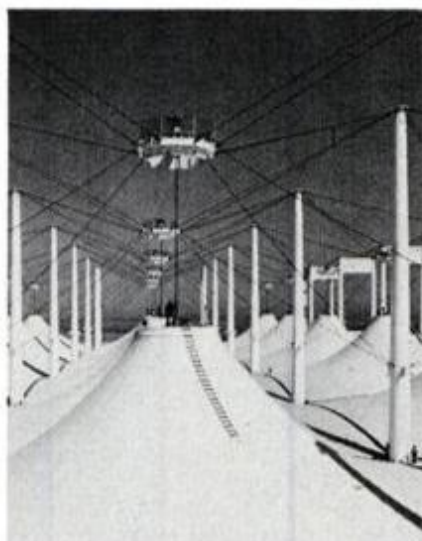
When finished, Haj Terminal in Saudi Arabia will boast the largest fabric roof in the world. The sheltered area is equivalent to 80 football fields.



Hoist lifts tent from center ring. Once out of crate, the bottom edges are pulled outward like an umbrella.

In the United States, the best known fabric structure is the Pontiac Silverdome, home of the Detroit Lions. It was erected for one third the cost of a conventional roof. Aside from cost, Fiberglas fabric is lightweight, fire-resistant, extremely strong and will stand up to climatic extremes. It will also help to cut electric bills for daytime illumination.

Other architectural uses include fabric-covered department-store malls, parks—virtually any large space. In fact, a fabric-enclosed tropical forest is currently under construction at the Franklin Park Zoo in Boston. **PM**



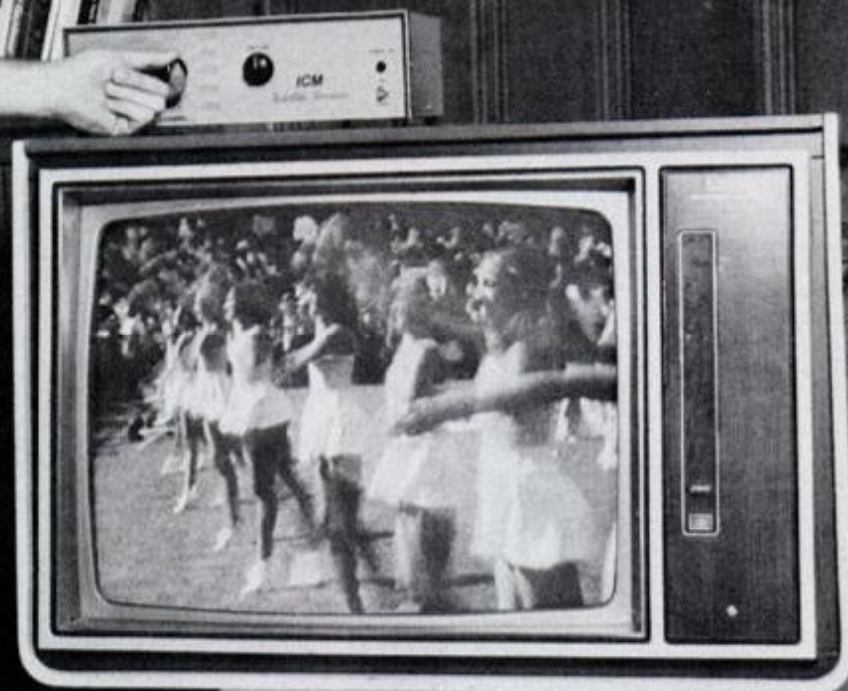
Tent edges are clamped to ridge cables and all tents are raised simultaneously to final 110-foot height.



# Now: Receive home TV directly from satellites

You've probably heard that satellite TV will be in the home soon—but we're telling you it's here now. Here's how other people have done it and how you can start to set up your own Earth station for reception.

by Bill Allen



**U**p in space are 11 communications satellites with a potential among them for 216 television channels (less than half are in actual TV use). These "birds" belong to RCA (Satcom), AT&T and GE (Comstar), Western Union (Westar) and the Canadian government (Anik).

Until recently, access to these satellites required prohibitively expensive (above \$100,000) and sophisticated "Earth stations." Professional-type television-receive-only (TVRO) Earth stations for cable TV systems, with 30-foot-diameter dish antennas and electronics to serve many customers, are still out of sight in expense. But suppliers' prices have been decreasing steadily and com-



U.S. Cable's system includes antenna, downconverter, LNA for a fairly reasonable \$5000; installation will cost extra.

mercial-grade equipment can be bought and installed, ready to use, for between \$5000 and \$36,500.

For most of us, such figures leave homebuilding as the only economic possibility. But even that prices out at \$2000 to \$3000.

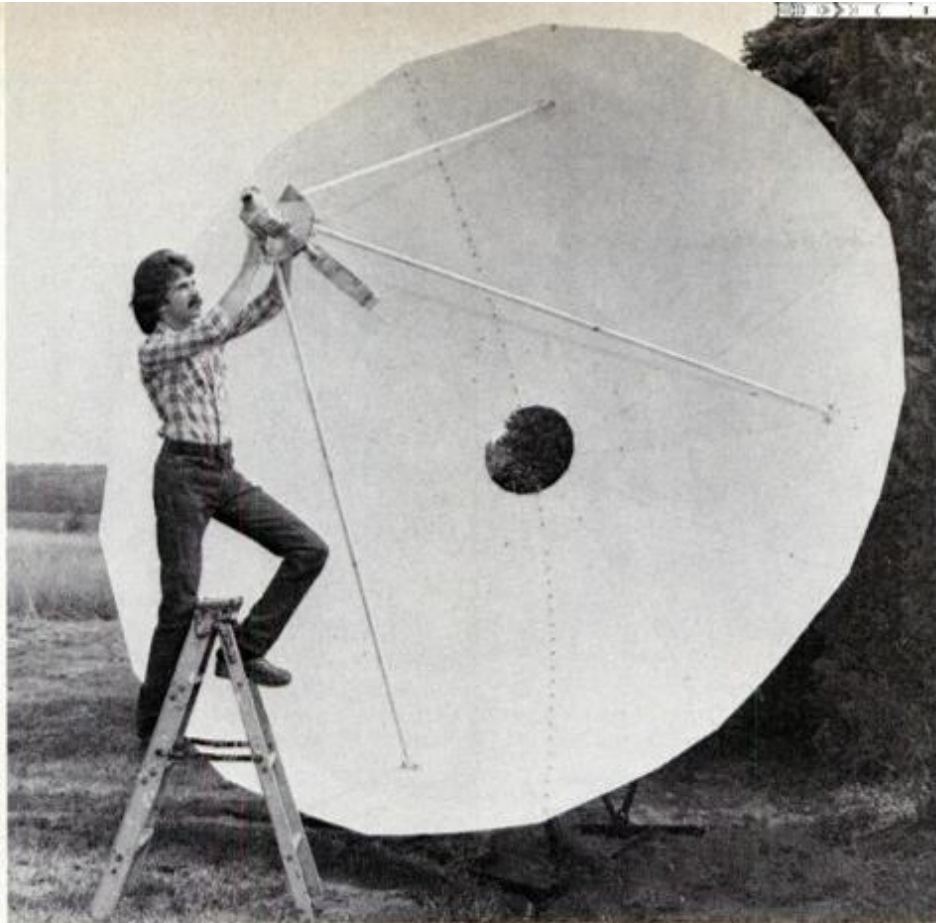
The first piece of equipment you'll need is the antenna. It has to be a parabolic dish with 1/4-inch accuracy over its wire-mesh, aluminum or fi-

berglass surface. A diameter of about 15 feet is generally recommended. In many areas, diameters down to 10 feet may be adequate. The antenna must be aimed exactly at the satellite, but, once set, needs little or no further adjustment (all the satellites hang in geostationary orbits above the equator).

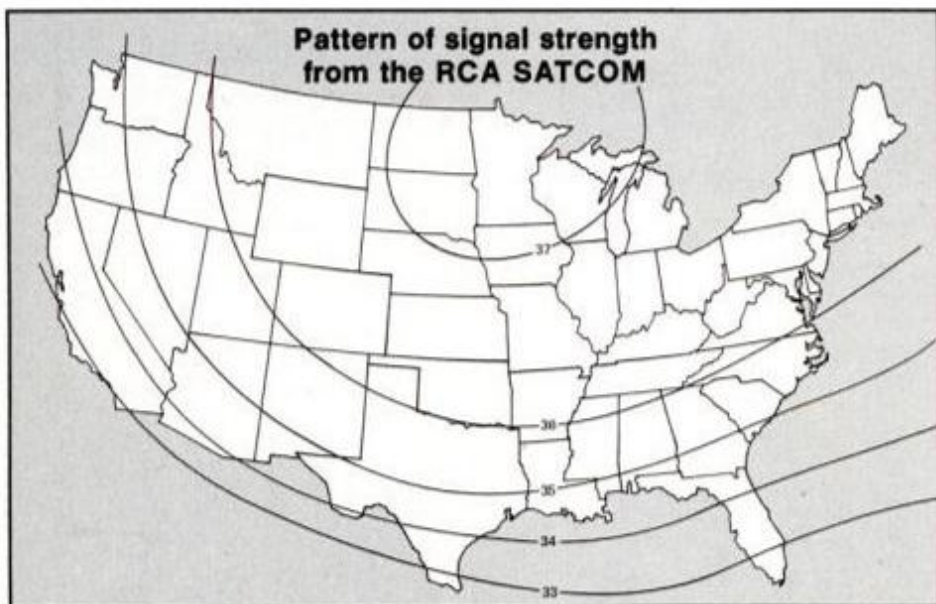
The still-weak signal goes via a short, super-efficient coaxial cable to a *low noise amplifier* (LNA). The cable is short so that the LNA can be mounted right above the antenna feed horn.

Another coaxial cable goes from the LNA to the *microwave receiver*. Receivers are either 12- or 24-channel tunables, or are single-channel with "screwdriver" tuning. Some





Here is one of U.S. Cable's back-yard installations, with the antenna being readied for the installation of the LNA on the feed horn above the 12-foot parabolic dish.



A TV satellite has a "footprint" and this is Satcom's. Diagrams like this show how strong signal is over certain regions. Numbers are strength in millidecibels (mdb).

satellites transmit 12 channels, while others, such as Satcom, double that to 24 by sending in both horizontal and vertical polarity. The receiver's audio and picture output can go directly to a closed-circuit video monitor or an adapted TV.

There are several obstacles beyond cost for you to consider. First off, you must be able to "see" the satellite. Weather poses no difficulty here, but physical obstacles do because transmission is strictly line of sight. (In the Northeast, Satcom 1 is

only 8° to 14° above the southwest horizon.)

You need a place to mount that big antenna, and your rooftop isn't the spot. Its own weight, plus wind loads versus roof construction, negate that idea. Many antennas sit on pedestals set in concrete. Zoning rules in a few locations may outlaw conversation pieces of this size.

Microwave interference at some locations can "blow you out of the water," which is why a few suppliers of complete systems provide an on-

site radio-environment inspection before selling a system. Radar, communications relay and public services radio all can wreak havoc on your reception.

### Check the 'footprints'

Each satellite has areas of best reception which are mapped out as "footprints" in "dbw" units. Some satellites, such as Satcom 1, direct certain channels at four different regions. (A set of charts for the 11 satellites' footprints is available from *CATJ* magazine, listed at the end of this article, page 164.)

Antenna Development & Manufacturing sells an 11-foot dish which, unlike those of most competitors, can be shipped by United Parcel, ready to bolt together, except that the heavy, bulky mount must be freighted. The ADM-11 is made up of



This 11-foot dish (shown here without horn) is from Antenna Development.

thin (.090-inch) aluminum petals which form the dish. It weighs 200 pounds, including a rotatable feed horn, and costs about \$1800 without mount, \$3295 with (see addresses at end of article).

Kintech makes aluminum antenna and antenna-mount kits in three sizes—13.3-, 16.5- and 20-foot diameters, priced from \$1200 to \$2400. Plans sell for \$54 to \$56, and various partial kit packages are \$500 to \$1700. The dish surface is .025-inch aluminum sheet.

John Van Laar has designed a 12-foot fiberglass antenna which weighs about 500 pounds and costs around \$500 in materials. It's meant to better withstand northern climes.

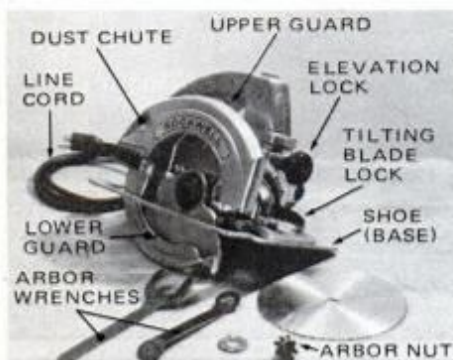
An experimental concept is the Swan spherical antenna which somewhat resembles a ballpark backstop, measuring 10 feet square. Satellite Television Technology pro-

(Please turn to page 163)

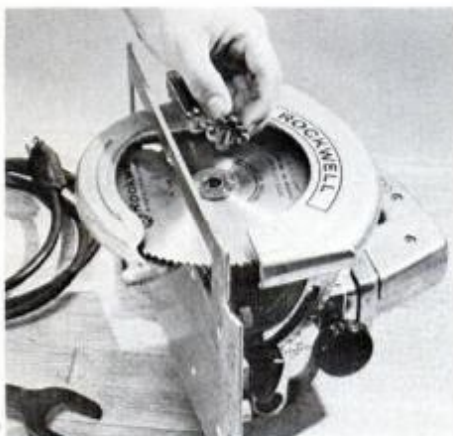


# WORKSHOP MINICOURSE

## PORTABLE CIRCULAR SAW



A portable circular saw as it comes from the maker. This model—industrial, rather than consumer rated—features an easy-to-use blade brake. Most saws don't.

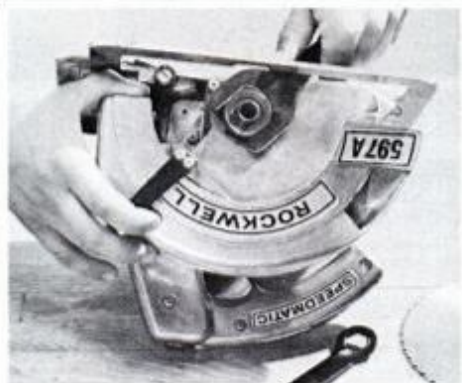


Next, the blade washer is slipped over the jackshaft and the arbor nut (blade screw) is inserted into the threaded shaft.

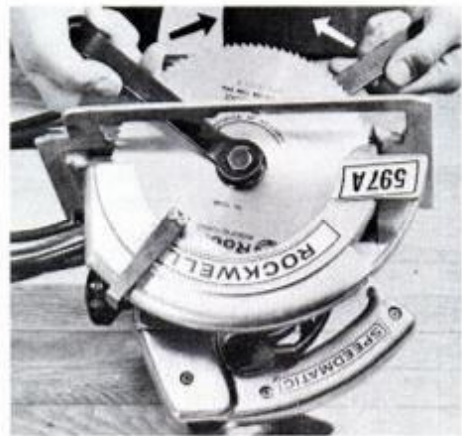
It seems that more do-it-yourselfers than ever are learning to appreciate the value of owning a portable circular saw. As the teacher of an adult-education woodworking class, I have noticed an increased awareness of just what this tool can do. With one, you can make cutoffs (crosscuts), rip, bevel, miter, dado—even cut edge rabbets. All of these cuts can be made with a handsaw, of course, but it will take a lot more time in every case.

### Picking a circular saw

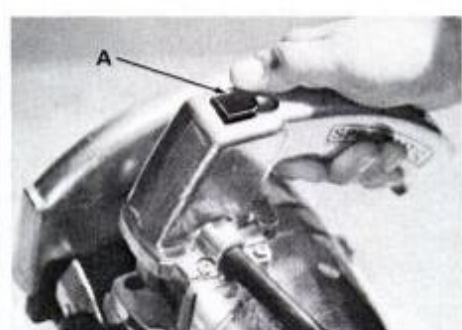
Make no mistake about it, the tool you buy should feel comfortable in your hands. For that reason, try to make your purchase in a store where you can pick up and heft the tools about. Ideally, you should also be able to plug it in and make a test cut or two. It makes little sense to spend \$60 or more for a tool by just looking at its pretty carton. You will find portable saws available with blade diameter ranging from 6 to 10



Blade is removed to show how wrenches are used to change blade. Large wrench holds shaft, smaller one loosens nut.

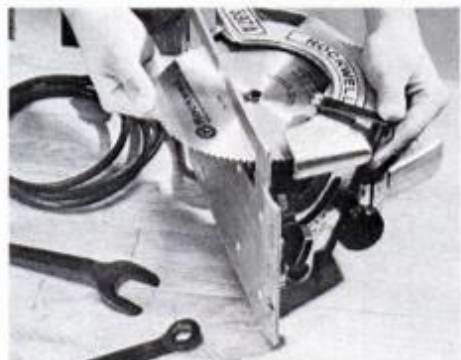


Wrenches are used as shown in photo at top. To secure blade, the wrenches are pulled in the direction of the arrows.



A good feature on this Rockwell saw is the blade brake (A) located on top of the handle for easy thumb operation. It's intended primarily to prevent a kickback.

in. The most popular capacity for homeowners is the 7¼-in. blade. With this size, you can cut 1½-in.-thick stock, even on the bevel. Check out the tool's operation and try to pick one that makes it easy to change blades, blade elevation and bevel adjustments. Also, maintenance and repair of your circular saw should be easily accessible in your area. **PM**



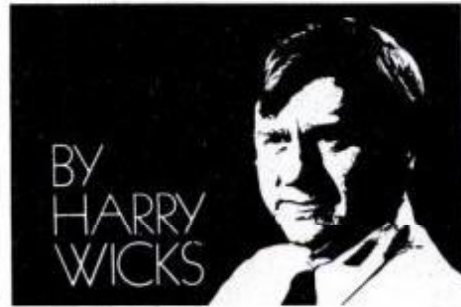
To install new blade, raise the lower (telescoping) guard and slip the blade in with its teeth pointing up at front. Blades have a directional arrow stamped on side.



It is important that the blade be set to the correct depth before cutting. It should project about ¼ in. below the bottom surface of the wood to be cut. Loosen elevation lock knob (arrow), set blade at desired depth, and retighten knob. Cuts can be made through stock and barely into sawhorse (or 2×4s below the workpiece).



As soon as cut is completed, the trigger (B) is released and the brake button depressed. Blade stops turning immediately, eliminating chance of accident.



BY  
HARRY  
WICKS

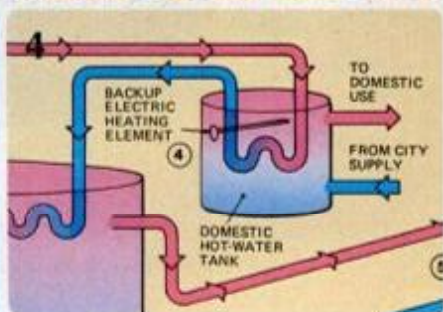
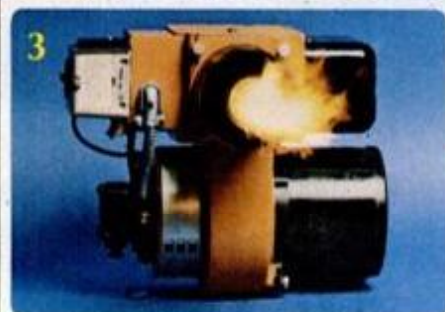


# HOME ENERGY GUIDE

As home heating and cooling costs continue to soar, homeowners are challenged to come up with efficient, economical methods of keeping themselves and their families comfortable. Starting here, you'll find dozens of ideas to help you achieve that goal.

There are many ways available *now* to cut energy costs. On the following pages, you'll find:

1. How and why to install a fireplace insert.
  2. Three different ways to build a better fire at home.
  3. What to look for when upgrading your heating system.
  4. A solar-centered home being built now.
- Plus lots more.





# WHY MORE AND MORE PEOPLE WILL BE MOVING UP TO A NEW MIDDLEWEIGHT THEY CAN'T EVEN PRONOUNCE.

Lots of guys  
are ready for a  
bigger saw.

And the new  
Poulan 3400

CounterVibe is the one they'll be  
moving up to. How come?

Because, feature for feature,  
dollar for dollar, there's never been  
a chain saw like it. With solid state  
ignition, all-position carburetor, 100%  
needle bearing construction, a  
powerful 56CC engine, an extra-  
quiet, spark-arresting muffler, a  
kickback-reducing sprocket nose  
bar and more.

And while it's got everything it  
takes to make cutting easier, it's also



The 3400 CounterVibe. Big enough to handle jobs most lightweights can't.

got everything  
it takes to make  
cutting easier  
on you.

Like an extra-  
large diameter, padded grab bar.  
A five-point fail-safe CounterVibe  
anti-vibration system that reduces  
cutting vibration by up to 78%. And  
a precision balanced crankshaft.  
So there's less noise, less vibration,  
less cutting fatigue and more  
comfort.

Of course, with the Poulan 3400  
CounterVibe, you may have a  
harder time saying the name.

But you've never had an easier  
time cutting.

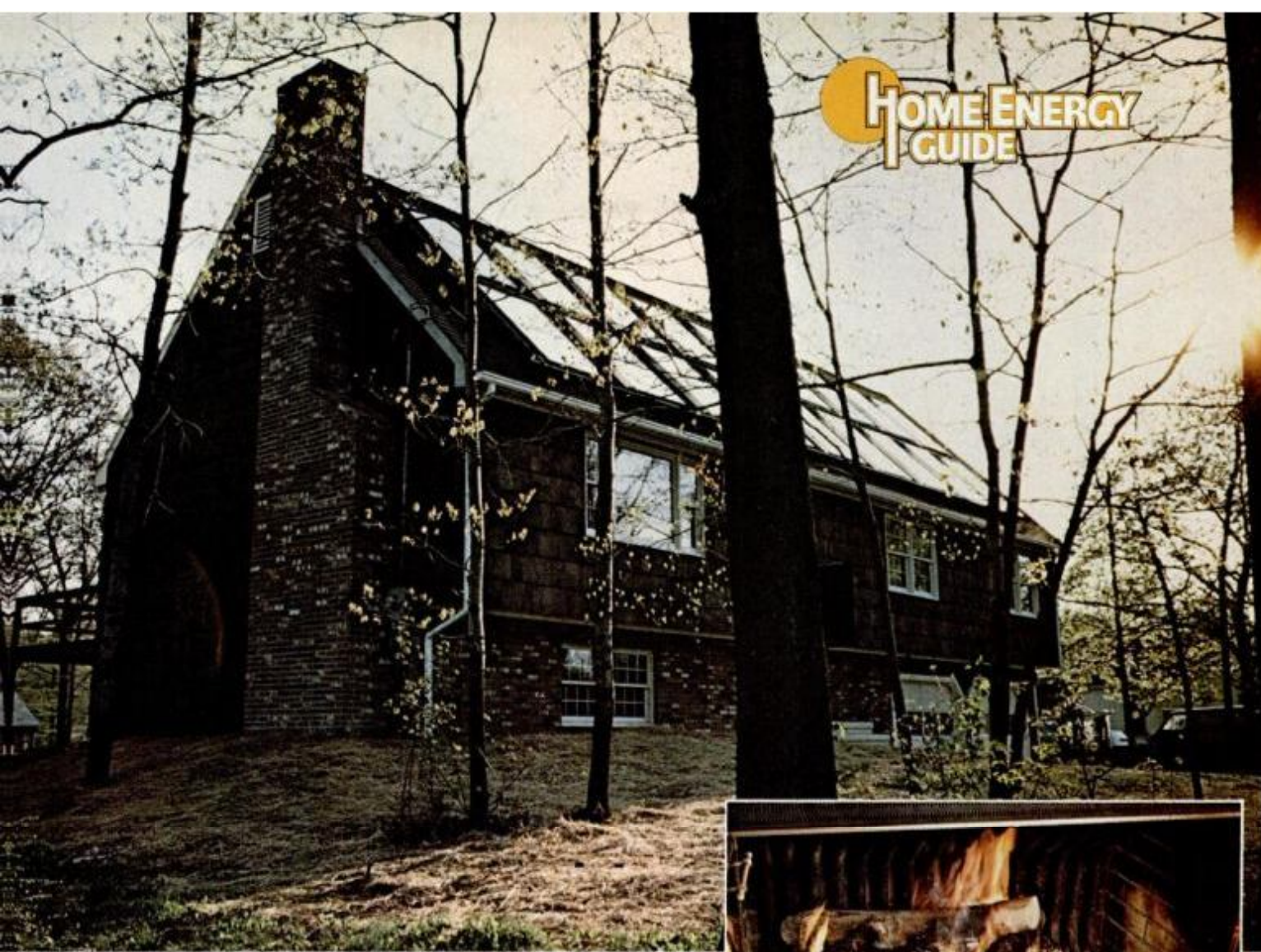


## The New Poulan 3400 CounterVibe.



Beaird-Poulan Division, Emerson Electric Co., Shreveport, Louisiana. Look in the Yellow Pages under "Saws" for your nearest Poulan Dealer.





Conventional styling belies the fact that this house is heated almost entirely by solar energy and wood. A hydronic fireplace with outside air intake supplements the solar system.

# A fireplace boiler helps the sun heat this new house

Renewable energy sources, plus new generation insulation, make this house independent of fossil fuels.

by Joseph R. Provey

ASSISTANT HOME AND SHOP EDITOR

Designer: Sydney Evans  
Builder: Marsilio Construction Co.  
PM photos: Carl Weese and Stephen Fay

**W**ere it not for the rows of solar collectors on the roof of this traditional raised ranch, most passers-by would not give it a second look. It has no earth berm nor Trombe walls nor startling geometry. Nevertheless, designer Sydney Evans estimates that only two to three cords per heating season, in combination with the solar system, will be required to provide most of the energy needed for both domestic hot water and space heating in this 2,200-sq.-ft. house in Trumbull, Conn. This is based on the house's performance last February and March.

The heating system, made up of off-the-shelf components, can be installed

as original equipment or often retrofitted to an older home. In principle, it is extremely simple. Water heated by solar collectors and/or a hydronic fireplace delivers B.T.U.s to a storage tank. The stored heat may be tapped for space or domestic water heating.

An optional house-cooling system can also be added to this system. It features an air intake cupola, located under trees when possible, that supplies a network of underground ducts with air. The air gives off its heat in the ducts and is then distributed to the house via the same air-handling unit used in the winter to distribute heated air.





Panelized storage tank (A), capable of storing 1.5 million B.T.U.s, is well-insulated and made with a heavy vinyl liner. Air-handling unit (B) transfers heat from water to air and distributes it throughout the house.



Most of the windows face south to maximize direct solar heat gain. Eave is sized so projection shades windows during warm months. Note shadow line at noon in early May.

### Insulation makes it work

Key to the success of this house is the new types of insulation used in ceilings and walls. The 3-in.-thick ceramic insulation used in ceilings has an R-value equivalency of 70 according to field tests, providing resistance to heat transfer equal to 28 in. of fiberglass or 26½ in. of cellulose. In addition, this

new material will not settle, is dimensionally stable, nontoxic, odorless, dustfree—and has a U.L. fire hazard classification of zero for flame, fire and smoke.

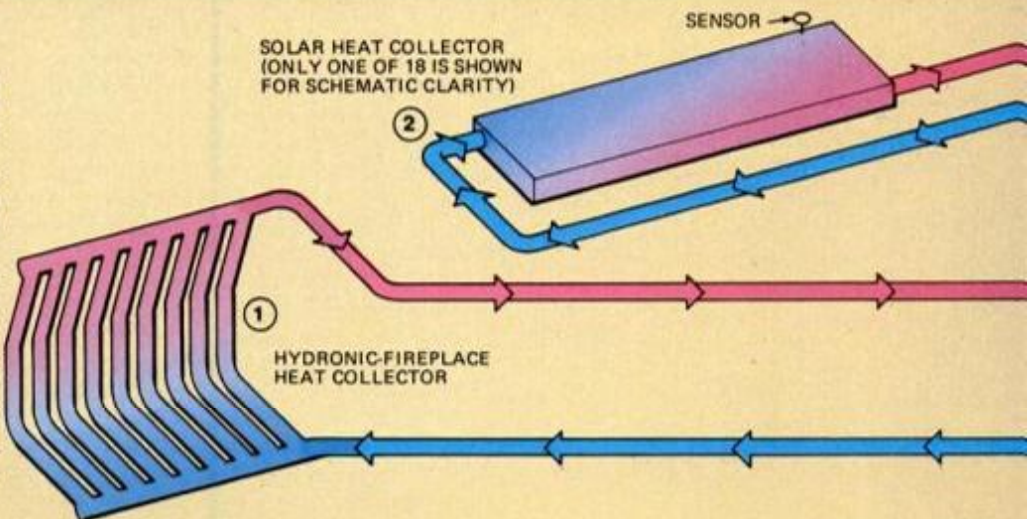
Ceramic insulation works as an insulator in the traditional sense and a heat reflector or infrared reflector. According to research by the manufacturer, heat

### HOW THE SYSTEM WORKS

Open loops between the hydronic fireplace (1) and collectors (2) pump heated water to a 2000-gal. water-storage tank (3). Cooler water from the bottom of the tank is recirculated to heat collectors. When collectors or fireplace are not producing water hotter than that in the tank, the pumps are automatically shut down.

Domestic hot water is provided by transferring heat from main tank to a smaller one, via a closed loop and heat exchangers (4).

Space heating is accomplished by pumping hot, stored water to an efficient water-to-air heat exchanger (5); then hot air is distributed in the house. If the main storage-tank temperature is too low to heat the domestic water or the house, electric resistance elements make up the difference.







1. New effective ceramic insulation pours from bags or it can be blown in.
2. Spreader facilitates even distribution.
3. A granular material at pouring, ceramic insulation is designed to bond to structural members and itself to form a monolithic radiant energy reflector.
4. Foil insulation for use in walls of house is supplied folded, in bulk rolls.
5. When installed, it is expanded to create heat-reflective, dead-air spaces.

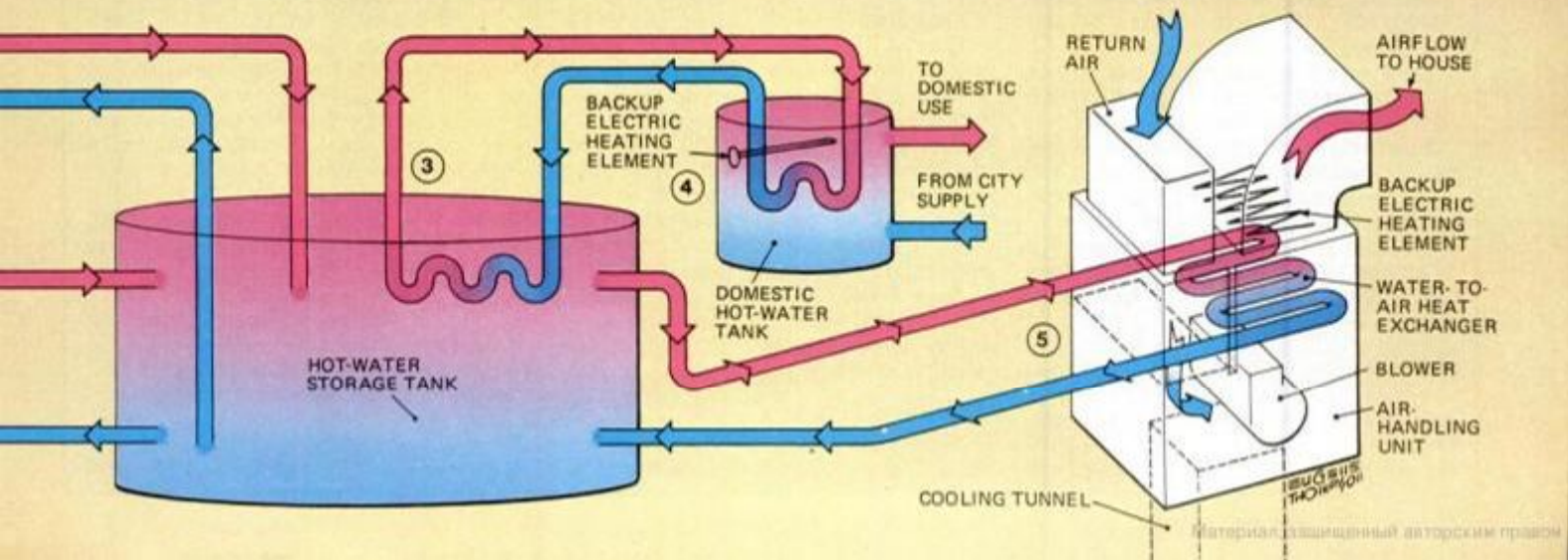
loss by radiation (and heat gain by radiation in summer) is the primary way heat is transferred in today's homes.

The foil-type insulation called Alfol, used in the 3½-in. exterior wall cavities, offers an approximate R-value of 11. It functions primarily as a reflector of radiant energy, but also helps cut down convection and conduction of heat. Easy to handle and nonirritating, it's installed by pulling the edges out-

ward to expand the foil pockets and stapling the flanges to studs. Three or four reflective dead-air spaces can be created between sheathing and drywall—three if it's face-stapled to the studs as shown (above right) and four if it's recessed ¼ in. between studs. The three-space system is better for reducing losses due to air infiltration since the flanges overlap, but it sacrifices one reflective air space. The maker has not,

as yet, determined which method is preferable. Currently, this product is not sold at retail, but only to insulation applicators. **PM**

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Whether you're replacing one leaky, drafty window or a houseful of worn-out energy wasters, Andersen® Perma-Shield® windows offer exactly what you need:

## Quality.

Trim, beautiful Perma-Shield windows are more than just replacements. They're the same high-quality windows that Andersen has been building for over 75 years. The same windows used in new homes.

## Fuel savings.

- ① Solid wood core provides maximum insulation.
- ② Two panes of glass, not just one, to cut heat loss.
- ③ Optional triple glazing system available to cut heat loss even more.

## Weathertightness.

- ④ At least two times better at sealing out leaks and drafts than air-infiltration standards require.\*

## Low maintenance, long life.

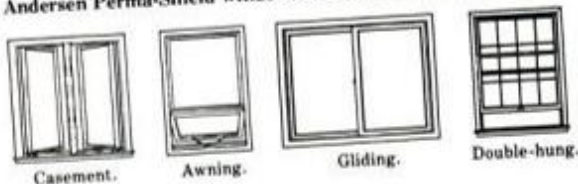
- ⑤ With a tough, rigid vinyl exterior in either white or earthy Terratone color, these windows won't rot, rust or corrode. Won't need painting every few years. (Gliding windows available in white only. Double-hung sash has a long-lasting, low-maintenance finish.)

## Quick, custom installation.

The Andersen window replacement system custom-fits stock size Perma-Shield windows to virtually any window opening. There's no waiting for special-sized, custom-ordered windows.

Get a better window the second time around. Tell your replacement/remodeling contractor to use Andersen Perma-Shield windows and gliding doors. Or see your Andersen dealer. He's in the Yellow Pages under "Windows."

Andersen Perma-Shield windows are available in these styles:



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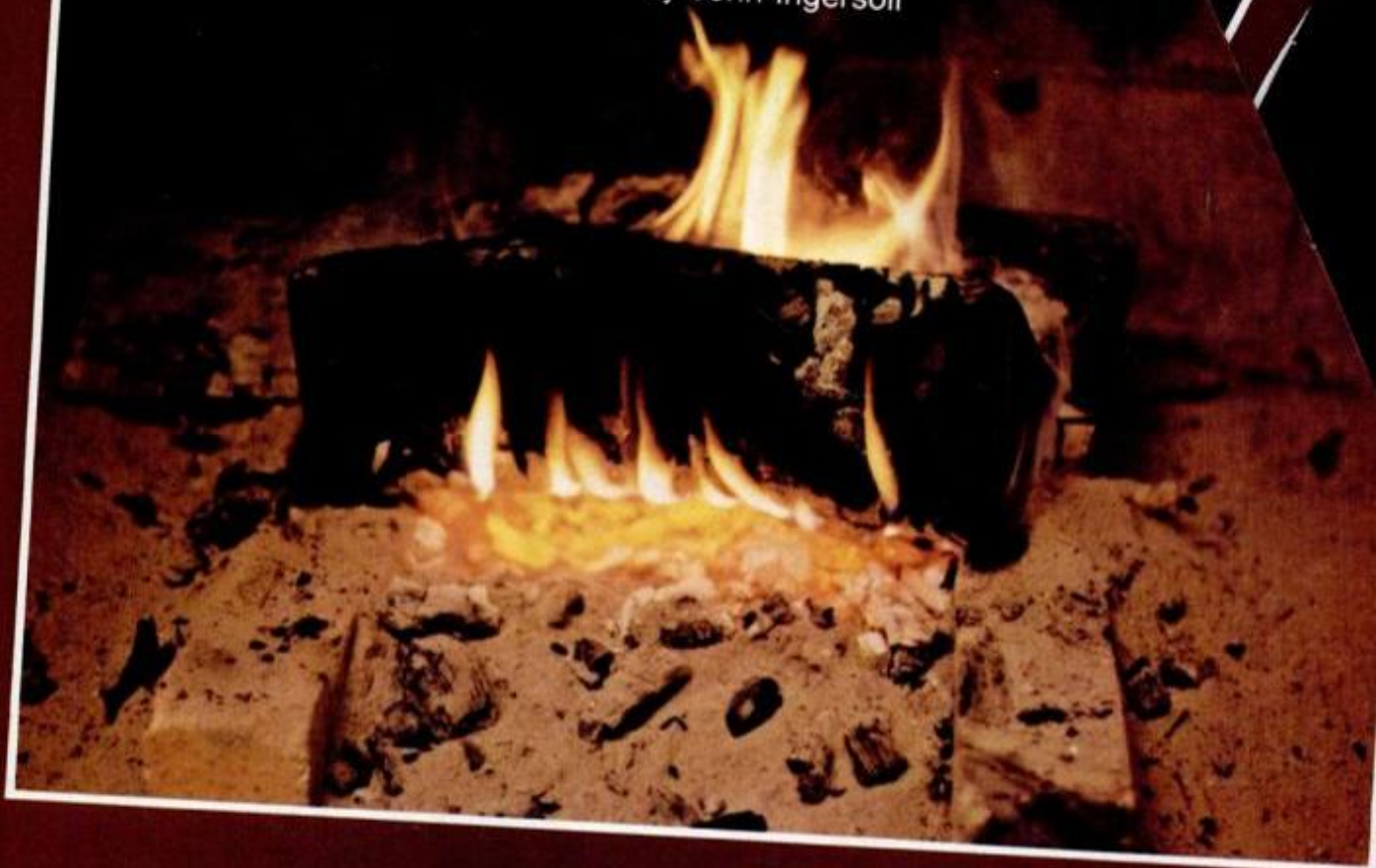
026-090



# The art of burning wood to more heat

There are three suggested methods, and we show you how to do each on these pages. Pick the one that suits you the best.

by John Ingersoll



**W**endell Stickney squirmed out of his sleeping bag and tramped over sopping-wet pine needles to the camp's pit fire, banked with wood ashes from the night before. After a rainy night, October mornings in the Maine woods can be bone-chilling.

With a firm length of birch, Stickney cleared away soggy ashes mounded in the pit and uncovered a bed of still-glowing charred wood. He quickly added short lengths of dry, split mountain maple, protected during the night by a tarp. In less than a minute, he had a warming blaze.

What has this got to do with building a fire in a stove, fireplace or furnace? Plenty. A wood fire is a wood fire—wherever you build it. The lessons learned over

generations of campfire builders apply to blazes by the hearth, as well.

Stickney, born and raised a Downeaster, now lives in Connecticut, where he's been building campfires in his fireplace for more years than he cares to tell.

This year he builds them in a small wood stove backed into his fireplace opening. Since its installation last February, the stove has delivered enough heat to keep his three-bedroom Cape Cod home comfortable with only two backup bursts of fossil-fuel energy from a gas furnace.

His secret ingredient that nurtures, controls, saves or extinguishes a Stickney fire is ashes, the fire residue many owners shovel up, sweep out and cart

away. "Don't toss them. Use them," Stickney urges.

A bed of ashes 3 to 4 in. deep in a fireplace is Stickney's working supply. In a new or newly cleaned fireplace, 7 to 10 days of wood fires can provide that amount of ashes.

Here's Stickney's step-by-step fire-building advice:

1. "Take those polished brass andirons or that cast log grate and store them in the attic. A super-hot ember fire will bend, break and corrode metal."

In place of metal, he suggests putting down four firebrick on edge, two to a side. "Where I buy supplies," says Stickney, "I can still get firebrick for 35 cents apiece. Brick will never sag or crack. It does a



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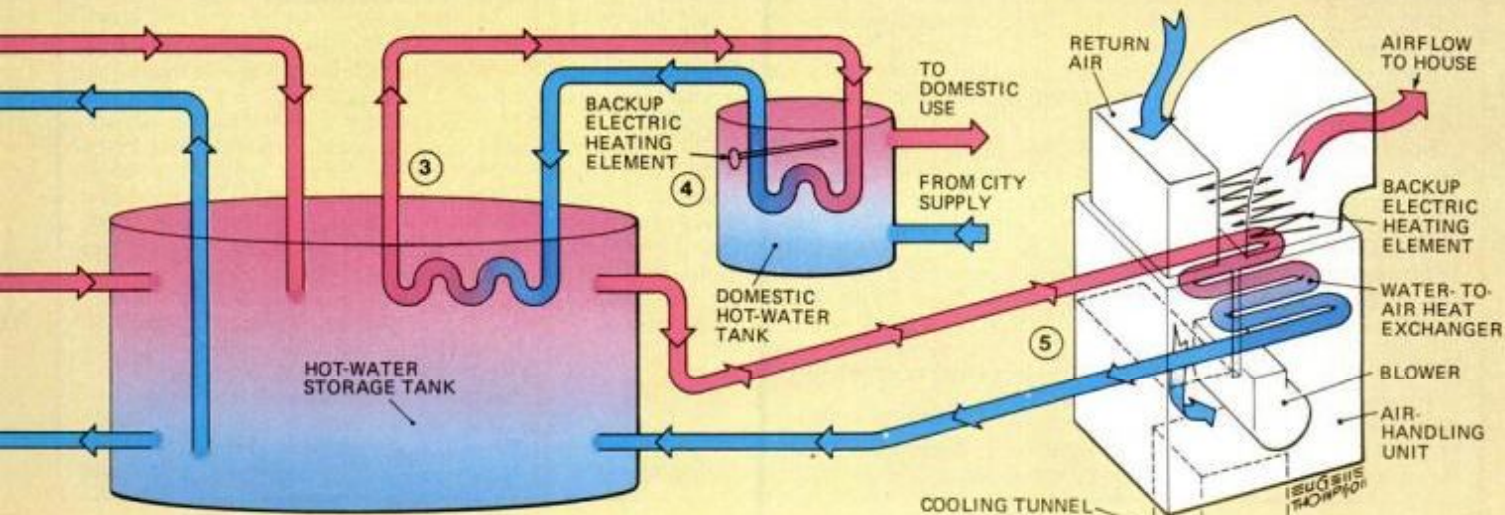
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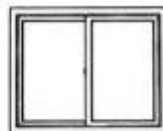
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Casement.



Awning.



Gliding.



Double-hung.

The beautiful way to save fuel®

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026-090



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**1.** "Take those polished brass andirons or that cast log grate and store them in the attic. A super-hot ember fire will bend, break and corrode metal."

In place of metal, he suggests putting down four firebrick on edge, two to a side. "Where I buy supplies," says Stickney, "I can still get firebrick for 35 cents apiece. Brick will never sag or crack. It does a



dandy job." Few people will identify the buried firebrick supporting the logs once the ash bed is deep.

2. Look up the throat of the firebox to see that the flue damper is fully open.

3. Position a large back log so it rests across the brick and against the fireback. "A good example of a back log is a three-way crotch log that's going to be a devil to split. Rather than waste energy challenging it with ax and wedge, make it a back log, as is.

"Let me stop a minute and say a word about the wood I burn," Stickney said to me when I visited him. "The logs are well-seasoned hardwood: hickory, white oak, ash, beech, birch or maple. By seasoned, I mean wood that's been drying under cover out in the open with plenty of ventilation for one year.

"Pine, fir and spruce make good kindling, but they burn too fast and are too resinous to use for logs.

4. "Pull out one double sheet of newspaper. Holding the outer edges, twist the paper loosely and fold in the ends. You need only one sheet. Lightly press the paper into the ash bed between the bricks, directly in front of the back log.

5. "Over the paper, crosshatch 8 to 10 sticks of dry kindling. Light the paper and stay around. The kindling will flame up and may throw some sparks. Wait through about 10 minutes of burning. Then you're ready for the next step.

6. "Slip on a pair of heavy work gloves, which ought to be at fireside all the time. Holding it by the ends, place a medium-size split log over the still-burning, very hot kindling. Position it about the space of one finger from the back log. This allows combustion air and gases to rise easily between the logs."

What about a third log forming a triangle over the first two? "I'd do that once in a while if the temperature outside is down to minus 10° F. and the wind is howling. But 98 percent of the time use two logs."

### The most warming fire

"Remember, and I think this point is important," cautioned Stickney, "You aren't trying to build a conflagration. A roaring fire, with flames leaping high in the chamber, directs heat up the chimney where it won't do any good. Those flames also suck up heated house air really fast.

"What you want from a fire is radiant heat which glows at its maximum from live coals bedded in ashes. Believe me, coals are much hotter than flames. Though I have no scientific proof, I'd be surprised if a bed of embers didn't draw less house air up the flue than a big fire." [True, says an environmental researcher in Montpelier, Vt.]

When the ember fire burns low, Stickney packs on a dry split log, again with a one-finger space between logs. "A big back log lasts two to three days."

Ashes can control the fire in four ways, according to Stickney.



Place firebrick on edge to support logs. Cast andirons are costly and breakable, but firebrick is cheap and permanent.



Here's what the ravages of a hot ember fire can do to cast metal. The middle support is missing; others are corroded.



The large back log is in place, along with a sheet of crumpled newspaper. Now put dry kindling in the firebox.



If the kindling is dry and well seasoned, one match should start a fire which can last for hours of heat and enjoyment.



Stand by for several minutes while the fire catches hold. Kindling may throw sparks, or you may need to add wood.



This is the kind of small, split, front log that woodsman Wendell Stickney recommends placing over a burning pile of kindling.



With gloved hands, position the front log, taking care to maintain a one-finger space between the two burning logs.



To get a long, slow burn from the fire, mound ashes under the logs. This reduces, but doesn't eliminate, air circulation.

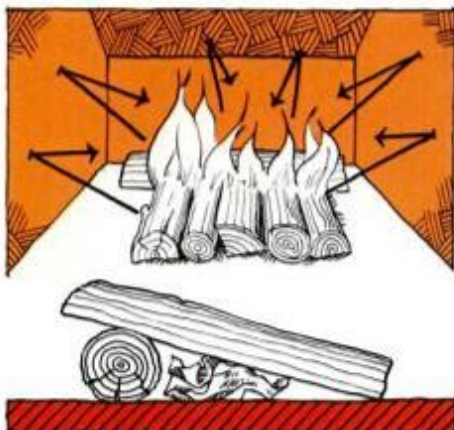


To save the fire until the following morning, push both logs together and cover everything with the available ashes.



To save the wood for another burn, roll the front log forward; rotate the back log to expose its embers; cover with ashes.

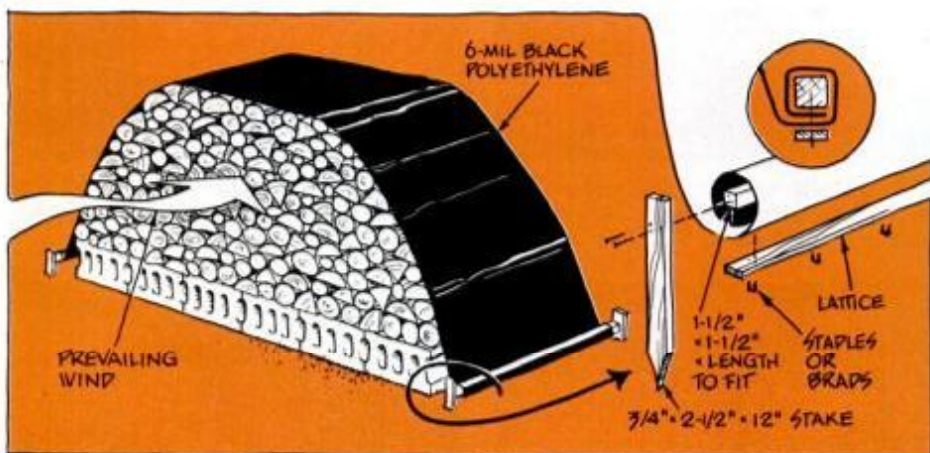




Bennett-Ireland's advice for starting a fireplace fire calls for eliminating all supports and building the fire directly on the firebox floor, as indicated here.

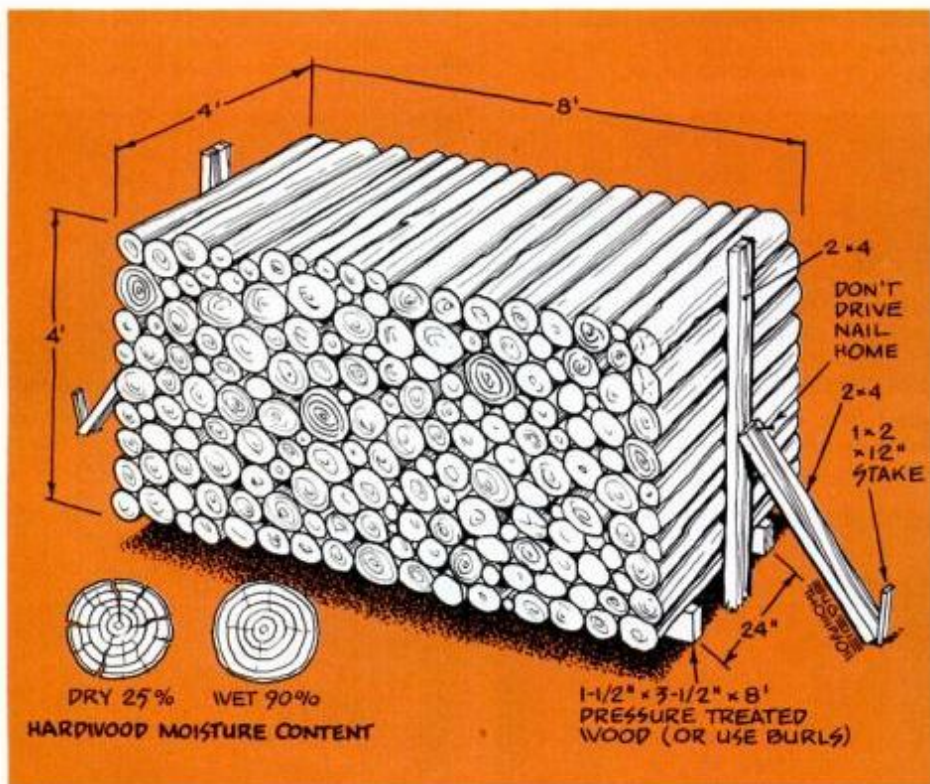


The Fireplace Institute favors a large fire, with three to five stacked logs and traditional andirons or a cast wood grate. It also suggests an ash bed of 1 to 2 in.



A black polyethylene cover not only protects the woodpile from weather, but absorbs the sun's heat to produce a kind of

natural kiln that dries the wood faster. An arrangement of stakes and lattice straps will keep the polyethylene in place.



A cord of wood measures 4x4x8 ft. Notice that logs are not yet split. Log end views tell you whether wood is dry or still green. Radiating cracks indicate seasoned logs.

"To make logs burn faster, dig out some of the ashes from beneath the logs. This increases the volume of air beneath the fire for combustion.

"If you want a slow burn, a tiny glow to last all evening, mound up ashes beneath the logs. That cuts down, but doesn't cut off, air for combustion.

"When you're ready for bed, use ashes to save the fire, or save the wood.

"To save the fire, push the logs together and cover the logs and embers with ashes. Next morning, scrape away the ashes and you'll find the remains of your logs still red. Just put on fresh logs.

"To save the logs until morning, roll the front log toward you until the portion burning is exposed. Rotate the back log away from you until its burning surface is exposed. Cover embers between with ashes and, if you like, scatter a few ashes over the logs. When you wake, the fire will be cold and the logs reusable."

### Burning in a stove or furnace

Stickney applies Steps 2 through 6 to operate his new stove, but he uses less material, since the firebox is smaller.

His goal is the same. He wants glowing live coals resting snugly in a bed of ashes. The stove is a Fisher Baby Bear, a unit with its air vent at about midpoint on the stove door. Combustion air travels horizontally across the fire.

Stoves delivering primary combustion air through a grate beneath the wood can't operate with a thick bed of ashes, since the ashes drastically cut airflow.

Nor could this system work in wood furnaces that draw combustion air from beneath the fire. (That includes all the furnaces I know.) Moreover, air vents on new furnaces are usually tied to a thermostat. So the Stickney method for starting a fire (minus the ashes) is fine. But once started, the fire is controlled by signals from the thermostat to the air vent. Your job: feed the fire; dump the ashes.

Stickney's counsel on burning only seasoned hardwood in a stove or furnace is reinforced by every researcher and manufacturer I contacted. At least that's the ideal. But, as John Hornich of the U.S. Forest Service says, "People are going to burn what's available." The implication is clear: Even if only softwoods are available, burn dry wood, not green or newly cut wood.

Not everyone agrees with the Stickney system for a fireplace fire. Here are two more methods:

First, Bennett-Ireland Inc., Norwich, N.Y., sides with Stickney on removing andirons and log grates. Their advice: Build your fire over the firebox floor.

Place a large back log on the brick chamber floor so it rests against the fireback. Next, crumple newspaper and add some kindling if you like, though B-I says kindling isn't needed if you use well-seasoned logs.

Now rest the ends of four or five small,



split logs over the back log, lean-to fashion. Choose splits no more than 16 in. long or 4 in. in diameter. Light paper.

What about the ashes? Bill Sheehan of B-I says, "It's a good idea to leave a layer of ash over the firebox floor. I'd clean out some about once a week."

On the other hand, The Fireplace Institute, an association of fireplace appliance and accessory manufacturers, distributors and dealers, hews to the traditional. It favors andirons or a metal grate. (The group would be hard put to say otherwise; some members make and sell them.)

The institute also recommends picking a large back log, then a smaller front log spaced about 6 in. from the back log. Between the two, build a teepee of kindling over crumpled newspaper. Fill the middle space with two or three logs, allowing small spaces between all. Light the paper. The institute prefers a 1- to 2-in.-deep ash bed.

### Gathering in the wood

Will firewood be scarce this winter? The Forest Service's Hornich says, "It's going to tighten up a little, but we haven't reached a critical stage."

Hornich explains that normally easy-to-get wood will be harder to find. Culls (standing timber in need of cutting to allow surrounding trees more room for healthy growth) and "dead and down" timber deeper in the forest will be plentiful. "On the other hand," he adds, "More dealers are getting into the business. I don't think buyers will have trouble locating firewood."

A Gallup poll last year put annual firewood consumption at 50 million cords. Hornich, however, says the Forest Service estimate is 20 million. "We aren't near potential use, which the Service puts at 600 million green cords a year."

The best time to cut wood for this winter was early last spring. By October or November, properly seasoned wood will be fairly dry. The next alternative is to buy it. Typical commercial sources of firewood are wood-lot owners, wood-stove dealers, lumberyards, building-supply centers, hardware stores and some heating dealers.

Prices are going to range from \$40 to over \$150 a cord. The price you pay will be a nearly pure reflection of the law of supply and demand. Where wood is plentiful, prices will fall in the \$40 to \$70 range. Far from forests or in urban centers, prices will easily top \$125 a cord. Last year, an unconfirmed report cited a dealer in a wealthy section of Los Angeles charging \$200 a cord.

To match the cost of firewood with local prices for other forms of energy, whip out your pocket calculator and base figures on the following: One cord of seasoned hardwood contains the energy of:

- 24,000 cu. ft. of natural gas
- 200 gal. of No. 2 fuel oil
- 1 ton of coal

### How do man-made logs stack up?

**H**ow good are artificial logs? The answers are: fine; okay for certain uses; not yet ready for home fires. The three answers apply to the three kinds of man-made products available. Here's a rundown:

**1. Molded logs.** Made from hardwood shavings and a binder similar to that used for particleboard, these logs can be treated in the same way as real wood. To my knowledge, there is only one of these: Recycl-Log by Recycled Wood Products, Box 9283, Chattanooga, Tenn. 37412.

Company president Morris Holder says one cord of Recycl-Logs turns out 2½ times the usable heat of a cord of air-dried wood. "You'll get about a three-hour burn from one log in a fireplace," he says. The cost is high; the price for a four-log pack ranges from \$3.50 to \$5.

**2. Extruded waxed logs.** There are many makers. The logs are great for campfires and many can be burned in a fireplace. Some deliver a show of colored flames.

Yet stove manufacturers are hesitant to recommend waxed logs for a wood-burning appliance.

First of all, some of the waxed products burn far too hot, endangering flue-pipe connections. Second, not all of the wax burns. Some of it condenses on the flue lining. If you switch to burning real wood, the wax attracts creosote and you have a flue that needs cleaning. It might also cause the start of a chimney fire.

**3. Pelletized wood.** This may turn out to be an answer in the future for wood furnaces designed to use pellets. At present, however, the product is sold almost exclusively to commercial and industrial users.

A typical pellet maker is Bio-Solar Corp.,



**U.S. Forest Service says wood will be plentiful this winter, though perhaps a little harder to get than in past years.**

Eugene, Ore., the producer of Woodex. Looking like chopped-up worms, the pellets are bound with chemicals extracted from the wood itself.

Their future promise results from the fact that any forest wood is grist for the Woodex mill, even diseased junk wood. "In fact," says vice-president Ted Carpentier, "We can produce Woodex from any biomass: straw, corn husks, peanut shells and even from secondary biomass, such as paper-mill sludge and nonmetallic garbage."

Coalex, a spinoff of Woodex, combines noncommercial coal (that having too high a sulfur content) and wood to produce pellets that meet ERA standards for emissions.

### When can we use them?

When will homeowners use either? Says Carpentier, "It's a chicken-and-egg dilemma. We've got the fuel, but appliance makers haven't developed the product for home use."—J.I.



**Man-made log of compressed shavings (at right) is claimed to provide a lot more heat than natural air-dried wood.**



**Coalex (black) pellets at left, and Woodex (brown) pellets at right, are used by industrial plants, hospitals, schools and facilities that have commercial-size boilers.**



## Is wood for energy truly renewable?

**Y**es, it is, but only under two conditions: First, it must vie in the marketplace with the demand for wood from other sources: construction, paper making and furniture manufacturing. Second, it must be harvested at a pace that allows new growth to mature in time to replace wood that has been cut.

Efforts to convert wood waste and forest residues into fuel, mentioned elsewhere in this report, eventually should relieve pressure on the demand for wood by other industries.

### Sloppy harvesting cuts supplies

Sound harvesting techniques have been known for centuries. Unfortunately, not every woodlands owner puts them to use. In addition, human nature being what it is, there probably will always be sloppy harvesters. That's why research by the U.S. Forest Service at Rhinelander, Wis., and more recently by Georgia-Pacific Corp. in Woodland, Me., looks promising.

Both groups seek a fast-growing tree. They may well have found it: the poplar. Using intense irrigation and fertilization, they have been able to produce poplars that have become 35 ft. tall and 8 in. in diameter within six years.

It's true that poplars aren't the best hardwoods to burn. But they do produce heat. Researchers hope to make these trees pay off by virtue of the fact that they will be available in large enough quantities.



Georgia-Pacific's chief forester, Oscar L. Selin, measures the height of new poplar growth at the firm's Woodland, Me., operation. Trees, planted and nurtured like beans or corn, will be ready for harvest as fuel or pulp within six years.

### ■ 4000 kw.-hours of electricity

Of course, that gives you only comparisons based on purchase price, not performance. In another issue, PM will tackle true comparisons between fuels.

Green, newly cut logs are generally somewhat less expensive than dry wood. But not always. John Lynn, a Eugene, Ore., energy consultant, says demand for wood in Oregon is so high that dealers can't keep up. Most logs sold are green, at prices the same as seasoned wood.

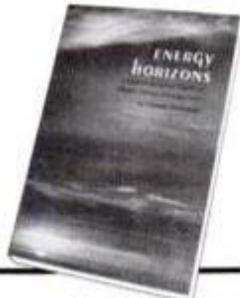
Sales of firewood are booming across the country. Profits are healthy. Those facts have attracted some shady dealers who may try one of these tricks:

They may pass off green logs as dry ones. Look at the cut ends. A seasoned log, air-dried for at least six months, will usually display spider-like cracks radiating out from the core. This, at least, indicates that the ends are seasoned.

A dealer may try to sell you a short or face cord as a full cord. A full cord of unsplit logs is 4 ft. high by 8 ft. wide and the logs are 4 ft. long. You're buying approximately 128 cu. ft. of wood (and a little air). A face cord has the same height and width measurements, but it's made up of logs 2 ft. or less in length.

Not all dealers stack logs neatly so that you can tell in a flash that you're getting the cord you bought. But you can tell

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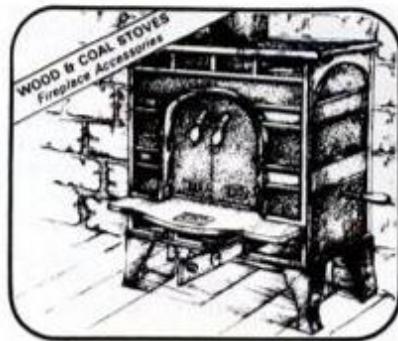
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when it's delivered. Any dealer who rolls into your driveway with a log load on the back of a standard pickup truck is shorting you. A full cord is over two tons.

Unless there's no choice, pass up a cord of gnarled and knobby logs. First, you're buying a lot of air in the spaces between the piled logs. Second, splitting those twisters is a back-breaker.

How to cut logs has been covered in previous PM reports. See *Firewood: The Born-Again Fuel* (page 125, Sept. '79). Here's where to cut firewood:

One possibility is to cut in your own wood lot, or one you intend to buy. The average sustainable yield from one acre of wooded land ranges between one-half and one cord per year. A four- to five-acre lot is roughly minimum for one family's need. Advice on cultivating woodlands for fire logs is available from the USDA extension service or a local branch of the U.S. Forest Service.

Woodland owners often allow neighbors or friends access to cut and haul out wood. Sometimes they charge. More often, they agree to your cutting and hauling one cord for you, one cord for them.

A few commercial wood lots and some state agencies are experimenting with "yarding" areas, according to Forrest Orr, a consultant for the Department of Energy. These are woodland clearings where loggers haul and dump tree-length

timber. You slice up the trees you want, toss the wood into your pickup and drive to a check-out gate. There, your load is weighed; you pay by weight. Prices are \$3 to \$10 per ton.

County, state and national forests are hunting grounds for firewood. Often you need a permit (\$2 to \$3). The rules: All felled timber is fair game, but only marked standing timber is yours to cut.

Head for wood that will deliver maximum heat with the least trouble. This means hardwoods, all of which have distinctive bark and leaf patterns. If you're new to forests, buy a tree-identifying book and check the fallen leaves.

What you don't want is fallen, water-soaked, decaying timber, no matter what species. Thump the downed tree. A solid sound? Green light. A dull plunk? Red light. Another clue: If the bark slides off easily, wet and gooey, forget the tree.

Stickney gathers some wood at local plants. He hauls off discarded pallets and skids, and he picks up end cuts and waste wood from mills.

#### Storing wood

Bark is water-resistant. Since moisture in unsplit wood is contained by the bark, it's better to cut the logs to size and split them before you stack them for drying.

Stack the wood off the ground for ventilation on all sides. Lay the pieces on pal-

lets or masonry blocks. If you store wood in a shed, it should have open or well-ventilated sides and a vented floor.

Split wood, stacked bark side up without covering, will dry, provided it gets plenty of air circulation. In fact, it's wise to turn the stack so the log ends face prevailing winds. Bring in the wood (under porch or carport or in a basement) during the last month or so of drying time.

Outside, wood will dry faster with overhead protection. A piece of sheet metal or plywood or a tarp or sheet of plastic laid over the pile will do fine. A black polyethylene cover not only protects the pile from weather, but absorbs the sun's heat to produce a natural kiln that makes the wood dry faster. Don't let the cover drape over the sides to impede airflow.

A fresh-cut green log contains 50- to 60-percent moisture. Used to heat your home, the wood is a waste. Most of the flames are spent driving off all that moisture (as well as creosote) up the flue.

A dry or seasoned log contains 20- to 25-percent moisture. Taking wood down from 55- to 25-percent moisture content requires a minimum of six months.

Whole logs, back logs or uncut timber won't really dry in less than one year. Wendell Stickney comes from Maine, where woodsmen tend to be conservative. He advises you to dry split logs for a year, unsplit wood for two years. **PM**

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# Install a fireplace insert and keep more heat in your house



With the unit shown, the author kept his furnace at 62° F. for most of last winter.

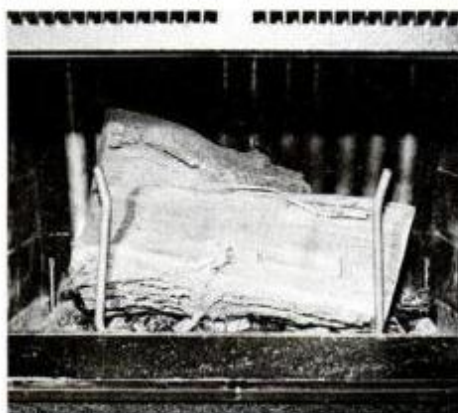
by Harry Wicks  
HOME AND SHOP EDITOR

**L**ooking for ways to lower the cost of heating a house is almost a national pastime these days. Homeowners are aware that the world's energy resources are dwindling while prices go up.

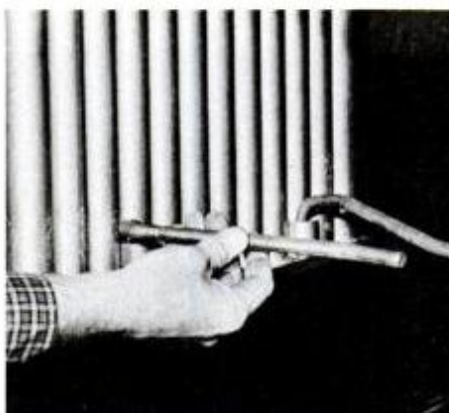
One of the most logical places to turn to is the fireplace. While a roaring fire in the fireplace is a delight to view, it is fairly common knowledge that a fireplace has only 10 percent efficiency. This means 90 percent of the heat escapes.

In simplest terms, a fireplace insert captures fire heat through a series of tubes upon which the fire is laid, and routes the warmed air back into the room. There are many inserts offered by several manufacturers; I opted for the Free Heat Machine made by Aquappliances Inc., 135 Sunshine Lane, San Marcos, Calif. 92069. The unit is well made, with models available to fit most fireplaces. Priced around \$650, plus shipping charges, the insert contains a pair of blowers that draw in cool air from the room and force it through 12 C-shaped tubes that also function as the grate. After the air moves through the heated tubes, it is pushed back into the room at the rate of 160 cu. ft. per min. (with the variable-speed blowers at maximum). Smoke and gases escape up the chimney, while the clean air returns to the room.

With this unit in operation almost every night last winter, we were able to keep our thermostat on 62° F. On the coldest nights, when the wind chill factor was minus 30° F., the insert kept the first floor in the comfortable 70 to 72° range. Over the



In assembled insert, the log retainers are flipped upright to prevent log roll-out.



The steel rods are mounted into heavy-duty pivots which are attached to the tubes.



Pivot installation is quick and easy; a single nut holds each one securely in place.



With the Free Heat Machine laid face down on the floor, the tube assembly is attached using screws into the predrilled holes.

PM photos: Julius Spedala



Fiberglass insulation, which comes with the unit, goes in next. Notice that the log retainers and leveling legs are installed on the unit at this stage of assembly.



past two years we have lowered fuel costs in three ways:

- Installed a solar domestic hot-water system (see page 132, Sept. '79).
- Invested in a small kerosene heater for a cold room on the north side.

■ Installed the fireplace insert shown.

Did these moves pay off? You be the judge. During the five-month period from Oct. 30, 1979, to Mar. 30, 1980, we used 500 gallons less fuel oil than during the winter before. **PM**



With assembly done, the insert is lifted—not slid—into position in the fireplace. Its sill should be flat against hearth.



To install ash collection pan, open the draft-control door as wide as possible and insert the pan through the opening.



Leveling legs are adjusted to eliminate any rocking motion. The front of the fireplace insert should be snug against the brick facing of your fireplace.



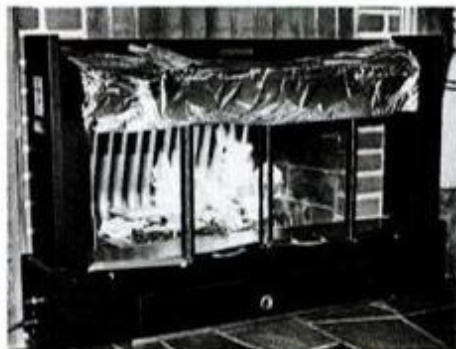
Any spaces between insert and fireplace face wall should be filled with insulation to eliminate possible smoking.



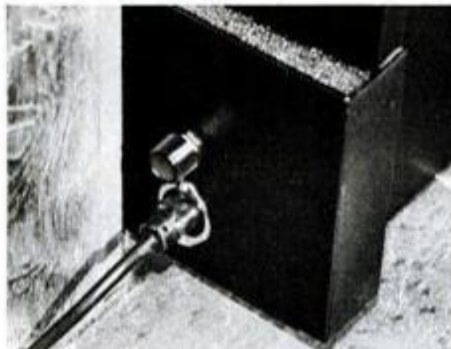
Blowers make this unit superefficient. Test rags hang limp with the unit turned off.



With blower full on, the rags stand out horizontally. This is how warmed air moves.



Oil left in heat exchanger tubes from the manufacturing process must be burned off before you use equipment. To do it, place aluminum foil over louvers and build a moderately hot fire across all 12 tubes. The draft control door remains closed; instead the glass doors are partially opened to create draft. The blower remains off.



Electric power to the fireplace insert is provided via a line cord that simply plugs into a 110-v., 15-amp. wall receptacle. The line can be made almost invisible by using insulated staples to secure it at the floor-wall angle. The blower's variable speed switch is located just above line. On-off switch is at the other end of the housing.

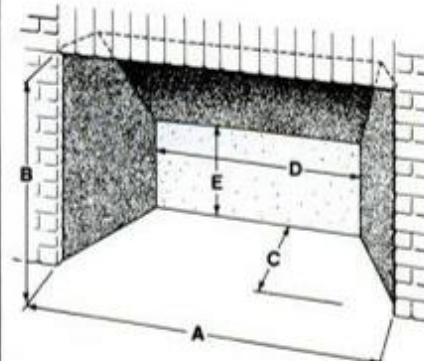
## Two other inserts you should know about



Fingertip control for air circulation through the air intake vents at the fireplace bottom (even for an outside vent) is claimed to provide longer-lasting fires. The result is up to 42 percent fireplace efficiency (compared to usual 10 percent). Fire in the firebox conducts heat through heavy steel walls to the steel air chamber surrounding the firebox. The heated air in the chamber is moved to the room by two-speed blowers at top of the fireplace front. Model CF36A shown is \$965 retail. Monarch Ranges & Heaters, Div. of Malleable Iron Range Co., Dept. PM980, Beaver Dam, Wis., 53916 has more information.



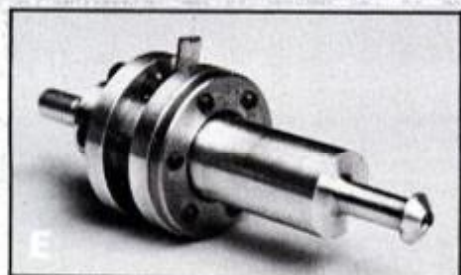
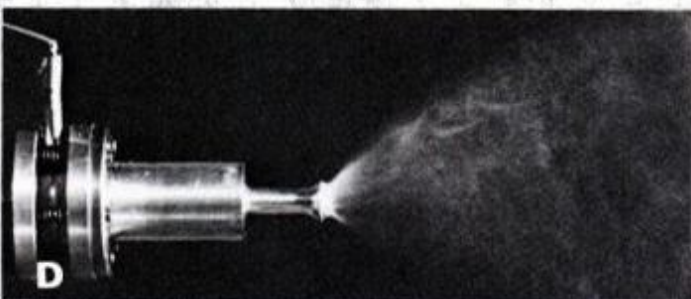
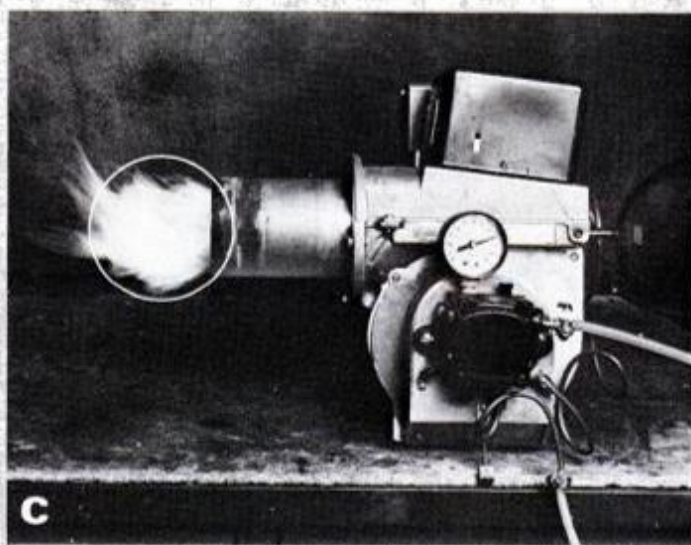
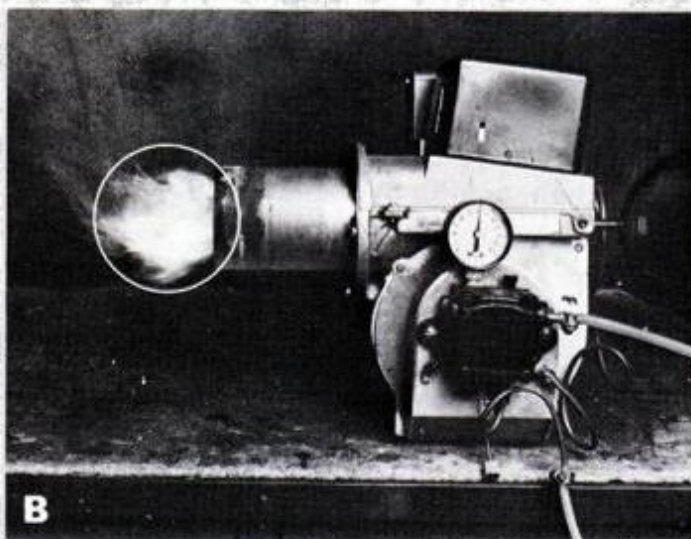
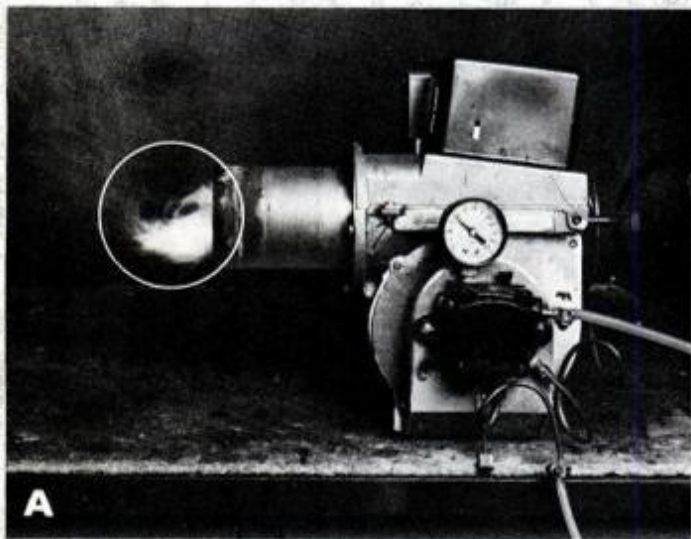
The Regal insert uses a Venturi-style air-guide system; cool air is drawn in at bottom and along both sides, where the guides confine expanding warm air. The compression is said to thrust warmed air into room at up to 75 cu. ft. per minute—without a blower. Model 4200 (\$780) has firebox lined with 2900° high-density firebrick. Sierra Marketing Inc., Dept. PM 980, Harrisonburg, Va. 22801.



To order any fireplace insert, you must know dimensions A through E. Make a simple drawing of fireplace, take measurements and enter them on drawing as shown. For some inserts, you'll also need depth (C) at fireplace top.



# 5 ways to get more heat from a furnace



**A** revolutionary ultrasonic nozzle enables this soon-to-be-marketed burner to modulate its firing rate over a range of 0.2 (A) to 1.0 (C) or more gallons of fuel oil per hour. Low firing rates reduce the frequency of heat-wasting furnace start-up and cool-down phases. Modulating capability allows the burner to be fine-tuned to react to outside temperature changes.

by Joseph R. Provey  
ASSISTANT HOME AND SHOP EDITOR

**P**eriodicals are filled with tantalizing stories about houses that rely little—if at all—on conventional fuel sources. But what about the 99 percent of us for whom renewable energy systems are still wishful thinking? Most of us are saddled with conventional, fossil-fueled, hot-air or hot-water heating systems. For many, the price of fuel rose 50 percent last year (from 60 cents to over 90 cents per gallon for No. 2 heating oil in much of the Northeast). What can be done with existing systems right now?

Depending on the type, vintage, location and fuel used by your furnace or boiler, considerable savings can be made by taking one of several courses. Note, however, that the course you choose *must* be tailored to your system—and that some devices will negate the effectiveness of others.

## 1. Replace an old, inefficient burner

If you burn oil, you expect at least six more years of service from your boiler or furnace, and you have not replaced your old burner with a flame-retention-head burner, do so as soon as possible. They have been around for about 10 years and their higher efficiencies are well proven. According to field tests by Brookhaven National Lab (BNL), you will achieve fuel savings between 5 and 22 percent. The cost of retrofitting a retention-head burner can run from \$300 to \$400. Note that the higher operating temperatures of these burners may require the addition of a refractory liner to existing stainless-steel chambers.

The latest in retention-head burners are high-static-combustion-pressure units. They achieve extremely high burner efficiencies by stabilizing the combustion airflow and optimizing the fuel/air mix. Hotter flames are achieved with less oil.

(Please turn to page 132)

**New nozzle (E) can convert a few watts of electrical power into intense, high-frequency vibrations at the cone-shaped tip of the nozzle. The oil is atomized (D) as it spreads over the nozzle tip.**





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an hour because it's 99.9% fuel-efficient. Compare that with the average central heating system that is likely to be only 45% to 65% efficient.

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PM

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And as long as I do, I'm powerful glad I spent the money to get a John Deere Chain Saw. You get so you actually enjoy the way that blade just glides through wood. Not just soft pine either. I'm talking about dried up hardwood.

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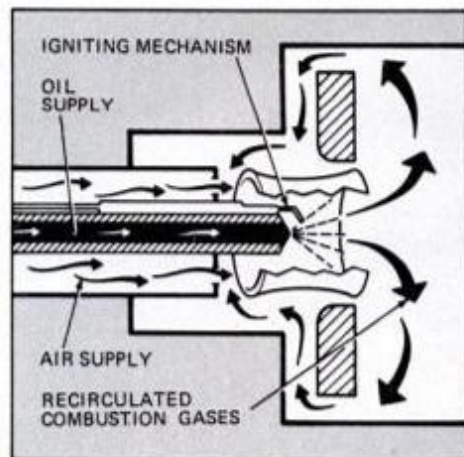
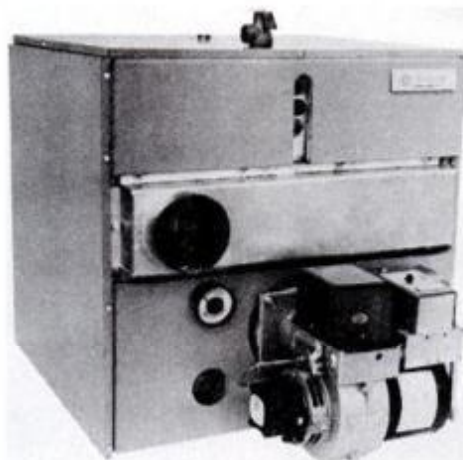
For a free folder, write John Deere, Dept. 52, Moline, IL 61265

## GET MORE HEAT FROM A FURNACE

(Continued from page 130)

A U.S. manufacturer, Sloan Valve Co., is now producing a high-static burner known as the Interburner. It was developed by Saab-Scania and can achieve a steady-state combustion efficiency of 87 percent. Steady-state efficiency is measured while the burner is operating and represents the peak efficiency of a system. A photo of the burner is shown on the cover of our Home Energy Guide, page 115.

There are several other imported models of high-static burners on the market and other U.S. manufacturers will soon be joining in. Wayne Home Equipment plans to market a high-static-pressure



**Burner and combustion-chamber design of Blue-ray boiler (top) makes incompletely burned gases recirculate to point of combustion. Operation is nearly soot-free.**

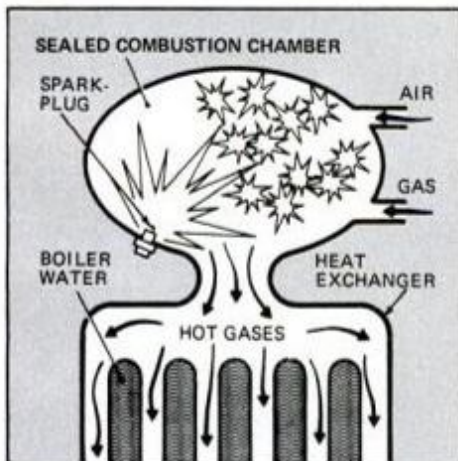
burner early next year. It will feature a built-in, off-cycle damper, overcome variations in fuel-oil viscosity and can use exterior combustion air if desired.

The most exciting advance in burner technology, however, comes from Sono-Tek Corp. in Poughkeepsie, N.Y. Carl Levine, president, and Dr. Harvey Berger, vice president, have come up with an ultrasonic nozzle that will, in all likelihood, revolutionize the oil-burner industry and save 35 percent in fuel costs for homeowners currently using an average-efficiency unit. (See photos on page 130.) In





In Hydro-Pulse heating unit (above and left), air and gas are mixed in a sealed chamber and a sparkplug ignites mixture. Hot gases are forced through heat exchanger that's surrounded by boiler water (below).



cooperation with Wayne Home Equipment and Sunstrand Corp., the nozzle was integrated with a high-static-pressure type of burner and it now can produce steady-state efficiencies of 88 to 89 percent.

More importantly, low firing rates and a modulating capability make possible overall efficiencies significantly greater than the previous 76 percent high for oil-fired units (as pegged by BNL). Overall efficiency is the heat which enters your distribution system divided by the total amount of heat available in a given fuel.

Low firing rates and flame modulation allow a more continuous flame to be used—instead of short, high-flow-rate blasts of flame. A modulating flame, tuned to changes in outdoor temperature, allows the boiler water or air in a hot air system to be heated to precisely the degree needed by the house, eliminating

overshoot problems of conventional systems. The result is: less heat lost up the flue when the burner is operating; reduced off-cycle time, during which sizeable heat losses occur; and, ultimately, less oil burned.

Other benefits of this new burner technology include less maintenance, non-clogging fuel passages, lower electrical operating costs and retrofit capability. The manufacturer has scheduled marketing for next fall at about \$150 more than conventional high-retention-head burners.

## 2. Install a new heating unit

A new, high-efficiency boiler or furnace represents an investment that can range



Enertrol unit uses its indoor and outdoor sensors to determine the precise amount of heat that must be produced by the boiler.



Enertrol model, suitable for boilers with tankless coils, allows you to program for periods of high domestic hot-water use.

from \$1200 to \$3000, significantly higher than that needed to retrofit a new burner. The payback is consequently longer, in spite of the fact that greater savings can be realized—23 percent or more in many cases.

If, however, you need a new unit anyway, take your time to research the many

innovative models on today's market. Start at the service department of your current fuel supplier or with a licensed heating contractor. Both should have energy fact sheets, supplied by the Department of Energy as part of the Federal Trade Commission's (FTC) appliance-labeling program, for the furnaces or boilers they sell. These will let you compare models so you get the one that can save you the most. Note that the BNL and the FTC testing methods are different. Generally, the FTC rating for a given unit will be higher than the BNL figures. Many people in the industry feel that BNL's direct-test methods are more accurate and that the FTC program has a tendency to overrate poorer units.

Overall efficiencies (the ratio of heat reaching your distribution system compared to the total amount possible from the fuel) for best oil-fired furnaces and boilers will exceed 72 percent. Overall efficiencies for gas-fired furnaces and boilers can range even higher.

One manufacturer, Blueray Systems Inc., has developed an oil-fired boiler (see photo on page 132) and furnace capable of recirculating unburned gases for more complete combustion. Tests at BNL have shown that an overall efficiency of nearly 76 percent—23 points higher than the average oil-fired unit in many of today's homes—can be achieved. The installed price of the furnace is about \$1600; of the boiler, \$1800 to \$2000.

Among the gas burners, even higher efficiencies can be achieved. Lennox Industries Inc., manufacturer of the Conservator II, boasts an overall efficiency of up to 82 percent. The unit comes with a built-in flue damper and electronic spark ignition, instead of an energy-wasting, standing pilot light.

Hydrotherm's pulse combustion boiler is even more impressive. It requires no burners, no pilot light, no flues or chimney and can reduce gas consumption by 30 percent. Efficiencies of up to 90 percent can be reached. The unit operates on the same principle as an internal-combustion engine. Outside air is used for combustion and low-temperature exhaust is eliminated through the house wall in a plastic pipe. Sound problems, previously associated with this technology, have been reduced to the level of a household refrigerator with the compressor on.

The price of the boiler is about twice as much as a conventional boiler, but the payback, estimated by the manufacturer, averages only about 3½ years. Hydro-pulse units can also be adapted to hot-air distribution systems.

## 3. Give your boiler a brain

If your gas or oil boiler "knew" the temperature outside and the amount of heat being produced in the house, it could determine precisely how much heat to produce to keep the house comfortable.

(Please turn to page 134)



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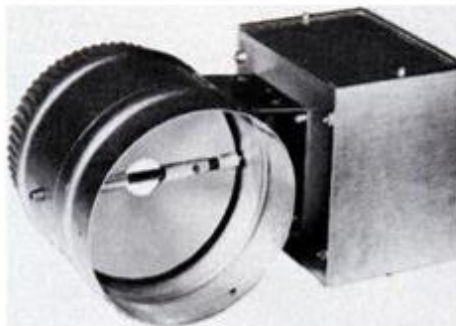
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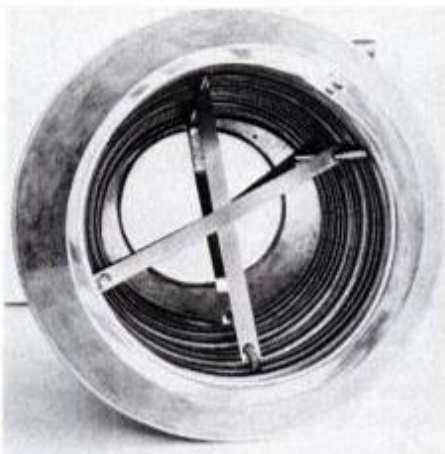
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## GET MORE HEAT FROM A FURNACE

(Continued from page 133)



Flue dampers, like this one from General Machine Corp., have a metal disc that pivots to stop draft when the burner is off.



Heat reclaimer, from Precision Systems (top), transfers heat from exhaust gases in the flue to the hot-water heater by way of this copper-coil heat exchanger (above).

This is what Enertrol, an electronic, solid-state, fuel-saving control, does. Instead of setting a boiler to meet requirements of the coldest day of the year (which is normal practice), boiler water temperature is allowed to fluctuate with need. This can save 15 to 25 percent, since less fuel is burned and heat loss up the flue is cut.

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The unit also lets you program house temperature setbacks, domestic water temperature setbacks and an automatic system shutoff at a predetermined temperature. Unit, installed, is \$350 to \$500.

#### 4. Save fuel with a flue damper

If you own a gas-fired boiler or furnace, a flue damper can help minimize heat loss up the flue when the burner is not on. This is especially important if your unit is located in a heated area of the house. Flue dampers are less effective, to the point of being a poor investment, on oil-fired furnaces or boilers already equipped with a flame-retention-head burner. These burners practically eliminate draft through the unit during the off cycles, since their air passages are so small. Flue dampers cost about \$400 to \$500 installed, and you can expect a savings from 2 to 14 percent. Installation should be by a qualified professional.

#### 5. Install a flue heat reclaimers

Heat reclaimers come in many types. The one thing they have in common is that they take heat from the flue that would otherwise be lost up the chimney. They don't make much sense if your unit is already efficient and doesn't lose much heat up the flue.

The most common type of heat reclaimer is an air-to-air heat exchanger powered by a small blower. The heat can be used in the immediate furnace area or be ducted to a nearby room. The best of these units have bimetallic thermostats that determine whether the heat exchanger in the economizer should be operating. If too much heat is drawn from the flue, the blower or circulator is automatically shut off. A flue cooled to the point where water in the exhaust gases condenses on the lining will quickly corrode the flue pipe.

To sum up, the best course of action for homeowners who burn oil and have a serviceable boiler or furnace is to retrofit a new-generation burner. For homeowners who burn gas and whose units are in good condition, install a flue damper. For homeowners who burn gas or oil in an old, inefficient unit (a dry-base boiler or a unit converted from coal), consider one of the new, high-efficiency furnaces or boilers. If you've already installed a high-efficiency burner or boiler, consider an electronic, fuel-saving control. **PM**

#### MANUFACTURERS LIST

- American Stabils Inc., Industrial Park, Lewiston, Me. 04240; electronic fuel-saving control
- Blueray Systems Inc., 22 Berger St., Schuylkill Haven, Pa. 17972; blue-flame furnaces and boilers
- General Machines Corp., Fourth and Furnace Sts., Emmaus, Pa 18049; furnaces, boilers, flue dampers, heat reclaimers
- Hydrotherm Inc., Rookland Ave., Northvale, N.J. 07647; pulse combustion heating unit
- Lennox Industries Inc., Box 400450, Dallas, Tex. 75240; high-efficiency gas furnaces
- Precision Systems Inc., Cane Mountain Resort, Snow Camp, N.C. 27349; flue heat reclaimers
- Sloan Valve Co., 10500 Seymour Ave., Franklin Park, Ill. 60131; high-static burner
- Wayne Home Equipment, 801 Glasgow Ave., Fort Wayne, Ind. 46803; high-static and ultrasonic oil burners

In times like these, there's no better way to cut the high cost of heating a home than with efficient, economical wood or coal stoves from Shenandoah.

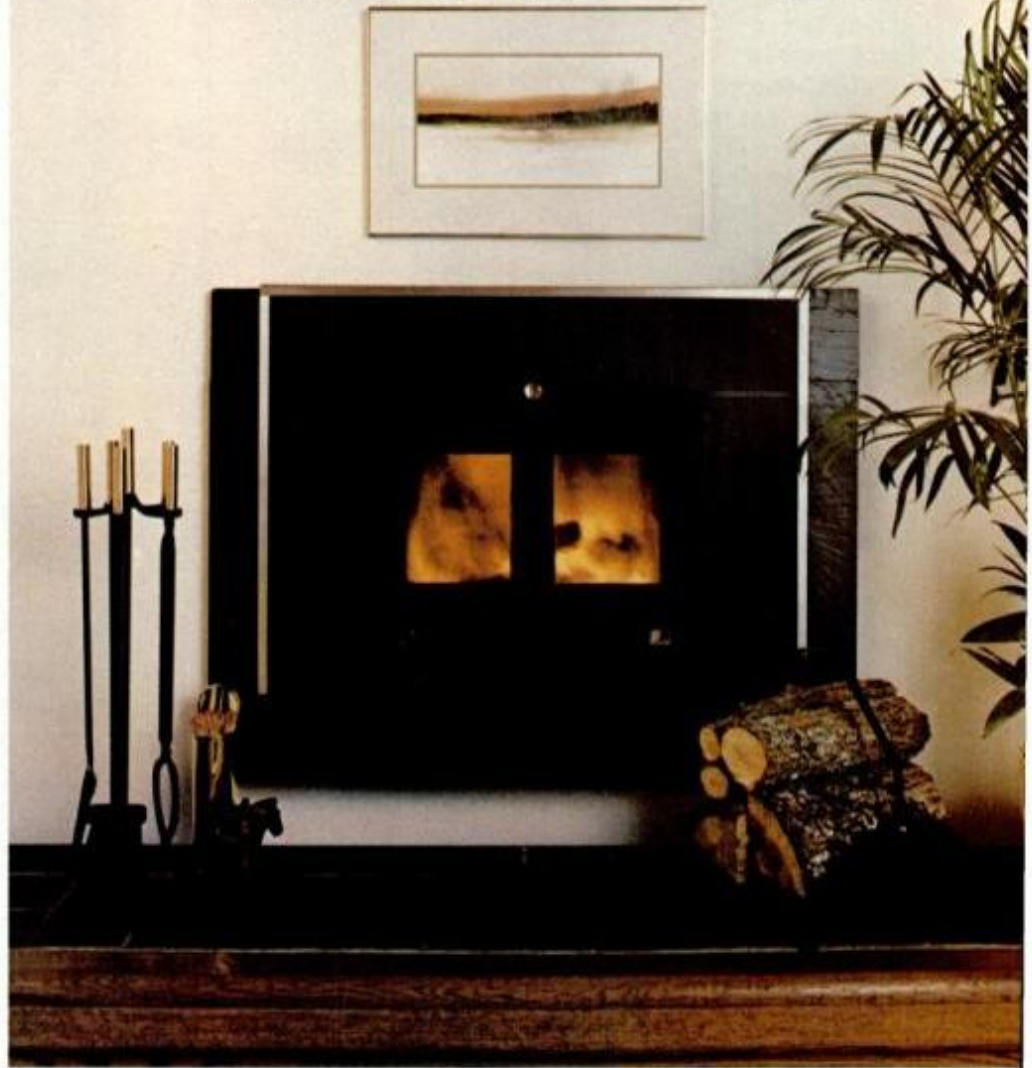
We make a choice of 19 models, from fireplace insert to add-on furnace, from a supplemental model to one with a 26" firebox! All have thermostat control, firebrick lining, and ash pan for easy ash removal. And all have that famous, dependable name—Shenandoah. This winter, get a Shenandoah for yourself. On top of all the quality engineering, the years of experience, and the innovative features, it also comes with our warmest wishes.

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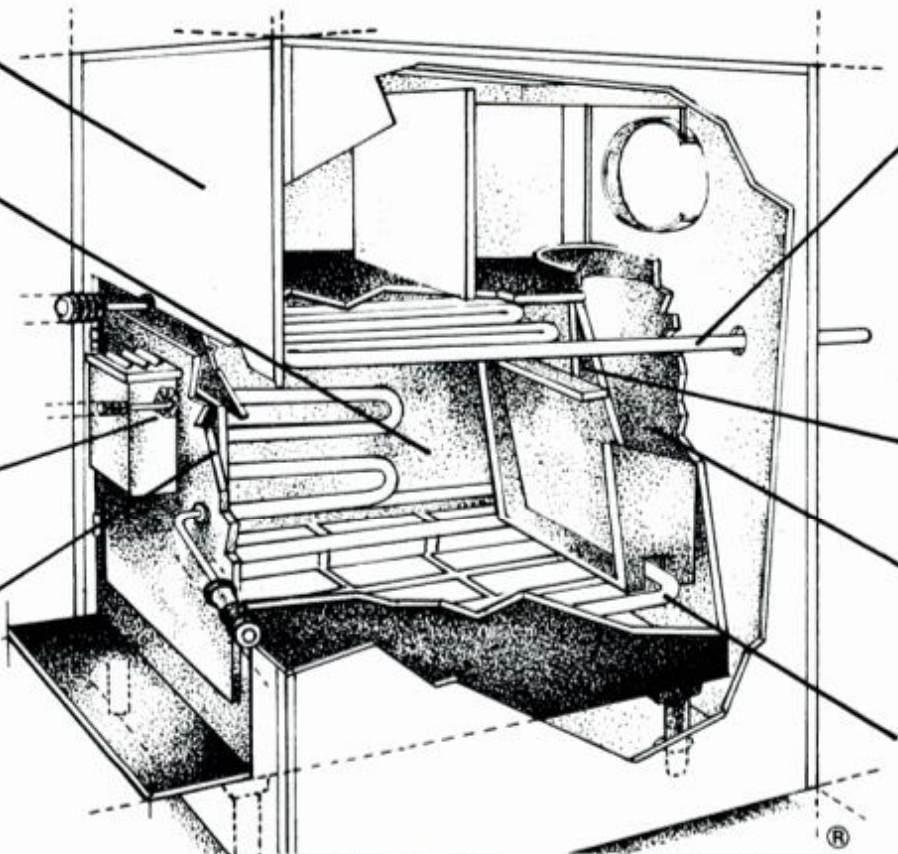
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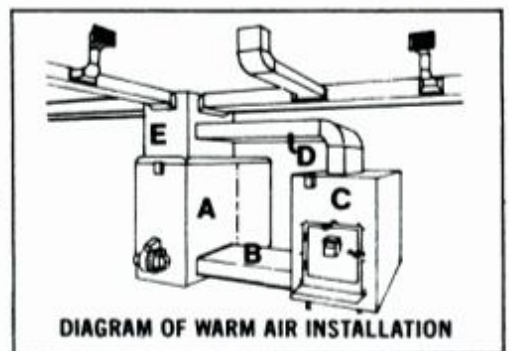
CUTAWAY DIAGRAM

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**HOME ENERGY  
GUIDE**

## 6 new products that save you energy

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The ThermoQuest portable heater is electronically controlled to give efficient, precise temperature regulation, says its maker. The heat cycles between 1500 and 750 w. or it turns off, depending on heat required. ThermoQuest has two fan speeds plus indicator lights for 750 w., 1500 w. and standby. It costs \$65 from Arvin Industries, Inc., Columbus, Ind. 47201.



Use the Young II kerosene heater where you need supplemental or emergency heat. You don't need matches, nor do you have to pump to ignite it. If the heater is tipped, an automatic shutoff device extinguishes the flame; dual-tank construction prevents leakage. Young II is \$150 from ALH Inc., Box 100255, Nashville, Tenn. 37210.



The Intertherm portable, electric heater provides hot-water heat without plumbing. A copper tube with an electric heating element heats a permanent water-antifreeze solution. The fan draws in and heats air to warm the room. The solution continues to warm even after the thermostat shuts off the electricity. The WP-1000 (\$130) is under 2 ft. high, from Intertherm Inc., 3800 Park Ave., St. Louis, Mo. 63110.



Glo-Warm, an oil-fired, radiant heater, provides 1100° F. heat at the radiating surface without smoke, odor or carbon monoxide emissions, says its maker. Use it at construction sites and in warehouses up to a 100-ft. range. Heater has a 9-gal. tank and costs \$595 from Malsbary/Carlisle, Route 119 N., Uniontown, Pa. 19401.



## HOME ENERGY GUIDE



A coal or wood-burning stove can become a home's central heating source. You can accomplish this by connecting the stove to the existing, forced hot-water heating setup with a Fireplate system. Mount the Fireplate heat exchanger directly into the firebox of the stove (top photo). The Fireplate is constructed of

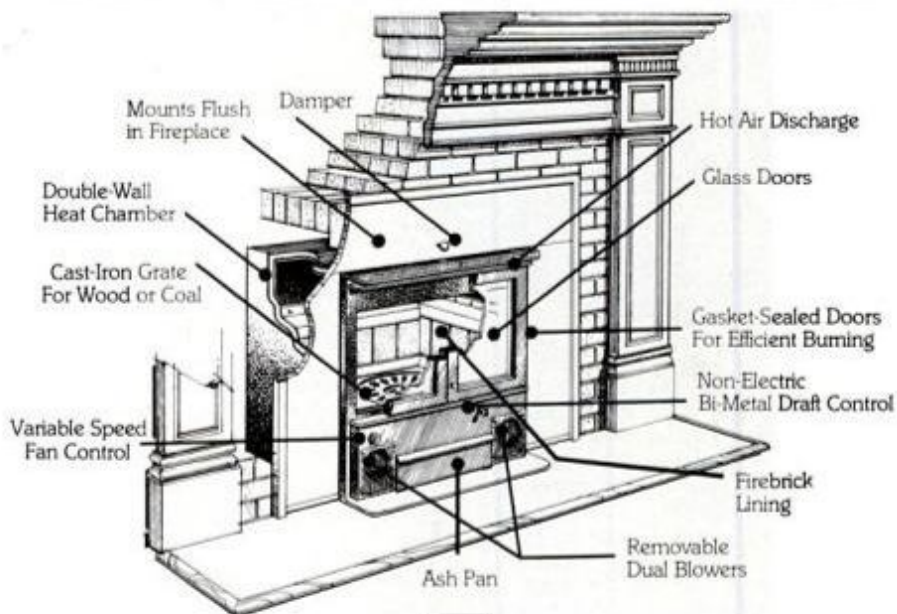
solid steel with internal passages through which water circulates. The heated water is then transferred to the hot-water furnace and distributed throughout the house. Models are available to fit 30 brands of wood stoves. The system includes the Fireplate, circulating pump, safety accessories, electrical controls and installation/operation manual (photo, above right). The unit is priced from \$380 by Fireline Inc., 80 Portland St., Fryeburg, Me. 04037.



Replace the worn door seal on your wood-burning stove for more efficiency. Fil-Flex seal is braided of Texo multistrand fiberglass yarn made by PPG Industries. Fiberglass seal provides heat, flame and spark resistance up to 800°F. without hazards of asbestos. Seals 1/8- to 3/4-in. thick cost from 25 to 70 cents per foot. A 4-oz. tube of high-temperature adhesive is \$4, and is available from Fil-Tec Inc., 1800 Woodburn Dr., Hagerstown, Md. 21740.

# HERE'S AN INSIDE LOOK AT SUREFIRE ECONOMY.

THE FP-I FIREPLACE INSERT, FROM SHENANDOAH.

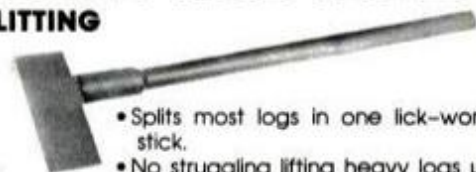


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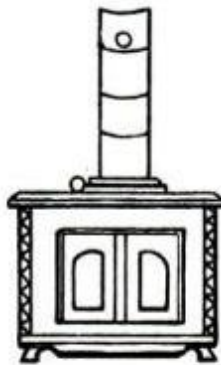
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The CHIMFEX Chimney and Wood Burning Stove Fire Extinguisher is a new and indispensable tool in fighting fires that occur from soot build-up in residential and commercial fireplaces and other chimney exhaust systems.

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Not just a variation on a theme nor a woodstove conversion, Ultracoal is built from the ground up to meet the special requirements of burning coal as well as wood. A choice of solid fuels, optimum efficiency, and a great view of the fire make Ultracoal the ultimate weapon in the war on winter. See Ultracoal and the rest of the Hearth Mate line-up at your dealer, or write for our free color brochure.

IN THE BATTLE AGAINST SOARING ENERGY COSTS, YOU NEED ALL THE HELP YOU CAN GET.

**Hearth Mate** the Fireplace Stove

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# Your insulation's effectiveness can be reduced if you don't have a vapor barrier.

Now, a latex vapor barrier that goes on like paint.

Why you need a vapor barrier...



1. Warm moisture from inside your house penetrates exterior walls. This moisture can condense and freeze inside cold outer walls. Insulation and building materials get wet, frost forms, and heat is conducted to the outside.



2. One coat of Insul-aid™ puts a vapor barrier on your interior walls. Keeps most of the warm, moist healthful air inside. Your insulation stays drier, more effective. Helps keep fuel bills down!

Your family produces gallons of moisture a day.

That's right, the average family of four produces 4 or more gallons of moisture each day. Just from taking showers.

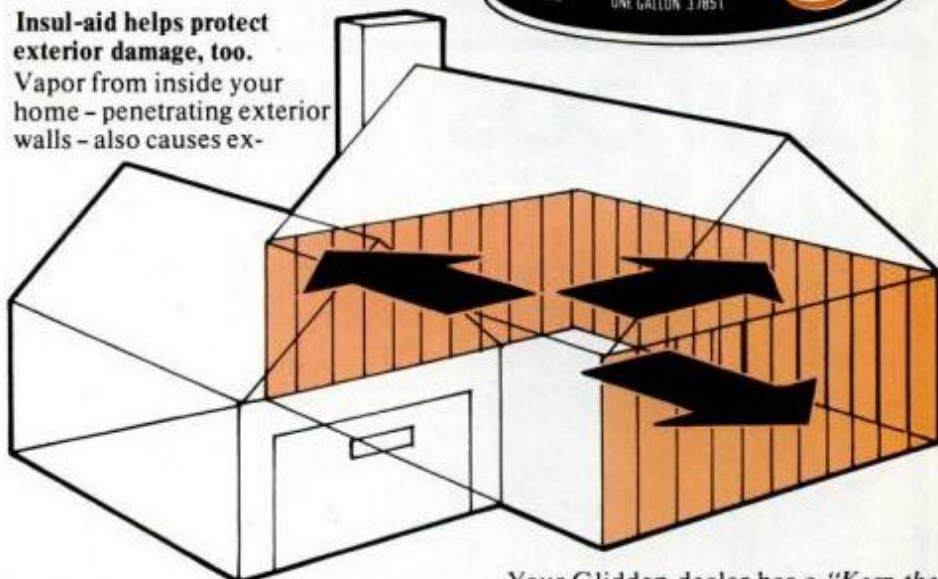


Washing dishes. Washing and drying clothes. Cooking. Breathing and perspiring. And if you have a humidifier, you'll produce gallons more moisture every 24 hours.

Independent tests show one coat of Insul-aid can cut heat loss through walls up to 20%.

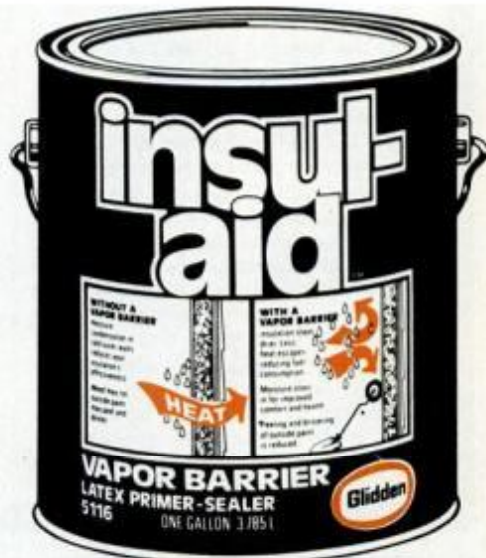
If you're planning on painting, plan on using Insul-aid. And remember... you can do it just a room at a time, and only the interior walls that face the cold outside. In most rooms, that's just one or two walls plus the ceiling (but only if beneath cold attic space). And you'll cut heat loss through those walls up to 20%.

Insul-aid helps protect exterior damage, too. Vapor from inside your home - penetrating exterior walls - also causes ex-



terior damage. The lack of a vapor barrier inside is the major cause of paint failure on the outside: peeling, blistering, staining can occur. Insul-aid keeps up to nine times more moisture inside.

Insul-aid exceeds FHA standards. Minimum property standards of the Federal Housing Administration call for a vapor barrier having a vapor transmission rate not exceeding 1 perm to be installed on the warm side of the walls (except for unfurred masonry walls). Insul-aid more than meets this standard.



Your Glidden dealer has a "Keep the Warm Inside" brochure with the whole story. And he has the Insul-aid you need to do it.



SCM GLIDDEN COATINGS & RESINS  
SCM CORPORATION, CLEVELAND, OHIO 44115



## NEVER MAKE A MORTGAGE PAYMENT AGAIN WITH THIS LOW-COST ENERGY SAVER!



Build this beautiful \$35,000 - 3 bedroom, 1140 sq.ft. home for \$6800 complete, and cut your heating & cooling bills 50%. Sounds incredible but it's true! See for yourself how easy it is to build the HOME KIT "80" and never make a mortgage payment again!

Tanyons' new do-it-yourself HOME KIT "80" includes 3 sets of building prints, special instructions, and easy to use material lists that show you how little the "80" costs. You'll discover, like thousands of others have, how easy and inexpensive it is to build & own this *no-mortgage home!*

If you want to price several low-cost energy saving homes before choosing one, then the HOME PRICER PLANNING BOOK is for you. It contains 49 home designs with floor plans & material lists that show you exactly what you need for any style you choose.

HOME PRICER's special section on finance shows you how to build your new home with only \$500 working capital.

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\$8.00 for Home Kit "80",  \$10.00 for Home Pricer,  \$15.00 for both, **saving you \$3.00!**  Or send \$1.00 for Information Pkg.

NAME \_\_\_\_\_

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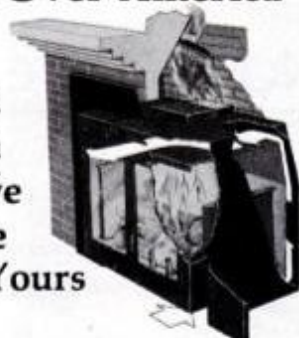
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## One Of The Finest Wood Or Coal Stoves You Can Buy Is Hidden In Fireplaces All Over America

You Can Have One In Yours



Now you can combine the efficiency of a free standing wood and coal stove producing up to 50,000 BTU's per hour with the charm and beauty of your fireplace.

The Leyden Hearth and Leyden Husky slip neatly into fireplaces without the need for any alteration to the hearth. You can do it easily with everyday house tools.

At the end of the season the units can be stored away or left in place. Should you decide to move, the Leyden Hearth and/or Leyden Husky come right along.

And now Leyden Hearth comes with ABC, the Anthracite Burning Component. You can choose between coal or wood burning and make the switch back and forth throughout the season. Only Leyden offers a completely reliable Anthracite Coal Burning Component in a fireplace insert stove. With its sensible price structure, Leyden Stoves afford a wonderful value in home heating.



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## LOW COST HEATER

Burns over 24 hrs. on low setting  
 No more middle-of-the-night stockings  
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 Engineered to prevent drum burn-out



OUR 24th YEAR

Sotz Corporation, 13643 Station Rd., Columbia Station, OH 44028

Before you spend \$500 to \$600 on a wood heater, try the Sotz Heater Kit for under \$60... **at our risk.** If (within one year) you don't agree it out performs any wood heater money can buy, or (within 10 years) if the kit cracks, warps, or burns up, your money will be refunded, including shipping charges.

Kit converts a 55 gallon drum (not supplied) into a high capacity wood burner. Features large 11 1/4" square door opening, cam-lock door catch, and spark-proof design. Patented internal draft channel, draft control, and airtight design allow controlled, efficient heat, while limiting metal temperatures of barrel, to prevent burnup. Use of draft control allows you to heat large or small areas. Basement installation heats your entire home. Great for your garage, workshop, or cabin. Top drum squeezes 60% more BTU's from heat normally lost up the chimney. Heavy steel kit bolts together quick and easy.

Thousands in use by U.S. Army, Navy, Depts. of Nat. Resources, Agriculture, Federal state and local government agencies. Assembled heater tested to U.L. specs Member 888.

**Free** info. about 15-30 gal. drum kits, heating water, drying wood, fireplace to wood stove and much, much more.

Price delivered to your door: Bottom Kit **\$38.95**. Top Kit **\$20.95**. Master card - Visa welcomed.



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## What are your windows costing you?

Every click of your gas, electric or fuel oil meter means another dollar out of your pocket. And at the rate energy costs are climbing, doesn't it make sense to do everything you can to slow those meters down?

One thing you can do is stop your heating and air conditioning dollars from escaping out drafty, rattling or falling windows. Window Fixer Replacement Channels by Quaker provide a permanent cure for your window woes. Rust-proof aluminum and stainless steel channels with a spring-powered center bead, provide the finest weatherstripping available. And they correct any sticking or falling problems your windows may have.

Window Fixer Replacement Channels are available at hardware stores, lumber yards and home centers. Pick up a pair. Invest an hour of your time. You'll get weather tight windows that work like new.



**Quaker City Mfg. Co.**  
701 Chester Pike, Sharon Hill, PA 19079

# A beautiful and better way to heat with wood

## A lovely way to heat longer

The Hearthstone combines the beauty and remarkable heating qualities of soapstone with the most modern woodstove technology. Soapstone absorbs twice the heat of metal — and radiates heat hours longer and more evenly than metal.



**Hearthstone**  
America's Quality Soapstone Stove

## More heat from less wood

Airtight and thermostatically controlled the Hearthstone will hold a fire up to 14 hours — and give off heat for another 4 hours. A unique secondary air system re-ignites otherwise waste gases — for extra heat and significantly less creosote.

## Watch the fire — keep the heat

You can enjoy the Hearthstone like a fireplace with the safety glass doors closed for maximum warmth, or open for quick heat on a chilly morning.

## Built to last for generations

Handcrafted to exacting Vermont standards, the Hearthstone combines yesterday's materials with today's technology — in an investment that will last for generations. It is available in top or rear flue models.

Hearthstone, Dept. PM9, Morrisville,  
VT 05661 802/888-4586

Please send your Illustrated Handbook.  
I've enclosed \$1 to cover postage and handling.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_ Zip \_\_\_\_\_



# WORTH WRITING FOR

LOOKING FOR IDEAS ON HUNTING, FISHING, CAMPING, BUILDING, TOOLS, ETC.? CHECK THESE LISTINGS. THEN USE THE COUPON BELOW.

## 294 Controlled Power - Elementary, Dr. Watt

If you're interested in reducing the electric power used by your home appliances, EverCon may have what you're looking for. Dr. Watt is a device using a NASA patent to cut down the amount of power that motors use. Can save energy and money, too. Free literature.

## 295 Patriotic Heating

Country Stove & Shelter would like you to know that using a stove for heating is safe, efficient and provides excellent value for the dollar. They offer a consumer's guide to burning coal, literature about their Patriot stove, and a coupon redeemable for a free Patriot cap at participating dealers. All for only \$1.00.

## 296 A hot investment

According to Lennox, comfort and value are still the main reasons for investing in heating/cooling equipment. Their colorful, 16-page booklet describes basic systems and how you can get the most from your comfort investment. Includes solar heating and tips on saving energy and money. Free.

## 297 Save Money and Sleep Nights

A leaky faucet can cost you money and a night's sleep. Here's a full-color 8-page brochure that illustrates the Simpson Street washerless faucets by Nibco. Functional with a stylish look. Designed with do-it-yourself installation in mind. Free.

## 298 For a Clean Sweep

Almost anyone who has a stove and chimney can clean them. An informative booklet offered by Clean Sweep tells you the Why's, as well as the How's. Free.

## 299 A Beautiful Barrel Stove?

The Sotz Corp. answers yes to that question and thinks you'll agree when you learn how its Heater Kit can keep you warm and save money. The 10-page "Sotz News" provides information on this barrel heater, heating water, drying wood, the Monster Maul log-splitter and more. Free.

## 300 The Window Way to In-Home Insulation

Brochure tells how to conserve energy through the use of insulated drapery lining and prolong the beauty of your draperies and room furnishings. Free from Rockland Industries.

## 301 For Owners of Chain Saws and Fireplaces

Poulan's COMPLETE BOOK OF FIREWOOD is a 140 page paperback detailing everything a person needs to know about cutting, selecting and preparing firewood for a fireplace. Includes the right woods to use, how to build a fire and even some hints on chain saw use. \$3.95

## 302 Thoroughbred - Through & Through

The Budweiser Clydesdale Team is truly thoroughbred and has been since 1933. This year Anheuser-Busch offers the Clydesdale Collection, a full-color, 36 page catalog filled with unique gifts of tradition, nostalgia and style. From glassware to jewelry to menswear and more. Only \$2.00.

## 303 Take This to Your Hearth

Whether you have a large house, a small house, a new energy efficient home, a mobile home or a vacation cabin, Earth Stove wants you to know they have a model for you. Full-color brochure shows how a wood stove helps capture the glow of yesterday and serves today's heating and energy needs. Free.

## 304 Let the Sun Shine In

Bring more light into your home with a skylight. Achieve energy savings, too. To do this, Venterama would like you to have two booklets giving ideas for every area of your home - even the pool area. Included are details and specifications. Free.

## 305 Energize Your Fluepipes

Condar offers information on two of its energy saving products: the Chim-

gard Surface Thermometer and Chimfin Heat Radiators. Designed to promote thrift, safety and achieve heating savings. Free.

## 306 Need Home Fix-up?

You can do home repairs and remodeling jobs that last - the easy way. Colorful brochure gives details on DAP products for a wide range of home fixup and paint-up needs. From DAP Inc. Free.

## 307 Both Fireplace and Stove

The "Americana" is a stove, as well as a free-standing fireplace. Autocrat offers an owner's manual, illustrated literature, and a list of 33 Reasons which demonstrate its features and performance. \$1.00.

## 308 Build a Low-Cost Energy-Saver House

Tanyon Press would like you to know how to build a home so inexpensively you won't need a mortgage. For less than \$7,000 you build this special-design house that can cut your heating and cooling bills 50%. Complete information package on this home and 49 other styles. \$1.00.

## 309 Fast and Easy Liquid Barrier

Insul-aid, a latex vapor barrier from Glidden, keeps insulation drier, reduces moisture-related exterior paint failures. All the info in a free, concise brochure.

## 310 All About Wood Heat

Many people are choosing wood heat for a number of reasons, including economy, reliability and warmth. An 8-page brochure from Columbia Products Co. tells you why and gives you information on the performance of their New America Stove. \$1.00

## 311 Wet Your Conservation Consciousness

Con-Serv would like you to have its informative brochure describing its water/energy saving products. Designed for years of use, these fixtures can save the average family of four over \$250 a year in water and water heating costs. Free.

## 312 More Power to You

Brochure describes new 3.5 and 5 KW Kohler Powerhouse generators. Use during blackouts to send electricity directly to a shop, office or home via a special emergency power kit. Two-wheel cart allows easy use for yard and garden or handyman projects. 25¢

## 313 Total Home Comfort

In addition to heating and cooling, in-the-home comfort involves two other important factors: air cleaning and humidification. Two booklets from Research Products Corp. explain their importance and how to control them efficiently with a new type air cleaner. Energy saving opportunities are also listed. Free.

## 314 You Too Can be Drafted.

Drafts around windows can cause energy loss. The BARRIER<sup>TM</sup> from K-Lux is an inside insulating window. Illustrated booklet shows how these styrene panels are installed quickly and easily and work to save on your heating and airconditioning bills. Free.

## 315 Sleep Warm - All Night

Want to stay warm this winter and save heating dollars at the same time? "The Woodburner," a 24-page, newspaper-size brochure is jam-packed with valuable articles, photos, and charts to help you save money and avoid trouble when you purchase a wood or coal stove. From All Nighter Stove Works, Inc. Only \$1.00.

## 316 Don't Leave Your Heat Behind

Cost conscious people can use portable space heaters to provide convenient comfort where they want it. Corona kerosene heaters for home or work offer heating output ranges from 8,800 Btu/hr to 22,600 Btu/hr and heating times from 18 to almost 20 hours. Free brochure from GLO-International.

## 317 Cheap Heat With Waste Oil

Here's a brochure describing the Burn'Zall waste oil heater that will burn used, dirty oil as fuel. It will cleanly heat shops and industrial areas with almost any old oil containing up to 20% water and pollutants. Free.

Popular Mechanics 9/80  
Box 1718, Sandusky, Ohio 44870

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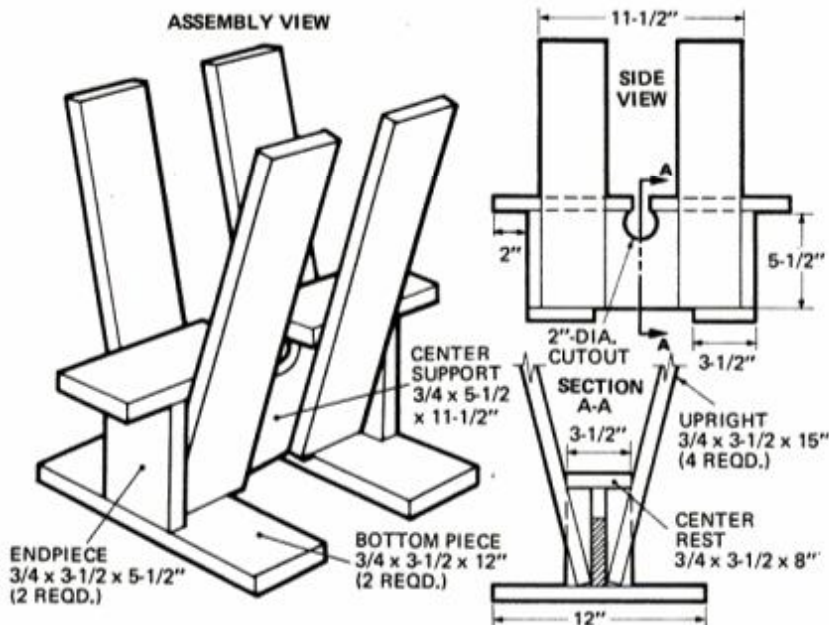


# Energy-saving tricks that work for readers

## Drying twigs for tinder

Whenever there's a strong wind, many small branches from the hardwood trees on my property fall to the ground. I bundle these and save them for use as tinder to start my fireplace fires. To make tying the bundles easier, I built the rack shown to hold the twigs. When I have enough to make a bundle 6 to 8 in. in diameter by about 15 in. long, I tie and stack it out-

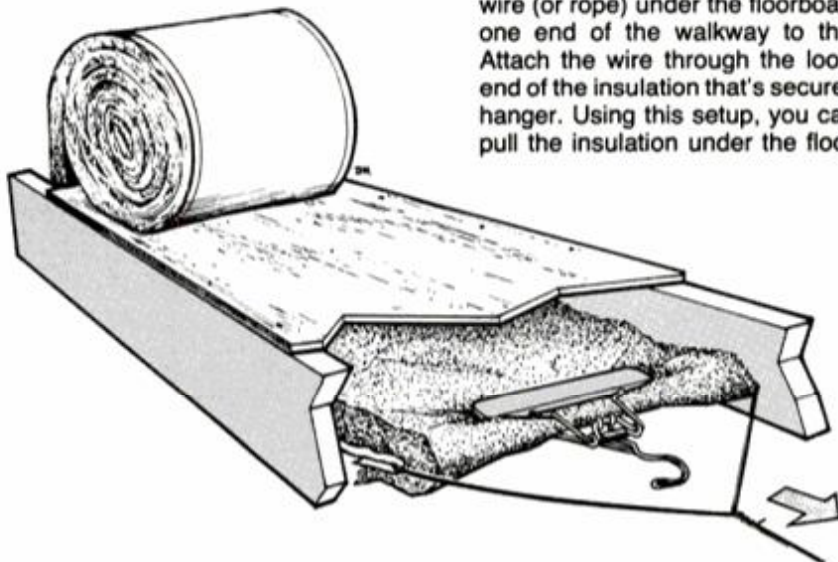
doors in the sun to dry. I also dry branches cut while pruning. Covered with black plastic, the twigs dry out and burn readily during cold weather. To tie the knot when securing the bundle, wrap one cord end around the other end as usual in starting to tie a square knot; repeat this operation and pull the knot tight. Change hand positions to make the second cross-over that completes the knot.—*James F. O'Brien, Oregon, Ohio*



## Easier attic insulation

You don't have to remove the floorboards in an unfinished attic to insulate beneath

a walkway. Simply fold the end of some blanket insulation back on itself and close a pants hanger over the folded end as far back on the insulation as possible. Pass a wire (or rope) under the floorboards from one end of the walkway to the other. Attach the wire through the loop at the end of the insulation that's secured by the hanger. Using this setup, you can easily pull the insulation under the floorboards



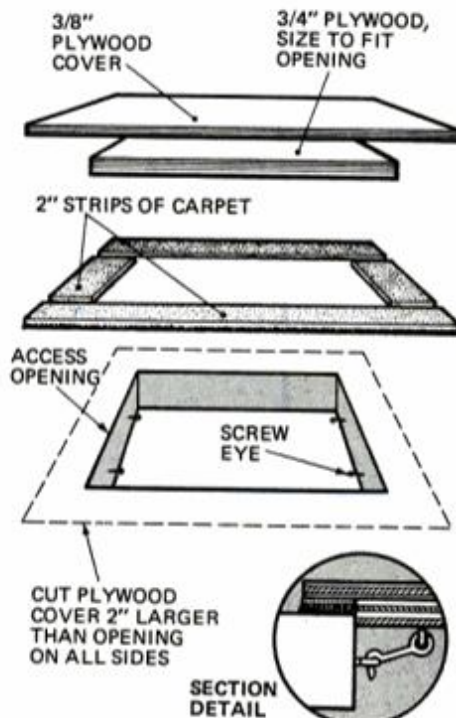
while someone else pushes it from the other end to reduce drag. The insulation stays flat, which insures that the entire area under the floorboards is covered, without your taking time or trouble to remove the floorboards.—*Peter Wislocki, Westfield, N.J.*

## Tight attic seal

As building inspector for our township, I am always amazed at the inadequate methods used to close off the access entrance to an attic or crawl space, which results in costly fuel waste. The standard way of covering the entrance is to lap the inside casing over the underside of the entrance by about 1 in.; then a thin piece of plywood or hardboard is fastened on this lip. On some occasions I've seen 1/2-in. gaps between the casing and the plywood covering the entrance.

To make a tight seal on your access opening, cut a 3/8-in. plywood cover 2 in. larger on all sides than the opening. Cut a piece of 3/4-in. plywood the exact size of the opening and nail it to the cover with 3d common nails. Glue 2-in.-wide strips of carpet around the inside of the cover perimeter so that the carpet butts the 3/4-in. plywood. Position the cover with carpet seal resting on the floor joists or flooring.

To insure that the cover is absolutely tight and rattle-free, install four screw



eyes and hooks, one per side. Fasten hooks to cover first and locate eyes so that the cover will be pulled snug when the hooks are engaged.—*Ronald O. Fluck, Perkasié, Pa.*

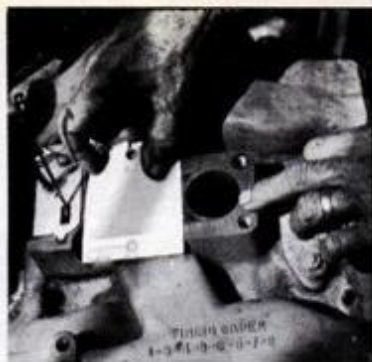
(Please turn to page 149)



# MOTHER'S PLANS



**FOR FASTER SERVICE  
CALL TOLL FREE  
800-438-0238**



## TURN YOUR V-8 INTO A V-4 AND GET 40% BETTER MILEAGE!

As you saw in MOTHER NO. 58, it's pretty easy to convert a muscle-bound, gas-guzzling V-8 engine into a reliable, plenty powerful, and economical V-4 . . . especially if you have a set of MOTHER's easy-to-follow plans to guide you along the way! Our simple, step-by-step plans are designed for the less-than-professional me-

chanic who wants to do it him- or herself . . . and do it *right*. They include all the information, schematic diagrams, and procedures you'll need to convert just about any V-8 engine of American manufacture into a sweet-running, money-saving V-4. The complete packet is yours for only \$15.

**84024 \$15.00**



### MOTHER'S WASTE-OIL BURNER

It's inexpensive to build! It's clean! It's environmentally sound! And anyone reasonably familiar with hand (or power) tools—and with \$36 to spare—should be able to assemble this dandy little furnace in jig time. MOTHER's waste-oil burner—which puts out approximately 21,000 usable BTU an hour from "free for the hauling" crankcase oil—will keep a small, well-insulated house snug and warm all winter long. Detailed plans—including filter, fuel storage, and feedline methods—are just \$10 per set and they include a full bill of materials.

**84011 \$10.00**



### MOTHER'S AMAZING WOOD-BURNING STOVE

All it takes are MOTHER's step-by-step, fool-proof instructions and some shop time to turn about \$40 worth of materials into a "custom made" woodburner that's the equivalent of commercial models selling for up to \$500. This little beauty quickly heats 1,100 square feet, and you can even cook on it!

**84001 \$10.00**



### MOTHER'S NEW, IMPROVED HEAT GRABBER

MOTHER showed you how this easy-to-install, energy-efficient solar furnace worked in issue 54. Now, you can build your own hardworking BTU-bagger in about six hours . . . and at a cost of around \$38. Designed to fit any standard window, MOTHER's Heat Grabber will heat any well-insulated room during cold, sunny days. Detailed, point-by-point plans are yours for just \$10. And they include lots of *extra information* such as woodworking tips, money-saving recycling ideas, and blowups of critical parts and cross sections.

**84012 \$10.00**



### MOTHER'S AMAZING, TIME-SAVING, SUPER HYDRAULIC LOG SPLITTER!

This durable, efficient, and *powerful* fire-wood-cracker can save you hours of back-breaking work this winter . . . and you can build it in just 20 hours. It can split logs as large as two feet in diameter and 21 inches long in *less than five seconds* . . . and it costs about \$600 (or less if you have access to a tractor with a hydraulic system)! Whether you're mechanically inclined or not, MOTHER's complete step-by-step instructions will show you how to construct a high-quality "automatic lumberjack" that will make log splitting amazingly easy for years to come!

**84025 \$15.00**









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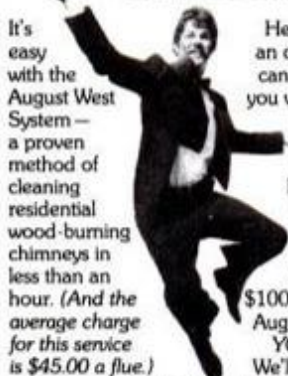
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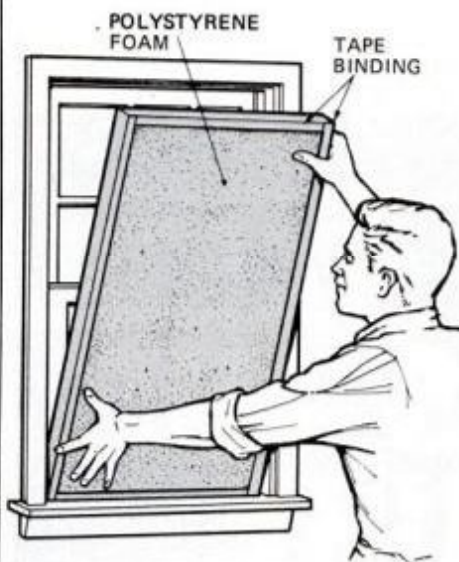
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# HOME ENERGY GUIDE

(Continued from page 145)

## Window insulation

My windows have a 2-in. space from the double-pane glass to the inside edge of the jamb. To seal out drafts, I cut slip-in insulation panels of 2-in.-thick polystyrene foam to fit the window openings. To strengthen the panels for constant handling, I covered all edges with tape binding. When it's sunny outside, I remove the panels. I replace the panels at night. In cold weather I permanently leave the panels over windows in rooms I don't often use, as the polystyrene does allow some light to pass through. I've had a marked reduction in gas consumption since using the panels. The house also feels much warmer at a



lower temperature. My theory is that there are no cold window surfaces to draw heat from warmer objects.—*Joseph H. Williamson, Cottage Grove, Minn.*

## Common-sense cooking

When I'm baking, roasting or broiling dinner, I always try to plan the menu to include vegetables or other side dishes that I can heat in the oven. Doing so uses the heat to greatest advantage.—*Barbara Genetti, New Tripoli, Pa.*

## 2 energy bypasses

The best way I've found to cut heating costs is to buy a down comforter and turn the heat off at night. Another way to save energy is to unplug that energy-gobbling clothes dryer and hang the wash on a solar clothes dryer—a clothesline.—*David Ward, Glenwood Springs, Colo.*

Share your home energy-saving ideas. PM will pay \$25 for each idea published. Include sketch or photo, if necessary, and a stamped, self-addressed envelope if you want unused material returned. Send to Energy-Saving, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.

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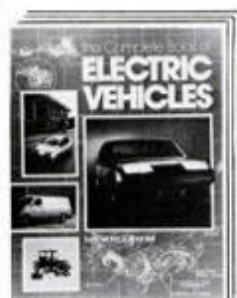
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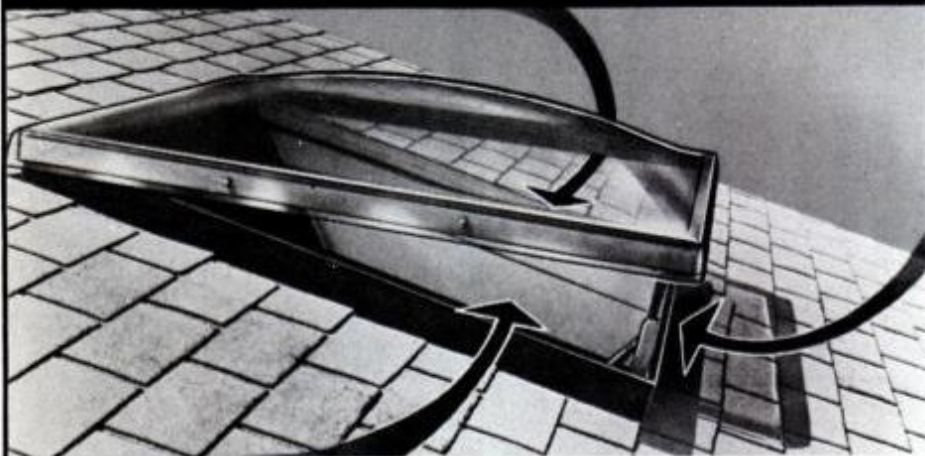
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## HOME ENERGY GUIDE

# Now, a heat pump for cold climates

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■ First, when outdoor temperatures



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drop to a point where conventional, single-compressor heat pumps can't fully satisfy indoor comfort levels, this new Weathermaster III heat pump automatically energizes its second compressor to boost the system's heating capacity. At such temperatures, conventional heat pumps switch to more costly electric-resistance heat. However, the Carrier heat pump cuts back on utility bills by functioning efficiently down to a lower, second thermal-balance point before resorting to standby electric heat.

■ Second, in northern climates where heating requirements are greater than cooling requirements, the dual compressor eliminates the need for oversize cooling capacities. By eliminating the traditional oversizing, humidity control isn't sacrificed. One compressor cools; two compressors heat.

The system is available in two sizes starting at about \$3000 including installation. The smaller unit has capacities of 29,000 B.T.U. cooling, 33,000 B.T.U. at high-temperature heating, and 29,000 B.T.U. at low-temperature heating. Its energy efficiency ratio (EER) is 8.4. Carrier Air Conditioning, Box 4808, Carrier Pkwy., Syracuse, N.Y. 13221. **PM**



## CHRYSLER'S SPECIAL K FORMULA

(Continued from page 77)

and Dodge Mirada. Unlike GM's compacts, Chrysler will offer no sporty versions (at least initially). That market is covered by the hatchback Omni 024/Horizon TC3, slightly smaller cars that already have become big successes for Chrysler.

I got into the base two-door first, a handsome silver car with red cloth interior. Its boxy styling reminded me of the very formal Buick Skylark, especially since it had the upright chrome grille that will be used on the Plymouth models. The finned Dodge grille presents a more sporty appearance.

This car was equipped with the all-new, American-made 2.2-liter, four-cylinder standard engine that produces 92 hp at 5200 rpm. It also had manual steering and manual brakes. A four-speed manual overdrive transmission is standard on the 2.2-liter cars, but was not available for testing, so my driving impressions are limited to the optional three-speed automatic.

The standard seats are comfortable, firmly padded benches that provide excellent lower back support. Only the back seat is lacking in thigh support, for the lower cushion is truncated to offer the illusion of more legroom.

With the front seat adjusted so that I was comfortable, there was just enough rear-seat legroom so that my knees didn't touch the back of the front seat.

### Interior is cheerful

The interior of the K-car is bright and airy. The dash is compact and set well forward, leaving plenty of space in front of the passengers, and the windows are large, so visibility is good in all directions. These cars are just as roomy for four passengers as the old Aspen and Volare were, but those cars had relatively little interior space compared to their exterior bulk and hefty 3200-pound (base) curb weight. And the K-car has a roomy 15.0-cu.-ft. trunk—just 1.4 cu. ft. smaller than the Aspen/Volare.

Driving the base car was a disappointment. The manual rack-and-pinion steering was heavy at low speeds and there was too much free play on center. Furthermore, the nonassisted brakes felt spongy.

Once under way, the 2.2-liter engine was sluggish. For example, 0 to 30 mph required a leisurely 5.6 seconds; 0 to 40 took 8.6, reaching 50 took a consistent 12.9, and 0 to 60 mph was a long 18.4—slower than some diesel-powered cars I've driv-

en. Accelerating the 2.2-liter engine past 60 mph was an exercise in frustration—the engine was totally out of breath by 70 mph. It should be added, though, that cars equipped with manual transmissions will undoubtedly have more pep than our automatic-equipped test car.

The other three prototypes all had the optional 2.6-liter, four-cylinder engine that is made for Chrysler by Mitsubishi in Japan. This engine, which produces 105 net hp at 5000 rpm, will only be available with an automatic transmission.

### Choose options carefully

These three cars also were equipped with the optional power steering and power brakes. They were vastly superior to the base car in acceleration and handling ease, proving once again how important it is to choose options wisely.

While the optional power, rack-and-pinion steering gave up something in road feel compared to the manual steering gear, response on center was much quicker, and there was less free play. Power steering also made the cars much easier to drive around tight turns, because the front-wheel-drive tendency for the front wheels to want to go straight is greatly masked by the power assist. Torque steer, the tendency for the steering to tighten more as the car accelerates out of a turn, was noticeably absent on all the prototypes.

The power brakes offered sure, safe stops from high speed without fading or causing the car to pull to one side. The pedal felt light and positive in use—a vast improvement over the heavy, spongy pedal on the base car.

Accelerating to highway speeds was much easier in the 2.6-liter-equipped cars. Zero to 30 mph took 4.5 seconds, 0 to 40 mph required 6.8, 0 to 50 was 9.5, and 0 to 60 mph could be attained in 12.8 seconds—5.6 seconds faster than the base car.

Passing times were adequate on 2.6-liter cars. Thirty to 50 mph took an average of 7.4 seconds, with the upshift to second gear occurring at 45 mph. Forty to 60 took 11.2 seconds, but 50 to 70 was a long 15.4 seconds. The automatic transmission shifted roughly under hard acceleration, but was otherwise unobtrusive.

On the open road, all four cars rode well. Coil springs at all four wheels impart a firm, but not uncomfortable, ride. At speed, wind and engine noise were low. The cars tracked bumpy turns without their rear ends veering off course, prov-

(Please turn to page 152)



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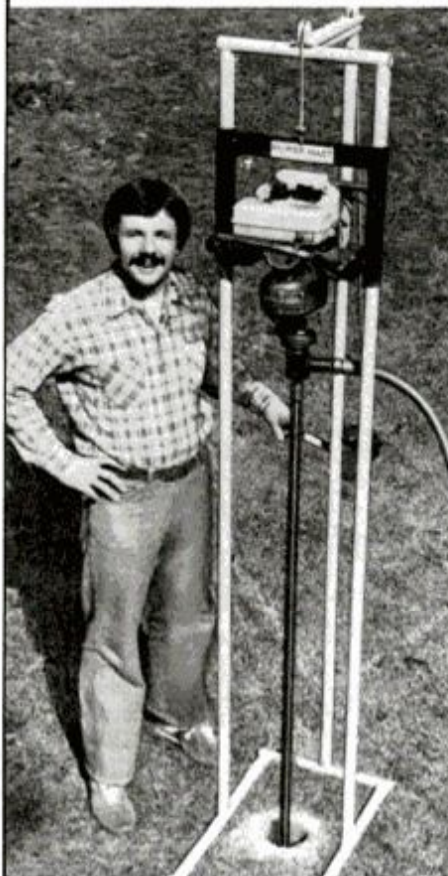


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## CHRYSLER'S SPECIAL K FORMULA

(Continued from page 151)

ing that the new flex-arm, beam-axle rear suspension with trailing links (a simple form of independent rear suspension) is a vast improvement over the Aspen/Volare rear suspension.

Surprisingly, there were very few problems with the engineering prototypes.

### Auxiliary gauges missing

The dash on the K-car is devoid of any auxiliary gauges. The Aspen/Volare was better in this respect, with ammeter and temperature gauges standard. On the K-cars, these gauges will be optional starting in mid-1981, but no tachometer will be available.

On the skidpad, I had a chance to compare the base car with two other cars equipped with power steering. One of these had the stock suspension, while the other was equipped with the optional handling package. This package includes wide 185/65P14 radials on 14-inch wheels (vs. 175/75R13 radials on 13-inch wheels), the addition of an antisway bar in front (all models use an integral torsion tube in the rear, that is, the flex-arm beam axle), and stiffer shocks and springs.

All three cars exhibited initial understeer. The two without the handling package went into terminal, grinding understeer when pushed hard, while the car with the handling package actually became neutral and then lapsed into oversteer—in other words, the tail would break loose if I drove through a turn fast enough. All three cars felt reasonably safe and predictable once I learned their vices.

The car with the handling package had much less body roll than the other two. Its only drawback showed up on bumpy roads, where the added roll stiffness caused more side-to-side pitching when only one wheel hit a bump.

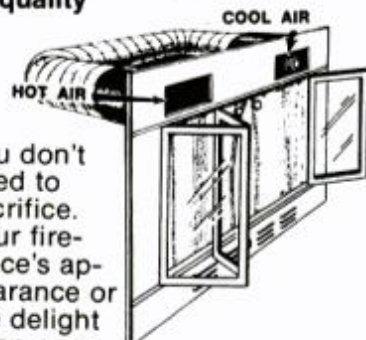
The K-cars are reasonably enjoyable to drive, but nowhere near as performance-oriented as cars like Chevy's Citation X11 or Pontiac's Phoenix SJ. And the fact that Chrysler plans no sport package or hatchback version further proves that the K-car is aimed at the conservative, economy-minded motorists who made the Plymouth Valiant and Dodge Dart such popular cars during the 1960s and early 1970s.

Chrysler is aiming at a 25-percent fuel-economy improvement over the Aspen/Volare, which should put the K-cars at 25 mpg city (EPA test cycle) with the 2.2-liter engine. **PM**

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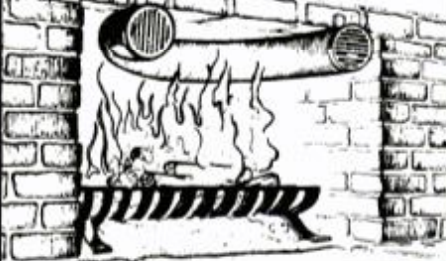
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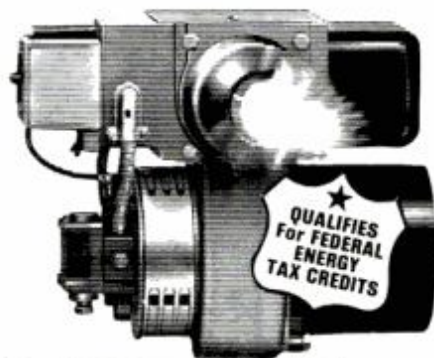
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## SEE MORE OF THE SKY

(Continued from page 85)

grain an extremely compact structure. An 8-inch model is only 2 feet long and weighs less than 30 pounds. A drawback: Schmidt-Cassegrains are priced at least 50 percent higher than Newtonian reflectors of comparable aperture.

The top-of-the-line telescopes, in terms of price and optical performance, are the Maksutov-Cassegrains. Similar in general appearance and function to the Schmidt-Cassegrain, these telescopes provide the sharpest images of the new-generation scopes—but you can pay more than \$1000 for a 3½- or 4-inch model. Six-inch models start at \$2000 and larger sizes quickly escalate through the clouds.

### Check your site

Choosing what type of telescope is best for you depends, of course, on how much you care to spend. But you would be wise to consider other factors, like your observing site. If you'll be doing most of your skywatching from in or near a city, you should choose a smaller-aperture telescope—a 6-inch Schmidt-Cassegrain, for instance—since artificial lights from urban areas tend to negate much of the light-collecting capacity of the bigger 'scopes. If a good percentage of your skywatching will be from a site reasonably clear of man-made illumination, a Newtonian reflector will give you the most stars per dollar outlay.

To bring you back to earth for a moment, there are a few *caveats*. One: The mirrors in the Newtonian are adjustable; moving the 'scope can throw it slightly out of adjustment—enough to cause you to see nonexistent flares, spurs or streamers on stars. Learn to adjust your equipment before you start to use it. Another: Aluminized optical surfaces on the Newtonian are subject to star-dimming deterioration, tarnishing enough in five or 10 years to require resurfacing. That's no big deal. Specialty shops (advertising in telescope magazines) charge roughly \$50 for the job. Schmidt-Cassegrain and Maksutov-Cassegrain 'scopes are enclosed and protected, so their aluminum surfaces last at least 20 years.

And a final suggestion: You can pick up many more tips like these, and save yourself money and headaches by reading widely on amateur astronomy before you train your eyes on the sky through a top-of-the-line telescope.

PM

The author, Terence Dickinson, is editor of *Star & Sky* magazine.

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**W**orried to a point barely short of panic over runaway energy costs, most of us are scrambling for alternatives—ceiling fans and shading devices for summer, wood burners and solar in winter. Or we're learning to do without. Most of us are also overlooking a barely tapped energy source right under our feet—ground water. This energy reservoir, dormant since dinosaurs roamed the earth, is due to play a larger role in home comfort during the years ahead.

A surprisingly simple machine, the water-source heat pump, provides the tap for ground-water energy.

Annual sales for this pump, on the market for more than 30 years, were creeping along at 5000 to 10,000 as recently as three years ago. Last year, sales broke through the 75,000 mark, and some in the industry expect to see sales at the rate of 300,000 units a year by the middle of 1981.

What's behind the boom? The same pressure that's driving people to buy wood stoves, flue dampers and awnings: out-of-sight fuel bills.

Buyers and would-be buyers of water-source heat pumps are discovering that this machine saves money and still delivers year-round home comfort.

# How to tap the energy under your back yard

As fuel costs rise, Americans in growing numbers are drilling their own land to cool and heat their homes.

by John H. Ingersoll

How much money? It could be as much as half of what you're paying now. Savings that high have been reported. Other homeowners cite more modest savings, in the 10 percent to 30 percent range.

## Energy in a well

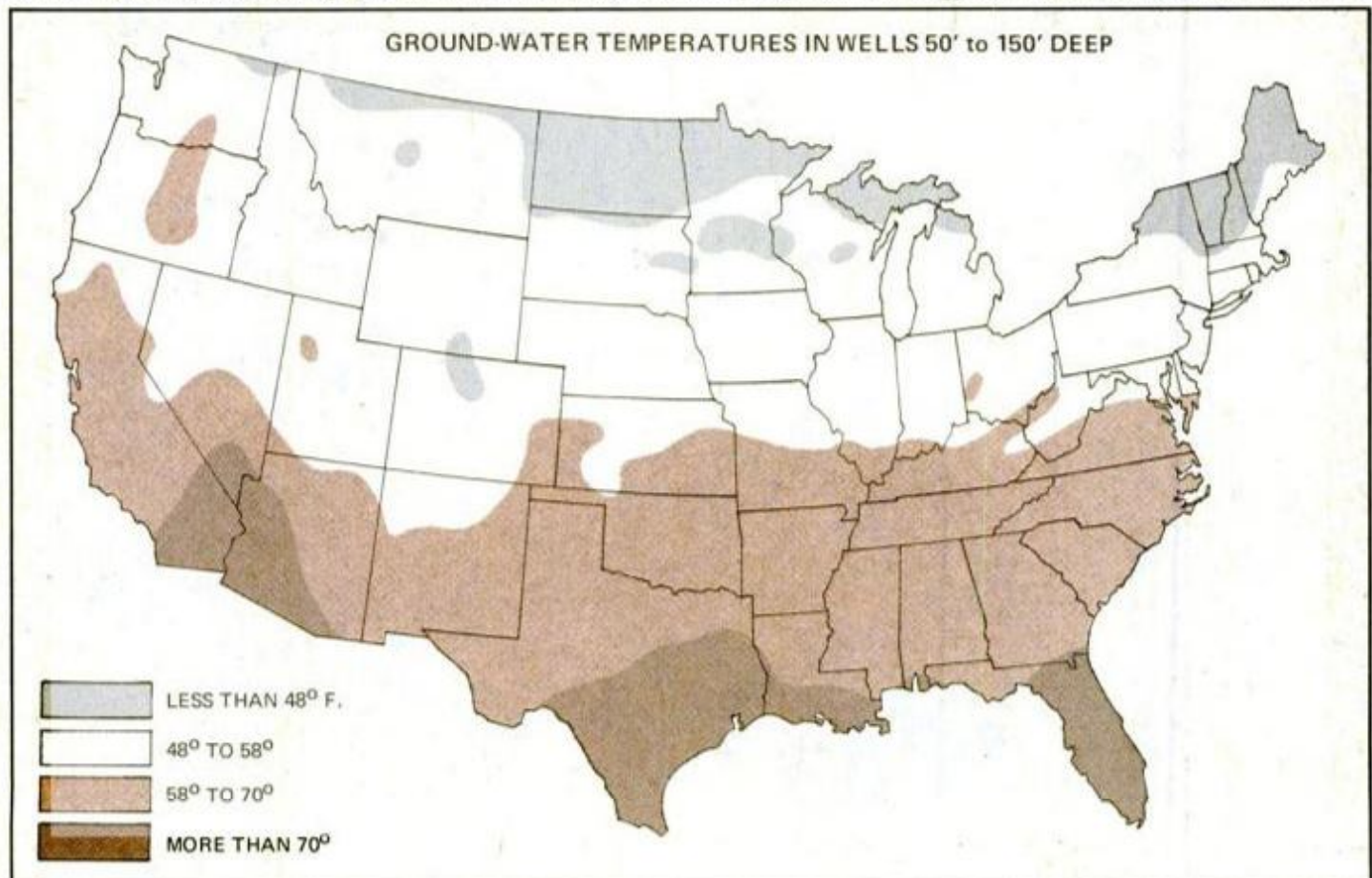
Ground water won't produce for everyone. Houses with steam or hot-water heating systems, for instance, are probably not good candidates for conversion. (We'll get back to potential problems and limitations later.) But for homeowners with easy access to underground water, the pay-

off from a heat pump can rival striking oil in your yard.

In 1978, Karl Osberg of Huron, S.D., heated his 1800-square-foot home with an air-source heat pump. His monthly electric bills ran to more than \$200.

Last summer, Osberg pulled out the pump and replaced it with a water-source heat pump tied to an artesian well already on his property. He reports that his total electric bills each month this past winter ranged from about \$65 to \$90 with a high one month of \$96. And his 1979-80 bills included a rate hike by the

Ground-water temperatures stay constant winter and summer. Modern pumps extract energy even when water is cooler than 50° F.





electric utility. (In both cases, the bills were for all electric appliances in the house, since there was no way to break out the heat-pump costs.)

He says last winter there were plenty of days when the wind whistled by at a chilling minus 15° F. Temperature of the ground water from his well is 60° F., more than adequate to heat his house. And in the summer? "We get hit with spells of 100° days back to back for a week at a time. The heat pump, still pulling water at 60°, practically cools our house free."

Osberg is one of a growing number of people who have learned that ground water, the source of the energy, is as dependable as sunrise. Wherever you live, the temperature of ground water remains virtually the same all year. In Butte, Mont., ground water stays an even 50° F. In Phoenix, Ariz., where summer air temperatures often top 100° F., ground water remains a comfortable 70°.

Obviously the same is not true of air temperature. Manufacturers admit that an air-to-air heat pump grunts to cool 100° F. air, and in winter needs help from auxiliary heaters when below-freezing weather arrives. That help is provided by built-in electric-resistance strip heaters. As air-source pump owners report somewhat bitterly, when those strip heaters turn on, their electric bills soar.

### How water beats oil

Performance figures confirm that the ground-water system works, at least theoretically. Coefficient of performance (COP) tells how much heating energy a pump delivers compared to the power it uses. A pump with a COP of 1.8 turns out 1.8 units of heat for each unit of electricity consumed. One of the beauties of all heat pumps is the fact that they deliver more than they consume. By comparison, an oil furnace that burns one unit of oil delivers

only 0.7 units of heat to your home.

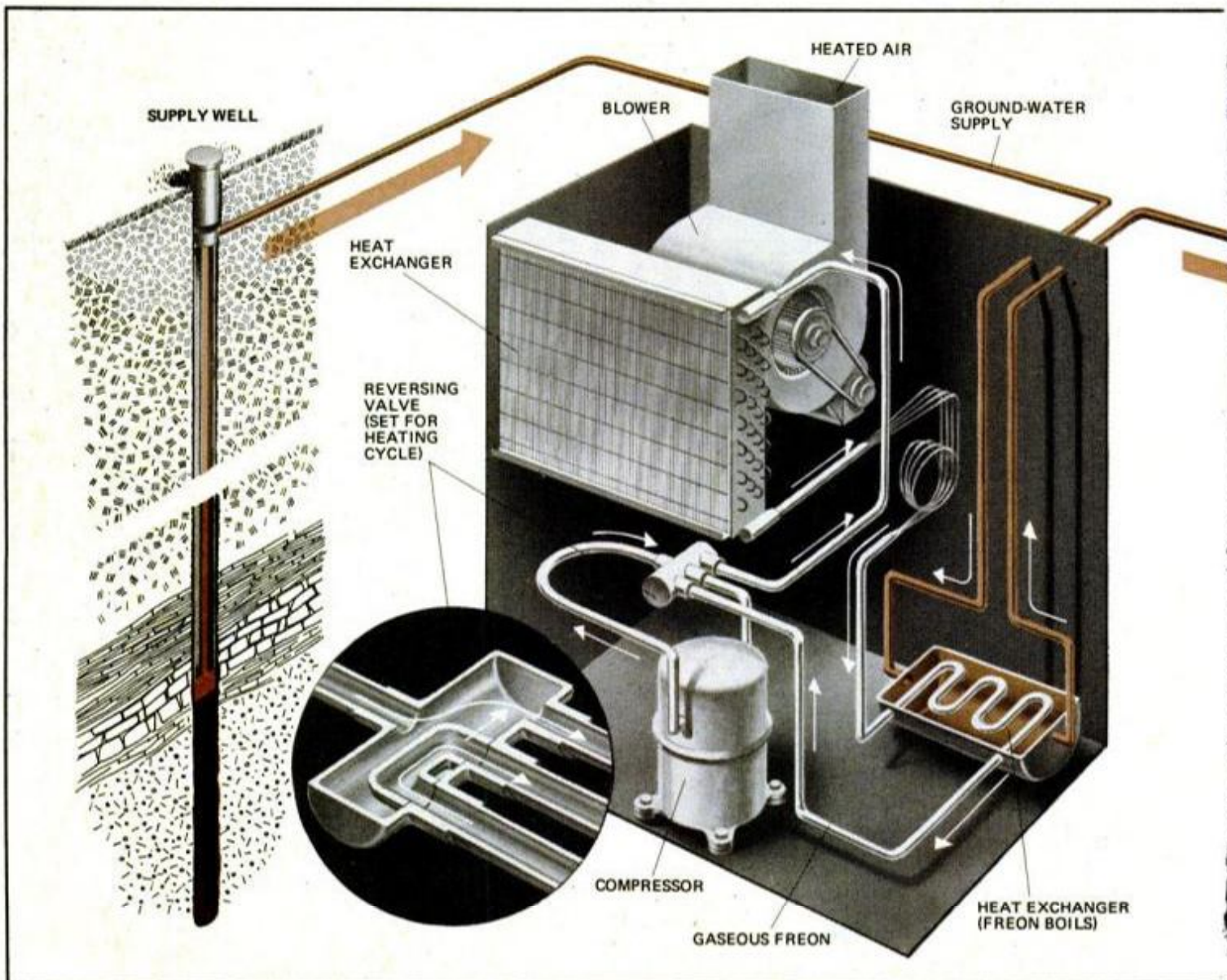
Quality air-to-air heat pumps average COP levels between 1.8 and 2.5. The ratio is less when the machine is subjected to long periods of freezing weather, and more when it operates in a mild climate. Some water-source heat pumps tick off a COP of 3.5 and there is industry speculation that improved engineering will soon raise that figure above 4.

On the cooling side, pumps are rated on the basis of an energy efficiency ratio (EER). EER also represents output divided by power input, which makes the high numbers desirable.

EER for air-source pumps fall between 6.8 and 9.0. Water-source pumps can reach an EER of 13 or more.

### A catch: drilling cost

Now the big question. If this clever, money-saving pump has been around for 30 years, why hasn't it





long since overtaken the air-to-air heat pump?

The law of least resistance is at work here. Even though an air-source pump usually costs more to run (and, in very cold weather, has its problems), air is free. Ground water is not. Drilling a well costs money. Electricity to run a well pump costs money, and wells just aren't an option for everyone.

"Imagine everyone in Manhattan drilling their own well," says James Calm, Energy and Environmental Div. engineer for Argonne National Labs, Argonne, Ill. "Besides," he says with a grin, "drilling through the subways might prove rather difficult."

Those who can drill may have to dig deep—into their pockets. The average domestic well in the United States now costs around \$2400. A second well to take back water used by the pump—called a recharge well—may or may not have to be as deep as the supply well. Its cost

## STATE ATTITUDES ON RECHARGE WELLS

**Will not permit recharge well**  
 Arizona  
 Maine  
 Minnesota†  
 Missouri  
 Oklahoma\*  
 Virginia  
 Wisconsin

**Recharge well okay with permit**  
 Alabama  
 California  
 Colorado  
 Connecticut  
 Delaware  
 Florida  
 Hawaii  
 Idaho

Kansas  
 Maryland  
 Massachusetts  
 Michigan  
 Nevada  
 New Hampshire  
 New Mexico  
 North Carolina  
 Ohio  
 Pennsylvania  
 Tennessee  
 Vermont  
 Washington  
 Wyoming

**No permit required**  
 Alaska  
 Arkansas  
 Illinois  
 Indiana

Iowa  
 Kentucky  
 Louisiana  
 Mississippi  
 Montana  
 Nebraska  
 New Jersey  
 New York  
 North Dakota  
 Oregon  
 Rhode Island  
 South Carolina  
 South Dakota  
 Texas  
 Utah  
 West Virginia

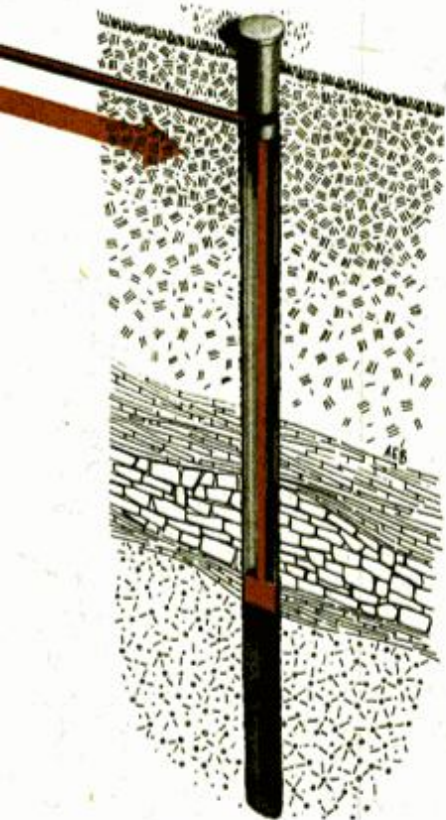
**Recharge okay for cooling water only**  
 Georgia

Source: National Water Well Assn.

\*Although Oklahoma statute permits no recharge wells, officials have not as yet enforced the law.

†At press time, Minnesota was considering a bill to permit recharge wells.

DISCHARGE WELL



**A** water-source heat pump extracts heat from ground water in winter and delivers it to your home via an air-moving system. In summer, the system reverses itself to pull heat from air in the house and pass it on to ground water colder than the air.

The machine accomplishes this feat with a heat carrier, Freon, the same refrigerant used in air-source heat pumps, airconditioners and refrigerators. Here's how it works:

Freon travels under pressure through the heat pump in a slim tube. The tube passes through two heat exchangers. In winter during the heating mode, Freon begins its journey as a liquid. Its tubing passes through metal coils in which ground water is coursing. The Freon boils in proximity to water, drawing off heat.

Gaseous Freon moves on through the compressor, and then passes to the second heat exchanger. Cool return air from the house passes across these coils. Heat packed into the Freon gas gravitates to the cool air, warming it. Heated air continues into the duct system for the house. And extracting heat from the refrigerant has caused it to condense to a liquid.

As a liquid, the Freon continues its journey in a loop toward the first heat exchanger. Still under pressure, the liquid passes through a narrow opening, which lessens the pressure, lowering the boiling point of the Freon. Again the Freon boils and takes on heat.

In summer, to cool your home, you reverse the cycle. The heat exchanger in the flow of the air-moving system becomes an evaporator, and the ground-water coils become the condenser.

could run between \$1000 and \$2500.

So the total investment might be close to \$5000 before you pay a penny on the heat pump. A water-source heat pump, installed, falls in the same price range as an air-source pump—between \$3000 and \$4000 for a unit for the average house.

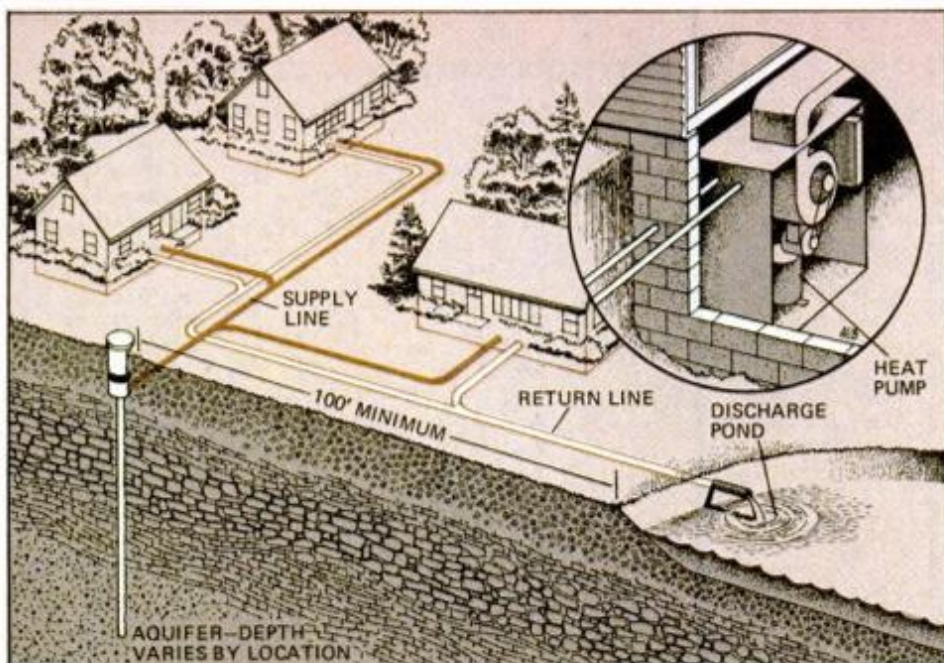
Dr. Jay H. Lehr, a hydrologist and executive director of the National Water Well Assn., says it may take five or six years for a suburban family to realize in operating savings the investment made for wells to run a water-source heat pump. "But when that family understands once the investment is wiped out, savings will be \$800 to \$1000 every year on energy costs, it seems to me they'll decide in favor of a water-source heat pump," Lehr says.

### Pumping out savings

"Water-source heat pumps save between 15 percent and 20 percent in operating costs over air-source units in our area," says Richard Getzschman of Getzschman Heating & Air Conditioning, Omaha, Neb. "And they save at least 40 percent over the costs of operating electric-resistance heating and a separate airconditioner."

Some claim they last longer, too. John Oyer, an executive with Friedrich, a major producer of water- and air-source heat pumps, was quoted recently in a trade journal claiming a life expectancy for water-source machines twice that of air-source units.





On the drawing board are plans to supply several houses with ground water feeding individual heat pumps. In a variation of the

system, a well supplies a central heat pump that provides heated or cooled water through insulated pipes to each house.

Others closely associated with this burgeoning branch of the business agree for two reasons: (1) the water-source pump is designed with fewer parts and more simplicity than its air-to-air cousin, and (2) drawing energy from water takes less mechanical work.

### Questions to ponder

Still, considering the cost, before committing yourself to a water-source heat pump, you'd want answers to a few questions like the ones listed here:

**Can I retrofit a water-source pump to my steam or hot-water heating system?** Not easily, several heat-pump dealers told us. You're probably facing an additional expense to install a forced hot-air system. That can be a complicated job with a long pay-back period. The dealers weren't encouraging.

**Is it OK to drill wells on suburban property?** At least six states currently forbid recharge wells (see list, page 157). Check with local code officials first, or with a well driller, whose business it is to know. And obviously you don't want to drill through buried natural-gas or power lines. Otherwise, the answer to the question is yes.

**Is a recharge well the only means for disposing of discharge water?** No. If the soil is sandy enough to encourage rapid drainage, you may be able to distribute the discharge water through a lawn-sprinkling system or by some method of crop irrigation.

Water could also be dumped into a stream, river or pond if soil

conditions permit the discharge to sift back down to underground water-carrying strata in a reasonable time.

Certainly, if your heat-pump system were able to draw water from and eject water to a pond, your initial investment would be dramatically reduced to the mere expense of of an electric pump and the necessary piping.

**Is it always necessary to drill 200 to 300 feet for water?** "No," says John Oyer of Friedrich. "Along coastal areas, especially in Florida, Virginia, Maryland and Long Island in New York, homeowners will find good water for heat pump purposes at depths of 20 to 30 feet."

People in these areas pay little to a driller for a well, and some successfully drill their own. Installation and operation of the water-source heat pump is the same as for other areas.

**Can anyone with property eventually save money with a water-source heat pump?** No, not everyone. Remember, this machine delivers comfort all year—heating in winter, cooling in summer.

If you live in a northern state and can survive summer without cooling, or in a southern climate that erases the need for winter heat, there's no way you could justify the cost of a water-source heat pump. You wouldn't want an air-source heat pump, either.

### Feelings run hot and cold

Within the heating and airconditioning industry, there are people going ho over water-source heat

pumps and others either unimpressed or downright negative about their prospects.

As Oyer puts it, "There is a certain amount of inertia built into this business—a hesitancy to jump into something new. What amazes and amuses me is the fact that once people are converted, they react as if they've 'seen the light.'"

Lingering skepticism in the industry might be dispelled by some recent research on ways to improve the idea. One way: integrate heat-pump use with city water suppliers. Water could be piped in, run through the pump and returned to community storage, since the water is in no way contaminated on its way through the heat pump. Or, it might pass through the heat pump before being stored or used inside the house (or apartment).

### One system for several homes

Another idea on the drawing board comes from Argonne Labs. Says engineer James Calm, "At some point, a point different for each community, it becomes more attractive to link several houses, all the apartments in a building or an entire community into a network of ground-water distribution from a common set of wells."

To date, only one practical application of this concept has gotten beyond the planning stages. McCall Brothers of Charlotte, N.C., is using a centralized set of wells to provide ground water for 28 townhouse condominiums. At this writing, the project is stalled because of lack of funding to complete construction of the houses.

And theirs certainly isn't the only ground-water heat project bottled up by financial difficulties. It may be difficult for you to lay out the thousands of dollars it would take to drill the well and install such a heat-pump system.

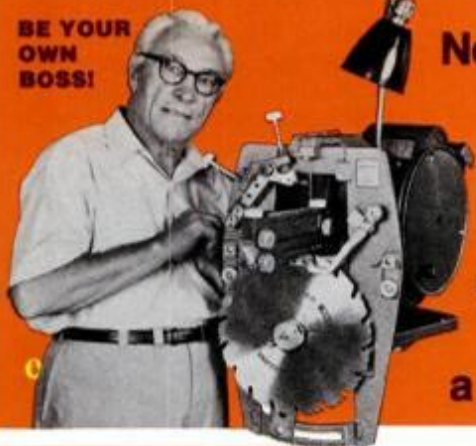
On the other hand, if fuel costs continue to rise, it may soon become difficult not to consider plans to pump some energy from your own back yard. **PM**

### MANUFACTURERS LIST

- Addison Products, Addison, Mich. 49220
  - Carrier Air Conditioning Div., Carrier Corp., Carrier Pkwy., Syracuse, N.Y. 13201
  - Command Aire Corp., Box 7916, Waco, Tex. 76710
  - Friedrich Air Conditioning and Refrigeration Co., Div. of Wylain Inc., Box 1540, San Antonio, Tex. 78295
  - Mammoth Div., Lear Siegler Inc., 941 East 7th St., Holland, Mich. 49423
  - National Geothermal, Box 703, Lawrenceburg, Tenn. 38464
  - Wescorp Inc., 15 Stevens St., Andover, Mass. 01810
  - York Div., Borg-Warner Corp., Box 1592, York, Pa. 17405
- For more information on water-source heat pumps, write to the National Water Well Assn., 500 West Wilson Bridge Rd., Worthington, Ohio 43085. For information on geothermal energy—energy in the Earth's interior—write to the Div. of Geothermal Energy, Resource Applications, U.S. Dept. of Energy, 1200 Pennsylvania Ave. N.W., Washington, D.C. 20461.



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Sturgis, Michigan 49091**



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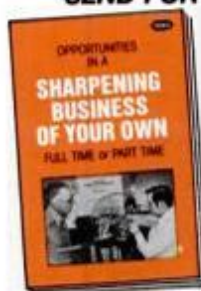
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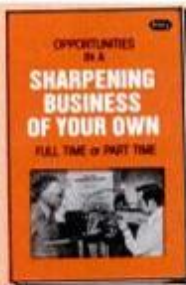
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**STATE** \_\_\_\_\_ **ZIP** \_\_\_\_\_

**AREA CODE** \_\_\_\_\_ **PHONE NO.** \_\_\_\_\_



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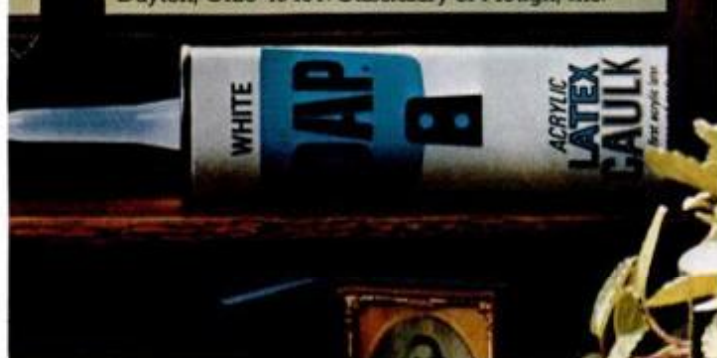
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## TODAY'S TELEPHONES: TOO SMART TO JUST RING

(Continued from page 91)

home decor. They take the incoming voice and step it up through a final speaker so that you have hands-off speaking and listening. They are driven, usually, by the line current, as is the phone circuitry. However, some use extra battery power.

Essentially dynamic microphones, they amplify your voice to the other party, or they cut down on noise and clear up the conversation. The Happy Talker from Roanwell works on this principle. Some are battery-driven, as are communications microphones.

### Remote extensions

Cordless phones are no longer toys; they've come of age. There are two kinds: long-distance and short-range. Both are "duplex" units, allowing the user to talk and hear at the same time.

The short-range unit uses the electrical wiring of your home as its antenna, while the long-range uses a more powerful independent antenna. Both come with self-contained base repeaters, which take phone impulses and retransmit them to a portable handset that looks much like a walkie-talkie.

The long-range unit boasts a potential range of a mile or more (depending on conditions), while the short-range unit will only transmit 300 to 400 feet.

Drawbacks to the long-range unit include possible interference from nearby citizens band sets (they operate on the CB band) and the fact that the Federal Communications Commission (FCC) is legislating them off the market. They can also be noisy. For the short-range unit, the most annoying drawback is the limited range.

All of this technology can be understood if you know how the phone system beyond the dial tone works. Phones are electromechanical instruments that take the numbers that you have dialed, push them through their own circuits, then transmit them over the phone line.

Once at the phone line, the numbers are in the form of either rotary pulses or tone codes. Most of the country still has rotary-pulse phoning, but the phone system is rapidly converting over to tone-coding and computer switching.

Rotary-pulse dialing is an electronic counting system based on the number of rotary impulses for each digit dialed, as determined by contacts inside your phone. The tone-coding system used with computer switching is called Dual-Tone Multi-Frequency (DTMF) dialing. It splits the tone impulses you get off your Touch-Tone into sounds that computers at the central office can recognize.

Most of the telephonic devices offered for sale are still based on the old pulse system.

### Computers aiding mobile phones

Mobile phones, however, are already benefitting from computers with the "low-powered cell block" concept where lots of users can be accommodated. Rather than depending on one powerful signal, the phone company uses many low-powered "cellular transmitters," which are controlled by computers in the car phone and in the switching office. The system offers drastic increases in the number of customers possible for mobile phones.

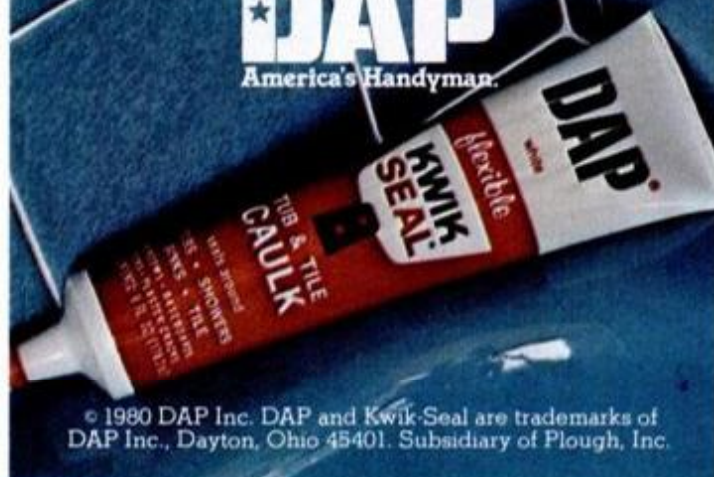
Where you have DTMF, you also have computer switching through microprocessors (mini-computers)

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which offers expanded service. The phone company is now offering computer-controlled services, such as call-waiting and speed-calling. In call-waiting, you get a signal letting you know someone wants to talk while you're talking to another person; you can put the first person on hold and talk with the second. Speed-calling is similar to the automatic dialers we've mentioned. Just push one or two digits for access to frequently called numbers.

Microchips offer even more potential: With them, there's plenty of room in a system (whether dialer, answerer or feature phone) for more memory, and thus more functions.

Compactness even extends into such accessory areas as Rovafone's Call-Tone, a slave phone bell which allows you the freedom of knowing a call is ringing without the expense of extra phones. Or there's Roanwell's Happy Talker, a dynamic microphone that slips over the standard phone mouthpiece, cuts out background noise and improves phone conversations.

Compactness is also evident in the new generation of mini-phones, which are all electronic and solid-state. These include the GTE Flip-Phone or Webcor Zip-Phone.

There's another area which has also been affected by competition with Ma Bell, and that's designer phones. So intense is the competition in the phone market today that Ma Bell has been forced to market a line of Mickey Mouse, Snoopy and other specialty phones.

It all began six years ago when the Federal Communications Commission loosened the fetters on the private telephone industry. The ruling

let people tie into Ma Bell's lines with their own equipment. Now all you do is notify the phone company. This has spurred development of the private phone industry.

What of the future? It's conceivable that phones which are state-of-the-art today will be outmoded next year, or sooner, as more functions are crammed inside them.

At Bell Labs, technicians have increased the density on microchips to 64K (roughly 65,000 bits of information). The new chip is also a microcomputer unto itself. Just imagine what a couple of these could do.

Bell says, "Unlike a microprocessor, which requires additional chips for memory storage, the MAC-4 microcomputer is totally self-contained on a single silicon chip. Along with a central processor, there's enough memory on the chip to store operating instructions for added features such as self-diagnosis when equipment malfunctions . . . Also, the microcomputer can easily be tailored to handle a wide variety of applications in telecommunications."

Boiled down, this says that with these little gems, a phone will be able to do just about anything! **PM**

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- Blechman Enterprises, 7217 Bernadine Ave., Canoga Park, Calif. 91307.  
 Buscom Systems Inc., 4700 Patrick Henry Dr., Santa Clara, Calif. 95050.  
 Cobra Inc., Communications Product Group, Dynascan Corp., 6460 Cortland St., Chicago, Ill. 60635.  
 Electra Co., 300 East County Line Rd., Cumberland, Ind. 46229.  
 Fathcom Inc., 24049 South Frampton Ave., Harbor City, Calif. 90710.  
 Fird Industries, 5001 Southeast Johnson Creek Blvd., Portland, Ore. 97222.  
 GTE-Sylvania (Automatic Electric), 700 Ellicott St., Batavia, N.Y. 14020.  
 Heath Co., Benton Harbor Mich. 49022.  
 Hi-Tek Corp., Consumer Products Div., 12311 Industry, Garden Grove, Calif. 92641.  
 Integrated Circuits Packaging (Superphone), 750 North Mary Ave., Sunnyvale, Calif. 94086 (Attention: Cliff Denchfield).  
 International Telephone and Telegraph, Personal Communications Div., 159 Terminal Ave., Clark, N.J. 07066.  
 JS&A National Sales Group, 1 JS & A Plaza, Northbrook, Ill. 60062.  
 Leisurecraft Products Ltd., 28 South Terminal Dr., Plainview, N.Y. 11803.  
 Panasonic Inc., Consumer Affairs Div., 1 Panasonic Way, Secaucus, N.J. 07094.  
 Radio Shack, Fort Worth, Tex. 76102.  
 Universal Security Instruments Inc., 10324 South Dolfield Rd., Owings Mills, Md. 21117.  
 Note: These are most of the major manufacturers of telephonic equipment. There are others, and you can find their products and addresses at electronics specialty stores.

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In my position as Director of American Entrepreneurs Association, I am informed of thousands of new ways people are making money every year. Many turn out to be hair-brained schemes, others require such a huge investment that they aren't practical for the majority of folks.

But recently, something crossed my desk unlike anything I'd seen before. I didn't know it at the time, but I was about to discover one of the most exciting opportunities ever uncovered for mechanically inclined people who want to use their special skills to make some extra money!

It was fascinating! This fellow had an easy-to-follow method that he was using to make more money in a month than most folks make in six months. I had to hear more.

Immediately I had my secretary contact the man who had sent me the outline of his idea. After all, it's not often I stumble upon something as hot as this. I was anxious to report it to both the readers of my syndicated column "Inside Small Business" as well as all the members of our organization.

He arrived at my office three days later, and I've got to tell you—what he showed me nearly floored me! I later learned that not only had he been completely truthful (we verify all statements), but he understated the potential. It is, in fact, staggering! And the best part is that virtually anyone who is handy with common

everyday household tools can do it!

I reported this to my readers and AEA members. I gave them all the inside details.

Then a wonderful thing started happening. Folks from all over the country began writing me excitedly about this new-found success.

I wish you could see all the letters...

I've made close to \$10,000 the first three months with your new system. Thanks for your advice!

STEVE COHEN, NEW JERSEY

I took your advice. Now (nine months later) I'm independent, I love what I'm doing, and I'm making enough money to buy my own home.

RALPH ALAMA, FLORIDA

Fantastic! I thought retirement was going to be boring. With your new system, I'm really enjoying life. The money is pretty good too. Thanks much.

PETER MARSTON, ILLINOIS

It's so easy to make money this way, I can't believe I never thought of it!

JIM STARNOW, CALIFORNIA

Now I invite you to read about this fascinating fun way to make money in your own workshop. I want you to see for yourself how easy it is to make extra cash with this system. Probably more in a month than most folks make in six months at their regular jobs!

Here's why:

- ★ **You don't need any special skills or training.** That's right. If you are handy with ordinary household tools and are mechanically inclined, you can start profiting from this immediately.
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- ★ **It will help you ENJOY life as well as earn extra money.** This is much more than just a way to make some easy money. You will enrich your life by doing something you genuinely enjoy—unlike the vast majority of working people today.
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I've written a very important booklet describing this new opportunity—and I'd like to send it to you absolutely FREE. No, there's no catch. You risk nothing but the cost of a postage stamp.

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1. Fill in the coupon below and send for my revealing free report today.
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Why am I willing to send you this valuable special report free of charge?

Simple. Because I honestly believe that once you read it, act on the system involved and start to make money with it, you will eagerly buy everything else I write, and perhaps even become a member of our exclusive organization.

I honestly hope you'll take this message seriously. There's no risk. All I ask is that you take a look. Then make your own decision.

So right now, cut out the coupon below, fill it out, and mail it to me today. Please mark the front of your envelope "personal" and I'll be sure your free report is rushed to you by return mail.

Your free copy is waiting for you. Order it now.

Sincerely,



Chase R. Revel

Chase Revel's financial column, "INSIDE SMALL BUSINESS," is syndicated by the giant Los Angeles Times syndicate throughout the U.S. Call your local editor to see if the column appears in your city. In case you haven't heard, Mr. Revel's publications are used extensively at USC and other prominent business schools across the country.

### SEND FOR YOUR FREE REPORT TODAY

Chase Revel, 2311 Pontius Avenue, Suite B-926, Los Angeles, CA 90064

O.K., Chase, prove it to me. Send my free report describing how I can turn my workshop into a great second-income source, and make as much money in a month as most people make in six months. I understand this special report is mine to keep—with no cost or obligation whatsoever.

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Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_



## RECEIVE TV FROM SATELLITES

(Continued from page 113)

vides plans for the antenna for \$30.

One company, U.S. Cable and Electronics, is now selling complete satellite reception stations to homeowners. The bill runs to \$5000 for all equipment, including the 12-foot antenna, LNA and downconverter. Depending on such variables as cable length from antenna to home, they also offer complete installation of the reception station for an additional \$250 to \$500.

We looked in at Ridge Electronics (U.S. Cable's upstate N.Y. retailer) and saw their system. They were getting impressively vivid reception. The lead photo (on page 112) and others in this article were shot on location at one of their customer's homes.

Bob Morley, president of U.S. Cable, hopes to install at least 50 such systems in the next year, but wouldn't be surprised at even more orders. They now have a string of six retailers in the Northeast and expect to continue their growth.

### Electronics for homebuilders

The most popular approach to homebuilding LNAs, microwave receivers and TV channel modulators, with connectors, is through two sets of plans created from the work of Prof. Taylor Howard and Robert Coleman. Both are provided by Satellite Television Technology for \$30 each (\$50 together).

Coleman's manual describes how to convert surplus telephone-company microwave equipment into an Earth station. It's claimed that the prototype installation costs under \$500. It's important to note, however, that supplies of the right surplus equipment are erratic and may be drying up. Circuit boards are available directly from Coleman for the scratch-built LNA described in the manual.

Howard's manual shows how to build all the electronics as simply as possible with easily located new parts. Although a very large project, it's said to be within the reach of persons with "modest" electronic skills for an investment of around \$2000, including a surplus antenna (may be hard to find now).

Two companies, Microcomm and Microwave Associates, are producing complete single-channel receivers for around \$2000, and Microcomm sells receiver subassemblies. Throughout the field, I also found high praise for a company named Satellite Innovations, which supplies plans, subassemblies and parts for some of the electronics and parts

of antennas. Many more sources of ideas and information can be found in *Home-Satellite TV Reception*.

### Fuzzy but fun

Some people are simply inveterate tinkerers. Mike Fletcher, a ham radio operator and telephone-company technician in Maine, did "a lot of reading and calling around" to find out how to capture satellite TV signals. He bought some surplus equipment, including an antenna that he hung on the side of his house, and scratch-built an amplifier (not low noise).

Fletcher's rig couldn't get the sound track, and he described the image as "somewhat discernible . . . not close to watching quality." But he "just wanted to see if I could get any picture at all." The answer came for less than \$100, which must define the bottom line for Earth-station cost.

Now he's upgrading the system using technical magazine articles and more conversations with other enthusiasts, but still isn't spending much. If you know where to look, he says, you can find good parts that are free because they don't meet military specifications, or because they are samples (including special transistors that hold up LNA and receiver costs).

### Legalities and fees

As of October 1979, you no longer needed a federal license for receive-only Earth stations. Some strong controversy continues, however, over the legality and morality of tuning in on communications which are only relayed transmissions from specific suppliers to designated recipients for broadcast over local TV stations or cable systems.

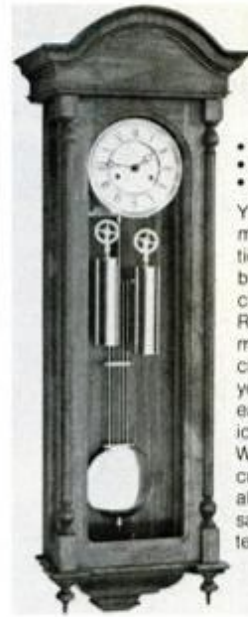
One possibility is to sell listening rights to private earth station owners. Producers of several religious networks, however, are happy to have viewers tune in and so charge nothing. Some commercial networks charge a single lifetime payment, or a fee similar to that for receiving the programming via cable. Others, like Home Box Office, refuse to sell (some say they don't have the rights to sell directly).

I talked with a top executive at a large supplier of complete Earth-station installations (of the \$35,000 variety) who was outraged at "theft" by those who watch programming to which they were not granted access. He said his company would sell only to people who had purchased permission from those who beam the transmissions.

An equally irate private owner

(Please turn to page 164)

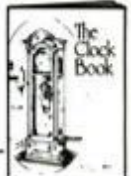
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## RECEIVE TV FROM SATELLITES

(Continued from page 163)

told me that if no cable system comes past his house, and he has no access to a signal which rains on his property, even though he is willing to pay, then he is being discriminated against by virtue of cable's limited distribution. He has no compunctions about tuning in.

There not only appear to be legal grounds for tuning in freely at home (so long as the signals are not retransmitted, copied, sold or made public), but there is also the fact that the government may be prevented anyway from inspecting to see if you *are* tuning in.

### Tuning in a revolution

Reports had it that Radio Shack was working on a "\$1000 Earth station," but they deny it. Equipment prices no doubt will come down some, but not enough to put an Earth station in every home, even if everyone did have obstruction-free back yards with room for large antennas.

What probably *will* come in the not-too-distant future will be more powerful, higher frequency satellites for broadcasting directly to home TVs with 3-foot receiving dishes. Purchase of access to programming might be part of the comparatively low price of mass-marketed receiving stations. But uses for such satellites would go beyond conventional programming to include two-way conferences for government, education or business and communication between hospitals and rescue units.

Obviously, there's a satellite television revolution underway. Amateur Earth-station owners not only have a front-row seat, but also are among the instigators. **PM**

### Where to obtain further information

Antenna Development and Manufacturing, Box 1178, Poplar Bluff, Mo. 63901  
Bob Cooper, Satellite TV Technology, Box G, Arcadia, Okla. 73007  
Kintech, 1080 Ticonderoga Dr., Sunnyvale, Calif. 94067  
Microcomm, 14908 Sandy Lane, San Jose, Calif. 95124  
Microwave Associates, 63 Third Ave., Burlington, Mass. 01803  
Sat Guide (monthly satellite TV program listings, \$28/year), Box 1569, Hailey, Ind. 83333  
Satellite Innovations, Box 5673, Winston-Salem, N.C. 27103  
Satellite Television Technology, Box 2476, Napa, Calif. 94558  
U.S. Cable and Electronics, 1548 Ridge Rd. W., Rochester, N.Y. 14615  
John Van Laar, Satellite TV, Box 140, R.D. 3, Oxford, N.Y. 13830

**Note:** Please send a stamped, self-addressed, business-size envelope when requesting information. Many of these businesses don't list phone numbers due to the potential volume of inquiring calls.



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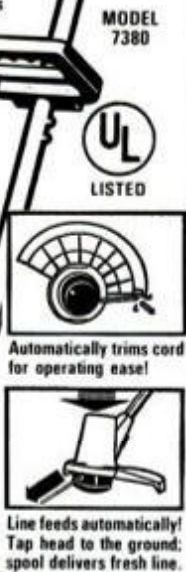
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## BUILD THE ART DESK

(Continued from page 99)

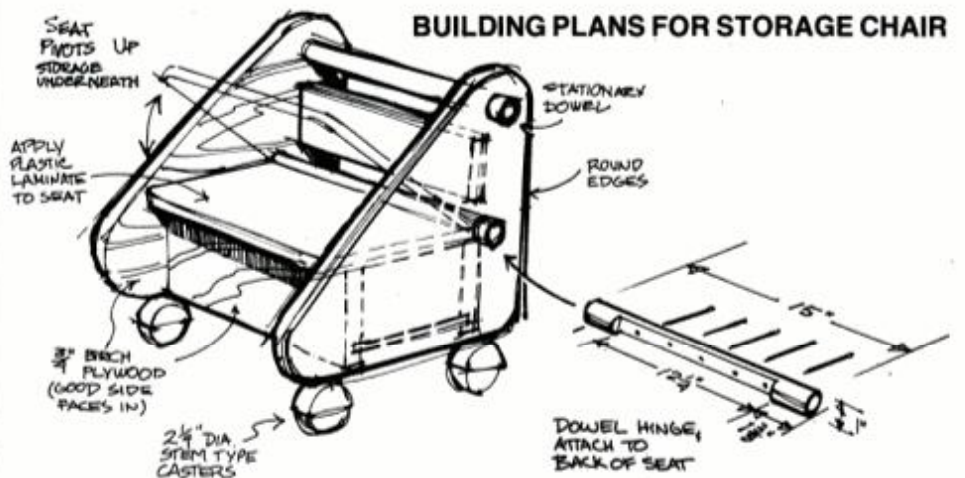
lot of sense since these two areas are subject to the most abuse. The plastic can also be used on the exposed sides of the desk and chair if desired.

To apply, cut each piece of 1/16-in.-thick laminate ¼ in. larger in length and width than the surface to which it will be bonded. Spread an even layer of contact cement over the surfaces to be mated. Allow the contact cement to dry until the adhesive doesn't lift when touched with brown paper.

Next, place clean dowels, or ¾ x ¾-in. pine sticks, about 12 in. apart on

certain that the room is well ventilated and that there are no open flames, cigarets or the like in the room. Also, avoid applying too much lacquer thinner at any glue line because the solvent can cause delamination.

*Note:* Before starting any laminating project, take the time to carefully read the manufacturer's instructions for using contact cement. It is imperative that you follow maker's recommendations. If you opt for one of the water-base cements, make certain you apply it correctly. This type is worked some-



the plywood surface. Carefully lower the laminate onto the spacer sticks, being careful to avoid contact between the two glued surfaces. Start at one of the corners. Align the corner so that there is approximately 1/8-in. overhang on both sides, make a final check of the other two sides—to make certain that the laminate and board are in alignment on all four sides—and withdraw the end spacer, making contact at the corner as you do.

Press the laminate into contact and immediately work your way across the board, pulling stick-spacers and pressing laminate into contact with plywood as you go. As soon as all sticks are removed, apply a good amount of pressure to the entire bonded surface. Use either a wooden roller (i.e., rolling pin) or a clean block of wood and a hammer to provide the clamping pressure. Start applying pressure to the bonded surface at the center and work toward the edges.

Cleanup can take place right after bonding. If you used the flammable type of contact cement, cleanup is with lacquer thinner and rags. Because of high flammability, make

what differently than the flammable type.

Finally, trim all overhanging laminate, using a straight carbide cutter in your router. Next, since all edges should be slightly rounded—including the thin laminate—use a small-radius rounding-over bit in the router; set it to remove a scant amount and slightly round the edges.

### Finishing the project

If you build this furniture with the idea of all paint and no plastic laminates, you should tone down the grain before applying the prime coat of paint. (Fir has a wild grain that tends to show through most paints.) To minimize the grain, after sanding the raw wood, dust and wipe with a tack cloth.

Next, you apply a coat of a grain tamer, such as Firzite, following the instructions on the can. Then proceed with the prime- and finish-coat painting steps.

If you can't buy Firzite locally, seal and prime with one of the pigmented shellacs such as Bin or Enamelac. Two coats are recommended. **PM**





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Koolatron now has tens of thousands of electronic fridges in use worldwide using these powerful solid state modules. Built to take it, 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.

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(in Canada \$199; \$109.00)



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. Tough, 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 (11 qts.) weighs 10 lbs. empty. Operates from supplied 12 volt power cord in vehicles or with optional 12VDC/110 VAC power adaptor.

As a travel fridge the P10 keeps foods and beverages fresh and cold wherever you go. Carry insulin, medical samples, dietetic foods. Great for private planes and golf carts. Photographers use it for films. Mothers...now you can refrigerate baby's formula in your car then heat with the flick of a switch. Powerboaters, just plug it into your boat's cigarette lighter to keep a day's food and drink ice cold without going ashore for ice. With your engine off, you can operate for up to several hours and still start your engine to recharge your battery. "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. Great in motels for travelling.

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The P34 is our standard portable refrigerator. This new, improved model has a non-adjustable solid-state thermostat which keeps your food at normal refrigeration temperature even in 95° weather. It holds more than three times as much as the P10. Fits into any boat, van, camper or car back seat. Plugs into car lighter receptacle, refrigerates over 40 lbs. of food (no space wasted by ice) yet it draws no more power than the P10.

#### MODEL P34A DELUXE RECREATIONAL FRIDGE AND FOOD WARMER

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The same size, colour, weight and capacity as the P34 but includes food warming features (up to 125°F), fully adjustable temperature control (you can even dial wine cooling temps.) and low battery warning indicator tells you when to recharge. Refrigerates in air temperatures up to 95°F. Or keeps hot foods hot at the flick of a switch...great for fall hunting, camping, boating and winter ice fishing, skiing and snowmobiling.

The P34A is our top of the line portable. It heats, it refrigerates and with specially designed electronic circuit control (patent pending) it allows you to dial a complete range of temperatures from very cold to very warm. Refrigerates weekend supplies for boating, camping, hunting and fishing. Then bring your fish or game home refrigerated. 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.

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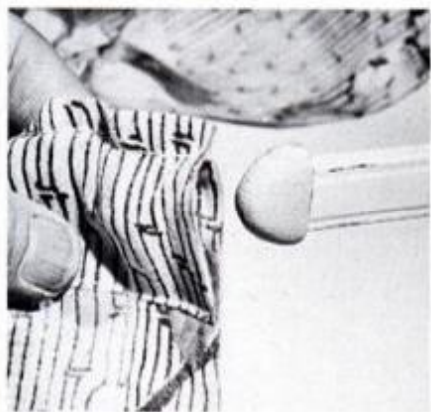


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**Whittle a curtain-rod leader**



Carve curtain-rod leaders of soft wood.



Leader prevents curtain snags on rod.

You can quickly carve a curtain-rod leader from soft pine (as shown in top photo) to prevent snags and tears when pushing a rod through. Carve the leader's stem so that it fits the rod snugly, yet removes easily when desired.—*Walter Fehlberg*

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Can't find your small adjustable wrench in a hurry? You can use a nutcracker for small nuts.

—*Ken Patterson*



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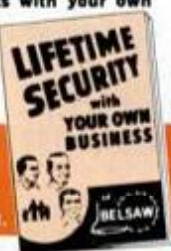
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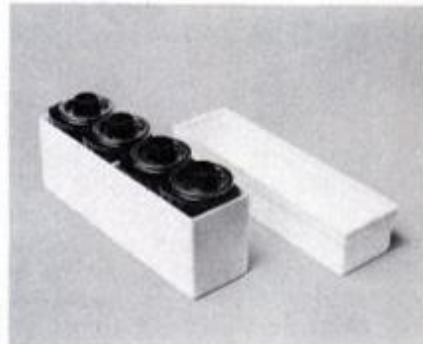
# PHOTO HINTS

## Print comparator



Prints that look okay under a safelight may look awful in room light. A properly exposed print mounted on darkroom wall can be used for comparison with safelight on.—*Robert Hertzberg*

## Film box



If your film lab returns your slides in top-opening containers, you can use the boxes as space-efficient film carriers. When putting a used roll in the container, turn it upside down to show it's exposed.—*Jim Colburn*

## Slip tip



Silicone sealer on the underside of a camera strap will keep it from slipping off your shoulder. Don't smooth out after application; the rough surface enhances friction.—*Frank H. Day*



of the engine. You must drop a plastic shield underneath to get to the water pump, but even that location is substantially better than almost anything else around. Once you have the shield off, the pump (and the idler-pulley adjuster) are open for service. The use of plastic for the shield is a happy contrast to some European cars' metal shields, which dent and go out of shape so easily.

The radiator fan is an electric unit, as you would expect with the transverse engine. Unlike most others, there are quick-disconnect plugs close to the fan (as on Omni/Horizon). So it's simple to electrically test the fan without referring to wiring diagrams.

The fan on airconditioning-equipped cars is not the same as that on standard ones (as on Omni/Horizon). It's a heavier-duty unit wired through a relay to a thermostatic switch in the radiator. Non-airconditioned models are triggered solely by the radiator switch.

The fan relay, starter relay and voltage regulator are conveniently mounted on the driver's side suspension strut well. The antidieseling relay is also mounted on the strut well. This relay contains a timer, and when the driver turns the ignition key to off, the relay closes and the timer turns on for eight seconds, activating the air compressor. This loads the engine, stalling it to prevent afterrun.

The relay has two sets of contacts and it also serves to complete the compressor clutch circuit during regular operation. If your airconditioning doesn't go on and/or the engine runs on, a defective relay could be the reason.

If Reliant and Aries have a service horror, it would seem to be an adjunct to the cooling system—the heater core. It sits in the duct housing under the dash, a traditional Chrysler design. This means that to change a leaking or plugged core, you must drop the housing. On cars with airconditioning, however, the evaporator core also is in that housing so you must discharge the air-conditioner first. This contrasts with GM's X-body, in which you remove an accessible panel under the dash to get to the heater core. Fortunately, heater-core replacement is usually needed only once every six years or so.

More common replacement items such as the oil filter are generally much easier to reach than on the competition. On the four-cylinder GM X-body, for example, you've got to work in tight quarters on the fire-

wall side of the engine to get to the oil filter. On Reliant and Aries, it's on the front side and you can reach it from the top of the engine compartment.

The fuel pump is another easy one. You've got to get it from underneath, but it's on the front side and very accessible.

The intake and exhaust manifolds are on the firewall side, but they present no service problems. The exhaust is underneath in tighter quarters, but it doesn't use a gasket. In fact, the only gaskets on the engine are on the intake manifold and cylinder head, just like the X-body V6. All other gasket surfaces are sealed primarily with room-temperature-vulcanizing (RTV) silicone.

If you ever have the valve cover off for gasket repair, however, you probably won't have anything else to do. The valve train has hydraulic "lash adjusters," which do a job similar to hydraulic lifters.

As in the GM X-body, you don't have to worry about clutch adjustments on the manual-transmission Reliant and Aries. A ratcheting device does the clutch adjustment automatically.

### Ignition service

Ignition service is a strong point on Reliant and Aries. All the sparkplugs are on the front side of the engine and they're very easy to get to. Ditto for the sparkplug wires, and that's not a small consideration. On at least one small car I can think of, the easiest way to change plug wires is to lift the airconditioning compressor out of the way. On others, you have to snake the wires through a series of bends in extremely tight quarters.

Chrysler makes it easy because the distributor is on the front side of the engine, just under the upper radiator hose. You can easily reach it for anything from plug-wire changes to replacing a cap or the electronic-ignition components inside.

One thing you don't have to reach it for is to loosen the distributor lock for a timing adjustment. The distributor is just bolted down and any timing changes are the responsibility of the computer, which is next to the battery on the driver's side. If timing is wrong, the problem is in the electronic system.

The ignition coil is on the passenger's side, bolted to the inner fender in a wide-open area. This location not only is good for coil removal, but great for connecting a tachometer

(Please turn to page 172)

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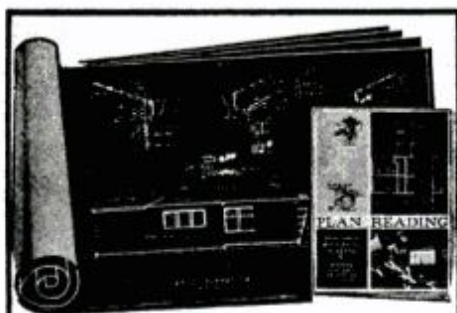
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## PM LOOKS UNDER K-CAR HOODS

(Continued from page 171)

or other instrumentation. You can adjust idle speed on this car manually, unlike most other 1981 models, which will have it controlled by the computer. The adjuster is on a throttle solenoid just like on the Omni/ Horizon, which uses a similar Holley carburetor.

Although Chrysler hasn't got on-board diagnostics yet, you'll be able to check out the digital computer system without special equipment. In fact, Chrysler reportedly is dropping the \$400 computer tester it has been marketing and will be providing manual test procedures.

Manual testing is feasible because the Chrysler computer just runs spark timing and fuel mixture, not exhaust gas recirculation, air pump, fuel vapor control and idle speed. Just blip the throttle and check timing with a timing light (the marks are conveniently located at the fly-wheel end of the engine).

To check fuel-mixture control, you insulate the throttle switch from the linkage with a piece of cardboard, then remove the wire from the oxygen sensor threaded into the exhaust manifold. You should see an

engine-speed change (usually an increase) on a tach. The test must be made with the engine warm and running, so it's best to trace the wire from the sensor up to the computer and make the disconnect at the black box. If idle speed changes, go ahead with a tune-up. If there's no change in rpm, there's a problem in the computer or the carb's mixture-control solenoid.

The air pump is controlled by engine vacuum through a thermostatic vacuum switch in the coolant thermostat housing. With the engine cold, the switch passes vacuum to an air switching valve attached to the pump, and pressurized air goes to the exhaust manifold. When the engine is warm, the vacuum switch closes and a spring moves the switching valve to direct air to a point in the exhaust beyond the three-way catalyst. To check out this system, disconnect the vacuum hose from the switching valve at cold idle and you should feel vacuum. Recheck when the engine is warm and there should be no vacuum.

If there is a failure on either test, the problem is in the thermostatic vacuum switch. Also squeeze the hoses to feel for pressurized air. If

the air is flowing through the wrong hose, the switching valve is defective.

The optional engine on this car is the 2.6-liter Japanese four-cylinder used on the Dodge Colt and other Chrysler imports. It has no computer or three-way catalyst and uses the air aspirator valve instead of the air-pump system.

The Reliant and Aries brake system should be more reliable than the one that's been used on larger Chrysler products. It's a floating type with rods instead of a slider on machined ways (guides). Like Ford, Chrysler is getting away from the machined ways, which work well when they're right, but tend to rust up and stick.

The Reliant/Aries dashboard is one of the best in the business for service accessibility. You can get to everything from the driver's seat with simple tools, including dashboard gauges, heater and airconditioning controls, switches and the radio. The only hang-up to radio removal is that it may be held by Eaton theft-resistant screws, which have an unusual head that requires a special socket bit. The screws are a plant option so they may not be used in all cars.



## PM'S CUSTOMIZED PONTIAC

(Continued from page 97)

can indulge without a guilty conscience.

The system we picked for our project car is Panasonic's exotic RM-600 Cockpit. The unique thing about this unit is that it mounts to the headliner. It also has enough buttons, switches and lights to confuse a 747 airline pilot. It has to be one of the slickest pieces of car audio equipment ever to come down the pike. It's also *loud!* It belts out a deafening 60 watts per channel of undistorted sound.

Installing the Cockpit is an all-day affair which requires you to remove the dome light and cut the headliner. Although it's a tricky task, the installation kit comes with enough bracketry and related bits and pieces so it can be installed on just about any American-built car. But any amount of work is worth it, because the product is a knockout.

### Lights, wheels and ears

To give the Phoenix some long-range visibility, we bolted on a pair of driving lights. The units we picked came from Ushio of North America. These flamethrowers almost double the range of the stock headlights, something that made driving at night as much fun as driving during the day.

For good looks and to reduce the unsprung weight of the suspension, we bolted on a set of Superior road wheels. These wheels are new on the market, specially made to fit on the GMX-cars. The X-cars have a five-lug bolt pattern that's different from any other American-built car, although it's similar to some European cars.

The CB was installed along with a police-band scanner for the same reason as the auxiliary lights—safety. Now that the CB craze has passed its zenith, the modulating loonies have pretty much abandoned the airwaves in search of other entertainment. The channels are once again clear for their original purpose—keeping drivers informed about road conditions and emergency situations.

The police scanner was an experiment, and we're not yet sure if it's a success. Our intention was to see if we could get some early warning on dangerous highway situations. Unfortunately the police don't speak English; they speak numbers. So if you don't know what all the code numbers mean it's confusing.

Both units are mid-priced Radio Shack equipment and we installed

(Please turn to page 174)

Photomicrographs of the three major types of fungus that cause athlete's foot.

1. *T. mentagrophytes*

2. *E. floccosum*

3. *T. rubrum*

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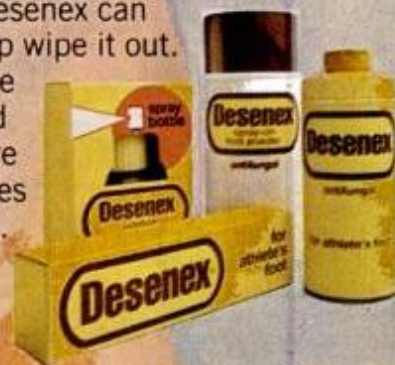
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## PM'S CUSTOMIZED PONTIAC

(Continued from page 173)

them stacked one on the other. This required making up a custom bracket with spacers, since the CB and the scanner are different widths. The spacers are nothing more than long bolts with a couple of nuts to provide the needed clearance.

## Durability, security and flash

To lengthen the life of things under the hood, we retrofitted all the stock belts and hoses with Gates heavy-duty items. We also replaced the stock plug cables with Accel cables. The Gates and Accel pieces were installed not so much to increase performance, but rather for an extra measure of durability.

And, to keep all the goodies from disappearing, we installed an Anes keyless alarm system.

The Anes system has a motion detector feature which sets off the alarm whenever the vehicle is rocked, whether by someone trying to break in or someone just sitting on the hood.

To give the whole package a really custom look we had Glen Designs do a lettering and pinstriping job on the sides.

The tools of Glen's trade are the hand-lettering brush, the airbrush and the pinstriping brush, also called a dagger because the bristles are shaped like a knife.

Pinstripes are painted by laying out the line first with masking tape. The tape isn't used as a mask, but just as a guide for the hand. The stripes are actually done freehand. The trick is to keep the width of the stripe even along its entire length.

The lettering is first done freehand on a large sheet of paper. Then a toothed roller punctures tiny holes on the outline of each letter. The sheet of paper is then taped to the spot on the body you want the lettering, and talcum powder is spread over the paper. When the paper is removed, the body panel will have the outline of each letter in talcum powder. You then trace the powder outline with paint and fill in the body of the letters.

With the paint job completed, the car looked about as subtle as a Kenworth. But that was our intention. We're happy with the way the Phoenix turned out and don't mind advertising it. We think we've turned a good, interesting car into an exciting, durable and safe highway cruiser. And, in the thousands of miles we've driven it, we're averaging about 29 mpg. Not bad for a car that provides the kind of driving fun we thought we had to give up. **PM**



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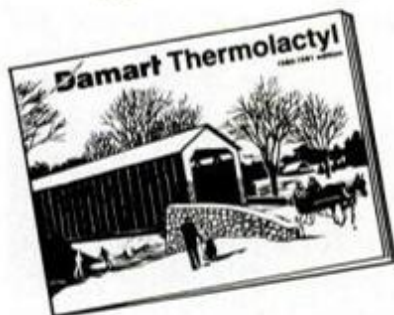
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## DRIVING THE NEW AMC EAGLES *(Continued from page 81)*



On or off the road, the Kammback provides tremendous traction and easy handling. The well-laid-out interior has a tachometer and a complete instrument package.



built 151-cu.-in. (2.5-liter) four-cylinder engine. This is standard across the entire Eagle line (except in California where it won't be available), as is the four-speed manual transmission with floor-mounted shifter. The 258-cu.-in. (4.23-liter) in-line, six-cylinder engine, standard last year, is now an option. It has been lightened 90 pounds, thanks to numerous engineering refinements, and now weighs just 445 pounds.

The Chrysler-built Torqueflite automatic transmission, formerly standard, is now also an option, but is not available on the four-cylinder, larger-sized Eagle.

EPA mileage figures were not available at press time, but an AMC spokesman estimated 17 mpg for the six-cylinder engine with automatic transmission and over 20 mpg for the Four with manual gearbox.

### Backroad bash

American Motors held their introduction of the SX/4 and Kammback Eagles at their test facilities on the grounds of Michigan International Speedway. We arrived after a heavy downpour had turned the test site into a muddy bog.

We climbed into a four-cylinder, four-speed Kammback and proceeded to plow through the muck. The four-cylinder engine, which produces just 90 hp at 4400 rpm and 128 foot-pounds of torque at 2400 rpm, had its share of troubles powering the heavy 3020-pound Kammback through the thick mud and heavy sand on the course. Fortunately, the four-wheel-drive power train prevented the car from getting stuck, but it did stall several times when the engine bogged down on tight S-turns. Slipping the clutch helped somewhat, but soon caused it to overheat.

Back on paved road, we managed to clock a 0-to-55-mph run in 18.1 seconds, not bad considering the friction losses of the 4x4 drive train.

The 151-cu.-in. engine produced little power below 3000 rpm, and refused to rev much past its 4400 power peak. While cruising, engine noise was relatively unobtrusive, despite the low 3.54 final-drive ratio.

The four-speed manual transmission was easy to shift, the gate having a precise, although notchy feel; the clutch was slightly on the heavy side.

Off-road handling on the four-cylinder car, which is 115 pounds lighter than its six-cylinder counterpart, remained stable under all conditions, even on slick, muddy switchbacks. The only problems were encountered when the standard P195/75R15 glass-belted radials (which have narrow tread grooves) filled up with muck. The Kammback would then plow off course when forced to take hairpin turns at speeds over 10 mph. But recovery was almost instantaneous once the car was slowed down.

Perhaps the most impressive aspect of the car was its ability to go over severe dips and harsh ruts without the suspension "bottoming out." All Eagles have stiffer springs and shocks than do stock Spirits and Concordes, and suspension travel is generous: 6.2 inches front and 9.4 inches rear.

These changes give the Eagles a taut, well-controlled ride and a seeming immunity to bad roads. However, it must be stressed that

*(Please turn to page 180)*





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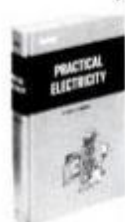
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## DRIVING THE AMC EAGLES

*(Continued from page 178)*

these are primarily all-weather on-road vehicles, not designed to take the punishment that other 4wd vehicles (Jeeps and Scouts, for example) are able to. In return for this restriction, the Eagle owner gets a vehicle that is much more comfortable and luxurious than any true off-roader.

### Surprising Six

The six-cylinder SX/4 hatchback felt like a totally different automobile. The Six, which produces 210 foot-pounds of torque at just 1800 rpm and 114 hp at 3200, transforms the little Eagle into a truly responsive car—especially when the going gets rough.

The engine's hefty torque output, combined with the pulling power of 4wd, enabled this four-speed SX/4 to climb steep, mud-slick hills almost effortlessly. On the S-curves, deep mud and sand were passed over with incredible ease. The SX/4's optional P215/65R15 Goodyear Eagle GT radials, on handsome 15-inch alloy wheels, had a more aggressive tread pattern than the standard tires, so the problem of plowing on slick turns was much less evident.

The six-cylinder prototypes did have a few drawbacks, however. One was a tendency for the engine to stall once the car was brought to a stop after a hard run. And the additional 115 pounds of weight over the front end caused the six-cylinder cars to be slightly more susceptible to bottoming over severe dips than their less powerful counterparts.

Back on the test track, we had a chance to test two six-cylinder Eagles for acceleration: the SX/4 four-speed and a Kamback with the automatic three-speed gearbox. On the four-speed, 0 to 55 mph took a reasonable 13.6 seconds, while the same run was 15.9 with the automatic. It should be noted that the automatic, while usually smooth in operation, shifted rather abruptly at 4000 rpm during the acceleration test. Once the six-cylinder cars had reached 55 mph, their tall 2.73 final-drive ratios enabled them to cruise at a leisurely 2300 rpm.

The test track was the best place to see how the Eagles would handle in everyday driving. Power steering and brakes are standard on all models, and both systems contribute to driving ease without taking too much road feel away from the driver.

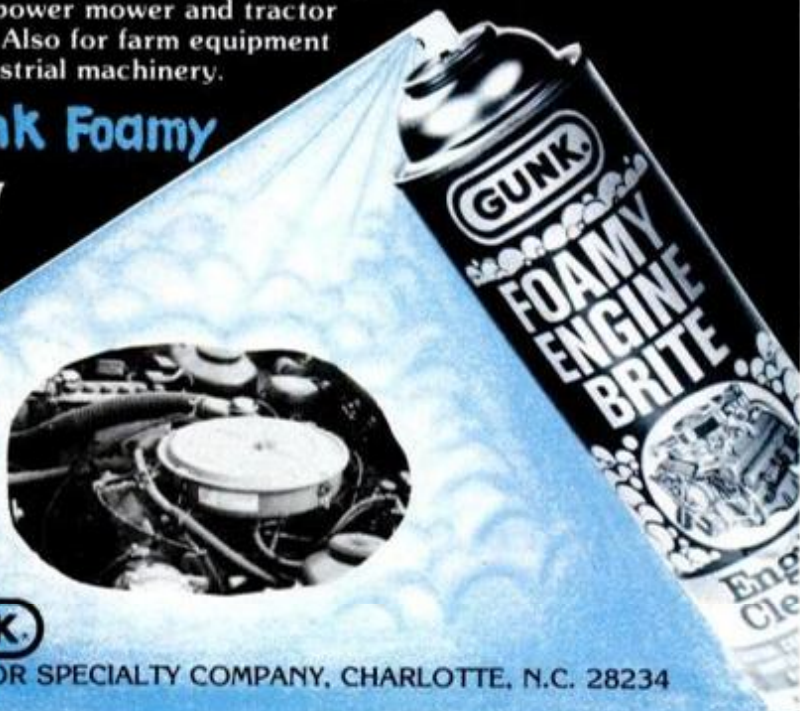
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*(Please turn to page 182)*

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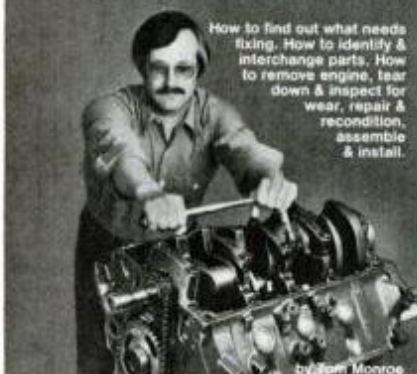
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**DRIVING THE AMC EAGLES**

*(Continued from page 180)*

turns lock-to-lock, and reasonably precise, with a minimum of on-center free play.

When pushed hard through turns on the paved test track, the SX/4 with the optional wide tires began to understeer—first moderately, and then considerably—but the car was never difficult to keep under control. Oversteer can crop up suddenly on a rear-wheel-drive vehicle, causing a loss of control, but it was almost impossible to induce on the Eagles (except on muddy surfaces, where it was sometimes evident if the cars were accelerated too quickly), again owing to the superior stability of their 4wd systems. In general, the cars are safe and easy to drive quickly.

**Comfortable to drive**

The SX/4 and Kamback are virtually identical to the larger Eagles in front-seat legroom: 40.1 inches. The test cars all had bucket seats, standard on SX/4 and Kamback. They are wide, firmly padded and comfortable, with excellent leg support. Back support is aided by a reclining mechanism—rare on an American car—but its fixed stops are too coarse for optimum adjustment.

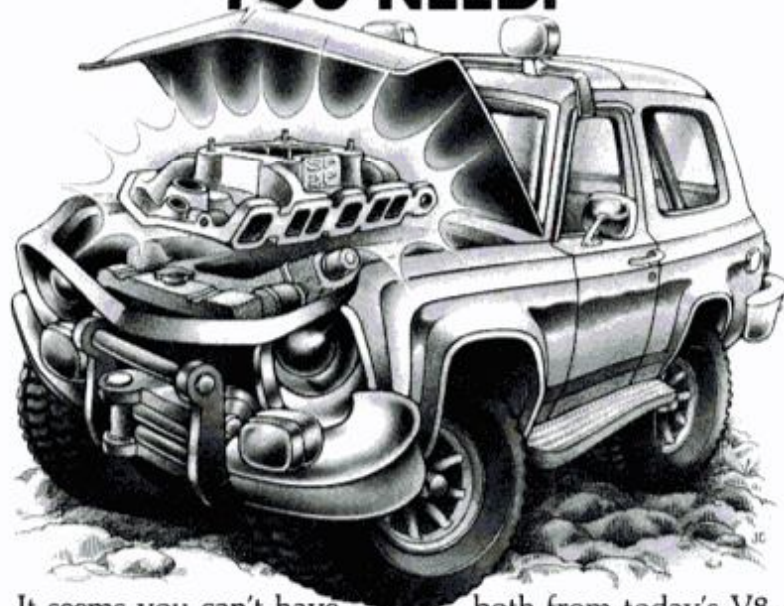
Visibility out the front is good, and the relationship of controls to driver can be aided by the optional tilt steering wheel. The wheel itself is too close to the driver, especially if the backrest of the seat is in an upright position.

While the SX/4 and Kamback do enjoy certain advantages over the larger Eagles, the most obvious being less weight (about 250 pounds lighter) and easier maneuverability, they do have some notable drawbacks. The most annoying is a severe lack of rear-seat legroom, making these cars practical only if you consider them as two-plus-twos. In that guise, with their split rear seats folded flat, they have reasonably good cargo capacity (25 cu. ft. for the SX/4, 28.7 for the Kamback). Even then, the spare must sit directly on the load floor. Finally, since the SX/4 and Kamback must ride on a much shorter wheelbase than do the larger Eagles, they tend to pitch more on very bumpy roads.

Despite these problems, the new SX/4 and Kamback are sure to be a success in dealer showrooms this fall. They are handsome, versatile cars that can take two people and plenty of luggage almost anywhere in style and comfort. With the four-

*(Please turn to page 184)*

**THIS SIMPLE REPLACEMENT GIVES YOUR V8 THE FUEL ECONOMY & PERFORMANCE YOU NEED.**



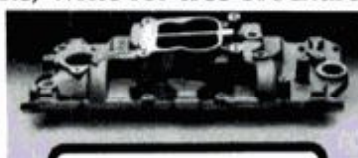
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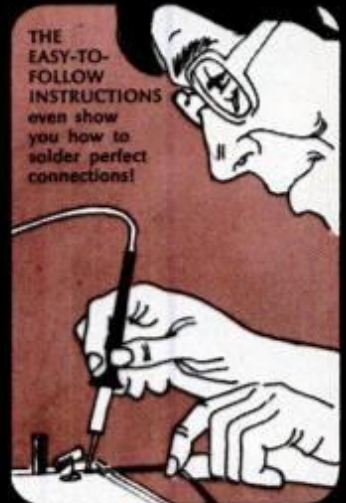
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**DRIVING THE AMC EAGLES**

*(Continued from page 182)*

cylinder engine, they should get better highway mpg than any other American-made 4wd vehicle. Furthermore, they're ruggedly constructed and fun to drive. What more could you ask for in a car?

—Moss Miller

**Driving the Renault 18i**

The best thing to happen to American Motors since Jeep is its partnership with Renault of France. The happy affiliation already has put fuel-efficient, front-drive Renault LeCars in AMC showrooms and will result in turbocharged and diesel-engine cars in the near future.

For this year, we have the United States introduction of Renault's best car yet, the 18i, in handsome four-door notchback sedan and five-door station-wagon variations. We arranged to drive both versions of the European 18 during a recent visit to Renault in France, and shortly after returning to Detroit managed a short drive and photo session with a pair of U.S. specification cars. Complete and final details had not been released at press time, but we've included some basic information on this important new model.

Like all Renaults since 1971, the 18i features space-saving front-wheel drive. It's powered by a thrifty, fuel-injected, four-cylinder engine of just over 1.6 liters coupled to a standard four-speed manual transmission. Both five-speed overdrive manual and three-speed automatic gearboxes are optional on the Deluxe model. Steering is precise rack-and-pinion and brakes are disc front, drum rear with a standard power assist. Front suspension is "double-wishbone" and a "rigid" axle supports the rear, with coil springs and a sway bar at both ends.

Besides the required shock-absorbing bumpers front and rear, reworked suspension to better suit American tastes and conditions, smog-controlled engine and larger, four-lug wheels, the major difference between U.S.-market 18s and their European counterparts is a much upgraded interior.

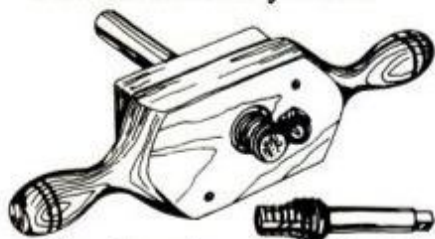
The instrument panel and controls (adapted from Renault's lovely, 18-based Fuego sport coupe, due for U.S. importation next spring) are as attractive to look at as they are functional to use. Large, easy-to-read dials (speedometer, fuel and temperature gauges in the base car, plus a tachometer and a unique oil-level gauge in Deluxe models) are

*(Please turn to page 186)*



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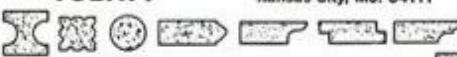
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Robert Sawyer - Roseburg, Oregon

"This machine pays for itself making money out of scrap boards. It is a very well built machine and I confess it is more than I really expected for the price. It does everything you say it will."

Stephen Schultz - Orangeville, Penna.

"I bought a batch of walnut in the rough, and after planing it on the Belsaw I figured I saved enough money to pay for two-thirds the cost of the Planer. It really does a good job."

R. S. Clark - Springfield, Ohio

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W. W. Robinson - Flat Rock, Illinois

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Jay Hedden, Editor  
Workbench Magazine

## DRIVING THE AMC EAGLES

(Continued from page 184)

deeply recessed and hooded to prevent reflections.

Three steering column stalks handle lights, wiper/washer, turn signals and the optional cruise control, while there are pushbutton auxiliary switches located on both sides of the gauge cluster. Radio and heater/ac controls are in a central panel.

There's a fairly large, bin-type glovebox and a flat dash-top parcel shelf (divided into two sections) on the right side, as well as a small bin above the central ash tray and (in Deluxe versions) two large door pockets for storage.

### Plush and practical

Standard on the base model (which should be priced to compete with Audi's 4000 and others in that range) are fully reclining seats, intermittent wipers, quartz clock and power-assisted brakes. The plusher Deluxe versions also include an electric rear-window defogger, styled wheel covers, extra sound insulation and a choice of cloth or vinyl upholstery.

Major options are stereo radio (with or without cassette tape player), pop-up sunroof, silver and black two-tone paint and/or a very-fancy-indeed touring package. The touring package comes with power steering, five-speed manual or automatic transmission, airconditioning, tinted glass, larger tires on sharp-looking aluminum wheels, power door locks and windows (front only), and a rear window washer/wiper on the wagon. The two-tone gets a special gray cloth to match, while the touring package has beautiful leather upholstery and superspecial "bio-formed" front buckets that are among the best seats we've seen.

Finally, the 18i drives as well as it looks. It's no speedster (about 14 seconds 0 to 60 with the automatic transmission and two aboard), but the little 1.6-liter engine is more than adequate for both city and highway driving. We won't have EPA numbers until later, but we expect ratings of 25 mpg or better city and 35 to 40 highway, depending on the power train and option load.

Like most French cars, the 18i combines a comfortably soft ride with excellent maneuverability and handling agility, whether in the suicidal traffic of Paris or the streets and freeways of Detroit. AMC/Renault dealers should have no trouble selling the 18i in the planned 80,000 amount in the United States in '81, and plenty more in years to come.

-Gary Witzenburg



# What Makes the Shopsmith MARK V a Better Buy for a Serious Craftsman than a Whole Workshop Full of Costly Single Purpose Tools?

Here are seven reasons that make the MARK V a better buy:

**REASON 1.** With the MARK V you can have the complete home shop to do accurate woodworking for considerably less than you would expect to pay for comparable single purpose tools. That's because it gives you the five most needed woodworking tools—a 10" table saw, a 16½" vertical drill press, a horizontal boring machine, a 34" lathe and a 12" disc sander—all in one compact unit.

**REASON 2.** You can do more with the MARK V than you can with single purpose tools. It lets you "share" features of one tool to enhance the capabilities of another. Because of this advantage, you can perform jobs with precision that's just not possible with individual tools.

**REASON 3.** The MARK V takes up far less room than individual tools. In fact, it takes up less space than a bike (2'x 6'). So you can have a lot of shop even if you don't have a lot of space.

**REASON 4.** The precision's built right into the MARK V. The control is built into your unit. So you make fewer mistakes. . . waste less materials. . . have more successful projects in less time.

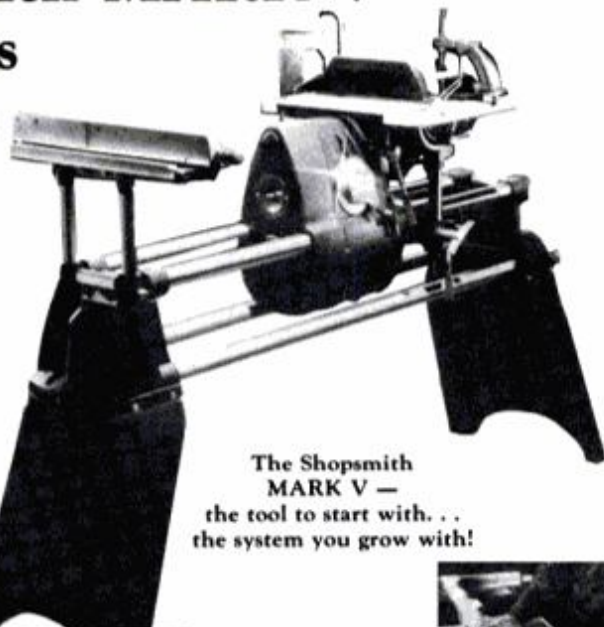
**REASON 5.** Your MARK V workshop grows with you. As you learn more skills and develop more needs, you can add other Shopsmith tools and accessories to your system. . . and they all run off your MARK V motor. So they cost less than buying individual tools.



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**REASON 6.** The Shopsmith MARK V is easy to learn and convert. It comes with home study manual and text that makes it simple to use. . . even for a beginner. And after only an hour's practice you'll be able to change from function to function in only 30 to 90 seconds.

**REASON 7.** Over 350,000 MARK V's have been purchased since the machine was introduced. . . and nearly all are still in operation today.

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engineered."—California civil engineer.

On the flip side, here are a number of representative negative comments.

"Due to the placement of the Rabbit's air intake vents, fumes come into the passenger compartment from passing cars. I wish they'd put in wind wings. [Ventipanes are now standard in Rabbit "L" models and optional in the "C."] Also, the passive shoulder harness is too snug across my chest, and it rasps against my wife's neck."—Washington construction inspector.

"The AM/FM radio that comes with the Rabbit as standard equipment is awful!"—California professor.

"Too many plastic parts, especially in areas like around the radiator and on the interior."—Alabama anesthetist.

"I live in a very rainy area, and when I open the driver's door to get in, water drips all over the seat where I'm about to sit."—California sociologist.

When we asked for suggested improvements, most Rabbit owners said, "Leave it alone." A few, though, did have recommendations.

An Oregon real estate agent wasn't alone when he urged that "... power steering ought to be an option. The car very much needs it." And a dentist from

the same state grumbled, "Some options come only as parts of packages. To get one option I wanted, I had to buy several others I didn't." He wasn't more specific, but the package ploy is common with many cars, not just VW.



Even tall passengers find ample legroom and headroom in Rabbit's rear section.

An Indiana printer recommended, "All switches should be underlighted so they're easier to find in the dark."

Several respondents urged larger fuel tanks, more comfortable front seats, ventipanes and better-quality materials.

However, praises outweighed all sorts of dissatisfactions, and more owners of 1980 Rabbits said they'd buy VWs again than did those queried back in 1975. In our earlier report, only 78.6 percent told us they'd go for another Rabbit next time; this year the figure grew to 83.2 percent.

Many were already repeat buyers with strong owner loyalties. A California retiree confided, "I owned a Bug previously and ran it for 275,000 miles. I intend to do the same with my Rabbit."

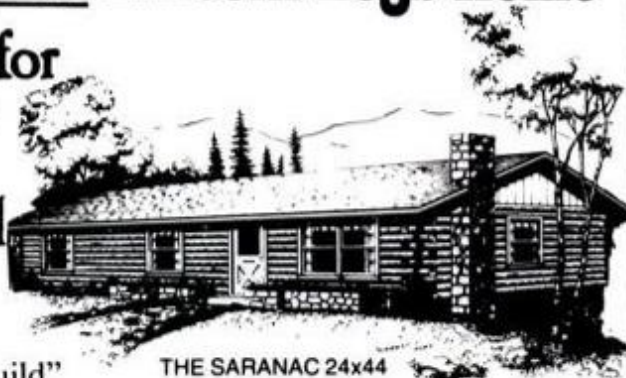
A New York director: "This is my seventh Volkswagen in the past 20 years."

Several Rabbit owners told us they might switch to a Scirocco next time, and we noted similar intentions to buy VW diesels, pickups, Dashers and vans.

One owner, a New Jersey electronics technician, sees his Rabbit as a multipurpose recreation and utility vehicle. "During the week, I use it to go back and forth to work. On the weekends, however, I check it out and go racing. You can't do

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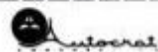
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that quite as easily with any other car."

And a New York trucker says, "I bought a Rabbit for the economy, but I intend to hold onto it because it's such a fun, responsive car."

"And in the winter, when the rear-drive owners are scrambling for traction, the front-wheel drive just pulls me out of the snow."

"If I ever sell it," says a Michigan plumber, "I definitely plan to get another VW."

And from a Florida businessman: "If my present Rabbit wears out, I think I'll go for the diesel next."

Our 1975 Owners Report concluded with a prophetic statement from a Kansas realty sales manager. He said, "When the

'kinks' are out, I feel this will be a fine car."

Judging from owner reactions to the 1980 model, those kinks are now out. As a result, people are finding out that the Rabbit sets an ever higher standard of quality, durability, economy, engineering, space utilization, handling, comfort, dealer service and just plain driving. **PM**

## SUMMARY OF 1980 VOLKSWAGEN RABBIT OWNERS REPORTS\*

<b>Total miles driven</b> 1,927,858	Reputation . . . . . 10.1	<b>Comfort opinion (front seats):</b>	Average . . . . . 19.4
<b>Average miles per gallon</b>	<b>Specific likes:</b>	Excellent . . . . . 37.2%	Fair . . . . . 9.0
1.5-liter Four	Economy . . . . . 69.3%	Very good . . . . . 40.6	Poor . . . . . 8.5
In town . . . . . 25.7	Handling . . . . . 49.5	Good . . . . . 18.8	<b>Number of vehicles owned</b>
Long trips . . . . . 32.6	Comfort . . . . . 28.7	Fair . . . . . 2.4	Rabbit only . . . . . 39.2%
1.6-liter Four	Performance . . . . . 20.3	Poor . . . . . 1.0	Two cars . . . . . 45.0
In town . . . . . 25.1	Styling . . . . . 14.4	<b>Comfort opinion (rear seats):</b>	Three cars . . . . . 12.4
Long trips . . . . . 32.1	<b>Specific dislikes:</b>	Excellent . . . . . 18.7%	Four or more cars . . . . . 3.4
<b>Engine choices:</b>	No complaints . . . . . 23.9%	Very good . . . . . 42.2	<b>Makes of other cars owned:</b>
1.5-liter Four . . . . . 65.7%	Disappointing gas mileage . . . . . 11.2	Good . . . . . 26.0	Chevrolet . . . . . 24.4%
1.6-liter Four . . . . . 34.3	Price too high . . . . . 7.4	Fair . . . . . 10.4	Volkswagen . . . . . 22.0
<b>Transmission choices:</b>	Poor dealer service . . . . . 7.4	Poor . . . . . 2.6	Ford . . . . . 13.4
Three-speed automatic . . . . . 27.2%	Car noises/rattles . . . . . 6.4	<b>Had any mechanical trouble?</b>	Oldsmobile . . . . . 8.7
Four-speed manual . . . . . 50.5	<b>What changes would you like?</b>	No . . . . . 58.0%	Pontiac . . . . . 7.1
Five-speed manual . . . . . 22.3	No changes . . . . . 18.9%	Yes . . . . . 42.0	Buck . . . . . 7.1
<b>Body-style choices:</b>	Better materials . . . . . 9.2	<b>What type of trouble?</b>	<b>Age distribution of owners:</b>
Two-door sedan . . . . . 54.1%	Different seat shape . . . . . 8.1	Electrical . . . . . 14.0%	15-29 years . . . . . 33.7%
Four-door sedan . . . . . 44.0	Add ventpanes . . . . . 7.6	Carburetor . . . . . 11.6	30-49 years . . . . . 37.8
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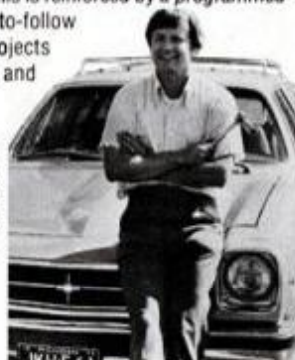
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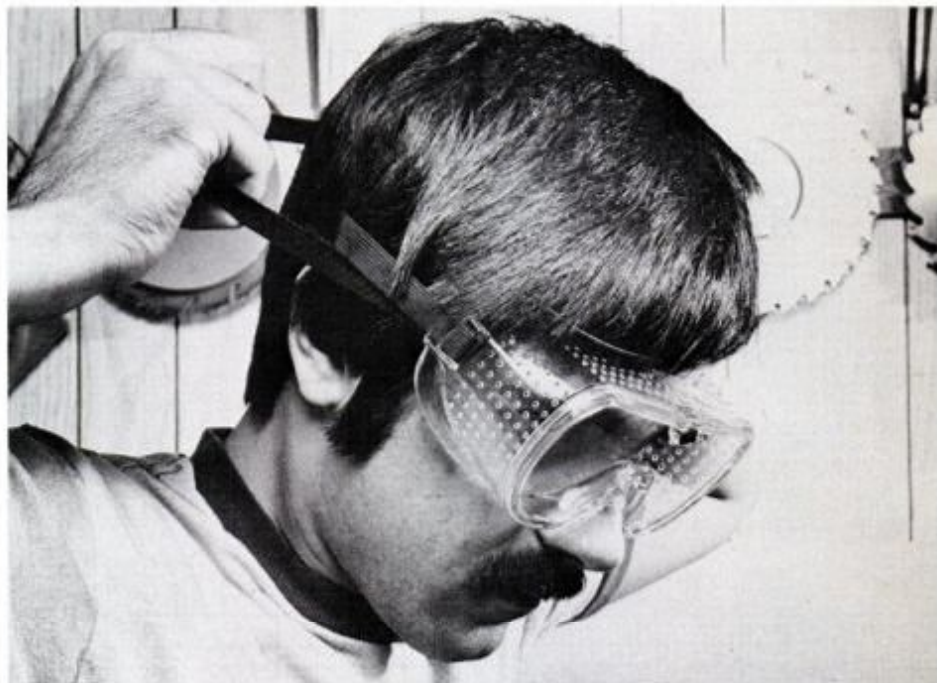
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# How to avoid the 6 most common hand-tool mistakes



**1. Right.** Tool experts say that one should not even begin to use a hand tool without first donning safety goggles or safety glasses with eye shields. These are plastic.

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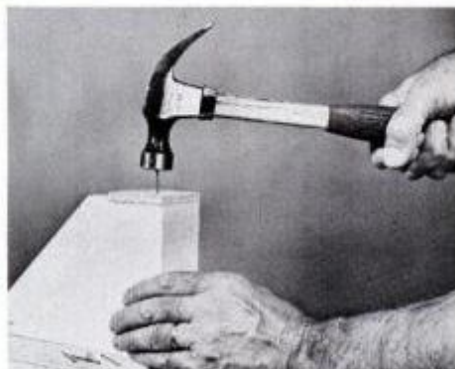
**W**hat are the worst things a person can do when using hand tools? In a recent query of its members, the Hand Tools Institute found that personal safety was constantly emphasized.

1. The single most-mentioned error was *failure to wear safety goggles or safety glasses with side shields while using hand tools*. This occupies the No. 1 spot because eye injuries are considered to be the most traumatic of the many thousands of hand-tool accidents that are reported yearly by the U.S. Consumer Product Safety Commission. Other bad practices listed were:

### Wrong tool for the job

2. *Using the wrong tool for the job.* For example, don't use a tack hammer if you're going to drive a spike.
3. *Right tool, improper use.* Even the best-made tool will botch a job when used improperly. Striking a nail with a hammer cheek instead of its face can cause a nailing problem and/or an accident. Handling a chisel incorrectly, as shown, can cause severe injury.
4. *Improper tool maintenance.* For

(Please turn to page 192)



**2. Wrong** (top photo). Use the right tool for the job. Don't use a hand maul, for example, to drive a finishing nail. **Right** (lower photo). For general bench work and most home carpentry, the correct tool to use is a 16-oz. nail hammer.

PM photos: Rosario Capotosto



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## HAND-TOOL MISTAKES

(Continued from page 190)



**3. Wrong.** Pushing a chisel with one hand while the other holds the work in front of the cutting edge invites injury.



**Right.** With work clamped in a vise, both hands are free to handle tool. Here, the right hand guides and the left pushes.

example, a worn tip on a screwdriver can result in a gashed hand. Similarly, a loose or damaged handle can turn a hammer head into a deadly flying object.

### Pushing your tools too far

**5. Overworking a tool's capabilities.** This is a "bush" or amateur mistake. Probably the most common error is to use a "cheater bar" to increase the leverage of a wrench. Don't do it; instead, move up to the next larger wrench.

**6. Hitting a tool with another—wrong—tool.** Certain tools are made to hit other specific tools or materials. Use only striking tools to strike with. Don't use a wrench to drive a nail; nor should one hammer be used to strike another. Such misuse invites injury and broken tools.

### Know your tools

There are many things that no tool should be asked to do; careless and uninformed do-it-yourselfers are particularly susceptible to accidents caused by tool misuse. To guard against infractions of common sense rules, the experts suggest taking a few minutes to become acquainted with an unfamiliar tool

(Please turn to page 196)



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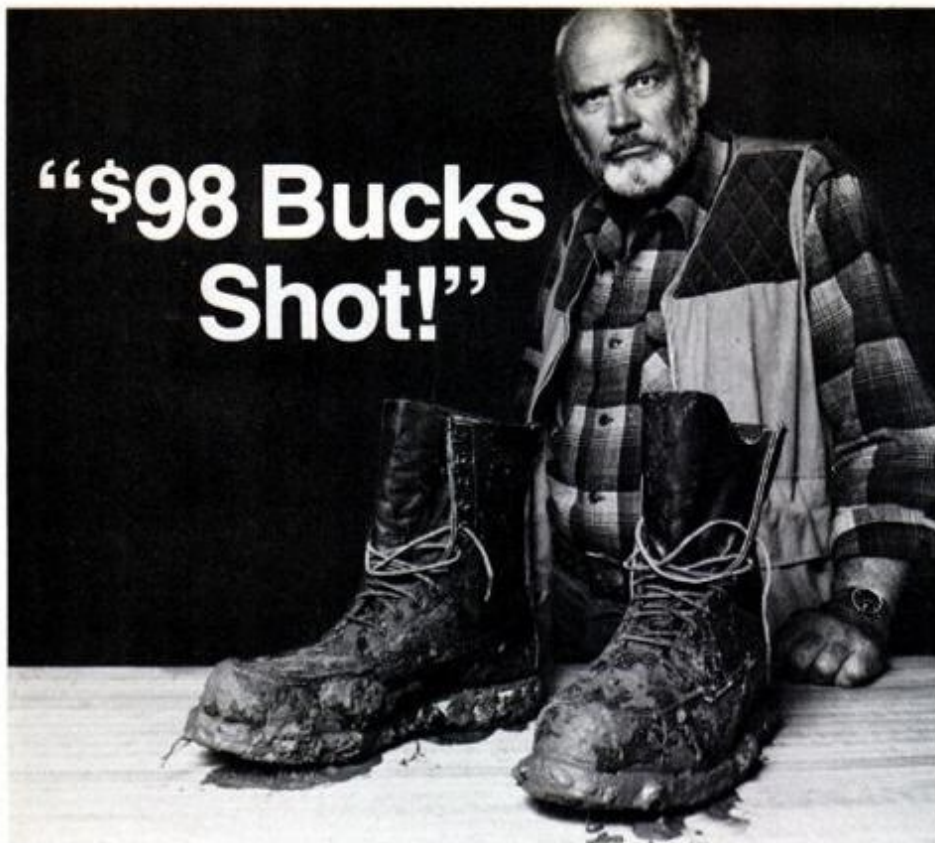


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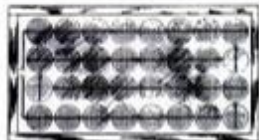


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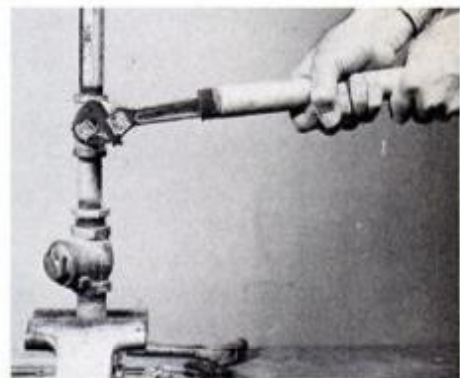
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**HAND-TOOL MISTAKES**

*(Continued from page 192)*



**4. Wrong.** Don't keep tools like this. Tools in good shape do a better job and are safer to use. Here, a loose-fitting hammer head could fly off to cause damage and injury; damaged file handle is almost certain to cause an accident.



**5. Wrong.** Don't overwork a tool's capabilities. For example, instead of using a pipe extension or a cheater bar to increase leverage, switch to a larger wrench.



**6. Wrong.** While some tools are designed to be struck, don't strike a tool if it isn't made for that purpose. It can break and result in injury to the user.

and its intended use. Also, frequently check your older tools for signs of wear and replace them when necessary. Finally, *always* take as much time as necessary to read the instructions which the manufacturer has packed with the newly made tool.

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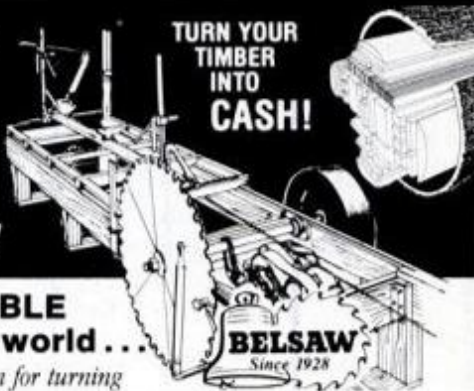
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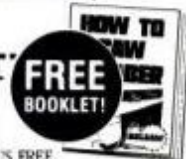
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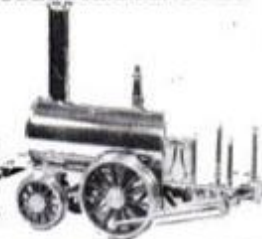


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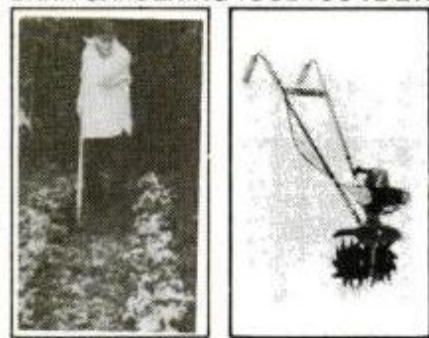
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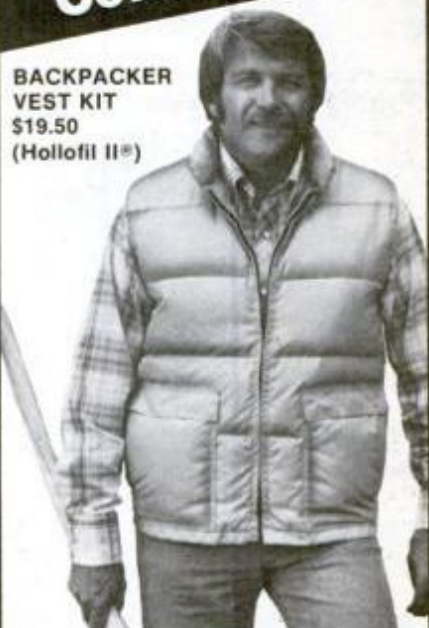
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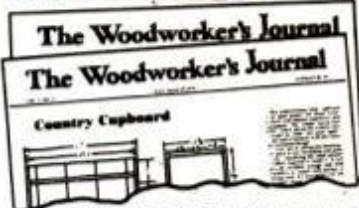
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