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Popular Mechanics

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Roomy, Child-Safe
Bi-Level Deck

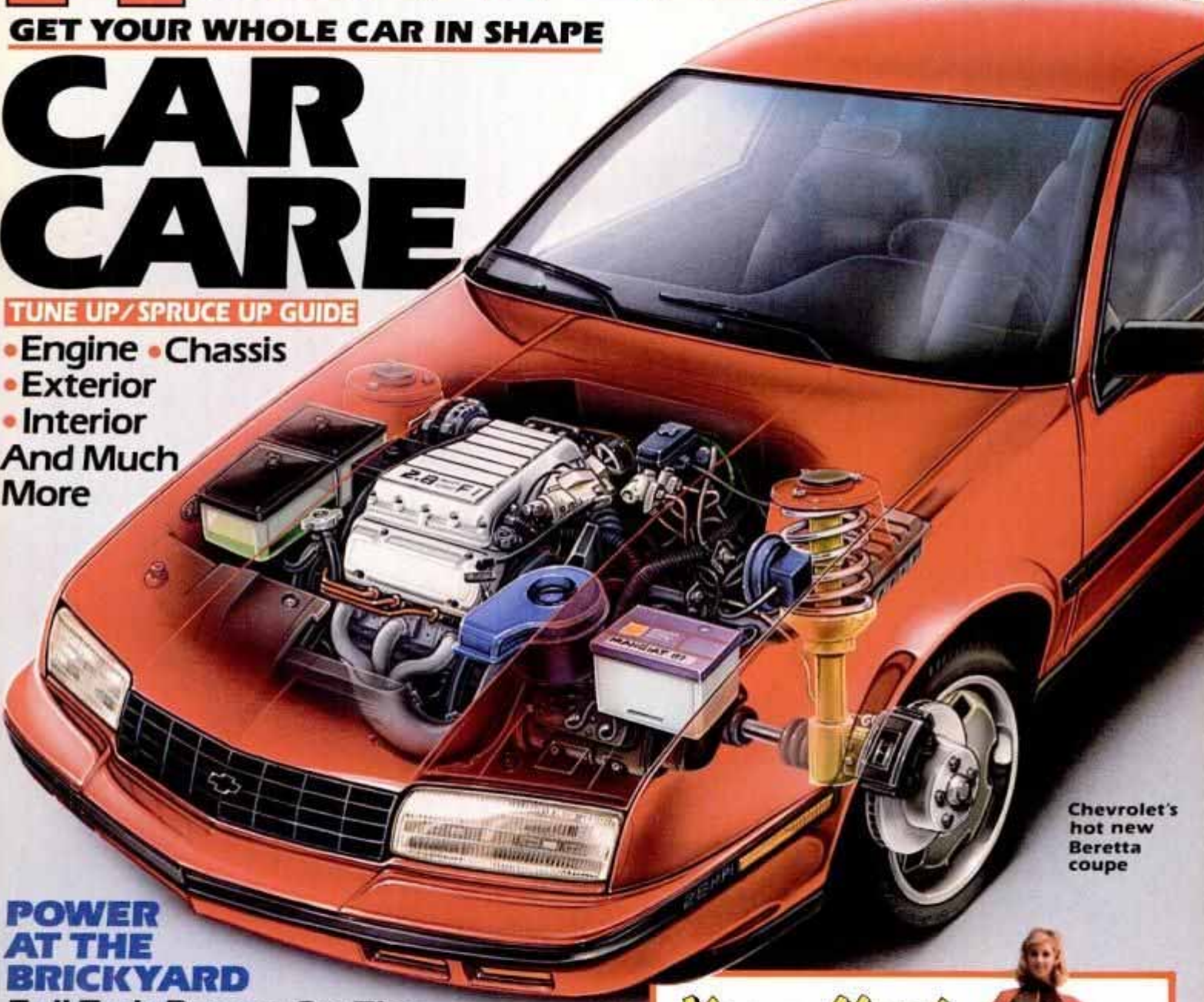


GET YOUR WHOLE CAR IN SHAPE

CAR CARE

TUNE UP/SPRUCE UP GUIDE

- Engine • Chassis
 - Exterior
 - Interior
- And Much More



Chevrolet's hot new Beretta coupe

POWER AT THE BRICKYARD

Full Tech Report On The Most Exotic Indy Engines Ever

DETROIT'S ULTRA SOUND SYSTEMS Ear-Testing Motown's Best New-Car Stereos

TESTING 10 NEW-ERA FAMILY SEDANS Common-Sense Cars You Drive Every Day



Your Next BIKE!

Bicycles Pedal Into The 21st Century With Revolutionary Materials, Styling And Aerodynamics



New Ford Ranger High Rider!

Announcing the tough '87 Ford Ranger STX 4x4.

You'll ride high 'n handsome in the new "High Rider" Ford Ranger with sporty STX trim.

It's time for the competition to move aside, because Ford now has the newest high-ridin' small 4x4!

Ford has added to the already sporty Ranger STX look by making this tough little 4x4 *higher* for off-road ridin'! Ford's high ride is designed in, not added on. The imports better double-check their shocks, 'cause the new High Rider's got improved handling and a smooth ride!

Port fuel-injected V-6.

To help you pack extra power under your hood, there's Ranger's 2.9L V-6 with electronic multi-port fuel injection. It's got 140 hp of muscle—to make this High Rider a real high-powered performer. Add the 5-speed manual transmission that's standard in all Rangers, and you

get one little pickup that's fully equipped for fun!

The STX look.

In addition to the sporty feel of ridin' high, this hot 4-wheeler also comes with The STX Look—special accenting, sporty trim, tinted glass, black foldaway mirrors, black grille and bumpers, and new tape treatment. *That's The STX Look!*

Built fun tough.

Above all, Ranger High Rider's one *tough* little truck—with Ford's exclusive Twin-Traction Beam independent front suspension to help soak

up jolts and bumps for more down-to-earth fun!

service on '86 models, and in a six-month period



Best-Built American Trucks six years running.

"Quality is Job 1." In fact, for the past six consecutive years Ford quality has led all other American automotive companies. This is based on an average of owner-reported problems in the first three months of

on '81-'85 models designed and built in North America.

6-Year/60,000-Mile Powertrain Warranty.

New Ford limited warranty covers powertrains for 6 years/60,000 miles and provides protection against body-panel rust-through for 6-years/100,000 miles, whichever comes first. Restrictions and deductible apply. Ask to see a copy of this limited warranty when you visit your Ford Dealer.

Buckle up—together we can save lives.

Optional light bar not for occupant safety.



Ranger

BUILT FUN TOUGH



This One



LXS8-BEJ-5XK0





The Peachtree™ Fuzzy Navel.

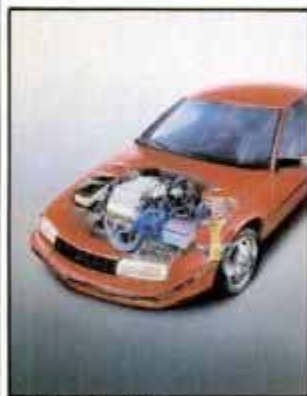
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**ON THE COVER**

Keeping a car running and looking like new is no simple task. It involves more than just changing the oil, filter and sparkplugs. This month's Car Care Guide starting on page 101 solves the complications and helps you keep your car humming along.

—PM Illustration by
Jeff Mangiat

**78 Tow it****81 Car tunes****84 Rad wheels****88 Social grace****CAR CARE GUIDE****101 Cover****103 Contents****104 Tune Up Your Whole Car**

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The trouble with being the Editorial Production Manager is that it sometimes seems like you can't leave your desk for five minutes. There's a deadline every hour, the in box is piled high with manuscripts that you must read and correct, line by line, comma by comma, and the computer at your left elbow is your only link with the outside world. Pretty bleak, right? Especially when all the other editors are running off to Palm Springs or Hawaii or Scottsdale or Paris or Italy, covering press conferences, shooting photos or even "scouting photo locations." Meanwhile, here you are, slaving away. Perhaps that's how our Editorial Production Manager, Peter Francesconi, was feeling that day a few months ago when a unique opportunity presented itself. The Home & Shop Department guys needed someone to be a model for a photo shoot. They needed someone to pose with the elegant butler's table we show you how to build in this issue (page 88). The person would have to dress in, and look good in, a full-bore formal outfit—right down to the black silk lapels and white gloves. Would Peter do it? You bet! Anything to get out of the office for a few hours. And besides, his photo would be in the magazine just like the other editors on staff who were always off in Tahiti testing blowguns or something. At the appointed hour, Francesconi was indeed in the required dress and did serve as our model. Unfortunately, as you can see on page 88, Peter's photo didn't exactly get into the magazine. Only one of his hands made it. So for all of you who would like to know what an Editorial Production Manager looks like, here is another take of the same photo with Peter Francesconi a little more prominent. . . . **The first photo** ever taken by Electronics/Photography Editor Steve Booth was snapped on the seventh day of his seventh year. It was taken at one of Booth's hangouts then, Yankee Stadium. And it was of the Yankee centerfielder who wore No. 7. Since that day, Mickey Mantle has remained one of Booth's heroes. And recently, at the Photo Marketing Assn. show in Las Vegas (see page 14), when Booth had a chance to have his photo snapped with The Mick, well, Booth went gaga and couldn't resist. What was it like to meet the Hall of Famer in person after all the years of hero worship from a distance. "He's a genuinely nice guy," Booth says. "Til next time."



Francesconi: Anything to get out.



Booth and Mantle: Together at last.

Joe Oldham

Marlboro



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you get a lot to like.

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Now Greatly Reduces Serious Risks to Your Health.**

16 mg "tar," 1.0 mg nicotine av. per cigarette, FTC Report Feb. '85

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POPULAR MECHANICS • MAY 1987

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New NEUTRA RUST Gets Rid of Rust For Good!

NOT A PAINT, NOT A COVER-UP, but an entirely new and revolutionary process for eliminating rust. Neutra Rust was originally developed to control the incredible rust on oil rigs in the North Sea and on ships of the Royal Navy. Think of the rust problems they have! Naturally they use vast quantities of Neutra Rust and buy it in huge 50 gallon drums. For a long time that was the only way you could buy it. But at last Neutra Rust is available in smaller sizes for home and shop.

Now you can get rid of rust for good just the way they do at industrial and military installations all over the world!

WHAT NEUTRA RUST DOES

Neutra Rust is like nothing you've ever used

before. It's amazing! No tiresome scraping, wire brushing and sanding to get down to bare metal. Neutra Rust works best applied right over rust! It penetrates the rust. Gets right down there and chemically changes the rust into an entirely new substance—a hard, black, paintable compound called ferrosferic. The rust is gone—not just covered up—GONE! For good. It no longer even exists.

NEUTRA RUST IS EASY TO USE

First knock off the loose or scaly rust, but leave the rest of the rust there. (Remember Neutra Rust works *with* rust.) Then just brush Neutra Rust on. Within minutes that rust will be gone and the new surface will be there. That's all there is to it. Clean up is easy, too. Just soap and water.

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When you first brush on Neutra Rust it is white. Then, as you watch, it turns pale green, then darker green, then finally a deep, wrought-iron

black. What you have seen is the rust being chemically converted. The hard new surface can be painted any color you want, or left as is.

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Letters



Projects On Wheels



Coach, emblem of GM's Body by Fisher, built by reader Wolf.

Now that I've finally finished the famous Fisher Body coach that I started over 50 years ago, I'm ready to build another model. (The one I remember so well is the Overland Coach, a classic stagecoach design you ran in PM years ago.) Back in 1930, Fisher Body of the General Motors Corp. sponsored a model-building competition for youths 17 years old or younger. The model was to be of the Napoleonic coach used as the trademark. Collins and Aikman donated swatches of velvet that could be used for the upholstery. I never finished the coach by my 17th birthday, but saved it for future completion. It was in a carton for the next 50-plus years traveling from house to house, cellar to cellar, through dry, wet, hot and cold conditions, until I rediscovered it and finally finished it. What is extraordinary is the velvet; the original 1930 pieces, are still strong and full of color!

RALPH J. WOLF
CLOSTER, NJ

Incredibly, a few days after receiving your letter we received another that saved us

looking up for you the date the Overland Coach appeared in PM.

Here's the letter:

Forty years ago I bought the January issue of POPULAR MECHANICS magazine (Vol. 85, No. 1—1946). In that issue was an 18-in. model of the Overland Stage. I started the model in '46, then changed jobs, moved three times and now, all of a sudden, its 1986 and I'm retired. I just finished the stagecoach and it's magnificent.

JOHN SCHLADENHAUFEN
BAY CITY, MI



Classic wagon was built from PM plans by reader Shutt.

Rolling stock

All the toys in your construction story were beauties (*Children's Toys: Three Classics You Can Build*, page 127, June '85). I chose to build the Coaster Wagon for my two grandsons. The oak I used is native Missouri lumber. A friend who built his cabin entirely of native oak planed some planks down to 1/2-in. thickness for my project. I formed the major hardware items from flat and bar stock. Thanks for the plans for this really classic wagon!

RAY SHUTT

MARYLAND HEIGHTS, MO

Two wingmen

Your Davis Flying Wing story (*Wing Ding*, page 53, Jan. '87) brought back memories of my college days at California Polytechnic in San Luis Obispo. Under John D. McKellar, we students helped design and build his prototype flying wing, working on it from '37 to '40. The design evolved into the Northrop wings of the '40s with McKellar's invention, "elevons."

EUGENE R. THOMSEN
SACRAMENTO, CA

I did all the steel and aluminum welding of the first Northrop wing, the N1M, and part of the welding on the magnesium XP-56 fighter. The Heliarc welding torch was inspired by Jack Northrop and developed in our

welding department. It was later assigned to Linde Air for marketing. Thanks for PM; I've enjoyed it since the '30s.

CHARLES DUNCAN JR.
INDIAN WELLS, CA

Desks for dollars

Your classic desk became a perfect project for me (*A Classic Desk For Your Computer*, page 106, Feb. '85). I have a part-time woodworking business and make clocks, tables, band-saw boxes and other items from unique woods and burls. Occasionally, someone will request a custom piece of furniture, like "some sort of desk to hold a computer." That's when I remembered your story. I added modifications to the plans, such as hidden casters, reversed slides, a



Computer desk of oak, built by Bob Behrent, brought top dollar.

lock for the file drawer, and dimension changes for my customer's computer system. I used solid oak—so those casters were a good idea! The best part was that the desk was so well described with plans in PM (where I've found so many great plans and articles over a good number of years). The desk was really easy to make, and it commanded a price to the customer of—let's say—in excess of \$1000. Thanks for a great publication.

BOB BEHRENT
FLANDERS, NJ

We've included this classic desk in our latest brochure of Plans And Ideas. It's PM-1047. To order blueprints, send \$4.95 to Popular Mechanics, P.O. Box 1014, Radio City Station, New York, NY 10101.

PM

“There are few things you can count on in this life. A friend should be one of them.” **MERCURY INTRODUCES A NEW FRIEND...**

“PHONES AREN'T supposed to ring at 3:00 a.m. And people aren't supposed to go 40 miles on turnpikes in their pajamas.

*But I'm glad he called.
And I'm glad I made the drive.
What are older brothers for? ”*



Buckle up— together we can save lives.

LINCOLN-MERCURY DIVISION



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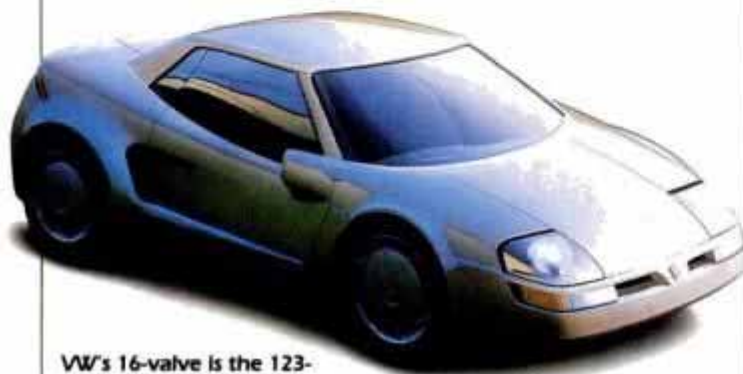
The shape you want to be in.

Imports



BY BILL HARTFORD

Fast-Track Valve Trains



VW's 16-valve is the 123-hp engine-of-choice for Treser.

Cars with engines yearning to breathe free are our latest immigrants. A turn of the key is all it takes to get heavy respiration going in 4-valve-per-cylinder motors. The increased horsepower and torque from these 16-valve Fours, 24-valve Sixes and 32-valve V8s are produced by the greater gas flow in and out of the cylinders, so the boost is as free as the air

you breathe. Even maintenance of the twin-camshaft designs is a free ride, with hydraulic lifters keeping the right clearances.

What can a modest displacement of 1.8 liters crank out? An answer can be found under the hood of VW's GTI 16V. Thanks to 16 valves, the hot hatchback has 123 horses ready at the gate. We gave them their head recent-



VW's 16V, seen mounted in the GTI, is a 1.8-liter handful.

4-VALVE IMPORTS

MAKE/Model
ACURA Integra, Legend
FERRARI GTB, GTS, Mondial, Testarossa
LAMBORGHINI Countach Quattrovalvole
LOTUS Turbo Esprit
MERCEDES-BENZ 190E 2.3-16
NISSAN Pulsar
PORSCHE 944S, Turbo; 928S 4
SAAB 900S, Turbo; 9000 S, Turbo
STERLING 825S, SL
TOYOTA Corolla FX 16, GTS, 1.6; MR2; Camry; Celica; Supra
VOLKSWAGEN Scirocco, GTI 16V

ly and found that, indeed, 8 seconds is all you need to get to 60 mph. As for the 124-mph claimed top speed, we had no legal place to try it, but can believe the top-end performance is as impressive as the car's ability to sprint from light to light.

If you think all this get-up-and-go is wasted on a plain and practical hatchback like VW's GTI, then take a look at a car where lots of power would be right at home: The Treser Roadster mounts VW's 16-valve amidships, and with the car's lighter weight could easily flash any GTI 16V over to the right-hand lane of the *Autobahn*. The roadster is the brainchild of Walter Treser, who developed his skills at Audi, and who now plans to build a half-dozen cars a day using the VW engine at his Berlin plant later this year. As for U.S. avail-



Speed techniques are on the Skip Barber Racing School video "Going Faster!" For info: 1-800-537-1600.

est car for the 62,000 miles was 132.542 mph. The endurance run of assembly-line Saab 9000s set world records confirmed by the autosports federation (FISA).

Saab's 16-valve gets its latest application, minus the turbocharger, in the 9000 S. This is the "bargain" 9000, new for '87, for drivers who don't need all the Turbo's punch and luxury, but appreciate Saab's basic attributes.

Drivers who do feel the need for speed, though, can



Saab's 16-valve is 2 liters, good for 160 hp with turbocharger.

ability, it's in the don't-hold-your-breath category.

Only one manufacturer on the 4-valve list has dared put its 16-valve powerplant to the test that Saab did recently. Under supervision of NASCAR, Saab ran three 9000 Turbos at full throttle for 100,000 kilometers at Alabama's Talladega Motor Speedway. Speed of the fast-

get it in a Saab of a whole different shape—an open-wheel racer used in the Barber Saab Pro Series. Here, Saab's 16-valve turbo is tuned for 212 hp, which will fly you down the straights at 160 mph. If you qualify to become one of these racers, you'll find that sweet sixteens are a helluva way to go—and go fast!

FM



VW GTI 16V turns 0-60 mph in 8 sec.; 124 mph is its top speed.

THE BEST GENERATORS ARE POWERFUL, RELIABLE AND QUIET. THAT'S WHY THEY'RE CALLED HONDAS.

Currently, Honda generators are the most widely-used, widely-trusted generators in the world.

Which should come as no surprise.

Especially when you consider that most Hondas are built around fuel-efficient, trouble-free Overhead Valve engines inspired by decades of world-class automobiles and motorcycles.

Or that Honda has the world's broadest range of multi-purpose generators from 650 to 6500 watts. For camping, boating, construction uses, power outages, outdoor parties, recharging car batteries—or most electrical needs at home or away-from-home.

Still, the real difference between an ordinary generator and a Honda generator can most accurately be summed up in one word: reliability.

The power you need is there when you need it. Because we engineer every single generator to ensure easy starts, quiet operation and durability that's measured in years—not months.

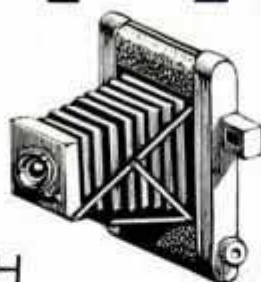
Honda generators. Quite simply the finest machines your money can buy. A claim no one else has the power to make.

IT'S A HONDA **Power Equipment**



For optimum performance and safety, we recommend you read the owner's manual before operating your Honda Power Equipment. Connection to house power requires transfer device to avoid possible injury to power company personnel. Consult a qualified electrician. © 1986 American Honda Motor Co., Inc.

Photography



BY STEPHEN A. BOOTH

Dawn Of A New Age

It's easy to take progress for granted. Each camera show heralds equipment that's faster, sharper, lighter or smarter—and the most recent photography exhibition in Chicago delivered as promised. Fortu-

nately, for me, the presence of former Yankee slugger Mickey Mantle provided a unique perspective on the innovations and new technology unveiled in the Windy City.



All-electronic control is the hallmark of Canon's EOS 650 and 620 autofocus SLRs.

The baseball hall-of-famer was on hand at Fuji Photo Film's exhibit to help publicize that company's sponsorship of major-league ball. Our chance encounter caused me to recollect that I'd made my first trip to the ballpark, and taken my first photograph, at the age of seven. Coincidentally, the subject of those early snapshots was No. 7 of the Bronx Bombers at the plate, making his customarily liberal contribution to the home team's 5 o'clock thunder.

On that warm spring day more than a quarter-century ago I carried the family camera, a fixed-focus Kodak of the box type whose design and operating principles hadn't

changed much over time. All you had to do was point and shoot. I was carrying a point-and-shoot camera in Chicago

the day I caught up with Mantle and his autograph, but it's a camera destined to change 35mm SLR photography.

The camera is Canon's new EOS 650, an autofocus SLR that is Canon's answer to Minolta's Maxxum series cameras. The 650 (\$600 with 50mm f/1.8 lens) and its sibling 620 model (\$800) share the EOS name, which stands for Electronic Optical System. The mythology buffs at Canon note that Eos also is the name of the ancient Greeks' goddess of dawn—and claim their cameras represent a new day in photography.

A hands-on evaluation of the EOS 650, plus brainstorming sessions with Canon's technical staff, confirms that these cameras are the first of a new breed. They're certainly the fastest autofocus SLRs available today. Though this feature owes mostly to the cameras' pioneering use of electronic controls, there are some new innovative mechanical aspects, too.

At the heart of the EOS cameras is the sensor that makes autofocus possible. The BASIS chip (Base-Stored Image Sensor) developed by Canon is more sensitive than the charge-coupled devices used in other autofocus SLRs. Accordingly, it can focus automatically in light levels as low as EV-1—an exposure requiring one sec-

ond at f/1.4 using ISO 100 film. Light that low would make it difficult to read a newspaper. Low light has been the stumbling block of all previous autofocus SLRs, the best of which can't focus in light below EV-2.

The BASIS chip enables the EOS cameras to autofocus one f/stop lower than other cameras, but it's the cameras' main microprocessor, all-electronic lens mount and lens motors that enable them to autofocus faster.

Whereas other electronic cameras use an 8-bit microprocessor to handle focusing and exposure information, the EOS duo uses a higher capacity 16-bit chip to speed communication between the AF sensor (in the body) and the microprocessor and motor within each lens. Additionally, there is no mechanical linkage between Canon's new EF (Electro-Focus) lenses and the EOS bodies. Instead, eight gold-plated contacts convey all the focusing and exposure instructions electronically. This not only increases speed and accuracy, but also means that EOS components won't become obsolete when the future brings even more electronic innovations.

Still another area of innovation in the EOS system is its autofocus EF lenses. With all other autofocus SLRs, the motor that focuses the lens is

(Please turn to page 16)

PM PHOTO ALBUM—TIPS FOR BETTER PICTURES

Long exposures will blur the image of most moving subjects on your film—but you can use this phenomenon creatively.

Take the subject on the right, the elevators. This scene was exposed for 16 seconds, using the B (bulb) setting on the camera. The camera itself was placed on a bench, facing straight up, and triggered with a cable release. Note how the elevator lights traced their movement on film.

Exposure was determined manually, at the 1-sec.

shutter setting. Double the exposure time whenever the aperture is closed down by one f/stop. For example, 1 sec. at f/4 is the same exposure as 2 sec. at f/5.6, or 4 sec. at f/8, and so on.

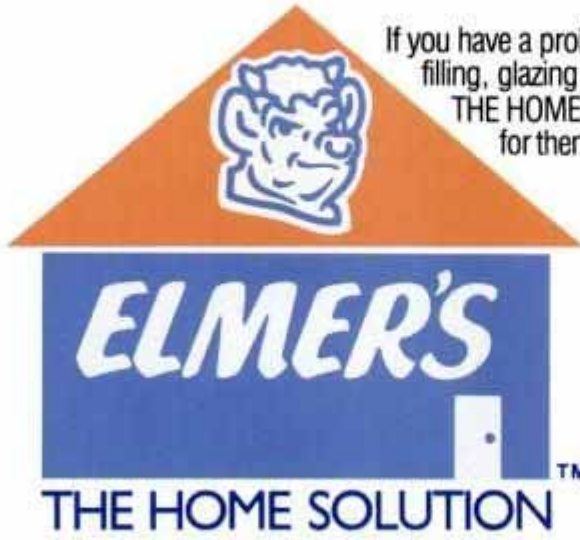
You can get similar effects with automatic cameras if you use a slow film, such as ISO 25. If you have control over aperture, set it to the smallest opening (largest f/stop number). The photo on the left was taken with an automatic camera from a moving car inside a tunnel.—Armand Ensanian



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Problem: How to replace caulking around your tub and tile.
THE HOME SOLUTION™: Elmer's Tub Caulk. Provides a flexible seal that's water and mildew resistant.



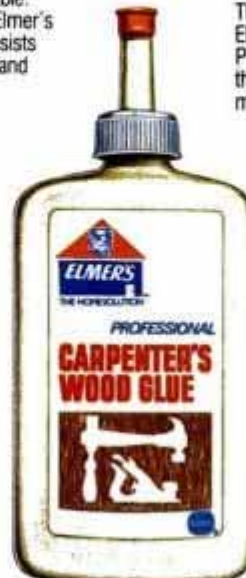
Problem: How to protect your hands from paint, oil and grease.
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Problem: How to attach Formica® to a countertop.
THE HOME SOLUTION™: Elmer's Contact Cement. Forms a strong bond.



Problem: How to glue the arm back on the armchair.
THE HOME SOLUTION™: Elmer's Carpenter's Wood Glue. Penetrates wood deeply for a strong bond.



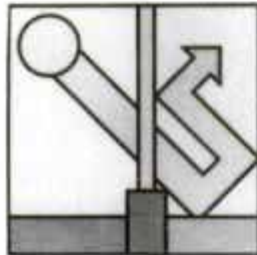
Problem: How to glue protective felt to the bottom of the statue.
THE HOME SOLUTION™: Elmer's Glue-All™. It's the ideal all-purpose household glue.

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PHOTOGRAPHY

(Continued from page 14)

housed within the camera body. Canon's system places the motors inside the lens—with no increase in the size and weight of the lens barrel.

Canon explains that building-in the motors enables them to be custom-tailored for the specific lens—with the advantage of faster operation. Besides the focusing motor, each EF lens contains a second motor, which regulates the aperture of the diaphragm. Canon says that such electronic control of the diaphragm provides more precise, reliable and quieter operation than lever-actuated mechanical diaphragms. Finally, a memory chip in each lens identifies its focal range and speed and provides other information that enables the microprocessor in the EOS body to calculate exposure and focus values.

The focusing motors in the 14 new EF lenses merit attention because they've never been used in photographic applications before. Twelve are focused by Canon's Arc-Form Drive, a tiny but powerful motor that's shaped to the curve of the lens barrel and closely geared to the moving elements of the lens.

Two other EF lenses, a novel 50mm f/1.0 (\$2760) and a 300mm f/2.8 telephoto (\$4210), are driven by a unique ultrasonic motor (USM) that adds virtually no bulk to the lens. The USM is comprised of two flat piezoceramic rings that fit inside the barrel on the same plane as the lens elements. When electrical current is applied, they vibrate at super-high but inaudible frequencies, rotating the lens either clockwise or counterclockwise to achieve focus. Operation is virtually spontaneous, and eerily silent.

Tiny motors aside, what contributes to the compact size of the EF lenses is their use of molded-glass (GMo) aspheric elements, a Canon first. Aspheric shaping means a lens needs fewer elements than are normally required, resulting in a smaller, lighter lens. Seven of the 14 EF lenses now available use GMo elements, including the 50mm f/1.0—the fastest lens available for a 35mm SLR camera.

The ability to manufacture such large-aperture lenses at reasonable cost is another benefit of this glass-molding technology. In the case of the f/1.0 lens, the speed is also made possible by Canon's adoption of a new, wider 54mm lens mount (compared to the 48mm gauge of current Canon cameras). This means you can't use EF lenses on non-EOS bodies, or non-EF lenses with the new EOS 650 and 620. But Canon maintains this break with the past is necessary in order to exploit future electronic innovations without compromise.

One final noteworthy point on the EF lenses is their calcium fluoride crystal elements. Canon's use of this man-made crystal in the optical glass lends a degree

of color accuracy usually found only in more expensive apochromatic lenses.

Does all of Canon's technological der-ring-do yield practical results in the field? You bet it does. In our hands-on evaluation we found the EOS 650 to be the fastest autofocus SLR we've handled so far, the only one that doesn't balk when the lights grow dim and, overall, a joy to use. (For the record, we used the standard EF 50mm f/1.8 and the \$356 EF 35-105mm f/3.5-4.5 zoom for our tests.)

Each camera is capable of single-shot or "servo" autofocus, plus manual focus. In the single mode, the cameras find focus and lock it in at that point. If the subject moves (or if you do), you have to refocus. In "servo" the cameras continually readjust focus to follow any motion. In these circumstances you'll want to use the continuous film-advance mode. Keep the shutter release pressed and the built-in motor drive will fire away at up to three frames per second.

As you might expect, the EOS 650 and 620 provide a variety of automatic exposure modes. They share a do-everything program that selects shutter speed and aperture for you. Also shared is shutter priority, aperture priority, metered manual and two flash programs. Here's where the differences begin.

The EOS 650 has an innovative program called Depth Of Focus Autoexposure. To use it, you first fix focus on the nearest point you want in sharp focus, then the farthest. The EOS 650 then calculates the proper f/stop to maintain the depth of field you desire.

In place of this program, the EOS 620 substitutes Autoexposure Bracketing. This lets you play it safe by compensating for the "correct" metered exposure with up to five stops of under- and overexposure. Set the camera for the degree of plus or minus compensation you want, release the shutter and EOS 620 makes three continuous exposures: under, correct and over. Until recently, this advanced feature was available only as a custom modification to pro cameras.

Other major differences between the EOS 650 and 620 are, respectively, 1/2000-sec. shutter speed vs. 1/4000 sec., and 1/125-sec. flash sync vs. 1/250 sec. Additionally, the EOS 620 can perform multiple exposures, and adds bright blue backlighting to the 650's plain gray LCD data display.

Shutter speed on both cameras is electronically controlled, in half-stop increments down to 30 sec. plus Bulb. Film speed ranges from ISO 25 to 5000 with automatic DX setting, and ISO 6 to 6400 manually. The cameras also share 6-zone evaluative center-weighted light metering, plus partial center metering (6.5 percent of the image). Each weighs 22½ ounces, including long-life lithium battery, and can use either of two flashes and two interchangeable data backs. **PM**

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19" ELECTRIC MOWER



FREE Grass Catcher
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After handling a Snapper trimmer, the others seem like toys. Whether for home or commercial use, you'll find all the power and features you expect—and more.

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Science

BY DENNIS ESKOW



A Simulated Goddess

Aurora is the Roman goddess of the dawn. It also is the name for the U.S. Army Laboratory Command's nuclear blast simulator. In the past year, Aurora has blasted more than 100 experimental objects with its four gamma-ray injectors. In each experiment, the object is dosed with the equivalent radiation of a nuclear weapon of a given charge. The process has cut down drastically on the need for actual nuclear blasts to perform tests.

At the Laboratory Command's Harry Diamond Labs in Maryland, the Defense Nuclear Agency passes judgment on all combat materials as to their "hardness" to a nuclear attack. Also, the Army's Space Command and several agencies working on the Strategic Defense Initiative have used Aurora's services. Even Defense Contractors are using the simulator to pretest new nuclear-resistant materials.

"A single underground test shot costs millions of dollars, and of course, can't be readily repeated," says Jack Agee, who runs the testing program. "A typical test shot at Aurora costs under \$3000 and can be repeated as needed to gather data."

When the Defense Department points to the new series of tests, a shift in nuclear testing policy is confirmed without comment. In seeking new weapons agreements with the Soviet Union, the U.S. has been trying for years

to select reliable testing procedures without actual nuclear weapons blasts. The testing on both sides has been a major bone of contention.

The doors to the Aurora chamber were recently enlarged to help it accommodate an M1 tank. Again, this is tacit acknowledgement that the familiar vehicle is going through material upgrades to "harden" it for nuclear combat.

Finally, Aurora has been upgraded recently to simulate electromagnetic pulse and high-power microwave environments. This suggests applications for hardening materials against known Soviet Star Wars machines. Aurora does not eliminate the need for underground nuclear testing, Agee points out. But it does reduce the number of tests.

Some readers may be alarmed at the presence of such a device. Does it spur us on in the nuclear arms race? I'd say no. The race goes on



A-bomb simulator reduces real blasts.

with or without Aurora. But it does reduce insults to the environment, and tensions in the diplomatic community.

Research giant

When the national telephone monopoly was broken up, there was a great cry from the scientific community. Bell Labs, generator of major research and winner of a pile of Nobel Prizes, might go out of business, was the concern many expressed at the time. It was really the only major lab in the country doing research that often didn't have an obvious payoff. Would any corporation in America risk R&D funds on such basic research? Well, Bell Labs is alive and well two years after the break-up, and now a new lab-in-the-making is growing out of a pact made between The Rockefeller University and the Howard Hughes Medical Institute. The Hughes Institute will invest an average \$10 million a year for the next 10 years in specific projects at Rockefeller's almost 50 labs. Actual research goals have not yet been announced, but Hughes has already devoted a lot of its energies to the medical application of lasers, radiological sciences and space medicine. Rockefeller, which has done breakthrough work in genetic engineering, physics, mathematics and other basic sciences, has also shown interest in these technologically generated fields. Look for breakthroughs in lasers themselves and in medical imaging equipment. This is a marriage made in science heaven, with lots of copycats waiting in the wings.

Remember this

Psychology Prof. William Hoyer of Syracuse University talks to older people. Most of them are professionals. And he reports one very unexpected discovery. Experts retain their memories on subjects about which they are expert into old age. Preliminary findings are that experts develop an unconscious set of reasoning rules that stay with them throughout their lives. This applies to scientists and other professionals, and it may well also apply to carpenters and other skilled people.

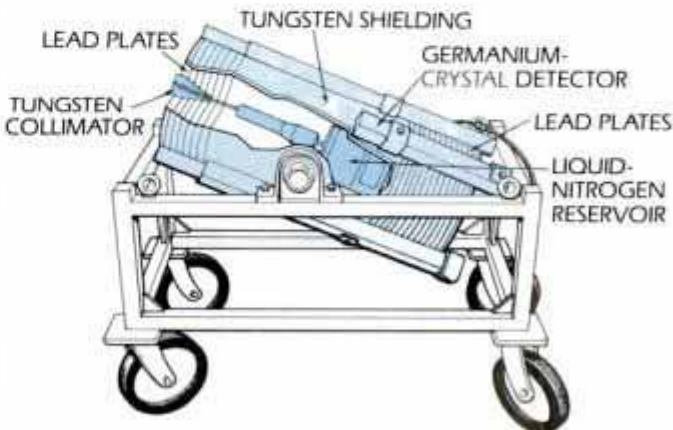
Hoyer currently is studying various groups of medical experts to see how far this memory-retention capability goes with them.

Waste not

Federal regulations for the policing of low-level radiation in waste products has gotten so demanding in recent years that new equipment has had to be developed.

One ingenious machine, discussed in a recent issue of the Electric Power Research Institute's journal, is called QuantiScan. The QuantiScan system was first used in the cleanup after the Three Mile Island nuclear accident. It is now commercially available.

Rigged like a telescope, QuantiScan is shielded by lead plates to eliminate interference and inaccuracies. Its tungsten collimator picks up gamma rays and feeds them to a germanium-crystal detector for an accurate count of radiation in nuclear waste. It should be in widespread use within five years. **PM**



The QuantiScan detects radiation in waste products with crystals.

ANNOUNCING: A VERY QUIET

The new Goodyear
Wrangler AT and ST radials.
Engineered for year-round
peace and quiet.

The biggest drawback of most tires made for light trucks, vans and RVs isn't the way they look.

It isn't even the way they perform.

It's the way they sound.

The noise they make. As they drone, whine, or rumble down the highway.

Now, with the introduction of the new Wrangler AT and ST radials, Goodyear has started a very quiet revolution.

And, as you'll discover, noise reduction isn't the only improvement to be found in these remarkable new tires.

The strong but silent type.

The characteristics demanded by our development engineers for the new Wrangler AT and ST radials were strategically very simple:

They had to be the strong but silent type.

And strong they are.

Both the Wrangler AT and ST are true steel-belted radials, with a minimum of two high-strength steel belts.

Beneath the steel belts, you'll find two plies of chemically stabilized polyester cord for long tire carcass life.

For additional strength, the sidewalls are reinforced and have a cut-resistant compound.

One more benefit of the

reinforced sidewalls; they provide responsive steering.

We also added a cool running sub-tread compound.

And a butyl liner for good air pressure retention.

And a new lower sidewall design for better stability in the bead area.

And those are just a few of the design features of the new Wrangler AT and ST radials.

So, as you can tell, we didn't take any shortcuts on our road to stronger, quieter tires.

Radials that aren't afraid of the weather.

Because you cannot always choose when or where you drive,



both the Wrangler AT and ST were designed for quiet, year-round performance.

In all weather. In all seasons.

On dry roads, they run cool, quiet and easy.

In the wet, they both channel away water to maintain contact and control.

And in snow, the deep traction biting edges dig in deep to get you through.

The concept is the same. The execution is different.

Although the Wrangler AT and ST radials share many of the same strong construction features, their final execution is different. Most noticeably in the tread design.

The Wrangler ST radial was designed for light trucks, vans, and RVs that operate primarily on the street and highway. And it has been tuned for quiet, smooth operation in that particular environment.



THE START OF REVOLUTION.



*When the road ends,
the performance doesn't.*

In everyday use, the new Wrangler ST radial will come as a very pleasant, quiet surprise.

It is a strong, year-round, all-weather tire that has been designed to give you long wear, better handling and excellent traction.

Ditto for the Wrangler AT radial.

Except that the new Wrangler AT has another pleasant surprise.

Because when the road ends, its true performance begins.

See the Wrangler ST and AT radials at your Goodyear dealer. And witness the start of a very quiet revolution.



The Wrangler AT, on the other hand, was designed for light trucks and RVs that need both an on-road and off-road capability.

The open shoulders of the new Wrangler AT radial let it reach down deep for a solid grip in dirt, mud and wet grass.

The broad, open tread face of the Wrangler AT also gives it excellent traction in soft soil.

And while the tread of the new Wrangler AT gives outstanding off-road performance, it has been tuned to a low noise pitch sequence to help maintain a quiet highway ride.

Additionally, the Wrangler AT comes in a wide variety of widths and sizes, with a maximum load capacity of up to 3,042 lbs. per tire.

But no matter which Wrangler you choose, both offer you low rolling resistance to aid fuel economy.

GOODYEAR

Take me home. The quiet way.



Car Clinic



BY MORT SCHULTZ

Ford Truck Tire Trends

In last month's Car Clinic (page 53), I brought up the business of steering pull (drift) and tire wear that concerns many Ford light truck and utility vehicle owners. The latest information about how to resolve pulling was addressed; now let's discuss abnormal tire wear. There are several factors you have to consider, as follows:

■ Toe of wheels should be set between 0 and $1/12$ in. out. If the shop manual for your vehicle doesn't say so, disregard the manual. Technical Service Bulletins (TSBs) 82-15-13 and 85-19-16 set the guidelines. Keep in mind that if your vehicle is modified and you don't reset toe, abnormal tire wear will probably occur. In other words, if you add a snow plow, winch or toolbox to the truck, the toe will be thrown off, so readjustment is a must.

■ Camber is a factor for those who like to ride high by beefing up the front suspension. This creates excessive positive camber. The best camber at which to set the wheels for maximum tire wear is 0 to 1.5°.

Watch it if you order a truck with a heavy-duty suspension system with plans to eventually install a snow plow or winch. Camber is set at the factory in anticipation of this weight. If you don't follow through and install the equipment, you'll be driving around in a vehicle that has excessive camber.

■ Modern tread patterns provide lower rolling resistance, improved fuel economy and better traction in all kinds of weather and over all types of terrain. These so-called all-season and all-terrain tires are more susceptible to irregular, heel-toe and diagonal wear. The only way to minimize wear is to maintain correct wheel alignment and tire pressure, and to cross-rotate tires as often as your owner's manual recommends.

That's shocking

How do my wife and I get out of our 1986 Plymouth Reliant and close the doors without getting shocks? The dealer says to hang a piece of rubber from the bumper to the ground. I've never heard of such a thing. Have you? I've

tried several static sprays on the seats, but no luck. Can you help, please?

WARREN D. HUGHES
NEWPORT, RI

I've tried a couple of things and have checked with a few knowledgeable sources concerning the long-standing problem of static electricity, and this is what I've learned:

Will a static electricity strap such as that recommended by your dealer work? Some of my sources say yes, others say no. So I tried one. I still got jolted.

Here's how I keep from getting a jolt. As I slide across the car seat and out of the car, I keep hold of the inner door handle, which is metal. But let me caution you that some handles are made of plastic and won't act as a ground. However, you could keep your fingers wrapped around a window frame if the window happens to be open or on the side of the door.

Pillars of strength

We are a small auto repair shop with the attitude that if you've paid to have it fixed, you're entitled to have it fixed right. We are having a problem with a 1978 Datsun 280Z that is putting our philosophy to the test, and we need your help. We can't get rid of a

front brake squeal. So far we've fine-turned rotors on an Ammco brake lathe, used Clover Lapping Compound and replaced pads several times with various brands and types. Still, within a day the darn squeal returns. We don't know what else to try. Can you give us a clue?

GUY PILLARS
ROCK FALLS, IL

Nissan has had success in dealing once and for all with this brake-squeal bugaboo. It's in the form of a fairly new compound called Nissan Brake Grease, which you can get from a Nissan dealer as part No. MSS 99990-00939. Apply it to the backs of brake pads and shims. The product does a great job absorbing high-frequency pad vibrations that are heard as squeals. One application is usually all that's needed for the life of the pads.

A brake with tradition

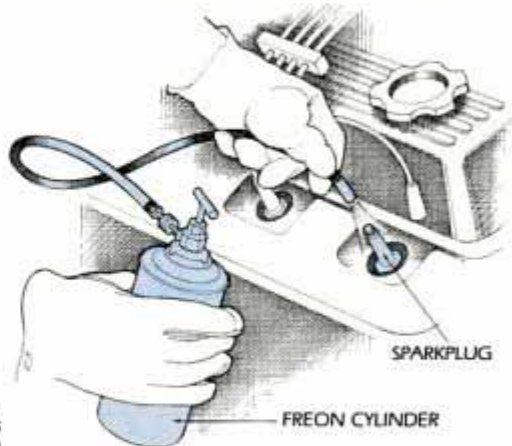
Our 1985 Oldsmobile Ciera has been a super car, except for one dangerous problem. When braking moderately hard, the rear tires don't hold. Carrying two 80-pound bags of sand in the trunk helps some. Is the trouble caused by unequal weight distribution, which would be a design flaw? Are there any

(Please turn to page 26)



Instant winter

Steel sparkplugs and aluminum cylinder heads often can be dangerous to separate when the head is hot. Either you wait 'til the engine cools off, or risk taking all the threads out of the head with the plug. Brian Ward of Pekin, Illinois, wrote to *Motor* magazine with this suggestion. He uses a rubber hose hooked up to a can of Freon refrigerant. A cold blast of Freon only a few seconds long directed right at the plug cools it off in a hurry. Wear gloves, or you'll



cool off your fingers more than you might like. Safety glasses, too. This beats pulling a head to fix stripped threads, but somehow just waiting to let the engine cool off doesn't sound too bad either.

Buckle up—for life!



IT'S NOT YOUR TYPICAL MAINSTREAM STATION WAGON.

Of all the good things you can say about the average station wagon, exciting to drive isn't one of them. Which is why Isuzu builds the Trooper II instead.

It's easy to drive and park, just like a station wagon. It carries a lot of luggage, just like a station wagon. And it even has seating for five, just like a station wagon.

But there, thankfully, the similarities end. Because with the shift of a lever, the Trooper II instantly turns into a four-wheel drive machine potent enough to win the

agonizing Baja 1000. An off-road machine that made even the premier enthusiast's magazine, *4-Wheel & Off-Road*, exclaim, "It accepts abuse with so much grace it's hard to stop looking for jumps to drive over." From \$10,809*

So the choice is yours.

Are you going to buy something practical, economical and middle-of-the-road?

Or something practical, economical and capable of leaving it?



*Manufacturer's suggested retail price P.O.E., excluding tax, license and transportation fee for Deluxe 2-Dr. model. 4 Dr. LS shown \$12,999. Price subject to change. Rear Seat Optional.

The First Car Builders of Japan.

ISUZU

Исuzu - зарегистрированный торговый знак

CAR CLINIC

(Continued from page 24)


recall notices I've missed or TSBs I should have my dealer look at?

C.R. RETTSTATT
KINNELON, NJ

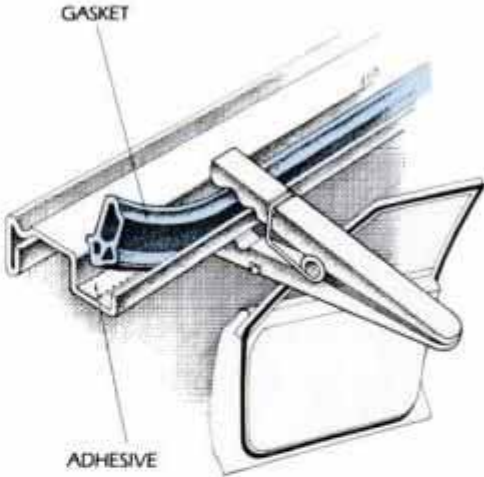
The answer is no to both questions. So where do you go from here? To an Olds dealer or first-class brake shop—that's where—to make sure every cause of uneven braking action is checked out. The Olds service and general brake repair manuals list 20 causes, with contaminated brake linings, including too much brake lining dust, being cited as the more probable cause. In addition to the 20, you should have two others looked into—possibilities that are more than remote with GM A-body vehicles. They are:

- One or both rear drums being out of round, which could cause brakes to lock under hard braking.
- The parking brake not releasing all the way when it's disengaged. If the parking brake is not adjusted correctly, the rear brake shoes which are set against the drums when the parking brake is engaged may remain in hair-line or very close contact with the drums when the parking brake is released. The effect of this "barely" or

PM CAR CARE



Tip



GASKET

ADHESIVE

Hung up to dry
Our thanks to Jerry Flentge of Freeway Truck Sales in Lyons, Illinois, for this gem we came across in the Fall '86 issue of *Service Life*, a magazine that Ford and Lincoln-Mercury service personnel receive:

Instead of using metal clamps that might scratch the paint, or tape that doesn't clamp well and leaves a sticky residue, try ordinary wooden or plastic spring clothespins to clamp weatherstripping in place until the adhesive dries. The things are so cheap that you'll be able to use one every inch or two all around the seal, ensuring a really good fit. The spring keeps clamping pressure constant as the rubber sets.

almost lining-to-drum contact would not be noticeable. However, when you brake, the pressure you bring to bear against the drums plus the pressure or closeness already there because of partial parking brake engagement could convert a moderately hard brake appli-

cation into a panic stop that is making rear tires break loose from the road.

Pesky ping (a.k.a. kooky knock)

My 1984 Pontiac Parisienne 5-liter engine began pinging (knocking) at about

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EMHART



6000 miles. The car now has 24,000 miles and continues to ping, despite all our efforts to get rid of the noise. The following is important for you to know:

- The ping occurs primarily when the car is warmed up and is under a light load, such as going up a slight grade.
- I use premium fuel of major oil companies. Regular gasoline causes an increase in the intensity of the ping.
- Octane additives have no effect.
- No trouble code is stored in the computer memory, and all voltage readings are per the factory shop manual.
- The dealer has replaced the EGR control solenoid, canister purge valve, temperature sensor, barometric sensor and oxygen sensor. I've replaced the 195° thermostat with a 180° unit and switched from R45 to R44 sparkplugs.

If you can help me, I'd greatly appreciate it.

JEFF FRANCIS
EATONTOWN, NJ

There are six causes of ping that you don't cover.

1. Don't assume that an intake air leak will set a trouble code in the computer. It doesn't always. The old way of finding an intake air leak is still effective—that's to spritz oil around possible leak areas with the engine running and a tachometer connected. If the tach records a change in engine rpm following a spritz, there's a leak at that point.

SERVICE TIPS

■ According to Ford TSB 86-25-9, a plugged manifold absolute pressure (MAP) sensor vacuum hose may be behind rough idling, black exhaust and/or poor fuel economy you're getting from a 1985 or 1986 Tempo or Topaz. The fix is to replace the plugged hose with a new one and install a new vacuum fitting (part No. E73Z-9A474-B) and MAP sensor bracket (part No. E63Z-9G476-A).

■ Buick says that a humming noise from the engine of a 1987 Century, Somerset or Skylark with 2.5-liter engine may be caused by an air cleaner cover that's too tight.

■ Chrysler has taken a long, hard look at all the complaints about its 2.2-liter carburetor-equipped engine sagging on acceleration until it gets warm, and has issued TSB 18-50-86. It applies to 1984-87 models. Now there's no reason for you to believe a mechanic who says, "They all do it—it can't be helped."

■ If your Toyota turbocharger begins making noise, check the oil supply pipe to make sure oil coke, caused by excessive heat being transferred from the turbo to the oil pipe by way of the oil pipe clamp, isn't clogging the pipe. If the pipe is partially or completely restricted, it has to be replaced. Don't try to clean it out. If you haven't experienced trouble yet, avoid it by removing the clamp. Toyota says doing so won't damage the pipe. In fact, the clamp is no longer installed during production.

2. You mention that the dealer replaced the EGR control solenoid, but did he test to see if the EGR valve is working? A malfunctioning EGR valve may cause ping. However, if the EGR valve is bad, the engine will usually stall as well.

3. Did your dealer check to see if the electronic spark advance (ESA) is operating as it should with timing set at the base specification given on the vehicle emissions control label?

4. Full-time EFE—it's supposed to be off when the engine is warm—will cause a ping under light-throttle operation.

5. Has anyone checked the Thermanac (heated inlet air) system? The Thermanac damper valve may be stuck in the ON position, so air being fed into the engine is too hot, resulting in pinging.

6. If the compression in one cylinder is much greater than in the others, knock will result. The valves in that cylinder may have to be reset to lower compression.

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, NY 10019. While letters cannot be answered individually, problems that are of general interest will be discussed in the column.



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Kings: 8 mg "tar," 0.5 mg nicotine av. per cigarette, FTC Report Feb '85

to Merit.

Breakaway to flavor.



Comparisons based on king-size versions of product shown and tar levels from latest FTC report.

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Tool Tests



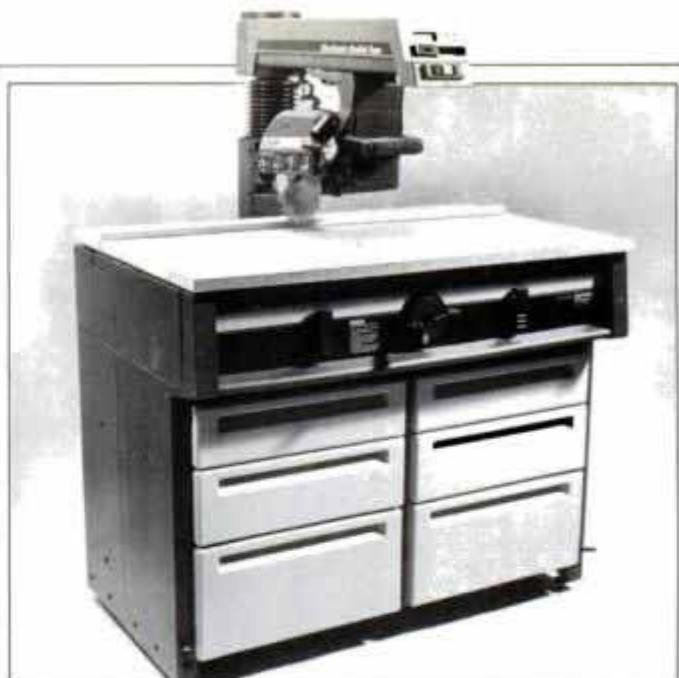
Electronic Radial-Arm Saw

After testing the new Craftsman 10-in. electronic radial-arm saw, I was so impressed that I decided I wanted one for myself. I gave my old, reliable radial-arm saw to my son. The features that sold me on the Craftsman include an electronic liquid-crystal display (LCD), large 27 x 44-in. worktable, up-front fence clamps and six roomy drawers. I also liked the horizontal handle.

Located on the end of the saw's arm is an LCD window and various pushbutton keys. Press a button and a digital

readout shows the blade position for elevation, bevel, miter and rip. Bevel and miter cuts are shown in $\frac{1}{2}$ -degree readings. Read blade elevation and rip cuts in .01-in. increments. The LCD is powered by a 6-volt battery. To save battery power, the LCD shuts off automatically after three minutes. However, a built-in memory will recall the last setting.

All these features are useless if the saw is inaccurate. After testing various types of cuts and settings, I found the saw to be precise and, just as



Saw has 27 x 44-in. worktable and 6-drawer storage cabinet. Or, choose a cabinet with one door/three drawers or two doors.

important, very consistent.

It's powered by a 1 $\frac{1}{2}$ -hp, direct-drive, ball-bearing motor with a maximum output of 2 $\frac{1}{4}$ hp. Maximum depth of cut at 90° is 3 in.; at 45° it's 2 $\frac{1}{4}$ in. The saw will crosscut a 15 $\frac{1}{2}$ -in.-wide board. Maximum ripping capacity is 26 in. wide. The ON/OFF switch has a removable locking key to prevent unauthorized use.

The saw comes with a carbide-tipped blade, antikick-back pawls and kerf spreader, and four casters.

The Craftsman 10-in. electronic radial-arm saw costs about \$470 at larger Sears stores and through the Sears tool catalog. Contact Sears, Sears Tower, Dept. 703-PM, Chicago, IL 60684.

—Rosario Capotosto



Smooth-sliding steel drawers with durable plastic fronts provide plenty of storage. The six drawers measure 3, 6 and 10 in. deep.



An easy-to-replace 6-volt battery powers the saw's LCD. To the right of the LCD window are six pushbutton function keys.



Quick-release clamps make it easy to change or reposition saw fence. Lift handles to release tension; push down to lock fence.



The saw will cut bevels between 0 and 90°. Here, a 30° bevel cut is made. Note the 30° reading visible in the LCD window.



To test accuracy, I cut an odd-angle miter—20 $\frac{1}{2}$ °—and then checked the cut with a bevel square. Cut was right on the mark.



Rule is used to check $\frac{1}{4}$ -in.-deep dado cut in $\frac{3}{4}$ -in. stock. Elevation reading of .50 in. is distance from table to blade.

COMPLETE 1987 BOATING GUIDE

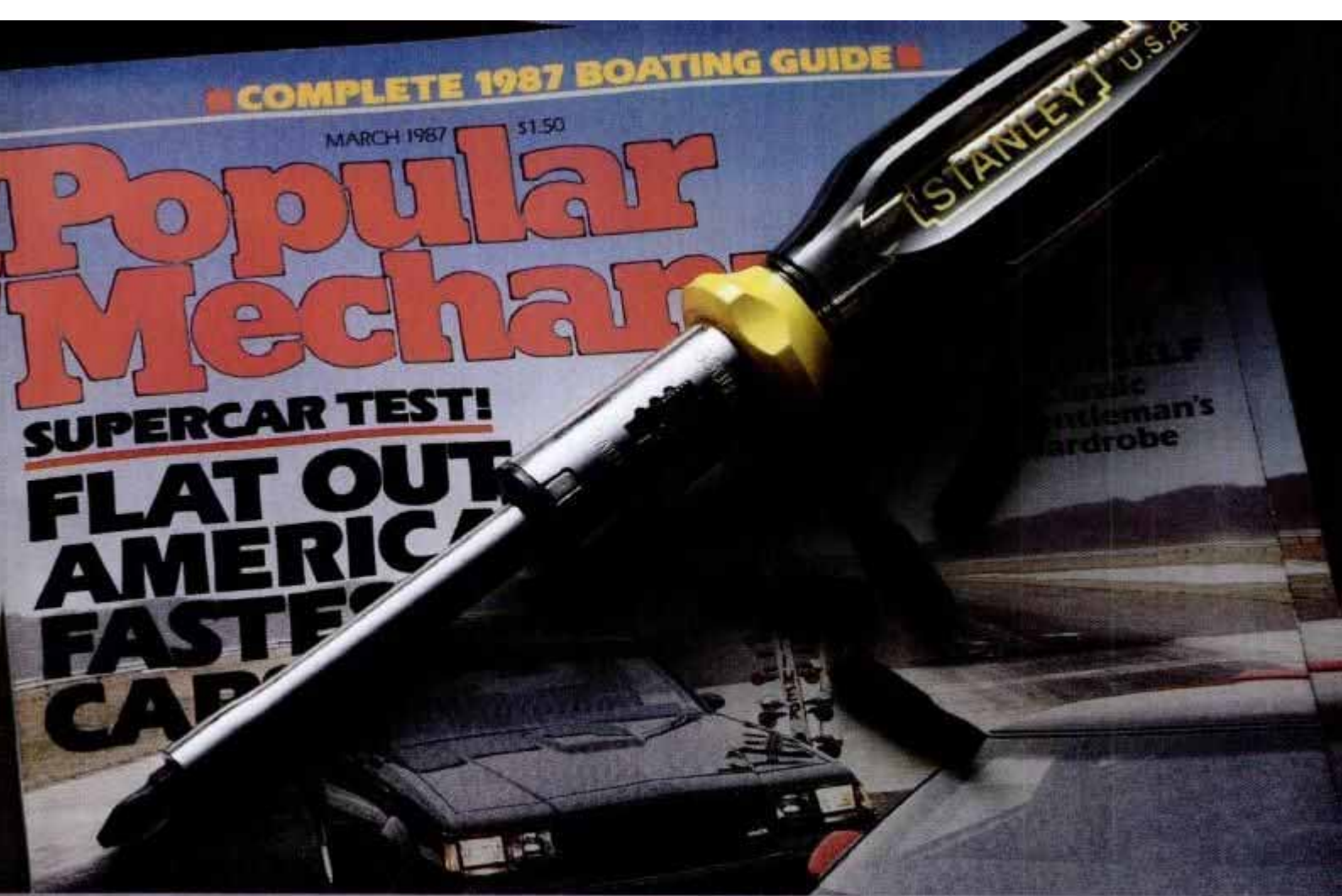
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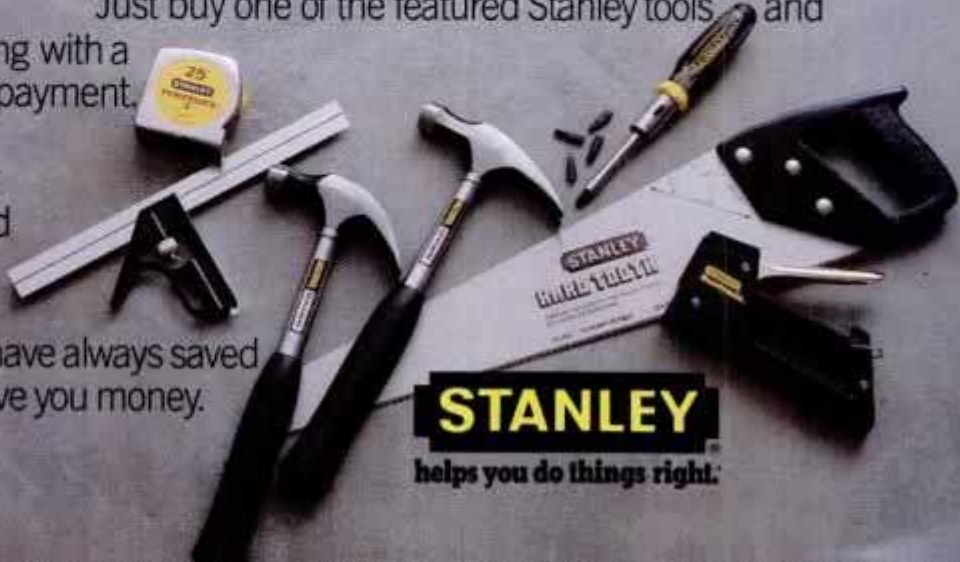
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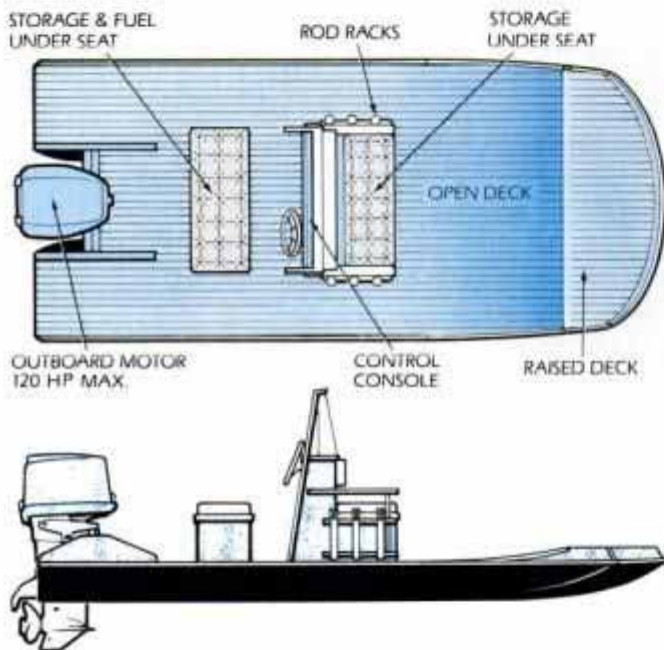
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Outdoors



BY TIM COLE

Running The Flats



The Texas Scooter—a perfect design for getting into tight spots.

Bone fishermen on the Bay of Florida and anglers along the Texas Gulf Coast are well aware of the problem. How can you get to where the fish are in extremely shallow water with a conventional boat and motor setup? The answer is: you can't. Unless you come equipped with a Scooter, a high-speed fishing platform that draws a mere 4 in. of water running.

Like most specialty boats, the Scooter is a product of its environment. It's characterized by reduced freeboard, a tunnel hull, center console and, usually, a means to raise and lower the engine bracket under way, in

addition to standard trim/tilt. I ran a Scooter following a recent boat show. After throttling easily onto plane, the water slicing through the tunnel provides the fluid medium that the prop operates in, and raising the engine vertically—out of harm's way—into the tunnel wash doesn't seem to result in any appreciable efficiency loss.

Glen-L marine designs recently came up with a Scooter design for the home-

builder. The Glen-L plans (\$45) include full-size patterns, or you can use Glen-L's prefab frame kit (\$310). Fastening kits for the Scooter are also available (\$68.20 for galvanized; \$147.50 for bronze), along with a fiberglass covering kit (\$129). The finished article is 15 ft. 9 in. long, 6 ft. 10 in. wide and weighs about 600 pounds. You can mount up to 120 horses on the back, and take a couple of friends to fishing spots that other boats will never—ever—get to see.

Contact Glen-L Marine Designs, 9152 Rosecrans, Bellflower, CA 90706.

Taking aim

Laser sighting devices for small arms have been around for quite a while, particularly on military arms. As an example, we covered the Laser Products 14A and 15A in the November '85 issue (*Setting Sights On The Future*, page 93). They're intended for the Ruger Mini 14 and Colt AR-15, respectively. But high cost (around \$1000) has always impeded the laser's acceptance on a broad scale.

Touring the SHOT Show in New Orleans, however, I stumbled on an interesting laser sighting instrument that's serviceable on a variety of weapons and costs a relatively inexpensive \$449. The Lasersight LS45 operates on twin 9-volt batteries that energize the helium-neon laser tube to 12,000 volts. The tricky part in manufacturing this compact unit is suspending the tube inside the casing so it won't break, and making it adjustable for windage and elevation. It weighs less than 12 ounces and offers 45 minutes of continuous use, or 2700 seconds of intermittent use. Best of all, it works. The laser beam concentrated a highly visible

pinpoint of light across the cavernous interior of the New Orleans Convention Center. The jury is out on how well the LS45, or any laser aiming device for that matter, operates in



The Lasersight—high-performance aim.

THE ANTIQUE
OUTBOARDER



The Antique Outboarder, AOMC's official book.

bright sun, but a 300-yard range at dusk or in the evening isn't bad. Contact Lasersight Inc., P.O. Box 8594, Incline Village, NV 89540.

Outboard info

The vast majority of requests for information we get at the PM Outdoors Department pertain to out-of-production outboard engines. A typical reader wants to know where he can get a water pump impeller for his Homelite Bearcat, or a new carb for his good-as-new '63 Evinrude, or a magneto for Dad's old Elto. Now there is a source for everything—and I mean everything—you'll ever want to know about outboard engines. The Antique Outboard Motor Club Inc. has literally thousands of members who buy, sell, swap and otherwise dabble in elderly outboards. Consider the following advertisement, typical of the classifieds found in the latest AOMC Newsletter: "Wanted—Forward gear for 1966 Sportfour 60-hp Evinrude. Prop shaft seals for 1943 Sea King 5 hp and 1963 Evinrude 7 hp." From basic components to musty esoterica, at least one AOMC member will have the part you need, or aim you in the right direction. To join and take advantage of AOMC information, newsletters and other activities. Send \$20 to The Antique Outboard Motor Club, Inc., c/o Marianne "Waterwitch" Jones, 436 S. Marina St., Prescott, AZ 86301.

(Please turn to page 46)



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THE SPECIAL VALUE DODGE RAM 50. \$6661.

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on the inside. All for only \$6661.* The new special value Ram 50. It's a great way to go in style, for a price that's right. Buy or lease it at your Dodge dealer now. And be sure to ask about special value packages available for other Ram 50 models.

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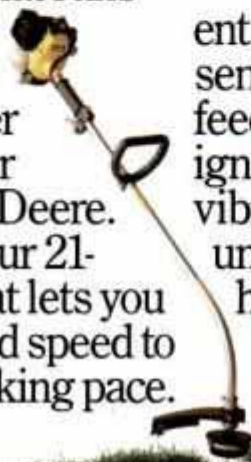
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For more information about the products that nothing else runs like, and the address of the John Deere dealer



nearest you, please call us toll-free at 800-447-9126. (In Illinois, call 800-322-6796.) Or write to John Deere, Dept. 52/62/82, Moline, IL 61265.



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NOTHING RUNS LIKE A DEERE®

OUTDOORS

(Continued from page 32)

Mergers and acquisitions

America's boating industry has always been characterized by a personalized mom-and-pop temperament. Unlike aircraft and automobiles, boats don't require ultrasophisticated R&D or tooling, which has fostered the growth of small- and mid-size boatbuilding companies.

The industry's laid-back attitude is bound to change, however, following the recent buying spree by Brunswick Corp., which owns the multifaceted

Mercury Marine, and Outboard Marine Corp., which makes Johnson and Evinrude outboards along with Cobra stern-drives. The highly competitive engine-making giants have snapped up six boat builders in the past six months, and industry observers anticipate additional acquisitions throughout the summer. The new megabuilders now join industry powerhouse Genmar Corp. in controlling the largest, most dynamic segment of the American boating market. Genmar was created by financier Irwin Jacobs of Minneapolis, Minnesota, and consists of Wellcraft, Lund, Larson and Hatteras. Brunswick's new divisions are

Bayliner and Sea Ray. Bayliner is the acknowledged leader in package boats and builds more than 45,000 units annually. Ironically, Brunswick's archcompetitor OMC recently completed a multimillion dollar agreement to furnish Bayliner with stern-drives, a deal the new Brunswick unit is expected to honor. Sea Ray, based in Tennessee, makes a full range of quality runabouts.

OMC's acquisitions form a diverse and profitable cross section of the market. Joining the fold are Four Winns, makers of lake runabouts, deck boats and small cruisers; Stratos, the highly regarded bass and saltwater boat builder; Lowe, which makes aluminum boats; and Sunbird. Insiders hint OMC is negotiating to buy Ranger Boats, America's leading bass boat maker.

What does it mean for you? Backed by plenty of clout and capital, the new boat-building agglomerations should be able to achieve special economies that could moderate prices. And marrying hull builder with engine builder may mean new packaging. Packaging—the 1980s marketing phenomenon that unites hull, motor and trailer under one affordable price tag—just might put a boat in every driveway by the year 2000.

A cross between . . .

Combine a scope-mounted rifle, a crossbow and a slingshot and you come up with a crossbow hybrid called the Linear Bow. The device fires a standard arrow at 280 ft. per second and has an effective range of 40 yds., according to manufacturer tests. The propellant is a latex band with extremely thick walls available in either 60- or 80-pound draw. In typical crossbow fashion, the Linear Bow is fired with a trigger mechanism, which has an automatic safety to prevent unintentional release. The extruded aluminum, flat-black stock and forearm assembly is 36 in. long and weighs 7 pounds. It combines sport and simplicity in a \$300 package. Contact Break Free, San/Bar Corp., 1035 S. Linwood Ave., Santa Ana, CA 92705-4396. **FM**



The brand-new Linear Bow borrows from traditional sporting arms.

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For All Your Fix-It Fastening Needs!



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Permits easy fastening in recessed areas, close corners, and other hard-to-get-at places with pin-point accuracy!

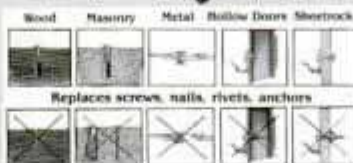


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A taxidermy advertisement for Ruger. The background is a detailed taxidermy of a large brown bear standing in a mountainous landscape with evergreen trees and snow-capped peaks. The bear is the central focus, shown in profile facing left. The text 'RUGER' is prominently displayed at the top in a stylized, orange, outlined font. Below it, the slogan 'BEST QUALITY SPORTING ARMS' is written in a smaller, black, serif font. At the bottom, the text 'COMING ON STRONG FOR 1987' is written in a white, serif font.

RUGER

BEST QUALITY SPORTING ARMS

COMING ON STRONG FOR 1987



RUGER® THE 9mm CHALLENGE



NEW

RUGER P-85™ AUTOMATIC PISTOL

The new Ruger P-85 semi-automatic pistol is the end product of a Ruger commitment to high-tech engineering and the relentless pursuit of perfection. This lightweight, compact, 15-shot, 9mm, double-action auto is reliable and simple to operate and maintain.

All parts are designed to meet or exceed U.S. Military specifications. Its advanced features, easy takedown, accuracy and reliability all contribute to its desirability for sporting use, competitive shooting, personal defense and as a law enforcement and military sidearm.



RUGER EMPLOYEES PRODUCE ANOTHER ONE-MILLION PRODUCT

The one millionth Ruger M-77 joins the ranks of five other Ruger guns which have already taken their place in sporting arms history by exceeding the one millionth mark. The other million "plus" Ruger guns are: the Ruger "old model" single-action revolver (1970); the Ruger Model 10/22 autoloading carbine (1978); the Standard and Mark I semi-automatic rimfire pistol (1979); the Ruger "New Model" single-action revolver (1979); and, the Ruger double-action revolver in Security-Six, Service-Six, and Speed-Six models (1983).

The company has achieved this singular acceptance in its field in less than forty years with a reputation for producing



"We're coming on strong" at the Ruger plant in Newport, New Hampshire, as seen in this photo which shows approximately 800 of the more than 1500 quality-conscious people who are employed in five Ruger manufacturing facilities across the country. All of us at Ruger are dedicated to manufacturing sporting guns of the highest quality, strength and reliability. Every Ruger firearm is tested by actual shooting on our ranges before shipping.

finely conceived firearms with an unparalleled record of quality control, safety, and reliability in the field at a fair price.

A large percentage of Ruger sporting arms are sold through the specialty gun dealer who provides expertise and "personal service" in the day-to-day business of meeting the requirements of the hunting, shooting, and law enforcement communities. Many of these dealers are listed in the Yellow Pages under headings such as *Guns, Gunsmiths, and Sporting Goods*. To experience the genuine pleasure that comes from handling fine quality Ruger firearms, visit and support your independent stocking gun dealer.

ABOUT OUR COVER ... ABOUT CONSERVATION ... ABOUT SPORTSMEN ...

To many sportsmen our cover painting, *Alaskan Brown Bear Out of the Shadows* by one of North America's greatest game-animal artists, Carl Rungius (1869-1959), exemplifies the objectives of the Pittman-Robertson Federal Aid in Wildlife Restoration Act which marks its fiftieth anniversary in 1987.

Much of the wilderness and its wildlife inhabitants as seen through Mr. Rungius' eyes has been restored as a result of the successful implementation of Pittman-Robertson. This unique program in which *hunters pay for*

conservation and hunter safety education is funded by a federal excise tax on firearms, ammunition and archery equipment. Since its inception Pittman-Robertson has provided the impetus for the preservation and perpetuation of vast populations of game birds and animals, particularly of those many species once thought to be extinct. The success of this program is a tribute to the millions of knowledgeable hunters who have helped make it possible.



RUGER® SINGLE-ACTION REVOLVERS



RUGER® BISLEY SINGLE-ACTION REVOLVERS

Ruger's Bisley mates a target shooting tradition with a modernized version of the Bisley grip shape to suit the most discriminating marksman. Offered in two frame sizes with roll engraved, non-fluted cylinders. Chambered for a variety of handgun cartridges for target shooting and hunting.



Stainless steel model.

New Model Super Single-Six



New Model Single-Six .32 H&R

NEW MODEL SUPER SINGLE-SIX® & .32 H&R REVOLVERS

The Ruger Single-Six was introduced over three decades ago and remains one of the most coveted single-actions. The patented Ruger transfer-bar ignition mechanism and other refinements have been features of New Models since 1973.

Originally chambered for the .22 Long Rifle Cartridge, the Single-Six is now offered in the new .32 H&R Magnum caliber, a hard-hitting small game, varmint and target load.



New Model Blackhawk



New Model Super Blackhawk

NEW MODEL BLACKHAWK® & SUPER BLACKHAWK® REVOLVERS

Ruger Blackhawk revolvers are expressly engineered for use with powerful modern centerfire cartridges. They incorporate all the best features of the Ruger New Model centerfire single-action design, including the transfer bar ignition mechanism.

The simplicity and dependability of our single-action revolver is legendary among outdoorsmen. Available in: .30 Carbine, .38 Special, .357 Mag., .41 Mag., .44 Mag. and .45 Long Colt.

Stainless steel model.

 **RUGER®**



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.44 MAGNUM CAL.

550-00003

Shown Actual Size



Service-Six

*Stainless steel model.
Goncalo Alves grips.*



Speed-Six

Stainless steel model.

RUGER SERVICE-SIX® AND SPEED-SIX® REVOLVERS

These two Ruger double-action revolvers are reliable, durable, and perfectly mated to the .357 Magnum and .38 Special cartridges.

Over one million of these revolvers in this series have been made for use by sportsmen and the law enforcement community around the world. Available in blued steel and stainless steel, with 2 3/4" and 4" barrels, and Goncalo Alves wood or rubber grip panels.



NEW GENERATION DOUBLE-ACTION REVOLVERS FOR HUNTING AND PERSONAL PROTECTION

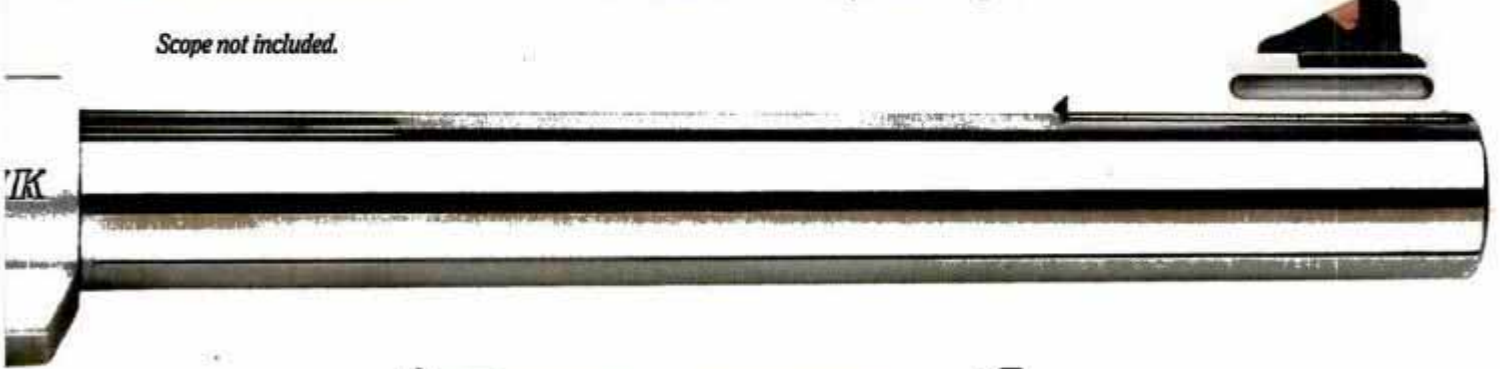
RUGER SUPER REDHAWK™ DOUBLE-ACTION REVOLVER

The Super Redhawk is seen as the ultimate development in a heavy frame .44 Magnum double-action revolver of unusual appeal for today's hunter and metallic silhouette shooter. It has all the mechanical features and patented improvements of Ruger's newest double-action revolvers. Unique new Ruger Cushioned Grip panels are anatomically designed to fit the hands of a majority of shooters.

The extended frame is designed to accommodate the Ruger Integral Scope Mounting System which positions the scope rearward for superior balance and performance. Interchangeable front sight system. Offered in stainless steel in a variety of barrel lengths.



Scope not included.



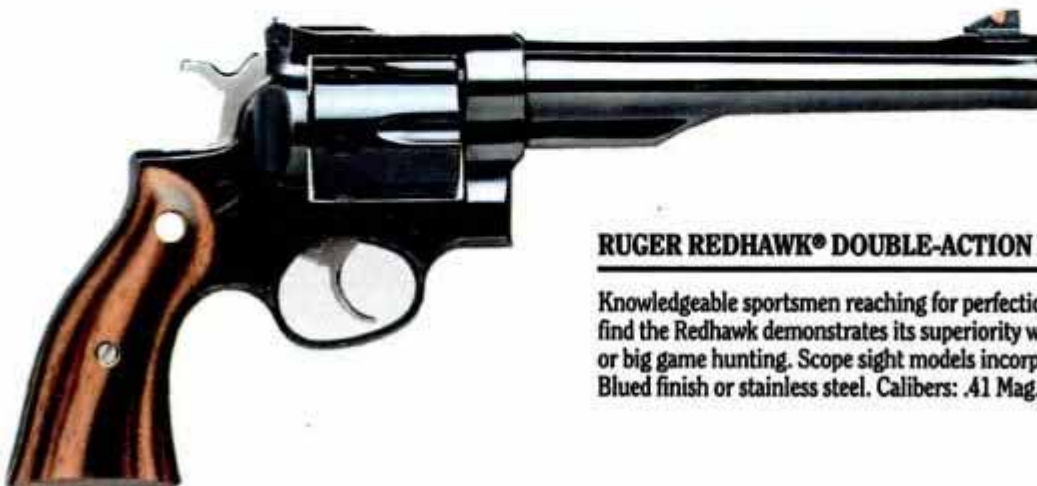
Stainless steel model.



RUGER GP 100™ DOUBLE-ACTION REVOLVERS

Designed as the ultimate .357 Magnum for police and personal defense use, the new GP 100 includes a heavy frame, rugged .357 Magnum cylinder, and cushioned grip panels which are anatomically designed to fit the hands of the majority of shooters.

A full length ejector rod shroud helps to achieve the slight muzzle-heavy balance considered desirable for rapid double-action firing. Interchangeable front sight system. Available with 4" and 6" barrels, blued and stainless.



RUGER REDHAWK® DOUBLE-ACTION REVOLVERS

Knowledgeable sportsmen reaching for perfection in a big bore handgun will find the Redhawk demonstrates its superiority whether silhouette shooting or big game hunting. Scope sight models incorporate bases for Ruger rings. Blued finish or stainless steel. Calibers: .41 Mag., and .44 Mag.



RUGER® RIFLES, CARBINES & SHOTGUNS

NEW



RUGER MINI THIRTY™ SEMI-AUTOMATIC RIFLE

Ruger's new Mini Thirty chambered for the 7.62 x 39mm cartridge is destined to become one of America's most popular deer rifles. This lightweight, compact new sporter (approximately the same size as the Mini-14) is ideal for hunting whitetail and other medium size game in heavy cover. Designed with Ruger Integral Scope Mounts for telescopic sights. One inch Ruger rings included.



RUGER MINI-14® AND RANCH RIFLE®

The Mini-14 and Ruger Ranch Rifle (illustrated) are rugged, easy handling, lightweight semi-automatics. The Ranch Rifle is designed for use with telescopic sights. Both the Mini-14 and Ranch Rifle are available in full and folding stock models that are ideal for camping and boating. Offered in blued alloy and stainless steel. Caliber: .223 Rem.



RUGER 77/22™ RIMFIRE BOLT-ACTION RIFLE

The new Ruger .22 rimfire bolt-action is an elegant small game and target rifle. Unique new 3-position safety offers a new dimension in security. Ruger 10-shot rotary magazine provides smooth feeding. Receiver with integral scope bases accommodate Ruger rings.



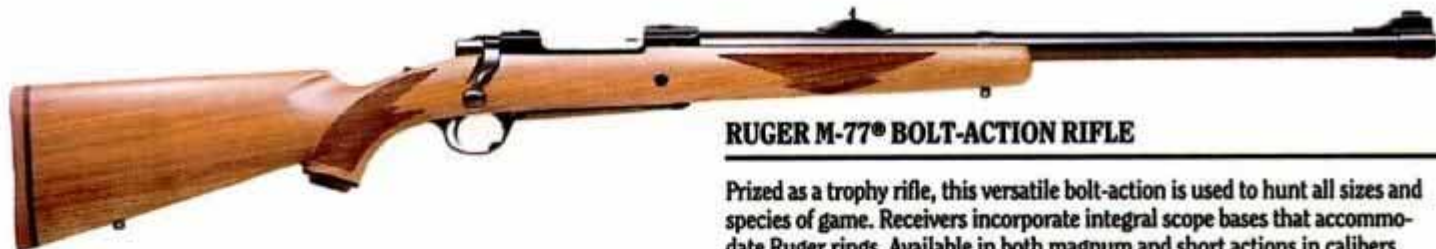
RUGER 10/22® AUTOLOADING CARBINE

The Ruger 10/22 offers light weight, short overall length, and mechanical dependability. A 10-shot rotary magazine handles .22 Long Rifle cartridges. The reliable Ruger 10/22 is an excellent choice for small game hunters, target practice or plinking. Standard model or Deluxe Sporter offered.



RUGER® "RED LABEL" OVER & UNDER SHOTGUNS

A precision-engineered and manufactured shotgun of exceptional value and quality. Excellent balance and superb swing provide superior over and under performance. Offered with 3" chambers in 12 and 20 gauge with 26" or 28" barrels in standard choke combinations.



RUGER M-77® BOLT-ACTION RIFLE

Prized as a trophy rifle, this versatile bolt-action is used to hunt all sizes and species of game. Receivers incorporate integral scope bases that accommodate Ruger rings. Available in both magnum and short actions in calibers ranging from .22-250 to .458 Mag.



RUGER M-77® INTERNATIONAL BOLT-ACTION RIFLE

This high performance sporting rifle has a full-length, high grade American walnut stock. Short 18½" barrel, open sights, and Ruger Integral Scope Mounts are features. Calibers: (short action) .22-250, .250-3000, .243 and .308 Win., (long action) .30-06, .270 Win.

NEW



Scope not included.

RUGER M-77® ULTRA LIGHT BOLT-ACTION CARBINE

Weighing in at just 6 pounds this easy-to-handle carbine encompasses all of the traditional features and craftsmanship that have made the Ruger M-77 one of the most popular hunting rifles in the world. Short 18½" barrel with iron sights. Chamberings include magnum and short action calibers: .270 Win., .30-06, .243 and .308.



RUGER® NO. 1 SINGLE-SHOT RIFLES

The Ruger No. 1 Light, Medium Sporter, and No. 1 Tropical Rifles are considered by many to be the ultimate development of a single-shot rifle. These classic rifles test the skill of the dedicated big-game hunter. Alexander Henry style forearm, adjustable folding leaf rear sight, gold bead front sight. Available in a range of calibers, barrel lengths and weights.



RUGER® NO. 1 STANDARD AND SPECIAL VARMINTER RIFLES

Standard model has a medium 26" barrel, semi-beavertail forearm, quarter rib with one inch Ruger rings. Varmint model with heavy 24" barrel is tapped for target scope blocks, one inch Ruger rings included. Available in a variety of sporting and varmint calibers.



RUGER® NO. 1 INTERNATIONAL RIFLE

Lightweight 20" barrel. Full length forend, adjustable folding leaf rear sight mounted on quarter rib with ramp front sight base and dovetail type gold bead front sight. Calibers: .243 Win., .30-06, .270 Win., and 7 x 57mm. Weight: Approx. 7¼ pounds.



RUGER® WORLD'S FAVORITE .22 PISTOLS



Stainless steel model.

RUGER® MARK II STANDARD MODEL SEMI-AUTOMATIC PISTOL

These models are basically refinements of the original Ruger Standard and Mark I Target Model pistols, over one million of which have been produced. New 10-shot magazine. Choice of barrel lengths. Blued or stainless steel. Shoots .22 Long Rifle rimfire cartridges only, standard or high velocity.



RUGER® MARK II TARGET MODEL SEMI-AUTOMATIC PISTOL

Competitive target shooters recognize the excellent handling and performance characteristics found in this version of the famous Ruger semi-automatic pistol, offered in tapered and bull barrel models in a variety of barrel lengths. Undercut front sight eliminates glare. Caliber: .22 Long Rifle only, standard or high velocity.



NEW

Government Model

RUGER® MARK II GOVERNMENT TARGET MODEL

A limited supply of the Ruger .22 pistol used by the U.S. Military is now available to civilian sportsmen. This model is identical to the military version except for the "U.S." government markings. Each Ruger Government Target Model automatic pistol is offered targeted by use of a special laser sighting device (patent pending) to exacting military specifications.



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Cycles

BY NORMAN
MAYERSOHN

Japanese Twins

On engine size alone, Kawasaki's 1500-cc Vulcan 88 is the king of the custom cruiser bikes.



It's a miracle made in America: among the multitude of brands that once existed in domestic motorcycles, only Harley-Davidson's timeless V-twins have managed to thrive in the face of marketing assaults mounted by the Japanese manufacturers. But there's a second stage of landings coming to chip away at the world's most prestigious brand, hitting our shore with stylish cruiser bikes that out-cubic-inch even the big Harleys.

To lure the faithful away from Milwaukee's "real steel" machines, Suzuki has introduced a 1400-cc version of its Intruder, and Kawasaki is unleashing an awesome 1470-cc model known as the Vulcan 88 (pictured above). Harley's current big gun is the 1340-cc Evolution engine, which, until 1987, was the biggest V-twin in production.

Last year, Suzuki's Intruder 700 hit the Harley-clone mark so precisely that it turned out to be the best-

selling bike in the line. Naturally, its strong points carried over to the new 1400. All the right touches are there—a massive 45° Vee engine highlighted in chrome, a low seat, the classic teardrop gas tank and an enormous 170/80-15 rear tire. If there's any department where the improvement over the 700 Intruder is most apparent, it's in big brother's cleaned up, simplified lines. Every possible wire and cable is neatly tucked away, the carburetors hide under the fuel tank and seat, and even the spark-plugs are concealed by chrome covers.

In the stretching exercise, the 1400 left behind a few of the 700's features. Four-valve-per-cylinder heads have been replaced by three valvers, and the cleverly disguised liquid-cooling system of the 700 has given way to an air-cooled front cylinder and oil-cooled rear jug, similar to the GSX-R sport models. The 5-speed gearbox has been trimmed to a 4-cog

transmission. Vibration control has been given minimal attention—there's no counterbalancer system and the crankpins, though offset, are only 45° apart, not 90° as would be needed for perfect balance. It's as though they've added vibration so that Harley fans will feel at home! Available with flat or pullback handlebars and wire spoke wheels, the VS1400 carries a \$5899 price tag.

Kawasaki's King Cruiser forsakes the "simpler is better" philosophy in order to live up to its intended role as the ultimate in this class. True, it has just a 4-speed transmission and carries no tachometer, but it does come standard with cast wheels, liquid cooling and an 8-valve, counterbalanced engine.

The emphasis, instead, is on finish, and everywhere you look the attention paid to outward sparkle is apparent. Polished castings, chromed covers and richly painted sheetmetal leave little room for improvement by the owner. And with hydraulic valve adjustment, a shaft drive and automatic compression release, the owner won't have much maintenance to worry about, either.

When the original prototype for the big bore Vulcan (Kawasaki sells a 750 version, too) arrived in the U.S., it was powered by a 1200-cc powerplant. Rumor has it that the 1470-cc displacement was specified when reports of Suzuki's Intruder 1400 hit the press; Kawasaki maintains that this was the intended size all along, of course. Either way, we can expect the next major volley in the battle for the biggest twin to come from Honda or Yamaha, now struggling along with mere 1100-cc cruisers.

Each year's new model launch seems to bring more clones intended to make inroads on Harley-Davidson's turf, yet the line between the original and its copies remains unblurred. Buyers

most interested in profile appearance go for the technologically advanced imports with their power advantages and modern conveniences.



At \$2899 the EX500 is a fully outfitted sport-bike steal.

The hard core purists still insist on Harley, paying a premium price for tradition and prestige, while appreciating the straightforward directness of the H-D approach. But with the release of these two behemoths, the temptation to go for the modern derivations gets ever greater.

Spring's best buys

You know the dollar/yen exchange rates are upside down when the Honda automobile folks start to export Ohio-built Accords to the homeland, so you wouldn't expect any bargains to come from across the Pacific in '87. But for under \$2500 there are several machines fit to carry full-size riders on moderate-length journeys. Honda, Kawasaki and Suzuki all have 450-cc bikes that are tried and true friends; for the sportier types there's the Kawasaki 250 Ninja and Yamaha SRX 250, and you can even come up with the single-cylinder Suzuki 650 Savage within that modest budget.

Surprisingly, there are also two entirely new entries in the Very Affordable field, the cruiser-styled Yamaha 535 Virago (\$2699) and the canyon scratcher Kawasaki EX500 (\$2899). Both are 2-cylinder models, and at approximately 400 pounds each, are easier for new or small riders to wrestle around than the liter-size models. Best of all, they both

(Please turn to page 38)

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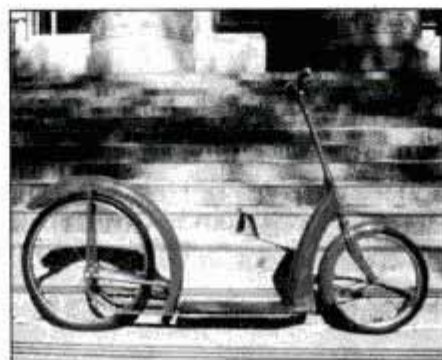
CYCLES

(Continued from page 37)

offer performance far better than the bargain-basement prices would lead you to expect.

The EX500 redirects the recent trend in middleweight bikes from increasing weight and complexity toward the more rational and cost-efficient approach of reduced weight and greater simplification. The 498-cc parallel twin is derived from the 454 LTD engine, modified to produce 20 percent more power. With eight valves, a 10.8:1 compression ratio and an 11,000 rpm redline, the engine pumps out serious horsepower. Think of it as half of a Ninja 1000 powerplant and you won't be far off. However, with so much less weight to haul around, it's anything but half fast.

Chassis specifications further certify the EX500 as a full-blooded sport bike. The frame and swing arm are rectangu-



Ingo scooter uses an offset rear hub.

lar steel tubing. An angular half fairing dresses up the appearance appropriately, and Uni-Trak rising-rate suspension components soak up bumps at the rear end. Wheel size is a fashionable 16 in. at both ends. New twin-piston brake calipers from the big K are so effective that the bike burns off speed rapidly with only a single disc up front.

The Virago 535 is similarly loaded with high-value components: shaft drive, an electric fuel pump and fine detailing of all the bits and pieces. The clever engineers responsible for this model have succeeded in pulling off a number of illusions that contribute to its visual appeal. There appears to be a stubby set of exhaust pipes to handle engine noise control, but closer inspection reveals tricky plumbing that conceals an intermediate silencer. The cylinder head covers atop each barrel hint of Harley-Davidson rocker gear, but in fact they just hide the sparkplug and its wire. Of course, the traditional gas tank is just a dummy cover, the real reservoir being located under the seat.

As a boulevard cruiser the 535 Virago offers a high profile at a very reasonable cost. With 45 hp on tap, it has muscle enough for the job, and the low 27.6-in.

seat height allows easy control at low speeds. The stretched out 59.5-in. wheelbase gives seating accommodations adequate for all but the biggest riders, though the short-travel suspension will likely keep your journeys short as well. As the lone V-twin populating the lower end of the cruiser class, the Yamaha is a remarkable bargain as well as a fully capable short-haul cruiser.

Eccentric travel

The current boom in kid's scooters might well remind senior readers of homebuilt contraptions cobbled together in our earliest days of tinkering. One very clever 2-wheeler from the 1930s was inspired by just such scrap-heap engineering, and it resulted in a now-classic bit of history known as the Ingo. Patented by Phillip and Prescott Huysen in the early years of the Depression, the scooter used an off-center rear wheel hub and developed momentum by pulling on the steering bar and setting up a rocking-rhythm motion. Though it was produced for just three years before WWI, the Ingo made a memorable footnote in the annals of 2-wheel transportation.

In the initial prototype trials the Huysen brothers were obliged to test the scooter far from their Chicago neighborhood, lest the locals label them as crazies. After securing a patent, they had action movies shot and displayed their invention to buyers at the New York Toy Fair. Rather than manufacture it themselves, the brothers released the rights to the Borg Warner company, manufacturer of automotive equipment, which later passed it along to their Ingersol division.

Something of a cult following resulted from the mass-production release. It made the rounds of newsreels and Hollywood fan magazines, and park rentals were common. Appearances in Three Stooges comedies and Ingo polo matches were overshadowed by a marathon 12-day ride from Chicago to Miami on one of the scooters by Phillip Huysen.

With the standing platform just a few inches off the ground, there's little chance of a rider getting hurt in a fall, and there's no chain and sprocket works to snag stray extremities. First sold under the Exercycle name, early advertising promised gentle daily exercise, though later pitches stressed the recreational aspect. The novelty of the vintage Ingo scooters has made them worthy of saving and restoring; don't be surprised when the propulsion principle of the eccentric rear wheel hub also makes another appearance in the current craze of unique scooter runabouts. **PM**

Stop Taking Vitamins

If you think the vitamins you are now taking are doing you any good, wait until you hear the latest news on why they may not.

By Joseph Sugarman

This may come as a shock. But according to the latest research, those vitamins that you take every day may be doing you absolutely no good. For example.

FACT: Vitamins should be taken after a meal—never before. The body must first have protein, fats, or carbohydrates in the digestive tract to properly break down the vitamins for proper absorption.

FACT: Your body has a need for a natural vitamin balance. Too much of one vitamin may cause another vitamin to be less effective. For example, vitamin A should be taken with vitamin E but excessive iron should not.

FACT: If you take too much calcium, you may deplete the magnesium in your system. And you need magnesium to convert food into energy.

FACT: Some vitamins are best taken in the morning and others at night. For example, the trace element chromium helps break down the sugar in your food which in turn creates energy—perfect to start the day. But at night you should take Calcium which has a relaxing effect—perfect for the evening.

FACT: Athletes or people who exercise a great deal need vitamins more than people who don't exercise. Vitamins are depleted at a much faster rate during exercise than during any other period of time.

But there was a series of other facts that surprised me too. For example, despite everything I've just mentioned on the care in taking vitamins, there are those people who need vitamins because of the mental or physical activity that they undergo. People on a diet, under stress, those who smoke, women who take contraceptives and even those who take medication—all rob their bodies of some of the essential vitamins and minerals that they need to help combat the various habits or conditions they are under.

And with vitamins in the proper balance and at the proper times, you may have more energy and vitality. Little changes may take place. Your nails may become stronger, your hair may become lustrous and your skin may remain more elastic which will keep you younger-looking longer.

DOCTORS HAD IDEA

About two years ago a group of doctors had an idea. They realized that many people were taking vitamins and not really noticing any difference in their health. They also realized that, based on the latest nutri-



Stop taking that innocent looking vitamin pill until you read this report.

tional findings, the vitamins people were taking may not have been doing them any good.

So they formed a group of advisors consisting of nutritionists, dieticians, dermatologists, biochemists and physicians, and developed one of the most effective combinations of vitamins and minerals, formulated four tablets—one for the morning and one for the evening—and one for men and one for women and then started a test program that lasted over two years. The results speak for themselves.

It was ideal for weight loss programs and it was ideal for people under stress. It helped many increase their energy levels. Smokers benefited. Some under medication benefited. And before long MDR Fitness Corp., the company that had developed the program, became one of the fastest growing vitamin companies in the United States. And no wonder.

SEVERAL BENEFITS

With a fresh vitamin and mineral balance, taken in the right quantity in the right combination and at the right time, several obvious benefits occur. First, you may develop a better mental outlook because you've got the energy and the zest to accomplish more. As a result of the trace elements copper, zinc and manganese, your body is helped to make its natural anti-aging enzymes that keep you fit. Improvements in your vitality translate into everything from better job performance to a greater sense of well being.

JS&A has been selected by the vitamin company to introduce their medically formulated vitamin program. Every two months we send you a fresh two month's supply of 120 fitness tablets—one to be taken after breakfast and one after dinner.

During the first two months, you will have ample opportunity to notice the difference in your energy level, your appearance and your overall stamina. You should notice small changes. Your complexion may even take on a glow. Some of you may notice all of these changes and others may notice just a few. But you should notice some of them.

If for any reason, you do not notice a

change, no problem. Just pick up your phone, and tell us not to send you any more vitamins. And if you're dissatisfied and ask for a refund, you won't even have to send the empty bottle back. It's yours free for just giving us the opportunity to introduce our vitamins. However, if you indeed do notice a difference (which we are confident you will), you'll automatically receive a two-month's supply every eight weeks.

ONE MORE INCENTIVE

I'm also going to give you one more incentive just to let me prove to you how powerful this program really is. I will send you a bonus gift of a fitness bag with your first order. This beautiful bag will hold all your fitness gear and it's great too for short vacation trips. It's a \$20 value but it's yours free for just trying the vitamins. Even if you decide not to continue, you keep the fitness bag. I am so convinced that you will feel and see a difference when you take these vitamins that I am willing to gamble on it with this unusual offer.

Vitamins indeed are important. And with today's research and new nutrition technology, you have a greater chance to achieve the fitness and health levels that may have eluded you with the typical store vitamins or the poor advice we may get in health food stores or from friends. Here is a safe, risk-free way to get one of the best vitamin programs in the country, formulated by a physician, with the right combination of vitamins, minerals and trace elements, in a convenient program that assures you of delivery every two months. I personally take and highly recommend them. Order your trial quantity, today.

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designed around you. The enormous windshield and side glass give you a commanding view. And there's more leg, shoulder, and head room than you ever thought possible.

STRONGEST ENGINE. Turn it on, it's made to perform. A 2.4-liter, fuel-injected engine sees to that. Twin-spark plugs and a hemi-head help crank out the most horsepower and torque of all the leading standard compact trucks. The 5-speed is standard.

Independent front suspension, steel-belted radials, and rear leaf springs combine to provide a smooth, easy ride without sacrificing payload. The rear brake's proportioning valve automatically adjusts to payload for improved braking under load. The Hardbody 4X2. Works tough. Plays rough. See your Nissan Dealer today.

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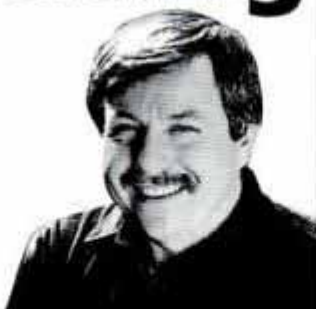


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Freewheeling



BY WADE HOYT

Technoid Of The Year



Lancia's ECV looks like and is based on last year's S4 rally car.

Jan Norbye, our friend in Europe, reports that Lancia's Experimental Composite Vehicle just bristles with advanced thinking. Its unitized body/chassis is made of carbon fiber and Kevlar impregnated with epoxy, surrounding a foam and honeycomb core. The result is a body/chassis



Composite chassis is light and strong.

that's 20 percent lighter, but it's just as rigid as the super-stiff S4 rally chassis on which the ECV is based. In less rigid street cars, the weight savings over a steel chassis could be 40 percent.

Even the wheels have honeycomb centers and carbon fiber-epoxy rims, making them 40 percent lighter than alloy wheels.

The engine is way out on

the techno fringes, too—an intercooled, twin-turbo, 16-valve, 1.7-liter 4-cylinder that puts out 600 hp at a screaming 8000 rpm. Part of its secret is the "thermal symmetry" of its 4-valve cylinder heads.

In a conventional 4-valve design, the two hot exhaust ports are on one side of the head and the cooler intake ports are on the other side. Differences in temperature and metal expansion on opposite sides of the head can be harmful in a highly stressed turbo race engine.

Lancia's solution is to cross-switch the ports, so that each side of the head has one intake and one exhaust valve. Doing so requires a fiendishly complex intake and exhaust system (see illustration at right) with manifolds splitting off in all directions.

Used in a high-performance road car, crisscross heads would allow a lightweight Four to produce the power of a V6 or V8 engine.

Staff cars

From time to time we get a letter from a reader outraged over one of our evaluations (either we've loved a car he hates, or vice versa), and he suggests that we leave the road testing up to "magazines that specialize in cars."

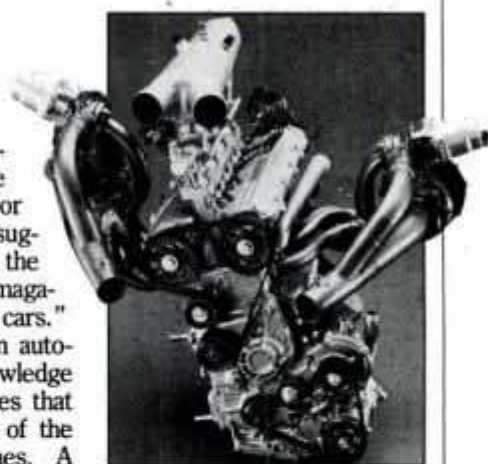
I think we've got an automotive staff whose knowledge and enthusiasm matches that of our friends at any of the major "buff" magazines. A sure indication of that is the kinds of cars and motorcycles our staff members own.

In a survey of the Automotive Department's cars and bikes, I included the managing editor and editor-in-chief because they're both former presidents of the International Motor Press Assn.

The following list shows a range of auto enthusiasm to rival any "buff book":

Cars and Trucks

- '87 Corvette Roadster
- Chevy Malibu
- '86 Honda Civic wagon
- Mazda B2000 pickup
- '85 Cadillac Eldorado
- '84 Fiero 2M4
- Jaguar XJ6
- Mazda 626
- Thunderbird
- '82 Mazda RX-7 Showroom
- Stock racer
- Pontiac Grand Prix
- VW Scirocco
- '80 Honda Accord
- Rover 3500
- '79 Cadillac Seville
- Saab 900 EMS
- VW Rabbit
- '78 Chevy Malibu
- '77 Honda Accord
- Pantera GTA
- '74 Ford F250 pickup
- Mercury Marquis
- VW Dasher GT
- '73 Porsche 914 1.8
- E-Production racer
- '72 Porsche 914 1.7
- '71 Porsche 914 1.7



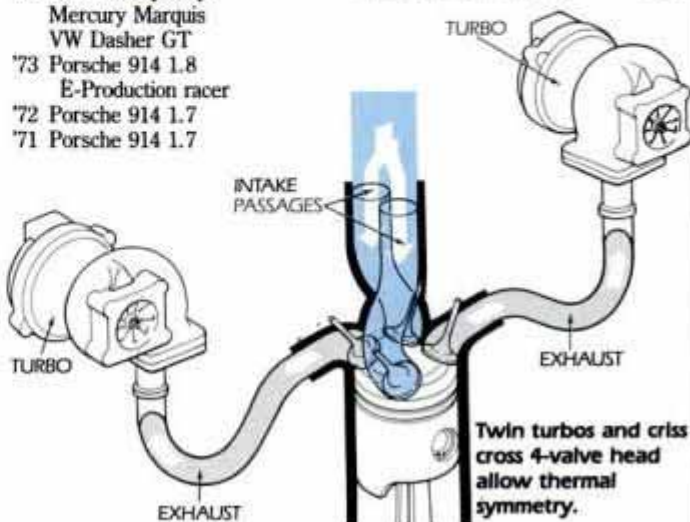
Complex 1.7-liter twin-turbo Lancia Four churns out 600 hp.

- Lynx Formula Vee racer
- Homebuilt Formula Vee
- '69 Camaro Rally Sport conv.
- '68 Firebird conv.
- '67 Camaro conv.
- Camaro Rally Sport
- '65 Buick Riviera
- Thunderbird conv.
- '64 VW Microbus
- '59 Berkley roadster
- Kellison J4-R competition coupe
- '58 Devin SS C-Modified racer
- '57 Thunderbird conv.
- '56 Porsche Speedster replica
- '36 Ford V8

Bikes

- '87 Yamaha FZR 1000
- '85 Puch moped
- '78 Kawasaki KZ 400
- Yamaha SR 500
- '74 Yamaha TZ 350 road racer
- '73 Yamaha RD 350 road racer
- '72 Kawasaki H2 750 3-cyl.
- '62 Norton Dominator 88 500
- '56 Ducati 125 Grand Sport
- factory formula racer

If that many wheeled toys spread around among nine guys doesn't qualify you as a rabid car and bike nuts, you haven't talked to our wives! **PM**



Twin turbos and criss cross 4-valve head allow thermal symmetry.

NEW/WORKSHOP

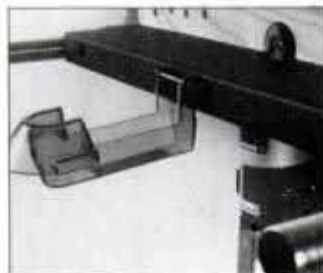
Bolt-On Router Table



Router table bolts to saw table. Here, the saw fence is used to route a groove. Auxiliary wood fence comes with the router table.



Router is attached to an adapter plate which mounts to table underside with four wingnuts.



Clear-plastic guard pivots out of way. Notch cut in wood fence permits partial edge routing.

The Bosch router table provides a way to increase your routing capabilities by using your table saw. The 10-in.-wide × 27-in.-long, heavy-gauge steel table (\$102) bolts to the saw table edge. It fits most Delta and Sears table saws and other 27-in. saw tables. Attach a router

to the adapter plate, which then mounts under the table with four wingnuts. Utilize the saw fence to rout precise dados, rabbets and grooves. The adapter plate will accommodate a sabre saw, too. For more information, contact Bosch Tools, 3701 Neuse Blvd., New Bern, NC 28560.



Thin-kerf saw blade produces fast, smooth cuts. This 10-in. blade has 40 carbide teeth.

Thin-kerf blade

The new 'Cuda thin-kerf carbide saw blade reduces friction and waste for a faster, smoother cut. Horizontal carbide teeth and an ultrathin body produces a kerf that's about .095 in. wide. The American-made blade is available in sizes ranging from 6½ to 10 in. dia. Prices range from about \$12 to \$36. You can use 'Cuda blades to cut softwood, hardwood, plywood and paneling. For more information, contact Credo Industries, 2765 National Way, Woodburn, OR 97071.

Power sander

Here's a clever new tool that converts a planer into a high-speed power sander. Called Tri-Sand, it mounts onto the planer without removing the cutterhead. It fits Foley-Belsaw and Sears planers. The sanding pad consists of industrial-grade sandpaper bonded to a flexible, nonwoven pad. Tri-Sand comes with three 100-grit sanding pads, a reduction pulley and all necessary parts to make the conversion. It

costs \$89.95 postpaid from Foley-Belsaw, 6301 Equitable Rd., Box 419593, Kansas City, MO 64141. Extra sanding pads cost \$7.95 for three.



Turn your Foley-Belsaw or Sears planer into a power sander. Sanding pad mounts on without removing the cutterhead.

Bench press

In an effort to save space, many home workshops are equipped with benchtop tools. In most cases, however, this means sacrificing power and features. A new line of Black & Decker benchtop drill presses boasts quality and performance usually found on floor-standing models. The 13-in., 12-speed tool shown (No. 9402), features a ½-in. chuck, cast-iron housing, ball-bearing construction and rack-and-pinion gearing. It's powered by a 7.4-amp. motor.

The 13-in. model costs about \$309. Also, 8-in. (\$185) and 10-in. (\$228) models are available. For details contact Black & Decker, 10 North Park Dr., Box 798, Hunt Valley, MD 21030.



Compact, 32-in.-tall drill press has 12 operating speeds ranging from 250 rpm to 3100 rpm.

Concrete buster



Powerful rotary hammer bores large diameter holes in concrete. Chipping feature breaks away bricks and concrete quickly.

Tackle tough concrete hole-boring and chipping jobs with the Skil model 1750 (\$460) rotary hammer/drill. A 6-amp. motor delivers 550 rpm and 3150 blows per minute. The heavy-duty chuck accepts bits from 3/16 to 1 in. dia. For details, contact Skil, 4801 West Peterson Ave., Chicago, IL 60646. **PM**

AVOID COSTLY PROP REPAIR

It costs more than you might think when you misjudge how shallow the water really is.

Here's a reliable way to help you protect equipment and, more importantly, your passengers. A Lowrance digital sonar instantly displays the water depth under the boat, even at full speed. Use the 3400 to become familiar with the waters you boat in and set the alarm to help you stay in areas you consider safe.

The 3400 is scanning the bottom 100 times a second. A loud tone sounds the instant you encounter depths outside the range you've selected.

Steer clear of shallow water hazards. Look into a 3400. It looks out for you.



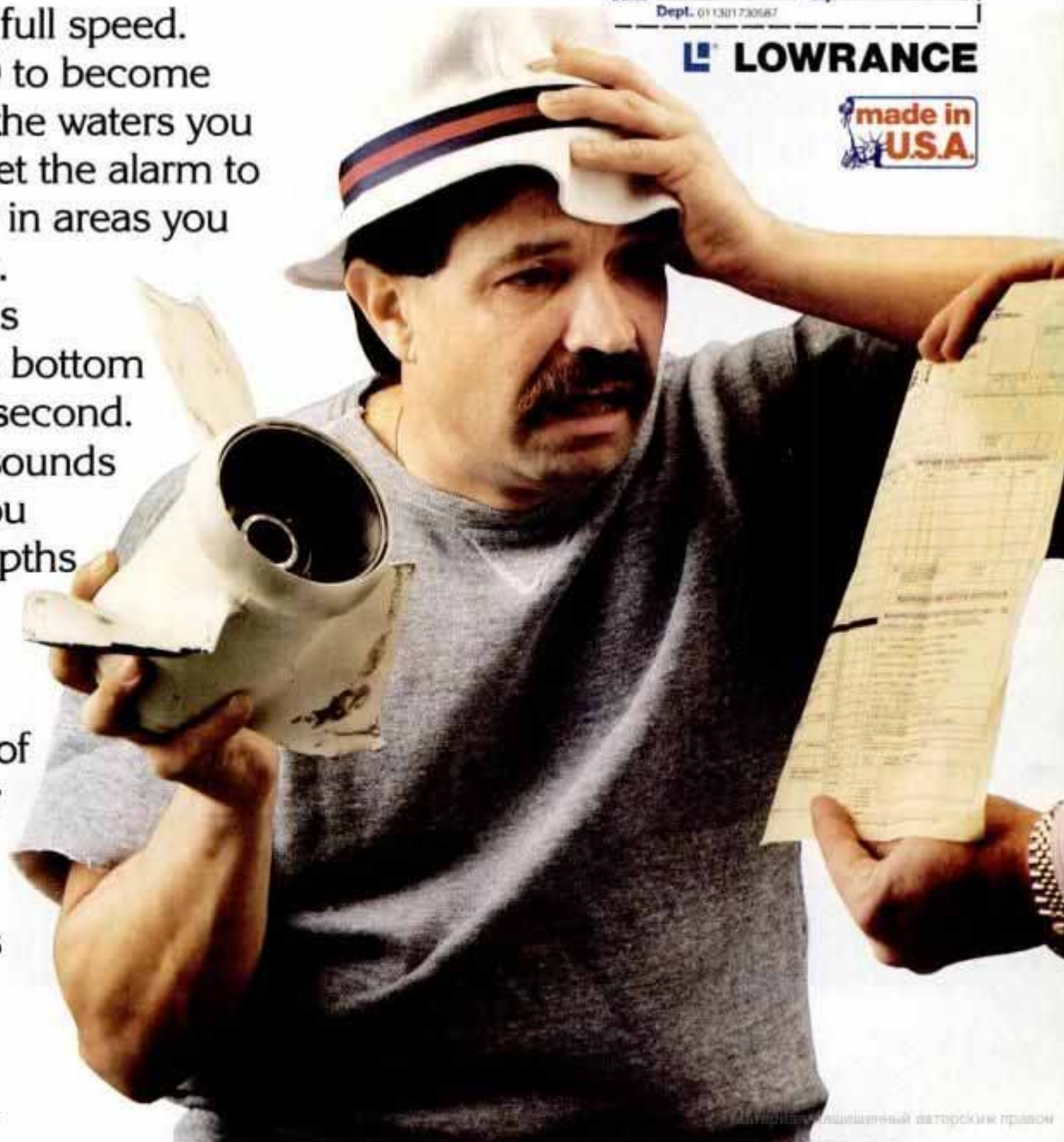
3400 Digital Depth Sounder
Mounts in dash and is only 2.9" in dia.

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LOWRANCE



Inside Detroit



BY JIM DUNNE

GM's 1990 Fwd Minivan



Real-world derivative of the Pontiac Trans Sport that was on PM's October '86 cover is nearly as radical as the show car.

Asleek, minivan now under test at GM will make its appearance in the Chevrolet and Pontiac lineups in 1990. The radically styled vehicle is GM's answer to the new group of passenger vans—Chrysler, Toyota, Nissan, Mitsubishi—that are taking a big chunk out of the family station wagon market.

GM's van will be the first of its type from the company to offer front-wheel drive. Body construction will be similar to that of the Fiero, with a cage of steel covered by plastic panels. Engines will be taken from existing GM drivetrains, with a 2.5-liter 4-cylinder as the base engine, and a 2.8-liter V6 as the performance option.

Styling is unusual. The windshield is slanted sharply, and the hood carries the angle forward to the top of the headlights. Front doors are set aft of the front wheels so there is no wheel hump to step over when entering.



Rear seat passengers enter via a sliding door on the passenger side.

The vehicle started GM's standard 60,000-mile prototype testing drive early this year. That test will take it over high-speed tracks, dirt roads, Belgian-block surfaces and other hazards to measure body integrity, engine reliability, brakes, transmissions and suspension life. Later, more testing will be done to refined prototypes, with some vehicles repeating the standard durability test.

Not quite

Ford's design of the 1988 Lincoln Continental has been criticized as being too much like that of the Taurus/Sable. But the new luxury cars are quite a bit different in appearance. For one thing, the Lincolns rely less on the aero



Front-drive '88 Lincoln Continental is more formal than Taurus.

look. Instead, their lines are more stately and formal. Doors and side panels are more upright, show less tumblehome than the successful Ford and Mercury sedans. Up front, a standard grille dominates the styling.

Similarities between the Lincoln and the smaller cars are inevitable, though. Both use front-drive with V6 engines; window glass is mounted almost flush with the sheetmetal; plastic bumpers wrap around all the way to the wheel wells and are colored the same as the body.

The new Lincolns replace the rear-drive Continentals in showrooms next fall.

GM fights back

A little late, but GM will have three completely restyled personal coupes to compete against Ford's highly successful Thunderbird and Cougar next year. The Olds Cutlass Supreme coupe will be the most radically changed of the three. By comparison, the Buick Regal and Pontiac Grand Prix will appear conservative.

Still, the Cutlass will be unmistakably an Olds. The front end features a split grille and small headlights. At the rear, the C-posts are covered by the side glass, imparting an open look to the

greenhouse. Underneath, the chassis and drivetrain will be all new, too. In place of the rear-drive, a front-drive setup similar to that of the Ciera will be used. Say goodbye to the V8 in this model. Olds will use a V6 as the standard powerplant. But in a switch from the normal way of doing things, the premium engine will be a 4-cylinder—Olds' 2.3-liter dohc Quad Four.

Thunderbird Super Coupe?

That could be the name of Ford's top performer in the 1989 Thunderbird line. Plans are to replace the turbocharged 4-cylinder engine in today's Turbo Coupe with a supercharged V6.

Thunderbird Super Coupe?

Will Ford call the new model a Super Coupe? The V6 will have 3.8-liters displacement, a big boost from the 2.3-liter Four used in the Turbo Coupe, which will make for better low-speed performance.

The supercharger will increase low-speed engine output, since the device has no lag time—a major complaint against the turbo.

Express delivery?

Chevrolet showed its turbine-powered Express dream car on the auto show circuit earlier this year, but delivery of the car to customers won't be for another 15

Express delivery?

(Please turn to page 46)



Hot engine in '88 fwd Cutlass is a Four; base engine is a V6.

Buckle up — Together we can save lives.

With a quality
record this
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1981.

Nationwide quality survey shows, Ford Motor Company is making the highest quality cars and trucks designed and built in North America.*

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Ford does it again.

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And again.

1984.

And again.

1985.

And again.

1986.

And again.

*Based on an average of owner-reported problems in a series of surveys of '81-'86 models designed and built in North America.

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**Restrictions and deductible apply. Ask your dealer for a copy of this limited warranty.



Quality is Job 1.

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Ford Trucks • Ford Tractors

INSIDE DETROIT

(Continued from page 44)

years, if ever. Details are impressive: rear-mounted turbine engine, 150-mph cruising speed, 25-mpg fuel economy, three TV screens that tell the driver everything he wants to know about the car and his location, and an overall height of less than 4 ft. The body panels are made of plastic and, in the case of the rear deck lid, a balsa wood sandwich.

Express is designed as a high-speed, long-distance commuter car that will travel on special highways at over 125 mph. That's in the future. For now,

Chevy put Express together to see how a lot of futuristic ideas could fit together in a car that the GM division is working toward for the next generation.

Stars and Stripes to intake manifolds

That seems like a long jump, but there may be a direct relationship. A drag reduction film made by 3M was applied to the hull of the America's Cup winner to give it more slipperiness through the water. The film has microscopic grooves in its surface that reduce turbulence as it passes through water.

Now, it has been suggested that the

same film can reduce air turbulence and drag in intake manifolds, acting on the intake stream of air in the same way it acts on water. Look for some type of grooving to appear on the inside of engine manifolds in the next year or so. Engines will take in more air, and efficiency (power output) will rise.

New tires needed

Work on active suspension systems at Lotus Cars Ltd. in England will lead to a new type of tire. That's the word from Michael Kimberley, chief executive officer of the Lotus Group, who says that the tires on active suspension cars are subject to different forces than those on cars today. "We're working with two tire companies (one European, one American) to develop a new type of tire," Kimberley points out. "We need to soak up more road shock in the tire, and there is no need for an extreme footprint on the road surface."

Active suspensions are being planned for a number of high-performance cars in the next couple of years. Typically, the system eliminates springs and shock absorbers, and in their place uses computer-controlled hydraulic struts. The struts can control body roll to less than 1/2 of 1 percent in sharp curves. When the body stays level for virtually all modes of driving, the tires can be designed for less sidewall rigidity. On the test Lotus, the action of the struts can be varied by the driver, thus changing the ride or handling.

"Active suspensions can give you total and utter ride control," Kimberley says. "You can have either Cadillac Boulevard or Lotus Grand Prix with the same suspension."

Dream truck

Aerodynamic shapes and advanced electronics are now spreading to those tough off-road vehicles. Chevy has a Blazer XT-1 concept vehicle that captures all the advanced features you see on many dream cars at auto shows.

While the XT-1's innovations admittedly are 15 years away from production, there are a few details of the 4-wheel-drive truck that will work their way into Blazers of the near future, like 4-wheel steer, steer-by-wire and 17-in. tires.

Other hints of what's in store for the 1990s are a steering wheel that turns only 90° to each side, radically variable steering ratios that range from lightning quick 3:1 at the low end, to a normal 16:1 for highway driving, and an instrument panel that presents information in a 3-dimensional picture. In the latter, the gas tank level, for instance, is shown as a block of fuel that gets smaller as gas is burned. The engine is an all-aluminum V6 of 90° that is much like the engines found in today's vehicles.

PM

NEW Breakthrough Design Adjustable Socket Kit

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This One Tool Replaces Twenty Sockets

No more need for a whole set of individual sockets. No more fishing around in your tool kit for the right size. This new CHANNELLOCK 906 Adjustable Socket does it all. Replaces 20 individual sockets. Fits 20 bolt or nut sizes, both metric and standard. Best of all —

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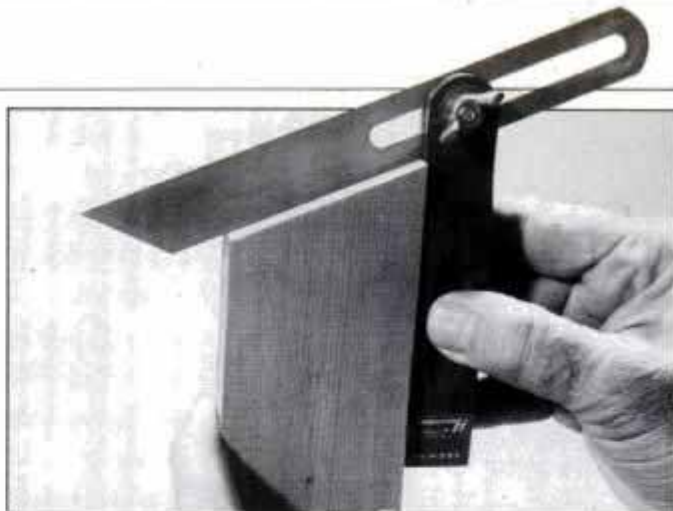
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Workshop Minicourse

BY ROSARIO CAPOTOSTO



Use a T-bevel to check angle of a miter cut. Hold tool's handle, or stock, firmly against the workpiece edge. Sliding, pivoting steel blade adjusts up to 180°. Tighten wingnut to hold blade securely.

Using A T-Bevel

This simple tool is indispensable for marking, transferring and checking angles. The sliding T-bevel, also called a bevel square, has a pivoting steel blade that adjusts to mark angles from 0 to 180°. It's particularly helpful when marking odd angles and dovetail joints.

Use a protractor to set the T-bevel to a desired angle. Hold the tool's handle against the base of the protractor, align the blade's edge with the protractor centerline and adjust the blade to the desired angle. Lock the blade by tightening the wingnut.

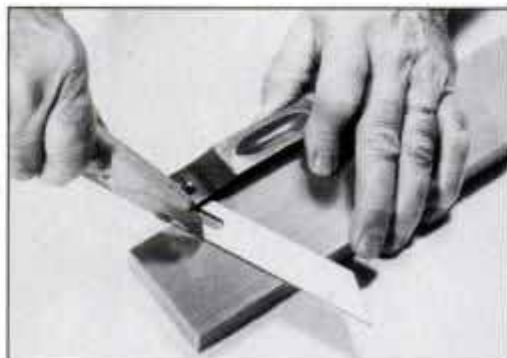
It's even easier to transfer an existing angle. Simply adjust the blade to match the angle and then lock it securely. You can now transfer the angle to a workpiece or read the degrees of the angle directly off a protractor.

Another useful application for a T-bevel is to check power tools when doing angular work. This includes setting exact blade angles on a table saw and radial-arm saw. Also, set the angle of the worktable on drill presses, band saws and jointer fences. Although power tools have angle indicators, these scales often are inaccurate. Use the T-bevel to check and reset the indicators.

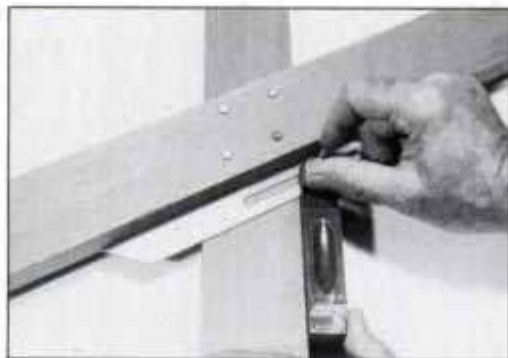
Sliding T-bevels are sold in hardware stores and through mail-order tool catalogs. Prices range from \$10 to \$20.—Rosario Capotosto



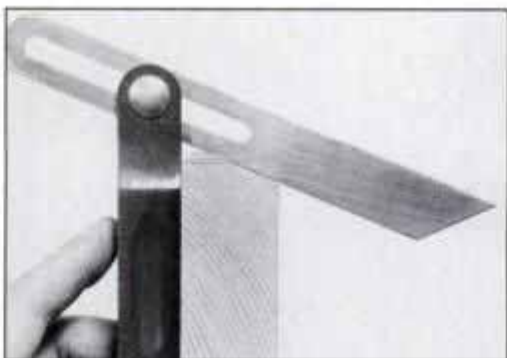
Adjust the T-bevel to a desired angle with the aid of a protractor. Hold the tool so that its blade aligns exactly with the protractor's centerline.



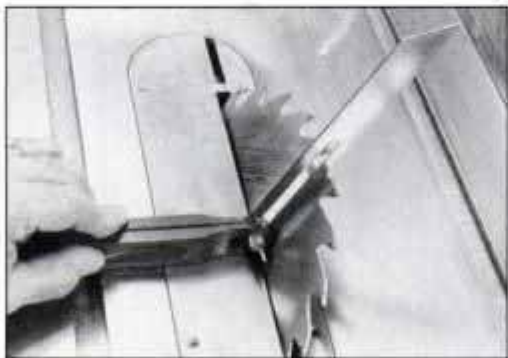
After setting the T-bevel to the desired angle, mark the workpiece using a utility knife. Hold the tool firmly against the work and keep fingers away.



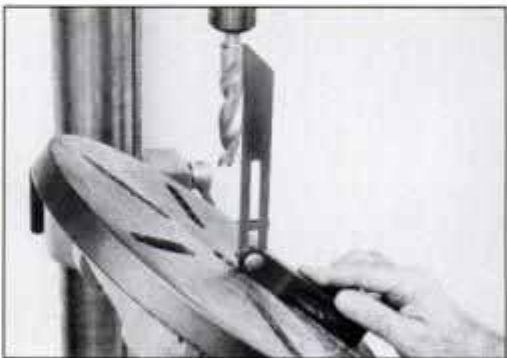
To transfer an existing angle, loosen the blade and slide the tool against the angle. Then, tighten the wingnut to lock the steel blade in position.



Sliding T-bevel is an excellent tool for checking bevels and chamfers, too. Here, the tool is adjusted to 45° and is being used to check a chamfer.



Use a sliding T-bevel to position blade angles exactly. Extend the sliding blade fully to allow the handle to rest flat on the saw table's surface.



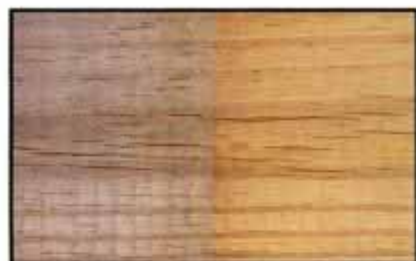
Bore angular holes accurately with the help of a T-bevel. Adjust the tilting drill press worktable until the tool's blade is parallel with the drill bit.

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repellent to beautify and protect pressure-treated wood. You'll find them all in a *Wolman* Deck Care Center at quality building supply dealers, hardware and paint stores. For information about your deck problem, or the location of a *Wolman* Deck Care Center near you, call 1-800-556-7737. Or write to the Koppers Company, Inc., Protection Products Division, Pittsburgh, PA 15219.



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Audio



BY FRANK VIZARD

Digital Dexterity



Kenwood amplifier had digital inputs for better CD sound.

If you thought "digital" was a word only to be used to describe a compact disc player, think again. In the near future, every component in an audio system will be able to bear the word "digital."

Toward the end of this year, for example, digital audio tape (DAT) players will arrive on store shelves. DAT decks promise the performance of compact discs with the convenience of cassettes. DAT offers recording capability while CD does not. Additionally, DAT's smaller size makes it even more suitable for personal, portable and car audio products.

While DAT is still some months away, some hi-fi amplifiers already sport the word digital. Two examples are the Kenwood KA-3300D and the Luxman LV-109 amplifiers.

At this point in time, the word digital used in connection with amplifiers means the amp is capable of receiving an input signal from a CD or DAT player in purely digital form. In the past, the digital signal would have to be converted to analog form before it could be routed through an amplifier.

Postponing the digital-to-analog (D/A) conversion stage so that it takes place within the amplifier prevents the slight degradation of the signal that would normally occur when the signal is transferred from the source unit to the amp. Having listened to the LV-109 on more than one occasion, the sonic benefit of a direct digital-to-digital connection is audible—although you do have to listen closely to appreciate the improved performance.



Sony's latest CD changer uses carousel arrangement for five discs.

To take full advantage of the digital connection, your CD or DAT player must have digital output jacks. Not every CD player on the market has digital outputs, but as you might imagine, Kenwood and Luxman both have such models. Kenwood, in fact, makes the connection between its DP-3300D CD player and the KA-3300D amplifier with a fiber-optic cable. This represents an effort to keep the signal as pure as possible, since fiber-optic cable is virtually free of distortion.

Both the Kenwood KA-3300D (\$1199) and the Luxman LV-109 (\$1500) are compatible with CD players that lack digital outputs. Undoubtedly, however, digital inputs and outputs will be common on many components as time goes on.

While digital amplifiers are sure to be commonplace in a few years, the digital format is spawning a few unusual items. Sony, for example, has developed a multiplay CD unit. Its front-loading carousel resembles a pizza tray capable of holding up to five discs. The CDP-C5F (\$500) is an alternative for people who don't want to be bothered with magazine-loading multidisc players. The CDP-C5F offers six hours of continuous play and the programming of up to 32 selections. Disc-to-disc changes are made in about three seconds.

The CDP-C5F is also one of a number of new Sony CD players incorporating a new aspheric optical pickup lens. This single lens weighs a tenth of a gram and is about a fifth the size of previously used multiple-lens designs.

Innovative speakers

If you ask most people to describe the appearance of a loudspeaker, they'll draw a rectangular box. The vast majority of speakers do have a box-like shape, but a few manufacturers have developed speakers that are anything but square.

A West German speaker company called Magnasphere, to name one example,

has three models (Beta, Gamma and Delta II) that use ball-shaped and baffle-free tweeters and midranges. Only the woofers are housed in traditional enclosures.

Winner of a number of audio awards in France, these ball-shaped drivers are designed so that the high and midrange frequencies emanate sound in all directions in much the same way a naked light bulb emits light. When the speakers are properly placed at least 2 ft. from a wall, you should not be able to perceive the direction from which the sound is coming. Magnasphere speakers are expensive, however. List price is \$895 each for the Beta model, \$1095 for the Gamma, and \$1495 for the Delta II. Magnat America Inc. of Marblehead, Mass., is the U.S. distributor.



Sound Cylinders from Ohm Acoustics—music-in-the-round.

A more unusual speaker shape comes from America's Carver, better known as an amplifier maker. The Amazing Loudspeaker is 6 ft. tall and weighs 145 pounds, but is only 1½ in. thick. The price is also amazing: \$1500 per pair.

Finished in black lacquer, the Amazing Loudspeaker uses a long ribbon driver to reproduce frequencies over 125 Hz to well beyond the audible range. This long, uninterrupted acoustic line is critical to delivering lifelike height, depth and width information, says Carver. The ar-

(Please turn to page 52)

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AUDIO

(Continued from page 51)

ray of six planar subwoofers for the lower bass frequencies uses dipole radiators, meaning they emit sound equally from their front and rear surfaces. The great weight of the speaker prevents the panel from moving in opposition to the subwoofers. When placed against a wall, the overall effect is of a large, 3-dimensional sound stage.

Less expensive but perhaps as unusual are the Sound Cylinders from Ohm Acoustics of Brooklyn, New York. Listing for \$549 per pair, these speakers utilize the unique Ohm Walsh driver, an inverted speaker cone mounted face down from the top of the cylinder. The sound radiates off the back of the cone in all directions. Treble response is supplemented with a tweeter mounted on top of the cone.

Like the Carver speaker, the Ohm model attempts to create a single sound wave emanating from one driver, a methodology both companies feel is superior to the sound pattern created by two or three drivers handling various portions of the audio spectrum. Magnasphere, by contrast, holds to a more traditional radiation pattern but uses its ball-shaped design to spread the higher frequencies over a greater area.

All three companies (and others using more box-like designs) are attempting to produce a sonic image that cannot be localized to a specific point of origin. Success means a 3-dimensional soundstage that allows you to sit anywhere in the room. For these companies, failure is defined as a flat stereo image which confines you to listening from a point equidistant between the two speakers. Ironically, and somewhat indicative of the direction speaker makers are headed, this very definition of failure would have been deemed the formula for success just a few years ago.

GM goes digital

General Motors has followed Ford in offering a compact disc player for the car. The CD player is a floor-mounted model that also includes a 6-disc storage compartment as part of the arrange-



Nikko's AVR-65 has jacks for hi-fi and video.

ment. The CD player is designed for dealer installation on the Chevrolet Celebrity, Oldsmobile Cutlass Ciera, Buick Century and Pontiac 6000. Plans call for the CD player to be offered as an option on the Buick Electra, Park Avenue and Cadillac De Ville in the near future.

After driving a Cadillac test car equipped with the CD player, I have to report that the sound is admirable. But having the CD player mounted on the floor makes operating the unit somewhat difficult, requiring you to take your eyes off the road more than you might like. The GM CD player is also a definite add-on, being linked to a separate in-dash cassette/receiver. One wonders how many people who are willing to listen to CDs will also listen to cassettes. A CD/tuner model might be a better option to offer.

GM's CD player does have one feature unique to the genre—a manually operated audio compression circuit. This circuit compresses on a 2:1 ratio. Assuming 100dB of dynamic range, for example, the compression button will reduce dynamic range to 50dB.

The audio compression circuit is designed to raise low volume information above the car's noise floor, and prevent high-volume passages from reaching the threshold of pain. The effectiveness of the compression circuitry may well depend on the type of music to which you're listening.

A good deal of rock 'n' roll may remain unaffected by the compression circuitry while classical music, with its typically greater dynamics, will be affected immediately.

AV honeymoon

Lots of receivers these days boast audio and video inputs that let you route the audio signal from your VCR through the stereo system. Many manufacturers say this simple connection constitutes a marriage of audio and video, but Nikko, one of the smaller Japanese hi-fi companies, says the marriage is far from consummated.

Nikko's AVR-65 might be the only true audio video receiver on the market in that it has a cable-ready 139-channel TV tuner as well as an AM/FM tuner. The remote control for the AVR-65 allows you to switch on the TV and change channels.

The 65-watts-per-channel receiver features an MTS decoder for stereo TV broadcasts, an SAP decoder for alternate language programs, and audio and video inputs for two VCRs that permit bi-directional video dubbing. Its list price is \$750.

Whether you're looking to upgrade to MTS, upgrade a monaural TV, retrofit a limited-channel TV, or simply upgrade to a new receiver, the AVR-65 audio video receiver fits the bill. **PM**

NEW/HOME

Long-Life Lawnmower

Jacobsen's new riding mower offers an attractive combination of power and convenient features. Power comes from a heavy-duty Briggs & Stratton I/C (industrial/commercial) 11-hp gas engine. The aluminum engine has a cast-iron cylinder liner that permits piston sleeve reboring. Hardened valves, rotators and valve seats, also add to longer engine life and less costly repairs, according to Jacobsen. Features include electric start, 30½-in.-wide cutting blade, rack-and-pinion steering and a 5-speed gearbox. A unique through-the-deck dis-



Riding mower has a powerful 11-hp, 5-speed engine with a 30-in. turning radius. Rear grass-catcher discharges into two standard 30-gallon trash bags (above).

charge system eliminates a side-mounted chute to permit close trimming. An optional twin-bag rear grass-catcher (\$200) accepts two 30-gallon

trash bags. The mower costs about \$1600 at Jacobsen dealers. For more information

and details, contact Home-lite/Textron, Box 7047, Charlotte, NC 28217.

Letter-perfect message maker

The LetraGraphix lettering system lets you produce professional-quality newsletters, fliers and signs quickly and easily. The typesetter's magnetic pad and transparent rule hold the paper securely to eliminate the No. 1 problem with using rub-on, transfer type—misaligned letters. A quick rub with the provided stylus transfers letters from a type sheet onto the paper or poster board. Type sheets come in various styles, sizes and colors. The system includes a typesetter, alignment bar, type sheet and stylus. It costs about \$80 at art supply shops and stationery stores. For details, contact Letraset, 40 Eisenhower Dr., Paramus, NJ 07652.



To produce professional-looking signs, posters and fliers, simply position type sheet, rub letter with stylus (top) and gently lift type sheet (above). Typesetter's magnetic pad and transparent rule helps to keep the paper and type aligned (below).

Quick-find organizer

This compact wall-hung cabinet provides neat storage for tough-to-find items such as postage stamps, pencils, tape, envelopes, coupons and spare keys. Called the Find-It Bits 'N Pieces Organizer, it's made of plastic and measures 5¼ in. deep x 14½ in. wide x 21¾ in. high. It's sold at home centers and department stores in brown, oyster white or almond for about \$37. For details, contact Essette Pendaflex, Clinton Rd., Garden City, NY 11530.



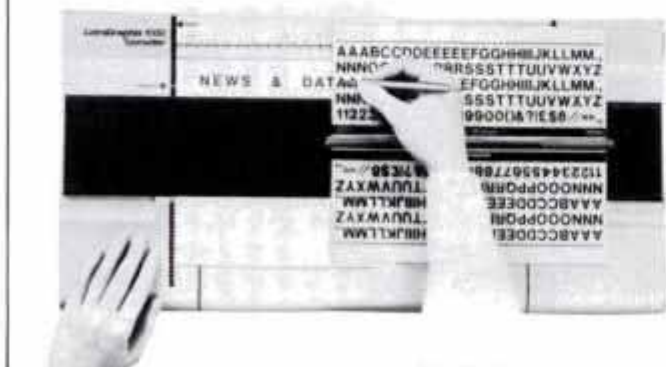
Wall-hung cabinet offers lots of storage for little items. It serves as a message center, too.

Piggyback air blower

Blow away leaves and grass clippings from your driveway, sidewalk and lawn with the Solo backpack air blower (Model 412-B). This compact, yet powerful, air blower has a 4½-hp, 47-cc, 2-cycle gas engine with electronic ignition. It weighs about 20 pounds and measures 11 x 18 in. wide x 24 in. tall. The blower is sold at Solo dealers for about \$340. For details, contact Solo, Box 5030, 5100 Chestnut Ave., Newport News, VA 23605. **PM**



Solo's powerful backpack air blower comes with a flexible 3-in.-dia. hose and a 3-ft.-long removable plastic nozzle.



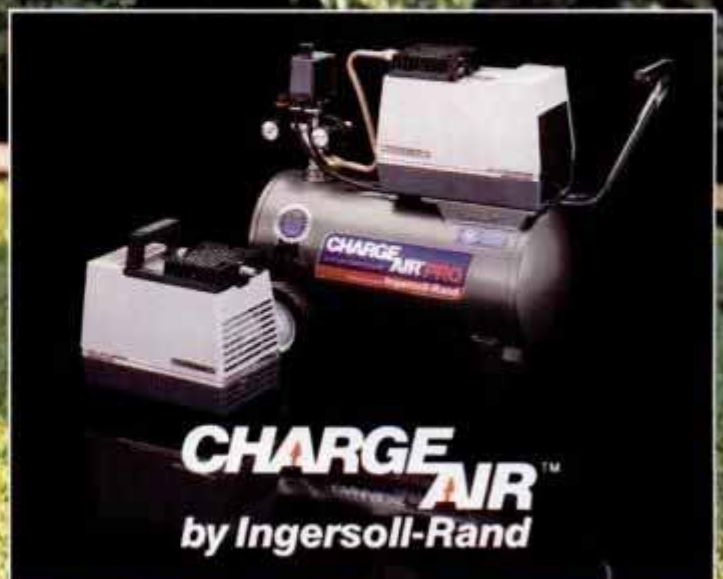
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Electronics



BY STEPHEN A. BOOTH

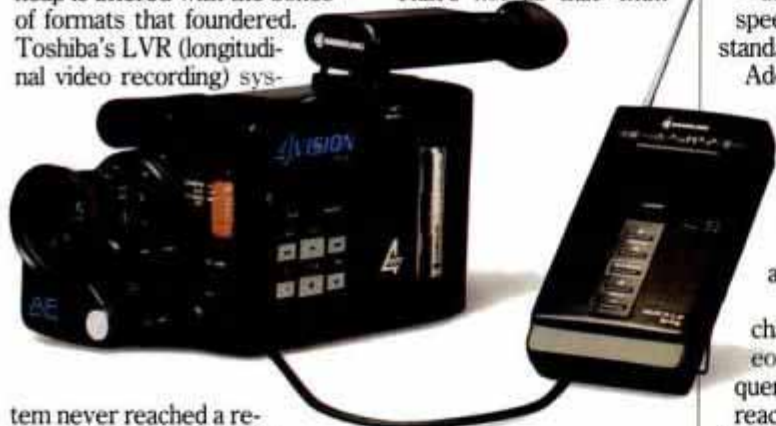
Korea Ups The Ante

No one would describe the history of home video as dull—or orderly. Following the format battles of the past 10 years is almost as vexing as trying to keep score on the Thirty Years' War of 17th century Europe.

The technological scrap heap is littered with the bones of formats that foundered. Toshiba's LVR (longitudinal video recording) sys-

—exactly the same as today's analog audio cassettes and tomorrow's digital audio tape (DAT). In fact, the 4mm system proposed by Samsung uses exactly the same metal-particle tape found in DAT, and it's housed in exactly the same cassette shell.

That's not all that 4mm



tem never reached a retail shelf. Technicolor's 1/4-in. CVC (compact video cassette) system and the Philips 1/2-in. V-2000 failed to catch on with the buying public. Beta, the first home VCR format, today defends a diminishing empire against the encroaching VHS system.

In the camcorder arena, 8mm, VHS and VHS-C are battling one another for dominance in home moviemaking—and yet another contender might weigh in. By this time next year, Korea's Samsung Electronics might join the fray with a video format of its own, called 4mm.

That's right—4mm! The name derives from the approximate width of the videotape used to record images and sound. That tape actually measures 3.81mm (15/100 in.)

Samsung's 4mm camcorder can record from 2 1/2-in. LCD color TV.

and DAT have in common. They share the identical VCR-like helical-scan system to store and retrieve signals on the tape. Helical scanning lays tracks diagonally across the tape width, to store more information.

A drum 30mm in diameter holds two magnetic heads spaced 180° apart, and rotates at 2000 rpm—slightly faster than the 1800 rpm of Beta and VHS. This is where the similarities between 4mm and DAT cease.

For DAT, the metal-particle tape passes by the rotating heads at a rate of 8.15mm per second. That's 1/3 in. per second (ips) in English. This

might seem slow compared to the 1 1/8-ips rate of today's analog cassettes, but the 2000-rpm helically scanning heads combine with tape travel for a "writing" or recording speed of 123 ips.

That writing speed is sufficient to cover the audio bandwidth of 20 Hz to 20 kHz (20 to 20,000 cycles per second) and yield two hours of digitally encrypted music. But the analog waveforms that constitute a video signal extend into the megahertz (millions of cycles per second) range. To achieve the faster writing speed video requires, Samsung has modified DAT's operating system.

According to Tae-Won Moon, chief of Samsung's Korea-based video research and development, video recording requires a near-doubling of tape speed, to 16.1mm per second. That's between 2/5 ips and 2/3 ips—about half the 1 1/3-ips speed of VHS tape in the standard (SP) mode.

Additionally, Moon explains that Samsung's modification also calls for the tape to wrap 180° around the head drum. This is twice the "headwrap" needed for a DAT system.

The result of these changes is one hour of video recording time, with frequency response that reaches 2 MHz before dropping off by 6 to 7 decibels (dB). Horizontal resolution is about 230 lines. Signal-to-noise ratio hits 42 dB in video and 43 dB in audio. In case these specs seem unfamiliar to you, they represent about the same level of picture and sound quality you'd get from a VHS-C camcorder. The video specs are about the same as 8mm's, but the latter format yields much better sound.

You might wonder why anyone needs yet another video format—especially since Samsung's 4mm doesn't seem to offer much more than its competitors, except for smaller size. Samsung's response to this obvious question is that the 4mm format promises to unify audio and vid-

eo, once and for all. The company's ultimate goal is a dual-purpose home tape deck that would play and record both 4mm video and DAT music cassettes. The deck would have a single tape transport mechanism, and adjust its tape speed and headwrap according to whether video or audio is desired.

Regarding quality, Samsung's Moon says the video frequency response will improve a visible 3 to 4 dB when new, metal-evaporated tapes are available.

He adds that two hours of video recording time is also possible. Moreover, the audio can be enhanced by incorporating the same depth-multiplexed FM recording system used for 8mm, Beta Hi-Fi and VHS Hi-Fi equipment.

For the time being, Samsung will concentrate on 4mm camcorders only. The company plans to introduce a tiny 2-pounder, priced around \$1300, by the time the 1988 Summer Olympiad opens in Seoul, South Korea.

Another clone

It's just as we predicted—1987 will be a banner year for computer discounts. The popular IBM PC continues to be flattered by a legion of imitators, all vying to deliver the most performance at the lowest price.

The latest PC clone to hit these shores hails from Great Britain's Amstrad and is distributed stateside by Longview, Texas-based Vidco. It's called the Amstrad PC 1512 and comes in a variety of bargain-priced configurations, six

(Please turn to page 60)



Another bargain brain: Amstrad PC 1512.

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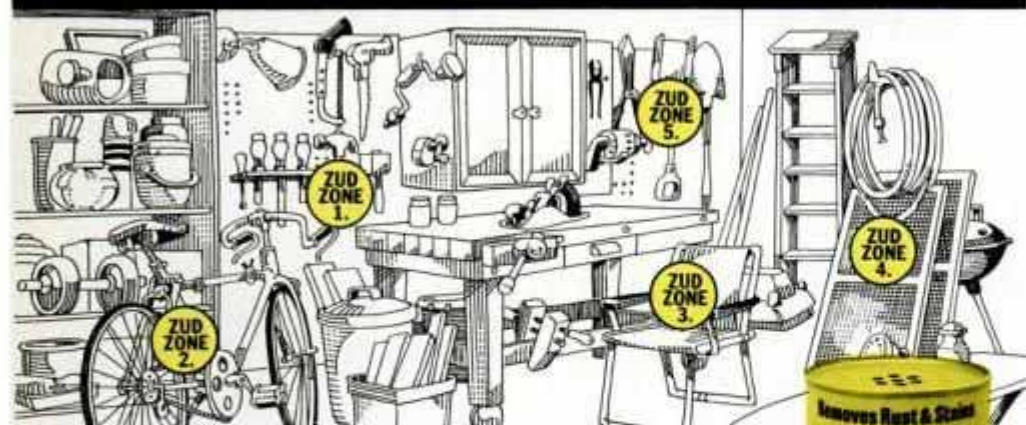
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Zud works where ordinary cleansers fail.

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ELECTRONICS

(Continued from page 57)

models in all. Amstrad's line begins with an \$800 package that includes a monochrome display monitor and single 5¼-in. disk drive. Another \$100 buys a dual-disk system, and \$1100 gets you two disk drives with a color monitor. At the top of the line is a color system with 20-mega-byte hard disk, for \$1500.

Common to all the PCs in Amstrad's lineup is 512 kilobytes of random access memory, expandable to 640K, and an 8-megahertz processor. Also standard is a built-in color graphics adapter. Five software programs are packaged with the system, including the MS/DOS 3.2 operating system. The keyboard is full-size.

Kid-vid

First, there was designer jeans for kids. Next came colognes for the lads and perfumes for the lasses. Obviously, what's been missing from the tough lives of today's upscale tots is a video camcorder just like the folks use. Wanna bet?

Get ready, Santa, because the elves at Fisher-Price Electronics are working overtime to deliver their PXL 2000 kiddie camcorder in time for Christmas.

The ingenious 2-pounder will sell for \$150—unless your kids demand the "deluxe" \$200 package with a 4½-in. monitor to call their own. Why ingenious? Because F-P's PXL 2000 uses regular audio cassettes to record video and sound. Running at a superfast 13½ ips, a regular C-90 cassette can hold 11 minutes of black-and-white video plus soundtrack. Playback comes directly from the camcorder when it's hooked to the antenna of any TV.

PXL 2000's quality is quite decent. The lens is prefocused from 4 in. to infinity, and rotates to adjust for indoor or outdoor lighting. All the junior videographer need do is peer through the viewfinder and press the record trigger. Six AA batteries yield five hours of record/playback time. The PXL 2000 comes in a high-tech anthracite gray and, says F-P, is appropriate for children 8 years and older. **FM**



Fisher-Price PXL 2000 camcorder uses audio tapes to record b&w video movies.

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Navigator™ Watch

Now, with new ratcheted safety bezel, and still only **\$49.95***



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The Navigator™ Watch is totally executed in black metal, including the linked, stainless steel band. It is waterproof to 150 ft. The new, exclusive ratcheted safety bezel prevents you from staying underwater longer than you had planned. The crystal is "mineral glass"—it will never scratch.

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Even if you've never built a model before, you can experience the relaxing pleasure and pride of accomplishment that is offered by this fascinating hobby. You can build the *Swift*. The secret's in our kit, designed especially for the first time modeler, with pre-cut parts that make assembly easy. Clear, large scale plans and instructions that virtually take you by the hand and guide you every step of the way through hours of the most relaxing fun you'll ever have. And when completed - a museum quality model you'll display with pride, with gleaming brass fittings, walnut planked hull, delicate rigging - lifelike in every detail.

Quality you can see and feel

The materials in our kit may be better than those used in the original *Swift*. The keel section and frames are pre-cut plywood, ready for quick assembly. The *Swift's* hull is planked twice; once with thick, flexible limewood for strength, then overlaid with planks of African walnut for lasting beauty.

You don't have to make the fittings - we've done that for you. Our kit contains ready-to-use blocks and deadeyes of rare, yellow boxwood. We include eyelets, bracers and belaying pins - over 70 parts of solid brass! Even the cabin door hinges are brass, as are the 250 miniature nails you'll use to fasten the planking to the hull and deck. And, since the original wooden *Swift* had no plastic parts, our kit doesn't either - anywhere!

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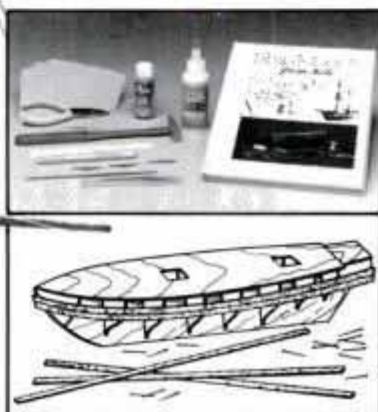
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NEW/AUTO

Big Stick



Hold-It keeps your stuff from moving around in the back.

Hold-It is a cross bar with neoprene-faced pads on both ends to hold cans or boxes, or whatever else, from sliding around in the back of your truck. Made of galvanized steel, it installs

and removes in seconds. Write to Hunt-Davis, Inc., 9500 Roosevelt Way N.E., Seattle, WA 98115, for the dealer nearest you. Depending on the size, it costs from \$24.95 to \$27.95.

Soft touch

Irritating, too-tight seatbelts can be a real drag. Belt-Eze, covered in Ultrasuede (\$9.95) or luxurious mink (\$75), attaches with Velcro over the shoulder harness to provide padding and relieve pressure. Works for cameras or luggage, too. Try your auto parts store, car wash or write to Belt-Eze, Box 12465, Fort Worth, TX 76121, for information.



Join the Club

If you worry a lot when you have to park the family Porsche in a nasty neighborhood, use the Club. It's an anti-theft device that locks through the steering wheel spokes, effectively preventing the car from being driven. Bright red high-strength steel is highly visible, too. It's \$59.95 for cars, \$69.95 for trucks (plus \$4 postage). The



The Club will make this car tough to move very far.

manufacturer, Winner International, is at 1330 Kimberly Rd., Sharon, PA 16416; 412-981-1152.



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Shine it!

If you want a nicely polished intake manifold to set off your engine compartment, try Eastwood's Aluminum Manifold Kit. It includes all the abrasives and polishes to pol-

ish the manifold or any other alloy casting. You supply the drill for buffing. It's \$49.95 from The Eastwood Co., 580 Lancaster Ave., Box 296-M, Malvern, PA 19355; 215-644-4412.

Year-round sledding

The clever Bed-Sled will make it easy to get anything out of the back of your pickup or van, but most people will use it for tools or building materials, the things that need to go on or off the truck often. It bolts to the bed, and easily rolls 'way out, so all that stuff in the front of the truck is easier to reach. Saves lifting up heavy objects like toolboxes over the side of the box, too. Depending on the size, it costs from \$265 to \$440, from Davison-Wood, 5055 N. Harbor Dr., Suite H, San Diego, CA 92106; 619-226-0933.

FM



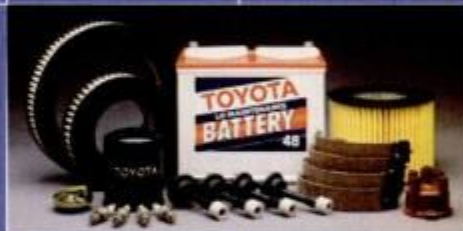
Bed-Sled makes it simple to get bulky items off your truck by easily rolling all the way out.

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Lights: 8 mg. "tar", 0.7 mg. nicotine. Lights 100's: 8 mg. "tar", 0.8 mg. nicotine av. per cigarette by FTC method.

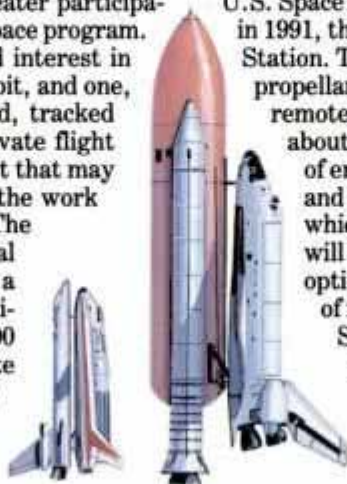
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PM TECHNOLOGY UPDATE 5/87



Private Shuttle May Fly In The 1990s

President Reagan last year called for greater participation by the private sector in the future space program. Several companies already have announced interest in the launching of satellites into low Earth orbit, and one, Space Industries, has successfully launched, tracked and recovered a Conestoga rocket on a private flight from Texas down the Gulf missile range. But that may turn out to be small potatoes compared to the work planned by Third Millennium of Nevada. The company, which uses the Roman numeral MMI (2001) as its logo, is currently building a prototype Space Van, a fully reusable mini-shuttle with a payload of more than 6000 pounds to low Earth orbit. That would make it capable of delivering supplies to the planned Space Tugs of NASA for delivery to the Space Station in the 1990s. The Space Van also is designed to deliver satellites into low orbit. The Space Van will be just under one half the length of the



The Third Millennium Space Van, left, shown in scale with the Shuttle.

U.S. Space Shuttle and is expected to be ready for service in 1991, the year before construction starts on the Space Station. The Van would be launched on a reusable liquid-propellant booster, which would have wings and be remotely guided to a recovery site after separation at about 15 miles above Earth. It will also carry a set of engines in its rear to give it both orbital transfer and fly-down capabilities. Unlike the Shuttle, which returns to Earth as a glider, the Space Van will be able to rely on its engines for more landing options, and for a higher, and thus a cooler, angle of re-entry. The Van will not need weight-adding Shuttle-type ceramic tiles for heat deflection. The rear engines are expected to be eight Pratt & Whitney RL10 rockets. The Space Van can be flown by a crew of three.

Editor: Dennis Eskow
Contributors: Michael Fillon, Jack Hammond,
Steve Eskow, Ted Francis, Richard Schrader

TECHNOLOGY UPDATE

AVIATION

Cargo flies first class

McDonnell Douglas has produced a concept for a new version of the ultrahigh-tech MD-11. The Combi will fly passengers and extra cargo on the same

deck. A typical arrangement, shown in illustration, would provide room for 214 passengers forward and six

freight pallets aft. The MD-11 itself is being offered in two fuselage lengths, one 18.6 ft. longer than a DC-10 and the other the same length as the popular jumbo jet. All the new MD-11s carry

three powerplants, either the General Electric CF-6 or the Pratt & Whitney 4000. Additional winglets on the MD-11 wingtips and other advances in the airfoil design give the

MD-11 about 17 percent greater fuel efficiency than the DC-10. All computerized systems are redundant with major systems on mechanical backup. The cockpit is entirely computerized.



MEDICINE

Brace yourselves

The knee brace has become a common piece of medical equipment that allows sports enthusiasts and professionals to get back into the game quickly after a knee injury. The best of today's knee braces, like the Lenox Hill model, are using a lot of composite materials to keep the



weight low and the flexibility high. But a new brace

developed by Georgia Tech engineer Ray Vito and his

associates is made entirely of composites, and, depending on the configuration for a particular athlete, can weigh one-quarter to one-third less than the best of the existing knee braces. The Georgia brace is comprised of a set of rigid components which can be shaped in a variety of ways. Because of the composites, the brace can stretch to accommodate younger wearers who are still growing.



AUTOMOTIVE

Stick in the mud

A British firm, PowerHouse, has developed a rescue device for vehicles mired in mud or snow. It fits on a flatbed truck and is rolled to a stuck vehicle under the power of a small motor. A pallet rolls back from the rescue device and hydraulic jacks push up the front end of the stuck vehicle enough to get the pallet under the wheels. After the stuck vehicle is secured, its driving wheels turn the treads.

MILITARY

Future Hawkeyes

The Navy currently places Grumman E-2C Hawkeye planes with radomes on aircraft carriers. The Hawkeyes can fly out of missile range and get a 360° view of the activities going on above and below the cloud decks. But there are a few things Hawkeyes can't do, and the Navy is shopping around for a next-generation "Multi-Mission Sensor System." Lockheed has shown us an early concept of two versions of the future Navy craft. One

is an Anti-Surface Warfare version (top in the illustration). The other is an airborne early-warning craft shown with the familiar radome. The future craft will be required to watch the skies for enemy aircraft and vessels, jam enemy radar, broadcast false radio messages and radar signals, and then some. In one configuration or the other, the new plane will drop mines at sea and carry out refueling missions for fighter planes. The planes are expected to have advanced aeronautical design, including winglets for lift and canards for greater maneuverability in flight.



Globe-trotting wings

Technology under development for America's stealth aircraft is being discussed as the wave of the future in moving air freight. Lockheed, under a grant from NASA Langley Research Center, is developing the initial design for a "global" transport plane. The technology being studied in laminar-flow experiments is the flying wing. Lockheed envi-

sions a stubby-bodied, rear-propfan-driven craft with winglets that could carry 150,000 pounds of cargo 6000 miles nonstop. The counter-rotating props could develop enough power to give the craft a mach 0.8 cruise speed. The wing design is the real key. Initial concepts call for a 227.2-ft. wingspan on a 125-ft.-long, 23.3-ft.-high body. NASA intends to test the wing concept on a C-141 test bed within the next two years.



Hard wheels, hard warfare

The first full-scale Small Intercontinental Ballistic-Missile Hard Mobile Launcher is undergoing tests. The 100-ft.-long, 200,000-pound vehi-

cle runs on a pair of 750-hp Cummins Diesel engines with all-wheel drive on 14 Goodyear military all-terrain steel radial tires. It will serve as a launcher for America's 30,000-pound single-warhead ICBM. The

small ICBM will have a range of 6000 miles when it undergoes test firing early in the next decade. The vehicle is being built by a consortium including Boeing Aerospace, Goodyear and Paccar Defense Systems. It must be

hard enough to withstand gamma-ray attack and fast enough to move out at 60 mph over rough terrain. In a crisis, the mobile launchers are supposed to disperse and await commands from a control center.



TECHNOLOGY UPDATE 5/87

INNOVATION

The razor's edge

Razor companies around the world are doing computer simulations of future razors to make them fit in your hand better. And chemically treated heads will keep the razor from dragging on your skin. For instance, Wilkinson Sword is working on Kompact, which has a hollowed plastic handle that feels solid in your hand. Inside the hollow tube is an injector that carries four replacement blades. The body of the shaving system is topped with Polyox, chemically known as PTFE or Teflon. Another blade manufacturer says that a genetically engineered antifriction chemical has already been developed in Europe and will be on the market here by next year. The advantage over Teflon will be its ability to come off the blade a little at a time with each shave. That will provide greater lubrication to the face.

"Architecture" has become a buzz word in the industry. The Schick blade edge is bevelled gradually and uniformly to give it the appearance of a "gothic" roof. This translates into



closer shaves with minimum risk of cutting.

On the electric shaver front, Norelco leads the way with a rechargeable machine that can go without a charge for over a month. The battery technology is secret, but it is nickel-cadmium in chemistry and is based on battery systems designed for NASA. The charge is held so well that the shaver retains its speed almost down to the last trickle of electrons. What is the future

of shaving? "We are looking at skin and researching methods for handling specific skin problems in a shave," says Norman Prioux, president of Wilkinson Sword, U.S.A. Much of the research money is going into the development of a shaving system that deals with pseudo-folliculitis, a skin disorder that causes tiny bumps to form on the skin of an adult, ingrown hair and other problems that can make shaving a painful experience.


ELECTRONICS

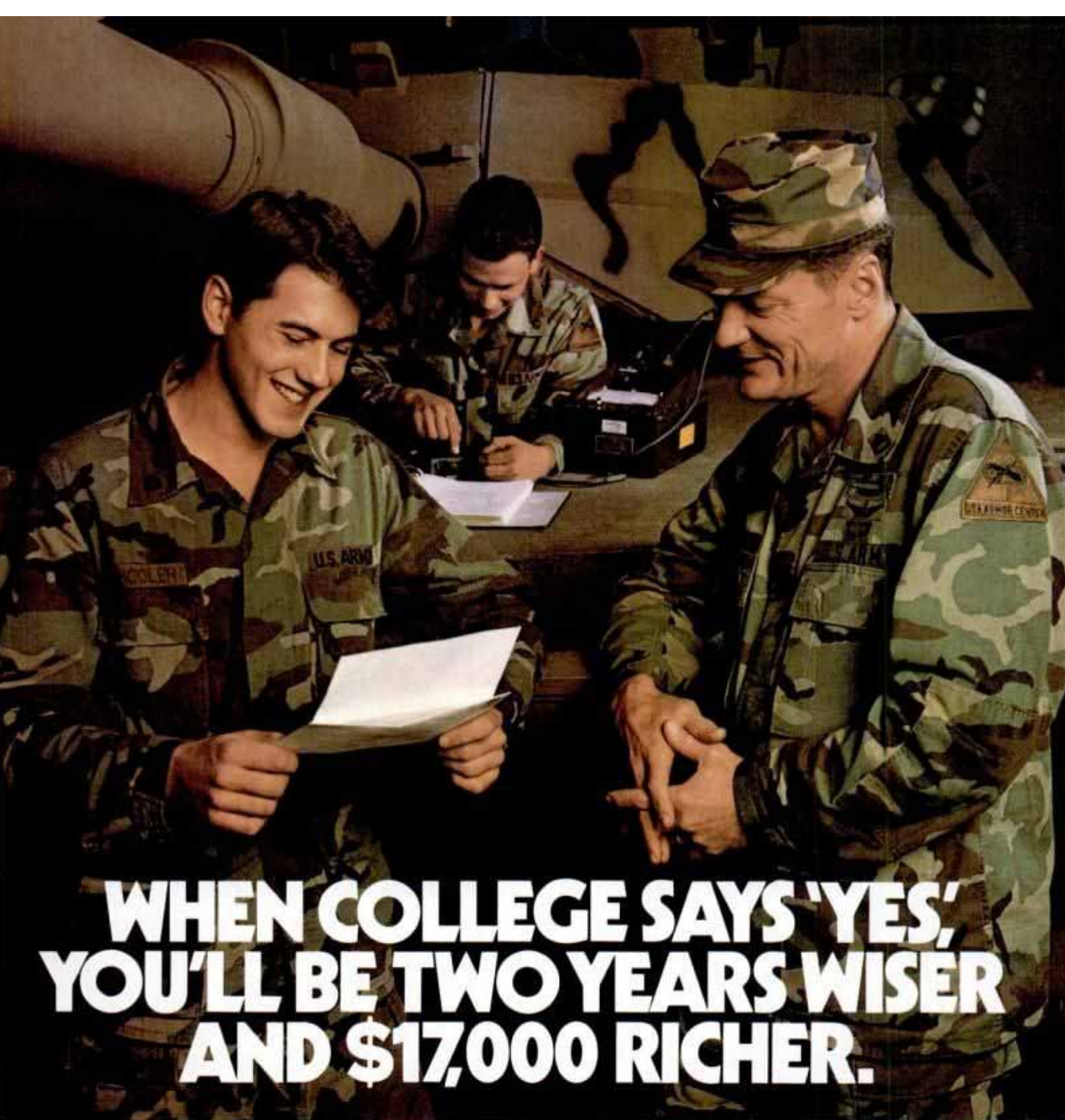
Play it again

The video disc has been married to a computer in various settings to make incredible breakthroughs in information retrieval. The latest breakthrough may show up at your local library in the next year or two. InfoTrak II is a single-user data base and retrieval system. A computer disk is contained within the system's microcomputer. InfoTrak II can let you read hundreds of periodicals, and with some adjustments, can also run graphic



and video images so that multi-media processing—from printouts of newspapers to the running of video scenes—can be accessed. At present, no library is using it to that extent. But future

up news footage onscreen as well as reference works from more than 400 periodicals per unit. It also will provide indexes to newspapers going back six months, with additional back-references available in customized systems. 



WHEN COLLEGE SAYS 'YES,' YOU'LL BE TWO YEARS WISER AND \$17,000 RICHER.

If you're interested in college but wondering how you'll pay for it, the Army's special Two-Year Enlistment might be your answer.

Because, if you qualify, The G.I. Bill Plus The Army College Fund lets you put away up to \$17,000 to pay for college, with just a two-year enlistment.

You can qualify for training in a long list of exciting career fields like mechanics and communications. Challenging fields which build confidence and self-esteem. And while you're growing, your money grows, too. Save \$100 a month from your paycheck for just 12 months, and the Army will send you home with the full \$17,000 for college.

The Army's special Two-Year Enlistment. Money for college. Experience for life.

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ARMY. BE ALL YOU CAN BE.**

Seat belts save lives.

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\$5,500. AND BUILT TO STAY THAT WAY.

Introducing the only \$5,500* car engineered like a Subaru, the Subaru Justy. It's reliable, durable and built to last. What's more, the Justy offers a range of standards including front wheel drive, a surprisingly roomy interior and a heri-

tage of customer satisfaction. Not to mention a 9 valve, 3 cylinder engine that's as powerful as it is economical (38 mpg city, 41 hwy).**

Of course, we wouldn't be doing the Justy justice if we left out another reason

to buy one: the car is truly fun to drive.

So think about it. Why spend your disposable income on a disposable car when you can put your money into a much more lasting investment, the new Subaru Justy.

*Suggested retail price. Dealers actual price may vary. Price does not include dealer prep, origin, transportation, taxes, license, and title fees.
**Use Est. Mpg. for comparisons. Your actual mileage will probably be less.

SUBARU JUSTY
Inexpensive. And built to stay that way.

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ACURA
INTEGRA LS

Popular
Mechanics

PM COMPARISON TEST:

DAILY DRIVERS

We pit Chevy's new Corsica against nine new-wave family sedans.

Fifteen years ago the typical American sedan was a 2½-ton, rear-drive, 18-ft.-long 4-door with a 250-hp V8 and room for six big people inside. On a good downhill run it might get 15 mpg. Two energy crises, a dose of double-digit inflation, and considerable government regulation later, the family sedan of the late '80s looks

like a prime example of reduced expectations: a 4- to 5-seater about 15 ft. long, 2200 pounds, with front-drive and a 110-hp Four or V6 rated at 25 mpg. Its price is about the only thing that hasn't gone down—\$12,000 to \$15,000.

But are we really living in reduced circumstances? Ten years ago, Honda's innovative Accord was the first of these

CHEVROLET
CORSIKA





**PONTIAC
GRAND AM SE**

new family sedans—a fun-to-drive 4-door that perfectly fit the trend toward smaller families and sportier lifestyles. Honda's design has become so right for the times that we were able to identify 10 Accord clones for our new family sedan test: six from Japan, three from America and one from Germany.

We took them all to Raceway Park in Englishtown, New Jersey, for our standard track testing. Then we spent two days driving back-to-back laps around our usual road loop outside Princeton, New Jersey. As always, our test results represent a consensus of eight different drivers' reports.

On paper, this could be the closest group we've ever tested. Not only are sizes, prices and specifications nearly identical, all 10 sedans posted similar performance figures at the track. They even look the same: an aerodynamic

wedge that couples maximum trunk capacity with minimal frontal area for better performance and fuel economy.

Despite their statistical similarities, these cars are remarkably different to drive. The group could be charted accurately on a bell curve. A couple are not very good at all, most are okay, and then there are a few that are not only practical, but enjoyable to live with. The top three are among the best cars you can buy, regardless of price or type. Few families *need* more car than these. The top half-dozen cars prove our long-standing belief that practical transportation doesn't have to be dull. But the two automobile manufacturers who tried to build ersatz sports sedans fell flat on their faces.

Produced by the PM Auto Dept.
Text by Rich Taylor
Photos by Humphrey Sutton

Mazda 626 GT Turbo

The Honda Accord is more refined. The Toyota Camry is more comfortable. But the Mazda 626 is more *fun!* Our fun-loving testers voted it their favorite, and it also finished in front at the track. The heart of the 626's appeal is a smooth and powerful turbocharged 2-liter Four. It's not technically exotic in any way, but it sure gets the job done. Mazda claims only 120 hp for this engine, but it acts like more.

For any 2-liter car to hit 16 seconds at 86 mph in the quarter-mile is excellent. For a fully equipped 4-door sedan, it's remarkable. The secret, of course, is the turbo, which Mazda is able to offer on a \$14,000 car while other manufacturers cannot. Take away the turbo package and you chop \$1500 off the Mazda's price, putting it far ahead in the value calculations.



**HONDA
ACCORD
LXi**



**SUBARU
RX TURBO**



**DODGE
SHADOW
TURBO**



**MAZDA
626 GT
TURBO**



TOYOTA CAMRY L

Happily, the 626 is not one-dimensional. It also has the best brakes in this group, was second in the slalom, and near the top on the skidpad. It even returned a hair under 22 mpg in the hands of our enthusiastic test group. With better tires than the Japanese Goodrich 195/60R-15s fitted to our test car, its track performance would have been even more spectacular.

Our testers said the 626 interior is pleasant and tasteful, pretty and well-assembled, with high marks for comfort and convenience. As one enthusiast noted, "It's *beyond* ergonomics. Everything is in the right place and found without conscious thought. The seats have excellent support."

Honda Accord LXi

The Accord is smoother, quieter and more refined than Mazda's 626. In fact,

it's so refined, it borders on being characterless. We suspect that Honda's clever marketing people have ordered the engineers to "soften" the Accord to appeal to traditional American sedan buyers. For our taste, they've gone too far. Everything about this car feels soft—the steering has little road feel, the brakes seem mushy, the clutch offers no resistance. It's unnerving.

The Accord was fifth in the quarter-mile. In all our other performance tests, the softly sprung Accord—fitted with inexpensive Michelin X radials—was at mid-pack. But our track tester praised its nice linear steering, precise shifter and excellent driveability. It feels like a much larger car.

Surprisingly, our testers found the Accord interior lacking in a couple of departments. The front seats need more support, the steering-wheel

spokes are inconveniently placed, and the dashboard controls are confusing and visually unmatched.

But we can see why Honda was voted first in a recent J.D. Power Customer Satisfaction Index, the first time any car has been rated higher than Mercedes-Benz. This car is beautifully finished and assembled.

Even more impressive, Accords for the eastern half of the country are American-built, in Ohio—proof that the quality deficiencies that plague many U.S. cars are not necessarily the fault of the guys screwing them together. Quality *is* a management decision.

Toyota Camry LE

Its \$15,431 price tag makes the Camry the most expensive car in this group. Still, two testers ranked the Camry first, and none had it lower than fourth.



**NISSAN
STANZA
GXE**



**VOLKSWAGEN
JETTA GLI**

DAILY DRIVERS

Like previous Toyota sedans, the Camry is conservatively styled. Like all Toyotas, construction quality of the Camry is perfect.

On the road, our testers found the Camry a pleasant car to drive—one that won't wear you out as the miles and years go by. The monochromatic interior was especially praised for its tasteful good looks, straightforward ergonomics and easy adjustability to drivers of all sizes and shapes. Our only complaint is the electric front seatbelt, which wraps itself around you when the door shuts. "The darned belt knocked my glasses off," said one tester. "I like this car as well as the Accord or 626, but the automatic belts would keep me from buying it," said another.

At the track, the Camry was predictable, easy to drive and slow. Our test car was fitted with Toyo Z all-season radials, which surely helped accentuate its massive understeer. The 16-valve engine is smooth, but acceleration is lackadaisical compared to the 626 Turbo. All in all, we see the Camry as an excellent everyday sedan—not as much fun as the Mazda, not as stylish as the Accord, but safe, dependable and good for years of family transportation.

Acura Integra LS

What a pleasant surprise! The Legend's Honda-built baby brother is a perky, cheerful little 4-door hatchback with all the personality that's missing from the Accord.

A 1.6-liter dohc engine that loves to rev to its 7000-rpm redline, a crisp 5-speed shifter, quick steering and excellent driving position combine to make Integra an absolute ball to drive.

Our testers were impressed by the Integra's obvious quality and its mod-

ern styling. The basic interior layout is so comfortable you never think about it. On the other hand, the "op art" seat upholstery was deemed a pain in the eyes, and the radio was criticized for inferior reception. More serious in a family sedan was a hatchback cargo area that won't hold shopping bags upright with the security panel in place.

The Integra's relatively low \$13,283 price is \$1500 less than the Accord and 626 and \$2000 less than the Camry. Overall, we thought the Integra pretty and exciting to drive, well-made and genuinely a good buy.

Volkswagen Jetta GLI

Volkswagen claims the Jetta is the best-selling imported model in this country, and has positioned it as a half-price alternative to expensive German sports sedans from BMW and Mercedes. Soon, VW dealers will have a 16-valve version of the GLI, and in another year or two, one with full-time 4-wheel drive like the Audi 4000CS Quattro. Those additions should make the Jetta even more competitive.

The Jetta scored very well at the track, at least partially due to excellent Pirelli P6 60-series tires. Like all Rabbit/Golf derivatives, the Jetta lifts its inside rear wheel in really hard corners, but at normal speeds the handling is steady. Fuel economy is near the top, and a Jetta would make a practical, fun-to-drive commuter car.

Rough-road ride is choppy. The little VW engine produces more noise than power, and the shifter is inexcusably rubbery. Nearly everyone complained about the Jetta's lack of room, plain interior, inferior radio and "Golf-like" ambience. At more than \$13,000, the Jetta doesn't seem like a bargain, but our Wolfsburg Edition test model did have some expensive options such as

leather upholstery and a sunroof.

This is a sound car that's rewarding to drive, but it looks old-fashioned. The chassis is good, but it's about time for VW to revamp the interior and bodywork to bring it up to par with the Japanese competition.

Chevrolet Corsica

The Corsica is Chevy's new-for-'87 replacement for the defunct X-cars, using a 2.8-liter V6. We think it's a reasonable alternative to the Japanese sedans. At 18 mpg, it's not especially economical, but at 16.4 seconds and 83 mph, the Corsica was second fastest at the dragstrip. It did extremely well in our handling tests, despite being shod with Firestone Supreme mud and snow tires.

Our testers found the Corsica quiet, easy to drive and—with the exception of its seats—comfortable. We also like the exterior styling, readable gauges and precise steering. This is the first car we've tested with GM's new Getrag-designed 5-speed gearbox, and it's the best GM manual ever.

But the Corsica needs totally different bucket seats, new controls to replace the silly little plastic buttons, and perhaps a more stylish interior. Happily enough, the chassis and engine are just fine, with great power and terrific handling. And the sound system is the best in this group, by far.

Nissan Stanza GXE

Two words occur in every tester's Stanza report: *adequate* and *bland*. The Stanza has been "Maximized" to look much like its big brother, but what it really needs is the Maxima's 3-liter V6. Every tester complained about the Stanza's lack of power.

The Stanza was near the back of the
(Please turn to page 172)

SPECIFICATIONS AND DIMENSIONS

	BASE PRICE	PRICE AS TESTED	ENGINE	TRANSMISSION	WHEEL-BASE (in.)	LENGTH (in.)	WEIGHT (lb.)
Acura Integra LS	\$12,159	\$13,283	114 hp DOHC 1.6-liter Inline-4	5-speed manual	99.2	171.3	2450
Chevrolet Corsica	8995	13,171	125 hp OHV 2.8-liter V6	5-speed manual	103.4	183.4	2609
Dodge Shadow Turbo	8169	11,704	146 hp SOHC 2.2-liter Inline-4 Turbo	3-speed automatic	97.0	171.7	2500
Honda Accord LXI	14,800	14,800	110-hp SOHC 2.0-liter Inline-4	5-speed manual	102.4	178.5	2600
Mazda 626 GT Turbo	13,149	14,849	120-hp SOHC 2.0-liter Inline-4	5-speed manual	98.8	177.8	2650
Nissan Stanza GXE	12,549	14,644	97-hp SOHC 2.0-liter Inline-4	4-speed automatic	97.2	173.4	2400
Pontiac Grand Am SE	12,899	15,134	125-hp OHV 3.0-liter V6	3-speed automatic	103.4	177.5	2750
Subaru RX Turbo	13,833	14,559	115-hp SOHC 1.8-liter Flat-4 Turbo	5-speed manual, full-time 4wd	97.0	174.6	2605
Toyota Camry LE	10,798	15,431	115-hp DOHC 2.0-liter Inline-4	4-speed automatic	102.4	182.1	2734
Volkswagen Jetta GLI	11,690	13,240	100-hp SOHC 1.8-liter Inline-4	5-speed manual	97.3	171.7	2350



INDY

ENGINE SPOTTER'S GUIDE

Speed has always been the essence of the Indy 500. But never have we seen the distance-over-time equation yield such numbers as recently: Last year the slowest qualifier ran 207 mph while pole-sitter Rick Mears set a record average of nearly 217 mph for his four qualifying laps. While a race car's chassis and tires obviously play a part in these phenomenal speeds, it's the engine that has the key role.

Ever since the first Indianapolis 500 in 1911, auto manufacturers have shown a keen interest in competing in the famed Brickyard's annual Memorial Day 500-mile race.

In those early days, the leading cars were modified road cars such as NAS-

Who's running what at
The Brickyard this year.

BY JOHN RETTIE

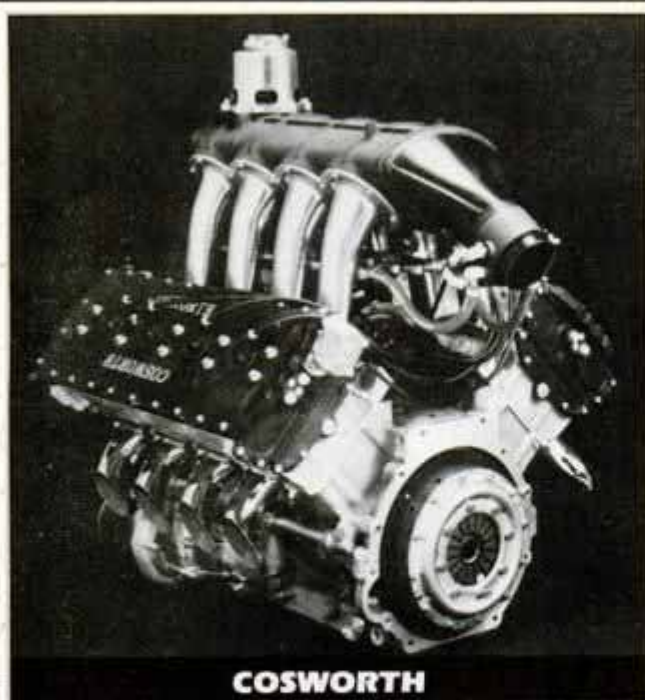
Bobby Rahal's March (above) and another 20 Cosworth V8s will have serious competition from other engines this year.

CAR stock cars are today. Then, in the early '20s, pure race cars took over and auto manufacturers lost interest when they could not compete effectively. Despite this, engines from some major auto companies such as Ford and Chevy have been used in Indy race cars over the years.

However, since 1935, most Indy 500s have been dominated by two purely racing engines: the 4-cylinder Offenhauser from 1935 onward and, since 1978, the V8 Cosworth DFX.

With carmakers' renewed emphasis on performance, racing participation by auto companies is now greater than it has been since the early days of Indy. Last year, 29 of the 33 cars that made the field were powered by Cosworth engines. This year, it looks as though Cosworth may only power 21 cars. The other 11 will be powered by Chevrolet, Buick and Honda. Next year, Porsche (see *The Germans Are Coming!*, page 77) and Ferrari or Alfa-Romeo will likely join the fray with new engines.

Basically three types of engines are



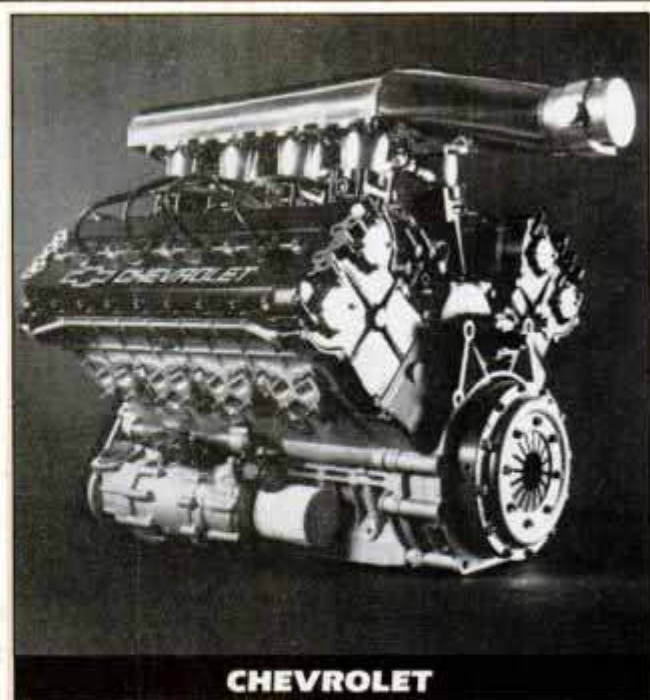
COSWORTH

Type: 90° V8, 32 valves, dohc
Capacity: 2642.7 cc (161.27 cu. in.)
Bore & stroke: 3.373 x 2.256 in.
Compression ratio: 11.2 to 1
Max. rpm: 11,500 to 12,000
Power: 720 hp @ 11,000 rpm

Max. Torque: 350 lb.-ft. @ 10,000 rpm
Turbocharger: Cosworth
Ignition: Cosworth
Fuel system: Cosworth Electronic Engine Management
Cars with engine at Indy: 21

Teams and drivers: All teams except the seven using the other three engines (Drivers include Bobby Rahal, A.J. Foyt, Al Unser Jr., Michael Andretti, Johnny Rutherford and others).

In 1975, Roger Penske approached Cosworth, the British racing engine manufacturer, to see if its 3-liter Formula One DFV V8 could be turbocharged. But it was Vel's Parnelli Jones racing team that first installed a Cosworth engine in an Indy car later that year. The following year Al Unser won the Pocono 500 race in this car, and other teams began to take note. Within a couple of years, the Cosworth DFX, as the turbocharged DFV is known, became the dominant Indy car engine. The original DFV was designed by Cosworth in 1967 for the Ford Motor Co. in England. It won first time out and went on to win more than 150 races and 12 World Championships before being outclassed by the present turbocharged 1.5-liter F1 engines. Cosworth is the world's largest manufacturer of race engines, and has also designed cylinder heads for Mercedes-Benz and Chevrolet among others.



CHEVROLET

Type: 90° V8, 32 valves, dohc
Capacity: 2646.9 cc (161.5 cu. in.)
Bore & stroke: 3.465 x 2.142 in.
Compression ratio: 11.0 to 1
Max. rpm: 11,600
Power: 720 hp @ 10,750 rpm
Max. Torque: 365 lb.-ft.

@ 8500 rpm
Turbocharger: Holset
Ignition: electronic capacitor discharge
Fuel system: mechanical multipoint fuel injection
Cars with engine at Indy: 6

Teams and drivers:

- Penske Racing (Rick Mears, Danny Ongais and Danny Sullivan)
- Patrick Racing (Emerson Fittipaldi and Kevin Cogan)
- Haas Racing (Mario Andretti)

In 1984, Chevrolet announced it was designing a race engine with Penske Racing and a newly formed British company called Ilmor Engineering. Ilmor's two founders, Paul Morgan and Mario Illien, both used to work for Cosworth, which led many skeptics to describe the engine as "a new Cosworth with different cam covers." Last year was the first time the engine raced and it took two pole positions and finished in the Top 10 three times. Due to limited production, only two extra teams will be able to run the engine this year. It will be powering six cars in the Indy 500. Without a doubt, it will be the toughest competition Cosworth has faced yet. Illien says they designed the engine so it could run well on high-speed oval tracks such as Indy as well as on tight road courses like Long Beach and Miami.

allowed to run in the Indianapolis 500:

- Pure race engines restricted to 2.65 liters.
- Turbocharged stock-block, non-overhead camshaft engines restricted to 3.43 liters.
- Normally aspirated stock-block, non-overhead camshaft engines restricted to 5.878 liters.

Other important rules include:

- Only one turbocharger is allowed with no intercooler, unlike the wild 1000-hp, twin-turbo Formula One engines.
- A maximum of eight cylinders is permitted.
- A pop-off valve restricts turbo boost to 47 in. on a race engine or 57 in. on a stock-block.
- Engines must run on methanol instead of gasoline.

■ Fuel tank capacity is restricted to 40 gallons.

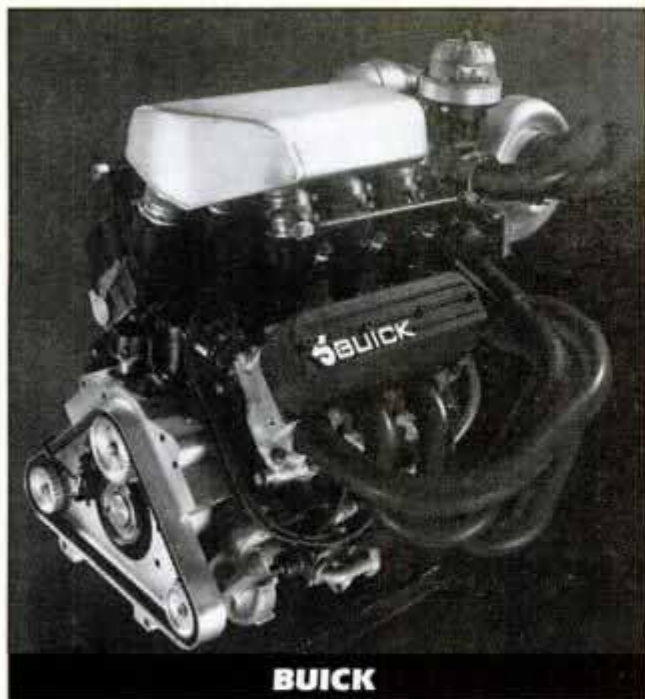
■ During the race, fuel consumption must not exceed 1.8 mpg.

Most teams have up to five or six engines available at any given time, and they cost around \$50,000 each! Top teams have engines rebuilt after every race to ensure they are running at peak performance. Some teams do their own engine rebuilding, others have the manufacturer rebuild them, but most rely on independent shops such as VDS Engines in Texas. Nearly every team uses slightly different parts in an attempt to gain extra horsepower. Teams are very secretive about technical details of their engines, which makes it difficult to know the real power output of an engine. Official figures issued by engine builders can appear to be lower

than those quoted by teams, but the variation from one engine dynamometer to another usually accounts for the discrepancy. Or, sometimes, someone is just blowing smoke to confuse the competition.

Ten years ago the first-ever 200-mph lap was set by Tom Sneva in a Cosworth-powered car. His pole position, with an average speed of 198.884 mph, sounded the death knell for the venerable Offy engine, although it was A.J. Foyt who won the '77 race in his Ford V8-powered Coyote special. Since 1978, every Indy-winning car has been powered by the Cosworth. Could 1987 be the year Cosworth loses to a new force in Indy engines? You'll have to wait until the 71st running of the oldest auto race in the world, on May 24, to find out!

FM



BUICK

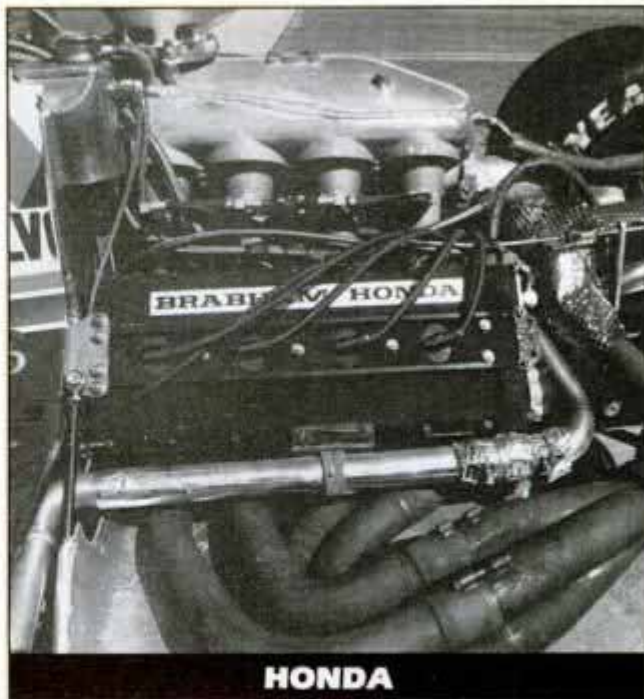
Type: 90° V6, 12 valves
Capacity: 3400 cc (209 cu. in.)
Bore & stroke: 4.00 x 2.75 in.
Compression ratio: 9.5 to 1
Max. rpm: 9000
Power: 800 hp @ 8600 rpm
Max. Torque: 550 lb.-ft.

@ 7200 rpm
Turbocharger: Garrett
Ignition: Buick heavy-duty
 Distributorless Power Source
Fuel system: mechanical fuel
 injection
Cars with engine at Indy: 3

Teams and drivers:

- ARS (Jim Crawford)
- Curb Racing (Tom Sneva)
- Hemelgarn Racing (Rich Vogler)

Buick's racing engine is different from all the others at Indy because it's based on a stock-block. USAC allows a stock-block engine to use 10 pounds more boost at Indy. CART gives them the same boost as other engines, which is why Buick engines are not used in any other races. It was first used in the 1983 Indy 500, and Buick engineers took it over as a company project the following year. In 1985, everyone was really surprised when the two Buick-powered cars set fastest times during qualifying. Since then, the cars have suffered from niggling problems and have yet to finish a race. Although the Buick powerplant is based on a production engine it doesn't mean it costs any less, as it uses a specially made block with thicker and higher grade iron plus many Cosworth components, such as pistons, pumps and fuel injection.



HONDA

Type: 90° V8, 32 valves, dohc
Capacity: 2642.7 cc
 (161 cu. in.)
Bore & stroke: 3.622 x 1.956 in.
Max. rpm: 12,200
Power: 740 hp
 @ 11,500 rpm

Max. torque: 350 lb.-ft.
 @ 9500 rpm
Turbocharger: H-I
Ignition: Honda Electronic
Fuel system: Honda Electronic
 Management System
Cars with engine at Indy: 2

Teams and drivers:

- Gales Racing (Geoff Brabham and Jeff MacPherson).

Honda started building Formula One racing engines as long ago as 1964. Its current turbocharged 1.5-liter V6 won the manufacturer's portion of the World Championship last year and led the driver's championship right up until the last race. Honda's Indy engine program started in 1985 when John Judd of Engine Developments in England built a V8 based on an engine that was originally planned as a nonturbocharged 3-liter Formula One powerplant. Gales started using the engine at the end of 1985. Last year, the team had troubles with its Lola chassis, coupled with the inevitable new engine teething problems. Brabham hopes one of the benefits of the Honda engine will be better fuel consumption. Thanks to the electronic engine management system, the Honda gets about 2.1 mpg versus 1.8 for the Cosworth. So the Honda should be able to race 500 miles with fewer pit stops than the six or seven needed by the competition. It's also less likely to run out of fuel during a race.

The Germans Are Coming!



Indianapolis is one of the few races that Porsche has never officially entered, although in 1980 their plans to do so with a 680-hp Fiat 6 Turbo scared USAC enough to change boost rules at the last moment and send the German firm away in a huff.

Now Porsche is ready to launch a counterattack by designing and building an entire Indy car—engine, chassis, and body—and have it sorted out in time to be competitive by May '88. The car will be whipped into shape during the last two to three CART races in the fall of '87 (Pocono, Laguna Seca and Miami).

Sponsored by Quaker State motor oil, this Indy Porsche will run the entire 1988, '89 and '90 Indy Car seasons. The Porsche engine follows the familiar Indy format of a 2.6-liter, 32-valve, 90° V8. Fitted with a single German KKK turbo,

its power is given only as "more than 700 hp."

Designed by the same team that created the successful TAG-Porsche Formula One V6, it's likely to share many of that engine's World Championship-winning speed secrets, including excellent (for racing) fuel efficiency.—W.H.



TOW IT

Choices are few, payloads are downsized, but you can still tote that Airstream.

BY JIM DUNNE, Detroit Editor

Few holiday weekend sights are sadder than that of an undersized car with trailer parked on the shoulder of the freeway, obviously in need of mechanical help. As you speed by, you get the feeling that the problem is a major one. Weekend service usually is spotty, and that means the trailer owner's holiday is off to a rocky start.

Those problems will never be part of your vacation experience if you take a few minutes to figure out what type of vehicle you should buy in order to pull your boat, or snow sleds, or travel trailer.

Luckily, the technique of choosing a good towing vehicle is a fairly simple one. Car and truck makers, through long experience, have worked out a system to match trailer to towing vehicle easily. They specify four separate classes of towing vehicles, in ranges that cover just about any weight of rig you want to tow:

Class I: Light-duty work pulling a trailer that weighs up to 2000 pounds.

Class II: Medium-duty goes up to 3500 pounds.

Class III: You need special equipment to meet this limit for trailers weighing up to 5000 pounds.

Class IV: Anything above 5000 pounds probably calls for a truck or van with heavy-duty chassis features.

Tongue weight limits are the maximum weight that can rest on the car's trailer hitch. They run about 10 percent of the total trailer weight.

Just about any standard car will pull a 1000-pound trailer without breaking down. However, some cars—mainly tiny imported econoboxes and turbocharged types—are not recommended for trailer towing under any circumstances.

Most folks can't afford to buy both a new car and a new trailer at the same time. What they do, according to Dave Tarrant, Ford's expert on recreational and specialty vehi-



For heavy towing duties, a full-size V8 is the only automotive choice.



Vars and utility vehicles are a popular towing solution.

TOW IT

cles, is to match an existing car to a new trailer, or vice versa.

"That's why the towing classifications are so important," Tarrant points out. "It's easy to match an older vehicle with a new trailer—just a matter of matching the weights. Buying a new car for your old trailer works the same way."

There are some additional facts you should keep in mind about why certain vehicles are good tow vehicles, while others are not:

- The heavier the tow vehicle, the better it is at holding a trailer on a straight track. Too light a car can cause "tail-wagging" from side to side.
- Powerful engines and heavy-duty drivetrains not only are easier to drive with a trailer in tow, but will last much

longer. However, turbos usually are not recommended since the turbo often is overworked keeping a steady highway speed with a trailer.

- Automatic transmissions get the nod over manuals because clutches in manuals get a lot of wear while towing. The newer 4-speed automatics have a great advantage. They can be driven in THIRD during heavy pulling, then shifted to overdrive when the highway is flat or the trailer is unhitched.
- Rear-wheel drive is better than front-drive, and 4-wheel drive is best of all for heavy-duty towing. Front-drive suffers because the trailer shifts weight off the front wheels, robbing them of driving and steering traction.
- A car with a separate frame is better

for towing than a unit-body car. The frame keeps the trailer's drag forces off of the body, preventing pulling and twisting on the sheetmetal.

- Underhood heat can become a problem because the engine runs hotter during towing. Extra cooling systems for radiator, transmission and oil are recommended for Class II vehicles and up. Equalizing hitches put more weight on the front wheels, so that setup may call for a power-steering pump cooler as well.

Just about any trailer expert will tell you to get all your towing equipment from the new car dealer when you buy your new vehicle. It is all custom designed at the factory, and covered with the same warranty as your car. **PM**

CARS (AND TRUCKS) YOU CAN STILL TOW WITH

Use this table to find the maximum trailer weight a 1987 model is able to pull safely without damage to the vehicle or the trailer. Trailer weights are listed in pounds.

If one weight is given, that is the maximum weight the car can pull when it is not equipped with a special trailer towing package.

Where two weights are given, the first weight is for a non-equipped car, the second weight for a car equipped with all the

towing equipment offered by its manufacturer. That may include automatic transmission, heavy springs, special hitch and heavy-duty cooling systems. It may also indicate that a bigger engine is needed to let you pull a heavier rig.

In some cases, primarily with the imports, the higher weight limit is possible when the trailer is equipped with its own brakes. Note: Car warranty may be voided if towing limits are exceeded.

CHRYSLER¹		Monte Carlo	2000;4100	ACURA		Pulsar NX	1000;2000 ²
Omni/Horizon	1000;1500	Corvette	Not recommended	Integra	Not recommended	Maxima	1000;2000 ²
Aries/Reliant	1000;1500	Sprint	Not recommended	Legend	1000	Stanza	1000;2000 ²
LeBaron Coupe/K	1000;1500					200SX	1000;2000 ²
Caravelle SE/		Trucks		AMERICAN MOTORS		300SX	1000;2000 ²
New Yorker	1000;1500	(Including comparable GMC		Comanche	2000;5000	Pathfinder	1000;2000 ²
5th Avenue/Diplomat/		badge)		Jeep J-10/J-20	3500;7500	Van	1000;2000 ²
Gran Fury	2000	Astro	2000;5000	Grand Wagoneer	3500;5000	Pickups	1000;2000 ²
Shadow/Sundance	1000;1500	El Camino	2000;6000	Alliance	1000 ³		
Lancer/LeBaron GTS	1000;1500	K Blazer (full size)	2000;6000	Wrangler	2000	PEUGEOT	
Dodge 600	1000;1500	Chevy Van/Sport Van	2000;8000	Cherokee/Wagoneer	2000;5000	505 Gas	1434;2865 ²
Daytona	1000;1500	S10 Pickup	2000;5000	Eagle	2000;3500	505 Turbo	1435;2865 ²
Colt	900;1000 ²	S10 Blazer	2000;5000			505 Diesel	1435;2865 ²
Caravan/Voyager	1000;2750	Suburban	2000;8000	AUDI		V6	1435;2865 ²
Conquest	1000;2000 ²	Full-Size Pickup	2000;10,000	4000S	1146;2000		
		(Fifth Wheel trailers to 13,500 on		5000S	1455;2000	PORSCHE	
		certain full-size pickups.)		5000CS Turbo	1499;2000 ²	924S	1100;2640 ²
Dodge Trucks				4000CS Quattro	1323	944S	1100;2640 ²
Mini Ram Van	1000;2000 ²	Pontiac		5000CS Turbo Quattro	1499;2000 ²	944	1100;2640 ²
Ram 50/Power Ram 50	2000	Fiero	1000			928S4, 911	"Not listed for towing."
Ramcharger	3500;6500	Firebird	1000;2000	BMW		RANGE ROVER	
Wagon/Van	2500;7500	Grand Prix	1000;3500	Towing not recommended with any		Range Rover	1650;7700 ²
Full Size Pickups	2500;8000	Bonneville	1000;2000	car in the BMW lineup.			
Raider	1000;2000 ²	Grand Am	Not recommended	HONDA		SAAB	
Dakota	2500;5500	Sunbird	1000 ¹	Towing not recommended with any		900 ¹	1000;2000 ²
Van	2500;8000	6000	1000;2000	car in the Honda lineup.		9000	1000;2000
Vista 2X4	1500	Safari	3500;5000				
Vista 4X4	1000;2000 ²			HYUNDAI		SUBARU	
FORD		Buick		Trailer towing not recommended.		Trailer towing not recommended.	
Tracer	1000	Skyhawk	1000 ¹			TOYOTA	
Taurus/Sable	1000;2000	Century	1000;2000	ISUZU		Tercel	700;1500
Mustang	1000	LeSabre/Electra		P'UP	2000	Camry	2000
Crown Victoria	2000;5000	Wagons	2000;5000	I-Mark	Not recommended	Cressida	2000
Lincoln Town Car	2000;5000	LeSabre/Electra		Trooper II	2000	MR2	1000;1500
Escort/Lynx	1000	Coupes and Sedans	2000	Impulse	Not recommended	Corolla	1500
Tempo/Topaz	1000	Riviera	2000			Celica	2000
Thunderbird/Cougar	2000	Somerset/Skylark	1000	MAZDA		Supra	2000
Grand Marquis	2000;5000	Regal	2000;3500 ¹	B2000 Pickup	1000;2000 ²	Van	2000
Mark VII/Continental	2000			Pickup	1000;1500 ²	Land Cruiser	2500
Full-size van	3500;10,000	Oldsmobile		Towing not recommended for any		Pickup	2000;5000
Club Wagon	3100;10,000	Firenza	1000	car in the Mazda lineup.		4Runner	2000;3500
Super Van	3200;10,000	Cutlass Ciera	1000	MERCEDES		VOLKSWAGEN	
Super Wagon	5300;10,000	Cutlass Supreme	1000;4000	Towing not recommended with any		Golf, Fox, Jetta,	"We have no
Ranger	1100;5000	Custom Cruiser	2000;5000	car in the Mercedes-Benz lineup.		Scirocco	recommended
Aerostar	1500;4900	Toronado	1000;2000				towing weight."
Bronco II	1600;5200	Calais	1000	MITSUBISHI		Quantum	1300;2000 ²
		Cutlass Cruiser	1000;3000	Mirage	900;1000 ²	Vanagon	1300;2000 ²
GENERAL MOTORS		Delta 88	1000;2000	Tredia	1000;1500 ²		
Chevrolet		Ninety Eight	1000;2000	Starion	1000;2000 ²		
Chevette	Not recommended			Montero	1000;2000 ²	VOLVO	
Nova	1000;1500	Cadillac		Cordia	1000;1500 ²	240	3300
Camaro	1000;3800	Cimmaron	1000	Galant	1000;2000 ²	740	3300
Caprice	2000;5000	Eldorado	1000	Pickup truck	1000;2000 ²	760	3300
Spectrum	Not recommended	Allante	Not recommended			780	3300
Camaro	1000;2000	Brougham	1000;5000	NISSAN		Towing with all car models must be	
Corsica/Beretta	2000	DeVille	1000	Sentra	1000;2000 ²	with frame-type hitch sold by Volvo.	
Cavalier	1000;2900	Seville	1000				
Celebrity	1000;3200	Series 75	Not recommended				

1. Towing not recommended with convertibles or turbocharged engines; 2. When trailer is equipped with brakes; 3. Diesel engine not recommended for towing.



CAR TUNES

America's automakers are developing high-octane mobile music systems. We evaluate the latest highway hi-fi from Detroit's Big Three.

BY FRANK VIZARD, Contributing Editor; Photos by Bill Ashe

Turn up your radio! That old rock 'n' roll war cry is the new anthem of America's Big Three carmakers. General Motors, Ford and Chrysler have all married into the hi-fi business, giving birth to autosound systems tailored to individual cars.

Whether it's the full sweep of a symphony orchestra or the intimate rhythms of a jazz quartet, the "premium" sound systems available from Motown's carmakers represent their best efforts to date in music reproduction.

The success of the car companies in audio rests in part on newly formed relationships with old-line American hi-fi companies. GM, through its Delco Electronics division, made the first deal when it approached the respected audio brain-trust called Bose Corp. The result was sound systems acoustically tailored to specific cars but installed on GM assembly lines. The success of the Delco/Bose marriage shotgunned Ford into a liaison with JBL while Chrysler raced to the altar with yet a third speaker maker, Infinity.

Bose, JBL and Infinity are honored names in home audio,

where each company takes an individual approach to the subject. Predictably, no two companies travel the same route to highway hi-fi, although each developed sound systems well-suited to the car. The differences in methodology, price, features and acoustic characteristics are substantial enough to warrant test driving a representative car from each of the three automakers. So PM's best ears went on the road with GM's Pontiac Bonneville, Ford's Lincoln Continental and Chrysler's LeBaron GTS. Here's what we heard.

Chrysler LeBaron GTS

The sound system in Chrysler's LeBaron GTS utilizes eight speakers: two $\frac{3}{4}$ -in. tweeters mounted in the dashboard, two $5\frac{1}{4}$ -in. woofers in the front door cavities, and a pair of $5\frac{1}{2}$ x $7\frac{1}{2}$ -in. coaxials (tweeter mounted on top of a woofer) in the rear deck. The front and back tweeters reproduce music's higher treble frequencies while the woofers in the doors and the rear deck handle the bass.

The Chrysler/Infinity system uses an unusual bi-amplifica-

Watts and wheels from Chrysler, Ford and GM (left to right): LeBaron GTS, Lincoln Continental, Pontiac Bonneville.



Chrysler's cassette receiver has 5-band equalizer (lower left), joystick-type balance and fader control (lower right).



Ford radio/tape unit has electronic tuning, mechanical push-button tape controls, rotary bass, treble, balance, fader.

tion scheme. Bi-amplification generally means separate amplifiers are used for the front and rear treble and bass speakers. Chrysler/Infinity varied the traditional definition by powering the front and rear tweeters with four amps built into the in-dash cassette/receiver. The woofers are independently amplified by amp modules attached to the back of each speaker. This amp arrangement greatly reduces the amount of space required for the autosound system. All told, 32 watts power the tweeters and 56 watts drive the woofers.

The Chrysler-brand cassette/receiver resembles its competitors, boasting tape auto reverse, Dolby-B tape noise reduction, and DNR noise reduction for tape and radio. AM stereo is also featured. The cassette/receiver sports some unique features, but the absence of others was felt.

Unlike its competitors, Chrysler's cassette/receiver comes equipped with a 5-band graphic equalizer and a sliding lever marked "ambience." The equalizer proved useful in that the system seemed to benefit from a slight boost at the 3.5kHz mark. The ambience control, designed to impart a "concert hall" effect, should be used judiciously, if at all.

Although the cassette/receiver performed well, the inclusion of seek feature on the radio and a tape search feature (which allows you to advance or rewind to the next song on a cassette) would have made it easier to use. Other shortcomings of Chrysler's cassette/receiver include:

- Slight lag in the identification of AM stereo stations, an inconvenience which makes blindly searching for an AM stereo station more time-consuming.

- Poorly visible tape direction indicator.
- Hair-trigger auto reverse, prompted by pressing the volume control knob, that often leads to its inadvertent use.
- Unduly complicated procedure needed to defeat the clock function so that radio frequencies are displayed constantly.

On the plus side, Chrysler's cassette/receiver offers the most radio presets (10 AM and 10 FM). A joystick balance-and-fader control made adjustment of the left-right/front-rear soundstage very simple. With the exception of the tape direction indicator, all the controls were adequately lighted and displayed for day or night. Controls were laid out well.

Overall, sound quality was very good with nice definition of musical instruments. The dashtop-mounted tweeters maintain a realistic soundstage in front of the listener. But the system does seem slightly underpowered for sustained listening at maximum volume, since distortion was quickly apparent with all types of music played at full throttle.

The Chrysler/Infinity sound is a \$600 option. Potential buyers should note that the Dodge Lancer is the same body type as the LeBaron, so the same conclusions apply.

Ford Lincoln Continental

The Ford/JBL system in the Lincoln Continental uses the same number of speakers as the Chrysler LeBaron but the actual number of drivers (tweeters, midranges and woofers) is greater. The dashboard houses two 5-in. coaxial speakers (concentric tweeter and woofer). Each front door contains a 5 1/4-in. woofer. And two 6x9-in. speakers mounted in the rear

MOTOWN SOUND: NOTEWORTHY SPECIFICATIONS

System And Automobile	CHRYSLER/INFINITY LE BARON GTS	FORD/JBL LINCOLN CONTINENTAL	GM/DELCO-BOSE PONTIAC BONNEVILLE
Number of speaker drivers	8 ¹	12 ²	4 ³
Total Amplification	88 watts	140 watts	100 watts
Tone Controls	5-band graphic EQ	Bass/Treble	Bass/Treble
Front/Rear Fader	Yes	Yes	Yes
Left/Right Balance	Yes	Yes	No
AM Stereo	Yes	No	Yes
Number Of Presets (FM/AM)	10/10	4/4	5/5
Radio Seek/Scan	No/Yes	Yes/Yes	Yes/Yes
Radio Noise Reduction	DNR	DNR	DNR
Tape Noise Reduction	Dolby-B/DNR	Dolby-B/DNR	Dolby-B/DNR ⁴
Tape Search	None	Forward/Reverse	Forward/Reverse
Tape Autoreverse	Yes	Yes	Yes
Tape EQ (120/70)	Manual	Automatic	Manual
Total Cost	\$600	\$856 ⁵	\$1500 ⁶

1. Two tweeters, two midrangers, two coaxials. 2. Two coaxials, two full-rangers, two 3-ways. 3. Four full-rangers. 4. Automatic operation. 5. Comprised of \$506 option price added to the \$350 cost of the standard system. 6. Comprised of \$1300 option price added to the \$200 cost of the standard system. Option price includes stereo control pod on leather-wrap steering wheel, plus automatic power antenna.



Delco's electronically tuned radio displays time except when selecting stations. Red-illuminated controls are easy to find.

deck each have a tweeter, midrange and woofer combination. The JBL speakers are powered by four separately mounted amplifiers delivering a total of 140 watts.

The Ford-made cassette/receiver mounted in the dashboard is best described as a hybrid. The radio section is electronically tuned while the cassette section uses mechanical transport controls. The "mechanical" aspect of the cassette section is hardly a drawback: The auto reverse mechanism, for example, is perhaps the fastest and smoothest on the market. Another plus for Ford's cassette/receiver is its ability to automatically adjust for either 70-EQ (metal/chrome) or 120-EQ (normal bias) tape. Like its competitors, Ford's cassette/receiver has Dolby-B and DNR noise reduction. Seek/scan for the radio and automatic music search for the tape section are also included.

On the down side, the Ford cassette/receiver lacks AM stereo, and the number of presets is limited to four AM and four FM stations. Display of the controls is adequate except for two instances: Tape controls do not light up, and there is no visual indicator that DNR is operating.

It's not unheard of for new-car buyers to return their vehicles to the dealer for fine-tuning. And in what's possibly the first case of a "Monday morning stereo," we had to return the Continental to Ford because of excessive rattling from the right-door speaker. Once repaired, the system performed superbly, though with the "bright" California sound characteristic of JBL. Adjusting the treble control downward compensated for this

perceived brightness. Bass response was awesome—to a point. In the Ford/JBL system, an "excursion control computer" prevents the speakers (primarily the bass woofers) from overloading—and thereby distorting sound—under high-volume use. (The Bose system also prevents overloads, though differently.) To our ears, JBL's overload control is overly cautious.

At loud but listenable levels, bass would taper off in relation to the midrange and treble sounds. The individual beats of a kettle drum, for example, would emerge less distinctly than they might on an adequately powered home hi-fi system. Though the excursion control prevents the system from producing unlistenable distortion, such manipulation of the music's normal frequency distribution is a form of distortion itself. It doesn't sound bad—it just doesn't sound correct.

One final criticism of the Ford/JBL sound system has nothing to do with its components, but concerns its installation. The Lincoln Continental had a tendency to resonate more than its competitors. This suggests that the speaker mounting and internal damping should be improved.

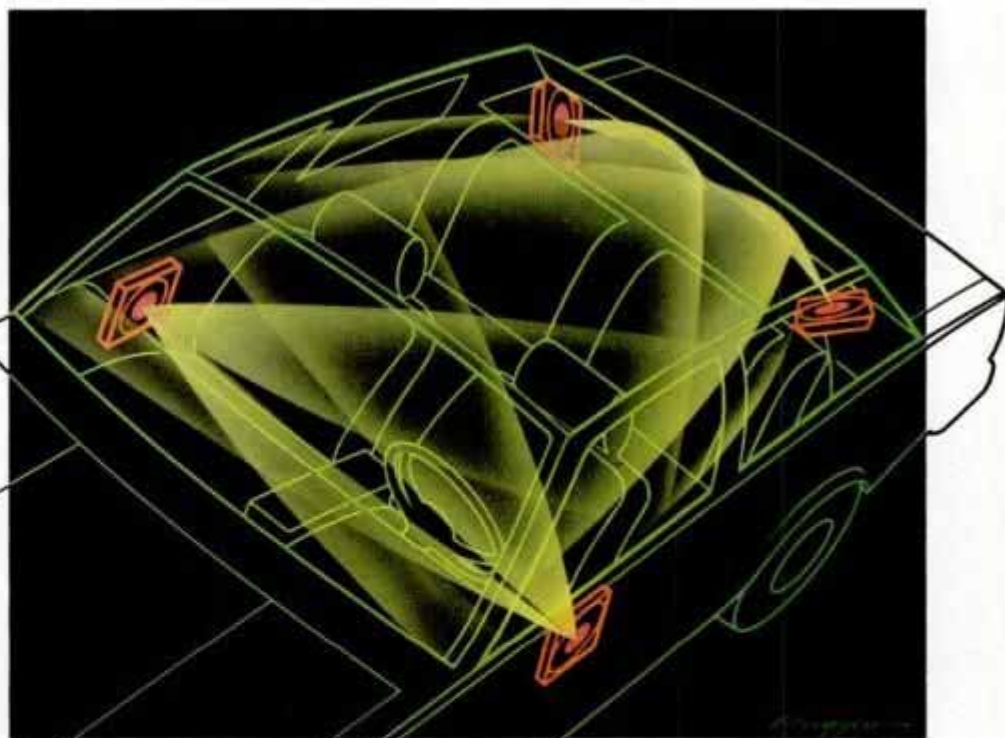
The Ford/JBL system in the Lincoln Continental has an overall cost of \$856. The option lists for \$506, but this is tacked onto the base sticker price of \$350 for the car's standard sound system.

Pontiac Bonneville

The Delco/Bose system in Pontiac's Bonneville differs from its competitors in that it uses only four 4½-in. full-range speakers. This means that each speaker reproduces the full bass-to-treble range of the music spectrum instead of dividing the chore among tweeters, midrangers and woofers.

One pair of speakers is assigned to the front doors while

(Please turn to page 174)



GM/Delco-Bose system, pictured here, provides a representative illustration as to how automakers' sound systems are tailored to the acoustics of the passenger compartment. Goal is to have soundwaves reflect off interior surfaces to direct strong stereo image to all passengers and maintain soundstage that seems to reach listeners from the front.

RAD WHEELS

Bicycles gear up for the 21st century with radical aerodynamics and lightweight aerospace materials.

BY NORMAN MAYERSOHN, Contributing Editor

Sensual and curvaceous though it may be, the Italian beauty captured by PM's camera for these pages really deserves notice more for the braininess of its construction technique than its captivating eye appeal. The basic diamond-frame form of bicycle design has been a constant for 100 years now, acclaimed for its versatility, strength and ease of production. From this point on, however, the fruitful marriage of two sciences—materials technology and aerodynamics—is making possible outrageous new bicycle shapes that will give riders a leg up on the forces of wind drag and inertia.

The Bottecchia Kronotech derives its shapely chassis from two mirror-image carbon-fiber shell halves that sandwich a honeycomb core section. But this bike is far from the first to use a composite material skin as the supporting structure—the Bowden Spacelander (see *Cycles*, page 46, Sept. '86) incorporated this plan 40 years ago. And fiber components can be traced back as far as the bamboo-framed models and

Aerodynamic! The exotic Kronotech is a working design exercise that showcases carbon fiber monocoque construction technique in an elegantly styled \$20,000 package. Inspired by the pursuit of maximum aero advantage for competition use, the bike's key elements take today's most advanced features years into the future.





Even the pedals get the aero treatment, thanks to a Kevlar shroud that does double duty as a footstop. Belt-like, quick fasteners are adapted from ski equipment.



Airfoil handlebar offers less wind resistance than a round tube and incorporates a trip computer at the center. Grips house levers to actuate hydraulic brakes.



Without aero headgear the Kronotech rider would be incomplete. Designed to rest flush against your back in the riding position, the helmet smooths airflow.



hickory-based cycles that were sold before the beginning of the 20th century. What is new, though, is the adaptation of the bike's shape to work with the peculiar properties of carbon fiber materials while reaping the additional advantage of aerodynamic advances.

Compared to conventional 4130 alloy chrome-moly steel, carbon-fiber composites can be five times as strong, twice as stiff and one fourth the weight, but all of that impressive might is in withstanding tension, or stretching force. Compression strength comes entirely from the resin that binds the fibers into a useful building material shape; its limits are far lower.

There are a number of conventional design bicycles built of carbon fiber tubing, but in the past they've been plagued with tube separations at the metal lugs used for junction points, and a vague road feel that results from the tubing's shock-damping qualities. They do offer the advantage of light weight, but at a high cost.

The Kronotech approach is based on the thinking of a pool of Italian manufacturers including Carnielli, Modolo and Selle Royal.

The clamshell chassis is itself the load-bearing unit. Like the tub of a Formula One Grand Prix car, the monocoque is well suited to coping with the various forces applied to a bicycle frame, making up for the properties carbon fiber tube alone doesn't possess. To deal with areas of high localized loading, such as the axle dropouts and bottom bracket, structural inserts of carbon wire are positioned according to the axes of stress.

By now the disc wheels on the Kronotech surprise

RAD WHEELS

no one, though these are the latest bubble shape intended to reduce sensitivity to crosswinds and provide some streamlining for the rider's legs. It's the frame shell itself, though, where the aero slick-up gets serious. The pedal cranks are incorporated into sleek discs that keep airstream disturbance to a minimum, and the wind-cheating footstops feature Kevlar shrouds with a ski-type quick fastener. Carbon-fiber handlebars with the cross section of an aircraft wing have built-in levers for operating the hydraulic brake system; a multifunction trip computer is flush mounted.

At present there are but a handful of Kronotech samples in existence, being used mostly for development work. Some features, like a



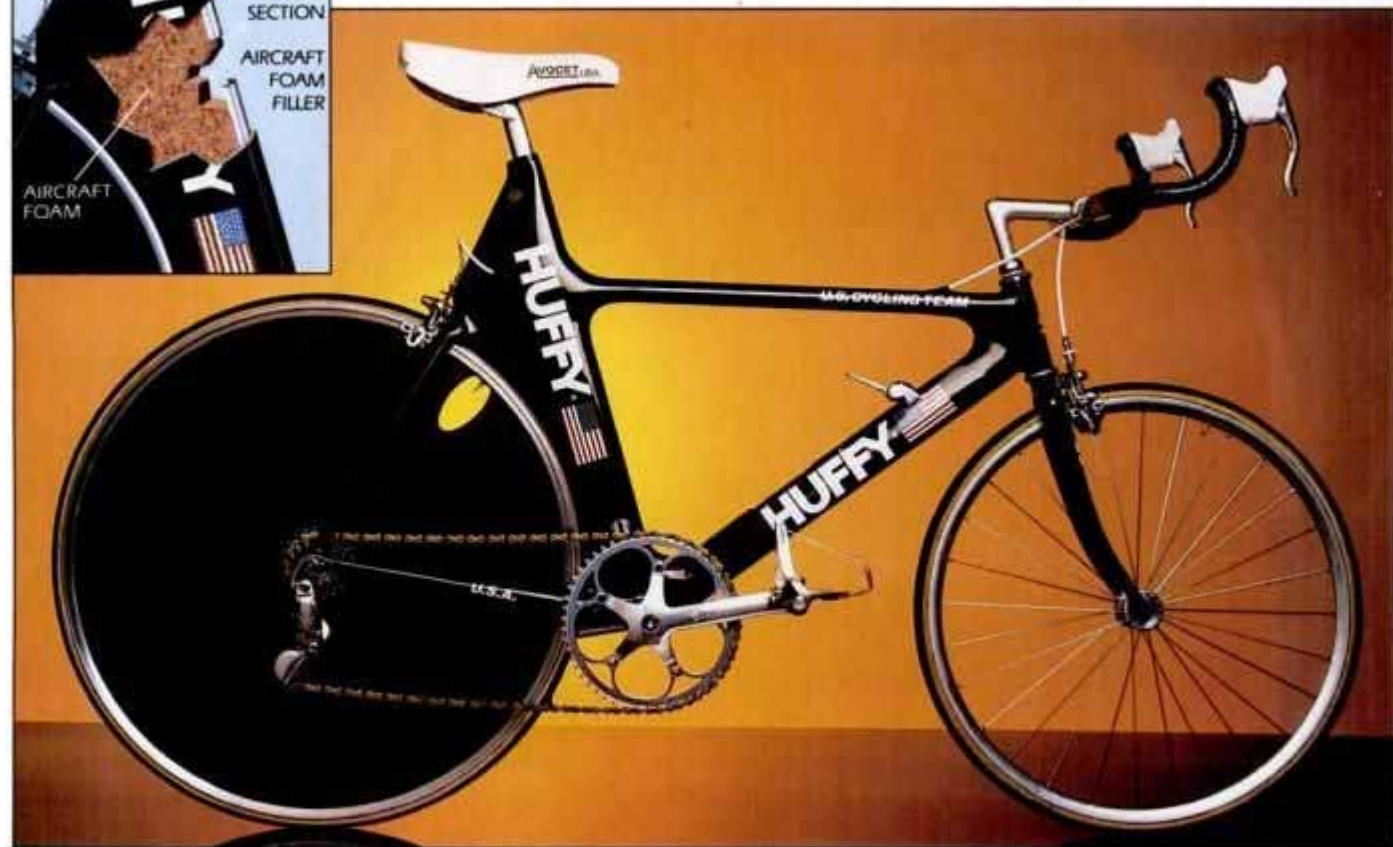
Cinelli Laser Kronos is a road-going time trial machine that displays racing posture with sloped top tube and competition wheels.

composite fork assembly, are already available to aficionados, and it's easy to see that details like the bellows that keep the saddle section wind-wise are bound to show

up on road machines. All told, the NASA-like Kronotech would take the better part of \$20,000 to pry from the consortium of innovators who built it.



Outlawed! Now illegal for UCI events, the Huffey Olympic hopeful for 1988 gained an aero edge with a carbon-fiber and aircraft foam seat tube section. New design is already in the works.



Using monocoque construction and carbon-fiber materials can sometimes run a builder afoul of the racing regulations. By the 1938 ruling of the sport's governing body, Union Cycliste Internationale (UCI), devices installed solely to reduce air resistance are disallowed from competition. Disc wheels are permitted because the discs are a structural element; simply covering a spoked wheel with a smooth fairing is illegal.

Though the UCI has no reservations about permitting the disc wheels in competition, they have drawn the line at Huffey's partial monocoque framework on the successors to 1984's Olympic funny bikes. The original multi-medal winners (see *Breakthrough Bike*, page 74, June '85) used tear-drop section frame tubing for superior windmanship. The latest generation machine shown here, an outlaw by UCI regulations, can



Bottecchia track bike (right) has fixed gearing, delta aero handlebar, webfoot frame gussets. Road racer (left) looks more familiar.

compete only in National races and triathlons. In team time trial trim as shown, the aluminum frame members are wrapped with fiberglass, Kevlar and graphite material. Most striking is the wide and controversial seat tube, which extends all the way back to the rear tire.

In the Cal State Long Beach wind tunnel, improvements up to 20 percent were realized over the '84 Olympic bikes by cleaning up the air-flow in this area. That's precisely what the UCI objected to, even though builder Mike Melton of Huffy was on hand with X-rays to show that the seat tube would collapse without the wide carbon-fiber skin structure and foam-insert support section.

With no choice but to step back and redesign the U.S. cycling team's 1987 hardware, Mike Melton reverted to a more standard 3-tube framework which is lighter, though not as aero-efficient as the outlaw bikes. The plan: curve the seat tube forward and tuck the rear wheel up against it to shorten the wheelbase. That way, the team pursuit riders can bunch closer together in an optimum drafting formation.

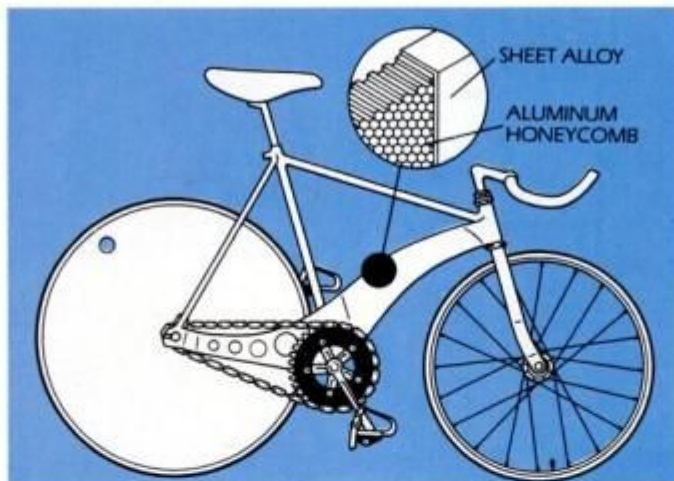
One possibility for other aero gains is in the realm of rider gear. At a 30-mph pace, the rider himself is the cause of two-thirds of the total aero drag. Small advances in the rubberized

synthetic skinsuits add up to seconds on the track, and the new helmet size regulations have caused trips back to the wind tunnel to determine the best shape.

Monocoque cycle-crafting doesn't only come from Italy and America, and it's not always done in carbon fiber. Japan's Fuji factory has

more widely known, this design offers a potential advantage in cost.

It may be a while before outrageous designs like the Kronotech are adapted for everyday road use, but already the rub-off of racing prototypes has made its mark. Witness the Cinelli Laser Kronos. At \$4300, it's



Full's one-of-a-kind semimonocoque bike gets high strength with low weight from an aluminum honeycomb downtube skinned with sheet alloy. The technique is less costly than carbon fiber.

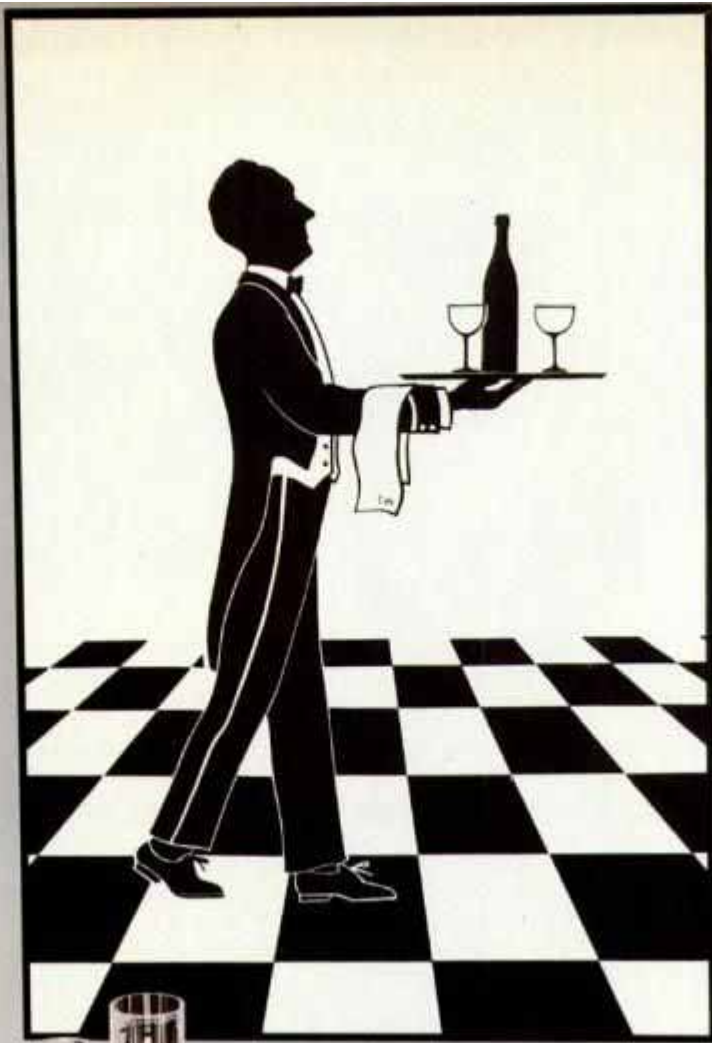
shown a track prototype that uses an aluminum-sheathed honeycomb downtube with conventional top and seat tubes. Because the material is more readily available and the construction process

not the sort of vehicle you leave leaning against a tree while you shop for groceries. Still, it is accessible to the serious enthusiast willing to sacrifice some cash and comfort for that final 2 mph of

output. As a time trial machine, it is designed to compete on sections of open road and carries all top-of-the-line accoutrements—Cinelli disc at the back, Ambrosia 26-in. wheel up front, Campagnolo components, Shimano dropouts. No one would call it a practical everyday machine.

The racing lineage in Bottecchia's production models is more apparent. In the pair pictured above, a road race model on the left looks positively tame up against the track bike on the right. With fixed gearing and no free-wheel mechanism to allow coasting, it's apparent that we're talking 100 percent business here. Carbon fiber is used in the disc wheels and the aero-styled delta handlebar. Frame junction points are webfooted, or gusseted, for strength and a slight advantage against the wind. This is the shape that street frames have begun to assume as the style of aerodynamics takes hold.

For most purposes, there's little to really be gained in slicking up road-riding bicycles. But as sure as aerodynamic racing sleekness has defined today's look in 55-mph automobiles, so it will in the world of people-powered 2-wheelers. And when it arrives full force, the trend will leave its mark far past the styling of the exoskeleton, all the way to the backbone of the beast. **FM**



SOCIAL GRACE

This butler's table of solid mahogany is an unusually versatile piece of furniture. It not only functions as a coffee table, but the top lifts off the base for use as a spacious serving tray.

Start construction by jointing and surfacing all 4/4 stock to $\frac{3}{4}$ in. Select the pieces to be used for the tabletop and leaves by matching for color and grain pattern. Crosscut all the pieces to rough length and use the jointer to true one edge of each piece. Rip the pieces selected for the tabletop panel $\frac{1}{4}$ in. oversize and joint the sawn edges. Rip the rails, stiles and aprons about $\frac{1}{16}$ in. oversize and remove this excess with one pass on the jointer.

Check for good contact between the mating surfaces of the panel pieces and spread with glue. Assemble the panel on a flat surface and use bar clamps on both the top and bottom to keep the panel flat and provide equal clamping pressure. Double-check that the clamped panel has no twist. After the glue has set for about 20 or 30 minutes, scrape off any excess with an old chisel.

Next, crosscut the rails and stiles to finished length. Plough a $\frac{1}{2}$ -in.-wide x $\frac{1}{2}$ -in.-deep groove centered in the rail and stile inside edges. This groove will house the top panel and serve as a mortise for joining the rail tenons.

Using a dado blade in the table saw, cut the tenons on the rail ends. Use a stopblock to ensure accurate repetitive cuts. Try the cuts on scrap wood first

Here's a classic mahogany butler's tray table you can build yourself.

BY NEAL BARRETT



and test-fit with the ploughed groove.

Scrape or plane the glued-up panel as necessary to achieve a smooth, flat surface on both sides. Rip the panel to finished width and crosscut to length. Be careful to make the cuts square.

Next, rout the panel tongue using an edge guide and $\frac{5}{8}$ -in. straight bit. Cut a $\frac{1}{2}$ -in. x $\frac{1}{4}$ -in.-deep rabbet around the panel edges on both sides. Prepare the tabletop pieces for assembly by softening the sharp corners along the edges of the rails, stiles and panel with 120-grit sandpaper. Avoid this sanding where the rails and stiles join. Apply furniture wax to both sides of the panel tongue at the corners. This will prevent any ex-

cess glue from bonding the panel to the frame at these points.

Apply glue to the tenons and those portions of the stile grooves that act as mortises, and put a drop of glue in the center of each rail groove. This glue tacks the middle of the panel in place while allowing the sides to move with changes in humidity. Center the panel in a stile groove and place each rail in position. Then place the opposite stile in position and clamp the joints tight. Center the panel to create a uniform $\frac{1}{16}$ -in. reveal and check opposite diagonal measurements to determine if the frame is square.

Using the drawing as a guide, make full-size templates for each size leaf and transfer the outlines onto the selected stock. Cut the curved edges on the band saw, following the waste side of the line. Clean up the saw marks with a belt sander or spokeshave. Set up the router table with a $\frac{3}{8}$ -in.-rad. rounding-over bit and ball-bearing pilot. Clamp a fence to the router table to shield the bit, and round the outside edges of each leaf.

Using a marking gauge held against the outer leaf edge, lightly mark the inner and outer lines for the fingerholes. Cut the circular ends of each cutout with a $1\frac{1}{4}$ -in.-dia. hole saw or spade bit mounted in the drill press. Complete the cutouts with a handheld jigsaw and smooth with 120-grit sandpaper. Then round the cutout edges with a $\frac{5}{16}$ -in.-rad. rounding-over bit.

Following the plan, lay out the position of the butler's tray hinges (Paxton No. 4041) on the leaves and tabletop. Using a sharp chisel, first cut the hinge

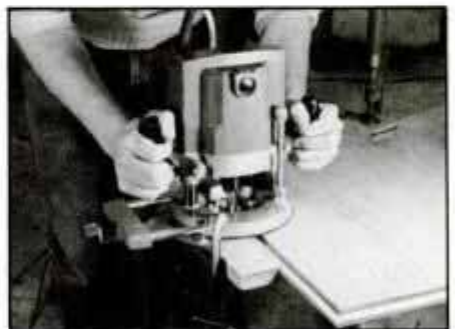
Color photo: Bill Ashe
Black-and-white photos: Neal Barrett
Technical art: Eugene Thompson
Photo stylist: Gabe Herrick



1 With the dado blade set for a $\frac{1}{4}$ -in.-wide cut, plough a $\frac{1}{2}$ -in.-deep groove on one edge of each rail and stile.



2 Cut the tenon cheeks on the rails using a dado blade. A stopblock on the miter gauge ensures identical repetitive cuts.



3 Cut the panel tongue by routing around the top and bottom of the tabletop panel. Use a straight bit and edge guide.

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mortises in the tabletop and then in each leaf. Note that these hinges require an additional recess in the leaf mortises to accommodate both the hinge barrel and tensioning leaf. This allows the table leaves to remain upright when desired. Check each hinge for fit and adjust as required.

Rip and dress the 10/4 stock for the table legs to size and crosscut to finished length. Lay out the mortises as shown in the plans. Clamp a fence to the drill press table so that the drill bit is centered over the mortise centerline, and drill overlapping $\frac{3}{8}$ -in. holes $1\frac{1}{16}$ in. deep to remove most of the waste from each mortise. Then use a sharp chisel to square the mortise ends and remove the ridges left by the drill bit.

Crosscut the aprons to finished length and set the table saw and dado blade for cutting the tenons. Make a

trial tenon with scrap wood and test fit with the leg mortises. After the apron tenon cheeks are cut, mark the tenon shoulders and cut them with a dovetail saw. Test-fit each mortise-and-tenon joint. Adjust where necessary.

Begin assembling the base by gluing each long apron to two legs. Clamp these assemblies and check for square. When the glue has cured, finish the base assembly by joining each pair of legs with the short aprons.

Cut the alignment strips for the tray bottom to finished dimension and bevel the bottom edges with a chamfer bit mounted in the router table.

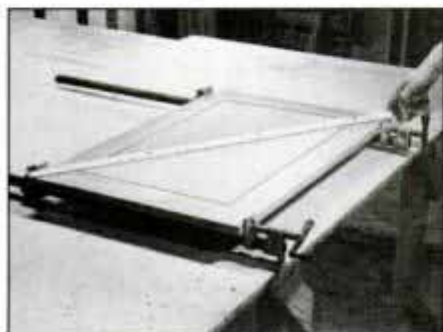
Turn the tabletop upside down and center the inverted base on it. Trace the inside of the base on the tabletop to mark the positions of the alignment strips and then remove the base. Place the strips in position and bore and

countersink the pilot holes for fastening the strips to the tabletop. Fasten the strips with $1\frac{1}{4}$ -in. No. 8 fh screws.

Carefully sand all table parts with 120-grit sandpaper. Thoroughly brush off each part and sand with 220-grit paper. Again brush off and lightly burnish with 4/0 steel wool.

We finished our project with a mixture of equal parts Watco Oil and McCloskey's Clear Gloss Varnish. Liberal brush on the mixture and allow it to soak in for about five minutes. Then wipe off and let it dry overnight. Repeat this procedure three or four times to build up the finish. After the final coat has dried, burnish lightly with 4/0 steel wool and apply a coat of Watco Satin Wax.

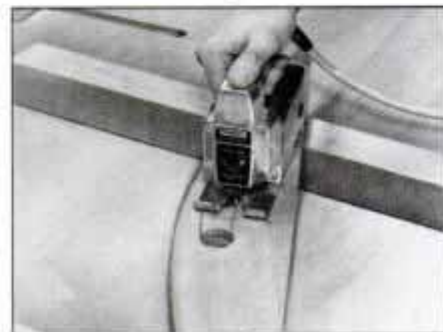
Finally, complete the table by drilling pilot holes for the hinge screws and then attach the hinges. **FM**



4 Use bar clamps on the tabletop assembly to bring joints tight. Compare opposite diagonals to ensure square.



5 Cut a bullnose on the outside curved edge of the leaves with a $\frac{3}{4}$ -in.-rad. rounding-over bit mounted in the router table.



6 After boring the circular ends of the fingerholes, support the stock on blocks and complete the cutout with a sabre saw.



7 Mark hinge positions and use a sharp chisel to cut each hinge mortise. Note extra recess required for hinge barrel.



8 Clamp a fence to the drill press table and bore overlapping $\frac{3}{8}$ -in.-dia. holes to rough out the mortises in each leg.



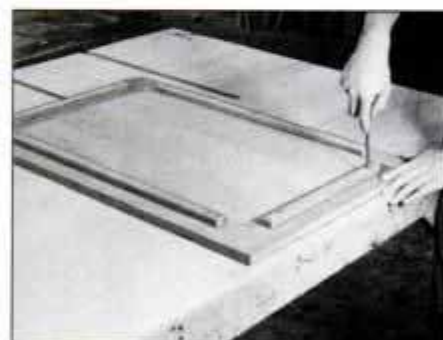
9 Clamp the table leg to the bench and use a sharp chisel to clean up the sides and square the ends of the mortise.



10 After cutting the apron tenon cheeks, mark and cut the shoulders using a dovetail saw. Check fit in leg mortises.



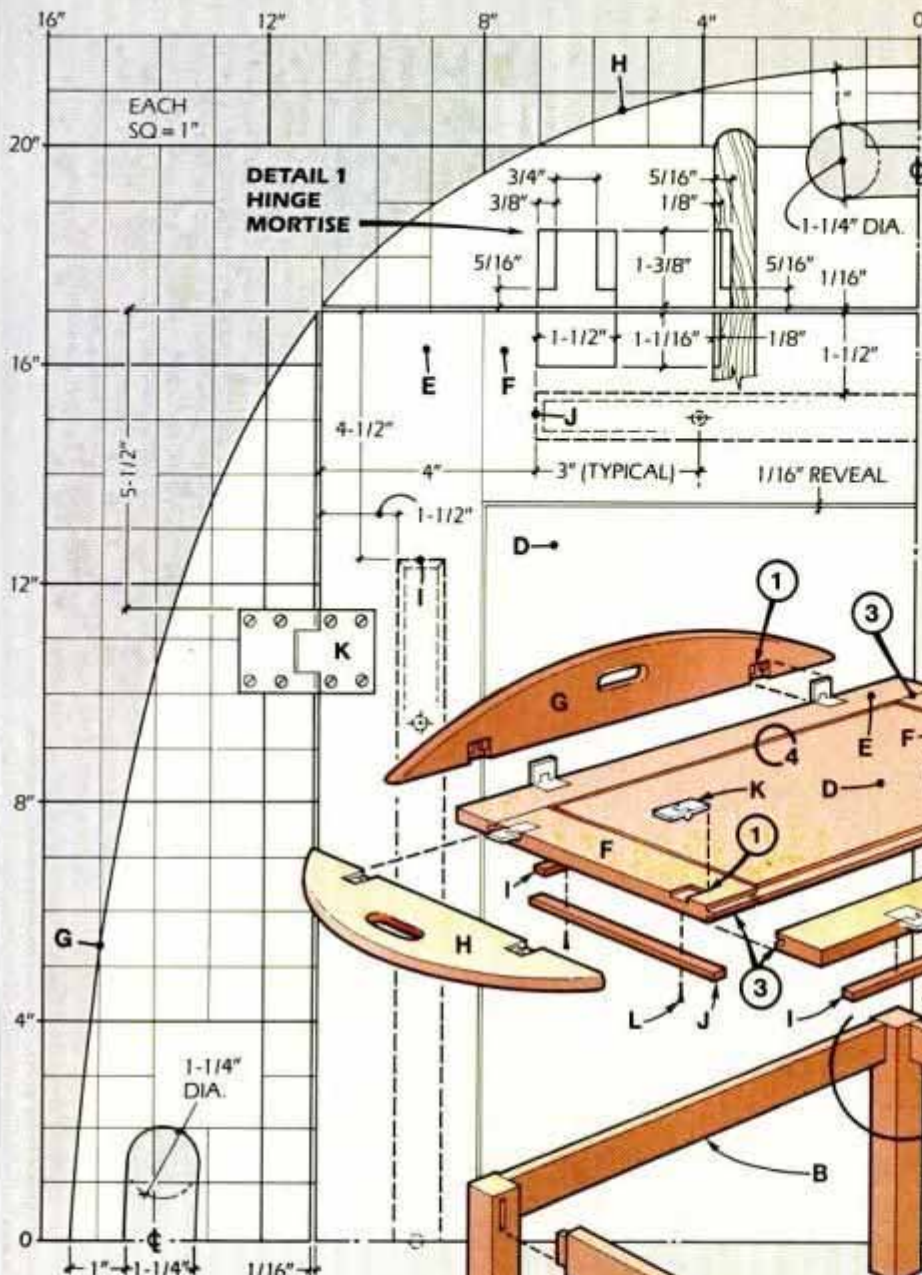
11 Assemble the table base by first gluing the legs to the long aprons. Then glue and clamp the short aprons in place.



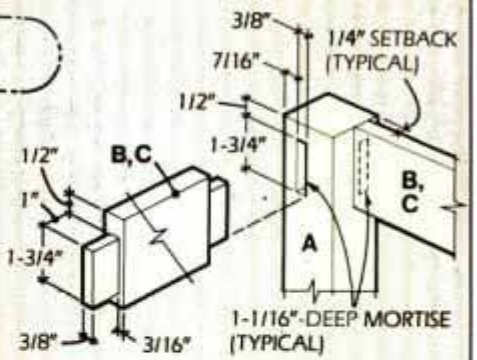
12 Bore pilot holes through the alignment strips into the underside of top. Fasten with $1\frac{1}{4}$ -in. No. 8 fh screws.

BUTLER'S TRAY TABLE

18-1/4" HIGH x 31" WIDE x 43" LONG



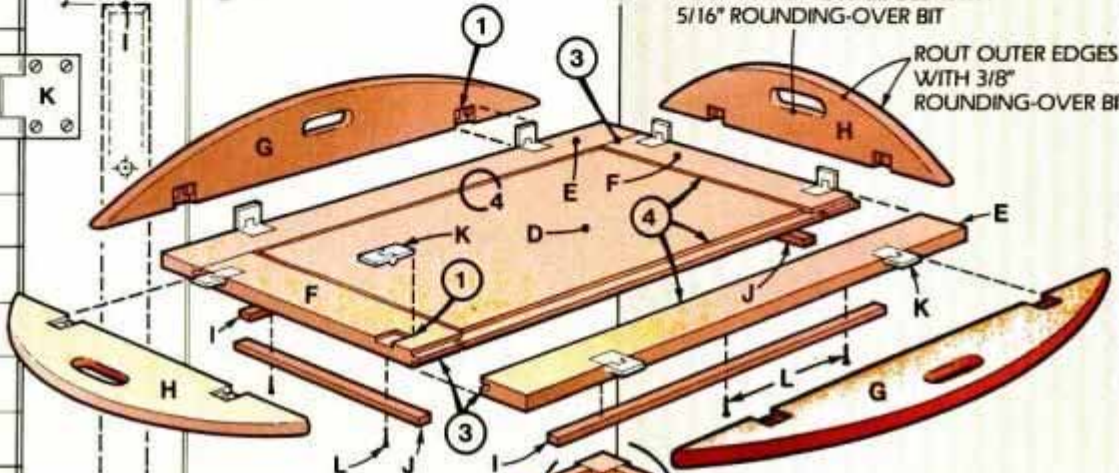
**DETAIL 1
HINGE
MORTISE**



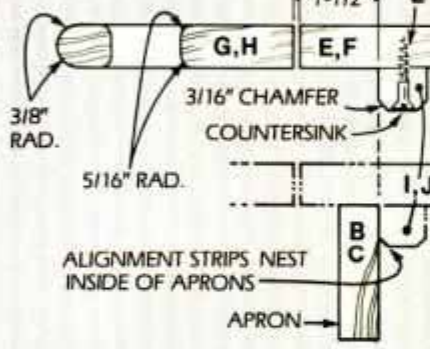
DETAIL 2—MORTISE AND TENON

ROUT HANDHOLE EDGES WITH 5/16" ROUNDING-OVER BIT

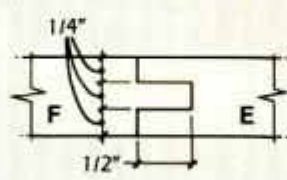
ROUT OUTER EDGES WITH 3/8" ROUNDING-OVER BIT



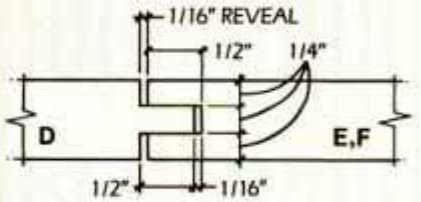
**PARTIAL TOP VIEW
LEAF PATTERNS**



SECTION VIEW AT LEAF CENTER



DETAIL 3



DETAIL 4

MATERIALS LIST—BUTLER'S TRAY TABLE

Key	No.	Size and description (use)
A	4	2 x 2 x 17 1/2" mahogany (leg)
B	2	3/4 x 2 1/2 x 31" mahogany (long apron)
C	2	3/4 x 2 1/2 x 19" mahogany (short apron)
D	1	3/4 x 16 1/2 x 27 1/2" mahogany (tabletop panel)

E	2	3/4 x 3 x 34" mahogany (stile)
F	2	3/4 x 3 1/2 x 17" mahogany (rail)
G	2	3/4 x 4 7/16 x 34" mahogany (long leaf)
H	2	3/4 x 4 7/16 x 22" mahogany (short leaf)
I	2	3/4 x 3/8 x 25" mahogany (long strip)
J	2	3/4 x 3/8 x 14" mahogany (short strip)
K	8	Butler tray hinges Paxton No. 4041*

L 10 1 1/2" No. 8 fh screws
 Misc: Carpenter's glue, 120- and 220-grit sandpaper, 4/0 steel wool, Watco Oil, McCloskey's Clear Gloss Varnish, Watco Satin Wax
 *Available from Paxton Hardware Ltd., 7818 Bradshaw Rd., Upper Falls, MD 21156

DOUBLE DECKER

This large, family-size deck is loaded with great features, including a special area for the safety of young children.

BY AUGUST AND SUSAN CAPOTOSTO



A steeply sloping back yard made it very difficult for us to define a safe playing area for our young children. And the small deck we did have we felt could be bigger to suit our growing family. That's what led to our idea for a bi-level design: a spacious main deck with a lower level especially for the children's enjoyment.

The children's deck is totally enclosed and includes other safety features as well, such as rounded corners on steps, table, bench and sandbox. Also, the table folds down when not in use to discourage young climbers, and the benches can be bolted down so they won't tip over or be moved to the railing and used as a launch pad. A child safety gate can also be installed between the levels. And, with 460 sq. ft. total, there's plenty of room for everyone else.

We built this deck with pressure-treated lumber throughout, including the lattice work, because of its high resistance to rot and insect decay. After all this planning, we wanted to make sure this deck was going to last for many years.

Upper level of deck (above) features built-in planters and seating bench with movable dining table and bench. Lower deck (right) has child's sandbox and folding table.





Upper deck

Lay out the perimeter of the main deck using string and batter boards. Level the strings with a line level and check for square at the corners using a 3 x 4 x 5-ft. triangle, constructed from 1x4 lumber. To check the entire layout, measure diagonally from corner to corner with a tape measure. If the layout is square the measurements should be equal.

Next, establish the location of the ledger boards on the house wall. Snap a chalkline on the wall that corresponds to the top of the ledgers. Then locate the post holes. Do this by measuring out from the house wall the required distance for the first set of posts. Run a string between batter boards exactly parallel to the house wall. Spot and dig the four holes 12 in. in diameter by 24 in. deep, or below the frost line for your area. Pour 8 in. of gravel in the bottom of each hole.

Nail square blocks cut from 2x8 stock to the bottom of the 4x4 posts and place them in the holes. Align each with the string as shown. The posts should be left slightly long to

Lower deck was completely enclosed for safety of young children. Kitchen window (left) has clear view of child's deck and can be equipped with simple pass-through shelf.

Color photos: Joann Sieburg-Baker; **Black-and-white photos:** August Capotosto; **Technical art:** Eugene Thompson; **Wolmanized Pressure-Treated lumber:** Koppers Co. Inc., Forest Products Group, Pittsburgh, PA 15219; **Furnishings:** Carolina Pottery, Fort Mill, SC 29715



1 Lay out perimeter of deck using mason's string and batter boards. Check corners for square with 3 x 4 x 5-ft. triangle.



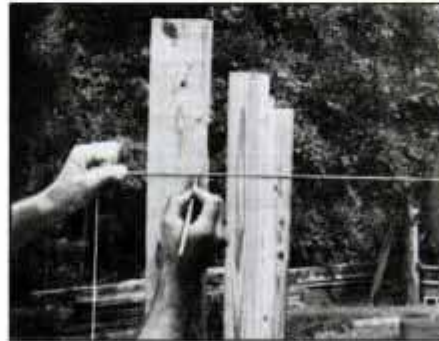
2 When all strings are in place, check for square by comparing diagonal measurements. The diagonals should be equal.



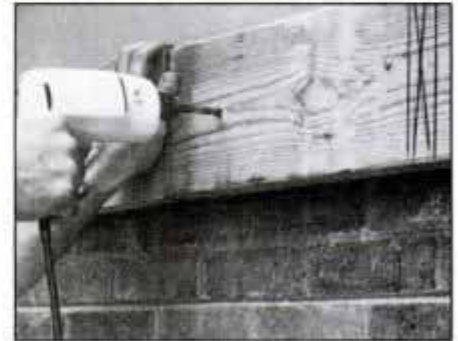
3 Dig holes at proper locations, then nail a 2 x 8 block to the bottom of each 4 x 4 post. The blocks help distribute deck weight.



4 Slide each post into proper hole and align side with layout string. Plumb the post, then back-fill the hole with gravel.



5 Locate top of ledger on house wall and attach string with line level at that point. Pull string tight, level it and mark post.



6 Tack-nail ledger boards to house wall and lay out position of joists on surface. Then bore pilot holes for lagscrews.

permit trimming to finished height.

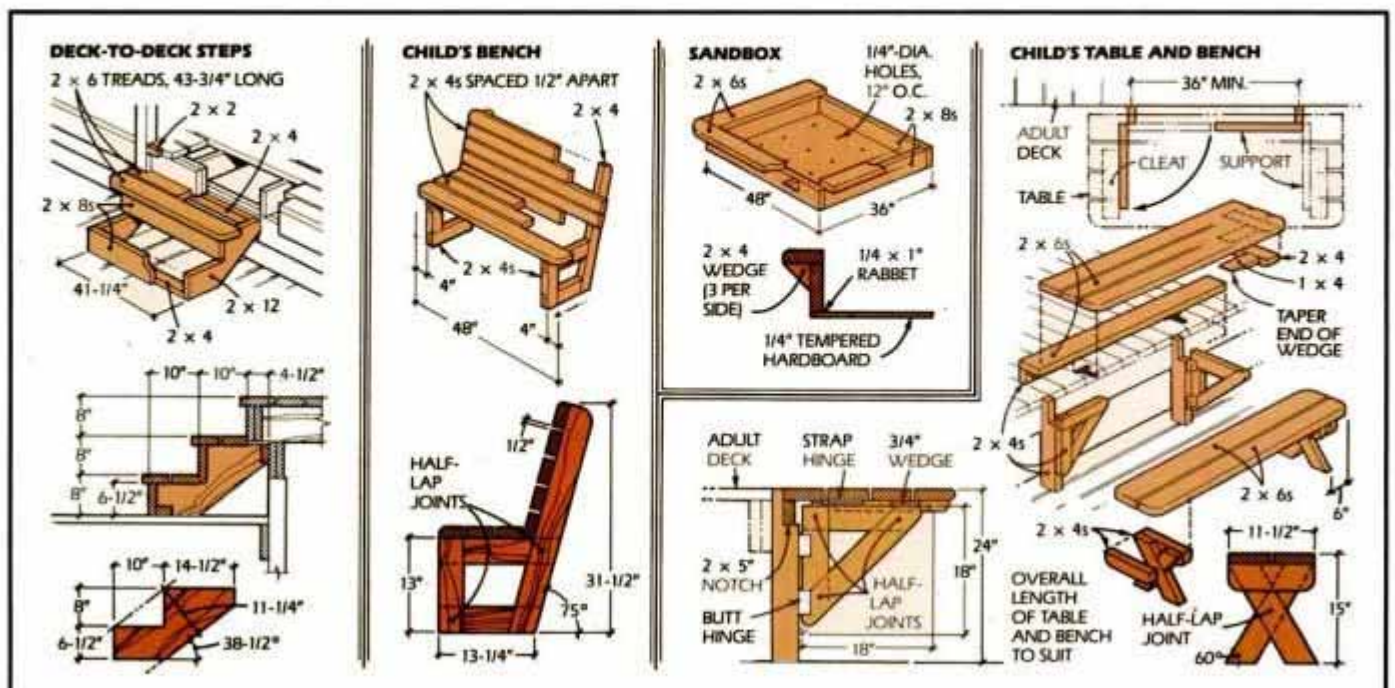
Plumb and brace the posts then back-fill with gravel to within 4 in. of the top of the holes. Pour a concrete cap over the gravel.

Run a string with a line level from the bottom of the ledger board to the posts, level the string, then measure down from the string the width of a 2x8, which is usually 7 1/4 in. Mark and cut the posts to this height. Nail post-to-beam connectors to the tops of the posts, then fabricate the beam by nail-

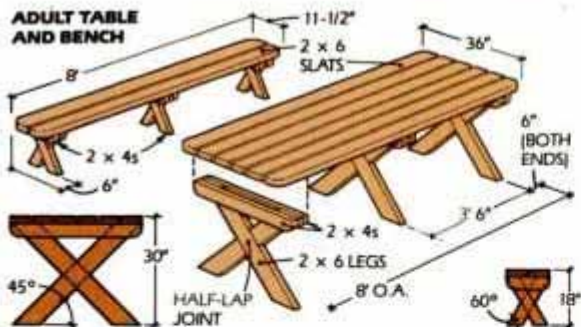
ing together 2x8 stock. Use 8- and 12-ft. stock, offsetting the butt joints. Cut the beam to the required length, place it on the posts and secure by nailing through the connectors. Repeat this entire operation for the second set of posts on the upper deck.

Tack-nail the ledger boards to the house wall then lay out the position of the joists and the lagscrews on the face of the ledger boards. Bore pilot and shank holes for the lags then remove the ledgers from the wall of the house.

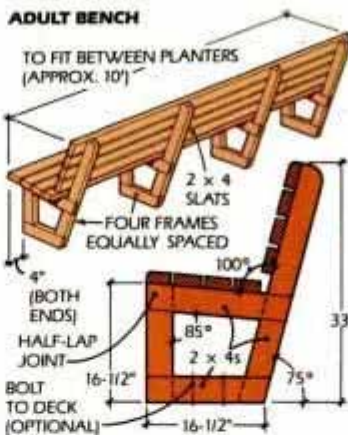
Prefabricate the end joists by nailing together two 2x8s. Attach these end doublers to the ledger boards with lagscrews. Note that the lagscrew holes in the rear of the ledger board are counter-bored to recess the heads. This assembly is done on the ground, forming two L-shaped units which are then individually lifted into position. The ledger boards are secured with lagscrews and the end joists are toenailed into the beam. A doubled 2x8 header is cut to length and attached to the for-



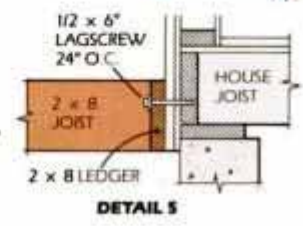
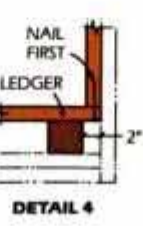
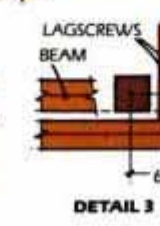
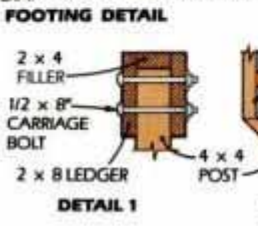
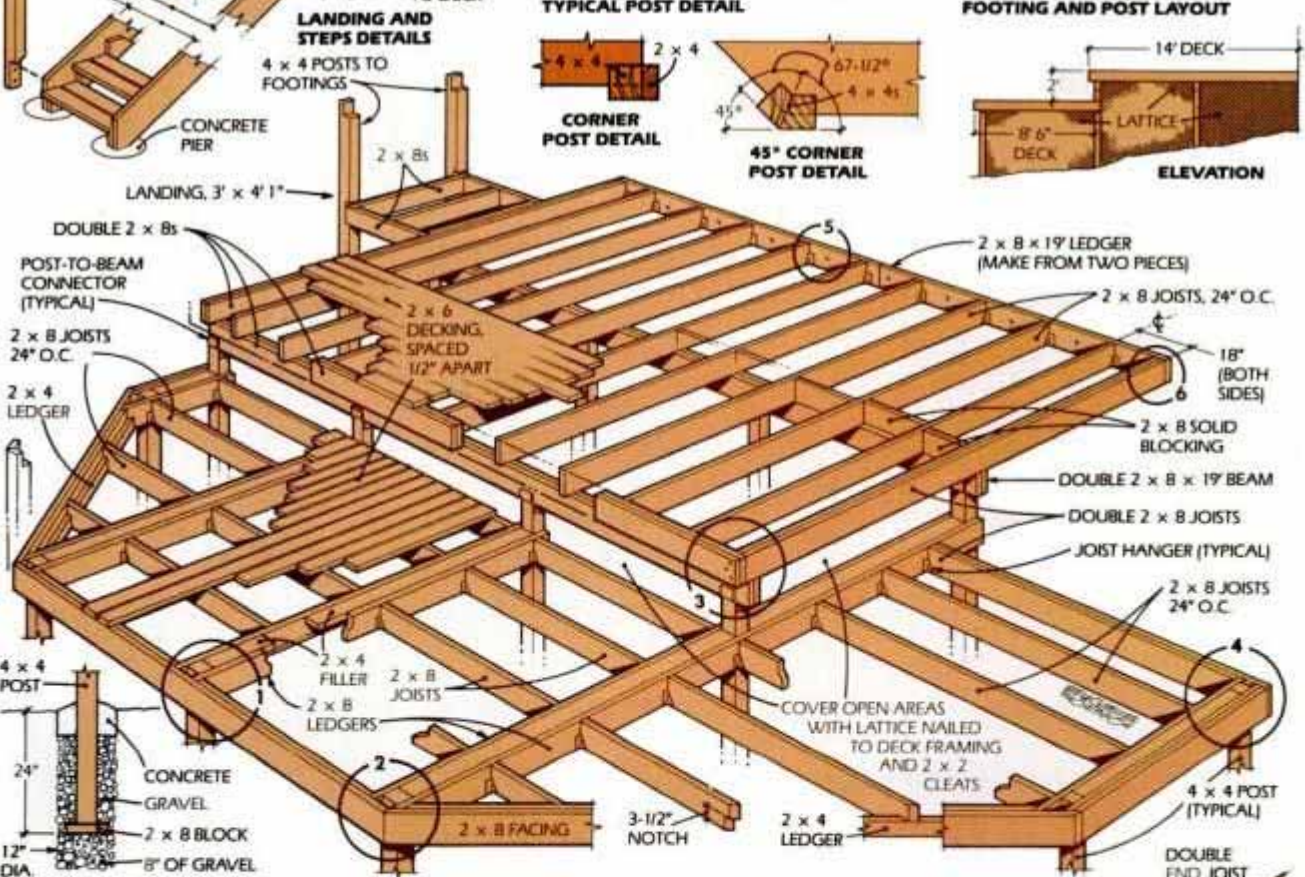
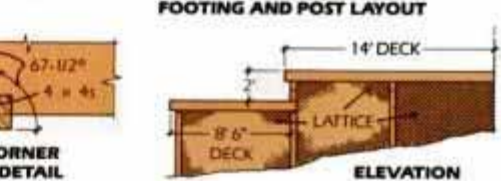
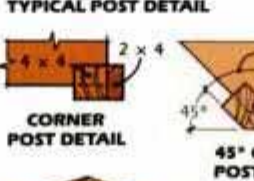
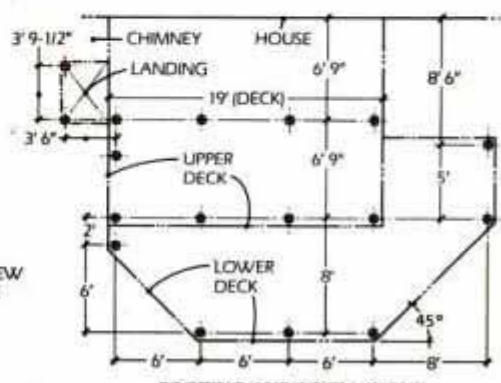
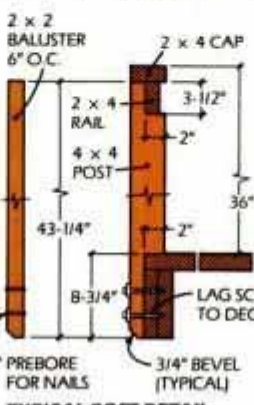
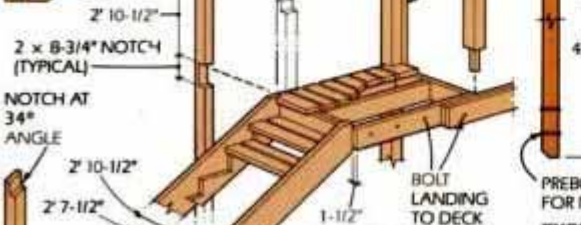
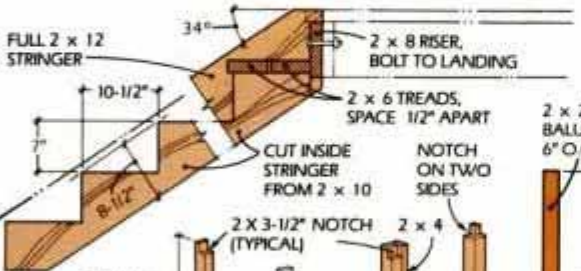
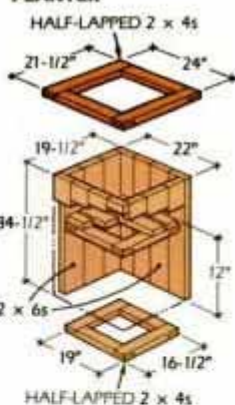
ADULT TABLE AND BENCH



ADULT BENCH



PLANTER



ward end of the joists with lagscrews.

Next, nail joist hangers into the ledger board and header. Cut the joists to length, set into the joist hangers and nail in place with the nails supplied with the hangers. Make sure to sight down each joist and install it with the crowned edge pointing up.

Lower deck

The posts for the children's deck are located using batter boards and string as before. Measurements are taken from the outer posts of the adult's deck. Plumb and brace the posts, then fill in the holes as described earlier. To determine the height of the children's deck posts, mark the adult deck posts 24 in. below the top of the joists. Run a level line from these marks out to the lower deck posts. Mark the posts and cut them off.

With 2x8 ledgers tack-nailed to both sides of the posts, locate and bore carriage-bolt holes. To determine where to make the mitered cuts on the angled ledgers, place a 2x8 on top of the nailed ledgers and mark the angle directly by tracing along the edge. Cut the angled ledger, then nail the smaller 2x4 ledgers against the face of the 2x8 ledgers. The 2x4s help support the joists along the angled side where joist hangers won't work. Bolt all ledgers to the posts securely.

Attach joist hangers to the ledgers that define the center sections. Cut the joists to size and nail in place. Add the joist hangers to the straight sides of the angled sections then scribe the joist to fit between. To mark the angle of these end miters, the joists are positioned above the joist hangers and aligned perpendicularly with the aid of a car-

pen's square. The cutoff can now be marked directly by tracing against the ledger. Notches are cut on the mitered ends to enable the joists to rest on top of the 2x4 ledger. Nail these joists in place, then construct the section of the lower deck that wraps around the upper deck using the drawing as a guide. When all ledgers and joists are in place, nail 2x6 decking onto both decks as shown in photos 14 and 15.

Landing

The stairway landing frame is constructed separately of 2x8s and is then mounted to the end joists of the upper deck with carriage bolts. Level it and brace it temporarily from below. Then, place two 4x4 posts into holes dug to receive them and mark where they touch the bottom edge of the landing

(Please turn to page 180)



7 Remove ledgers and bore pilot holes at end for lagscrews that hold double end joists. Counterbore to accept socket wrench.



8 Attach ledger to end joists then support assembly and attach to house wall as a unit. Tighten ledger lagscrews securely.



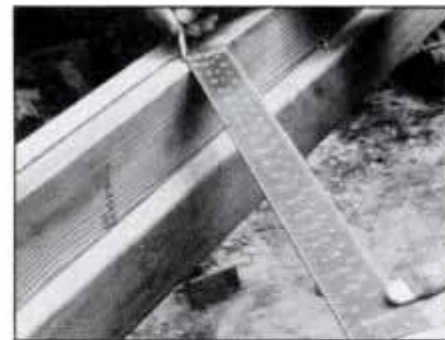
9 Attach joist hangers to ledger boards using nails provided. Then cut joists to length, slide into hangers and nail in place.



10 Tack-nail ledgers for lower deck to both sides of posts. Then bore clearance holes through parts for carriage bolts.



11 First install all ledger boards and facing boards on lower deck. Then lay out joist positions in center sections.



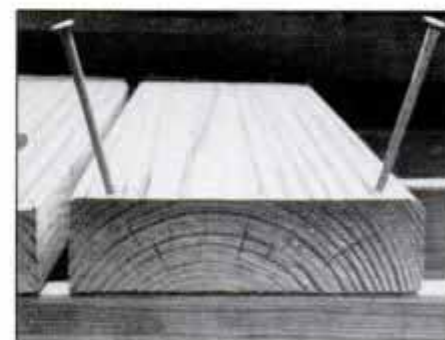
12 To keep joists aligned, use a framing square to transfer the position of joists in center sections to the angled sections.



13 Install hangers, then cut joists to fit and nail in place. Ends of joists must be notched where they meet angled 2 x 4 ledgers.



14 Maintain even spacing between decking boards by using wood spacer. Ends of boards must always fall over middle of joists.



15 Install 2 x 6 decking bark side up and attach at each joist with two hot-dipped galvanized nails driven at a slight angle.



INSTANT COLOR

Basic techniques for applying the ever-popular plastic laminate—including special edge treatments.

BY ROSARIO CAPOTOSTO, Contributing Editor

The post-war housing boom introduced American homeowners to a new building material—plastic laminate. This inexpensive sheet material quickly became the overwhelming choice for use on kitchen countertops. It provided a durable, easy-to-clean surface. But best of all, laminates were available in various colors and patterns.

By the 1950s, decorative laminates seemed to be everywhere. They were applied to cabinets, desks, tabletops, shelving units and bathroom vanities, to name a few common uses. Laminates became a popular material for remodeling projects, too. Then, during the late 1960s and into the '70s, the popularity of plastic laminates started to wane. The reason: overuse, most probably.

Today, however, decorative laminates are enjoying a renaissance of sorts. Manufacturers are offering lami-

nates in an incredible number of colors, patterns and textures. For example, Wilsonart brand decorative laminates offers more than 100 colors in more than 90 patterns with a choice of 13 different textures. Nevamar brand laminates boasts more than 200 colors and patterns. With this profusion of laminates came, not surprisingly, a growing interest by do-it-yourselfers. Plastic laminates are readily available at lumberyards and home centers and they're easy to work with. No special skills are required, so you can achieve satisfactory results in your first attempt—simply follow the procedures shown here.

Photos: Rosario Capotosto

Plastic laminate: Wilsonart, Ralph Wilson Plastics Co., Temple, TX 76501

INSTANT COLOR

Laminate grades

There are five basic grades of laminates available: standard, vertical, solid color, backing and postforming. Standard, or horizontal, grade is $\frac{1}{16}$ in. thick and recommended for use on horizontal work surfaces such as a counter, table, desk and bar top.

Vertical-grade laminate is about $\frac{1}{32}$ in. thick and, as its name implies, is used on vertical surfaces such as cabinets, cabinet doors and wall applications.

Solid-color laminate is a relatively new, and expensive, grade. Unlike the other laminate grades that consist of a brown core topped with a decorative face, solid-color laminates have no brown core—they feature solid-color construction. Solid-color laminates eliminate the familiar dark edge lines caused by the core material used on regular laminate grades.

Backing laminate is the least expensive grade. It's about $\frac{1}{20}$ in. thick and has no decorative face. Backing grade is used on the back side of a large panel that has decorative laminate applied to its front surface. The backing sheet will offset the decorative laminate to prevent warping.

Finally, there's postforming laminate. This special-grade laminate is designed to be heat-formed to a very small radius. It's used in specially equipped shops to make wraparound countertop/backsplash assemblies. Postforming laminate isn't recommended for home shop use. However, you can form small areas of vertical-grade laminate using a heat gun (see photos on page 100).

Besides the wide variety of colors and decorative patterns available, there are a few other interesting laminates worth mentioning. These include the many different wood grain, leather, marble and quarry patterns. Chrome, aluminum, brass and copper laminates with polished or brushed surfaces are also available. Realistic-looking, deep-textured laminates come in wood grain, leather and slate patterns.

Another recent innovation is tambour laminate. Use this flexible product as a tambour door for a rolltop desk or apply it to curved walls, doors and columns. Tambours come finished in various color laminates, metallic laminates, wood veneer and solid wood.

Most laminates come in sizes ranging from $2\frac{1}{2}$ ft. to 5 ft. wide and 8 ft. to 12 ft. long. Solid-color laminates are generally sold only in 4 x 10-ft. sheets. Laminate prices vary greatly depending on grade, texture, pattern, manufacturer and geographic region. But, standard (horizontal) laminate, in a stock color, costs about \$1 per sq. ft.

Therefore, a typical 4 x 8-ft. sheet will cost about \$30 to \$50.

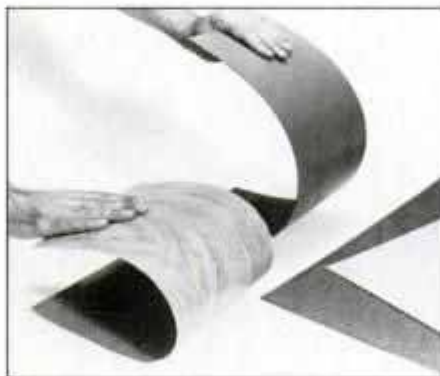
Core material

A successful plastic laminate job depends heavily on using the proper core material—the substrate that the plastic laminate is bonded to. Particleboard is the most popular core material. It has a smooth, flat surface and is dimensionally stable and inexpensive. Lauan- or birch-veneer plywood are more expen-

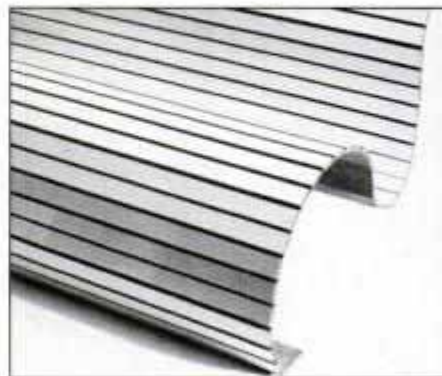
sive than particleboard, but they are much easier to work with. Avoid using low-grade plywood that has a rough, uneven surface, knots and voids in the veneer and edge. Also, don't apply decorative laminate to gypsum board (drywall), plaster, concrete or large pieces of solid lumber.

Applying laminate

There are five basic steps to applying plastic laminate: cut the laminate; apply



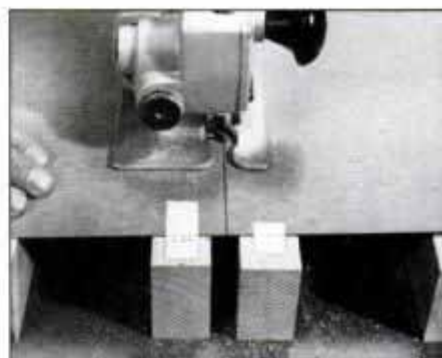
A simple hand-pressure test reveals that vertical-grade laminate (left) has more flexibility than thicker standard grade (right).



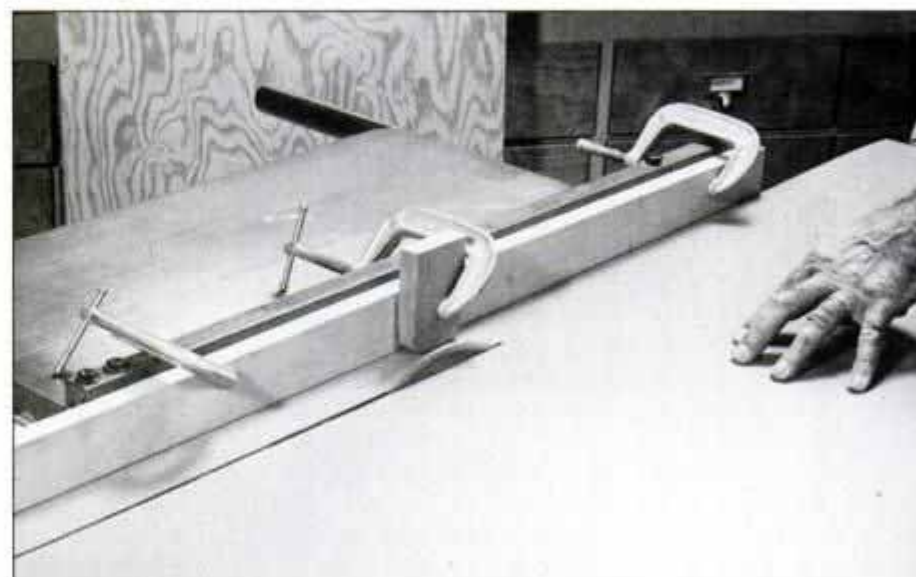
Flexible tambour laminates make it easy to cover round and curved surfaces. Tambours come in various colors, shapes and sizes.



Inexpensive scoring tool will cut laminate. Clamp down a straightedge, score laminate a few times, and then lift it up to snap.



To prevent chipping the decorative surface, place the laminate facedown when cutting with a sabre saw or portable circular saw.



Cut laminate face-up on a table saw. Long board clamped in place keeps laminate from sliding under fence. Small hold-down block near blade keeps laminate from fluttering.

adhesive to the core and to the back side of the laminate; bond the laminate to the core; trim off the overhanging laminate; file the edges smooth. See the step-by-step photos showing a typical countertop lamination.

Always cut the laminate slightly oversize so that it extends beyond the core's surface at least 1/4 in. on all sides. There are several tools you can use to cut decorative laminates, but for the best results, use a table saw fitted with

a carbide-tipped blade that has at least 60 teeth. A small-tooth plywood blade will give satisfactory results, too. You could also use a radial-arm saw, sabre saw or portable circular saw. If power tools aren't available, use a scoring tool, hacksaw or a 10- or 12-point handsaw. To avoid chipping the laminate's decorative surface, cut it *face-up* when using a table saw, radial-arm saw, handsaw, scoring tool or hacksaw. Position the laminate *facedown* when using a

portable circular saw or sabre saw.

Use contact cement to bond plastic laminate to the core material. Conventional woodworking glues can also be used, but contact cement is much easier and quicker since it doesn't require clamping. Be sure that the core's surface and the back side of the laminate are free of dust and chips. Fill and sand any holes or gouges with wood putty. Apply contact cement with a natural bristle paint brush or, for large areas, use a short-nap roller sleeve designed for use with contact adhesives. Spread a uniform cement coat on *both* surfaces and allow it to dry according to the manufacturer's recommendation—usually about 10 to 15 minutes. Edge-band surfaces require a second cement coat after the first coat has dried.

Note that contact cement is available in two types: flammable and nonflammable. *Caution:* Never use flammable contact cement near a sparking electric motor or an open flame such as a gas pilot light. Regardless of which type you use, be sure to provide adequate ventilation. Read the container's label for specific instructions.

Once the cemented surfaces are dry, you're ready to apply the laminate. Since a permanent bond is made the instant the two surfaces come in contact with each other, it's important to align the laminate carefully prior to bonding—there's no final adjustment once contact is made. An easy way to align the laminate to the core surface is with the slip-stick method shown. Arrange several wood sticks between the two cemented surfaces. Position the laminate to cover the core's entire surface. Then, slide out the sticks one at a time. After removing all the sticks, press down on the laminate with a J-shaped laminate roller. The more pressure you can apply, the better the bond will be. Now work over the entire laminate surface with a hammer and wood block.

Next, trim the overhanging laminate flush to the core's edge using a router fitted with a ball-bearing piloted flush-trimming bit. The excess laminate can also be trimmed using a block plane and smooth mill file.

After trimming the laminate with a router, file the edge smooth and perfectly flush. Now apply the next, adjoining laminate piece. When making a countertop, always apply the edge band first. Then, apply the top-surface laminate. This will protect the edge band and make the joint line least visible.

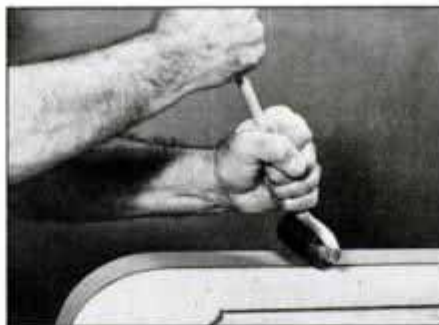
Once the top-surface laminate has been trimmed, file its edges smooth to the adjacent laminate surface (edge band). File on the down stroke only to avoid lifting and chipping the top laminate. The edge can also be finished using a router fitted with a bevel trimming bit. Check the router's depth-of-



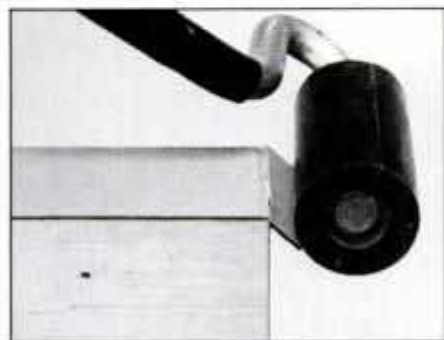
Apply contact cement to laminate and to the edge of core. When it's dry, apply a second coat. To brush on the contact cement neatly, tape the laminate strip to a narrow wood stick.



Start at one end and apply edge band. If you have to remove laminate, squirt lacquer thinner behind it to dissolve cement.



Use a J-roller to press down the laminate over its entire length. Then, tap the laminate down with a hammer and wood block.



Be careful not to roll off end of countertop or you'll break the laminate. Instead, use hammer and wood block to secure it.



Trim off the overhanging edges of the laminate with a router fitted with a flush-trimming bit. Be sure to wear goggles.

INSTANT COLOR

cut carefully. If the bevel is too deep, it will expose the core and the piece will be ruined.

Edge treatments

There are various easy-to-make edge treatments that will complement a plas-

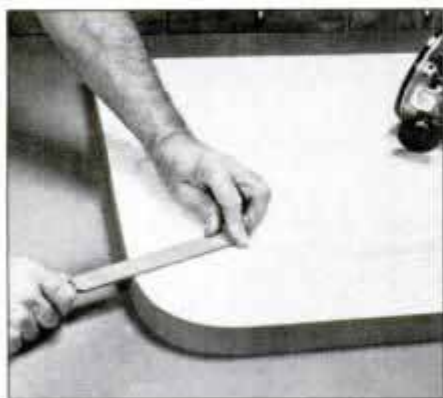
tic laminate countertop, tabletop or shelf (see the photo on page 176). Some of the more attractive edges combine laminate with hardwood. Wide hardwood edge strips also provide strength and rigidity to the countertop.

Here's how to make a chamfered edge with a hardwood reveal. First, glue a hardwood strip to the edge of the

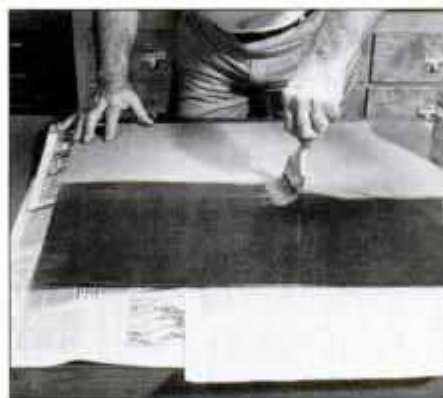
core. Next, apply the plastic-laminate edge band followed by the top-laminate surface. Then, use a router with a 45° chamfering bit to cut into the edge to expose the hardwood.

Make an attractive pin-stripe edge using solid-color laminates. Start by applying a strip of laminate to the core's

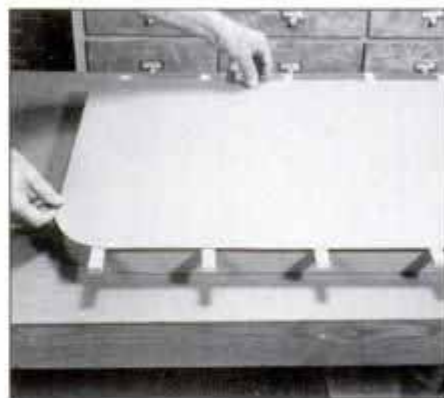
(Please turn to page 176)



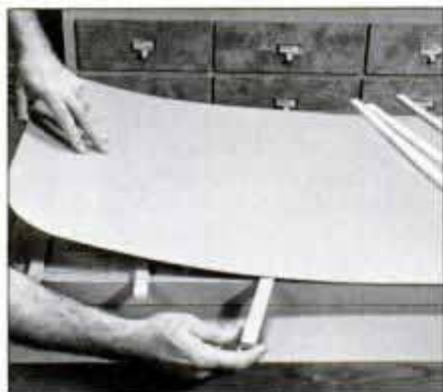
File the laminate's edges perfectly flush with the core's surface. Lift the file on the backstroke to avoid chipping laminate's face.



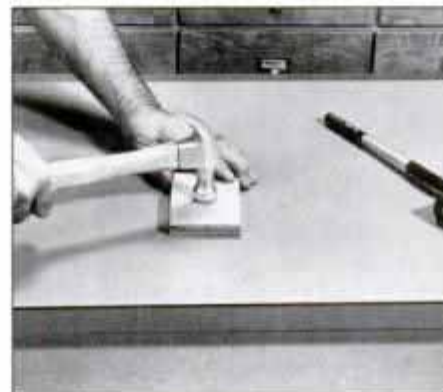
Next, apply contact cement to the laminate and to the core's top surface. Apply cement with a brush or, on large areas, a roller.



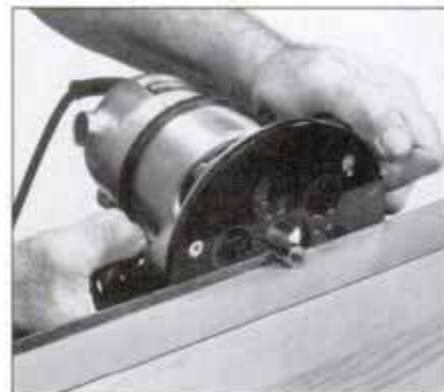
Place several narrow sticks under the laminate to permit exact positioning. Be sure laminate covers core's surface completely.



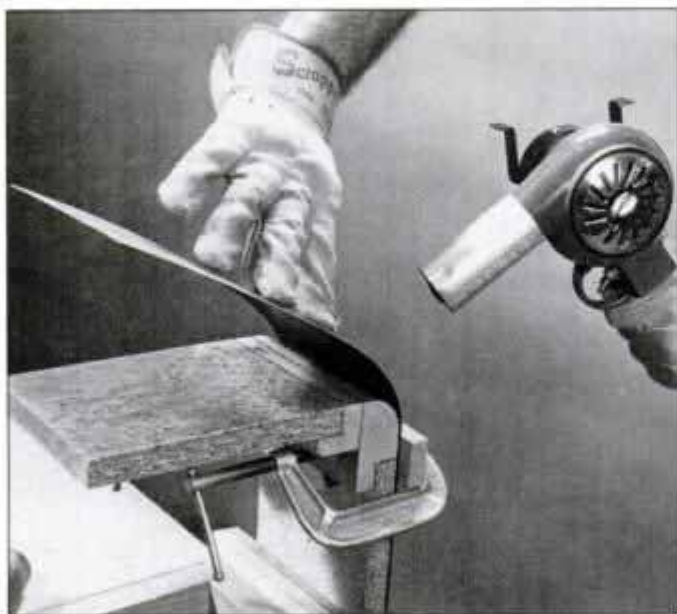
Slide out the sticks one at a time making sure the laminate doesn't shift out of position. Press down the laminate as you go.



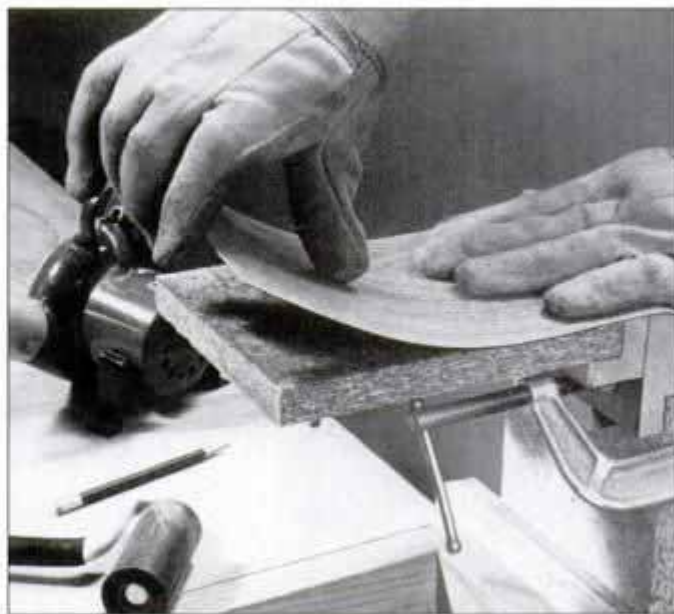
Apply pressure first with a J-roller and then with a hammer and wood block. Tap the block over the entire laminated surface.



Trim the excess laminate with a ball-bearing piloted flush-trimming bit. The pilot rolls against the edge band to guide the cutter.



Bend vertical-grade laminate to a 1½-in. radius using a heat gun. Apply heat between 313° and 325°F. Too much heat will blister the face of the laminate. Be sure to wear heat-resistant gloves.



Once the laminate bends around the radius, hold it down until the contact cement cools. The wood block clamped in place prevents the laminate from lifting as the heat softens the adhesive.

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CAR CARE

HOW TO TUNE UP YOUR WHOLE CAR

KEEP YOUR CAR RUNNING
AND LOOKING LIKE NEW

**STEP-BY-STEP GUIDE
FOR TUNING UP YOUR:**

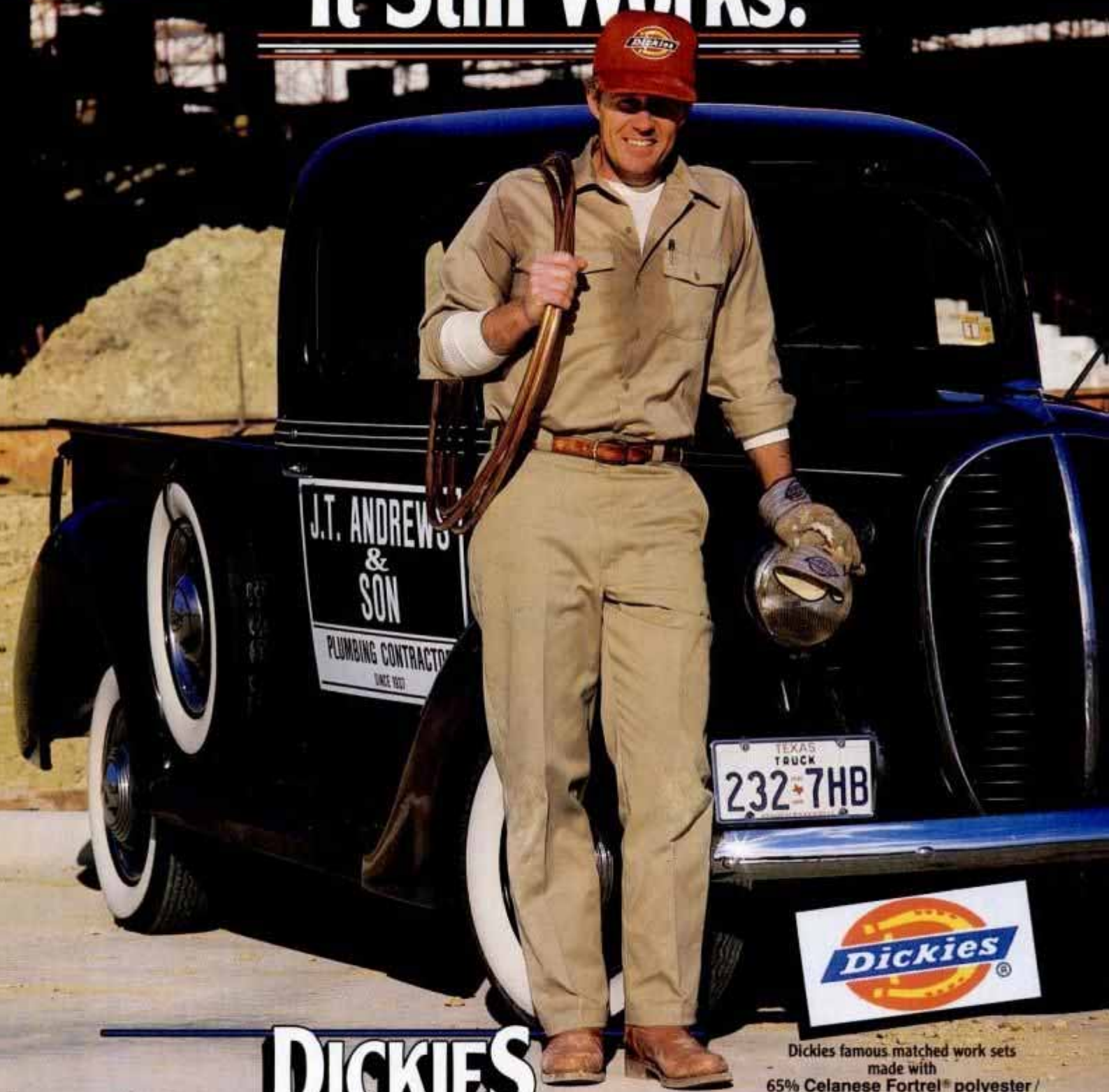
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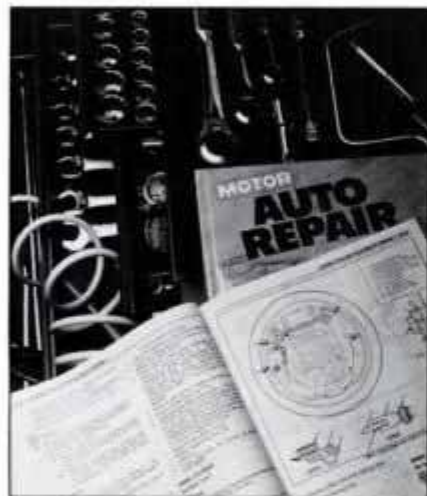
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CAR CARE GUIDE

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Chevy's sleek 1988 Corsica typifies the sophistication challenging today's Saturday mechanic.



Cover: Reliable tools and new parts are just a portion of what it takes to keep your car forever young. Knowledge and know-how are just as important. Photo by Bill Ashe.

Car Care Guide produced by the PM Auto Dept.
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CAR CARE GUIDE

TUNE UP YOUR WHOLE CAR

To get the best out of any car, you've got to do more than just change the oil, filter and plugs.

Cars, nowadays, are supposed to run as long as 15,000 miles between services. The manufacturers have spent a lot of effort increasing that interval from the 1000 miles between lube and oil jobs needed on cars only a generation ago. Better oils and additives, improved metallurgy and design in engine and transmissions—even so simple a thing as better seals on ball joints and tie-rod ends—have made owning and driving a car less of a hassle. Unfortunately, not having your car up on the grease rack every six weeks means nobody looks at the bottom of the car for as long as a year. And in spite of the best efforts by those who screwed your car together, sometimes that's too long.

The friendly guy who worked at the corner gas station in the B.O. era (Before OPEC) and who checked your oil at every fill-up also had a weather eye cocked for loose belts, leaks, corroded battery terminals or any other problems under the hood. But in today's \$4.95-all-you-can-eat, please-pay-first, self-serve, maintenance-free world, he's been replaced by a cashier who

knows and cares nothing about the state of your car's health. For that pre-OPEC style of service today, you have to pay plenty extra for gas—or pay a mechanic just to open the hood.

Don't let your investment in a car, new or old, suffer from lack of preventive maintenance. For example, replacing a worn fan belt yourself might take only 10 minutes on a Saturday afternoon—if you catch it before it gives up the ghost. But if that belt breaks on the road, you might be looking at a bill for towing, or even a new engine.

For even light maintenance, you'll need the usual simple tools, and probably one or two special tools. The days of fixing your car with a pair of Vise-Grips and a Boy Scout knife are over. You just can't do much today without a starter set of combination wrenches, sockets and a torque wrench.

Cars aren't all the same mechanically any more—with the engine in front, transmission in the middle and drive axle in back—so you'll need the proper manual that details the procedures for adjustments or reassembly.

In this Car Care Section, we've covered not only preventive maintenance and tune-up procedures, but also the scheduled maintenance items that you can do yourself. Just remember that the manufacturer's recommended intervals are *maximums*—very few drivers should consider them appropriate for the way most cars are really driven. Stop-and-go urban service, high-speed freeway cruising, short-tripping or any kind of trailer towing all come under the category of "severe" service, so reduce the mileage between oil changes and other maintenance to match. **PM**

INTERVAL	WHAT TO DO
When filling the fuel tank	<ul style="list-style-type: none">● Check engine oil level.● Check coolant level in coolant recovery tank.● Fill windshield washer fluid container, if necessary.
Once a month	<ul style="list-style-type: none">● Check tire pressure (include spare); examine tires for cuts and abnormal wear.● Check that all lights work.● Check ground beneath parked car for fluid leaks.
Twice yearly (spring and fall)	<ul style="list-style-type: none">● Check power steering fluid level.● Check brake fluid level.● Check automatic transmission or manual transmission fluid level.● Check fluid level of hydraulically operated clutch.● Check fluid level in rear axle.● Check protection level strength of coolant.● Inspect drive belts.● Inspect radiator, heater and air-conditioner hoses.● Inspect exhaust system components for rust-through; retighten clamps.● Rotate tires if mileage traveled since last rotation conforms with tire manufacturer rotation recommendation (usually after the first 7500 miles and every 15,000 miles thereafter).● Examine fwd axle boots for cracks, leaks.● Examine battery and starter motor cable terminals for corrosion.
Yearly	<ul style="list-style-type: none">● Inspect brake lines for cracks; inspect brake pads/linings for wear (do this twice a year if most driving is stop and go).● Lubricate all lock cylinders.● Lubricate body points: door hinges, hood hinges and latches, trunk hinges and latches, fuel door hinges.● Lubricate door weatherstripping.● Test ability of parking brake and PARK position of automatic transmission to hold.● Flush underbody with water and clean off mud and salt buildup.

We'd like to bring up the rear.



Who said never look back? It's where you'll find some of the Civic 4-Door Sedan's best features.

The trunk, for example. Pop it open with a remote release. Then fill 'er up. Groceries for a week or luggage for a week's vacation are an easy fit.

You'll also be happy to know that our backseat doesn't take a backseat. There's plenty of room for adults. Honest.

If your passengers happen to be just a bit younger, you'll find special child safety

features the next best thing to eyes in the back of your head.

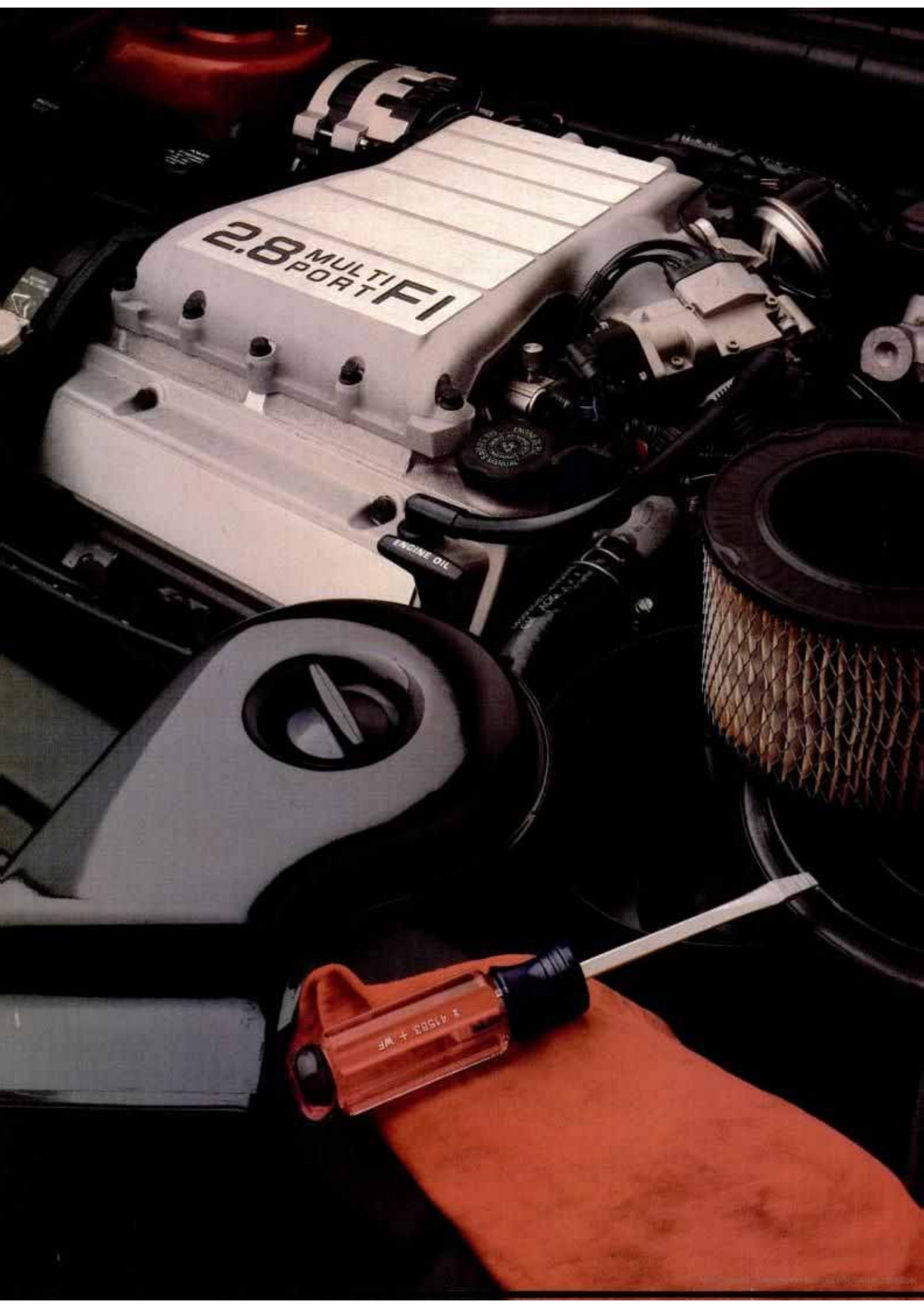
Of course, we haven't put everything worth mentioning behind you. The steering wheel is adjustable. The instrument panel is neat. Logical. The view forward is great.

And with a peppy 1.5 liter 12-valve engine, the Civic Sedan is fun to drive. Now that gives you something to look forward to.

HONDA

Civic 4-Door Sedan





TUNE UP YOUR ENGINE

Get maximum engine power, economy and durability. Here's how to keep your engine humming along.

Tuneup" is a word that may very well have contributed to the premature failure of thousands of automobiles. Somewhere back in the early days of motoring history, tuneups consisted of little more than replacing the sparkplugs and the contact points. A modern tuneup should be a plan for comprehensive care of all vehicle mechanical systems, including inspection, adjustment and replacement procedures that can eliminate problems before they become serious enough to cause widespread damage.

Changing the oil

The more dirt and combustion by-products that you can eliminate from your oil the better. We recommend changing oil at 3000 miles, and we know a number of mechanics who swap their lube when 2000 miles roll by. Use SF, SF/CC or SF/CD oil. Use only SF/CC or SF/CD for diesels. Drop by your dealer and pick up a dozen or so oil-pan drain-plug gaskets if your car uses replaceable ones. That way you'll have a new one on hand every time you change your oil.

Drive your car for at least 20 minutes to warm the oil. Then, park it on a level surface. It may be necessary to use ramps to get the car high enough to

gain access, particularly if the oil filter must be removed from the bottom. If your driveway slopes enough, fine, but at least be sure that the drain plug is at the very bottom of the pan when you drain the oil. Use a drain pan that is big enough to hold about twice as much oil as the engine sump holds. Then unscrew the drain plug using a box wrench (Fig. 1), so you won't round off the drain plug's hex. For some cars, you may need a square drive or socket drive (Allen wrench) tool. While the oil is draining, remove the old oil filter (Fig. 2) and drain it into the drain pan.

Once the oil has drained completely, reinstall the drain plug by hand. Tighten it with a wrench no longer than 10 in. (so you don't overtorque) and don't muscle it down.

If your oil filter mounts in an upright vertical position, partially fill the new filter with some of the fresh engine oil. Lube the filter's gasket with this oil as well. Install the filter, tightening it by hand according to the directions printed on it or $\frac{3}{4}$ of a turn after the gasket makes contact with the flange. Add the rest of the oil, start the car and make sure you have oil pressure. Then run the engine for five minutes and check for under-car leaks. Turn off the engine, allow it to sit for five minutes, then check oil level and adjust if necessary. Take the old oil to a local service station for recycling.

Under the air cleaner

Continue your maintenance procedure by removing the air cleaner. Unscrew the hold-down wingnut, remove the cover, then lift the snorkel and detach the heat riser tube. Now lift the base of the air cleaner, detaching the PCV hose and the vacuum line joining it to the

engine (Fig. 3). Wipe out the base and replace the PCV filter, which, on most air cleaners, is held in place with a spring clip (Fig. 4). Install a new air filter, but don't reinstall the air-cleaner base on the engine until you've completed the entire maintenance tuneup. On some cars, the PCV filter is in the oil filler cap.

Replace the PCV valve. It may be in a valve cover or intake manifold, or connected to the intake by a large vacuum hose, which should also be replaced if damaged, cracked or brittle.

Some cars with computerized engine-control systems have an EGR solenoid filter that should be replaced at tuneup time. On engines with carburetors, make sure the choke snaps closed when the engine is cold and you open the throttle. If it doesn't close, it's binding or needs adjustment. On fuel-injection throttle bodies, make sure all wire connectors are properly joined and are not cracked or corroded. If necessary, clean them with a small knife and some electrical contact cleaner.

Replace the fuel filter at every maintenance tuneup. If your engine is carbureted, the filter is either in the fuel line between the pump and carb or behind the carb's inlet fitting. Use a rag to catch spilled gas when removing the fuel filter.

To replace a filter behind the inlet fitting, disconnect the fuel line using two wrenches to hold the inlet fitting and fuel-line fitting. Some engines have a neoprene-hose fuel line that is attached to the inlet fitting with a spring or screw clamp. Replace inline filters by disengaging the neoprene hose from each end. The new filter should have an arrow stamped on its housing to indicate direction of flow.

SMART AUTO ADVICE

The #1 way to smooth your rough-running engine.



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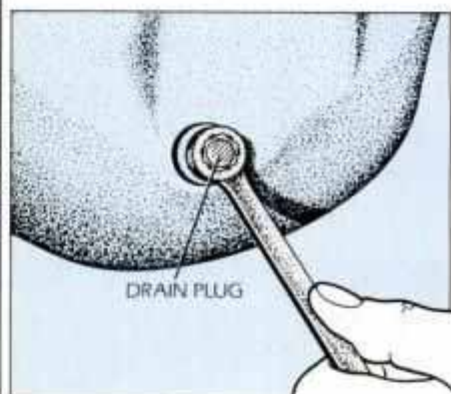
Quality Products of the Pennzoil Products Company.



Check your vehicle service manual for specific instructions on relieving fuel pressure and changing the filter of fuel-injected cars. It's extremely important that instructions for relieving pressure be followed, as gasoline under high pressure remains in the lines for days after the engine is shut off. Even if you're working outdoors with little danger of fire, gasoline could spray into your face as you open a fitting. In-tank filters are replaced only if they fail.

Sparkplug R & R

Sparkplugs are the most critical of the wear parts, and they can tell you quite a bit about the rest of the engine. To replace plugs on an engine with limited access, such as a transverse-mounted V6, you'll need a high-quality spark-plug wrench. But for any engine you'll need at least a proper-sized plug socket and ratchet, and perhaps an extension and universal. Use pieces of masking tape to number each wire. Once you're certain that you'll be able to reconnect



1 Use a box wrench on an oil drain plug.

all of the plug cables accurately, remove them from the plugs with care. Hold the rubber boot and twist it back and forth until it releases from the plug insulator. Then pull off the connector.

After removing all of the cables, unscrew the plugs with your ratchet and socket (Fig. 5). Don't hold the tool at an angle or you'll crack the insulator. As each plug is removed, keep it in cylinder order and examine it carefully. Check to see that all the plugs are approximately the same color, ranging from gray or brown to white or tan, depending on the type of fuel used and the engine calibration.

Some symptoms, particularly a plug that is somewhat black and/or wet with fuel, could indicate that the plug had stopped firing. If the engine still misfires after the tuneup is complete, the plug or the other tuneup parts that you replaced were not the problem and further diagnosis is necessary.

If you have an old car with breaker-point ignition, replace each plug at the

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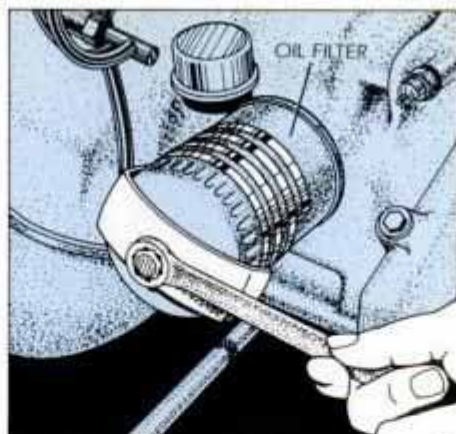
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2 Oil filter wrench will be needed to remove a tight oil filter.

10,000-mile interval, regardless of condition. If you have high-energy electronic ignition, check each plug for excessive wear. If the edges of the plug's inner and outer electrodes are noticeably eroded, replace it. If the plug is merely coated with light deposits of the proper color and otherwise looks brand new, it can be cleaned and reused (Fig. 6).

When you buy replacement plugs, make sure they're of the heat range recommended by the manufacturer. For the most part, don't experiment with hotter or colder plugs, even if the old-timer at the corner gas station thinks you should. The plugs used today have a broad heat range to cope with all normal driving conditions, and use of a hotter or colder plug could adversely affect engine calibration. If, however, your plugs were running exceptionally cool, showing very dark gray or brown color, or exceptionally hot, showing blistered insulators and melted electrodes, the bad color is probably the result of some other problem, such as incorrect fuel mixture or engine operating temperature, that you should track down and repair.

Find the manufacturer's specification for plug gap in your owner's manual or on the Vehicle Emission Control Information label, located somewhere under the hood. Check the gap of the plugs with a wire gauge, using the tool at the end of the gauge to bend the outer electrode if you have to change the gap.

When installing the plugs, try to screw them in with your fingers as far as possible. Never start the plugs with a ratchet; it's easy to cross-thread them. Once they're in most of the way, finish

up with the socket and ratchet. A length of hose that fits over the end of the plug makes a good starting tool, especially when access is restricted.

A hose is flexible enough to reach in oddball places, yet permits your other hand to spin the plug in, without applying enough torque to cross-thread anything. If space permits, use a torque wrench and tighten the plugs to 20 lb.-ft. Otherwise, just make them snug.

Plug-cable service

Once you've replaced the plugs, don't just reconnect the cables without giving them a good once over. Look for brittleness, cuts, cracking, burns or excessive corrosion of the terminals on both ends. If the wires are three years old or more, replace them. If they've been exposed to severe doses of road salt, they might fail sooner. If one of your sparkplugs showed that the cylinder wasn't running, replace the cables. If they're almost brand new, replace just the one cable.

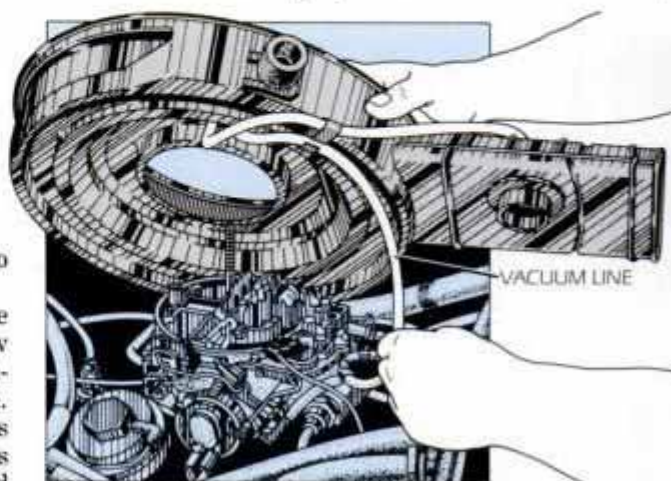
For cars with high-energy electronic ignition, use the more expensive silicon-jacketed cables for replacement. These are standard on most cars with this type of ignition, but some of the early high-energy systems used conventional plug wires. To upgrade to the high-quality cables is worth the extra money. We use them on all our cars, high-energy and conventional. If the plug-cable terminals were coated with dielectric silicone grease, replace the grease when you install new cables.

To install new cables, remove one old wire at a time and match it to a new one. Use all looms and separators and route the wires exactly as the old ones.

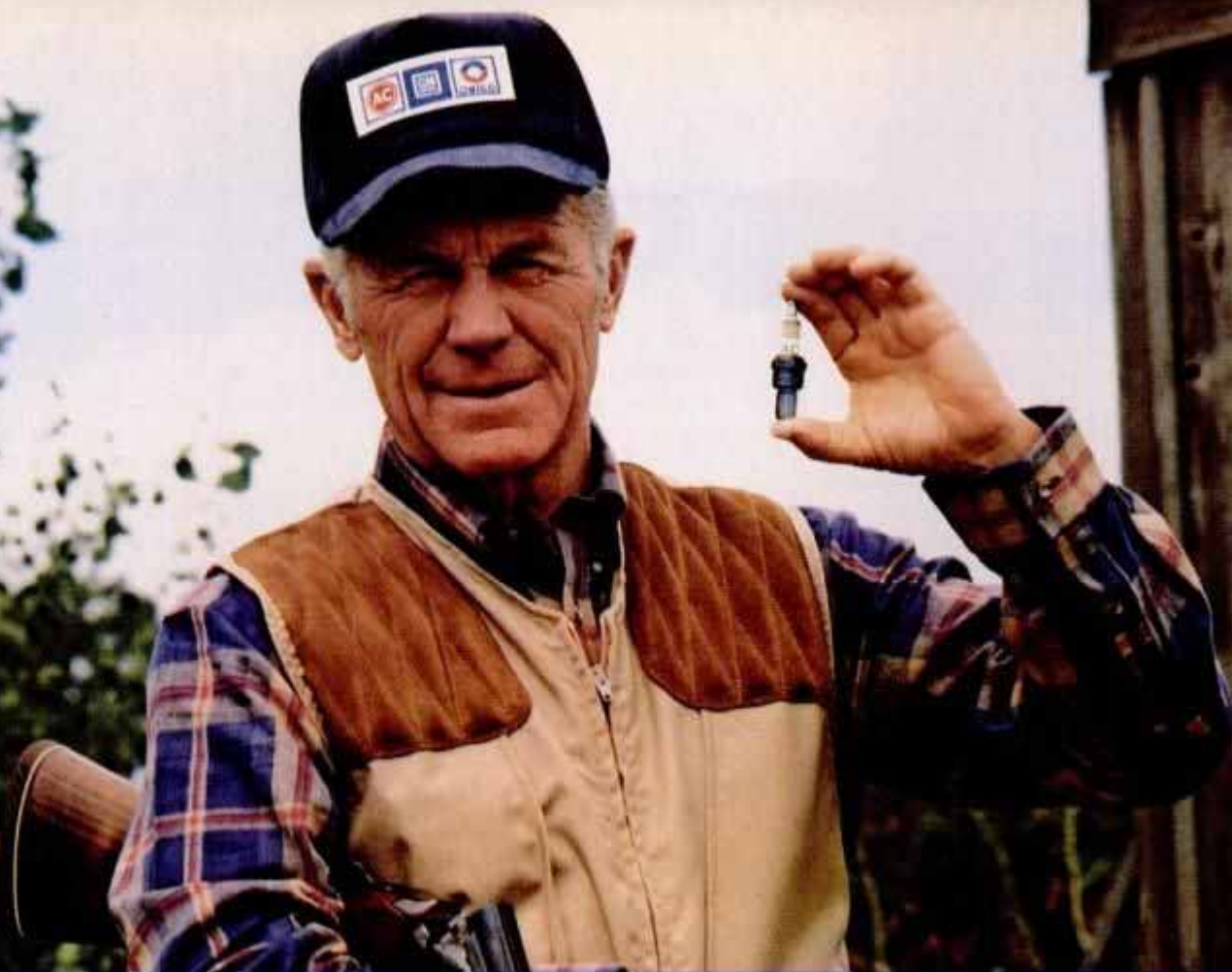
Cap and rotor

Replacement of cap and rotor depends primarily on their condition, but don't expect more than 30,000 miles.

On GM cars with the big high-energy distributor, release the plug-wire retaining cap and move it out of the way



3 After disconnecting the PCV hose and hot-air hose, invert the air-cleaner base and mark and remove the vacuum hose.



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*See your owner's manual for recommended change intervals.

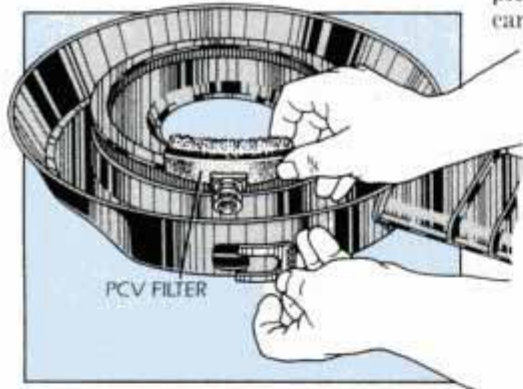


GENERAL MOTORS CORPORATION

to remove the cap (Fig. 7). On most late models you'll have to remove at least three or four cables from the cap to obtain enough room to lift it off the distributor and turn it over.

Remove the distributor cap by releasing the spring clip latches or unscrewing the screws. Some GM caps have what appear to be screws, but they're really latches that are released by pushing down with a screwdriver, and then turning a quarter-turn (Fig. 8). Spring clip latches can sometimes be disengaged by hand. If not, pry gently with a screwdriver under the center of the clip until it pops open. Label the wires and matching cap terminals.

Once you've maneuvered the cap into a position where you can see inside it, check the inside of the cap for cracks, fractures or evidence of carbon tracking between terminals. If in doubt as to its condition, replace it. Light surface corrosion on the terminals can be scraped off with a knife blade. If you hit bright metal under the surface corrosion, the cap is okay. But if the metal is eaten away or can't be scraped clean, replace the cap. On many new cars, the terminals are coated with silicone grease. Replace the grease with an equal amount—don't overdo it.



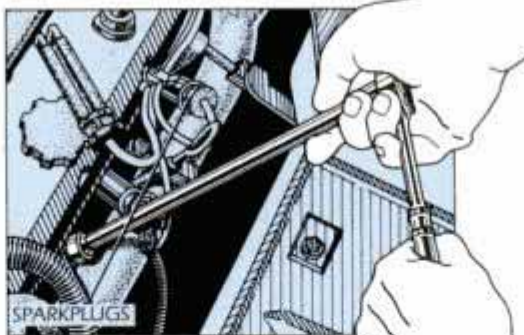
4 PCV filter is frequently attached to the air cleaner base by means of a spring clip.

Check the rotor for corrosion and clean it up with knife blade or file (Fig. 9). Replace it if it's severely corroded. Inspect the rotor for burns or cracks.

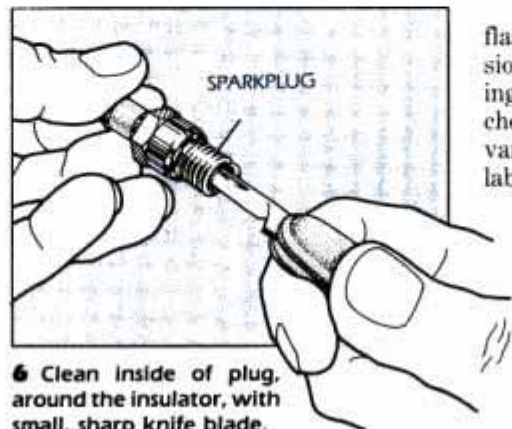
Points and condenser

Although an American car hasn't been equipped with a contact breaker-point ignition for many a year, we know many of you are still tuning these older models.

The points and condenser should be serviced while the distributor cap and rotor are off for inspection. Before removing the points, turn the engine until the rubbing block of the points rides on the high portion of the distributor cam. Disconnect the wires attached to the point set. If you have to remove the screws com-



5 Use a ratchet, a medium-length extension and plug socket to remove sparkplugs.

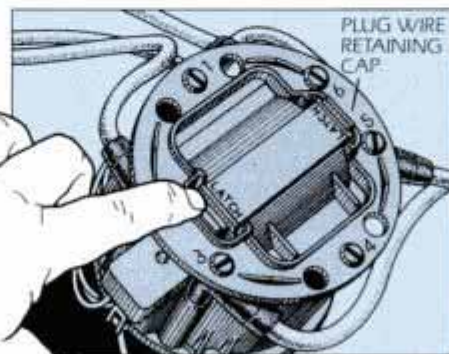


6 Clean inside of plug, around the insulator, with small, sharp knife blade.

pletely to remove the point set, be careful not to drop them.

To remove the condenser, loosen the retaining screw until the condenser slides out of its bracket. If the condenser is spot-welded to the bracket, you'll have to remove the screw completely.

Install the condenser and point set and make sure that the rubbing block touches the high point of the distributor cam. If not, turn the engine as necessary. Attach the wires to the point set terminal. Finally, adjust the point gap to the specification recommended for your vehicle. Use a feeler gauge to measure the gap, and adjust the point set either by moving the breaker plate or—on GM cars—by turning the socket head screw adjuster. Once the adjustment is complete and the distribu-



7 Remove the plug-cable retainer ring from a large GM distributor. **8** Then, release the spring clips that secure the cap to the distributor base.

tor cap and rotor have been reinstalled, check the adjustment with a dwell meter (the carmaker supplies a spec for both dwell and gap), and readjust if necessary.

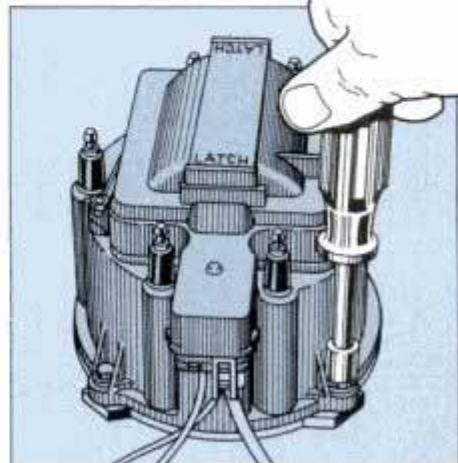
Spark-timing check

After the distributor has been serviced, ignition timing should be checked, particularly on cars with breaker-point ignition. You'll need a timing light, and unless you have access to one of the more expensive powered ones, you'll need a shaded or indoor spot to be able to see the flash clearly. Check your Vehicle Emission Control Information label for timing specs and to determine if timing is checked with the engine's vacuum advance disconnected and plugged. This label explains what must be done to check timing. If you have an early-model car with no information label and are without a shop manual or other instructions, check a general service manual for specs and special instructions.

The timing light will enable you to see the firing position of the No. 1 cylinder in respect to the crankshaft. First, however, fully warm the engine and check idle speed with your tachometer to make sure it is at spec.

Turn off the engine and attach the light to the No. 1 plug cable, and the vehicle battery if you are using the powered type of light. Then start the engine and aim the light at the scale or pointer on the front of the engine or flywheel bellhousing. The flashing stroboscopic light will indicate where, in relation to crankshaft rotation, the No. 1 cylinder is firing. To change spark timing on most cars, loosen the distributor clamp bolt and rotate the distributor slightly as you watch the timing mark. You may want a special wrench to turn the clamp bolt easily, but a little perseverance and an occasional busted knuckle may be all that is necessary.

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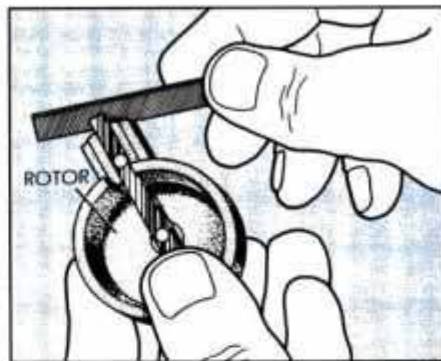
should tighten the bolt and check again.

On cars with vacuum and centrifugal advance mechanisms (most of those built before 1982 or so), rev the engine while watching the timing marks and with the vacuum hose still disconnected. The timing should advance.

If the timing does not advance, the centrifugal weights may be stuck. Then attach the vacuum line with the engine at 1200 rpm. The timing should change. On most engines with computer-controlled spark, timing should advance when the engine is revved. For more specific information about timing, consult your service manual.

EGR inspection

A lot of mechanics tell us that failure of the exhaust gas recirculation (EGR) valve is so common that they give it a quick once-over at every tuneup. Unfortunately EGR systems differ widely from one vehicle to the next, so you should consult directions for EGR system checks in your service manual. We can point out, however, that any test should answer three questions. First: Is EGR control vacuum present at the specified level? Second: Does the EGR valve open when control vacuum is supplied during cruise conditions? And third: Are the exhaust-gas passages in



9 File corroded metal from the edge of the rotor's contact, and make sure current hasn't burned the plastic.

the valve and engine allowing the flow to reach the combustion chambers?

Hot air/cold engine

Most cars are equipped with a heated-air system for cold driving. This should be checked after reinstalling your air cleaner assembly. The system provides heated inlet air during warmup, drawing it from a stove that surrounds the exhaust manifold.

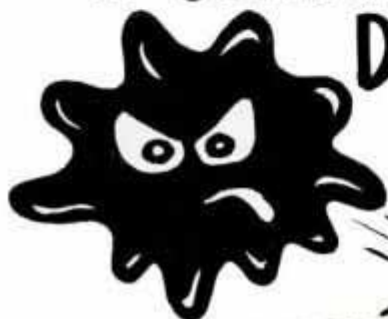
Most of these systems are regulated by a vacuum motor that opens or closes a hot-air duct leading to the air cleaner. The vacuum is turned on and off by a thermal switch in the air cleaner. The vacuum hose that you disconnected when removing the air cleaner is the supply for this system.

Start the cold engine and use a flashlight and mirror to make sure the door is in the heat-on position when the engine is cold. If ambient temperature is above 70°, apply an ice cube to the thermal switch before conducting the test. Watch the door as the engine warms up to see if it moves to the heat-off position.

Cooling system

Check all the belts and hoses at your 15,000-mile tuneup and replace any that are in poor condition. Belts should be free of excessive wear, glazing,

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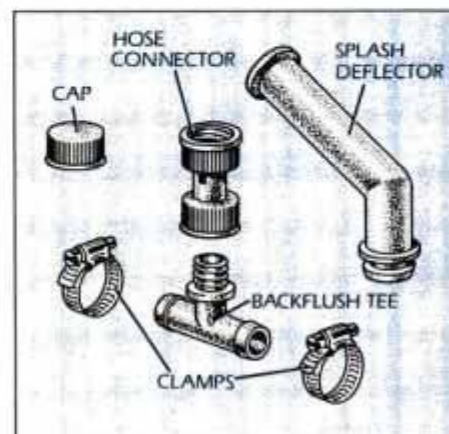
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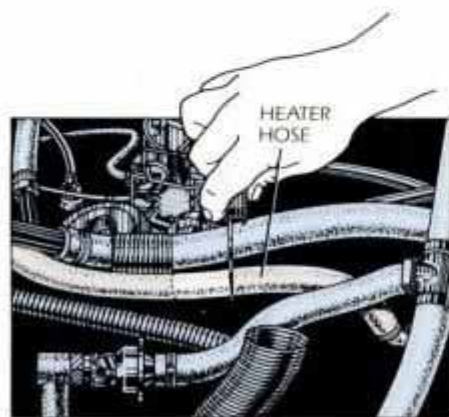
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10 Tee is inserted into the heater hose. Connector is attached between the tee and garden hose to flush system.

cracking on the bottom or frayed cords. Check tension and adjust as necessary.

Hoses should be free of soft spots, cracking, swelling or oil and grease contamination. The best advice for both belt and hose maintenance: replace them before they wear out. We recommend replacing all belts and hoses every three years. Some mechanics recommend 4-year replacement, but that's stretching the limit. Of course someone will tell us they have a hose that lasted 23 years, but we'd rather not take a chance on being left by the side of the road with a busted hose or belt.



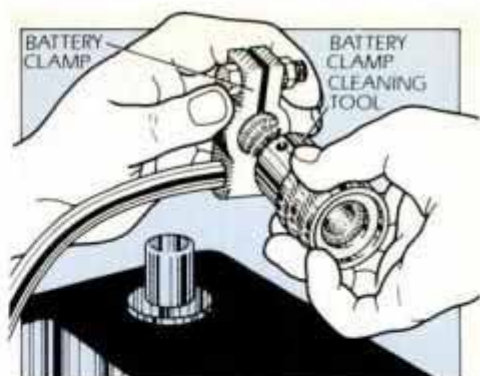
11 To keep your heater hose layout neat, slice a couple of inches out of the hose when inserting the tee.

A regular cooling system flush every 15,000 miles or every two years—whichever comes first—is just about right.

Complete backflushing kits are available at auto parts stores. One of these includes the tee (in several sizes), a garden hose connector, clamps and a tube to prevent the radiator overflow from splashing all over (Fig. 10).

To install the tee, make sure the engine is cold. Remove the radiator cap to relieve pressure, then replace it. Find the heater hose that runs from the heater core to the top of the engine—not to the water pump. Cut the inlet hose, place the screw-type hose clamps over the hose ends and install the correct-size tee. To preserve your neat-looking hose arrangements, shorten the hose by an inch or two to make up the length of the tee (Fig. 11).

To backflush, remove the radiator cap from the cold engine, and unscrew the flushing tee's cap. Install the connector on the tee and insert the splash deflector device into the radiator neck. Attach your garden hose to the connector and open the radiator petcock drain. Turn on the water supply. It should start running out of the radiator if you have everything hooked up right. Once you see the water overflowing, turn on the engine and let it idle. Turn the



12 Battery post cleaning tool is easy way to clean battery posts and terminals.

heater control to high heat. Keep the flow on until the water runs clear, but not for less than five minutes.

When you've finished backflushing, remove the hose, connector and deflector and close the radiator petcock. Cap the tee. Then fill the cooling system with a 50-percent mixture of coolant and water. There'll be some plain water left from the flushing, so start filling with pure antifreeze. Look in the manual for the capacity of the system, add half this amount of antifreeze, then top up with water. For cars with aluminum engine parts—almost all cars—use only antifreeze intended for use with aluminum. Flush the coolant recovery system and fill it to the FULL COLD mark.

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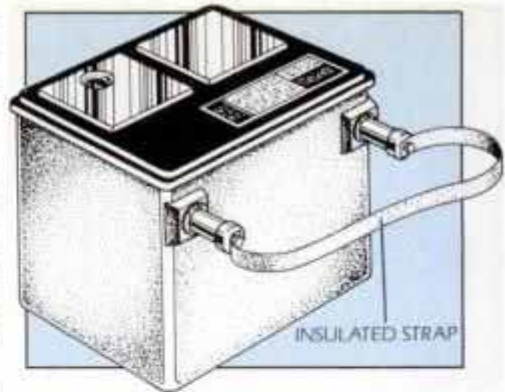
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Then cap off the radiator, warm the engine fully, allow it to cool and check coolant level again—both at the radiator and the coolant recovery tank.

Battery care

You should give your battery a good bath at tuneups. First, remove the negative terminal, then the positive, and finally the holddown clamps. Wash the whole unit with a mixture of baking soda and water, scrubbing with a brush. Rinse with water.

If it's not a maintenance-free battery, check electrolyte level and add distilled water if necessary. *Warning:*



13 Side terminal charging adapters have a tether to keep them from getting lost.

Getting A Full Life From Your Battery

Why is it that some maintenance-free batteries last for years while others are junked in a year or less? Notice that the question says "are junked"—not "have to be junked."

Tests on "dead" maintenance-free batteries that were returned to the manufacturer show that most were buried alive, because professional as well as do-it-yourself mechanics didn't know how to resuscitate them. How can you avoid this trap?

Here are five facts about maintenance-free batteries that will help:

1. Cars of the '80s have electronic devices that can draw 8 to 20 milliamps from a battery continuously. This parasitic load, plus a battery's normal self-discharge rate, can result in a deep enough discharge to fool you into replacing a battery that seems dead after the vehicle hasn't been driven for a while. To guard against this, disconnect the negative cable from the battery to avoid a drain if your car's not going to be used for 30 days or longer. Or, use a trickle charger. There are even solar-powered trickle chargers available that plug into the cigaret lighter.

2. You probably know that if a green dot is visible in the "eye" (built-in hydrometer) of a maintenance-free battery, the battery is charged; if only darkness shows (no green dot), the battery is undercharged and should be recharged; and if the eye is clear or light yellow, fluid level is low and the battery should be replaced. But don't be fooled if your battery has a translucent case. Daylight passing through the case may make a dark hydrometer appear clear or light yellow, thereby deceiving you into replacing a sound battery. One way to be sure that what you're seeing really exists is to block light by taping cardboard to the sides of the battery. Then, look the battery in the eye.

3. If a dead battery you've turned over to a garage for charging is returned with the comment, "It's a goner," ask if the battery charger that was used has a polarity protection circuit,

which keeps the charger off if the battery isn't connected correctly. To activate the charger when polarity is correct, the charger requires a small amount of current output from a battery. A discharged battery, however, may not emit even that minimal voltage—and the charger won't switch on, making it appear as if the battery is too far gone to accept a charge. Try again, this time following charger manufacturer's instructions on how to bypass the polarity protection circuit.

4. If you don't have the proper adapter available when you have to charge a battery with side terminals, be careful: Bolts alone aren't a suitable substitute—they may produce resistance that's too high for the charger to overcome. You can make an adapter with two 3/8-in. bolts that are 1 1/2 in. long or longer and two 3/8-in. nuts having standard threads. Run a nut all the way up to the head of one of the bolts and screw the bolt into a terminal by hand until it bottoms. Don't use a wrench!

Turn the bolt back out one full turn; then, as you hold it steady, screw the nut down until it rests against the battery. Finally, use a wrench to turn the nut until it's just snug, but don't ram it so hard that you crack the case. Do the same thing at the other terminal. Now, connect the battery charger to the 3/8-in. nuts—not to the bolts.

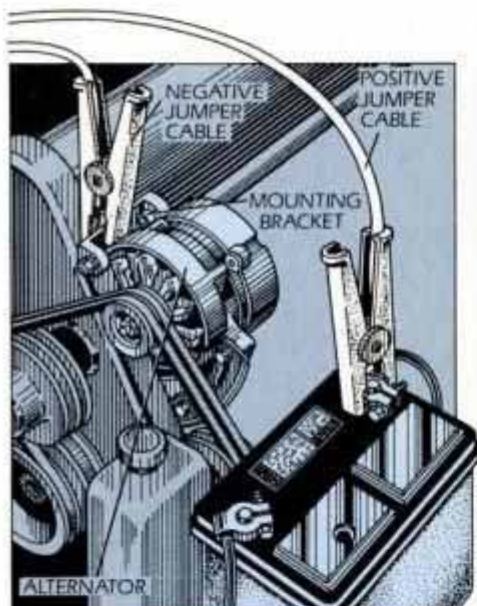
5. Batteries should provide four, five or even more years of service. If your battery runs down, tests okay, is recharged and runs down again, it's probably not the battery's fault. Here are several "killers" to look into:

- A loose or slipping drive belt, sick regulator or alternator, or a short circuit.
- Driving at very low speeds for extended periods of time.
- Installing so many aftermarket accessories that they place an electric load that exceeds what the alternator can generate.
- Clocks and burglar alarms both draw small amounts of current even when the key is off.

Batteries that look like maintenance-free batteries may not necessarily be maintenance-free. "Low maintenance," "easy care" or other similar terms do not mean maintenance-free. A regular battery can explode with enough force to buckle the hood if it runs dry.

Once the battery case has been scrubbed, clean the terminals and posts with a post and terminal cleaning tool (Fig. 12). If you have a side-terminal battery, clean terminals with a knife. Make sure cables are free of corrosion and tightly secured at the opposite end, away from the battery. If your cables are the clamp-on terminal type that aren't soldered onto the wires, be aware that the clamped joint can be a problem if corrosion builds up. Either clean them regularly, or better yet, replace them with the better type.

If you're forced to jump-start your car, make sure all the electrical accessories of both cars are turned off. Make sure the vehicles are not touching. For



14 To jump-start a car with a dead battery, follow directions in the text.

side-terminal batteries, special adapters are available to facilitate the attachment of a charger or jumper cables (Fig. 13). Connect the positive cable to both batteries first. Now connect one end of the negative cable to the negative post of the booster battery. Connect the other end of the negative cable to the alternator bracket of the car with the discharged battery (Fig. 14). Do not connect the cable to the negative post of the discharged battery. Never lean over a battery, and do not attempt to jump or charge a discharged maintenance-free battery with an indicator eye that's turned yellow.

After jumping, disconnect the negative cable from the alternator bracket first; then the negative cable from the booster battery. Finally, disconnect the positive cable. **PM**

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TUNE UP YOUR CHASSIS

For comfort and safety, take proper care of your brakes, tires and suspension.

Taking care of your car's engine is important, but it's not enough. Most Saturday mechanics don't mind popping the hood once in a while and making sure all is well, but working under the car isn't quite so appealing. However, it's every bit as important—perhaps even more important—since those undercar parts determine whether your car will stop and steer. Furthermore, the underside of the car is subjected to a constant barrage of salt, water and mud, not to mention damage from road hazards.

What we recommend is that you get on your creeper and slide under the greasy side every 3000 miles. At 15,000-mile intervals, make your tune-ups "whole-car tuneups." Do your 3000-mile lube job but add a safety inspection and replace any parts that don't make the grade.

While you're making sure that the vehicle is safe, don't forget about your own personal safety. Use only high-quality jackstands or ramps for supporting a car. Never work on a car that is supported by a lifting jack of any type. Don't use ramps or jack stands to lift more than one end of the car at a time and chock both of the opposite wheels with concrete blocks or similar objects that are large enough and heavy

enough to prevent movement. Locate jackstands only in the manufacturer's approved jacking positions. Before crawling under the raised car shake it vigorously to make sure that it can't slip off the supports.

Make sure you wear safety glasses under the car. When you beat on an undercar part, you'll probably be showered with debris.

Topside lube service

Since there are a number of areas that require lube on the topside, attend to these before raising the car.

First clean all linkages with aerosol carburetor cleaner. Then lubricate with a light machine oil, Teflon spray or silicone spray. Apply engine oil to the door hinges, hood hinges and hood spring anchor. Use light machine oil or one of the spray lubes on the door locks. Use chassis grease on the hood latch. Clean the power antenna mast and apply a thin coating of spray lube. Check the windshield washer reservoir and add windshield washer fluid—no substitutions allowed save in climates where the temperature never dips below 32° F. In these areas, you can use water. Check fluid level in the power steering reservoir and add power steering fluid as required. Don't use automatic transmission fluid unless your owner's manual says it's okay. If your owner's manual says the power steering fluid has to be hot for an accurate reading, check it when you check the automatic transmission's fluid level.

Check the brake master cylinder level and fill to the full mark or to within 1/2 in. of the top with fluid that meets DOT 3 specifications. Fluid must be fresh; don't use fluid that has been stored in an open container as it could be contam-

inated with moisture. Don't use fluid if you can't find an indication of its DOT specification on the can. If your car loses fluid at a significant rate, you must locate the cause immediately. The fluid level of disc brake pads will drop gradually as the pads wear, but a sudden and substantial drop is definitely abnormal.

If your car is equipped with a hydraulic clutch, check fluid level. If it needs topping off, consult the carmaker's recommendations for fluid replacement. Most hydraulic clutch systems require DOT 3 brake fluid.

Automatic trans lube service

You'll remember that in our engine tuneup article we recommended driving the car for 20 minutes before changing the oil. With most cars this would be an excellent time to check the automatic transmission, automatic transaxle or manual transaxle fluid level and top it off if necessary, but make sure that the manufacturer recommends that transmission fluid be checked hot. (Some manual transaxles use ATF; others are filled with engine oil. Check your owner's manual.) When your car is new, check transmission fluid every time you check oil, which should be every time you fill the gas tank. If after a couple of months you see that the transmission never loses fluid, you can check at 1000-mile intervals.

When adding fluid take care not to overfill, as too much fluid can cause seal damage, fluid foaming, and leakage through the dipstick tube and other areas. Most dipsticks have a "safe range" indicated. Usually the transmission will take a pint of oil when the level reaches the bottom of the range. You

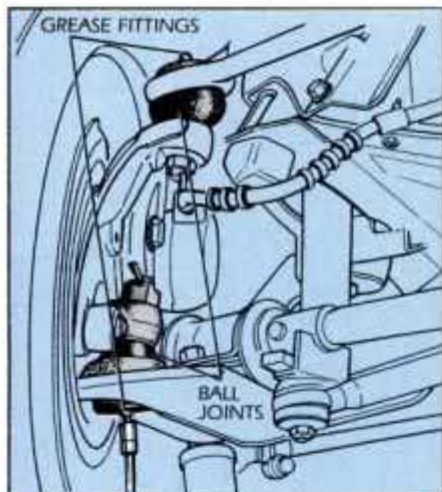
don't have to try to hit the top line of the safe range. Slightly below the maximum limit is better than slightly above.

We recommend changing the automatic transmission or transaxle fluid and filter every other time you do your chassis tuneup; which should be about every 30,000 miles.

Some carmakers agree, others say every 100,000 miles is often enough. If you use your car to tow a trailer, drive in 90° F heat more than half the time, drive in dusty or mountainous areas or do short-trip delivery work, swap fluid and filter at every chassis tuneup.

Make sure the transmission has been warmed to operating temperature before draining the fluid (you can do it when you change the engine oil). After making sure the car is securely raised, place a drain pan under the transmission. If it is equipped with a drain plug, simply remove it. Then, once the fluid has drained, remove the transmission's oil pan to gain access to the filter.

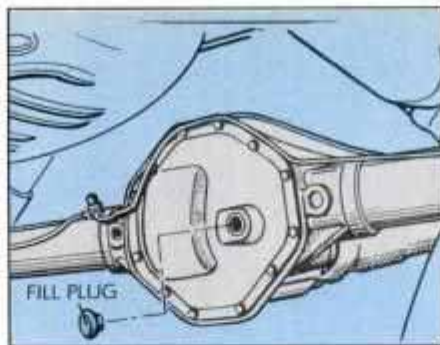
If your transmission is not equipped with a drain plug, locate the drain pan



1 Lubricate all Zerk fittings. Pump grease into the fitting until rubber boot over the ball joint swells slightly.

under one rear corner of the oil pan and remove all pan bolts except three in the corner opposite the point from which you want the fluid to drain. Slowly remove these bolts, allowing the fluid to drain gradually as the pan corner drops lower and lower.

When you can't drain any more fluid without removing the bolts completely,



2 Add lube to the level of the differential's filler hole, then replace the plug.

support the pan and remove the last bolts. Carefully lower the pan and pour the remaining fluid into the drain pan. An accumulation of clutch material and even some brass powder in the bottom of the pan is normal.

The filter is probably secured to the bottom of the transmission by one or two bolts or screws. Remove it and replace it with a new filter, taking care to properly insert any O-rings or gaskets. Remove the old oil-pan gasket, clean the pan and make sure its gasket surface is flat.

If the flange bulges around the bolt holes, flatten it using a ball-peen hammer and a block of wood under the flange. Attach a new gasket to the pan with a small amount of fast-drying adhesive. Use just enough adhesive to hold the new gasket in place. Carefully place the pan and gasket against the transmission case and start all the bolts by hand. Using a wrench, tighten bolts snugly. Work your way from side to side in an alternating pattern.

Refill with the type of fluid recommended in your owner's manual. Don't substitute. Take care not to overfill. The cold fluid level will be much lower than the hot level. If your dipstick doesn't have a cold fluid level indication, as some do, measure the amount of fluid you drained and add new fluid accordingly.

Chassis lube

After you've changed oil and, when necessary, automatic transmission fluid, make sure every moving part under the car is lubricated. Begin by lubing all grease fittings in the suspension and the steering linkage (Fig. 1). Some new cars may have plugs installed in place of grease fittings. If so, purchase the grease fittings at an auto parts store and install them yourself. Remove the plugs with a box wrench or

socket wrench and install the fittings with the same tool.

Check your owner's manual or service manual to locate all grease fittings. Your car may have as few as four or as many as 20. Some cars with independent rear suspension even have a few grease fittings on the rear suspension parts. Others have fittings on drive-shaft U-joints.

The important thing is to make sure you locate all of them. Hand-operated grease guns and chassis grease are available through auto parts stores.

When applying grease to parts with a rubber dust cover, pump grease in only until the cover of each joint swells slightly. When applying grease to components without a rubber dust cover, keep pumping until old grease comes out of the joint.

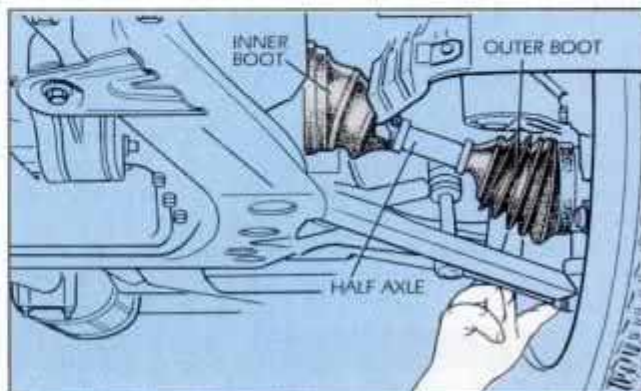
Next, apply a small amount of chassis grease to the parking brake cables at every point where they move through guides. Fill a squirt can with engine oil and lube all transmission or transaxle shift linkage parts, the clutch linkage pivot points, and all floor shift linkage moving parts.

Remove the press-in filler plug or screw plug from the differential carrier of rear-drive cars to check the level of the rear-end lube. The housing should be full to the level of this plug. If it isn't, top it off with the lube recommended in your owner's manual—SAE 90 hypoid type for many cars. Most cars with limited-slip differentials require a special lube. If the differential carrier is equipped with a rubber press-in filler plug (Fig. 2) make sure it is fully seated in the housing when you reinstall it.

Most rear-wheel-drive cars with manual transmissions require a lube similar to or the same as that used in rear differentials. Again, a filler plug is provided on the side of the case and the oil level should be up to the plug hole.

General undercar inspection

A detailed examination of all undercar components should be a part of every 15,000-mile whole car tuneup. Check



3 On front-wheel-drive cars, examine all CV-joint boots for tears or signs of deterioration. Don't wait to fix problems here.



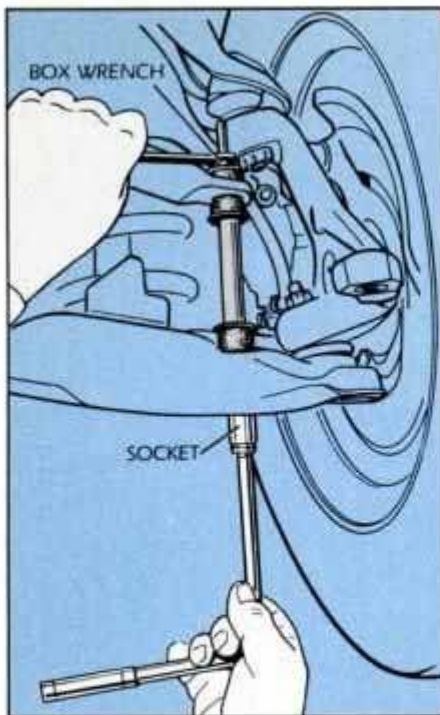
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4 Check every bolt on the chassis and suspension for tightness.

the complete exhaust system first. If exhaust fumes find their way into the passenger cabin they can kill you. Make sure all hangers are sturdy and firmly attached to both the exhaust parts and the chassis. Examine each pipe joint for smudges of carbon that signal leaks. Pay particular attention to the seams of mufflers or resonators. Look for small rust holes forming near the lower rear of mufflers.

Examine each shock absorber. If there are indications of a fluid leak, the shocks should be changed. If your car undulates up and down after hitting a bump, the shocks should be changed. On most medium- or full-size cars shocks rarely last more than 30,000 miles, so renewal at every other maintenance tuneup is a good idea. On light-weight machines they may last 45,000 miles.

If your car is equipped with MacPherson struts (the strut/damper unit is surrounded by a spring and serves as a suspension support member), leave the job to a professional unless you have the proper type spring compressor, experience doing this type of work and the correct service manual.

With conventional shock absorbers, replacement is simply a matter of unbolting the old ones and installing new ones. On shocks where the upper shaft is inserted directly into the mount and retained with a single nut, you'll have to hold the shaft with a square drive socket or a pair of locking pliers while you turn the nut with a box wrench. In many cases, however, you'll find that some of the retaining nuts have frozen with rust. So if you can't loosen them

with a wrench, chisel them off or use a nut splitter.

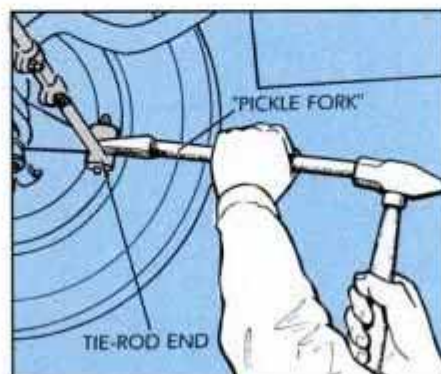
Check the steering box and power-steering lines for leaks or physical damage. On front-wheel-drive cars, clean and inspect the CV joint boots (Fig. 3). On cars with rack-and-pinion steering, check the bellows boots that cover the inner tie-rod ends for cracks, splits or other physical damage. On cars with power rack and pinion, fluid in the boot can be a sign of leaking seals. Lubricant in the boot of a manual rack is normal. If a boot is slightly torn or shows signs of deterioration, it should be replaced. Using the proper wrench, check all chassis part bolts for tightness (Fig. 4).

Chassis part checkup

Examine all suspension joints. The most practical way to check the four tie-rod ends of a car with parallelogram steering or the two outer rod ends of a rack-and-pinion system is to simply grab the tie rods and shake them vigorously. The rod ends shouldn't show signs of sloppiness or looseness. Even a brand-new joint allows some horizontal movement against its internal spring loading, but a good joint should not show unrestricted vertical movement. Joints that are loose should be replaced, as should those with missing or torn dust boots.

To replace a tie-rod end, remove the cotter pin from the rod end stud and unscrew the nut. Then use a "pickle fork" with a narrow slot between the tangs (as opposed to a ball-joint pickle fork, which has a wide slot between the tangs) to remove the joint from its mount. Drive the fork in between the joint and its mount. Position the fork so that its flat side faces the rod end and its sloped side faces the steering arm or center-link mounting position (Fig. 5). In lieu of the pickle fork, you can use a rod-end puller (Fig. 6). Since it is not as likely to tear the dust boot, this tool is particularly handy if you intend to reuse the rod end and are just removing it to gain access to another part.

Before unscrewing the rod end from the tie rod, measure from the center of

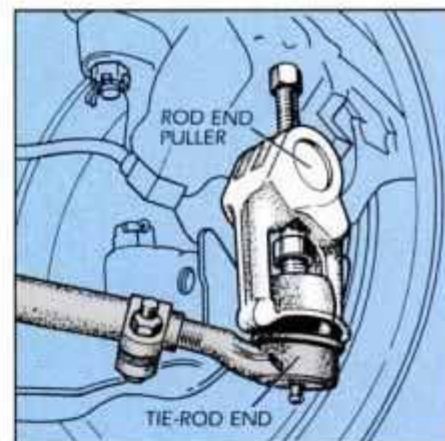


5 Use sledge and "pickle fork" rod-end separator to release tie-rod ends.

the tie rod's other rod end to the center of the rod end you plan to replace (Fig. 7) and record this figure. On cars with rack-and-pinion steering, measure from the center of the outer rod end to the boot retaining groove on the inner rod end. When you install a new rod end, you can position it correctly to avoid changing toe adjustment. Once you have your measurement, loosen the locking bolt on the tie-rod collar and unscrew the worn-out rod end.

Check the idler arm on cars so equipped by pushing the end of the arm that is attached to the center link up and down. It should not show vertical movement. This part frequently is the offender on cars with a bad case of steering-wheel shimmy.

Examine the sway bar frame-mount bushings and the bushings and links that join the bar to the control arm. If any are worn, broken, deteriorated or missing, they must be replaced. A missing or worn sway bar bushing is frequently the cause of a loud clunk heard when hitting a bump in the road or when cornering.



6 Tie-rod end puller will squeeze apart reusable rod ends when bolt is turned.

Checking ball joints is a simple matter if your car has wear-indicator ball joints, as most now do. The check should be made while the wheels are resting on ramps or on the ground. Most wear-indicator joints have a collar that protrudes from the lower surface of the joint and encircles the grease fitting. As the joint wears, this collar sinks below the surface of the joint. When this happens, replacement is necessary. A second type of wear-indicator joint is found on other vehicles, including late-model Chryslers. With this type, you attempt to wiggle the grease fitting. If it moves, the joint is worn.

To check ball joints on cars without wear-indicator joints, you have to relieve the load on the load-carrying joint—the one that frequently wears out first on cars with upper and lower control arms.

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On cars with dual control arms, the arm that carries the spring is the arm with the load-carrying ball joint. To relieve the load on a loaded upper joint, wedge a block of wood between each upper control arm and the frame, with the wheels resting on ramps or with jack stands under the lower control arms. Then lift the car, locate the jack stands under the frame and lower the car to rest on them, following all precautions in respect to location of the stands and chocking the wheels.

The joints are worn out if they permit too much sideways movement or too much up and down movement. To measure up and down movement, mount a dial indicator with its stem resting against the bottom surface of the steering knuckle. The stem should be parallel to a line through the center of the ball joints. Lift the wheel with a pry bar and watch the indicator. Compare the amount of play to the tolerance figure in your service manual.

Check sideways movement by mounting the indicator on the edge of the wheel. For an upper joint, locate it at the top edge of the wheel, and at the bottom edge for checking a lower joint. Push the wheel in and out and watch the indicator. For most cars the maximum radial movement is $\frac{1}{4}$ in. at the edge of the wheel. Make sure any movement is not due to an improperly adjusted wheel bearing.

Cars with MacPherson strut suspensions have only one ball joint. To check it the wheel should be off the ground. Grab each wheel at the top and bottom and shake it in and out while watching for movement of the steering knuckle relative to the ball joint. Any noticeable movement calls for replacement of the joint. Play seen at the wheel bearing will be discussed later in this article.

A loud clunk when shifting from DRIVE to REVERSE indicates a possible U-joint failure. Check all cross-type universal joints by grasping the shafts and twisting them back and forth as hard as you can while pushing up and down. Any looseness is grounds for replacement. Front-wheel-drive CV joints are checked most easily by listening for failure symptoms while driving. A clunk during acceleration usually indicates a worn or damaged inboard joint. Shudder or vibration and/or a clicking noise when turning frequently indicates a bad outboard joint.

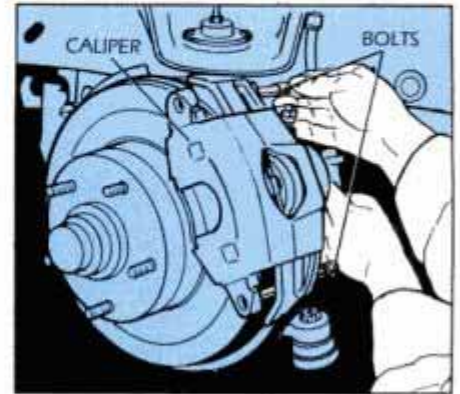
Brake-system maintenance

While our instructions below can serve as a general guide to brake maintenance work, you should also check your shop manual carefully for any specific information or procedures that relate to your brake system. The brakes should be inspected at every 15,000-miles, with parts replaced as necessary. In most cases front pads will last 30,000 miles, while rear pads or linings will last 45,000 miles. But if you drive aggressively or use your left foot for braking, they may not last nearly that long. Wheel bearings should be repacked at 30,000-mile intervals or sooner.

Begin the brake inspection by checking the master cylinder, calipers, wheel cylinders and various junctions in the hydraulic system for leaks. If there is a leak, it must be fixed before the car is driven again. Master cylinder, wheel cylinder or caliper leakage requires rebuilding or replacement of the part. Line or fitting leakage is grounds for replacement. After repair or replacement of a hydraulic system component, the brakes must be bled.

Most disc-brake-equipped new cars have wear indicators that contact the

brake disc when the pads have worn out. If you see that an indicator is within $\frac{1}{16}$ in. of the brake disc or if it has contacted the disc and squeals when you drive the car, the pads must be replaced. For cars that have disc brakes without wear indicators and with bonded brake pads, you can inspect lining thickness through the hole in the top of the caliper. The thinnest part of the pad material should be thicker than the backing plate.



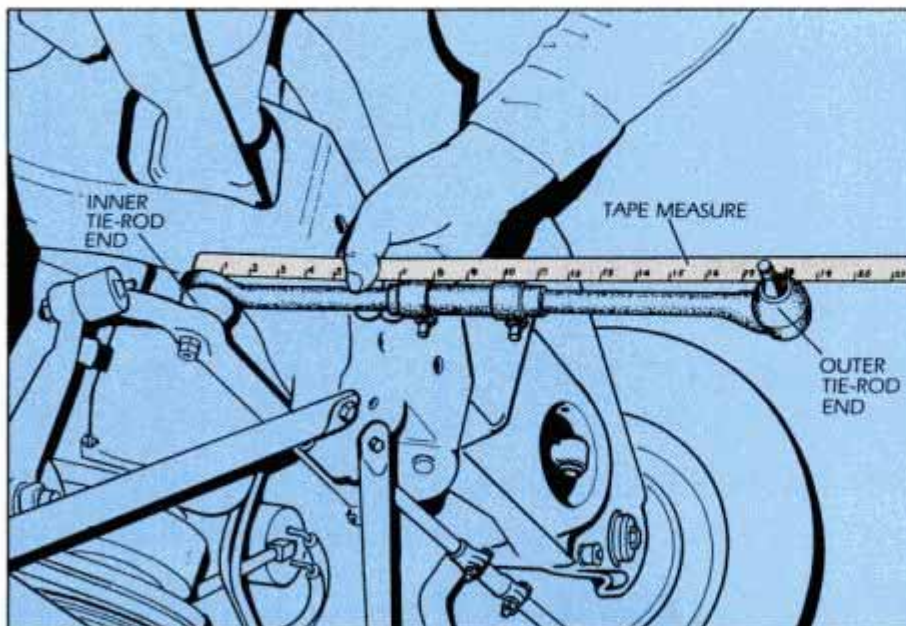
8 Some calipers must be partially removed to inspect brake pads for wear.

If there are no inspection holes in the top of your caliper or if you can't be sure whether your pads are riveted or bonded, you'll have to remove the caliper to check the pads. On GM cars and most Chryslers, the calipers are removed by extracting the two bolts (Fig. 8). On most Japanese imports, just remove one caliper bolt and swing the caliper off of the disc. Fords usually have a retaining key that must be removed to disengage the caliper.

Volkswagens and most German cars require that you remove one or more pins and clips to pull the pads clear of the caliper. If you have a car with rear disc brakes, consult a shop manual. These brakes, which incorporate a parking brake, vary widely and are sometimes complex.

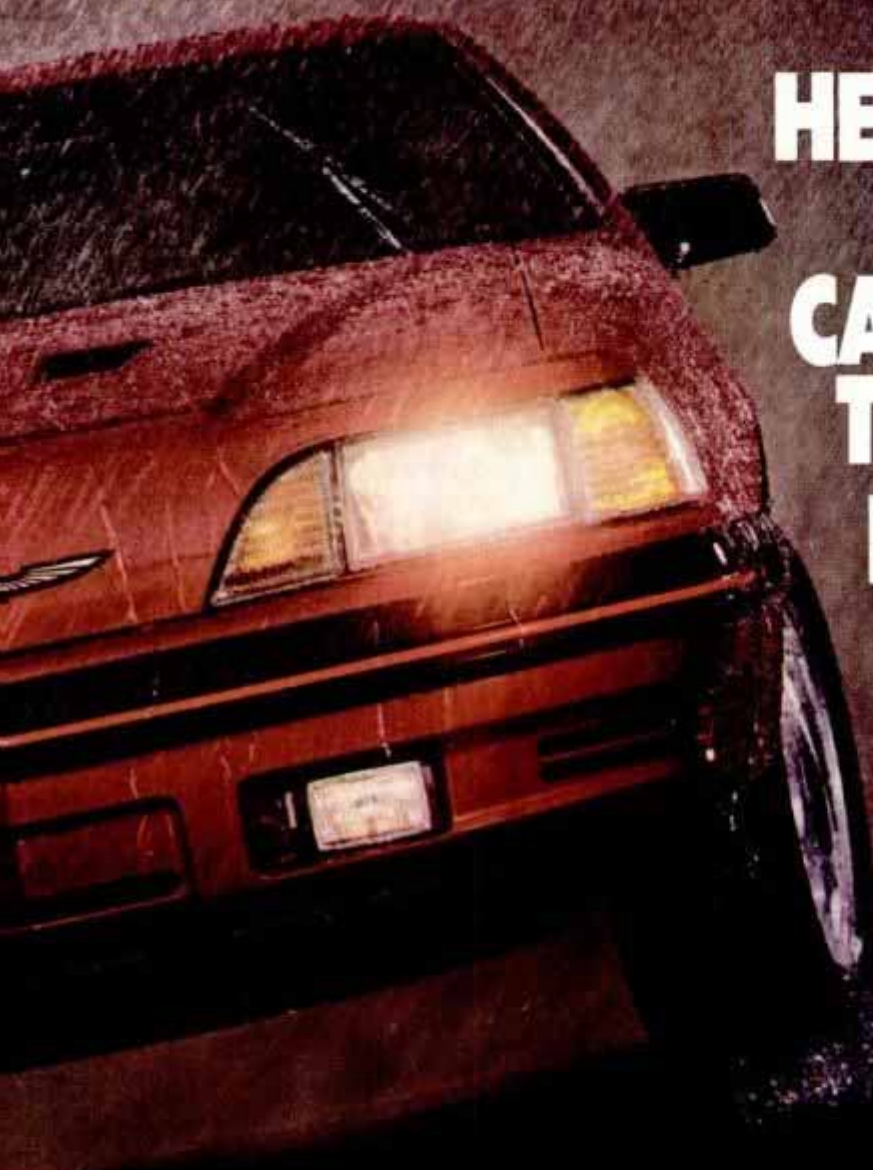
Examine the material on the pads. Nonmetallic pads should have more than $\frac{1}{16}$ in. of friction material above the rivets. With semimetallic pads, the material should extend at least $\frac{1}{32}$ in. above the rivets. If everything looks okay, bolt it all back together after repacking the wheel bearings as described below. (While you're servicing the wheel bearings or performing additional brake service, hang the caliper from a suspension part with a wire coat hanger, taking care not to stretch the brake hose.)

If the rotors show any discoloration or heat cracking, they'll have to be replaced. If you've noticed a pulsating pedal or if the rotors are more than just a little bit scored, they will have to be resurfaced at your auto parts store or automotive machine shop.

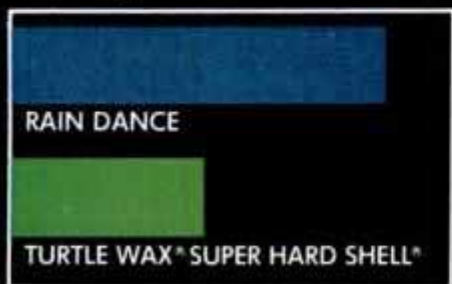


7 Measure tie-rod length from center to center before replacing a bad rod end.

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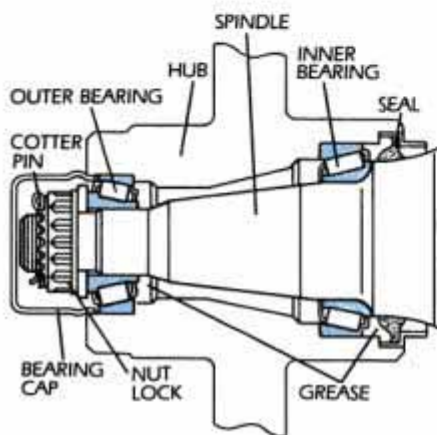
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If the pads are to be replaced, remove them from the calipers and wipe all caliper surfaces clean. Check carefully for fluid leakage around the bleeder screw, piston and seal. If any is evident, replace the caliper with a new or rebuilt unit. Some mechanics rebuild the caliper every time they change pads. It's a good way to ensure that relocation of the piston inside its bore won't provoke a hydraulic leakage problem. If you decide to rebuild your calipers, follow the instructions in your shop manual exactly. If there's any part of the job you can't do or don't understand, purchase rebuilt calipers from your auto parts store.

On cars with drum brakes, the drums must be removed to check the linings.



9 Lube front or rear wheel bearings with grease recommended by the carmaker.

You should wear a breather mask while doing this to prevent the inhalation of asbestos particles. On some fwd cars and on rear-drive cars with drum brakes in front, you'll have to remove the wheel bearings to remove the drums. On most other cars, a rear drum is simply pulled off of the lug-nut studs, but you'll probably have to retract the shoes with an adjustment tool first. On cars that have not been serviced previously, you'll usually have to cut a retainer washer off one stud on each drum. Use a pair of side-cutter pliers.

Wheel bearing service

While you might think this section belongs with the lube service described previously, we've moved it to the end of the procedure because, on rear-drive cars, it's a job you'll want to do at the same time you remove the front brake rotors for machining, should that be necessary. On front-drive cars with conventional wheel bearings on the rear axle, you'll want to service them while the drums are off. Virtually all fwd cars have sealed front bearings.

If you use your car for delivery work or drive primarily in stop-and-go traffic where brakes are applied frequently,

repack the wheel bearings every 15,000 miles. If your use is less severe, 30,000-mile repacking is sufficient.

After removing the bearings from the drum or rotor with a brass drift and a hammer, thoroughly wash all the old lube from the bearings and from the hub cavity with nonflammable solvent. Check the rollers for signs of pitting or other surface distress and replace the entire wheel set of bearings if necessary. Light discoloration is normal.

Repack with the grease recommended in your owner's manual. Purchase a bearing packer if you don't have one, as this tool makes the job much easier and it's not very expensive. In any case, make sure you push grease all the way through the bearing cage, completely surrounding each roller. Add a small amount of new grease to the hub cavity before installing the rear bearing and a new seal (Fig. 9). Use an old brake piston or similar object to drive the seal into the back of the rotor or drum.

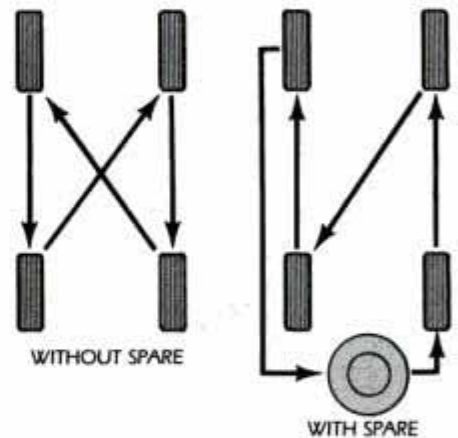
Install the hub assembly on the wheel spindle along with the outer bearing, washer and nut. Tighten the nut to about 25 ft.-lb. with your torque wrench while turning the hub. Then back off the adjusting nut about 1/4 turn and retighten it with your fingers. Install the nut retainer lock and cotter pin, then the grease cap.

Tire care and rotation

Don't put those wheels back on the car just yet. First make sure all of your tires show normal wear patterns. Abnormal tire wear is a sign that something is wrong. If a tire wears only at the edges, it has either been running underinflated, it hasn't been rotated regularly, or you tend to zip around corners. If a tire wears on one side and not the other, wheel alignment is incor-

rect, the tire is bad, or—if it's on a rear driving wheel—you tend to accelerate aggressively. If a tire shows scuffed tread or feathered edges on one side of tread ribs or blocks, wheel alignment should be checked.

In any case, tires should be rotated as soon as they start to wear uneven-



10 Rotate tires as soon as they begin to show wear, as early as 7000 miles.

ly—as soon as 7000 miles on some short-wheelbase, front-drive cars. At the very least, the tires should be rotated while the wheels are off the car for your 15,000-mile interval. Use a cross-rotation plan (Fig. 10) for all tires, radial or bias, and tighten wheel lug nuts with a torque wrench, working from side to side. Check your owner's manual or shop manual for the right torque figure. If you can't find a spec, torque 1/2-in.-dia. lugs to 85 ft.-lb. and 7/16-in. lugs to 70 ft.-lb.

Check tire air pressure every time you check oil. This practice will add thousands of miles to the life of your tires and, perhaps, numerous years to your own.

FM

New Brake Linings Offer A Wide Choice

Due to health concerns about asbestos dust, several new brake pad materials have been introduced. So-called semimetallic brake pads and linings use steel wool, wool slag or glass fibers in the lining material, along with metal chips and finely ground metal powder. They offer excellent fade resistance, but tend to squeal. Some combinations (see chart) also wear out drums and discs faster than others because the linings are so abrasive.

Aramid fibers (Kevlar is one brand name) are the newest brake material. They're quiet and last a long time, but tend to fade more in hard use.

Asbestos is still found in some brake materials. Unfortunately, few packages reveal what specific materials are found in a given brake lining. You often have to write to the manufacturer or rely on an unusually knowledgeable salesperson to find out this information.

BRAKE MATERIAL CHARACTERISTICS

	Steel Wool Fiber	Glass Fiber	Wood Slag Fiber	Aramid	Asbestos
Heat Stability (Fade Resistance)	Excellent	Good	Good	Fair	Fair
Noise Generation (Squeal)	Poor	Poor	Poor	Good	Good
Rotor/Drum Protection	Good	Fair	Poor	Excellent	Good

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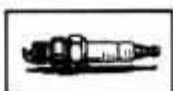
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When you've made a living cleaning cars for 23 years, you must be good. Doug Wilson fits that description. He works in Fort Lauderdale, Florida, a part of the country that's tough on vehicles: lots of sun and salt air. Doug's a professional "detailer" and the tips he gave us could help make your car the envy of the neighborhood.

The order in which you clean your car is important—you don't want to mess up one part of the car when you clean the next area.

Open the trunk to begin cleaning the inside of your car. Wash all metal with a solution of mild liquid soap and water. If the trunk is carpeted, give the rug a going-over with a vacuum. Then, sharpen up the spare tire with tire dressing. The final step in the trunk is to spray silicone on the weatherseals around the rim of the opening. This is not done to make seals look pretty, but to help keep them from drying and cracking.

Heads up

Use the vacuum inside the passenger compartment. Hit hard-to-reach spots such as the floor under the seats and crevices between cushions. Remove floor mats and clean them outside the

car, on a clean surface so they don't pick up grit.

Once all loose debris and dust have been vacuumed, look at the headliner. If it isn't stained, the only treatment it needs is a rubdown with a wet cloth. But if the kids put jellied fingerprints onto the headliner, or you sit so tall in the car that your hair has left a stain, use a fabric cleaner or mix up a solution of liquid detergent and water, and give that headliner a good scrubbing. Follow it with a clear water rinse. Clean stains from carpet with a foaming cleaner meant for automotive carpeting, which is different from household carpet due to the fire-retarding properties it has.

Selective cleaning

Next, clean hard-plastic components such as the console, steering column shroud, kick panels and rear deck. They can be cleaned with liquid detergent and water, but don't stop there. When the plastic has dried, apply liquid furniture polish to give these components a nice shine.

Use a liquid detergent and water solution or a fabric cleaner to wash blended cloth, including velour, upholstery. Give the seatbelts a going over, too, as well as fabric on the floor and on door panels. Unless upholstery is stained (see below), this is all that's needed to get it clean.

If your car has leather upholstery, Nissan recommends you wash it with mild liquid soap and water. Ford and GM recommend their own brand leather cleaners. After leather has dried, a coating of old-fashioned saddle soap, Neatsfoot oil or a commercial leather conditioner will make it shine and keep it supple. Follow container directions.

Incidentally, avoid using auto body

wax on leather. It may cause leather to dry and crack.

The one soft-plastic (vinyl) part of a car that should get the most attention is the dash. If you leave it to fate, in time the sun's rays, intensified as they come through the windshield, will dry out vinyl and cause it to crack. Remove surface dirt with soapy water and then rub vinyl dressing into the dash. Give vinyl seats, vinyl armrests and vinyl door panels similar treatment.

Wrapping it up

In addition to what's been suggested, consider doing the following on the inside of the car:

- Wash simulated chrome. If it doesn't come out sparkling, use a piece of extra-fine steel wool that's been saturated with auto-body liquid polish, but be careful—employ a gentle touch or you'll leave scratches.
- Apply tire dressing to brake, clutch and accelerator pedals, and to rubber kick pads.
- Wash rubber floor mats in a sink filled with liquid detergent and water solution; then, rinse them with clear water and hang them up to dry. Vacuum carpet mats and use the stain removal techniques discussed below if necessary.
- Give door and window weatherseals a shot of the same silicone spray you used on trunk weatherseals. Be sure to use a piece of cardboard as a mask to keep silicone off the paint. Some brands leave behind a greasy stain.
- Wash door jambs and frames with a sponge and dry with chamois or paper towels. These are the parts car washes always miss.
- Clean glass inside and out with a commercial glass cleaner or ammonia

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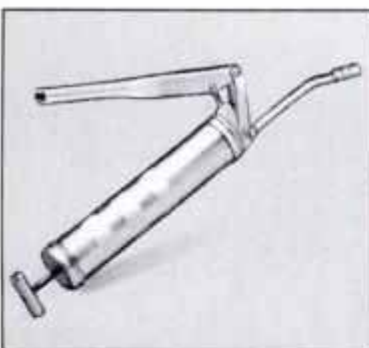
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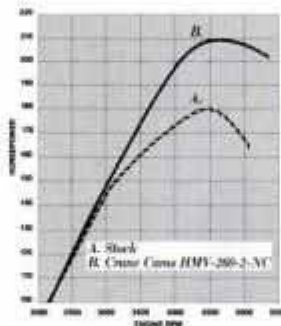


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and water. If you use vertical cleaning strokes inside the car and horizontal strokes outside, you can tell immediately which side of the glass any remaining streaks are on.

Treating stains

The "problem" part of getting an interior clean is removing stains from cloth upholstery.

Tough stains are those made by food or beverages. Tougher stains are those made by petroleum (grease, oil or tar) and by almost-indelible products such as lipstick, ink and crayon.

To get out a tough stain, use furniture upholstery cleaner. You get this in a supermarket. Pour some of it on a soft-bristle brush or sponge and apply cleaner using a circular motion until the stain disappears. Start in the center of the stain and increase the diameter of the swirl you make until the brush or sponge overlaps the outer edges of the stain. Then rub the area with a water-dampened cloth. If some stain remains, repeat the procedure.

To treat tougher stains, buy a spot-lifter or stain remover in a supermarket, auto parts store or new-car dealer. Read the label to make sure it will handle the kind of stain you want to get out. Most products come in spray cans. Hold the can 8 to 10 in. from the stain and give it a spritz. Leave it alone for five minutes. Most spot-lifters form a white residue when they've done their job and are ready to be brushed off with a bristle brush or vacuumed.

If any of the stain stays, take more drastic action. Saturate a cloth pad with the spot-lifter and press it on the stain. Then, using circular motion, rub the area to work the cleaner into the cloth. Rinse the spot with clear water.

Repairing velour

Car owners may be faced with cigaret burns or tears in upholstery. Vinyl repair kits have been available for a few years. They'll let you copy the "grain" from an undamaged area of vinyl and use it for matching the repaired area. You can even match colors. Now companies are coming out with kits to meet a growing demand for patching velour. One huge kit is sold to professional upholstery repairmen by Auto Velour Inc., Box 553, Ozona, FL 34265.

As this was being written, a small-size kit to make a 1-shot repair was not available—only the large version (cost, about \$300), which contains a variety of colors. The president of Auto Velour Inc., however, indicated that his company would have small 1-color kits for do-it-yourselfers in auto supply stores by the time this article appears. The intended price is under \$10. You might want to check this out before going to a professional shop.

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TUNE UP YOUR BODY

Careful inspection and quick action is the key to staving off the ravages of rust.

Believe it or not, you should start cleaning the outside of your car by letting the engine run for five minutes, then turning it off. Now, hose down the body—not to wash off dirt, but to get the body slick so dirt that may accidentally splatter as you degrease the engine won't stick. Wet the windshield, too. That's the first thing that professional detailers do before they start sprucing up the exterior of your car.

Now, remove the battery and air cleaner, if the engine has a carburetor or throttle body. Cover the carb or throttle body with plastic wrap. Also cover the distributor and sparkplug cables, electrical connectors and wires.

Forward march

Working from the rear of the engine compartment forward, spray engine degreaser on the firewall, fender wells, battery tray, warm engine block, hood hinges and underside of the hood (remove the hood insulator if possible—if not, skip the hood). Let the cleaner do its work for the length of time recommended in the instructions, usually at least five minutes. Then, hose it all down.

If a second treatment is necessary, fine; but chances are only a film will

remain. That's where a wash mitt comes in handy. Mix a liquid dishwashing detergent with water, saturate the mitt in the solution and wash down the engine compartment. This will get rid of the film. Then rinse again. To really make that engine compartment sparkle, do one or both of the following:

- Repaint the engine to its original color with a fire-resistant paint that you can buy in an auto parts store.
- Give fender wells and firewall a high gloss by treating them with a liquid furniture polish. That's how Doug Wilson gets his customers' engine-bay sheetmetal to sparkle.

Dealing with wheels

Use mag-wheel cleaner if you have mag wheels, plain wheel or an all-purpose cleaner if you don't. Spritz the stuff into recesses you can't get your fingers into. Then, wipe off the wheels with a rag and use a toothbrush to reach into cavities.

Incidentally, watch it with mag-wheel cleaner. Avoid getting it on plastic, such as wheel emblems, or paint or a polished wheel rim. It's a lot stronger than most other cleaners and may cause discoloration.

Finish up down below by cleaning tires with an all-purpose or whitewall cleaner. Don't apply tire dressing yet; save that for last. Otherwise, soap and wash water may undo the dressup work you've done.

Bugging out

Give the body a walk-around, looking for splatters of tar, road grit and bugs. Remove with bug and tar remover. Bug splats often look like chipped paint, so don't be fooled into ignoring them. To be sure, treat everything that looks

suspicious. If the cleaner removes the stuff, it's bug residue—if not, it's a chip you should touch up with paint.

Wet the body again and use a mild liquid dishwashing agent mixed with lukewarm water to wash it. This time concentrate on getting off dirt. Then, let the car air dry or hasten the process with a chamois. Either way, the tops of body-side molding strips, window frames, taillight housings and any place else where water may be lying in a puddle needs special treatment. Make sure to wipe these areas dry. If you don't, the body cleaner you apply will become gooey muck when it mixes with water.

Calling Dr. Clean

Now comes the major operation, and it requires good judgment as well as muscle. You have to select a polishing agent. Agents fall into three categories:

1. A liquid polish or cleaner—This is mildly abrasive and should be used if paint isn't chalky.

2. A polishing compound—This is moderately abrasive and should be used if the paint has a chalky glaze.

3. A rubbing compound—This is highly abrasive and should be used on badly chalked paint as a last resort to restore gloss. If this fails, the choice is to ride around in a car that looks like a school blackboard at the end of the day, or to repaint the car.

Selective treatment

You may find that a liquid polish is adequate for parts of the car not subjected to direct rays from the sun (doors and sides of fenders), while a polishing compound has to be used on the roof, tops of fenders, hood and trunk lid. The point is to use the least



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abrasive agent you can get away with on each individual body panel to avoid removing more paint than necessary.

There's danger when using a polishing or rubbing compound of cutting through the paint and into the primer. Once this happens, the car is a candidate for repainting. If you don't repaint, moisture may seep through a porous primer and start rust that will eventually cause the paint to blister and, if ignored long enough, to perforate the sheetmetal.

When you do polish, it's best to do the job by hand or to use a buffer/polisher, also called an orbiter. The orbiter is a power tool designed to provide the safest way to polish a car—safest in the sense of maintaining the integrity of the paint. The tool, which costs about \$150, has a thick (about 3 in.) rotary buffing pad with a large diameter (about 12 in.). The tool is designed to practically force you to apply the entire flat surface of the buffer to the car body with relatively light pressure.

The problem with using an electric drill or any rotary tool as a buffer is that many who work with them hold these tools at an angle to the car or use too much force, "burning" the paint or rubbing through to the primer.

You can also polish by hand, which is a long afternoon's work and not as consistent as using an orbiter. You may find orbiters at tool rental stores that carry automotive tools. When the polishing phase is done, look for polish residue caught in cracks around moldings, lamp housings and gutters. Remove residue with a soft-bristle toothbrush, then apply wax to the body.

The best kind is a paste wax. Only one application is necessary—two won't get you any greater protection than a single coat, which brings up another point. Wax doesn't give paint a gloss—the polishing agent does. The job of wax is to protect the finish. Water forms nearly spherical beads on a newly waxed car. As the wax wears down, beads flatten out and get bigger. When water forms quarter-size "puddles," it's time to re-wax.

Final touch

Give dressy exterior parts their special treatments. Use a vinyl cleaner on vinyl tops, vinyl moldings, and urethane or polypropylene bumpers. After cleaning black plastic bumpers, try a coat of black, wax-type shoe polish to really make them stand out.

Sharpen up the black parts of tire sidewalls with tire dressing. Clean simulated chrome with an all-purpose cleaner. If "chrome" doesn't come out sparkling, it may need a stronger treatment. Try extra-fine steel wool that's saturated with a liquid body polish, but apply it gently to avoid scratches. **PM**

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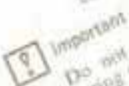
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4.4 LEADING/TRAILING DRUM BRAKE ASSEMBLY

- Spring washer (5) with the concave side against web of adjuster shoe and lining (9).
- Adjuster actuator (4) so that its top leg engages the notch in the adjuster screw (14). view C.
- Spring connecting link (3) and hold in place.



- Important**
- Do not over stretch the upper return spring (2). The spring will be damaged if extended length is greater than 139.5 mm (5.49 in).
 - Upper return spring (2).
 - Insert angled hook end of spring through park brake lever (18) and shoe and lining view A.
 - Grasp long, straight section of spring with J-3027 pliers. Pull spring straight across and then down to hook into crook on spring connecting link (3).



- Important**
- Do not over-stretch actuator spring (1). The spring will be damaged if the extended length is greater than 83.0 mm (3.27 in).
 - Actuator spring (1) with suitable pliers, view B.

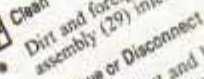
- Adjust the rear brakes as described in this section.
- Apply and release park brake 6 times to 10 times. Release park brake pedal.
- Check parking brake pedal assembly for release by turning ignition to "ON" and inspecting the "Brake" warning lamp. The lamp should be off. If the "Brake" lamp is on, the brake appears to be released, operate the release lever and pull downward on the parking brake cable to remove slack from assembly.
- Raise car and suitably support, see Section 3E.
- Remove access hole plug (32).
- Adjust parking brake cable until a 1/8 in (3.17 mm) drill (34) can be inserted through access hole lever as shown in figure 6. Suitable 1/8 in (3.17 mm) drill will fit into the space between the shoe web and the parking brake cable adjustment is achieved.
- Check for free wheel rotation.
- Replace access hole plug (32).
- Lower car.
- Torque wheel nuts. See Section 3E WHEEL AND TIRES.

WHEEL CYLINDER

See Figure 1 and 7



- Clean
- Dirt and foreign material around wheel cylinder assembly (29) inlet and pilot.



- Remove or Disconnect
- Remove tube nut and line.
- Opening in line to prevent further contamination.
- Check for leaks (19).
- Check for leaks (19).
- Check for leaks (19).

MOTOR AUTO REPAIR

LEADING/TRAILING DRUM BRAKE ASSEMBLY SC45

- ACTUATOR SPRING
- UPPER RETURN SPRING
- SPRING CONNECTING LINK
- ADJUSTER ACTUATOR
- ADJUSTER SHOE & LINING
- SHOE & LINING
- SPRING CLIP
- ADJUSTER SCREW
- ADJUSTER SCREW
- PARK BRAKE LEVER

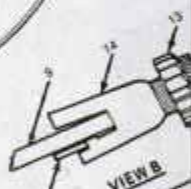
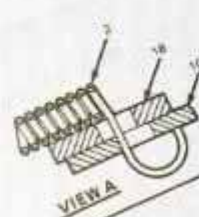
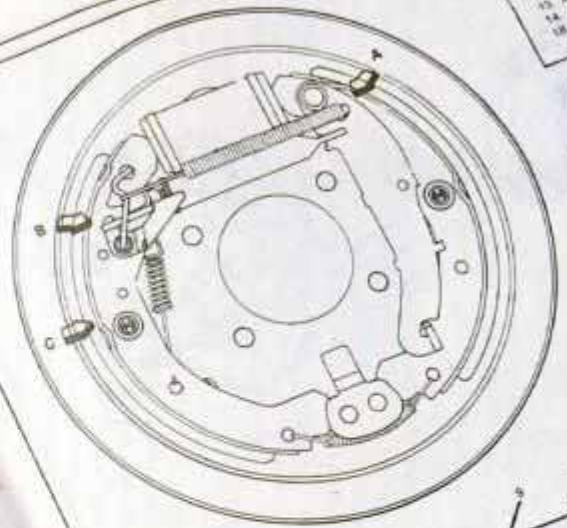


Figure 4 Brake Assembly

- Parking brake cable from backing plate.
- Hub and bearing bolts.
- Backing plate.
- Install or Connect
- Backing plate
- Install or Connect
- Backing plate
- Install or Connect
- Backing plate
- Install or Connect
- Backing plate

torque assembly with bolts
52 N·m (39 lb ft)

TOOLS OF THE TRADE

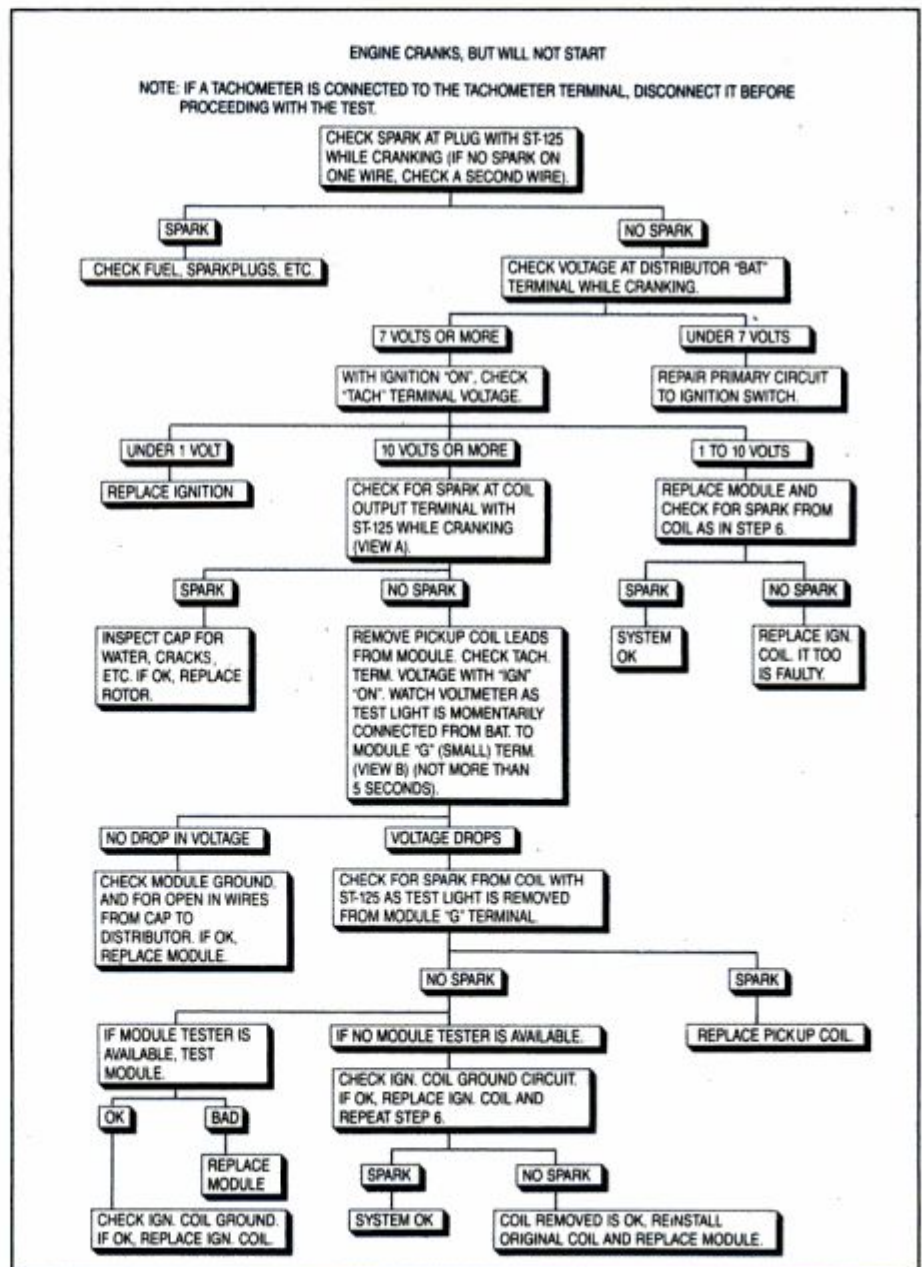
You can't do good work without good tools. One of them is a service manual.

To a mechanic, "tools" fall into two important categories: "hardware" tools, the implements that actually do the job, and "software" tools, the books and other publications that provide the information necessary to do the job. To work on your own car with any measure of success, you'll have to stock your garage with some of both.

Strategies and Instructions

There's no good excuse for a driveway mechanic to be without the factory service manual for his automobile. General auto repair manuals that cover a variety of makes are less expensive than several factory manuals if you have more than one car to work on. *Motor Auto Repair Manuals* are available for domestic (\$21.50) and imported (\$25.50) cars and for light trucks and vans (\$27.50) in bookstores or from Motor Publishing, 555 West 57th St., New York, NY 10019. You can usually buy the factory manual through your car dealer's parts counter. For some cars, more than one instruction book is necessary to fully cover drivetrain as well as body and electronics.

1 "Trouble tree," found in service manuals, takes you to problem in fewest steps.



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The service manual

Most factory service manuals begin with a general information section, usually with charts that tell you how to interpret your car's VIN number. You'll be able to pinpoint the specs of the engine installed, the plant at which the car was built, and similar data. Other charts interpret body ID plates with paint and interior color codes as well as trim levels. Other general information will include overall specs, fluid capacities of the various systems and even data on bolt ID and torque. This chapter should also show the correct jack and lift points for raising and supporting your car.

The general information section is often followed by a maintenance and lube chapter. Use this material in conjunction with our car care plans to tailor the maintenance routines to your specific vehicle.

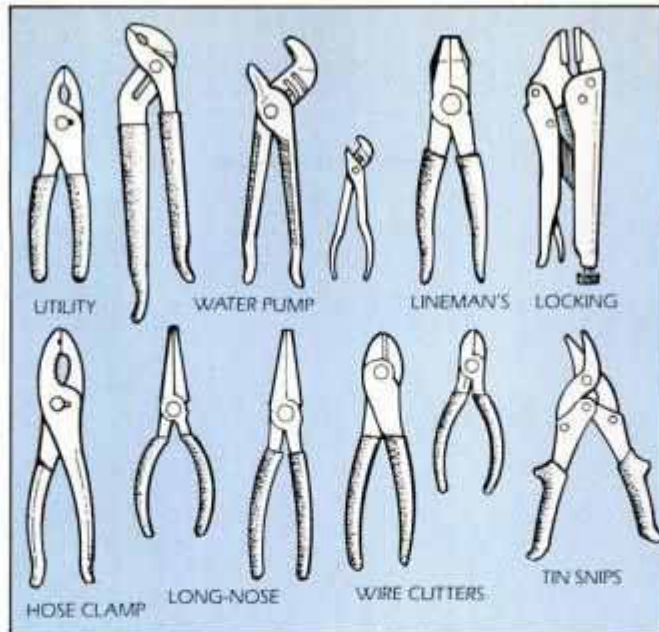
The rest of your service manual is divided into chapters, each of which covers one specific system, such as heating and ventilation, or a group of systems, such as emissions controls.

Most manual chapters include three types of information. First, where applicable, many chapters begin with a short explanation on how a particular system operates. This information can help when it comes to making logical decisions about the possible causes of a given problem.

Next comes diagnostic information. This troubleshooting material can be very general and somewhat brief or it can be incredibly specific and detailed. Typical of the first kind of diagnostic directions are those for engine mechanical diagnosis. Here you'll find lists of possible causes that relate to a symptom. For example, in the 1985 Celebrity manual there are eight potential problem areas listed under the heading "Excessive Oil Loss."

Much more complicated are the diagnostic procedures for driveability problems. Some makers, such as GM, instruct you to begin the diagnosis of a driveability problem by triggering the diagnostic mode of the computer system. You progress from there to troubleshooting individual systems with test lights, ohmmeters and the like, and sometimes finish up checking symptom-organized lists of possible causes.

Other manufacturers, notably Chrysler, begin diagnosis of computer-controlled engine driveability problems with visual checks. In either case, you have to read the manual material carefully and do things in the right order.



2 Pliers are handy for many specialized jobs. Just don't use them when what you really need is a wrench or socket.

The procedures work on a process of elimination basis. If you don't begin at the beginning, you throw the whole diagnostic plan out of whack.

At some point, the troubleshooting of complex systems is sure to include a diagnostic "tree diagram" (see Fig. 1). To follow our example of this type of diagram, you obviously begin by performing the test in the box at top. Then, depending on whether you find "spark"

or "no spark" you proceed on to one of several "branches." Notice that every path eventually concludes with a repair or with a "system ok."

The third type of information, usually at the end of a service manual chapter, is on repairs. It often doesn't include tasks considered simple by professional mechanics.

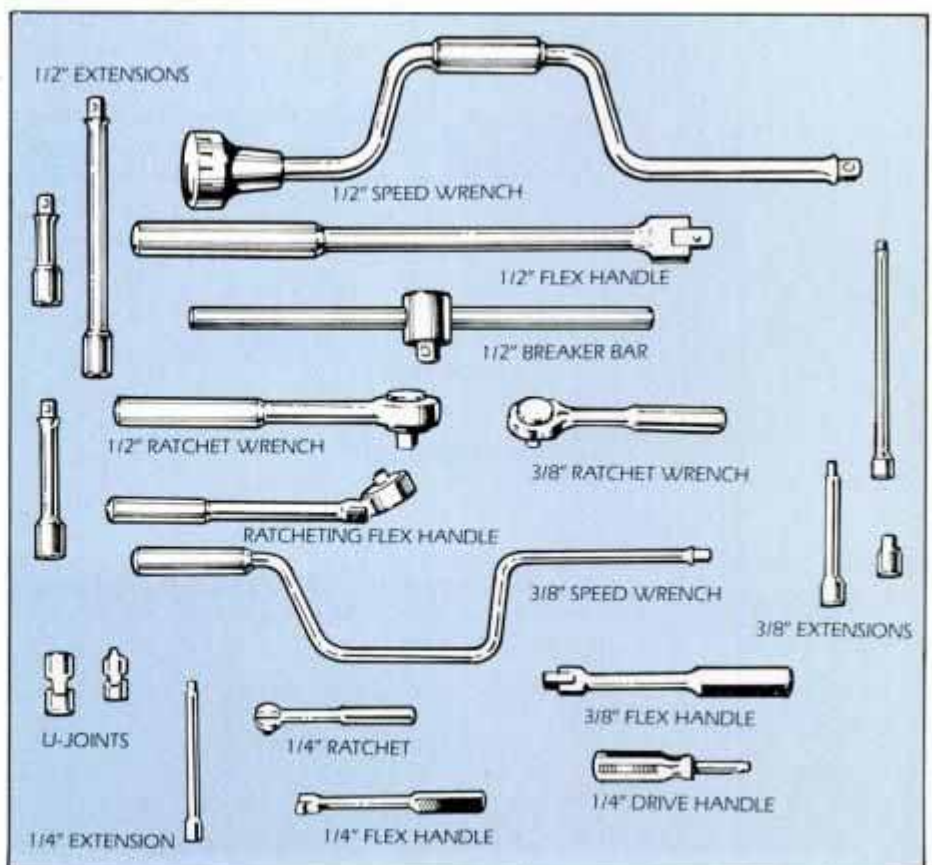
The toolbox

How many tools do you need to service your car? Frankly, as many as you can afford. Realistically, however, you can get by with a fairly basic set if you intend to do only maintenance jobs. But if you're going to perform complicated repairs you'll need a lot of special tools, many of them designed to do just one specific job.

Plier tools

From among the vast number of plier tools, you'll need at least three basic types: a conventional slip-joint plier, a pair of side-cutters for cutting and stripping wire and—among many other uses—prying out cotter pins, and a pair of long-nose or needle-nose pliers.

Once you have the basic three you'll eventually want to expand your plier drawer (Fig. 2). You might first add a



3 Whether you need to turn sockets fast, really tight, from an odd angle, or from far away, there's a special ratchet, extension or handle to do it.



4 Twelve-point sockets will fit hex and square nuts. However, they have a tendency to round off tight hexes.

locking-plier, the most common type is sold under the Vise-Grip trademark. Among many other possible uses, this tool can be clamped tightly around a stripped bolt for removal or it can be used to hold parts in place for welding. Lineman's pliers with insulated handles are useful for various electrical-system chores. Water-pump pliers offer nearly parallel jaws and lots of leverage. A second pair of long-nose pliers can be sharpened for service on snap rings, or special snap-ring pliers are available as well. Small side-cutters can be of use when working with delicate components. Hose-clamp pliers are grooved to grab the spring-type hose clamps that are standard equipment on many cars. Wire strippers/terminal crimpers (not pictured) are very useful pliers with a row of split circles on the jaws for stripping wires of various gauges and a special crimping area behind the jaws for attaching solderless wire terminals. Tin snips, available for cutting left-hand curves, right-hand curves and straight cuts, are a necessity if you're going to do serious bodywork.

Screwdrivers

For servicing today's cars, you'll need an assortment of flat-blade and Phillips screwdrivers in various sizes. You'll ruin a lot of screwheads if you use the wrong-size driver. In addition to various-sized tips, you'll need some variety in handle lengths. Cheap screwdrivers are not well suited to driving screws, so buy high-quality tools that will not distort the screwheads.

For most cars you'll also need a couple of Torx-style screwdrivers, distinguished by their 6-point drives. On some cars, you'll need this type of screwdriver to replace a headlight bulb or seatbelt housing.

Our favorite screwdriver is a high-quality, flexible-shaft ratchet job with interchangeable bits of tool steel. The extra bits fit in the handle, and are



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Tufoil turns your motor oil into a super lubricant, protecting all internal engine parts.



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1. Read text for the National Bureau of Standards data.
2. Six U.S. and a number of foreign patents have been awarded to Fluoramics for Tufoil®. More are pending.
3. Independent laboratory tests throughout the country and throughout the world have proven Tufoil's claims of making your car's engine run better, smoother, cooler.
4. In Canada, government tests show a big improvement in low temperature starting for gas and diesel engines with Tufoil® (5% fuel savings)
5. In Australia, researchers at the University of New South Wales reported fuel savings of up to 7%.
6. In Israel, scientists at the Technion Research Institute found Tufoil® a reliable lubricant for scorching desert driving. Save fuel too (4%).
7. In Texas, stationary engines used to pump natural gas are lasting more than twice as long and running cooler on hot sunny days when Tufoil® is used.
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Other U.S. Patents issued and pending

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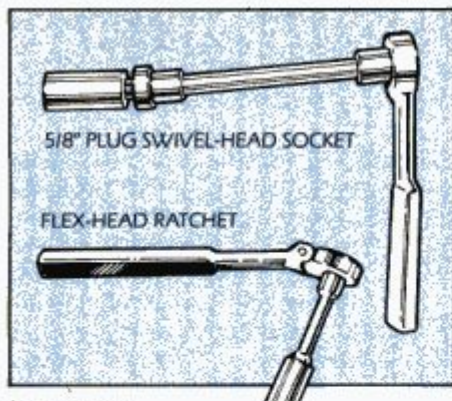
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PM57



5 Swiveling wrenches with sparkplug sockets fit cramped engines.

available in every size and style you might need. Angle screwdrivers, with a tip mounted perpendicular to the shaft, are useful for screws that can't be reached with anything else.

Socket tools

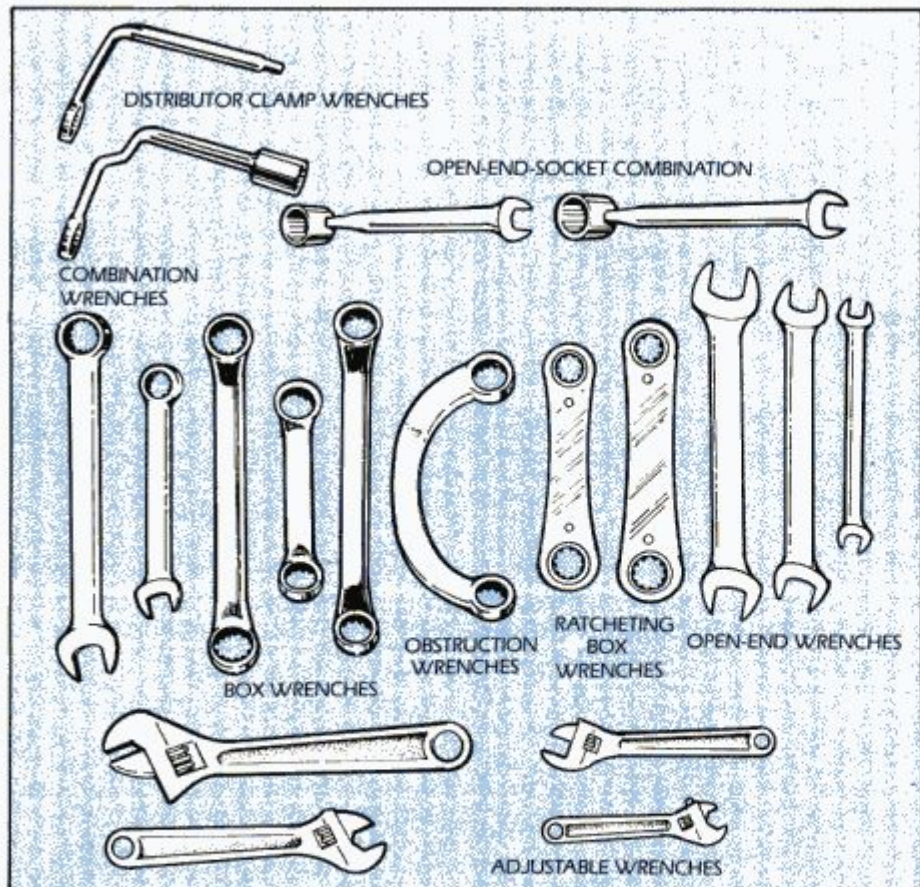
Square-drive tools are probably the most important for someone who intends to service automobiles. To begin, you'll need both $\frac{3}{8}$ -in.-drive and $\frac{1}{2}$ -in.-drive ratchets and breaker bars (Fig. 3), at least one short and one long extension for each drive and a complete set of standard sockets for each. If your car is fully metric, you may want to purchase just metric sockets at first. If your car includes both metric and inch

sizes, you'll need a set of each.

You'll need a sparkplug socket of either $\frac{13}{16}$ -in. or $\frac{5}{8}$ -in. size. Don't just use a deep-socket for this purpose. Sparkplug sockets have a special rubber insert to hold the insulator, helping prevent breakage while giving you a means to lift the plug away from the engine without dropping it.

A torque wrench is also a necessity, as it should be used for everything from installing wheels to tightening cylinder head or manifold bolts. The most common and least expensive type has a pointer attached to the drive head that rests against a scale near the handle. More expensive types replace the scale and pointer with a dial. A style used by many mechanics has a rotating handle with a scale of torque figures on the tool. You dial-in the torque figure you want by turning the handle. Then, when you tighten the bolt, the wrench will click to signal you when you reach the specified figure.

Eventually, you'll want to add universal joints, which can be fitted at the end of an extension; speed handles; T-handles; additional extensions; and a $\frac{1}{4}$ -in. ratchet, extension and screwdriver handle for smaller capscrews. Adapters that allow the use of $\frac{3}{8}$ -in.-drive sockets on $\frac{1}{2}$ -in.-drive ratchets (or various other combinations) can also be handy at times. You'll want to expand your socket set to include hex or Allen drive



6 Use adjustable wrenches as a last resort—they're hard on both the bolt head and your knuckles. Use the box wrenches whenever you can for the same reason.

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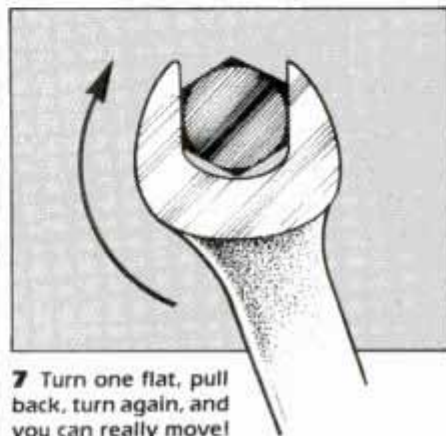
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sockets, sockets for large slotted screws, deep-well sockets, universal-joint "swivel" sockets, and 1/4-in.-drive sockets, all in both inch and metric sizes.

You'll also want to supplement your standard 12-point sockets with some 8-, 6- and 4-point sockets (Fig. 4). Six-point sockets are needed when you have to loosen a bolt with rounded corners where the 12-point might slip. Our 3/8-in.-drive deep-well sockets are of the 6-point type. Thick-wall 6-point sockets (usually black for identification) are available for use with impact wrenches. Eight- and 4-point sockets are for removal of square plugs. If you have the 8-pointers, you really don't need the fours.



7 Turn one flat, pull back, turn again, and you can really move!

If you can't reach the sparkplugs on your engine with a conventional plug socket, extension and ratchet, you may need either a swivel-head plug socket or a 3/8-in.-drive ratchet with a jointed hand that can be rotated to a different angle in respect to its handle (Fig. 5).

Wrenches

A basic set of combination wrenches—box at one end and open end on the other (Fig. 6)—will get you started in this department. Use a box wrench when you don't have clearance for a socket. Open-end wrenches are really only suited to running down a bolt or backing it out, as they slip quite easily, ruining both the bolt-head and your knuckles.

Fig. 7 shows how an open-end wrench should be used, handle angled away from the direction of rotation. Once the bolt is rotated, the wrench is slipped off, slid around in a counter-clockwise direction and reinserted. Once you've practiced this technique, an open-end can be used to turn a bolt very quickly. When loosening a fastener with a combination wrench, break it loose with the box end, then flip the wrench around and run out the bolt with the open end.

Once you have a basic wrench set, you'll want to expand with some other


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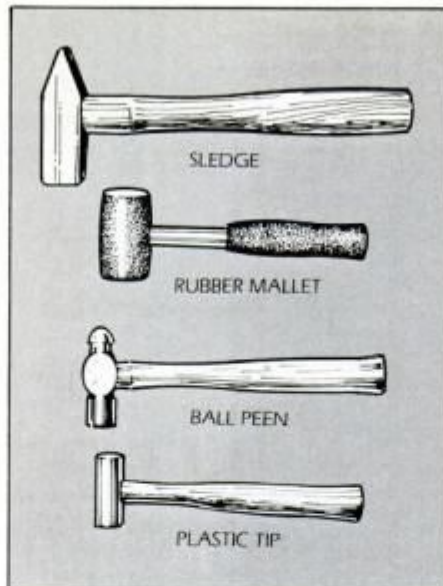
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8 If you're looking for a claw hammer, it belongs in the woodshop, not the garage.

types. Those that have a box on both ends generally have a greater offset than the combos, making them useful for certain problem areas. Both box and open-end wrenches are available in a variety of lengths. You'll also find box wrenches shaped like a crescent for inaccessible bolts, box wrenches that ratchet, and sockets attached to a handle with an open-end opposite. We frequently use a very thin open-end "tap-

pet" wrench for any double-nutted bolt or stud or in tight spots.

You'll also want tubing wrenches (not pictured) which are like a 6-point open-end with one side missing. Once slipped over a tube, the five remaining points of the wrench can loosen the soft nut on the end of the tube without rounding it off. Special L-shaped box wrenches that can be driven with a ratchet are available for loosening hard-to-reach distributor clamp bolts.

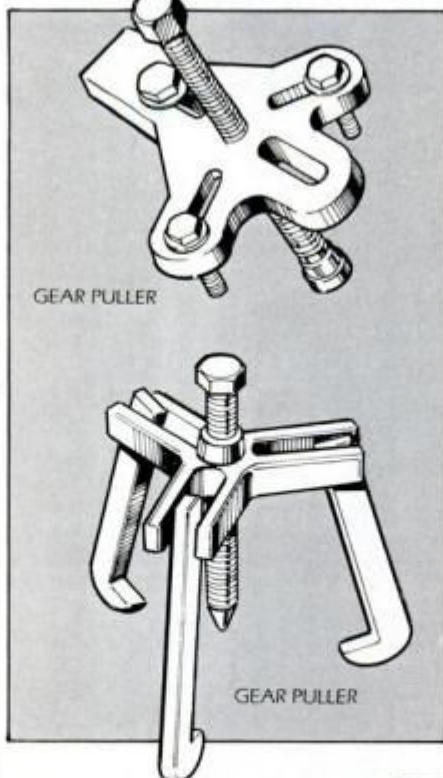
You might be better off without adjustable crescent wrenches, as these tools are most likely to round-off a hexhead. But it's good to have a couple of them around in different sizes for those times when you have to turn a simple-to-reach, not-very-tight bolt, the size of which you are not sure.

Hammers

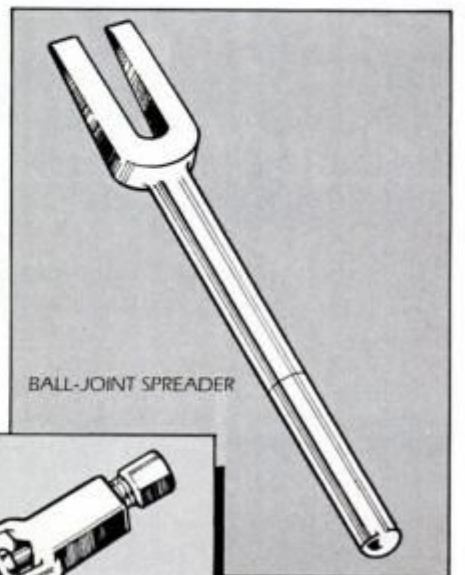
Hammers must be used with great restraint when working on a complicated machine like an automobile. But you will need one from time to time (Fig. 8). Begin with a ball-peen for tapping your drift or making a center-punch mark, and supplement it with a rubber mallet for banging things into position. Eventually, you'll want to add a brass hammer for driving lugs into hubs and similar tasks. A plastic-head hammer is useful for dislodging somewhat delicate parts. Finally, you'll want a good hand sledge to drive a large chisel into a large rusty nut.

You'll want to have some chisels, punches and drifts that you can hit with your hammers. If you work on cars regularly, you'll undoubtedly have to chisel off a rusted nut or bolt before long, probably on a shock absorber. Drifts are used for removing pins from shafts, studs or hubs. A center punch is necessary to provide a spot to start a drill bit in steel or aluminum.

You'll need only a couple of files at first. A small ignition-point file is good



9 Don't even think of prying off a pulley or harmonic balancer with a screwdriver—use a puller. Nut splitter is great for exhaust nuts. Ball-joint tool is affectionately known as a "pickle fork."



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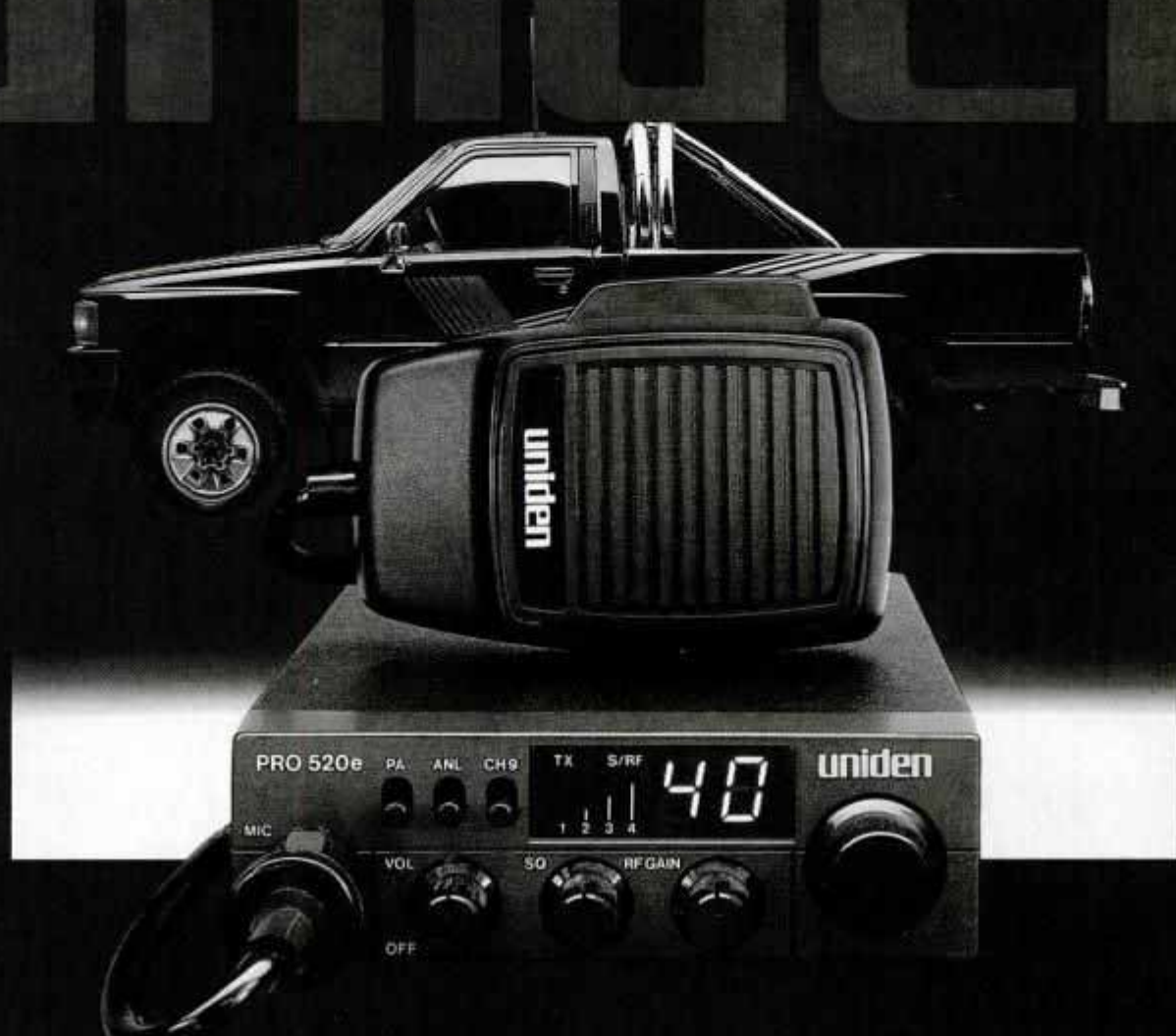
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for cleaning up sparkplugs or even repairing the threads on a small screw. One medium-size flat file will also come in handy for smoothing rough edges or flattening slightly distorted surfaces. Later, you'll want to add a rattail for smoothing out holes and a 3-sided file for getting into corners. A hacksaw and a couple of high-quality, fine-tooth blades will come in handy if you have to shorten a bolt or fabricate a bracket.

An assortment of tool-steel high-quality drill bits and a 1/2-in. or 3/8-in. chuck electric drill is also necessary.

Pullers and pluckers

Hub pullers, nut splitters, gear pullers, pickle forks and other devices of this ilk probably won't be purchased until you need them. Sooner or later you will undoubtedly want them, however.

A good 3-pronged gear puller (Fig. 9) can be used for removing a variety of hubs and gears. This tool is available in several sizes to suit various applications. A puller with slots through which bolts can be inserted is useful for removing any type of hub with threaded holes, such as a steering wheel hub or engine damper pulley. Various other pullers, including slide-hammer devices for removal of rear-drive axles, are also available. Some of them can be rented for one-time use.

A nut splitter is a good substitute for a chisel when you have to remove a rusted nut. A ball-joint spreader and rod-end separator, commonly known as pickle forks, are necessary for suspension-system work. The ball-joint spreader has the wider slot between its prongs.

Oil change and lube tools

An oil filter wrench is, of course, an absolute necessity for any driveway mechanic. Before you buy, make sure you get one that will work on your car, as there are numerous types available (Fig. 10).

Most of the long-handled metal-band jobs work great where there's room for them, but on most cars there isn't. The best of these are adjustable for different type filters.

A handy oil filter wrench is the type that has a sturdy nylon strap attached to a piece of square tubing with a 1/2-in. hole down the center. The strap is placed over the filter and the tubing is rotated counterclockwise until the strap snugs up. Then a 1/2-in. square drive extension and ratchet are used to continue rotating the tubing until the filter is loosened.

In addition to a filter wrench, you'll want an oil-can spout, if you can't get oil in plastic bottles with built-in spouts.

Precision tools

Every home mechanic should have at least a good pair of vernier calipers for determining the size of pins, bolts and other similar items as well as a set of feeler gauges and a wire gauge for checking sparkplugs. If you're going to rebuild engines, you'll need much more, including micrometers, snap gauges, a dial indicator and magnetic base, a depth micrometer, and—ideally—a dial-bore gauge. A good ring compressor will also be needed for engine work. The best type is a tapered sleeve for each bore size. If you plan on assembling cylinder heads, you'll need a valve-spring compressor.

The dial indicator and magnetic base are probably worth having even if you never touch the inside of an engine as it is useful for gauging a lot of different things, such as ball-joint wear and even wheel-bearing adjustment.

Other good stuff

Sooner or later you'll want to invest in a battery charger. A small, 10-amp job can bring a partially discharged battery to full charge in a few hours. You'll need at least a 6-amp model for decent performance. In addition, you'll need a battery post and terminal cleaning tool. You can use a knife for this job, but the special cleaning tool is inexpensive and

"IF YOUR VEHICLE'S PERFORMANCE NEEDS A BOOST, I'D SUGGEST

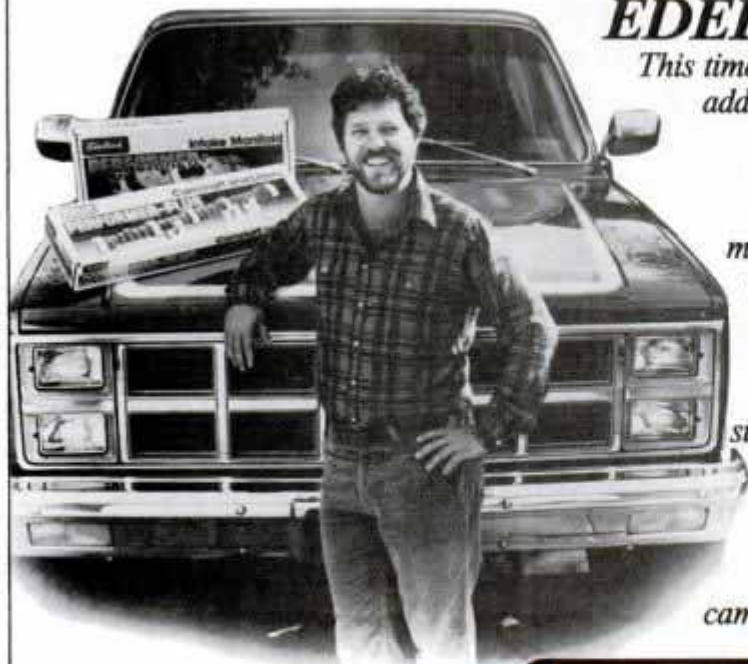
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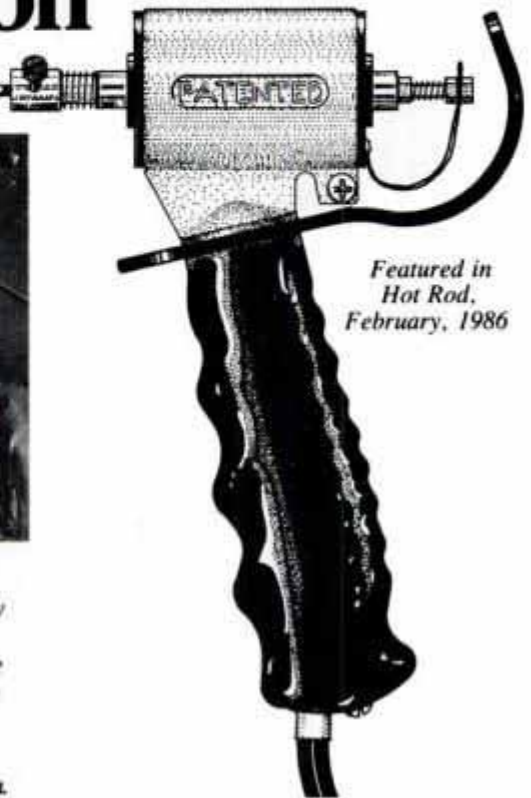
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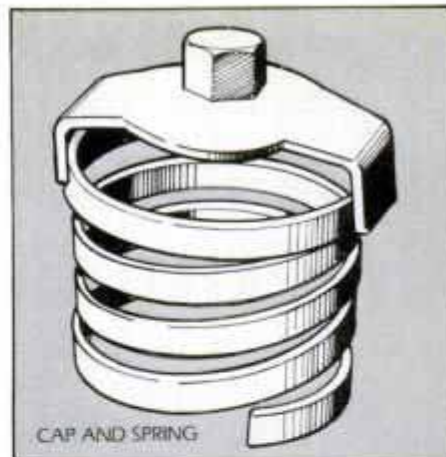
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does a better job. You'll need a timing light to perform tuneups. If you're willing to suffer, you can use the cheap kind that attaches only to the plug wire. A power timing light, which provides much more illumination and is immeasurably easier to use, costs about three times as much.

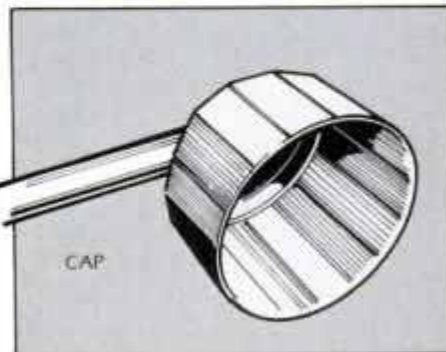
And you can't get by without a miniature analyzer, which includes a tachometer, ohmmeter, voltmeter, ammeter and dwell meter. Use it for tuneups, charging-system troubleshooting, general electrical-system troubleshooting, and a wide variety of other jobs.

A good set of taps and dies is expen-

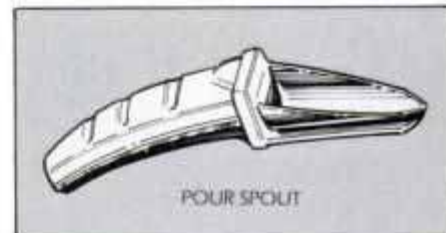
sive but necessary when you have to straighten out the threads on a mangled bolt or clean the threads in a rusty cylinder block. Finally, don't forget to be nice to your tools. You don't have to get into public displays of affection, but you should wipe off the grease each time you use one. And you should have an organizational plan for keeping everything in its place, whether you have a 12-drawer top-and-bottom tool chest or a 2-drawer mini toolbox. Knowing where something is when you need it can cut your creeper time in half. It also makes it easier to tell when something is missing. **PM**



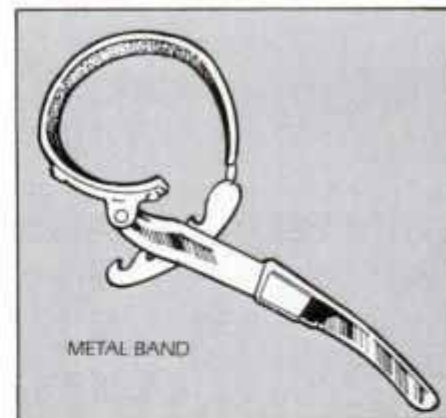
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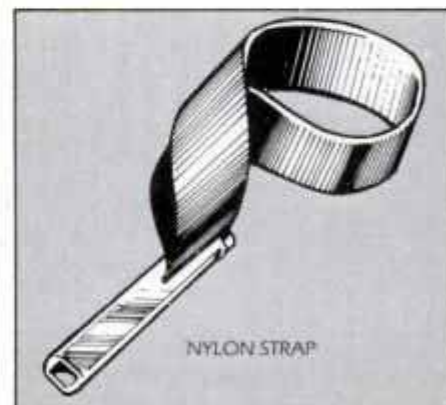


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METAL BAND

10 Get the filter wrench that fits your car. Pour spout is optional nowadays.



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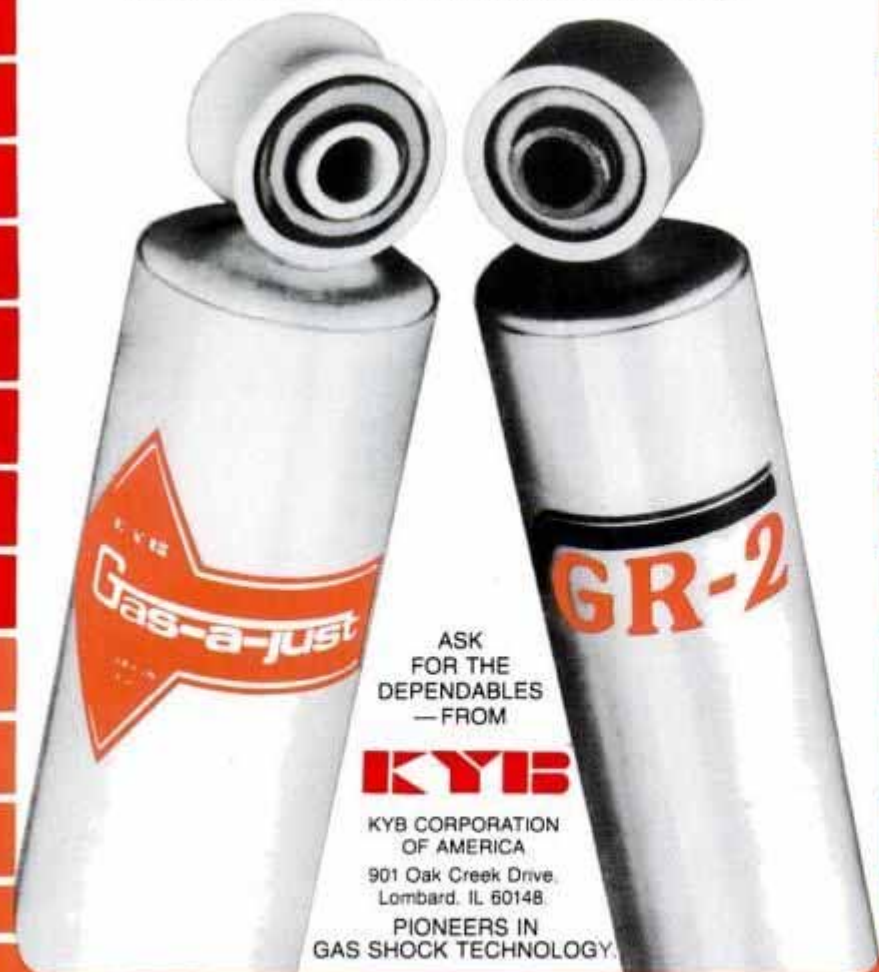
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One of the country's most respected research institutes reported applying a powerful ultrasonic cleaning process to a Slick 50 treated engine and were surprised at its permanence. "We actually expected the Petrolon Slick 50 TFE Resin coating to also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

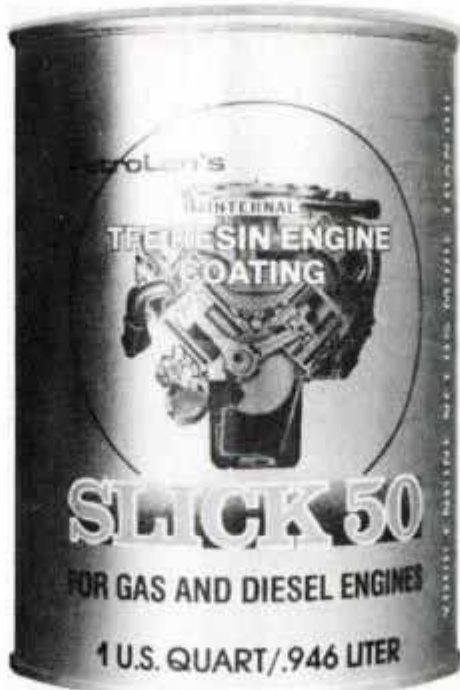
"Dune Buggies & Hot VWs" magazine April 1983 issue records the results of their one year testing of Slick 50. "We can indeed say scientifically that Slick 50 does work, and that it does reduce engine wear! . . . for the price of one treatment when compared to engine rebuild, we feel that you'd be money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

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1030	Audi 80-85 all models	\$14.95
1244	AMC 70-83 all models	\$14.95
1184	AMC 75-82 covers AMC, Matador, Pacer	\$14.95
9157	AMC 80-83 covers Eagle, SX/4, Kammback	\$14.95
0919	Arrow 76-80 covers all models	\$14.95
0891	Aspen 76-80 all 6 & 8 V8 models	\$14.95
7122	Audi 100 70-77 all models inc 100LS	\$14.95
1229	Audi 4000 80-85 all sedan & coupe	\$14.95
9699	Audi 5000 77-83 factory shop manual	\$44.95
4688	Audi 5000 84-86 factory shop manual	\$89.95
0726	Audi Fox 73-79 covers all models	\$14.95
0379	Barracuda 65-72 all 6 & V8 inc 'Cuda	\$13.95
1942	BMW 2002 59-77 all inc 160i, no CS	\$14.95
9813	BMW 320i 75-83 covers all models	\$14.95
8199	BMW 528i, 530i, 75-80 for all models	\$14.95

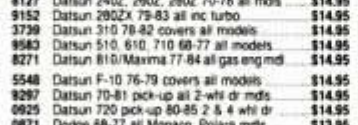
2565	Intarmati 62-80 wagon, pick-up, Scout	\$13.95
8206	Intri Scout 67-73 A, B, I, 8000 models	\$13.95
1043	Jaguar E-type 61-72 all 6-cyl models	\$14.95
9399	Jaguar XJ6 68-84 covers all models	\$14.95
0020	Chrysler 74-79 tractor, mail, give year	\$29.95
9148	Chrysler 80-85 all 6-cyl + Buick Skylark	\$14.95
8732	Colt & Champ 70-83 front wheel drive	\$14.95
8032	Concorde 80-89 all models inc turbo	\$13.95
8372	Corvette 68-82 all engines & models	\$14.95
4200	Corvette 84-86 covers all models	\$13.95
1242	Cougar 67-73 covers all 6 & V8 models	\$13.95
1756	Croquet 70-73 all + Hieman Avenger	\$14.95
8188	Datsun 720 70-82 covers all models	\$13.95
9582	Datsun 200SX 82-82	\$14.95
8065	Datsun 1200/8210 71-78 all models	\$14.95
0783	Datsun 210 79-82 for all models	\$14.95
8127	Datsun 240Z, 260Z, 280Z 70-78 all models	\$14.95
9152	Datsun 280ZX 79-83 all inc turbo	\$14.95
3728	Datsun 720 70-82 covers all models	\$14.95
9583	Datsun 510, 610, 710 80-77 all models	\$14.95
8271	Datsun 810/Maxima 77-84 all gas eng mdl	\$14.95
5548	Datsun F-10 76-79 covers all models	\$14.95
8287	Datsun 70-81 pick-up all 2-w/hi dr models	\$14.95
9225	Datsun 720 70-82 covers all models	\$14.95
8871	Dodge 68-77 all Monaco, Polara models	\$13.95
1257	Dodge 72-84 tune all rear-wheel dr mds	\$14.95
8056	Dodge Aries 81-83 for all models	\$13.95
9256	Dodge Daytona 84-85 all inc turbo	\$14.95
1259	Dodge Omni 76-84 all + 024, Chrg, Rmpg	\$14.95
0953	Dodge 67-84 pick-up all 4-w/hi dr mdl	\$13.95
1298	Dodge 71-84 pick-up all 2-w/hi dr mdl	\$14.95
8370	Dodge D-50 79-85 pick-up + Mitsubishi	\$14.95
8203	Dodge 67-70 vans to 1 ton + Plymouth	\$13.95
6070	Dodge 71-83 vans to 1 ton + Plymouth	\$14.95
1180	Dodge Caravan 84-85 + Plymouth Voyager	\$14.95
8192	Duster 70-76 all models inc Scamp	\$13.95
9688	Escort 81-84 all mds inc EXP	\$14.95
8189	Fairlane 62-70 for all models	\$13.95
3366	Farmort 78-83 for all models	\$14.95
8776	Fiat 124 67-82 all, Spyder, 2000, turbo	\$14.95
9640	Fiat 128 72-79 all mds + SL, Rally	\$14.95
8106	Fiat 131 79-80 all 1.8 & 2.0 engines	\$14.95
0399	Fiat X1/9 71-80 covers all models	\$14.95
6022	Fiat Strada 79-80 all models	\$14.95
1073	Fiesta 78-80 covers all models	\$14.95
6309	Ford 70-81 all V8 mds + TransAm	\$14.95
1685	Freight 82-84 covers all models	\$14.95
9436	Ford Granada 75-82 covers all models	\$13.95
9611	Ford 71-82 Elite, LTD II, Pincho, Tbird	\$13.95
0872	Ford 68-85 Custom, Galaxie, LTD XL	\$13.95
9551	Ford Tempo 84-85 all + Mercury Topaz	\$13.95
0369	Ford Courier 72-82 covers all models	\$14.95
8205	Ford 55-66 pick-up 2 & 4 w/hi to 1 ton	\$13.95
0451	Ford F-100 pick-up 59-84 2-w/hi dr + dest	\$14.95
9458	Ford 73-79 pick-up 2 & 4 w/hi F-mts	\$14.95
10403	Ford 80-83 pick-up 4-w/hi dr gas F-mts	\$14.95
10322	Ford Ranger 83-84 all 2 & 4 w/hi dr models	\$14.95
8204	Ford 61-66 vans all to 1 ton	\$13.95
0453	Ford 69-80 vans all 6 & 8 cyl mds	\$14.95
1648	Honda Accord 76-84 covers all models	\$14.95
9787	Honda Prelude 88-82	\$14.95
8894	Honda Civic 73-83 covers all models	\$14.95

9617	Jaguar XJ12 72-80 all inc XJ5	\$14.95
9769	Jeep Willys 66-65 sta wagn & pick-up	\$21.95
8207	Jeep 66-84 Cherokee, Wagoneer, Commdo	\$13.95
9605	Jeep Wagoneer J-series w/230 otc eng	\$21.95
8155	Jeep CJ 49-83 all models and engines	\$14.95
0596	Lancia Beta 76-80 sedan, coupe & HPE	\$14.95
1254	Lanovier 59-77 2A, 3 mds + diesel	\$14.95
0481	Mazda RX7 79-83 covers all models	\$13.95
8211	Mazda 62 71-77 all models + Comet	\$13.95
1550	Mazda GLC 71-82 rear wheel drive mds	\$14.95
0812	Mazda GLC 81-84 front wheel drive mds	\$14.95
0444	Mazda 71-78 includes RX4 & Cosmo	\$13.95
9941	Mazda RX7 79-83 covers all models	\$14.95
8105	Mazda 626 79-81 covers all models	\$14.95
0593	Mazda 908, 818 72-78 covers all mds	\$14.95
0680	Mazda Pick-up 71-85 covers all models	\$13.95
8187	Mercedes 59-70 all 190, 250, 220, 250 mds	\$13.95

9851	Olds Fireza 82-85 all + Pont J-2000	\$14.95
8148	Olds Omega 80-85 all + Pont Phoenix	\$14.95
8273	Olds 66-75 all GT, Kadett, Monza, 1900	\$14.95
0107	Olds Ispuzu 76-79 last mail, give year	\$20.95
7124	Peugeot 504 68-79 all gas eng models	\$14.95
9604	Peugeot 504 Diesel 74-80 all models	\$14.95
0813	Pinto 79-80 all mds + Mercury Bobcat	\$14.95
0874	Plymouth 66-76 Fury, Vol, Gran, Subura	\$14.95
1259	Plymouth Horizon 78-84 inc TC3, Turzmo, Scmp	\$14.95
8066	Plymouth Rebel 81-83 all models	\$14.95
8373	Pontiac 77-85 all full size	\$13.95
9710	Pontiac 74-84 LeMans, GT0, GP, GrandAm	\$13.95
8601	Pontiac Fire 84-85 covers all models	\$13.95
0489	Pontiac Torquest 68-73 + GT0, LeMans	\$13.95
9535	Porsche 911 65-82 inc E, S, C & T	\$14.95
9654	Porsche 914/89 69-76	\$14.95
1635	Porsche 924 76-82 all mds inc turbo	\$14.95
8008	Porsche 928 76-81 all models + 924	\$13.95
8758	Porsche 944 83-85 covers all models	\$14.95
9229	Renault 12 69-79 for all models	\$14.95
0645	Renault 15 73-79 all except T1	\$14.95
9763	Renault 18 81-84 covers all models	\$14.95
9552	Renault Fuego 82-84 covers all models	\$14.95
0750	SAAB 99 69-80 covers all models	\$14.95
9133	SAAB 900 79-83 all mds inc Turbo	\$14.95
0618	Subaru 72-82 all 1300-1800, Brat, MPV	\$14.95
9518	Subaru 80-83 all mds 2 & 4 w/hi dr	\$14.95
8894	Subaru Alpine, 260 Tiger, Raper mds	\$10.95
8105	Torino 68-75 all inc Elite, Ranchero	\$13.95
8209	Toyota Camry 83-86 covers all models	\$14.95
0824	Toyota Celica 71-81 all except Supra	\$14.95
0420	Toyota Celica 82-85 all 4-cyl + 1-w/hi dr	\$14.95
9132	Toyota Corolla 68-83 all models	\$14.95
7812	Toyota Corona 70-82 all 4-cyl models	\$14.95
0198	Toyota Cressida 78-82 all models	\$14.95
0923	Toyota Starlet 81-84 covers all models	\$14.95
0576	Toyota Supra 79-81 covers all models	\$14.95
0901	Toyota Tercel 80-82 for all models	\$14.95
0647	Toyota Land Cruiser 68-82 all mds	\$14.95
8524	Toyota 66-82 pick-up all 2-w/hi dr mds	\$14.95
8124	Toyota pick-up 79-83, gas 2 & 4 w/hi dr	\$14.95
9220	Toyota Sprinter 82-81 all models	\$14.95
1015	Triumph TR5, TR6 67-76 all inc TR250	\$14.95
8869	Triumph TR7 75-81 for all models	\$14.95
0193	Valiant 68-76 all inc Scamp, Signette	\$13.95
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8018	Volare 76-80 covers all models	\$13.95
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8383	VW Jetta 80-81 gas engine models	\$14.95
1125	VW Bus 61-81 transporter models	\$14.95
1248	VW Vanagon 80-83 all air-cooled models	\$14.95
9589	VW Type 3 62-73 squareback, fastback	\$14.95
9778	VW Jetta 84-85 covers all models	\$14.95
8748	VW Passat 74-79 covers all models	\$14.95
1414	Volvo 140, 142, 145, 96 & all models	\$14.95
9529	Volvo 164 68-75 for all models	\$14.95
9758	Volvo 242, 244, 245 75-83 all models	\$14.95
8311	Volvo 264, 265 75-80 for all models	\$14.95



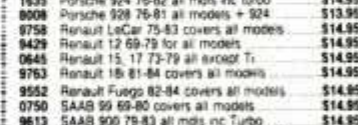
9760	BMW 2500, 2800, 3.0 all models, no CS	\$14.95
0504	Bronco 66-81 all 2 & 4 w/hi dr mds	\$13.95
9322	Bronco II 84 all 2 & 4 w/hi dr mds	\$14.95
6382	Buck 68-76 Electra, LeSabre, Wildcat	\$18.95
8080	Buck 74-84 Century, Regal, rear whi dr	\$14.95
4087	Buck Century 82-85 all front-wheel dr mds	\$14.95
4015	Buck Skylark 80-85 covers all models	\$14.95
9851	Buck 80-85 Skylark & Cad Camaron	\$14.95
0678	Buick/Cadillac 85 full size C-body fwd	\$13.95
6016	Cadillac 67-84 for all full-size models	\$13.95
8678	Camaro 67-81 all 6 & V8 models	\$14.95
2468	Camaro 82-84 covers all models	\$14.95
9557	Capri 70-76 all 2000, 2600, 2800 mds	\$14.95
9386	Capri 79-83 all engines & models	\$14.95
1002	Celexia 82-85 all + fwd Buck Century	\$14.95
0379	Challenger 70-72 all 6 & V8 models	\$14.95
9462	Challenger 75-83 all inc Sapporo	\$13.95
0363	Chev 64-69 for all inc Malibu	\$13.95
8469	Chev 70-85 + Malibu, Monro Carlo	\$14.95
0838	Chev 76-85 all mds + Pont 11000	\$14.95
1038	Chev 80-85 all 5-cyl models	\$24.95
0808	Chev 49-54 reprint factory manual	\$22.95
1001	Chev 55-65 all full-size models	\$18.95
9951	Chev Cavalier 82-85 covers all models	\$14.95
0919	Chev 69-84 BelAir, Bison, Capri, Impala	\$14.95
8179	Chev 61-68 all 4, 6 & V8 models	\$13.95
0787	Chev LUV 72-82 all 2 & 4 w/hi-diesel	\$14.95
2477	Chev 82-85 100 pick-up + GMC S-15	\$13.95
0464	Chev 5-10, S-15 62-84 Blazer & Jimmy	\$14.95
8154	Chev 67-85 pick-up, Subrtin, Blazer, GMC	\$14.95
1662	Chev 67-83 vans all models + GMC	\$14.95
1257	Chrysler 72-84 tune all rear-wheel dr mds	\$14.95
9756	Chrysler Laser 84-85 all inc turbo	\$13.95



9485	Mercedes 250, 260 68-72 all plus 230	\$14.95
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0416	Mercedes 68, 75, 220, 300 + diesel models	\$13.95
8308	Mercedes 350, 450 71-80 for all mds	\$14.95
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9688	Mercury Lynx 81-84 all mds inc LN7	\$14.95
0222	Mercury Zephyr 78-81 covers all mds	\$14.95
1098	MG Midget 58-80 all + A+ Sprite 58-71	\$14.95
6038	MGA 56-62 covers all models	\$14.95
1720	MGB MGBGT 62-81 roadster, coupe mds	\$14.95
0917	Mini 59-78 all mds inc Mini-Cooper	\$14.95
1825	Mitsubishi 83-85 covers all models	\$13.95
0310	Mitsubishi Pick-up 79-85 covers all models	\$13.95
0884	Monza, Chev 75-80 + Astra, Strlr, Skylk	\$13.95
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4120	Nissan 300ZX 84-86 covers all inc Turbo	\$14.95
9271	Nissan Maxima 77-84 all mds inc B10	\$14.95
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0561	Nissan Pulsar 82-85 all gas & diesel	\$14.95
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0951	Nova 71-79 covers all models	\$14.95
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6473	Oldsmobile 77-85 for all 88 & 98 mds	\$13.95
0678	Oldsmobile 85 98 Regency front whi dr	\$13.95
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1223	Brakes, Steering & Suspension 76-83	\$16.95
8478	Customizing Cars, inside & out	\$12.95
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9883	Chilton Auto Repair 79-86, all U.S. cars	\$21.95
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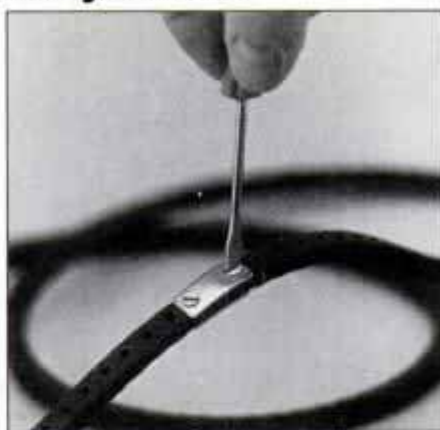
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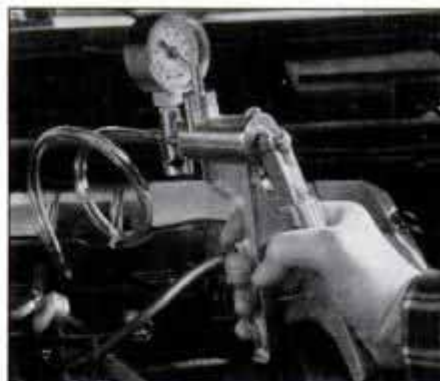
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Rust never sleeps

Some cars don't justify rechroming the chrome parts that 'ol Mr. Rust has eaten. Instead of painting them to match the body and then convincing the neighbors that you've got an AMG Volkswagen, try some Instant Chrome, which almost looks like the real thing when it dries. It's made by Dupli-Color and sells for \$5.16.



Hot stuff!

Yup, that's right, we're showing a silicone gasket sealer being used on a header pipe. Permatex (division of Loctite Corp., Cleveland, OH) says its new Ultra Copper is suitable for really high-temp uses. It's available in can, tube or power cartridge (from \$5.81) at local auto parts stores. **PM**

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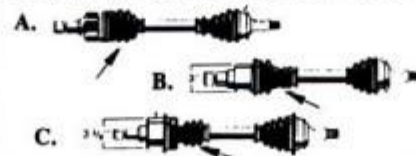
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SELECTION GUIDE

Boot Kits available for • MOST imported and domestic front wheel drive cars • GM (thru 1984) • Ford (thru 1986 except 5 spd and turbo) • Chrysler (thru 1986).

Important Note For Chrysler Owners -- Look under your car to determine if the inside boot (arrow) looks like Diagram A, B or C.



DAILY DRIVERS

(Continued from page 74)

pack in every handling test, no doubt due to its Bridgestone SF-402 all-season tires, which allow lots of understeer and don't stick very well. Conversely, it has an excellent ride on both smooth and rough surfaces.

We like the Stanza's driving position. Everything adjusts, and the seats are especially comfortable. The controls are well thought out, and the conveniently mounted overdrive switch was singled out for praise.

There's nothing very exciting about the Stanza, but there's nothing wrong with it, either. It's just a bit dull compared to the competition.

Subaru RX Turbo

We had trouble coming to grips with this Subaru. Some testers ranked it as high as fifth, others had it last. The problem is that the RX is equipped like a sports sedan with new-for-'87 full-time 4wd, overhead cams, turbocharger, 5-speed, power mirrors and door locks, full instrumentation, etc. At \$14,500, it also has a price to match.

But the car simply doesn't *work* like a sports sedan. The RX feels like an optioned-up economy car that's rough and noisy. The interior is cramped and uncomfortable, the engine is whiny, the shifter is balky, and the Bridgestone RE86 Pontenzas are not enough to straighten out this car's steering and handling woes.

Our testers called the interior "vacuum-formed plastic" and the exterior

"tepid." The turbocharger and 4-wheel drive teamed up to deliver a mediocre 16 mpg over the road. Other track test numbers are middle of the pack.

Subaru buyers are among the most loyal on the road. All we can figure is that they're sold on the advantages of 4wd, and oblivious to the car's other deficiencies. Our test RX seemed well-built and sturdy, but its semi-agricultural ambience turned off our testers.

Dodge Shadow Turbo

The Dodge Shadow and its sibling Plymouth Sundance are brand-new cars for 1987, and two of the new family sedans that inspired us to assemble this road test in the first place. We got the hottest version, with 2.2-liter turbo, Goodyear Eagle VR50 205/50VR-15 tires and all Chrysler's go-fast goodies. The Shadow was fourth fastest in the quarter-mile, fastest in the slalom, and right near the top on the skidpad.

Unfortunately, it lost points for old-time, 15-mpg fuel economy, weak brakes, a tiny trunk and cramped interior. That's how it ended up next to last in our track testing. For less than \$12,000, the Shadow is something of a bargain hot-rod, but our test procedure rightly rewards the all-rounder rather than the one-dimensional specialist.

Our testers criticized the "too-close" seat/wheel, and cited "lots of gaps" fit and finish. Handling limits are high, but a lot of effort is required to get there. Turbo lag and torque steer are intimidating, while the steering is abrupt and darty. Not the best combination for everyday driving.

Pontiac Grand Am SE

Since this car was fitted with every high-performance option from Eagle GT tires and 3-liter V6 to rocker panel moldings and driving lights, we expected it to be even better than our relatively plain Corsica. Imagine our disappointment when this Grand Am was a full second and 4 mph slower in the quarter-mile, more than 1 mpg thirstier, and significantly slower in the slalom. Only on the skidpad, where its sticky tires pulled it into first, was the Grand Am better than the Chevy. The 165-hp 2-liter turbo engine from the Sunbird should soon be available to boost its performance—and price.

Driving the Grand Am is not a lot of fun. Our group criticized the high-effort, low-feel steering, numb brakes and harsh suspension. Pontiac engineers obviously wanted to build a high-performance sports sedan, but the go-fast gizmos keep tripping over each other to produce a car that's slower and less fun than many less radical sedans.

Everyone had harsh things to say about the Grand Am's ergonomics. As one tester complained, "The interior is almost willfully bizarre: window switches on the console, radio equalizer switch on the driver's door, upside-down mirror adjusting switch, minuscule gauges, power-seat switch that fouls the door handle, steering wheel angled to the left, and so on."

Summed up one disgruntled tester, "This car has lots of electronic gimmicks, at the expense of solid chassis and drivetrain engineering. At \$15,000? They must be kidding." **PM**

TEST RESULTS

	GAS MILEAGE (EPA city/ PM test)	¼-MILE (sec. @ mph)	BRAKING (ft.) (60-0 mph)	SLALOM ¹ (mph)	SKIDPAD ² (cw/ccw)	TRUNK SPACE ³	INTERIOR SPACE INDEX ⁴	TEST TRACK RANKING ⁵	ROAD TEST RANKING ⁶	OVERALL RATING ⁷
Acura Integra LS	29/25.25	16.500 @ 82.11	135	60.67	.79/.83	10	131.30	4	4	4
Chevrolet Corsica	19/18.48	16.406 @ 83.02	131	60.14	.75/.78	14	135.62	6	6	6
Dodge Shadow Turbo	23/15.24	16.621 @ 81.74	136	62.23	.79/.81	13	131.30	10	9	9
Honda Accord LXI	27/22.87	16.755 @ 82.11	137	59.34	.73/.75	16	132.51	2	2	2
Mazda 626 GT Turbo	22/21.83	16.032 @ 86.28	120	60.97	.77/.77	17	134.66	1	1	1
Nissan Stanza GXE	26/21.54	18.671 @ 71.94	130	57.40	.77/.78	17	127.90	8	7	7
Pontiac Grand Am SE	19/17.12	17.389 @ 79.01	128	59.71	.83/.87	15	127.54	9	10	10
Subaru RX Turbo	24/16.28	16.841 @ 79.50	127	60.94	.73/.79	18	137.79	7	8	8
Toyota Camry LE	29/23.07	17.803 @ 77.51	141	56.60	.75/.78	19	137.72	3	3	3
Volkswagen Jetta GLI	27/22.24	17.002 @ 80.21	126	58.48	.79/.82	17	131.65	5	5	5

- Best speed while weaving through seven cones placed 100 ft. apart; the higher the speed, the better the transient handling.
- G-forces generated during steady-state cornering around a 200-ft.-dia. circle; cw=clockwise, ccw=counterclockwise.
- The number of standard-size 7" x 12" x 17" grocery bags that will stand upright (1-in. crush space permitted) in trunk with rear seatbacks up.
- Front-seat width x headroom x legroom + rear-seat width x headroom x legroom + 1000.
- Points are awarded from best (1) to worst (12) in each category. Fewest total points ranks first, and so on.
- Subjective ranking on the road by a team of testers; cars are graded by "feel," independent of test track results.
- Average of Test Track and Road Test ratings. Road Test score breaks ties. Bold numbers show best performance.

Vision Break-through

When I put on the pair of glasses what I saw I could not believe. Nor will you.

By Joseph Sugarman

I am about to tell you a true story. If you believe me, you will be well rewarded. If you don't believe me, I will make it worth your while to change your mind. Let me explain.

Len is a friend of mine who has an eye for good products. One day he called excited about a pair of sunglasses he owned. "It's so incredible," he said, "when you first look through a pair, you won't believe it."

"What will I see?" I asked. "What could be so incredible?"

Len continued, "When you put on these glasses, your vision improves. Objects appear sharper, more defined. Everything takes on an enhanced 3-D effect. And it's not my imagination. I just want you to see for yourself."

COULDN'T BELIEVE EYES

When I received the sunglasses and put them on I couldn't believe my eyes. I kept taking them off and putting them on to see if indeed what I was seeing was indeed actually sharper or if my imagination was playing tricks on me. But my vision improved. It was obvious. I kept putting on my cherished \$100 pair of sunglasses and comparing them. They didn't compare. I was very impressed. Everything appeared sharper, more defined and indeed had a greater three dimensional look to it. But what did this product do that made my vision so much better? I found out.

The sunglasses (called BluBlockers) filter out the ultraviolet and blue spectrum light waves from the sun. You've often heard the color blue used for expressions of bad moods such as "blue Monday" or "I have the blues." Apparently, the color blue, for centuries, has been considered a rather depressing color.

For eyesight, blue is not a good color too. There are several reasons. First, the blue rays have one of the shortest wavelengths in the visible spectrum (red is the longest). As a result, the color blue will focus slightly in front of the retina which is the "focussing screen" onto which light waves fall in your eye. By eliminating the blue from the sunglasses through a special filtration process, and only letting those rays through that indeed focus clearly on the retina, objects appear to be sharper and clearer.

The second reason is even more im-

pressive. It is harmful to have ultra-violet rays fall on our eyes. Recognized as bad for skin, UV light is worse for eyes and is believed to play a role in many of today's eye diseases. In addition, people with contact lenses are at greater risk because contacts tend to magnify the light thus increasing the sun's harmful effects.

SUNGLASS DANGER

Finally, by eliminating the blue and UV light during the day, your night vision improves. The purple pigment in your eye, called Rhodopsin, is affected by blue light and the eyes take hours to recover from the damage.

But what really surprised me was the danger in other conventional sunglasses. Our pupils close in bright light to limit the light entering the eye and open wider at night—just like the aperture in an automatic camera. So when we put on sunglasses, although we reduce the amount of light that enters our eyes, our pupils open wider and we are allowing more of the blue and ultraviolet light into our eyes.

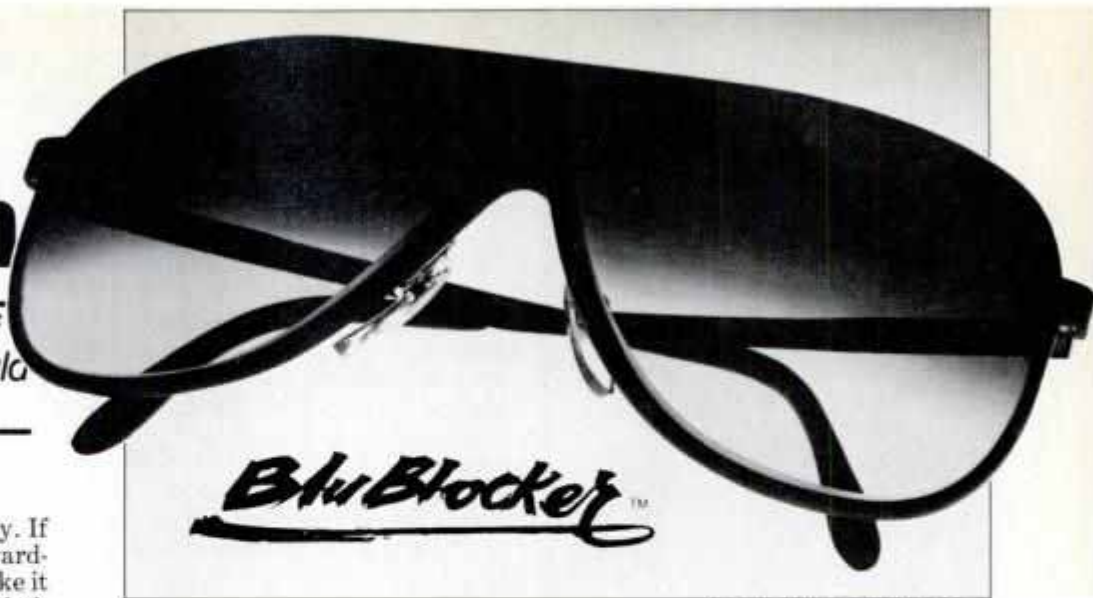
DON'T BE CONFUSED

There are a few companies making similar claims as BluBlocker with some models selling for over \$100 but without the same blocking ability. Be careful. Each pair of BluBlockers is guaranteed to perform exactly as described and uses the latest in optical science. I'm often asked by people who read this, "Do those Blu-Blockers really work?" They really do and please let me prove it.

BluBlocker sunglasses use the CR-39 lens which most eye doctors will tell you is one of the finest materials you can use for glasses and each lens comes with an anti-scratch coating.

The black light-weight frame is one of the most comfortable I have ever worn. The nose rest will fit any nose. The hinge causes the frame to rest comfortably on your face and can be adjusted for almost any size face.

We also have a clip-on pair that fits



They look like sunglasses.

over your regular glasses and weighs less than one ounce and a plastic model that costs only \$39.95. All models include a padded carrying case.

I urge you to order a pair and experience your improved vision. Then take your old sunglasses and compare them to the BluBlocker sunglasses. See how much clearer and sharper objects appear with the BluBlocker pair. And see if your night vision doesn't improve as a direct result. If you don't see a dramatic difference in your vision—one so noticeable that you can tell immediately, then send them back anytime within 30 days and I will send you a prompt and courteous refund.

DRAMATIC DIFFERENCE

But from what I've personally witnessed, once you use a pair, there will be no way you'll want to return it.

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CAR TUNES

(Continued from page 83)

the other pair is installed in the rear deck. A 25-watt amplifier resides in each speaker enclosure, which is larger than the speaker/amp modules in the Chrysler LeBaron. Its total power is 100 watts.

The Delco cassette/receiver offers many of the same features as its competitors, including AM stereo, auto reverse, radio seek/scan, automatic music search for tape, five AM and five FM presets, Dolby-B and DNR noise reduction. Uniquely though, Dolby is engaged automatically once a cassette is inserted into the system. The Dolby circuitry cannot be defeated.

Delco's cassette/receiver had the best organized control layout of the three systems under review. Tape controls are grouped together, and the same is true for the radio section. Push-buttons were conveniently large, and their red backlighting made the controls easy to find at night. A small negative, however, was the inability to defeat the clock and display the radio frequency full-time—which is desirable since the Bonneville already sports a clock in the dashboard.

Absent by design is a left/right balance control (present in the Ford and Chrysler systems). Bose claims its system is equalized to the car to a degree which makes left/right balance control unnecessary—and our audition confirms that claim. The system maintains a good stereo image even with the front/rear balance controls set at extreme positions.

This particular sound system, at high volume, was flawed by a persistent clicking akin to the sound of a movie-film projector. The noise, audible even over the music when the volume's cranked to 75 percent or more, is caused by a new electronic ignition module built into the Bonneville. This module emits radio frequency interference that the Delco/Bose system picks up and amplifies. GM says it will correct this as a "running change" in the production line. If you bought one of the first Bonneville's off the line, and encounter this noise problem, see your dealer about corrective service.

Overall cost for the Delco/Bose system in the Bonneville is \$1500. Normally, the cost of a Delco/Bose system in other GM cars is \$905. In the Bonneville, though, the system includes auxiliary radio controls mounted in the steering wheel, a leather steering wheel cover and a power antenna, bringing the total to \$1300. Add another \$200 to cover the cost of the standard equipment to be replaced if you exercise the Delco/Bose option.

Conclusion

Compared to aftermarket systems installed by independent car stereo retailers, the Chrysler, Ford and GM packages should have the advantage of being physically, cosmetically and acoustically tailored to the interior of a specific car. This advantage is evident in the generally good sound of each system, but the physical and cosmetic aspects are not exploited so well.

Chrysler does the best job of integrating the sound system to the passenger compartment. In fact, Infinity's assignment was to design a system that would fit into Chrysler's existing speaker cavities—to be heard but not seen. The Ford and GM speaker systems have an "added-on" look—more so in GM's case where the large Bose speaker/amp modules protrude from the Bonneville's front doors (Bose says its new "wafer" speakers will streamline future installations.)

Though all three Motown systems boast Dolby-B circuitry for tape noise reduction, they lack the superior Dolby-C system. This feature is common in aftermarket gear in the same price range—and it is built into just about every home cassette deck sold today. Though Dolby-B is adequate for store-bought prerecorded tapes, the C-type circuitry gives home recordists a sonic edge—especially when taping digital compact discs.

The lack of Dolby-C illustrates a key point about factory sound systems: You don't get to choose the features you want, the way you could from among the wide assortment of aftermarket gear. Furthermore, our experience with the Pontiac's noise problem and the Continental's door speaker indicates that during the break-in period, you ought to check out the sound system as carefully as any other function of the automobile.

In our final analysis, based on sound quality and operating convenience alone, the Ford/JBL system gives the best value of the three. This praise is given grudgingly, since you can't buy it in a Taurus, T-Bird, Aerostar van or Escort. Though available in several GM cars, the equally impressive Delco-Bose is much higher priced.

Our dark-horse candidate is the Chrysler/Infinity system, soon to be an option in more cars. With a little more power (to prevent distortion at high volume) and a tape-search function, it could surpass its competitors. Just keep in mind that the three systems represent Detroit's initial attempts to overcome the problems of music reproduction in a car. These first efforts merit praise and augur improvements that should eliminate our criticisms over time.

PM

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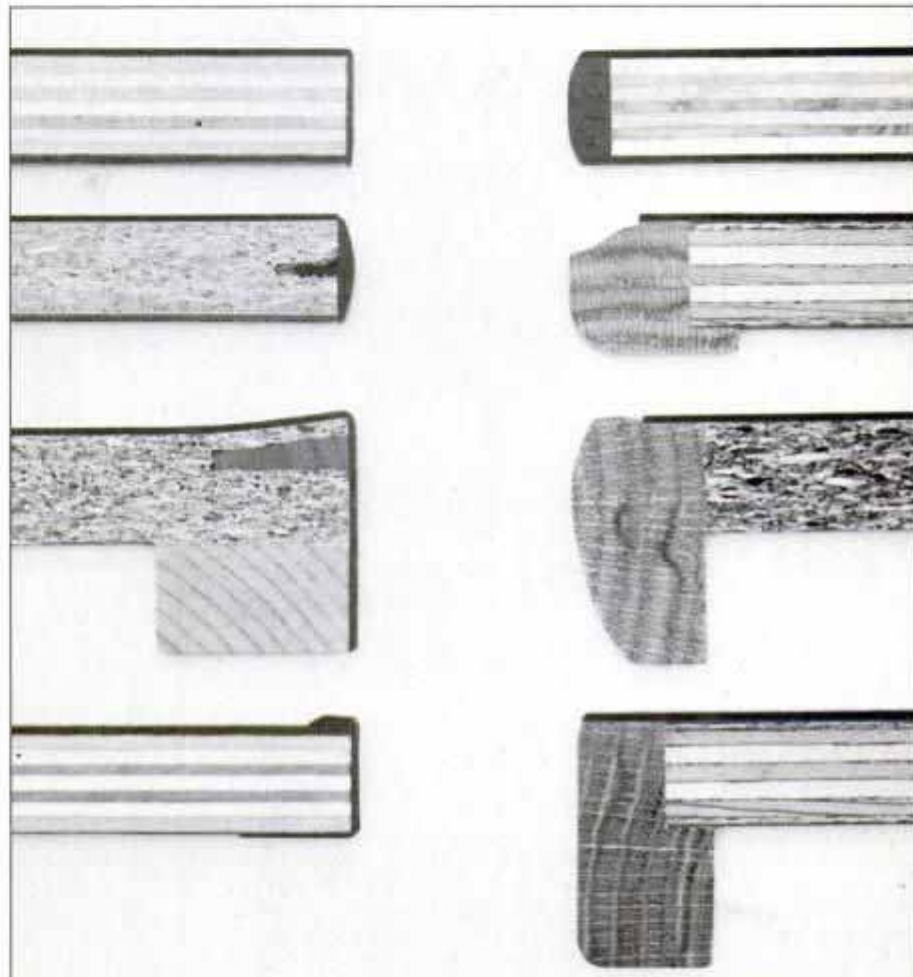
Riverside, Calif. 92517



INSTANT COLOR

(Continued from page 100)

edge. Sand the laminate's face with 80-grit sandpaper to promote good adhesion to the edge band. Next, apply a contrasting color edge band and top-surface laminate. Then, rout the edge with a 45° chamfering bit to expose the pin-stripe accent. Note that colorless contact cement, made specifically for solid-color laminates, should be used



Various edge treatments (left): plastic laminate; plastic T-molding; wood wedge for a drip-free edge; snap-on metal molding. Wood edges (right): round edge with flush laminate; routed ogee lip; clamshell with laminate set back; wood rail with flush laminate.



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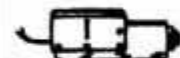
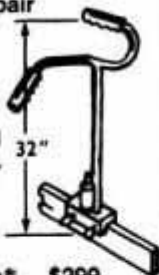
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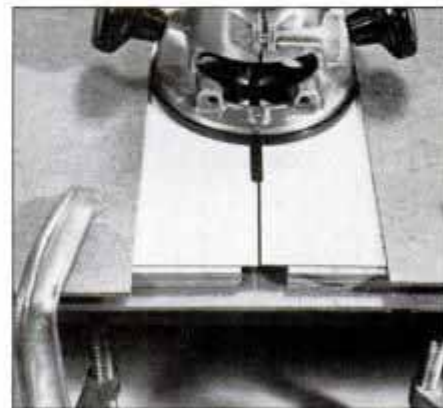
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Here's an easy way to get the wood edge flush with the laminate. Place the laminate upside-down and plane the wood flush.

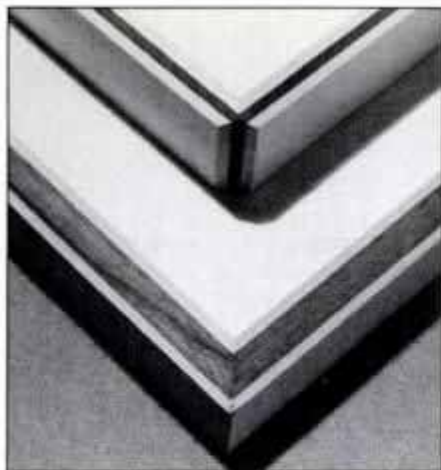


Try this setup to cut matched laminate edges for a perfect butt joint. Guide router, fitted with a straight bit, along a straightedge.

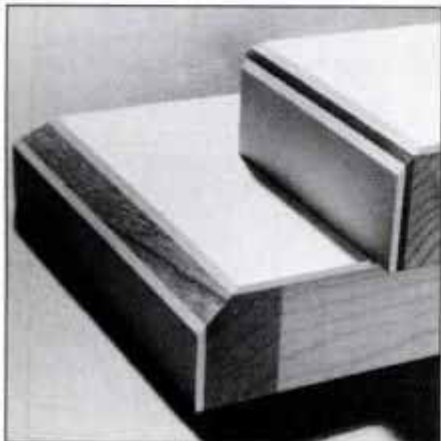
LAMINATE SOURCE LIST

- Formica, 155 Route 46 West, Wayne, NJ 07470
- Laminate Council of America*, Box 725, Mahwah, NJ 07430
- Micarta Division, Westinghouse Electric, Hampton, SC 29924
- Nevamar, 8339 Telegraph Rd., Odenton, MD 21113
- Pionite/DuraBeauty, Sterling Engineered Products, 1715 Indian Wood Circle, Maumee, OH 43537
- Wilsonart, 600 General Bruce Dr., Temple, TX 76501

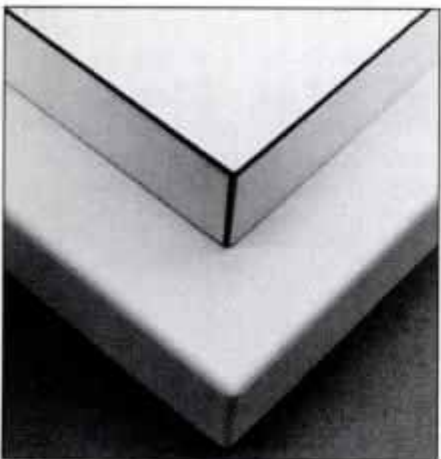
*An association that represents several laminate manufacturers.



Here are two attractive, easy-to-make edges: pin-stripe (top) of solid-color laminates, and chamfered hardwood edge.



Cutaway view reveals their construction. After applying the laminates, cut chamfer with router fitted with a 45° chamfering bit.



Upper piece is covered with standard laminate; bottom piece features solid-color laminate. Note the absence of dark edge lines.

for invisible glue joints. Easy-to-install plastic T-molding snaps into a 1/16-in.-wide kerf cut in the core's edge. T-molding is sold in hardware stores and through mail-order hardware firms. One such firm is the Woodworkers' Store, 21801 Industrial Blvd., Rogers, MN 55374. **PM**

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Bad News For Escort

3RD IN A SERIES

Dear Customer,

From Drew Kaplan

Escort has ignored DAK's second, one-on-one Maxon versus Escort radar challenge. And frankly, I'm fighting mad. I suppose they have a right to ignore me. But after referring to my challenge as only an "advertising gambit" and calling Maxon's radar detector an off-shore, primitive, and bottom-end unit, I'd think they'd be glad to wipe us out in a head to head duel to the death. But, I'm really mad for two other reasons and I think that you may be as fascinated by them as I am.

Mad Reason 1. Road and Track Magazine held an independent general radar detector test in their September 86 issue.

As far as I can see, Maxon beat Passport in Uninterrupted Alert, and Passport beat Maxon in Initial alert. Now to be fair, neither of us seem to have beaten the other by even 2 seconds at 55 miles per hour. So, we didn't win or lose by much.

And, Maxon's \$99⁹⁰ detector was tested against the \$295 Passport, not the \$245 Escort we challenged. What's interesting is that Road and Track had nice things to say about Passport and even about Escort, which wasn't even included in the tests any more.

Now, if you've been following DAK's challenge, you know we've only been challenging Escort. If you've read Road and Track's tests, you'll be amazed when you read Boardroom Reports, which I've reprinted for you to the right. What's really interesting is that it's the exact same person in both publications.

Actually, Maxon did extremely well. Road and Track only used 'over hill' and 'around curve' tests because on straight-aways the differences weren't worth describing. (Imagine that!)

It's just as I've said in my challenge. I don't think there's much difference between Maxon's and Cincinnati's Radar detectors when it comes to sensing radar.

THE CHALLENGE GROWS

In view of the opinions stated in the article in Boardroom Reports about the \$245 Escort, DAK hereby adds the \$295 Passport to our challenge.

Mad Reason 2. Did you ever hear about the cure for dandruff that was developed in the middle-ages? It was the guillotine. And frankly, I think you should be aware of Cincinnati Micro-

wave's advertising cure for the Rashid VRSS Collision Avoidance System.

The Rashid VRSS system, as described in Popular Science magazine, January 1986, sends out a radar signal on the K band ahead of your car. The good part is that it can help you avoid running into things higher than your front bumper. The bad news is that since it operates on K band, it sets off radar detectors.

Well, hats off to Cincinnati Microwave. I've tested the Passport against the Rashid unit and, as usual, they have done a splendid job. While every other detector I tested, including Maxon's, was driven crazy, theirs didn't utter a peep.

But then, my Maxon hasn't uttered any peeps lately either and let me tell you why. I was on my way to the Far East to visit Maxon, so I asked Tom, a manager at DAK, to purchase and test the Rashid.

Well, did I ever hear from him. First the unit cost \$558 plus about \$100 to install. Then buying it and finding someone to install it took almost a month.

But the real reason he was unhappy was that the recommended method of installation involved cutting a 6½" hole in the front grill of his neat new car.

Well, much to my wife's chagrin, it's now installed in her station wagon.

After installation, it has to be set by an installer. He drives between 15 and 30 miles per hour toward a solid object. When the installer thinks he's reached a safe stopping distance, he adjusts the warning alarms to sound. Then in the future, when a similar distance is reached, lights will flash and an alarm will sound.

Of course, if you accelerate too quickly into a lane behind another car the same alarms can go off.

And, I haven't figured out what to do if

there's a dog in the road, dirt on the radar sensor, or how to compensate for the different stopping distances encountered on dry, wet, icy or snowy roads.

MOST IMPORTANT PART

Speaking of advertising gambits, in virtually every magazine I pick up, I've been seeing Cincinnati's Bad News for Radar Detector ads spelling out the obsolescence of all other detectors.

If it's such an important feature that distinguishes them from us, there had better be some of these devices on the road, or Cincinnati Microwave's credibility may just be on the road as well.

I will add \$10,000 to my Escort/Passport challenge if Cincinnati Microwave can prove that there are even 1000 Rashid units on the road anywhere in the U.S. Oh heck, I'll add \$5000 if they can even find 500. (And, look at this.)

NOTE: There are several other potential collision avoidance systems on the drawing boards and each may have a DIFFERENT FINGERPRINT.

So, if you're a current Escort or Passport owner, I suggest that you find out how many Rashid units there are and what Cincinnati Microwave will do about the 'other' units before you pay \$\$\$ to have your current detector upgraded.

Besides, with over 3,000,000 square miles in the U.S., even 1,000 units would work out to less than one unit for every 3,000 square miles.

If a major car company successfully sells a collision avoidance system, then Maxon will be ready. But, the car companies currently can't even get consumers to pay \$200 for air bags. So, you decide. Is it significant, or an advertising gambit?

Below is the NEW version of the challenge. Escort, a reply please!

A \$20,000 Challenge To Escort

Let's cut through the Radar Detector Glut. We challenge Escort & Passport to a one on one Distance and Falsing 'duel to the death' on the highway of their choice. If they win, the \$20,000 check pictured below is theirs.

By Drew Kaplan

We've put up our \$20,000. We challenge Escort to take on Maxon's new Dual Superheterodyne RD-1 \$99⁹⁰ radar detector on the road of their choice in a one on one conflict.

Even Escort says that everyone compares themselves to Escort, and they're right. They were the first in 1978 to use superheterodyne circuits and they've got a virtual stranglehold on the magazine test reports.

But, the real question today is: 1) How many feet of sensing difference, if any, is there between this top of the line Maxon Detector and Escort's or Passport's? And 2) Which unit is more accurate at interpreting real radar versus false signals?

So Escort, you pick the road (continental U.S. please). You pick the equipment to create the false signals. (Don't forget our \$10,000 Rashid challenge). And finally, you pick the radar gun.

Maxon and DAK will come to your

...Next Page Please



DOUBLE DECKER

(Continued from page 96)

frame. Measure up from that line $8\frac{3}{4}$ in. and cut a 2-in.-deep notch between both marks. This notch will accommodate both the landing frame and the decking. From the upper end of this notch, measure $34\frac{1}{2}$ in. up and mark the post for cutoff. Remove the posts, cut them to length, and then cut the railing notches in the top as shown in the drawing. Keep in mind that the short inside posts that butt against the landing and deck are notched differently. The lower ends are notched on two adjoining faces to form the shoulders that rest on the decking.

Next, cut the posts for the railings to length, then notch both ends and chamfer the bottoms as indicated. Doubled 4x4 posts are required at the angled

corners of the lower deck. Build these as shown in photos 19 and 20. All the posts receive a 2x4 horizontal support to stiffen the top railing board and to conform to the plane of the balusters. Space the posts about 5 ft. apart or as required to suit your deck dimensions. They attach with lagscrews.

After the posts have been installed, set 2x4s in the notches, on edge, and nail them in place. Then cut the 2x4 top rails and nail them into the supports and posts. Cut the balusters to length from 2x2 stock and chamfer the bottom ends. Space the balusters about $4\frac{1}{2}$ in. apart, or less, if required by local building codes. It is advisable to prebore nail pilot holes to prevent splitting.

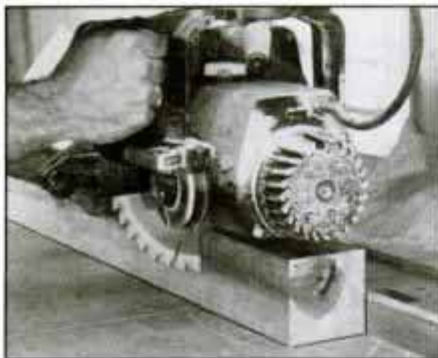
Stairs

Dimension the stairs as indicated in the drawing. Then cut the inside stringers

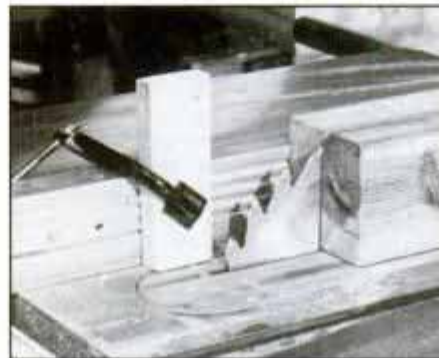
to shape and nail them to the outside stringers. Join both assemblies to the top riser. Temporarily clamp this assembly to the landing so it rests on concrete piers at the bottom. Adjust the stringers until they are square to the landing then attach to the landing with carriage bolts. Cut and fit the treads, then nail them onto stringers.

The posts for the stair railing must be notched at top and bottom. To determine the angle, hold a 4x4 against the outside stringer and plumb it with a spirit level. Trace a line against the edge.

Conceal the open spaces below the decks with pressure-treated lattice panels attached to the posts with nails. When all construction is complete, sand over any sharp edges. Let the deck air dry for three to six months, then stain normally. **FM**



16 All railing posts are notched before attaching to deck. To do this, first make crosscut using a circular or radial-arm saw.



17 Complete notches in posts by ripping to the crosscut kerf using a circular or table saw. Finish the cut with a handsaw.



18 Hold notched post in place and plumb with level. Then bore pilot holes for lag-screws. Install lags and tighten securely.



19 To form angled corner posts, rip 4 x 4 stock to $22\frac{1}{2}^\circ$ on band saw. Circular saw will work if cut is made from both sides.



20 Join both sides of angled post together with $3\frac{1}{2}$ -in. No. 12 fh screws. Bore pilot holes, countersink and plug screwheads.



21 Cut bench support parts to size, then cut all required half-lap joints. Join with plastic resin glue and galvanized nails.



22 Nail 2 x 4 cleats to upper deck beam and lower deck floor boards. Cut stair stringers to shape and nail into cleats.



23 Cut parts for support braces on folding table to size and join with half-lap joints and hinges. Attach supports to deck framing.



24 Nail boards for tabletop to end cleats. Then attach wedge-shaped stop blocks and galvanized T-hinges to bottom of table.

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R.P.K., DVM

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— A.W., Ft. Arthur, TX

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— G.R., Key West, FL

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— P.B., Knoxville, TN

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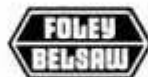
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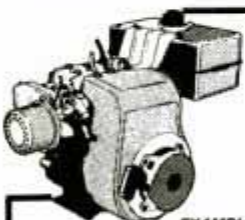
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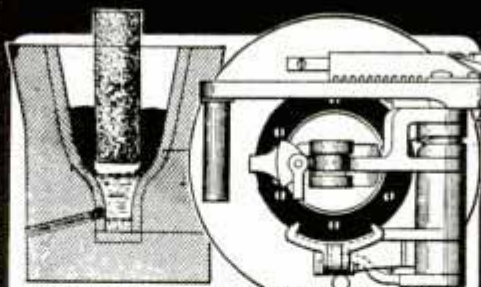
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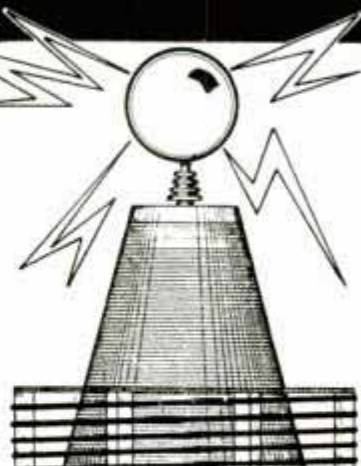


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HYUNDAI EXCEL

More than a million owner-driven miles bring lots of smiles.
The price of this Korean car makes buyers happy, too.

BY MICHAEL LAMM, Contributing Editor

What sells Hyundais here is partly price, but that's not the whole story. The Excel's initial \$4995 base sticker brought floods of customers into Hyundai showrooms. Yet, it took more than price to convince people to buy.

"I was originally attracted by the price," confessed a Texas aircraft sheetmetal mechanic, "but when I

looked at the Excel I was pleasantly surprised by the car's quality of construction, its attractiveness, standard equipment, roominess and economy. I think it's a good *value* for the money."

Value, then—perceived or real—holds the key to Hyundai's phenomenal U.S. and Canadian successes. Word of mouth and good advertising helped, too. Early Excel ads told American

telev viewers they could now afford two cars for the price of one. Judging from unsolicited remarks at the bottom of questionnaires we sent out, quite a few respondents took the TV hint literally. Several households now drive two and even three Excels.

Despite its recent arrival in North America, Hyundai already stands out *(Please turn to page 188)*

Seats on low-line care were judged comfortable, but owners of high-line GLS models often found seats rocked on their mounts.



The 68-hp, 1.5 liter Mitsubishi Four came in for a lot of criticism as having inadequate power for the weight of the Hyundai.

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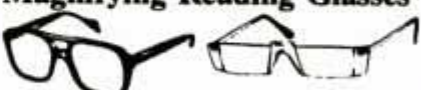
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HYUNDAI EXCEL

(Continued from page 186)

as a textbook success story, straight from the pages of *In Search Of Excellence*. It's the story of a totally unknown, unproven Korean automaker that arrives in Canada in 1984. Two years later, by sidestepping Canada's Japanese quota restrictions and on the

strength of a \$4300 car called the Pony, Hyundai becomes Canada's No. 1 best-selling import.

It now appears that Hyundai might repeat that performance here in the United States. By December 1986, the Korean automaker had sold 160,000 Excels to eager U.S. buyers. That number set a sales record that no freshman Japanese or German importer ever

came close to before. The figure also forced Hyundai to raise its first-year U.S. sales projection by 50 percent. In 1987, the company is aiming at 250,000 sales.

And now we find that the great majority of owners are more than happy with their cars. For example, a South Carolina receptionist wrote, "I'm averaging 38 mpg, and the fuel saving

SUMMARY OF 1986 HYUNDAI EXCEL OWNERS REPORTS*

Total miles driven	1,064,212	Specific likes:		Comfort opinion, front seats:		Average	10.2
Average mpg		Economy	54.5%	Excellent	55.5%	Poor	6.1
4-speed manual transaxle		Price	46.6	Good	38.9		
In town	30.4	Styling	46.6	Average	4.2	Number of vehicles owned:	
On the highway	34.8	Comfort	28.5	Poor	1.4	This car only	25.8%
5-speed manual transaxle		Handling	24.9			Two cars	40.3
In town	30.8	Specific dislikes:		Comfort opinion, rear seats:		Three cars	20.5
On the highway	36.4	Not enough power	36.7%	Excellent	42.1%	Four or more cars	13.5
3-speed automatic transaxle		No complaints	9.7	Good	46.4	Makes of other cars owned:	
In town	26.6	Hard to shift gears	8.4	Average	10.7	Ford	24.4%
On the highway	31.2	Quality of materials	5.3	Poor	0.7	Chevrolet	22.0
Series choices:		Transmission	4.9	Had any mechanical trouble?		Oldsmobile	15.1
Hyundai Excel (standard)	29.1%	What changes would you like?		No	64.3%	Toyota	14.6
Excel GL	31.9	More horsepower	34.1%	Yes	35.7	Honda	10.7
Excel GLS	39.0	No changes	22.8	What type of trouble?		Would you buy an Excel again?	
Major accessories and options:		Easier shifting	6.0	Electrical	16.2%	Yes	64.5%
AM/FM stereo cassette	87.6%	More optional equipment	3.4	Shifter/transmission	14.1	No	6.1
Air conditioning	59.1	How much did you pay?		Carburetor	14.1	Maybe	29.4
Alloy wheels	38.6	Average	\$6949	Clutch	10.1	Would you buy a Hyundai again?	
Why did you choose the Hyundai?		Range	\$4995-\$10,493	Air conditioner	9.1	Yes	69.1%
Price	85.2%	Workmanship opinion:		Dealer repairs satisfactory?		No	26.5
Styling	25.6	Excellent	49.3%	No	28.4%	Maybe	4.4
Economy	18.1	Good	48.6	Yes	71.6	Age distribution of owners:	
Hearsay	12.2	Average	1.8	Dealer service opinion:		Under 29 years	36.6%
Construction quality	9.3	Poor	0.4	Excellent	38.3%	30-49 years	47.3
				Good	45.4	50-plus	16.2

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

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Do you need my shop drawings

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fore I finally found the right design and measurements and tricks to the manufacturing of P.V.C. pipe furniture. I only wish that when I started, I could have bought these shop drawings and I would have gladly paid \$100 for just one of them.

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plus the low initial price practically pay for the car." A Missouri technician said, "This car drives like a luxury vehicle. My mom has a Cadillac, and the Excel rides just as smoothly."

A Rhode Island computer manager said, "Workmanship is superior to American cars and as good as Japanese. Dollar for dollar, my Excel has to be the best automobile sold in America. Not since Henry Ford introduced his Model T has a car been so underpriced."

"Comfortable ride, easy to handle, and stops great even on wet roads," said a Tennessee lab technician.

A Massachusetts retailer wrote, "In my opinion, Hyundai has the same workmanship and quality as cars costing three times as much."

Nearly half of our respondents gave workmanship an excellent rating, and another 48.6 percent marked it good. A California police dispatcher observed, "Haven't been able to find anything wrong with this car, even after looking intentionally for a defect."

And so on and so forth. We could run quotes for pages and pages.

Cost versus price tag

About a third of our respondents bought the standard \$4995 Excel, but not many paid that amount. Even subtracting freight, tax, license and so on, a mere 7.4 percent drove home for \$4995. A Florida hotel manager told us he'd been charged \$800 for rustproofing, "and I didn't have any choice in the matter." A New York systems technician grumbled, "You don't barter with the dealer. He knows if you don't buy this car, he's got others waiting."

Because dealers so often refuse to dicker on price and unashamedly "pack" their cars for extra profit, the importer has adopted a followup program to soften any hard feelings. "Hyundai Motor America immediately got in touch with me," wrote a Massachusetts aerospace specialist, "to be sure I was satisfied with the car. They left me with the impression that I, the customer, am very important to them."

Not to take away from overall owner satisfaction, the Excel does seem to have one big flaw and a lot of little ones, all of which Hyundai can easily correct.

The biggest gripe had to do with horsepower: not enough of it. The 68-hp, 1.5-liter Four—a carbon copy of the engine used in the 1995-pound Mitsubishi Colt/Mirage—struggles to make the 10 percent heavier Excel keep up with traffic. "Very poor on hills," noted a New Hampshire nurse. "On long grades, speed drops to 40 to 45 mph." A California bookkeeper: "You can really feel the air-conditioner compressor kick in—the engine lugs way down."

Among lesser complaints, we consis-

(Please turn to page 192)



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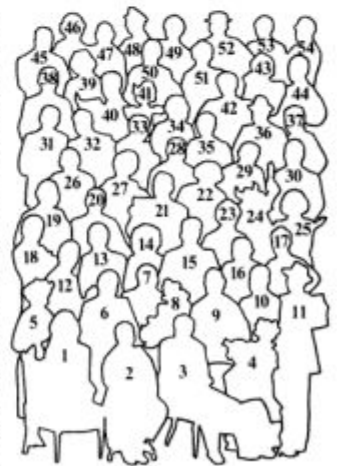


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HYUNDAI EXCEL

(Continued from page 189)

tently heard the following: "Difficult to shift, especially into REVERSE," said a Texas homemaker. In all, 14.1 percent of our respondents reported taking their cars back to the dealer to try to correct balky and imprecise shifting.

"The plastic window cranks break off in your hand," snapped a California naval ensign, "and the dipstick is hard to get at." He wasn't alone, either.

A number of people had trouble stuffing fuel in their Excels. A California estimator noted that: "The tank used to be hard to fill because the neck was so small. The dealer put in a bigger neck, and now it works fine."

There were those, too, who pointed out that the deck lid wouldn't stay open. "It's dangerous," wrote a Massachusetts special assistant, "because you hit your head leaning forward while the trunk lid's slowly coming down."

"Driver's seat rocks on its floor attachments," complained a California X-ray technician, "and the dealer has yet to fix it." This was a problem only for owners of the Excel GLS, because that top-of-the-line series comes standard with a 6-way adjustable driver's seat. Seats in the lesser GL and conventional Excel were judged comfortable and solidly planted.

Despite all the standard equipment that graces even the base Excel, a few items weren't offered at all on any series: power steering, tilt column and cruise control, to name the primary three. A number of buyers missed not being able to buy these options.

Give it time

No big deals, any of these gripes. Give Hyundai a year or so and it'll likely fix everything at the factory level. Meanwhile, rumor has it that within two years the company will offer either a turbocharger or a bigger engine.

And finally, there's this from a Massachusetts civil engineer who'd been assigned to work in Korea. "My experience includes thousands of miles in the Hyundai Pony and Pony 2 wagon. These vehicles were in a car pool accessed by many different drivers and subject to Korea's harsh road conditions. The Hyundais performed well mechanically and maintained their tightness even though driven 'round the clock. My work took me on several visits to the Hyundai Heavy Industries shipyard, a few kilometers from the auto factory. My experiences with the workers led me to an overall faith in the reliability and the export quality of their products. I intend to purchase the Hyundai Stellar when it becomes available in the U.S." And so, undoubtedly, will a lot of other Americans. **PM**

THE BETTER HOME



How To Repair A PORCH

Because the porch is generally not built as an integral part of the main house, repairing or replacing it is well within the realm of the competent home craftsperson. The porch we rebuilt was set into the corner of the building. Other types include those that are open at both ends, and those supported by the building on three sides.

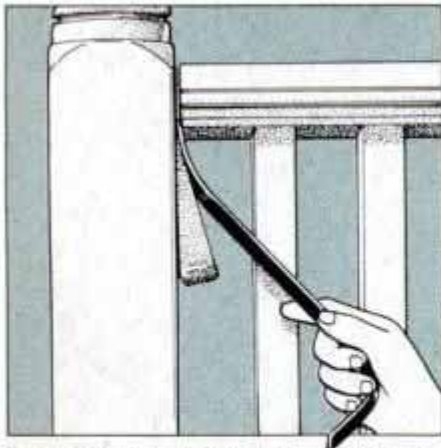
Before you begin work, make a preliminary inspection to determine the

BY PAUL BARRETT
Illustrations by George Retseck

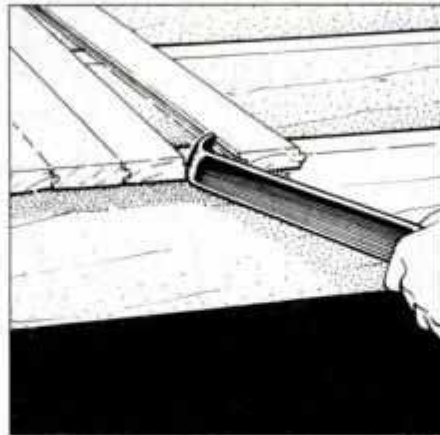
scope of the project. Inspect the deck, railings, posts and related woodwork for deterioration. To check for decay, probe the wood with an awl or screwdriver in several places. Bad flooring may be all that needs to be repaired, but this often suggests more serious problems underneath.

Frequently, newel posts (the posts that terminate the railing at steps and do not connect to the roof) are poorly secured to the porch floor. These should be replaced or refitted for safety. Also check the condition of the roof support columns which are prone to deterioration at their bases.

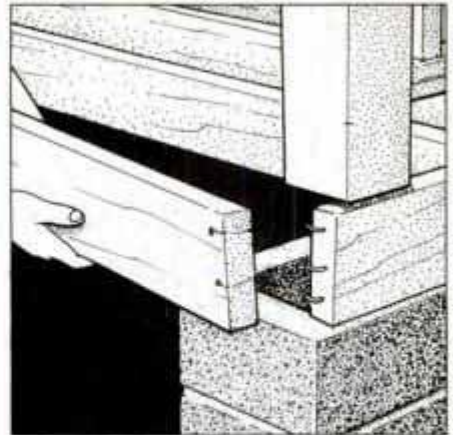
Next, inspect the porch for sags that may indicate frame deterioration. Hold a level against the roof support beam. If it's not level, determine whether the



4 Remove the rails with a prybar and wedge. If you plan to reuse them, drive the nails through with a drift punch.



5 Remove the old flooring to completely expose the underlying structure. Inspect the framework for structural soundness.



6 With the roof temporarily supported, disassemble the framework. Begin by removing the end rim joists.

and nail them in place. Be sure to keep the top of the new joists flush with the top of the rim joists. If the whole deck framework is rotted, remove all the joists and start from scratch.

With the old framework out of the way, and the roof temporarily supported by the 2x6s, you can remove any porch columns that may need to be replaced. Columns that are left should be connected temporarily to the roof

roof beam so it doesn't slip.

The first step in rebuilding your porch is to construct the outside of the framework, or box. Begin by selecting a piece of joist stock to install on the building. It's rare to find perfectly straight framing lumber. Most boards have a crown which must be marked before you use it for framing. Sight down the length on one edge and mark the edge of the board that has the convex crown. The joist should be installed "crown up" so that the weight of the floor will tend to straighten the board over time. If the joist is severely crowned—more than $\frac{1}{2}$ in.—strike a chalkline along its length and saw or plane to this line.

Next, determine the height of the joist that's fastened to the house. Measure the thickness of the new flooring, and add $\frac{1}{8}$ in. for

clearance. Then mark the house wall at this point and strike a reference chalkline. Cut the joist to length, taking into account the thickness of the joists that will meet at corners.

Use 16d galvanized nails followed by $\frac{3}{8}$ -in.-dia. x $3\frac{1}{2}$ -in. lagbolts to fasten the first rim joist to the building. Next, attach the perpendicular rim joists and the remaining outer rim joist. Double those rim joists that carry the internal joists, span long distances or support posts that hold up the roof. On our job,

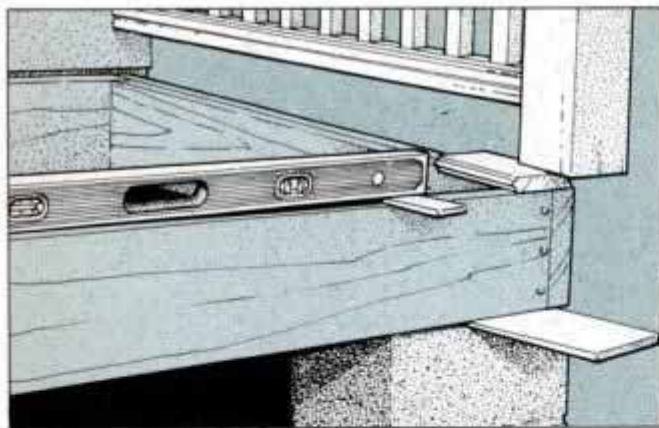
though the porch was a small one, we doubled the rim joists around the perimeter. Liberally nail these doublers with 16d nails.

The porch should be pitched away from the building about $\frac{1}{4}$ in. over 4 ft. to allow for water runoff. Set this slope before the internal joists are placed. Place a 4-ft. level on one of the rim joists that extend out from the building. Insert a $\frac{1}{4}$ -in. shim between the outer end of the level and the joist and raise or lower the box until the bubble centers. Install cedar shims under the frame to fix this height, or notch the joists if the frame is too high. Make this check on each side of the porch.

Next lay out the positions of the interior joists. Minimum spacing for the floor joists should be 16 in. on center for good structural support. If your porch is small you can divide up the length into equal spaces that come as close to 16 in. as possible. Mark the joist positions with a square line down the inside faces of the rim joists that they hang on. Place an "X" to indicate which side of the line the joists are hung.

Mark the crown on the lumber to be used for the joists and check that they're all the same width. Occasionally, sizes will vary slightly and this should be taken into consideration when positioning the joist hangers so the tops of all the joists will be flush. Set the joist hangers at the proper height and nail them in place using the special nails provided.

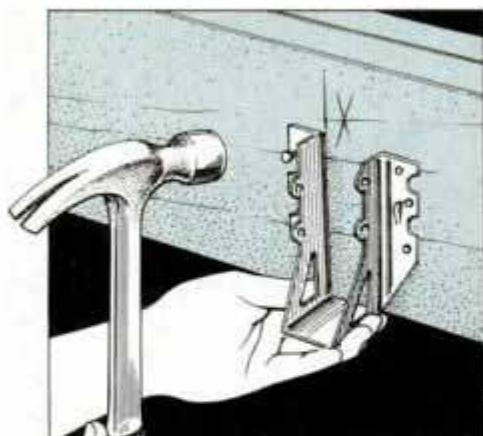
Measure the joist length across the box at both ends and cut the joists to fit. Slip them in place and nail through the hanger holes using the joist hanger nails. Then toenail the interior joists to the rim joists using 16d nails. Two nails per end are adequate.



9 For good drainage, slope the deck away from the house about $\frac{1}{4}$ in. over 4 ft. Use a 4-ft. level with a $\frac{1}{4}$ -in. shim under one end. Adjust the frame until the bubble centers.

beam with lengths of scrap wood. These posts were never intended to hang from the roof and, depending on how they're fastened, are liable to simply fall off.

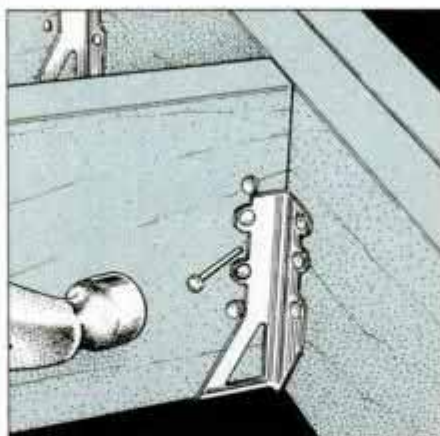
Place a hydraulic jack between a foundation pier and porch post and slowly lift the roof. Raise the roof to its correct height plus about $\frac{1}{4}$ in. for clearance. Adjust the temporary supports as you go. If the porch posts have been removed, you can nail two 2x4's together for a jack post. Be sure it's plumb and toenail the top end to the



10 Using a framing square, lay out and mark interior joist positions on rim joists. Nail the joist hangers to correct height.

Next, prepare the framing to accept the newel post. On this job, we found that the post was not fastened directly to the frame, but was held in place with angle brackets screwed to the floor. Since the post was basically sound and architecturally attractive, we decided to use it as part of the new structure. To attach it properly, we notched the end to receive a poplar splice that would extend below the floor and attach to the frame. We cut out the inside piece of the doubled rim joist so that the poplar extension fit it snugly and lagbolted the post to the frame. Then we fit 2x4 blocking across the joint. This blocking supports the floorboards around the post. If you're replacing your post with a new one, extend it into the framework and box it in.

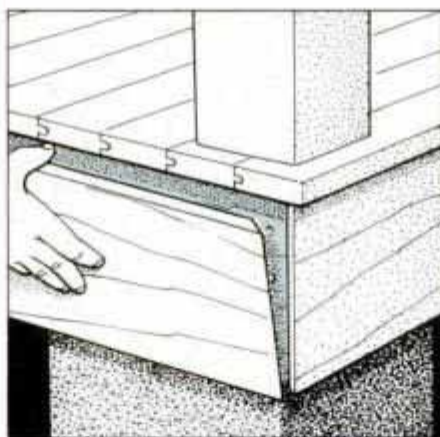
Porch posts, both the ones that support the roof and the newel posts, can be made if necessary. Design details of these posts give character to the house and attention should be paid to building posts that are in keeping with the house design. Round posts are made on a lathe. If the post is longer than the capacity of your lathe, you can make it in sections. Turn a tenon in the end of each section that will fit a corresponding hole bored in the adjacent piece. Assemble the sections with waterproof glue. Square posts can be solid or hollow. Hollow ones allow you to create a wider post without the unnecessary weight of solid wood. They are built up with boards butt-joined at the corners, and can be made in sections with sides that are parallel or tapered. Square posts are ornamented with base and crown moldings in keeping with the style of the house. Both solid and built-up square newel posts should have a cap, usually with bevelled edges, to



11 Cut the joists to length and nail in place with joist hanger nails. Complete the nailing with 16d toenails, two per end.

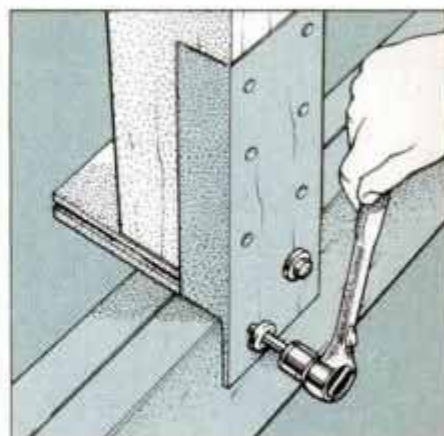
protect the end grain of a solid post, or to close off the open end of a hollow post.

To deck over our porch, we used tongue-and-groove clear fir, which is standard for porch floors. Face-nail the



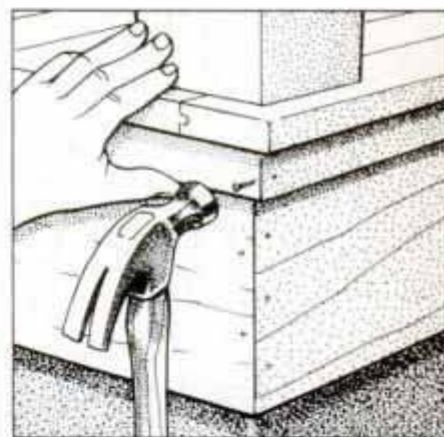
16 Fascia boards are installed over the rim joists. Miter the corners and fasten with 8d galvanized finish nails.

first piece in place using 8d galvanized finish nails, tongue edge out. If the groove edge of the first piece is exposed, rip or plane this edge to remove the groove. Nail the succeeding pieces by driving the nails diagonally through the tongues. Use a nailset to finish driving the nails and avoid marring the wood. If you have trouble fitting the boards, avoid hitting them in place with your hammer. Instead, cut a scrap of flooring to use as a tapping block. For badly bowed boards, face-nail and toenail a portion of the board that you can get to fit, and use a pry bar to pull the rest of the piece in place. Let the ends run wild, to be trimmed when the floor is completed.

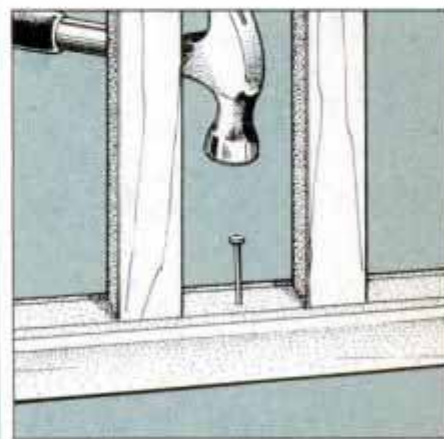


12 We spliced an extension on the old newel post to fasten it to the frame. Box in around the post for flooring support.

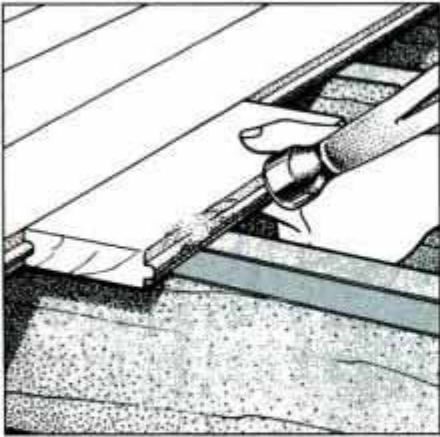
After the flooring is installed, you can remove the roof supports and allow the posts to rest in place on the deck. If you're replacing any posts, install them now. Toenail the posts in place with 8d galvanized nails. Snap a chalkline along



17 Install the decorative molding under the flooring overhang. Leave a 1/2-in. to 1-in. deck overhang beyond the molding.

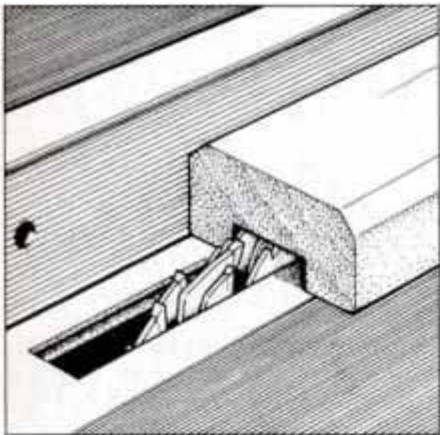


20 Attach the completed baluster assembly to the top and bottom rails by nailing through strips with 6d galvanized nails.

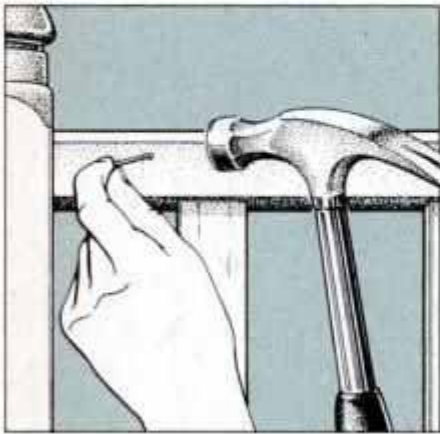


13 Use a tapping block to tighten up the joints in the flooring. This saves marring the tongue-and-groove boards.

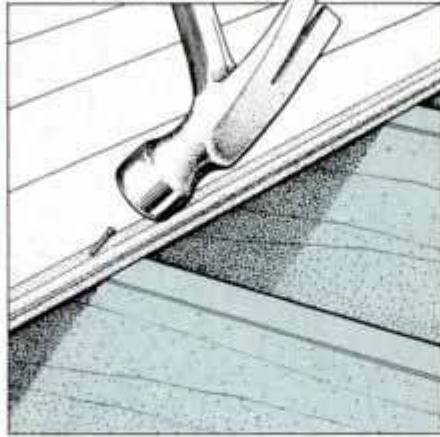
the uncut floorboards to the desired deck overhang and cut to the line. When figuring the overhang, be sure to take into account the fascia and molding that will be applied and add an additional $\frac{1}{2}$ in. to 1 in. to the overhang for a



18 Use a dado blade in the table saw to plough the $1\frac{1}{2}$ -in. x $\frac{1}{2}$ -in. groove in the rails for the baluster assembly.



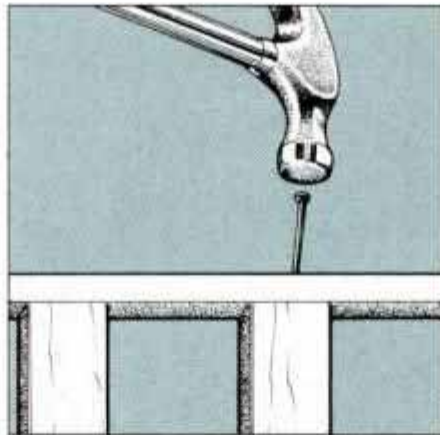
21 Install the railing by toenailing it to the posts with galvanized nails. Finish driving the nails with a nailset.



14 Drive 8d galvanized finish nails diagonally through the tongue. Finish driving the nails with a nailset.

reveal. If you're reusing the old railing, toenail it back in place with 8d finish nails. You can also purchase ready-made railing and baluster parts at some lumberyards, or make your own.

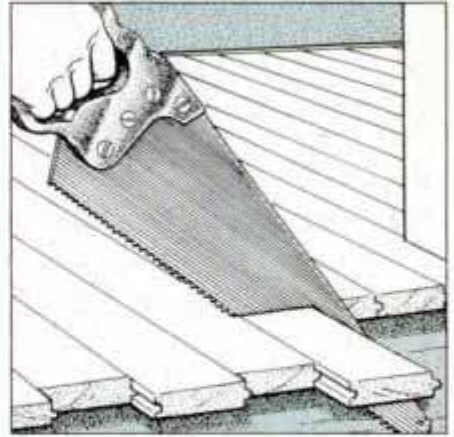
To make the railings, select weather-



19 Mark the $1\frac{1}{2}$ -in. x $\frac{1}{2}$ -in. strips with the baluster spacing and nail to the baluster ends. Keep the edges flush.

resistant 2x4 stock such as cedar, redwood or pressure-treated lumber. Use a router or table saw to shape the top of the rail to the desired profile. We used a table saw to cut a simple 45° bevel along the top edges of the top and bottom rail. Then set up the table saw with a dado blade and cut a $1\frac{1}{2}$ -in.-wide x $\frac{1}{2}$ -in.-deep groove in the bottom of the top rail, and the top of the bottom rail. Rip two strips to fit flush inside these grooves the full length of the rail. Cut the balusters $1\frac{1}{2}$ in. square and to finished length. Measure the distance between the posts and cut the rails and strips to exact length.

To figure the baluster spacing, first estimate how many balusters you think



15 It's quicker to trim the flooring after it's all installed. Strike a chalkline, taking into account necessary overhang.

you need for a run of railing. Divide the total rail length by the number of balusters desired plus 1 to get the approximate baluster spacing. Then multiply the number of balusters by their width ($1\frac{1}{2}$ -in.) and subtract this from the total rail length. Divide this amount by the number of balusters plus 1 to get the exact spacing between each baluster.

Mark off the strips with the correct spacing. Nail the $1\frac{1}{2}$ -in. strip to the ends of the balusters at the marks and keep the edges flush. Repeat this on the other ends of the balusters. Place the assembly in the groove of the bottom rail and nail through the strip. Then turn over the unit and repeat the procedure with the top rail. Place the assembled railing in position and toenail it to the posts with 8d galvanized finish nails. Use a nailset to finish driving the nails.

The frame is then covered with 1-in. fascia boards of the same width as the joist stock and mitered at the corners. Apply this fascia to the box with 8d galvanized finish nails. Because the porch is sloped, the line for the miter cut on the end fascia boards will not be precisely square to the edge of the board. Mark the appropriate cutting line by holding the uncut fascia in place and tracing the frame corner on it. Follow this line when cutting the 45° miter. Don't forget that it represents the inside line of the miter. After applying the fascia, install the molding with 4d galvanized nails.

Finally, caulk around the edge of the deck where it meets the siding to seal the corner and protect the house and porch framework from moisture. Reattach the steps using 16d nails. Then prime your porch and paint it with a good quality oil-based enamel. **FME**

Homeowners' Clinic

BY NORMAN BECKER, P.E.

A shrinking problem

I just moved into a house that's 1 year old. There are open joints between some of the walls and floors which, I assume, are caused by shrinkage of the wood framing. What is the effect of the moisture content of wood on shrinkage and decay? Is the shrinkage of wood proportional to the change in its moisture content?

PAUL KLIENKOPF
RIVERVALE, NJ

There is a direct relationship between the moisture content of wood and shrinkage. However, this only exists when the moisture content is below the fiber saturation point, which for most species of wood is about 30 percent.

Moisture content (MC) is expressed as a percentage that defines the weight of moisture-bearing wood relative to the same piece when oven dry. Moisture exists in freshly cut (green) wood in two forms: as free water contained within the cell cavities, and as absorbed water contained within the cell fibers. The moisture content of green wood can be as high as 200 percent. Initially, as the wood dries, only the free water is given up.

The moisture content at which all the free water has been lost and all the absorbed water remains is called the fiber saturation point. Even though the moisture content has been reduced from 200 percent to 30 percent, no shrinkage occurs.

Shrinkage primarily occurs across the grain and begins when the cell fibers give up the absorbed water. The total shrinkage that can occur takes place between fiber saturation point (about 30 percent MC) and a theoretical moisture content of 0 percent. For every 1-percent moisture loss below fiber saturation, there will be a $3\frac{1}{5}$ -percent shrinkage or $\frac{1}{30}$ of the total shrinkage.

Depending on the temperature and humidity of the surrounding air,

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wood will give up or take on moisture until its moisture content is in equilibrium with the moisture in the air. Normally wood never reaches a moisture content of 0 percent.

If wood is kept constantly in 70° air with a 60-percent relative humidity, its moisture content will eventually reach about 11 percent. As far as decay is concerned, the decay fungi (rot) will only grow in wood when the moisture content is above 20 percent. Moisture levels below this will not support decay and the wood could last for hundreds of years.

Bugged

Our problem is box elder bugs. Our house is light green with shaker shingle siding. We plan on repainting and would like to keep the color light. Can you tell me if there is an additive for paint that will keep the bugs away? It seems the color is attracting them by the thousands. At night they crawl under the shingles, only to come out the next day. Can you help?

THOMAS BURTON
DYER, IN

Box elder bugs feed on the seeds of the female box elder tree and their presence indicates that there must be one nearby. In the fall the bugs seek protected dry places for winter shelter.

I consulted entomologists at Cornell University and the Cooperative Extension at the University of Wisconsin about the effect of color on the box elder bug. Both indicated they were unaware of any preference to light or

dark colors. At present there are no insecticides that you can add to paint that will eliminate your problem. Phil Pellitteri, the extension entomologist at the University of Wisconsin, suggests spraying the bugs in the early fall with a solution of Tide laundry detergent and water. Although this will not eliminate the problem, they have found it an effective control. The best long-term solution is to remove the nearby female box elder trees.

Creosote problem

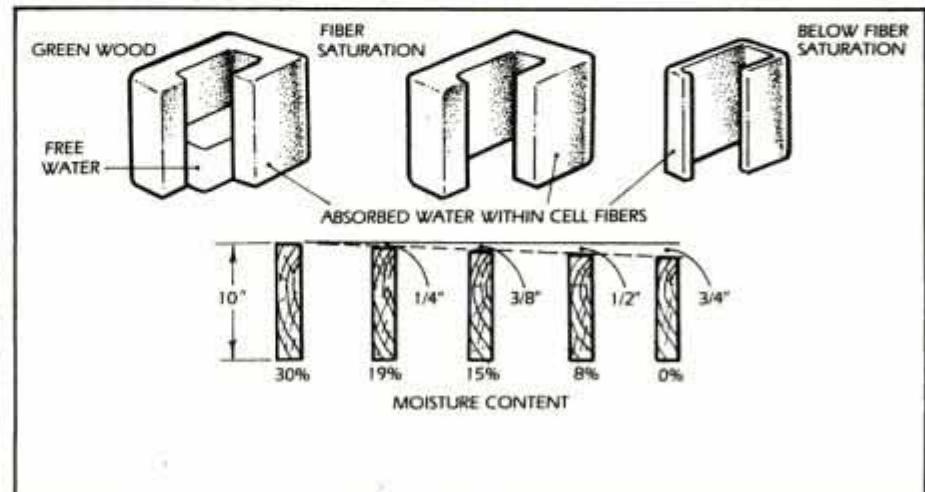
When I was installing a wood stove in my fireplace, I discovered that the smoke chamber above the damper was covered with creosote. The damper opening is too small to reach up into this space from below. A chimney cleaning brush pushed down from above will not reach the area. Do you have any suggestions?

ROBERT J. WHITTIER
DUXBURY, MA

If you can't remove the damper plate (almost all damper plates can be removed or pushed aside once the handle is removed), then do the job with a "pull-cord chimney brush," which has a cord attached at its top and bottom. One person stands on the roof and, while holding one end of the cord, drops the brush down to a person by the fireplace hearth.

Make sure to drop enough cord down so the brush is positioned in the smoke chamber. Then, alternately pull from the top and bottom to brush away the creosote.

PM



How To Replace A Lockset

Worn-out locksets can be a major aggravation. They're not hard to replace, though, using common household tools.

To remove the inside handle, first examine the sleeve for either a small opening or a clip that protrudes through a slot. If the sleeve on your lockset shows a protruding clip, press it with a screwdriver and pull off the handle. If there's a small hole, you should push an awl or nail through it to depress the clip.

The cover plate or rose usually snaps off by means of a slotted clip, or by turning it past a number of grooves in the rose flange. If your lockset has a slotted clip, depress it and pry the rose

free. If the rose is the grooved-flange type, look for an opening and use your screwdriver to pry off the rose.

If you don't find a screwdriver slot, use adjustable pliers to turn the rose until the grooves line up with the gaps in the mounting plate, and then you can remove the rose.

Next, separate the lock halves by removing the two long screws that hold them together, and remove the lock from the door. Then you should take out the bolt by removing the two small wood screws that fasten the bolt plate on the edge of the door.

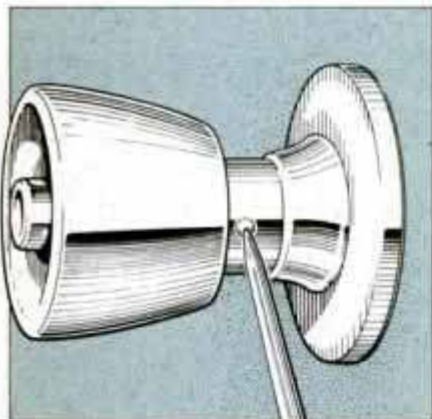
To install your new lockset, first install the new bolt. If you're lucky, the new bolt plate will be the same size as

the old one. If it's larger, extend the recess in the door with a chisel. If the recess is too big, install the bolt and fill the excess with wood filler to be finished later. Then slide the lock cylinder through the door from the outside. Make sure that the bolt catches in the slot of the lock. Assemble the lock halves with the two long screws.

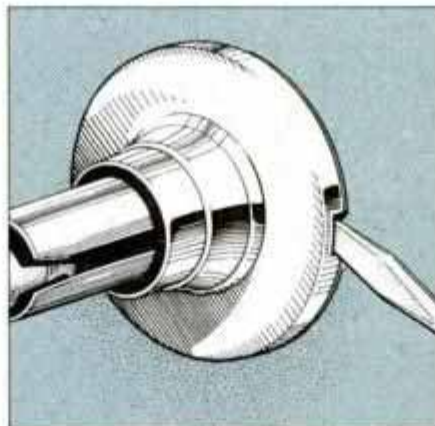
To install the rose and handle, simply snap them over the clips. If your rose needs to be twisted on, press it firmly against the door and turn it until the grooves in the flange catch on the mounting plate.

Now, check to see if the old strike plate works with the new lock. If so, and the finish is an appropriate match, the job is done.

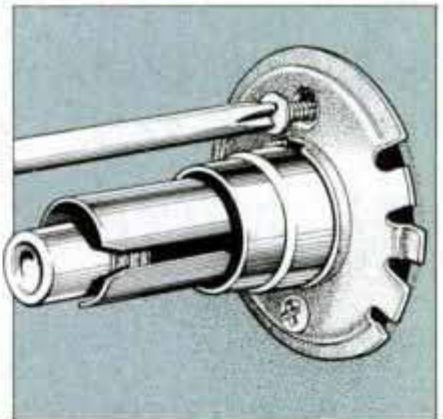
Otherwise, you should remove the old strike plate and install the new one. To measure the exact location, close the door and mark the correct bolt position. Align the new plate and adjust the recess as necessary as with the bolt plate.—*Merle Henkenius*



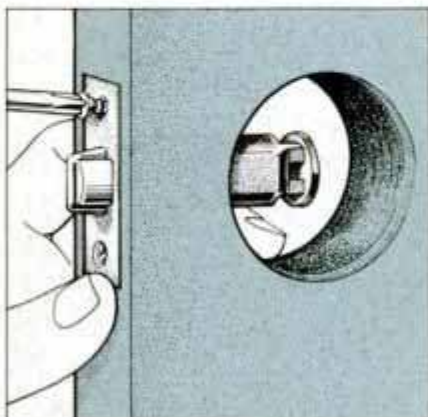
1 To remove the handle, find the clip on the sleeve and press. Use an awl if the clip is reached through a small hole.



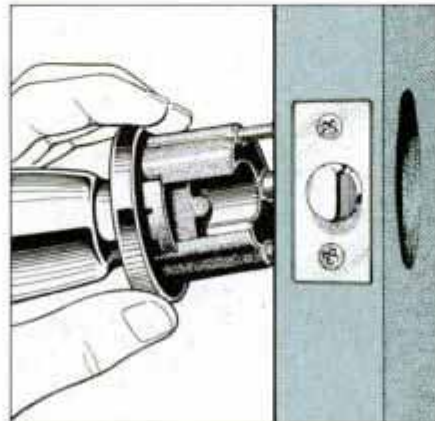
2 After the handle is removed, pry off the rose with a screwdriver to gain access to the main lock screws underneath.



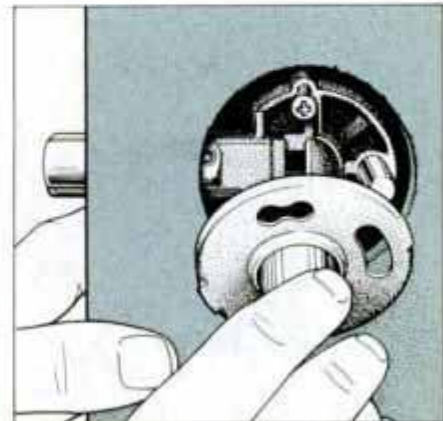
3 Two long screws extend through the door and hold lock halves together. Remove these and lock will come apart.



4 Take out the bolt by removing the two small screws that attach the plate to the door edge. Pry out the bolt if it's stuck.



5 After installing the new bolt, slide the lock cylinder in place and check that it engages properly with the bolt.



6 Reassemble the lock with the two long screws. Snap the new rose and handle in place and then install the strike plate.

Appliance Clinic

BY STEVE TOTH

Washer eats clothes

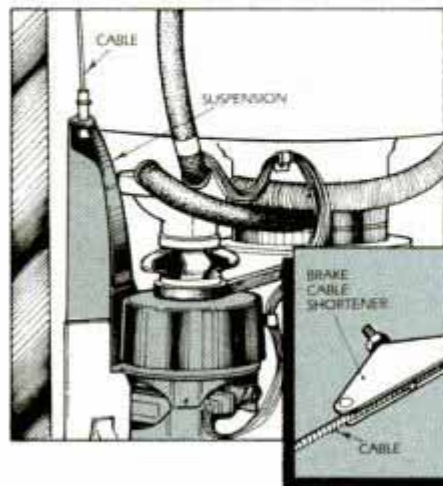
I have a General Electric automatic washer, model No. 1WA50BMA, serial No. LC124876. The machine has a very annoying habit of allowing small articles of clothing to escape the inner tub and get in the outer tub and pump. How can I fix this?

JIM J. MCCAIN
SALEM OREGON

Check to be sure the clothes retainer ring is mounted properly and secured to the basket. Next, check the plastic cover shield and its attachment to the top of the machine.

If these parts are in place and in good shape, then you'll probably need to narrow the gap between the cover shield and the tub. Purchase an emergency brake cable shortener, available at auto parts supply stores, and install it on the vertical suspension cable at the rear right corner of the machine. By shortening this cable, the tub will lift and narrow the gap between the cover shield and clothes retainer ring, lessening the opportunity for clothes to go over the side.

To install the cable shortener, first unplug the machine and remove the back cover. You'll see a cable that goes from the suspension up to the top rear corner on the left side. Install the shortener on this cable and adjust it



Install a brake cable shortener on the suspension cable to narrow the space between the cover shield and tub.

until you get a distance of 1/4 to 1/2 in. between the cover shield and the clothes retainer ring. Be sure the cable shortener doesn't vibrate against the shell of the machine.

A nonmechanical solution, if the gap is not too great, is to place all small items, like handkerchiefs and socks, together in a mesh washing bag.

Leaves a gap

I have a Whirlpool refrigerator and recently installed a new door gasket. I followed all the instructions, but now find a space at the bottom corner of the door on the handle side. What's the cure?

CATHY HUGENBERG
COVINGTON, KY

First, make sure the refrigerator is level and on a solid floor. Also check the inner plastic door panel to be sure it's not cracked or bowed. If it is, replace the panel. Next, unplug the refrigerator, and remove everything from the inner door panel and shelves.

Roll the gasket back to expose the screws and retainer, which hold the inner door panel and gasket to the outer door panel. Loosen these screws 1/2 to 3/4 of a turn on the top, bottom and handle side of the door. You'll notice that the door is now somewhat flexible. Close the door and adjust the outer door panel so the top and bottom edge of the gasket comes in contact with the entire front of the refrigerator cabinet equally. Then carefully open the door so as not to bend or twist the panel. Roll back the gasket again and tighten a few of the screws on the top, and then the side.

Close the door and test the gasket for complete contact. If the seal is good, tighten a few more screws and test again. Finally, tighten the remaining screws and re-check for proper contact.

Out of balance

My Kenmore 700 automatic washer, model No. 1106914712, serial No. C-40318701, works fine until it goes off balance and the machine sounds. A buzzer sounds and the washer won't start in any of the cycles.

The repairman started it by shaking the agitator. Can you tell me what's wrong?

VINCENT BELLETTO JR.
RICHWOOD, WV

Your machine is equipped with an off-balance switch that's activated by the motion of the base plate. Then a holding solenoid is energized, which breaks the electrical circuit to the timer and motor and causes the buzzing noise. By moving the agitator, you also move the base plate and in turn move the trip lever on the off-balance switch, enabling the machine to start.

First, check the snubber pad. Unplug the machine and raise the top by inserting a putty knife between the top and cabinet front about 2 1/2 in. from each corner. Push in on the two top locks while lifting the top. At the right rear corner, you'll see the snubber pad and spring. Lift the spring and remove the pad. Check the underside of the pad to see that the surface is not glazed or worn down and make sure the spring is not broken or slack. If either of these parts need replacing, order a snubber pad and spring, Sears part No. 350902, for about \$4.

Next, remove the rear access panel and check the off-balance switch. On the left side, at about the same height as the base plate, you'll see the switch and trip lever mounted to the cabinet. Gently move the trip lever back and forth to be sure it moves freely. If it binds or there's any corrosion, replace the unit. Use Sears part No. 350780, which costs about \$12. While you're in this area, check that all the gear case braces are fastened securely.

*Finally, check to make sure the machine is level. To do this, plug in the machine, open the lid and start a cycle. Allow the water to rise to the bottom row of holes in the basket, and then shut off the water by pulling out the control knob. Adjust the two front leveling legs until the water is level in the tub. Load the machine with clothes and test-run through a cycle. **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, NY 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.

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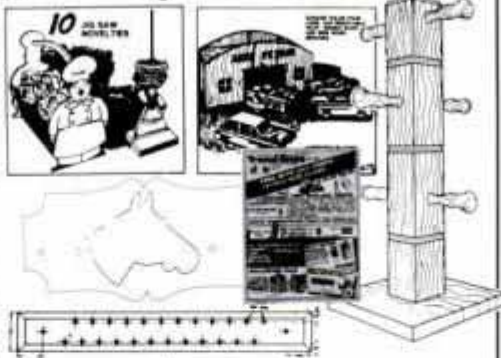
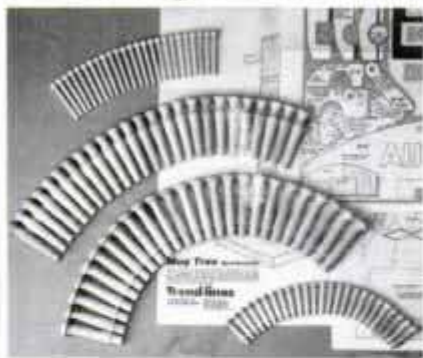


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(Continued from preceding page)

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(Continued from preceding page)

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(Continued on next page)

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(Continued from preceding page)

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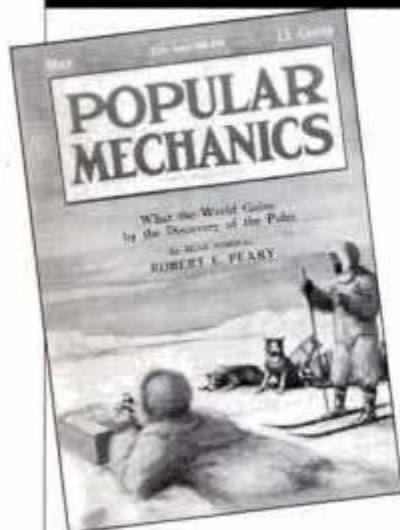
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TIME MACHINE

75 YEARS AGO: May 1912



Peary describes the poles.

Dominion poles

Writing for PM in 1912, explorer Robert Peary noted: "In the first chapter of Genesis, we read that on the sixth day the Creator . . . created man, and said: 'Let them have dominion over the whole Earth.' It is only now, with the attainment of both uttermost points of the Earth, the North and South Poles, that the scriptural permission and command has been effective." Peary said conquest of the poles would open new shipping lanes and create new avenues of exploration.



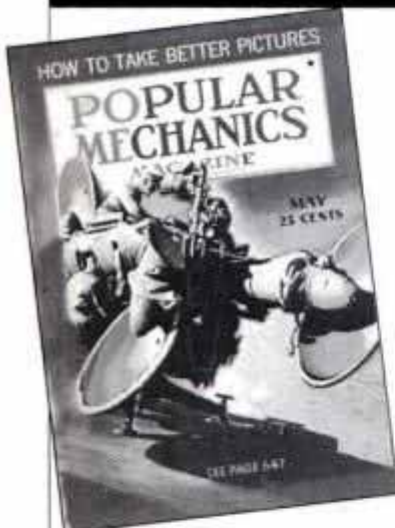
Hydro-cycle rides

By attaching two canoe-shaped metal floats and a motor rig to a motorcycle, a California inventor created a new machine. A 3-bladed screw propeller was driven directly from the motorcycle's engine. A 3-ft. shaft connected the propeller to the bike's chain drive.

Put us to sleep

Insomnia was almost impossible to cure in 1912. But a London inventor created a machine to put insomniacs to sleep. The patient would lie down on a bench with his head facing the ceiling over a bucket. A pumping mechanism would drip "medicated fluid" across the patient's forehead at a graduated speed and a fixed quantity. The flow would lull the patient to sleep in a kind of mechanical hypnosis. Based upon an African nursing custom, it didn't work well on Western adults.

50 YEARS AGO: May 1937



Infrared plane detectors.

Ears for war

It looked like a circus clown's tricycle gone haywire. It was an Austrian aircraft detector, a rigging that had hydraulic legs and three huge dish "antenna" ears. These used a combination of radio waves and infrared light to spot approaching planes. The radio waves worked well at the horizon level. The infrared rays were able to detect approaching aircraft above the cloud cover. The American military was using it at the start of World War II before radar was perfected.

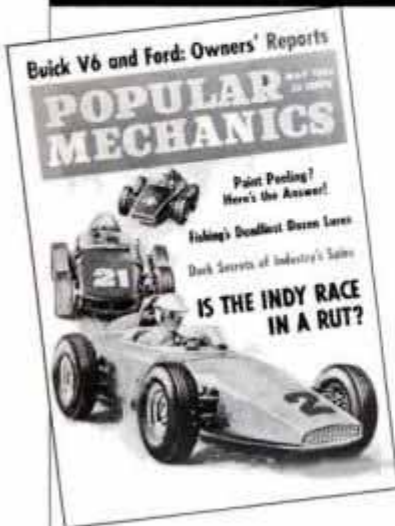


Airline or bomber flies

America was not yet at war with Germany, so we treated as good news the announcement that the German Postal Service had successfully tested a 30-passenger, single-wing, 4-engine plane that could fly across the Atlantic nonstop at speeds of up to 186 mph.

The German aircraft carried pontoons for emergency landings only. It could hop from Germany to the English Channel Islands across the Atlantic to Newfoundland in less than nine hours. Once the war began, however, the technology loomed as a constant threat.

25 YEARS AGO: May 1962



Would Indy last?

Indy in a rut

We wondered if the Indianapolis 500 hadn't become "a beer festival" without much interest for racing fans. The basic race had become a formula: "Take a group of carbon-copy, Meyer-Drake-engined cars, stuff them with fearless, well-coordinated boys, and let them go round in a circle until something goes wrong . . . the crowd loves blood." Despite our reservations, we reported on breakthrough developments in the engineering of the auto body and other systems for the race.

Abu's are forever

A panel of experts selected fishing lures they felt were so good the lures would last forever. The Abu reflex spinner topped the list with more than 70 varieties. The Bass-Oreno came with a floating-diving wiggler and was especially good for Bass and Northern Pike. The Bomber was called "the hottest thing in deep fishing anywhere." In all, the panel selected 12 all-time greats including: Dardevil; Flatfish; Hawaiian Wiggler; Jitterbug; Ike; Mirrolure; Pokie Minow; and River Runt.

Industrial spies

Industrial espionage was coming into its own as former FBI and CIA agents began opening private agencies dedicated to peering through your competitor's keyhole. One spy, Ulmont Cumming of New York City, declared that he was "the top industrial spy in the country." Ingenuity was the main tool of the industrial spy, but some new technologies were emerging to help him, such as microphones so sensitive they could pick up sound a quarter mile away, and rapid-sequence cameras. **PM**



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