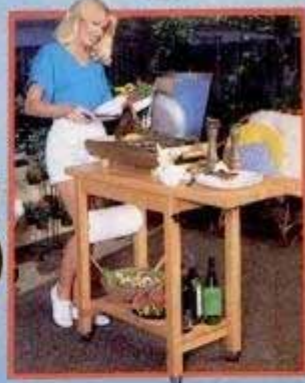


JULY 1985 \$2.00

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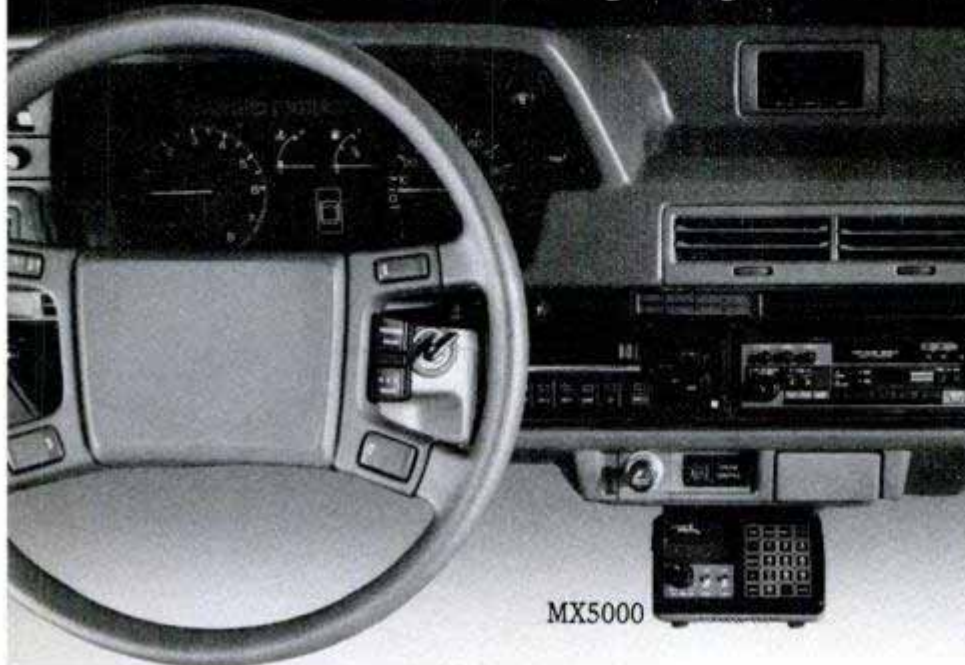


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MX5000



MX4000



MX3000

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more, it has a full function digital readout, priority, search and scan delay, dual scan speed, and a brightness switch for day or night operation.

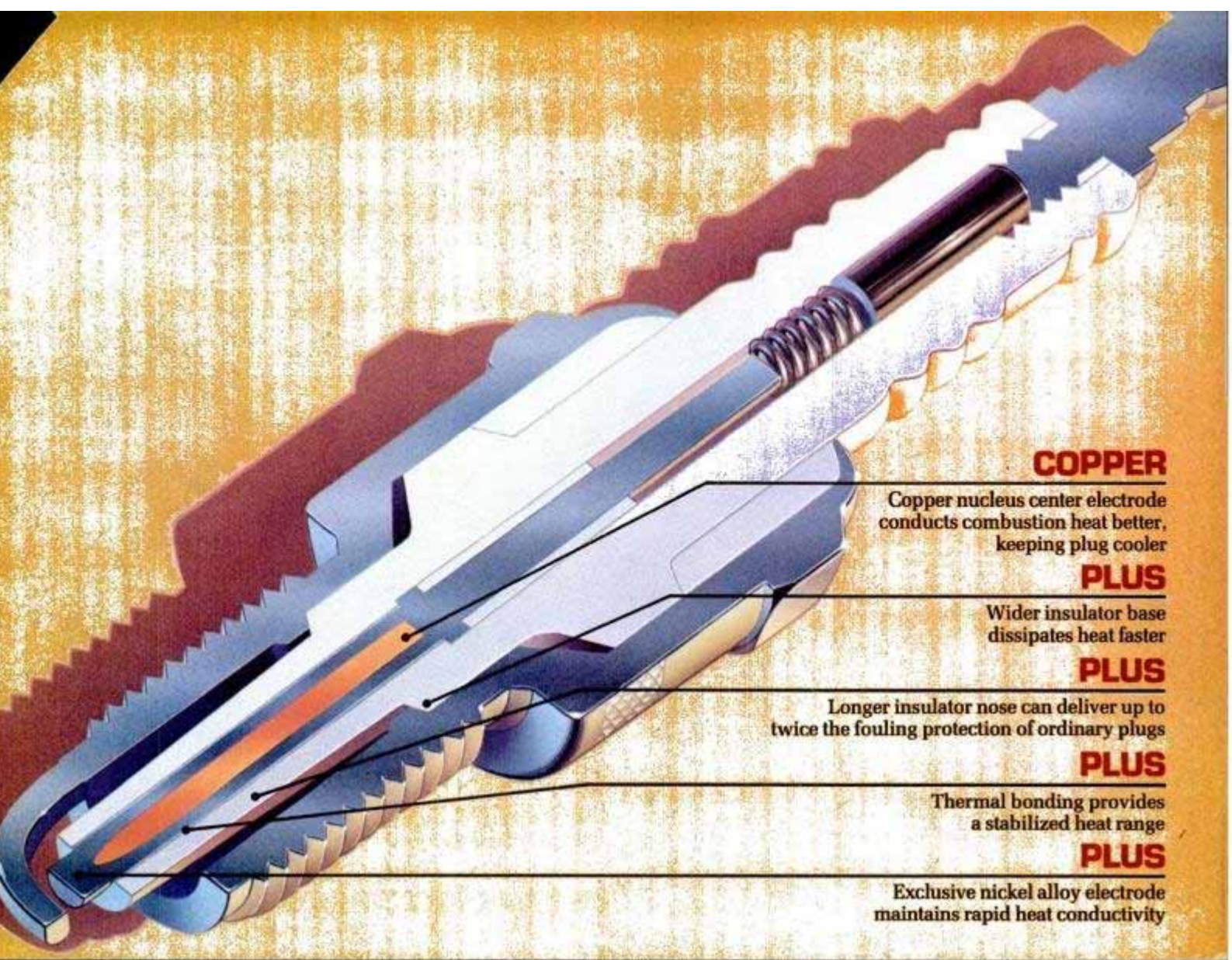
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This fast, sporty, two-seat Polliwagen is just one of 14 new make-your-own fun planes you can build from plans or kits. From as little as \$5,000 to as much as \$100,000, you'll find a full range of choices in the exciting story on page 86.

—PM photo by Howard Levy

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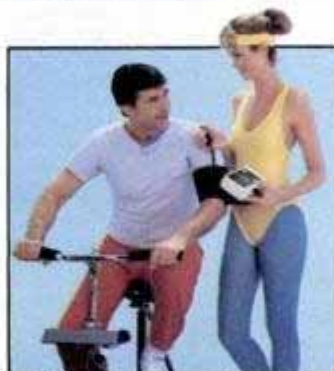
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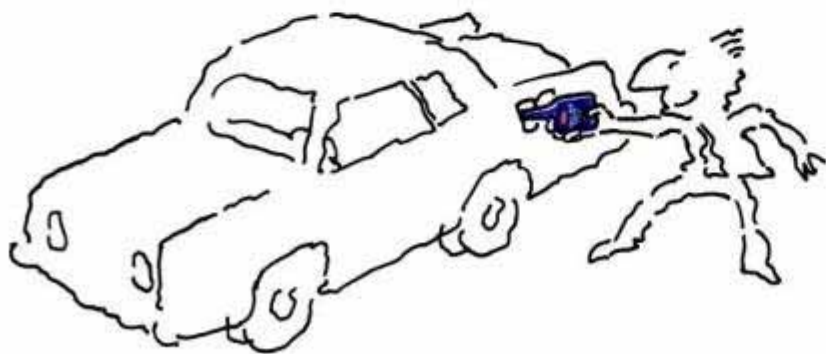
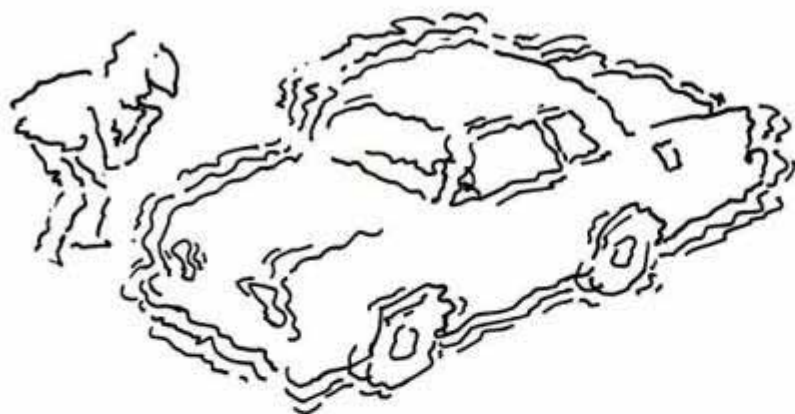
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OMC's Cobra may make quite a splash in the sterndrive market

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The Dieseling Dilemma:



End It All with Fuel Mix.

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EDITOR'S NOTES

JOHN A. LINKLETTER

1923-1985

There is a voice missing from this issue of Popular Mechanics.

John Linkletter, who began his career with PM in 1959 and became our Editor-in-Chief in 1974, has been one more voice stilled by that specter we call cancer. To us, the stillness is deafening.

To walk in his company was to revel in an enthusiasm for the positive side of life. Though soft-spoken, his voice crackled with the sharpness of his wit, and rumbled with the depth of his understanding. His talent could be matched by few in this world, and this world called him "friend."

An ultimate Navy Man, he served his country in the Second World War as a carrier pilot. He never lost his enthusiasm for flying, and he never deviated from his belief that world peace is attainable through our country's strength.

Secretary Lehman and the United States Navy felt the same about John, and on April 12 of this year he received the highest civilian commendation the Navy can confer—the Distinguished Public Service Award.

In his own way, this quiet man changed the world for the better. He did it by lighting not just one, but millions of candles of hopes and dreams. His goal was to help man have a better life, and a better understanding of life. He did that through a conduit that was an important part of *his* life—Popular Mechanics.

He will live on through that important part of his life, for those of us who loved him so much are forever committed to the maintenance of those standards of excellence he labored so hard to achieve.

John was many things—outrageous, ironic, irreverent, consummately intellectual. His dry wit could cut to the heart of the most ponderous of situations—usually using his pipe as a pointer. His

unfailing humor always brought a smile to everyone he met. That's how the people of Popular Mechanics, and indeed our entire Company, remember him.

But most of all, he possessed that one quality so elusive to most of us: People universally *liked* him.

We liked him. He was our friend. We miss him deeply.

Daniel J. Coleman
Publisher



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8⁹⁹ 21-pc.
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Has 18/3 SJT heavy-duty cord, on/off switch and handy side outlet. 3-wire grounded for safety. Hurry! Offer good from June 20 only while supplies last, at participating True Value Hardware Stores. 235705

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Not an easy task, mind you.

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So no matter what you need batteries for, count on Duracell.

Our delivery is strictly First Class.



When it comes to making them last longer,
we never stop.

LETTERS TO THE EDITOR



A junked dream car is still a dream

Your article *Yesterday's Dream Cars* (page 92, Apr. '85) was very enjoyable. In it, you asked readers to let you know if they knew of other long-lost dream cars. Here's a photo (below) of my Ford XM-800, a one-of-a-kind show car that Ford donated to the University of Michigan way back in 1957.

Many years later, I found it abandoned in a farmyard. Its body is fiberglass or it never would have lasted as well as it has. I plan to restore it completely.

DAN BROOKS
JACKSON, MICH.

For years there has been a car here in the Huntsville area that has appeared in auto shows listed as a 1967 Studebaker, which it couldn't be since Studebaker ceased production in



It's seen better days, but is still a prize: Ford's XM-800 show car of the '50s about to be restored by reader Brooks.

1966. I figure it has to be a prototype car that never went into production.

There are also tales about a 1953 Corvette fastback sitting in a Birmingham junkyard. But there never was any such thing as a 1953 Corvette fastback. I believe it could be an early Corvette that GM slapped a fastback on and took to the Motorama as the first Corvair.

CHRIS CAMPBELL
HUNTSVILLE, ALA.

The real head turners

While I enjoy *Popular Mechanics*, your article '85 Imports: *The Sports Sedans* (page 92, Mar. '85) was just too much. The German Merkur XR4Ti, which your test drivers swooned over, is the worst-looking car I have ever laid eyes on. It's a "head turner," all right, but only because it's so ugly.

While I'm sure that the Merkur is mechanically sound, for only one-quarter of its \$16,500 price tag you could buy a '57 Chevy, a '65 to '68 Mustang, a '67 or '68 Cougar or a '49 Cadillac. These automobiles are the real head turners. I dare you to print this letter.

TOM VINCENT
SUNNYSIDE, WASH.

We'll not only print it, but a lot of us agree with it. Our May '85 Car Care Guide (page 123) was all about having fun with vintage Fords, Chevys and other great oldies. We call them Everyday Classics.

Chopper power

You did a good job on your story about combat helicopters (*No Longer Sitting Ducks: Now Helicopters Shoot Back*, page 86, Feb. '85). But I have a complaint. You didn't say much about the engines that power these mighty ma-

chines. The Hughes Apache has two General Electric T-700 turbines made here in Lynn. The T-700 turbine also powers the Sikorsky Black Hawk, Bell Super Cobra and several other important choppers.

I think that General Electric deserves a little bit of credit. Of course, you may already have guessed that I work for GE—and am proud of it.

BOB SCANLON
LYNN, MASS.

Not new, but newsworthy

I've enjoyed reading your magazine for many years, but I was surprised to see you describe the continuously variable transmission (CVT) as if it were some great new development (*Technology Update*, page 42, Mar. '85).

The CVT has had industrial applications since early in this century. Kraft Foods has used this system in its plant at Danville, Ill., for nearly 40 years.

LLOYD DEAN
TUSCOLA, ILL.

You're absolutely right that the CVT is not new in principle, but only recently has it been seriously considered for use in automobiles. It is this application that makes the CVT especially news worthy.

Two great pilots

I was pleased to see your article *History's Best Test Pilots* (page 78, Apr. '85). It's always nice to have my father, Joe Walker, remembered. However, I must point out that the pilot identified as Joe Walker in the photograph of the X-15 rocket plane is not my father. Thank you nevertheless for including him with the best. He certainly was.

JIM WALKER
LOS ANGELES

The man identified as Joe Walker is actually Pete Knight and the speed record he set in the X-15 was 4,534 mph, not 4,104 as you stated. How do I know this for sure? You see, I married Pete's sister and he married mine.

CLYDE A. LIMOGÉ
MORRISVILLE, VT.

Both were great test pilots and both flew the X-15. We deeply regret the mixup in identification.

You said Convair's experimental VTOL plane was nicknamed *Pogo* after the Walter Kelly cartoon character. I think you'll find that the name was derived from the plane's unusual landing gear. It had four spring-loaded legs to cushion landing shocks. They worked much like giant pogo sticks.

LAR HOTHAM
LANCASTER, OHIO

Congratulations on a great story, but I must call your attention to one error. The plane in which Jimmy Doolittle made his historic "blind" flight in 1929 was a Consolidated Aircraft NY-2 Husky, not the Consolidated-Vultee BT-13 Valiant that you showed. The BT-13 didn't fly until 1939, 10 years after Doolittle's feat.

R.T. LE VINE
FLIGHT CAPTAIN, CONVAIR (RET.)
SAN DIEGO

Polar plane

We were pleased to see the photo of the Dornier DO-228 polar exploration aircraft on our skis (*Technology Update*, page 75, Feb. '85). However, we wish to clarify that the ski installation was a joint American/German project. We designed the skis and supplied them to Dornier for its flight tests.

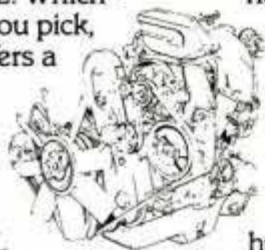
DALE A. HEWITT
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MINNEAPOLIS, MINN.

Team Ranger: Tough 4x4 and 4x2.

Ford's tough Ranger comes in rugged 4x4's and street-smart 4x2's. They go where you want to go!

It's a tough team to beat—Ranger and you.

Bash around the boonies in a Ranger 4x4 with a couple of dirt bikes in the back—or zip around town in an easy to park 4x2. Which-ever one you pick, Ranger offers a hefty V-6 engine that the imports don't. And Ford's 2.3L Four now gives you the



extra response and performance of electronic fuel injection. And this high-tech engine is standard.

Go on all 4 wheels.

For 4-wheeling, nobody's topped Ford's exclusive Twin-Traction-Beam front suspension and its proven four wheel drive system (choice of manual or optional automatic locking hubs). Also, there's a 5-speed transmission that

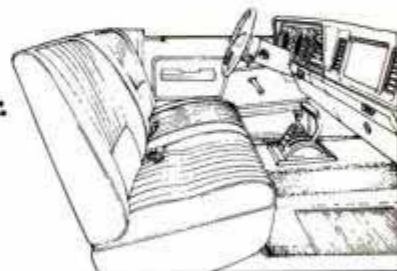
comes standard in all Rangers.

Or just two wheel power.

Ford's 4x2 Ranger is one tough American-built small pickup! It has the widest cab in its class. Up front, there's Ford's exclusive Twin-I-Beam suspension. In back, strong double-wall box construction—plus payload options up to 1,765 lbs.

If you have a boat or trailer to tow, tough Ford Ranger adds to your fun. When properly equipped with the trailer towing package, gutsy little Ranger can tow up to 5100 lbs. For working hard and playing hard, it's Ranger!

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thing else Ford Ranger is a great value. It's a small price to pay for a lot of fun.

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Dealer installed light bar not for occupant safety.



"My Ford Ranger and Me."

"My Ford Ranger 4x4 and Me."

FORD RANGER
AMERICA'S TRUCK BUILT FORD TOUGH



This One



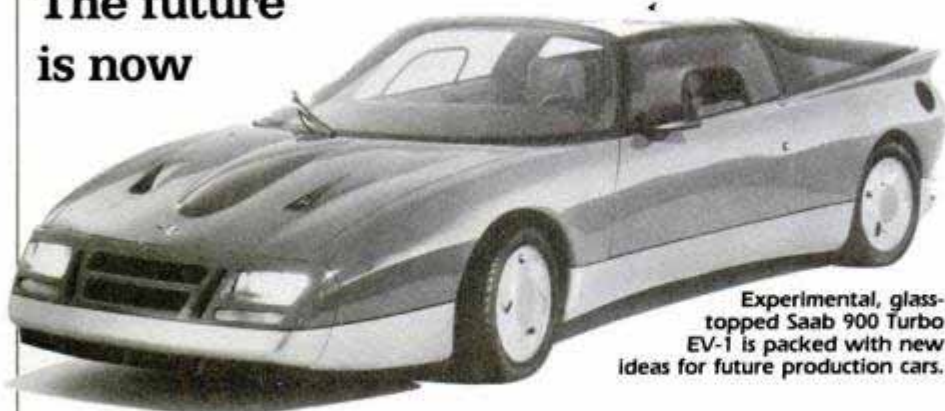
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Get it together - Buckle up!

IMPORTS & MOTORSPORTS



The future is now



Experimental, glass-topped Saab 900 Turbo EV-1 is packed with new ideas for future production cars.

Long production runs of successful cars make life frustrating for auto designers and engineers. To keep the good ideas bubbling, Saab turned its staff loose to brainstorm an innovative, high-performance sports car on the 900 Turbo



Solar cells power a fan that ventilates the interior when car is parked in the hot sun.

platform. The auto-producing Swedes put together a cruiser that would stop even a Norwegian bachelor farmer in his tractor tracks. Have to park this one in the hot July sun? No sweat. The roof's solar cells power a vent system that changes inside air once a minute. Need good headlights for a midnight dash to the sea at 168 mph? Hit the switch and separate light sources in the new-generation Hella minis let you run with high beam and low beam at the same time. For things that go bump in the night, the front and rear panels are of aramide fiber reinforced plastic—it's light, strong and deforms and restores its shape without cracking. And, for a real kick in the pants, Saab's 2-liter Turbo has been tuned to 282 hp.

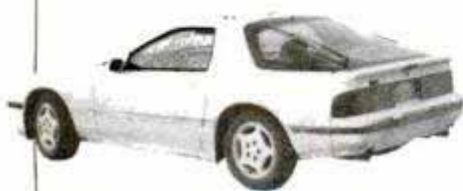
Redo for a rotary

Sneak shots of Mazda's new RX-7—or will it be the RX-8?—reveal a sports car that bears absolutely no resemblance to the rotary-engine two seater that has been a best seller for the last seven years (see *Driving The Mazda RX-7*, page 34, May '78). The second-generation RX-7 will still be a rotary-front-engine design with rear-wheel drive, but it promises to be more powerful, more luxurious and more expensive. If it is dubbed the RX-8, it



Scoop on new RX-7 means it's a turbo.

may not replace the RX-7 but join it in the lineup (see *No Back Seat For Performance*, page 80, in this issue for the RX-7 tested with other two-seaters). Design of the new car is certainly more contemporary, but it is a hodgepodge, with strong influences of the Porsche 944 and 928 seen in the body styling from the nose to the B-pillar, and the rear glass hatch looking like it came right off the current Camaro/Firebird. Still, it looks good.



Big glass hatch on the rotary could have been supplied by GM from Camaro/Firebird.

Volvo 780 coupe

In Italy, young upwardly mobile *paisanos* love Volvos. Italy's a good market for the Swedish cars and so is the United States. So good, in fact, that we'll be the only two countries to get Volvo's new coupe. The car was designed in Italy by Bertone, and the renowned coachbuilder will assemble it there, too—in a new Bertone plant designed especially for the 780.

If you look at the photo closely, you'll see that the coupe shares no body panels with Volvo's 760 models, but it is designed around the same chassis and suspension of those rear-wheel-drive cars. The coupe will arrive here early in '86 with Volvo's turbocharged, intercooled, 2.5-liter V6, good for 163

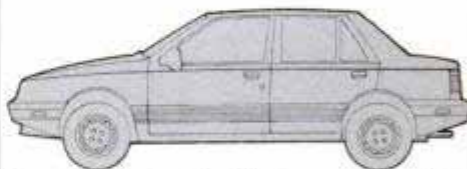


Volvo 780 coupe, due here early next year, is a \$30,000 personal luxury car being assembled in Italy by the coachbuilder Bertone.

hp. We'll get only a couple thousand 780s a year and the price tag will be about \$30,000. For that price you can be sure that the coupe will have power everything, leather seats and, anticipating Jaguar defectors, "wood accents," says Volvo.

Good-looking profile

The current Isuzu I-Mark is as homely as the Impulse is hot. It's not easy styling a sedan just right. The sporty



Isuzu I-Mark for '86 will be a good-looking four-door sedan with front-wheel drive.

Impulse, on the other hand, looks so right that you wonder how designer Giugiaro makes it look so easy. For '86, though, the I-Mark four-door will get an all-new look and fwd. The profile sketched here is just a teaser of what's to come.

PM

When the Big Q flows, America goes.



I've helped Dad take care of the old convertible ever since it was new. Always with Quaker State. I learned early about Quaker State's unique formula—it starts with Pennsylvania Grade Crude. About its stable viscosity, and its smooth flowing, steady protection. I had a good teacher. Thanks, Dad.

Quaker State.
The Big Q stands for quality.
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HOMEOWNERS' CLINIC



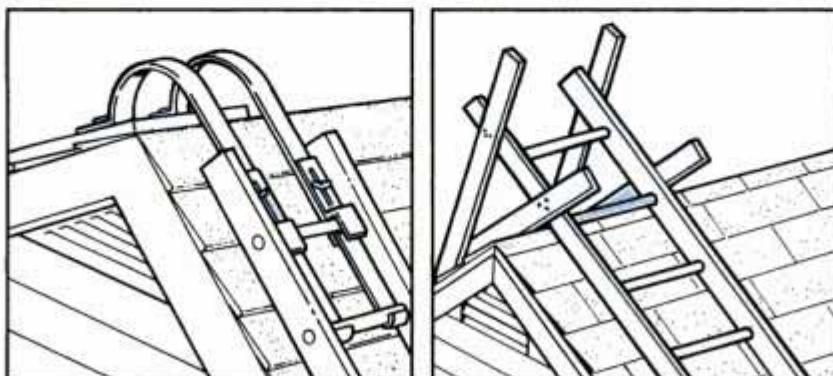
Reroofing a steeply pitched roof

I own a 2½-story home that needs reshingling, and I could use some tips on working safely on a multigabled, steeply pitched roof. I'm also wondering about the most economical and practical way to go about the job. The roof now has three layers of cedar shakes over tar paper and boards of varying widths. Many of the boards have 1- or 2-in. spaces between them. We like the shakes, but the cost seems prohibitive compared to asphalt shingles.—Tim Huyck, Kimball, S.D.

For working safely on a roof, wear loose-fitting clothes so you can move around freely. Also wear soft-soled shoes to prevent slipping. High-top sneakers with good ankle support are recommended. Never go on a roof on a wet or windy day. Shingles can be slippery when wet.

On a steep roof the roofing ladder should be anchored in place with a bracket or framework that extends over

the ridge, as shown in the drawings. This is especially important for roofs with a 4 pitch or greater. (You can also use roof brackets in conjunction with the ladder. These are shown in our story *How To Install New Windows*.



Anchor roof ladder with hooks over the peak. Brackets, shown at left, can be purchased for aluminum ladder. For steeper roof, a 2 × 3 framework can be nailed to a wood ladder. Extended arms of the framework provide handholds.

page 110, Apr. '85.) Position the ladder so that you won't have to reach far out to work. If you do have to reach out, always hold the ladder with the other hand and keep your hips between the ladder rails.

As to reshingling, regardless of

whether you use asphalt shingles or shakes you will have to remove the existing three layers first. If you use wood shingles, these can go on the existing boards. However, if you want to use asphalt, you'll have to cover the roofing boards with plywood sheathing to span the gaps between the boards.

You are concerned about the cost difference between shakes and asphalt shingles. Wood shingles are considerably more expensive than asphalt—as much as three or four times the cost, and are more time-consuming to install. A professional might charge five to six times as much for the shakes.

Asphalt shingles come in various weight classes from

210 to 400 pounds per roofing square. A roofing square is 100 sq. ft. The heavier the shingles, the greater the durability, and the higher the cost. The cost for top-of-the-line asphalt shingles, however, compares favorably with that of ordinary wood shingles.

Painting aluminum trim

I recently purchased a house with finished aluminum soffits, fascias, gutters and window trim. I would like to paint these a different color. Is this possible? And if so, will I be repainting every four years and lose out on the benefits of aluminum trim?—Rich Pagnusat, Elmhurst, Ill.

Not to worry! PPG Industries has a latex paint specifically formulated for repainting prefinished aluminum siding and trim. It's called Metal Siding Refinish, and comes in a variety of colors to match current popular siding colors. If the surface is prepared properly and the paint is applied properly, it will last for about 10 years. This compares favorably with many older types of prefinished aluminum siding which required painting after about 10 years. The Metal Siding Refinish can also be used on unfinished aluminum after applying a primer.

For information on preparing the surface and applying the paint write to

PPG Industries Inc., 760 Pittsburgh Drive, Delaware, Ohio 43015. Ask for Informational Bulletin EL-40, *Repainting Prefinished Aluminum Siding*.

Concrete driveway stain

I would like to know if there is any way to put a permanent black stain on a concrete driveway.—Lawson K. Broadrick, Atlanta, Ga.

No, there isn't. Opaque penetrating stains for concrete are available, but the color will probably last only three to five years. The stain colors the top surface and depending on the porosity of the concrete, penetrates 1/16 or 1/8 in. below the surface.

It is particularly difficult to keep a uniform dark color on a concrete driveway because of the bleaching effect of the sun, the weathering, and wear from vehicle and foot traffic. Also, if the porosity of the concrete varies along the driveway the stain will be uneven and blotchy. If you want an even black color you will have to restain periodical-

ly. Proper preparation of the driveway is important. It must be clean and dry. The stain is applied with a pump garden sprayer.

Tamm Industries, 1222 Ardmore Ave., Itasca, Ill. 60143, makes an opaque masonry stain called CHEMSTOP Stain for Masonry. It is available at hardware and building supply stores. A five-gallon can covers 400 to 500 sq. ft. and costs about \$80.

To minimize the effect of uneven porosity in the concrete, Tamm recommends first applying a coat of their clear waterproofing, also sprayer-applied, called CHEMSTOP Masonry Regular. A five-gallon can covers 400 to 500 sq. ft. and costs about \$60. **PM**

Do you have a home-maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

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THE PM GARAGE



Workbench rolls tools to the task

Around my place, the work to be done and the tools for the job are never right next to each other. Never, that is, until I discovered Tool-Up, a mobile tool caddy. It rolls around on a single pair of wheels and has a solid foot at the other end of its base, so it won't drift away from where you put it. Available with two or three 14 x 19-inch fiberglass trays, Tool-Up adjusts up to a 42-inch height, and another 2 feet higher with an optional extension post.

The all-steel framework will support up to 40 pounds on each tray and the top cradle swivels as well. When it's not in use, Tool-Up knocks down to a compact 5 x 18 x 25 inches and weighs in at an easy-to-tote 16 pounds. Two-tray models sell for \$54.50, and the three-tray design with high quality 5-inch ball bearing wheels goes for \$69.50.

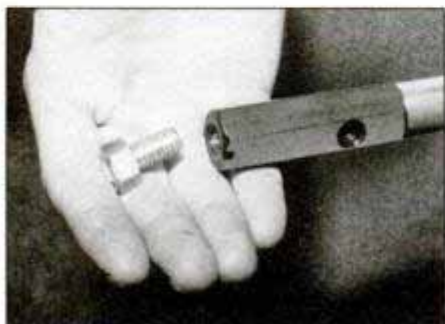
Inside, Tool-Up is handy for holding rollers and trays while I'm on a ladder painting ceilings. Order it from National Marketing Plus Inc., 986-PM, Azusa, Calif., 91702.—M.L.



Rolling tray will bring tools to the job.

Shock treatment

When a shock absorber's piston rod nut is rust-frozen in place, I've got a standard operating procedure: Put a deep socket on the nut, and with a long extension as a lever, rock back and forth on the socket to break the rod. When I'm lucky, the rod breaks below the nut and shock removal is easy. Unfortunately, the socket sometimes slips and the rod breaks off above the nut, leaving me to chisel away at the nut. But now there's a new tool manufactured by the Lisle Corp. that threads directly onto the shock absorber rod,



Shock tool ensures clean breaks below nut.

securely against the nut, and makes the break-off a sure thing.

To make it even more useful, the handle either threads into the top or the side of the tool, so it can be used even in the tightest quarters. At \$13 list price (\$25 for a universal set), this shock absorber tool is one of the better timesavers and aggravation-eliminators I've come across in a long time.



It's manufactured by the Lisle Corp. at 807 East Main St., Clarinda, Iowa 51632, and is sold in auto parts stores that cater to professional mechanics and to serious do-it-yourselfers. You won't find it in the "Home and Auto" aisle of your supermarket.

—Pete Warren

Spill stopper

The best ideas really are the simplest ones—like this magnetic parts tray I've been using. It's steel and measures 4 x 6 inches. The rubberized magnetic surfaces inside and out ensure that neither



Magnetic tray takes hold of tools, parts.

your car's paint job nor your tools will suffer the slings and arrows of metal-to-metal contact. It's roomy enough for small tools, and even if turned over the magnet prevents tools, bolts and small parts from escaping. Thexton Mfg. Co., 7685 Parklawn Ave., Box 35008, Minneapolis, Minn. 55435, makes the tray. It costs about \$9.22 at auto parts houses.—Bob Berger

20/10 vision

Next to 20/10, most other windshield cleaners are just soap and water. The amazing 20/10 is one of those chemicals that works so well, it's hard to imagine how I ever got along without it. Its strong point is removing the oily film



Washer fluid is formulated to cut road grime.

that blows from the roadway in rainy traffic. It makes glass that's in good shape seem to disappear. A quart of concentrate is \$3.09 in auto parts departments. Manufactured by 20/10 Products, P. O. Box 1726, Beaverton, Ore. 97075.—Don Green



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helps prevent loss of alignment, improper handling and poor steering response when carrying loads.

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So install a set of Monroe Load-Handler variable rate coil springs on your vehicle. They won't let you down when you load up.

*Load carrying ability is limited by the vehicle suspension and tires. See owners manual.

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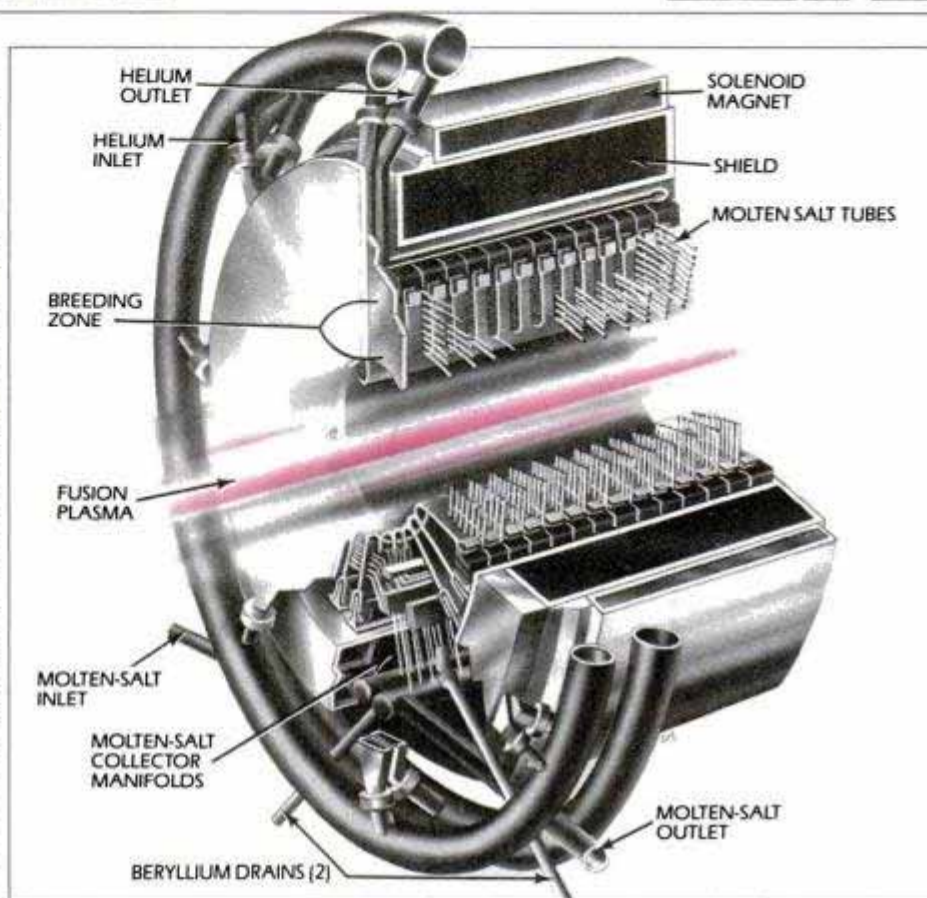


SCIENCE WORLDWIDE



Fusion-fission

Studies at the Lawrence Livermore National Laboratory suggest we may have an energy-producing breeder reactor by the turn of the century. It would produce electricity through nuclear fusion while converting thorium 232 or uranium 238 into fuel for less energetic fission reactors. Key to the new technology is a "blanket" that extracts heat to make turbine steam while converting fuel. A top candidate for the 21st century reactor blanket—so-called because it is wrapped around the reactor—is the Molten Salt Blanket (right). It surrounds the fusion plasma. Helium surrounding the blanket extracts heat for steam. Tiny beryllium pellets flowing through tubes provide a surface for fuel conversion. The uranium-carrying pellets are kept nonradioactive by flowing molten salts inside the fusion chamber. Pellets are drained out of the chamber to collect the fission fuel. To speed up the process, the uranium breeding zone is next to the fusion plasma. The fusion cloud is kept at the center using a solenoid magnet and shielding. Such reactors could remain operational into the 22nd century.



PM ILLUSTRATION BY DON MANNES

Forecast: Earthquakes

Forecasting the weather is a science that has met with mixed results. We're still working on it. But forecasting earthquakes is practically a form of voodoo. Few scientists have been willing to say much more than that a particular area has quake potential.

Thus, you may share my amazement at the National Earthquake Prediction Evaluation Council's endorsement of an earthquake prediction for Parkfield, Calif. The council, established by Congress in 1977, has never endorsed a prediction before. Scientists working independently at Berkeley and the U.S. Geological Survey made the prediction last year. Their studies of previous Parkfield quakes lead to a computer model indicating there will be a temblor of magnitude 5.5 to 6 within the next eight years.

The researchers noted that seismograph readings were identical in the last three Parkfield quakes. We won't know how good their predictions are until there's a quake, or unless 1993 passes without incident.

Speaking of computers

Computers that follow simple voice commands like "stop," "go" or "wait" have been around for years. But scientists have been hard-pressed to create a computer that can engage in anything like normal conversation with a human. Now, IBM has a device that may achieve that goal to a modest extent.

IBM's experimental speech-recognition system uses a training program and statistical software to give the machine a 5,000-word vocabulary. To program it, you read in one word at a time of a specially designed business correspondence, for example. It takes about 20 minutes, and will be programmed for your voice only.

Later, when you want to write a memo or letter, you just sit at the console and dictate at about the rate a boss dictates to a secretary. The IBM hardware takes 20 measurements of your voice every one-hundredth of a second. By comparing it to the original input, the machine translates the sounds into words and types them out with 95 percent accuracy.

Blood vendetta

Japan's Green Cross Corp., which makes artificial blood, says the blood has been used to cure cancer in five patients. The patients, Green Cross reports in a Japanese medical bulletin, were given injections of artificial blood once a week for five weeks. They also received radiation therapy. The artificial blood reportedly carries dead cancer cells out of the body to prevent natural cloning of new cells. American scientists are studying the experiments without comment for now.

That sinking feeling

University of Virginia researchers Robert Dolan and H. Grant Goodell say their studies indicate that cities around the world are sinking at a disastrous rate. Within the next 100 years, Long Beach, Calif., Houston and New Orleans will have sunk so much that annual flooding will cause billions of dollars in damage. The sinking is caused by three factors: rising sea levels, the weight of tall buildings and the extraction of ground water for drinking. **PM**



La Fédération Internationale de l'Automobile presents ...

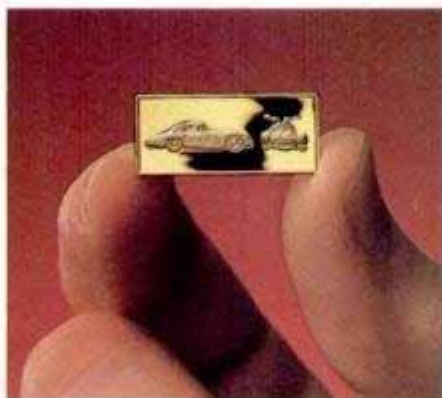
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dramatic advance in automotive technology. And the Mint Edition of the collection will be struck in the beauty of pure 24 karat gold electroplate on solid sterling silver.

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To subscribe, simply return the accompanying application to the official minter by August 31, 1985. But remember, there is an absolute limit of 25,000 Mint Edition Sets. So it is important to respond as soon as possible.

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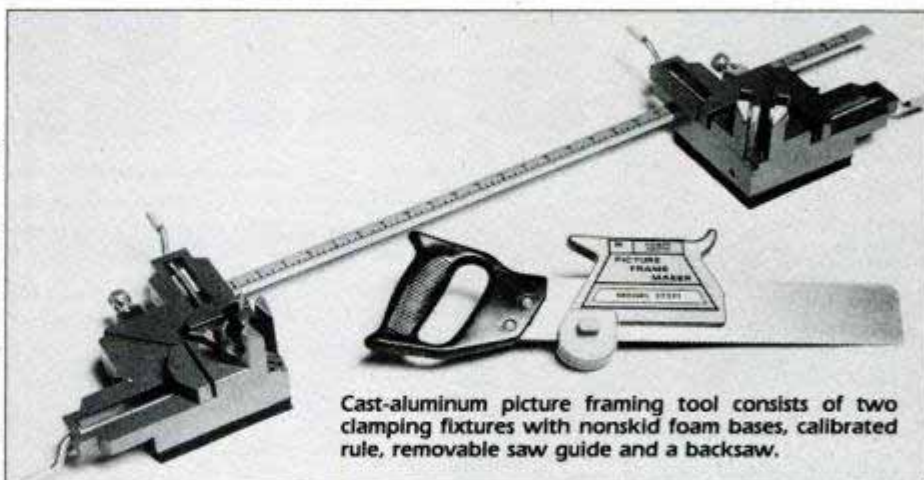
THE PM WORKBENCH



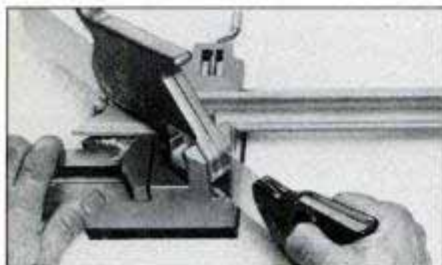
Make picture perfect frames

Making professional-quality picture frames is now possible thanks to the Hempe picture framing tool (model No. 37371). The tool cuts precise 45° miters and is designed to produce matching frame members of identical length to ensure a square frame. After cutting the members, the tool converts to an accurate clamping jig for assembling the frame.

The device consists of left and right corner clamping fixtures, calibrated rule, saw guide and backsaw. The cast-



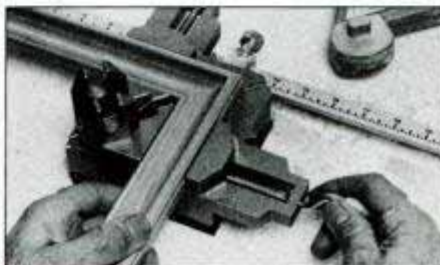
Cast-aluminum picture framing tool consists of two clamping fixtures with nonskid foam bases, calibrated rule, removable saw guide and a backsaw.



After adjusting the tool for the desired length of cut, clamp frame molding in both fixtures and make the left end miter cut.



Move saw guide and backsaw to right end clamping fixture and make the second miter cut. Repeat for matching frame member.



When the four frame members are cut, remove the backsaw and guide and use the clamping fixtures to assemble the frame.

aluminum tool accepts frame moldings up to 3 1/4 in. wide. The maximum molding length that can be cut is 30 in.

The Hempe picture framing tool is available from Leichtung Inc., 4944 Commerce Parkway, Cleveland, Ohio

44128, for \$74.45 postpaid. For more information, write for a free catalog.

—Rosario Capotosto

Ladder levelers



Ladder levelers are essential for working safely on stairs and uneven ground. Nonskid swivel feet maintain full ground contact.

Eliminate the use of dangerous makeshift props when using a ladder on uneven ground with Xtenda-Leg ladder levelers. The zinc-plated steel levelers adjust up to 15 in. to keep the ladder upright and level. Each leveler is fitted with a nonskid, swiveling foot that ensures full ground contact. Xtenda-Leg levelers fit most aluminum and wood ladders and are available at paint and hardware stores for about \$35. For details, contact K.O. Products, 15301 Ventura Blvd., Suite 300, Sherman Oaks, Calif. 91403.—J.T.

Get a grip

Add sure-grip comfort to your woodworking and lawn and garden tools with accessory Grab-On foam grips. The durable, weather-resistant grips come in six sizes, ranging in price from \$2 to \$10, to fit most tool handles.

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ters. For details, contact Grab-On Grips, 100 North Avery, Walla Walla, Wash. 99362.—Rosario Capotosto



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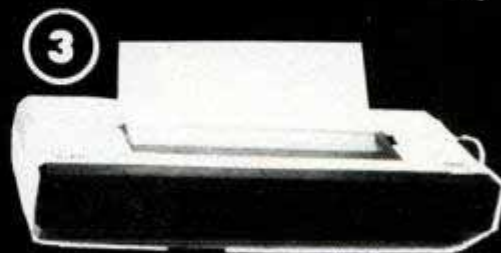
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ALL OUTDOORS

Houseboat vacations

Houseboat vacations are a fun change of pace, but high rental costs (usually about \$800 a week for a 37-foot model) can put a big dent in your vacation budget. One company with a new idea in houseboat rentals offers 15 weeks for \$2,000, or only about \$133 per week. The only hitch is that you pay the whole amount up front and spread out your time (up to four weeks in any one year) over a 10-year



Creative financing makes inexpensive houseboat vacations possible.

period. You can share the cost with a group of friends and work out your own vacation schedules. The 37-foot houseboat sleeps six, and comes with everything you need except food and linen. You also pay for fuel. The various rental locations from Maryland to Florida each offer about 1,500 miles of rivers, lakes and intracoastal waterways to explore. No license or special knowledge is necessary. You should contact Susquehanna Santee Boat Works, RD 2, Willow Street, Pa., 17584 (717-464-3668).



Bigger bang

Want more bang than a .22? Marlin's new 9-mm Camp Carbine is a good shot for recreational shooting and small game hunting. The Model 9 has sporting lines with its 16 1/2-in. barrel, and weighs just 6 3/4 pounds. Open rear and ramp front sights are standard, and the solid top receiver is drilled and tapped for easy scope

Light weight and 9-mm power combine in Marlin's new Model 9. A 20-shot optional clip adds fire power.

mounting. The Model 9 comes with a 12-shot clip, and a 20-shot clip is available as an accessory. Safety features include Garand-type safety, manual bolt hold-open and automatic last-shot hold-open. It sells for about \$247. Contact Marlin Firearms Co., 100 Kenna Dr., North Haven, Conn. 06473 (203-239-5621).



Warm hands for all weather, any sport.

Cold/wet glove

If you've ever fished or ridden a bike in cold, wet weather, you know how uncomfortable cold hands can be. The Glacier Glove has closed-cell neoprene construction, sewed and glued seams and Velcro wrist strap. In a variety of outdoors activities, we found them very warm, with excellent sensitivity and good gripping ability. Full, and open thumb and index finger models, are \$39.95. Glacier Glove, 218 California, #204, Reno, Nev. 89509 (702-786-0202).

Fishing for one

The Sidekick one-man fishing boat is only 9 feet long. It gets you into the shallow water and heavy cover where the big ones hide. The 48-pound hand-laid fiberglass boat is easy to car-top and carrying capacity is a respectable 350 pounds. Foot pedal steering lets you concentrate on your casting. Sidekick costs \$450 in kit form or \$500 completely assembled. Only through Folboat, P.O. Box 70877, Charleston, S.C. 29405-0877 (803-744-3483).



The Sidekick one-man sport boat weighs only 48 lb. but has a 350-lb. carrying capacity.

Motorbike plus



The generator mounts on power take-off.

Jobby is a little motorbike that not only folds up to fit into its carrying bag, but also will power a variety of useful accessories. The bike's 50-cc, two-cycle engine is hooked to a special transmission equipped with three power take-offs that operate at different rpm for the different accessories. You can hook up an air compressor, a self-priming pump and a high-pressure pump. For emergency lighting, running small appliances or charging your car's battery, you simply hook up the Jobby's accessory generator set. The Jobby's base price is about \$900, and the package price, including all accessories, is about \$1,800. Trans-Import Organization, 2541 N.W. 74 Ave., Miami, Fla. 33122 (305-592-0053). **PM**

**YOU'RE
IN FOR
A
TREAT**

You're in for flavor that's as good as it can get.
At a price that can't get any better. Dutch Treats.[®]
About 52¢ a pack. Also available in economical cartons.



Price may vary depending on state taxes.

Regular, aromatic Pipe-Aroma and refreshing Menthol.

Материал, защищенный авторским правом

ISUZU

WOULD YOU BUY ONE OF THESE TRUCKS AFTER WHAT THEY'VE BEEN THROUGH?

Before you answer, we think you should know a little more about what they've been through.

The Isuzu pickup in the top photograph was entered in the Baja 1000, a race acknowledged around the world as the toughest in the world.

And against determined opposition from Ford, Toyota and Nissan, it not only crossed a thousand kilometers of truck-destroying desert, it crossed the finish line.

First in its class.

On the other hand, the four-wheel drive Isuzu Trooper II in the bottom photograph endured something even worse than the world's worst off-road race.

4 Wheel & Off-Road magazine's annual search for their "4x4 Of The Year."

They drove it through sand dunes, mud holes, jagged rocks and burning heat.

Through places with names like Death Valley and the Valley of Fire.

And after 1300 miles of every kind of off-road and on-road driving, they reached an important conclusion.

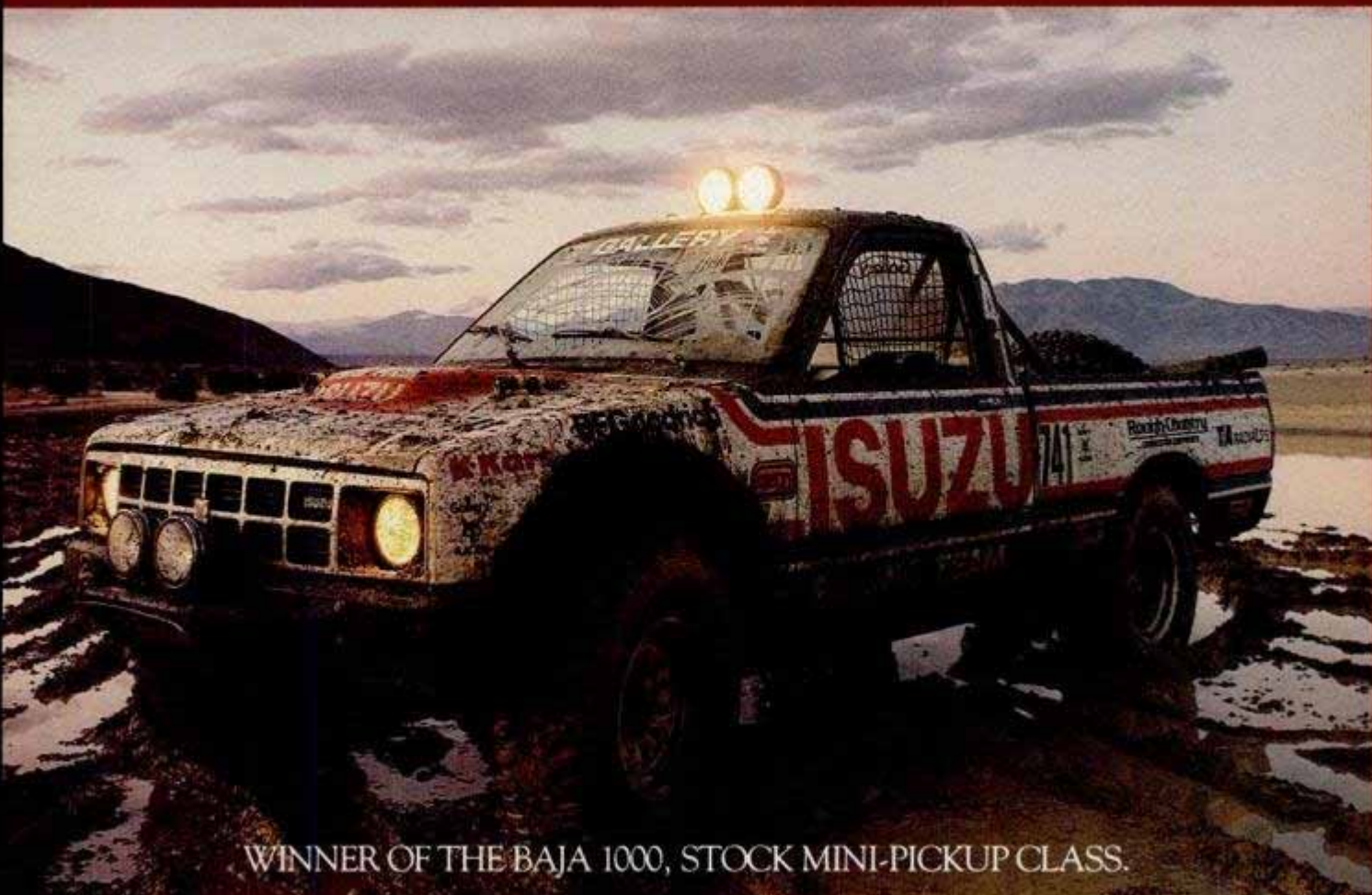
Not only did the Trooper II give more value per dollar, "it proved on the track, over pavement and especially out in the field that it deserves to be our 4x4 of the year."

Given these facts, we can probably guess your answer to our first question. So, naturally, we'd like to ask you an even harder one.

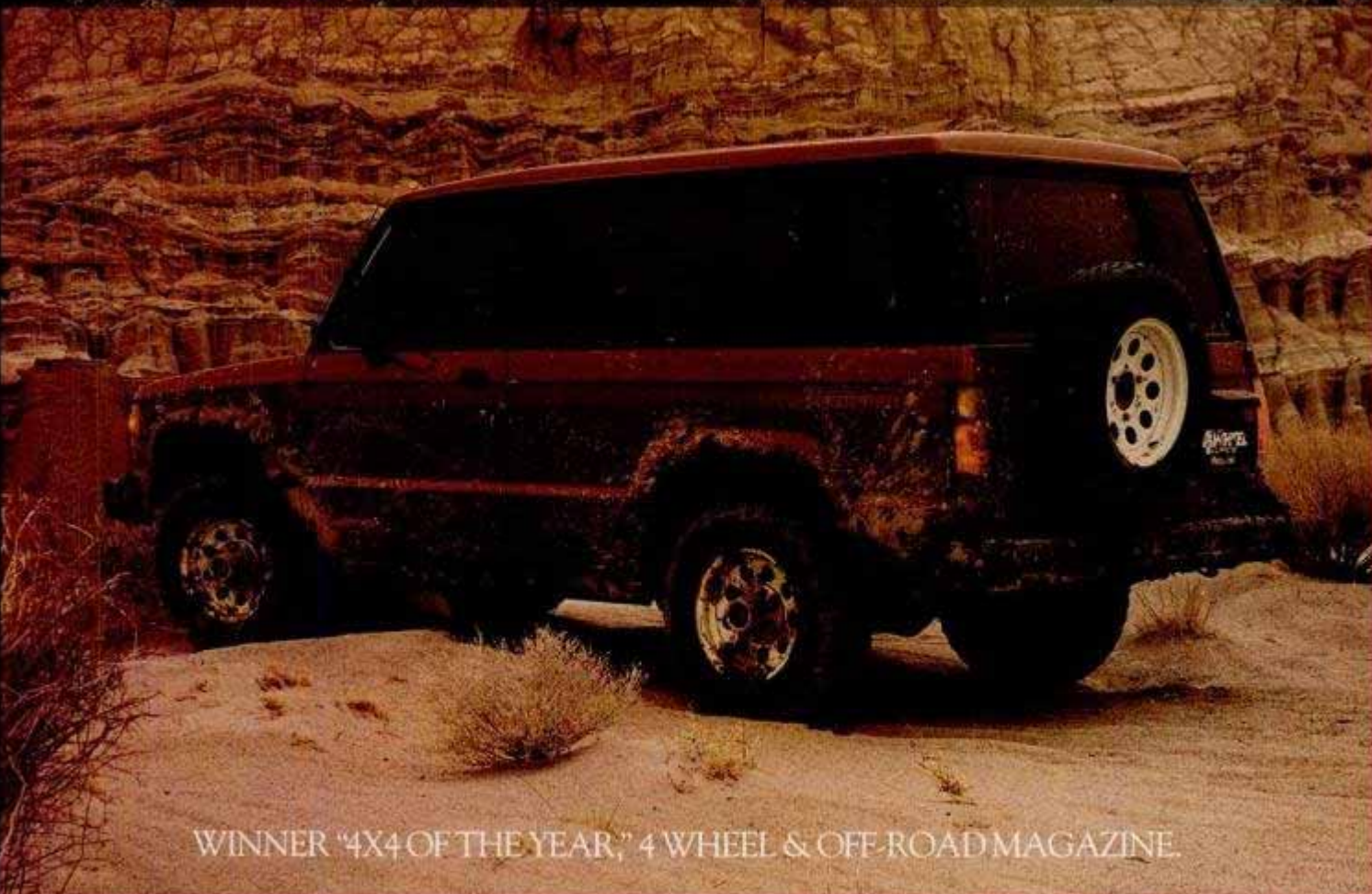
Which one are you going to buy?



THE FIRST CAR BUILDERS OF JAPAN.



WINNER OF THE BAJA 1000, STOCK MINI-PICKUP CLASS.



WINNER '4X4 OF THE YEAR,' 4 WHEEL & OFF-ROAD MAGAZINE.

Buckle up — for life!

Матеріал, зв'язаний з автою, є приватним

Why Rust-Oleum is now in the auto care business.

We're in it for the money, guys. But we've got something worth buying. We've found a way to make a car wax

The shine, incidentally, is fabulous.

Our new body fillers will outlast and outperform whatever you're

that prevents rust.

A body filler that prevents rust.

A whole line of auto care products (including touch-up paints)

that prevent rust.

Without taking you through chemistry 101, let us just say that these new Rust-Oleum products create an electro-chemical barrier on the surface of a car that prevents rust like no other products in the world.

Our car wax will, indeed, prevent rust.

What's more the stuff that makes Rust-Oleum car wax prevent rust also makes it last longer through washings and lousy weather—so you don't have to wax as often.

using now.

As for the touch-up paints—remember who they're from.

The same guys who make the rust fighting paint for your iron fence, your lawn furniture, your locomotive and,

yes, even your space shuttle.

These new products aren't in every store in the country yet. So fire up the old rust-mobile.

And start looking.

For the nearest store, call

our toll free number:

1(800)323-0851.

In Illinois, 1(800)942-0876.



RUST-OLEUM.

Nobody fights rust like Rust-Oleum.

Paintable wallpaper

The Classic Coverup is a heavily embossed paintable wallpaper that is designed for use on problem walls and ceilings. The paper's high texture effectively conceals cracks, rough areas and

surface irregularities. It's hung like ordinary wallpaper and applied with a nonstaining cellulose paste.

Once it is hung, the paper is then painted with any standard interior latex or oil-base paint.

Classic Coverups are available at most paint and wallcovering stores in six designs ranging from Victorian to contemporary. The paper is sold in bolts that measure 20½ in. wide × 11 yards long (56 sq. ft.) for \$10 to \$12 per bolt.

For more information, contact Decor International Wallcovering Inc., 37-39 Crescent St., Dept. PM, Long Island City, N.Y. 11101.



Wallpaper features a heavily embossed surface which will effectively hide cracks in walls and ceilings (above). Once applied, the paper accepts latex or oil-based paint (right).

Sun-block furniture cream

Weiman's furniture cream is formulated with a sun-block additive that reportedly screens out destructive ultraviolet sun rays. According to the manufacturer, this castor oil-base cream will protect fine wood furniture from exposure



to direct sunlight, and thus help prevent drying, fading, cracking and discoloration of the wood's finish.

Weiman's furniture cream is sold at hardware and department stores in 8-ounce liquid (\$3) and 12-ounce aerosol (\$3.39) containers. For details, contact Herbert Stanley Co., 8140 North Ridgeway, Skokie, Ill. 60076.

Mini-microwaves

Whirlpool's three new subcompact microwave ovens provide 500 watts of cooking power in a small package—each model is only 9½ in. high × 13 in. deep × 18¾ in. wide. The space-saving ½-cu.-ft. capacity ovens can be used on a countertop or, by means of an optional mounting kit (\$16), be suspended from the upper cabinets.

The three models have slightly dif-



ferent operating features and range in price from about \$200 to \$262. For details, contact Whirlpool, 2000 U.S. 33 North, Benton Harbor, Mich. 49022.

Disappearing screen



Because screens are needed only when a window is open, Pella offers Rol-screen—a disappearing window screen. The screen is housed in a bronze-tone box mounted at the window head. Simply pull the screen down like a window shade. When the window is closed, roll the screen up into the box and enjoy an unobstructed view.

Rolcreens are available for all new and existing Pella casement windows for about \$40 to \$55 each. For more information, contact Pella, 100 Main St., Pella, Iowa 50219.

Air-powered drain cleaner



The Hydro-Pulse drain cleaner hooks up to any air compressor of ½ hp or greater to create a pulsating shockwave that dislodges stubborn clogs. The trigger-action gun comes with a toilet fitting, four rubber inserts to fit most drain sizes and a splashback shield. The Hydro-Pulse is available at hardware stores and home centers for about \$30. For details, contact Campbell-Hausfeld, 100 Production Dr., Harrison, Ohio 45030.

FM

APPLIANCE CLINIC



Dishwasher clouds glassware

I am writing to you about a problem I'm having with my Kitchen Aid dishwasher, Model KDS-18, serial No. 201166372. All our glassware and stemware come out cloudy at the end of the wash cycle. My wife has to wash these pieces separately by liquid detergent to get them bright and clear. I have increased the temperature in my water heater to 150°, but this doesn't help. Hope you can give me a solution.—Arthur Duclos, Westbrook, Me.

Your glassware may be suffering from hard-water filming. This is usually caused by a deposit of hard-water minerals on the surface of the glassware

that creates a film when it dries.

To correct the problem, you should first determine the hardness of your water. If you have city water, check with your local water company. It can probably tell you the grain-hardness of the water. If you have well water, send a sample to a water analysis laboratory. A designation of 0-5 grains means soft water; 5-10 grains, moderately hard; over 10 grains, hard water.

Once you know the grain-hardness, you will be able to determine the right amount of dishwashing detergent to use per load. If the water is from 0-3 grains, you should use 1 tablespoon of

detergent; 4-6 grains, 2 tablespoons; 7-9 grains, 3 tablespoons; 10 grains or more, 4 tablespoons.

The next thing to do is to lower the water temperature so that water enters the dishwasher at 140°. You can check this temperature by allowing the machine to fill, then opening the door and placing a candymaker's thermometer in the water.

You might also try using a rinse additive such as Jet Dry. If the water is more than 14 grains hard, use solid form Jet Dry. Hang the additive dispenser-basket in a back corner of the lower rack.

By following these suggestions, I think your problem will clear up.

Replacing a dryer belt

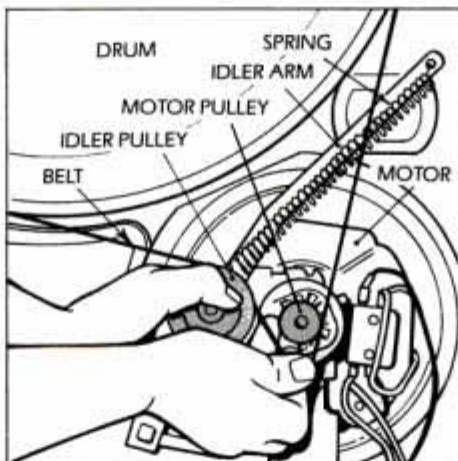
I own a General Electric gas clothes dryer, model No. DDG5200UBLWH, serial No. H1303839G. My problem has to do with replacing the drive belt. In this model dryer, the drive belt goes the entire distance around the drum. I cannot find an easy way to remove and replace this belt and would appreciate your assistance.—Vincent A. Coulton, Brooklyn, N.Y.

It's actually not that difficult a job to replace the drum belt on your gas clothes dryer. The first thing you should do is get the belt, which is G.E. part No. WE12X42. It's available at local G.E. parts dealers for approximately \$12.

Unplug the dryer, then shut off the gas supply valve and move the dryer away from the wall. Open the door and remove the four Phillips-head screws on the upper lip of the door opening that hold the top down to the front panel. Then raise the top.

Next, remove the screws holding the front panel to the cabinet (use a 5/16-in. nut driver or socket). These screws are about 3 in. down from the top of the panel on the inside. Now loosen the two lower screws at the bottom of the panel near the kick plate. Raise the front of the panel up off the screws and swing it around, along with the wire connected to it, to the right and rest it against the cabinet side.

Raise the drum up a little so it is detached from the front slides that support it. Slip the old belt off the drum, then between the slide and drum, and



To replace a dryer drive belt, slide new belt around drum. Then place flat side of belt over idler pulley, stretch idler spring and place belt on the motor pulley.

remove it. Slip the new belt on the drum the same way, then let the drum down. Work the new belt back to its proper location, about 4 or 5 in. from the rear of the drum.

Now go to the back of the dryer. Remove the exhaust duct and the lower access plate. This will allow you to get at the motor, the idler pulley and the loosely hanging new belt. Place the flat side of the belt over the idler pulley. Take the idler arm and pull down, stretching the spring. Place the ribbed side of the belt around the motor pulley, then release the tension on the idler spring.

Turn the drum by hand to be sure the belt is riding properly on the drum. Now reassemble the dryer.

Altering convection oven

I have a Tappan convection oven, model No. 30-3867, serial No. 23-05024/8924/2009. I am very unhappy with this method of baking and would prefer a conventional system. Is it possible to disconnect the blower system and have this unit operate as a conventional oven?—Ted Hughes, Union Beach, N.J.

Definitely not! A convection oven blower recirculates the warm oven air, and also helps draw air into the gas burner. If you disconnect the blower, the burner flame wouldn't have sufficient air to burn properly. The flame will no longer burn on the burner but will find its way back to the orifice on the gas valve, and burn there. This would create a fire hazard within the range, and possibly an explosion.

Refrigerator door gasket

I must replace the rubberized gasket on the door of my Frigidaire refrigerator, model No. SDV91N. Can you tell me if this item is still in stock?—Rev. Max Epstein, Brooklyn, N.Y.

You're in luck. The door gasket for your 1955 model refrigerator is still available from Frigidaire. Order it from your local distributor, who is D.L. Dineen Service Co., 139-29 Hillside Ave., Jamaica, N.Y. 11435. It's part No. 587-3896 and costs about \$36. **PM**

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



Hardware • Home Center
• Lumber stores

SUPER SAVER SALE



SALE PRICED!

AMES

HOSE REEL
\$19⁹⁹

Non-rusting, 16" poly basket. Holds 150' of 3/4" hose. (23-890)

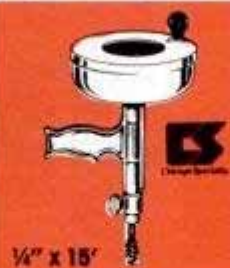


SWAN

1/4" x 50'

VINYL HOSE
\$5⁹⁹

Knitted reinforcing provides durability. Easy to coil. (20021)



1/4" x 15'

DRUM AUGER
\$7⁹⁹

Spinning action allows passage of wire for fast cleaning of drains. (3593C)



2 1/2" BLADE

HYDE TOOLS

SCRAPER
\$3⁴⁹

4-edge, lifetime blade. Long sturdy handle with pull knob/nail setter. (10540)

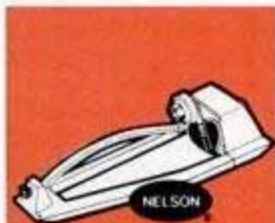


kwikset

1" DEADBOLT

SECURITY LOCK
\$8⁸⁸

1 piece cylinder housing and recessed cylinder guard. (660 US3 CP)

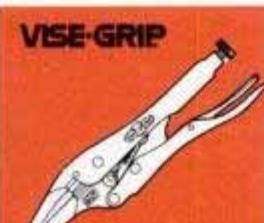


NELSON

OSCILLATING

SPRINKLER
\$5⁴⁹

Shaped cam eliminates puddling. 16 spray openings, water saver dial. (1015)

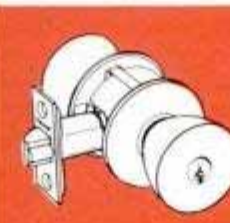


VICE-GRIP

6" LONG NOSE

LOCKING PLIERS
\$5⁹⁹

Reach all those places your fingers can't—and lock on tight. (8LN)



SCHLAGE

ENTRY LOCKSET
\$12⁹⁹

Bright brass high-quality finish. (FS1NV-BELL-605-KA2)



SKIL

7 1/4"

CIRCULAR SAW
\$45⁹⁹

Wrench & combo. blade incl. Double insulated. Needs no ground. 5250 (576)



Blue Lustre

16 Oz. FOR CARPETS

FLEA KILLER
\$3⁸⁸

Special formula kills fleas, ticks & insects that live in carpets. (51102)

COUPON



"TOOL CADDY"
\$6⁸⁸

Keeps tools & nails in easy reach for jobs around the home. (1506)

COUPON



PUNCTURE SEAL
89¢

12 oz. can seals & inflates tires in seconds. Great for emergencies. (M11-12)

COUPON



SHELF BRACKET
36¢

Bonded finish (797-W-8x10) 10" x 12" Shelf Bracket (797-W-10x12) 54¢

\$8⁸⁸

STANLEY

POWERLOCK TAPE

\$8⁸⁸

1" x 25'

"MYLAR"-protected blade. Chrome finish case, belt clip. Exclusive blade lock. (33-425)

\$8⁸⁸

SEE THE YELLOW PAGES FOR YOUR NEAREST PRO HARDWARE
SPECIAL PRICES END JULY 31, 1985
AT PARTICIPATING DEALERS



PROMART
HOME CENTER

"Pro Advice Plus a Real Good Price"

DETROIT LISTENING POST



Aero look for '87 Chevys

Is it 1987 already? Shown here are two prototype Chevrolets scheduled to debut in '86 as '87 models. First out of the chute will be the front-drive GM-25/L-body Corsica, seen here as a four-door sedan very much in the aerodynamic mold cast by the Ford Taurus. Corsica hits showrooms in the spring of 1986, powered by a fuel-injected V6.



Spy photos show 1987 Chevy Baretta (above), which may be the next Camaro, and the '87 four-door Corsica (left), which will replace the Citation. So, while making fun of Ford's "Jellybean" styling, GM followed in their footsteps!

The second photograph is somewhat more puzzling. Called Baretta, this "L-Special" body has obvious styling cues linking it to present-day Camaros. Take a look at those taillights! The current Camaro/Firebird F-body has been scheduled for a redesign in the 1989 model year, but GM could be pulling a fast one here. The next Camaro/Firebird will be a front-drive V6. "Baretta"

could be its code name. The spy shot shows the Baretta with a disguise—the front end of the Corsica is grafted onto it. Sources indicate the production front end will give the Baretta a steeply sloped front, featuring raked-back, wind-cheating headlamps. The L-Special will get the same EFI V6 as the Corsica, but we wonder if it might not also get something more potent—a 3.8-

liter high-output unit, say, or an uprated 2.8-liter H.O. V6.

The aggressive posture Baretta assumes encourages these speculations. We know that a brand-spanking-new Firebird/Camaro is on its way; it might be let out of the design studio early enough to beat back some of the hot Ford competition expected from Europe before 1989 rolls around.

The Fornander Paragon



The Paragon looks like an amalgam of pre-War Packard and Bentley lines. Who would guess that a Toyota Cressida lurks beneath those classic lines? American ingenuity strikes again! Price: \$60,000.

That may sound like a terrific new Robert Ludlum espionage thriller, but it is in fact one of the most tasteful, complete and better looking neo-classic car treatments we've encountered in a long while. The Paragon is based upon the Cressida chassis stretched 20 in., to a 124-in. wheelbase. Atop this engi-

neering feat goes a stylish metal exterior which we think evokes the elegance of pre-war Packards and Bentleys. The best thing about this design is that it all works so well together. Most neo-classics look like they were designed by three different guys who never spoke to one another!

Under this skin goes muscle—Toyota's efficient twin-cam Six pushing 143 hp at 5,200 rpm. The Paragon suspension and electronically controlled four-speed automatic with lock-up torque converter are both direct implants from the Cressida donor vehicle.

The car, designed by talented Tom Fornander at Pactran Developing Group in San Marcos, Calif., works as good as it looks. The amazing part of this story, however, is the seven-passenger Paragon limo.

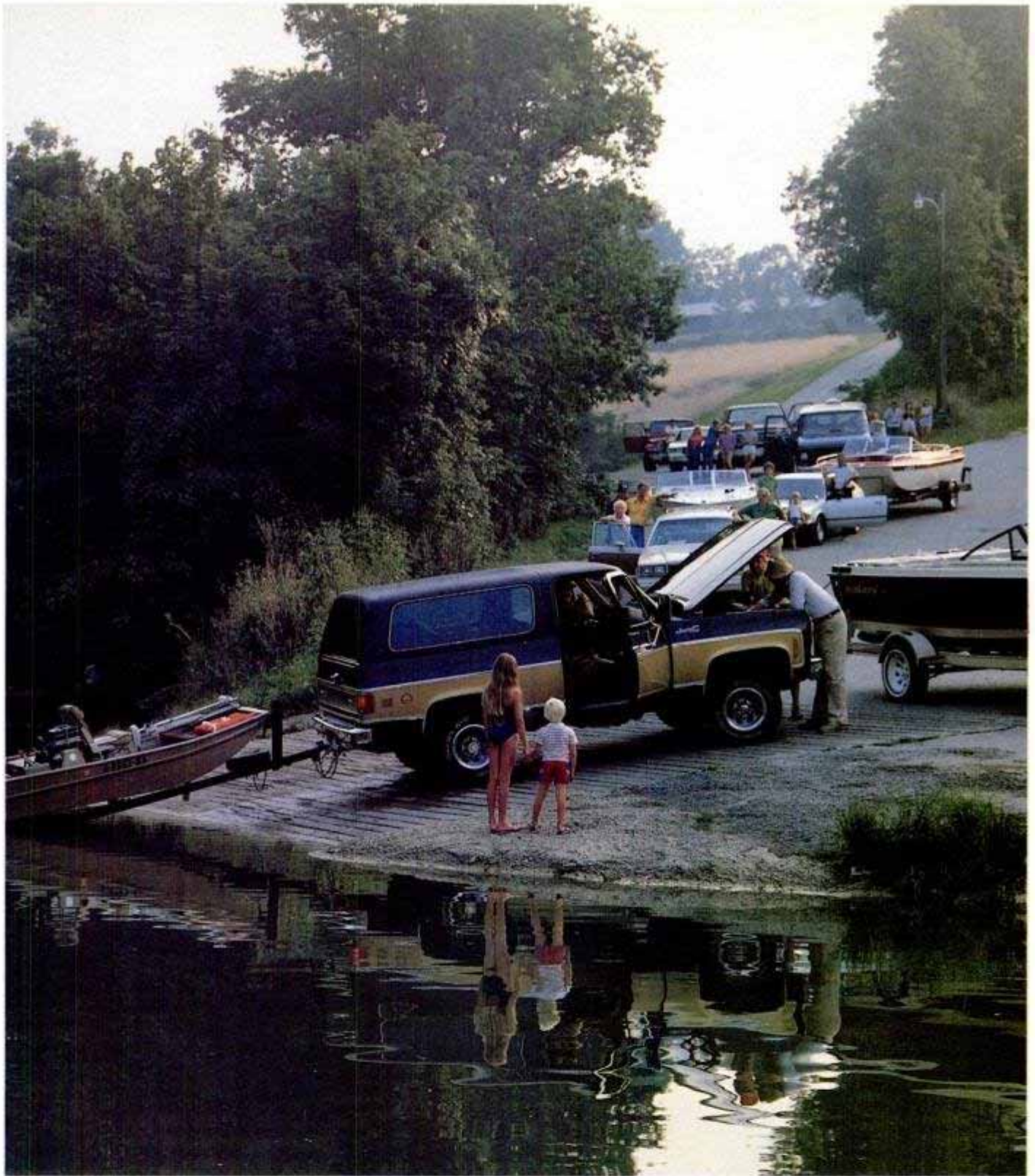
Is this car big? In limousine mode, the Paragon stretches a tape to a wheelbase measurement of 166.6 in., a monster of a vehicle moved to those dimensions by the grafting of a 42-in. center section. Five passengers can ride in comfort in back, separated from the driver by a sliding glass partition.



Chrysler mini-mini van dead?

Word now comes from Chrysler sources that the fascinating Chrysler

(Please turn to page 38)



**AIN'T NO FUN WHEN YOUR CAR WON'T RUN.
SHOULD'VE USED NAPA PARTS.**

Don't get in over your head. Count on quality NAPA parts to get you goin' and keep you goin'! Every NAPA Brand part is as good or better than original equipment. They're made better than they have to be. So do it right. Depend on quality NAPA parts to keep your car running NAPA Brand New. Available wherever you see the NAPA sign.



MAKE IT NAPA BRAND NEW

Check your Yellow Pages

© 1985 R. J. REYNOLDS TOBACCO CO



**SAVE
\$1.50 ON VANTAGE
AND ENJOY GREAT TASTE PERFORMANCE**

PLUS GET ADDITIONAL SAVINGS
(SEE DETAILS ON ATTACHED CARD)

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

ULTRA LIGHTS MENTHOL, ULTRA LIGHTS MENTHOL 100's:
5 mg. "tar", 0.4 mg. nicotine, FILTER 100's, MENTHOL:
9 mg. "tar", 0.7 mg. nicotine, av. per cigarette, FTC
Report JAN. '85; ULTRA LIGHTS, ULTRA LIGHTS
100's: 5 mg. "tar", 0.4 mg. nicotine, FILTER,
MENTHOL 100's: 9 mg. "tar", 0.7 mg.
nicotine, av. per cigarette by FTC
method.

VANTAGE. PERFORMANCE COUNTS.



DETROIT LISTENING POST

(Continued from page 32)

"Z-van," a genuinely miniature front-drive van that was to be pulled off the impending P-car chassis, may be delayed indefinitely.

The Z-van is designed to be a tiny vehicle, barely wider than a grown man can stretch his arms to the sides. I've seen a prototype buck for the rear section of this vehicle, and I thought it was for a large child's toy!

This is a *small* van, car-poolers. While it will probably be marketed as a five-passenger unit, fully three of those

passengers are going to have to be a commuter's kids. The P-car, an Omni/ Horizon replacement scheduled for the middle of next year, is a two- and four-door sedan sharing some components that were originally used in the H-body Lancer/LeBaron GTS.

The Guam connection

Sometimes federal regulators just fail in getting their point across. All the while the Voluntary Restraint Agreement (VRA) on the importation of Japanese cars was in force, Japanese cars were being shipped here *exempt* from VRA scrutiny. The reason is because cars

imported from *Guam* aren't considered part of the deal.

The flap first blew up because American military personnel were bringing their Japanese cars home from stations in Guam in ever-increasing numbers. When the Commerce Department took a harder look at the practice, they found GIs weren't the only ones who were getting around Uncle Sam's and Japan's good intentions.

In the first year of the VRA (April '81 to March '82), not a single Japanese car was shipped to the United States from Guam (or the Virgin Islands and the Trust Territories, which also became part of the scheme, according to the Commerce Dept.) In the second year, 2,175 cars made the transition. By the fourth year, more than 20,300 cars were shipped through Guam!

Admittedly, 20,000 or so more Japanese automobiles in a market as large as the United States causes a very small ripple in a very big pond. The practice, though, increased more than 10 times over the period examined by the Commerce Dept.

There must be an entire cottage industry of Guamanian customs brokers now looking for work.

Ear to the ground

Plymouth best: According to federal NHTSA data, the 1985 *Plymouth Caravelle* tested as best able to take a 35-mph crash without serious passenger injury. Testing worst were the new Chevy Astro minivan and the Renault Alliance convertible.

CAFE down? Under a petition brought by Ford and General Motors, NHTSA is considering *lowering the '86 mileage standard* from 27.5 to 26 mpg. The car companies are complaining that the standard is too costly to meet in view of stable fuel prices. Chrysler Corp., effectively thumbing its nose at the two larger companies, sniffed that *it* would have absolutely no trouble in meeting the goal.

New Saturn chief: GM's revolutionary Saturn Corp. has a *new president* in former Pontiac chieftain Bill Hoglund. Hoglund was appointed to succeed the late Joe Sanchez.

Short drive: The prototype Chevrolet Spectre is a tasteful custom of a staid Caprice Classic with a 40-hide leather interior and bronze-out treatment of its brightwork. Under its hood is a 5.7-liter V8 from a Corvette. Suspension bits were firm but not harsh, and Camaro IROC-Z 16-in. wheels and tires made for eyeball-ripping cornering. The Spectre knocked 'em dead at the car wash. Chevy says this car could be built as either a hyper-formance street car or as its new police package. I can tell you if they do the former, they're going to need the latter. **PM**

NEW ORTHO-KLOR

SOIL INSECT & TERMITE KILLER.

THE POWERFUL REPLACEMENT FOR CHLORDANE!

ORTHO-KLOR Soil Insect & Termite Killer is a brand new concentrated liquid insecticide from ORTHO that will kill all the insects that Chlordane was originally used to control and is especially effective against tough-to-kill ants and termites.

Since it contains the broad spectrum, professional insecticide Dursban,[®] you can count on this new ORTHO-KLOR to control the major outdoor home pest invaders quickly and effectively.

ORTHO-KLOR Indoor & Outdoor Insect Killer is a milder, general-purpose insecticide dust that kills pests inside *and* outside your house. Use it to kill most nuisance pests including roaches, ants, spiders and fleas and many others in and around your home.

New ORTHO-KLOR. The powerful replacement for Chlordane that gives you so much more.

Avoid accidents. For safety, read the entire label including precautions. Use all chemicals only as directed. Copyright © 1984 Chevron Chemical Company. All rights reserved.



ORTHO
Chevron Chemical
Company



**ORTHO
WORKS
WONDERS**

**NEW
ORTHO-KLOR**

Amazing New Third Brake Light Can Save Your Life

by Patrick Killeen

Introducing one of the most fully tested safety devices ever to reach the market.

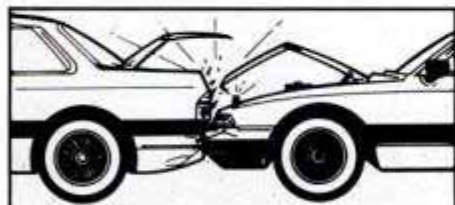
Gov't approved Mandatory for 1986

Ten years of 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 (National Highway Traffic Safety Administration) believes the third brake light is the biggest safety breakthrough in the history of the agency. Agency 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

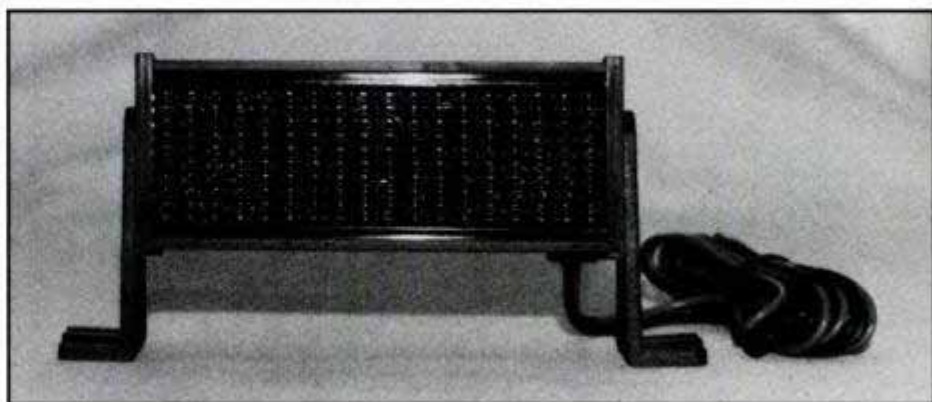
Because it is mounted at eye level, the brake light is bright and easy to see. Also it will shine through your window and directly into the eyes of the drivers in the second and third cars behind you. Lastly, since the light comes on only when you brake, it can't be confused with turn signals or tail lights.



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

Reduce rear-enders

Our brake light is the cheapest insurance in town. It can prevent painful whiplash injuries, remind tail-gaters to back off, and gives the driver behind you better depth perception, day or night.



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

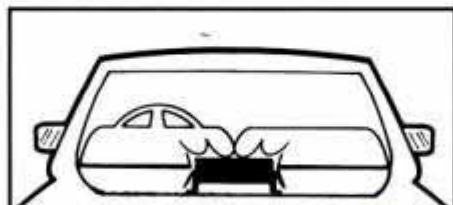
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This light meets all FMVSS (Federal Motor Vehicle Safety Standards) including Federal Standard #108. It's available for use in your car now. Check with your insurance company. Many are offering discounts for these lights.

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. (For convertibles, we have a model that mounts outside your car.)

We offer two inside models — one for American cars and one for foreign cars. The pivoting legs are easily adjusted to fit all sedans, hatchbacks and station wagons. Good instructions and snap-on wire connectors make this a job you can do with a screwdriver and pliers in just 20 minutes.



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

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.

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., 3148 South York, Englewood, CO 80110.

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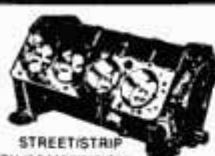
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UNASSEMBLED

350 CHEVROLET 4 BOLT MAINS



9 or 10-1 COMPRESSION RATIO

SHORT BLOCK KIT

350 4 bolt main block bored oversized, forged for Moly Rings. Decked, line honed, painted inside Rustolium, under factory orange. Filled Cam bearings & brass freeze plugs. Forged T.R.W. pistons fitted to PAZ heavy duty connecting rods with A.R.P. chrome Moly rod bolts. Chrome Moly rings, carburetor custom ground on rod & main journals. Moly polished with Chrome 77 rod & main bearings for perfect fit. Double ring timing chain set, your choice hydraulic or solid camshaft. Assembly balanced for maximum performance.

LONG BLOCK KIT

As above with cylinder heads, performance valve job. New valves 1.94" intake & 1.50" exhaust. Hi-performance springs, HD locks. Chrome Moly push rods, lifters. In-vehicle oil pump. Complete gasket set & long slot, rocker arms.

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OPTIONS AVAILABLE

For 11.3 Compression Ratio ADD \$100.00
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Kit Includes Arms, Balls, Nuts

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1. BLOCK, seaoned truck grade overal, 40 Custom roller piston, new main and side shaft, freeze plugs, Cam bearings, timing chain, lifters, Con Rods, Crankshaft fitted.

PISTONS Available in all popular sizes

Compression ratios from 9.00 to 12.00

CONNECTING RODS

Lightweight for maximum performance

CRANKSHAFT Custom ground on Rod and Main Journals

with 40 Main Journals, 40 Rod Journals, 40 Main Journals, 40 Rod Journals

BEARINGS Top quality for perfect fit

40 Main Journals, 40 Rod Journals, 40 Main Journals, 40 Rod Journals

TIMING CHAIN SET

40 Main Journals, 40 Rod Journals, 40 Main Journals, 40 Rod Journals

CAMSHAFT

40 Main Journals, 40 Rod Journals, 40 Main Journals, 40 Rod Journals

YOUR LOW PRICE

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SUPER STOCK MASTER KIT



Kit Includes:

• PISTONS & PINS
• CONNECTING RODS
• ROD & MAIN BEARINGS
• CRANKSHAFT
• CAMSHAFT—LIFTERS—SPRINGS
• TIMING CHAIN SET
• OIL PUMP
• CAM BEARINGS

YOUR LOW PRICE

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SUPER STOCK CRANKSHAFT KIT



Kit Includes:

• PISTONS & PINS
• PISTON RINGS
• CONNECTING RODS
• CON ROD & MAIN BEARINGS
• CRANKSHAFT

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SUPER STOCK PISTON KIT



CAR CLINIC



Beltin' out a different song

I've driven my 1979 Ford Fairmont 61,000 miles. I can't find any mention of a mileage at which Ford recommends replacing the timing belt of the 2.3-liter engine in this car. Although the belt looks okay, I don't want to risk being stranded or having the engine damaged should the belt break.

Also, could you tell me why a sticker on the air cleaner states that only SF oil should be used—not SF/CC or SF/CD? Would SF/CC or SF/CD cause rings to stick?—Rick Szalkowski, North Olmsted, Ohio

You raise an interesting question about that timing belt. In its maintenance schedule for the 1.6-liter (Escort/Lynx) four-cylinder engine Ford says, "Replacement of the engine timing belt is required at 60,000 miles. Failure to replace the engine timing belt may result in serious damage to the engine." Yet, no mention is made of the timing belt in the maintenance schedule for the 2.3-liter four-cylinder engine—not even to inspect it.

When I asked an engineer at Ford about this, he explained that the timing belt on the 2.3 liter is "very reliable." He added that the belt should be replaced if a repair is made that necessitates taking off the belt.

I may get into a dispute with Ford about this, but I don't like the odds. I've seen what happens to an engine when a timing belt breaks, and it isn't pleasant. For this reason, I suggest you apply the advice Ford gives about timing belts in 1.6-liter engines to your 2.3 liter. Replace it every 60,000 miles.

As for the recommendation to use "only" SF, you're reading too much into that label. For the 2.3-liter engine, SF means SF, SF/CC or SF/CD.

Let down on the relay team

I just replaced the second cooling fan relay in my 1983 Chevrolet Cavalier because of burned contacts. The dealer checked electrical connections and says they are clean and tight. He tells me he's had this problem on other cars. His explanation is that a bunch of bad relays must have gotten into the supply chain, and I should keep replacing relays until I get a good one. Is there no other solution?—Ed Alexander, Milwaukee

I've heard nothing about bad relays, and I doubt this is the cause. After ensuring that electrical connections are in good shape, the dealer should check the fan motor for excessive amperage draw and the functioning of the cooling fan switch. If either is out of whack, it would cause the relay to fail.

Test fan amperage with the engine warmed up. Current draw should not exceed 15 amps. If the amperage draw goes higher than that, you should replace the fan motor.

Caution: Be careful if you do this test yourself. Disconnect the battery ground cable when connecting and disconnecting the ammeter; then, reconnect it to make the test. A warm engine may allow the fan to turn itself on without warning.

If the fan motor is operating properly, connect a test light to check the cooling fan switch. Start the engine. As

coolant temperature climbs, the test light should glow. When coolant temperature hits about 230°F, the fan should start running and the test light should go out. If these things don't happen, replace the cooling fan switch.

Although a malfunctioning cooling fan motor and cooling fan switch can cause the relay to burn out, I want to emphasize that most times relay failure is a result of corroded wire terminals or a loose connection. Give wiring another going over, just to be sure.

Pop must pay

Bearings on the heater blower motor of my father's 1980 Buick Skylark have worn out. A dealer told us the entire blower motor has to be replaced (a \$60 job). Isn't there a way to replace the bearings instead of the whole motor?—Jeff Chattos, Fairview Park, Ohio

Nope. Sorry—you'll have to tell Pop to pop for the 60 bucks.

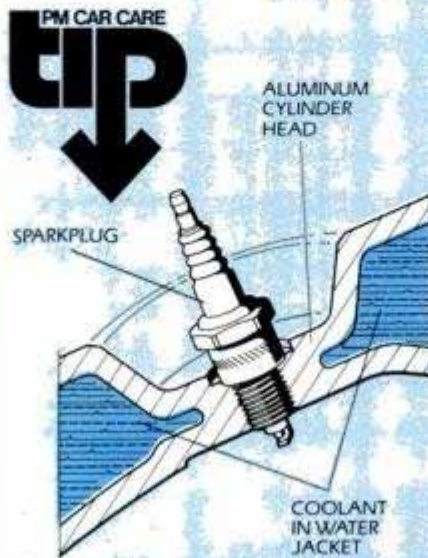
Just plain shiftless

Yesterday, for the first time since I bought my 1984 Plymouth Reliant, I shifted the automatic transaxle manually. Lo and behold, it had no first gear. I've had no problem when the transaxle is used in automatic mode. Does lack of first gear when shifting manually indicate big trouble ahead?—Richard P. Walsh, Lake Placid, N.Y.

Probably not. What it means is the gear selector cable has to be adjusted so first gear will engage. Put the gear-shift lever in PARK position and loosen the cable clamp at the transmission. The clamp is held by a single bolt. Pull the transmission's shift lever forward to the front detent position with 10 pounds of force. While maintaining the 10-pound pull, tighten the locknut to 90 in.-lb. You should get FIRST gear engagement in the "1" (manual FIRST gear) position on the shift quadrant.

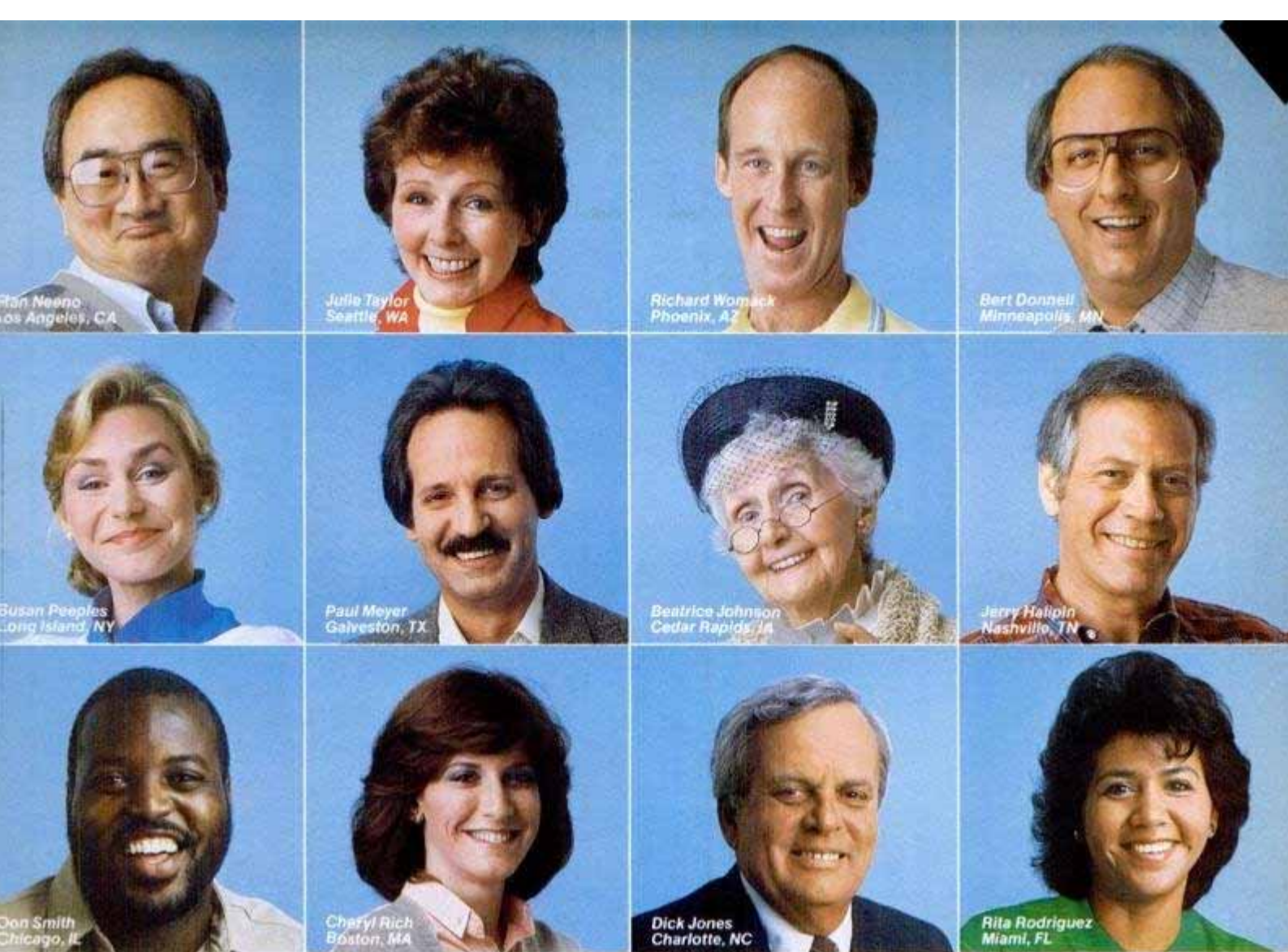
Picks on Wix

At 1,000 miles, I replaced the oil filter of my 1985 Mitsubishi Mighty Max
(Please turn to page 47)



Tight topics

Don't try removing sparkplugs from an engine that has an aluminum cylinder head until the engine and sparkplugs are cold. Sparkplugs lie near the cylinder head water jackets. When the engine is running, coolant keeps plugs and the cylinder head at about the same temperature. However, when the engine is turned off, the aluminum head cools more quickly than plugs and shrinks, causing the thread to grip plugs tightly. If you try removing plugs before everything is cooled down, there's a chance of stripping the threads in the head, because the aluminum is softer than the steel sparkplugs.



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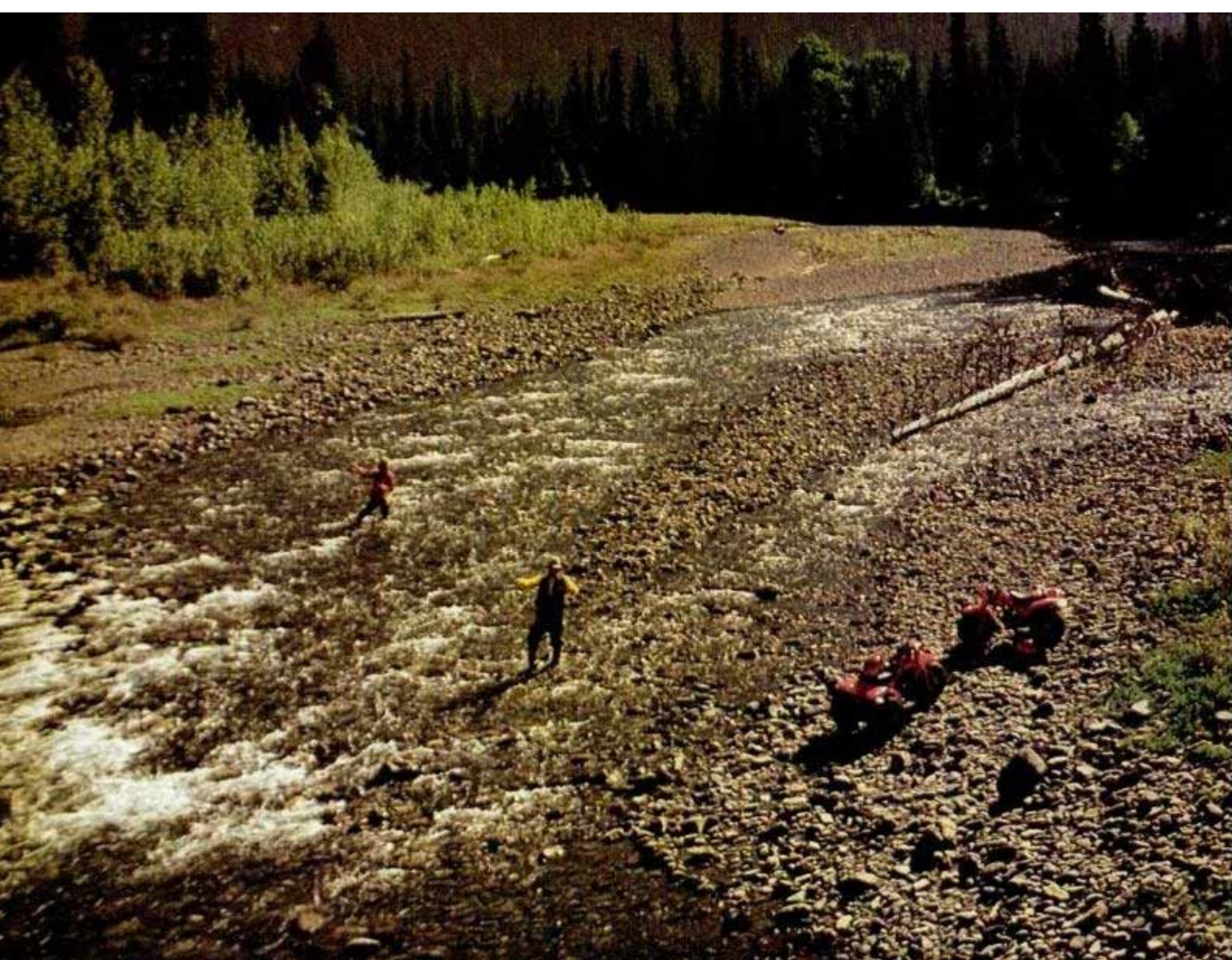
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IS WHERE HE GOES TO CATCH THEM!"**

—Catherine Bach

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Материал, защищенный японским патентом



"You've got your automatic clutch and five-speed gearbox. And the 160 even has reverse and shaft drive.

"You're going to go for these two hook, line and sinker. So check them out at Uncle Bert's second favorite spot. Your local Kawasaki dealer.

"From now on, the only one that should get away is you."

"You won't catch me on anything else."



Kawasaki
TAKING IT TO THE LIMIT

CAR CLINIC

(Continued from page 42)

pickup truck with one made by Wix. One hundred miles later, engine oil pressure went to zero, and I had to have the vehicle towed to the dealer. Repairs cost me \$112.

The owners manual says to use a Mitsubishi oil filter or equivalent, but the warranty didn't cover the cost of this failure. Apparently the Wix filter doesn't fall into the "or equivalent" category.

The service manager of the dealership claims he's seen or heard of 70 engines blowing, because they didn't have a Mitsubishi oil filter. Any comments?—Alan Lee, Lisle, Ill.

Mitsubishi doesn't have knowledge of this kind of wholesale problem among owners using Wix or any other "equivalent" oil filters. Ken Reeves at Mitsubishi explains the "or equivalent" standards as a filter with the proper clearances, possessing a relief valve and able to withstand 256 psi of oil pressure.

An aftermarket filter that has these specifications written on it or on the container, or one bearing the statement that the filter meets Chrysler Corp. specs for pressure requirements, can be used on a Mitsubishi engine.

Suppose a problem develops, as it

SERVICE TIPS

■ A noisy 318- or 360-cu.-in. engine in a 1984 Chrysler rwd vehicle may be caused by one or more pushrods having penetrated the rocker arms. Replace all 16 rockers with new ones—eight having part No. 4100774 and eight having No. 4100775. Also replace any pushrod that is damaged. See TSB 09-11-84.

■ Are sparkplugs in your GM 1985 2.8-liter multiport fuel-injected engine fouling? It may be because of a poor fuel-spray pattern. Have injectors replaced with those in a kit having part No. 17111297. Also replace sparkplugs. Don't be surprised if the injectors clear up a driveability problem you're having.

■ A worn thrust washer in the torque converter stator of a 1984 Honda Accord or Prelude and some 1985 Accords will cause a vibration while driving in fourth gear between 32 and 42 mph. A new torque converter (part No. 26000-PC9-305) will stop this. TSB 85-005 gives details. Even if the car is out of warranty, take it to a dealer—you're covered.

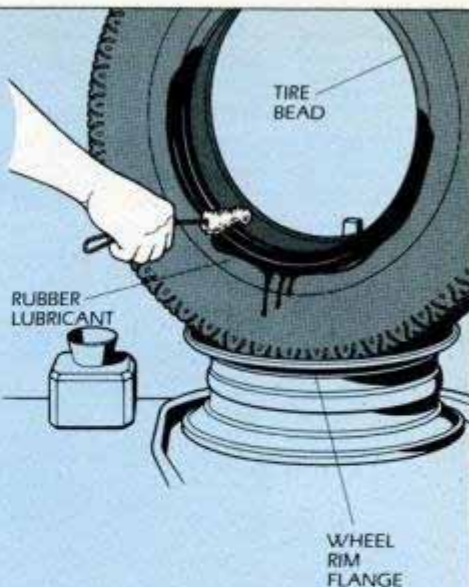
■ A new power steering dipstick/cap has been designed to stop a fluid leak from the pump in 1982-85 FoMoCo cars and trucks. It has a baffle and O-ring the old cap doesn't. Refer the parts department of the dealership to TSB 85-1-11 for an illustration of the new dipstick/cap along with additional requirements for those vehicles equipped with 2.3-liter EFI turbo and 5.0-liter high-output engines.



Gobbledygook

Have you ever wondered about the stuff that the guy mounting tires on your car slops all over the place? It's a special rubber lubricant that helps to seat and protect tires. It should be spread on the wheel rim flange as well as on the tire bead. Make sure it's used, because if it isn't, beads can be damaged.

Remember—this is a special rubber lubricant for tires. Oil or grease should not be used.



did in your case. Who's responsible?

You are, if you did the work and didn't install the component properly. However, if it was put on correctly and the component (any component—not just an oil filter) didn't cause the failure, Mitsubishi is responsible under the warranty. If the component caused the problem, the component manufacturer is responsible.

Tubeless tiger

I've gone over my 1983 Jeep Cherokee with a fine-toothed comb, but have not been able to find the reason why it's powerless and why gas mileage has taken a nose dive.

Fuel and ignition systems have been checked and adjusted according to the service manual. The EGR valve works. So does the thermostatically controlled air cleaner. The PCV system is in good shape. The engine is a 2.5 liter, and the vehicle's been driven only 13,000 miles. This problem is driving me nuts. What am I missing?—Charles Firestone, Marietta, Ga.

You may be overlooking an air leak at the EGR valve tube. The tube connects at one end to the intake manifold and at the other end to the exhaust manifold. An air leak at the tube is a condition that could also cause hard starting when the engine is hot.

There are three reasons for a leak: a loose tube, a distorted tube or a bad gasket. Tighten the tube at both ends. Specs call for tightening the nut holding the tube to the intake manifold to 30 ft.-lb. and tightening and bolts holding the tube to the exhaust manifold to 14 ft.-lb. If this doesn't stop your trouble, you should remove the tube, discard gaskets and clean any gasket material left on surfaces.

Lay a straightedge across the ends of the tube. If you see daylight between the straightedge and a surface, the end is distorted. Take the tube to the parts department of a Jeep dealer and get a new one.

If the tube is okay, get new gaskets. Then, reattach the tube and carefully tighten the nut at the intake manifold and bolts at the exhaust manifold. Be careful not to distort the tube.

A heady answer

At 30,000 miles the 360-cu.-in. engine of my 1979 Chrysler LeBaron started fouling No. 4 sparkplug. A test showed compression of only 90 pounds, and a valve job was done. It held for another 30,000 miles.

Now, I'm getting fouling of the same plug. Is there no solution except to replace the engine?—Jim Holdcroft, Rancho Palos Verdes, Calif.

Usually, on this particular engine, when one plug starts fouling at periodic intervals (in your case every 30,000 miles) it indicates a defect with the cylinder head.

A portion of the head near the No. 4 exhaust valve may have been cast slightly thicker than elsewhere. This extra thickness in the cylinder head gets hotter than the surrounding area, causing the exhaust valve to eventually burn, which allows fuel to leak out and the plug to foul.

Have a machine shop mill the cylinder head. It's a much less expensive solution than replacing the engine. **PM**

DO YOU HAVE A CAR PROBLEM?

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

STEPHEN A. BOOTH

PM ELECTRONICS MONITOR



Pick your own channel



ChannelPlus (top) sends several video sources to TV's unused UHF stations. Hawkeye (right) transmits video signal wirelessly to and from VCR.

The videocassette recorder has changed the way we watch TV and go to the movies. Now two accessories expand your VCR's versatility.

One, the Hawkeye VTR-80 from VDO-PAK of Port Orange, Fla., is a portable transmitter that lets you send the output from your videocamera—wirelessly—more than 200 feet to your VCR. Alternately, the Hawkeye can transmit tapes directly from your VCR to TV sets anywhere in your home over UHF channel 14 (or another unused UHF frequency). Battery-powered, it

weighs 2 pounds and costs \$400.

Another versatile accessory that employs unused UHF-TV frequencies is the ChannelPlus series of video distributors from Multiplex Technology of Fullerton, Calif. These devices use household wiring to route the signals from broadcast TV, cable, videodisc, VCR or videocamera to any TV in the house. Each source is assigned to an unused UHF frequency. You simply tune your TV to the frequency for the source you wish to monitor. Channel-Plus systems range from \$130 to \$300.

Fingers do the talking

Deaf persons now can use the telephone anywhere they go, thanks to a portable, battery-powered device that displays messages transmitted by anyone with a Touchtone phone. Echo 2000, made by Palmetto Technologies under license from General Electric, connects to any Touchtone phone a deaf person is using. The party talking

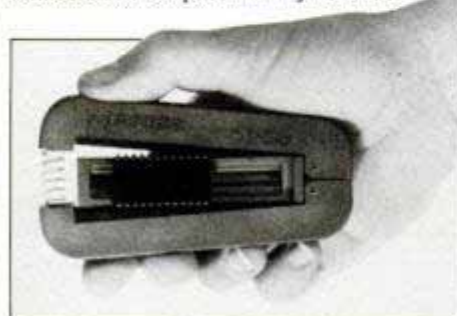


Echo 2000 converts tones to words on a scrolling display for the hearing impaired.

on the other end uses the Touchtone keypad to type out words and numbers. Echo 2000 converts these tones to words on a liquid-crystal display. It even stores the message, allowing the deaf user to review it at will. Echo 2000 is available for \$249.95 plus \$5 shipping from Palmetto Technologies, 151 West Main St., Duncan, S.C. 29334, (803) 439-4309.

Chip fixer

If you work with integrated circuits, you know how the legs can become bent out of tolerance. A simple squeeze with the DIP-R-SIZER T516AS tool, made by Aries Electronics, Frenchtown, N.J., will re-form any .300- or .600-center chip. Cost is just \$15.



Tool from Aries Electronics will reset bent legs of integrated circuits to tolerance.

Double-dealing deck

Dual-transport tape decks let you copy one cassette onto another, and even play two cassettes sequentially. Now, Walkman-inventor Sony has developed a dubbing deck you carry in your palm. Available this month, the latest Walkman boasts back-to-back tape transports in a 12-ounce package, slightly smaller than the original 1980 Walkman. Price for the WM-W800 is \$180, including lightweight headphones and one-point stereo microphone. One tape transport on the WM-W800 is for playback only, includ-

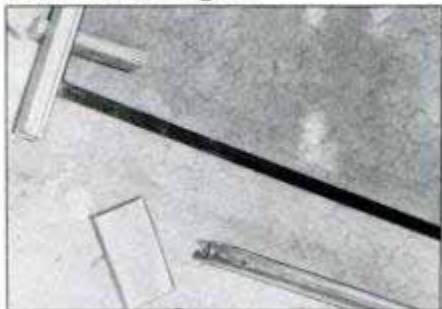
ing metal tapes, and has Dolby-B noise reduction. The other allows you to play or record, in stereo, with standard tape. **PM**



Dual-cassette Walkman dubs tapes from one side to the other.

HINTS FROM READERS

Patio door repair



Prop door bottom on blocks and remove lower channel containing the rollers. Tap channel loose with a wooden block.

Plastic rollers on insulated patio doors often break. If you can obtain metal replacement rollers for the doors, they can be installed easily with the aid of an assistant.

Lift the door into the upper track to remove it. Prop the bottom of the door on a block and unscrew and remove the bottom horizontal channel by tapping it



Original plastic roller (center) had cracked. Metal replacement helps door glide freely. To remove the door it may be necessary to jack up a sagging header.

with a wooden block. Remove and replace the faulty roller assembly. Reinstall the channel and replace the door in its tracks.

If the upper frame of the opening has sagged so you can't lift the door high enough to clear the lower track, raise the upper frame with a pair of jacks and 2x4 extenders. Protect top and bottom tracks with wooden blocks. If a 2x4 bows too much while jacking, nail two 2x4s together for rigidity.

—John F. Dinges

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PM OWNERS REPORT:



Roominess of interior and trunk appealed to most Caprice buyers, although some would like a "real" full-size spare tire.

CHEVROLET CAPRICE

Big-car fans find plenty to like in the last of the big Chevs.

BY MICHAEL LAMM
West Coast Editor

You can't call the Caprice small by today's standards. Yet, that's how the car looked when Chevrolet first downsized it back in 1977.

Nowadays the Caprice seems huge, especially alongside most imports and front-drive American models. But, when GM decided to shrink all its B-bodied cars for 1977, including Chevrolet's flagship, the corporation realized it was taking a huge gamble. Full-sized cars had always been General Motors'

bread and butter, and no one inside GM could really tell how the American public would react to this seemingly drastic downsizing.

As it turned out, the smaller Caprice became an instant bestseller: 628,000 were sold in 1977 alone. Even more amazing is that Chevrolet's big cars are now in their ninth year of profitable

A NATIONWIDE SURVEY BASED ON 497,511 OWNER-DRIVEN MILES

sales—an unusually long run. In all that time, Chevy's heavies have remained pretty much unchanged.

(Please turn to page 60)



PHOTOS BY BILL ASHE

"The whole car is tight."
—ILLINOIS RETIREE

"Does not shift up or down smoothly."
—ARIZONA RETIREE

"Excellent pickup at all speeds."
—UTAH RETIREE

"Controls are hard to see and light switch very awkward."
—ILLINOIS STEEL WORKER

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—KENTUCKY TECHNICAL TRAINER

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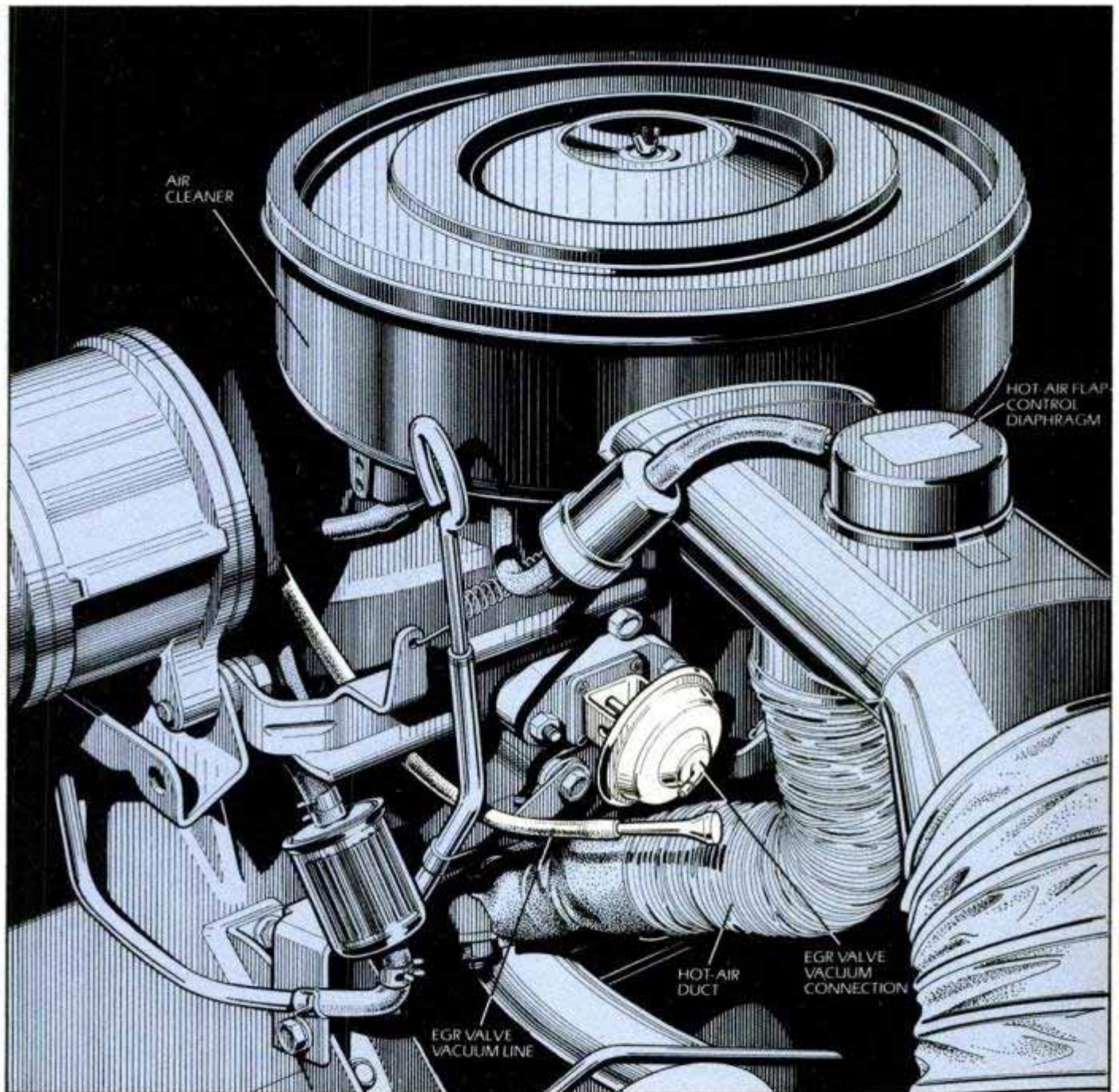
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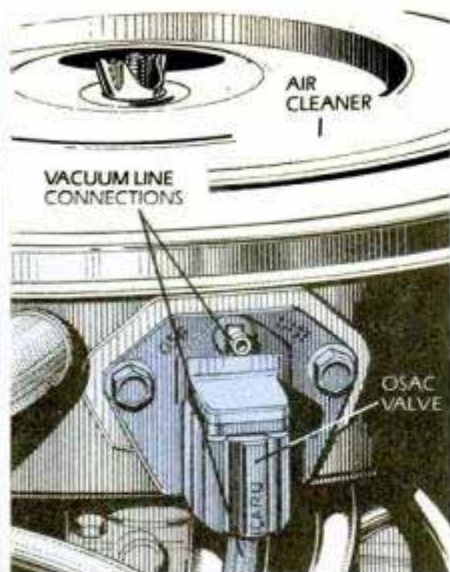
FIXING YOUR MECHANIC'S MOST COMMON GOOFS

You'll get pinging because of high combustion temperatures if your mechanic disconnected the EGR valve and plugged the vacuum line.

If your car is running poorly, perhaps an out-of-date mechanic is the reason. Too often we hear the excuse, "Can't do any better. It's the emission controls." That's sometimes valid, but it's also used by mechanics who just got left behind when the auto industry began to clean up tailpipe emissions.

The computer-equipped car is one source of service hassles for mechanics who haven't kept up with the technology. However, many of the problems we've seen are caused by ignorance of

BY PETE WARREN



1 Bypassed OSAC valve will allow excess vacuum advance and often cause pinging.

engine control systems that have been around since the 1960s, and not all of them are emissions related. Many times, if the ill-trained simply left things alone, the cars would run a lot better. But instead they've disconnected and bypassed critical systems. Unfortunately, the things they left alone were worn-out parts that required extra effort to replace.

Here are many of the underhood errors we and our mechanic friends have seen, obvious things that should have been fixed, but were not. If you discover one of these problems and choose not to fix it yourself, find a professional who *has* kept up to date.

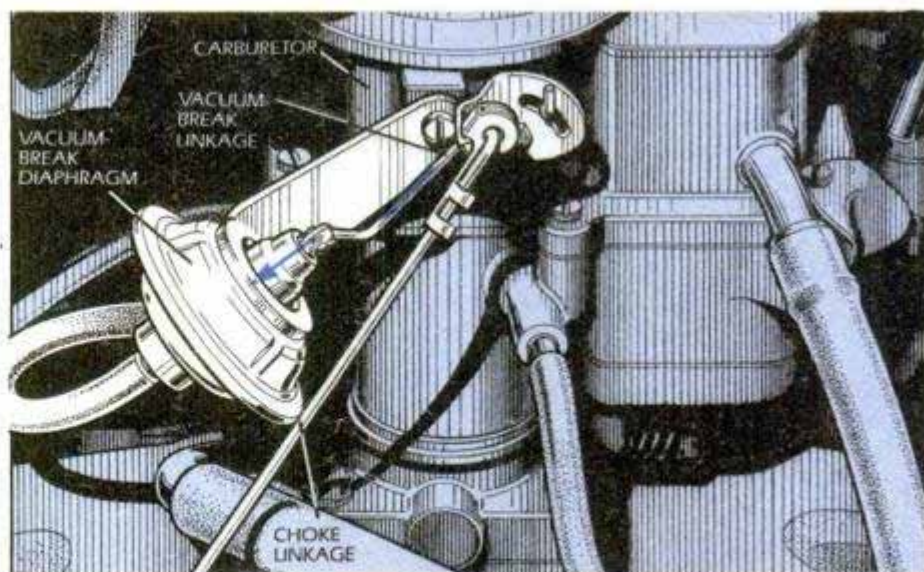
Disabled EGR

Exhaust gas recirculation valve disconnected, resulting in ping.

The vacuum hose was taken off and plugged, because someone was convinced that recirculating exhaust gas back into the engine had to be bad.



2 Ford-type electronic ignition modules must be jumped to set timing correctly.



3 When a vacuum-break diaphragm fails, the choke may stay closed, causing poor mileage and black smoke. If old diaphragm is reinstalled, even a new carb won't help out.

even if it does reduce emissions (see lead illustration). Well, because it reduces peak combustion temperatures, it also prevents ping on most cars.

Port vacuum bypass

Vacuum spark advance hoses rerouted, resulting in ping.

One of the most common steps is to bypass anything between the distributor vacuum advance and the vacuum source. In some cases, the bypass just results in excessive spark advance when the engine is hot, but in most of those we've seen the problem was too much advance applied on takeoff.

On a Chrysler, for example, the carburetor and distributor hoses were disconnected from the Orifice Spark Advance Control (OSAC) valve on the air cleaner and one hose was run from the carburetor base to the distributor (Fig. 1). The OSAC valve delays spark advance between idle and part throttle.

On other cars, a distributor vacuum advance hose was connected to the intake manifold or carburetor base. Either one is a source of manifold vacuum, instead of the original equipment source, which was a port above the throttle plate. Manifold vacuum is highest at idle and still relatively high going to part throttle. Port vacuum is zero at idle and builds up gradually as the throttle is opened up to part throttle.

Improper advance

Ignition timing set incorrectly, resulting in ping or poor performance.

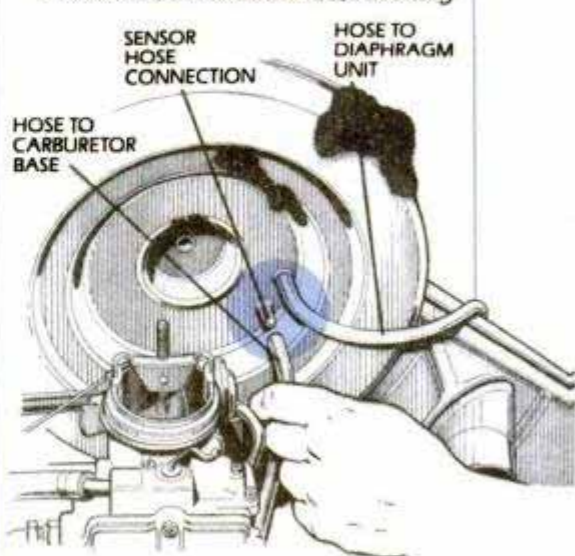
Even mechanics who wouldn't touch computers know there is a procedure to be followed before checking ignition timing, generally a wiring connector to

be grounded or to be taken apart.

Because an AMC six-cylinder engine didn't have a computer, the timing was set the conventional way. However, it had a Ford-type ignition system with an ignition module containing a timing-retard circuit that must be cancelled before any timing check and adjustment is made. The car's underhood decal that gave the procedure was missing, but a mechanic who was up to date would know what to do. The procedure, which also applies to many Fords, is to unplug the two-wire (yellow and black) connector from the module and connect a jumper wire across the male terminals (Fig. 2).

Vacuum-break failure

Choke vacuum break failed, resulting



4 Bypassing thermostatic air cleaner sensor locks system in the heat-on position.



5 A disconnected carburetor hot-air duct will cause cold hesitation and stalling.

in poor gas mileage and black smoke on startup, plus rough idle and poor drivability when warm.

When the engine starts, the vacuum break diaphragm link should pull in, but if the diaphragm fails, it won't (Fig. 3).

We've seen cars on which the carburetor was replaced to correct poor mileage and black smoke on startup, but the old defective diaphragm unit was transferred to the new carb, so the problem remained. In one case, the car was used in short-trip operation, and warm drivability was passable because the cooling system thermostat was stuck open and the engine warmed up very slowly. In another case, the sparkplugs were

removed, found to be fouled, and replaced, but nothing else was done.

Temperature sensor bypass

Thermostatic air cleaner sensor bypassed, leaving system stuck heat-on, resulting in poor performance with the engine warm.

The temperature sensor in the air cleaner controls vacuum to the diaphragm unit that operates the flap in the snorkel. As the engine warms up, the sensor should reduce vacuum, so a spring forces the flap to pivot from heat-on to heat-off.

In this case, the two hoses—one from the carburetor base to sensor, the second from sensor to diaphragm unit—were replaced with one hose from the carburetor base to diaphragm unit (Fig. 4), so the flap was always in the heat-on position. Cold starts were fine, but once the engine was warm, the hot air coming in contributed to overheating (and leaning out) of the fuel mixture, reducing performance.

Unheated intake air

Thermostatic air cleaner disabled, resulting in hesitation and stalling until the engine fully warmed up.

Unless the thermostatic air cleaner goes to heat-on position when the engine is started cold, the engine will run poorly for several miles.

There are several ways we've seen the system disabled. Inadvertently, the hot-air duct from the heat stove on the exhaust manifold was left disconnected at one end (Fig. 5) or the vacuum hose at the air cleaner sensor was unplugged. However, we've also seen the vacuum hose at the diaphragm unit pulled off and plugged, and the hot-air duct left out completely, and both were deliberate acts.

Disabled idle stabilizer

Digital idle stabilizer on a VW Rabbit bypassed, resulting in rough idle.

The stabilizer, on engines with fuel injection, makes continuous small adjustments in ignition timing to keep idle within a specified range. It takes at least a moderately knowledgeable mechanic to know about this part, and to remove the connectors and plug them into each other to correctly perform an ignition timing check (Fig. 6). However, the mechanic forgot to plug the connectors back into the stabilizer when the tune-up was done.

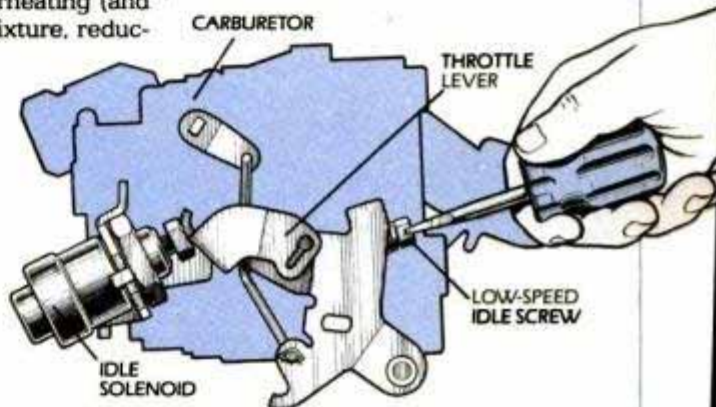
Disabled idle solenoid

Idle solenoid failed and idle speed set on low-speed screw instead of at the solenoid, so the engine diesels when shut off.

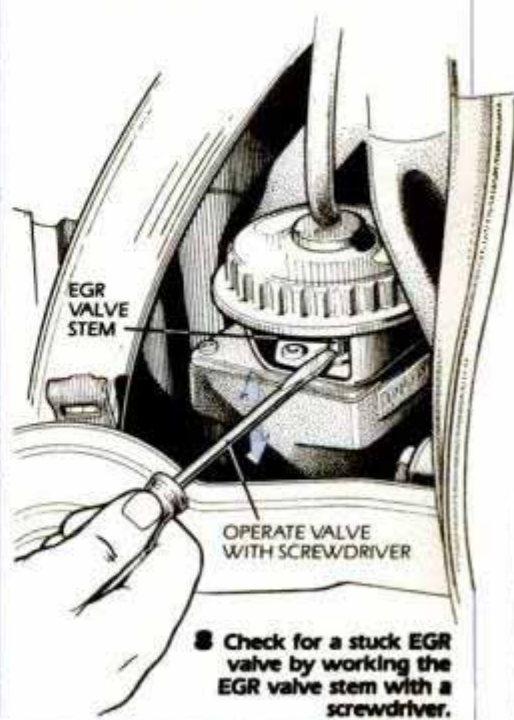
The electric idle solenoid was introduced in the late 1960s. Its job is to permit the throttle to remain open far enough to hold a suitable idle speed, yet allow the throttle to close almost completely when the engine is turned off to prevent dieseling. But some mechanic apparently still didn't know about it. When it failed, the engine began to stall. Instead of replacing the solenoid, he turned up the idle using the low-idle-speed screw (Fig. 7). So the throttle didn't close when the engine was shut off.

Stuck EGR valve

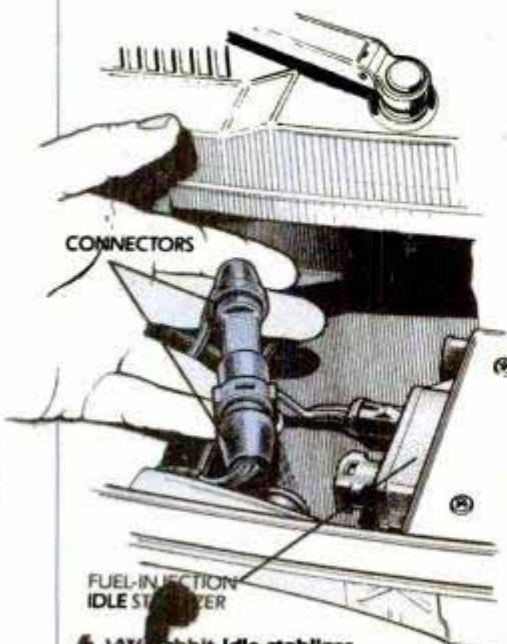
Idle speed turned up to reduce rough running caused by exhaust gas recircu-



7 If idle speed is set using screw when an idle solenoid fails, dieseling will result.



8 Check for a stuck EGR valve by working the EGR valve stem with a screwdriver.



6 VW Rabbit idle stabilizer must be bypassed for timing check, then reconnected for smooth idling.

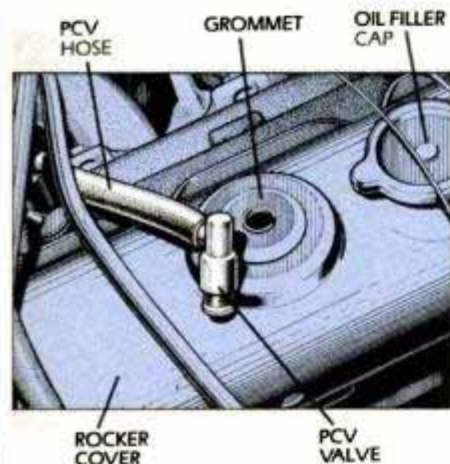
lation valve stuck in the open position, resulting in dieseling.

In this case, the idle speed was controlled only by an idle-speed screw—no idle solenoid was originally fitted. At the throttle opening required for factory-recommended idle speed, the engine normally wouldn't diesel. However, with the wider throttle opening from the too-high idle speed, it did diesel. Further, the engine ran almost as rough even at the high idle speed.

On some cars, you can see or feel the EGR valve stem and operate it with a screwdriver to make sure the valve will move (Fig. 8). If you can't, unbolt the valve and operate it from the inside end to be sure it's free.

Kickup solenoid failure

Idle kickup solenoid failed and the engine stalled when the air conditioning was turned on.



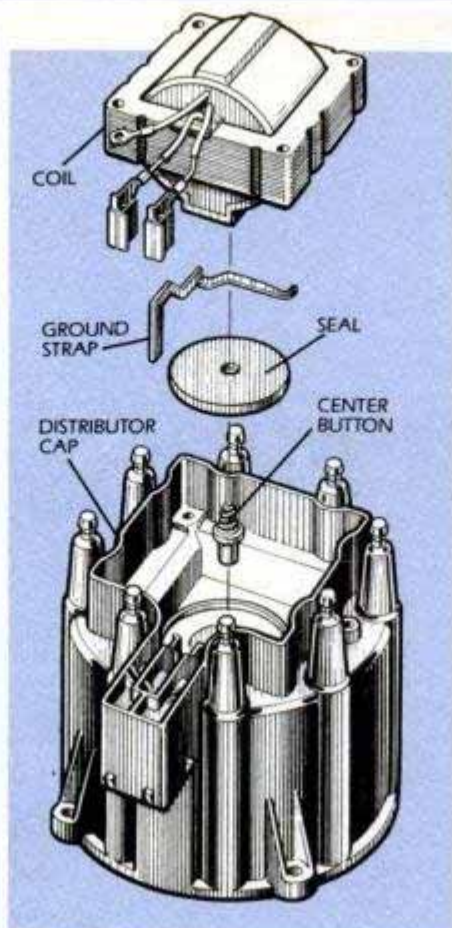
9 An inoperative PCV valve can cause oil to flow up into the air-cleaner housing.

In an attempt to correct this, the idle-speed screw was turned, raising the idle speed so the engine died when shut off. On many cars the correct idle-speed throttle position does not cause a dieseling problem (often because the idle speed is kept low), but there is a solenoid, used to provide an idle-speed kickup only when the air conditioning is turned on. In this case, the high idle speed did not always stop the stalling when the a/c kicked in, and it added the dieseling.

PCV system disconnection

Positive Crankcase Ventilation valve pulled out and not pushed back into its grommet, resulting in oil flow into the air cleaner (Fig. 9).

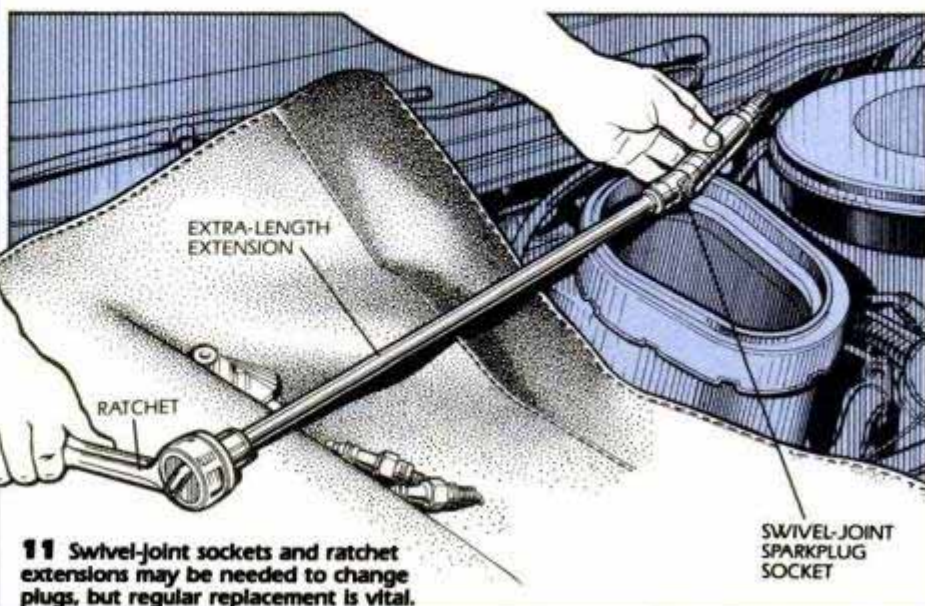
The oil splashed around and helped plug the filter (reducing performance



10 Omission of the center button in GM HEI systems will cause short plug life.

and mileage) and also was pulled into the combustion chambers (resulting in oil loss).

Cause: When the PCV valve was out, a flow reversal occurred in the crankcase ventilation system. Air rushed into the engine through the PCV valve opening and oil vapors and droplets flowed up the fresh-air intake, into the air-cleaner housing.



11 Swivel-joint sockets and ratchet extensions may be needed to change plugs, but regular replacement is vital.

HEI shortchange

High Energy Ignition distributor cap "button" left out when cap was replaced, resulting in short plug life and erratic performance.

The center button in General Motors HEI distributor caps is a separate part, normally included with a new cap (Fig. 10). The old cap's button and the rotor were burned out (a problem that has occurred on HEI systems) and when the new cap and rotor were installed, the old coil and rubber gasket were transferred, but no one looked inside the box to get the new center button. Perhaps the center button was left out of the box, or was not included with that brand, but the installer should have had a cap that included one.

Inaccessible sparkplugs

Difficult-to-reach sparkplugs never changed, so the engine idles roughly and runs poorly.

The problems of reaching some of the sparkplugs on the Chevy Monza V8 are well known, but a couple of other cars also have inaccessible sparkplugs that were never changed.

The plugs in the rear bank of the 2.8-liter V6 in the transverse-engine, front-drive GM X-cars were very difficult to reach on 1980 models, but the access was improved when an air pump was installed instead of the Pulsair valve assemblies. In either case, the job looks worse than it is.

The rear plug on many installations of an inline American Motors six-cylinder also is a tough one, but if you have a very long extension, it can be removed, albeit with some difficulty (Fig. 11). But a lot of AMC engines are running on only five cylinders. **PM**

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CHEVROLET CAPRICE

(Continued from page 50)

Caprice buyers told us that the main reason they chose this car was *habit*. They'd always driven large, comfortable sedans with V8 engines. An Illinois retiree, for example, commented, "We bought this Caprice because we liked the other four we'd had previously. Big cars are safer and can tow our trailer. I

feel, too, that Chevrolet has improved the 1985 model greatly. The whole car feels tighter, and there aren't any gaps the way there were in our last Caprice."

Most owners prized riding comfort and roominess along with price. "I'm 6-foot-6," explained a Michigan chemist, "and the Caprice is the only car I can fit in that I could afford!"

"Lots of legroom in the back seat, plus comfort everywhere and a goodly

amount of trunk space," said a semiretired gentleman from Illinois.

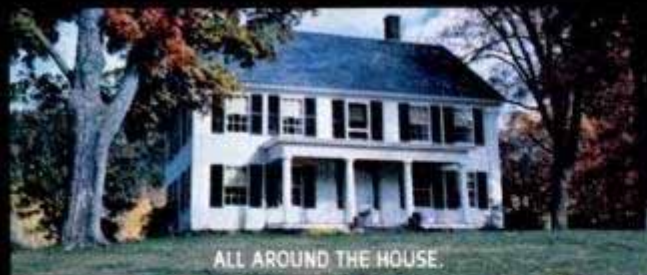
Workmanship received outstandingly high marks in our survey, with 90.7 percent of our respondents rating it good to excellent. "Quality is excellent," stated a Kentucky technical trainer. "I haven't found a single flaw in my Caprice Classic. This 1985 model proves that American industry can again produce a quality product." An

SUMMARY OF 1985 CHEVROLET CAPRICE OWNERS REPORTS*

Total miles driven 497,511	Styling 35.6	Comfort opinion:	Good 50.0
Average miles per gallon	Handling 30.7	Front seats	Average 9.1
With 5-liter gasoline V8	Economy 26.7	Excellent 68.3%	Poor 2.3
In town 17.6	Specific dislikes:	Good 29.2	
On the highway 22.6	No complaints 21.0%	Average 1.7	Number of vehicles owned:
Engine choices:	Noises and rattles 7.4	Poor 0.8	This car only 38.3%
4.3-liter V6 9.4%	Price too high 7.4	Rear seats	Two cars 38.3
5-liter V8 85.8	Space-Savr spare tire 6.2	Excellent 52.7%	Three cars 13.3
5.7-liter diesel V8 4.7	What changes would you like?	Good 42.7	Four or more cars 10.0
Body style choices:	No changes 34.8%	Average 4.5	
Coupe 13.4%	Better fuel mileage 8.7	Poor 0.0	Makes of other cars owned:
Sedan 61.3	Better workmanship 6.5	Had any mechanical trouble?	Chevrolet 56.8%
Wagon 25.2	Quieter operation 6.5	No 67.5%	Ford 32.4
Why did you choose this car?	Move power window switches 5.4	Yes 32.5	Oldsmobile 9.5
Owned Chevrolets before 39.3%	How much did you pay?	What type of trouble?	Buick 9.5
Liked the styling 25.0	Range \$10,235-\$16,000	Transmission 36.8%	Pontiac 9.5
Liked the size 20.5	Average \$13,147	Electrical 18.4	Would you buy another Caprice?
Got a good price 13.4	Workmanship opinion:	Poor shifting 9.7	Yes 72.9%
Interior roominess 11.6	Excellent 41.5%	Dealer repairs satisfactory?	No 3.4
Specific likes:	Good 49.2	Yes 63.3%	Maybe 23.7
Riding qualities 46.5%	Average 7.6	No 36.7	Age distribution of owners:
Comfort 37.6	Poor 1.7	Dealer service opinion:	15-29 years 2.5%
		Excellent 38.6%	30-49 years 26.3
			50-plus 71.2

*Percentages might not equal 100% due to rounding or insufficient data.

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Iowa retiree told us, "The V8 doesn't need oil between changes."

Relatively few purchasers reported mechanical problems of any sort. Nearly 70 percent said their cars had been totally troublefree since delivery. The main complaint, when there was one, centered on the automatic transmission. A few mentioned odd noises and fluid leaks, but a Wisconsin assembler summed up the leading headache this way: "The four-speed automatic TH-700R hangs up in LOW range until around 35 mph. It then finally decides to upshift. I've had the car in the shop three times to correct this, and they're working on it again today."

Dealer service

Despite that hitch, the majority of Caprice drivers think very highly of their dealers' service departments. Caprice owners, in fact, rated service satisfaction higher than owners of the Mercedes 190 we surveyed back in March. Nearly 90 percent of our Caprice respondents judged dealer service good to excellent, as against 88.7 percent for the Mercedes. Of the minority who did report mechanical problems, 63.3 percent said everything was fixed the first time. And even that's a hard statistic to beat.

Handling wasn't one of the big reasons anyone bought a Caprice, but almost 31 percent of our respondents appreciated handling enough to list it as one of the car's best liked features.

When we asked for improvements, a Michigan powerplant operator wasn't alone in urging, "Put a full-sized spare tire in this car." In toto, the Space-Savr spare brought scowls to the faces of 6.2 percent of our owners. Another 5.4 percent suggested moving the power window switches to a more convenient location. They're in a hard-to-reach receptacle on the door panel.

Most owners, though, showed genuine fondness for their big Chevys. A Massachusetts housewife said: "Two months after I got my Caprice, another member of my family loved it so much that he went out and bought an identical car. He says that in the 50 years he's been driving, this is the best automobile he's ever owned."

And a Maryland sales manager concluded by saying, "I feel the Caprice is the most beautifully designed and comfortable car for the money that's offered today." And that's just the attitude that has restored the traditional big car to popularity at GM, causing them to miss the government's mandated CAFE corporate average fuel economy targets. Chevy could seemingly go on selling this model forever, make more money and have fewer problems than it does with its fleet of high-tech front-drive cars. **PM**

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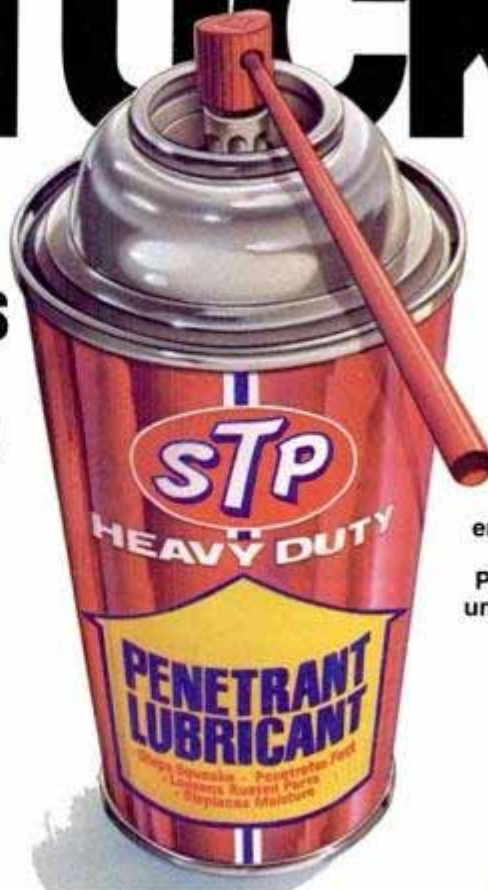
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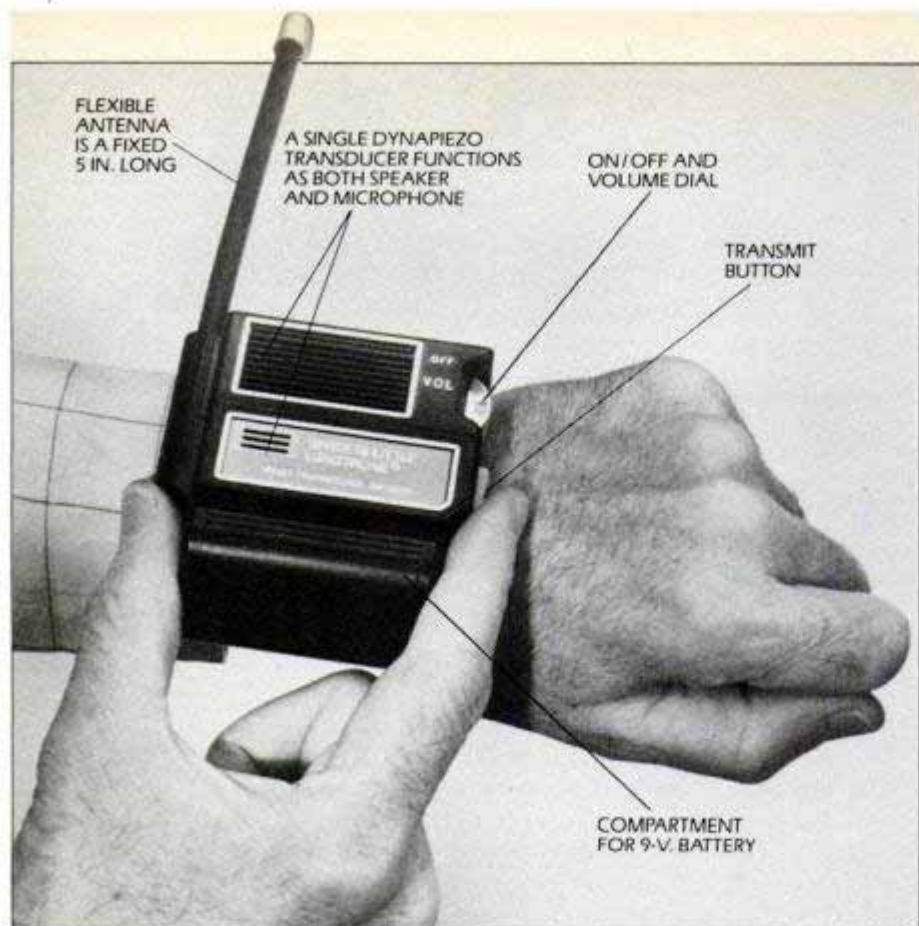


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Space Shuttle Wristwalkie weighs 2 ounces, measures 2 in. square by 1/2 in. deep.

The Two-Way Wrist Radio Arrives

Calling Dick Tracy! Advances in ceramic-speaker technology make the comic-strip fantasy come true.

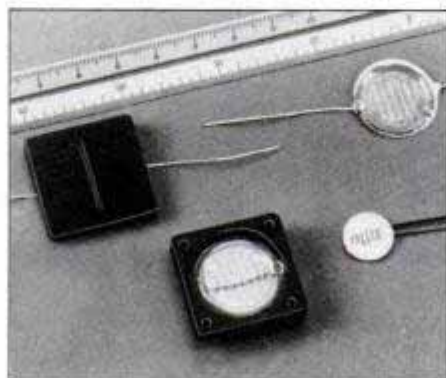
BY STEPHEN A. BOOTH, Electronics Editor

The philosophers say art imitates life, but electronics provides examples to the contrary.

One figment of imagination that became real is the Clarke Belt of satellites, which today relays phone calls and TV around the world. Just 40 years ago, this network existed only in the science fiction of Arthur C. Clark.

In a similar flight of fancy, cartoonist Chester Gould decades ago outfitted his comic-strip detective with a miniaturized transmitter/receiver for voice communications. Now, Dick Tracy's two-way wrist radio is here for real.

This breakthrough in miniaturization



Hi-fi for Tom Thumb: Sawafuji's piezo-electric transducers are pictured here just slightly smaller than their actual size.

results from the development by Japan's Sawafuji Corp. of a single, wafer-like piezo (pee-ay-zoh) transducer that functions both as loudspeaker and microphone. Although this new technology makes its debut in a toy called the Space Shuttle Wristalkie priced below \$40 a pair, the tiny, nonmagnetic transducers have serious applications for electronic devices of all descriptions.

As a wrist-borne transceiver, the 2-ounce, 2-inch-square Wristalkie uses a 9-volt battery and the 49.82-megahertz frequency to convey voices nearly 500 feet. But the unit could not have been made this small had conventional, magnet-driven dynamic speakers and microphones been used.

Not only are dynamic transducers larger, but the strong magnets that drive them must be shielded to prevent interference with other internal electronic components. Sawafuji's piezoelectric transducer combines mike and speaker in a lightweight assembly 1 inch square by 1/8 inch deep—and is nonmagnetic. The challenge was designing a piezo transducer that could reproduce sounds as complex as speech and music. For some time, they've been used for simple buzzers.

Mechanical motion

In its simplest form, a piezoelectric device is a man-made ceramic material that exerts mechanical motion when an electrical impulse is applied. Compared to dynamic loudspeakers, whose cone-shaped driver creates sound by pumping back and forth in response to an electrical signal, the flat, ceramic piezo membrane makes sound by oscillating or vibrating under current.

To get this simple membrane to produce complex sounds, Sawafuji bonds proprietary integrated circuits to the piezo. These ICs enable the ceramic membrane to reproduce and amplify a broad range of sounds as quickly and accurately as a dynamic loudspeaker. Sawafuji calls it the Dynapiezo.

Size and power requirements aside (the Wristalkie's Dynapiezo consumes only one-tenth the power required to drive a cone-type dynamic speaker the same size), it's the nonmagnetic nature of the piezoelectric transducer that will revolutionize product design.

For example, it's possible to mount tiny stereo piezo speakers on a Walkman-type cassette device without hazarding tape erasure from a dynamic speaker's magnetic field. And, whereas magnet speakers placed near a TV tube will distort the picture, piezoelectric transducers can bring hi-fi sound to micro-size TVs. Pocket-size cordless telephones and tiny walkie-talkies are in development. Perhaps the two-way wrist TV that Dick Tracy wears today may be a hot gift tomorrow. **PM**

RUGER® Security - Six® Double-Action Revolvers

Rear sight, adjustable for windage and elevation, has white outline notch on target models.

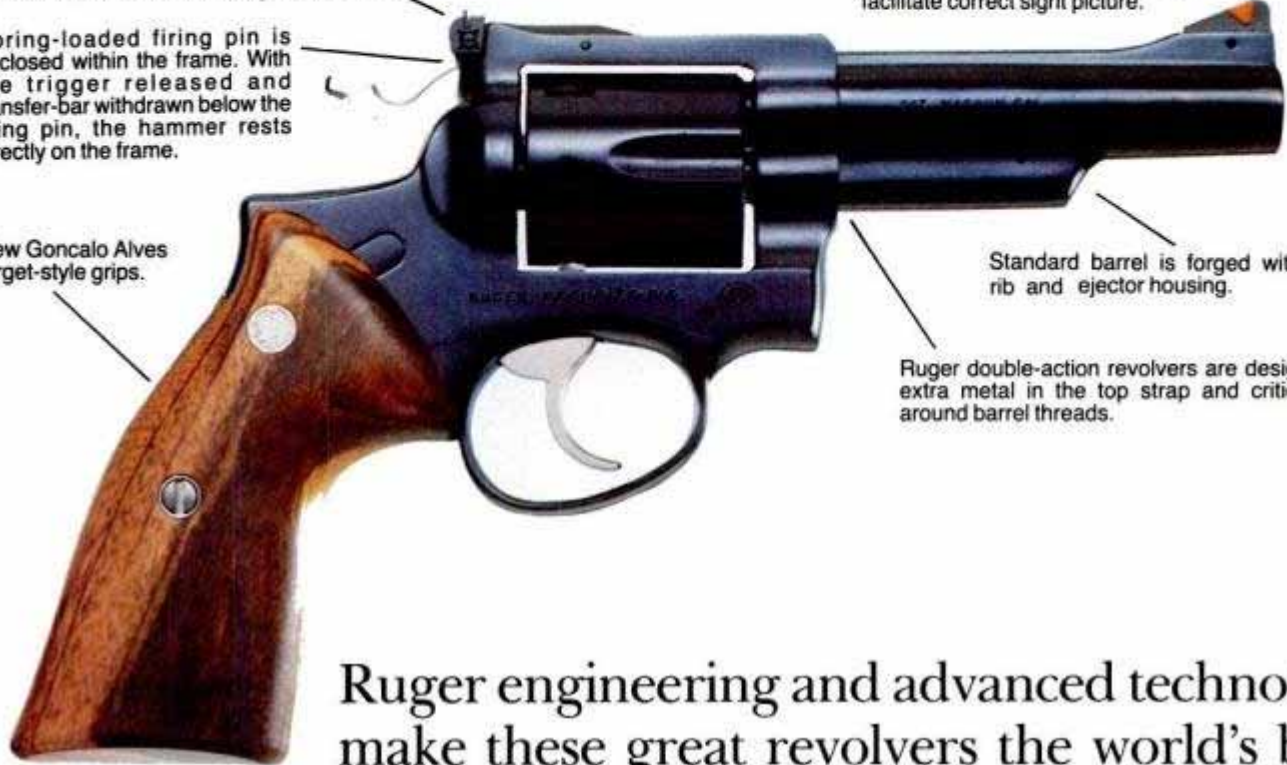
Spring-loaded firing pin is enclosed within the frame. With the trigger released and transfer-bar withdrawn below the firing pin, the hammer rests directly on the frame.

New Goncalo Alves target-style grips.

Serrated ramp style front sight on target models has red insert to facilitate correct sight picture.

Standard barrel is forged with integral rib and ejector housing.

Ruger double-action revolvers are designed with extra metal in the top strap and critical areas around barrel threads.



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When the Ruger Security-Six revolvers were created, they represented the first significant improvement in double-action revolver design in many decades. During the past fifteen years of production, over one million Security-Six revolvers have been built, and today this great revolver is recognized by experts throughout the world for its logical design and fine workmanship. *But, the real basis for its reputation is that tests have proven that it will outshoot and outlast any comparable revolver ever made.*

Ruger Security-Six revolvers are chambered for the .357 Magnum cartridge and .38 Special in standard and +P loads, and are furnished with white outline adjustable rear sight and serrated ramp front sight with red insert on target models. Barrel Lengths: 2³/₄", 4", and 6". Oversize grips are Goncalo Alves. Finish: polished overall and blued. Stainless steel models have brushed satin finish. In 14 models at suggested retail prices from \$309.00.

The Ruger Police Service-Six and Speed-Six revolvers are based on the Security-Six design, with fixed sights, and a variety of barrel lengths, grip styles, and in blued or stainless steel versions.



Ruger
Police Service Six

Ruger
Speed-Six

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Not only the most expensive, but also the fastest selling spinning reel ever sold by this multi-million dollar New York firm, it is ideal for both trolling and casting in both salt and fresh water. Precision crafted of newest space-age materials, it is built to last. Yet, unbelievably, it weighs just 7 ounces, making it the perfect reel for your ultra-light rig.



These famous SWIFT-660/F Spinning Reels will not be sold at this price by the company in any store. To obtain one at this special Anniversary Price, mail this *original* printed ad to the company before Midnight, September 30, 1985.

Each reel is covered by a full one-year money-back guarantee and will thus be replaced or refunded by the company, free of charge, if it fails to function. There is a limit of two (2) reels per address at this price, but requests which are mailed early enough (before Sept. 25) may request up to five.

To obtain your SWIFT-660/F Spinning Reel, mail this original Anniversary Ad together with your name and address and \$4 for each reel. Add only \$2 shipping and handling no matter how many reels you are requesting. (New York residents add sales tax.) Allow up to 6-8 weeks for shipment. Mail to: **Abernathy & Closther, \$4 Spinning Reel Offer, Dept. 114-100, Box 1736, Hicksville, New York 11802.**

(A25160)

FREE BONUS: We will also wind 250 feet of our special 6-lb-test monofilament line onto your reel, free of charge, if your request is mailed before Sept. 25.

With the sun above and the clouds below

Scientists studying the Earth's climate know that it has been changing. But they are not sure why. Could it be caused by a crack in the ozone layer? Or is the problem in the sun where energy output may be fluctuating? To get some answers, NASA next year will launch a massive General Electric satellite.

The Upper Atmosphere Research Satellite (UARS) is actually nine satellites in one unit. Powered by a solar array and launched on NASA's new multimission spacecraft, UARS will monitor energy output of the sun at all wavelengths as well as record wind speed and cloud formation at different atmospheric levels down on Earth. The solar pointing platform will use solar energy to point detectors at the sun. Radiometers will look for cracks in the ozone.

By 1987, researchers hope UARS will have provided us with clues that indicate why the global climate is changing dramatically.

Editor: Dennis Eskow
Contributors: Sheldon M. Gallager,
Howard Levy, Jack Hammond, Norman
Sklarewitz, Ann Liguori, Steve
Eskow, Fran Wenograd Golden,
Ken Saunders



TRANSPORTATION

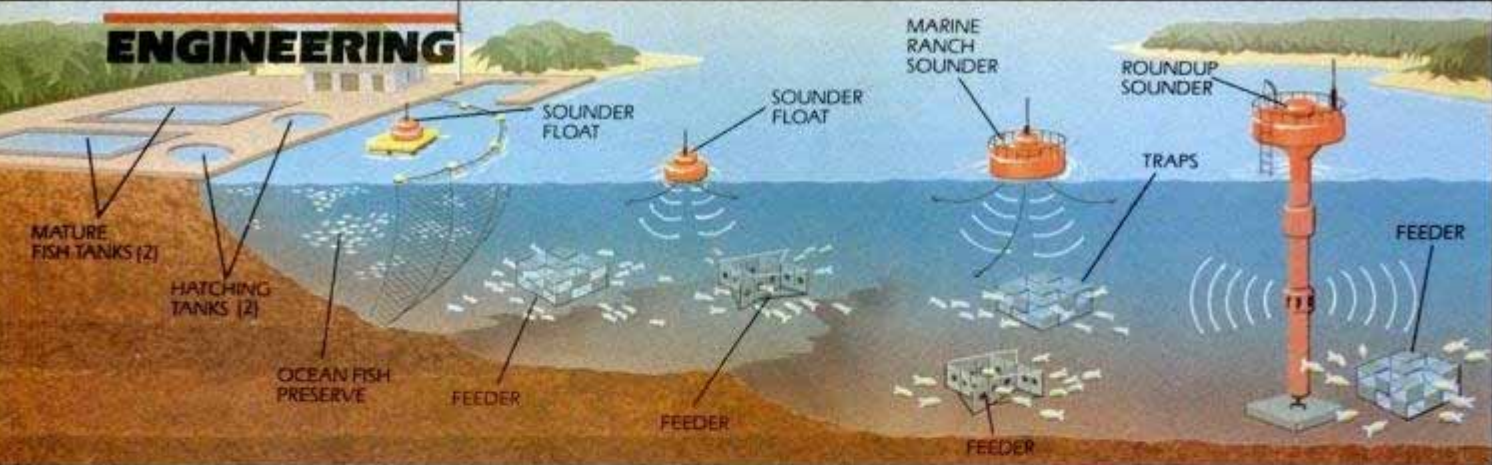
Maglev milestone

Skimming along on a thin film of air, Germany's sleek, electromagnetically propelled Transrapid-06 recently hit a speed of 188 mph—a world record for a manned maglev train. In remote-controlled tests, it has gone over 200 mph and a Japanese version has exceeded 300 mph—without people aboard.

The two-car train accommodates 196 passengers and operates on the principle of electromagnetic levitation, raising it off its rails. Developed by Transrapid International, a West German consortium, it will soon go into regular commuter service in northern Germany and is also under consideration by the U.S. Department of Transportation as the basis for a high-speed rail link between Los Angeles and Las Vegas in the 1990s.



ENGINEERING



PM ILLUSTRATION BY GEORGE RETSECK

Japan's new plains beneath the sea

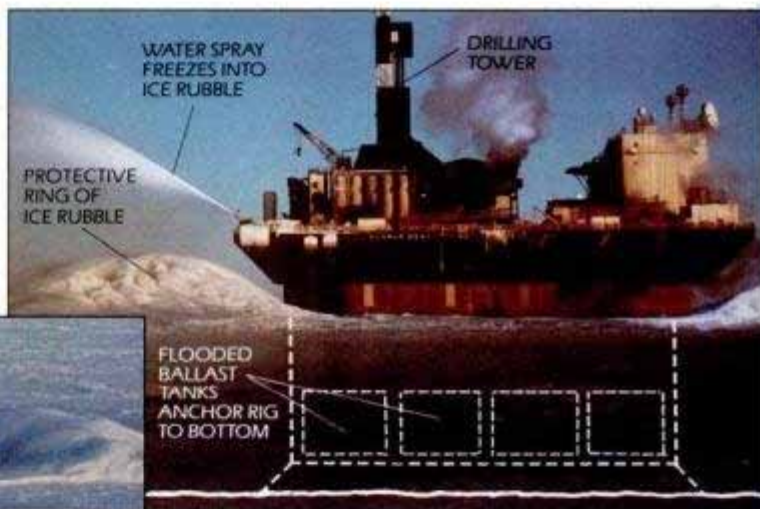
Japan's newest cowboys will cover the range in fishing boats. And when they round up a herd at Oita Ranch they'll use nets instead of ropes. The ranch is running experimentally at the moment, and the meat Oita cowboys are raising is sea bream, a popular food fish.

The ranch is set up in a bay where fish eggs are hatched in a pair of tanks on shore. The fry are soon transferred to mature

fish tanks. Within weeks, they're moved off land into an ocean fish preserve. Here, they are fed and subjected to a specific frequency radiowave from a sounder float. Conditioned to eat when the radiowave sounds, they are released to an area where submerged feeders work with sounders. Within a few months, they are let out to pasture. When they are mature, a large ranch sounder calls them home for the final roundup.

Putting the freeze on ice

Oil rigs operating in the Arctic are at the mercy of crushing ice floes that would quickly wreck any conventional structure. One clever answer is a new concrete-walled platform that uses a special trick to outwit ice. Once in place, it sprays high-pressure streams of water all around it. The spray freezes as it falls, forming a thick ring of loose, spongy ice called ice rubble. This acts as a resilient cushion to fend off heavy, destructive pack ice. Called CIDS (for Concrete Island Drilling System), the rig is moved easily by blowing out ballast tanks to float it, then reflooding the tanks to anchor it to the ocean bottom at a new location. The system was designed by Global Marine Development Inc. of Houston, Tex.



MEDICINE

Robot teeth fill the bill

Airline pilots have their simulators. And now dental students have their robots. It's tough enough to learn dentistry without having to deal with the patient's anxieties.

Dr. Frank Faunce of Emory University has created robots for dental students. The Dental Simulation Unit has a human head complete with jaw, tongue, teeth and gums. The vinyl gums "bleed" a red liquid if they are pierced. "The dental student can literally sit down and go through any dental procedure," Faunce says.

PM PHOTOS BY STEPHEN M. GARDNER JR.

Device fights infant deaths

Sudden infant death syndrome is a mysterious disease that kills otherwise healthy babies in their sleep. All that doctors know right now is that the infants suddenly stop breathing. If they could be attended when breathing stops, the babies could be revived before it's too late.

University of Virginia biologists Gene Block and W. Otto Friesen have invented a monitor whose sensor pad fits under the crib sheet. If baby stops breathing, a tabletop monitor sounds an alert. The device, to be marketed next year, may save many lives.



SPACE



PM ILLUSTRATION BY BRIAN SULLIVAN

To Mars in ships

More than 100 scientists and engineers have been talking at meetings this past year about a new American mission to Mars. NASA is just beginning to do studies on a manned mission to the red planet. But the professionals meeting independently this year under the auspices of the Planetary Society, American Astronautical Society and National Space Institute have decided to get ready for a full-bore push for exploration of Mars. Several aspects were discussed, but the most exciting was agreement on what Mars exploration ships will be like.

The scientists agree that a multiship Mars mission can be launched aboard a specially designed super-shuttle by 1995.

As the vehicle approaches Mars, its last stage would separate into five units. A central spherical unit will serve as the command module, where a small crew would operate Earth communications and other equipment. Each of the remaining units would serve as landers or orbiters. Each vehicle would carry a crew of four to and from the surface of Mars or on orbit around the planet. NASA officials say they are studying the proposal and will comment on it early next year.



PM PHOTOS BY TALLAT MOHAMMED

Beep beep and you're out

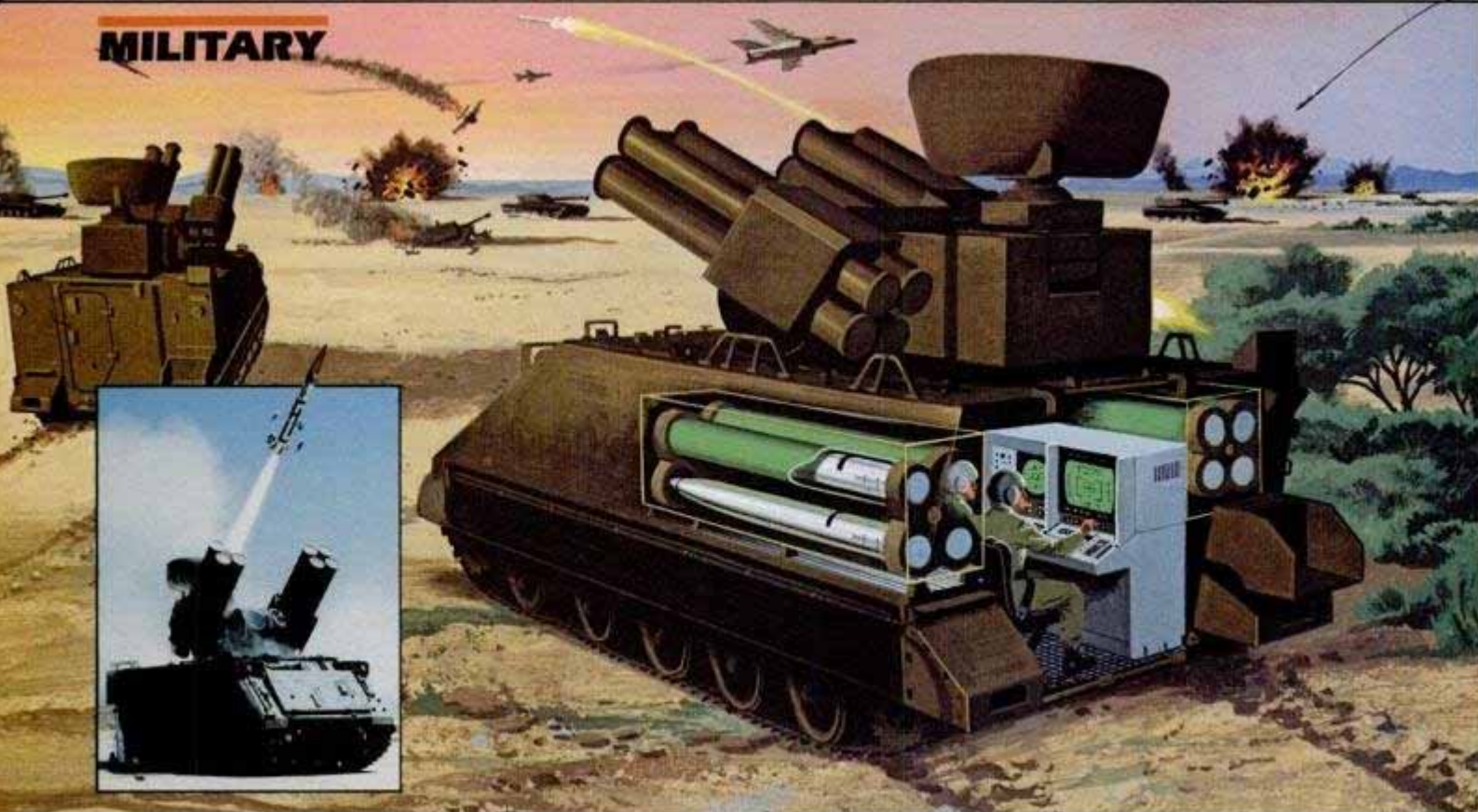
National League spring training camps this year had noisy outfielders. They were experimenting with Mizuno's new outfield screen, designed to save the careers of baseball players. The screen uses radar-like sensors to pick up an outfielder as he approaches a fence. When the computers detect a human approaching, a beeping sound comes from the gate warning the player of the fence's proximity. The closer the player gets, the louder and more frequent are the beeps. The \$20,000 system is already in use in Japan, and may appear in American baseball by next season.



Sneaky sports devices

The newest lightweight tennis racket is Kneissl's White Star Aero. The graphite and Kevlar racket is extremely lightweight. But the new technology is in its beveled frame. The bevel makes the racket aerodynamic so its enlarged head doesn't slow the player's swing. Also for sports technocrats is Spaulding's Tidal Wave bat. The bat nub unscrews so the hollow aluminum bat can be filled with water to adjust its sweet spot.

MILITARY



Hot new missiles: No place to hide

It's getting harder and harder for an enemy to hide. The two new mechanized missile launchers shown here are designed to make it virtually impossible for a hostile force to avoid detection and ultimate destruction. At left above is the ADATS (for Air Defense Anti-Tank System), the first dual-purpose missile launcher capable of defending against both ground and air attack. Enemy targets are detected and tracked by a combination of day/night sensors, including radar, TV and infrared, making it possible for gunners inside the vehicle to see the targets on video screens even in darkness and bad weather.

Once a missile is launched, it is automatically guided to the target by riding a coded laser beam. It has a ground range of five miles and is effective to an altitude of 16,000 feet against airborne threats. The eight-missile ADATS launcher, in addition to being vehicle mounted for mobility, can also be used in fixed emplacements such as for guarding airfields and coastal approaches. It was jointly developed by Oerlikon-Bührle in Switzerland and Martin Marietta Aerospace here.

The vertical-firing antitank weapon shown on the facing page can hide safely behind a hill or other cover and lob its missiles at



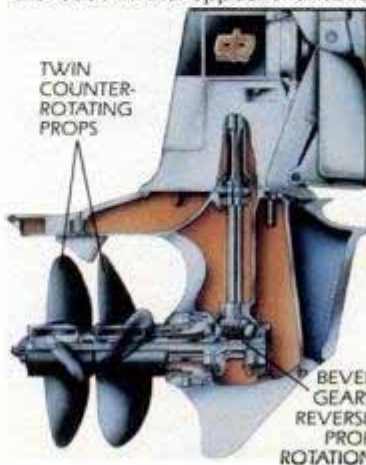
Fast help for fast ships

The Navy's high-speed hydrofoil patrol boats need to know exactly what's ahead at all times, especially when they're in tricky waters, since a suddenly looming threat could come too fast to avoid.

Now, a Sperry-developed system called HYCATS (Hydrofoil Collision Avoidance and Tracking System) makes navigating faster and easier. A conventional radar plot is superimposed on a moving map display of a harbor or coastline. Thus, a navigator can quickly see not only radar blips, but his own ship's position in relation to land contours, channels, navigating hazards and other ships.

Dual props boost boat speed

When are two propellers better than one? When they're turning in opposite directions. That's the secret of a new twin-prop sterndrive under development by Volvo, maker of the popular Swedish Volvo car. A single prop turning in one direction produces a reactive force, called prop torque, that tends to twist the boat in the opposite direction, wasting power. A second,



counterrotating prop cancels out prop torque and converts wasted energy into added thrust. The dual props, driven by reversing gears on concentric shafts, also allow the engine to run at a lower, more efficient speed due to the greater blade area.

Called Duoprop, the system has produced some impressive test results: a 10 to 20 percent increase in cruise speed, a 30 percent boost in burst acceleration and fuel savings of up to 15 percent.



PM ILLUSTRATION BY DEAN ELLIS

unsuspecting attackers miles away. The secret: As a missile is launched, it pays out a fine optical fiber—like fishing line spiraling off a spinning reel. A TV camera in the missile's nose scans the battlefield for hidden enemy positions and transmits visual images back to video monitor screens over this fiber-optic link. When a tank or other armored vehicle is spotted, the missile is automatically guided to the target by computerized instructions fed to it over the same umbilical link. Called FOG-M (for Fiber Optic Guided—Missile), the system is a joint Hughes Aircraft/U.S. Army development.



NEW NAVY T-45A TRAINER



NEW AIR FORCE T-46A TRAINER

New planes for future fliers

Fledgling Navy and Air Force pilots will soon get their hands on hot, new training planes designed to more closely simulate the fighter jets they will eventually fly. The Navy's new T-45A is a derivative of Britain's highly successful Hawk trainer now being modified for U.S. carrier operation by McDonnell Douglas. The versatile, 600-plus-mph tandem two-seater will replace two current Navy trainers, the intermediate T-2C Buckeye and the advanced TA-4 Skyhawk. It will cut training time by 25 percent and training cost by almost 50 percent.

The new Air Force/Fairchild T-46A is a 450-mph, side-by-side primary trainer designed to replace the aging T-37 Tweet, in service since the mid-'50s. It will be faster and more maneuverable than the T-37 while burning only one-third as much fuel. It will also have removable wings. Why? So it can be trucked back to base if an errant trainee comes down in a cornfield.



Self-propelled rescue rig

Rescuing an injured or unconscious victim at sea is difficult, especially in rough waters, because he can't help himself. Now you just send out this self-propelled basket, scoop him up in it and haul him to safety without having to risk the lives of rescuers.

The remote-controlled rig, which can be launched from a ship or helicopter, is supported on inflatable pontoons and powered by two variable-speed, reversible electric thrusters that permit it to be steered by rescuers through the water to the victim's location. Called Jet-Net, the rig is made by SEI Industries, Vancouver, B.C.



Record-breaking speedboat

The trouble with conventional hydroplanes, says speedboat designer Tom Austin, is that they become virtually airborne to reduce water drag, yet aren't designed to fly. Resulting instability makes them hard to control and limits their speed.

Austin's answer is a twin-hulled, center-wing craft that flies like an airplane while scarcely touching the water. Aileron-like vanes at the sides provide roll control, while differential ruddervators in the tail control both pitch and yaw. Under development at Austin Aeromarine, Las Vegas, Nev., the Ram-2 currently is powered by two 135-hp outboard motors. With bigger engines, it may be able to exceed 250 mph—enough to set a new world speed record for prop-driven racers.

Tu

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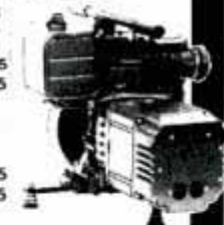
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GENERATORS

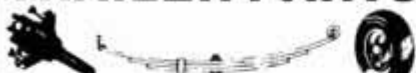
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FIRSTHAND DRIVE REPORT



Have you driven a Ford that looks like this lately? Aerodynamic Taurus has more radical lines than Audi.

1986 FORD TAURUS AND MERCURY SABLE

Ford brings aerodynamics to the heartland with its new family cars.

BY DANIEL CHARLES ROSS
Detroit Editor

Why all the hoopla over the Ford Taurus and Mercury Sable? Ford intentionally started leaking photos to the press several months before anyone had a chance to see and drive the new line. It's probably to condition everyone to the radically aerodynamic styling of a front-wheel-drive, mid-range car that will replace the intermediate-size rear-drivers—LTD and Marquis—that have long been among the favorites of American families.

The new Ford family automobiles won't go on sale until later this year, but we've already had a crack at them at the Moroso Motorsports Park road racing track in Florida. We drove sedans and wagons that were dubbed production-quality cars, though still engineering test mules. On the track we found that

the Taurus and Sable have more than just styling going for them. The suspension is fully independent front and rear, consisting of four-corner MacPherson struts, Motorcraft double-acting nitrogen-pressurized shock absorbers and coil springs. Both front and rear setups feature a stabilizer bar. Brakes are vacuum-assisted discs in front, drums in the rear.

The station wagon's rear suspension differs from the sedan's, with the use of unequal-length control arms in place of the struts. This eliminates the shock towers that would otherwise intrude into the cargo area.



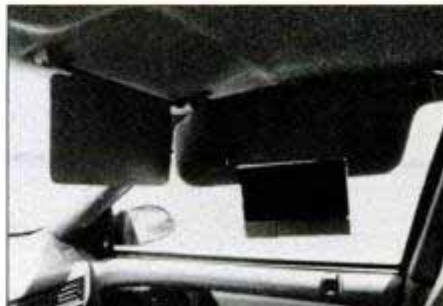
All-new 3-liter V6 has 60° angle between cylinder banks for smooth operation. Distinctive fuel-injection manifold is aluminum.

Slick interior, too

The interior treatment is contemporary in feel and execution. The instrument cluster presents an uncluttered look of easy readability. Controls are simple to identify and are within a driver's reach. A bank of power window buttons is located on the driver's door, as is the power mirror switch. The sun visors are engineered to fold down and sideways to protect from the sun in front and at the side.

New engines

When they go on sale, Sable and [\(Please turn to page 137\)](#)



Unique double-hinged sun visors have a pull-down see-through blind on side that will protect even small kids from the sun.



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THE WORLD'S BIGGEST DAM

Still five years from completion, Brazil's huge Itaipu Dam already provides one province's power.

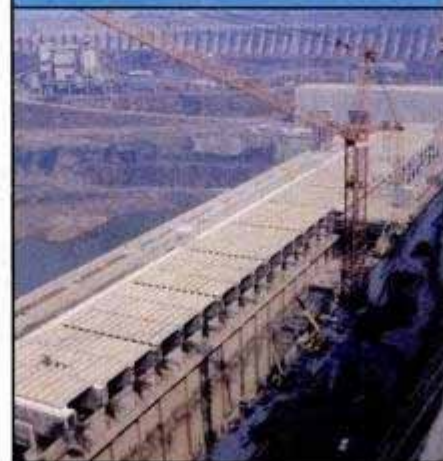
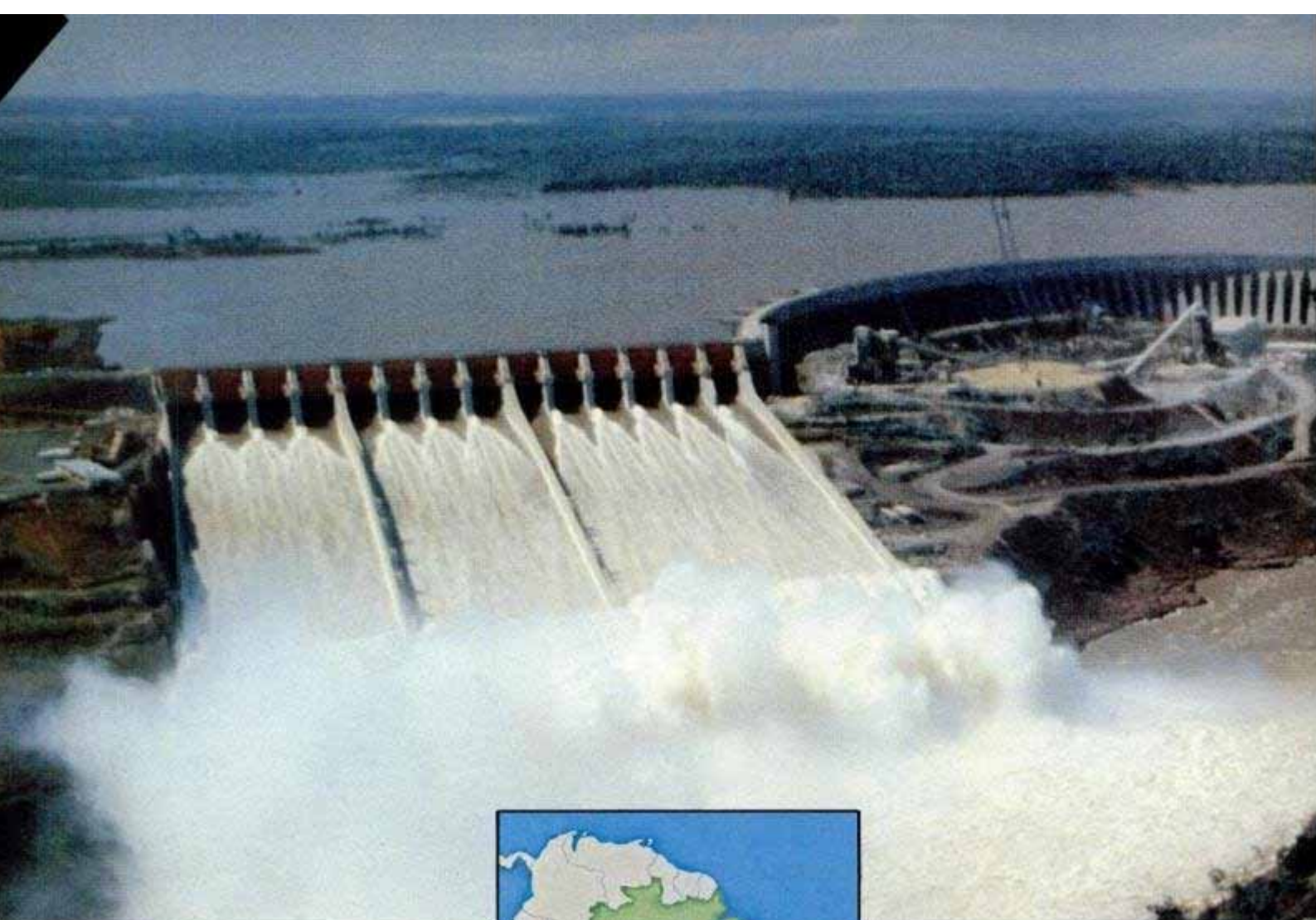
TEXT AND PHOTOS BY TIM SNIDER

The men in the staff car are silent as we cruise up the dusty mountain highway, stopping at a gate where Brazilians in starched uniforms, with pistols in holsters, check our papers. We are unceremoniously waved through and the car bounces up and down for a couple of miles farther up the road. Suddenly, the driver swings into a red clay parking lot where huge trucks and giant earthmovers sit coldly in the early morning light. The sight is awesome, but quickly forgotten as we come to the edge of the lookout point.

Without warning, the most magnificent vision I've ever seen breaks the forest scene below. Itaipu, the world's largest hydroelectric dam, stands like a concrete temple high above the Paraná River near the Brazil-Paraguay border.

The main dam is as high as an 80-story building. Its four spillways, each 100 yards wide, are slanted downriver off to the left. When a spillway gate is open, the water churns at up to 100 mph as it completes a downward slide of about a third of a mile.

Itaipu, with the last of its 18 genera-



A crane moves generator parts at Itaipu near the Brazil-Paraguay border (map).

tors scheduled to be installed within the next five years, will be the most powerful electric dam in the world. It will have 50 percent more power capacity than the Grand Coulee, America's grand dam. Itaipu will provide most of Brazil's and all of Paraguay's electric power, opening doors to industrial development in the two countries.

Only one generator is running as I visit Itaipu. Still, it produces all the electricity for the Brazilian province where the dam is built.

If Itaipu didn't exist, then Canada's new Hydro Quebec project would be the world's biggest. But the Brazilian operation will finish at 20 percent greater capacity than the Canadian system. Designers say the Canadian project—which harnesses the power of La Grande Rivierre—could power two cities the size of Los Angeles with Minneapolis thrown in.

Still, Itaipu is greater.

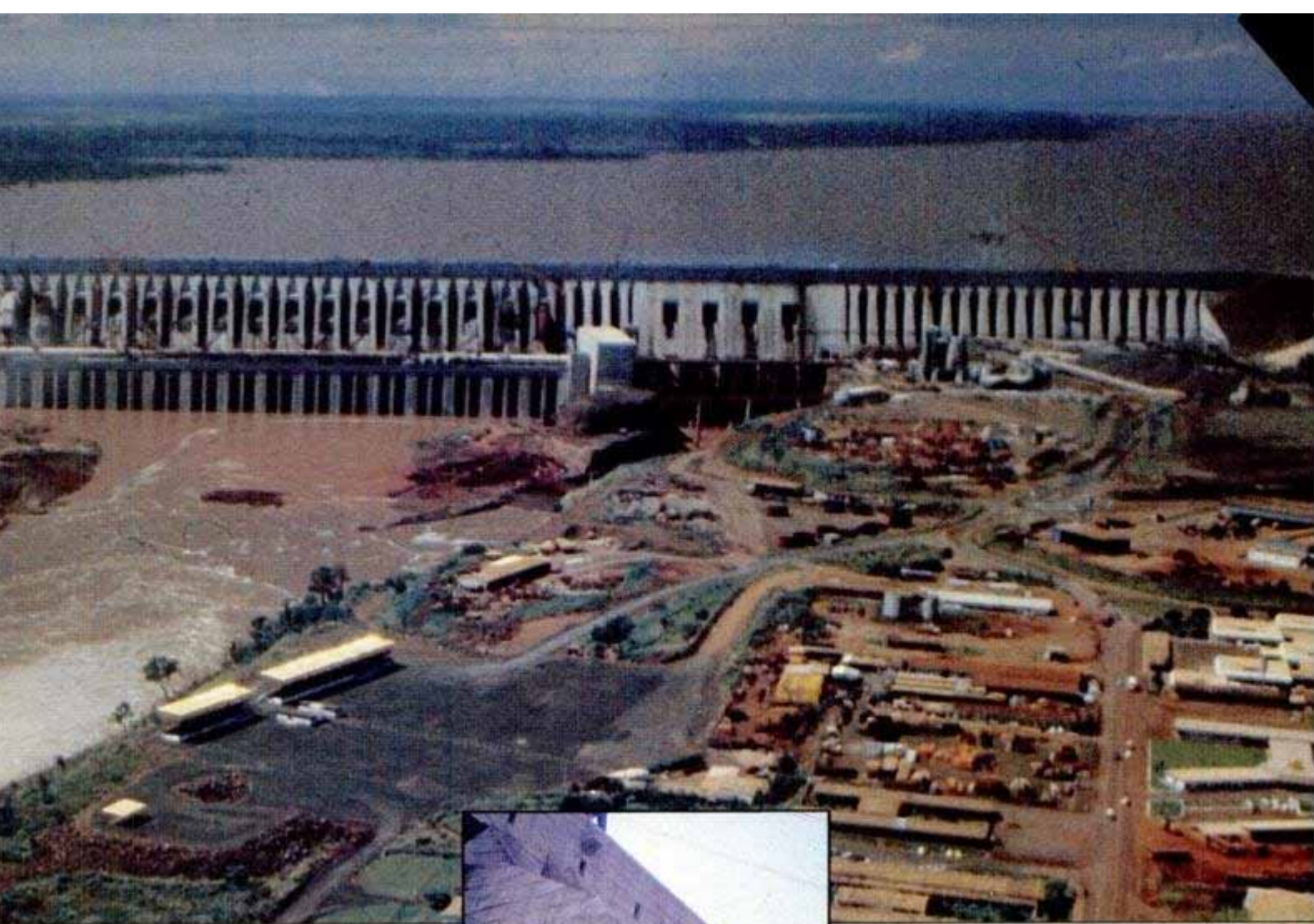
Numbers do not adequately convey the significance of Itaipu. It has a 12,600-megawatt capacity. But the story is more dramatically told by the men, machines and materials that are building this colossus.

Construction began in 1976. To house the work crews, a small city had to be built with schools, hospitals and shopping centers. By the peak of activi-

ty, between 1979 and 1981, the daily work force stood at 40,000. Today, a skeleton crew of 12,000 men puts the finishing touches on Itaipu. A pair of rock-crushing plants, each with a 160 ton per hour capacity, provides gravel for the concrete. Three ice plants provide the water for the cement mixture. Plain water would evaporate too quickly, and besides, the ice helps form expansion bubbles in the mixture to ensure longer life to the structure. Six concrete mixing plants finish the job.

Itaipu borrows the Paraná's water for the few seconds it takes the river to cascade over one of the system's giant subterranean turbines. Sitting atop the turbines is the main powerhouse. House may be an understatement. The building is about half a mile across. About 370 feet above are four 100-ton bridge cranes used for installation and maintenance of generators. In the back of the room, behind a huge glass wall, is the computer room, where white-coated men scurry around with clipboards watching the dials and computer screens that control and monitor the dam's sluice gates.

Watching the turbines under construction is a civil engineering education in itself. Each turbine is powered by two watertubes—or penstocks—each 470 feet long and 35 feet in



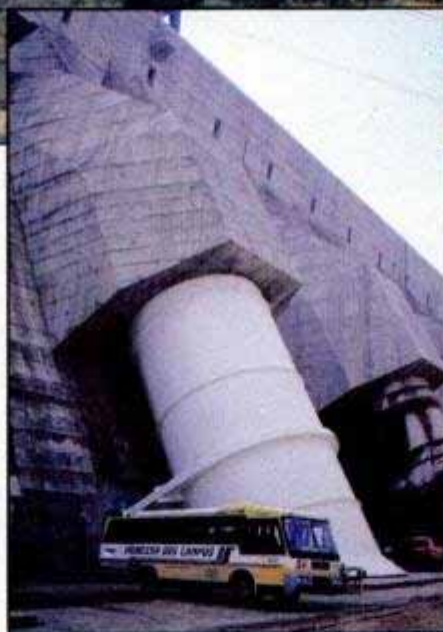
diameter. During operation, 700 cubic meters of water will rush down the tube and over the wheel each second to generate power.

The water running the turbines is nothing compared to the liquid running down the spillways to keep the excess from overflowing. Itaipu's 14 steel control gates—each 65 square feet in area—are raised and lowered to keep the lake behind the dam at a constant level. During the hot summer, when most of the water is lost to evaporation, only one or two gates will be open. During the winter flood season, all 14 gates will be open. The lake level is constantly monitored in the powerhouse computer room.

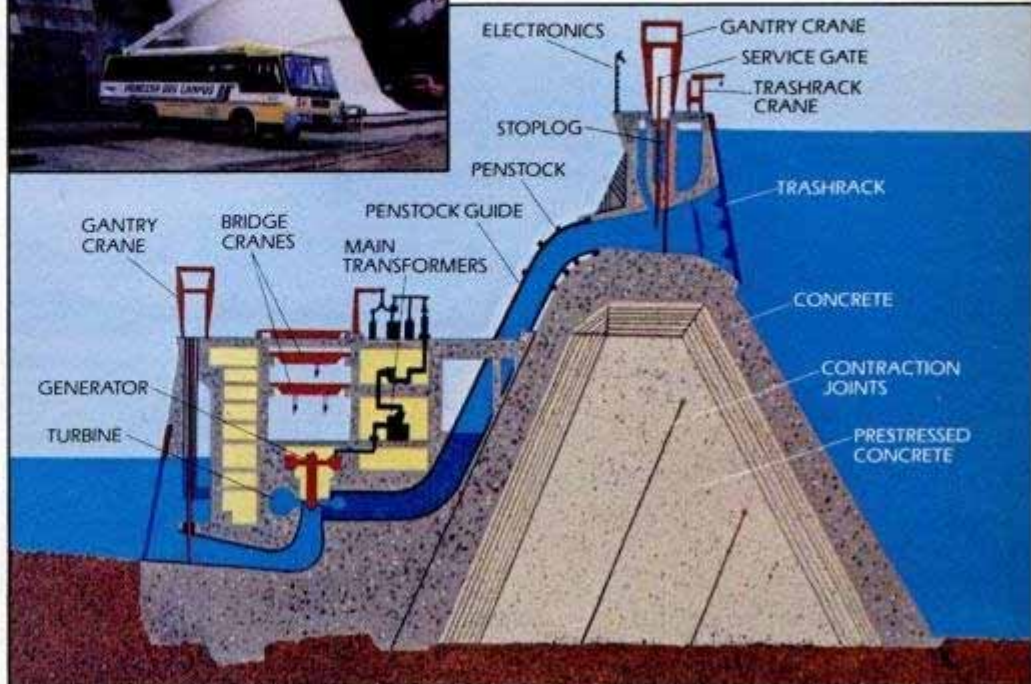
To make room for the dam and the underground powerhouse and turbine stations, the Paraná had to be diverted for four years. A mile long diversion channel, 500 feet wide and 300 feet deep, was constructed of rock and earth excavated right at the dam site.

Although the remaining generators are still being installed, Itaipu's basic framework is complete. Today, it runs about three miles across the river valley from wing to wing. Behind it stands the new lake, formed when the diversion channel was opened. It took two weeks to fill the lake at a rate of 10,000 cubic

(Please turn to page 118)



Photograph above shows Itaipu project with its four spillways (facing page) and 18 penstocks, the large tubes lining the dam. One penstock (photo left) runs 700 cubic meters of water per second over a turbine. Subterranean powerhouse (illustration below) sits atop turbine room. As it turns, it runs generator above it. Service gates can be open to different levels to adjust the flow of water.



TAMING THE FEATHER RIVER

The Feather River took one life too many. So they built the Oroville Dam. It's a civil engineering landmark today.

BY WILLIAM HOFFER

At midnight on Dec. 23, 1955, the waters of the Feather River in northern California surged across Yuba City, destroying 400 homes and killing 38 people.

The disaster spurred design engineer Donald Thayer of the California Department of Water Resources to proceed with ambitious plans for a dam near the town of Oroville, in the foothills of the Sierra Nevadas, that could prevent further catastrophe. What's more, the harnessed water could supply electricity to the entire area and then be diverted to the parched areas of the south.

This year marks the 15th anniversary of Thayer's grand achievement. In 1970 the new Oroville Dam and Edward Hyatt Powerplant was presented with the Outstanding Engineering Achievement Award of the American Society of Civil Engineers.

The distinction was highly deserved. Thayer and thousands of workers conquered a legion of problems. To begin with, they had to worry that the Feather River might flood once more and wash away their early efforts. Then there was the problem of moving 80 million cubic yards of dirt to fill the deep gorge. The 6,920-foot-wide by 770-foot-high structure would be the highest earth dam in the world.

The potential users of water diverted by the dam had conflicting requirements. The Feather River Fish Hatchery wanted cool water, but farmers wanted warm water.

Finally, since it's earthquake country, geologists needed to build precision instruments into the structure.

Construction began in May 1963. To provide immediate protection against flooding, contractors erected a 128-foot-high concrete core block at the bottom of the chasm. This



unique dam within a dam contained 252,000 cubic yards of concrete and provided a smooth base for the main bulk of the earthen dam.

The land around Oroville, Spanish for "town of gold," was long ago displaced by miners who had gouged the river, dumping huge mounds of dirt along the banks. Now, construction crews attacked those discarded mountains of dirt, scooped them up with giant wheel excavators, and shipped them by rail 11 miles to the site of the dam. Every hour the crews moved 120 train cars full of dirt.

Work proceeded through the 100° days of summer and into a fog-bound winter. By December 1964 less than half the earth was in place when floodwaters again raged along the Feather River. The peak run-off was the greatest on record, but the incomplete dam held firm. When the waters receded, workers returned to the job with special satisfaction. They had already seen the value of their efforts.

As the earthmovers labored on, other crews were busy solving special problems. Engineers designed elaborate movable shutters to draw water from the reservoir at various depths to satisfy conflicting temperature needs.

Integrated seismic monitoring devices were specially



A special railroad line (left) was set up to move 120 carloads of dirt every hour. Excavation cars (right) carried mounds of dirt.



developed and then were built right into the huge structure.

Off to one side and 600-feet beneath the surface, drilling contractors carved out a 69-foot by 500-foot cavern within a mass of solid rock to house the electrical generating plant.

The dam was topped out on Oct. 6, 1967, after four incredible years of activity.

When the Edward Hyatt Powerplant became fully operational three years later, it was the largest underground powerplant in the nation, its six generating units boasting a capacity of 655,000 kilowatts.

And after the water was used to power large northern areas of the state, it was diverted into the California Aqueduct for a 444-mile journey to the thirsty south.

Fifteen years later the Oroville Dam is still the highest earth dam in the United States. The Edward Hyatt Powerplant operates with efficiency, and its cavernous underground site is being used as a cosmic ray shield for University of California at Berkeley scientists searching for evidence of the mysterious and theoretical subatomic particle known as the "neutrino."

And the periodic flooding has ended, proving that Donald Thayer and thousands of unsung heroes had tamed the Feather River.

Only seven dams have been registered as national historic engineering landmarks. And the list is surprising. In addition to Oroville, the dams include: Ascutney Mill, Vermont; Buffalo Bill, Wyoming; Cheesman, Colorado; Druid Lake, Maryland; Elephant Butte, New Mexico; and Theodore Roosevelt, Arizona. The only internationally known dam in the group is the Roosevelt. It was the first project of the Bureau of Reclamation. Completed in 1911, it was the nation's first multi-use dam, built for power, irrigation and flood control.

Vermont's Ascutney Mill Dam, built in 1834, is still in service. The granite dam is considered the prototype of today's concrete gravity dams.

The Buffalo Bill Dam, when it was built in 1910, was the first concrete dam to be built higher than it was wide. That has since become an industry standard.

In Colorado, the Cheesman Dam has been the key



Oroville Dam is seen at end of construction in 1967 (above). Dam is 770 feet high. Spillways (far left) have a series of gates to control water flow precisely. Work crews carved out a 69-foot by 500-foot cavern (left) 600 feet below ground to house a generating plant.

structure in the Denver water supply system since its construction in 1905.

The Druid Lake Dam was the first major earth-fill dam built in the United States. Finished in 1871, it is a benchmark for design of earth-filled dams being built today.

The Elephant Butte Dam in Truth or Consequences, N.M., became the first international water project when it was constructed in 1916. It was used to control the flow of water at the Mexican-American border.

The Oroville Dam shares with the others a unique place in American civil engineering history. Built before the Arab oil embargoes in the 1970s, it was designed to save hundreds of lives and millions of dollars in property taken by flooding each decade.

The electric powerplant, however, filled an important gap during the oil embargoes and has since become a major element in California's energy supply network. **PM**

PM TESTS THE TWO-SEATERS

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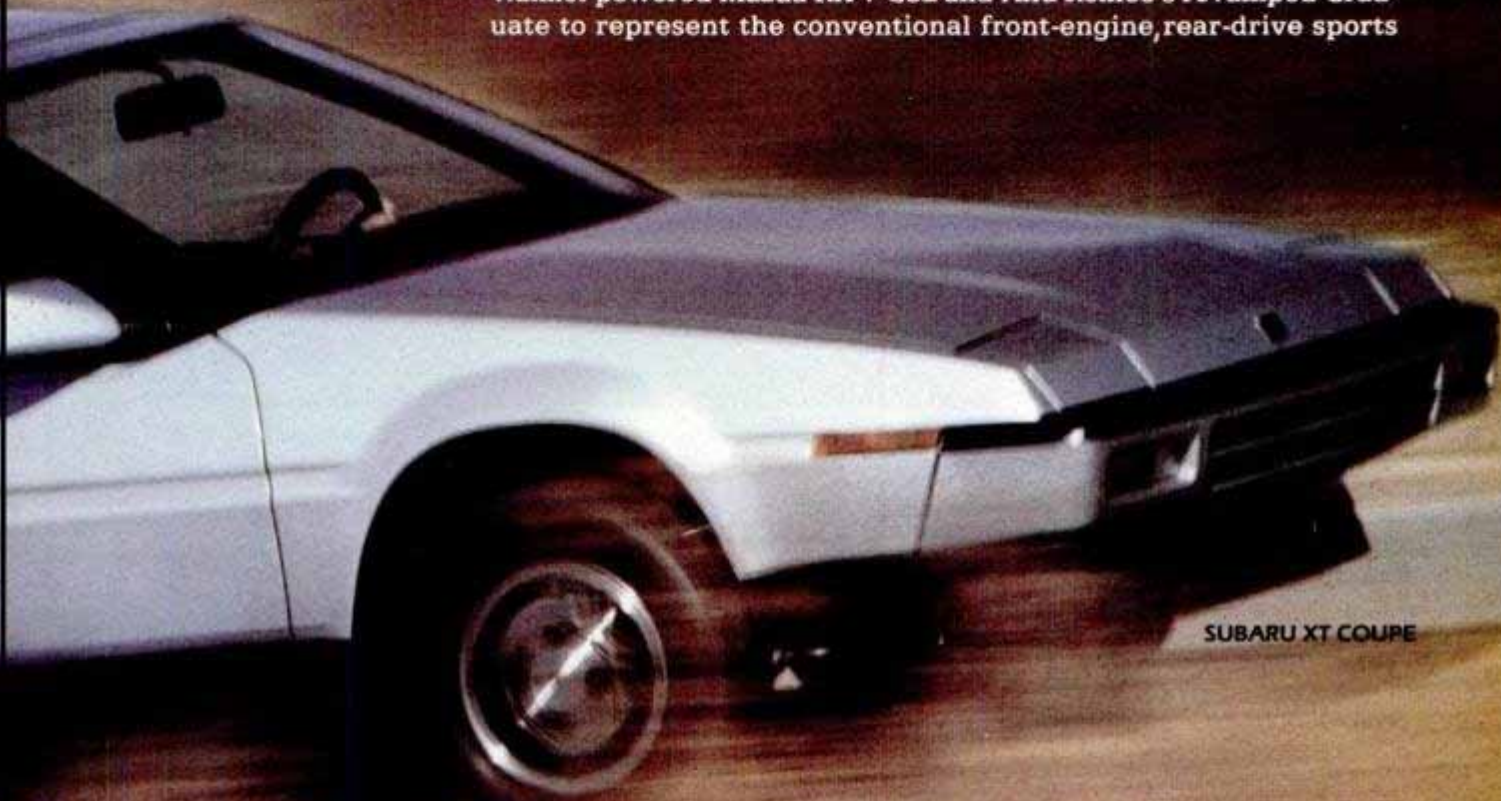
HONDA CRX SI



PONTIAC FIERO GT

Remember those drafty, hard-riding roadsters we used to call sports cars? Well, today's two-seaters outperform them by a long shot. And even laden with nice power equipment, air conditioning and super sound systems, they're more fun to drive than those original two-seaters ever were.

We identified seven two-seaters that you can actually drive away for under \$15,000. This eliminates expensive performance machines like the Corvette, Nissan 300ZX, Lotus Esprit, and the Porsches and Ferraris. In the group we tested at Raceway Park in Englishtown, N.J., two were modern-as-tomorrow, front-wheel-drive Japanese two-seaters—the Honda CRX Si and Subaru XT Coupe. We had a Wankel-powered Mazda RX-7 GSL and Alfa Romeo's revamped Graduate to represent the conventional front-engine, rear-drive sports



SUBARU XT COUPE



BERTONE X1/9



ALFA ROMEO GRADUATE



TOYOTA MR2

PM COMPARISON TEST

car. And we had three variations on the mid-engined sports car theme: the Bertone (formally Fiat) X1/9, Pontiac Fiero GT and Toyota MR2.

Honda Civic CRX Si

We have seen the future, and it sure is cute. Bill Mitchell, the former vice-president of General Motors Styling, used to say, "Styling a small car is like tailoring a dwarf—it's hard to make it look right." He should talk to the designers who work for Honda. The CRX is just 12 feet long, but our testers called it "absolutely adorable," and "puppy dog cute."

For a puppy dog, the CRX has some bite. It will accelerate faster than most big V8s. The secret is the new fuel-injected engine, which gathers revs like a Honda motorcycle. In the extremely lightweight CRX, it provides a power-to-weight ratio that's unbeatable in its class. Each horsepower has only 19.8 pounds to lug around.

Overall, we found the CRX Si a joy. "Easy and fun to drive fast or slow," and, "Like driving a little racing car," raved our testers. In our slalom, skidpad and braking tests, the CRX was near the top, hampered only by tall, narrow and not very sticky 175/70R13 Michelin tires.

Although it didn't win any track tests outright, the CRX had enough second- and third-place finishes that it was able to beat out some faster cars in our test track ranking.

What separates the CRX from the other cars is its practicality. Only the CRX and Subaru have any luggage space to speak of, and only the CRX

"pulls off the illusion of being very large inside, spacious and airy."

In addition, we thought it was "user friendly," with "great instruments, legible and properly placed," and "wonderful ergonomics." Even with a sunroof, there's plenty of headroom and good visibility in all directions. Routine maintenance chores are handled easily under the hood and, like all Honda products, the quality is remarkable at such a low price. The CRX Si we tested cost anywhere from \$2,500 to \$7,000 less than the two-seaters it whupped.

Toyota MR2

Mr. 2 was almost Mister One in this group. Half of our road testers ranked it



Mazda's rotary engine is barely visible under wires and hoses, but service access is okay.

first, and the CRX Si pipped it by just a single point. That's significant, because the mid-engine Toyota is about as different from the front-wheel-drive Honda as two small cars can be.

Mr. 2 has the engine/transaxle from

the front-wheel-drive Corolla set behind the seats and fitted with the double-overhead-cam, four-valve-per-cylinder head from the Corolla GT-S. This gives a power-to-weight ratio of 21:1. The result is excellent fuel economy, plus dazzling acceleration.

Putting the engine behind the seats gives a lower polar moment of inertia by concentrating all the weight within the wheelbase, plus a more equal weight distribution while allowing a lower, more aerodynamic hood. Mr. 2 is marvelously nimble, as shown by its excellent slalom speed, fastest in this group. Its .84g on the skidpad is not only the best in this class, it's the fastest we've ever recorded. Mr. 2 also has



Subaru's new overhead-cam flat-four has excellent service access without a/c or turbo.

excellent braking from four-wheel discs, and good fuel economy.

Every mid-engine car on the market—from X1/9 to Lamborghini Countach—has a cramped cockpit and deficient luggage room, and Mr. 2 is no different. The cockpit is more spacious than the X1/9's, but it's a shoehorn fit for a 6-footer. And there's only half as much luggage room as in the CRX.

Produced by the PM Auto Dept.

Text by Rich Taylor

Lead color photo by Randy Leffingwell

Other photos by Peter Tenzer

TWO-SEATERS—TEST RESULTS

CAR	GAS MILEAGE (EPA city/ PM test)	1/4-MILE (sec. @ mph)	SLALOM ¹ (mph)	SKIDPAD ² (cw/ccw)	BRAKING (ft.) (60-0 mph)	TRUNK ³ CAP. INDEX	INTERIOR ⁴ SPACE INDEX	TEST ⁵ TRACK RATING	ROAD ⁶ TEST RATING	OVER ⁷ - ALL RATING
Alfa Romeo Graduate	21.0/23.4	17.38 @ 78.29	60.74	.80/.79	145	4	53.8	5	6	6
Bertone X1/9	23.0/25.7	18.15 @ 73.05	55.39	.79/.80	146	5*	49.5	7	7	7
Honda Civic CRX Si	28.0/26.8	16.16 @ 83.02	58.88	.80/.83	145	14	59.4	1	1	1
Mazda RX-7 GSL	17.0/16.0	16.83 @ 81.85	55.39	.76/.76	158	7	54.7	6	3	5
Pontiac Fiero GT	20.0/19.7	15.63 @ 87.04	58.01	.83/.82	135	2	64.9	3	5	4
Subaru XT Coupe	26.0/27.1	17.85 @ 76.61	55.77	.69/.72	190	15	59.6	4	4	3
Toyota MR2	26.0/24.3	16.19 @84.58	61.69	.84/.84	145	6	56.6	2	2	2

1. Best speed achieved while weaving through seven cones placed 100 feet apart; the higher the speed, the better the transient handling.

2. G-forces generated during steady-state cornering around a 200-foot-diameter circle; cw = clockwise, ccw = counterclockwise.

3. The number of standard-size grocery bags that will stand upright (1-inch crush space permitted) in the trunk.

4. Front-seat width × headroom × legroom + rear-seat width × headroom × legroom ÷ 1,000.

5. Points are awarded from best (1) to worst (7) in each measured category. The car with the fewest total points ranks first, next lowest second, and so on.

6. Subjective ranking on the road by a team of testers; cars are graded by "feel," independent of test track results.

7. Average of Test Track and Road Test ratings. Ties are decided in favor of Road Test score.

Bold numbers indicate best performance. *Five bags lying down; none standing upright.

Our testers complained about the lack of proper lumbar support in the seats, confusing controls, awkward shifter, and overly busy interior and exterior detailing.

The MR2 is an engineer's car. The "high-winding, perky powerplant runs like a good Japanese motorcycle engine," wrote one tester. "It lives most happily between 5,000 and 7,500 rpm." The gearbox is smooth and precise, the steering light and accurate and the brakes well-modulated.

As one of our testers said: "Mr. 2 feels fast, strong and safe. You find yourself going faster than you think. Driving is easy and effortless. It's a great sports car, at a reasonable price."

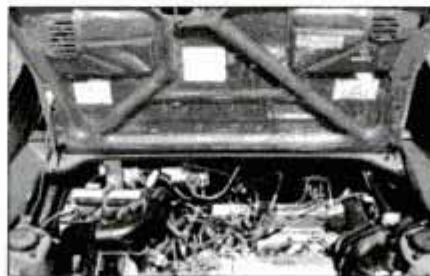


Chevy's 2.8-liter V6 is a tight squeeze in Fiero's engine bay. Note flat intake manifold.

Other testers defended it, because the Subaru was competitive with genuine sports cars like the Alfa, RX-7 and Bertone on the test track. It also returned the best gas mileage, and had by far the largest luggage space and most comfortable passenger compartment.

Subaru's swoopy exterior earned admiring glances from pedestrians and parking lot critics. Where Subaru's designers really need help is the interior. Our test car had a dark brown interior with seven different vinyls and fabrics, none of which matched for color or texture. It was immediately dubbed the "gerbil upholstery" in honor of the horrid two-tone brown seat fabric.

These seats are actually quite com-



Toyota's 16-valve Four sits sideways in the MR2. Access is cramped, but not impossible.

Subaru XT

Subaru's new two-seater engendered more discussion than any car in this group. Most of our testers had a hard time accepting it as a "sports car." They accused it of having clunky handling, weak brakes and a noisy engine described as "agricultural." Some wanted to describe it as a "sporty economy car" rather than a sports car.

portable, and the unusual controls—housed in pods cantilevered from the steering column—are easy to use. Everything is marvelously adjustable, including the steering wheel.

The XT is a brand new model in need of fine tuning. Larger high-performance tires, a stiffer suspension and a tasteful interior would make it a more pleasant driving machine.

Pontiac Fiero GT

The Fiero originally was proposed as a stylish two-seat commuter car, and we'd say that description is entirely accurate. The Alfa and Bertone feel awkward around town, but get them wound up on a winding road and everything comes together in a most delightful way. The Fiero, on the other hand, is at its best pottering along in traffic. As a track tester observed: "The Fiero is easy to drive slow, a difficult handful to drive fast."

Our testers liked the Fiero's styling, calling it "zoomy," "mean" "racy" and "attractive." They also liked the smooth 2.8-liter V6, which powered it to a quick 15.6-second quarter-mile at 87 mph. The Fiero also had the best brakes in this group—four-wheel discs that stopped it straight and sure.

Unfortunately, the Fiero is not fun to drive. The interior is uncomfortable and awkward, the shifter is too high and balky, the clutch is heavy and the engine impossible to see, let alone service. But the biggest disappointment was the handling. On the test track, with an expert behind the wheel, the Fiero can post impressive figures. But it's on the ragged edge of control all the time. An average driver trying to go fast on the street could get himself into big trouble with this car.

Even on a smooth skidpad, there's a curious jacking motion from the modified Chevette front suspension, and the heavy steering isn't quick enough to compensate when the tail starts to come around in hard transient maneuvers. Trailing throttle oversteer is easy to

(Please turn to page 122)

TWO-SEATERS—SPECIFICATIONS AND DIMENSIONS

CAR	VEHICLE* TYPE	BASE** PRICE	PRICE** AS TESTED	ENGINE	TRANS- MISSION	WHEEL- BASE (in.)	LENGTH (in.)	WEIGHT (lb.)
Alfa Romeo Graduate	2-door convertible	\$13,495	\$14,340	115-hp DOHC 2.0-liter inline-4	5-speed manual	88.6	168.8	2,500
Bertone X1/9	2-door targa top	\$9,995	\$10,643	75-hp SOHC 1.5-liter inline-4	5-speed manual	86.7	156.2	2,150
Honda Civic CRX Si	3-door hatchback	\$7,999	\$8,178	91-hp SOHC 1.5-liter inline-4	5-speed manual	86.6	144.6	1,800
Mazda RX-7 GSL	3-door hatchback	\$10,945	\$14,800	101-hp 1.1-liter 2-rotor Wankel	5-speed manual	95.3	169.0	2,400
Pontiac Fiero GT	2-door coupe	\$11,795	\$14,269	140-hp OHV 2.8-liter V6	4-speed manual	93.4	165.8	2,650
Subaru XT Coupe	2-door coupe	\$7,889	\$10,558	82-hp SOHC 1.8-liter flat-4	5-speed manual	97.0	175.0	2,300
Toyota MR2	2-door coupe	\$11,350	\$13,219	112-hp DOHC 1.6-liter inline-4	5-speed manual	91.3	154.5	2,350

*The Honda Civic CRX Si and Subaru XT Coupe are front-engine, front-drive. The Alfa Romeo Graduate and Mazda RX-7 GSL are front-engine, rear-drive. The Bertone X1/9, Pontiac Fiero GT and Toyota MR2 are mid-engine, rear-drive.

**Prices are rounded to the nearest dollar.

Electronics That Makes

Battery-powered health monitors are no substitutes for a doctor—but they may tell you that you need one.

BY WALTER SALM; Photos by Harry Hartman

Given America's intense interest in physical fitness, it's small wonder that there are so many gadgets available for checking on the state of your own health. The fact that so many of these devices are electronic is relatively new, and some of them offer exceptional sophistication and convenience for very low cost.

Best known health-care products are probably the electronic digital bathroom scale, electronic thermometer and the sphygmomanometer or blood-pressure gauge (just call it a BPG). Besides these, you'll find all sorts of devices that meter your pulse—some are even built into wristwatches and stopwatches. There are calculators that measure your caloric intake and computer programs to help you plan your diet. Electronic timers built into pillboxes beep to remind you when your medication is due, while breath analyzers alert you to potentially hazardous alcohol levels in your bloodstream.

These products carry some well-known and not so well-known brand names such as Copal, Delta, Lumiscope, Marshall, Norelco, Omron and Pollinex. You'll find them in a wide variety of retail stores, and in mail-order catalogs as general as Sears' or as specialized as Edmund Scientific's. We'll focus here on the scales, thermometers, BPGs and breath analyzers.

Pounding the circuits

The electronic bathroom scale probably succeeds more because it satisfies our national gadget happiness than for any increased accuracy over mechanical models. Instead of reading your weight off a moving, mechanical dial, you'll get the good or bad news from a large, bright digital readout. Electronic scales won't read your fortune to you, but the best will talk to you and other family members, telling you in a hollow, electronic voice how much you've gained or lost since your last weigh-in.

While the more expensive electronic scales are very accurate, some of the lower priced models use a spring-tension measuring technique that's no more accurate (less in some cases) than the cheapest mechanical models.

In all cases, electronic scales are particularly susceptible to water damage in the bathroom: This writer has had to pour out water and dry the circuit board in his scale more than once to get it working again. Mechanical scales seem to be relatively impervious to the water. If you have a drainage problem, move the

(Please turn to page 120)

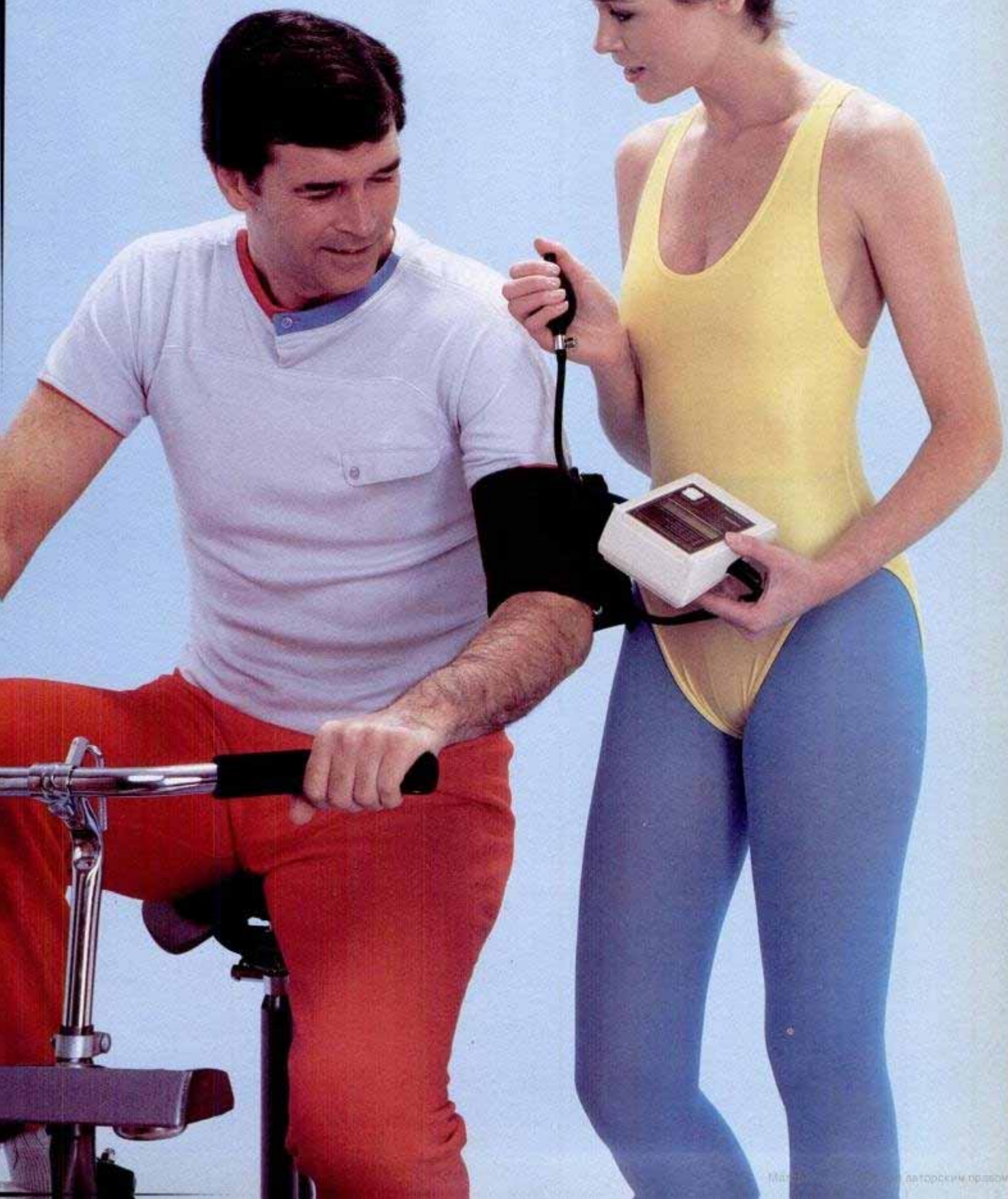
You can check blood pressure and pulse right after exercising. Omron's Homecare Clinic monitor (right) gives instant readout.



Electronic home health products aim to prevent illness. But if emergencies strike, "smart" phones like this Mura Sage-1 (1) will place a prerecorded call for help when you activate the handheld panic button. Lumiscope's blood pressure/pulse meter (2) prints a record of vital functions; Blotron (3) from Delta Labs sets off lights

to indicate blood-alcohol level; and the Weight Talker scale (4), which is available from Edmund Scientific, announces how much you've lost or gained. Wristborne Actimeter (5) by Copal meters your pulse as you exercise; and Marshall's Care-All 8 thermometer (6) has easy-to-read digital display

House Calls



14 HOT, NEW

SPORTS PLANES

YOU CAN BUILD

From \$100,000 to less than \$5,000, here are the latest fun-to-fly machines you can make from plans and kits.

BY SHELDON M. GALLAGER
Photos by Howard Levy

It may come as a shock to learn that you can spend as much as \$100,000 on a homebuilt sports plane. But you can also spend as little as \$5,000. This will give you an idea of how wide a choice you have.

It's somewhat ironic, though perhaps not surprising, that the homebuilt movement, historically dedicated to no-frills, low-cost flying, has recently begun to spawn some supersophisticated, Mercedes-class entries with fancy manners and price tags to match.

Take the Swearingen SX300, an awesome 300-hp, 300-mph two-seat speedster that represents the ultimate in flashy performance and showy panache. Of classic all-metal construction and loaded with luxuries, the SX300 starts at \$37,500 for a basic airframe kit without engine, prop, instruments, avionics or interior appointments. Depending on your choice of engine and extras, you can expect to spend from \$60,000 to \$100,000 before you have a finished airplane ready to fly.

Too expensive for a homebuilt? Not on your life. As of press time, more than 50 kits had already been ordered with every indication that the total could climb into the hundreds.

Another sign of the upscale trend in homebuilts is the emergence of plush, roomy four-place models, a rarity among what have traditionally been small, spartan one- and two-seaters. Of the 14 new homebuilts shown here, three are four-seaters—the Defiant,



Originally designed for unlimited-class aerobatic competition, this Super Acro Zenith is now sold as a kit for anyone looking for the fun and thrills of a hot stunt plane. The 200-hp single-seater can hit 250 mph, climbs at 3,000 feet per minute and is stressed for plus or minus 8 g's. Kit price is about \$14,000, less engine.



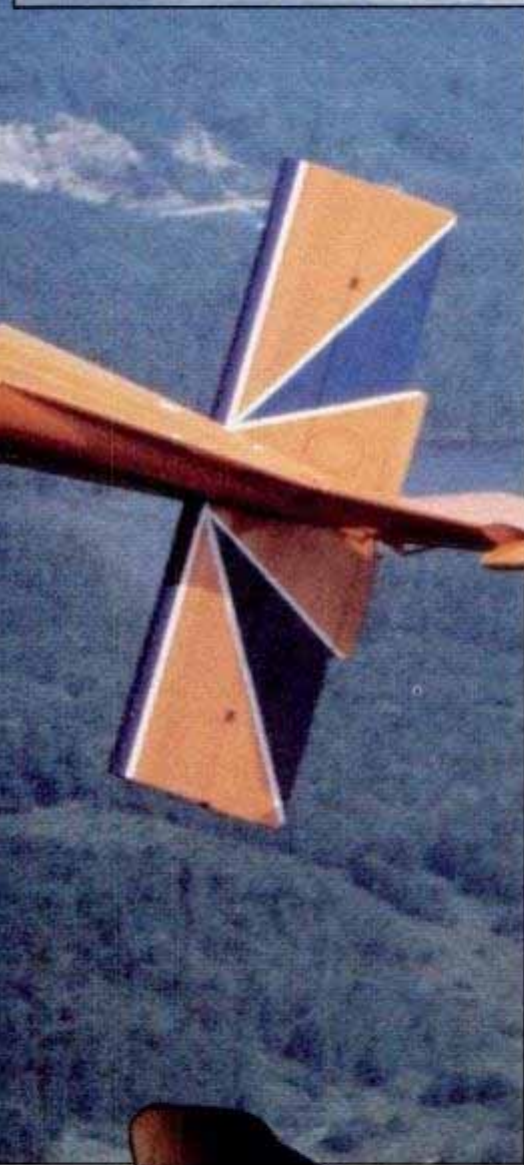
Unusual tail-mounted engine on this striking four-place Seawind amphibian reduces cabin noise and vibration. Kit of preformed parts is \$16,000, less engine.



Sporty little two-seat Polliwagen tops 200 mph, can be built from plans alone or prefabbed parts.



Twin in-line, push-pull engines and forward-mounted canard make this four-place Defiant one of the safest planes to fly.



It's not cheap, but what a blast! Sleek and speedy, this 300-mph, two-seat SX300 is \$37,500 as kit, less engine.



Twin-tailed, canard-winged Sun Ray amphibian comes in one- and two-seat models for under \$10,000. Two-place Kitfox (inset, above right) sells with engine for \$8,200. Panther Plus (left) is a more powerful version of Rotec's Panther ultralight. Single-seater is \$6,800; two-seater, \$7,600.

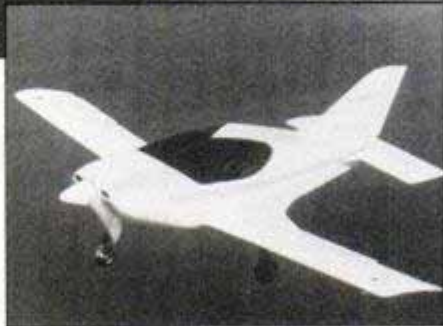


Futuristic Prescott Pusher, shown as mockup above, is 180-hp, retract-gear, metal-and-composite four-seater capable of cruising at nearly 200 mph. Rear-engine layout permits slim bullet nose with superb visibility, low cabin noise. Kit is \$15,350, less engine.

Seawind amphibian and Prescott Pusher. The Defiant, an exotic canard-winged, twin-engined craft with one engine in the nose and the other in the tail, is a build-it-yourself version of the commercial Defiant designed several years ago by famed aviation innovator Burt Rutan. Because the engines are in line with each other, a sudden loss of power in either one does not result in the violent off-center thrust that can endanger a conventional twin with its engines out on the wings.

If the Defiant loses an engine, it cruises merrily along unfazed, making it one of the safest homebuilts ever designed. Of all-composite construction, the 300-hp, 215-mph craft can be built from plans for \$20,000 to \$30,000, depending on engine choice.

The Seawind and Prescott Pusher are both single-engine four-seaters of strik-



ingly futuristic design. Both are of composite construction and have their engines in the rear, an arrangement that reduces cabin noise, improves forward visibility and puts the wings in clear, undisturbed air for better lift, less drag and a smoother ride.

The 200-hp, 175-mph Seawind amphibian and the 180-hp, 200-mph, retract-gear Prescott Pusher are both kit-priced at about \$16,000, less engine and instruments. You can't do much better than this when you consider that factory-built four-seaters start at \$50,000 to \$60,000 and go on up.

In any case, you don't have to have a rich uncle to own and fly a homebuilt. One of the most economical, both to



Low cost is a key feature of this trim little tandem-seat V-8 Special (above). Powered by a 125-hp converted auto engine, it does 195 mph, has retract gear, can be built from plans [\$125] for less than \$5,000 complete. At left is sleekly styled Aero Mirage TC-2, an all-composite, retract-gear two-seater with folding wings. It can do 208 mph, will sell as kit for about \$9,000, less engine.

build and operate, is the V-8 Special, a 125-hp, 195-mph tandem two-seater that's designed around a converted eight-cylinder auto engine to beat the high cost of aircraft powerplants. Combining wood, metal and composite construction, it can be built from plans for less than \$5,000, including converted engine. The plans are \$125.

For a little more, there are the Silhouette, Kitfox, Panther Plus, Zenair Zodiac and Sun Ray amphibian—all kit-priced at under \$10,000, complete with engines and all necessary parts. The Kitfox and Zodiac are both dual-control, side-by-side two-seaters, ideal for beginning pilots. The Sun Ray and Panther Plus are available in either one- or two-seat models, while the Silhouette is a single-seater.

All have small engines ranging from [\(Please turn to page 131\)](#)



Easy to build and fly, two-place, dual-control Zenair Zodiac (above) is designed for beginning pilots. Plans are \$150. Kit with 65-hp engine is \$9,000. Below is racy-looking Miller GEM-260, a 100-hp, 270-mph two-seater. Kit, less engine, is under \$20,000.



With the graceful looks of a glider, this single-seat, all-composite Silhouette is designed around a long, slim sailplane-type airfoil, giving it a glide ratio of 20 to 1 for leisurely power-off soaring.

A small 45-hp engine burns less than two gallons of fuel an hour, yet gives the lightweight craft brisk speeds up to 140 mph. A kit of premolded parts, available in either tri-gear or taildragger configuration, is under \$9,000.



CARS YOU CAN'T GET HERE:

JAPANESE MICRO-MINI CARS

Having a good time in a small space is a grand old Japanese tradition.

Japan is a relatively small, definitely overcrowded nation, with half the population of the United States compacted into less area than the state of California. As a result, over the centuries the Japanese have learned how to live and play in a minimum amount of space. One example is the K-Class of cars, (the K stands for *karui*, which means "light" in Japanese). These tiny autos carry four passengers with an engine that's no bigger than 550 cc. Their length is limited to 10½ feet—a foot and a half less than the truncated Honda CRX. Maximum weight is just over 1,200 pounds.

Within these strict confines, Japanese engineers have offered a wild variety of cars and vans—two- and three-cylinder shoeboxes with



BY TERRIL JONES



Daihatsu Delta van (top of page) comes equipped with swiveling bucket seats, dual sunroofs and electrically-controlled window curtains. The Honda City Turbo II (above) is a 110-hp pocket rocket only 11 feet long featuring "Bodysonic" bucket seats that vibrate in tune with the stereo system. The three-cylinder Daihatsu Charade (left) has 80 hp and delivers over 70 mpg on the highway. Turbodiesel model is capable of 84 mpg.



Suzuki Alto two-door hatchback with swiveling driver's seat makes entry and exit easier. Three-cylinder gets up to 85 mpg.



Subaru Domingo four-wheel-drive van is little over 11 feet long, yet seats seven. It has "California mirrors," just like big trucks.

turbochargers, four-wheel drive and all manner of mechanical novelty. The K-Class is very popular because it offers a substantial break on Japan's hefty auto taxes, plus fuel economy of up to 85 mpg.

Cute as they are, the K-cars are just too tiny to make it in the States. When Malcolm Bricklin imported the egg-shaped Subaru 360 back in 1968 he couldn't sell them, and some wound up as bumper cars on New Jersey go-kart tracks! K-cars have come a long way since then. Here are some of the more interesting ones, plus a few noteworthy bigger brothers. Some of the K-Class cars are from manufacturers that you may not have heard of.

Daihatsu

The Mira two-doors, which look suspiciously similar to the Mitsubishi Minica four-doors, have 547-cc, two-cylinder engines and five-speed transmissions. The four-wheel-drive version has a normally-aspirated 30-hp engine, while the front-drive Turbo sports 41 hp. The whole thing is only 10.6 feet long, and the Mira gets 59 to 66 mpg.

The Charade Turbo is a nice-looking hatchback that falls outside the K-Class and is sold in Europe, but not the United States. Its 1-liter, three-cylinder, 80-hp engine delivers 45 mpg in city driving and 71 mpg on the highway. A model with sportier trim is called the

Big sampans for big business

Japan exports only its wide range of mid-size cars. In addition to withholding the micro-mini K-cars from the American market, it doesn't export its biggest rear-drive V8s, either. These are Japan's Lincolns and Cadillacs. They are used almost exclusively as limousines for high-rolling executives and government officials. Although they look frumpy and old-fashioned, they incorporate some high-tech features.

Nissan's top-of-the-line luxury limo is appropriately named the President. Measuring 17½ feet long and 5 feet tall, it's powered by a 200-hp, 4.4-liter V8 that delivers a very American 13 mpg in the city and 24 mpg on the highway. Automatic transmission, a/c with climate control, power steering, windows and brakes are standard. Optional equipment includes automatic door locks, eight-speaker sound systems, an air purifier, reading lamps, heated seats and TV console. Even the



Nissan President is powered by a 200-hp, 4.4-liter V8 that delivers 13 mpg in city driving.

lowest priced model is prewired for a telephone, which pretty much tells you who buys these cars. All the goodies go into the back seats—it's assumed that there will be a chauffeur.

Toyota's high-zoot limo is the Century. A more compact 16.8 feet long and 4½ feet tall, it gets 15.4 mpg in city driving. It's powered by a 190-hp, four-liter V8. The "rear lounge power seats" not only recline individually, but have built-in massagers! Unlike the "Magic Fingers" motel units, you don't have to feed quarters to Toyota's magic seats. A hatch in the front

passenger seatback can be opened up so that the big shot in back can stretch out his legs comfortably, using the front seat as a handy Ottoman.

The chauffeur is not completely ignored. He has a high-tech Communications Center that features 12 warning lights and the first large-scale use of fiber optics in any automobile. The optical strands relay information from more than 60 points to five microcomputers. The Super Monitoring Display on the dash spells out messages in ABC's, oddly enough, not in Japanese characters.—T.J.



Toyota Century limo has a 190-hp V8 and rear-wheel drive. Interior includes rear seats with a built-in massage function. Although right-hand-drive dashboard looks like a '60s Chevy, it masks an ultramodern, fiber-optic electrical system.



Subaru Rex Combi features four-wheel drive and a two-cylinder engine good for 65 mpg. Normal engine has 31 hp, turbo 41 hp.

DeTomaso, after the busy Italian auto magnate who owns Maserati, Moto Guzzi motorcycles and Innocenti—front-drive minicars that use Daihatsu three-cylinder engines. There's also a turbodiesel model, said to be the world's smallest, and that car gets a phenomenal 84 mpg.

The Delta Wagon is not a station wagon at all, but the name the Japanese use for people-mover vans. All Japanese vans seem to look alike, except for their size. The Daihatsu is a dead ringer for the Toyota, which looks an awful lot like the Suzuki. The Delta has such neat options as swiveling bucket seats front and center, a five-speaker stereo, a sunroof for the passengers, "moon roof" for the driver, and electronically controlled window curtains.

Honda

The City Turbo II is another tiny car that's just a little bigger than K-Class and is sold in Europe, but not America. This 110-hp screamer with its "Combax Turbo" engine is just over 11 feet long, and is as unconventional on the inside as it is outside. The interior is studded with 15 storage pockets (Honda calls it a "Pocketterior"), including a compartment that will keep four soft drink cans cold when the air conditioner is on, another specially made to hold a driver's license, and others for cassette tapes. "Body-

Mitsubishi Minica looks a lot like a four-door version of the Daihatsu Mira. Its two-cylinder engine has 29 hp in normal trim, 42 hp turbocharged.



Suzuki Jimmy SJ is a miniature Jeep only 10 1/2 feet long. Its three-cylinder, 539-cc engine belts out a rompin', stompin' 28 hp.



Daihatsu Mira hatch has a two-cylinder engine and four-wheel drive with 30 hp. Turbo model with 41 hp has front-drive only.

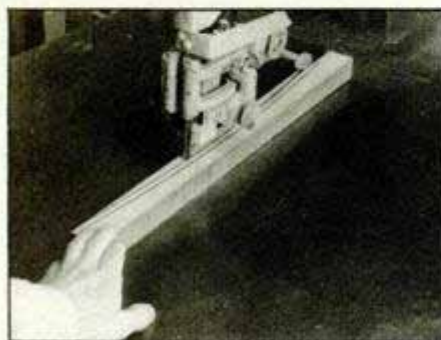
sonic" bucket seats are imbedded with transducers that let you literally feel the music. The Honda City rates a 10 on the urban entertainment scale.

Mitsubishi

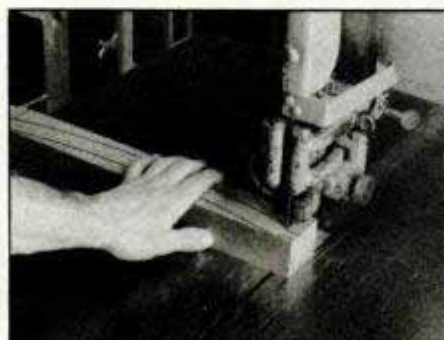
The Minica four-door hatchback is available in about nine different models, all with variations of the same 546-cc, two-cylinder engine. The low-line version wheezes out 29 hp, but the turbocharged, intercooled

(Please turn to page 117)

Build PM's Mahogany Deck Furniture



Using the drawing as a guide, carefully cut the profile of all curved parts on the band saw. Be sure to cut on waste side of line.



Before cutting curved shape for lower rail on seat back, cut tenon on each end. Use a band saw, then trim to fit with sharp chisel.



Sand all curved surfaces smooth with a drum sander chucked in a drill press. Clamp an oversized table in place to support work.

These folding chairs and table are reproductions of those used on the world's great ocean liners.

BY NEAL BARRETT

The great days of the luxury transatlantic ocean liners may have passed, but the memories of those vessels are still very much with us. If nothing else, their voyages represented a time when elegance and style still held their own against speed and efficiency.

In the minds of many, one image stands apart from others, that of relaxing in a deck chair and watching the sea pass by. Because of this we decided to duplicate the chairs—and a small companion table—and give plans for building them.

The pieces shown here are not only sturdy and stylish, but also exceedingly practical. They are comfortable, lightweight for their size, and each folds compactly so it can be stowed away when heavy weather sweeps over your back yard or deck.

Keep in mind that the very nature of these projects requires careful planning, layout, cutting and sanding because there are so many curved parts that require mortise-and-tenon joinery.

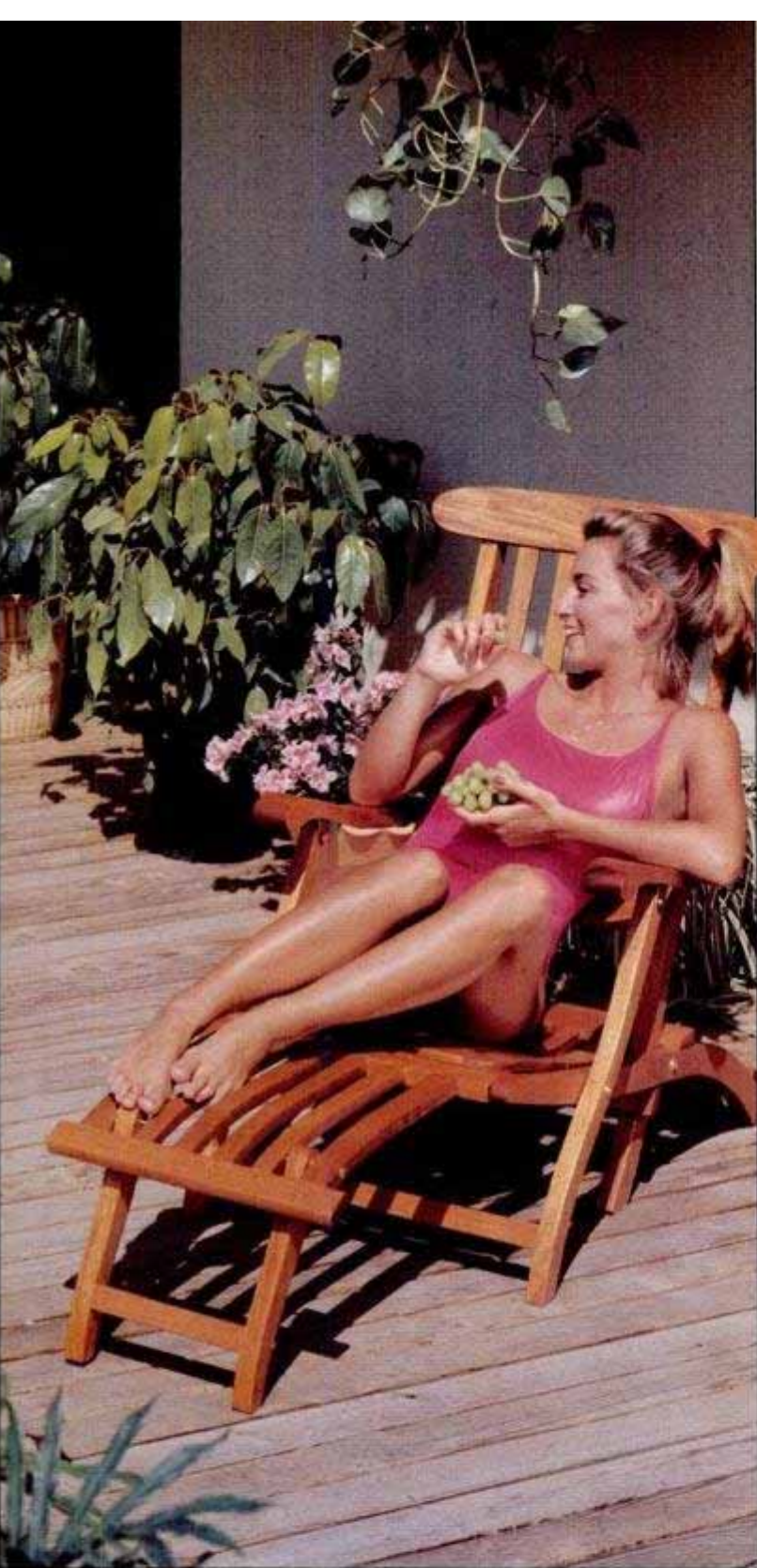
But, if you study the drawing carefully and reproduce the patterns accurately, these pieces will go together smoothly. Your reward will be furniture that is both graceful and useful, and that will clearly demonstrate your command of fine wood joinery.

Cutting the chair stock

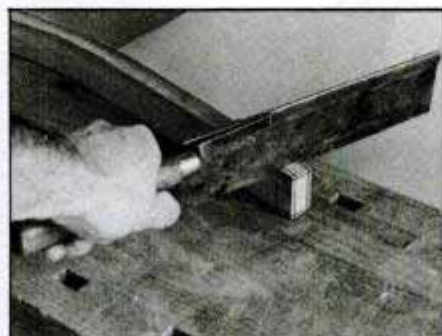
Begin by cutting the stock to rough size for all the contoured pieces. To facilitate making identical curved parts, it is recommended that a cardboard template be made for each part and that each piece be traced directly from the template. Use the band saw to cut out the profiles of rear legs (seat-support sides), seat-back sides, footrest legs, arm posts and armrests. Be sure to cut on the waste side of the line. Use a sanding drum in the drill press to remove the saw marks and to refine the profile of each piece. Compare like items frequently to make sure they are identical.

Color photo: Skip Gandy Photo stylist: Gabe Herrick
Black and white photos: Neal Barrett Technical art: Eugene Thompson

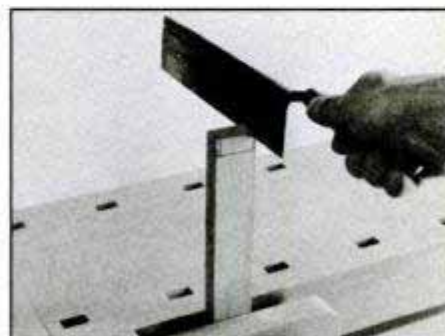
Made of solid mahogany and joined with brass hardware, these furniture pieces can fold compactly for easy carrying and storage.



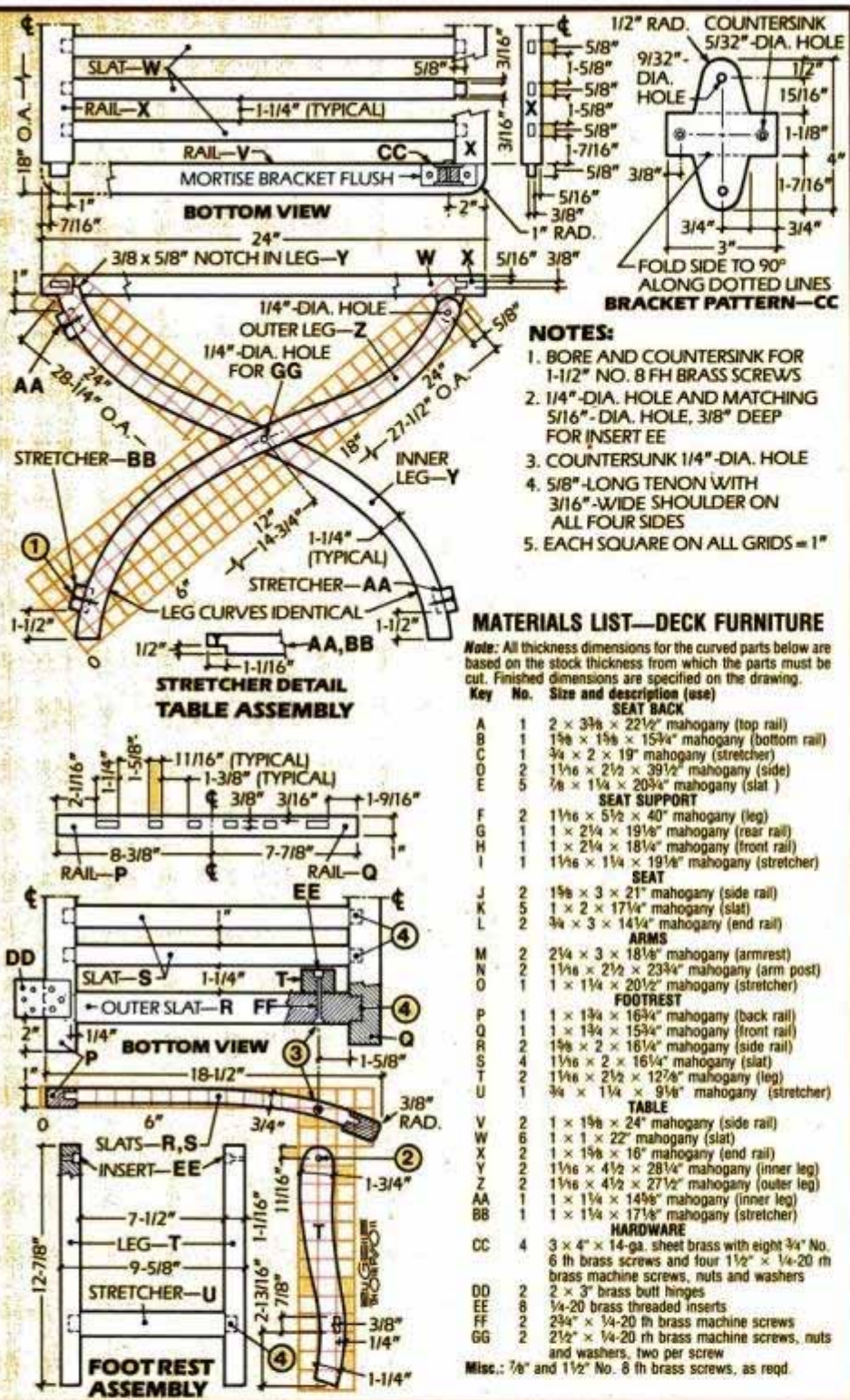
Use a mortise marking gauge to lay out mortises and tenons. Be sure to hold gauge square to surface of piece while marking.



For accuracy, cut all slat tenons with a dovetail or backsaw. Use the drawing as a guide for proper depth of shoulder cuts.



Make the cheek cuts on each tenon with a dovetail or backsaw. When the waste is removed, smooth tenon with sharp chisel.



Chair folds to depth of 7 in. for easy transport.

Next, use a mortise marking gauge to lay out each tenon for the footrest slats, seat slats and back slats. Using a dovetail or backsaw, first make the shoulder cuts for each tenon. Then, clamp the workpiece in a bench vise to make the cheek cuts. Be sure to cut just on the waste side of your

layout marks, then use a sharp chisel to pare the tenons to finished dimension. The only exception to this method involves the tenons on the seat-back bottom rail. These should be cut before cutting the curved profile on the rail because both tenons are square to the sides, not angled. Use the band saw to make the necessary shoulder and cheek cuts, always staying on the waste side of the line. Again, use a sharp chisel to trim the tenons to finished dimension.

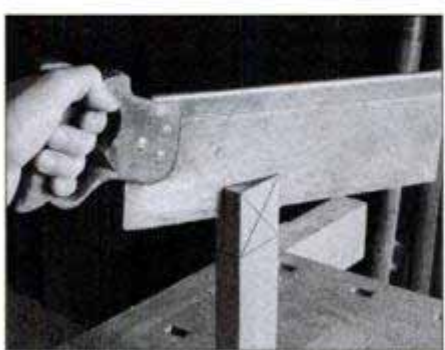
Next, use the table saw to rip and crosscut all straight parts to size. With dado blades in the table saw, cut the tenons on seat rails, front seat-support rail and stretchers as required. Also using the dado blades, cut the rabbets in the rear leg stretcher.

Carefully lay out all mortises using a marking gauge. Then, bore overlapping 3/8-in.-dia. holes to the required depth to remove most of the waste from each mortise. Once the holes are bored, use a sharp chisel to square the corners and side walls.

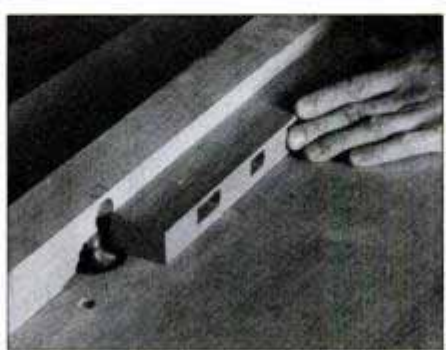
Test each mortise-and-tenon joint for proper fit and adjust as necessary. The fit should be snug but should not require great force to bring the joint tight.

Lay out the notches in both the rear seat-support stretcher and at the top of each seat-back side. Use a backsaw to make the cuts. With a 3/8-in. rounding-over bit in the router, ease the leading edges of the footrest rails and front

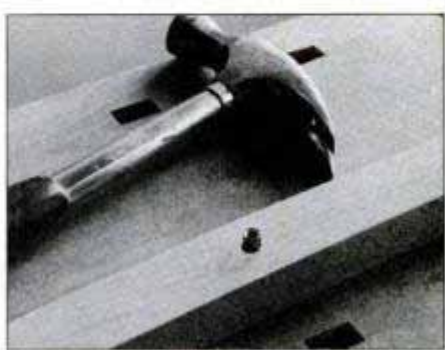
(Please turn to page 115)



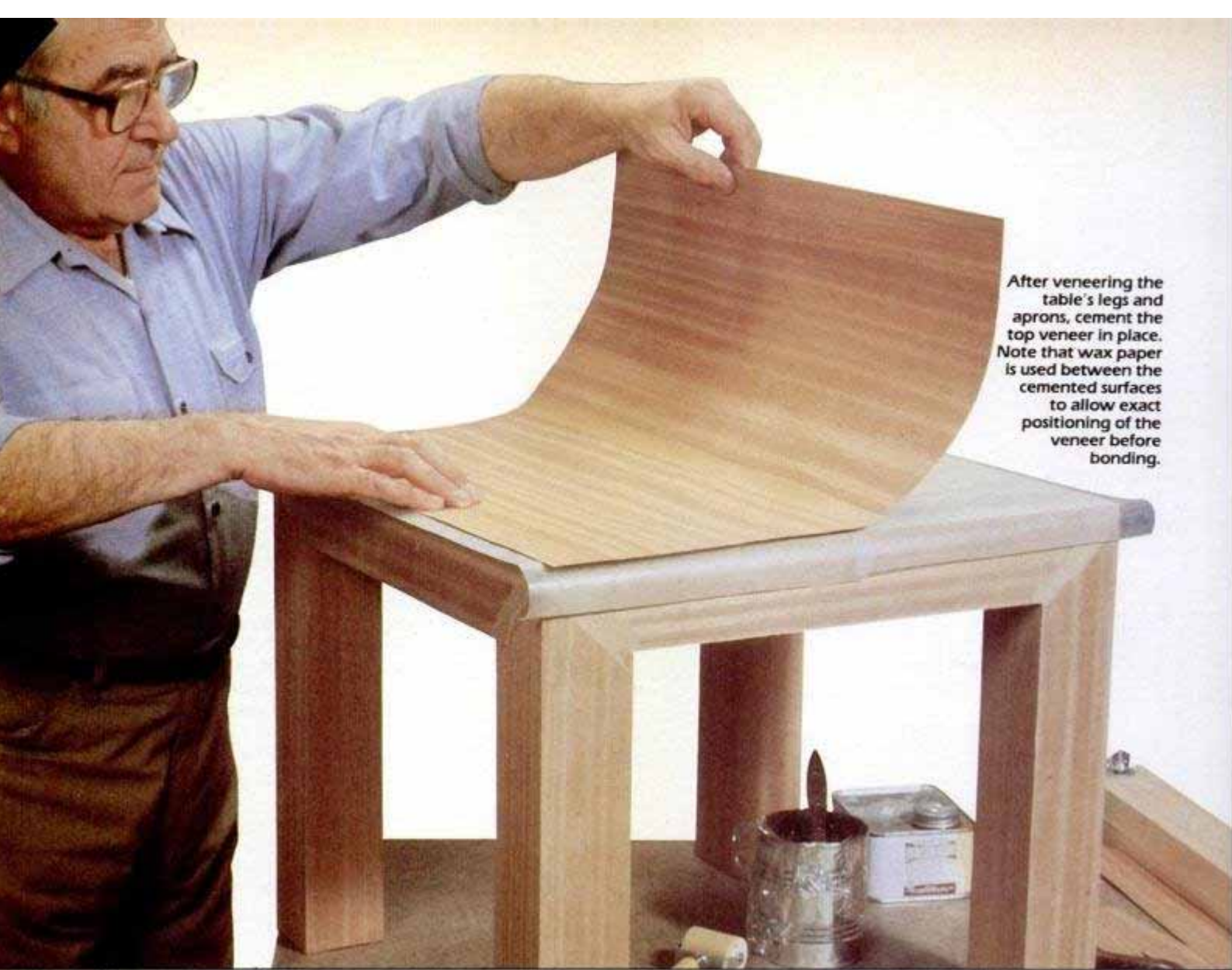
Cut bevelled notch at both ends of rear seat support using a dovetail or backsaw. Remove waste and smooth with sharp chisel.



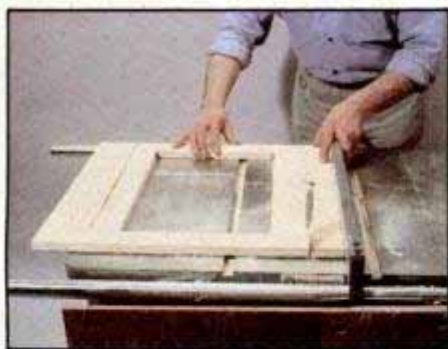
Use a router table—or handheld router—and a 3/8-in.-dia. rounding-over bit to ease rail edges on leg rest and front support.



Join chair parts with screws and threaded inserts. To install the inserts, bore a 3/16-in.-dia. hole, then tap in place with a hammer.



After veneering the table's legs and aprons, cement the top veneer in place. Note that wax paper is used between the cemented surfaces to allow exact positioning of the veneer before bonding.



1 Cut the one-piece leg/apron parts from a nested layout which minimizes lumber waste. See cutting diagram on page 98.



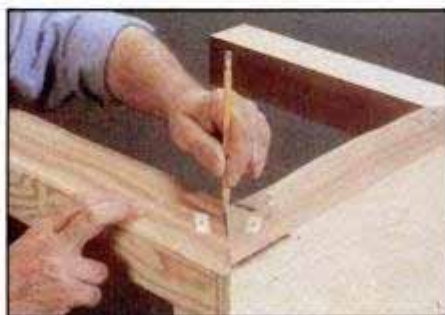
2 First, nail together the inside corner leg strips. Then, nail the L-shaped corner assemblies to the plywood leg/apron parts.



3 Fill all the voids in the plywood's edge with wood putty. After the putty dries, sand it flush with the wood surface.



7 Clamp a backup board to the leg to permit trimming the veneer. Cut the veneer using a sharp utility knife or a veneer saw.



8 Miter-cut the apron veneer to size and pin it down. Slip the leg veneer under the apron veneer and mark the line of cut.



9 Cut the leg veneer's mitered end using a veneer saw and straightedge. A backup scrap board protects the workbench.

WOOD VENEERING

WORKING WITH NATURE'S LAMINATE

Discover the latest wood veneering methods and materials. Then, build our mahogany-veneered Parsons table from the plans included.

TEXT AND PHOTOS BY ROSARIO CAPOTOSTO

The fine art of wood veneering is a simple, inexpensive way to use beautiful, exotic and rare woods in your woodworking projects.

In fact, most of the world's most precious and rare woods are available only in veneer form.

Wood veneer is generally sliced 1/28 in. thick, although it's available in 1/16-, 1/40- and 1/64-in. thicknesses, too. Veneering requires no special skills or expensive equipment and only a few basic hand tools are needed.

Veneered Parsons table

This simple, attractive table is an excellent first-time veneering project for the novice woodworker. The table is constructed of 3/4-in. fir plywood and then veneered. We selected striped mahogany veneer, but you could choose from any of the over 100 veneers available today.

The table is dimensioned for use as a small cocktail or



Easy-to-build mahogany-veneered Parsons table is a good project for the beginner.

occasional table. However, you could alter the dimensions easily to make a large square coffee table, a tall rectangular writing desk or a dining table.

Start by cutting the fir plywood table parts to size as given in the materials list. Note that all the plywood parts are cut from a 23 1/2 x 66 3/4-in. plywood panel as shown in the cutting diagram. First, crosscut the panel to obtain two 22 3/4 x 23 1/2-in. pieces. Cut the remainder of the panel 21 x 21 in. for the tabletop (part A in the materials list). Next, cut out the center of the 22 3/4 x 23 1/2-in. panels. Saw the inside leg parts (D,E) from the center cutouts. Then, cut the one-piece leg/apron members (B,C) from the panels.

Assemble the table with glue and 4d finishing nails. First, nail together parts D and E to form the L-shaped inside leg corners. Next, nail a pair of inside leg corners to each of the leg/apron members, parts B. Then, attach the remaining



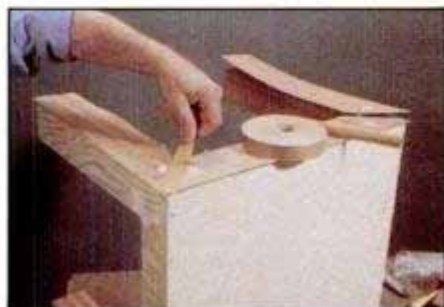
4 Use a veneer saw and straightedge to cut the inside leg veneer. Cut the strips slightly wider and longer than needed.



5 Apply glue to the veneer strips and to the inside leg surfaces with a brush. Tape down the strips to prevent curling.



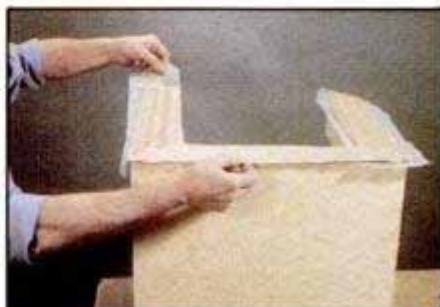
6 Use wax paper to separate the glued surfaces to allow positioning veneer. Then, remove paper and press veneer down.



10 Use push pins to hold the apron and leg veneer strips in place. Tape miter joints closed with gummed veneer tape.



11 Apply veneer glue to the leg/apron veneer assembly. The parts are taped together to ensure tight-fitting miter joints.



12 Place taped-together veneer assembly on table separated by wax paper, which prevents bonding before final positioning.

WOOD VENEERING

wider leg/apron members, parts C. Finally, nail the top (A) to the assembled table. Now set all nails and fill the holes with wood putty. Also, fill any voids in the plywood's edge to provide a solid foundation for the veneer. After the putty dries, hand-sand it flush with the wood's surface. The table is now ready for veneering.

Start by cutting the veneer (I) for the inside leg surfaces using a veneer saw and a steel rule straightedge. Note that veneer is always cut slightly oversized to permit exact positioning and finish-trimming. Next, apply veneer glue or

contact cement to the veneer and to the inside leg surface with a 2½-in.-wide brush or a short-nap paint roller. Allow the glue to dry, then apply a second, light glue coat to both surfaces to ensure 100 percent coverage. Wait for the second coat to dry. Now, cover the leg's glued surface with a strip of wax paper. The paper prevents the glued surfaces from bonding and allows you to shift the veneer into position. Place the paper so that ½ in. of the glued surface at the top

All veneer and tools supplied by Constantine's, 2050 Eastchester Rd., Bronx, N.Y. 10461. Technical art by Don Mannes.

of the leg is exposed. Butt one end of the veneer against the apron, centered over the leg, and press down along the exposed area. Before removing the wax paper, be certain that the veneer overlaps the leg's sides and bottom edge. Finally, remove the wax paper and press down the veneer firmly with a 2-in.-wide veneer roller to ensure total contact. Now, trim the overhanging veneer flush to the leg using a sharp utility knife. Clamp a backup board to the leg, as shown, to support the veneer. Repeat the veneering procedure for the remaining inside leg surfaces.



13 Use this easy-to-make jointing jig to plane the abutting edges of the two tabletop veneer strips simultaneously.



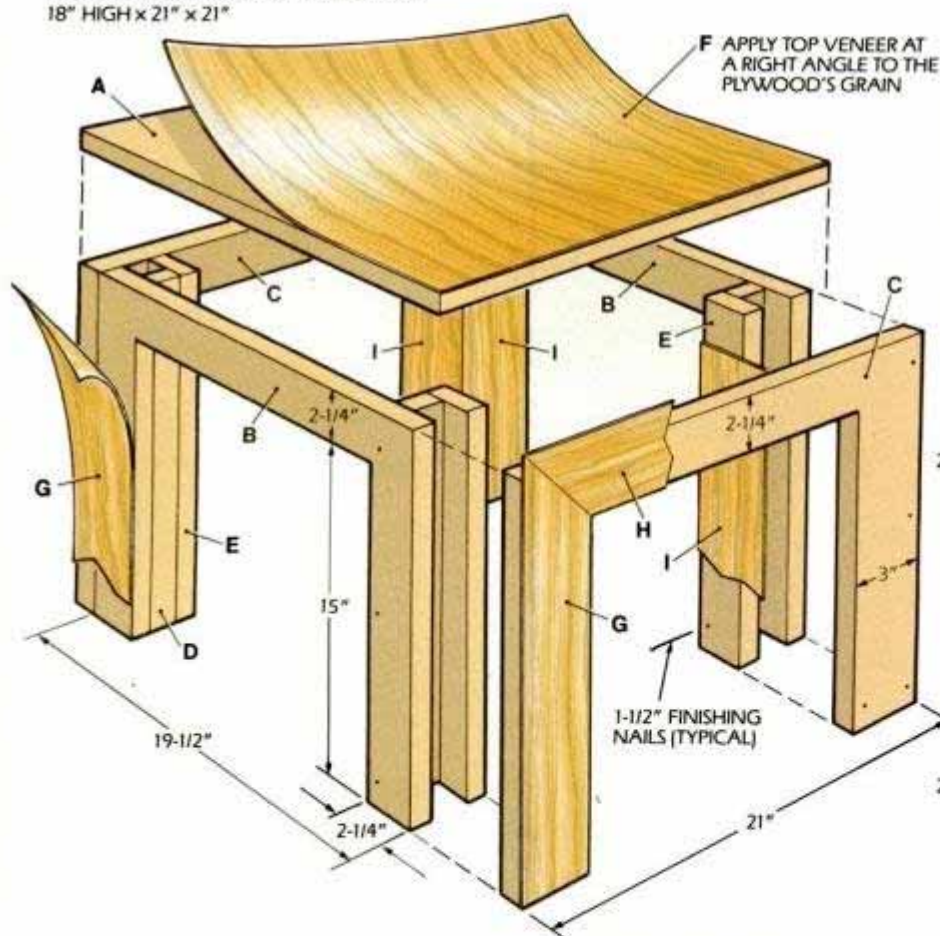
14 Book-matched veneers are taped together to form the tabletop veneer. Apply veneer glue with a short-nap paint roller.



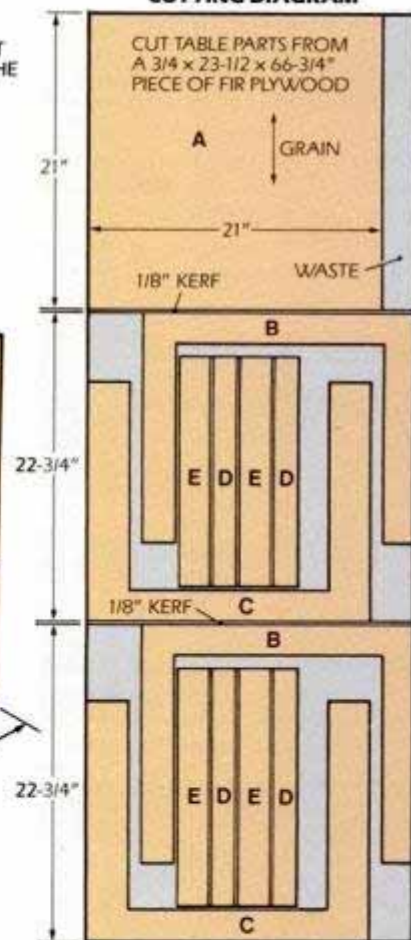
15 Remove the veneer tape from the tabletop by first moistening it with water and then scraping with a cabinet scraper.

VENEERED PARSONS TABLE

18" HIGH x 21" x 21"



CUTTING DIAGRAM



MATERIALS LIST—PARSONS TABLE

Key	No.	Size and description (use)
A	1	¾ × 21 × 21" fir plywood (top)
B	2	¾ × 17¼ × 19½" fir plywood (leg/apron)
C	2	¾ × 17¼ × 21" fir plywood (leg/apron)
D	4	¾ × 1½ × 17¼" fir plywood

E	4	¾ × 2¼ × 17¼" fir plywood (inside leg part)
F	1	22 × 22" mahogany veneer (top veneer)
G	8	4 × 19" mahogany veneer (leg veneer)
H	4	4 × 22" mahogany veneer

I	8	4 × 15½" mahogany veneer (inside leg veneer)
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Misc: Carpenter's glue, 1½" finishing nails, veneer glue, gummied veneer tape, clear varnish. *Form top veneer by edge-joining two 11-in.-wide × 22-in. pieces of veneer.

Next, cut the mitered veneer pieces (G,H) for the outside leg surfaces and the aprons. Although the veneers are cut individually, they're taped together and applied as a single unit. First, cut the apron veneer (H) to length mitering both ends with a veneer saw. Pin the apron veneer to the table using push pins. Then, slip a leg veneer piece (G) under each mitered end of the apron veneer. Pin the leg veneers in place and mark the line of cut with a pencil, as shown. Miter-cut the leg veneers using a veneer saw.

Now, pin the leg veneers to the table and tape the three veneers together with gummed veneer tape. Unpin the three-piece assembly and lift it carefully from the table for gluing. Apply and trim the veneer as described above. Again, you should use wax paper between the glued surfaces to permit positioning the veneer exactly. Be certain that you align the miter joints perfectly with the leg and apron's inside and outside corners. Repeat this cutting, fitting, taping and veneering procedure for the three remaining table sides.

We veneered the tabletop by edge-joining two pieces of 11-in.-wide \times 22-in. veneer (F). But as a timesaving alternative, you could use flexible paper-backed veneers which are commonly available in 24- and 36-in.-wide sheets. Adhesive-backed peel-and-stick veneers and iron-on veneers are also available in 24-in.-wide sheets.

To ensure a tight-fitting, inconspicuous joint, plane the abutting veneer edges straight with a simple jointing jig, as shown. Make the jig from two straight hardwood boards and two machine bolts with wing nuts. Clamp both veneer pieces in the jig and trim the edges simultaneously with a block plane. Next, tape the veneer pieces together to form a 22 \times 22-in. sheet. Then, apply the veneer to the tabletop and trim the edges.

Now, remove the veneer tape from both the tabletop and the mitered leg/apron joints using a cabinet scraper. First, moisten the tape *lightly* with a water-dampened sponge. Then, scrape the tape from the veneer while holding the cabinet scraper at about a 75° angle, as shown. Next, finish-sand the table with an orbital sander starting with 120-grit abrasive paper and progressing to 180 and, finally, 220-grit. Round over the sharp corners with a sanding block to deter splintering.

Allow the veneer glue to cure fully, about 48 hours, before applying a finish. We applied three coats of a clear satin finish to accentuate the mahogany veneer's rich color and grain pattern.

It's done with mirrors

Use two mirrors hinged together with tape to help visualize a completed [\(Please turn to page 124\)](#)

GETTING STARTED



Veneering tools (clockwise from lower right): saw, knife, veneer roller, brush, paint roller, glue, thinner, veneer tape, pins, combination square and straightedge rule.



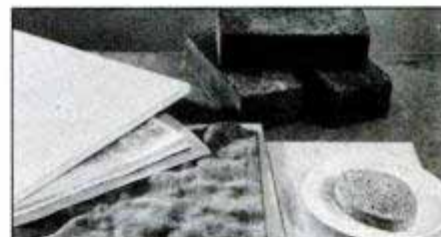
A box of 50 assorted veneer samples provides an easy way to identify and select veneers for your woodworking projects.



Apply iron-on veneer with a hot clothes iron. Place a sheet of paper between the iron and the veneer to prevent scorching.

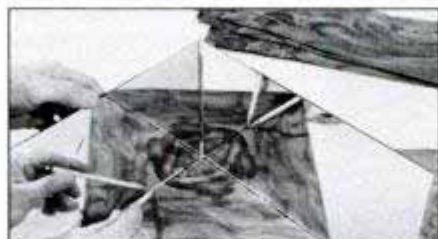


Peel-and-stick adhesive-backed veneer is another alternative to using veneer glue. Simply peel off the backing and apply.



Flatten buckled burl veneer by dampening with water then sandwiching it between paper and weighted plywood panels.

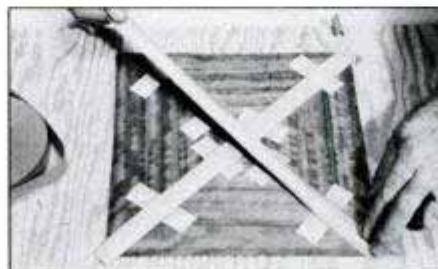
DIAGONAL-QUARTER MATCH



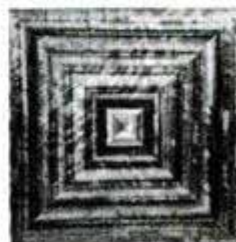
Mirrors held at 90° reveal the finished four-piece veneer match. Shift mirrors along the veneer to see a different grain pattern.



Cut the four 90° segments simultaneously from a stack of matching veneer strips using a veneer saw and combination square.



Assemble the four veneer pieces with gummed veneer tape. First tape across the joints, then lengthwise, corner to corner.



Completed diagonal-quarter matched veneer after the tape is removed. This technique is often used for tabletop veneers.



GET AN EDGE ON LAWN CARE

A crisp, attractive edging of wood or masonry between lawn and garden can eliminate hand trimming.

BY PENELOPE A. SPANGLER

A well-manicured yard is a pleasure to look at, but takes a lot of work. So, most of us opt for a simple landscape that we can keep in shape without daily care. One easy-upkeep way to give a crisp look to lawn and planting beds is to make a clear separation between them with edging.

An edging helps keep creeping plants in place and helps define planting areas even when plants are dormant. When the edging is sunk so its top surface is nearly flush with the ground, it serves as a lawnmower base. You can wheel your mower on the edging and eliminate hand trimming.

There are many different types of edging made of wood or of masonry.


Photos: Derek Fell, Koppers Co., Penelope A. Spangler, George Talouris
Stone: Bergen Bluestone Co.



Brick sunk lengthwise on edge is mortared together to serve as a retainer for brick laid with long sides together.



Brick laid with long sides touching is fanned out to form curved edging. Sunk flush with the ground, the brick serves as a base for a lawnmower, which will reduce hand trimming.



The rugged surface of old cobblestone, also called Belgian block, makes it a handsome edging between ground covers. Once used in seaports as street paving, the stone is still available.

Although it cannot be used as a lawnmower base, strip edging of metal or plastic combined with a bed of tree bark or stone aggregate also looks neat and requires minimal maintenance. In selecting an edging material, weigh appearance, cost and ease of installation.

Wood edging

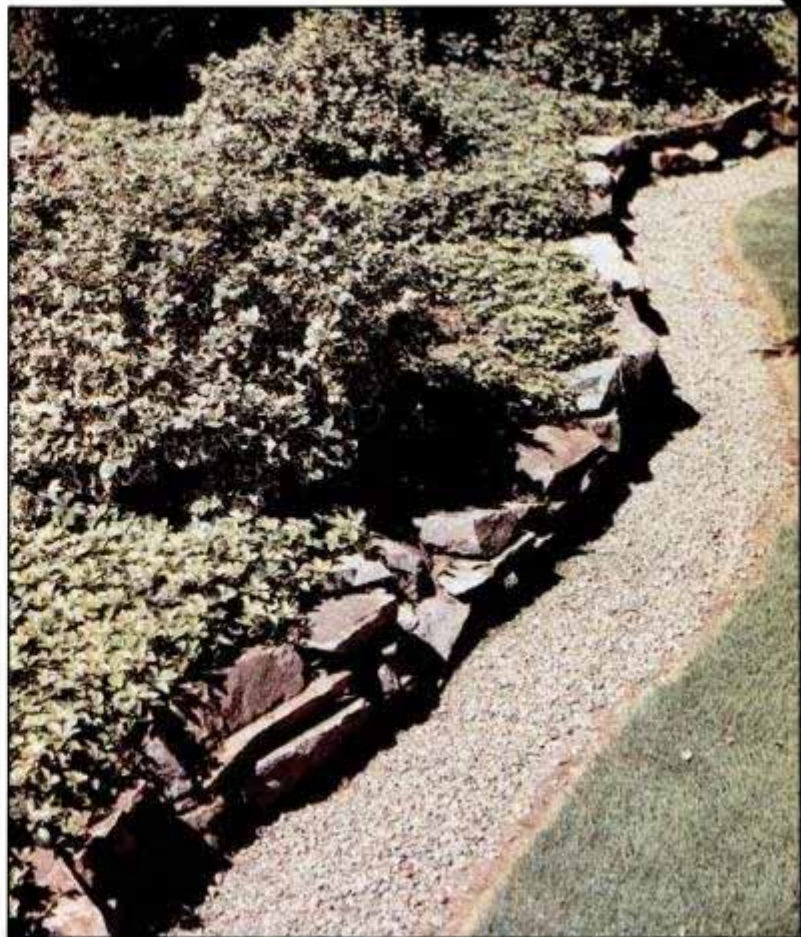
Of the edging materials available, wood looks the most natural with green and blooming plants. It is also an easy material to install. However, it doesn't lend itself to curved planting beds.

Redwood is the most readily available wood that is naturally decay resistant. When the wood is in contact with the ground, use all-heart redwood (solid-colored with no light-colored streaks of sapwood in it). Cost of an 8-ft.-long 2x4 can run \$5 to \$6. All-heart cedar is also naturally decay resistant.

To install 2x4 edging, first drive



This sweeping, curve-shaped lawn edging is composed of straight pieces of Wolmanized pressure-treated wood. You can paint the wood before installation or let it weather naturally.



A serpentine stretch of low stone wall fronted by stone aggregate crisply separates this lawn and bushes, while reducing the maintenance required.

stakes into the ground at each end of your run. Then, stretch a string taut between the stakes for use as a guide in excavating. Use a straight spade to cut a 5½-in.-deep, clean-sided trench. Shovel in a 2-in. bed of sand; this helps level the edging and realign it after winter when the ground heaves due to freezing and thawing. Install the 2×4s, top edge flush with the ground, and secure them with 1×2×18-in. stakes positioned every 4 ft. Nail to the edging with 6d hot-dipped, galvanized nails.

Softwood timbers that have been pressure-treated with preservative make excellent edging. Be sure to get stock designated for ground contact use as not all treated wood serves this purpose. Also know the species of wood you are purchasing. Some, such as southern yellow pine, most Douglas fir, ponderosa pine and hemlock, take treatment better than others such as

One to 4-ft.-long pieces of bluestone are sunk on edge to separate lawn from flower bed. When selecting stone edging, choose pieces of uniform width and depth. These stones are 1½ in. wide and 3½ in. deep.

aspen and Englemann spruce. Another safeguard is to check for a quality-control label such as the cloverleaf of the American Wood Preservers Bureau.

The active preservative ingredient in most pressure-treated wood is chromate copper arsenate (CCA), which is nontoxic to plants. Wolmanized wood, one brand of pressure-treated wood, is guaranteed to resist rot, decay and termite attack for 30 years. Cost for an 8-ft.-long 6×6 is about \$12.

If you have softwood timber on hand, you may elect to apply a coating of



Stone edged with weathered wood covers the area under this bench.

GET AN EDGE ON LAWN CARE

preservative on it for edging use. Softwood timbers dipped or brushed with preservative can last for five years or more. One such preservative is Cuprinol No. 10 Green Wood Preservative. The active ingredient, copper naphthenate, is not toxic to plants. In applying this preservative to edging, the more applied the better. If brushing it on, use a thick brush and apply several coats.

Sink large wood timbers directly into the ground, or on a 2-in. bed of sand for ease of installing and releveling.

Sand is sold by weight. For small projects such as edging, you can purchase it in bags. A 60-pound bag costs under \$3. To determine the amount of sand you need, find the cubic footage involved by multiplying length by width by depth (in feet or fraction of a foot). Then, multiply the answer by the number of bags of sand needed to make a cubic foot. (Sand weighs 100 to 110 pounds per cubic foot; therefore, almost two 60-pound bags are needed to make a cubic foot.)

Log rounds, cut 3 or more inches thick and 4 in. in diameter, make a rustic edging that can be used as a mower base when imbedded in a trench. The rounds can split in time if used in an alternately wet and dry area or exposed to direct sunlight. Taller rounds can serve as a raised border. One company, Trans Continental Imex, 5155 Rio Vista Ave., Tampa, Fla. 33614-5323, joins 3-in.-dia. x 5-in.-high wood posts with galvanized wire and sells them in 36-in. lengths. Each has anchor spikes at both ends.

An L-shaped length of wood can do double duty, serving as a raised decorative border and as a lawnmower base (see illustration above).

Masonry edging

For a durable edging that can run straight or in gentle curves, use mason-



An L-shaped wooden structure sunk in the ground is used as a raised, flower-bed border and as a lawnmower base.

ry such as brick, tile, stone or concrete block. Tools required to lay masonry edging include: stakes and string, flat-blade spade, rubber mallet (to tap brick in place), hammer, broad-blade chisel (to cut masonry), broom and shovel.

Laying out masonry edging in a straight run involves driving stakes into the ground at each end of the run and stretching a string taut between them as a guide. When laying out curved patterns, experiment with different shapes using a rope or a garden hose. When satisfied, cut inside the line.

For ease of leveling and realigning, place the masonry units on a 2-in. bed of sand as with wood edging. To inhibit weeds growing between edging pieces, lay polyethylene sheet over the sand. If drainage is a problem, put the sand on a 2-in. bed of gravel. Gravel for small projects is sold by the cubic yard. To estimate the amount you need, find the cubic footage of the area to be covered (length by width by depth). Then, divide the number by 27, the number of cubic feet in a cubic yard. A cubic yard of gravel can cost in the neighborhood of \$13. Most building materials suppliers have a minimum order charge.

Since it isn't a structural member, edging doesn't have to be installed on concrete. It can ride with the earth as it freezes and thaws. If one unit is thrown noticeably out of line you can relevel the sand and replace it.

Brick edging

Brick is the most widely used masonry edging. Besides common building brick both new and used, textured brick with stippled, grooved, sand-finished and water-struck textures make handsome edging. Use brick with an SW (severe weather) rating.

When purchasing brick, figure 32 common bricks ($2\frac{1}{4} \times 3\frac{3}{4} \times 8$ in.) for each 10 ft. of edging if the long edges of brick are placed side by side, perpendicular to the run of edging. Figure 15 bricks per 10 ft. if the brick length parallels the edging run.

If using a 2-in. layer of gravel topped by a 2-in. layer of sand, excavate to a $6\frac{1}{4}$ -in. depth so the top surface of the brick will be flush with ground surface for use as a mower base. A layer of polyethylene over the sand inhibits weed growth. Position the brick and tap it in place with a rubber mallet.

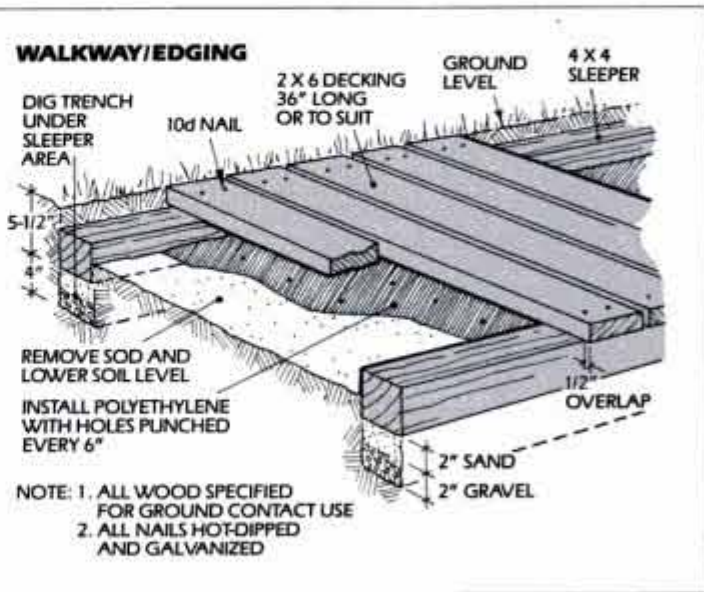
If a curved edge is desired, you can fan out the brick slightly, or cut wedge-shaped brick with a broad-blade chisel. To do this, first score top and bottom surfaces of the brick on the cut line by tapping a broad-blade cold chisel with a hammer. Then, strike a blow to the chisel with the hammer. Wear eye protection when cutting.

To finish the edging, pour or shovel on sand and sweep it between the brick and around their edges.

Concrete block, both cinder and patio block, make inexpensive, long-lasting edging. For a special look or shape you can also cast your own concrete blocks in wooden molds. If you purchase or make colored blocks, natural tones such



Wood 2x6s on sleepers separate lawn and planting bed, serve as a walkway when the lawn is wet and become a base on which the



lawnmower can ride. All wood should be pressure treated or naturally decay resistant and specified for ground contact use.

as amber, clay and terra cotta look best with plants. Edging of a single color looks the most natural.

Stone edging

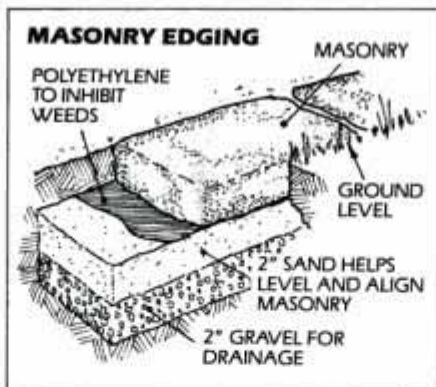
Stone makes a durable edging that is compatible with plants. Several different cuts of stone can be used in this way: natural uncut field stone, thin flagstone slabs and square-cut rectangular stones. Sunk with tops at ground level they serve as a lawnmower base. It's best to select stone that's at least 1 1/4 in. thick, with pieces cut to uniform width and thickness. If economy is important, select a stone that is quarried in your area.

Many types of stone can be used as edging. For example, marble—pink or white with streaks—can be cut uniformly to make a handsome formal edging. Pieces 2 1/4 x 4 in. and ranging from 1 to 3 ft. long cost about \$1.75 per linear ft. Bluestone is also cut relatively uniformly and makes attractive edging in blue-gray, gray-green, tan and lilac hues. Granite in a great variety of colors ranging from grays and tans to reds and mahogany is used as edging. A popular edging is cobblestone or Belgian block.

To buy stone, consult the Yellow Pages under "Stone Dealers." Some dealers have self-service areas where you can pick the stones to control size and color uniformity. To estimate materials, simply determine the running footage of edging required and keep tally as you make your choice.

If you must order by weight, first determine the total length of edging needed. Then, select the stone and determine its thickness and width and compute the total cubic footage of this stone in the proposed edging. A rule of thumb is that stone will probably average about 140 pounds per cubic foot.

Installation is similar to that of brick. Set stones on the ground, on a bed of



For ease in leveling and realigning later, set masonry on a 2-in. layer of sand. For drainage, add a 2-in. base layer of gravel.

sand for ease of leveling, or on sand over gravel for drainage.

Strip edging

Strip edging used in conjunction with bark or stone aggregate ground cover helps minimize lawn maintenance. Strip edging helps contain the ground cover. The edging should be installed flush with the ground on the lawn side. The garden bed should be lower.

Plastic edging comes in green and black with a rounded bead on its top edge which is safe for bare feet. However, plastic edging can crack in cold weather and fade in deep sun.

Aluminum edging is lightweight and doesn't rust. It usually comes unpainted. Steel edging comes painted brown, green or black. It rusts in time.

Installing strip edging in a straight line can be a challenge. When selecting a product, hold it with both hands spread apart and bend the edging. If it wobbles and seems flimsy rather than making a smooth curve, it will be hard to install in a straight line.

For ease of installation, work with strip edging in the spring when the ground is moist. With a flat spade, open

the earth and install the edging. To seat it, step on both sides of the edging.

Ground covers

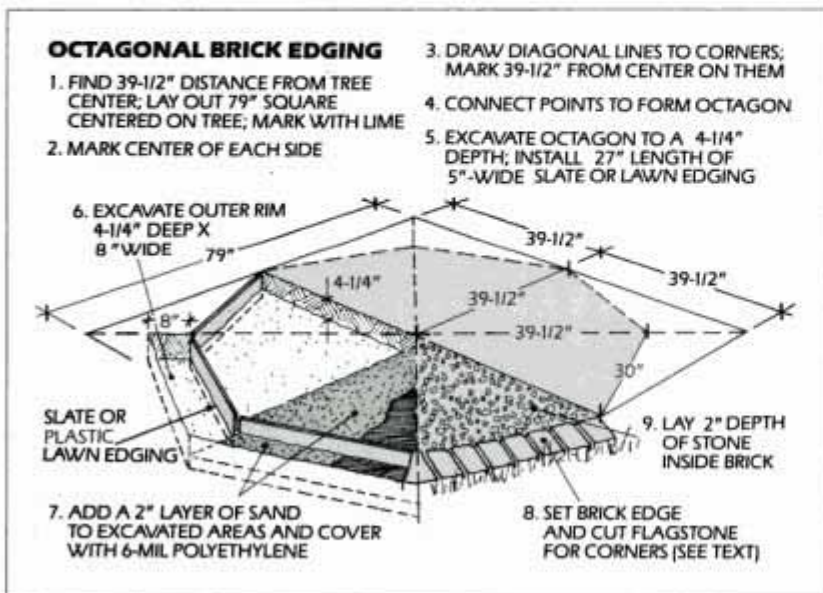
Bark nuggets or shredded mulch reduce maintenance, retain moisture and retard weeds. Shredded bark gives a soft, uniform appearance or a blanket effect. Bark nuggets which come in three sizes from 1/4- to 3-in. diameters have a coarser appearance. The larger sizes are used for larger plantings.

Lay the bark 2 to 4 in. deep directly on the ground, the coarser the product the greater the depth. A layer of black polyethylene plastic under the bark discourages weed growth. Poke holes in the plastic every 6 in. to let rain water drain. A new spunbonded polypropylene material for use in place of plastic sheets lets water and fertilizer through, yet weeds can't grow. One brand is called Landscape Fabric by Du Pont. Call 800-448-9835 for a source in your area.

Bark is sold by the cubic foot. A 3 cu. ft. bag (about 40 pounds) is \$2 to \$4.

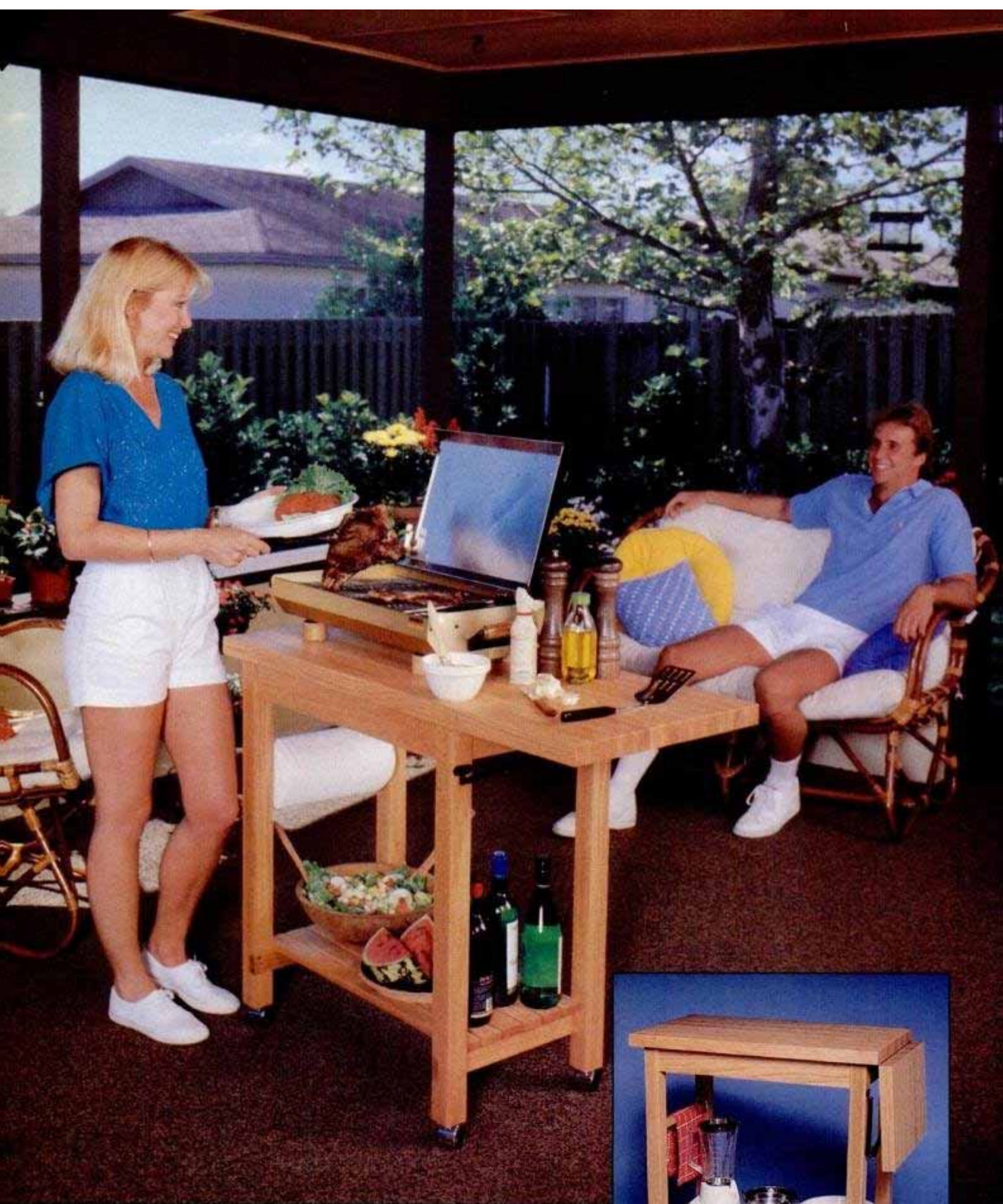
More expensive yet more durable and providing better drainage than bark, stone aggregate gives a decorative look yet requires minimum maintenance. You can choose gravel, which is rounded pebbles in sizes from 1/4 to 1 in. in diameter and hues of tan, gray, white or black. Another choice is rounded river stones. Or select a type of crushed rock that is processed and angular in shape, such as marble, quartz, sandstone, granite and limestone. Sizes range from 1/2 to 3 in. in diameter and larger. Larger stones are best on a sloped area.

Aggregate is laid 1 to 4 in. deep over plastic. It's sold in 50-pound bags. Price per bag ranges from about \$1 for sandstone to about \$6 for marble chips. Coverage per 100 pounds for a 1-in. depth is 8 to 10 sq. ft.; for a 3-in. depth, it is 2 to 3 sq. ft. **PM**

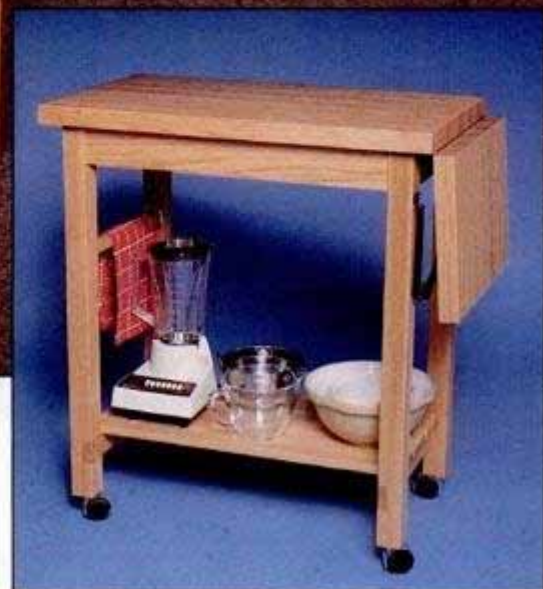


Brick, flagstone, slate or strip edging, and stone aggregate make up this unusual edging design. Materials are sunk flush with the

ground. To form the octagon, first lay out a square around the tree having sides that measure 39 1/2 in. from the tree center.



This cart was designed specifically for an electric barbecue grill (above), but it can also be used as a kitchen gourmet table (right) when barbecuing season is over.



Cook's Companion

Roll this cart onto your porch to help with the barbecue, or use it in the kitchen as a gourmet table.

Barbecuing is a great summertime activity. It lets you spend time out in the open air instead of the confines of a kitchen and it yields such distinctive flavors and aromas. But there are those days when the weather prohibits barbecuing and forces a change in your plans.

Recently, we came across a new electric grill that was designed specifically for barbecuing on a porch—and even inside the house near a range hood exhaust fan—that gives you real control over weather conditions. This grill, made by Maverick Industries Inc., 5 Stahuber Ave., Union, N.J. 07083, features an adjustable heat control from 200° to 700° F. and stainless-steel grease tray that can be removed easily for quick cleanup.

The unit shown here, model No. MB-2015, measures 7 × 12 × 25 in., is UL listed and operates on standard 110-volt house current. It costs \$149.95 postpaid from the manufacturer. A smaller grill is also available for \$119.95. It measures 7 × 12 × 21 in.

Because this grill seemed like such a good idea, we decided to design a simple roll-around cart specifically for it. The cart features a drop leaf at one end for condiments and platters of food, as well as a large center drawer for cooking utensils. Also included is a towel bar for cloth or paper towels and a full bottom shelf for other cooking and

BY NEAL BARRETT



The cart's extra-wide single drawer has ample room for bulky barbecue utensils.

entertainment supplies. And, if the end of summer brings your barbecuing days to an end, the cart can be wheeled inside and used as an all-purpose gourmet table in the kitchen.

Cutting stock to size

Begin construction by cutting to rough size the red oak stock for the top, legs, aprons, stretchers, shelf and drawer front. For the top, use $\frac{3}{4}$ " stock; for the legs, $\frac{3}{4}$ "; for the aprons, $\frac{3}{4}$ "; and for the slats, $\frac{1}{4}$ ". Joint one edge of each piece, then surface to specified thickness. Rip all pieces to finished width and crosscut all parts except those for the top to finished length. The top will be trimmed after it's glued up.

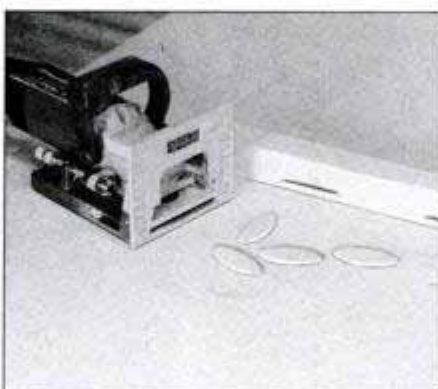
We used plate fasteners to reinforce and align the pieces for the butcher-block top. This system uses a portable tool which cuts a matching semicircular groove in the mating edges of adjacent boards. These grooves accept a football-shaped spline called a plate. When the plate is glued in place, the moisture in the glue causes it to swell and hold the joint tight. The tool shown is the Virtex Model O-81; it's available from Fine Tool & Wood Store, 7923 North May Ave., Oklahoma City, Okla. 73120,

(Please turn to page 126)

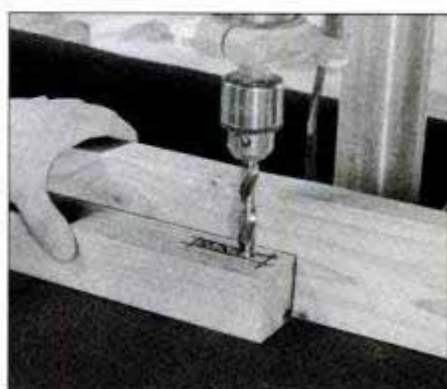
Color photos: Skip Gandy **Photo stylist:** Alana Russell
Black and white photos: Neal Barrett **Technical art:** Eugene Thompson



A good way to join top boards is with plate jointer tool. It registers off workbench to cut concave grooves for premade splines.



Once the mating grooves are cut, apply glue to board edges and splines. Slip splines into the grooves and clamp boards together.



Using a drill press, cut apron mortises in leg by boring overlapping $\frac{1}{2}$ -in.-dia. × $\frac{3}{4}$ -in.-deep holes. Square holes with a chisel.

Build A Playhouse For The Kids And A Workbench For Yourself

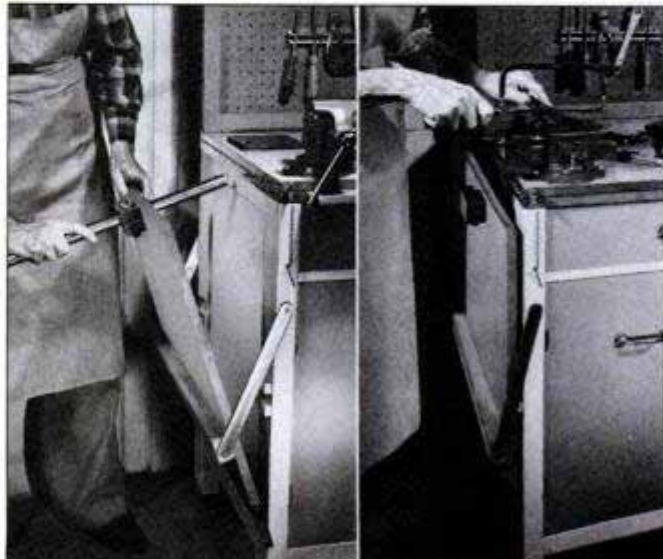


PLAYHOUSE

Believe it or not, you can still build a house for under \$300—a back-yard playhouse, that is, complete with a front porch. This sturdy yet easy to build structure has rough-sawn plywood siding and a shingled roof.

WORKBENCH

This modular workbench has a swing-over top and a two-position drop leaf, supported by a steel pipe leg. The bench can be used either in compact form or extended, depending on the size of your job. The drawer and magnetic clip on the pegboard hold small tools while larger tools are stored below, behind doors.



SPACE EXPANDERS

Our two spacemakers give your kids more room of their own, and you more room to work. Each packs a lot into a small area. Our back-yard playhouse measures just 6 ft. square. The modular workbench is a mere 2 ft. square when folded. The latter, however, expands to nearly three times this size for larger projects.

Begin the playhouse by selecting the site. Since the foundation is not anchored in the soil, the 6 × 6-ft. area must be level, and the earth should be well packed.

Cut the 4 × 4 posts and the 2 × 6 braces and joists to length. Use pressure-treated stock. Spike the braces (parts B and C) and perimeter joists (parts D and E) to the posts with 16d galvanized nails. Make sure all the braces and joists are square and at right angles to the posts.

Level the assembled foundation by removing any high spots in the supporting soil. Then, install the five interior joists by nailing them in place through the perimeter joists using 16d galvanized nails. Lay the 3/4-in. plywood floor on the back side of the deck as shown in the Plan View on the drawing. Secure with 6d galvanized nails.

Nail down alternate 1 × 4 and 1 × 5 pressure-treated boards for the porch floor with 8d galvanized nails. Space the planks evenly, leaving approximately 1/4-in. space between each.

Cut studs and top and bottom wall plates from 2 × 4 stock for the two side walls. Then, nail the studs in place by driving 16d nails through the top and bottom plates and into the ends of the studs. Once the wall frames are completed, stand them in place on top of the plywood flooring and nail the bottom plates through the plywood and into the joists using 16d nails. Check for plumb, then nail temporary diagonal braces onto the inside of the walls and from the ends onto the sides of the deck.

Mark the door location. Cut and nail the 2 × 4 bottom plates on either side of the opening. Also nail the bottom plate to the deck for the rear wall. Cut the six

rafters to the length given in the materials list, then miter one end of each at a 45° angle. Notch the other end of each rafter to fit atop the plates of the side walls as shown in the drawing. Nail them in place with 12d nails. Cut and notch the front and back wall studs and toe-nail them into the bottom wall plate and against the sides of the end rafters using 8d nails. Frame the window opening with 2 × 2 stock.

Cut the 3/4-in. Texture 1-11 siding to size for the side walls and nail the panels in place with 6d galvanized siding nails. Position the upper edge of the plywood 3/4 in. below the top of the top plate to allow for the roof sheathing to extend over it. Set the front wall panels in place, then scribe the inside surface of the panels to locate the position of the rafters and the door and window openings. Cut the plywood to shape, and nail in place as before.

Cut the 3/4-in. exterior plywood roof sheathing to size and nail in place with 6d nails. Make sure the roof sheathing is flush to the edge of the rafters on the front and back walls, and overhangs the side walls 1 in.

Mark and cut stringers and treads, and assemble the steps with 16d galvanized nails. Use pressure-treated lumber. Fit the stringers to the side of the deck joist and toe-nail in place with 16d galvanized nails. If the soil at the stair bottom is not solid, embed a couple of flat stringer bottoms.

Nail the bevel-ended balusters to the side of both the porch rail and the deck joists as shown. Leave a 4 3/8-in. space between balusters. Toe-nail the end rail to the corner frame of the playhouse.

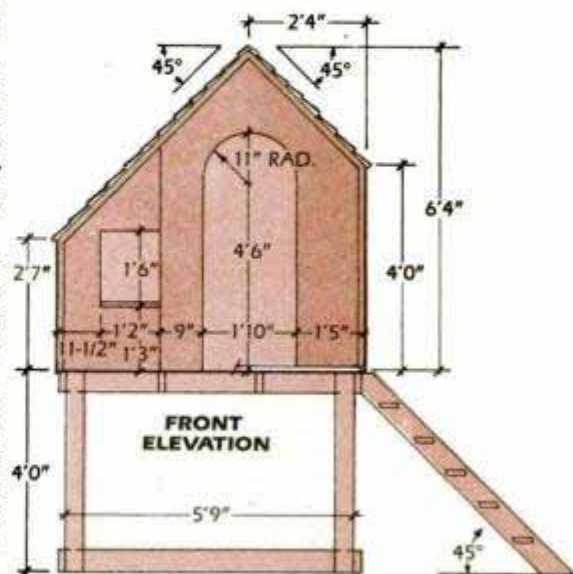
Trim the playhouse at all four corners and along the roof rakes and eaves with 1 × 2 pine strips. Cut the windowsill to shape and nail it in place with 6d galvanized nails. Nail a strip of 2 × 2 under the windowsill to give it additional support.

We roofed our playhouse with 15-pound felt covered with asphalt shingles. The shingles overhang the wood

Expand your kids' play space with our playhouse, and your shop space with our modular workbench.

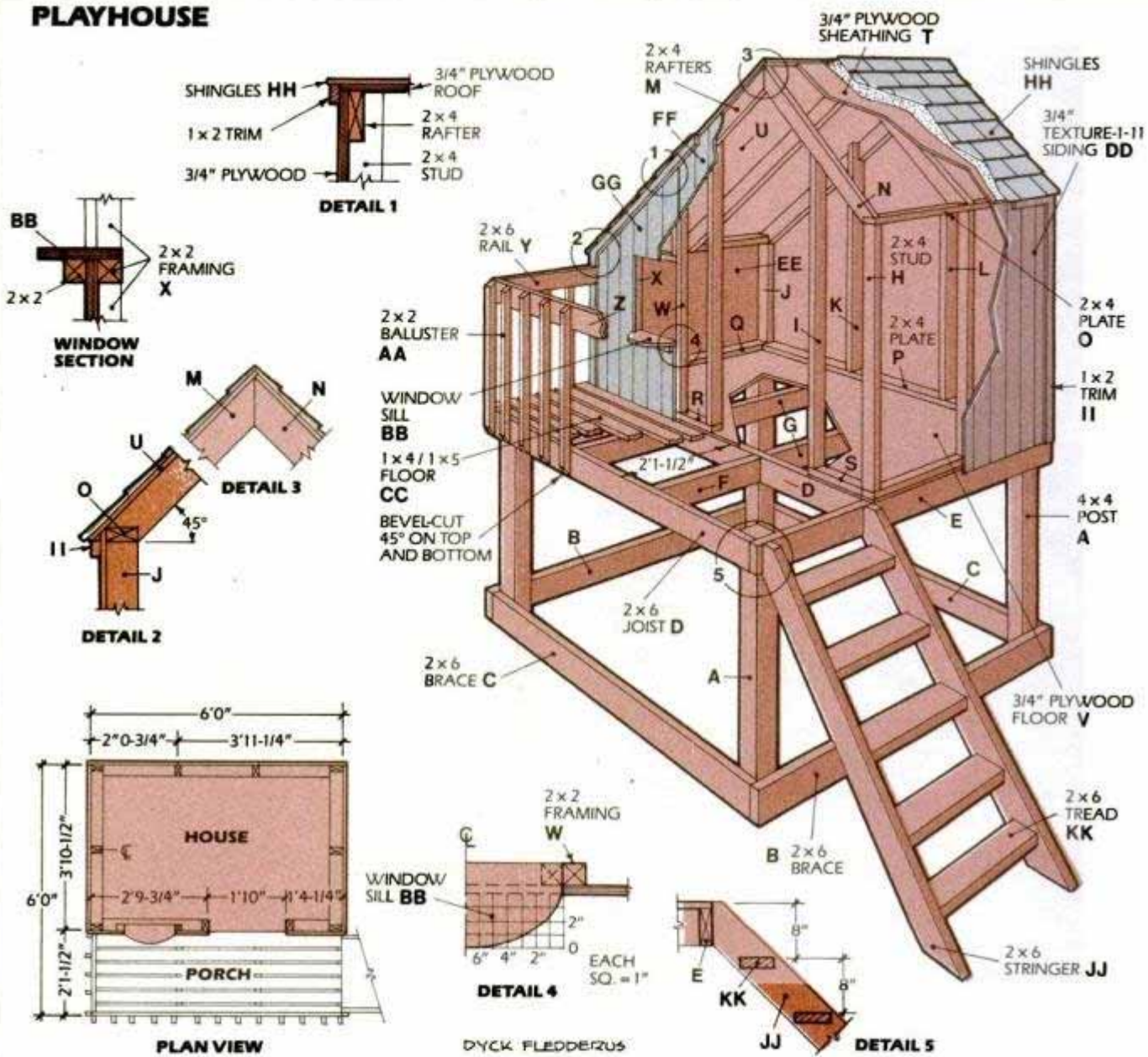
Playhouse text and photo by Stan Roberts

Workbench text and photos by Walter E. Burton



Playhouse stands on 2 × 6 foundation braces enclosing 4 × 4 support posts. Interior headroom at peak is just over 6 ft.

PLAYHOUSE



MATERIALS LIST—PLAYHOUSE

Key	No.	Size and description (use)
A	4	3 1/2 x 3 1/2 x 4'0" fir (post)*
B	2	1 1/2 x 5 1/2 x 6'0" fir (brace)*
C	2	1 1/2 x 5 1/2 x 5'9" fir (brace)*
D	3	1 1/2 x 5 1/2 x 5'9" fir (joist)*
E	2	1 1/2 x 5 1/2 x 6'0" fir (joist)*
F	2	1 1/2 x 5 1/2 x 2'0" fir (joist)*
G	2	1 1/2 x 5 1/2 x 3'7" fir (joist)*
H	3	1 1/2 x 3 1/2 x 3'8 1/4" fir (stud)
I	2	1 1/2 x 3 1/2 x 5'4" fir (stud)
J	3	1 1/2 x 3 1/2 x 2'3 1/4" fir (stud)
K	1	1 1/2 x 3 1/2 x 4'8" fir (stud)
L	1	1 1/2 x 3 1/2 x 6'4" fir (stud)
M	3	1 1/2 x 3 1/2 x 5'6" fir (rafter)
N	3	1 1/2 x 3 1/2 x 3'6" fir (rafter)
O	2	1 1/2 x 3 1/2 x 3'10 1/2" fir (top/bottom plate)
P	1	1 1/2 x 3 1/2 x 5'5" fir (bottom plate)

Q	2	1 1/2 x 3 1/2 x 3'10 1/2" fir (top/bottom plate)
R	1	1 1/2 x 3 1/2 x 2'6 1/4" fir (bottom plate)
S	1	1 1/2 x 3 1/2 x 1'3 1/4" fir (bottom plate)
T	1	3/4 x 3'7" x 4'0" exterior plywood (roof)
U	1	3/4 x 4'0" x 5'7 1/2" exterior plywood (roof)
V	1	3/4 x 3'10 1/2" x 6'0" exterior plywood (floor)
W	1	1 1/2 x 1 1/2 x 4'6" fir (window framing)
X	1	1 1/2 x 1 1/2 x 10'0" fir (window framing)
Y	1	1 1/2 x 5 1/2 x 1'11 1/4" fir (rail)*
Z	1	1 1/2 x 5 1/2 x 6'0" fir (rail)*
AA	19	1 1/2 x 1 1/2 x 3'0" fir (baluster)*
BB	1	1/2 x 6" x 1'2" exterior plywood (windowsill)

CC	3	3/4 x 3 1/2 x 6'0" fir (porch floor)*
DD	3	3/4 x 4 1/2 x 6'0" fir (porch floor)*
DD	1	3/4 x 3'10 1/2 x 3'11 1/4" Texture 1-11 plywood (right wall)
EE	1	3/4 x 2'6 1/4 x 3'10 1/2" Texture 1-11 plywood (left wall)
FF	2	3/4 x 4'0" x 6'4" Texture 1-11 plywood (front/back wall)
GG	2	3/4 x 2'1 1/2 x 4'9" Texture 1-11 plywood (front/back wall)
HH	1	bundle asphalt shingles
II	40'	3/4 x 1 1/2" pine (trim)
JJ	2	1 1/2 x 5 1/2 x 6'0" fir (stringer)*
KK	5	1 1/2 x 5 1/2 x 1'8 1/4" fir (tread)*

Misc: 6d, 8d, 12d and 16d galvanized common nails; 6d galvanized siding nails; 3/4" roofing nails; 15-lb. building felt, 80-grit sandpaper; waterproof stain
*Pressure-treated lumber

trim 1/4 in. in all directions. We applied the shingles with 7/8-in. roofing nails so nails would not protrude through the roof sheathing.

Finally, we sanded rough edges around the window, doorway and railing, and applied two coats of waterproof stain.

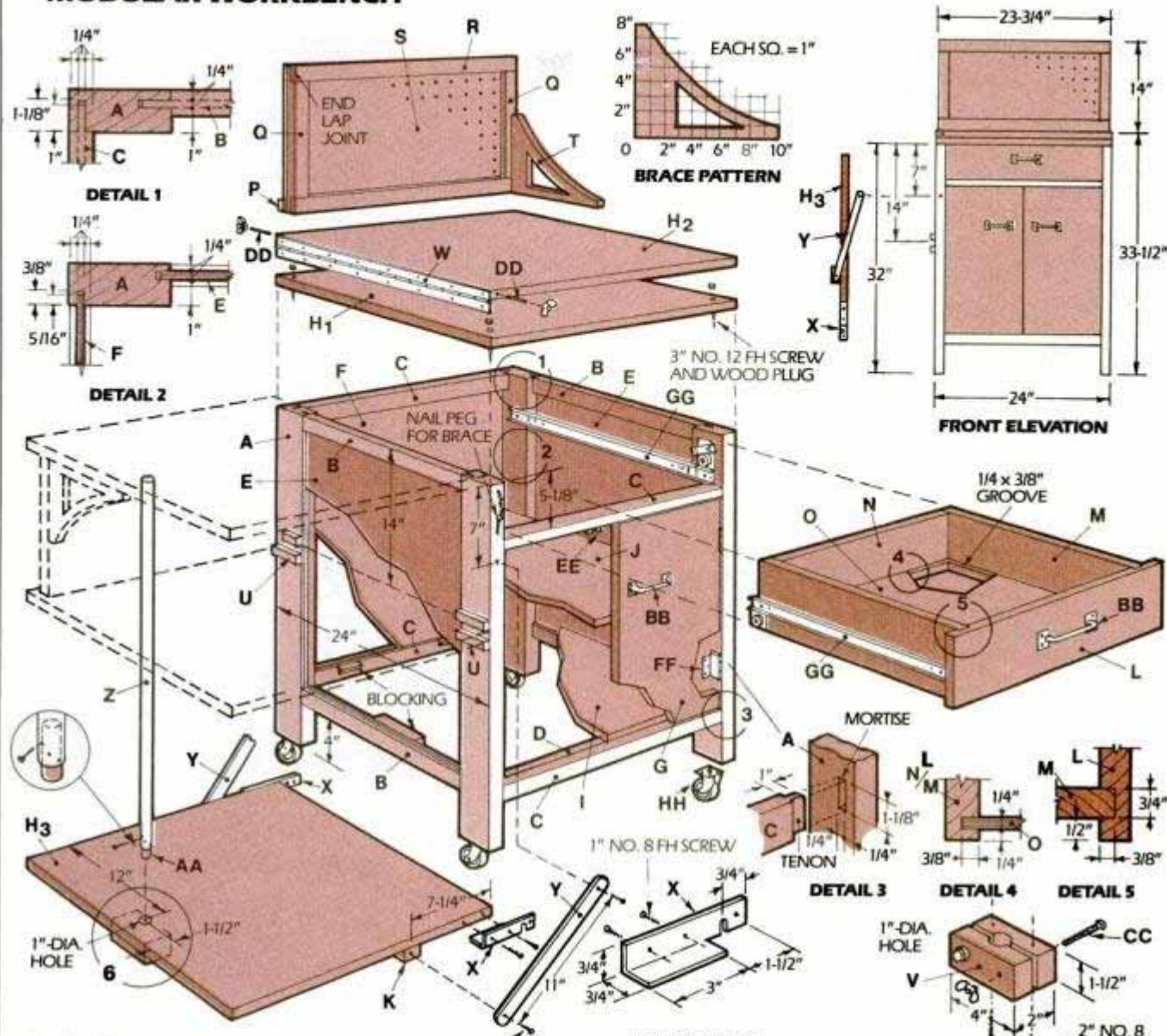
Modular workbench
Our expandable workbench is designed as a place for general home-maintenance tasks, hobby activities and to supplement your other shop facilities while occupying only 4 sq. ft. of space.

The workbench has three tops—the fixed one, a swing-over panel hinged to

it, and a drop leaf that can either extend the upper work surface or serve as a lower shelf when the hinged top is extended. A pegboard panel at the back of the hinged section holds a magnetic tool rack strong enough to secure tools in either position.

The workbench legs are 2 x 4 stock.

MODULAR WORKBENCH



DYCK FLEDDERUS

MATERIALS LIST—WORKBENCH

Key	No.	Size and description (use)
A	4	1 1/2 x 3 1/2 x 32" fir (leg)
B	4	3/4 x 1 1/2 x 19" pine (side rail)
C	4	3/4 x 1 1/2 x 23" pine (front/back rail)
D	1	3/4 x 3/4 x 21" pine (support cleat)
E	2	1/4 x 17 3/8 x 25 1/16" fir plywood (side panel)
F	1	1/4 x 21 5/8 x 25 1/16" fir plywood (back panel)
G	2	3/4 x 10 3/4 x 20 1/2" particleboard (door)
H1	1	3/4 x 24 x 24" birch plywood (fixed top)
H2	1	3/4 x 24 x 24" birch plywood (hinged top)
H3	1	3/4 x 24 x 24" birch plywood (drop-leaf top)
I	1	1/2 x 22 3/4 x 23" fir plywood (bottom)

J	1	1/2 x 20 3/4 x 22 3/4" fir plywood (interior shelf)
K	1	1 1/4 x 2 x 24" hardwood (cleat)
L	1	3/4 x 5 x 20 3/4" pine (drawer front)
M	2	3/4 x 5 x 21" pine (drawer side)
N	1	3/4 x 5 x 18 1/4" pine (drawer back)
O	1	1/4 x 19 x 20 3/4" fir plywood (drawer bottom)
P	1	3/4 x 3/4 x 23 3/4" pine (panel cleat)
Q	2	3/4 x 1 1/2 x 14" pine (vertical panel frame)
R	2	3/4 x 1 1/2 x 23 3/4" pine (horizontal panel frame)
S	1	1/4 x 14 x 23 3/4" pegboard panel
T	1	3/4 x 8 x 10" fir plywood (triangular brace)
U	3	1/2 x 3/4 x 3" hardwood (support block)
	1	1/2 x 3/4 x 1 1/2" hardwood (support block)

V	1	1 1/2 x 2 x 4" hardwood (tube-clamp block)
W	1	1 1/2 x 24" continuous hinge
X	2	3/16 x 3/4 x 3/4 x 4 1/2" steel (latch)
Y	2	1/8 x 1 x 12" steel (hinge arm)
Z	1	1"-dia. x 33" steel pipe (leg)
AA	1	7/8"-dia. x 6" hardwood dowel (foot)
BB	3	3" door/drawer pull
CC	2	1/4-20 x 2 1/2" carriage bolt, nut and wingnut
DD	2	1/4-20 x 2" hanger bolt, washer and wingnut
EE	2	double-roller door catch
FF	2pr.	door hinge, Amerock #8P-5988-M3
GG	1pr.	22" drawer slide, Knappe & Vogt #1300
HH	4	2"-dia. swivel caster with lock

Misc: Screws, shelf clips, oil-base enamel, Tung oil finish

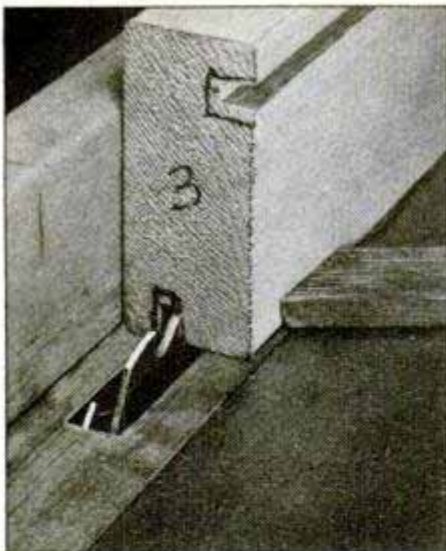
Horizontal rails are 1 x 2 pine, secured to the legs by mortise and tenon. The 1 x 2 rails and the legs are grooved to receive 1/4-in. plywood back and sides. The three top sections are 3/4-in.-thick birch plywood. Doors are 3/4-in.-thick particleboard.

Begin by cutting the legs and rails to

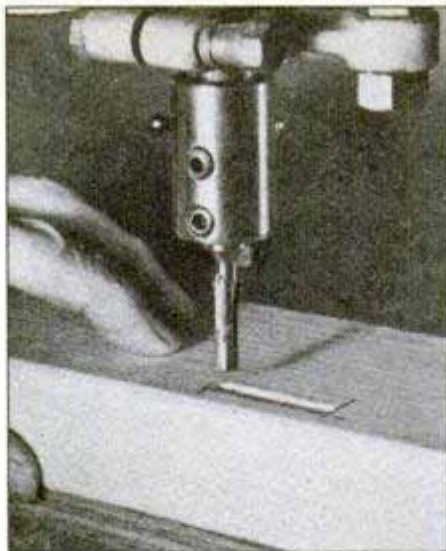
length. Then, cut the 1/4-in.-wide x 3/8-in.-deep grooves for the sides and back. Cut the 1-in.-long x 1/4-in.-wide tenons at each rail end. Then, cut mortises for the rail tenons 1 1/8 in. deep. Note that the rail below the drawer lies flat, the others are installed on edge.

Cut the side and back pieces, and

assemble the cabinet without glue to check fit and squareness. Reassemble, gluing the mortise and tenon joints, and clamp. Do not glue the plywood panels into the grooves, so they may expand and contract with changes in temperature and humidity without damaging the cabinet.



Groove rear legs for side and back panels, front legs for side panels only. Rough marks assure proper location of cuts.



Cut 1/2-in.-deep mortises for rails with drill press and 1/4-in.-dia. drill or router bit. Square corners with a sharp chisel.



Cut the leg grooves for the side and back deeper where the rails intersect so they will accommodate the longer tenons.



Bottom rests on edge of back and side rails, and a support cleat at front. Glue blocks around bottom give cabinet rigidity.



Flush doors butt against edge of cabinet bottom, and are held with catches at top. Plug-in clips support adjustable shelf.



Join the fixed top to the swing-over top with a continuous hinge. Then, attach the fixed top to the legs with screws.

Glue and clamp the blocking and the support cleat to the bottom rails. Cut the bottom to size, and notch the corners to fit around the legs. The bottom rests on the side and back rails, and on the support cleat at the front. Attach the bottom with screws through the cleat and blocking, and add small glue blocks for further support.

Cut the doors and drawer parts to size. Mortise the door edges 1/16 in. for the hinges. Groove the drawer side, front and back to receive the bottom. Dado the drawer front to receive the sides. Assemble with glue and 4d finishing nails. Mount the drawer slides, and check for proper fit.

Join the fixed and hinged top sections with the continuous hinge. Then, attach the fixed section to the cabinet with screws into the tops of the legs. Counterbore the screw holes, fill with wood putty and sand smooth.

Attach the hardwood hinge-arm cleat to the drop-leaf section, and bore the 1-in.-dia. hole for the support leg. Fabricate the tube-clamp block by first boring a 1-in.-dia. hole through a 1 1/2 x 2 x 4-in. block, then cutting this piece in half. Mount the block with screws on the drop leaf in alignment with the hole.

The support leg can be made from any 1-in.-outside-dia. steel pipe or tubing. Drill a series of holes at the bottom end of the leg to hold the adjustable foot in place. The foot can be set to accommodate unevenness in the floor.

Form the drop-leaf latches from 1/16-in.-thick steel. The hinge arms are cut from 1/8-in.-thick steel bar. After the drop leaf is attached to the cabinet with the hinge arms, locate the proper placement for the four support blocks (part U) and secure them to the leg sides with glue and screws. Locate the position for the 1/4-in.-dia. hanger bolts in the front

and back edges of the swing-over top, bore pilot holes, and screw them into place. Also bore a hole in the leg for the nail peg that locks the drop leaf in its upper position.

Cut the back frame, pegboard and triangular brace parts, and assemble them with glue and screws. Attach this assembly with 2-in. No. 6 screws.

Mount the interior shelf on plug-in metal shelf clips. Bore four equally spaced clip holes in the inner leg sides so the shelf can be adjusted easily.

We mounted our workbench on ball-bearing swivel casters with 2-in.-dia. rubber wheels and toe-activated locks. We then painted it inside and outside with oil-base enamel, except for the work surfaces, which were given a wipe-on Tung oil finish. The pegboard was left unfinished. When the paint is dry, hang the doors and attach the door and drawer pulls. **PM**

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Car and Driver March, 1985

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DECK FURNITURE

(Continued from page 95)

seat-support rail. By mounting the router upside down in a router table, you can eliminate awkward clamping of the narrow parts while routing.

Lay out and bore $\frac{1}{4}$ -in.-dia. holes for bolts and threaded brass inserts that join the subassemblies together. These inserts are called FINserts, model No. 270-4, and they're from E-Z LOK, Div. of Tool Components Inc., 240 E. Rosecrans Ave. Gardena, Calif. 90248.

Install the threaded inserts where specified by tapping in place with a hammer. Then, firmly seat each by threading a $\frac{1}{4}$ -20 bolt into the insert. The bolt will force the fins into the sides of the hole.

Since this furniture is designed for outdoor use, we chose a waterproof epoxy glue for assembly. The West System Epoxy by Gougeon Bros., 706 Martin St., Bay City, Mich. 48706, is

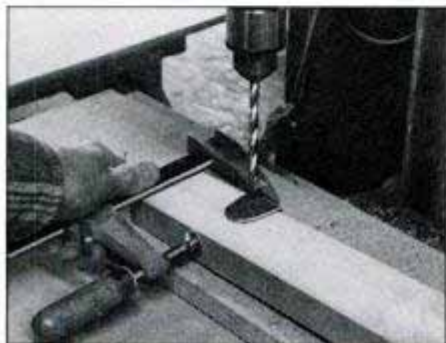
specially formulated for marine use and is highly recommended for its strength and waterproof qualities.

Joining the subassemblies

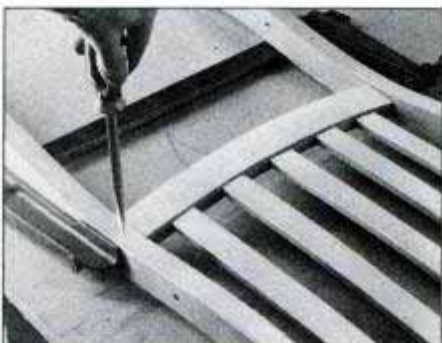
Begin assembly of the seat by first gluing the slats to the end rails and then gluing the end rails to the side rails. Clamp to bring the joints snug and check that the seat is square by comparing diagonal measurements as shown. Be sure that the assembly is not twisted, since misalignments here could prevent the chair from folding properly when completed. When clamping, it's important that the direction of force be in line with the joint and that only enough pressure is exerted to close the joint without distortion.

Assemble the footrest and seat back slats and rails in similar fashion. Also

(Please turn to page 116)



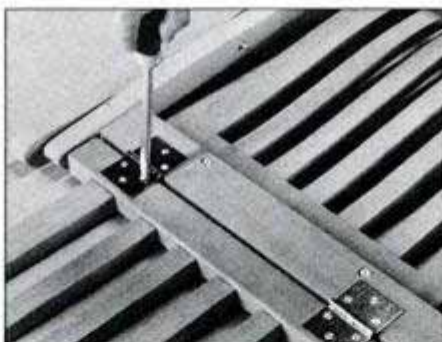
Clamp each armrest bracket to scrap block, then drill a hole through the assembly to assure exact hole alignment in both leaves.



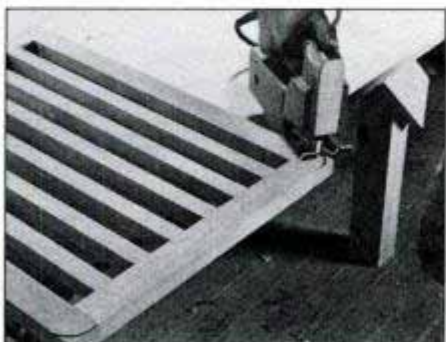
Glue and clamp the lower seat-back rail to the sides, then reinforce the joints by driving a $\frac{1}{4}$ -in. brass screw into both tenons.



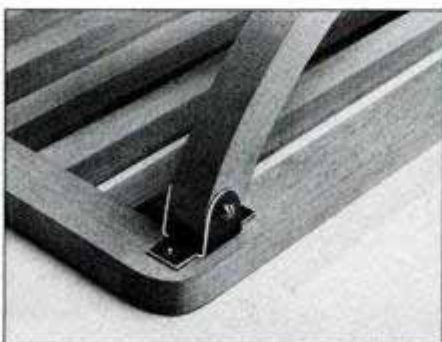
Attach the seat-back upper rail to the sides with $1\frac{1}{2}$ -in. No. 8 fh brass screws. Bore pilot holes and countersink the screwheads.



Join the footrest assembly to the seat assembly with brass butt hinges. Mount hinges on surface; do not mortise in place.



Once the tabletop is assembled, mark a 1-in. radius on each corner. Cut off the waste with a sabre saw and sand corners.



Attach table legs to underside of top with shop-made brass brackets and $1\frac{1}{2}$ -in. long $\frac{1}{4}$ -20 rh machine screws and nuts.

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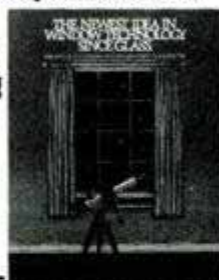
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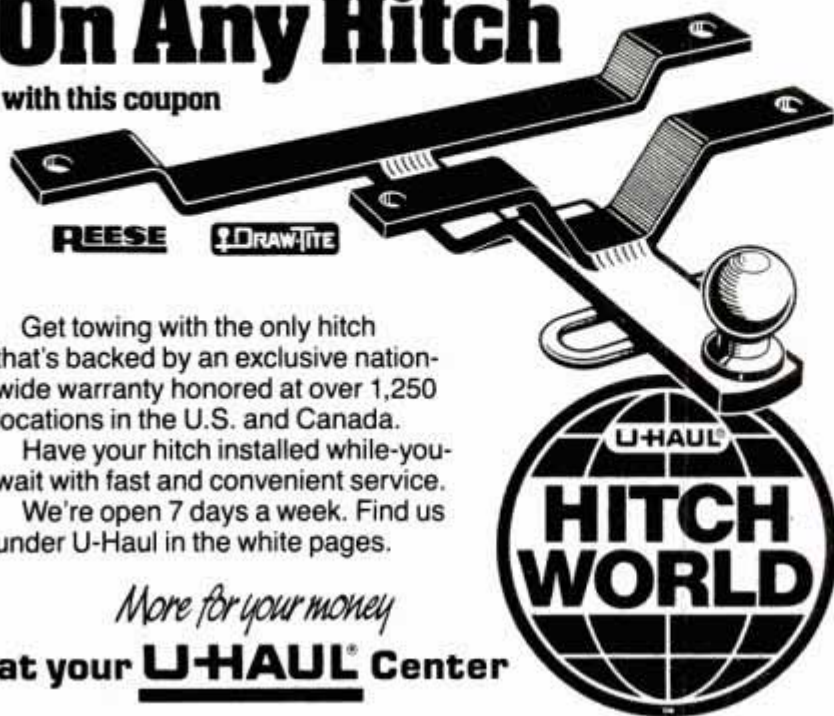
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DECK FURNITURE

(Continued from page 115)

glue and clamp the arm posts to their stretcher and footrest legs to their stretcher. Set each part aside until the glue is fully cured.

Next, fabricate the brass brackets that attach the arms to the arm posts. Following the plans, cut out the shape of each bracket from 14-ga. brass sheet stock using a band saw or jigsaw with a fine-tooth, metal-cutting blade. Smooth the cut edges with a file. Then, place each piece in a vise and bend each leaf so it forms a 90° angle. Clamp a scrap piece of lumber, 1 1/16 in. thick, between the leaves of the bracket and, using the drill press, drill a 9/32-in.-dia. hole through both leaves. The block ensures perfect alignment of the holes on both sides of the bracket.

Next, lay out the radii on the corners of the seat and cut them with a band saw or jigsaw. Sand the edges smooth with the belt sander.

Using a 1/2-in.-dia. straight bit and an edge guide, rout the 1/2 x 3/8-in. rabbet in both front and rear seat bottom edges and in front and rear seat-support rails. Be sure to firmly clamp each piece to the workbench before routing.

Assemble the seat support by first gluing the front rail in place and then screwing the seat-back support rail and rear stretcher in place. Be sure to bore pilot holes for the screws and to countersink the heads flush to the surface.

Proceed with assembly of the seat back by gluing the lower seat-back rail into the seat-back sides. Reinforce this joint by driving a 3/4-in. No. 6 fh brass screw through the back of each side member into rail tenons as shown. Also attach the top rail to the sides, but do not install the lower stretcher yet. Pre-sand all subassemblies with 120- followed by 220-grit sandpaper.

Final assembly

Position the 2 x 3-in. brass hinges that attach the footrest to the front seat-support rail. Bore pilot holes and attach the hinges to each piece with 3/4-in. No. 7 fh brass screws. Also, attach the brass brackets under the arms with 3/4-in. No. 6 fh brass screws.

Join the front folding legs to the footrest with brass machine screws, as shown on the drawing. Use two 1/4-in.-dia. washers between each moving part. Next, attach the arm posts to the seat-support sides, again using brass machine screws. Put one washer under the screwhead and two washers between the moving parts. Slide the back rest into position straddling the seat, and attach with screws in the same way. Then, screw the lower stretcher to the seat back with its beveled edge up.

(Please turn to page 129)

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JAPANESE MICRO-MINI CARS

(Continued from page 91)

model belts out 42 hp. The 10½-foot micro-mini will deliver 50 mpg in the city and a whopping 76 mpg when driving on the highway.

Subaru

The Domingo 4wd Wagon is a tiny van that is only 11.2 feet long and can seat seven close friends. Its 1-liter, three-cylinder, 56-hp engine is backed up by a five-speed transmission and On-Demand 4wd.

The seats flip and flop into various configurations, including beds, in typical minivan style, and can also be removed to increase cargo room. The high-line GS-S version sports "California mirrors," mounted like the ones on big-rig trucks.

The Rex Combi 4wd is a big name for a little 4×4 two-door hatchback only 10½ feet long. Its two-cylinder, 544-cc engine produces 31 hp in normal form and 41 hp turbocharged. The four-wheel-drive hatchback gets 62 to 65 mpg with a five-speed manual transmission. A Steering Guide meter in the middle of the Rex Combi's soft urethane steering wheel shows the angle of the front wheels, to help drivers prevent nasty surprises in tight city traffic.

Suzuki

Known mostly for its motorcycles in America, Suzuki has been building four-wheelers since 1961, and brings the same excitement to its cars and trucks that it does to bikes.

The Alto two-doors and Fronte four-doors are K-Class cars with three-cylinder, 543-cc, 31-hp engines and five-speed transmissions. There are about a dozen different models with fuel economy that ranges from 40 to 60 mpg when driving in the city and 60 to 85 mpg on the highway.

The Alto is available with four-wheel drive, and both it and the four-door version can be had with driver's seats that swivel 60° to the side, making it easier to get in and out of the tiny cars.

Another Suzuki, the Jimmy SJ, is a Jeep-like 4×4 that is barely 10½ feet long with a 28-hp, three-cylinder, 539-cc engine. It's available in four different models with the quaint names Van Deluxe, Van, Full Metal Door and Half Metal Door.

While 31 to 42 hp may not sound like a thrill a minute, in an ultralight 1,200-pound car, it's more than enough for a bonzai charge through snarled urban traffic. The 110-hp Honda City Turbo II is a real rocket in these conditions. And the vans pack an awful lot of utility into a minimum amount of space. Maybe Malcolm Bricklin was just a man ahead of his time. **PM**

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<i>Larger diameter means more damping power.</i>					
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¹Source: Competitive advertising *Approximately

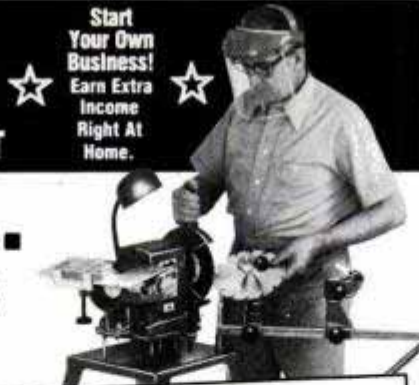
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WORLD'S BIGGEST DAM

(Continued from page 77)

meters per second. The lake covers almost 700 square miles.

Oddly, construction is more complicated for the less-powerful Canadian project. Hydro Quebec uses 198 dikes and eight dams to control the flow of water. If they were put in a line, the system components would spread across 60 miles.

By next year, the power from the Quebec project will supply Quebec, upstate New York and much of New England. The building of Hydro Quebec involved so much land area that it was preceded by three years of environmental impact studies. Although small forests were removed for Hydro Quebec,



One of Hydro Quebec's eight dams stretches across Canada's La Grande Riviere banks.



Water spills over a series of dikes at Hydro Quebec. The project uses 198 control dikes.

new waterways it created also have opened spawning grounds for fish and sanctuaries for birds. The dam changes its surroundings.

Itaipu means singing stone in the language of the local Indians. Before the dam, there was a rock in the water that made musical sounds as the Paraná swirled by. Now the submerged rock no longer sings. But the Brazilian government is singing praises to a project that will cut oil imports by 100,000 barrels a day. And they hope that Itaipu will translate into entire new cities and jobs for an emerging South America. **PM**

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A GREAT WAY TO SERVE

ELECTRONIC HOUSE CALLS

(Continued from page 84)

scale out of the bathroom or revert to a mechanical model.

Digital thermometers

Like the bathroom scale, the digital thermometer costs two to three times the price of the conventional analog model, but with a difference. Digital thermometers are easy to read—a fact you'll appreciate if, like most people, you've always struggled to get the magnification angle just right to read that skinny sliver of mercury.

Doctors and hospitals generally use digital thermometers for another reason—most models can be fitted with throwaway single-use mouthpieces. This makes for absolute sterility without the taste that comes from disinfecting with alcohol. Additionally, digital models can't be fooled by the patient who's faking and rubs the thermometer to get a higher temperature. The reason: The nurse never leaves the room, because the digitals react so fast.

A digital thermometer is the first electronic health care item you might buy. Prices range from about \$12 to \$35, and extra probe covers, in 50 or 100 packs, cost from 5 to 10 cents each.

The price, by the way, may be a real

bargain, because unlike glass thermometers, the digitals are hard to break. There's a safety benefit here, especially if you have infants or young children.

The LCD displays on electronic thermometers read degrees and tenths of a degree Fahrenheit. While most are one-piece designs that weigh hardly more than a conventional analog version, a few more expensive models have a probe on a cable that connects to the electronics and the digital readout.

There are no clear standouts among brands of thermometers. Just as with buying a glass/mercury type, buy what your drugstore, catalog showroom or department store happens to be featuring. Shop around for price, though. Unless you're buying for a hospital, a \$12 model will work just as well for you as one of the more expensive ones.

Checking your blood pressure

The most popular home health care item today is the electronic BPG—a roll-your-own blood pressure gauge.

The bare-bones blood-pressure gauge retails from \$70 to \$90, and will have a liquid-crystal display to show your systolic (the peak pressure during each heartbeat) and diastolic (lower pressure between heartbeats) blood pressure after you pump up the cuff sensor wrapped around your arm.

Because there are so many marginally similar products, some manufacturers add more features at a higher price. For example, a more expensive \$170 BPG automatically inflates the cuff and might also measure your pulse. It might even print a timed and dated record of these measurements on regular adding-machine tape. When it's not measuring your vital signs, the BPG may display the time of day.

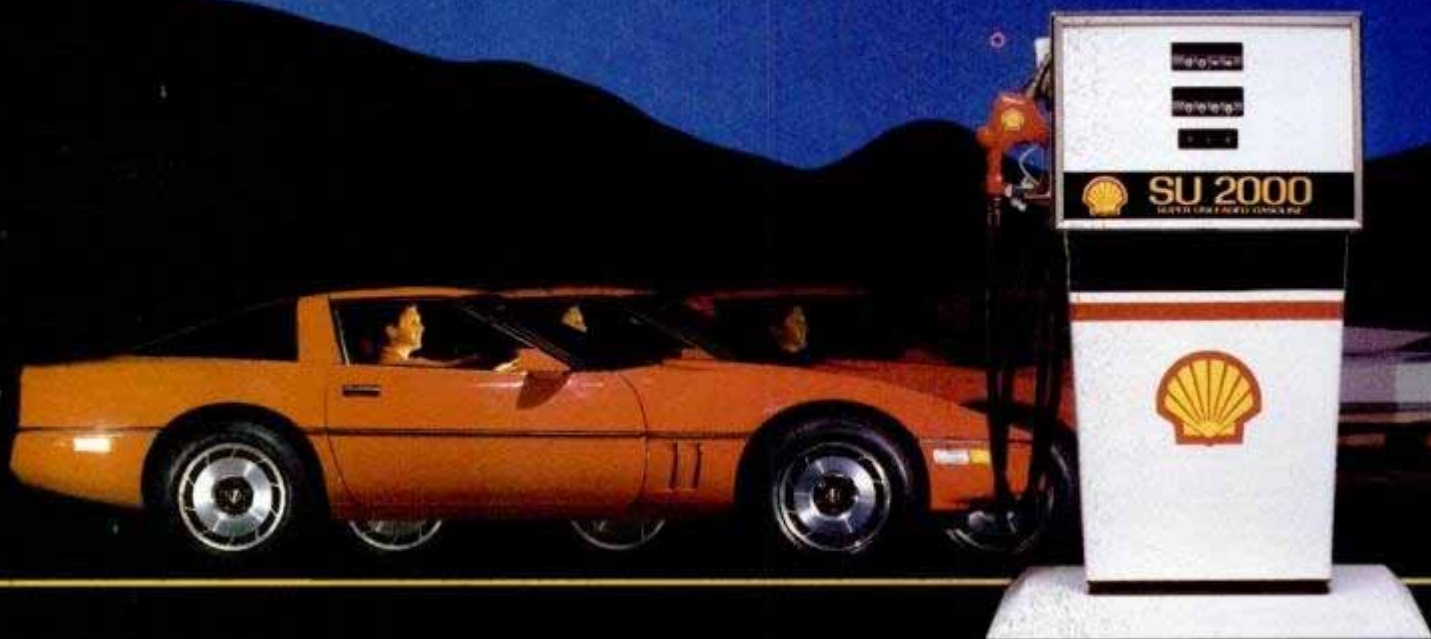
Which one is best? That depends on your budget, and how much convenience you want in your BPG. One word of caution, though.

Electronic BPGs are sensitive devices that can malfunction from several causes. These include vibration or rough handling, excessive heat, exposure to strong magnetic fields or electrical signals.

We checked with various medical and consumer product safety agencies around the country and found no pattern of complaints against faulty electronic BPGs. But for an extra margin of safety, medical authorities recommend that you bring a newly purchased BPG to your doctor to check its accuracy against the regularly calibrated office model. Repeat this precaution on subsequent visits to the doctor.

The best defense against possibly misleading BPG readings is regular

Turn your car into an



medical checkups. If you know your blood pressure is generally high, a "normal" or "low" reading on the home unit will tell you something's amiss.

Checking your pulse

While some BPGs also measure pulse, there are people who want to know their pulse rate only. Simple fingertip pulse gauges are available from several sources. Some are even built-in as part of digital wristwatches.

A one-of-a-kind device is the fingertip Pulse Tach, which also contains an audio beeper so you can "listen" to your heart beat. It comes on a neck lanyard and doubles as a stopwatch when it's not counting pulses. A combination unit called the Actimeter is really an exercise computer. The master unit—about half the size of a pack of cigarettes—is worn like a wristwatch, and is cabled to a fingertip pulse meter. The computer meters your exertion during exercise, and lets you know when you reach a preset pulse rate.

Breath analyzers

Worried about drunk drivers? You should be. Intoxication causes more highway deaths than any other single cause today, and state laws are getting tougher and tougher to combat this menace. If you're a homeowner giving a

party, some states have laws that hold you liable if someone who drinks in your house gets into an accident.

To be alert to physical and legal hazard, breath analyzers are accurate and inexpensive (about \$40) devices for judging blood-alcohol levels.

Breathalyzers are easy to use. Your subject simply blows into it. The sample is automatically sealed in a compartment where it's measured against a "standard" calibrating gas—the same standard gas used by the police in their own breathalyzers.

The Blotron breathalyzer by Delta Labs uses lights to denote alcohol levels. If there's too much alcohol present, a red LED lights up. A lack of measurable alcohol flashes the green light. Some alcohol, but not enough to make an adult *legally* drunk, illuminates a yellow bulb. This should be read as a danger warning. Because it takes some time for alcohol to enter the bloodstream, your subject might still be capable of lighting the red bulb soon after getting behind the wheel.

By comparison, the Lumiscope breathalyzer provides an actual alcohol percentage readout on its digital LCD display. To use this model, you'll need to know what blood-alcohol levels will lead to arrest in your community. These levels vary around the country.

Calling for help

While not strictly a medical electronics item, there's a new class of potentially lifesaving telephones to help the elderly or partially incapacitated.

These are memory-dialing phones with a prerecorded message. Hit a "Help" button on the phone, and it dials a preprogrammed number for the police, ambulance squad, hospital or relative. As soon as the connection is made, the phone plays a recording to describe your condition, potential health problems and location.

Typical are units made by AT&T, Mura and Technicom. The AT&T model isn't really a phone at all, but an emergency medical alert system that places the call automatically. The other two are full-featured memory phones with the additional panic-button feature. Prices range from \$199.99 for the Mura (Sage-1) to \$349.99 for the Technicom Smart Care. The AT&T Emergency Call System is \$259.98.

The most intriguing feature of these automatic phones is their remote-control panic button. This is a radio transmitting device, about half the size of a pack of cigarettes, with a single panic button to activate the emergency-dialing phone. It can be carried on a wrist lanyard, worn as a pendant or on a belt—ready for instant action. **PM**

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TWO-SEAT CAR TEST

(Continued from page 83)

induce, despite its wide 215/60R14 Eagle GT tires. On rough surfaces, the Fiero is a handful even when driving at low speeds. And as for taking rough road at high speeds, forget it.

"Like the Corvette," wrote one tester, in summary, "the Fiero has a confined driving compartment inside a large, wide car. Judging from the spec sheet, this car *should* be fun to drive, but the awkward driving position and inept steering/suspension spoil all of its potential."

Mazda RX-7 GSL

Two of our test group own RX-7s. They like their GSLs, but our test car was one of the worst Mazdas we've ever been in. An extra \$4,000 worth of useless geegaws had been tacked on by the importer, while the engine was down on power and handling was compromised by cheap and slippery Bridgestone Steel Belted 70 tires.

Eight years after it came out, the RX-7 is still one of the prettiest cars on the road. Unfortunately, our particular car had an inexpertly installed air dam and rear spoiler which not only ruined the

car's lines, but were cheaply made and about to fall off.

"The new console and dashboard do not complement the rest of the interior," wrote one of the testers who owns a GSL. "The gaudy, overstuffed seats are inappropriate in a sports car. Mazda is trying to Americanize the RX-7, and it's not half as nice as when the car first came out."

The Wankel rotary has always been thirsty, so we expected poor fuel economy. What we didn't expect was sluggish performance, a notchy shifter and handling/braking that are embarrassingly poor. We blame carburetor choke problems, shift linkage maladjustments and cheap tires, respectively. The 135-hp GSL-SE is a much faster car than Mazda's RX-7 GSL, but is above the \$15,000 ceiling we set for this test. This RX-7 felt old-fashioned compared to the CRX Si or MR2.

Mazda obviously feels the same way. This fall, the RX-7 will be replaced with a new model. It will use the larger 13B rotary from the GSL SE, all-independent suspension similar to that under the 626 and rounded bodywork reminiscent of Porsche's 928 (see *Imports And Motorsports*, page 10). Prices will be much higher than currently, as Mazda aims to take on the Nissan 300ZX, Porsche 944 and Corvette.

We'd like to see Mazda call its new car the RX-8, and keep the current RX-7 in production in the \$10,000 range. A good RX-7 is lovely to look at, pleasant to drive, surprisingly spacious and just about indestructible.

Alfa Romeo Graduate

You remember Dustin Hoffman in the red Alfa Romeo Spider in "The Graduate"? Well, it's taken 17 years, but Alfa has finally been able to capitalize on that free publicity by naming its new convertible after the movie. Ironically, it's literally the same car Dustin Hoffman drove. As one of our testers commented, "The only thing missing is Mrs. Robinson."

The Graduate is the Spider Veloce with \$4,000 taken out of the price tag by the deletion of leather upholstery, power accessories, air conditioning and alloy wheels.

If what you want is a brand-new 1968 Alfa Romeo, the Graduate fills the bill. It has low-back bucket seats, a huge wooden-rimmed steering wheel, a big round tach and speedometer, and a shift lever that grows almost horizontally out of the dash. The body is a timeless Pininfarina design reminiscent of Ferrari models that went out of production sometime during Lyndon Johnson's term in office.

It's a time warp, pure and simple. If you respond to the vintage driving position, the heavy but positive steering

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and jaunty exhaust note, you'll think the Alfa is terrific. If you want high-tech convenience and reasonable comfort, the Graduate will seem like an overpriced anachronism.

The Alfa is actually a pretty good car, even by 1985 standards. The double-overhead-cam, two-liter Four is still state-of-the-art, as are the four-wheel disc brakes and crisp five-speed transmission. The Alfa Romeo Graduate was faster through the slalom than all but the MR2, and posted .80 on the skidpad, which is very respectable. The brakes are terrific, the acceleration sprightly and the handling exquisitely neutral. Best of all, you can put the top down.

Bertone X1/9

The Bertone is the former Fiat X1/9, which was also designed in the late '60s. Unlike the vintage Alfa, however, the Bertone X 1/9 is up-to-the-minute in specifications—a mid-engined, single-overhead-cam, 1.5-liter wedge with a hardtop that lifts off to make a quasi-convertible. And it's got four-wheel disc brakes and all-independent suspension under all that.

Our testers thought the Bertone was "still pretty after all these years," and "fun to fling around." But most of them had trouble accepting it as a real car. The small Fiat Four feels out of breath at any rpm, acceleration is lackluster, and as you might expect from a mid-engine car, the loud engine "feels like it's in your inner ear."

Surprisingly, the Bertone's handling is not nearly as quick as you'd expect. Our testers also mentioned a disconcerting side-to-side wander at highway speeds, and a feeling of instability even driving on mild off-ramps. Wrote another tester: "It's not as much fun to drive as it looks."

Other testers criticized its "flimsy controls, even the steering wheel seems fragile," the "poorly laid out instruments," "antiquated ventilation system" and "impossible engine maintenance." As they summed it up: "The car is seriously outclassed in this group. It's a design whose time has passed."

Conclusions

Our conclusion? The Japanese are taking over the sports car world, too. Our first choice out of this group of two-seaters is pretty much a tossup between the more practical CRX and the racy MR2. Subaru needs some time to polish its act, which is common with many brand-new models. For honest sports car virtue, try an RX-7 with as few options as possible. The Fiero needs serious development work to move out of the overpowered commuter car category. And the Italian cars are just outdated.

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WOOD VENEERING

(Continued from page 99)

multi-piece veneer assembly such as the diagonal-quarter match and hexagonal table top shown. Position the mirrors at a 90° angle to reflect a four-piece match. Shift the mirrors to 60°, 45° and 22½° to visualize a 6-, 8- and 16-piece match, respectively.

Once you find the desired match, mark pencil lines along the inside edges of the mirrors. Cut out the veneer pieces using a veneer saw or utility knife guided by a straightedge or hardboard template. Then, tape the veneer pieces together with gummed veneer tape and apply them as a single unit. After trimming the overhanging veneer edges, moisten the veneer tape and remove it with a cabinet scraper.

Decorative walnut box

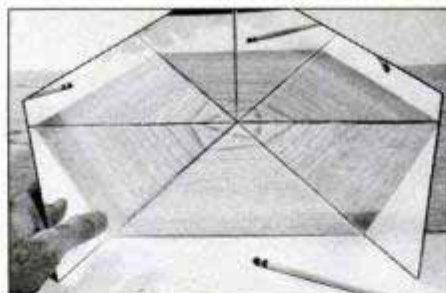
This attractive box is accented with a floral design overlay top veneer and an inlay veneer border. Both of these veneers are typical examples of the many ready-made veneers available for enhancing your woodworking projects.

First, cut the four box sides and bottom from ½-in. walnut. Make the box top, which receives the overlay veneer, from ½-in. birch plywood edged with ½ × ½-in. walnut.

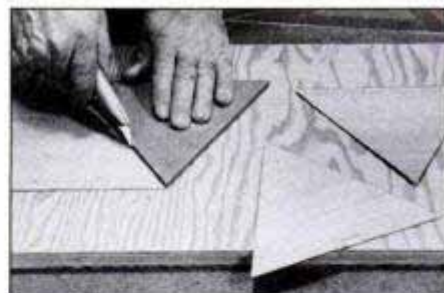
Since the floral design overlay veneer was wavy and uneven, we applied it with yellow woodworking glue instead of veneer glue to reduce the possibility of buckling. To prevent the veneer from shifting while clamping pressure is applied, drive two ½-in.-long brads into the veneer. After the glue dries, set the bradheads slightly then fill the holes with walnut-colored wood putty.

Next, apply veneer to the underside of the box top to counterbalance any expansion or contraction in the top veneer that could cause warping. Then, shape the top's edges with a 5/32-in. roman ogee bit. Now, cut a shallow groove in the box bottom's edges on a table saw to receive the inlay border. Glue the border in place with yellow woodworking glue.

HEXAGONAL TOP WITH INLAYS



Hold two mirrors at a 60° angle to reflect a six-piece veneer match. Then, mark pencil lines along the inside mirror edges.



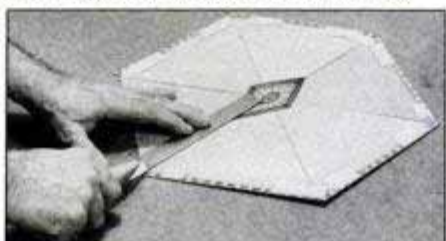
Use a hardboard template to cut six veneer pieces. Make a small cut in veneer edge to prevent splintering as the knife exits.



Assemble the pieces into a hexagon shape using gummed veneer tape. If cut accurately, the last piece will fit without trimming.



Tape the diamond-shaped inlay motif to the veneer assembly for use as a template when cutting out the center area with a knife.



Cut and tape the border inlay strips in place. Align a steel straightedge rule with the veneer joints to cut tight-fitting miters.



Apply veneer glue to the hexagonal assembly and to the table top which is made from ½-in. fir plywood edged in hardwood.



Separate glued surfaces with wax paper to permit positioning veneer exactly. Remove the paper and press down the veneer.



The completed table top after trimming, tape removal and finish-sanding. Allow about 48 hours before applying a finish.

BOX WITH DECORATIVE INLAY AND OVERLAY VENEERS



Make the box top from ½-in. birch plywood edged with ½ × ½-in. walnut. Glue and tape the edging to the plywood top.



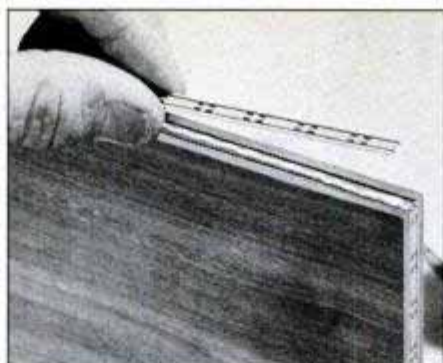
We applied the wavy overlay veneer with woodworking glue. Apply glue to both surfaces and clamp quickly before it sets.



Remove protective paper from the veneer by moistening it slightly and then scraping it with a wide chisel or cabinet scraper.



Shape the decorative box top edges using a router fitted with a $\frac{5}{32}$ -in. roman ogee bit. Finish-sand the top with 220-grit paper.



Cut shallow grooves in the box bottom edges on a table saw for the inlay border strips. Install the strips using glue only.



The finished walnut box is enhanced by the use of the ready-made floral design overlay veneer and the unique inlay borders.

Door with walnut crotch inlay

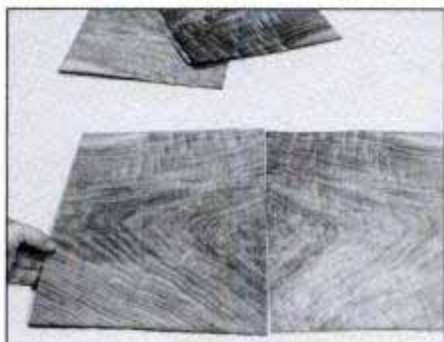
Here's a clever way to make unique, custom cabinet doors featuring two veneers of different wood species. We used book-matched walnut crotch veneer for the center inlay and contrasting butternut veneer for the border. Apply the veneers to a $\frac{3}{4}$ -in. fir plywood door panel edged with hardwood.

First, tape together two matching crotch veneer pieces. Next, cut a full-size hardboard template of the center inlay. Use the template to cut out the center of a sheet of paper. Position the paper "window" on the crotch veneer, selecting the most desirable wood grain pattern for the inlay.

Then, mark the paper's corner loca-

tions with masking tape. Tape the butternut veneer over the walnut crotch veneer and use the template and a sharp utility knife to cut through both the veneers simultaneously. Now, tape the walnut inlay to the center of the butternut veneer border and apply the veneers as a single unit to the door panel using veneer glue. **PM**

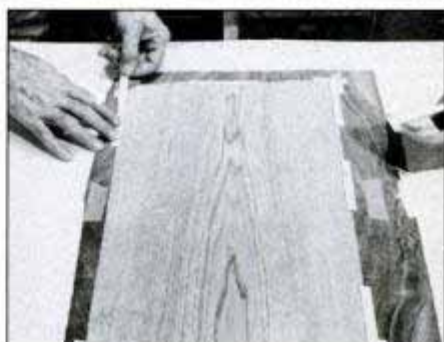
CABINET DOOR WITH WALNUT CROUCH INLAY



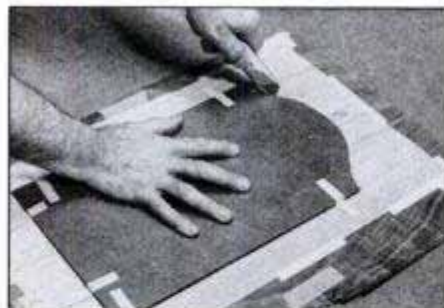
Butt together two walnut crotch veneer pieces in a book match design. Trim the mating edges to form a tight-fitting joint.



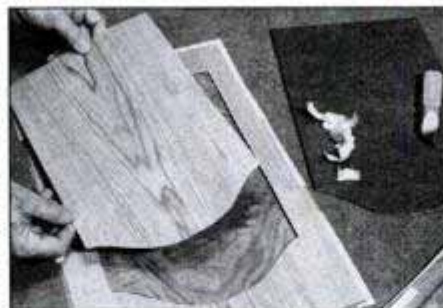
Mark the paper window corner locations with masking tape. Position the window so that the most attractive wood grain shows.



Tape the butternut veneer to the walnut veneer using the tape corners as guides. Butternut veneer will form door border.



Tape a hardboard template in place and cut through both veneers at once. Firm pressure on template will prevent shifting.



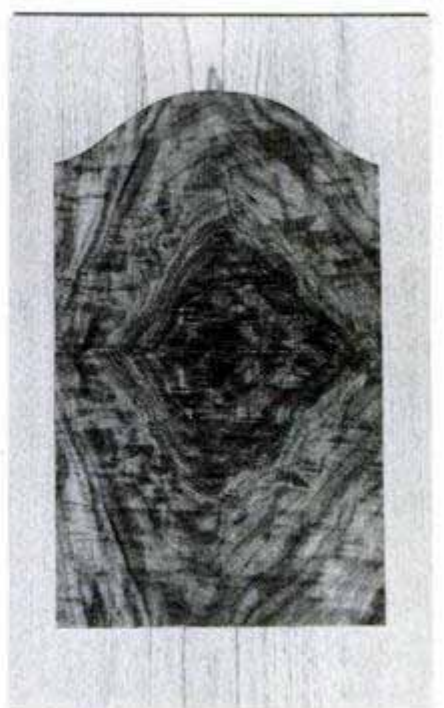
Remove butternut center cutout and the outer walnut border. Then, tape together the walnut inlay and the butternut border.



Veneer the door panel backside to counter-balance any expansion or contraction of the face veneers which might cause warping.



Apply the face veneer to the door panel with veneer glue. Use a veneer roller to ensure 100 percent surface contact.

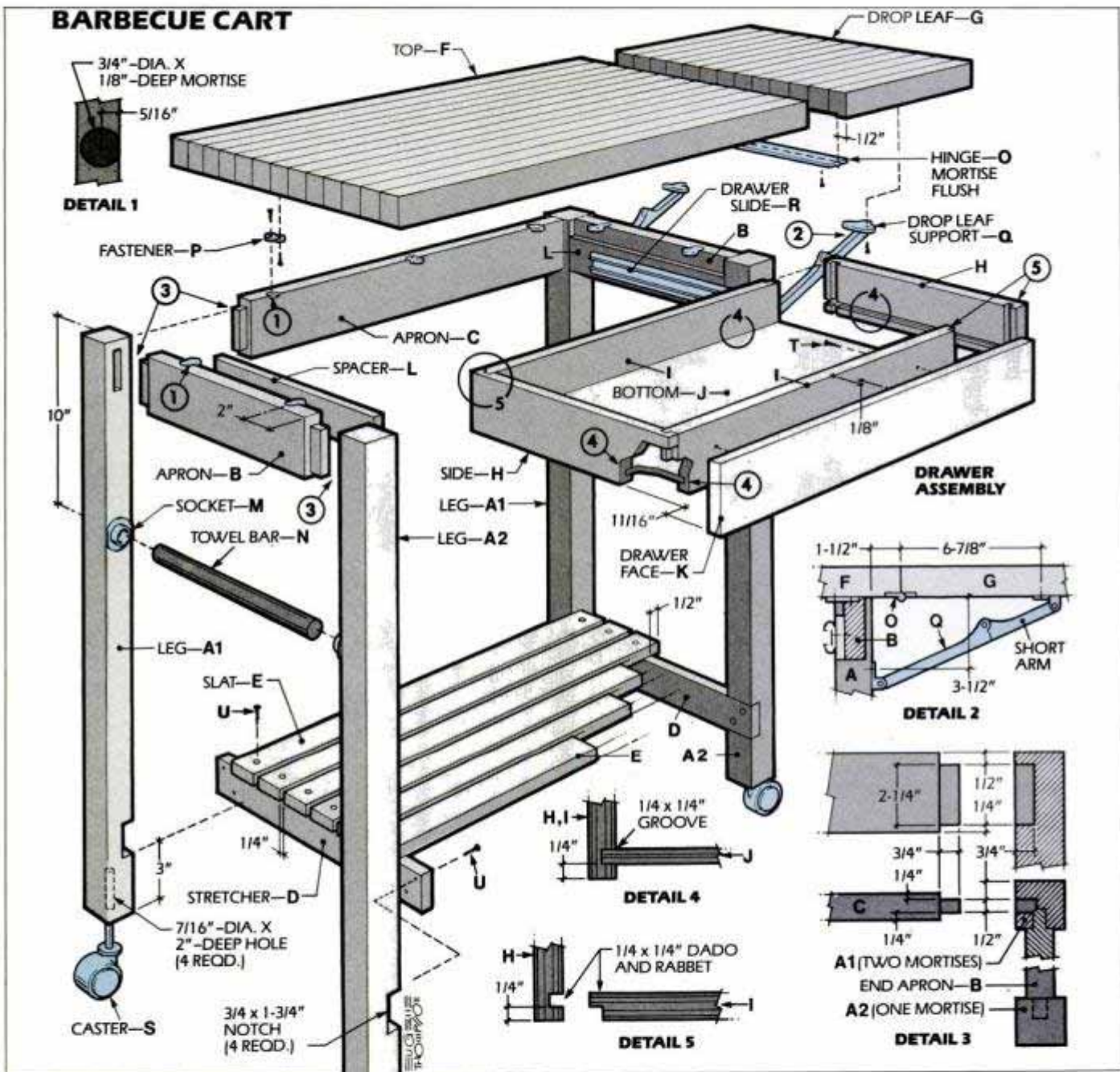


The completed cabinet door shows off a unique walnut crotch inlay surrounded by a contrasting butternut veneer border.

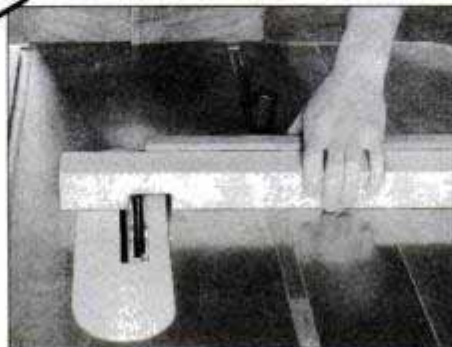
MATERIALS LIST—BARBECUE CART

Key	No.	Size and description (use)	H	2	1/2 x 23/4 x 13" Baltic birch plywood (drawer side)	N	1	1 1/4"-dia. x 12 1/8" red oak (towel bar)
A	4	1 3/4 x 1 3/4 x 30" red oak (leg)	I	2	1/2 x 23/4 x 21 1/2" Baltic birch plywood (drawer front, back)	O	1	1 1/2 x 17" continuous hinge
B	2	1 x 3 x 14" red oak (end apron)	J	1	1/4 x 12 1/2 x 21 1/2" birch plywood (drawer bottom)	P	7	tabletop fasteners
C	1	1 x 3 x 25" red oak (side apron)	K	1	3/4 x 2 1/8 x 23 3/8" red oak (drawer face)	Q	2	10" Stanley No. 1956 drop-leaf supports
D	2	3/4 x 1 3/4 x 16" red oak (stretcher)	L	2	1/2 x 2 x 12 1/2" Baltic birch plywood (spacer)	R	2	12" Knafe & Vogt No. 1400 full-extension slides
E	6	3/4 x 1 7/8 x 26" red oak (slat)	M	1	1 1/4"-dia. closet rod support bracket set	S	4	2" Shepard Pacer casters
F	1	1 1/4 x 18 x 30" red oak (top)				T	2	1" No. 10 rh brass screws
G	1	1 1/4 x 12 x 18" red oak (drop leaf)				U	20	1 1/2" No. 8 rh brass screws

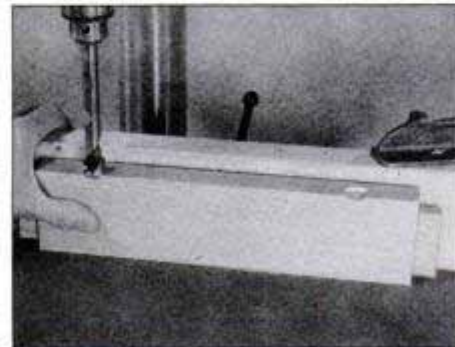
BARBECUE CART



Cut apron tenons on table saw using dado blades. Clamp, on miter gauge, acts as stop block for making repeated cuts accurately.



Also use dado blades to cut notches in legs for stretchers that support shelf slats. Stretchers are glued and screwed in place.



Using a drill press, bore 1/4-in.-dia. x 1/8-in.-deep holes in top edge of aprons to act as mortises for tabletop fasteners.

for about \$340. This method creates strong, durable joints in a fraction of the time required by other techniques. There are, however, many other ways to join the top boards. For reference on these see *7 Expert Ways To Make Butcher Block*, page 76, Sept. '84. Because this cart may be exposed to the weather, use plastic resin glue on all joints.

Next, lay out the mortises in the legs. Then, using a drill press, bore overlapping $\frac{1}{2}$ -in.-dia. holes, $\frac{3}{4}$ in. deep to remove most of the waste. Use a sharp chisel to square the ends of the mortises and pare the walls smooth. Cut the tenons on the ends of each apron member with dado blades in a table saw. Then cut the notches in the legs for the stretchers.

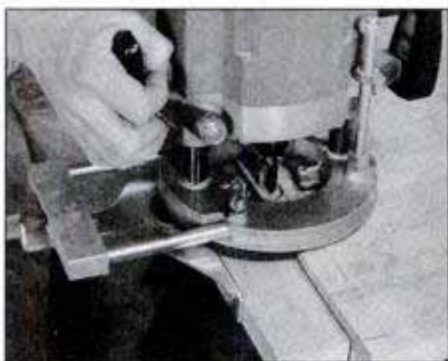
Using the drill press, bore $\frac{3}{4}$ -in.-dia.

$\times \frac{1}{8}$ -in.-deep mortises in the top edge of the apron members to accept the tabletop fasteners. Then, test each mortise-and-tenon joint and adjust as required for proper fit. The joints should be snug but should not require great force to bring them tight. Finally, bore a $\frac{7}{16}$ -in.-dia. \times 2-in.-deep hole in the bottom of each leg for the caster sockets. Presand the legs, aprons, stretchers and slats with 120- followed by 220-grit sandpaper.

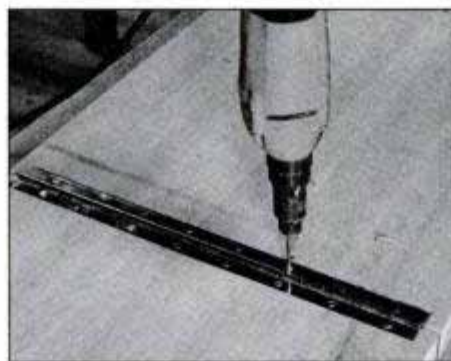
Assembly

Begin the base assembly by gluing one of the end aprons between its respective legs. Then, glue and screw the stretcher in place and check the side for square. Repeat this process for the other side. When both sides are dry,

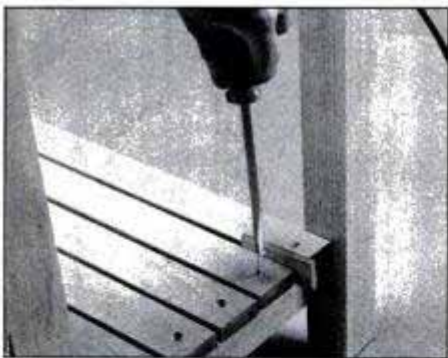
(Please turn to page 128)



Using a router with edge guide attached, cut shallow mortise in underside of top and drop leaf to receive continuous hinge.



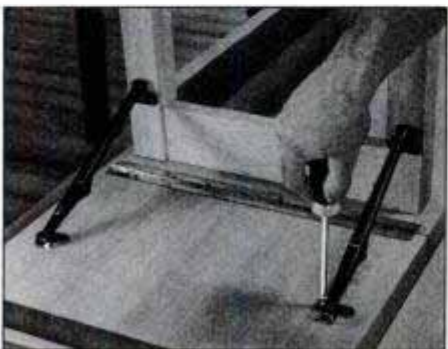
Join top and drop leaf by installing continuous hinge in precut mortises. Bore pilot holes and use $\frac{1}{4}$ -in. No. 5 fh screws.



Join slats to stretchers with screws driven into countersunk pilot holes. Use $\frac{1}{4}$ -in.-thick scrap block to maintain even spacing.



Attach tabletop fasteners to aprons using $\frac{3}{8}$ -in. No. 8 fh screws. Note how fastener mortises intersect inside edges of aprons.

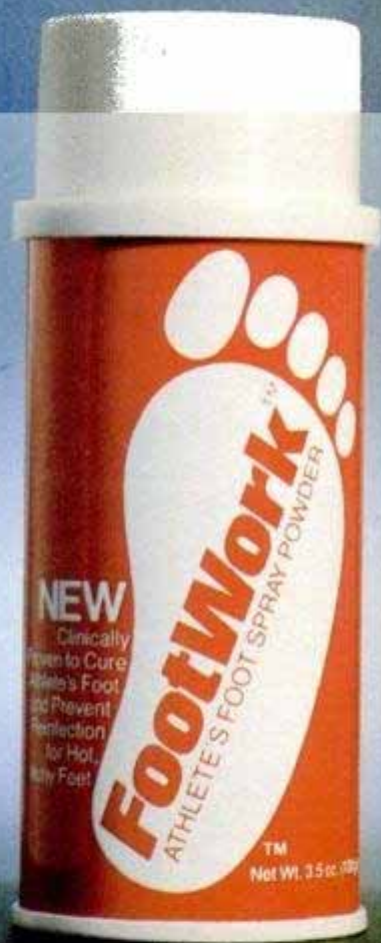


Invert top and leaf assembly on workbench, then center base over top section only. Attach fasteners and leaf support brackets.



Turn towel bar to $1\frac{1}{4}$ -in. dia. on lathe using red oak stock to match rest of cart. Sand smooth, then cut to length on table saw.

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OAK BARBECUE CART

(Continued from page 127)

install the side apron. Be sure to work on a flat and level surface so that the base will not twist.

Next, screw the slats to the stretchers to form the bottom shelf. Use a 1/4-in.-thick wood spacer between the slats to ensure uniform alignment. Attach the tabletop fasteners to the apron with 5/8-in. No. 8 fh screws.

Surface the top using a hand plane, belt sander and cabinet scraper. Cross-cut to finished dimension, including the drop leaf, using a circular saw and straightedge guide, then cut the leaf from the top using the same method.

Lay out the position of the continuous hinge on the underside of the top. Then, using a router with an edge guide attached, cut a 1/16-in.-deep mortise for the hinge in both the top and leaf. Use a sharp chisel to square the corners of these mortises. Then, sand the top with 120- followed by 220-grit sandpaper and install the hinge.

With the top still upside down, center the base over it and mark the position of each tabletop fastener. Bore pilot holes for the screws and fasten the top to the base. Install the drop-leaf supports and casters according to the manufacturers specifications that are supplied with the hardware.

Stand the cart upright and install the closet rod brackets for the towel bar. Then, turn a 1 1/4-in.-dia. red oak dowel on the lathe for the towel bar. Sand the dowel with 220-grit abrasive while in the lathe, then use the table saw to trim to finished length.

Building the drawer

Following the plans, cut the drawer sides, front and back from 1/2-in.-thick Baltic birch plywood and the drawer bottom from 1/4-in.-thick birch plywood. Use dado blades in the table saw to cut the grooves for the drawer bottom in the drawer sides, and to cut the matching rabbets and dadoes that form the drawer corner joints. Presand all drawer parts and assemble with glue and 4d finishing nails. Check the drawer for squareness and set it aside. When the drawer is dry, attach the red oak drawer face with two, 1-in. No. 10 rh screws.

Screw 1/2-in.-thick spacers to the inside surface of each end apron and mount the drawer slides according to the manufacturer's instructions.

Spot-sand the workpiece as necessary to remove any scratches. Then, finish the barbecue cart with mineral oil or another nontoxic finish. Apply at least three coats of oil, allowing each to soak thoroughly into the wood before wiping off. If desired, the base of the cart may be finished with a more wear-resistant finish such as Watco oil. **PM**



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DECK FURNITURE

(Continued from page 116)

This stretcher should bear against the lower edge of the seat-support sides when the back is in its upright position.

Join the armrests to the seat back, and to the arm posts. Then, check to see if all parts move smoothly and do not bind when the chair is folded. Disassemble the chair for finishing.

Since the chairs are designed to be used outdoors, we chose a tough marine varnish. We applied three coats of Waterlox Marine Finish, thinning the first coat 15 percent with turpentine and applying the next two coats full strength. Let each coat dry thoroughly and sand lightly with 220-grit sandpaper between coats. Remove any dust with a tack cloth.

Folding table

The mechanics and construction methods for the folding table are much the same as those used for the chairs. The brass brackets used for attaching the legs are identical.

Cut all parts to size and surface to specified thickness. Make a template for each leg shape and trace the shape onto the blanks. Using the band saw, cut out each leg and drum-sand smooth. Rip and crosscut to size the tabletop parts and leg stretchers.

With the dado blades, cut the tenons on the tabletop slats and end rails. At the same time, cut the rabbets on the stretcher ends. With a fence on the band saw, cut the shoulders for the tenons on tabletop slats and end rails.

Lay out the position of the mortises in tabletop rails. Bore overlapping $\frac{3}{8}$ -in.-dia. holes to remove the waste from the mortises. Again, use a sharp chisel to clean up the mortise corners and side walls. Test-fit and adjust all joints.

To assemble the tabletop, begin by gluing the slats to the end rails. Then, slide the side rails over the end rail tenons, clamp and check for squareness by comparing diagonal measurement. Set aside to dry.

Lay out and bore holes in the legs where indicated and assemble each pair to their respective stretchers with glue and brass screws.

When the top is dry, mark the radii on the corners and cut. Sand these edges smooth, then sand the remaining parts with 120- followed by 220-grit sandpaper. Attach the brass brackets to the underside of the tabletop and join the legs together with machine screws and nuts as shown. Use one washer under the screwhead and two between the legs. Bolt the two legs with rounded tops to the brass brackets and check that the table sits flat when open and that it folds smoothly. Disassemble, spot sand and finish. **PM**



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—Alice and Robert Tupper

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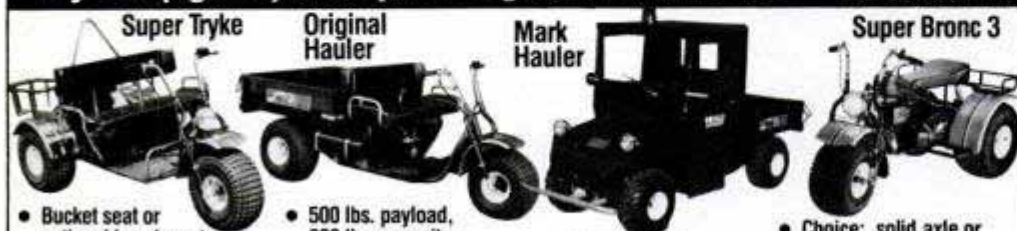
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SPORT PLANES

(Continued from page 88)

42 hp in the Panther Plus to 65 hp in the Zodiac and are designed to offer leisurely fun flying on low, economical power. Top speeds, generally modest, run from 70 mph to a surprisingly zippy 140 mph for the lissome, sailplane-like Silhouette.

For those looking for something a bit hotter, there are the Polliwagen and Aero Mirage TC-2, both fast, sporty, side-by-side two-seaters of all-composite construction with speeds in the 200-mph range. Both are also designed to take a variety of engines—from 65 to 100 hp in the TC-2 and from 75 to 160 hp in the Polliwagen.

The Polliwagen can be built from plans alone costing \$120 or from pre-fabbed parts totaling about \$12,000, less engine. The TC-2 sells as a kit for about \$9,000, less engine.

Faster still are the Miller GEM-260, a 100-hp, 270-mph tandem two-seater, and the Super Acro Zenith, a 200-hp, highly stressed, aerobatic single-seater with speeds up to 250 mph.

The Super Acro Zenith was designed by Chris Heintz, famous maker of the Zenith, Tri-Z and other popular homebuilts, including the Zenair Zodiac also shown here. It was developed especially for Jay Hunt, a top Canadian aerobatic competition pilot, and is now being offered to homebuilders. The kit is expected to sell for about \$14,000, less engine.

The GEM-260, a distinctive shape with a pusher prop tucked in under a high tail, is patterned after an earlier Jim Miller design for a Formula One racer and looks fast just standing still. It will sell as a kit for under \$20,000, less engine.

FM

KIT PLANE SOURCES

- **Aero Mirage TC-2:** Aero Mirage, 3009 N.E. 20th Way, Gainesville, Fla. 32601 (info pack \$7).
- **Defiant:** Rutan Aircraft Factory, Building 13, Mojave Airport, Mojave, Calif. 93501 (info pack \$10).
- **Kitfox:** Denney Aircraft Co., 6140 Morris Hill Lane, Boise, Idaho 83704 (info pack \$5).
- **Miller GEM-260:** Miller Air Sports Inc., Municipal Airport, Rte. 2, Box 356-D, San Marcos, Tex. 78666.
- **Panther Plus:** Rotec Engineering Inc., Box 220, Duncanville, Tex. 75116 (info pack \$5).
- **Polliwagen:** Polliwagen Inc., Box 860, 40940 Eleanor Way, Murrieta, Calif. 92362 (info pack \$7).
- **Prescott Pusher:** Prescott Aeronautical Corp., 1006 West 53rd St. North, Box 4590, Wichita, Kan. 67204 (info pack \$25).
- **Seawind:** Seawind International, Box 878, Haliburton, Ontario K0M 1S0, Canada (info pack \$10).
- **Silhouette:** Task Research Inc., 848 East Santa Maria St., Santa Paula Airport, Santa Paula, Calif. 93060 (info pack free with large-size SASE).
- **Sun Ray:** Sun Aerospace Corp., Box 317, Napanee, Ind. 46550.
- **Super Acro Zenith CH180:** Aerovol, 2689A Sandalwood Dr., Ottawa, Ontario K1V 7P4, Canada (info pack \$20).
- **Swearingen SX300:** Swearingen Aircraft Corp., 5418 Brewster, San Antonio, Tex. 78233 (info pack \$7.50).
- **V-8 Special:** Chris Beachner, Box 31294, Tucson, Ariz. 85751-1294 (info pack \$5).
- **Zenair Zodiac CH600:** Zenair Ltd., King Rd., Nobleton, Ontario L0G 1N0, Canada (info pack \$8).

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BRAKES

A CENTURY OF PROGRESS

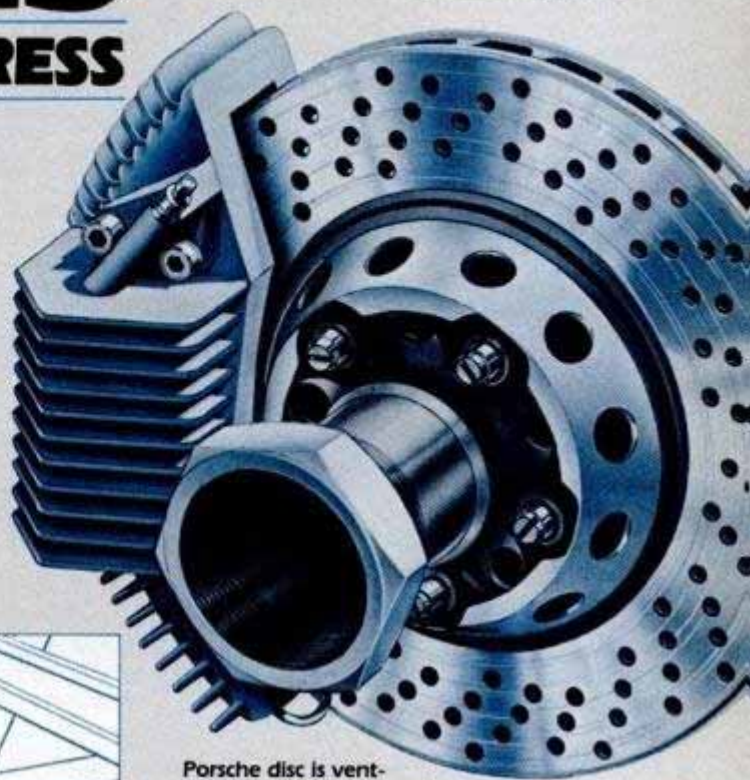
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YEARS

From cable-operated brakes with leather linings to computer-controlled antiskid four-wheel discs, brake progress won't stop.

BY MORT SCHULTZ

Illustrations by Pat Ruggero and George Retseck

A steel cable wrapped around a drum on the rear wheel formed the braking system of the 1899 Daimler. It's a system that dates back to the "axle-snubbing" chains used by Roman chariot drivers. Turn-of-the-century cars used similar contracting external brakes on the rear wheels only, on the driveshaft, or on both.



Porsche disc is vented and drilled for cooling. Reinforcing ribs keep caliper from flexing due to the high hydraulic pressure. Such brakes slow racers from 230 mph to 30 mph repeatedly during 24-hour endurance races.



A major test of brake systems took place in 1902 on an unpaved road in New York City called Riverside Drive. Ransom E. Olds had arranged to test a new brake system against the tire brake of a four-horse coach and the internal drum brake of a Victoria horseless carriage. His *Oldsmobile* sported a single flexible stainless-steel band, wrapped around a drum on the rear axle. When the brake pedal was applied, the band contracted to grip the drum.

Olds had entered his car in the Blue Ribbon Contest, a 100-mile race scheduled for August, and wanted to be sure his external brake was a match for the Victoria's expanding-shoe internal drum design and the coach's tire brake—a pad that was applied to the tire by a long lever. Although it ground down solid rubber tires pretty quickly, the tire brake was popular on carriages and many early autos.

From a thunderous speed of 14 mph, the *Oldsmobile* stopped in 21½ ft., the Victoria in 37 ft. and the horses (which may not have been going 14 mph, but had no engine braking to aid them) in 77½ ft.

The *Oldsmobile* went on to win two of nine blue ribbons awarded in the race. The car's braking system made such a big impression on other manufacturers that by

(Please turn to page 134)

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

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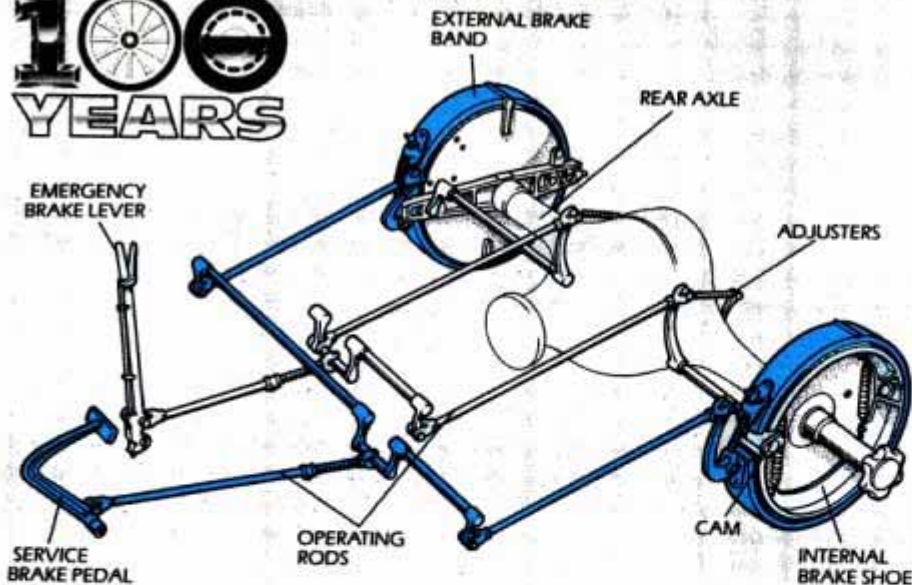
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100 YEARS



The Cadillac Eight of 1915 used internally expanding shoes and externally contracting bands working on the same brake drum. The system was used on the rear wheels only.

1903 most had adopted it. By 1904, practically all car makers were building cars with an external brake on each rear wheel.

Almost at once, the external brake demonstrated some serious flaws in everyday use. On hills, for example, the brake unwrapped and gave way after several seconds. A driver unlucky enough to stall on a grade soon found himself rolling backward.

For this reason, chocks were an important piece of on-board equipment. It was a common sight to see a passenger scurrying from inside the car with wood in his hands to block the wheels.

There was another drawback to the

external brake. It had no protection from dirt so its bands and drums quickly wore. A brake job every 200 to 300 miles was considered normal.

The problems associated with the external brake were overcome by the internal brake. As long as the brake shoes were under pressure, they stayed against the drums to keep the car from rolling backward on hills. And, since brake parts were inside drums and protected from dirt, drivers could go over 1,000 miles between brake overhauls.

The drum brake, as it is now known, became all-dominant in the United States. In Europe, particularly in Great Britain, it had to share the stage with disc brakes. Disc brakes became more or less standard on European cars during the '50s, about 20 years before they were adopted by American manufacturers in 1973.

This is ironic, because the spot-type disc brake is an American invention. In 1898, Elmer Ambrose Sperry of Cleveland designed an electric car having front-wheel disc brakes.

He made a large disc integral with the hub on each wheel. Electromagnets were used to press smaller discs, lined with a friction material, against spots on the rotating disc to bring the wheel to a stop. Springs retracted the spot discs when current was interrupted.

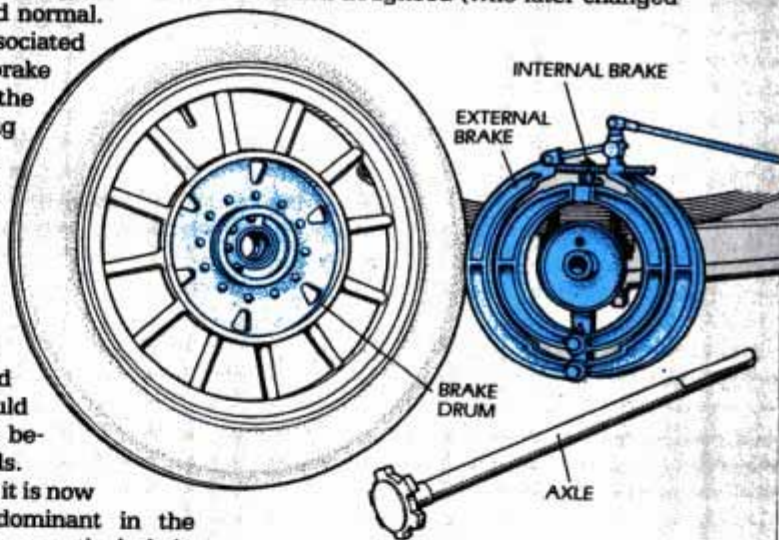
Meanwhile in Great Britain, a patent was issued in 1902 to F.W. Lanchester for a nonelectric spot disc braking system that's similar in principle to what we have today. The biggest problem

that Lanchester encountered was noise. Metal-to-metal contact between his copper linings and the metal disc caused an intense screech that sent chills through anyone within earshot.

This problem was solved in 1907 when Herbert Froad, another Englishman, came up with the idea of lining pads with asbestos. The new material was quickly adopted by car manufacturers on both drum and disc brakes. Asbestos linings also outlasted other friction materials by a wide margin. The 10,000-mile brake job had arrived.

As roads improved and cars began to be driven at high speeds, manufacturers recognized the need for even greater braking power. One solution to the problem became apparent during the Elgin Road Race of 1915. A Duesenberg took the flats at 80 mph, then screeched to a virtual crawl to negotiate the hairpin curves. Duesenberg's secret for such magnificent braking power was to simply use an internal brake on each front wheel as well as each rear wheel.

In 1918, a young inventor named Malcolm Lougheed (who later changed



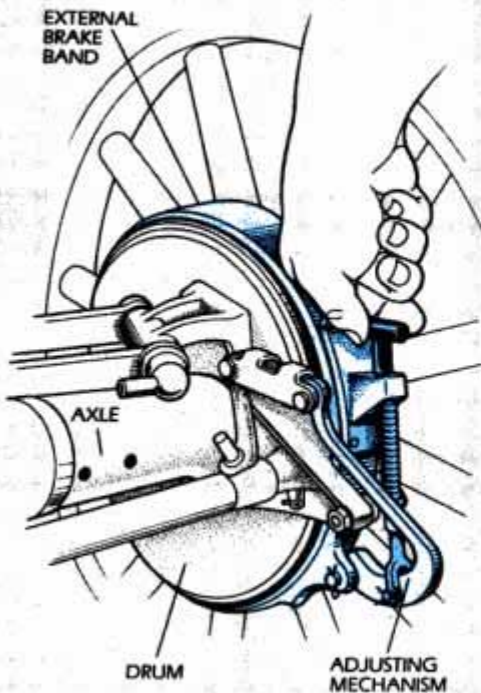
A 1908 design ignores finicky lining materials in favor of metal drums and shoes!

the spelling of his name to Lockheed) applied hydraulics to braking. He used cylinders and tubes to transmit fluid pressure against brake shoes, pushing the shoes against the drums. In 1921, the first passenger car to be equipped with four-wheel hydraulic brakes appeared—the Model A Duesenberg.

Carmakers as a group were not quick to adopt hydraulics. Ten years after the Model A Duesenberg, in 1931, only Chrysler, Dodge, Desoto, Plymouth, Auburn, Franklin, Reo and Graham had hydraulic brakes. All the others still had cable-operated mechanical brakes. In fact, it wasn't until 1939 that Ford finally gave in, becoming the last major manufacturer to switch to hydraulic brakes.

The basic braking system we have today was pretty much in place by

(Please turn to page 136)



External brakes were adjusted by large turnbuckles to compensate for wear; internal brakes by shortening the rods or cables.



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Photo: Peter B. Kaplan

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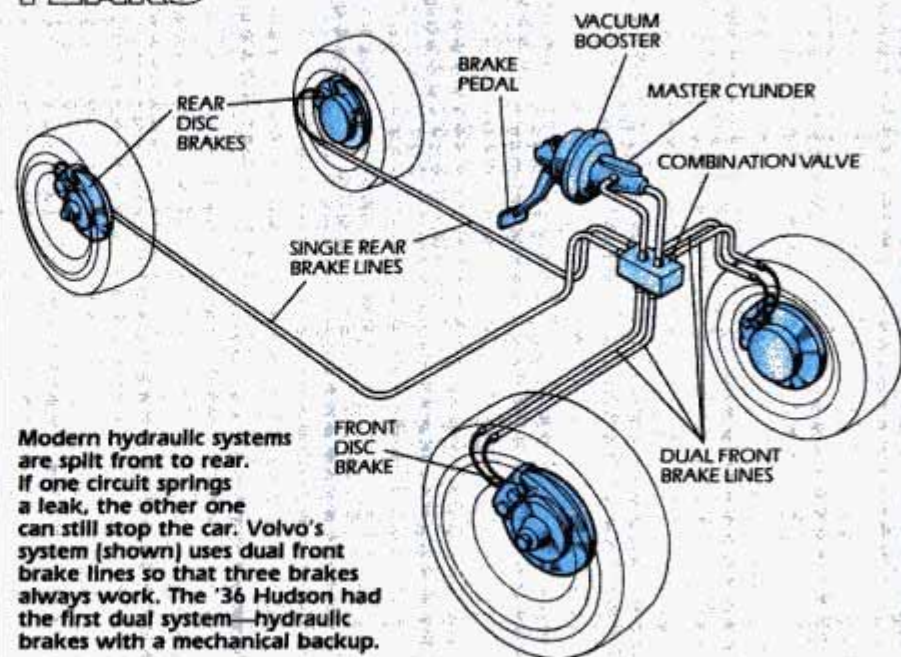
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BRAKES: A CENTURY OF PROGRESS

(Continued from page 134)



Modern hydraulic systems are split front to rear. If one circuit springs a leak, the other one can still stop the car. Volvo's system (shown) uses dual front brake lines so that three brakes always work. The '36 Hudson had the first dual system—hydraulic brakes with a mechanical backup.

1921, including a refinement some regard as contemporary—power assist.

Power assist, technically, dates back to 1903 when a car called the Tincher used air brakes. But the first car to be equipped with a vacuum-operated power booster similar to those we have today was the 1928 Pierce-Arrow. It used vacuum from the inlet manifold to reduce the physical effort needed to apply brakes. Vacuum boosters from then to now have similar designs.

The first widespread deviation from vacuum power assist came about this year. Some 1985 GM cars use an electrically driven brake booster, which is smaller and lighter than the conventional vacuum booster, giving an all-hydraulic system. Some cars with antilock brakes also use all-hydraulic systems.

The first car to have self-adjusting brakes was the 1925 Cole. The prototype for today's systems appeared on the 1946 Studebaker. The mechanism, by Wagner Electric Co., consisted of an adjusting wedge under the influence of a tension spring. As linings wore, a plug receded to move a pin and lever against the spring. This forced the adjusting

wedge against brake shoes, which expanded to keep linings at a preset distance from the drums.

As for the antilock (antiskid) units now becoming available in the U.S., they are hardly new. The first practical antiskid braking system, named Maxaret, was developed in 1958 by the Road Research Laboratories in Great Britain and was first applied to the Jensen FF sports sedan in 1966.

Three years later, in 1969, the Lincoln Continental Mark III was equipped with an Auto-Linear antilock unit developed by Kelsey-Hayes. Sensors on the rear wheels transmitted signals to a transistorized "computer" behind the glove box. The computer controlled a vacuum-operated valve on the rear brake line to modulate pressure to the rear brakes when the sensors told the computer that the brakes were locking.

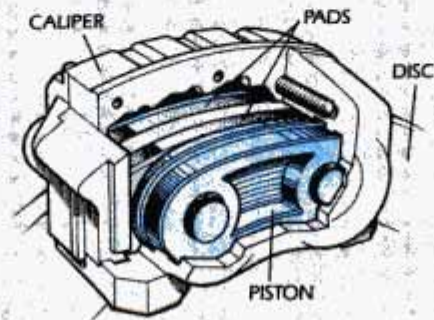
Cost and some technical problems caused the shelving of this unit. But now, updated versions that give four-wheel skid control are being offered by Lincoln, Mercedes and some other cars currently sold only in Europe.

Computerized brakes notwithstanding, there is a piece of advice about using brakes that's as relevant today as it was in 1909 when it was first published in *The American Cyclopaedia of the Automobile*:

"Good driving in traffic is shown by making the minimum use of brakes. The strain on passengers amounts to intense nervousness when the car is constantly driven so that the least alteration of direction or of pace on the part of any vehicle ahead results in the violent application of the brake."

And so it will always be.

PM



Alhart racing discs use kidney-shaped pistons for even pressure transfer to pads.

FORD TAURUS/MERCURY SABLE

(Continued from page 71)

Taurus will be powered almost exclusively by a new 3-liter 60° pushrod V6 that has a cast-iron block, an aluminum intake manifold, overhead valves and port fuel injection. The engine should make 140 hp at 4,800 rpm and 160 lb.-ft. of torque at 3,000 rpm. Later on, Ford will offer a 2.5-liter Four of 95 hp.

A newly designed four-speed auto-



Even though there's no tailgate, you can lunch or party at this slide-out picnic table.

matic overdrive transaxle puts the V6's power to the front wheels. A three-speed automatic will be offered with the Four, and four-speed manuals are in the works for both engines, as is a V6 police package that handles like no cop car I've ever been in.

After several hours of driving, we knew that Ford had done its homework on the Taurus/Sable. Swooping through curves and corners, taking the turns faster than one might to exit a typical expressway off-ramp, we found that all the models were rock-steady and completely predictable in response to steering input. Both sedan and wagon were sure-footed during braking maneuvers, with no straight-line deviation.

The handling capability the vehicles display is due in part to standard power-assisted rack-and-pinion steering, which exhibits good road feel. Ford suspension engineers have taken lessons learned from target-cars such as the BMW 733i and Audi 5000S and applied them to bread-and-butter cars that parents will use to shuttle children to school. What a concept!

With that in mind, the Taurus/Sable sedans and station wagons probably offer the best handling and highest margin of operational safety in a domestic family car. We took the wagon

down Moroso's long main straight at well over 55 mph, and simulated the action required to swerve suddenly away from an imaginary truck panic-braking in front. The car displayed very little longitudinal roll during this maneuver, and always remained under control without feeling any need to slow down.

Hard dodging left and right in both the wagon and sedan demonstrated a level of stability we've never associated with family cars.

In an Audi 5000S that Ford provided for comparison, we repeated the sequence and experienced a significantly greater amount of body roll, a phenomenon repeated when we took the Audi around the track at the same pace as the Fords. The Ford station wagon had *outhandled an Audi 5000S!*

The bottom line of this exercise is that the Taurus and its Sable stablemate bring to the everyday family car the high-quality maneuverability and handling surety previously associated only with expensive sports sedans. None of this detracts from the cars' ride quality or low-speed handling.

Family performance cars

Taurus and Sable are a totally new breed of car, able to offer the luxury of a family car combined with the safe capability of a sports car, all in a 21st-century sheet-metal wrapper. They sacrifice none of the family car's amenities, yet are safer and better-handling than any domestic bread-and-butter car in recent memory. After them, car pooling will never be the same. **PM**

THE PM REPORT CARD

Ford Taurus/ Mercury Sable	GRADES	COMMENTS
Acceleration	B+	Good power with V6
Handling	A+	Outhandles Audi 5000S
Braking	B	Significant nose dive
Steering	A	Precise, good feedback
Transmission	B	Automatic is class-average, four-speed is an A
Ride	A+	Filters bumps without diminishing handling
Fuel economy	NA	No good guesses yet
Seating	A	Comfortable yet supportive, wagon seats 8-9!
Vision	B+	Big greenhouse diminishes blind spots
Gauges/controls	B	Highly readable in analog; LCD also fun
Ventilation	A	Lots of well-placed outlets
Noise @ 55 mph	A	Quiet as a limo
Cargo capacity	A	Big trunk in coupe; wagon's seats fold flat to hold 4'x8' panels
Engine serviceability	B+	Few problems for garage mechanics
Fit and finish	A	Ford improves with each new model

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Hassle-Free Hookups FOR CAR STEREO

Every autosound system is different, but these basic installation rules can make the job go more smoothly.

BY FRANK VIZARD

Ford's original '64 Mustang had AM radio as a factory option, and it took no special skill to slap one of the new-fangled four-track tape players under the dash. It was as simple as that.

Sonically speaking, today's car stereo gear is a lot more sophisticated, and better to look at, too. But the hidden cost of this refinement is more complicated installation procedures, especially for the do-it-yourselfer.

In a perfect world, there'd be standardized, easy-to-follow instructions for installing any sound system in any car. But the roll-your-own world of highway hi-fi has no equivalent to one-size-fits-all products.

Mounting, wiring and grounding requirements differ from one piece of equipment to another—even within the same manufacturer's brand. Complicating matters further, different cars pre-

sent different installation obstacles.

Given this state of autosound anarchy, PM asked top independent installers and the service managers of car stereo manufacturers for their tips on avoiding the most common installation mistakes. Their comments provide some fundamental installation guidelines that apply to any product and any car. Some of their suggestions are embarrassingly simple.

For instance, installers and service managers concur that do-it-yourselfers could solve most installation mysteries on their own if they'd only take time to ask questions before buying, and read the instructions that come with the products. This comes under the heading of Basic Preparations.

No instruction pamphlet can give precise installation directions for every type of car. But you will learn, for

example, that yours might not need all the screws, washers and plates that come with the cassette/receiver. Extra hardware is always supplied to cover as many situations as possible.

Conversely, by asking questions before you buy, you won't be surprised when halfway through the installation you discover that the equipment doesn't fit exactly in the dash, or that the power connections don't match those of your car.

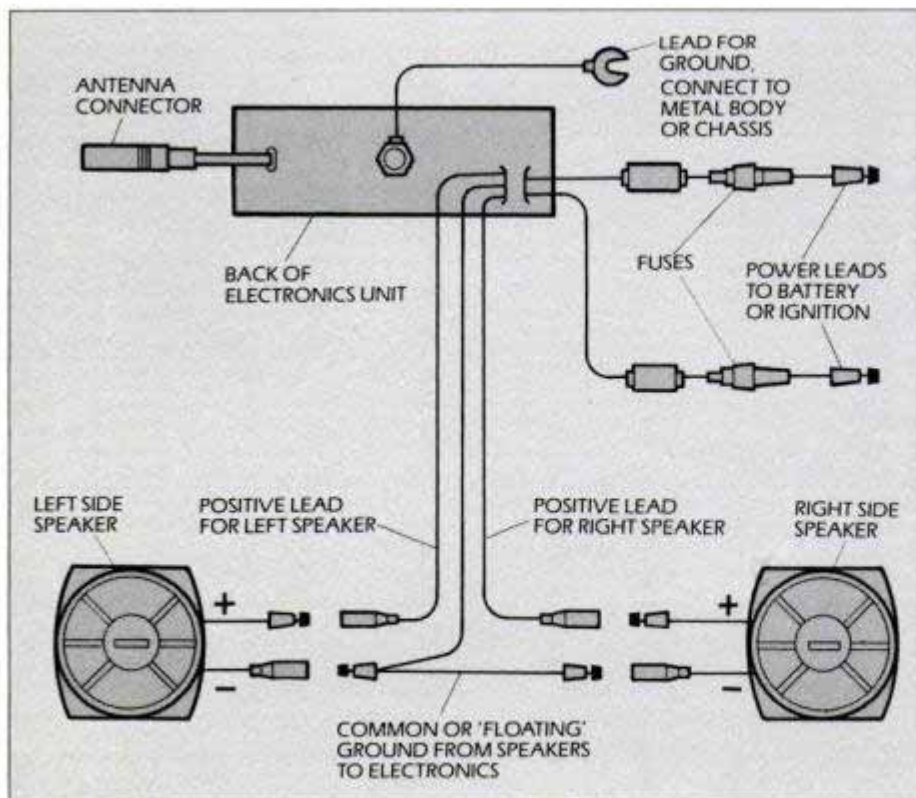
What you need is an accessory installation kit. Most car stereo shops carry them, and have a directory to match the right kit to your car and the autosound gear you buy. (If not available in your area, use the listing at the end of this article to call the kit manufacturers—some directly and toll-free.)

The right connections

Basics aside, the pros say that most actual installation mistakes have to do with wiring. These errors often lead to short circuits, or noise, and most can be traced to improper grounding.

With inexpensive autosound systems involving only two speakers, the cassette receiver generally has only four wires coming out the rear: a power line, a ground wire (usually black) and two positive ("plus") wires that connect to the speakers' positive leads. A common mistake is to wire the negative lead of each speaker to the cassette/receiver's ground. Instead, the receiver's ground and the speakers' negative leads should be grounded, *independently*, to nearby metal surfaces of the car.

More sophisticated autosound receivers have what is called a common or floating ground. This means the negative leads of right- and left-side speakers should be wired to the "common" ground on the receiver. Difficulty sometimes arises in four-speaker installations. Often, the do-it-yourselfer will ground the right and left front speakers correctly, then ground the second pair of negative leads to the car body. This creates a short. The correct way to install four speakers is to connect all four negative leads to the common or



The "floating ground" on sophisticated receivers isolates electrical noise best. Always connect the negative speaker leads to the ground—never to the body of the car.

"floating" ground. Keep this in mind if you upgrade from a promotionally-priced cassette receiver to a more sophisticated model with a floating ground. It's essential that you rewire your existing speakers correctly.

Another typical wiring error involves cassette receivers with FM and AM memory presets. Often times, the power lead for the cassette receiver's memory is wired to a power source that is turned off with the car (the ignition, for example). This will erase the memory and cause you to believe the unit is defective. To prevent preset amnesia, always wire the memory's power lead to a constant power source, such as the car's cigaret lighter, clock or battery.

Inadvertent noise

From time to time, you'll encounter wiring or grounding problems that have absolutely nothing to do with your installation technique.

Noise, for example, is the most common ailment afflicting autosound systems and often, the cause is some individual oddity of the car itself. The fiberglass body of the Corvette, for instance, provides no shielding of the engine compartment, creating noise problems for high-quality (read sensitive) cassette receivers.

Most manufacturers' instruction booklets address the problem of noise and how to solve it. There also are numerous noise-suppression devices (filters) on the market which can be wired into the system easily. One common noise source is the so-called ground loop—a condition whereby the system has been grounded at several points and these grounds are not equally effective.

To solve this, eliminate the ground points one by one until the noise disappears. Also, make sure that the cassette receiver's back-support strap and shaft mounting nuts (or the mounting screws of an amplifier) do not come into contact with the car's metal. Isolate these parts from the car's body with a plastic or rubber washer.

Hard to solve noise problems

Occasionally, you'll find noise problems that defy easy solution. One mystery that baffled professionals for a long time occurred in the 1979-81 Honda Accords. With the lights on and the engine running, a high pitched tone could be heard through the speakers. The receiver's tuner, it turned out, was picking up electrical noise transmitted through a metal ashtray nearby, which had to be isolated from the dashboard with a plastic screw and washer.

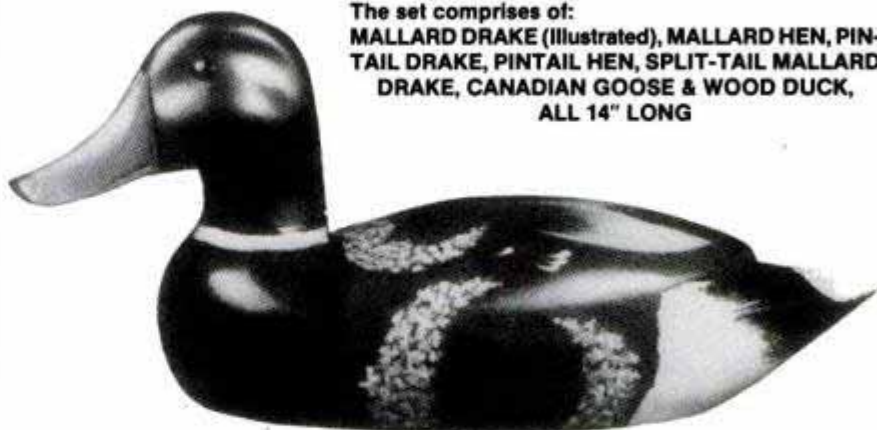
Similarly, some late-model cars with on-board computers may have special

(Please turn to page 140)

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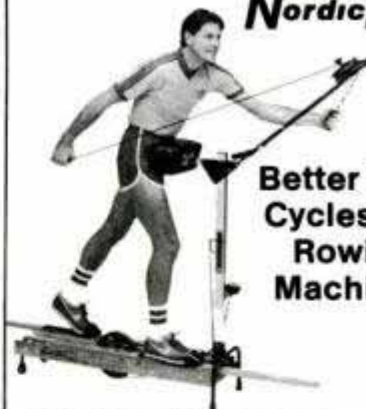
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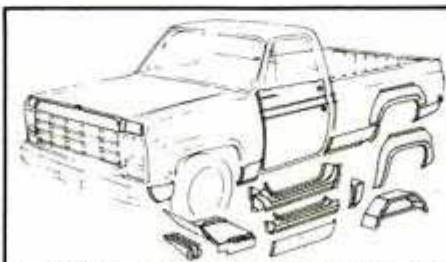
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(Continued from page 139)

problems only a dealer can solve. The professionals not only have experience with a wide variety of cars and equipment, but they also are the first people who the manufacturers alert to potentially incompatible marriages between certain cars and electronics equipment.

Go slowly but surely

You can keep yourself out of the service shop if you take the time and effort to plan carefully and execute your installation methodically. Many of the silliest installation mistakes can be categorized as "Sins of Omission" or "Precautions Unobserved."

For example, make sure all equipment is securely mounted, particularly the cassette receiver. Use the back-brace support that comes with the unit. A cassette receiver that bounces with every bump in the road will not operate very long. Also, it may be necessary to reinforce the rear deck with plywood for large speaker installations.

Always measure before you cut holes for speakers in doors or rear shelves. A common mistake—discovered after it's too late—is to cut a hole too large for the speakers. Use the template supplied with the speakers.

When installing door speakers, check behind the panel to be sure there's adequate room for the window when in the down position.

Externally, position the speaker to leave clearance for the window crank to operate. Use rubber grommets when routing wire from doors into the passenger compartment: Jagged metal edges will scratch away at the speaker wire. Use high-quality electrical tape for all connections and make sure all door speakers are waterproofed.

Proper placement and ground

Finally, and most important, adhere to the first rule printed in most instruction pamphlets. That is, make sure all wiring connections are properly in place and grounded before you supply power to the system.

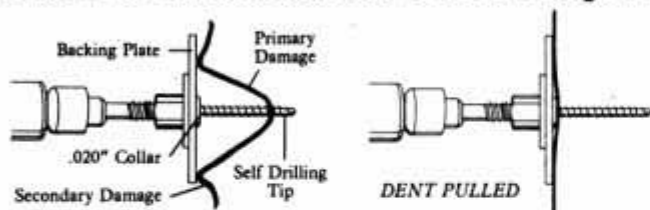
It may prove inconvenient to connect the power lead last, but you can disconnect the battery or pull the radio fuse from the fuse box. This takes little effort, and is a sound precaution against accidental power surges that can endanger your system, your battery and yourself. **PM**

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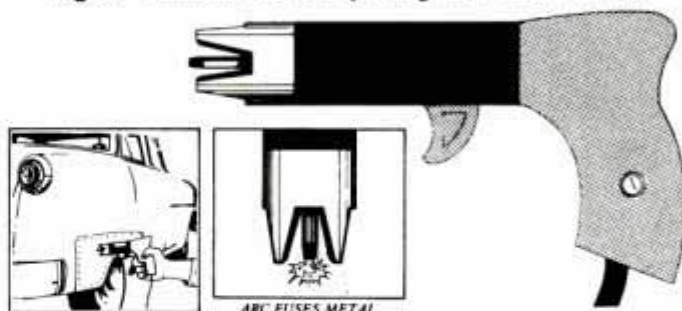
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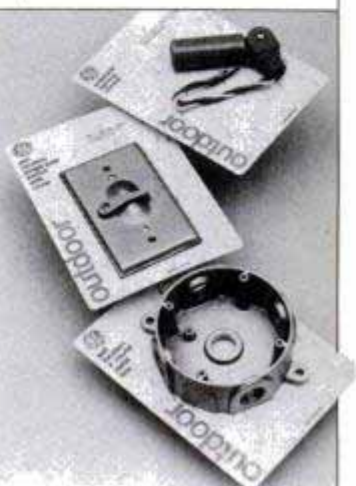
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about \$25 at home center and hardware stores, or you can contact Point Electric, 33 Route 304, Nanuet, N.Y. 10954, for a store in your area.

Lightscaping

Knight Lights is a low-voltage, outdoor lighting system that is designed for easy installation with a screwdriver. The system includes six each: covered lamp housings, 12-v. 12-w. bulbs, mounting stakes with 4- and 12-in. posts and cable connectors. Also included are a transformer with a 24-hour timer and 50 ft. of low-voltage cable. The system costs \$99.98 postpaid and is from D.R.I. Industries Inc., Box 20612, Bloomington, Minn. 55420.



Outdoor wiring

Outdoor wiring devices designed for the d-i-y'er from General Electric are, from top: automatic on-off lighting control (\$18.95), wet location single-pole switch and cover (\$7.50) and wet location 4-in.-round metal electrical box (\$8.25).



Victorian splendor

Here's a nostalgic lamp light that's all aluminum with antiqued acrylic lens and a frosted chimney. The lantern part measures 15½ × 36 in. and can use up to a 250-w. mercury vapor lamp or 150-w. high pressure sodium lamp. The lamppost is 8 ft. high and has an 11½ × 28-in. base. The unit is priced at about \$575 and comes in 10 finishes. It's at lighting showrooms, or contact the maker, Sternberg Lanterns Inc., 4048 West Schubert Ave., Chicago, Ill. 60639, for a dealer near you.



Contemporary classic

This post lantern is crafted of solid brass, antiqued to have a weathered look. Double-strength glass panels are finished in solar bronze. The flared, polished brass reflecting column in the center of the lantern multiplies the illumination of the four candle bulbs. Lamps used should be 60-w. each maximum. The lantern is 11½ × 20 in. tall and costs \$309. It fits onto a 3-in.-dia. post, which is purchased separately. It's by Progress Lighting, Erie Ave. and G St., Philadelphia, Pa. 19134.



Energy-miser

Miser Deluxe high-pressure sodium outdoor flood (\$50) gives more light than a standard 150-w. flood and uses 42 percent less electricity, says its maker. Aluminum fixture is from GE Lighting Business Group, Nela Park, Cleveland, Ohio 44112.



High-intensity halogen

These low-voltage outdoor floodlights have halogen lamps that are whiter and brighter than conventional incandescent lamps, and provide more light per watt of power, according to the maker. A six-light set costs about 5 cents to operate for 10 hours, based on average national electrical rates. A six-light set includes floodlight fixtures, four assorted color lenses, cable and a power pack with photo control for automatic ON, and an interval timer for OFF. The system LV2006EH costs \$116 at home centers and hardware stores from Intermatic Inc., Intermatic Plaza, Spring Grove, Ill. 60081.

Ever-alert light

Light Alert turns on its own floodlights when people or cars come within its 40-ft. zone. It adjusts to turn off 10 seconds to 20 minutes later. The ready-to-plug-in package including floodlights and sensor costs \$299 postpaid. Or buy only the sensor unit (\$239 postpaid) from RAB Electric Manufacturing Co., 321 Rider Ave., Bronx, N.Y. 10451.



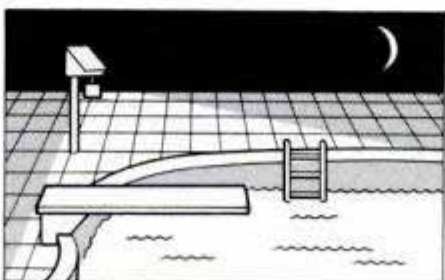
Small but mighty

This floodlight is very lightweight (15.5 pounds) and compact (5½ in. deep × 10⅞ in. high × 10⅞ in. wide), yet it can use powerful high-pressure sodium lamps from 35 to 150 w. The SPI-F floodlight is adjustable by means of a threaded mounting arm and can be installed on a pole or a building. The floodlight's housing is finished with bronze enamel. The SPI-F floodlight is manufactured by Halo Lighting Div., McGraw-Edison Co., 400 Busse Rd., Elk Grove Village, Ill. 60007.



Solar-powered light

During daylight hours the batteries of The First Star solar-powered light are charged. As night falls the light turns on automatically for up to 8 hours. No wiring or additional power is required. The First Star is priced at \$299 postpaid and comes with a one-year warranty from Southern Audio Video Electronics, 2100 Marietta Blvd., Atlanta, Ga. 30318. **PM**



Backyard
Gardeners

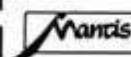
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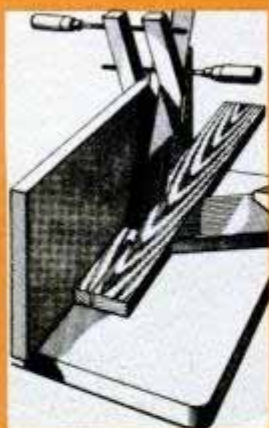
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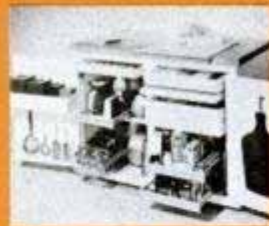
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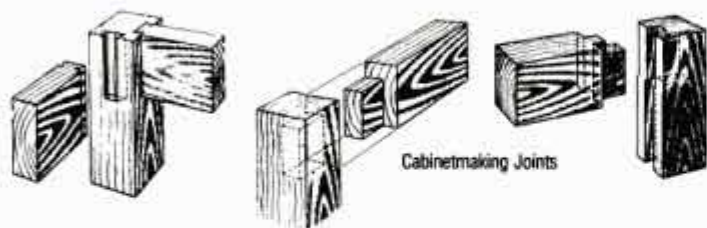
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PM LONG-TERM CAR TESTS



Regal lines of Buick N-car give a more formal look than Pontiac Grand Am or Olds Calais.

BUICK SOMERSET REGAL

Ten-grand GT

CHRYSLER LEBARON GTS

K-car as sport sedan

CHEVROLET CORVETTE

The beat goes on

SUBARU GL 4WD TURBO

Ending with a bang

RENAULT ALLIANCE

A reliable appliance



Chrysler's hatchback looks like a notchback, except for rear wiper.

Two sporty new cars have joined our long-term test fleet: Buick's Somerset Regal and a Chrysler LeBaron GTS. Our '85 Corvette is charging right along, and the Renault and Subaru are bowing out, one with nary a whimper, the other with a bang.

Buick Somerset Regal

Buick's latest reply to the success of middle-price-range compacts is the Somerset Regal Coupe. A member of the N-car or GM-20 family, sharing basic floorplans with the Oldsmobile Calais and Pontiac Grand Am, the Somerset offers many convenience features for a reasonable base price. Though our fully optioned test car, at \$14,036, may be the most expensive Somerset ever to roll off the Lansing assembly line, local dealers are selling air-conditioned, four-cylinder models for just under \$10,000. At that price, this car represents good value for the money.

The 3.0-liter V6 and front-wheel drive we've come to know from other new-generation GM cars work well in the Buick, but it's not without the thunks and grunts that come from excess drive-train lash. Minor body problems have cropped up since delivery, too. The horn didn't work at all (now fixed) and one window refuses to stay in its lift channel (soon to be fixed for the second time).

Also, the Somerset

comes with trendy LED instrumentation, and the green glow of the bar graph readouts is almost indistinguishable from the graduations. Unless there's movement at the instant you take a reading, the eye and mind take a few seconds to decipher the data. Worse yet, the glow is overly bright at night; turn it down to a reasonable level and the lights in the auxiliary switches get so dim that they can't be read. In a final show of dashboard insensitivity the oil pressure, volts and temperature indicators plus tachometer have been combined into one small area of the dash panel, each accessed by a pushbutton "gage" (sic) switch. They can only be read one at a time, so they represent almost no improvement over old-fashioned idiot lights.

The same design group did find plenty of room for sound-system controls—all 24 identical-looking buttons!—though the tape deck is inconveniently tucked behind the shift lever. Send these folks out for a ride in an '85 Corvette. With an absolute minimum of knobs and switches, the Delco/Bose system in the 'Vette sounds better than any factory-installed system we've ever heard. The Buick's video-game display for the fader and equalizer controls may impress Cub Scouts, but we're not convinced that you get anything more for the complexity than complexity.

To this point, the Somerset has averaged 16 mpg in city commuter duty, with driving range cramped by a smallish gas tank capacity of 13.6 gallons. Handling is surprisingly sporty for the cushy ride quality—chalk that up to the bargain-priced F41 Gran Touring Suspension (\$27). And with the high-level center stop lamp (\$25 option), we ought to be safe from attack from the rear.

—N.S.M.

Chrysler LeBaron GTS

Our on-again-off-again relationship with the Chrysler H-car (see *Chrysler: Turning Up The Performance Wick*, page 70, Sept. '84, and *PM Tests The New American Sports Sedans*, page 80, Apr. '85) has been turned on again with the arrival of a LeBaron GTS Turbo for our long-term test fleet. The silver hatchback had 5,350 tough press test miles on it when we took possession, so we cannot report on any delivery problems, but knowing our colleagues we can assume that the car was often run hard and put away wet, and those 5,000 miles are the equivalent of three times the mileage with a loving owner.

During our first 700 miles with the GTS, fuel economy fluctuated between 17.4 and 28.5 mpg. The car was returned to the dealer to have a transmission leak stopped, and a tuneup because the engine would occasionally stumble or stall while idling. It no longer stalls, but there's still an occasional hiccup when hot idling in traffic.

Our test car was equipped with \$4,000 worth of options, raising its \$9,995 base price right up to \$14,110. The Luxury Equipment Discount Package (you name it, we got it) makes this a fairly painless car to commute in, but



Improved '85 'Vette has enough power to do smokey burnouts down to the lug nuts!

adds \$1,349 to the base price. Our silver bullet also contains a mediocre \$515 Ultimate Sound and Cassette system, a \$120 liftgate washer/wiper, a \$50 leather-wrapped steering wheel and a \$737 air conditioner.

The substantial mechanical options are the \$1,050 Turbo Sport package and \$180 Sport Handling II package, which include P205/60HR15 Eagle GT radials. These two options are supposed to elevate the H-car into the sport sedan ranks, but they are only a partial success. The 146-hp, 2.2-liter Turbo Four will make the car fly, but the awkward cable-operated five-speed is slow-shifting and makes going fast more work than it needs to be.

The suspension is still a bit rubbery and is extremely sensitive to tire pressures. When we first got the car, the handling was very skittish. Then, we checked tire pressures and found a 3-psi difference at the rear. Bringing all four tires up to the recommended 32 psi cured most of the torque steer and rear-end twitch.

If you don't drive like Mario Andretti, the Chrysler is very comfortable. The deeply contoured buckets hold you snugly and are adjustable eight ways (six of them powered). There are cubby holes for everything but toll money, and even a fold-down beverage holder in the dash. It looks like a notchback sedan, package shelf and all, but is as useful as a hatch back. The rear seat backs are split 60/40 and fold forward.

With a little tuning of the shift linkage and suspension, Chrysler would have one heck of a sports sedan here. Right now, they have a hot-rod K-car. It's not that bad, but it could be so much better.—W.H.

Chevrolet Corvette

As we continue to pile up mileage on our long-term Corvette—current reading, 7,347—let's delineate the changes on this car compared to the '84.

First of all, the Crossfire dual throttle body injection setup for the 350-cu.-in. V8 is gone. In its place the '85 sports the new L98 engine. Still based on the 350, the L98 breathes through a direct port fuel-injection system with the sexiest set of aluminum ram-tuned tubes you've ever seen.

The system also makes good use of a mass-airflow sensor and a newly designed plenum chamber, all of which adds up to 230 hp (up from 205) at 4,000 rpm and 330 lb.-ft. of torque (up from 290) at 3,200 rpm. On the road, all the techno-talk translates to devastatingly quick acceleration (0 to 60 in 5.6 seconds) and a top speed of 150 mph.

There's no question now that the '85 Corvette is the quickest and fastest production car sold in America.

But Chevrolet engineers didn't stop with the engine. The main complaint about the '84 was its rock-hard ride. Both the base suspension and the Z51 Performance Handling package have been modified to mollify complainers. Base suspension cars now have 26 percent softer front springs and 25 percent softer rear springs. The antiroll stabilizer bars remain the same with the base suspension.

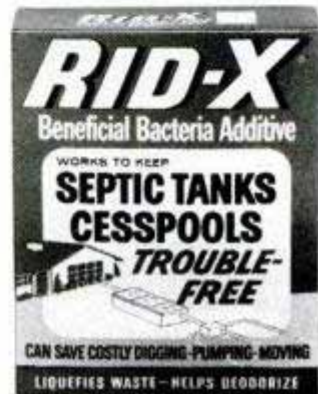
You can also order Delco-Bilstein gas-pressurized shocks (as we did for our test car) with the base suspension. These shocks were previously available only with the Z51 package. Caster was increased from 3° to 4° to give you a more locked-in straight-ahead steering feel, too.

On Z51 cars, the front springs are 16 percent softer and the rears, 25 percent softer. All Z51s also got new larger antiroll stabilizer bars, so that total roll stiffness is about the same as an '84 Z51 when you bend an '85 through a turn. Lastly, 9.5-inch-wide wheels are now found all around rather than on the rear only. Z51s now all have a heavy-duty cooling system, an oil cooler and 3.07 rear axle as standard equipment.

The brakes on all '85s have a large power booster and different ratio linings to cope with the increased performance. Gearboxes have been modified, too. The four-speed manual with computer-controlled overdrive now has its overdrive button right atop the gear-shift lever, replacing the awkward-to-use console-mounted rocker switch of last year. And the computer program that controls shifts into overdrive has been simplified to eliminate the annoying hunting up and down. A similar program modification was made to the automatic's computer as well.

(Please turn to page 152)

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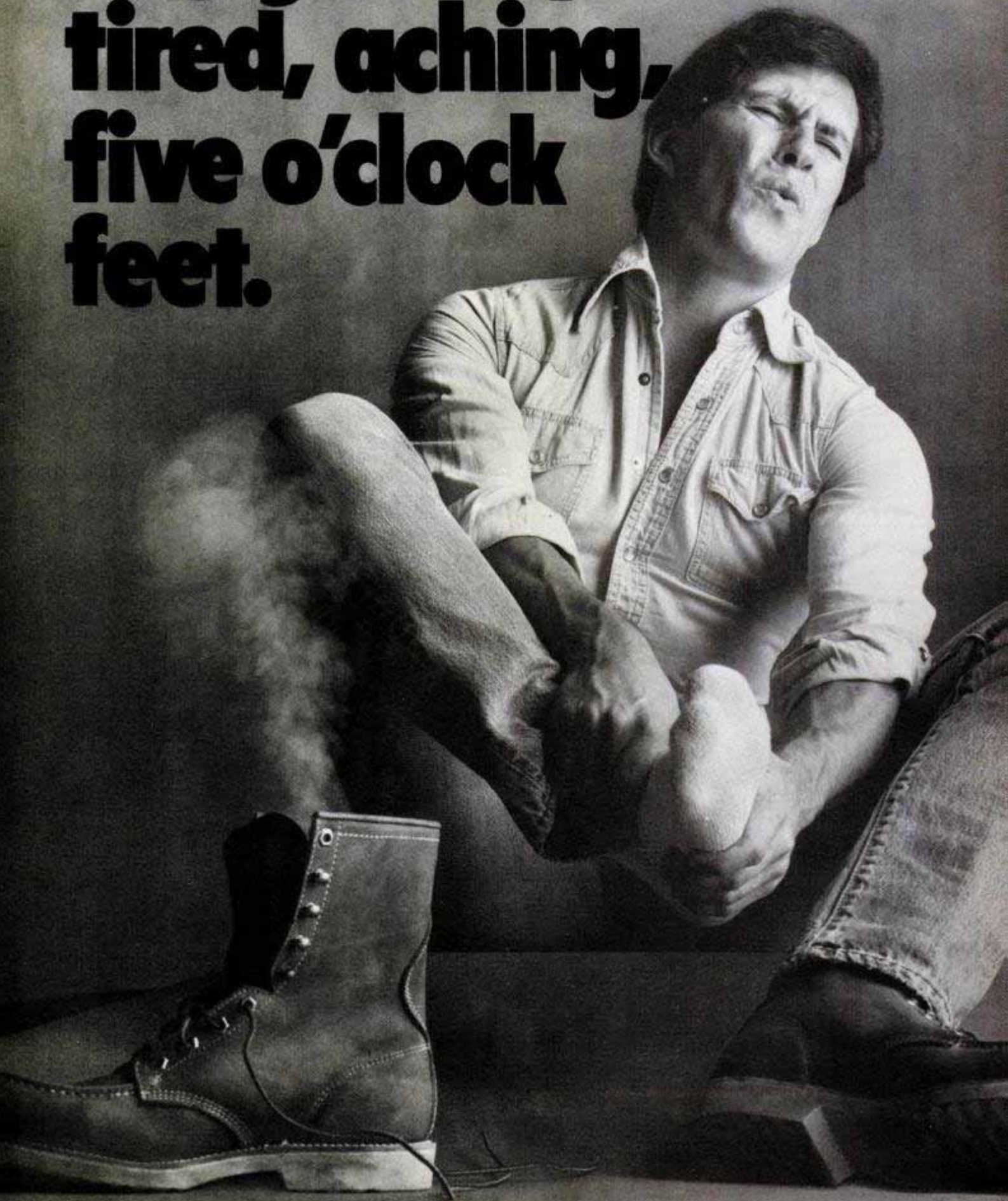
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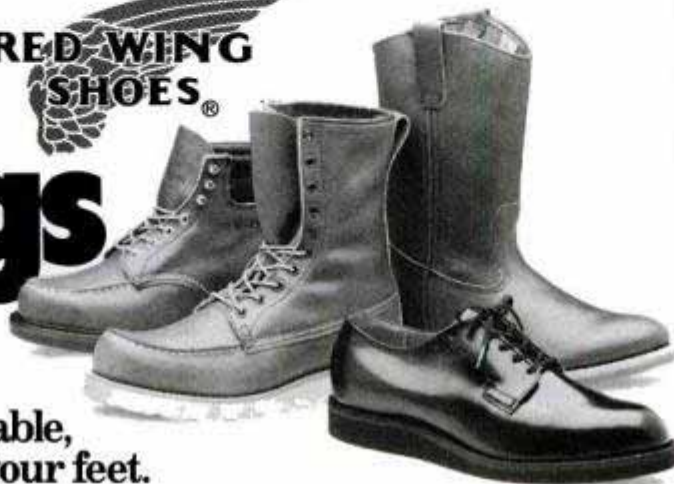
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SEATTLE... Red Wing Shoe Store
4553 California Ave. S.W.
Red Wing Shoe Store, 627 S.W. 153rd
SEDRO-WOOLLEY... Oliver Hammer, 817 Metcalf
STEVENSON... Joseph's of the Gorge, P.O. Box 788
TACOMA... Red Wing Shoe Store, 7250 Pacific Ave.
VANCOUVER... Red Wing Shoe Store
6718 N.E. Fourth Plain
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ANTIGO... Samolinski Shoe Service, 837 5th Ave.
APPLETON... Bohl and Maeser Shoes, 201 No. Appleton St.
BLACK EARTH... The Shoe Box, Ltd., 1130 Mills St.
DENMARK... The Cobbler Shop
FOND DU LAC... B & H Footwear, 661 W. Johnson St.
GREEN BAY... Rothes Shoe Store, 124 So. Broadway
JANESVILLE... Red Wing Shoe Store, 18 So. Jackson St.
LACROSSE... Ora's Shoe Store, 318 Pearl St.
LITTLE CHUTE... Vanderloop Shoes Inc., 127 E. Main St.
MADISON... Klitsner's Inc., 402 S. Park St.
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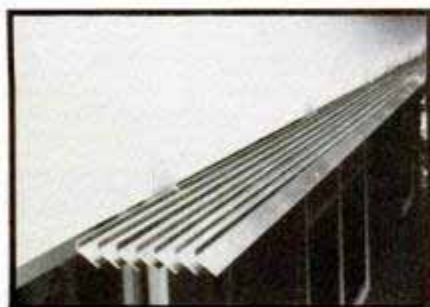
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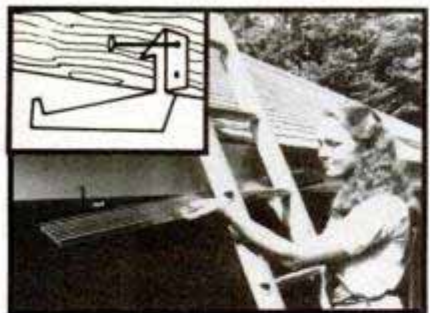
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PMR 785

LONG-TERM CAR TESTS

(continued from page 149)

To control the various shakes, squeaks, rattles and chirps of last year's car, over 200 small structural changes were made by Corvette body engineers to make the Corvette tight and right.

All this had made for a road car equal to anything the world can dish out. The Corvette's performance has always been first class. Now, the quality, ride and handling are there to back it up.

We're about to try our test car with a set of experimental Goodyear Eagle VR snow tires, the base shocks in place of the gas Bilsteins, and we're even going to sample a stick shift Z51 to make sure Chevy's keeping their word about improvements throughout the Corvette line.—J.O.

Subaru GL 4WD Turbo

No one was hurt, but our extended 1985 Subaru test ended with a bang when a woman in a 1969 Nova did a soft landing into both left doors. She apologized profusely and told our West Coast editor, who was driving at the time, that she first lost her brakes and then her head. In effect, she used our Sube as a crash barrier. Thanks a lot!

Up to that point—at 5,300 miles—the Subaru performed flawlessly, and it continued to do so even with \$4,004 worth of body damage. The driver's door would still open and close, and even the electric window rolled up and down, sort of. No mechanical problems of any type developed in 5,700 miles; in fact, we have to commend Subaru for engineering and building so totally troublefree an automobile.

People have funny ideas about Subarus. Strangers have stopped me to comment on this '85 car's styling, saying: "It's not lumpy like the earlier one, is it?" and to register strong pros and cons about the checkerboard upholstery. Most men like it and all the women I met, without exception, hate it. Several women told me they wouldn't buy the car just because of the upholstery. Personally, I think it's fine. Reminds me of the early Porsche 928.

The Subaru's IHI turbo cuts in at about 2,800 rpm, and keeps the car from running out of breath at highway speeds. Full-throttle power, though, isn't totally smooth. It comes in definite surges as the turbocharger wastegate opens and closes. This new overhead-cam version of Subaru's 1.8-liter Flat Four now puts out 111 hp with the turbo and fuel injection, and it's a great improvement over previous models.

One improvement U.S. Subarus didn't get is the true "On Demand" four-wheel drive that's available with automatic transmission in Japan and Europe. Electronic sensors at the accel-



The Cobra at speed. It's OMC's entry in the tough sterndrive market.

NEW DRIVE FOR POWERBOATS

Until the late 1950s, boat owners had only two choices available with which to power their boats—inboard or outboard.

Then in the late '50s, an ingenious combination of an inboard engine and an outboard drive unit was introduced. The I/O, or sterndrive, unit offered unique advantages to the boatbuilder as well as the boat owner, not the least of which was a hinge effect inherent in the design, allowing a tilt-up capability for trailering, launching or recovery, beaching, or maneuvering in shallow waters. If the lower portion of the unit struck an underwater obstruction, the hinge flexed much the same as an outboard does, lessening the severity of damage to the outdrive.

MerCruiser sterndrives have dominated the market for quite some time. Volvo-Penta and OMC sterndrives have been available, but not on a great

variety of boats. The fact of the matter is that builders have installed more MerCruiser units on their production lines than any other sterndrive system, for a variety of reasons.

BY JOHN WOOLDRIDGE

For the last two decades, both MerCruiser and Volvo-Penta sterndrives have used the identical design concept of rigidly mounting a transom assembly and outdrive to the transom, while isolating the engine from the boat by use of rubber engine mounts. Steering is achieved by rotating the entire outdrive about an axis by means of a yoke and steering arm arrangement. The tilt and trim functions are one and the

same, using a hydraulic system. Power is transferred through universal joints. The standardized sterndrive design made it easy for boat manufacturers to install this type of unit on an assembly line. And its universality made for economic installation as well.

Now, there's a third sterndrive manufacturer that has come into the design mainstream. Outboard Marine Corp. in Waukegan, Ill., recently showed us a new sterndrive system that should be on sale just about the time you read this. It's called the OMC Cobra and we expect it to have considerable impact on the sterndrive market.

OMC's previous sterndrive system was, frankly, out of touch with the realities of the marketplace. The outdrive and engine assembly was an integral inline system. The entire assembly was rubber isolated from the

(Please turn to page 156)



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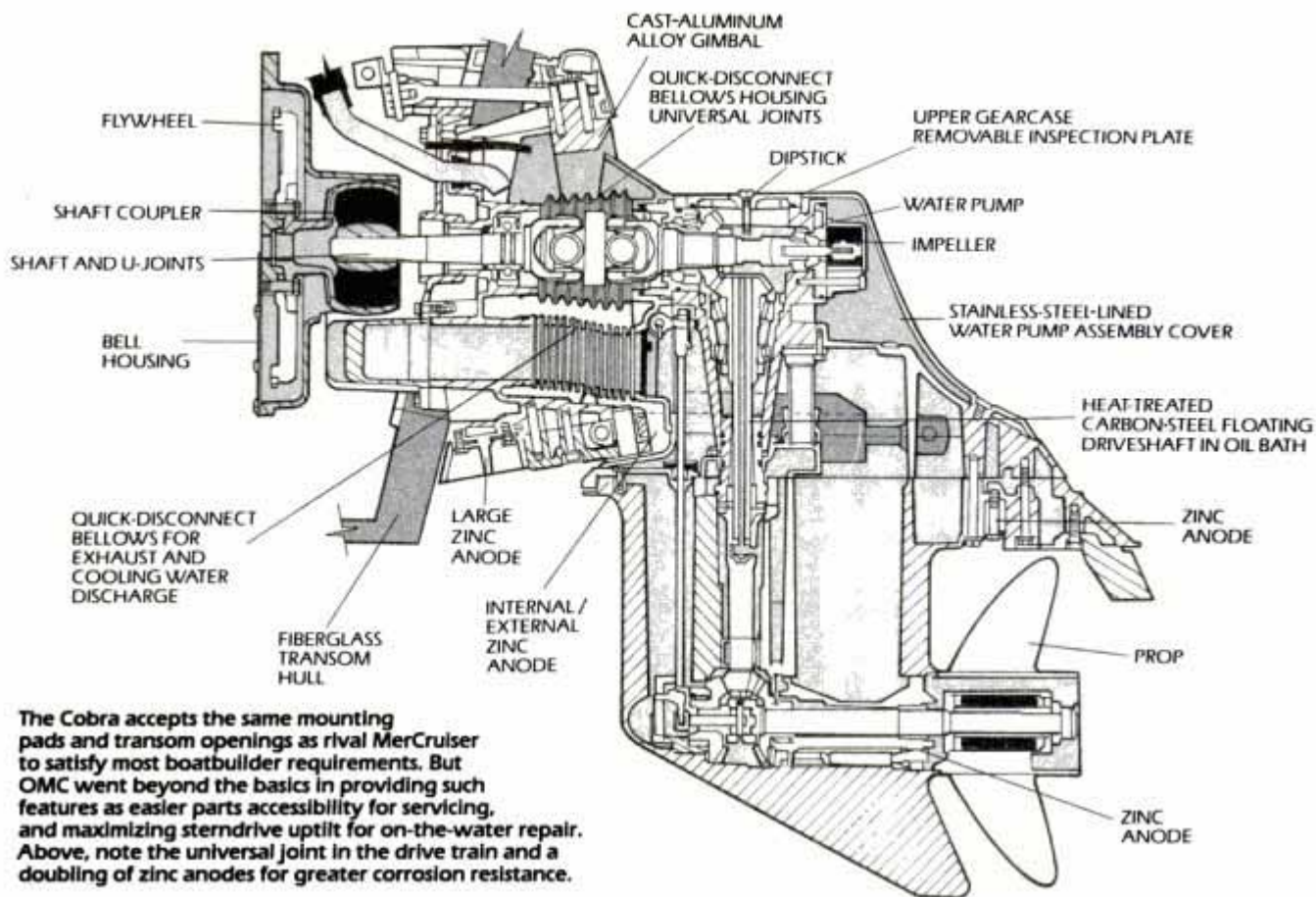
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PM ILLUSTRATION BY ED LIPINSKI

boat. Steering was controlled by worm gears rotating the outdrive around the upper gear case. The tilt and trim systems operated independently of each other. And power was transferred through ball gears.

Two years ago, OMC engineers went out on the road after extensively reviewing the sterndrive market and honestly appraising their own sterndrive's shortcomings. They interviewed owners, service department personnel, dealers and even their own warranty department, combining all the feedback of the survey into the decision-making process for a new sterndrive design.

The result is the new OMC Cobra, a vast departure from previous design philosophy. In fact, the Cobra conforms to the design concepts used by all other sterndrive makers. Not only is the unit stylistically very clean, the Cobra also incorporates both U-joints and a gimbal mechanism to effect steering and tilt/trim functions.

The OMC Cobra will offer a particular cost advantage to boatbuilders and dealers, as it was designed to accept the same mounting pads and transom openings as a MerCruiser. This means that manufacturers are able to build any one boat design and then equip it with OMC or MerCruiser power/drive units.

In designing the Cobra, OMC engineers wanted more structural integrity,

a high-capacity drive train, improved corrosion resistance, the newest technology paint systems and the latest computer-aided inspection methods.

Beefier structure

Rigid aluminum castings for gear housings were specified to minimize unwanted flex under high-thrust loads, thereby gaining better control over bearing and gear wear. The gimbal is

OMC's previous sterndrive system was, frankly, out of touch with the realities of the marketplace.

made from a permanent mold-cast aluminum alloy that is heat treatable for greater strength.

Drive train

The drive train was given particular attention to assure it would deliver a long life under high-torque conditions. The flexible coupler is larger than its competitors.

The ball gears have been replaced by universal joints, a feature that will be appreciated by those who operate their boats in shallow water. The upper gear housing was enlarged, enabling the use

of larger gears and higher load capacity bearings. All driveshafts are made of heat-treated carbon steel and operate in an oil bath. The water pump is no longer driven by the vertical driveshaft, eliminating the need for the inertia-welded stainless-steel midsection in the driveshaft. A long floating shaft has been incorporated into the drive train to accept misalignment without creating bending loads on the shafts and splined joints.

In addition to this improved integrity in the drive train, the application of critical shaft seals has been reduced from five on the current product to only three on the OMC Cobra, thereby minimizing the chance of water intrusion into the gearcase.

Corrosion resistance

In saltwater applications where aluminum and stainless steels are in close proximity, the potential for corrosion is extremely high. OMC attacked this problem by better than doubling the zinc anode protection, using all 300-series stainless-steel fasteners and stainless-steel threaded inserts, strategically locating the zinc anodes, and optimizing their high solids paint coatings and paint systems.

The Lexington plant, where the Cobra is built, was designed for consistency of coating effectiveness—the best

paint job OMC could get. It begins with extensive substrate preparation. At the plant, every aluminum casting gets additional deoxidation and rinsing beyond what the piece gets in the original manufacturing process. An engine washing system for iron blocks doubles the cycle time beyond what OMC already schedules on existing powerplants. An outdrive washing system doubles again the cycle times already in use, all for the sake of better paint adherence and consistency. In the actual painting process, OMC doubles the thickness of paint applied compared to existing units.

Computer-linked probes set up for on-line inspection ensure that the units end up the way they were designed, and hopefully with zero defects.

Serviceability

OMC has given considerable attention to the serviceability of the Cobra. The engineers strived to keep the design simple and rugged.

For instance, by removing the top cover on the upper gear case, virtually every moving part that is in the upper assembly can be inspected. The Cobra's water pump has been removed from the vertical drive train and relocated to a position that's just behind the end of the upper gear case shaft. It's approximately a 10-minute job to replace the water pump impeller.

This is a major improvement. In fact, on some other sterndrives, it's necessary to remove the lower gear case to replace the water pump—a costly repair job, as any sterndrive owner knows. The transom-mount assembly has been designed for easy serviceability as well. All components in the transom-mount assembly are accessible from behind the boat, without removal of the engine.

Once the lower support housing at the bottom and the steering arm at the top are removed, the gimbal and pivot housing assembly can be removed. Both the U-joint bellows and exhaust bellows are equipped with quick disconnects from the rear.

Working out on the water

OMC even found a way to maximize the uptilt and get the prop higher out of the water for service. This means that, should you ever have to change a prop or replace a shear pin out on the water, you run a decent chance of not having to work with your hands and tools underwater to get the job done.

You won't have much trouble recognizing a Cobra. It sports new Metallic Charcoal paint with stylish orange and red graphics—a big change from the Performance Silver we've grown accustomed to on OMC sterndrives. It looks like OMC has something here. **PM**

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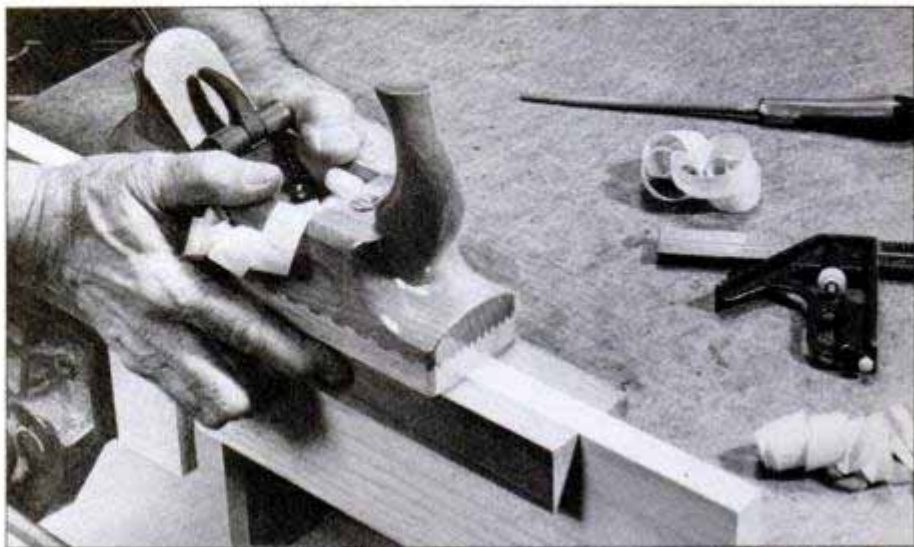


Jointing edges without a jointer: Part 1

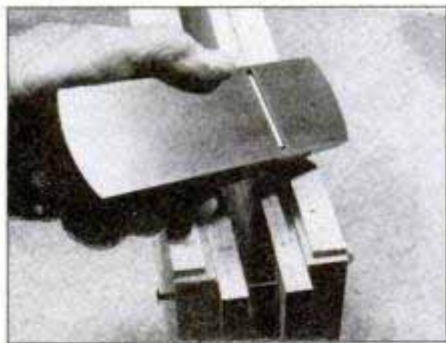
Here's how to get smooth, square board edges without a jointer by using a hand plane, portable circular saw and table saw.

The track jig makes it easy to hand plane edges smooth. Clamp the workpiece between the jig's two middle spacer boards. Trim the rough edge until the plane body makes contact with the jig's two outer boards.

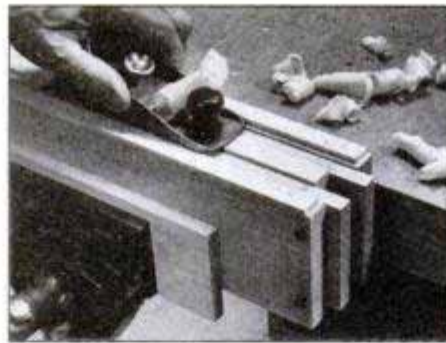
Use a circular saw to true the edges of two boards simultaneously. Clamp the boards edge to edge, then make a straight cut along the joint. If needed, repeat this procedure until the boards fit together tightly. To true a board with two rough edges on a table saw, nail a straightedge to the workpiece with it overhanging the edge slightly. Then, make a cut with the straightedge against the fence. Next month in part two, we'll show how to joint edges with a router.—Rosario Capotosto



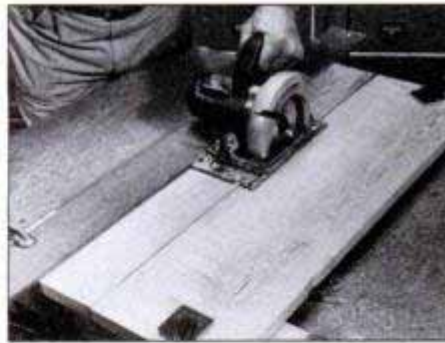
Hold two 1x2s against the plane bottom and sides of work to keep plane level (above). File notches in the 1x2s to clear plane iron. Cut square edges by sliding the plane along the benchtop (right). Clamp a spacer under the work so the edge meets the center of the plane iron.



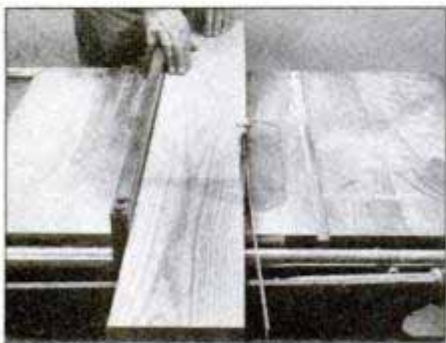
Track jig consists of four boards held parallel by nail-pins placed in prebored holes. Plane rides on ledges alongside top strips.



Clamp jig in vise with workpiece slightly above the two center spacer boards. Trim edge until plane body rides against ledges.



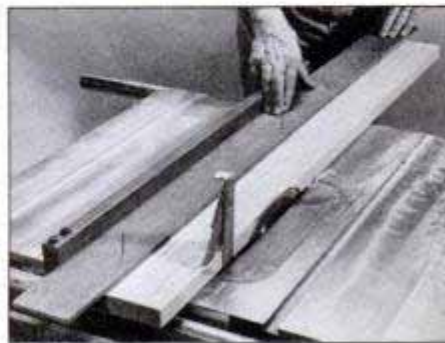
Trim the edges of two boards simultaneously with a circular saw. Make a pass along the joint to remove stock from both boards.



This example proves that a table saw won't produce a straight, true cut if the edge that rides against the saw fence is bowed.



Notice that when straightedges are placed alongside the stock, the just-cut right edge parallels the severely bowed left edge.



Nail a straightedge to the board so it overhangs slightly. Then, make the cut with the straightedge riding against the saw fence.

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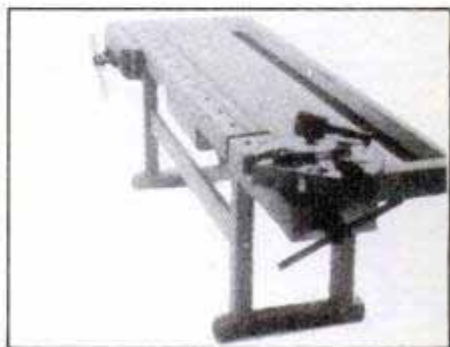
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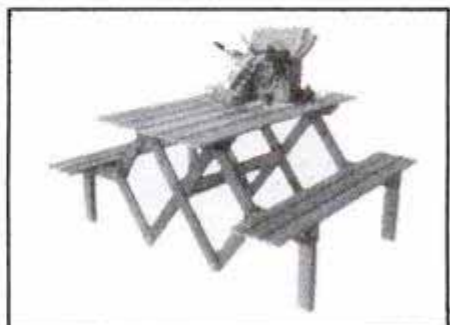
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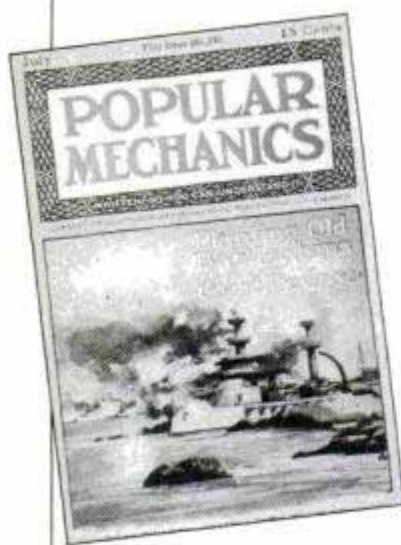
"CHAIN Alarms" for \$10.95. Walter Hampton, P.O. Box 451, Columbus, GA 31902

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PM'S TIME MACHINE

75 YEARS AGO: July 1910



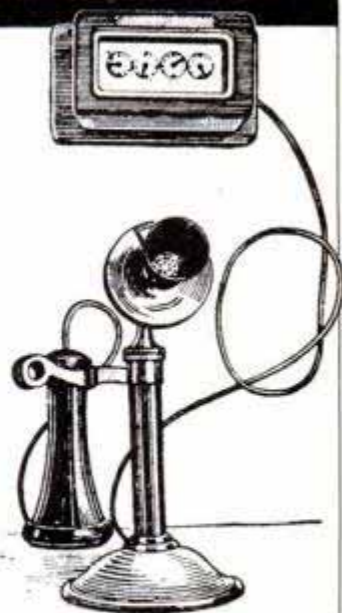
From battleship to battery.

Battleships retire

Commodore W.H. Beehler suggested placing outdated warships at key points along our coast. The commodore said the vessels could be "planted" on the shoals lining harbor approaches such as Key West, Fla. Beehler proposed using Monitor class and other battleships as permanent turret forts. Some members of Congress suggested selling the ships for use as yachts. Ultimately, monitors such as the *Terror* and *Puritan* were sold as scrap. The *Texas* was used for target practice and sunk in the Tangier Sound.

Call meter studied

Telephone billing by the call was studied to replace the flat yearly rate for unlimited service. "Phone companies complained the flat rate was impracticable . . . as it places upon the telephone company the burden of handling a large percent of frivolous and unnecessary calls." A meter installed in the home or office was turned on when the phone was taken off the hook. The call was free if it was kept short enough. Today's computer billing system allows telephone companies to bill customers for fractions of a minute.



50 YEARS AGO: July 1935



A plane for every household?

Streamlined to sell

One of the first attempts to build a popular, salable aircraft was depicted on PM's cover. Built for the private plane owner or airline operator, its two supercharged engines developed 156 hp, for a top speed of 233 mph. The autolike design and 36-foot wingspan was expected to attract buyers. But its Shelton flying wing contour gave way to the single-engine Piper Cub, one of the most popular light planes made in the United States. The Cub and its variants were developed in 1932 from an earlier Taylor J-2 Cub.

It was a snow job

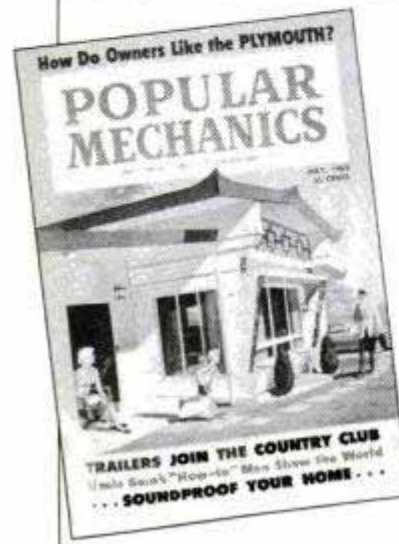
The snows of Northern Canada helped inspire this snowplane (below). Essentially, it was the automobile of the snow-covered far North. It carried six and skimmed along at a brisk 50 mph on a Ford engine. Skis and a rear-mounted propeller took the craft just about anywhere.

Microfilm update

Banks began microfilming documents in the 1920s. By the mid-30s, numerous businesses were microfilming important papers. Libraries still use microfilm, but other industries are turning to computer storage and holographs, which can hold up to 10,000 books in a computer's memory.



25 YEARS AGO: July 1960



Bing Crosby's mobile homes.

Trailers take hold

The country club was Bing Crosby's new million-dollar trailer court near Palm Springs, Calif. The 26-acre court offered a swimming pool, billiard and card rooms, shuffleboard courts, a pitch and putt course and a recreation room. "This is not cheap," the article cautioned. "A deluxe trailer . . . costs \$15,000." More than 10 million people live in trailers in the '80s. In 1979, they accounted for 14 percent of new housing. Economy and easy care made them popular in the '50s after the post-war housing shortage.

A waterbug

The Volkswagen bug was so well constructed it floated. Australian Peter Webster took it one step further. Webster waterproofed the ignition of his VW bug, ran snorkel pipes from the exhaust pipes, oil breather and carburetor air intake. He attached a propeller to the fan-belt pulley and ran the shaft through a bearing in a bumper slot. He took his altered bug to the beach, cruised around the harbor for five miles and returned to land. To keep his "ship" from sinking, a passenger manned a small bilge pump.

Private shower?

You could wash the dirt and grime from that long day of driving at any campsite—even without a trailer—just your car. With a collapsible, portable shower that could be set up alongside a camper, truck or car—anywhere there was water. Water from a two-gallon container on the roof of the car activated by gravity provided the spray. Anyone standing more than a foot higher than the plastic curtains, however, would compromise the bather's privacy. Fortunately, the bather could step from the shower into his vehicle to dress. **PM**

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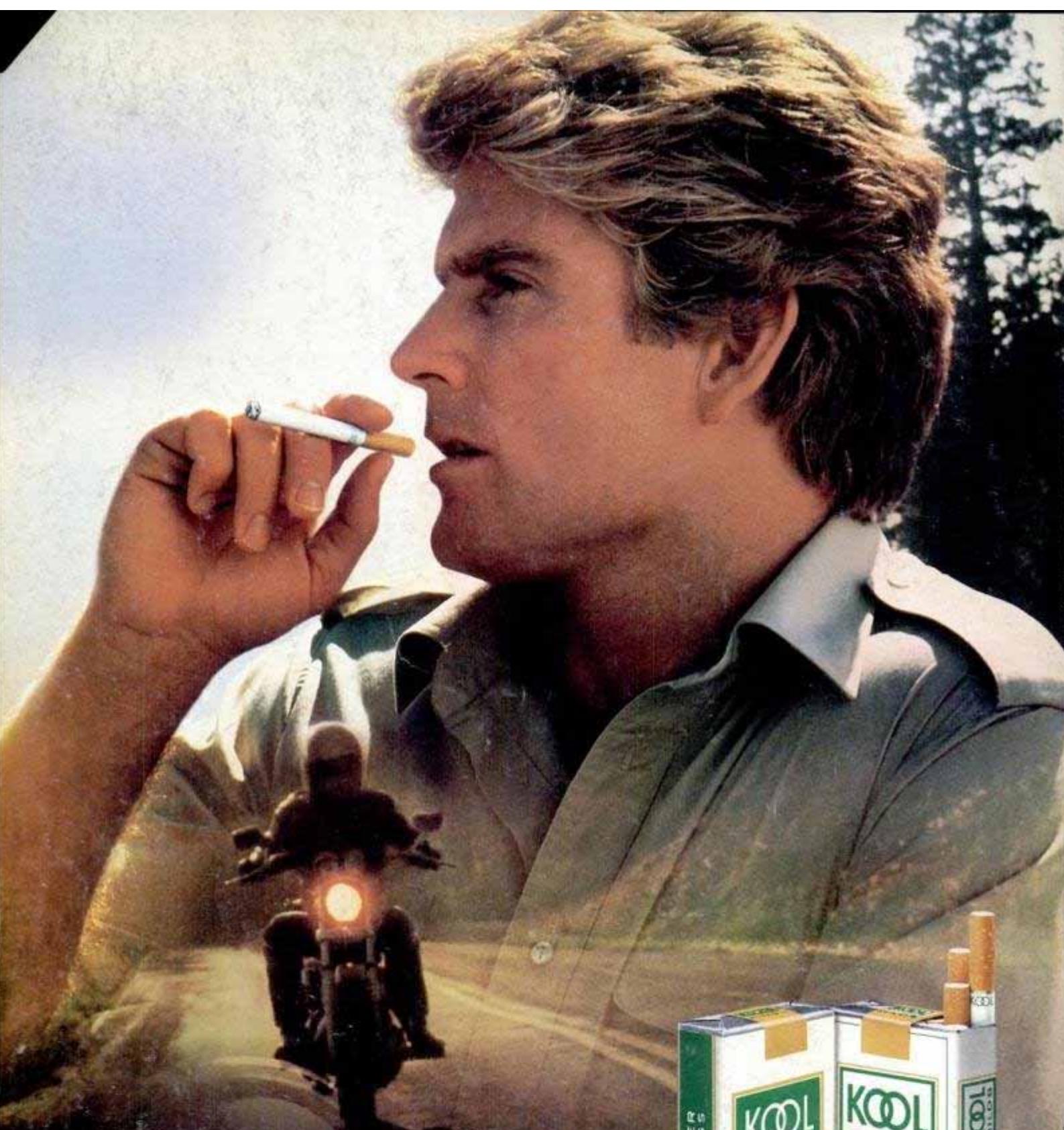


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