

APRIL 1984 \$1.50

# Popular Mechanics

**SAVED!**  
When Pilot  
Skill Counts



## 5 SMARTEST ROBOTS—ALL HOMEMADE!

The 10 Scariest Places  
To Drive In America

**PM TESTS**  
**5 MINI-VANS**  
Chrysler Beats  
The Imports

**PLANS:** Make Our  
Portable Tools For  
Back-Yard Work

**VIDEO:** 7 New  
Lightweight  
Cameras For  
Home TV

## 44-PAGE SPECIAL: HOME IMPROVEMENT

- How To Install  
Wood Paneling  
and Vinyl Flooring
- Transform Your Home  
With New Siding  
And Windows
- Plus Much More



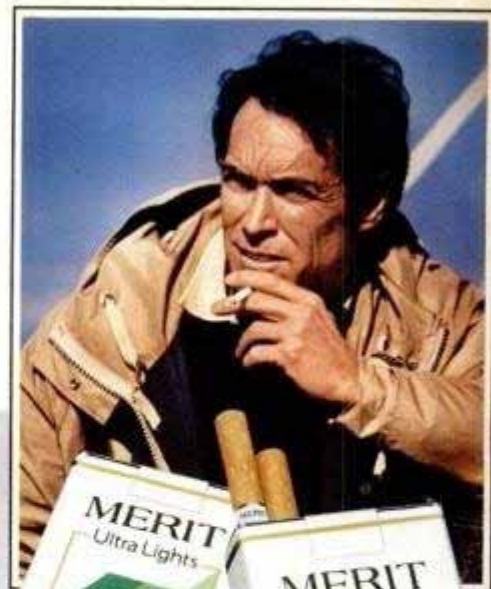
Charlie, a  
computer-run  
homebuilt, uses  
a wheelchair  
motor to move.





# MERIT

## ULTRA LIGHTS



A world of flavor  
in an ultra light.

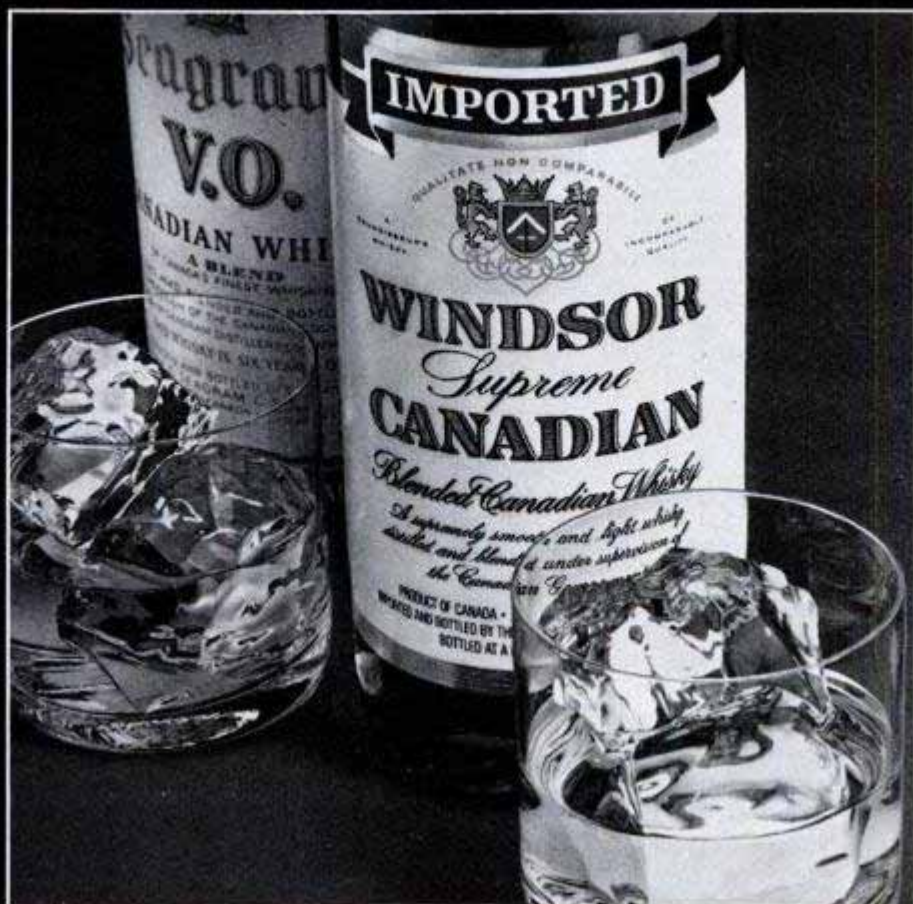
Warning: The Surgeon General Has Determined  
That Cigarette Smoking Is Dangerous to Your Health.

Kings: 4 mg "tar," 0.3 mg nicotine  
Men: 3 mg "tar," 0.3 mg nicotine  
av. per cigarette, FTC Report Mar. '83.

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**NEW TASTE TESTS PROVE IT.**

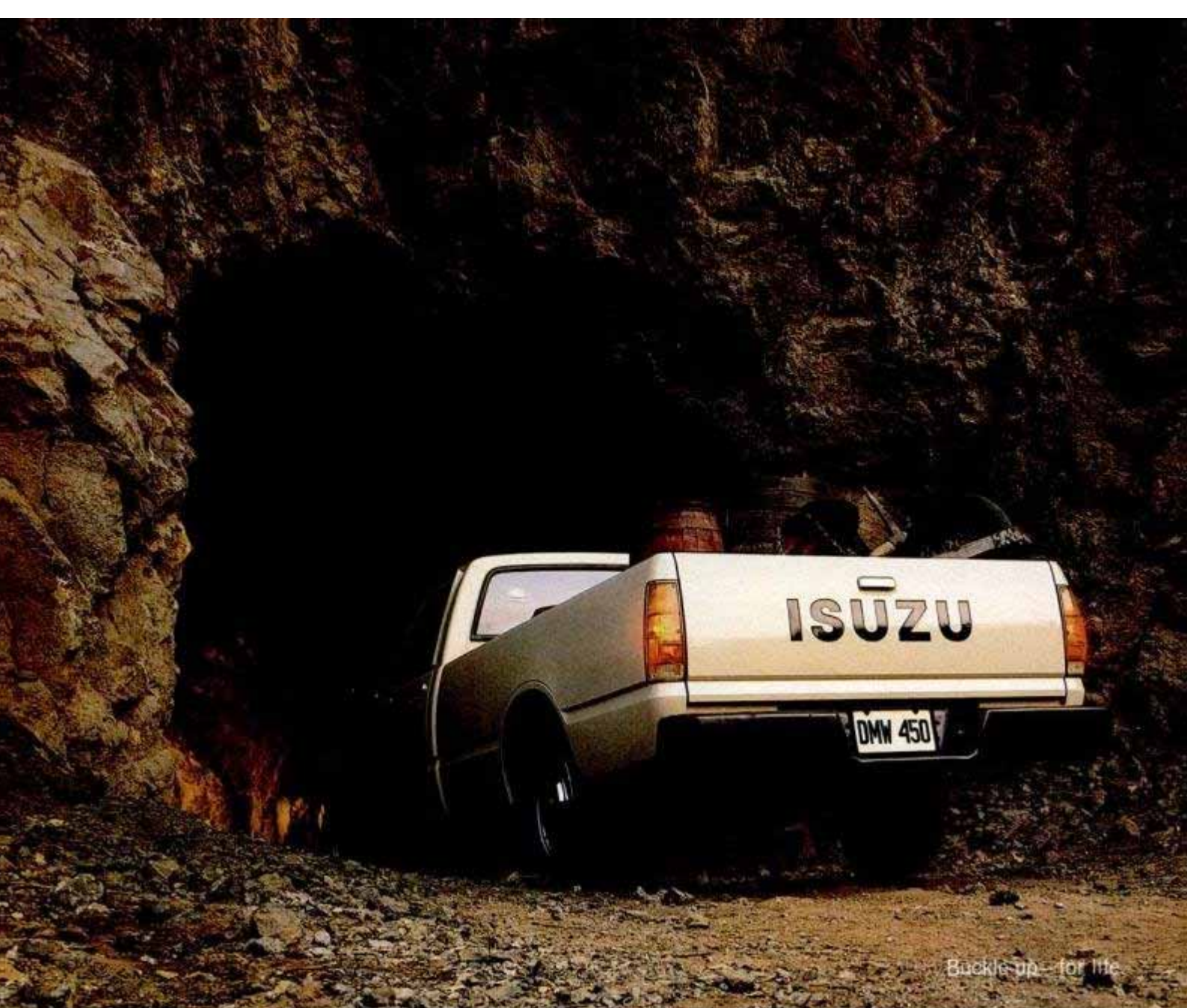
# WINDSOR CANADIAN BEATS V.O.

Two separate broad-scale taste tests were conducted in late 1983 among Canadian whisky drinkers. The results: Windsor's mild, smooth taste was chosen over the new 80-proof V.O. both times.

Try the taste of Windsor and find out for yourself why you can't beat its taste. And you certainly can't beat Windsor's price.

**WINDSOR**   
ONE CANADIAN STANDS ALONE





Buckle up — for life.

## At Isuzu, we claim we're the toughest truck on earth. Now we hear we're also the toughest truck under the earth.

Haiti and Kenya. The World Atlas lists them as countries—but they're more like cauldrons.

The South Pole. A place so cold, Santa Claus goes North for the winter.

Arid plains, steamy jungles, frozen tundras—for 60 years Isuzu has gone to the ends of the earth to prove how tough they are.

And now, as incredible as it may seem, a new world has been conquered. Isuzu trucks have gone underground. Down into the damp, dark mine shaft of a Utah coal mine.

Seems a coal mine somewhere outside Salt Lake City has been using a fleet of Isuzu trucks to travel over two miles underground, hauling the mine's most precious resource—their hard-working miners.

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With a rugged all-steel welded body and steel ladder frame. Special six-stage anti-corrosion painting process. Choose between Isuzu's 1.9 liter SOHC gas engine or the 2.2 liter OHV diesel.

What it all comes down to is whether you're going down into a mine or up to the summer cabin, when you're in an Isuzu truck, you've struck the mother lode.



## Tougher than the world's toughest roads.



# Popular Mechanics®



**THIS MONTH**  
This miraculous dead-stick landing of a helpless Air Canada 767 saved 66 lives. It's just one of the many feats of pilot skill and courage in the face of disaster that you can read about in the exciting story on page 77.  
—PM painting by Ed Valigursky

VOLUME 161 NUMBER 4

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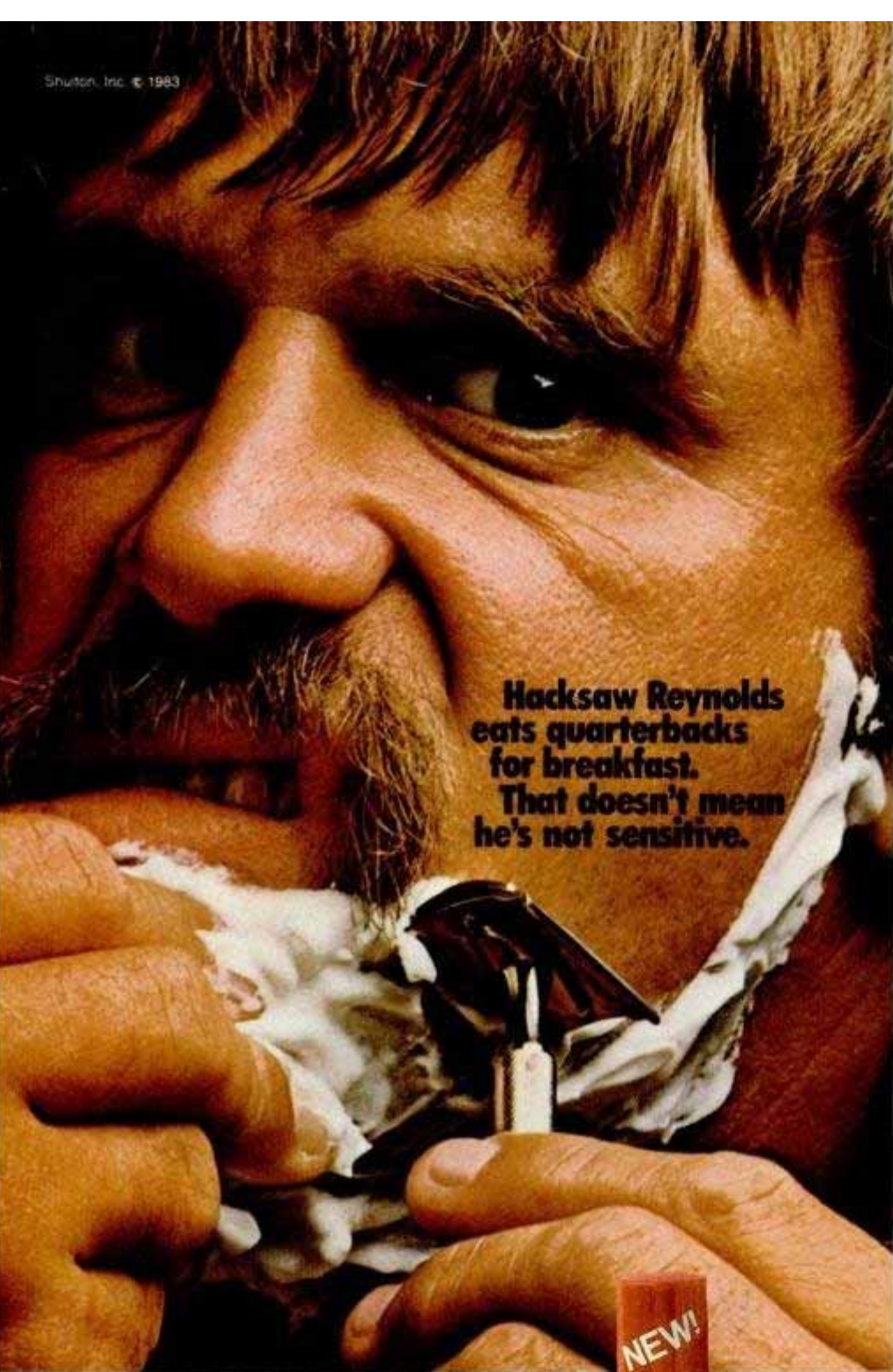
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eats quarterbacks  
for breakfast.  
That doesn't mean  
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**INTRODUCING OLD SPICE®  
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On those occasions when Jack "Hacksaw" Reynolds takes blade to beard (definitely not before a big game), he can get real sensitive.

It's that burning, itchy feeling called "Shavers Skin" that sometimes lingers into the afternoon if you're not lucky. That's when Hacksaw sends in OLD SPICE Conditioning After Shave. It's more than an after shave, because it's rich with emollients to tame even the meanest face.

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# EDITOR'S NOTES

**T**he amazing creatures that appear in *The Smartest Homebuilt Robots* (page 88) are all the work of amateur builders. Just shows you what can happen in a home workshop, doesn't it?

There is a fascination in building robots that you don't get in other projects. As our writer, Tom Carroll, explained to Science Editor Dennis Eskow, "They're machines, but sometimes they have a certain human quality."

Tom, who's generally acknowledged to be the dean of amateur robot builders, may be in the process of losing his amateur status. He has been asked to focus his ingenuity on an android for a to-be-announced Hollywood movie.



Robotist Tom Carroll examines one of his earlier homebuilt creatures.

**PM has achieved a certain status** in Greensboro, N.C., that we're not sure we should talk about. In a recent newspaper article on the problem of theft in local libraries, an interview with a librarian ends thus: "'Sports magazines go very quickly,' she says, adding that the same is true for *Popular Mechanics*." We're pleased to be wanted, but somehow promoting ourselves as "the most stolen magazine" doesn't have the right ring to it.

**Your least-favorite road** may not have made it. But writer Ed Fales talked to lots of drivers all over the country to compile *The 10 Scariest Places To Drive* (page 84), so we think we've covered the worst of them. Still feel you have one that will top ours? Tell us where it is and what's wrong with it, and we'll add to our own list in a future issue.

**Best-selling author William Hoffer** (*Midnight Express*, among others) says he has no fear of flying, though he had one experience that might have intimidated a less adventurous soul. He recounts the incident in *We Made It!* (page 77) as he tells of several close calls when pilot skill overcame mechanical failure—and averted disaster.



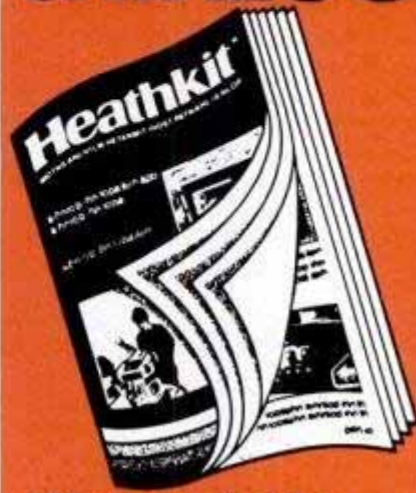
Author William Hoffer lived a "We made it!" jet experience.

Bill admits that he generally takes special note of unusually nervous passengers on commercial flights. If you're one of the fidgety ones, take along his article on your next flight. There's comfort in knowing how much skill there is in the hands at the controls.

Incidentally, in researching the story, we asked the Airline Pilots Assn. whether life-saving flying tactics should merit a bonus. "No," said a spokesman, "It's part of the professionalism of a pilot."

*John A. Sibley*

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# LETTERS TO THE EDITOR



## Corralling computer clutter

Your article *Build PM's Computer Workstation* (page 92, Aug. '83) came just in time. My desk had become so cluttered with computer gear that I jumped at the chance to build your clever modular design (right).

I made some modifications that might interest other readers. In the printer module, I installed a fluorescent light under the lid, using a tilt-sensitive mercury switch to turn it on and off. The light comes on automatically as you lift the lid.

In the storage module, I added a shallow tray at the top to hold small items. The tray, half the width of the cabinet, slides sideways on rails so you can easily reach the contents below it. The workstation has proved to be very efficient and enjoyable.

L. R. MURCHISON  
SANTA CLARA, CALIF.

*You added some great features. For others who may be interested, photocopies of the article are available for \$3 postpaid from Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.*

**PM's computer center, built by reader Murchison, is shown at right. Printer module is on left side, storage module on right.**



## Corvette pro and con

The obvious lack of objectivity in your article *Corvette Takes On The World* (page 88, Jan. '84) disturbs me greatly. Despite the fact that the Corvette ranked first in three of the six test categories, you gave it an overall rating of seven. Incredible!

The comments on interior design were simply out of touch with reality. Any turkey who can't find a windshield wiper switch that's right by his left hand probably couldn't find the steering wheel either.

FRANK BIEWER  
SAN DIEGO, CALIF.

*Auto Editor Wade Hoyt replies: As we explained in the article, there were two parts to our test: track performance, which the Corvette won hands down, and subjective road evaluation, where it placed seventh. It was the fastest, most uncomfortable car we've driven in a long time.*

I was glad to see someone with enough guts to finally come out and criticize the Corvette. I own a 1970

Vette with 250,000 miles on it and it's a great car. But now it appears the new Corvette may just be trying to live off its past reputation.

JAMES B. HENDERSON  
MOULTON, ALA.

## Pooh didn't say it

In your *All Outdoors* column for January '84 (page 10), you credited Winnie-The-Pooh with talking about the fun of "messaging about in boats." I think you'll find this famous line in *The Wind In The Willows*, not Pooh. I hope you fellows know more about boats than you do literature.

C. PETZEL  
PORTLAND, ORE.

*It was a Pooh-type lapse of memory that accounted for this blooper.*

## No dreaded computers?

In your article *1984—The Dreaded Year* (page 60, Jan. '84), you falsely quoted Orwell as saying that computers would be "keeping tabs on our

lives." I don't recall any mention of computers in *1984*. The book is famous for depicting television as an instrument of tyranny, but not computers.

WALLY SIMPSON JR.  
WALDWICK, N.J.

*It's true that the book does not mention computers by name, but it refers to a vast information-gathering system that can store and retrieve data with computer-like speed. Clearly, Orwell saw what was coming.*

## Not so fast

Your excellent article *Our Fast New Armada* (page 83, Jan. '84) correctly pointed out how we're making great progress in modernizing our Navy. However, you gave us a bit too much credit. The fully loaded speed of the USS *Spartanburg* (LST-1192) is 20 knots, not the 30 you stated.

GEORGE D. BESS, CAPT. U.S. NAVY  
FPO, NEW YORK

*The speed we gave was clocked during a test run with no load aboard. PM*





# The 1984 Olds Cruisers. Everything else is just a wagon.

You get a lot more than room in these Olds wagons. You get an Oldsmobile. And that means you get something special, inside and out. Like handsomely-appointed interiors, as quiet as they are comfortable. And smooth, stylish lines. The kind

maybe you never expected from a wagon. And, of course, Oldsmobile quality through and through.

The 1984 Olds Cruisers. 3 different sizes, sure to fit any size family. Compare for yourself. Next to them, everything else is just a wagon.



There is a special feel  
in an



*Oldsmobile*



# ALL OUTDOORS



## Race a canoe

Canoe racing doesn't have to be a sport only for steel-limbed paddlers who try to outdo the fur-trading voyageurs of the last century. Nowadays, it can be a sport for the whole family. The National Flatwater Championships will draw more than 200 competitors from all over the world to Flint, Mich., Aug. 18 and 19. As many as 500 boats come to a regional event like the Josh Billings Triathlon, scheduled for Sept., 16 in Pittsfield, Mass.

Don't let the Triathlon in the title scare you off. Sure, the idea comes from the innovative Hawaiian Ironman event, where superathletes swim 2.4 miles in the ocean, bike for 112 miles, and then run a 26.2-mile marathon without pausing for breath. But the Josh Billings substitutes canoeing for swimming, and you can do the other events as a relay with teammates. There are classes for family cruising canoes as well as competition models. Juniors, seniors, teams, singles, champions, new paddlers—all can try their skills.



A paddler can average 10 mph easily in this 25-pound prototype from Mad River Canoes.

The capabilities of the canoes for racing vary as much as the paddlers. An 18½-foot, space-age plastic Mad River racer weighs just 25 pounds, with lighter ones on the way. Commercial variants can weigh 36 to 50 pounds and can cost close to \$2,000. A good plastic cruising canoe runs \$700-plus. However, if you enter events in your

battered aluminum cruiser, you'll find lots of similar company.

For more information on types of canoe competition, plus places and dates, write to The American Canoe Assn., Box 248, Lorton, Va. 22079. Tell them the kind of canoeing that turns you on and they'll send you information on equipment and places to go.

## Scooter with front-wheel drive

Like the scooter you rode as a kid and pushed with one foot, the front-drive Skoot Cub can take you almost anywhere you can walk—on or off-road. Its 50-cc Tecumseh gas engine pushes it up to 20 mph. A wrist twist sends you forward, rocking back on the foot platform applies the brakes.

You stand on the Skoot Cub rather than straddling it like a bike. To slow down or stop, simply put down a foot, as on the old push scooter. And if the Skoot Cub should start going down, all you have to do is step off. It won't take you with it.

Pulling the pivot pin breaks down the Skoot Cub into two parts that will easily fit into a car trunk. And you can take the machine with you on a boat or RV.

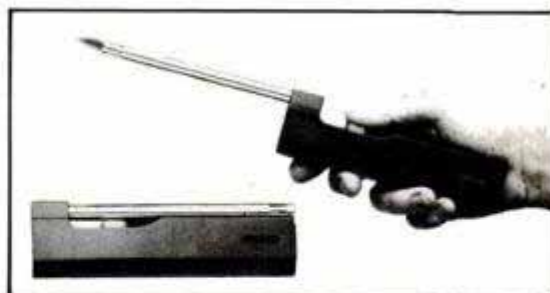
Skoot Cub can be ordered for \$395 plus UPS charges from Summit Prod-



Skoot Cub rides trails that are too tight for a bigger bike. It can be tucked in a car trunk by just pulling the pin (inset) to separate the front power section from the rear.

ucts Inc., Box 2555, Lincoln, Neb. 68502. Or you can order the machine by phone by calling toll-free 1-800-228-0167. In Nebraska, dial (402) 423-2776.

## Mechanical match

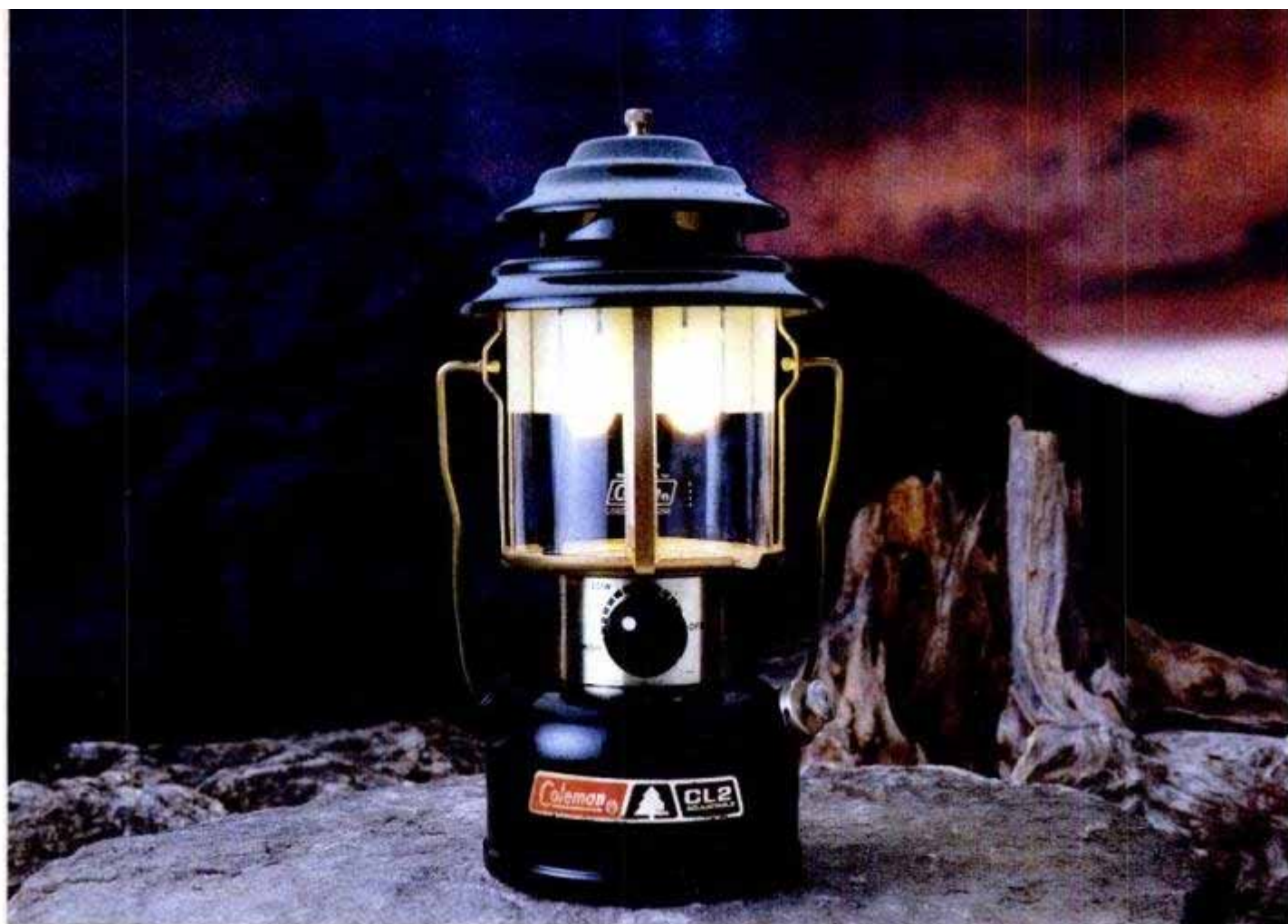


The Supermatch XL lights campfires safely.

A long-reach, folding butane lighter makes it easy to start a campfire or set off starter-fluid-soaked briquettes. The Supermatch XL uses a piezoelectric crystal to make the spark that sets it off when you push the button. A window lets you check the fuel level. The case folds in half and a pull-out ring makes it easy to hang up.

The Supermatch XL is available in patio and outdoor stores or can be ordered from Zelco Industries Inc., 620 South Columbus Ave., Mount Vernon, N.Y. 10550 for \$27.95 postpaid. **PM**





## NEW FROM COLEMAN. THE ULTIMATE LANTERN.

That's a big statement, considering that the Coleman® Lantern has become a legend for toughness and performance. But then, we've made some revolutionary breakthroughs that let our new "Gold Standard" lanterns do things for you that just weren't possible before.

### Ultimate control.

One knob does it all. To light, just hold a match to the mantle and turn to the High setting. Then adjust from full bright to mood light. (At lower light levels, you also save fuel.) This new simplified system even



cleans the generator tip automatically for efficient, dependable performance.

### Ultimate in new efficient size.

The CL2 here is 30% more compact, easier to fit into your car trunk, but gives you the same big, full circle of light as before. It outshines a mere spot or dim fluorescent

glow – and operates at a fraction of the cost of any other portable outdoor light.



### 3 new "Gold Standard" models.

The double mantle CL2. The single mantle CL1. And the super high power CLX, with 36% more adjustable light. All have ultimate features. All have Coleman quality for dependable performance. Head for your Coleman retailer and join the "Gold Rush!"

### Gold Rush Sweepstakes.

Prospect for a Grand Prize trip for two to Alaska, plus a special Gold Edition Jeep Cherokee. First Prize, an F-80 Strada Skeeter Boat with motor and trailer. Or any of 1,060 other prizes. Look for details and entry coupons at participating retailers from Feb. 15 through July 15, 1984.\*

### Ultimate soft light:

This new globe has a reversible frosted stripe to soften light, up or down.

### Ultimate in standby light.

For use during power outages, bad weather, emergencies. Just put a match to the mantle, open the valve, and you have dependable light.

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**We outfit your outdoors.**



Easy to light; dims to a glow.

\*Offer void where prohibited, no purchase necessary. Ohio residents may obtain details and official rules by writing to: Gold Rush Entry Blank, P.O. Box 3510, Syosset, NY 11775.





# PM ELECTRONICS MONITOR



## New standards are being set in many fields

The past year has been a chaotic one in the area of consumer electronics. New devices with new formats have been appearing faster than even industry experts have been able to track. The loser is always the consumer, who never knows if the new product he buys today will be outmoded tomorrow.

The cry for standardization has been heard in many areas of electronics. In some areas, notably that of the compact audio disc, there has been much success. In others, manufacturers have turned a deaf ear while engaging in "I'm-the-best" rhetoric.

Here are some new devices being offered for some new "standards."

### Computer graphics

Spectravideo, at the 1984 Winter Consumer Electronics Show, showed the world the first "MSX" standard computer. Its Model SVI-728 is a microcomputer with a Z-80 processor, an 87-key keyboard and MSX BASIC built-in.

The MSX BASIC runs under the more usual CP/M operating system. What distinguishes the MSX system from other CP/M computers is its graphics capability.

CP/M was developed before graphics were affordable (the SVI-728 is currently selling for about \$350). Now there are as many ways to do graphics on the screen as there are computers with color displays.

The people behind MSX (which includes many Japanese companies) hope that MSX will become the language to use to tell your computer how to draw.

While such a standard might seem a great idea, we are forced to predict failure for the MSX standard. Companies such as IBM, Apple, Atari and Commodore have shown absolutely no interest in going along with the Japanese crowd. Until the big boys play, you don't have much of a ballgame.

### Teletext video

Sony, on the other hand, has announced a new teletext decoder which is based on an already more-or-less accepted standard. The decoder, like all teletext devices, will translate

computer-encoded tones (often delivered via the telephone line) into colorful video pictures.

The Sony teletext device follows the North American Broadcasting Teletext System (NABTS) standards to which many teletext suppliers are adhering. Because the teletext people seem to be getting their standardization act together, we predict that such decoders may be showing up in millions of homes in the next five years. However, in this case, whether that prediction holds is dependent not only on standardization of techniques, but on how those techniques are applied.

Teletext will have to begin offering information in such a way that the reader cannot get it, without expensive equipment costs, via print media. If this teletext puzzle is solved, then the NABTS standards will really take off.

### Video movies

Kodak, when it launched its new video products (see *Video—More Portable Than Ever*, page 96) also announced an 8-mm videotape standard. Of course, when you are one manufacturer and you announce a "standard," the question of definition arises. But a company like Kodak has a pretty good chance of writing its own definition.

RCA has just announced that it, too, will be entering the 8-mm VCR market with a camera/recorder unit sometime after June of this year.

To us, it seems that the 8-mm VCR market will be the next snowball to gather momentum, picking up manufacturers all along its path.

### Cheaper compacts

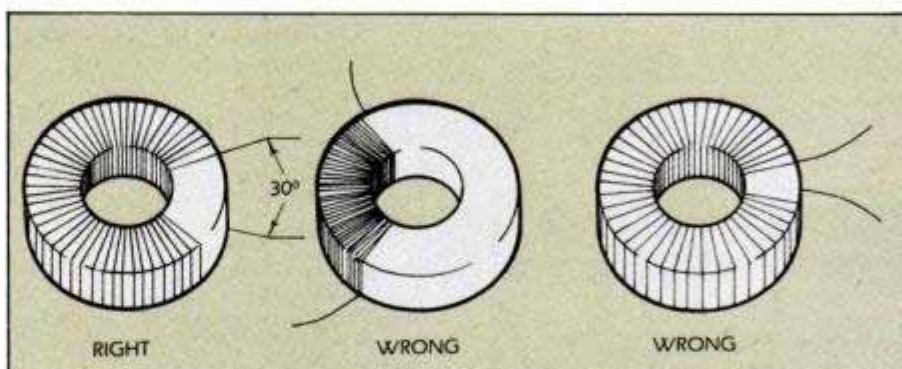
As mentioned, the audio industry does have its act together on standardizing the audio world's compact disc, a digital marvel of ear-pleasing sound.

But it still has to please the wallet. Disc players are expensive—or at least they used to be. Companies are now announcing new, more affordable machines.

In New York, we were able to see and hear Yamaha's new CD-X1, which will retail for \$599. The tonal quality of the unit is claimed to be equal to those selling for almost twice the price. And, judging by what we heard, we can verify the claim. Other features include complete display of time, tracks, mode and other "luxury" level features.

Okay, I know \$600 is still pretty steep, but the point is that standardization has already brought down the price, and will continue to make it more affordable.

PM



### The Right Way To Wind Toroids

In many printed-circuit board applications, a toroid transformer can be used as an RF choke. A small number of wire turns (usually specified in a parts list) is wound on a doughnut-shaped, ferrite core. Often neglected is the final position of the leads. Many times, after com-

pleting a circuit, a toroid may not work. This is often due to having an angle of lead separation different from 30° (above, left). Usually, this mistake results in a capacitance effect which degrades the toroid's performance. Simply readjust the separation angle to 30°.



# CAMEL

## LIGHTS and FILTERS



Experience the  
Camel taste in Lights and Filters.

LIGHTS: 9 mg. "tar", 0.8 mg. nicotine av. per cigarette by FTC method;  
FILTERS: 15 mg. "tar", 1.0 mg. nicotine av. per cigarette, FTC Report MAR. '83.

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



# IMPORTS & MOTORSPORTS



## The Kamei connection



VW Rabbit convertible gets a whole new look with X1 body parts made by Kamei.

One of my first stops at the 52nd International Geneva Motor Show was the Kamei exhibit. No, a Kamei is not a car; it's a body hop-up. Kamei takes a car from a manufacturer's mass-production assembly line and makes it something special. The company, which has headquarters in Wiesbaden, and research and manufacturing plants at other locations in Germany, has refined some pretty racy cars. But I wanted to

see what they could do with a plain Golf (Rabbit to us), which I heard would be there.

The Golf X1 that was on display was hardly recognizable as a VW. Kamei had done a lot more than add its fuel-saving, aerodynamic body parts. The car was coated with pearlescent paint from wiper arms to wheel covers, and if you never heard of Kamei you'd never forget the name after seeing that show

car. Under the heavy customizing were the X1 parts: front and rear spoilers (the primary air-redirecting devices for picking up mpg), grille, fender flares, side skirts and hood aircoop.

After the Geneva show I visited Kamei USA (at 300 Montowese Ave., North Haven, Conn. 06473) to see what they do here. An excellent example was in the works. The Rabbit convertible seen here is a special project that also includes BBS sport wheels, Callaway turbo and Sony sound system.

You don't have to go this far to customize your car; Kamei's aerodynamic parts alone are a good start.



Fender flares and rocker panel skirts are part of Kamei's fuel-saving X1 package.

## A classic reproduction



Austin Healey zooms anew—in fiberglass.

It took Classic Roadsters Ltd. to put North Dakota on the map for me. That's where Classic builds the Saxon 100S, which is the spittin' image of the Austin Healy 100S. The 100S joins Classic's repros of the Austin Healy 3000, '39 Jaguar SS-100 and '52 MG TD. The 100S, fiberglass with steel frame, costs between \$5,000 (unassembled) and \$20,000, which is the fully optioned, factory-built price with choice of one of three engines. Classic Roadsters is at 1617 Main Ave., Fargo, N.D. 58103; hot-line is 1-800-437-4342.

## Time for add-ons

The first thing I do when I feel spring in the air is reach for my parts and accessories catalogs, especially if I've just paid off my car. Time to look at special wheels, driving lights, suspension parts and the like. Or, if the budget can't take it, there are always new coco mats, sweet-smelling chamois and other glovebox stuffers. One good catalog is Fastcars, \$3 postpaid from Autoworld, 701 North Kaiser Ave., Scranton, Pa. 18508.

## The road to Lugano

Geographical names are ever popular as car names and Ford of Europe is sticking with a city name for its Granada successor. Ford went from Spain to Switzerland for "Lugano." It'll be introduced in Europe this summer and spread the aero look farther across the Ford model line.

PM

Ford Lugano, smooth from front end to rear, resembles Sierra.





# To each his own four wheel drive.

At Subaru we believe the extra measure of safety and traction of four wheel drive should be available to every driver.

**Subaru presents the only full line of "On Demand"™ four wheel drive vehicles in America.**

And we don't mean Jeeps® or trucks. We mean a family size Wagon, sporty Two Door Hardtop, open back BRAT®, practical Hatchback, even a luxurious Four Door Sedan.

**Four Wheel Drive for everyone, because everyone needs Four Wheel Drive.**

A sudden shower, a snowy road or a steep hill can cause a sharp loss of traction. Under conditions like these, "On Demand" Four Wheel Drive gives you an extra measure of safety and traction at the flick of a lever or a push of a button. Without stopping. So any time conditions look hazardous you can switch the odds in your favor. And your passengers'.

**Extra safety that doesn't cost a lot of extra money.**

Another feature of our "On Demand" Four Wheel Drive is its

affordability. It adds very little to the cost of a Subaru. And it's also economical to operate. In fact, our four wheel drive Hatchback is among the mileage\* leaders in its size class.

Clearly, Subaru has done more with four wheel drive than anyone else.

So much that now Subaru not only has a car that's perfect for every driving condition, we have a car that's perfect for every driver.

**SUBARU.**  
Inexpensive. And built to stay that way.



Seatbelts save lives.

\*27 EPA EST. MPG. 37 EST. HWY. 1984 EPA estimate for our 4WD Hatchback. Use EST. MPG. for comparisons. Your actual mileage will probably be less.

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# CAR CLINIC



## Keep the Cavalier boots dry

According to the owner's manual for my 1984 Chevrolet Cavalier station wagon, front end boots are to be liberally coated with chassis lubricant. Does this refer to the four rubber bellows? They're the only boots I see. If so, then there's something wrong, because the car came from the dealer with dry boots. Should I grease them? I asked two dealerships, and no one knows.—Barry Wood, North Bergen, N.J.

I searched the owner's manual and

found no mention of front end boots having to be lubricated. However, the maintenance schedule for the vehicle (a separate document), does say to liberally lubricate all drive axle boots with chassis lube. Front end boots, drive axle boots and rubber bellows refer to the same thing.

The maintenance schedule is dead wrong. The boots *should not* be coated with chassis grease, which can cause the rubber to deteriorate.

## Steering runaround

This concerns a 1981 Oldsmobile 88 that's developed a problem with the power-steering system. It began with fluid leaking from both ends of the high-pressure hose. The hose was replaced. Then, fluid began leaking from the O-ring seal on top of the steering gear housing and, again, from the high-pressure hose. The hose and steering gear were replaced. This hasn't stopped the leak. No one has an answer.—Gerald Rowe, Cicero, Ill.

Did your mechanic put a pressure tester on the pump before replacing parts? If not, excessive pressure (which can cause fluid leaks) was not detected. What causes excessive pressure? A stuck flow control valve, which is in the bore on the rear of the pump housing. The valve can be removed and cleaned

and polished with crocus cloth. If the fluid is exceptionally dirty, the entire system must be cleaned.

## Double-entendre

I read in your "PM Car Care Tip" (Car Clinic, page 22, Dec. '83) about not leaving a battery stored on a concrete floor. How can concrete harm or discharge an otherwise good battery?—Jerry Williams, Abbotsford, Wis.

It can't, but I didn't say it would. The point is that battery acid may leak and damage concrete. The likelihood is that a sound battery won't leak, but the battery may not be sound. It may have a crack. Since an ounce of prevention is worth a pound of cure, place a hunk of wood or plexiglass between a battery and a concrete floor.

## Currying favor

My car, a 1983 Mitsubishi Tredia, has been missing and hesitating for the last 7,500 miles when the engine has been shut off for short periods and then restarted. The dealer replaced a diaphragm in the carburetor, rebuilt the carburetor, then replaced the carb. Still no cure, and I'm desperate. My warranty is about over. Please help.—Judy Curry, Irvine, Calif.

Give your dealer this message: It isn't the carburetor, Bub. So what is it? I'll lay money on the vapor control system hose between the carburetor and charcoal canister. I'll bet it's kinked. When the engine is shut off, instead of allowing float bowl pressure to get to the canister, a twisted hose traps fumes in the carburetor. Pressure forces fuel through the metering circuit. When the engine is started, a condition akin to a flooded carburetor results, and the engine runs poorly until "flooding" clears.

## Raunchy Ranger

I own a 1983 Ford Ranger, which is equipped with a 2.3-liter, four-cylinder engine. The vehicle ran fine its first 5,000 miles, but since then it's been surging, accelerating poorly and using more fuel. The dealer has worked on it eight times. The truck now has 19,500 miles, and it's no better than it was at 5,000. Is there no solution other than

(Please turn to page 16)



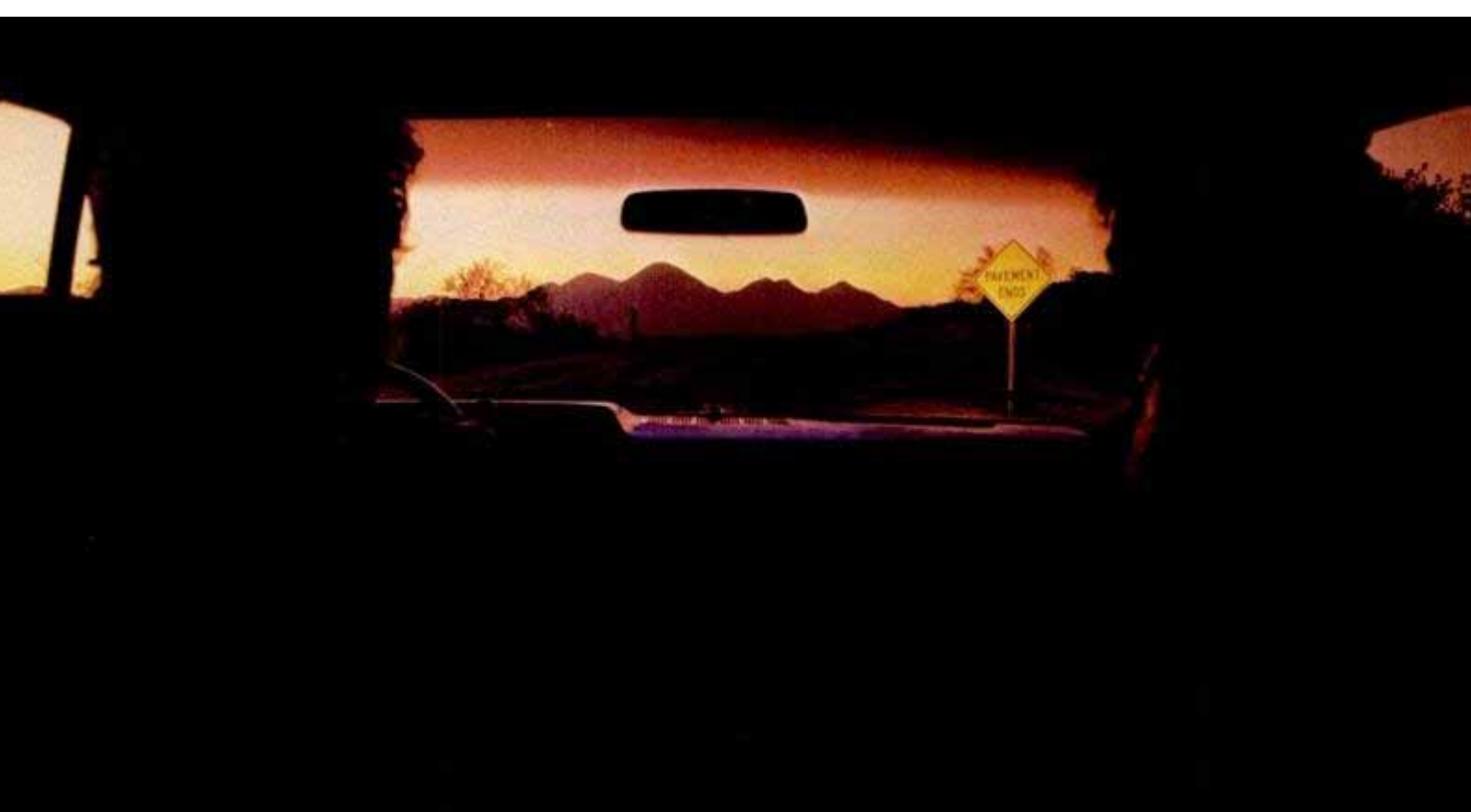
## Learning your ABCs

This really isn't a Car Care Tip. It's just information that may help "deconfuse" you.

Letters to Car Clinic have asked me to unravel GM's alphabet mystery. As one guy put it, "Just what the hell is an A-car, or a C-, or a G-, or an X- . . . ?"

Cars	A	B	C	D	E	F	G	J	K	P	T	X	Y
Buick	Century	LeSabre	Electra		Riviera		Regal	Skyhawk					Skylark
Cadillac			Fleetwood Brougham; DeVille	Fleetwood Limousine	Eldorado			Cimarron	Seville				
Chevrolet	Celebrity	Impala; Caprice Classic				Camaro	Malibu; Monte Carlo	Cavalier			Chevette	Citation	Corvette
Oldsmobile	Ciera	Delta 88	98		Toronado		Cutlass Supreme	Firenza					Omega
Pontiac	6000	Parisienne				Firebird	Bonneville; Grand Prix	2000	Fiero	1000	Phoenix		





# IT TAKES A STRESS-TESTED OIL TO PROTECT YOU A HUNDRED MILES FROM NOWHERE.

Protect your hard-working RV engine with the oil that can stand the strain.

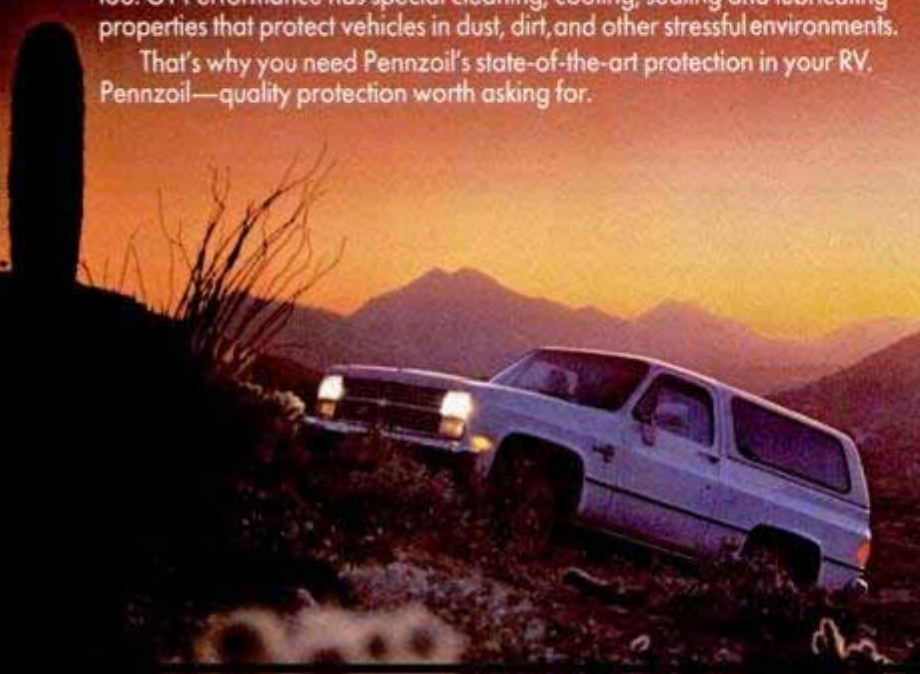
When you and your family travel to out-of-the-way places, your RV is often the only lifeline you have. In many cases, an RV engine is under as much stress as a race car. And there's no pit crew to help if you break down a hundred miles from nowhere. That's why you need a motor oil that won't let you down. And that's why Pennzoil GT Performance has been stress-tested and formulated in SAE 20W-50 and 20W-40 weights. Special weights for tough protection.

A multi-viscosity oil like Pennzoil GT Performance is necessary for quick fluidity at startup. Pennzoil GT Performance provides stress resistance to heat build-up, due to hot driving conditions, as well as superior lubrication. Pennzoil GT Performance protects your engine in other important ways, too. GT Performance has special cleaning, cooling, sealing and lubricating properties that protect vehicles in dust, dirt, and other stressful environments.

That's why you need Pennzoil's state-of-the-art protection in your RV. Pennzoil—quality protection worth asking for.



**HIGH TECHNOLOGY** = **PENNZOIL**  
**QUALITY**





# WAIT TILL YOU SEE WHAT THIS BABY'LL DO.

Open it up and this little portable air compressor'll do just about anything one of those tank-mounted monsters'll do.

**SUPER PAL™ THE TANKLESS AIR COMPRESSOR THAT WORKS LIKE A TANK.**

1 hp/6.0 cfm/115 volts/U.L. Listed/Includes 3/4" diameter 25' air hose, 10-100 psi adjustable regulator, and tire chuck.



IT'LL PAINT AND PRIME.



IT'LL AIR OUT A FILTER.

IT'LL UNBOLT A SHOCK.



IT'LL INFLATE AND ROTATE.



IT'LL KNOCK OFF A MUFFLER.



**THE CAMPBELL HAUSFELD TANKLESS AIR COMPRESSOR.**

**CAMPBELL HAUSFELD**  
a Scott Fetzer company

## CAR CLINIC

*(Continued from page 14)*

*selling the vehicle?—Gary Balanesi, Daly City, Calif.*

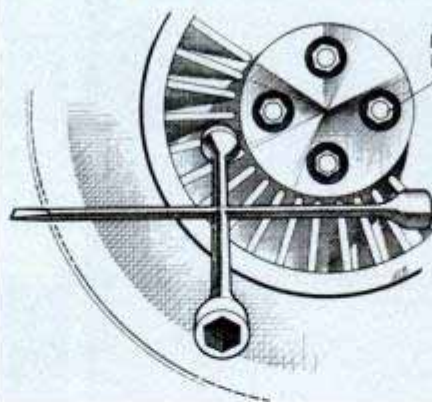
A competent engine diagnostician, working with a scope, emission analyzer, power balance tester and compression gauge, should be able to at least determine if the problem is the result of improper fuel mix, vacuum leak, ignition fault or internal engine damage.

The problem, however, must be present in order to track it down. If it only occurs under load, the test equipment may have to be used in conjunction with a dynamometer. If your mechanic can't at least narrow down the condition to a general category, find a new one who is NIASE-certified in engine tuneup to do the job.

If your mechanic does determine that the problem is the result of incorrect fuel mixture, there are a couple of unusual problems that have been outlined in recent service bulletins that may help you:

■ A bad carburetor feedback control solenoid (FCS). This part, which is on the carburetor, under the air cleaner assembly, is easy enough to check. Put your finger on it or put your ear near the carburetor. Have someone turn on

## Goodbye, you old lug



LUG NUT MAY BE MARKED "METRIC"



Be prepared to give away that old four-post lug wrench if the lugs on your new car are marked "metric." That English-measurement wrench may feel like it fits the metric lugs, but it's a trifle large and will roll over the edges. If lugs are plated, plating will fracture and give rust a foothold. Even if lugs aren't plated, the wrench may round the nut edges.

the ignition, but don't start the engine. If the FCS and solenoid circuit are working properly, you'll feel or hear the solenoid oscillating at a constant frequency. It's not? Okay—pull off the wire connector at the solenoid and test the voltage supply by connecting a d.c. voltmeter to the terminal. With the ignition switch ON, 7 to 8 v. should be present. If so, install a new feedback control solenoid (part No. E3PZ-9S565-A) and gasket (E1PZ-9S521-A). If not,

the trouble is in the electrical circuit to the FCS.

■ A problem involving the air cleaner. If the dealer has checked the FCS, your car's bad performance could be a result of a mechanic having damaged the air cleaner support bracket (the air cleaner is removed to get at the FCS), or improperly reinstalling the air cleaner. I know of a few cases in which a new FCS straightened out trouble for about 1,000 miles. Then the problem return-



ed, because improper air cleaner installation allowed dirt to get on the FCS, causing it to stick. Furthermore, the air cleaner cover must make a perfect seal over the housing. If it doesn't, the cover may be damaged and should be replaced.

In checking the air cleaner assembly, inspect the zip (flexible) tube leading from the air cleaner to the manifold. There have been instances where a ripped tube has caused the kind of problems you describe, especially when the engine is cold. Look at the bottom side of the tube. Deterioration usually begins here. If the tube is bad, replace it with one having part No. E3TZ-9A624-G.

■ A malfunctioning exhaust gas recirculation (EGR) valve can cause lean surge and rough idle. Disconnect the vacuum line at the EGR valve and plug the end of the line. Drive the Ranger. If the surge and roughness disappear, install a new EGR valve. The one you get has to be the one designed for your particular engine according to its calibration number. The Ford parts department will find this data listed in technical service bulletin (TSB) 83-13-28.

## Hoodwinked

*The rear axle of my 1976 Plymouth Volare is making a grinding noise, and gear lubricant is leaking out through the breather on the housing. My*

*mechanic took off the cover and found nothing wrong. He can't explain what's happening with the car. We're in a bind and need help.—Bill Leonard, Union, N.J.*

The two problems, grinding and leaking, may or may not be related. I can't pinpoint exactly what's causing the grind. And a mechanic may not be able to, either, without disassembling the axle.

The Chrysler service manual for the 1976 Volare includes specific instructions for tracking down rear axle noises. Generally, a grinding noise is the result of a bad pinion or wheel

bearing. The emission of lubricant through the axle breather may be caused by heat buildup from a bad bearing. On the other hand, it's possible that the leak is not related to the noise. Perhaps the rear end was overfilled. This can occur if it was filled while the rear of the car was jacked up and the front was not. **FM**

## DO YOU HAVE A CAR PROBLEM?

*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 discussed in the column.*

If you're like most weekend wood cutters, you want a chain saw that will run and run and run.

Well, that's the kind of performance you get from a Husqvarna Rancher.

Every part of a Husqvarna Rancher—from its fully automatic chain brake to its excellent anti-vibration system—is built to run hundreds and hundreds of hours without stopping.

And, if by some chance, anything should ever stop running on a Husqvarna, it can be repaired quickly and easily at a Husqvarna dealer. Because we won't let a dealer sell our saws, unless he can service our saws.

So if your chain saw isn't running the way it should, run out and get a Husqvarna Rancher at your local Husqvarna dealer.

## SERVICE TIPS

■ Have you been unsuccessful in getting rid of a spark knock (ping) in the 2.8-liter engine of a 1983 GM A-car? If so, GM recommends you retard engine timing from 10° BTDC to 6° BTDC.

■ An "unrepairable" knock from a 1983 Ford LTD or Mercury Marquis 3.3-liter engine coupled to a C5 transmission may just be a misaligned rear engine cover plate hitting against torque converter studs. Remove the inspection cover plate at the lower end of the transmission housing. Then, use a long screwdriver to pry the engine cover plate away from the converter.

■ Chrysler cautions owners of 1980-84 rear-wheel-drive cars that a leak at the heater core-tank seam may have been caused by oil in the cooling system that damaged the rubber seal. If so, that oil has to be removed by draining and cleaning the cooling system before a new heater core is installed. Advise your dealer that the caution is given in TSB 24-08-83.

■ Does fluid in the rear windshield reservoir of your 1982 Honda Accord hatchback siphon out when the car is parked nose-up on a hill? If so, open the hatchback door, cut the rear washer hose in half and install a check valve (Honda code No. 129217). Push the two hose ends all the way onto the valve and make sure the arrow on the valve points toward the washer nozzle.



## MARATHON RUNNER

### FREE SPLITTING MAUL OFFER

Get a free Husqvarna wood splitting maul with a \$29.95 suggested retail price when you buy a new Husqvarna 37, 44, 50 or 61 Rancher chain saw, at participating dealers, while supplies last.

 **Husqvarna**  
SWEDEN  
**The Chain Saw Professionals.**

For the dealer nearest you consult your Yellow Pages. Or write Husqvarna, 224 Thorndale Avenue, Bensenville, Illinois 60106.



# THE PM GARAGE



## Carwash to go

The Thunder Gun Auto Wash Power Washer has the look and feel of the pistol-grip wands at coin-operated commercial car washes. It attaches to your garden hose and siphons a soap solution from a used plastic milk bottle that you can sling over your shoulder. Separate ON-OFF switches control the flow of water and soap. Thunder Gun does

not eliminate the old bucket and cham-  
mois—you still have to scrub the car with  
a clean rag or sponge, and dry it off—  
but it sure speeds up the soaping and  
rinsing. We washed a VW Vanagon in  
under 15 minutes. Sold by Briar Indus-  
tries Inc. (Box 87, Norman, Ark.  
71960). Thunder Gun's price of \$34.95  
includes postage, and detergent. —W.H.



Thunder Gun and an empty jug supply the suds. You still must supply the elbow grease.

## Easy oiler

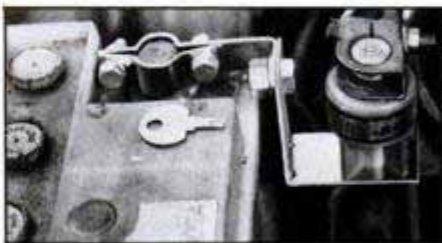


No muss, no fuss, no funnel, no spout.

Quaker State is offering its entire line of motor oils in easy-to-pour, European-style plastic containers that eliminate the messy spouts, funnels and rags usually associated with adding or changing oil. Long-neck, 1-qt. bottles and 5-qt. jugs will be available by summer at no increase over normal prices. Owners of 3½-qt.-capacity engines can easily recap half-empty bottles. For more information, contact Quaker State Oil Refining Corp., Oil City, Pa. 16301. —W.H.

## Cutting crash fires

Most car crash fires start when shorted wiring ignites fumes from spilled fuel. Fire-Ban impact switch automatically



Impact switch is clamped to battery post.

kills all circuits and isolates the battery in impacts of 22 mph or greater in 6 milliseconds, its maker claims. It can also be used as a no-start-type anti-theft device, or to isolate the battery when working on the electrical system, by turning it off with its key or a small screwdriver. Made by Eagle Automotive Products Co., Van Nuys, Calif. 91405, it's \$24. —Angus Laidlaw

## Magnetic timing tester

Magnetic timing testers with a probe that you insert in a holder at the timing marks aren't new. Until now, however, they were limited to GM, AMC and



Magnetic timing tester can be used with ease on Ford, GM, AMC and Chrysler motors.

Chrysler because, on those makes, the holder is the same place (9.5° to 10° after top dead center). Fords have off-

sets of 15°, 45° or 52.5°, depending on the engine.

Now there's a new, microprocessor-type digital tester you can use on anything, because you can punch in any offset you want, up to 90°. It also comes with special bushings for Ford and Chrysler.

Flip a button to get the exact offset, then read the timing on the digital display. The tester also has a built-in dwell-tach, so you can check rpm before timing. When I tried the unit, all three functions showed up dead accurate compared with equipment known to be right.

List price for the tester is \$200. It's made by Kal-Equip, Box 188, Otsego, Mich. 49078, and sold through parts jobbers as No. 2831.

It's also available through AC-Delco dealers as No. ST-129.

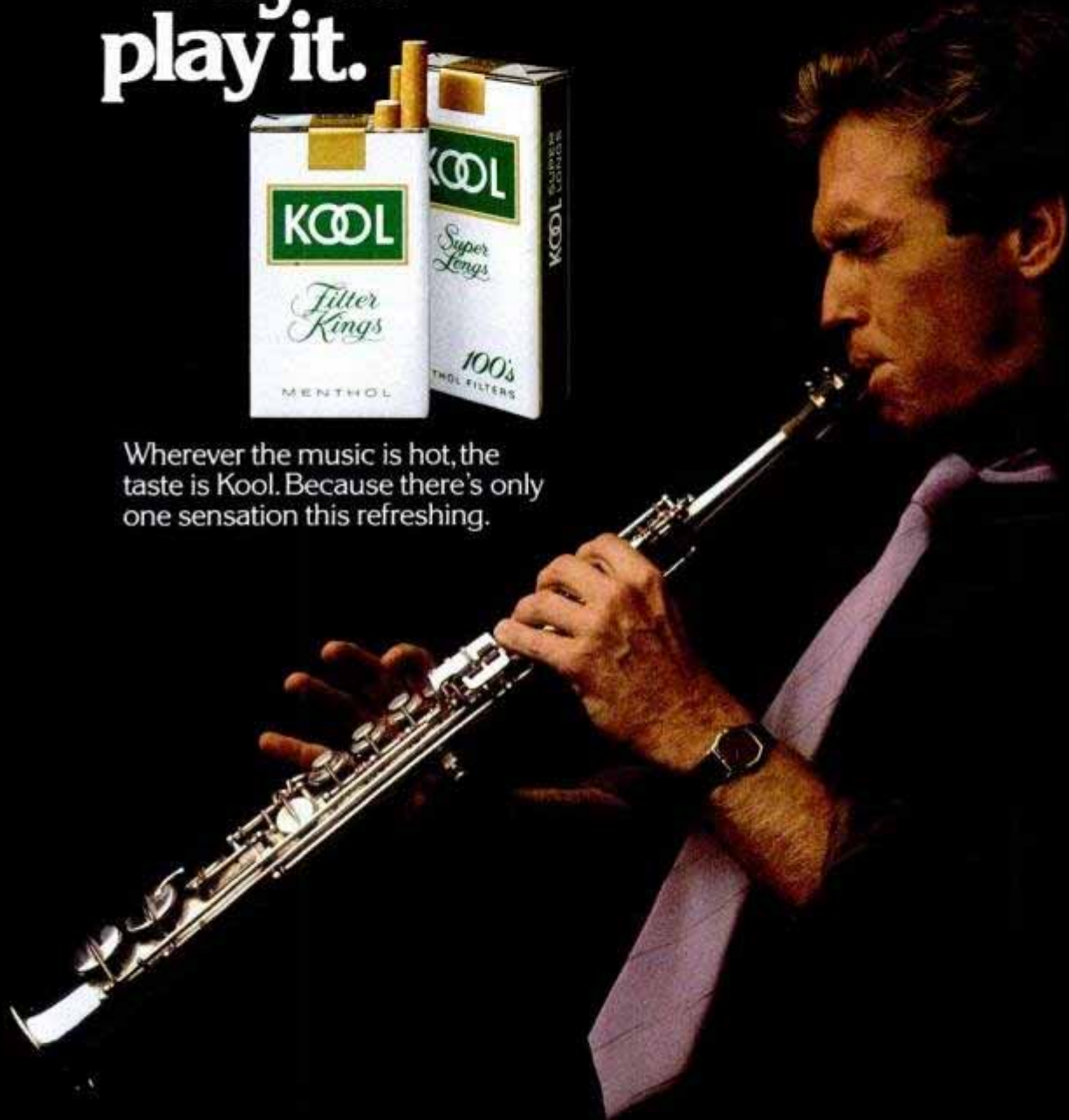
—Paul Weissler



There's  
only one  
way to  
play it.



Wherever the music is hot, the  
taste is KOOL. Because there's only  
one sensation this refreshing.



Kings, 17 mg. "tar", 1.1 mg. nicotine; Longs, 14 mg. "tar",  
1.0 mg. nicotine av. per cigarette, FTC Report Mar. '83.

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



# Introducing the

The new Honda Civic Wagon has many advantages. Some obvious. Like its added roominess and new aerodynamic profile. And some not as obvious. In back, for example, we have hidden two secret compartments. One is under the floor.



And the other? Well, if we told you that, everyone would know.

Under the passenger seat we've tucked away a sliding drawer. And we've split the rear seat so you can fold away one or both sides.





# 4-drawer Civic.

On the dash, a coin box keeps your change and valuables out of sight.



Of course, the new Civic Wagon is built to carry more than loads of stuff. It also carries people very comfortably.

In every way, the new Honda Civic Wagon is a remarkable vehicle. That's something we couldn't hide if we tried.

**HONDA**

The Civic Wagon





# HOMEOWNERS' CLINIC

## Treating dry rot in a crawl space

We recently purchased a home in the Pocono Mountains of Pennsylvania. The home is 10 years old and has a 4-ft.-high crawl space with a dirt floor. The crawl space is wet during the rainy season. The house has a musty odor and some of the beams in the crawl space have white blotches that are soft to a fingernail touch. I believe the beams are dry rotted. How should I treat this problem?—Phil Speciale, Philadelphia

Rot (wood decay) is caused by microscopic, plantlike fungi that grow within the wood and attack the cell walls. The fungi thrive in a wet/damp environment and will only grow and develop when the moisture content of the wood is greater than 20 percent. Musty odors and white staining on wood are also the result of fungi, although not the type

that causes rot. Since rot can only develop in wet wood, the term "dry rot" is a misnomer. It evolved because wood that is in an advanced stage of rot, when dry, will crumble and break into small cubes.

To correct your problem, you must dry out the crawl space, or at least minimize the moisture buildup. By controlling the moisture in the crawl space, you will eliminate further rot deterioration of the wood framing. If you can't penetrate the beams beyond a fingernail, they are still structurally adequate. However, if an ice pick or screwdriver penetrates them easily, they should be replaced.

The dampness in the crawl space is the result of condensation and seepage. Normally, you can control condensation by installing ventilation open-

ings on all sides of the crawl space, and covering the dirt floor with plastic sheets, overlapping the joints.

A formula for determining the total square footage of needed vent openings is  $T = (6L + A) \div 300$ , where L is the perimeter of the crawl space in linear feet and A is the area of the crawl space in square feet. A dehumidifier can also help control moisture.

If the crawl space gets wet because of water penetration, you must locate the source of the water and eliminate it. Faulty gutters and downspouts, a high water table and leakage through foundation walls are some causes. Correcting the problem requires regrading around the house, redirecting downspouts away from the foundation, installing a sump pump and perforated drain tiles, or sealing foundation walls. Sometimes, all four steps are needed to dry the crawl space.

## Carpeting a basement

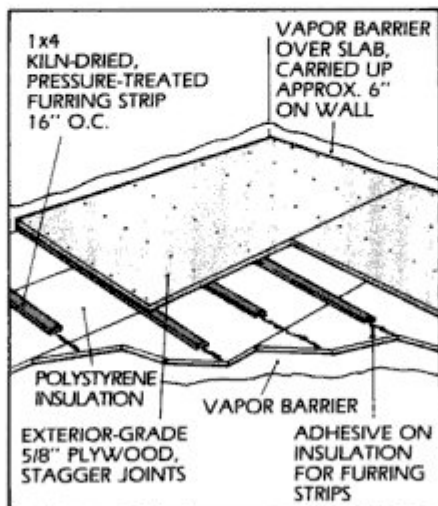
I would like to put regular carpeting and padding on a basement floor and over an outside enclosed porch floor. They are both concrete on a Visqueen vapor barrier over a slab base. How can I moisture-proof this type of surface so that dampness and moisture don't penetrate through the carpeting? I would also like to put some type of insulation on the floor. What would be the best type, and what would I put over that as an underlayment? I am aware of one method: Put a foundation coating on the floor, 15-pound felt on the coating, furring strips on the felt and 1/4-in. tempered Masonite on top. Will this achieve the results I want?—John C. Cunningham, Pittsburgh

Another reader, Michael Kirsh of Kenosha, Wis., has a concrete floor that is spalling off in 2-ft. areas, up to 1/2-in. deep. After he fills in the spalled areas with mortar, he may wish to follow our suggestions for your project.

If you're certain that you have an undamaged vapor barrier under your slab, you really don't need a second one. However, there's always a chance it was pierced during concrete placement, so you're wise to install another. Try using 6-mil polyethylene. It is much easier to install and only needs

adhesive to spot-fasten the sheet about 6 in. up the wall.

On the vapor barrier, place polystyrene insulation (1 in. minimum thickness) over the entire floor area. When it's down, place 1x4-in. kiln-dried, pressure-treated furring strips every 16 in. at right angles and on top of the insulation. It is important that the polystyrene have a minimum compressive strength of 25 pounds per square inch.



Before carpeting a basement, apply a polyethylene vapor barrier, polystyrene insulation, furring strips and exterior plywood.

Dow's Styrofoam TG brand insulation meets this requirement.

The furring strips may be glued to the insulation board with a bead of Styrofoam No. 11 mastic (see drawing). Glue and nail 1/4-in. exterior grade plywood at right angles to the furring strips with ring or spiral nails 6 in. on center at the edges and 10 in. on center on interior strips. Allow a 1/16-in. space between panel ends and 1/8 in. between panel edges. All the plywood joints must be located in the middle of the furring strips.

When you're finished, sand off any irregularities at the plywood joints, and you're ready to put down the new carpeting.

The 5/8-in. plywood is not only to better span the furring strips, but is usually required by most building codes as a 15-minute fire barrier over the insulation. Since codes vary, make certain that you check with your local housing authority for compliance. **PM**

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 the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.



# MOTORCRAFT. NO OTHER LEADING FILTER TRAPS AS MUCH DIRT BECAUSE NO OTHER LEADING FILTER LASTS AS LONG.

**NOT FRAM.  
NOT PUROLATOR.  
NOT AC.**

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The Radial All-Terrain T/A is built strong and rugged to maximize truck dependability—off the road or around town. Its tread pattern delivers remarkable wet and dry traction on all kinds of terrain and a quiet ride on-the-road.

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  - B. Folded belt system provides excellent handling plus strength.
  - C. Tread pitch sequencing offers quiet ride.
  - D. Dual compound tread imparts outstanding mileage.



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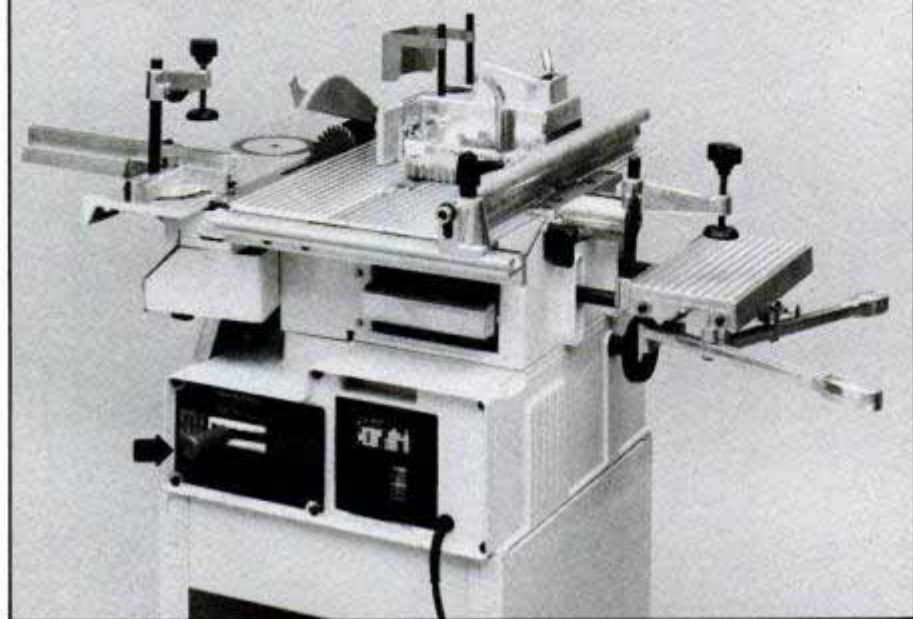
**WE MAKE TRUCKS PERFORM**



# THE PM WORKBENCH



## A woodworking supertool



This multiple-function woodworking machine features a convenient, single control lever (arrow) that enables you to switch from one operation to another in just seconds.

Multiple-function woodworking machines are becoming popular items in many home workshops. For the serious woodworker, these machines offer the ability to perform several functions from one space-saving, relatively low-cost machine.

This unit, the Zinken Model MIA-6 combination woodworking machine, has two unique features. First, it's compact and lightweight (105 pounds) for use at the jobsite. Second, a single con-

trol lever allows you to switch from one operation to another in just a few seconds, thus eliminating setup time completely.

The MIA-6 functions include a table saw with sliding carriage, shaper, horizontal borer/mortiser, jointer and thickness planer with power feed. It sells for about \$1,400.

For more information, contact Woodworks International, 634 Hope St., Stamford, Conn. 06907.—J.T.

## Sanding tool kit

The Ali-Gator-Grit Master Pack is a complete workshop sanding kit. The kit contains three backup pads with adhesive-backed abrasive discs, a tool-sharpening kit, abrasive sheets for an orbital sander, a V-shaped hand sand-



This complete workshop sanding kit comes with easy-to-use, adhesive-backed abrasives. Most of the sanding accessories shown here are for use in a portable drill.

er, three barrel sanders with abrasive refills, one flexible brush-sander and one sand/buff wheel. The complete kit is available for \$34.94 postpaid from Sanding Tools of Ohio, Box 1677, Fairborn, Ohio 45324.—Rosario Capotosto

## Service manuals

John Deere offers four books showing the basics of servicing and repairing compact tractors and small, engine-



Learn to service and repair equipment with these books. No brands are cited; only generic principles are covered.

powered equipment. The manuals cover: engines (\$10.50), electrical systems (\$9.50), power trains (\$8.40) and hydraulics (\$8.40). Order all four books for \$33.10. Write to: John Deere Distribution Center, Dept. 944, 1400 Third Ave., Moline, Ill. 61265.—J.T.

## Unparalleled planes

E.C. Emmerich Co. of Remscheid, West Germany, has been manufacturing the world's finest wood planes since 1852. Shown in the foreground is their Primus smoothing plane (about \$90) made of pearwood with a lignum vitae sole (a tropical wood impregnated with natural oils for smooth planing). In the background is the Expert Model 605 (soon to be available) made of red beech with a white beechwood sole. E.C. Emmerich planes are available from many fine woodworker supply houses as well as at larger Sears stores.—J.T.



Wood-bodied Primus planes feature a knurled knob and lever mechanism for easy and precise plane iron adjustments.



# "4X4 OF THE YEAR"

**For the first time ever, all three leading off-road magazines made the same choice. Jeep.**

If you're thinking about 4-wheel drive, consider this. The all-new leaner, meaner size Jeep Cherokee has just been named "4x4 of the Year" by all three leading off-road magazines: 4 Wheel & Off-Road, Four Wheeler, and Off-Road. That's never been done before.

#### **Ride and drive is what it's all about.**

The all-new Cherokee was compared to the toughest competitors available, foreign and domestic. They were driven thousands of miles through snow, soft sand, subfreezing temperatures, and high winds—on and off the road.

4 Wheel & Off-Road said:

"Cherokee scored well across the

board, excelling in our evaluations of mechanical, urban and off-road driving and interior comfort." Four Wheeler called the Cherokee Sportwagon: "the year's most significant advance in 4-wheeling." Off-Road said: "Jeep is a smaller, more maneuverable off-road vehicle that provides plenty of room."

#### **Test drive it and compare for yourself.**

Compared to Bronco II and S-10 Blazer 4x4, only Cherokee has four doors, room for five, and a choice of two

4-wheel drive systems. And Cherokee has higher ground clearance, higher horsepower per pound, and the highest gas mileage, (24) EPA EST MPG/33 EST HWY.\*

It's nice to be named No. 1, but not unexpected. After all, Jeep wrote the book on 4-wheel drive. Buy or lease the triple award winning Cherokee, or the luxurious new Wagoneer Sportwagons. Only at your Jeep dealer.

\*Use these figures for comparison. Your results may differ due to driving speed, weather conditions and trip length. Actual highway mileage and California figures will probably be less.

**SAFETY BELTS SAVE LIVES.**

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**Triple award winning**

**JEEP**  **CHEROKEE SPORTWAGON**



# NEW —NOW

## HOME & SHOP

### Programmable saw

An electronic, 10-in. radial-arm saw is now offered by Sears, Roebuck and Co., Sears Tower, Chicago, Ill. 60684.

The 1½-hp saw is equipped with a microprocessor and features a digital display and touch control panel for automatic blade height elevation. This eliminates the need for crank handles.

Simply program in the desired blade height on the push-button control panel. Then, as the digital display reads out the blade height to .005 of an inch, the saw automatically raises or lowers the blade to the programmed height. An elevation jog button allows you to raise or lower the blade in .005-in. increments with each touch of the button. The digital display also reads bevel and miter angles to half a



degree. The saw is available through the Sears Spring/Summer catalog and at larger Sears stores for about \$700.

### Handheld fire fighter



The Flam-X portable fire extinguisher measures only 3 × 6 in., but is claimed to be effective against the major classes of fires: solid fuel, liquid, electrical and chemical. When Flam-X is discharged, halon, a liquefied, nontoxic gas, is released to suffocate the fire quickly. And according to the maker, Flam-X evaporates completely, leaving no residue on surrounding areas.

Flam-X is handy in the home, workshop, garage and car. It's available at hardware stores and from Flam-X USA, 1734 West Pembroke St., Hampton, Va. 23361, for \$14.95 postpaid.

### Remote-control switch



You won't have to enter a dark house again with the Genie remote-control switch. It operates lights and small appliances up to 300 ft. away, according to the maker. The system consists of a handheld transmitter and an outlet-mounted receiver. It's available for about \$60. For details, contact Alliance Manufacturing, 3040 West Market St., Akron, Ohio 44313.

### Cordless jigsaw



Black & Decker introduces a cordless jigsaw for woodworking and light-weight metalworking. The saw and 9.6-v. rechargeable battery pack sell for about \$144. Two charging units are offered: a 120-v. wall-outlet model (\$49) and a 12-v. charger that operates from a vehicle's cigaret lighter (\$60). Contact Black & Decker, 626 Hanover Pike, Hampstead, Md. 21074.

### Powerful new riding mower



The John Deere Model S-92 rear-engine, 38-in. mower (\$1,849) has an 11-hp engine—the most powerful rear-engine mower Deere has ever built. Features include electric starting,

five-speed transmission and disc brake. Deere claims the S-92 can mow an acre of grass in less than an hour. Contact Deere & Co., John Deere Rd., Moline, Ill. 61265.

PM



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Turbo V is the first motor oil specially formulated to

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Get new Valvoline Turbo V. Extra protection for any engine. The only protection for turbos.

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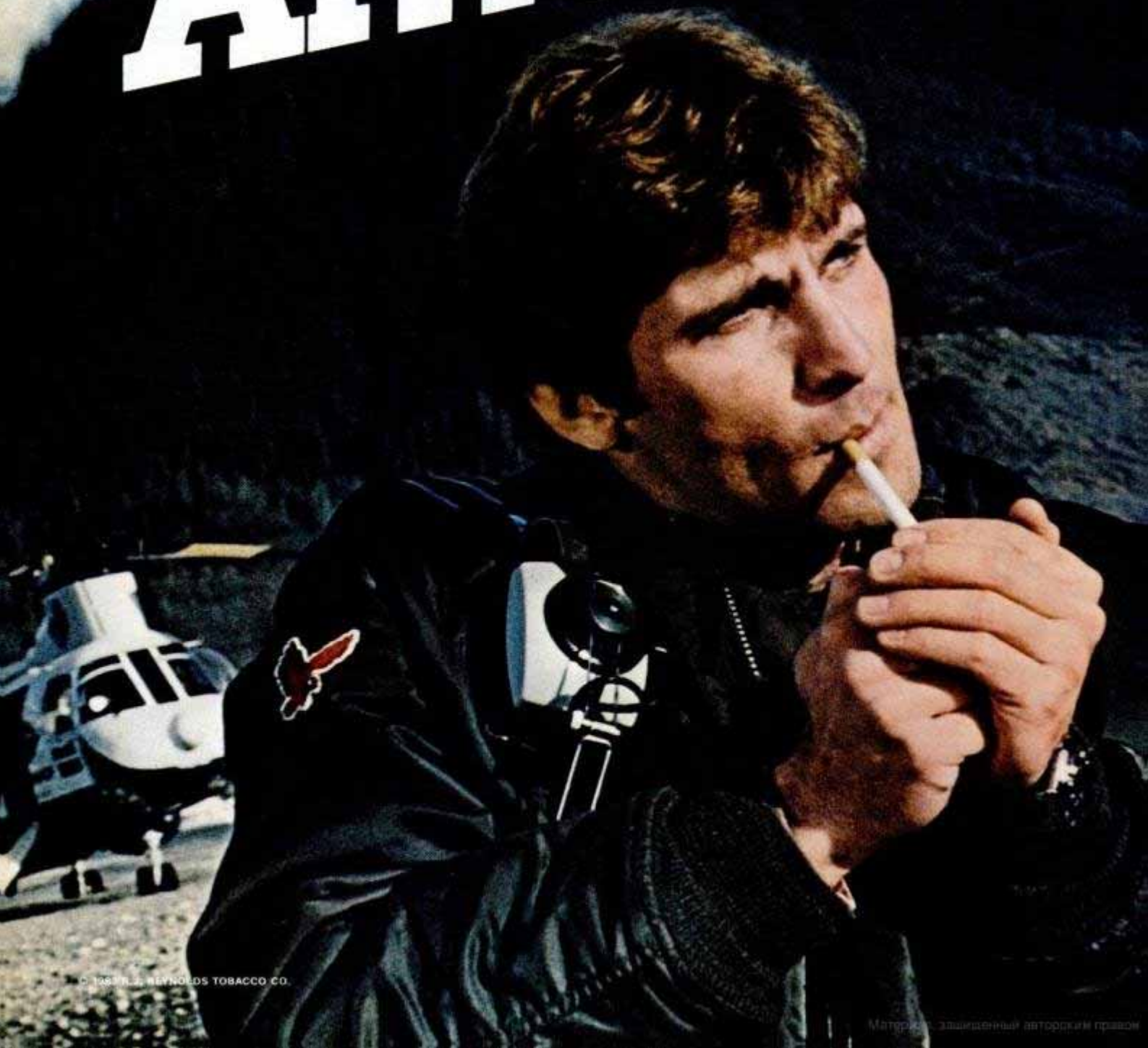


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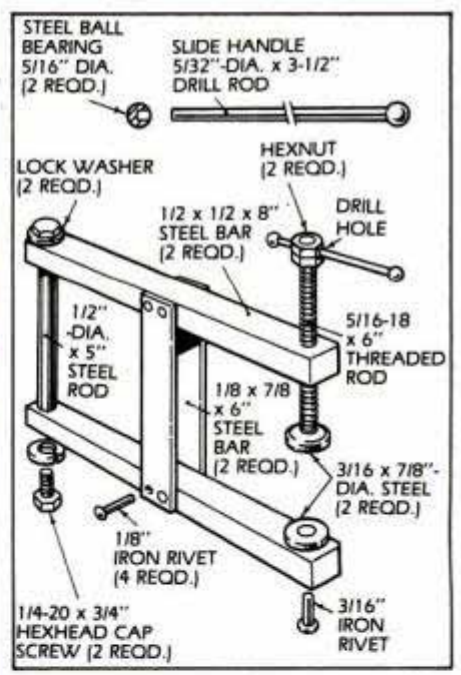
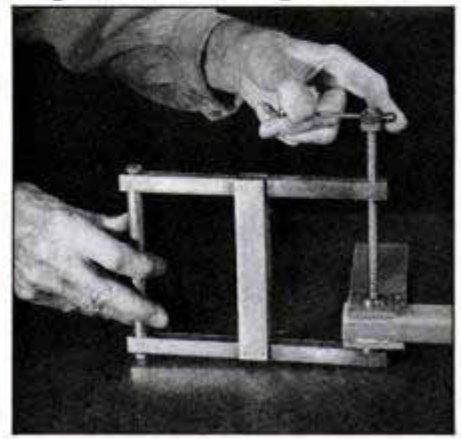
The Stihl® FS-50E gas-powered trimmer has all the power you need to cut through tough weeds and grass. Yet it weighs just 10.5 lbs. And after the trimming is done, clean up is easy with the BG-60E Airbroom. It makes raking and sweeping a thing of the past. Both lawn tools are equipped with easy starting, electronic ignition systems. For quality power equipment, Stihl's **STIHL**® the One. The World's Largest Selling Chain Saw



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 Ontario N6A 4G3.  
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## HINTS FROM READERS

### Improved C-clamp



This homemade C-clamp is more rigid than commercial C-clamps. It doesn't open and throw parts out of alignment when it's overloaded, as do standard C-clamps. The materials used in our clamp are 1/2-in. square steel bar, 5/16-in.-18 threaded rod, 1/2-in.-dia. steel rod, two 1/8 x 7/8-in. flat steel bars and assorted rivets and bolts. The optional ball ends of the sliding handle rod are steel ball bearings. Anneal the bearings by heating them until they're bright red, then letting them cool in the air. Drill and secure them to the rod with cyanoacrylate adhesive.—Frederico Strasser and Walter E. Burton



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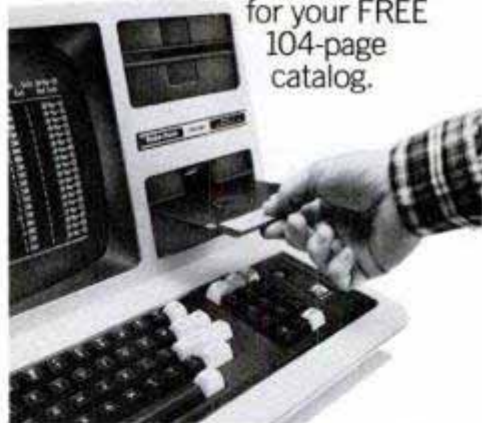
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The new generation 1984 Toyota trucks are turning the truck world upside down, because they're the most advanced trucks ever built. But if one truck had to do it all by itself, this would be the one.

It's the all-new Standard Bed with a big, powerful 24 liter SOHC engine, powering a 1,400-pound payload\* with ease. However, the biggest news is the price — \$5,998\*\* — making it Toyota's lowest-priced truck. Low price doesn't mean compromise, either. Besides the 24 liter SOHC engine, 4-speed synchromesh transmission, and fully transistorized

ignition, the Standard Bed comes with all this equipment: power-assisted brakes with ventilated front discs and rear drums, steering-column controls designed for ease of operation, mist cycle wipers with twin stream washer, and the comfort of full three-across seating.

This truck is designed to be easy on the eyes. But the exciting new wedge-shaped front is not just for good looks. It's part of overall improved aerodynamics. Add-

**1400 lbs.\***

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**TOYOTA**

front and side windows with the bonus of reduced wind noise. The Toyota Standard Bed.

**\$5998\*\***

It'll measure up to your tough demands for an all-around machine. And you'll see why it's one of the new generation 1984 Toyotas turning the truck world upside down.

\*Including occupants, equipment and cargo.  
\*\*Manufacturer's suggested retail price. Dealer's actual retail price may vary. Price does not include tax, license, transportation, optional or regionally required equipment.

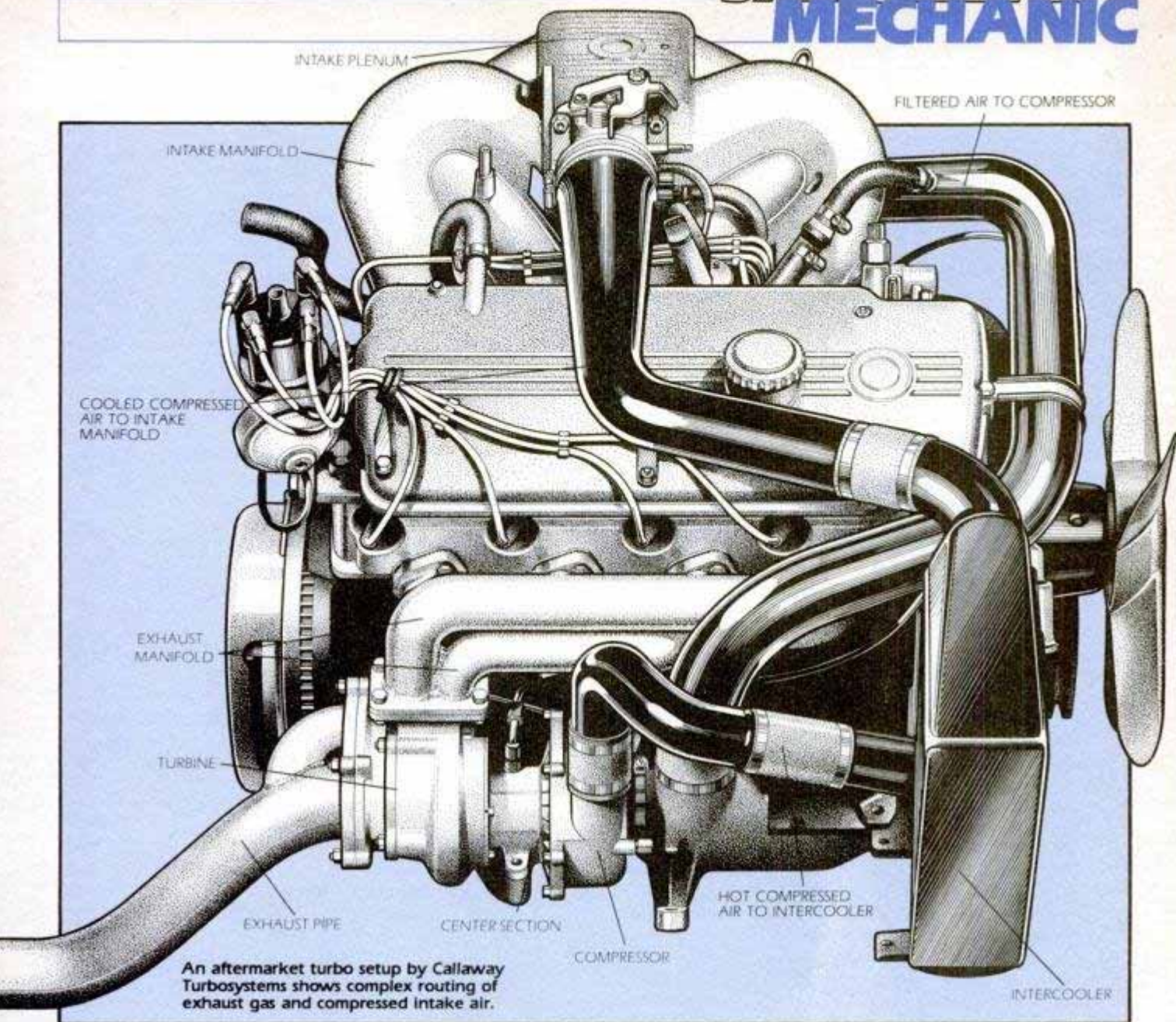
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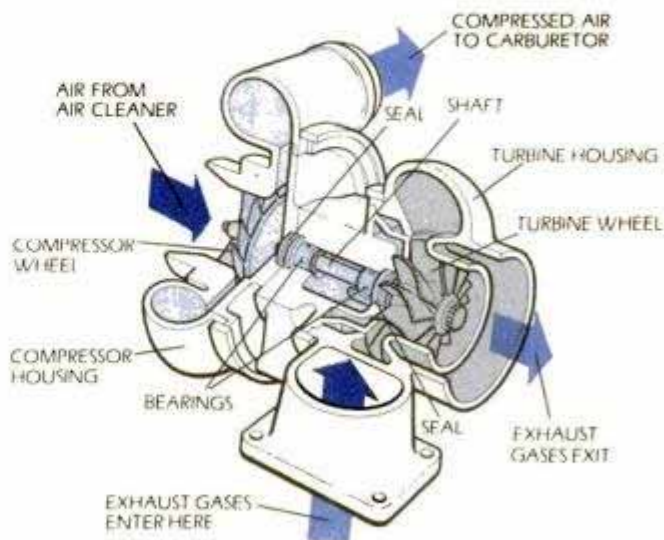


An aftermarket turbo setup by Callaway Turbosystems shows complex routing of exhaust gas and compressed intake air.

## Turbocharger Maintenance And Repair

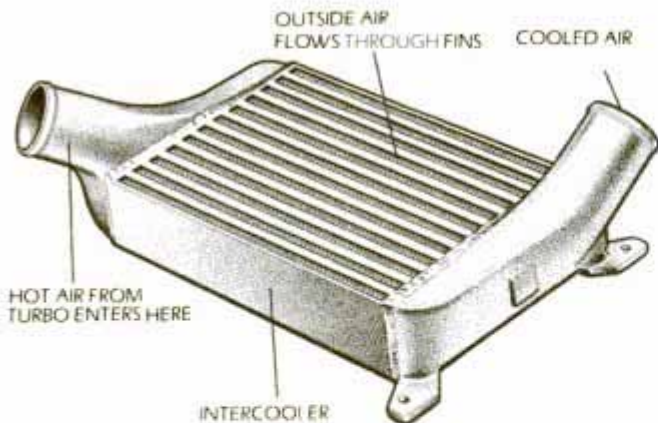
BY BRAD SEARS

**A**n underhood device that can improve the performance of today's small engines while maintaining at least some of their former fuel economy—the turbocharger—has become quite widely used in the past several years. The turbocharger is a relatively simple device that increases the pressure in the intake manifold of an engine, forcing more fuel and air into the cylinders. The power needed to operate the turbocharger, which is nothing more than a simple centrifugal compressor, is derived from the unused energy in exhaust gases that flow out of the tailpipe. These gases are



Cutaway view of the turbocharger unit shows the shaft bearings and the seals that depend on a constant supply of oil.





1 Acting as a simple air-to-air radiator, an intercooler will cool the compressed air coming from the turbo output.

routed into a turbine, causing it to spin at speeds up to 120,000 rpm. The turbine turns a shaft connected to the centrifugal compressor, or impeller. The impeller accelerates the air-fuel mixture to a high speed, resulting in increased pressure in the intake manifold. This higher pressure causes the cylinders to fill more completely when the intake valves open.

Increasing the volume of mixture that flows into the cylinder is somewhat like increasing the compression ratio of an engine. Although it will increase performance, there is an associated problem of detonation. The heat generated by compressing the intake mixture and heat brought to the turbocharger housing by the exhaust adds to this problem.

Auto manufacturers have recognized these problems and added either or both of the following controls: The first is a diaphragm-controlled waste gate valve that opens when manifold pressure rises above a predetermined level. The waste gate is in the exhaust system, upstream from the turbine. When it opens, exhaust gas goes around the turbine, limiting boost and reducing exhaust back pressure.

The second device is an electronic spark-advance control system that uses a knock sensor mounted on the engine to listen for detonation. When the sensor detects the rattle of detonation, the engine computer or control module retards timing until the detonation is gone. Some systems open the waste gate to reduce boost when detonation occurs. The newest systems regulate both boost and timing.

To combat the increase in temperature caused by compression of the intake mixture, a heat exchanger called an intercooler is placed between the turbo and the engine on many cars today. Outside air flowing over the radiatorlike intercooler carries away the turbo-generated heat inside, making the mixture that goes into the cylinders more dense (Fig. 1). This increases power considerably, while making the engine less prone to detonation.

### Increasing turbo life

It is estimated that the average life of a turbocharger in the real world is 30,000 to 50,000 miles, but that figure depends on how well the car and the turbo are looked after. There are reports of turbos giving well over 100,000 miles of useful life, but these units have received exceptional care. When one figures that a turbo center section replacement cost is more than \$300, plus labor, then maintenance gains new importance. The turbocharger's life can be increased by following a few simple rules:

1. Keep the engine oil clean and change it often. The technicians at the Callaway turbo installation center in Old Lyme, Conn., claim that 2,500-mile oil and filter changes are mandatory. The turbocharger becomes very hot in oper-

ation and will quickly deteriorate the engine's oil that is used to lubricate the center bearing.

2. They also recommend that an oil temperature gauge be installed and that the driver not call for turbo power (stay off the gas pedal) until the engine's oil temperature is up to 85° C.

3. If the oil temperature approaches 125° C., they further recommend that an oil cooler be installed on the car (Fig. 2). But they warn against installing an oil cooler that is not thermostatically controlled, because keeping the oil too cool can be as harmful as allowing the oil to become too hot. The oil in any engine must get warm enough to vaporize unburned fuel and water condensation so that the positive crankcase vent (PCV) system can draw them away. They recommend that oil temperature stay near 110° C.

4. Since exhaust gas temperature is about 1,300° F. when driving, according to Callaway, but idling gas temperature is only 850° to 950° F., they recommend that the engine be idled for a minute or so before you shut it down. This also allows the shaft and blades to slow down or almost stop, so there will be no bearing damage when the engine oil pressure drops as the engine is shut off.

### Troubleshooting

If you are a serious turbo driver, you should "baseline" your car (run it through a series of road tests) and keep notes on its performance for future reference. The numbers that you should record and keep at hand are as follows:

1. The turbo boost cut-in speed. To determine this, accelerate from a relatively low speed in top gear at full throttle, observing the engine rpm when turbo boost begins. To accomplish this, your car must be equipped with a tachometer and a turbo boost gauge.

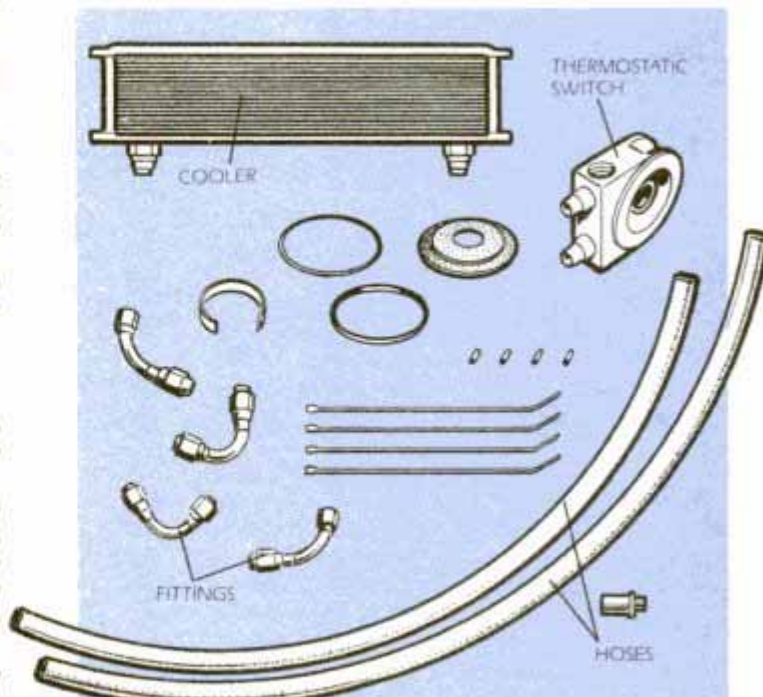
2. Record the maximum turbo boost at full throttle at legal road speed on a level stretch of road.

3. Record a 0-to-60-mph time, or the acceleration time between two landmarks, such as telephone poles.

4. Record the normal oil consumption.

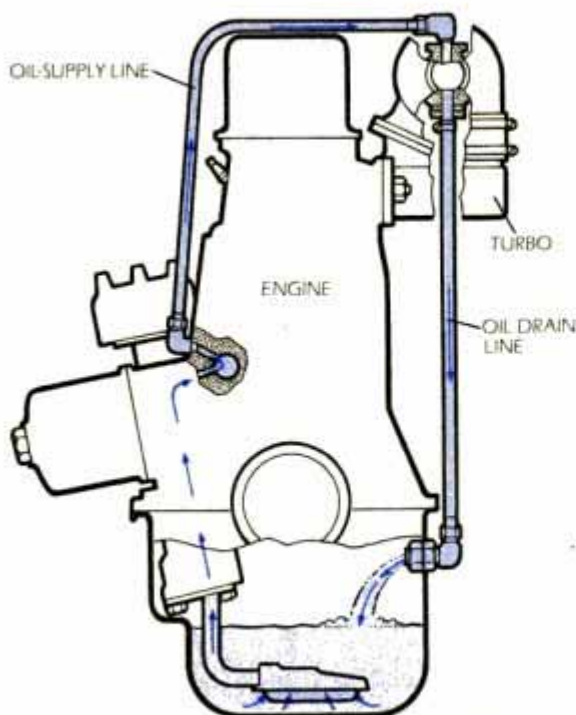
5. Record the normal fuel consumption.

Should you have any future doubts about the perfor-



2 It makes good sense to use oil coolers on turbocharged engines. Be sure to install a thermostatically controlled model.





3 Oil return lines from the turbocharger must be free-flowing and be properly located to prevent lubrication failures.

mance of the turbocharger system on your car, you will have accurate reference material to draw from.

Problems that could cause you to suspect turbo failure fall into three categories:

1. Oil consumption or blue smoke from the tailpipe.
2. Noise from the turbo, detonation or spark knock.
3. Lack of performance.

Diagnosis is the most difficult part of turbocharger service, but the following checklist should help:

To diagnose detonation or spark knock, begin the same as with any normally aspirated engine:

1. Check fuel quality by filling the tank with the highest octane fuel you can find.
2. Check basic ignition timing.
3. Check the electronic spark control system, or the vacuum/centrifugal advance system.
4. Check exhaust gas recirculation system. An inoperative EGR system is often the main cause of spark knock.
5. Check the heated intake system on the air cleaner.
6. Check air-fuel ratio. A lean mixture will sometimes cause spark knock. This could be a malfunction in the carburetor, fuel-injection system, or the oxygen sensor that feeds information to the fuel-monitoring system.
7. Check sparkplug heat range and condition. Too hot a plug can cause detonation.
8. Check engine operating temperature.
9. Check for carbon buildup on pistons or combustion chambers.

If your engine uses excessive oil, do the following:

1. Check turbocharger seals.
2. Look for external oil leaks.
3. Inspect the PVC system.
4. Check for restricted or improperly installed oil-return line from the turbocharger.
5. Look for the problems of a normally aspirated engine, such as worn valve guides and piston rings.

If you are plagued by poor performance, check for the following conditions:

1. Dirty or restricted air cleaner.

2. Normal engine tuneup problems.

3. Mechanical problems in the engine. Do engine cylinder leak-down test and check timing chain or belt.

4. Exhaust system restricted. Check all pipes for kinks and the catalytic converter for restriction. A vacuum gauge works well here.

5. Center section bearing binding, impellers loose on shafts or hitting the inside of the housing.

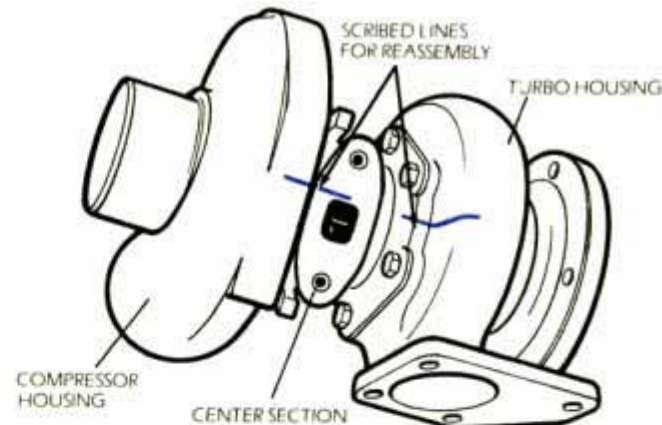
6. Waste gate inoperative, stuck open or restricted with built-up carbon. Pressure signal line from the manifold to waste gate control diaphragm leaking or disconnected.

## Excessive oil consumption

Oil problems occur when the seal in the center section of the turbocharger has been damaged by excessive heat or lack of oil, when the center bearing in the unit is worn or when the oil return line to the crankcase is restricted.

Under normal conditions, oil is forced into the turbo's center section under oil pump pressure, then returns to the oilpan. One of the biggest problems with retrofit, do-it-yourself turbocharger installations is an oil return line that is either too high or else enters the engine below the level of the oil (see Fig. 3).

There are two seals in the center section of the turbo housing that separate the oiling system from the intake compressor and the exhaust turbine. Oil leaking into the intake side can usually be spotted by removing the intake hose between the turbocharger and the intake manifold, and checking for an oil film on the inside surfaces of the intake system. A leak on the exhaust side is not so easily spotted, because the high temperature exhaust will burn the oil as soon as it enters the system.



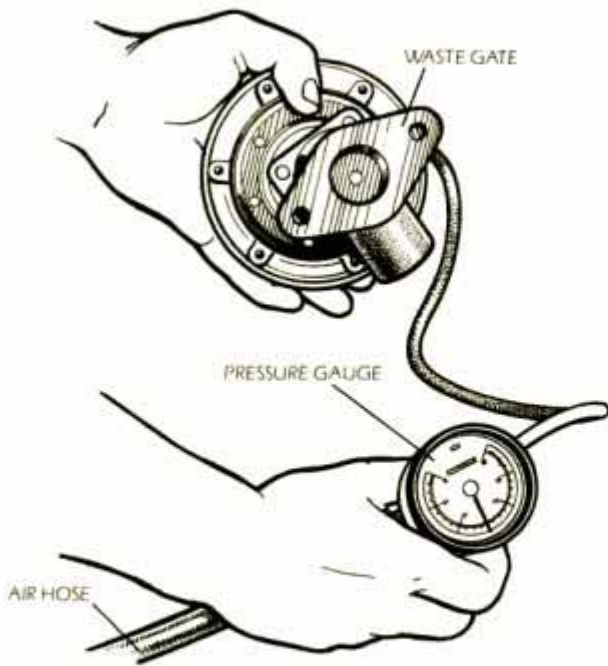
4 Before taking apart the turbo, it's smart to scribe a reference line on the housing sections to ensure proper reassembly.

## Servicing the turbocharger

Problems with the center section of the turbo require its replacement. Before removing the unit, label the lines going to the turbocharger and the waste gate for correct reinstallation. Remove the outlet from the compressor to the carburetor or intake manifold. Tape over the outlet to the engine with duct tape to prevent small objects from falling into the intake manifold.

Disconnect the line from the air filter to the compressor and tape it shut, as well. Remove the exhaust system from the turbine side of the unit. Removing the exhaust inlet from the housing will be about as difficult as removing a front exhaust pipe from a manifold or header. Care must be taken to keep from breaking the bolts or studs in the manifold or rounding off the corners of fasteners. Use new bolts or studs on reassembly. Penetrating oil can help, too.





5 The operation of most waste gates can be checked by using a regulated source of compressed air and an air gauge.

Most turbochargers are made up of three sections. Place yours on a bench and scribe a line across all three sections as a reference for reassembly (Fig. 4). Remove the bolts that hold the two housings to the center section and separate the three pieces. On some units the waste gate assembly is connected to the turbo, and its linkage will have to be disconnected to separate the housings.

Visually check the inside of the housings, both turbine and compressor, for signs of oil leaking past the seals. Also check the compressor and turbine blades for signs of contact between the blades and the case, damage caused by debris getting into the housings, buildup of combustion by-products on the blades or in the housings or for bent, burned or cracked blades. Spin the rotating assembly; if it binds or drags, the center section must be replaced.

If the visual inspection shows no problems, check the bearings. There should be .001-in. to .003-in. of end play in the center section shaft. The easiest way to check this is with a dial indicator; there should be between .003-in. and .006-in. of clearance between the bearing and the shaft. A special dial indicator with an offset shaft and a mounting adapter are needed to make this measurement on most turbos. Replace the center section with either a new or rebuilt unit if these specifications can't be met.

Make sure there aren't any deposit buildups in the housings that might contact the turbine or compressor. Then reassemble the turbo, aligning the scribe marks carefully. Replace any gaskets or O-ring seals that were removed and torque together the bolts holding the housings. The average torque is 13 to 15 ft.-lb., but refer to your shop manual for the exact specs. Check the spin of the turbine for binding and pre-oil the unit before installing it in the car.

### Waste gate service

If you notice a drop in power or a lack of power, you may have a waste gate problem. Excessive spark knock can also be caused by a waste gate failure if boost is excessive.

Check the hoses and fittings carrying the boosted air into the intake system before you test the waste gate. All of these lines should be firmly clamped and intact, with no chafed holes from rubbing against the fan belt. If your car

has a boost gauge on the dash, you can check the waste gate operation as you drive. While accelerating at full throttle on a level or uphill stretch of road, the boost pressure should reach, but not exceed, the maximum figure listed in your repair manual or owner's manual. If you baselined your car as described earlier, you can use the boost figure from that test. If boost is above or below spec, the waste gate may not be operating correctly.

The waste gates on some cars without boost gauges can be checked by using a small air-pressure regulator, like the ones sold to fit the inlet side of a paint spray gun, and a compressed air supply. Find the maximum boost spec for your car in a repair manual or the owner's manual. Install the air-pressure regulator in the compressed air line and connect the air line to the waste gate control diaphragm (Fig. 5). If your diaphragm unit has two lines connected to it, attach the air line to the outboard nipple. Slowly increase the pressure through the regulator until the linkage that joins the waste gate to the control diaphragm just moves. Read the gauge. It should match the maximum boost spec for your car. Turn the air off and on several times to be sure that the valve does not hang up and stick in either the open or closed position. If the valve opens later or earlier than is specified, replace it. (Some waste gate valves, including those on 1981 Buick engines, cannot be tested.)

A valve that opens at too high a pressure setting (this would be noticed by audible detonation, an increase in power and the boost gauge on the dash reading too high) is more serious than a valve that opens too low. A turbocharger that is allowed to "run away" will overboost to the point that engine damage from detonation will occur.

It is possible to reset the opening of some waste gate valves to a higher pressure, but this practice is generally discouraged by turbo experts because most engines are too close to detonation already.

Should you be bothered by detonation on a retrofit turbo installation, install an aftermarket knock eliminator kit. These are widely available at specialty auto parts outlets. A popular model used by Callaway is the Carter Engine Knock Eliminator, made by Carter Automotive Div., 9666 Olive Blvd., St. Louis, Mo. 63132 (Fig. 6).

The turbocharger looks like it's here to stay—because it's giving us the performance of yesteryear with fuel economy that's needed today. If you don't already own a car with a turbo, you're likely to get one with your next car. Now you know how to keep it spinning right. **PM**



6 Carter's Knock Eliminator senses detonation and will retard the spark as required.



# Win a trip to L.A. and watch America strike gold

**Grand Prize:** An expense-paid trip for 2 to the Summer Olympics in L.A. Includes 4 days and 3 nights accommodations aboard the Norwegian American Cruises' Luxury Liner Sagafjord, round trip air fare, event tickets and meals.

**10 Second Prizes:** Projection television systems.

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## And Save 50¢ on Lucky Strike Filters



### LUCKY STRIKE FILTERS SWEEPSTAKE RULES

1. NO PURCHASE NECESSARY. To enter for the Grand and Second Prizes, use the store coupon in this ad by April 30, 1984. Or print your name and address on the coupon or a 3" x 5" card and mail to Lucky Strike Filters Sweepstakes, PO Box 24, NY, NY 10046. Enter as often as you like, but each entry must be mailed separately and received by May 15, 1984. All entries become property of American Brands, Inc.
2. Sweepstakes is open to U.S. residents at least 21 years of age. Employees and their immediate families of American Brands, Inc. its subsidiaries, affiliates, divisions, advertising agencies and Marden-Kane, Inc. are ineligible. Void where prohibited, taxed, licensed, regulated or otherwise restricted by law. All Federal, State and local laws and regulations apply.
3. Winners of the Grand and Second Prizes will be selected in a random drawing from among all entries received by Marden-Kane, Inc. on or about June 15, 1984. Decisions are final and binding. Odds of winning the Grand and Second Prizes depend on total number of entries received. No prize substitutions or transfers.
4. To see if you are an instant Third Prize winner, match the first three numbers of the U.P.C. Code on the coupon to the first three numbers on any Lucky Strike Filters pack or carton. Residents of Ohio only may receive a free facsimile of the winning U.P.C. Code by sending a stamped self-addressed envelope to Lucky Strike U.P.C., PO, Box 10409, L.I.C., NY 11101. If you're an instant winner, mail your completed coupon via First Class mail to: Lucky Strike Filters Instant Winner, PO, Box 10255, L.I.C., NY 11101. Instant winners will receive a certificate for a free carton of Lucky Strike Filters and will be automatically entered in the drawing for the Grand and Second Prizes. All instant winner coupons must be received by May 15, 1984. Unclaimed cartons will not be awarded. Odds of winning a free carton are approximately 500 to one.

5. Winners will be notified by mail and may be required to sign an Affidavit of Eligibility and Release. All taxes are winners' responsibility. Only one Sweepstakes prize per family or household. For winners' names, send stamped, self-addressed envelope to: Lucky Strike Filters Winner, PO Box 10667, L.I.C., NY 11101.

12 mg. "tar", 1.0 mg. nicotine av. per cigarette by FTC method.

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

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You could be an instant winner.  
See Rule No. 4.



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CONSUMER PHYS. SALES TAX, IF ANY, LIMIT ONE PER PURCHASE. OFFER LIMITED TO CONSUMERS 21 YEARS OF AGE OR OVER. Offer void where prohibited, licensed, taxed or otherwise restricted by law. TO THE CONSUMER. CAUTION: This coupon is good on a pack of LUCKY STRIKE Filter Kings or 100's. It may not be transferred or assigned. Any other use constitutes fraud. TO THE RETAILER: The American Tobacco Company will pay you 50¢ plus 8¢ handling and actual postage costs incurred if you, acting as our agent or strict accordance with the terms of this offer, redeem this coupon. By submitting this coupon for payment, you represent that you redeemed it pursuant to all applicable terms. This coupon is good only when redeemed by you from a consumer requesting a pack of LUCKY STRIKE Filter Kings or 100's. The coupon may not be assigned, transferred or reproduced. Any other use constitutes fraud. Invoices proving purchases of sufficient quantities of LUCKY STRIKE Filter Kings or 100's Cigarettes to cover coupons presented for redemption must be shown upon request. SUBMIT PROPERLY REDEEMED COUPONS BY MAIL TO: THE AMERICAN TOBACCO COMPANY, PO BOX 1192, CLINTON, IOWA 52734. COUPONS MUST BE RECEIVED AT THIS ADDRESS NO LATER THAN 6 MONTHS FROM THE EXPIRATION DATE PRINTED HEREIN. CASH VALUE 1/20 OF 1¢. COUPON EXPIRATION DATE: APRIL 30, 1984.



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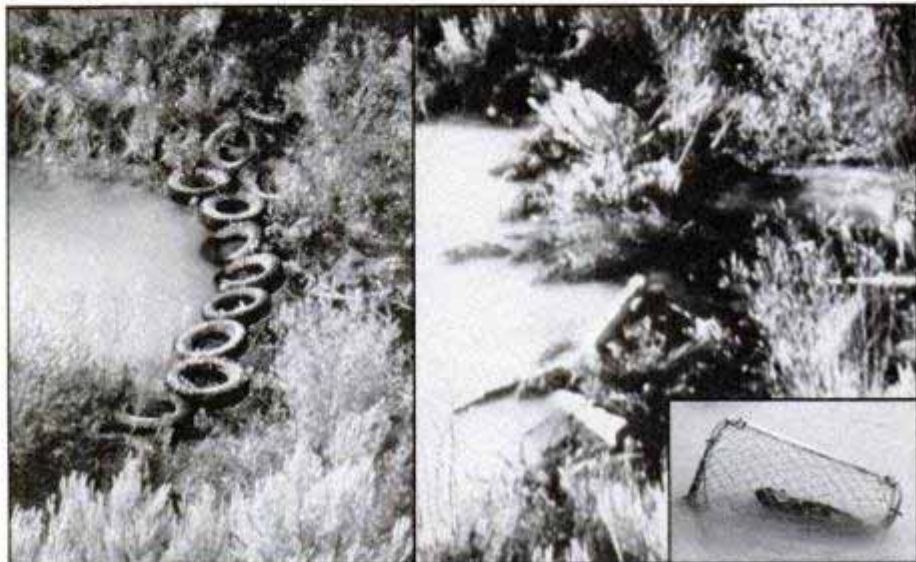
# SCIENCE WORLDWIDE



## In Wyoming, beavers give a dam

Cattle grazed freely along the small streams on federal land in southwestern Wyoming. Too freely. Overgrazing removed grasses and brush from river banks, water spilled over, erosion started, fish were killed and rolling riversides became desolate marshes. To build the land back up, the Army Corps of Engineers could erect dams for tens of millions of dollars.

Enter the Bureau of Land Management and biologists Bruce Smith and Dick McCuiston. They had been watching as the ecological upset drove off local beaver populations. The solution: trap beavers from areas where they are thriving and carry them to eroded streams. Bring in aspen growing far away and help the beavers start natural dams. The animals have taken up the challenge and are building Wyoming dams for free.



Photos by Bruce Smith, BLM  
To start new dam, old tires were placed across stream (left). Beavers were trapped (inset) and brought to the site. Using tires as a base, beavers built a solid dam (right).

## Accidentally on purpose

Murphy's Law may stir guffaws at cocktail parties, but in the nuclear power industry, the maxim that anything that can go wrong will go wrong is a serious matter. To arm nuclear scientists with information on what can go wrong, University of Florida researcher Glen Schoessow and his associates have designed a model reactor. At a scale of 1/2 inch to the foot, the reactor parts are kept inside a tabletop glass chamber connected to a computer that can order up accidents faster than you can say Three Mile Island. It's being used to help determine optimal safety requirements for future reactors.



A model reactor creates mock accidents.

## Photo session

NASA is a step closer to photographing the tail of the comet Giacobini-Zinner. Next year, the path of a NASA satellite will go through the comet tail so the particles in the tail can be identified. The satellite passed its first big test last December when it was steered around the dark side of the moon to see if its electronic sensors could survive the intense cold. They did, with the help of battery-powered heaters. Operating them depleted the batteries, but as soon as the satellite was back in the sunlight the solar collectors recharged the batteries to maximum power. As of now, all systems are "go" for the photo mission.

## Sunspot pipeline

Fiber optics are making possible the first observation of sunspots on distant stars similar to our own sun. Lawrence Ramsey of Penn State and Dimitri Mihalas of the National Center for Atmospheric Research hooked fiber-optic lines to the 42-inch mirror at the Lowell Observatory in Flagstaff, Ariz. Each of the glass wires is run to a computerized spectrographic device. By analyzing the light of stars that act like our sun, they hope to determine

whether our sunspot cycle works for other stars.

## Memories are made of this

Where does the human brain store memory? Stanford psychologist Richard Thompson says memory may be pinpointed to specific areas. Thompson studied the way a rabbit learns to blink its eyes in response to a noise stimulus. Making lesions in the rabbit's cerebellum, he discovered he could cause the eyes to forget to blink. His work opens the door for more complex research.

## Fish 'n chips

Scientists observing the run of salmon up the Columbia River in Washington have counted thousands more fish early in the run than they find at the end of the run. Investigations have failed to come up with a reason. Fishing along the river route can't account for the vast numbers of missing salmon. But, backed by a Bonneville Power Administration grant, biologists this year have implanted computer chips in young salmon before letting them go at the start of their spawning cycle. When the fish make their run next year, radio receivers will "read" the chips, hoping to solve the mystery. **PM**



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# A MARINER GETS YOU WHERE THE BIG ONES ARE BITING. AND BACK TO TELL ABOUT IT.

---

If the fish were always biting close to shore you probably wouldn't need a Mariner Outboard.

But fishing isn't that easy. Which is why Mariner makes outboards that can take you wherever you need to go.

Mariners are designed to start easily and run faithfully without need of complicated tune-ups or serious service.

For example, most of our motors feature a trouble-free CD ignition system for quick starts and less fouling of plugs.

And to improve fuel efficiency without sacrificing performance our engineers combined fixed-jet carburetion with a fuel economy linkage system. So your Mariner will run as efficiently at idle as it does at cruising speed.

The result is an outboard that

does something better than just take you where the fish are biting. It also gets you back.

For a catalog of Mariner Outboards from 2 to 200 horsepower, write Mariner, Dept. 84, 1939 Pioneer Road, Fond du Lac, WI 54935.



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## BETTER IN THE LONG RUN.







# DETROIT LISTENING POST

## Olds will build GM-20

General Motors has picked Oldsmobile to build the 1985-86 GM-20/N-cars not only for Oldsmobile, but for Pontiac and Buick as well. GM will spend upward of \$250 million to prepare Olds and Fisher Body-Lansing to produce all three nameplates on a single, integrated assembly line. We always knew the main difference in many cars today was just the name tags, right? The GM-20/N-car is a compact, sporty import-fighter that will fall between GM's J-cars and A-cars.

This decision comes despite all the press hoopla about GM dividing itself into two parts: a small car/low-buck/Chevy-Pontiac Group and a luxury car/big-buck/Buick-Oldsmobile-Caddy Group. Note that the big-buck cars are not necessarily large automobiles; they



Spy photo shows Pontiac's version of the front-drive N-car, now code-named GM-20.

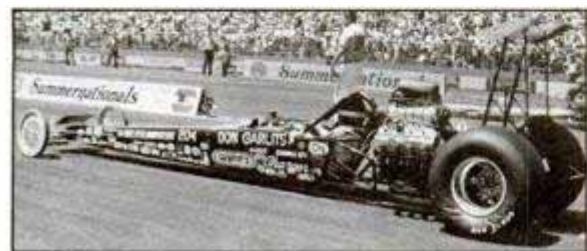
can be expensive small ones. Also, the fine print in the GM press release points out that the Cheviac Group can buy big cars from the Cadickmobile Group if it wants to. What all this means is that it will take many years to finally realign the company into two

giant Groups. By that time, up to 25 percent of the middle management jobs will have gone down the tubes, which may be the whole point of the exercise, anyway. How much difference the public will notice remains to be seen.

## Drag racing immortalized

Drag racing, that loud, smoky glorification of Detroit iron, hasn't received the attention it deserves since the early 1970s. Now it has its own museum. Drag racing great Don "Big Daddy" Garlits last month opened the *Don Garlits Museum of Drag Racing* in Ocala, Fla., after a years-long effort to get the showplace off the ground.

The museum offers for public scrutiny some of the most famous and merely interesting drag racing cars ever to trod the quarter-mile. The museum's distinguished inventory includes many of Garlits's own championship dragsters, including the first drag car to top 250 mph. Other Garlits notables are the first modern, rear-engined dragster and his famous helicopter turbine-engined car. Also on display are: Chris Karamasines's famous Silver Bullet slingshot dragster, which beat Garlits



"Big Daddy" in a vintage rear-engined fuel dragster.

in 23 consecutive match races in 1966; Tommy Ivo's twin-engine drag car; Art Malone's 1968 compressed air-powered car; and the very last steel-bodied funny car—with title—from the days when funny cars had to be "street" cars.

Champion Spark Plug and Kendall Oil have displays of drag racing memorabilia, too. The museum is located at 13700 Southwest 16th Ave., Ocala, Fla., 32674. It's in sight of I-75 at Exit 67, 10 miles south of Ocala. When Don Garlits isn't drag racing, he'll be there to swap war stories with you.

## Chrysler's Mexican link

Chrysler is rattling its economic sword over the GM-Toyota joint small-car venture. If the FTC permits the two companies to build its proposed subcompact in GM's Fremont, Calif., auto plant (and everything points favorably in that direction), Chrysler threatens to do one of two things: its pending P-car (an Omni/ Horizon replacement) will either be cancelled outright, or production moved out of the U.S. Either way, there go the jobs.

Chrysler wants to use its

Belvidere, Ill., plant to build P-cars. If it makes good on its threat *not* to, Belvidere would begin assembling T-wagon minivans to supplement the Windsor, Ont., production. Chrysler Chairman Lee Iacocca says he wants to double Windsor's 200,000-unit capacity.

Now the company is exploring the feasibility of doing the P-car project in Mexico, where wages are much lower than in the United States. It's pretty obvious that Chrysler wants and needs the P-car. What isn't so certain is whether the company feels it can afford to produce it competitively here.

## GM to offer car phones

When the Federal Communications Commission approves the public use of cellular mobile telephone technology, Buick will be the first automaker to offer factory-endorsed, dealer-installed car phones as an option. The AT&T mobile phone system will be offered first in Chicago, and Buick dealers there will sell GM's first in-car telephones.

Seen on a map, a cellular mobile phone system looks like an electronic honeycomb. As a driver with a car phone travels from one grid to another, he is automatically switched from one frequency to the next. This system pro-

*(Please turn to page 46)*





# Help your image as well as your bottom line.

The trucks you choose for your business say a lot about your business. So let GMC's good reputation add to your reputation. GMC trucks are done right, because, after all, we're the people who bring you nothing but trucks.

But a GMC pickup can pick up more than just your image. It can help your business run more efficiently by being just the right truck for the job.

The full-size pickup on the right will handle really large loads. Depending on the model, you can haul from 1,983 up to 5,256 pounds of whatever you're hauling. Or, when properly equipped, it can tow up to 10,000 pounds.

If you choose the rugged 6.2 liter V-8 diesel engine as an option, you'll have a practical pickup ideal for work situations involving stop and go driving.

The compact S-15 on the left is available with 4-cylinder or V-6 power. The 2.2 liter L4 diesel can haul up to 1,250 pounds, and the V-6 up to 1,625 pounds. Or when properly equipped, the S-15 can tow up to 5,000 pounds.

Full-size pickup cargo beds are available in 6½' and 8' lengths. The S-15 pickup has 6'1" or 7'5" cargo beds available.

Both versions feature tough, girder-beam, independent front suspension. You can get optional four-wheel drive. S-15's Insta-Trac system lets you shift from 2- to 4-wheel drive without stopping.

Whatever you choose, a full-size C-series or compact S-15 truck, you'll have picked right; a pickup that knows how to work.

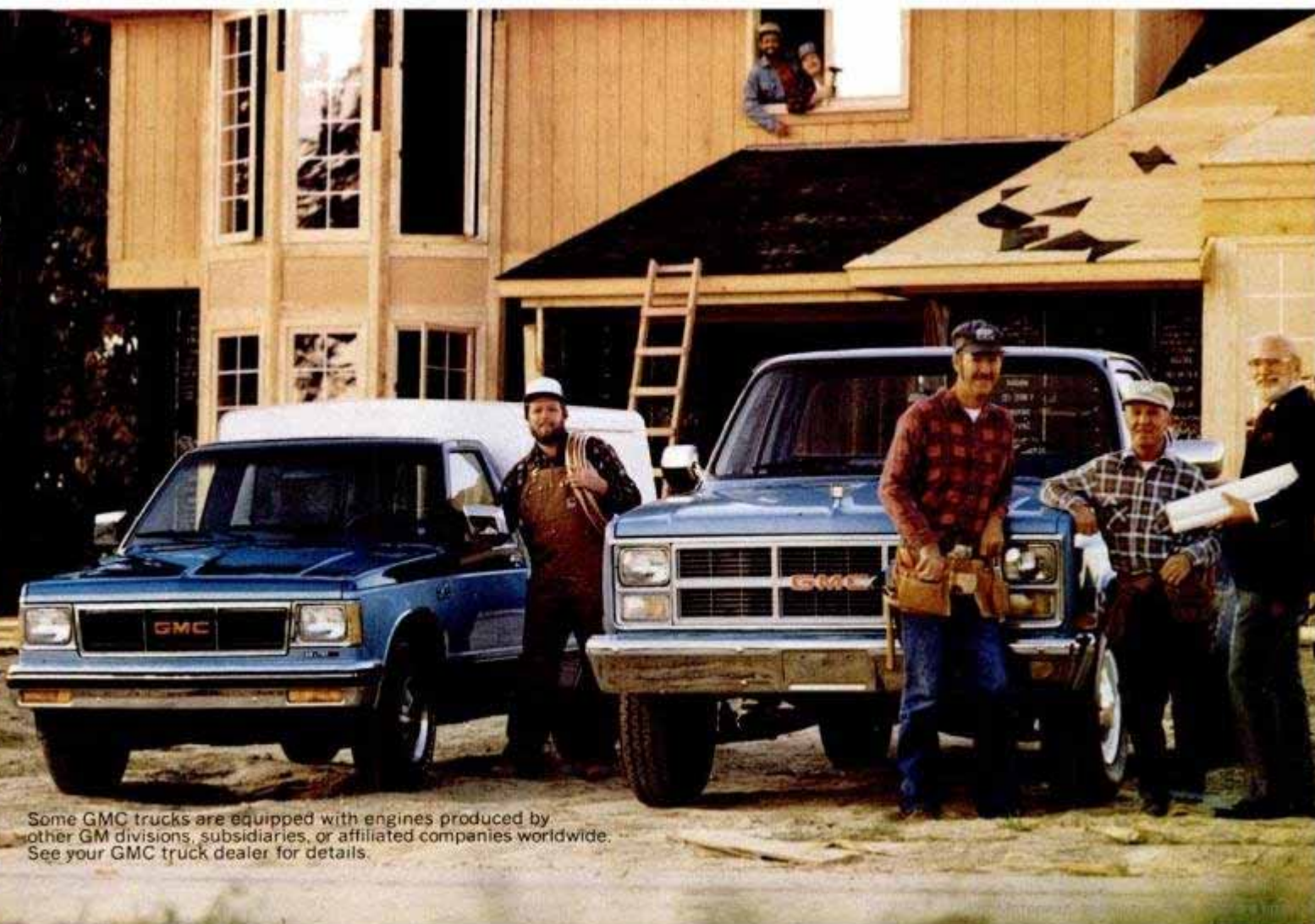
Hard.  
From GMC.



Official Truck  
of the XXIIIrd  
Olympiad  
Los Angeles  
1984

# GMC

## A truck you can work with.



Some GMC trucks are equipped with engines produced by other GM divisions, subsidiaries, or affiliated companies worldwide. See your GMC truck dealer for details.



## DETROIT LISTENING POST

(Continued from page 44)

vides for significantly better usage of frequencies, and is said by AT&T to offer improved reception.

### It's a Merkur!

Speculation has been running rampant about the European Ford Sierra that Lincoln-Mercury will begin to sell here in 1985. In America, they will call it the Merkur, which means Mercury in German. A turbocharged 2.3-liter Four dubbed XR4Ti will sell in the \$16,000

range. A three-liter V6 called the XR6Ti is in the chute for early '86, and it could cost around \$22,000.

### Ear to the ground

**Mandatory in Michigan?** A bill to make Michigan the first state to require the use of seat belts may be reintroduced this year. Lawmakers shelved the bill in 1983 following the recall of two of their colleagues over tax-related issues.

**Ford and racing:** Ford Motor Co. and Cosworth Engineering's Keith Duckworth are back at the drawing board to update the venerable Ford-Cosworth

engine. The new motor would be adaptable to both Formula One and Indy-car racing. The new engine would apply advanced electronic controls to racing engines for the first time. Ironically, today's passenger car engines are much more sophisticated in this respect. The present Ford-Cosworth engines have won over 150 Grands Prix, and six Indy 500s in a row.

**Court defangs EPA:** A federal appeals court has ruled 2-1 that automakers cannot be forced to recall vehicles more than five years old, or those with more than 50,000 miles. The ruling came when GM appealed a 1980 EPA rule that would have recalled 220,000 1975 Cadillacs, two-thirds of which, the EPA alleged, emit too much pollution.

By Congressional definition, a car has an effective life of only five years or 50,000 miles. Therefore, the court ruled, GM can't be required to recall or repair cars that are legally obsolete.

**But is it a better idea?** Tom Feaheny was a Ford Motor vice-president for vehicle research until he sued his company and Chairman Philip Caldwell for \$330 million, alleging they stalled his career. They fired him. Now Feaheny, holder of about 10,000 shares of Ford stock, has submitted a shareholder proposal for consideration at Ford's May 10 annual meeting. It's termed a response to the GM-Toyota joint venture: *Ford and Chrysler should merge*—with Lee Iacocca as the new commander-in-chief!

The proposal has little chance for success without support from the Ford family, which owns approximately 40 percent of Ford Motor's voting stock.

**Different drummers?** The General Services Administration (GSA) signed a contract with Chevrolet for about 12,500 new 1984 cars, mostly Citations, worth an estimated \$68.3 million. These are used as *official vehicles* in many federal departments. Meanwhile, the Justice Department forges ahead with its suit to force GM to recall about a million 1980 X-cars, including Citations, for alleged brake defects that the feds say make the cars unsafe.

**Sino-American Motors?** AMC, whose AM General Div. used to build military vehicles for the U.S., has just inked a \$51 million deal with mainland China to make *army and civilian Jeeps* near Peking. Civilian versions of this Chinese Jeep will be exported in Asia, to compete with Japanese 4x4s.

**CHiPs saddle hogs:** The California Highway Patrol has placed an order for 131 Harley-Davidson police special motorcycles, breaking an 11-year streak of Kawasaki purchases. The big bikes will have 1,340-cc V-Twin engines and cost \$4,400 each, \$1,100 less than Harley's last (unsuccessful) CHiPs bid. **PM**

There is only ONE leader... Wheel Horse. We invite you to compare. This Work Horse LT-1100 3-speed lawn tractor is backed by the same Wheel Horse engineering and design excellence, and is available at a price you can afford. This spring, you won't find a better "quality value" in a lawn tractor anywhere!

**WORK HORSE**

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Quality. At an affordable price.



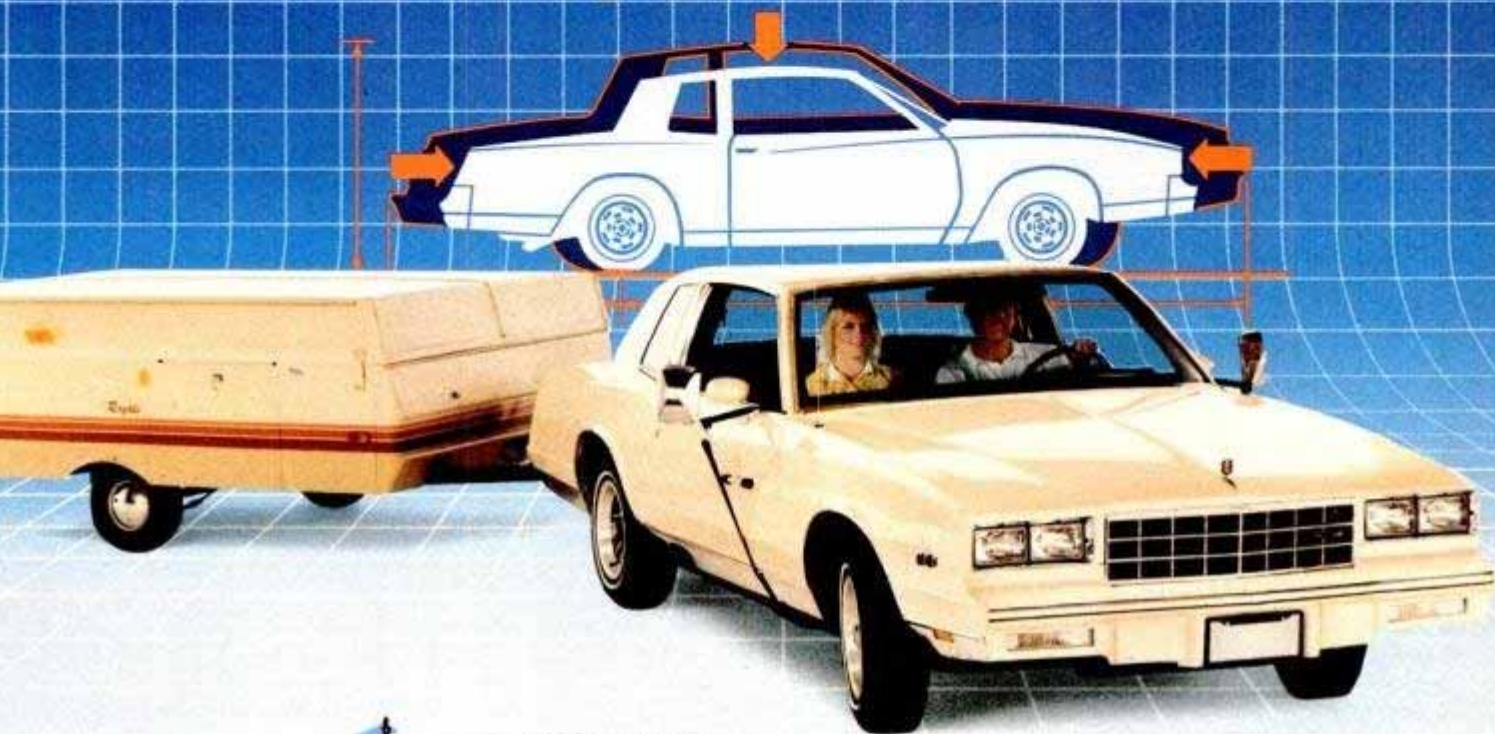
\*Base price for tractor only. Mowers and other attachments optional — available at participating Wheel Horse dealers only. Freight, dealer prep, delivery, state and local tax not included.

Manufactured by Wheel Horse Products, Inc., South Bend, Indiana. 1-800-348-2424. In Indiana, call 1-800-552-3333.



# How to Tow With Today's Car

and save up to \$15 at Hitch World



New cars and trucks have lighter bodies, transmissions and suspensions to save you gas. But if you plan to tow, you need added protection for these areas of your vehicle.

Here are a few basic tips to follow.

## 1. GET THE RIGHT HITCH.

All hitches are not alike. The wrong one can cause body damage. Or tear out.

Hitch World selects and installs the hitch that is designed to meet your towing needs. They carry top-brand names like Draw-Tite and Reese. Every hitch is backed by an exclusive nationwide warranty that is good for as long as you own your tow vehicle.

## 2. GET A TRANSMISSION COOLER.

When towing with a downsized car, heat builds up inside of your transmission. This added stress can burn its fluid and shorten the transmission's life.

Hitch World experts select and install the transmission cooler,



such as Hayden, that can extend the life of your transmission by releasing the added heat caused by towing.

## 3. GET A TOWING SUSPENSION.

A standard suspension is basically made to carry passengers. By adding a trailer, you can overload your suspension.

Hitch World installs air lifts or air shocks, such as Monroe and Hellwig, that give your tow vehicle added frame support, and reduce rear-sagging and tire wear caused by a weak suspension.



## NOW SAVE UP TO \$15

Take this ad to your nearest Hitch World. It is good for \$5 off the price of a hitch, a transmission cooler, and a suspension system (\$15 maximum discount, offer expires 12/31/84).

Look in the White Pages under U-Haul Centers for the location nearest you.

Write for a FREE HITCH GUIDE:  
HITCH WORLD, Dept. PM,  
P.O. Box 21503  
Phoenix, AZ 85306



at your **U-HAUL** Center



# SUPER SOUND THAT SURROUNDS YOU



Digital information already on your videotapes and discs can be decoded to give the same great sound as at the movies.

BY DAWN GORDON

After erecting a 10-foot projection TV in your living room, plunking down the \$800 or so for a high-quality Laser Disc player, and then connecting it all to your \$2,000 stereo system, you may very well believe you have the closest thing to the movie theater experience. Think again. While all this expensive equipment certainly does capture much of the local cinema's ambiance, there is still something missing, and it's not buttered popcorn.

Those wonderful special effects that seem to surround you in the theater are simply not there. Planes and spaceships don't fly overhead, and the music lacks the depth and presence you've become accustomed to. Fortunately, you can buy a Dolby surround decoder that retrieves that movie sound.

## Two kinds of surround system

In the average theater, two kinds of surround systems are used: the elaborate 70-mm, six-track magnetic setup, and the more conventional 35-mm optical system. The first system uses a magnetic strip attached to the film, supplying six discrete channels with Dolby A noise reduction. However, 70-mm cannot be reproduced in the home.

The 35-mm optical type is shown in most theaters and is the kind of surround system that consumer decoders come closest to. The 35-mm method uses a two-channel optical track that's part of the film for its audio signal. But

every dolby-encoded stereo videodisc, videotape and simulcast still contains the same rear-channel information because the two-channel magnetic master was produced from the theater optical soundtrack. All your stereo videotapes or videodiscs of *Superman*, *Star Wars* and *The Thing* can be decoded to produce spectacular surround sound at home.

Each decoder manufacturer has its own method of decoding the rear-channel information, and they all provide excellent sound. One unit has a built-in low-powered amp, and some others supply wired remote control. Prices for these decoders run from \$150 to \$499. The difference in cost is directly related to the extra features on the machines, and to higher quality components.

The sound these boxes produce is spectacular. Spoken dialogue stays up front where it belongs, and an open, live sound can be heard from every angle of the listening position. Music emanates from both the front and rear speakers, and for the first time at home you will hear such things as star cruisers streaking overhead.

## You are there

During helicopter scenes in the film *The Thing*, you can easily imagine that you are on board because the roar of the blades surrounds you. This is especially realistic when watching a large-screen television—the combination of sight and sound makes you feel like you're in the middle of the action.

Other striking examples of the surround effect can be found in the Spielberg classic *Close Encounters Of The Third Kind*, where small UFOs fly toward you, soar overhead, and then pass behind you at lightning speed. Even more exhilarating is the end sequence, when the mother ship approaches Devil's Tower. The room is enveloped in a low bass thunder, and

for a moment you actually believe you're there. The effect is so pleasing that it becomes difficult to listen to a soundtrack with the decoder off.

In addition to extracting surround-sound effects from your favorite movies, these multitasking decoders do a very nice job in another area. Regular LP's, audio cassettes, FM broadcasts and especially Compact Disc players produce stunning realism when used with these units.

## Exact sound reproduction

Unlike a digital delay add-on device such as an Audio Pulse, Koss or Advent, which simply delay the front-to-back signal for a somewhat artificial concert hall effect, the surround-sound decoder will bring out the actual ambiance contained in the music. For instance, if you're listening to a live concert, the decoder will reproduce the concert hall exactly as it was recorded—no more, no less. If the hall was extremely large, it will sound that way. And applause can be heard from the front as well as the rear. If the music was recorded in a small jazz club, the sound will take on that atmosphere.

While there are only a handful of decoders on the market right now, things will change in the near future. You can expect many more companies to get involved in this new area of consumer electronics. But until then, you can buy what is available now. So go out and splurge—it certainly is cheaper than buying your own theater. **FM**

## MANUFACTURERS—DOLBY SOUND SYSTEMS

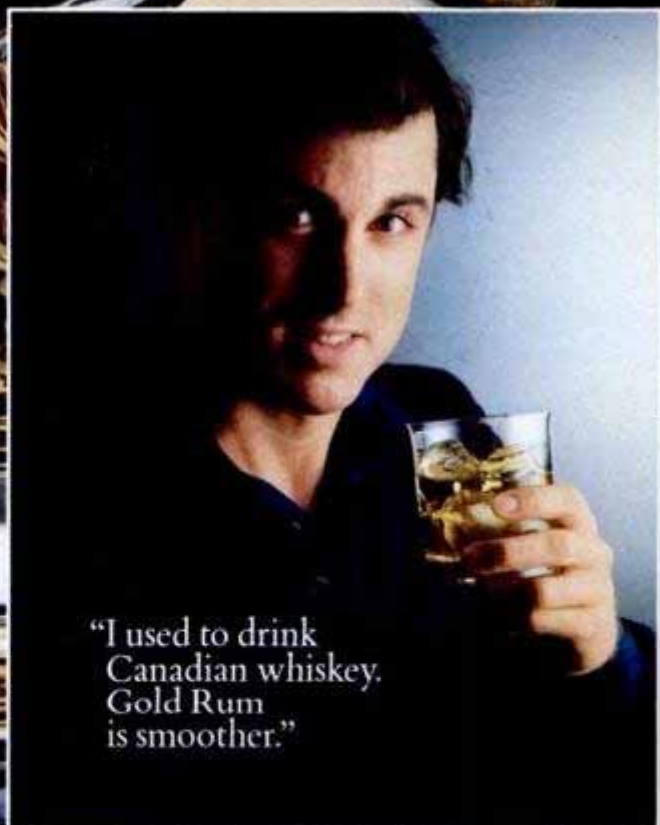
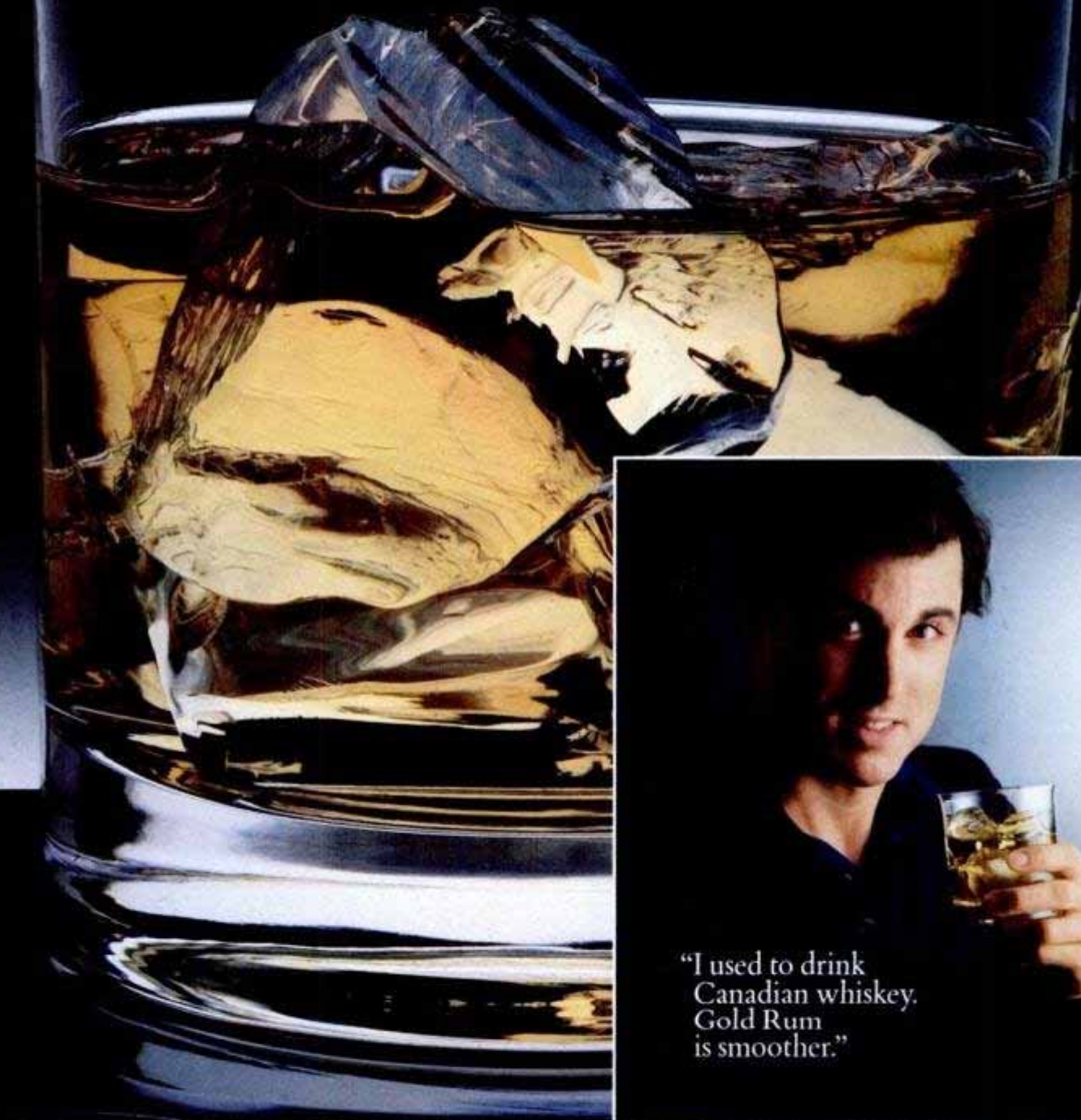
Fosgate Research Inc., 714 Clubhouse Drive, Prescott, Ariz. 86301 (Tate Model 101A, \$499.95).

Phoenix Systems, 91 Elm Street, Manchester, Conn. 06040 (Model P-25-DL, \$200).

Surround Sound Inc., 14025 Panay Way, Marina Del Rey, Calif. 90292 (Model M-360, \$329.95).



**Gold Rum. The first sip will amaze you.  
The second will convert you.**



“I used to drink  
Canadian whiskey.  
Gold Rum  
is smoother.”

People everywhere are switching to Puerto Rican gold rum. The reason? Puerto Rican gold rum has the lightness that people prefer today.

You'll find that gold rum makes an exceptionally smooth drink—on the rocks, with soda or ginger ale, or with your favorite mixer.

If you're still drinking Canadian, bourbon or blended whiskey, it's because you haven't tasted Puerto Rican gold rum.

**THE GOLD RUMS OF PUERTO RICO**







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

9 mg. "tar", 0.7 mg. nicotine av. per cigarette, FTC Report MAR. '83.



# THE TASTE OF SUCCESS



# VANTAGE

Great Taste with Low Tar.  
That's Success!



# PM SOFTWARE MONITOR



## MODULA-2 language is worth it

Swiss computer scientist Niklaus Wirth spent 10 years evaluating the strengths and weaknesses of his popular and influential programming language, PASCAL, before returning to the drawing board to design its replacement, MODULA-2. The first commercial implementation of this new language is now available for several makes of personal computers from Volition Systems (Box 1236, Del Mar, Calif. 92014).

MODULA-2 is one of the new breed of "extensible" programming languages, meaning that you may modify and extend its command vocabulary to expedite your own programming chores. In effect, you can build your own personal programming language atop the foundation that is provided by the basic MODULA-2 design.

In MODULA-2, new commands are defined as subprograms of existing commands. Related commands are collected together in *modules*. In order to use a group of commands, a program *imports* the appropriate module. The Volition Systems implementation of MODULA-2 permits you to define a virtually unlimited number of new commands using the module mechanism.

Most of the features which make PASCAL the primary vehicle for teaching structured programming techniques are present in MODULA-2. But Wirth also intended his new language to be a tool for writing practical, commercial software. The MODULA-2 package therefore includes modules of predefined commands for handling video special effects and cursor positioning, random-access data files, character strings and extended-precision numbers.

System documentation ranks with the best we've seen. Within hours of opening the thorough, ring-bound manual, programmers who are already familiar with PASCAL should be able to write interesting MODULA-2 programs. BASIC and FORTRAN programmers have been able to reach the same level of expertise after about a week of study. Either group will have fun experimenting with the example programs on the MODULA-2 disk. Wirth's textbook, *Programming In Modula-2* (second edition; Springer-Verlag, 1982), is included in the package at no additional charge.

Volition Systems MODULA-2 runs on the Apple II, Apple IIe and Apple III computers, under the Apple PASCAL

operating system. For the IBM-PC and the Sage II and IV, Volition supplies not only the MODULA-2 compiler, but also operating system software that is based on an early version of UCSD PASCAL. An "adaptable" MODULA-2 package is available on 8-inch, single-density disks for computers that are based on the 8080/286 family of microprocessors. To install this version, you should have some programming expertise. You must graft a CP/M BIOS for your particular computer onto the UCSD PASCAL-style operating system.

Most programs written in MODULA-2 for any one of these computers should compile and execute on the others with little or no modification. As a bonus, a conditional compilation feature permits the MODULA-2 compiler to construct different versions of a program from alternatives contained within a single-source text file.

MODULA-2 is well worth the asking price of \$495 (\$595 for IBM-PC and Sage versions). These days, that might seem like a lot to pay for a programming language. But MODULA-2's ability to grow with you and adapt to your changing needs gives it the staying power to remain a useful, vital tool for years to come.—Jim Merritt

## The evil king



Onscreen hourglass keeps track of time you have left before it's back to the dungeon.

Many computer adventure games tend to look and act alike, but *The Coveted Mirror* from Penguin Software (for Apple and Atari computers) is unique. Touches of animation, eyes that roll and mouths that snarl will enliven the computer screen as you go on your quest. That quest is to retrieve eight

shards of a magic mirror which the evil King Voar has hidden somewhere within his kingdom.

As you progress, an onscreen hourglass shows how much time you have until King Voar will look into his own mirror piece, see you, and magically yank you back into a dungeon. By the end of the game, King Voar will have become a fellow that you'll love to hate.—N.S.

## Fast-moving strategy

Imagine chess with hundreds of pieces, with each of them having intelligence. That's just about what you have in the new *Cytron Warriors* game from Strategic Simulations Inc. (for the Apple and Atari).

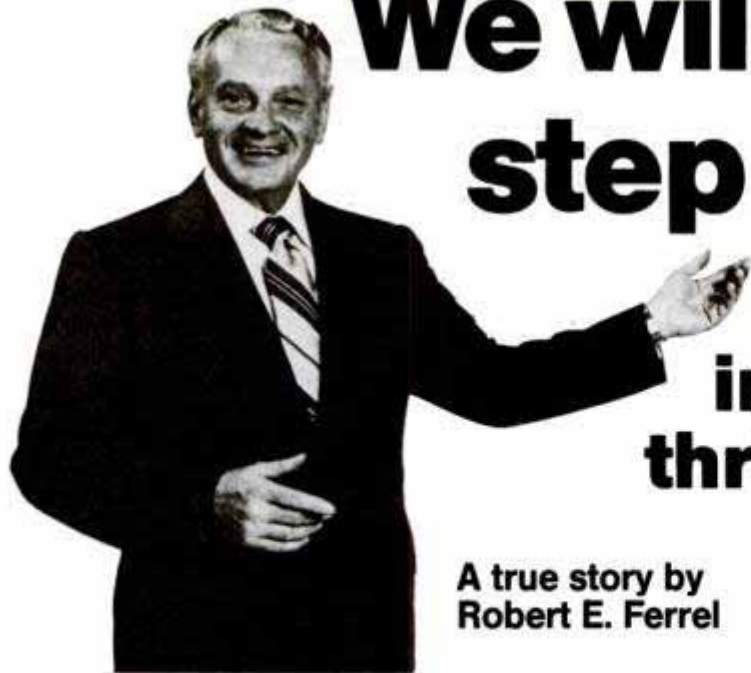
Two human commanders—or one person foolhardy enough to go up against the wily computer—issue orders to their men to move onscreen.



Hundreds of symbols represent intelligent "chessmen" in supertactical *Cytron Warriors* from Strategic Simulations.

The shifting tactical problems, as some men balk and others do better than expected, will make all but the calmest of master strategists moist-palmed. While the speed is that of the arcade, the pressure to think rivals the chessboard.—N.S.





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A true story by  
Robert E. Ferrel

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## PATENTLY UNUSUAL The Rubber Band Plays On



MacKinnon gun uses trigger of small rifle.

MacKinnon gun is loaded with six heavy-duty rubber bands (above). It is similar in design to the LoBiondo rubber band rifle in drawing.

Rod and gun hobbyists are familiar with the work of gunsmith Robert F. MacKinnon, but even they will be surprised to see the rifle he built for *Popular Mechanics*. The body is a solid piece of wood and the trigger mechanism is a standard small rifle piece. But the ammunition consists of large rubber bands.

MacKinnon's rubber band gun will probably never be mass produced, but there are patents on more than 35 rubber band guns awaiting investment from any interested toy manufacturer.

Rubber band guns have been a patent item since the 1920s, when the most popular models were in the shape of pistols. It was a mark of the gang-ridden Roaring '20s.

Over the years, the patented rubber band weapons became more sophisticated and several were manufactured as toys. Today, there is a lull in the demand for such toys, largely because the Consumer Product Safety Commission could reasonably be expected to declare such a device dangerous to small children.

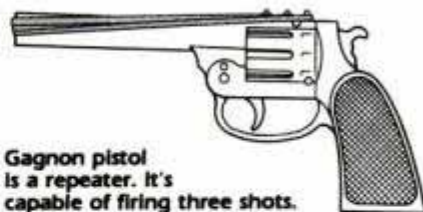
The latest patent issued for a rubber band gun was in 1983. New Yorker Vincent LoBiondo was awarded U.S. Patent 4,379,445 for his repeating rubber band rifle. A user lays in heavy-duty rubber bands one at a time, hooking one end to the front of the rifle and pulling the band back tightly to slip over the trigger mechanism and onto a notch in the wood stock.

MacKinnon's rifle, a repeater like the LoBiondo rifle, can hold six shots. Aim

at the target and you release them one at a time in rapid fire.

Some of the more interesting rubber band weapons include a pistol invented by Louis and Angeline Gagnon and granted U.S. Patent 2,098,001 in 1936. It also is a repeater, capable of firing three salvos in short—or even long—order.

Rubber band gun designs apparently follow the popular modes of the day. If a gangland-style pistol was popular in the '20s and '30s, a copy of the military



Gagnon pistol is a repeater. It's capable of firing three shots.

submachine gun was just as popular in the war years of the mid-1940s through early '50s. Texas inventors Louis D. Wright and Thomas C. Swope shared U.S. Patent 2,576,248 in 1947 for their machine-gun-like repeating rubber band gun. It even included a noise-making device located in the trigger housing.

To order copies of patents, send \$1 with the patent number to: Commissioner of Patents and Trademarks, Washington, D.C. 20231. Your local public library may also serve as the regional patent library in your state. Patents should be available there, as well.—D.E.



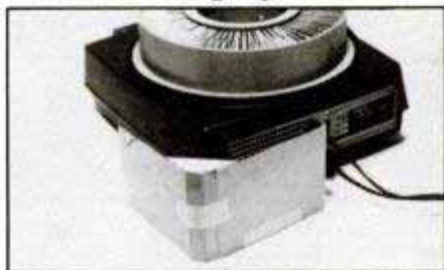
# PM PHOTO HINTS

## Mirror, mirror



A used, disposable woman's compact has a mirror which may prove invaluable in your gadget bag. Use it to direct light in closeup or tabletop photos, or to read lens settings when the camera is on a tripod.—Gene Hennessey

## Deflector for projector



Bothered by projector exhaust? Make this taped-up deflector of cardboard, with a square base, and position it under the machine.—Robert Hertzberg

## Block light



Light can enter the eyepiece of an auto-exposure camera when it is used on a tripod for long exposures. Pull the film tab out of the memo holder to block the eyepiece.—Ron Jegerings

A large, detailed image of a hand holding a cigar against a background of a large, textured tobacco leaf. The leaf is a rich, golden-brown color with prominent veins. The hand is holding the cigar from the bottom right, with the tip of the cigar pointing towards the center of the leaf. The overall composition is warm and emphasizes the natural origin of the tobacco.

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with the natural leaf wrapper.**

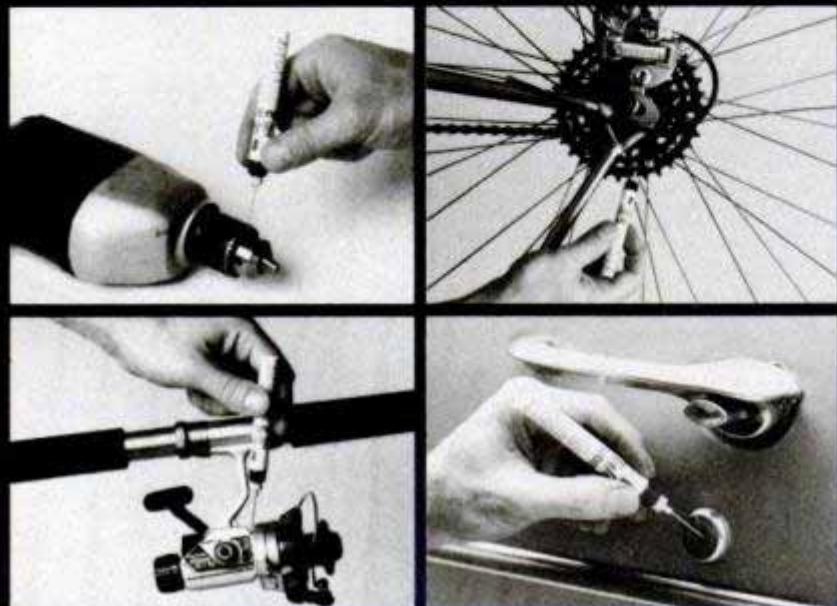
The *imported* natural leaf wrapper. That gives Antonio y Cleopatra its rich, distinctive, real tobacco taste. The most expensive, best-tasting cigars are still made with the natural leaf wrapper. And at a very reasonable price, A & C is the best cigar for the money. In light or dark imported natural leaf wrapper. In a variety of shapes to fit your style, including Grenadiers, Classics, Panetelas.

Three packs of A & C cigars are shown in the bottom left corner. From left to right: Panetelas (light wrapper), Classics (dark wrapper), and Grenadiers (light wrapper). Each pack features the A & C logo and the text 'IMPORTED NATURAL LEAF WRAPPER' and 'ANTONIO Y CLEOPATRA THE QUALITY LEAF'.

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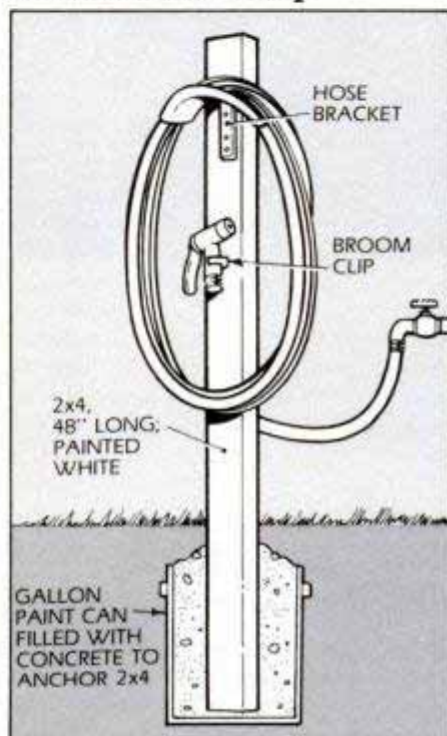
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# HINTS FROM READERS

## Garden hose caddy



Build this simple hose caddy to keep a garden hose neatly coiled where you need it. Cut a 2x4, 48 in. long. Position it in an empty gallon paint can and fill the container with cement. Paint the 2x4 white using an exterior paint. Mount a commercially available hose bracket to the top of the post. Then fasten a metal broom clip in the center of the 2x4 to keep the nozzle handy when you're using the hose with a sprinkler. Finally, bury the can in the ground, making sure that the 2x4 is straight.—E. Paul Cohn

## Removing putty

Putty is difficult to remove from a window frame unless you can use heat to soften the material. A soldering iron with a metal shield wired to extend  $\frac{3}{4}$  in. beyond the tip of the iron does a good job of softening the putty. Make the shield of rigid metal cut to the width of the putty. Steady heat and a putty knife are all it takes for you to remove the softened substance.

—Robert G. Fisch



## NEWSSCIENCE/UPDATE

## James Head: Learning about Earth by studying the planets

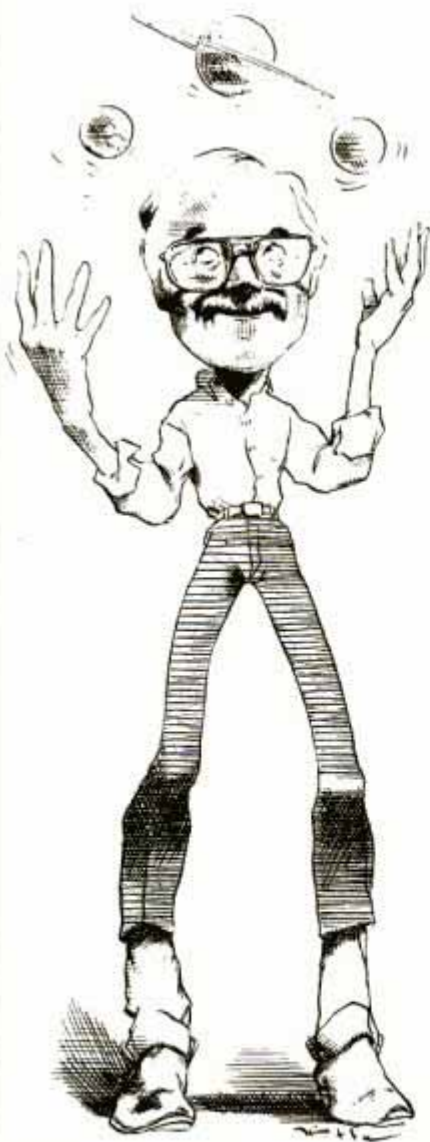


ILLUSTRATION BY MICHAEL WITTE

In 1968, when geologist James Head III applied for a job helping NASA choose lunar-landing sites for its Apollo missions, he was afraid he wasn't qualified. "It turned out to be surprisingly easy," he says, "since the field I was going into was very new, and everybody had a lot to learn."

Since then, Head has helped plan NASA missions to the moon, Mars, Venus and Jupiter. He has analyzed photos, rocks and data returned by our space probes, and he taught lunar astronauts how to find rocks worth bringing home. As a result of his tutelage, astronaut David Scott recovered a "Genesis rock"—one of the oldest moon rocks. Head has said it was like being there himself.

His activities have made him, at 42, one of the leading pioneers in comparative planetology, the study of similarities and differences among the planets. "By trying to understand some basic things about the origin and evolution of planets," he says, "you hope to figure out something about the early parts of Earth's history."

Although our planet is 4.5 billion years old, terrestrial geology covers chiefly the last billion years. The preserved record of fossils and undisturbed rocks from the Precambrian Era—the first 85 percent of Earth's history—is meager. With the advent of powerful radar on space probes and satellites, however, we are beginning to learn more about how the planets, including our own, formed.

As an example, Head cites the meteors that created such lunar features as the Man in the Moon. "In contrast to Earth," he says, "the moon has a stable surface that tells you what was going on in the first half of solar-system history." Observations of Mars and Mercury, as well as of the moon, suggest that craters dug by the impact of meteorites were a major factor in forming our planetary crust.

Head emphasizes that it requires time and thought to connect planetary studies with terrestrial geology. "One has to think in terms of accumulating knowledge. The revelations come slowly. But it gives us a framework to accept ideas that would have been outrageous twenty years ago."

For instance, Head explains, the channels of Mars appear to be dry riverbeds, not canals dug by extinct Martians, as some early observers thought. "What's going on with those channels?" he asks. "It's very clear that water flowed over Mars' surface at some time.

The atmosphere must have been considerably different in the past than it is now." This suggests to him that "drastic atmospheric change is part of the evolution of a planet."

He feels that geology has taught us some things about roughly the most recent third of Earth's history, and planetary studies have helped reveal the first third. "But there's a big gap there," he says. "The middle third is not well understood. That's where Venus may come in. Venus may represent Earth as it was two billion years ago."

Head is trying to determine if Venus has a stable surface like Mars, Mercury and the moon—or whether, like Earth, its surface is made of multiple crustal plates. If so, plate tectonics may be related to other features the two planets have approximately in common: density, size and distance from the sun. If Venus does not have a plated surface, then perhaps some unique feature of Earth, such as its abundance of water, is responsible for its structure.

Because of Venus' dense cloud cover, Head and other researchers are forced to rely mainly on radar observations. These seem to reveal features similar to folds and mountain belts on Earth. He believes these regions may be formed by moving plates pressing against one another, like plates on Earth. "But it's still elusive," he says.

Comparative planetology is a multidisciplinary field, and Head has studied volcanism, geophysics and radar technology. And he often seeks the expertise of colleagues in related fields. He's a professor at Brown University and regularly audits undergraduate courses on perception, personality, social psychology, the arts—anything related to "what forms opinions."

These studies, he believes, also help make him a better communicator, especially when presenting new or controversial ideas. "Scientists are human beings," he says. "They have their prejudices. Having a good idea and proposing it is only one-tenth of the battle. You have to know what your colleagues are thinking and how to present your ideas to them."

Head looks beyond the boundaries of his discipline. "I like to push myself into new things because it makes me do the old things new ways," he says. Does he ever worry about venturing too far afield? "I've never had any second thoughts about anything," he says. "I just press on."

—Steven Oppenheimer



# NEWS SCIENCE

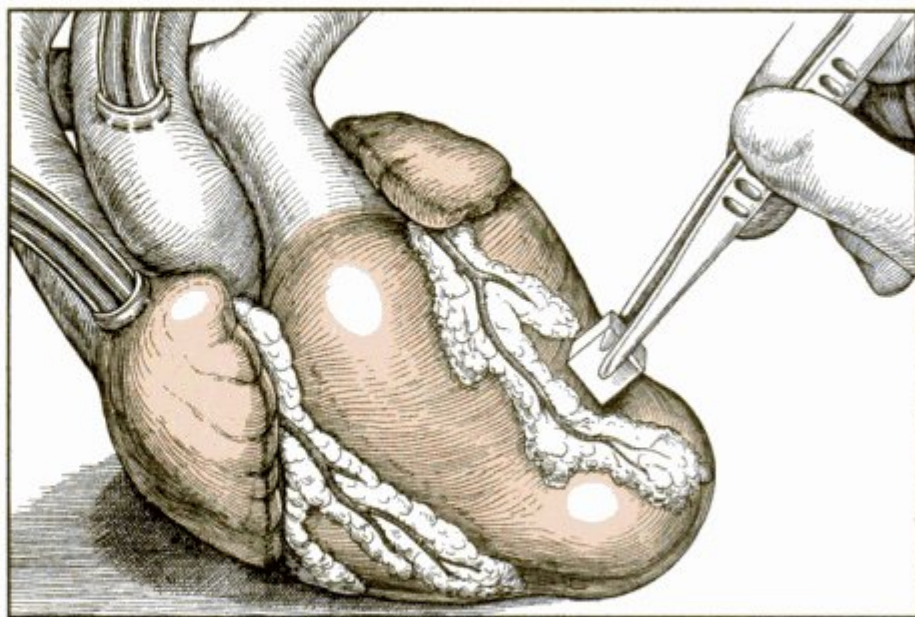
## Ice-cube surgery saves sick hearts

To diagnose life-threatening heart trouble, one cardiologist uses a basic household item: ice cubes.

Lawrence Gessman, of the Deborah Heart and Lung Center in New Jersey, calls his method cryomapping. If it proves effective, each year it could save the lives of hundreds of people with ventricular tachycardia—a disorder in which the heartbeat jumps from a normal 70 beats a minute to a hazardous 250 beats.

This happens when an area of damaged tissue around an aneurysm—a bulge of dead heart muscle—goes haywire and beats faster than the heart's normal pacemaker, a cluster of cells called the SA node. The heart then follows the faster pace.

"Cryomapping is easier and less expensive than a conventional electrogram map," says Gessman. During surgery, sterile ice cubes are moved along the damaged tissue. The surgeon can distinguish the offending area because when it is chilled, it stops beating, and the heart resumes its normal pace. Ice cubes pinpoint the trouble spot so precisely that it can be removed without sacrificing any healthy heart muscle surrounding it.



Using an ice cube, a surgeon can find the trouble spot in a heart that is beating too fast. When the offending tissue chills, the heart beats normally.

When newly hatched chicks learn not to peck at bitter-tasting beads, their brains respond by quickly growing bigger.

between neurons where data is sent from one cell to another—were 15 percent larger.

The results, Rose says, show that learning "causes visible changes in the brain's form and structure that affect future behavior." The experiment may shed light on how mammalian—even human—memory works.

## Baby-bird brains can think big

British researchers are discovering that what chicks learn in the first 24 hours of life affects the way their brains develop later on.

In an experiment, biologist Steven Rose and colleagues at the Open University, in Milton Keynes, gave newly hatched chicks glass beads coated with a bitter substance. Chicks instinctively peck at small objects such as beads. After only one peck at the bitter beads they stopped pecking. They learned the beads didn't taste good.

When Rose examined the brains of the chicks a day later, he found impressive changes. In an area responsible for coordinating experience with memory, the trained chicks had 70 percent more synaptic vesicles—tiny sacs that store and release nerve transmitters—than did a control group of chicks that had been given beads coated only with water. And the synapses—the interfaces



## Alcohol test can't single out drunks

Alcohol levels in the bloodstream don't accurately measure one's ability to drive or perform other tasks.

That is the finding of experiments at the University of Colorado, Boulder. Says professor of behavioral genetics Robert Plomin, "It's the first study that mimics drinking in the real world."

In one experiment, volunteers imbibed until their blood alcohol levels reached Colorado's legal limit of 0.1 percent. That level was maintained for three hours, after which it was discovered that some of the drinkers performed as well on judgment and muscle-control tests as they did when sober. Plomin concludes that legal limits are not reasonable indicators of drunkenness: Some people are impaired below the limit, while others act sober despite being legally drunk.

The saguaro cactus is one of the slowest-growing plants. It takes 30 years for just one branch to form.



## Brain tumors blasted by sound

Ultrasonic waves are so versatile that they can be enlisted to do jobs as diverse as imaging a fetus or destroying kidney stones.

Several years ago, surgeons developed a device, called the Cavitron Ultrasonic Surgical Aspirator (CUSA), that cuts with ultrasound. Now this tool is being used by brain surgeons to remove tumors that were once virtually inoperable.

High-frequency sound waves cause the probe's slender tip to vibrate 23,000 times a second. When a section of the tumor is touched by the probe, it shatters. The fragments are then flushed out of the brain with a saline solution. If the procedure is repeated several times, the tumor can be removed bit by bit.

"Before the CUSA, we usually removed large tumors with suction," explains pediatric neurosurgeon Fred Epstein, of the New York University Medical Center. "But the tumors would cling to healthy tissue; when they were pulled, part of the brain was pulled too. This tugging could result in brain damage. But the CUSA doesn't harm healthy tissue because it works on only a fraction of the tumor at a time."

Besides safety, there are other advantages. "With the CUSA," says Epstein, "I can do in a half hour what it usually takes four hours to do with a conventional tool." And the device can even be used to remove very firm tumors, which suction could not.

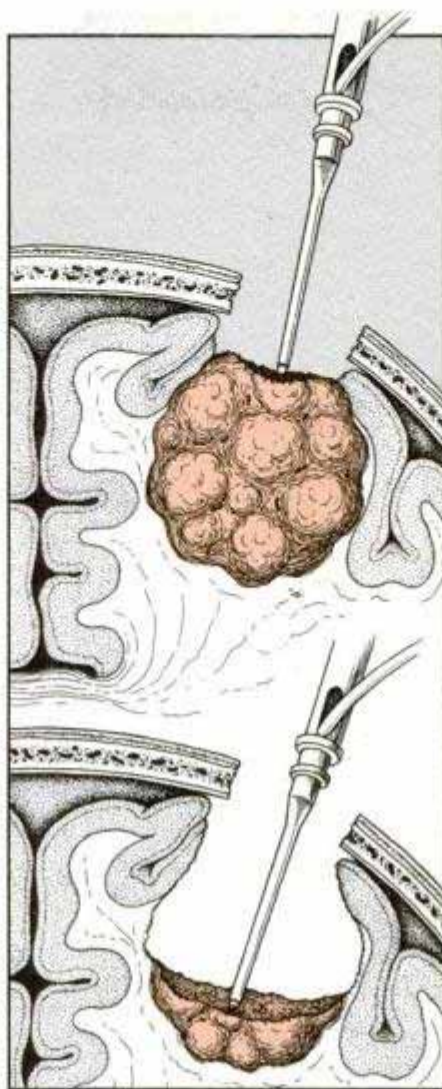
Epstein reports that he has already used the CUSA successfully on about 80 patients.

### Sonic waves size up skin burns

High-frequency sound waves may also find application in burn centers. That is, if a technology spin-off at NASA's Langley Research Center, in Virginia, proves as successful on humans as it has on animals.

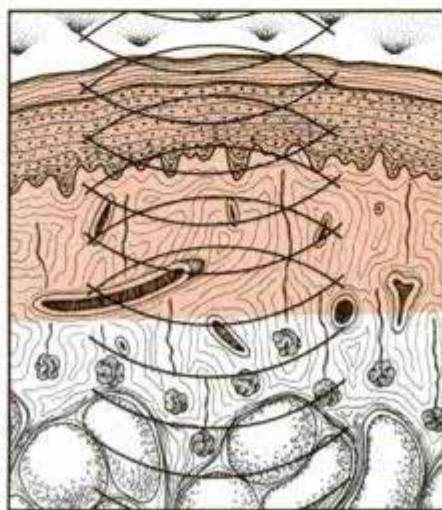
Currently, there is no good way for a physician to determine how deeply a burn penetrates. This is important because the depth of a burn dictates its treatment. Burns near the surface are simply kept clean and left to heal. With deeper burns, however, the charred tissue should be surgically removed before infection sets in.

John Cantrell, a physicist who spe-



Surgeons are now using an ultrasonic tool to vibrate brain tumors to pieces, shattering them one bit at a time.

A skin burn's depth (red) can be found by the use of high-frequency sound waves.



cializes in the effects of high-frequency sound waves, has found that ultrasound can solve the problem. When ultrasound waves are directed at a burn, he explains, some reflect from the exact point where the burned and healthy skin meet. This provides a convenient measure of the burn's depth.

The key to the technique's success is that when skin is heated, collagen—a protein that makes up 40 percent of skin—becomes more dense. It is this difference in density between damaged and healthy tissue that causes the sound waves to reflect.

The technique has only been tried on pigskin, which is similar to human skin, but thicker. Trials on humans are due this year.

## Chilly sea on Neptune moon?

In mythology, Triton was the son of the Greek sea god Poseidon. In astronomy, the same name is given to the larger moon of the planet Neptune, the Romans' name for Poseidon. Now astronomers have made a discovery that proves the choice of names to be particularly apt: Triton appears to have an ocean. It isn't the kind you'd want to bathe in, though. It's liquid nitrogen.

The discovery was purely accidental. A University of Hawaii research team was trying to determine whether the Moon-size moon has any sort of atmosphere. They suspected there might be one, made mostly of methane, so they analyzed the faint infrared light Triton gives off in order to find out.

The methane was there, all right, though whether in gaseous or solid form wasn't clear. But there was also evidence of nitrogen. "There is no shortage of it," says team leader Dale Cruikshank. "There may even be enough for an ocean over three hundred feet deep." As Triton rotates, once every six days, observers see the strength of the nitrogen signal change. "It implies that the nitrogen is irregularly distributed," says Cruikshank. One explanation: The sea covers only part of the moon.

The biggest pinecones in the world grow on the sugar pine tree. They are almost two feet long, a fitting fruit for a tree that grows almost as tall as an 18-story building.



## RESEARCH ROUNDUP

## Spider lassos prey with sticky rope

**B**ola spiders are unique. The various species are famous for their ability to trap hefty moths by mimicking the female's sexual-signal scents and then lassoing the male with "glue." Now, a study by Harvard biologist Mark Stowe indicates that a Florida strain knows when their male prey is looking for a mate.

The dime-size spiders work fast, Stowe says. As the moths hover about, attracted by the imitation scent, the spider hurls its bola—a ball of glue dangling from the spider's leg. Then the spider wraps the moth—sometimes four times its size—in silk, sets it aside and goes after another while they're still plentiful. ■

## Addicted chimps

**D**o chimpanzees get the munchies? A recent report in *Primates* tells of 30 chimps' peculiar attraction to three species of an herb. The feeding habits of chimps observed in two places along Lake Tanganyika suggest the plants may stimulate appetite.

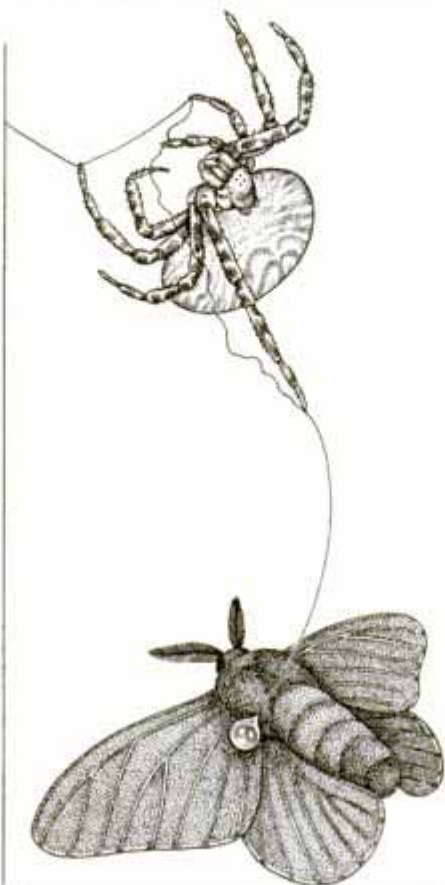
According to Richard Wrangham, a University of Michigan anthropologist who coauthored the study, the chimps never chewed the young leaves they plucked from the *Aspilia* plants—indicating the plants were not sought for nutrients. At one site, the chimps slowly rolled the leaves in their mouths. And some went out of their way to find the plants before dawn. After that, says Wrangham, feeding was heavier than normal. ■

All the water on Earth would fill 10 quintillion, 566 quadrillion, 293 trillion bathtubs.

## Mother's milk deters diabetes?

**D**octors are seldom smarter than nature. Yet from the 1940s until the 1970s, many thought artificial formula was healthier than breast milk.

Now researchers at the Steno Memorial Hospital in Gentofte, Denmark, have found that this use of formula may be related to a simultaneous increase



Bola spiders lure male moths with a false perfume, then trap them with glue, wrap them in silk and set them aside for later.

This herb may have chimps hooked: They slowly roll its leaves in their mouths.



in childhood diabetes. Eleven percent of 181 diabetic children they studied had never been breast-fed, compared with 2 percent of their disease-free siblings. And breast-fed diabetic children were likely to have been weaned earlier—by age four months—than a control group of children.

Because diabetes is thought to be triggered by a virus, it's suspected that antibodies in breast milk may help prevent the disease. ■

## Slug spray

**G**ardeners take heart. A study published in *Experientia* last fall supports what many plant enthusiasts have claimed all along: An effective way to combat garden pests is to use sprays containing remnants of those species on the attack.

Two biologists say that most of the 14 slugs they tested at New York City's Barnard College were repelled by food coated with the ground-up remains of fellow slugs in water. Instead, the pests preferred lettuce coated with water alone.

One of the researchers, Michael Landauer, now at the Medical College of Virginia, speculates that an alarm substance released by the crushed slugs may have inhibited the others' feeding. ■

The coldest spot on Earth—Vostok, Antarctica—has a mean annual temperature of minus 72° Fahrenheit.

## Two-handed swat flusters flies

**Y**ou can lure flies with honey, but if your reflexes are just a wee bit slow, a one-handed swat misses most of the time.

George Gray, professor emeritus of anatomy at University College in London, suggests in *Nature* that you try using two hands instead: "A piece of tissue paper is taken in each hand and the fly approached from the left and right, keeping the hands equidistant from the fly and moving to and fro slightly, then both hands simultaneously pounce." A fly can avoid only one threat at a time, Gray explains. When it sees two, its central nervous system overloads, and it can't decide which direction leads to safety, so it becomes immobilized. ■



## NEWSCIENCE/INNOVATIONS

**Will the real  
Andy Warhol  
please stand up  
and say  
something?**



ILLUSTRATION BY MICHAEL WITTE

**"**It's all there. The affectless gaze. The diffracted grace . . . the bored languor, the wasted pallor . . . the chic freakiness . . . the chalky, puckish mask, the slightly Slavic look. The shaggy, silver-white hair. It's all there. Nothing is missing. I'm everything my scrapbook says I am."

The words are Andy Warhol's, and he's describing himself. But if all goes as planned, he could also be talking about A2W2, the Andy Warhol robot so lifelike—at least so Warhol-like—you'll have trouble telling the two apart.

The android Warhol, to be built at an estimated cost of \$400,000, will have a role in life as soon as it's born: It will star in a one-robot show, perhaps 45 minutes long. Producer Lewis Allen, who was one of the producers of *Annie* and *My One and Only*, hopes to open on Broadway this fall.

Explains Allen, "The robot will be seated in Andy's room, with the telephone and a couple of television sets behind him, and he'll simply talk. Then there'll be a section where the audience asks him questions, and he can reply. The last part will be a kind of probing of himself as a person. But, of course, it will be a robot doing it."

The robot will operate only in a seated position, but according to Allen it will be able to do everything a seated human can do: "The mouth will move, the eyelids will open and close. And it will be synchronized and move as an organic unit, so that when it moves an arm forward, the rest of the body will compensate. Plus there will be a kind of sensory feedback: If it's going to pick up a phone or a glass, it will have the sense to apply the right kind of pressure to lift without crushing. It will move the way Andy moves and talk in his voice. It will even stutter."

Allen is A2W2's godfather; its technological parents are several. The robot is being constructed by AVG Productions, of Valencia, California, whose president, Alvaro Villa, helped create many of the animated figures in Disneyland. Villa had Warhol come to his office to be photographed and measured in detail. "Then we made a sculpture of him out of clay and a fiberglass mold from the sculpture," Villa explains. "We used the mold to make clear plastic shells for the chest and limbs, including every last detail. We even included details of his fingerprints, and we're making dentures to match his teeth."

The robot's body will be made of clear plastic so that the mechanisms

inside remain visible (when not covered with clothes). But the face and hands will be covered with a flexible, skinlike material.

Disneyland's robots work on hydraulics (moving because of internal pressure from a liquid); A2W2 will work on pneumatics (pressure from a gas). Says Villa, "Pneumatic machinery is much more complex, but it breaks down much less often." Inside the ersatz Warhol, valves at the base of a pneumatic cylinder will be connected to mechanical activators that will manipulate A2W2's face and limbs. The robot's actions will be controlled by microprocessors.

The computerized program to direct the microprocessors is being designed by Robert Shapiro, once a senior mathematician-programmer for IBM, now head of a consulting business, Meta Information Applications, of New York City. "The robot's speech will be synchronized perfectly to its lip movements," says Shapiro. "The speech is completely digitalized and controlled by the computer. This means that it's possible for the robot to choose different things to say under different circumstances. It's like a word processor, where you can move a sentence around. If you move a sentence around in our system, the system understands the motions and utterances that are connected with that sentence—it knows what Andy sounds and looks like saying those words."

**T**he system will only be able to move sentences, however, not single words or syllables. This will avoid the disjointed, inhuman sound of most synthesized speech. Warhol will record the voice himself. Says the artist, "I was hoping they'd use someone else's voice. I don't like my voice, but I guess I'll have to talk for the recording."

Producer Allen got the idea for A2W2 from Warhol's books: "Andy has always said, 'I'd always wanted to be a machine,'" he explains. "He carries a camera and a tape recorder around with him all the time, and he tries to remove himself more and more as a person. I think, in a funny way, he has anticipated the computerization and robotization that's been happening in our society. So I thought, why not use a robot of Andy to dramatize his philosophy? It's an implicit comment on what's happening in the world."

Says Warhol, "I think if the robot goes on talk shows for me, it'd be great." ■



# NEWS/SCIENCE

## New tool spots cavities earlier

Detecting tooth decay has always been an imprecise art, the 200 million cavities filled yearly in the United States to the contrary. But a new electronic device available to dentists since last fall may improve early detection.

Called the Vanguard, the machine is a portable, battery-powered tool designed to identify trouble spots as they develop on the biting surface of the tooth. The Vanguard can pinpoint microscopic changes that occur as the tooth enamel loses minerals—a sign of a cavity forming.

A painless electric current detects excess water accumulating in pores that form as vital minerals are lost; increased conductivity spells more erosion. A frowning face flashes on the machine, along with a number indicating the seriousness of decay. A nine is a full-blown cavity, while a zero (accompanied by a smiling face) means the tooth is sound.

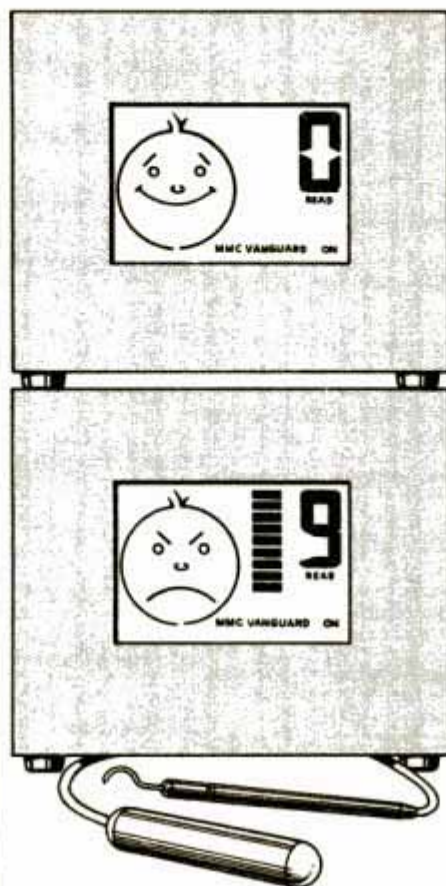
"We're talking about oral health and not waiting for the disease to reach end stages," says Allen Douma, of the Massachusetts Manufacturing Corporation, which developed the machine with Tufts University School of Dental Medicine. ■

## Computer literacy for cattle

When you're herding 100 cows, you can't always remember which is which. And if each cow needs its own special diet to maximize milk output, feeding time can be chaos.

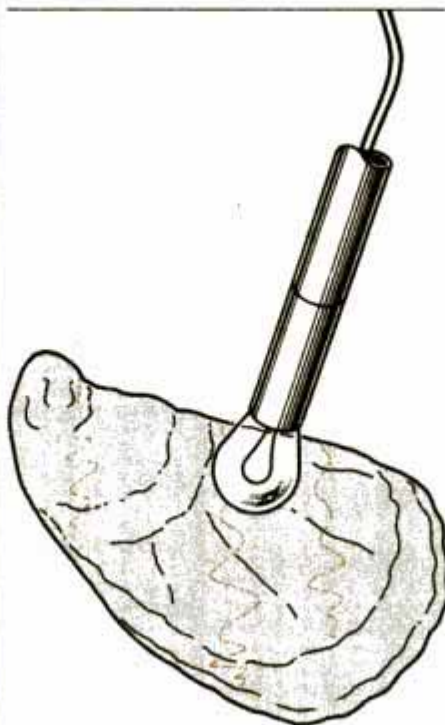
Which is why agriscience is introducing electronic "dog tags" to hang on cows' necks. Tags developed at Cornell University and others manufactured by Alfa-Laval, of Kansas City, contain a transponder that sends radio signals to a computer whenever a cow, entering her stall, passes by an antenna. Says Don Calhoun, product group director at Alfa-Laval, "The computer recognizes cow number one, two, three—then checks its memory to see if that cow is due or not due for a feeding."

**More than 10 percent of the known chemical elements are man-made; they have never been found in nature.**



A new cavity detector frowns at signs of decay and smiles when teeth are healthy.

Just touch the microwave antenna to the shell, and your oyster will shuck itself.



If the cow should get food, the computer triggers a mechanism that lets the cow's particular feed pour into its trough. The longer a cow waits between meals, the more food is dispensed. This prevents both overfeeding and underfeeding.

Calhoun says a system to handle 100 cows could cost as much as \$18,000 but will save more than that in feed and labor costs. In July, Alfa-Laval expects to offer a more sophisticated version that checks each cow's daily milk output and adjusts her feed accordingly, without instructions from the farmer.

Cows wearing these tags are reported to be utterly content. ■

**Countdowns to rocket blast-offs were invented by movie director Fritz Lang for his 1929 film *The Woman on the Moon*. Lang thought they would increase tension in the audience.**

## Blasting the shell from an oyster

The Romans loved oysters as much as modern shellfish fans do, and they found it just as tough to open them. The primary obstacle is the tough adductor muscle, which keeps the two halves of the shell shut tight. Even after the mollusk is dead, it takes a sharp knife, precision placement—and, inevitably, occasional severe cuts—to liberate the edibles.

Modern technology may have the answer. A patent for a microwave oyster shucker has been granted to the University of Maryland. The device is based on the same principle that operates a microwave oven: Electromagnetic pulses penetrate to the interior of tissues, where they make water molecules vibrate rapidly. The friction generates heat.

The oyster opener, the invention of electrical engineer Leonard Taylor, is a hand-held device with a small loop antenna. When it is properly positioned against the outer shell, microwaves are directed to hit the adductor muscle, which, in seconds, heats up and literally explodes in a tiny burst of steam. The rest of the oyster is left cold and raw, the way aficionados prefer it. "If you eat it right away," says Taylor, "you might taste a small warm spot." He sees the device being useful in plants, homes—and taverns. ■



## The undulating outboard motor

A retired machine designer hopes to revolutionize boating with a new engine made from scrap materials and a used chainsaw motor. The engine, which he built in his kitchen, moves a boat forward and backward not with a propeller but with paddles.

Two thin, bladelike paddles—each 12 inches long and 2 inches wide—extend straight down in the water, their flat sides parallel to the sides of the boat. When the motor, which remains above water, is turned on, each paddle begins a sculling motion—that is, it oscillates clockwise-counterclockwise and at the same time wags back and forth. The paddles wag in opposite directions, like a swimmer's legs doing a frog kick.

Ron Young, the designer, claims his engine uses only two-thirds of the fuel consumed by a comparable propeller drive. At top speed, his two-horsepower prototype oscillates at about 1,000 cycles per minute.

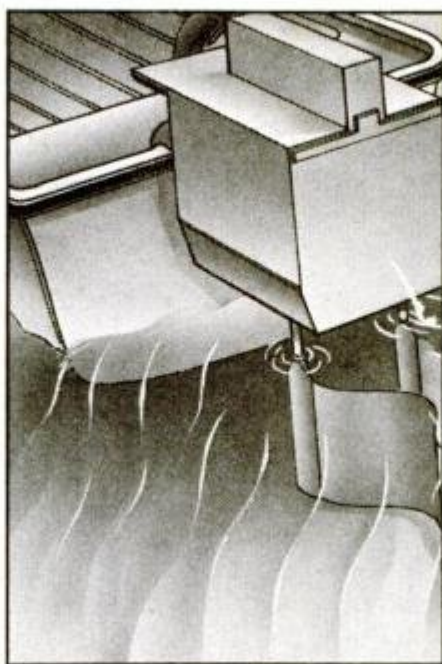
He got the idea, he says, from his childhood in England, where he watched fishermen drive their boats by moving a single oar from side to side in the water rather than rowing. ■

## Foolproof system locks out thieves

Each year, many millions of dollars' worth of portable electronic equipment—from cameras to microwave ovens—is stolen in the United States. But by 1985, the newly developed Kaish Circuit Lockout could render these stolen wares useless. Once unplugged, they won't work without the proper code.

Existing security measures are easily outwitted, says Norman Kaish, president of International Electronic Technology Corporation, in New York, which has filed a patent for the new system. "All you need do is buy one of the same products you stole and make copies of its chip."

The Kaish system is based on a consumer-devised personal code, which can have any number of digits in any combination. Then, says Kaish, the thief has six chances to put the code in correctly. Failing that, the microprocessor can be unlocked only by its factory's master code. ■



This unusual new motor design imitates the swimming action of a fish. Instead of a spinning, screw-type propeller, it uses a pair of thin metal paddles. A sculling motion makes the boat go.

Skating rinks may soon replace ice with interlocking tiles made of hardy plastic.



## Impotence cured electronically

Impotent men may soon be able to reverse their problem at the push of a button, thanks to a collaboration between medicine and electronics.

Last year, in several laboratories around the country, scientists discovered a group of nerves in the groin that seems to control erections. Already, a Philadelphia company, Biosonics, Inc., has developed a device called the Male Electronic Genital Stimulator, or MEGS, that can be hidden in the rectum and, by remote control, stimulate the vital nerves. Monkeys wearing it have maintained erections for nearly an hour and a half, says inventor Henry Brenman of Philadelphia's Jefferson Medical College. No test, however, has determined whether ejaculation terminates a MEGS-induced erection.

MEGS is not yet available. FDA approval is pending, and Biosonics says the stimulator will be sold only by prescription from a physician. ■

## Ice-skating without ice

Ice-skating without ice? That's what happens when technology overtakes Mother Nature.

The need for expensive refrigeration or a long cold spell has been eliminated by a British company, High Density Plastics, Ltd., which is now distributing ice-skating surfaces made of interlocking, solid plastic squares.

The newly developed material "is not too hard for the skate to bite into, but not so soft that the skate would peel the plastic away," says managing director Peter Sutcliffe. Every three days, the plastic is sprayed with a fine film of "gliding fluid" (a glycol-water solution); the fluid contains a disinfectant, in case the skater is cut in a fall on the "ice."

What's the reaction to skating in the heat? "A hockey team in England skated on one of our floors," Sutcliffe says. "They just had to discard their heavy underwear." ■

Lions mate insatiably. One male, watched in the wild, mated 86 times one day and 62 the next.



## EVERYDAY SCIENCE

## What lives in your lawn?

If you think parks are crowded, take a look at your lawn. Far from being a sterile green carpet, a lawn is a thriving jungle of mutually dependent plants and animals.

According to ecologist John Falk, director of the Smithsonian Institution's office of educational research, "The average lawn has twenty to thirty species of plants, and there may be a hundred different species of animals large enough to be seen."

Swarms of leafhoppers dive in and out of the canopy layer. Bees, flies and other hovering insects feed and breed among the grass blades. And, says Falk, "suburban birds extract more food per square foot from lawns than their cousins take from equivalent areas of prairie."

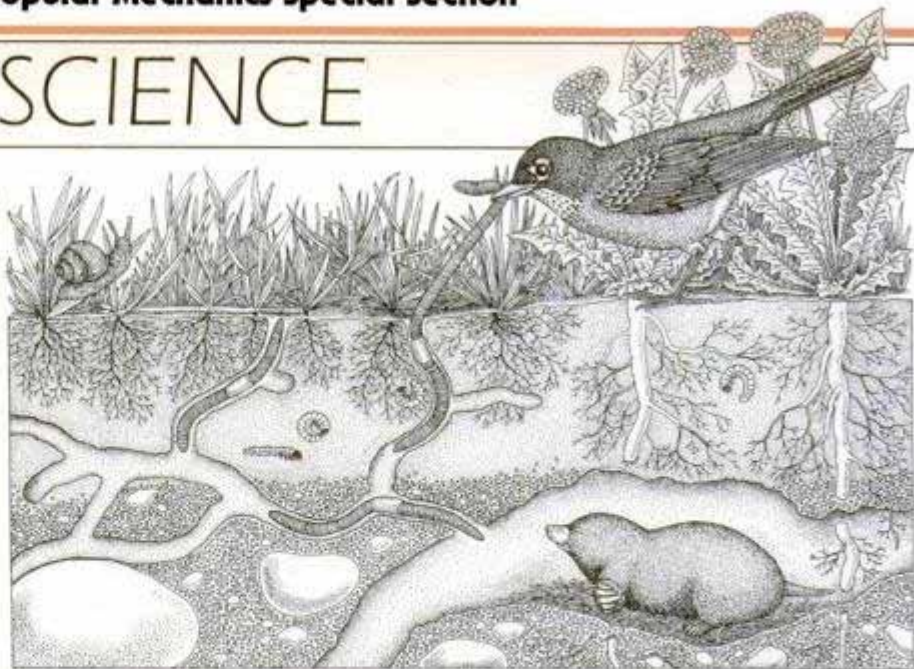
Among the leaves and stems, aphids and insect larvae suck on plant juices, while on the ground the slimy trails of slugs are crisscrossed by foraging beetles, snails, crickets, millipedes, spiders and ants.

But most of the action is underground. In the mass of roots, eel-like nematodes prey on bacteria, fungi and other nematodes. Insect eggs incubate and hatch. In some lawns, moles dig for grubs, and their tunnels are reused by voles, mice and shrews.

The rich, earthy smell of a lawn comes from millions of actinomycetes—moldlike bacteria used for making antibiotics—in the humus layer below the roots. Decay is the life of a lawn. Bacteria, fungi, algae, molds and yeasts break down dead animals and plants, releasing carbon, nitrogen and other nutrients with which plants make new proteins. Earthworms plow up and aerate tons of soil per acre each year as they burrow to the surface to deposit their castings and drag debris and dead leaves underground.

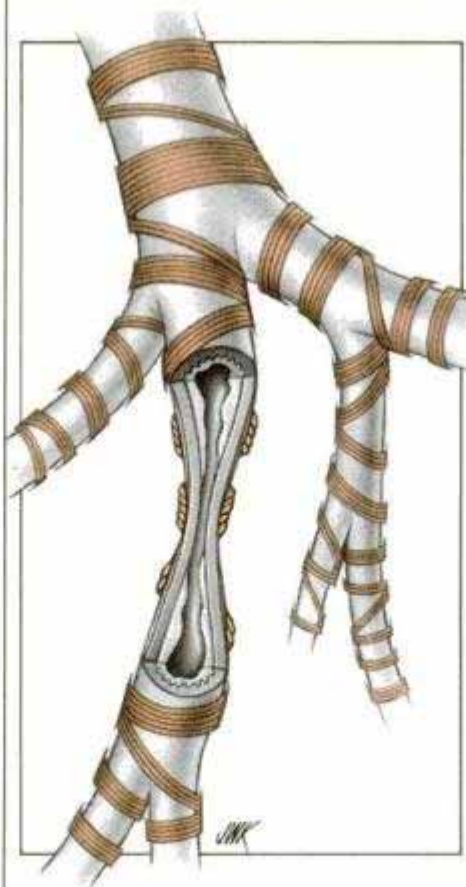
The dark world one foot underground is a stable community with little temperature change. And while an asphalt driveway may be 30 to 40 degrees hotter than the air in the summertime, a lawn remains at least 10 to 20 degrees cooler. ■

**Although only nine inches tall, an adult roadrunner can keep pace with a human sprinter.**



The multiple layers of a lawn teem with life. Birds and insects feast in the grass, while, underground, moles dig and plants are broken down and recycled.

Muscles wrapped around hollow tubes in the lungs control the inhalation of air. During an attack of asthma, they tighten, and the victim must fight for breath.



## What is asthma?

The sufferer gasps and wheezes. His chest feels tight. He coughs to fight the mucus in his lungs. He is having an attack of asthma—a debilitating disease that plagues 10 million Americans, primarily children.

Asthma's cause is not yet known. Researchers do know that asthmatics inherit abnormally sensitive lungs that react to allergies, irritants, climate, overexertion and stress.

Normally, air passes easily into the lungs' branching tubes. The tautness of muscles wrapped around these bronchi determines the size of the airway.

When an asthmatic's bronchi are irritated, the muscles tighten and the bronchial lining swells or mucus is secreted. Air can't get through. This struggle for air can set off vibrations—high-pitched wheezes—in the narrowed tubes. A severe attack may require hospitalization and can be fatal.

No one outgrows asthma, notes Manon Brenner, a pediatric allergist at the National Jewish Hospital-National Asthma Center in Denver. Children may be more susceptible to attacks because they are prone to viral infections. ■

Editor: Andy Revkin. Staff: Madeline Chinnici, Andrea Dorfman, Mike Lemonick, Nina Wallace. Contributors: Calvin Allen, Susan Allport, Geoff Becker, Randall Black, Kelly Costigan, Margery Facklam, Brian Feinberg, Carol Fletcher, Susan Gilbert, Dina Ingber, Steven Oppenheimer, Andrea Panciera, Stan Pinkwas, Lawrence Prescott, Henry Weil.





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# APPLIANCE CLINIC



## Moving a refrigerator in a truck

*We will be transporting a refrigerator in a pickup truck. We have heard that you should not lay the appliance down. You must keep it upright, or it won't work after you move it. Is this true?—Paul Miller, Cologne, Minn.*

Moving a refrigerator on its side is risky business. There is always the possibility that the refrigerator compressor or the freon lines may become damaged en route, or that the compressor's internal mounting springs may become dislodged from the motor within the

compressor shell. This may cause permanent damage to the compressor.

If there is no other way to move the refrigerator other than on its side, the best advice I could give is to unplug the refrigerator at least one day before you intend to move it. This will let the pressure in the sealed system equalize and let the oil in the system drain back to the compressor. Next, defrost the refrigerator thoroughly. Empty the drain pan, then clean it with a mild solution or soap and warm water. Dry

the inside liner of the refrigerator with a towel. Remove all shelves or secure them with tape. Finally, shut the door and tape it closed.

When loading the truck, use several blankets or furniture throws under the refrigerator side to help protect the unit from hard jolts and bumps during the trip. After the refrigerator has arrived at its destination and is in an upright position again, allow it to remain idle long enough for the oil in the sealed system to drain back to the compressor—a safe amount of time would be about 24 hours. Then plug it in.

## Rusting dishwasher

*I have a General Electric portable dishwasher, model No. 1SP4041, serial No. PR706476. Rust has formed around the center heating element bracket. Is there any way I can replace this area with new metal? Also, the motor is not working. The replacement motor costs \$100. Is there any kind of motor I can get to replace my present one that isn't so expensive? How about a rebuilt motor?—Will Adams, Cincinnati*

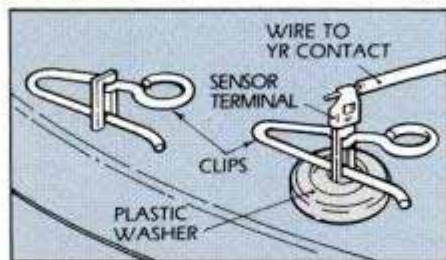
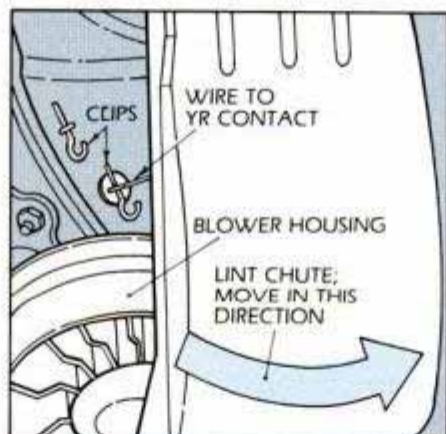
As far as the motor is concerned, it depends on its condition. An electric-motor rebuilding shop can probably replace the windings and bearings.

As for the rust, you can remove it if it has not gone entirely through the tub. Take the heating element bracket and the element out of the dishwasher. Then buff and clean the rusted area with a wire brush. Make sure there is no dirt or oil on the area.

Use an epoxy repair kit available from GE. The part number for the kit is WD49X46. Cover the rusted area with a thin layer of epoxy. Let it set, then either drill out or ream out the holes and reposition the element.

## Reticent dryer timer

*The timer on our Kenmore gas dryer, Model 110.8718110, will not advance in the cotton/sturdy cycle. Thus, the dryer continues to run unless shut off manually. On the timed cycle, the timer advances normally. Using a voltmeter, I noticed that the timer motor received no voltage on the cotton/sturdy cycle. I checked all wiring for conti-*



**To remove a sensor in a dryer tub, loosen the lint chute and swing it aside (top). Disconnect wire to a sensor terminal (above). Remove the clips and push on terminals.**

*nuity, and checked each of the five contacts on the electronic sensor circuit board. I also checked circuits to ground and to the in-tub sensor. They seemed fine. Finally, I replaced the electronic sensor boards. The machine still doesn't work.—Joe Mertens, Alex. La.*

It sounds as if you may have either a bad timer or a grounded sensor. To check the timer, first unplug the dryer from its power source. Remove the

rear cover from the dryer control panel. Turn the timer knob to the cotton/sturdy position. Use an ohmmeter set on the lowest resistance scale and check the continuity between timer contacts labeled Y and BG. These contacts should be closed for timer motor operation. Also, check contacts EC to TM-1, which remain open for the first five minutes of timer operation then close. If any of these contacts remain open, replace the timer.

To check the in-tub sensor, disconnect the printed circuit board from the quick-connect block located in back of the control panel. Check for continuity between contact YR and any cabinet ground with your ohmmeter set on its highest scale. There should be no reading (infinity). If you do get a ground reading (0 ohms), some part of the sensor is touching the cabinet or something may be shorted between the two metal strips on the sensor pad.

To remove the sensor, first remove the rear service panel. Then remove the two screws which hold the lint chute to the dryer top. Next, remove the four screws which hold the chute to the blower housing at the bottom. Now swing the chute to the side. Disconnect the wire attached to one of the sensor terminals. Remove the two clips and push in on the terminals. Take out the sensor through the dryer front. **PM**

*If you have a problem with any appliance, send your question, 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.*





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V-115

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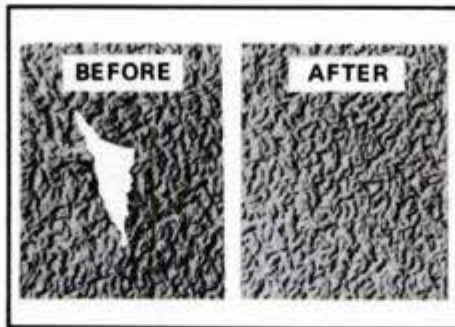
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Chevy S-10 shines with a four-layer paint finish and an extra fifth layer: a chip-resistant coating on the lower body side panels. Check out all the facts before you buy your next truck. Check out the zinc-and-steel-tough Chevy S-10.

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Chevy S-10 Pickup



## CHEVY TOUGH IS TAKING CHARGE



**A**t times when you're doing close work in the shop, a brighter than normal worklight would contribute to greater accuracy.

I assembled the light-control unit shown to regulate a high-wattage incandescent lamp. Most of the time the control holds the illumination at a comfortable working level. But when I need it, a twist of the control knob brings the lamp to its maximum 200-w. brightness.

The light control shown is intended for mounting on a wall, ceiling or elsewhere within convenient reach from the work spot. The main components of the control are a push on-off dimmer switch of 600-w. rating and a grounded duplex outlet that accepts two or three-prong plugs.

I housed these two parts in a pair of surface-mounted steel outlet boxes which I had on hand, fastened to a plywood base. (However, you can simplify the arrangement by using one double duplex outlet box and a combination outlet-switch plate.) The two boxes are linked by a piece of No. 10 copper wire so they both will be grounded. If made with two boxes, remove the adjacent knock-outs where the wires will pass, and smooth the edges of the holes with a rattail file. Fasten the boxes firmly to the mounting base.

A length of No. 16, three-wire, flexible cord brings power to the unit from a conventional outlet. If the power-supply outlet isn't grounded, provide the unit with a wire connected to one of the screws holding the box-connecting link, and to a water pipe.

## Make This Light Control For Close Jobs



The light control shown is tested for use with a No. 1 photoflood lamp on a workbench.

Attach the wall plug so the polarity is proper; the dimmer switch should be in the power side of the circuit (black wire in the diagram). Thus, the black wire should be attached to the brass-colored plug tine which goes into the small slot in the wall outlet.

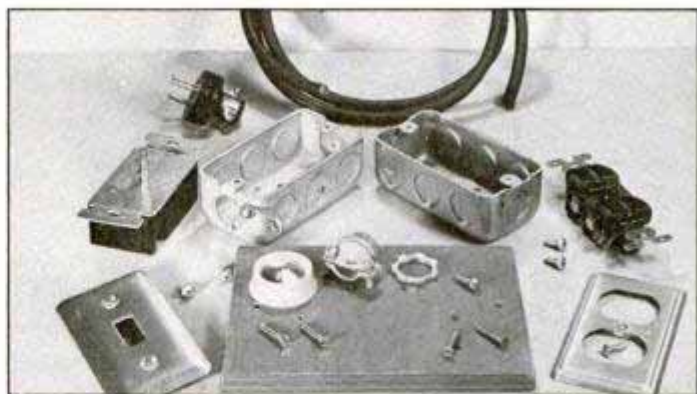
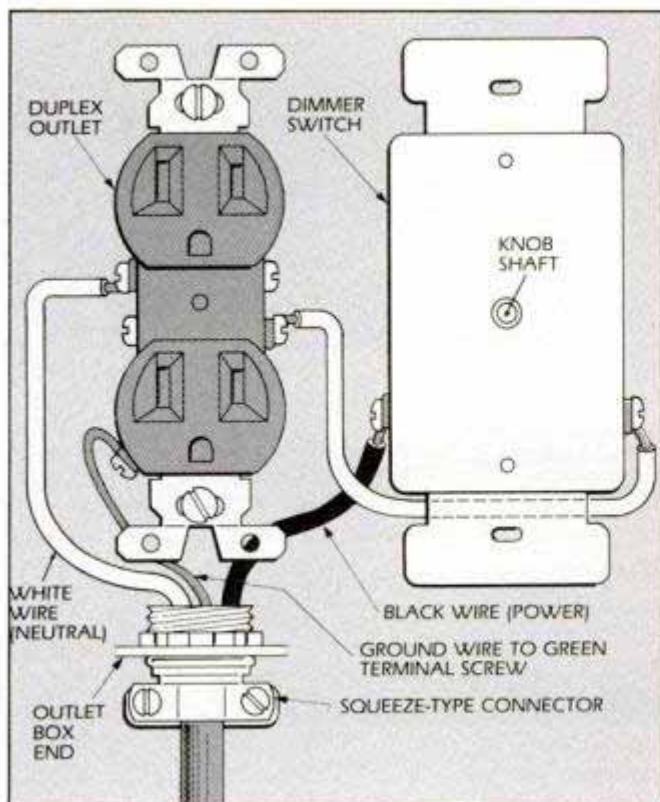
Make sure that the dimmer you use is rated to handle the wattage of your worklight.

Note that this control is *not* suitable for fluorescent lights.

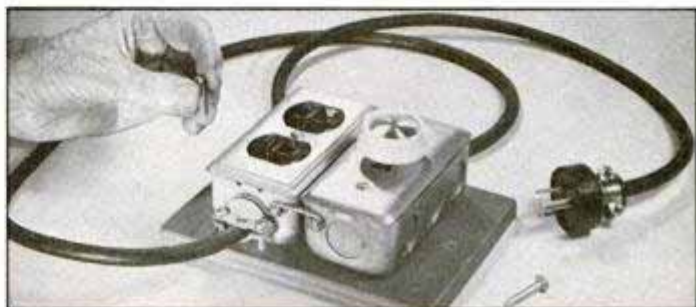
—Walter E. Burton

### MATERIALS LIST—DIMMER

No.	Description
1	Dimmer-switch, 600-w. rating at 120 v.a.c., push-on action
1	Duplex outlet, grounded, 15-amp., preferably heavy-duty
2	Outlet boxes, surface-mounted, steel (or use one double-duplex, steel, surface-mounted box)*
1	Toggle-switch plate for dimmer-switch box*
1	Duplex outlet plate for outlet box*
1	Squeeze-type cable connector
1	No. 16, three-wire, flexible cord, length as needed
1	Grounded, three-prong plug
1	No. 10 copper wire (bare), cut to length required by screw spacing, to link boxes
1	1/2 x 4 1/2 x 5 1/2" wood base or similar
Misc.:	Screws as required, No. 12 insulated wire
	*If you use a double-duplex, surface-mounted outlet box, you can use a combination toggle-duplex outlet cover.



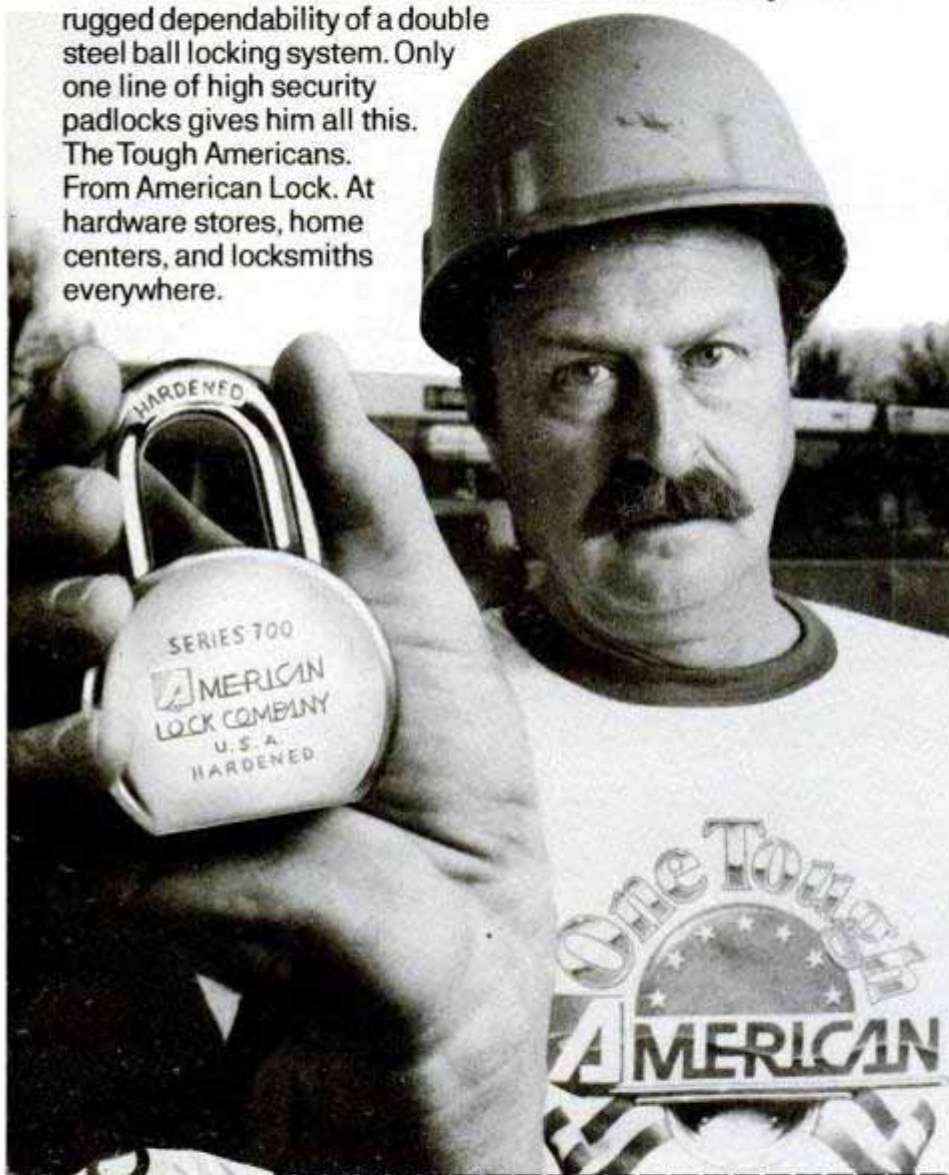
Components of the light-control unit (above) are at hardware stores. Completed light control (below) is ready for mounting on a wall or other surface. Note box-connecting link near power cord clamp.





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## HINTS FROM READERS

### Notch identifies key



I marked my house key so that it can be distinguished readily by sight or by feel from similar keys on my key ring. In the photograph above, the key on the right has a smooth-edged notch, which I filed in the key head. It's easy to pick out this notch when I'm carrying groceries and can't see the keys. Also, the key is easily identified at night when the porch light isn't on.

—Walter E. Burton

### Breaking concrete



When breaking concrete or other masonry with a star drill or cold chisel, an old straw broom can come in handy in several ways. It can help absorb the shock of the sledge. It can also hold down flying debris that may otherwise strike someone. Since dust collects in the broom, use one that's not needed for housework. —James D. Ritchie

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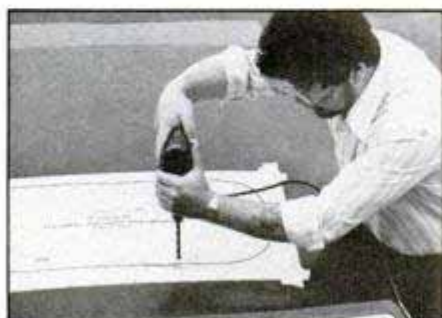
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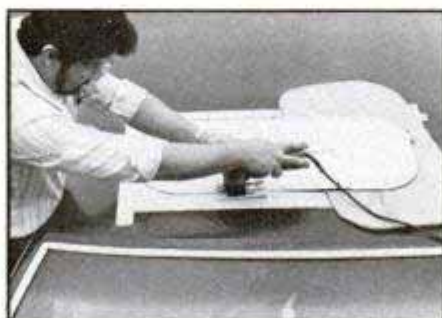
# Install Your Own Sunroof

It's not the world's easiest do-it-yourself job, but it's not as hard as it looks.

BY WADE HOYT, Auto Editor; Photos by Marshall Spiegel



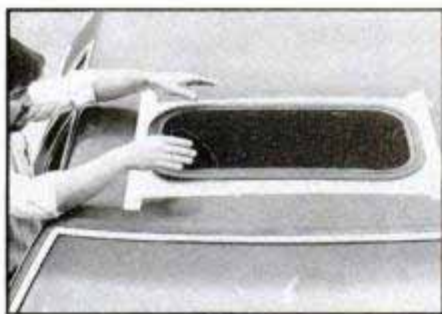
**1** Center the sunroof kit's paper template on the car's roof and secure it with wide masking tape. Cover the interior of the car with a dropcloth. Next, drill a  $\frac{3}{8}$ -in pilot hole as indicated on the template.



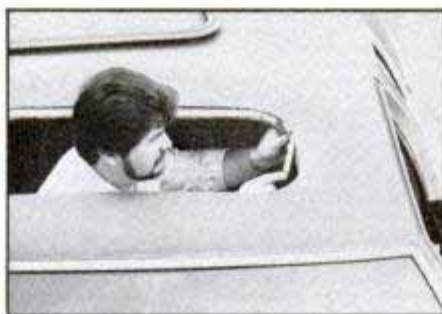
**2** Use a sabre saw to cut through the roof and headliner on cars which have rigid composition headliners, such as this Ford LTD. Follow the outline on the sunroof template when you cut the car's roof.



**3** On cars with fabric headliners, like this Honda, you should use electric shears to cut through the roof only. Carefully cut back fabric to within a few inches of opening so that it can be tucked under the frame.



**4** Test-fit the sunroof frame in the hole, then remove the masking tape and the template. Use a file to remove any burrs from the metal edge. Carefully apply primer to the cut edges so the metal won't rust.



**5** When the primer dries, you should insert Styrofoam spacers between the roof's sheet metal and the headliner underneath it. Apply weatherstripping tape around the sunroof opening, about  $\frac{1}{8}$ -in. from the edge.



**6** Install the sunroof frame in the opening. Align the inner trim ring with the frame, tape it in place and tighten the screws. Seat the corners of the frame with a C-clamp as you are tightening the screws.



**7** Attach the glass to the sunroof frame from inside the car, following the instructions in the kit. Next, secure the hinges and the latch. Trim any excess weatherstripping from around the sunroof frame.

Some sunroofs are installed at the factory, some by new and used car dealers, and some by adventurous owners. The job is not as hard as it looks. The toughest part is getting up the courage to cut a hole in your car's roof! There are many brands and models available. The one shown here is a 15 x 30-in. Skyport III from LeVan Specialty Co., 14923 Procter Ave.,

Industry City, Calif. 91744.

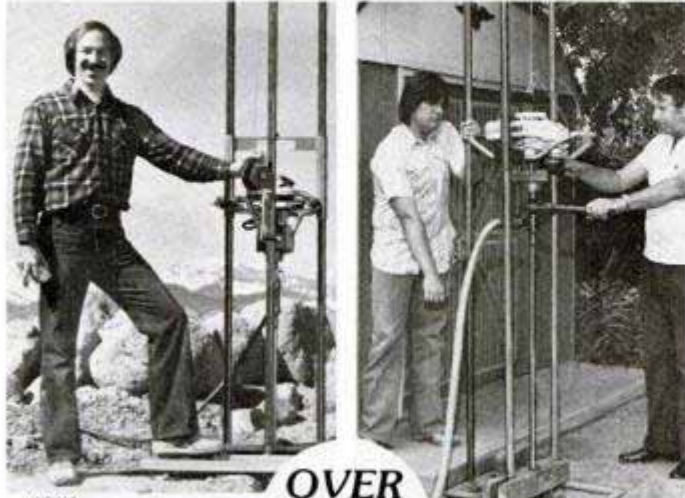
Position your sunroof to avoid dome lights and other interior accessories. Rent electric shears to cut the roof on a car with a fabric headliner, and be careful not to cut through any wiring. When cutting the fabric, leave a margin of several inches to tuck under the sunroof frame. On cars with a rigid headliner, you can use a sabre saw. **PM**



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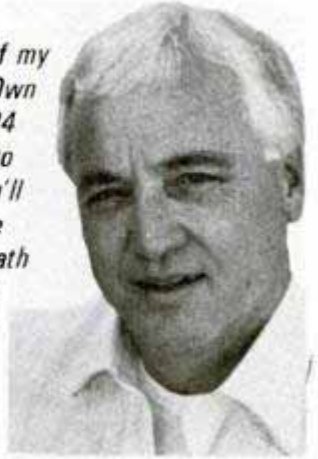
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# PM'S TIME MACHINE

75 YEARS AGO: April 1909



Unique furnace is revealed.

## Iron process

The chilled iron that often blocks the taphole of a blast furnace can be pierced in a few minutes, even though it's two or three feet deep. The mass is heated to combustion, then a blast of oxygen is turned on. Under the high pressure, it's removed almost instantly.

## Salty weed killer

The Oregon Short Line railroad has been using salt water for ridding its roadbed of weeds. The water of the Great Salt Lake kills the grass and weeds.



## Uncle Sam's derelict destroyer

The main reason for the *Seneca* is, of course, indicated by her title of "derelict destroyer." A derelict is a submerged hull that floats hither and thither with the tides, constituting the most serious menace to

modern navigation and the one most difficult to avoid. The *Seneca's* steaming radius is exceptional . . . she will carry enough coal to steam across the ocean in her chase after derelicts so they can be sunk.

50 YEARS AGO: April 1934



Large models hit the water.

## Potsdam modelers

One of the most remarkable dockyards in the world is near Potsdam, where an old seaplane station has been converted into a plant for building large working models of famous boats. Here, unemployed German boys are trained to become model ship builders. One craft is a model of the battle cruiser *Hindenberg*. It's nearly thirty-three feet long, has a beam of a little less than five feet, weighs more than three tons and makes a speed of more than seven miles an hour.



## Telephone poles

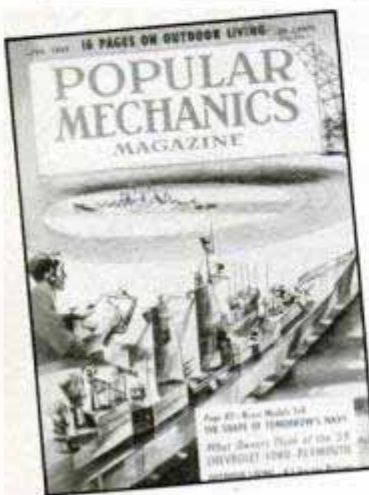
Hazards of cleaning high-voltage insulators are reduced greatly by a truck

equipped with a telescopic pole, on top of which is mounted a small platform for the workman. The truck also is used in fighting fires along the transmission line right of way.

## Fish won't hear you

Fish possess some kind of hearing apparatus, but it is very poor at best. If a diaphragm is placed between the air and the water and made to vibrate, the fish will respond. But shout all you want while fishing, the fish won't hear you, according to scientists.

25 YEARS AGO: April 1959



The Navy designs new ships.

## New look for ships

The new carriers and cruisers and destroyers are going to have a bare and sometimes blocky appearance. Part of this is for nuclear protection. But most of the new look comes from what is called "electronic architecture." Radio engineers are working with naval architects to design the ships. "A modern ship may require upward of 300 different radio antennas," says Valor Smith, head of the ship antenna-systems section at the Navy Electronics Laboratory.

## Go-Kart derby

Many a winning Go-Kart driver has coaxed his mechanical steed to a noisy 50 miles per hour. If that seems slow, as auto races go, try it yourself. But be prepared to shell out some cash for a Go-Kart of your own. Skids and spin-outs there are aplenty, but with their low centers of gravity,



none of the buggies has ever flipped over.

## Weightlessness is fun

When the first American goes into orbit, his body won't weigh an ounce. Obviously, it is impossible

to duplicate weightlessness. But the Air Force has developed an aircraft flight trajectory that creates a period of weightlessness of about 15 seconds. **PM**



Canadian Hair Breakthrough:

# BALDNESS TREATMENT GROWS NEW HAIR!



## NEW GROWTH CLAIM FOR HAIR RESTORER WINS CANADIAN GOVT. APPROVAL!

Amazing Lotion Receives Official "Notice Of Compliance" As A...

*"TREATMENT FOR ARRESTING EXCESSIVE HAIR LOSS AND FOR INCREASING NEW TERMINAL HAIR GROWTH ON THE SCALPS OF MEN AND WOMEN WITH UNCOMPLICATED MALE PATTERN OR DIFFUSE HAIR LOSS"*

*R.A. Armstrong, M.D. Assistant Director and Chief  
Drug Evaluation Division Bureau of Nonprescription Drugs Canada*

Today there is a remarkable treatment for baldness... FORMULA MJS HAIR RESTORER LOTION... Named by the Canadian Government in an official NOTICE OF COMPLIANCE after clinical studies in which over 70% of the 40 patients treated actually grew new hair! These studies were supervised by an eminent physician (then Head of Dermatology for the Toronto General Hospital and Associate Professor of Dermatology at University of Toronto Medical School), and promptly submitted to the Canadian Government. The results were astonishing. Most patients experienced a significant reduction of hair loss. And within 6 months more than ¾ began to REGROW HAIR!

### THE GALEA THEORY

We are all born with a thin membrane called the galea, which protects the vulnerable soft spot at the top of the skull as the occipital bones grow together. The galea covers the crown of the head, or the first part "to go" in typical cases of male pattern baldness. In many of us the galea thickens with age. Some researchers believe that this thickening chokes off blood supply to the hair follicles, causing them to atrophy and die. FORMULA MJS HAIR RESTORER is said to revitalize dormant hair follicles and gradually thin the galea, renewing the circulation necessary for a normal pattern of hair growth.

### U.S. GOVERNMENT POSITION

It is the unanimous opinion of the Food and Drug Administration, the U.S. Postal Service, and the Federal Trade Commission that nothing

can halt the process of male pattern baldness and grow new hair. Obviously Canadian Authorities disagree... and so strongly that they have approved the extraordinary claim of NEW HAIR GROWTH and granted FORMULA MJS a Notice Of Compliance for over-the-counter sale to the general public. Of course, governments aren't in the business of endorsing and promoting commercial products but according to Canadian Officials, FORMULA MJS MAY BE SOLD AS A TRUE HAIR RESTORER THAT GROWS NEW HAIR ON BALD HEADS!

### NOW AVAILABLE IN THE U.S. THROUGH THIS OFFER ONLY!

After months of careful planning and high level negotiations, we are pleased to announce that FORMULA MJS HAIR RESTORER LOTION will be released for sale to the American public beginning immediately. This is the exact same formula tested in clinical trials which has grown new hair and satisfied countless thousands of customers throughout Canada. FORMULA MJS HAIR RESTORER LOTION is available exclusively through this offer. **It cannot be purchased anywhere else.**

### PROVE IT TO YOURSELF ENTIRELY AT OUR RISK

If you are bald, thinning, or worried about losing your hair, we think you should try FORMULA MJS. In Canadian studies, over a period of just 6 short months, the vast majority of those treated grew **at least** some new hair. And while it is not possible to predict in advance which people will be helped, or to what extent they will be



helped by the MJS BREAKTHROUGH—You risk nothing because you must be completely satisfied or we will refund your purchase price in full.

FORMULA MJS... The Ultimate Treatment For Baldness... Approved By The Canadian Government For Claims Of New Hair Growth... FORMULA MJS—The Canadian Hair Breakthrough... We urge you to take advantage of this unique opportunity and ORDER YOUR NO-RISK SUPPLY RIGHT NOW! YOU HAVE NOTHING TO LOSE BUT YOUR BALDNESS!

MJS RESEARCH GROUP Dept. HL-30  
190 5th Ave., Suite 812A, New York, N.Y. 10010

Please RUSH me the following supply of FORMULA MJS:

- 1 MONTH SUPPLY OF FORMULA MJS: \$45 plus \$2 shpg. & hndlg. (Total \$47)
- SAVE \$14—2 MONTH SUPPLY OF FORMULA MJS: \$80 plus \$3 shpg. & hndlg. (Total \$83)
- SAVE \$27—3 MONTH SUPPLY OF FORMULA MJS: \$110 plus \$4 shpg. & hndlg. (Total \$114)
- SAVE \$122—RECOMMENDED 6 MONTH SUPPLY OF FORMULA MJS: \$160 (We pay shpg. & hndlg.)

Total Enclosed \$ \_\_\_\_\_ (N.Y. res. add sales tax)

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**Important notice:** In clinical studies results were observed after 4 to 6 months of use. The MJS Research Group therefore recommends daily application for a full 6 months.

**6 Month Money Back Guarantee**



# I Earn More Per Day Now...



than I used to make in a week.

I started my own business part-time as a Von Schrader Associate . . . got step-by-step help and success beyond my dreams.

How it really happened, by William Turnbow

"Fresh out of the Marines I bought a farm. Unfortunately, it wouldn't support a wife and three growing boys. Next I managed a food store. But I got tired of having somebody always telling me to do this and do that. I wanted to be my own boss.

"So I answered a Von Schrader message like this one, which opened the door to new opportunity for me. It was just what I was looking for. No big investment. No licensing or franchise fee. No waiting, no training needed. What really appealed to me is that you pay no dues, fees or royalties—every single penny you earn is yours to keep!

"I started out part-time. Jobs started to snowball and pretty soon I had as much business as I could handle. Before long I went full time.

"Now I make more in one day than I used to make in a week. I made \$43 per hour on one job recently . . . have made \$1,600 in a week. Now I have the time and the money to go hunting and fishing all I want. Recently we moved to a new, larger house."

How would you like to earn big money, starting out spare time, like William Turnbow? Be your own boss? Become financially independent? You can start in business for yourself using your home as a base. Everything you need on a job fits easily in your car.

As a Von Schrader Associate you can have three money-making businesses in one, if you want! Carpet

cleaning, with the only foam machine that cleans and vacuums carpets in one pass. Upholstery cleaning, that quickly results in bright, sparkling clean upholstery without harmful overwetting. And wall cleaning, almost 5 times faster than bucket-and-sponge, with little effort, no streaking.

Our easy-to-follow instructions tell you step-by-step how to operate your equipment. Absolutely no experience or special training is necessary. Our proven sales and servicing methods are backed by over 50 years of experience. You get all the know-how you need to become a home furnishings maintenance expert.

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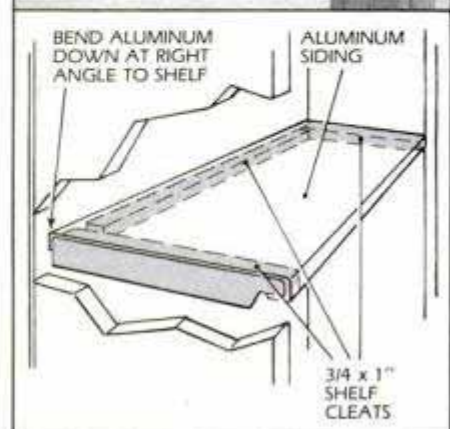
To expedite call toll-free 1-800-558-2484. Ask for operator 1044

## 2 Easy-Make Shop Aids

To secure the drawers of multidrawer storage cabinets for safe carrying, join two cabinets of the same size with a length of continuous hinge. Attach latches to the opening side. Attach one end of one handle to each unit with wingnuts on threaded rods. Disengage one end of the handle before opening the cabinets.—George F. Luteri and Arthur F. Licht



Use leftover aluminum siding to make a neat cabinet shelf for your shop. The lower, factory-shaped edge of the siding forms the shelf's front edge. Trim the top edge to suit the desired shelf width and make a bend to form the back edge. Fasten a wood cleat under this edge and attach it to the back of the cabinet. Install the end cleats as shown—Walter E. Burton

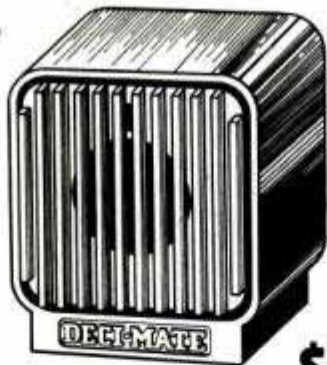


Shelf is fashioned from a length of aluminum siding mounted on three wooden cleats.

## Pests R Gone™ with Decimate

Ants, rats, mice, roaches, fleas, bats, spiders, etc. etc. What a pain they can be! You can fumigate them, poison them, trap them, etc. But what do you do with those dead and unsightly things? And those poisons can be harmful to humans and pets. Bentley's knows a better way! DECIMATE delivers an ultrasonic sound that cannot be heard by humans or pets. It is completely harmless. But it is another story to all those pests and varmints. It drives them looney! DECIMATE causes them extreme discomfort and pain. Would you take this kind of treatment? Heck no. And neither will they. In just a few weeks all those pests and varmints just leave and never come back.

Just plug the EPA and UL approved DECIMATE 500C (the biggest unit) into any AC outlet and in a few short weeks those pests will be gone forever. (Beware of units of low intensity and constant frequency). DECIMATE sweeps two levels from 25,000 to 65,000 kHz in each cycle. It protects 3,500 ft.<sup>2</sup> or 25,000 ft.<sup>2</sup> It uses less than 5 watts of power. DECIMATE, the pioneer in ultrasound pest control, has rid tens of thousands of homes and plants of pests. One year limited manufacturers warranty. Try it free for 60 days and if you are not 100% satisfied return it for a prompt refund.



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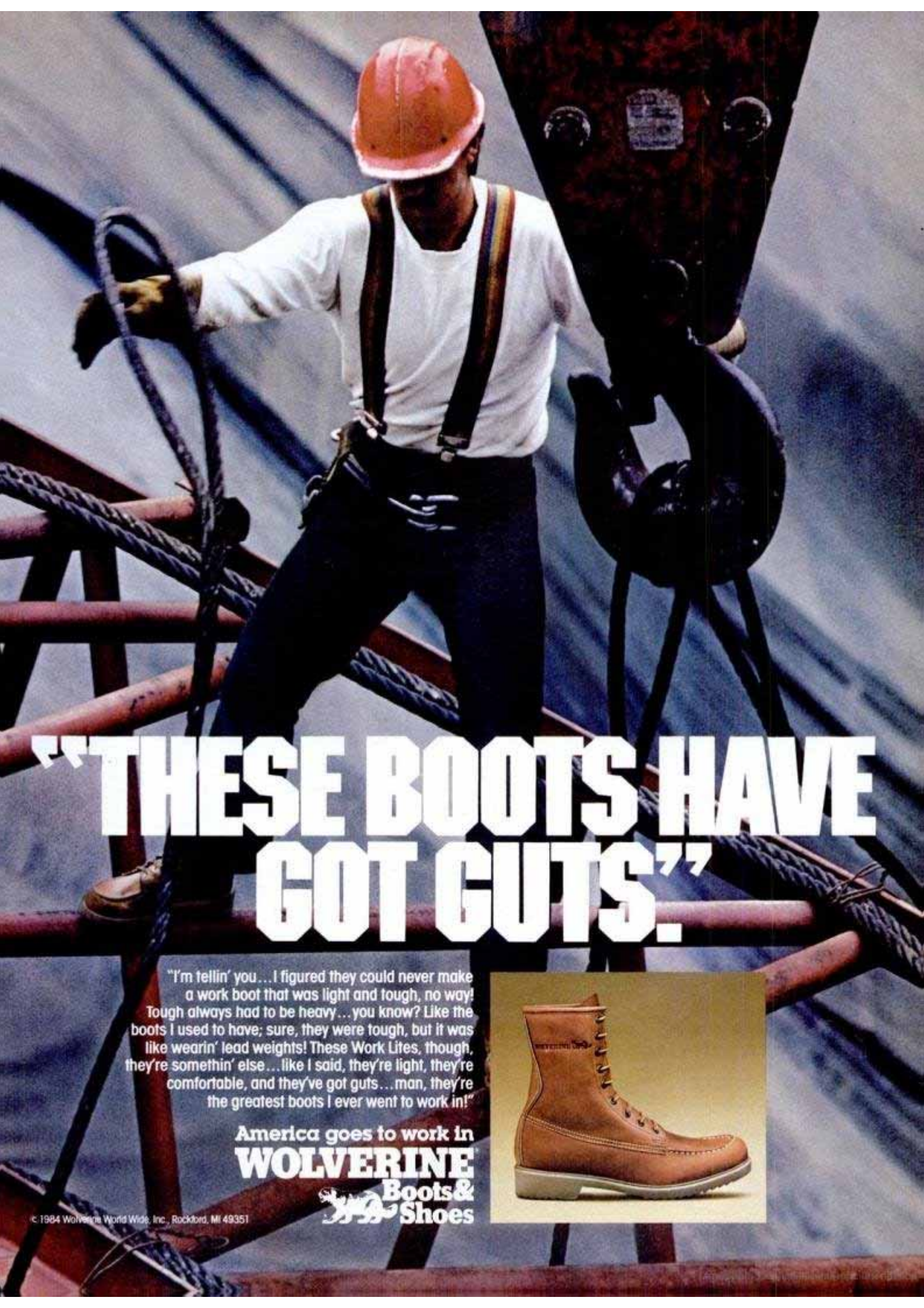
For fast service major credit card holders ask for extension 37. Order BD7 for Decimate 500C or send check for \$69 plus \$2.95 for delivery. California residents add 6% sales tax.

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# “THESE BOOTS HAVE GOT GUTS.”

“I’m tellin’ you... I figured they could never make a work boot that was light and tough, no way! Tough always had to be heavy... you know? Like the boots I used to have; sure, they were tough, but it was like wearin’ lead weights! These Work Lites, though, they’re somethin’ else... like I said, they’re light, they’re comfortable, and they’ve got guts... man, they’re the greatest boots I ever went to work in!”

America goes to work in  
**WOLVERINE**  
Boots & Shoes







1984 Mercury Cougar



# Vision Becomes

## The Vision

The visionary cars of the future are always sleek and elegant and technologically



Probe III

sophisticated. Unfortunately, they usually possess one terrible flaw. They're never real, always remaining the stuff of dreams and imagination, always on the drawing board, but never on the road.

In the late seventies, Ford Motor Company began development of the Probe Series, producing some of the most aerodynamically-efficient cars of the time. Aerodynamically-efficient design can achieve better handling and stability, better fuel economy and a quiet ride.





1984 Thunderbird

# Reality.

## *The Reality*

You saw the reality born of that vision in February of last year, with the introduction of the Thunderbird and Cougar.

You saw it again in May, with the debut of our Ford Tempo and Mercury Topaz. And in November, when we introduced the new Mark VII.

Making our vision a reality required inventiveness and creativity, a renewed commitment to quality and



## **Quality is Job 1.**

FORD • LINCOLN • MERCURY • FORD TRUCKS • FORD TRACTORS

Get it together—Buckle up.


workmanship, and a new spirit of cooperation between labor and management.

But most of all, it required a desire to be the best.

1983 was the beginning of the greatest outpouring of new products in our history: Automobiles of elegance and power, sleekness and beauty, quality and precision. Automobiles that in the words of *Car and Driver* "simply change the rules in the domestic car business."

You can see all the 1984 models at Ford and Lincoln-Mercury dealers everywhere.



A cowboy wearing a white hat and a red shirt is riding a dark brown horse with white markings on its face and legs. He is holding a lasso in his right hand. The background is a vast, open landscape with tall grass and a blue sky with some clouds.

# Come to Marlboro Country.



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

17 mg "tar," 1.1 mg nicotine av. per cigarette, FTC Report Mar.'83

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



# "WE MADE IT!"

Quick thinking and nerves of steel have turned airline flight officers into heroes of the skies.



This Boeing 767, its escape chutes hanging out, sits on an abandoned Canadian Air Force runway after it glided to a safe dead-stick landing with no fuel. The old field (inset), used as a drag strip today, was familiar to the copilot. There was only minor damage to the plane, but no passengers were injured.

BY WILLIAM HOFFER; Illustration by Attila Hejja

**T**he United Airlines DC-8 was on final approach to San Francisco when we heard a loud *bang* off to the right. Gasps of alarm came from throughout the cabin.

Soon, the pilot's soothing voice explained that the right-side landing gear door had failed to open. The wheels had lowered, forcing the door, but no one knew how badly they were damaged. We would circle the airport and prepare for an emergency landing.

"To tell you the truth," the pilot said, "we don't know what's going to happen. All we can tell you is, we're up here with you."

Lightheaded with fear, I felt an impulse to smash the window glass and jump, taking my chances outside the plane. But I had no alternative than to trust in the skill of the pilot. Who are these men who seem so cool in the face of disaster?

It took only a few minutes to circle and come in for the landing, but it seemed an eternity. The shaft of the fuselage closed in upon me, reinforcing my feeling of helplessness.

Finally, as we mortals crouched in the emergency landing position, the pilot brought us in, touching down first on the secure left gear. We sped down the runway, tilted crazily to the left while the pilot lowered the nose, allowing the front gear to touch and leveling before he risked dropping the damaged right gear to the ground.

The right side of the plane bounced heavily upon impact, but the gear held firm. Gradually we lost speed. And then, as we edged to a stop in the midst of the runway, a handclap sounded from the rear of the aircraft. Others joined in. Soon we were all applauding the pilot who had brought us down safely from the friendly skies.

I've forgotten the name of the pilot, but I'll never forget that landing.

### A pilot's not a computer

Captain Mel Hoagland spends much of his flight time monitoring the eight brilliantly colored video displays which assure him that his Boeing 767 is in full



Eastern Airlines 727, with its malfunctioning landing gear only partially down, came in for a smooth, safe landing in a hail of sparks on the foamed Miami runway. President Reagan congratulated the pilot, R.R. Curti.



control of itself. Underneath the flight deck, a bank of 100 computers handles nearly every conceivable situation. Flying by computer is easy, comfortable and almost boring.

There are occasions, however, when it is essential that the cockpit contain a living, breathing, heroic human being—someone who is "up here with you."

"The pilot is in a potentially life-critical situation at all times," declares Hoagland, who flies for United Airlines and doubles as chairman of the Air Line Pilots Assn.'s Task Force on Cockpit Automation. "The buck stops with the pilot. His human brain has judgmental capacity that no computer can match."

A case in point occurred on July 23, 1983. As Captain Bob Pearson prepared Air Canada Flight 143 for service from Montreal to Ottawa and Edmonton, he faced a minor problem. The fuel gauges on his 767 were unserviceable and would have to be repaired in Edmonton. In the meantime, fuel supply had to be calculated manually. Someone in Montreal (the

blame has not, as of this writing, been fixed) erred in his math. Pearson was given false information and punched it into his computer system. The computer was then satisfied that fuel supply was sufficient when, in fact, it was some 26,000 pounds short.

Pearson guided Flight 143 uneventfully to Ottawa, then took off for Edmonton with a load of 61 passengers—unaware that the aircraft's tanks held precious little fuel.

At 41,000 feet, westbound over Red Lake, Ont., warning lights blazed in the cockpit. Pearson informed the passengers that he was diverting to Winnipeg for an unscheduled landing due to an unknown problem with fuel supply affecting both engines. Cold, impotent fear settled upon the passengers, for they were at the mercy of the pilot and fate. A pilot, however, does not have the luxury of succumbing to fear.

Within minutes, the port side engine failed. A few minutes later the beautiful computer displays sud-





denly went black. "What happened to all the instruments?" Pearson asked aloud. What had happened was that the starboard engine had failed also, terminating the electrical power.

### **Airliner becomes a glider**

Quickly, the pilot activated the emergency battery and dropped the ram-air turbine outside the plane's belly to provide the power for minimal hydraulic control. Without enough power for the computers, Pearson was now guiding the most sophisticated airliner in the world with only an altimeter, airspeed indicator, horizon control and magnetic compass.

To the passengers, hope seemed to fail along with the engines. But they were not yet out of luck. Fate had dealt them a trump card. Their pilot, years earlier, had been a glider enthusiast.

By the time Flight 143 had descended to 8,000 feet it was still 27 miles from Winnipeg. The aircraft was losing altitude at the rate of 2,000 feet per minute

and could not reach the airport. An air traffic controller offered Pearson an alternative. He was only 12 miles distant from an abandoned Royal Canadian Air Force base outside the little town of Gimli.

Copilot Maurice Quintal had trained at Gimli and knew that its 6,800-foot runway was adequate.

"Okay," Pearson said, "it's Gimli."

He turned around, heading back up the western shore of Lake Winnipeg. The airplane was not flying; rather, it was in a controlled fall. There was time to reach Gimli, but little time for adjustment.

They came in on a sharp, wide left-turn leg. Some of the passengers screamed, thinking the plane was out of control, but the opposite was true. Pearson was sideslipping to lose altitude in preparation for his one and only chance to land.

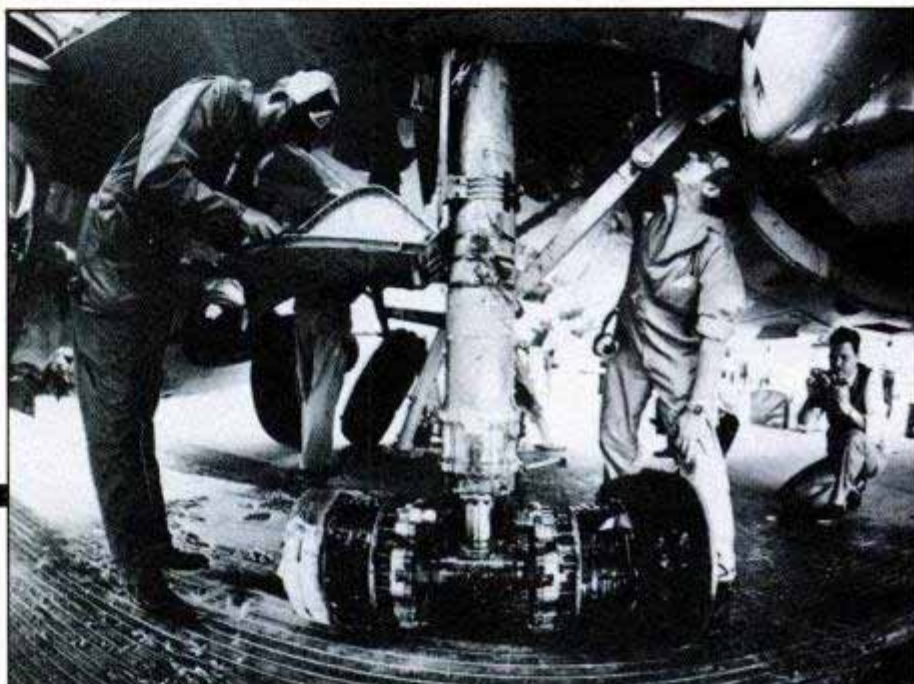
Gimli, no longer in use by the Air Force, is now a drag strip. An old taxiway today serves as an airport for small planes. But only members of the Winnipeg Sports Car Club were on hand this Saturday evening



Frontier pilot Duane Cook (below) drew applause after bringing in a Boeing 737 with two tires that had blown on takeoff. The plane had 102 persons aboard. Passengers waited on the tarmac (right) to cheer him. After the incident, an inspection of the plane showed only minor damage to the wheels (right, bottom) and no damage anywhere else. Cook had to circle the airport for two hours to consume the fuel supply.



PHOTOS BY ANTHONY SALAU, DENVER POST



at twilight, preparing for Sunday's races. They looked up to see the frightful vision of a 767, heeled over nearly on its left side, silently homing in on them. As it straightened, leveled and descended, they scattered in terror.

The main gear touched down 800 feet past the threshold of the runway. The front settled down moments later, its unlocked nose gear collapsing and sending the plane and passengers screaming into a skid. The 767 shrieked down the runway until it halted just short of a cluster of house trailers.

Pearson telephoned Air Canada headquarters and reported calmly that there were no serious injuries. The realization of his accomplishment still had not set in—nor had the fear. Maybe tomorrow, he thought, his legs would collapse.

### Belly landing in Miami

Having your life snatched from the jaws of disaster by a skillful pilot and crew rarely leaves the passengers as speechless as it does the men on the deck. There were cheers and plenty of words of gratitude on the tarmac Feb.

15, 1983, after pilot R.R. Curti brought in a Boeing 727 whose landing gear had failed to retract fully after takeoff from Palm Beach, Fla., on a nonstop flight to New York.

"We made it!" exclaimed a jubilant Gail Nemeck of West Palm Beach, one of 67 passengers whose lives were saved by the quick thinking and steel nerves of the pilot. "It was smooth. I never thought an emergency landing could be so smooth."

Curti had kept his passengers calmly informed as he brought the plane in for a belly landing at Miami International Airport. The jet sent out a shower of sparks as it scraped the runway, which was foamed down to prevent a fire. There were no injuries, no fire erupted and only minimal damage was done to the plane's underside. Not only did the passengers gather by the emergency chutes of the plane to give Curti a round of applause, but President Reagan telephoned him the next day to

congratulate him for his sharp flying.

A pilot's brain must make instantaneous judgments that can mean life or death for all on board, and for this reason it cannot short circuit with fear.

Consider the case of Captain Adam Kagel. On Sept. 22, 1981, he was in command of Eastern Airlines Flight 935, a three-engine L-1011 jumbo jet en route from Newark, N.J., to San Juan, P.R.

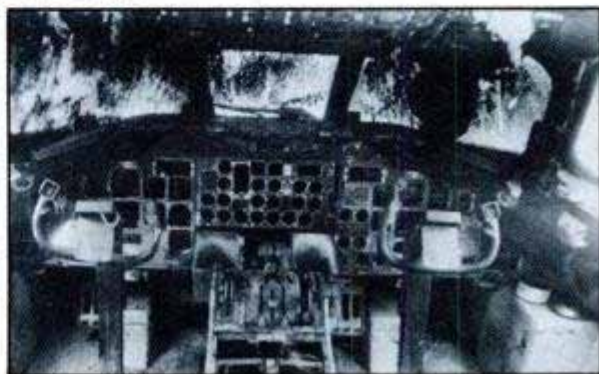
In the innards of No. 2, the tail-mounted engine, the low pressure location-bearing failed soon after takeoff. Hot oil splashed onto the fan shaft and also onto the airborne vibration indicator, which, in turn, failed to warn Kagel that the engine was breaking apart.

Just as the airplane ascended to 10,000 feet a severe explosion jarred everyone on board. A section of the fan module in No. 2 slammed into the fuselage, slicing into one of the unoccupied lavatories. Flying debris shot holes through the stabilizer. To Kagel, it felt





Flames engulfed the Air Canada DC-9 after its emergency landing in Cincinnati (left). Although 23 lives were lost, an equal number were saved after pilot Don Cameron landed the plane without instruments. He had trouble finding the forward exit (left, bottom) in the smoke. However, Cameron kept his wits even as the flight deck began to burn. Extent of the damage to the cockpit is seen in the photo (below), which was taken after the fire was extinguished.



PHOTOS BY WIDE WORLD

as if he were flying a B-17 over Germany and had just taken a severe hit. He wondered if the tail might fall off.

The plane shivered. The left wing sank and the nose heeled over. Kagel realized that for one brief moment he had been shocked into inaction. It was the only such moment he could afford. He quickly reduced thrust in the two remaining engines. That calmed the buffeting somewhat and allowed him to keep the plane fairly stable as he assessed the damage and reported to the 190 frightened passengers, who now looked to him for deliverance.

The job was a tough one. Three hydraulic systems had failed. Only one system remained operative and Kagel did not know the extent of damage to it. He had no outboard ailerons, no rudder control and no certainty that the shattered tail section would hold together.

#### One slow circle

Flight 935 was vectored over the Atlantic Ocean to dump fuel. Then it made one slow circle to the right and headed toward John F. Kennedy International Airport.

Kagel was flying by the seat of his pants now. Most of his automatic landing aids were inoperative. He found it increasingly difficult to handle the plane at lower speeds.

At 300 feet he encountered a strong crosswind that pushed the nose to the left. Lacking rudder control, Kagel tried to correct with inboard ailerons, but the damaged plane "crabbed" farther to the left.

Options were few. Kagel could abort the landing, circle and try again, but the necessary engine thrust would strain the battered airplane. He could go in at this awkward angle and risk missing the runway. Or he could find some way to straighten out the nose. And whatever his decision, it had to be made now!

Instinctively, his hand moved to the throttle. He pulled more power on the port engine, swinging the nose forward only seconds before touchdown. The plane bounced far down the elongated runway until it came to a quiet, uneventful stop.

Was he scared? "Oh, yes!" Kagel said later. "But the key is having hold of

the plane, knowing that *you're* in control."

To maintain control in a dangerous situation, the pilot has to keep his eyes on the trouble, the potential landing place and the passengers all at once. Frontier Airlines Flight 194 from Los Angeles to Denver had 102 people aboard on Aug. 5, 1982, when two of the Boeing 737's six tires blew on take-off. The craft still had good wheels in the nose and on the right side.

Unlike Kagel, pilot Duane Cook couldn't dump fuel over the ocean. Instead, he continued to Denver and circled Stapleton International Airport for two hours to burn off fuel and lighten the craft's load. With First Officer Jim Rimer watching the flight indicators, Cook finally brought in the plane, maintaining a delicate level on the wingspan to keep the jet from tipping violently on touchdown.

Frazzled nerves were among the most serious problems reported by the passengers. As in the other cases, they stopped to applaud their pilot.

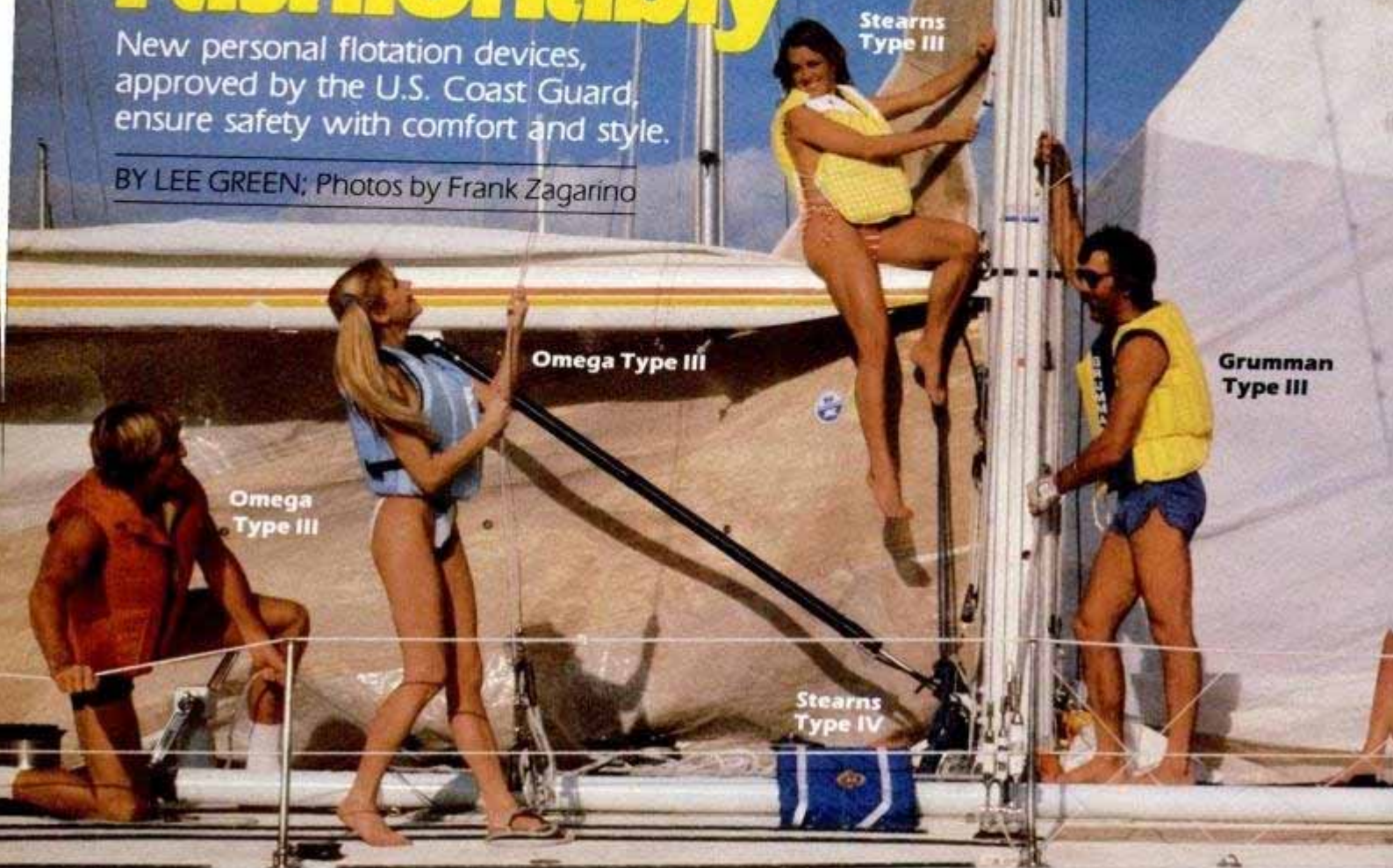
We speak of "the pilot" in a collective *(Please turn to page 174)*



# Stay Afloat- Fashionably

New personal flotation devices,  
approved by the U.S. Coast Guard,  
ensure safety with comfort and style.

BY LEE GREEN; Photos by Frank Zagarino



Stearns  
Type III

Omega  
Type III

Grumman  
Type III

Omega  
Type III

Stearns  
Type IV

Sewn-in straps on skier vests  
hold in 50-mph water impact.



Stearns Type III

O'Brien  
Type III

The Type II horse collar on child  
floats her face up, head high.

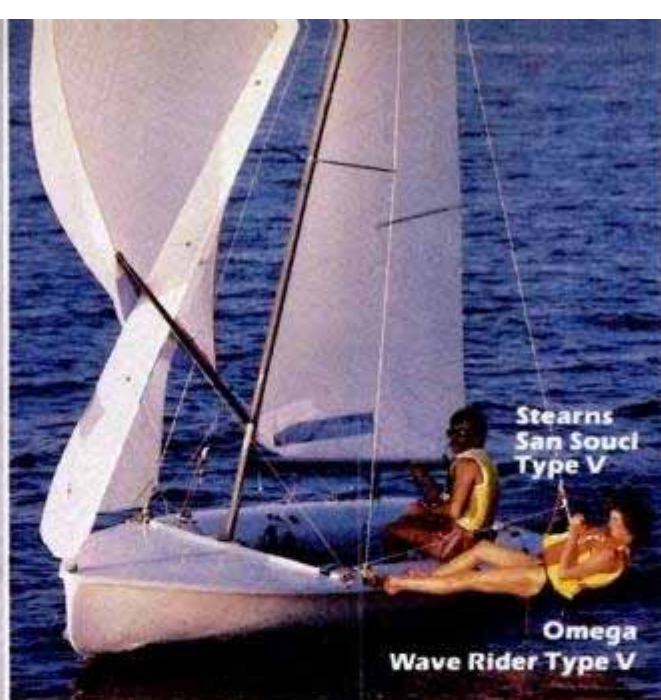
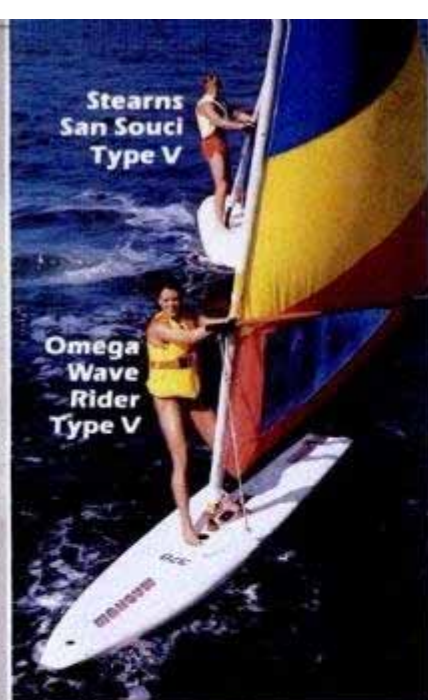


Kent Type III

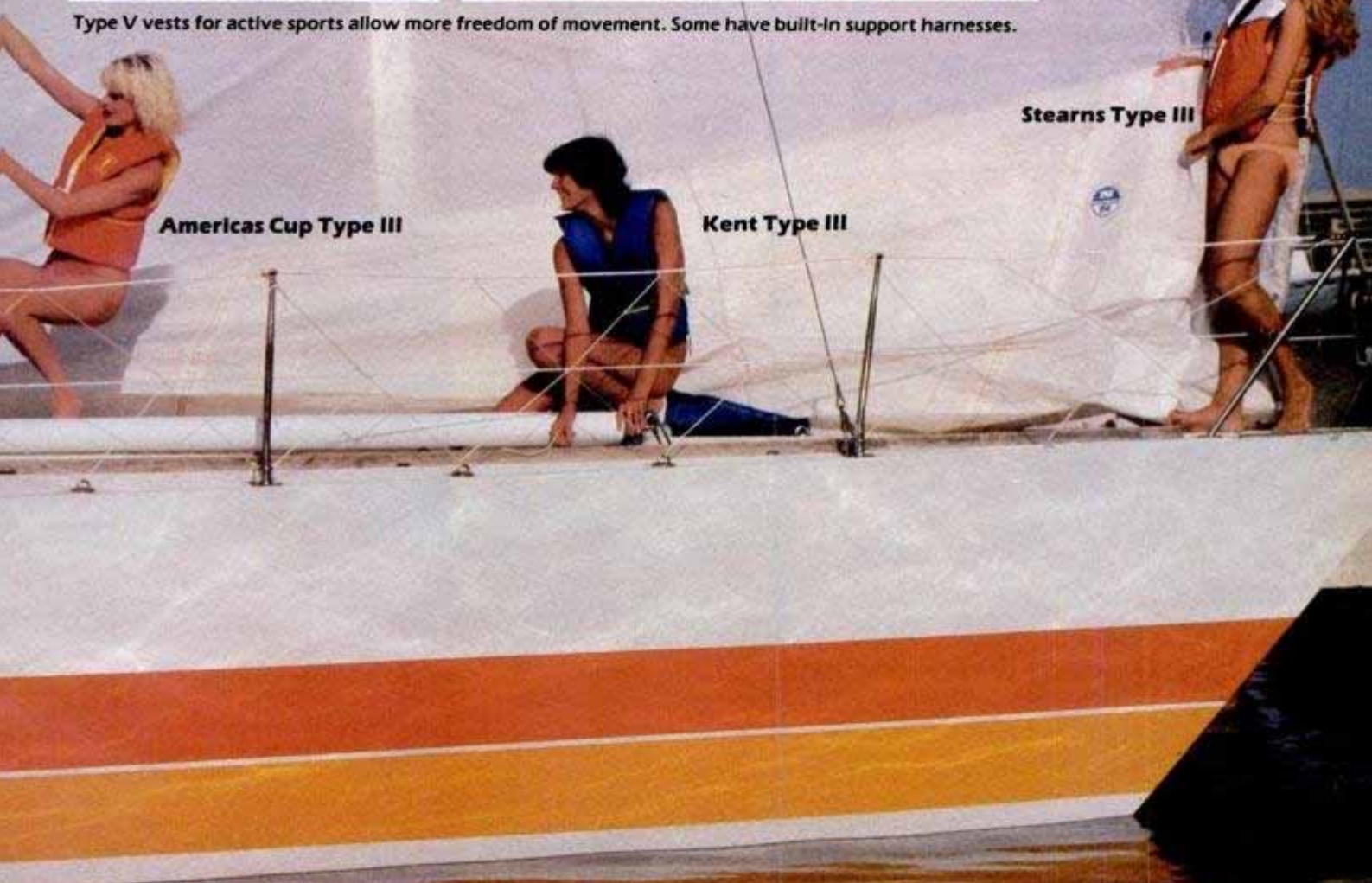
Black  
Sheep  
Type  
III

Stearns  
Type II





Type V vests for active sports allow more freedom of movement. Some have built-in support harnesses.



**L**ifebelts, like auto seatbelts, can't save you if you don't wear them. Yet relatively few boaters have worn them consistently. For the past 10 years, though, a new breed of life vest has been changing all that and halving fatality statistics.

The U.S. Coast Guard, which is responsible for recreational boating, requires a PFD—in government jargon, a life vest is a Personal Flotation Device—for each passenger in a boat, just like the NHTSA requires a seatbelt for each place in a car. But unlike the car-safety bureaucrats, Coast Guard planners re-

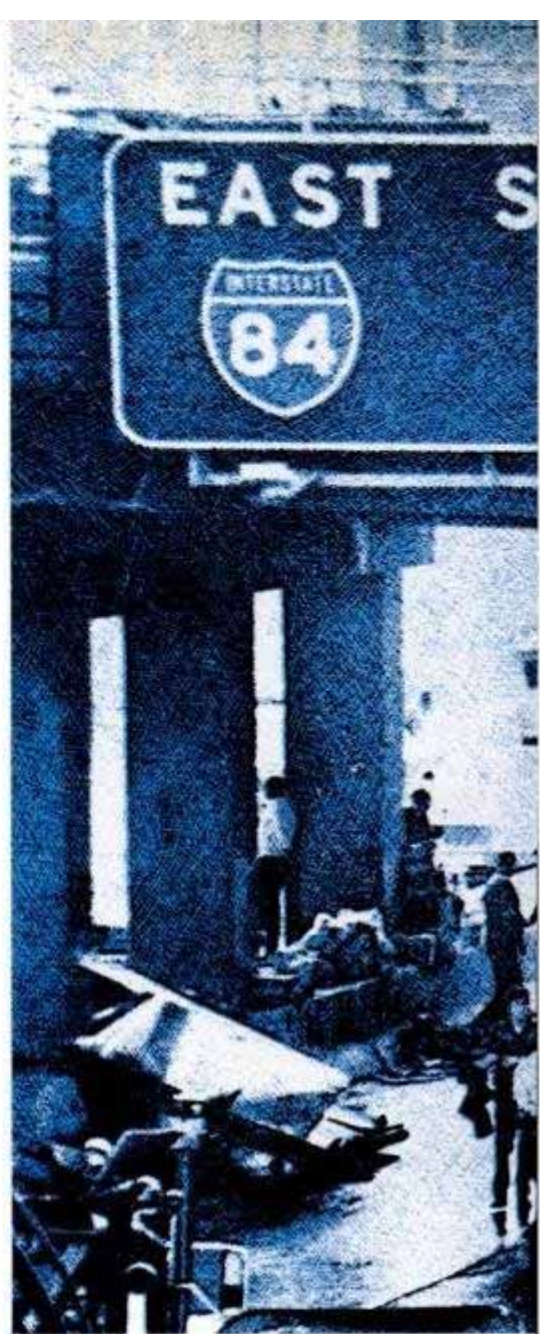
alize that coercion would work even worse with free-spirited mariners than it does with stubborn car drivers. By relaxing buoyancy standards somewhat, the CG spurred the manufacture of new types of life vests that look good, help keep you warm, and offer both comfort and convenience—while still keeping you afloat should you go into the drink.

Recreational boating statistics suggest that the new vests are working. In the decade before 1973 when the new flotation device rules came into effect, there were never fewer than 18.7 fatalities per

*(Please turn to page 176)*



# The 10 Scariest Places To Drive



Where are the worst spots in America? Here's what over 100 experts and cross-country drivers had to say.

BY ED FALES

**Y**ou're in the San Geronio Pass on I-10 above Palm Springs, Calif. A sudden "blowhole wind" sandblasts your windshield in seconds, strips your paint, knocks cars and trucks together. A trucker from Waco, Tex., finds his 18-wheeler kicked into another lane, wrestles it back and stops. When gales hit the San Geronio, says Southern Cal's AAA, even trains stop, hang out flares and wait.

You're southbound on the notorious Beltway (I-495) around Washington, D.C. On a bridge ahead a car clips a truck. The truck's cab flies open, and its driver sails head-over-heels across the rail into the Potomac below. Then flames close the bridge.

You're following a truck on New

York's nightmarish Cross-Bronx Expressway (I-95). It's really no proper expressway at all, just a concrete chute where smashups echo. The truck stalls in an area where vandals can strip the rig. The trucker phones for help, but is refused by a dispatcher. Finally, it costs the driver \$400 to get a tow and his engine started, a rip-off he calls "hostage ransom."

Where are the scariest places to drive in the whole U.S.? The worst engineering traps? The worst drivers?

We asked more than 100 experts and learned that drivers all over America point the finger at each other. Some curse the "stupidity" of Los Angeles freeway drivers who, they say, do okay when the sun shines, but rush pell-mell

into 100-car pileups when fog rolls in. Others get violent about weirdo crashes by people who run red lights on the Las Vegas "Strip" after drinking hours. Some damn the emotional drivers in Dallas: "They've been known to shoot you there." Others are paranoid about drivers on Philadelphia's Schuylkill Expressway: "If you don't go too fast, they look at you like you're nuts." In Houston, some drivers said, "people steer with coffee in one hand. It's crazy."

Just where the "worst" places are depends, of course, on whom you ask. We spoke to engineers at the Triple A's headquarters near Washington, to Chicago's Motor Club, the Auto Club of Southern California, AAA of Texas, the Insurance Institute for Highway Safety, the feds, and the all-industry Research and Advisory Council.

According to the National Safety Council's list of dangerous places, Houston is the deadliest spot in the United States, with 4.8 deaths per





## HARTFORD

I-84, I-91

The "Hartford Mixmaster," where I-84 feeds into I-91, simply infuriates drivers. The problem is the absolutely unbelievable high-speed traffic mess—much of it wall-to-wall. "It's even worse than Boston," says Wisconsin trucker John Janovetz. "Just sit and wait. You'll see an accident," says Steve Oliver of Albany, N.Y.

10,000 cars. Looking at it another way, nearly one car in 2,000 in Houston is involved in a fatal accident each year. That's pretty bad. Next on the NSC list are San Antonio (4.3), El Paso (3.8), Oklahoma City (3.7), Jacksonville (3.6), Dallas (3.6), Kansas City, Mo. (3.5), Corpus Christi, Tex. (3.5), Boston (3.1) and Nashville (3.0).

But here's an oddity. When we asked 100 long-distance drivers at roadside stops what city they were most glad to





get out of alive, many simply exploded: "New York!"

"Nobody signals," drivers said. "The roads are awful." "Nobody gives you a break." Several said: "The taxi drivers are a menace."

Okay, New York's got problems. But take another look at the NSC list above. See New York anywhere? They must

*(Please turn to page 167)*



## NEW YORK Cross-Bronx Expy.

New York City, home of red-light runners, is on the list because its trashy expressways are so terrible, and no one seems to care. Driving there, the author heard a crash behind him. Someone's wheel came rolling merrily along, overtaking him at 45 mph. No one even slowed down to look! On another day, from somewhere behind, a spring-loaded bumper went up like a satellite and came down ahead of the author's car. New Yorkers just yawn. In one awful crash on the George Washington Bridge, a truckload of chickens hit a gasoline tanker and caused a world record barbecue.

One day recently three 18-wheelers overturned, blocking three expressways in the same rush hour. New Yorkers simply waited, some for hours. It's old stuff in the Big Apple.

George Mattson used to haul beef from Dallas. "When my codrivers saw New York, they'd pull off and stop," he says. "They'd say, 'You take it now. I'm chicken.'"

Mostly, drivers fear the "chute" that begins at the northern end of the New Jersey Turnpike, fires them over the George Washington Bridge and lands them on the crash-prone West Side Highway or that awful Cross-Bronx Expressway.



## BOSTON 128, I-93

Even the patrician *Boston Globe* quotes a local official as saying: "A yellow light here is a sign to speed up, and a red light is strictly advisory." Boston's high-tech industry highway, Route 128, "has to be one of the world's worst" admits Administration Dean E.F. Petersen of the Bay State's Middlesex College. "It's plagued by fast lane changers. Avoid it in rush hours."

And Boston radios crackle with reports of crashes on its Southeast Expressway (I-93), where drivers say no one would think of giving anyone else a break. "I have been absolutely petrified," says a young Boston executive, "trying to stay alive in 65-mph traffic on Boston's Storrow Drive, where no one even slows for ice."



## WASHINGTON—The Beltway (I-495)

Washington's Beltway (I-495) does to cars what cyclotrons do to atoms. Commuters can cope, but for strangers the mix of on-off traffic, the uncontrolled lane-changing and the

speed threaten disaster. Most people agree: Duck it if you can, especially in Washington's rush hours, which begin at 6 a.m. and 3 p.m. and continue for hours.



Notorious Beltway around Washington, D.C., seems to cause endless trouble, especially when doddering tourists mix it up

with hotshot commuters. AAA maps warn members to pay attention to confusing signs at southern junction of I-95 and I-495.

## What Drivers Say About Other Places

**Cleveland:** Look out for the suicidal 20-mph corner on the Lake Shore Expressway (I-70). "You have to see it to believe it."

**North Carolina's I-77:** "You look down 2,000 feet, then look back and find a truck on your tail—and a runaway spillout area ahead."

**Denver:** "Worrisome congestion on I-25 and I-70."

**St. Louis:** "Too many expressways merge to cross the Mississippi."

**Birmingham:** "Streets okay, but Interstates are bad."

**Salt Lake City to Denver:** Mountainous I-70 is so risky some pros now use I-80.

**Loveland Pass, Colo.:** Well engineered, but so high (11,000 feet) "it scares hell out of us, especially in snowstorms."

**Northern New Jersey:** "Awful congestion, squeezes."

**Detroit:** Dangerous left-side lane drop-offs and exits, especially on freeways like the John Lodge.

**U.S. 19, Florida:** Some drivers fear the cloud-busting Tampa Bay Bridge (knocked down by a ship a few years ago). They also fear collisions near Pinellas Park and Brantenton. Some bumper stickers say: "Pray for me. I use U.S. 19."

**Fort Worth:** Sharp turn in its "Mixmaster" traffic regularly turns over vehicles.

**Indianapolis:** "Too many lights."

**Fort Wayne:** "Screwed up by too much development along the Coliseum Blvd. Bypass (U.S. 30-24). All those stoplights now cause wrecks. It's sometimes quicker and safer to go through the city."

**Seattle:** "Beautiful!"

**Kansas City:** "Not too bad."

**Oklahoma City:** "They got some fast drivers down there. And bad fogs all the way to Memphis."

**Atlanta:** "No real problems."

**West Virginia Turnpike:** "Real scary. Two high-speed lanes, one each way. Even the road maps warn you. Potholes, construction."

**Cincinnati:** "Hardnosed combat driving. Some people hell-for-leather. Won't give an inch."

**I-80N between Portland and Boise:** Some fear the Deadman's and Cabbage Head Passes, especially in snows.

**Ogden, Utah:** Drivers don't like the "black ice stretch" that forms on I-15 between Tremonton and Salt Lake City.

**San Francisco:** "Not too bad until you get downtown."





## DALLAS

### Real cowboys

Drivers who can tolerate Houston somehow find trouble with Dallas. Commuters are experts at dodging and weaving. But visitors hate the scary zigs and zags through high-speed on- and off-ramp traffic. Even worse, they hate the rear-end crashes on the frantic, creeping North Central Expressway, said to be the busiest superhighway in the country.

Exploding growth has trapped Dallas with expressways that are years behind the times, says the AAA's Southwest Motor Club.



## LOS ANGELES

### Freeway system

The drivers I've interviewed are divided. Some call L.A. drivers the most sophisticated and the fairest. ("They'll let you in.") But all that sophistication vanishes when fog rolls in, long-haul drivers say. "They follow each other like kids at 70 mph right into doom. It's Pied Piper driving. When fog comes down, they all become amateurs."

One trap for travelers is the mad downhill rush through Sepulveda Pass on I-405 near Encino. Suddenly, cars travelling at 70 to 80 mph plow into slower traffic floundering along near the Ventura Freeway. "It's everyone for himself out there. And the road is scarred with rubber," Los Angeles drivers say.

Even hairier are the tragic Southern California "burners," when cars crash head-on with trucks on narrow, inadequate Route 86 near the Salton Sea and Route 126, east of Santa Paula. "Horrible," says an AAA expert. "Fiery, spectacular."

## THE SAFEST CITIES TO DRIVE IN

Here's how the National Safety Council rates the best big cities on the basis of number of deaths per 10,000 cars.

1. Minneapolis (0.5)
2. Washington, D.C. (1.0—Good enforcement *within* the city. The infamous Beltway is outside city limits.)
3. Oakland, Calif. (1.1)
4. St. Paul (1.1)
5. Akron (1.2)
6. Indianapolis (1.2)
7. Milwaukee (1.2)
8. Buffalo (1.2)
9. Seattle (1.2)
10. Anchorage (1.2)



## PHILADELPHIA

### Schuylkill Expy.

Some Philadelphians like the Schuylkill Expressway, but others call it the "Surekill": miles of narrow lanes with blind twists—and the usual suicidal city expressway speeds. It feeds western traffic into the city from the Pennsylvania Turnpike. "A trip through hell," one truck driver said.



## CHICAGO

### Dan Ryan, Edens

Hypnotism and confusion typify Chicago's problem traffic. Chicago itself isn't bad. The streets are straight arrows: You can see home 20 miles away in rush hour. But not on the "Dirty Dan" (I-90/I-94). The trouble is confusing on-off feeds, squeezes and lane drops. Some exits, like one to the Eisenhower Expressway, spiral down into a single deadly lane—the crazy sort of windup exit that should be barred by law.

Even worse is the giant waterfall of traffic that pours down into the Dan Ryan each morning from the Kennedy Expressway, where reversing commuter lanes—east in the morning, west in afternoon—help get visitors to Chicago in trouble.

Visitors should beware the Ryan. There are eight lanes each way, 16 in all. If you ever get in Lane No. 8, you've got only seconds to fight back across seven lanes to make your exit. No wonder that in three miles, last year, there were 1,474 wrecks!

Chicago's other hot spot is at the north end of the famous Edens Expressway (I-94 Extension). Let's say you're just in from Florida, Maine, Texas or California—you've driven 1,500 to 3,000 miles without a traffic light. Suddenly: uproar. Everyone slides, tires smoking, toward the Clavey Road traffic light.

The Illinois DOT has tried everything: strobe lights, signs, rumblestrips. The accidents just keep coming. In despair, an engineer cries: "How do you cope with Interstate hypnosis"?



## HOUSTON

### 24-hour rush

Houston is drowning in sheer numbers. The rush hour in this booming city, which has outgrown its own belted highway system, begins at midnight and ends at midnight. Even going through Houston on I-10 at 4 a.m., the author found, can be wild: a melee of shifting, rushing traffic made worse by a jungle of headlights.



## BALTIMORE

### Tipsy drivers

In brief, the big problem in Baltimore is said to be drunk drivers. When even California drivers talk about it, Baltimore definitely has a problem! You should stay out of Baltimore, especially at night. I've ridden with city police patrols and I even feel sorry for them.



Chicago's Dan Ryan and Edens Expressways funnel 16 lanes down to a traffic light.

Despite its bad record, the pros didn't damn Houston as vociferously as they did some other places.

Most fearful crunch area is the intersection of the partly built "B-8" and the Imperial Valley Road near International Airport. The problem: There are too many expanding developments, a mall, offices and motels. Runaway development causes many Houston expressways to suffer from severe arteriosclerosis.



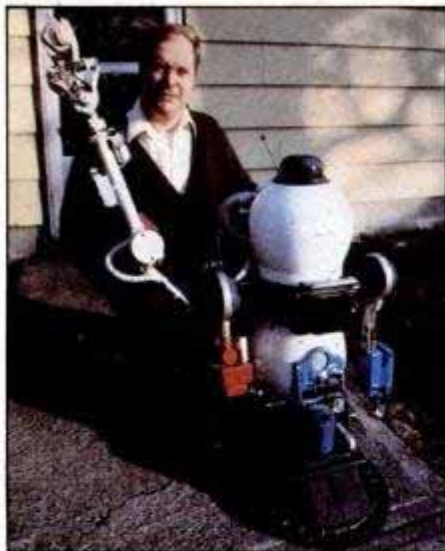


PHOTO BY JEFF HINCKLEY

Chuck Balmer and Avatar greet guests at the door. The 85-pound Avatar uses three on-board processors to perform tasks.



PHOTO BY ROGER BENNETT

Marc Arc's Sir-O-Gate features a Motorola experimenter's board. The user can constantly change inputs to expand memory.



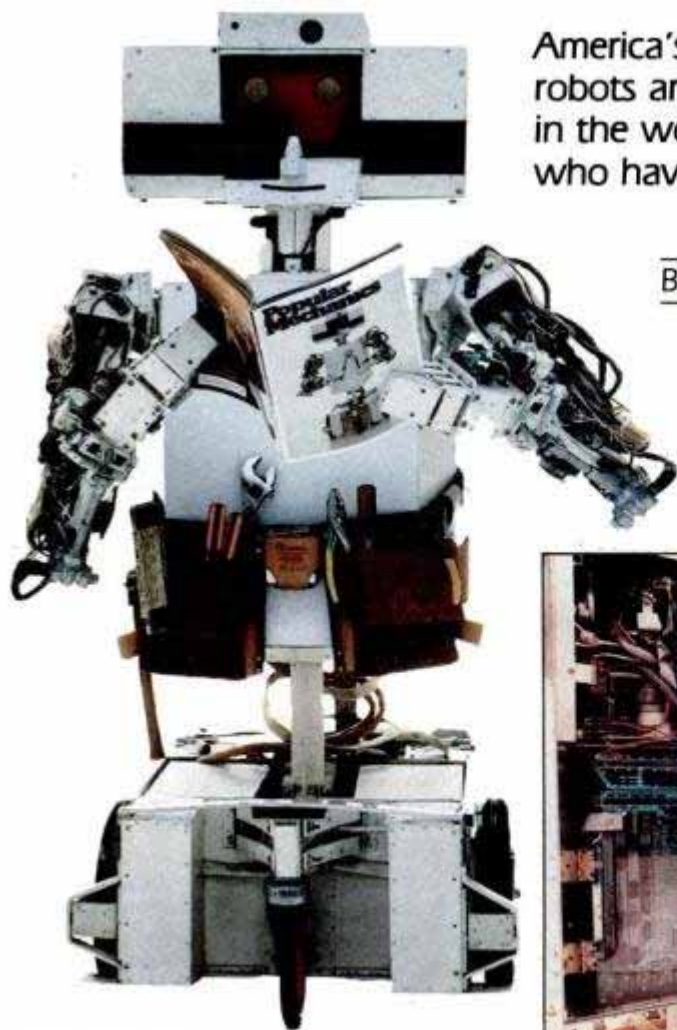
PHOTO BY ROGER BENNETT

Author Tom Carroll works on his next robot, called Ultima, in his shop. With him is Squirt, which is a 3-foot-high android.

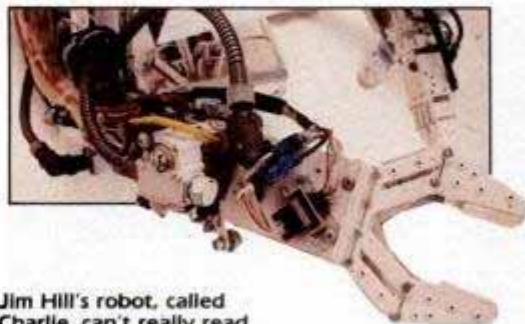
# The Smartest Homebuilt Robots

America's hottest new robots are being constructed in the workshops of amateurs who have a vision for the future.

BY TOM CARROLL; Illustrated by Pat Ruggero



The best parts of a great robot



Jim Hill's robot, called Charlie, can't really read *Popular Mechanics*, as shown in the photo (far left). But it can "sense" walls electronically and avoid running into them. The robot is being rewired to coordinate hand movement with sensing. The processor unit (left) controls the 200-pound robot. The arm and hand (above) are able to grasp and lift heavy objects.

PHOTOS BY BRIAN WOLFF



The guests have arrived and are standing about your host's elegant oceanside home, exchanging the social chit-chat of the day. Suddenly, the host excuses himself, taps on the kitchen door and says, "Sam, you may serve the hors d'oeuvres now."

The door opens silently and out rolls a shining, squat robot deftly carrying a tray of olives and mini-sandwiches. The silver mechanical servant, reminiscent of R2D2 of *Star Wars* fame, glides among your friends. Its synthesized voice coaxes the guests into serving themselves from the tray, but the robot also takes orally-recognized orders for food and drink. Then the host's faithful servant retires to the kitchen to prepare crab.

How far from reality is this picture? The finished product may be some years away, but the technology is with us today. And, while there are about a dozen companies producing kits and ready-built robots, the state-of-the-art in home robots is being accomplished by the "scratch" robot builders.

Jim Hill of Covina, Calif., is somewhat typical of the home robotics experimenter. A parts department manager for an automobile dealership, Hill handcrafted his second robot, Charlie, from auto power-seat motors, aircraft flap actuators and numerous surplus items. The 200-pound, computer-controlled robot has a level of sophistication unequaled by its industrial counterparts. Constructed over four years, Jim made his robot using basic shop hand tools. At

DIRECTIONAL MIKE AND INFRARED SENSORS

**Ultima is a 'strong-arm' robot with a computer brain.**

COMPUTER BOARD AND CONTROLS



EXTERNAL KEYBOARD (ABOVE) CAN COMMUNICATE WITH 'DROID BY RADIO LINK

DISK DRIVE (INSIDE ROBOT) AND OTHER ELECTRONIC PARTS

ARM DRIVEN BY OFF-ROAD WINCH MOTOR LIFTS UP TO 100 LBS.

ROBOT'S BODY SEAM FOR ROTATION OF TOP FOR SCANNING

PM's drawing of Tom Carroll's Ultima robot shows the complex series of processor boards and machinery that will make this unit a household helper when it's completed. Ultima uses infrared sensors and a directional microphone to tell its "brain" where it's heading, or that people or animals are blocking the way. The robot can move in any direction on its motorized wheelchair base. A seam in the body about halfway up allows the android to swivel. The robot's arms can lift up to 100 pounds with the power provided by an off-road winch motor, shown protruding near the shoulder in the cutaway. Ultima can negotiate steep inclines, even move over shag carpets, while it performs its tasks, such as retrieving packages.

DIRECTION SENSOR

ELECTRIC WHEELCHAIR MOTOR (BEHIND COVER)

HEAVY-DUTY WHEELS COVERED FOR PROTECTION



present, the robot can "sense" walls electronically and avert them. Jim's goal is to coordinate the robot's vision system with basic hand movements.

Mark Arc, a marine electrician from Long Beach, Calif., took another approach in fabricating Sir-O-Gate. This robot consists of a microprocessor-controlled motorized base with a small claw mounted on a telescoping boom. The base serves as a small tabletop and the robot can pluck small objects from its top. Surplus motors and a retractable electric antenna assembly supply power and radio-control direction. Sir-O-Gate uses a Motorola "6800-based" experimenter's board, allowing a user to change inputs continuously.

A technical consultant from Ohio, Chuck Balmer of Urbana, constructed Avatar, an interesting little android.

The 'droid stands 36 inches high and uses three on-board processors to control the movements of its 85-pound body. Balmer used his knowledge from computer consulting in developing links to Avatar's separate computer and disk drives. Balmer and a partner are now developing plans to market a multipurpose home robot.

My interest in robotics dates to the late '50s, when I built a crude robot out of plywood, tin and old jukebox parts. This was typical of early experimenters. Relays and bumper switches served as logic and sensors.

The advent of inexpensive logic integrated circuits allowed robots to have more onboard intelligence, due to the small size and very low power drain of these ICs. But it was not until the intro-

duction of the microprocessor chip that smart mobile robots became a real possibility. Robot instructions no longer had to be "hand-wired" in. They could now be programmed and these programs updated by sensory inputs. Though trailing the microcomputer hobbyists by about 10 years, home robotics is now booming.

The home robot builder usually ends up tearing apart his creation to improve

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## Ultima will be able to answer the telephone or respond to emergencies.

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it. Even the kit and ready-built robots work their way back to the workbench for modifications. The appeal of robotics is the many scientific disciplines involved: electronics, computers, mechanics, optics and speech technology.

Get a group of amateur roboticists together and ideas from each of these disciplines are bound to flow. Having gathered many suggestions on designs for the "ultimate" home robot, I coupled them with my own ideas and the most current technology to begin building Ultima.

Home robots have always been plagued by physical weakness, an inability to travel uphill, over rough terrain or even on shag carpets. Most robots have extremely limited lifting capabilities, unable to lift more than a pound or so. Ultima will use electric wheelchair motorized wheels for effi-

ciency, quietness and power. These motors can carry more than 250 pounds at walking speeds for eight hours or more. Off-road vehicle winch motor assemblies provide power for the robot's arms. Even though they draw 50 amps. or more at stall loads, robot arms driven by these motors should be able to lift 75 to 100 pounds and grasp objects at floor level and raise them to 52 inches. Heavy-duty bearings, thick aluminum plate and large-capacity, gelled-electrolyte batteries allow for strength and object handling capabilities approaching that of a human.

Other features such as radio link to my household Apple computer, tracking wires buried beneath my carpeting and a gyro-navigating system will help the robot in a structured home environment. A simple verbal command, such as "Get me a glass of juice," will send Ultima through the house. Actually, the robot would only be following a simple, programmed routine.

The onboard computers can be programmed through a radio link or through the built-in floppy disk drive. In this manner, Ultima can answer the telephone or front door, monitor household conditions, or respond to emergencies without direct connection to outside devices. The onboard gas, smoke, heat and object-detection sensors can create an alarm condition that can call the police or fire department.

If you're interested in experimental robots, write to Robotics Experimenters Amateur League, Box 3227, Seal Beach, Calif. 90740, or Robotics Society of America, 200 California Ave., Suite 215, Palo Alto, Calif. 94306. **PM**



Modular home (left) includes a walking robot (center) that can perform household chores, even setting the dinner table (right).

## Japan Loves Robot House

**W**e often hear about the emerging superiority of Japanese technology. But Japanese engineers marveled last year as they judged a "robot" home designed by students and faculty at the Illinois Institute of Technology. The modular home was given the \$40,000 grand prize in the Osaka International Design Competition. The house can be assembled in scores of configurations from clip-on modules. Interior or exterior walls may be replaced on the rigid steel frame. The prospective buyer can sit down at a computer terminal, enter data on his lifestyle and economic condition and watch a highly sophisticated program assemble the modules to his specifications.

But the part of the house most appealing to the technologically oriented Japanese was its control system. The Illinois

team viewed its house as a machine, and electronic controls became a central theme of the design. The house has a decentralized computer network, meaning that each "station" (kitchen, heating, cooling and the like) is controlled by a microprocessor. An overseer computer monitors operation of the microprocessors. Finally, the IIT home includes a voice-activated robot with infrared sensors and sophisticated arms and hands. The robot can be programmed to set a table, answer the door, or bring in the dog and put out the cat.

Prof. Charles Owens, who led the project, emphasizes that the robot does not yet exist, and that the house can be constructed today without the robot and still be valuable to its owner. But the age of robotics is much closer than just around the corner. And the IIT robot certainly helped sell the house of the future to the Japanese.—D.E.



## PM ANSWERS

### The Most-Asked Questions About

# Motor Oil

Oil is one of those "black magic" products that none of the experts can seem to agree on.

BY MORT SCHULTZ

**T**he subject of motor oil evokes more questions from car and light truck owners than any other automotive subject. That's what 20 years of mail sent to PM's *Car Clinic* has told us. Here are samples of some received recently:

"My gas station guy advises changing oil every 2,000 miles. The manufacturer says to do it

every 7,500 miles. Whom should I believe?"

"Will it do my old klunker good to feed it the most expensive oil?"

"Do oils that advertise themselves as gas-saving live up to their billing?"

Here are the answers to these and other most-asked questions.

**Q:** If oil doesn't wear out, why do I have to change it at regular intervals?

**A:** True enough, oil doesn't wear out—but the additives in oil do. Furthermore, oil gathers and holds contaminating agents. If you don't change oil regularly, these agents (acid, asphalt and resin), which are by-products of combustion, gain dominance as additives are depleted. In time, they can ruin an engine.

High-quality motor oils have the following additives (chemical compounds) put into them by oil companies:

■ **Oxidation and bearing-corrosion inhibitors.** Engine heat causes oil oxidation, which results in thickening of the oil and erosion of some metals used in bearings. Inhibitors slow down the rate of oxidation and form a temporary shield on bearing surfaces.

■ **Rust and corrosion inhibitors.** Combustion produces water and acid that can cause rust and corrosion. These additives keep water from metal by holding it suspended in the oil, and they also neutralize acid.

■ **Pour-point depressants.** Oil thickens as temperature falls and flows more slowly, depriving engine parts of necessary lubrication. This results when cold ambient temperature causes the tiny wax particles found in oil to crystallize and form larger honeycomb structures. Pour-point depressants, which are found in oils designated "W" for use in

cold weather, prevent wax crystallization.

■ **Detergent/dispersant additives.** As some combustion by-products mix with oil, they can form sludge and varnish that are harmful to the engine. These additives keep by-products suspended in such fine form that they can't clump together.

■ **Foam inhibitors.** As oil circulates, air causes tiny bubbles to form. These bubbles can reduce the oil's ability to lubricate. Furthermore, since air bubbles are compressible (liquid oil isn't), hydraulic valve lifters filled with bubbly oil can collapse and hasten valve-train wear.

There are more additives that give oil capabilities other than those needed for engine protection:

■ **Viscosity index (VI) improvers.** Oil gets thicker when it's cold and thinner when it's hot. Multiviscosity oils contain VI improvers that keep them flowing more or less consistently as the ambient temperature changes from cold to hot and vice versa.

■ **Friction modifiers.** These recently developed additives reduce friction inside an engine, thereby increasing fuel economy. Oil with friction modifiers often has the term "gas-saving" printed on the container.

According to the SAE (Society of Automotive Engineers): "Friction reduction for improved fuel economy is now considered a vital component of

engine lubricant technology." Two round trips from New Jersey to Florida—one of them using a gas-saving oil—convinced me of the value of friction modifiers: On the trip using ordinary oil, my car averaged 27.5 mpg. On the trip using oil containing friction modifiers, it averaged 28.4 mpg.

**Q:** Should I mix an over-the-counter additive with my motor oil?

**A:** "High-quality motor oils are chemically balanced products, and aftermarket additives provide no benefit other than those the oil already gives," says Norm Hunstad of General Motors Research Laboratories.

Oils having familiar brand names and carrying the SF and ASTM designations possess a full range of additives; they are the most expensive. However, you can purchase such oil from discount stores and even food markets for as much as 50 percent less than at service stations.

**Q:** How do I pick the right oil for my car? What does all that alphabet soup on the label mean?

**A:** Every oil container provides the following information:

■ **Service classification.** In 1970, the American Petroleum Institute (API), American Society for Testing and Materials (ASTM) and SAE combined to set up the API Engine Service Classification System. There are nine designations.

(Please turn to page 180)



# PM's Minivan Test:

Chrysler's the one to beat in our comparison with Mitsubishi, Toyota and VW.

BY MICHAEL LAMM, West Coast Editor



Chrysler's new front-drive minivan comes in two versions: the Dodge Caravan (front) and Plymouth Voyager (rear).



# T-Van's The Tops



Toyota's Van (left) features futuristic styling on a short wheelbase. Big VW Vanagon (right) has most room.

**A**s the full-sized American station wagon sinks slowly into oblivion, half a dozen minivans and similar vehicles are making their move to take its place. You can buy four different entries today—five if you count Dodge and Plymouth separately. By this time next year, you'll probably find three more in dealer showrooms (see *What's Up Next* on the next page).

The four we drove are the Volkswagen Vanagon, Chrysler's new T-115 minivan, the Toyota Van and the Mitsubishi Vista. All look and behave quite differently, but they do serve the same purposes. Each can carry seven adults, and they do it with much greater economy, efficiency and, in some cases, more cargo capacity than the big station wagons of yore. If you're in the market for one of these vehicles, here's what you ought to be aware of, and look for:

The roomiest of this group is the VW Vanagon. It's the minivan's godfather and really sets the standard by which, I feel, we have to measure the rest. For sheer spaciousness, none of the others even comes close.

True, the Vanagon uses a 30-year-old design, but it's been updated many times. And



Mitsubishi says its Vista is really a car, but its practical, vanlike styling makes everyone call it a minivan.



## MINIVANS—SPECIFICATIONS

Vehicle	Base Price	Displacement (cc/cu. in.)	Horsepower @ rpm	Cargo Cap. (cu. ft.)	Payload (lbs.)	Wheelbase (in.)	Length/Width/Height (in.)	Curb Weight (lbs.)	Fuel Cap. (gal.)	EPA Mileage (city/hwy)
Chrysler T-Van	\$8,678	2,213/135	101 @ 5,200	125.0	1,200-1,700	112.0	175.9/68.9/64.8	2,911	15.0	24/39
Mitsubishi Vista	\$8,290	1,997/122	88 @ 5,000	63.9	1,200	103.3	174.6/64.6/59.8	2,493	13.2	28/40
Toyota Van	\$8,998	1,998/122	90 @ 4,400	149.8	1,500	88.0	175.4/65.7/71.5	2,925	16.1	25/31
Volkswagen Vanagon	\$11,700	1,915/117	82 @ 4,800	201.0	2,000	96.9	179.9/72.6/77.2	3,400	15.9	19/27

Note: All data for base models. Maximum seating for all vehicles is seven passengers. Chrysler and Mitsubishi have front engines with front-wheel drive; Toyota has mid-engine with rear-wheel drive; Volkswagen has rear engine with rwd.

## MINIVANS—REPORT CARD

	CHRYSLER	MITSUBISHI	TOYOTA	VOLKSWAGEN
Acceleration	B	B	B+	C
Handling	B+	C	B-	B-
Braking	A	C	D	B
Ride	A-	A	B	B
Fuel economy	B	A	B	B
Seating	A	A	A	A
Vision	B	A	C	A
Gauges/controls	B	C	B	C
Ventilation	A+	A	A+	C
Noise @ 55 mph	A	A	C	C
Cargo capacity	A	D	B	A+
Engine serviceability	A	A	C	A
Fit and finish	A	B	B	B

A - Excellent; B - Good; C - Average; D - Fair; F - Poor.

VW's new water-cooled engine gives the Vanagon more power and greater silence than it's ever had before. This engine still uses the opposed-four layout, but nothing interchanges with its air-cooled ancestors. Transaxle ratios have also been changed. The Waterboxer Vanagon delivers 22 percent more horsepower and 19 percent better fuel mileage than before.

The Vanagon's two rear benches unbolt with simple hand tools—an operation that takes about 20 minutes. With the rear seats out, cargo volume measures a room-sized 201 cu. ft. The next biggest in our group is Toyota's Van at 149.8 cu. ft. and then the Chrysler T-115 van (marketed as the Plymouth Voyager and Dodge Caravan) with 125 cu. ft.

I should mention that the Vista, also sold by Dodge and Plymouth dealers, isn't really a van at all, nor does Mitsubishi or Chrysler Corp. call it one.

Rather, the Vista takes on the configuration of an abbreviated station wagon. The part that's abbreviated is the engine compartment, where the 2.0-liter Four stands crosswise and drives the front wheels. Otherwise, except for being about 10 inches narrower than traditional American station wagons, it's almost as spacious for seating, but not nearly so roomy for cargo. That's because, while the three true vans make it possible to remove their rear benches, the Vista doesn't. Its seats stay anchored down, but the split seatbacks fold forward individually or together for load carrying, giving a maximum 63.9 cu. ft. of volume. Or, you can recline the seatbacks to form a two-person bed. It's not a tremendously comfortable bed, being short and never quite flat, but I suppose it'll do when all the local motels are full.

The easiest seats to remove are those in the Chrysler T-van and the Toyota Van. You merely flip some levers, tug, and the seats pull free. One strong person can lift a bench out, but it's best to share this job with a friend. The Toy-

### WHAT'S UP NEXT?

In addition to these four current entries in the minivan/microwagon field, there are at least three others that are being readied for 1985 introduction (see *A Real Family Car: The Garageable Van*, page 66, June '83).

General Motors has been testing its 1½-box M-Van, which will have rear-drive, the 2.5-liter Iron Duke Four for standard power, with Chevy's 2.8 V6 and perhaps Oldsmobile's 4.3 V6 optional. The M-Van weighs about 200 pounds less than Chrysler's T-115 and will come in both

passenger and commercial versions. It might even be available with optional 4wd. Look for easy-out seats and lots of versatility.

Ford, meanwhile, plans a 1985½ intro for its so-called Aerovan. Similar to the M-Van, Ford's entry will offer the four-cylinder and V6 engines available in the Ranger and Bronco II. It's also rear-drive, but could be 4wd, as well. Rumor has it that Ford's Aerovan will use some body panels from existing Club Wagons and Econolines, so it won't be completely new.

From Japan comes word that Mitsubishi might import the 4wd Delica minivan. This short-wheelbase vehicle shares mechanicals with the Montero (see *PM 4WD Comparison Test*, page 80, July '83), but carries six to seven people or a lot of cargo.

And Nissan could always bring in the Prairie, a front-engined, fwd eight-seater that borrows its engine and driveline from the Stanza/Pulsar.—M.L.



Ford's droop-snoot Aerovan mini will debut in '85.



ta's second bench reclines to form a bed in combination with the rear seat.

The Chrysler T-van's two rear benches, unfortunately, don't recline, but they do interchange. Thus, you can remove the two-place second seat and replace it with the folding three-place rear bench, leaving a good-sized cargo deck aft. The T-van also has a low loading sill and offers a completely flat floor right up to the front-seat pedestals. None of the others do.

One space problem with Toyota's Van is the fact that its engine stands between and slightly behind the two front buckets. The tall, upholstered engine cover forms a "T" with the crosswise bulkhead, and together they take up a fair amount of floor space. Since the Van uses rear-wheel drive, its flat floor stands fairly tall, so the lift-over sill is high. It's not so easy to get things in and out of this vehicle, (including its seats) as with the T-van.

### Chrysler's T-van

To me, the most fun to drive and the most generally cooperative of these four vehicles are, first, the Chrysler T-van and, second, the Vista wagon.

The T-115 blends the tall seating position of a van with the riding comfort and silence of a big station wagon. It handles well, maneuvers like a dream and never feels oversized. Its ride on paved roads is superb, though on rough surfaces it tends to get a little quirky; it could use better shock control.

T-vans come with two different engine/transmission combinations: MoPar's own 2.2-liter with five-speed manual transmission or three-speed automatic, and the Mitsubishi 2.6 with automatic only. Although I usually prefer manual transmissions, in this vehicle I'll take the automatic. The 2.2 lacks low-rpm torque, and you move away from stops by slipping the clutch. In either form, though, the T-van accelerates briskly enough. It'll do 0 to 60 mph in 15 seconds with the 2.2-liter and manual five-speed, or about 14 seconds with the 2.6 and automatic.

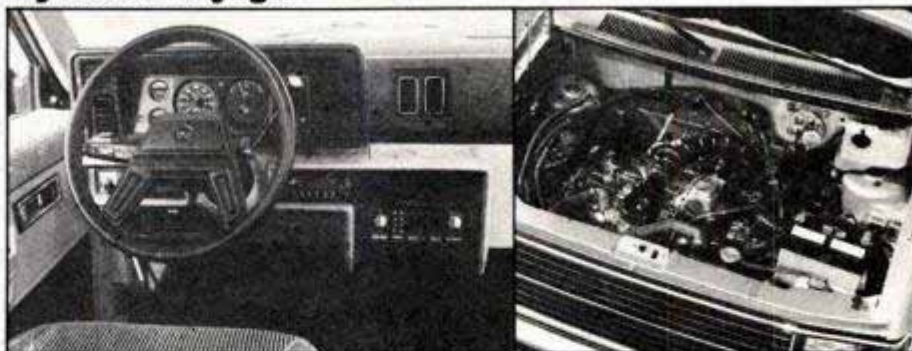
There's a touch of torque steer during hard low-gear acceleration, and the manual shift linkage lacks precision. With the five-speed, you also have to be ready to downshift from FIFTH (or even FOURTH) in hilly country, but THIRD winds out to an unbuzzy 65 mph. If you're willing to shift and keep up the revs, you'll be perfectly happy behind the T-115's more economical manual transaxle.

### Mitsubishi Vista

The Vista feels even more like a conventional station wagon. I found the ride very comfortable over all surfaces—controlled and nicely modu-

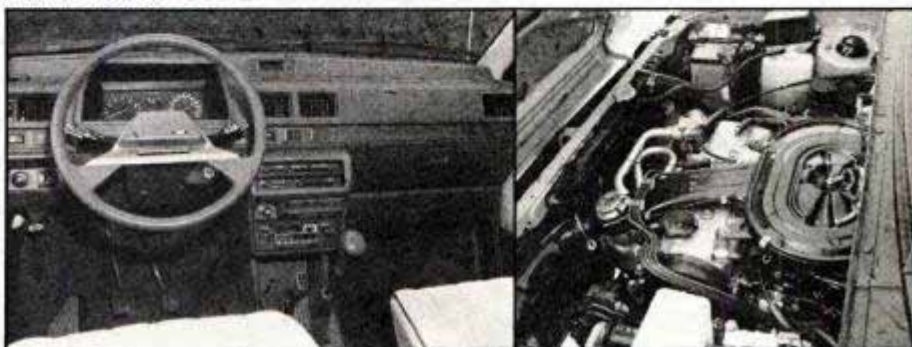
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## Plymouth Voyager



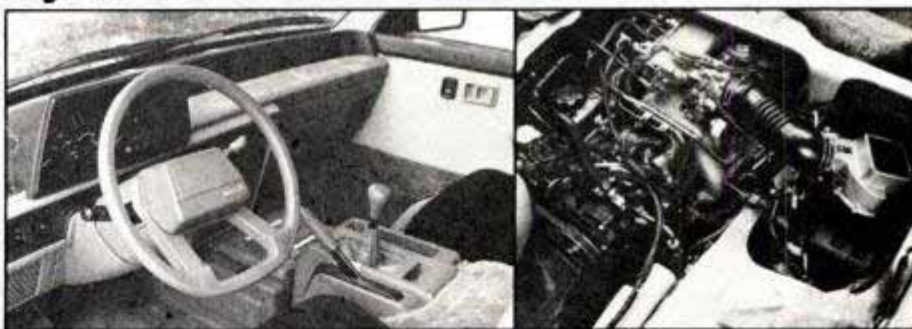
Not surprisingly, the interior of Chrysler's van-on-a-car-chassis looks like a typical American sedan (left), with a column-mounted shifter for the automatic transmission. Service access to the standard K-car engines (2.2- or 2.6-liter Fours) is good.

## Mitsubishi Vista



The Vista's interior (left) is typical of Japanese automobiles, with lots of little trays and cabinets for storage. There are two glove compartments plus a drawer under one seat. Transverse two-liter engine is based on Mitsubishi's Cordia/Tredia sedans.

## Toyota Van



Toyota Van is a conversion of the Town Ace commercial vehicle. Restyled interior (left) has the same clean look as the exterior. Engine is under a housing behind the bucket seats, which takes up floor space and makes access less than ideal.

## Volkswagen Vanagon



VW's interior (left) is all black plastic, just like any other German economy car. The long shifter is definitely trucklike. Flat Four engine is reached through a hatch in the raised cargo floor. Service access is good for most items from above or below.



# VIDEO

## More Portable Than Ever

Everyone loves movies, but VCRs are replacing film—not only in versatility, but in portability.

BY ART ZUCKERMAN  
Photographs by Bill Ashe

In case you've been wondering what became of all those people who used to immortalize their family doings on film in home movies, you can now find them up to their old tricks in a new way—home video.

Leading the pack is the new Betamovie, developed by Sony. It's a combination videocassette recorder and camera that weighs under 6½ pounds, ready to go with battery and cassette. (All other VCRs require that you purchase an add-on camera.)

Like the Super-8 film camera it replaces, Betamovie is only for filming. It can't play back what it's recorded—all others here do have playback. With Betamovie, the playback job goes to a conventional VCR. Betamovie is also like a Super-8 camera in that it uses a through-the-lens, optical viewfinder, not an electronic viewfinder.

But instead of a three-minute, 8-mm film cartridge, it uses a full-size Beta cassette that can take three hours and 20 minutes of recording. It's

*(Please turn to page 188)*

**Sony Betamovie** is a superportable unit with both a VCR and a camera. The combo weighs 6½ pounds.

**JVC HR-C3U** uses the new 20-minute VHS Compact tapes so that you can easily carry the unit around.

**RCA VJP 900** looks like a conventional home VCR, but you can lift out the recorder section to shoot your tape.

**Sharp VC-3500** is a VHS-format machine that has a handle and accepts an optional rechargeable battery.

**Magnavox VR8480BK** has a stay-at-home tuner and a portable VCR unit. It also offers One Touch Recording.

**Magnavox VR8471BK** is a combination unit with many of the VR8480 features, but at a lower price.

**Sharp VC-220** is an ultralightweight, VHS-format portable that weighs in at 5.7 pounds with the battery.



Sony Betamovie




JVC HR-C3U with optional GZ-2CU camera



Magnavox VR8480BK combo





 **RCA VJP 900  
with optional  
CC017 camera**



 **Sharp  
VC-3500**



 **Magnavox  
VR8471BK combo**

 **Sharp  
VC-220**



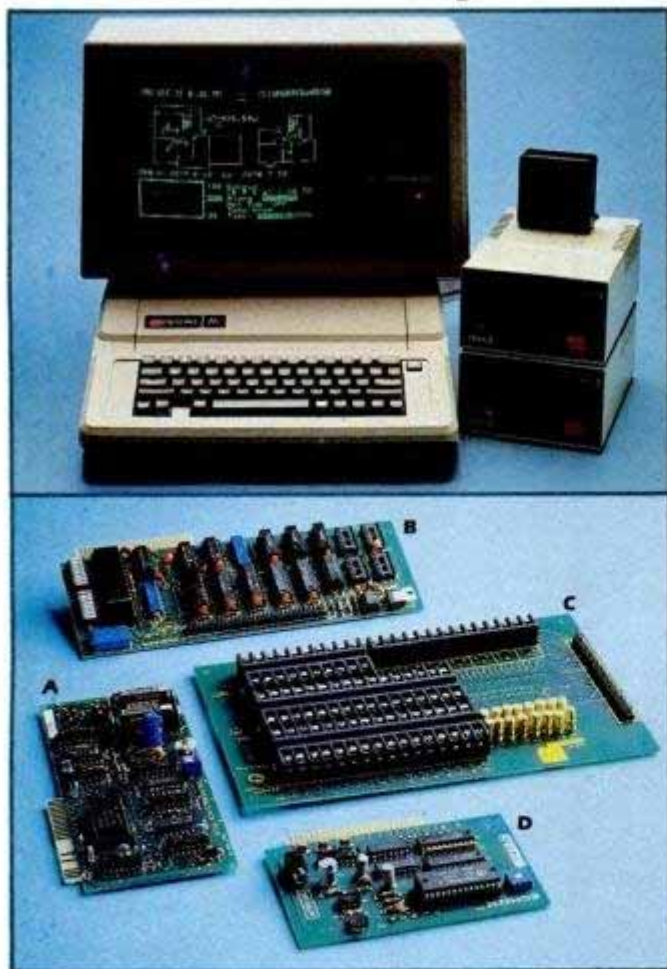


# Make Your Home A Smart House

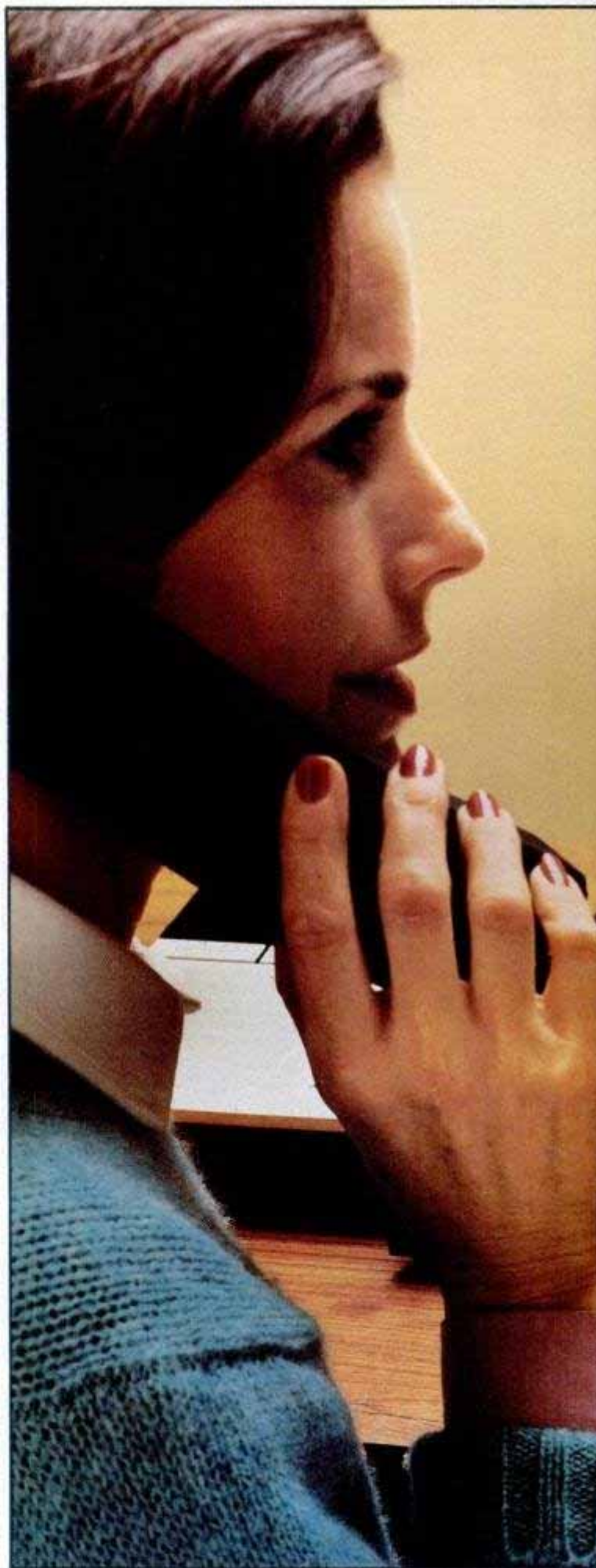
**Y**ou don't need a computer if you want to wire your home so it practically thinks for itself. The latest home-control hardware does more than ever before. We'll explain some of these stand-alone units, then take a look at a couple of systems that do use your computer as part of their brain centers.

Inspired by the demand for security—an estimated \$1.4 billion was spent nationally in 1983—firms such as Anova Electronics of San Mateo, Calif., have devel-

## The Tomorrowhouse system



Most sophisticated of the home-control systems is Tomorrowhouse from Compu-Home. This one does use a computer: an Apple IIe. Parts inside include board A, the Echo II speech-synthesis device; boards B and C, which send the computer's commands to home appliances; and board D, the Thunderclock.







BSR's system X-10 features an optional timer/programming unit (left) for controlling home appliances. Modules (right) plug into the house wiring. The appliances plug into the modules.



HomeBrain (above) must be programmed by the dealer's computer, but then it operates on its own to control the house. The system 1200 from CSI (on top) needs a dedicated personal computer.



The Anova Electronics Master System is a modular unit with many features. It comes with a phone, appliance control and security control with clock. It's probably the easiest "off-the-shelf" way to have a Smart House.



oped stand-alone home-control systems. Its Master System combines a telephone center and appliance control with its home-security setup.

With the three-piece Master System, you can install a wireless home-security system that monitors intrusions. If it senses one, it sounds an alarm, turns on the lights and phones a prerecorded message for help to anyone you choose. During personal emergencies, or whenever the smoke detector is activated, the Master System also automatically dials an emergency number.

In addition, this system integrates a Telephone Center—which includes a pushbutton phone, two-way speakerphone, 16-number auto dialer and answering machine—with a remote beeper that allows you access to this system from any location. And the Master System provides complete appliance control by giving you instant or remote access for up to 16 lights and appliances.

It's not an inexpensive system, at over \$900, but it's a good example of all the things you can do without a home computer.

### Even simpler

The best-known home control unit is the BSR System X-10 from BSR of Blauvelt, N.Y. Although this system has been modified to work optionally with home computers, it began as a stand-alone unit.

The basic System X-10 consists of a master controller/timer and control modules. Using a.c. house cur-

rent, the X-10 communicates with each module and tells it when to turn on or off. The module then controls the appliance or light plugged into it.

Each control module responds only to a signal with its code number. This is because the house wiring acts as the antenna for this system. Each module is a two-way radio transmitter, and if there were no encoding feature, it would be possible for your system to respond to the signals sent by another BSR system in your neighborhood.

Another stand-alone system is the Gulf + Western Sensaphone. Not only will it allow you to monitor your home (*Here's Your Ultimate Telephone Center*, page 100, Jan. '84), but it will also help handle emergencies while you're away from home. Using sensors, the Sensaphone monitors for burglars, fire or other trouble. If it senses something is wrong, it will automatically dial the proper authorities and inform them of the problem with a voice-synthesized message. It will also phone you, wherever you are, and inform you of the trouble.

### Computer sophistication

Although stand-alone systems are powerful, they aren't as versatile as home computers. But you don't have to make a sudden leap into home computers because there is a way station in our journey—the \$999 Homebrain from Hypertek of Whitehouse, N.J. The brain in the Homebrain is a tiny microcomputer chip. Once it is told what to do (by a personal computer program), it carries out the instructions independently.

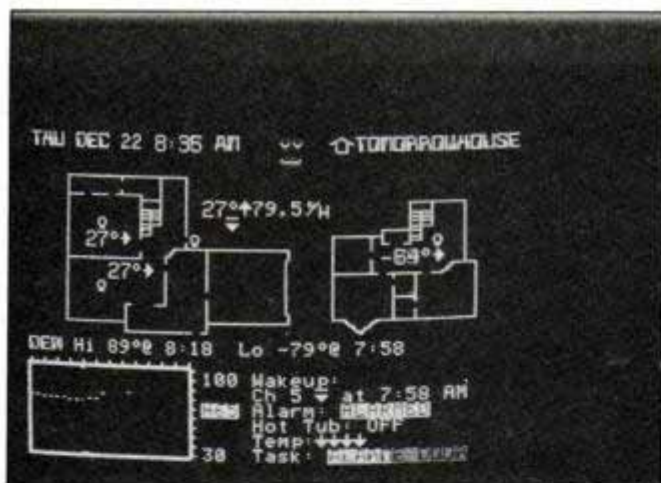
Homebrain controls up to 256 optional wireless home control modules by sending signals down your home's a.c. wiring. It not only talks to these devices and gives them orders, but it also listens. For instance, it can monitor thermostats, motion detectors and smoke detectors. If it senses something amiss, relays are activated which can sound sirens or turn on emergency lighting. The same relays can activate telephone dialing equipment to relay the alarm to the authorities.

Homebrain is an excellent example of the marriage of stand-alone and home computer technology. The instructions you give it must be fed in from a personal computer. But once those instructions are encoded into the Homebrain, it needs no further contact with that computer. Instead, it relies on its own "brain." If, for some reason, you want to change the instructions, you must link it to the home computer again and give it the new information. If you don't have access to a home computer, the dealer will probably be able to provide this service.

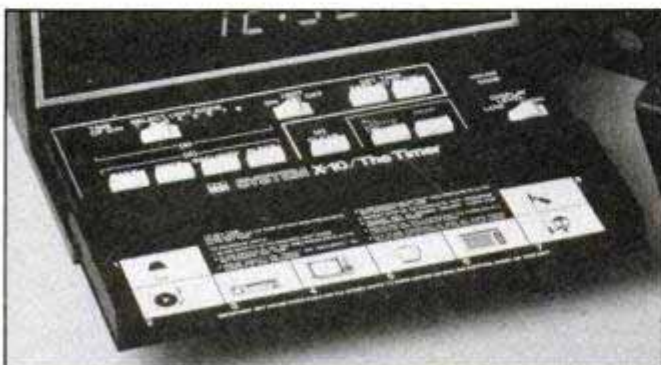
Although our Smart House is versatile, all the devices so far can't match the flexibility of a home control system run directly from a personal computer. Such a system is the Tomorrowhouse, a software and hardware package from Compu-Home Systems Inc. of Everett, Wash.

It consists of an Apple II or IIe microcomputer, special computer program and a variety of plug-in boards, such as an Echo II voice synthesizer board from Street Electronics of Carpinteria, Calif.; a Thunderclock from Thunderware of Oakland, Calif.; and a

*(Please turn to page 192)*



Detailed floor plan on screen of the Tomorrowhouse computer system can easily be customized to your own home. Plan shows controlled appliances and a graph of interior temperature.



Press-on pictures of appliances and lights allow you to set up the keyboard of a BSR X-10 timer/programmer unit exactly as you need it. Labels may be changed as needs change.





Except for the "Quattro" badge on the trunk lid, Audi's 4x4 looks identical to its fwd companion model. Note low stance.

## DRIVING THE AUDI 4000S QUATTRO

Audi's 'baby' sedan gets full-time 4wd from its fast, big brother.

BY WADE HOYT  
Auto Editor

**T**he 4000 is the smallest sedan that Audi sells in America, and for 1984 it becomes one of the most advanced. That's due to the addition of the full-time, all-wheel-drive system originally developed for the fast and expensive Audi Quattro Turbo sports coupe (see *Germany's 4x4 Cruise Missile*, page 147, June '82).

Unlike the turbocharged 160-hp engine in the Quattro coupe, the 4000S uses a normally-aspirated, five-cylinder engine that produces 115 hp. This 2.2-liter engine has a new, less complicated Bosch KE fuel-injection system that helps it produce 15 percent more power than last year's version. That gives the 4000S a top speed of 115 mph and 0-to-60 times of 9.5 seconds.

### Compact four-wheel drive

The most fascinating feature of the Quattro, of course, is Audi's compact 4wd system, which has neither transfer case nor external front driveshaft (see

the drawing on a following page).

A differential at the rear of the transaxle splits torque between the front and rear wheels. The shaft between this center differential and the forward one runs *through* a hollow gearbox pinion shaft, taking up no more space than a normal front-drive Audi transaxle. Torque is carried to the rear wheels via an exposed driveshaft. The rear sus-



Five-cylinder engine is really crammed into engine compartment, but most service items are easy to reach. Five see-through reservoirs allow for visual fluid checks.

pension is independent, with the aluminum rear differential case attached to the frame.

Because there is no external front driveshaft, the suspension doesn't have to be jacked up and the 4000S Quattro has the same 5-in. ground clearance as its fwd counterpart.

Full-time 4wd, of course, has the

expected advantage of improved traction on slippery roads. But Audi points out additional advantages of increased drive train and tire life because four wheels share the driving torque, instead of the two wheels on a 2wd car. Audi also claims no fuel economy penalty, since the Quattro system has only 3 percent more friction than the 2wd car, and this is cancelled out because driven wheels have less rolling resistance than free-rolling ones. Nonetheless, the Quattro's EPA fuel economy rating of 21/28 mpg is only fair for a car of this size.

### Locking the diffs

Another unique feature of the Quattro drive train is that the center and rear differentials can be locked by pulling a switch on the console (you cannot lock the front differential because that would interfere with steering). This gives greater traction in deep snow, but is not recommended for normal driving because it increases tire scrub.

There are other disadvantages to locking up the differentials: When the center diff is locked, it forces the front and rear wheels to rotate at the same speed, cancelling out the effect of the front-to-rear brake proportioning valve. It also makes the car behave like a conventional 4wd vehicle, increasing its

(Please turn to page 168)



# 4 Handy Home Accessories

## 1 Clothes Hamper

Organize your laundry day by using this easy-to-build clothes hamper. The 3/4-in. pine cabinet is dimensioned to accept two standard 12×24-in. fixed louver doors. A perforated hardboard back provides additional ventilation.

Begin by ripping the cabinet bottom and two sides from a piece of 1×12 No. 2 pine.

The lid is a full-width 1×12 (actual dimension: 11¼ in. wide). Then rip four 1½-in.-wide pine strips to make the two upper support rails.

Assemble the L-shaped rails with glue and 1½-in. finishing nails. Note that the back rail has a 3/16-in. setback for accepting the hardboard back. Also, you must rabbet the back edges of the cabinet sides and bottom to accept the back.

Bore 1/16-in.-dia. pilot holes at the 10 screw locations in the cabinet sides. (The two wood buttons at the top center of each side are decorative only; they don't conceal screwheads.) Now, counterbore 1/8-in.-deep × 1/2-in.-dia. holes at all 12 wood button locations.

### Assembling the cabinet

Next, glue and clamp the cabinet together. Continue boring the 1/16-in.-dia. pilot holes into the cabinet cross members. Then, carefully bore 3/16-in.-dia. screw shank holes through the cabinet sides, but *not* into the cross members. Now, assemble the cabinet using 1½-in. No. 8 fh screws. Check the cabinet for square before securing the back with 3/4-in., No. 6 fh screws.

Sand the outer surfaces and ease the cabinet's sharp edges with 120-grit abrasive paper. Glue the wood buttons in place.

Next, install the nonmortise door

hinges. First, screw the smaller hinge leaf to the door. Then hold the door in position and screw the larger leaf to the cabinet. Finally, install four ready-turned furniture legs, available at hardware stores, as shown.

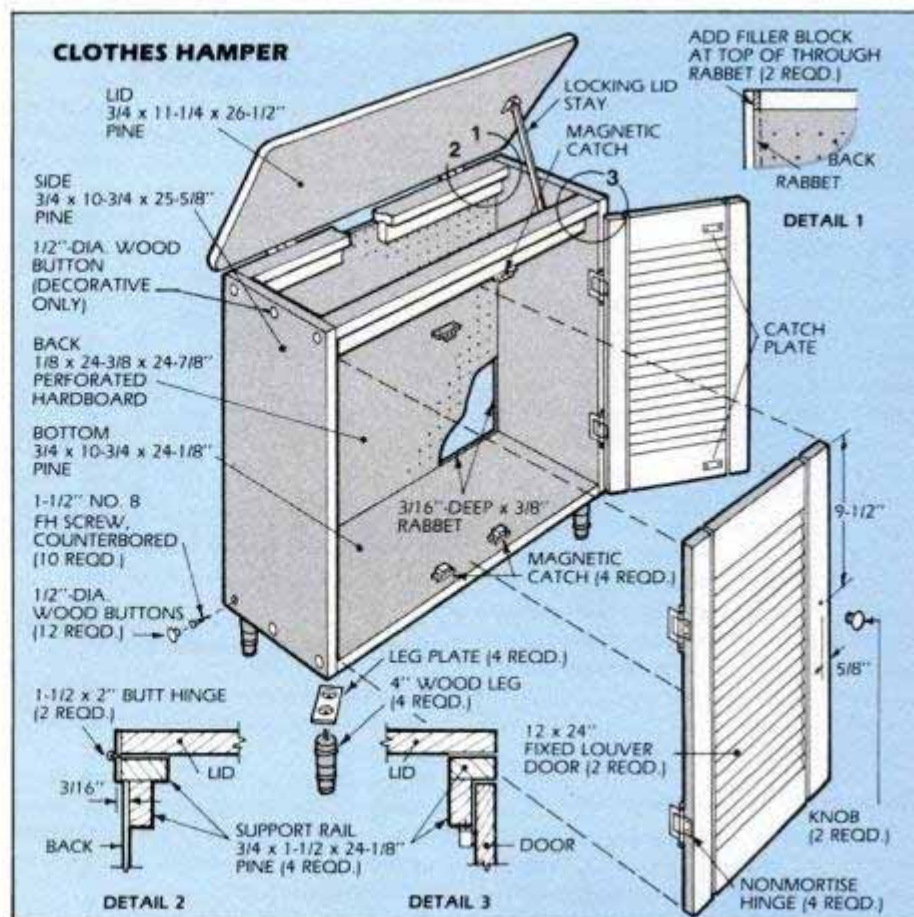
Now, attach the door knobs, magnetic catches and lid stay. Adjust the hardware for smooth operation, but remove it before finishing.

Apply three coats of polyurethane



This functional pine clothes hamper is compact enough for use in a bathroom, hallway or laundry room. The cabinet accepts standard 12×24-in. louver doors.

varnish to all surfaces, both inside and out. Be certain to sand between coats with 220-grit abrasive paper.—Rosario Capotosto (original hamper design by Thomas J. Kolba)







There's no need for you to fasten this bookshelf to the wall. Simply assemble the units and lean the 4x4 uprights against the wall. All of the shelf hardware faces toward the rear.

## 2 Gravity Shelves

This contemporary, fully adjustable bookshelf incorporates many features that aren't found in most bookshelf designs.

For example, the unit leans against the wall and isn't fastened to it. And, unlike most shelving, the more weight placed on the shelves, the more stable they are. The shelves are comprised of 3-ft. units which can be added as needed. Each unit should contain three to five shelves. Also, note that the shelf brackets and standards face the rear, out of view.

### Making the supports

Make the upright shelf supports from straight, kiln-dried 4x4s. If the lumber is twisted or bowed, even slightly, it will be difficult to assemble the units. After cutting the uprights to length, cut two grooves in each upright, as shown, to accept the metal shelf standards. Use a router or table saw and dado blade to cut the grooves.

Next, line up the uprights on the floor with their bottom edges flush. Be certain that the standards all measure the same dimension from the bottom of the upright before screwing the standard in place. Now, install a shelf bracket in each standard and place a straightedge across them. Check to see that the notches in the standards are properly aligned.

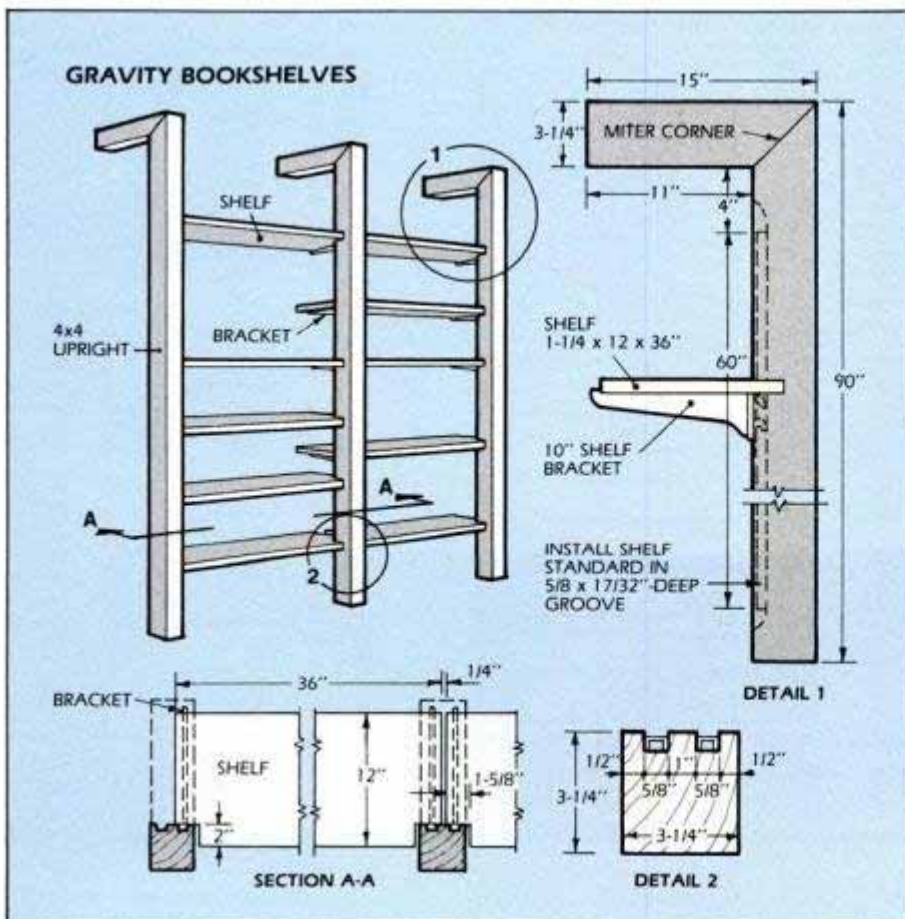
Complete the uprights by gluing and nailing on the horizontal top section. Drive 2-in. finishing nails in from the top and toenail in both sides. Glue on a heavyweight felt pad to the upright end which leans on the wall.

### Shelf construction 1

Make the 1 1/4-in.-thick shelves from particleboard or glued-up 5/8-in. A-C plywood.

To assemble a unit, hold two uprights—be sure to have a helper—with one shelf between them. Move the uprights the proper distance apart so that the shelf fits properly. Check the uprights for plumb using a level. Once you're satisfied with the fit, put books on the shelf to stabilize the unit. Continue adding shelves and books until the unit is secure.

Add other units, one upright at a time, to complete the shelving system.—Bob Zychek





## 3 Salt And Pepper Shakers

**M**ake these simple, yet attractive, salt and pepper shakers on a drill press. Each shaker is made by gluing together four  $\frac{3}{4}$ -in.-thick hardwood discs.

Of the eight discs that are needed, four should be cut from a light-colored wood such as maple or ash, and four from a dark wood, like walnut.

Start by cutting six discs—three light, three dark—using a 2-in.-dia. hole saw. These discs form parts B (4 required) and C (2 required). Note that a 2-in. hole saw actually produces a  $1\frac{1}{8}$ -in.-dia. disc.

Parts A (2 required), which form the top of the shakers, must be cut differently to prevent the hole saw pilot bit from cutting through the top. First adjust the pilot bit so that it protrudes beyond the hole saw by about  $\frac{1}{4}$  in. Then bore just deep enough so that the hole saw cuts into the wood about  $\frac{1}{4}$ -in. deep. Now adjust the pilot bit so that it's  $\frac{1}{2}$  in. inside the hole saw. Finish boring through the piece. Cut one light-colored top for the salt shaker and one dark top for the pepper.

### Making the discs

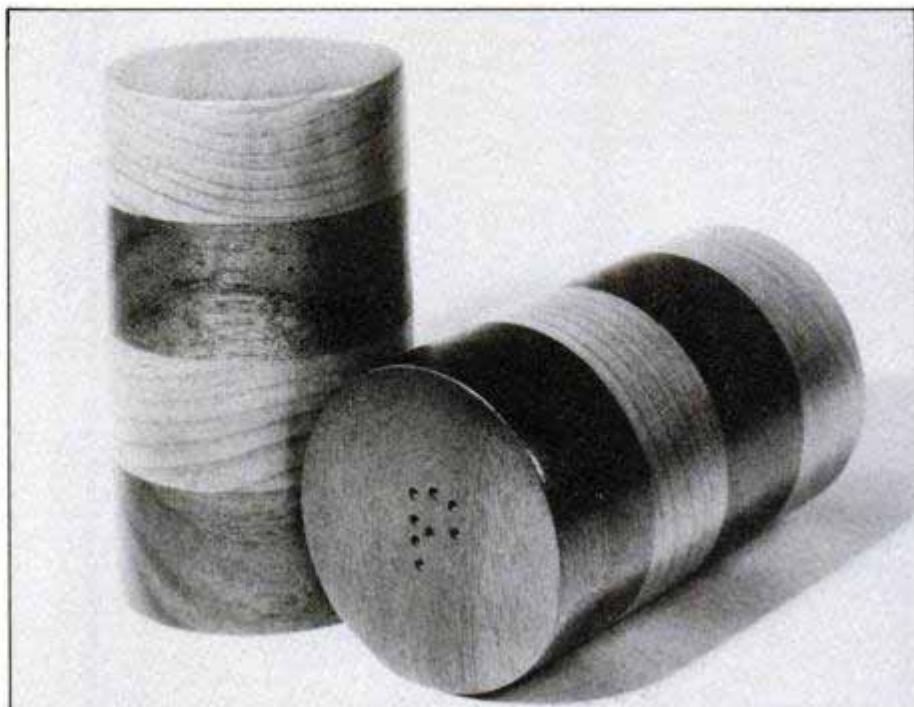
Next, use a 1-in.-dia. hole saw to cut out the centers of the four middle discs (parts B).

Bore a  $\frac{3}{8}$ -in.-deep  $\times$   $1\frac{1}{4}$ -in.-dia. recess in the shaker bottoms (parts C), using a spade or power bit. The recess provides room for removing the cork stopper. Then center-bore a  $\frac{1}{2}$ -in.-dia. through hole as shown.

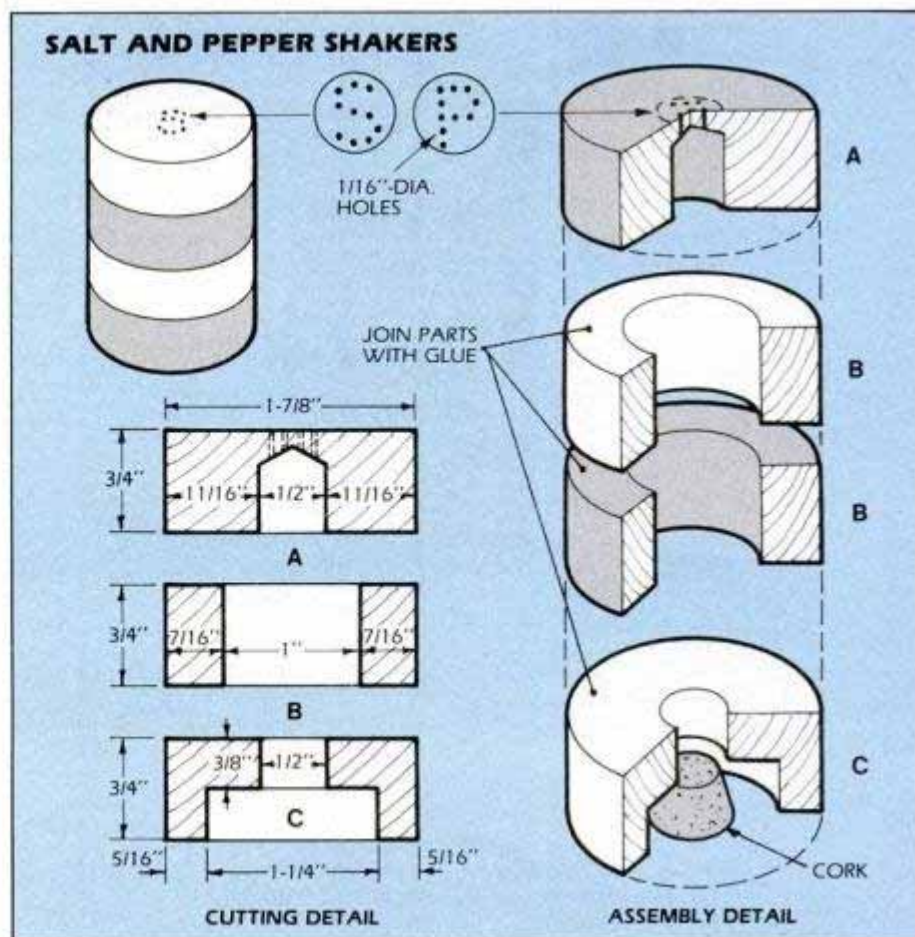
Glue and clamp together alternate color discs to form each shaker. Carpenter's glue can be used if you don't fully immerse the finished shakers in water. Otherwise, you should use resorcinol resin.

After the glue has dried, sand the shakers smooth using first 80-grit abrasive paper, then 100-grit, and finally 120-grit. Next, draw a  $\frac{1}{2}$ -in.-dia. circle on top of each shaker and pencil on an S and a P.

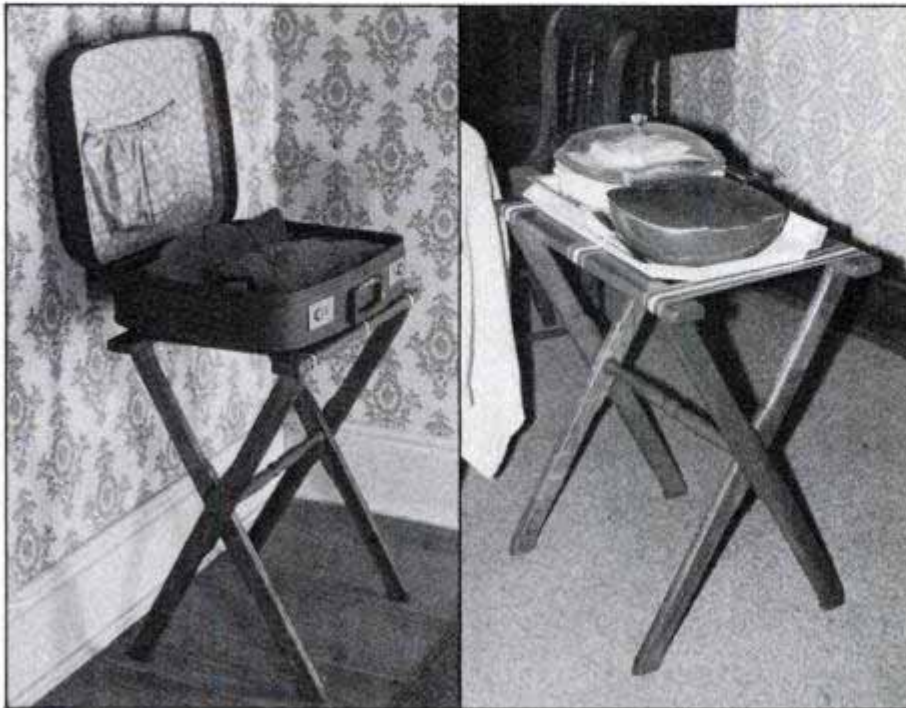
Use a  $\frac{1}{16}$ -in.-dia. drill to bore a series of holes along the letter outlines. Complete the shakers with two coats of clear satin finish applied from a spray can.—*Sam Allen*



You don't need a lathe to fashion these attractive salt and pepper shakers. Use only a drill press and a hole saw. Glue the hardwood discs together to form each shaker.







This sturdy cherry luggage stand folds flat so that it will store neatly in a closet. In addition, it doubles as a helpful serving tray (right) in either the dining room or bedroom.

## 4 Luggage Stand

If your guest room doesn't have a convenient place for opening luggage, build this space-saving stand which can also double as a serving tray at a crowded dining table. When it's not in use, simply fold it flat for storage.

### Hardwood construction

The stand shown is made of cherry, but any other hardwood may also be used. Cut nominal 1-in. stock for the legs and top rails (actual dimensions:  $1\frac{3}{16}$  in. thick). Then, sand all pieces smooth, using 120-grit abrasive paper. Bore a  $\frac{5}{8}$ -in.-dia. hole through the side of each leg, as shown, to hold the spindle. Now rout the edges of each leg with a  $\frac{1}{4}$ -in. bead-and-quarter-round bit.

Turn the spindle on a lathe. Cut the tailstock end first until it fits snug in the leg holes. Then turn the headstock end to match. If you don't own a lathe, buy a ready-turned spindle or use a simple hardwood dowel. Before assembly, stain all parts, if desired. Then apply two coats of satin polyurethane varnish.

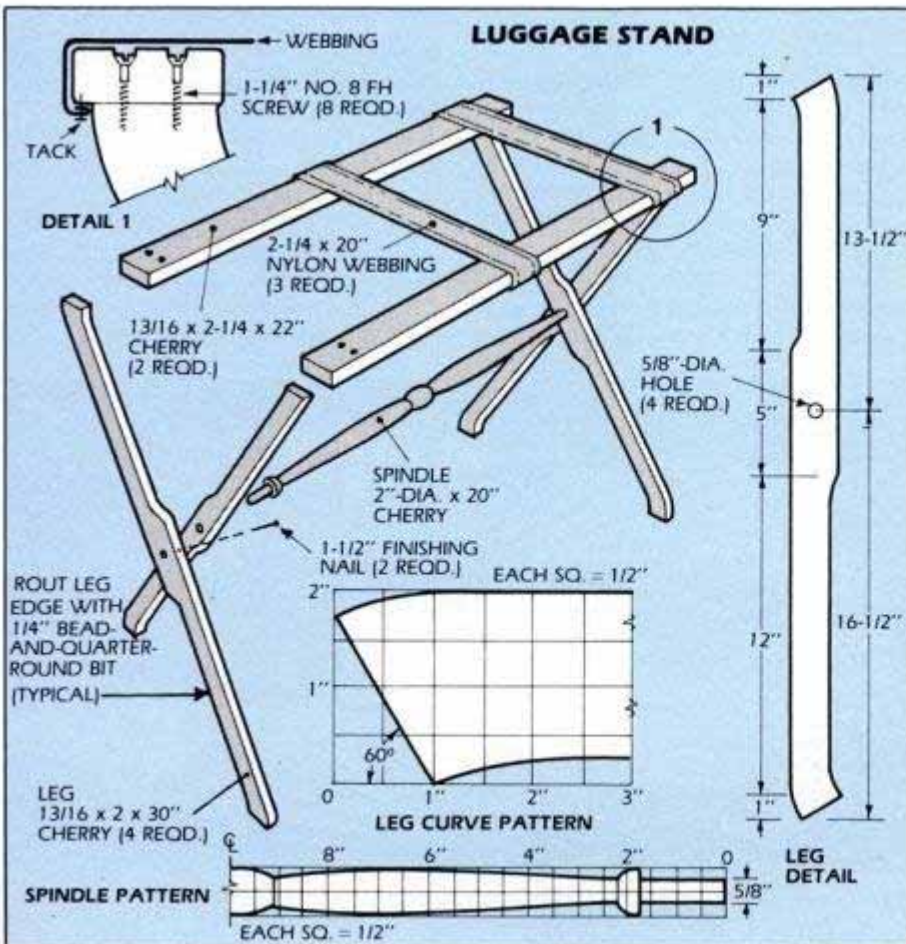
### Attaching the legs

Next, fit the inside pair of legs onto the spindle. Then screw the top rail to the legs, as shown. Apply glue to the hole in the *outer* legs only and fit them onto the spindle. Check to be certain that glue doesn't squeeze out onto the inside legs.

Now, screw the rails to the legs. Loop a cord around the rails to prevent the stand from collapsing, and place it on a flat surface until the glue dries. Be certain that all four legs rest evenly on the floor. Then, bore a  $\frac{1}{16}$ -in.-dia. hole in each *outer* leg as shown. Tap a  $1\frac{1}{2}$ -in. finishing nail into the leg and through the spindle. The nails strengthen the glue joint and lock the spindle to the leg.

Next, cut three strips of lawn furniture webbing (available at hardware stores), or seam strips of heavy canvas to fit around the top rails. Be certain to cut the strips to the same length before nailing them to the rail underside with three or four  $\frac{5}{8}$ -in. upholstery tacks.

—Ralph Wilkes



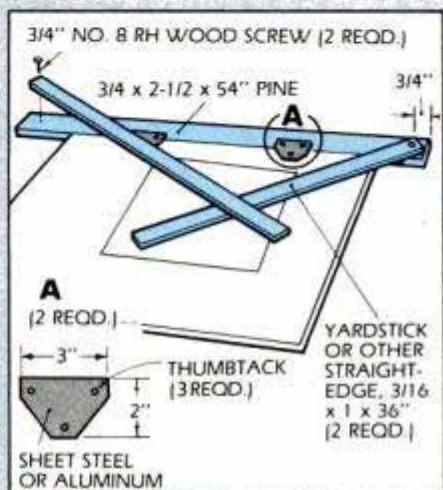
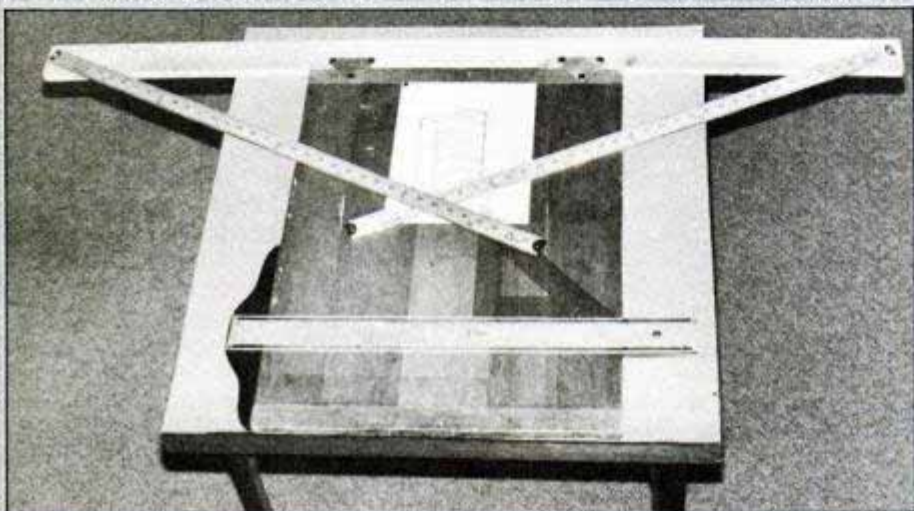


# 4 Ways To Draw Better Plans

Whether you're enlarging a PM plan or designing a project, these time-saving aids will help you do a better job.

BY RALPH S. WILKES

## Device For Drawing Perspectives



A perspective device, T-square, right-angle triangle and a sharp pencil can help you make accurate perspective drawings.

**W**hen you're planning a shop project, a perspective drawing will give you a good idea of the completed project's three-dimensional appearance. This simple guide helps maintain the correct perspective in a drawing, whether you're designing furniture or sketching a landscape.

The only materials you'll need are: two yardsticks or similarly sized pieces

of wood,  $\frac{3}{4} \times 2\frac{1}{2} \times 54$ -in. main support of pine, two  $\frac{3}{4}$ -in. No. 8 wood screws to secure the yardsticks to the support, two small scraps of sheet steel or sheet aluminum, and six thumbtacks. The last two materials fasten the device to a drawing board.

To use the device, secure it and drawing paper to the board. Use a T-square to draw horizontal lines, and a

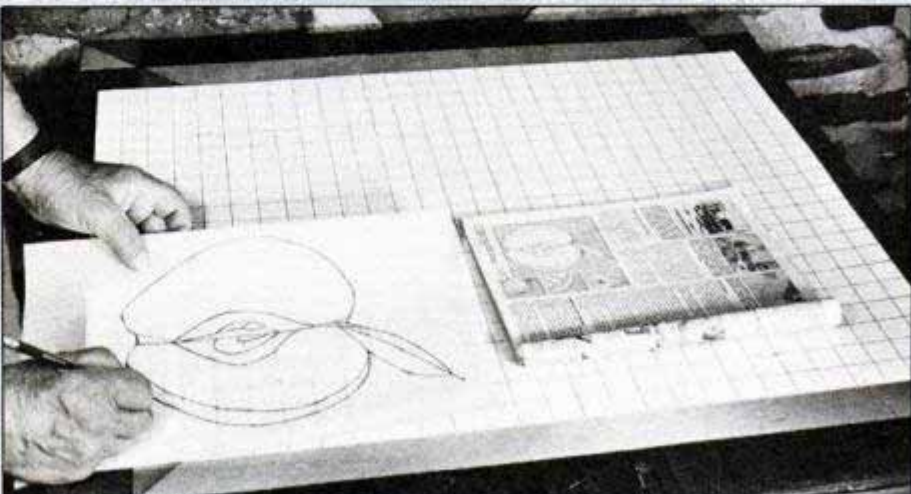
right-angle triangle to draw vertical lines. Use the yardsticks as guides in drawing the lines that go back to the predetermined vanishing points—the far ends of the yardsticks.

To store the device, slip a rubber band around the yardsticks to hold them to the main support. Store it in a closet, or hang it on a nail from a hole bored in one end of the support.

## Permanent Grid For Enlarging

**P**roject plans involving curves and unusual shapes are often placed on grids. When enlarging such a plan, you must first draw a full-size grid. Then you draw in the plan, using the placement of the lines on the original as a guide to line placement within the squares of the full-size grid.

You can save time by accurately drawing a permanent full-size grid on poster board. Then lay a sheet of tracing paper over the grid to enlarge a plan. Your work will be uncluttered by squares, and you can use the grid indef-



A permanent grid will eliminate the need to redraw a grid each time you enlarge a plan. Draw the new plan on tracing paper that's placed over the permanent grid.

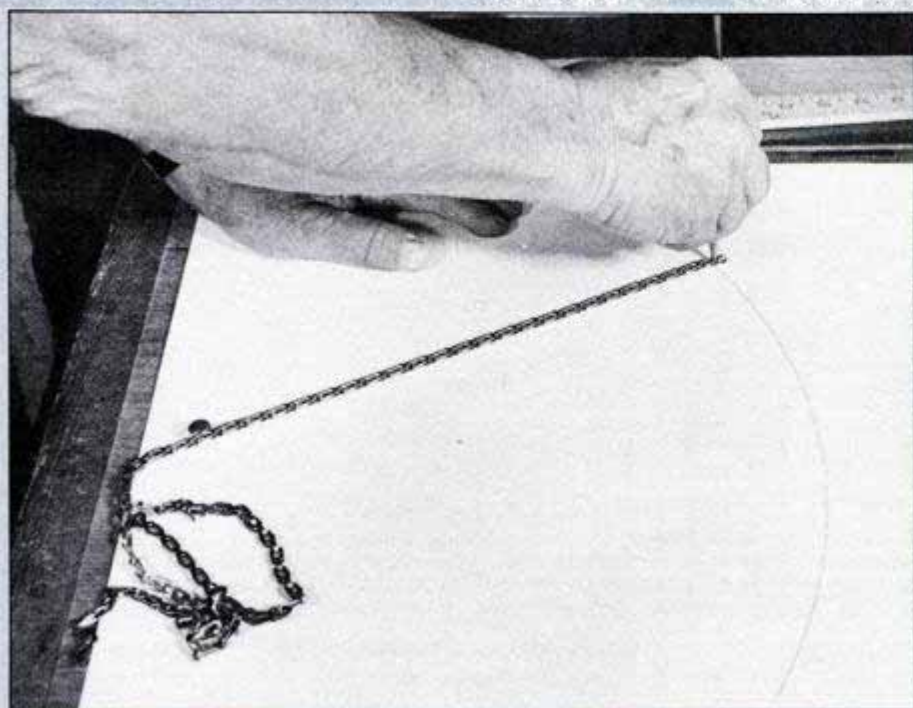


initely. Two grids, one of  $\frac{1}{2}$ -in. squares and one of 1-in. squares, will serve most needs.

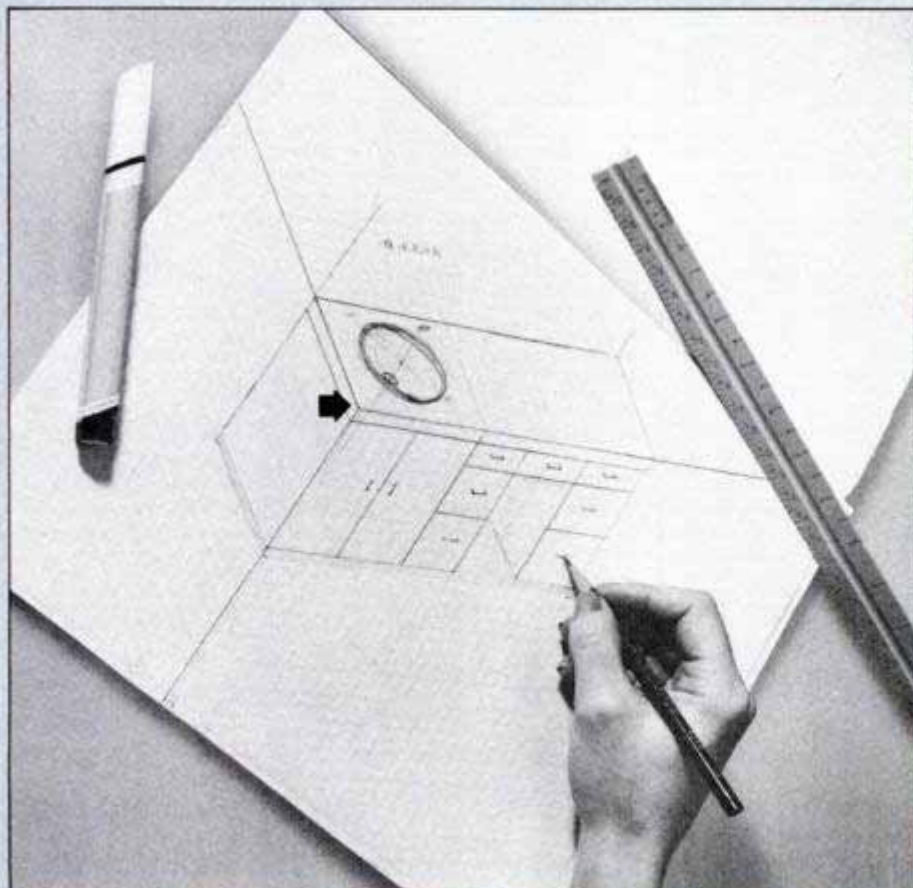
You can also draw an original grid on

$8\frac{1}{2} \times 14$ -in. paper and make extras on a duplicating machine, if you prefer to draw directly on the grid. However, you should note that the duplicated grid

may be somewhat larger than the original. It may be necessary for you to change the sizes of other project parts slightly.



Use an upholstery tack to hold one end of a length of flat-link chain. Use the other end of the chain as a holder for a pencil, and you have an aid for drawing oversize arcs.



An isometric chart has guidelines drawn to scale of the three visible sides of an object. Slipped under a sheet of tracing paper, the chart helps you make freehand drawings.

## Flat-Link Chain For Large Arcs

**A** 3-ft. length of a nickel-plated, flat-link chain is a handy aid in drawing arcs that are beyond the range of a compass. Anchor one end of the chain with an upholstery tack.

This type of chain, available at most hardware stores, has links spaced about every  $\frac{1}{2}$  in. through which you can position a marking pencil. However, you can mark an exact length, too. For example, you can make two arcs spaced exactly  $1\frac{1}{4}$  in. apart. Simply attach a paper clip to the stationary end of the chain and bend the clip until the pencil is at the exact distance needed.

If the arc planned is greater than the length of the drawing board, make an extension of pine or other soft wood. Position the extension below and against the drawing board. Secure the stationary chain end with an upholstery tack to the extension.

## Isometric Chart For Sketching

**A**n isometric drawing of an object depicts its three visible surfaces equally inclined. This means that all three surfaces have the same prominence. Many people who are beginning to draw find that an isometric drawing, which uses the same scale for all three dimensions, is easier to make than a perspective drawing. An isometric projection chart has the scale and angle guidelines for each side already drawn. Just slip the chart under tracing paper.

To use a chart, first determine the viewpoint and scale of the object you wish to draw. For example, I selected the left, front view of this counter. I made each square equal to 4 in. Begin by drawing the corner of the selected view at the point where the three visible sides meet (arrow). Count squares for height and depth. Rough in the outline, then draw in the details.

Isometric projection charts (and perspective charts) are available at art supply stores. An  $11 \times 14$ -in. isometric chart comes in a package (No. C426, \$5 postpaid) from Arthur Brown and Brother Inc., 2 West 46th St., New York, N.Y. 10036. **PM**



# WORKSHOP MINICOURSE



## Using cabinet scrapers

It's a good bet that many home workshopers are unfamiliar with cabinet scrapers. If you happen to be one of them, you've been missing out on a good thing. These tools excel at smoothing wood and, when properly sharpened, can yield a ready-to-finish surface without the need for tedious—and expensive—sanding.

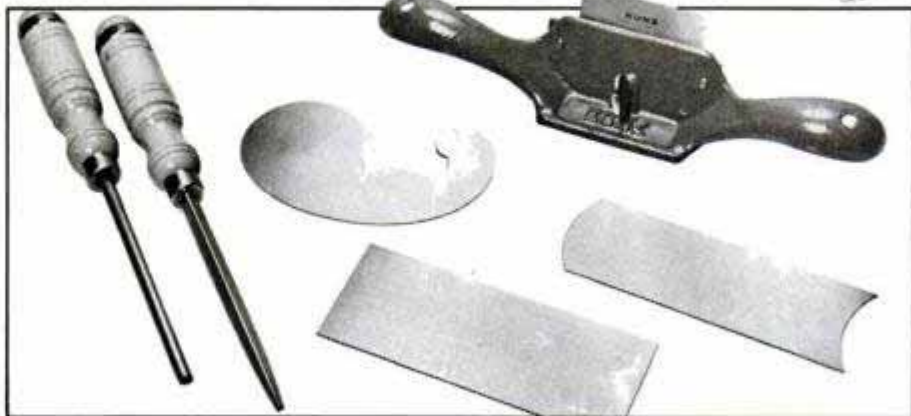
Used with moderate to heavy pressure, these blades can remove saw marks, tool burns and milling defects such as planer ripples in any kind of wood stock. They can eliminate ridge marks left by a smoothing plane and can also flatten wavy grained stock that doesn't respond well to planing.

The scraper is nothing more than a flat piece of tough but malleable steel that is about  $\frac{1}{32}$  in. thick. The steel lends itself to burnishing, or "turning over," the edge which forms a slightly hooked flare of steel. When the blade is held at an angle of about  $70^\circ$  to the workpiece and pushed or pulled over the surface, this hook cuts the stock, producing very fine shavings. Despite its name, the only time the tool actually scrapes is when the edge is dull and produces dusty particles, not shavings.

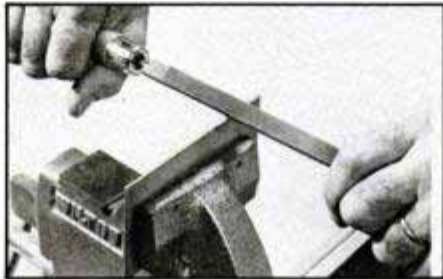
Although using the scraper is easy, sharpening it is a bit tricky. When an edge just begins to dull, it can be revived with a few burnishing strokes. This will work several times before filing and honing must be repeated. To burnish properly, just make four or five progressive passes over each edge until you obtain a flare of about  $10^\circ$  relative to the blade edge.

To sharpen the gooseneck scraper and the blades with concave and convex ends, use the same method, but different tools: a round file, slip stone and round blade burnisher.

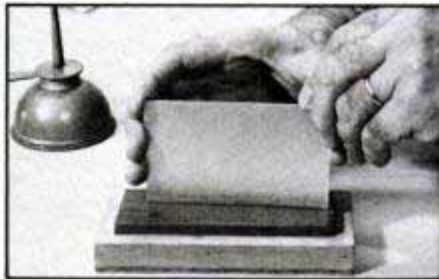
For normal use, the handheld blades—which cost about \$5 each—will work well. But for heavy-duty work, the frame-mounted type that looks much like a spokeshave is a better idea. These cost between \$12 and \$18 apiece. Unfortunately, most hardware stores don't stock these tools. However, they are listed in most woodworker supply catalogs. The ones shown here are sold by Garrett Wade Co., 302 Fifth Ave., New York, N.Y. 10001. **PM**



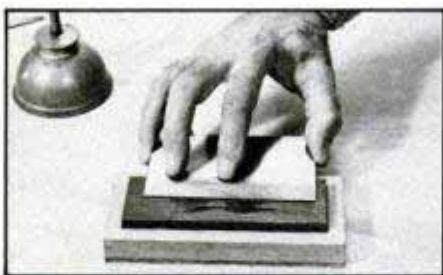
Cabinet scraper blades (above) come in three basic shapes: rectangular, straight with concave and convex ends, and gooseneck. Your choice depends on the shape of the workpiece. For heavy-duty jobs, there's also a tool holder (top) that accommodates a rectangular blade. Sharpening burnishers (left) come with either round or triangular blades.



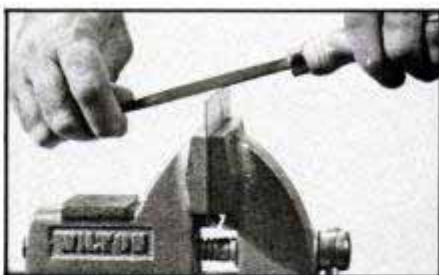
To sharpen scraper, first clamp blade in vise, then file edges flat using a single-cut fine mill file. Be certain to use full, firm strokes.



Remove file marks on edge by honing blade on oilstone. Keep blade perpendicular to stone at all times. Avoid rocking motion.



Once edge is honed, lay scraper flat on the stone and hone both blade faces. This will remove the fine wire edge left from filing.



Final step in sharpening is to clamp blade in vise, apply oil to edge and draw burnisher across each side of edge several times.



To use cabinet scraper, hold it firmly in both hands, bow blade slightly with thumbs. Tilt blade in cut direction and push.



Use straight blade with concave and convex ends, or gooseneck scraper, to smooth curved surfaces like those on cabriole leg.



# 3 Traveling TOOLS You Can Make

These three easy-to-make tools—collapsible workbench, folding camp saw and compact field pruning saw—are rugged and ready to go.

TEXT AND PHOTOS BY ROBERT F. BESSMER



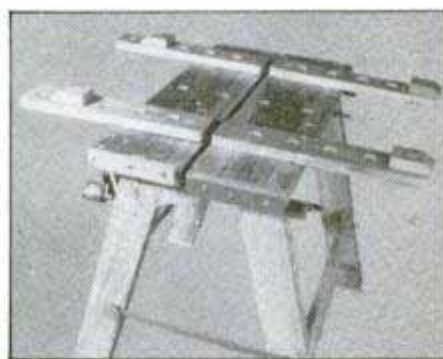
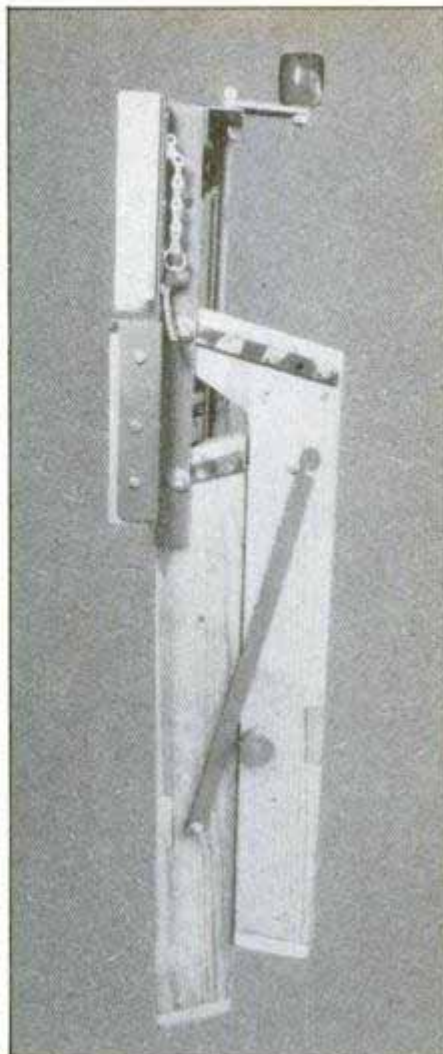
## Collapsible workbench

**T**his workbench design was inspired by the need for a sturdy, compact work surface portable enough to use around the house and yard for building and maintenance chores. It functions as a worktable and substitutes for a pair of sawhorses. Its operable top sections work as a clamp or vise for both straight and tapered workpieces. The bench dogs and extension arms make it

a handy assembly bench for clamping oversized workpieces. Overlaid with a sheet of plywood, the workbench becomes a sturdy base for a much larger worktable. Its splayed-leg design enables it to be used as a step stool.

The portable workbench folds up into a narrow package that's easy to carry, or to store in a limited space.

Make up the benchtops (parts E in materials list) by edge-gluing 2x4s. Add hardwood trim (E1 and E2) to the edges of the benchtops as shown. The hardwood trim provides a durable



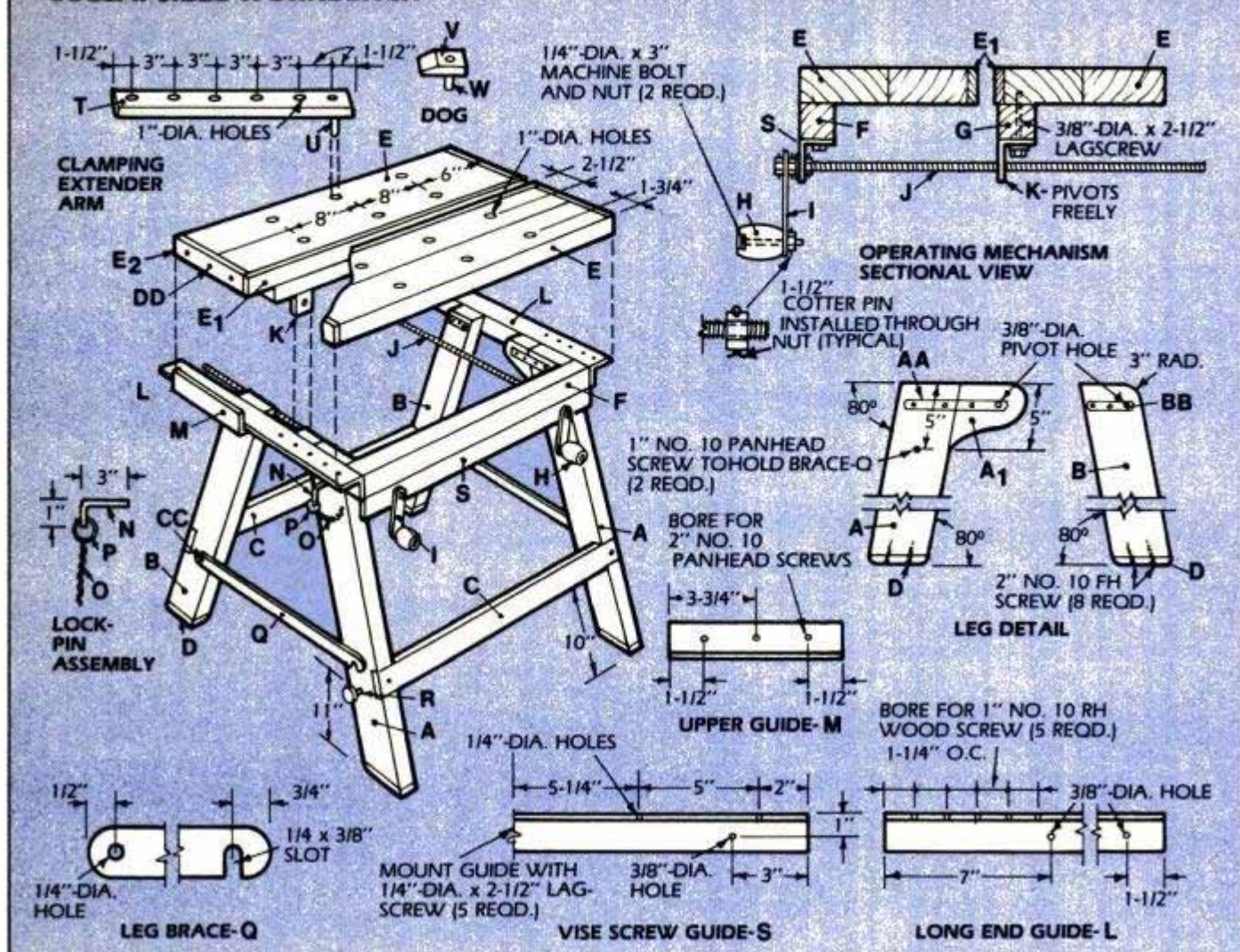
This sturdy portable workbench (left) features an adjustable, clamping top. The bench collapses into a narrow 8-in. package (top) that you can store easily. Extension arms on the bench (above) are able to hold many oversized workpieces.

clamping surface and protects the end grain of the tops. Next, fasten the front and rear screw guide mounts (F,G) to the underside of the top sections with glue and countersunk screws. Lay out and bore 1-in.-dia. holes through the top sections for the bench dogs.

Cut the legs (A,B) from 2x4 stock and miter the ends 80°. Glue hardwood pads (D) to the leg bottoms to protect the end grain from splitting. Notch the outside edges of the legs to let in the stretchers (C). Glue 5-in. extensions (A1) to the upper inside edges of the



## COLLAPSIBLE WORKBENCH



front legs (A). When the glue joints have cured, shape the leg extensions (A1) and bore the pivot holes. Cut pivot plates (AA, BB) from 1/4-in.-thick steel strapping. It's a good idea to bore the holes a little off center so that screw shanks won't interfere with one another as they're run in from opposite sides of the legs. The pivot plates are designed to reinforce the glue joints of the legs and leg extensions, and to minimize wear caused by the pivots.

Next, cut the various lengths of angle iron you'll need for the screw guides (K), long end guides (L), upper end guides (M) and vise screw guide (S). Bore 1/2-in.-dia. holes and tap threads in the screw guides (K) to accept the threaded rod. Make the crank assemblies as shown, using hardwood knobs (H), steel straps (I) and threaded rods (J). Form leg braces (Q) from steel strapping and make up locking knobs (R) by epoxying lagscrews with washers into plastic bottle caps. Bore holes at the ends of two 4-in. lengths of 1/4-in.-dia. round steel stock and bend the pieces to right angles in a vise to form locking pins (N). Attach the pins to lengths of chain with key rings.

### MATERIALS LIST—WORKBENCH

Key	No.	Size and description (use)	L	2	1 1/2 x 1 1/2 x 16 1/2" angle iron (long end guide)
A	2	1 1/2 x 3 1/2 x 28" hemlock (leg)	M	2	1 1/2 x 1 1/2 x 7 1/2" angle iron (upper end guide)
A1	2	1 1/2 x 3 1/2 x 5" hemlock (leg extension)	N	2	1/4"-dia. x 4" steel rod (lock pin)
B	2	1 1/2 x 3 1/2 x 28" hemlock (leg)	O	2	5" chain
C	2	3/4 x 2 1/2 x 24" pine (stretcher)	P	2	3/4"-dia. key ring
D	4	1 1/2 x 1 1/2 x 3 1/2" oak (leg pad)	Q	2	1/2 x 3/4 x 18" steel (leg brace)
E	2	1 1/2 x 7 x 27" hemlock (workbench top)	R	2	1/4"-dia. x 2" lagscrew and washer epoxied into plastic cap (locking knob)
E1	2	1/2 x 1 1/2 x 28" oak (trim)	S	1	1 1/2 x 1 1/2 x 24 1/2" steel (vise screw guide)
E2	4	1/2 x 1 1/2 x 7" oak (trim)	T	4	1 3/16 x 3 x 16 1/2" maple (extender arm)
F	1	1 1/2 x 1 1/2 x 24 1/2" hemlock (front screw guide mount)	U	4	1"-dia. x 2 1/4" hardwood dowel
G	1	1 1/2 x 1 1/2 x 20 1/2" hemlock (rear screw guide mount)	V	4	1 3/16 x 2 x 3" maple (dog)
H	2	1 1/2"-dia. x 2" oak (knob)	W	4	1"-dia. x 1 1/2" hardwood dowel
I	2	1/4 x 3/4 x 4" steel (knob strap)	AA	4	1/8 x 3/4 x 6" steel (pivot plate)
J	2	1/2-13 x 18" threaded rod, six nuts and six 1 1/2" cotter pins	BB	4	1/8 x 3/4 x 3" steel (pivot plate)
K	2	1 1/2 x 1 1/2 x 1 1/2" angle iron (screw guide)	CC	2	1/4"-dia. x 2" machine screw with Tee-nut
			DD	22	1" No. 8 fh screw

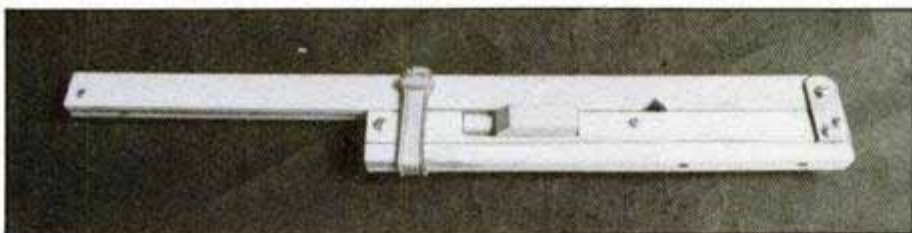
Glue and screw the stretchers into each pair of legs. Place the benchtop sections (E) face down on the floor. Mount the vise screw guide (S) to the underside of the front table section and insert crank assemblies through the holes in the face. Thread screw guides (K) onto rods and align rear table section with front. Position screw guides on the guide mounting strips (F, G).

Now, remove the rear screw guides from the rod and fasten them to the mounting strip on the rear benchtop

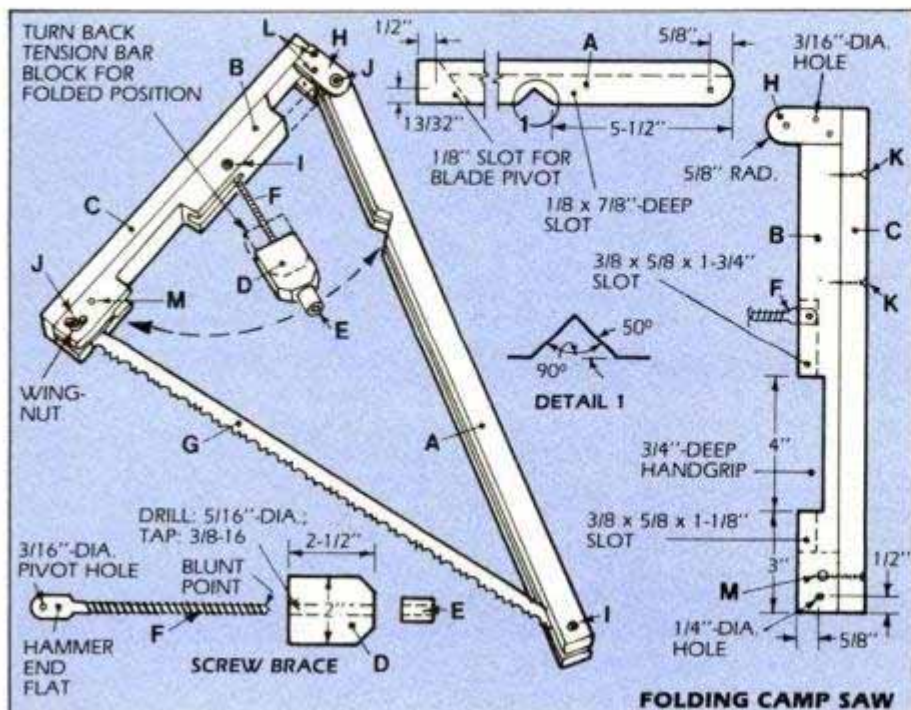
section, leaving the screws loose so the screw guides (K) pivot freely. Rethread the guides onto the crank assembly, making sure the two table sections close completely. Mount the upper end guides (M) to the ends of the rear benchtop section and fasten the long end guides (L) to the legs. Slip the legs onto the assembled top so that the guides engage, then screw the long end guides to the front benchtop section.

Finally, mount the leg braces, locking knobs and locking pin assembly.





Folding camp saw is tough enough to cut through 7-in.-dia. logs (top). When the saw is collapsed (above), the frame encases the blade for safe handling and packing.



FOLDING CAMP SAW

## Folding camp saw

**A** bow saw is an extremely useful tool to have at a campsite for cutting up firewood, or clearing and building temporary shelters and camp furniture. Most bow saws, however, are too large to stow conveniently and too unwieldy for backpacking. This folding camp saw works like a bow saw and folds up into a slim 1 × 3½ × 25-in., 3-pound package.

Because the tool must be able to stand up to the elements, material selection is very important. For wooden parts, locust is the best choice, followed by white ash, Eastern red cedar and black cherry. Maple or birch treated with oil or polyurethane varnish will also do. Brass hardware is recommended for use throughout the saw to combat the weather.

Before starting construction, purchase a bow saw blade at a hardware store or tool supplier. Dimensions for the saw frame are based on the blade size. For the saw shown, use a 1½ × 24-in. bow saw blade. The saw frame dimensions can be altered to accept a different size blade as long as the frame proportions remain approximately the same as those shown in the drawing.

### Construction

Cut the wood members (A through E) to size. Use a table saw to cut a ½ × ⅞-in.-deep slot down the center of the long arm (A). Then, notch the arm as shown in Detail 1. The screw brace tension bar (D,E) is placed in this notch during sawing to prevent the saw frame from collapsing. Shape the upper end of the arm to a ⅝-in. radius and bore holes for the pivot bolt (J) and blade retainer bolt (I) at each end.

Next, bore one hole through the lower end of the handle (B) for the blade retainer bolt (J) and another higher up, for bolt I that holds the screw brace to the handle. Now, cut a ⅜ × ⅝-in.-deep × 1¾-in. slot into the handle for the screw brace threaded rod (F) to fold into. Slot the handle bottom end to receive the back end of the blade, and

### MATERIALS LIST—FOLDING SAW

Key	No.	Size and description (use)
A	1	¾ × 1¼ × 25" ash (arm)
B	1	¾ × 1¼ × 15" ash (handle)
C	1	¾ × ¾ × 15" ash (handle support)
D	1	¾ × 2 × 2½" birch (tension bar block)
E	1	¾"-dia. × 1" hardwood dowel
F	1	¾-16 × 7" threaded rod (screw brace)
G	1	24" bow saw blade
H	2	⅝ × 1 × 2¼" brass (pivot plate)
I	2	⅜"-dia. × 1" machine bolt, nut and lock washer
J	2	¼"-dia. × 1" machine bolt, nut and lock washer
K	3	1¼" No. 10 fh screw
L	4	¾" No. 8 rh screw
M	1	⅝"-dia. × ¾" hardwood dowel (screw support)



then cut a 3/4-in.-deep handgrip into the handle as shown. Round the handle edges for a comfortable grip. Using waterproof resorcinol resin, glue and screw the handle support (C) to the handle. Insert a dowel (M) through the blade slot as shown to provide some solid wood for the screw to turn into.

Next, assemble the screw brace. Flatten the end of the threaded rod (F)

and bore a 3/16-in.-dia. pivot hole. Then, bore and tap threads into the tension bar to receive the threaded rod. Now, cut pivot plates (H) from brass sheet stock. Attach the pivot plates to the saw handle and arm, and bolt the blade in place.

To collapse the saw, simply turn back the tension bar and swing it into the handgrip. Then, remove the wingnut at

the heel of the saw blade and place the blade into the slot cut in the arm. Fold the frame closed and secure it with a rubber strap used for holding snow skis together. Once the saw is folded and secured, you can transport it safely without fear of being cut.

During use, be certain to keep the tension bar socked snugly into the notch in arm A.

## Compact field saw

**P**art of the beauty of this compact field saw is that it folds up like a jackknife. Also, it can be made from shop scraps and tag sale finds. Your only investment: a little know-how.

Salvage a blade from a crosscut handsaw. Using tin snips, cut the heel of the blade to the curved shape shown in the drawing, but for the moment, don't cut the notch. Before attempting to bore a pivot hole in the blade, it's best to anneal the steel. Heat the spot with a propane torch until a dime-sized, red-hot spot develops. Let it cool, then bore the 3/16-in.-dia. pivot hole.

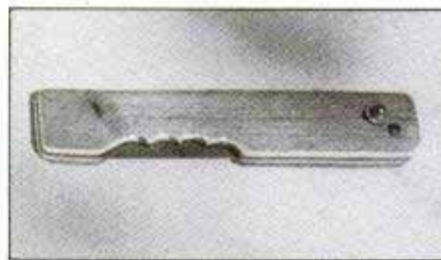
Select 1-in.-thick, tight-grained oak for the handle. Before cutting the handle to its finished size, cut the 1/8 x 2 1/2-in.-deep slot in the edge. Then, rip the oak to the handle's 2 3/4-in. width.

Next, cut the handle contours with a band saw or sabre saw. Bore the hole for the pivot and cut the slot for the sliding bolt. Now, bore the 3/16-in.-dia. inner pocket for the spring. Extend the centerline of the bolt slot to the butt of the handle and center your bit on that line. Load the spring into the pocket, and make a trial assembly of the sliding bolt in the slot. Make certain the spring

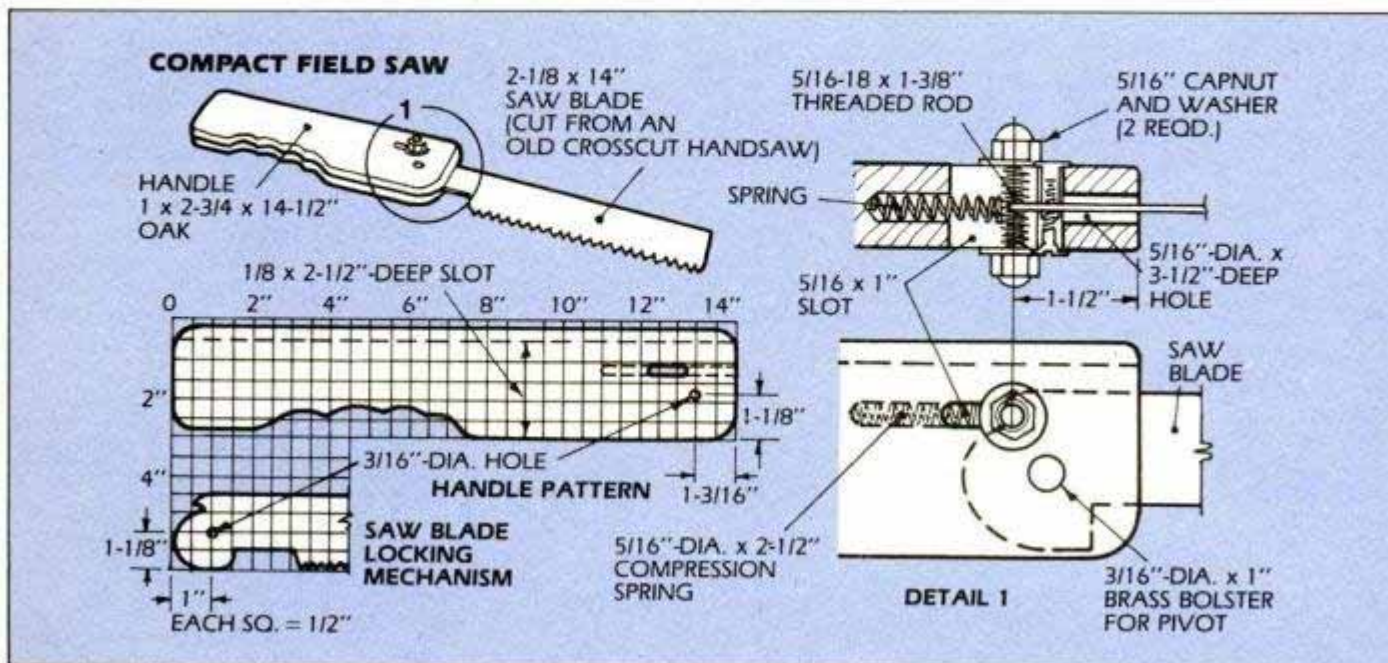


pushes the bolt all the way forward.

Next, remove the sliding bolt assembly and attach the blade with the brass bolster pivot bolt. With the top of the blade parallel to the top of the handle, mark the heel of the blade where it shows through the slot. Disassemble the blade and handle, and cut the notch. Round the handle corners so that the grip is comfortable, and finish it with polyurethane varnish before final assembly.



Compact field saw locks open like a jackknife (top). Simply pull back on the bolt and the blade folds into the handle (above). **PM**





# Home Ideas Guide

You can work wonders with your home—without professional help. Our projects, some of which are represented below, include all the how-to you need to know.

*Paneling*

*Flooring*

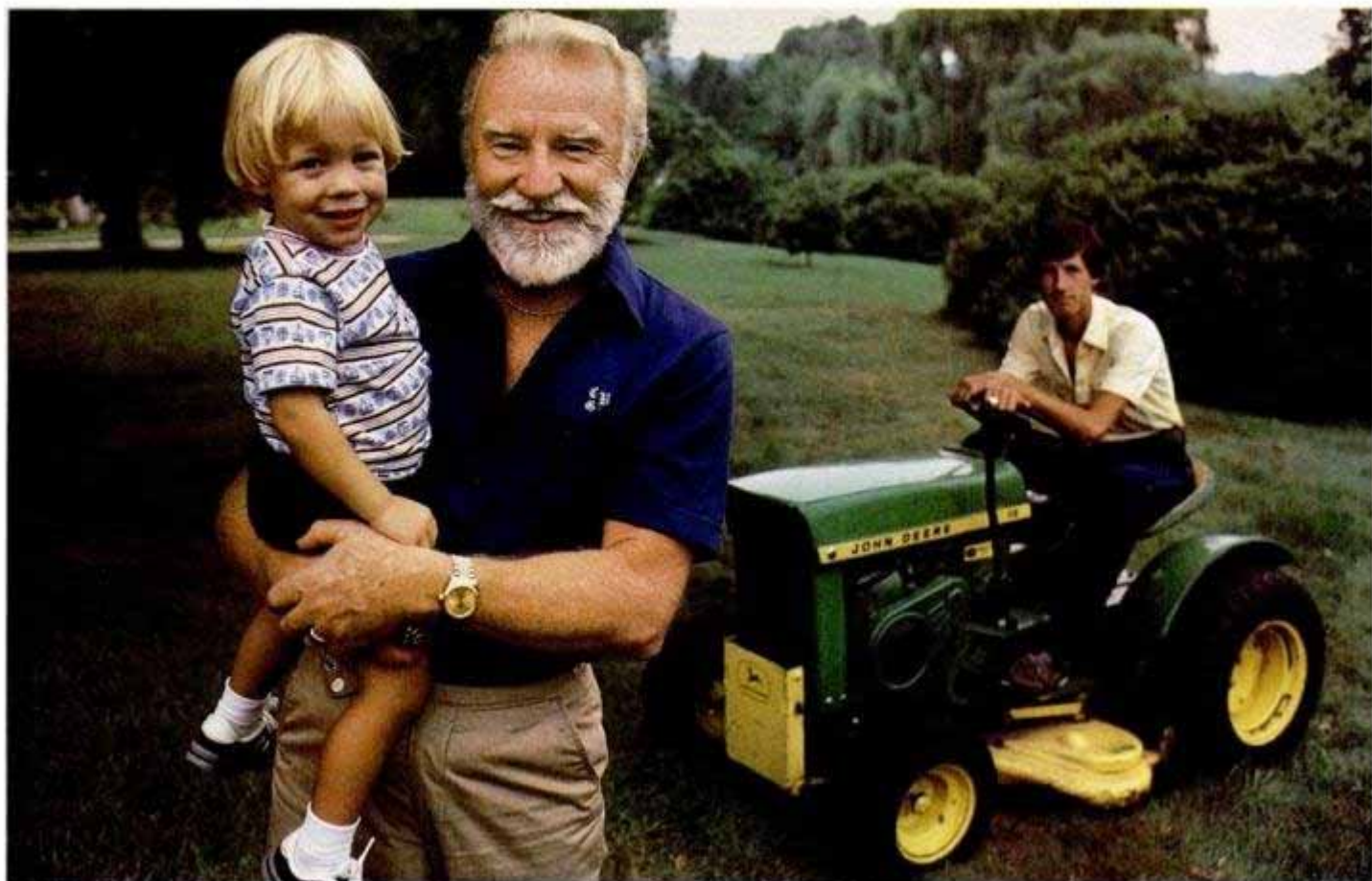
*Window*

*Tile*

*Storage Wall*

*Siding*





## “The way things are going, my grandson will learn how to mow lawns on the same tractor my son did.”

It's not every day you hear about a three-generation lawn and garden tractor. After all, the average lifespan of a “bargain” tractor is only about four or five years. So when we received a letter from the Brenner family of Towson, Maryland, we were pretty pleased.

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Of course, when you know how they're built, it's no surprise they last so long. You can even feel the difference. They're tighter. More solid. So you don't bounce around as much. And with dozens of optional top-quality attachments, you can use them year-round for mowing, tilling, landscaping and snow removal.

So if you're looking for a lawn and garden tractor that'll stand the test of time, take a look at the new 1984 models at your nearby John Deere dealer. They come in eight sizes, from 10 to 20 hp.

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*For more information or the name of the dealer nearest you, call 800-447-9126 toll free (Illinois, call 1-800-322-6796). Or write John Deere, Dept. 50, Moline, IL 61265.*

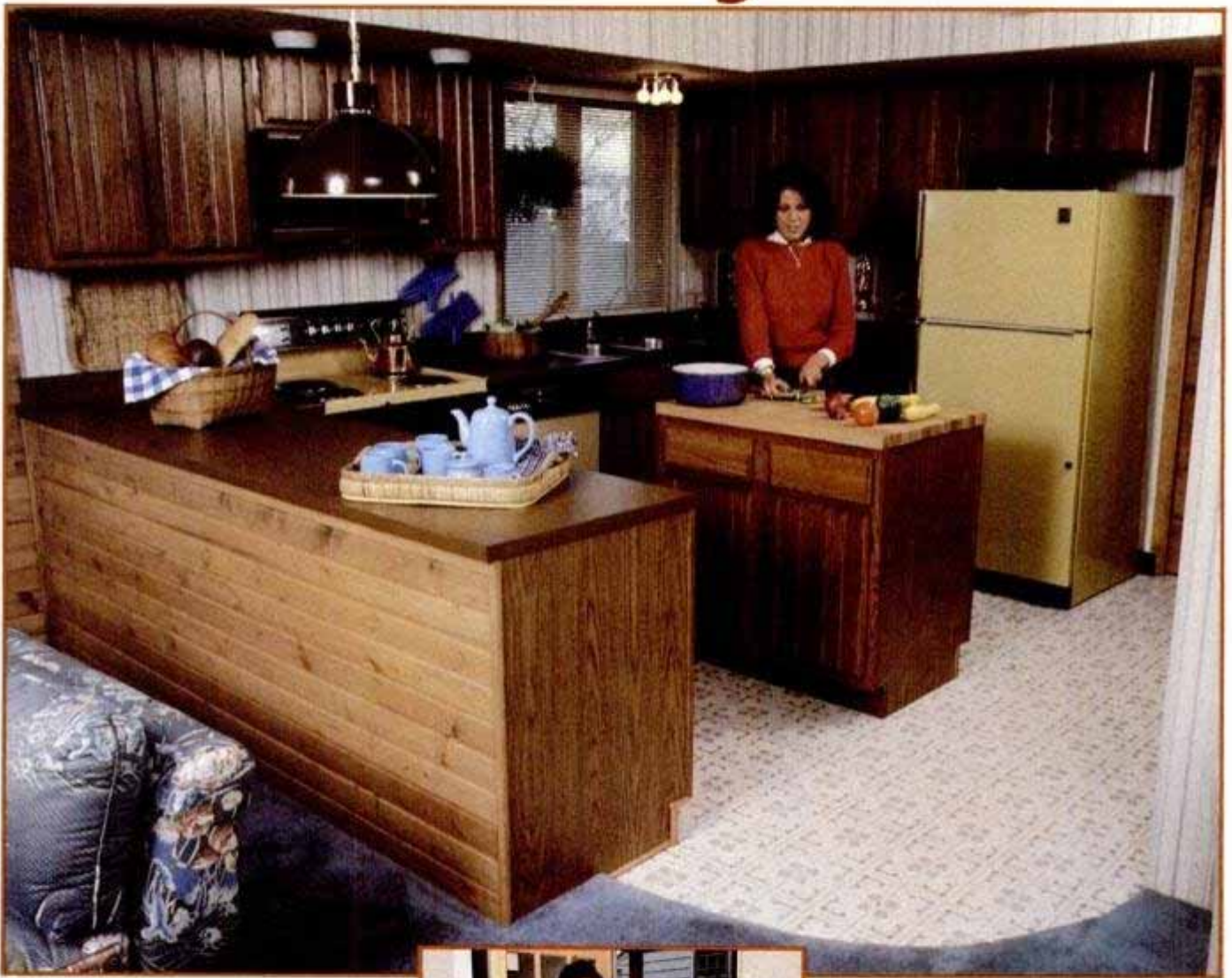


**Nothing Runs Like a Deere®**





# How To Finish New Space With Style



Here's how you can panel the walls with wood and use a new vinyl floor that's easy to install.

**T**he Arnold Monahan family was strapped for space. Lucia, a concert singer who gives voice lessons at home, wanted a studio to accommodate a baby grand piano. The Monahans also wanted a family room and a lavatory on the first floor. When foster child Jessica came to stay, the space demands became greater. So the Monahans



The kitchen flooring (top) is sheet vinyl that lies flat without adhesive. You should bring the flooring indoors (above) at least 48 hours before you plan to install it.

decided to build a new addition, customized to their special needs.

The result is a light, open space. The piano studio opens up to the master bedroom above it. The kitchen, family room and studio also open onto each other without partition walls.

To reduce the costs of the new addition, Lucia and Arnold did much of the finish work themselves, using new do-it-yourself products that are easy to work with. Complete directions for two of these finishing projects—paneling walls in the family room-studio and laying a vinyl floor in the kitchen—are on the following pages. The Monahans





Natural finishes such as pine paneling and quarry tile in the studio, and brick on the raised hearth and stove surround in the family room, create a warm, casual feeling.

used Pine Valley 4 paneling of knotty pine lumber with tongue-and-groove joints. It can be installed vertically, horizontally or diagonally, with either the rough side or smooth side exposed.

### Installing wall paneling

In planning a paneling project, first determine the square footage of the walls to be paneled, then add 10 percent waste. Each package of Pine Valley 4 paneling (\$26) contains enough pieces to *(Please turn to page 120)*

Wall paneling: Pine Valley 4, Champion International, 1 Champion Plaza, Stamford, Conn. 06921.

Vinyl flooring: Acclaim, Village Garden pattern, Mannington Mills Inc., Box 30, Salem, N.J. 08079.

Carpeting: Meadowbrook in Anso IV nylon, Downs Carpet Mills, Box 475, Willow Grove, Pa. 19090.

Vertical blinds: Spice Buckwheat fabric slats, Levolor Lorentzen Inc., 1280 Wall St. W., Lyndhurst, N.J. 07071.

Kitchen accessories: Bloomingdale's, Stamford, Conn.; Styling: Gabe Herrick  
Room photos: Paul Kopelow; How-to photos: Robert Zuckerman

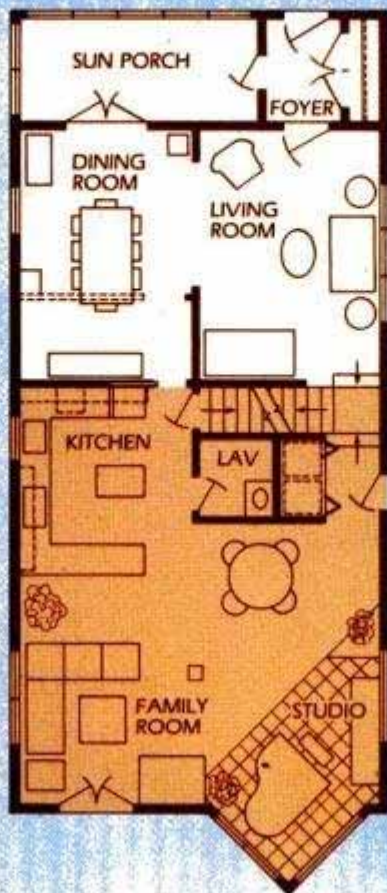


In this house, the family room separates the studio and kitchen. It's finished with horizontal pine wall paneling.





## Planning A New Addition



**B**efore approaching professional builders for help on their proposed addition, Lucia and Arnold Monahan formulated a clear idea of their needs, wants and abilities. They wanted a master bedroom and bath on the upper floor of the addition; a kitchen, lavatory, family room and music studio were planned for the first floor (see shaded area, above).

In addition, they wanted a light and airy space that would also be cozy in the evenings and on cold winter days. The space had to fit in with the traditional

styling of the rest of the home. To illustrate their preferences, they clipped magazine photos of rooms and spaces.

To reduce costs, the Monahans decided that they could tackle much of the finish work themselves. They made a list of those jobs they could handle—for example, painting, wallpapering, paneling and installing kitchen flooring. Arnold also did much of the plumbing and electrical work. With all this in mind and a preliminary budget, the Monahans consulted an architect. After discussions, they agreed on a plan and started work.—P.S.

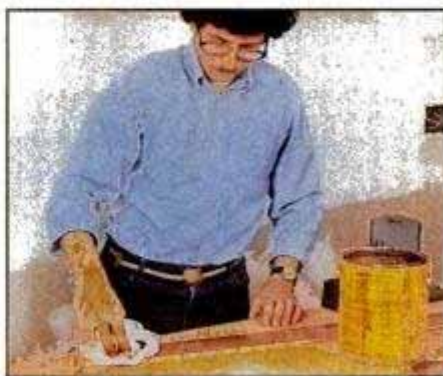
## HOW TO PANEL A WALL



Condition the paneling by stacking it in the room it will be installed in for 48 hours. Place spacers between layers. This minimizes expansion and contraction.



Stain the paneling, if desired, before installing it. Follow the maker's directions to brush the stain on the entire surface, including the tongue-and-groove edges.



Let the stain set the required amount of time, then wipe it off with a clean, dry, lint-free rag. This procedure will give the paneling a natural matte appearance.



# Introducing the Wagner® pan. Gets rid of the mess. And

Remember pouring out paint into an aluminum pan?

Remember stopping time and again, to dip a dripping roller?



Remember taking forever to finish a single room?

Well now you can forget about all of these things.

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empty an entire gallon.

And in just an hour or so, you can finish an average room.

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To help make painting easier still, there are a number of optional accessories.

There's a Power Roller handle extension, for painting the ceiling



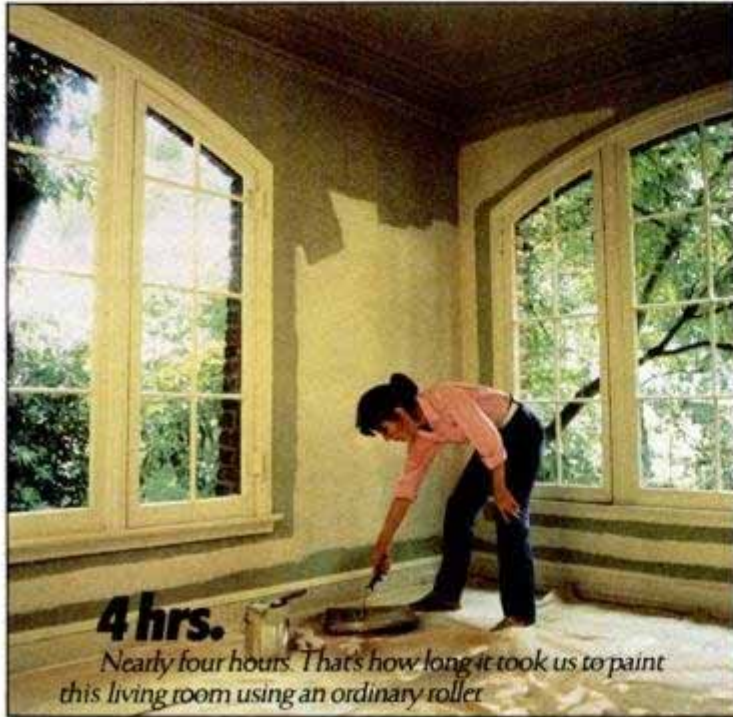
without using a ladder.

And an optional snap-on, spatter shield to work all but speckle free.

There's a Power Roller trim pad, for edging along corners and baseboards.



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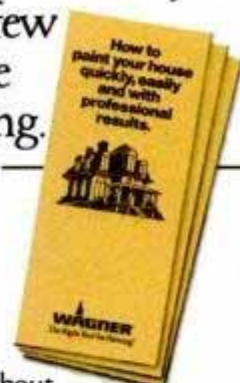
Cleanup is even simple.

The Power Roller is so easy to clean it does much of the work itself. All you do is fill up a can with water or common solvent, place it inside the Power Roller cannister, and turn it on. It'll not only rinse out the hose, but most of the paint from the roller as well.

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ing that needs to be done, do it with a Wagner Power Roller.

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## HOW TO FINISH NEW SPACE WITH STYLE

(Continued from page 116)



Accurate angle cuts are essential. Use a sharp crosscut handsaw and a miter box, a table saw or a radial-arm saw. Plane or sand rough-cut edges smooth.



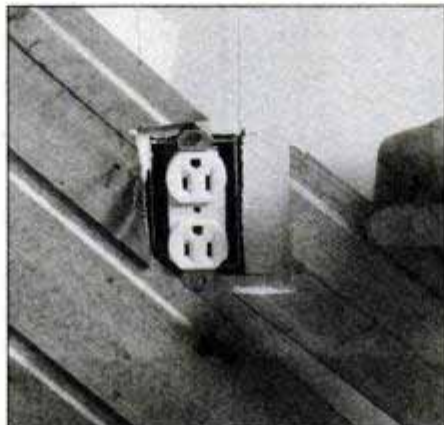
Diagonal installation starts with a triangular piece, tongue edge up, sloped 45°. Mark a guideline. Leave space— $\frac{1}{8}$  in. at sides,  $\frac{1}{4}$  in. at top and bottom of wall.



Apply a continuous  $\frac{3}{8}$ -in. bead of adhesive vertically to the gypsum board between studs spaced maximum 16 in. on center. Face nail at each stud with 4d nails.



When installing short pieces between window and corner, maintain the proper angle. An angle change would be evident farther up the wall where it widens.



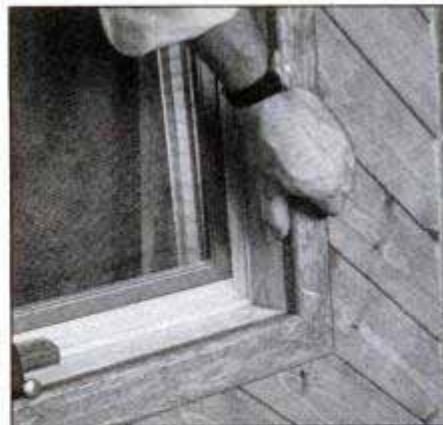
Cuts around outlets don't have to be precise—the edges will be covered by a wall plate. You may have to shim out the box to accommodate panel thickness.



Where a full length of a diagonal strip is longer than 8 ft., you must splice boards. Beveled cuts look the best. Make vertical joint over a stud and nail both pieces.



Paneling on one wall is completed and ready to receive finishing trim. Note that all panels are carefully positioned at the same angle. The ragged edges at top and bottom, made by joining unequal lengths of paneling, will be covered by trim. However, the variation in panel length cannot exceed the width of the finishing trim.



Mitered trim along the sides and bottom of the window cover inequalities in paneling length. Take care that the moldings are installed flush with the windowsill.

cover 21 $\frac{3}{4}$  sq. ft. You'll also need molding at the windows, ceiling, floor and corners to conceal spaces left for expansion and contraction.

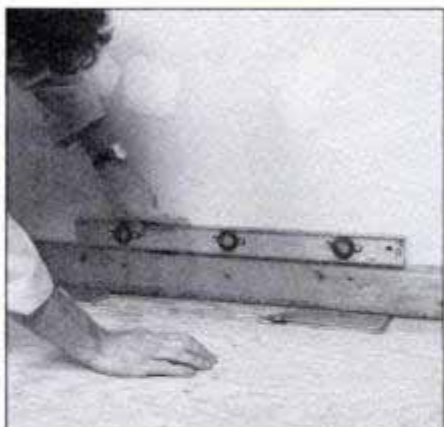
Use 4d finishing nails, or a nail length that penetrates 1 in. into the framing members. On the diagonal installation, we used a combination of nails and adhesive.

For a horizontal installation, you can face-nail the panel through the wall into the studs. On new walls, the studs are easy to locate by the spackle used to cover the nails that secure the gypsum wall board to the studs. On a wall that has been papered or painted, you must locate the studs by tapping or using a magnetic stud finder.

For a vertical installation, you should apply 1×3 furring spaced 16 in. on center horizontally across the studs. Nail the paneling to the furring.

If you plan on staining the panels, do so before installing them. Set and fill the nail holes with wood filler before applying a finish such as lacquer, varnish, shellac or polyurethane.





For horizontal installation, level the first course. Studs should be spaced a maximum of 16 in. on center. Leave wall space:  $\frac{1}{8}$  in. at corners,  $\frac{1}{4}$  in. at top and bottom.



Install paneling with 4d nails, tongue edge up. As you work, check frequently with a level. You can make small adjustments easily to keep the boards horizontal.



Nail vertical boards to horizontal furring strips spaced 16 in. on center. Use a carpenter's level to plumb the first panel. Leave space at corners, top and bottom.

## HOW TO INSTALL VINYL FLOORING



Following the floor plan used when buying the flooring, mark the layout on the material, adding several inches on all sides. The excess will be trimmed later.



Double-check the dimensions on the flooring with those of the floor it will cover. Then cut the flooring to its rough size. It is cut easily with household scissors.



Move the flooring into its intended room and fit it along the longest straight wall, allowing it to curve up the wall. It will also curve up against the other walls.



On an inside corner, locate the intersection and make a vertical upward cut. Tuck in the cut pieces. Make second and third relief cuts so that the flooring will lie flat.



At an outside corner, cut vertically so flooring can lie flat. Press one side in along the wall. Cut with a utility knife, leaving a  $\frac{1}{4}$ -in. gap between the vinyl and the wall.

### Installing vinyl flooring

In their kitchen, the Monahans installed Acclaim sheet vinyl flooring by Mannington Mills.

This vinyl flooring is designed for do-it-yourselfers, as it is very flexible, cuts easily with scissors and is installed without adhesive. It comes in 12-ft. widths and is priced at about \$10 per sq. yd.

Before buying vinyl flooring, make a dimensional floor plan of the room in which it will be installed, including counters, doorways and other obstructions. Take the floor plan as a guide when you purchase the flooring. At the same time, get seam tape and seam sealer (if needed) and any other supplies recommended for the particular flooring you select.

Gather the necessary tools before you begin the project. You'll need a



tape measure, straightedge or yardstick, scissors, utility knife and marker.

### Readying the room

Prepare the room by clearing all furniture and movable appliances. Remove and save thresholds, base molding and other trim on the floor.

Make sure your present floor is clean, dry and smooth. Acclimate the new flooring by keeping it at room temperature for several days before installation.

After you've installed the flooring, reinstall the base molding, nailing it to the wall, not the floor. Lay down plywood runners so that you can relocate the refrigerator and other heavy items. **PM**



It's a good idea to use scrap flooring as a thickness gauge at a doorway. Make a 1/8-in. notch in both sides of the casing. The vinyl flooring will simply slip into the notches.



To cut a curved entry area, use vinyl weatherstrip or other flexible material as a marking guide. Cut along the mark. Later, carpet molding butts the vinyl flooring.



To seam, overlap pieces 1/8 in. so pattern coincides. Cut through the overlap center with a utility knife, using a straightedge as a guide. Remove the waste strips.



Turn back the flooring at the seam. Place a strip of seam tape, sticky side up, under the seam and press flooring onto the tape. Then close the seam with seam sealer.



At a doorway, secure vinyl trim with contact cement, then cut flooring so it will tuck under the trim. Replace base molding at walls. Allow 1/8-in. clearance from floor.



Use plywood or hardboard runners to replace a refrigerator or heavy furniture. Glide or walk the piece back into position. Or move it with a rented appliance dolly.

## What's Available In Resilient Flooring

**W**hen it comes to resilient flooring, you have two choices: vinyl tile or vinyl sheet, according to Robert Marker at Armstrong. Once-popular linoleum, which couldn't be installed below grade and was subject to damage by grease, has been replaced by sheet vinyl. Vinyl tiles have replaced cork, rubber and asphalt tiles in the home. Vinyl-asbestos tiles, while still available, are decreasing in use.

Tiles usually come in 12 x 12-in. sizes, although some 9 x 9-in. tiles are available. They most often are backed with adhesive, so you simply peel off the paper and press the tile in place. Until the introduction of the lightweight, highly flexible vinyl sheet flooring, such as Mannington's Acclaim shown above, most do-it-yourselfers worked with tiles.

Sheet vinyl comes in 6- or 12-ft. widths. There are two different types of sheet vinyl: *rotogravure-printed vinyl*, in which the design is printed on and covered with a coat of clear vinyl, and *inlaid vinyl*, in which vinyl granules are placed in a pattern and consolidated by heat and pressure. Do-it-yourself sheet flooring is usually rotogravure printed, since this type is

lighter in weight, more flexible and easier to handle. It comes in 12-ft. widths. Often no seaming is needed. Inlaid vinyl, a heavier flooring, is usually installed professionally. It is available in 6-ft. widths.

Still another difference in sheet vinyl flooring concerns the no-wax feature. There are two kinds of no-wax flooring. A vinyl no-wax with a vinyl surface needs no wax to protect its surface. However, to maintain a gloss, waxing is recommended. On the other hand, a no-wax flooring with a urethane coat never needs wax, even to maintain its high gloss.

The latest news in sheet vinyl is the lighter, flexible flooring that can be installed without adhesive. You can tuck the flexible material into corners without creasing or cracking it. And it cuts with ordinary scissors; just leave a 1/4-in. gap between the flooring and the wall for normal expansion of the subfloor. This will be covered by base molding.

The range of prices in vinyl flooring is enormous. Flooring can be priced as low as \$5 to \$6 per yard and as high as \$40 per yard.—P.S.



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The Moto-Tool is available in several different models, including both adjustable and constant-speed versions. Each features a reliable motor, an assortment of useful accessories, and most models come with a rugged carrying case.

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# PRESTO!

## A New Look With Siding And Windows



House, before siding and window installation, needs attention.

Here's how to apply vinyl siding and replace a bay and other windows. They can do wonders for your home's appearance and energy efficiency.

BY PENELOPE A. SPANGLER, Assistant Home And Shop Editor





**W**hen it was time to paint his house last year, PM Electronics Editor Neil Shapiro didn't. He chose an alternative—to install vinyl siding. Since color goes entirely through the vinyl, his painting days would be over and maintenance would be minimal.

Neil selected solid vinyl siding by Celotex in a new almond color. Before siding, he replaced the old angle-bay and double-hung windows in his home.

The visual improvement on the house is overwhelming. And the projected energy and maintenance savings are just as attractive.

Most of the tools required for a vinyl siding job are already in your shop. One tool you should purchase when you buy the siding is a snaplock punch. It punches lugs or ears in the cut edges of vinyl siding so the siding can lock into vinyl trim. Another helpful tool is an unlocking tool. It's a hook that unlocks a panel that's already in position.

We wanted aluminum fascia trim to match the brown aluminum gutters. That meant renting an aluminum brake to shape aluminum coil. The brake rests on sawhorses and is operated manually. In our area, the brake rents by the day (\$25), week (\$75) or month (\$225). However, using preshaped vinyl trim eliminates the need for a brake. Scaffolding is needed on houses higher than one story. You can also rent this.

In figuring a bill of materials, begin by calculating the siding needed. Add the square footage of all walls, subtract the square footage of the doors and windows and add 10 percent for waste. Siding comes in squares. Each square is 100 ft. of siding. This house required 20 squares.

For energy conservation, you should consider installing insulation boards over the existing wall before re-siding. Order the same amount of insulation as you order siding. If you plan on siding

the soffits, you will also need soffit panels. It's figured in square feet.

There are many different types of accessories that you can use, depending on the house structure. Some that you'll definitely need include outside corners, starter strip, J-channel and finish trim. You may also need soffit channel and inside corners. Accessories are figured by the running foot. It is important that you order them properly sized for the siding panels to provide a snug, weatherproof fit. Nails should be aluminum, or at least galvanized or electroplated. They should be long enough to penetrate  $\frac{3}{4}$  in. into the

**Vinyl siding:** Celotex Corp., Box 22602, Tampa, Fla. 33622.

**Angled bay window:** Andersen Corp., Bayport, Minn. 55003.

**Double-hung windows:** Kasson & Keller Inc., Florida, N.Y. 12068.

**Technical assistance:** Mipat Construction, Bethpage, N.Y. 11714.

**Photographs:** Steve Fay



New bay and double-hung windows are in place. Rigid insulation and siding have been installed on the first floor. Scaffolding will be needed to work on the second floor.



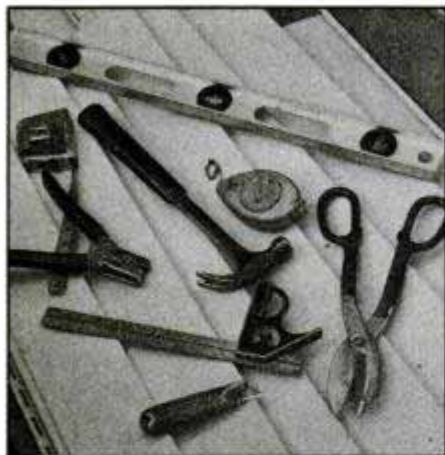
Siding is applied above the raised deck in the back of the house. Note that the seams of the rigid insulation are offset.



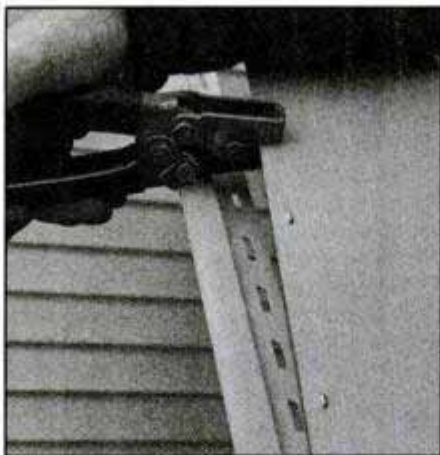
A close-up of the completed job shows almond siding with trim around the double-hung window, new soffit overhead.



## Installing Vinyl Siding



Tools include a spirit level, rule, snaplock punch, hammer, chalkline, tin snips, square and utility knife. A fine-tooth power saw (no set, 12 to 16 teeth per in.) helps.



The snaplock punch forms ears or lugs in the cut edges of siding used for the top course and around the openings. The punched edge locks into undersill or finish trim.

framing or other reliable substrate.

Before you start siding the house, secure and nail any loose boards. Remove downspouts, lighting fixtures, shutters, molding and old caulking around windows and doors. Use furring strips for sidewalls that aren't plumb. Make sure there is adequate attic and crawl-space ventilation and that there are no moisture problems.

As you work with vinyl siding, keep these points in mind:

- Vinyl siding expands and contracts with the temperature. It must be able to move without binding on the installation nails or against the trim.

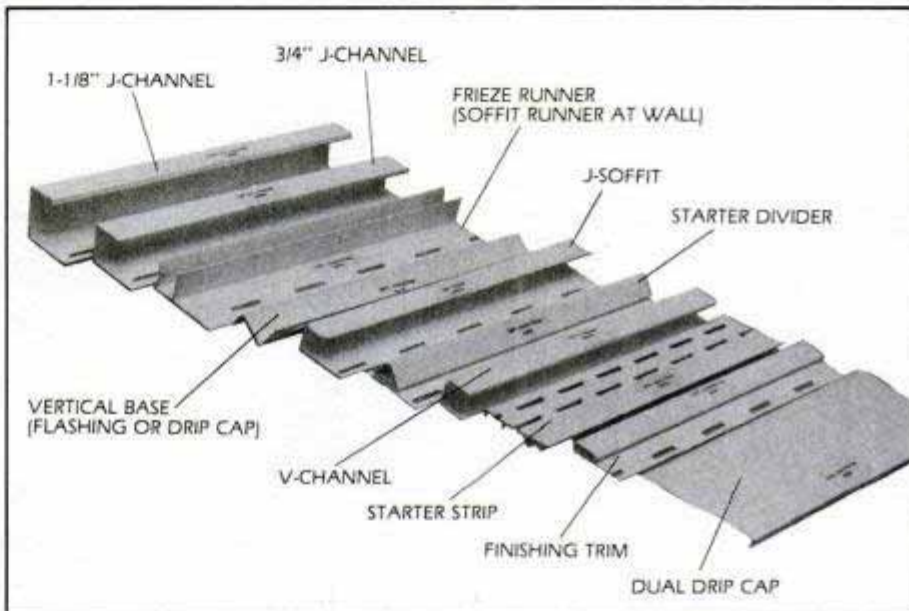
- Nail in the center of the slot, but not too tight so that it prevents lateral expansion.

- Don't stretch the panels vertically or the end laps will gap.

- Don't nail closer than 10 in. to the



To match the brown aluminum gutter and downspout, we bent an aluminum fascia to shape with an aluminum brake. Preshaped vinyl fascia eliminates need for brake.



The vinyl accessories shown are designed to give the project a finished look and to make weather-resistant joints. Inside and outside vinyl corner posts are also needed.



After installing rigid insulation, snap a chalkline for the starter strip parallel to the top of the foundation wall. Before snapping, check line with a spirit level.



Nail starter strip in place with corrosion-resistant nails. Leave a 1/4-in. gap between strip and corner post for expansion. Use nails that will go 3/4 in. into framing.



Install outside and inside corner posts before beginning to side. Nail posts on 12-in. centers in the center of the slots, but not too tight to prevent lateral expansion.



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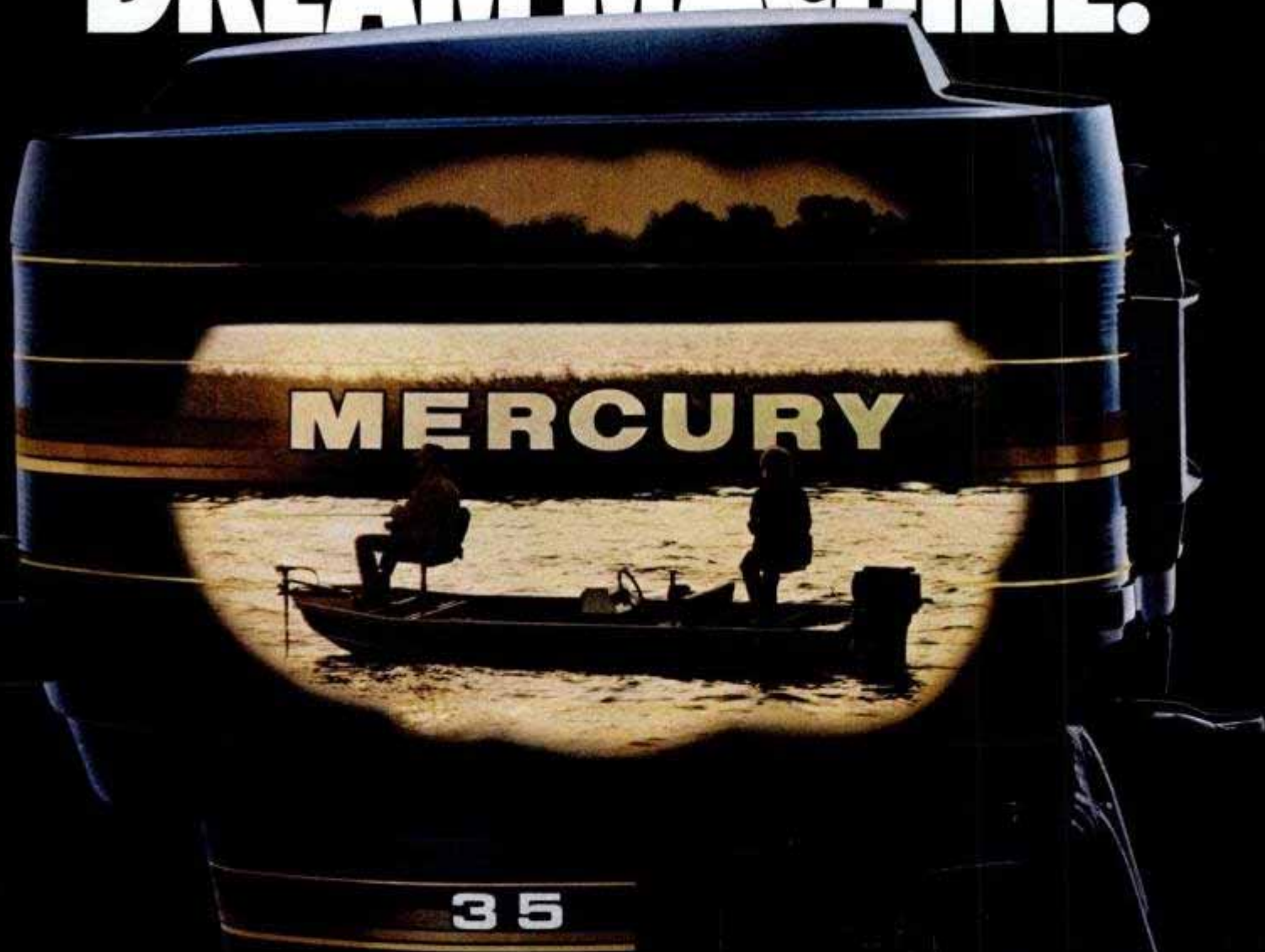
And behind every Merc stands the Mercury Outboards System, the marine industry's strongest manufacturer-to-dealer-to-customer network ever. From the newest technology, to dealers who help you buy right, The System keeps Mercury owners satisfied.

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# **DREAM MACHINE.**



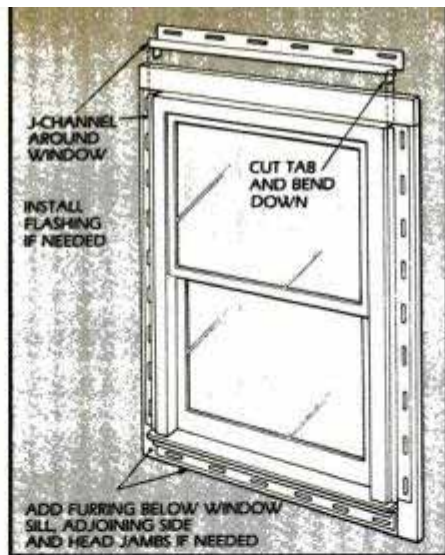
**MERCURY  
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The possible dream.





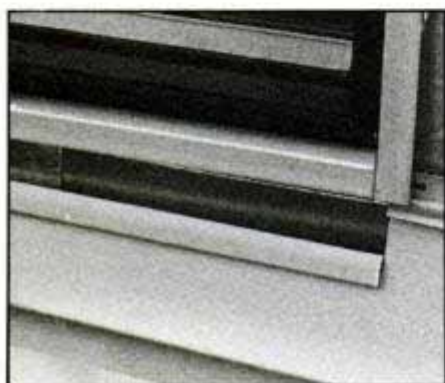
Install the first panel into the interlock of the starter strip. Make sure it's securely locked. Nail every 12 to 16 in., but not so tight that panels can't move.



After installing flashing at the head (if not already flashed), outline the window with J-channel. You may first have to fur around the window to align panel surfaces.



Measure the cutout for the panel that goes under the window. Then cut the panel to opening width, score the panel with a utility knife and snap out the section.



Punch lugs into the cut edge of the siding with a snaplock punch. Then lock a length of finish trim over the cut edge. Here, panel is ready to lock into J-channel.



Lock the finish trim into the J-channel and nail through the slots. At the window head, again cut siding, punch the cut edge, add finish trim and install in J-channel.



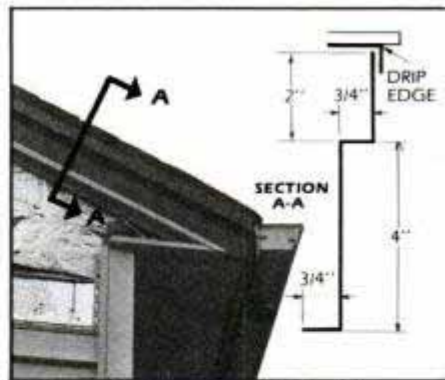
Panel over the garage door is also cut. Lap field cuts under factory ends, but avoid vertical joint alignment. Use scaffolding on a house two or more stories [see text].



To provide a tight seal around a faucet or other protuberance, seam together two pieces of siding with cutout. With ends overlapping, center seam on object.



Nail soffit channels at the wall and at the fascia edge. A punch helps, but don't nail too tight. Cut soffit panels 1/8 in. shorter than the distance between channels.



We bent aluminum [see drawing] to cover the rake fascia. J-channel is installed below the aluminum fascia. It will hold the finish trim, which covers top courses.

end of an overlapping panel to produce neat end laps. Lap panels 1 1/2 in. after cutting off the nailing flange so there is a gap (1/8 in. per 4 ft.) between adjacent panels.

After preparations are made and the insulation is secured following the maker's directions, begin work by snapping a chalkline to position the starter strip. It's nailed in place about 1/4 in. from the corner-post flange. The corner post sets into a length of J-channel with a 90° cutout taken from the center of the nail-

ing flange so you can bend the channel to form a corner. The toughest part of siding is fitting panels at openings.

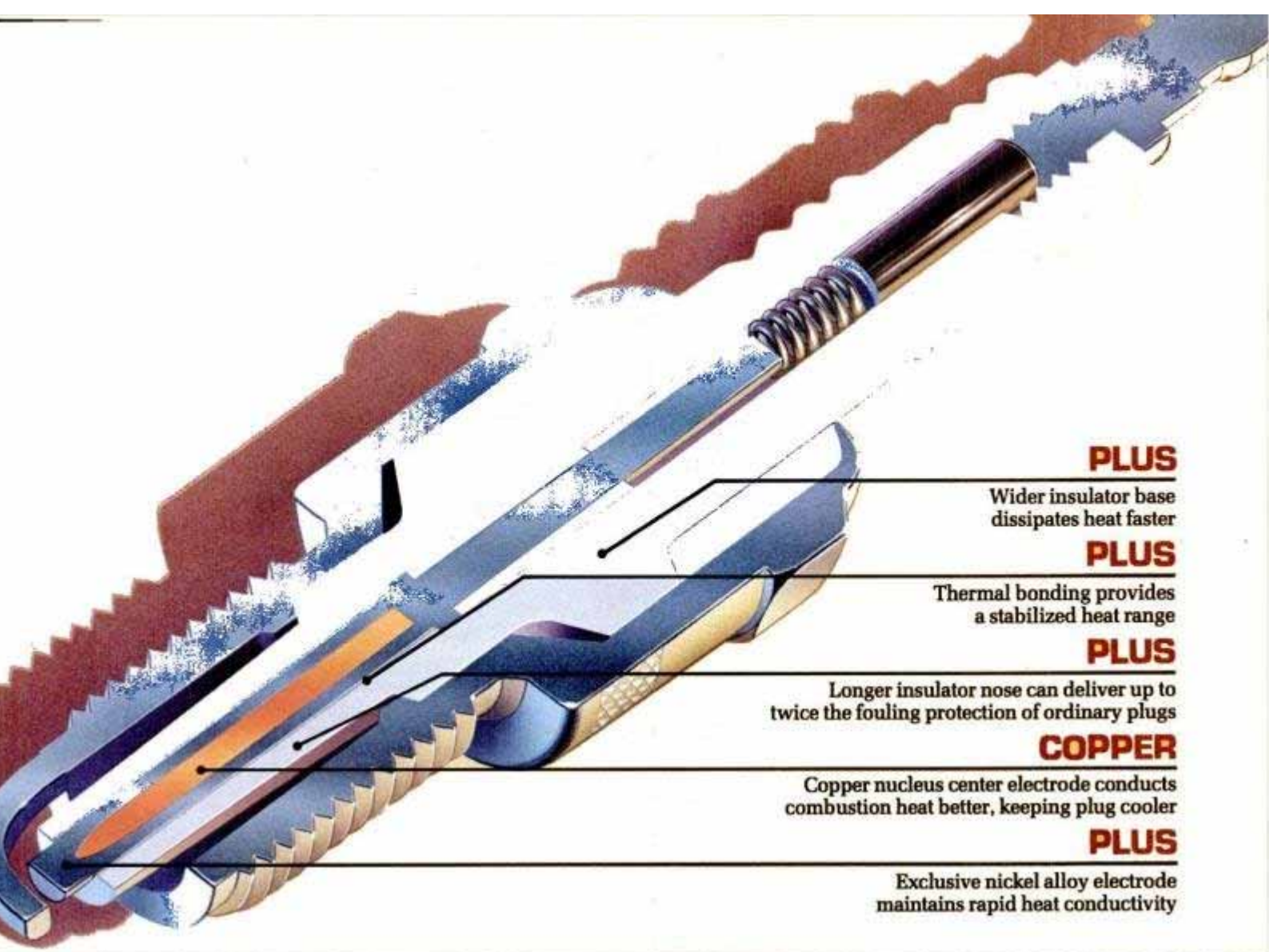
Unless you have a one-story house, you'll want to rent scaffolding. Professionals use a pump-jack-type scaffolding. However, the safest type for a homeowner is a stationary steel-platform-type scaffolding. You can rent this by the week or month. When you go to the rental outlet, have snapshots of the four sides of your house, or a plan drawing. Note length and height of the

walls. The salesperson can help determine what you'll need. He should also provide you with information on safe usage, including a copy of safety codes, such as those developed by the Scaffold Industry Assn. Use care when working on scaffolding.

### Installing new windows

Before applying vinyl siding on the house, we installed an angled bay window in the front brick wall. The window came as a single unit, composed of





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Copper nucleus center electrode conducts combustion heat better, keeping plug cooler

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Exclusive nickel alloy electrode maintains rapid heat conductivity

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These design improvements, in conjunction with copper, allowed us to lengthen the spark plug's insulator nose. Which resulted in vastly improved fouling protection.

The combined effect of all our improvements produced a plug that delivers surer starts and superior performance in stop-and-go driving. It also produced one performance feature unique to Copper Plus®—we're so confident that Copper Plus will make your engine run better, we've equipped it with

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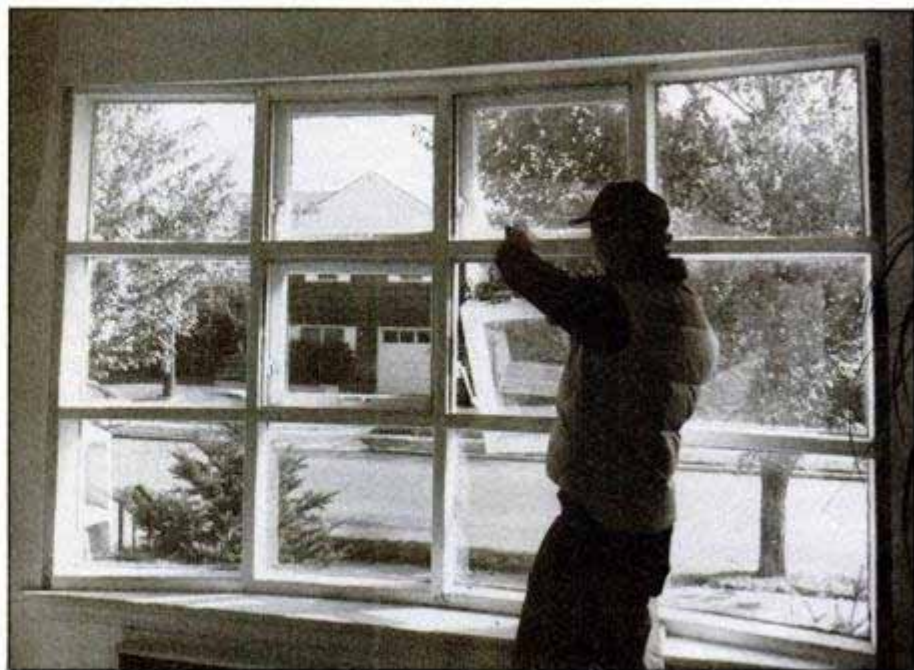
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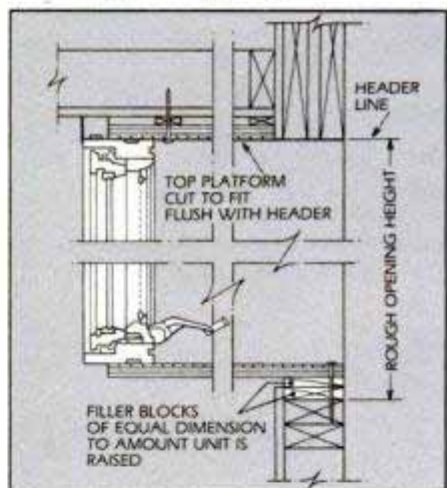
## Replacing An Angled Bay Window



Work from indoors to remove the old window. First, dismantle the inside casing molding and any operable panels. Then use a sabre saw to cut through the fixed window frame. Wear gloves and eye protection when you are removing the old glazing.



If needed, install 2x4 fillers on all sides. First install 2x4s at top and one side only before hoisting the window in place. This allows space to maneuver the window unit.



If you must raise the window above header to meet soffit, cut top platform to clear the header. Add filler blocks at the sill plate. Fill any voids with insulation.



Check that the window is centered in the opening and is plumb and level. Shim as needed. Bolt through top and bottom platforms with 3-in. No. 16 bolts every 8 in.



Use the headboard as a template to cut rigid insulation for head and sill platforms. Notch the insulation to accommodate 1/4-in. nailing blocks for headboard and seatboard.



Andersen's Perma-Shield casement windows with top and bottom plywood platforms to provide rigidity and to help close in the top and bottom of the unit. It also came with pine veneer head and seatboards and pine extension jambs.

To find the right size window unit, remove the inside casing of your present bay window to reveal the rough opening—header, sill plate and side jamb studs. Measure the width and height of the rough opening. The overall width of the replacement unit for an



Dismantle the window down to the rough opening. After the glazing and frame are removed, use a pry bar to remove the stool and apron so the wall won't be damaged.

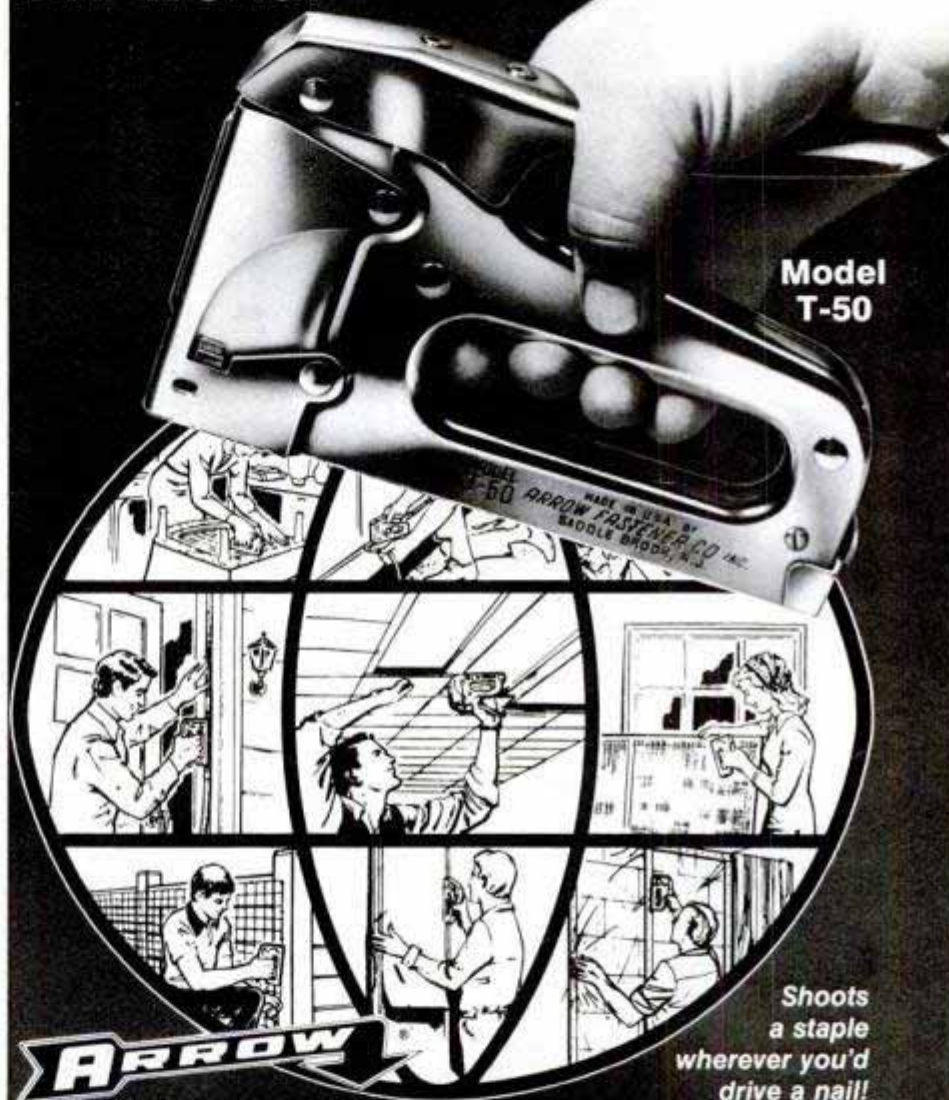


Four people hoisted the unit and one person secured it. To keep it from falling outward, we bored a hole in top platform and tied a rope, which we held indoors.



Install jamb extensions that come with the window. Rip or plane flush with the wall as needed. If your window needs exterior knee braces, install at mullion posts.

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Model  
T-50

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

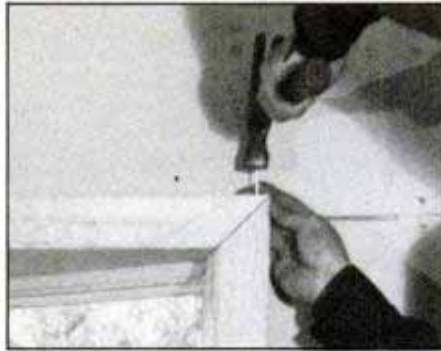
**ARROW FASTENER COMPANY, INC.**

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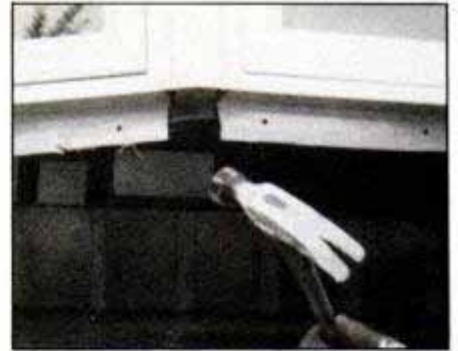




Install the finished headboard and seat-board by nailing through the extension jamb. Fill gaps at jambs with batt insulation. Don't force insulation into the spaces.



Install the furnished inside stops and mullion casing. Cut clam casing trim to size with mitered corners. To keep joints closed, apply white glue before nailing.



Outside, under the mullion posts, we secured 2x4 supports between the unit and brick. Add blocking around outside edge of lower platform, caulk and nail finish trim.

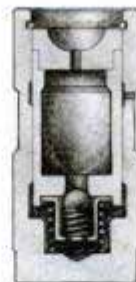


View shows unit without trim. To finish the top of the window, we screwed 2x4s into the rough head to serve as cleats. Then we installed 1/2-in. plywood flush from window flange to soffit.



We ripped 2x4s to size for side fillers and nailed them in place. Then we nailed furnished angled side flanges. We bent aluminum to cover the wood trim and secured it with finish nails.

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a Scott Fetzer company

installation in brick should be as close as possible to the rough opening, plus 7/8 in. Overall height should be the closest size smaller than the opening.

You must adequately secure the top platform through the headers and soffit. For additional support, install knee braces or support brackets below each mullion post.

To prepare the window unit for

installation, cut off the vinyl side flanges with a sharp knife, leaving 3/8-in. tabs for a 30° angled bay. Also, miter each end of the auxiliary casing 15°. Prebore pilot holes for 1 1/2-in. No. 8 wood screws. These holes will be used later to help secure the window to the rough opening.

Perhaps the most time-consuming part of the installation is removing the

old window down to the rough opening. Work indoors to remove the old unit. It is best to remove the old glass before attempting to remove the frame. Otherwise, twisting the frame during removal will cause the remaining glass to break. Wear gloves and eye protection while removing the old glazing. After removing operable panels, drape an old

*(Please turn to page 135)*

## Replacing A Double-Hung Window



Remove Phillips-head screws on flange that holds window sash. Slip out sash. If working on a wood window, remove inside trim and lift out lower and upper sash.



Aluminum storms are out of level and must be removed as one unit. Pound gently with a hammer cushioned by a wood block and use a pry bar to force out the unit.



From outside, remove the exterior wood casing frame and aluminum trim. Remove the jamb frame of the primary window to expose the side jamb studs and header.



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Inside, remove the stool so as not to damage the walls. Since we were going to replace stool, we split it down the center and pried it off. Remove apron molding.



Check the rough opening with a spirit level to see if shims must be used. If needed to receive new window, frame in to the correct rough opening with spacer blocks.



Open the window to carry and position it. Set the window in the center of the rough opening. Once it is in position, close and lock the window before leveling it.



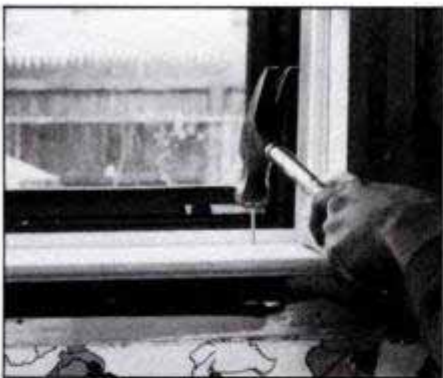
Check the unit with a spirit level; then shim corners (jamb horns), which are areas of great stress. Screw through side jamb (or nailing flange) to the rough opening.



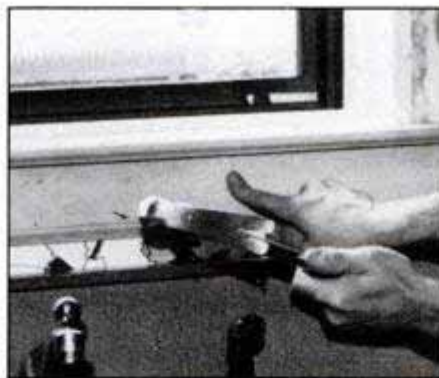
Extend jambs as needed to bring them out flush with the wall. In this case, we ripped 1x3 down to 3/4 x 1 1/4 in. and nailed it to the jamb with 8d finishing nails.



Install batt insulation to fill any gaps between the jamb and the rough opening. Don't force insulation into the gaps because the window may begin to bow.



Cut a window stool to accommodate the new window, or reinstall the old one. Stool molding is available in several widths. Install it using 8d finishing nails.



You should install the apron molding with 8d finishing nails. Then check to make certain that the stool is level and that it doesn't tilt in any direction.



Cut head casing molding. Molding should be set back from the jamb edge. Use white glue at joints, 4d finishing nails at thin edge and 8d finishing nails at thick edge.

## PRESTO! A NEW LOOK

*(Continued from page 133)*

blanket outdoors over the window before hammering out panes to keep broken glass corralled. The actual installation requires several helpers.

Replacing old double-hung windows in this house should lower the heating bills considerably. The window we used is Kasson & Keller's Omni aluminum double-glazed storm combination. An insulated window combined with a

storm window provides optimum insulation. The aluminum unit was selected for its special thermal barrier between interior and exterior frame parts, which reduces cold-air transfer. The glazing is Solakleer, a low-iron glass that allows 16 percent more sunlight indoors than does standard glass, according to its makers.

The best way to determine the proper size replacement window is to remove the inside trim and measure the rough window opening. The manu-

facturer of the window you select will have a list of the proper sizes of windows to purchase for specific rough openings. You can frame in a rough opening for a smaller size window.

Since we applied new siding to the house, we built up the exterior around the rough opening for the new window so that it was flush with the old siding. Then we sealed the window frame perimeter with caulk. If you're not installing siding, then install outside casing with 10d galvanized nails. **PM**



# Build PM's Multipurpose Wall Cabinets



These cabinets accommodate a wide variety of entertainment equipment, including a slide projector on a center pull-out shelf.

**A**s promised last month in our story *The Rediscovered Basement*, here are the built-in cabinets which defined the central wall of our conference room.

These cabinets were designed with both form and function in mind: We wanted a clean, contemporary appearance and plenty of room to accommodate a generous sampling of today's popular home entertainment equipment.

Included were two tape decks, a stereo receiver and speakers, a turntable on a sliding shelf, a television, and a slide projector on a pull-out section of the countertop that allows for convenient image projection on an adjacent wall. All this—and there was still room left over for storing records, tapes, books and other items.

## Construction steps

Begin by making the base for the lower cabinets. Cut the plywood and the supports to size, then screw the front plywood rail to the face of the front support. Next, screw the

The clean, modern design of these built-in cabinets satisfies a host of storage and entertainment needs.

BY STEVEN WILLSON  
AND STEVE FAY

plywood base to the top of the front support as shown in the drawing on the facing page. If your base is over 8 ft. long, the platform must be built from two pieces of plywood, spliced in the middle as shown in the first photo on page 139.

Cover the base top and front with plastic laminate, using contact cement. Carefully follow the directions on the container of the cement you use. If you

want to duplicate the laminate colors we used, they are: Formica No. 917, Tidal Sand, on the platform base and on the upper and lower cabinets; and Formica No. 907, Smoked Hickory, on the countertop.

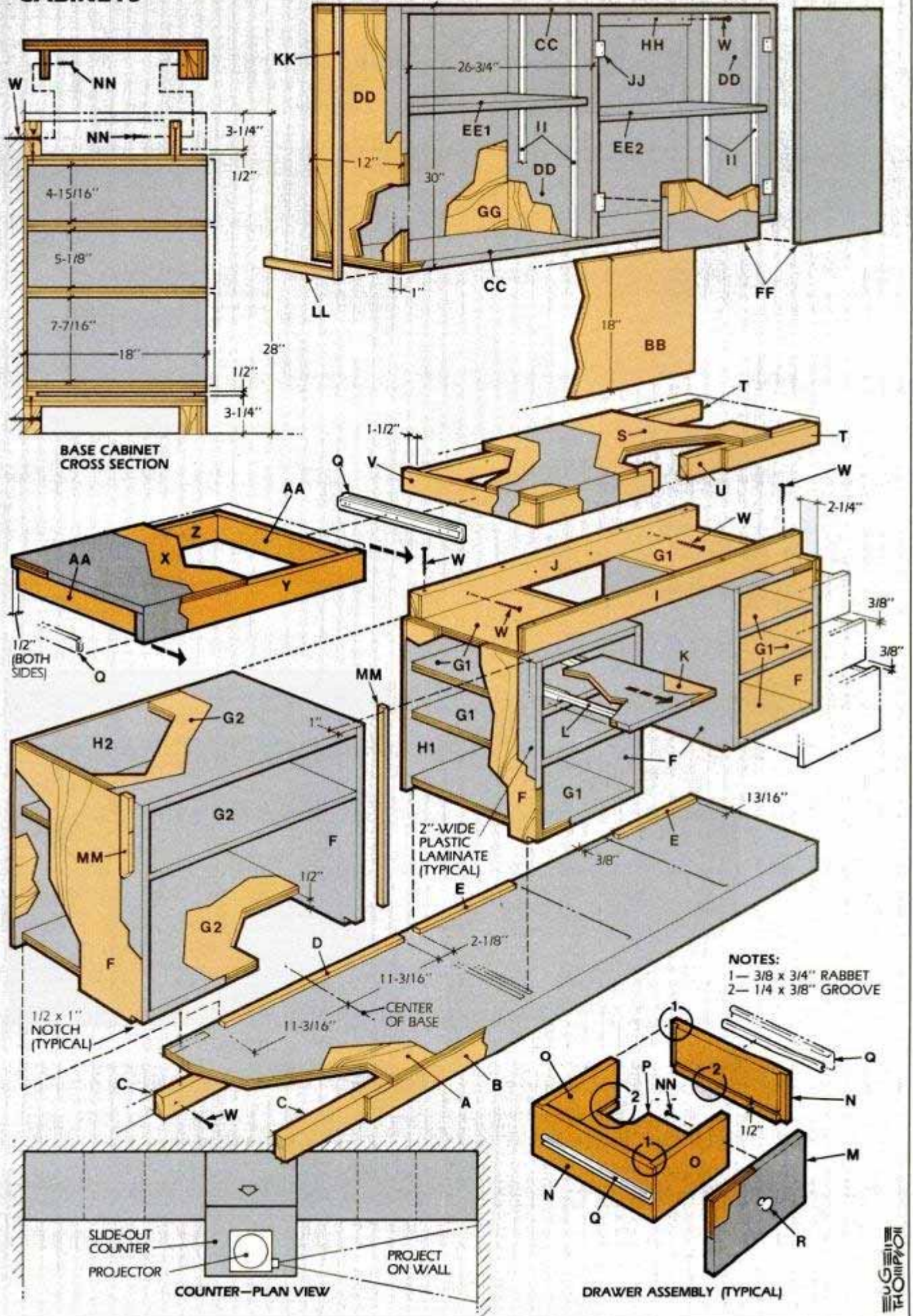
Next, attach the rear base support to the room wall by driving 3½-in. No. 10 flathead screws through the support and into the wall studs. Make sure this support is installed level.

Place the finished base over the rear support and attach it with screws driven down through the base and into the support. Position these screws so they'll be covered by the cabinets later.

*(Please turn to page 139)*



# CABINETS



**NOTES:**  
 1— 3/8 x 3/4" RABBET  
 2— 1/4 x 3/8" GROOVE





# VICTORY AT SEA.



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Because cabinet base is longer than one plywood sheet, it must be assembled from two pieces. Join halves together with a splice block installed below the plywood.



Assemble cabinet "box," then cut shelf and cover with laminate. Position shelf with scrap blocks clamped as shown; attach with screws driven through sides into shelf.



Assemble countertop parts and position on cabinets to check for fit and operation of sliding shelf. Do not attach. When you're satisfied, remove and cover with laminate.

### Building in a 'recess'

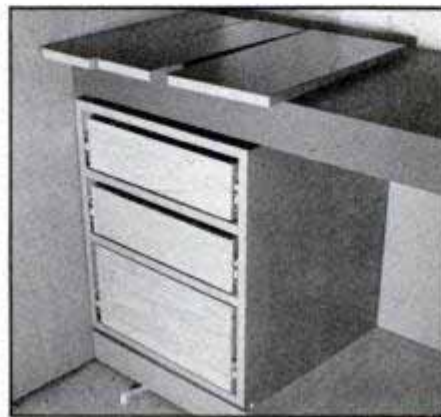
Cut all the base cabinet sides, bottoms, tops and backs to size. Be sure to cut the  $\frac{1}{2}$  x 1-in.-deep notch at the bottom front corner of all the sides. This "recess," and the  $\frac{1}{2}$ -in.-wide space between the three middle cabinets and between the cabinets and the countertop, are design features. They yield a shadow line between all the units that make the cabinets appear to float.

Apply laminate to the inside surfaces of all the cabinet parts and to the front edges that are exposed to view. Assemble with countersunk  $1\frac{1}{4}$ -in. No. 10 flathead screws driven through the sides into the edges of the tops and bottoms. Make sure each cabinet is square before installing the back. At this point, determine the number and position of the shelves you want. Then, cut the shelves to size and apply laminate to the top and front edge of each. Install with countersunk screws through the sides and into the shelf edges.

Once the shelves are installed, cover the outside cabinet surfaces with laminate as indicated on the drawing.

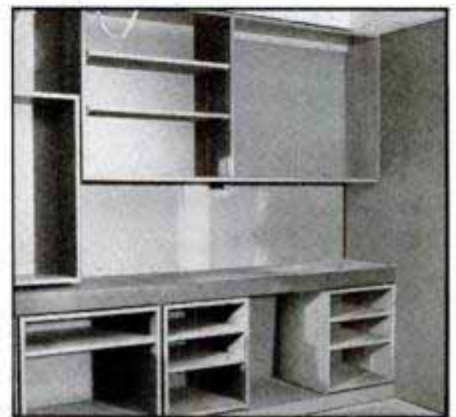
The cabinets which border on the open speaker areas should have laminate over the entire exposed side. On the cabinets that join directly to each other, all that's required is a 2-in. strip on the sides to cover the plywood that's visible in front of the recessed spacer cleats. A 2-in.-wide strip is also applied to the cabinet tops, except on the center cabinet. It should be covered entirely with laminate so that when the slide projector shelf is pulled out, the plywood will not be visible.

Build the drawer cabinets and drawers as shown, then install the drawers, using full extension slides. These cabinets were designed so the drawer side edges would be set in  $\frac{3}{8}$  in. from the perimeter of the cabinet and with a  $\frac{3}{8}$ -in. space between each drawer front. It's not necessary to cover the inside surfaces of the drawer cabinets with laminate.



Assemble drawer parts and install with drawer slides. Cover drawer front with laminate, then attach with screws driven through inside face of false drawer front.

Now, determine the best position for your cabinets along the platform base—or use the positions we indicate—and install the cleats (Parts D and E on the drawing). These cleats



Upper cabinets were designed to fit flush to side walls and ceiling. Install one unit, then position the other on the countertop to find width of spacer cleats KK and LL.

keep the individual cabinets from shifting side-to-side without the need for actually joining them to the base.

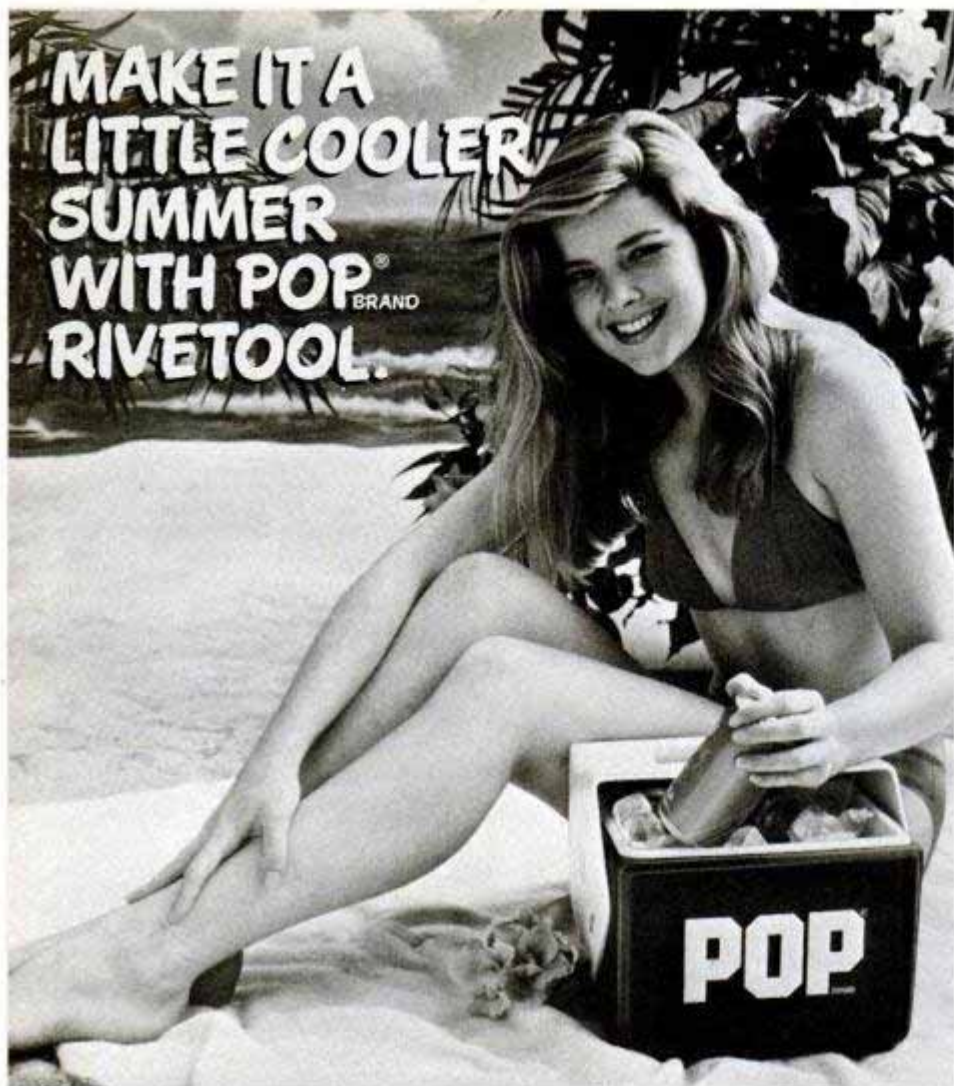
Cut a panel from  $\frac{1}{4}$ -in.-thick plywood to back up the open speaker areas, and

### MATERIALS LIST—CABINETS

Key	No.	Size and description (use)	Q	7 pr.	16" Grant No. 328 drawer slide
A	1	$\frac{3}{4}$ x 18 x 121" plywood (base)	R	6	Stanley No. 4482 drawer pull
B	1	$\frac{3}{4}$ x 2 $\frac{1}{2}$ x 121" fir (rail)	S	2	$\frac{3}{4}$ x 18 x 48 $\frac{1}{2}$ " plywood (countertop)
C	2	$1\frac{1}{2}$ x 2 $\frac{1}{2}$ x 121" fir (support)	T	4	$\frac{3}{4}$ x 2 $\frac{1}{2}$ x 47 $\frac{3}{4}$ " plywood (front, rear rail)
D	1	$\frac{1}{2}$ x $\frac{3}{4}$ x 22 $\frac{3}{8}$ " fir (cleat)	U	2	$1\frac{1}{2}$ x 2 $\frac{1}{2}$ x 47 $\frac{3}{4}$ " fir (cleat)
E	4	$\frac{1}{2}$ x $\frac{3}{4}$ x 14 $\frac{3}{8}$ " fir (cleat)	V	2	$\frac{3}{4}$ x 2 $\frac{1}{2}$ x 18" plywood (end rail)
F	10	$\frac{3}{4}$ x 17 $\frac{3}{4}$ x 21" plywood (cabinet side)	W	*	$3\frac{1}{2}$ " No. 10 fh screw
G1	15	$\frac{3}{4}$ x 14 $\frac{1}{2}$ x 17 $\frac{3}{4}$ " plywood (small cabinet top, bottom, shelf)	X	1	$\frac{3}{4}$ x 18 x 23 $\frac{3}{8}$ " plywood (countertop)
G2	3	$\frac{3}{4}$ x 17 $\frac{3}{4}$ x 22 $\frac{1}{2}$ " plywood (large cabinet top, bottom, shelf)	Y	1	$\frac{3}{4}$ x 2 $\frac{1}{2}$ x 23 $\frac{3}{8}$ " fir (front rail)
H1	4	$\frac{1}{4}$ x 16 x 21" plywood (small cabinet back)	Z	1	$\frac{3}{4}$ x 2 $\frac{1}{2}$ x 21 $\frac{1}{4}$ " fir (back rail)
H2	1	$\frac{1}{4}$ x 21 x 24" plywood (large cabinet back)	AA	2	$\frac{3}{4}$ x 2 $\frac{1}{2}$ x 17 $\frac{1}{4}$ " fir (side rail)
I	2	$\frac{3}{4}$ x 3 x 47 $\frac{1}{4}$ " fir (cleat)	BB	1	18 x 121" burlap-covered fiberboard
J	2	$1\frac{1}{2}$ x 3 x 47 $\frac{1}{4}$ " fir (cleat)	CC	4	$\frac{3}{4}$ x 11 $\frac{3}{4}$ x 60 $\frac{1}{4}$ " plywood (cabinet top, bottom)
K	1	$\frac{1}{2}$ x 14 $\frac{1}{4}$ x 16" plywood (turntable base)	DD	6	$\frac{3}{4}$ x 11 $\frac{3}{4}$ x 28 $\frac{1}{2}$ " plywood (cabinet end, divider)
L	1 pr.	14 $\frac{1}{2}$ " Grant Model A Record Player Slide	EE1	3	$\frac{3}{4}$ x 11 $\frac{1}{2}$ x 26 $\frac{1}{4}$ " plywood (open cabinet shelf)
M1	4	$\frac{3}{4}$ x 5 $\frac{3}{8}$ x 15 $\frac{1}{4}$ " plywood (small drawer front)	EE2	2	$\frac{3}{4}$ x 11 $\frac{1}{2}$ x 30 $\frac{3}{4}$ " plywood (closed cabinet shelf)
M2	2	$\frac{3}{4}$ x 7 $\frac{1}{8}$ x 15 $\frac{1}{8}$ " plywood (large drawer front)	FF	4	$\frac{3}{4}$ x 15 $\frac{3}{4}$ x 29 $\frac{1}{4}$ " plywood (door)
N1	8	$\frac{3}{4}$ x 4 $\frac{1}{2}$ x 17 $\frac{1}{2}$ " plywood (small drawer side)	GG	2	$\frac{1}{4}$ x 30 x 60 $\frac{1}{4}$ " plywood (back)
N2	4	$\frac{3}{4}$ x 7 x 17 $\frac{1}{2}$ " plywood (large drawer side)	HH	2	$\frac{3}{4}$ x 1 $\frac{1}{2}$ x 31 $\frac{1}{4}$ " fir (cleat)
O1	8	$\frac{3}{4}$ x 4 $\frac{1}{2}$ x 12 $\frac{3}{4}$ " plywood (small drawer false front, back)	II	16	28 $\frac{1}{2}$ " shelf standards, with 32 support clips
O2	4	$\frac{3}{4}$ x 7 x 12 $\frac{3}{4}$ " plywood (large drawer false front, back)	JJ	4 pr.	Hinge-A-Matic No. 591-26 self-closing, overlay door hinge
P	6	$\frac{1}{4}$ x 12 $\frac{3}{4}$ x 16 $\frac{3}{4}$ " plywood (bottom)	KK	1	$\frac{1}{2}$ x $\frac{3}{4}$ x 30" fir (spacer)
			LL	1	$\frac{1}{2}$ x $\frac{3}{4}$ x 10 $\frac{1}{4}$ " fir (spacer)
			MM	2	$\frac{1}{2}$ x $\frac{3}{4}$ x 21 $\frac{1}{2}$ " fir (spacer)
			NN	*	$1\frac{1}{4}$ " No. 10 fh screw

\*As required.





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cover it with laminate. Make it slightly wider than the opening so that when the cabinets are attached to the wall it will be held in place. If you want to avoid the expense of making these panels, simply paint the rear wall with a color to match the laminate.

Place the lower cabinets on the base, starting with the end cabinets. Then position the middle cabinet. Cut the spacers (part M) to size, cover their front edge with laminate and screw to the side of the middle cabinet as shown. Place the last two cabinets on the base.

Install the countertop cleats (parts J and I) across the cabinet tops. Then attach the rear cleat to the wall, making sure to hit at least two studs per cleat. Build and laminate the stationary countertops as shown. Be sure to cover the ends of these tops with laminate, too, so that when the slide projector section is pulled out, all the edges will be finished. Install the counters by screwing the rear rail (part T) to the rear cleat (part J). Do this in the open speaker area where both boards are accessible from underneath.

Now, take the measurement between these tops to determine the actual size needed for the slide-out top. You should plan on having two 1/8-in.-wide gaps between the three tops after the laminate is installed. Build the sliding top and install it with full extension slides hung on the sliding top and the ends of both fixed tops.

Next, construct the upper cabinets as shown. Both cabinets have one open and one closed section built with a common back. We installed adjustable shelf standards in all compartments. If you prefer fixed shelves, proceed as explained for the base cabinets earlier.

**Adding the upper cabinets**

When the upper cabinets are complete, install one, using the hanging cleat (part HH). Be sure to hit at least two studs in the length of the cleat. Position the other cabinet on the countertop or brace it in position at the proper height, and measure the distance between the cabinets.

Cut the spacer cleats (parts KK and LL) to match this dimension, cover the front edge with laminate, then remove the second cabinet and attach the strips to the installed cabinet. This method will yield a tight, professional fit.

Now install the second upper cabinet and hang all the cabinet doors. Instead of using door pulls, we routed out a 3/8-in.-deep by 3-in.-long section of the bottom, back door edge to use as a finger grip.

To finish the job, just paint the wall behind the cabinets and countertop, or install panels of burlap-covered fiberboard as we did. **PM**



# Surround Your Tub With Tile

Here's PM's step-by-step guide to installing ceramic tile around your bathtub or shower.

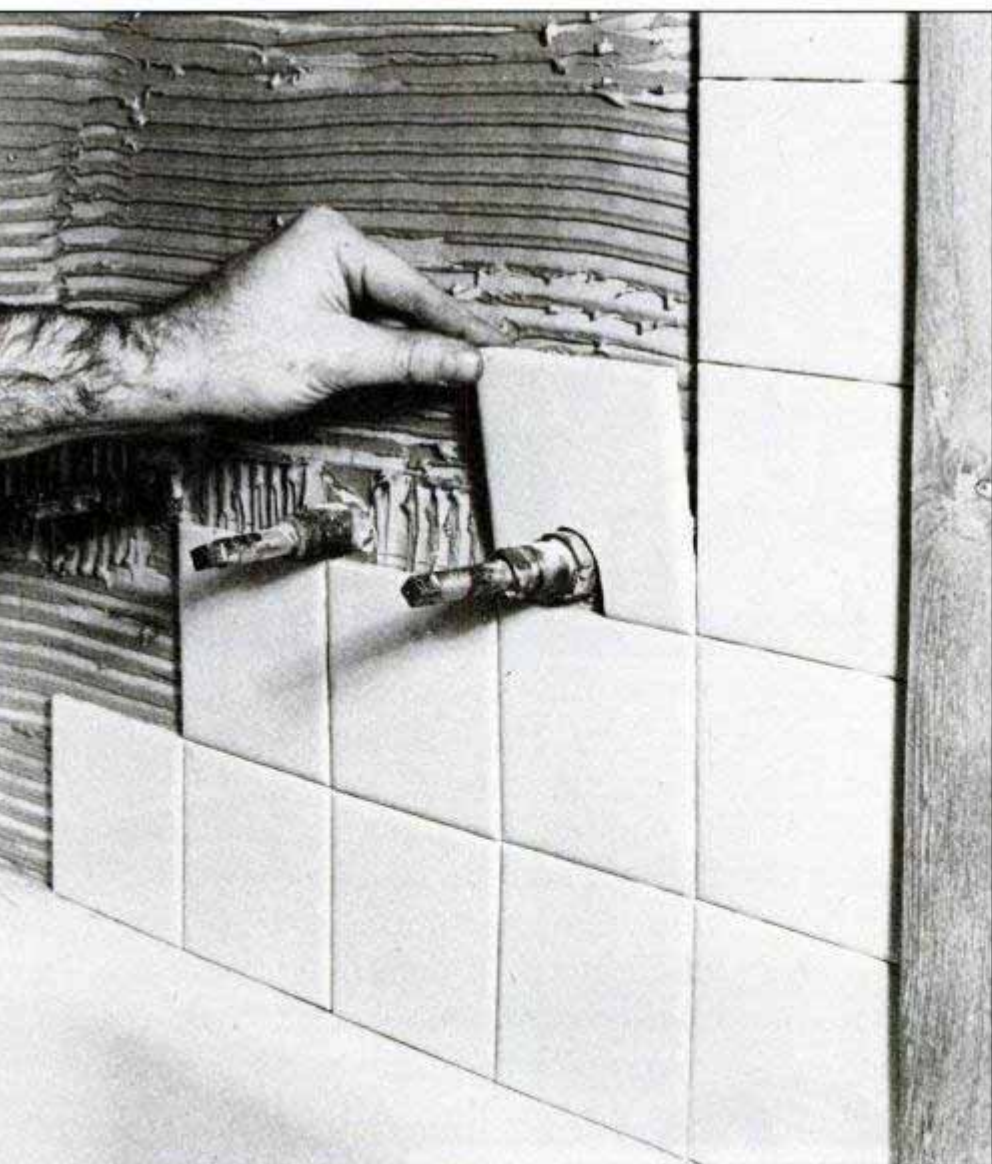
TEXT AND PHOTOS BY STEVEN WILLSON

**T**raditionally, ceramic tile has been the preferred building material for covering walls in high-moisture areas like bathrooms. The tile is durable, attractive and, when properly installed, highly water resistant. It's also relatively easy to apply and is therefore a logical choice for homeowners who are plan-

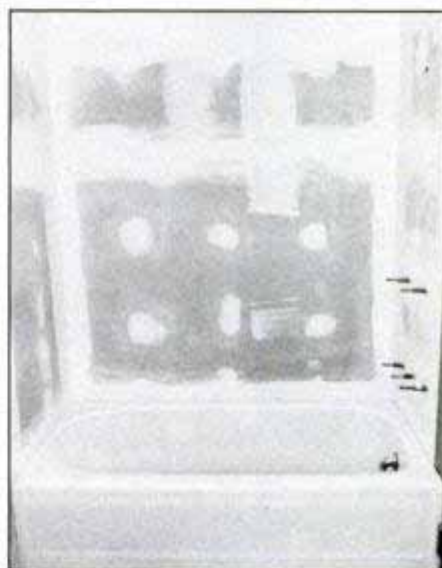
ning to remodel a bathroom on their own. The photos here are a step-by-step guide to help you along the way. And, we've included a brief roundup of other tub enclosures on page 147 to let you know what else is available.

The first step in any ceramic tile installation is to make sure that the

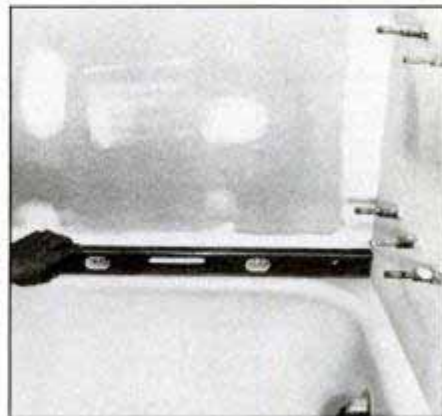
walls you are covering are sound. There should be no holes, protrusions, flaking paint or other abnormalities on the surface. The walls should be square and plumb within  $\frac{1}{4}$  in. in both dimensions. If the walls do not conform to these standards, remove the drywall or plaster, shim the walls until they are square



Properly installed ceramic tile yields an attractive, highly water-resistant covering for bathtub walls. And installing the tiles is well within most homeowners' abilities.

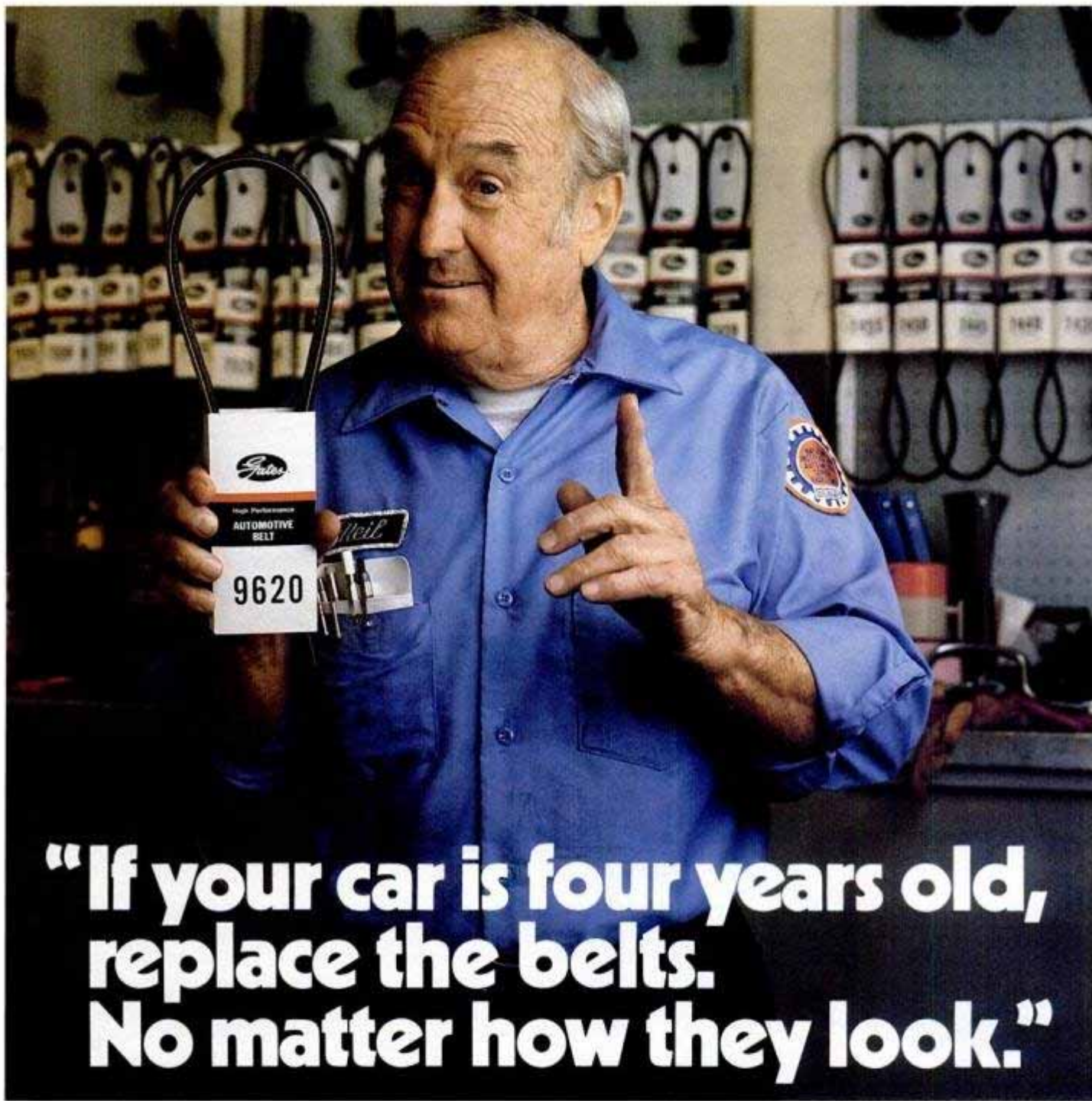


**1** Tub walls should be plumb and square and covered with water-resistant drywall before tile installation. Apply tape and compound to all joints, then sand smooth.



**2** The first step in tile layout is to determine low point of tub rim. Use a level and be sure to check all three sides. This step is especially critical on old tubs.





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replace the belts.  
No matter how they look.”**

Today's engine belts don't show wear the way they used to. Even an experienced mechanic can't always tell if they're about to go, just by looking. And strangely enough, most car owner manuals don't say when to change them.

Fact is, after four years in a modern engine compartment, even the best belts can go at any time. So if your car is four years

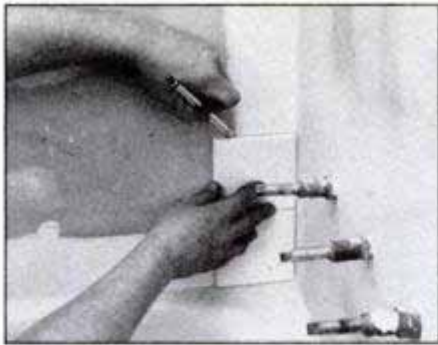
old or more, you ought to change the belts. It's just part of good maintenance.

And tell them you want Gates. We invented the V-belt over 60 years ago, and have been the world leader in drive belts ever since. At quality-conscious service stations, garages, and auto parts stores everywhere. **After four years, it's time for a change.**

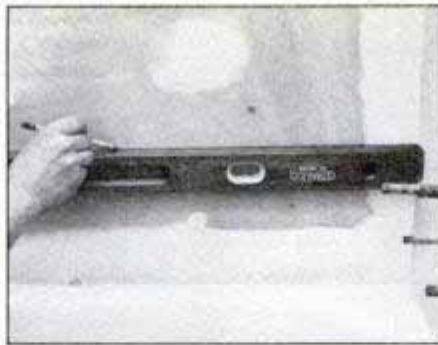


The Gates Rubber Company, Denver, Colorado.

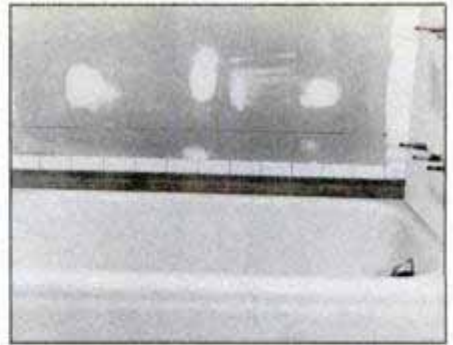




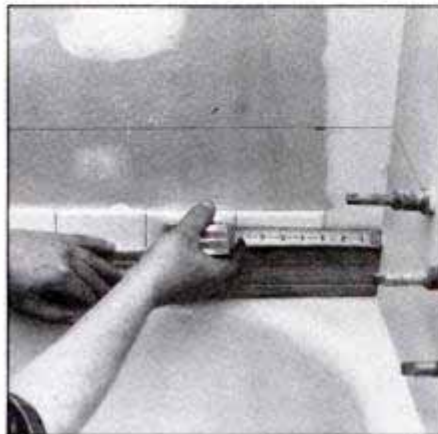
**3** At the lowest corner of the tub rim, place two full tiles on top of the tub and make a mark as shown. This reference point establishes your horizontal base line.



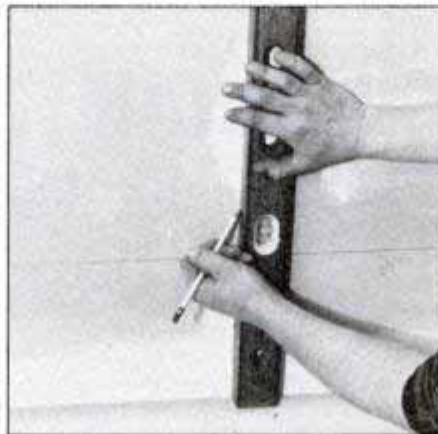
**4** Place level at base-line point and draw line across back wall. Then transfer this line onto end walls. Make all lines dark enough to read through adhesive later.



**5** To establish proper vertical alignment of tiles, begin by cutting scrap board slightly longer than back wall and wedging into place. Slide full tiles behind board.



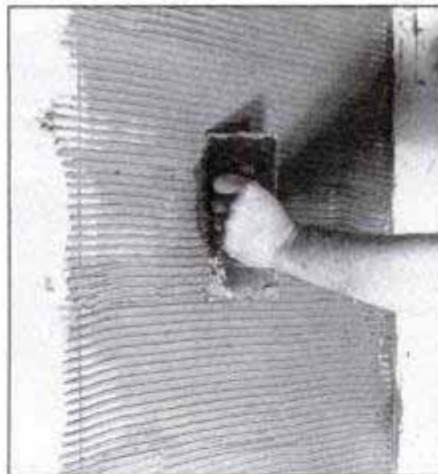
**6** Arrange tiles behind board so width of end tiles—which must be cut—is same. This should be at least 2 in. If not, remove one tile, recenter row and measure again.



**7** Mark grout line between two tiles at center of wall, then remove tiles and scrap board. Draw heavy plumb line through this point to establish vertical tile alignment.



**8** To find vertical line on end walls, position trim and full tiles as shown. Mark wall between tiles and on outside of trim tile. Draw plumb line through both marks.



**9** Spread adhesive evenly onto wall using  $\frac{1}{4}$ -in.-deep notched trowel. Note that vertical line (seen above) and base line, near tub, must be visible through adhesive.



**10** Install first tile by pressing into adhesive, twisting slightly back and forth, then aligning under the base line and inside the vertical line. Tile will not slip.



**11** Install row of tiles below base line, then above. Measure space between rows and corner to see if they're the same. Then deduct  $\frac{1}{8}$  in. for ease of fitting cut tile.

and plumb, then install new water-resistant drywall. Finish all joints with joint compound and tape, and sand the joints smooth.

Next, measure the total square footage on the tub walls. Make a sketch of where the tub is situated in the room and include all pertinent dimensions. Take this information to a local tile supplier and discuss the project. A good supplier will be able to provide the tile, adhesive and grout needed for the job.

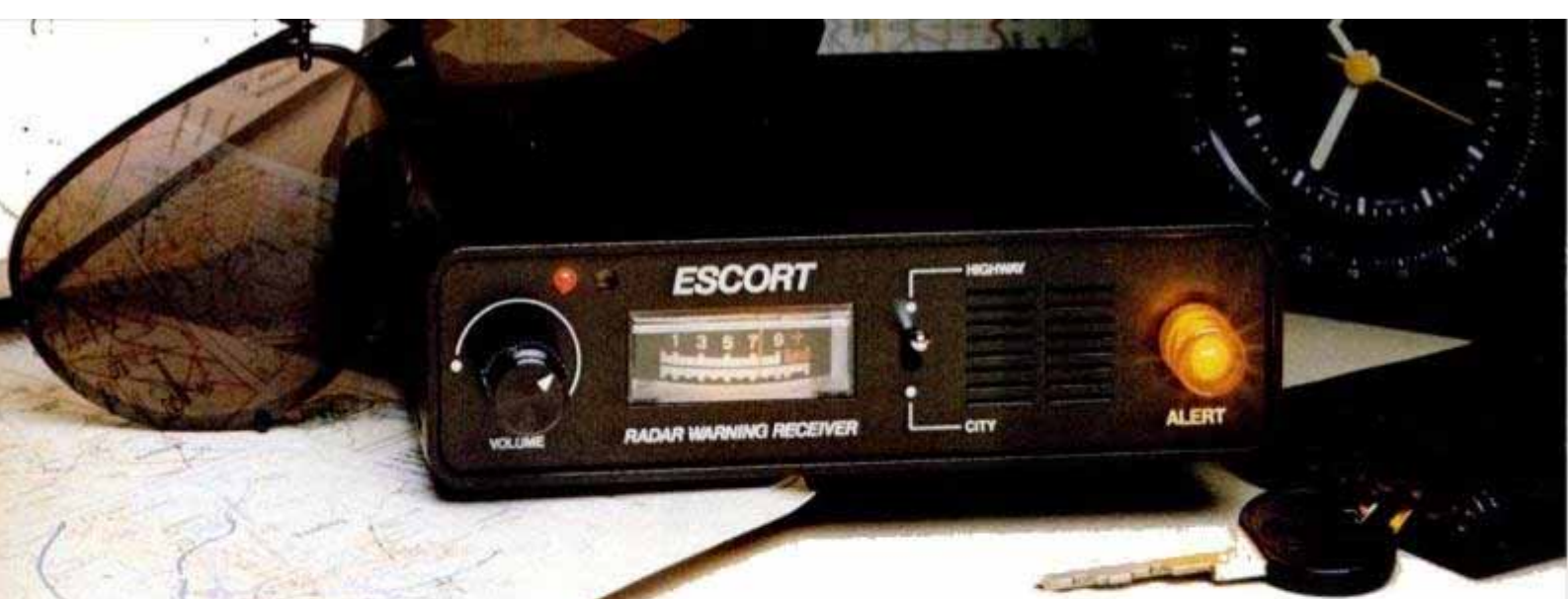
You'll also be able to choose what type of trim tiles you want as well as any accessories, such as ceramic soap dishes and towel racks. Most tile suppliers also carry the tools required for the job, including inexpensive notched trowels for the adhesive and rubber-faced trowels for grout application. And the supplier may loan or rent tile cutters.

Once you've made your selections, lay out the tub walls to establish the

horizontal and vertical tile alignment lines as shown in the photos. Be sure to make the layout lines dark enough so they will show through the adhesive later. Then begin applying the adhesive according to the maker's directions.

Begin installing a row of tile under the base line, working from the vertical line toward the wall corners. It's a good idea to install at least two courses before cutting any end tiles so you can check to make sure the tile cuts are





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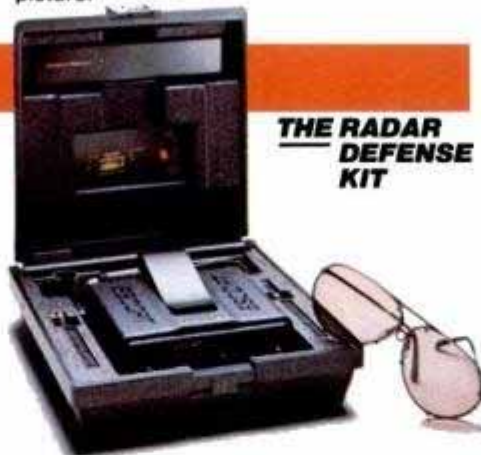
You see, we know how difficult it is to buy a camera or stereo component, or any precision gear. Every store has different prices so you feel obligated to shop around. Then you have to wait for a salesman. He may not know much about the products or may try to get you to choose another brand. And the week after you buy, they go on sale.

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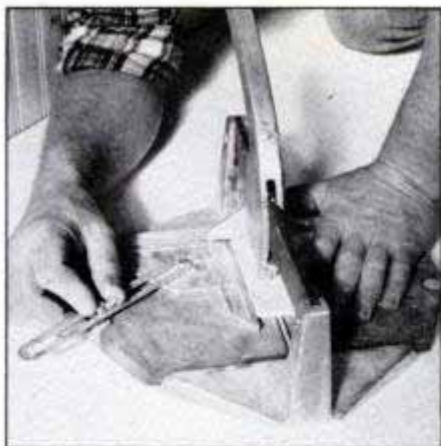
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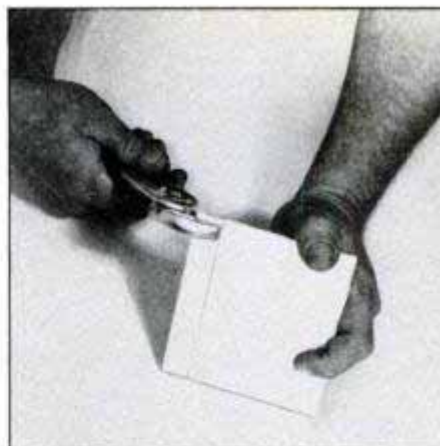
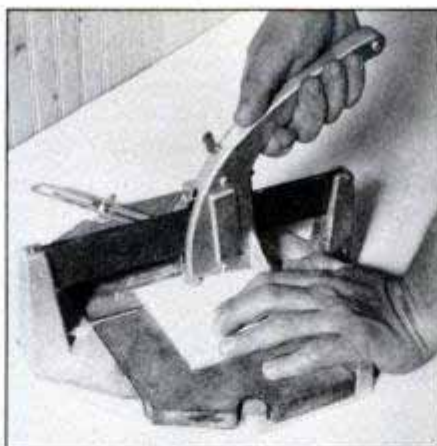
**ESCORT**  
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**12** A tile cutter (above) consists of sliding arm with glass scoring wheel, breaker bar just below wheel, rubber pads on both sides, and triangular measuring gauge. To use, set gauge to desired width, hold tile firmly, bear down on cutter handle and pull across tile. Then pivot handle so back ears bear on tile and push. Tile will break cleanly.



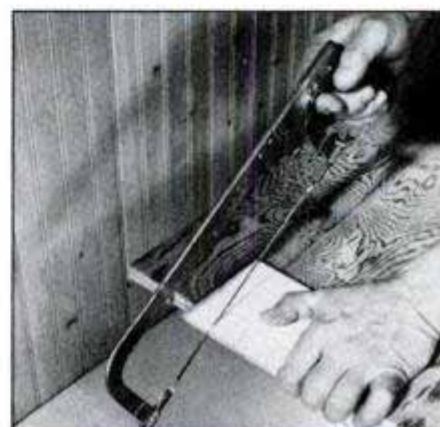
**13** Tiles can also be cut using simple glass cutter and metal straightedge for a guide. Once glaze is scored, grip waste piece at cut line with deep-jawed pliers and snap.



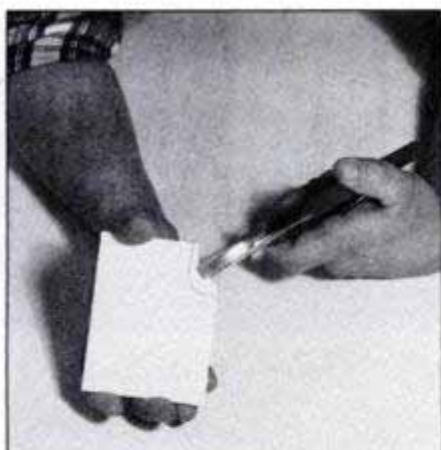
**14** To finish cuts—whether from tile cutter or glass cutter—rub edge until flat with a piece of coarse abrasive like the 36-grit floor sanding paper shown above.



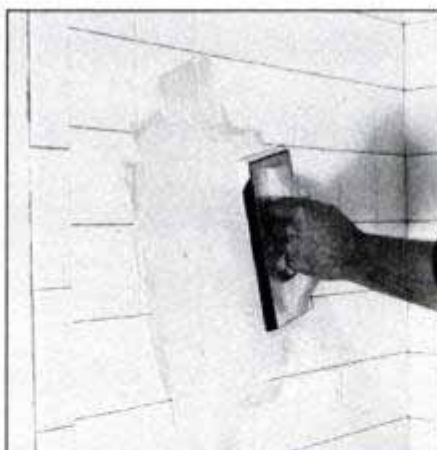
**15** Press cut tile into adhesive and move up and down slightly to achieve good bond. Do not force tile if it doesn't fit easily. Instead, remove and sand edge.



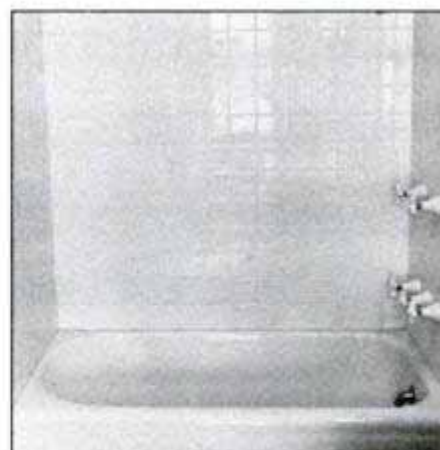
**16** To cut curved notches in tile, which are often required around faucet valves and shower head nipples, use a carbide-coated round saw blade in a hacksaw.



**17** To cut off tile corners when smooth edge is not required, use deep-jawed pliers or tile nippers. Work from the corner, breaking off small pieces as you go.



**18** Allow adhesive to cure for 48 hours, then mix grout to consistency of heavy whipped cream. Apply grout to walls and force into joints with rubber-faced trowel.



**19** When installation is complete, grout must damp cure for 72 hours before shower is used. To do this, soak walls three times a day for three days with a wet sponge.

approximately the same for both rows. If there is a difference of more than  $\frac{1}{4}$  in. in the width required, double check your layout lines and correct the error.

Also, periodically check the tile alignment for both level and plumb as you work, and make any required adjustments. On the installation shown, alignment was almost automatic be-

cause the tiles we used—American Olean Brite White No. 47—had two alignment ears in each grout joint.

When cuts have to be made, proceed as shown in the photos. Keep in mind that if you choose to set a course of cove tiles directly on top of the tub, you must make any required cuts in the tile course just below the base line, not in the coves. On this job, we elected not to

use the coves, and instead cut the bottom course to conform to the tub rim.

Irregular cuts—such as those around faucet valves and shower heads—can be made by breaking off small pieces of tile with pliers, as shown in step No. 17, or with a round, carbide coated hacksaw blade, as shown in step No. 16. This blade, called a Rod Saw, is made by Stanley. It yields a clean, smooth cut





## Engineering innovation. Just for the fun of it.

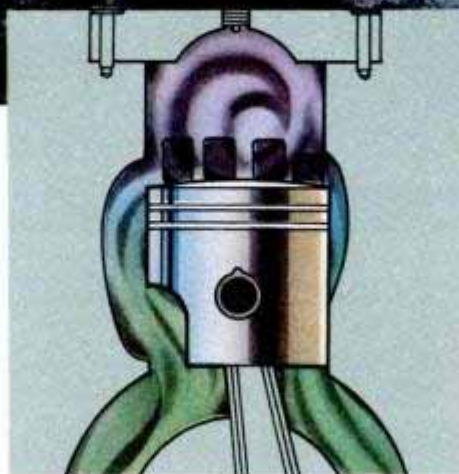
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and should be used for exposed cuts.

Once all the tile is installed, allow the adhesive to cure for at least 48 hours, then apply the grout. To do this, mix the dry grout with water until it is the consistency of heavy whipped cream. Then, working in areas of 15 to 20 sq. ft., apply the grout to the tile using a rubber-faced trowel. Use firm strokes to drive the grout completely into the joints. Go over every joint with a 1/2-in.-

dia. wood dowel to compact the grout and give each joint a finished look.

When all joints are filled, wipe the excess grout off the face of the tile using the rubber trowel or a wet sponge. Once the grout begins to dry—about 10 to 15 minutes—it will form a hazy surface. At this point, rub the surface with cheesecloth or a soft cotton cloth to buff it clean.

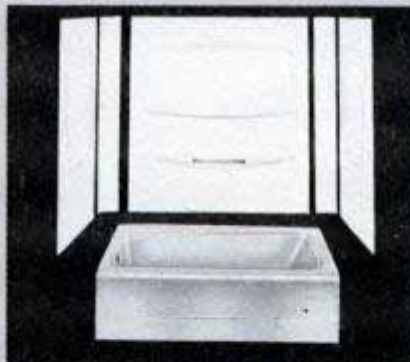
The last step is to damp-cure the

grout, a process that takes 72 hours. Completely soak the joints with a wet sponge three times a day at eight-hour intervals. After the damp-curing is complete, fill the tub with water and caulk the space between the bottom row of tile and the tub rim with white silicone caulk. Use the same caulk behind all faucet and shower head escutcheons. Let the water out of the tub and you're done. **FM**

## Three More Ways You Can Finish Off A Bathtub



Redi-Set ceramic tile sheets consist of individual ceramic tile pregrouted with white silicone rubber grout. According to the manufacturer, the grout holds the sheets together firmly yet is flexible enough to permit easy installation. The manufacturer also advises that the sheets can be installed over drywall, masonry and even existing tile. The sheets must be cut on an oversized tile cutter, but the pregrouting definitely represents a time savings as well as assuring near-perfect joint alignment. Once all the sheets are installed, the joints between them are filled with the same silicone grout used between tiles. Available in a wide selection of colors, the product is made by American Olean Tile Co., Lansdale, Pa. 19446. The material required for the basic 5-ft. tub shown above, including corner trim, grout and adhesive, costs about \$240 at dealers.



Perma-Wall is a five-piece bathtub surround made of ABS plastic that consists of two end panels, two corner panels, a side wall, installation adhesive and color-matched caulk for sealing the joints. According to the manufacturer, the product is designed to fit above most standard 5-ft. tubs. It features a grab bar and two soap dishes molded into the side panel. Installation is accomplished by spreading adhesive on the walls above the tub, then pressing the corner panels in place first. The side panel comes next, followed by the two end panels. Holes for the faucet valves and shower head must be cut on site with a hole saw in an electric drill. Available in six colors and white, the bathtub surround is manufactured by Kohler Co., Kohler, Wis. 53044. Do-it-yourself instructions are included with the product. It sells for about \$215 at Kohler dealers.



If you plan to replace your tub instead of simply refinishing the walls above it, a new tub with a surround kit that's included may well be your wisest choice. The four-piece assembly shown above is Model OC-60, made by Owens-Corning Fiberglas Corp., Fiberglas Tower, Toledo, Ohio 43659. According to the manufacturer, no grout, caulk or adhesive is required. Instead, the parts snap together securely and are installed directly against the surrounding wall studs with nails driven through flanges at the tops of the panels. These nails are hidden later when the flanges are covered with drywall. Made of a glass-fiber-reinforced resin compound, the product features a slip-resistant tub bottom and two toilet shelves on each end wall. The unit is available in eight colors and white and sells for approximately \$250 at Owens-Corning suppliers.



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# TROUBLESHOOTING A HOME ALARM SYSTEM

Here's how to stop those frightening false alarms and keep your system silenced—until you really need it.

BY ISAAC SZLECHTER

It's the middle of the night, you're sound asleep, and suddenly your fire or burglar alarm lets out a loud blast. You jump out of bed and search madly for the trouble, but there's none—no sign of intruders, no smoke, nothing to indicate what triggered the alarm. It just went off by itself. The next day, you or a serviceman run a manual test on the system and—naturally—it works perfectly.

False alarms are an increasingly frequent problem these days as more and more homes are equipped with fire and intrusion alarms. At best, false alarms are a nuisance, and at worst a frightening experience that can also unnerve your neighbors and annoy local police. To make matters worse, the most frustrating causes of false alarms are invisible and fleeting, and don't show up under routine tests or inspection.

The problem lies in the very fail-safe principle on which alarm systems are based. Since the alarm is designed to sound when current through the house circuit is interrupted, such as by opening a window, any accidental break in the circuit—however slight or brief—will set it off.

Such short, intermittent breaks—called "swingers" by professional installers—may not occur for months at a time and may last only a second or so when they do. They may show up only when wind rattles a window, opening a hairline crack in a foil loop, or when wood swells or shrinks, causing electrical contacts to part. Frayed wires or loose connections can momentarily separate due to vibration or temperature changes, then "heal" themselves later, giving no clue to the trouble. A thin film of dirt or corrosion can also be the rea-

son for intermittent contact failure.

Because these sneaky swingers come and go so unpredictably, they must be tricked into showing themselves by simulating the conditions that bring them out. The troubleshooting procedures described here are easy to follow and will work on any alarm system that's based on a continuous-loop circuit, regardless of the type of sensors you may have. The sensors may be foil loops around window panes, magnetic detectors on doors and windows, sliding metal contacts, or fusible links in a fire protection circuit.

The idea is to divide your main house loop into smaller loops so that trouble spots can be isolated and the faulty wiring replaced. You then check each loop individually for intermittent breaks using an electrical continuity tester.

Two types of testers can be used—a



Check each foil loop on a window individually. Disconnect loop from rest of system, then clip tester leads to terminals, as in diagram at left. Pound vigorously on the window sash (above) to jar the foil. If problem is a "swinger"—an intermittent break in the foil or its connections—it should show up on the tester. Before beginning tests, disconnect circuit and its power supply from control panel (right).



simple ohmmeter that measures electrical resistance, or a special instrument called an Ademco No. 12 Tester. The ohmmeter needle will reveal a break in a circuit by jumping from zero ohms to a high reading, indicating that no current is passing through the loop. You have to watch it carefully, however, since a momentary break could produce a brief, easily missed flicker.

The Ademco No. 12 Tester has a handy feature that makes it easier to use. Instead of a needle, it has an indicator lamp that flashes on as soon as a break in current is detected. The lamp then remains on even if current starts to flow again, giving you a permanent indication. Thus, there's no chance of a missed reading. The Ademco No. 12 Tester (by Ademco, 165 Eileen Way, Syosset, N.Y. 11791) is available at shops that sell or service alarm systems. It costs about \$25, but can sometimes be rented over a weekend for less.

### Dividing your system

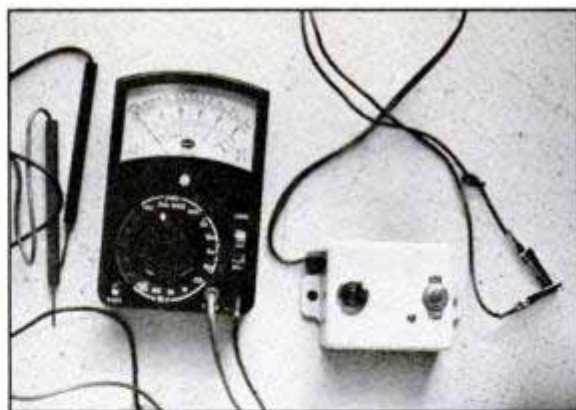
Start by disconnecting your system at the main control panel. Also disconnect the power supply, which may be located elsewhere. (System power is not needed for testing, as both testers contain their own batteries.)

The next step is to divide your sys-

tem into a series of short sections, each one controlling a particular protected area, such as a single door or window. The diagram at the bottom of the page shows how this is done. Break the circuit at points where wires can be easily detached from terminal screws, rather than having to cut them.

At one end of each section, twist the two wires together. At the opposite end, clip your tester leads to the other two wires. You now have a self-contained loop affecting just one door or window, with your tester wired into the circuit. Now turn on the tester and pound the door frame or window sash sharply with your fist, moving your hand over areas where circuit wires or sensors are located. The vibration from your rapping should cause any intermittent breaks to show up on your tester.

If a break is detected at any point, it may then be necessary to subdivide the section into still smaller segments in order to pinpoint the exact location of the trouble. Foil loops on windows, for instance, should be checked individual-



Ordinary ohmmeter (left) can be used to check for intermittent breaks in system, but Ademco's No. 12 Tester (right) has a special advantage: Its indicator light remains on even if a break lasts for only fraction of a second.

ly. Disconnect each loop from the circuit, one at a time, and connect the tester across its terminals. If a break shows up, only that particular loop of foil need be replaced.

Pay special attention to junction points that are subject to movement, such as electrical contacts between window sashes. These, along with invisible cracks in foil strips, are common sources of trouble due to expansion and contraction caused by changes in temperature and humidity. Isolate these areas and rap the surrounding woodwork as you test for breaks in

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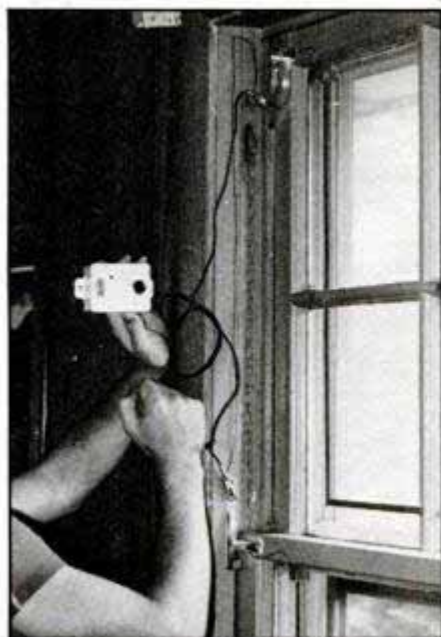
wires or poorly mating contacts. Clean all contacts as you go and check them for proper alignment. Replace or readjust any that are faulty.

Also check the wiring between doors and windows. Frayed wires may be hidden by their insulation. You can check a long run of paired wires by twisting them together at one end and

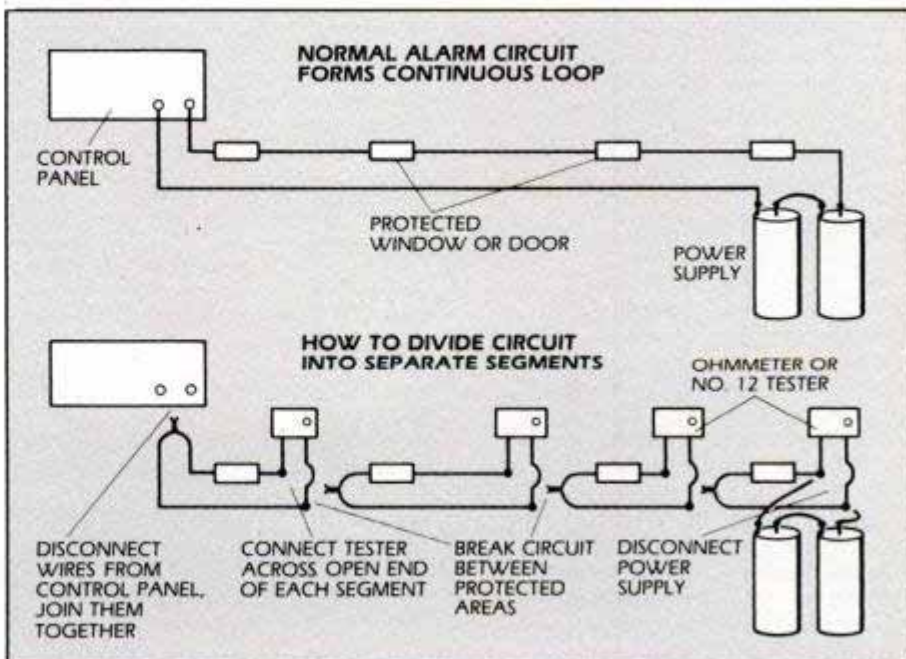
clipping your tester leads to the other ends, forming a loop. Pound the wall along the entire run as a helper watches the tester for you. Replace any length of cable that proves defective.

Repeat the process for all of the sections in your system. If you do spot a break, don't assume it's the only culprit. Note its location and keep on test-

ing the rest of the system. Other swingers may be lurking elsewhere. If your troubleshooting is thorough, you can be sure your alarm system will never again get you out of bed—unless it's the real thing. And if that does happen, you can act confidently, knowing that your call to the police or fire department is not just another false alarm. **PM**



Checking for invisible breaks inside insulated wire is done in same way as testing a foil loop. Clip tester leads to ends of a suspected wire and pound the wall around it.



Secret of troubleshooting an alarm system is to divide it into small segments so problem can be isolated. Lower diagram above shows how each protected area can be broken into a self-contained loop, including the tester. Any fault within loop will show up on tester.





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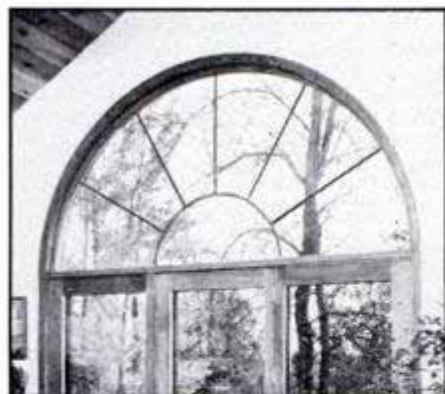


## Home Ideas Guide

# New Products For Your Home



The Crane Co. has introduced a new line of easy-to-clean acrylic products featuring the Royal rolled rim bathtub. Durable, nonfading acrylic makes the bath lightweight for easy do-it-yourself installation. The free-standing, sloped-back Royal features cast brass legs and exposed brass plumbing, which includes supply fittings, waste and overflow. The bathtub is available in two models: the Royal I, which is 22½ x 30 x 60 in. (\$969), and the Royal II, which is 22½ x 30 x 66 in. (\$1,066). Both models come in a choice of seven high-gloss colors and white. For additional information about Crane's complete acrylic product line, contact Crane Co., Plumbing Div., 300 Park Ave., New York, N.Y. 10022.



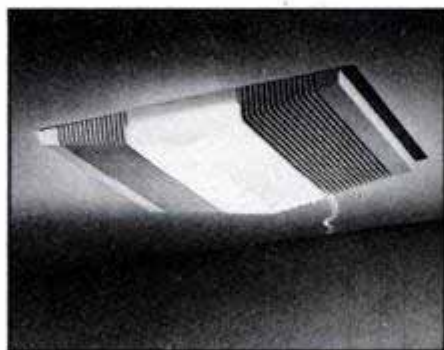
The Marvin Window Co. offers made-to-order round and round-top wood windows in virtually any design, shape and size to fit your home. Shown here is a round-top window that comes with a snap-on grid. (Windows can also be ordered with authentic divided lites.) This window is installed over a terrace door. The windows are constructed of ponderosa pine and come finish-sanded, ready to stain, paint or varnish. Marvin windows are available with ½- or 1-in. insulated glass, or you can get them with triple-glazing for increased energy conservation. Prices for made-to-order round-top windows start at about \$300. For additional information, you should contact Lynette Erickson, Marvin Windows, Warroad, Minn. 56763.



Here's a do-it-yourself, battery-operated home burglar alarm system from Dicon Systems Limited, 719 Clayson Rd., Toronto, Ont. M9M 2H4. The system consists of a key-activated control unit which monitors door/window switches and pressure-sensitive detector mats. The switches (\$5) and mats (\$15) are sold separately to create a custom alarm system for any size home. The C100 alarm kit (\$50) contains a control unit, one door/window switch and 10 ft. of wire. A D200 siren (\$80) connects to the C100 kit and sounds when the alarm is activated. For more information, contact the manufacturer.



The Duro Perfect Match do-it-yourself countertop repair kit fixes nicks, scratches, holes and burns in plastic laminate surfaces. The kit contains seven colors, which are blended to match the damaged laminate, a syringe of repair compound, a spatula and spreader. Two kits are available: one for colors and one for wood-tone laminates. Each kit costs \$10. For details, contact Loc-tite Corp., 4450 Cranwood Ct., Cleveland, Ohio 44128.



The Model 660 bath unit (\$97) from NuTone combines a 1,500-w. heating element with a 60-w. ceiling light to provide both heat and light from a single appliance. A five-blade fan distributes the heat throughout the room. For further information, send \$1 to NuTone Div., Madison and Red Bank Rds., Cincinnati, Ohio 45227.

(Please turn to page 154)

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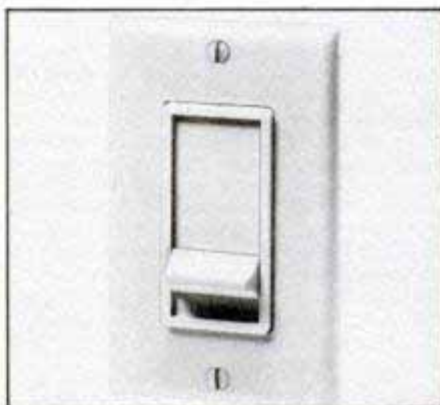
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## Home Ideas Guide

(Continued from page 153)



The Concept 5-ft. hinged patio door (\$600) by Pease Industries, 7100 Dixie Highway, Fairfield, Ohio 45014, features a wood interior on an energy-efficient steel door. Oak, walnut and ash interiors are available. The door has a 1-in. deadbolt and 1-in. insulating glass. For details, contact the maker.



Leviton's new 600-w., solid-state slide switch dimmer, model No. 6631 (\$16), offers full-range dimming with positive on-off action. A locator light makes the switch visible in the dark. The slide switch dimmer is sold nationally for \$16. For more information, you should contact Consumer Products, Leviton Manufacturing, 59-25 Little Neck Parkway, Little Neck, N.Y. 11362.



Jacuzzi Whirlpool Bath, 298 North Wiget Lane, Walnut Creek, Calif. 94596, introduces the Espree portable whirlpool spa (\$2,195). The Espree is a totally self-contained unit that you simply plug into a 115-v., 20-amp. circuit and fill with water. No plumbing is required. The 28 x 64 x 70-in. acrylic spa accommodates four adults and comes with factory-installed redwood skirt and cover. For details, contact the maker. **FM**



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### MINIVAN TEST

(Continued from page 95)

lated. The Vista's acceleration is the best of this group, hitting 60 mph in approximately 12 seconds. Even so, the two five-speeds I drove both had a mysterious carburetor stumble between 1,500 and 2,000 rpm. There are two other transmissions available for the Vista: a Twin-Stick four-speed with manually selectable overdrive, and a three-speed automatic.

The Vista's seats feel good, and driver vision is excellent in all directions. The hooded instrument cluster is well



Seats in the Mitsubishi Vista are not as easy to remove as those in a true van, but they do flip and fold into five different configurations, including this bed.

placed, but could use gauges for oil pressure and alternator. I appreciated the two over-and-under gloveboxes, especially the huge bottom one. And there's an additional storage bin under the front passenger seat. All these vehicles, though, offer an abundance of nooks and crannies to hide things, and all but the Toyota have under-seat bins.

The Vista's handling and braking suffer slightly from a lack of tread patch. The P185/70R-13 tires just aren't very wide, and that makes the car lose its grip before it ought to. The brakes aren't hard to lock up either, and

## A VERSATILE



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I noticed a fair amount of understeer on the tight, short course I drove. The Vista isn't intended for road racing, nor are any of these vehicles, but I think you have to be careful about hurrying them on slippery surfaces.

### Volkswagen Vanagon

You get an awful lot of room in the VW Vanagon, and that's by far its greatest attribute. You pay for that space, though, in a number of ways.

First, the Vanagon, being the largest of these four vehicles, is also the heaviest.

And it has the least powerful engine, so performance suffers. You simply have to be patient and not dart into traffic. You learn to live within the Vanagon's performance limits, which include 0 to 60 in about 18 seconds.

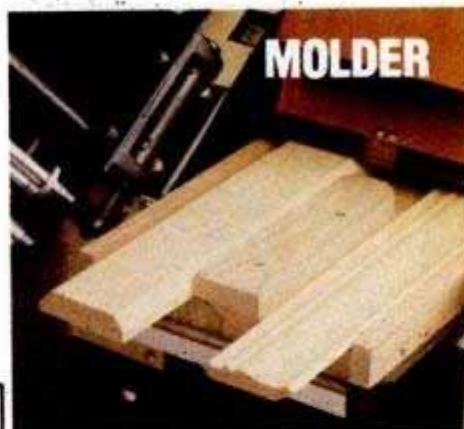
Also, with much of the Vanagon's weight in the rear, gusty sidewinds and passing trucks tend to blow the vehicle around quite a bit. Again, there's not an awful lot of rubber on the road. The example I drove veered to the left under panic braking, and its rear wheels had a tendency to lock.

Volkswagen has done a commendable job of civilizing the Vanagon. There's a lot less engine and road noise than in previous generations, especially during acceleration and at highway cruising speeds. Gear shifting with the manual four-speed is easier and smoother than before. VW offers a three-speed automatic, as well.

The Vanagon's seats are firm, and the driver has total visual command of the road. Passengers find loads of room in every direction, but there are problems with ventilation. The heater/vent system itself is confusing and difficult to use. Three of the four slide levers don't seem to do much, and the front fan isn't very forceful. In defense of the system, there's a second set of vents plus another heater/ventilation fan un-

(Please turn to page 187)

## A PRECISION



### MOLDER

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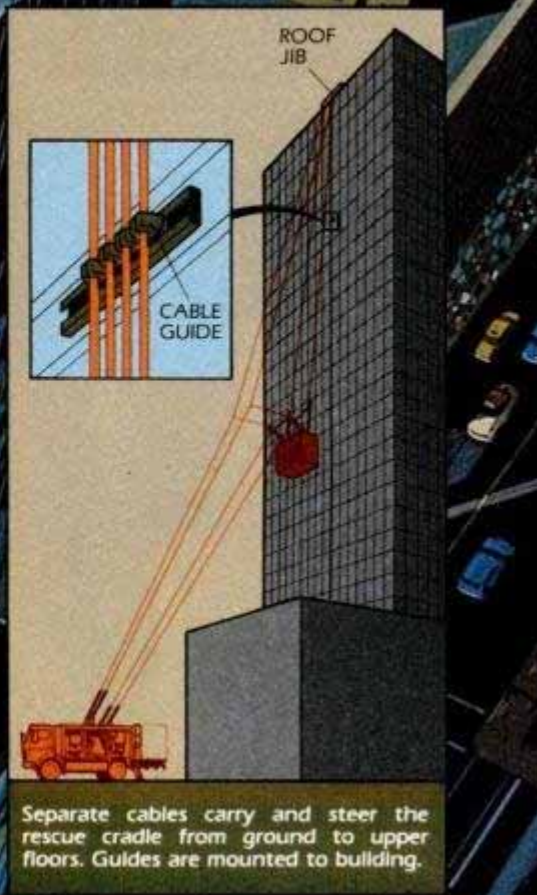
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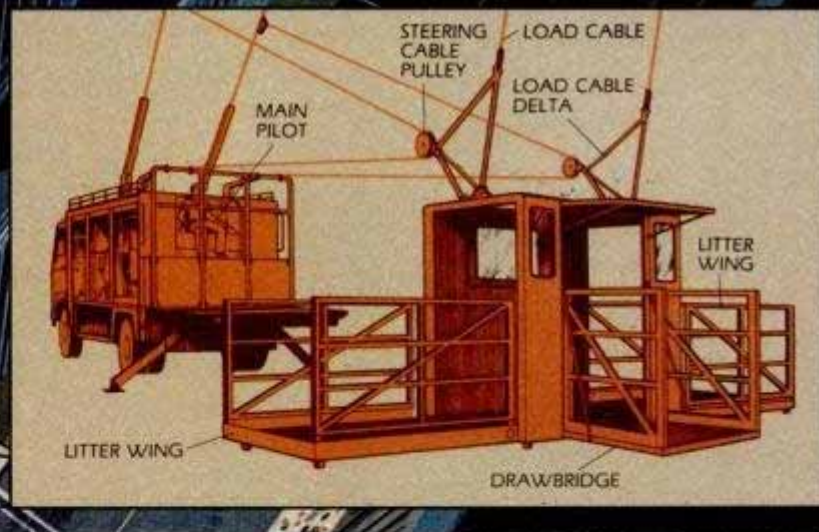
# TECHNOLOGY UPDATE



Cables mounted to a permanent roof jib carry rescue cradle over obstruction and up to fire. With drawbridge on a windowsill to steady the cradle, firemen stand on litter wings using hoses connected to standpipes on a lower floor. Roof jib can be used for window-washing platform when there is no fire. Platform can be used for rescue, too.



Separate cables carry and steer the rescue cradle from ground to upper floors. Guides are mounted to building.



## Safe exit from a towering inferno

Disaster movies generally exaggerate the possibilities, but when the film *Towering Inferno* appeared in the '70s, there was one chilling note of realism. If a fire breaks out and spreads across the upper floors of a skyscraper, there's little equipment available to get people trapped inside to safety or to fight the blaze. A West German company, however, has come up with one solution.

The High Rise Rescue Cradle from Wahlefeld is a gondola that climbs the

lofty heights of a high-rise building. Its side walls fold out to form bridges from which firefighters can run hoses. They also can be used as litter carriers for injured persons. The front wall folds out like a drawbridge to be set against a windowsill, steadying the gondola as up to 12 people get on board.

"The system works with the standard window-washing units they're starting to install on most high rises today," says Doug Eastwood, vice president of Wahlefeld Safety Corp., the

American distributor located in Butner, N.C. "A jib set on tracks on the roof of the building lowers cables down the side. The cables carry the window-washing unit up and down, but if a fire breaks out, they can be used to bring up the rescue cradle."

The 2,200-pound gondola is brought to the scene on a special truck. After cables are connected to the building's jib system, a pilot sitting in the back of the truck can steer it up at the rate of 10 stories per minute. Inside the gondola,



## ENGINEERING

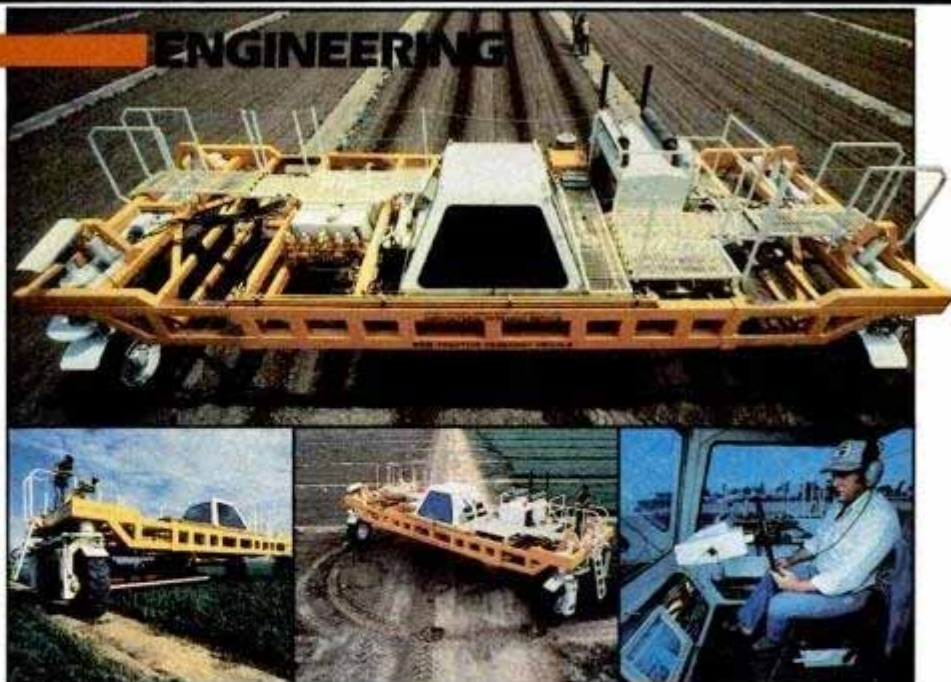


One fireman works rescue cradle controls in his lap aboard the cradle (1), while the main pilot sits in the rear of the truck (2), watching the cradle rise and, if necessary, taking control on a panel in truck (3). The cradle can open to carry a litter (4) on either side. With both litter wings open (5), the cradle can carry 12 passengers.

Drawings by Dean Ellis, photos by Brian Wolff

a second pilot can use a set of controls to adjust the safety cradle precisely.

When the side walls are folded out to form the litter wings, firemen can connect their hoses to standpipes on one floor, bring the cradle up to the next floor and hose down the building beyond the range of any fire truck. The fire departments of New York, Boston, Detroit and Miami have taken part in demonstrations of the \$500,000 system, which may be used in some American cities within the next two years.



## Heavy tractor has light touch

**W**hen a typical 5-ton tractor rolls across a field for tilling or harvesting, it destroys valuable soil and hinders crop growth. The sheer weight of the tractor compacts the soil and keeps water from seeping into the ground. Wherever the wheels roll, plant growth is inhibited.

To combat the problem, the federal Agricultural Research Service has developed a behemoth dubbed "The Spanner" (top). The machine's 30-foot-wide frame lets the farmer till more acreage per pass than he could handle

with an older tractor. Camera equipment on the tractor or a worker stationed at the far ends of The Spanner (above, left) help him keep his eyes on his work.

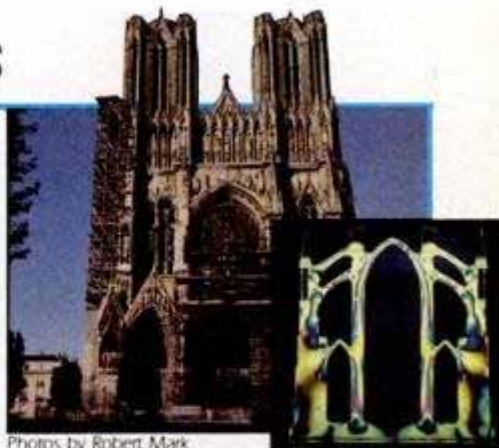
After covering the length of the field, the farmer would take one wide turn and start a new super-row (center). A computerized cabin (right) lets the farmer have as much control of his work as if he were driving a smaller tractor. Researchers believe this type of tractor will increase crop yields by 10 percent.

## ELECTRONICS



### CARDS WITH BRAINS

It looks like a credit card, but it works like a small computer. The Smart Card from France contains a 16K computer chip on a tiny circle in the corner of the card (above). The card is inserted into an inexpensively produced terminal and its memory is activated by entering a secret number. The card can then be programmed to work like a checkbook, entering deposits, withdrawals or other transactions. J.C. Penney will start using the Smart Card next year, and it will be available for home use by 1986.



Photos by Robert Mark

### POLARIZED CATHEDRALS

Princeton University Prof. Robert Mark's new book, *Experiments in Gothic Structure* (MIT Press, \$20), reveals how architects like Mark are using optical analysis to determine loads and stresses on tall structures. The photo above of the Cathedral at Reims, France, and the polarized light photo of a plastic model of the same section (inset) is a case in point. Passing polarized light through the model, architects can pinpoint sources of wind stress.





## Return of the propeller?

**N**ot all airliners of the future will necessarily be jets—some may start sprouting propellers again. The props, however, will look like nothing you've ever seen before. Developed under a joint NASA/Pratt & Whitney program, they sweep sharply backward at the tips and are arranged in two multibladed clusters that turn in opposite directions on concentric driveshafts. The design, which looks something like an oversize eggbeater, is said to move large masses of air more efficiently than conventional straight-bladed props. The counterrotating blades also cancel out prop torque, providing smoother control and greater safety in the event of an engine failure.

The new swept-blade props are turbine-driven and are

called propfans. According to current studies, for short-range airliners of the 120-passenger size, propfans could reduce fuel burn by as much as 30 percent over turbofans of comparable thrust. Locating the engines near the tail puts the wings in clean air, improving lift. It also greatly reduces cabin noise. An ingenious coaxial gearbox, using planetary gears to reverse the rotation of the turbine's output, simultaneously drives one prop cluster clockwise and the other counterclockwise.

If propfans prove to be as fuel-efficient as they seem, they could start showing up on small airliners within 10 years. They may look strange, but to financially strapped airlines, those eggbeaters could be beautiful.



## Can flying boats make a comeback?

**T**he great flying boats of the '30s, like Pan Am's luxurious Clippers to the Orient, have long since faded into wistful memory. But now the flying boat may be coming back. Two new prototypes are currently exploring the feasibility of using small, water-borne airliners to take some of the hassle out of air travel.

The SS-X (left), built by Shin Meiwa of Japan, is a 40-passenger, twin turbofan amphibian designed for island hopping in the Pacific, where conventional

airport facilities may be nonexistent or too small to handle land-based jetliners. The Do 24 TT (right), built by Dornier of Germany, uses three turboprops instead of jets. Its purpose is to serve coastal cities where passengers could be delivered directly to downtown docks instead of to less convenient, out-of-town airports.

Editor: Dennis Eskow  
Contributors: Sheldon M. Gallager, Jack Hammond, Richard Schrader, Joel Davis, Jeff Richmond, John Ginsberg



## FOR ONE-HAND FLYING

The relaxed-looking gentleman above is actually flying a giant airliner—one-handed. Gone is the big central control column with its familiar two-handed yoke. Instead, the pilot controls the plane with a small handle on an armrest at the left side of the cockpit. The miniature side stick, similar to those on modern fighter jets, is being tested for commercial airliner use in an A300 Airbus. Some advantages claimed include more precise control of the airplane, less arm fatigue and an unobstructed view of the instrument panel.



# TECHNOLOGY UPDATE

## MILITARY



### New watch buys time

**S**aving the life of a wounded soldier depends on medical help arriving on time and knowing right off how to treat him. A new concept for a combat wristwatch-like communicator designed by Dr. W.A. Tacker of Purdue University may be what Army medics have been hoping for.

When a soldier is downed, he or a buddy can activate the watch, or sensors touching his skin would activate it automatically as his vital signs changed. Coded data on his temperature, pulse and location would be beamed to a radio interrogator device on a truck. The interrogator signals medics that someone is down, tells them where he is and decodes the medical data. An airborne interrogator could work with the truck interrogator to locate the fallen soldier.



### First all-Israeli fighter jet

**I**srael will soon have a supersonic fighter jet of her very own design for the first time. It's the long-awaited and still highly hush-hush Lavi shown in the artist's impression above. Until now, Israeli fighter pilots have had to rely heavily on the Kfir, a hybrid remake based on the French Mirage, and on aging U.S. F-4 Phantoms.

The new Lavi (Young Lion), expected to appear in the late '80s, is an advanced canard/delta configuration capable of speeds near Mach 2. Its all-moving canard foreplanes and computerized fly-by-wire controls will give it exceptional combat maneuverability and also permit low-speed takeoffs and landings on short desert airstrips. The Lavi will be partially funded through U.S. aid.

U.S.

## TRANSPORTATION

### UNSTOPPABLE TRANSPORT

According to its maker, only a helicopter can go into more places than this double-jointed, double-tracked all-terrain vehicle. Consisting of a pair of self-powered, articulated crawler units, it can climb 54° grades, ford streams and slog through deep snow or mud without sinking in because of its low ground pressure—less than half that of a human footprint. It's shown here as a mountain transport for skiers, but has many other uses, both civilian and military, from wil-



demess rescue ambulance to antitank missile launcher. The vehicle, which is designated the Bv 206, is manufactured by Hagglunds of Sweden. The machine has been adopted by the U.S. Army as part of our go-anywhere Rapid Deployment Force.



### ELECTRONIC DOG TAGS

In 1983, the Army started replacing its Jeeps with a new land-rover vehicle. And the old steel pot helmet, in which soldiers once bathed, shaved and even cooked, gave way to a plastic helmet that provides added protection, but would melt from cooking. By next year, another Army institution may give way to technology. New computerized dog tags are being tried by some units. The tags contain a microchip that encodes name, rank, service number and medical history. They have a 1k memory, about the same as a hand calculator.

### SPACE STATION 1991

NASA's next major project, a permanent space station, received its initial boost with the submission of design concepts. And now NASA says the space station (right) could be launched into orbit as early as 1991. The unit, which is estimated to cost approximately \$8 billion, would eventually be used as the launch base for exploration of Mars and beyond. Components of the space station would be shuttled into low Earth orbit and assembled in space. The space station would be equipped with a propulsion module, a docking module and a separate module to carry sensing instruments.

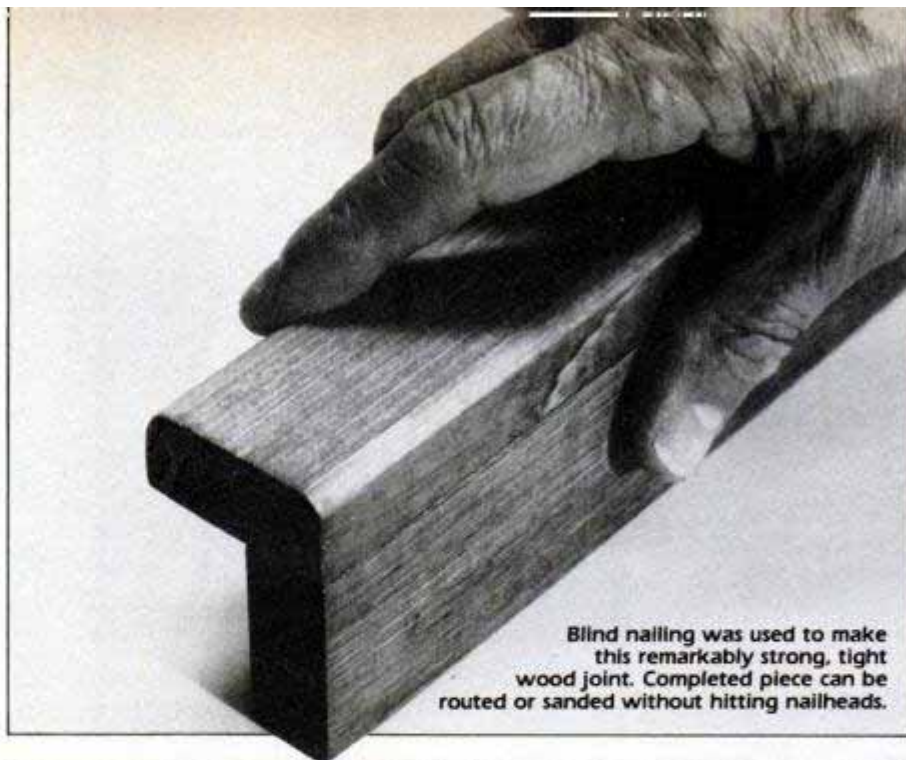




# Joinery With 'Invisible' Nails

Open your eyes to a no-show and no-tell wood joinery technique.

TEXT AND PHOTOGRAPHS  
BY JORMA HYYPIA



Blind nailing was used to make this remarkably strong, tight wood joint. Completed piece can be routed or sanded without hitting nailheads.

**T**he next time you need to join two lengths of wood, but don't want the nailheads to show, try a technique called blind nailing. When combined with glue, blind nailing is a fast, easy means of making remarkably strong wood joints.

This technique is most often used to produce a finished, L-shaped trim around countertops and table edges, and to conceal a plywood edge. You can also produce a wide variety of moldings—including baseboard, crown, chair rail and corner guard—by blind-nailing two, three or four routed pieces. Blind nailing is also used to edge-join boards to form wider panels.

## A tight-fitting joint

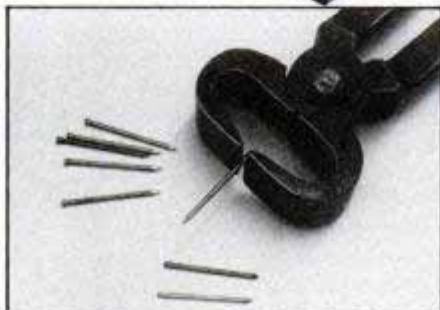
First, be certain that the two pieces to be joined form a tight-fitting joint. Sand or plane the wood where necessary. Next, mark the nail positions onto the larger, flatter piece. For most jobs, 1½- or 2-in. finishing nails spaced 6 in. apart work fine. In the photos, 4d (1½-in.) finishing nails are used to blind-nail ¾-in.-thick pine.

Cut off the nailheads with end-cut nippers or cutting pliers. Then hammer the nails partially into the edge of the first piece, as shown in the photograph. You should make certain that the nails don't protrude too far, otherwise they'll pass through the second piece.

Next, grind sharp points onto the protruding nails using a stone grinding wheel in a drill press or portable electric drill. The sharpened tip offers less resistance to wood penetration than the blunt-end nail.

## Gluing the wood

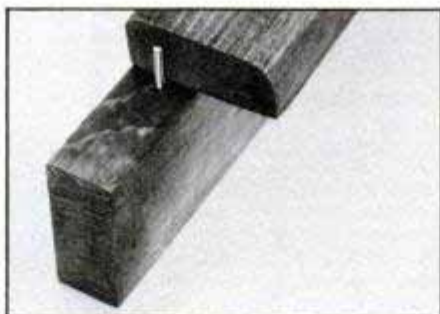
Apply carpenter's glue to the first piece and clamp it to the edge of a workbench. The protruding nails with the sharpened ends should be facing the rear of the bench. Position the sec-



Snip off the nailheads before you hammer the nails into the edge of the workpiece.



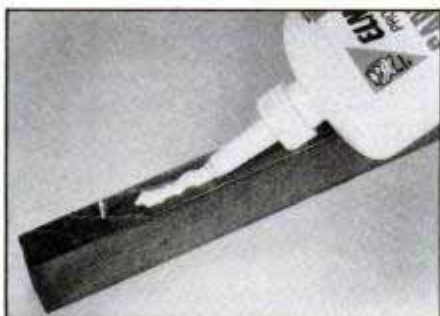
Space the nails as needed and drive them partially into the edge of the workpiece.



Use the mating workpiece as a guide to check the height of the protruding nails.



Grind the nails to a sharp point. A file can be used to sharpen the nails as well.



Apply carpenter's glue to the nailed edge. Be sure that the surface is clean and dry.



Tighten the C-clamps gradually to draw the two pieces together. Place newspaper down to absorb messy glue squeeze-out.

ond piece against the nails and apply pressure *gradually* by squeezing the two parts together with C-clamps. Tighten the clamps little by little, starting at the ends and working toward the

center. Place newspaper under the work to absorb any glue squeeze-out. After the glue has dried, the assembly is ready to be sanded, routed or planed without hitting the nailheads. **FM**



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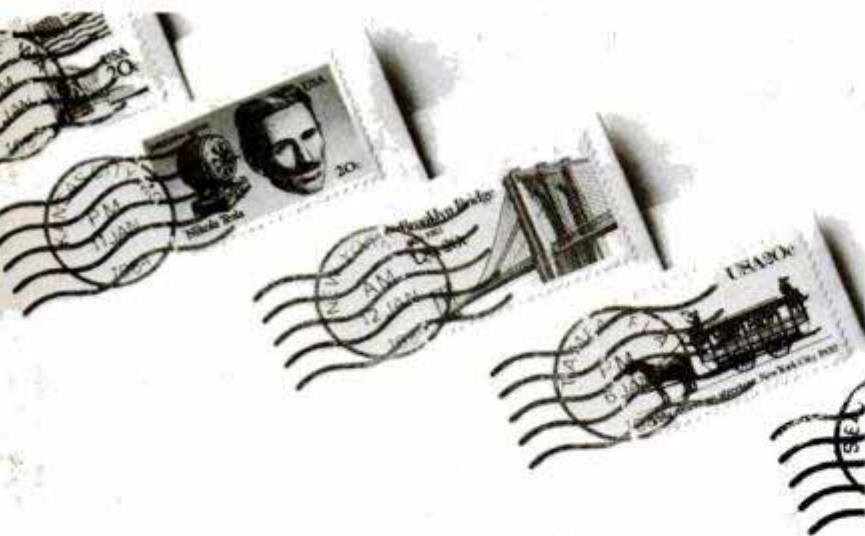
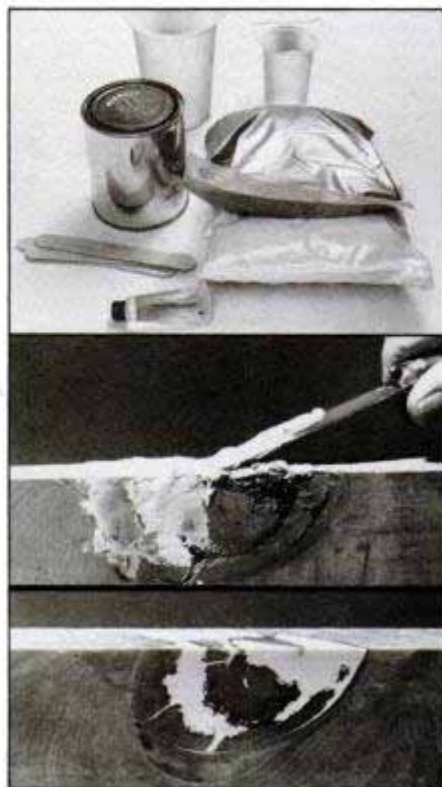
## A Wood And Masonry Filler

Miracle Putty is a resin-based patching compound used for making difficult repairs in wood, masonry, ceramic tile, plaster and more. The kit includes resin gel, wood mix, cement mix and a hardening agent. To use it, combine the proper mix with the gel and add a few drops of hardener. Mix thoroughly and apply with a putty knife. The wood mix is used for all but masonry repairs. It can be sanded, but the cement mix cannot. Both were found to be effective. The wood patch surpassed similar products because it could form a sharp corner (as shown) without chipping during rough use. Similarly, the cement mix showed excellent adhesion to masonry and could be feathered into a fine edge without loosening.

Each kit can make up to 1½ qts. of concrete mix or 1¼ qts. of wood mix. It costs \$16 postpaid from Anacon Co., 2737 North Hampden Court, Chicago, Ill. 60614.—Rosario Capotosto

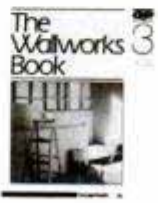
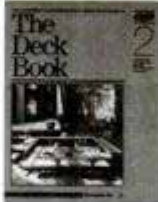


The kit (top, right) contains resin gel (can), wood mix (lighter bag), cement mix, liquid hardener, cups and sticks. It costs \$16 postpaid. Apply the filler with a putty knife (middle, right). Repaired gaps and cracks in the wood (below, right) are stronger than the wood itself, yet the putty can be easily sanded smooth. The cement mix adheres exceptionally well to masonry materials (above). It's quite durable and can be feathered to a fine edge before the filler sets.



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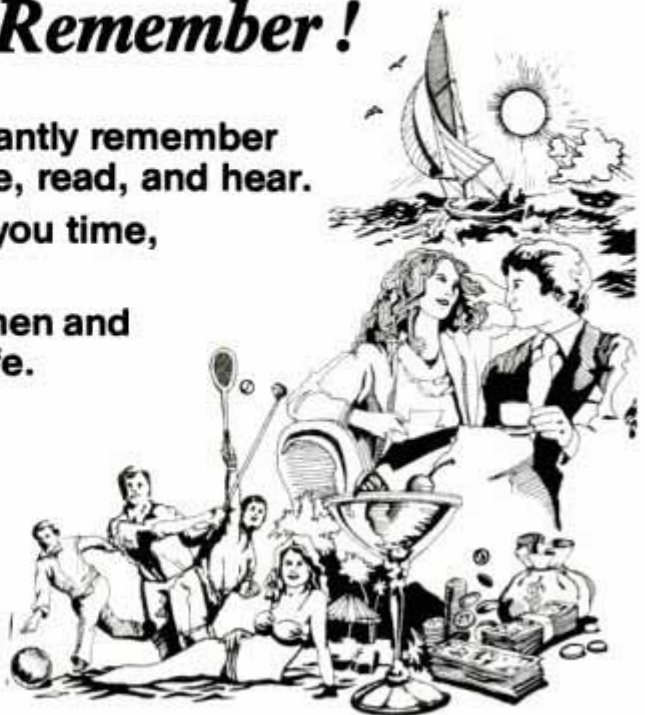
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## SCARIEST PLACES TO DRIVE

(Continued from page 86)

be doing *something* right. For some drivers, the worst place of all was Chicago's brutal Dan Ryan Expressway, known to long-haul truckers as the "Dirty Dan." This is where traffic from all over America thunders together from 12 directions, in 16 lanes! (But do you see Chicago in the NSC's top ten?) Now take a look at the story on page 86 for the "driving man's list" of the scariest places.

Out of all these gripes comes one discovery: Drivers are *really* pretty much all alike. If they're "stupid" because they don't signal in Boston or pile up in Los Angeles, then critics must also call them stupid in Houston because they drink coffee. It's hard to point a finger. New Yorkers told us New Jersey drivers were "the worst." Jersey drivers return the compliment.

But it doesn't prove anything. Where there's danger, we found, the finger often points not to drivers at all, but at the people who are handed billions of

dollars to rid our highways of dangerous places, and aren't doing it! In highway and police headquarters, some officials keep saying, "It's those stupid drivers." Then they go on sticking little black death pins in their maps to show just how those "stupid drivers" keep getting into trouble over and over again, in the same spots.

On some maps there's no more room for pins. Yet the same death traps remain unchanged. But when so many drivers find so many places to fear, it's time for some changes. **PM**

## PM Editors Pick Their 'Favorites'

**M**y least favorite road is the Brooklyn-Queens Expressway, which snakes its way through those two New York City boroughs. For the most part, it is an antiquated, twisting, potholed nightmare, sunken below street level—an open vehicular sewer clogged with private cars, commercial vehicles and the worst kinds of mobile urban wreckage, vehicular and human.

In fact, it's the people on the BQE who make it as bad as it is. Spastic drivers are the norm. They careen around trucks, have no lane discipline at all, loll along at a drug-numbered 30 mph, suddenly accelerate to 70, then brake to 20—all without warning and for no apparent reason. At night, parts of the Expressway are used for drag racing, three abreast.

My worst experience occurred several years ago when a bunch of drunks riding in a station wagon tried to throw firecrackers into my open convertible at 50 mph! It's a real pest hole.—*Wade Hoyt*

### California Highway 17

The worst stretch of highway—the one I hate most—snakes its miserable way over the coastal range between San Jose and Santa Cruz. California Highway 17 used to be a lot hairier before they put in those four-foot concrete center dividers, but it's still a 20-mile roller coaster.

Crowds of surfers and beach-goers stage weekend grands prix on 17, usually with drivers in the slowest cars going the fastest—those in Bugeye Sprites and clapped-out Baja Bugs. Then there's usually a couple of dicing Porsche 914s or the guy in the blowby Alfa trying to press by two girls in a new Supra. Mix generously with 18-wheelers puffing laboriously up the grades, stir in some blind entryways and even blinder curves, and you end up with what's essentially one never-dull lane each way.

There are turnouts, thank God, some even offering radiator water, and those

oases get plenty of use in the summertime. Triple A wreckers ply 17 like the Coast Guard off Florida, and if you want to see the signatures of drivers who either cashed it in or came close, check the center dividers for rubber marks. Some roll right up over the top! If ever a road needed straightening or widening or both, this is it.—*Michael Lamm*

### Henry Hudson Parkway

The silent, rusted-out hulks of wrecked cars dotting the route of the Henry Hudson Parkway (West Side Highway) north into the Saw Mill River Parkway are mute testimony to the dangers of this route into and out of Manhattan.

The Manhattan Island stretch is mostly under reconstruction now. But there are still long stretches of old cobblestone roadbed that become a virtual ice rink when wet. In addition, there are several tight switchbacks with exposed clumps of steel that used to be safety barrier, making this road an accident that's just looking for a place to happen.

Once up into Westchester, the Henry Hudson Parkway becomes the Saw Mill River Parkway and it's just as dangerous.

For many miles, there is no inside shoulder—just raw, exposed steel barrier inches away from your sheet metal. Combine that with many, many tight turns and switchbacks and it's no wonder the steel is twisted open, crushed and even missing in many spots. Not a fun road.—*Joe Oldham*

### John Lodge Expressway

There is a sign, but the determined usually ignore it. Leaving the GM Building in Detroit's new Renaissance Center area, the quickest way back downtown is to scoot south on U.S.-10, the John Lodge Expressway. The alternative is to exit the Lodge to eastbound I-94, then hit southbound I-75. This is where it gets tricky. The entrance to I-

94 east exits left from the Lodge, only 1,000 feet or so south of the Milwaukee Avenue on-ramp. To hit it, one must cross all four southbound Lodge lanes in quick order, causing no end of disorder among onrushing traffic. That's why it's prohibited.

The hurried or merely foolhardy still attempt it, since the move is virtually impossible to police. But if it's been raining or snowing, the hurried or foolhardy have a surprise waiting for them: As the exit from the Lodge turns left into the entrance to I-94, it apexes beneath an overpass. It's dark there, and in bad weather there frequently is a large puddle over the curve. This results in catastrophic, hydroplane-induced oversteer into the concrete retaining walls lining the passage.

Let's be careful out there, okay?—*Daniel Charles Ross*

### Northern State Parkway/Route 1

It's not the job of highway engineers to keep us on our toes—or brakes—but to design roads for the lowest common denominator of driving skills. Too many challenging highway quirks can be found from coast to coast. Decreasing radius cloverleaves are particularly perilous, especially in the wet. The world's tightest cloverleaf is Exit 31, southbound, Glen Cove Road on the west-bound side of the Northern State Parkway on Long Island. Calling it the Wall of Death may be exaggerating a little, but it's got to be the closest thing I've seen to the high-banked turn at the Mercedes-Benz test track.

Then there's Route 1 in Florida, the stretch through Coral Gables: In both directions it's a three-lane, concrete, slot-car track with curbs on either side, undulating and unforgiving. To negotiate it in heavy traffic is the greatest challenge to your sense of lane discipline. Signaling and changing lanes in a predictable manner is a must. Even the best driver, if he's in a car too large and softly sprung, will have trouble with this one.—*Bill Hartford*



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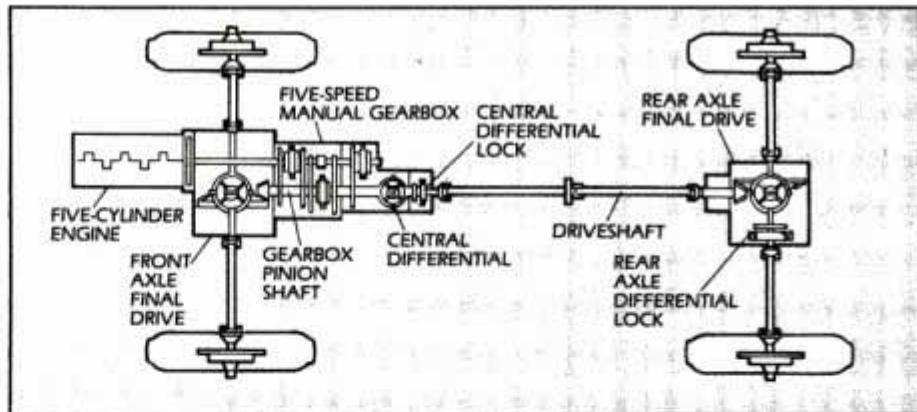
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Quattro drive train adds a driveshaft, rear axle and two differentials behind the normal Audi front-drive hardware. A driveshaft for the front differential passes through the tubular gearbox pinion shaft. The center dif-

ferential prevents tire scrub in turns, when the front and rear wheels travel through different arcs. The center and rear differentials can be locked for maximum traction when the going gets rough.

## FIRSTHAND REPORT: AUDI

(Continued from page 101)

fuel consumption. Even the Audi people seemed a bit confused about when to lock the differentials and when not to, but it was agreed that locking them would make the car understeer ("push") more in turns, and could make it more likely to skid on icy or slippery roads.

However, in deep snow, locking the diffs may be the only way to go. With the differentials locked, a Quattro can get stuck only if three of its four wheels lose traction.

Many 4wd vehicles can be immobilized if only two wheels begin to spin, and conventional cars won't move if only one wheel spins.

### Terrific handling

The Quattro's handling on dry pavement is wonderful. The tires stick to the road in a confidence-inspiring way and you feel there is no limit to the speed at which corners can be negotiated.

There is less understeer in the nose-heavy Audi with 4wd than with fwd, but on a dirt road I was able to detect mild understeer and even trailing-throttle oversteer—let off the gas suddenly in a turn and the rear end begins to slide out. Give it some gas and steer into the skid and you'll be okay, but it's a tricky maneuver for a novice to handle.

We drove the new Audis in Vermont ski country before the snows came. Acceleration on hilly roads is good only if you use the gears and really rev the engine. Performance is lackluster below 4,000 rpm, although the Audi's short gearing provides plenty of rpm when you need it.

There is a fuel economy penalty for all this buzzing, of course. The engine is busy, but not especially noisy, so Audi has thoughtfully provided a rev limiter that kills the ignition at the 6,200-rpm

redline to prevent any overrevving.

The transmission shifts crisply despite a rubbery linkage and lots of driveline windup. This windup occasionally causes a disconcerting "rubber band" effect on the 1-2 upshift, and on downshifts if you don't heel-and-toe the pedals to match the speeds of the engine and transmission before you let in the clutch.

An automatic transmission would mask this behavior, and Audi expects to have one available for the Quattro by next year.

### Brakes among the best

The Audi's four-wheel disc brakes are among the best I've ever used, and they worked perfectly to stop the car with no drama when I came whipping around a blind turn—only to find a dump truck backing out of a building site!

The Quattro's \$16,500 list price includes power steering, brakes, windows, door locks, antenna and mirrors (the latter are also heated), spoke-style alloy wheels, cruise control, full instrumentation and a four-speaker stereo system. The only options that you can get are a power sunroof and metallic paint.

That's a lot of hardware, but for \$16,500 one would like a few more luxury touches in the Audi's austere interior.

The 4000 retains its cheap plastic instrument pod, which is surrounded by flimsy switches, a dinky 2x4 vanity mirror and several pieces of Volkswagen hardware on the windows and doors.

Service accessibility on the Audi engine is a lot better than it looks at first glance. The five-cylinder engine is really packed into the engine bay, coming within about an inch of the grille (the radiator is alongside the engine). You really don't want to think about an

(Please turn to page 193)



# Save Gas, Save Engine with 'POLY'

The following introduces one of the most fully tested and credentialed gas-saving, friction-reducing engine treatments ever to reach the market!

**WHAT IS POLY?** "Poly" is short for polytetrafluoroethylene (TFE). It is the slipperiest substance known to man (1981 Guinness Book of World Records, p. 188). The Petrolon Corporation, makers of Slick 50, has invented a way to permanently bind this slippery chemical to your engine with one treatment. All you do is add one quart of Slick 50 to your oil during oil and filter change. By reducing engine friction, Slick 50 increases gas mileage and horsepower and reduces engine operating temperature, thus causing your oil and engine to last longer. Just as important, it reduces metal wear, defraying costly overhauls.

**HOW DO I KNOW THIS ISN'T A FRAUD?** Slick 50 has some very impressive credentials. The "Consumers Digest" magazine (March/April, 1982, p. 35) states "Slick 50 does reduce engine heat and ordinary wear, and our informal tests indicate that it will improve gas mileage by about 2 or 3 miles per gallon." Researchers at the Franklin Institute Research Laboratory, after applying a powerful ultrasonic cleaning process to a Slick 50 treated engine, were surprised at its permanence. They stated, "We actually expected the Petrolon Slick-50 TFE Resin coating to also be removed, but later found it was still there."

The FAA (Federal Aviation Administration) has fully accepted Slick 50 Aircraft Piston Engine Treatment (F.A.R. #33.49). An FAA test simulating 1400 hours of engine use (equivalent to about 70,000 miles on a car) showed almost zero engine wear!

2500 miles after removing Slick 50 from the crankcase, lab tests at a leading university engineering experiment station showed that the benefits of Slick 50 were still there. They reported a horsepower increase of 16.9% and 9.9% for light and heavy loading respectively. The senior engineering researcher at the University of Southern California in San Diego stated this, "Slick 50 does increase horsepower and decreases fuel consumption in tests done at the university." The Space Shuttle Columbia uses the chemical "poly" in its gears and bearings because it is the only chemical lubricant which can withstand the heat and corrosive elements of space.

Perhaps most dramatic of all is a tor-



ture test overseen by the Automotive Services Council for Pennsylvania and shown on television station WTVE. Three cars with between 75,000 and 129,000 miles on them were treated with Slick 50. Six months later the oil was drained from each vehicle, and the cars were driven without the oil plugs for about a half hour. The water temperature never rose, and the engines sustained no apparent damage. There are many more tests available. If you are still skeptical, send \$2.00 to defray printing and postage costs, and we will send you additional, more detailed test information, etc.

**HOW DO YOU TREAT AN ENGINE?** Very simply. A few minutes before oil and filter change, add engine flush (sent free with each order) to clean out the engine. Let the engine idle for 10 minutes. Then drain the oil, change the filter, and add the proper amount of oil less one quart. Add one quart Slick 50, drive for 30 minutes, and leave it in the crankcase for 3,000 miles. As the engine operates, the oil carries the polytetrafluoroethylene between the parts where it is burnished into the pores of the metal. Once impregnated, it is permanent, so you do it only once, not each time you change oil. One quart of Slick 50 will treat all standard 4-, 6-, and 8-cylinder gasoline and diesel engines.

**WILL IT WORK WITH MOST OILS?** Yes, Slick 50 will work with all petroleum-based oils and all synthetics that are compatible with petroleum-based

oils. An exception is graphite oils. However, once an engine is treated, you can go back to a graphite type if desired.

**WHAT ARE THE BENEFITS OF SLICK 50?** Your actual benefits in percentages may vary, depending on the kind of driving you do, vehicle condition, weather, and geographic area. By reducing friction, Slick 50 does all of the following: It increases gas mileage. It increases horsepower—small economy cars and large RV's really need this! It reduces operating temperatures, thus increasing the lubrication and life of the oil and the engine. Last but not least, the drastic reduction in engine wear defrays or eliminates costly overhauls which could save you up to \$1,000. Slick 50 eliminates the "lubrication starvation" that all cars experience when first started before the oil has a chance to circulate. Up to 90% of the engine wear on a car can be caused by this lubrication starvation. You receive all of these benefits for \$34.95, less than the cost of two tanks of gas.

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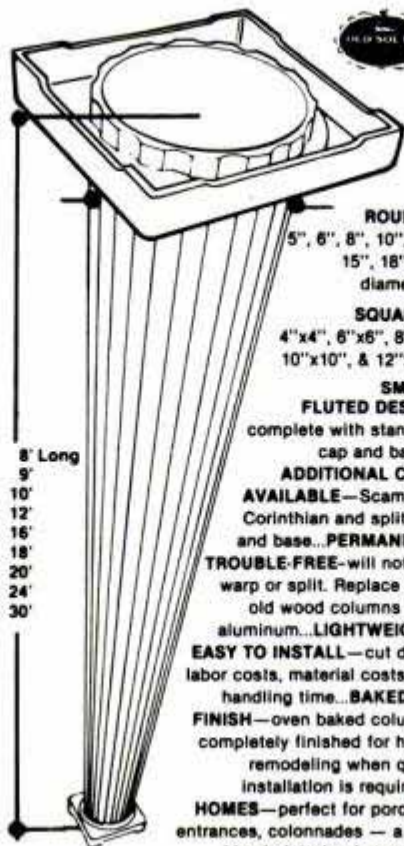
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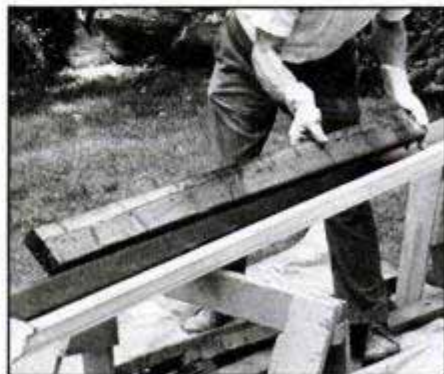


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A length of rain gutter makes an efficient "vat" for treating wood in preservative.



Seal end caps on the gutter with plaster of Paris to prevent chance of leaks.

gutter. I sealed the end caps on the piece of aluminum gutter with plaster of Paris (there's a chance that the petroleum solvents used in the wood preservative would dissolve other sealants and cause leaks).

With the gutter resting level on a pair of sawhorses, I was able to immerse 20 ft. of 2x4s and an 8-ft. length of 1x4 simultaneously. It required nearly 2 gal. of preservative to immerse this amount of lumber.

Since a three-minute immersion is required for 2-in.-thick-wood, I treated more than 120 ft. of 2x4s plus 240 ft. of 1x4s in about two hours. This amount of lumber absorbed almost 3 gal. of chlorinated phenol-type wood preservative in this length of time.

—David W. Roberts



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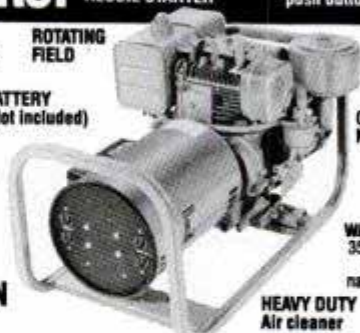
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manhandle the rudder controls to keep a straight course. Finally, at the far edge of safety, the airliner bounced off the tarmac and nosed over easily into a ditch, its tail pointing up. Miraculously, all on board escaped without injury.

"A man would be a fool not to be scared in that situation," Gibson said afterward. "But we did what we had to do."

"Tremendous job," said President Reagan during a special White House ceremony in Gibson's honor.

Pilots stopped wearing silk scarfs eons ago, and the computerized deck has taken some of the romance out of the pilot's image. But a well-trained and experienced crew, and a pilot who can think quickly in an emergency, are more than a luxury.

A case in point was the fiery landing of an Air Canada DC-9 at the Cincinnati airport last June 2. The landing ended in the deaths of 23 aboard the Dallas-to-Toronto flight, but eyewitnesses said it was a miracle that 18 passengers and five crew members survived.

### Jet fills with smoke

The incident erupted quickly as the jet began to fill with smoke in flight. All electronic indicators flickered and faded as pilot Donald Cameron struggled to bring the jet down safely. The fire originated in a lavatory, and the crew assumed it was caused by a cigaret. But it was later determined to have been caused by an electrical malfunction.

"I had no way of accepting directions from air traffic controllers," Cameron told a National Transportation Safety Board hearing. "I was unable to accept any readings." Still, with verbal instructions from air traffic control, and with help from a nonelectrical position-indicator, he managed to land the jet within minutes, allowing half the passengers to scramble out. When the smoke had cleared, the plane was burned out.

During the incident, Cameron had his hands full simply landing the craft. He had to rely on shouted reports from the crew on the condition of the plane inside the smoke-filled passenger section. Smoke reached the cockpit, too, and Cameron put on a pair of goggles. The smoke was so thick by the time the jet touched down that Cameron could barely find the cabin exit. The goggles may have been the main factor in saving 23 lives.

Airline pilots are often taken for granted. They're sitting behind a closed door or drawn curtains talking in monotones to the folks down below. Their world is flashing lights and changing numbers.

But to anyone who has faced a potential disaster, the pilot is bigger than life. Sometimes, he's life itself. **PM**

### WE MADE IT!

(Continued from page 81)

sense. Flying an airliner is a team effort, never illustrated better than in the cockpit of a Reeve Aleitoam Airways L-188 Electra turboprop en route from Cold Bay, Alaska, to Seattle on June 8, 1983. Captain James Gibson, First Officer Gary Lintner and Flight Engineer Gerald Laurin were in the cockpit.

At 20,000 feet, the propeller suddenly flew off of No. 4, the outboard starboard engine, and sliced into the belly of the fuselage. The cabin floor buckled. A few passenger seats—fortunately unoccupied—tilted toward the hole in the floor.

The plane dipped into a falling right-hand turn. Gibson pulled at the controls, but they wouldn't budge. He tried to throttle back the port engines to overcome the imbalance of power, but there was no response. He reasoned that the collapsed cabin floor had jammed the cables that ran through the lower level of the fuselage. All the controls were frozen.

Gibson activated the autopilot, hoping that its mechanical strength could overcome the resistance. The aircraft slowly leveled off, although engine speed remained uncontrollable.

The pilot reported honestly to the passengers, explaining the control problems. He continued his reports

periodically, as the drama stretched out over the next six hours. They turned back toward Cold Bay, reversed course to King Salmon, Alaska, and finally headed for Anchorage, where emergency equipment was plentiful. The problem was that the plane could not land on autopilot.

Gibson hoped that the mechanical system would slowly wear grooves in the debris that rested on the control cables. Finally, he disengaged the autopilot and discovered that when he and Lintner—and sometimes Laurin, too—applied their muscles to the stick, they could, indeed, force some movement. Gibson took the microphone and told the exhausted, frantic passengers that they were ready to land.

Gibson shut down No. 2 in order to lose altitude. He and Lintner forced the flaps down and manned the stick in tandem as Laurin navigated. They pushed and pulled at the controls, managing to bring the plane down in a long, shallow glide. As the wheels touched, they shut down the remaining engines.

### Careening down the runway

Impact was unexpectedly harsh. The brakes were frozen on, causing the tires to blow. The plane careened down the runway, using up the available distance. The pilots could do nothing but



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# TEXACO





## STAY AFLOAT

(Continued from page 83)

100,000 boats per year, and mostly the rate hovered around 20. By 1974, the rate dropped to 13.5, and since then it has gradually declined, to 7.9 for 1982.

That may look pretty good, especially considering that the number of boats has doubled. But there are still about 1,200 fatalities a year from boating accidents. The Coast Guard estimates that this number could be cut in half if everyone wore PFDs while on or near the water.

### How a life jacket works

Primarily, a life vest helps you stay afloat. To do this, its buoyancy must support the body's 10- to 12-pound weight when submerged. Increased buoyancy floats you higher in the water.

Turning you onto your back so you float face up is secondary. A vest's righting moment depends on where it's buoyant. If most of the flotation is in the chest area, and little or none in the back, the PFD has a strong righting moment. Evenly spaced flotation keeps you afloat, but can't turn you over if you land face down in the water.

Since current rules do not allow inflatable PFDs, buoyancy means bulk. For strong righting moment, that bulk must be concentrated in the front with a large padded collar behind your head to hold it up.

**Problem:** You can order navy sailors to wear whatever you issue them, but recreational boatmen won't buy—and certainly won't wear—life jackets that are hot, awkward and uncomfortable. Some active boating and water sports would become impossible in such vests.

The trade-offs balance comfort and wearability against buoyancy and righting moment. You can easily tell how the compromise went for any PFD by its type and labelling.

### Life jacket types

**Type I** offers the most buoyancy, 22 pounds minimum in the adult size, and the greatest righting moment. It's bulky and the least comfortable, but, to quote Coast Guard specs, suitable "for cruising on waters where there is a probability of delayed rescue, such as large bodies of water where it is not likely that a significant number of boats will be in close proximity." Except for offshore cruising, chances are a Type I is not for you.

**Type II** includes the familiar horse collar or bib that's been around since WWII. Smaller than a Type I, it has only 15½ pounds of flotation in the adult size instead of 22. And, while it will

turn you face up, it has less righting moment than a Type I. The spec suggests, "you may prefer to use the Type II where there is a probability of quick rescue."

**Type III** PFDs, first permitted by the 1973 regulations, distribute flotation evenly around for a trimmer, less bulky look and greater wearability, but offer little or no righting moment. It won't turn you face up in the water, but you shouldn't have to fight it to keep your face out, either.

The Coast Guard recommends a Type III for the same well-trafficked waters as a Type II. Their specification reads, "A Type III can be the most comfortable, comes in a variety of styles which could be matched to the individ-



**Type III Sportsman Vest by Coleman has two cargo and two breast pockets for gear.**

ual use, and is usually the best choice for water sports such as hunting, fishing, canoeing, and kayaking. . . ."

We show an assortment of Type IIIs which are usually offered as vests or jackets and may have extra features like pockets, water skiing harnesses, and other options.

**Type IV** PFDs are not wearable. They're cushions and rings you throw to someone in the water and should be used only to supplement wearable life jackets, not as substitutes.

**Type Vs**, with the same buoyancy as Types II and III, have been approved for restricted use. Until this year, none has met standards to be carried on recreational boats.

Recently, several Type V boardsailing vests—approved for sailboard use only—and flotation foul-weather gear or deck suits gained acceptance. They're approved only for boats carrying other approved PFDs, and only if they're being worn, since most would take dangerously long to don in an emergency.

Permanent labels tell what a PFD has been designed to do. Every Coast Guard-approved model has a Type I, II, III, or V label. The label also indicates intended uses like ski vest or white water vest, and gives sizes and weight ranges for wearers. You also get advice about cleaning, construction materials, legal requirements and other special requirements like Impact Class. A vest for water skiers must stay in place in a 50-mph impact with water. General-purpose boating vests are tested at up to 35 mph.

### Specific features

Once you've picked your PFD type, look for specific features. If you need a Type II, the choice is limited, since all are about the same. You can have either kapok or plastic foam flotation material. Kapok costs less, but requires more care. Plastic foam material will hold up better, but the vest may be uncomfortably stiff.

Cover materials vary. Pick canvas for comfort, but remember it can mildew and disintegrate with time. Nylon requires less care, but is slippery and nonabsorbent. Since Type IIs cost about \$30, they're easier to replace than the more expensive Type IIIs, which can go for up to about \$100; most are about \$60.

Type IIIs come with a dazzling variety of special features, colors and designs. Hunting and fishing models in plain colors or camouflage offer a multitude of special pockets, lure hangers and creel clip rings. Ski vests, in a blinding rainbow of colors, mount from two to five belts to make the 50-mph impact standard. Canoe PFDs have padded shoulders to take the pain out of portaging. Flexible, lightweight kayaking vests are cut for freedom of motion.

General boating vests have been made thinner and more flexible, with the accent on high style, while meeting flotation requirements. Many of these life vests look like conventional land-bound outerwear.

You can pick any Type III that appeals to you. All perform about the same and the intended-use label is merely a suggestion. There's no reason you can't use a kayaking vest on a sailboat or vice versa.

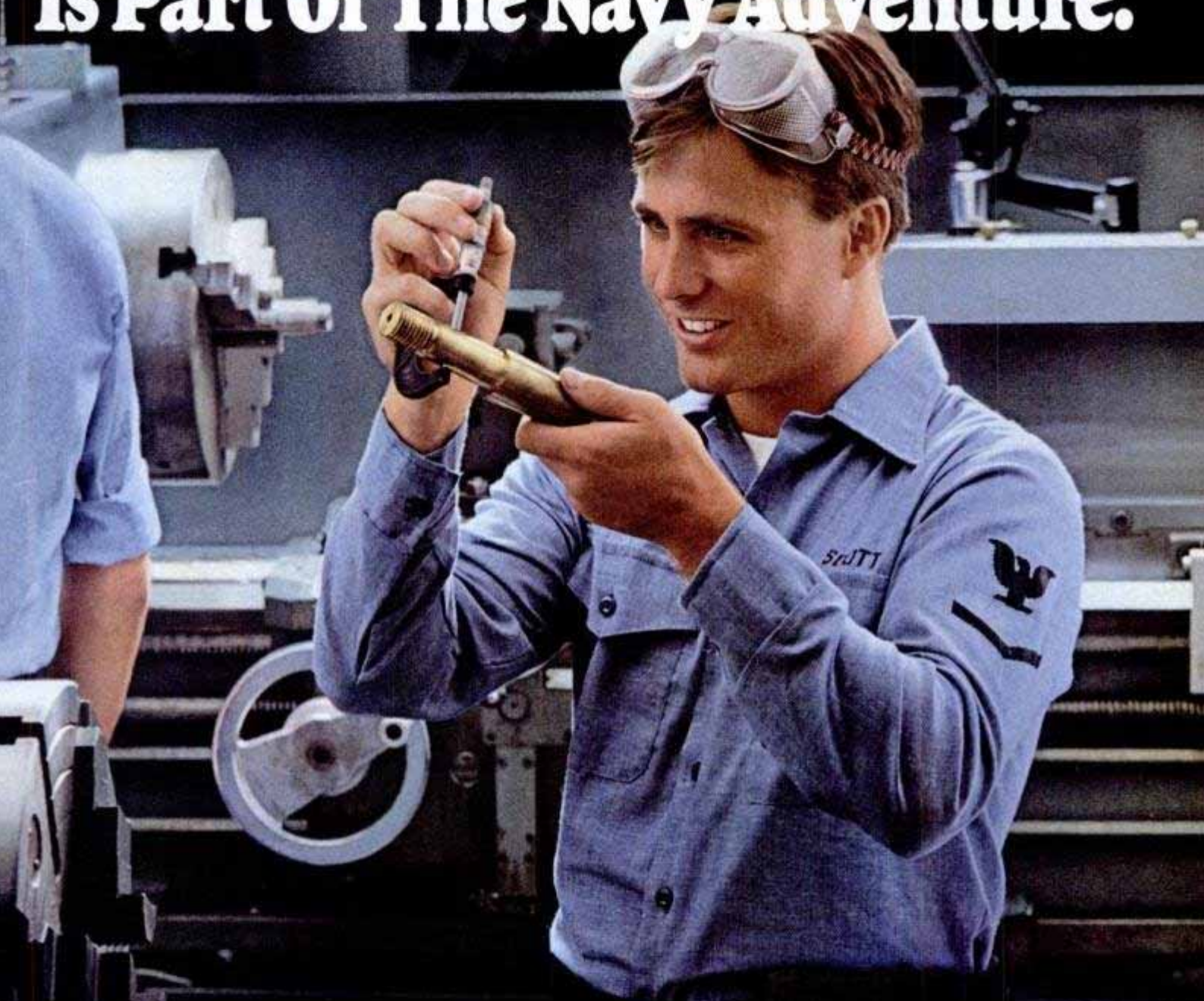
### A comfortable, snug fit

Any PFD should fit comfortably and snugly. Check for binding and chafing. Try going through the motions of your normal boating activities while wearing it in the store over your normal boating clothes. Check that straps or webbing are securely stitched and seams reinforced.

Strong colors can speed rescue as  
(Please turn to page 178)



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## STAY AFLOAT

(Continued from page 176)

well as brighten appearance. Reds, oranges and yellows work well.

Adjustment systems differ, so one may work better for you than another. While you'll probably wear your PFD a bit loosely, you want it to fit tightly in the water to keep you warm and make swimming easier. A snug-fitting vest can stave off hypothermia, a debilitating lowering of body temperature, and thus save you from more than drowning.

Pockets with plastic zippers resist saltwater corrosion that can cause a metal zipper to stick. Snaps and Velcro also work well. Carry warning devices secured in the pockets as well as your keys or wallet.

### Learning your life jacket

Once you get your life jacket, try it out in the water as well as on board. Weight and size ratings are approximate at best, and what you really care about is how your PFD works with you in it. Make certain it keeps your mouth above water. Work its adjustments. Try swimming in it to see what stroke works best. Practice putting it on and taking it off in the water, as well as when you're high and dry. Remember, you don't want any surprises in a real emergency.

Once you've adjusted your PFD for fit, make it really yours. Put your name on it if you're the only wearer. Don't attempt to alter it. If you want changes, get a different brand or model that incorporates them.

Don't use your life jacket for a kneeling pad or boat fender. Avoid rips and punctures. Inspect its condition periodically. If it has kapok filling, make sure it's not waterlogged or hard. If it gets wet, dry it slowly, not quickly in front of a radiator or fire.

And, when you go out on the water, wear it. **PM**

### MANUFACTURERS—PFDs

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- Atlantis Weathergear Inc., Sag Harbor, N.Y. 11963.
- Buddy Schoellkopf Products Inc., Dallas, Tex. 75236.
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- Gladding Corp., Flotation Div., Greenville, S.C. 29604.
- Grumman Boats, Marathon, N.Y. 13803.
- Kent Sporting Goods Co. Inc., New London, Ohio 44851.
- Medalist Leesburg, Leesburg, Fla. 32748.
- Mustang Sportswear Inc., British Columbia, Canada.
- North Sports Div., North Sails Inc., Milford, Conn. 06460.
- O'Brien International Inc., Div. Coleman Co., Redmond, Wash. 98052.
- Omega Corp., East Boston, Mass. 02128.
- Red Head Brand Corp., Dallas, Tex. 75236.
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**MOTOR OIL**  
(Continued from page 91)

nations. Five are preceded by the letter S and apply to gasoline (spark-ignition) engines. Four are preceded by the letter C and apply to diesel (compression-ignition) engines. The following descriptions will help you select oil having the correct service classification for your engine:

Oils designated *SF* are needed by gasoline engines in 1980-84 cars and light trucks. They possess the extra additives that these engines, which have advanced emission-control systems, need. Many *SF* oils also have friction modifiers. Non-*SF* oils don't.

If you own a pre-1980 model, you can still use *SF* oil. However, you'll be paying extra for additives your engine doesn't need.

Oils designated *SE* are for 1972-79 gasoline engines. They possess more additive protection than *SD*, *SC* and *SB* oils, but not as much as *SF* oils. Oils designated *SD* are for 1968-71 gasoline engines, *SC* oils are for 1964-67 gasoline engines and *SB* oils are for those old "classics." As a practical matter, it is difficult to find oil that is *not* rated either *SE* or *SF*.

The C classifications are *CD*, *CC*, *CB* and *CA*. *CC* and *CD* oils are designed for naturally aspirated, turbocharged or supercharged diesel engines. Many

times they can be used interchangeably, but sometimes they can't, so be sure to consult your owner's manual. Ironically, oils designated *CC* were introduced in 1961, oils designated *CD* in 1955.

It's not unusual to find the *S* designation combined with *C* on a container—for instance, *SF-CC*. It means the oil may be suitable for both API Service *SF* and API Service *CC*. But don't automatically assume that it is okay for your car. Some diesel manufacturers suggest the use of oil designated *only CC* or *CD* (with no *S* designation). Be sure to check your owner's manual.

You may find a whole string of designations on some oil cans—*SF-SE-SD*, for example. It just means the oil may be used in engines calling for any of the designations, except as noted above.

■ **Viscosity rating.** Selecting oil compatible with the ambient temperature in your area assures you that the oil won't thicken when it's cold (which may reduce lubricity). The viscosity rating of oil is on the container, preceded by the initials *SAE*. The higher the *SAE* number, the higher the temperature at which the oil can protect an engine.

There are two types of viscosity ratings—single and multi. Single-viscosity oils have one number—*SAE 30*, for example. Multiviscosity oils have two, such as *SAE 10W-30*. The letter *W*

(Please turn to page 183)

**Mail-Order Oil Analysis**

**T**ruck fleets, airlines, Amtrak, the U.S. Army Corps of Engineers and many industries depend on spectroscopic oil analysis to tell them when to change engine oil, perform routine maintenance and rebuild (or unload) vehicles.

Just as a blood test can tell a doctor what's wrong with your body, a lab test of your engine oil or transmission fluid can tell you what's happening inside this equipment. For \$20.95 to \$17.25 (if you buy four), Precision Diagnostics will send you a little kit that allows you to draw a sample out of the dipstick tube on your engine or transmission. When you mail them the sample, they will check it for metal and dirt content, coolant and fuel dilution, then send back a computer print-out of recommended action.

Our staff sent in several samples, and the findings ranged from a bland but welcome "unit and oil are in satisfactory condition" to "abnormal amount of abrasives (dirt) present," with the recommendation to change oil and filter immediately.

Less fortunate owners have been informed of "abnormal wear conditions" and advised to "inspect rod and main bearings," to "inspect turbocharger for wear" or to "inspect (transmission) clutches and oil cooler."

Good as it is, this service is a bit expensive for every oil change. But it's a good

idea every 15,000 miles or so, before you buy a used car, or before your new car warranty expires. Sampling kits are available from Precision Diagnostics Inc., 777 Silver Spur Rd., Suite 132, Rolling Hills Estates, Calif. 90274.—*W.H.*



Suction container included with kit is used to draw an oil sample from engine.



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"There are lots of slick oils on the market but we've found one that does what it promises... TUFOIL works. It stayed in dispersion and cut the fuel bill 10%."

Popular Mechanics Magazine, January 1982

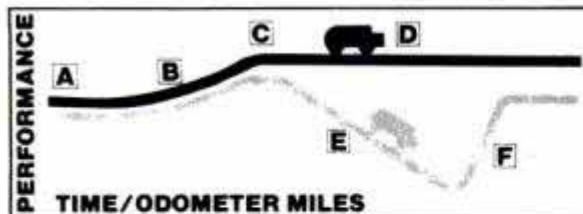
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Robert Peppin, 1982 NAPA/NIASE Mechanic of the Year

"Lubrication engineer Franklin Reick succeeded where everyone else had failed... TUFOIL is a unique, different, but safe kind of Teflon/oil additive."

Motor Age Magazine, April, 1982

**Chart Shows**....how TUFOIL improves and maintains high performance levels in new cars and helps restore older cars to their best performance level.



**A.** Performance level of Black and Grey cars when new. **B.** Improvement in performance as both cars break in. **C.** Further improvement of Black car's performance when TUFOIL is added. **D.** Regular use of TUFOIL in Black car significantly slows decline in performance through age and mileage. **E.** Decline in performance of Grey car with age and mileage without use of TUFOIL. **F.** When TUFOIL is added to Grey car, performance dramatically improves.

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## MOTOR OIL

(Continued from page 180)

indicates that the oil is suitable for use in winter.

Single-viscosity oils are restricted to more limited temperature ranges. For example, SAE 30 oil gets too thick for use when the outside temperature goes below 32° F. and too thin when ambient temperature exceeds 105° F. Before winter, therefore, it usually has to be replaced with a thinner oil, such as SAE 20W, and in a hot climate in summer, with a thicker oil (SAE 40).

Most people prefer the convenience of not having to change oil with the seasons or when driving from one climate to another. A multiviscosity SAE 10W-30 oil, for example, may be used from 10° F to 105° F.

With the exception of VI improvers, both single and multiviscosity oils generally contain the same additives.

Why use a single-viscosity oil? The only advantage is that it's less expensive than multiviscosity oil. However, offsetting this is the fact, says GM, that multiviscosity oil—SAE 10W-30, in particular—allows you to get a "tad better" fuel economy.

**Q:** What does the term "passes ASTM sequence tests" mean on an oil can label?

**A:** Although they're not required to do so, most oil companies indicate on their containers if oils have undergone ASTM Sequence Tests, which are also called Car Manufacturer Sequence Tests. These are a series of laboratory tests that measure the performance of oils under severe conditions.

The inclusion of a statement, such as the following, is a further guarantee that the oil you pour into your engine is of high quality:

- "Meets Car Manufacturer's Test Requirements"
- "Passes ASTM Sequence Tests"
- "Sequence Tested"
- "Exceeds (or Surpasses) Car Manufacturer's Service Requirements"
- "Meets (or Exceeds) Car Manufacturer's Warranty Requirements"

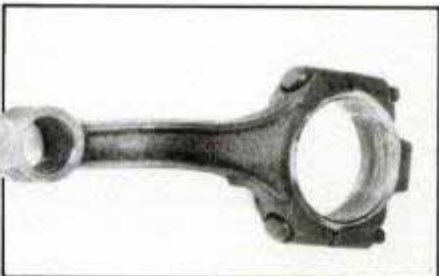
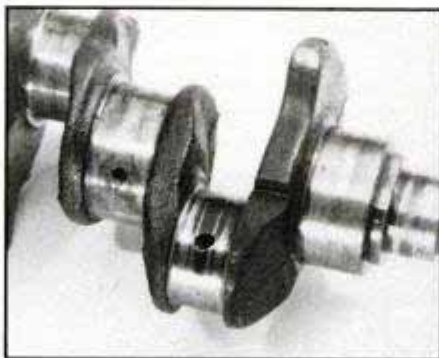
Some oils just squeak past these tests, while others exceed them by a wide margin. When one company offers several lines of oil that all pass ASTM tests, the more expensive ones usually got better "grades."

**Q:** Can I really change my oil at 7,500-mile intervals, as recommended in my owner's manual? My mechanic recommends 2,000 miles. Whose advice should I take?

**A:** In the days before additive development, the only way to get rid of contaminating agents before they caused trouble was to change oil frequently. For example, with the 1953

Skylark, Buick advised owners to change oil every 2,000 to 3,000 miles. For a 1983 Skylark, the recommendation is every 7,500 miles or 12 months, whichever comes first.

Surprisingly, the '53 recommendation applied to a 322-cu.-in. V8 engine, which supposedly ran at a cooler temperature and was less punishing to its oil than the 151-cu.-in., four-cylinder



Catastrophic engine damage caused by oil breakdown includes severe wear on crankshaft journals (top) and big-end bearings (center). This damage caused a connecting rod to seize, which bent the rod (bottom) and damaged the engine's cylinder bores.

engine that's standard in the '83 Skylark. But did it and was it? The answer to this question is the answer to a current controversy.

Some oil companies, engine rebuilders, independent mechanics and aftermarket parts manufacturers say that smaller engines run hotter and punish oil more than large, "lazy" engines. Therefore, oil should be changed frequently (every 2,000-5,000 miles) in small engines. Auto manufacturers and many oil companies say "no."

At an API meeting in Detroit last year, test results were submitted that showed four-cylinder engines actually operate at lower temperatures than V8s. The design of the smaller engines

(Please turn to page 184)

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## MOTOR OIL

(Continued from page 183)

and the use of thermostatically controlled cooling fans were cited as reasons.

Therefore, the report stated: "There is no evidence to support the contention that oil in four-cylinder engines is being punished."

Also, last year, a team drove several new Hondas on round trips between the Honda Training Center in Moorestown, N.J., and New York City. The route included stop-and-go operation in the Big Apple. Each car was fed SF oil

that was changed no oftener than every 7,500 miles.

When the cars had accumulated 100,000 miles, they were sent to Japan and the engines were dismantled for inspection. The outcome? No unusual wear or damage!

The API report and the Honda test say to us that a motorist can achieve maximum engine life at the lowest cost per mile by following the oil change recommendation of the carmaker as stated in the owner's manual. However, be aware that every manufacturer provides two sets of recommendations—one for "normal" driving condi-

tions and the other for "severe" driving conditions.

Although there are some minor differences between manufacturers in defining these conditions, GM's definition seems to cover it: Normal driving, says GM, is when a vehicle is driven daily in a clean environment for at least 20 miles, with five of those miles at a steady speed. Furthermore, an ambient temperature of 32° F. to 90° F. must exist.

Severe driving is defined by GM as all other driving conditions. This includes short trips; stop-and-go operation; allowing the engine to idle for long periods; most winter driving; driving in dusty or industrial areas; driving at sustained high speeds with the ambient temperature over 90° F.; and towing a trailer.

If a vehicle is driven under "severe" conditions, automakers generally recommend changing oil at about one-half the "normal" driving interval, or even more frequently. For instance, Ford suggests 7,500-mile (normal driving) and 3,000-mile (severe driving) intervals.

If you exceed the recommended change period, the following may happen:

- A greater buildup of soot and partially oxidized hydrocarbons could result. They contribute to sludge and varnish formation that can plug the oil screen and oil rings, interfering with oil circulation and resulting in severe damage. This gum can also cause hydraulic valve lifters and valves to stick.

- Corrosive acids may form that will attack piston rings and cylinder walls.

- Steam may condense on cylinder walls, then drain into the crankcase, combine with acidic gases and circulate to cause rust on valve lifters, valve stems, piston pins and rocker arm shafts.

**Q:** What are the advantages and disadvantages of synthetic motor oils?

**A:** Synthetic oils are made by synthesizing raw materials to make the base stock, rather than refining them from crude oil. The additives put into synthetics are the same as those put into natural motor oils.

The major advantage of a synthetic oil is that it outperforms a natural oil in extremely cold temperatures. Because it's thinner, it allows better starting. It also increases fuel economy by a few tenths of a mile per gallon.

Manufacturers of synthetic oil claim that it doesn't have to be changed for 15,000 to 25,000 miles. However, this oil costs \$3 to \$5 a quart, so the longer change interval gives you no price break compared to natural SF oils.

Furthermore, if your vehicle is under  
(Please turn to page 186)



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## MOTOR OIL

(Continued from page 184)

warranty, you still must change oil when the carmaker says so to keep from voiding the warranty. Vehicle manufacturers say that additive depletion progresses at the same pace for both synthetic and natural oils.

**Q:** Should I replace the oil filter at the same time I change oil?

**A:** The answer to this one question comes down to whom you believe—vehicle manufacturers or auto repair facilities. Service people generally contend that it's foolish to leave dirty oil trapped in the filter to mix with and contaminate new oil. They therefore suggest changing the filter when you change oil.

Auto manufacturers say that the small amount of contaminating agents in the one pint to one quart of oil remaining in the filter will not adversely affect several quarts of fresh oil.

What do we think? We're on the side of caution. A new filter doesn't cost that much, especially if you install it yourself.

**Q:** Should I use a nondetergent oil in my older car?

**A:** All carmakers now recommend that you use a high-detergent oil. Many oil companies put

the letters HD (for High Detergency or Heavy Duty) after the SAE numbers on their labels. As a matter of fact, it's pretty hard to find nondetergent oils anymore.

**Q:** I thought that Teflon and motor oil don't mix. How come I still see Teflon oil advertised?

**A:** This is a long story that we'll try to make as short as possible: Teflon is duPont's registered trademark for polytetrafluoroethylene (PTFE).

Frank Reick of Fluoramics Inc. spent years finding a way to combine PTFE with motor oil in a way that won't settle out or harm an engine. He sells it as an additive called Tufoil (see *A Super-slick Oil Additive That Works!*, Jan. '82, page 74). Then the energy crisis hit and so did the snake oil salesmen, bringing out many quick mixes of Teflon and oil that either didn't work, or clogged up oil passages and caused engine damage. DuPont got a lot of nasty mail and issued a statement that Teflon and oil don't mix.

Reick cried "Foul!" and duPont eventually sent him a letter that, in very careful legal terms, essentially said: "We didn't mean Tufoil." But the bad publicity has travelled farther and faster than the retraction, as usual. For the record: PM has tested Tufoil and found

that it worked. Brands that use the word "Teflon" on the label (Tufoil says "PTFE") do not have duPont's blessing and often do not work.

**Q:** How should I break in a new car? Are there still special break-in oils for the first few hundred miles?

**A:** Modern engines no longer need special break-in oils nor an elaborate break-in procedure. Follow the advice in your owner's manual. Most say to avoid full-throttle acceleration and high speeds (over 55 mph) for the first 500 to 1,000 miles. On the highway, don't drive at steady speeds and load for extended periods. Let up on the accelerator every few minutes, if it's safe to do so, and let the engine coast for a few seconds. And that's all there is to it!

**Q:** When will American oil companies start selling oil in easy-to-pour plastic bottles, like they do overseas?

**A:** Quaker State has already started (see *The PM Garage*) and other companies are likely to follow. The main problems, up to now, were finding a big enough supply of bottles for the U.S. market at a low enough price, and figuring out how to fill them as fast as cans at the packaging plant.

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## MINIVAN TEST

(Continued from page 155)

derneath the rear bench. Unfortunately, its control switches are on the dashboard.

The VW's main cargo floor suffers from a raised area over the rear-mounted engine. In other words, the floor stands on two different levels. The huge sliding side door opens wide for easy entry to both benches, the rear seatback folds flat, and the liftgate gives good access to the engine and elevated cargo deck.

### Toyota Van

Toyota's Van (formerly called Van Wagon) does everything well, but nothing outstandingly. Its radically short wheelbase (88 inches) makes for a choppy ride, and the soft shocks give a mushiness that creates a pitching sensation in the front seats. There's also noticeable impact harshness over rough surfaces.

I felt a fair amount of understeer during hard cornering, and this vehicle broadcasts more engine noise and wind roar than the rest. I also experienced an excess of brake fade after several repeated panic stops from 55 mph, and the brakes on this particular vehicle pulled to the right. There's a load-sensing proportioning valve in the braking system, but I've seen test drivers lift both rear tires a foot off the ground by stomping the brake pedal. This was with a fully loaded Van!

Hard acceleration with Toyota's four-speed automatic transmission is adequate, but not spectacular. Toyota's overdrive lockout button behind the shifter keeps the automatic from engaging its top ratio, or you can punch it anytime you want to downshift from FOURTH to THIRD. The Van's standard transmission is a manual five-speed. Both gearboxes deliver pretty much the same performance and fuel mileage.

The Van's ventilation proved the best of the lot, especially with the optional dual air-conditioning system. This provides a multitude of outlets not only in the instrument panel, but also in the central bulkhead for rear passengers. The dual air costs \$1,200 extra and includes a separate set of temperature and fan controls to the left of the middle bench. However, the main a/c switch is on the instrument panel.

Toyota also offers an optional single air conditioner for \$600, an ice-making refrigerator (\$200) and twin sunroofs (\$800). Even without air conditioning, though, the split front/rear vent system does a fantastic job and moves a great volume of air. Then, on top of that, the side windows slide open and shut for even more ventilation versatility.

Driver vision in the van, however,

suffers in two ways. First, there's a forest of headrests to peer through, and second, the side windows are heavily tinted with a bronze or bluish metallic mirroring. This tint cuts heat, but it also reflects the van's interior under certain lighting conditions. I don't favor reflective windows in any automobile for that reason.

All four of these vehicles seemed extremely well put together, and I have no quibble with any of their overall workmanship. However, each make showed orange peel on its painted surfaces. I noticed bubbles, too, in the Vanagon's windshield.

Except for the Toyota, all engines are highly accessible for routine maintenance. In fact, even the Toyota's powerplant isn't all that hard to reach, just harder than the rest. To compensate, Toyota's service intervals are the longest of the group.

### Minivans in review

To recap, then: My first choice among these vehicles would be Chrysler's Dodge Caravan and Plymouth Voyager. They are by far the most friendly, well-engineered and pleasant of the lot. It's also a very good financial deal at a base price of approximately \$8,700.

If you don't need the cargo-carrying capacity—if you're hauling just people—go for the Vista. It's tremendously thrifty and as smooth-running, comfortable, and nearly as accommodating as any full-sized American station wagon. Yet its economy, versatility and price make it exceptionally attractive.

The Volkswagen Vanagon gets the nod for those who need vast echo chambers of space. And the Toyota Van has, admittedly, a certain flair in its futuristic styling.

All these vehicles come in several trim and equipment levels. Most can be ordered with all the convenience and power options available for passenger cars, including cruise control, power windows and door locks, sophisticated sound systems and so forth, easily adding \$2,000 to \$4,000 to their base prices.

The Vanagon can also be factory outfitted as a camper; in that configuration it's \$15,800. Chrysler tells me that several camper conversions are in the works for the T-van, and I suspect the same applies to the Toyota Van.

Chrysler has shown customized sporty T-vans plus commercial versions of the T-115, with blind rear quarters and a blanked-out liftgate window. Even now, Dodge dealers offer a stripped Mini Ram commercial model, sold with the driver's seat only, for approximately \$7,600. There's sure to be more in the boudoir vein when van conversion shops get their hands on these versatile vehicles. **PM**

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## VIDEO

(Continued from page 96)

teamed with a rechargeable battery pack that can power one hour of continuous taping. The camera has an extremely fast, f1.2 lens with a 6x zoom range. With a suggested retail price of \$1,595, Betamovie isn't cheap, particularly since it can't even be used to dub a tape.

Recently, other video manufacturers have been offering battery-powered recorders compact enough to make home videography practical. Today, such portable recorders seem to have cropped up in almost every video-equipment line.

Some portable VCRs are really scaled-down home machines, lighter in weight—usually about 15 pounds or so—and battery operated. But this isn't the kind of machine you lug around on a strap over your shoulder. You carry it by its handle to where you want to shoot and set it down.



A 20-minute Compact video cassette is shown in front of a normal VHS cassette.

A truer breed of portable is the pure recorder that weighs about 6 to 9 pounds. It's light and compact enough to carry with a shoulder strap while you are shooting, yet it uses a standard-size Beta or VHS cassette. Many of these true portables come with a companion tuner/timer. Others are sold separately but will work in conjunction with auxiliary tuner/timers.

Among VHS portables are several super lightweights that use special, compact, 20-minute cassettes (which can be played on a full-size deck with an adapter). Though some have facilities for recording from a tuner, these super portables are really designed for recording from a camera.

### Portable rundown

Typical of the fully featured carryables is Sharp's VC-3500, a 15.2-pound, VHS-format machine that accepts an optional rechargeable battery and is equipped with a carrying handle.

On a.c., it can record up to eight hours at the slowest of its three VHS speeds, has an audio dubbing feature and rewinds automatically at the end of play. A built-in tuner/timer can be set to make one unattended recording a day for seven days, a feature normally used at home. A wired remote control unit comes with the VCR.

The Sharp VC-3500 carries a sugary

(Please turn to page 190)



Kodak's new Series 2000 portable video units feature a choice of two camera-recorders, called "camcorders" (left and right). Behind the units is the cradle, which holds camcorders to play back tapes. Remote control is in the foreground.

## Kodak Enters The Fray

**K**odak recently announced in New York City that it will be entering the video market in a big way. Kodak is even introducing a new videotape size—8 mm—to compete with the present 1/2-in. tapes in the familiar Beta and VHS formats.

The new Kodavision 2000 system features a choice of two one-piece camera-recorders, called "camcorders." The Series 2000 camcorder Model 2200 and the Model 2400 accept only the new 8-mm cassettes, which are only slightly larger in size than audio cassettes and offer only one hour of taping. Both camcorders weigh about 5 pounds and have features that include fast forward, fast reverse, electronic viewfinder and automatic iris. The 2400 adds autofocus and still-frame capability.

The Series 2000 cradle, Model 2020, allows users to play back tapes when the camcorder (either one) is placed within it and when the cradle is connected to a television

set. Kodak will also make an optional tuner/timer available for the cradle and the cradle will be compatible with existing 1/2-in. tapes.

Meanwhile, Kodak has also announced that it will be making available Kodak-brand videotape, not only in the 8-mm format, but also 1/2-in. tape in both Beta and VHS. So, even if you don't buy a Series 2000, you may wind up using Kodak tape in your present VCR.

While all of these announcements are interesting, they could not be considered surprising by those who have been following Kodak's marketing. For some time, the company has been engaged in electronic, or computer, areas. In the business market, Kodak already is represented by computer-output microfilers and high-speed video motion-analysis cameras. Sooner or later they had to get into home video, and now's the time.

When the "big yellow box" starts to market video as well as film, it's safe to say the video revolution is here.—N.S.

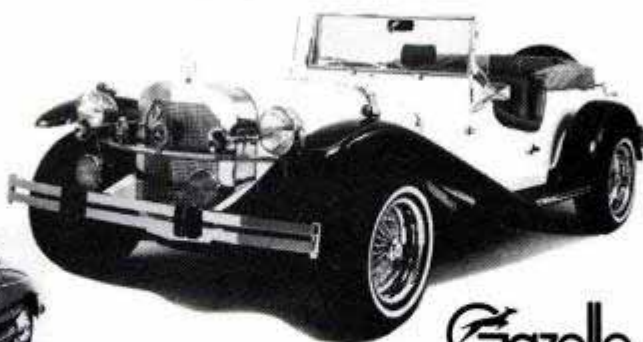


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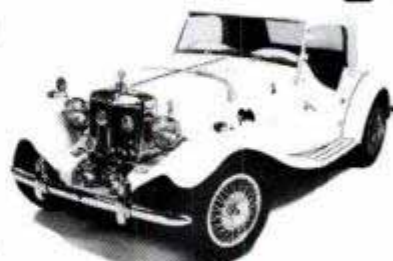
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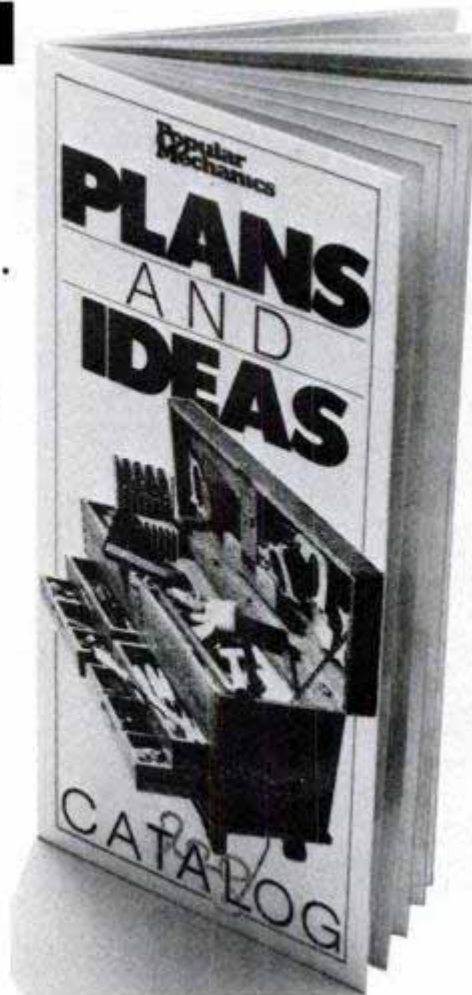
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**VIDEO**

(Continued from page 188)

gested retail price of \$899, but it has been advertised in the highly competitive New York City market for \$739.95 with a manually focusing color camera thrown in.

Another portable is the Sanyo VCR7300. It's a 15-pound, Beta-format unit that has a 105-channel, cable-ready tuner with seven-day timer. It can record up to five hours on one Beta tape. A memory-equipped counter permits rewinding to a predetermined location on the tape.

This hefty Sanyo portable also has the state-of-the-art, Beta Hi-Fi sound recording system. Stereo sound is recorded by the video head as part of the video signal. This gives it a frequency response (or tonal range), a dynamic range (the spread between the softest and loudest sounds) and freedom from



Canon's VC-10 camera, shown with the VR-20 VCR, is an easy-to-carry portable unit.

noise comparable to the incredible new digital recordings.

As with other Beta Hi-Fi VCRs, the VCR7300 also records sound with a standard, fixed audio head so that it will be compatible with conventional equipment and tapes. The VCR7300 sells for about \$1,000.

Representative of the more advanced true portables with companion tuner/timers is the Magnavox VR8480BK, an 8.6-pound, VHS-format recorder.

It has a stereo sound system with Dolby noise reduction that can be used to record a main track and later add a companion track for music, sound effects or voice-over commentary. A memory-search feature operates in rapid advance or rewind. Its companion tuner/timer has a 105-channel capacity and will automatically make four re-

cordings on any channel over 14 days.

The VR8480BK is also equipped with One Touch Recording. Tapping the OTR button once starts the record mode instantly for a 30-minute period. A second tap adds another 30 minutes, and a third tap, still another. Up to two hours of continuous recording, followed by automatic shutoff, can be programmed this way. You can capture an unexpected telecast without losing any of it while setting the timer the normal way. The VR8480BK has a suggested retail price of \$1,399.99. Many of the same features may be found on the somewhat lower priced Magnavox VR8471BK.

Features similar to the Magnavox are found in Panasonic's 8.4-pound PV-6600. It has two double-azimuth heads to reduce jitter in stop-action mode. The PV-6600's companion tuner/timer can handle up to 128 channels and can be adapted to record one cable channel while another is being viewed. This VCR will record up to eight programs in a 14-day period, and it can be programmed by OTR for up to four hours. The PV-6600 also has full memory search and a stereo sound system with Dolby noise reduction that can record in sound-with-sound mode. The recorder has a wireless remote control for all functions. It carries a suggested retail price of \$1,400.

A similar but lighter-featured Pana-

sonic VCR, the PV-6500 with a suggested price of about \$1,300, has been offered by a New York store together with an autofocus color camera for \$1,599.

Hitachi's VT-7A portable recorder, weighing in at 7.9 pounds, boasts a five-head design for improved picture quality, particularly in slow motion, and rock-steady, stop-action performance. It, too, offers stereo/sound-with-sound, with Hitachi's own Audio Noise Limiter system.

The Hitachi has many of the features of the Magnavox, but its separate tuner/timer, the VT-TU7A, can handle up to 133 cable channels. It records up to seven programs on any channel over a 14-day period. If there is a power failure, a backup power supply maintains such advance programming in its mem-



ory for up to one hour. There is also a 19-function, wireless, remote control. The VCR, with its tuner/timer, sells for \$1,495.

Another four-head, VHS-format recorder with Dolby stereo sound, the Canon VR-20A, weighs 8.4 pounds. It's sold alone at a suggested price of \$825. An additional \$475 adds Canon's VT-10A tuner, which also serves as a charger for the recorder's built-in battery. Programmable up to four times in 14 days, the tuner has a 105-channel capacity and 14 buttons for tuning in preselected stations.

One of the most unusual VCRs in the VHS-format portable category is RCA's VJP 900. It looks like a conventional home VCR, with tuner/timer controls arrayed on the left and tape-transport controls on the right. But if you flip down a door at the bottom of the machine you can simply lift out the entire recorder section. Then all you have to do is insert an optional battery, put the VCR in its optional carrying case, plug in a video camera, and you're all set to shoot your own tape.

The recorder, with battery, weighs 7.9 pounds. It has five video heads for enhanced picture quality and rock-stable stop action and slow motion. And it offers both audio and video dubbing and stereo/sound-with-sound audio re-

ording. When the recorder section is redocked with the tuner/timer base unit, it offers a broad array of operating features. The tuner/timer has a 133-channel capacity, and it can be programmed for up to eight recordings over 21 days with OTR. An infrared remote control included with the VJP 900 must be used for special effects, such as reverse play and variable slow motion. The VJP 900 sells for \$1,300.

#### Ultralightweight portable

Among the ultralightweight, VHS-format portables is Sharp's VC-220, which retails for \$799. It weighs 5.7 pounds with battery and uses a VHS Compact cassette that gives 20 minutes of recording time. The recorder offers audio dubbing. While it can be used to dub to another recorder for editing, and it will play back through a conventional TV set with the help of an a.c. adapter, the VC-220 is not designed to record from a telecast source. Its camera input accepts a 10-pin connector. A battery pack, car-battery cord and a.c. adapter are optional.

Perhaps the most compact portable recorder is JVC's HR-C3U, which costs \$850. With slip-on battery pack (included in the price along with a charger), it weighs 5.3 pounds. The regular battery pack provides about 30 minutes of con-

tinuous recording. An optional, high-capacity pack provides about 50 minutes. Like the Sharp portable, the HR-C3U uses a 20-minute, VHS Compact cassette. Audio dubbing is also provided in this JVC unit, which also features a memory counter. When the camera's stop button is pushed, the HR-C3U automatically backs up for one second to assure synchronization with the next stop. The HR-C3U is really part of a recording system that includes the superlightweight (2.75-pound) GZ-S3U camera. These two units can actually be combined by mounting them on a special shoulder frame.

Sony, which created the home VCR with its Betamax machines, is very much a part of the portable field, not only with Betamovie but with its SL-2000, a 9.25-pound recorder that retails at a suggested \$700. The companion tuner/timer, the TT-2000, has a price of \$250. It will program up to four recordings over two weeks, and it has wireless remote control.

Toshiba's V-X34, also a Beta-format machine, weighs only 5.5 pounds, rivaling the VHS superportables. But it uses a standard Beta cassette and can record up to two hours on one battery charge. Slow motion in both reverse and forward is possible at the slowest speed.

*(Please turn to page 192)*

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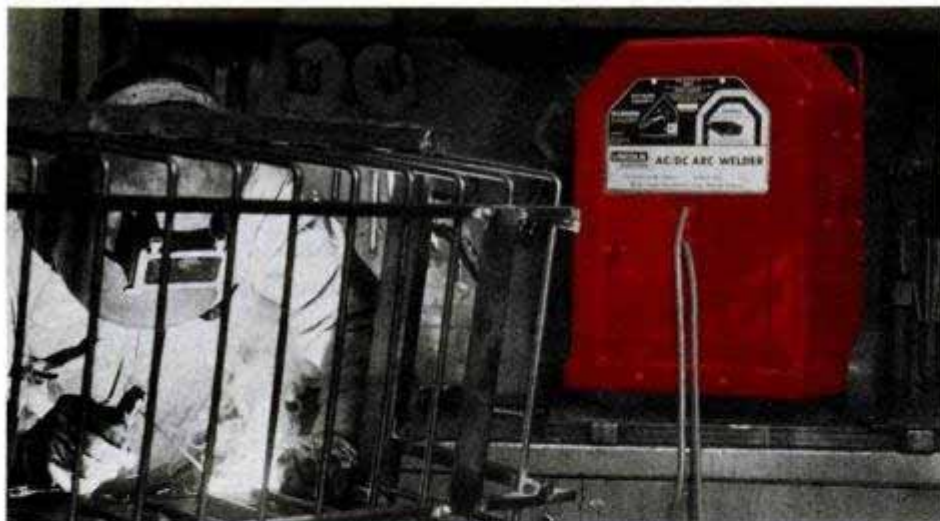
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## SMART HOUSE

(Continued from page 100)

BSR System X-10 and control modules. Tomorrowhouse also uses several temperature-sensing devices for such appliances as the thermostat, hot water heater or a hot tub. This system—which can cost from \$895 without the basic computer to more than \$2,000—will do everything for you. It will boil your eggs in the morning, check the temperature of various rooms and turn your lawn sprinklers on and off.

The brainchild of Russ Coffman, a computer hobbyist who wanted to control his own home appliances, Tomorrowhouse can also be programmed to report to you when you ask it to via telephone. The voice synthesizer board handles this chore.

### Reprogramming Tomorrowhouse

There's much more to Tomorrowhouse than meets the eye because you can even reprogram it from a Touch-tone telephone. So, if you forget to tell it to turn on the sprinklers at 5 p.m., you can order them on from a telephone. And, if it detects something is wrong, it will alert you to the problem. It can also act as a personal secretary, reminding you of important dates and times.

As you would expect, a computer system provides a good measure of security. The security program is handled by another Apple board, the \$399 Smarthome I from Cyberlynx Computer Products of Boulder, Colo.

Now that our Smart House can be programmed and monitored, it would be nice if you could *tell* it what you wished to do. After all, using a keyboard or a telephone touchpad is a lot more inconvenient than just talking to your system. Well, with the Speechlab board from Heuristics Inc., your system will respond to your voice.

Computerized home control is here to stay. And in many cases you don't need a computer to have it. Our Smart House isn't a dream. It's real, and it's available today. **PM**

## VIDEO

(Continued from page 191)

Both audio and video dubbing are provided. The V-X34's suggested retail price is \$1,099 and includes a separate tuner/timer with infrared, wireless, remote control. It has a 105-channel capacity and can program up to eight recordings over 14 days.

If you do a lot of home-movie-style taping, you can easily come out way ahead of the total cost of filming. And showing this kind of movie is as easy as turning on your television. **PM**



## FIRSTHAND REPORT: AUDI

(Continued from page 168)

accident that the 5-mph bumper couldn't handle!

### Within easy reach

Changing a V-belt looks pretty tricky, but everything else you need to get at is within easy reach: The sparkplugs are right up top, and so is the distributor. The tiny oil filter is easy to get at from under the car. Fuses and relays are in a plastic box on the cowl. And translucent containers allow visual checks of the power steering, brake and windshield washer fluids, as well as engine coolant and battery electrolyte.

### Poise in performance

All in all, the 4000S Quattro is a much nicer car than a 4x4 Subaru or AMC Eagle.

It has considerably more poise in its handling and performance, but it also has a vestigial 4x4 ambiance. Maybe it's just psychological, but you always seem to be aware that there's a lot going on under the floorboards of the Audi.












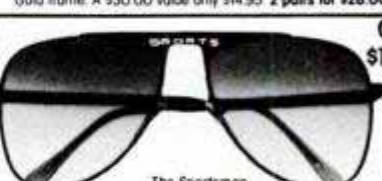
Perhaps 4wd means that it's no longer a "pure" GT or sports sedan, but with studded snow tires at all four corners, it's perfect for the worst winter weather. It will probably become the standard form of transportation for knowledgeable skiers and lucky snow bunnies. **PM**

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Steering	A	Accurate, with good road feel.
Transmission	B+	Crisp shifts; rubbery linkage.
Ride	B-	Jiggly on rough roads.
Fuel economy	C	Fair for a compact: 21/28 EPA.
Seating	A	Firm, but comfortable.
Vision	B+	Good; A-pillars are thick.
Gauges/controls	B-	Nice gauges, cheap switches.
Ventilation	B	Average. No side window defrosters.
Noise @ 55 mph	B	Engine whines; some wind/road noise.
Cargo capacity	B+	Deep, medium-size trunk.
Engine serviceability	A-	Everything but belts easy to reach.
Fit and finish	B-	Cheap hardware out of place.

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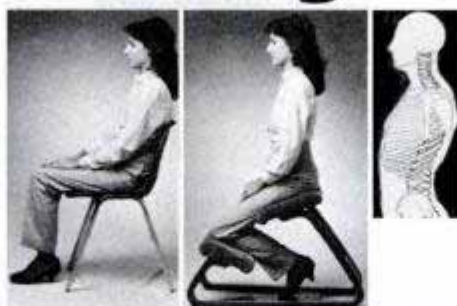
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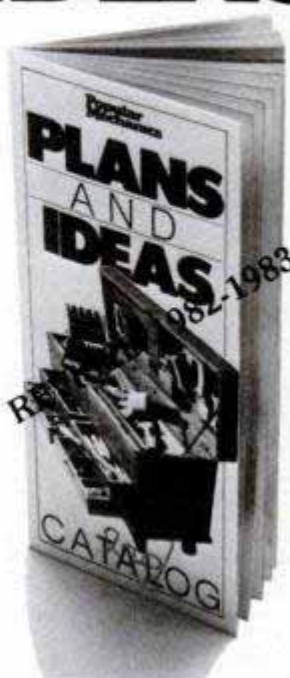
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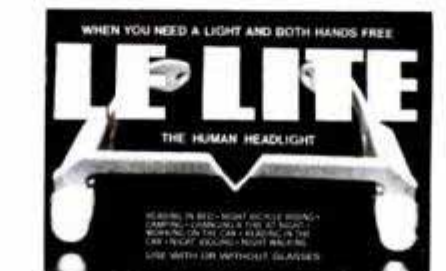
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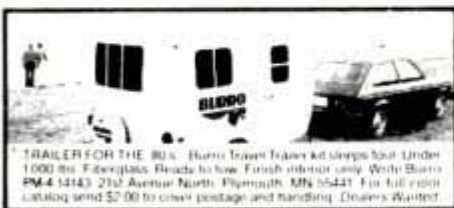


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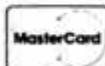
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