

SEPTEMBER 1982 \$1.50

Popular Mechanics

**SPECIAL: 40-Page
Home-Energy
Handbook**

OUR MIGHTIEST FLYING LIFTER

PM DRIVE TESTS

**U.S. Mini Pickups
Beat The Imports**

**All About Shelves:
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'em, Hang 'em**

**EXCLUSIVE: How Safe
Are Those Portable
Kerosene Heaters?**

**Logo: Newest
Computer Language...
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**PLANS: Build Our
Old-Time Family
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**Nuclear Fusion:
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Ford Extended Service Plan 

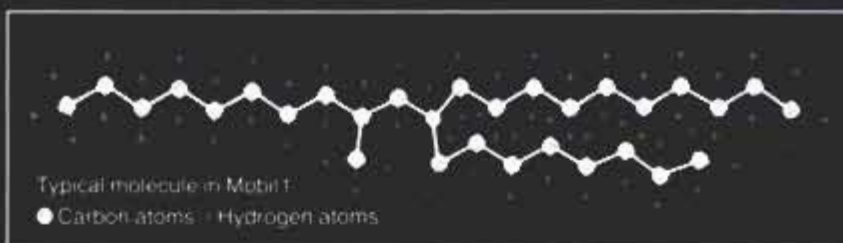
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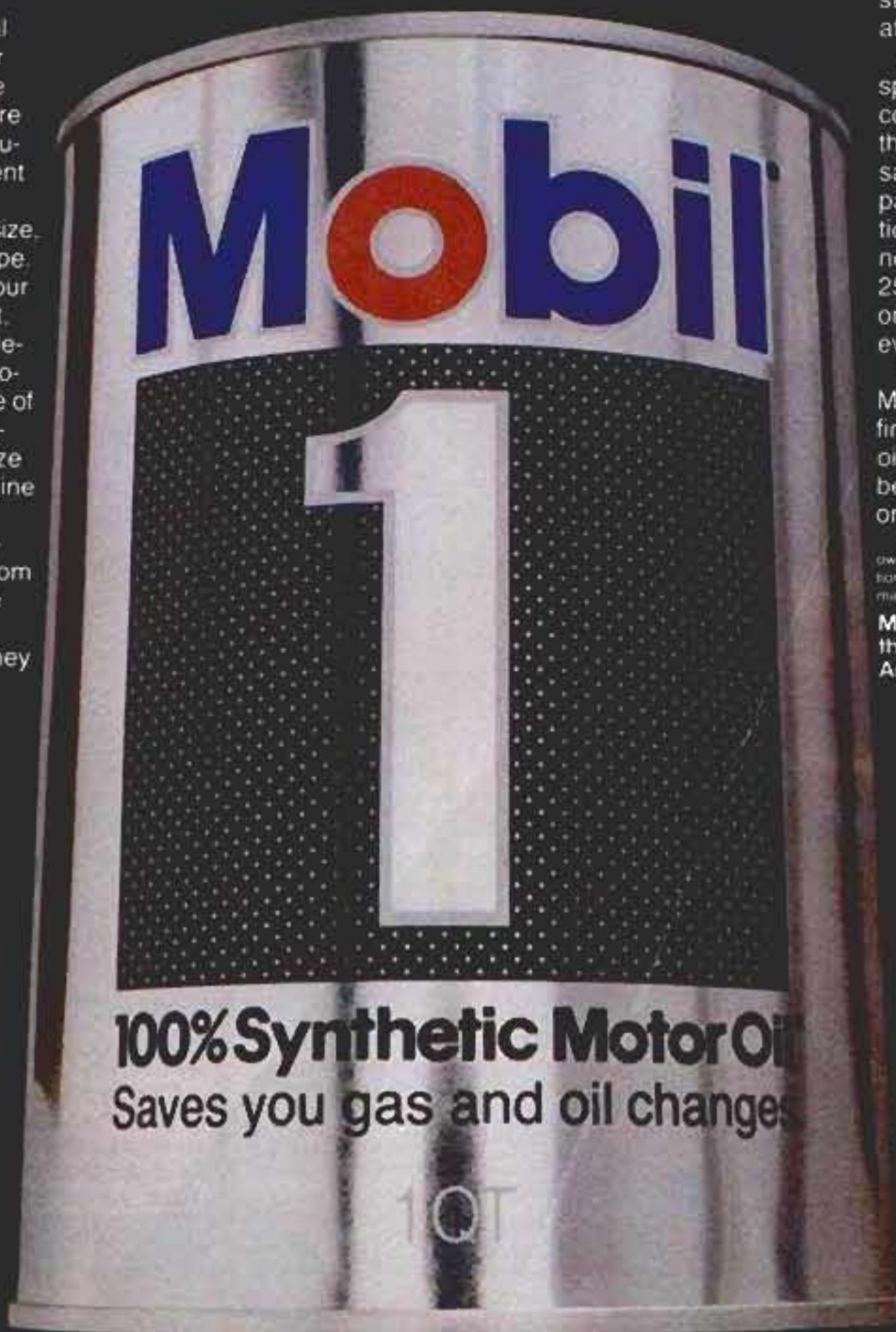
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On the cover

A radical new concept for building this country's first true heavy-lift helicopter comes from a designer known best for one-man models. Story on page 172 tells how scaled-down prototype was built for a giant that will carry 160 tons.

—PM painting by Ed Valigursky

Popular Mechanics

SEPTEMBER 1982

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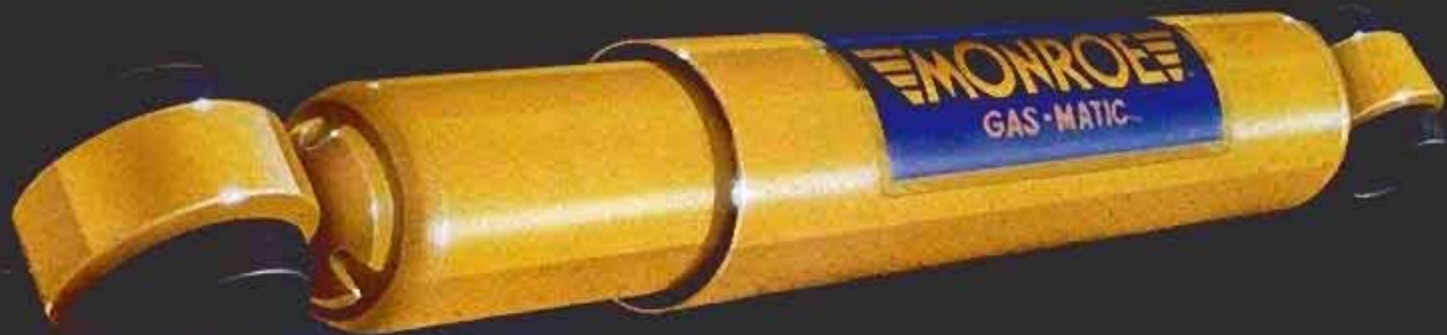
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LETTERS TO THE EDITOR

Battleship debate

Referring to your June '82 cover story (*The Born-Again Battlewagons*, page 73), I think it's a waste of taxpayers' money to reactivate World War II battleships that were designed nearly half a century ago. The costs for their logistical support, fuel and personnel will be staggering. And a number of smaller vessels will be needed to screen and supply these huge dreadnoughts, thus forcing normally offensive warships to be used purely in a defensive capacity.

E. GRANT REES
IDAHO FALLS, IDAHO

Your battleship cover depicted only the glory of war and none of its horror. Let's have peaceful subjects, please.

JOE MITCHELL
PORTLAND, ORE.

No one enjoys the thought of war, but it's necessary at times to examine the means of adequate deterrence. While the battleship question will certainly give rise to legitimate debate, it was precisely for reasons of economy that the Navy proposed the reactivation plan, as our article pointed out. Refitting basically sound existing hulls with modern weaponry is a way of getting a strong naval deterrent at just a fraction of what it would cost to build new ships from scratch.

High-flying achievement

I found it thrilling to read Kelly Johnson's article on the SR-71 high-altitude reconnaissance plane (*The 'Blackbird' Story*, page 70, July '82). This awesome technical achievement should gratify all Americans, especially since the great effort and cost produced a peace machine—not a war machine.

If those who stage "peace walks" want a worthy objective, let them campaign for the 250,000-ton forging press that Johnson wants and our country needs.

KENNETH BROOKS
VASHON, WASH.

Kelly Johnson, who headed up the SR-71 Blackbird program at Lockheed, pointed out in his article that the lack of adequate forging presses had seriously hampered our work with such critical metals as titanium—a lesson not lost on the Rus-

sians, who have much more powerful presses than we.

Four PM desks—wow!

In your September '80 issue, you featured plans for a clever child's desk (*Build The Art Desk That Never Runs Out Of Drawing Paper*, page 98). Since I have three grandchildren and another on the way, I set up a mass-production operation and made four of the desks at once, two



Mass production: One of four PM art desks made by reader Arnold, with young artist at work. Note second desk in background.

of which are shown in the enclosed photo (above).

The desks were easy to build and are well liked by the children. Incidentally, I had trouble finding the rolled poster paper you specified, but discovered that plain butcher's paper, readily available in large rolls and inexpensive, makes a good substitute. This might be a help to other readers.

IVAN L. ARNOLD
TIGARD, ORE.

Thanks for the helpful tip and the appealing photo. For others who may be interested in constructing one of their own, photocopies of the desk plans are 75 cents from Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

Inspired by dream garage

My compliments on your article *How To Design And Equip Your Own Dream Garage* (page 126, May '82). It certainly was an inspiration to all of us weekend auto mechanics.

EDUARDO ROJAS
WEST COVINA, CALIF.

Ripped off, but wiser

Your June '80 issue had an excellent article on avoiding solar gyp artists (*Don't Get Burned By Solar Rip-*

Offs, page 84). Unfortunately, it arrived a few months too late to save me grief, but confirmed what I later found out.

Shortly after my system was installed, I discovered it was shutting down long before it should, then couldn't be restarted until the next day. The dealer who installed it was no longer in business (naturally). The manufacturer admitted it was a problem they were having trouble with, but couldn't help. Now we're into the third year and still have the problem.

It pays not only to pick a system that's earned a good reputation, as you pointed out, but also to monitor it closely after it's installed. Only then can you be sure it's functioning properly.

FRED H. MAILLOUX
NORTHAMPTON, MASS.

Wing-walkers immortalized

You did such a great job on my wing-walk adventure (*Anatomy Of A Wing-Walk*, page 31, June '82) that I've been besieged with requests for copies of the photo showing the 19 parachutists clinging to the wing just before jumpoff.

Your readers might like to know that I've had it made into a full-color 17 x 22-inch poster—suitable for framing, as they say. It's \$5 postpaid from Project Wing-Walk, Box 14461, Gainesville, Fla. 32604.

MARTIN CAIDIN
GAINESVILLE, FLA.

Thrill rides not all new

The Peter Pan thrill ride you showed at the Knoxville World's Fair (*Technology Update*, page 111, July '82) is not the only one in the country. A version of this screamer, called The Ranger, was introduced this summer at Darien Lake, a theme park in western New York.

Darien Lake also introduced the first boomerang-type track contortion as part of its new roller coaster, called The Viper.

DON GWOREK
BUFFALO, N.Y.

We didn't say Knoxville had the only Peter Pan ride—just the first. And the boomerang feature actually made its debut two years ago at Kansas City's Worlds of Fun park under the name Kamikaze Kurve (see Terror On Wheels—By Design, page 70, Aug. '80).

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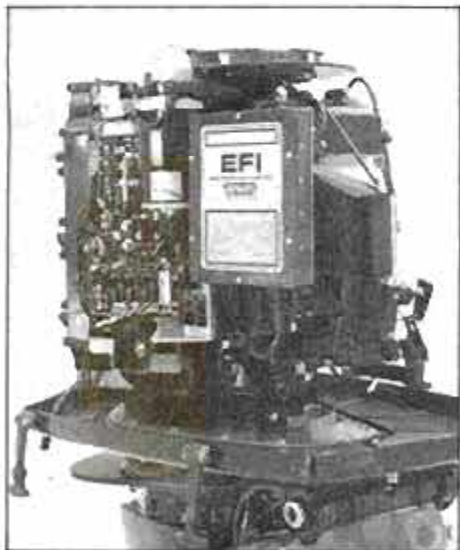
ALL OUTDOORS

Faster—lighter

Naval architects have pointed out that an orange crate has been known to drift across oceans without any damage. Light, strong and offering practically no resistance to the water, it can survive storms and breaking waves virtually intact. That doesn't mean modern boats should be built like orange crates, but it does point up the advantages of good basic construction and minimum displacement.

Add power—sails or engines—and the hulls to mount them properly, however, and wind and water start to fight back against the objects trying to push through. Up to a point (usually 10 to 20 mph, depending on the length of the boat) the hull can speed up by pushing the water out of the way as it displaces it. But to make the breakthrough from displacement to planing hull, the craft has to be light enough to skim the top of the water, strong enough to take the added impacts involved and powerful enough to provide the extra speed required. Just in the last few months there have been some major refinements.

Mercury Marine is starting to move its outboards into the electronic age with "EFI." That stands for Electronic Fuel Injection, and adapts Bosch injectors similar to those used on automobiles to two experimental engines. One is the 2.4-liter EFI, developed with the 142-cu.-in. V6 powerhead, that's reported to produce 250 crankshaft hp at about 6,500 rpm. And from the 207-cu.-in. 3.4 Merc V6, the Hi-Perfor-



Electronic fuel injection is boosting horsepower of Mercury's 3.4 to well over 325.

mance Products Div. is pulling over 325 shaft hp—how much more they won't say. Superior tuning possible with the electronic control of the injected fuel seems to make the power boost possible. Normally, allowance must be made for average conditions of temperature, humidity and barometric pressure. But if a built-in computer can determine and factor in these variables, the engines can be set up more exactly and save fuel at the same time. Initially, the 2.4 and 3.4 EFIs will only be available for racing. But there's little doubt that we'll see electronic fuel injection on other production Mercury models if the first ones are successful.

Deep-freeze prepreg

Materials used in building the space shuttle have now been incorporated



Light Nomex honeycomb inside Kevlar gives Aramid Arrow speed and economy.

in a 26-footer from Wellcraft Marine in Sarasota, Fla. Modelled on Wellcraft's Nova II, and built by light-hull specialists Force Engineering, the new Aramid Arrow uses Du Pont's Nomex honeycomb core and Kevlar high-strength aramid materials derived from nylon. The craft is called the first all-honeycomb composite powerboat and weighs over 1,000 pounds less than a similar boat of fiberglass.

Pound for pound, Kevlar is claimed to be five times stronger than steel, and for the Aramid Arrow a fabric of Kevlar filaments was prepared by Ciba-Geigy with a mechanical preimpregnation of epoxy resin and catalyst. It's been found with fiberglass that this prepreg can be prepared with a very precise and efficient mix of resin. The prepreg is then stored in a freezer so that the resin does not kick over and catalyze. For the Arrow, Kevlar prepreg is removed from the freezer and cut to shape with templates. Several layers are laid up by hand in a female mold, covered with a layer of honeycomb Nomex, and

then topped with several more prepreg layers.

Finally, the hull and deck are vacuum bagged and baked in an oven for a bonded cure of great strength and lightness.

The result is a boat that is more expensive, but one that is faster and about 25 percent more economical to run. (Comparative commercial fishing boats have shown a 53.7 percent improvement in fuel economy, 10 percent increase in speed, longer range and greater payload.) Using a 260-hp MerCruiser stern-drive, the Aramid Arrow clocked 49.6 mph.

Bite-proofing

High in the Colorado Rockies where I grew up, the ranchers used to claim that rattlesnakes couldn't take the altitude. At least we never saw any above 8,000 feet, but almost any place else in the country there's always the possibility of meeting an unfriendly snake afield. Thick boots and leggings are one form of heavy protection, but now Bob Allen (Box 477, Des Moines, Iowa), the maker of

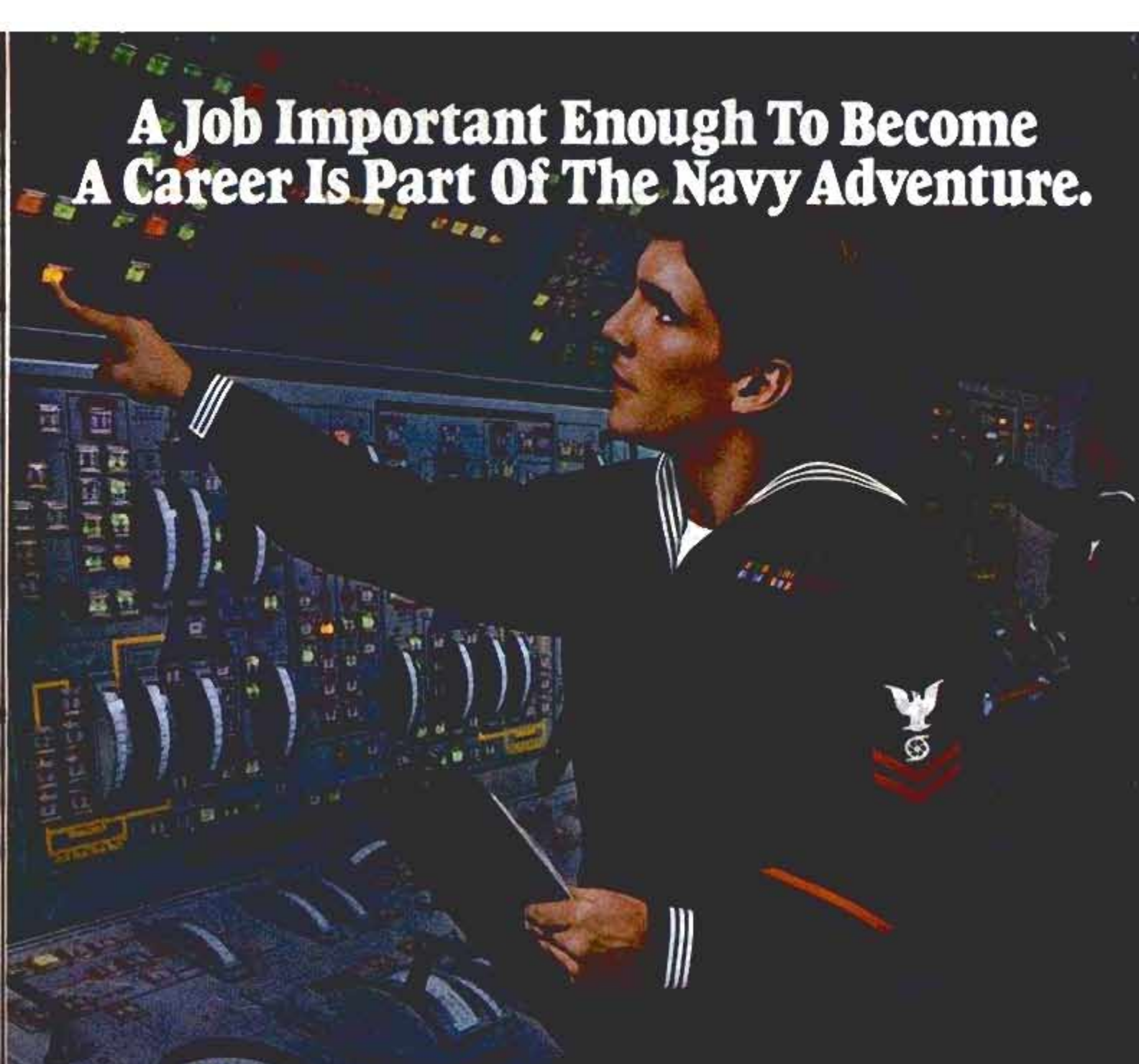


Snake Chaps, new from Bob Allen, use Cordura to blunt bites of snakes found afield.

fine sportswear and luggage, has come up with Snake Chaps for \$50—a decent price for peace of mind. They are made of urethane-coated Cordura with nylon zippers on the outside of the legs for quieter walking and sewn-in creases for easier brush-busting. And they've been bite-tested successfully. **PM**



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Navy. It's Not Just A Job, It's An Adventure.

PM ELECTRONICS MONITOR

Three-D computers

Have you ever wondered what's inside an IC—one of the integrated circuit "chips" that are used in digital circuits? If you took one apart, you'd find a very thin wafer of silicon, covered with microscopically small tracings. The tracings often resemble a map or stylistic drawing.

The tiny tracings, called junctions and structures, simulate the thousands of transistors that would otherwise have to do the job performed by that circuit. These junctions and structures are deposited onto the silicon in a "gaseous environment" during manufacture. The placing of these "impurities" must, of course, be extremely accurate.

Most chips use wafers that are pretty much two dimensional—like a fold-out map.

But researchers at Stanford University (Prof. Jim Gibbons and colleagues) have developed a way to "shoot" impurities into the wafers at various depths. They use an ion beam as an "atomic shotgun" in order to develop three-dimensional chips.

Why three dimensional? Keep in mind that the shortest distance between two points is a straight line—and the shortest way is also the fastest way. This ability to stack junctions and structures atop each other with great and complex accuracy may result in faster chips and far more powerful computers.

The Japanese and French are also examining this concept. The next "space race" may be for microscopic areas of three-dimensional space.

Audio/video marriage

Component stereo—a complete system built from a separate amplifier, tuner, turntable and other parts—has been around a long time. Component video has now taken a giant step forward with the introduction of the world's first combination audio/video receiver from Kenwood.

The new unit is styled to match others in Kenwood's new video line (see photo at right), complete with large push-pad, as well as pushbutton controls.

Operating in its video mode, the unit will offer the home videotapist some very professional capabilities. You can connect two video cassette recorders (VCRs) to it, as well as a TV monitor (to view as you would a normal TV), a video game/computer, or a videodisc.



Notes and digits

Touch-Tone telephones signal the central switching office by means of tones. But what most people don't realize is that a push on one button actually sends out two blended tones. Each button has two associated tones—one in a high frequency, the other in a lower range.

Pressing the "7," for example, sends out a tone of 852 Hz and one of 1,209 Hz. Because individual tones are within voice frequencies, the phone company came up with this method of using two tones so background noise wouldn't result in a wrong number.

Once the various units have been connected, you can use the controls to dub between VCR 1 and VCR 2. Or, you can dub from video onto the audio line. The receiver even synthesizes a stereolike sound from a normally monaural television signal. The power output is 30 watts per channel and it's priced at \$419 retail.

new line of video products is very good; we wonder if it will, in fact, be the audio companies that extend the boundaries of all electronic home entertainment. Pioneer has already demonstrated its leadership with its Laserdisc videodisc machine.

New video editor

We mentioned above that audio companies are getting in on video. So are camera companies, such as Canon, which recently unveiled the first video editor designed for consumer, at-home use. It will be available later this year.

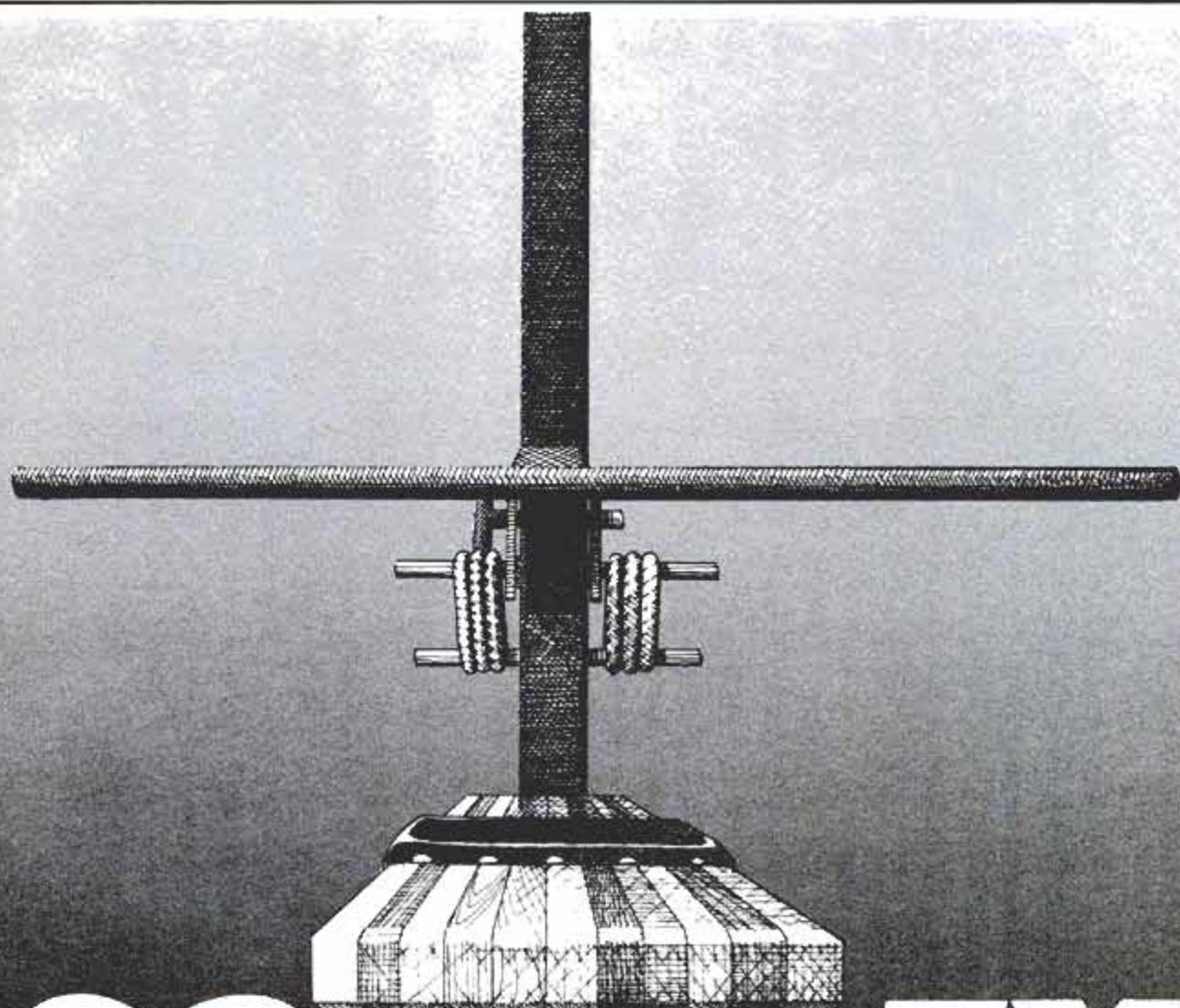
This handy box (pictured at left) will bring many professional editing techniques to the amateur. The unit allows audio dubbing onto one or two VCRs and controls such things as frame advance, slow motion, review and cue, insert and assemble. The liquid-crystal display gives precise tape readouts.



Kenwood's KVR-510 (top) is the first receiver for both audio and video signals. Canon's VE-10A (bottom) is a video editing device with many professional features.

As more people become involved with video—and maintain their interest in good audio—you'll be seeing more such units. What we find most interesting is that this first one was introduced by Kenwood—an established audio company which is relatively new to the video world. Its





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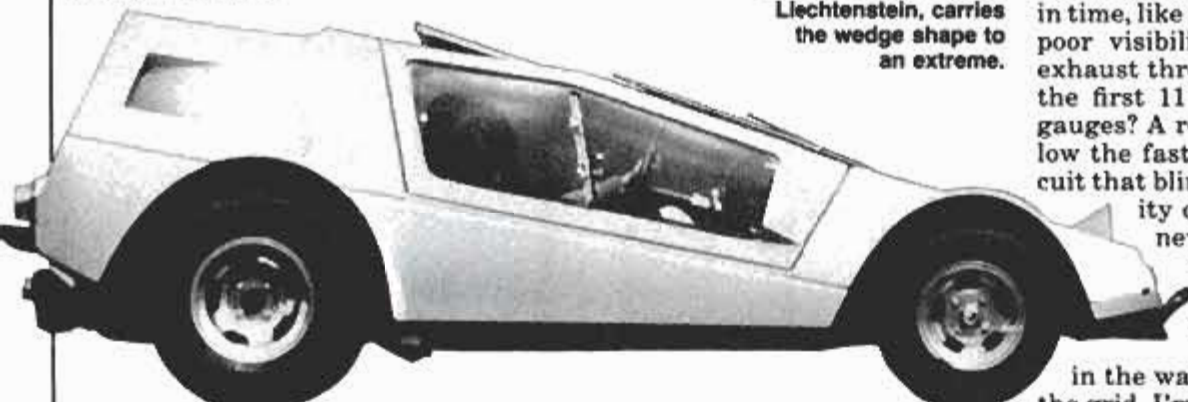
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A world of cars

Saphier coupe, built in Liechtenstein, carries the wedge shape to an extreme.



Scoop! Here's a first look at the Saphier from Liechtenstein. You can't look it up in your Funk & Wagnall's, and you won't even find it in the automobile bible: *World Cars 1982*. The flip-top box is the idea of Xaver Jehle, who is building the fiberglass bodies to mate with '69 Beetle chassis. The rear-engine layout uses the 1.5-liter VW engine. The "door" is a roof window, as the designer calls it, and can be removed completely for less-claustrophobic,

The Saphier is too new to be listed in *World Cars 1982*, of course, so you won't find it in the cars of Europe section. There, after the final listing for Italy, the Nuova Innocenti Mini De Tomaso, the book goes right to Poland (there are no J,K,L,M,N,O car countries in Europe; you'll find Netherlands under Holland) and the Fabryka Samochodow Osobowych, or FSO, which is the only way we can refer to this state-owned company and still be understood. And don't think that the magnificent *World Cars* volume doesn't describe cars from little nonestablishment companies, kit cars, if you will; everybody is there: In the U.S.A. section, for example, you'll find such limited-edition American car builders as American Custom Industries (Duntov Turbo), Antique & Classic Automotive (Frazer Nash TT), Avanti, Blakely (Bearcat), Classic Roadster (Grand Duchess), Clenet, Daytona (Migi/Moya), Excalibur, Kelmark (GT) and Stutz. So, for the world of cars, it's *World Cars 1982*; it's \$39.50 from Herald Books, Box 17, Pelham, N.Y. 10803.

Calculated risks

Didier Pironi, stalled in his Ferrari, is smashed from behind by another car going over 100 mph and he steps out unscratched. That's one story from this year's Canadian Grand Prix. It happened at the Gilles Villeneuve circuit in Montreal just after the standing start. I was on the walkway over the pits watching the field funnel around pole-sitter Pironi. A couple of cars clipped the Ferrari, but Riccardo Paletti, after accelerating from the next to the last row for a full five seconds, went straight into the rear of the stalled

racer. What kept him from reacting in time, like the other drivers? Was it poor visibility from the dust and exhaust thrown up from the cars in the first 11 rows? A glance at his gauges? A rookie's eagerness to follow the fastest line around the circuit that blinded him to the possibility of the unexpected? We'll never know: Paletti died of internal injuries soon after being rushed to a local hospital.

From where I stood, in the wake of the racers leaving the grid, I'm convinced that clouded visibility caused the fatal delay in reaction time. Paletti knew that by keeping his foot in it at the start he was taking a calculated risk, figuring all the faster-qualifying cars ahead would be strung out and whipping through the first turn. He took the risk willingly, and took it in the only arena where such a risk should be taken: on the racetrack.

All too often, poorly calculated risks are taken by drivers like you



Single "door" of the Saphier flips up. Car "bible" (left) is best book to find out about cars of the world.

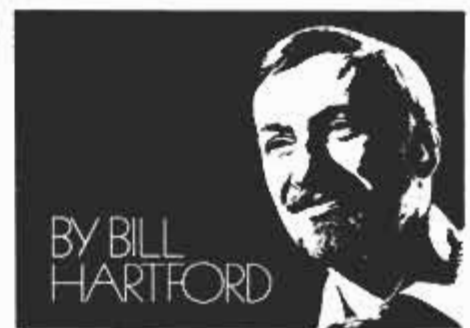


open-car motor-ing. The shop of Xaver Jehle is in a town that soon may be referred to as the Detroit of Liechtenstein. He's at Speckle 14, FL 9494 Schaan. That's near the capital, Vaduz, but then, as I found out a couple of years ago, if you're not near Vaduz, you're no longer in Liechtenstein, but in either Austria or Switzerland which wedge in the tiny principality from all sides.



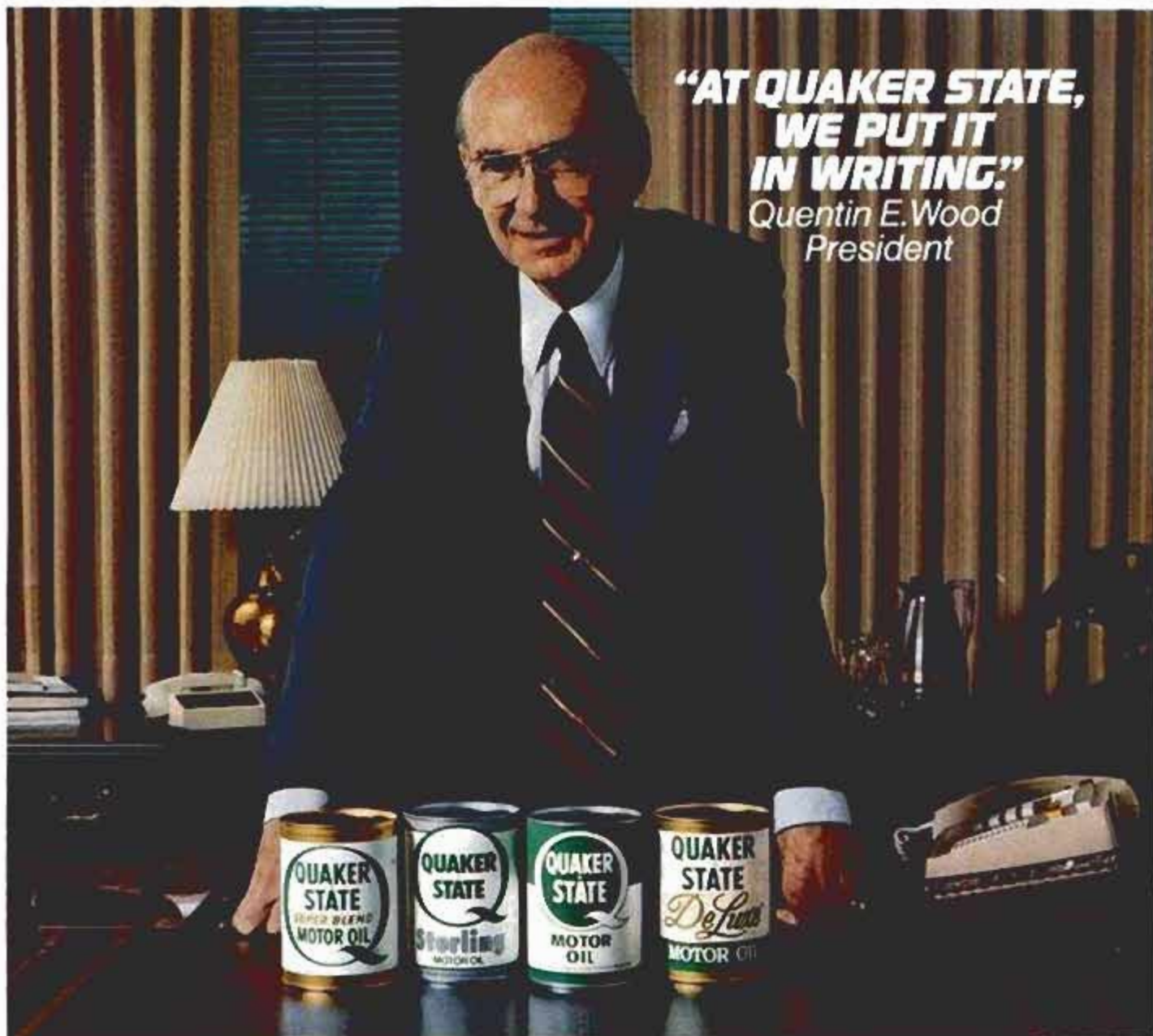
Driver in Formula 1 car sits so far forward, his feet are ahead of the front wheels.

and me on highways where visibility is wiped out by thick fog, or in other situations where we assume the road ahead is clear. Good examples of the foolishness of driving blind are the pileups that occur regularly in fog on turnpikes and freeways, often involving hundreds of vehicles. Just leaving the driveway is calculated risk enough for me: In the future, whenever I'm tempted to drive too fast when I can't see where I'm going, I know I'll think of Riccardo Paletti, a brave Grand Prix driver whose business was speed. **PH**



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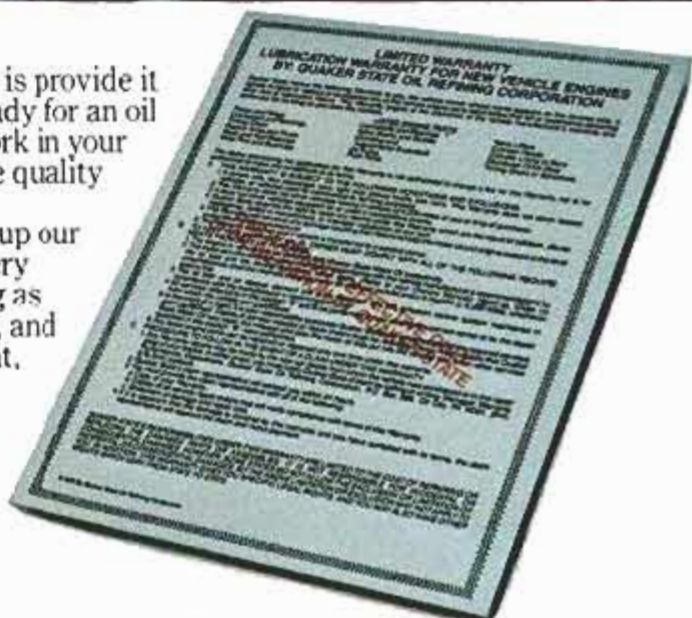
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NOTES FROM THE EDITOR

John A. Sillitto

For the past two or three winters, a couple of us on this staff have pretty well given up using our fireplaces for auxiliary heat. We've opted for portable kerosene heaters. They glow, they're warm, they're really quite satisfactory substitutes. But how safe? we're constantly asked. We passed the question to long-time contributor Dick Dempe-wolff. His answer begins on page 132. (No question, we'll keep on using our kerosene heaters, but if you have any kind of auxiliary heat, you'll want to see what he says.)

Invented here, but the Japanese have used it best. Sound familiar? It's true with the robot. Even so, and despite its limited intelligence, it'd be great to have one around to shovel the walk, wouldn't it? But before you give up the neighbor kid, read Technology Editor Robin Nelson's report (page 77) on the true state of robot art.

When wringing out pickup trucks (page 82) becomes routine, PM's auto staff turns to racing for excitement. And it does it quite well. For instance, Tony Assenza, competing for the first time, drove a modified stock Mustang to first place in a regional Sports Car Club of America race in New Hampshire early this summer. Then PM's own entry in the Quaker State/Longest Day of Nelson Ledges wound up in first place in that endurance event. The four drivers—Assenza, Detroit Editor Gary Witzenburg, plus Fred Baker and Bob Nickel—covered 1,908 miles in 24 hours, averaging 80 mph. And we put out a magazine, too!

Auto Editor Assenza (right) exits Mustang after victory in SCCA regional race. Below: PM's car and crew after winning Longest Day of Nelson Ledges race. In foreground are drivers Witzenburg, Assenza, Nickel, Baker; at left, Joe Oldham, team manager.



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DETROIT LISTENING POST

Minivans on the way

The slick little van you see here is an experimental Ford design, but it looks like Chrysler will get the jump on Ford and other domestic and foreign competitors when it begins churning out a small front-wheel-drive van from its Windsor, Ont., plant about a year from now.

Code-named T-115, the baby van will be based on fwd K-car mechanicals, with the 2.2-liter Four standard, the Mitsubishi 2.6-liter "Silent Shaft" Four optional and a new 2.5-liter diesel Four (derived from the old 3.7-liter, slant Six gas-burner) a likely second option. Wheelbase is 112 inches, and passenger capacity is seven, or five with the optional, fold-down third seat.

Sports car wars heat up

At long last, sports cars seem to be making a big comeback. All three Detroit makers are now committed to bringing out an all-out two-seater and dropping pretensions of calling them dual-purpose economy/fun cars. These buzz-bombs are performers, pure and simple, and we're glad to have them.

We've already reported on the Pontiac mid-engine P-car, a definite go for '84. Now there is rumor that Ford will not be outdone and will produce its own mid-engine car, built around the EXP/LN7 (Escort) mechanicals. It might look a little (or a lot) like the Ghia Brezza showcar currently making the European auto show rounds. It could not become available until late '85.

Chrysler, on the other hand, has its sports car plans finalized. Code-named the G-24, it will be powered by a 2.2-liter turbocharged motor producing around 147 hp, weigh around 2,400 pounds and turn 0 to 60 mph quicker than a Camaro Z28. Unlike the Ford and Pontiac cars, the G-24 will have front drive mechanicals, rather than mid-engine rear-drive, borrowed from the current K-cars. All we can say is, it's about time. If they can produce these exciting, good-handling cars at an attractive price, they'll all be in the same happy circumstance Chevy and Pontiac are in with their F-cars—not being able to make enough to satisfy demand.

More hot rods

Commemorating the 15th anniversary of the first performance-orient-



Future Ford van will be based on Escort platform. It will be 157 inches long, have a 94-inch wheelbase and carry six or seven passengers. A Chrysler minivan will beat it to market.

ed Hurst Olds, GM's Oldsmobile Div. will introduce a new Hurst Corp.-modified version of the rwd mid-size Cutlass for '83.

It plans to feature a hopped-up V8 engine, special suspension and—are you ready?—a four-speed transmission with Hurst linkage. When was the last four-speed Cutlass you can remember? (Or do they mean four-speed automatic?)

Meanwhile, VW of America will introduce a European-type GTI performance model Rabbit, just two or three years after it should have. It will have a fuel-injected, 1.8-liter engine coupled to a close-ratio five-speed transaxle, sport suspension, tuned exhaust, vented disc brakes and special instrumentation, plus seats, steering wheel and GTI graphics from the well-respected European GTI.

VW also plans a 1.6-liter turbodiesel with five-speed transmission for its U.S.-built Rabbits, as well as four- and five-cylinder turbodiesels for the made-in-Germany Jetta and Quantum lines.

GM engine plans

Reacting to changing market conditions, Oldsmobile has shelved its V5 diesel program originally intended as an '84 option for small trucks and fwd X-cars; and Cadillac has delayed a V6 version of its 4.1-liter aluminum V8 for at least a year.

But that lightweight Cadillac V8, introduced a year ago, is being converted for transverse installation in the downsized, '84 fwd luxury C-cars—and is a logical candidate for

mid-ship mounting in the rumored Buick and/or Cadillac luxury sports car for '85 and '86. Buick Div., too, is adapting its 3.8-liter V6 for transverse fwd applications—probably for those same '84 C-cars.

Name game

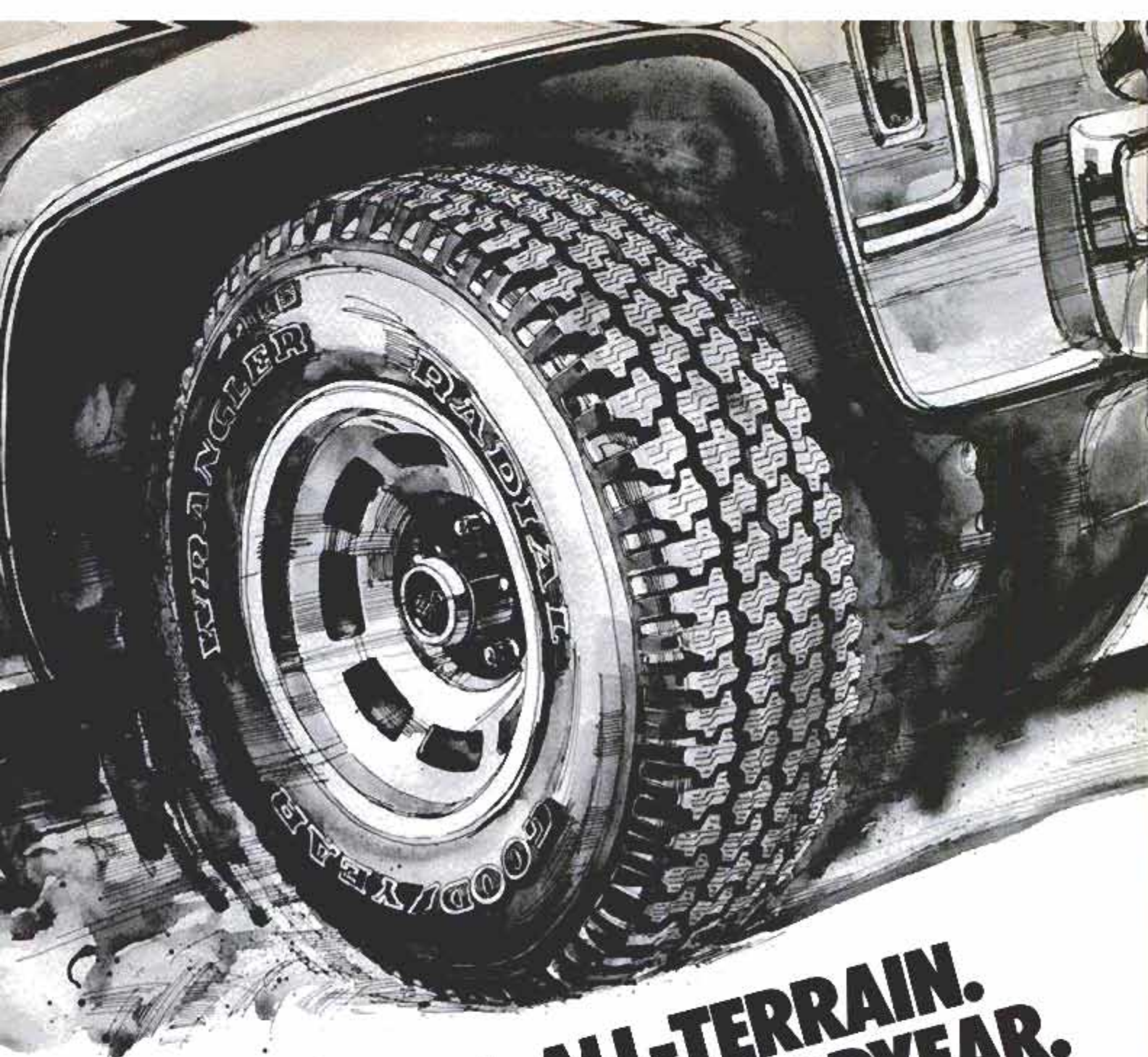
If you ran one of GM's car divisions, what would you do with long-popular, big-car names like Impala, Caprice, 88 and LeSabre once the cars that bear them are phased out? Pontiac already transferred its Bonneville moniker to a jazzed-up rwd "G-car" version of what used to be the intermediate LeMans "A-car," so Chevy, Olds and Buick could do the same.

However, those divisions' G-cars already have successful names (Malibu, Cutlass, Regal)—besides which, they're not likely to be around much longer either.

My guess is that those names are too well established to be retired, and they'll probably be hung on top-of-the-line versions of the new fwd A-cars (Celebrity, 6000, Cutlass

(Please turn to page 24)





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This year everybody wanted the prize. The competition sported all the names; includ-

ing Datsun, Chevy, Toyota and the new Ford Ranger in its first race ever. Manny Esquerria at the wheel.

Seven hours and twenty minutes later, the Ford Ranger crossed the victory line alone: a full hour ahead of the nearest competitor. And five weeks later Ranger made it two in a row, winning the "Mint 400" in Las Vegas.

Of course, defeating the competition is

LIPE 250 LINE



A reenactment of Ford Ranger winning the San Felipe 250.

An Hour Behind This Picture.

always gratifying. More important however, is knowing our design, manufacturing and quality performance has kept Ford trucks first in total truck line sales leadership since 1970. (Based on R.L. Polk registrations for calendar year 1970 through 1981).

And, of course, the more quality we put into every Ford truck, the further behind us the competition's going to be.



Ford Ranger



There's A Ford In America's Future.

DETROIT LISTENING POST

(Continued from page 20)

Ciera and Century) within the next couple of years.

Lee's for belts

Chrysler chairman Lee Iacocca has come out solidly in favor of mandatory seat belt usage laws, which won't make him any too popular with almost 90 percent of Americans who still stubbornly refuse to use them.

"We've been saying for years that the government should do whatever

saves the most lives at the lowest cost to the public," he said at a White House ceremony kicking off the administration's latest traffic safety campaign. "This is it.

"Virtually every free country in the world except the United States has a program to promote the use of safety belts. It's about time we made it compulsory. The potential for saving lives and money is enormous. The Province of Ontario proved that safety belts can prevent most injuries and fatalities. Every car has safety belts. All we have to do is use them."

If only other industry and government leaders had the nerve to follow suit, this country—like many others—could start saving thousands of lives and crippling, disfiguring injuries overnight, instead of waiting for air bags or some other expensive Rube Goldberg device to be phased into new cars that are already way too expensive.

Of course, such a law would not affect those of us who already have the good sense not to drive or ride around the block without buckling up first.

Computerized transmissions

The '83 fwd Renault Alliance, an AMC-built version of the widely acclaimed European Renault 9, will be the first of many AMC/Renault products to use a new electronically controlled, three-speed, automatic transaxle when it hits U.S. showrooms next month. The computerized transmission is smaller, lighter and (says AMC) more durable than a conventional automatic, conserves fuel through more precise selection of gear ratios for changing conditions and is easily adaptable to various power-train configurations.

Ford update

While GM moves closer to at least one, and maybe two, joint ventures with Japanese manufacturers, Ford's plans for a co-developed '85 minicar with partner Toyo Kogyo appear to be on the rocks. Reports are that TK, perhaps wary of future U.S. trade restraints, was moving too slowly to suit Ford.

Meanwhile, the lovely new fwd Topaz and Tempo compacts, replacements for the rear-drive Fairmont/Zephyr, are set for introduction next spring. They'll weigh some 600 pounds less and shrink more than 2 feet in length and 6 inches in wheelbase. Most suspension and power-train components are derived from the smaller Escort/Lynx econocars.

New this fall are the face-lifted and upgraded '83 Mustang/Capri (both available as convertibles) and Granada/Cougar series—the latter wearing Ford's LTD and Mercury's Marquis big-car nameplates. A 4wd Bronco version of the new compact Ranger truck is also ready for its fall debut, while the totally restyled T-Bird and SR-7 are due for a mid-winter unveiling.

As noted here before, Ford's new styling philosophy runs toward soft, flowing, rounded lines—"no more boxes." Average drag coefficient (cd) of '83 Ford products will be .40, a good start toward the company's goal of .33 by 1990.

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PM's Whatsit

Are these burly lads at work or play? Will this conveyance replace the electric car? What's going on here, anyway? When you've run out of guesses, we'll fill you in on the next page.

Young and wasteless

As fuel pump prices slowly float upwards, the old economy run might get to be hot competition again. To their credit, a group of Southern California Audi dealers isn't waiting for a headline-making squeeze—the association recently sponsored its second annual economy run for area high school students. Twenty schools sent peer-picked drivers to drive identical diesel Audis over a 200-mile course. And if you think all today's young drivers know how to do is drift into corners and peel off at the greens, check out Ron Beale's figures: The Burroughs High (in Burbank) senior chalked up a crisp 91.84 mpg over the course at legal speeds to win the event and a \$1,000 college scholarship.



Sports Car Club of America official waves student driver into Audi Economy Run finish.

Actor's hobby became a serious business

The late Reginald Denny made more than 200 films—and in almost every one of them he was the model of a proper English gentleman. Offscreen, the dapper Denny had an unusual passion: building radio-controlled drone aircraft. He got so good at it, in fact, that he started a company called Radioplane, which signed a \$33,000 contract to produce target aircraft for the U.S. Army in 1935.

Radioplane was eventually sold to Northrop Corp. and became its Ventura Div. in Newbury Park, Calif. Including Denny's early efforts, the company has produced more than 77,000 target drones. Today, it's looking at a possible \$200 million market for just one product—an air-launched version that behaves like a cruise missile and can be used to teach pilots how to combat incoming guided weapons.

Parachute recovery systems have added greatly to the longevity of target aircraft. With enough inexperience on the part of those firing at it, a parachute-equipped drone has a better than even chance. One Northrop drone used for NATO training in Greece, for example, set a record of 64 missions before somebody was able to shoot it down.



Reginald Denny's model plane passion led to Northrop's vast target drone business. "Chukar" drone is launched from ground.

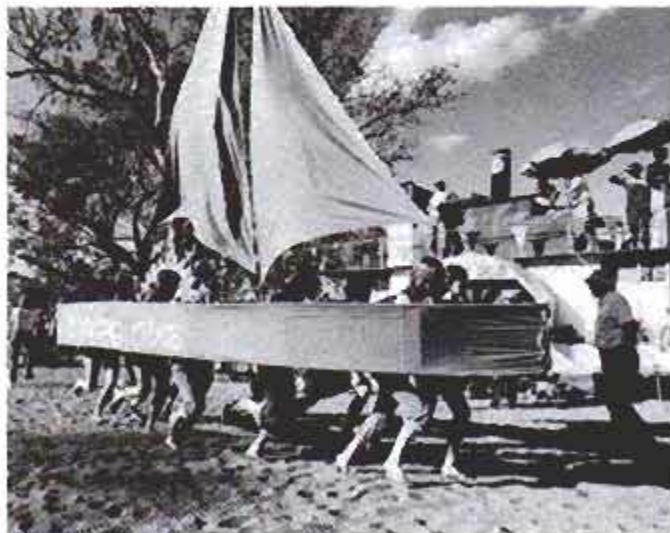
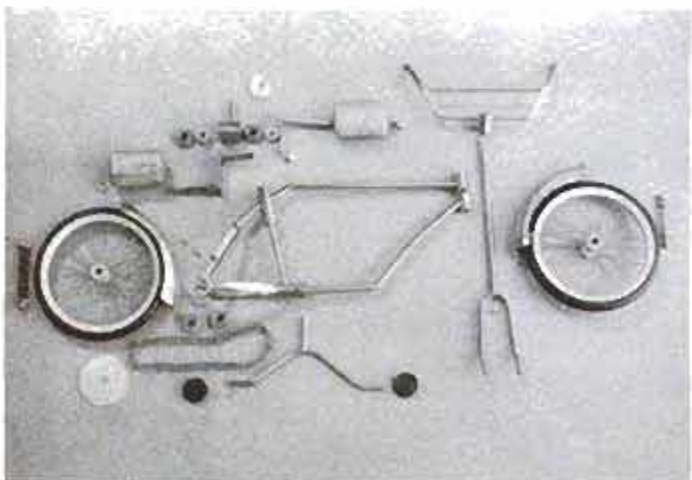
Light as a feather

After PM's recent article on superlight, Space-Age bikes appeared (*Superbikes: Built Like Airplanes*, page 76, July '82), word came that the lightest handmade bike available sells for about \$450. For the birds, we said, and it turns out we were right.

Hubert Manning, 59, of Temple City, Calif., actually has a going business in "bird props," which he ships to entertainers and circus acts all over the world. Miniature vehicles head the list, and bicycles are a favorite. The small bikes must be carefully machined and balanced (it takes a bird months to learn to ride one—but he never forgets how). Manning works with his own jigs and specially designed



Bird outfitter Hubert Manning builds bike wheel on special jig.



PM photos: Paul Wiles

Whatsit revealed

What started out, according to our primer on exotic cultures, merely as another way to generate a beauty of a thirst has become a sizeable tourist attraction for the town of Alice Springs, Australia. It's the annual "boat" race held on the town's prime natural feature—a dry riverbed. Procedure is this: You build a craft suitable for entry in any number of show or competitive categories, then variously carry or flog it along the sandy river bottom to the end of the course. Then you drink beer.



Demonstration which teaches kids about bike safety features a veteran performer known as "Officer Byrd"—on his Manning bike.

tools; a tandem bike for two birds will run you \$750. For untrainable avians, Manning will supply battery-powered jeeps, police car, and so on, at prices from \$650 up. So far, however, no parrot has been able to steer one and talk at the same time.

PM

when I planned to retire before fifty

this is the business that made it possible

a true story by John B. Haikey

Starting with borrowed money Duraclean gave me the opportunity for financial security...
In eight years I sold out at a profit and retired.



"Not until I was forty did I make up my mind that I was going to retire before ten years had passed. I knew I couldn't do it on a salary, no matter how good. I knew I couldn't do it working for others. It was perfectly obvious to me that I had to start a business of my own. But that posed a problem. What kind of business? Most of my money was tied up. Temporarily I was broke. But, when I found the business I wanted I was able to start it for a small amount of borrowed money.

"To pyramid this investment into retirement in less than ten years seems like magic, but in my opinion any man in good health who has the same ambition and drive that motivated me, could achieve such a goal. Let me give you a little history.

"I finished high school at the age of 18 and got a job as a shipping clerk. My next job was butchering at a plant that processed boneless beef. Couldn't see much future there. Next, I got a job as a Greyhound Bus Driver. The money was good. The work was pleasant, but I couldn't see it as leading to retirement. Finally I took the plunge and went into business for myself.

"I managed to raise enough money with my savings to invest in a combination motel, restaurant, grocery, and service station. It didn't take long to get my eyes opened. In order to keep that business going my wife and I worked from dawn to dusk, 20 hours a day, seven days a week. Putting in all those hours didn't match my idea of independence and it gave me no time for my favorite sport — golf! Finally we both agreed that I should look for something else.

"I found it. Not right away. I investigated a lot of businesses offered as franchises. I felt that I wanted the guidance of an experienced company — wanted to have the benefit of the plans that had brought success to others, plus the benefit of running my own business under an established name that had national recognition.

"Most of the franchises offered were too costly for me. Temporarily all my capital was frozen in the motel. But I

found that the Duraclean franchise offered what I had been looking for.

"I could start for a small amount. (Today, only \$3,488 starts a Duraclean dealership. The full cash price is \$11,588). I could work it as a one-man business to start, and operate from my home. No office or shop or other overhead, no salaries to pay. Equipment would fit in my car trunk. (I bought the truck later, out of profits.) Best of all, there was no ceiling on my earnings. I could build a business as big as my ambition and energy dictated. I could put on as many men as I needed to cover my volume. And I could build little by little, or as fast as I wished.

"So, I started. I took the wonderful training furnished by the company. When I was ready I followed the simple plan outlined in the training. During the first period I did all the service work myself. By doing it myself, I could make much more per hour than I had ever made on a salary. Later, I would hire men, train them, pay them well, and still make an hourly profit on their time that made my idea of retirement possible — I had joined the country club and now I could play golf whenever I wished.

"What is this wonderful business? It's Duraclean. And, what is Duraclean? It's an improved, space-age process for cleaning upholstered furniture, rugs and tacked down carpets. It not only cleans but enlivens and sparkles up the colors. It does not wear down the fiber or drive part of the dirt into the base of the rug as machine scrubbing of carpeting does. Instead it *lifts out* the dirt by means of an absorbent dry foam.

"Furniture dealers and department stores refer their customers to the Duraclean Specialist. Insurance men say Duraclean can save them money on fire claims. Hotels, motels, specialty shops and big stores make annual contracts for keeping their carpets and furniture fresh and clean.

"Well, that's the business I was able to start with such a small investment. That's the business I built up over a period of eight years. And, that's the business I sold out at a substantial profit before I was fifty."

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Better Things for Better Living

PHOTO HINTS

Clamp your photofloods



Make an adapter to clamp your photoflood to a tripod. Use a 6-inch length of wood and a steel insert (from any hardware store) with a 1/4-20 internal thread and a coarse exterior thread. Drill a 3/8-inch hole in wood and screw in the insert.—*Bob Brightman*

Temperature control



A block of Styrofoam can be cut to hold your film tank (leave a 1-inch "floor"). Push a thermometer next to tank. Warm block and tank in the sun (or heating pad) or cool with ice or freezer.—*Paul Jones*

Cheap contacts



An inexpensive contact printer can be made from a towel and a glass plate. Sandwich negatives and photographic paper between towel base and glass top. Use your enlarger to expose for prints as if you had a normal negative in the enlarger.—*Bob Mulligan*

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HINTS FROM READERS

Magnet aids lathe work

A permanent magnet is useful for holding small iron or steel parts as you insert or remove them from a chuck. When you try to hold them by hand, parts often slip from your fingers.

You can use a magnet to hold a workpiece in proper alignment and to place it in the chuck without inserting it too far. A magnet of moderate strength is preferable to a very strong one, since



strong magnets tend to grab the chuck. The photo above shows an old magnet being used to manipulate a short steel cylinder in a collet chuck.—Walter E. Burton

Extra door security

Here's a simple and inexpensive way to bar unauthorized entrance through a door. First, bore a 1/4-in.-diameter x 1-in.-deep hole on the inside of the door sill. Then, insert a bolt or screw which has the same diameter, but is slightly longer than 1 in., so that it protrudes from the hole. Make certain that the pin is long enough to stop the door from opening, yet not so long that an intruder could break through a glass in the door, reach in, and remove the bolt or screw.—D.M. Montgomery

Softening caulk

Caulking compound bonds better if it's applied warm. You can warm a tube or can of caulk in minutes by placing it in a pan of water and heating it on the stove. A cardboard tube of the compound won't get soggy if you place it in a sealed plastic bag before immersing it. Make sure that the water doesn't get too hot, since this can melt the plastic bag.

—Lane Olinghouse

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ULTRA LIGHTS: 4 mg. "tar", 0.4 mg. nicotine,
LIGHTS: 11 mg. "tar", 0.9 mg. nicotine,
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SCIENCE WORLDWIDE

Diamonds are a gas

Look for diamonds deep beneath the Earth's surface and you may find something very valuable: natural gas. At least that's the theory proposed by geophysicists Thomas Shankland of Los Alamos National Laboratory and Alfred G. Duba of Lawrence Livermore National Laboratory. According to the theory, diamonds are pushed toward the surface at various speeds. Diamonds and natural gas are both forms of carbon, the diamonds forming much deeper in the Earth's crust. Gas is generally found close to the surface, near pockets of decomposed plant and animal tissue. But some gas has been found in areas where no such decay has taken place.

If the diamond rises near the Earth's surface and cools in just a few thousand years, it keeps its gem structure. But if it's pushed to the surface and cooled more slowly by movements of the Earth's crust, the diamond decomposes into graphite. This may react with water to form methane—the principal component of natural gas.

Invasion of the purple plants

Wetlands in the Northeast and upper Midwest are being threatened by a new menace: purple loosestrife. The tall, woody and flowery weeds grow quickly, taking up space formerly inhabited by plants that feed ducks and other waterfowl.

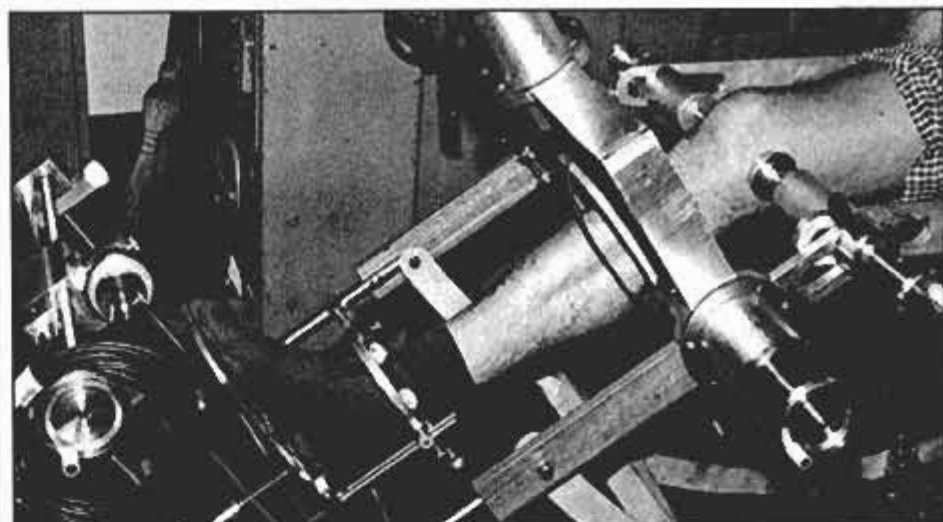
A European native, the hardy purple plant's seeds probably entered the United States aboard merchant ships more than a century ago. The plant's sudden rise over the past decade, however, is a mystery.

And although no one knows how to wipe out a purple loosestrife population, Cornell University graduate student Thomas Rawinski, working under the direction of wildlife biologist Richard Malecki, has found that Japanese millet plants will quickly overspread a purple loosestrife community and reduce growth to near zero. And the millet is also a welcome addition to wildlife diets.

Oldest feet yet

Footprints made 50 million years ago in the Wyoming Badlands are big news today. Johns Hopkins paleontologist Robert Bakker and his students have unearthed six Badlands sites where they found jaws and foot bones of *Cantius trigonodus*, a very distant primate relative.

New device helps repair body's 'shock absorber'



Diagnosing a knee injury is no big trick—you just X-ray the joint. Yet treating the injury often puts the doctor on a tightrope. There's no instrument to measure precisely the subtle motions of a knee. And misjudgment of a fraction of an inch may lead to incorrect setting or support for the knee, and arthritis, as well.

But now, Catholic University researcher Youngil Youm, and Walter Reed Army Medical Center surgeon David Tremaine, have created a device to measure all possible movements of an injured knee (above). In early experimental

use, doctors have found that the device calculates exactly how much knee movement is possible without causing muscular damage.

The examination is conducted on a standard table, where the patient rests the injured limb on a foot-to-thigh support structure. A potentiometer inside an around-the-calf clamp measures muscle and ligament movement, telling doctors where to apply a cast or bandage.

Youm calls the knee "a shock absorber for the body," adding that improper healing may place stress on other parts of the body.

The bones are said to include the oldest primate foot fossils ever found.

Bakker says, "These fossils prove that *Cantius* is entitled to wear the label 'euprimate.'" The term applies to any primate with a grasping toe, such as those found in living apes.

The Jupiter 'defect'

The "Jupiter effect" was supposed to occur last March, during the "grand alignment" of all nine planets in our solar system. It was going to set up tidal forces in the sun that would lead to earthquakes and other tragedies on Earth.

Obviously, nothing happened. Moreover, astronomer John Glaspey of Montreal's Observatoire Astronomique du mont Megantic reports that there have been greater forces exerted on the sun. He did a computer study of the total tidal forces on the sun from 1972 to 1994. Glaspey found 14 cases in which the tidal force was, or will be 25 percent stronger than that logged last March.

How much force was exerted on the sun during the supposed calamity period? Kitt Peak National Observatory's Gary Mechler told me that the grand alignment effects were probably near zero.

Coming: little green maps

In the 17 years since the first Mariner flyby of Mars, more than 50,000 photos have been taken of the planet's surface by orbiting vehicles. Two Viking landers have also sent back volumes of geological data.

There's so much information available, in fact, that former Viking Orbiter mission director Michael H. Carr, has taught a course on the geology of Mars at the California Institute of Technology. And this year he published the textbook. Called *The Surface of Mars* (Yale University Press, \$45), the book is loaded with aerial and surface photos of the red planet and replete with detailed maps and photos. **PM**



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PEST-PRUFE™ is small and unobtrusive—rugged, hi-impact case has black finish with brushed silver face. Measures only 3-1/2" x 4" x 3-1/2". Weighs about a pound.

Clear Your Home of Mice, Rats, Roaches and Other Pests -- and Keep Them Out!

PEST-PRUFE™ is a home-size version of the commercial pest control device that's safe for people, pets and the ecology. Try it in your home for 30 days.

They don't call them pests for nothing. The bugs and rodents of this world can make life miserable. Traps, sprays and poisons seem to have little effect . . . and professional exterminators don't come cheap. But now you can eliminate troublesome pests and keep them out thanks to new ultrasonic PEST-PRUFE.

The electronic PEST-PRUFE unit doesn't kill rodents or insects—it repels them. Early laboratory research showed that ultrasound was effective in modifying the behavior of mice and rats.

As commercial exterminators began using ultrasonic sound to control rodents, other studies indicated that certain frequencies affected the behavior of insects, too. Now, professional pest control companies acknowledge the usefulness of ultrasonics in controlling certain rodents and insects.

UNIVERSITY TESTED

The heart of this new, electronic marvel is a special quartz crystal speaker. It enables PEST-PRUFE to emit ultrasonic sounds that only pests can hear.

These ultrasonic frequencies "attack" the auditory and nervous systems of rodents and certain insects causing pain and discomfort. The pests are forced to abandon the covered area and will not return while you continue to use PEST-PRUFE.

A leading university tested PEST-PRUFE

PEST-PRUFE is effective in repelling:

Mice	Rats
Roaches	Carpenter Ants
Crickets	Silverfish
Water Bugs	Locusts
Fleas	. . . and many other pests

Note: In spite of some claims, studies show that ultrasound is not effective in controlling bats or spiders.

as absolutely safe for humans and pets. And since there are no poisonous chemicals, the ecology is not harmed in the slightest.

The ultrasonic output is above the hearing range of humans and household pets, so PEST-PRUFE is safe for use anywhere. It will not interfere with any electronic burglar alarms, fire or smoke detector, TV reception or other electronic equipment.

SET UP A BARRIER TO KEEP PESTS OUT THIS WINTER.

When you get your PEST-PRUFE you'll begin to notice some results in a few days. In two to six weeks your infestation will be eliminated. Then continual operation of your unit will prevent further nesting and inhabitations.

Even with colder weather approaching, you can keep pests from coming indoors as long as your PEST-PRUFE is in operation.

JUST PLUG IT IN.

There's no installation with PEST-PRUFE. All you do is plug it into any 110-Volt AC outlet. The solid-state electronics and quartz crystal speaker require only 5 watts of power—just pennies per month—and it's maintenance free.

Put PEST-PRUFE anywhere: home, apartment, store, warehouse, or factory. It's the perfect answer for facilities where food is stored or handled such as schools, hospitals, and nursing homes.

It will repel pests from areas that are difficult to seal-off such as garages, farm outbuildings, boats and vacation homes. One unit protects an area up to 2500 cubic feet.

YOU CAN'T BUY BETTER PEST PROTECTION.

PEST-PRUFE is state-of-the-art technology. Until now, commercial units used by professional pest control companies cost up to \$200—but lower cost solid-state components allow PEST-PRUFE to give you the same pest repelling power for only \$49.95 (plus \$2.85

shipping and handling). Now there's no need to empty messy traps or buy poisonous chemicals again and again.

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We urge you to try the PEST-PRUFE unit for 30 days. If you don't see proof that it is the most advanced, efficient pest eliminator available today, return it for a complete, no-quibble refund—including return postage. You are protected by a one-year manufacturer's warranty as well as Shelburne's 26-year reputation for satisfied customers.

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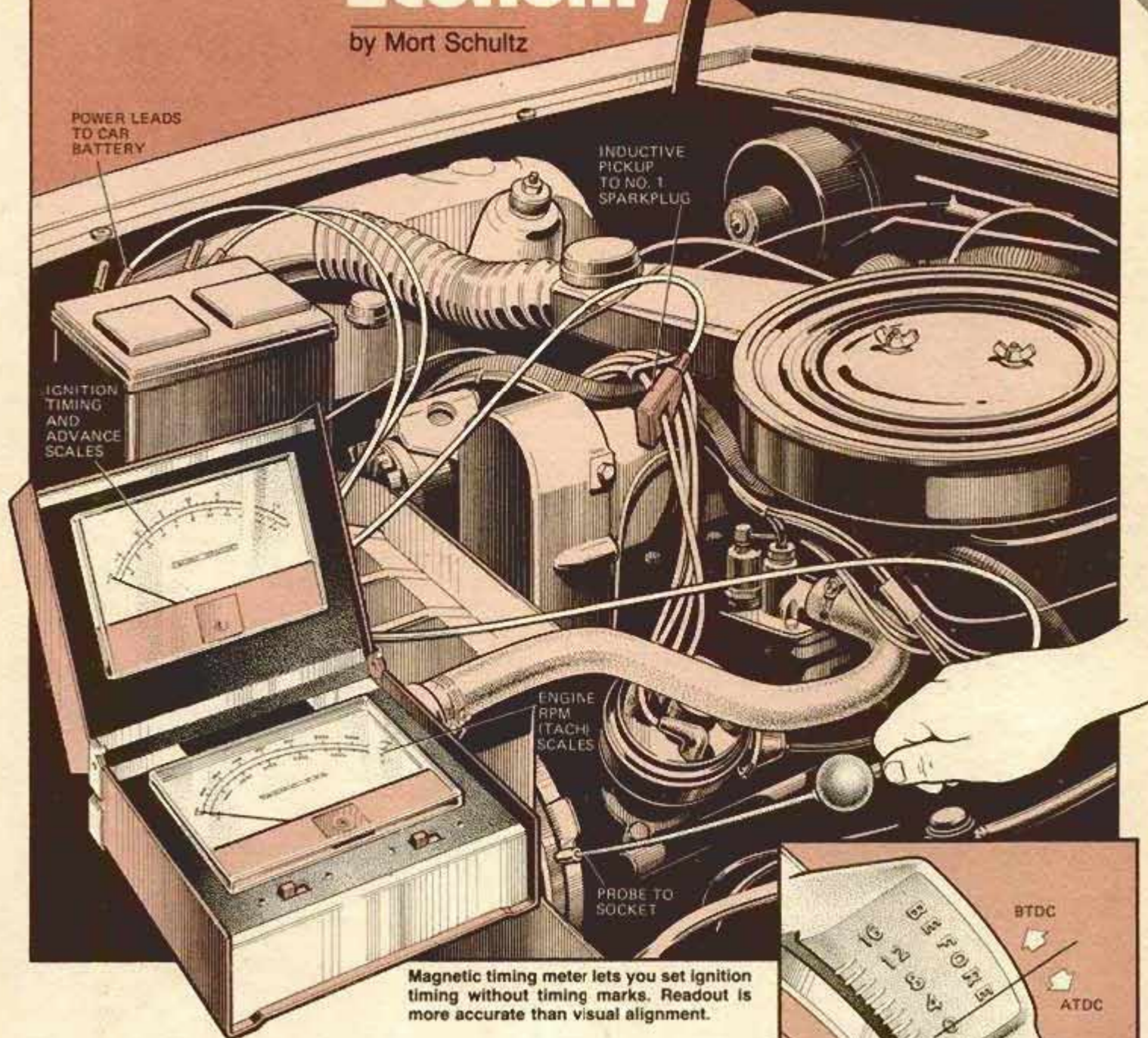
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Timing Your Engine For Performance And Economy

by Mort Schultz



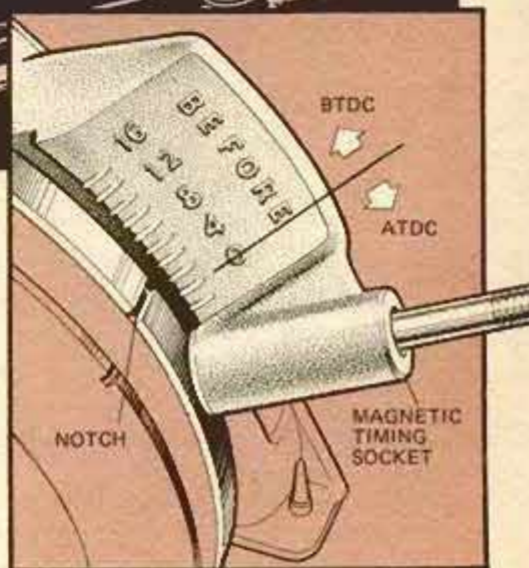
Magnetic timing meter lets you set ignition timing without timing marks. Readout is more accurate than visual alignment.

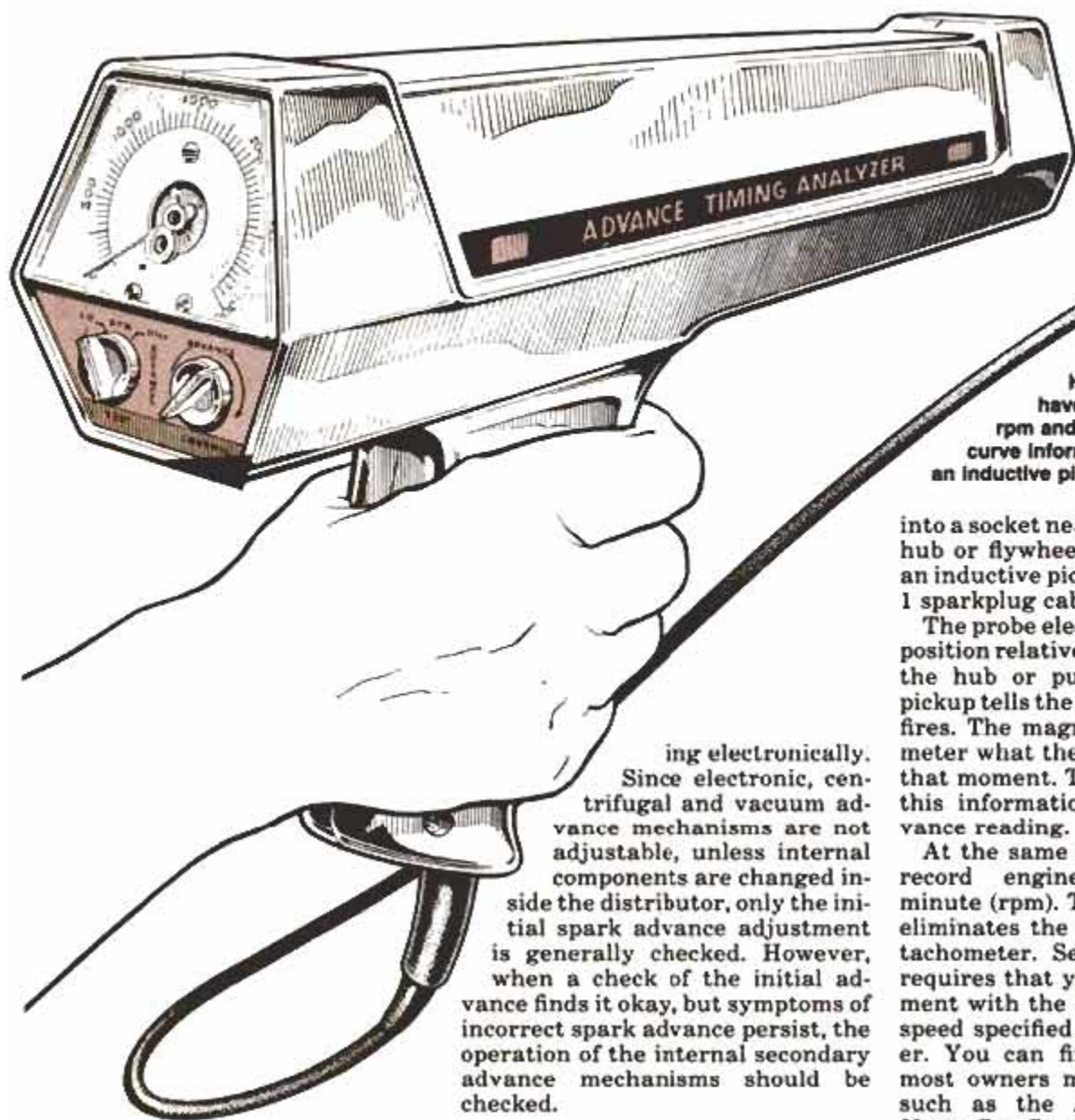
Smooth, powerful, efficient engine performance is impossible if the ignition spark does not occur at exactly the right time. That's why a check of initial spark advance is necessary when your car is tuned up or when poor performance symptoms suggest that a spark advance problem is present.

Such symptoms include hesita-

tion, lack of power, poor fuel economy, overheating, detonation and high idle emissions.

The initial spark advance figure is always given in degrees. This figure describes the relative position of the piston at the moment of spark. An advance specification of 5° BTDC means that spark occurs five crankshaft degrees before the No. 1 cylin-





High-priced timing lights have a built-in tach to show rpm and they can give advance-curve information. Lights that have an inductive pickup are easiest to use.

into a socket near the engine's crank hub or flywheel. Then you connect an inductive pickup clamp to the No. 1 sparkplug cable.

The probe electronically senses its position relative to an index mark on the hub or pulley. The inductive pickup tells the meter when the plug fires. The magnetic probe tells the meter what the crank position is at that moment. The meter translates this information into a spark advance reading.

At the same time, the meter can record engine revolutions per minute (rpm). Therefore, the meter eliminates the need for a separate tachometer. Setting initial timing requires that you make the adjustment with the engine running at a speed specified by the manufacturer. You can find tuneup specs in most owners manuals or in books such as the *Popular Mechanics/Motor Car Care Guides* or *Saturday Mechanic Car Care Illustrated*. The tachometer function also permits precise measurement of mechanical and vacuum advance operations at engine speeds above idle.

With a timing light, you have to be able to observe crankshaft position as the plug fires. With a timing meter, you obtain numerical readouts of ignition advance. Readouts are checked against engine manufacturer specifications. By checking advance at speeds above idle, vacu-

ing electronically.

Since electronic, centrifugal and vacuum advance mechanisms are not adjustable, unless internal components are changed inside the distributor, only the initial spark advance adjustment is generally checked. However, when a check of the initial advance finds it okay, but symptoms of incorrect spark advance persist, the operation of the internal secondary advance mechanisms should be checked.

Magnetic timing

For many years, stroboscopic timing lights have served as the principal means of checking ignition timing. Now, however, there's a better—but more expensive—way to check ignition spark timing: the magnetic timing meter.

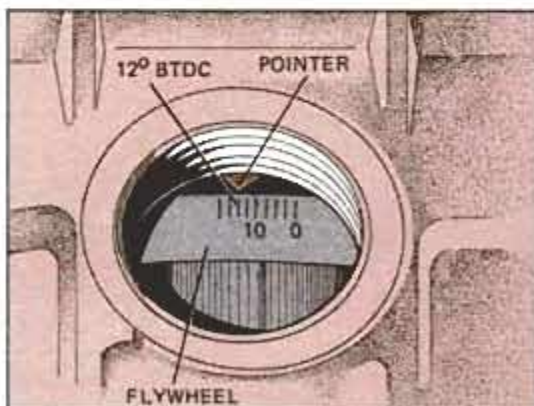
Magnetic timing is also called monolithic timing and electronic timing. It's done by connecting the test instrument to the car battery and inserting an electronic probe

der's piston reaches the top of its bore, or top dead center. This specification is called *initial* because it is measured while the engine is idling and with all spark control devices disabled.

Spark control devices are necessary, because the piston moves faster at high rpm and because the spark advance requirements of an engine change as load changes. These devices vary the amount of advance under different conditions.

On most cars, this variation is accomplished by means of a vacuum diaphragm and centrifugal weights. The vacuum diaphragm moves the points or electronic pickup within the distributor cam or trigger and, thereby, changes the moment of spark. Centrifugal weights on the top of the distributor shaft move the rotor in relation to contacts within the distributor cap, again changing the moment of spark. Late-model cars equipped with computer-controlled systems may vary spark tim-

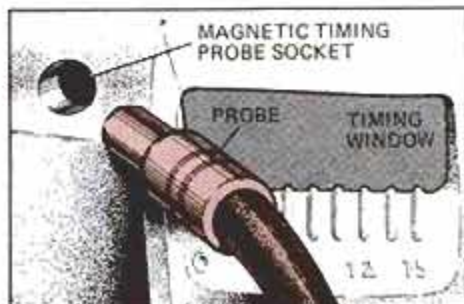
Timing marks can be extended. On some cars, this may be needed just to check timing. On others, you may want to extend the scale to check secondary advance. In the example on the right, a 16° scale is being expanded to 20° before top dead center (BTDC). First, lay a piece of tape across the scale. Then, make two marks, A and B, on the tape, representing 4°, the distance between 12° and 16° marks. As shown (far right), move the tape over to add a distance equal to 4° to the scale. Finally, mark 20° point with a punch.





um and centrifugal advance mechanisms can also be checked.

The stroboscopic timing light can also be used to check vacuum and centrifugal advance. However, since the total advance of many cars approaches 45° at high engine speeds, the scale that is attached to the engine for checking idle speed advance won't serve for this purpose. To check high speed and intermediate advance with a conventional timing light, you would have to mark your crankshaft pulley with degree indications up to about 50° or install one of the timing tapes that are generally available for some engines through high-performance parts outlets.



Cars with timing mark scale positioned at the engine's rear may also have a magnetic timing probe socket. Look for it.

Buying a timing meter

Before deciding that you want to set timing electronically, check to see if your engine has a timing socket. If it doesn't, you can't use a meter.

If you buy a meter from an auto parts dealer, make sure you can return the equipment if the probe doesn't fit the socket on your engine.

Most people aren't ready to shelve their timing lights. Either their engines don't have magnetic timing

sockets, or they don't want to pop for a meter (figure on spending at least \$200).

Even if your car doesn't have magnetic timing sockets, you can still time most ignition systems using a light. But accuracy depends on how you do it. Let's run down the steps.

1. Note the initial spark advance figure on your underhood vehicle information label. If the label is missing or illegible, get the information from another source.

2. Make the specified timing mark stand out by painting it white or coating it with white chalk. Also paint or coat the pointer or index mark.

3. With the engine off, connect a tachometer, following the instructions that come with the instrument. Some timing lights have a built-in tachometer, as well as a distributor advance scale. They cost more than conventional timing lights, even more than some magnetic timing meters. But you may want to look into them if you're in the market for both a timing light and tachometer.

If you have a GM car equipped with a High Energy Ignition (HEI) system that has the ignition coil inside the distributor cap, but the engine doesn't have a diagnostic connector, you'll need an adapter to connect the tachometer. The adapter hooks to the terminal marked TACH on the distributor, and the tachometer is connected to the adapter.

If your GM engine has a diagnostic connector, attach the tachometer to terminal No. 6 of the connector (see *Troubleshooting With GM's Diagnostic Connector*, page 35, June '81).

You can probably buy a tachometer adapter from an auto parts store. If not, you can order it from Borroughs Tool and Equipment Corp., 2429 North Burdick St., Kalamazoo,

Mich. 49007 or from Kent-Moore Tools, 29784 Little Mack, Roseville, Mich. 48066.

You can also use the same adapter on a Ford or AMC engine that has a cover over the terminals of the SSI (Solid State Ignition) coil.

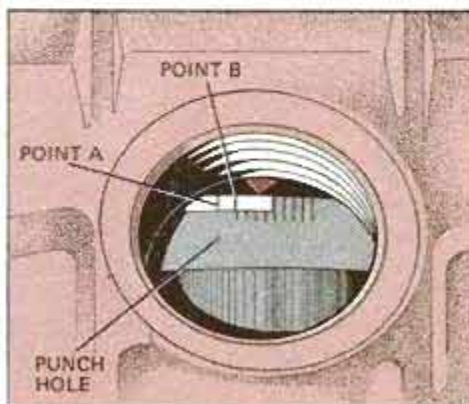
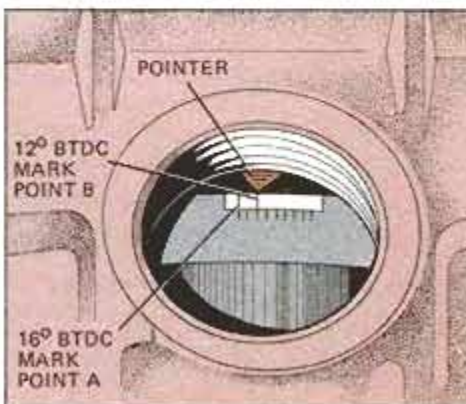
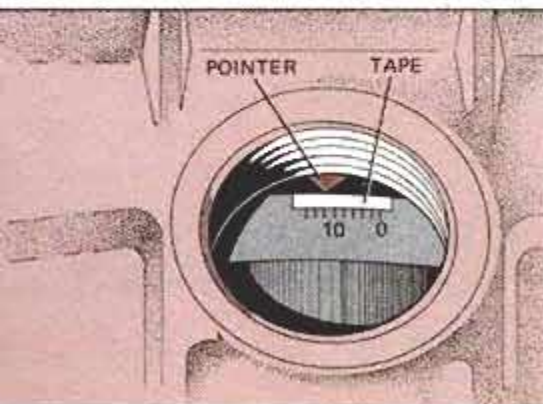
4. Connect the timing light according to instructions that come with the instrument. Hopefully, your timing light has an inductive pickup, so you can clamp the pickup right on the sparkplug cable going to the No. 1 cylinder. If your timing light is not an inductive type, place an adapter between the No. 1 sparkplug and its cable, and connect the timing light lead to the adapter.

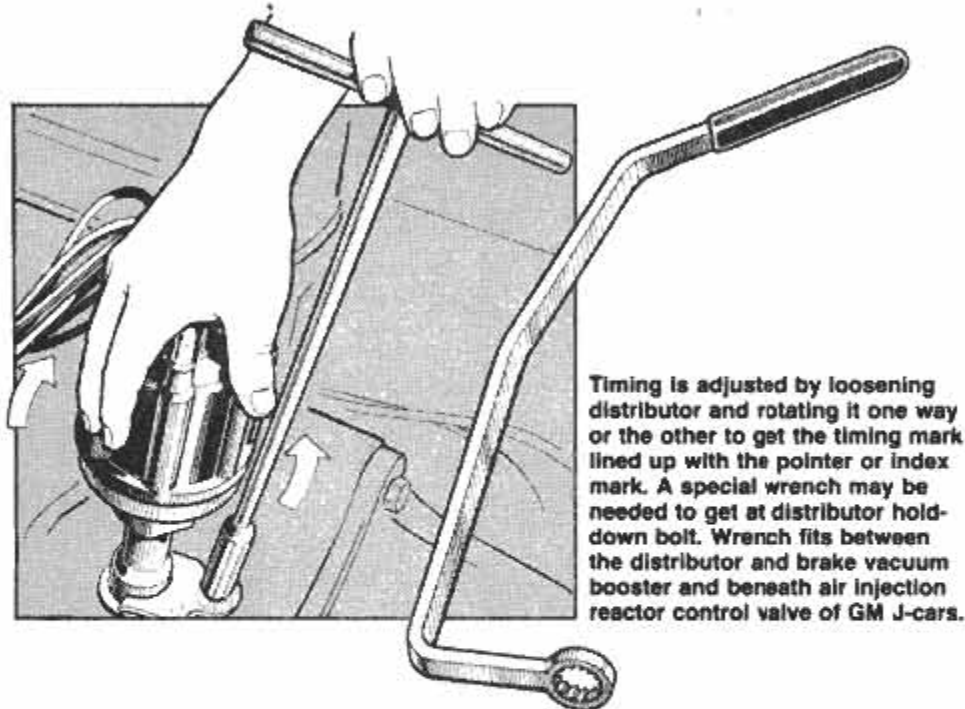
If you don't have an adapter, don't time the engine before you get one. Piercing the sparkplug cable to connect the timing light lead ruins the cable. It can cause a hard-to-trace engine misfire. Voltage jumps to ground through the broken cable insulation before it gets to the sparkplug. The sparkplug, therefore, can't fire.

5. If your distributor has a vacuum advance (many 1981-'82 models don't), you probably have to disconnect the vacuum hose from the vacuum advance chamber and plug the end of the hose with a pencil or golf tee. If this is a requirement, it says so on the vehicle information label in the engine compartment. Other requirements, such as the speed at which timing should be checked, the point to which the engine should be warmed, and what accessories should be on or off during the test, will also be noted on the decal. On cars equipped with electronic spark control, the label may instruct you to unplug an electrical connector. *Do this with the ignition turned off.*

6. Start the engine and adjust idling speed, if necessary. Then, if nothing blocks your view, aim the timing light at the specified timing mark and sight down the center of the light barrel. Hold the light straight.

If you can't get a clear view of the timing mark by sighting down the barrel of the timing light, sight





Timing is adjusted by loosening distributor and rotating it one way or the other to get the timing mark lined up with the pointer or index mark. A special wrench may be needed to get at distributor hold-down bolt. Wrench fits between the distributor and brake vacuum booster and beneath air injection reactor control valve of GM J-cars.

along the side of the light. Get your eye as close to the instrument as possible, but don't get your hand or hair caught in the fan.

The pointer or index mark should line up with the mark and both should appear stationary. If they're not aligned, adjust timing by loosening or removing the clamp that holds the distributor. Keep the specified timing mark under the pulsating flashes of the timing light as you rotate the distributor until the timing mark and pointer or index mark are aligned. If they don't appear stationary, you may have a bad distributor.

Distributor hold-down bolts of some newer cars are hard to reach without specially made wrenches. If you need a special wrench for your car, check your local auto parts store or the parts department of a dealer selling your make of car.

If the distributor housing is stuck, wrap a strap wrench or oil-filter wrench around it and try turning. If it doesn't turn, let the engine cool and give the base of the distributor a shot from a dry chemical fire extinguisher. Then try it.

7. After you set timing, reposition and tighten the distributor-holding clamp. Then, recheck the adjustment to make sure it hasn't wavered. Finally, disconnect instruments and reattach the vacuum advance hose or electrical connector.

If timing marks for your engine are at the rear of the engine and are seen through a hole in the bellhousing, the hole may be fitted with a pull-out rubber or plastic cover to keep out dirt. Reinstall the cover after making the adjustment.

Secondary advance mechanism

When initial timing is adjusted to the correct specifications, but symp-

toms of incorrect spark advance persist, the vacuum and centrifugal advance mechanisms should be checked for proper operation.

Reconnecting the vacuum advance hose with the engine running at 2,000 rpm, while watching the timing indicator with your light, will tell you if the vacuum advance is functional. But a more specific test is necessary to ensure that it's working the way it should. Increasing engine speed while watching the indicator should cause the centrifugal weights to advance the timing. But again, this procedure doesn't tell you if this mechanism is working *correctly*. It just tells you it's working.

Reasonably accurate tests of centrifugal and vacuum advance functions are fairly easy to perform. But to perform this check with absolute precision, a distributor testing machine is necessary. Either way, you need vacuum and centrifugal advance specifications for your car. These aren't on the underhood information label, but they're included in most repair manuals, such as the *Motor Auto Repair Manual*. Because specifications may vary within a single model year, the various applications are generally listed by distributor number. As an example, here's the procedure for checking secondary advance mechanisms on a 1978 Ford Fairmont with distributor No. D7EE-CA.

Centrifugal advance is checked with the vacuum line to the distributor disconnected and plugged.

Specifications indicate that centrifugal advance for this distributor should begin with 1° advance at 800 rpm. At 1,500 rpm, total centrifugal advance should be 1° to 3½° at 2,500 rpm. This distributor should provide 7½° centrifugal advance total. To check, accelerate the engine while

watching the marks on the timing indicator with your light. Again, this is much easier to check with a magnetic timing meter and tach combo, since some advance specs go beyond the range of the timing marks on the crank pulley or indicator scale.

If the indicator scale on your engine doesn't extend to the range necessary for checking advance mechanisms, you can extend its range by measuring the width of a 5° increment of the scale and then painting additional pulley marks.

A hand vacuum pump is necessary for accurate testing of vacuum advance. Figures for vacuum advance are given as a certain amount of advance at a specific vacuum level.

The specs for our Ford distributor call for 13½° vacuum advance at 15¼-in. vacuum. The vacuum advance should begin operating at 2.3-in. vacuum. To check, adjust idle to a point below that figure where centrifugal advance begins, in this case, 800 rpm. Then attach a hand vacuum pump to the distributor's vacuum diaphragm with the engine idling.

Point your timing light at the scale and begin pumping up vacuum. Note the point where timing starts to advance. Continue pumping until you reach the vacuum figure where advance should be full. Compare the amount of advance indicated on the crank pulley to the specification. You don't have to split hairs to see if it's within half a degree. Just check if it's working approximately the way it should.

Again, on most cars you'll have to extend the timing scale on the crank pulley if you're using a light, rather than a timing meter. Remember, if the increase in idle speed that results from the vacuum advance raises the idle above the figure where centrifugal advance starts, it will throw off your reading.

Some mechanics disable the centrifugal advance by securing it in position with little strips of duct tape while they're checking vacuum advance. But this is only practical on distributors where the centrifugal advance weights are directly under the rotor.

If the vacuum advance diaphragm is defective, replace it.

If the centrifugal advance is not functioning, it could be the result of sticking due to rust or lack of lubrication. The centrifugal advance can also fail because of weak springs or worn advance weights. Worn advance weights may result in excessive centrifugal advance, while worn springs would result in the advance coming in at a lower rpm than specified.

PM

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CAR CLINIC

SOLUTIONS
FOR MECHANICAL
HEADACHES

BY
MORT SCHULTZ



Self booster

The brakes on my 14,000-mile Chevrolet Monte Carlo have no power boost after the car sits idle for several hours. After driving a few blocks, the brakes begin working normally. The dealer installed a new vacuum booster and filter, but it hasn't solved the problem. Can you give him a hand?—Tom Self, Roanoke, Va.

Tell him to order a new vacuum-booster vacuum check valve (part No. 18003614) to replace the valve booster, which may have a flaw that's causing it to leak. The leak prevents power boost of the brakes until there's a sufficient buildup of vacuum in the booster to compensate for the loss. Also, make sure the rubber grommet that seals the joint between the check valve and vacuum booster housing is firmly seated. If it isn't, vacuum will be lost, and there will be a subsequent loss of power boost.

Pinning his hopes

I have to replace the kingpins of my 1980 Ford F-150 pickup (300-cu.-in. engine) after only 26,000 miles of driving. I admit that I haven't lubricated the vehicle according to the maintenance guide. However, a front-end mechanic told me that frequent kingpin replacement is common with Ford vans and pickups which receive lubrication on schedule. Is there a defect here?—Michael J. Sockoloskie, Coatesville, Pa.

There have been instances of premature kingpin failure, but the truck engineers at Ford Parts and Service contend that problems are caused by lack of proper maintenance. To avoid trouble, owners of vans and trucks have to observe these instructions:

1. Follow the scheduled maintenance interval for your van or truck as given in the owner's manual. In your case, Mr. Sockoloskie, lubrication is called for once every 7,500 miles unless the vehicle is used off the road under dusty conditions or is driven through water and/or mud. If the vehicle is an off-roader, grease

kingpins every 1,000 miles. If it's driven through water and/or mud, lubricate the suspension that same day.

2. Don't mix different kinds of grease. In production, Ford greases kingpins with a lithium-base grease. Lithium-base grease is not compatible with sodium-base grease. When the two are mixed, they form a rock-hard substance that blocks grease from reaching the innards of the kingpins.

Containers of grease aren't often marked "lithium" or "sodium" so there's no way of knowing what you're using. To be on the safe side, buy grease from a Ford dealer. Cartridges will carry the correct Ford specification number for lithium-base grease, which is ESA-M1C75B.

3. Give kingpins sufficient grease. Many guys pump the grease gun just until they see grease oozing from a spot. That's not enough. Grease is supposed to exude from

several specific points to flush kingpins sufficiently. Locations of points are difficult to describe, but a sketch in service bulletin 8210 (5/24/82) shows them. If you can't get a Ford dealer to let you look at the sketch, my advice is to keep greasing kingpins until grease flows from several points.

Those who own relatively new F-100 and F-150 Ford pickups may not have kingpins on their trucks. Some late 1981 and all 1982 models are equipped with ball joints, rather than kingpins.

"E" for effort on an "A"

Since the first day it hit the road, the 3.8-liter V6 engine (automatic transmission) of my 1981 Pontiac LeMans when cold has hesitated, stalled and spit back through the carburetor on acceleration. The dealer has had the car 10 times and has consulted with the factory field representative. Another dealer had the car nine days. No one has come up with a solution. Now, they're telling me that I can't expect the engine to perform any better until it warms up. Please help.—John M. Suit, Annapolis, Md.

I can't believe that everyone is overlooking technical service bulletin 81-T-8, but it seems that way based on the long, but partial, list of repairs and adjustments you provided in your letter. Although the dealers have done many things, including replacing sensors of the Computer Command Control system, it doesn't appear that they've made the repairs called for by the service

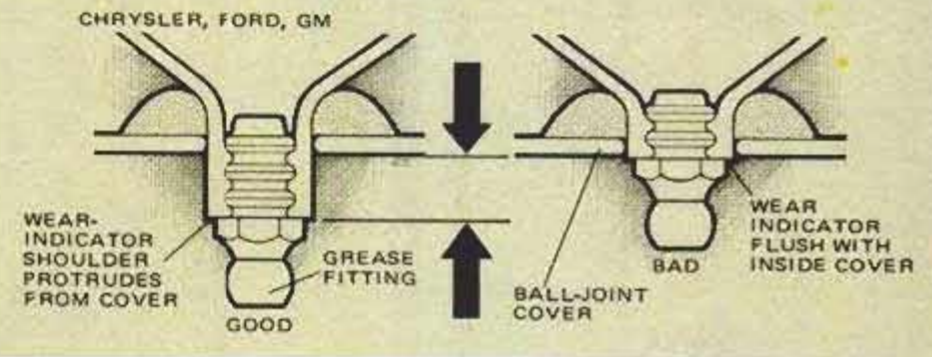
(Please turn to page 42)

The joint is jumping

In 1973, GM began putting ball joints with wear indicators in some of its cars. Since then, GM's use of self-diagnosing ball joints has expanded to all models, and AMC, Chrysler and Ford have installed them on many models. It's important to remember that these ball joints must remain "loaded" when you check them; that is, the car should be on a level surface and the wheels on the ground, not lifted.

To check Chrysler, Ford and GM joints, it's important that you wipe the grease fitting or plug and wear indicator shoulder clean. Scrape a screwdriver or fingernail across the cover. If the surface is smooth, the indicator shoulder is flush or inside the cover. This indicates that the joint is worn and should be replaced.

To check ball joints of the AMC Pacer, remove the plug from the lower ball joint and insert a stiff wire in the lubricating hole until it hits the ball stud. Scribe a mark on the wire where it aligns itself with the outer edge of the hole. Now, measure the wire from its end to the scribe mark. If the wire is $\frac{7}{16}$ inch or more, replace the ball joint.



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CAR CLINIC

(Continued from page 40)

bulletin. The service bulletin is entitled "Cold Driveability and/or Cold Start Difficulties" and applies to all GM "A" series cars with the 3.8-liter engine. After attempting certain adjustments, dealers are instructed to install a new choke and cam kit (part No. 17068034).

If this fails to correct the problem, look for a vacuum leak in a system that is active only when the engine is cold.

Another possibility would be an inoperative cold-start spark advance system. Mechanics who are experienced in troubleshooting cold start problems generally try to keep such problem vehicles overnight. In the morning, they make a visual check of the system as the car warms.

Knock, knock. Who's there?

Am I being taken for a dummy by my Ford dealer? He's telling me that a rumbling knock as I drive my 1981 Granada over sharp bumps, such as railroad tracks, in cold weather is normal. He says that Ford calls this a "strut knock," and it's to be expected with MacPherson struts. What do

you say?—Rick Seibert, Sawyer AFB, Mich.

The Ford and Mercury dealers weren't aware that the front rubber isolator mounts originally installed on Granadas and Cougars with MacPherson struts are made of synthetic material that becomes inflexible in cold weather. That sets up a situation causing struts to knock. Ford just issued a new natural rubber mount. Uppers and lowers for the front struts are contained in a kit (part No. E2DZ18198A); it became available in June.

Some like it hot

Your articles on solving cold-weather problems with the GM 5.7-liter diesel engine (Saturday Mechanic, page 37, Jan. '82 and page 35, Feb. '82) prompt me to write. One of them mentions that GM has available as an option a fuel-line heater kit that helps lower the cloud point of diesel fuel in cold weather. Can I use this on my Volkswagen diesel?—Clarence D. Wiloughby, Rockford, Ill.

For my "uninitiated-in-diesel-terminology" readers, the cloud point is the temperature at which the waxy

Hot and stuffy

If your van or pickup truck is equipped with dual fuel tanks, do not—I repeat, do not—run one tank dry before switching over to the other. Doing so will create a super-lean fuel condition that can send temperatures in the catalytic converter soaring to a point where the catalytic substrate melts. You'll find out about it when the high-exhaust back pressure that's created as the melted substrate blocks exhaust gases creates an engine driveability problem, such as missing. If that's not bad enough, the converter is very expensive to replace. Allowing a passenger car or light truck with a single fuel tank to run out of gas can cause the same trouble.



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Made of durable blue nylon, this bag is as versatile as it is stylish.

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legendary LT-48, our incredible Edge, the colorful Crown Jewels, and many others.

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*as defined by Federal Hazardous Substances Act.

constituent present in diesel fuel congeals and forms particles. For No. 2 diesel fuel, which is the most common sold for use in motor vehicles, the cloud point occurs at approximately 20° F. As temperature falls below this, wax particles get larger and are trapped by the fuel filter, which can clog. A clogged fuel filter cuts off the flow of fuel to the engine. The job of a fuel-line heater is to melt wax before it reaches the fuel filter.

Now, back to the question of whether there's a fuel-line heater for VW diesels. Yes, there is! In fact, there are two kinds you can get. One uses heated coolant. It's the warmth from coolant to the fuel as the fuel circulates through the element of the fuel-line heater. With the fuel-inlet temperature at 0° F., this heater provides sufficient warmth to heat fuel to about 60° F. This heater will fit all domestic- and foreign-made diesel cars and trucks.

The one drawback to a coolant heater is that coolant must be heated before the heater is effective. On a really cold day, it's debatable whether the cloud point of fuel is reached before coolant gets warm enough to stop wax clogging. Letting the engine idle for two minutes

before starting often helps. At idle, the fuel-flow rate is minimum, reducing the chance that wax particles will plug the fuel filter before warm coolant melts them. For more information, write directly to the Sales Dept., Phillips Temro Inc., 9700 West 74th St., Eden Prairie, Minn. 55344.

The other type of fuel-line heater is an electrically operated coil that automatically turns on and gets hot as soon as you turn on the START key. When the ambient temperature drops below 30° F., its effect is practically instantaneous.

The electric fuel-line heater heats fuel to a temperature that's 20° F. above the fuel inlet temperature. Therefore, it's effective down to a fuel inlet temperature of about minus 10° F. Below that, waxing will begin in spite of the heater. For more details about the electric fuel-line heater, contact the Sales Dept., Diesel Systems Group, Stanadyne Inc., Hartford, Conn. 06102.

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.

SERVICE TIPS

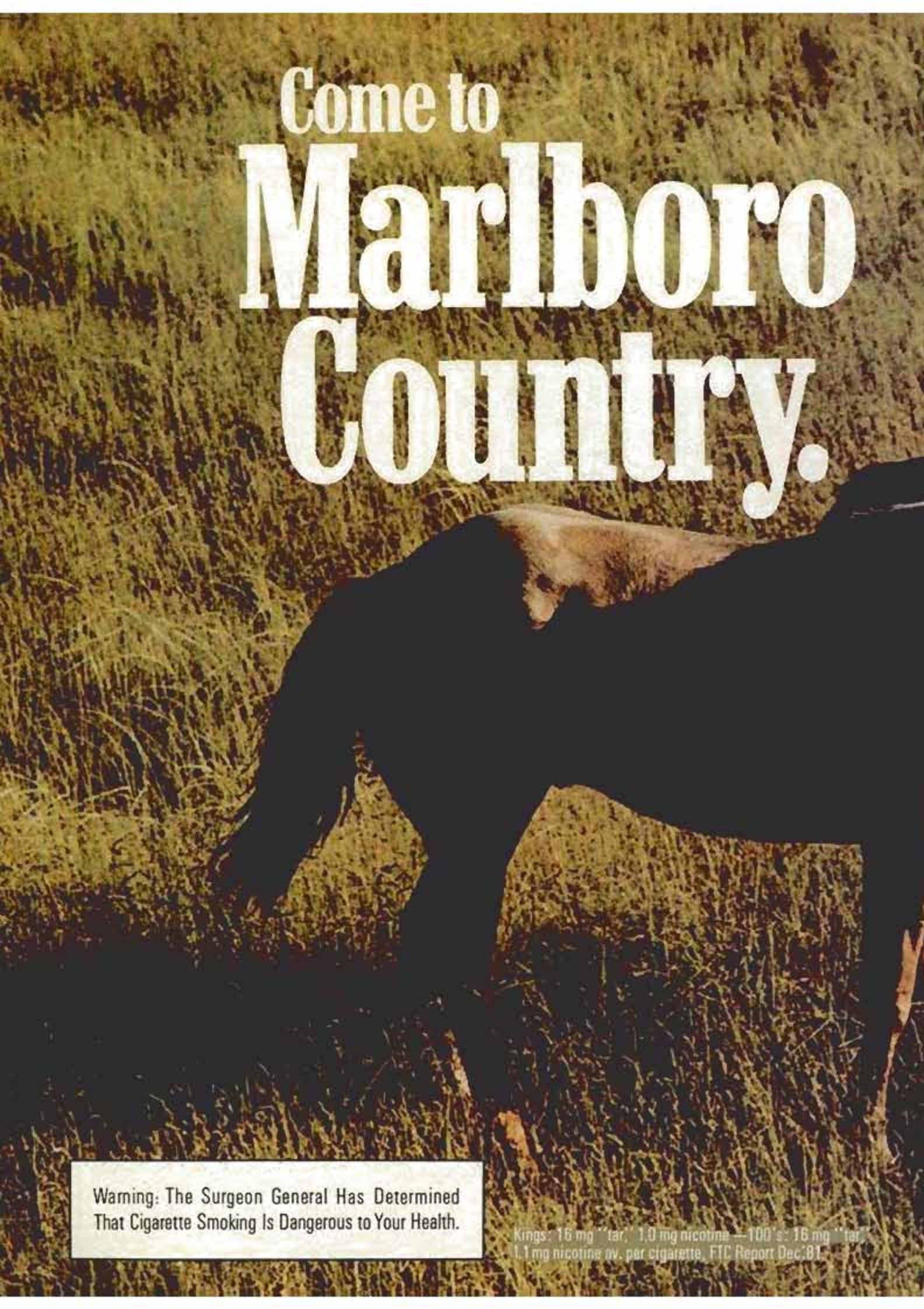
■ Early production model 1982 Omegas equipped with 2.8-liter V6 engines may foul sparkplugs if used often for short trips. (The same holds true for other '82 GM cars with this engine.) Fouled plugs may prevent starting or cause rough idling and stalling. You should be using AC R43CTS (engine VIN X) or AC R42CTS (engine VIN Z) plugs. Also, the vacuum breaks, valve rod and choke unloader should be reset to specs not in the service manual. Complete instructions are on page 53 of the April 1982 Oldsmobile Service Guide.

■ You can get rid of a torsional vibration in your 1982 New Yorker, Diplomat, Gran Fury, Cordoba or Mirada equipped with 318-cu.-in. engine and 2.26 rear axle. The vibration—a continuous, drumming or droning sound from the drive train—occurs around 40 mph. Service bulletin 21-08-82 recommends installation of a new torque converter lockup spring (Part 4202672) in the transmission valve body.

■ If you're seeking the cause of an engine performance problem in a Ford Escort or Mercury Lynx, and notice an oil track inside the distributor cap, look elsewhere. This oil track is normal and doesn't affect engine operation.

■ I've received letters about brake pulsation in 1980 and 1981 Chevy Chevettes after brake jobs are done. That's because brake jobs are being performed according to instructions in the shop manual, which is okay. However, Chevy has added other procedures (see service bulletin 81-T-60) to be followed that eliminate the pulsation.

PM



Come to
Marlboro
Country.

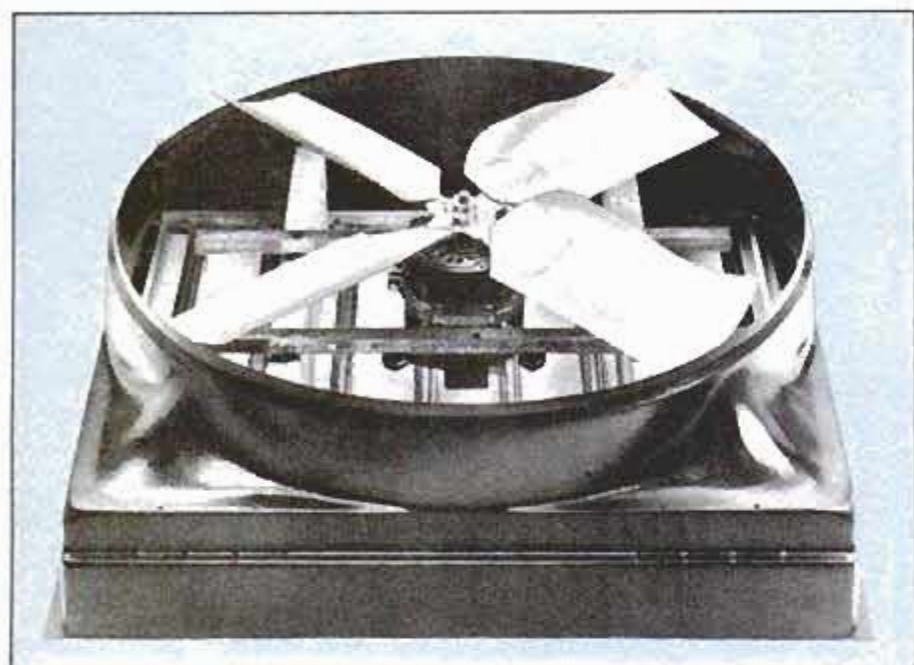
Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

Kings: 16 mg "tar," 1.0 mg nicotine — 100's: 16 mg "tar,"
1.1 mg nicotine av. per cigarette, FTC Report Dec. 81



Marlboro Red or Longhorn 100's—
you get a lot to like.

NEW NOW for home and shop



A

A The Nautilus Whole House Ventilator, designed so you can install it yourself without cutting ceiling joists, pulls cooler outside air into the house through downstairs windows and expels superheated attic air. Claimed to consume only 20 percent as much power as central air conditioning, the 24-in.-dia. fan lists for \$239.90, plus \$67.90 for ceiling shutters; the 30-incher is \$259.90, plus \$89.90. Made by Nautilus Industries, Box 159, Hartford, Wis. 53027, it's available through home centers.

B Aerosol paint remover softens and bubbles paints, enamels, polyurethanes and assorted finishes, so they can be scraped or scrubbed away. Spray can application makes it easy to apply in hard-to-reach areas. Called Formby's Paint Remover, from Formby's Inc., Box 667, Olive Branch, Miss. 38654, it comes in 15-oz. spray cans for about \$6 at hardware and paint stores and home centers.

C A two-speed, portable, metal-cutting band saw slices through solid steel bars up to 3⁷/₃₂-in. dia. and rectangular stock, measuring up to 3⁷/₈×4¹/₈ in. besides cutting pipe and conduit. Model 1010's Hi-Lo 110-volt a.c./d.c. motor draws 4 and 7.5 amps. to maintain cutting blade speeds of 200 and 250 feet per minute. Planetary gears on ball-bearing shafts drive the blade, while tension controls ease blade changing. The 1010 is made by Skil Corp., 4801 Peterson Ave., Chicago, Ill. 60646. Its suggested list price is \$339 from lumberyards, building supply houses and jobbers supplying building contractors.

D The Classic Home Alarm System for houses or apartments is activated by a code number the homeowner can change himself. Its security panel has a button for POLICE which alerts a central station to call police immediately; FIRE to turn in an alarm; NO DELAY to put normally delayed signals from protected points on instant alarm; and ON WATCH to sound a low warning tone if someone enters or leaves through a protected point while the system is partially activated. The maker, Honeywell Inc., Honeywell Plaza, Minneapolis, Minn. 55408, installs systems starting at \$1,390 and monitors them for \$20 per month.

FM



B



C



D

AIM HIGH



Reach for new horizons.

It's never easy. But reaching for new horizons is what aiming high is all about. Because to reach for new horizons you must have the vision to see things not only as they are, but as they could be. You must have the dedication to give the best you have. And you must have the courage to accept new challenges.

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THE PM GARAGE

CAPSULE REPORTS ON NEW AUTO PRODUCTS

Bike in sheep's clothing

Many motorists have discovered the comfort of quality sheepskin seat covers. Now the same posterior pampering also can be enjoyed by bike buffs.

Luftmeister's sheepskin motorcycle seat covers come in two sections, for rider and passenger. The covers



Genuine sheepskin motorcycle seat covers really reduce fatigue on extended trips.

are made of 100-percent natural sheepskin, have elastic straps for a universal fit and Velcro tabs to keep them in place. We found that the covers reduce fatigue on long trips. They come in brown-beige, white or silver and cost \$59.95 at your local BMW motorcycle dealer or from Luftmeister Inc., 135 East Stanley St., Compton, Calif. 90220.

—Joel Breault

Roll-up tool pouch

Here's a handy way to carry a basic set of tools in a motorcycle saddlebag or in the corner of your car trunk. It's a roll-up tool pouch that opens up to 17 x 19 inches. The pouch has one large pocket for an owner's manual or shop rag, eight narrow pockets to hold open-end wrenches or pliers, and four shallow pockets for a spare sparkplug and



Roll-up tool pouch is a handy, space-saving way to carry along a basic tool set.

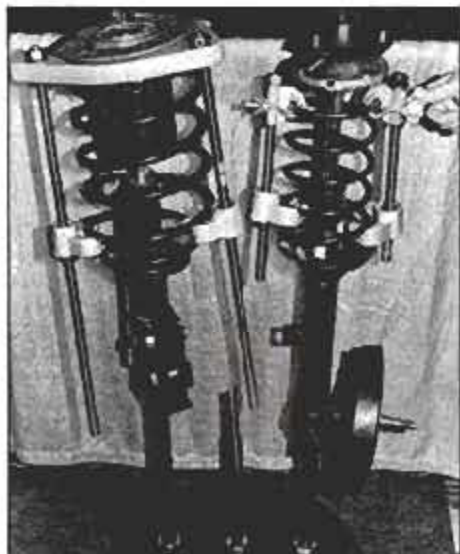
the like. We found the tough vinyl pouch offered good tool protection and the two webbed straps with plastic cinch buckles kept the pouch

securely rolled up. The Tool Pack is \$17.50 (without tools) from Rev-Pack, Box 175, New Cuyama, Calif. 93254.—T.A.

Strut compressors

One thing that makes us nervous about changing a MacPherson strut is the chance that the spring compressor will slip off the strut. The compressed spring, suddenly released, can cause serious injury.

We found two spring compressors—one for GM X-car struts, the other for all other models—that solve this problem. The X-car strut compressor uses a top plate with



No-slip MacPherson strut compressors are made for X-cars (left) and others (right).

three rods to secure the tool. The general-purpose model uses safety hooks held by wingnuts. We tried both models and found no danger of the tool slipping off the struts.

Both compressors share the same compressing fingers. They are offered together with only three fingers, for \$124, or separately, at \$100 for the X-car tool and \$47 for the general-purpose unit. Available at auto parts outlets, the strut compressors are made by S&G Tool-Aid Corp., 43 East Alpine St., Newark, N.J. 07114.—T.A.

Fog fighter

If you're bothered by car windows that fog up, check out Cadie Products' No Fog Mitt.

The slip-on foam and cloth mitt, about the size of a potholder, is treated with an antifog compound. Wet a corner of the mitt with water



No Fog Mitt protects your windshield and windows against fogging for a month.

and wipe it around the inside of the windows. The sudsing action leaves a clear coating that we found lasted almost a month. We got six windshield treatments from the mitt.

You can find the No Fog Mitt (\$1) at variety stores. Cadie Products Corp. is at 100 6th Ave., Paterson, N.J. 07524.—Joel Breault

Big charge

Several battery manufacturers are having a "horsepower" race to see who can come up with the most powerful automotive battery. Right now, Prestolite's new Firepower FP800 is the champ. It has a cold-cranking rating of 800 amps. at 0° F., and a reserve of 150 minutes.

We tested the FP800 in three vehicles: a 5.7-liter Olds where it replaced both original equipment batteries, a hard-starting Chevy diesel pickup and a Camaro with a high resistance in the starter circuit. The FP800 provided fast starts every



Prestolite FP800 battery features a cold-crank rating of 800 amps. at 0° F.

time, even when the temperature dropped to 20° F.

At a list price of \$173.95, the FP800 is a bit steep, but it will give you more power than you can get anywhere else. From Prestolite Battery Div., 511 Hamilton St., Toledo, Ohio 43694.—Joel Breault



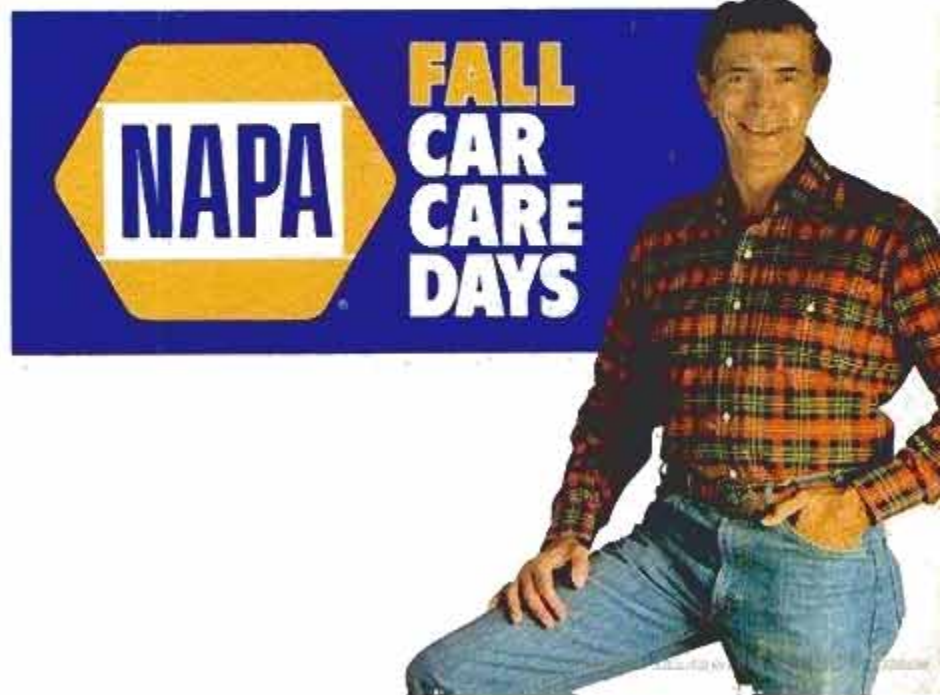
**IT TOOK YOUR BUMPS.
PROTECTED YOU FROM THE ELEMENTS.
AND GOT YOU OUT OF A FEW JAMS.**

NOW IT'S TIME TO SETTLE UP.

Your car took care of you. Now's the time to take care of it—during NAPA Fall Car Care Days. You'll find what you need for your domestic or import car at NAPA auto parts stores and participating garages and stations. Look for the NAPA Fall Car Care Days poster. And reward a clutch performer.



Check your Yellow Pages



APPLIANCE CLINIC

QUESTIONS ANSWERED

Converting convection oven

I have a Tappan Convectionaire self-cleaning range, Model 30-3847-23, serial No. 04065. My problem is with my oven. Cookies, cakes and light breads bake fine, but richer and heavier products don't bake through and brown much too fast. The recipe book says to cover the items with aluminum foil. The foil sticks to pumpkin pies and makes them look awful. Jenn-Air has a forced-air oven which also operates as a conventional unit with a flick of a switch. I've owned my range almost three years and wonder if it's possible to convert it permanently to a conventional oven.—Concerned, Haubstadt, Ind.

I contacted Tappan Co. in Mansfield, Ohio. They tell me your model range cannot be converted to a conventional oven. You have a straight convection range. The problem you are having with the richer and heavier baking products may be with the placement of the pans on the racks. This type of oven requires different cooking methods. The oven cooks and broils by moving hot air which comes down from the top of the oven. The upper rack positions would be for broiling; the lower rack positions would be for normal baking.

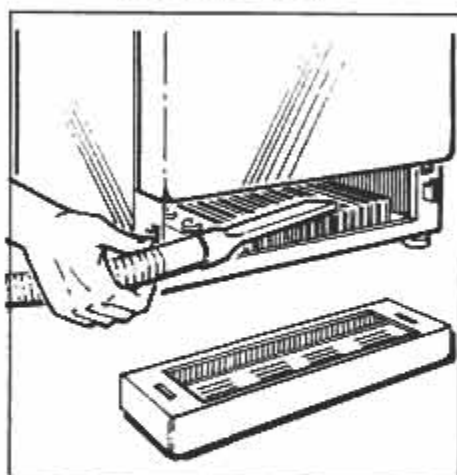
When you bake a pumpkin pie, or any from-scratch pie, build up the pie crust $\frac{1}{2}$ in. above the pie pan and make a fluted edge. Then make a dome or tent with the foil before placing it over the pie. This should prevent your sticking problem. The only time the use of aluminum foil is recommended is for baking pie and pizza. These foods are baked at a high rack position to get them brown on the bottom, but they must be shielded to prevent them from burning. Tappan also recommends the use of aluminum bakeware in the oven. They will be sending you a new, revised cookbook for your model range.

Plugged evaporator drain

I have a 1968 side-by-side Sears Cold-spot refrigerator/freezer, Model 106-6679361. After owning this refrigerator for about six years, the evaporator bottom drain has become plugged. This, in turn, causes the ice to build up at the back of the cabinet and stop the impeller on the unit's circulating fan.

This problem has been repaired. However, about every two years the

SERVICE TIP



If your refrigerator has a fan-cooled condenser located in the bottom front of the unit, this simple maintenance procedure will help the appliance run at peak efficiency. Unplug your refrigerator. Then remove the metal plate along the bottom front to expose the condenser, so it can be cleaned with a vacuum cleaner. You should repeat this procedure every three months.

ice builds up again and the fan has to be removed. The drain in the evaporator cabinet is always clean, and I am unable to ascertain why this buildup occurs. I would appreciate any help.—Emanuel Piotrowicz, Toledo, Ohio

The defrost drain tube is the first thing to check. The original drain tube was shaped in the form of the letter W.

The tube came right off the bottom of the refrigerator and went down to the drain pan. The drain tube had to be modified on your model refrigerator to correct a problem of ice buildup in the drain. If your drain tubing is in the shape of the letter W, you will have to remove the tube and cut it so a stub about 1 in. long remains.

Before reinstalling the short stub in the drain hole, check the drain grommet to make sure it is free of any restriction. This should correct your problem.

If the drain tube has already been modified, another area to check is the defrost bimetal. If the bimetal is not reaching the desired tempera-

If you have a question about any appliance, send it, along with the model and serial numbers, to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.

ture, this could also cause the problem you are having.

Mysterious washer

We own a Maytag washer, serial No. 318198FQ. We are having problems with the spin cycle. The washer goes through one load of wash fine. However, the washer stops on the second and third loads, when it reaches the spin cycle (the point where the motor switches to reverse). The motor hums and the overload protector on the motor trips.

We called a Maytag serviceman who replaced the timer. The machine worked fine for two months, then the problem started again. After we replaced a switch (for regular and gentle washes) and checked every connection, the washer still wasn't working.

I called in an electrician to check the machine. He checked it out under actual operation. It stopped again on the spin cycle. He said he could smell acrid smoke and replaced the motor. The washer was fine for two months. Now, the same problem is back again. I am at my wits' end. Do you have any ideas?—Werner A. Schiedt, Morrisville, Pa.

Sounds to me as if you have a low-voltage problem. When your machine goes into spin, it is at the point where it uses the maximum voltage. If the voltage is low at that point, it will trip the overload so you don't burn out the motor; you might get a little odor from it.

My suggestion would be to put a capacitor in the motor line. Use Part 2-6103 which contains a 216 to 259-mfd. capacitor and a wire (available from Maytag for approximately \$7.35, plus tax and shipping). Remove the red No. 22 wire from the timer and plug it into the capacitor. Then run the wire from the capacitor back to terminal No. 22 at the timer. This should cure your problem. **FM**



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PM WORKBENCH

PM EXAMINES PRODUCTS AND SERVICES

Glass cutter magic

Cutting glass is relatively easy if you hold the tool perfectly perpendicular, while pressing straight down—easier said than done. The hard part is gripping the slender shaft of the conventional glass cutter tightly enough to apply the straight downward pressure required while holding it like a pencil.

Now you can cut glass like a pro on your first attempt with the newly patented Magewick glass cutter. It has a circle in the handle so your index finger becomes part of the same axis as the cutter. This allows effortless downward pressure and makes it easy to keep the cutter perpendicular.



Ring in handle of Magewick glass cutter makes it easy to hold perpendicular while pressing down to score glass.



The Magewick Comfort Grip glass cutter comes with steel or carbide wheels from Pro Glass Cutter Co. Inc., 13910 Creekside Dr., Matthews, N.C. 28105. Cost with carbide wheel is \$9.50, steel wheel \$4.50, postpaid.—H.W.

Flood insurance

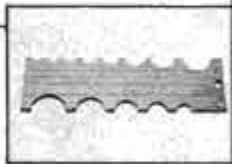
Pipe sizes can be hard to measure correctly if you don't work with plumbing all the time. The penalty for guessing wrong is time lost and the expense of getting the wrong fittings at the very least, or a flooded basement at the worst.

A new plastic gauge takes the eyeball out of pipe sizing by giving you a quick, easy way to measure the inside or outside diameters of copper

or aluminum tubing or the inside diameter of galvanized or black iron pipe. Pipe Gauge costs \$1 and will be available through home centers and



Fitting the plastic gauge to the pipe's outside gives instant o.d. reading; plug gauges i.d.



hardware stores. You can order it by mail for \$1.34, postpaid, from Florida Specialty, Box 11682, St. Petersburg, Fla. 33733.

—Rosario Capotosto

Handy tap and drill set

This 10-piece, heavy-duty tap and drill set comes in a handy vinyl pouch for easy, safe storage on a pegboard.

Shown here is the NC set which includes $\frac{1}{4}$ -20, $\frac{1}{8}$ -18, $\frac{3}{8}$ -16, $\frac{1}{16}$ -14 and $\frac{1}{2}$ -13 carbon taps and matching high-speed steel drills. NF taps are also available in the same sizes. Industrial quality sets come in the same sizes and feature precision-rolled, high-speed steel taps with



Matched tap and drill sets for the home handyman store neatly in plastic pouches.

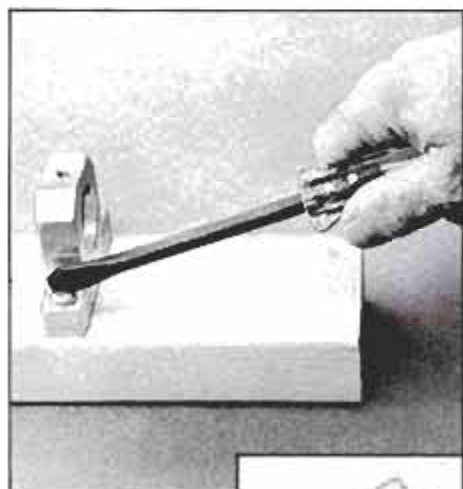
high-speed steel drills. Available at hardware stores and home centers, prices range from \$29 to \$49. From Henry L. Hanson Inc., 220 Brooks St., Worcester, Mass. 01606.

—Angus Laidlaw

Three-way screwdriver

Three-sided, angle-tip screwdrivers work from directly above or from an angle for increased leverage. Angle driving increases torque, reduces effort and makes it easier to reach into corners.

Three-tool ScrewTriver kits in $\frac{1}{4}$ -, $\frac{1}{16}$ -, and $\frac{3}{16}$ -in. sizes are available from hardware stores or by mail from Rodan Tools Inc., 17200 Libby



Angled blades allow you to adjust the handle, increasing torque needed to turn tight screws.



Rd., Maple Heights, Ohio 44137 for \$12.95 plus \$1.50 for handling.

—Rosario Capotosto

Rockwell bench saw recall

Defective switches on some Rockwell Model 8 motorized bench saws have caused unexpected restarts by bumping the saw. Five laceration injuries have been reported.

Model 8 saws with serial numbers from LL-100 through P-110 or from 80 A 00000 through 81 C 02615 made before December 1980 are affected.

Saws can be taken to Rockwell Service Centers for free switch replacements, or owners can request free Switch Retrofit Kits with installation instructions by sending the serial number of the saw to: Customer Service Dept., Rockwell International Power Tool Div., 400 North Lexington Ave., Pittsburgh, Pa. 15208.

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.

A Formby's guide to the buried treasure in your house.

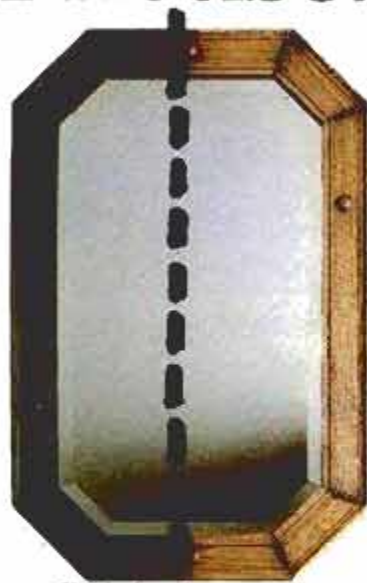
—Homer Formby 3rd generation restorer and refinisher



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Who doesn't have a long-forgotten chair or mirror or desk that's doing nothing but gathering dust?

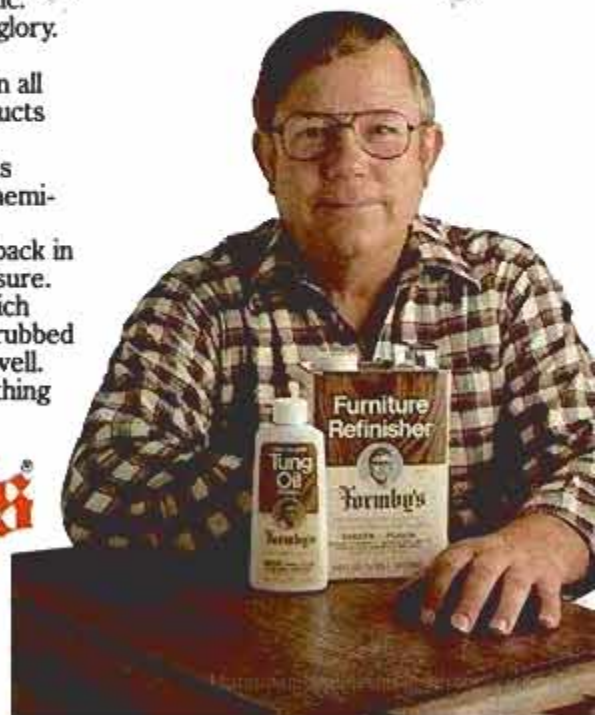
With Formby's Furniture Refinisher, it can be gathering compliments.

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HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

Improving acoustics

We would like to improve the acoustics in our 13x20-ft. piano room. Since the house is rented, we don't want to spend money on solutions that we can't take with us.—Richard Morris (no address)

You are delving into a science that requires years of schooling and experience. I checked with one of the largest acoustical consultants in the country, Bolt Beranek and Newman Inc., Cambridge, Mass. Larry Philbrick passed along some basic guidelines that depend on whether you want a good "practice" room or a good "recital" or "performance" room. If the goal is practice, you should introduce absorptive panels. These are usually floor-to-ceiling panels of 1- to 2-in.-thick fiberglass sound insulation, made by Owens-Corning. They should be staggered on opposite sides of the room. Since you're renting, you could hang these panels on the wall like pictures, or you could use heavy-duty, floor-to-ceiling drapes.

If you desire recital-quality acoustics, you'll want as little absorption as possible. To accomplish this, you should create random hard panels for diffusion; no two hard surfaces should be parallel. Hard-surface pyramids make good diffusers; these may even be hung from the ceiling. For recital, it's also more important to create the diffusion close to the piano. One architectural reference, available in many libraries, is *Time-Saver Standards, A Handbook Of Architectural Design*, by John Callender. It has a section devoted to acoustics. An interesting sidelight: Most of the books cited as references in Callender's work are authored by the principals of Bolt Beranek.

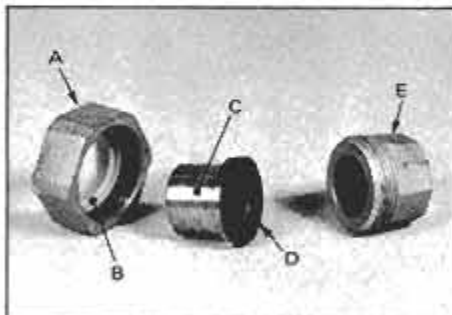
Corrosion problem

What can I do about the corrosion at the junction of the copper pipe of my water system and the galvanized iron pipe of my water heater? Would a plastic collar or some kind of grounding work?—William L. Schulz Jr., Baytown, Tex.

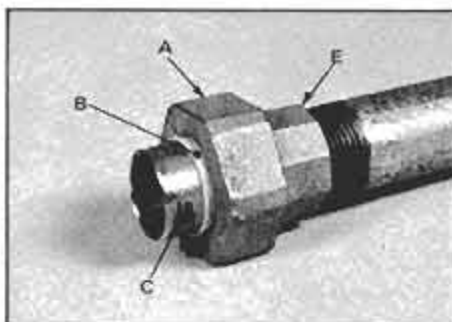
Even though I answered a question recently about pipe corrosion (see "Pipe Corrosion," *Homeowners' Clinic*, page 56, May '82), the query comes up so often that I'll field this one, too. At right are photos of a dielectric union (connection of dissimilar metal piping using dielectric connectors). On a dielectric connec-

tor, a fiber or plastic sleeve (B in the photo) keeps the brass fitting from touching the galvanized collar or nut. A rubber washer (D) assures separation of metal at the end.

Brass, an alloy of copper and zinc, suffers no adverse reaction when it's soldered to copper. The brass fitting should be soldered to the tubing



Plastic separator B keeps brass fitting C from touching galvanized nut E (above). Washer D (above, not visible below) separates C from galvanized pipe (below). Connectors are joined to galvanized pipe (below). Copper pipe is soldered to C first.



before you assemble the union. This assures that there will be no damage to the plastic separator or the washer from the heat of the torch. Make sure you slip the nut and plastic over the tubing before you solder the brass fitting onto the tubing. The 3/4-in. dielectric union shown costs about \$5.

Cold-air intake

Cold air comes into my house through gaps where my aluminum siding meets the foundation. What would you recommend?—Nick Galamis, Milwaukee

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 orders(s) to *PM*, Box 1014, Radio City Station, New York, N.Y. 10101.

Nick, most of the so-called add-on sidings, whether aluminum, vinyl or other, start at the foundation line, where they're hooked to what is called a starter strip. This strip is fastened to the old siding, sheathing or other previous surface so the bottom course of siding is "locked-in" to the structure. The top of the siding is fastened according to the manufacturer's directions.

Your starter strip may have come loose, or the siding may have been yanked loose from the starter strip. You can check this by pushing in gently on the siding. If it gives when you apply pressure, your best bet is to surface-nail the siding in these problem areas. This will prevent the siding from bowing out when you apply caulking or stuff insulation into the gap.

Carefully prebore the siding, and tap in aluminum nails while applying pressure to the siding with your other hand. After the siding is nailed in place, caulk the nailheads. Then apply a good grade of caulking in the joint between the bottom of the siding and the foundation wall. You may need to fill large gaps with fiberglass insulation.

I stand corrected

In "Warming A Cold Floor" (*Homeowners' Clinic*, page 32, Apr. '82), I mentioned that Styrofoam, if inadvertently burned, might produce toxic fumes. Dow Chemical U.S.A. states that the fumes from its product are no more "toxic" than those emitted from burning wood, carpeting, draperies or furniture. The flammability of polystyrene, not its toxic gas emission while burning, is the reason Dow requires you to apply a fire retardant skin over its product. Although Dow recommends a 15-minute fire barrier, I suggest you check with your local building department to make certain that the skin you choose meets the local code. **PM**



BY JOHN GAVNOR

How To Squeeze 50 Miles Per Gallon From A Volkswagen

A special engine rebuild can turn your tired, old Beetle into a lively daddy-longlegs.

by Michael Lamm WEST COAST EDITOR



Modified Karmann-Ghia delivers a solid 50 mpg in real-world driving.

Hawaiian Jon Karcey has developed an engine rebuilding process that squeezes 50 mpg from the air-cooled Volkswagen engine. It's a system that not only works, but one that's now available to anyone who owns a 1,300-, 1,500-, or 1,600-cc, air-cooled Beetle or Karmann-Ghia.

Karcey recently let me drive his modified 1968 Ghia and, on a 61-mile freeway trip at 55 to 60 mph, I averaged an honest, real-life 50.7 mpg. That figure came without babying the car or pampering the engine.

When I first heard about Karcey's claim of a 50-mpg Bug, I remembered the Moodymobile and figured that anyone could get any mpg he wants if he were willing to compromise performance. A go-kart engine in a limo might make for mega-mileage, but don't expect the car to be practical.

Yet Karcey's 50-mpg Ghia performs better than it ever did stock. This car covers the quarter-mile in 18.2 seconds, with 0 to 60 mph coming in 17 seconds flat. That compares with 21.2 and 17.5 seconds for the stock 46-hp Karmann-Ghia tested new. And a Ghia weighs about 200 pounds more than the average VW Beetle, so both fuel mileage and performance should be even better in a Bug.

Karcey, who used to build dragster engines for a living, began formulating ideas for a 50-mpg VW back in 1979. As the owner of a VW/Porsche repair shop in Makawao, Maui, he had access to parts aplenty, and he also knew the Beetle engine's strong and weak points.

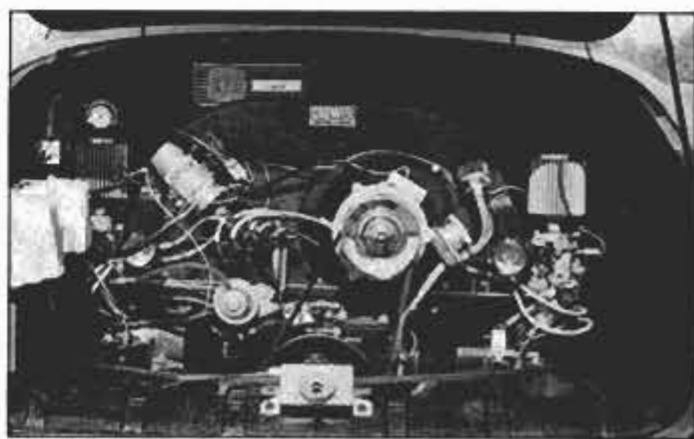
Five essential steps

After considerable experimentation that lifted the Flat Four's mpg step by step, the Karcey process involves these steps:

1. He resizes the engine to 1,415 cc by adapting the 77-mm cylinder barrels from a 1966 VW to any stock 1,300-, 1,500-, or 1,600-cc VW crankcase. These 77-mm barrels and pistons, mated with a counterweighted, 76-mm, aftermarket crankshaft, result in a nearly square bore and stroke (77 x 76 mm), which moves the torque curve to a lower rpm range (1,800 to 3,600). Maximum torque comes in at 2,400 rpm, which translates to 55 mph on the highway.

2. A new camshaft, developed to Karcey's specifications, snaps the valves open and shut faster than stock, and keeps duration to a minimum for greater port velocities through the relatively small, 1,300-cc valves. High port velocity plus the smaller diameter barrels have the added advantage of making the 1,415-cc engine run cooler.

3. Jon recommends twin Weber ICT-34 carburetors



Rebuilt engine is resized to 1,415 cc. It uses special crank, faster-acting camshaft, twin Weber carbs and other special parts.

with 24-mm venturi diameter. These plus the camshaft, crank and rods are available only through Karcey, and I'll explain more about getting parts and instructions in a moment. Jon also recommends using a capacitive-discharge ignition system along with the stock Bosch 205 VW distributor, but with vacuum retard to prevent pinging under load. He's also worked out a special ignition curve.

4. To keep the 1,415-cc engine rotating with minimal fuel use, Karcey adds a heavier 180-mm flywheel and clutch plus a heavier rear crankshaft damper/pulley fashioned from one off a Jaguar XKE. If you can't find such a damper in a wrecking yard, Karcey will sell you one made especially for the job. This damper/pulley has the added advantage of running the cooling fan 12 percent faster than stock, again helping keep temperatures reasonable.

5. And last, but by no means least, Jon Karcey turns

(Please turn to page 62)



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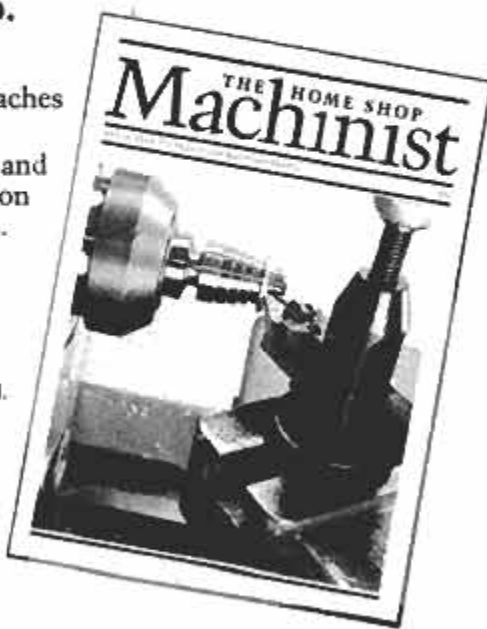
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SQUEEZE 50 MPG FROM A VW

(Continued from page 60)

his attention to the VW transaxle. He says that his engine mods alone will net you 45 or 46 mpg at a steady 55 mph. Transmission modifications will take the stock 1600 VW from its 28-to-30-mpg range to 36 mpg at 55 mph. Combined, though, engine and transaxle mods result in 50-plus mpg.

Briefly, the transmission gets the taller fourth gear from a VW Transporter (0.82 to 1 instead of 0.87 to 1). And by using the ring gear and pinion from a 1974 Super Beetle, the ratio changes from 4.120 to 1 to 3.875 to 1 for a final drive ratio of 3.180 to 1. Karcey is currently working on an 0.73 fourth, which he believes will boost mileage all the way up to 56 to 58 mpg.

Those are the major modifications but, of course, in this article, we can only hit the highlights. Jon Karcey publishes a 32-page booklet that goes into full detail on what to use, where to get it and how to make it all go together.

If you want more information, write him at: Jon Karcey Enterprises, Box 877-PM, Makawao, Maui, Hawaii 96768. The booklet costs \$14.95 plus \$1 postage and handling. Karcey will also send you all future updates of his book as further modifications come to light.

And if you're not the sort who's interested in the hands-on experience of building such an engine/transaxle combination, you can now order the complete setup or any part of it through an outfit called Southern Volks, 132 West Main St., Grand Prairie, Tex. 75050. Southern Volks is one of the United States' largest Volkswagen engine rebuilders. No prices have been announced at press time.

Extended payback period

In this case, high mileage doesn't come cheap. Prices aren't yet firm, but Karcey estimates that a complete engine and transaxle package, with exchange of your old one, will run you about \$2,500. The package will be complete and all you do is bolt it in.

Even with 50 mpg on the road, your payback period will be very long indeed. This retrofit package realistically only makes sense if your old, air-cooled engine has packed up and you need a complete rebuild.

Since you're going to rebuild it, you might as well go the high-mileage route, rather than stick to stock specifications. In either case, the bill will be just about the same. **PM**

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Mounted on wheels (inset), this inexpensive and easy-to-build cart makes short work of big leaf-gathering jobs. You just drive up, drop a side, and rake in the leaves.



A Collapsible Leaf Cart You Can Make

Having many beautiful shade trees around your house is a blessing in the summer, but they present an almost unmanageable situation when fall comes. Here's my solution: a leaf cart with three collapsible sides that holds well over 100 bushels of dry leaves.

To make the cart, begin by assembling the joint for the rear uprights and the base supports. Position the top of the notch $36\frac{1}{2}$ in. from the top of the upright. Because I was using 6-in.-dia. wheels, I bored the axle hole $1\frac{1}{4}$ in. from the bottom of the upright. If you use different wheels, allow clearance so when sides are dropped they won't hit wheels.

After the joint is complete, attach the crosspieces to the base supports and rear uprights, then install the hitch assembly as shown. Next, assemble the three folding sides and attach the hinges. The detail shows how to build sides and front so they meet compactly.

You'll have to experiment to position the hinges on the front base crosspieces. I accomplished this by having the hinges overlap slightly. When folded up, the sides are

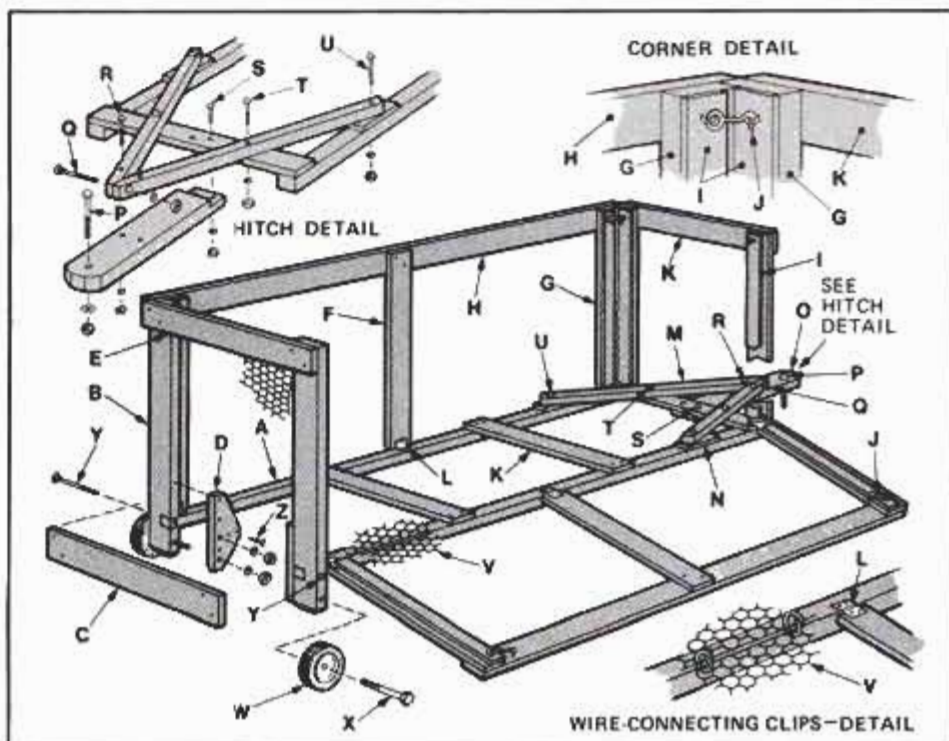
splayed slightly because the upper rails (H) butt against the outside edge of the rear uprights.

Install the chicken wire with staples, using one continuous strip for the back, bottom and front, and one 8-ft. piece on each side. Nail the lattice over the wire for extra support; install 2-in. hooks and eyes on all four corners. Finally, bend 6d nails into small loops to act as clips that join the wire on the sides to that on the bottom.—Wilson G. Walters

MATERIALS LIST—LEAF CART

Key	No.	Size and description (use)
A	2	$1\frac{1}{2} \times 1\frac{1}{2} \times 96"$ fir (base rail)
B	2	$1\frac{1}{2} \times 3\frac{1}{2} \times 42"$ fir (rear upright)
C	1	$\frac{3}{4} \times 4\frac{1}{2} \times 36"$ fir (crosspiece)
D	2	$\frac{1}{2} \times 5 \times 10'$ plywood (gusset)
E	1	$\frac{3}{4} \times 2\frac{1}{2} \times 36"$ fir (crosspiece)
F	4	$\frac{3}{4} \times 2\frac{1}{2} \times 36"$ fir (side upright)
G	4	$\frac{3}{4} \times 2\frac{1}{2} \times 35\frac{1}{4}"$ fir (front corner upright)
H	2	$\frac{3}{4} \times 2\frac{1}{2} \times 96\frac{1}{4}"$ fir (side rail)
I	6	$\frac{1}{8} \times 1\frac{1}{2} \times 34"$ lattice (cleat)
J	4	2" hook and eye
K	4	$\frac{3}{4} \times 2\frac{1}{2} \times 32"$ fir (base crosspiece)
L	8	2" double-hole utility hinge
M	2	$1\frac{1}{2} \times 1\frac{1}{2} \times 40"$ fir (A-arm)
N	2	$\frac{3}{4} \times 1\frac{1}{2} \times 5"$ fir (spacing block)
O	1	$1\frac{1}{2} \times 3\frac{1}{2} \times 20"$ fir (hitch tongue)
P	1	$\frac{1}{2} \times 5"$ carriage bolt, nut, washer (hitch pin)
Q	1	$\frac{3}{16} \times 4"$ carriage bolt, nut, washer
R	2	$\frac{1}{4} \times 3\frac{1}{2}"$ carriage bolt, nut, washer
S	2	$\frac{1}{4} \times 2"$ carriage bolt, nut, washer
T	2	$\frac{1}{4} \times 2\frac{3}{4}"$ carriage bolt, nut, washer
U	2	$\frac{1}{4} \times 4"$ carriage bolt, nut, washer
V		36"-wide chicken wire, about 32' long
W	2	6"-dia. wheels with nylon bushings
X	2	$6\frac{1}{2}" \times$ dia. to suit, machine bolt, nut and spacing washers
Y	2	$\frac{1}{4} \times 4\frac{1}{2}"$ carriage bolt, nut, washer
Z	10	2" No. 8 flat screws

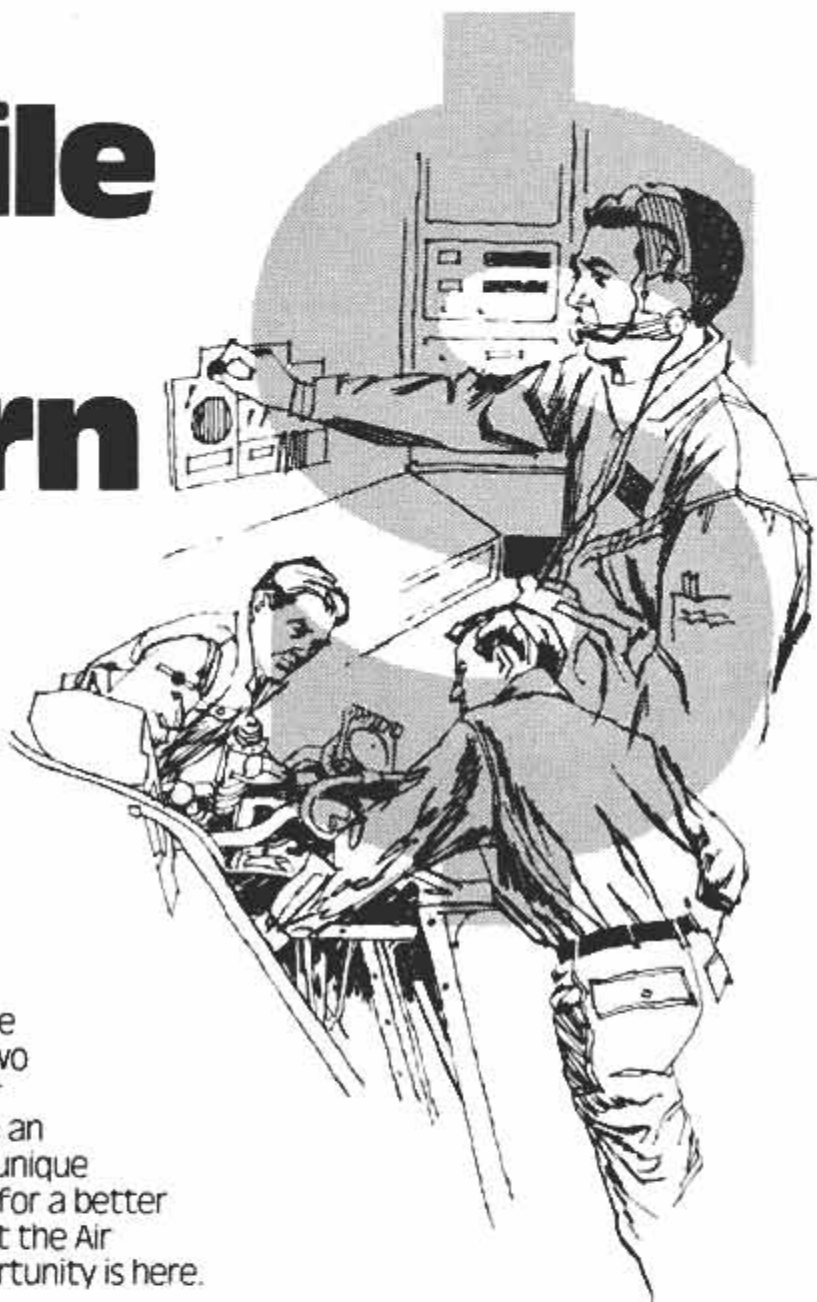
Misc.: 4d nails, $\frac{5}{8}"$ U-shaped staples



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* Top drum kit squeezes 60% more BTU's from heat normally lost up the chimney.

* Engineered to limit metal temp. of barrel to prevent burn up.

* Heavy all steel kit won't crack as poorly made cast iron imports with undersized door openings.

* 55 Gal. kit has a king-size 15½" diagonal opening for easy loading, less splitting of wood.

* 30 Gal. Sotz has bigger opening (9½" Rnd.) than other brands' 55 gal. kits.

FREE info. about heating water, drying wood, fireplace-to-woodstove.

Sotz Corporation, 13643 Station Rd., Columbia Station, OH 44028

OIL TRUCK DOESN'T STOP

It really makes us feel good to see the oil truck drive by our house. We are into our fourth winter using your heater kit. Our 10,000 cubic foot house is always warm night and day. Outside temperatures range from minus 10° to 30° above for 7 months; the barrel stove is never completely out during this time, and after twenty cords of wood there is no sign of wear or burnout. It is great what you can do with one of these barrel stoves. And for such a low price for a quality product, you can't go wrong. We never had any problem with smoke or sparks; the only complaint is from my wife sometimes when I get the temperature to around 80°. We have about 250 gallons of oil in our tank, and I expect that to last about 6 years. Please send your Lift-N-Saw tree lifter, and keep the Sotz news coming.
R. Greiner, Greenville, N.Y.

CHIMNEY SWEEP SPEAKS

I have your 2-drum kit, Woodstove Tools, Monster Maul, and Lift-N-Saw and they are all what you say they are. . . I would like to congratulate you on such fine products. . . I am a chimney sweep and I am finding a lot of people who are wanting to convert their fireplaces with inserts. I can speak for your products first hand. . . I can show them that there is no need to spend five or six hundred dollars for a wood burning unit. . . your products are just as good, in my opinion better than those real expensive inserts.

Dwight Siemiaczko, Hansford, W.V.

SON TOPS DAD'S GRANDMA

The 55H is in and working. (much to my wife's surprise), absolutely beautiful. I felt it would work, but I didn't really expect it to perform so well. Neighbors all think it's great and plan to have one before next winter. Enclosed is \$24.98 for your M12 Monster Maul. Enjoyed your write up in "Mother Earth News" and no longer do I have plans to build a wood splitter. These two items, I'm sure, have saved me well over \$1200.00 and I thank you. P.S. My nephew stayed with us one rather cold evening, and said my barrel puts out a lot more heat than his dad's "Grandma Fisher".

Sidney Bennett, Lambric, Ky.

NO BARREL OF PICKLES

I have a three year old double barrel stove and couldn't be more pleased. It's just as good as the day I built it. There was an Earth Stove in our house when we moved here and my barrels out perform it 100%. As far as I'm concerned there isn't a more practical, useful, or easier-to-operate stove in the world. If more American manufacturers delivered on their claims for their products the way Sotz does, our country wouldn't be in the pickle it's in now.

L.E. Peterson, Connersville, Ind.

A HEARTY "ALL RIGHT"

I bought a "Monster Maul". Best move I ever made. Your product does what you say it will. After my wood was split, my friends had to give it a try. To a man, each who tried it bought one. The end result

was: R. Jones bought two; R. Franklin, one; D. Witt, one; E. Crosson, one. Your maul is your best advertisement, once you use it, you have to have one of your own. Could have sold mine over and over but—use, yes; buy, "NOT ON YOUR LIFE"! Thank you for a tough product built in the Old American tradition. It works and it doesn't break. So, from all the wood splitters at the Thos. Somerville Co., Annapolis Branch, a hearty "All Right."

L. Mould, Annapolis, Md.

NO OVERSEAS JUNK

I would like to commend you on your heater kit. With Illinois winters being what they are I expected to cut at least seven or eight cords of wood. But your fifty-five gal. unit gives so much heat for so little wood used and keeps hot coals longer than I expected. It is going to take a lot less wood than I figured. . . This bottom heating unit does a fine job heating up our four rooms. I am glad there is a company that's making a heater kit that is affordable. What this country needs is more quality items at decent prices, instead of expensive junk from overseas. Thanks for a great product.

Vernon Dace, Rushville, Ill.

SAVED 40% ON GREENHOUSE OIL BILL!

I have 12,000 sq. ft. of greenhouse and we used four of your 55HDD heaters last year and saved about 40% on our bill. We want you to know that we are very pleased with the results. I would like to order three more 55HDD heater kits. Enclosed is a check. . . Rick Henderson, Roebuck, S.C.

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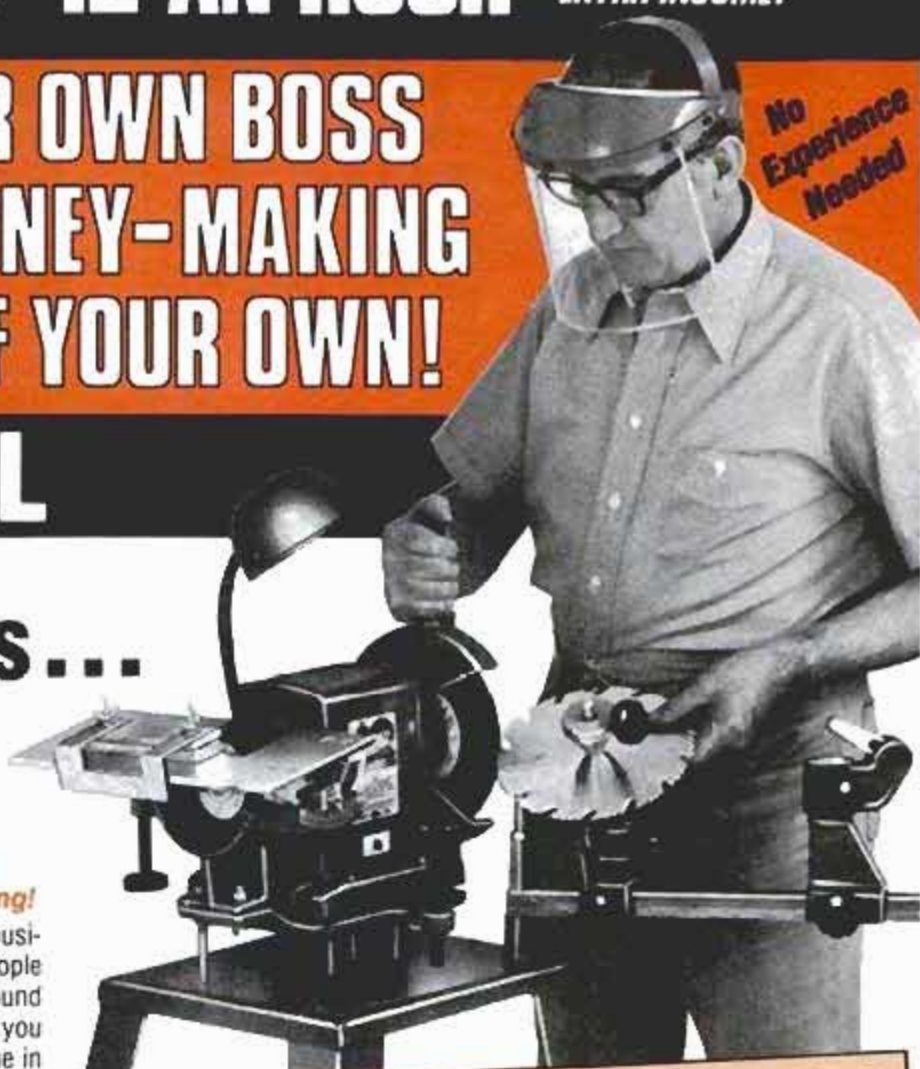
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 - 9 reg. sockets, 3/16"-1/2", 6 pt.
 - 2 reg. sockets, 1/4"-5/16", 8 pt.
 - 11 reg. sockets, 4mm, 12mm, 6 pt.
 - 9 deep sockets (2 1/2"), 3-16"-1/2", 6 point.
 - 2 extension bars, 2" and 6"
 - 3 handles, 5" long (reversible ratchet, flexible; spinner).
 - 1 cross bar, 4 1/2" long.
 - 1 ratchet spin disc, 1 1/4"
- 3/8" SQUARE DRIVE (59 pieces)
 - 7 reg. sockets, 3/8"-3/4", 12 pt.
 - 9 reg. sockets, 9mm-19mm, 12 pt.
 - 4 deep sockets (1 1/4"), 3-8"-9-16", 6 point.
 - 4 deep sockets (2 1/2"), 5-8"-13-16", 12 point.
 - 4 deep sockets (1 1/2"), 10mm-13mm, 6 point.
 - 4 deep sockets (2 1/2"), 14mm-19mm, 12 point.
 - 1 spark plug socket, 13-16"
 - 7 universal joint sockets, 3-8", 3/4"-12 point
 - 7 hex bit sockets, 1/8"-3/8"
 - 4 screwdriver bit sockets (2 slotted, 2 Phillips)
 - 2 ratchet adapter sockets (to 1/2" and 1/4")
 - 3 extension bars (3", 6", 8")
 - 1 reversible ratchet handle, 8"
 - 1 flexible handle
 - 1 adapter, 1/4"

- 1/2" SQUARE DRIVE (32 pieces)
 - 18 reg. sockets, 3/8", 1 1/4", 12 pt.
 - 8 deep sockets (2 1/2"), 15-16"-1/2", 6 point
 - 1 ratchet handle, 10" long.
 - 1 universal joint socket
 - 1 speeder handle, 16" long.
 - 2 extension bars, 5" and 10"
 - 1 sliding "T" handle.

- WRENCHES (71 pieces).**
- 11 comb. wrenches, 1/4"-7/8"
 - 11 comb. wrenches, 7mm-19mm
 - 6 open end wrenches, 5-16" x 11-32", 13-16" x 7/8"
 - 5 box ratchet wrenches, 1/4" x 5-16", 11-16" x 7/8"
 - 18 comb. ignition wrenches, 1-8", 1-2"
 - 4 adjustable wrenches, 6", 8", 10" and 12"
 - 8 hex key wrenches, 1/16"-1/4"
 - 8 hex key wrenches, 1.5mm-6mm.

- SCREWDRIVERS (29 pieces):**
- 11 heavy duty screwdrivers (4 Phillips, 6 slotted, 1 two-fister)
 - 5 ratchet handle screwdrivers, 4 bits
 - 7 nut drivers, 3-16"-1/2"
 - 6 precision screwdrivers, 2 cross point, 2 slotted

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- 5 screw extractors (for 2/8" & 3/4" screws).
 - 34 taps & dies, 4-36 thru 1/4" NTP

- 1 "T" handle tap wrench
- 1 long handle adjustable wrench
- 1 die handle.
- 1 screw pitch gauge
- 1 screwdriver

- MISC TOOLS (39 pieces).**
- 13 twist drill bits, 1/16"-1/4"
 - 1 12 oz. ball peen hammer.
 - 1 16-oz. rubber mallet.
 - 1 16-oz. soft face mallet
 - 1 deluxe hacksaw
 - 21 hacksaw blades (Hi-carbon steel)
 - 1 safety goggles.

- PLIERS (7 pieces, all insulated grip)**
- 1 groove joint pliers, 10" long
 - 1 slip joint pliers, 8" long
 - 1 lok-grip pliers, 10" long
 - 1 diagonal pliers, 7" long
 - 1 long nose pliers, 8" long
 - 1 crumpling tool
 - 1 lineman's pliers.

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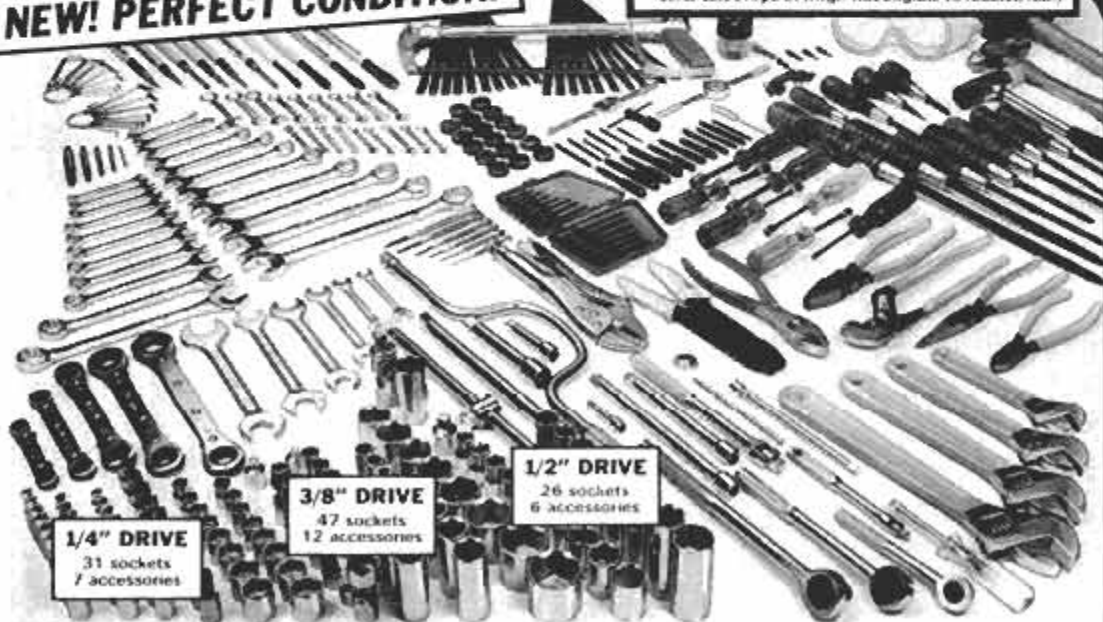
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© 1982 Classic Motor Carriages, Inc. Some Equipment depicted is optional.

PM LOOKS AT A NEW GRINDING/CARVING TOOL

Black and Decker's new 9416 Rotary Hobby Shop is the first of the combination grinding/carving tools to feature a tray for accessory bits that's incorporated into the tool's base. This convenient tray has a clear acrylic cover which rotates independently of the base and an opening for easy bit removal.

The entire base also swivels, allowing the power head to follow the 36-in.-long, permanently lubricated flexible shaft. This reduces the chance of the shaft binding and being damaged.

This tool's 1.8-amp., 0-to-1,900 rpm, double-insulated motor has a sliding, variable-speed switch and produced more than enough power to cut the walnut fish carving shown. It worked equally well for grinding the cutting edge on my pruning shears and—using the proper bits—it excelled at drilling, cutting and deburring ceramics, steel and soft metals.

Thirty-five different bits, includ-



Grinding and carving tool has swivel base and 36-in.-long flexible shaft. There are 35 different accessory bits included.



Tool has enough power for light-duty metal and ceramic work and for hardwood carving, like the walnut fish shown above.

ing sanding drums and polishing wheels, come with the tool. The handpiece's universal collet accepts all 1/8-in.-dia. shank bits.

The manufacturer recommends attaching the base directly to the workbench when using the tool. Holes are drilled in the base for this purpose. Or, if you plan to use the tool infrequently, attach it to a piece

of plywood which can then be clamped to the bench or a table when needed.

The complete package is available at hardware stores and hobby shops and retails for about \$80. If you can't locate it, write to Black and Decker, Customer Service, 3012 Highwoods Blvd., Raleigh, N.C. 27625.—*John Gaynor*

THE WESTERNER. IT'S EVERYTHING A MODEL 70 SHOULD BE. EXCEPT EXPENSIVE.

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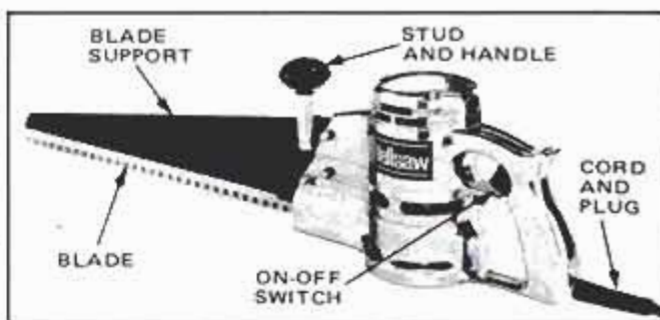
PM LOOKS AT TOUGH LITTLE RECIPROCATING SAW

The time comes for every serious do-it-yourselfer when he needs a reciprocating saw, such as the one shown at right. This one, a relative newcomer on the market, is from Wells Manufacturing. Priced at \$216 or \$242, depending on size, the tool is a good value. I used it to cut several rough openings in a 150-year-old building (right). This meant cutting through sections of 6x8 posts, as shown. The saw performed well.

I have since used it for other cutting tasks—such as rough cross and rip cutting—and am very satisfied. For more information, write the maker.—H.W.



This little beauty of a saw chewed its way through the framing in this old building with bulldog tenacity. Because its blade cuts in both stroke directions, there is practically no kick or pull. Extra handle over blade (see photo right) makes tool comfortable to support.



SPECIFICATIONS—WELLSAW

Blades: 8 available
 Motor: 115 v.a.c., 50 or 60 Hz., single phase (or 115 v.d.c.)
 Weight: Approximately 8 lbs.
 Blade capacity: 8 and 16 in.
 Blade stroke length: 1 1/8 in.
 Blade speed: 8,000 strokes per minute
 Price: \$216 (8-in. model); \$242 (16-in. model)
 Manufacturer: Wells Manufacturing Corp., 407 Jefferson St., Three Rivers, Mich. 49093

The new Winchester® Model 70 Westerner looks like a Model 70, shoots like a Model 70, and lasts like a Model 70. Which only makes sense, since it is a Model 70...from its smooth-working action to its chrome-molybdenum barrel to its American walnut stock. What's missing are some of the dress-up features that might cramp the style of this no-nonsense utility gun. This is a hunter's rifle. At a price you're used to paying for a lot less gun.

What you get with the Westerner are the standard Model 70 features: fine-cut checkering, three-position safety, ramped front sight, adjustable rear

sight, anti-bind bolt, epoxy-bedded recoil lug on magnums, and a receiver drilled and tapped for a scope. You can choose 243, 270, or 308 Winchester and 30-06 Springfield with a 22" barrel, or 7mm Rem. Magnum and 300 Winchester Magnum with a 24" barrel. For a few bucks more, we supply a high quality 4X steel scope.

We've designed the Model 70 Westerner to give you the same high level of hunting performance as its more costly Model 70 XTR® counterpart. We've also designed it to cost a lot less. Your wallet will know the difference. The game won't.



WINCHESTER
 more than a gun,
 an American legend.

Winchester trademarks licensed from Olin Corporation.

There's only one way to play it...



© 1982 B&W T Co.

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

Kings, 9 mg. "tar", 0.8 mg. nicotine,
100's, 10 mg. "tar", 0.9 mg. nicotine
av. per cigarette by FTC method.

HINTS FROM READERS

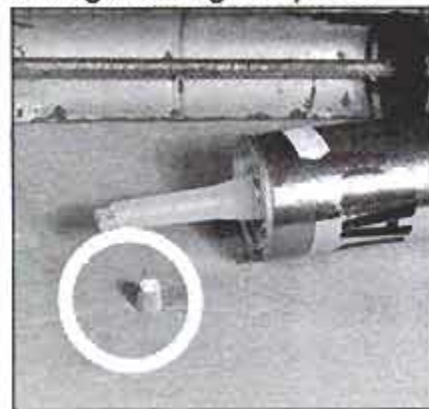
Wire-loop spreader



To distribute paint remover, rust-removing jelly and other preparations over small or medium-sized surfaces, a wire with a small loop on one end is often more useful than other tools. The wire picks up the correct amount of material and manipulates it easily. And it's simpler to clean than a brush when the job is completed. A wooden handle which has been removed from a broken tool or a handle from a file makes the wire spreader easier to grasp.

—Walter E. Burton

Saving caulking compound



When you have some material left after a caulking project and you don't plan another such project in the near future, here's how to prevent the caulk from drying out before the next use. Seal the open spout against the air with a small dowel or cork from a tiny bottle or salt and pepper shaker. Taper the dowel so you can insert it easily into the tube; then tap it to ensure an airtight seal. Corks similar to the one circled in the photograph above are generally available at discount stores.

—C. Boyd Pfeiffer

HINTS FROM READERS

Erasers polish metal



You can chuck a pencil-shaped ink eraser in a drill press or hand drill and use it to restore the polish on tool surfaces. Here, an eraser polishes the degree scale of a combination-square protractor. You should keep the eraser short to minimize wobble.

—Walter E. Burton

Figuring screw diameters

When trying to determine the outside diameter (o.d.) of a bolt or screw, I refer to a screw-thread chart, if one is available. When no chart is on hand, figuring fractional sizes is easy. However, figuring numbered sizes is another story.

You can use the following rule of thumb to compute the o.d. of numbered screw sizes from 0 to 24, whether they're wood or machine screws: Multiply by 13 and add 60. Specifically, multiply by 13 thousandths and add 60 thousandths. For example, with a No. 8 screw, multiply 8 by .013, which equals .104; then add .060, which equals .164. This is the same value shown on the chart below.

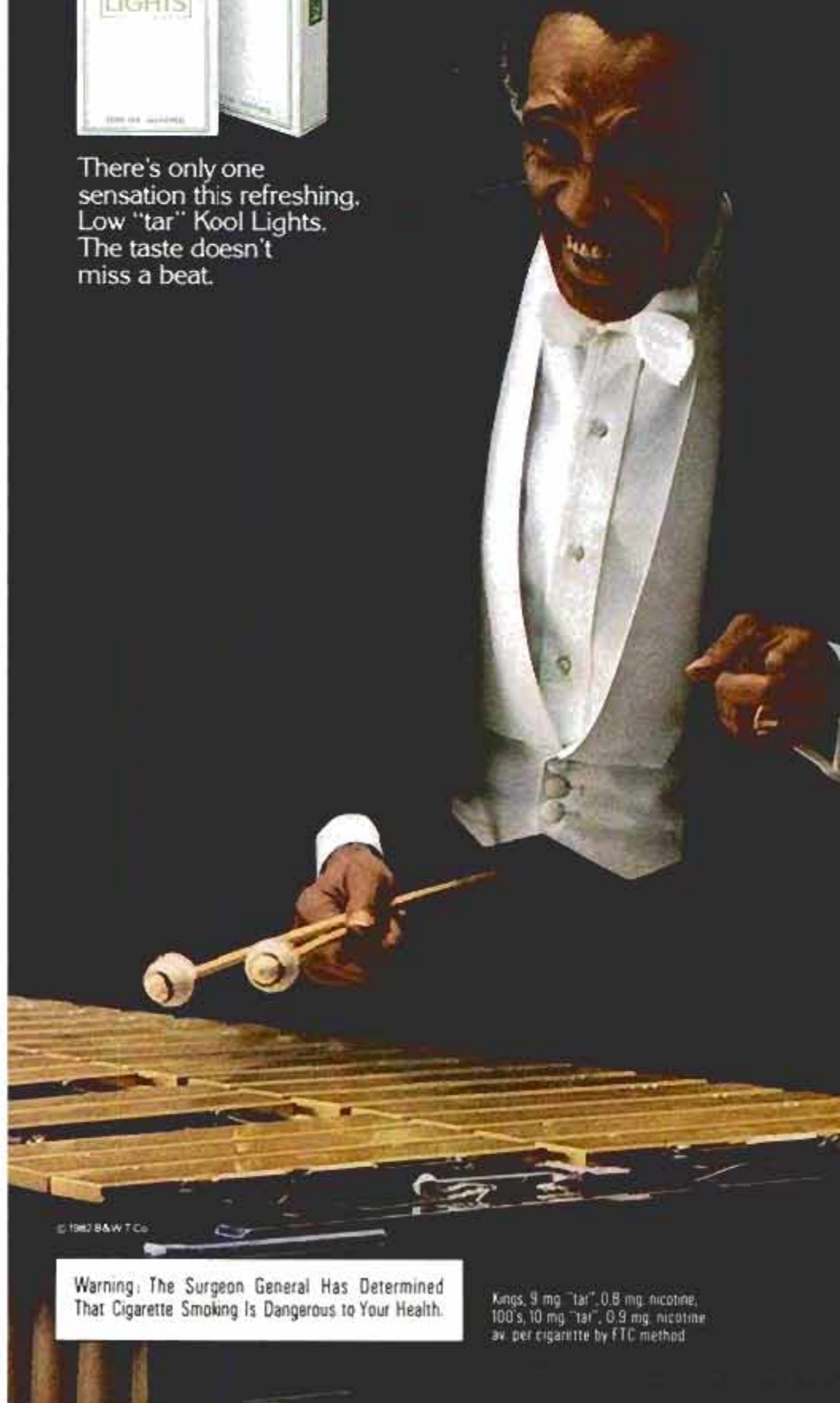
—Paul E. Selter Sr.

Shank Numbers	Shank Body Diameter (in.)
0	.060
1	.073
2	.086
3	.099
4	.112
5	.125
6	.138
7	.151
8	.164
9	.177
10	.190
11	.203
12	.216
14	.242
16	.268
18	.294
20	.320

KOOL LIGHTS



There's only one sensation this refreshing. Low "tar" Kool Lights. The taste doesn't miss a beat.



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

Kings, 9 mg "tar", 0.8 mg. nicotine, 100's, 10 mg "tar", 0.9 mg. nicotine av. per cigarette by FTC method.



3-passenger seating,
standard.

Tinted glass,
standard.

14.8 gallon fuel tank
for long range:
562 EPA estimated
highway miles.

Swing-out
side vent
windows,
standard.

Intermittent
windshield wipers,
standard.

Steel-belted
radial tires,
standard.

5-speed
overdrive transmission,
standard.

It's hard to believe this is the lowest-priced truck sold in America.

1982 Mazda B2000 Sundowner
\$5895*

You can believe it. The Mazda B2000 Sundowner is today's lowest-priced truck. Yet it comes with an astounding number of standard features, including a 5-speed and steel-belted radials.

Not one of these features is available on Toyota's or Datsun's lowest-priced truck, each of which costs hundreds more.

Just one look inside the cab and you'll see more of the Mazda B2000's exceptional



value. There you'll find a three-passenger seat detailed in textured vinyl. New instrumentation with electronic check panel. And handsomely trimmed door panels complete with armrests.

You can also believe this

truck is built to haul a heavy payload—1400 pounds of it. Even so, its 2-litre, 4-cylinder engine delivers outstanding fuel economy.

38 **27** If you still find it all a little hard to believe, we invite you to visit your Mazda dealer for a close-up look at the B2000 Sundowner.

Seeing is believing.

MAZDA

The more you look,
the more you like.

*Manufacturer's suggested retail price for B2000 Sundowner Shortbed. Actual prices set by dealers. Taxes, license, freight, options and other dealer charges extra. Prices may change without notice. Availability at dealers of vehicles with specific features may vary. **1982 EPA estimates for comparison purposes for B2000 Sundowner Shortbed. Your mileage may vary with trip length, speed and weather. Actual highway mileage will probably be less. Calif. 36 Est. hwy. mpg, 26 Est. mpg.

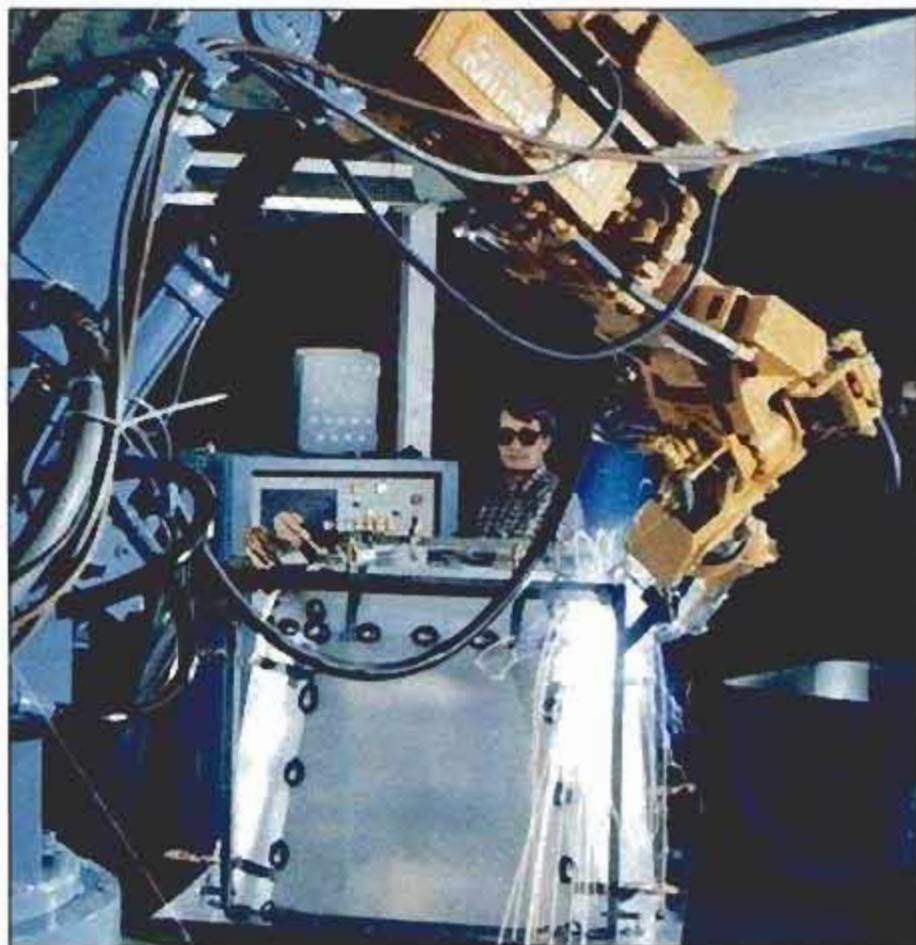
THE TRUTH ABOUT ROBOTS

Real robots don't look like us and can't do what we can. But they can do things we can't and someday may even think.

by Barbara Krasnoff



Which is the real robot? Humanoid "Bumpy" (above) is basically a remote-controlled device, used primarily to attract attention at promotional events. Machine at right is one of Cincinnati Milacron T³ family. It's a true working robot, capable of spot-welding car or aircraft bodies in less than one-third the time previously consumed. Bonus: It can be operated without stopping the assembly line.



If you were to meet a typical robot, strolling down the street, what do you think it would look like? Chances are you would expect to confront a waist-high, beeping cylinder, or perhaps a metallic creature with a strong resemblance to the Tin Woodsman of Oz. In either case, you would be dead wrong.

There are approximately 4,700 high-technology, computerized machines at work in factories throughout the United States today. These automatons assemble automobiles and aircraft, paint furniture, adjust delicate electronic systems—and are known in industrial and scientific circles as robots. The term "robot" was coined by Czechoslovak writer Karel Capek for his 1923 play *R.U.R.* and is a derivation of the Czech word for "compulsory service"; since then, it has come to refer to any



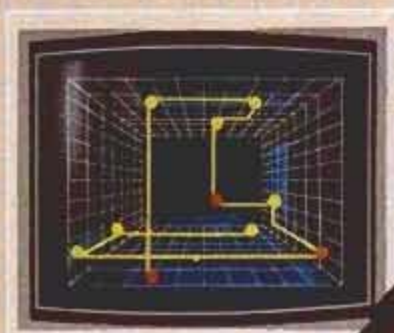
Robots at work: Designing "down" to smaller jobs is illustrated by Unimate robot (left), assembling a TV set; its older relatives learn welding jobs (center) in a matter of minutes, or can simply stack heavy metal parts as they come from the finishing process. Unimation pioneered commercial robotics in the United States, but now has heavy competition.

THE SEEING, FEELING SUPER ROBOT'S TIME HAS COME...

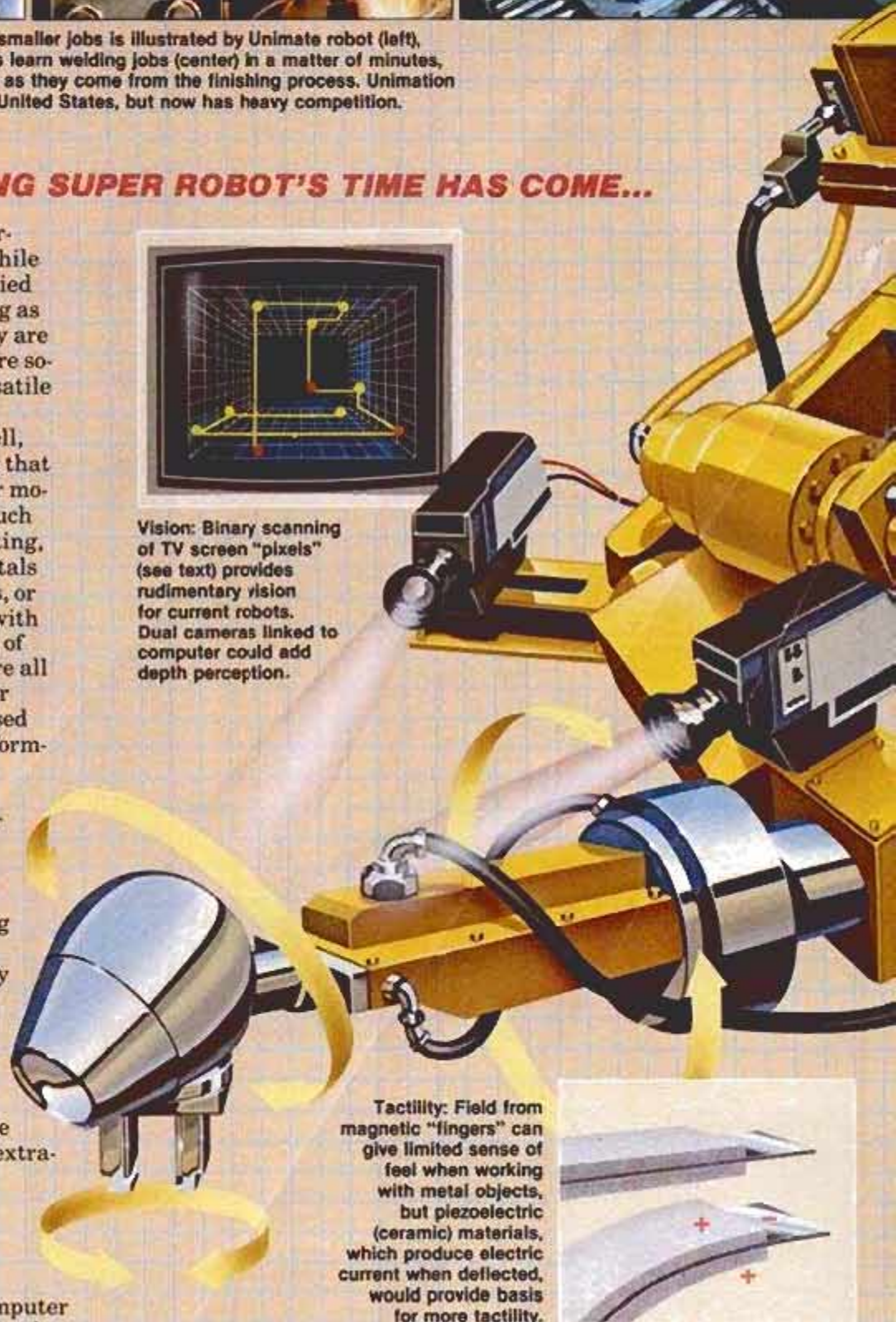
programmable machine that performs some type of work. And while U.S. industrialists originally shied away from investing in anything as "sci-fi" sounding as a robot, they are now clamoring for more and more sophisticated, intelligent and versatile automatons.

What exactly do robots do? Well, they started out doing anything that was considered too dangerous or monotonous for human workers. Such jobs as spot welding and die casting, which involve working with metals at extremely high temperatures, or spray painting in a room filled with toxic fumes, or the transporting of heavy, awkward machinery, were all deemed ideal testing grounds for robotic workers. They have passed the tests with flying colors, performing those jobs with greater consistency, dependability and (eventually) economy than their human counterparts.

While these tasks demand an artificial intelligence—through computerization—far surpassing anything used in the past, real industrial automatons in no way resemble the popular fictional robots from such films as *Star Wars*. These are machines, not pseudo-people; they will neither pause in their routines for a passing wisecrack, nor take time off to save the Earth from extra-terrestrial threats. Few of today's robots could be said to have anything approaching awareness. All they "know" are the movements that have been programmed into their computer minds; and, in fact, if you happened



Vision: Binary scanning of TV screen "pixels" (see text) provides rudimentary vision for current robots. Dual cameras linked to computer could add depth perception.



Tactility: Field from magnetic "fingers" can give limited sense of feel when working with metal objects, but piezoelectric (ceramic) materials, which produce electric current when deflected, would provide basis for more tactility.



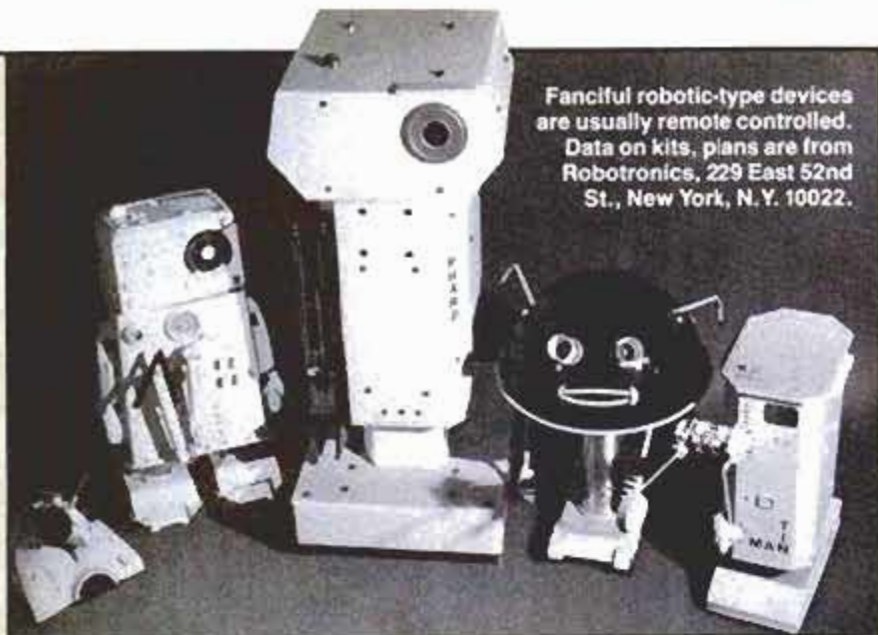


Precision: For critical assembly or processing jobs, conventional gearing doesn't supply consistently accurate robot positioning. Ball-bearing drive system could replace gears in future robots.

Next-generation industrial robot will resemble current systems, but will be enhanced with upgraded precision, vision and tactility. The addition of several axes of motion will also enable it to follow work along an assembly line without slowing normal flow. With accuracy of positioning to the millimeter, three-dimensional vision and tactile feedback enabling it to measure or weigh workpieces—or even to “feel” them—the super robot will be capable of much more complex tasks than is today's generation.

R. Stone

Fanciful robotic-type devices are usually remote controlled. Data on kits, plans are from Robotronics, 229 East 52nd St., New York, N.Y. 10022.



FOR HOBBYISTS, THE HUMANOID LOOK IS IT

"He tried to attack a police officer once," laments 19-year-old Louis Steinberg, who builds robots in his spare time. He is talking about his second automaton, Speda II. "At an industrial show, the Nassau County (N.Y.) police had the booth next to us. And Speda II was just walking around in random patterns, with his arm out and the claw opening and closing. The cop had his back to him. I wasn't paying attention and I looked up just in time to see him heading for the cop! We ran over and stopped him. The cop never knew, fortunately, that he was about to be attacked by a robot."

Steinberg is one of a new generation of robotists—people, many only in their mid and late teens, who are building their own automatons. Their inventions vary from radio-controlled mobile units that are essentially nonrobots, to computer-programmed, independently operating devices, such as Lou's Speda, a true robot.

While many of these young inventors started from scratch, in the last few years, a small industry has begun forming for the benefit of the robot-happy hobbyist.

To begin with, there are a couple of book

publishers who have turned out several nice how-to manuals: Back in 1977, the Hayden Book Company (50 Essex St., Rochelle Park, N.J. 07662) published the highly popular *How To Build A Computer-Controlled Robot* by then-15-year-old Tod Loofburrow. It has since gone into several printings. Hayden's latest is for the more experienced robotist: *The Handbook Of Advanced Robotics* by Edward L. Safford Jr. Tab Books (Blue Ridge Summit, Pa. 17214) has produced a number of good how-to books on robots, the most recent of which is entitled *Android Designs* by Martin Weinstein.

While many hobbyists find what they need by scavenging from local electronics outlets, those who feel they need a little help may want to consult the 1982 Robotics Industry Directory (Robotics Database, Box 423, Tujunga, Calif. 91042). This handy \$35 directory lists industrial robot manufacturers, available robot components, information resources and other items of interest to the enthusiast.

One resource recommended by young robotists is the bimonthly magazine *Robotics Age*. This comprehensive publication offers articles on new developments in the field and on general topics concerning robotics; it also provides more specific technical advice for the hobbyist. A subscription is \$15 yearly.

Finally, those who want to meet and greet robotists from all over the country (not to mention their robots) may want to attend the annual convention sponsored by the Robot Institute of America and Robotics International of the Society of Manufacturing Engineers.

Next year's April gathering, Robot VII, will be held in Chicago. For additional information, write to Paul Von Jankowsky, Office of Public Relations, Robot Institute of America, One SME Drive, Box 930, Dearborn, Mich. 48128.

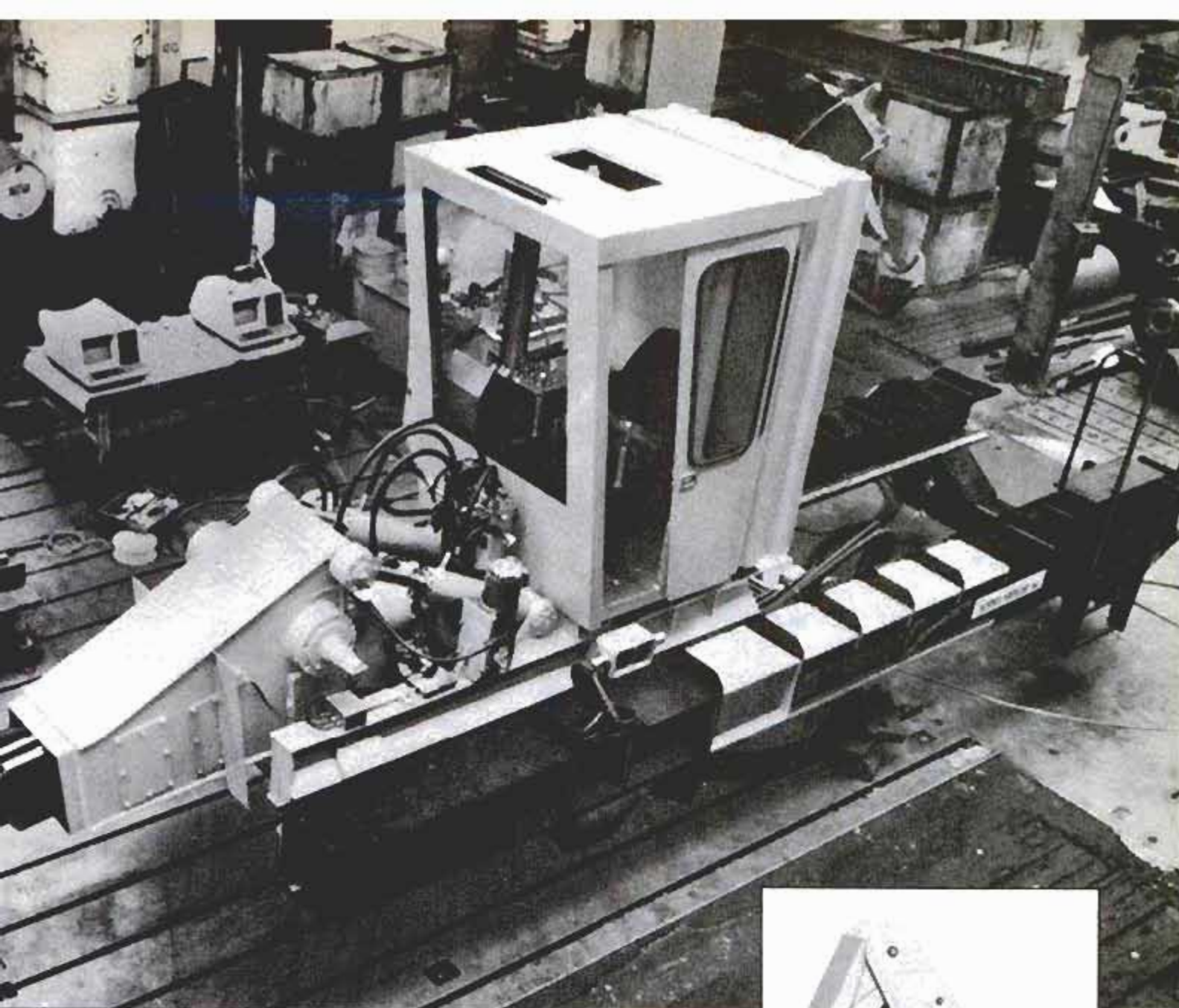
Young builder with RU-2 unit, which has gripper arms and treads. Kits are from Hobby Robotics, Box 997, Lilburn, Ga. 30247.



to wander a little too near to one during business hours and defeated its safety interlock, it would be quite happy to weld your arm to the side of a car body—it just doesn't know the difference between you and a door. (The first such bizarre fatality occurred in Japan last year.)

While present-day robots may be less intelligent than their fictional ideals, they're no less interesting. Humanity has been dreaming about nonhuman servants ever since the first Greek myths of statues coming to life, and, finally, we're entering the first stages of a robot revolution. But instead of simply reproducing an interior copy of *homo sapiens*, we're tailoring these first robots to fit specific economic needs.

Most of those in industry agree



that the production of industrial robots in the United States began with Unimation Inc., the country's first and largest robot manufacturer. The company began in 1956 when businessman Joseph T. Engelberger met George C. Devol, an engineer who had an idea for a "pick-and-place robot"—a machine "smart" enough to pick up an object and put it somewhere else. Devol's vision of an American industry aided by increasingly sophisticated robotic workers fascinated Engelberger. He decided to gamble on that vision. In 1961, Unimation sold its first robot. It was designed to pour hot metal into a die, for General Motors.

Twenty years later, Unimation's sales for the 1981 fiscal year totaled \$56.4 million, and 1982 sales are expected to increase considera-

bly. It is also competing with a number of other corporations for dominance in the robot industry. Cincinnati Milacron, General Electric, Westinghouse and IBM are among the prime U.S. competitors.

The robots which are receiving so much attention in industrial circles usually consist of two parts: the arm (or manipulator) and the control system. The latter can be made up of a very simple series of switches, but, for the most part, consists of a computer with a programmable memory. (This is not necessarily a one-to-one relationship; often, a single computer can be used to control several robots.)

A majority of industrial robots is programmed through the "playback" method. The robot "learns" its job by being guided through the

(Please turn to page 166)



The large and small of it: Scottish firm, Lambert Robotics, has world's largest free-moving robot (top photo). Its lifting capacity is figured at about 1.3 tons. A human programmer occupies cab during the learning process and then behemoth is on its own. Small robotic arm belongs to the TeachMover, a system which uses a handheld control to program as many as 53 movements in sequence. This teaching and testing unit can also be computer-coupled. It's available from Microbot Inc., 453-H Ravendale, Mountain View, Calif. 94943.



PM ROAD TEST

Detroit Pickups Vanquish The Imports

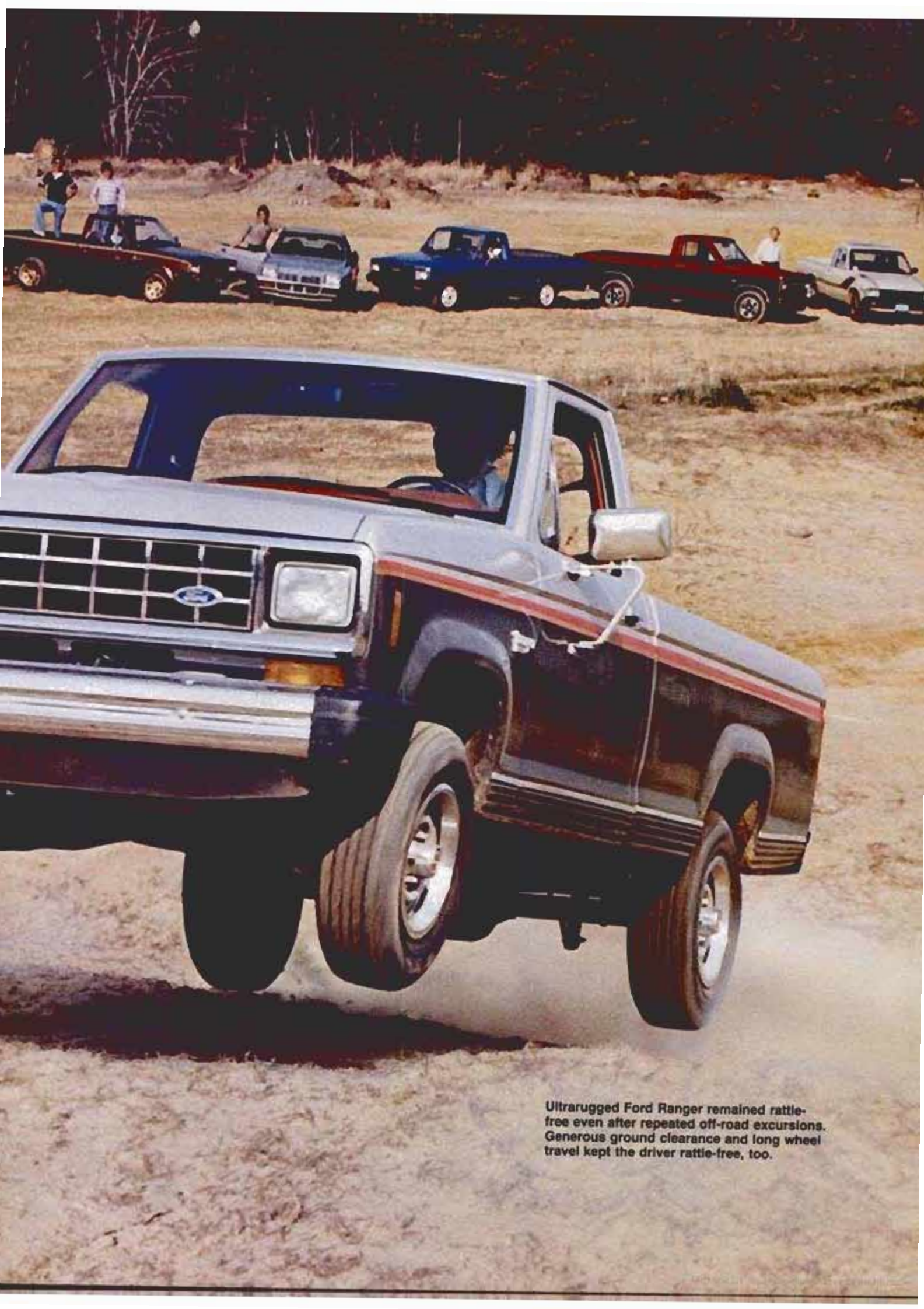
Three new domestics go head-to-head with the established imports and come out on top.

The All-American pickup is back! Chevrolet, Ford and Chrysler all have introduced new trucks this year, downsized to beat the Japanese minis, and these trucks are *good*. The red, white and blue Chevy S-10, Ford Ranger and Dodge Rampage routed the competition in our head-to-head comparison test, finishing 1-2-3 in our editors' ranking and pulling away. By any standards, they're the best small pickup trucks anybody has ever built.

We discovered that you really have to judge mini-pickups from two points of view—as trucks designed for the haulage of inanimate cargo, and as two-passenger cars that are fun to drive, economical and comfortable.

Not surprisingly, the most “trucky” trucks—the S-10 and Ranger—were designed from the ground up as pickups, while the most “car-ish” are modified automobiles, like the O24-derived Rampage and Rabbit-based VW. Five of these trucks—the Datsun, Volkswagen, Isuzu, Mazda and Toyota—are available with diesel engines, and six—the Datsun, Dodge Ram, Isuzu,





Ultrarugged Ford Ranger remained rattle-free even after repeated off-road excursions. Generous ground clearance and long wheel travel kept the driver rattle-free, too.



Lined up for the drag runs are (left to right): Subaru Brat, Toyota SR-5, Isuzu P'up, Dodge Rampage (out front), Volkswagen pickup, Mazda B-2000, Ford Ranger and Chevy S-10.

'The Rampage is an absolute ball to drive.'

Subaru, Toyota and Jeep—can be ordered with four-wheel drive. We chose to limit our group to gasoline power and two-wheel drive—except for the Brat and Scrambler, which come only as 4x4s—for the simple reason that for a majority of buyers, that's the best combination in terms of fuel economy, performance, convenience, cost and usefulness.

In general, we *liked* these trucks. A lot. If you could only own one vehicle, and it had to do everything from 30-mpg commuting to weekend camping, there's really no other choice. Besides, there's something elemental and good-natured about a pickup truck, over and above its marvelous versatility and robust dependability. It's something very appealing and, well . . . American.

In our discussion of the pickups that follows, we've listed the vehicles in the order we'd pick 'em, from our first choice to our eleventh.

Chevrolet S-10

The slickest small pickup in the world is Chevrolet's S-10, which is also sold by GMC as the S-15. It's a masterful blend of GM style, comfort and all-American utility . . . "a Malibu with a pickup bed," as one tester succinctly put it.

Driving it is just like driving a GM intermediate—same compliant ride, same power-assisted controls, same V6 performance, same comfy interior decked out with every imaginable convenience.

Nevertheless, at the same time, it's a real truck, with a double-wall bed, 3/4-ton load rating, and optional 7.5-foot box. Only the Ford Ranger felt as heavily built.

The S-10 is a standout at the drags. General Motors' excellent 2.8-liter V6 and four-speed transmission—helped by a very high final drive ratio—conspire to fling it down the quarter-mile as quickly as

most medium-size sporty cars. What this means to you is that the S-10 is fun to drive, and heavy loads won't bog it down. Towing a heavy boat/trailer with the torquey V6 is child's play.

Hampered by mediocre tires, the S-10 was only average in our handling and braking tests. And logically enough, since it has the second-largest engine in this group, it also drank the second-largest portion of fuel, an embarrassing 17.7 mpg in moderate country-road driving.

On the other hand, the sound-proofed cab of the S-10 is as pleasant a place to relax as anything this side

'High-performance GTs could learn a few things from the S-10's ergonomics.'





of a Seville. It has the most logically designed dashboard we've sat behind in years, with a full set of gauges right in front of the driver. The seating position is terrific, except for a close-chested steering wheel, and there's plenty of headroom, legroom and visibility. Many of the world's carmakers could learn a lesson or two about ergonomics from the S-10 interior.

They could also learn something about styling. The S-10 has one of the smoothest bodies ever put on a truck, with really excellent detailing. It retains the "macho" appeal of full-size Chevy pickups, yet it's classically "pretty" in a fine-boned way.

Aside from the disappointing fuel economy, there were only two things

(Please turn to page 17B)

PICKING A PICKUP PM Editors' Choice

1. Chevrolet S-10	\$10,166*
2. Ford Ranger	9,995
3. Dodge Rampage	9,080
4. Datsun King Cab	8,839
5. Volkswagen Pickup	8,225
6. Dodge Ram 50	8,388
7. Isuzu P'up	8,792
8. Subaru Brat	8,008
9. Mazda B-2000	7,598
10. Toyota SR-5	8,044
11. Jeep Scrambler	9,722

*Price as tested



Toyota SR-5 (far left) and the Mitsubishi-built Ram (center) were eclipsed by new Detroit pickups. Chevy S-10 (left) seduced everyone with its V6 power and excellent interior. On the road, PM testers (above) kept notes, discussing strong points and shortcomings to determine overall ratings.



FUSION—We're Harnessing The Power Of The H-Bomb

Once, fusion power seemed unlikely. Now, we wonder: Which fusion system—magnetic or laser—will go on line first?

by Hans Fantel

The cheapest and most plentiful fuel on earth would be water—if you could burn it. That's no longer a pipe dream. From the way it looks now, we may soon have practical fusion reactors to liberate the atomic forces in seawater. The world would then have a virtually boundless source of energy.

Atomic fusion—the principle basic to the use of seawater as fuel—has been known since the dawn of the atomic age during World War II. But so far, no practical fusion device has been built (unless you consider the hydrogen bomb as practical). But two gigantic research projects—one at Princeton University, the other at the University of Rochester—are finally getting within spitting distance of producing useful energy from fusion reactions.

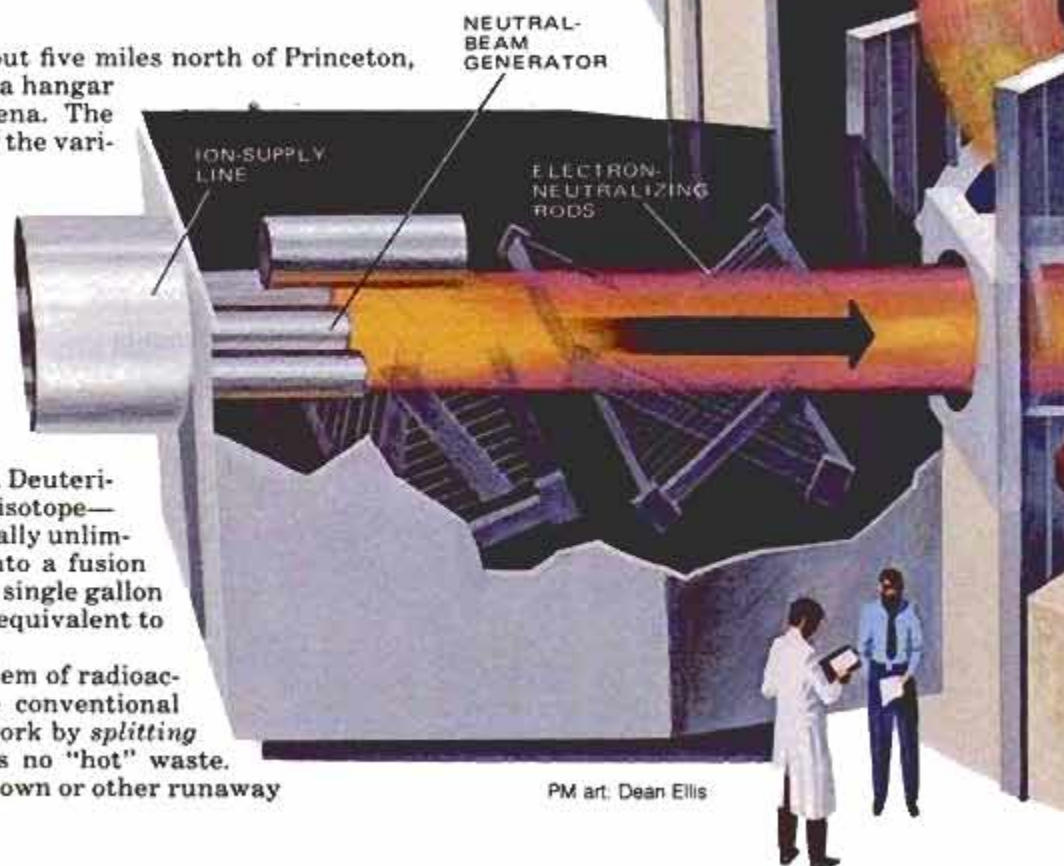
The two schools are taking different tacks toward this goal. Princeton uses a method called magnetic fusion; Rochester uses laser fusion. In the competition to deliver huge quantities of usable power, this is where development stands today.

Magnetic fusion

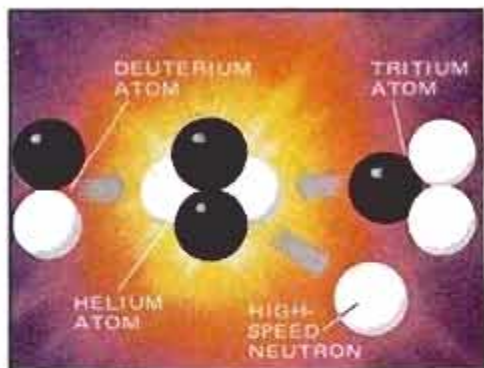
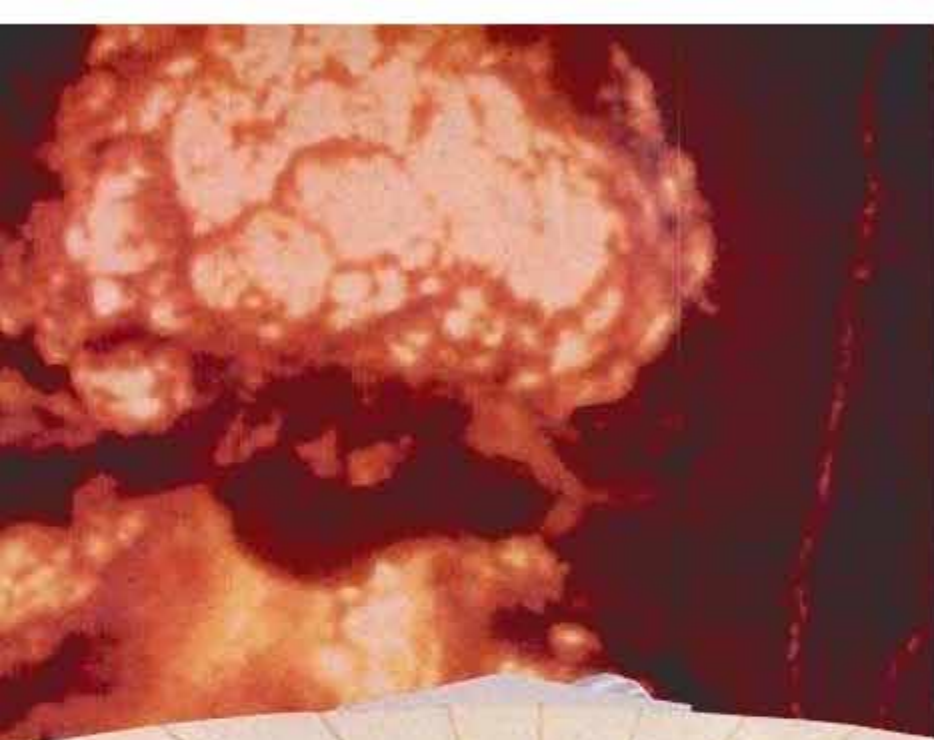
In a former cow pasture about five miles north of Princeton, N.J., a herculean machine fills a hangar space as big as a sports arena. The water-cooled cables connecting the various parts are as thick as a man's thigh. At the center of this vast metal jungle is a huge, ring-shaped tube, resembling an outsize doughnut. It is inside this circular tube that the energy-liberating reaction takes place.

Called the Tokamak by its Russian inventors, the machine uses deuterium as raw material for energy production. Deuterium is a form of hydrogen—an isotope—that's found in water in practically unlimited quantities. If triggered into a fusion reaction, the deuterium from a single gallon of water could produce energy equivalent to about 300 gallons of gasoline.

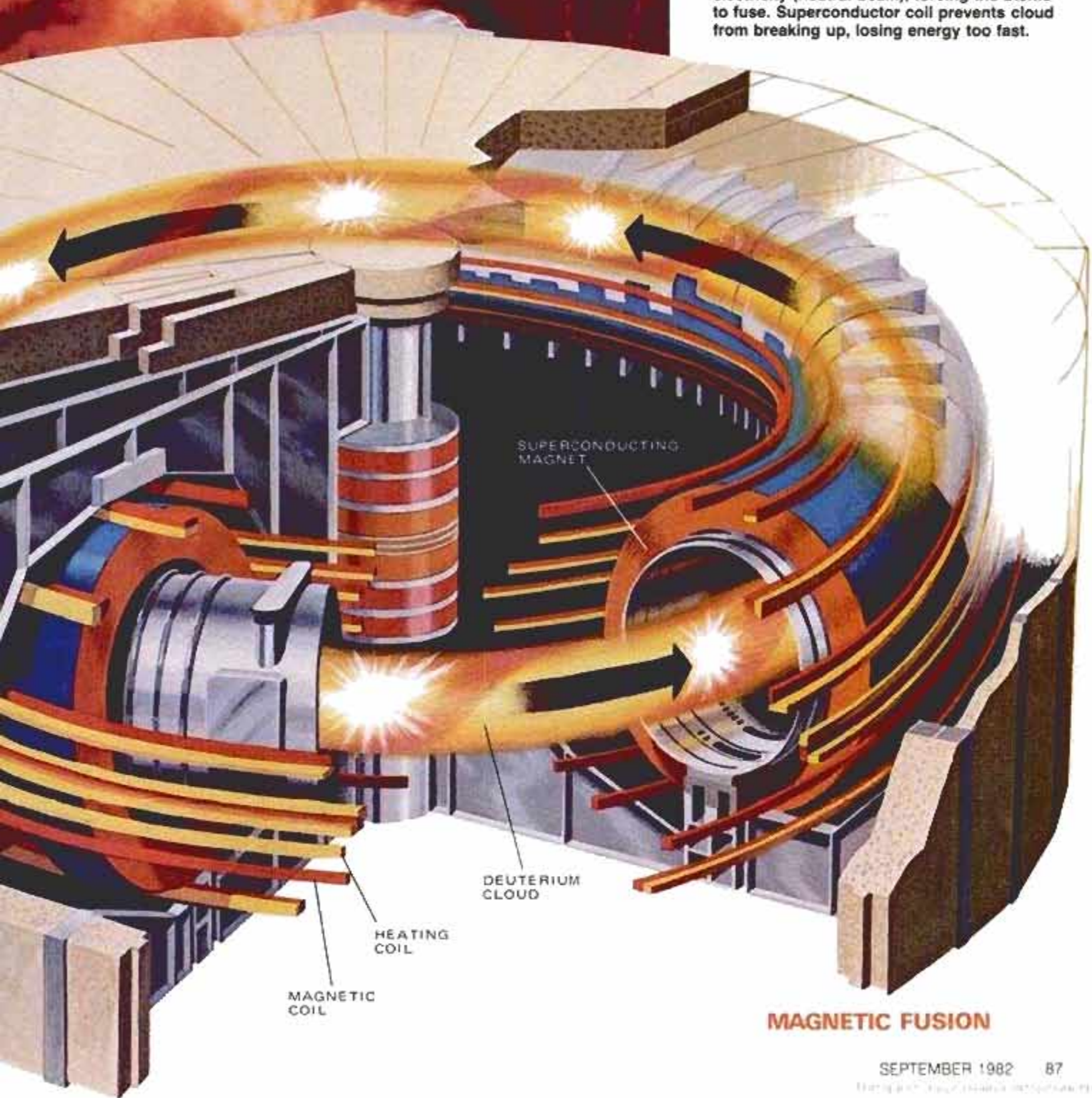
What's more, the whole problem of radioactive waste is avoided. Unlike conventional atomic power plants—which work by *splitting* atoms—fusing atoms produces no "hot" waste. And there's no danger of meltdown or other runaway



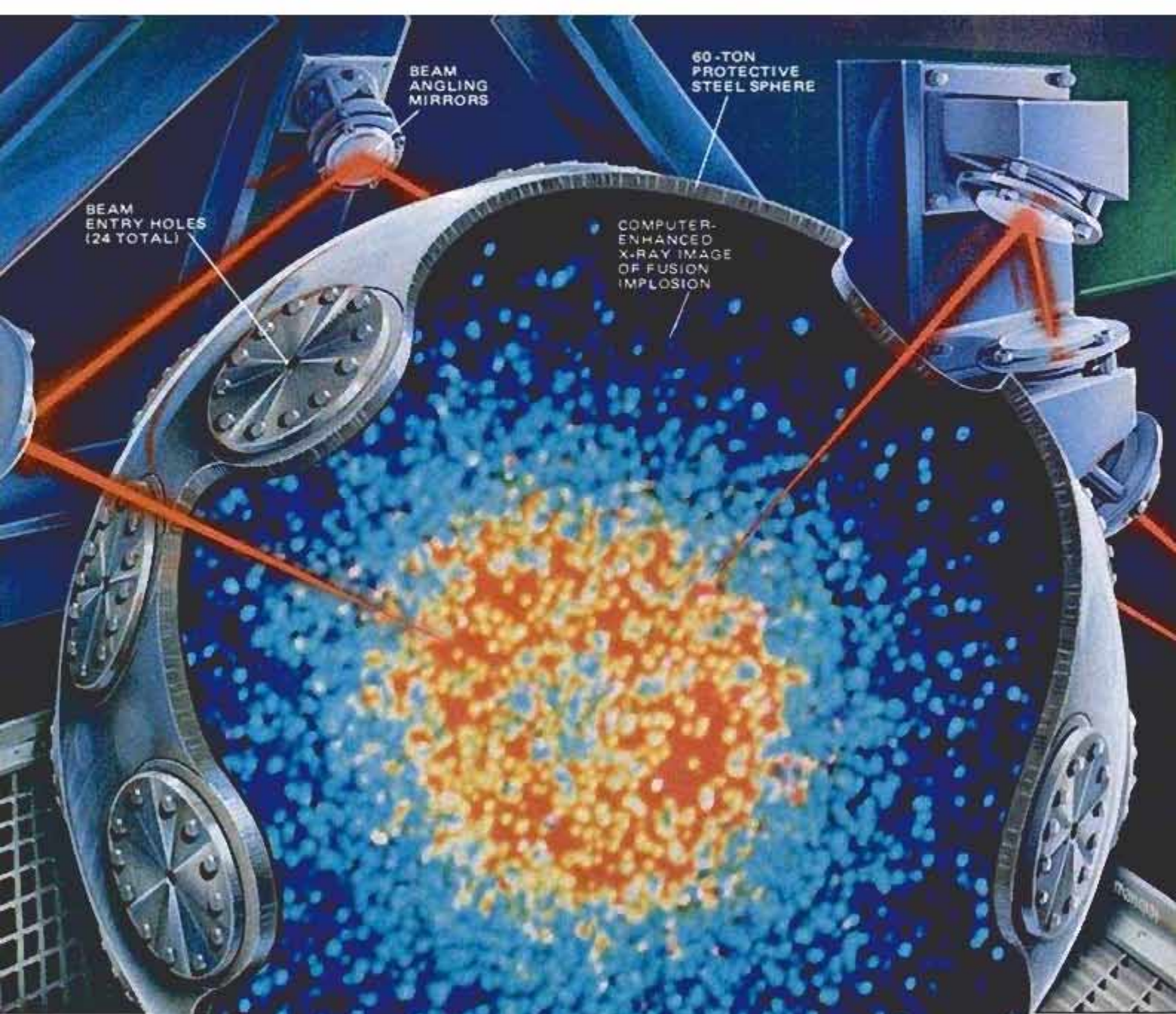
PM art: Dean Ellis



In any fusion reaction, light atoms combine to form heavier atoms, yielding high-speed neutron (above). In Tokamak system (below), deuterium cloud is heated and jolted with electricity (neutral beam), forcing the atoms to fuse. Superconductor coil prevents cloud from breaking up, losing energy too fast.



MAGNETIC FUSION



reactions caused by accident or sabotage. As one technician put it, "Instead of blowing up, it simply fizzles out when something goes wrong."

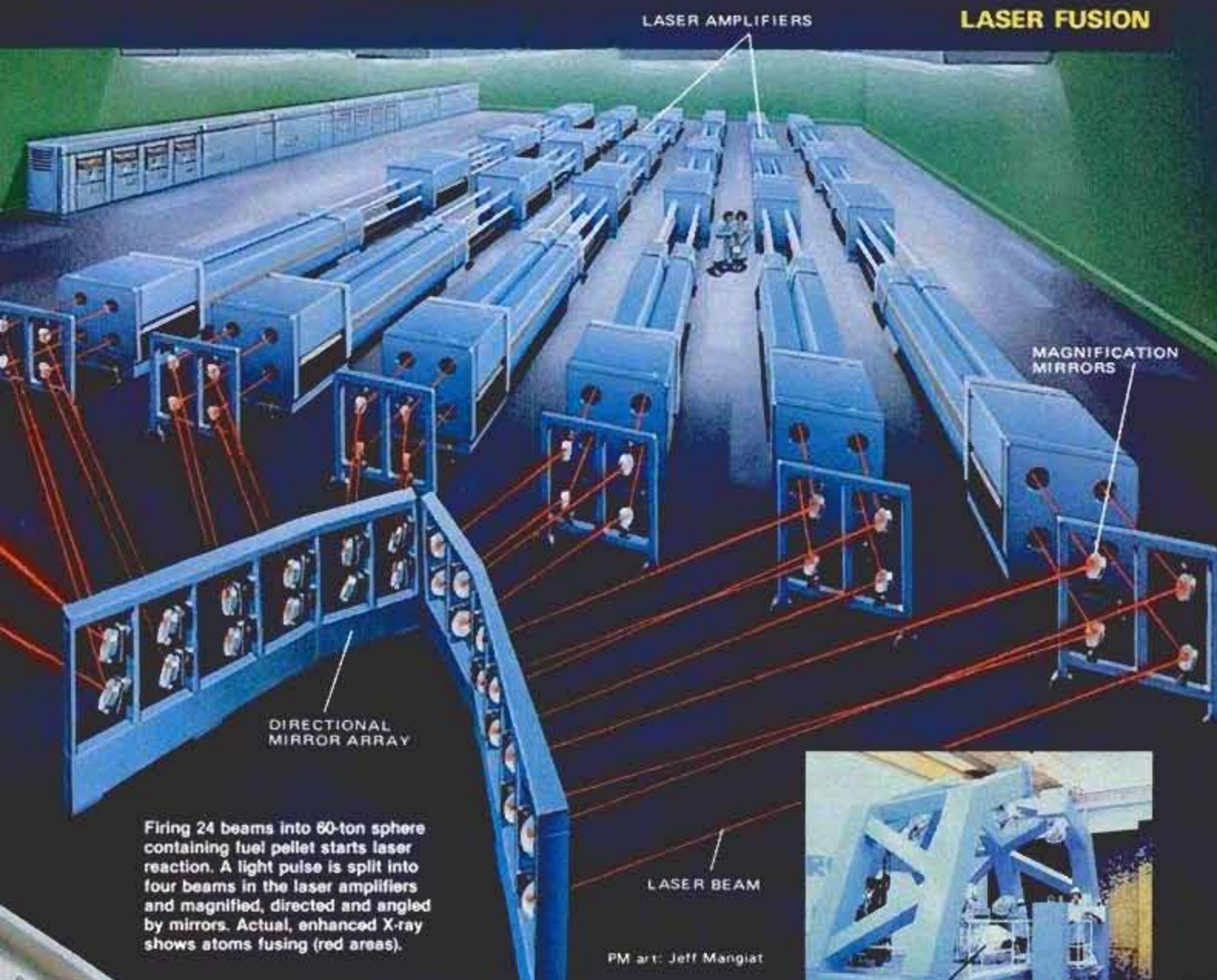
With all these advantages, fusion energy seems to be the answer to many national and worldwide problems. The United States is pouring billions into its development. But though the goal is in sight, tremendous engineering challenges must be overcome before we can all plug ourselves into a fusion-fueled electric power grid.

In the Princeton fusion reactor, deuterium atoms combine with tritium—another plentiful hydrogen isotope. In the process, they create heavy helium atoms and shoot off neutrons at high speeds. This produces vast amounts of energy

that can be used to drive conventional electric power generators. The hitch is that these atoms start fusing only when the temperature gets up to millions of degrees. In fact, the reaction really gets rolling only when temperatures are well over 100 million degrees. That kind of climate is found normally only in the interior of stars like the sun. Thus, in principle, the Tokamak is attempting to create stellar conditions on Earth.

Several ways are being tried. One method jolts the deuterium inside

of the Tokamak with a strong electric current, the neutral beam in the illustration on pages 86 and 87. Since the deuterium is ionized and, therefore, conductive, it acts like a wire in an electric heater and heats up by its own electric resistance. But this doesn't suffice. Additional heat is produced by heating coils and magnetic coils and by magnetic squeezing: A huge superconducting magnetic coil surrounds the reaction chamber, pushing the deuterium toward the center of the tube. This magnetic compression—like any other form of pressure—raises the temperature even further. To pour on still more heat, the ionized mass of deuterium gas is "zapped" with hundreds of kilowatts of high-frequency radio waves sluiced into the reaction chamber



Firing 24 beams into 60-ton sphere containing fuel pellet starts laser reaction. A light pulse is split into four beams in the laser amplifiers and magnified, directed and angled by mirrors. Actual, enhanced X-ray shows atoms fusing (red areas).

PM art: Jeff Mangiat

through wave guides (not visible in the drawing on pages 86 and 87). The principle is similar to cooking in a microwave oven.

Combining all of these heating methods, the latest version of the Tokamak has been able to reach stellar temperatures, trigger a fusion reaction and sustain it long enough to generate significant amounts of power. So far, the big machine has managed to keep this up for about 20 milliseconds. To become an efficient energy producer, it will have to run much longer than that—about 10 seconds or more for each power burst. But keeping the Tokamak going for so long is a very tricky task.

The trouble is that no material on Earth can contain the raging stream of stellar stuff inside the Tokamak. If the swirling deuterium touches the wall of the metal tube containing it, the deuterium cloud

breaks up, cooling to the point where the fusion reaction falters. So the torrent inside the Tokamak must race inside the ring-shaped tube without ever touching its walls. It is, therefore, "contained" in what is called a magnetic bottle—an ultra-strong magnetic field, shaped to hold the deuterium suspended within the doughnut, away from its walls.

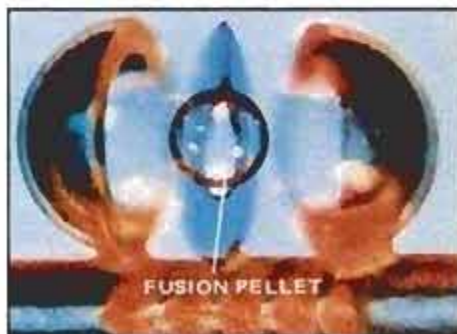
Unfortunately, the bottle still leaks. Often, the hot material breaks through the magnetic restraint, cools off instantly and stops the reaction. That's the main reason why the Tokamak is still just a research tool, rather than a working power source.

But this may change by the late '80s. A machine almost twice as big as the present Tokamak—called the TFTR, or Tokamak Fusion Test Re-

(Please turn to page 159)



Platform for laser fusion target (above) must be very stable. It contains fusion pellet (below), with its immense energy.



PONTIAC 6000

*"Glove and door pockets
won't even hold a map."*

RETIRED
NORTH CAROLINIAN

*"ROOFLINE STYLING
TAKES SOME GETTING USED TO."*

WYOMING
ENGINEER

*"IT'S GOT
THE SPUNK OF
A SPORTS CAR."*

NEBRASKA FARMER

*"Dash lights reflect
on windshield at night."*

MINNESOTA
MARKETING MANAGER

*"Engine hiccups
at 50 to 60 mph."*

FLORIDA
MAINTENANCE EMPLOYEE

*"Goes great
in mud
and snow."*

WEST VIRGINIA
SPEECH PATHOLOGIST



Pontiac has been in transition for several years now—from muscle-car company to question mark. It'll probably take a few more years for Pontiac to sort out just exactly what kind of car division it finally wants to be.

When OPEC hit, Pontiac shoved muscle out the back door. No more GTOs or hairy 455 Trans Ams. And then in 1981, Pontiac dropped its B-bodied, full-sized sedans and its homegrown V8s—the first GM division to do so.

The muscle and hair it took Pontiac decades to grow all withered in a few seasons. And Pontiac has been a



Instrument-light glare on windshield was common complaint, but visibility was good.

name in search of a reputation ever since.

For the 1980s, Pontiacs have been downsized, Europeanized, comput-

erized, economized and homogenized. But they're still not being lionized. The only Pontiac that currently shows a strong personality and a strong sales pattern is the Firebird. Yet the Firebird serves a limited audience, and what Pontiac needs is an exciting car in the mass market.

Pontiac hoped GM's new A-body might provide that car. The A is an extension of General Motors' X-car and is called the Celebrity by Chevrolet, Century by Buick and Ciera by Oldsmobile.

Pontiac general manager Bill Ho- glund christened his A-car the

"For \$12,000, you should at least get a light in the trunk."

NEW YORK
HOMEBUILDER



"Compares favorably to more expensive sports cars."

OHIO C.P.A.

"Fun to drive even on long trips!"

ILLINOIS
REAL ESTATE SALESPERSON

A6000, but then reconsidered and dropped the "A." Today it's just the Pontiac 6000, and it's not doing what he (and all of GM) had hoped.

The Pontiac 6000's appeal seems limited to the more mature buyer, not the rising young executive who finds himself admiring such class rivals as BMW, Audi, Volvo, Saab, Datsun (with its Maxima) and Toyota (with its Cressida).

Apparently that younger buyer still looks longingly at those cars—and buys them—because, according to our survey, well over half the people who now own 6000s are above age 50, and that's certainly not

where the mass market is found.

Keeping that in mind, what does the typical Pontiac 6000 owner expect from his car? Is he getting it?



V6 mill provided adequate, if not thrilling performance. Idle vibration was problem.

What does he like and dislike about it? Is his dealer treating him right? Is he getting the fuel mileage he expected?

We asked all these questions and more, and here's the consensus.

He's not getting the fuel mileage the EPA told him he would (25/40 mpg city/highway for the Four), but he's happy with it anyway. Economy came up the No. 1 "like" with just over half the owners we queried. Only 6.1 percent grumbled about fuel mileage, and the rest just smiled and told us they were averaging 23.7/31.2 mpg with the Four and

(Please turn to page 162)

PM's Long-Term Car Tests



The latest installment in our long-term test report deals with two of the hottest cars to come along in years. One, the Toyota Celica Supra, is as slick a piece of machinery as our friends in the Land of the Rising Sun have ever made. The other, Ford's 5.0-liter V8 Mustang, is just as exciting, but makes its statement from a completely American point of view. Where the Celica is sharp, precise and can be wielded like a Samurai sword, the Mustang's persona is rather like that of a Remington shotgun—loud, powerful and a little sinister in the cut of its cloth.

In addition, there are updates on our long-term Pontiac 6000 and Plymouth Horizon.

Toyota Celica Supra

We now have 6,636 miles on our test Toyota, enough to draw some conclusions about the car.

There's no question that the new Celica Supra has to be one of the most stunning cars on the road, both in looks and performance. Our test car draws stares wherever we go. The high-tech look carries over into the interior, too. The eight-way adjustable driver's seat, digital and graphic dash instrumentation, and an aircraft feel to the whole cockpit, makes you want to go out and push this car hard—which is what we've been doing.

Powering the Supra is possibly the most advanced powerplant ever offered in a Toyota. It's a 2.8-liter, twin-cam, in-line Six that produces horsepower beyond your wildest dreams. It's rated at 145 hp at 5,200 rpm, but feels like 245. Tramp on the



Auto Editor Tony Assenza bids fond farewell to Mustang (top) after 8,600 miles. Service and mechanical problems were minimal. Stunning Celica Supra (above) drew stares wherever it went. Its 2.8-liter, in-line Six responded well to hard use, including a sprint up Mount Washington in New Hampshire. At left, Editor John Linkletter stows gear in the Horizon.

accelerator from a dead stop and you're gone. Shift the automatic transmission manually from first to second at the redline and the shift is so quick, firm and sure that you'll chirp the tires.

Zero-to-60-mph time is just 8.3 seconds and it feels quicker than that. The 4.10 rear axle ratio certainly contributes to this scintillating performance, yet won't harm your fuel mileage, thanks to the overdrive fourth gear on the automatic. A five-

speed manual with overdrive fifth is also available. So far, our gas mileage has averaged 18.6 mpg overall, with a range between 10 and 25 mpg, depending on how deep we sink our right foot into the accelerator.

Happily, the handling of the Supra is well suited to the performance levels generated by the twin cam engine. The suspension is independent all around, with MacPherson struts and a stabilizer bar up front;

(Please turn to page 168)

The Fastest Boats On Water

Picture a jet-propelled hydroplane streaking across a millpond-smooth lake at well over 300 miles an hour. Most of the hydroplane is riding on air. Only a few square inches of the sponsons are in contact with the water and even these break free as they skip over tiny ripples. At this speed, hitting a three-inch wavelet would be like slamming into a concrete curb—enough to send the boat cartwheeling down the course, smashing itself to pieces.

But on Oct. 8, 1978, Peter Warby made such a run over a measured mile course on Blowering Dam Lake, New South Wales, Australia, in his *Spirit of Australia*. Then he turned around and repeated the run in the opposite direction to cancel out any wind or current effects, as required for any record attempt. His average for the two runs was 319.627 mph—shattering the mark of 285.21 set by U.S. driver Lee Taylor back in 1968. The previous year, using the same boat at the same location, Warby had set an unofficial mark of 345 mph.

Speeds that turn a boat into an air/water missile are a constant challenge to engineers. Latest attempt to crack the outboard motor record books is scheduled for mid-November near Las Vegas, Nev., on Lake Mead.

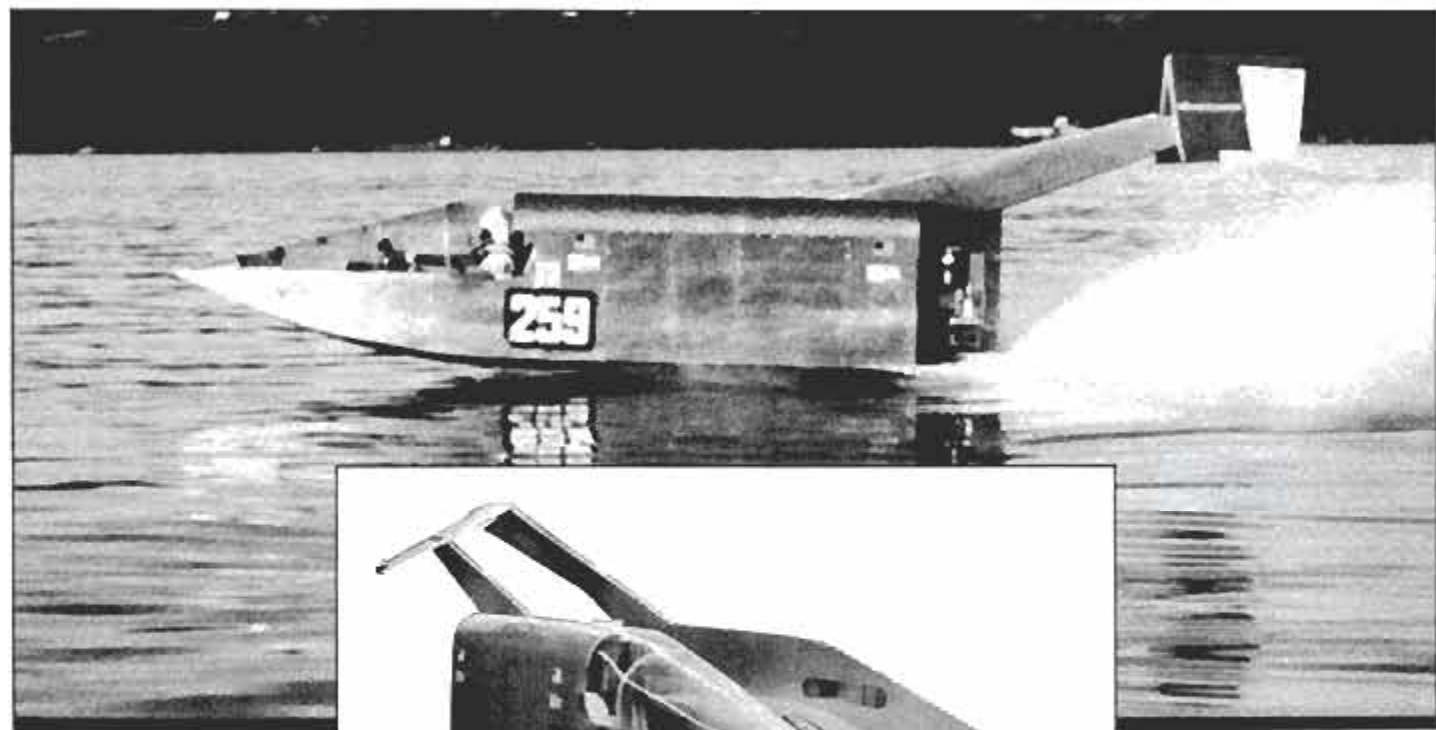
Better hulls, sails, engines are rewriting record books.

by Tom Bottomley

The craft that will make the try is called the *Ram-2*. It has 17-foot twin hulls joined by a "lifting wing," as well as a raised and inverted-V tail section with adjustable control surfaces that extend the length overall to 24 feet, 9 inches. So far, the Austin Aeromarine design has tested at 125 mph with two 135-hp motors, and larger Mercury outboards are predicted to make possible speeds topping 200 mph. The air-control surfaces are claimed to give the boat stability at higher speeds over rougher water.

For the fastest run at present in a propeller-driven boat, the *Guinness Book of World Records* lists Larry Hill in *Mr. Ed*, which reached 202.42 mph in August 1971. The American Power Boat Assn., however, shows the APBA-UIM (Union Internationale Motonautique) record to be 201.340 mph, set June 2, 1974, by Dennis Pollaccia in a Chrysler-powered Howard hydroplane, at Oakland, Calif. Designed for drag racing, the boat reached its peak speed at the end of just a quarter of a mile!

When it comes to standard closed-course racing hydroplanes, the big Unlimited Class boats with their Rolls-Royce and Allison World War II aircraft engines—



Austin Aeromarine's 25-foot *Ram-2* will try for new record near Las Vegas in November, using aerodynamic control surfaces for planing stability.

Speed records on the water continue to go up

- 1 **JET POWER.** Lee Taylor's *Hustler*, last U.S. boat to hold record (285.21), was topped by *Spirit of Australia*, at 319.627, in New South Wales, Australia, in '78.
- 2 **UNLIMITEDS.** One-mile mark of 200.419 mph was set 20 years ago by Roy Duby, but Dean Chenoweth in *Miss Budweiser* has achieved unofficial speeds of 225 mph in record tries.
- 3 **OUTBOARDS.** Latest world record run for outboard-powered craft was with Mercury motor at 137.96 mph on Lake Windermere in England by Tony Williams in 1981.
- 4 **OFFSHORE.** Deep-V hull record of 90.555 mph is held by Bob Nordskog driving a 1976 Cigarette hull. Englishman Ted Toleman in his *Stick 50* catamaran did 97.44 in 1981.
- 5 **HYDROPLANES.** With Mercury outboard power in a Ron Jones Modified U-class hull, Jim Merten drove 132.09 mph over a kilometer course at Kaukauna, Wis., in 1978.
- 6 **MILITARY.** Believed to be fastest of all armed forces vessels, Canadian Royal Navy's *Bres d'Or*, a hydrofoil-equipped subchaser, does estimated 80 mph.
- 7 **DIESEL.** A record for diesel-engined offshore racers, 64.467 mph, was set in 1967 by driver Don Aronow's *Maltese Magnum*.
- 8 **SAILING CATS.** Catamarans have been clocked at 41.5 mph, and a 61-foot cat holds a 9-day transatlantic record.
- 9 **SCOWS.** Fastest of all monohull sailboats, big Class A scows have topped 30 mph.
- 10 **OCEAN LINERS.** The *S.S. United States* has held the transatlantic blue ribbon (40.9 mph) since 1952 for a three-day crossing.
- 11 **CLIPPER SHIPS.** The fastest big ships of the 19th century, clippers set speed records of up to 22 mph for runs of 24 hours.
- 12 **OCEAN RACING KETCH.** The 73-foot *Windward Passage* sailed the Miami-to-Nassau 1969 race in 15 hours, 54 minutes.
- 13 **SCHOONER.** In 1905, three-masted yacht *Atlantic* set a 12-day transatlantic record.
- 14 **J-CLASS SLOOP.** Biggest of single-masted yachts, Js of the early 1900s could average over 11 mph.
- 15 **12-METER YACHTS.** Today's America's Cup sloops approach 10 mph while racing.
- 16 **THE AMERICA.** In 1851, this famous pilot schooner won The Cup at 6.21 mph.



the Gold Cup racers—are the fastest things afloat. In the 1981 race season, Dean Chenoweth, at the controls of *Miss Budweiser*, shattered almost every record in the books: 140.187 mph for a 2½-mile qualifying lap; 139.212 mph for five miles (two 2½-mile qualifying laps); 138.639 mph for a 3-mile qualifying lap; 127.728 mph for a 2½-mile competition lap; 123.814 mph for 15 miles in a competition heat; and 117.662 mph for 45 miles in a race. Because these boats must slow down so much for the turns, it means Chenoweth was reaching speeds of 200 mph or better when accelerating in the straights.

The one record Chenoweth failed to break was the one

set 20 years ago by Roy Duby: 200.419 mph for an Unlimited Class racer over a measured mile. It was set, in the rain, on Guntersville Lake, Ala., and it took three runs to do it (the second run was discounted because spectators accidentally kicked a wire off the timing clock). Chenoweth's 1979 attempt at this record ended in a spectacular crash and six broken ribs, but in a recent issue of the APBA publication *Propeller*, he reported the boat was doing better than 225 mph at the time of the accident, and that it was capable of reaching 250 mph.

Unlike the hydroplanes, which require fairly smooth water, offshore racing boats can reach and maintain



high speeds in normal ocean conditions; indeed, it takes a little chop to help them "break free" and run at their best.

Big catamarans are the fastest of this breed, averaging about 35 feet in length. With a pair of sterndrive engines putting out a total of 1,200 hp or more, they can run at speeds up in the 90s. It was just Sept. 26, 1981, that Ted Toleman and co-driver Harold (Smitty) Smith made two runs over a measured mile at Southampton, England, averaging 97.44 mph for a new offshore record.

The boat, Toleman's *Slick 50*, was fitted with a wing structure over the cockpit to provide additional lift. Did

it help? According to Toleman, it may have provided an extra 2 mph one way, but acted as a drag going the other way. A week later, sans wing, the boat was back racing.

The big catamarans, with the extra lift developed by the air funneled through the tunnel between the hulls, can run faster than the traditional deep-V monohulls used for the sport. But when seas really get rough, the stresses on the structure can be so great that the cats break apart—while the deep-V drivers can keep pouring on the coal. Several drivers on the offshore championship circuit bring a cat and a deep-V to each race.

(Please turn to page 164)

Now Your Kids Can

A new language for computing, Logo, is taking educational centers by storm. Eight- and ten-year-old programmers are common. But adults can learn computing this new way, too.

by Neil Shapiro ELECTRONICS EDITOR

Their dreams sketched on graph paper, the class of inner-city fourth-graders filed boisterously into the computer-filled room. As the youngsters entered the room and saw the computers, the air vibrated with their excitement. By twos and threes, they sat down in front of the glowing screens and shiny keyboards on a visit to New York Teachers College.

The class began to type a string of numbers into the computer. On the group's graph paper was a storybook castle, which soon appeared on the computer's screen.

When it did, the kids' faces lit up far brighter than the screen.

"These kids," the teacher exclaimed with happy amazement, "are picking it up faster than I am."

The scene was fascinating to anyone not familiar with the magic of kids and computers—but it's all in a day's work to educators who have become familiar with

Logo. Logo is a new computer language that's allowing kids—and adults—to control computers and have fun with them. Logo, which was developed at the Massachusetts Institute of Technology by Seymour Papert and his colleagues, is the most startling software development in personal-style computing. The language can be learned in just a few hours by an adult—but more impressively, it's the first language designed expressly for education. Using Logo, even preschoolers can begin to enjoy and learn about computers.

Logo owes much of its success to the idea of "turtle graphics." A small triangle in the middle of the computer's monitor screen is called a "turtle." The kids imagine that the turtle's tail, dragging behind it as it crawls on the screen, draws a line. Easy commands tell the turtle to turn, how far to move, whether to back up or go for-

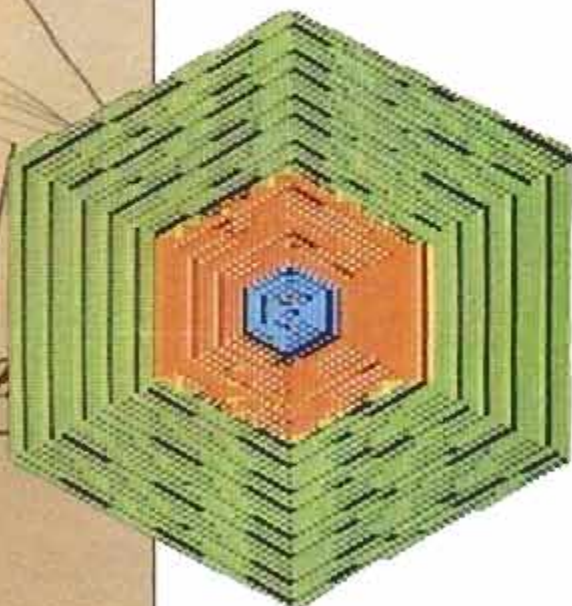


Teach You To Compute

PI SIDE : ANGLE
: SIDE
: ANGLE



Logo, an exciting new computer language, is finding its way into more classrooms. Using easy commands, students can move a pointer called "turtle" on the computer's screen and have it draw many colorful, complex designs. One company, Terrapin, goes a step further. Its version of Logo will also control a real, robot turtle. The robot turtle moves on a tabletop the same way as its on-screen counterpart moves on the computer display. The robot turtle drags a real pen underneath its hemispherical body. In this way, the robot can draw on paper designs that repeat the ones on the screen (a design is illustrated below). Youngsters of all ages find that learning Logo is fun. And the language has many features that make it strong enough to interest an adult computerist. It is the simplest and best language we've encountered to begin learning how to compute. (Photograph was taken at The Fieldston School in New York.)



PH photos Peter Terzler

```

TPO "PETAL
TO PENUP :SIZE
RIGHT :SIZE 50 RIGHT 90
END

```



```

TPO "LLEAF
TO PENUP :SIDE
RIGHT 90
PENDOWN :SIDE
BACK :SIDE 90
RIGHT 90
END

```



```

TPO "RLEAF
TO RLEAF :SIDE
PENUP :SIDE
RIGHT 90
SPIN 20
PENDOWN :SIDE
ARCLEFT :SIDE 90
LEFT 90
ARCLEFT :SIDE 90
RIGHT 180
PENUP
END

```

```

TPO "LEAVES
TO LEAVES :SIZE
PENUP :SIZE * 1.3
RLEAF :SIZE
LEAF :SIZE
END

```



A Logo program is made up of a number of building blocks—each block being a smaller, self-contained program. In the photos shown above, we illustrate how

the FLOWER program (the fourth set of screens) is made to draw a picture of a flower by using the subsidiary programs of PETAL, LLEAF, and RLEAF. Typing out

the phrase PETAL 50 on the computer's keyboard would produce a petal of size 50, as shown. Entering RLEAF 50, in the same manner, would produce a similarly

'These kids get the idea that computers are dumb little machines—that you can control them.'

ward—even if he should lift his tail and not draw.

A program line such as FORWARD 10 (or FD 10) would send the turtle 10 "turtle steps" forward on the screen. Other coded commands include PC for changing pen color; BK for backup; RT for turn right; LT for turn left.

One company, Terrapin, even markets a personable turtle robot (pictured on the preceding page) that will draw on paper what its video counterpart is drawing on the computer's screen.

But drawing pretty pictures is not Logo's only function.

"Logo gives young people real training in how to think creatively," explains Jim Mueller, head of the non-profit group Young People's Logo Assn. (YPLA). "All too often, educational processes have tended to be highly structured. Computers put youngsters in control of the situation."

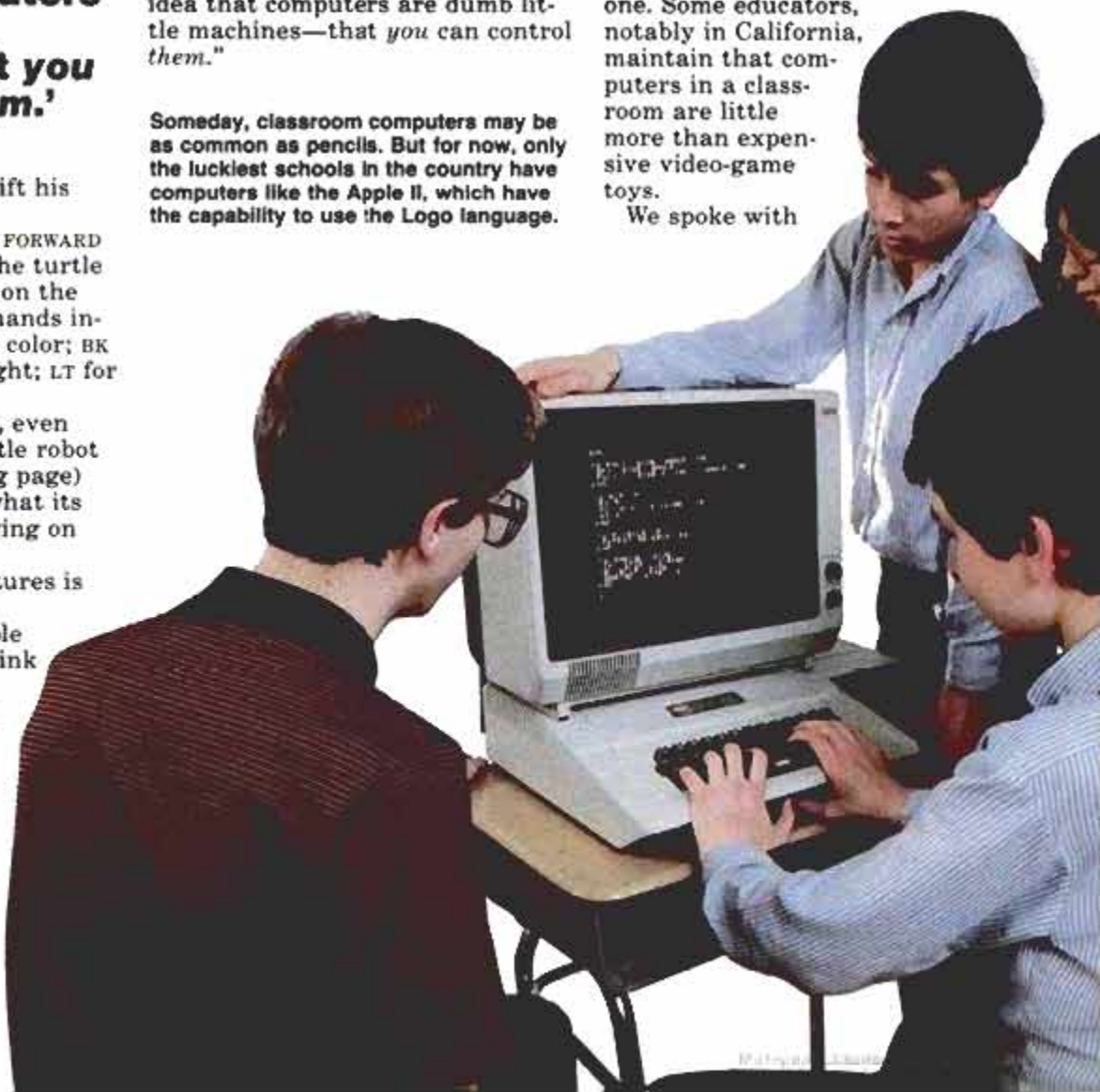
And according to Ursula Wolz, an instructor at New York Teachers

College Microcomputer Resource Center, "These kids get the proper idea that computers are dumb little machines—that you can control them."

Someday, classroom computers may be as common as pencils. But for now, only the luckiest schools in the country have computers like the Apple II, which have the capability to use the Logo language.

This idea of putting the kids in control of computers is a heady one. Some educators, notably in California, maintain that computers in a classroom are little more than expensive video-game toys.

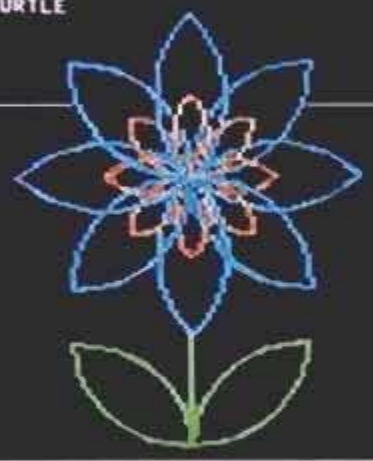
We spoke with



```

TO "FLOWER
  FLOWER SIZE
  PENUP
  FORWARD 20 PENDOWN
  REPEAT 8 [SETPC 5 PETAL SIZE SETPC 4 R]
  SETPC 45 PETAL SIZE - SIZE / 23
  SETPC SIZE
  STEPS SIZE
  LEAVES SIZE
  PENUP
  HOME
  TURTLE
  END

```

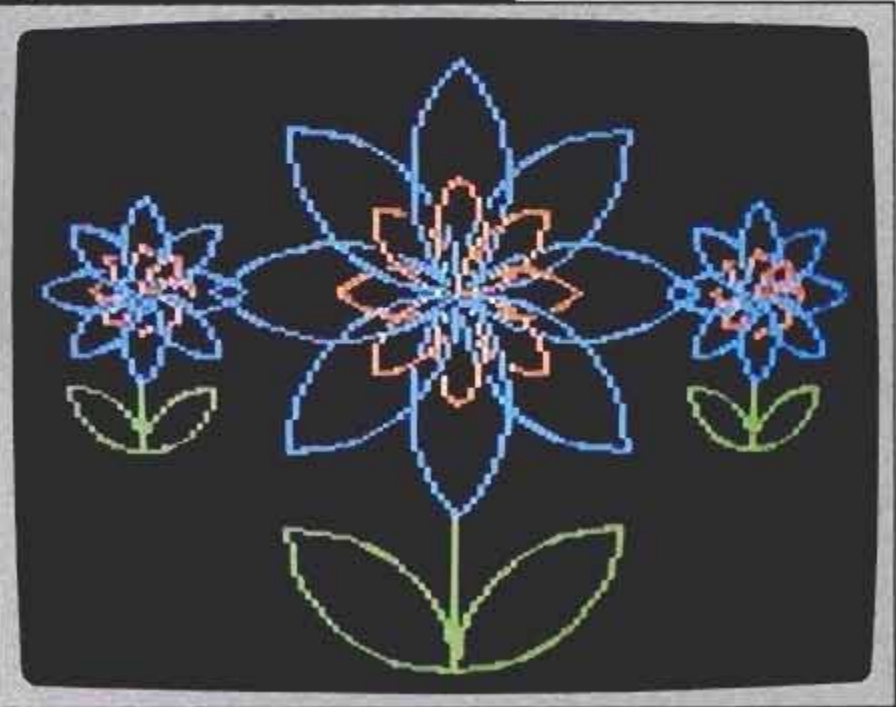


```

TO "GARDEN
  TO GARDEN :1FLOWER :2FLOWER :3FLOWER
  FLOWER :1FLOWER
  FORWARD 90
  LEFT 90
  FORWARD 90
  PENUP
  HOME
  TURTLE
  FORWARD 90
  LEFT 90
  FORWARD 90
  PENUP
  FLOWER :3FLOWER
  END

```

GARDEN program (left and below) draws three flowers on the screen. It uses the FLOWER program three times—and each time, the FLOWER program uses the building-block subprograms of PETAL, LLEAF and RLEAF. Typing GARDEN 50 30 30 produced the pictures below.



sized right-hand leaf. Typing FLOWER 50 would cause the leaf and petal programs to draw their shapes in perspective to each other so as to generate the flower.

Seymour Papert, the designer of Logo, and asked him to reply to the video-game accusations. "Some people," Dr. Papert told us, "do learn well without computers. But the computer enables knowledge to be shown in such varied ways that people with different approaches, and in different cultures, can all succeed."



His sentiments were echoed by teacher Roz Keller, whose New York City class we observed at the Microcomputer Resource Center. "I'm seeing a different kind of child than I usually do," she said. "These kids," she waved around the room at the students all busily computing, "are coming out of their shells!"

Learning Logo

The youngsters we observed at Teachers College didn't have a computer in their home classroom. Instead, they learned the rudiments of Logo computing by, among other things, crawling around on the floor as if they were turtles. The classroom floor had been measured and

each student took a turn pretending he was a turtle, following another student's programmed orders. Right now, Logo is available in a few "flavors" for the Apple II computer and there's a version for the Texas Instruments TI-99/4A computer. Other versions are presently being developed for the Atari 800 and 400 machines and, rumor has it, for the new TRS-80 Color Computer as well.

We took a look at Apple Logo and at Terrapin Inc.'s Logo, as well as Texas Instruments'. The Apple Logo was developed for Apple Computer Inc. by Logo Computer Systems International (L.C.S.I.). The Terrapin version is an offshoot, also for the Apple, developed by Prof. Harold Abelson. The Texas Instruments Logo is similar to the Terrapin variety, with some drawbacks and additions.

All of the Logo types have the turtle graphics. The Apple Logo has a number of preprogrammed command words that Terrapin's lacks. But Terrapin can be interfaced to the little, turtle-shaped robot. The Terrapin Logo also has

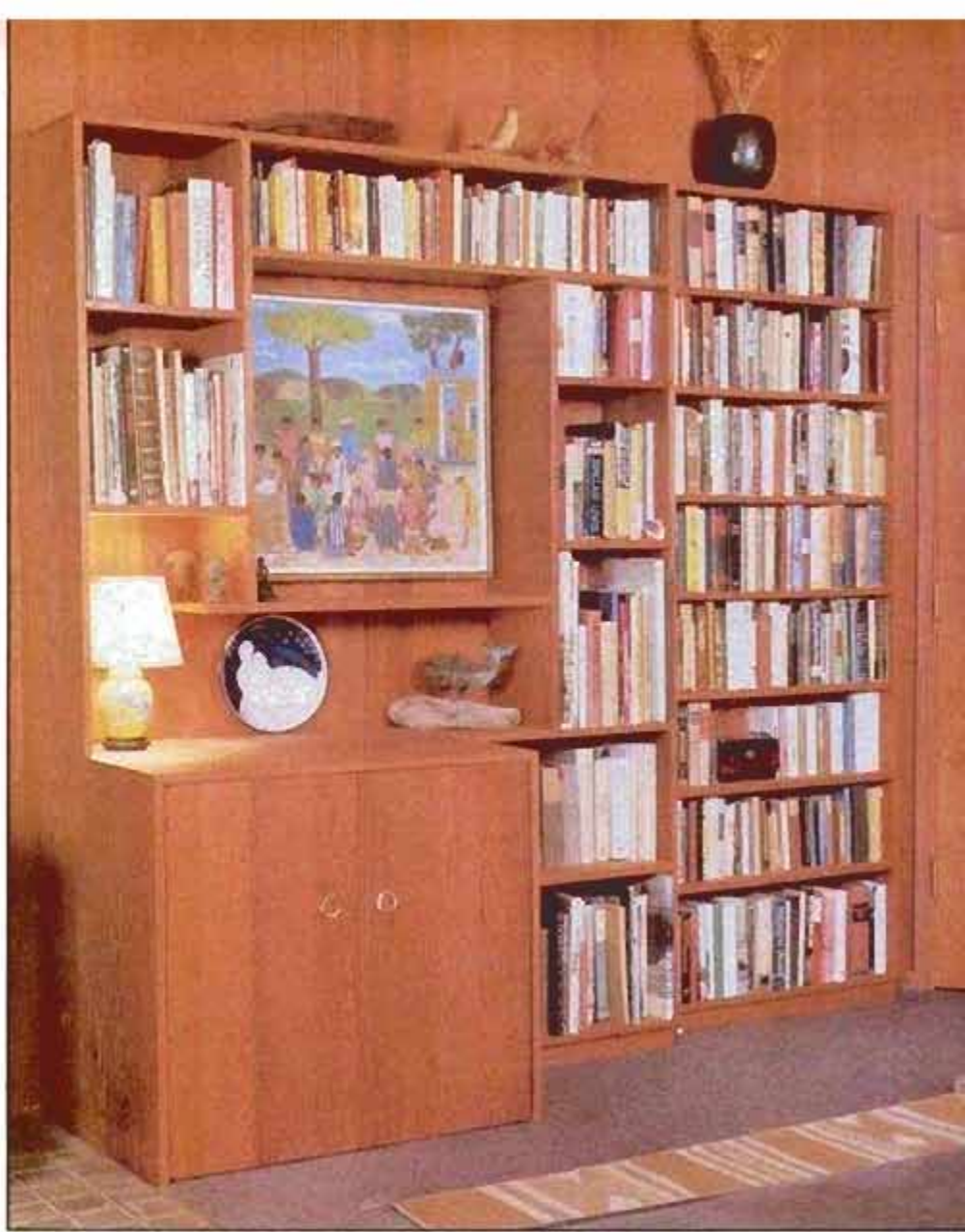
How To Put Any Shelf Anywhere

There are shelves and mounting hardware to suit any need, solve any problem. Here's a guide to the many storage systems you can buy or make yourself.

by William Beyer
and David Warren

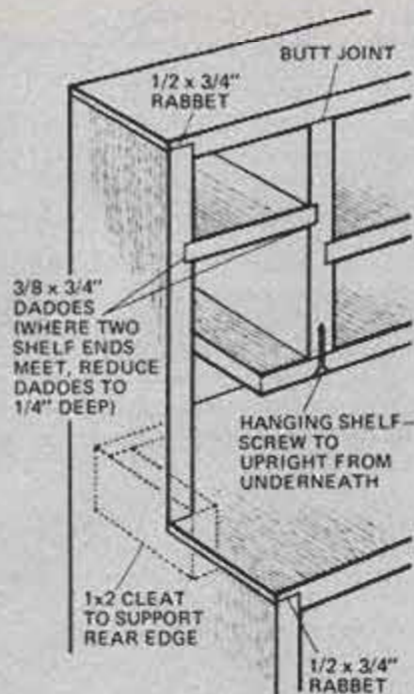
The trouble with shelves is they collect things. You put up something originally intended for decorative glassware or a collection of beer mugs—no problem. Later, your needs change and you start loading on hefty books, hi-fi gear and that souvenir ship's anchor you found last summer. After a while, time and gravity take their toll. Suddenly your shelves are falling off the wall.

Because most shelves, by their nature, will have to handle heavy loads—either now or later—it pays



Metal utility shelving (above), now in smart-looking decorator colors, has moved out of the cellar and into living areas. These Sears units can also support a desktop between them, ideal for a den. Adjustable wood shelving (right), mounted on slotted wall standards, is easy to put up anywhere and lets you create a variety of attractive arrangements. System shown is from Knappe & Vogt.





Free-standing bookcase

Handsome bookcase/storage wall (facing page) looks like a built-in, is actually free-standing unit that can be moved. Made of rich, warm-toned redwood, it suggests how similar units can be designed to suit individual needs. Open niches provide space for pictures and decorative objects. Deeper base cabinet houses TV set, also acts as foot to stabilize shelves. Basic joinery used in such self-supporting shelf units is shown in drawing above. Assemble joints with glue and finishing nails.

Color photo, facing page: California Redwood Assn.

to get them up right the first time, especially wall-hung shelves that have no floor support. The job needn't be difficult. Commercial shelf hardware comes in types and styles to suit any need; mounting fasteners are available for any wall surface you'll encounter. It's just a matter of picking the right system.

Wall-hung shelves

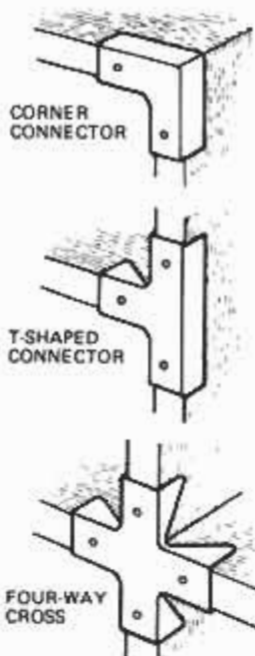
When putting up wall-hung shelves, you face two basic considerations: proper wall attachment to support the total load, and proper bracket spacing to prevent sagging of individual shelves. For example, assuming screws are into solid wood, a 3/4-in. pine shelf on brackets spaced 12 in. apart will support a whopping 670 lbs. per sq. ft. But the same board on brackets 36 in. apart will hold only 38 lbs. per sq. ft.—and at 72 in., just 5 lbs.

In general, the maximum safe span for a heavily loaded 3/4-in. wood shelf, with no support at the back



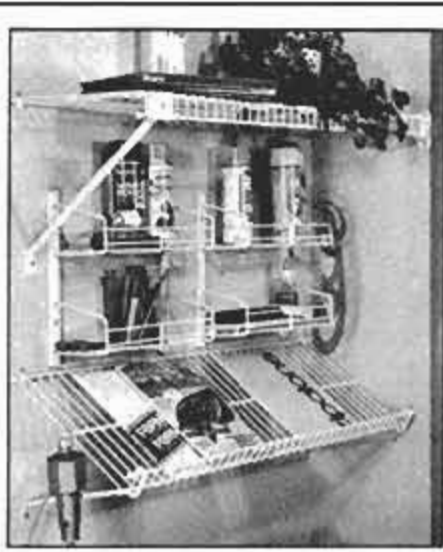
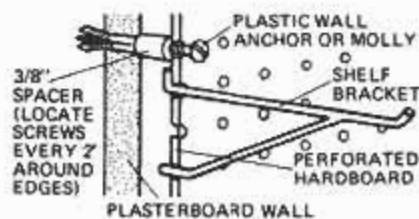
Clip-together organizers

You can design your own bookcase or closet organizer with these versatile shelf connectors from Knap & Vogt. The metal, tack-on clips fit standard 3/4-in.-thick, prefinished shelf boards and come in corner, tee and four-way-cross styles. By combining the connectors in various arrangements, you can create compartmented storage units to suit any space and need.



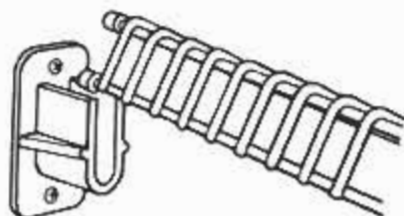
Versatile storage wall

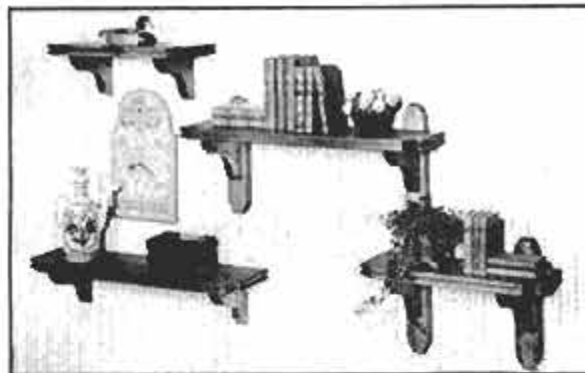
Perforated hardboard provides flexible storage for changing needs, can support shelf brackets as well as many special fixtures that simply hook into prepunched holes spaced 1 in. apart. Mount panels on 3/8-in. spacers to give clearance in back for the fixture hooks (drawing below). You can also use plastic wall anchors that come with standoff collars, made especially for this purpose. Installation at right features attractive "shadow box" frame around it, with fluorescent fixtures recessed into cove at the top to give soft, indirect lighting.



Utility shelves, racks

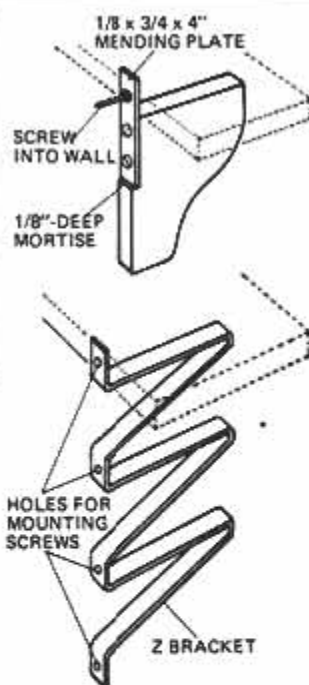
Open-work shelves and racks made of vinyl-covered welded rod have light, airy look, collect less dirt than solid surfaces and are handy for use in closets, kitchen, pantry, laundry room, workshop and garage. These from Closet Maid come in many shapes to hold typical household supplies and are easy to mount in special snap-in wall clips (below).





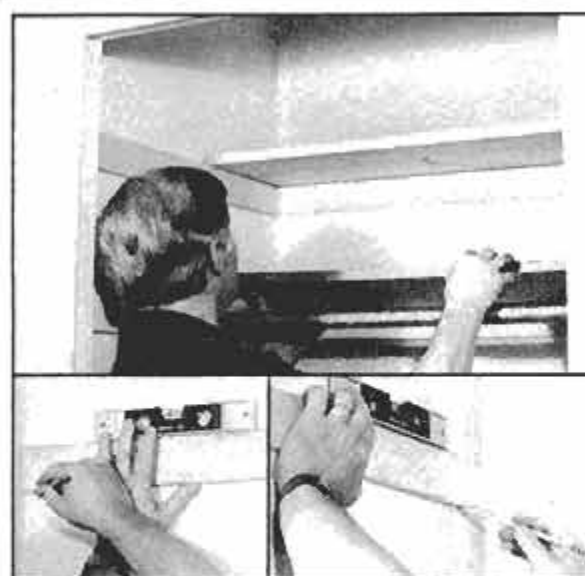
Wood shelves to buy or make

Invisibly mounted wood shelves (above) have metal inserts in back with keyhole slots. You anchor screws in wall with heads protruding slightly, then hook on the slotted brackets. These shelves from Flair Fold come in five period styles and many sizes. You can also make your own wood shelf brackets, using metal mending plates for hangers (upper right). When shelf is in place, it hides ends of plates. Metal Z brackets (lower right) hold three planks per strip and are quick, inexpensive way to put up utility shelving.



Space-age stud finder

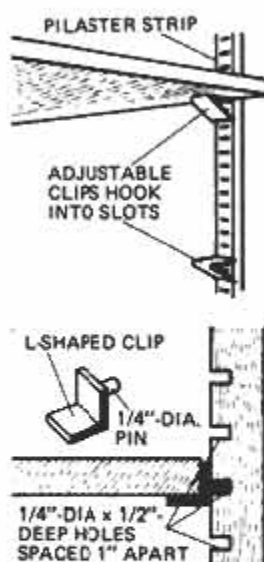
New electronic stud finder sets up field that senses the presence of wall studs by their greater density, compared to hollow spaces in between. You move it back and forth until you get highest reading, as indicated by row of tiny LED lights. The device, made by Zircon International, is said to be easier to use and more accurate than older magnetic detectors, developed for use in days when plaster lath was attached with many closely spaced nails. Today's plasterboard, often applied with adhesive and only a few nails, offers little metal for magnetic detection.



Installing closet and cabinet shelves

Installing shelves in an enclosed space, such as a closet or alcove, is easy because side walls can support the ends of shelves. Cleats of 1x2 or chair-rail stock can usually be nail-fastened to studs. Put up back cleat first, using a spirit level to ensure that it's straight (lower left). Then install end cleats, leveling them as well (bottom center). Most closets have

waste space above clothes, can usually take two shelves. Where you want adjustable shelves in a cabinet or bookcase, the drawings at right show two alternate mounting methods using slotted pilaster strips or L-shaped clips that fit into rows of 1/4-in. holes. (A strip of perforated hardboard makes a handy guide for locating holes 1 in. apart.)



edge, should not exceed 32 in. (Shelves in enclosed bookcases with back support can span up to 48 in.) Glass shelves of 1/4-in. plate, such as typically used in medicine cabinets, should not exceed about 20 in. between the supports, though much heavier 3/4-in. plate can safely span up to 40 in.

Screws turned into thin wood paneling or plasterboard will soon pull loose. Wherever possible, it's best to screw shelf brackets into wall studs. This way, the studs—not the surface wall—support the load and no special anchors are needed. Since studs are spaced on 16-in. centers, you can screw into every other one and maintain a sturdy 32-in. spacing. For lightly loaded shelves, or shelves of heavier 3/4 or two-by-stock, you can go to every third stud.

But studs are often hard to find or may not fall exactly where you want your shelf brackets. Here you need anchors made especially for hollow walls. Screws turned into simple plastic sleeves will support hundreds of pounds and stay put indefinitely. Other anchors are made for solid masonry walls. Here's a rundown on the many types of shelving and anchoring systems you have to choose from.

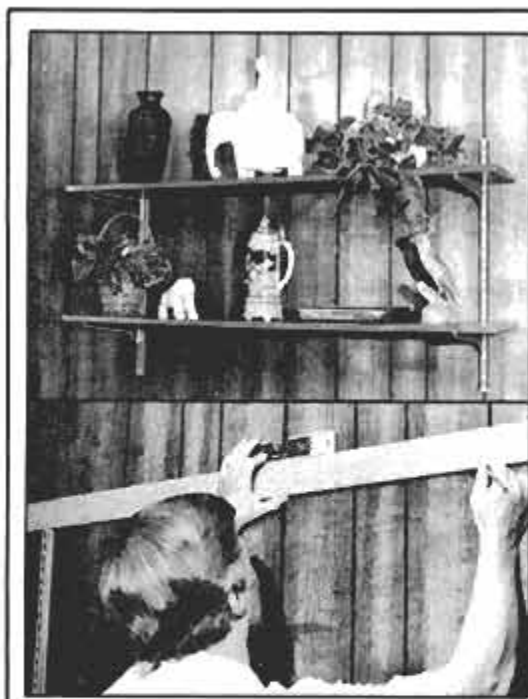
Metal utility shelving

Once relegated to the basement, steel utility shelving now comes in bright, attractive decorator colors, making it equally at home in a family room, den, pantry, home office, children's room and other upstairs areas.

Consisting of predrilled angle-iron legs and lipped metal shelves, these handy bolt-together units can be assembled in minutes with only a screwdriver and they provide fast, flexible storage wherever substantial shelving is required. The leg angles have rows of closely spaced bolt holes so the height of the shelves can be adjusted easily.

Most metal utility shelving is designed to be free-standing, making it readily movable. Some units, however, can be wall-hung with special clips. Stock sizes range from 47 in. high by 30 in. wide up to 71 in. high by 42 in. wide. Shelves come 9 to 24 in. deep. For storing preserve jars and other breakables, the shelves can be mounted lip side up to keep such items from sliding off.

Sears, Hirsh and Quaker Industries are among the makers now offering utility shelving in smart, decorator colors, as well as the traditional battleship gray. Sears also has a system that combines stacking shelf units with a butcher-block desktop and a two-drawer, color-

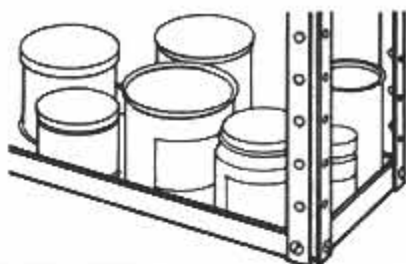


Adjustable shelves

When installing wall standards for adjustable shelves, care must be taken to mount all uprights at the same height so shelves will be level. Use this simple procedure: Locate first standard, mark for top-most screw and install wall anchor. Standard will hang vertically by gravity, but should also be checked for plumb with a spirit level. Mark for and install remaining anchors. Then, with first standard in place, rest a straight board and spirit level on top and mark location for top of second standard (lower left). Do the same for all succeeding standards. Check to make sure slots are at same elevation. Note in this case that standards are positioned over grooves in paneling. This avoids marring face of paneling if the shelves must be removed later.

Metal utility shelving

Metal, bolt-together shelf units are designed to be free-standing, but can also be wall-hung using special clips (right). Shelves have lipped edges that can be turned up or down. Turned up (below), the lips keep jars and other breakables from sliding off. Predrilled leg angles, available in lengths up to 6 ft., allow easy adjustment of shelves to any level.



matched file cabinet to form a complete study center.

Special utility hardware

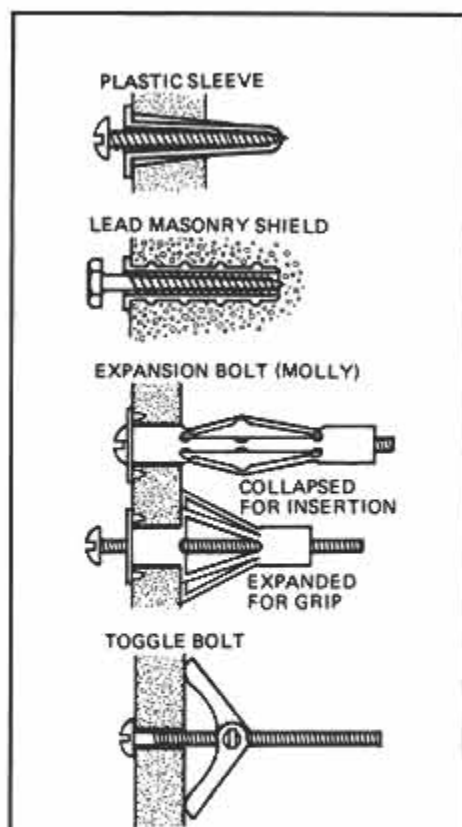
You can also make your own utility shelving, using commercial brackets that take wood planks or big plywood sheets. Such hardware is especially handy for custom-tailoring large or odd-shaped shelves to fit a particular space, such as in attic eaves, under a stairway or over the hood of a car in a garage. Particleboard, available in sheets or standard shelf widths, is cheap and resists warping—ideal for utility use.

Installing shelves in closets, alcoves and other enclosed areas is easy with Solar Hardware's adjustable metal units. These consist of a telescoping steel shelf and closet pole that expand to fit between two side walls. Eight sizes handle openings from 2 to 10 ft. wide.

Suspended shelving

There are also systems for suspending shelves from overhead. One, called Modular Link from Specialty Manufacturing, has pairs of shelf hangers that hook into hefty screw eyes turned into ceiling joists. Each pair of hangers supports a shelf board between them. If you want several shelves, you just hook additional pairs of hangers into the bottom of those already in place, creating a tier as tall as you like. Such systems leave the floor area clear, permit easy removal, and are handy for temporary storage in attics and basements, where ceiling joists are usually exposed.

Where good appearance is not a consideration, you can make your own hanging shelves by bolting pairs of 2x2 or 2x4 uprights, spaced several feet apart, to ceiling joists. With cross cleats nailed to the



Which wall anchor?

Wall-hung shelves need sturdy support. Where you can't screw into wall studs, special anchors are required to keep screws from pulling loose. For hollow walls, there are three basic types: plastic sleeve, expansion bolt (Molly) and toggle bolt. Plastic sleeve is simplest, requires only small pilot hole, is good for light to moderate loads. Mollys and toggles both work by gripping back of wall and are a better choice for heavily loaded shelves, especially deep ones that put considerable outboard strain on brackets. On solid masonry walls, you should use lead shields. These expand as lagscrews are turned into them, locking them securely in place.

uprights at appropriate heights, you can suspend a tier of shelves from overhead. For extra-sturdy support, extend the uprights down to the floor.

Adjustable shelving

One of the most versatile and attractive systems for wall-hung shelves uses slotted metal uprights, called standards, that can be attached to any wall surface. Metal arms, keyed to fit in the slots, lock in at any height to support a series of adjustable shelves wherever they are needed.

The standards come in lengths of 1 to 6 ft. and in a variety of decorative finishes, including brass, bronze, aluminum, chrome, black and white. Matching brackets are available in 6-, 8-, 10- and 12-in. lengths and take either prefinished shelves in stock

(Please turn to page 186)



PM's traditional drop-leaf harvest table offers plenty of room for a hearty meal. With leaves down, table is great for buffet-style service.

Table Fit For A Harvest Banquet

This drop-leaf harvest table seats eight comfortably, yet stores away neatly when it's not in use.

Eight people can gather in comfort around this traditional harvest table. Yet, when floor space is limited, you can place the table against the wall, lower one leaf and still use it to dine; drop both leaves and it becomes a serving table.

Our harvest table is constructed of cherry, coated with satin-finish varnish for a hand-rubbed look. Begin construction by truing one edge of each piece of cherry or other hardwood stock on the jointer or with your plane. From these, select the best boards for the tabletop and drop leaves.

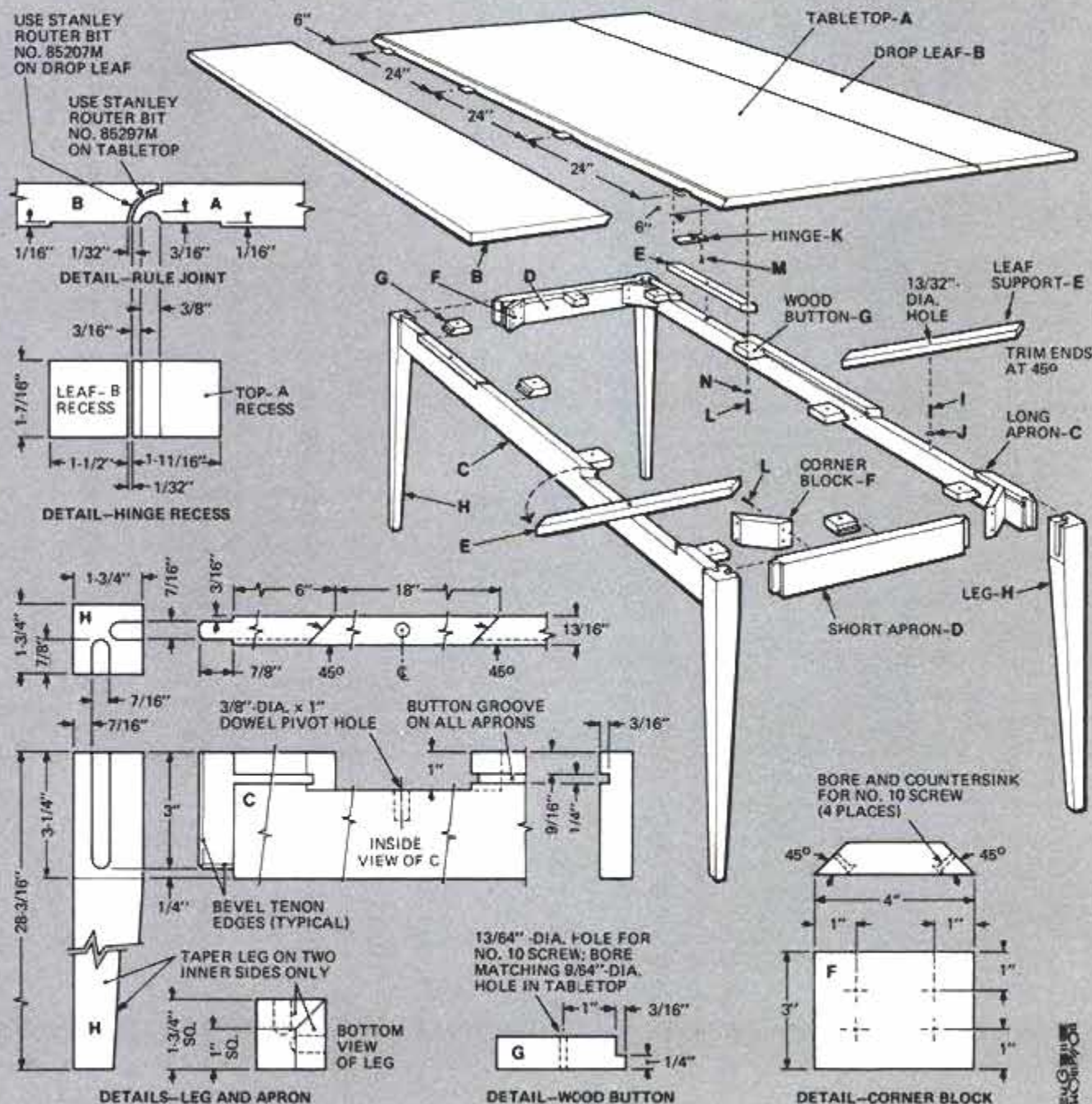
Cut the boards for the top and

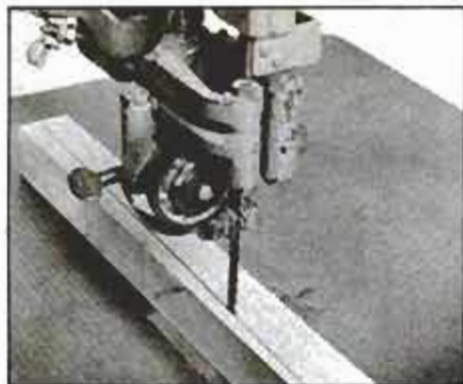
MATERIALS LIST—HARVEST TABLE

Key	No.	Size and description (use)
A	1	1 3/8" x 22" x 84" hardwood, edge-joined (top)
B	2	1 3/8" x 10 1/2" x 84" hardwood, edge-joined (leaves)
C	2	1 3/8" x 3 1/4" x 78 1/2" hardwood (aprons)
D	2	1 3/8" x 3 1/4" x 18 1/4" hardwood (aprons)
E	4	1 3/8" x 1 3/8" x 18 3/4" hardwood (supports)
F	4	1 3/8" x 3" x 4" hardwood (corner blocks)
G	10	1 3/8" x 2 1/2" x 2 1/2" hardwood (buttons)
H	4	1 3/4" x 1 3/4" x 28 3/16" hardwood (legs)
I	4	3/8"-dia. x 1 3/4" hardwood dowel (pivots)
J	4	3/8"-i.d. flat washer
K	8	1 1/2" table hinge, such as Stanley No. 810
L	26	1 1/2" No. 10 fl. screws (16 for corner blocks, 10 for buttons)
M	48	5/8" No. 8 fl. screws
N	10	No. 10 finishing washers, countersunk

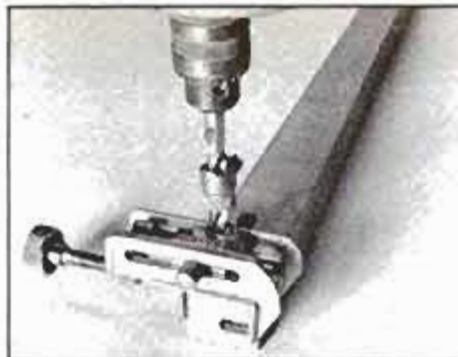
Misc.: Carpenter's glue, sandpaper, tack cloths, finish.

PM color photo: George Ancona
Design, construction, how-to photos, text: Neal Barrett
Technical art: Eugene Thompson

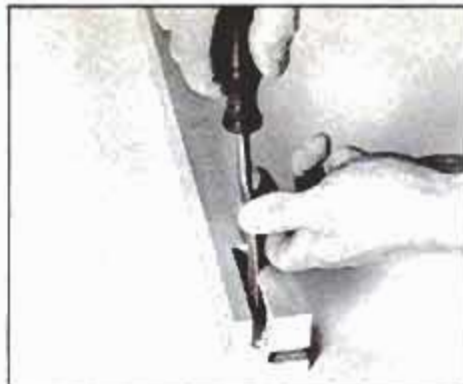




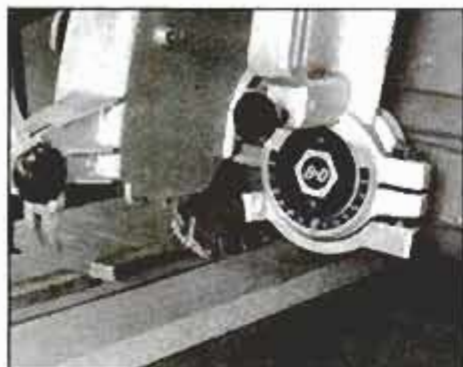
1 Builder cuts the leg tapers with a band saw. Saw on the waste side of the line.



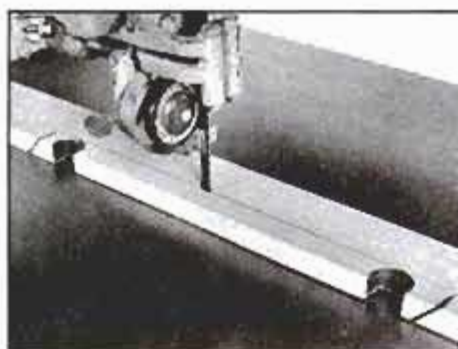
2 Use a doweling jig and adjustable depth collar on the drill bit to bore out the waste for the table-leg mortises.



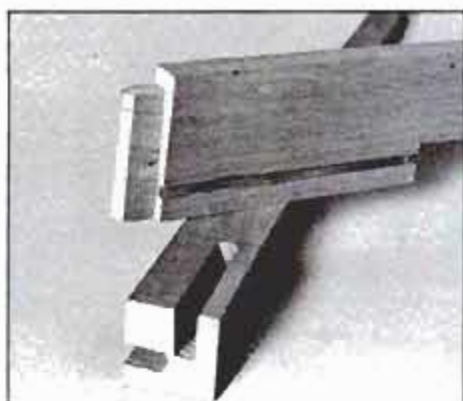
3 Clean out mortise sides using a sharp chisel. The bottom and end can stay round.



4 Cut a 1/4-in.-wide x 3/16-in.-deep kerf on the inside of the apron to accept wood buttons, which fasten to the tabletop.



5 Before making the cutout on the apron for the leaf support, make 45° cuts at both ends and escape holes for the blade. Do final trimming with a very sharp chisel.



6 Mortise and tenon are ready to fit. Note chamfers on tenon's end, bottom edges.

leaves to rough length, approximately 1 1/2 in. over the finished dimension. Rip each board 1/16 in. wider than you want it to be when finished. Use jointer or plane to true the ripped edges and ensure good glue joints. Edge-join the boards for the top and both leaves, making sure to coat all mating surfaces evenly with glue. You may also use 1/4-in. dowels, spaced approximately 10 in. on center, to align and reinforce the joints.

After the glue has set, plane the top and leaves flat and trim the pieces to finished lengths. Since the top is too long to handle easily on the table saw, and too wide to cut on the radial-arm saw, it can be cut by hand or with a portable circular saw. In either case, clamp a straight board across the work to serve as a guide for your saw. Set the top and leaves aside and proceed with the base.

Shaping the legs

Rip 8/4 stock for the legs to 1 3/4 in. square. Cut the legs to length and mark the tapers on each. The finished height of our table is 29 in., but you can alter table-leg dimensions. A table should be about 12 in. higher than the floor-to-seat top height of the chair that will be used with it.

Note that the legs are tapered on the two inside planes only and that the taper begins 3 1/4 in. down from the top of the leg. This allows for a

square joint with the apron. Cut the tapers on the band saw; be careful to cut on the waste side of the line. Use a sharp plane to remove the saw ridges and to finish shaping the legs.

Lay out the mortises in the legs as shown in the drawing. Bore overlapping 3/16-in.-dia. holes to eliminate most of the waste from the mortise. A doweling jig and adjustable depth collar on the drill bit facilitate the work. Clean up the sides of the mortise with a sharp chisel. You can leave the bottom and end of the mortise rounded.

Making the aprons

Rip 4/4 stock for aprons to a 3/4-in. width and cut to finished length. Also rip one piece 2 1/2 in. wide and cut it to 30 in. in length for the wooden hold-down buttons. Cut the tenons on each end of the apron members using the radial-arm saw and dado blades. (See the tenon detail in drawing on the preceding page.) Cut the 3/4-in. shoulders first on all pieces and then readjust the saw to cut the 1/4-in. shoulder at the bottom edge of the tenon. Since the dado blades leave small ridges on the cheek of the tenon, cut the tenons a bit large and trim to fit with a sharp chisel.

While the dado blades are in the saw, cut the rabbet on the length of stock for the wood buttons, which hold the tabletop to the base. Read-

just the saw and cut the rabbet according to dimensions in the drawings. Then use the table saw to cut off the individual buttons.

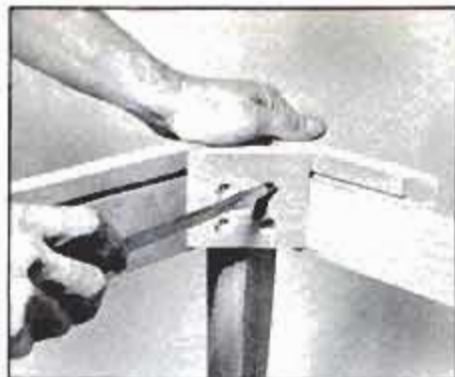
Next, use the radial-arm or table saw and dado blades to cut a 1/4-in.-wide x 3/16-in.-deep groove on the inside of each apron member (see apron detail). This groove receives the wood buttons, as shown.

Cut the corner blocks on the table saw from 4/4 stock to dimensions shown in the drawing. Bore and countersink pilot holes for No. 10 flathead screws. Next, clean up the tenons on the aprons and chamfer the end and bottom edge of each tenon. The chamfer allows the tenon to fit snugly into the rounded bottom of the mortise.

Test each leg-apron joint to ensure a good fit. The joints should be snug, but they shouldn't require undue force to bring the members tightly together. Make the cutouts in the long aprons for the leaf supports, positioned as in the drawing. First make the 45° cuts on the table saw. Then bore a large hole 1 in. from each end of the cutout. Using the band saw or handheld jigsaw, cut on the waste side of the line between these holes. Pare down to the line and clean out the ends of the cutouts with a razor-sharp chisel. Bore a 3/8-in.-dia. hole 1 in. deep in the center of each cutout for the wooden pivot pin. Glue a 3/8-in. wood



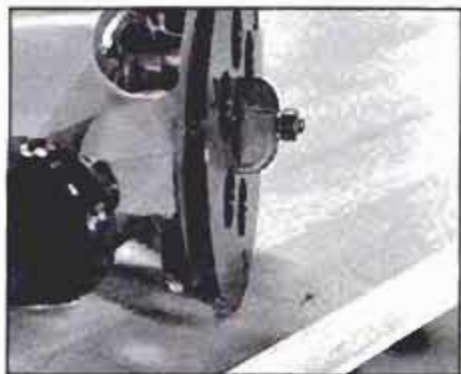
7 Clamp the legs to the long apron. Scrap board clamped to the legs maintains proper spacing at the bottom. If frame is square, the diagonal measurements are equal.



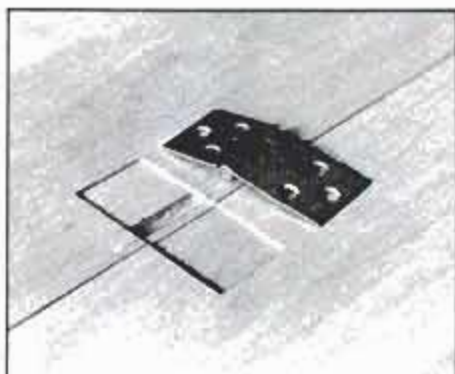
8 Install the corner blocks with 1 1/4-in. No. 10 flathead countersunk wood screws.



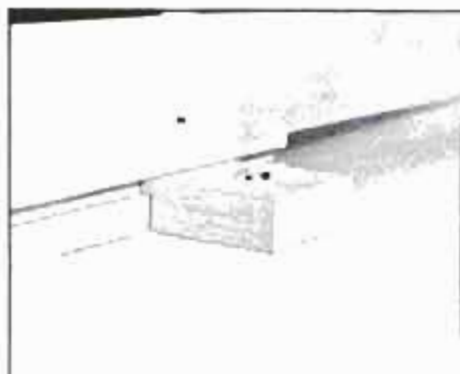
9 Using a router bit with a ball-bearing pilot greatly simplifies the task of cutting the rule joint on the tabletop.



10 Cut the cove joint on the drop leaf with a matching cutter. Turn the leaf upside down to make the leaf-edge cut.



11 Mortise the table hinge. Make an added recess in the mortise for hinge barrel.



12 Wood buttons fit into a 1/4-in. kerf on apron. They're screw-fastened to the top.

dowel in each hole projecting 1/16 in. above the surface. Cut four leaf supports to size and bore a 1/2-in.-dia. hole in the center of each support.

Assembling the table

Presand all parts before assembly. We started with 120-grit paper and progressed to 150-, 180- and 220-grit. If you assemble the table with reasonable care, only a small amount of touch-up sanding will be required before finishing the piece.

Assemble the long aprons to the legs first and the short sides afterward. Put a thin, even coat of glue on the walls of the mortise and the cheeks of the tenon, but don't fill up the mortise. Clamp the legs to the long aprons in pairs, using 8-ft. bar or pipe clamps. Tighten the clamps gently to avoid bowing the apron. Clamp the bottoms of the legs to a scrap board the same length as the inside measurement of the assembly at top (about 78 in.). Make sure that the legs are square to the apron. The best method is to measure from corner to corner; both diagonals should be equal. Then clean up any glue squeeze-out. If you wait until the glue dries, it will have penetrated the wood surface and will require tedious scraping and sanding in the tight corners.

After the glue has dried, finish assembling the base by joining the short aprons to each long side. This

should be done on a flat, level surface, so you can be sure that the base is free from any twisting or winding. All four legs should rest firmly on the floor after the base is assembled. If the base rocks, readjust the clamps until the twisting is corrected. Install the corner blocks with 1 1/4-in., No. 10 flathead wood screws.

Cutting tabletop joints

Cut the rule joint on the tabletop and leaves, using a Stanley No. 85297M router bit for the top and a Stanley No. 85207M bit for the leaf edge.

Turn the leaves upside down to rout the edge; but rout the top, right side up. Be sure that the workpiece is firmly clamped to the bench or table. Take special care at the beginning and end of each cut to avoid damaging the edges. Advance the router slowly along the edge to achieve the smoothest possible cut.

Test-fit the joints for alignment of the top surfaces. If they're misaligned, adjust the depth of cut with the router.

Turn the tabletop and leaves upside down and mark the position of the table hinges according to the drawing. Allow a space of 1/32 to 1/16 in. between the top and leaves so the members won't rub together. Using a razor-sharp chisel, cut the mortises for the hinges 1/16 in. deep with

an additional mortise 3/16 in. deep and 3/8 in. wide for the barrel of the hinge, which is installed facing up into the tabletop.

Assembling the tabletop

Finish-sand the tabletop, using 180- and 220-grit sandpaper in succession. Install the hinges by boring 1/8-in. pilot holes and using 3/8-in., No. 8 flathead wood screws.

Assemble the table by placing the base upside down on the inverted top. Install a 3/8-in. washer (J) between each leaf support and apron as shown. Position the base over the top with proper spacing all around, and fasten together with wood buttons which fit into the 1/4-in. kerf around the apron. Bore a 1/32-in. pilot hole in each button and a 3/64-in. pilot hole in the top and fasten with 1 1/4-in. No. 10 flathead wood screws with No. 10 finishing washers.

Finishing procedure

Before applying the finish, sand any spots that were scratched in assembly. Rub down the entire table with 4/0 steel wool, brush off thoroughly and go over the piece with a tack cloth. To finish the table, we used Pratt and Lambert satin finish varnish. Thin the first coat 25 percent with turpentine and apply the next two coats full strength, sanding lightly between coats with 220-grit paper.

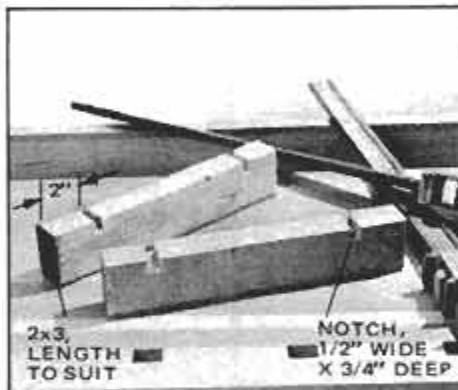
PM

WORKSHOP MINICOURSE

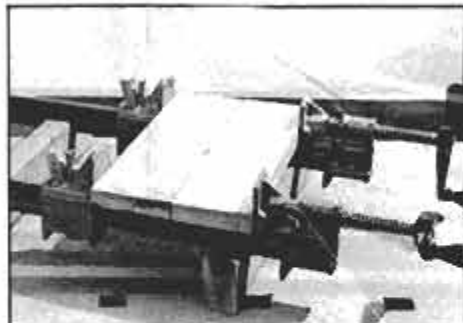
MORE ABOUT CLAMPING



This is a simple way to hold bar clamps so both hands will be free to align the work and tighten the clamp fixtures. The notches are sized to suit the clamps; here, Jorgensen bar clamps are being used.



For rigidity, the clamp cradle consists of two short lengths of 2x3 stock. These are cut specifically to suit each job.



In use, the clamps are positioned in the cradle and the work is then inserted between the jaws. Note: In order to crank the clamp handles, the entire arrangement must be turned on the workbench so that handles overhang the bench front.

Last month we promised a design for a simple cradle for holding bar clamps; a basic—but good—version is shown above. As every woodworker knows, it gets pretty hectic when you try to hold a workpiece in line, keep bar clamps from twisting and turning and tighten the bar clamps, all at the same time. In fact, it's often downright impossible.

Professionals, as a matter of practice, often fashion a clamp-holding device of some sort so both hands are free for the clamping task at hand. In my experience with beginning woodworkers I have often noticed a tendency on the part of the novice to overbuild; that is, to create more jig than is needed. The opposite, however, is often true in the workshop, where the byword should be "keep it simple." The cradle shown does exactly that. In fact, it's nothing more than two lengths of 2x3 stock notched to suit the clamps that I

want them to hold. For the bar clamps shown, the notches must be as indicated in the photo. At the job's conclusion, the cradle is simply placed in the shop scrap box.

It is impossible to have too many clamps in the shop. For example, though I have one wall almost covered with clamps, practically all of them were put into service recently, clamping up an oak server that will appear in a future PM. Buy the clamps as the need arises. In most cases, the savings created by building the furniture yourself more than offsets the \$20 or \$30 you might lay out on each project.

The point is that if you own a limited number of clamps, each job takes far longer because you will only be able to do a certain amount of work at a time. A healthy clamp inventory keeps the work moving, and that is extra-important for weekend woodworkers.

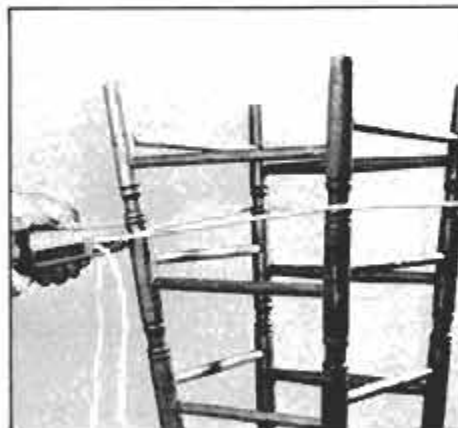
Buy only quality clamps. I have seen poorly made clamps and have wondered why anyone would purchase them. After two or three clamping sessions, you're sure to agree. An inexpensive way to build up a supply of clamps is to start with pipe clamps. Here you pay for the clamp fixture, then purchase black pipe to suit the length you need for the job. For example, you can have pairs of varied pipe lengths (18 in., 24 in., 36 in., and so on) for each set of clamp fixtures.

Then you merely use the clamp heads with the pipe lengths that the job calls for. When you buy the pipe, thread both ends to suit the clamp fixture. Eventually, though, you should progress to bar clamps, since they have greater strength and rigidity.

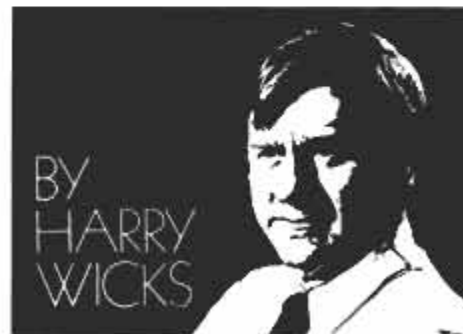
A final point: Don't think the only clamps available are those that your hardware store has on display. Ask your dealer for a look at his catalogs. In them you will find a surprising array of clamps for all jobs. Large retailers, such as Sears and J.C. Penney, stock clamps, and the more esoteric versions (as well as conventional clamps) are sold through all craftsmen supply houses. **PM**



A clamp couldn't be simpler than this Cinch clamp from Black & Decker. Author has added four of these to his own shop.



Clamp is great for odd-shape clamping, such as around chair legs when you reglue spindles, hexagons, and the like. Loop is pulled tight and clamping action is result of turning the wheel at handle's end.



HOME ENERGY GUIDE

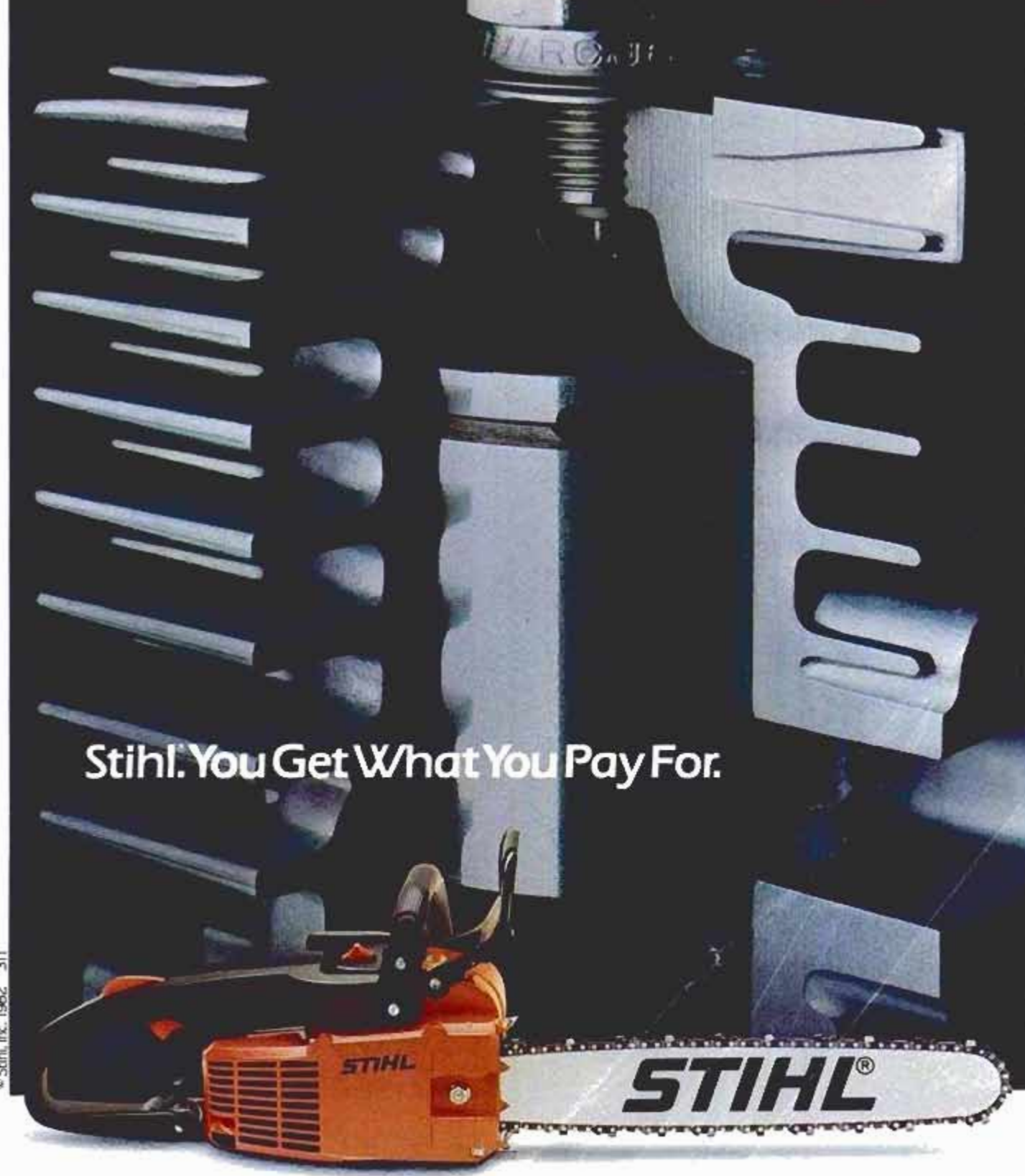
Popular Mechanics' annual roundup of great ideas for cutting down your home energy bills

■ **Caulking—The Fuel Saver In A Tube**—This guide will help you to look for and correct drafty cracks with the best caulk for the job. ■ **Auxiliary Space Heaters—How Safe Are They?**—We separate myth from fact and find some surprises. They'll help you heat your home more safely this winter. ■ **PM's Home and Shop Editor Heats His Workshop With Solar**—It's an air-to-air unit that can be installed in one day. ■ **How To Get Your Home Heating System Ready For The Winter**—A clean system is more efficient which means savings for you. Here's what to check for. Plus lots more.



Thermogram by Daedalus Enterprises Inc.

Prepared by the PM Home and Shop Dept.



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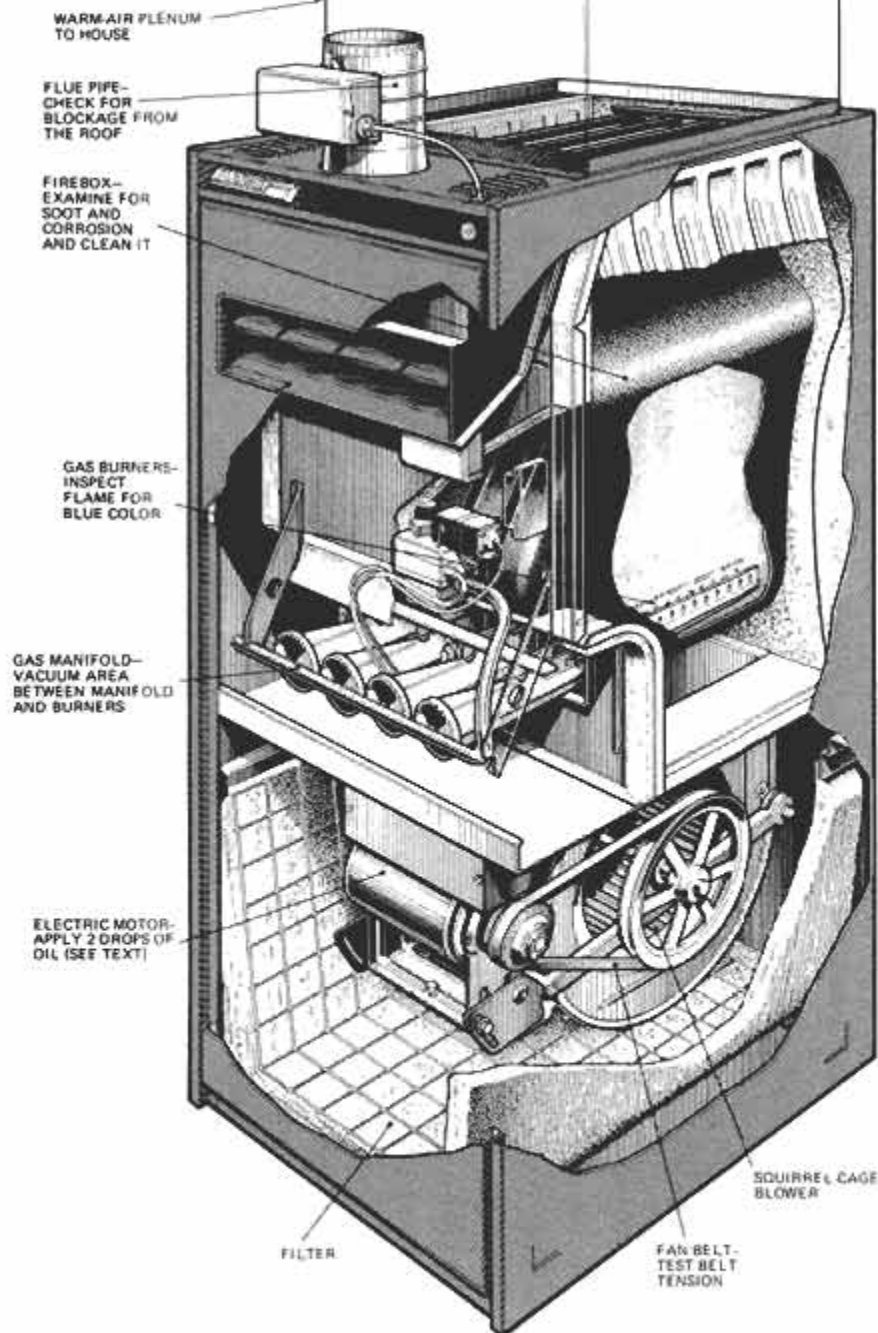
STIHL
The World's Largest Selling Chain Saw.

Preseason Checklist: Get Heating Equipment Ready For Winter Now

From furnace to fireplace to kerosene heater, here's how to get ready before the first chill sets in.

by John H. Ingersoll

WARM-AIR HEATING (VERTICAL GAS FURNACE)



Another cold winter lies ahead. The U.S. Weather Bureau practically guarantees it. The last thing you want is a heating system breakdown in mid-January.

About 90 percent of getting equipment in shape is simple: check, clean, change. Here's why it pays to do these easy chores now:

- It's cheaper. A simple maintenance step now could save you hundreds of dollars for an unwanted midwinter repair.

- It preserves your heating equipment. Checking and fixing now will stretch the life of your heat source.

- It's safer. You'll know your heating equipment will operate through the winter without intrinsic safety hazards.

Beginning below are steps for readying a wide array of equipment.

Gas-fired, forced-air furnace

A whopping 75 percent of all residential heaters in the U.S. operate on natural or manufactured (LP) gas. Here's what you can do for little or no cost:

1. Turn off the blower motor switch, if it isn't already off.

2. Change or clean the filter on the return-air side of the ducting.

Remove a used fiberglass filter and toss it out. Since they're just 60 to 80 cents apiece, buy a carton. Dennis Fallon of Fasco Industries, manufacturer of heating equipment, advises that you change a fiberglass filter about once a month during the heating season.

Remove an ordinary metal filter and wash it in warm water and detergent. Rinse it thoroughly and let it dry for eight hours before replacing it.

One producer, Research Products, makes a high-performance aluminum filter. Wash and dry it as noted above. Then spray the filter core with a special adhesive for these filters such as RP Super Filter Coat, a water-soluble spray adhesive that sells at hardware stores for about \$2.25.

3. Test belt tension on a belt-driven fan. Poked at midpoint between motor and fan, the belt should depress within a range of ½ to 1 in.—no more. Adjust tension by loosening the motor mount and pulling the belt taut. Then tighten mounting bolts. Look for signs of wear: cracks, frayed edges or discoloration. Replace a weak or worn belt.

4. Unless the motor is a sealed, permanently lubricated type, give it a yearly dose of oil. Two drops of SAE-20 motor oil is plenty. Don't overoil and do not use household oil.

5. Vacuum the fan blades. Though the blades shouldn't be dirty, clean them (this

(Please turn to page 112)

Gas-fired units are the most widely used furnaces in America. Suggestions for maintaining them are noted above.

is best done by using a shop vacuum).

6. While you have the vacuum out, go over the connection between burners and gas manifold. Draw out any dust and lint.

7. Up on the roof, poke a powerful flashlight beam into the furnace flue to spot blockages. There could be an emptied bird's nest, for example. Clear blockages or else deadly, odorless carbon monoxide gas could seep back to living spaces.

Checking the furnace burner

Following the furnace manufacturer's instructions, ignite the burner.

8. If the pilot light malfunctions or the spark igniter fizzles, the problem is serious. Get help from a heating serviceman.

9. When the burner ignites, open the access door and watch the flame. The flame should be solid blue. A flame with a yellow tip or yellow streaks anywhere is a signal that something is wrong in the gas delivery lines. Call a serviceman.

10. While you have the access door

open, examine for soot or corrosion on the heat exchanger or burner pouch. Turn off the furnace; clean out the soot; call the serviceman to adjust the burner or gas lines, whichever is responsible for producing the soot.

11. A vent damper should open the moment heat rises in the flue. If it doesn't, call a pro. A malfunctioning damper could distribute carbon monoxide to the area surrounding the flue.

House registers

With the furnace and the blower still operating, tour the house.

12. See that air is flowing through all the supply registers. Hold a strip of tissue by the grille. If there's no moving air, there may be a duct blockage or an incorrectly adjusted duct damper.

A blockage is rare, but possible. Remove the grille and flash a strong beam down the duct run.

Duct dampers balance airflow throughout the house. Often, the damper on a line delivering no air has been closed accidentally. But rebalancing the system for

optimum comfort and efficiency can be tricky. If you think you can do it yourself, go ahead; otherwise, call a professional.

13. Turn off the system. Run the vacuum wand over each register—supply and return—to remove accumulated dirt, soot or dust.

Gas-fired, hot-water boiler

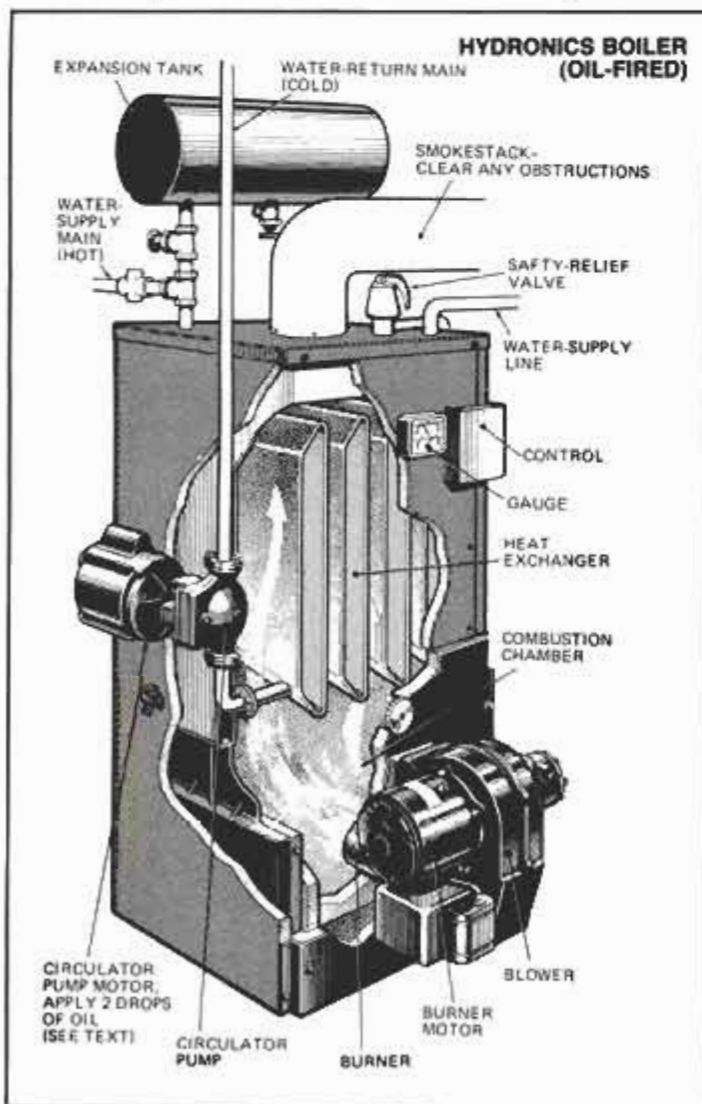
1. Apply oil to the electric motor, called a circulator, since it drives the water pump, circulating hot water through the lines. Follow the instructions given for gas-fired forced-air furnaces (Step 4). Cut off power before doing anything to the motor.

2. Continue with Steps 6 through 11 from the preceding section.

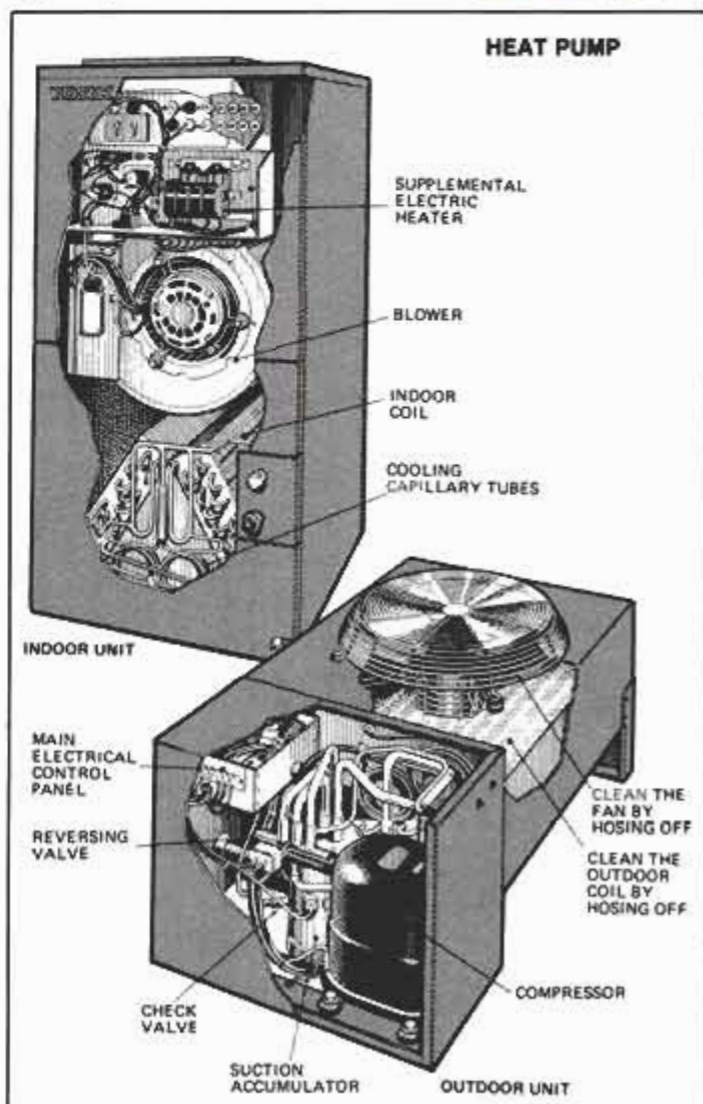
3. Vacuum each baseboard fin-tube convactor (or cast-iron, stand-up radiator) to remove dust. It will blacken the wall behind the unit if left on the metal after heat rises.

A smoothly operating system should be virtually noiseless in the living areas. Excessive clanking or gurgling in the lines

(Please turn to page 114)



With oil prices rising, any maintenance that you can perform on an oil-fired boiler to make it more efficient saves you money.



Changing filters and hosing coils to keep a heat pump clean will help keep it working efficiently and at its peak performance.

15 PLACES WATER CAN BE SILENTLY DESTROYING YOUR HOUSE.

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 14. Wood Garage Door
 15. Brick Chimney

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after the boiler has been turned on for the season indicates an excess of air in the system. (Another indication: hot convectors on the first floor, lukewarm units on the second floor).

4. Release air in the lines at petcocks on each radiator or convector. Hold a cup beneath the opening, since water will accompany the airstream. Or open the air eliminator valve on the boiler. Check your owner's manual for the valve's position. Open the valve until all the bubbling stops.

Gas-fired steam boiler

1. Before you turn on the system, check the water level in the gauge glass, usually located on the side of the boiler. While still cold, water in the gauge glass (a glass tube) should be at midpoint in the glass, and clear. Murky water signals dirt, lime or rust. Empty the tank of murky water through the drain valve at the base of the boiler. Open the fill valve on the supply line until the gauge again shows a water level at midpoint.

2. Follow Steps 6 through 11 suggested for gas-fired, forced-air furnaces. Thoroughly vacuum dust from radiators.

3. If no heat flows from a steam radiator, open the air vent (extends from the

side of the radiator) a notch or two. Trapped water may also be blocking the steam.

Condensed water inside the radiator is supposed to flow down the inlet valve. Check that the valve is fully open, and that the radiator is level (older radiators should be pitched slightly toward the valve). A slightly canted recent vintage radiator could collect steam-blocking water at the end opposite the inlet valve.

Oil-fired furnace

Fuel and firing mechanism on an oil furnace differ from one fired by gas. Otherwise, everything mentioned above about blowers, motors, circulators, steam valves and so on applies to an oil unit.

1. Follow all applicable steps as per instructions for gas-fired furnaces.

2. Make sure the tank is full of oil. Check the flue carefully, since oil usually burns dirtier than gas. You may have to have the flue cleaned with an industrial vacuum.

3. Once a year, have a serviceman, check the burner. You can't evaluate the flame color or read the balance of CO and CO₂ emanating from the burn by eye.

Electric furnace

All advice for gas furnaces related to filters, motors and other parts applies to electric furnaces.

1. Turn off the power and examine the heating elements. Using great care not to push, stretch or bend the filaments, clean the elements with a soft brush or a vacuum attachment held an inch from the filaments.

2. If the elements don't heat, call a serviceman. The moment you try to repair a resistance element, the manufacturer warranty is cancelled.

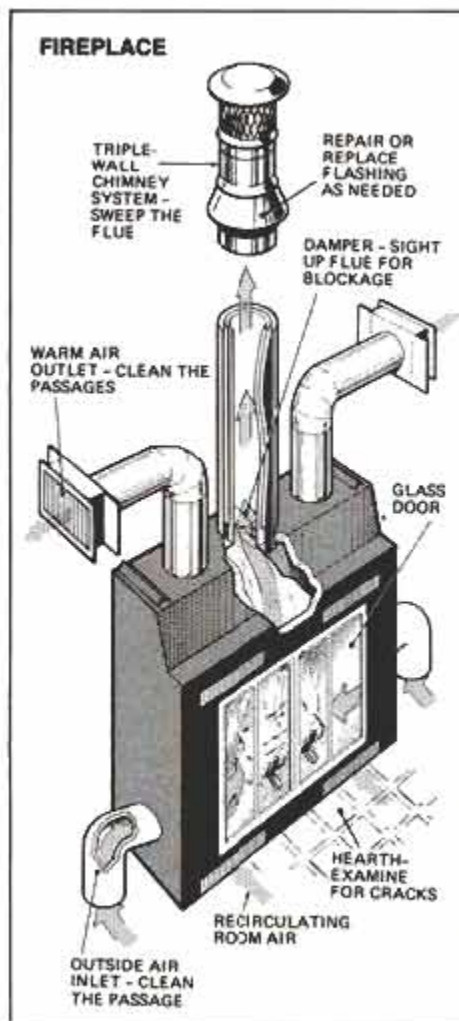
Heat pump

1. Follow maintenance steps for the electric furnace. In addition, hose down the outside coils to rid them of any accumulated dust, dirt, grass clippings or weeds.

2. Remove the cover from the inside coil, which is next to the filter, as a rule. "If you see any dirt," advises Bob Austin, general service manager of Borg-Warner Central Environmental Systems, makers of York heat pumps, "you could hose it out the same way you'd clean the outside coil. But it would be more practical to clean the coils with a shop vacuum."

3. It's a good idea to have a serviceman give the system a prewinter check. He'll make sure the coolant lines are charged properly. And to save your-

(Please turn to page 116)



To maintain a fireplace properly, it's important to check the chimney and flue from the roof; also check the hearth area.

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self money, have him test the accuracy of the resistance-element signaling device.

Fireplace

Despite its romantic appeal, a fireplace is not a practical source of house heat, even with the modern additions of glass screens, an outdoor source of combustion air and heat distribution vents.

Rod Hempel, marketing director for Majestic fireplaces, offers the following five-step winter-ready program:

1. Clean inlets and outlets for warm-air circulating passages around the

parts you need. Two- and three-wall metal flues must have a clear opening at the chimney top for the outer walls beneath a protective baffle. Air moving in those outer walls cools the flue to give it a Class A fire rating, as shown in the drawing on page 115. If the baffle is bent down, or an obstruction blocks the air passages on those outer walls, the flue could get too hot.

5. Sweep the chimney yourself, or have it done by a professional. Prices for sweeps range from \$50 to \$75 per chimney. Prices for complete chimney sweeping kits depend on flue size. A kit for a 4-in.-dia. flue runs around \$45; one for a big 12x17-in. masonry flue is roughly \$75.

Some manufacturers advise you to use a polyester brush on a stainless-steel flue and a steel brush on a masonry flue. Sweep again whenever soot or creosote buildup on the flue lining reaches a thickness of 1/4 in.

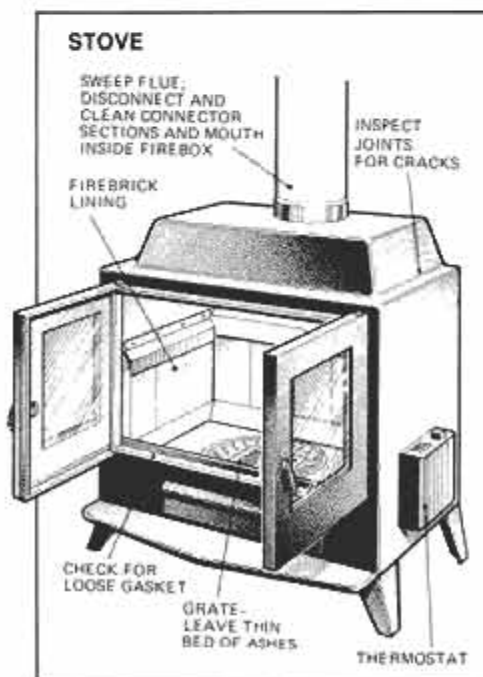
Fireplace insert

1. Leave a thin bed of ashes on the insert firebox floor, but never so many that the draft controls are blocked.

2. Slide out the insert so you can inspect the fireplace and flue. Follow the suggestions recommended for readying a fireplace.

3. Clean and vacuum the insert air inlets and outlets. Check for any blockages.

4. Slide back the insert and lay in a winter's supply of wood.



Sweep the stove flue, disconnect and clean the connector sections and check the stove for cracks or a loose door gasket.

fireplace, assuming there are such passages. A shop vacuum is the best tool for this.

2. Examine the hearth. Cracks wider than 1/8 in. in brick, stone, marble, joints or concrete can be dangerous if a live ember lodges in the crack. Replace cracked stone or masonry and fill the crack with a rich mortar.

3. Open the damper and sight up the flue for signs of birds' nests or dead leaves. At the same time, work the damper back and forth. It ought to move easily and shut snugly.

4. Go to the roof and examine the chimney flashing. Repair any breaks, bulges or tears in the flashing, preferably with new flashing. A patch of roof mastic over old flashing might endure for the winter.

Recaulk the flashing wherever a slight opening appears. Better yet, caulk all the way around the chimney.

Repair brickwork that is weak or crumbling, and inspect metal flues for corrosion. Buy only those flue replacement

Wood stove

1. Sweep the flue and connector pipes (unless this was done last spring). Disconnect the connector sections and clean all parts. Make certain the connectors are reassembled correctly.

At the same time, examine the stove for cracks, leaks at the joints or a loose gasket around the door. Have repairs made before you fire up this fall.

2. Leave a thin bed of ashes on the firebox floor, but don't block the draft vents.

Note: If you had a chimney fire last year; have the wood stove (or fireplace insert) inspected by a pro before building the first fire this season.

Coal stove

1. Clean the flue, connector pipes and inside of the coal stove before firing up. Coal-dust residue on the flue lining comes out far easier than wood-generated creosote. A polyester chimney brush will do it. Inspect the stove for signs of cracks, open joints or loose gaskets. Have repairs made before building the first fire.

2. Lay in a supply of low-sulfur coal,

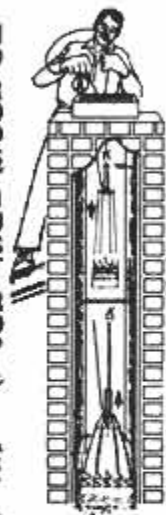
(Please turn to page 120)

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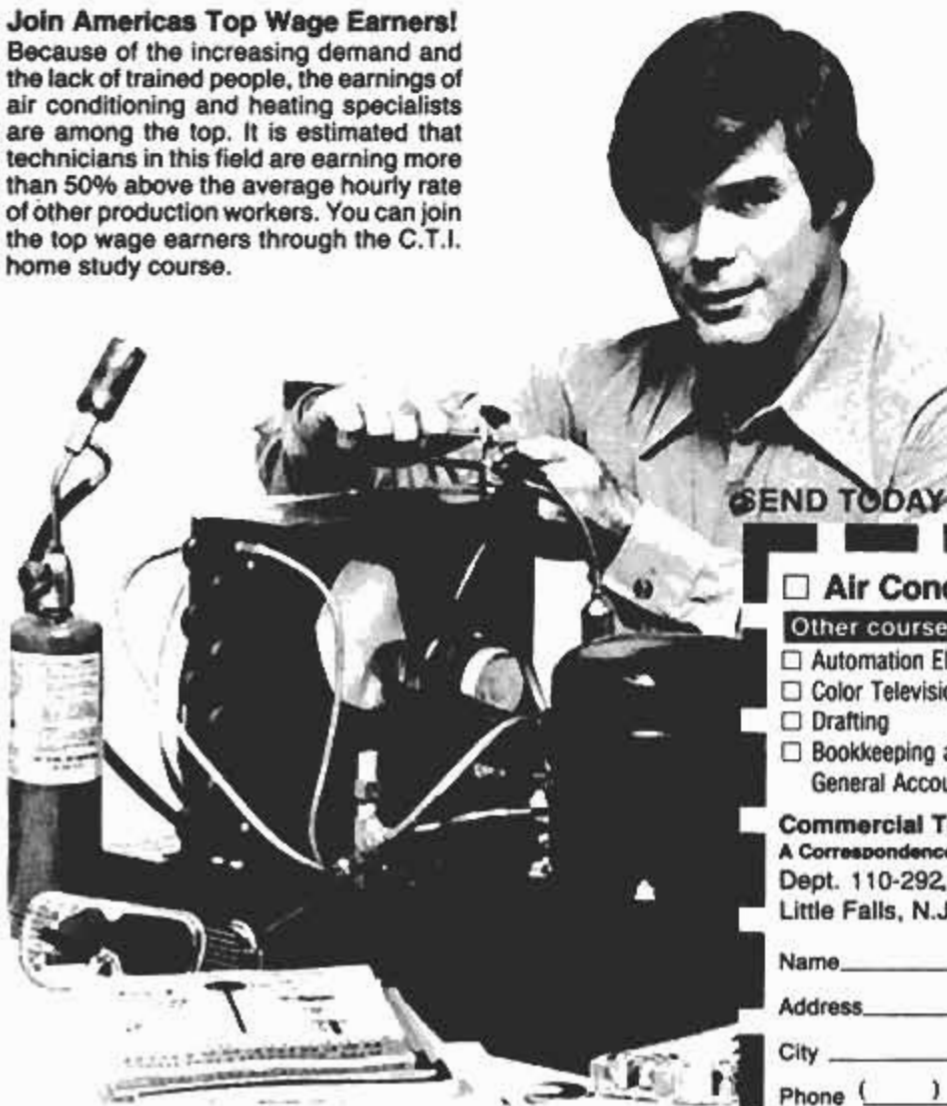
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HOME ENERGY GUIDE

PRESEASON CHECKLIST

(Continued from page 116)

stored where it can remain cool (below 70° F.) and dry. High-sulfur coal creates more pollutants when burned; its smoke is highly corrosive to steel and cast iron, but not to stainless steel or firebrick.

Kerosene heater

The procedures you follow depend on how long kerosene heaters have been in storage.

"Let's assume the heater has been stuck away in the garage, untouched since its last use in, say, April," says Mike Baron, technical training manager for Kero-Sun Inc., makers of kerosene heaters. "Here are the steps to take."

1. **Empty the tank of kerosene.** Kerosene is not a stable fuel, and tends to deteriorate over time.

Clean the tank if sediment was apparent in the emptied kerosene; pour in a small amount of fresh kerosene, swirl it in the tank and discard.

2. **Unless the wick has been used for only a very short time, replace it** (a new wick costs about \$10). Otherwise, remove the wick, squeeze it dry with paper towels, and let it dry completely.

3. **Vacuum the air ports at the base of the heater.**

4. **While you have the wick out and the heater partly disassembled, clean the entire unit with a household cleaner.** Don't use a spray cleaner.

5. **Test the batteries, if your heater uses an electric spark for ignition.** Replace near dead batteries.

6. **Clean contact points, terminals.**

7. **Refill the tank after the unit is reassembled.** Buy standard U.S. kerosene or Jet A, kerosene-base fuel, so long as the fluid is water clear.

Electric baseboard heaters

To shape up your electric baseboard heaters, follow these steps:

1. **Disconnect the current.**

2. **Remove the outside cover and vacuum the heating elements.** Don't damage the resistance wiring. A clean unit will prevent black marks from appearing on the wall behind the heater.

3. **Replace the cover, connect the power and turn on the unit.** If it doesn't work, call an electrician.

SOURCES FOR CHECKLIST

- Borg-Warner Corp., York Div., Box 1592, York, Pa. 17405 (heat pumps).
- Fasco Industries Inc., Box 150, Fayetteville, N.C. 28302 (electric resistance and other heating equipment).
- Kero-Sun Inc., Kent, Conn. 06757 (kerosene heaters).
- Lennox Industries Inc., Box 400450, Dallas, Tex. 75240 (furnaces and other heating equipment).
- Majestic Co., 245 Erie St., Huntington, Ind. 46750 (fireplaces).
- McGraw-Edison Co., Portable Appliance Group, 1801 North Stadium Blvd., Columbia, Mo. 65201 (portable electric heaters).
- Research Products, 1015 East Washington Ave., Madison, Wis. 53701 (spray adhesive for aluminum grille of filter).

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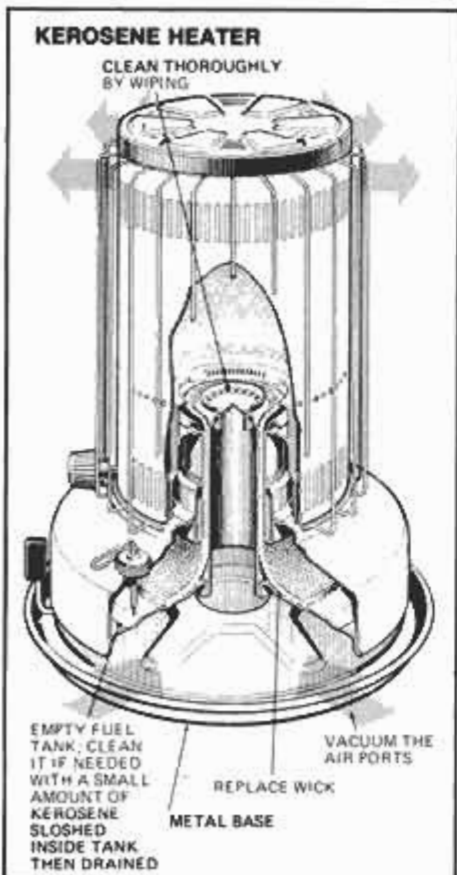
Electric wall, ceiling heaters

Maintenance for electric wall and ceiling heaters is the same as that for base-board units. The difference on many wall and ceiling heaters is a fan. If the unit has a fan, clean the blades. If the motor is the type that takes oil, add one drop a year of SAE-20 motor oil.

Portable electric heaters

Nichrome- and quartz-element heaters are readied the same way. The three steps are:

1. Check for exposed wire on cord; check plug. Replace if defective.
2. If the heater was stored where it could have been banged or dropped, check for damage to the case.
3. With a soft brush, or a brush on a vacuum wand, clean off any dirt and



Maintaining a kerosene heater includes cleaning the unit, emptying and wiping the tank, and replacing or drying the wick.

dust from the outside of the elements.

Don't open or take apart a malfunctioning portable heater; that automatically voids the guarantee.

Thermostat

Thermostats are more complicated than ever before. If you call a serviceman for any other repair in the list above, have him examine and test the thermostat. In fact, better have a pro look at it anyway. A bad thermostat could throw your budget into a tailspin.

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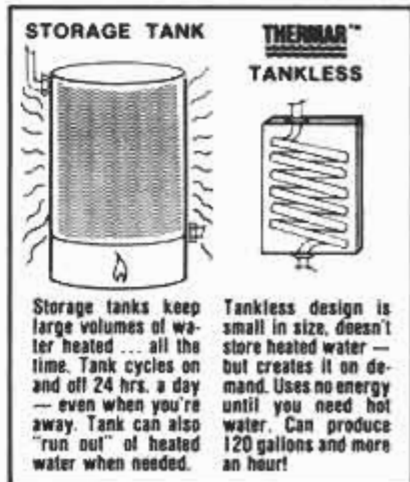
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Caulk: The Fuel Saver In A Tube

Cracks in your house lose more heat than you may realize. Caulk now to save costly fuel this winter.

by John Ingersoll

Get out your keyhole saw. Cut a hole the size of a basketball in the north side of your house and let the cold wind whistle in. Nutty? Right. Yet an equivalent amount of air leaks through minute cracks and crevices in an average house.

Cold air infiltration remains the No. 1 heat robber and energy waster, even though fewer houses suffer from winter chills than a decade ago. In summer, the same cracks leak out cooled inside air and let in hot outside air. Homeowners are learning: Among the energy conservation steps they take most often—after insulating—is caulking those energy-dumping slits.

Though it takes time and a little practice, caulking isn't difficult. Few do-it-yourself home energy improvements pay back more, sooner, or for less outlay.

Costs, based on a standard 11-oz. cartridge, depend on the type of caulk, the size of the bead it takes to fill the crack, and the number of feet to be sealed. In the case of a house with severe cracks, or a new, unsealed house, the cost of applying a 3/8-in.-wide bead of caulk to 500 linear ft. of cracks would require 28 cartridges of caulk, each covering about 18 linear ft. of cracks; at \$6 a cartridge, total cost would run \$168. However, the cost of tightening an average house might run under \$100. Here's why:

■ You don't have to buy the highest priced caulk. Materials at \$3 to \$4 a cartridge could serve you admirably.

■ Whatever the age of your home, it would be odd if some caulk didn't already pack the cracks around the windows, doors and other joints.



Thermogram is a photo taken with infrared film that registers heat rather than light. Red areas show where heat is escaping

through uncaulked cracks. Leaks around windows show up as separate heat-loss lines, as do those at edges of eaves.

■ A 3/8-in.-wide opening at seams is big. Most cracks are narrower. Figure a 1/4-in. bead as average for the job.

■ The coverage estimate of 18 linear ft. per cartridge in the example is conservative. Depending on crack depth and spreading technique, you will actually be able to cover from 18 to 27 linear ft. with a 3/8-in.-wide bead, with one single cartridge.

Added up, these four price-reducers put your actual cost for caulk more in the range of \$20 to \$50.

Buying the right caulk

In store racks, you'll find a number of different basic qualities of caulk. Here's a rundown on each, listed by its approximate price, starting with the cheapest.

Oil-base caulks are used by contractors because they're cheap. Homeowners shouldn't use them. That's a statement by a lab technician for a company that makes oil-base caulks, along with a full line of acrylics, butyls and others.

Consider yourself lucky if you get two years' performance from an oil-base sealer before cracking and shrinkage begin to

appear. Some of these products won't survive one year. Oil caulk doesn't gun as easily as acrylic latex, requires a prime coat in the crack before application on new work, shouldn't be applied unless ambient temperature is 60° F. or above, and is paintable—in fact, should be painted to stretch its durability. Cost: \$1 to \$2 per 11-oz. cartridge.

Butyl caulk is a rubber-base material that lasts for many more years than oil-base because of its elasticity. Available in some colors, as well as white, butyl doesn't require a primer, and can be painted after approximately 12 hours of curing.

You'll find it is somewhat more difficult to gun than acrylic. Don't apply butyl when temperature is below 50° F. Cost: \$2 to \$3 per 11-oz. cartridge.

Acrylic latex caulk is a favorite of many pros. One homeowner, with a house in Pennsylvania's Pocono Mountains, gunned acrylic into the house cracks 15 years ago, and hasn't touched it since. Acrylic flows from the cartridge more easily than any other material, yet

Photo: AGA Thermovision

doesn't sag, especially those brands reinforced with a small amount of silicone.

Acrylic can even be applied over a surface that's slightly damp, but not when temperatures are below 50° F. The bead is paintable when the surface forms a skin and isn't sticky to your touch. That takes 24 to 36 hours of curing in temperatures above 50° F. Available in colors, clear and white, it costs the same as butyl: \$2 to \$3 per 11-oz. cartridge.

Acrylic copolymers are the new guys in town. Pros say their performance is every bit as good as that of still higher-priced stuff, maybe better. Makers claim acrylic copolymers adhere more tightly to a wider variety of materials than do the silicones.

Available in white, clear and some colors, these materials don't need a primer before application and can be painted once the solvent has evaporated, a process that takes about seven days. As with acrylics and butyls, caulk only when temperatures are above 50° F. These caulks gun easily, don't sag and stick to themselves when you make two runs in a wide crack. Cost: \$3 to \$4.50 per 11-oz. cartridge.

Hyalon caulk is a high-quality elastomeric available in white and colors. It can be applied in temperatures down to 40° F. You can paint this caulk, it doesn't require a primer and makers claim a 20-year life for the material. It doesn't gun as easily as acrylic or acrylic copolymer caulk. Some producers distribute it in a cartridge with an oversized tip for that reason. One problem: You may not find it stocked at your favorite building-supply outlet. Cost: \$3 to \$5 per 11-oz. cartridge.

Silicone caulks were king until the acrylic copolymers came along. Silicones are still excellent—in fact, they've been improved since makers now offer three types: a plain silicone for most outside jobs, a masonry caulk formulated to adhere to masonry better, and a door-and-window caulk that now, for the first time, is paintable. All three are priced almost the same.

Silicone caulks can be applied in just about any weather—even below freezing. They don't gun as easily as acrylics, and are tougher to use in icy temperatures. Durability is certainly as long as competing materials and, in many cases, longer. Most of the silicones do require a primer before application. Check the label. Cost: \$5 to \$6 per 11-oz. cartridge.

Neoprene, moisture-cured urethane and polysulfide caulks are used mostly in commercial construction, where substantial movement in the building requires a highly elastic sealer. They cost about the same as silicones, or a bit more.

Foamed urethane caulk is a relatively new workhorse that not only seals a joint, but insulates, as well. Use it alone, or apply a bead in a deep crevice to fill the

(Please turn to page 124)



Caulk wherever unlike materials meet, even if you cannot feel an air leak or spot water seepage after a heavy rain. Here, wooden door jamb meets brickwork.



Metal frame for sliding window should be caulked by pushing gun (from left to right as shown here) to force caulk into crack. Push gun; don't pull it toward you.



Sealing a vertical joint where brick chimney meets board-and-batten siding keeps out driving rain. Push the gun up at an angle to drive caulk deep into cracks.



Aluminum-sheathed soffit meets brick wall and air escapes. Use dark caulk, match soffit color or use clear caulk which takes on appearance of adjacent surfaces.



Foamed urethane insulation from aerosol tube can seal larger gaps, like this rough opening around hose bib in the brick foundation. Apply several thin coats.



Outside corner where side walls meet can be caulked with clear acrylic copolymer.

CAULK *(Continued from page 123)*

space before sealing it in with a standard caulk. The foam applies and cures fastest at 75° F.

The foam is packed as a liquid in an aerosol can with a flexible tube spout. The can contains 14 oz. of chemical, which produces roughly 175 linear feet of bead at 1/2-in. width. Cost: \$7.50 to \$8 per can.

Application tips

■ Before applying new caulk, remove the old. Use the side of a paint scraper or a stiff, bent wire to clean the crack.

■ Though some materials don't require a primer, it's good to use a primer with any caulk. Apply one coat and let it dry. This step contributes to a caulk's longevity.

■ A crack more than 1/4-in. deep ought to be stuffed with fiberglass or steel wool or filled with urethane foam before applying a bead of caulk. You want the caulk to exercise a two-way stretch—right and left—rather than be pulled from behind. The third pull may suck in the bead, leaving a gap you thought you'd closed. Don't use oakum, even if you can find it. The oil in oakum bleeds through the caulk.

■ Don't pull the bead down a crack. Push the nozzle of the caulking cartridge at a 45° angle. This forces caulk into the crack, rather than on top of it.

■ Release the gun trigger at the end of a run or caulk will continue to run out.

■ When you're through, and want to use the remaining caulk another day, seal the tip tightly after cleaning out excess caulk. If the cartridge isn't sealed, air leaks in to begin curing the caulk in the tube. Shelf life for most caulks is about two years, unopened.

The hardest part of any caulking job is getting started. Whether you use a hand-powered caulking gun or an air-powered one working on a small compressor, applying the caulk to the crack is easy. The returns are highest if your home is reasonably well insulated and has storm windows and doors already. **PM**

SUPPLIERS—CAULKING

Boston Consumer Div., USM Corp., Muhlenberg Industrial Mall, 4408 Pottsville Pike, Reading, Pa. 19605.
 Dap Inc., Box 277, Dayton, Ohio 45401.
 Danworth Co., Box K, Avon, Conn. 06001.
 Dow Corning Corp., Elastomer Business, Midland, Mich. 48640.
 H.B. Fuller Co., 315 South Hicks Rd., Palatine, Ill. 60067.
 General Electric Co., Silicone Products Div., Waterford, N.Y. 12188.
 Geocel Ltd., Box 653, Elkhart, Ind. 46515.
 Gibson-Homans, 1755 Enterprise Pkwy., Twinsburg, Ohio 44087.
 Gulf Adhesives & Resins, Box 2900, Shawnee Mission, Kan. 66201.
 Insta-Foam Products Inc., 1500 Cedarwood Dr., Joliet, Ill. 60435.
 Macco Adhesives, SCM Corp., 900 Union Commerce Bldg., Cleveland, Ohio 44115.
 Red Devil Inc., 2400 Vauxhall Rd., Union, N.J. 07083.
 Tremco Mfg. Co., 10701 Shaker Blvd., Cleveland, Ohio 44104.
 United Gilsonite Laboratories (UGL), Box 70, Scranton, Pa. 18501.
 Weldwood Products, Roberts Consolidated Industries, 600 North Baldwin Park Blvd., City of Industry, Calif. 91749.
 Woodhill Permatex, Box 7183, Cleveland, Ohio 44128.



Black caulk is inconspicuous where metal chimney flashing tucks under the shingles.



Stiff brush cleans dirt from cracks, so caulking can adhere to both materials.



Push caulk into joints where a skylight meets the roofing and over the flashing.



Clear caulk seals joint between acrylic bubble and the aluminum skylight frame.

HOW TO CHOOSE THE RIGHT CAULKING

	Price	Color	Paintable?	Applications	Advantages	Disadvantages
Oil base	\$1 to \$2	White	Must be painted	Around windows, doors; not for outside use	Inexpensive; paintable	Short life; usable only above 60° F.; guns less easily than acrylic; needs painting; cracks
Butyl	\$2 to \$3	White and some other colors	Yes, when cured	Around windows, doors, joints, foundations, flashing	Inexpensive; long-lasting elastic	Short life; usable only above 50° F.; guns less easily than acrylic
Acrylic latex	\$2 to \$3	Clear, white, gray, brown, red, black, some others	Yes, when cured	Same as for butyl	Inexpensive; long-lasting elastic; guns easily; many colors available	Usable only above 50° F.; takes 1 1/2 to 2 days to cure
Acrylic copolymer	\$3 to \$5	Clear, white, some colors	Yes, when cured	Same as for butyl	Moderately priced; durable; long-lasting elastic; guns easily	Usable only above 50° F.
Hypalon	\$3 to \$6	White, some colors	Yes	Same as for butyl	Durable; long-lasting elastic; usable at temperatures as low as 40° F.	Guns somewhat slowly; difficult to buy at retail; expensive in quantity
Silicone	\$5 to \$7	Clear, white, gray, brown, some other colors	Specially formulated silicone only	Same as for butyl	Durable; long-lasting elastic; usable at temperatures below freezing	Guns slowly in cold weather; expensive in quantity
Foamed urethane	\$7 to \$9	White	Yes, when cured	Same as for butyl; also good for filling holes	Moderately priced; easy to foam; insulative	Usable only above 75° F.; as combustible as wood framing

All materials are packaged in 11-ounce cartridges, except for foamed urethane, which comes in a 14-ounce spray can.

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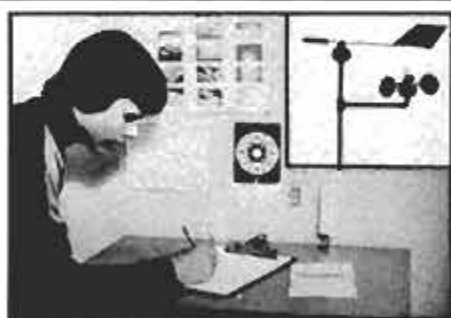
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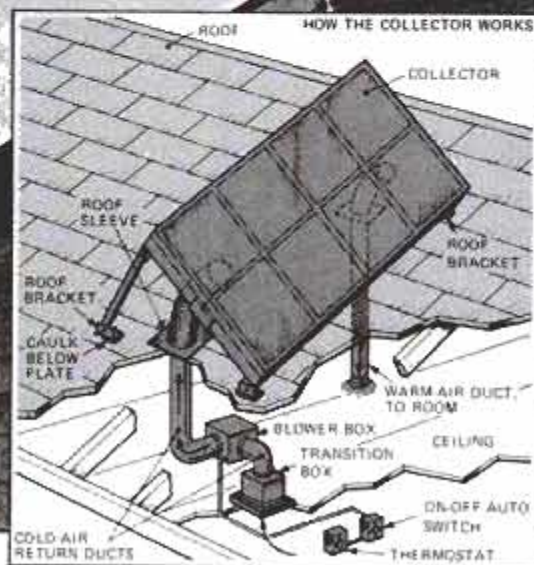
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PM Editor Warms His Shop With The Sun



Independent roof system includes the 4x8-ft. collector, blower and thermostat.



by Harry Wicks
HOME AND SHOP EDITOR

The fact that you are a Popular Mechanics reader means you know how to get the most for your money. And I'm no different. My workshop is located on Long Island and, unfortunately, it is heated by electric radiant heat. This is probably the ideal heat system for a workshop (because it is clean and safe), but it's no bargain. That's why I wanted a reliable solar system to minimize electric use.

The system shown basically recirculates warmed shop air through a 4x8 roof-mounted solar collector plate. It retails for \$1,095 and is made by Manumark Inc., Browns Ridge Rd., Box 997, Chatsworth, Ga. 30705.

Since the system's installation last February, I have had a marked decrease in my electric bills. Instead of the shop thermostat staying at 60° F. or so, I now turn this control down to 50° F. The solar system is set to go on when the collector's temperature reaches 110° F. (which doesn't take very long) and the unit shuts down when the shop temperature reaches the setting on the Manumark wall thermostat.

The model I picked is designed for installation from collector to ceiling-mounted grilles. The manufacturer offers several other roof, ground, and window-

(Please turn to page 130)



To prevent water leaks, quality caulk is applied and bracket is fully seated in it.



Panel is large and heavy enough to require two men to do the hauling up to the roof.



Correct tilt angle for the collector is determined using method that is described in the text. Once tilt angle is achieved, the support legs are then marked and cut.



Inside, a 2x4 cleat is spike-fastened across several rafters; upper brackets are anchored to this member, while another is installed near eave for lower brackets.

Installation consultants: Ed and Nelson Dina,
Dina Power Center, Milton, N.Y. 12547
PM photos: Rosario Capotosto and Harry Wicks

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mounted models including one for installation into a central ductwork system, and add-on collector panels which connect to the primary collector to increase heating capacity.

The actual installation is well within the range of an experienced do-it-yourselfer. But there are a couple of prerequisites.

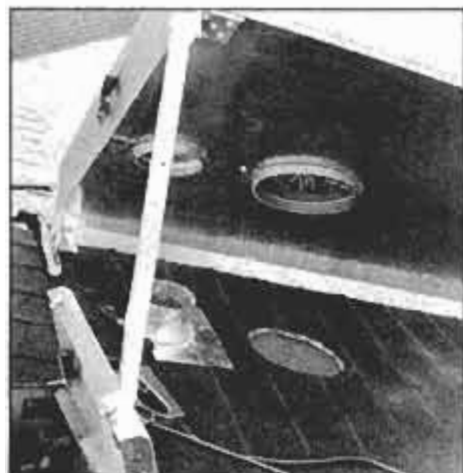
■ It is important that you are comfortable working on a roof. If you're not, hire a roofer for this part of the job.

■ If you do your own installing, have at least one helper to get the collector onto the roof and in place.

Pick a roof location for the collector that ensures maximum exposure to the sun—and take care when setting the angle of the collector surface so that it is as nearly perpendicular to the sun's rays as possible. A tilt equal to the local latitude plus 10° (to focus on the winter sun) is generally considered the ideal angle, according

to Ed Dina, the consultant who rode shotgun on the installation shown.

Good instructions for installing the system (we used roof Model 5220) come with the package; the kit includes collector, blower thermostats, grilles and all major parts except flexible ducting. You can always get help from the dealer that you buy the unit from. For the Manumark dealer in your area, write the manufacturer at the address on page 126. **PM**



With collector plate installed, roof cutouts for ductwork are marked and made. Warm air duct flange is already in place.



Flexible duct is pulled up around collar (flange) and is held by clamp. Next, insulation is positioned and secured with duct tape. Under normal conditions, flexible ducting outdoors should last five years.



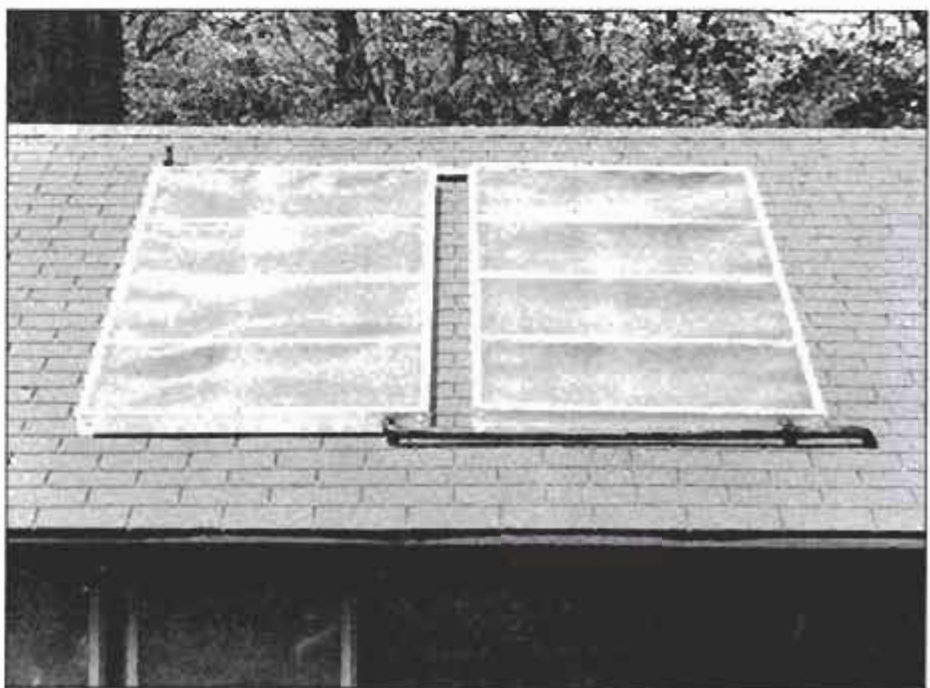
In attic crawlspace, Nelson Dina completes the hookup of the return air flexible ducting.

Solar Collector You Can Build

This inflation-fighting solar hot-water system can save you up to two-thirds the cost of comparable commercial units. It is a flat-plate solar collector which can be easily assembled by the homeowner, using ordinary home workshop tools. The collector consists of an absorber panel made from a series of copper tubes fastened to copper plates which have been painted black to absorb the sun's heat energy.

The absorber panel, containing a non-toxic antifreeze, is mounted in an insulated enclosure, which retains the heat produced. As the absorber panel heats up, the antifreeze solution circulates through the copper tubes and a heat exchanger in the domestic hot-water tank. The insulated tank stores the heated water until needed. For maximum heat absorption and transfer, the surface of the tubing is increased by utilizing flat copper sheets which are formed in a simple bending fixture to fit snugly around the tubing. The two are later soldered together to form an efficient heat absorber panel. The plates are fabricated from copper flashing, available at building and roofing supply houses.

The tubing is rigid 1/2-in. type M and is available at hardware and plumbing supply shops. The outer enclosure is of alu-



On a sunny day, solar collectors shown supply all hot water needs for a family of four.

minum construction, which combines light weight, strength and excellent resistance to the weather. The aluminum "U" channel, angles and sheet are standard sizes and are stocked by metal suppliers. The glazing used is a clear fiberglass sheet, available through Sears catalog sales or from solar collector suppliers.

—John Capotosto

HOW TO ORDER PLANS

The building plan for the collector shown above includes 24 step-by-step photographs, dimensioned drawings and complete instructions.

Send your check or money order for \$4.95 to C & R Engineering, Box 204, Lake Grove, N.Y. 11755. Canadian residents should remit in U.S. funds.

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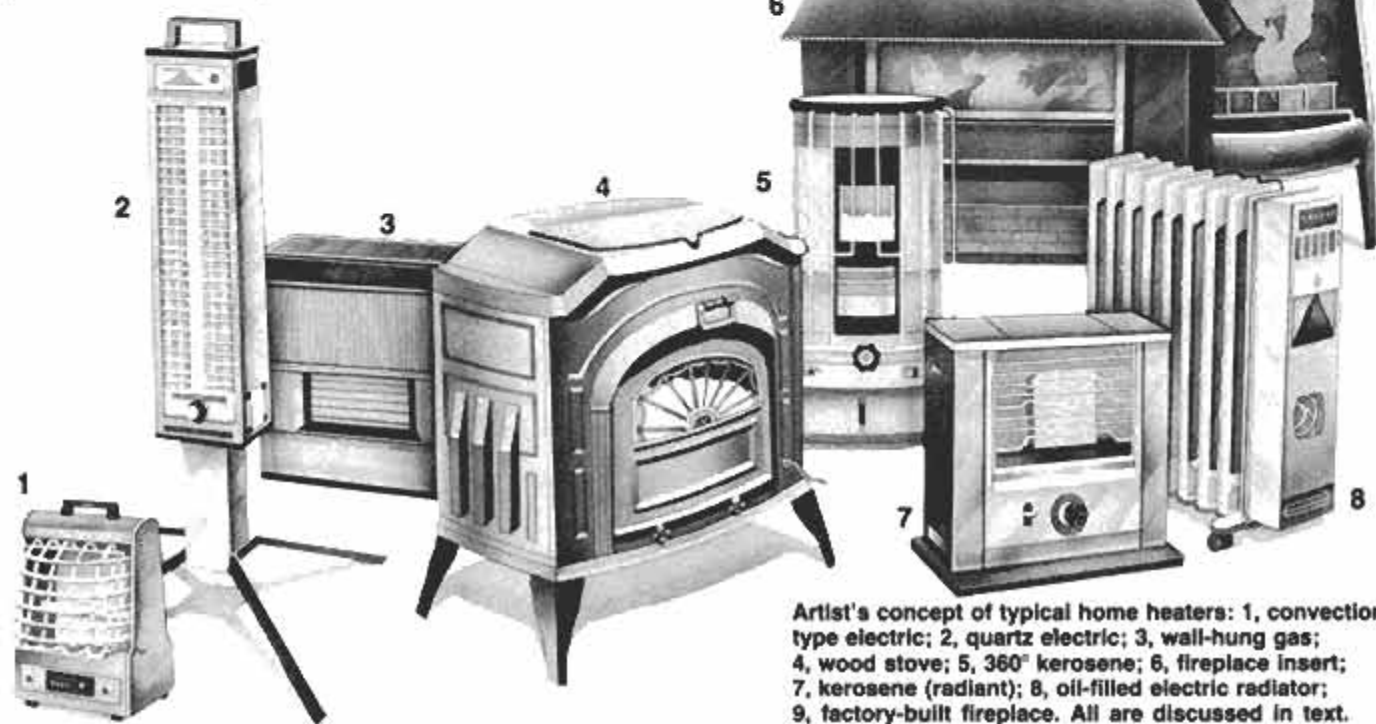
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RALEIGH LIGHTS

Auxiliary Space Heaters— How Safe Are They?

Modern space heaters can be both efficient and safe. Here are some suggestions for their proper use.

by Richard F. Dempewolff



Artist's concept of typical home heaters: 1, convection-type electric; 2, quartz electric; 3, wall-hung gas; 4, wood stove; 5, 360° kerosene; 6, fireplace insert; 7, kerosene (radiant); 8, oil-filled electric radiator; 9, factory-built fireplace. All are discussed in text.

In Port Jervis, N.Y., the owner of a wood-burning stove emporium checked the installation of a heater he'd sold to a local citizen. He found it with fire crackling in the firebox. It sat in the middle of a small room. The metal stovepipe extended horizontally, without an insulating thimble, through a lath and plaster wall, on across the adjoining room propped on the back of a wooden chair, and out through a half-open window in the far wall. "A setup for total loss by fire," recalls the dealer, "despite our careful instructions and the maker's precise installation recommendations."

In Kentucky, an old lady was found dead in her bed last winter. A kerosene heater placed too close to the bed had burned all night, scorching bedclothes and producing lethal quantities of carbon monoxide in the tightly sealed little bedroom.

In West Virginia, a whole family expired when the illegal portable propane gas stove in their bus-conversion mobile home used up all the oxygen in the weathertight dwelling. The vent above the stove, normally open for cooking, had been sealed to keep out chilly night air.

In New York, a youngster knocked over

the family's portable electric quartz space heater on a wet tile bathroom floor, shattering the glass tube. He grabbed the metal handle and was electrocuted.

In each instance, well-established rules for the safe operation of domestic space heaters were flagrantly violated, resulting in personal tragedy, and casting doubt on the relative safety of such heaters. Already, a number of localities have banned the use of certain types of space heaters. Recently, the Newark, N.J., fire department filed a petition with the Consumer Products Safety Commission in Washington, D.C., to ban the use of unvented kerosene room heaters entirely. After tests (described here later), the petition was denied.

Other communities have written ordinances prohibiting the use of certain types of space heaters, and have established rigid rules governing installation of packaged fireplaces, wood stoves and other heating appliances.

With the proliferation of all kinds of space heaters following the oil shortage, public confusion has resulted over what is safe in such stoves, and what isn't.

Just what is the truth? Have there been valid safety tests on these devices?

You bet there have.

Space heaters of all kinds have been under careful investigation by the Consumer Products Safety Commission (CPSC) since 1973 (when the agency was founded), and by the Underwriters Laboratory. By 1974, it became clear to CPSC officials, from ongoing fire surveys by the UL, that while some fires involving space heaters were caused by the characteristics of the product, many other factors had a more vital bearing.

KEROSENE HEATERS

When a petition comes to Jim Hoebel requesting an investigation of some apparently troublesome commodity, CPSC's safety expert on liquid and solid-fuel heaters assigns a study to determine if the problem constitutes a serious hazard, as charged. He did that when the resurgence of kerosene heaters coincided with the lifting of old bans against them.

"What we did," says Eleanor Perry, head of Engineering Services, "was to buy three brands on the open market and put them through a battery of tests. We knocked them over to test center of gravity. All were okay. We filled them with fuel,

(Please turn to page 134)

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SPACE HEATERS

(Continued from page 132)

lit them and tipped them over. One spilled and ignited enough fuel in 15 seconds to destroy itself and everything around it. Another spilled and ignited a small amount of fuel before a cutoff valve on it shut. The small amount of fire did little damage. The third had a fast automatic cutoff. The flame went out before any fuel spilled.

"We got samples of all the new stove brands and measured temperatures all over them during operation. Some combustion chambers got very hot. A child touching them could get a second-degree burn. But some had protective grilles around them that stayed cool enough to touch. So, after a litany of tests we were able to make recommendations for manufacturers' standards."

"Now, says Perry, "the Underwriters Lab requires a switch producing tip-over flameout in 10 seconds. All approved kerosene heaters must have protective walls around the hot surfaces." Today, kerosene heaters are as safe as room heaters using liquid fuel can be if they carry a UL label.

Jim Hoebel points out a curious fact. Despite the surging increase in sales and promotion of these room heaters, there has been no relative increase in fires and casualties. Incidents that do occur often are from ancillary causes.

"People who should know better keep putting gasoline instead of kerosene into them," he reports. "They sometimes mix up containers, and they store the flammable stuff in the house. When you have all types of people storing and using liquid fuel improperly, there will be some accidents regardless of regulation."

What about the grade of kerosene used in these heaters? Most manufacturers of unvented portable heaters specify K1, a highly refined white kerosene. Grade refers to sulfur content. K1 should contain less than .04 percent by weight. In a series of K1 samples checked recently by the American Society of Testing and Materials (ASTM), some ran as high as .07 percent. Some refiners claim that K1 can't be consistently refined to close tolerances; others claim that most modern heaters can use fuel with up to .09 percent sulfur without producing a detectable level of sulfur dioxide—the stuff you don't want to breathe—as long as a window or door is left ajar.

Can you tell by color? Not always, though most high-sulfur kerosenes do have a yellow tinge, and an odor. But others, loaded with sulfur, can appear water-white with little trace of smell.

Last February, a reporter named Broderick Perkins on the *Wilmington (Del.) News Journal* bought 20 samples of K1 from outlets in his area and had them test-

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ed. Five of them had sulfur levels above what is considered safe for unvented heaters.

Can it constitute a real hazard? Not likely. But the best advice, according to CPSC officials, is the same as they suggest for options in all space heaters: Stick to manufacturers' recommendations.

SOLID FUELS

Even allowing for the number of heaters in operation in each category, it quickly becomes apparent that solid-fuel heaters (wood stoves and fireplaces) lead the pack in the total number of fires and casualties associated with space heaters, as well as in the rate per million units in use. Portable unvented kerosene heaters, over which there has been much recent controversy, along with fixed electric heaters, have been involved in the fewest incidents by far.

But that doesn't tell the whole story. Jim Hoebel emphasizes many interesting points: "Solid-fueled heating equipment—primarily wood—made up more than one-half of all 1980's heating equipment fires, and more than 40 percent of the resulting deaths." He adds, however, that the largest share of components contributing to the total in this category and others were chimneys and the connector stovepipes that carry the smoke and gases from all vented heaters to the chimney stack.

What this signifies to Debbie Kale, who performs hazard analyses for the CPSC, is that misapplication of venting components and improper do-it-yourself installation, rather than flaws in the heaters themselves, causes the most fires.

She points out that 70 percent of all solid-fuel heaters are consumer-installed and have never been inspected by a building or fire official. Standards adhered to, if any, are out of date. Single-wall flues are jerry-built through walls and, in almost every case, stove and connector pipes are too close to combustibles.

"We contacted fire departments everywhere and, from data they supplied," Kale reports, "we learned that the big troublemakers are metal stovepipe-type chimneys installed by amateurs. People use the wrong kinds—single-walled things stuck through wood-frame walls without a thimble. Only a small percentage of metal flues are installed professionally, and few homeowners read instructions carefully."

What's more, Kale notes, though some multiwalled metal chimneys are safety-tested for fireplace fire temperatures, few are tested to withstand chimney fire temperatures, and they just can't take them. A number of serious fires resulted when inner sections of such chimneys overheated, broke

loose and telescoped down into the fireplace.

Kale also observes that a safety engineer in North Carolina recently reported four fires in his area due to obstruction of air vents by the installation of glass doors on packaged zero-clearance fireplaces with triple-walled metal chimneys. With doors closed, thermal siphoning was blocked in such chimneys, which depend on airflow through the outer walls to keep the center flue from overheating.

There has been a high percentage of fires involving some fireplace inserts, as well. "Some inserts call for a connection between stove and flue,"

Kale notes. "Others don't. Often the latter are sealed into the fireplace opening and can't be pulled out to clean creosote buildup behind—a set-up for a hot fire."

Creosote buildup is a most common villain in wood-burning heater fires. "A frequent cause of creosote accumulation," says Dale Ray, economic advisor to the CPSC, "is flue-sharing. A recent survey of ours revealed that 44 out of 360 families questioned had two or more stoves or fireplaces tapped into a single flue or chimney—another invitation to creosote buildup and the fires which are associated

(Please turn to page 136)

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SPACE HEATERS

(Continued from page 135)

with it." Flue-sharing, of course, should be avoided.

"When two or more heaters are used simultaneously on a single flue, draft is reduced," Debbie Kale explains. Creosote from the burning wood has more time to condense on the chimney walls, which are cooler and further enhance condensation.

Much creosote buildup, even in a prop-

er installation, depends on how the wood burner is used. Closing down dampers to create a slow, smoldering fire accelerates accumulation, since the chimney stays cool and the vaporized tars condense on its walls more readily.

"We know from our research that all woods produce creosote," says Hoebel. "What also turned up was the surprising fact that softwoods produce less than hard, and wet wood less than dry—despite what we've all heard to the contrary."

On top of it all, when creosote builds up in flues and chimneys, it means that the stove is no longer properly vented, and toxic fumes back up into the room, creating another hazard.

GAS HEATERS

Improper venting is a major problem with many types of space heaters. "People hate to waste expensive heat," observes Dale Ray, another CPSC expert, "so they tend to keep windows and doors tightly shut when heaters are going. It's the worst thing they can do, especially if the burner is unvented." (See *Bring In Fresh Air Without Losing Heat*, page 138.)

While heater manufacturers, the Underwriters Lab and agencies such as the CPSC all issue specific guidelines and warnings regarding installation and operation of their products, there's no telling what people will do, the experts say. Many fires and cases of asphyxiation and carbon monoxide poisoning have occurred—especially in the rural South—from people bringing portable propane gas stoves and hibachis, bright with burning charcoal, into weathertight trailers to take the chill out of a cold morning.

Dennis McCroskie, the CPSC's specialist in gas and electric heater engineering, points out that portable propane heaters are illegal for residential use, yet some people will use them anyway—often with tragic results. "While containers are designed to provide safe heat outputs and pressures," he notes, "people fill empty propane bottles themselves, a problem especially in cold weather. When the weather warms, the fuel expands and pressures skyrocket. The safety valve opens and propane escapes. In cases where a pilot light was going, or someone was smoking, there have been disastrous fires and injuries."

Last year, to stem a rising tide of deaths from oxygen depletion and carbon monoxide poisoning from gas heaters, the CPSC proposed a standard for an oxygen sensor and cutoff valve on such heaters. "Oddly," McCroskie points out, "there are more carbon monoxide poisoning cases with vented heaters than with the unvented ones. Why? People plug the vent pipes because they waste heat."

"The gas problem is a serious people problem. The public needs to know a lot more about the unusual properties of gas. Carbon monoxide is heavier than air, so you can't vent it with overhead fans. It seeks low spots and puddles in them."

Fixed gas heaters, for which propane or natural gas is piped to permanently installed heaters, are legal and relatively free of problems if users follow the manufacturers' operating instructions.

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is that users should constantly remind themselves that gas is toxic and—under certain conditions—explosive. "Adequate ventilation is a must," Jim Hoebel warns, "especially for unvented types of heaters that leave combustion products in the room."

Actually, on all gas heaters produced since January of this year, a new regulation requires manufacturers to include an oxygen depletion sensor that shuts off the stove if the oxygen content of room air falls below 18 percent. "While the real hazard is carbon monoxide poisoning, rather than oxygen depletion," Hoebel explains, "if the oxygen drops as little as 10 percent, it's a sure thing that the monoxide level is too high."

ELECTRIC HEATERS

Since fixed electric room heaters—such as baseboard heaters—have caused few incidents of fire or injury per million users, most of the CPSC's work has been with portable models. These come in two basic kinds—convection types that warm the air passing around them or that blow air across their elements, and radiant types that reflect the heat and warm any objects (such as people) within the path of their radiant beams.



Most accidents involving portable electric heaters probably are related to fire rather than electric shock—though there are problems in both areas, according to Carl Blechschmidt, program manager and specialist in electrical hazards at the CPSC. "We had tip-over problems among earlier portable models with a high center of gravity," he recalls. "Some had fallen into furniture and started fires. There were also cases of shock with quartz-type heaters in which the heating element is enclosed in a glass tube. If they tipped over on a hard floor—like ceramic tile in a bathroom—the glass could shatter, exposing the element, which then might short against the metal housing, energizing it."

People, wet from bathing, try to right such tip-overs, and have suffered fatal shocks. "Electricity and water don't mix," Blechschmidt observes. "The fact is, you can't tell when you feel the tickle if you've got hold of a potentially lethal 10 milliamp can't-let-go jolt, or a harmless half-milliamp nudge. The same current that tickles a guy standing on a carpet with rubber-soled shoes can kill a man in bare feet on a wet bathroom floor."

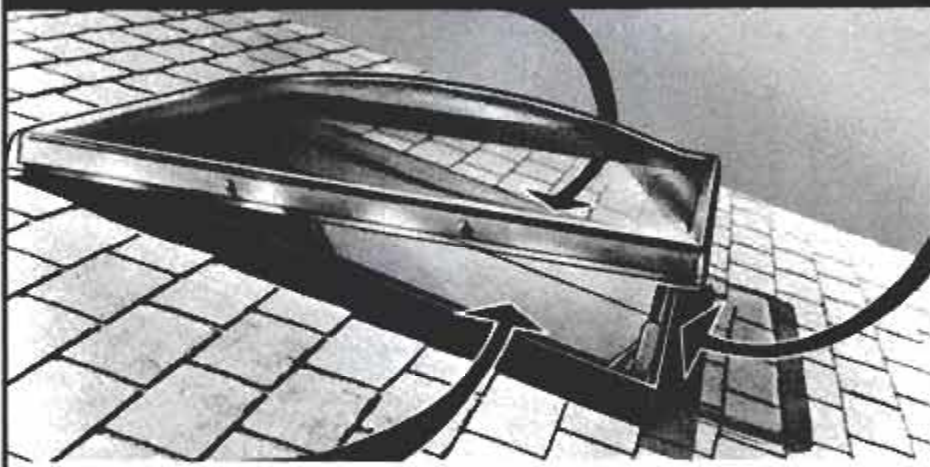
"The best advice," Blechschmidt adds, "is to heat the bathroom before you go in, then unplug the heater when you bathe—to avoid electric shock."

A new tip-over cutoff switch should cut incidents way down," he says. Late-model, UL-rated electric stoves have it.

In short, you won't go wrong with any type of heater bearing a UL label—if you use it exactly as directed.

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by John Ingersoll

High fuel prices have driven many homeowners to add more insulation, block out drafts, caulk cracks, install tighter windows and generally seal up their houses. The object of this exercise is to contain skyrocketing heating costs.

All of these procedures work, but now some homeowners are finding that they have done too good a job. Sure, they're saving on fuel bills, but they're also finding that the odor of Uncle Oscar's cigar lingers not for hours, but for days. Steam from the shower collects as condensate on windows. Yesterday's burned beans continue to haunt you. In short, the stale air inside the house remains inside instead of filtering out through the cracks.

The buttoned-up home of the '80s needs mechanical help to move old air out—and fresh air in. Typical air-exchanger setup works as shown in the drawing on the right.

The solution to this indoor air pollution problem is obvious—ventilate. But the difficulty is that you ventilate your expensive heat right out the window or open door.

There is a way to ventilate while retaining up to 80 percent of the heat that would otherwise exit with the stale air. Air-to-air heat exchangers have been around on a commercial scale for more than a generation, but smaller models for residential use are new. Up until now, there was no need. All houses breathed. Stale air, water vapor and other odors escaped

through the cracks—along with quite a lot of heat.

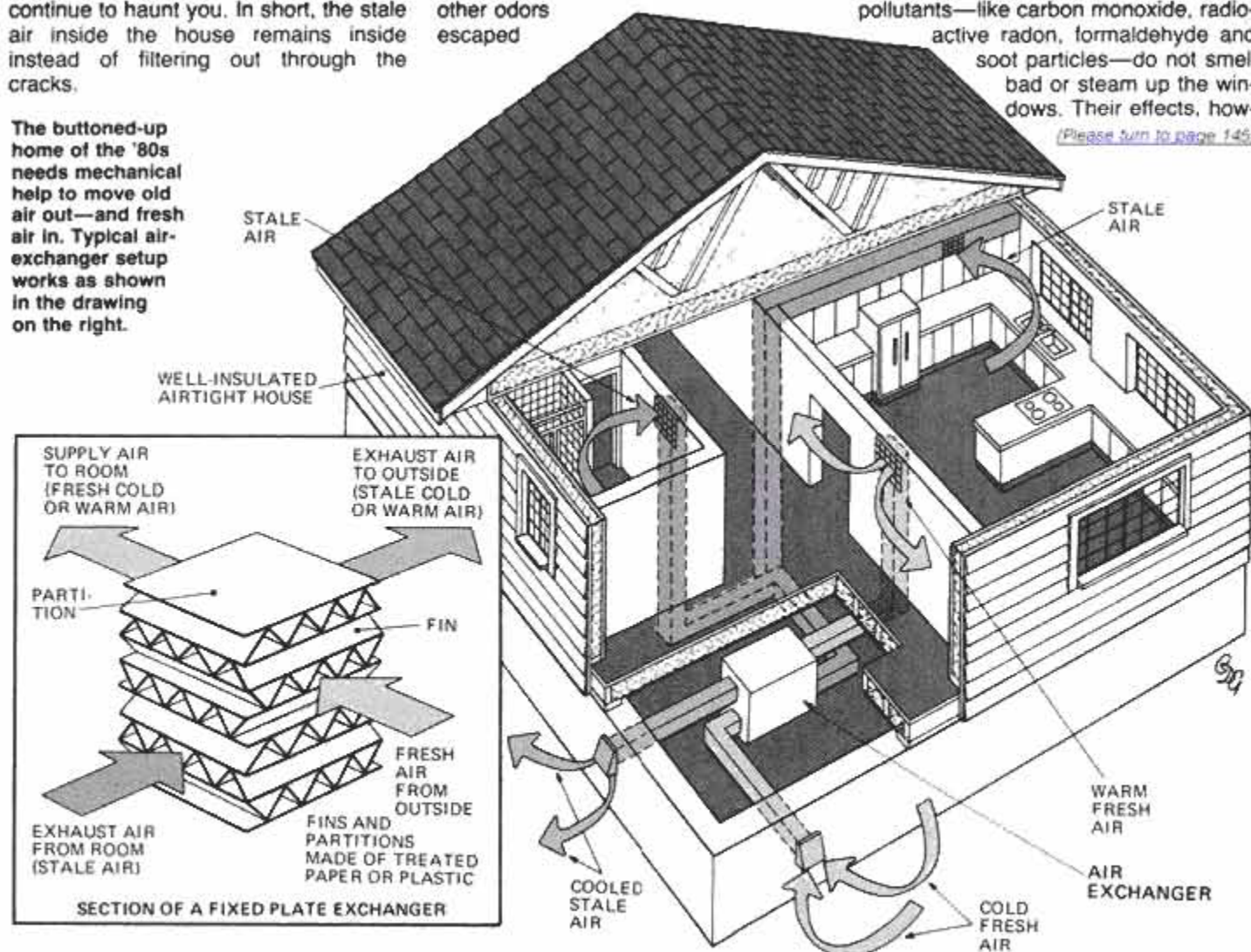
All those air leaks changed the air in the house several times each hour. In many dwellings, you could feel the cold drafts, and the air-change rate was much higher. Uncle Oscar's cigar odor and the burned beans smell escaped with the rest of the hot air.

Then came the energy crunch, driving fuel prices up by sometimes as much as a factor of 10. Instead of 16 cents per gallon, oil prices jumped to \$1.50 or more. Heating bills for many houses soared to more than \$2,000 per year. Natural gas rose, too, despite price controls, and electricity went out of sight in many parts of the country.

All of which completes the circle and brings us back to houses so tight they may have only one air change in five hours or 0.2 air changes per hour. Some of these houses bustled with activity and the air reeked and steamed. Owners complained of moisture and odors.

These same homeowners did not complain about even more serious types of indoor air pollution because they were unaware of its dangers. Many of these pollutants—like carbon monoxide, radioactive radon, formaldehyde and soot particles—do not smell bad or steam up the windows. Their effects, how-

(Please turn to page 145)



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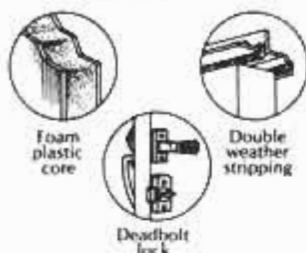
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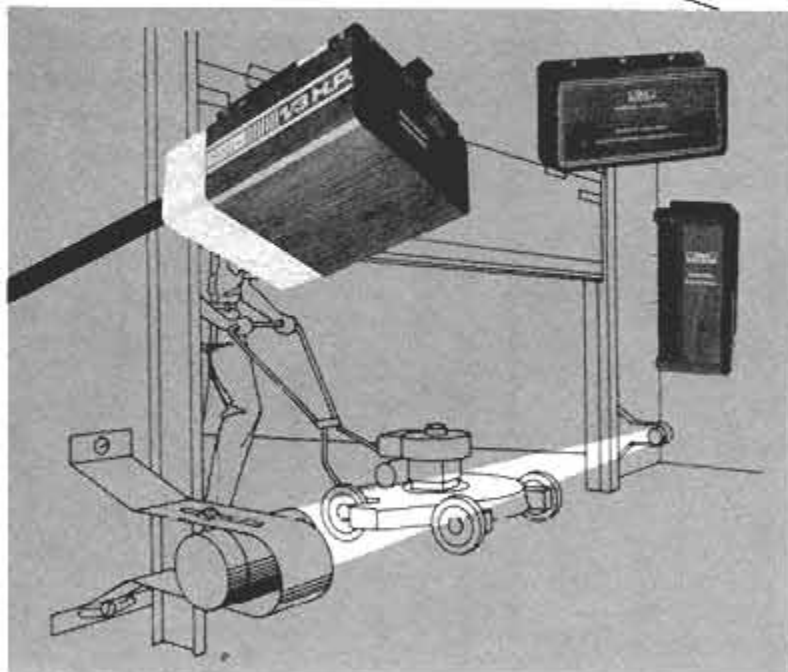


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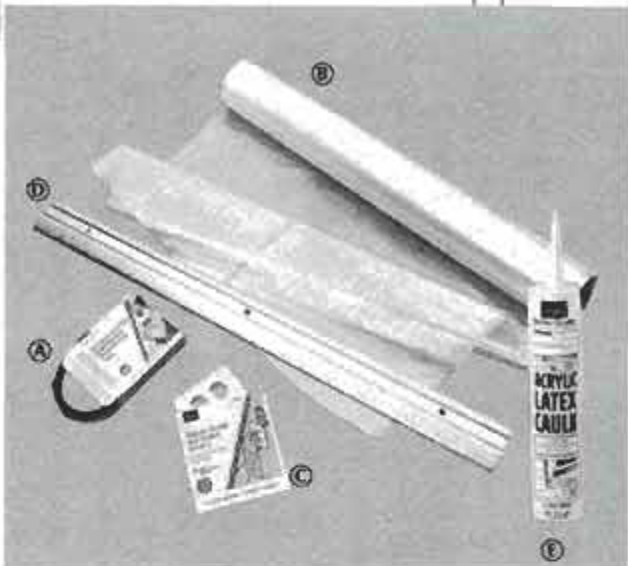
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So many ways to see your dream kitchen come true. A wide choice of looks, of woods, of sizes to match your taste and budget. Our Brookside Oak (#640) Series with solid oak doors, front frames and drawers is shown above, but there are 10 other beautiful styles to choose from. And all at wonderful savings. ON SALE: Aug. 29-Sept. 18.

Does not include sinks, faucets, countertops, or appliances. Professional installation available.

SAVE \$20 Kenmore® Power Miser™ 5 Water Heater \$149⁹⁹

Energy-efficient foam insulation helps save money, helps prevent heat loss. Provides up to 175% greater insulating effectiveness than our standard models. 24-hour emergency installation available weekdays. Installation extra. Or install it yourself. 30-gal. Gas (#33434) or 40-gal. Electric (#31444).

ON SALE: Aug. 29-Sept. 18.

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Water Heater Insulation Jackets

Wrap your present water heater with this high-density insulation jacket. Helps cut energy costs. R value = 6.0.

For electric heaters.

Now \$12.99* (#1722)

For gas heaters.

Now \$9.99* (#1723)

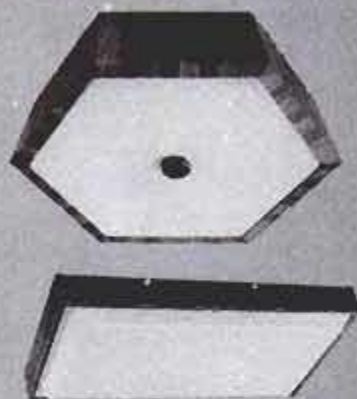
ON SALE: Aug. 29-Sept. 11.

SAVE \$10 or \$15 Butcher Block-look Light Fixtures

Fashionable wood look complements any decor. Energy-saving fluorescent bulbs use 59% to 67% less energy than incandescents, while providing equal light output.

Hexagonal. Now \$49.99. Includes one 22 and one 32-watt warm white circline bulbs. (#9139) Save \$15.

Rectangular. Now \$29.99. Includes two 20-watt warm white bulbs. (#9198) Save \$10. ON SALE: Aug. 29-Sept. 11.



SAVE \$10 Kenmore® Disposer \$69⁹⁹

Powerful 1/2-HP motor. Corrosion-resistant stainless steel grinding chamber and ring. Quick-mount collar for easy do-it-yourself installation. (#6653) ON SALE: Aug. 29-Sept. 18.



Sears Fall Fixup Festival

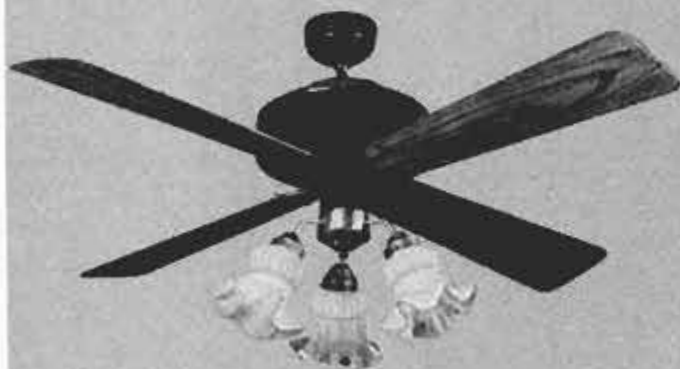


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Paints

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per gallon

Sears Best paints give you smooth one coat coverage when applied as directed. Easy Living Interior Satin Flat (#91005) wipes clean like enamel, comes in 23 colors. Weatherbeater Exterior Flat (#30005), its name is its promise. Same low price, too, for Easy Living Ceiling Paint. (#91955)
Easy Living Interior Semi-Gloss.
Now \$11.99 per gal. (#78005) Save \$5.
ON SALE: Aug. 22-Sept. 11



SAVE \$50
52-in., 3-Speed
Ceiling Fan
\$99.99

Adds beauty and nostalgia, and it's energy efficient. Uses only 10 watts of power on low speed. Helps circulate room air for summer cooling and winter heating. Your choice in either Brown or White with woodgrain polystyrene blades to match. (#9042, #9044)
ON SALE: Aug. 29-Sept. 25.

Decorative Victorian 3-light fixture.
Sears everyday low price, \$39.99. (#93007)

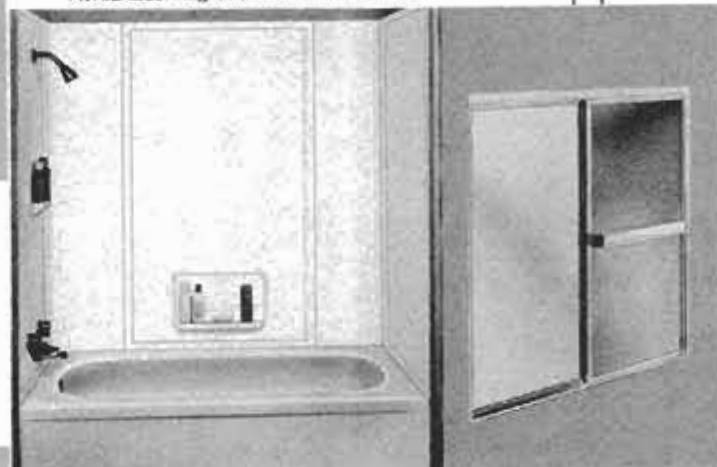
SAVE \$100
Kenmore® High-Capacity Water Softener
\$379.99

It will help your glasses and dishes sparkle. You'll feel cleaner after bathing or shampooing. Removes up to 50 grains of hardness per gallon of water. (#3483)
ON SALE: Aug. 29-Sept. 18

SPECIAL PURCHASE†
Washerless, Single-Control Faucets

\$22.88

Bright, triple-chrome plating. Includes water-saving aerator. Lavatory Faucet. (#20612)
Kitchen Faucet. (#21922)
Kitchen Faucet with Sprayer.
Only \$29.88. (#21932)
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SAVE \$20
Tub Wall Surround
\$79.99

5-pc. construction for easy adjustment to fit most 5-ft. tubs. Two soap/storage shelves. Fashionable textured finish. In White. (#6761)
In Blue, Gold or Bone color.
Now \$89.99. (#6762, #6763, #6764) Save \$20.
ON SALE: Aug. 29-Sept. 11.

SAVE \$40
Mirrored Tub Door
\$99.99

Designed for easy installation. Bottom track won't trap soap scum, so it's easy to keep clean. Choose frame in Silver tone (#68075) or Gold tone (#68076).
ON SALE: Aug. 29-Sept. 11

SAVE \$1
Smoke Alarm
\$9.99

Solid-state circuitry with test button. Includes 9-volt battery. UL listed. (#57351)
ON SALE: Aug. 29-Sept. 25.



***Price of this merchandise can be used toward computing energy tax credit.**
†A special purchase, though not reduced, is an exceptional value.
Minimum savings nationally.
Prices and dates apply only to the continental United States.
Available at most Sears retail stores.



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BUY MILLIONS OF CRAFTSMAN®
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- Full unlimited warranty on all Craftsman hand tools
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SAVE 29% TO 63%

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(A) SAVE \$20 on Miter Box and Saw Outfit. Comes complete with 16-in. Kromedge® back saw. Four treaded rollers guide the saw. (#36304) **Now \$39.99.**

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(C) SAVE \$5 on Handsaw. 8-pt. saw (#36153) or 10-pt. saw. (#36154) **Now \$11.99.**

(D) SAVE \$4 on Combination Square. (#39558) **Now \$7.99.**

(E) SAVE \$1.50 on Utility Knife with blades. (#9487) **Now \$1.99.**

(F) SAVE \$4 on 1-in. x 20-ft. Tape. (#39131) **Now \$8.99.**

(G) SAVE \$5 on Hammer with Steel-Reinforced Wood Handle. (#38141) **Now \$8.99.**

(A)-(G) ON SALE: August 29-September 18.

(H) SAVE \$12.05** on 6-pc. Screwdriver Set. (#41091) **Now \$9.99.** ON SALE: Aug. 29 (while quantities last).

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**SAVE \$200
ON SALE:
Aug. 22-Sept. 11.**

SAVE \$200
Sears Best 1-HP Compressor
\$399⁹⁹

Delivers 7.5 SCFM at 40 PSI. 12-gal. ASME tank. Includes spray gun, air hose and tire chuck. (#15821)

SAVE \$160
Sears Best 10-in. Cast Iron Table Saw Outfit
\$329⁹⁹

Comes with rugged leg set and two steel extensions. 1-HP motor develops 2-HP. Has 3½-in. depth of cut at 90°, rips to 24-in. (#29803)



**SAVE \$40*
ON SALE:
Aug. 29 (while
quantities last)**

7¼-in. Circular Saw
HALF PRICE*
Now \$39⁹⁹

Powerful 2-HP motor delivers 4600 rpm. Depth and bevel controls; ball and bronze bearings. (#1080) ON SALE: Aug. 29 (while quantities last)



**SAVE \$160
ON SALE:
Aug. 29-Sept. 18.**

†If any Craftsman hand tool ever fails to give complete satisfaction, return it for free replacement.
*Savings based on 1982 Fall General Catalog prices.
**Savings based on regular separate retail prices. Minimum savings nationally. Prices and dates apply only to the continental United States. Available at most Sears retail stores.

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AIR (Continued from page 138)

ever, are noticeable and complaint-worthy. Breathing difficulties, headaches, dizziness, nausea, eye and throat irritations and rashes may have been attributed to other causes, when foul indoor air was the real culprit.

Formaldehyde got bad notices when fumes from foamed-in-the-wall insulation caused massive allergic reactions and made a few homes unlivable for some people. What many do not realize is that formaldehyde is an important ingredient in the adhesives that make plywood and particleboard possible. Besides irritating nasal passages and eyes, its fumes may also be a cancer-causing agent.

Radioactive radon—emitted in minute quantities by stone, brick, earth and concrete—is another indoor air pollutant which has been getting serious attention recently. The radioactive radon itself is no problem, but when it starts to decay, it gives off a radioactive gas that the EPA believes may have caused as many as 10,000 cases of lung cancer annually. Tighter houses with fewer air changes per hour could drive that figure up to 20,000 in the years ahead.

Other inside air pollutants range from paint fumes to tobacco smoke. A self-cleaning oven can increase carbon monoxide concentrations to dangerous levels if used without an exhaust fan. The residual products from aerosols, water heaters, gas stoves, and even hair from family pets no longer escape as before. Vacuuming may pick up pet fur and the larger dust fuzzies, but it also puts into the air superfine particles which then don't filter out through the chinks as they used to.

Why an air exchanger

Air-to-air heat exchangers ventilate the whole house effectively, while handling the heat-loss problem efficiently. Efficiencies up to 80 percent save most of the heat which would otherwise be lost, while changing indoor air frequently enough to keep it both pleasant and healthy.

Some new air exchangers also transfer latent heat—the heat trapped in the water vapor held by the warm stale air. Condensing this water out of the stale air reclaims still more heat.

By exchanging both heat and vapor, the total energy content—called enthalpy—of the incoming clean air can be raised so it's from 70 to 80 percent of that in the outgoing stale air. This helps to maintain a comfortable temperature and humidity level inside the house.

When indoor relative humidity stays between 40 and 50 percent, your feeling of comfort prods you to turn down the thermostat by a few degrees—a step that makes a noticeable difference in fuel bills. It also keeps your furniture from drying out to the point where glue joints crack and walking on your rugs produces

sufficient static electricity to cause shocks.

Air-to-air heat exchangers work equally well in summer to conserve your air-conditioned cool air. The principle is the same, but the direction of the heat and moisture exchange is reversed. Stale but cool indoor air (whether air-conditioned or not) is vented to the outside, taking the heat and excess moisture from the warmer incoming air with it. Enthalpy air-to-air heat exchangers also extract water vapor from the warmer incoming air, while cooling it to keep your house from the clammy feeling of excess humidity.

So much for the pluses. Even enthalpy air exchangers have their minuses. For one, unless your house is supertight, with an air change rate of 0.5 or less (one change every two hours), they do no good. In fact, a house that changes its air once an hour without help will only lose excessive amounts of heat no matter how efficient its air exchanger may be.

The other problem with air exchangers, especially enthalpy models, is freeze-ups. Most are plagued by freeze-ups on the incoming airstream side when the outside temperature drops below 10° F. Ice forms, blocking up the openings. Most soon thaw from the warmth of outgoing air. Some have electric heaters, but these have their own energy expenses. Still, ice dams do lower the efficiency of some enthalpy air-to-air heat exchangers.

Types of exchangers

Different types of air exchangers react differently to freeze-ups. Here's a quick rundown on the three main types of air-to-air heat exchangers: the fixed-plate "sensible" models, fixed-plate enthalpy designs, and rotary enthalpy exchangers.

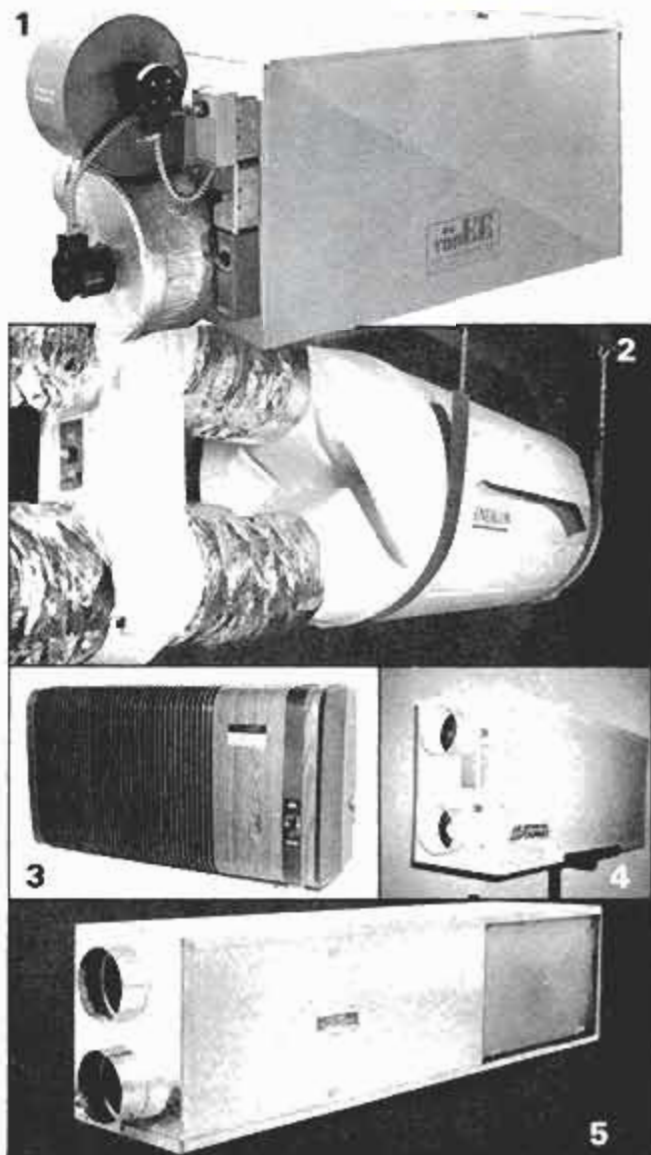
Fixed-plate sensible heat exchangers get their name from your being able to sense the heat in the incoming air. They contain a series of nonporous separators mounted so that incoming and outgoing air travel through side-by-side channels; that way, the heat from one can warm the other without contaminating it. Heat is transferred

through the separator. Two small fans pull in outside air and push out indoor air.

When a freeze-up occurs, a sensor can shut down the fan on the incoming side, or you've got to do so yourself. Then, outgoing warm air continues to transfer heat to the iced-up incoming channels, melting the ice. At about 20° F. outside, this is claimed to take only a minute or two. Down at 0° F. or below, it takes longer.

A very tight house collects vapor from cooking and bathing, which can steam up windows in cold weather. An air exchanger also removes this excess moisture quite rapidly, while bringing in only small amounts of humidity with the colder outside air in winter.

Some air exchangers require a humidifier. (Please turn to page 146)



Five typical air exchangers go in basement or attic to ventilate superinsulated houses and reclaim heat from outgoing stale air. Four—vanEE (1), Enercon (2), Air Changer (4) and E-Z-Vent (5)—are "sensible" designs (see story), which warm incoming fresh air by passing it through a heat exchanger next to outgoing stale air. Econofresher (3) is a rotary enthalpy design that conserves latent heat, resists freeze-up and rehumidifies.

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This colorful 20-page booklet uses a question and answer format to explain window and gliding patio door replacement. A replacement job is discussed step by step and photographed before, during and after. It also includes a detailed energy section with tables, shows the complete Andersen line in before/after installations and explains The Andersen Window Replacement System. Mail coupon to Andersen Corp., Box 12, Bayport, Minnesota 55003.

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Andersen Windowalls



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AIR (Continued from page 145)

ifier to replace the moisture removed with the stale air. This is a separate operation and is not incorporated in most models, so you may have to add a humidifier to the cost of an air exchanger. The need is most important on cold days.

Fixed-plate enthalpy exchangers work the same way as sensible models. The difference is in the separators. These are water absorbent, so they filter the moisture out of the stale air and pass it through to the clean incoming air. Thus, these models pass through both sensible and latent heat.

By passing the water vapor through with the outside air, these models help to maintain the relative humidity balance in the house. However, they still lose some moisture to the outside, though markedly less than with a sensible design.

Rotary enthalpy exchangers are, at this writing, only available under the Econofresher name. In this design, a honey-combed wheel transfers heat and vapor from the outgoing warm air to the incoming cold air. Since the surface of the wheel is exposed to both cold and warm air, it appears to have overcome the freeze-up problem effectively. No single set of ducts is constantly exposed to freezing temperatures, so ice never builds up. Company literature claims frost-free operation down to 5° F. In summer, it's claimed to work well in keeping interiors cool and humidity balanced at a comfortable level.

Another air exchange system relies on rising hot air for circulation and thermostat controls in roof vents to minimize heat losses. Called the Thinking Cap, it includes one or more roof vents to remove the stale air and manually controlled ceiling grilles to regulate airflow.

Each cap has a thermostat which opens air flaps when the temperature reaches 80° F. and closes them at 60° F. It has a built-in fuse to close the vanes and keep them closed in case of fire. By opening ceiling vents that feed inside air to the

cap, you can keep the house comfortable and the humidity controlled.

With these vents closed in winter, the system is claimed to balance humidity and conserve energy. Fresh air enters the house through open downstairs windows or by natural infiltration if the house is not too tightly sealed. While this system does not heat the incoming air with the outgoing stale air, it requires no power for fans because it works by giving the hot, stale air a place to go when it rises.

Air exchanger problems

Three problems remain: how to select the right size unit, how to install it or have it installed, and where to find one.

Sizing depends on the volume of your house. A rough rule of thumb is to specify an air exchanger delivering 75 c.f.m. (cubic feet per minute) per 1,000 square feet of floor space.

You can arrive at a more precise estimation by using the calculations of ASHRAE (American Society of Heating, Refrigeration and Air Conditioning Engineers). They advise 40 c.f.m. for each bath or kitchen and 10 c.f.m. for each occupant. Then multiply the number of cubic feet in your home by the air-infiltration rate to get the air-change rate.

Air-infiltration rates were once determined by multiple instruments all over the house, but this expensive piecemeal method has been replaced by a machine which creates a vacuum and then measures how hard it has to work to do it. Called The Big Sucker (what else?), it was developed by a Texas utility about six years ago. Now, you can hire its services through local utilities and some air conditioning contractors. Once the Big Sucker gives you the air-infiltration rate per hour for your home—remember, adding insulation and sealing windows, doors or other air leaks changes it drastically—you can figure your air-change requirement.

In a supertight house, the average

HOW AIR EXCHANGERS COMPARE

	Price (Approx.)	Size (in.)	Weight (lbs.)	Latent Heat?	Airflow (c.f.m.)	Energy Draw (w.)
Air Changer	\$790 ¹	54 × 22 × 14	75	No	150	70
Air-X-Changer	\$235	7 × 7 × 14	13	No	60 to 135	1,500 ²
Econofresher	\$300	22 × 12 × 8	21	Yes ³	30 to 55	40
Enercon	\$1,250	48 long × 20 dia.	85	No	150	150
E-Z-Vent	\$550	62 × 16 × 14	90	No	100 to 200	200
Lossnay ⁴	\$350	22 × 16 × 12	29	Yes	40 to 63	52
Memphremagog	\$700 ⁵	50 × 28 × 14	80	No	180 to 255	70
Thinking Cap	\$199	18 × 18 × 7	18	No	0 to 200 ⁶	None
vanEE	\$750	49 × 22 × 15	75	No	0 to 200	200

¹ Air Changer also has a "Standard" model for \$650.

² This unit is not a true air-to-air heat exchanger. A resistance heating element in the unit heats air drawn into the house to replace negative pressure brought about by losses up flues.

³ Rotary type.

⁴ Mitsubishi (Lossnay manufacturer) produces two smaller models and one larger unit for residential application. The smallest exchanger is not an enthalpy unit and is suitable for manually operated, high-humidity areas, such as a bath.

⁵ The same model is available for \$500 without fans.

⁶ Thinking Cap is a thermostatically controlled home venting system that varies airflow by temperature and ceiling vent regulation. Two caps and six ceiling vents in system can move from 0 to 400 c.f.m. (200 c.f.m. per cap).

number of air changes per hour ranges from 0.2, to 0.3. To find out yours, multiply the air-infiltration rate per hour by the number of cubic feet in the house. Divide that number by 60 to get the number of c.f.m. of air your house changes naturally. Subtract this c.f.m. rate from your calculated need to get the exchanger capacity.

Installing an air exchanger

Installation calls for commonly used home-handyman skills and tools. Do not attempt to tie in with any existing ductwork if your house is heated by hot air, but make the air exchanger system separate and independent.

As the outgoing air gives up its heat to warm the fresh air coming in, moisture condenses. The drain line (which can be a plastic tube leading to the floor drain in the basement) gets rid of this water.

You will also have to work with ducting. Most air exchanger makers recommend flexible, insulated ducting with a vapor barrier. It must also fit the air exchanger fittings and should be available from the same source as the air exchanger.

Cellar installations support the air exchanger system on ceiling joists with straps. Attic installations can rest on ceiling joists. Some smaller models can be wall-mounted in a bathroom or kitchen like a sort of super exhaust fan.

Stale air can come from anywhere in the house, but the most effective systems take it from as high up in the room as possible. The area of the air intake should be open to the rest of the rooms. Plan to deliver fresh air to one room or several and exhaust it from another to minimize cross-contamination. There's no advantage in exhausting your fresh air or mixing it more than necessary with the outgoing stale air. Keep the outside air intake and the exhaust vent at least 6 feet apart to avoid cross contamination outside the house.

Air exchanger systems can be found in your classified directory under Conservation, Heat Exchanger, or Heating Equipment. Air-conditioning contractors might be a source, or you can write directly to one or more of the manufacturers listed in the equipment chart below. **PH**

MANUFACTURERS LIST

- Air Changer Co., 334 King St. E., Studio 505, Toronto, Ont. M5A 1K8 (Air Changer).
- American Energy Products, 603 Fenimore Rd., Mamaroneck, N.Y. 10543 (Thinking Cap).
- Berner International Corp., 12 Sixth Rd., Woburn, Mass. 01801 (Econotresher).
- Conservation Energy Systems Inc., Box 8280, Saskatoon, Sask. S7K 6C6 (vanEE).
- Des Champs Laboratories Inc., Box 440, East Hanover, N.J. 07936 (E-Z-Vent).
- Enercon of America Inc., 2020 Circle Dr., Box 632, Worthington, Minn. 56187 (Enercon).
- Memphremagog Group, Box 456, Newport, Vt. 05855 (Memphremagog).
- Mitsubishi Electric Sales America Inc., 3030 East Victoria St., Compton, Calif. 90221 (Loosney).
- Standex Energy Systems, 620 Main St., Detroit Lakes, Minn. 56501 (Air-X-Changer).



The new Husqvarna 50 Rancher cuts weekends down to size.

Some chain saws may not be used all the time, but that doesn't mean they shouldn't have the same high standards of quality and performance that professionals demand. That's why the Husqvarna 50 Rancher is built to the professional standards of all our chain saws.

The power-to-weight ratio is among the best in the industry. Its easy-to-handle design, and ample torque reserve make the Husqvarna 50 Rancher one chain saw that meets the tests of professional working techniques and conditions.

Electronic ignition, automatic oiler, anti-vibration system, plus a totally automatic, permanently adjusted inertia chain brake are all standard. It's easy to start, but more importantly, the Husqvarna 50 Rancher is easy to restart.

Any way you look at it, a Husqvarna 50 Rancher is no ordinary chain saw. A saw that's designed to make the non-professional work like a pro, is truly extraordinary.

For the dealer nearest you write Husqvarna, 224 Thorndale Avenue, Bensenville, Illinois 60106 or consult your Yellow Pages.



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SWEDEN
The Chain Saw Professionals.

Get More Heat From Your Fireplace

Add an insert and stop heating dollars from going up the flue.

by Al Sittner and Harry Wicks

If you own a fireplace, one of the easiest and quickest ways of reducing your winter heating bill is to install a fireplace insert. By now, most Popular Mechanics readers are well aware that an open fireplace is one of the biggest heat wasters in the home.

While a roaring fire is a visual delight, almost all of the warmth that it generates exits via the chimney. Additionally, when you retire for the night with fireplace flue left open—to keep the house smokeless—air warmed by your furnace also exits through the chimney. For this reason, fireplaces get a minus efficiency rating—they don't even break even.

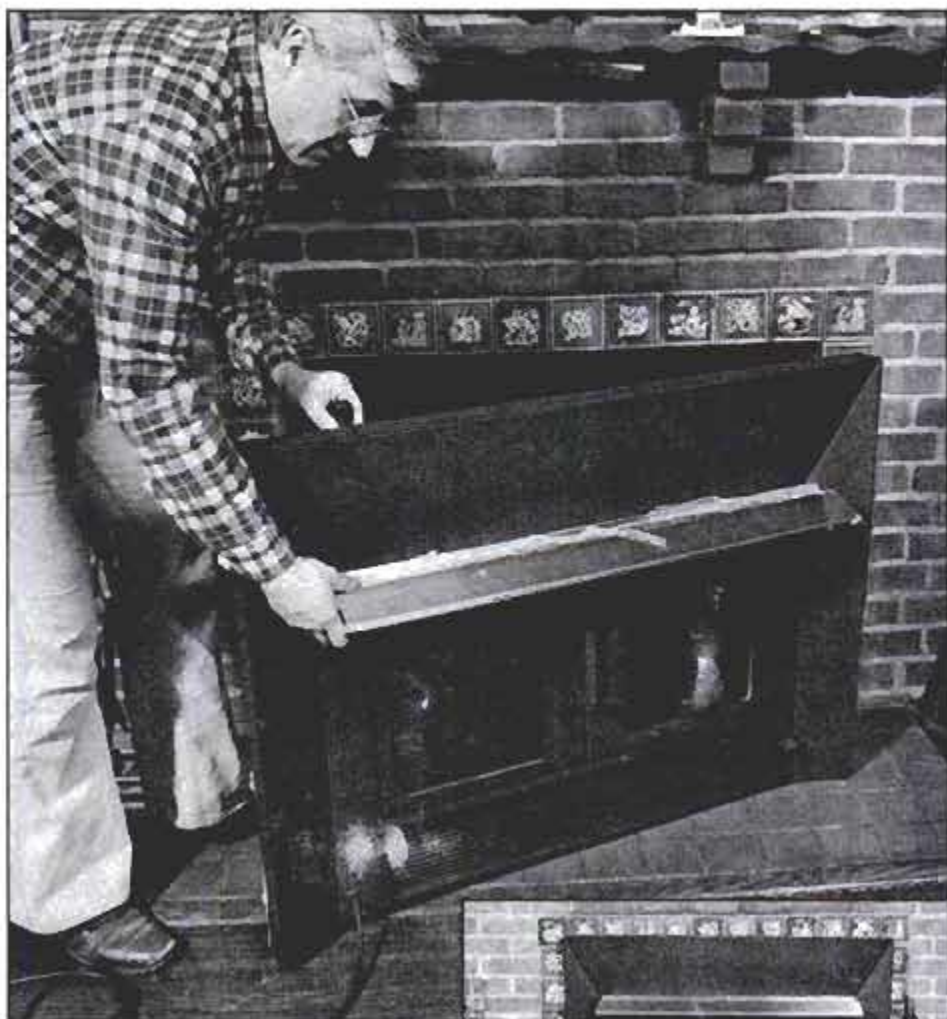
Changing that picture

By adding a fireplace insert to your fireplace, you can, in fact, help keep furnace use to a minimum. But there are some key points to consider when making your purchase:

■ Does the unit have a powered fan? You want an insert that does; and it is better if the fan is either a multi- or variable speed type. A fan draws in air from beneath the insert's hearth, directs it up the back and across the top of the insert, then out into the room.

■ Check the insert's construction. Do the glass doors fit well and close tightly? Are all fabrication seams airtight? In use, deposits tend to build up on the inside of the glass to diminish the view of the fire. The paradox is, the more efficient the insert, the greater the buildup.

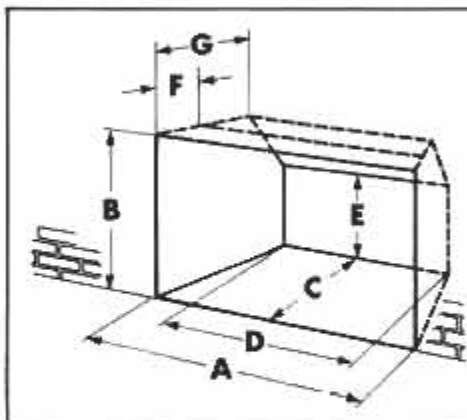
The unit we picked to install and test was the In-Majic Insert from Majestic, 1000 East Market St., Huntington, Ind., 46750. Designed to fit most masonry fireplaces (as well as Majestic's own Series L and M fireplace models), the insert controls fuel combustion to minimize creosote buildup according to Rod Hempel, marketing manager for Majestic. He adds



Unit comes from the factory pretty much assembled. Here, flange is affixed using screws provided. At right, insert is "burned off" immediately after installation. Chart below lists fireplace dimensions needed when you order insert.



PM photos: Rosario Capolosto



FIREPLACE DIMENSIONS FOR INSTALLING INSERT

Fireplace Dimensions	Your dimensions must be:	
	Minimum	Maximum
A	36"	40"
B	24"	30"
C	19½"	•
D	22½"	•
E	14½"	•
F	3"	6"
G	15½"	•

* Maximum dimension does not apply.

that the "insert reduces by 75 percent the room air loss associated with typical masonry fireplaces."

Installing the unit

Since the insert comes almost completely assembled, it can be installed in less than an hour. Because of its weight, get some help to slide the unit in or out without damage to floor or hearth.

Basically, the installation consists of these steps:

1. Clean out your masonry fireplace and remove its damper, if possible. If not, position the damper at full open, (once it is installed, the insert, in effect, becomes the fireplace damper).

2. Remove any screens, glass doors, log lighters and other paraphernalia

(Please turn to page 150)

WORTH WRITING FOR

LOOKING FOR IDEAS ON ENERGY SAVINGS, THE HOME AND MORE? CHECK THESE LISTINGS. THEN USE THE COUPON BELOW.

586 Solar Space Conversions

New do-it-yourself interlocking polycarbonate panels from Sunforms can make screened porches, patio covers, breeze-ways into solar-rooms. Add year-round comfort to your home. Brochure and "Master Guide for Sun-space-with Sunforms." \$2.50

587 Warm The Home And Cool Fuel Bills

Consolidated Dutchwest believes that craftsmanship is what distinguishes an excellent stove from a good one. That's why each of its stoves is produced by hand . . . from casting to packing. 16-page, full-color brochure shows complete line, accessories and specifications \$1.00

588 A Wonderful Way To Heat

United States Stove's Legacy Wonderwood and Wondercoal circulators offer leather-grain embossed, earth-tone steel cabinets. Baffled, stainless steel heat exchanger captures heat previously lost. Large firebox provides up to 10 hours of heat with one load of logs. Free brochure.

589 Smoke Burner For Woodstoves

Corning® would like you to know how its Catalytic Combustor helps you operate a cleaner, safer, more efficient stove. Informative package provides technical data and answers the questions most often asked about catalytic combustion. Free

590 Log Home Living

Heritage Log Homes offers its award winning "Log Home Buyers Kit". Contains data and floor plan sheets on 24 models, including units featuring passive solar heating. Answers many of the questions asked about log home building. \$5.00

591 Balance Your Comfort And Budget

Your thermostat system should fit your family's style of living and comfort needs. The Micro Electronic Thermostat, from Johnson Controls, saves by using energy *only* when it is needed. Simple operation allows up to four temperature changes per day. Free

592 Doing The Wood Split

Colorful brochure from C. E. Mann illustrates their complete line of Quick-Split® log splitters. Models for the homeowner to the professional. Splitting power ranging from 15 tons to over 100 tons. Free

593 Wide, Wide, World Of Windows

Andersen Corp. answers the most-asked questions about windows and gliding doors in a 24-page, full-color booklet. Contains special sections on window planning, energy, remodeling and replacement. Both wood and vinyl-sheathed windows are described and illustrated. Free

594 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, drying wood, the Monster Maul log-splitter and more. Free

595 Need Home Fixup?

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, energy-saving caulking and paint-up needs. From DAP Inc. Free

596 Log Splitters And More

Discount catalog featuring log splitters and the parts to build your own. Plus hydraulics, 3-18 HP gas motors, trailer parts and more. From Northern Hydraulics. \$1.00

597 Control Moisture Inexpensively

Hub States offers a booklet describing "Damp Out"™ a new chemical dehumidifier. Attracts moisture from the air. Works continuously for 12 months to two years. Free

598 The Sky For Your Ceiling

Brochure tells you what to look for and look out for in ventilated residential skylights. From the industrial pioneer manufacturing guaranteed, weatherproof, hand or motor operated domed skylights . . . Ventarama Skylight Corp. Free

599 Beat The High Cost Of Comfort

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that may be in your masonry fireplace.

3. Remove insert contents from the carton and check that no parts are missing. At this time, also check measurements—to make sure you received the insert you ordered.

4. Slide hood (which directs warmed airflow down toward the floor) into position. Make sure you remove any plastic factory protective wrappings from it and secure with the screws provided.

5. Install the masonry-surround trim. The trim supplied with the unit we

installed will efficiently seal a masonry opening 30 in. high by 40 in. wide. Install all three trim pieces on the unit, finger-tightening the nuts only. When all pieces are on the insert, and mitered corners are aligned, tighten the nuts with pliers or wrench.

6. Slide the unit into the fireplace and check the insert's damper operation, to make sure it isn't obstructed.

Build initial fires as per the maker's instructions to burn off protective oils. Now, enjoy warmth and lower heat bills. **PM**



Insert is uncrated and set in front of fireplace opening. Since it weighs about 150 pounds, the job is easier with a helper.



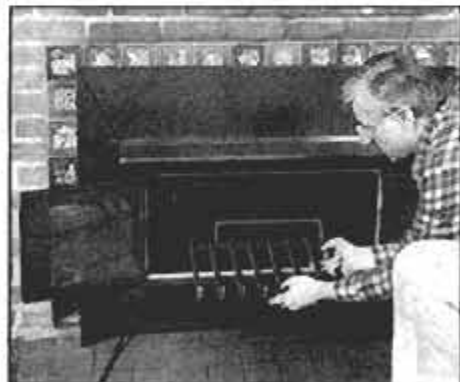
Fireplace-surround trim (arrows) is installed using screws supplied. Three pieces come with insulation affixed.



Screws holding first two trim pieces are only finger-tightened until third piece has been aligned and attached to unit.



With trim pieces installed, machine screws can be turned home using a pliers. Slot in the foreground is the unit's damper.



It took approximately 30 minutes for the authors to install the unit. Here, prior to starting initial fire, the grate is installed.

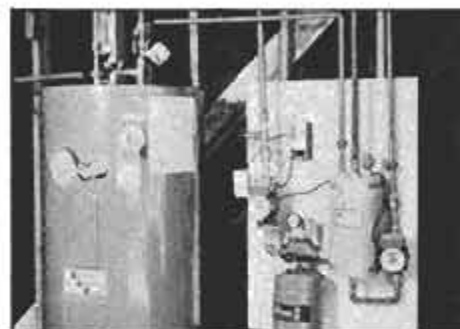


First few fires are intended to burn off the smell of factory-applied protective oils and the like. Put kindling and paper in the insert, open the damper, light the fire and close the glass doors. Blower is not turned on until the fire is well ignited.

New Energy-Saving Products



The Model CH-77 wood heater (\$575) has a catalytic combustor positioned in the smoke stream that ignites smoke particles for a second burn. This results in less creosote buildup, higher heat extraction and reduced air pollution, according to the company, Shenandoah Mfg. Co., Box 839, Harrisonburg, Va. 22801.



This do-it-yourself solar hot-water system is available by mail from Heath Co., Benton Harbor, Mich. 49022. Components include: collector panels (top), storage tank and heat exchanger (above), pumps, controllers and plumbing hardware. Items not included are piping runs, which must be sized at the site, propylene glycol fluid for the collector and pipe insulation. A typical kit is \$2,289; purchasers are eligible for a 40-percent energy tax credit, according to the distributor. It is suggested that you buy instruction manual NS-1100-3 (\$25) before ordering the components.

(Please turn to page 156)

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The top number on meter shows total gallons delivered. Bottom number indicates gallons remaining in tank.



Unscrew the old gauge on your oil tank and gently pry the cap with a screwdriver (left). Lift out the old gauge assembly and bushing. Position Accu-oil-meter and inch aluminum float and string into the tank (right).

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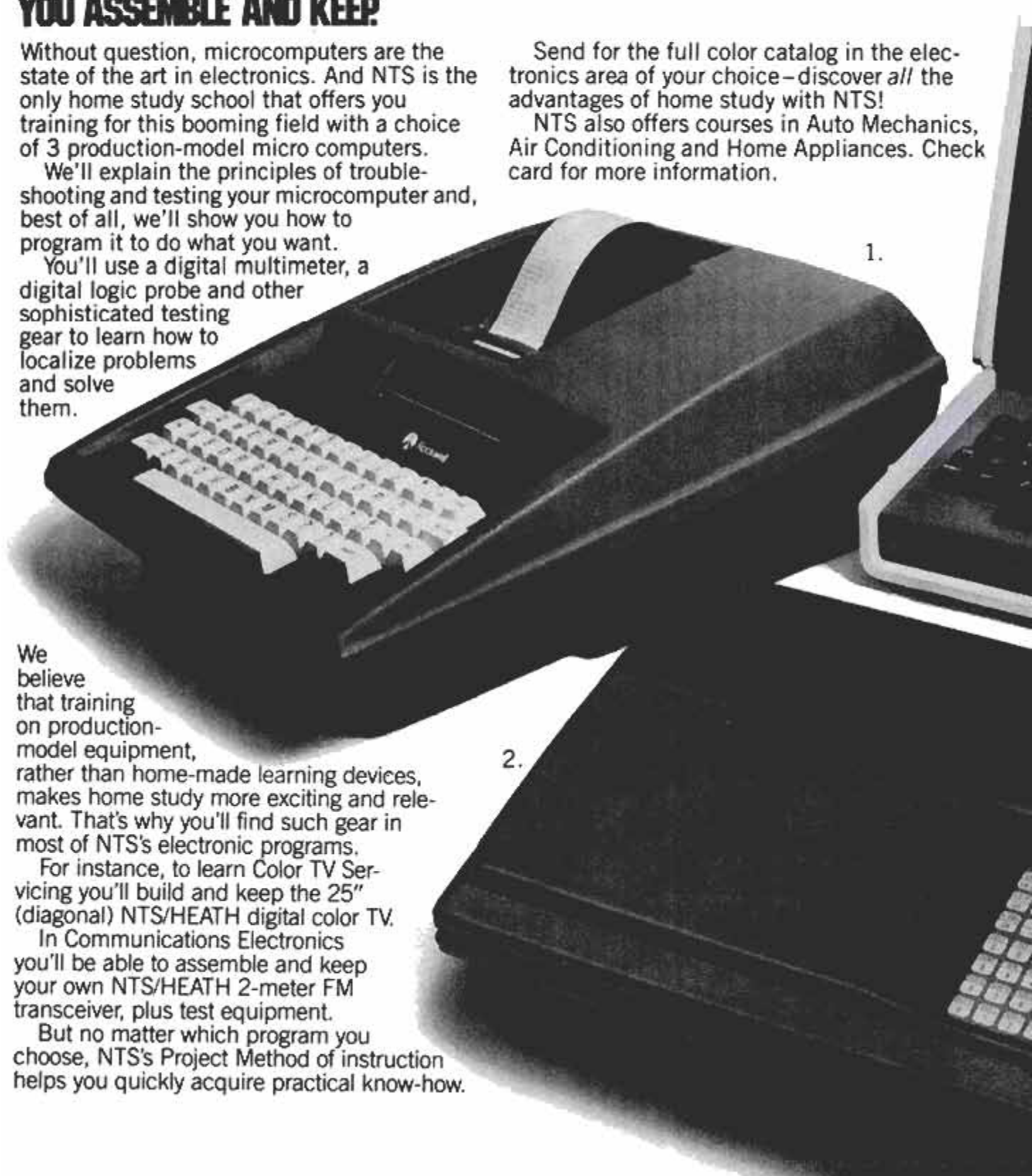
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HOME ENERGY GUIDE

(Continued from page 151)

The Sun Twin is an electric heater that uses infrared energy and a bimetal exchanger plate to distribute heat. It is capable of heating areas up to 500 sq. ft., according to the company. The heating unit costs approximately \$540, with the wood cabinet included. Sun-Twin Corp., 2500 North Airport Commerce Ave., Springfield, Mo. 65803, is the manufacturer.



The Superba built-in dishwasher (\$650) has a water-heating system that heats incoming water to 150° F. This allows homeowners to lower the home water-heater setting by 20° and save on home water-heating costs. According to the maker, KitchenAid Div., Hobart, Troy, Ohio 45374, the energy savings realized may pay for the original cost of unit over a 10-year period.

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The Thermar Homemaster tankless hot water heater makes hot water on demand; it uses less energy than conventional storage tank heaters that heat standby water. Thermar (\$595) is made for natural or LP gas by the Tankless Heater Corp., 20 Melrose Ave., Greenwich, Conn. 06830.



HOME ENERGY GUIDE

The Folding Stair Heat Saver is a zippered canopy that is installed in the attic and sealed to the framed opening of the stair to form a dead-air space and stop heat loss. Beside cutting heating bills, the canopy reduces moisture buildup in the attic, according to the maker. The canopy is constructed of vinyl which has been laminated to a dense nylon weave. The vinyl makes



the canopy flexible and durable over a wide range of temperatures, while the nylon weave helps guard against ripping. A zipper positioned at the base of the canopy provides easy access into the attic and reseals the canopy. The Folding Stair Heat Saver kit includes four prebored canopy support posts, 15 ft. of prebored sealing canopy strips, instructions and nails for the installation. The Heat Saver canopy kit is \$31.50 from Energy King, Box 1037, Wappingers Falls, N.Y. 12590.

This translucent window insulation cuts heat loss through glass in winter up to 49 percent, yet it still lets in 70 percent of the outside light, according to its maker. To install the insulation, simply cut to fit and press the adhesive material in place. An 18 x 96-in. roll (\$7) has enough material to insulate six average-size basement windows. It's made by Bede Industries Inc., 8327 Clinton Rd., Cleveland, Ohio 44144.

(Please turn to page 158.)



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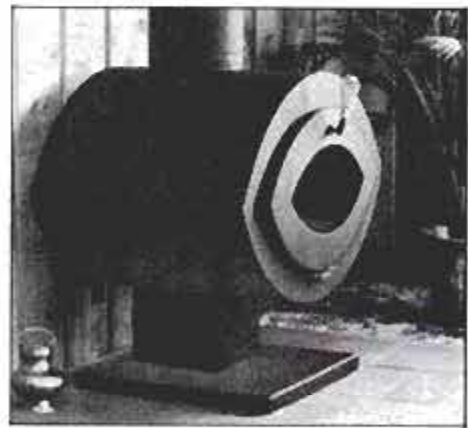
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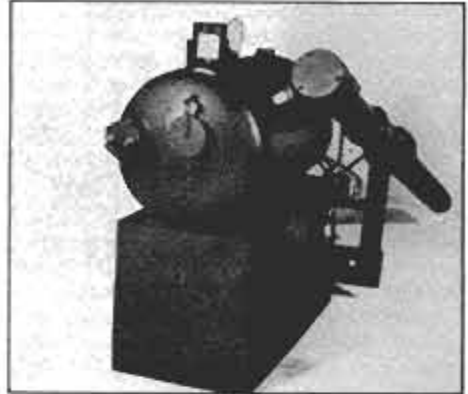
HOME ENERGY GUIDE

(Continued from page 157)

This Greenbriar wood stove features an arched fire chamber which, according to the manufacturer, helps resist warping. The maximum output of the model C-32 is 60,000 BTUs per hour. It can be connected to an outside air source from below or behind the pedestal base. The stove, which is \$595, is from Greenbriar Products Inc., Box 473, Spring Green, Wis. 53588.



The top-feeding Boston boiler below is designed to burn either wood pellets or coal. It is constructed with four areas of heat transfer within it; this helps the boiler heat more efficiently. The unit burns with 83-percent efficiency, according to the maker. The boiler is \$3,200, not including plumbing parts and installation. It's made by the Boston Boiler Works, Boston Post Rd., Enosburg Falls, Vt. 05450.



This microelectronic set-back thermostat is controlled by a single microprocessor that automatically raises or lowers home temperature up to four times a day, cutting heating and cooling costs. A digital clock displays time and temperature. It's \$100 from Johnson Controls Inc., 2221 Camden Court, Oak Brook, Ill. 60521.

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actor (see *Science Worldwide*, page 8, June '82)—is nearly completed, and its size alone may help solve the problem. The bigger doughnut contains a thicker stream of hot material, giving its turbulent particles greater leeway for random motion. Within the thicker stream, atoms can jump sideways greater distances without touching the wall. What's more, the web of magnetic force fields holding the swirling stuff in suspension will be knitted more tightly. This leaves fewer loopholes for escape, making a tighter "bottle."

Dr. Harold P. Furth, director of the Tokamak project, believes that he might break even by the mid-'80s. The break-even point would be reached when a reaction lasts long enough to generate as much energy as is consumed in the heating process. Once this is accomplished, progress toward a practical power source is expected to accelerate. "We've still got a long way to go," Dr. Furth sums up the status of his project. "But we're past the point where it could fizzle."

Laser fusion

At the University of Rochester, fusion researchers are taking a different approach. They aren't even trying to obtain a sustained reaction. Instead, they're shooting multiple laser beams at a tiny pellet containing deuterium and tritium. By concentrating the light of 24 giant lasers on a target smaller than a pinhead, they've succeeded in raising the temperature inside the pellet to the point required for atomic fusion. Ignited in this way, each pellet becomes a miniature hydrogen bomb whose energy can be captured for generating electricity. By popping one pellet after another—at intervals of about half an hour—enormous energy could be produced.

Looking at the Laboratory for Laser Energetics at the University of Rochester is like stepping into a sci-fi movie. First, you see 24 lasers, each as long as a basketball court. Each laser is mounted on a 30-inch-thick concrete slab, which is atop 14 feet of shock-absorbent material and another 30-inch-thick concrete slab. The entire structure acts as a filter to isolate the lasers from ground vibrations. That way, their beams hold steady and hit just the right spot with an accuracy of 10 microns (0.0005 inch).

As I walked across the gigantic lab high up on the glass-enclosed observation deck, I was struck by the clarity of all the outlines. Everything

looked as if it were embedded in crystal.

"That's because of the clean air," my guide explained. "Every bit of dust or droplet of moisture in the atmosphere would diffract those finely focused light beams. That's why all the air in here is filtered and dried."

Packed into a pulse lasting less than a billionth of a second, the array of lasers delivers a salvo of light equivalent to 30 trillion watts. That's approximately 75 times the

power of all the generating plants in the United States. When this blast hits the target, the outer layer of the pellet vaporizes with explosive force and flies off toward the outside. But by Newton's Third Law, the material flying away from the center creates an equal and opposite reaction, imploding, or pushing the rest of the fuel inward toward the center of the pellet. The resulting pressure generates the heat needed to make the deuterium and tritium fuse, liberating energy in the form of neutrons. This Newtonian squeezing of the

(Please turn to page 160)

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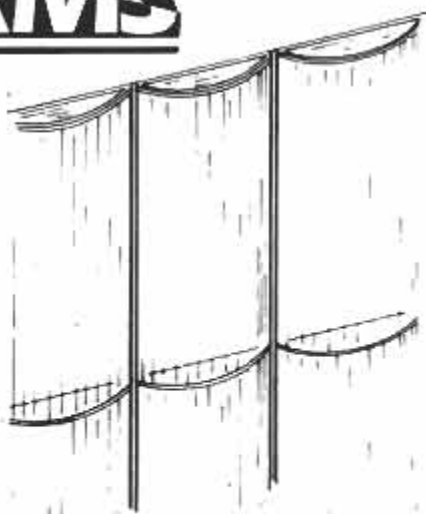
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HARNESSING H-BOMB POWER

(Continued from page 159)

pellet is called "inertial confinement," in contrast to the "magnetic confinement" of Tokamak.

Until recently, not even the huge lasers at Rochester were able to heat the target enough to set off an efficient reaction. "At the risk of very rough analogy, you don't shoot ducks with howitzer shells—or elephants with buckshot. So we try to tailor the content and form of the energy within the beam to the ability of the target to absorb it," explains Dr. John Soures, one of the project scientists.

Last year, the laser project made enormous strides when ways were found—through the insertion of certain crystals into the light beam—to shift the wavelength of the laser light from infrared to ultraviolet, increasing energy transmitted to the pellet.

Other advances were made with the timing of the beams. A single flash from something like a strobe light triggers all 24 lasers. But because the lasers are different lengths from the target, arrival time of the beams must be synchronized. All 24 beams must hit within millionths of a second.

The tiny target itself hangs suspended in an enormous, 60-ton steel frame to insulate it from vibration. Yet despite its smallness, it must be perfectly spherical. Otherwise, the 24 beams wouldn't converge at the precise center and the optimal conditions for compression and heat generation wouldn't be achieved. It's mainly in the geometry of the target and the mapping of impact sites that many engineering challenges have yet to be met.

Dr. Jay Eastman, Acting Director of the Laser Energetic Laboratory, hopes to reach the break-even point (a reaction generating as much energy as it consumes) in the latter part of this decade.

Back to Einstein

Though different in method, both magnetic fusion and laser fusion rely ultimately on Albert Einstein's famous formula $e=mc^2$.

In Einstein's formula, e stands for energy, m for mass and c for the speed of light. It's the c^2 that really counts. Multiplying by this factor, you get enormous quantities. And that's what accounts for the huge energy yield of fusion reactions.

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some programs to make learning a bit easier. We liked the Instant Logo feature that makes the commands only one letter long, so even very young children can move the turtle around.

The TI-99/4A's main advantage is in "sprite animation." A sprite is a design (a car, boat or face, for instance) that can be moved instantly on-screen. Up to 32 of these sprites can be moving at once. Right now, these sprites aren't available for the Apple versions, although L.C.S.I. plans on marketing a plug-in circuit card soon for the Apple to offer this as an Apple Logo option. Unfortunately, except for the sprite graphics, the TI Logo is the most primitive of the three.

Learning Logo and writing a program in turtle graphics is straightforward, as the accompanying pictures show. We wrote this program, called GARDEN, in a few hours one afternoon. (Probably any of the kids we met while we were researching this article could have done it in half the time!)

GARDEN draws three flowers of various sizes that the program user chooses. For instance, typing GARDEN 50 30 30 would result in a big flower flanked by two smaller ones. Changing that to GARDEN 20 40 40 would produce a small flower with one big one on each side of it.

The photos and their accompanying captions detail how the program works. But notice how GARDEN is made up of smaller programs called FLOWER, LEAVES, LLEAF (left leaf), RLEAF (right leaf) and PETAL. This building-block-system approach is what gives the Logo language its educational clout.

Thinking logically

Drawing three flowers with one program would be a complicated procedure. But drawing a petal isn't very hard, nor is designing a leaf. The trick lies in learning to think logically enough to break down a hard problem into easier-to-solve pieces. Many educators maintain that this approach to problem solving will help students in all areas of their lives.

The Logo language is a real powerhouse, with far more serious applications than just drawing pretty pictures. As a student learns Logo, he can use the language's easy-to-understand graphics commands to acquaint himself with its "string-handling" features.

In computer talk, a "string" is a word or grouping of letters. Logo can manipulate words very quickly and

with great versatility. In fact, it's one of the languages now being used to help researchers understand how artificial intelligence might be programmed into a computer.

The spark of the Logo language might set the educational world ablaze, but for one thing: the lack of fuel. The scarcity of classroom computers limits the spread of Logo.

"One thing we find, is that very often computers are left to the talented and gifted," Jim Mueller of YPLA said.

Steve Jobs, chairman of Apple Computer, sparked a controversy by offering to place one computer system in every school in the country—in exchange for a tax write-off. Even with the write-off, the cost to Apple would exceed "ten million dollars."

Some of the opponents of the plan—including Seymour Papert, the designer of the Logo language—feel Apple's plan wouldn't work.

"Give 500 children one computer," Papert says, "and they'll make trivial use of it."

Jim Mueller, however, thought Apple's proposal was a "marvelous plan . . . on the assumption that Apple would back it up to make the computers accessible."

Computers for all

Many of our sources pointed out that, right now, most educational computers are in the wealthier neighborhoods.

Greg Smith, Apple's director of educational marketing, suggested that this disparity "helps to maintain the gap" between rich and poor.

Seymour Papert maintains that this problem will get worse if "the people without computers do not protest. As all the people of the world understand what computers can do, they'll demand them for themselves and for their children."

There may very well be a new and worldwide movement beginning in the classroom. A new, computerized, children's crusade may be pointing the way to our collective futures. **FM**

LOGO SOURCES

- COMPUTERS FOR LOGO** *Apple II:* Apple Computer Inc., 10260 Bandley Dr., Cupertino, Calif. 95014; *TI-99/4A:* Texas Instruments, Box 53, Lubbock, Tex. 79408.
- SOFTWARE** *Apple Logo:* Logo Computer Systems Inc., 989 Avenue of the Americas, New York, N.Y. 10018; *Logo for the Apple:* Terrapin Inc., 673 Massachusetts Ave., Cambridge, Mass. 02139 (also makers of robot turtle); *TI Logo:* Texas Instruments, Box 53, Lubbock, Tex. 79408.
- NATIONAL CLUBS** *Friends of Lisp, Logo, Logic Programming and Kids (FOLLK):* The FOLLK Foundation, c/o Social and Information Science, HLL 382, San Francisco State University, 1600 Holloway Ave., San Francisco, Calif. 94132. (Student memberships are free without newsletter, \$7.50 with; individuals \$25, companies \$100); *Young People's Logo Assn. (YPLA):* 1208 Hiltsdale Dr., Richardson, Tex. 75081. Students free (includes newsletter), adults \$25, international mail \$40.

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OWNERS REPORT: PONTIAC 6000

(Continued from page 91)

21.2/27.7 with the gasoline V6. Not enough respondents had bought the diesel V6 to tabulate, though.

The top "dislike" turned out to be windshield glare, especially at night. The Pontiac 6000 has a wide, horizontal instrument cluster and a relatively "fast" windshield. A Minnesota carpenter was one among many who commented, "The dash is of poor design because at night the lights reflect onto the glass—very annoying and even dangerous."

The car's overall styling, though, brought forth enthusiastic praise. Styling, in fact, ranked as the main reason most people bought the Pontiac 6000. An Arizona aeronautical engineer said, "Several strangers have stopped my wife and me and asked about the car—what kind it is, what it cost. It's a real eye-catcher!"

A New York manufacturer told us, "I like this Pontiac version of the A-car better than Oldsmobile's or Buick's." And a Minnesota farmer noted, "More people turn around and do double takes than with any other new car we've ever owned."

The most unusual comment regarding the Pontiac 6000's aerody-

amic styling, though, came from a Florida retiree. "This car is a coasting fool," he observed. "On a straight road, I can be doing 60 mph and take my foot off the gas, and it'll coast for half a mile before it gets down to 45 mph."

Ride and handling garnered a lot of praise, too, and owners seemed absolutely sold on front-wheel drive.



Trunk space earned praise; the skimpy-sized glovebox and map pockets did not.

Quoth a Montana secretary: "Here in Montana, the winter roads are always a little slippery, and the 6000 handles just great. In fact, I like the way it handles all the time."

A retired Idaho oil company president added, "This car handled like one of the better European or Japa-

nese cars, certainly better than the new Cadillac Seville."

As for the Pontiac's 6000's riding qualities and comfort, a Tennessee salesman remarked, "I'm particularly pleased with the ride. It's very smooth and quiet."

From Texas, a machine shop foreman wrote, "Here's a sedan that weighs 3,000 pounds, yet rides more smoothly than most 4,500-pound cars."

Most owners rated seating *good to excellent* generally, with 89.7 percent specifically praising comfort in the rear. That's something of a record among smaller cars.

Individual comments went on to praise visibility, driving position and trunk space, but among minor criticisms were: "The window crank handles winding up and down backwards," "the tilt steering wheel blocks the speedometer in most positions," "I hate those new touch-type electric door locks," "not enough space for maps in the map pockets," and "glovebox too small."

A Wyoming railroad conductor, though, volunteered, "This Pontiac 6000-LE has an excellent heating and ventilating system. It's the best I've ever had in any car."

Owners expressed mixed feelings

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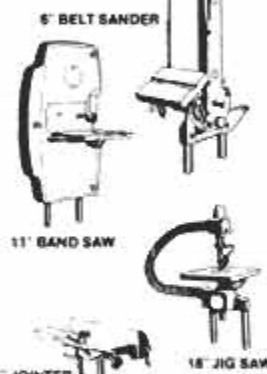


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on performance. Not everyone liked either the Four or the V6 but, on the whole, most drivers were satisfied. The V6 drew some comment concerning idle vibration and noise. The Four's throttle-body injector wasn't always trouble-free. But a Minnesota retiree observed that "... the Four has good pickup and is easy to start. You never need to pump the accelerator to start it."

Yet a New York restaurateur countered (also regarding an Iron

Duke Four): "No passing power on hills. Or even on flat roads."

Quality and workmanship satisfied the vast majority of Pontiac 6000 owners, with 80.1 percent marking them *good to excellent*.

And an Illinois quality control manager who does *not* work for Pontiac told us: "As a person involved in quality, I'm extremely fussy about my cars—to the point of becoming a pest. I maintain my own cars with pride, and I can state that the 6000-

LE is proving to be the best automobile I've ever owned.

"I think Pontiac did its homework," he continued, "when it designed and built the 6000."

And despite a handful of complaints that the 6000 was a little expensive, an Ohio C.P.A. summed up most owners' views with these words: "This car compares very favorably to imported sedans with a much higher price tag. I received a lot of value for my money." **PM**

SUMMARY OF 1982 PONTIAC 6000 OWNERS REPORTS*

Total miles driven 1,060,504	Specific dislikes:	Poor 0.0	Poor 7.9
Average miles per gallon:	No complaints 26.4%	Comfort opinion (rear seats):	Number of vehicles owned:
151-cu.-in. Four	Windshield glare 12.7	Excellent 48.4%	Pontiac 6000 only 40.9%
In town 23.7	Costs too much 7.1	Good 41.3	Two cars 48.1
Long trips 31.2	Poor workmanship 6.6	Average 9.4	Three cars 7.2
173-cu.-in. V6	Fuel mileage lower than expected 6.1	Poor 0.9	Four or more cars 3.9
In town 21.2			
Luxury trips 27.7			
Engine choices:	What changes would you like?	Had any mechanical trouble?	Makes of other cars owned:
151-cu.-in. Four 56.6%	No changes 14.9%	No 50.6%	Pontiac 29.5%
173-cu.-in. V6 43.4	Eliminate windshield glare 19.7	Yes 49.4	Chevrolet 14.4
	Better seat shape 10.1		Ford 12.2
	Bigger glovebox and map pockets 10.1	What type of trouble?	Oldsmobile 7.9
	Better quality materials 8.7	Transmission 16.0%	Volkswagen 6.5
Why did you choose the Pontiac 6000?	Workmanship opinion:	Oil leaks 15.1	
Styling 50.9%	Excellent 32.6%	Air conditioner 10.9	Age distribution of owners:
Economy 41.0	Good 47.5	Electrical system 10.9	15-29 years 6.8%
Front-wheel drive 23.9	Average 12.7	Windshield wipers 7.6	30-49 years 33.8
Size 21.4	Poor 7.2		50-plus 57.4
Handling 12.4		Dealer repairs satisfactory?	Would you buy another Pontiac 6000?
Specific likes:	Comfort opinion (front seats):	Yes 58.9%	Yes 84.7%
Economy 50.7%	Excellent 64.0%	No 41.1	No 15.3
Styling 47.1	Good 33.1	Dealer service opinion:	Would you buy another Pontiac product?
Handling 46.6	Average 3.0	Excellent 30.8%	Yes 89.0%
Comfort 43.9		Good 41.4	No 11.0
Ride 24.0		Average 19.8	

*Percentages might not equal 100% due to rounding or insufficient data.

and decide which to run on race morning. Since race distance is a minimum of 175 miles, it's not just a matter of determining the course conditions at the start, but what they will be later, and elsewhere on the course.

For the deep-V offshore boats, the record is 90.555 mph, according to APBA. This mark was set by Bob Nordskog back in 1976 in his *Powerboat Magazine Special*, a Cigarette powered by a pair of Chevrolet engines he had modified himself.

Hydros, cats lead way

When it comes to outboards, the fastest boats listed in the APBA records are hydros and the tunnel-hull catamarans that were the fore-runners of their offshore class counterparts. The current APBA record holder is Jim Merten Sr., who ran a Mercury-powered, Ron Jones-built Modified U-class boat at 136.381 mph over a measured kilometer at Kaukauna, Wis., on Aug. 8, 1973. In a July 15, 1979, race at Chippewa Falls, Wis., Jimbo McConnell maintained 102.564 mph for five miles in an Evinrude-powered Molinari tunnel hull. A Johnson-powered Molinari driven by Ken Stevenson averaged 102.578 mph for one hour in June 1979, at Lake Alfred, Fla. In October 1981 a European one-way record of 137.96 mph was set by a Mercury on Lake Windermere, England.

An outboard record recognized by both APBA and UIM is 120.269 mph for the kilometer, set by John F. Stevens running a Mercury-powered Lewis-built, 1100-cu.-in., Hydro-class boat at Lincoln City, Ore. on Oct. 24, 1981. This is a professional racing class; the boats are smaller versions—in basic hull form—of the Unlimited-class inboards. APBA records show that Wayne Baldwin, driving his Konig-powered *Shadow Fox* averaged 90.817 mph for a three-lap, five-mile race in September 1976 at Yelm, Wash.

The fastest military vessel whose speed is known is the Canadian Royal Navy's *Bras d'Or*, a hydrofoil-equipped subchaser. Its speed is an estimated 70 knots (80 mph). The blue ribbon for the fastest crossing of the Atlantic last went to the S.S. *United States*, for its time of 3 days, 10 hours, 40 minutes back in 1952—an average of 35.6 knots (40.9 mph). The *Queen Elizabeth 2* may be faster, but neither its owners nor the British government are saying so.

Noteworthy sailing speeds

As might be expected, speeds under sail come nowhere near those

achieved with mechanical propulsion, but they are equally impressive. Timothy Colman's 73-foot, 6-inch catamaran, *Crossbow II*, for example, was clocked at 36.04 knots (41.5 mph) over a 500-meter course in Portland Harbor, England, on Nov. 17, 1980. Designed by Rod McAlpine-Downie, the boat carried 1,400 square feet of sail. Lake scows, in spite of their name, are the fastest of the monohull sailboats; a Class A scow has been timed at more than 30 mph.

For yachts, the fastest over a long distance may still be the three-masted schooner *Atlantic*, which averaged 10.318 knots (11.9 mph) for 3,013 miles in 1905.

Atlantic still tops

The *Atlantic's* 1905 run was from Sandy Hook at the entrance of New York Harbor to Lizard Point, England, a trip that took 12 days and 4 hours. This was the record passage across the Atlantic Ocean that stood for 75 years and is still considered the best time for a monohull sailing vessel. In the summer of 1980, Frenchman Eric Taberly made the same run in 10 days, 5 hours, 14 minutes. His boat was the 54-foot trimaran *Paul Ricard* (see *Breaking The Sailing Speed Barriers*, page 74, July '81). As so often happens after a longstanding record falls, the new mark lasted just a short time. In July 1981, another French crew, headed by Marc Pajot, brought its 61-foot catamaran, *Elf-Aquitaine*, from New York to Brest, France, in 9 days, 10 hours, and 6 minutes.

Because long runs give the best indication of a sailboat's performance, some other passages are worth noting. The fastest Trans-pac (Los Angeles-Honolulu) race was won by Bill Lee's *Merlin*, a 67-foot sloop, in 1977. Time was 8 days, 11 hours, 1 minute. The fastest run in a monohull pleasure boat from Australia to Cape Horn was made by Poland's Chris Baronowski in his 45-foot, 3-inch *Poloney*: 45 days in 1973. Alain Colas of France made this run in 37 days in the trimaran *Manureva* (formerly the *Pen Duick IV*) in the winter of 1973-74. Even that is slow compared to the time of the 244-foot clipper *Lightning*, which took only 19 days and 1 hour—back in 1854.

It was another clipper, Great Britain's *Red Jacket*, which set the record for a circumnavigation of the globe under sail. Under Capt. S. Reid, it made the voyage in 62 days, 22 hours, in 1854. And, it stopped to load and unload cargo along the way.

For solo circumnavigations, the record is held by Alain Colas in the 70-foot trimaran *Manureva*, which took 167 days in 1973-74. The Bulgarian George Georgier, starting and finishing at Havana, Cuba, made the fastest monohull run—201 days, 21 hours, 36 minutes—in 1976-77.

Sail propulsion is not limited to watercraft. It long has been used on ice boats, and in recent years on wheeled "sand yachts." Because both types don't have to overcome the problems of wave-making resistance and skin friction faced by regular boats, they are capable of much higher speeds in any given wind condition. But while few vessels will attempt to sail in a wind of about 70 mph, John D. Buckstaff did so in a Class A stern-steerer ice boat on Lake Winnebago back in 1938. He was clocked at 143 mph! The *Guinness Book of World Records* reports the official world speed record for a sand yacht is 66.48 mph, set by Yves Nau in *Mobil* at Le Touquet, France, on Mar. 22, 1981. However, it is noted that Nord Embroden of the United States reached 88.4 mph in his *Midnight At The Oasis* on Superior Dry Lake, Calif., in 1976.

While the general laws of hydrodynamics are such that the larger the boat, the faster it will go, small boats that can get up and plane on the water's surface can attain some fantastic speeds. A windsurfer is about the smallest craft that floats, but Jaap van der Rest of Holland was timed at 24.63 knots (28.4 mph) on one at Maalaea Bay, Maui, Hawaii, on July 18, 1980.

Rowing records

When it comes to boats that are rowed, the fastest are the eight-oared sculls, and the highest recorded speed for one of these is 13.46 mph, the *Guinness Book of World Records* shows. This was attained by the East German crew at the Montreal Olympics in 1976. However, a team from the Penn Atlantic Club was timed at 14.03 mph on the Meuse River, Liege, Belgium, in 1937.

On Sept. 12, 1911, the Rev. Sidney Swann rowed across the English Channel in 3 hours, 50 minutes. Gerard d'Aboville of France rowed across the Atlantic in his 18-foot *Capitaine Cook* (Chatham, Mass., to Ushant, France) in 71 days, 23 hours in 1980—the fastest crossing by sheer muscle power. John Fairfax and Sylvia Cook, both of Great Britain, rowed from San Francisco to Hayman Island, Australia, in just under a year (362 days) in 1971-72. The *Guinness Book of World Records* does not indicate if they were still on speaking terms at trip's end. **PM**



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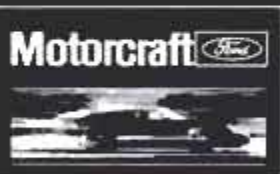
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...FOR SURE

MOTORCRAFT

THE TRUTH ABOUT ROBOTS

(Continued from page 81)

necessary motions by a human operator. As the operator puts the robot through its paces, he presses a button on a handheld teaching control. At the end of the teaching session, the robot repeats the movements set for it, at the desired speed, over and over again. In addition, most robots are capable of storing these programs in their memories, so that once taught, any series of movements can be recalled.

The robotic arm used most often in today's factories comes equipped with several—usually about five or six—"degrees of freedom." These could include:

- *Arm sweep:* a left-to-right movement of the arm around the base.
- *Shoulder swivel:* an up-and-down arm movement at the "shoulder," where the arm meets the base.
- *Elbow extension:* an up-and-down movement of the upper arm along the "elbow."
- *Pitch:* an up-and-down movement of the hand at the wrist.
- *Yaw:* left-to-right hand motion.
- *Roll:* circular hand motion

This doesn't include the various movements of the robot's hands, or grippers, also known as the "end effectors." These come in a wide variety of models, depending upon the use to which the automation is put. The most familiar is probably the clawlike mechanical gripper, used to grasp parts and tools—and even these can vary according to their functions. For example, a gripper may have to grasp a very wide object, or a lightweight cardboard carton, or even something as fragile as a neon tube. If the manufacturer needs the robot for only one basic task, such as welding or spray painting, it may be less expensive for the machine to be permanently fixed to a blowtorch or sprayer as its end effector. Other popular end effectors include vacuum cups for handling sheets of glass and other thin materials, and electromagnets for high-speed pick and place. A robot can also change tools in mid-job, using special snap-in attachments.

Industrial robots such as these have become full-fledged members of U.S. assembly lines. A typical welding robot now costs about \$25,000 and is expected to pay for itself in three to five years, prompting more manufacturers to warm to the idea of investing in intelligent automation. The prime factor behind this sudden increase in interest is not so much the growth of practical robotic manufacturing as the realization that we are being sur-

passed in our use of this new technology by our competitors—predominantly Japan.

It is by now a well-known fact that Japan has welcomed the industrial robot with open arms. It presently employs some 14,200 robots (as compared to the U.S. figure of 4,700) for uses which range from factory work to traffic direction. Most of this lead has been attributed to Japan's greater cultural acceptance of the robot in workplace.

However, U.S. robot manufacturers are now intent upon taking up the slack. While Japan boasts some 40 robot manufacturers to America's 30, the latter insist that the U.S. firms still hold the lead in innovation and expertise. Corporations such as IBM and Westinghouse, together with universities such as New York State's Rensselaer Polytechnic Institute and the Carnegie-Mellon Institute for Robotics in Pittsburgh, are joining with Unimation and Cincinnati Milacron to produce robots that are more productive, intelligent and, not incidentally, cost efficient.

Two of the more prominent entries in the new generation of increasingly sophisticated robots are Cincinnati Milacron's T³ and Unimation's PUMA robots. The T³ is the basic industrial robot made more capable: It can work on a constantly moving assembly line, for example, and can be programmed to do several tasks at once. In addition, its "abort and utility" modes allow the T³ to act as its own physician when something goes wrong. It can disconnect the part it's working on without damaging it, while searching its own systems to find (and sometimes correct) the problem.

Worker-size robot

Unimation's PUMA robot was designed in concert with General Motors in order to solve a problem basic to today's industrial robot: size. The typical robot weighs some two and a half tons and takes up a great deal of space. Thus, the cost of buying such a machine must include not only the robot itself, but also adjusting the factory to fit the robot. The pint-sized PUMA, on the other hand, comes in models weighing as little as 75 pounds, and can fit in the space once occupied by a human worker.

At the other extreme, a Scottish engineering firm called Lamberton Robotics recently developed what it believes to be the world's largest free-standing, mobile robot, capable of lifting 1.3 tons. Other new robots include Westinghouse's new series 7000 system and IBM's latest, the RS 1. The former is a welding robot

which can detect any deviation from the weld groove and immediately correct itself. The RS 1 was designed for precision assembly. It not only includes sophisticated sensing abilities but uses a new programming language, AML, which IBM calls the world's most advanced.

Senses such as sight and touch are the new frontiers upon which today's robots are venturing. The older industrial robots (those designed 10 or so years ago) were, in essence, blind, deaf and without any real sense of touch. They accepted limited input from their immediate, real-time environment and could only know what they had been programmed to know, without being capable of determining whether a job had been done correctly. However, if that same robot could *see* what it was doing, or somehow *feel* the tool that it was holding, its efficiency could be multiplied a hundredfold.

Primitive sight

Actually, primitive forms of sight have been in use in factories for several years now. A camera suspended above an assembly line can do a quick check of the passing products, and any defective parts are blown off the line and into a refuse bin. But we have already surpassed this.

The problem in creating a robot that can "see" rests in translating a video image into terms simple enough for a computer to follow. A robot is a sophisticated tool attached to a computer mind—it has no innate mechanism to process visual data.

Instead, it uses a special computer called a digitizer. A television image is broken down into its most basic form, a series of dots called *pixels*—picture elements. Each pixel is then assigned a value, according to the brightness it represents. For example, a dark object might be made up of pixels valued at 10, while a brightly lit background would have a considerably higher rating.

In order to simplify things further, the computer is now given a certain threshold value for the object. In other words, if a pixel falls below that threshold, it will be assigned a value of 0; if it registers above, a value of 1. Thus, the image has been translated into the binary language that is the basis of computer thought.

Of course, the above is only the foundation upon which modern robotic sight rests. Mechanisms such as the General Motors Comsith can identify a part on a moving assembly line and relay the information to a robotic arm, which picks up the part and places it in its appropriate bin.

Scientists are now finishing work

on what is known as the "bin-picking problem"—picking one specific item out of an assortment. (It's an easy task for a five-year-old human, but an enormous problem for a robot.) They're also experimenting on various means of providing three-dimensional sight, such as binocular vision, and utilizing lasers to relay visual information.

A close second on most manufacturers' lists of desirable robotic abilities is touch, in the form of proximity and tactile sensing. Proximity sensing is just that: determining how close or far an object is from the robot's hand. For example, if the robot's "fingers" are magnetized, it may be able to sense how close a metallic object is from its grasp simply by measuring the level of attraction. Tactile sensing is more complex: By using sophisticated sensor devices, including piezoelectric materials, robots are slowly becoming able to "feel" what an object weighs and how firmly it can be grasped.

The list of robotic improvements on the drawing board is almost endless. Such attributes as voice recognition—so the robot will stop if its boss tells it to—and manual dexterity are being developed.

As the years pass, robots will

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indeed come closer to the ideals we have all come to expect, but there's no reason why they will ever resemble us physically. Manufacturers hope that in a decade or so, robots will be capable not only of doing a job, but also of figuring out more efficient ways of accomplishing it. The totally roboticized factory is still far beyond our reach, but the experiment has been tried in Japan. Technically, it succeeded, but at too high a cost to be practical.

Those scientists whose imaginations wander toward the stars foresee a time when fully independent robots will mine precious ores in the asteroid belt, send the refined metals back in roboticized ships, and use those same metals to build their own robotic replacements. And coming back to Earth, Unimation's Joseph Engelberger is so optimistic about his product that he has commissioned his engineers to develop the first practical household robot.

However, the household robot is the exception, rather than the rule. Today's robots, for the most part, are neither cute, clever, nor humanoid—nor are they meant to be. They are, instead, measures of our desire to free ourselves from unnecessary labor, and measures of our ability to do so.

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PM'S LONG-TERM CAR TESTS

(Continued from page 92)

and semitrailing arms, coil springs and a stabilizer bar in the rear.

Toyota's suspension engineers have dialed over 3° positive caster into the front end, so you get a fantastically stable, straight-ahead feel from the rack-and-pinion steering, with excellent centering. The suspension is taut, just shy of stiff, in fact, and you kind of thump over tar strips and bumps in the road. But there's no wallowing or unnecessary motion with this car. Instead, you get the feeling that you're not just rolling over the road, you're smashing it flat and there is no obstacle you can't overcome. It's a tremendous feeling of security.

Take no prisoners

One night, we found ourselves in the wilds of northwest New Jersey after a business meeting. It was late and we wanted to get home. We kicked the Supra awake with a twist of the key, gave it its head and made a take-no-prisoners run down to the Jersey Shore. The route was mostly twisty two-lane blacktop and it was raining. We pressed on, at mostly illegal speeds, in safety and security. It was a 75-mile trip. We were home in an hour. Not too many cars sold in the world could have made that trip at those speeds. It's a tribute to the Supra that we didn't once feel pressured or insecure.

So, is all perfect with the 1982 Celica Supra? No way. Like all cars, the Supra has its weak points. The tires, for one thing, could be upgraded. Yes, they're adequate and got us through anything we put to them. But the Bridgestones on our test car are not the most responsive tires in the world and feel squishy in hard cornering situations. If you order the GT model (our test car is the luxury DL version of the Supra), you get wider 225/60R14 tires that are more performance-oriented than the skinnier skins you get on a DL.

Other bones of contention: The ignition key is difficult to remove from the ignition lock, which itself is awkwardly positioned.

The left-hand stalk pushes forward to activate the high beams. Only slight pressure is needed, so it's difficult to use the directional signals at night without inadvertently flashing the highs. Drivers ahead think you're trying to flash them out of the way.

The radio on-off switch is a push-button type, rather than cw/ccw on-off type, which is undesirable in a moving vehicle. Any car movement while you're adjusting volume and

you turn off the radio. Besides this, the controls themselves were designed for midgets. They're way too small.

In a couple of areas, our Toyota test car is not up to the quality standards one would expect these days in a luxury Japanese car. The super-duper radio system in the Supra plays mostly static. No amount of



Both the front and rear wipers conked out on the Toyota at exactly the same time.

fiddling with the radio or equalizer can remedy the problem.

Also, on the morning of a freak April blizzard in the northeast, our test car's front and rear windshield wipers and rear defogger conked out simultaneously. Luckily, we were still in our own driveway warming the car up. So we got into our own "old technology, poorly built" American car. It started right up, the windshield wipers worked perfectly, and we pushed on through the blizzard into New York City. So much for the myth of imported car reliability.

General Toyota, in Woodbridge, N.J., fixed the wipers under warranty, but not the radio. A service writer there told us that almost everyone who has bought a Celica Supra has complained about the radio static. They offered to remove the radio to attempt a fix. But we passed and decided to live with it instead. We'll let you know if it gets better or worse.—Joe Oldham

5.0-liter Mustang

This is our final report on the 5.0-liter Mustang and, frankly, we're really sad to see it go. By the time

you read this, the car will have been returned to Ford's press pool, prepped and sold off for a bargain price through its dealer network. We really hope the lucky dog who ends up with the car treats it right because we've gotten to be quite fond of the beast.

For the record, the car has accumulated 8,600 miles, consumed four quarts of oil and yielded 14 mpg in city driving and 21 mpg in highway driving. The only service it has received: The oil and the filter were changed, a new air filter was installed and the plugs were pulled, checked and reinstalled. The color was good and the gap still within specs.

The mechanical breakdown list is brief. The cigaret lighter packed up, probably due to overuse by crazed nicotine addicts. The rake adjustment knob on the passenger's side seat fell off. But 10 minutes of fiddling with a needlenose pliers fixed the problem and it hasn't recurred. A rattle developed at around 8,400 miles in the driver's side window. The rattle only happens when the window is wound completely down and you hit a moderately severe bump at above 40 mph.

The only item that needed replacement was a left side front turn signal lens which disintegrated after hitting a deer late at night in the Pennsylvania hills. Considering the closing speed, we were surprised at the minor damage to the car. Unfortunately, the same could not be said of the deer.

Those are the unadorned mechanical facts about the Mustang. To say that it's reliable, as powerful as you could want, and comfortable, is an understatement. But what have we found that we'd like changed? Here, the list is a bit longer than the breakdown list.

We'd ask Ford to crank more steering effort into the wheel and less effort into the clutch. My left calf is now roughly twice the size of my right one. We would also throw out the Fairmont/Continental steering wheel and get something smaller, thicker and sportier looking to match the car's performance. Like perhaps the base Mustang steering wheel.

Lastly, we'd ask Ford to drop its top-of-the-line TRX suspension package and replace it with a package designed around the super Goodyear NCT radial. We've driven cars with both, and the NCT tire makes for better handling and stickier road-holding.

With these changes, a car which has already achieved the status of a cult object would be propelled into the ranks of superstar. Yes, the boss is back.—*Tony Assenza*

Pontiac 6000

Because we've been concentrating on wrapping up the results of a couple of other long-term test cars, we've only accumulated 1,434 miles on our Pontiac 6000. Up to this point, results have not been reassuring.

The delivery of our car was delayed because of "several mechanical problems," according to the Pontiac man, including a breakdown on the delivery trip from Detroit to New York. The car then had to be brought back to Detroit for a fix. So far, we haven't been able to determine what "several mechanical problems" included. When we find out, we'll let you know.

Since we've had the car, it has per-

(Please turn to page 170)

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PM'S LONG-TERM CAR TESTS

(Continued from page 169)

formed flawlessly. It also has a very high level of fit and finish quality, something that American cars have come under some criticism for in past years.

Other initial impressions are that the fuel-injected, 2.5-liter Four is quite spritely in performance and rather miserly on gas, although you won't take home any trophies with it from Drag City. Like most GM A-body cars, our Pontiac 6000 rides smoothly and quietly and the handling prowess is quite high. We'll give you more details on it in our next report.—*Joe Oldham*

Plymouth Horizon

After clocking 5,819 miles on the 2.2-liter Plymouth Horizon, we've finished our testing and returned the car to the manufacturer. It's another car we were reluctant to give back.

As Auto Editor Tony Assenza wrote in his 3,050-mile report (page 89, June '82), "... the 2.2-liter engine in our test car powers out the Horizon with brisk acceleration. Zero to 60 happens in 10.9 seconds, shifting the automatic manually. We've surprised many so-called sports cars with the Horizon's excellent performance and handling."

The Horizon's brisk takeoff satisfied even the younger (and heavier footed) members of my family as we took turns at the wheel.

Superb all-around visibility and the stable, sure-footed handling produce a high level of driver confidence: You're sure nothing can sneak up on you, but even if it does, you know you can drive your way out of a bad situation.

My few complaints can only be called nitpicking: The fuel gauge seems stuck off in a dark corner of the dash, behind the spokes of the wheel, and I'm not really fond of having air and heat controls off to the left side of the dash where a passenger cannot reach them.

In his earlier report, Tony Assenza wrote that he got 22.3 mpg on a long trip and averaged 21.7 mpg overall. I wound up with a 20.3 mpg average.

The only real problems any of us found during the entire test were few. The front spoiler fell off as Tony Assenza pulled into a parking lot. That was at 2,654 miles. And at 2,834 miles, he had to add two quarts of oil during a gas stop. Nothing more.

Would I be happy with a Horizon as the family car? Sure. It's fun to drive, roomy and holds up very well.—*John Linkletter*

TECHNOLOGY UPDATE

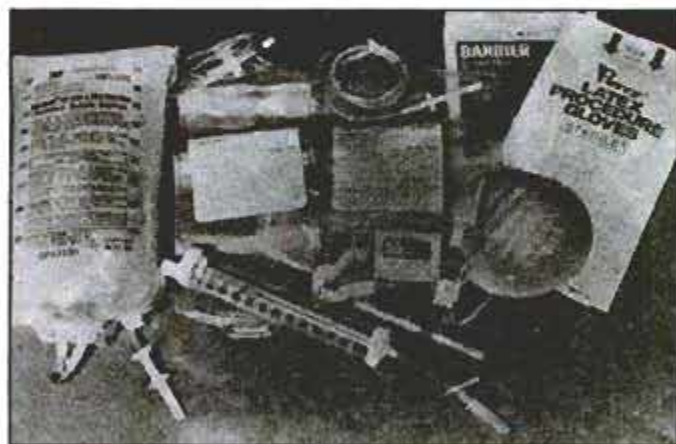
Body's own filter material replaces kidneys

Medicine

Filters come in all shapes and sizes and are used in everything from go-karts to spacecraft. But in each instance, they have one critical function: to remove impurities. Take away those filters and it's only a matter of time before any mechanical wonder comes to a grinding halt, choked by an accumulation of debris.

In the human body, living filters—the kidneys—rid the blood of wastes and excess water, helping to keep that magnificent machine in a stable biochemical state. When kidney function is lost, some form of artificial blood cleansing, called dialysis, must be used or the patient dies.

For years, the conventional treatment for kidney



Complete kit (above) for Continuous Ambulatory Peritoneal Dialysis can replace in-hospital machine for kidney patients.

failure has been the massive artificial kidney machine. But recently, scientists have developed a new system, called CAPD, for "Continuous Ambulatory Peritoneal Dialysis." This process costs about half that of conventional dialysis, is less traumatic to the body, requires far less time

and can be done at home. This is good news for the more than 49,000 people who now need dialysis treatment to live.

To undergo CAPD, the patient has a small, flexible catheter surgically implanted into his abdominal cavity. A plastic bag containing a sterile sugar and salt solution is attached to the catheter and held up, so the fluid can drain, by gravity, into the bottom of the abdominal cavity.

Then, the catheter is clamped off, and the bag, which is still attached, is folded into a compact rectangle and stored in a pocket or inside the user's clothing.

Waste products in the blood, normally removed by the kidneys, are naturally drawn through the peritoneum, the semipermeable membrane which lines the abdominal cavity, into solution in the sterile fluid. The peritoneum thus acts as a filter, doing the work of the kidneys. After about four hours, the bag is placed on the floor, the clamp is released, and the impurity-laden fluid is drained off.

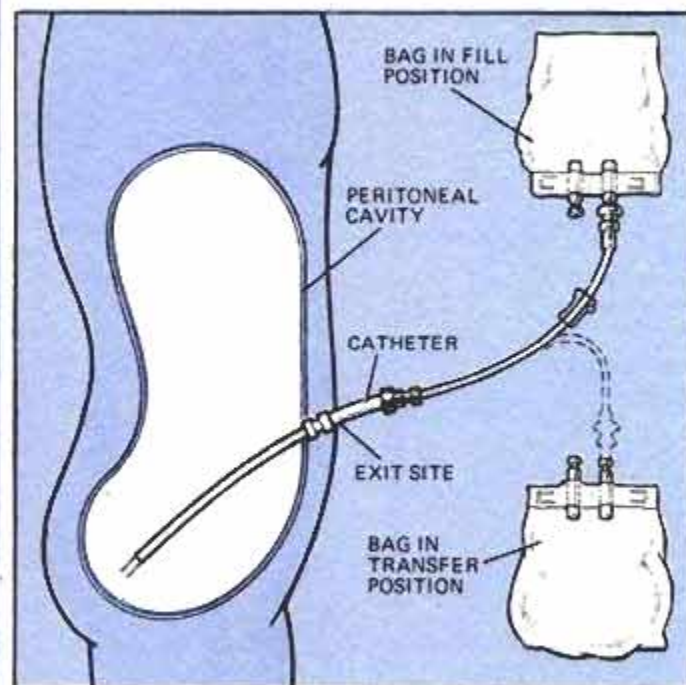


Young dialysis patient demonstrates use of CAPD kit. Bag is kept in pocket after introduction of sterile fluid into the peritoneal cavity.

A new bag of solution is attached and the process begins again. It will be repeated four times each day. This may sound cumbersome, but each bag change takes only about half an hour, and patients are allowed to get a full eight hours of undisturbed sleep at night.

"The entire exchange process is painless, and patients quickly become accustomed to the presence of dialysis fluid in the abdomen," explains Dr. Steven Alexander, director of the CAPD program in Portland, Ore., and a leader in adapting the procedure for use in infants and small children.

CAPD is allowing children who were once confined to hospitals to live at home, attend school and engage in sports, including swimming, that would otherwise be impossible.



Sterile fluid drains into bottom of peritoneal cavity from elevated bag; after it absorbs wastes, the fluid is drained out.

Aviation

Airborne octopus

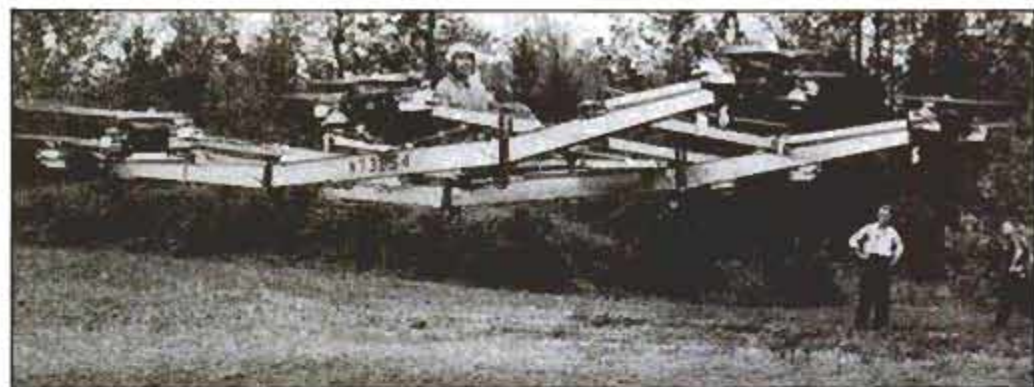
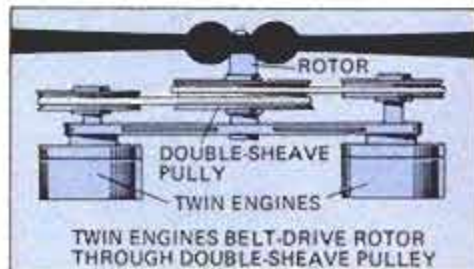
It resembles a huge, steel-tentacled octopus that's gone berserk. Actually, the strange machine shown here and on this month's cover is an eight-rotor helicopter, a prototype for what could be the world's largest, most powerful flying crane. The exciting new concept, unlike any present heavy-lift cargo copter, is the work of Dr. Igor Bensen, whose company, Bensen Aircraft Corp. (Box 31047, Raleigh, N.C. 27612), manufactures the renowned little home-built Bensen Gyrocopter.

Why the eight rotors? It's a matter of simple arithmetic. The maximum practical lifting capacity of any single rotor—no matter how big—is limited to about 20 tons. To increase lift, you must add rotors—in Bensen's case, many. His eight-rotor design, at 20 tons per rotor, will have a potential payload capacity of 160 tons—enough to carry two of the Army's mammoth new 58-ton M-1 battle tanks, with plenty of lift to spare. (The current aerial cargo-lift record is 44 tons, held by a twin-rotor Russian craft.)

Bensen's initial effort, however, is more modest: The eight rotors in the first version planned will lift 5 tons each, or a total of 40 tons. The "fuselage" is merely an unsophisticated framework of criss-crossed beams, looking much like a tic-tac-toe grid, with a rotor at either end of each beam. In the full-scale production model, the pilot and controls will be enclosed, but only by a rudimentary cab similar to those on farm equipment. There's nothing fancy to add weight and expense.



Proposed eight-rotor helicopter lifts 40 tons, has payload potential of 160 tons, world's largest. Simple, gridlike design keeps cost low. Inset shows how rotor is driven by two engines.



Scaled-down prototype in first test flight. Trickiest job: coordinating 8 rotors, 16 engines.

Because of this bare-bones simplicity (the rotors are the only aerodynamic elements in the entire craft), projected cost is low—less than half that of a conventional helicopter possessing a comparable capability.

Even more surprising than the eight rotors is the fact that each set of blades is powered by two engines, making up a total of 16 independent powerplants. Each pair of engines drives its rotor shaft through a simple belt-and-pulley ar-

angement with overrunning clutches, like those on a kid's go-kart (see inset drawing above). If either engine quits, the rotor will continue to produce lift, providing backup redundancy for safety.

Cruising speed is deliberately limited to 80 mph, eliminating the need for costly streamlining—the airframe is what pilots call "real dirty." Synchronization of controls for the eight rotors and 16 engines—the big trick—is done automatically, though details

on just how this works are predictably being kept a secret.

Bensen plans to market his giant skyhook in separate modules, each consisting of a two-rotor section capable of lifting 10 tons. Any number of sections can be joined together like Tinker Toys to produce an aerial crane of virtually any capacity. A radical departure? Well, for Bensen, not really. After all, his tiny, one-man, build-it-yourself Gyrocopter also comes in pieces.

Alternatives

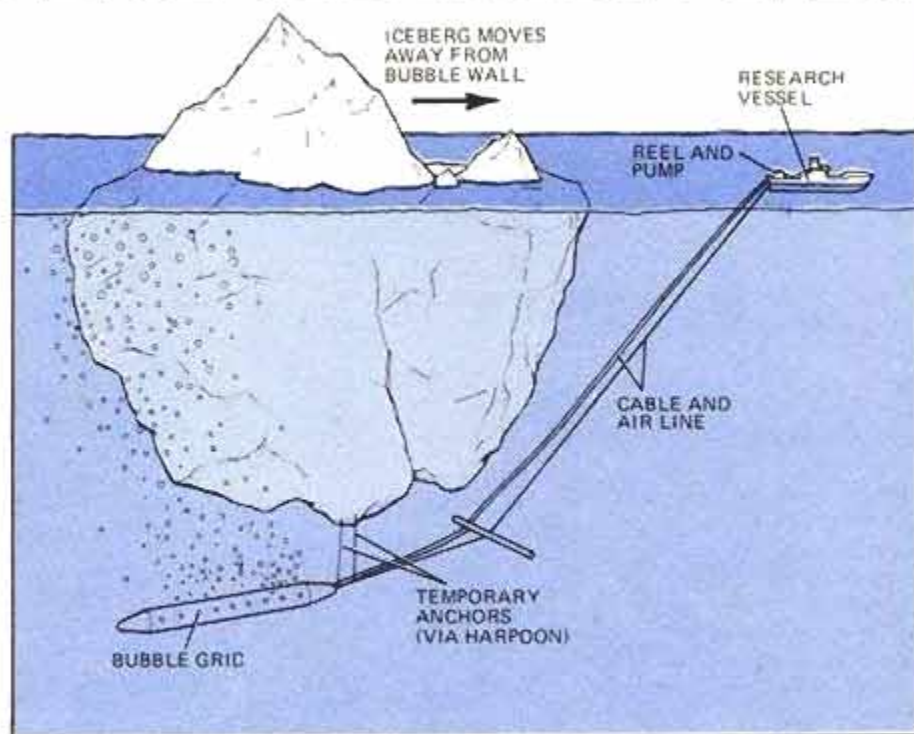
Another iceberg try

Iceberg-towing schemes cropped up a few years ago (see *World's Biggest Moving Job—Icebergs!*, page 47, Jan. '78), but the few actual attempts made with conventional apparatus proved difficult beyond imagination. Now, an Illinois inventor thinks he has the answer: Do it with bubbles. His recently granted patent covers a low-cost method of transporting an iceberg from one location to another in a body of water. And you don't even have to board the iceberg or push or pull it physically.

The process revealed in Patent 4,320,989, awarded to Anthony C. Mamo of Arlington Heights, is to release billions of air bubbles under one side of a floating iceberg, affecting its center of gravity and pushing it in the opposite direction. One or more ships can supply the compressed air, and the tubes may be anchored to the iceberg by spikes and cables.

Throughout the ages, Mamo says, icebergs have been known as sources of fresh water to aid sailors in distress. And in arid or desert countries, plants experimentally watered with melted ice have increased yield.

In addition, the glacier-formed floating mountains often drift into North and South Atlantic shipping lanes and fishing grounds, endangering navigation.



Boom with bubble-releasing grid is positioned beneath iceberg toward one side. Release of billions of compressed air bubbles causes berg to move away from bubbles.

Now an independent inventor with a dozen of his own patents issued or pending, Mamo was formerly a staff scientist at the Borg-Warner Research Center in Des Plaines, Ill., and obtained 115 patents for that company. His iceberg research includes review of an international conference on iceberg utilization held under sponsorship of the National Science Foundation at Ames, Iowa, in 1979.

While conducting his tests—with small models—on the effects of salinity, he noted that air bubbles apparently insulate the ice wall and reduce the berg's melt rate.



Inventor Mamo made a number of scale tests of bubble movement process. Photo shows pattern emerging around a block of ice, which moves to the right.

Meantime, back at Boeing . . .

What was reported more than a decade ago as the ultimate in U.S. military heavy-lift copters is still alive, according to its developers. Boeing Vertol's XCH-62 was designed as a means of landing troops and supplies in areas where no major port facilities are accessible. But the 89-foot ship (with 92-foot rotors fore and aft) would also have civilian uses: It could off-load 35-ton con-

tainers or taxi over and straddle objects 14 feet high. Yet another military version would have a long-range, low-drag fuselage to carry tanks and vehicles—plus medical evacuation capabilities. A civilian version might carry 225 passengers.

Work continued on a prototype until 1975, when the XCH-62 was mothballed because of budget cuts. At that point, the airframe was 90 percent complete. All major components except for the transmis-

sions, huge and complex gearboxes, had been built and tested. In '81, NASA funded a \$732,000 project to complete the transmission hardware

and overcome the upscaling problems of current copter technology. Flight testing is slated for mid-decade.



Boeing's heavy-lift entry awaits final transmission hardware.

Military

Sky stovepipe

The Darth Vader object at right may not be flying according to your definition, but the U.S. Army has already trained three inexperienced men to operate it competently. It's the Williams Aerial Systems Platform (WASP) prototype, built by Williams International of Walled Lake, Mich.

Unlike some previous one-man vertical life devices proposed to the military, this one is powered by a small turboprop engine, not a rocket.

The system can supply up to 600 pounds of thrust, depending on the ambient temperature, and it has the potential to fly for half an hour at altitudes of up to 10,000 feet.

The pilot has only a throttle, plus handgrips that help to control the WASP's attitude. "You just



WASP piloting requires careful throttle, kinetic sense.

have to feel it," says test pilot Robert Courter, who also told PM that vertical flight skill in the device, once learned, tends to stay with you. "It's like riding a bicycle," he explained.

Leaning the WASP a few degrees in any direction causes it to translate (not fly, strictly speaking, since there is no lifting wing) in that direction, while remaining in the leaning position. Maximum speed—while maintaining altitude—is about 60 mph.

Transportation

Second maglev tested in Japan

The magnetically levitated body run at the so-called record speed for trains—over 300 mph—by Japanese engineers in 1979 was really nothing more than a scaled-down locomotive with a special fairing over the engine (see *Beyond The Bullet: Japan's New Train Shoots For More Speed*, page 95, Apr. '80). But recently, a two-car train prototype was tested over the Japanese National Railway's facility at Miyazaki. It exceeded 186 mph on the 4-kilometer track.

The geometry for levitating the two-car prototype is completely different from the T-shaped track on which the record was established. It is raised and suspended for running in a U-shaped guideway, that has magnetic coils laid on the bottom and both sides.

Current which is induced into these coils as the train passes converts them into electromagnets with the same polarity as those carried on the train. The mutu-



The first full-scale, two-car magnetically levitated train had initial test recently at the Japanese National Railroad's facility in Miyazaki. The train has hit 186 mph on a 2.5-mile track.

al repulsion forces so generated supply both friction-free levitation and guidance along the track.

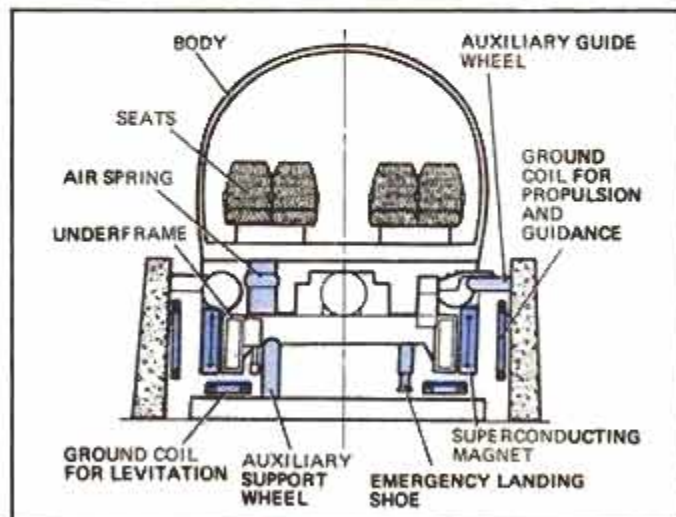
The linear synchronous propulsion system is acti-

vated by magnetic coils on the sides of the guideway. Each of the magnets on the train is attracted by a guideway coil of opposite polarity that's immediate-

ly ahead of it, and simultaneously repulsed by the coil it has just passed.

The successful testing of a two-car (MLU-001 series) vehicle nearly 70 feet long and weighing 10 tons indicates the Japanese favor the U-shaped guideway as the system for commercial development. This geometry may require employment of electrical braking systems, as well as emergency mechanical suspension (see drawing).

Some engineers claim the energy required for maglev systems is economically prohibitive. Yet the maintenance costs for the latest (wheel and rail) high-speed trains in Europe are known to be running far ahead of projections. And a no-contact system would eliminate roadbed wear.



Cross section of MLU-001 test vehicle shows positioning of magnetic coils, as well as the suspension and emergency systems.

Editor: Robin Nelson

Contributors: Linda Freedman, Shel Gallagher, Toshiba Honda (WPP Photos)

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wrong with our S-10. The V6 is so crowded under the hood that even regular maintenance requires a surgeon's dexterity from fairy-size fingers. And at \$10,166, it was \$1,000 or \$1,500 more than similarly equipped trucks from Japan, even though the imports have to pay a 25-percent surcharge. We'd spend the extra money because we like the S-10 \$1,000 better, but it's hard to justify on a strictly economic basis.

Ford Ranger

There's nothing prissy about Ford's Ranger. The thing is designed and built like an F-100, right down to the Twin-I-Beam front axle. It's a little smaller and more economical, but just as rugged. The Ranger has the largest cargo volume in this group, as well as a 1,600-pound load rating and double-wall bed. You can picture it 15 years from now, rockers rusted out, a dent in the hood and one sagging rear spring, still hauling calves to town without complaint. It's that kind of truck.

This resemblance to the indestructible F-100 is obviously intentional. Not only is the chassis "big truck tough," but unless you see a Ranger parked next to a full-size Ford pickup for scale, you can't tell which is which. Even the interior is styled like that in an F-100. But there is a difference: the engine. The Ranger is by far the least powerful of a not very powerful lot.

To be fair, it was the only pickup in the test supplied with an automatic transmission, but even so, its little Pinto-derived, 2.3-liter, four-cylinder engine simply doesn't have the

guts to haul a 2,500-pound truck plus a 3/4-ton payload.

If you want to know what we thought of the Ranger, when it came time to take pictures of a truck jumping through the air, our drivers unanimously selected the Ford. "It's the only one that won't break," said one confidently.

Sure enough, the Ranger absorbed terrific punishment and was still the quietest, most rattle-free of all the next day. That prompted one tester to recite an old saw from the Model T days: "A piece of tin, a piece of board, a little gas, you've got a Ford." He meant it as a compliment.

Dodge Rampage

The Rampage really belongs in a sports car test since it's more fun to drive than just about any two-seater you can buy for under \$20,000—its performance will simply blow you away. If you need a truck for driving rather than hauling, this is the one.

The 2.2-liter, front-wheel-drive Rampage is by far the fastest of this group in the quarter-mile, not to mention faster than most two-liter GTs. It has the second-best brakes and, at least when shod with sticky Firestone HPRs, will claw its way around a skidpad and through a slalom course as fast as any vehicle you care to name, Porsches and Ferraris included. Lining it up against these mini-pickups was like shooting fish in a barrel.

How come the Rampage is so good? Well, a combination of things. The Rampage is carved out of the hot Charger 2.2 coupe, one of the perfor-

mance surprises of the past year. But the Rampage wheelbase is 7.6 inches longer than the Charger, a happy accident which improves the ride and handling, while leaving room for a 5.5-foot bed and half-ton load.

The Rampage cab is that of the Charger 2.2, cut off behind the front seats. This means you get the typically deep-dished Omni steering wheel, uninspiring dashboard and wobbly shifter, but a pleasantly spacious interior with good visibility and comfortable bucket seats. Tucked behind the seats there's even a full-width package shelf that will accommodate briefcases and small overnighters. It's the next best thing to a King Cab.

Nobody would really buy a Rampage as a strictly working truck—the bed's too short even to carry a single motorcycle. But you can carry light lumber or flats of plants in the back, while giving Porsche drivers fits on the way home from the nursery. The Rampage is even beautifully styled, as sleek and contemporary as a cruise missile. It's the El Camino of the '80s.

Datsun King Cab

The way it worked out, our group of test trucks divides neatly into three categories: the down-sized "intermediate" S-10 and Ranger; the "car-truck" Rampage, VW and Subaru; and the Japanese "mini-pickups." The Datsun won the "Japanese" category, largely on the strength of its unique King Cab.

What's most surprising about the King Cab is that no one else has cop-

(Please turn to page 180)

PICKUPS—PERFORMANCE-TEST RESULTS

	1/4-Mile Acceleration (sec. @ mph)	Braking* 60 to 0 mph (ft.)	Slalom† (mph)	Skidpad** (cw/ccw sec.)	Fuel Economy (mpg)	Maximum Load (lbs.)	Cargo Space Index††	Interior Space Index‡	Interior Sound Level (dB)	
									Full Throttle (30 to 60 mph)	Constant (30-60 mph)
Chevrolet S-10	18.06 @ 74.75	171	52.32	61/61	17.7	1,625	2,834	77.9	75	74.70
Ford Ranger	20.76 @ 64.78	143	51.39	55/59	20.7	1,600	3,299	79.2	74	60.68
Dodge Rampage	17.89 @ 76.33	154	58.58	68/70	18.1	1,140	2,322	74.2	76	68.72
Datsun King Cab	19.04 @ 71.20	165	55.26	57/63	24.0	1,400	2,529	82.4	79	64.74
Volkswagen Pickup	18.65 @ 72.52	156	55.07	65/68	31.4	1,103	2,239	73.0	78	60.73
Dodge Ram 50	18.16 @ 74.44	191	54.13	55/62	22.7	1,530	2,838	90.7	76	68.73
Isuzu P'up	20.28 @ 65.96	169	50.31	55/51	27.4	1,680	3,226	94.8	78	75.71
Subaru Brat	20.26 @ 66.42	188	48.57	63/67	25.7	1,100	2,307	83.0	76	68.74
Mazda B-2000	19.47 @ 67.87	163	54.25	61/61	24.3	1,400	3,173	84.6	81	68.78
Toyota SR-5	18.63 @ 71.54	206	54.20	60/65	23.3	1,400	2,624	81.1	74	65.71
Jeep Scrambler	19.79 @ 67.36	174	49.79	57/59	13.5	1,485	1,937	84.2	82	74.82

*Impending lockup. †Slalom is speed in mph through seven cones spaced 100 feet apart, with an entry speed of 60 mph. **Skidpad is measured in G force with a 200-foot-diameter skidpad; cw, clockwise; ccw, counterclockwise.

††Cargo space index is bed length x bed width x bed depth x width between wheelwells (in inches) divided by 1,000. ‡Interior space index is headroom x elbowroom x legroom (in inches) divided by 1,000.

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DETROIT PICKUPS

(Continued from page 178)

ied it in five years. As any pickup owner knows, the one drawback to these versatile vehicles is the absence of a safe and waterproof place to store small personal items—the equivalent of a back seat. That's what the King Cab gives you: 7 cu. ft. of priceless inside storage space.

Otherwise, the Datsun is rather anonymous. At \$8,800, ours was priced right in the middle of this test group. And at the track, it finished in the middle of the pack in every test except the slalom, where it was a surprising second behind the Rampage. At 24 mpg, even the fuel economy was smack dab on the median.

One tester said, "Nothing roused me about the Datsun, one way or the other—it's roomy, reasonably well built, crisply styled and, since the basic chassis has been in production for ages, pretty thoroughly debugged. But it has no personality." As another wrote, though, "The King Cab makes this the most versatile in the group, and for that reason alone, one of the best."

Volkswagen Pickup

For the way most people use a pickup, the \$8,225 Rabbit is one of the better buys in this group. While not exactly feisty, its fuel-injected, 1.7-liter gas engine zipped it to fourth on the drag strip, just a whisker behind trucks with a 500-cc to 1,100-cc advantage. It was third best in braking and slalom, second on the skidpad and with 31.4 mpg, 4 mpg more frugal than the next best truck.

The bed is double-wall construction—unlike any of the Japanese trucks—and can handle 1,100 pounds in a six-foot length. And because of its front-wheel-drive chassis, it has excellent traction even on slippery surfaces, something that lightly laden, rear-wheel-drive trucks are not noted for.

Unlike conventional pickups, the Rabbit, Rampage and Brat also have one-piece bodies rather than a separate cab and bed, which tends to keep them rattle-free. Our VW was tightly and nicely built, and the boxy Rabbit styling has held up surprisingly well over the years. As one tester put it, "There's nothing you'd want to change."

The Rabbit is a blast to drive hard. The handling is wonderfully predictable, though the inside rear wheel likes to lift off the ground in hard cornering. The steering is light and precise, the shifter is decent, and as one tester said, "It's like a slot car—fun to drive."

If the VW Pickup is so wonderful, how come we ranked it fifth? Size. The interior is so cramped that even our smallest test drivers complained, while the six-footers barely fit at all. It's a shame, because to enlarge the cockpit would mean designing a whole new truck. And this one is pretty good now. It just needs to be let out at the seams.

Dodge Ram 50

The Mitsubishi-built Ram is, as one of our testers wrote, "a mini-pickup, not a car-truck or miniature truck." In other words, it's a typical Japanese pickup, though more sophisticated than the others. We liked quite a few things about it. The basic styling is very clean and modern. The big, 2.6-liter, Silent Shaft Four is smooth and powerful, and the chassis is pretty well balanced, though very "trucky." The interior is nicely conceived, though the typical Japanese bucket seats lack lumbar and side support, and the steering wheel is too close to your chest.

The Ram was third fastest in acceleration. The brakes were quite poor, however, and while the Ram finished in the middle of the pack in our handling tests, its high center of gravity, over-assisted steering and slippery Bridgestone tires make it not much fun to drive. Moreover, that big engine sucks up a fair amount of gas and makes a lot of noise, as well as horsepower.

The Ram has the second largest interior, and fourth largest cargo volume. It's also available in a 3/4-ton package that has the fourth heaviest load rating. In other words, the Dodge Ram is a truck, not a car. It's the closest of all the imported trucks to the S-10 and Ranger in performance and utility, but not nearly so refined. The price is a significant \$1,500 less than the American duo, but as one of our testers so nicely summed it up, "This is your basic, no-frills mini-pickup... nothing fancy, but it gets the job done."

Isuzu P'up

Most people don't know that the "all-new" Chevrolet S-10 is actually an Isuzu P'up with a different body. Even the S-10's standard 1.9-liter gasoline engine is built in Japan. Theoretically, this should mean that the P'up is as good a truck as the winning S-10. And in many ways, it is. The big difference is Chevy's optional V6, which cures the P'up's one major weakness. It's slow as molasses running uphill in December.

Our P'up wasn't last at the drag strip; that distinction belongs to the

(Please turn to page 182)



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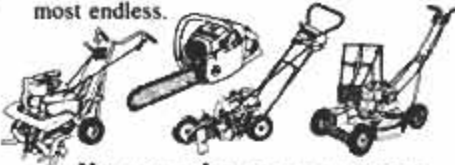
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automatic-equipped Ranger. But it would be slower than a four-speed Ranger, which makes it the least powerful of these minis. On the other hand, it has very good brakes, and was hampered in our handling tests by really awful bias-ply truck tires. With comparable tires, the P'up would handle as well as the S-10.

Where the P'up wins is in practicality. Our 7.5-foot-bed Isuzu has the greatest cargo volume except for the Ranger, and at 1,680 pounds, the highest load rating of all. The interi-

or volume is also the largest, unless you add the Datsun's 7 cu. ft. behind the seats. And at 27.4 mpg, the P'up is second only to the VW in frugality.

The Isuzu's styling, inside and out, is the best of this class: thoughtfully sleek, with restrained details. The long wheelbase gives it the softest ride in the group.

Subaru Brat

Some of our testers thought the Brat was "cute," "fun to drive,"

"classy," and "best in the test." Others found it "overdone," "not fun to drive," "too small" and "antique." Averaged together, it all consigned the Brat to eighth place in our overall ratings.

The Brat is so clever it's overwhelming. It's the only vehicle in the world in which you can switch from front-wheel drive to four-wheel drive—high or low range, yet—while on the move, at any speed up to 50 mph, simply by pulling on a lever. It also has the only T-roof that clips open like a pair of gull wings, or that lifts out completely.

"Cute" and "sporty" are the words that keep recurring in regard to both exterior and interior styling, and drivers of most sizes thought that the interior was comfortable, though a snug fit for six-footers. The bed is a snug fit for cargo, too. The Brat is competitive with other car-trucks for cargo space and load rating, but you really can't carry much back there due to the two seats bolted to the bed.

At the track, the Brat was third from the bottom in acceleration and braking, last in the slalom and average on the skidpad. However, it did have the third best fuel economy, 25.7 mpg from its raspy, 1.8-liter, flat Four.

Most impressive of all, the Brat's \$8,008 price tag—including four-wheel drive, Halo Twin Roof, top-line trim, spoke wheels and excellent radio—was the cheapest in the test except for our stripper Mazda B-2000. That wins it the "value for money" prize, hands down. The reason for this low price is simple. While other imported trucks carry a 25-percent import duty, Subaru has convinced the U.S. government that the Brat is a passenger car, because it has two plastic bucket seats permanently mounted in the open bed. Subaru, like the Brat, is surpassingly clever. But it's not clever enough to make it a really useful pickup.

Mazda B-2000

The Mazda B-2000 is the least expensive truck in our test, a whopping \$2,500 less than the S-10. But it also isn't nearly as well appointed as the others. The lesson is age-old: If you want a fancy truck with a high profile, you have to pay for it. If all you want to do is haul a load, the no-frills Mazda is plenty good enough.

Mazda invented the "sport truck" a decade ago, with the diabolically fast, Wankel-engined pickup. But the Wankel is long gone, replaced by a two-liter Four that one tester

(Please turn to page 184)

Hunt with the Old Timer.

This outstanding lockblade is perfect, no matter where you go. The high carbon steel blade takes and holds a razor sharp edge. The saw-cut Staglon® handles are virtually indestructible. Lock open the blade and it's ready to tackle any job, big or small. The Mustang comes with its own genuine leather sheath for easy traveling. When you travel with an Old Timer, you're in good company.

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It's called STOP-IT. It's the first really effective and practical answer to that common household horror, basement sewer drain back-up. STOP-IT is so simply designed, anyone can install it in minutes...so effective, you'll wonder what took so long to invent it. Independent lab tests have proven the STOP-IT Anti-Back Flow Valve can withstand at least a ten foot head pressure in a two inch stand pipe without leakage. This is far in excess of normal basement sewer line pressures.

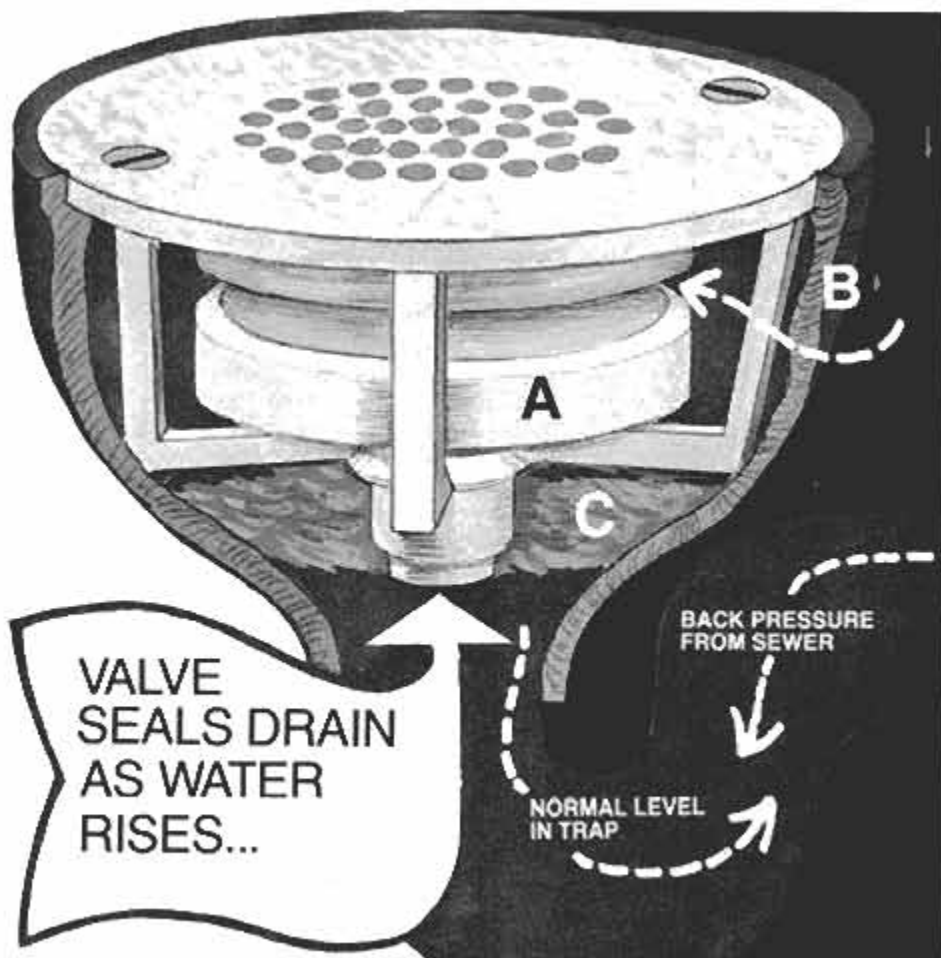
STOP-IT is made of HIGH DENSITY POLYETHYLENE, a material so tough, it is almost indestructible. It cannot be damaged by chemicals or solvents generally used in the home. (Even glue won't stick to it.)

HOW IT WORKS-(LIKE A FLOAT)

The valve **A** floats up or down with the water level in the trap **C**. If the sewer backs up, or your washing machine, dishwasher or garbage disposal causes a temporary back up, the water rises in the trap and the valve closes against the seat **B** sealing the drain tight. The valve seat contains a closed cell neoprene "O" ring gasket, so even the lightest pressure will seal the drain. When the water recedes in the trap, the valve opens automatically...so you'll never see that yukky sewer water!

BOY SCOUT MOTTO (A SMART IDEA)

Being prepared isn't too dumb. Maybe you've never experienced a sewer back up, but if ever you have any ideas about using that valuable space in your basement — like finishing a Rec Room or putting down rugs or even wood floors...hold it! Consider the risk and the cost if your sewer does back up—even once! (Plus the smell and health hazards). Chances are too, that your homeowners insurance probably won't cover that kind of flooding. Common sense says STOP-IT is the cheapest, most effective kind of insurance you can get. Why chance all that mess anyway, when for a few dollars you can prevent it from happening so easily.



INSTALL STOP-IT IN MINUTES - THEN FORGET IT!

The rugged construction and simplicity of the STOP-IT valve means you'll never have to bother with it. About the only time you might remove it would be to get access to the sewer line. All that takes is to remove the two screws in the drain cover. Everything is attached to the cover. It's that simple! STOP-IT won't clog up, either. The drain holes will not permit entry of materials larger than the valve-to-seat clearance, so it can't get plugged up. Also, all the parts are slippery smooth so waste won't stick to it (except the floor surface of the cover which has a no-slip texture for safety).

STOP-IT is sized to fit all average floor drains. Drain cover sizes are usually either 5" or 6 3/4" in diameter. STOP-IT comes in both sizes. Since we introduced STOP-IT through retail stores in limited areas, the stores have been unable to keep them in stock. So we decided to offer it to a national market through these ads. One look at the unit and people realize what a great idea it really is. (Naturally we've protected it with U.S. and Canadian patents).

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We're very confident that once you get your hands on STOP-IT, we won't be able to pry it away...but if for any reason, within 30 days of receipt you decide you don't want it, just repack it and send it back. We'll send you a complete refund of your purchase price, no questions asked. We ship direct to you by UPS. Due to sales volume and order processing time, expect a 2 to 4 week wait after ordering.

HOW TO ORDER STOP-IT..

First, measure your drain cover across its center. Then check the correct size/choice box. Mail your check or money order to the address listed below. VISA or MASTER CARD purchases are also welcome. (Just fill in the required information in the space provided.) Note: if your home has more than one floor drain it's important to equip them both.

STOP-IT comes complete, needs no assembly. Just installation that takes minutes. A set of special screws are supplied to replace those on your present drain cover, if needed. STOP-IT is warranted for a full year against defects...so don't wait for that flood to happen. Protect your home against sewer back ups. Order STOP-IT now. For each unit enclose \$19.95 plus \$1.00 Shipping and handling. Minnesota residents please add 5% Sales Tax. (No CODs)

5" SIZE 6 3/4" SIZE (CHECK ONE)

No. units ordered	Amt. Enclosed
VISA <input type="checkbox"/> MASTERCARD <input type="checkbox"/> EXP. DATE / /	
CARD NO. /	
NAME _____	
ADDRESS _____	
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wrote "feels like the handbrake is always on." It's also quite noisy, with lots of vibration and drumming. But that's in keeping with the Mazda's old-fashioned feel throughout. It's the only vehicle in the Mazda line which hasn't been totally modernized within the last few years, and it's desperately overdue.

On the other hand, the B-2000 has been in production for so long that it's totally debugged. The paint and panel fit are typically excellent Maz-

da, the interior is nicely laid out, if plain, and the styling is unpretentiously clean. As one of our testers put it, "This is your basic Japanese pickup. It has no standout features, but also no major flaws." Said another, "What you see is what you get—a truck."

Toyota SR-5

The Toyota is pleasantly styled, perfectly assembled and sure to be long-lived. It will handle a ¾-ton load, and has one of the largest car-

go areas of any of these trucks. But the steering is vague, and much too light. The shifter is notchy, and the seating position uncomfortable. The engine is very rough, and the ride is "early buckboard." It's like a mini-pickup from 10 years ago.

At the track, the SR-5 was one of the fastest in the quarter-mile, as befits its large 2.4-liter, overhead-cam engine and five-speed gearbox. But the brakes are so bad, they're literally dangerous, stopping from 60 in over 200 feet. The handling is quite good on a smooth test track, and the fuel economy average. But the SR-5 is another "no-frills" pickup, and not very enjoyable to drive.

Jeep Scrambler

The Jeep is as specialized in its own way as a Formula One car, which doesn't suit it for too many other tasks. The 5-foot pickup bed of the Scrambler is the smallest of any truck, though it does carry a ¾-ton rating. And you can't buy a Jeep without four-wheel drive. As one wit said, "If you need to carry a very heavy telephone booth to the top of a mountain, then the Jeep's the truck for you."

There's been lots of publicity about Jeep rollover problems. Well, it is faster than a Brat through a slalom, and only a tick behind the Japanese trucks. On the skidpad, it beat the new Ranger, as well as three other trucks. Realistically, the center of gravity is very high, and an experienced driver has to work hard to drive it near the limit. You could get yourself in trouble with a Jeep, sure enough.

This is not an efficient vehicle. It weighs 3,600 pounds—more than most full-size pickups—and with its optional 4.2-liter AMC straight Six, returned an embarrassing 13.5 mpg, even when locked in two-wheel drive. Despite the big engine, it was slow in acceleration, and our test driver wrote "Deadly!" after the Jeep results in the braking test.

Like a Harley-Davidson, it's old-fashioned, crude, noisy and slow, but Jeeps have a perverse macho image that still turns heads. There's a stone-axe mythology about the Jeep that's still potent in this era of cruise missiles, and they're surprisingly popular in certain quarters. One tester wrote under "features you particularly like": "resale, value." That says it all. **PM**

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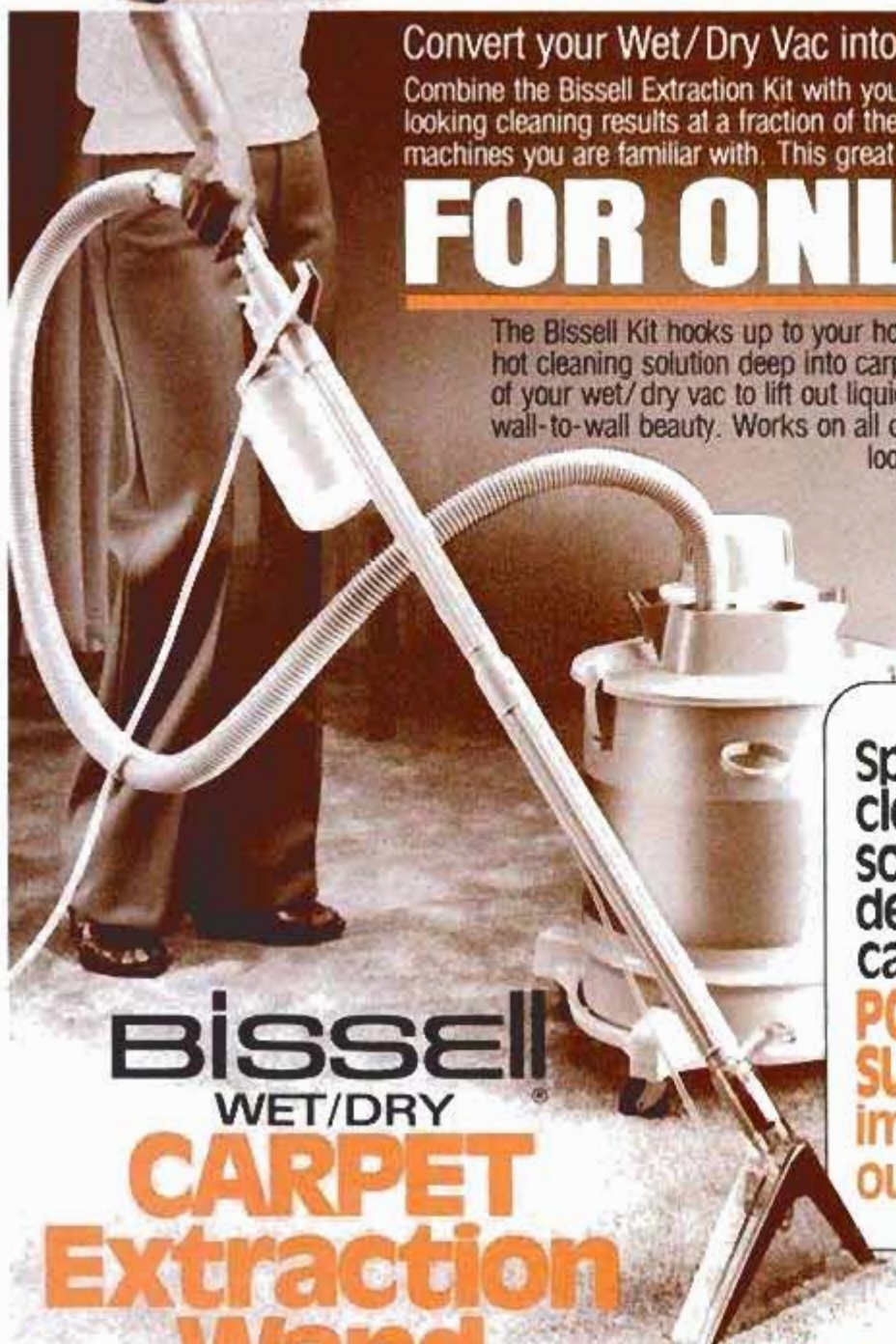
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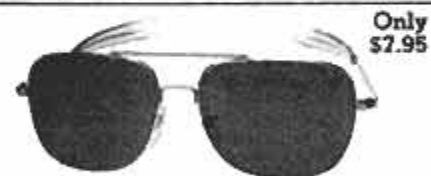


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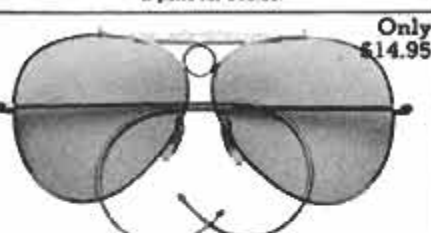
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PUT ANY SHELF ANYWHERE

(Continued from page 103)

widths or plain boards you finish yourself. Among the many makers are Stanley, National Manufacturing and Knappe & Vogt.

The great advantage of this type of system is its flexibility. You're not locked into a fixed arrangement, as with a rigid bookcase. You can add shelves at any time, rearrange them to suit changing needs, and lift them out for easy cleaning. By using three or more standards, you can stagger shelves at different heights, creating dramatic display niches for pictures and decorative objects. Special angled brackets also let you add sloping racks which are ideal for maps, games, magazines and over-size books.

Prefinished shelving

Prefinished shelving, marketed in many stock sizes from 8x24 in. to 12x72 in., is an ideal choice for use with adjustable shelf standards. It comes in both solid colors and such wood grain finishes as walnut, pecan and butcher block. Most surfaces are melamine, which looks good and stands up very well to cleaning. For extra-long shelving, Weyerhaeuser offers particleboard planks, either plain or prefinished, in stock widths up to 12 ft. long.

In putting up shelf standards, there are a few cautions to observe. The parts of one system are generally not interchangeable with those of another make, so be sure that all your fittings are of the same make and that the manufacturer offers a full line of additional fixtures for future needs.

To ensure that your shelves are level, don't just measure up from the floor or down from the ceiling—neither may be perfectly true. Instead, use the leveling method shown in the photographs.

For good support and appearance, shelves should slightly overhang the bracket at each end—3 to 4 in. for short shelves, 6 to 8 in. for long ones. When attaching a bracket to a standard, be sure it locks firmly into the slots. A light tap with a hammer is usually needed to seat it securely. A loose bracket will pop out the minute you put a load on it. Finally, shelf standards are only as strong as their fasteners. See the section on wall anchors (page 188) for tips on choosing the right type for your installation.

Ready-made shelf units

If you prefer the look of all-wood shelving with ready-made convenience, there are several types to

choose from. Flair Fold, for instance, sells solid-wood shelves with matching wood wall brackets in five styles to harmonize with Tudor, colonial, early American, provincial and contemporary furnishings. The brackets have slotted metal inserts at the back that simply hook over screws turned into wall anchors. The same brackets can also be attached to wood standards to tie several shelves into a single unit. Heavier mantel-type units are available, as well.

Free-standing shelving in natural wood is sold by Sears, Montgomery Ward and similarly large retailers. These easy-to-assemble, twist-together units consist of prefinished, walnut-stained, hardwood shelves with matching legs, spacers and decorative finials. The sections simply screw together without tools and can be built up to any desired height, depending on the number of shelves and spacers you use.

Another ready-to-install system is Closet Maid's Space Builder line of wall-hung fixtures made of vinyl-covered metal rods. These have an open, grille-like look, are easy to keep clean and come in brown or white. Shelves and racks of various shapes and sizes can be combined to create a custom storage system in any space.

Perforated hardboard

Masonite's versatile Peg-Board, widely used for storing tools, sports equipment and other gear, can also serve as the basis for a flexible shelf system. Metal shelf brackets, made to hook into the prepunched holes in hardboard, are available in 4- to 8-in. lengths and can take prefinished or homemade shelving boards.

While the brackets are not designed for extremely heavy loads, they'll handle most common household items, are readily adjustable in the 1-in.-spaced holes, and can be combined with the many other Peg-Board fixtures to provide an almost endless variety of storage arrangements. While the standard panel size is 4x8 ft., many hardware stores and home centers sell half and quarter sheets for do-it-yourself convenience.

The panels are easy to put up, but must be spaced at least 3/8 in. away from the wall to provide clearance in back for the fixture hooks. On large sheets, this is best done with furring strips around the edges and horizontally at 2-ft. intervals in between. Small panels can be mounted with

(Please turn to page 188)

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PUT ANY SHELF ANYWHERE

(Continued from page 186)

commercially available spacers or with special standoff wall anchors that come with a ¼-in. collar.

Shelf clips and tracks

Adjustable shelves in cabinets, bookcases and built-ins are often more convenient than fixed ones and can actually be even easier to install using commercial hardware. One system consists of thin, slotted metal tracks called pilasters. Small metal clips snap into the slots to support the ends of shelves at any desired height.

Pilaster strips come in a brass or nickel finish and are installed in pairs on each side of a cabinet or other enclosure. They can be surface-mounted or, for a neater appearance, can be recessed into shallow grooves. Once the tracks are in place, any number of shelves can be installed at any levels.

Where you need only a few inches of adjustment up or down, you can use individual shelf clips instead of full-height tracks. These are small, L-shaped metal hangers that are merely pressed into ¼-in. blind holes bored in the sides of a wood enclosure. Like pilasters, the clips are arranged in pairs to support the ends of shelves, with the holes spaced 1 in. apart in vertical rows to permit height adjustment.

Which wall anchor?

Nearly all wall-hung shelves, except those screwed directly into studs, will need some kind of wall anchors to hold them solidly in place. On plasterboard and other hollow walls, the simplest and easiest to use are plastic sleeves that are tapped into small pilot holes. As a screw is turned into a sleeve, it forces the sides to expand and wedge firmly in the wall.

Plastic anchors come in several sizes, taking screw sizes from No. 6 to No. 10. In general, the larger the anchor, the more it is able to hold. Instructions on the package tell you which size screw to use with each anchor and what size pilot hole to drill. As a general working rule, use the largest anchor that your particular shelf hardware will accommodate.

Plastic sleeves can be used in solid plaster as well as plasterboard, but are not intended for masonry. Here you need lead sleeves, called expansion shields, that are made especially for brick and concrete. Like plastic sleeves, these come in several sizes and work by expanding as screws are turned into them. You'll

need a star drill or carbide-tipped masonry bit for boring their pilot holes.

For heavy loads in hollow walls, you have two choices—toggle bolts and expansion anchors. Both work by gripping the back side of the wall, providing a locked-in clamp that can't pull loose. Toggle bolts have spring-loaded legs on a threaded bushing. The legs compress as they're inserted in a pilot hole, then spring open behind the wall to lock the bolt in place.

Such fasteners are ideal for heavily loaded shelves, especially those suspended from a ceiling, where sleeve-type anchors would pull out. But they do have one disadvantage. Once installed, the bolt can't be removed or the toggle will fall off inside the wall. Thus, you have to attach the bolt to your shelf bracket before inserting the toggle in the wall. This can be difficult where you have several fasteners that must be lined up and inserted at one time.

Expansion anchors, familiarly known as Molly bolts, are also designed for heavy loads. They have a slotted sleeve that expands as the bolt is tightened, forming a spider-like clamp behind the wall. Unlike toggles, the bolt can be removed without the sleeve falling off, permitting the anchors to be installed before you attach your shelf brackets.

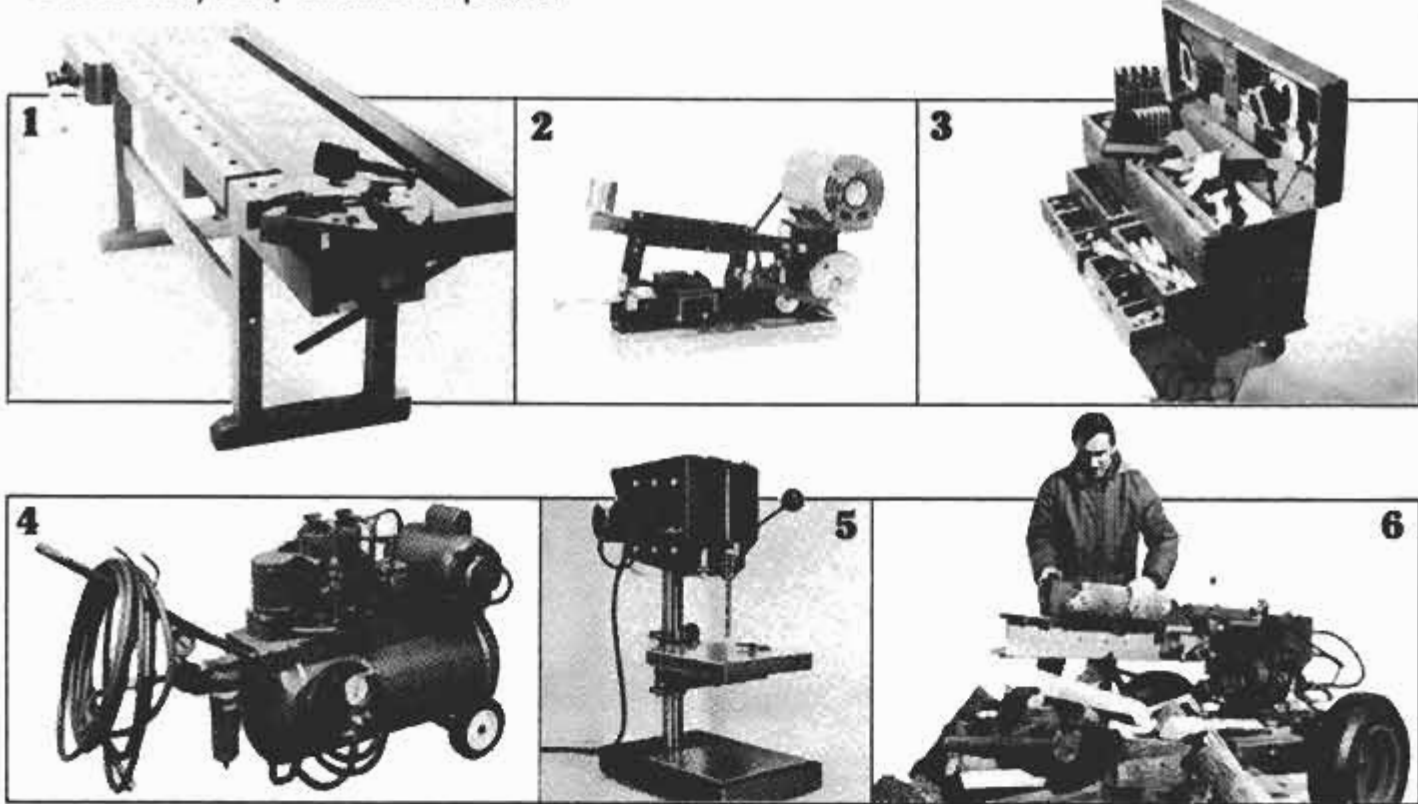
One caution, though: Expansion anchors are sold in different barrel lengths to suit specific wall thicknesses. Because the sleeve must pull up snugly against the back of the wall, you must buy the right barrel length for your particular wall thickness. There are three common sizes: ¾ in. long for walls ¼ to ¾ in. thick; 1 in. long for ¾ to 1¼ in.; and 1½ in. long for 1¼ to 1¾ in. **PM**

SOURCES—SHELVING AND SHELF HARDWARE

- Closet Maid Corp., Clairson International, Box 304, Ocala, Fla. 32670
- Fair Fold Inc., 75 Carmans Rd., East Farmingdale, N.Y. 11735
- Hirsch Co., 8051 North Central Park Ave., Skokie, Ill. 60076
- Knappe & Vogt Manufacturing Co., 2700 Oak Industrial Dr., Grand Rapids, Mich. 49505
- Masonite Corp., 29 North Wacker Dr., Chicago, Ill. 60606
- Montgomery Ward, One Montgomery Ward Plaza, Chicago, Ill. 60671
- National Manufacturing Co., Box 577, Sterling, Ill. 61081
- Pluswood Inc., 1145 Oshkosh Ave., Oshkosh, Wis. 54903
- Quaker Industries Inc., 90 McMillan, Antioch, Ill. 60002
- Quinn Products Inc., 1695 Elmhurst Rd., Elk Grove Village, Ill. 60007
- Sears, Roebuck and Co., Sears Tower, Chicago, Ill. 60684
- Solar Hardware Corp., Box 525, Taylorsville, Miss. 39168
- Specialty Manufacturing Co., 2356 University Ave., St. Paul, Minn. 56114
- Stanley Works, 195 Lake St., New Britain, Conn. 06050
- Star Expansion Industries, Rte. 32, Mountainville, N.Y. 10953
- Steel City Corp., 190-200 Meridan Rd., Youngstown, Ohio 44501
- Weyerhaeuser Co., 2525 South 336th, Federal Way, Wash. 98002
- Zircon International Inc., 475 Vandell Way, Campbell, Calif. 95008

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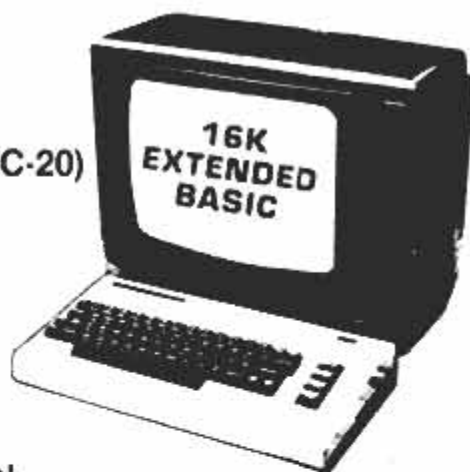


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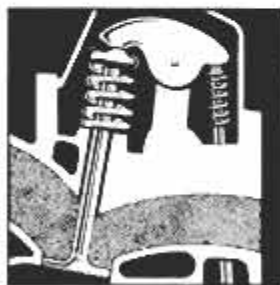
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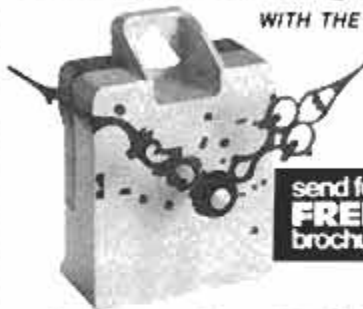
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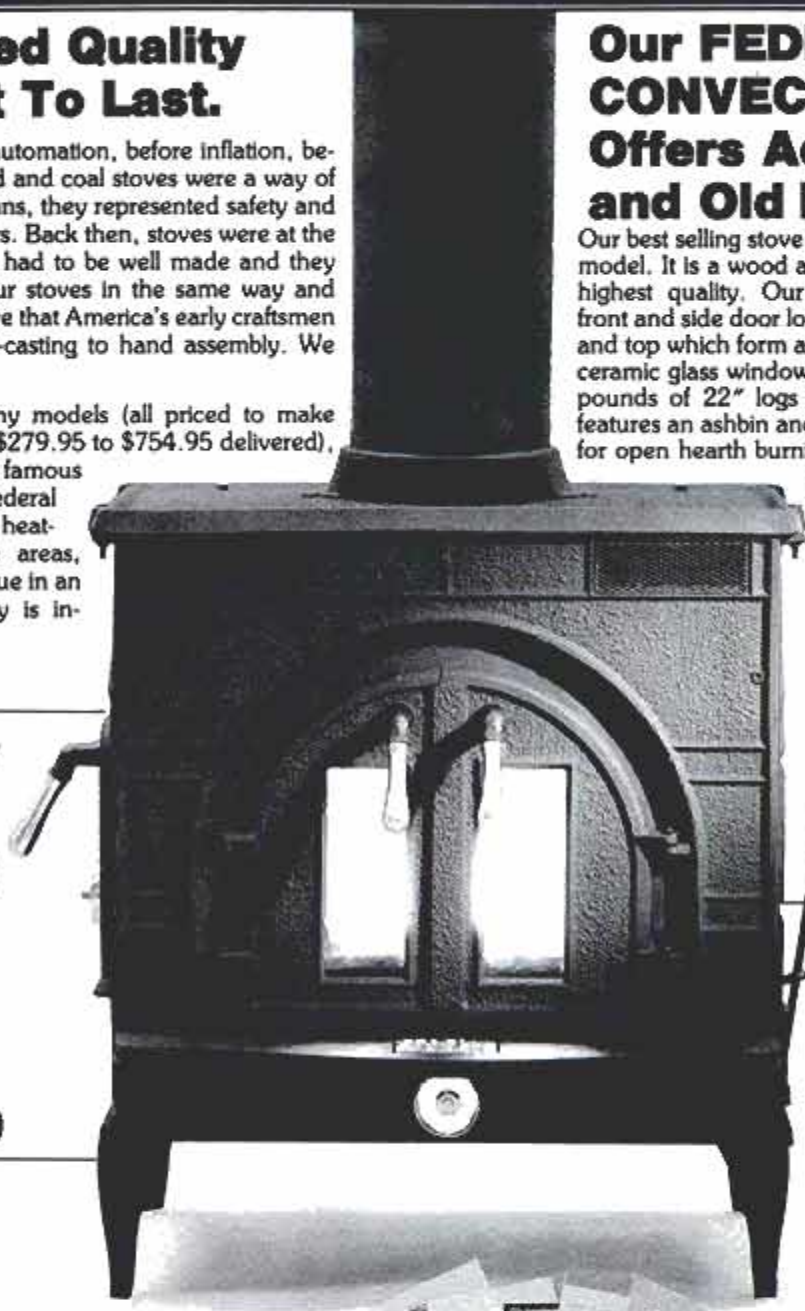
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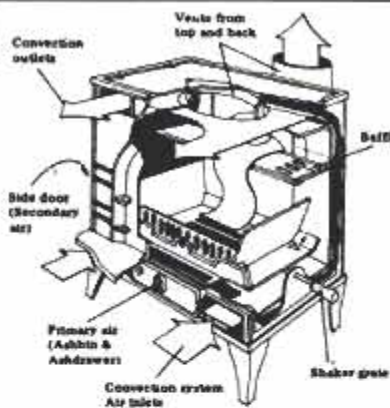
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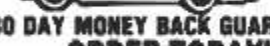
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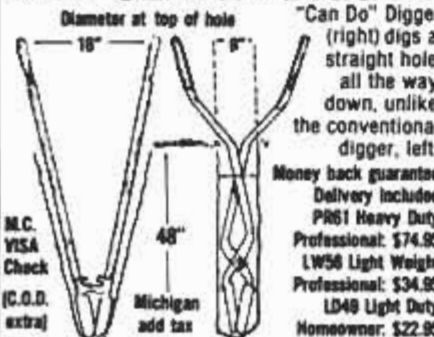
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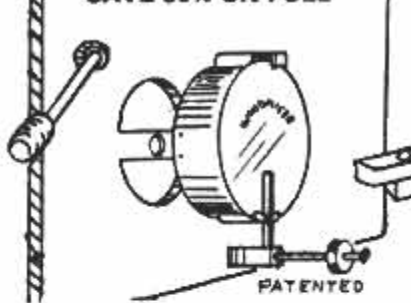
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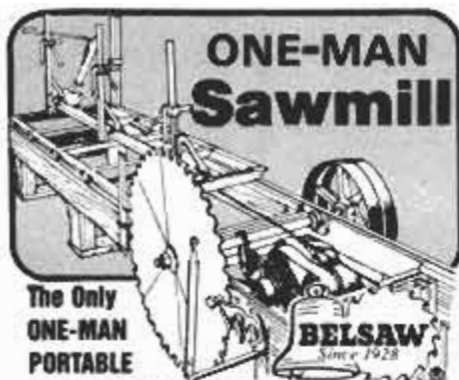
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MAN 73, SPLITS 7 CORDS!

I agree with you that your Monster Maul really splits wood! As Bemidji is in the coldest region of the United States, one spends more time working on his woodpile. I'm just finishing sawing and splitting 7 cords of birch. It runs from 4" to about 16" in diameter. So being 73, I can sure use the help. . . Another thing I like about the Monster Maul is not having to fight with it to get it out of a block that didn't split on the first blow.

Walter C. Port, Bemidji, Mn.

MONSTER MAKES HIM A BELIEVER!

Quite frankly, I ordered the "Monster Maul" because of your no risk money back guarantee. I figured I would try it and if it didn't work out I would return it and the real loss would be yours, not mine. Well, you won't be getting it back. You made a believer out of me. . . the Monster Maul does get the job done and for the money, it's the best bargain around. Thanks for a darn good product at a price that is "easy" to live with.

John Geras, Bolingbrook, Ill.

AN AGING BELLY DANCER

I have to admit there are some surprises among the flood of junk being sold to woodcutters. So I'll say it - you old Sotz can make a maul! Just swinging the 15# has this old wood cutter's belly dancing around his body like a happy kid. P.S. Would you know anybody that needs an aging belly dancer act that splits wood on his days off?

Jim Kirby, Dwight, Il.

HE DIDN'T BELIEVE

I didn't believe the letters in your newspaper - but I am a believer now! We just had our oil tank topped off; and since November to now (3 months), we have only used 182 gallons of oil. In the past, without the benefit of your 55 gallon stove we burned probably that much every month. Considering how cold it was this year, we figure a savings so far of about \$450.00. I put your drumstove in the basement, and cut vents in the floors, and our entire 2-story, 6-room house is heated comfortably.

William Miller, Princeton Jct., N.J.

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H. Patrick Trites, Covelo, Ca.

FRANKLIN OUSTED

I have used your 12 lb. Monster Maul. It's Super! I've converted my fuel oil furnace to a wood barrel burner (55 gal. drum). Since then I've discovered Sotz Products. Yours are the best. Please send my 30HDD. I'm anxious to put it in use to replace my Franklin fireplace.

Wray Zenker, Jr., Sparta, Mich.

MONSTER ATTACKS

I've been swinging your Sotz Monster Maul for about two weeks now. It's incredible! It's great! It's everything you claim, and more. I split mostly oak, some logs are 20-24 inches in diameter. The Monster attacks those logs like nothing I've ever used before. It practically splits those oak logs all by itself, with little effort on my part. I'm sending a check for...a set of your Sotz Woodstove Tools.

Gary Maurer, Willow, N.Y.

FAMILY FEUD!

I am writing this letter in desperation! In the fall I ordered a Monster Maul for my husband. Your article in the "Country Journal" magazine was impressive and on impulse I sent for it. In due course it arrived and was promptly tried on some difficult pieces of oak and hickory we had been unable to split. Sure enough, it did a great job. In fact, too great a job. My husband gave his Monster Maul to our 14 yr. old son. My son's favorite past time is splitting logs. One day my husband, Dick, let our son Richard try the maul. Big mistake! These two are now arguing over who gets to use the maul. These arguments are getting worse and will soon come to blows for both sides. In conclusion, the only way to settle this is to order another one. Please rush and I'll start saving for a third one as we also have a 10 yr. old boy. Your maul is a great time saver and keeps my 14 yr. old from just sitting around. The challenge is great for him.

Donna Waite, Hampden, Ma.

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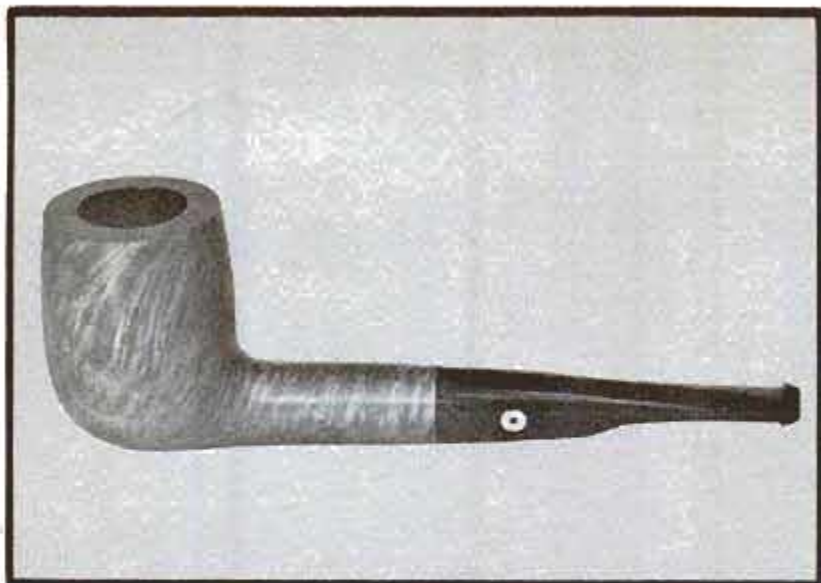
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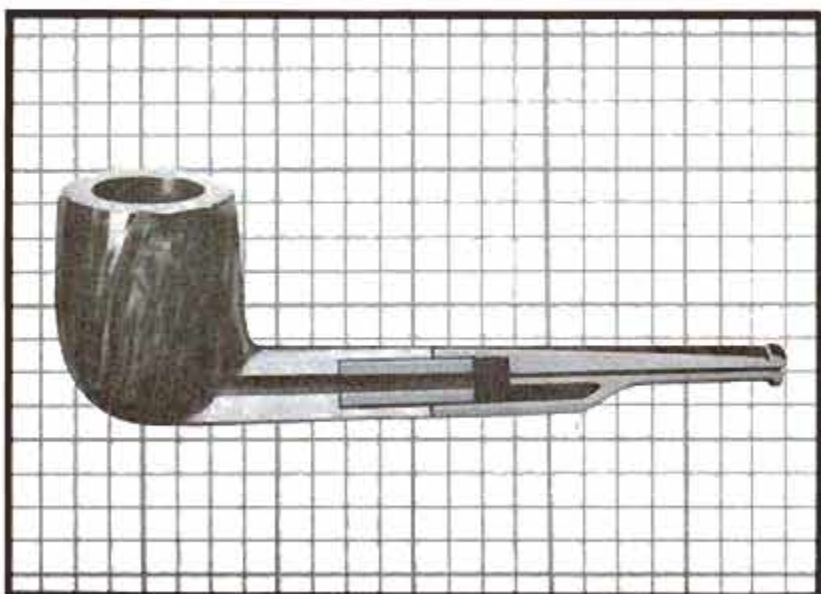
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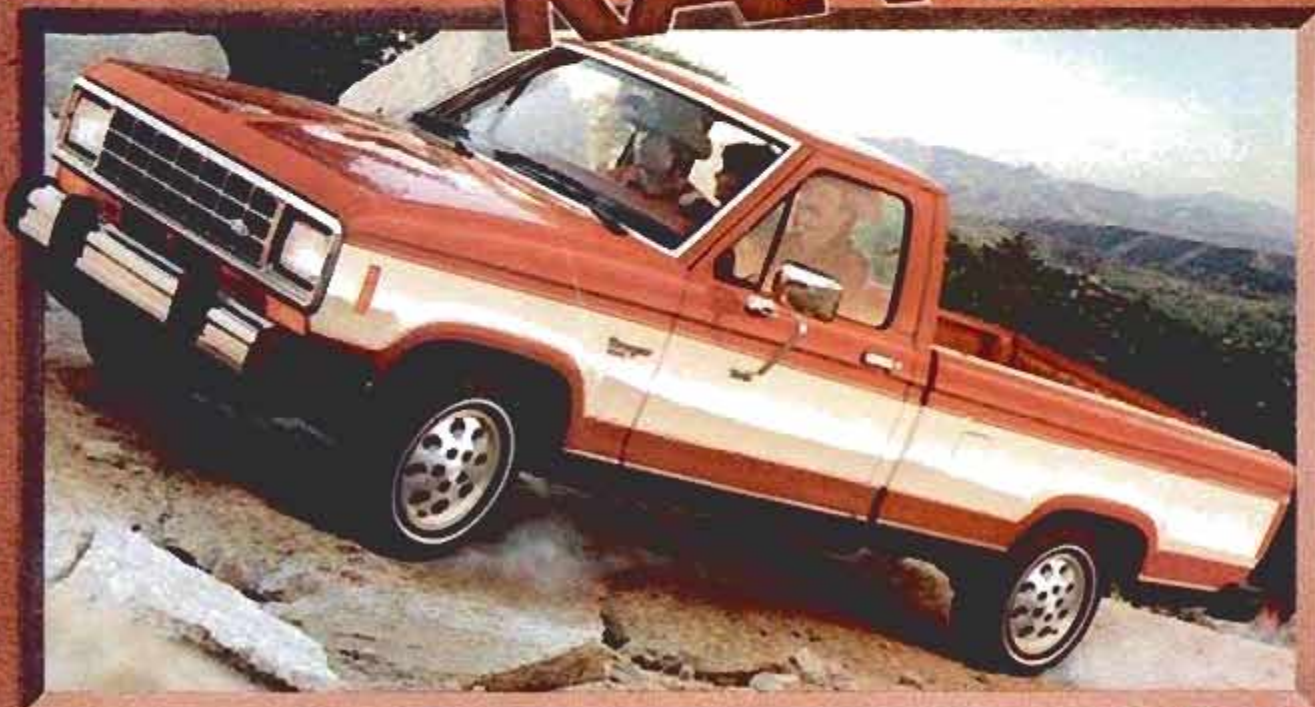
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only small truck with it. And it's
computer-tuned for smooth ride.

DOUBLE-WALL box sides
mean dings on inside won't mar
the outside. No import has it!

1625-LBS. payload option.
More than most compacts and
many standard-size pickups.

CHOICES include: 6- or 7-ft.
box, 2.0L or 2.3L 4-cylinder truck
engine, Trailer Towing Package,
Auxiliary fuel tank.

**AMERICA'S TRUCK.
BUILT FORD TOUGH.**

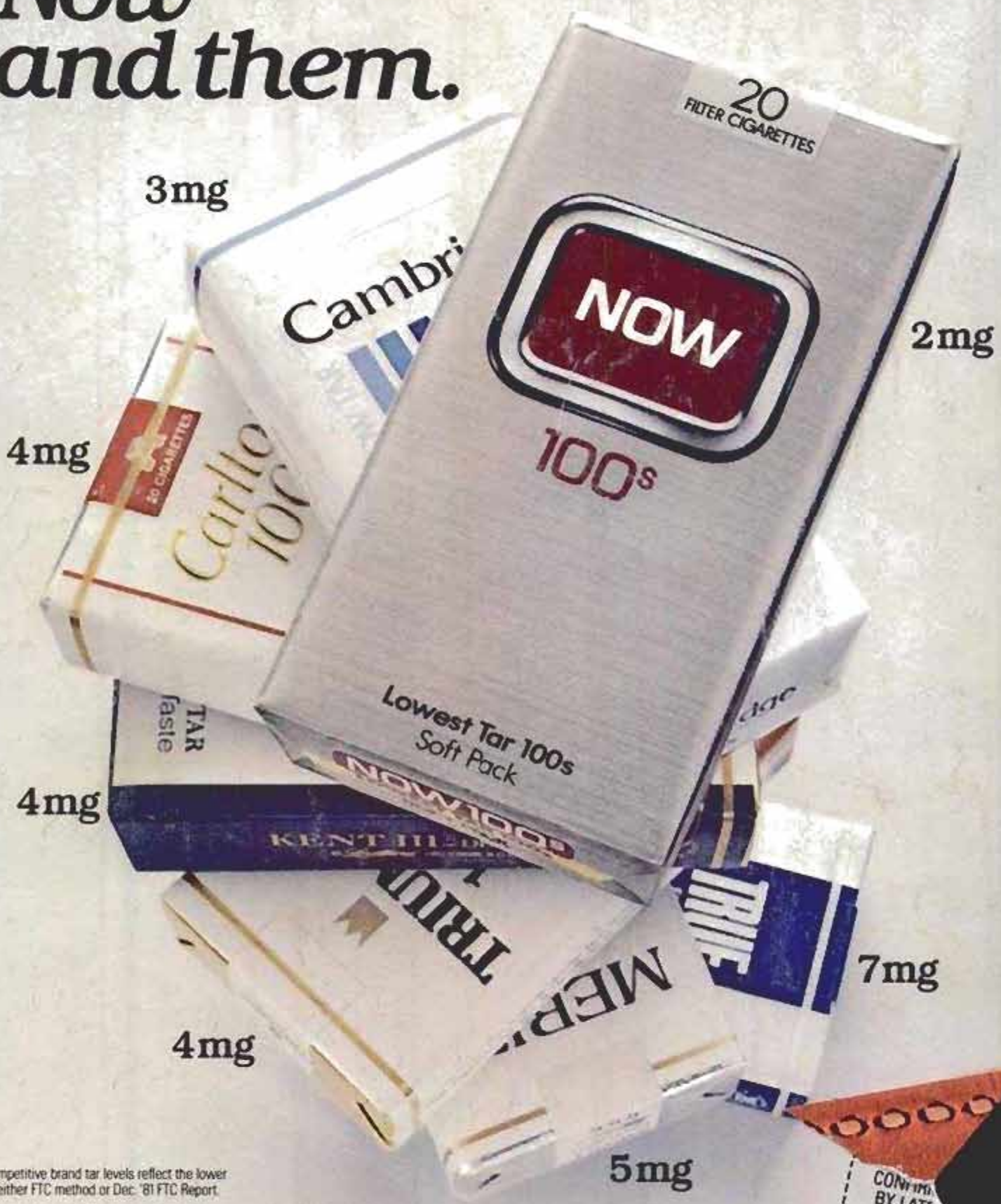
FORD

FORD DIVISION



**BUILT LIKE THE BIG ONES,
SAVES LIKE THE SMALL ONES.**

Now and them.



Competitive brand tar levels reflect the lower of either FTC method or Dec. '81 FTC Report.

SOFT PACK 100's FILTER, MENTHOL: 2 mg. "tar", 0.2 mg. nicotine av. per cigarette by FTC method.

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

CONFORM BY LATEST U.S. GOVT. REPORT ON TAR

NOW The Lowest

The lowest in tar of