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**Only Dodge Backs Every Truck It Builds
With 5/50 Protection, Standard.**

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TOUGH**



DIVISION OF CHRYSLER CORPORATION

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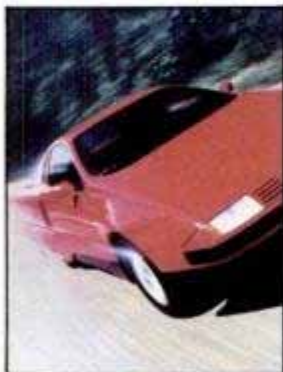
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ON THE COVER
Ford's experimental Ghia Brezza slices through the air thanks to aerodynamic improvements that are changing the shapes of the cars we'll drive. Born in wind tunnels, Detroit's '86 aerox rival the best from Europe and Japan. The stories begin on page 89.

—PM photo by Humphrey Sutton

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U.S. and Soviet scientists are working up a co-op space mission	
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IT'S HARD TO MANAGE YOUR HEAT DAY TO DAY WHEN YOU FIND OUT HOW MUCH YOU'RE USING JUST ONCE A MONTH.

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Our Hunter Energy Monitor programmable thermostat. It does something no other set back thermostat can do. It tells you the amount of time your heating system operates.

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Home and Shop: Steven Willson, editor; Joseph Truini, Shop and Tools editor; Arthur Rooze, associate editor; Roy Berendsohn, assistant editor
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Editorial Production: Peter Francesconi, chief; John Bostonian Jr., art; Rebecca Harth, David Meyer, assistants
Design Director: Ira Herrick
Art: John Johaneck, director; Alan Andresen, Ann Bennett, associate art directors

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Reader Service Department: Gary Frederick, supervisor; 224 West 57th St., New York, N.Y. 10019; (212) 262-4292

Advertising Director: Floyd Sembler

Advertising Offices:

New York: 224 West 57th St., New York, N.Y. 10019; (212) 262-8824

Chicago: 1 South Wacker Drive, Chicago, Ill. 60606; (312) 984-5190

Detroit: 377 Fisher Rd., Grosse Pointe, Mich. 48230; (313) 881-3520

Cleveland: PDC Building, 3659 Green Rd., Cleveland, Ohio 44122; (216) 292-7334

Los Angeles: 460 East Carson Plaza Dr., Carson, Calif. 90746; (213) 532-8101

Director of Marketing: Edward Vaquero

Production Manager: Lori Ellwood

Advertising Production: Patricia Woods; (212) 262-4800

Classified Sales Manager: Sophie Gronowicz; (212) 262-4825

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There's a menace in your motor oil. Microgrit—the dirt you can't even see. In yesterday's engines it just went along for the ride. But today's engines are smaller, harder working and Microgrit is leaving its mark. Scratching, scoring, grinding away at bearing surfaces. Your engine won't tolerate it. Why should you?



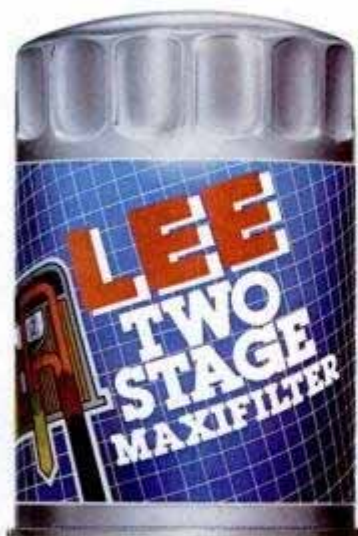
A super magnification of Microgrit scratching and scoring vital bearing surfaces.



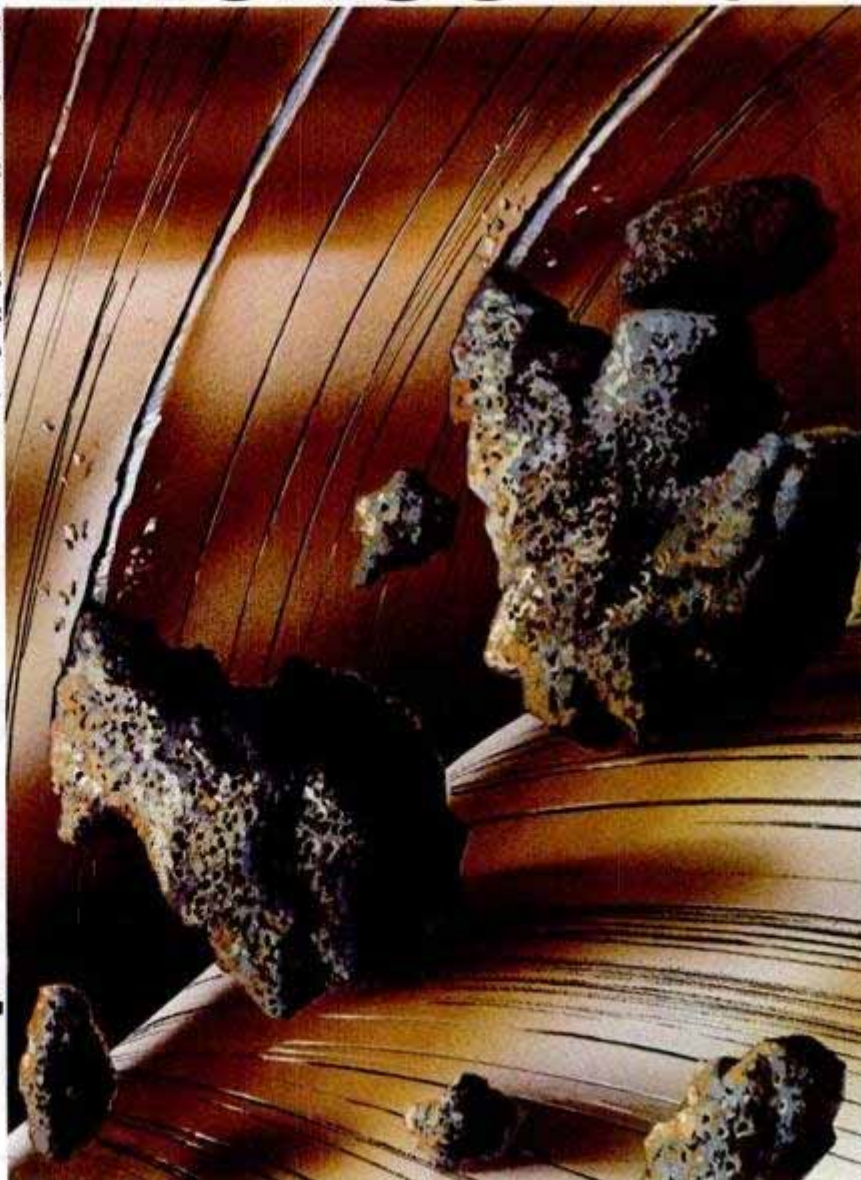
LEE TWO-STAGE TRAPS MICROGRIT.

Finally, an oil filter for today's engines. The Lee Two-Stage Maxi-filter. In lab tests, the Lee proved so effective at cleaning oil, it even trapped particles to ten microns. That's one-fifth the width of a human hair. That's protection. That's clean oil. Get Maxi protection for today's smaller, harder working engines with the filter that lives up to its name.

Lee Two-Stage Maxifilter.



TRAPS MICROGRIT
FOR U.S. AND IMPORT CARS.



True Value
HARDWARE STORES®

TOOL VALUE OF THE MONTH



Both
for **6⁹⁹**



**GREEN
THUMB**

Shrub/Leaf Rake Combo

Get at every leaf in the yard with 24-tine deluxe sweep and 6-tine shrub rakes. Act fast! Offer good from Sept. 10 only while supplies last, at participating True Value Hardware Stores. 2P

**HARDWARE
VALUE
OF THE MONTH**

7⁹⁹



2,101-pc. Nut & Bolt Center

Has most commonly-used nuts, bolts, screws, more! 25 trays, 50 compartments. Offer good from Sept. 20 only while supplies last, at participating True Value Hardware Stores. SG2101

CHARGE IT at participating True Value Hardware Stores. For store nearest you, see "Hardware" in the Yellow Pages.



EDITOR'S NOTES



Aero is hot! That's the word out of Detroit these days from our Automotive Department staff. In fact, Automotive Editor Wade Hoyt, Assistant Automotive Editor Norman Mayersohn and West Coast Editor Mike Lamm have been practically commuting to Detroit the past few months to attend the press previews of all the new 1986 models. The operative buzzword is definitely aerodynamics. "The wind is shaping today's cars and the cars of tomorrow," says Hoyt. While not everyone likes the worn-out-bar-of-soap styling produced by aerodynamically clean designs, there are benefits. Read about them in this month's cover story (page 89). . . . **Speak-**



Mayersohn calls the office from Detroit.

ing of cars, October is national Car Care Month. Good friend Jim Fournier, who is senior vice president of Maremont Corp. and also chairman of the Car Care Council, reminds me that car owner apathy and/or ignorance contribute far more to large auto repair bills than do overcharging or ripoffs by mechanics. Car Care



Art Director John Johaneck, Smith and Truini check solar plans.

Month is one way to call motorists' attention to the fact that periodic car maintenance is a bargain in the long run. Duly noted, Jim. . . . **For those of you** who think the solar home thing is a moot point, check out the new design in this issue. Tom Smith, the designer and builder of the home featured, lived in Asia for 16 years and was greatly influenced by the Oriental penchant for spare, simple expression even in home design. Smith was one of the pioneers in solar home development. He built the first house to use double-envelope construction on back in 1976—before the boom (and bust) in solar home interest. Joe Truini of our Home and Shop Department spent several days with Smith and his

house to develop the article in this issue (page 114). "Smith has simplified solar design, made it more affordable, and best of all, practical to a whole new generation of home buyers," says Truini. Let the sun shine in. . . . **The aviation world** comes to Oshkosh every summer. In fact, hundreds of thousands of aviation enthusiasts from every state and 70 countries fly in to this Wisconsin city every July. The reason for this airborne traffic jam is the annual Experimental Aircraft Association International Fly-In Convention and Sport Aviation Exhibition. Anyway, that's the official name, but we just call it Oshkosh. This year I was, once again, simply astounded by the sight of over 14,000 planes that had been flown in for this event. Planes, planes everywhere. Everything from ultralights to the British Airways Concorde. Everything from the U.S. Aerobatic Team and their super stunt planes to the Warbirds of America and their flying B-29. This is an event that overwhelms the senses from the minute you arrive until the minute you leave. If you love flight, you'll love Oshkosh.



Prop-driven warbirds pulled 'em in at Oshkosh.

Joe Truini



Interstate, the battery that starts The Great American Race.

What does it take to get nine dozen cars, fifty years old and older to travel thirty-three hundred miles in ten days? It takes reliable, quality

parts, like Interstate batteries. That's why it's such a kick for us to sponsor The Great American Race, and have our batteries performing under those terrific old hoods. Of course, most Interstate batteries go into newer models, like yours. Last year alone almost 5 million people replaced their old batteries with new Interstate batteries at over 120,000 Interstate dealers all across America.

And for good reasons. Such as starting power and staying power. Even a toll-free number you can call from anywhere, anytime you have battery problems.

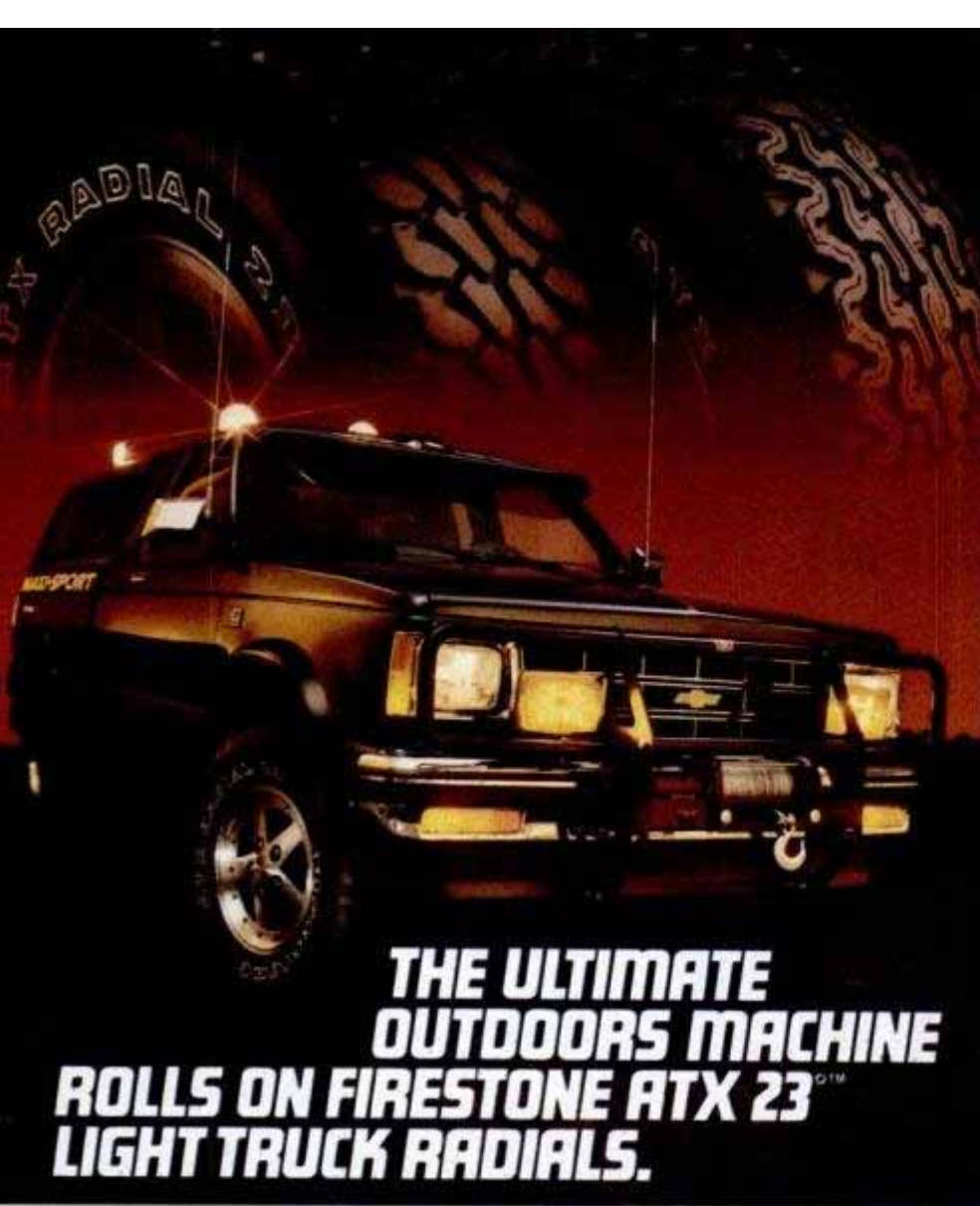
But you'll probably never need our number. After all, if we can get fifty-year-olds cross-country without a hitch, just think of what we can do for your car.

Starts Great for you too.



Sponsor of
The Great American Race





**THE ULTIMATE
OUTDOORS MACHINE
ROLLS ON FIRESTONE ATX 23[™]
LIGHT TRUCK RADIALS.**

The Firestone Outdoorsman. As special as the tires it rolls on and put together by the experts, including the Hess & Eisenhardt Company, one of the world's most respected automotive coachbuilders. Starting with a tough Chevrolet S-10 4x4 Maxi-Cab and adding quality components chosen for price and value, chosen for all around comfort, safety, versatility, and performance.

To keep it rolling, Firestone ATX Radial 23° tires. Built for toughness with a strong steel belt and polyester cord body construction. Built for traction with a tread design based on the same one that's made Firestone farm tires traction leaders in the field. Part of a complete line of tough Firestone light truck tires that includes our original Firestone Radial ATX®.

So if you're looking for a tough, go-anywhere hunting,

camping, or fishing truck, write Firestone, P.O. Box 1474, Hudson, OH 44236. And if you're looking for tough, go-anywhere light truck tires, just talk to your nearest Firestone retailer.

Firestone
LIGHT TRUCK TIRES
WE BUILD THEM TOUGH FOR YOU.



*The Firestone Outdoorsman
Supplier Roster*

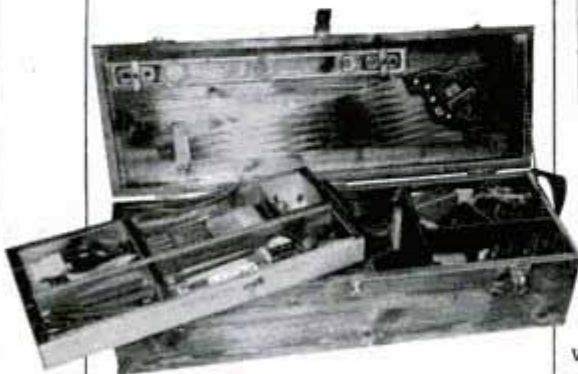
- A&A Specialties** ABS Sunvisor
- Bestop/Dualmatic** In-Bed Spare Tire Carrier
- Brahma® Inc.** Cab-Hi Bed Cap
- Chevrolet** S-10 Maxi-Cab Four Wheel Drive Pickup Truck
- Cibie** 275 Amber Foglights (2), 35 Clear Foglights (3), 190+ "Oscar" Driving Lights (2)
- Coleman Company** Air Mattresses (2), Black Cat™ Propane Catalytic Heater, Folding Camp Oven, Folding High Stands (2), Inflate-All 1™ 12-Volt Tire Pump, Poly-Lite™ 48 Qt. Cooler, Propane Camp Lantern, Propane Camp Stove, Sleeping Bags (2) with Duffel Bags, Sundome V™ 4-5 Person Dome Tent with Carrier
- Cotter & Company/True Value Hardware/Master Mechanic Tools**
- D.H. Buck Company** Urethane Fender Flares with Splash Guards
- Durakon® Industries** Duraliner® Bed Liner
- Firestone** ATX Radial 23°™ Tires, PV4 Master™ Shock Absorbers, Supreme® HD Batteries (2)
- Gunslinger** Stowage Pocket
- Hess & Eisenhardt Co.** Aftermarket assembly and component installation
- Kelsey-Hayes** Electronic Trailer Brake Controller, Five-Star Cast Aluminum E-T Mag™ Wheels
- Marchal** High Intensity Back-Up Light, High Intensity Tail Light, Quartz-Halogen Headlights
- Midland® International Corporation** Citizen Band Walkie-Talkies with cases (2), Microphone Control C.B. Radio, Mirror Mount C.B. Antennas (2)
- OSRAM Inc.** Copilot "L" Mounted Interior Light, Copilot "M" Plug-In Interior Light
- Reese Products** Frame Mount Trailer Hitch
- Reflexion Industries** Rear Step Bumper
- Warn Industries** Warn MX6085 Winch, Brush/Grille Guard and Accessories
- Walter Kilde Company** Fire Away 1A10BC® Dry Chemical Fire Extinguisher, Force 9® Halon Fire Extinguisher
- Whistler®/Controlonics Corporation** Spectrum™ Superheterodyne Radar Detector

LETTERS TO THE EDITOR



Neat tools

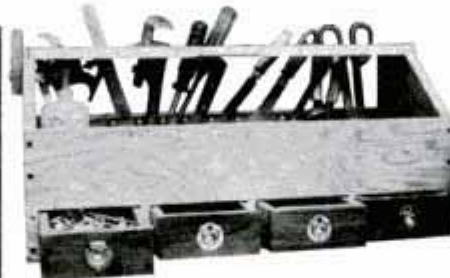
I operate a home repair service and my work has been much easier since I built the toolbox shown in your November



'80 issue (*Build PM's Contemporary Toolbox*, page 116). I am enclosing a photo to say thanks for a very useful project.

DAVID P. BURTNICK
ST. PAUL, MN

Here's a photo of the carry-all tool chest I built from plans in your October '84 issue (*2 Portable Toolboxes You Can Build*, page 114). I sized the compartments to suit my own needs and added brass corner protectors to keep the



Two handy toolboxes: Carry-all tool chest (left) made by reader Leonard Wallinger and contemporary toolbox (above) by reader David Burtnick.

wood from chipping when the chest is slid in and out of a pickup truck. Otherwise, I followed your plans closely and am very pleased with the results.

LEONARD R. WALLINGER
YORKTOWN HEIGHTS, NY

Thank you both for letting us know. For others who may be interested, photocopies of the plans are \$2 for the contemporary toolbox and \$3 for the carry-all tool chest, both postpaid, from *Popular Mechanics*, Box 1014, Radio City Station, New York, NY 10101.

Repairing the barriers

I read in *Breaking The Speed Barriers* (page 71, June '85) that a Russian Alfa-class sub will do almost 42 knots at a depth of 3000 feet. What is the pressure at 3000 feet? I find it hard to believe.

CHARLES S. WILLIAM JR.
LOWELL, MA

John Lee of the Maritime College in New York says the pressure at 3000 feet would be 1470 pounds per square inch. That and its speed are what makes the Soviet sub so extraordinary.

In reference to your comment that "Mach 7 has not been seriously threatened since" (*Breaking The Speed Barriers*, page 114, June '85), Mach 7 was reached and broken on April 12, 1981 by the Space Shuttle Columbia. Since then, 16 more flights have broken that barrier.

P.N. FIAT
MERRITT ISLAND, FL

We considered the Space Shuttle, but

rejected it in the end because, strictly speaking, it isn't an airplane. Launched on reusable rockets, and landing as a glider, the Space Shuttle is a new kind of craft altogether. We think the Mach 7 record won't be set until an aircraft does it on one set of engines.

Extinguished errors

I was glad to see the article titled *Hot New Gear For Fire Fighters* (page 87, Mar. '85) in a magazine such as yours. However, I noted a couple of errors.

The lower photograph's caption on page 89 indicates a man using a Hurst tool on a leaking bottom valve of a tank car. It looks like the same pipe wrench in the top photograph on page 88.

On page 89, the top caption says the three firefighters are wearing positive pressure suits. How can this be? The suits are not one piece.

W.O. GREEN JR.
SEMMES VOLUNTEER FIRE DEPT.
SEMMES, AL

You're correct on the misidentifica-

tion of a pipe wrench as a Hurst tool. But we were correct on the positive pressure suits. The new suits being tried out by the Los Angeles Fire Department had outer reflective layers and positive pressure inner layers.

URP infested

Unfortunately your article *The Glowing Future Of Nuclear Waste* (page 91, May '85) left out a key fact about irradiating food with nuclear waste. Irradiated food produces traces of thousands of different chemicals known as URPs—Unidentified Radiolytic Products. Nobody knows if they are safe.

ED GOGOL
CHICAGO, IL

It's true that critics of nuclear radiation of food call URP an unknown factor. However, defenders of nuclear radiation note that currently used chemical preservatives have shown mutagenic or worse effects from cooked food. (A mutagen causes cell mutation.) Early tests on URPs show no such danger.

Give it time

I enjoyed your section on home improvement, but your article *How To Relocate A Toilet* (page 149, Apr. '85) failed to inform people that when you join copper pipe to galvanized you need a dielectric union to eliminate electrolysis, a major cause of corrosion between dissimilar metals.

JIM HENDERSON
HAYWARD, CA

Yes, you're right, a dielectric union should have been used instead of the standard adapter we show. In time, electrolysis will degrade our joint. But the situation is not critical, the corrosion doesn't happen overnight.

Who's there?

Allow me to knock the "Science Worldwide" article titled *Lasers Knock Again*, (page 40, Apr. '85). The accompanying photograph is of Jean-Marc Halbout, foreground, and Daniel Griscmkowski of IBM. It shows part of the equipment used to produce the world's shortest laser pulses (12 Femtoseconds) by a new IBM technique called light compression.

WILLIAM G. WICKUN
BINGHAMTON, NY

We're knocked out! Due to a glitch in our laser research file, the wrong photo was printed.

PM

Ford welcomes you to the Age of Aerostar.



Ford Aerostar. Shaped by the wind and today's changing needs.



the vehicle to help cushion the ride.

It's "people friendly!"

You sit tall in Aerostar, with a clear view of the road ahead—surrounded by luxury, style and comfort. Rear riders enjoy the open feel of sliding side windows. Plus unusual options like rear stereo controls and headphone jacks.

Easy to park. Fits your garage.

For all its interior room, Aerostar is the shortest minivan. You slip into parking spots with ease. Aerostar is sized to go in your garage or through the car wash.

Quality is built in.

Ford took the time to make Aerostar right the first time. Built to Ford's high quality standards, it's already

Ford's totally new Aerostar is strikingly shaped to slice the wind. The unique wedge design gives it aerodynamics unmatched in its class.

Inside the sleek body shell there's uncrowded comfort for seven.* Or the capacity for 140 cu. ft. of cargo.**

Aerostar is fun to drive, easy to maneuver, and park. Its new technology offers features others don't have.

Aerodynamics... the wind works for you.

The wedge-shaped Aerostar slides smoothly through the air. Minimizes wind noise. And actually uses the airflow to press down on the vehicle for improved road holding and handling.

Choice of V-6 power or high-tech Four.

Aerostar has an advanced 2.3L Four standard. Its multi-port electronic fuel injection meters a lean mist of fuel precisely to each cylinder.

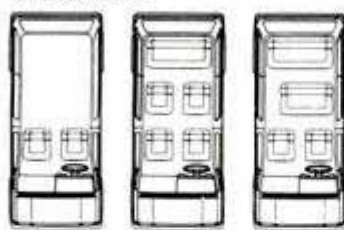
If you want added power and response, choose the

computer-controlled 2.8L V-6—bigger and stronger for extra performance.

Tows almost 2½ tons.

Because of its high strength, optional V-6 power and rear-wheel drive, the versatile Aerostar can be equipped to tow up to 4,900 lbs.† That's nearly 2½ times more than most mini-vans!

Whether you're carrying people or cargo or towing a trailer, the weight is on the rear driving wheels where it needs to be for full traction and control.



Take your seats.

The Aerostar Wagon offers you a selection of matched seats: buckets, Captain's Chairs and bench. There's



Ford Aerostar vs. Chrysler Mini-vans

	AEROSTAR	CHRYSLER
Aerodynamic for lower air drag	.37 Cd	.42 Cd
Standard 4-cylinder engines	2.3L	2.2L
V-6 engine power option	2.8L V-6	NONE
Bigger cargo space (cu. ft.)**	140	133
Extra driver legroom	41.5 in.	38.3 in.
Max. opt. trailer towing capacity†	4900 lbs.	2000 lbs.
Longer wheelbase, smooth ride	119 in.	112 in.

room for seven adults.* There's also a path so you can step to the back to reach baggage or children.

Take your seats—out.

Rear seats have quick-release mountings. They slide out to turn Aerostar into a load carrier with over 7 ft. of clear cargo floor.

The easy loader.

The rear liftgate swings up out of your way. You step right up to the flat floor to ease in grocery sacks or slide in heavy objects.

Smooth on the road.

For extra smoothness, Aerostar has a luxury car 119" wheelbase—plus a premium gas-filled shock absorber at each corner of

had over a million miles of accelerated proving ground testing. Now it's ready for you.

Lifetime Service Guarantee.

Participating Ford Dealers stand behind their work, in writing, with a free Lifetime Service Guarantee good for as long as you own your car or light truck. Ask to see this guarantee when you visit your participating Ford Dealer.

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*With optional rear bench seat.
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IMPORTS & MOTORSPORTS



Hyundai Excel

If you're planning to buy a front-wheel-drive hatchback in the \$5000 to \$6000 range next spring, you'll have to add the Excel to your list of candidates. By then, the Korean-made car will be sold in the United States by Hyundai dealers who, at this writing, number 113. As we reported last year (*Coming: Cars From Korea*, page 86, Aug. '84), the



Korean-made Excel promises roominess, good fuel mileage available for under 6G.



Four-door hatchback was styled in Italy.

rear-drive Hyundai Pony that's been sold in Canada for the past two years would be dropped for a new front-driver. The Excel is it. Hyundai will start business in the U.S. with the

Excel and later bring in its larger, more luxurious Stellar, a four-door sedan. The Hyundai name may be unfamiliar, but the Excel is strictly mainstream: It's a Toyota-looking hatchback with its lines done by Ital-Design and power from Mitsubishi's 1.5-liter Four. Japan's Mitsubishi owns 15 percent of Hyundai, hence the choice of engine. Mitsubishi's Korean connection will also lead to a variation of the Excel for Mitsubishi dealers, probably in 1987. The first Excels, instrumented for testing, have been spotted, so we know that Hyundai Motor America is doing its homework. Headquarters is 7373 Hunt Ave., Garden Grove, CA 92642-2669.

Golfing on Pikes Peak

A Volkswagen Golf with eight cylinders? That's right. But the rally car that placed third at the Pikes Peak Auto Hill Climb has four of the cylinders forward and four aft. Two separate engines put power to front and rear axles in the VW Motorsport racer that was run by German rally driver Jochi Kleindt. The two twin-cam, 16-valve engines add up to 3.6 liters and 390 hp. One stick works both 5-speed gearboxes to pop it to 60 mph in 4 seconds. Top speed is 140 mph. Fore!



Golf's back-seat driver is a second engine.

Welcome, race fans!

If sitting in the stands or craning your neck from the infield doesn't get you close enough to the racing action, consider a behind-the-scenes tour. Chartrek Travel's Motorsports Adventure trip to the Daytona 500, for example, sets you up with pit passes, a chance to meet Grand National drivers, garage tours, flight and accommodations. Write them at 972 Boston Post Rd., Darien, CT 06820.

BMW convertible

While archrival Mercedes-Benz maintains its tradition of offering a softtop roadster, BMW has not had an open car in years. Most BMW cabriolets were specials by European coach-builders. But now a 3-Series BMW—probably the 6-cylinder 325e—is a candidate for topless treatment. **PM**



A 3-Series BMW, like the 6-cylinder 325e, would look good opened up on top.

New Mercedes wagon

Next year, when Mercedes-Benz celebrates its 100th anniversary as an automaker, it will have a new station wagon in its model lineup. The wagon version of the mid-range 300E and 300D sedans, just going on sale for '86, will replace the 8-year-old 300TD. The new wagon will be



M-B wagon joins 300E/300D '86 sedans.

lighter, faster and more fuel efficient than its predecessor.

Airflow is especially smooth due to aero tricks like a single wiper that cleans an amazing 86 percent of the windshield (see *PM Technology Update*, page 67, May '85).

From the pole position

Fastest F1 lap—The Silverstone circuit in England, with only 5 corners, is one of the fastest in Grand Prix racing. But, 160.925 mph! That's the F1 lap record set by Keke Rosberg in his Williams Honda Turbo V6 qualifying for the British Grand Prix.

Super Supra seats—Toyota's got the Blaupunkt of car seats in its Supra. They disappear so fast that they've joined expensive car radios, mag wheels and other fashionable options on the most-stolen list.

Electric Avenue—The little electric 3-wheeler that Clive Sinclair introduced in England (see *I & M*, page 10, April '85) is coming here. Newcastle Co. on Route 18 North, P.O. Box 322, New Castle, PA 16105-9017, handles it.

Renault at Indy—In France, fans know how committed Renault is to motorsports. We'll find out, too, when its turbo motor comes to Indy. The Renault Mirage Indy engine is being tested for the '86 CART season.

Born in the U.S.A.—Honda, Nissan, Mazda, and now Toyota. A U.S. plant (and another in Canada) will be all its own (not a joint deal with GM).

IF YOU CAN DRIVE IT, AUTOLITE MAKES A COPPER PLUG FOR IT.

England is a country renowned for building unusual cars.

But, even there, this one raises a few eyebrows.

It's the Aston Martin Lagonda Bulldog, and it's propelled by an extremely modern, highly-efficient engine. Which, like all modern, high-revving engines, whether British, Japanese, or German, can develop a problem. If you use the wrong kind of spark plug.

When you do a lot of short trips, ordinary plugs can develop something called "carbon fouling." This means that carbon can build up at the spark plug tips and cause misfiring, or even prevent the engine from starting at all. The answer? Autolite *copper* spark plugs. Autolite makes plugs for today's smaller engines that not only have copper in the center electrode, but they also have a longer insulator, to help burn off carbon fast.

And they also have something no other major American-made plug has.

Copper either in the seal or the gasket, because it does a great job of conducting heat and electricity.

The result is a plug that helps cars like this Aston Martin perform as beautifully and efficiently as they were designed to.

A plug that will perform equally well in your car.

Autolite *copper* spark plug.

Autolite Division, Providence, Rhode Island 02916.



IF AUTOLITE'S ON IT, THERE'S COPPER IN IT.



 **ALLIED** Automotive

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SCIENCE WORLDWIDE



Meet Sir Walter

The 1900-ton research vessel Sir Walter Raleigh (right) is in the middle of a 4-year 'round the world tour. The diesel-powered science ship is carrying British scientists and students to modern and more exotic ports to run a series of experiments on the world environment and to deliver supplies to out-of-the-way places where researchers are currently at work. The smallest part of the research effort, but perhaps the most important in the long run, is a global water sample. The crew is examining water of local rivers everywhere, and at the end of its journey in 1988 will make a



report on the future of the rivers of the world. The information is expected to

revolutionize our thinking on the future of the world's rivers.

Blast of life

President Reagan's colon surgery earlier this year has drawn new attention to colon cancer. But a promising new surgical technique may overshadow even the news of Reagan's successful cancer surgery.

Columbia Presbyterian Medical Center researchers in New York say they have successfully used a new type of laser to remove tumors from a colon. Even better, the same laser was used to fuse blood vessels to stop bleeding in the colon. For patients who get recurring benign colon tumors, this is great news. Blasts of light from the specialized laser cleanly incise the tumor very quickly. A lower-power blast then seals up the blood vessels surrounding the excision. In the future, the laser treatment will cut the time a patient spends on the operating table and eliminate some major post-op concerns.

Undersea jets

Will the submarine of the future be powered by jet engines? Researchers John M. Gosline and M. Edwin DeMont have studied the movements of Japanese squid and suggest that we may use the squid's propulsion system some day. They noted that the squid travel thousands of miles at a rate of up to 1 mile per hour. That's slow by submarine standards. But squid have an inefficient engine. They swallow water and expel it behind them. A waterpowered ramjet, several researchers now say, would operate more efficiently. Such a jet could be on subs by the next century.

Icemaking glacier

In the photo below we are watching history in the making. Alaska's Columbia Glacier is shrinking at the rate of almost one mile per year.

U.S. Geological Survey scientists began watching the glacier closely in



U.S. GEOLOGICAL SURVEY PHOTO

Aerial photo shows Columbia Glacier retreating (left), forming new Alaska Isle.

1978. The aerial photo dramatically shows the formation of a new island, Heather Island on the right. In the center, chunks of ice are melting in a narrow ridge forming a new river to the sea. On the left the glacier itself is retreating.

"All signs now indicate rapid and accelerating breakup of the glacier," says geologist Mark Meir.

At the end of 1985, researchers expect the Columbia Glacier to be retreating at almost 1.5 miles a year in parts. This is the first glacier ever to be watched as it retreated and formed new land masses, an exciting living laboratory for geologists.

Cancer wonder drug?

The standard drug currently used to combat cancer is adriamycin. It has achieved impressive results in reducing and eliminating tumors. But Stanford University researchers are working on a new cancer-fighting drug that appears to be 100 to 15,000 times as effective as adriamycin.

The new drug, chemically called MRA-CN is being studied in the lab and won't reach clinical trials for another two years. It may be seven years before doctors can start prescribing it. If it eventually meets with FDA approval, MRA-CN will have one other advantage: It does not seem to damage heart tissue, which current cancer drugs often do over the long term.

Join me in space

I hope. Now that NASA has begun training the first teacher in space, the agency's mission leaders are turning their attention back to choosing the first journalist to ride the Space Shuttle. I was among the earliest applicants, but I'm told the list of journalists who want that seat has swelled to almost 8,000.

If I'm going to get a shot at this ticket on the Shuttle, I have my work cut out for me. I weigh 300 pounds and may be competing with journalists who have extensive flying experience. While I'm waiting to hear from NASA, I've been preparing myself to get involved, physically and mentally, for a mission to outerspace. Starting next month I'll be taking you on a month by month adventure as I prepare to be a Shuttle passenger. Watch this space.

PM

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PM ELECTRONICS MONITOR



Stereo—no strings



Recoton's wireless V622 extracts stereo signals from older TVs that lack stereo tuners.

TV programs with stereo sound are now available to any household within broadcast range of America's 100 largest cities. All you need is a late-model set with a built-in stereo tuner, or a post-1981 stereo-ready set with jacks for an outboard stereo processor.

Until recently, there was no way to get stereo sound with older TV sets—and about 100 million of these are estimated to still be in use. But now it's possible to upgrade your pre-'81 TV for stereo sound with a *wireless* decoder that sells for less than \$150.

The V622 Stereo Decoder comes from Recoton, a company that began selling replacement needles made of cactus back when Sinatra was cutting 78s. The device is the brainchild of Larry Schotz, one of the nation's fore-

most FM engineers. Schotz's invention takes advantage of the fact that every TV set leaks minute amounts of radio frequency (RF) energy through its shroud. That leak contains the undecoded stereo TV signal. The V622 comes with an RF probe that you move around the TV until a light on the main unit indicates you've found the leakage point. That's where you affix the self-adhesive probe.

From this point, the probe conveys the incoming TV signal to the V622, where the stereo portion is decoded. Output cables from the V622 send the sound to your hi-fi system, to amplified loudspeakers, or back to the stereo amp and speakers in a post-'81 TV. A second set of outputs routes the sound to any VCR that records in stereo.

New TVs for old

Want to add remote control to your old TV? Add-on systems have been around for years, but most cost about half the price of a new 19-in. color set.

A less expensive alternative comes from ChannelScan. The company's wireless SC-50 sells for \$39 or less and fits over your TV's rotary tuning knob. This unit is connected to a wall-mounted module that plugs into an electrical outlet and becomes the receptacle for your TV's power cord. The wireless handheld remote lets you switch 30 channels in either direction, turn the TV on or off, or set the TV to shut off after 30 or 60 minutes.

Wireless ChannelScan remote control is for rotary-tuned TVs.



CD boombox battle escalates

August's *Electronics Monitor* (page 42) reported on Sony's new boombox with built-in Compact Disc player. And in the me-too world of electronics, it didn't take long for other brands to retaliate in kind. The latest portable hi-fi systems with laser turntables come from Panasonic, Magnavox and General Electric. In addition to digital sound, Panasonic's RX-CD70 (\$600) houses a 2-transport cassette deck for high-speed tape dubbing. The Magnavox CD-555 (\$500) lacks the dubbing feature but adds a 5-band graphic equalizer. G.E.'s Model 3-7010 (\$600) has a 7-band equalizer. All three have detachable loudspeakers, and their CD sections can be connected directly to hi-fi systems. **PM**



GET THE KNOW-HOW TO REPAIR EVERY COMPUTER ON THIS PAGE.

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Praised by critics as the "most intriguing" of all the IBM-PC compatible computers, the new Sanyo uses the same 8088 microprocessor as the IBM-PC and



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the 8088 microprocessor functions, using machine language. You'll also prepare the interfaces for future peripherals such as printers and joysticks.

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HOMEOWNERS' CLINIC



Covering roof turbines in winter

I no longer cover my soffit vents during the winter, since I read that they should be left open to permit air circulation. Does the same theory apply to revolving roof turbines? I don't know if it's better to leave them open as well, but I have seen many that are covered.—John H. Kiser, Midwest City, OK

If the ventilation openings of the roof turbines are in excess of the attic's

recommended free-air ventilation openings, then you can cover them. The recommended attic vent openings are 1/300 of the attic floor area when there is a vapor barrier on the underside of the insulation, and 1/150 of the attic floor area if there is no vapor barrier.

Many people cover the turbine vents in the winter for the same reason they cover gable vents—to keep attic heat in

the attic. This can create condensation problems. The heat loss should be controlled by insulating the attic and not by blocking ventilation openings.

Adequate ventilation is necessary in summer to prevent heat buildup. In winter, however, ventilation is required to reduce or eliminate moisture buildup and condensation that can cause plywood roof sheathing to delaminate, paint to peel, and insulation to get wet and lose its effectiveness.

Flooded chimney flue

I have a new 2-story house with a gas hot-water heater and a gas furnace. When the exhaust gases hit the clay chimney flue tiles, they condense. On the average, I collect half a gallon of water a day from the chimney cleanout pit. If I don't siphon the pit, the water seeps into the basement.

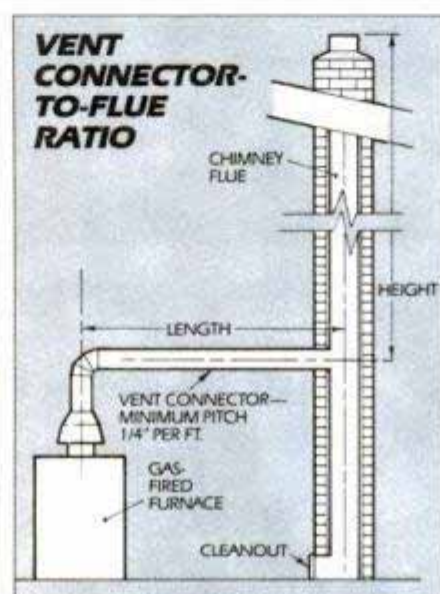
The furnace has an electronic flue damper. The vent connector is 25 ft. long, on a sloped horizontal run from the furnace to the brick chimney. The water heater is connected after the damper to the same vent. The chimney does not have a flue cap, but I get little or no rain in the flue that I can notice.

Would capping the flue create a better draft? Would disconnecting the flue damper help? Or running a smaller-diameter metal flue within the existing chimney?—Jon Marcacci, Dunlap, IL

The problem is not with the chimney, but with the length of the vent connector running to the chimney. The exhaust gases give up an excessive amount of heat as they travel through the long pipe. You might think that's good, because you can heat the basement for nothing, since the exhaust gases are going up the chimney anyway.

However, water vapor is one of the byproducts of combustion in a furnace. By giving up their heat, the exhaust gases are cooled down to a temperature that is at or near their dew point. In other words, the temperature is too low to allow the gases to make it up the chimney without the water vapor condensing.

As a matter of fact, this is a problem often encountered after installing one of the various kinds of heat recovery devices on the vent connector with the hope of saving energy. Too much heat is extracted from the exhaust gases and the products of combustion condense



Furnace exhaust gases must retain heat to carry moisture vapor up the chimney. Vent connector length should be no more than 75 percent of chimney flue height.

before venting to the atmosphere.

I don't understand why your furnace is 28 ft. away from the chimney. You didn't mention the height of your chimney, but it is probably no higher than 25 ft. According to the American Gas Assn. and the National Fire Protection Assn., the horizontal run of a vent connector to a natural draft chimney should not be more than 75 percent of the height of the chimney above the connector. Unless there is a design criteria with your system that you didn't mention, your vent connector is too long for a natural draft, and requires a draft-inducing fan.

To minimize the condensation, you might try insulating the vent connector, or use insulated pipe. This will reduce the heat loss of the exhaust and keep its temperature above the dew point.

No-freeze heating

My home is heated by a hot-water baseboard heating system. In the winter I'm concerned that if the heating system shuts down, the water in the system would freeze. I'd like to know if the system can be winterized.—Louis Magliente, Tappan, NY

Yes, you can protect your heating system from freezing. In a hot-water heating system the furnace, piping and radiators are completely filled with water all the time. To protect against freezing you should remove some of the water and replace it with ethyl glycol antifreeze, which is available at plumbing supply stores.

Determine the total volume of water in the heating system. The percentage you remove and replace with antifreeze will depend on the lowest temperature against which you may need protection. For most climates a 50-50 mixture is adequate.

Before introducing the antifreeze, make sure the seals on the circulating pump will not be affected. Check with the manufacturer. Some pumps with seals not meant for antifreeze can be retrofitted with new seals.

Maintain the water level in the system using the manual gate valve rather than the automatic fill valve. If a problem should develop with the fill valve, it could dilute the antifreeze. Also, keeping the gate valve closed will isolate the antifreeze from the potable water supply and prevent the risk of backflow contamination.

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.

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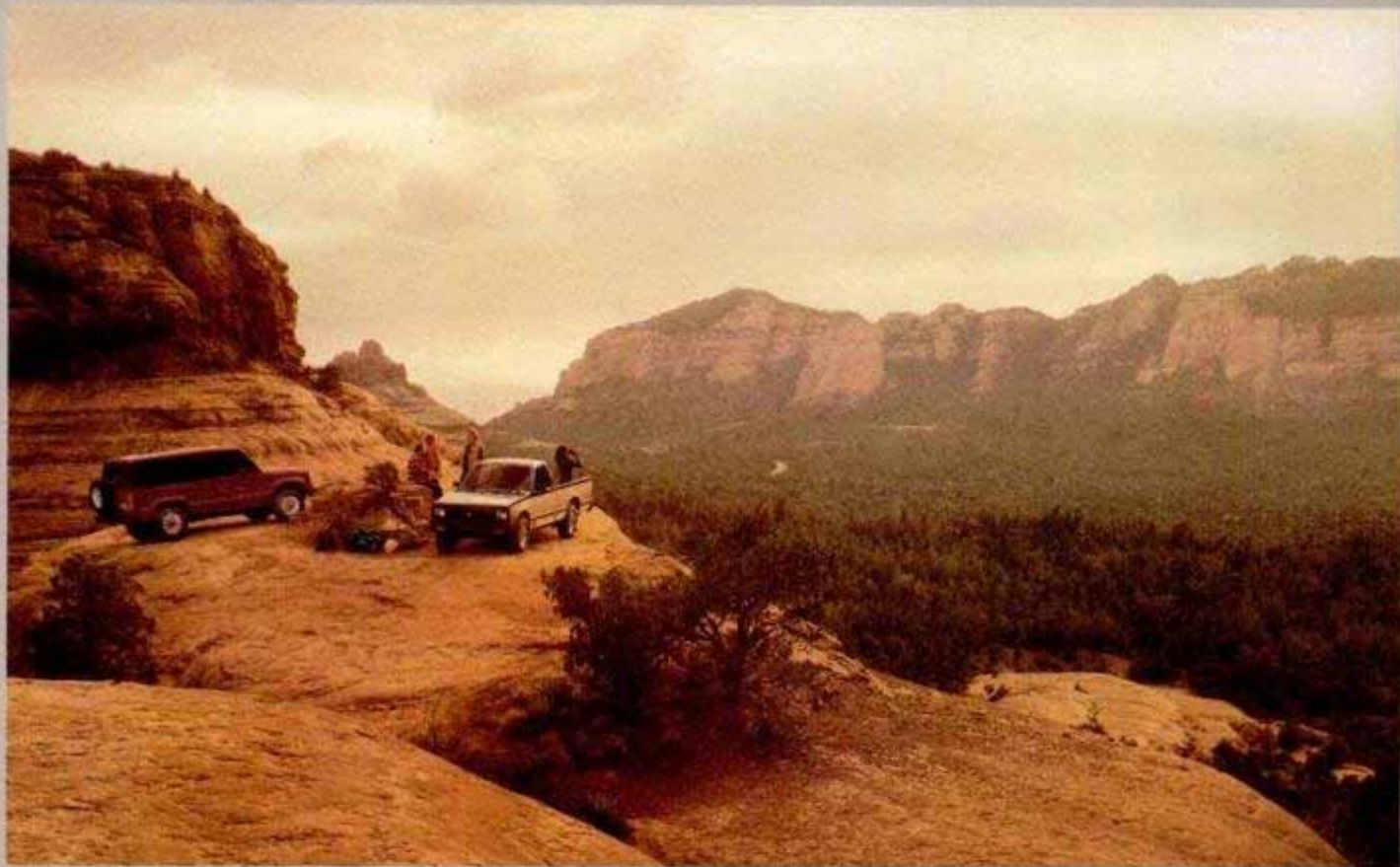
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REMEMBER—ALL ARE EQUAL IN ALCOHOL CONTENT

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During your day-to-day driving you'll find plenty of good reasons to appreciate a four-wheel drive Isuzu.

Such as the surefooted way the Trooper II can carry a full load of people and baggage over slippery rain-slick streets.

Or the confident way the P'UP 4x4 can take one of the heaviest payloads in its class almost anywhere you want to take it.

But then there are those other days. The days when you have nothing to do but pick out an



intriguing line on your map and follow it to the end.

That's when you start to appreciate the kind of quality that prompted *4Wheel & Off-Road* magazine to name the Trooper II their "4x4 Of The Year."

Or the kind of engineering that helped an Isuzu P'UP win the world's most grueling off-road race, the infamous Baja 1000.

But what you'll appreciate most of all is what an Isuzu 4x4 lets you do when you reach the end of the line. Keep on going.

THE FIRST CAR BUILDERS OF JAPAN.

ISUZU

THE PM GARAGE



Easy rethreads

When you strip threads, or if worn threads won't hold, the usual cure is to drill out and tap the hole, install a threaded insert and a new bolt. If the bolt isn't supercritical (such as a main bearing cap or suspension part), try a new easier-to-use \$8.30 kit called Form-A-Thread. It's made by Loctite Corp., 4450 Cranwood Court, Cleveland, OH 44128, and sold in auto parts stores.

Spray the bolt with an aerosol release agent, then mix the nonmetallic thread compound and fill the hole. Carefully turn the bolt into the hole to form new threads in the compound. Allow two hours for the material to cure, and torque the bolt to specs. This kit handles bolts up to SAE grade 5 and

Form-A-Thread lets you mold your own.

Metric 5.8, and the biggest bolts will take over 100 ft.-lb. torque. The compound is not compatible with transmission fluid.—*Pete Warren*



EGR valve test plate



Test plate is for checking your EGR valve.

When an engine runs poorly, a leaking Exhaust Gas Recirculation valve is one of the first things I suspect. I check with a new test plate that fits between the EGR valve and its mounting pad, allowing me to block off the exhaust passage. If the car runs better, I know the EGR valve is at fault. The test plate's metal alloy is too thin to be used as a permanent bypass, according to Thexton Mfg Co., P.O. Box 35008, Minneapolis, MN 55435.—*Pete Warren*

Safety catches on hydraulic jack keep it from falling.



Hydraulic safety jack

The light-duty floor jack in my garage gets a real workout at times, lifting cars for tire rotation and raising them high enough to slide safety stands under the frame. Here's one jack that gives me a big boost in user confidence, thanks to a pair of clever safety catches that

hold the jack in the raised position even if the hydraulic unit fails.

The Alltrade Safety Jack carries a 2-ton rating and offers a 16½-in. reach. At just 42 pounds, it certainly ranks as a home-shop jack, where it should last a good long time. The safety catches allow three levels of height adjustment, and though they are no replacement for true safety stands, they are still a wise idea. The Safety Jack carries a suggested retail price of \$69.95 at auto parts stores and mass merchandisers. For more information, contact Alltrade, 2140 Davie Ave., City of Commerce, CA 90040.—*N.S.M.*

Look out behind you!

Backing big rigs, including motor homes and even some vans, takes nerve and luck. Mirrors help, but you never know what's in that blind spot.

Now you can, thanks to Super Eyes Backing Radar. I installed one on a friend's 25-foot motor home, and it works like a charm.

Two little ultrasonic sensors attach to the rear of the vehicle, with a microprocessor and monitor up front. The reverse switch on the transmission triggers the system. The sensor puts

out a 6-foot signal pattern, and the monitor starts beeping when the motor home gets within 6 feet of an object. As the vehicle closes in, the beep gets faster and louder, and a colored display on the monitor also tells you how near you are to impact.

Backup scanner puts "eyes" behind you: Sensors mount on back of vehicle (far right) and monitor (right) mounts on dashboard.



Prices range from \$124.50 to \$198 (depending on whether you want one to four sensors) plus shipping. Units can be ordered from Fleet Specialties Co., Box 4575-PM, Thousand Oaks, CA 91360.—*M.L.*



CAR CLINIC



Play it again, Mort

Regarding Rick Szalkowski's letter ("Belting out a different song") in the July 1985 *Car Clinic* (page 42), he quoted precisely the information on the sticker of his 2.3-liter Ford engine air cleaner. Ford says oil carrying the designation CC or CD should not be used in the 2.3-liter engine. A letter to this effect was sent by Ford to owners of cars with 2.3-liter engines, so your answer that he can use oil designated SF/CC or SF/CD is wrong. You should have checked before you dismissed his question so glibly.—Curtis E. Odell, Fawnskin, CA

I did check, Curtis, but perhaps my

answer to Mr. Szalkowski's letter should have explained the matter in more detail. Let's do that now.

The letter you mention was sent by Ford in January 1979. It said that Ford vehicles equipped with 2.3-liter engines should not use an oil showing CC or CD on the container. The letter pointed out that use of oil having CC and CD designations could cause premature camshaft and rocker arm wear, because there was no additive in the oil to prevent wear. It mentioned in particular SE/CC and SE/CD, and "SF where available." Oil designated SF was just beginning to come on the market. In-

cluded with the letter to Ford owners were decals with the warning printed on them. These were to be placed on air cleaner covers and in the owner's manuals as reminders.

After this advisory was issued, an additive to prevent camshaft and rocker arm wear was developed. It is contained in oil having SF/CC and SF/CD designations.

Therefore, as I said in answer to Mr. Szalkowski's question, owners of Ford-build vehicles that have 2.3-liter engines, including vehicles that were manufactured before the date of the letter, can use oils designated SF/CC or SF/CD without fear that the oil will cause engine damage.

Lash back at backlash

I own a 1978 Plymouth Volare and ask your help in trying to solve a rear-end noise problem. The car has always given a metallic bang from the rear when shifted into reverse. Mechanics have offered different opinions about treating the condition, which they call backlash. For example, one wants to put shims in the rear, while another wants to use expansion washers. What is the correct solution?—G. Leslie Nichols, Scarborough, ME

Your problem probably results from excessive rear-end backlash. Then again, it may be caused by a high fast-idle speed. The fast idle should coincide with the specification given on the emission control information label mounted in the engine compartment. If it does or if adjusting fast-idle speed doesn't eliminate the banging noise, then measure for excessive rear-end backlash by putting the car on a hoist, placing the transmission in NEUTRAL, turning off the engine and engaging the parking brake.

Rotate the prop shaft clockwise by hand as far as it will go. Scribe an index mark on the rear-axle carrier nose and another in line with it on the seal guard. The nose is a stationary member; the seal guard moves as the drivetrain rotates. Now, rotate the prop shaft counterclockwise by hand as far as it will go. Scribe another index mark on the seal guard in line with the one previously made on the carrier nose.

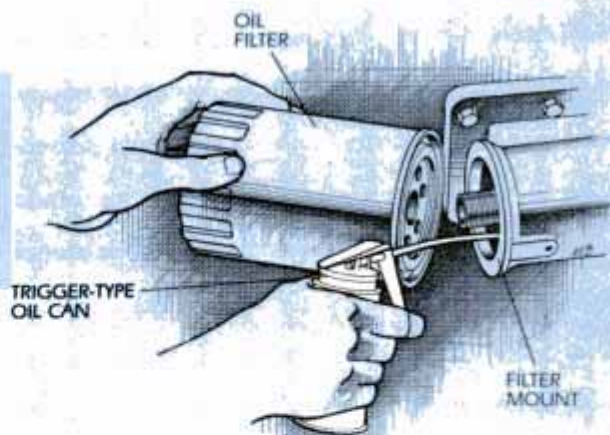
To determine if there's excessive backlash, measure the distance between the two marks on the seal guard.

If this distance is more than $\frac{3}{16}$ in. there's too much backlash, but what's done about it depends on the location of the slack. There are three possibilities—between differential side gears, between ring and pinion gears, and the pinion gear nut.

Disassemble the rear axle and take measurements according to instructions in the service manual to find the

problem area. If there's excessive slack between side gears, take it out with shims. Eliminate excessive slack between ring and pinion gears by taking up on the adjuster. (Incidentally, the correct adjustment is .003-.006 in.—not the .004-.007 in. given in the manual.) If the pinion nut is loose, a spacer to fit the nut is available from the supply

(Please turn to page 29)



Prime time suggestion

Credit our friends at Atlas Supply Co. for this tip, which may come in handy one of these days when you're changing oil.

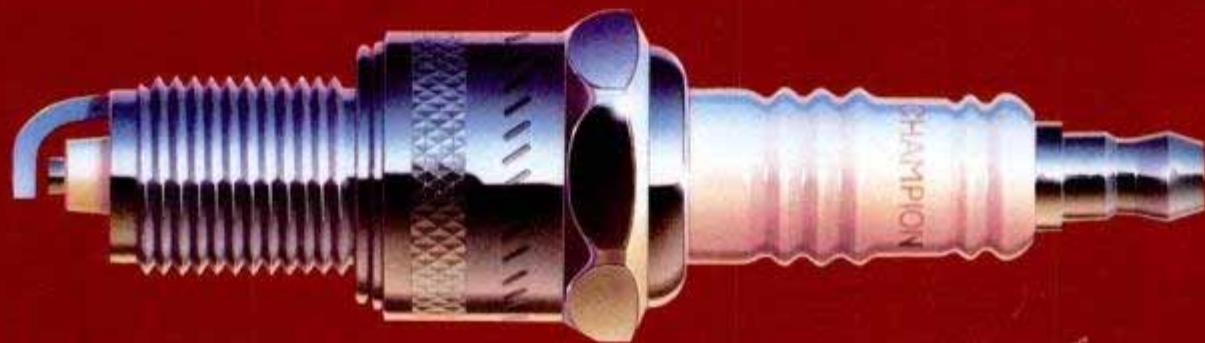
If the oil pressure indicator light stays on when you start the engine immediately after completing the job, turn off the engine at once. Complete drainage of old oil probably caused the pump to lose prime, so do this:

1. Remove the oil filter.
2. Using a trigger-type oil can, squirt five drops of SAE 30 oil into the inlet side of the engine through the oil filter mounting base.
3. Reinstall the oil filter and start the engine again. The oil pressure indicator light should go out within two or three seconds. If not, repeat the procedure.



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GOODYEAR

CAR CLINIC

(Continued from page 24)

department of a Chrysler dealer. After spacer and nut are installed, adjust pinion gear preload according to instructions in the service manual.

Loose LOW and REVERSE automatic transmission bands are another possible cause of noise like the one you describe. If measuring shows that rear-end backlash is not excessive, adjust the LOW and REVERSE transmission bands. Also, don't overlook the chance that a worn U-joint or front yoke is causing the noise.

Fix a broken break

You've helped us with our car problems for a long time—now I'd like to return the favor by presenting a solution to the hard-starting problem that's affecting GM X-cars when the engine is cold. The problem I'm speaking about results from engine flooding and is accompanied by black exhaust smoke.

I went back and forth with my dealer on this until the car was no longer covered by warranty. I finally took the matter out of his hands and sought help from a local NAPA dealer who told me that some GM X-cars with 4-cylinder engines came from the factory with plugged choke vacuum break bleed holes. To prove the point, he told me to

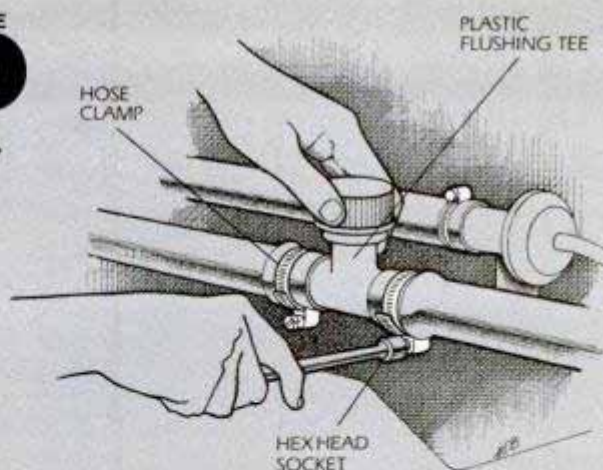
SERVICE TIPS

■ If you're wondering how to check the oil level in a 1985 Pontiac Fiero manual transmission, remove the speedometer cable fitting. There's an indicator at the base of the fitting. Check oil with the engine off, car parked on level ground and the transmission warm to the touch. Use SAE 5W-30 SF-engine oil.

■ No one owning a 1984 Chrysler Corp. car or pickup truck equipped with 2.2-liter engine and electronic feedback carburetor should be troubled by weak acceleration and power flat spots—not if you refer your dealer to TSB 18-23-85.

■ In April 1985, Ford Bronco II and Ranger vehicles with 2.3-liter EFI engines started to be equipped with cast aluminum oil pans. Before that, they were outfitted with stamped oil pans. The new pan requires five quarts of oil (this includes a quart for oil filter replacement). The old oil pan requires six quarts of oil. So, whichever pan you have, don't be upset if you learn that someone with the same model vehicle has a different oil capacity requirement.

■ Owners of Hondas who complain about brake vibration should examine the way they're tightening lug nuts. Excessively high lug nut torque can distort brake rotors and brake drums, causing vibration. The lugs of 1973-83 Civics and 1976-81 Accords should be tightened to 58 ft.-lb. Lugs of all other models should be tightened to 80 ft.-lb.



Clamping down on overzeal

What could be simpler than tightening a hose clamp. Clamp manufacturers provide two ways for you to do it. The clamp fastener has both a screwdriver slot and a hexhead that accepts a socket. Many guys are so happy with the arrangement that they tighten and tighten and tighten. Before they know it, they distort what's underneath—like a plastic tee in the heater inlet hose

that's used to flush the cooling system, or a radiator or fuel line fitting.

So the rule is this: If the clamp is around something solid like a plastic flushing tee, tighten the clamp until it's snug. If the clamp is around a hose, tighten the clamp until the hose just starts to bulge. After running the engine a few miles, check for leakage. If there is none, that clamp is tight enough.

watch the choke linkage as he started my car (engine cold). Sure enough, the linkage didn't move. We replaced the vacuum break, and I've not had trouble since.

Just for the heck of it, I took the old vacuum break apart and found that the bleed hole wasn't punched through. This defect keeps the vacuum break from pulling the choke linkage back to open the choke plate enough and prevent flooding when starting a cold engine.—Vern Holt, Mendham, NJ

Thanks for telling us your story, Vern. It could solve a mystery for X-car owners who read Car Clinic.

Being slipped a mickey?

In discussing my rough-running/stalling/missing 1980 Datsun 210 with the service manager at a Nissan dealership, he asked what gasoline I was using. When I answered, "Shell super." He said, "Switch."

The service manager contends that all major fuel companies are putting alcohol in super unleaded gasoline, and it's eating fuel pump diaphragms, causing vapor lock and overheating, and may lead to burned valves. Is there any truth to this?—Charles R. Bedle, Columbus, GA

The latest information I have is that no major fuel company blends alcohol into gasoline being sold in Georgia.

Furthermore, Shell happens to be one of seven companies that doesn't put alcohol into gasoline sold anywhere in the United States. The others are Exxon, Gulf, Marathon, Mobil, Sohio and Union. The service manager seems to be off base.

Be aware, however, that there have been instances of fuel tampering in which alcohol has been poured into gasoline after it has left the province of the fuel company. If the service manager suspects that gas you're using is adulterated, he can make a test with an alcohol detection kit, such as one sold by Kent-Moore tools (part No. J-34353) or by Miller Tool Co. (part No. C-4846).

Your question opens an area that PM is presently exploring: How detrimental to an engine is gasoline that contains alcohol? Our findings will be reported in a future article on gasoline.

Incidentally, if you go through the list of routine services given in the service manual, and none solves your driveability problem, have the original primary jet in the carburetor replaced with one of a different design. It carries part No. 16033S5800. **PM**

DO YOU HAVE A CAR PROBLEM?

Just ask Mart 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.

DETROIT LISTENING POST

Smooth faces at Ford



Thunderbird for '87 has a V-shaped nose and flush headlights but body stays the same.

Ford Motor Company's commitment to aerodynamics is total, extending even to its light trucks, as the spy shot on the right shows. That's a full-size F-350 pickup with flush headlights and grille, just like a Lincoln, only vertical. Above is what we believe to be the first clear photo of the aerodynamic nose and flush headlights planned for the '87 Thunderbird, which was shown photographed through a chain link fence last month (see *DLP*, page 29). The new nose arrives in '87, the bubbleback hatch in '88 and an all-new BMW-like body with front-drive in '89.



Full-size F-350 pickup prototype sports flush aero headlights, just like on a Mark VII.

CAFE break

Car companies have been complaining to the EPA for years about running changes in the way the government conducts its fuel economy tests. Changes made since 1979 include lab humidity, fuel, dyno controls, weight categories, motor oils and exhaust samplers. All have hurt mpg results, the carmakers said, and now they face multimillion-dollar gas guzzler fines. The EPA was given a court order to reevaluate its changes and give the carmakers mpg credits, if necessary. The best anyone hoped for was one or two tenths of an mpg. What they got was a bonanza.

GM and Ford each got a 2.7-mpg giveback, enough to get them out of the gas guzzler hole and \$400 million in fines. Biggest winner was GM, who

went from 1.8 mpg in the red to 0.9 mpg surplus. Volvo and Saab also climbed out of the CAFE hole. Rolls Royce got off the gas-guzzler hook entirely. Seems someone at Rolls finally read the fine print in the law and discovered that it doesn't apply to vehicles over 6000 pounds. Since Rollers aren't lightweights, the EPA now has to refund some \$4 million in guzzler fines.

GM sends out

As previously reported here, the 1990 Corvette will be designed by a British engineering firm, Hawtal-Whiting Design Co. HWD has also landed the contract to do the 2-seat Buick Riatta sports car, and a future station wagon known only as GM-10 right now. GM will be farming out up to 80 percent of its future design work.

Chrysler's zippier H-cars

Chrysler's scheduled a major reworking for its H-bodies—LeBaron GTS and Lancer—for 1988. They'll look and perform much differently than the current cars. The engine will be the 3.0-liter V6 Chrysler has coming from its Japanese partner, Mitsubishi, and the bodies will be completely reskinned. The hood will drop to give a stronger aero look.

Other down-the-road stuff coming from Chrysler: A small utility vehicle—"a scaled-down Jeep," as one source describes it—and 4-wheel drive for its T-wagons. The company is looking at several 4-wheel-drive packages—one for conventional driving, another for off-road vehicles and a version for performance cars. Ford is also developing a "cowboy" version of 4-wheel drive and a more sedate package for families.

Avanti bust

Avanti Motor Corp. has filed for bankruptcy and reorganization. The South Bend, Indiana, firm, which seemed to be doing just fine building Chevy-powered replicas of the Raymond Lowey Studebaker, ran into trouble a few years ago when it began several ambitious projects, including a modernization of the Lowey body, a convertible, a Daytona race car and a new sports car designed by Herb Adams. The reorganization plans are no less ambitious: loans of \$5 to \$8 million, moving the factory to Detroit, dropping the well-known Lowey coupe, continuing the convertible and introducing a new coupe and roadster.

GM's Rubicon

It looks like a plain '85 Cadillac Fleetwood. But there's a lot inside that doesn't show outside. Nicknamed Rubicon, it's a one-of-a-kind car GM's put together incorporating all the electronics currently available for automobiles. Not blue-sky stuff, but electronics that are practical right now, although not necessarily on the market. Many of the devices you already know about—temperature controls, cruise control, trip computer, radio, lights, wipers, seat adjustment. But some of the gear is new and won't show up before 1988 or later.

The heart of the system is a small TV screen set in the center of the steering wheel. The driver can call up any information programmed into the system

(Please turn to page 33)

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WOLVERINE
WORK-LITES TLC

DETROIT LISTENING POST

(Continued from page 30)

without taking his hands off the wheel. By making finger contact with the edge of the screen, the information on the screen changes.

GM is also considering a no-hands phone. Suppose you want to call home or the office to let them know you'll be late. With the phone function on the screen, a list of most-called numbers appears at the center of the steering wheel. Instead of numbers, they're names. If you touch "home" or "office" the number is dialed automatically. When the phone is answered on the other end, the voice comes through a speaker in the console. The driver's voice is picked up by two different mikes, one built into the steering wheel, another in the rear-view mirror.

Second example: The driver senses something is wrong with the car. A series of probable faults appears on the screen. When the "menu" hits a fault corresponding with the problem being experienced, the driver touches the edge of the screen and the display suggests the service required to correct the problem.

GM isn't promising these things will show up on production cars, but they are well within the realm of possibility.

More 4-wheelin'

An in-house spy at Chrysler predicts all cars will eventually have 4-wheel drive. "Maybe in the next four or five years," he adds. But a source in engineering at GM adds a qualifier, "You'll see it on all performance cars, no question, but I don't envision it across-the-board. There's a big cost factor and you have to figure a substantial price increase to cover it. That argues against it on low-price cars." Stay tuned.

Fade in, fade out

Instrument panels have become so cluttered that engineers have been forced to look for other areas to position devices being developed for cars of the future. But where? The problem is that the device or display has to be where the driver can reach it or see it. One idea that's getting a lot of attention is a heads-up optical projection system that will flash information on the windshield as the driver asks for it. Press a button and the information appears on the windshield for a few seconds—just long enough to read—and then disappears. GM has a program to develop this and the other companies are getting into it.

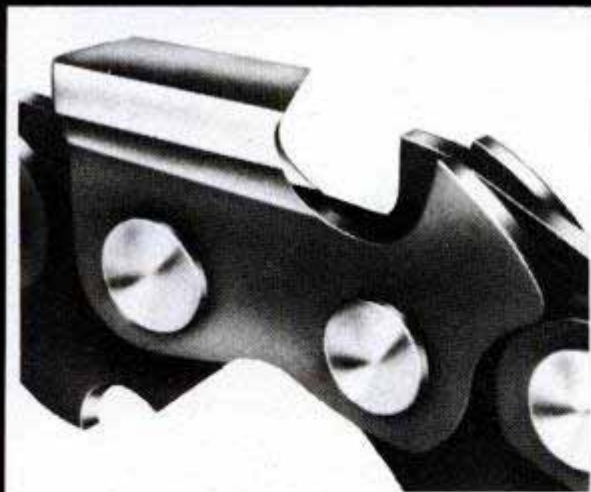
Body computers

Automakers would like to put a "body computer" that automatically regulates

vehicle height on everything they make. The computer would also alert the driver via a buzzer or warning lights, possibly even kill the ignition, if the car's overloaded or if there's an unsafe distribution of weight. The technology already exists, but there's a stiff cost penalty that makes it impractical for low price cars. GM and Ford are looking at body computers for all cars above a certain price level, say \$10,000 and up, as a guess. Chrysler's taking a different approach. It's trying to figure a way to get the price down and volume up so it could install a body balancer on everything it produces.

Service by computer

Some Ford dealers now offer service by computer. It's called OASIS (On-Line Automotive Service Information System). If you take your car to a Ford dealer with a problem the mechanic can't figure out, he puts in a call to OASIS. Using a computer in the dealership, he enters the car ID number and symptoms of the problem. The computer is linked via phone to a main computer at Ford headquarters in Dearborn, Michigan. In a matter of seconds, the mother computer sends back the necessary information to repair the car. It's in some Ford dealerships now and will be nationwide by next year. **FM**



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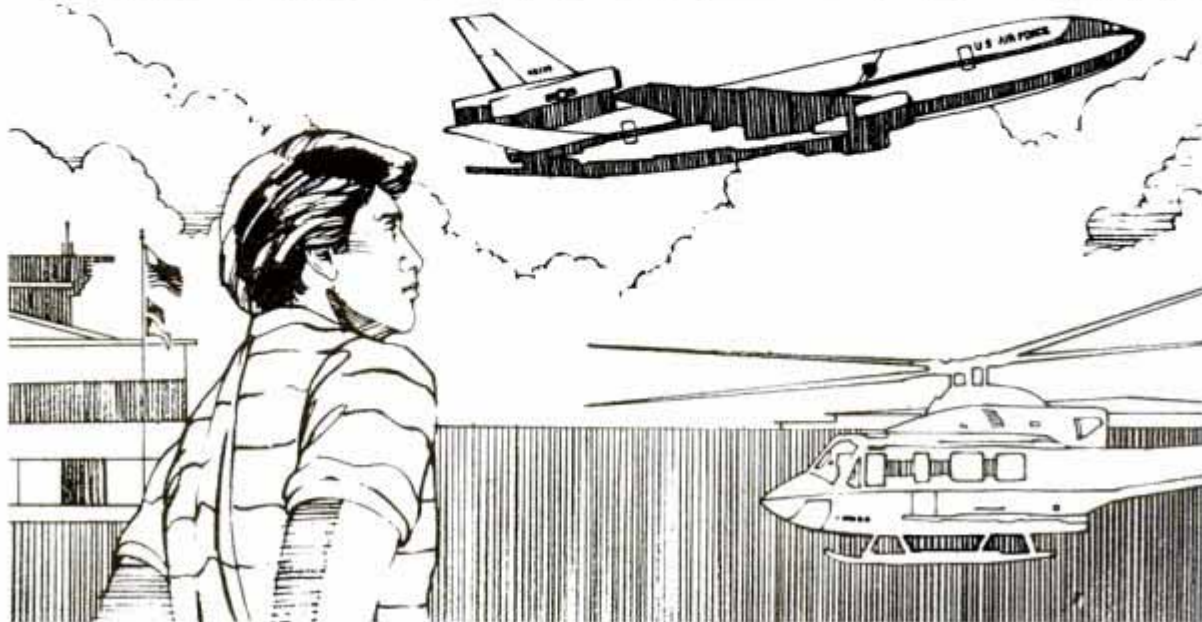
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TECHNICAL HIGHLIGHTS

Technical twists will make 1986 a very interesting year.

A though there are some exciting new cars coming out of Detroit this year, two of the Big Four (AMC and Chrysler) have no all-new models on the launch pad. But that doesn't mean these automakers have been idle. There's a lot going on under the skin, even on cars that don't look very different from last year's models on the outside.

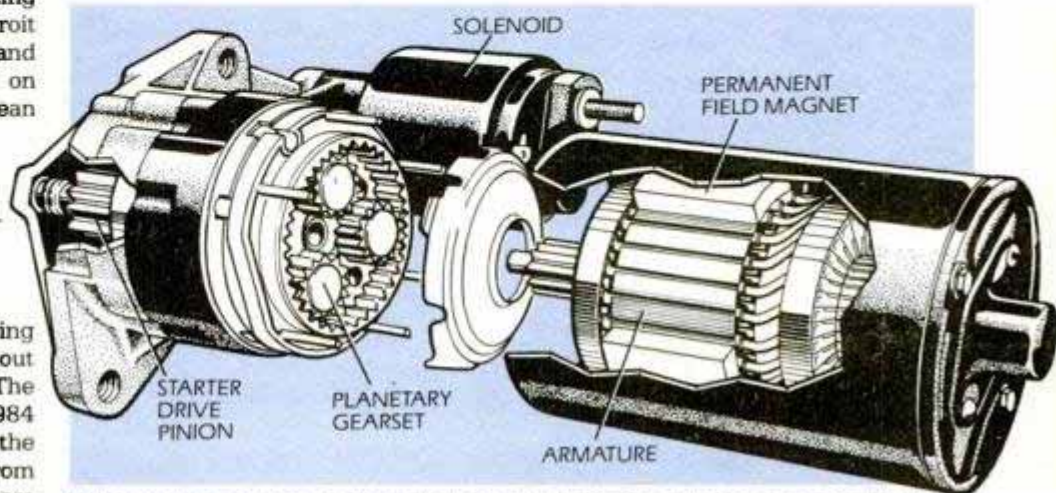
AMC

You know the times are changing when American Motors is talking about being a horsepower leader in '86. The 2.5-liter Four AMC introduced in 1984 on Cherokee-Wagoneer, now in the new Comanche pickup, goes up from 105 to 117 horses (torque is up from 132 to 135 lb.-ft.). This gives the Comanche the most powerful standard engine in the field.

All that was done was to bolt on throttle-body fuel injection (TBI) tied to a new engine control computer. Usually, TBI wouldn't make such a horsepower difference. It does so in this case because AMC engineers knew it was coming and did the 2.5 design work with a 2-barrel carb, giving the 2.5 engine the capability for deep breathing. However, for '84-'85 production they mounted a 1-barrel, which left the engine gasping for breath. The '86 TBI and a new computerized spark curve are like opening an oxygen valve and giving the patient a shot of adrenalin.

Both the 2.5 and the Alliance's optional 1.7-liter engine have new permanent-magnet Bosch starters with a reduction gear to boost cranking speed about 10 percent, which is particularly helpful in starting at 20° below and colder. AMC's starter is lightweight (under 8 pounds, compared with about 17 in '85). Gear-reduction units normally add to a starter's size, because one gear goes above the other. But this one has a planetary gearset, similar to those used in automatic transmissions, so all the gears fit in-line, into a space 3/8 in. wide in the starter housing.

The permanent magnets reduce the starter current draw—very helpful at cold temperatures when batteries are in trouble. The minus-20° draw on the 1.7, for example, is only 320 amps, com-

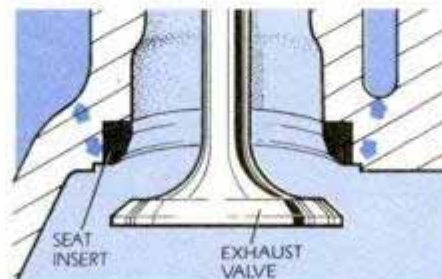


New permanent-magnet starters eliminate the field windings, cutting starter weight in half. Planetary gearset boosts the cranking speed 10 percent to aid cold-weather starting.

pared with 420 on the '85 starter.

The 2.5 cast-iron head also gets hardened exhaust valve seat inserts, normally used only on aluminum heads. The inserts are strong, so the engine now sails through AMC's tough 1000-hour durability test, in which it previously struggled. An insert adds a joint, which normally means poorer heat transfer. However, AMC has improved its head casting so it can carefully control metal thickness between the hot exhaust valve seats and the water jacket. The iron wall is as much as 0.2 in. thinner between exhaust seats and water jacket, so heat transfer is better.

Comanche and Cherokee-Wagoneer also get an optional off-highway package that reflects AMC's new philosophy toward ride control: keep the spring rates down (so the vehicle isn't a harsh rider on the highway) and use high-



Hardened exhaust valve seat inserts aid heat transfer to water jacket, so head thickness can be reduced slightly (arrows).

pressure (400-psi) gas shocks, which offer high resistance to oil aeration. Result: The shocks can be tuned for low-speed performance without the compromises needed to compensate for high-speed ride and handling problems that usually result from aeration on washboard surfaces.

Chrysler

What do you do when you don't have new lines of bigger cars and engines to sell today? Chrysler's answer is to try to give its 1986 4-cylinder cars the performance, quiet and smoothness of the V6s and V8s that its competitors sell.

Its big move was to rework its 2.2-liter Four, lengthening the stroke to increase the engine's displacement to 2.5 liters, a popular displacement choice. That size adequately powers intermediates, and is about as big as you can go in a 4-cylinder engine without objectionable shaking and vibration problems. Even at that displacement, the other guys all have big bore/short stroke engines, because a long stroke increases shake.

However, Chrysler needed low-end torque, and a long stroke helps get it—136 lb.-ft. at 2800 rpm. Chrysler added balance shafts, which are chain-driven off the crankshaft and rotate at twice crank speed, to help control engine shake and vibration.

Balance shafts aren't new (the 2.6-



liter Mitsubishi engine that Chrysler used for years has them). However, the 2.6 has one shaft at the lower right and a second at the upper left of the block. This would have posed packaging problems on the Chrysler engine. Further, the Mitsubishi uses a long chain that has suffered from stretch problems.

Chrysler came up with an ingenious answer: It put the shafts side-by-side in a housing under the crank so that it could be driven by a short chain. Chrysler's 2.5 now replaces the Mitsubishi 2.6 in all models except mini vans.

The fuel tanks were also reworked to get rid of a common Chrysler complaint that many considered a sign of "4-cylinder weakness"—engine sag on hard turns. Actually, it's fuel starvation, caused by fuel sloshing away from the pickup in the tank. The pump sucks more air than fuel. The fuel pump pickup in the new tank is surrounded by a wall that holds fuel in at all times. So, now, even when you really crank the car around a bend, the pickup should still have a pool of liquid fuel to feed the pump.

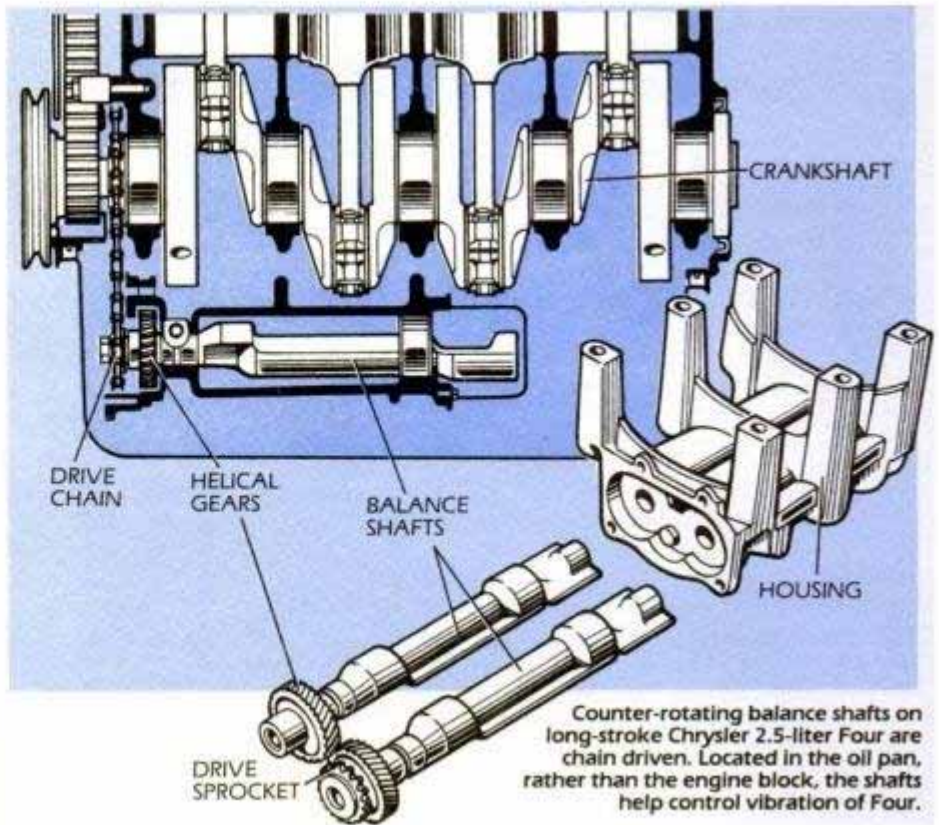
All these steps are useful, but a V6 still is a must. One will arrive shortly from Mitsubishi, but a Chrysler-built V6 is still in the labs.

Chrysler believes it has an answer for the hot restarting problems caused by alcohol additives in fuels. The alcohols vaporize in hot weather, affecting the fuel feed circuit. Chrysler's '86 models have a temperature sensor in the throttle body. When the temperature hits 190° F, the sensor triggers some new software in the computer to gradually increase the amount of fuel being sprayed. Once the fuel flows, it starts to cool, the spray pattern returns to normal and then the engine should start.

Chrysler will also be installing a Borg & Beck-developed solution to NEUTRAL gear rattle, the objectionable rattling noise that seems to afflict everyone's standard-shift 4-cylinder cars, particularly the transverse front drives.

The problem is thought to be the transfer of engine firing impulses and other roughness to the transmission gears, causing them to oscillate. A similar problem may even occur with the car moving; it's called drive rattle. The NEUTRAL rattle can be reduced by raising idle speed and the drive rattle by tightening up the transmission. Some of that has been done, but there are limits. Raising idle speed reduces gas mileage and tightening up the gearbox can cause cold shifting problems.

The Borg & Beck answer is a spring-



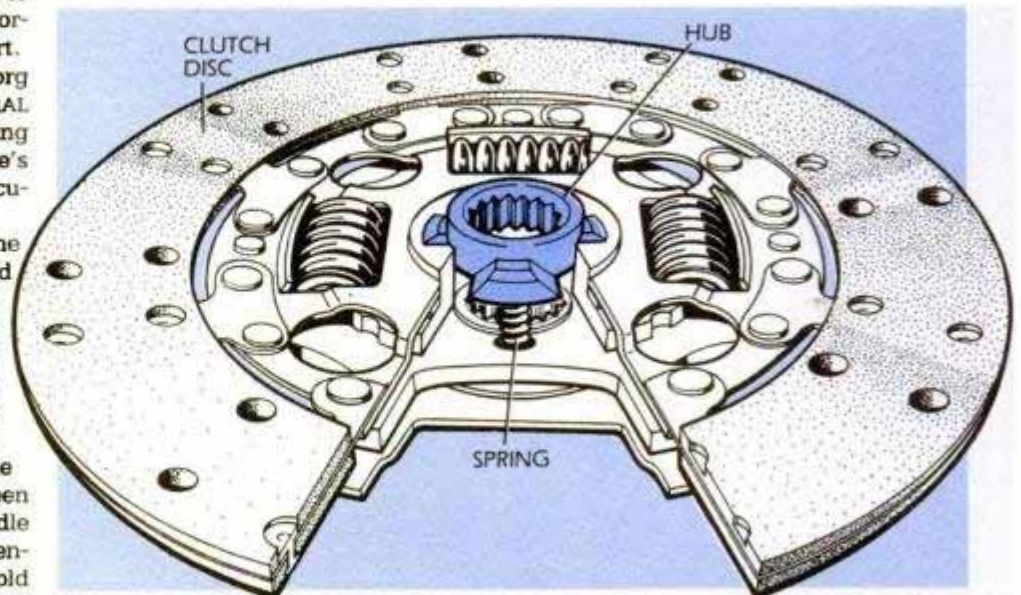
Counter-rotating balance shafts on long-stroke Chrysler 2.5-liter Four are chain driven. Located in the oil pan, rather than the engine block, the shafts help control vibration of Four.

loaded 2-piece plastic hub operating independently over a metal hub. The spring allows the plastic section to flex in and out, cancelling out the rotational impulses from the engine. The disc also has inner-and-outer dampening springs, which are calibrated to work on drive rattles. On a scale of 0 to 10, it's a 7 or better, according to a Chrysler engineer, making it the best answer to date. The new disc will debut on Chry-

ler vans with the 2.2-liter engine, 2.2 turbos and all 2.5-liter engines.

Ford

Ford's '86 Taurus and Sable are the intermediate latecomers, so to make inroads they need more than aero styling. Horsepower is selling, and so a high-compression 3-liter V6 with fuel injection is the standard powerplant for Job 1, with a 2.5-liter Four not available



To reduce annoying NEUTRAL gear rattle, new Chrysler clutches use a 2-piece, spring-loaded plastic hub. The hub's floating design dampens the engine's rotational impulses.

in these '86 Fords until mid-year.

The 3-liter has a 60° angle between the cylinder banks, good for balance and engine compartment fit. It's slightly larger and rated as more powerful than the '85 Chevy 2.8 V6 (140 horsepower vs. 107 for the standard Chevy and 135 for the high-performance model). Injection is the port type with a separate fuel injector at each intake port. The 9.25:1 compression ratio seems high for regular unleaded, but the V6 has the latest Ford fast-burn combustion chamber, which cuts octane needs. It features a mask around the intake valve to promote fuel mixture swirl and a more centralized sparkplug that projects deep into the chamber.

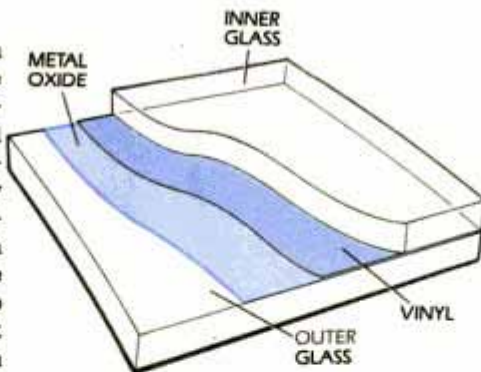
Both engines have low-friction technology, which includes low-tension piston rings, plus premium rubber gaskets and oil seals so they can use 5W-30 oil without leaking. The V8, which has to pass a 22.5 mpg standard for 1986 to avoid the gas guzzler tax, also gets sequential fuel injection (the injectors trigger one at a time following the firing order, instead of the simpler but less effective four at a time). Roller tappets, installed on some V8s last year, go on all of them in '86.

Taurus and Sable have a couple of better ideas that will undoubtedly see wide use: an electrically-heated windshield that can remove frost in a couple of minutes at 0° F, and structural plastic bumper that can really take a whack.

The windshield system is very different from the grid-heated rear window (which would interfere with the driver's view). It's an expensive design Ford used in the mid-1970s which required a second alternator, wired to produce 110 volts, and a windshield with an ultra-thin gold film coating.

The new one begins with a standard three-piece windshield construction: outer and inner layers of glass and vinyl sheet safety divider. An ultra-thin coat of silver and zinc oxide is applied to the inner surface of the outer piece of glass. The coating does not noticeably affect visibility. A slightly thicker coat is applied around the perimeter of the windshield, and wiring terminals are attached to it.

Push a dashboard switch and the alternator runs without voltage regulation to quickly produce 70 volts or more. The high-voltage current runs to the windshield for four minutes. Then, the module breaks the circuit to the windshield and the alternator is again controlled by the voltage regulator. The windshield system is locked out if the battery is weak.

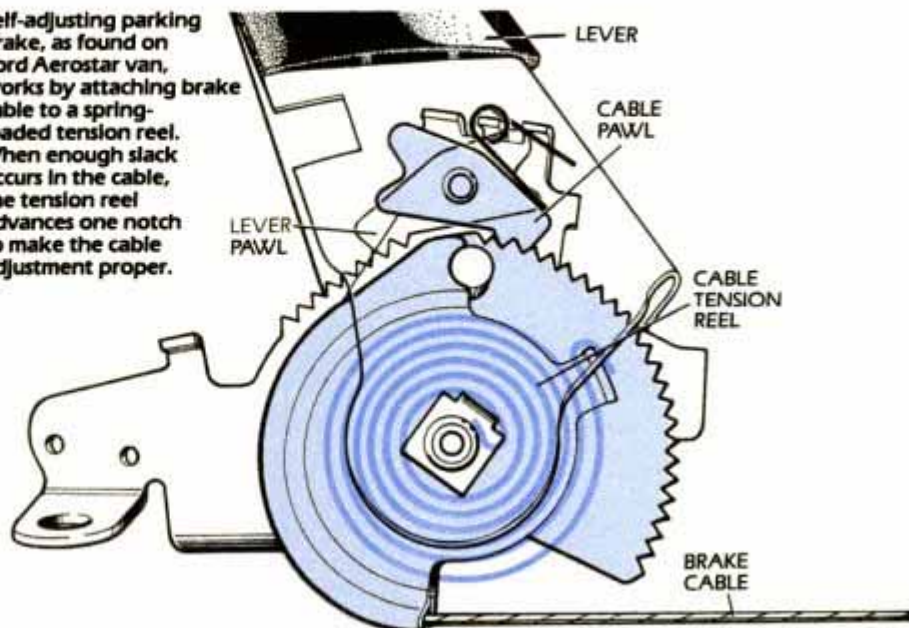


Ford's heated windshield uses a transparent layer of metal oxide as a heating element to melt ice in just two minutes at 0° F.

The structural plastic bumpers, also on Ford's Aerostar van, are a first U.S. application. They're a 2-piece design, an outer "face" section bonded to an inner reinforcement, and attached to conventional shock-absorbing members. The bumpers are rated for 5 mph, but take higher-speed impacts if the load is distributed evenly, such as bumper-to-bumper. At higher speeds, the bumper may get nothing more than a gouge. It takes a major whack to cause the bumper to crack.

The Aerostar van also gets a better Ford idea all its own: a self-adjusting parking brake. It has the standard brake handle with a spring-loaded pawl that locks against a ratchet-toothed section on the bracket. However, the brake cable is attached to a spring-loaded circular reel pinned to the bracket. This reel, which also has a toothed section, meshes with a second spring-loaded pawl in the handle. When the handle is pulled up, the reel rotates with its toothed section locked to the second

Self-adjusting parking brake, as found on Ford Aerostar van, works by attaching brake cable to a spring-loaded tension reel. When enough slack occurs in the cable, the tension reel advances one notch to make the cable adjustment proper.



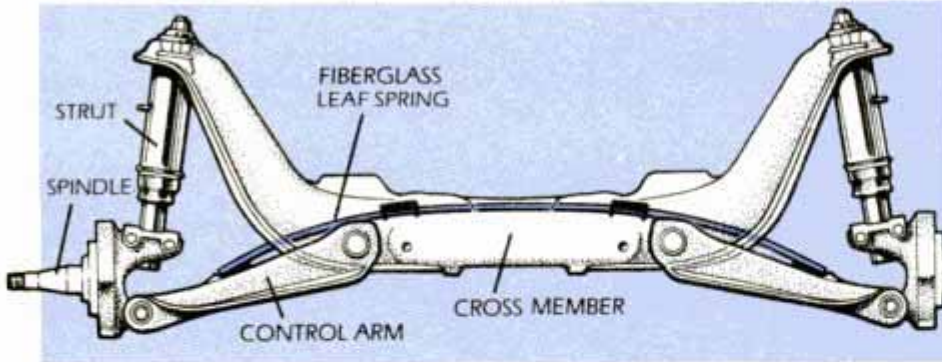
pawl to operate the cable. Push the release button on the handle and a rod disengages the first pawl. When the handle is moved down, a tab on the bracket disengages the second pawl from the cable reel teeth. If there's any cable slack, the spring-loaded reel turns to compensate, moving its toothed section around a notch, so that the next tooth is opposite the second pawl. Lift the handle and the second pawl reengages the toothed section at the new point, taking up any slack.

General Motors

The '86 Corvette looks like a carryover, but it's GM's leader in under-the-skin changes. The most customer-pleasing achievement is passing '86 gas guzzler specs (22.5 mpg) on the 350-cube V8. New parts include aluminum cylinder heads with reworked ports and combustion chambers, an exotic exhaust system with three catalytic converters, plus revised gear ratios in the manual overdrive transmission (down from 0.67 to 0.60:1) and a 2.59 rear axle ratio (with last year's 3.07 available as an option).

The three cats are free-breathers, and the first two, one behind each exhaust manifold, heat up quickly to cut hydrocarbons. With HC lowered, Chevy can add up to 8° of spark advance at part throttle, improving fuel economy.

The aluminum heads save over 40 pounds, but their most significant achievement results from port and chamber changes that increase fuel mixture burn rate. With a faster burn, the compression ratio can be raised from 9.0 to 9.5:1 for fuel better economy without raising octane needs.



Fully independent rear suspension on rear-drive Toronado/Riviera/Eldorado uses a Corvette-type transverse leaf spring, which is completely constructed of fiberglass.

For better oil leak control, Chevy will go to external rear crank seals on V6 and V8 engines. The 350 V8 develops 230 horses, about as much as the improved '86 Buick Regal 3.8-liter V6 with turbo and intercooler. The intercooler adds 40 horses for '86.

The Vette is close to the 3375-pound emissions class and could make it when an 8-pound Delco permanent magnet starter (saving 8-9 pounds), is installed by midyear. The starter uses GM's "Magnaquench" magnets, which reportedly are stronger than those of iron oxide in Bosch starters.

The '86 Corvette also will have GM's sophisticated new antitheft system: a key with an electronic resistor that signals a decoder to turn on the engine computer. There are 15 possible resistors, and use of the wrong one shuts down the system for two minutes. GM says this will slow down a thief by an average of 15-20 minutes. Actually, it adds only about 15 seconds to a steal by a sophisticated crook because the engine computer has been left accessible for service. All a thief needs to buy is any matched setup of key, ignition switch and decoder, then quick-connect them to the computer. However, it may discourage the strong-arm types, who just smash into the left side of the steering column and trip the lock bar.

The Vette also gets a Bosch antilock brake system that's simply an add-on to the vacuum-boosted hydraulic system already in use. However, the front-drive C-cars (Caddy deVille and Fleetwood, Olds 98 and Buick Electra) will offer the Teves antilock system, introduced last year on the Lincoln Continental. The Teves is an all-hydraulic system with an electric motor to provide pressurized oil for the assist. Both systems use computers to operate hydraulic pump motors and solenoid valves. The Teves is more compact and some-

thing similar may be on the Vette in a couple of years.

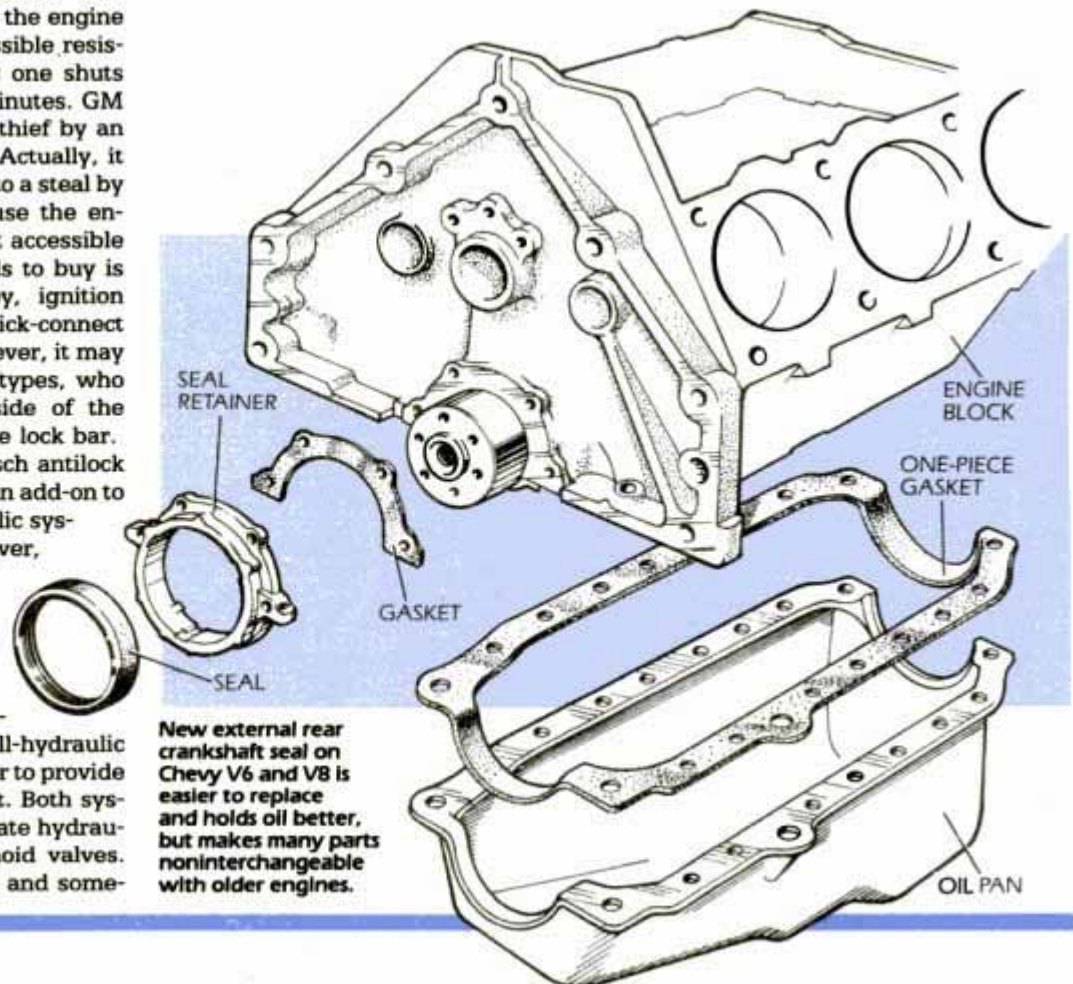
GM's '86 Toronado, Riviera and the late-coming Eldorado and Seville are the leaders in on-the-skin engineering. All inner and outer body panels are galvanized on both sides to prevent rust, even a break in the paint won't lead to rust because of the exterior galvanizing. So long as the body isn't dented, GM engineers say it will go over 10 years without rusting. The exhaust system also is designed not to rust—it's stainless steel from end to end. All of its joints are welded to

prevent noise.

The TV touch screen that Buick tested on a few cars last year, passed, and it will be standard on the '86 Riv. The tube is wired to the engine computer, heating-a/c computer, radio, trip monitor and gauge sensors.

The luxury front-drives get a development pioneered on the rear-drive Corvette—a plastic leaf spring mounted transversely for an independent rear suspension. The suspension, however, uses one control arm and a strut instead of the upper and lower arms on the Vette. The spring has two cushioned mounts spread relatively far apart, so if only one wheel hits a bump, the section between them can flex to provide a stiffer spring rate than just the length between the mount and control arm.

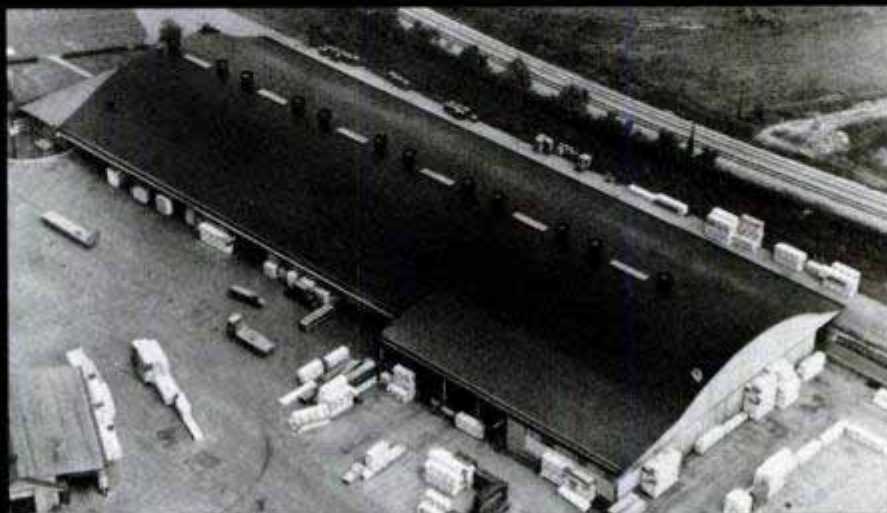
Although new technology draws the most attention, GM didn't forget new ways to work with old technology on the 2.5-liter 4-cylinder: The pistons are of an aluminum-silicon alloy very similar to that used on the block of the Vega engine. Unlike the Vega alloy, which was chemically etched, the piston alloy is machined to expose silicon minisurfaces, which are very wear-resistant. They prevent damage to piston ring lands from wear at high speeds. **PM**



SKYROCKETING ROOF COSTS TURN SEAMLESS SPRAY INTO AMAZING PART-TIME MONEY MAKER

Good for
**\$25,000 a year
and more...
much more!**

**THIS BIG ROOF RENEWAL ▶
PAID GEORGE SINGLETON
\$4,154.65**



When George Singleton made \$4,154.65 on one order for Seamless Spray, he said it seemed like a miracle . . . making such Big Money with so little effort. But that's the remarkable track record of our SEAMLESS SPRAY . . . the process that makes old roofs like new again.

One new man after another has enjoyed the same BIG SELL thrill when they introduced Seamless Spray and closed sizable orders on the first call.

Like Joe Kimpel, a former welder, who was making \$1,000 a month. His first 5 weeks with Pace paid him \$2,799.69.

Bob Kronner, 55-year old former steel salesman, made one call, got his first Seamless Spray order, and made \$1,429.43.

How can this happen so easily for men with no experience in our business? It's all very logical.

If you've talked to a roofer lately, you know the incredible charges for putting on new roofs. For industrial buildings, shopping centers, motels, hospitals, schools, etc., prices have gone sky-high. With our process, we bypass the roof

contractor. The commercial building owner uses our Seamless Spray to apply Pace Roof Renewal Sealant right over the old roof. The cost is so low, the proven results so satisfactory for such well known firms like General Motors, American Airlines, Holiday Inns and hundreds more, there is virtually no sales resistance.

Pace ships Seamless Spray equipment on Free Loan. Your customer pays only for the Sealant. His own men apply it. It's as simple as that.

The field-tested sales kit we furnish you gives you all the know-how you need to get into this BIG SELL immediately. There's no waiting, no training needed. You don't waste your time on small, penny-ante business.

YOU CONCENTRATE ON BIG SALES—BIG EARNINGS

That's how part-timer Jim Deveau earned a weekly check for \$2,760. (We think he'll go full-time now!) How Dave Lute, with 2 sales in 2 days, made over \$1,500. And how rookie Bob Shelhorn parlayed several roofs for one company into a \$1,433.78 paycheck!

And that's on just *one* of the inflation-beating Pace Products that keep you selling big on every call. Along with Seamless Spray, you'll make big sales and see big profits with PARK-KING Blacktop Sealer, Liquid Metallic Siding, Concrete Plus and all our other 1-coaters that fill maintenance needs wherever you go.

SEE HOW JUST 1 SALE A WEEK IS GOOD FOR \$25,000 A YEAR . . . AND MORE. ALL FACTS FREE WITH NO OBLIGATION.

Just mail this coupon. I'll mail you the impressive facts about Seamless Spray and all the rest of our amazing part-time money makers. You're under no obligation. No one will call on you. Everything comes to you by mail. Put this coupon in the mail today so you'll lose no time getting into this BIG SELL!

SNOW-BELT SALESMEN! Winter's miserable ice and snow conditions bring incredibly big 1st call orders with the most sensational money maker in the ice and snow control field. Check off ICE MELTER BOX in coupon and you'll receive all details FREE.



Mike McIntosh, Vice-President
PACE PRODUCTS, INC., Dept. PM-1085
Quality Plaza, 112th & College Blvd.
P.O. Box 10925, Overland Park, KS. 66210

PLEASE RUSH BY MAIL all facts about Pace SEAMLESS SPRAY, the amazing part-time money maker that's good for \$25,000 a year . . . and more. No obligation.
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ALL OUTDOORS



Zodiac's sporty, safe inflatable

"Crank it hard over and see what happens," said Zodiac's Ed Washburn as we blasted along on a full-throttle sleigh ride aboard the company's new Mark II Futura. I spun the wheel all the way to the lock and the inflatable etched what seemed like a 90° turn in gray-green water. No banking. No skidding. No chine-walk. Just a quick g-force-inducing dodge. This kind of evasive action can be fun under proper conditions (with life jacket and kill switch securely fastened, that is). But more importantly, it inspires confidence when the boat you're driving is nimble enough to lunge out of danger on very little notice. Secondary tubes



The new 13-foot 9-inch Mark II Futura offers unbelievable maneuverability. Secondary tubes on bottom (right) make it happen.



running port and starboard down its underbody make it happen. These appendages contribute greatly to enhanced tracking and stability resulting in tight high-speed turning radii. With transom wheels for beach launching, an

inflatable seat and room for a beefy 55-hp outboard. Zodiac has added a \$4000 complement to its normally utilitarian product line. Contact Zodiac of North America, P.O. Box 400, Thompson Creek Road, Annapolis, MD 21666.

Low-cost shooting fun



Air Soft means shooting fun for under \$30. The .357 replica, top, accepts plastic BBs.

For apartment dwellers and others whose shooting addiction is hampered by confined spaces, some BB-gun manufacturers have developed plastic target arms that fire light, low-velocity plastic projectiles. Daisy has entered this market with true-to-life replicas of such standards as the Walther PPK, Luger, Colt .45 and Smith & Wesson

.357 magnum. Class 3 Airguns in Berkeley, California, makes an H&K submachine gun look-alike. Most of the guns use plastic shell casings that automatically eject when the gun is fired, adding an amusing touch of realism. Contact Daisy Manufacturing, Rogers, AR 72757, or Class 3 Airguns, Suite 1239, Berkeley, CA 94704.

Leaded-fuel reduction

PM contacted Mercury and OMC's Johnson and Evinrude to learn how the EPA-mandated leaded-fuel reduction affects outboard motor owners. Mercury says its complete product line will operate normally with unleaded fuels. But OMC engines greater than 115 hp, built between 1969 and 1984 must be modified to accept fuel with a lower lead content. Kits with thicker head gaskets to better control unleaded fuel detonation will be available Oct. 1. Contact your dealer or OMC service, Central Avenue, Waukegan, IL 60085.

New cycle helmets



Simpson's Bandit (left) sells for \$199; the Voyager helmet (right) is priced at \$149.

High strength and low weight, the Holy Grails of engineering, make a harmonious blend in Simpson's new line of motorcycle helmets. These buckets feature hand-laminated fiberglass in several aerodynamic styles that dampen wind noise. Interiors are made of brushed nylon and the scratch-resistant Lexan face shield has a ratcheting feature that holds it open. The helmets also offer a ventilated chin area. Contact Simpson Sports, 22412 S. Normandie Ave., Torrance, CA 90502.

Tasco's Halley series binoculars

Tasco's new binoculars offer tremendous light-gathering ability due to oversize objective lenses. The 8x56-mm 445Z version (left) features a 315-foot field of view at 1000 yards. All air-to-glass lens surfaces are fully coated and the binoculars have fold-down rubber eyecups. The 7x50 model has a 420-foot field of view. All are covered by Tasco's new 75-year warranty. Model 445Z is priced at \$179.95. Contact Tasco Optical Co., Box 520080, Miami, FL 33152-0080.



Star gazing made easy with Tasco's Model 445Z.

Win a boat

We're giving away PM's Grumman Skidaddle project boat to the reader who submits the best photograph on any subject. Mail your best photo with the entry blank on page 159 of our June '85 issue. Deadline: midnight, Oct. 14. **PM**

AT DISCOUNT STORES, THIS MAY BE THE CLOSEST YOU'LL GET TO PERSONAL ATTENTION.



Somewhere along the line of discount store evolution, the phrase "Good afternoon" turned into "Attention, shoppers..."

But at Sentry Hardware, we don't go in for that kind of progress.

So our knowledgeable people will greet you right on the floor, not from a speaker on the wall.

They'll help you find all the hardware you want. And if you need advice, they can help with that, too.

Next time, shop Sentry. We'll answer your questions with a smile, not a recording.



Where hardware isn't a sideline.

Check the Yellow Pages under Hardware for the Sentry store nearest you. Sentry Hardware Corporation, Cleveland, Ohio 44113. Merchandise shown in this advertisement is available from participating dealers only. Offer expires October 31, 1985. All Sentry dealers own their own stores. They select their merchandise and set their own prices. There may be variations in products, available quantities and prices in individual stores.

WAGNER
Power Stripper
(028300) \$39.88

3M
Press-In-Place Caulk
(2150) \$3.44

WISE-GRIP
10" Locking Pliers
(10WR) \$5.99

Kwikbol
Single Cylinder Deadbolt
(660X3CP) \$7.44

VERMONT AMERICAN
7-7/8" 16-Tooth Carbide Blade
(27150) \$3.66

Geocel
Clear Exterior Sealant
(10100) \$2.75,
\$1.25 After \$1.50 Rebate

HANSON
13-Pc. Drill Bit Set
(60134) \$6.66

Devcon
5-Minute Epoxy
(5-208) \$1.33

WERNER
6' Alum. Stepladder
(376) \$25.88

shop-vac
6-Gal. Wet-Dry Vac.
w/Free Accessories
(700-02-62) \$49.99

WD-40
WD-40® 1 Gal. Container
w/Free Spray Applicator
(4010L, 40301) \$9.99

Warp's
10'x25' Clear Coverall
(4CH10) \$4.44

3M
9" x 11" Alum. Oxide Sandpaper, F, M, C
(9001, 2-3) \$1.22 Per Pack, Your Choice
(Rebates up to \$12 Avail)

Lufkin
3/4" x 16' Unilok Power Tape
(8316) \$4.99

SKIL
Cordless Screwdriver
w/Free Charging Stand
(2305.02) \$33.88

3M
Wood, Metal, Plastic & Painted Surfaces
3M surfaces

3M
3M surfaces

3M
3M surfaces

Y Seal Alum. & Vinyl Door Set
(95Y) \$3.88

THE PM WORKBENCH



Power painter goes cordless

Black & Decker takes the convenience of power painting one step further with its new carbon dioxide (CO₂) gas-powered painting system. This totally self-contained, nonelectric system has no power cord to contend with—a real plus when working on ladders and scaffolding—and it clips right onto your belt.

The pumping head, which operates on a standard CO₂ cartridge, pumps paint from a 1-quart container through a 4-ft. flexible tube to the roller. Paint flow is controlled by a pressure regulator on the pumping head and by a push-button on the handle.

The system includes two 1-quart containers, a 7-in. roller frame and cover, a 1½-in.-wide trim brush, four CO₂ cartridges and a faucet connector for rinsing the system clean. It's available at hardware stores and home centers for about \$70. Contact Black & Decker, Box LGK, Bourse Building, Philadelphia, PA 19106.

—J.T.



Self-contained, cordless power painter clips right onto your belt (top)—no more troublesome extension cords. The pumping head operates on a standard CO₂ cartridge (above, left). The handle accepts a paint roller, painting pads or a trim brush (above, right) to tackle most painting chores. The system is designed for use with latex (water-based) paints.

Knock-out veneer flaws

Repairing damaged or defective veneer is easy with a veneer punch. Simply position the tool over the defective area and strike the tool's handle with a mallet. The hardened steel cutting edge punches out a neat, irregular-shaped disk. Then, punch out a replacement disk from a veneer of the same wood species and glue it to the spot where the defect was punched out. Be sure the replacement disk matches the veneer's grain pattern to ensure a virtually unnoticeable repair.

The 52-mm.-dia. punch shown is available for \$73.70 postpaid from Constantine's, 2050 Eastchester Rd., Bronx, NY 10461. Veneer punches are also available in 25-mm. (\$48.70), 32-mm. (\$49.70), and 45-mm. (\$65.70) sizes.

—Rosario Capotosto



After punching out the defective spot, cut replacement disk from same species of veneer. Backup board ensures a clean cut.



Replacement disk fits the cutout exactly. If you match the grain pattern carefully, the repair will be virtually undetectable.

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

Furniture fixup kit



Repair kit comes with everything you need to fix scratches, nicks and cigaret burns in wood and plastic laminate surfaces.

Fix unsightly furniture scratches and nicks with this handy wood repair and touchup kit. Simply mix one of the five dye powders with the mixer finish to obtain the desired color. Then, brush on the mixture to conceal the defect. After it has dried, apply a top coat finish. The kit works well on wood-grain plastic laminate surfaces, too.

Each kit contains dye powders in oak, walnut, teak, pine and mahogany shades; a mixer finish; camel hair brush; mixing tray; cleaning cloth; and steel wool.

It's available for \$14.95 postpaid from Woodcraft Supply, 41 Atlantic Ave., Woburn, MA 01888.—J.T.

Amazing New Third Brake Light Can Save Your Life

Introducing the biggest safety breakthrough in the history of the National Highway Traffic Safety Administration (NHTSA).

Gov't approved Mandatory for 1986

Stringent government tests prove that the third brake light mounted at eye level reduces rear-end accidents by over 53%. The government is so amazed with these test results they are demanding all 1986 cars be equipped with this new third brake light. (These cars will be introduced in September of 1985.)

The NHTSA estimates predict that this light will prevent 900,000 rear-end collisions a year and 40,000 personal injuries a year. And when accidents do occur, tests show that personal injuries are reduced. Car damage and repairs are also reduced by almost 60%.

Here's why it works

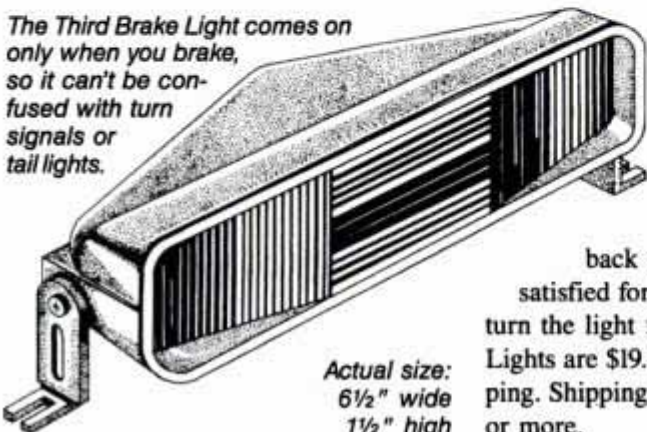
Mounted at eye level, the brake light is bright and easy to see because it shines directly into the eyes of the drivers in the second and third cars behind you. Also, since the light comes on only when you brake, it can't be confused with turn signals or tail lights.

Reduce rear-enders

The third brake light can prevent painful whiplash injuries, remind tail-gaters to back off, and gives the driver behind you better depth perception, day or night.

Many insurance companies are offering discounts for these lights.

The Third Brake Light comes on only when you brake, so it can't be confused with turn signals or tail lights.



Actual size:
6½" wide
1½" high



Amazing results — your chance of a rear-end accident is reduced by over 53%.

Exclusive Design

The versatile design of our light comes complete with everything you need — so it fits every kind of car. The patented bulb assembly snaps out for easy bulb replacement. The contemporary style has a low profile — so it looks good on all vehicles.

This American made light meets all Federal Motor Vehicle Safety Standards (FMVSS) including Federal Standard #108.

It's easy to install

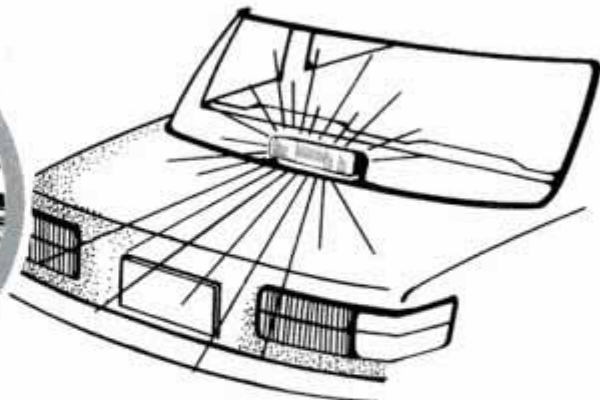
The eye level brake light mounts inside your rear window — like the new cars, where it is protected from weather, car washes, body damage and theft.

We offer two assembled models — one for American cars and one for foreign cars. Pivoting legs (with leg extensions) make it adjustable to fit all sedans, hatchbacks, station wagons and pick-up trucks. Good instructions and snap-on wire connectors make this a job you can do with a screwdriver and pliers in just 20 minutes.

Money-back Guarantee

Our lights are backed by a one year manufacturer's warranty and our own 60-day money-

back guarantee. If you are not satisfied for any reason, you may return the light for a prompt full refund. Lights are \$19.95 each, plus \$3.00 shipping. Shipping is FREE with orders of 2 or more.



Mounted at eye level, the third light is easy to see.

Be first to experience safer driving — it could save your life.

Order today

For ordering or further information, CALL TOLL FREE 1-800-525-8624 (in Colorado 303-762-1385) or send to: Progressive Energy Corp., Dept. PM1085, 3148 South York, Englewood, CO 80110.

All orders are shipped promptly. Fleet prices available. Dealer inquiries welcome.

Yes, send me the amazing new brake light that could save my life. If in 60 days, I am not satisfied, I can return for a prompt refund.

- Please send me one brake light at \$19.95 and \$3.00 shipping.
 Please send me 2 or more brake lights at \$19.95 each. SHIPPING IS FREE.

2 models:

_____ For American cars

_____ For foreign cars)

_____ Year _____ Make _____ Model

Check MasterCard/VISA COD

Card # _____

Exp. Date _____

Name _____

Address _____

City _____ State _____ Zip _____

PEC

Progressive Energy Corporation

Dept. PM1085, 3148 South York, Englewood, CO 80110.

Toll Free 1-800-525-8624.

In Colorado 303-762-1385

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APPLIANCE CLINIC



Washer oils clothes

I have a Kelvinator washing machine about six years old, model No. AW-1800POT, serial No. 049AO75858. It leaks oil into the tub and onto the clothes it's washing. There isn't a dealer within 50 miles of where I live. Can you tell me what the problem is and where I can get a service and repair manual for this machine?—Donald Lord, Stanbough, MI

It sounds like the seal around the agitator block has allowed water to get down into the washer's transmission. The transmission has probably filled up with water, creating a pressure in the gear case. This forces oil up the transmission shaft, around the seal and into the tub. The shaft seal has failed because of a worn transmission housing bearing and shaft.

To correct the problem, you should replace the top oil seal along with the transmission housing, which has the

top bearing built into it. You should also replace the agitator drive shaft which goes through the top bearing.

No special tools are required to repair the transmission, but it will take several hours. You should purchase both a parts manual and a repair manual to assist you in disassembling the transmission. These books will help you pick out the worn parts and will provide you with the proper replacement part numbers for your washer.

The manuals, as well as a list of franchised Kelvinator or White Westinghouse appliance parts distributors in your area, can be obtained by writing to Kelvinator Consumer Service, 325 West Main St., Newark, OH 43055. Attn: Marketing Services. The part number for the parts manual is K1780-28; it costs \$2.50, plus tax. The washer service manual is KLUA-15069, and costs \$5, plus tax.

Clanging mixer

My 10-year-old Oster mixer/blender Imperial model No. 966-04E, has developed a clanking sound in the gear case attached to the motor. I've disassembled the base as far as the gear case, but can't remove the plastic drive unit mounted on the top side of the base housing. The drive unit meshes with the sprocket mounted on the underside of the upper arm. Where do I go from here?—Ralph Mason, Portland, OR

The part you're having trouble with is the drive coupling. This part can be very difficult to remove because it is constantly being tightened under normal use. Due to the age of the unit, it may be impossible to remove it without chipping it off with a cold chisel. Once the coupling is off, you can disassemble the unit and remove the gear case.

Individual gear parts for your mixer/blender are no longer available, so you will have to replace the entire gear case with a replacement kit. The part number for the gear case is 208234 and it sells for about \$26. The number for the drive coupling is 4550-003 and it costs about \$1.

These parts, along with installation instructions, are available from Oster, 5055 North Lydell Ave., Milwaukee, WI 53217. Attn: Product Service Dept. Be sure to enclose the model number of your unit in the letter.

Rusty dryer drum

I have a Kenmore clothes dryer, model No. 76971100, serial No. F83210634. It is about five years old. The finish on the inside of the drum has worn off and the drum is rusting, so rust gets on the clothes. I sanded the drum and sprayed it with a high-temperature paint, but this soon wore off. Do you know of a finish I could use that is more durable?—Gary Upchurch, Alice, TX

A washer drum takes many a hard lick, especially if you dry a lot of clothes with zippers or large buttons. To cope with the rust, buy a spray can of primer gray paint—the same paint used on the assembly line to coat the dryer drum. The 13-ounce spray can, available from your local Sears repair parts center, is part No. 350938 and costs \$8.25. You will have to remove the drum to spray it, so you should also buy the dryer service manual, part No. LIT-787207, to assist you in disassembling the dryer. The manual costs \$8.

Sand the drum, then thoroughly clean it with a solvent such as lacquer thinner in a well-ventilated area. Once the solvent has dried, spray it with several light coats of paint. Reassemble the dryer after the paint has dried overnight. Then turn the dryer to a high heat setting and let the drum tumble without clothes in it for 45 minutes to cure the paint.

Dishwasher service tip

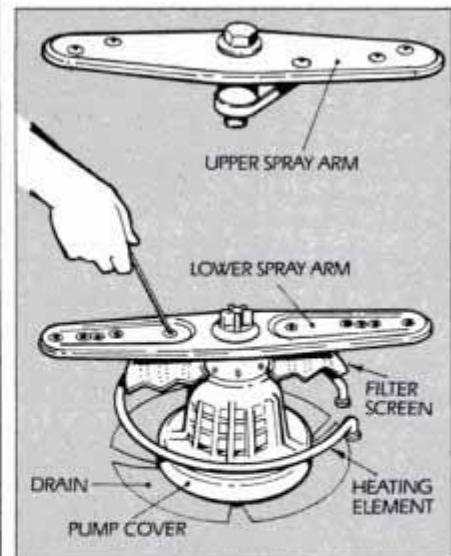
To keep your dishwasher humming efficiently, periodically clean the spray arms and drain area. On some models, the filter screen and drain are in plain view; others require some disassembly to gain access.

Turn off the electrical power to the dishwasher. Remove the bottom spray arm and filter screen and clean them with a scrub brush. Loosen any lodged particles in the spray holes with a piece of stiff wire. Clean the top spray arm without removing it.

Clear away particles from around the pump cover and drain area, and remove any buildup of mineral deposits from the heating element using vinegar and a scrub brush. Make sure both spray arms turn freely. If they don't, check for debris or mineral buildup around the pivot holes.

Some standing water should remain visible at the bottom of the drain. This keeps the pump seals from drying out. But standing water should not touch the bottom of the heating element. If it does the dishwasher may not be draining properly. Remove the bottom access panel and check the drain hose for kinks or sharp bends.

PM

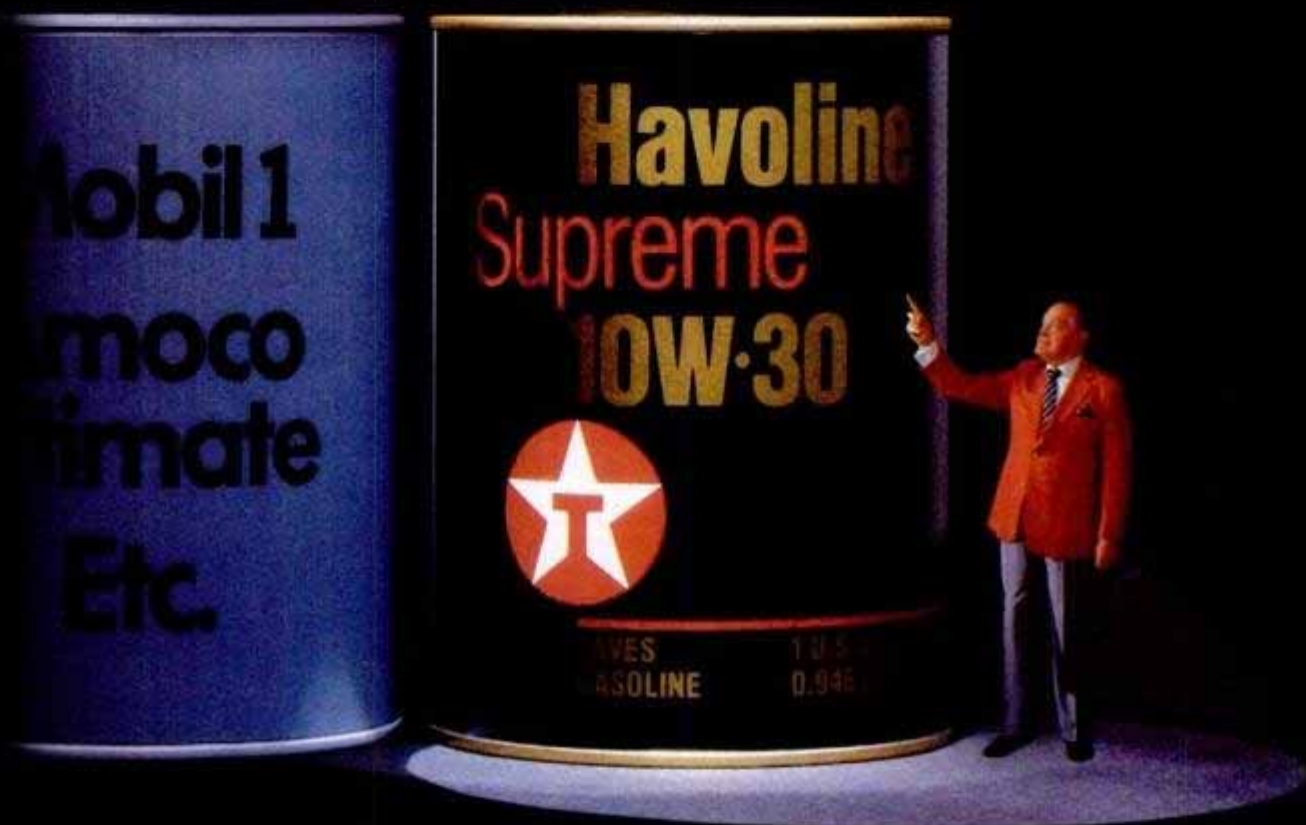


Dishwasher maintenance includes periodic cleaning of the holes in the spray arms.

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.

"TEXACO'S NEW FORMULA HAVOLINE CHALLENGES THE WORLD'S MOST EXPENSIVE MOTOR OILS"

—BOB HOPE



Do you have to pay the high price of synthetic motor oils like Mobil 1 or Amoco Ultimate to get the engine protection your car needs?

Check out these facts.

Both the expensive synthetics and Texaco's Havoline Supreme 10W-30 give you the quality protection demanded by these industry yardsticks:

Both exceed carmakers' warranty requirements for virtually all gasoline-powered cars. Both meet or exceed industry standards in helping prevent wear, keeping engines clean, saving gasoline, and protecting against rust.

But only Havoline comes without the high price. And that you can check out wherever Havoline is sold.

HAVOLINE SUPREME. HIGH QUALITY PROTECTION WITHOUT THE HIGH PRICE.

AEROEN



"Air flow management does more than help Aerostar and Merkur get better mileage, it also contributes to better handling!"

*Larry Socha
Manager,
Exterior and Aerodynamics,
Design Engineering*



*Complete air flow management helps make Aerostar's fuel economy ratings better than those of many 1985 compact sedans.**

Ford Aerostar is one of the newest examples of the commitment to quality at Ford Motor Company; demonstrating leadership in applying aerodynamic principles to automotive design.

A swept back front end, spoilers, flush glass and door handles are all quality refinements that help Aerostar slip through the air with a whisper.



*26 EPA estimated city mileage (van).
23 EPA estimated city mileage (wagon).

Get it together—Buckle up!

ENGINEERING

Merkur's biplane rear spoilers not only contribute to solid road feel but also help reduce the air turbulence behind the vehicle for greater aerodynamic efficiency.



Merkur uses a small scoop to take only as much air as the engine needs for cooling and let the rest flow over the car smoothly to exert

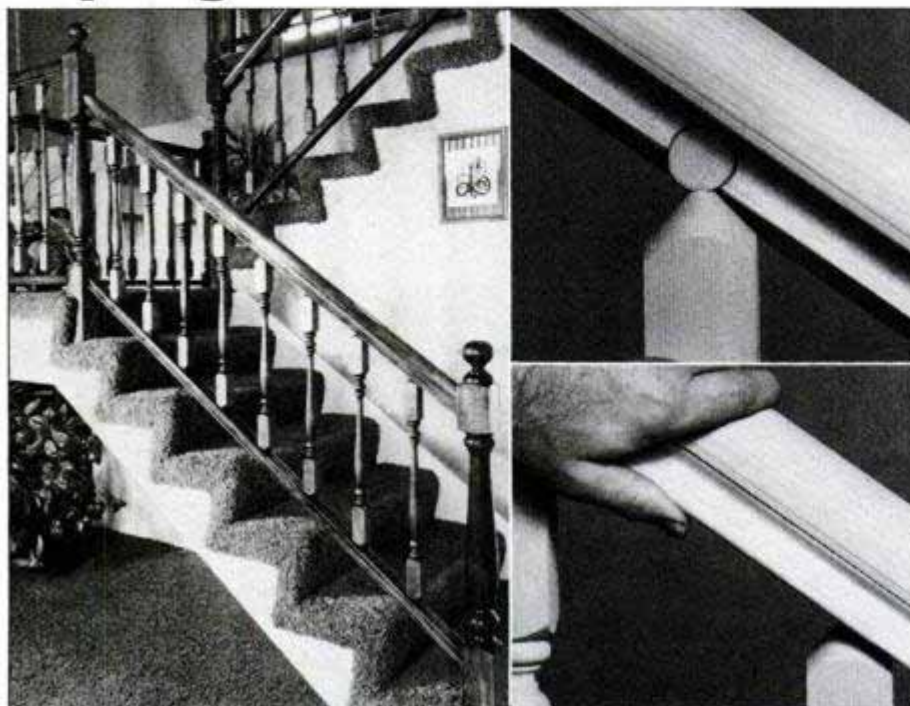
"down force" on Merkur's biplane rear spoilers. Result: The feel of solid, in-touch-with-the-road, quality.



Ford • Lincoln • Mercury • Merkur
Ford Trucks • Ford Tractors

**Quality
is Job 1.**

Pop-together handrail



Do-it-yourself wood stair rail system features balusters with preshaped locking disks that fit in sockets bored in the handrail (top, right) and bottom support rail. The adjustable socket joint is then concealed by nailing a piece of molding in place (above, right).

Install a custom-looking wood handrail in your home with the do-it-yourself Promontory stair rail system. The system features balusters with disc-shaped ends that fit into prebored sockets in the rails. This permits the balusters to adjust to any angle, or level, run of railing. A molding strip is nailed in place to conceal the socket joint. The balusters are available in two

sizes—29 in. and 34 in. high—and two styles: traditional ($1\frac{1}{8} \times 1\frac{1}{8}$ in.) and elite ($1\frac{1}{4} \times 1\frac{1}{4}$ in.).

The handrail system comes in oak and hemlock and costs less than \$25 per running foot. For example, a 5-ft. hemlock handrail kit costs about \$112. Newel posts are purchased separately. For details, contact Mansion Industries, Box 2220, Industry, CA 91746.

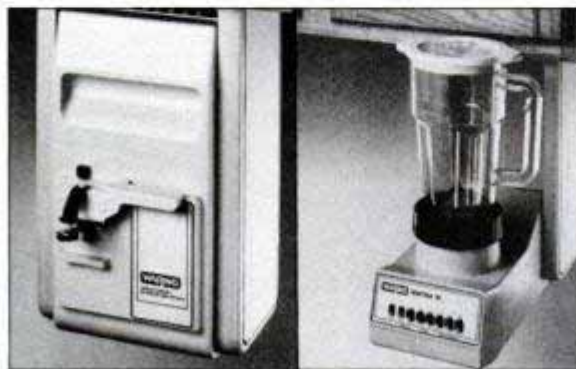
Double-duty appliance

Reduce kitchen counter clutter with Waring's new under the cabinet blender/can opener. This unique appliance is a fully automatic can opener that flips down to reveal the base of a 10-speed blender. Just install the blender's 45-ounce carafe and you're ready to process foods and liquids.

Features include a strain-and-serve lid and a carafe base-lock that holds the container securely to the motor.

The blender/can opener is available at housewares

and appliance stores for about \$90. For information, contact Waring Products Div., Dynamics Corp., New Hartford, CT 06057.



Press-in-place caulk

Two new products from 3M take the pain out of glazing windows and caulking cracks. These neat, easy-to-use products come preshaped in rolls. Simply press the compound in place and peel off the protective backing. Then, apply either a latex or oil-based paint, if



desired. Press-In-Place glazing (\$4.25) comes in a $\frac{3}{8}$ -in.-wide \times 17-ft. roll. The caulking (\$3.25) comes in a $\frac{5}{16}$ -in.-wide \times 22-ft. roll.

For details, contact the Household Products Div., Bldg. 223-4S, 3M Center, St. Paul, MN 55144.

Dual-position step stool

The Step Deck is a cleverly designed, space-saving step stool that converts to a 2-step work platform. Simply unlock the stool's top step and rotate it downward until it locks level with the second



step to form a wide, sturdy platform.

The Step Deck's weight capacity has been tested to 800 pounds and it folds flat to just $2\frac{3}{8}$ in. for easy storage. It's available at hardware stores and home centers for about \$40. For a dealer near you, write to Cosco Inc., 2525 State St., Columbus, IN 47201.

PM

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Mechanics
PLANS**



Barn/Garden Shed Our well-designed yard building provides handsome storage for yard tools, hand tools, power equipment, gardening supplies and a gardening center for the whole family. It also has an upstairs loft! Dim.: 12 x 16 ft. Plans, instruction manual & material list. (1 plan: PL-1278—\$10.50) (2 plans: PL-1278A—\$17.50)

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NEW PLANS FROM

**Popular
Mechanics**

COLONIAL-BARN GARAGE Holds two full-size cars in separate bays. Measures 24' x 26'. A 3 ft. overhang on one side provides excellent storage for wood and garden equipment. Plans include overall perspective, basic wall-building steps, and construction details for framing loft, floor, roof and end gables. Plus exterior finishing details and suggestions for alternative versions of the garage.

PL-1277 \$30.00—1 plan
\$20.00—each additional plan when purchased with first plan.

POP-TOP CHILDREN'S DESK Has a tilting top that can be angled for drawing or set flat for puzzles and games. Plenty of storage under the tabletop and the hinged seat, plus two roomy drawers. Features handy paper feed.

PL-6831 \$6.95

ICE BOX BAR Collector-style design doubles as bar and storage cabinet. Holds glassware, beverages and mixers. Has plastic-lined mixing compartment, frame and panel construction, brass hardware and casters. Size: 31 1/2" x 33 5/16".

PL-1284 \$10.50

PORTABLE IRONING CENTER Compact and well-designed, allows you to iron where you want—kitchen, living room, etc. Includes shelves, storage and wiring for iron and lamp.

PL-4801 \$5.95

CLASSIC WOOD TOYS Bring great pleasure to the young person who receives this, as well as the person who builds them. Full-size plan. Just trace, cut and assemble.

PINE ROCKING HORSE Provides hours of fun. Sturdy construction. Saddle is padded for comfortable ride. Size: 25" x 36"

C-245 \$9.00

SIX-CAR TRAIN Rolls on rear wheels; cars couple together. Locomotive, tender, box car, log carrier, crane and caboose. Locomotive is 10" long; others, 8". Manned by engineer and assistant, plus crane operator.

C-295 \$7.95

TOY TRUCKS/VEHICLES Special set of 5 of the most popular trucks and construction equipment: 18" Trailer Truck, 12" Ice Cream Truck, 12" Bulldozer, 15" Power Shovel and 17" Dump Truck.

C-5 \$10.00

List of accessories and suppliers included with these 3 plans.

All plans include: Assembly instructions, layout and materials list. Send check or money order to:

POPULAR MECHANICS

P.O. Box 1014, Radio City Station, New York, NY 10101

Popular Mechanics is a publication of Hearst Magazines, a division of The Hearst Corporation

"How To Get Rich Sooner Than You Think."

A Whole New Class of Millionaires Can Be Created In The Next Three Years!

My name is Joanna Jordan, and I have created a "New" and fantastic money making program just for you.

Let me tell you why I am so charitable.

No, I am not crazy and I don't like giving away my confidential money making secrets. But as you read further you will understand why I have to. "I HAVE NO CHOICE."

There are, at this very moment, fifty million Americans who are geared up to spend an estimated 2 Billion Dollars in the next twelve months on services like my program offers, and someone else, besides myself, has to take advantage of this opportunity or it will be lost forever.

If you are looking for a way to clear up all those overdue bills laying on your desk, or kitchen table, then this may be the solution to your problems.

I will show you how to start my new program entitled "How To Get Rich Sooner Than You Think" on a "beginner budget" and perhaps pocket up to \$25,000 dollars the following month you receive it.

Wait! Don't get the wrong idea. Let me assure you, right now, that you are NOT working for a parent, franchise or distributorship company. You are Not working for me or my company. You are in business for yourself and all the money you make with this marvelous business is yours to keep. You don't have to share any of it with anyone.

But, before we go on I would like you to take a few minutes and CALL my private telephone number for a personal recorded message I made just for you

(703) 450-6052

Now that I've got your attention, it would be my pleasure to continue.

Maybe you won't make \$25,000 dollars the first time out, you may do better. I have no way of knowing. All I know is that it is URGENT that you move on this opportunity now. Not next week or next month but Now. It would be a shame for all that money (over 2 Billion Dollars) to just pass you by without you getting your fair share of it.



That brings me to this very important point.

If I could handle all the business that will be generated in the next twelve months, I wouldn't be telling you one solitary thing about this potentiality "strike-it-rich opportunity." I wouldn't be writing you this urgent message. Nor would I be revealing my inside secrets. I would be just working the system I have invented and be making all the money I could spend. But that's not the case. I can't handle all the business. Neither can ten other people, or 100 or 1,000 for that matter. It's just too big!

Okay. Okay. I understand that *not everyone* wants to become a millionaire in the next twelve months. Maybe you don't want the headaches of handling all that money at this time. Maybe you're looking for something "short-term" and not long term. That's okay. Give me a few more seconds of your time, I think I've got the answer for you.

Let's assume for a minute that you want to make \$300,000 dollars, not one million. And let's further assume that you want to work part-time only. That's fine. You can do it. You can operate the program part-time, weekends only or evenings if you like, and make up to \$300,000 dollars in seven months. Then, you could stash away the money in the bank and live off the interest for the rest of your life. For example: 12% interest on \$300,000 is \$36,000 a year; without touching the principal.

Listen Closely! What I am offering you here is an opportunity for you and your family to perhaps retire early in life. Stop worrying about the everyday chores and live off the interest on the money that will be made by you in the next seven months. **Once and for all be free** from having to get up on those cold and chilly mornings, start the car that may or may not start; get stuck in the traffic or snow that may or may not be blocking your path to work.

Instead, with my system you are free to choose the days you want to work. You could decide, on those snowy days in January, to sit at home and watch TV all day if you like, play in the snow like we used to do when we were kids, or catch a plane for Hawaii or Florida. **Never having to worry** about how you are going to pay the mortgage or car payments while you are on vacation. **Never having to worry** about someone taking over your job while you are missing a few days from work.

You and I both know *that* is no way to live. We have been through those headaches over and over again. Let's don't make the same mistakes twice. Take my advice, and don't pass up this "once-in-a-lifetime" opportunity to perhaps get rich sooner than you think. Order my program now, Today.

Let me level with you. We all come into this world naked and broke and we are *all* going out the same way. What we do with our lives in between those two points in time is *what counts*. Darn, I would hate for my friends to say after my death: "She never enjoyed herself while she was on this earth. All she did was go back and forth to work 350 days a year, took two weeks off for vacation, if she was lucky, and spent the rest of the year working for someone she couldn't stand."

Listen, that's not going to happen to you and me. We are going to have some fun for a change. We are going to do some of the things we have always wanted to do and we are going to do them Now.

Let me let you in on a little secret. I know what it's like to be skeptical. I also know what it's like to purchase inspirational books, money making programs and income opportunities from other companies and individuals. You name it and I've bought it. I have probably bought and tried every money making program on the market today and then some. I even went to the trouble of buying two of them from two overseas companies in Australia and Japan.

Nothing seemed to work for me. Most of them I enjoyed reading, but when it came right down to putting the program into operation I was lost. There just wasn't enough good information for me to follow. *Oh*, I know they intended to do a good job in the beginning, but their writing skills and instructions left me flat. Every time I started to do some investigating about a particular system or put a plan into operation I came up empty handed.

My money making program is complete, well written, precise, detailed and perfectly understandable. There are no if's or but's to it. Order my program now and see if I am right or wrong. If I am wrong you have wasted a postage stamp. But if I am right, you may be able to walk into the showroom of the Mercedes dealership and hand the salesman \$42,000 dollars in cash (*in one-hundred dollar bills*) and drive away in the automobile of your choice. *A two-door 380 SL convertible would be nice.*

Purchase The Home of Your Dreams!

Once you start receiving your monthly checks from your new business do you realize that you may be able to purchase that new home in that special neighborhood you always wanted to live in. *You know the one I mean.* That special place or street you always wanted to live on. You could *waltz* right in and tell the real estate agent you would like to buy the home up on the hill. You then hand him or her a check for the down payment, and start the paperwork to move in right away. With your new business and the proposed yearly income you could be making you should have no problem qualifying for the mortgage.

Once you read the "two volumes" of my new program that I have prepared for you. You will see that this hypothetical situation can become a reality for you—not just a dream.

Listen Closely! I know I don't know you personally, but for the sake of all that money that might be lost, over Two Billion Dollars, I am going to reveal to you powerful inside secrets that most people don't even know exist.

I will give you names and addresses of companies that have been kept hidden from the American public for over fifty years. These companies are the "key to your future" that will help you achieve success like you never thought possible.

Here's What You Are Going To Receive: You are going to receive "TWO VOLUMES," a complete set of my ideas and systems written exactly as I use them on a daily basis. The same ones I used, last year, to make over one million dollars.

Both volumes are handsomely designed and printed by one of the most sought after printing companies in the country. There are 238 pages altogether, about 210 pages of text and about 28 pages of exhibits, pictures and illustrations. There are insider secrets, start up beginner budgets, detailed through instructions, **hard-to-find business contacts,** and my own special powerful money-making ideas. *These publications are both brand new and the creative pro-*

gram you will find in them is being offered for a limited time and a limited time only.

I shared my secrets with some of my closest friends before I decided to select the readers of this publication, as some of the few qualified people in this country, to participate with me in this unique opportunity.

Here's how they did:

\$12,000 in fifteen days

When you showed us your materials my wife and I sat up to 3:00 AM reading every word of your money making program. Two days later we put your methods into operation. Wow! Were we surprised when we made \$12,000 in fifteen days. Our goals are set higher.

Thank you from both of us.

Mr. and Mrs. G. A., Santa Monica, California
\$1,000 A Week

Since I read your program on how to get rich, my life has taken a turn for the better. I was earning about \$200 a week in a job that I really didn't like, working for a boss I couldn't get along with.

After applying your money making program for the last four weeks, my income has already reached \$1,000 a week. I am hoping to make \$5,000 a week by next spring. I can't thank you enough for showing me how to put this kind of money into my own bank account, instead of my bosses.

Mr. S. McC., Newtown, CT

\$9,000 dollars Richer

Every week I would work all week long, pick up my paycheck, and 24 hours later after paying by bills I would be flat broke. Your program "How To Get Rich Sooner Than You Think" came in the mail three weeks ago yesterday.

Today after applying your methods for only two and a half weeks I am \$9,000 dollars richer. I have money in my savings account for a change and I am buying myself a new car. You're the greatest.

Mr. R.I.G., Los Angeles, California

I Made \$93,455.00 in one month

I don't know whether or not I am the most successful person to use your techniques, and I may not be, but, with no exaggeration, I made \$93,455.00 in one month.

I just wanted to write and tell you that your information is incredible. I am happier than I ever thought I would be.

Joanna, thank you.

Mr. J. A., Danbury, Connecticut

Dear Reader:

I want to tell you of my experience with Joanna Jordan — and her new money making program "How To Get Rich Sooner Than You Think!"

My name is Kathy Rice and I am a close friend of Joanna's. Until recently, I thought I was happy in my job and family life.

But what I learned from Joanna helped me see that I was going about it all wrong. In fact, I was on the same treadmill everyone else seems to be on these days. "Make a few dollars this week, and spend more than I made next week."

Joanna Jordan has an individual and "different" approach on how to make big money that lasts for more than a couple of weeks. Her methods are logical and effective. And her way of explaining her new unique program makes it easy to understand and quick to apply.

Her program entitled "How To Get Rich Sooner Than You Think!" can show you how to earn money fast, and her confidence in its money making ability shows in her guarantee. She will give you a "Three Month" FREE TRIAL. (That will give you plenty of time to try her techniques and find out that Miss Jordan has been completely sincere in what she has been telling you.) Use the information and put the money making program into action, for that period, and if you are not satisfied, for any reason, just mail the materials back and she will refund every cent of your money to you.

Sincerely yours,
Kathy Rice, New York, New York

"There is a limited supply of my first edition programs available, and because programs of this quality are normally sold out in fifty days."

YOU MUST ORDER NOW!

"Please don't hesitate, this is your One-Time chance to get in on something really fascinating. Do it now. Order today."

Let me prove to you that I know what it's like I know what it's like to spend every cent of your paycheck two days after you get paid. I know what it's like to write a questionable check at the grocery store on Wednesday, for \$25 dollars, and hope to cover it by Friday. I know what it's like to have more bills to pay at the end of the month than you brought home in all four paydays. I know what it's like to stand in line in a department store with your Visa card in hand, hoping you won't be embarrassed by some clerk behind the counter when she calls in your number to the controller.

I know all these things because I have experienced all these things. Isn't it about time you made a change in your everyday life? Isn't it about time you said "enough is enough" and started a new way of life? **Don't Let Someone Else Control Your Life. Do something about it Today.**

You could start, right now, and be on your way to your fortune by the end of next week. If you order today, not next week, or next month. But Now! Send **\$12.95** for both volumes of "How To Get Rich Sooner Than You Think!" Today!

Before I go any further. Let me clear up any possible misunderstanding you may have.

I didn't write this money making program and then expect to make my fortune. I made my fortune before I wrote the first word in "How To Get Rich Sooner Than You Think!" In fact, while we're on the subject, the year before I wrote "How To Get Rich Sooner Than You Think!" I made \$1,031,000 dollars. The year before that I made \$780,000 and two years before I made \$554,000. It's all Documented!

The amount of money I made using my system is documented and can be backed up with bank records and financial statements from my Certified Public Accountants.

I don't wish to brag, but I must make you understand that you too can perhaps do as well as I did for the past three years. You may even do better.

Here is an Example Of What My Plans Can Do!
My Bank Deposits For The Past 12 months:

January	\$ 63,010.60
February	\$123,138.29
March	\$171,129.43
April	\$107,404.62
May	\$ 88,097.60
June	\$ 64,613.08
July	\$ 65,116.00
August	\$ 89,883.63
September	\$ 94,222.50
October	\$ 45,560.33
November	\$ 44,567.21
December	\$ 74,357.78

These are the facts. You can believe them or not. It's your choice. But I'll tell you this, I didn't have a lot of money when I first started, and that's why I designed this program with you in mind. I wanted anyone who was interested in improving themselves, to be able to start producing Big money immediately.

Two Volumes!

Don't Delay! Don't miss out on this opportunity! If you put this urgent message down without ordering, the opportunity will not be available to you again. You may never know how Great It Feels Having \$30,000 dollars in the bank any time you need it for emergencies. You may never know what it's like owning three luxury automobiles. You may always wonder what it's like owning two homes worth over \$500,000 dollars in perhaps the best neighborhood in your state. Why don't you place your order today for "How To Get Rich Sooner Than You Think!"

I promise you will be overjoyed with "both volumes" of "How to Get Rich Sooner Than You Think!" and I guarantee that this "first-time offered"..... **Money-Making Program**, will not be found in any other book, magazine, newspaper, manual, booklet or anything. It is my exclusive money making program. It is all original and it is waiting right here in my office, waiting to be shipped to you.



"What if I don't like it?" — You Can Return It! I'll Give You A Full 90 Day Money-Back Guarantee. If at any time after receiving "How To Get Rich Sooner Than You Think!" you want to return it, for any reason, do so. I will immediately refund your \$12.95 along with my congratulations to you, for at least having given it a try. There will be No questions asked! No delays! Just a cheerful and prompt refund.

In fact, if you still feel a little uncertain about mailing a check to someone you don't know. You can: Postdate Your Check For 30 Days From Now. I won't deposit your \$12.95 check or money order for 30 days after you get my materials. Use the new program in "How To Get Rich Sooner Than You Think!" during that time. Then, if you don't think it's for you, just send the materials back and I'll return The Same Check You Sent Me Uncashed.

Take the time "Right Now". Pick up your pen. Fill out the "Order Form", and mail it in Today! In a few days time you will have "How To Get Rich Sooner Than You Think!" in your hands. Use the information and start making big money with my Money Making program. I think you'll see very quickly that it's everything I say it is and just by following the step-by-step guidance it offers, you'll begin to realize your dreams of success as soon as next week.

Or call Toll Free: and **CHARGE IT!**
1-800-528-6050 Ext. 219

Charge your order to: American Express — Mastercard — Visa. 24 hours a day. 7 days a week. "We're open Sundays." **Note:** Operators can only take orders. Any questions please call 703-450-4374. Thank You.

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Joanna Jordan
100 Glenn Drive
Dept. PM-55, P.O. Box 139
Sterling, Virginia 22170

Dear Joanna, please RUSH me my program (both volumes) of "How To Get Rich Sooner Than You Think!" only with the understanding that I have a full 90 days to test your program. If I am not completely satisfied, for any reason, I may simply return "How To Get Rich Sooner Than You Think", and you will immediately refund the full purchase to me. What's more, I can postdate my check for thirty days. On that basis here is \$12.95 for both volumes.

Name _____
Address _____
City _____
State _____ Zip _____

Note: Because of the heavy package I will be sending you, please add \$1 (in cash) to partly cover the cost of postage. Thank You!

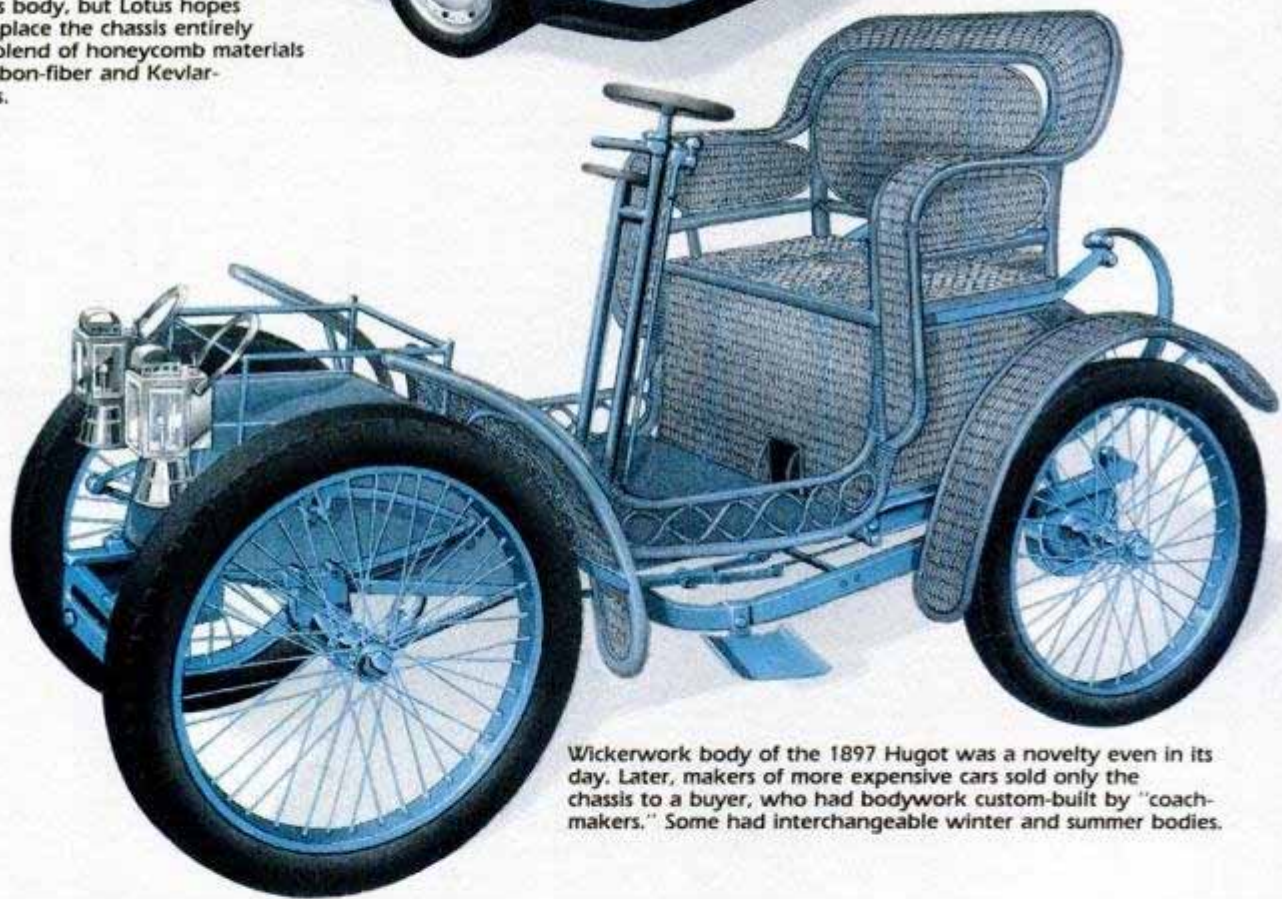
BODY/CHASSIS

A CENTURY OF PROGRESS

100
YEARS



The 1988 Lotus Etna will feature the traditional Lotus backbone chassis with a fiberglass body, but Lotus hopes to eventually replace the chassis entirely with an exotic blend of honeycomb materials and plastics: carbon-fiber and Kevlar-reinforced resins.



Wickerwork body of the 1897 Hugot was a novelty even in its day. Later, makers of more expensive cars sold only the chassis to a buyer, who had bodywork custom-built by "coach-makers." Some had interchangeable winter and summer bodies.

Automobile structures have progressed from wood to metal to exotic plastics.

BY MORT SCHULTZ
Illustrations by Pat Ruggero
and George Retseck

PM thanks the patent library of the Motor Vehicle Manufacturers Assn. (MVMA) for its help in preparing this series of articles.

Unlike the first engine and chassis builders, who had no precedents to follow, the first auto body engineers represented an old established craft. It mattered little to them whether vehicles were to be propelled by a gasoline engine, electric power or steam. Their task was the same as in the days of chariots: to construct a conveyance that would carry people.

The body builders contended that if carriages were good enough for horses,

they were good enough for engines. They were even given carriage names—phaeton, brougham, tonneau, landaulet and wagonette.

Don't get the idea that early body engineers were a stodgy conservative bunch. When it came to trying new structural concepts and materials, they were as radical as the engine and chassis guys—so much so, in fact, that practically every body structural tech-

(Please turn to page 54)



Rickie Smith's Motorcraft Pro Stock Thunderbird



Willy T. Ribbs
Chris Kneifel
SCCA Trans-Am
Mercury Capri



Wally Dallenbach Jr.
John Jones
IMSA Mustang GTO



Ricky Rudd's NASCAR
Motorcraft Thunderbird

All these winners go with winners: Motorcraft parts.

The Motorcraft Mustang didn't win by just a mile at the 1985 Daytona 24-Hour. It left competition 135 miles behind as Dallenbach, Jones and Bundy took the GTO class. The same car also finished miles ahead of competition in the 12 Hours of Sebring. Mercury Capris flying Motorcraft colors are out to capture the SCCA Trans-Am manufacturer's championship again this year. Motorcraft is on the 1985 NASCAR Winston Cup Circuit with Ricky Rudd in his Thunderbird. Rudd, one of the most promising new-comers, is teamed with veteran car builder Bud Moore. Rickie Smith—first Pro Stock driver to break the 180 mph and 8 second barriers—is driving his Pro Stock Motorcraft Thunderbird in '85 NHRA and IHRA events. All of these are proof positive of Motorcraft parts' exceptional performance under all types of rugged racing conditions. Get Motorcraft's out-to-win performance going for you out on the street. Motorcraft. Quality parts for all makes of cars and trucks.



Motorcraft

EXCEEDS THE NEED

nique in use today had been tried by 1920, even gluing bodies together.

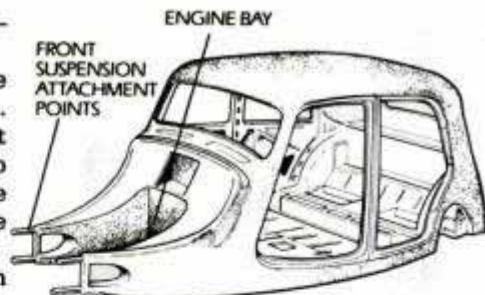
In 1984 Volvo announced the use of epoxy to tack-weld body parts together, thus reducing the number of conventional spot welds from 4000 to 500 (see *I Have Driven the Car of The Future And it Works!*, page 134, June '84). But Volvo isn't No. 1 in the use of glue for this purpose. Body engineers used casein to hold early wooden body members together on the Cadillac, Columbia, Locomobile and Peerless of 1898 to 1904 among others.

If we had to pick the two most revolutionary events in the development of the auto body, we'd select the transition from wood to metal and the

development of quick-drying lacquer—events that occurred 25 years apart.

The wooden body panels of those early cars restricted body designers. Wood can only be steamed and bent into simple curves. When applied to wooden frames, the body panels of one make of car looked pretty much like those of any other make.

When sheet steel and aluminum came along in 1900, this sameness in appearance started to change. New metalworking techniques were perfected—drop- and power-hammering in the 1900 to 1910 era, hydraulic stretching around 1920, and drawing and stamping around 1935. As each occurred, metal panels began taking on new, novel shapes. The first U.S.-built auto to sport a steel body was the 1901 Eastman Steamer, the first to have an aluminum body was the 1902 Marmon. Both were built with all-wood frames to which metal panels were pinned.



Unitized construction replaced the frame entirely. Sheetmetal box sections carry the load. This is the 1934 Citroen.

The wood frame/metal panel arrangement lasted about 10 years. Then, wood frames reinforced with steel to give the car body greater rigidity came along. Called armored wood, it saw its first use as framing to hold the steel body panels of the 1911 Hupmobile. Built by Edward Budd, the Hupp body was the traditional design for that day—a touring (open) car.

Closed cars were available from about 1900 on, but they found few takers since they cost about 20 percent more than open vehicles. To protect passengers in open vehicles, several automobile accessory companies made lots of money selling folding, cape and canopy tops.

The closed car, or sedan, became less expensive and more attractive soon after World War I thanks to Budd, who devised ways to cut the manufacturing cost. In 1919, Dodge brought out the first closed car with steel frame members and body panels.

The development of quick-drying lacquer that could be sprayed on occurred in 1924. It, more than any other development, ushered in the era of mass auto production. Until then most auto bodies were finished with paint and varnish, which took weeks to dry. Some old timers remember the days when new cars were lined up for miles along Detroit's Woodward Avenue waiting for "that damn varnish to lose its tackiness." Meanwhile, the production lines slowed to a crawl. There was just no more room to put cars.

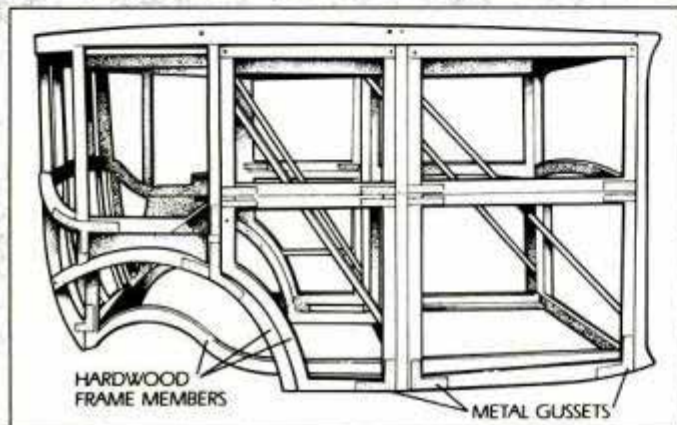
Lacquer cut the drying time first to days—then to hours. Developed by Duco, its first use was on the 1924 Oakland. Oakland was the original division of General Motors that later became Pontiac.

Unity forever

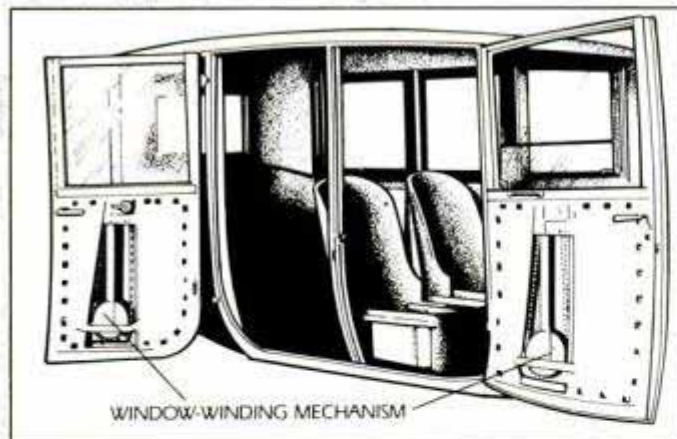
On a late October afternoon in Detroit in 1915, an auto body engineer by the name of H. Jay Hayes was presenting a talk before the annual conference of the Society of Automobile Engineers. Hayes represented the Ruler Auto Co. and recounted in rather humdrum fashion the development of the auto body.

During a pause in his speech, a voice

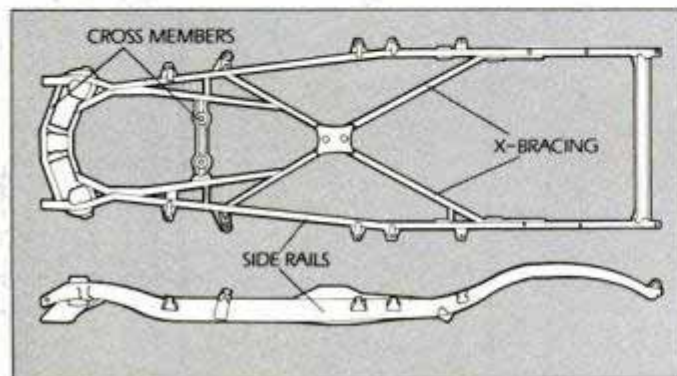
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Typical body of the early 1900s had pressed steel panels pinned to wooden frames. The Weymann company in Paris covered its frames with padded canvas and leather. Weymann bodies were both light and colorful.



Budd all-steel body for the 1919 Dodge was a breakthrough. To demonstrate its strength to a doubting public, early publicity photos showed the Dodge on its roof, which wouldn't collapse under the weight of the car.



Steel frames with X-braced cross members were introduced by Auburn and Cord in 1929 and soon became popular. The X-member provided extra strength and reduced chassis flexing, which improved handling.

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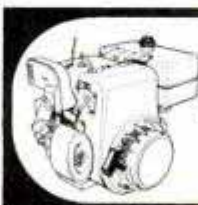
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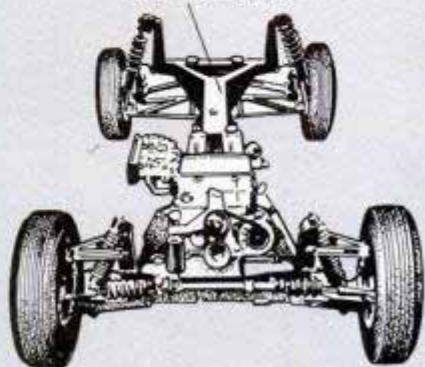
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from page 54)

boomed, "What do you think about the moot theory of combining the body and frame into one unit?"

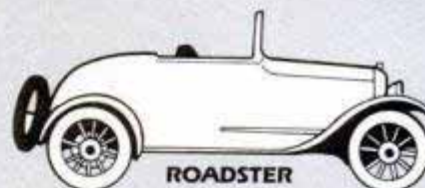
The voice got the attention of everyone in the audience. They waited with interest to hear Hayes' response. The combined body-frame theory had been bandied about for almost 10 years, but no car company had developed a cost-effective way to turn theory into reality.

Hayes presented a 15-minute dissertation on the virtues of unitized body

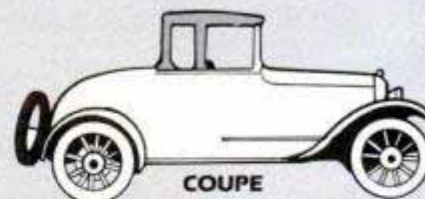
I-BEAM "BACKBONE"



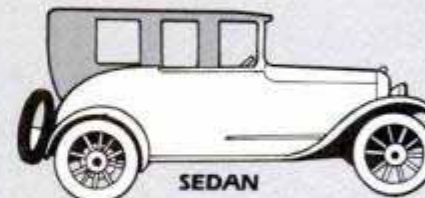
Single steel girder "backbone" chassis was introduced by Lotus in the early '60s.



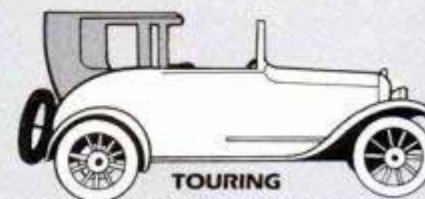
ROADSTER



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TOURING

Interchangeable bodywork could transform the McGuires into four different cars.

construction—what we today call unit-body or unit body construction. He explained to his fellow engineers how, by making the car smaller and lighter, it was possible to overcome the two main disadvantages of combined body and frame construction: excessive cost and body vibration.

Hayes then dropped a bomb by announcing that the following week his company was going to put on sale 3000 vehicles with unitized bodies. The car was called the Ruler Frameless.

As Hayes had promised, the vehicles appeared on the market without framing. Instead, body members were fashioned into tubular form to give metal the rigidity it needed to do without a frame. The engine and suspension members rested on a platform.

Other notable events

Here are some highlights in body evolution:

■ In 1897, a car named the Hugot hit the street with a wicker body. The nameplate and body soon became basket cases.

■ Aluminum and steel started vying to replace wood body panels as early as 1900. At the time, sheet aluminum was more expensive than steel, and cast aluminum brackets more expensive still. Thus was born the first car caste system. Cars having sheet steel body panels were manufactured for the masses, while those with aluminum body panels were made for the rich.

■ The first ever Cadillac, the 1902 model, sported patent leather fenders.

■ In 1903, a car that was called the Bates seemed to offer significant improvement in the way the body was attached to the frame rails. Engineers fitted the transverse rear frame girder with hinges, so the body could be attached with two slip-on security bolts. By slipping out the bolts, the body could be swung back easily so mechanics could have better access to the under parts of the vehicle.

■ Hinged side doors—two of them—became popular in 1905; four of them started to become popular in 1913, although they were available in 1910.

■ In 1922, the Auburn came out with the first X-member frame. The structure provided a major stride in torsional stiffness and cut down on vibration.

■ Some called it J.J.'s joke—the patent acquired by John Joseph McGuire of Yonkers, New York, on Oct. 24, 1922. But it turned out to be one of the most unique body ideas in automotive history. Based on the 1903 Bates idea of a bolt-on bolt-off body, McGuire's vehicle was an all-in-one car. Within minutes, whatever body was on the chassis could be unbolted, lifted off and replaced with a different body—limousine, 4-door closed sedan, 4-door open touring se-

dan, 2-door coupe, or 2-door roadster.

■ The first production wood-body station wagon was the 1923 Star. The first all steel-body production model was the 1935 Chevy.

■ Called pants at first, fender skirts were first used by Frank Lockhart in a 1928 Stutz racer.

■ Credit for the first modern hardtop convertible goes to Chrysler—with a 1946 model. But the first hardtop retractable convertible was invented by B.B. Ellerbeck in 1931.

■ The Kaiser Darrin and Chevy Corvette share the honor of being the first production sports cars with fiberglass

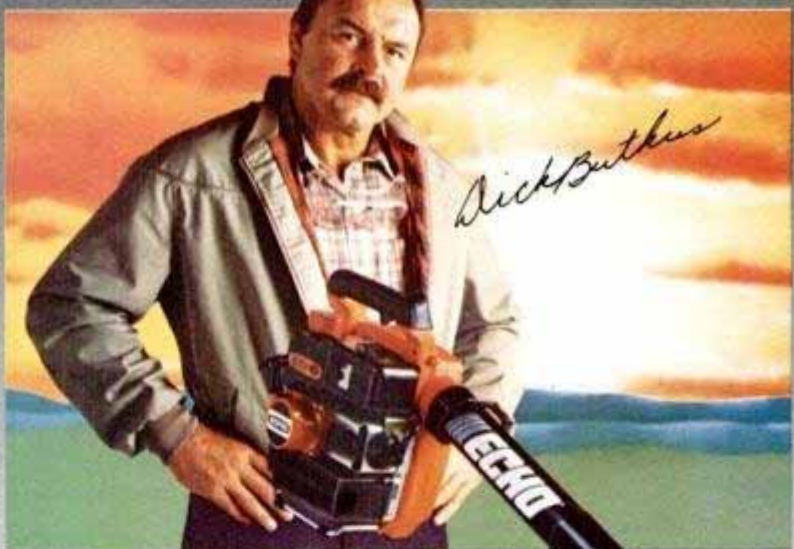
bodies—in 1953—but Ford built a fiberglass prototype as early as '38.

■ Lotus introduced its "backbone" chassis on the 1962 Elan. A central steel box section carried the engine, drive shaft and suspension. The fiberglass body was bonded (glued) to this steel frame.

■ Lotus recently announced plans to produce a honeycomb unit body structure using the lightest and strongest materials available, such as Kevlar- and carbon fiber-reinforced resins. According to Lotus, the body structure they envision would reduce noise and vibration to nil.

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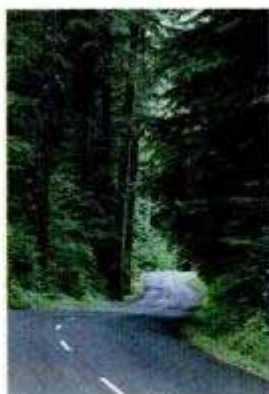
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ZAPPING STATIC

A fingerful of static electricity can scramble the brainy chips in today's electronics. Here's how to prevent microprocessor amnesia.

BY MARC STERN

Does the digital clock on your video-cassette recorder lose track of time when you touch it after crossing the room? Or, does the data in your home computer become mysteriously trashed when you sit down at the keyboard? In either case, it's a safe bet that static electricity is the culprit.

Static is with us all the time, and ZAP is the sound it makes when it jumps to ground. Walk across a rug or slide across a car seat and you'll feel the zing when you touch your hand to metal. You might think the jolt doesn't pack much voltage, but you can carry a charge of 3000 volts or more.

Though you're not likely to hear or feel voltages under 3000, you're generating them and passing them along. The door-knob won't mind, but static is the bane of

(Please turn to page 66)

Built-up static electricity that you might not even feel can jump from you to your computer, packing enough wallop to cause microchip memory blackout.



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ZAPPING STATIC

(Continued from page 62)

today's electronics components. The tiny integrated circuit chips and micro-processors they use are particularly prone to damage from such electrical discharges. In fact, a 300-volt surge you can't even feel is enough to scramble the memory of any computer, telephone or clock. Even if it doesn't destroy the device, it may weaken the part and thereby shorten its lifespan.

The omnipresent bolt

Static electricity is a tough customer to control, because it's generated by everything we do. Carpeting most often takes the rap for causing static, but plain wood floors also are to blame. Dry air promotes static, but this condition isn't limited to Southwestern climates. Household heating that dries the air will strike a spark, too. You needn't despair for your electronics, though. There are some store-bought and homemade remedies that will take the sting out of static.

Humidifiers fall into the store-bought category, but they can't do the job alone. They'll cut the amount of static present roughly by half—but that still leaves enough to stun a semiconductor.

In most homes, it's not likely you'll take up the wall-to-wall broadloom because it's causing problems for your computer equipment. Even if you did, the wood flooring underneath would still create static electricity.

Spritz it out

Since this is the case, consider using one of the many antistatic sprays on the market. If you can't find these sprays in your local electronics store, try an office supply service. The reason you'll find it there is because this type of spray usually is aimed at businesses, which have to protect the vital information stored in their computers.

Administer a healthy dose of the spray on the carpet around your entertainment center. This will suppress static. But be aware that you'll have to renew the application at periodic intervals. If you have a home computer, there's a spray available for the display tube of your computer's monitor—which is the prime cause of static in this atmosphere. Use this special antistatic spray liberally on the screen's surface and you'll be surprised at how it will suppress static.

Mat it down

If you have a lot of carpeting in your home, sprays can become expensive. A more local and economical alternative is to install antistatic mats under your equipment and in front of your entertainment center. They're available from

many manufacturers, in a variety of sizes—including strips that attach to computer keyboards. You'll find them in electronics, computer and office supply stores.

This type of mat consists of a conductive material that will bleed off a static charge and shunt it to ground. Just be sure to attach the ground cable to a good ground point. You'd be surprised at the number of people who fail to do this, assuming the mat will work without the connection. It won't.

Static electricity must have a path to ground. You can use the screw on a wall socket in a properly installed, 3-wire electrical system. That screw is connected to the socket's frame, which is also connected to ground in that 3-wire system. The ground wire will be attached to the antistatic mat by a clip or snap of some type.

Brace yourself

For most installations, this should provide more than enough protection. But another thing that provides an extra margin of safety is an antistatic bracelet you can build for less than \$5. It's a simple device which attaches to a metal watchband. When connected to a ground point, it bleeds off excess static charge you may have built up.

To make this device, all you need is a soldering iron and a pair of wire cutters. The parts are readily available from your local electronics store, and include an alligator clip, a 1-megohm resistor (a 1/4- to 1/2-watt, 5-percent one will do), a cable (about 10 feet of 18- or 20-gauge wire) and a ground lug.

Making the bracelet

First, trim the leads of the resistor to a manageable length, about 1/4 inch. Then, solder one end of the resistor to the alligator clip, and the other to the cable. Finally, solder the ground lug to the other end of the cable.

To use the bracelet, simply attach the alligator clip to your watchband, secure the ground lug to any ground point (such as the screw in a wall socket) and you'll be grounded effectively. Your watchband must be metal—leather won't do. And be sure the alligator clip is attached to a part of the band that touches your skin. For this purpose, flexible-style wristwatch bands provide better contact than loose, jewelry-like wrist bracelets.

If you're prone to forgetfulness, leave the bracelet permanently installed and prominently displayed near your equipment. This way you won't need a shock of recognition—and a blown semiconductor—to jolt your memory about the power of static electricity. **PM**

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Slick 50 has been thoroughly tested in independent laboratories and out on the road:

The March/April 1982, p. 35 issue of "Consumer Digest" magazine stated, "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."

One of the country's most respected research institutes reported applying a powerful ultrasonic cleaning process to a Slick 50 treated engine and were surprised at its permanence. "We actually expected the Petrolon Slick 50 TFE Resin coating to also be removed, but later found it was still there."

"Dune Buggies & Hot VWs" magazine April 1983 issue records the results of their one year testing of Slick 50. "We can indeed say scientifically that Slick 50 does work, and that it does reduce engine wear! . . . for the price of one treatment when compared to engine rebuild, we feel that you'd be money ahead using Slick 50!"

The 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 showed almost zero engine wear!

The senior engineering researcher at a leading southern California university stated, "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 torture test overseen by the Automotive Services Council for Pennsylvania and shown on WTVE television. Three cars with 75,000 to 129,000 miles on them were treated with Slick 50. Six months later the oil was drained from each vehicle, and the cars driven without the oil plugs for about a half hour. The water temperature never rose and the engines sustained no apparent damage.



There isn't room here to tell you about the dozens of other tests proving that Slick 50 is everything we say. However, if you're still skeptical, send \$2.00 to cover printing and postage costs, and we'll send you detailed test results plus actual letters from users who report how Slick 50 saved their engines and saved them money!

It's Easy to Treat Your Engine

A few minutes before oil and filter change, add the engine flush you get free with each order to clean out the engine. Let the engine idle for 5 minutes. Then drain the oil, change the filter and add the proper amount of oil, less one quart. Add one quart of Slick 50, drive for 30 minutes, and leave it in the crankcase for at least 3,000 miles. As the engine operates, the oil carries the "poly" between the parts where it is burnished into the pores of the metal.

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Works with Most Oils

Slick 50 will work with all petroleum-based oils and all synthetics compatible with petroleum-based oils with the exception of graphite oils. However, once an engine is treated, you can go back to a graphite type if desired.

4 Ways Slick 50 Saves You Money

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1. Increase mileage
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**This fall, don't forget
your hoses.**

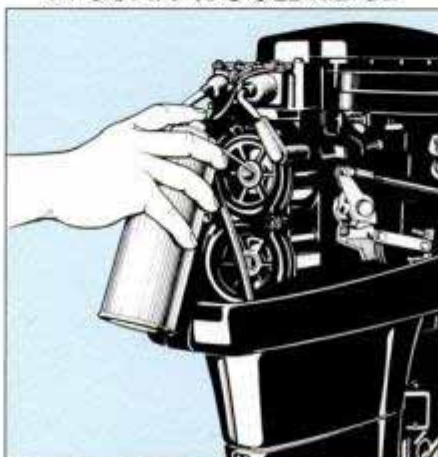
Out In The COLD

It's a rough way to treat your outboard. Use these lubrication ideas when storing your engine and run quicker and better next spring.

As cold fronts appear more regularly, it's important to get your boat out of the water and the outboard serviced before a sudden freeze causes real damage. Just follow our PM checklist and prep it now. Spending a little time and money this fall could save you a lot of money next spring.

After the last autumn outing is over, and the outboard is either still mounted on the transom of the trailered boat, or is mounted on a sturdy stand, the cooling system should be flushed with fresh water and allowed to drain completely. Some small motors have removable flush plugs that allow pressure flushing with special adapters coupled to garden hoses, making it unnecessary to operate the engine during flushing. Larger outboards may require flushing devices which cover the normal water intakes, also coupled to a hose, to provide cooling water for the motor as it runs at idle with the prop removed. Flush the system until exhausted water is very clear, at least five minutes if the outboard sees lots of salt water use. While the prop is removed, check the blade edges for minor nicks, which you may want to smooth out. Cracks or gouges should be

BY JOHN WOOLDRIDGE



Proper storage will win against corrosion. After removing the sparkplug, coat combustion chamber with an approved, high-quality petroleum storage seal.

referred to a boat dealer.

While the engine is idling, remove the cowl or engine cover and locate the carburetor, or carburetors if you own a larger, high-horsepower model. Disconnect the fuel line from the outboard, lay it aside at least at arm's length and be sure it's not leaking. Spray storage seal as recommended by the manufacturer into the carb's air intake. When the engine starts to sputter as the fuel in the system burns up, spray the intakes once more. This ensures that everything from the crankcase, to the needle bearings, to the connecting rods, and even the piston tops, are protected for the winter.

Once the flushing attachments are disconnected, check to see that all water drain holes in the gear housing or lower unit are open and free running. Some outboards have flushing plugs which must be removed for complete drainage. Failure to remove them could mean a cracked housing over the winter. Reinstall all flushing plugs when all water has drained out of the cooling system.

Now that the powerhead is visible and the engine has stopped, a quick check for loose or worn wires, hoses and



This is not proper winter storage for your outboard. Bring it in from the cold and follow our flush and lube techniques.

fittings is a good idea. Disconnect the battery to prevent accidental cranking. Loose connections are tightened easily, but worn components require immediate replacement. In particular, you should watch for signs of weeping around the fuel lines, which indicate potentially hazardous leaks.

Some outboards have a fuel line filter located on the fuel pump, which requires annual inspection. Follow the manufacturer's recommended procedure in your handbook, or call them to get one. Do this incorrectly, and you run the risk of a leak next spring. In fact, you should tag your key or throttle lever as a reminder to double check for fuel leaks in the spring. Clean the prop shaft with steel wool, lube it and put the prop back on tight.

Lubrication is an essential step in preparing your outboard for winter storage. You'll need light oil, grease and gear case lubricant. Often, the outboard manufacturers will specify their own formulas to meet the special needs of the powerplants they sell. On the average, there are 18 to 20 internal and external points which need lubrication more than once a year, as directed by your owner's maintenance guide. Swivel brackets and pins, tilt-tube fittings, throttle/shift linkages, reverse lock levers and clamp screws are among those items which need servicing every 30 to 60 days of use, depending on whether you run in salt or fresh water.

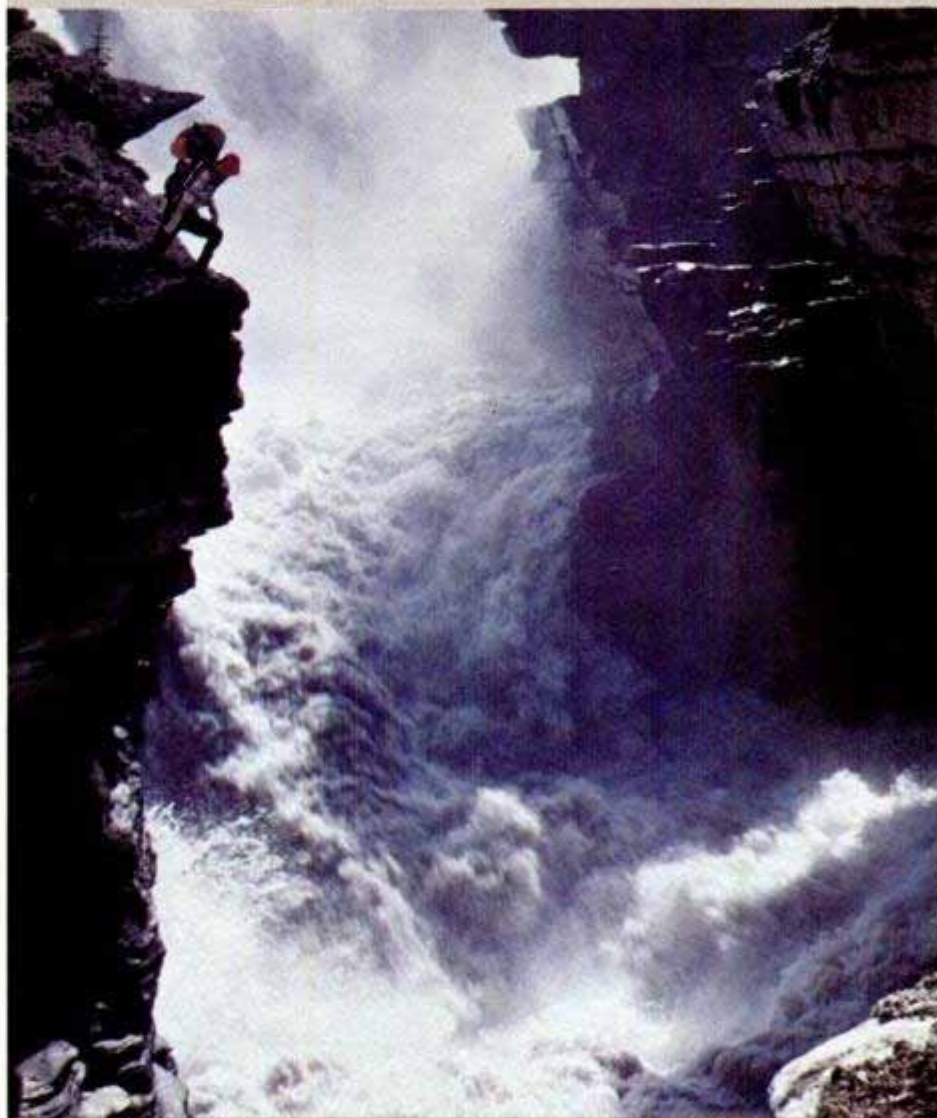
Of particular importance is the gear housing, which should be serviced every 30 days, normally with specially recommended gear case lubricant only, to keep friction and gear wear to a minimum. The screws and washers for the filler hole and a vent hole must be removed. Gear housing lubricant is forced upward into the housing from the bottom until the old grease is displaced, so it is very necessary to remove both screws. If any water drains from

(Please turn to page 73)



Remove filler hole screw and vent screw when lubricating gear housing. Total lubrication is achieved when new grease displaces old grease through vent.

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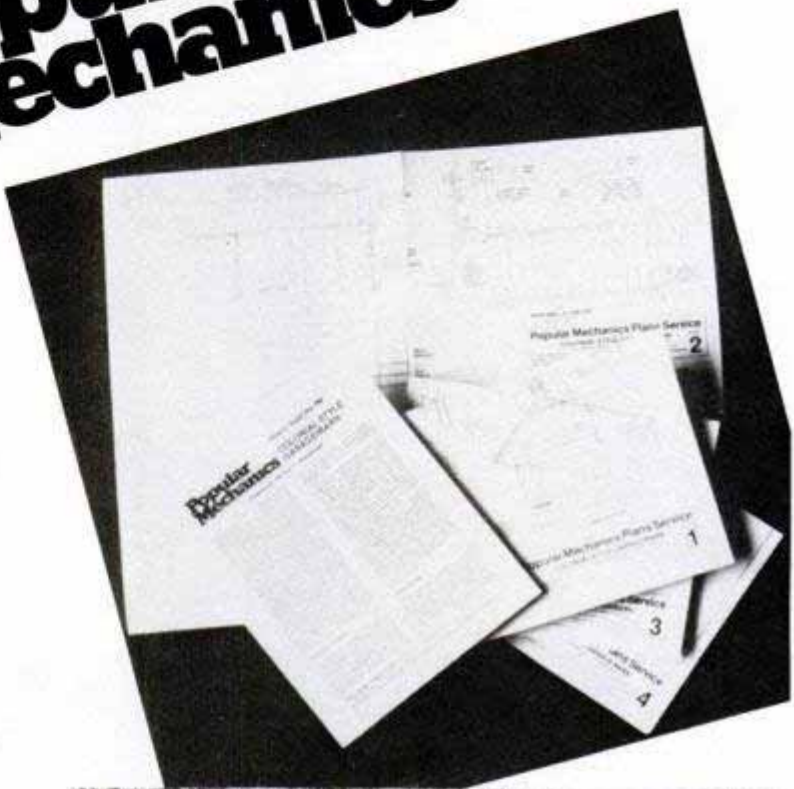
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OUT IN THE COLD

(Continued from page 71)

the filler hole, if the old lubricant is milky brown or if a greater than usual application of lubricant is used, take your motor to a local dealer very soon and have it checked.

When you're satisfied that the lubrication is complete, spray the exposed powerhead with corrosion and rust preventative, usually a WD-40-type light oil, to protect from possible condensation and corrosion. Replace the cowl or engine cover and clean the motor thoroughly with soap and water to remove salt spray, dried weeds or mud. Dry the motor carefully and inspect the external surface for scratches or scrapes where bare metal or primer is showing. Touch them up with a coat of matching spray paint from your dealer to continue rust protection.

Whether you leave the outboard on the transom, or store it in a garage or basement, remember to keep it clean and dry. A waterproof fabric cover will work for those stored outdoors, but ventilation is necessary in all locations to prevent moisture buildup. Storage area temperatures are not critical, but wide ranges of temperatures promote condensation and corrosion.

The process of winterizing your outboard is nearly complete, but there are still fuel systems and batteries to check. Be very careful with gasoline! Don't assume that everything is safe—check and double check to make sure that open flames or sparks are all absent from your area.

If your boat has built-in fuel tanks, be sure to add fuel stabilizer if you regularly leave the tanks wet. If you suspect that there's alcohol mixed in your fuel tanks, you're better off draining them or running them dry at the end of the season. Alcohol will separate out of standing gasoline, and corrosion of metal fuel tanks is sure to follow.

If your fuel system is equipped with a bulkhead-mounted, in-line water separator filter, be sure to drain it so that it will not freeze and crack open. If you use small metal tanks, it will be necessary to remove the plastic housing connected to the hose to examine the fuel tank filter at the end of the pickup tube. Clean the filter and flush the tank with no-lead gasoline. Be prepared to replace the gaskets for the filler-hole cap and the plastic hose housing.

Tape or tie your battery leads and other equipment leads together in two individual bundles as they come off the terminal posts, one positive and one negative, and tag them appropriately for the spring. Clean the battery case, removing greasy accumulations of dirt and any corrosion from terminal posts. Protect the posts with petroleum jelly and spray the case with rust preventative spray.

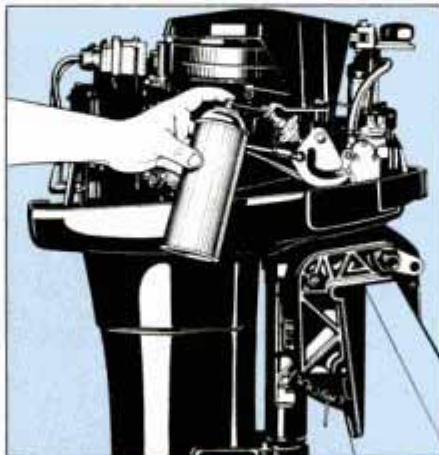
To make it through the winter, you will need a hydrometer, a battery charger, safety glasses and some distilled water.

Before storage, check the electrolyte level, making sure it is above the plates in all chambers. Add distilled water accordingly, but carefully, as the electrolyte is usually a strong acid. Charge the battery at no more than 6 amperes until the hydrometer indicates 1.260 specific gravity. Every 45 days, check that the specific gravity drops no lower than 1.230. If it does, you'll need a recharge. Store the battery in a box, preferably in a cool, dry place where temperatures do not vary a lot.

All things considered, preparing your outboard for winter storage should take you no more than a hazy fall afternoon if you've gathered your supplies and thought the process through. That's a pretty small investment that could pay off in big savings next spring. **PM**



Storage care doesn't stop at the power head or gear housing. Remove the propeller, clean the prop shaft with steel wool and apply lube grease.



The final step is to apply a film of marine-grade light oil to working components in the power head, including the carburetor and throttle linkage.

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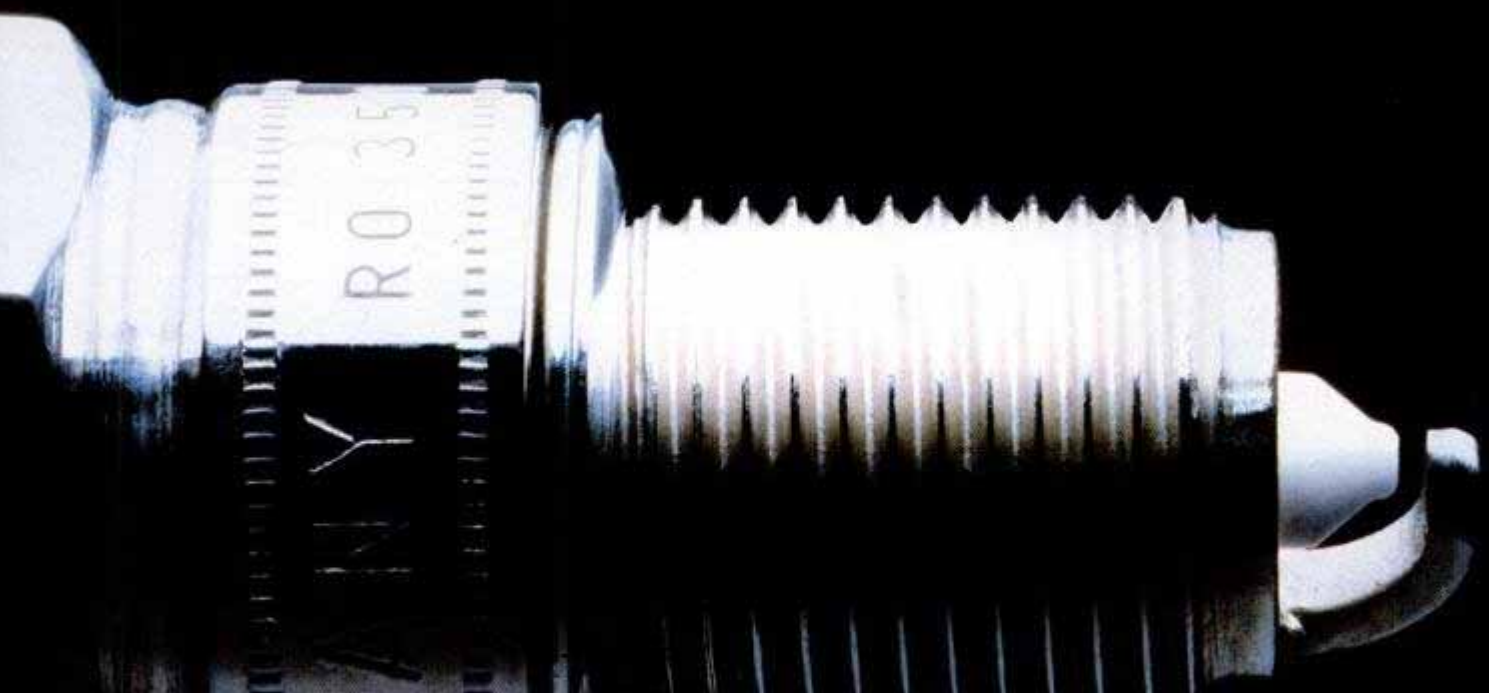
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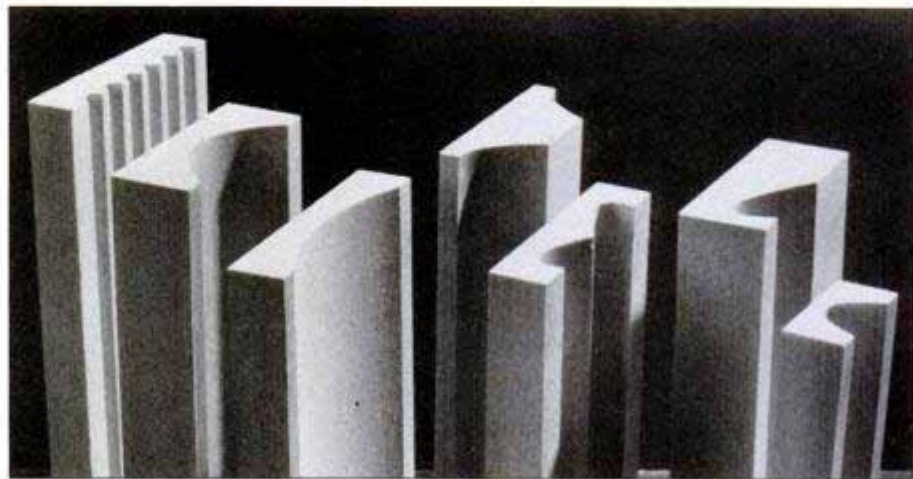


Cutting coves on a table saw

Cutting coves is a relatively simple operation on the table saw. It is performed by clamping an auxiliary fence to the saw table at an angle to the axis of the saw blade. As the workpiece is pushed along the fence, it contacts the blade at an oblique angle, which results in a broad, expanded kerf. This kerf can take many different shapes, all of which are elliptical, not true arcs.

The depth of the cove is controlled by the height of the saw blade above the table. The width is controlled by the angle of the fence. A simple jig, called an adjustable parallel rule, is used to establish the fence angle that will produce the cove you desire. The rule jig shown here was made of four pieces of 1 x 2 pine stock. The ends are 9 in. long, the sides are 22 in. long. All four are joined with 1-in. No. 12 panhead screws that act as pivots.

The following example explains how the jig works. Assume you want to cut a cove 1 1/8 in. deep and 3 3/4 in. wide. First, elevate the blade to a 1 1/8-in.



Using a table saw to cut single coves and combination coves allows you to design and create a wide variety of different moldings that are not commercially available.

height. Next, adjust the parallel rule so the inside edges are 3 3/4 in. apart. Hold the rule in this position and then lower it over the saw blade so that both sides just touch a tooth. Leave the rule on the table in this position and carefully

clamp the auxiliary fence to the table in line with the jig.

This establishes the proper angle of the fence but not the proper distance between the fence and the saw blade.

(Please turn to page 85)



1 The first step in cove cutting is to mark desired cove depth on end of board in pencil. Then elevate blade to this line.



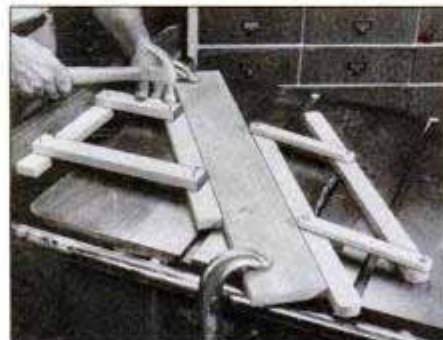
2 Build a parallel rule jig as explained in the text, then adjust it so the space between sides equals the desired cove width.



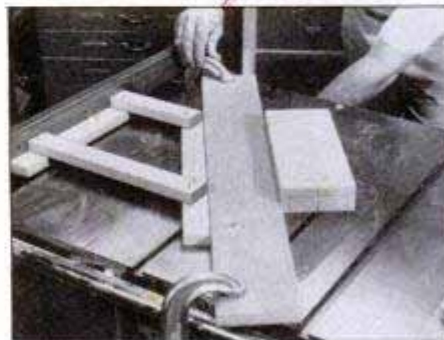
3 Tighten screws to maintain width, then lower jig onto table. Find place where jig sides just touch saw tooth at front and back.



4 Temporarily clamp an auxiliary fence to the saw table in line with the jig. Be careful not to knock jig out of alignment.



5 Build an angle frame out of scrap lumber that fits precisely between the auxiliary fence and the table saw's standard fence.



6 Unclamp auxiliary fence and use angle frame to reposition it so that centerline of workpiece and saw blade align perfectly.

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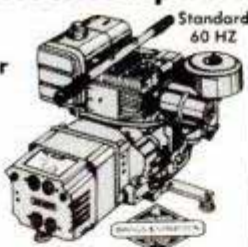
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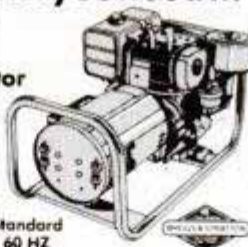
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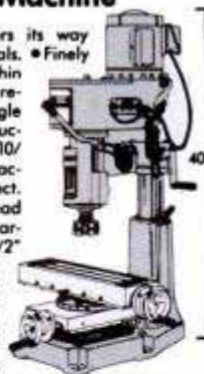
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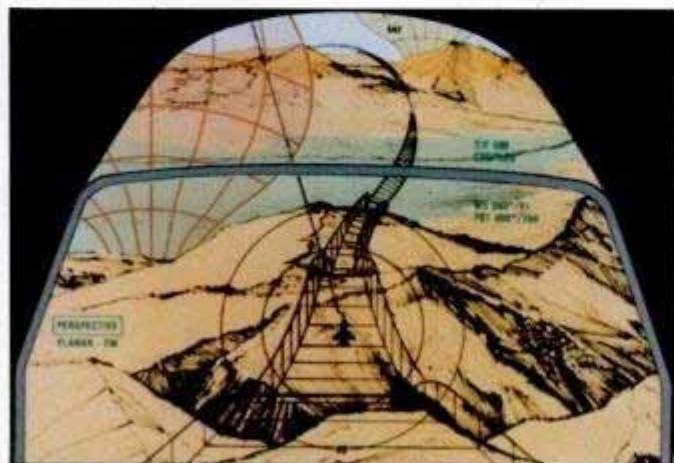
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course, fires weapons or takes evasive action.

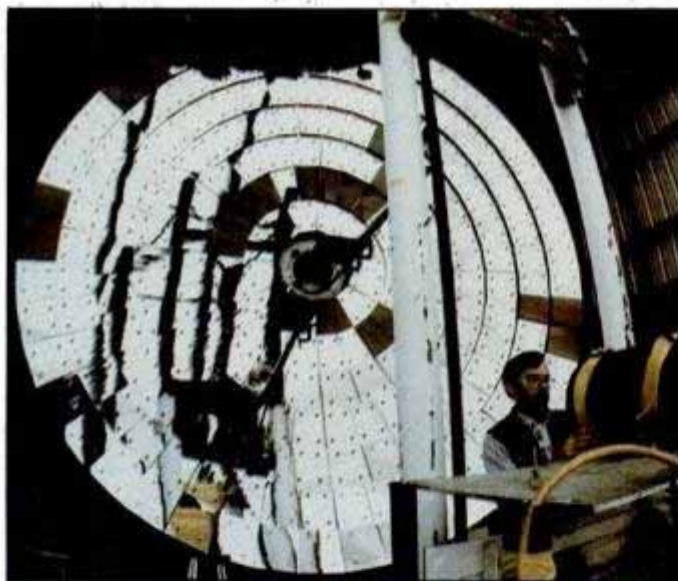
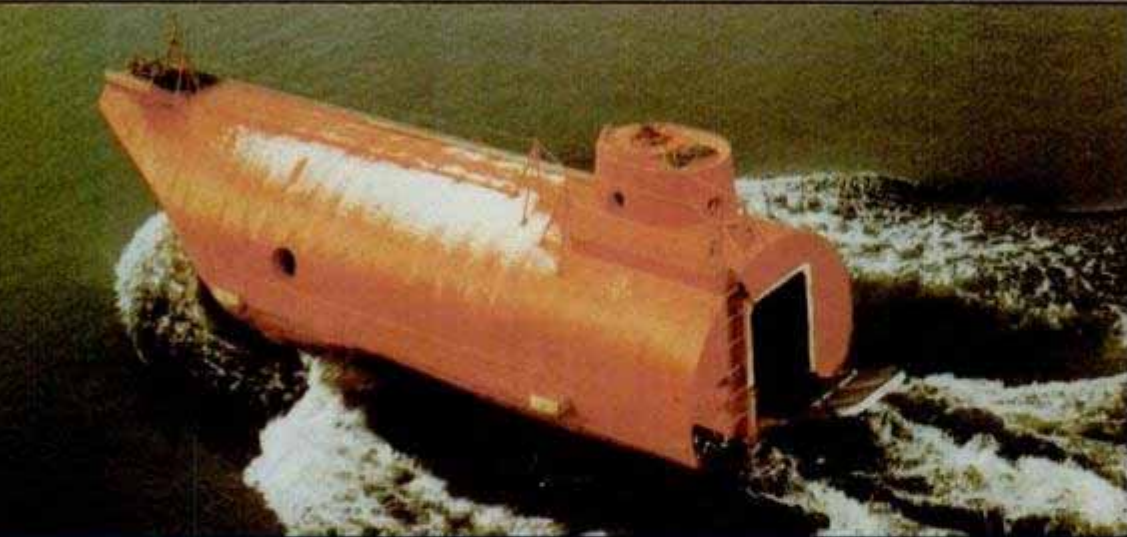
Last year we looked at a similar system, designed by engineer George Hoover, called Highway In The Sky. It would keep airliners on course graphically. Both systems could be in operation in transport and fighter cockpits before 1990. This year, a military unit was test-flown.

Editor: Dennis Eskow
Assistant Editor: Ted Francis
Contributors: Sheldon M. Gallager,
Jack Hammond, Alton Blakeslee,
Ken Sanders, Chris Mitchell, John
Domberg, Michael Fillon

RESCUE

Lifeboat capsule

West Germany's Survival Satellite (top) is touted as the lifeboat that will reduce the 2000 lives lost annually in marine accidents. The satellite is launched from a foundering ship via an inclined slipway (bottom right). The watertight, bullet-shaped unit holds 45 people. After it's launched, it dives to 65 feet and can remain submerged until its 35-hp diesel engine propels it out of danger. It can be loaded and launched in two minutes and its lightweight steel hull is fireproof and heatproof (bottom left). At least two of the survival satellites currently are safeguarding passengers and crew on West German refrigerator ships.



ENERGY

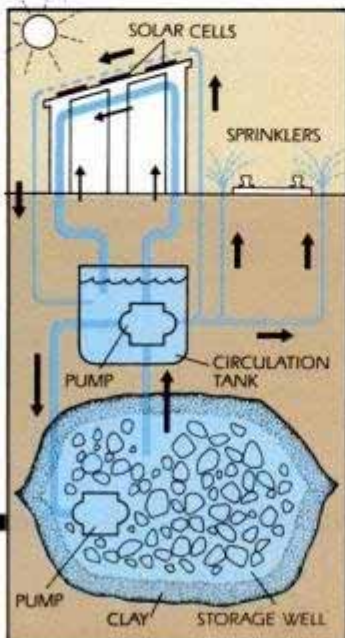
Furnace aids research

Sandia Laboratory scientists are using their solar furnace (left) to test effects of high temperature on materials used in solar facilities and nuclear powerplants. It consists of a sun-tracking mirror array that reflects sunlight onto a parabolic dish solar concentrator which focuses sunlight onto a platform holding test objects. Researchers plan to use the furnace to produce high-purity silicon.



Sun repeater

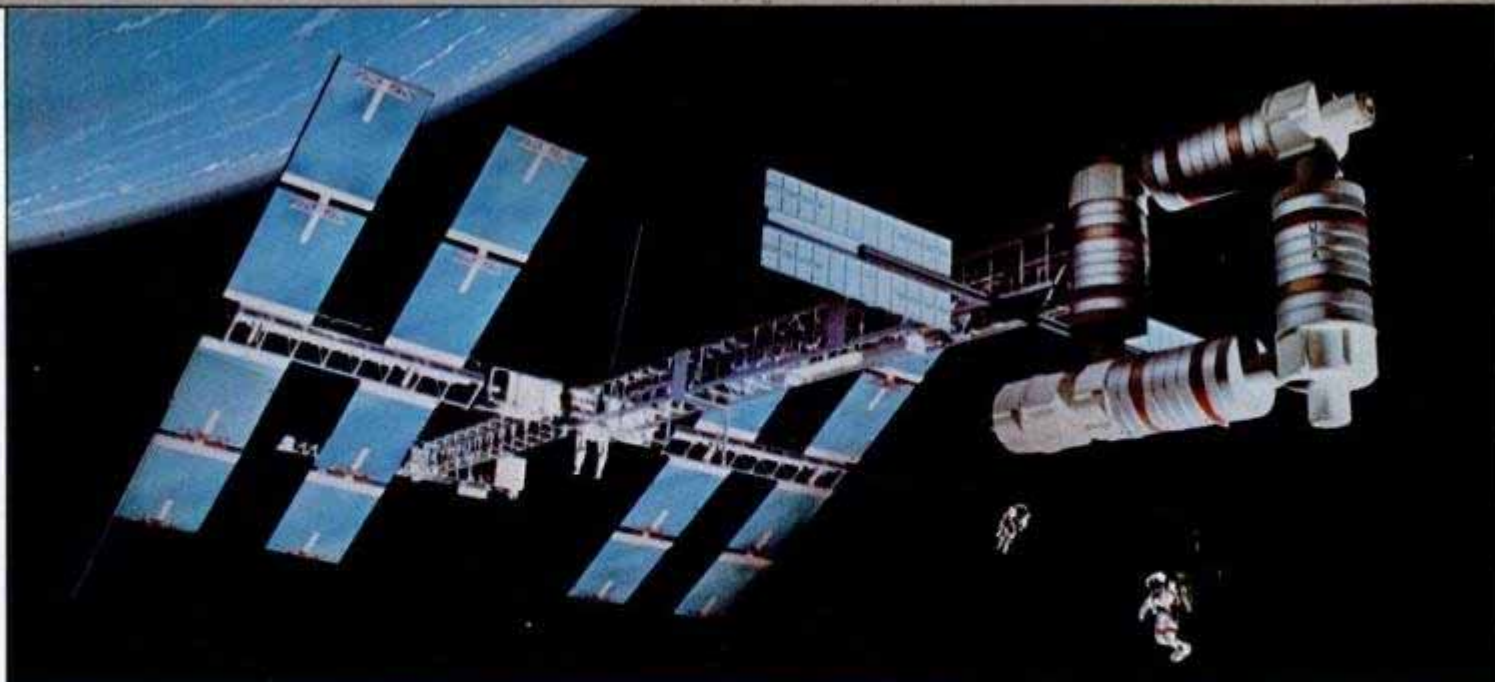
Isolated repeater stations require power to boost radio signals and occasionally are so remote that fuel or power lines are difficult to provide. Arizona's public safety agency uses a photovoltaic array to power their station 60 miles from Phoenix.



Solar heat clears snow

A Japanese National Railways research group is using solar energy, stored as warm water during summer months, to melt snow along tracks and rail stations on the bullet train lines (far left). During initial tests, solar energy was collected on a station rooftop (illustration at left) and stored as 10,000 tons of heated water underground at the station compound at 90°F. During January, pumps were used to

propel the heated water to sprinklers on the station roof and along nearby tracks. The temperature at pumping was approximately 64° to 68°F. The melted snow (as well as rain) was collected, pumped to a heating tank, then stored in a well surrounded by clay insulation. The test showed that 34,000 gigacalories of solar energy—the equivalent of 22,500 barrels of oil—could be stored between April and September. The system may be modified to store cold air in winter for air conditioning.



PM ILLUSTRATIONS BY BRIAN SULLIVAN



AEROSPACE

NASA orders space designs

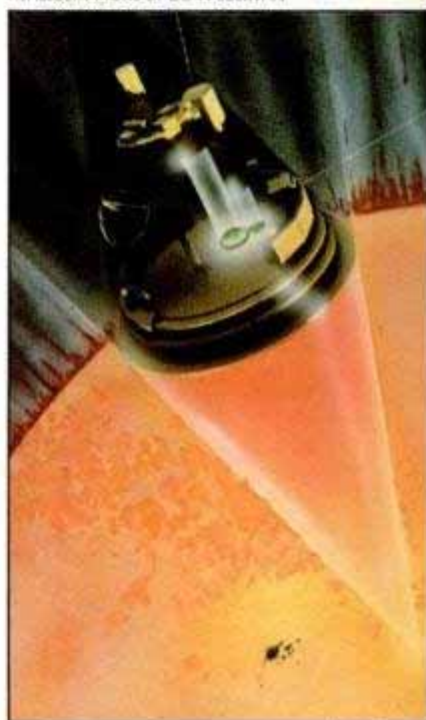
NASA has chosen the Martin-Marietta Aerospace and Boeing Aerospace Co. to design modules for the proposed space station (drawing top) scheduled for assembly in the 1990s. Boeing is developing a design of a pressurized common module (above right). The Boeing design

may be configured for use as laboratories, living areas and logistic transport. Boeing will also design internal environmental controls, propulsion systems and docking mechanisms for orbital transfer vehicles.

Martin-Marietta already has a leg up on the module design with its full-scale mock-up (above left). NASA currently is using the mock-up at Martin-Marietta's Michoud, Louisiana, facility to aid in planning the overall station.

Once upon a probe

Scientists at NASA's Jet Propulsion Laboratory are at work on Project Starprobe, a fanciful but plausible dream to send a probe into the Sun's corona. Despite the \$1 billion price tag and technological obstacles, NASA researchers have targeted the 1990s for launch. The craft (drawing at right), must withstand solar radiation 3000 times as intense as Earth's and temperatures about 1,150,000° F. NASA is testing carbon shielding at a unique solar furnace in France. Starprobe will come within 1,730,800 miles of the Sun—15 times closer than record holder, Helios. Starprobe's data will aid solar studies.



AGRICULTURE

Mobile fertilizers

Aeronautical engineer Moshe Alamaro has devised a novel approach to solving world hunger. Using his engineering knowledge, Alamaro is proposing to modify the old Birkeland & Eyde plasma arc furnace (photo right)—used during the '40s to produce nitrogenous fertilizer—to increase its efficiency and



yield. And, by transporting them to areas of need (drawing at right), cheap fertilizer could be produced anywhere there was ample electricity, air and water.





PM ILLUSTRATION BY ED VALIGURSKY

MILITARY

Soviets expand

The drawing above shows a Soviet Delta IV class submarine, the newest addition to the underwater fleet, breaking through the Arctic ice cap to fire a missile. The Delta IV represents a serious Soviet

effort to bolster its naval force. The Soviets launched the first Delta IV last year. The sub fires an SS-NX-23 ballistic missile with multiple warheads. Delta-class subs are viewed as a threat since they can hit North America from launching areas in the Sea of Okhotsk and Barents Sea, well out of reach of any known countermeasures. The Delta IV is undergoing sea trials.

New flares for choppers

Sophisticated ground detection methods are turning helicopters into fodder for heat-seeking missiles. But a new,

lightweight module, which can dispense up to 30 flares, may solve the problem. A CH-46 Chinook helicopter (below) fires infrared flares. The flares confuse heat-seeking and radar-guided missiles.



Avenger adds muscle

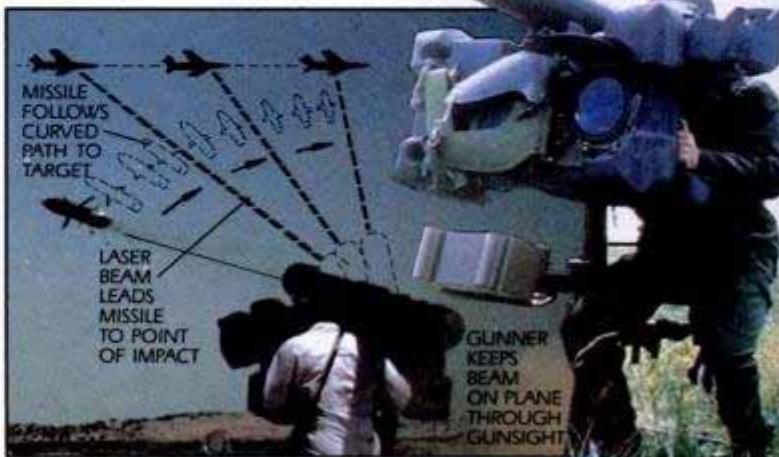
Boeing's added some muscle to its Avenger Mobile Air Defense System (photos below). The Avenger now has the ability to fire 2.75-in. rockets as well as ground-to-air Sting-

er missiles. Armed with a 7-rocket module, the Avenger is effective against light ground vehicles. The Avenger can fire Stingers while mounted on the Army's multipurpose Humvee truck, but a heavier truck is needed to fire rockets. The Avenger can accurately fire while rolling at 20 mph on an unimproved road. Its gyro-stabilized turret can carry and rapidly fire eight anti-aircraft missiles. It has automatic target tracking, friend/foe identification, rapid turret and reload action and day/night all-weather capabilities.

Missile rides laser

As long as the unit operator keeps his RBS-70 portable missile launching system aimed at an aircraft (below), a laser-line-of-sight system will guide the launched missile to the target. The RBS-70 can be

carried by three men and is effective against high-speed, low-flying attack aircraft. It's tripod-based to eliminate shoulder-fired weapon problems such as aiming, limited missile speed and limited range. The system takes only 30 seconds to set up.





AVIATION

Copter extends range

The Boeing 234 (above), with an extra fuel tank, is shuttling

up to 32 passengers between Alaska's St. Paul's Island and oil rigs more than 325 nautical miles at sea. The 234 is the only commercial helicopter capable of extended flight as well as carrying more passengers and freight.



Giant eye in the sky

The Navy may be returning to the airship to counteract the threat of submarine-launched Soviet cruise missiles. With

more than 9000 square feet of surface and a 40-foot antenna that hung down within the Goodyear ZPG-3W (circa 1950) envelope (above) it was the world's largest radar antenna. Such airships may again guard our coasts.

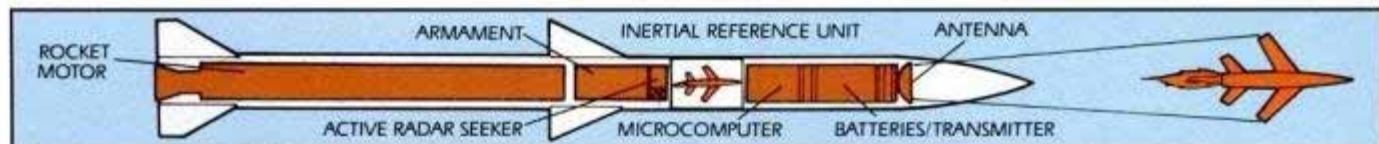
AVIONICS

State-of-art missile coming

Hughes' new Amraam (advanced medium-range-air-to-air missile) is expected to improve U.S. fighter combat capability. Amraam (photo

right, drawing below) is two-thirds the weight of the missile it will replace, the Aim-7 Sparrow. Amraam can be launched at an enemy aircraft beyond visual range.

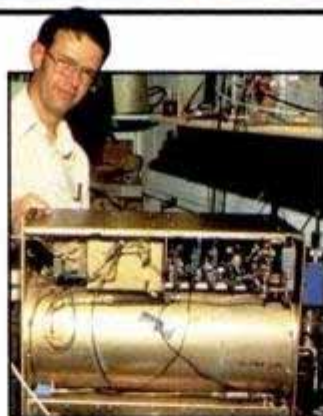
Initially, the missile is guided using target coordinates provided by the launching aircraft. Later, its active radar seeker guides it.



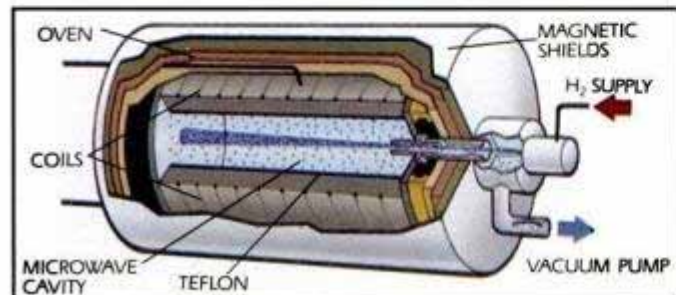
ENGINEERING

Have you the exact time?

A newly developed portable atomic clock (right) is five times more precise than the traditional cesium clocks that have been the standard in commercial time-keeping. The atomic clock measures time using the magnetic movement of hydrogen atoms heated within a microwave cavity. A clock beams radio waves at 1.4 billion cycles per second from an oscillator into



the teflon-coated cavity. It maintains its precision five to ten times longer than other atomic clocks.



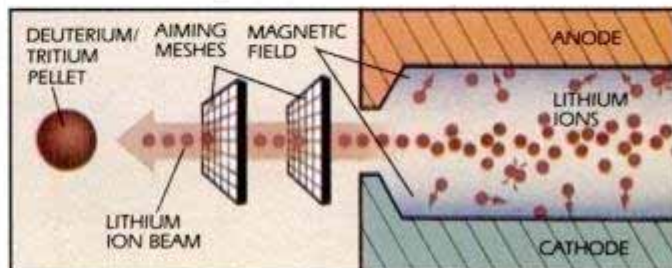
FUSION

Lab preps accelerator

This winter, Sandia Laboratories will attempt to initiate a fusion reaction with their powerful 36-spoke Particle Beam Fusion Accelerator (right). Thirty-six accelerators will be fired simultaneously, creating a lithium ion beam which, when filtered through a pair of aiming meshes, bombards a deuterium-tritium target pellet (below). A transparent plastic mesh allows the electrons to be emitted uniformly and fast



enough for a 40-billionth of a second ion pulse to shoot forward.





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WORKSHOP MINICOURSE

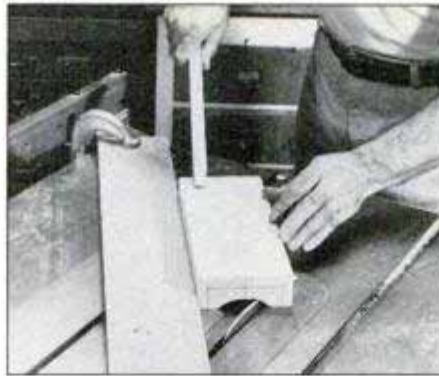
(Continued from page 76)

To do this, fabricate a small angle frame of scrap wood as shown. This frame should fit perfectly between the auxiliary fence and the regular table fence.

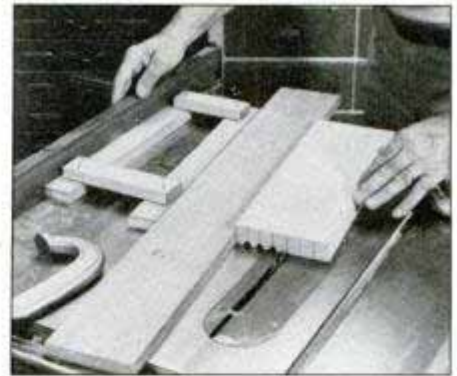
Now you are free to unclamp the auxiliary fence and shift it along the angled frame until the workpiece properly intersects the saw blade. To find this point, you must first establish the centerline of the cove you want on the end of the workpiece. Draw this clearly on the end grain in pencil. Then lower the saw blade and slide the end of the workpiece over it. Adjust the auxiliary fence and angle frame until the centerline of the workpiece lines up precisely with the centerline of the saw blade. When satisfied, clamp the auxiliary fence securely to the saw table.

Cut the cove gradually in successive passes until final depth is achieved. In softwoods a 1/8-in.-deep cut per pass is okay, but hardwoods require 1/16-in.-deep passes. To produce the smoothest finish, adjust the blade for extremely light cuts on the last two passes. Also, when making extremely deep cuts—especially in hardwoods—the work will go much faster if you first hollow out some of the waste by making straight cuts in the board with a dado blade.

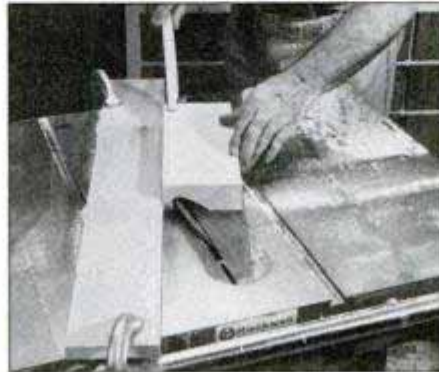
—Rosario Capotosto



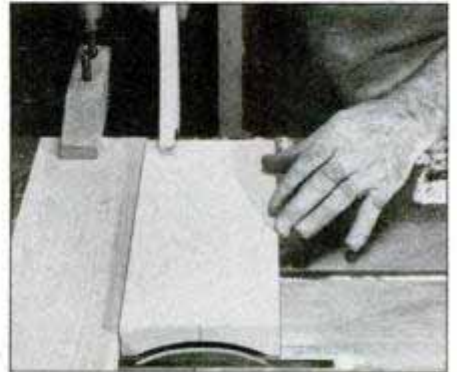
7 Cut cove in successive passes by pushing stock against fence and over blade. Be sure to use a push stick at back of board.



8 Multiple flutes can be cut in a board face using the same method. The auxiliary fence must be repositioned after each cut.



9 Slanted coves of various shapes can be cut by merely tilting the saw blade on its arbor. In this case the blade is set at 45°.



10 To cut a cove with a true arc instead of ellipse, use a right-angle feed. Push slowly over blade and cut in several passes.

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Lagoon Nebula
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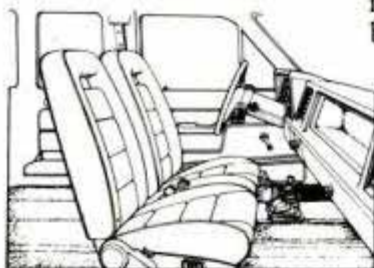
Материал, подготовленный по старинному рецепту

The Long Ranger.

Tough Ford Ranger Supercab 4x4.

Ford's new Ranger SuperCab is here... with more room and comfort than ever! Ranger's new 2.9L V-6 engine is the most powerful in any small pickup, too. And new "Touch-Drive" option lets you shift to 4WD high on the fly!

Now there's a tough, small 4-wheeler that gives you more room for off-road roamin'!



Ford's new Ranger SuperCab has over 22 cu. ft. of space behind the split-back front seat—more room than any Ranger ever. With optional rear jump-seats, it's the only small pickup that can ride five.

Most powerful V-6!

There's extra off-road power, too—140 horses* worth in Ford's new, bigger 2.9L V-6

option. It's the most powerful engine in any small pickup!

Like the standard 2.3L Four, it's electronically fuel-injected for quick response.

New "Touch-Drive" system.

When the outback beckons, just touch and

go for it! A button in Ford's new "Touch-Drive" console shifts electrically from 2WD to 4WD high and back at any speed. Nobody ever made it simpler! (Manual locking hubs are still standard for you traditional off-roaders.)



Supertough Truck.

Above all, this Ranger 4x4 is one tough truck—built Ford tough, with a Twin-Traction beam independent front suspension... double-wall construction... tough ladder-type frame. And a payload of 1625 lbs.

Special STX trim.

All this off-road room and toughness comes with all the "goodies," too, in the new

Ranger STX optional package—sporty trim, Captain's Chairs, lower two-tone accent, the works. It's the look that says, "4-wheelin', you ain't seen nothin' yet!"

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*Based on SAE Standard J1349.



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SHAPING UP TOMORROW'S CARS

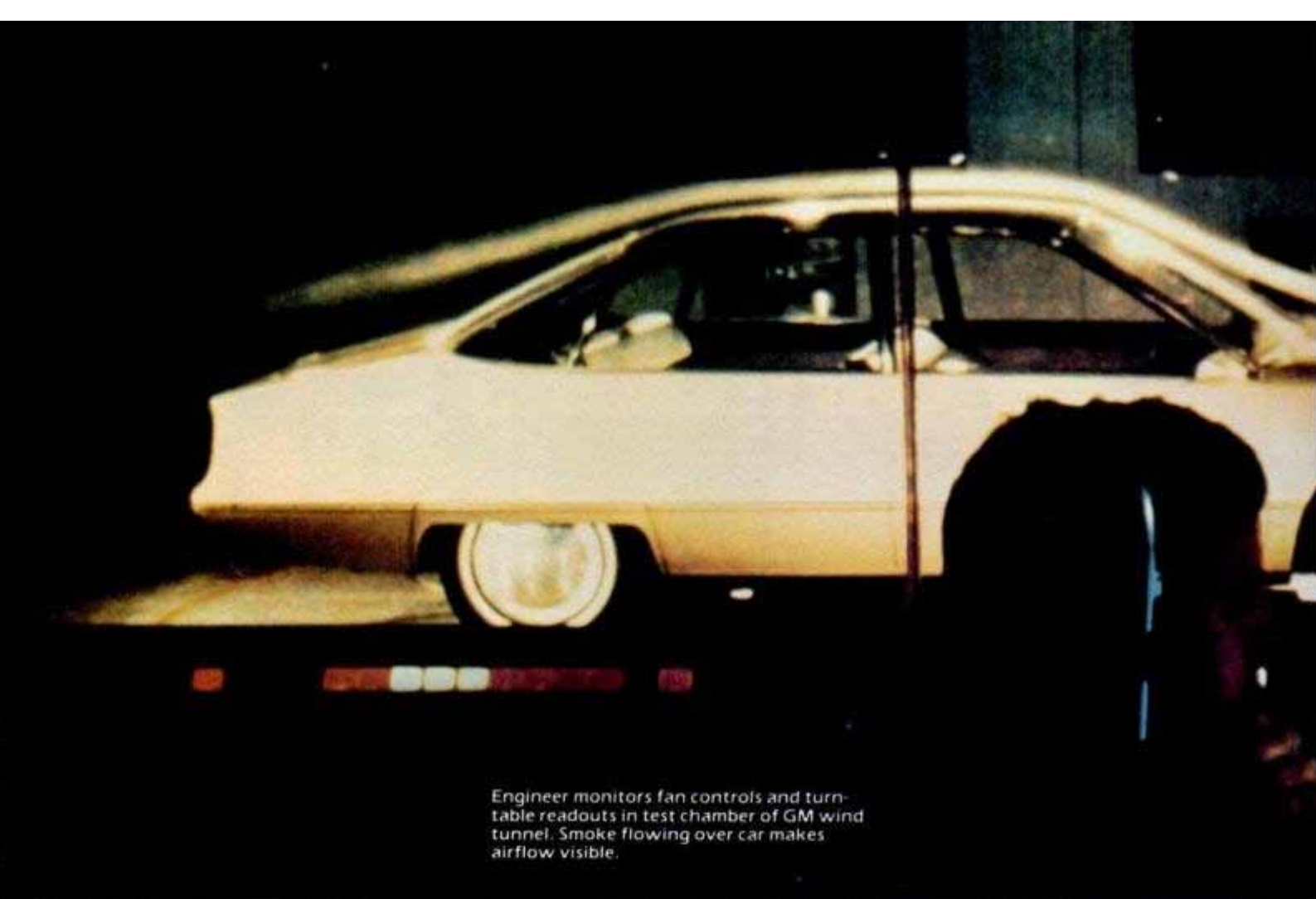
It's all done with wind tunnels.

BY WADE HOYT, Auto Editor

When engineers at Volkswagen rolled a bizarre-looking 1921 Rumpier out of a German museum and into the company wind tunnel for testing recently, they recorded a drag coefficient of 0.28—making it the most aerodynamic production car ever sold to the public. The closest any manufacturer has come to that figure is 0.29 by Subaru with its new XT Coupe.

We don't know where Dr. Edmund Rumpler got his aero expertise, but we know that to move through the air with the ease of a Rumpier, tomorrow's cars will have to be born in a wind tunnel. No longer does a stylist whip up some sexy shapes on a sketch

Engineer is dwarfed by 43-ft. fan in GM's giant wind tunnel. A 4000-hp electric motor circulates 80 tons of air through the 700-ft. closed-loop tunnel at up to 150 mph.



Engineer monitors fan controls and turntable readouts in test chamber of GM wind tunnel. Smoke flowing over car makes airflow visible.

pad, then build clay models for management to squint at, debate and approve, according to its whim. Aerodynamics is the key to the automotive shapes of tomorrow, and that's the province of engineers, not stylists and executives.

Among the domestics

Ford started the current aero revolution with the slick 1983 Thunderbird and is still leading the pack with its '86 Taurus and Sable. GM will follow suit in 1987 with the Ford-like Chevy Corsica and Baretta (see *Detroit Listening Post*, page 32, July '85). Chrysler is moving more cautiously, but when it replaces the 1978-vintage Omni and Horizon with its Shadow and Sundance P-cars next year, they will have a pronounced aero look.

Why all this interest in aero? Ford Design Vice President Don Kopka says, "Just by the way we shape the metal, we've contributed a mile and a half to the corporate average

fuel economy (CAFE)." Ford calculates that it would cost \$3 billion for a 1½-mpg CAFE reduction via traditional engineering methods: downsizing, improved engine and transmission efficiency, tires with lower rolling resistance, and so on. GM's estimates are even higher.

"We figure it cost us about \$10 million in testing and trimming [in the wind tunnel] to get that 1½ mpg. We look at it as a \$10 million investment with a \$3 billion payoff," says Kopka.

Although many Americans seem to have lost interest in fuel economy for the moment, the government hasn't, and the EPA is still enforcing its CAFE requirements. Abroad, heavily taxed gasoline makes fuel economy a big selling point. In Europe, leaded regular costs \$2.50 to \$3.25 a gallon. But cars have already been lightened and downsized to the point of buyer resistance. Tire, engine and drivetrain technology has reached a plateau. Aerodynamic efficiency

Little Things Mean A Lot

Once engineers and designers come up with a shape that's pleasing to management, it goes into the wind tunnel for



Trans Am has no grille. Cooling air is taken in from high-pressure area under the nose.



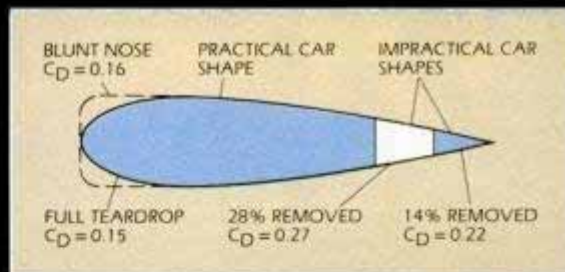
Dual rear wing on Merkur reduces turbulence behind car, allows room for wiper.



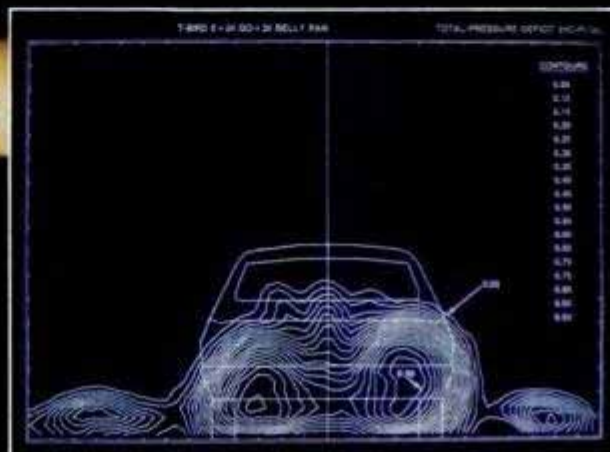
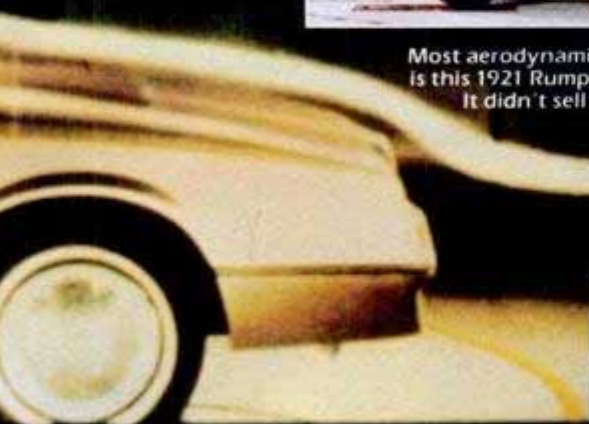
Ground effects panels reduce amount of air that can spill back under the sides of a car.



Most aerodynamic production car ever tested is this 1921 Rumberg Teardrop car. Its Cd: 0.28. It didn't sell and Rumberg folded in 1926.



Drag increases dramatically as you cut down a teardrop to make a practical car shape. Blunt nose has little effect.



Wake imaging contours of a Thunderbird show pressure drops of 5 to 90 percent behind the car and asymmetrical turbulence vortices.

is the only area left that has room for improvement.

You measure aerodynamic efficiency in a wind tunnel—a multimillion-dollar installation that employs a giant fan to blow air through a chamber in which a car or model sits atop a delicate scale set into a turntable so the car can be angled to test its behavior in side winds.

The turntable in GM's huge new tunnel in Warren, Michigan, can detect the extra weight of a half dollar placed on one fender. The turntable measures force in three directions: up or down (lift or downforce), side to side (side force) and front to back (drag). The turntable can also detect wind-induced rocking motions from side to side (roll), front to back (pitch) and the twisting motion called yaw. Drag is the buzzword in the business—a measurement of the ease or difficulty with which a particular shape can pass through the air. It's expressed by a decimal called the drag coefficient, or Cd for short.

A parachute has a Cd of 1.35; a square board (the proverbial barn door) is 1.17. Cones, pointy end upwind, vary from 0.51 to 0.34 as they get slimmer. The slickest figure is the 0.024 of a slim teardrop. This was also the shape of wheel-driven Bonneville Land Speed Record cars, before the era of locomotive-like jet and rocket cars.

A decade ago, 0.55 to 0.61 was not unusual for passenger cars. Some old shapes also developed so much aerodynamic lift at high speeds that you could feel the steering get lighter as high pressure under the nose and low pressure above the hood lifted the car on its suspension.

On today's cars, noses slant downward to avoid lift and air dams below the bumpers sharply reduce the amount of air that can get under cars.

"We've only scratched the surface," says Ford's Kopka. Today, most cars range from 0.35 to 0.45 Cd and auto show [\(Please turn to page 130\)](#)

"trimming"—fine tuning that provides the lowest possible drag. It's often here that spoilers or wings sprout on the rear

deck, air dams grow below the front bumper and ground effects panels inch down from the rockers.



Rear lip on Porsche 944 Turbo controls air exiting from under car to reduce turbulence.



Flush headlights smooth airflow around nose of car. Most have replaceable bulbs.



Pegs on Audi windows ride on internal tracks so side glass can be flush with frame.

WORLD-CLASS

Wind-wise and space-efficient, Detroit's new

DETROIT 1986



Egg-carton dividers dress up the taillights of the high-line Taurus.



Aerodynamic touches on upscale Taurus nose include flush-fitting headlights, blocked-off grille with floating Ford logo.

Ford's distinctive new Taurus, with a C_d of .32, is the result of a five-year, \$3-billion-dollar development project.

BY WADE HOYT, Auto Editor, AND NORMAN MAYERSOHN, Assistant Auto Editor

The catch-up game is over in Detroit. After years of diligent work to recover from the marketing and technology lead held by foreign car builders, Motown once again has a generous offering of high-performance models back in the lineup, and the econocar sector is well covered by domestic minis and captive imports. With those two categories out of the way, American companies are turning their attention to a market segment that until

1986 has been dominated by European manufacturers—the super family sedans.

More than just another way to part Yuppies from their paychecks, the new-generation family sedans are aimed at providing high levels of comfort and convenience features in a stylish 4-door body shell. Chrysler's H-cars were early entrants in this market segment, and are now followed by GM's 4-door version of the N-car (Pontiac Grand Am, Olds Calais

FORD PHOTOS BY BARRY PENFOUND

SUPER SEDANS

family 4-doors rival the best that Europe and Japan have to offer.



Mercury Sable is distinguished by lights integral with grille. GM N-cars take on the Euro look in '86, as shown by Pontiac Grand Am.



and Buick Somerset Regal). Most stunning of the group, and clearly the models with the greatest continental influence, are the Taurus and Sable stablemates from Ford. They'll be built in Atlanta, Georgia, but the styling clues and engineering fine points are unmistakably European.

The aero Fords

The Ford Taurus, Mercury Sable and the Aerostar van are all excellent examples of Ford's total commitment to European styling and leading-edge aerodynamics. The Taurus/Sable is one of the auto industry's worst-kept secrets, and intentionally so. Ford wanted to give the public a lot of time to get used to these radical new shapes before they hit the showrooms. The sedans and wagons have been pushed hard in consumer clinics, and early prototypes were released to the press months ago (see *1986 Ford Taurus And Mercury Sable*, page 71, July '85).

Lou Veraldi, Ford's chief engineer of large production cars, says that the T/S cars represent a new philosophy at Ford: "Let's do a car that adapts to the customer, instead



Cherokee pickup is derived from Wagoneer series, offers Jeep's first 2wd truck since 1947.

of the other way around." Just one example is the seat construction, which cost Ford \$40 more than the competition's seats. And they feel like it, too. This is yet another European design trend, picked up early by the Japanese but only now filtering into Detroit—foreign companies usually put a larger percentage of the car's cost than U.S. firms do into making the driver/buyer comfortable. That's a pretty smart way to sell cars—your first test drive in the vehicle is a revelation.

Ford put five years and \$3 billion into the Taurus/Sable project, including all-new engines and suspension setups. Standard powertrain when the cars go on sale in Novem-



Mercury Lynx XR3 is a red-hot pocket rocket with the 115 hp, fuel-injected, 1.9-liter Four and 5-speed transmission.



Astro Sport styling exercise could reach production in '86.



Ford Aerostar is finally on line after numerous delays.

New Ford philosophy: A car that adapts to the customer, instead of the other way around.

ber will be a 3-liter 60° V6 with multiport fuel injection. Mounted sideways, it drives the front wheels through a 4-speed automatic with an overdrive/lockup high gear. EPA city/highway gas mileage figures are expected to be in the 20/30-mpg range for the sedans and 18/28 for the wagons.

By February, a 2.5-liter version of Ford's pushrod HSC Four (now in the Tempo/Topaz) will be offered with a 5-speed manual or 3-speed automatic. Expect 35 highway mpg from this version, but not a whole lot of fun. The stick shift prototype we drove was sluggish and notchy, and had the definite feel of a fleet car.

The V6 is no scorcher either, doing 0 to 60 in 12 seconds if you use dragstrip techniques, but more like 14½ seconds with a couple of people on board and plain old foot-to-the-floor driving. The fact that the T/S twins are intended as family cars is underlined by the fact that neither performance tires nor a 5-speed transaxle (to come from Mazda) will be offered until 1987. Power ratings are 140 hp @ 4800 rpm and 160 lb.-ft. of torque @ 3000 rpm for the V6 and approximately 100 hp and 138 lb.-ft. for the Four.

For family cars, their ride and handling is uncanny. Front and rear suspension are fully independent with

MacPherson gas struts at each end. Ten inches of wheel travel allows for a smooth ride in cars that otherwise handle like European imports. The power steering is precise, not overboosted, and 4° of positive caster makes the cars track straight and true on the highway.

Of course, there were still some rough edges on the handbuilt prototypes we drove at the proving grounds and on the road. Perhaps because there was so little wind noise (Cd is an outstanding 0.32 for the sedans, 0.34 for the wagons), you can hear a lot of road rumble in the back seats. The plastic molding around the rear windows doesn't fit well and needs a quick redesign. The map/dome light looks like a \$3 mail-order item. Rear windows open, but only halfway due to the wheel arch intrusion. Most disconcerting is the impressive instrument panel/pod, which is canted toward the driver and gives the illusion that its right side is drooping. All the labelled buttons are angled downward toward your knees, rather than upward toward the eyes. You can still read them, but it seems funny not to point them the right way.

Nit-picking aside, the Taurus/Sable cars have lots of thoughtful features, including bi-fold sun visors, and picnic trays in the wagons. The cars look a lot like Audis, corner flatter and ride smoother than Audis, but don't seem to perform like Audis. The weak V6 isn't helped by slow, sloppy shifts in the automatic—the engine actually seems to rev up between shifts when you've got your foot down. It's a shame that a car that looks so sporty, isn't. However, Ford has performance options and police packages up its sleeve for '87, with a 4-cam, 24-valve V6 in the works, too. Ford is serious about working all the bugs out of its cars before they go on sale, which is why the intro has been pushed back a couple of times already.

Space van

The Aerostar van (much-delayed for the same reason) is expected in stores by the time you read this. Falling midway in size between Chrysler's front-drive T-vans and Chevy's rear-drive midivan, the rear-drive Aerostar is smooth-riding and carlike, closer to the Chrysler in feel than the truck-like Chevy Astro. Built on a Ranger/Bronco platform, it has the 2.3-liter pushrod Four as its base engine and the German-built 2.8-liter V6 optional.

Front seats are buckets, and so are the middle ones with the 7-seat option, giving a central walk-through aisle to the 3-place bench in the rear. A 5-speed is available with both engines, but even the automatic has a floor shift with a 3-ft. lever! The setup works well and it's kind of fun. Again, we had only a prototype to play with, and the seat latches did not work as smoothly as the ones in the Chrysler or Chevy vans when we wanted to swap seats around. Tons of neat options here, including a separate sound system with headphones for the punk-rockers in the back seats.

Other changes

Elsewhere at Ford, the Tempo and Topaz get new aero

(Please turn to page 162)



J-cars from Buick and Pontiac (Sunbird above) get flip-up eyebrows to cover halogen headlights.



Ford Tempo gets a new aero nose, with flush headlamps.



GM SATURN

The "real" Saturn will be more aerodynamic than the running prototype shown to the public. Mechanically, it's a fairly conventional front-drive, 4-cylinder sedan.



DETROIT'S NEW-ERA CARS

Saturn, Liberty and Alpha hope to sock it to the Japanese and save the U.S. auto industry by knocking \$2000 off the cost of building a car.

BY PAUL LIENERT; Illustrations by Mark Stehrenberger

Saturn, Alpha, Liberty—code names all. They could be future space missions, or target beachheads for some top-secret invasion. But these are the project names at General Motors, Ford and Chrysler for low-cost, high-tech "import-fighter" projects now under way at the Big Three.

For now, only GM plans to produce an actual car that would carry the Saturn project nameplate. Ford and Chrysler say that advanced manufacturing techniques developed by their Alpha and Liberty projects would be incorporated in future small cars.

An ironic twist: Although all three domestic automakers have asked the UAW to participate in the planning and development of their advanced programs, both Ford and Chrysler have suggested that their small cars in the 1990s may be produced abroad if manufacturing costs can't be slashed to a level that's competitive with low-priced imports from Japan and Korea.

GM has trotted out the heavy artillery for Saturn, naming one-time Pontiac General Manager Bill Hoglund as president of Saturn Corp., the first new GM passenger-car division since Chevrolet was added to the family in 1917. It's the first new GM nameplate since Cadillac issued the LaSalle in 1927.

In addition, GM has committed \$5 billion to the project, including \$3.5 billion for an integrated manufacturing complex that could be the biggest and most advanced facility of its kind when it begins production in late 1988. The Saturn complex will encompass more than 6 million square feet—twice as big as GM's newest assembly plant in Detroit—and may incorporate stamping, engines, transmissions, plastics-extrusion

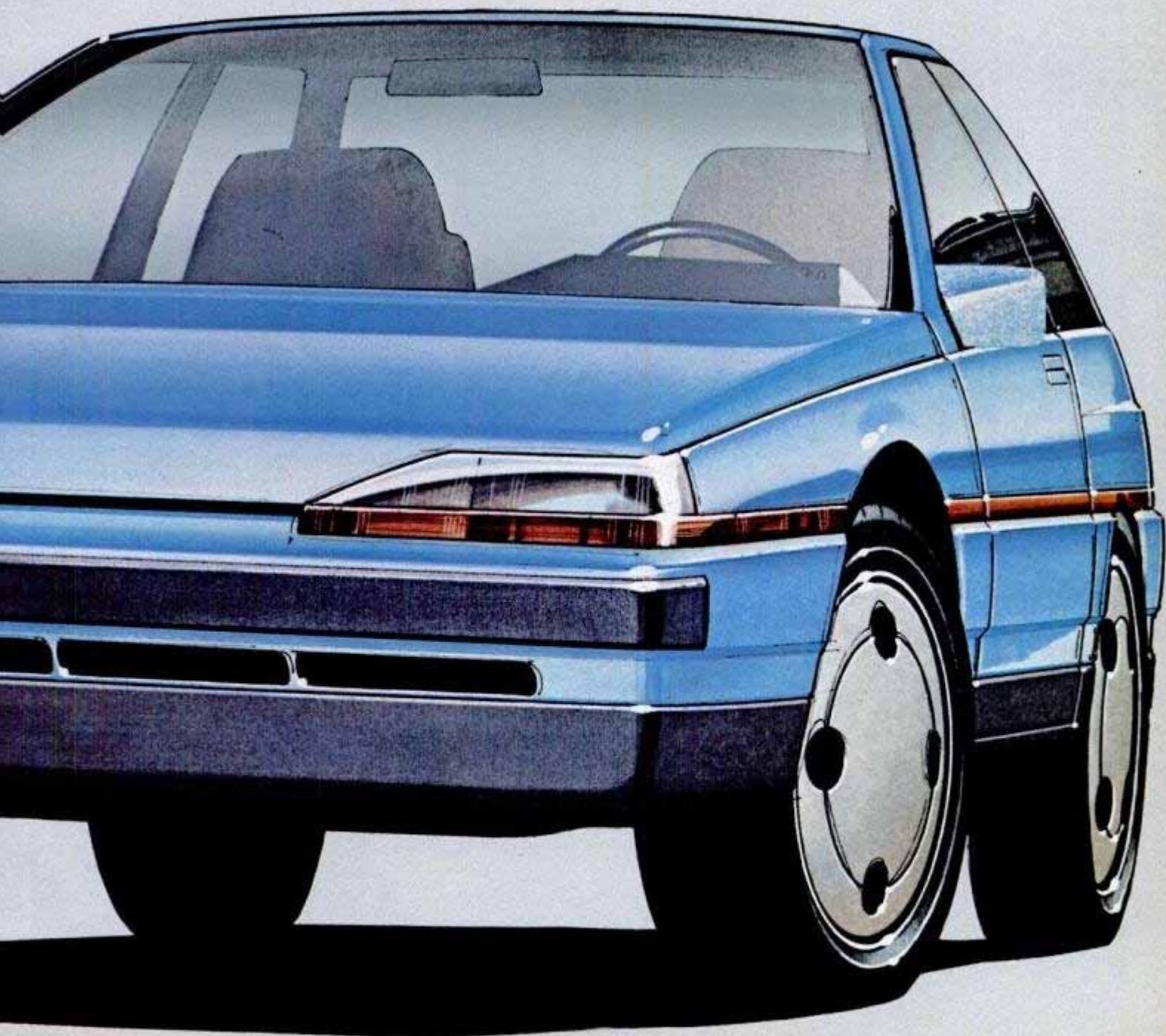
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CHRYSLER LIBERTY

The Liberty project's advanced manufacturing techniques will be used in a new line of small Chrysler cars scheduled for a 1990 introduction.

FORD ALPHA

Like Chrysler, Ford will use production techniques from its Alpha project, but not necessarily the name, in its next series of small, world-class cars, due in '88-'89.





American competitors may take on any of several designs shown in artist's conception. On this page, McDonnell Douglas AST (right) would fly at Mach 2.2. Lockheed's SCV (middle) would be slightly faster. A NASA concept (top) would reach almost Mach 3.

NEW BREED SSTs:

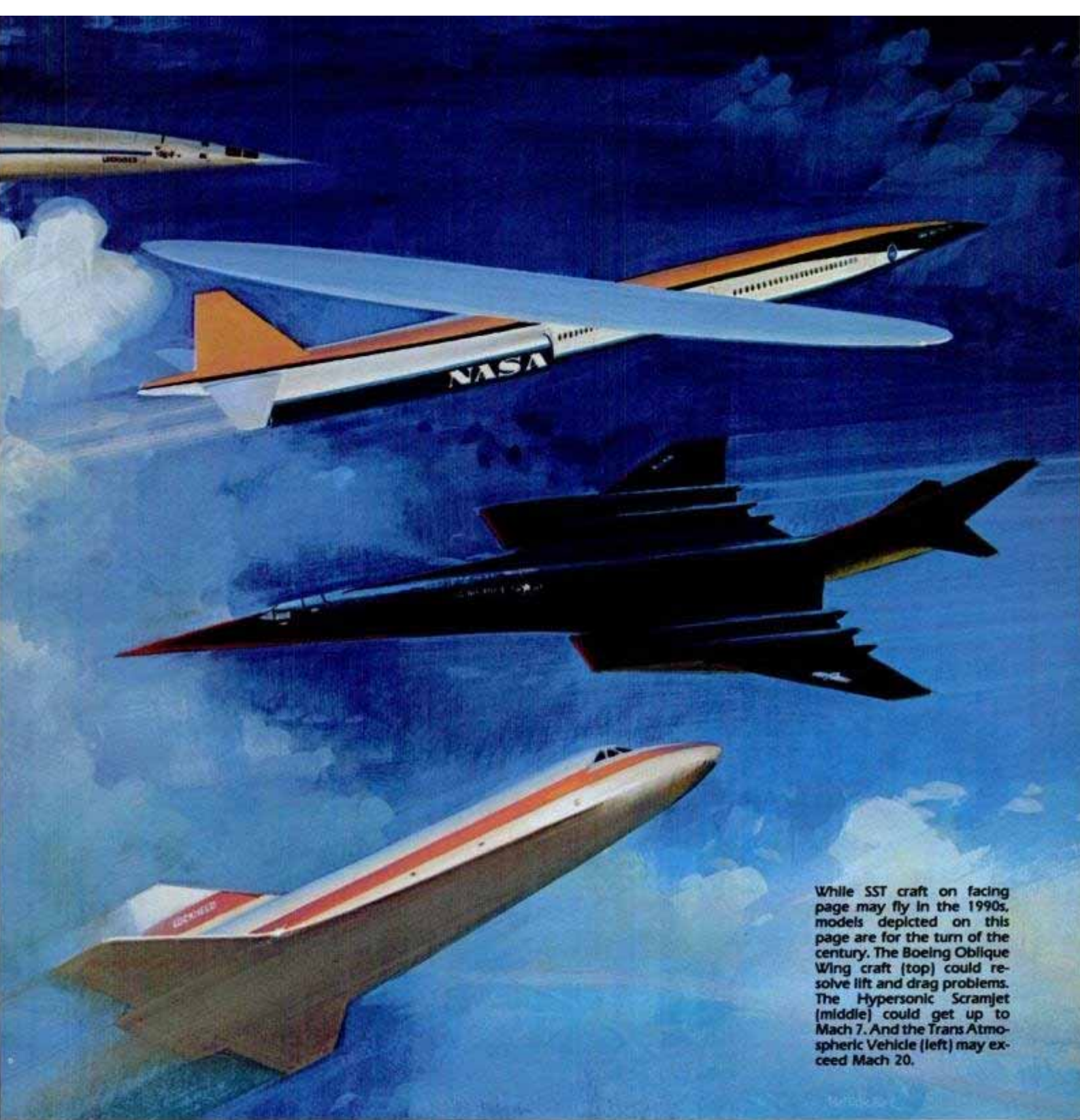
New engine performance, streamlined bodies and tough new wings will bring us an SST during the 1990s.

BY SHELDON M. GALLAGER
Illustrated by John Berkey

Today's SST, the Concorde, takes off at a sharp angle.

PHOTO COURTESY
BRITISH AEROSPACE





While SST craft on facing page may fly in the 1990s, models depicted on this page are for the turn of the century. The Boeing Oblique Wing craft (top) could resolve lift and drag problems. The Hypersonic Scramjet (middle) could get up to Mach 7. And the Trans Atmospheric Vehicle (left) may exceed Mach 20.

SKY-HIGH MUSCLE

The snub-nosed airliner with its swept wings taxis down the runway like any other jet. It stands ready for takeoff, then flies away at such a sharp angle of attack it seems to be rising straight up like a rocket. Its scramjet engines hoist it over the ocean, where it breaks the speed of sound with a sonic boom. Now at full throttle, with its 250 passengers and crew pushed back in their seats by the growing gravitational force, the airliner reaches top speed as it approaches 100,000 feet. The pilot no sooner throttles

down, leveling off the jet, and it's ready for the descent. NASA's answer to the British-French Supersonic Transport (SST) is on its way from New York to Los Angeles—a one-hour trip.

Just 10 years ago, America's dream of building SSTs was shattered when Congress scrapped the project as too costly, too noisy and too marginal in the benefits it could bring. But today, the White House and Congress have given NASA a mandate to come up with the fastest airliner in the world by the 1990s.

NEW BREED SSTs

That would be an advanced SST. And, by the turn of the century, NASA and the aerospace industry are now reasonably expected to come up with a Trans-Atmospheric Vehicle (TAV) that skips the atmosphere at speeds approaching Mach 25 (see *Coming: A Mach 20 Airliner*, page 97, Nov. '84). Working with NASA on a variety of projects that add up to the SST of the future are Lockheed, McDonnell Douglas and a dozen subcontractors.

What suddenly makes an American SST an attractive prospect? The answer, according to a recent NASA preliminary report, lies in new technologies and materials not available when the British-French Concorde was built in the '70s. The European SST, which has outlived the operational life originally predicted by its critics, has undergone several modifications. But the real hope for a future American SST comes from an entire new breed of aircraft on the drawing boards and in the wind tunnel testing phase.

McDonnell Douglas is working on an SST that could be flying at Mach 2.2 by 1990. Dubbed the Advanced Superson-

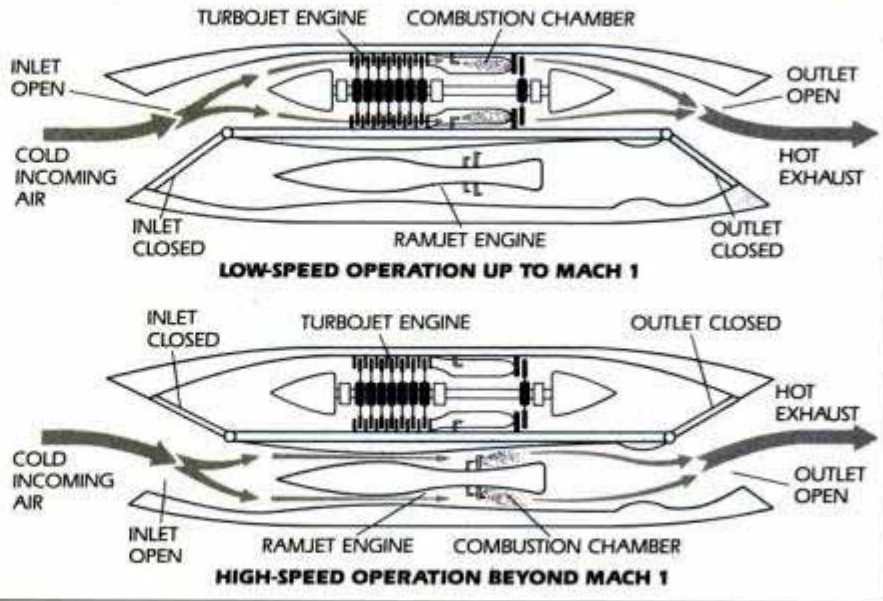
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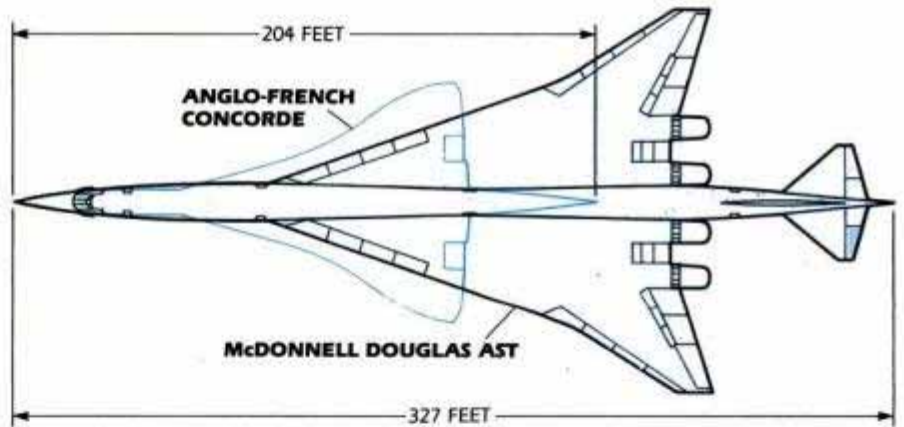
Delta wing SST (above) showed good lift but extra drag in wind tunnel tests. An advanced design (right) calls for a swing wing that can be angled sharply for high speed, or moved out to the wider delta position for subsonic flight.



TWO-IN-ONE ENGINE COULD HIT MACH 5 OR MORE



The over-under scramjet engine would operate on Mach 20 vehicle in painting at top. The engine works on turbojet or ramjet, as shown in drawing above.



THEY LOOKED GOOD ON PAPER



Early swing-wing model in wind tunnel tests was flyable but too expensive.



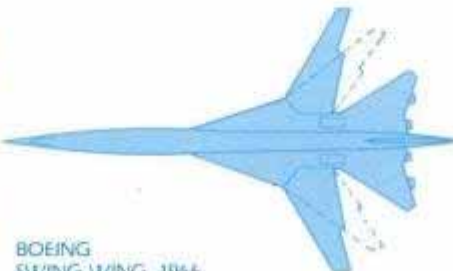
BRITISH M-WING, 1955



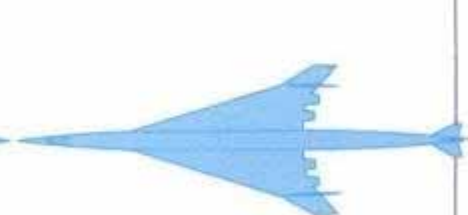
BRITISH DELTA WING, 1958



BRITISH ARROW WING, 1960



BOEING SWING WING, 1966



LOCKHEED HYDROGEN-FUELED ARROW WING, 1978

Wing design was a major stumbling block to early SST development. The M-wing stalled too easily, while others were unstable in flight.

COMRADES IN ORBIT

Even while Washington and Moscow go through cold war posturing, scientists are working up a co-op space mission.

BY LOUIS D. FRIEDMAN; Illustration by Brian Sullivan

I concluded my talk with a short sentence of apology: "Pro-*ceetye menya, ya govaru po-ruuski ochen mald.*" (Excuse me, I speak Russian very little.) Then, the first question was asked: "What about manned missions to Mars—are there any studies in the U.S. about this?" I laughed—because whenever I give a talk in the U.S. mentioning Soviet planetary missions, the one question I'm always asked is, "What are the Soviets doing about manned missions to Mars?" Now, here at the Institute for Space Research, in Moscow, the mirror image was being reflected. I was there as a guest of the USSR Academy of Sciences to see preparations for the Soviet Venus-Halley spacecraft, and to discuss international cooperation on future exploration of the solar system. The Soviets hosted me for an extraordinary week—an opportunity made possible by Soviet academician Roald Sagdeev, director of the Institute, a man devoted to the international peaceful and cooperative exploration of space.

In part, my trip was the result of The Planetary Society's program to promote international projects for solar system

Louis D. Friedman is executive director of The Planetary Society, a California-based group that conducts space research and encourages planetary exploration.

American astronauts and Soviet cosmonauts would work side by side from an orbiting space station around Mars. Station would be composed of parts from both countries and European partners. Our concept art shows lander leaving for Martian surface.

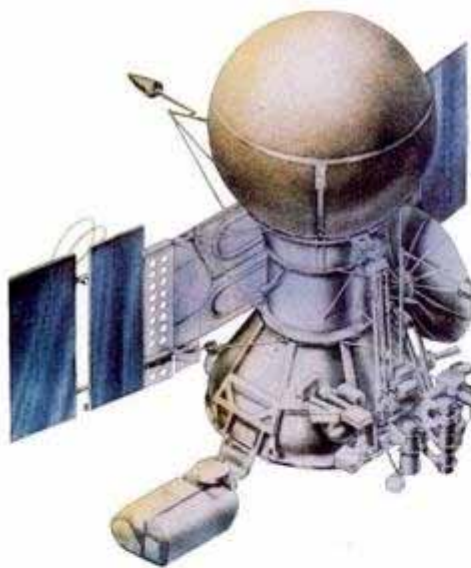
COMRADES IN ORBIT

exploration. Dr. Sagdeev is an adviser of the Society, and I like to think that my participation was a recognition of a small part I had played while I was at NASA's Jet Propulsion Laboratory with another Society adviser, Prof. Jacques Blamont of France, identifying trajectory opportunities which resulted in the Venus-Halley mission. (Of course, we were trying to define a mission for a U.S. visit to Halley's Comet.)

It doesn't take a written or acknowledged policy to know that a manned Mars expedition is where the United States and the Soviet Union are heading in space. It would be most sensibly done as a project of Earth, by all space-faring nations. This requires the cooperation of the two leading such nations—the U.S. and the USSR.

The first handshake

Ten years ago, at 4:09 p.m. GMT, July 17, 1975, the principle of such cooperation was established when two spacecraft rendezvoused and docked 222 kilometers above the Earth. A few hours later, Astronaut Tom Stafford and Cosmonaut Aleksei Leonov shook hands and visited each other for dinner



Concept art of an interim planetary explorer shows craft that could perform mapping and other missions in the 1990s.

in their respective spacecraft: Apollo and Soyuz.

Critics called the Apollo-Soyuz mission a stunt, a billion-dollar handshake, or worse yet, a billion-dollar close-up look at our technology for the Soviets. But now, looking back from a perspective of 10 years, we realize that this was a first step in changing space from an arena of chauvinistic competition, to a place for international cooperation in exploration. Such cooperation has

proved to be of scientific value and of mutual benefit—if not to the decided advantage of the United States.

The Soviets' capability to maintain human life in Earth orbit, their study of the effects of long-duration space flight on crews, and their impressive series of landing and exploration at Venus have given them a decade of achievement at least equal to that of the United States. And in all of these activities they have shared their science and knowledge with us, teaching us much in important areas we would have otherwise known little about.

Even during times when most exchanges were stopped between the two countries, American and Soviet scientists have continued to meet and exchange data about such important factors as motion sickness, calcium loss in bones and the ability to adapt to weightlessness. Recently, a cooperative experiment was conducted by the two nations to measure bone mass in cosmonauts before and after the long Salyut flight.

In the planetary program, Soviet Venera radar images have been given to U.S. scientists planning the Venus Radar Mapper mission for 1988. As a result, the specifications for the U.S. mission have been altered, and improved results are expected. In addition, several U.S. scientists have been invited to participate on the Venus-Halley Mission (called VEGA in Russian) and other future missions.

Recently, the U.S. proposed a joint USA-USSR simulated space rescue mission. The idea is to have the Space Shuttle rendezvous in orbit with the Salyut, the Soviet space station, to practice rescue operations. Such operations might include extravehicular activity by astronauts and cosmonauts.

Political differences have prevented this proposal from being advanced thus far. One difficulty is the Soviet posture stating that the Shuttle is a military vehicle. Another may be a desire by the Soviets to have their own shuttle operational before agreeing to a joint operation in Earth orbit. A Shuttle/Salyut mission would be of value in the near term to prove the feasibility of space rescue and in the long term to provide additional capability for human activity in space.

Nations in space

International cooperation is already an intrinsic part of Earth's exploration of the solar system. Of the 13 spacecraft now in flight, or planned, to explore beyond the Earth, seven carry more than one nation's contributions, and all

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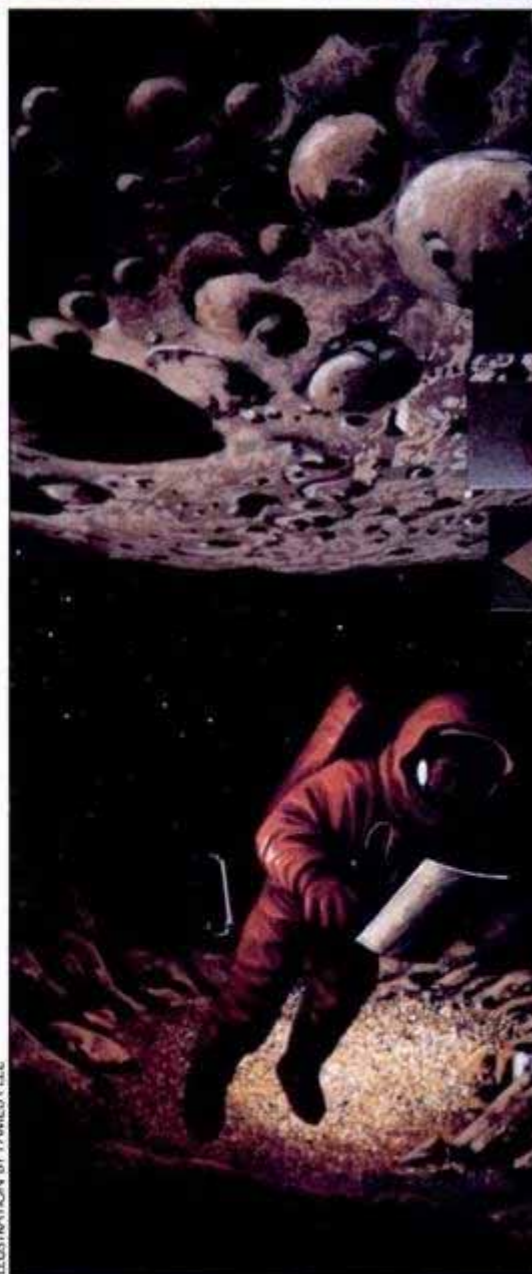
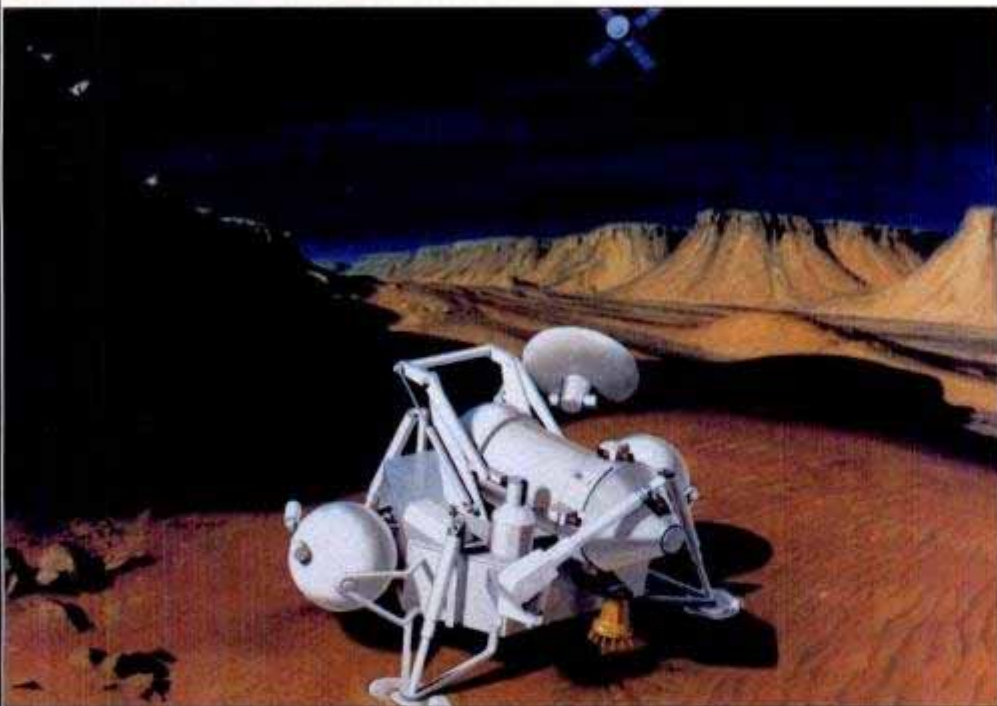


ILLUSTRATION BY PAMELA LEE



COURTESY THE PLANETARY SOCIETY

In the 1970s, Americans and Soviets shook hands at the Apollo/Soyuz docking (above). Future missions may include a Soviet-American polar exploration of Mars (far left), following a robot lander exploration (left) using technologies of both countries. One 21st century mission suggested in a report to The Planetary Society would be a multinational landing on the Martian moon Phobos, visualized below. A dozen nations are already interested in such a mission.



Guide To Satellite TV

STAR GAZING

What you can see, the gear you need, and what it all costs.

BY FRANK VIZARD

When man first looked to the stars, his imagination showed him the shapes of Taurus and Sagittarius. Today, gazing skyward might bring to mind such names as Westar and Satcom, reminders of the programming feast available to owners of home satellite television systems.

As romantic as the old names might sound, their practical value is restricted to the horoscope page of the daily newspaper. Offering greater promise are the man-made satellites orbiting the earth. The sign of Aquarius has been replaced by the call letters of over 100 channels delivering a myriad of programming. The news channels alone provide a more accurate prediction of tomorrow's events than the Gemini twins ever could.

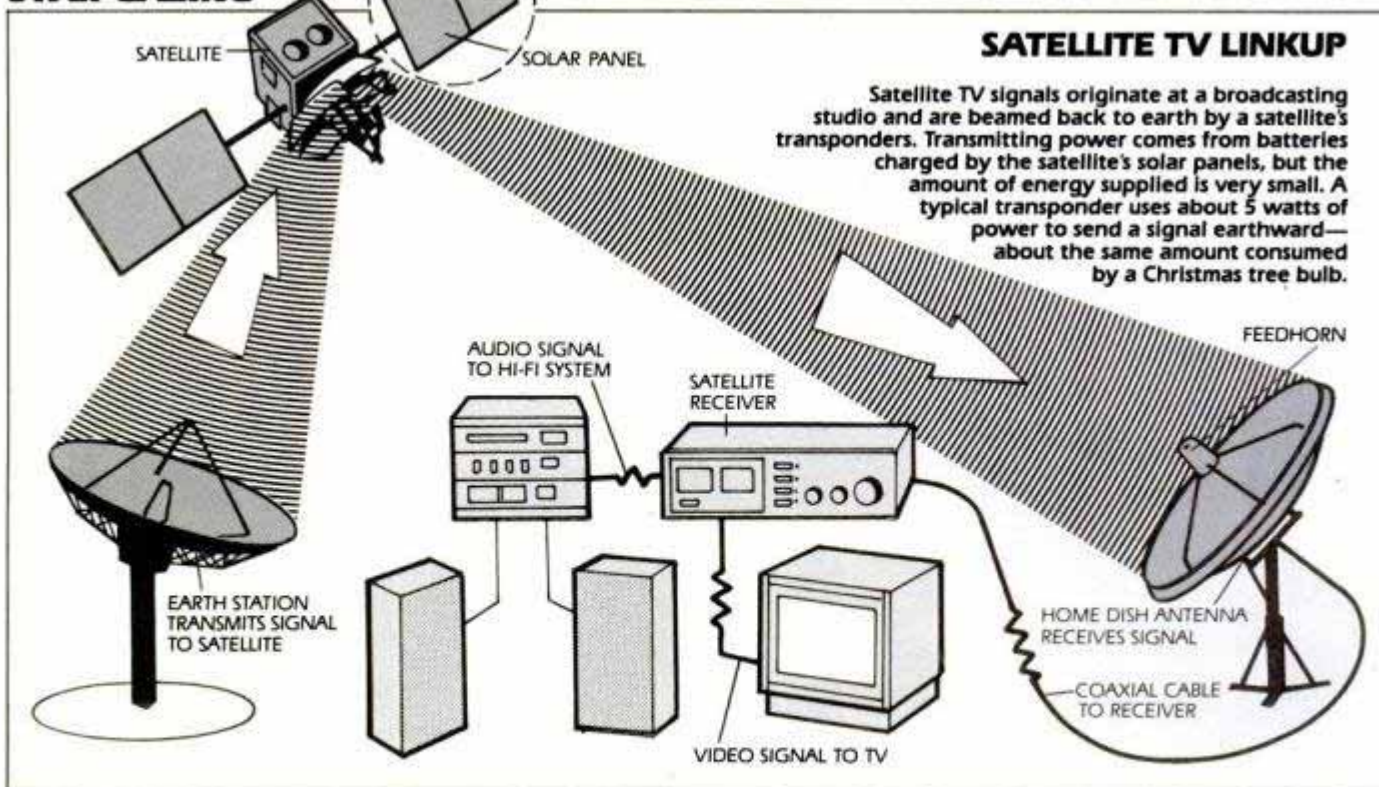
The dish antenna, the most visible part of a home satellite system, has come to symbolize a revolution in home entertainment among more than a million homeowners. Most of these households, located in rural America, receive only one or two broadcast television stations and are beyond the reach of cable operations. But technological advances and price reductions are now making home satellite system ownership a more appealing prospect—anywhere in the nation.

The satellite dish provides access to a world that might otherwise slip through your fingers. In addition to

PHOTO BY JOHN EARLE/THE STOCK MARKET OF N.Y.



STAR GAZING



SATELLITE TV LINKUP

Satellite TV signals originate at a broadcasting studio and are beamed back to earth by a satellite's transponders. Transmitting power comes from batteries charged by the satellite's solar panels, but the amount of energy supplied is very small. A typical transponder uses about 5 watts of power to send a signal earthward—about the same amount consumed by a Christmas tree bulb.

news—often in the form of raw, unedited footage—programming includes:

- About a dozen national and regional sports networks;
- New and classic movies on services such as Home Box Office, Cinemax and The Movie Channel;
- MTV, The Nashville Network and other music video stations;
- Superstations on the scale of Atlanta's WTBS and WOR-TV in New York;
- Special-interest channels including National Christian Network, Spanish Independent Network, The Disney Channel and The Playboy Channel.

Regular network fare is also available—everything from "Good Morning America" to "Miami Vice" and "Merv Griffin" to "Monday Night Football." Besides video entertainment, satellites also carry more than 40 separate audio channels, offering everything from classical to reggae music. Much of this music is in hi-fi stereo.

Bird watching

The satellites in space of most interest to home dish owners in the United States are Satcom F1, F2, F3 and F4; Galaxy G1; Westar W2, W3, W4 and W5; Spacenet S1; Comstar D3 and D4; and Anik D1. These satellites—or "birds"—hover some 22,300 miles above North America and relay the most popular TV programming. Although each one is capable of transmitting up to 24 channels of entertainment,

not every satellite is used to its fullest capability. Satcom F3, for example, uses 22 video channels while Westar W5 uses just five. Some channels are employed only on an intermittent, unscheduled basis, primarily for network news feeds.

With few exceptions, all satellite transmissions are aimed at the center of the continental United States. This target area is called the satellite's footprint. In general, home satellite systems located in the Midwest receive the strongest signals, while systems located on either coast receive the weakest transmissions.

Location, therefore, may be the determining factor in choosing an antenna. A large dish—12 feet in diameter—is almost mandatory in Maine, but a household in Kansas can easily make do with one as small as 4 feet.



PICO'S KID

Pico's Kid, with offset feedhorn, has low-profile 4 by 7-foot surface that can be painted to blend with surroundings. Dual-band receiver by Panasonic is ready today to receive tomorrow's 12-GHz signals. Sierra's remote control positions dish and tunes channels.



PANASONIC Ku/C-6000

CHAPARRAL SIERRA

Installing a 10- or 12-foot dish is not always feasible, especially in urban areas where space is limited. Under these conditions, 6- or 8-foot dishes might have to be used. Such a compromise might entail the loss of some channels, and perhaps poor reception on others. However, this is not as bad as it sounds.

Reception of only two satellites, say Galaxy G1 and Satcom F3, would still give you access to about 40 channels of popular programming. Many people have opted for dishes as small as 4 feet that receive only Galaxy G1 signals—so many people, in fact, that a separate programming guide called *Galaxy One* magazine exists to serve them.

Local satellite dealers will know the reception peculiarities of your area, and can tailor a system to match both your programming desires and your budget. One Los Angeles satellite retailer, for instance, advertises a variety of systems from as low as \$895 to as high as \$4995.

Choosing a dish

Dishes come in a variety of sizes, and they are constructed from a variety of materials. These range from fiberglass to stainless steel, and may be solid or see-through mesh. The respective manufacturers may argue that one material or the other enhances picture quality, but this judgement really depends on the eye of the beholder and on local reception characteristics. If you live in a harsh climate, a dish made from solid material will increase the product's wear-life. Mesh dishes, meanwhile, might preserve your relations with the neighbors where blending in with the environment is an issue (see story on legal issues on this page).

While most dishes have a shape akin to a salad bowl, some companies, notably Birdview and Pico, offer dishes somewhat different in appearance. Pico's dish is a 4 by 7-foot rectangular

Satellite TV And The Law

It's legal to own a home satellite reception system. Congress settled the issue with passage of the Cable Communications Act in October 1984. At the same time, though, the lawmakers recognized that the cable TV industry has a legitimate beef. Home dish antenna owners receive satellite-transmitted cable programming (such as Home Box Office movies) without paying the cable company's subscription fees. Accordingly, Congress authorized the cable industry to develop a compensation plan by which dish owners could legitimately receive their programs.

As a result, some cable programmers plan to scramble their satellite-borne signals. These include HBO, The Disney Channel and Showtime/The Movie Channel. Others might follow.

Once the scrambling begins, satellite dish owners will have to pay a monthly fee to the cable operator, just as cable TV customers do today. But the monthly fee will include a device called VideoCipher II, which decodes the scrambled signals. This device is addressable: The programmer

can disconnect service (by disabling the decoder) if the fee isn't paid. Satellite antenna owners who aren't served by a cable company will be able to purchase a VideoCipher II. Congress was very clear in stating that programs transmitted by satellite must be accessible to anyone willing to pay for them.

Though the legality of dish ownership has been established on a national level, local authorities might block your view of the stars. Zoning boards in communities around the nation have imposed restrictions on the size and location of dish antennas. One city, for example, limits the size of solid dishes to 4 feet in diameter, 6 feet for mesh dishes. Other localities confine dish installations to backyards.

At this writing, the Federal Communications Commission has proposed a rule that would prevent local authorities from placing "unreasonable" restrictions on home dish installations. But it still makes sense to check the local zoning laws before you buy. The satellite retailers in your area should be aware of any restrictions.—F.V.

model. Its low profile is suited to installations where space is at a premium. Birdview offers a spoon-shaped, 7-foot dish. Both feature offset feedhorns which, the makers claim, provide reception quality usually found in larger, conventional dishes.

While the dish is the structure that physically collects the satellite's signal, an array of electronic equipment is required to process that signal before it can be seen on your television screen.

The signal collected by the dish is reflected upward (or outward) toward a feedhorn suspended over the dish. Connected to the feedhorn is a low-noise amplifier (LNA), which boosts the weak satellite signal so that the downconverter can translate the signal from gigahertz (GHz, or billions of cycles per second) to megahertz (MHz, or millions of cycles per second) that your television can process.

LNA's are rated by noise temperature in degrees Kelvin. The lower the number, the better. An 80° LNA, for example, will produce a picture with fewer sparkles (little dots of noise) than an LNA rated at 120°. A good LNA is important if a small dish is being used.

A standard LNA used with a downconverter is called single conversion. This means the dish antenna can be hooked up to only one satellite receiver, and that only one channel may be viewed at a time. An alternative is block

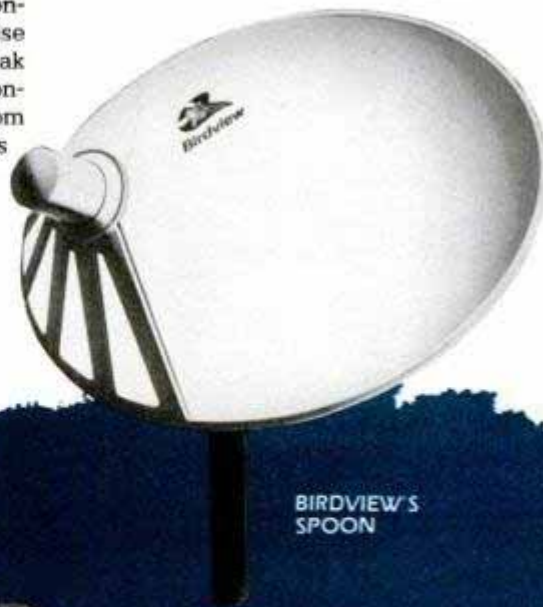
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UNIDEN UST-7000 RECEIVER



UNIDEN'S UST-730 POSITIONER



BIRDVIEW'S SPOON

The unconventional 7-foot Spoon was the first dish antenna to use an offset feedhorn, which is said to improve reception. Though some companies package receiver and dish positioner in a single chassis, Uniden still offers separate components.



GOLDEN GUNS

■ Harrington & Richardson Custer Memorial, Enlisted Men's Model, 1873 Springfield Carbine (top), .45-70 caliber, 243 issued at \$2000, current value, \$2500.

■ Winchester "Landmark" Model 94, \$37,500, commemorates the 3,500,000th rifle.

Commemorative firearms are beautifully crafted and can bring a sizable return on your investment.

BY JOHN WOOLDRIDGE; Photos by Bill Dolce



You can tell it's not a two-for-the-price-of-one sale. The legendary Winchester Model 94 carbine and Colt revolver come as a set and are etched in gold—with Winchester's signature on the rifle tang and Colt's on the pistol backstrap. Both are works of art in a limited production series numbering only 4400 sets. The price? They're yours for a mere \$3995.

These particular guns represent a very special set of commemorative firearms. But you can get into collecting commemoratives for far less money—and you're not limited in types of firearms available or the period they represent. Commemoratives are issued as pistols, rifles or shotguns, from black-powder revolvers like the Colt 1851 Navy to a brace of Marlin Model 39 lever-action carbines in .22 and .30-30 calibers. In some areas, restrictive handgun laws make collecting rifles and shotguns more popular, but revolvers and rifles constitute the majority of commemoratives issued by the major weapons manufacturers because of the mystique that surrounds them and

- **Colt Single-Action Army (top)** from Colt-Winchester factory commemorative set, .44-40 caliber, 4440 issued at \$3995, current value, \$3995.
- **Garibaldi Special Edition, 1851 Colt 3rd Model Dragoon**, .44 caliber percussion revolver, 200 issued at \$2400, current value, \$2500.
- **1873 Colt Single-Action Army Pony Express Commemorative**, .45 caliber, 1004 issued at \$250, current value, \$950.
- **1959 Colt 1st Type, 4th Model Derringer**, .22 caliber to commemorate 125th anniversary of the founding of Geneseo, Ill., 104 issued at \$27.95, current value, \$495.



Part of the special appeal of commemorative arms is the way they're usually displayed. Here, the Colt .45 S&W Pony Express Model rests on a baize within a rich wooden case. Also occupying the case are two spare cylinders and a Pony Express medallion.

the roles they played in our history.

Although some would argue that commemorative arms have been a feature of weapons collecting since the caveman contrived the stone axe, the modern era of commemorative gun collecting began in 1961. A private issue of 104 .22 caliber Colt Model 4 derringers (one is pictured on the preceding page, lower right) was made for Bob Cherry, president of *Cherry's Sporting Goods* in Geneseo, Ill. The derringers were produced to commemorate the 125th anniversary of Geneseo's founding. They were gold-finished and carefully boxed, and at \$27.95 a piece, they sold fast. The current asking price for one of these rare guns is \$495—that is, if it's in perfect condition, and if you can persuade a collector to part with one.

The number of commemorative issues escalated after that, peaking in 1964 when 29 specially designed, numbered and boxed issues, mostly Colts, were offered to a growing audience of collectors. Some of them were immediate successes, while others were slow sellers. Marlin, Winchester, Remington and Ithaca all began dabbling in commemoratives during this period.

By a recent estimate, there are 210 commemorative issues available. The last 10 years have been characterized by fewer annual issues, some in larger quantities to hold the price down, some in very small numbers which are more costly not only because of quantity but also by their quality of finish, engraving and embellishment. And that doesn't count the untracked number of "limited editions" offered by some manufacturers, like the Garibaldi percussion .44

pictured on the previous page.

If you're interested in starting your own commemorative arms collection, there are certain things you should know about the marketplace. Every genuine commemorative gun issued since 1961 has been numbered in its own series. Numbering systems for each issue ensure a finite supply, which ultimately affects a gun's asking price. For example, only 500 Theodore Roosevelt .44/40 Single-Action Army (SAA) revolvers were manufactured last year, in series from No. 1 to No. 500. A total of only 4440 Winchester-Colt carbine and revolver sets were produced, with both arms bearing the same serial numbers 1 WC through 4440 WC.

Collecting commemoratives doesn't require a vast firearms background because the only way they are seriously collected is in perfect condition, in the factory display box and often in their original cardboard packing boxes. They must be pristine, which means they can never be cocked or fired, as any kind of use will ultimately result in cracked or scorched metalwork. There is an established market price for them when they are in perfect condition, and arms in lesser condition will not command top dollar.

"We try to discourage people from collecting commemorative firearms just from an investment point of view," says Bob Cherry. "But I'd say that about half of the people who collect them do so for investment. For me and others like me, the guns themselves are attractive, something worth having for the pure pride of ownership."

Bob Cherry publishes a quarterly newspaper called *Cherry's Sporting Goods News*, which gives considerable space to descriptions of issues about to be released along with current values of commemorative issues from past years. A quick glance shows that practically all of the issues have appreciated handsomely, but some more than the rest. Back in 1970, for example, Colt issued two World War II commemorative .45 automatics, one for the European theater, one for the Pacific. Contrary to projections, they sold very slowly at \$250 each—so slowly that Colt had to take them out of their presentation boxes and sell them as standard guns.

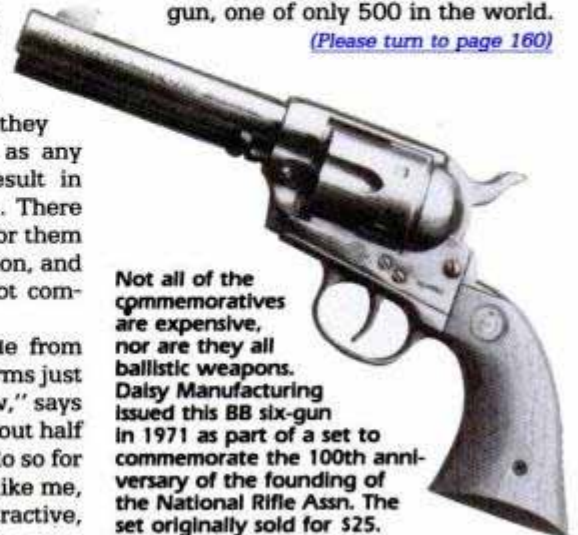
"You couldn't give them away," Cherry says today. "They made too many. But now we have a waiting list as long as your arm for them at \$495 per."

Look farther down the list and you'll find something for nearly every interest in firearms: from a nickel-plated and walnut-cased Colt Ned Buntline, to a Harrington and Richardson Custer Memorial with gold inlays to commemorate individuals who fell at the Battle of Little Bighorn, to a 3-pistol Colt set in a 3-drawer walnut chest, to a Browning Belgian Superposed 12-ga. shotgun engraved with gold mallards.

There are even several issues offered in escalating grades of engraving and presentation that appeal to almost every budget. The most recent example was issued by Colt in 1982 commemorating John Wayne's life and work. The "standard" model comes with factory ivory stocks and a deep-blue finish that contrast with five major gold etchings, including the Wayne brand and signature on the pistol. Boxed in a solid oak case with Wayne's signature woodburned in the righthand corner of the lid, it sells for \$2995.

The "deluxe" version will run about \$7250 at the moment, but that's what you might expect for a hand-engraved, silver-plated, ebony-gripped handgun, one of only 500 in the world.

(Please turn to page 160)



Not all of the commemoratives are expensive, nor are they all ballistic weapons. Daisy Manufacturing issued this BB six-gun in 1971 as part of a set to commemorate the 100th anniversary of the founding of the National Rifle Assn. The set originally sold for \$25. It'll fetch between \$150 and \$200 today if it's perfect.

Woodworking: Maple Table And Chairs



Dinner From Four To Six

Ideal for apartment dwellers, our gateleg table and folding chairs make the most of limited space.

BY NEAL BARRETT

It seems that we never have enough room. It's a complaint that's as common from owners of 3-bedroom homes as from studio apartment dwellers. Because of this, there's a natural appeal to furniture that's both compact and versatile, like the solid maple table and chairs shown here.

Construction photos: Neal Barrett
Technical art: Eugene Thompson
Color photo: Harry Hartman
Photo stylist: Gabe Herrick



When not in use, table folds next to wall and extra chairs can be stored in closet.

When it is folded against the wall, this maple gateleg table measures just 10 in. deep by 36 in. wide. However, when both leaves are up, the surface of the table measures 36 in. wide by 56 in. long and can seat from four to six people comfortably.

The chairs fold too, so they can be stored away, but comfort was not sacrificed to achieve this end. Instead of the wood seats and backs commonly found in folding wood chairs, we used caning in both places. This way, you can enjoy just sitting at the table as much as you do eating at it.

CHAIR CONSTRUCTION DETAILS



1 Use a 2-in.-dia. hole saw to cut outline of circular recess on each end of front seat support. Clamp work securely in vise.



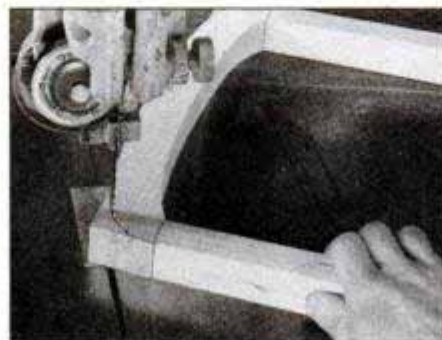
2 Cut the bulk of the waste from the front leg recesses using a backsaw. Then cut out the remaining waste using a sharp chisel.



3 Lay out clearance notches for folding hardware on back side of front seat support. Cut with a backsaw; clean out with a chisel.



4 Hold tapered shim between seat rail and outboard flange of doweling jig to obtain proper hole angle for assembly dowels.



5 After chair back is assembled and dry, use band saw to trim off clamping ears on top rail. Remove saw marks with belt sander.



6 Cut template to size and clamp securely to seat frame and bench. Then cut spline groove using router with template guide.

MATERIALS LIST—MAPLE TABLE AND CHAIR

Key	No.	Size and description (use)	R	1	3/4 x 1 1/4 x 14 1/2" maple (stretcher)
TABLE					
A	1	3/4 x 8 x 36" maple (top)	S	1	1 3/4 x 2 1/2 x 16 1/2" maple (front support)
B	2	3/4 x 23 1/2 x 36" maple (leaf)	T	1	1 x 1 3/4 x 13 3/4" maple (rear support)
C	2	1 x 3 x 32" maple (base stretcher)	U	2	1 x 1 3/4 x 10 3/4" maple (side support)
D	2	1 x 4 x 26 3/4" maple (base leg)	V	1	3/4 x 1 3/4 x 17 3/4" maple (front seat rail)
E	2	1 1/2 x 3 x 8" maple (base foot)	W	2	3/4 x 1 3/4 x 11 1/2" maple (side seat rail)
F	4	1 x 3 x 12" maple (gateleg rail)	X	1	3/4 x 1 3/4 x 14 1/4" maple (back seat rail)
G	2	1 x 3 x 28 1/4" maple (gateleg)	Y	2	1/8 x 3/4 x 11 3/4" galvanized steel
H	2	1 x 3 x 23 1/2" maple (gateleg stile)	Z	2	1/8 x 3/4 x 8 3/4" galvanized steel
I	42	5/16"-dia. x 1 1/4" dowel	AA	2	1/8 x 3/4 x 8 1/2" galvanized steel
J	4	2 x 3" Brainerd No. 8200 butt hinge	BB	2	1/8 x 3/4 x 10 3/16" galvanized steel
K	6	Tabletop fastener with two 5/8" No. 8 fh screws per fastener	CC	2	1/8 x 3/4 x 2" galvanized steel
L	6	1 1/4" Stanley No. 810 drop-leaf hinge	DD	8	5/32"-dia. x 3/4" rivet
CHAIR					
M	2	1 x 5 x 34" maple (rear leg)	EE	4	3/16" ID washer
N	1	1 1/2 x 2 1/2 x 14" maple (top rail)	FF	2	1/4"-dia. x 72" cane spline
O	1	1 x 1 1/4 x 12" maple (lower rail)	GG	2	18 x 18" preformed caning
P	1	3/4 x 1 3/4 x 12" maple (stretcher)	HH	28	5/16"-dia. x 1 1/4" dowel
Q	2	1 x 1 1/4 x 16 1/2" maple (front leg)	II	2	1/2"-dia. x 1 1/4" dowel
			JJ	7	2" No. 10 fh screw
			KK	2	2 3/4" No. 14 fh screw
			LL	10	3/4" No. 8 self-tapping panhead screw

Start chair construction by cutting 5/4 maple stock to approximate size for each chair part. Use the jointer to flatten one face of each piece, then plane to thickness given in the materials list. Rip and crosscut to finished dimension on the table saw.

Following the pattern on the drawing, make a full-sized template



To fold chair for easy storage, just lift up rear of seat.

for the rear chair leg using a piece of 1/4-in.-thick plywood. Trace the template onto each leg blank, then cut the legs with a band saw or sabre saw.

Next, trace the outline of the chair back top rail onto its blank. Use the band saw to cut the finished inside profile. But, when cutting the outside curve, leave a squared off "clamping ear" on each end to help in clamping later. These ears will be trimmed off after assembly.

When all pieces are cut, lay out the position of the dowels and use a doweling jig to accurately bore the holes. For the holes that must be bored at an angle, for example on the seat panel and support frame, slide a tapered shim

under the outboard flange of the doweling jig to achieve the proper angle (see photo No. 4).

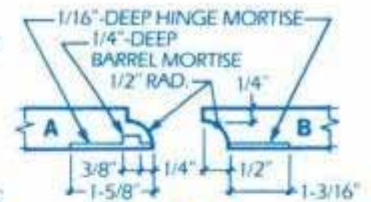
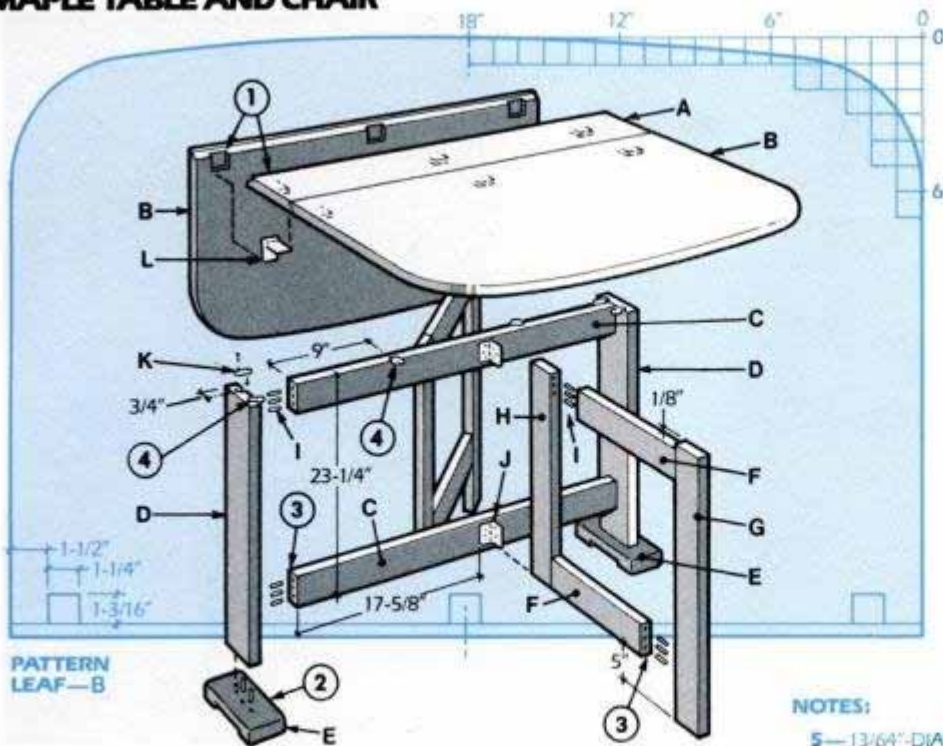
Seat construction

Assemble the seat frame using 5/16-in.-dia. threaded dowels. Be sure to cut the dowels 1/16 in. shorter than the combined depth of the mating holes to allow for glue squeeze-out. Tap the mating parts together with the mallet, shielding the surface with a scrap block of wood. Use bar clamps to draw the joints tight.

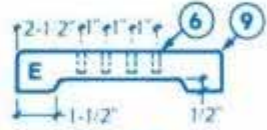
Next, cut notches in the seat support rear rail for the support hardware, using dado blades in a table saw. Then, lay out the angled clearance notches on

(Please turn to page 122)

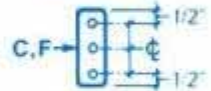
MAPLE TABLE AND CHAIR



DETAIL 1



DETAIL 2



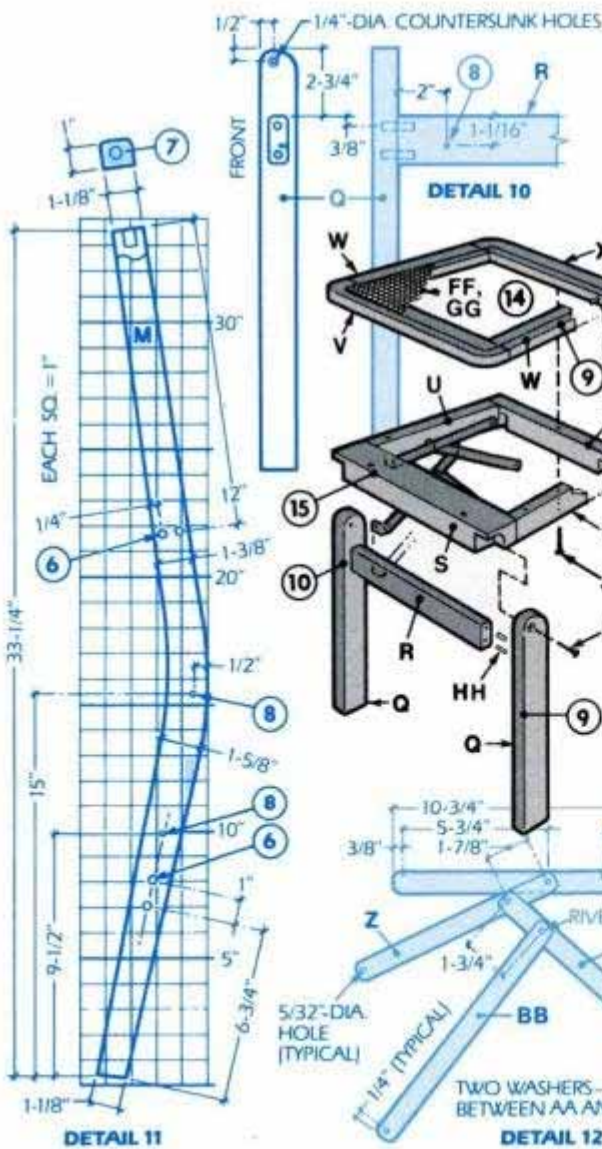
DETAIL 3



DETAIL 4

NOTES:

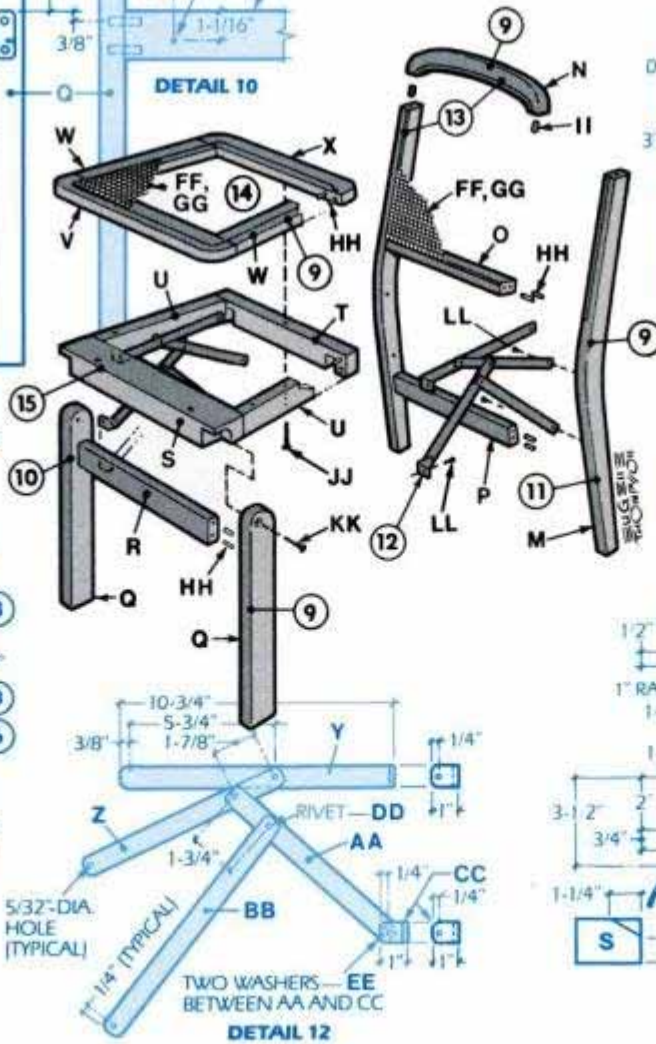
- 5—13/64"-DIA. COUNTERSUNK HOLE
- 6—5/16"-DIA. X 11/16"-DEEP DOWEL HOLE
- 7—1/2"-DIA. X 11/16"-DEEP DOWEL HOLE
- 8—1/8"-DIA. PILOT HOLE FOR HARDWARE
- 9—ROUND OVER EDGES TO 5/16" RAD.



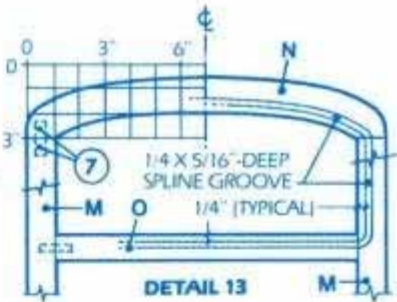
DETAIL 11



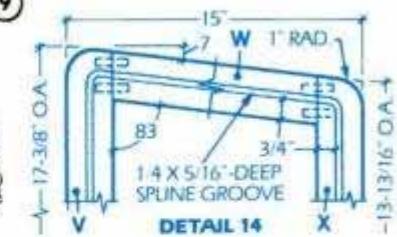
DETAIL 10



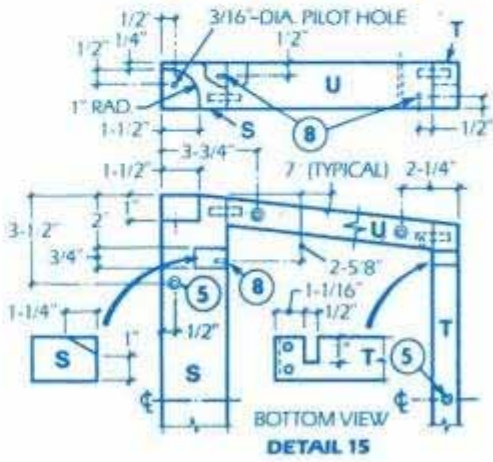
DETAIL 12



DETAIL 13



DETAIL 14



DETAIL 15





SOLAR SIMPLIFIED

A maverick builder shoots down solar home misconceptions with a surprisingly simple—and affordable—solar home design.

BY TOM SMITH

Whatever you do, don't call it a solar house," I caution my clients. "It's better to think of it as a cottage with a sunroom that does all sorts of good things." I say this because over the years I've grown careful about how I use the term solar, even though I was one of the inventors of the passive solar concept.

But now I'm a builder and inventor of a new type of passive solar home, and if I ever let the word *solar* slip, I'm trapped into dealing with overwhelming misconceptions and stereotypes that abound with both solar experts and lay people. It's unfortunate but true. In the past I've seen solar design take a quantum leap—almost overnight—from its Model T simplicity to the confusion of an Edsel, without the intervening grace of a '49 Ford.

In my view, this house—cottage, if you will—is a fairly uncomplicated piece of work. But don't let its simplicity fool you. It accomplishes an array of significant objectives, starting with those that most builders share: standard architecture, standard cost, standard construction techniques and standard building materials.

The operative word here is *standard*. My primary goal has always been to design a passive solar house that belongs on Main Street, USA. I wanted to avoid the huge



Passive solar home features a south-facing sunspace (above and below). The sunspace is separated from the inner house by a wall of sliding glass doors and awning windows (facing page). Winter solar heat is collected in the sunspace during the day and then circulated into the house by the sunspace ceiling fan.



expanses of angled glass so common on solar homes. I wanted to eliminate expensive and unsightly roof-mounted solar panels and all the installation and maintenance problems that go along with them. And I wanted something affordable that could be mass-produced so more people could enjoy better energy efficiency, better aesthetics, better comfort and better health. This meant bypassing much of the established solar dogma and eliminating all the solar gimmickry, as we'll see.

In a nutshell, this house incorporates a southerly facing sunspace that is connected by simple floor vents to an insulated basement or crawlspace. The sunspace is separated from the rest of the house by a series of sliding glass doors and operable awning windows. With this setup and a couple of tricks of the trade, this house matches or surpasses all of the original objectives. The house shown is located in eastern Long Island, New York. However, I've built this particular solar design with equal success throughout the country. Here's how the system works, starting with a typical winter day and night, and then a summer day and night.

Winter day

During the day, the south glass of the sunspace collects solar heat from the low winter sun, creating what is known as the greenhouse effect. This raises the interior sunspace temperature significantly. On a fair day, there is an excess of solar heat and

Photos: Keith Scott Morton
Technical art: Dyck Fledderus
Stylist: Gabe Herick
Props provided by: Cookery Dock, Southampton, N.Y.
(kitchen items); Lifestyle, Southampton, N.Y.
(dining room chairs)

midday temperatures in the 80s are common. At this time, the doors and windows between the inner house and the sunspace should be opened to allow the heat to enter the house.

In the past, the typical practice was to absorb the excess heat into some form of thermal mass such as masonry Trombe walls or large containers of water. There are several things wrong with this idea. First, such storage structures are a construction problem. Second, if the mass becomes cold it has to warm up again before you can warm up. Third, extremely large areas of south-facing glass are required to absorb enough solar heat to keep the mass charged. Fourth, thermal mass is often unpleasant-looking.

This cottage collects less heat than some solar homes, but it uses it more efficiently. Rather than trying to store

the excess heat in thermal mass, this system emphasizes heat distribution throughout the house interior. There is enough mass—in the structure and furnishings—to absorb excess heat. It is then distributed by means of one or two (depending on the size of the house) strategically located ceiling fans. There is no need for the elaborate duct work and fan systems currently in solar vogue. Plus, this approach increases comfort because heat distribution raises the radiant heat of the surroundings more thoroughly than does concentrated thermal mass.

I realize that this borders on heresy, because thermal mass is a mainstay of solar doctrine. But in this case, the accepted wisdom is not particularly wise. The fact is, you can put this cottage next to a house having a huge expanse of south-facing glass with pre-

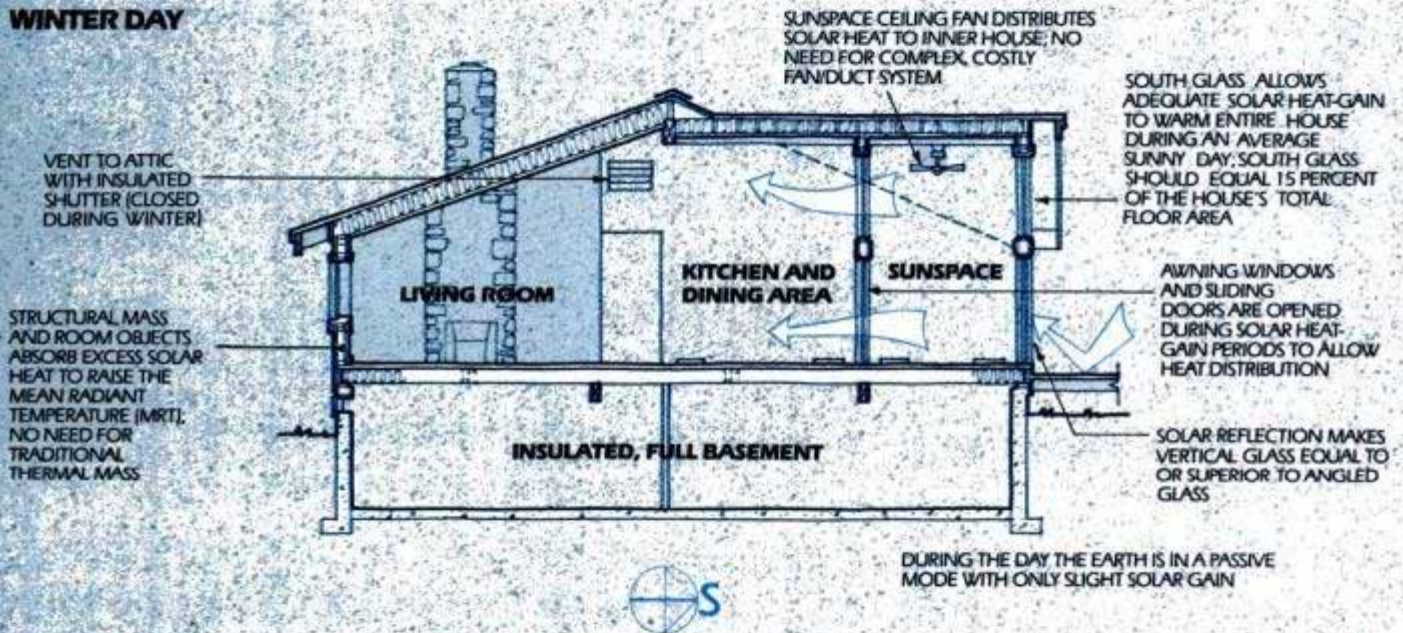
cisely calculated angles and tons of thermal mass and the difference in performance between the two will be negligible.

So, during the winter day we have plenty of comfort as the inner house acts as an absorber of solar warmth. The sliding doors and awning windows between the sunroom and house are open and the ceiling fan distributes the heat to the inner rooms, where it's stored in the structure and furnishings. The real problem with winter occurs during the middle of the night.

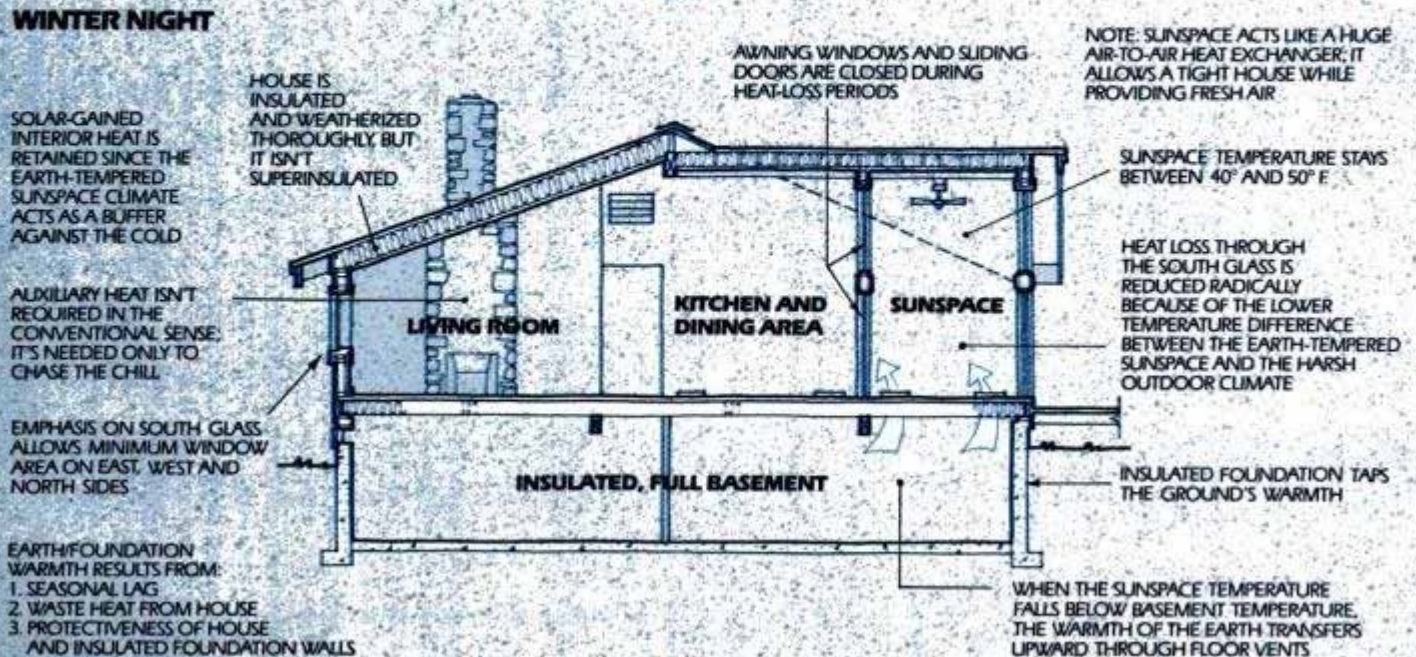
Winter night

It's 3 a.m. and the wind-chill factor puts the outside temperatures at sub-zero levels. At dusk, the sliding doors and awning windows of the cottage are closed to seal off the sunspace from the inner house. Now, how does this cot-

WINTER DAY



WINTER NIGHT



tage behave? First, remember that the house does not have just a south-facing sunspace, it has a south-facing sunspace connected to an insulated basement. There is a wealth of overlooked warmth under any house. This hidden warmth is the accumulation of summer heat absorbed day by day, week by week, deeper and deeper into the earth. This warmth is not high-grade like the solar heat gained during the day, but it does hover in the 50° F range. Now 50° isn't shirt-sleeve weather, but it's warm enough to create a superb buffer between the house interior and the harsh outdoor temperature.

When the winter sun disappears, the temperature in the sunspace drops rapidly. All that glass that was so beneficial during the day is now the main cause of heat loss during the night. But, when the sunspace temperature drops below

the basement temperature, there is a transfer of warmth up to the sunspace through the open floor vents. This is a natural phenomenon since warmer air rises. This rising basement warmth creates a thermal brake—or buffer—maintaining the sunspace temperature around 50°.

This may not seem like much, but the effects on efficiency are substantial. All the glass that would normally lose the lion's share of heat at night now becomes very efficient.

Any heat that is inside of the house is lost at a greatly reduced rate because it is transferring to a much more moderate buffer zone; not directly to the sub-zero outside temperatures. In addition, this mode works for inclement winter days, thus making the system adaptable to less sunny climates.

The solar-textbook method for retain-

ing heat at night is to use superinsulation. It is very popular right now and it means just what the name implies: increasing by two or three times the amount of insulation in exterior walls and ceilings.

Actually, installing superinsulation is a lot like fixing something that isn't broken. Conductive heat loss through the walls and roof is the least significant factor in thermal performance. It's much more efficient to protect the house where it really counts, at the south-facing glass.

The same criticism pertains to underground houses. They are using the warmth of the earth to improve the performance of the walls and the roof—areas that don't need the help. In contrast, the crux of this system puts our efforts where we need them the most:

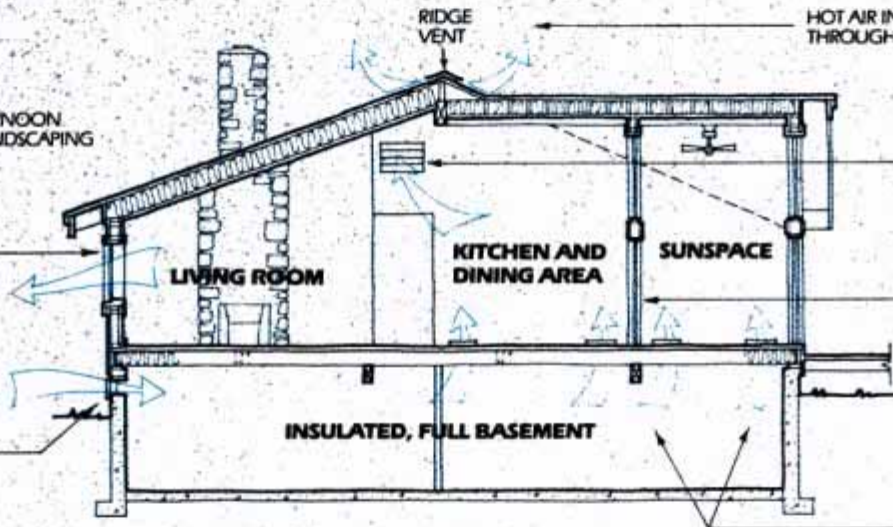
(Please turn to page 146)

SUMMER DAY

PROTECT THE WEST-SIDE WINDOWS FROM LATE AFTERNOON SUN WITH DRAPERY AND LANDSCAPING

OPEN WINDOWS TO CREATE CROSS-VENTILATION, WHICH WILL DISSIPATE ACCUMULATED HEAT

NORTH-SIDE FOUNDATION VENTS ARE OPENED TO ACCELERATE THE EVENING COOL-DOWN PERIOD



HOT AIR IN ATTIC EXHAUSTS THROUGH RIDGE AND GABLE VENTS

VENT OPEN TO ATTIC TO EXHAUST INTRINSIC HEAT

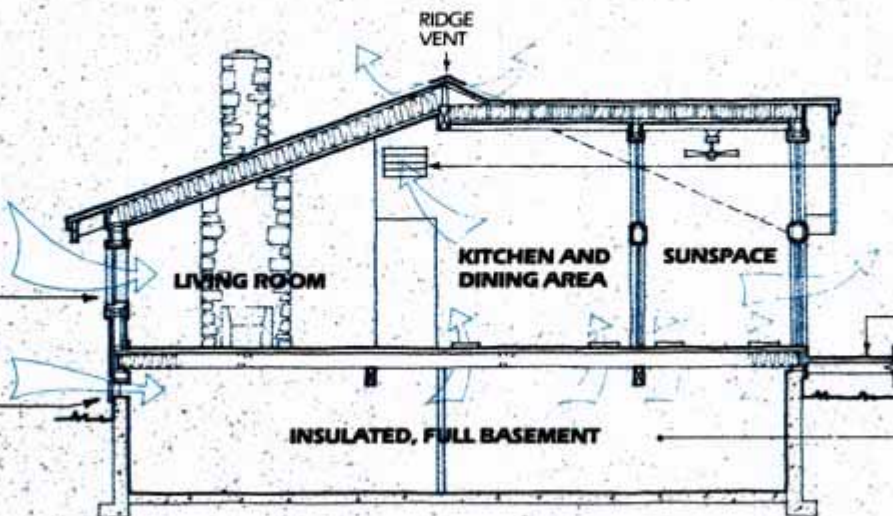
HOUSE IS OPEN COMPLETELY DURING DAYS THAT STAY BELOW 85° F; WHEN THE TEMPERATURE GOES OVER 85°, THE INNER HOUSE IS CLOSED OFF TO THE SUNSPACE

STRATEGICALLY PLACED FLOOR VENTS ALLOW COOL BASEMENT AIR TO ENTER

SUMMER NIGHT

OBJECTIVE IS TO COOL DOWN THE HOUSE THROUGH CROSS-VENTILATION; THE COOLER THE HOUSE BECOMES, THE BETTER IT CAN ABSORB HEAT THE NEXT DAY [UNTIL THE EVENING COOL-DOWN CYCLE STARTS AGAIN]

NORTH-SIDE FOUNDATION VENTS ARE OPENED TO ACCELERATE THE EVENING COOL-DOWN PERIOD



OPEN VENT EXHAUSTS AIR INTO ATTIC AND THROUGH RIDGE AND GABLE VENTS

DECK

COOL BASEMENT AIR ENTERS THROUGH FLOOR VENTS

PART TWO:

DRILL PRESS

NOT JUST ANOTHER BORING TOOL

Discover 16 more reasons why the drill press is one of the most versatile tools.

TEXT AND PHOTOS
BY ROSARIO CAPOTOSTO

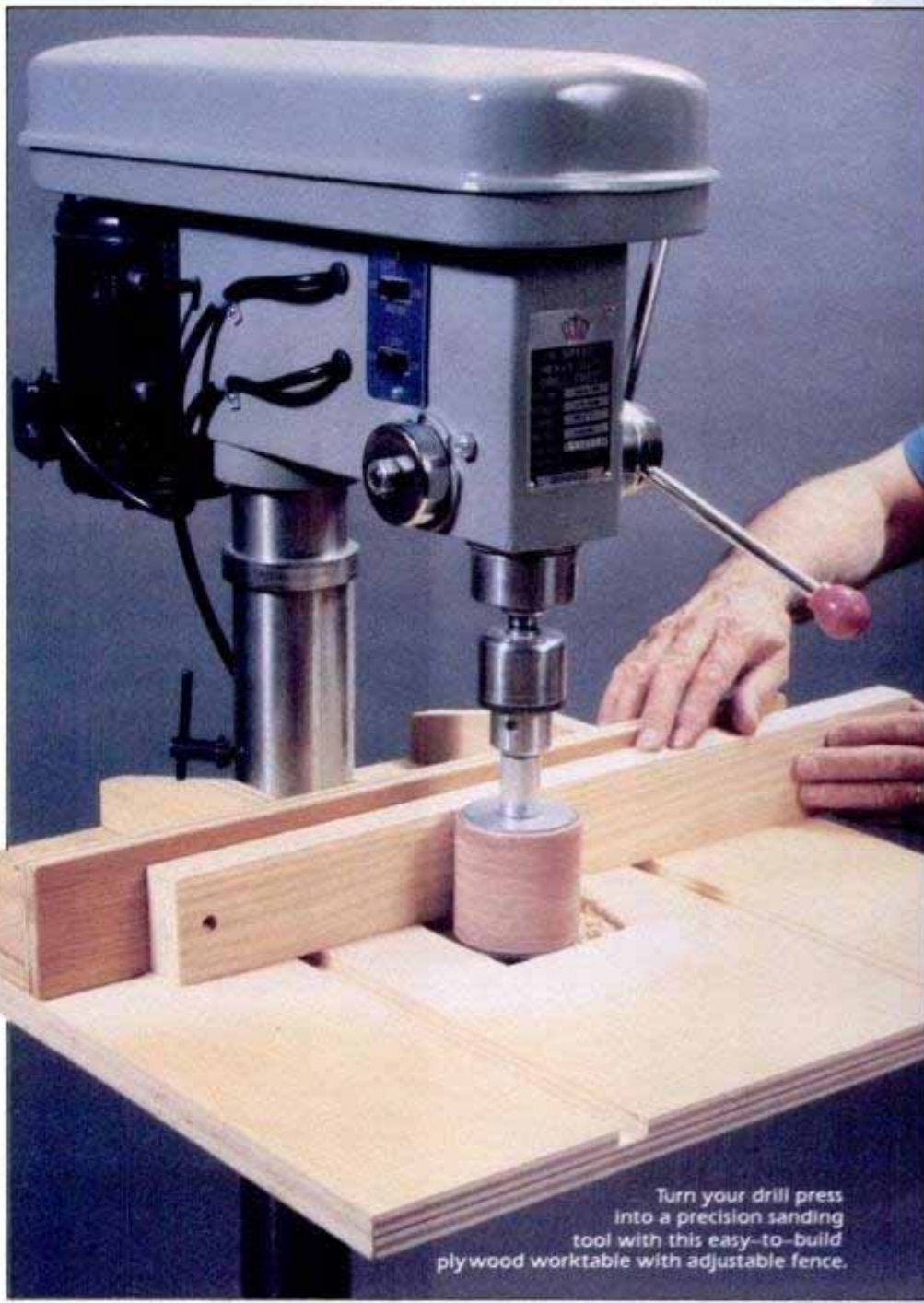
In Part One in our August issue (page 100), we discussed drill press fundamentals and presented a detailed look at various hole-boring techniques. Now we'll show how to use the drill press to perform a wide variety of shop techniques, including sanding, hole sawing, shaping, metalworking and buffing and grinding.

Since most of these techniques require using an accessory tool, such as a fly cutter, wire wheel or shaper cutter, be certain that the tool is designed for use in a drill press. *Caution:* Never exceed the accessory tool's maximum rpm rating and don't use accessories designed exclusively for the drill press in any other power tool. Also, be sure to wear safety glasses during all drill press operations.

Sanding

When fitted with the right accessory, the drill press becomes an effective sanding machine—especially for smoothing contoured surfaces and curved edges. During sanding operations, be certain to feed the work *against* the rotation of the accessory.

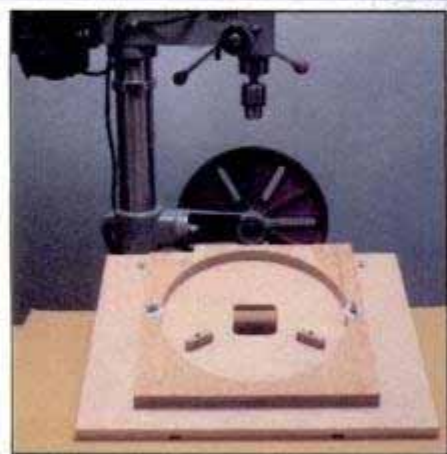
Sanding drums, which are commonly available in sizes ranging from 1/2 to 4 1/2 in. dia., can be used for both contour and straightedge sanding. Build the auxiliary worktable, as illustrated, to



Turn your drill press into a precision sanding tool with this easy-to-build plywood worktable with adjustable fence.

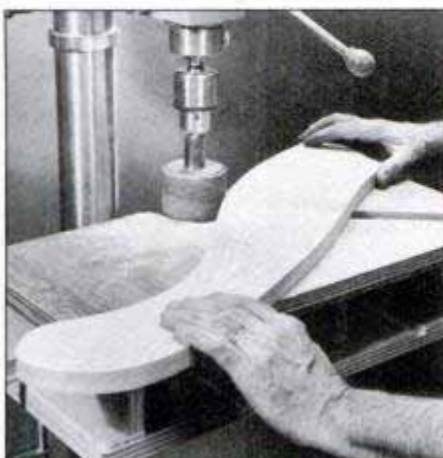
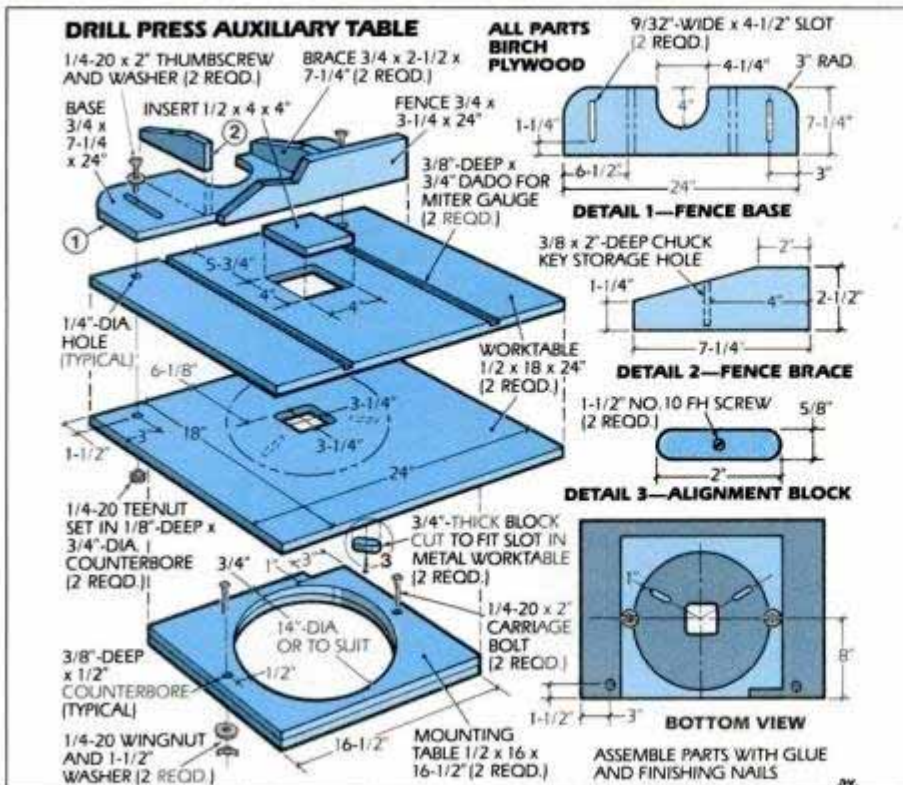


Auxiliary table provides a large, sturdy surface for handling oversized workpieces. Replaceable, 1/2-in. plywood table insert is removed for certain sanding operations.

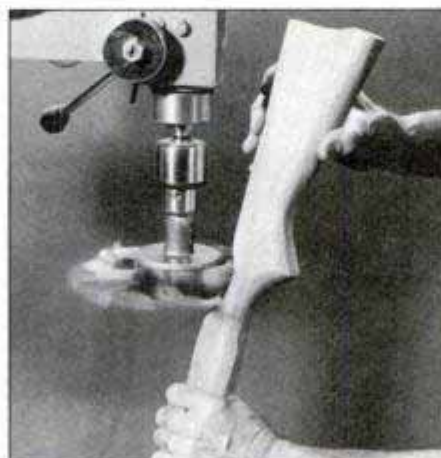


Worktable underside is cut out to fit over the metal drill press table. Wingnuts with large diameter washers hold the auxiliary worktable securely to the drill press.

SANDING TECHNIQUES



Elevated platform clamps to auxiliary worktable to permit using the drum's entire surface. Feed work against the rotation.



Contour sander has eight abrasive strips that conform to curved surfaces. Each strip is reinforced with flexible brushes.

get the most use out of the sanding drums. Note that the auxiliary table has a plywood insert that can be removed to allow lowering the drum about 1 in. below the table's surface. However, to utilize the drum's entire abrasive surface, construct a simple elevated plywood platform about 6 in. high. Clamp the platform to the auxiliary table and raise or lower the sanding drum as needed to promote even, total wear of the abrasive.

To sculpt irregular-shaped workpieces, first move the worktable out of the way. Then, work the stock freehand against the rotating drum until achieving the desired shape. Now replace the sanding drum with a flexible contour sander to smooth out the workpiece. This sander has eight abrasive strips that are supported by stiff brushes that conform to the workpiece. Note that the contour sander is for finish-sanding only, not for heavy stock removal.

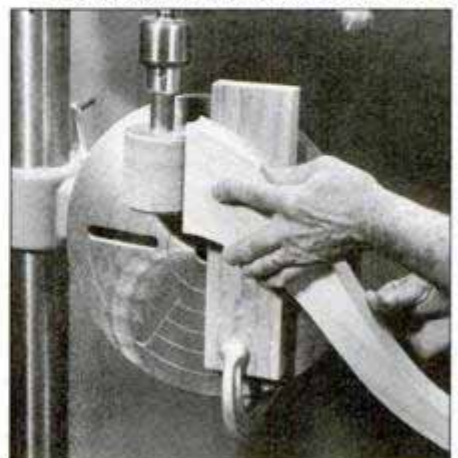
Hole-sawing

For boring large diameter holes in wood, plastic and sheetmetal, hole saws are available up to about 3 in. dia. To cut very large holes, up to about 8 in. dia., use an adjustable fly cutter.

Hole saws come in several styles, but they all work in the same basic way. Each tool has a pilot bit, usually 1/4 in. dia., which projects from the center of the hole saw. The bit centers the tool and helps guide the saw through the stock. When using any style hole saw, it's a good practice to back out the saw frequently to clear away chips and sawdust. This will prevent the saw from overheating.

A new hole saw from Enduro has a unique feature: a single carbide-tipped cutting edge (which Enduro claims will last 50 times longer than conventional hole saws). For details, contact Omark Industries, 2765 National Way, Woodburn, OR 97071.

A fly cutter is adjustable to cut holes



Use a sanding drum to form a concave surface on a leg that fits a round pedestal. Drum size must equal pedestal diameter.

HOLE-SAWING



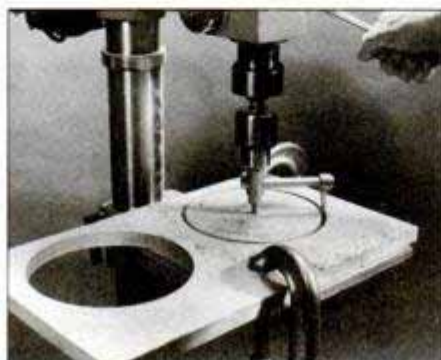
Fly cutter (upper left) is shown with hole saw models (clockwise from top center): adjustable, Enduro, bell type and 7-in-1.



Adjustable hole saw can be changed to cut any size hole within its capacity. This model cuts holes from 1 1/2 to 2 1/2 in. dia.



The Enduro hole saw features a single carbide-tipped tooth and the capacity to cut through 1 1/2-in.-thick stock in one pass.



Use a fly cutter to cut very large holes up to about 8 in. dia. Be sure the work is clamped securely to the drill press table.

of varying diameters—typically between 1 1/4 and 8 in. dia. Simply slide the cutter along the cross bar and secure it by tightening the setscrew. Then, clamp the workpiece securely to the drill press worktable separated by a scrap backup board. Set the spindle speed between 500 and 600 rpm. Now turn on the drill press and lower the cutter slowly into the workpiece. Don't force the tool to cut. *Caution:* When the cross bar and cutter are rotating, they become virtually invisible. So, be sure to keep your hands well clear of the tool.

Shaping and routing

If you have a high-speed drill press capable of running at 5000 rpm or greater, you can perform routing operations using standard router bits.

If your tool's top-end speed is only about 4000 rpm, use low-speed shaper bits that are designed for use between 3000 and 4000 rpm. Each bit has at least nine cutting edges that enable you to achieve smooth cuts at a relatively slow speed. Note that low-speed shaper bits are designed for use at speeds no greater than 4000 rpm. *Never* use these bits in a router.

For details regarding low-speed bits, contact Portalign Corp., 4909 Pacific Highway, San Diego, CA 92110.

Regardless of whether you're using a router bit or a low-speed shaper bit, always feed the work against the rotation of the bit. And, unless the bit has a ball-bearing pilot guide, install a fence to support the workpiece and control the depth of cut.

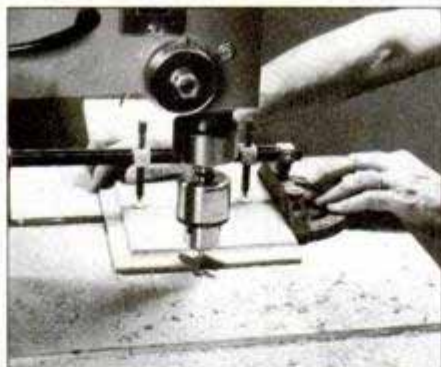
Pin routing also is possible on a drill press. Install a table insert that has a short dowel protruding from its center. Be sure that the dowel pin aligns perfectly with the router bit in the chuck. Next, tack-nail a 1/4-in. plywood template to the workpiece underside. Then, turn on the drill press and guide the template edge against the pin. The bit will cut the workpiece as indicated by the template's shape. This technique is especially useful when producing several identical pieces.

(Please turn to page 144)

SHAPING AND ROUTING



Perform shaping operations using standard router bits (top row) or specially designed low-speed shaper bits (bottom rows).



Spindle speed of 5000 rpm or greater is necessary when using router bits. Make shallow passes to obtain a smooth cut.



When using a low-speed shaper bit, clamp a fence to the drill press table to guide the work and control the depth of cut.

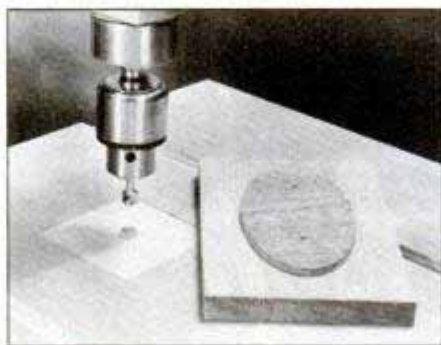
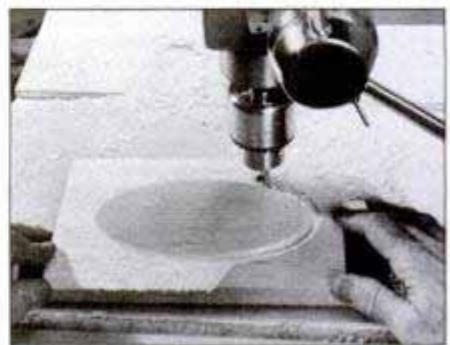


Table insert with dowel protruding from center is used for pin routing. Nail 1/4-in. plywood template to underside of work.



As the template edge is guided against the dowel pin, the router bit will cut the workpiece to match the template's shape.

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the back of the front seat support rail and use a dovetail saw and sharp chisel to make the cuts.

Mark the location of the leg recess at each end of the front seat support rail and cut the outline to the specified depth with a 2-in.-dia. hole saw. Remove the waste with a dovetail saw and sharp chisel. Assemble the seat support frames with $\frac{5}{16}$ -in.-dia. dowels and glue, and clamp until dry.

Next, use a band or sabre saw to cut the rounded profile on front edges of the support assembly. Then use a $\frac{5}{16}$ -in.-dia. rounding-over bit in the router to ease the other edges.

Use the drill press to bore and countersink $\frac{1}{4}$ -in.-dia. holes at the top of the front leg. Then glue and clamp these legs to their stretcher and check the assembly for square. If not square, readjust clamps. Next, glue and clamp the rear legs to the rear stretcher and lower rail. Again, check for square.

Assembly

Glue and clamp the top rail to the rear legs with $\frac{1}{2}$ -in.-dia. dowels. The ears left on the top rail make clamping easy. After the glue dries, trim off the ears with a band saw and belt-sand the edges smooth. Use a router and $\frac{5}{16}$ -in.-dia. rounding-over bit to ease the outside edges of rear legs and top rail.

Use templates for routing the cane spline groove in both the seat and back. These grooves are $\frac{1}{4}$ in. wide and $\frac{5}{16}$ in. deep. To make the seat template, first cut a "plug" of $\frac{3}{4}$ -in. plywood so

it's a snug fit inside the seat frame. Then nail a $\frac{1}{4}$ -in.-thick plywood template to the plug so the template extends $\frac{9}{16}$ in. beyond the plug—and onto the frame—on all sides. Press this assembly into the seat frame and rout the groove. We used a $\frac{5}{8}$ -in.-dia. template guide attached to a $\frac{1}{4}$ -in.-dia. straight bit. The template guide must bear firmly against the template edge at all times and the router must move in a counterclockwise direction. Make sure the workpiece is clamped firmly to the bench and complete the cut in two or three passes.

Use a similar process for routing the groove in the chair back, but this time, make the template the same size as the opening between rear legs and the top and bottom rails. Use two pieces of $\frac{3}{4}$ -in. plywood and press the template into place so it projects $\frac{1}{4}$ in. above the surface of the chair back. Clamp the work to the bench and rout the groove as before.

Caning

Cut prewoven cane 1 in. oversized in length and width for both openings, and cut a $\frac{1}{4}$ -in.-dia. spline for each that is 2 in. longer than needed. Soak the cane and splines in water at room temperature for four hours. Presand the seat frames and chair backs with 120- followed by 220-grit sandpaper.

When ready to apply the cane, cut four or five pieces of scrap spline, each 1 in. long. Beginning with the seat, run a bead of white glue in the bottom of the

spline groove. Stretch the cane over the frame opening and hold in place by driving the scrap spline pieces about halfway into the groove on all four sides. Using shears, trim the cane even with the outside edge of the groove.

Cut a 45° angle on one end of the continuous spline and start driving it into the groove with a hammer and wooden block. Work slowly around the perimeter of the seat, removing the scrap splines as you come to them. When you reach the beginning of the spline, use a knife to miter the end of the spline so it fits tightly in place. Do the same for the seat back. Let both dry overnight.

Folding hardware

Next, use a hacksaw to cut the steel flat stock to length for each piece of folding hardware. Lay out the position of the holes and use a punch to mark their locations. Drill the holes, then use a file to remove burrs on the back side of the stock, and a grinding wheel to round the ends of each piece.

To make the 90° bends on Part Y, clamp the stock in the vise and use a hammer to make the bend as shown. For the short pieces, Part CC, that attach to the front leg stretcher, it is best to first drill the holes in a long piece of stock, make the bend, then cut off the piece. Finish each by lightly sanding with 120-grit sandpaper.

To assemble the hardware, we used $\frac{5}{32}$ -in.-dia. \times $\frac{3}{8}$ -in. roundhead solid

(Please turn to page 125)



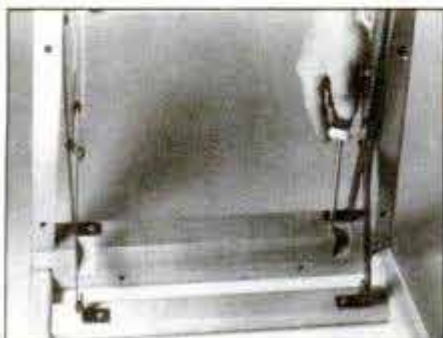
7 Stretch cane over frame and hold temporarily with 1-in.-long dowels. Drive full spline into groove with hammer and block.



8 Clamp steel bar stock, for upper member of folding hardware assembly, into vise and bend over 1-in. section to a 90° angle.



9 Slide solid rivet through mating holes in folding hardware, then round over straight end by striking riveting tool with hammer.



10 Attach hardware with $\frac{3}{4}$ -in. No. 8 pan-head screws. Note clearance notch in lower back edge of front seat support.



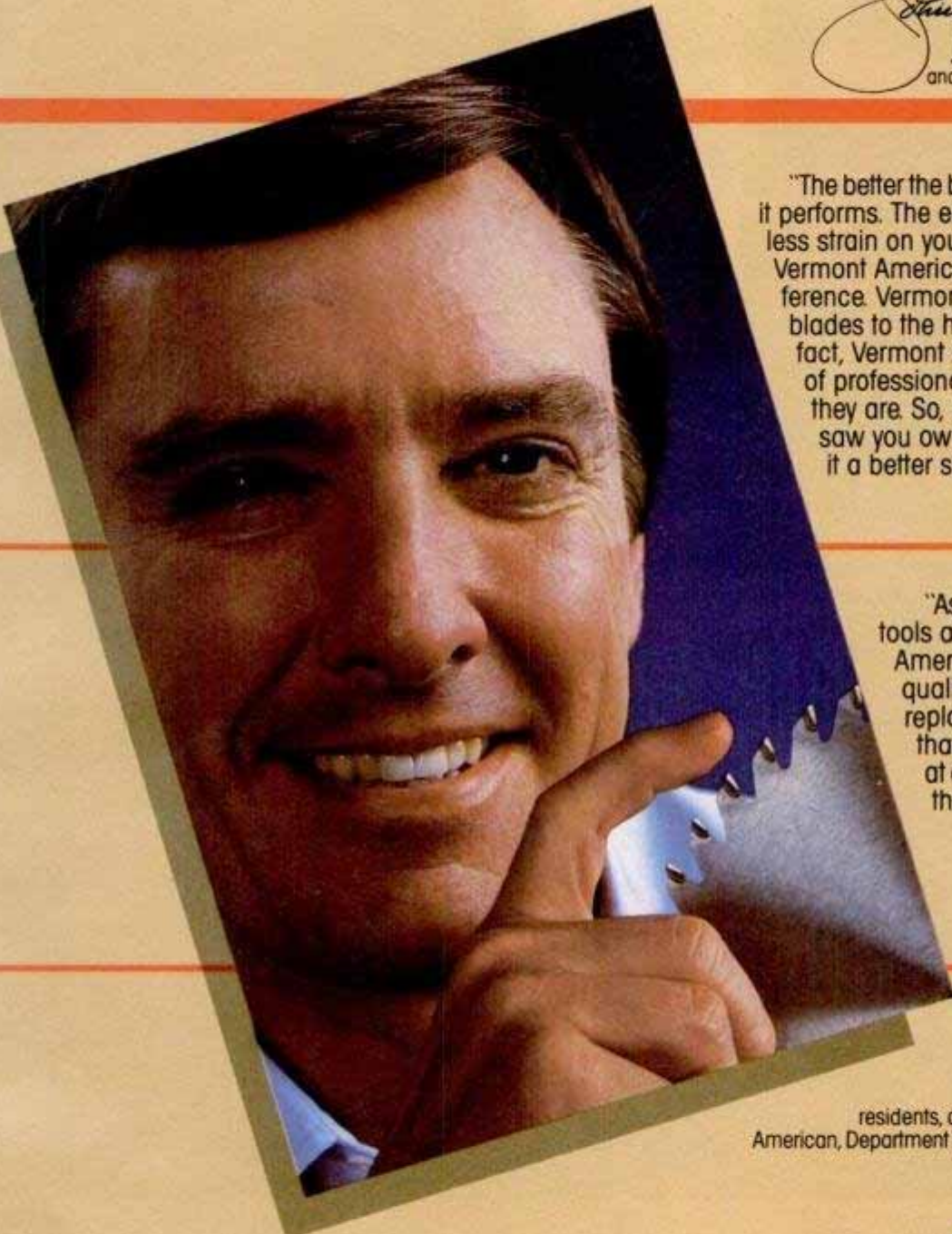
11 After hardware is attached, join seat to support frame by driving screws up through support frame into underside of seat panel.



12 Once chair is assembled, fold several times, then add washers between hardware and legs until action is smooth.

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DINNER FROM FOUR TO SIX (Continued from page 122)

rivets and inserted two $\frac{3}{16}$ -in. flat washers between adjacent pieces of steel. Place the rivet through the holes and rest the rivet head on an anvil. Then round-over the end with a hammer and riveting tool. When all the hardware has been assembled, paint with a spray enamel—we used Testors No. 1240 medium brown.

Before assembling the chair, prebore and countersink $\frac{13}{64}$ -in.-dia. pilot holes for attaching the front legs to the seat support frame, and $\frac{1}{8}$ -in.-dia. pilot

holes, as specified, for attaching the folding hardware. Finish-sand all remaining parts.

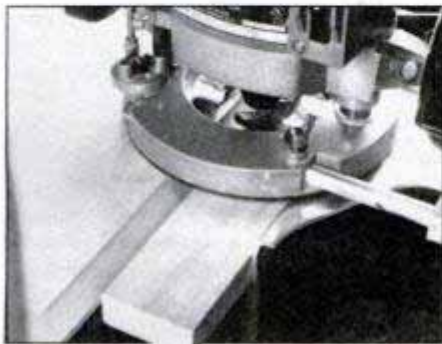
Begin assembly by attaching the front legs to the seat support frame. Next, attach the folding hardware to the front stretcher and seat support frame with $\frac{3}{4}$ -in. No. 8 panhead screws. Use the same screws to fasten the hardware to the rear chair legs, but add $\frac{3}{16}$ -in.-dia. flat washers—as needed—between the hardware and leg to ease friction between the parts. Attach the

seat. At this point the chair should open and fold properly. If there is any binding, use gentle hand pressure to slightly bow the parts to avoid rubbing.

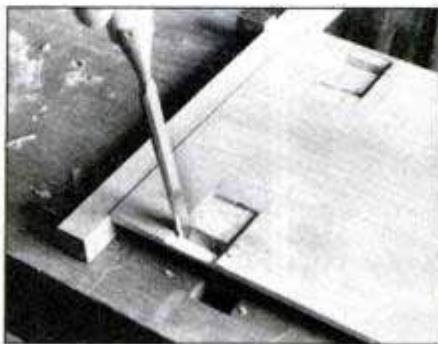
To finish the chairs, we applied three coats of Behlen brushing lacquer. Thin the first coat 50 percent with lacquer thinner, and apply the succeeding coats full strength.

Sand lightly with 320-grit sandpaper and use a tack cloth between coats. When the finish has dried, rub with 0000 steel wool to give a satin finish.

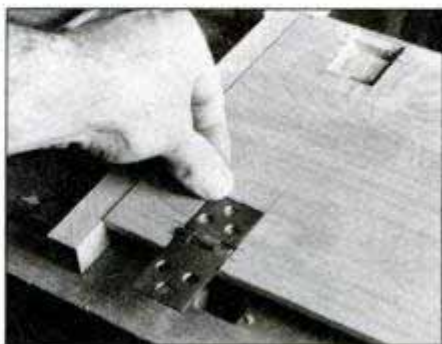
TABLE CONSTRUCTION DETAILS



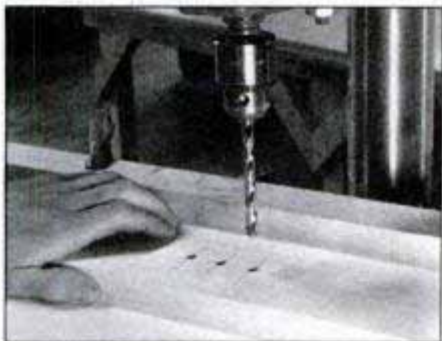
1 Join stock to form tabletop and leaves, then cut rule joint on both using router. Cut top from above, leaf edges from below.



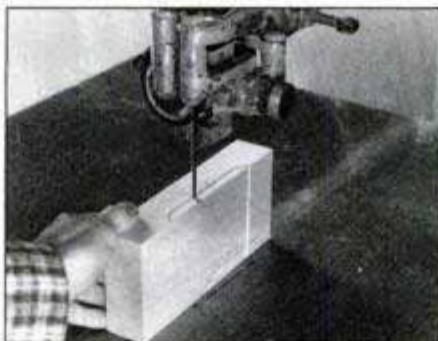
2 Lay out position of hinges that join top and leaves simultaneously. Then cut mortise for hinge leaves and barrel with chisel.



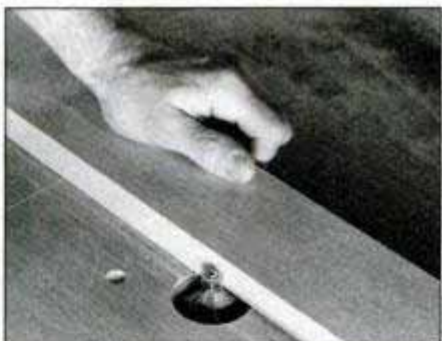
3 Test-fit all hinges, making sure that hinge leaves are flush to wood surface. Then attach and check movement of rule joint.



4 Use drill press to bore dowel holes in base legs and feet, but use doweling jig with depth gauge to bore other dowel holes.



5 Cut base feet to size from $\frac{3}{4}$ stock, then cut profile on each using a band saw. Remove saw marks with a cabinet scraper.



6 Before assembly, round over edges on all parts using $\frac{1}{2}$ -in.-dia. rounding-over bit in handheld router or in router table.

Begin the table by cutting $\frac{3}{4}$ maple stock to rough length for the tabletop and leaves.

Joint the edges and surface to a $\frac{3}{4}$ -in. thickness. Use $\frac{1}{4}$ -in.-dia. dowels spaced 6 to 8 in. along the mating edges to reinforce and align the joints. Glue and clamp the boards together. When dry, plane and scrape each blank flat, then sand smooth.

Using the drawing on page 113 as a guide, make a full-sized template for the drop leaf shape from a scrap of $\frac{1}{4}$ -in.-thick plywood. Trace the outline onto each leaf blank. Then use a band saw to cut the outline and belt sander to remove saw marks on the edges. Rip and crosscut the tabletop to finished size on a table saw.

To cut the rule joint, first clamp the tabletop to the workbench right side up. Then, using a router with a $\frac{1}{2}$ -in.-dia.

rounding-over bit (Bosch 85595M) and edge guide, rout both long edges of the top. Be sure to make a test cut in scrap before routing the tabletop to ensure that the depth adjustment is correct on the router. To form the matching profile on the drop leaves, clamp each *upside down* on the bench and cut the edges with a $\frac{1}{2}$ -in.-dia. cove bit (Bosch 85589M) and edge guide. Again, make a test cut to check that the profile is correct.

Lay out the position of the drop-leaf hinges on the underside of the tabletop and leaves. Note that the hinge is mounted with the barrel projecting into the tabletop, therefore the barrel as well as the leaves must be mortised into the wood. Also, be sure to allow a $\frac{1}{16}$ -in. space between the top and each leaf to prevent binding. After each hinge is positioned properly, outline it in pencil

and cut the mortise with a sharp chisel.

Next, use a $\frac{5}{16}$ -in.-dia. rounding-over bit (Bosch 85593M) to round the upper outside edges of the tabletop and leaves. Sand these parts with 120- followed by 220-grit sandpaper. Join the top to the leaves by installing the hinges. Check that the parts do not bind when the leaves fold.

Cut pieces of $\frac{5}{4}$ stock to rough size for the table base and gateleg; use $\frac{3}{4}$ stock for the table feet. Joint and plane to finished thickness, then rip and crosscut the parts to specified dimension. Mark the profile of the table feet on each piece and use the band saw to cut the shape. Remove the saw marks with a cabinet scraper. Then use a $\frac{5}{16}$ -in.-dia. rounding-over bit to ease the top edges of each foot.

Lay out the hole positions for the dowels that join the base parts, then use

(Please turn to page 126)

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DINNER FROM 4 TO 6

(Continued from page 125)

a doweling jig, where possible, to accurately bore the holes. Where the jig is inappropriate, use the drill press with an auxiliary fence clamped to the table to ensure precise alignment of all holes. Again, use the $\frac{5}{16}$ -in.-dia. rounding-over bit to ease the long edges of table legs, stretchers and the outside edges of gateleg stiles. Inner edges can be eased after the gateleg is assembled.

Presand all parts with 120- followed by 220-grit sandpaper, then assemble the gatelegs with glue and $\frac{5}{16}$ -in.-dia. spiral-grooved dowels. Clamp, check for square and set aside. When dry, round over the inside edges of gateleg stiles, then join the table legs to stretchers with $\frac{5}{16}$ -in.-dia. dowels. When this assembly is dry, attach the feet.

Mark the position of the tabletop fasteners and use a $\frac{3}{4}$ -in.-dia. Forstner bit to cut the $\frac{1}{8}$ -in.-deep \times $\frac{3}{4}$ -in.-dia. mortise for each fastener. Locate the butt hinges for attaching the gatelegs and bore pilot holes for the screws. Attach the hinges to the gatelegs first, then to the table base.

Next, place the base on a flat surface and make sure the legs move smoothly. Attach the tabletop fasteners to the base rails, then place the top upside down on the workbench. Invert the base over the top, and join the two with fasteners. Finish-sand as necessary to eliminate any scratches resulting from assembly and apply the finish in the same manner as the chairs. **PM**



7 Join gateleg frames to base stretchers with butt hinges. Hinges are surface-mounted to allow clearance between parts.



8 Bore $\frac{3}{4}$ -in.-dia. \times $\frac{1}{8}$ -in.-deep holes in base legs and stretcher for tabletop fasteners. Then screw fasteners in place.

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Now, when experts refer to the high-water mark in radar protection, they automatically turn to ESCORT. In March of this year, *Car and Driver* published its latest detector test, this one comparing remote-mounted models. ESCORT is designed for dashtop or visor mounting. But the magazine included ESCORT in the test anyway, as the reference against which the performance of the others would be measured. ESCORT scored 412 points in the final rating, compared to 274 for the highest-finishing remote. You might say the comparison showed that there is no comparison.

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Seven years is a long time in the radar warning business, but there is no shortcut to a good reputation. *Car and Driver* said, "The ESCORT radar detector is clearly the leader in the field in value, customer service, and performance..."



These excerpts were taken entirely from advertisements for other radar detectors.

So it's easy to understand why other detectors would try to stand in our limelight. ESCORT has seven years worth of credibility, the one quality that money can't buy in this business.

Check our references

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STAR GAZING

(Continued from page 107)

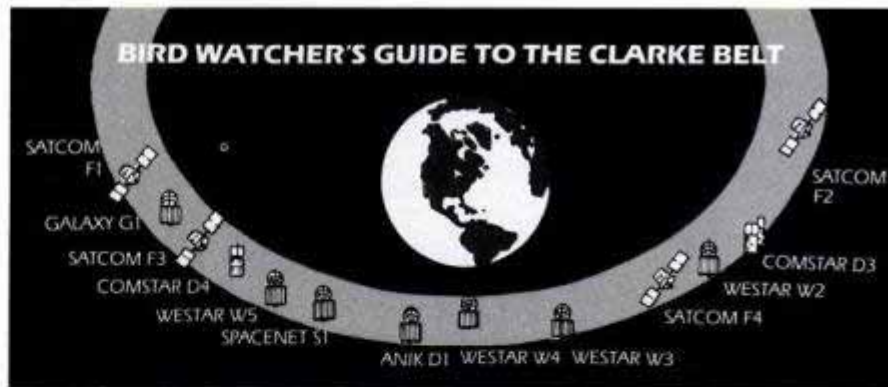
downconversion, by which the LNA and a special downconverter, collectively called an LNB, can simultaneously receive all the channels transmitted by an individual satellite. With block downconversion, additional receivers can be added to different televisions throughout the house, allowing anyone in the house to tune-in any channel transmitted by the targeted satellite. (A signal from a single conversion system can, of course, be routed to multiple televisions using a signal splitter.)

Bringing it home

So far all this equipment is located outside the house and routed to one or more receivers indoors through a coaxial cable. For best results, the dish should be situated as close to the house as possible. Extended cable runs will deteriorate picture quality.

Inside the home, two pieces of electronics take over. One is called an actuator or positioner, which, upon your instructions, physically aims the outside dish from one satellite to another. The dish can be positioned by hand, but this chore soon becomes tiresome.

The other electronics component, and the business end of the system, is



In 1945, novelist Arthur C. Clarke proposed beaming signals around the globe via satellites that orbit 22,300 miles above the equator at a speed that keeps them in fixed positions relative to points on earth. Today, there are many "birds" in the Clarke Belt. The 13 seen here transmit TV programming across North America.

the satellite receiver. Like a radio or TV, this lets you tune to the satellite channel of your choice. The most expensive satellite equipment combines actuator and receiver in a single unit, for convenience and good looks.

Once the downconverted satellite signal reaches your receiver, its next destination is your TV set, via a cable. For more dramatic sound reproduction, you can use another cable to route the audio portion of the program from the satellite receiver to your home hi-fi system. This will enhance even monaural sound. Some satellite programs are transmitted in stereo, but not all. For

this reason, stereo reception is a standard feature only on the most expensive satellite receivers. Most receivers, though, let you add an optional, out-board stereo processor.

Assembling your gear

Installing a home satellite system is a complex and time-consuming job. Some aspects are well within the ability of the do-it-yourselfer, but other phases might require the expertise of a professional installer.

The physical labor involved in setting up a satellite dish can be handled by most homeowners. Certainly, anyone

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who has ever laid a concrete patio can pour the cement foundation for a dish—so long as the mast is set perfectly plumb. This might save \$250 from the cost of a custom installation. You'll also save by digging the trench for the coaxial cable yourself. Additionally, anyone with extra hands and patience can assemble a mesh dish (compared to solid antennas, mesh dishes require precise assembly of dozens of parts with hundreds of bolts).

A local dealer might prove helpful in the more technical aspects of setting up. These include surveying the site for physical obstacles (such as nearby structures or trees) and microwave interference, sighting the dish on the satellite belt with reference to your latitude and longitude, and programming your actuator and receiver to scan the belt for the particular satellite you wish to tune.

Sighting a satellite dish requires precision. Remember, you are trying to hit a target (the satellite) the size of a large garbage can from 22,300 miles away. Minute deviations can be critical. Some companies and mail-order firms that cater to do-it-yourselfers supply kits and instructions—including for sighting—that are very complete.

Moreover, some of the latest actuators and receivers will program them-

selves once the satellite dish has been sighted. One thing a mail-order kit can't do is test for "TI"—terrestrial interference from microwave signals that originate on earth (mostly telephone transmissions).

TI, depending on its strength, is seen as grainy sparkles in your satellite TV picture. Generally, it is heaviest in the western and mountain states, but wherever you live, it might be a good idea to have a local satellite dealer survey your location for TI.

Most dealers do a survey routinely before they'll sell you a system, then deduct the cost of the survey from your final bill. If you buy your equipment elsewhere, you'll just pay for the survey—about \$100.

The future

At this writing, the home satellite industry is developing do-it-yourself, packaged installations that someday will be as easy to set up as a home hi-fi system. That's not the only change in the stars.

Most satellite signals today are relayed to earth over the 3.7 to 4.2 GHz frequencies, known as C-band. But because microwave telephone transmissions on earth use the same range of frequencies, signals from space must be transmitted at low power levels (5 to

9 watts—about the same power consumed by a Christmas tree bulb) to avoid interfering with terrestrial communications. Consequently, dish antennas must be large in order to scoop up those weak signals.

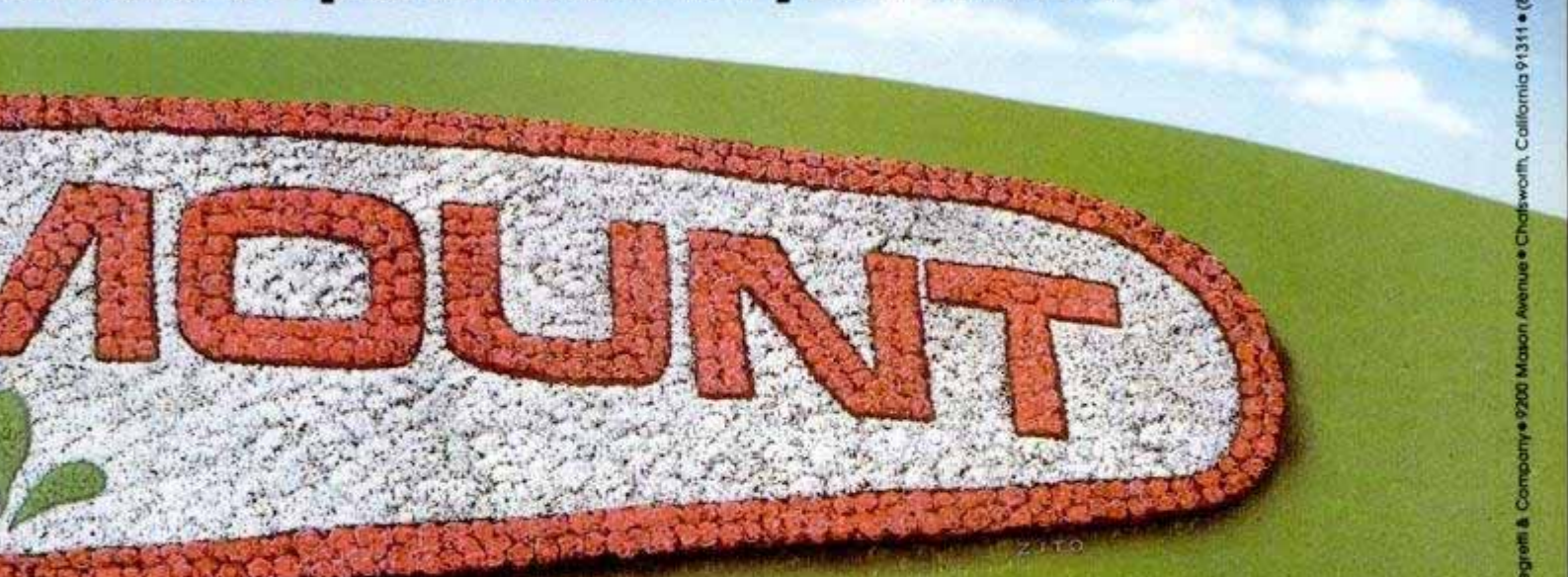
By the end of the decade, though, it's likely we'll be using dishes as small as 2 feet in diameter. That's because many satellite channels will shift to the Ku-band of higher frequencies, ranging from 11.7 to 12.2 GHz. These frequencies can carry much stronger signals, easily collected by small dishes.

To pick up Ku-band transmissions, you'll need a receiver that can tune to the higher frequencies. For the time being, though, it's safe to buy and use C-band equipment.

The transition to Ku-band will be slow because of the high costs involved in sending new birds aloft, converting older ones and their earth-based transmitting equipment.

Industry experts predict that for a time, C-band and Ku-band will be used simultaneously. And it's likely that some programmers will continue using C-band because of the large audience already owning such equipment. Meanwhile, many new receivers are capable of handling both bands, so the gear you buy today can fix its gaze on the stars well into the next century. **PM**

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SHAPING CARS

(Continued from page 91)

cars of varying practicality have values of 0.12 to 0.20.

Good aero does more than just save gas. Volkswagen's Dr. Rolf Buchheim points out that: "Aerodynamics contributes significantly to the overall quality of an automobile. Reduced fuel consumption, good handling and stability, low interior noise, comfortable heating and ventilation are all related to aerodynamics." It can also improve engine cooling and reduce dirt buildup on the windows and lights.

Until recently, to get good aero, you chose a likely design from the styling studio, then tested scale and full-size clay models in the wind tunnel, fiddling with such details as body contour radii, windshield rake and spoilers until you got the lowest possible drag. Computer-aided design and manufacturing (CAD/CAM) are changing all of that.

In Ford's Concept 2000X Studio, designers and engineers are working toward the day when they will conceive a shape on the computer terminal, develop it in three dimensions and get computer readouts of drag, downforce, lift and roll, all without putting a model into the wind tunnel.

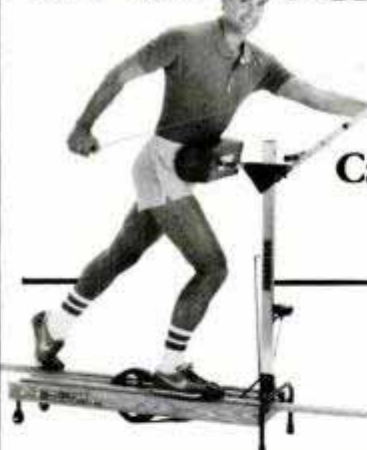
Consultants from Disney World are helping Ford to project full-size holographic images of these computer designs that look like a real car. According to Kopka: "It would reflect light and be shiny and everything," allowing management to make its go/no-go decisions without the bother of clay models. "If you had the guts," Kopka adds, "and everybody trusted the system, the day you saw that holographic projection, you could use the computer's magnetic tape to cut metal-stamping dies somewhere in the world."

Ideal shapes

Auto engineers pretty much agree on the ideal shape of an aerodynamic sedan. Seen from above, the nose and windshield are rounded, almost semi-circular. The roof and tail are tapered as much as practical at the rear. The hood should slope downward to a small, round grille. No grille at all is even better because the conventional cooling system is a great source of drag. Ford's Probe IV aero study car has rear-mounted radiators that draw cooling air in at the sides, which helps to keep the boundary layer of moving air attached to the body, reducing turbulence. Hot air is exhausted out the back, helping to fill that low-pressure area. The wheels—giant air churns—are enclosed as much as possible.

The ideal profile has a sharply raked windshield and a rear window that follows a gentle fastback line, continu-

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ing unbroken to a high tail. That profile works fine on a station wagon or hatchback. For a sedan, the best compromise is the high trunk line that's been so common lately.

The body sides should be well rounded, seams between metal and glass as smooth as possible, and the underbody flat. Because the latter is impractical, the common solution is to use air dams and ground effects panels to keep as much air as possible from getting under the car. This not only reduces parasitic drag, but increases downforce too, resulting in better high-speed stability.

Does this mean that all aerodynamic cars will soon look alike? No more than all the cars of the tailfin era looked alike. They will have certain features in common, but there's still plenty of room for innovation. Subaru gets a Cd of 0.29 with its wedge-shaped XT Coupe and Mercedes will match that with its new 300E/300D sedan. Pontiac gets 0.31 with the now dated-looking Firebird, Ford 0.32 with the Star Wars styling of the Merkur XR4Ti and Audi 0.33 with its tuberous 5000 sedan.

Wake imaging

Looking at basic shapes in the wind tunnel, it soon becomes apparent that what you do to the trailing edge is a lot more important than what you do to the leading edge. A cylinder has up to 50 times more drag than a slim teardrop of the same width. Of course, a teardrop-shaped car is only practical at Bonneville. In traffic, it's too long and unwieldy. But with a few modifications, a teardrop can turn into an Audi or Ford.

Take a pudgy teardrop with a Cd of 0.15, blunt its nose, and the Cd rises only 7 percent to 0.16. Remove 14 percent of its length, however, and Cd jumps up 47 percent to 0.22. Shorten it 28 percent and Cd shoots up 80 percent to 0.27.

That's why Ford is hot about a new technique called wake imaging—a procedure that can pinpoint sources of drag and lift in the wind tunnel using accurate scale models that include drivetrain, suspension, exhaust system and radiator drag. An array of 42 pressure probes called a *wake rake* is moved across the wind tunnel behind the model. Each of the 7-holed probes measures airflow angles, velocity and pressure.

The resulting computer printout shows constant pressure lines behind the model, which are similar to the isobars on a weather map. The pressure lines represent the aerodynamic "fingerprint" of the car. Using wake images, engineers can easily experiment with body contours, spoilers, wings and other aerodynamic aids on the model to reduce drag and turbulence.

Better aero can lead to a revolution in powertrains. Overcoming drag requires

horsepower. Power requirements go up with the cube of the speed. In other words, to double your speed from 20 to 40 mph you need eight times as much power; to triple speed to 60 mph, 27 times the power; and 64 times for 80 mph. This leads to a measurement called "aero horsepower"—the power needed to push a car through the air at a given speed. This can be separated from "friction horsepower"—the power needed to overcome the rolling resistance of the tires plus the friction in the bearings, cylinders, gears and other mechanical components.

Aero horsepower

The Cd numbers bandied about in auto advertising can be misleading. Cd is a useful number for comparison because it eliminates the variables of speed and car size. But it's not the whole story of drag. The raw data from the wind tunnel gives a car's total drag. This is divided by the car's frontal area and a multiple of its speed to calculate Cd. A large car with a low Cd may actually have a greater total drag than a small car with a higher Cd. Car-to-car variations in body panel fit can cause a 4 percent difference. The same car, measured in different wind tunnels, can show a 5 percent Cd variation. Aero horsepower is a much better yardstick than Cd because it takes total drag into account. You may soon see aero hp quoted in ads.

Ford's Probe IV needs only 2½ aero hp to sustain 50 mph on a flat road. "Think about it," says Don Kopka. "You're talking about a lawn mower engine here."

"Add another 2 to 3 friction hp and you're talking about a car that can run 50 mph on 5 to 6 hp. That's practically reinventing the automobile," Kopka says. "What kind of engine and transmission do you want? I think you want a very small-displacement, high-revving engine with a constantly variable transmission [CVT] so you can throttle it down to the point where it's idling at 5 hp and geared up to go 50 mph. You can still get plenty of torque through the CVT when you need it for acceleration or passing. I can see something like a very small displacement direct-injection diesel or maybe a tiny turbo that can rev to 11,000 or 12,000 rpm."

Movable accessories

Movable aero aids are also on the way: suspensions that squat at highway speeds, spoilers that deploy further as speed increases, thermostatic radiator slats that close up the grille when coolant temperatures are normal and open when the engine gets hot. The only question seems to be, who'll do it first—us, the Europeans, or the Japanese? **PM**

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COMRADES IN SPACE

(Continued from page 102)

have foreign participants. Europe conducts its planetary program for the most part under the aegis of the European Space Agency (ESA), a multinational cooperative effort. The Soviet Union's spectacular VEGA mission to Venus and Halley, now under way, has nine participating nations, and even some U.S. involvement.

One extraordinary example of international cooperation is Pathfinder, in which the USSR, the European Space Agency and NASA are working together to provide data for the navigation of ESA's Giotto spacecraft to Halley's Comet. Soviet pictures of Halley from VEGA will be given to U.S. and ESA scientists. The U.S. will also track the Soviet craft. The data will be used to update knowledge of the comet's orbit and quickly given to ESA so that a final mid-course correction can be applied to target Giotto closer to Halley's nucleus.

The next decade

The plans for the next decade of space exploration are well-developed. The U.S. will have its Voyager encounters with Uranus in 1986, and, we hope, Neptune in 1989; Galileo to the asteroid Amphitrite in 1986, Jupiter, Io, Europa, Ganymede and Callisto in 1988-'89; Venus Radar Mapper orbiter in 1989; and Mars Geoscience Climatology Observer in 1990-'91. Also under study are a Lunar Polar Orbiter, a comet (probably the comet Wild 2) rendezvous and asteroid flyby, a near-Earth asteroid rendezvous and a Saturn orbiter and Titan probe for the 1990s (the latter may not occur until the 21st century).

The Soviets are planning a rendezvous with the Martian moon Phobos in 1989, along with a 1988-'89 orbit of Mars. They are studying additional Venus exploration with advanced landers and either an asteroid or a comet rendezvous following a Venus encounter in the early 1990s. A specific mission plan now under joint study by the Soviet Union and France is a Venus/Asteroid mission for 1991 or 1992. The Soviets would build Venus vehicles for atmospheric and surface exploration and the French would build an asteroid module to encounter three asteroids, culminating in a rendezvous with Vesta, the second largest asteroid.

Western European nations—as part of the European Space Agency, and also with bilateral agreements—are considering involvement in several of the U.S. and USSR missions. And there are a number of obvious opportunities:

Venus—The Soviets are now getting radar pictures of the northern hemisphere of Venus, and the U.S. will map the planet, with more detailed pictures,

in 1989. Data exchange is clearly called for, and already Soviet scientists have been providing their U.S. counterparts with such data.

Mars—Both the U.S. and the USSR are planning to send spacecraft to orbit Mars at the end of the decade. Not only would a data exchange be useful, but cooperative planning of measurements, joint calibration of instruments by scientists on the two spacecraft and other interaction would benefit both nations. Recently, the USSR and ESA agreed to cooperate in the Phobos mission.

Beyond 1990, the spacefaring nations are all interested in extensive and detailed exploration of the Martian surface. Returning to Earth with a sample of the surface is extremely important since it is the only way to determine ages and periods of Martian planetary evolution. Journeys across different regions of Mars—by people and machines—will be exciting, as well as valuable in looking at geological and topographical conditions. All such missions have many components that could benefit significantly from international cooperation in the mission design.

Comets and asteroids—Again, with both nations designing rendezvous, working together could maximize the possible scientific return from the encounters. The many primitive bodies (small bodies that have not undergone alteration due to internal activity) in the solar system demand that scientists exchange data wherever possible.

The Moon—The U.S., USSR and the Europeans are each studying lunar polar orbiters. The USSR has now approved a mission for the end of this decade. The best lunar mission might include a number of small spacecraft working together to study the Moon's geochemistry and interior.

Titan—The U.S. and ESA are now studying a joint Saturn Orbiter/Titan Probe mission. Titan, a moon of Saturn, may be the most interesting place in the solar system to visit because of its rich composition of organic molecules and its probable liquid surface. Although there is little hint of Soviet missions to the outer solar system, the Venera landing technology would be applicable to Titan.

These ideas for international cooperation were developed and discussed at a meeting called and hosted by The Planetary Society in Graz, Austria, in the fall of 1984. Leading scientists of the U.S. and the USSR space programs met, informally, to consider how and why international cooperation between the two nations could enhance their space programs, as well as the broader aspirations of both countries.

Interestingly, no consideration of a manned mission to Mars had ever been

(Please turn to page 134)

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COMRADES IN SPACE

(Continued from page 132)

made taking into account the Shuttle, Spacelab or other post-Apollo developments. The Planetary Society therefore commissioned such a study from Science Applications International Corp. SAIC is a frequent NASA contractor for advanced mission design and planning studies. It found that the first human-crewed mission to Mars could be done for \$40 billion in today's currency, half the cost of the Apollo mission.

As an example, SAIC considered a mission for the first decade of the 21st

century involving no exotic new technology, other than present capabilities extrapolated 20 years. The scenario involves 18 Shuttle flights with 10 Orbital Transfer Vehicle (OTV) stages.

The crew will leave Earth's environment in June 2003 and arrive at Mars in December of the same year. At Mars, they will select a landing site from orbit. The major goal of the crew will be to find a site for a future permanent settlement. In the example mission, it was assumed about 900 kilograms of scientific equipment will be carried to Mars.

One of the most exciting ideas in the SAIC study is a hyperbolic orbit rendez-

vous for the astronauts at Mars. A spacecraft orbiting a planet flies in an ellipse if the orbit is closed, and follows a hyperbolic path if the orbit is open—that is, if it is not captured by the planet's gravity. A retro-maneuver using a large amount of fuel would be needed to slow the spacecraft into a closed orbit about Mars. We can save fuel by letting the return vehicle fly by Mars on hyperbolic orbit, aimed to return to Earth like a boomerang. Because the orbit doesn't close about Mars, the crew has only one chance to rendezvous with the return vehicle. Although this is risky, the SAIC engineers found it to be acceptable compared to other mission risks. Of course, they are engineers, not pilots.

The trip back

The return to Earth will take 2½ years, so the life support needs will be greater than for the 6-month outbound trip. The difference is due to orbital geometry and planetary alignments. We either wait for favorable alignments, or fly on slower trajectories.

After the lengthy trek back across interplanetary space, the crew would return to Earth orbit for a rendezvous with a space station, in January 2004—three years after they left home.

Now is not too soon to begin this project. The scientific and technological preparations for sending humans to Mars should take approximately 25 years. It could be done faster, but the logical sequence of precursor missions—remote sensing orbiter, robotic surface explorations, including perhaps sample return—will take some time. The necessary technical developments of propulsion systems, aerocapture vehicles, life support systems and spacecraft design—in addition to the important development of the space transportation system including upper stages and some space platform or station capability in Earth orbit—will also take time.

Adoption of the goal to explore Mars together, with humans and machines, by the U.S. and the USSR is also politically advantageous at this time. There is a strong desire and an initiation of new dialogue in both nations to find common areas of agreement in order to lower tensions and dangers from super-power confrontation. A joint project would give each side a common and peaceful objective, a window into the creativity and technology of the other, and give an opportunity for increased communication among the scientists and engineers of both nations. The result of such an immense cooperative achievement—the human species on another planet—is almost an anticlimax, an anticlimax which may serve as our generation's proudest legacy. **PM**

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NEW BREED OF SSTs

(Continued from page 100)

ic Transport (AST), it would carry 350 passengers. The AST swept wing and engine shape have already received excellent grades from wind tunnel tests with scale models.

A slightly faster SST planned by Lockheed would achieve Mach 2.55. It would be fueled by liquid hydrogen. Lockheed, which was working on SST concepts even before the Concorde, is capitalizing on its experience in developing a concept for a Supersonic Cruise Vehicle (SCV) that would carry 290 passengers at an altitude of just over 60,000 feet. Lockheed is working with both Pratt & Whitney and General Electric, who are building engines that behave like turbofans during takeoff at slow speeds and like turbojets during supersonic portions of the flight.

Two more SSTs for the 1990s are under development by NASA. Each would cruise at between Mach 2 and Mach 3. A Mach 2.7 SST, based largely on a Lockheed design, would carry up to 400 passengers on transoceanic flights. High-temperature composites and aluminum alloys would help shed heat, a problem at supersonic speeds where airframe temperatures rise to 170°F and beyond. The current Concorde handles the temperature load by expanding 9 inches in flight. The jet's floor is on rollers to facilitate the expansion. With new aviation materials, such devices won't be necessary.

The other NASA craft is based on a Boeing oblique wing craft that would be able to pivot its wing up to 80° from the centerline of the fuselage. The oblique wing reduces noise and drag at high speeds, as already shown in flight tests of NASA's Ames Dryden-1 turbojet.

One or all of these craft could be competing with the Concorde within 10 years. But now that Congress is supporting the SST concept, the aerospace industry and NASA want to push way beyond competing with the original SST. They want to go hypersonic, 5 times the speed of sound or more. Two likely craft to fill that bill are the Hypersonic Scramjet and the TAV.

Hypersonic engines

The Mach 7 Scramjet's body could take on any of the already proposed configurations or a combination of them. But its engine would be unique. Researchers at NASA's Langley Center already have patented such an engine. The Scramjet takes off on pure rocket power. As it reaches Mach 2, the forward speed of the aircraft rams air into the engine, so no turbine is needed. NASA is continuing work to lighten the engine since weight will be a major

(Please turn to page 140)

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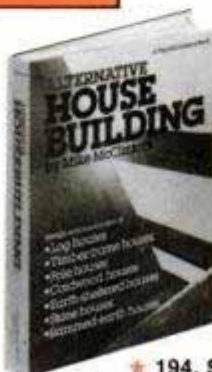
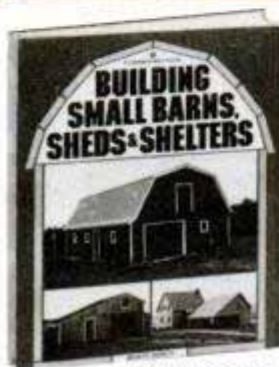
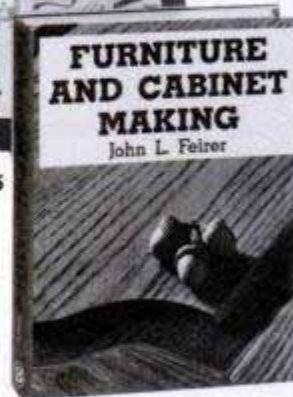
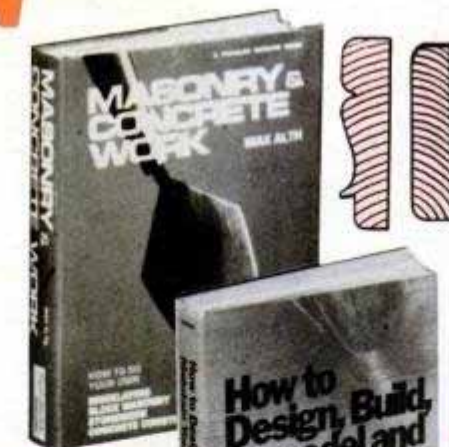
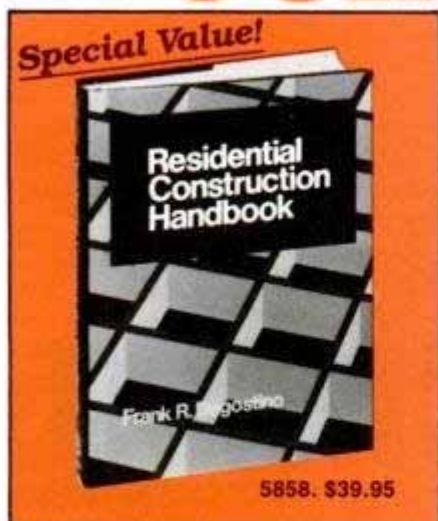
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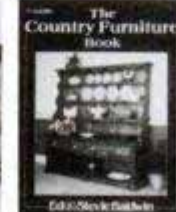
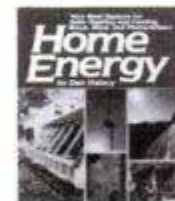
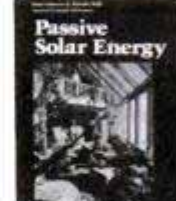
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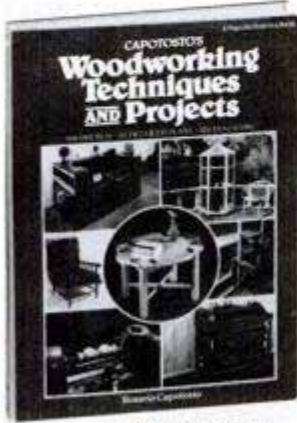
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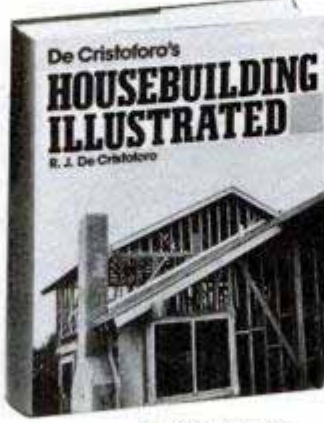
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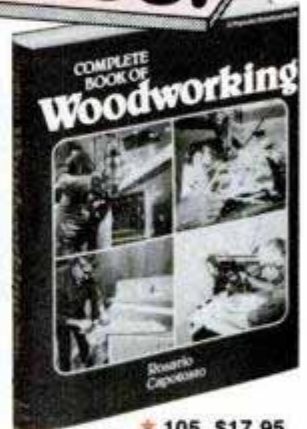
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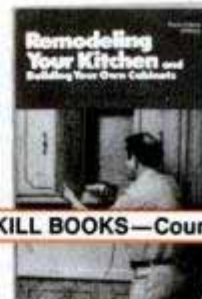
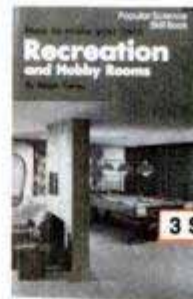
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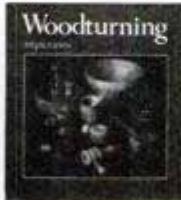
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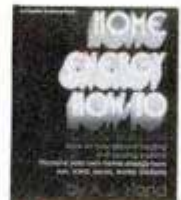
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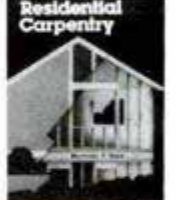
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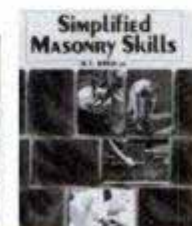
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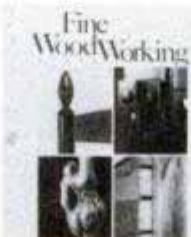
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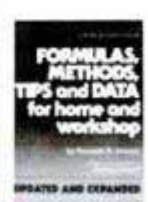
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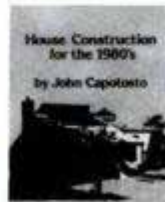
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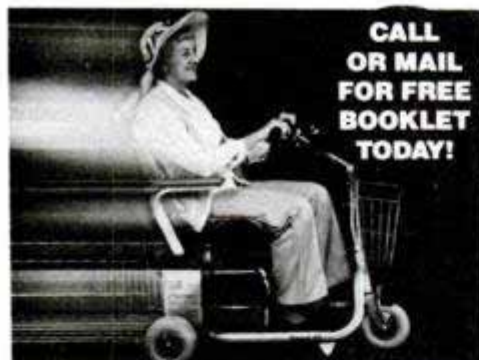
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NEW BREED OF SSTs

(Continued from page 135)

factor in the development of the turn-of-the-century jet.

The TAV concept was made public by the Air Force last year and Lockheed, McDonnell Douglas, Boeing and Rockwell have produced drawing-table versions. The TAV may be launched over water on a recoverable rocket platform that falls to sea as the craft leaves the atmosphere. Or it may be dropped from the belly of a Space Shuttle. In either event, the TAV craft is being designed for speeds beyond Mach 20. Some industry experts are even predicting Mach 25.

Both the Hypersonic Scramjet and the TAV are expected to use the scramjet engine concept. In the likeliest configuration, the engine will run on its upper turbojet chamber at speeds up to Mach 1. A lower ramjet engine's intake would be closed in that mode. Beyond Mach 1, the turbojet's inlet and outlet would be closed and the ramjet's air chambers would be open, sucking in cold air.

Ideas take wing

While the engine technology is almost in place, wing design has moved ahead quickly and may now be established, at least for the 1990's American SST. Lockheed is on the leading edge of wing development with its arrow wing design. In the 1970s, the conventional SST wing was delta shaped for quick lift. But it was heavy and limited the jet's range to 3250 nautical miles. A newer design, already wind tunnel tested, is the arrow wing, a sleeker lifting device that provides more lift per square inch than the delta.

With the coming of new lightweight aviation materials, the arrow wing can be made to withstand the extra lift without adding wing area. It performs every bit as well as the delta, but it has a range of 3800 nautical miles.

American SST designers are in the best position they've ever been thanks to a generation of mistakes with the concept. Beginning in the 1950s, SST failures led to present-day successes. The British M-wing, for example, which looked good on paper in the 1950s, proved unstable in wind tunnel testing. The gull-wing lines of the M-wing theoretically provided super lift. But wind tunnel tests indicated the wings would have stall problems in flight.

In 1958 the British introduced the delta-wing concept. The first delta-wing craft was extremely stable, but it was a heavyweight and showed no promise where range was concerned.

The earliest arrow wing was designed by the British in 1960. It showed great promise in the wind tunnel. But

graphite and epoxy materials were unavailable at the time and the wing's support structure required too much weight in metal.

The biggest challenge facing SST wing designers has been the compromise between two levels of speed. At low altitude and on takeoff, the SST has a normal cruising speed of under Mach .5. Something like the delta wing is needed to give it extra lift. But the delta-wing surface rolls and yaws more than any other type. It's difficult to control. The arrow wing has somewhat less lift, but it provides a more stable flight under the speed of sound. Above Mach 1, the aerodynamics of an arrow wing cut down on drag and give the SST more speed and range.

Swing-wing SST

Boeing offered a solution in 1966 in the form of a swing-wing SST design. The swing wing would be able to fly in the delta shape at low speed. The wings would be movable so they could go all the way back to the arrow position at Mach 1 or above. A similar design has been adopted for the B-1B bomber. But when Boeing proposed it for the SST, the engineering required to swiftly and safely change the wing configuration was not yet in place. Also, the change in wing position mandates moving the

fuel supply from one tank to another to redistribute the plane's weight. A fuel transfer system at that stage would have been far too expensive.

In 1978, Lockheed proposed the hydrogen-fueled arrow wing configuration. It had the most promise of all the early SST proposals. But it could only carry under 100 passengers. With new aviation materials, the rejected Arrow design may show up in a modified form in the next generation SST.

Although the French are out of the SST business, the British have added to their fleet, further fueling the argument for an American competitor. How are we going about producing one?

This year the Defense Advanced Research Projects Agency (DARPA) is spending \$7 million on the ramjet technology for the scramjet program. The mandate in the current research program is to develop an engine for horizontal takeoff that can operate at 150,000 feet. Such an engine could be tested on a plane by 1988.

A working Hypersonic Ramjet may be dropped from the Space Shuttle as early as 1990. NASA deputy administrator Hans Mark recently told a congressional panel that NASA could drop such a craft "precisely the way we dropped the X-15 and the airplanes we built in the '60s. And we are in the

process of developing a proposal to do just that."

DARPA is also under White House orders to work on the airframe concepts. A White House report issued earlier this year envisioned a Mach 3 airliner before the end of this century.

Business jets

NASA, several universities and the major aircraft builders have also begun work on supersonic business jet designs. One wind tunnel model demonstrated at St. Louis University showed a potential for cruising at Mach 2.2 on a pair of available Pratt & Whitney engines. It would carry 10 passengers.

The high cost of jet fuel has long been a stumbling block for the SST. But new methods for making liquid hydrogen and coal-derived gases now offer a ray of hope. NASA scientists, in fact, believe the liquid hydrogen fuel technology is fully in place and will answer questions raised by critics.

Anyone who travels from coast to coast or across oceans will tell you: If a ticket can be purchased at a reasonable price for a supersonic trip, they'll take it. The aerospace industry seems on the verge of producing a craft that fills the bill. And you can almost hear the engines of an American SST warming up on the runway. **PM**

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DRILL PRESS: PART TWO

(Continued from page 120)

Metalworking

The procedures for drilling in metal are similar to those for boring in wood. However, since metal is a much harder material, it's necessary to drill at slower spindle speeds and to apply less pressure on the feed lever. This will prevent overheating, which would weaken and dull the bit.

It's also very important to clamp the workpiece securely to the drill press table to prevent it from spinning with the bit. Use a drill press vise to hold small workpieces. Then, clamp the vise to the table. The tendency for the workpiece to spin is the strongest when the bit just breaks through the underside surface. At this point, the bit may grab and break or it may tear the work from its holdings. To prevent this, simply hold back on the feed lever slightly as the bit starts to break through.

When you start to drill in metal, the bit may tend to wander on the surface. Prevent this by striking a starting point with a centerpunch. If the centerpunch mark is too small to seat a large diameter bit, drill a small diameter hole first and then drill the larger hole.

Drilling an angled hole with a twist drill is difficult because the bit can't cut into the slanted surface. Solve this by using a two-lipped end mill to start the hole. Then, switch to a twist drill to complete the hole. If an end mill isn't available, start drilling the hole with the bit perpendicular to the workpiece. Then, tilt the work to the desired angle and continue drilling.

Buffing and grinding

With the proper accessory, a drill press can clean, polish, buff and grind a wide variety of materials.

Wire brushes are useful for removing paint, rust and grime from metal parts. They're available in cup and wheel types with either brass or steel bristles. For aggressive brushing action, you should use a steel wire wheel. Choose the softer brass wire wheel for more delicate work.

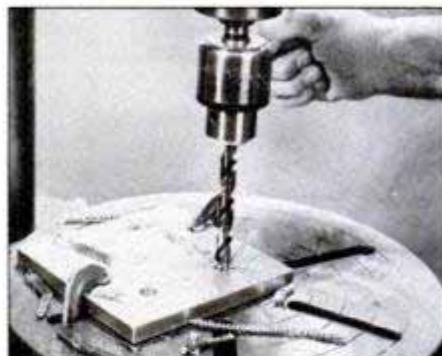
Use a soft buffing wheel coated with jeweler's rouge to buff a high luster on plastics and metals. First, sand the work with lubricated wet/dry abrasive paper. Then, you should buff the piece on the drill press. Be sure to keep the work in constant motion to prevent scorching.

Grinding stones are available in various sizes and shapes. Use the stones for sharpening steel blades and bits and to fabricate metal parts. **Caution:** Inspect the grinding stone before each use. Never use a stone that is fractured or damaged in any way. **PM**

METALWORKING



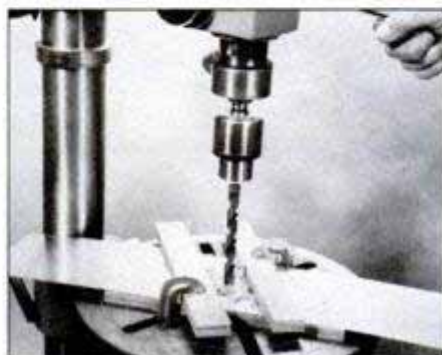
Metalworking accessories (clockwise from upper left): twist drill set, vise, end mill, centerpunch, twist drill and countersink.



Select a low speed when drilling in metal. As the bit starts to cut through the underside surface, release the feed pressure slightly.

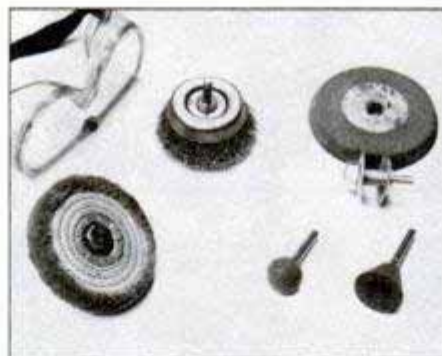


Drill press vise provides a safe, secure way to hold workpieces. Be sure to clamp the vise securely to the drill press table.



Drilling in sheetmetal can be very dangerous if it isn't clamped securely to the table. Employ this double clamping method.

BUFFING AND GRINDING



Accessories (clockwise from upper left): mandatory safety goggles, wire brush, grinding wheel and stones, buffing wheel.



Cup-type wire brush removes rust, tarnish, paint and grime from metal surfaces easily. Grip the work firmly with two hands.



Polish plastics and metals against a buffing wheel coated with rouge. Keep the workpiece in motion to prevent scorching.



Sharpen router bits with a cone-shaped grinding stone. Short bolt in threaded insert holds the bit securely in a homemade jig.



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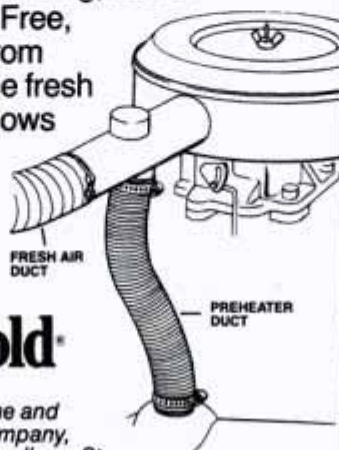
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SOLAR SIMPLIFIED

(Continued from page 117)

into buffering the solar glass.

Summer day

This design works just as efficiently during the summer. Instead of the classic solar utilization of cumbersome shading devices and superinsulation to protect the house from excess solar heat accumulation, we emphasized ventilation. This approach requires a little more thought on the drawing board, but the end result is well worth the effort.

All window and door openings must be sized and located with cross ventilation and heat escape in mind. This includes locating them to catch prevailing breezes and to let the air pass effortlessly between—and through—all the rooms. Interior heat is exhausted through ridge, roof and gable vents as well as through louvered vents connecting the inside of the house to the attic.

However, there is a catch. If you are addicted to the chilling effects of an air conditioner running full blast, you're in

RULES OF THUMB

The following list highlights 10 rules of thumb Smith uses in his solar design process:

1. Southerly facing glass area should equal about 15 percent of the house's total floor area. For example, a 1500-sq.-ft. house should have 225 sq. ft. of south glass. Standard solar procedures call for an average of at least 25 percent.
2. The sunspace doesn't have to face exactly south. Solar orientation of the sunspace can be flexible, up to 45° either east or west of true south.
3. Allow about 5 sq. ft. of basement or crawl space area—excavated below the frostline—for each sq. ft. of south glass. For example, a sunspace with 225 sq. ft. of glass should have 1125 sq. ft. of subspace to feed it.
4. Insulate and weatherize the house thoroughly. Superinsulation, however, isn't necessary.
5. Use one of the new housewraps, such as DuPont's Tyvek, to reduce air infiltration.
6. Install large, operable windows and glass doors between the sunspace and the main living area to allow heat distribution by a ceiling fan.
7. Build the main living areas along the sunspace as much as possible for both energy efficiency and visual appeal.
8. Minimize east, west and north side windows, but install enough windows to provide adequate ventilation, light and views.
9. Install an interior vent to allow trapped summer heat to escape into the attic and through ridge and gable vents.
10. Place a 6-mil polyethylene vapor barrier under the basement or crawl-space floor to retard condensation on the sunspace windows.

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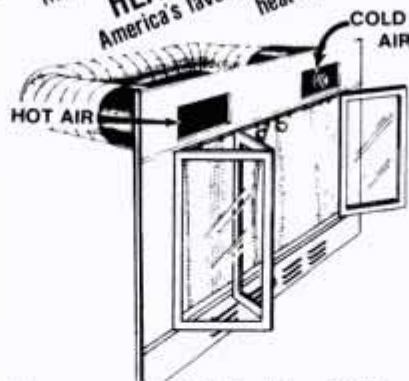
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for a disappointment. But if you think in terms of an ideal natural climate—like a shaded cabana on a Jamaican beach, or a covered lanai in Hawaii—you are in for a pleasant surprise. I prefer this natural comfort over the artificial, and it is much easier and less expensive to achieve. Here are some principles to show you the potential of ventilation.

If you can keep the interior of the house at or below 85°, you can achieve excellent comfort just by inducing breezes. These may be natural breezes captured by opened windows and doors, or they can be created by ceiling fans. Creating a breeze of just a few miles per hour makes the temperature feel 5° to 8° cooler. But remember, for the system to work properly, there must be a way to exhaust the hottest air out of the house.

A common mistake is to place a ceiling fan right where the hot air accumulates, but without a place to exhaust it, so you merely blow extremely hot air around your house. In this cottage, we've installed a louvered wall vent that allows the hottest air—circulated by the ceiling fan—to exhaust into the attic and out of the house through the ridge and gable vents.

However, there are many times during the summer when conditions are so stifling that keeping the house wide

open all day long will cause the interior temperature to climb above 85°. In such cases we have to offer more protection for the inner house. This is done by closing off the sunspace to the inner house first thing in the morning.

The sunspace, however, remains open to the outside to avoid an excess heat buildup. At this point, the sunspace acts as a protective overhang and shading device. Because the sun is higher in the sky during most of the summer, the direct penetration of the sun into the interior of the house is reduced drastically. Again the sunspace acts as a buffer to separate the house interior from the outdoor temperatures.

During these heat spells, you must remember to leave the vent to the attic open to allow the intrinsic heat—that is, heat from cooking, hot water, lighting, appliances—to escape. It may not seem like much, but in summer it is critical.

Summer night

How well a house maintains comfort during the summer day is usually determined by how well it was prepared the night before. The cooler we can make the house during the night, the better it can absorb heat the next day.

Conveniently, this capability is built into the design. The same ventilation system that captures daytime breezes

while exhausting unwanted hot air can transfer the greatest amount of cool air into the house during the night. This, in turn, will offset the heat buildup during the next day.

Between the accelerated evening cool-down, the enhanced ventilation, the shade provided by the sunspace, the efficient exhaust of unwanted hot air and the use of a ceiling fan or two, the cumulative effect is that the house will withstand much more exposure to heat without becoming unbearably uncomfortable. Of course this capability is not infinite. There are some climates that require backup assistance in the form of room air conditioners. But even in those cases, the need to run those appliances will be reduced greatly.

A word about autumn and spring

Autumn and spring are usually ignored in the scheme of super-efficient houses, and that's too bad because in most regions they comprise half of the

(Please turn to page 148)

ADDITIONAL INFORMATION

For those wanting more information, Tom Smith offers a plans book (\$12) and a design manual (\$24.95). The plans book shows his passive solar system incorporated in 10 different home styles. The manual, intended for those who wish to design their own house, gives step-by-step instructions through drawings, charts and clear calculations. Both are available from Tom Smith, Box 584-PM, East Hampton, NY 11937.

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year. True, they are relatively mild, but there are a few things worth noting.

The first is the use of west-facing windows. This is considered a no-no in traditional solar textbooks because west side windows trap unwanted heat during hot summer afternoons. However, the problem can be greatly mitigated by the use of drapes or blinds and the benefits are worth the trouble.

In autumn and spring, there are many times when a house is marginally comfortable in the early evening. The added solar heat offered by west windows can be just enough to make the house naturally comfortable well into

the evening. It may not seem like much in actual quantities of heat, but it occurs at a very strategic time of the day.

So, all in all, I believe this system gives far more while using far less than any design I've seen. It should be emphasized, however, that this design is not a shortcut around good, sound construction practices. It is necessary to insulate—not superinsulate—every area in the walls and ceiling, no matter how small. And you must seal against air infiltration with appropriate caulking and weatherstripping and by using one of the new house wraps, such as DuPont's Tyvek. Staple the house wrap

to the wall sheathing before installing the siding.

Now you may understand why I resist calling this cottage a passive solar house. It's much more than that. It does have solar gain and heat distribution, but contributing in equal parts are: the warmth of the earth, good ventilation design, high-quality construction practices and, finally, the idea that living in ideal, natural climates is far superior to living in artificial ones. In the process, many of the old solar rules may have been broken, but it seems to me that many of them were made for exactly that purpose. **PM**

Passive Solar In Perspective

The energy crisis of the early 1970s started 10 years of experimentation in home building. During this time, architects and home builders proposed a variety of solutions to the problem of high heating costs.

Proponents of passive solar energy banked on the capacity of large expanses of south-facing glass to provide all, or almost all, of the heat the occupants in the house would need. A storage medium, like masonry walls, would hold the excess heat for use at night or on cloudy days. Early enthusiasts of solar energy believed that the combination of glass and mass would become standard throughout the housing industry. But their forecasts fell on deaf ears.

Home buyers tended to shy away from passive solar houses because the homes—especially the early "solar machines"—looked different from other houses. The solar solutions some builders proposed called for totally redesigning the standard house. For the most part, consumers did not accept the drastic changes.

In a survey conducted in 1982 by the National Association of Home Builders (NAHB), builders said that solar components—the glass and mass—added too much to the cost of a house and that there was a general lack of confidence in solar. Still, enough people purchased passive solar houses to keep the solar enthusiasts going. The limited acceptance, however, forced architects and builders to refine solar designs and try new ideas. Some ventured to the opposite end of the energy spectrum and started building superinsulated houses with as much as R-70 in the ceilings and R-40 in the walls.

According to John Spears, a housing researcher with the NAHB Research Foundation, "The designs of energy-efficient housing are coming to a common ground between strictly solar and

strictly superinsulated. The trend today is to build houses that receive a moderate amount of solar energy and at the same time are well insulated. This allows for traditional-looking homes that don't scream, 'Hey, I'm solar!'"

Just such a balance is seen in a solar program sponsored by Northeast Utilities (NU), a group of utilities that serves Connecticut and western Massachusetts. NU asked local architects to create energy-efficient structures in the style of six traditional designs: Cape Cod, Colonial, Country Classic, Raised Ranch, Ranch and Saltbox. The architects could add any energy-saving options they wanted as long as incremental cost increases due to these components had a payback period of seven years or less.

The utility was hoping for six different energy solutions, but instead found all the architects were thinking along the same lines. All the houses had higher than average insulation values—R-25 in the walls and R-38 in the ceilings—but not levels that are considered superinsulated by today's standards. They also shared—in various degrees—the following: foundation insulation, air-infiltration barriers, double glazing with nighttime insulation, or triple, and in some cases quadruple, glazing. But most notable was that none of the houses had large expanses of glass: The south-facing solar glass equaled no more than 10 percent of the building's total floor area.

The NU designs counted on the sun providing only a moderate amount of energy; the rest of the savings would come through conservation. The total energy-saving potential of these homes is claimed to be between 40 and 53 percent of the energy used in neighboring conventional homes.

So, by raising insulation levels, plugging energy leaks with weatherstripping

and caulking and by installing good windows and doors, builders can make it possible for homeowners to save a good deal on purchased energy without radically changing the outward appearance of a home.

Spears says that passive solar building manuals have always stressed the importance of these conservation measures. But only recently have they been given the credit they really deserve. Furthermore, these methods are straightforward and reliable, which make the idea easier for builders to adopt. And because the houses look traditional, home buyers are more likely to accept them.

In fact, the NU models are having some remarkable success among potential buyers. Over 4000 people toured two models—in a 2-weekend period—that were open to the public as part of the program. And close to 30,000 people have purchased *The Solar Home Planbook*, a publication that explains the six designs. NU plans to publish a new edition that will include two more designs. For more information, contact Northeast Utilities, Operation Solar, Box 270 Hartford, CT 06141.

Spears also points out that buyers can still find "traditional" solar homes, those with lots of glass and lots of mass. In fact, the newer trends discussed here represent a consensus of opinion among researchers more than actual preferences of builders and home buyers. Yet many architects and builders seem to be moving in the new direction.

"People don't want to live in energy systems," says Donald Watson, an architect from Branford, Connecticut, who designed a house for the NU program. "They want to live in houses. After 10 years, we've ended up with some pretty straightforward designs and any builder not using them is doing a disservice to his clients."—David Eaton

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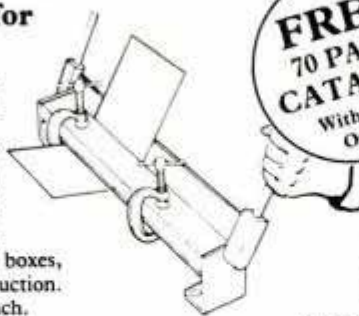
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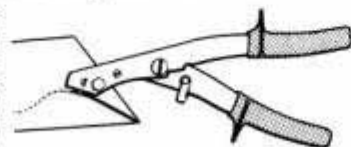
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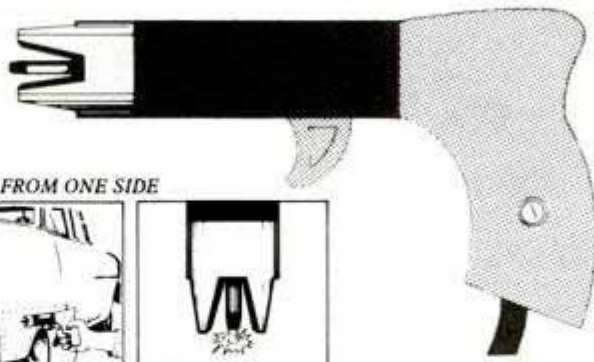
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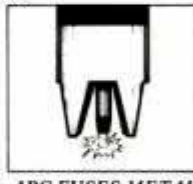


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DETROIT'S NEW ERA CARS

(Continued from page 96)

and final assembly under one roof; sort of a latter-day version of Henry Ford's Rouge complex. The plant will employ up to 6000 workers to turn as many as 500,000 cars a year at the outset.

The Saturn prototype that GM has displayed is fairly conventional in design—no exotic materials, no innovative designs to speak of. The Cavalier-size subcompact is a 2-door notchback coupe powered by a fuel-injected, aluminum-block 1.9-liter 4-cylinder engine

for a tiny van-wagon people mover and perhaps either a notchback 2-door or a sporty/performance hatchback.

The look will be aero, but other than that, Rybicki will say only that the Saturn cars "won't look like anything that's on the road now." He implies the styling will be more revolutionary than the engineering features.

As far as Saturn manufacturing techniques go, we've heard that the aluminum-block engine will be cast using the lost-foam process, although the engineers have been having some recent problems with that system, and may



GM's Saturn prototype has the "formal" roofline typical of so many GM models. The Cavalier-size car has a 1.9-liter aluminum Four with fuel injection and fwd.



Chrysler's Liberty I prototype is a Colt-sized hatchback with a plastic body and a 1.6-liter, 3-cylinder version of the Mopar 2.2-liter Four. Styling has Honda overtones.

driving the front wheels through either a conventional 5-speed manual or a 4-speed automatic overdrive transaxle. Inside, the prototype features one-piece foam bucket seats, with instruments clustered in a pod behind the steering wheel and the sound system and climate controls in a freestanding console between the front seats.

Don't be fooled by the styling of the Saturn prototype. GM Design Vice President Irv Rybicki hints, "If you like the looks of (the prototype), wait 'til you see the real Saturn car when it goes into production." Rybicki says there will be three or four body styles, with staggered introductions. First up will be the 4-door notchback sedan and maybe a hatchback coupe, probably in the 1989 model year. Six to 12 months later, look

switch back to a more conventional method. It wouldn't be too surprising if something as mundane as Olds's new 16-valve 2.3 or even Pontiac's old 2.5 Iron Duke winds up in Saturn instead.

Two new transmissions are being developed for the Saturn: A 5-speed manual and 4-speed overdrive automatic, both relatively conventional so they can be built cheaply. Same goes for the structural design: No costly composite bodies over space-frame chassis, but merely simple stamped steel panels and conventional unitized design. Biggest innovation is the so-called "modular assembly"—subassemblies like instrument panels or rear suspension modules will be built at substations, then sent to the final assembly line for installation.

GM also talks about using flexible automation (program the computers so machines can perform several tasks) and machine vision (robots with video cameras that can actually see the parts they're working on), among other advanced methods. Also, computer control of inventories, quality control—even payroll—all tied to a central system that can be accessed from the executive suite or shop floor, thanks to the wizards at EDS, the electronics company GM recently bought.

GM anticipates excellent fuel economy with Saturn: 45 mpg in city driving and 60 mpg on the highway. And Smith says Saturn, although it won't be GM's lowest-priced car, will compete in the same market against such leading imports as the Toyota Corolla and Nissan Sentra. But he adds that GM, after it launches Saturn, will continue to import even smaller and cheaper cars from Korea and Japan—including the Sprint (Suzuki) and Spectrum (Isuzu).

Chrysler's Liberty

Chrysler Chairman Lee Iacocca, hopping no doubt to cash in on some of the Saturn publicity, told Wall Street auto analysts that Chrysler would beat GM to market with an import-fighter of its own, dubbed Liberty. He showed analysts a plastic-bodied prototype of a Colt-size 2-door hatchback, powered by a 1.6-liter, 3-cylinder variant of Chrysler's 2.2-liter Four, with mileage touted as high as 75 mpg. The car looked very Honda-like from some angles.

The Liberty prototype uses resin-injected body (something like Lotus uses, but much simpler and cheaper) to test stronger, weight-saving composites. The Liberty can also be built in modules, including the cooling system, front end (fenders/hood/grille/headlamps), instrument panel, rear hatch (a one-piece molding with glass and taillights). Later, even the front doors may be built as modules.

Advanced engineering features on upcoming Liberty-type cars are said to include electronic power steering and automatic transmission, controlled from a central microprocessor. It's suggested that top-of-the-line cars with lots of options and accessories will use up to a dozen microprocessors, all multiplexed to save weight and complexity.

Chrysler is relying more heavily on advanced technology from outside suppliers than GM, both in engineering and manufacturing.

When Iacocca visited Japan in April, he recanted some of his earlier Liberty hype. "I don't think there will be a 'Liberty' car, per se," he told reporters in Tokyo. Instead, he said, Chrysler will apply manufacturing techniques it learns from its Liberty project (original-
(Please turn to page 152)

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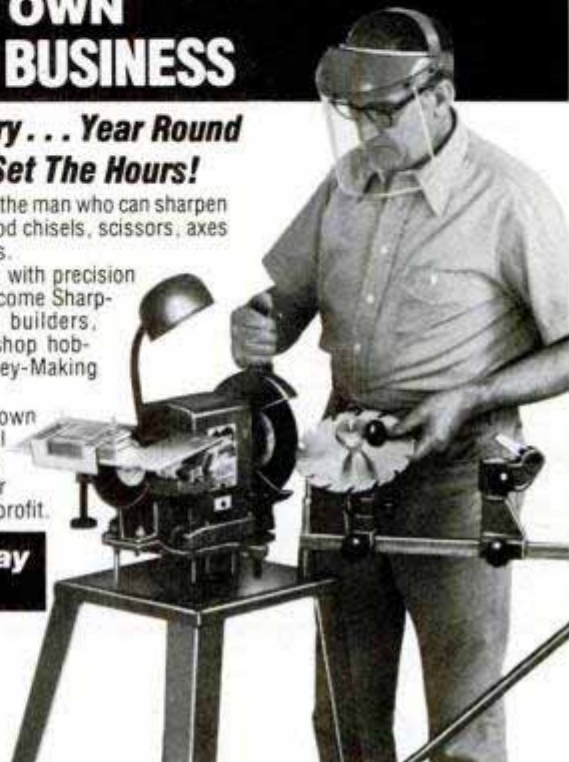
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DETROIT'S NEW ERA CARS

(Continued from page 151)

ly called Concept 90 when the project was begun in early 1983) to cut costs of its other new-car programs, including a subcompact line planned for 1989, code-named Z-body. The goal of Liberty, he added, is to learn how to slash 20 to 30 percent from the cost of building a domestic car by using new materials and methods.

Iacocca said, "The urgency of (Liberty) is to try to build a car—we didn't say what car—and, through new manufacturing processes, take \$2000 (in cost) out of the average car."

In May, Chrysler showed the same prototype to its shareholders at its annual meeting in Anaheim, California, referring to the car as "Liberty I."

"Our goal is to build it in America," noted Iacocca proudly—although his public relations people a month earlier insisted that the prototype was "an idea car that's part of the Liberty project... not the Liberty car." Liberty, in fact, was not a car at all, they admitted, but basically "a project" to learn "how you can efficiently build a small car in the U.S. to compete with imports."

Confusing? Certainly. Iacocca added fuel to the fire at a press conference in Korea, where he observed: "Liberty is an advanced development project that will develop into a car or series of cars around 1989 or 1990. Where we might be building those cars in 1989-'90, using the best of the Liberty concepts, depends on the strength of the dollar. There might be a great deal of it built in the Far East, some in Korea and Japan, hopefully much of it in the U.S."

Chrysler meanwhile has asked its Japanese affiliate Mitsubishi to ship it up to 200,000 subcompacts a year, including 1-liter minicars, and will jointly produce sporty small cars designed by Mitsubishi in a new U.S. plant in 1989. Iacocca also has speculated that Chrysler's new parts-buying partnership with the Korean conglomerate Samsung could lead to small-car assembly in Korea in early 1990s. Those Asian ventures cast further doubts on whether Liberty will ever become a full-fledged car line, or simply remain a development project.

Ford's Alpha

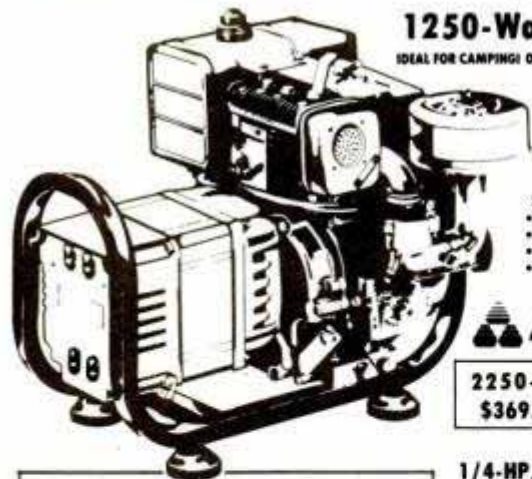
Similar doubts linger over the future of Ford's Alpha project, although Ford officials say they've already begun incorporating elements of Alpha's advanced manufacturing techniques—modular assembly and so on—in some of their newest cars and plants, including St. Louis (Aerostar) and Atlanta (Taurus/Sable).

As for the Alpha project itself and the prospect of building a total car, "It's

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mainly a paper program right now," says one Ford marketing official. Another describes Alpha as "a fundamental approach to designing cost-competitive small cars, as well as our factories of the future, incorporating leading-edge technology."

Paul Guy, director of Ford's Manufacturing, Engineering and Systems office, says Alpha "will lead to major changes in the systems and design procedures we use. It's a re-examination of the whole process of designing, manufacturing and marketing our products." Guy said the Alpha project was established in early 1984 and now has 30 full-time participants, including members of the technical and strategic planning staffs. Eventually, design and manufacturing people from Ford's European operations will be assigned to the project.

One objective of Alpha, Guy said, "is to produce a cost-competitive, high-quality, world-class small car, not necessarily a domestic small car." Our Alpha illustration shows Ford's next generation small car, which will include Alpha project techniques but will probably not carry an "Alpha" nameplate. Guy added: "This is a worldwide effort. The (Alpha) concepts and technology will be made available to all our worldwide operations."

One exception: Ford has no plans to include its Japanese affiliate, Mazda Motor Corp., in the planning of Alpha, although Mazda will play a key role in the development of other future Ford small cars. Mazda will supply engineering and parts for a new sporty subcompact Ford will produce in Mexico in 1988, and it will build a high-performance, front-drive compact model for Ford in Flat Rock, Michigan, in late 1987 that will replace part of the Mustang line.

Far East partnerships

Ford has also talked with Mazda and its Korean affiliate, Kia Industries, about importing a new 1-liter minicar that Mazda will unveil this fall in Japan. Ford may buy a Korean-built version of the car from Kia in 1987-'88 to slot below the Escort in the U.S. As with Chrysler and GM and their Far East partnerships, Mazda's growing involvement in Ford's future small-car plans could preclude Alpha ever developing into a formal car line. Regardless of the fate of Alpha and Liberty, a key ingredient of both projects (as in GM's Saturn program) is to develop new ways of designing, engineering, building and selling cars that are faster and cheaper than the present systems.

As Dr. David Cole, director of the University of Michigan's Office for the Study of Automotive Transportation, observes: "It's important to realize that the products themselves are not that revolutionary. The new processes will be far more important."

In 1984, GM produced only 11½ cars per employee each year. Ford built 16, Chrysler 18½, and Toyota an astounding 66.7 cars per employee! So Detroit has a lot of catching up to do. Says Cole: "All the companies expect to employ some 'leap-frog' technology in both hardware and electronic integration on the shop floor." The new processing systems, he adds, will be "far less labor-intensive than anything we've seen," which will help reduce production costs.

Manufacturing efficiency

The automakers hope to bring the manufacturing engineers into the development process early to ensure that manufacturing efficiency is considered in designing the vehicles. Suppliers will work closely with designers and Eaton; newer, high-tech firms like Motorola, IBM and Hewlett-Packard; and materials experts like DuPont and 3M.

Just how successful these efforts are in integrating new systems and technology and reducing costs will determine to what extent all three domestic programs—Saturn, Alpha, Liberty—will be true import-fighters. **PM**

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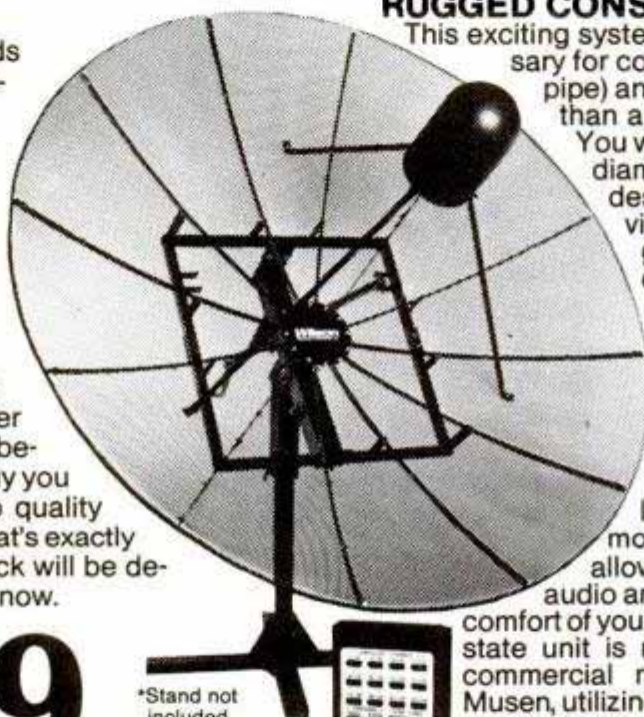
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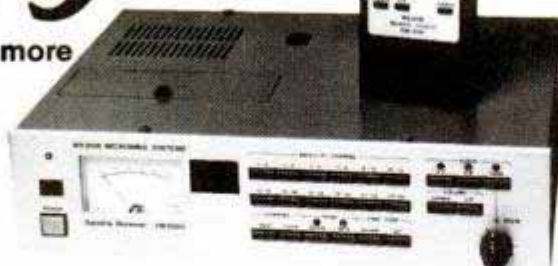
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Here's a common sense guide to the new thinking thermostats.

BY LEE GREEN

The homeowner trying to pick a thermostat today is much like a kid in a candy store. There's just too much to choose from.

Computerized, programmable, solid-state, energy-efficient or just plain "smart"—there are literally hundreds of thermostats on the market, using the most up-to-date technology to help save you energy. The chart on page 158 lists some of the major brands available and tells what each will do.

Faced with all this sophistication, it's sometimes hard to remember that an automatic thermostat's job is essentially a simple one: to turn down your home's heating or cooling when it's not required and to turn it back on automatically when it is. Keeping that job in mind, though, can help you save money and avoid some unexpected pitfalls when you go about selecting a thermostat.

The reason an automatic thermostat can save you money is because a cool house loses heat more slowly to the outdoors than a warm house (we'll be talking here mostly about heating; during the cooling season, of course, the direction of heat flow is reversed but the principles involved are the same). The cooler the house, and the longer the period of time it's kept cool, the more you save on your heating bills.

You could, if you wanted to, achieve the same savings without an automatic setback thermostat by simply turning down your manual thermostat whenever you didn't need heat, and turning it up when you did. But

you'd find yourself waking up to a cold house each morning, and coming home to a cold house when you return from work.

Even under the least optimal conditions, a setback thermostat is likely to save you some fuel. It will guarantee you at least six or seven hours of sleeping time reduction even if you forget to turn back the heat before going to bed. Besides, you can cut back your nighttime temperature to as low as 50° if the heat is set to rise before you do—so you can avoid frostbite getting out of bed.

An automatic setback thermostat's main job is to provide the savings without the discomfort. And what the thermostat is required to do to accomplish this job depends upon your house, your heating system and the way you live.

Daily setback cycles

Turning down a thermostat doesn't really begin producing significant savings until the house has just about cooled down to the lower temperature you've selected. Until then, any reduction in heating costs during the cooling-off period will be offset by a corresponding increase later while the furnace reheats the house. If your house takes, say, 2 hours to reach the lower setback temperature and another 1½ hours to return to the comfort temperature, 3½ hours of the total setback cycle time will produce little energy saving. In other words, a cycle of less than 4 hours or so won't do you much good. If your house can cool down to the set temperature and reheat within 2

hours, then 3 hours will be your minimum worthwhile setback cycle time.

Generally, masonry homes, or homes with steam heat, take longer to reheat than those with hot air or hot water heat. And the length of time required will depend on how many degrees you lower the thermostat setting for setback, the heating capacity of your furnace, the outdoor temperature and how well-insulated your house is. The simplest way to tell is to try it. Manually turn down your existing thermostat on a cold day, and time how long it takes the room temperature to drop to the new setting. Then, reset the thermostat and time the reheat portion of the cycle.

The point of all this is to determine the maximum number of cycles per day that can do you any good. There's no point in paying extra for a thermostat just to get more cycles than you need. Experience has shown that, for most people, a two-cycle-per-day thermostat is adequate. If there's someone home all day, and you don't normally turn the heat down except at night, one cycle per day is all you really need.

Weekend cycles

If you like to sleep late on weekends, or if you turn down the heat from, say, 9 a.m. to 2 p.m. on weekdays but don't want to on Saturday and Sunday, a thermostat with provisions for different setback times and temperatures on weekends is for you. There are several arrangements available on today's thermostats, varying from

the capability of programming each day of the week separately (summarized on the chart in the Day of Week column as 7 days) to the simpler ones that offer only one combination of cycles each day (1). In between are the ones with which you program 5 weekdays identically, but permit a different program for the two weekend days (5/2) and those that keep the weekdays on the same schedule but let you program the two weekend days independently from each other (5/1/1).

Skip and vacation controls

Automatic thermostats don't vary their routine. They don't have late parties, go on vacation, take days off from work or just simply change their minds about what's comfortable. But you do.

Since you want your thermostat to make your life easier, and not to dictate how you should live, it's important to have a convenient way to override the thermostat's programming. If, for instance, there's a movie on the "Late, Late Show" that you don't

want to miss, and your thermostat is programmed to turn the heat down to 55° starting at 10:30 p.m., you might find yourself thoroughly chilled by the time "Casablanca" is over. Or, if you and your family decide to take a winter vacation, your thermostat would continue switching your furnace on and off at the same times whether you were there or not.

You could, of course, reprogram your thermostat whenever you wanted it to depart from its normal routine, but reprogramming can be tedious and complicated. A much better solution is provided by the thermostats that have a simple skip control—to skip one change without affecting subsequent ones—and a vacation control—to lock the thermostat at the desired temperature setting until it's instructed otherwise.

Different thermostats have different labels for skip and vacation controls; many involve several steps of programming. The chart lists those that let you make the settings with minimum fuss.

How setback thermostats work

The number of cycles possible per day, the presence or

absence of weekend programming and skip and vacation controls are, for most people, the features of greatest importance in a thermostat. There are some other important considerations, dealing less with what the thermostat does than with how and how well it does them. Let's take a closer look at automatic thermostats.

In its simplest form, an automatic thermostat is a clock-operated switch, changing settings back and forth between two temperature settings at preset times. Traditional mechanical designs, first introduced in the '30s, still work that way. Although today's mechanical thermostats are much more flexible than their early ancestors, they are basically electric clocks with a mechanism for tripping a mercury or snap-action switch.

More recently, the electronic thermostat, a child of micro-computer and digital-watch technology, has arrived upon the scene, and is grabbing most of the advertising headlines. The electronic models offer the possibility of much more sophistication in programming timing and control functions. But both types of thermostats have their advantages and disadvantages.

The earliest mechanical thermostats used a.c.-operated clocks, powered by a pair of wires separate from the furnace control circuitry. This led to 3-wire and 4-wire installations, as opposed to the 2-wire systems typical of nonautomatic models. The extra wires made conversion from nonautomatic to automatic thermostats a difficult one because it involved stringing wires through existing walls.

When the energy crisis of the '70s created a renewed interest in replacing thermostats, the industry responded with battery-operated clocks on their thermostats; the batteries automatically recharged whenever the thermostat wasn't calling for heat. These thermostats—they're still around—require only two wires, so they made easy do-it-yourself installation possible.

Typically, a mechanical thermostat is programmed by positioning removable pins onto a rotating dial. Some will permit as many as three cycles per day, but none of the widely available ones allow different settings for weekends.

An electronic thermostat replaces the clock mechanism with a solid-state electronic clock, and the removable pins with a programming keypad.



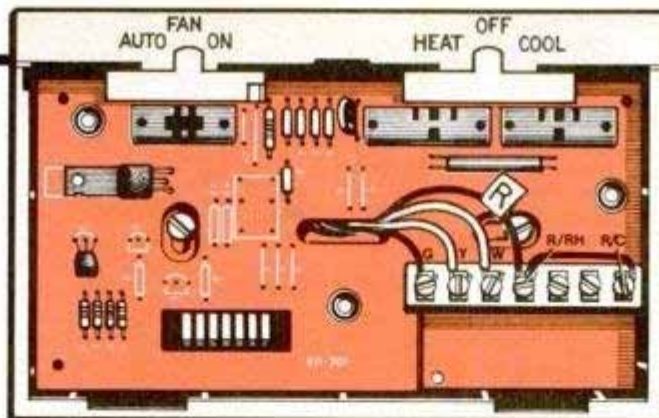
The "smart" operation and the memory of the electronic model's microprocessor make possible a variety of fancy features. Besides programming for weekends and vacations, they can even keep a running record of the energy you use, or computed turn-on times to adjust for varying weather conditions.

Picking the right thermostat

Even though setback thermostats aren't that expensive, they can be complex. It's important to choose one that not only suits your comfort needs, but one that will install and operate without problems.

Early battery-equipped mechanical thermostats had some problems with battery life and replacement availability. This situation seems to have cleared up. However, some mechanical models, the Honeywell 8082 for example, still operate on special batteries that are available only from dealers.

If you have a heat pump, keep in mind that heat-pump systems present unusual problems to setback thermostats, especially mechanical models. Because the process of reheating the house after a setback often requires more heat than



Typical 4-wire heating/cooling hookup: green, yellow and white wires go to marked terminals; red heat and red cool terminals are joined by jumper wire. If your wires aren't color coded, mark them with tabs before removing them from old thermostat.

the heat pump can supply, most heat pump controllers will automatically switch in expensive-to-run resistance strip heaters to make up the difference. Thus the net cost of reheating can easily cost much more than was saved by the setback.

Several manufacturers produce setback thermostats for heat pumps (indicated by HP on the chart).

These thermostats, most of them electronic models, can adjust their programs to avoid inefficient operation. If you have a heat pump and are planning to install an automatic setback thermostat, make sure the thermostat you select is compatible with a heat

pump. We've noted the thermostats in our chart that are suitable for such service, or which also are available in a heat-pump version.

Electronic thermostats can also suffer some annoying problems. Many models, even though they incorporate a battery to power their electronics and maintain the program's memory, use the power line's 60-cycle frequency to time their solid-state clocks (these are identified on the chart as L in the column headed Clock Timing). As a result, any power outage, even a brief one, will cause the thermostat's clock to drift off the correct time. This situation doesn't exist with mechanical clocks

equipped with battery backup: The clock just continues to chug along on battery power during a power outage.

To make matters worse for these electronic models, some heating system control circuits create their own power "outages." Many automatic vent dampers and zone-valved systems cut the supply of electricity to the thermostat during part of the system's operation. The result, to a thermostat that depends upon line voltage for timing, would be a never-ending demand for resetting the time-of-day. To avoid this, you must install a separate relay to isolate the thermostat's power source from the heating system circuitry.

Some of the electronics (marked with a B on the chart) have gone completely to battery operation, with the timing circuits independent of the power lines. These avoid the problems associated with loss of power. The PSG Compustat is one such model. However, like the mechanical Honeywell, the Compustat uses special batteries; this could be a nuisance in case of an emergency failure. The other thermostats marked B on the list use commonly available batteries, a real advantage.

- A. First Alert Autostat (round)
- B. Emerson 1F70
- C. Delta Dore Tybox 3A
- D. Quad Six Magic-Stat 2000
- E. PSG Compustat
- F. Harper-Wyman Pro-Stat T5020
- G. Honeywell CT352
- H. Hunter Energy Monitor
- I. Jade J3000
- J. American Stabilis Digistat
- K. Robertshaw T60
- L. Sears Thrift-T
- M. First Alert Autostat (square)
- N. Johnson T100



Another difficulty with some electronic units is the often peculiar logic required to program them. The Johnson T100, for instance, requires you to enter the *starting* temperature for each cycle, not the temperature you wish to reach. And the Quad Six Magic-Stat requires programming to occur at the time you wish the cycle to change: If you want to switch on heat at, say, 5 a.m., you must get up at 5 a.m. to program it.

Modifying programs usually calls for a review session with the instruction manual, and can take a good deal of time. The Robertshaw T60, for example, requires five key-strokes to set the time, five more to set the comfort temperature level, and 23 key-strokes to set the first day's two setback cycles. After that, you can either copy that program to another day (four strokes for each day), or use up to another 28 strokes for each day you wish to program differently.

Heating system compatibility

The major question you must answer when you're buying an electronic thermostat is that of compatibility with your heating systems'

controls and circuitry. Home heating system controls are astoundingly nonstandardized, and some existing installations—including many that work well—are not only tributes to the installer's ingenuity but worthy monuments to the late Rube Goldberg.

Trying to manufacture an electronic thermostat adaptable to all the variations is well-nigh impossible. Trying to write a comprehensible instruction manual to cover all the situations in which the thermostat would work well is just as awesome a job. Mechanical thermostats make the task a good deal simpler, if only because they're easier for both homeowners and servicemen to understand. The electronic models tend to be harder to adjust in order to cope with a heating system's peculiarities.

How can you be sure that the thermostat you choose will work with your heating system? That's not always easy to answer. Even the instructions supplied with the thermostat don't help much—they're packed *inside* the package, and you generally don't get to read them until after you've bought the thermostat.

Probably the closest thing to a universal electronic setback

thermostat anyone has come up with is the First Alert Autostat—and that isn't really a thermostat at all. The Autostat is an add-on electronic timer that can be programmed to readjust your existing nonautomatic thermostat at preselected times.

The Autostat comes in two versions: one for round thermostats and one for rectangular ones. Both versions are battery operated and completely independent of the power lines. The Autostat can be programmed for two cycles per day, and handles weekends with a 5/2 arrangement. Its greatest advantage, though, is that if your existing thermostat controls your heating system properly, the Autostat won't create trouble.

The Autostat isn't without drawbacks, however. Since it attaches to your existing thermostat, the complete installation can be twice the size of a thermostat alone—a possibly jarring note in your decor. The Autostat won't work with multistage heating or cooling systems, nor with heat pumps. And the motor that changes the setting on your old thermostat makes a loud whirring noise every time a setting change is made.

In general, virtually any

electronic thermostat will be compatible with your heating system if it's a simple, 1-zone system, and does not cut off electrical power to the thermostat. Electrical interruptions can come from a furnace with spark ignition, electric vent dampers, zone valves or an oil burner with a purge cycle. If you have any of these, use a thermostat that operates entirely by battery.

If you plan to control both your heating and air conditioning systems, be sure to choose a thermostat intended for these functions (marked H/C in the Comments column of the chart). For a multistage heating and/or cooling system, select from among those marked MS on the chart.

If you're still uncomfortable about picking the right thermostat and getting it to work properly, you can always have a reputable heating contractor do the job. A professional contractor can usually give you a performance warranty.

If you buy the thermostat and do the installation yourself, and run into a problem, call the manufacturer and yell for help. Many manufacturers maintain toll-free hotlines for that purpose. Chances are pretty good, however, that you won't need any help. In fact, the only help you're likely to need—after you've installed the little wonder—is remembering *not* to turn down the heat before bedtime. **PM**

COMPARATIVE GUIDE TO THERMOSTATS

MANUFACTURER	MODEL	SUGGESTED LIST PRICE	TYPE	CLOCK TIMING	CYCLES PER DAY	DAY OF WEEK	SKIP CONTROL	VACATION CONTROL	COMMENTS
American Stabilis	Digistat	\$150	E	L	3	5/1/1	Y	N	H/C
American Stabilis	Superstat	376	E	L	3	7	Y	Y	H/C, HP, MS
CEMCO	Ultra-Stat	55	E	B	2	1	N	Y	H/C
Delta Dore	Tybox	120	E	B	5	1	Y	Y	H/C
Delta Dore	Tybox 3A	365	M	B	4	7	Y	Y	H/C
Emerson	1F70	60	E	B	3	1	Y	Y	H/C
Emerson	1F90 Digital	119	E	B	2	5/2	Y	Y	H/C
First Alert	Autostat	40	E	B	2	5/2	Y	Y	Add-on timer
Harper-Wyman	Pro-Stat T5020	240	E	L	2	7	Y	Y	H/C
Harper-Wyman	Pro-Stat T5000	290	E	L	2	7	Y	Y	H/C, HP, MS
Honeywell	T8082	95	M	B	3	1	Y	Y	H/C, HP
Honeywell	T8200	120	E	L	2	5/2	Y	Y	H/C
Honeywell	CT350 series	80	E	L	2	1	N	Y	H/C, HP
Hunter	Energy Monitor	100	E	B	2	5/1/1	N	N	H/C
Jade	J3000	65	E	L	1	1	N	Y	H/C
Jade	2000	100	E	L	4	5/2	N	Y	H/C, HP, MS
Johnson	T100	120	E	B	2 1/2	7	N	Y	H/C
PSG	Compustat	97	E	L	2	1	Y	Y	H/C
Quad Six	Magic-Stat	80	E	L	3	7	Y	N	H/C
Quad Six	Weather Wizard	100	E	B	3	7	Y	Y	H/C
Robertshaw	T60	100	E	B	2	1	Y	Y	H/C
Robertshaw	Quartz Setback	50	M	B	2	1	N	Y	H/C
Sears	Thrift-T	50	M	B	3	1	N	Y	H/C
Sears	Weekender	100	E	B	2	5/2	Y	Y	H/C
Trane	T8300	275	E	L	2	5/2	Y	Y	H/C
Valera	Enerstat K3	130	E	L	2	5/1/1	Y	Y	H/C
Valera	Enerstat HP-1	230	E	L	2	5/1/1	Y	Y	H/C, HP, MS

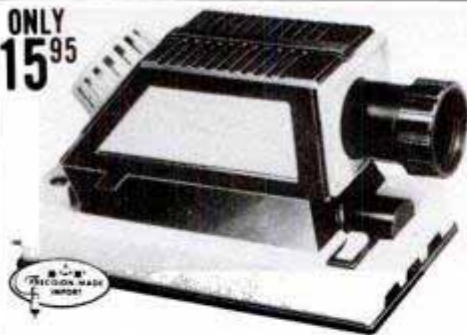
E=electronic, M=mechanical, L=house current, B=battery, Y=yes, N=no, H/C=heating/cooling, HP=heat pump, MS=multistage

SOURCES

American Stabilis, P.O. Box 1289, Lewiston, ME 04240
 Autotronics, 1399 Executive Dr. W., Richardson, TX 75081
 CEMCO, Rt. 2, Box 289A, Piney Flats, TN 37686
 Delta Dore Corp., 11400 Rockville Pike, No. 750, Rockville, MD 20852
 Emerson Electric Co., 9797 Reavis Road, St. Louis, MO 63123
 First Alert, 780 McClure Rd., Aurora, IL 60504
 Geodesco Energy Services, 6011 Benjamin Rd., Tampa, FL 33614
 Harper-Wyman Co., 930 N. York Rd., Hinsdale, IL 60521
 Honeywell Inc., 1985 Douglas Dr. N., Golden Valley, MN 55422
 Hunter Div., Robbins & Myers, Inc., 2500 Frisco Ave., Memphis, TN 38114
 Intertherm Inc., 10820 Sunset Office Dr., St. Louis, MO 63127
 Jade Controls, Box 271, Montclair, CA 91763
 Johnson Controls Inc., 1250 E. Diehl Rd., Naperville, IL 60540
 PSG Industries Inc., 3753 Plaza Dr., Ann Arbor, MI 48104
 Robertshaw Controls Co., 100 W. Victoria, Long Beach, CA 90805
 Sears, Sears Tower, Chicago, IL 60684
 Sunne Controls, 4720 S.E. 17 Ave., Portland OR 97202
 Trane Co., 3600 Fammell Creek Rd., La Crosse, WI 54601
 Valera Corp., 428 Fourth St., Annapolis, MD 21403

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LEISTER

GOLDEN GUNS (Continued from page 110)



Just what do commemorative arms actually commemorate? In this case, it's the life and work of actor John Wayne. Winchester issued this John Wayne silver engraved Model 94 in 1981 as part of a 300-unit set. Inset shows detail of the Model 94's distinctive stock medallion.

The "presentation" grade is finished in Colt Royal Blue, lavishly hand engraved with tasteful floral patterns and embellished with high-relief gold inlays. Ivory stocks, where they are allowed by law, and a glass case set off with Tyrol red velvet round out the presentation, currently priced at \$20,000. All three grades represent prime examples of the master-engraving and gunmaking arts.

But it's not necessary to spend thousands to become a commemoratives collector. The factory list price on a Colt SAA .45 revolver finished in plain blue and packed in a cardboard box is \$699.95. For about \$4 less you can own the same pistol issued in 1971 as one of 5000 NRA Centennial commemoratives, or one of the 900 issued in 1970 for the Missouri Sesquicentennial. There are still some decent buys for less than \$1000, and there's still room for commemorative arms to appreciate as an investment. The two pistols just mentioned originally sold for \$250 and \$220, respectively.

A great deal of the difference in price will be determined by the nature and the extent of ornamentation engraved on the gun's metal parts. Lesser priced arms are often roll-engraved, a process that transfers engraved characters on the rim of a disc to the gun metal as the disc rolls across it under pressure. Etching is the next level, and can be mechanical or acid-solution, both of which allow more intricate scribing of letters and scrollwork. Hand engraving is by far the most costly, and there are not that many practitioners in the field.

The three rules that really count for the beginning collector and the veteran alike are "condition, condition and condition." The finish should be perfect in every way, with no signs of wear. Gold inlays should be a uniform color all over the gun,

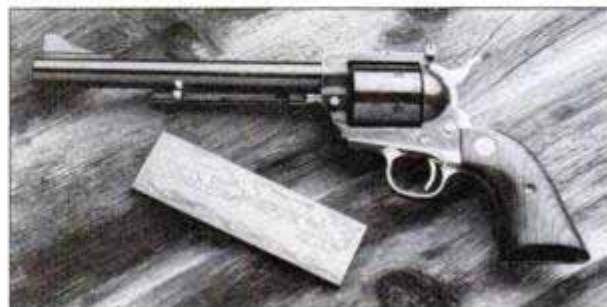
without discoloration on backstraps, trigger guards or other places where handling is likely.

The arm should never have been fired—nothing diminishes the value so fast. The presentation box should be in perfect condition, and it should contain all the accessories that came with the gun—including special books, medallions, ammunition, cleaning tools or black powder accessories.

Before you start collecting, get to know your local gun dealers a little better, and find out if any of them already deal in commemoratives. Attend the gun shows held in your region, and don't be timid about asking all the questions you want. Find a dealer you can trust. Make sure that if you're not happy with the arm, you don't own it. Several monthly magazines can alert you to new issues. You may be getting in on the ground floor of what may turn to be a handsome investment.

Bob Cherry likes to tell the story about the guys he plays poker with on weekends. He told them back in 1961 when the first modern commemorative, the Colt derringer, came on the market, "You know you guys should buy one of these Geneseo Commemorative Colt derringers for \$27.95, because you're going to lose more than that tonight." Not one of them would buy the tiny .22, now valued at \$495.

I guess we've all had opportunities like that. **PM**



Colt issued this .45 caliber New Frontier in 1966 to commemorate the Abercrombie & Fitch Co. department store. The value of the Abercrombie & Fitch commemorative issue has increased dramatically in 20 years, from \$275 when issued to a current price of \$1950.

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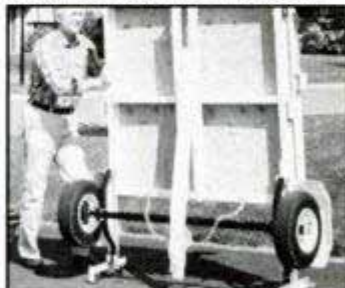
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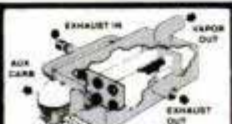
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(Continued from page 95)

noses with flush headlights that make them look 1000 percent better. Sleeper of the year is the new 86-hp, 1.9-liter engine for the Escort and Lynx. The HO version of this overhead-cam Four has multipoint fuel injection, good for 115 hp @ 5400 rpm and 115 lb-ft. of torque @ 4600 rpm. Combined with the GT package (called XR3 on the Lynx), 5-speed transaxle, 3.73 final drive ratio and 195/60HR15 Goodyear Eagle GT tires, this is one fun car that's fast, agile and modern enough to have run away with our *Pocket Rocket Comparison Test* (page 76, Aug. '85), had it been available.



Pontiac Advanced Radio Concept adds full radio control to the steering wheel hub.

Biggest change in Ford's carryover rear-drive cars is the addition of multipoint sequential fuel injection to the 5-liter V8. It's easy to spot because it incorporates a large and elaborate aluminum intake plenum. Base engines develop 8 percent more power (160) and 6 percent more torque (280), but the HO engine used in hot versions of the Mustang, Capri and Mark VII is down 10 ponies from 210 hp last year to 200 in '86. All is not lost, however, because torque is up 20 lb-ft. to 285, and the Mustang we slid around the test track felt just as strong as last year's.

The ears have it

In what sounds like a successful attempt to one-up Delco-Bose, Ford will introduce a new top-of-the-line Ford-JBL sound system in the '86 Continental. JBL is one of the biggest names in quali-

ty loudspeakers, widely used in pro sound studios and live concerts. The 4-amp, 140-watt system features a Ford receiver and cassette player with 12 JBL speakers. The clarity and response of the system is uncanny, especially for high-quality metal tapes. This is one car stereo you'd want for your living room.

New strategy at AMC

Jeep, the brand name that doesn't even sound right unless you say 4-wheel drive first, has taken a fresh look at the compact pickup truck market. Realizing that many of the trucks sold never see serious off-road duty, AMC will now offer its first 2-wheel-drive pickup since 1947. The all-new Comanche will, of course, come in 4wd as well, with a choice of 4wd systems, either the part-time Command-Trac or the full-time Selec-Trac both having shift-on-the-fly capability. A prototype Comanche was included in our 4 x 4 test last month (see *4-Wheel-Drive Pickups—Torture Test*, page 84).

In that encounter with the Comanche, we found the truck to be a worthy member of the Jeep family, rugged and dependable without being abusive to drivers. The hard facts of the new model show how well the product planners did their job: It has the longest wheelbase in the class at 119.7 in., the greatest payload (2205 pounds with optional suspension) and the widest double-walled pickup box, at 44 in. between the wheelhouses.

There are three engine selections for the Comanche. Most utilitarian is the throttle-body, fuel-injected 2.5-liter Four, a chopped version of the venerable AMC Six. For heavy hauling there's the 2.8-liter V6 (sourced from Chevrolet) and a French-built 2.1-liter turbodiesel Four. The TBI Four actually outpowers the V6 117 hp to 115, but the Six has an advantage in torque output.

Three trim levels will cover the Comanche buyer's needs—the base Custom for commercial users, the upgraded X model and the decked-out XLS with snappy exterior graphics.



Corvette convertible, caught in a spy shot, goes into production at press time.

French cooking

Low-profile AMC and its partners from Renault are quietly bringing the rest of the product line up to industry-leading standards. For instance, the Alliance, Encore and Renault Sportwagon now carry a 5/50 Plus Limited Warranty (introduced last spring), which covers all required maintenance at no charge to the owner. Items like sparkplugs and filters even are covered, and though the owner must pay for oil, AMC pays for the labor to have it changed.

Alliance and Encore remain essentially unchanged, though advances have been made in the electronics department. A 6-speaker Accusound by Jensen option is available for all stereo radios, and an Encore Electronic model has been added. In this case, Electronic does not mean a new type of powerplant, but rather a digital instrument cluster.

Up-rated suspensions, new interior trim and a bigger push for the Renault Sportwagon (the company's only true import) round out the AMC lineup at this point. But the company with America's lowest-priced convertible (the Alliance at \$10,345) has a few cards up its sleeve: the new Jeep YJ to be announced in the spring and the French-built Alpine sports car.

The GM game plan

The majority of new developments at General Motors are focused on two body lines, the family-size H-cars (Buick Le Sabre and Olds Delta 88) and the revised personal luxury models in the E-body category (Buick Riviera, Olds Toronado, Cadillac Eldorado). All but the Eldorado have been previously covered (*American Technology Takes Charge*, page 77, Sept. '85), and the Cadillac will not be shown publicly before the fall.

Grandeur Am

Pontiac's Grand Am SE has to be Detroit's best shot at the Euro-look super sedan, all dressed up in air dams, side skirts and rear fascia extension to improve the car's wind-cutting ability. The grille and wheels are finished in body color paint, and aero composite headlamps round out the SE package. When you see it all on the 4-door body, the effect is not too far away from the specialty shop renditions of Mercedes and BMW sedans.

The 4-door N-body, of course, is new this year, and shared with Oldsmobile's Calais and the Buick Somerset (known as a Skylark when the rear doors are added). It shares the 2-door's roof panel, backlight and deck lid, so it has the same interior and exterior dimensions as the coupe.

(Please turn to page 164)

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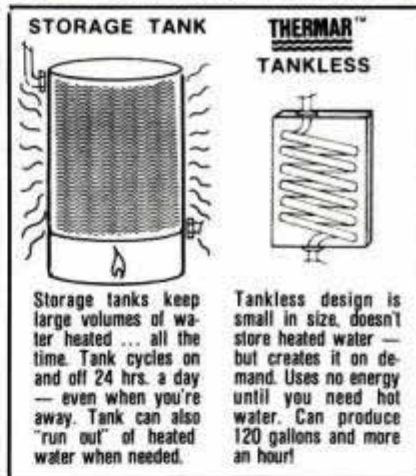
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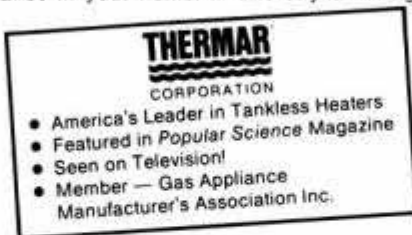
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WORLD-CLASS SUPER SEDANS

(Continued from page 163)

More doors for Calais, Somerset

The sister divisions get into the sports sedan fray, too, with their N-bodies. Olds doesn't have the GT package for the 4-door, but does have an ES sedan with the composite headlamps and blacked-out rocker molding, bumpers and mirrors. The FE3 suspension plus alloy wheels and 14-in. Goodyear Eagle GT tires move it into the "driver's car" category. Though Buick's Skylark is available with the Grand Touring suspension, the real concentration has been placed on the T Type version of the Somerset 2-door. A real transformation from the previous bread-and-butter sedan, this born-again Buick comes alive with a Level III suspension, 3.18:1 performance axle ratio and optional Lear Seigler multi-adjustable seats.

Grand Touring minis

The compact GT class hasn't been forgotten either. Pontiac is again leading the way here, with the addition of a GT option package for all models of the Sunbird except the station wagon. The 150-hp, turbocharged, 1.8-liter Four is the mainstay of this option. The Grand Touring powertrain was available last year in the convertibles and coupes, but in the 4-door it gets our vote as Most Promising American Giant Killer of 1986, with 215/60R15 Eagle GT tires and a new 120-mph speedometer.

Other updates in the J-car family include new flip-up headlight eyebrows for the Sunbird and Buick's Skyhawk, plus an entry-level notchback Firenza for Oldsmobile.

Number one's newest

GM's biggest gun, Chevrolet, is firing its biggest shot in the teeny car range this year. The Nova joint venture steps up to double-shift production in Fremont, California, and adds a 5-door hatchback model. Engine mounts have been improved for better vibration isolation, and the a/c compressor enlarged for smoother, more efficient cooling. The Sprint and Spectrum captive imports will move into nationwide distribution from their one-coast-only introduction scheme. Spectrum only gets minor improvements, but the Sprint adds a delightful 4-door with a 4-in.-longer wheelbase. Now here's a sensible subcompact, and it has a Chevy nameplate! To come later in the year will be a 3-door, fuel-economy leader, which Chevy rumors to be spectacular.

Chevy's J-car, the Cavalier, will get an RS package of performance and appearance upgrades. The RS option

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will be available on 2-doors, 4-doors, the convertible model and even the station wagons.

Sporty F41 suspension and catchy graphics place this Chevy series just one notch below the long-promised, and heretofore undelivered, Z24 Cavalier. With the multiport fuel-injected 2.8-liter V6 and 4-speed gearbox it ought to be hot, but we'll wait to see actual production models before we'll commit to any opinions. Keep your eyes peeled also for the limited-production California Cavalier, a Golden State special.

Corvette goes through another round of detail improvements, mostly aimed at weight savings—including aluminum cylinder heads for the 350-cu.-in. V8 (see *Detroit '86: Technical Highlights*, page 35). There's also the Bosch ABS antilock braking system, considered by many an interim plan until Delco's own unit is perfected. Antilock systems are coming across the board, to be sure, but GM's program has been to parcel out the development work.

Olds is working out electronic brake control for the 98, Pontiac for the 6000 STE and Buick is applying the system to the Electra.

The Corvette convertible is just now being introduced. The car was made for a drop top from the outset. The conversion adds very little weight, since the design had allowed for the required stiffness from the beginning.

Sporting luxury

Cadillac, the only company building all its cars within the Detroit city limits once the Hammtramck plant comes on line, hasn't been sitting still, either. Though the new Eldo and Seville are slated for late intros, word of the new Allante 2-seater is firing up morale among the troops. Seen running around the Proving Grounds in open view of the press, Cadillac is getting downright bold about their stance as a world-class car builder.

Current news includes a new nose treatment for D'Oro editions of the Cimmaron and the addition of real American walnut interior trim on Fleetwood Sedan d'Elegance models. For those motoring enthusiasts who are both bucks-up and sporty-minded, the Touring Coupe and Touring Sedan will be irresistible additions to the front-drive De Ville line.

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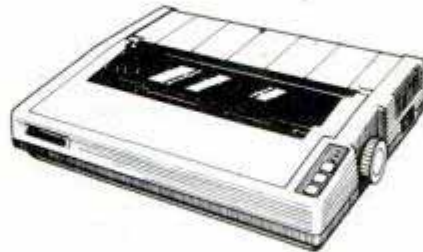
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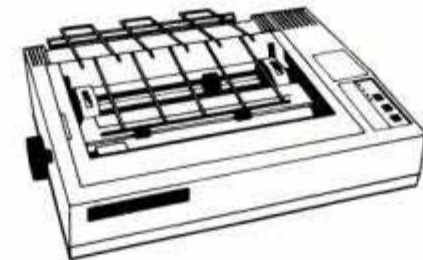
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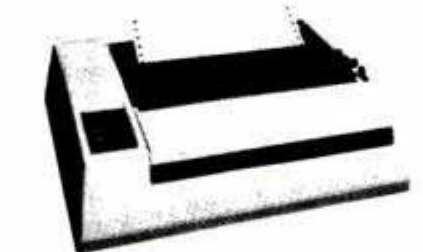
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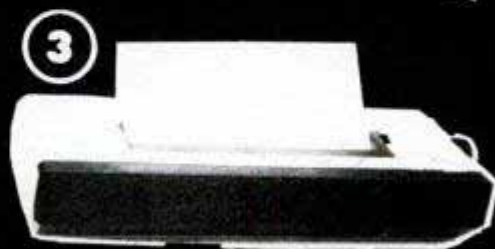
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1986 Audi 5000 Turbo Quattro

Not sleet, nor snow, nor dark of night stopped our 8800-mile 4wd Audi tour.

BY GARY WITZENBURG

It's 2 a.m. on a pitch black night and the freeway's deserted. The snow has let up, but the 50-mph crosswinds are treacherous. The temperature is 20 below zero, and the road surface is solid ice. Black glare ice, interrupted by sections of rutted, bumpy stuff.

We're running late but making up time at something more than the national speed limit—but less than double it. Bruno Kriebich (proprietor of Bruno's Audi/VW shop in Queens, New York, and one of the country's best Pro Rally pilots) is driving masterfully. So smoothly and controlled, in fact, that I'm completely at ease in the copilot's seat.

On the flats and uphill, he switches in both differential locks for added stability. On the long and treacherous



Under old skin of rally prototype (above) are mechanicals of 5000S Turbo Quattro. The 1986 sheetmetal is at top.

downhills, he switches them out so as not to interfere with the action of the ABS antilock brakes. Ace navigator Clark Bond is sleeping soundly in back.

The suspension is taking quite a beating on the rough stuff, but nothing

seems to faze it. We discuss slowing a bit to save the shocks, but decide to press on. At this rate, after a long, long day of frustration and delays that began at Houghton, on Michigan's Upper Peninsula, we'll make our checkpoint at Three Forks, Montana, just about on time.

A lot of others wouldn't make it at all. Of the 78 cars that started the Uniroyal One Lap of America endurance rally from Detroit a day and a half earlier, only 31 would get through this storm-ravaged section in northwest Montana. Some were turned back by the Highway Patrol. Others, hearing on their CBs (as we did) that I-90 through the mountains was closed, decided on their own to turn around or stop for the night.

(Please turn to page 172)

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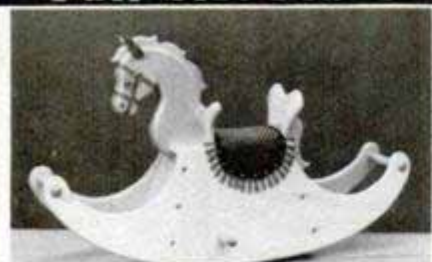
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1986 AUDI 5000

(Continued from page 170)

Not us. Heck, that's why we had this all-wheel drive Audi in the first place. No-o-o problem. Until the climate control shorted out—on full fan, full air conditioning!

It probably failed from the pounding it was taking, and the fact that whoever had prepared our car back in Germany



Center dash panel carries controls and display for differential lock functions.

had ripped out the radio and installed a trio of unlabeled gauges in its place, leaving a jumble of wiring behind them. Also, our car was an early prototype (one of four brought over just for the rally) of a model that would not officially arrive until several months later.

Subaru may have popularized the 4wd passenger car and made it affordable, but Germany's Audi is fast making it fashionable. It began with the \$35,000 Quattro Turbo, a 160-hp 4wd bullet of a coupe designed expressly to win high-speed rallies—the kind we call Pro Rallies and run on closed roads in this country. The Quattro has won two World Rally Championships and three consecutive U.S. Pro Rally titles.

Last year came Audi's first fairly affordable all-wheel-driver, the \$16,000 4000S Quattro sedan. For '85, it (and the regular 4000S and Coupe GT) were nicely facelifted and upgraded with new interiors, more power and (of course) higher prices.

Now comes the larger, roomier, prettier, faster and considerably more expensive 5000S Turbo Quattro. Its engine is Audi's well-proven 2.2-liter fuel-injected 5-cylinder, turbocharged and intercooled to a very healthy 158 hp at 5500 rpm and 166 lb.-ft. of torque at 3000 rpm. Suspension is fully independent with MacPherson struts and a 26mm stabilizer bar in front, a 4-link trapezoidal arrangement with coil spring struts in back. Brakes are 4-wheel discs with ABS antilock control,

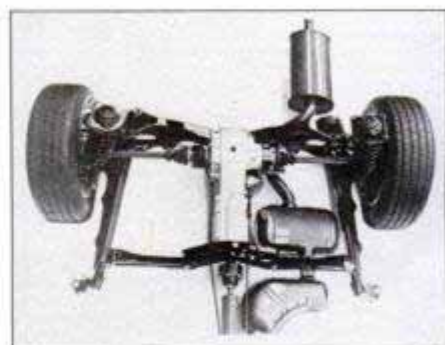
and its tires are 205/60HR15 all-season radials on 15x6-inch alloy wheels.

Audi's 4wd system is full-time, with nary a lever to pull or button to push. There's a differential between each pair of wheels, plus a third behind the transaxle to balance power front-to-rear. A console switch electrically locks the center and rear diffs for really tough going, but it's seldom needed. The computer-controlled ABS antilock brakes, unfortunately, are incompatible with locked differentials, so a relay cuts out the ABS function whenever one or both differential locks are engaged.

The 3-differential system (so neatly packaged that you can't tell a 4wd Audi without checking the badges) absorbs only 3 percent more power than Audi's regular fwd layout. And, since driven tires have less rolling resistance than nondriven ones at highway speeds, fuel economy hardly is affected. Amazingly, our 5000S Turbo Quattro (according to its on-board trip computer) averaged 30-plus mpg throughout its 8-day, 8800-mile One Lap of America ordeal.

Performance and handling, slick or dry, are outstanding. With its standard 5-speed manual transaxle, the big Audi sedan leaps from rest to 60 mph in eight seconds flat. With due credit to its super-sleek aero shape, top speed is well over 130 mph.

Inside, the controls are excellent. So are the instruments, except there's no oil pressure or voltage gauge. The car's only significant weakness, in fact, is the same miserable electronic climate control that went south on us at the worst possible time. We never liked the darned thing in the first place: It's obstinate and has a mind of its own. You



For Quattros only: Driven rear wheels are located by control arms and spring struts.

make an input, change the mode or temperature, and several seconds later it might respond. There's no control over fan speed in the ECONOMY or DEFROST positions, no way to get unprocessed fresh air through it at all, and the air conditioner is too weak for hot, sunny American climates.

Minor faults: I thought the brakes felt soft (too much pedal travel), but they worked just fine. The power window

switches atop the driver's armrest were exactly where Bruno liked to prop his elbow—every so often a back window would roll itself down unexpectedly. And the rear roof pillars and headrests combine to make a couple of fair-sized blind spots in rearward vision.

Obviously, we survived the cold and stormy night in the western Montana mountains, but it was pretty tense for a while. We stopped to pull the fan fuse, then continued—with cold air from the defroster and heating ducts freezing our hands, faces and feet—some 70 miles to warmth and civilization. The time it took to jury-rig the thing to get some warm air again caused us to miss the next three rally checkpoints and sacrificed any chance at a respectable finish. Two other 5000S Turbo Quattros eventually placed first and second, though, and ours performed flawlessly the rest of the way.

There are precious few other vehicles that I'd consider driving, riding and living in for a week and a day. The big Audi's trunk is huge, its seats first-rate, interior storage ample and the rear cabin spacious, comfy and (with 3-point belts) plenty safe. Its driving demeanor, stability and response are so good that it eats up miles by the thousands without causing fatigue, regardless of the road and weather.

I can think of only one car, in fact, in which I might rather do next year's One Lap rally: the Audi 5000S Turbo Quattro wagon.

Watch for the wagon soon as Audi continues to spread all-wheel-drive wonderfulness across its line. **PM**

THE PM REPORT CARD

AUDI 5000 TURBO QUATTRO	GRADE	COMMENTS
Acceleration	A	Eight seconds 0 to 60
Handling	A	Precise, stable, responsive
Braking	B+	Soft pedal feel
Steering	A	Excellent, great feedback
Transmission	A-	Very good 5-speed, no automatic
Ride	A-	Touch of harshness on sharp bumps
Fuel economy	A	30+ mpg on the road
Seating	A	Great room, comfort, front and rear
Vision	B-	Blind spots at rear pillars
Gauges/controls	A-	Excellent, but no oil or volt gauge
Ventilation	C	Obstinate electronic climate control
Noise @ 55 mph	A	What noise? Great aero shape
Cargo capacity	A	Huge trunk, good interior storage
Engine serviceability	B	Lots of plumbing
Fit and finish	A	Up to typical German standards

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1262	12"	7"	22 1/2"	4 lbs.	8.50
1263	12-13"	7"	25 1/2"	5 lbs.	10.00
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Item #	Capacity	Springs	Leafs	Sale
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1251	2000 lb.	2	3	\$24.00/pr
1252	3000 lb.	2	3	\$27.00/pr

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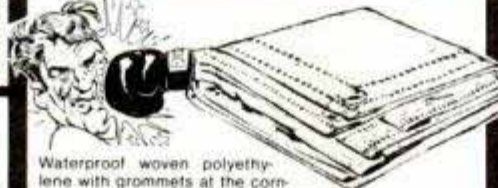


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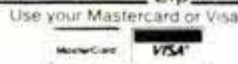
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BY MICHAEL LAMM, West Coast Editor

Who says you can't take it with you? If kids and kitchen sinks are your kind of cargo, Nissan's new 1986 Stanza Wagon is your kind of hauler.

What you've got here is a minimax vehicle—minimal on the outside, maximal on the inside. You've heard of a 2+2 coupe? Nissan calls this a 5+2 wagon. It seats five adults in true big-car comfort—and I mean arms-and-legs-akimbo comfort, not huddled-in-a-tunnel comfort.

That's inside the main compartment. Then you can get two optional inward-facing rear jumpseats for the twins. The jumpseats are removable, like those in Nissan's King Cab pickup.

Or you can fold the rear bench up, flush against the front buckets, to make way for 80 cubic feet of tall and usable cargo area. It's the Stanza Wagon's *tallness* that really packs in the cubes. Maximum ceiling height beats the Toyota Tercel wagon's by a full 10 inches, and the Stanza's total hauling volume aces the Tercel by 16 cubic feet, or 20 percent. That's with basically the same overall floorspace and other dimensions as the Tercel wagon (see chart on page 178).



Square-rigged Stanza Wagon has hinged front doors, two sliding side doors and a hatchback/cargo door. There are no B pillars.

How it feels to drive

The driver and front passenger, perched on captain-chair buckets with fold-down armrests, likewise ride tall in the Stanza Wagon. Result: superb vision in all directions. To sit in it, you'd think you were in a van, but the Stanza Wagon feels and handles like a car. It's quiet, thanks to good insulation, and not rough or pitchy, thanks to controlled strut and shock damping. Front suspension is by MacPherson struts, while at the rear you'll find independent trailing arms on twin transverse torsion beams. The two parallel torsion bars result in a spring rate equal to one bar with twice the effective length.

In my opinion, the Stanza's standard rack-and-pinion power steering gives this wagon good response, good road feel, plus good surface and cornering feedback. Cornering is aided by relatively large, wide, 14-inch wheels and tires. Overseas versions use 13-inchers; for the U.S. Nissan specified 14s as standard equipment.

Acceleration from the 2.0-liter, 97-hp, ohc Four feels strong enough for all normal grades and traffic situations. The manual 5-speed gearbox puts more power on the

ground and gives more flexibility than the 4-speed automatic, but the automatic works well, too. The automatic, by the way, comes with a lockup torque converter.

Already proven worldwide

The Stanza Wagon is new to this country but not to the world. It began life as the Nissan Prairie in Japan in 1982 and currently is sold in Canada, Europe, Australia and the Far East. Nissan would have brought it to the States sooner but couldn't due to voluntary import restraints. The Stanza Wagon's principal rivals are Toyota's Van

(Please turn to page 178)

QUIT YOUR JOB or START PART-TIME. Chimney Sweeps Are Urgently Needed Now!

My name is Tom Risch. I'm going to show you how to make \$200.00 a day saving people from dangerous chimney fires.

This is serious business. People are paying \$45.00 to have their chimneys cleaned, and the average sweep completes the job in less than an hour. You can make \$200 a day part-time—\$1,000 or more a week full-time. Now before you turn the page, let me explain.

Tens of millions of people are burning wood to supplement the high cost of oil, gas, and electric heat. There are now over 50 million woodburning chimneys in the U.S.—an increase of 10 million in only one year.

As a result, an estimated 44,000 chimney fires killed almost 1,000 people last year and destroyed over 180 million dollars in property.

Thousands of chimney sweeps are needed now.

Time Bomb In Your Chimney

A dirty chimney with about a quarter inch of soot contains a highly flammable substance called Creosote. If a spark from your fireplace or woodstove ignites the creosote in your chimney—watch out! The draft gets stronger and stronger, and before you know it, the entire inside of the chimney catches on fire.

As the fire grows in your chimney, the draft also increases to a tremendous velocity. The heat, generated from the draft and the burning creosote reaches a temperature of up to 3,000° F which is hot enough to melt the mortar holding the bricks together. Secondly, small flaming balls of creosote loosen from the side of the chimney and are projected out of the top with the force of a jet engine.

Like a roman candle, these flaming creosote balls shower the area. Some land on your roof, on your lawn and on your neighbor's home. The excessive heat of the chimney can catch the wood framing of your house on fire.

The only way to avoid a disaster like this is to clean the chimney before it catches fire. This is where you come in.

Chimney Sweeping

Here's a new business where you can earn more in one hour than most jobs pay for a whole day. More in one week than a lot of people make in an entire month. You're the boss. You set the hours and best of all, it's fun. You'll work your tail off, but the business will be your baby. I've had people tell me that the August West Chimney Cleaning System literally changed their lives. Not just because of the money they are making or the fact that they use more Ivory soap, but mainly because they are motivated. They're doing their own thing and loving it.

How Much Money?

Recently I telephoned some of the people we helped get started in the chimney cleaning business. I wanted to find out—first hand—just how well they were doing. Here's what a couple of them said....

Dave Richison, Ohio

"The 3rd quarter of this year I did \$23,000. The 4th quarter I did \$24,000. We should hit between 55 and 60 thousand this year."



"Home heating is now the number one cause of residential fires. Eighty-six percent of wood heat related fires originate in the chimney. The demand for qualified chimney sweeps is skyrocketing and now is the time to get started," says Tom Risch, Founder of August West Systems, Inc.

Chris Nestor, Massachusetts

"My first day on the job, I cleaned seven fireplaces. Now, after sweeping over 8,000 flues, I still look forward to going to 'work' every morning—six days a week, all year round."

John Moszulski, Canada

"Last month I worked 18 days, and I made 2,600 bucks!"

Ed & Mo Simonson, Texas

"We're very pleased with it. We're making a dream come true. We've always wanted some land, and thanks to chimney sweeping we now own 30 acres."

Just what do these people do to earn that kind of money? Sweep chimneys. Six to eight a day if they're full-time. Two to three an evening, plus ten or so on the weekends for those part-timers who keep their present jobs. Since the average charge is \$45 for the first and \$35 for each additional in the same house, it's easy to see how John Moszulski made \$2,600.00 in 18 days!

The Height of Technology

How do you clean a chimney? You do it as quickly and efficiently as possible. The more chimneys you can clean in a day the more lives and loss of property you'll save. And how do you do a good job in record time? You use the most advanced system available—The August West System.

One of the key elements in the August West System is the SootSweeper. This machine is a high-powered, high-volume dust collection unit that was designed specifically for cleaning chimneys. New filter technology is the key to its efficiency and dependability.

Other key elements of our system are an assortment of high carbon steel brushes, spe-

cially designed fiberglass cleaning rods (that let you do most jobs from below), an easy-to-follow handbook with everything from advertising to chimney design, a bi-monthly newsletter, telephone consultation and much, much more. I don't have room to go into all the details right now. Our information kit will explain everything to you.

10 Years of Dependable Service

I'd just like to say that many years and a tremendous amount of devotion have gone into the development of the August West System. We are a strong, national company with thousands of dedicated sweeps in our network! You can join us and count on us to help you build a business you can be proud of. We take pride in the quality of our equipment and service to you.

Sweep John Moszulski says, "Not only do I think your System is fantastic, but I am also totally impressed by the way you treat people who have bought your System. I have just finished my third \$1000 week—on a part-time basis."

To Sum Up, Then...

Sweeping chimneys may not exactly be a "Lazy man's way to riches"... you'll work hard—but the pay is exceptional, the demand is steadily growing, and new equipment and methods make the job far easier, faster and safer than ever before. Perhaps best of all, this is one of those "dream" businesses that so many of us are always looking for: a cash business with flexible hours, low overhead and a reasonable start up cost—figure about \$1800 to get started.

And don't forget, when you run a small business out of your home, you can take tax deductions for that portion of your home you use for your office and work area, as well as car payments, phone bills, utilities and anything else you use in business.

As a matter of fact a lot of sweeps pay for their system in tax savings alone.

FREE Information Kit

Find out more about what it's like to be a chimney sweep cleaning 25 chimneys or more a week. Just call TOLL-FREE 800-225-4016 and ask for extension 424. I'll rush you a detailed information kit with the complete August West Story and your 33 $\frac{1}{3}$ RPM record entitled, "Now Hear It From The Sweeps." We urge you to call us at no obligation, TODAY.

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August West Systems
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NISSAN STANZA WAGON (Continued from page 176)

and Tercel wagon, the Mitsubishi Colt Vista, plus the smaller domestic minivans. In blending sedan, wagon and van, Nissan's designers incorporated sliding rear doors on both sides. These eliminate the usual B-pillars and make getting in and out a little easier. They're handiest in tight parking spaces or for stuffing cargo through the sides with the rear bench folded.

I found the sliding doors easy enough to open and shut. They're not heavy or awkward, although the rear seat itself is. And yet part of the sliding doors' effect is negated by the front shoulder harnesses hanging down in the same location as B-pillars. Also, you can't open the righthand sliding door when you fill the fuel tank. In that regard, the right slider becomes a bit of a handicap.

The only major components this vehicle shares with other Stanzas are the engine and drivetrain, although the wagon's fwd transaxle does use a slightly lower final drive ratio. The wagon's floorpan and all body stampings are unique. So far, the Stanza Wagon comes in only one trim level, that being equal to the Stanza XE sedan's. Like the XE, the wagon's long list of standard equipment includes power steering, tilt column, folding front and rear armrests, digital clock, variable intermittent wipers, AM/FM stereo, tach and remote openers for the liftgate and fuel door.

Four-wheel drive is planned for the near future, as are additional trim levels. The EPA quotes 23/28 mpg for the

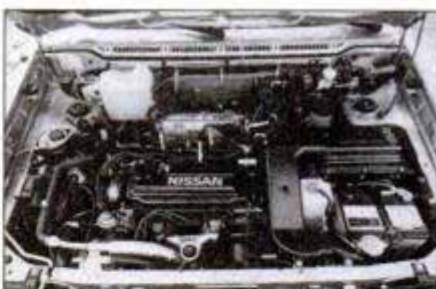


Folding, removable seats add to the Wagon's versatility. Rear jumpseats, center bench and front buckets make it a 5+2.

THE PM REPORT CARD

NISSAN STANZA WAGON	GRADE	COMMENTS
Acceleration	B+	Ample with 5-speed
Handling	B	Acceptable for this type vehicle
Braking	A	Good; well modulated
Steering	B+	Right amount of boost and road feel
Transmission	C	Vague on downshifts
Ride	A	Comfortable and silent
Fuel economy	B	Good considering carrying capacity
Seating	A	High and comfortable; love those armrests
Vision	A+	Excellent every way.
Gauges/controls	C	Sensible but incomplete
Ventilation	A	Good with or without a/c
Noise @ 55 mph	A-	Minimal
Cargo capacity	A	Nothing short of amazing
Engine serviceability	A	Easier to get at than vans
Fit and finish	A	First-rate in every way

manual and 20/25 for the automatic. The Stanza Wagon's price was quoted at press time as under \$10,000, which I take to mean \$9995. Fully loaded with a/c, cruise control, automatic transmission, roof rack and the few other available options brings the price to about \$11,500. Nissan expects to import 3000 Stanza Wagons a month. I expect they'll be in short supply. **PM**



Carlike hood makes the transverse 2-liter, 97-hp, 4-cylinder engine easier to service than the typical van powerplant.

COMPARATIVE SPECIFICATIONS

	TOYOTA TER-CEL WAGON	COLT VISTA WAGON	CHRYSLER T-VAN	NISSAN STANZA WAGON
Base price	\$6918	\$8721	\$9238	\$9995 ¹
Engine placement/drive	front/fwd	front/fwd	front/fwd	front/fwd
Engine type	ohc 4	ohc 4	ohc 4	ohc 4
Displacement, cc/cid	1452/88.6	1997/122.0	2198/135.0	1947/120.4
Horsepower @ rpm ²	62 @ 4800	88 @ 5000	101 @ 4800	97 @ 5200
Wheelbase (in.)	95.7	103.3	112.0	99.0
Overall length (in.)	169.7	174.6	175.9	170.3
Overall width (in.)	63.6	64.6	69.6	65.6
Overall height (in.)	59.1	59.8	64.2	64.2
Curb weight (lb.)	2288	2486	2935	2809
Fuel capacity (gal.)	13.2	13.2	15.0	15.9
Cargo area L x W x H (in.)	59 x 44 x 36	73 x NA x NA	82 x 50 x 48	57 x 53 x 46
Max. cargo cap. (cu. ft.)	64	64	125	80
EPA est., city/hwy. (mpg)	31/37	24/30	24/29	23/28

1. Estimated; 2. Standard engine

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P205/75R14	68.00
P215/75R14	71.00
P225/75R15	74.00
P225/75R15	77.00
P225/75R15	79.00
P235/75R15	83.00

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MICHELIN
XZX/MX
Steel Belted Radials Blackwall

SIZE	PRICE
155SR12	34.00
145SR13	34.00
155SR13	35.00
165SR13	40.00
175SR14	46.00
185SR14	52.00
185SR14 Rein	65.00
165SR15	50.00
165/70SR13	39.00
175/70SR13	43.00
185/70SR13	47.00
185/70SR14	53.00
P185/70SR15	67.00

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MICHELIN
XA4
All Season Steel Belted Whitewall

SIZE	PRICE
P155/R0R13	49.00
P165/R0R13	52.00
P175/R0R13	54.00
P185/R0R13	58.00
P175/75R14	58.00
P185/75R14	69.00
P195/75R14	72.00
P205/75R14	79.00
P205/75R15	79.00
P215/75R15	82.00
P225/75R15	85.00
P235/75R15	88.00

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High Performance
XVS/MXV
TRX

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205/70R14	81.00

SIZE	PRICE
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P185/65R365	78.00
190/65R390	85.00
200/60R390	89.00
200/60R390	129.00

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SIZE	PRICE
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155SR13	37.00
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185SR14	54.00
185SR14 Rein	57.00
165SR15	43.00
165/70SR13	40.00
175/70SR13	42.00
175/70SR133W	56.00
185/70SR13	46.00
185/70SR14	51.00
195/70SR14	62.00

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P-4/P-44 P-8
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SIZE	PRICE
155SR12	30.00
145SR13	25.00
155SR13	30.00
165SR13	33.00
175SR14	39.00
185SR14	40.00
165SR15	38.00
175/70SR13	38.00
185/70SR13	41.00
185/70SR14	44.00
195/70SR14	48.00
185/65SR15*	58.00

*P-8
Some sizes may still be
P-3, P-370

PIRELLI P-77
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SIZE	PRICE
P185/75R14 WW	64.00
P195/75R14 WW	64.00
P205/75R15 WW	69.00
P215/75R15 WW	82.00
P205/70R13 WW	63.00
P195/70R14 WW	59.00
P205/70R14 WW	67.00
P225/70R15 WW	84.00
P175/70R13 BW	49.00
P185/70R13 BW	53.00
P205/70R13 BW	65.00
P185/70R14 BW	56.00
P195/70R14 BW	56.00
P205/70R14 BW	67.00
P225/70R15 BW	83.00

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SIZE	PRICE
205/70VR15	117.00
215/70VR15	122.00

P-4

SIZE	PRICE
185/60HR13	61.00
205/60HR13	82.00
185/60HR14	67.00
185/60HR14	74.00
195/60HR14	74.00
225/60HR14	100.00
195/60HR15	83.00
205/60HR15	98.00
215/60HR15	140.00

PIRELLI
P-7
Steel Belted Radials
Built for Ultra High Performance

SIZE	PRICE
175/80R13	94.00
195/55R13	90.00
205/60R13	106.00
205/55R14	130.00
225/55R14	141.00
195/50R15	106.00
205/50R15	147.00
225/50R15	171.00
205/55R16	180.00
225/50R16	189.00

techna
R4000
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SIZE	REPLACES	PRICE
P185/70SR13	BR78-13	48.00
P185/70SR14	BR78-14	50.00
P195/70SR14	CR78-14	53.00
P205/70SR14	DR78-14	56.00
P215/70SR14	FR78-14	58.00
P225/70SR14	GR78-14	60.00
P225/70SR15	SR78-15	62.00
P235/70SR15	HLR78-15	67.00
P235/70SR15	LR78-14	72.00
P175/70SR13*	—	43.00
P185/70SR13*	AR78-13	46.00
P185/70SR14*	BR78-14	49.00
P195/70SR14*	CR78-14	51.00
P205/70SR14*	DR78-14	54.00

*Blackwall

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P205/70R13	70.00
185/70R14	69.00
195/70R14	71.00
P205/70R14	76.00
P225/70R15	87.00
P235/70R15	90.00
P255/70R15	98.00
P285/60R13	89.00
P235/60R14	84.00
P245/60R14	86.00
P235/60R15	88.00
P255/60R15	93.00

BFGoodrich
TA HIGH TECH RADIALS
EURO T/A, 60H, 70H

SIZE	PRICE
175/70R13	62.00
185/70R13	64.00
185/70R14	67.00
195/70R14	69.00
205/70R14	74.00
225/70R15	87.00
215/60HR13	71.00
195/60HR14	76.00
215/60HR14	79.00
235/60HR14	86.00
205/60HR15	79.00
235/60HR15	88.00
255/60HR15	96.00

BFGoodrich
TA HIGH TECH RADIALS
COMP T/A

SIZE	PRICE
185/70R13	71.00
195/70R14	78.00
205/70R14	83.00
185/70R15	81.00
205/60R13	88.00
195/60R14	97.00
215/60R14	102.00
235/60R15	123.00
255/60R15	130.00
195/50R15	135.00
225/50R16	153.00
P245/50R15	156.00
P265/50R15	179.00
205/50R16	160.00
225/50R16	170.00

GOODYEAR
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P245/50R16	191.00
P255/50R16	193.00

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P205/70R14	89.00
P215/65R15	97.00
P225/70R15	95.00
P175/80R14	95.00
P255/60R15	111.00

European NCT

SIZE	PRICE
P205/55R16	138.00
P225/50R16	149.00

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195/60HR14	74.00
205/60HR14	84.00
195/50R15	99.00
205/55R16	138.00
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SAFE AND SOUND

A Viper in the dashboard will charm you with music and protect against theft at the same time.

BY FRANK VIZARD

Automobile thieves can appreciate good sound as much as anyone else. Often, they'll just swipe an attractive AM/FM stereo cassette player and leave the rest of the car alone.

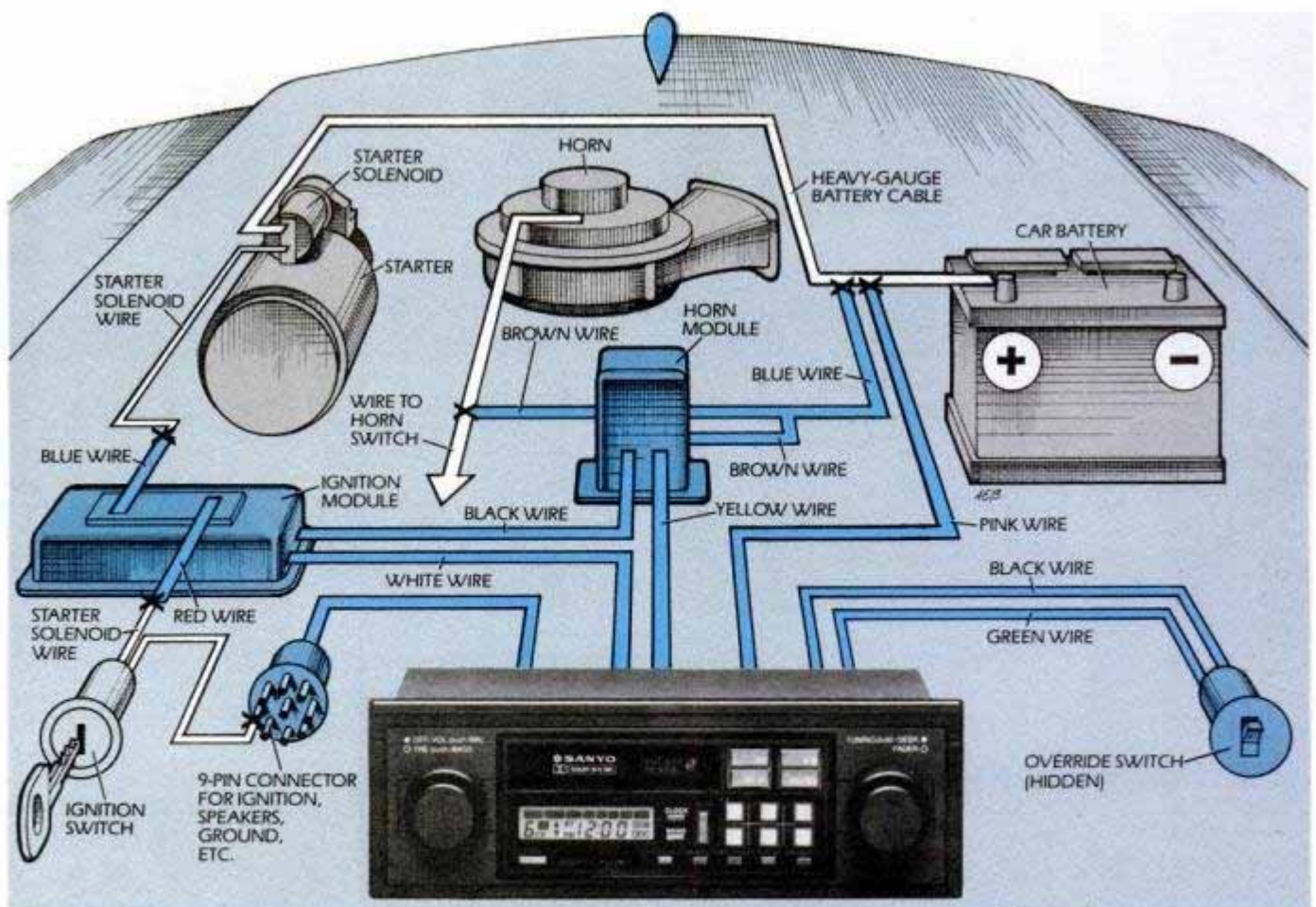
An innovative response to this refinement among burglars is Sanyo's new in-dash auto-sound unit, dubbed the Viper. Also known as Model FTE60, it offers all the top-of-the-line audio features anyone could demand—along with security circuitry that protects the hi-fi and the car.

What's different about this radio-cassette? Quite a few things, but nothing that's evident at a

glance. Hidden away in the engine compartment are two security modules that you wire in-line to the car's horn and ignition cables.

The horn module protects the Viper from theft. Any attempt to remove the radio-cassette (by cutting or disconnecting any two wires) sets the horn bleating at 1-second intervals for five minutes. (If your car's horn functions only with the ignition on, you'll have to add a horn.)

Meanwhile, Viper's ignition module protects the car from theft by functioning as an ignition-kill device. Upon leaving your car, you punch a 3-digit



Owner-installable Viper is the first car stereo that protects itself and the car from theft. Above, wires and modules shaded in blue

denote Viper components; X's mark the spots where they connect to automobile's electrical system.

code (of your own choosing) into the innocuous-looking keypad on the Viper's front panel. This code activates the ignition-security system (the horn module functions independently). The car cannot be started again without first entering the security code. For people with poor memories, the Viper offers a face-saving and car-starting option: A master switch that comes with the unit can be easily and discretely installed to override the ignition-kill system.

Do-it-yourself

Overall, installing the Viper is pretty simple. The instruction manual, produced in the U.S., is clearly written and easy to follow. Attaching and connecting the security modules adds about 20 minutes to the time it would take to install an average car stereo system.

Despite this simplicity, you might want to have the unit installed by a professional autosound/security dealer. Effective as the Viper might be, the ignition-security system can be defeated by disconnecting then reconnecting the car's main (positive) battery cable.

This is because the system's security modules are little more than passive relays. The real brains behind the Viper are programmed into the microprocessor that controls its ETR (electronically tuned radio). Cutting off power to the ETR chip erases its memory—including the security code (this can be reprogrammed).

For this reason, a more comprehensive approach to car security entails using the Viper in conjunction with a separate, professionally-installed hood lock. In fact, a qualified auto-security dealer will probably devise some very sophisticated theft-deterrents using the versatile Viper as a starting point.

Potential buyers should note that at a suggested retail price of \$349.95, the Viper's security characteristics are virtually cost-free features.

On the audio side, Viper offers 9½ watts of power per channel. Those are clean watts, measured at only 1 percent total harmonic distortion, and enough to drive four loudspeakers crisply (Viper will put out 25 watts a side with higher distortion). Dolby noise reduction, types B and C, make tape hiss inaudible, and Viper's computer-controlled cassette transport mechanism eliminates variations in tape speed that cause wow and flutter.

Besides these high-end audio virtues, Viper incorporates several convenience features. These include automatic tape reverse; automatic search-and-scan for tape and radio; 18-station memory preset tuning; automatic cassette loading and ignition-off ejection. Given this level of performance and features, Viper's a steal compared to other car stereo units in its price class. **PM**

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The manufacturer replaced this model with a newer version. As a result, we obtained a limited supply of this discontinued model for liquidation.

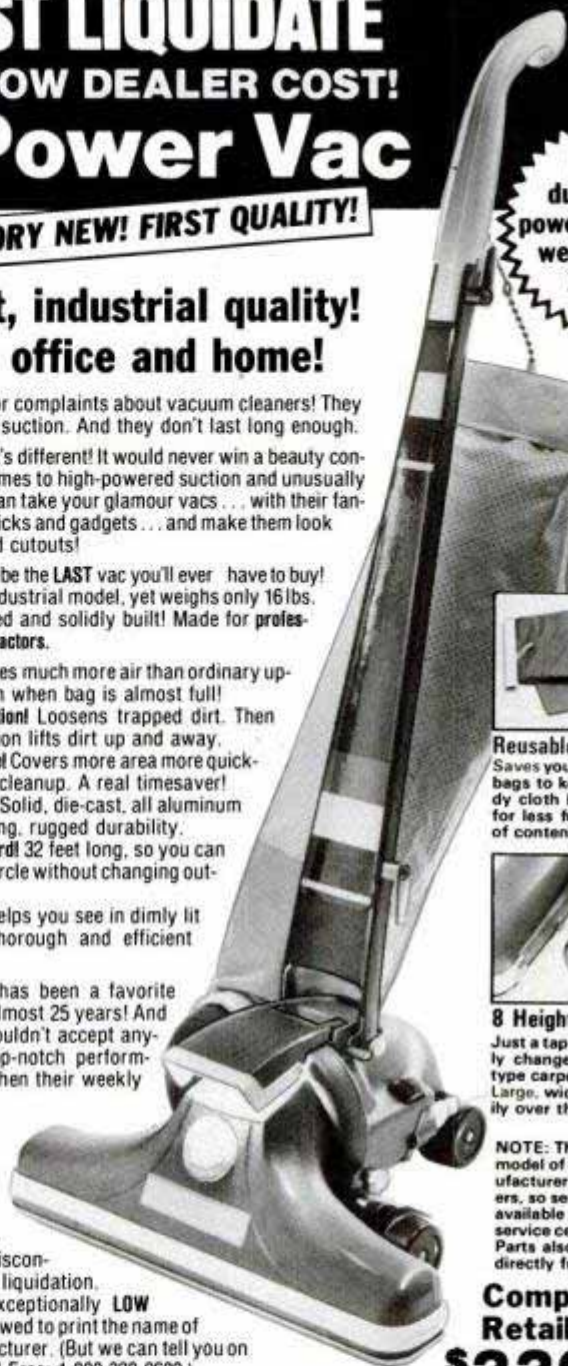
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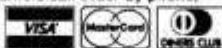
8 Height Adjustments! Just a tap of your toe quickly changes height for any type carpet, any type floor! Large, wide wheels roll easily over thickest carpeting.

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Smooth, Honda-like lines should be popular with Isuzu and Chevy buyers alike [the I-Mark is also sold as the Chevrolet Spectrum].

-- FIRSTHAND DRIVE REPORT --

ISUZU I-MARK

All-new front-drive car lurks under the old nameplate.

TEXT AND PHOTOS BY MICHAEL LAMM, West Coast Editor

Isuzu redid everything but the name. They're still calling it the I-Mark, but nothing else interchanges. The previous I-Mark was getting a little long in the tooth, having started here as the Buick Opel Isuzu. That was in 1976. Then in 1981, American Isuzu Motors Inc. began offering basically the same car as the original I-Mark.

This latest 1985½ I-Mark, though, is totally changed and now comes with a transverse, 1.5-liter, 70-hp ohc Four, front-wheel drive, fold-down rear seats, considerable standard equipment, plus ample room for four 6-footers and luggage. It's again available as a 3-door hatchback or 4-door sedan.

Chevy version

And if the new I-Mark looks familiar, that's because it's also sold by Chevrolet as the Spectrum. Doubling as the Spectrum means you can get I-Mark parts and service at any Chevy dealership. That's a definite plus since Isuzu

has only 520 dealers nationwide, while Chevy's network numbers 5120. (Chevrolet dealers understandably can't hon-



Interior has lots of plastic, but also lots of useful storage cubbies. Bucket seats would be comfy without their headrests.

or Isuzu's 24/24 new-car warranty, however.) Some of the items that differentiate the I-Mark from the Spectrum include larger tires on alloy wheels, ribbed lower rocker moldings, slightly stiffer suspension calibration, tachometer and tilt steering column.

GM input

General Motors helped design both generations of I-Marks. For that reason, the current car's front and rear suspensions follow typical GM small-car practice. The rear twist-beam axle uses barrel-shaped coils, and the front setup is by MacPherson struts.

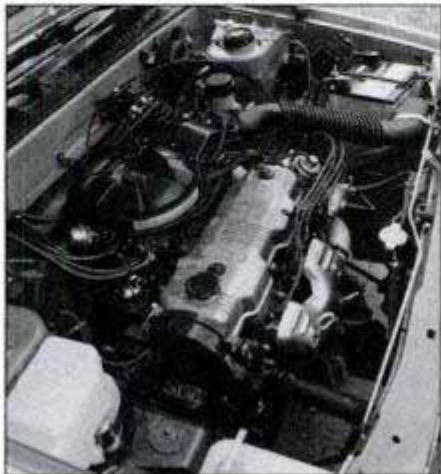
I found the I-Mark's ride comfortable, and the car gives average, predictable handling. The disc/drum brakes are fine for normal duty but fade slightly after repeated hard stops. I suspect that you would find some fade on long downgrades, too.

The I-Mark's unassisted rack-and-pinion steering benefits from a soft-grip

wheel but lacks on-center precision. Optional power steering, which I found unnecessary, has a valving feature that reduces boost and increases road feel at higher speeds.

Engine attributes

The I-Mark's engine gives decent acceleration with excellent fuel economy. The carbureted 1471-cc Four uses just two rings per piston (as opposed to normal three rings) to cut internal en-



Transverse 1.5-liter Four with carburetor provides performance that is only average in a mild-mannered class of cars.

gine friction. It also has an aluminum crossflow head and weighs only 190 pounds totally dressed.

The induction system is interesting in that it incorporates so-called intake jets—a set of four small tubes that parallel the manifold runners. These tubes let added air into the combustion chambers to promote swirl for better fuel economy. At times, the intake jets also pick up tiny amounts of extra fuel from the carburetor.

In addition, the intake system has an electric heating element between the carburetor and intake manifold. The purpose of this heating element is to increase driveability while the engine is cold. The element grid instantly glows red hot on startup to help atomize and heat the rich cold-start choke mixture. As the engine warms up, the heating element grid turns off.

Tepid performance

I'd call the I-Mark's acceleration with the standard 5-speed slightly better than average. The car outpaces its class, but that's almost a backhanded compliment. The optional 3-speed automatic cuts acceleration and increases engine noise noticeably.

Fuel mileage likewise drops by 5 to 8 mpg with the automatic. If I were buying an I-Mark, I'd definitely stick with the stick shift.

In my opinion, this car has four [\(Please turn to page 184\)](#)

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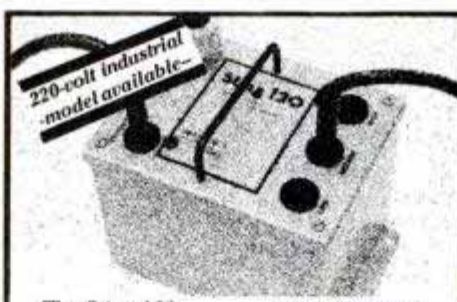
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ISUZU I-MARK

(Continued from page 183)

important things going for it: fuel economy, interior spaciousness, quality of assembly and price. EPA estimates range from 38/43 mpg with the 5-speed to 33/35 for the automatic.

As for interior roominess and comfort, there's plenty of leg and hip space fore and aft, and the rear seatbacks fold forward separately for extra hauling capacity. This feature ups the hatchback's normal 16.9 cubic feet to 29.7. The I-Mark's cabin is pleasantly full of little bins, and there's even a deep, useable glovebox.

The front buckets are nicely contoured, and they'd be great if the headrests weren't so hard-surfaced and oddly angled. Unfortunately, they tilt forward and catch me right where my skull meets the spine. Ouch.

Standard equipment includes the alloy wheels, steel-belted radials, tach, tilt wheel, plus a digital quartz clock, twin electric outside mirrors, passenger assist grips, tinted glass, remote releases for trunk and fuel door, intermittent wipers, reclining buckets, miniconsole, fold-down rear seatbacks, cargo shade, rear defogger, childproof rear door locks, flip-out rear quarter panes and rear wiper/washer. Best of all, everything's put together beautifully; fit and finish are first-rate. I-Mark prices start at \$7149 for the hatchback and, considering all that standard equipment, it's not a bad deal. **PM**

THE PM REPORT CARD

1985½ ISUZU		
I-MARK	GRADE	COMMENTS
Acceleration	B-	Slightly above average
Handling	C	Some understeer, body roll, lots of tire scrub
Braking	C	Noticeable fading after repeated stops
Steering	B	Not especially crisp on center
Transmission	B-	5-speed shifter lacks definition
Ride	A	Good; well modulated and smooth
Fuel economy	A	EPA says 38/43 mpg with 5-speed
Seating	C-	Headrests uncomfortable; too firm and angled the wrong way
Vision	B	Wide pillars in coupe
Gauges/controls	B	Needs oil pressure & voltmeter
Ventilation	A	Good vent locations, powerful fan
Noise @ 55 mph	B	Some tire rumble; otherwise relatively silent
Cargo capacity	A	Rear seats fold for added space
Engine serviceability	A	Plenty of room all around
Fit and finish	A	Excellent inside and out



CHEVROLET NOVA

Can a Japanese car built in California find happiness in America?

BY MICHAEL LAMM
West Coast Editor

The greatest compliment you can pay any car is to say simply that it's good. It does what it's supposed to do without quirks or qualms. The new Chevrolet Nova is an all-around *good car*: very livable, reliable, comfortable and economical. If you're looking for value in transportation, this is it.

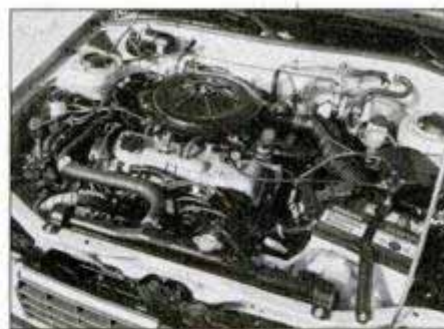
I can hear you thinking, though, "Well, fine—it's also basically a Toyota with a Chevy bow tie on the grille." Not quite. True, the Nova began life as a Corolla, but it's not the Corolla you can get here in the States. It's a Japanese version called the Sprinter, and while the Nova uses the same 70-hp, 1.6-liter ohc engine, same crosswise fwd drivetrain, same suspension and brakes as the U.S. Corolla, its body is altogether different. No sheetmetal will interchange, and the greenhouses are visibly different, with seven windows in the Nova versus five in the Corolla.

Prices range from \$7195 to \$9815, depending on option packages (you can't get individual options, only



bunches of them, in the Japanese fashion). The Nova is more expensive than its Toyota cousin, partly because the Nova comes better equipped. For instance, it has fabric door panels instead of the Corolla's vinyl, a foam headliner for greater noise and temperature insulation, upscale seats with height and lumbar adjustments, fourth-generation mud/snow radial tires, plus heavy-duty heater, rear defogger, wipers and battery. That's in the base Nova.

The CL version boasts 30 additional



Toyota-built Nova has different bodywork from Corolla. Interior is more upscale, but still very Japanese-looking. Powertrain, however, is the same transverse 1.6-liter 70-hp Four with a 5-speed manual or 3-speed automatic transaxle.

extras, including all-velour upholstery, tilt wheel, fore/aft-adjustable headrests, remote releases for trunk and fuel filler, trunk lamp, and so forth. It's by no means a stark or stingy automobile.

Over the road (I put about 600 miles on a brand-new CL sedan), the Nova feels almost exactly like the Corolla (I also put 100 miles on a Corolla during the same trip). The only difference is in road noise. The Nova is a little quieter—very little wind whistle, some tire rum-

[\(Please turn to page 186\)](#)

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ble, but altogether a pleasant long-distance runner.

Chevrolet supplied an even dozen Novas for our press convoy from Ontar-



Rear view looks least like Corolla, but some Novas may wind up in Toyota showrooms.

io, California, to Tucson, Arizona. The fleet's fuel mileage ranged from a low of 31 mpg to a high of 52. The 31-mpg figure came with 100 percent high-speed driving, with no concession at all to economy.

The driver who managed to turn in 52 mpg drafted trucks and kept below 55 mph all the way. The EPA says the Nova with 5-speed should average 30/37 mpg city/highway.

I found the Nova driver's seat very comfortable, and there's a surprising amount of legroom in back, plus a large, flat-floored trunk. One of the Nova's prime virtues is its roominess. The sedan is as spacious inside as the VW Jetta and Nissan Stanza. What I'd like to see, though, are fold-down rear seat-backs, like the Corolla's.

The Nova handles well enough under all normal driving and maneuvering conditions, and its 70-hp engine generates plenty of scoots for around town. But long upgrades and passing take some downshifting. I prefer the 5-

speed despite its wide 3-4 gap, yet the 3-speed automatic isn't bad either.

Joint venture adventure

What's really important about the Nova, though, isn't the car itself, good as it is. It's the way the Nova's being manufactured; the fact that it's being built in a fishbowl. Everyone in the auto business has his eye on the Toyota/GM joint venture, because if the NUMMI experiment works, it'll change the way cars are built.

NUMMI stands for New United Motor Manufacturing Inc. It's the joint-venture company founded and funded 50/50 by Toyota and General Motors. GM owned the original plant in Fremont, California, but shut it down in 1982, mostly because of labor problems: high absenteeism, low morale, poor quality, alcohol, drugs—the works. A Fremont city councilman, Yoshio Y. Fujiwara, on his own time, lobbied both Toyota and GM and eventually got the two companies together. Toyota put all the Nova machinery in place, trained the key people in Japan, and pretty much runs the NUMMI show. Ninety percent of the labor force, though, worked at GM Fremont before the shutdown. They're UAW to the core.

The United Auto Workers sincerely wants NUMMI to succeed. For one thing, that gets them off the hook for previously low production and quality. The Japanese have totally retrained the UAW's workers, infused them with Japanese goals and spirit, dressed them in blue uniforms, provided a gym, organized them into teams, allowed them to redesign their work stations, let them change tasks within groups, even encouraged them to stop the production line whenever they see unacceptable quality. What Toyota has done is translate the workforce into Japanese.

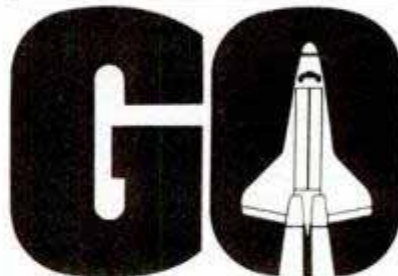
If this noble experiment works, great. And so far it seems to be working. Nova quality is high at the moment—as high, I think, as anything from Japan. Fremont, though, is still on its honeymoon.

The 12-year, joint-venture contract calls for GM to buy up to 200,000 cars a year from NUMMI. But GM doesn't have to buy all those cars. Nor must they all be Novas. NUMMI can build 250,000 per year of whatever will sell, including cars for Toyota dealers. Future replacements for the Nova are already under study.

For now, though, what you see as the Chevy Nova is actually a lot of different cars wrapped into one. It's a Japanese car, an American car, a world car and an experimental car in the manufacturing sense. But on its simplest level, it's just a good car.

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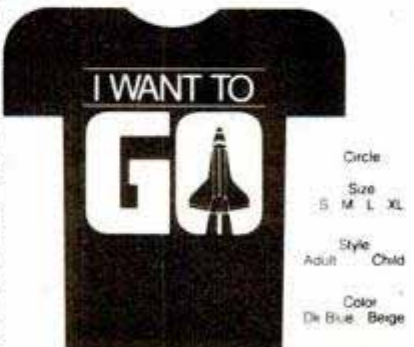
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THE PM REPORT CARD

CHEVROLET NOVA	GRADE	COMMENTS
Acceleration	B	Not great, not bad
Handling	B	Fine for an economy car
Braking	A	Fade-free
Steering	B+	Responsive, good feel
Transmission	B	Long throws, wide 3-4 gap
Ride	A-	Amazingly quiet and good
Fuel economy	B	EPA says 30/37 mpg
Seating	A+	Excellent all around
Vision	A+	Fine in every direction
Gauges/controls	C	Readable, but only two gauges
Ventilation	A	Good air conditioner, too
Noise @ 55 mph	B	Some tire rumble
Cargo capacity	A	Amazing trunk capacity
Engine serviceability	A	Ample access
Fit & finish	A	As good as the best

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Wendell Smith of Hearst's Midland, Texas, Reporter-Telegram has creative ideas every day that are improving his paper's photo reproduction.



Wendell Smith
Assistant Camera Foreman, The Midland, Texas, Reporter-Telegram

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Howard Ritchie's creative idea was to serve the community by offering a program called "Ident-A-Kid" to help trace children if they were ever missing. Volunteers from WDTN-TV go to shopping malls over the week-end, fingerprint children on special cards and give these priceless records to the parents.

Wendell Smith's creative ideas have helped him develop the high level of skills necessary to operate a new scanner machine that analyzes color photographs and translates them into fine reproductions. The results of his work at the Midland Reporter-Telegram can be compared to the very best in the newspaper industry.

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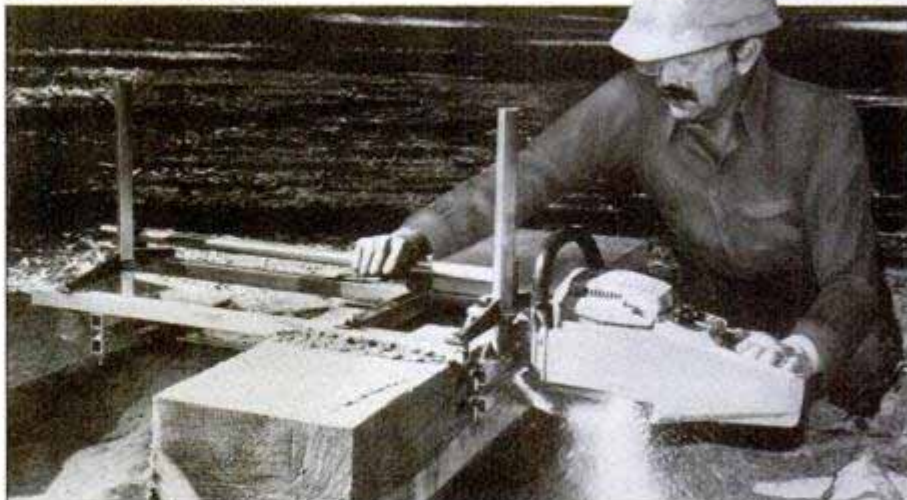
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Making The Cut

11 new chain saw accessories

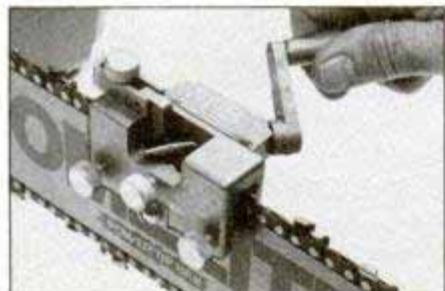


This suspension helmet provides shock absorption to reduce the impact of falling objects hitting your head, and it has adjustable ear protectors and a polyester mesh face shield. The lightweight, 1-pound helmet comes in an orange color with the Husqvarna logo and costs about \$30. It's available from Husqvarna dealers, or write to Husqvarna, 224 Thorndale Ave., Bensenville, IL 60106.



The Alaska MK III portable saw mill cuts logs into dimensional lumber on site for buildings and fences. The mill clamps onto a chain saw bar to make lumber from 1/2 to 12 in. thick, up to 48 in. wide. It comes in four

sizes: 24 to 48 in. (\$150 to \$190) to correspond to chain saw bar lengths. For information, write to Grandberg/Firmont, 224 South 24th St., Richmond, CA 94804. Be sure to specify your bar length.



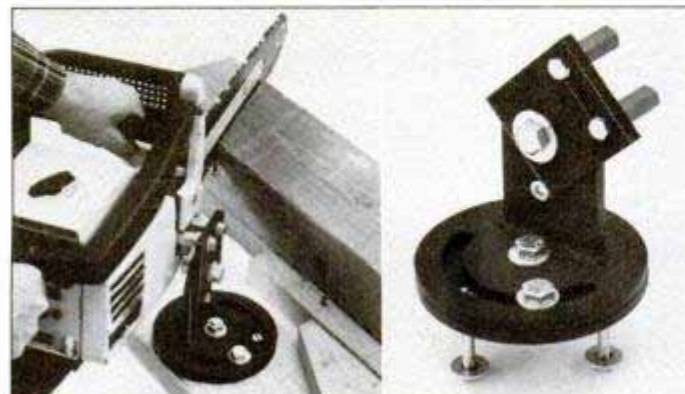
The Gamn' chain saw sharpener has a long-wearing carbide cutting burr permanently set at a 35° angle to ensure identical grinding of all chain teeth. The burrs come in 1/32-, 1/16- and 1/8-in. sizes. The tool comes with depth gauge and instruction booklet for \$34.95 postpaid from Gamn' Enterprises Inc., R.R. 5, Box 39 A., Evansville, IN 47711. Be sure to state make and model of your saw when ordering.



The Roller File Guide consists of a fixed guide that rests on the bar and chain and a roller mounted file that allows chain saws to make uniformly smooth and accurate cuts. It costs \$6.25 and is available for nearly every make and size of saw chain at Stihl chain saw dealerships. You match the pitch and gauge of your chain. For more information write Stihl Inc., 536 Viking Dr., Virginia Beach, VA 23452.



The Log Jaw lifts long logs off the ground for easier, safer cutting. The all-steel jaw clamps around the log, then you rock the handle back and down to the ground. This hoists the log several inches in the air. The Log Jaw (\$40) is available at hardware stores, home centers and chain saw dealers. For information, write Omark Industries Inc., 4909 S.E. International Way, Portland, OR 97222-0080.



The Miter Right adapts to electric and gas-powered chain saws so they can miter logs, timbers and dimensional lumber. The unit must be bolted to a sturdy surface before the saw can be mounted. Use it to work on log buildings, decks, retaining walls and other landscape projects. Miter Rite costs \$54.45 postpaid from Miter Right, 2604 Anderson Rd., Duluth, MN 55811.



The Utilitip attaches to the tip of a chain saw bar to protect it if the tip hits the ground (right). Its spiked tip also permits the user to pivot the saw on a second log and make the cut using a leverage action. There is no danger of kickback since the guide bar tip is stationary. The tool costs \$18.95 postpaid from Utilitip Inc., Box 11704, Rock Hill, SC 29731.



The Nordtec Protective pants for chain saw users protect the torso, front and back leg areas of a chain saw user. The front panels run from waist to ankle; back panels run from knee to ankle. This garment is made of the same nylon polypropylene used for ballistic protection and comes in waist sizes 28 to 44 with button holes for suspenders and belt loops. The color is black. They're sold at Pioneer/Partner and Husvarna dealers for \$59. Write to Husqvarna, 224 Thornedale Ave., Bensenville, IL 60106.



Drive the spiked feet of The Logger's Filing Vise into a log or tree stump with a sledgehammer or maul. Then, once secured, the vise can hold the saw bar while you sharpen the chain out in the woods. Both your hands are free for precisely controlling the file angles. The weight of the chain saw engine holds the other end. The vise is useful in other ways too, for example, embed it in a tree to hold clothesline on camping trips. The Logger's Filing Vise (\$7.75) is sold in hardware stores, home centers and at chain saw dealers. For more information write Omark Industries Inc., 4909 S.E. International Way, Portland, OR 97222-0080.

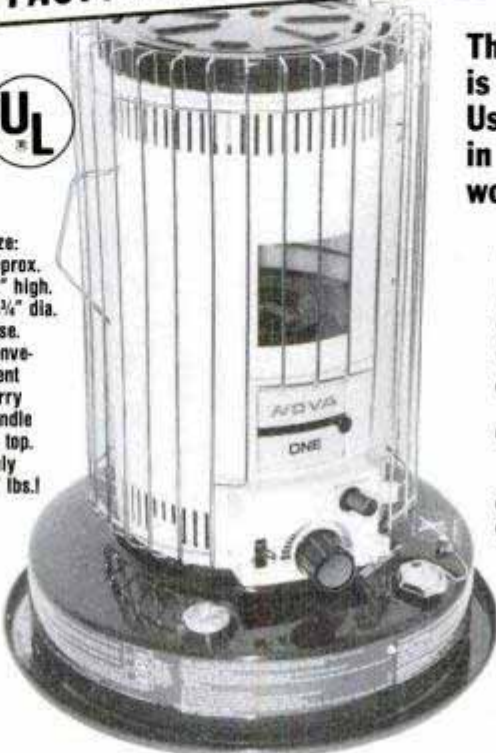
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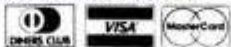
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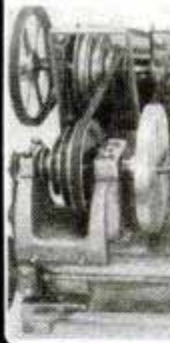


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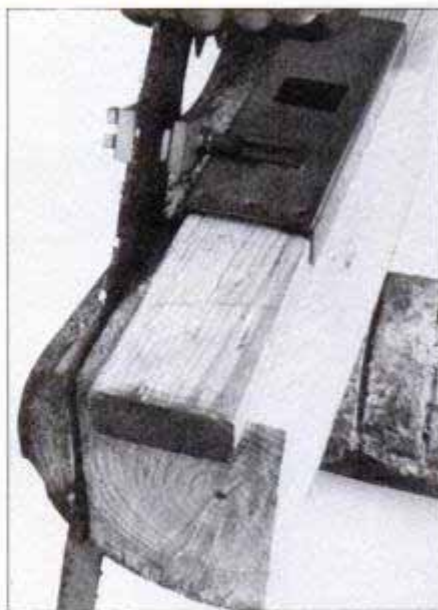
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MAKING THE CUT

(Continued from page 191)

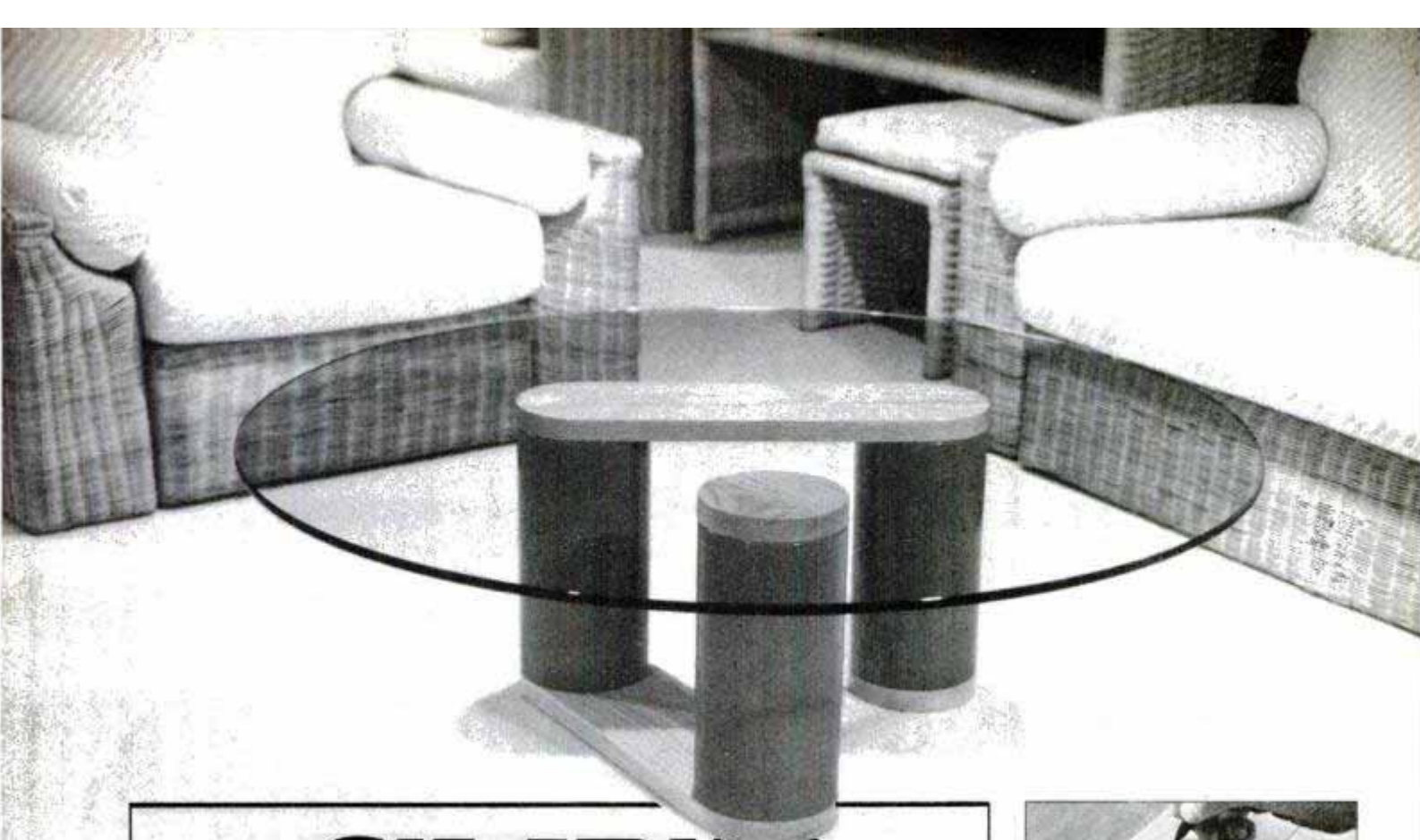


The Beam Machine is a guide that attaches to a chain saw bar to help you mill lumber. It's easily assembled and doesn't require unusual strength to operate. Just position and nail a straight 2x4 to the top of the log to be squared. Then pull the guide along the 2x4, cutting through the log as you go. Cut the remaining three sides in the same way to complete the beam.

The Beam Machine is of solid steel construction. It fits any chain saw, and is guaranteed to be replaced if broken. The guide costs \$29.95 postpaid from Hal E. Verble & Son Inc., 4670 North El Capitan, Suite 108, Fresno, CA 93711.



This handy tool kit contains everything you need for the basic maintenance and sharpening of McCulloch series 100 and 500 chain saws. The file guide (top) ensures that the teeth are sharpened to the correct angle. The depth gauge used with the flat file (center left) sharpens the top of the teeth so all will cut to the same depth and the hook on the end of the tool is used to clear debris from the chain channel. A tool called a Srench (bottom) sets proper chain tension and installs sparkplugs. The kit comes in a plastic pouch and costs \$17 at McCulloch dealers. Write McCulloch Corp., Box 92180, Los Angeles, CA 90009. **PM**



SIMPLY ELEGANT

Hardwood and PVC pipe come together in this designer-original glasstop table.

TEXT AND PHOTOS BY KEITH BRIGGS

Grace your living room or your family room with a unique, easy-to-build coffee table. Its original, contemporary design brings together three different materials—plastic, hardwood and glass. The table legs are made from 6-in.-dia.

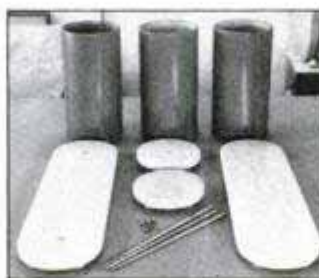


Table disassembles easily to allow repainting, if you desire.

polyvinyl chloride (PVC) pipe. Short PVC pipe cutoffs are often available from local plumbing supply firms and plumbing contractors. (If PVC pipe isn't available in your area, you can send \$50 to Briggs Design & Manufacturing, 10715 S.W. 190 St., No. 24, Miami, FL 33157. You will receive a 6-in.-dia. × 42-in. section, enough for three legs.

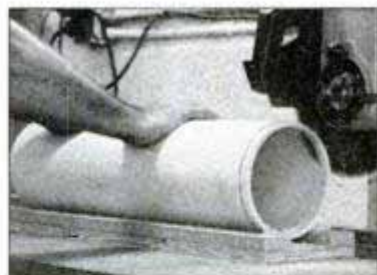
First, cut the pipe into three 13-in. sections using a hand saw, sabre saw or radial-arm saw. To ensure square cuts, mark the pipe using a sleeve made of heavyweight paper, as shown in photo No. 1. Cut a paper strip about 12 × 24 in. and wrap it around the pipe. Align the paper's overlapping edges and tape it together. Using the sleeve as a guide, mark the line of cut on the pipe.

After cutting the pipe, sand the ends to remove all saw-blade marks. Also, rout the outside edge of each leg end with a 1/4-in. rounding-over bit. Then, use an orbital sander with 150-grit abra-

(Please turn to page 194)



1 To ensure square leg ends, wrap a sheet of heavyweight paper around the pipe. Align overlapping edge and use it to mark the line of cut.

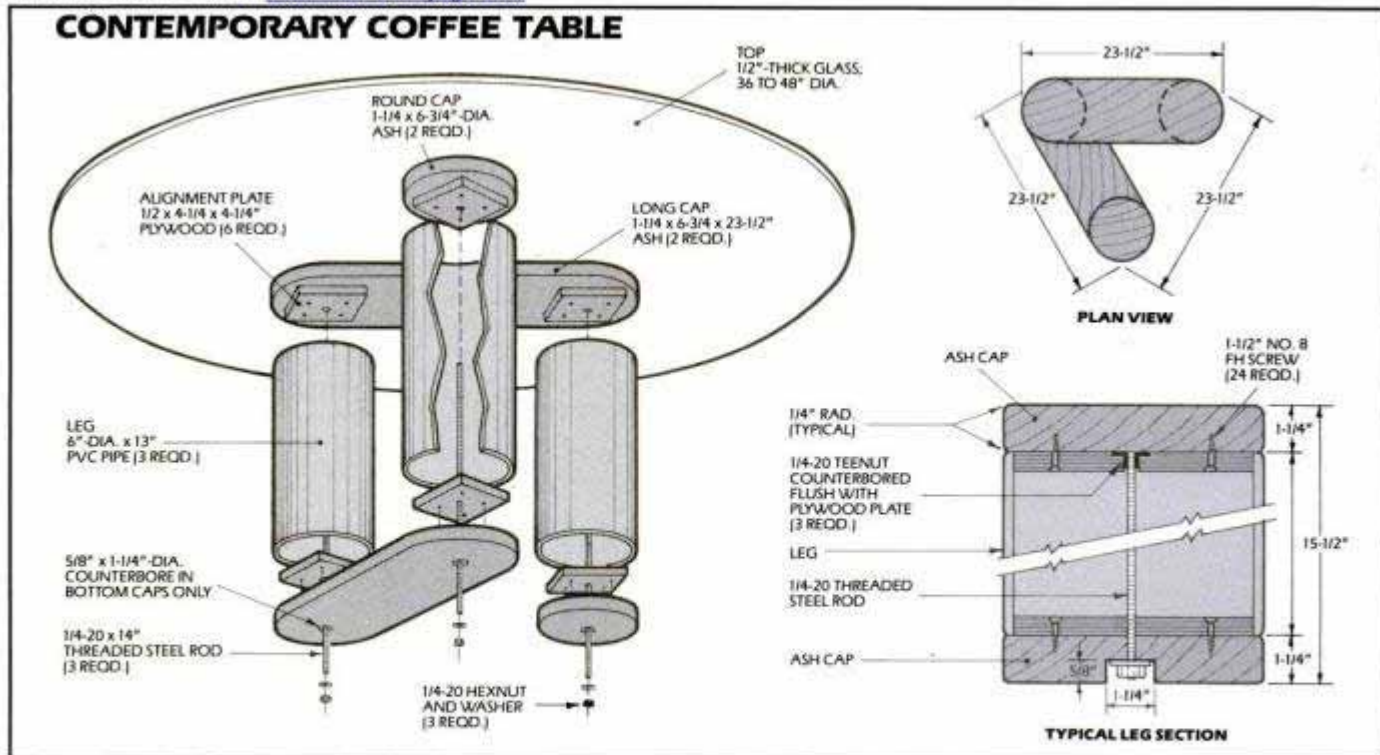


2 To cut legs on a radial-arm saw, hold pipe with two hands and rotate it slowly away from you. Note the use of homemade cradle to hold pipe.



3 Remove saw blade marks from pipe ends with a belt sander. Keep sander moving at all times. Marks can be removed with a rasp, too.

CONTEMPORARY COFFEE TABLE



sive paper to sand the leg's outside surface. This will provide a better surface for the paint to adhere to.

Spraypaint the legs with two coats of enamel primer, and sand lightly between coats with 240-grit abrasive paper. Remove the sanding dust with a tack cloth and spray on a gloss enamel finish coat in the color of your choice. Apply a second finish coat, if you find that it's necessary.

Next, cut the four ash caps to the dimensions shown in the drawing. Note that the caps are 6 3/4 in. wide to match the outside diameter of the legs. Rout

the caps' edges with a 1/4-in. rounding-over bit. Then, sand each cap smooth and apply two coats of polyurethane varnish. Counterbore the underside of the bottom set of caps, as shown in the drawing, to accept the washers and nuts. Then, bore a 3/8-in.-dia. hole through each counterbore.

Next, cut six 4 1/4 x 4 1/4-in. alignment plates from 1/2-in. plywood. Bore 3/8-in.-dia. centerholes through the three plates used with the bottom caps. Counterbore a 1/8-in.-deep x 1-in. recess in the remaining three plates. Then, bore a 3/8-in.-dia. hole through each recess

and install 1/4-20 teenuts. Glue and screw the plates with the teenuts to the underside of the upper set of caps. Be sure to position the plates so that the flange of each teenut is against the cap. Fasten the remaining plates to the bottom set of caps with glue and screws.

Next, cut three 14-in. lengths of 1/4-20 threaded steel rod. Position the upper caps face down and thread the rods into the teenuts. Then, slip the legs over the rods and attach the bottom caps with washers and nuts. Finally, turn over the assembled base and place the 1/2-in.-thick glass on top. **FM**



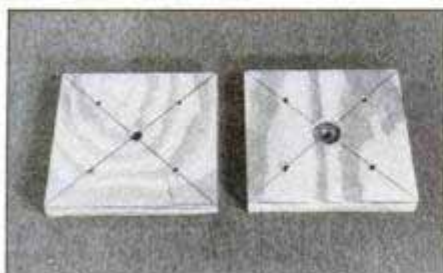
4 Rout the outside edge of each leg end with a 1/4-in. rounding-over bit. Hold the pipe securely upright in a vise and advance the router slowly for smooth, clean cuts.



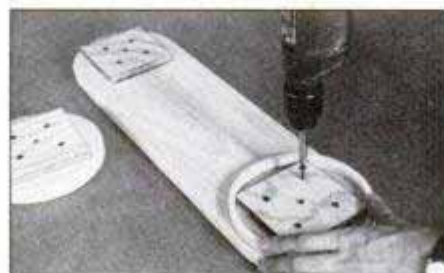
5 To help the paint adhere better, sand the legs with an orbital sander and 150-grit abrasive paper. Fill any nicks and deep scratches with plastic auto body putty.



6 Suspend the legs between sawhorses to make painting easier. Apply two coats of sandable enamel primer followed by a coat of gloss enamel in the color of your choice.



7 Half-inch plywood alignment plates are shown ready for installation. Plate on left is used with the bottom caps. Affix plate with the teenut (right) on the upper caps.



8 Glue and screw the alignment plates to the hardwood caps with the aid of a 1/2-in.-wide x 6-in.-dia. PVC pipe ring. Use ring to position the alignment plates exactly.



9 Assemble the table upside-down. Thread the steel rods into the teenuts, then slip the legs over the rods. Finally, fasten the bottom caps with washers and hexnuts.

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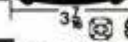
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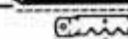
 #S5 Galley Spindle
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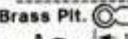
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CHEVROLET CORVETTE

Improved ride and quieter brakes please new owners, while performance takes over as the best liked feature.

BY MICHAEL LAMM, West Coast Editor

The 1984 Corvette got its official launch on Mar. 21, 1983. Even by the time we surveyed Vette owners that November (*PM Owners Report: Chevrolet Corvette*, page 132), the car was still wet-paint fresh.

As such, it had the sorts of bugs you'd expect. Nothing serious, but little things like rattles and odd noises, squealy brakes, too-long waits for parts, sluggish power windows, rough ride with the Z-51 suspension package and premature shifting from the automatic transmission.

This *Owners Report* amounts, then, to a followup. We decided to find out whether the 1985 Corvette is rid of those early little tics and hiccups.

Squeaks and rattles haven't gone away, unfortunately, but there are now fewer of them. A California real-estate broker put it like this:

"If Chevrolet could just find a way to build a fiberglass car that doesn't rattle, the company would have a legitimate claim to world-class excellence. And even as it is, the Corvette still represents far and away the best value per dollar for this type of car." In all, 13.1 percent of our respondents complained of body squeaks and rattles last year, versus 12.8 percent this season, so there really hasn't been much improvement.

Brake squeal, though, has been drastically reduced in the 1985 car. Last year, 21.7 percent in our survey listed noisy brakes as a notable problem, as against 7.8 percent this year. The reason seems to be that the Australian Girlock 4-wheel disc brakes now have stiffer backing plates and use semimetallic pads that comple-

(Please turn to page 198)



PHOTO BY CLIFF GROMER

PM PHOTO HINTS

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Sheet-music stands make lightweight, inexpensive props for flash units or homemade reflectors. Their height is adjustable, and they collapse for easy carrying.—William J. Frazier

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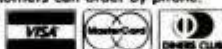
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CHEVROLET CORVETTE

(Continued from page 196)

ment the damped-iron rotors.

And those initial long waits for parts are mostly gone, too. The original complaint stemmed from a factory recall that involved replacing some smog-pump pulley bolts. Since the engine uses one long Poly-V drive belt for all accessories, the car wouldn't run without those bolts. Dealers, though, didn't stock them at first, and demand for the new bolts got backed up—as did orders for other newly designed parts.

If you're a keen observer of Corvettes, you're surely aware that Chevrolet made several important changes in the 1985 car. The 1984 model's twin TBI ("Crossfire") induction system, for example, has given way to direct port injection. This 1985 modification, developed jointly by Rochester and Bosch, adds 35 horses and 40 lb.-ft. of torque to the 350-cu.-in. V8.

Also, the Z-51 package has been tamed for '85 by taking out some of the earlier version's bone-jarring ride stiffness. Ride rates of the fiberglass leaf springs have been reduced 10 to 20 percent in the '85 Vette's standard suspension and 30 to 40 percent in the Z-51, with shocks revalved to match.

Delco/Bilstein gas-over shock absorbers have been made a new and separate option, independent of the Z-51 package (which also uses the same Delco/Bilsteins), and about half our respondents now own a set.

Finally, the long-awaited 4+3-speed overdrive stickshift became available in September 1983 at no extra charge. A third of our 1985 respondents opted for a copy. Ironically, our current survey shows that the Turbo Hydramatic 700-R4 automatic delivers roughly 1 mpg better fuel economy than the 4+3, both in town and on the open road.

While styling still leads the purchase parade this year, power and performance, not looks, now rank as the Corvette's single best liked feature. "The new TPI 350 V8 really puts out," said a California engineer, "yet it's an extremely reliable engine." And a New York electrical engineer passed along this tidbit: "I believe the reason for variations in the automatic-equipped 1985 Vette's acceleration times comes from the way you handle the throttle. For maximum acceleration, I let up on the gas at 4000 rpm for the 1-2 shift. If I keep the throttle wide open, the transmission shifts as programmed at 5300 rpm, and engine torque above 4500 really isn't there. I feel the shift point

should be lowered to 4500 rpm."

No one complained about the Corvette's acceleration, but as a best liked feature, handling was down this year by 10 percentage points. And despite the various suspension fixes, the '85 Corvette's ride still shook up some owners.

"Needs a smoother ride," lamented a New York manufacturing president. This owner's car did have the Z-51 package, but his real complaint—and that of several others—was wheel balance. "The car vibrates," he continued. "It's the computerized wheel-balancing system."

A Florida retiree agreed: "I've been to three different dealers nine times for wheel alignment and rebalancing. Due to low factory warranty payments, dealer mechanics aren't allowed enough time to do the job right." And a Georgia credit manager noted, "When delivered, my car had three wheels out of round; not tires—wheels!"

Yet a North Carolina pilot capsulized many owners' opinions of the '85 Corvette's handling when he wrote: "Ride is firm but in no way unpleasant. It's hard to imagine a car that handles this well riding any better."

Drivers of early 1984 cars hadn't yet gotten the hang of shoehorning themselves into and out of their cars, but

SUMMARY OF 1984 AND 1985 CHEVROLET CORVETTE OWNERS REPORTS*

	1984	1985						
Total miles driven	632,629	756,722	Noise and rattles.....	13.1%	12.8	Smog pump.....	10.4	—
Average miles per gallon			No complaints.....	—	10.8	Windshield wipers.....	10.4	—
With automatic transmission			Harsh ride.....	19.4	10.8	Automatic transmission.....	9.6	7.8
In town	16.6	16.7	Foor entry and exit.....	9.1	—	Dealer repairs satisfactory?		
On the highway	22.8	22.3	Squeaky brakes.....	8.6	—	Yes.....	62.9%	48.1%
With 4+3-speed manual transmission			Parts aren't available.....	6.3	—	No.....	37.1	51.9
In town	—	15.9	Quality of finish.....	—	5.4	Dealer service opinion:		
On the highway	—	21.4	Poor workmanship.....	—	5.4	Excellent.....	25.1%	33.1%
Transmission choices:			What changes would you like?			Good.....	39.2	33.1
Automatic.....	100.0%	66.9%	No changes.....	17.3%	17.3%	Average.....	25.7	18.5
4+3-speed manual.....	0.0	33.1	More horsepower.....	7.5	9.3	Poor.....	9.9	15.2
Performance options:			Smoother ride.....	12.1	7.5	Number of vehicles owned:		
Delco/Bilstein gas shocks.....	—	54.4%	Fewer noises.....	—	6.5	This car only.....	13.6%	11.4%
Performance axle.....	—	42.8	Better materials.....	8.7	6.1	Two cars.....	30.2	37.4
Z-51 handling package.....	66.6%	41.6	How much did you pay for your car?			Three cars.....	31.2	24.4
Comfort and convenience options:			Average.....	\$24,833	\$25,628	Four or more cars.....	25.1	26.8
6-way driver's seat.....	—	86.8%	Range.....	\$19,500-\$21,000-	\$30,000 \$30,000	Makes of other cars owned:		
Delco/Bose sound system.....	80.9%	83.2	Workmanship opinion:			Chevrolet.....	39.5%	45.9%
Leather sport seats.....	33.8	60.0	Excellent.....	52.3%	58.0%	Corvette (included in Chevrolet above).....	15.7	24.8
Transparent roof panels.....	—	58.8	Good.....	42.6	37.4	Ford.....	14.5	21.6
Custom sport seats.....	—	22.8	Average.....	4.6	4.1	Oldsmobile.....	12.2	17.0
Why did you choose this car?			Poor.....	0.5	0.5	Cadillac.....	20.3	16.5
Styling.....	56.4%	51.4%	Comfort opinion:			Pontiac.....	—	15.1
Performance.....	21.5	36.1	Excellent.....	61.5%	60.6%	Buick.....	11.6	—
Past experience.....	24.1	25.5	Good.....	34.0	36.1	Would you buy another Corvette?		
Handling.....	16.9	14.8	Average.....	3.0	2.9	Yes.....	71.1%	74.0%
Made in U.S.....	11.3	—	Poor.....	1.5	0.4	No.....	7.8	4.1
Power.....	—	7.4	Had any mechanical trouble?			Maybe.....	21.1	22.0
Specific likes:			No.....	43.1%	63.1%	Would you buy another Chevrolet?		
Performance power.....	60.6%	78.3%	Yes.....	56.9	36.9	Yes.....	79.1%	50.4%
Styling.....	78.8	70.5	What type of trouble?			No.....	4.0	13.8
Handling.....	65.7	55.6	Electrical.....	—	17.8%	Maybe.....	16.9	35.8
Comfort.....	19.2	—	Oil leaks.....	—	14.4	Age distribution of owners:		
Sound system.....	—	15.0	Alignment and wheel balance.....	—	13.3	15-29 years.....	1.3%	14.7%
Specific dislikes:			Brake squeal.....	21.7%	7.8	30-49 years.....	70.9	72.9
Inadequate headroom.....	—	14.8%	Power windows.....	20.0	—	50-plus.....	15.7	12.3
			Manual shifter.....	—	7.8			

*Percentages might not equal 100% due to rounding or insufficient data.

apparently 1985 drivers have, because only a few mentioned tight entry and exit. Overall comfort opinions, however, remain about the same as last year. A Texas engineer told us, "I'm 6-foot-4 and still have good visibility. Legroom is ample. Very comfortable but somewhat fatiguing on long trips." A self-employed North Dakotan: "Limited seat width. People with muscular backs find the seats too narrow. I'm 6 feet tall, and my head almost touches the roof."

In terms of quality and workmanship, our overall 1985 versus '84 ratings rose in the "excellent" and "poor" columns but went down under "good" and "average." A Minnesota dentist noted, "Slight orange peel in the paint. The finish can't compare with a Porsche's. But who sees the paint when you're outperforming them at every turn?" And a California fireman: "New Vette paint jobs are better than in the past, yet for \$30,000 I feel there's still plenty of room for improvement."

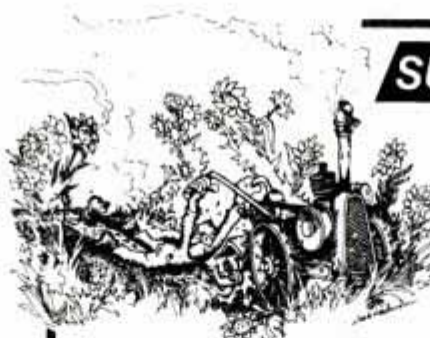
Of mechanical defects, the most common were electrical, followed by oil leaks around the valve covers and at the filter.

As with the '84 cars, dealer service didn't set any records. "Their main problem," said a Florida small-business man, "is that they think in terms of Chevrolet, not Corvette. Corvette buyers are a breed apart, and this is a high-priced car. Chevrolet is competing here with Porsche, Ferrari, Lotus, Mercedes, and so on. Chevrolet's service should reflect that."

In a California supervisor's opinion, "The service people do more damage than good. I spent this much money to have a nice car, but they treat it like a pickup truck." And an Ohio auditor: "I owned an '84 Corvette and traded for this '85 model. The '84 had digital instrument problems, and the dealer replaced the panel with a new or reworked panel four times. I hope this doesn't carry over into the '85, because I see some major repair bills once the car goes off warranty—like \$1600 to replace the instruments again."

One interesting statistic in our data is the number of 1985 Corvette owners who also own earlier models. That percentage rose from 15.7 in '84 to 24.8 this year. These people know their Vettes and realized that the '85 model would have worth-waiting-for improvements over the early version.

It seems clear that the '85 Corvette represents a big leap over the '84, which was already a vastly improved and highly satisfying car. Some of the earlier problems still exist, but most owners agree with the self-proclaimed gigolo from Illinois who stated simply that, "The '85 Corvette is the fastest, best looking and best handling sports car that money can buy!" **PM**



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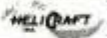


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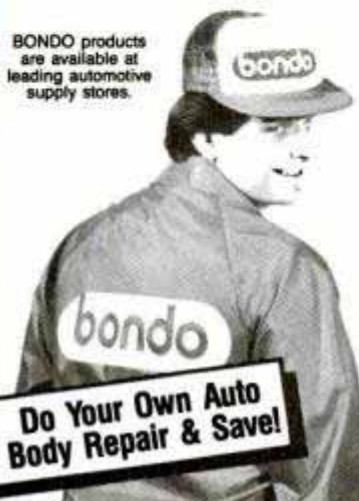
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135 HOUSEHOLD INVENTORY RECORD

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TIME MACHINE

75 YEARS AGO: October 1910

Flight of fancy

It's interesting to look back on a prediction realizing that what seemed fanciful actually was understated. In *Across The Atlantic In An Aeroplane*, Victor Lougheed, spurred by recent aviation advances such as Bleriot's English Channel crossing and record speeds, wrote, "So great has been the progress that it taxes the imagination . . . but it is at least fairly safe to suggest that the next great flight which is destined to awaken even the most skeptical of mankind will be the crossing of the Atlantic by aeroplane."



Coffee, tea . . .

English airplane concept (above) proposed an enclosed hull for passengers. More radically, the inventor proposed wings that twisted and turned with the wind rather than by hand control.

Mothmobiles

Destructive gypsy moths were plaguing Northeast foliage. PM alerted the public to the spread of the insects by automobiles. Since the female couldn't fly, it attached itself to automobiles and dropped off hundreds of miles from its starting place to lay its eggs. Massachusetts cleared underbrush along main roads to stop the hungry pests.



Atlantic crossing prediction.

50 YEARS AGO: October 1935

Designing patriarch

French aircraft designer Louis Bleriot, often called the father of ocean flying, proposed building a new craft that would make ocean transport more profitable. Bleriot's *Avion-Marin* was designed as a marine airplane. The craft consisted of a 100-ft. wing atop two whale-shaped passenger and freight-carrying compartments and was capable of landing on land or sea. Bleriot felt his craft, in conjunction with man-made island airports called seadromes would make the Atlantic hop profitable.



Whale of a boat

The latest design in speed boats was this whale-shaped streamlined speedster. The 16-foot plywood boat was powered by a 4-cylinder Ford engine. Its hydroplane hull and hooded pilot's compartment cut air resistance and permitted it to skim over water at high speeds.

Speaking of movies

As more drive-in theaters disappear from America's landscape, it's fun to look back on their evolution. An enterprising owner was one of the first to install individual speakers. He placed 460 speakers along the parking rows. Sound traveled through auto radiators.



Putting profit in long flights.

25 YEARS AGO: October 1960

Inner space

It included PM's eighth annual home section and it presented readers with innovative methods of creating space in the home where there normally would be a lack of space. "Build-it-in," was the catch phrase and the article described beds that slid into walls and wall-based stereos, hi-fis, intercome systems and TVs. Detailed diagrams illustrated how a home could be landscaped behind a masonry wall while utilizing inner-garden courts and glass walls to bring the outdoors inside, yet maintain privacy.

Outer space

The lunar landing module depicted in the article *Our Moon Program Starts Now* was remarkably similar to the lander from which Neil Armstrong stepped onto the moon's surface July 20, 1969, and uttered the phrase often found in latter-day history books. Note the 2-stage system (the lower portion to be left on the moon). The article detailed the preparatory steps for the landing, including development of the Ranger unmanned spacecraft, guidance systems and splashdown recovery operations. **PM**



The battle for space at home.

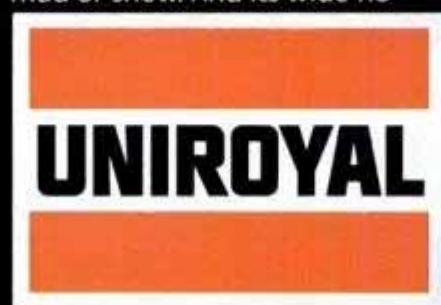


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tation design helps in loose surfaces by distributing vehicle weight over a broad area.

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