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Popular Mechanics

**STUNNING
NEW LOOK
FOR YOUR
HOME**



Easy-To-Build Fence That Beautifies And Protects

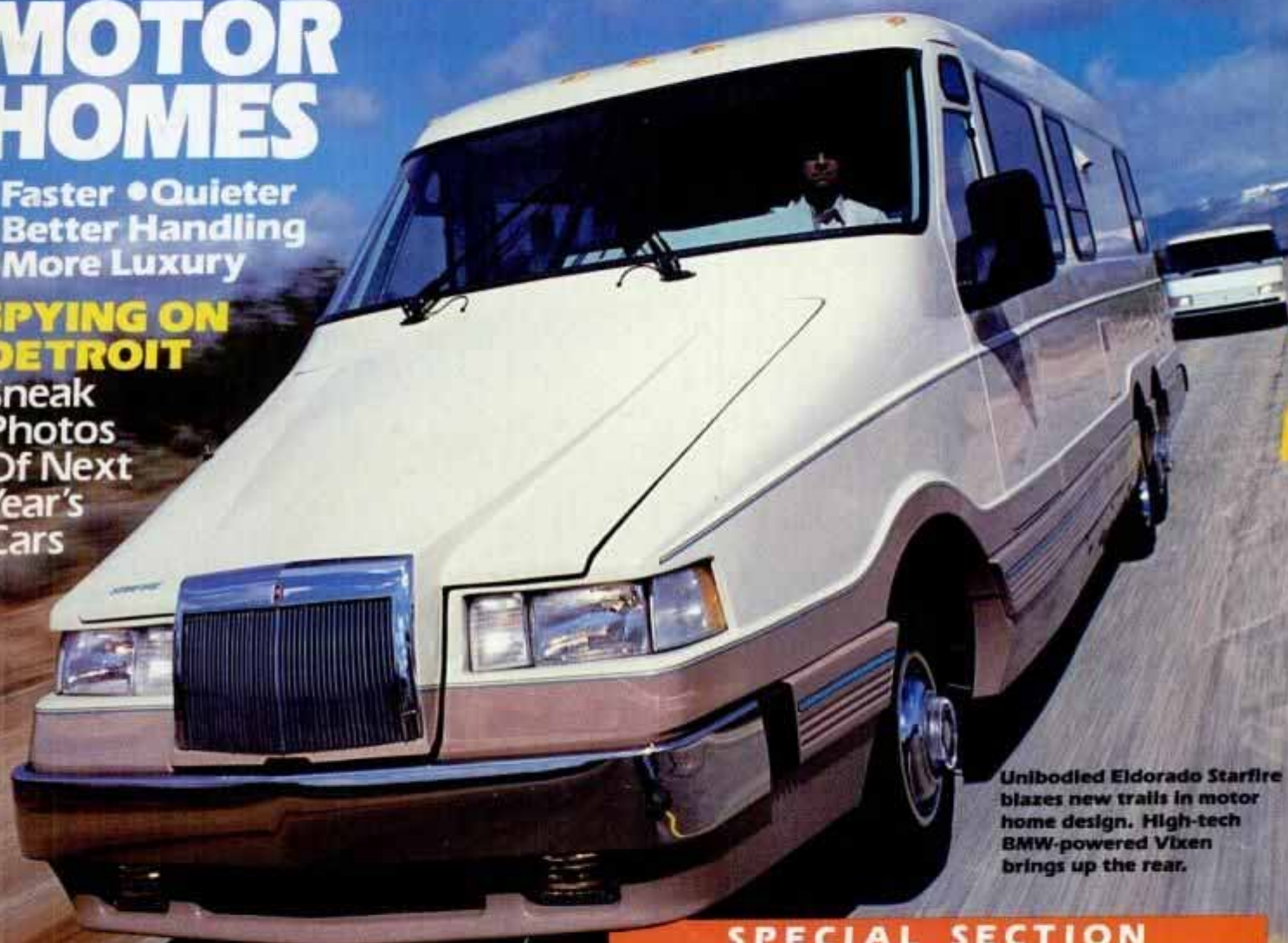
NEW FROM THE GROUND UP

HIGH-PERFORMANCE MOTOR HOMES

- Faster • Quieter
- Better Handling
- More Luxury

SPYING ON DETROIT

Sneak
Photos
Of Next
Year's
Cars



Unibodied Eldorado Starfire blazes new trails in motor home design. High-tech BMW-powered Vixen brings up the rear.

HOT NEW DECK BOATS

Party Boat Comfort,
Speed Boat Thrills

RAGTOP FEVER We Test
8 Cool New Convertibles



THE ART OF MOTORCYCLE TOURING

By Malcolm Forbes

SPECIAL SECTION

CAR STEREO

Sensational Sound For Any Car Or Truck



- Newest State-Of-The-Art Equipment
 - How To Upgrade Your Present System
 - Installation Tips For Vans, Wagons, 4x4s
 - Hottest Accessories
- Plus Much Much More*

Now, Two Ford Bronco II's ...4-wheel and 2-wheel drive models.

Choose a Ford Bronco II to suit your active lifestyle—with traditional four-wheel drive, or a two-wheel drive only model.

For those who love their town and country driving, Bronco II gives you more ways to have fun with style: either tooling around the out-back or threading city streets. That's because there's now a two-wheel drive model available... great for people who like the kick of a Bronco II but don't need 4WD.

Rear antilock brake system.

Both Bronco II's feature a first in their class—rear antilock brakes. They're designed to help you make straight stops when you're traveling in 2-wheel drive. Only Ford has them, and they're standard!



Unbeaten V-6 power.

For '87 Bronco II turns loose the juice with an electronically fuel-injected 2.9L multi-port V-6. This powerplant is unbeaten by any standard engine in its class! On the freeways or in the mountains you have 140 hp* at your command.

The Ford Bronco II is versatile and fun to drive. Its "command seating" puts you in charge of the road. On or off road, it's the way to go first class in pure comfort!

Touch and go.

Just push a button on the 4WD Bronco II and Ford's electric "Touch-Drive" option automatically kicks from two-wheel drive into 4WD high at any speed. The traction you want in all-weather driving is there instantly. You don't have to stop, get out, or shift.

Eddie Bauer

Eddie Bauer Bronco II features unique two-tone paint and special trim, high-style interior with dual Captain's Chairs for extra comfort. And it comes with "Ford Care" extended service plan** protection too—24 months or 24,000 miles, whichever comes first. Plus an Eddie Bauer garment bag and 6-pocket gear bag.

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.

Best-Built American Trucks six years running.

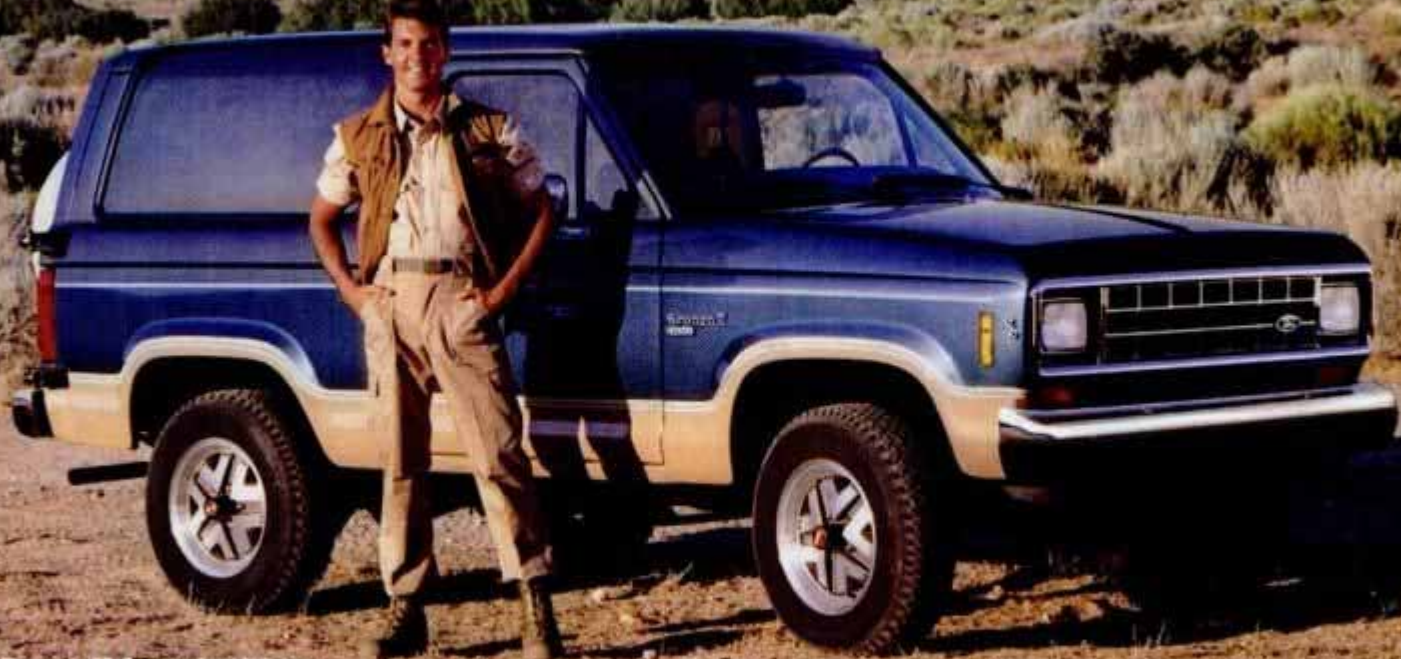
"Quality is Job 1." In fact, for the past six consecutive years, Ford quality has led all other American automotive companies. This is based on an average of owner-reported problems in the first three months of service on '86 models and in a six-month period on '81-'85 models designed and built in North America.

Buckle up— together we can save lives.

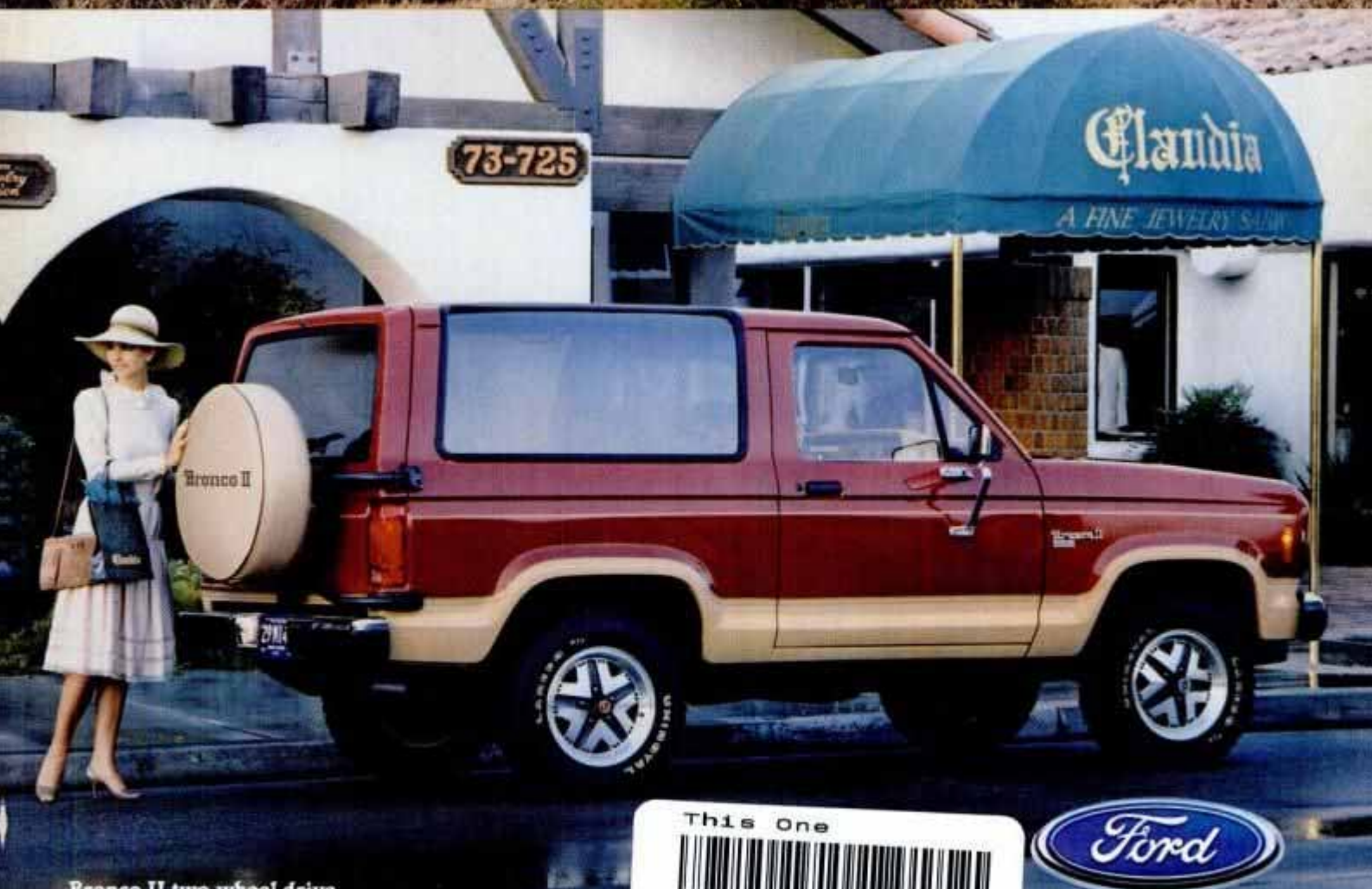
*Based on SAE Standard J1349.
**Limited warranty. Ask to see a copy at your dealer.



Bronco II
BUILT FUN TOUGH



Bronco II four-wheel drive



Bronco II two-wheel drive

This One
L5RX-Y1X-PSKH

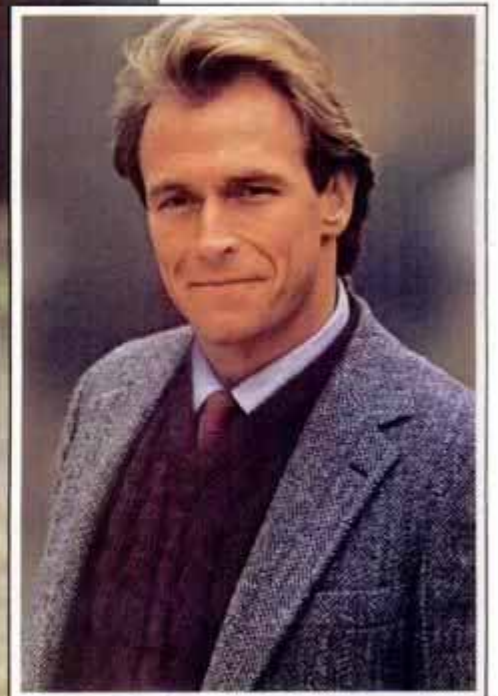


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ON THE COVER

Traditionally, motorhomes have never been fancied by car buffs who want real driving machines. But today, the more sophisticated motorhomes feature computer-generated aerodynamic styling, molded construction and more efficient chassis design. Read about the future of motorhome design and function on page 86.

—PM photo by Rich Cox



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Editor's Notes



I met Malcom Forbes, the man they call the Capitalist Prince, in 1970. He was just getting into the sport of motorcycling, and he was doing it the way he does everything—almost overboard. He had already purchased an interest in a motorcycle dealership and was the owner of 12 bikes. He decided he'd like to meet the motorcycle press. As the editor then of a magazine called *Supercycle*, I was among a group of invitees to a fabulous weekend at his compound in Far Hills, New Jersey, and aboard his yacht *Highlander* berthed on the Hudson River. A great weekend and an unforgettable introduction to a man who lives life the way all of us would like to—maxed out to the limit. Even after all these years, Forbes, the publisher of *Forbes* and *American Heritage* magazines, is still the man I remember from that night 17 years ago—a super-enthusiast and a down-to-earth human being. Happily for us, he channeled some of that enthusiasm into an article starting on page 90 on what he's learned about motorcycle touring, something he's done all over the world. . . . One of the things I've always thought made our magazine stand out has been the consistent high quality of our illustrations, especially the technical illustrations that accompany our Home and Shop how-to articles. One of the people who produces those top-quality technical illustrations is Gene Thompson, an artist who has been at the top of his craft for about 30 years. He's worked for POPULAR MECHANICS for 12 of those years, adding his innovative artwork to a package of construction articles that is unsurpassed in the publishing field. Thompson has the skill to add new dimensions to the field of technical illustration not only on the drawing board, but in the classroom as well. Naturally, Thompson did the technical illustrations for our fence article starting on page 98. What's more, he also designed the fence and, with wife, Beth, built it at their home in Glen Cove, New York. That's what I call being the complete artist. . . . Speaking of articles that come out of our Home and Shop Department, you may have noticed our expanded *Better Home* section that began last month. The *Better Home* has proved to be so popular with you readers that we've gone from four to eight pages every month. One of the things we've done is move the popular *Appliance Clinic* and *Homeowners' Clinic* monthly columns into the *Better Home*, where they're more at home. . . . We were



Framed in their gate: Beth, Gene Thompson.

very proud to learn recently that staff member Tim Cole has been voted the Magazine Feature Writer of the Year by the Unlimited Racing Commission, the governing body that sanctions hydroplane racing in this country. Tim's winning article on the *Miss Budweiser* unlimited hydroplane appeared in our October '86 issue.

"Til next time.



Miss Bud's owner, Bernie Little, and Cole.


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Published by The Hearst Corporation:

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POPULAR MECHANICS is published monthly by the Hearst Corporation, 959 Eighth Avenue, New York, NY 10019, U.S.A. Frank A. Benaick Jr., President; Randolph A. Hearst, Chairman; Harvey L. Lipton, Vice-President and Secretary; Edwin A. Lewis, Vice-President and Treasurer. Hearst Magazines Division: Gilbert C. Maurer, President; K. Robert Brink, Executive Vice-President; George J. Green, Executive Vice-President; Mark F. Müller, Executive Vice-President, General Manager; Raymond J. Petersen, Executive Vice-President; Thomas J. Hughes, Vice-President & Resident Controller; Daniel J. Coleman, Vice-President for Popular Mechanics.

INTERNATIONAL EDITIONS: CARIBBEAN, MEXICO, SOUTHERN HEMISPHERE

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POPULAR MECHANICS • JUNE 1987

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Letters



Upscale Model



Reader Jedd's SS United States is scaled up from PM plans.

Your article and plans for building a model of the superliner SS United States (page 182, Dec. '82) launched me on quite a voyage. It was a 12-year sign-on, in fact, that took me to the U.S. Lines and the Smithsonian. I was so impressed with the 990-ft.-long United States (1,200,000 blueprints were used in her construction!) that I wasn't happy to build my model 36 in. as per your plans; I built her 54 in. long. I'm now constructing a 5-ft. model of the Normandy.

MICHAEL G. JEDD
WATERDOWN, CT

United States plans are \$9.95 from Popular Mechanics, Radio City Station, New York, NY 10101.

Chopper Flak

As a helicopter pilot with some 20-years experience in various types of helicopters from lightweight trainers to heavy transports, I want to read even more about the Voljet *Hot-Air Chopper* (page 82, Feb. '87). Also, you say the collective is on the right side of the pilot. This would be a first for me!

EUGENE L. OSMONDSON
COL. (RET.) USMC
MILTON, FL

We got up on the wrong side of the collective that day; it's on the left side of the pilot, of course. As for more about the chopper, Terry Jones of Voljet International says there are significant weight savings in eliminating the transmission, shafts, couplings, gearboxes, tail rotor and long tail boom associated with the mechanical drivetrain of the conventional helicopter. A portion of these savings, however, are offset by the need for the larger engine required to produce equal propulsive power to the rotor—more in the Voljet 585 because it's designed to meet hot and high mission requirements. Still, the 585's ratio of useful load to gross weight is far better than any of its conventional competition. Regarding limits, the only readily measurable ones are those of fuel consumption and speed. The greater fuel consumption is directly related to the increased power requirements referred to above.

Doubling Up

Since I have two girls, ages 6 and 9, I had to build two of the jewelry boxes you showed in your Bonus Woodworking Section last year (*Miniature Chest*, page 160, March '86). I made them of laminated oak and walnut strips with birch drawers lined with red velvet. I made the boxes 1 in. deeper than your plans show so I could build in a small music box.

FRED UECKERT
VERNON, BC
CANADA



Miniature jewelry chest is one of two made by Fred Ueckert.

Fast...Drivers

Maybe it's time you referred to American *drivers* who love the feel of a fast car under them. Keep in mind that there are women—like me!—who know a few things about "speed thrills" (*Speed Thrills*, page 63, March '87). I bought a Buick Regal GN and find that it's more of a driver's car. With automatic transmission, it takes more skill to tap the GN's horses.

KATHY GROLD
MALIBU, CA



The power to merge.

Do you trust your car to perform well on the on-ramp? Does it accelerate smoothly? Hit cruising speed quickly?

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And when your car performs better, you feel better about driving. Now that's a nice balance of power.



Simply stated: Ford Thunderbird.

You'll notice that its glass and headlamps fit flush with the body. And that its hood is sleek and low to the ground.

These refinements not only give Thunderbird its distinctive new look, but are functional as well. Its design reduces interior wind noise and allows air moving over its surface to actually contribute to road stability.

The principles of flight.

A fuel-injected 3.8 liter V-6 and MacPherson strut suspension gives Thunderbird the kind of performance you would expect from a true driver's car.

And the driver is the focus of attention inside as well. The seats have been designed to position

the driver comfortably behind the wheel. And the controls have been placed where they can be easily found and operated. All of which allows the driver to perform as well as the automobile.

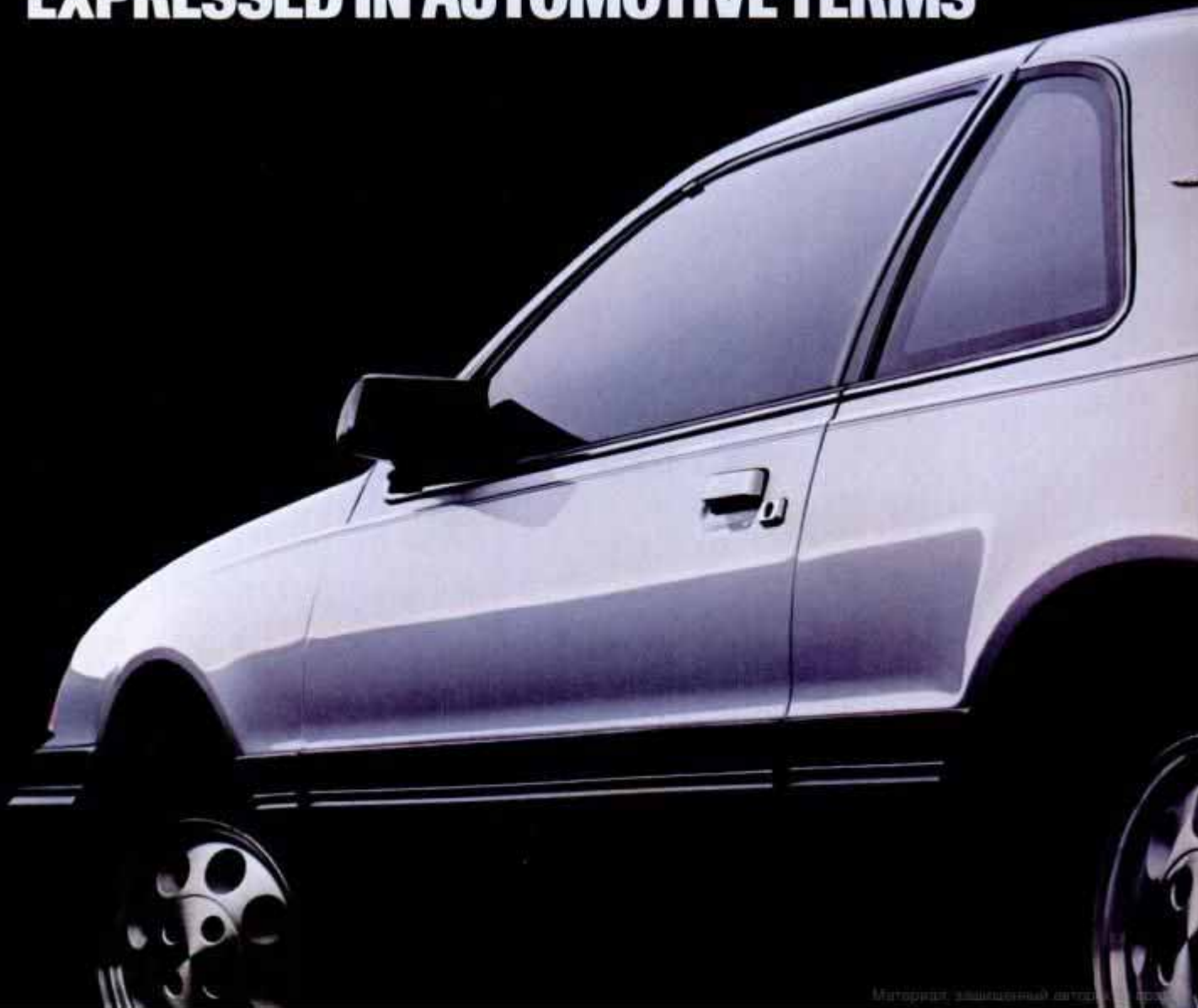
The new Ford Thunderbird.

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FORD THUNDERBIRD

problems in the first three months of service on '86 models, and in a six-month period on '81-'85 models designed and built in North America.

Have you driven a Ford...lately?



Buckle up—Together we can save lives.

Imports



BY BILL HARTFORD

Volley Of Volkswagens



Quantum jump: Finally, a totally integrated design.

There's a passionate sense of tradition in Germany—a commitment to the long term. Some years ago, it led VW to wonder why the Beetle, which became a classic of this century, should ever have to be changed. After all, who would dare update Bach, or Beethoven, or Brahms? But if you're in the business of selling cars today, you have to be on the popular charts. Volkswagen did get on the bandwagon with up-tempo models, and more are on the way. The venerable van, for example, will go to fwd, abandoning the Boxer rear-engine rear drive. It will, however, maintain its

very clean profile. VW does know about good taste in design: How else could this vehicle, also known as the Type 2 or VW Bus, pass the 6-million mark in 36 years of



Polo concept is sports car-like coupe.

production? The new van will offer a choice of VW's in-line engines, to be mounted transversely in the longer nose, and a 4wd option, too.

A stunning design for a new coupe in the European Polo line shows a 2-seater that looks like a sports car. It will likely get one of VW's small-displacement but high-horsepower engines for very impressive performance. And, the Quantum—which has been technically, but never stylistically, up to date—will finally arrive as a perfect package.



It's the Van again, but now with fwd.

Way Off Road

Now that the Range Rover has blazed the 4x4 trail from England to the United States, can the Africar be far behind? This new off-roader offers a selection of chassis sizes and modular construction that lets you choose from among several body styles. The body panels are constructed of a plastic-reinforced plywood. The production start-up of this very simple—and inexpensive—"Third World" concept is imminent. Africar International is a Brit-

ish enterprise that's located at Caton Rd., Lancaster LA1 3NG, England.



Africar prototype made arctic-to-equator shakedown run.

Rolls Warranty

The advantages of buying a brand-new car and keeping it "forever" are well known to PM do-it-yourselfers. But here's news that might make you consider buying used—maybe even 10-years used. What if an oldie came with a warranty covering engine,

transmission, drivetrain, suspension, a/c and more? Well, that's exactly the deal you get on Rolls-Royces and Bentleys up to 10 years old with up to 80,000 miles on the odometer. Now just ask your dealer to let you know when that little old lady's '77 Silver Shadow comes in.

Proton And Yugo

Be glad that when Tan Sri Dato Jamil Jan, chairman of the Board of Perusahaan Otomobil Nasional SDN. BHD., signed an agreement in Kuala Lumpur, Malaysia, to export cars here, that it was for the Proton Saga. That's one of the easiest pronounced new-car names of all the imports coming from those far-away places with strange-sounding names. There's no way anyone can mess up the name of this Malaysian subcompact

hatchbacks which will start under \$5000. The Proton Saga is a Malaysian National Car Project involving the Heavy Industries Corp. of



The \$10,000 Yugo: Convertible version is due next spring.



Proton Saga, \$5000 subcompact from Malaysia, arrives Feb. '88.

(but then I thought there was no mispronouncing Yugo until I heard "Hugo!"). February is the due date for the fwd 4-door sedans and 5-door

Malaysia (HICOM) and Mitsubishi, with 70/30-percent equity, respectively. The arrangement accounts for Mitsubishi's 1.5-liter Four powering the 94-in.-wheelbase automobile. If you've followed the story so far, you should also know that Proton America, Inc., and Yugo America, Inc., are both subsidiaries of Global Motors, Inc., which will operate dealerships. A new Yugo model to be available soon after is a convertible, the GVC, which will have a powered top and unique tailgate design for luggage access. **PM**

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Outdoors



BY TIM COLE

Itasca's "Little Brother"

As you can see from the feature in this issue called "New-Age RVs," motorhome design has come a long way from the corrugated crackerboxes that once lumbered along America's roadways. Except for Airstream,

homes, however, still clung to that severe, blunt-nosed rectangle we tend to associate with motorhomes generally. Refinements in lightweight, high-strength materials, the once (and future?) fuel crunch, power-



Updated Itasca Phasar 220I—leading the RV "aero" wave.

which adopted its distinctive aerodynamic trademark way back in the '40s, contemporary coach builders are slowly embracing a cleaner, more fuel-efficient profile.

Our article, written by *Motorhome* magazine editor Bill Livingston, points out that the motorhome industry has matured, adopting automotive manufacturing techniques and styling ideas from the often converging spheres of aviation and marine technology.

One might say that all this fuss about aerodynamics is pretty old news. R. Buckminster Fuller enflamed a generation of automotive aerodynamicists in 1933 with his 3-engine, omnidirectional Dymaxion. Prompted by this vision of the future, post-War automakers crafted cars using complex shapes and sensuous contours. Motor-

train developments and, perhaps most important, public styling demands, all contributed to the lean, clean look of motorhomes in the '80s.

Call it quaint (and therefore irrelevant), but we're prone to establish benchmarks for developments such as these, and we can make a case that the leader of the new wave in aerodynamic RV design rolled off the Winnebago assembly line two years ago. Its LeSharo and identical Itasca Phasar "garageable" motorhome has taken the RV world by storm, accounting for a sizable portion of Winnebago production. The latest styling package is a Phasar 220I with an updated "Euro" nose job. Recent Phasar/LeSharo innovations also include a sculpted rear cap, zippy accent stripes and upscale wool/velvet upholstery.

Not the kind of package

that can easily assault the Rockies, but definitely a superior highway cruiser. And the motorhome that has changed an industry.

Putt-putts Are Forever

We admit to an inordinate fascination with large, complicated, swift, expensive marine powerplants. That's why we concentrated on large outboard technology in our March boating guide, and why our most recent comparison tests have involved sterndrives. We haven't forgotten the ubiquitous kicker, however, and that brings us around to the new Mercury 4-hp., a well-engineered entry in the micro-outboard field. Mercury has sensibly downsized various features found on much larger outboards for this unit—like the twist-grip throttle and F-N-R gearshift. These features keep hands away from the powerhead—thereby putting all eyes front during dockside maneuvering.

The Merc 4 differs from its OMC rivals in that it has no detachable fuel reservoir, which some outdoorsmen may actually prefer. For more information, contact Mercury Marine at 1939 Pioneer Rd., Fond du Lac, WI 54935.

Econocamper

With all this talk of motor-



Propulsion solution for small boats on ponds, lakes, rivers.

homing this issue, it's easy to lose sight of what some may consider the best way to see the outdoors—attaching a lightweight, pop-up tent camper to the hitch of a compact truck or auto and heading for the nearest trout stream. The 575-pound Coleman Colorado is one of the smallest models in the genre, and offers a compelling blend of comfort and simplicity.

The unit has a low profile on the road for enhanced fuel economy, and converts at the campsite to a roomy tent with 6 ft., 7 in. headroom. A unique canopy over the rear door provides protection from sun and rain.

The whole rig is the answer for campers on a budget. At the very least it's a camper for those who find comfort in the bare necessities.

For more information, contact The Coleman Co., Inc., Camping Trailer Division, R.D. 2, Somerset, PA 15501. **PM**



It's back to basics with the Coleman Colorado mini-camper.



A RIDING MOWER THAT COULD BE THE CAR-OF-THE-YEAR.

If that seems a bit far-fetched, consider: Our automobiles have earned the title twice in the last six years alone. So, why not our riding mower?

After all, both feature powerplants that evolved from innovative Honda engineering. Mid-mounted for optimum maneuverability, the advanced Overhead Valve

engines that drive our riding mowers set the industry standard for fuel and oil efficiency. Like our automobiles, our riding mowers are easy to handle. With Honda's exclusive Mechanical Autoclutch Transmission (MAT™), there's no clutch pedal to operate. You just shift gears and mow. Of course, all Honda products share an impressive reputa-

tion for reliability.

Admittedly, a top speed of 5 mph is slow for a Car-of-the-Year, but a beautifully manicured lawn may help you overlook that. Indeed, you may be inclined to overlook our competition, once you realize that for the price of a riding mower, you can own a Honda.

IT'S A HONDA

HONDA
Power
Equipment

For optimum performance and safety, we recommend you read the owner's manual before operating your Honda Power Equipment. ©1986 American Honda Motor Co., Inc.

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.



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.

When the road ends, the performance doesn't.

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

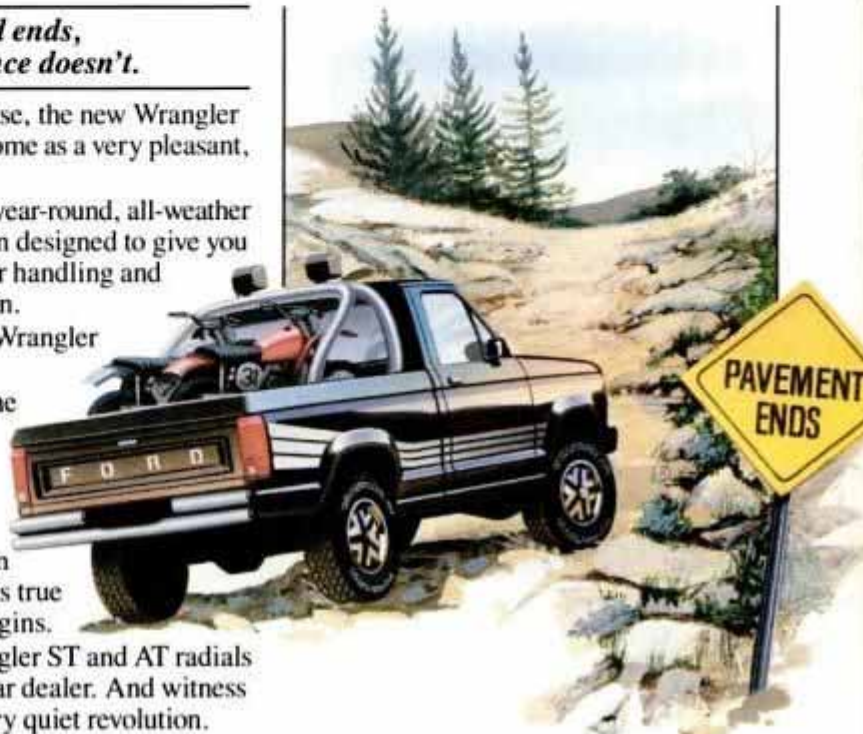
It is a strong, year-round, all-weather tire that has been designed to give you long wear, better handling and excellent traction.

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.



GOODYEAR

Take me home. The quiet way.



Home Video



BY JAMES B. MEIGS

Putting Heads Together

Making sense of the "head games" VCR salespeople sometimes play can be the toughest thing about buying a VCR. Walk into almost any electronics store and you'll hear people touting the advantages of their 3-, 4-, 5- and even 6-head VCRs.

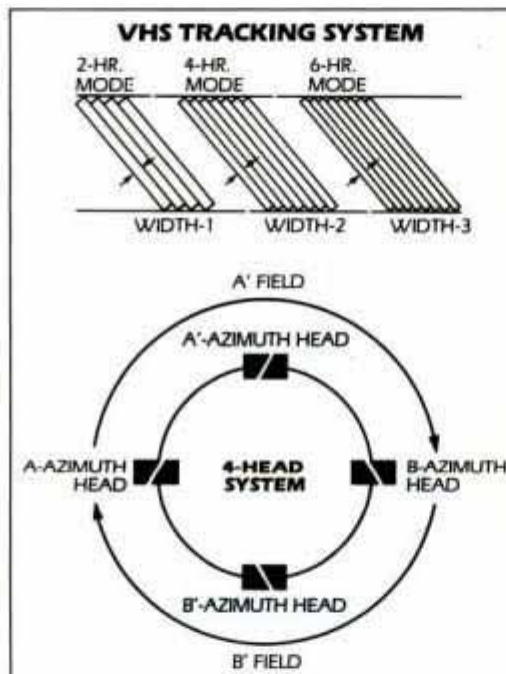
Yet, while the video head count can be confusing, it's also an important indicator of a VCR's capabilities. Video heads are critical to VCR performance; they actually write the signal on the videotape during recording, and then read it back for playback. Here's a brief guide to how they work.

In essence, a video head is like a tiny horseshoe magnet. It consists of two magnetic poles separated by a fraction-of-an-inch gap. During recording, a tiny electric current (in this case, a video signal) is fed to the head, and an electromagnetic flux develops in the head gap. If you slide the head across a strip of magnetic tape, the head will magnetize the tape in a pattern that matches whatever signal you've been feeding it.

During playback, the same head sliding across the tape will create a tiny signal based on the magnetic information on the tape. That signal, when amplified, becomes the video picture.

But video pictures contain a

huge amount of information, far too much to record by simply dragging the tape across a single head. Instead



Four heads improve long play and special effects.

the video heads are mounted on the outer edge of a small drum (shaped like a small hockey puck) which spins rapidly, moving the heads past the tape at high speed. The tape wraps around the drum in a diagonal pattern, so that the heads cross the tape in a series of narrow diagonal stripes, or "tracks," each as wide as the head gap that makes it.

The least expensive VCRs use two video heads, one for each of the two video "fields" that make up a complete TV frame. There are a couple of limitations to this approach.

For one thing, in order to record or play back at the 6-hour—or extended play (EP)—speed, the video tracks have to be much narrower (as shown in the accompanying diagram). But the wide head gap appropriate to the standard play (SP) speed can't record or play back those narrow tracks without producing a scrambled picture. Most 2-head VCRs get around this problem by using a compromise head gap, one that does an adequate—but not great—job in either speed. A better solution is to add a second set of heads (the A' and B' heads on the accompanying diagram) designed specifically for slow-speed recording. This is the reason salespeople are likely to suggest buying a 4-head VCR.

Another problem with 2-head decks comes during slow-motion or freeze-frame playback. Because the heads track across the tape at a different angle during those special effects, it's difficult for a 2-head VCR to yield acceptable pictures with special effects, especially in the SP mode. One solution is to optimize the second set of heads on a 4-head deck to get special effects playback—and, in fact, most 4-head VCRs will provide much better special effects than 2-head models. VCRs manufactured by Hitachi (including RCA's models) often include a single, extra head for special effects, thus turning what would be a 2-head model

into a 3-head deck and 4-head models into 5-head decks. All offer very good special effects.

One word of warning: Don't let a fast-talking salesperson include nonvideo heads when he gives you a deck's head count. Many decks have additional heads that aren't involved in video recording and playback (although they do provide important functions). VHS Hi-Fi machines have two heads just for audio, for example, and some 8mm and Beta home decks offer "flying erase heads" that help give cleaner transitions between scenes during editing. If a salesperson describes a 4-head VCR that also has two Hi-Fi audio heads as a "6-head VCR," he may be taking you for a ride.

Video To Go

Did you ever wish your video gear were a little more portable? Citizen has just introduced a compact video cassette player (VCP), with a built-in color monitor, that can go wherever you go—the bedroom, RV or summer house. While the VCP-5MU's 5-in. monitor may be too small to entertain a roomful of people, it's fine for up-close viewing and small groups. The \$599 player is only slightly bigger than a briefcase, and weighs in at 22 pounds. It can operate on either AC or DC power.

Aside from the player's value as a portable movie machine, it has obvious advantages for business and salespeople. It could make many presentations as simple as inserting a cassette.

In fact, the VCP-5MU is sold through Citizen's Business Products division in Los Angeles, California.

(Please turn to page 21)



Citizen video cassette player has a built-in, 5-in. color TV.



**INTRODUCING
A VEHICLE TO MEET YOUR
HIGHEST EXPECTATIONS ...**



... AND EXCEED THEM. SIERRA: THE ULTIMATE PICKUP FROM GMC TRUCK.

You demand a lot of your possessions.

To fit your life, a vehicle must do more than simply fit in your driveway. It must offer a sense of adventure that complements your own personal style. It must suggest endless possibilities — and then fulfill them. What you drive must be as comfortable as a broken-in pair

of jeans, and yet as contemporary as anything on the road today.

In short, you expect a lot. But you are easy to satisfy — because you only want the best. It is for individuals like you that we proudly introduce Sierra. The ultimate pickup from GMC Truck.

Sierra is clearly a new concept in full-size pickup design. Designed to

be the last word in pickups, from the first name in trucks: GMC Truck.

But don't just take our word for it. We invite you to refer to the last page of this section for a detailed explanation of Sierra.

And don't forget to bring your expectations.



SIERRA. SOPHISTICATION YOU NEVER EXPECTED IN A PICKUP. ALL THE ROOM, POWER AND PERFORMANCE YOU EXPECT FROM A GMC TRUCK.

Your expectations are high. Sierra will fulfill them. And then some.

Advanced aerodynamic lines give Sierra a fresh contemporary shape, with a rakish windshield and flush-fitting side glass for a quiet, comfortable ride. With its sophisticated styling, Sierra is ready to go everywhere. Select a four-wheel-drive model (with the Insta-Trac system that lets you shift conveniently from two-wheel to four-wheel drive without stopping) and "everywhere" can be almost anywhere!



Full-size inside.

Sierra's interior features more shoulder and leg room than previous full-size pickups from GMC Truck. So there's plenty of stretch-out space for three adults. Standard power steering and power brakes ease your driving.



And you can add almost every conceivable driving amenity, from electronic cruise control to power windows and power door locks.

Full-size outside.

In today's world of "mid-size,"

"small-size," and "downsized" pickup trucks, Sierra is a full-size pickup that still delivers the goods. Select from 6½' short-bed or 8' long-bed models. The long-bed can still accommodate the proverbial 4' x 8' sheet of plywood between the wheelhousings.

Full-size power.

The amazing 4.3-liter Vortec V-6 engine is standard (except on 3500 models which feature a standard 5.7-liter V-8). And with the available five-speed manual overdrive transmission and Vortec engine, a two-wheel-drive Sierra is rated at an impressive EPA estimated MPG city 17 and highway 23. Or you can select from a big choice of V-8s: 5.0-liter (305 cu in), 5.7-liter (350 cu in), 7.4-liter (454 cu in), or the 6.2-liter (379 cu in) diesel. Standard electronic fuel injection on all gas engines gives instant starting response and outstanding over-the-road performance. When properly equipped, Sierra is ready to move up to 19,000 lbs, including itself, passengers, trailer, equipment and cargo.

Built to be driven.

Sierra gives a whole new meaning to the phrase, "drives like a truck," thanks to a new fully independent torsion bar front suspension on 4 x 4 models or its newly improved two-wheel-drive front suspension.

The standard rear-wheel anti-lock brake system (operable only in the two-wheel-drive mode on four-wheel-drive models) is designed to prevent rear-wheel lockup and helps control skidding on sudden stops, on wet or dry pavement, loaded or unloaded.

The fuel tank is mounted between the frame rails. There's a new box-section front frame with impressive strength. And the side glass has been increased by 33% over our 1987 Full-Size Pickup, for greater visibility.

Built to last — in the GMC Truck tradition.

The majority of all exposed metal surfaces are galvanized steel, protected by deep-luster basecoat/clearcoat acrylic enamel — the same advanced

painting technique that protects some of the world's finest automobiles. An uncluttered underhood area offers impressive service access, and a new aluminum radiator reduces weight and helps prevent corrosion.

It's not just a truck. It's a new idea.

At GMC Truck, we've been saying, "It's not just a truck anymore," when we speak of our entire product lineup. And no product better exemplifies that phrase than our new Sierra.

It's not just a new pickup. It's a whole new way of thinking that says the traditional American full-size pickup can be just as advanced as any automobile on the road today, while still accomplishing all the truck-like things you usually buy a pickup for.

And every new Sierra is backed by a 6-year/60,000-mile warranty on the



powertrain and a 6-year/100,000-mile warranty on outer-body rust-through. Buckle up and visit your GMC Truck dealer for the terms and conditions of this limited warranty. (Check the Yellow Pages under "Truck" or "Automobile.")



Then, take a look at Sierra. It's like nothing you've ever expected in a full-size pickup. And everything you've come to expect from a GMC truck.

GMC TRUCK
IT'S NOT JUST A TRUCK
ANYMORE.

HOME VIDEO

(Continued from page 16)

Get Ready For S-VHS

We've been hearing rumors about an ultrahigh-quality version of the VHS home video format for years. And just recently, JVC, inventor of the VHS format, shook up the video world by announcing that it will be unveiling what it's calling S-VHS—for Super VHS—any day (see *Electronics*, page 34, April '87).

According to JVC, the new format will boast the most remarkable performance in the history of home video: pictures with more than 400 lines of horizontal resolution. That's better than live broadcasts! How do they do it? The latest specifications have just come in from Tokyo. Here's what we know so far.

S-VHS decks will be able to play and record both S-VHS tapes and today's VHS cassettes. That means you won't have to worry about your current library of VHS cassettes being incompatible with the new VCRs. But in order to produce an S-VHS picture, S-VHS VCRs use a new type of videotape. The new S-VHS cassettes—which look almost exactly like ordinary VHS—will contain a high-density, oxide-tape formulation that lets them handle the higher frequency signals of S-VHS. TDK, Maxell, Fuji and 3M have all announced that they will offer S-VHS cassettes.

The new super cassettes include a special identification hole that enables S-VHS VCRs distinguish them from ordinary cassettes. If you were to record with an S-VHS cassette in a conventional VHS VCR, you would get an ordinary VHS picture—and you can play it back in an S-VHS deck. On the other hand, a recorded S-VHS cassette won't play at all in an ordinary VHS deck.

In most respects, S-VHS VCRs will work exactly like their conventional cousins. S-VHS tape runs at the same speeds. Audio recording—whether conventional or Hi-Fi—is performed as it is today. Video recording will use essentially the same "color-under" process used today. The difference will be in the frequency used to record the picture's luminance (or brightness) information. S-VHS machines move the entire luminance signal into a higher frequency range. Instead of recording the signal in the range between 3.4 and 4.4 MHz (MegaHertz) like conventional VHS, S-VHS uses the range between 5.4 and 7.0 MHz. Why is that important? Because the new luminance signal is not only higher in frequency, it also occupies a much broader frequency band: 1.6 MHz compared to 1.0 MHz. This increase in bandwidth should mean a dramatic improvement in picture quality.



NEC uses digital circuit to reduce noise, improve picture.

S-VHS decks will also have another unique quality. According to JVC, S-VHS VCRs will offer special outputs that keep the luminance and chrominance (color) signals separate. Keeping the two components of the video signal separate, instead of combining them in a conventional—or "composite"—TV signal, eliminates the picture degradation otherwise caused by interference between them. This is an approach used in some professional video equipment, and should help S-VHS VCRs maintain an impeccable level of picture quality when sending signals to other components (S-VHS decks will also have composite outputs).

What sorts of products might have the special luminance/chrominance inputs to accept these signals? There are reports from Tokyo that the leading VHS manufacturers will be introducing new TV monitors along with S-VHS VCRs. Featuring luminance/chrominance inputs, the new sets should be able to take advantage of every bit of picture quality this remarkable new format has to offer.

Though it's not definite which companies will have the first S-VHS VCRs available in stores, it appears that JVC, Sharp, Matsushita (parent company to Panasonic and Quasar), Mitsubishi and Hitachi will all have S-VHS models on display soon. We'll keep you posted.

Beta Bites Back

Yes, you guessed it: Sony's looked at Super VHS and contends Beta's still better. Not Superbeta—that exists already. But ED Beta, meaning extended definition. Sony says the new improved Beta will emerge this fall with 500 lines of horizontal definition. The system uses cassettes housing metal particle tape—which can't be played or recorded in older Beta VCRs. Conventional Beta cassettes can be recorded in the ED Beta machine, but only at the Hi-Band Superbeta level—not ED. At press time, it was not known whether older Beta recordings will play on the ED system. Stay tuned.

Digital Dilemma

While super VCR systems are in the making, conventional VCRs with picture-improving digital circuitry are here.

From NEC Home Electronics come two digital effects VCRs, the DX-1000U (\$699) and DX-2000U (\$819). Both use their digital memory capacity to remove unwanted noise from the video image, and

(Please turn to page 22)



Bill Koch
8 time Nat'l X-C
Ski Champion
Olympic Silver Medalist
World Cup Winner

Scientific Study Ranks NordicTrack #1

In tests of exercise efficiency at a major university, NordicTrack burned more calories and provided greater aerobic workouts.

Rank of Exercise Efficiency

1. NordicTrack X-C Ski Exerciser
2. An Exercise Bike
3. A Rowing Machine
4. A Shuffle-Type Ski Exerciser

NordicTrack's higher oxygen usage test scores show that more muscle mass is involved in the exercise and more calories are being burned.

It's Only Logical that NordicTrack Would Get the Highest Scores

- because NordicTrack is more complete than an Exercise Bike. Adds important upper body exercise. Provides more uniform leg muscle usage.
- because NordicTrack is more thorough than a Rowing Machine. NordicTrack's resistance is proportioned according to the individual muscle strength—no major muscles are overstressed or under-worked.
- because NordicTrack has inertial resistance not available on a Shuffle-Type Ski Exerciser. Other ski exercisers use less efficient frictional resistance with a resulting calisthenics-like feeling. NordicTrack's unique flywheel resistance for a life-like feeling of smoothness and continuity is matched only by real skiing.

Burns Up To 600 Calories per 20 Minute Workout

Free Brochure, and New Video!

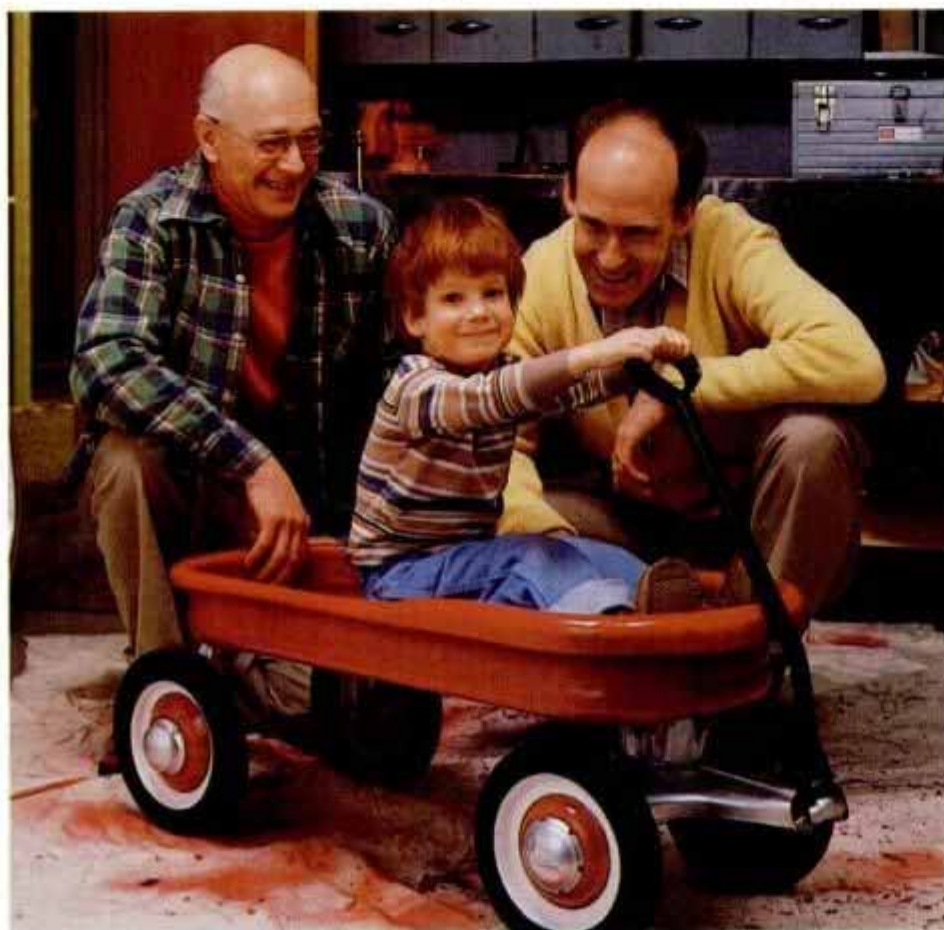
800-328-5888

Minnesota 612-448-6987

NordicTrack
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141PM Jonathan Blvd. N., Chaska, MN 55318

Any metal worth painting, is worth protecting.



Your father gave you that wagon for your fifth birthday. Now it's your turn to pass it on.

Any spray paint could make it red again. If that's all you wanted.

But Rust-Oleum, with an average of 50% more protective ingredients than its nearest competitor, can do more.

Its protective formula not only prevents rust, it also gives metal better protection from chipping, peeling and fading than other spray paints.



RUST-OLEUM
CORPORATION

© 1987 Rust-Oleum Corporation USA

HOME VIDEO

(Continued from page 21)

to provide clean special effects (such as freeze frame) with two heads instead of four. Other so-called digital VCRs use their memory to provide secondary picture-in-picture viewing, but do nothing to improve picture quality.

NEC's two machines improve the picture's video signal-to-noise ratio by an impressive and visible 9 dB. Compared to conventional VHS machines (whose S/N ratio is about 43 dB) this yields a 50-dB rating on par with the signal transmitted by broadcasters and the reproduction capability of most TVs.

In practical terms, this means that noisy, poor-quality tapes (from any sources) will look dramatically better when played back on NEC's digital VCRs. Tapes recorded on the DX-1000U and DX-2000U can be played back in other machines, but won't benefit since the digital noise reduction operates only in playback on the NEC machines.

The DX-1000U is a monaural audio machine that includes picture-enhancing HQ circuitry. The DX-2000U adds hi-fi stereo, and MTS broadcast stereo reception. By the way, each machine does perform a neat trick. They'll freeze a live TV frame on your screen on those occasions when you want to scribble down a toll-free phone number.

Maxxum Of Camcorders

Possibly the neatest VHS-C camcorder introduced to date is Minolta's new Master Series C3300. Within its compact body are several tricks Minolta learned in the film-camera business. We'll have a full hands-on report in a future issue.

Video CD Is Coming

You read it here first, nearly a year ago (*Audio*, page 14, July '86). Digital audio Compact Discs with 5 minutes of motion video are coming. In addition to the video's soundtrack, there's another 20 minutes of music on the discs. The first combo player (also for playing 8- and 12-in. videodiscs) will hail from Magnavox, later this summer. **PM**



Forthcoming Magnavox unit plays CDs, video CDs, and regular laser video discs.

WINNER!

Top-rated radar detector beats Passport.
Costs \$115 less!

"It produced the earliest warning in our [road] tests."

Road & Track,
September, 1986



Only 1 1/4" tall,
3 1/4" wide, and 4 1/2" long.
Fits in your pocket.
Travels where you travel.

Shown actual size.

No doubt who won.

Road & Track magazine recently tested eight popular radar detectors. SNOOPER D-4000 won big. In actual road tests where it counts. Around the corner and over the hill radar ambushes. What about current best-seller Passport? "... second only to the SNOOPER D-4000." Sorry guys.

Fact: The SNOOPER D-4000 beats Passport on performance. Fact: It costs \$115 less! No doubt who won.

"The SNOOPER D-4000 produced the earliest warning in our around-the-corner and over-the-hill tests."

Road & Track, September 1986

Sold on new high performance cars.

The SNOOPER D-4000 is made in Garland, Texas by Microwave Systems, Inc. — the inventor of solid-state radar detection for cars. The first to use superheterodyne



All accessories are included.



circuitry. The pioneer in remote devices. Maybe that's why SNOOPER came in first. Innovation and experience!

Until now, the SNOOPER D-4000 has been sold mainly through new car dealers. So you could wait and buy one with your next Porsche, BMW or Corvette. Or you can pick up the phone now and have one in your hands tomorrow. The SNOOPER D-4000 is NOT sold in catalogs, parts stores or discount chains.

Only \$180!
If you can afford one of theirs...

... why not buy TWO of ours? ONE Passport costs \$295. For another \$65, you can have TWO of ours. Protect other drivers in your family against radar surveillance, too. SNOOPER D-4000 is the top-performer, and at \$180, it's the runaway winner for top value.

All the features you want.

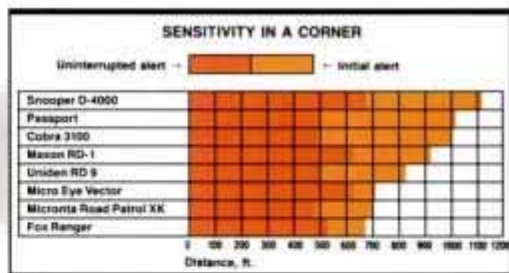
The SNOOPER D-4000 is a triple superhet advanced radar detection device. Sniffs

out both X- and K-bands radar, alerts you with a loud audible signal and simultaneous warning light.

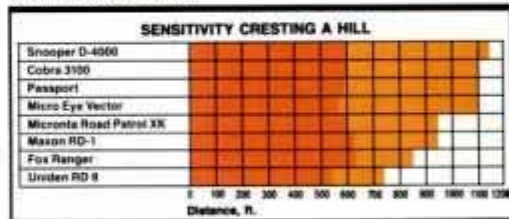
Filters out false alarms, and "dirty" signals from other radar detectors. Comes with visor clip and dashtop mount. Plugs into car cigarette lighter. On/off and highway/city switches. Simple. No complicated dials or bar graphs to slow your reaction time.

Order today.

Order yours at no risk. Call toll-free to order. Drive with your SNOOPER D-4000 for 30 days. If not satisfied, return it and we'll refund your purchase and your shipping costs. Comes with one-year factory warranty. And, remember, it's the winner. The most for less. You can't go wrong!



SOURCE: ROAD & TRACK



SNOOPER D-4000
TRIPLE SUPERHETERODYNE XK

SNOOPER DIRECT
47 RICHARDS AVENUE
NORWALK, CONN. 06857

\$180 (plus \$5 S&H)
(Conn. res. add \$13.88 tax)
Want it tomorrow? We'll ship
Federal Express overnight,
just \$10 extra.



TOLL-FREE 1-800-367-4534

Extension 231

in Connecticut 855-8717
(Phone M-F 8:30-10, Sat. 9-5 EST)
By mail send to address at left.
Orders processed immediately.

Car Clinic



BY MORT SCHULTZ

Overdrive Options

I have received conflicting instructions regarding the operation of my 1986 Oldsmobile 98 overdrive automatic transmission. The owner's manual says to operate the unit in Overdrive at all times, except in hilly areas. The dealer says to disregard the owner's manual and operate the transmission in Drive at all times, except on freeways and level rural roads—then, shift to Overdrive. Could you straighten this out so I can operate the unit properly?

JOHN GRAY
STOCKTON, CA

Sure, John. Do what's comfortable. Either way, you won't harm the transmission. The owner's manual recommendation allows for maximum fuel efficiency, which full-time Overdrive operation gets you. Your dealer may be hedging, because he doesn't want you parked on his doorstep complaining about transmission hunt. Operating in Overdrive all the time will result in the transmission shifting between gears as you vary your driving speed. On freeways, where you operate pretty much at a constant speed, this won't happen. It's all up to you. If transmission hunting doesn't bother you, use Overdrive; but if hunting is annoying, use Drive for all except freeway driving.

Yellow Flag

I think you should alert your readers to a recent experience I had, since the warning

may save someone's life. The vehicle that's involved is a 1987 Ford Ranger with a 2.9-liter V6 fuel-injected engine. Soon after I took delivery, I filled the gas tank and made a 60-mile round trip. On the return leg, I was surprised to find the fuel gauge needle laying on the $\frac{1}{4}$ mark. When I reached home and opened the door of the vehicle, a strong odor of gasoline whacked me in the nose, causing me to suspect a leak. I checked and was amazed to find that plastic fuel lines possessing push-on connectors are being used instead of metal lines and fittings. The area of leakage was at the pressure-relief line from the fuel-injection pump. It was

resting against the exhaust manifold, and the hot manifold had melted a hole in the side of the line; consequently, gas was leaking onto the manifold. I was lucky there was no fire. Neither the dealer nor Ford's Customer Service organization seems concerned. They should be.

ALFRED KAVALAR
TRAVERSE CITY, MI

Your warning shouldn't fall on deaf ears. If plastic fuel lines aren't retained securely with brackets, they can constitute a hazard. Therefore, because of your experience, other drivers may want to check or have their dealers check those plastic fuel lines. They should be at least 2 in. from hot engine parts and retained securely with brackets, as they were meant to be.

Just at press time the National Highway Traffic Safety Administration (NHTSA) announced additions to an ongoing investigation of engine compartment fires in Ford trucks and other vehicles by several manufacturers. Ford products included '84-'86 pickups, Ranger, Escort, Tempo and EXP, as well as Mercury versions of the same vehicles, Lynx and Topaz.

Beating Tenacity

I've tried to find out how to remove vinyl siding from a car, but no one knows. You're my last hope. Help!

HELEN BEATZ
JAMESTOWN, TN

I figure you're asking about the simulated wood grain panels on a station wagon. You have two ways to go. You've had good luck removing vinyl overlays with an ordinary hair dryer. This works pretty well on bumper stickers as well. Get a corner started with your fingernail and then, with a blast of heat right along the parting line, slowly peel back the vinyl. The secret is not to try and rush things, because the metal and glue have to heat up as you go along. The heat isn't intense enough to damage the paint because your hands are right there in the hot-air blast. This method tends to remove most of the glue, so try it first. But if the vinyl is old and brittle, it tends to tear, no matter how careful you are.

If that's the case, get some 3M Woodgrain and Stripe Remover (3M part No. 051135-08907). Try an auto parts outfit that caters to body shops. Following in-

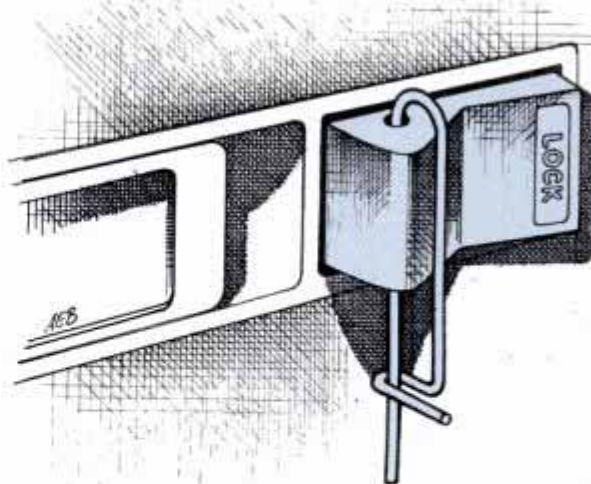
(Please turn to page 26)



Keeping Kids On Board

"Terror is driving along with three small kids in the rear of the car and having a back door opened by an 18-month-old child who reached over and operated the lock and door handle although he was securely belted into a car seat," writes Diana Hilliard of Newton, Manitoba, Canada.

After this experience, Diana and her husband, Joe, attempted to find a safety device for the rocker-style locks on the doors of their 1984 Reliant station wagon. They weren't successful, so they



made their own from wire coat hangers they fashioned into safety pins.

"With the lock in locked position," Diana says, "we drilled a hole in the protruding part of the hollow rocker mechanism and

stuck the safety pin through it. For a child to unlock the latch and open the door now, he or she would have to open and withdraw the safety pin. This is a task most preschool children would find difficult."



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Motorcraft from Ford
EXCEEDS THE NEED

CAR CLINIC

(Continued from page 24)

structions, spray the siding and let the chemical soak in. Then, peel off the vinyl. The tough job is to remove the glue adhering to the metal. Use 3M Woodgrain and Stripe Adhesive Remover (3M part No. 051135-08908)—it won't damage the paint. You're going to need lots of patience.

Batch Of Scratches

How can I remove scratches in a windshield, which are especially hazardous when driving at night? The windshield disperses light because of the scratches, which were caused by long-time scraping by the wipers. Is there a chemical I can use?

ROBERTO C. LOZADA
CEBU CITY, PHILIPPINES

Jeweler's rouge, which resembles a bar of soap, may be a remedy for very light scratches. It can be bought from a jeweler or a glass shop. Rub some on a buffer pad you've attached to a 1/4- or 3/8-in. drill and go at it—gently. If this doesn't work, the only alternative is to get a new windshield. There are some commercial products for polishing windshields as well, and



This Caps It

If the gas filler in your car is behind the license plate, as it is on GM models, you'll be interested in this bit of ingenuity, courtesy of Chuck Lewis of Zeniople, Pennsylvania. Chuck says that pulling on the corner of the plate can cause the plate to bend. That's true. It's especially a nuisance in winter when wearing gloves makes it difficult to get your fingers behind the plate. You often have to take the glove off and touch cold metal—not a jolly state of affairs when the ambient temperature is below freezing. What Chuck did was to drill a hole in the center of the plate and install a



small brass drawer pull (see illustration).

Also add the following to your bag of tricks about flapped plates: After pulling the license plate down and removing the cap, lay the cap across the right-hand hinge. By doing this, you'll accomplish two things: First, the cap will keep the license plate flap down so you can insert the nozzle without having to hold the plate; and, second, since it's in view, you won't drive off without screwing the cap back on.

you may want to talk to a glass shop about doing the polishing. In the U.S., the labor might be prohibitive when weighed against the cost of replacing the windshield. But that may not be true in the Philippines, where finding replacement parts could be tough.

False Economy

I have a 1982 Ford Bronco with a 302-cu.-in. engine and 2-barrel Motorcraft carburetor, and I'm going broke replacing the carb's economizer valve. So far, this has been done six times, the carburetor has been rebuilt once, and a rebuilt

Get the flavor of these leading brands, but less tar.



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

SURGEON GENERAL'S WARNING: Smoking By Pregnant Women May Result in Fetal Injury, Premature Birth, And Low Birth Weight.

© Philip Morris Inc. 1987

Comparisons based on king-size version of products shown and "tar" levels from Feb. '85 FTC Report or by FTC method.

carburetor has been installed once. Each time, the vehicle runs great for a few days; then, gas mileage goes way down because the economizer valve ruptures. The condition is verified by the presence of gas in the economizer valve cover. The Bronco presently has 64,000 miles on it and has given no trouble until this started a short time ago. Ironically, a friend of mine drives a Ford van with a 351-cu.-in. engine and a 2-barrel carburetor. His truck, which has 68,000 miles, is now doing the same thing. Help me and you'll be helping him at the same time.

JOHN LANG
BASTROP, LA

Just because you're finding gas in the power valve cover—the economizer valve is also called the power valve—it doesn't mean the valve keeps going bad. What should have been done the first time your economizer valve became suspect was test it using a hand-vacuum pump and vacuum-cup adapter. If you have a hand-vacuum pump but no adapter, you can get one from a tool company, such as Borroughs or Kent-Moore. To make the test, the vacuum-cup adapter is put over the diaphragm side of the power valve with the hand-vacuum pump attached to the adapter. Vacuum is

then applied. If the gauge on the hand-vacuum pump shows that the valve retains vacuum for 2.5 seconds or longer, the valve is in great shape and should not be replaced. There's gas in the power valve cover because it's normal for it to be there. It's the result of fuel vapor condensing in the cover. The presence of fuel in the power valve cover does not indicate leakage past the power valve, nor does it mean the valve is bad. So why do you get such a sharp drop in fuel economy a few days after replacing the power valve? I suggest you look at other possibilities.

To begin with, I would test the EGR system. The problems a malfunctioning EGR causes—poor fuel economy, rough idling and shoddy low-speed performance—are the same as those a bad economizer valve causes. Check the EGR valve for sticking and for the presence of the proper vacuum signal. If the EGR system checks out okay, look for plugged or restricted carburetor booster air bleeds. They will cause the carburetor to run rich, which would kill your gas mileage.

PM

DO YOU HAVE A CAR PROBLEM?

Just ask Mort about it. Send your question to the Car Clinic, Popular Mechanics, 221 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.

SERVICE TIPS

- Owners of 1987 Chrysler-built Ram Raiders having power steering take note: You may be losing fluid from around the steering-gear side-cover adjusting bolt. Have a dealer install a new seal (part No. MB553220) as instructed by technical service bulletin (TSB) 19-01-87.
- If a rear strut of your 1985-87 GM car that's equipped with Electronic Level Control pops a bladder and starts to leak air, don't replace the strut. Instead, order a Rear Strut Electronic Level Control Air Bladder Service Kit (part No. 220625061).
- A low-coolant warning light that comes on when the coolant level is up to snuff may simply mean that your 1985-86 Merkur XR4Ti needs a newer-design low-coolant warning sensor. The new sensor carries part No. E6RY-10D968-A. Its use is sanctioned by TSB 87-1-6.
- Many 1986-87 Nissan models have automatic transaxles or transmissions that shift sluggishly in cold weather. It's because of the fluid installed at the factory. Have the factory-fill replaced with Dexron automatic transmission fluid. Have dealer check the lineup in TSB TS87-010 to see if your car fits the description.

Breakaway to flavor.



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TODAY'S
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Electronics



BY STEPHEN A. BOOTH

Apple's New Mac



New Apple crop: Macintosh II (left) and SE upgrade core machines.

Draw up a wish list for Macintosh fanciers, and you'll come close to the spec sheet for Apple's new top-of-the-line Macintosh II. The computer keeps the Mac's essence but offers both a new look and, more importantly, a new level of power and utility that rivals the Intel 80386-based muscle cars of the MS-DOS world. Gone from the Macintosh II is the one box configuration of the original Mac. Instead, the new machine adopts the "system"-look of the IBM PC and its clones: a main module housing CPU and storage units, a separate monitor and a separate keyboard.

For starters, the new Mac II offers a faster microprocessor, the fully 32-bit, 16-megahertz MC68020. According to Apple, the chip promises at least a 4-fold improvement in program execution speed over the former top-of-the-line Macintosh Plus, along with, as standard equipment, a powerful coprocessor for math and engineering applications. What's

more, one megabyte of RAM is standard, with expansion up to 8 megabytes possible on the logic board. For RAM dreamers a lot more memory—up to 2 billion bytes—is accessible via the computer's NuBus slots.

Color, at long last, is the next major addition that the Macintosh II brings. At its best, the Mac II's video adapter offers an on-screen display of 256 colors out of a palette of more than 16 million, plus a new, higher resolution of 640 x 480 pixels. Apple offers two new, larger monitors to couple with the Mac II's superior video output, a 13-in. color CRT and a 12-in. monochrome model. On the sonic side, the new computer now features 4-voice stereo sound using an Apple digital-sound chip.

Massive data storage is available too: Apple offers three sizes of hard disks for the Mac II, including a fast (30-millisecond access time) 40-megabyte internal drive, and an 80-meg external unit.

Like its decade-old prede-

cessor the Apple II, the Macintosh II is highly expandable. Six expansion slots are available. That means there's space for Apple's respectful nod to the MS-DOS universe, an optional Intel 80286-based add-in board that gives the new Apple micro IBM PC/AT-grade compatibility and power. Adding to the machine's flexibility are two serial ports, a SCSI parallel port, and two Apple Desktop Bus ports.

The new micro comes with a hefty 230-watt power supply that automatically configures itself to the voltage needs of whatever country it finds itself in. Additionally—and a first for Apple—there's a variable-speed fan to keep the system cool.

All this wish fulfillment doesn't come cheaply. The Macintosh II, in basic dress, starts at about \$3900. Tricked out with hard disk, count on spending between \$5500 and \$7000 on this "Maserati for your mind."

More affordable is Apple's other new entrant in the micro-

computer marketplace, the new SE.

The SE is basically an enhanced version of the Macintosh Plus that keeps the original Mac's compact chassis on the outside, but reworks the Mac's innards to provide some agreeable amenities to the Mac formula.

Like the Macintosh II the new Macintosh SE includes a fan and a stronger power supply (75 watts). The SE retains the Mac's 9-in. monochrome display and MC68000 microprocessor, but adds a couple of major new wrinkles along with a host of other improvements.

For one thing, Apple is bowing to practicality by offering the SE only as a 2-drive machine. You get a choice of either two 800KB micro-floppy units or one floppy drive with a 20-megabyte internal Winchester fixed disk.

Secondly, the SE includes one expansion slot that could house, among other things, an accelerator card or a coprocessor card for MS-DOS

(Please turn to page 34)

Electronic Transparencies

Hitachi is bringing yet a newer twist to the new field of filmless, electronic still photography. Its Compton, CA-based industrial division introduced two video color printers that yield transparencies as well as prints. Other still-video printers yield opaque prints only.

Hitachi's transparencies are intended primarily for overhead projectors used in audio-visual presentations. They measure the same 3 x 4 in. as the company's electronic prints, and take the

same 80 seconds to produce. Color quality's good, thanks to the VY-100A printer's thermal dye-transfer process and 64-tone color scale.

The VY-1000A, at \$4000, isn't cheap. Nor is its 32-tone little brother, the VY-50A (\$2500). Both print from any type of video source.



Hitachi's new video color printers for filmless photos make 64-tone transparencies (left) or hard-copy prints (above).



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It exceeds the toughest automotive engine oil requirements in the world. And it's been rated as superior by a leading national consumer testing group.

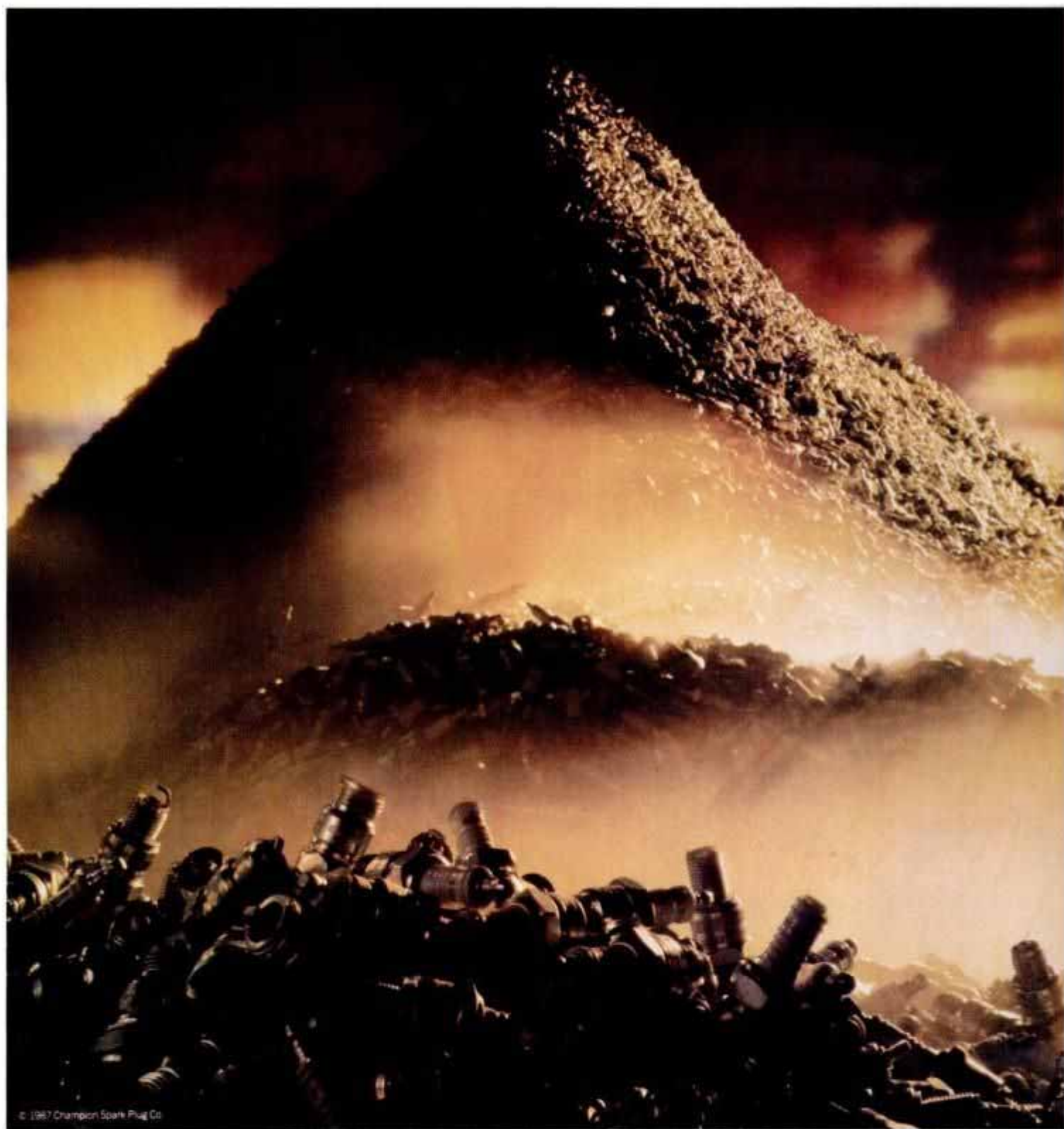
It's the oil that protects in *any* temperature, even the extreme temperatures found in today's turbocharged engines. Plus, it fights against engine oil thickening, corrosion, and wear.

So the next time you reach for turbo protection on your store shelf, reach for the oil that protects at NASCAR. World Class P•Z•L* Turbo 10W-30 Motor Oil.

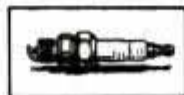


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Standards laid down by Chrysler and Ferrari to name but two of the 38 auto makers who choose Champion spark plugs as original equipment in their cars.

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ANY OTHER SPARK PLUG IN THE WORLD.



ELECTRONICS

(Continued from page 30)



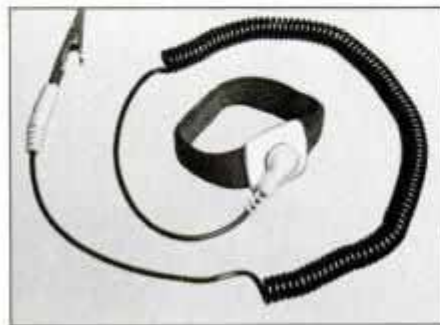
SharpWriter, by Sharp Electronics, combines full-fledged PC-clone capabilities with flexibility of regular typewriter.

software compatibility. The SE includes a new logic-board design that Apple claims will yield from 15 to 20 percent better performance than the Macintosh Plus, with noticeably faster screen updates.

The 2-floppy SE is priced at \$2900, the hard-disk model at \$3700. Both earlier Macintoshes now in the Mac family, the 512K Model E and the Macintosh Plus, will remain in the expanded line and keep their current suggested retail prices of \$1699 and \$2199, respectively.—Ron Scibilia

Typewriter Or Computer?

Cross a computer with a typewriter and you'll get a SharpWriter model ZY-1000S by Sharp. The Mahwah, New Jersey-based electronics company has cloned its ZX-420 electronic typewriter to an IBM-compatible PC to produce a \$3400 system that works either way. If the price appears steep compared to the latest econoclones, bear in mind that the typewriter portion performs double-duty as a multifunction letter-quality computer printer. As a computer, the SharpWriter is no slouch. It comes with dual 5¼-in. floppy drives, 448KB-RAM (expandable to 704KB), 80 character/25 line screen, a full complement of ports (including telecommunications ability),



Wristex conductive bracelet sends static to ground, instead of to your computer, to avoid risk of chips getting amnesia.

and the ability to run thousands of IBM-compatible software programs.

It's a practical machine, too. At the flip of a switch, it reverts to being a typewriter—for quick jobs that don't require computer word-processing.

Antistatic Cling

Here's yet another handful of help in man's battle to protect the computer from static.

It's called Wristex and you wear it—guess where?—to conduct harmful static to ground, instead of to your computer. Unlike similar conductive bracelets, this one's flexible and comfortable, with a coiled cord that stretches to 6 ft. It costs \$14.50 and is available from Solder Absorbing Technology, Springfield, MA.



The latest satellite receivers have built-in descramblers. Experimental Zenith system packages receiver, descrambler and antenna-positioner into 27-in. stereo TV.

Blue Chips Drop Price

In previous columns, we've commented on the influx of bargain-priced IBM PC-compatible computers. The first to break the \$1000 line was the Blue Chip PC, built by Korea's Hyundai of econo-car fame.

That XT-compatible machine entered the market late last year at \$699—though monitor and accouterments brought the final ticket near to \$1000. Now, Chandler, AZ-based Blue Chip Electronics has lowered the base-price sticker to \$599—and throws in the DOS (disk operating system) free. This item formerly cost \$99.

We've worked with the Blue Chip PC, and found it a good clone for the money. The unit comes with 512 kilobytes of RAM standard, expandable to 640K. Power supply is rated at 130 watts,

sufficient to drive peripherals such as a 20- or 40-megabyte hard disk. Though the IBM-AT-style keyboard is less responsive than you might like, it's certainly adequate, and you can always upgrade. Likewise, the single 5¼-in.



Cheyenne IR/D from Chaparral integrates satellite TV receiver with descrambler.

floppy disk drive can be supplemented by a second unit. A cutout in the PC's dashboard makes this retrofit possible.

Satellite Sightings

The skies didn't exactly go dark when major TV programmers began scrambling their shows. But the practice did require you to pay for the programming—and to buy a separate, outboard descrambler to make it viewable.

Well, as we forecast in our October '86 issue (*Down To Earth*, page 138), the manufacturers of satellite receivers have begun to incorporate the descrambler into the receiver chassis. This consolidation saves you money as well as space.

The latest manufacturers to take this tack include Zenith, Chaparral and General Instrument (whose VideoCipher II system is used for scrambling in the first place). Zenith's combo is the most interesting—though it's not for sale.

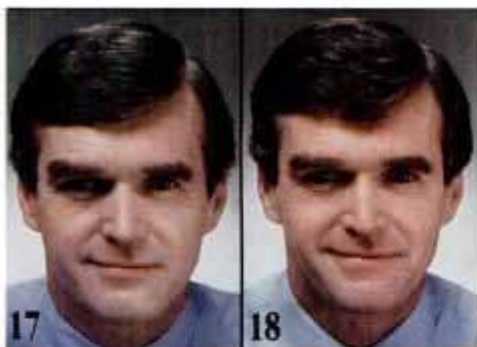
The veteran TV company packages a satellite receiver, descrambler and an antenna-positioning actuator into the same chassis with one of its top-shelf 27-in. stereo TV sets.

An infrared remote controls everything, even a VCR. At this writing, we're waiting for Zenith's space commander to radio a launch date.

Two enterprising electronics companies are even selling the scrambled programming with their receiver/descrambler combo units—at a discount too, until June 30. It's Houston Tracker Systems and Echosphere, dba Discount Satellite Programming. Ask your satellite-TV dealer, or call (404) 827-2500 for more information. **PM**



Scrambler-owner General Instruments also builds descrambler into its remote-control VideoCipher II 2400R satellite TV receiver.



PICTURE YOURSELF

with a little less gray, a lot less, or none at all.

All over the country, there's a group of men—actually millions of them—who have a secret they don't share with anyone. Not even with each other.

Their secret? That nobody knows they're using Grecian® Formula 16® to gradually take away as much gray—or as little as they want to lose, without anybody knowing. That's their secret.

They do it with a clear liquid, as easy to use as a hair tonic. Here on this page you can see the undoctored photographs of the hair taken day-by-day as one of these Grecian users gradually took care of that older look.

Note in the photos around the page how the change each day seems like no change at all. But compare #1 (when he began) with #18. The nearly invisible day-to-day changes have eliminated the gray and created a younger looking man.

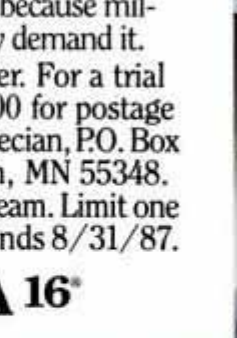
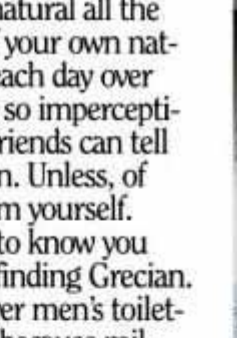
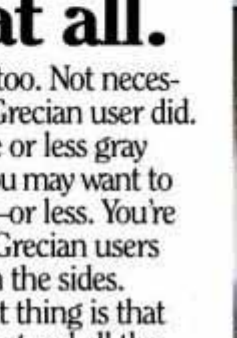
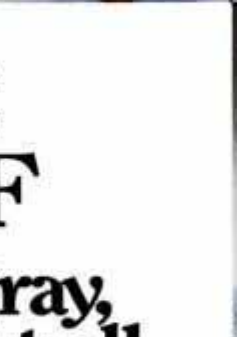
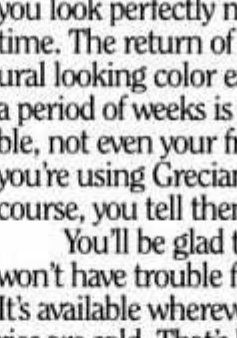
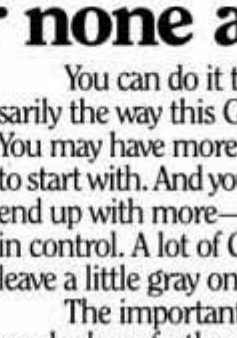
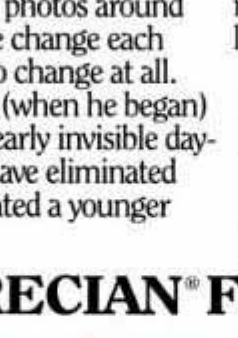
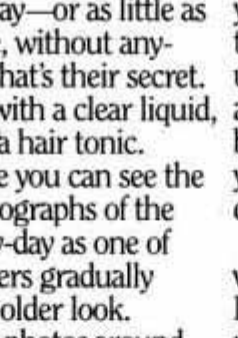
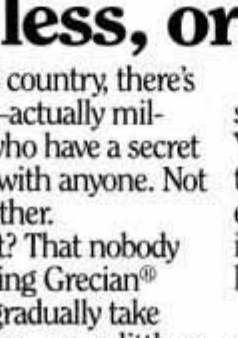
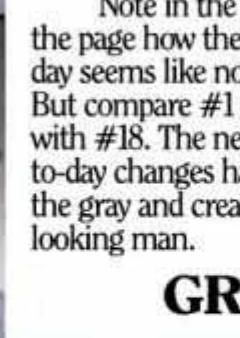
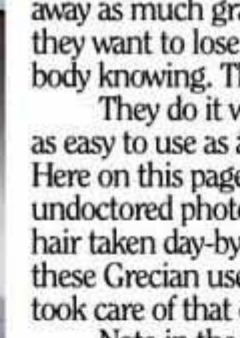
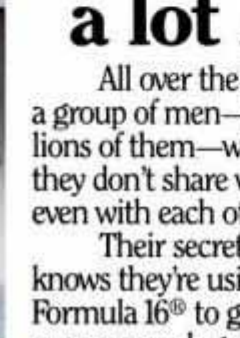
You can do it too. Not necessarily the way this Grecian user did. You may have more or less gray to start with. And you may want to end up with more—or less. You're in control. A lot of Grecian users leave a little gray on the sides.

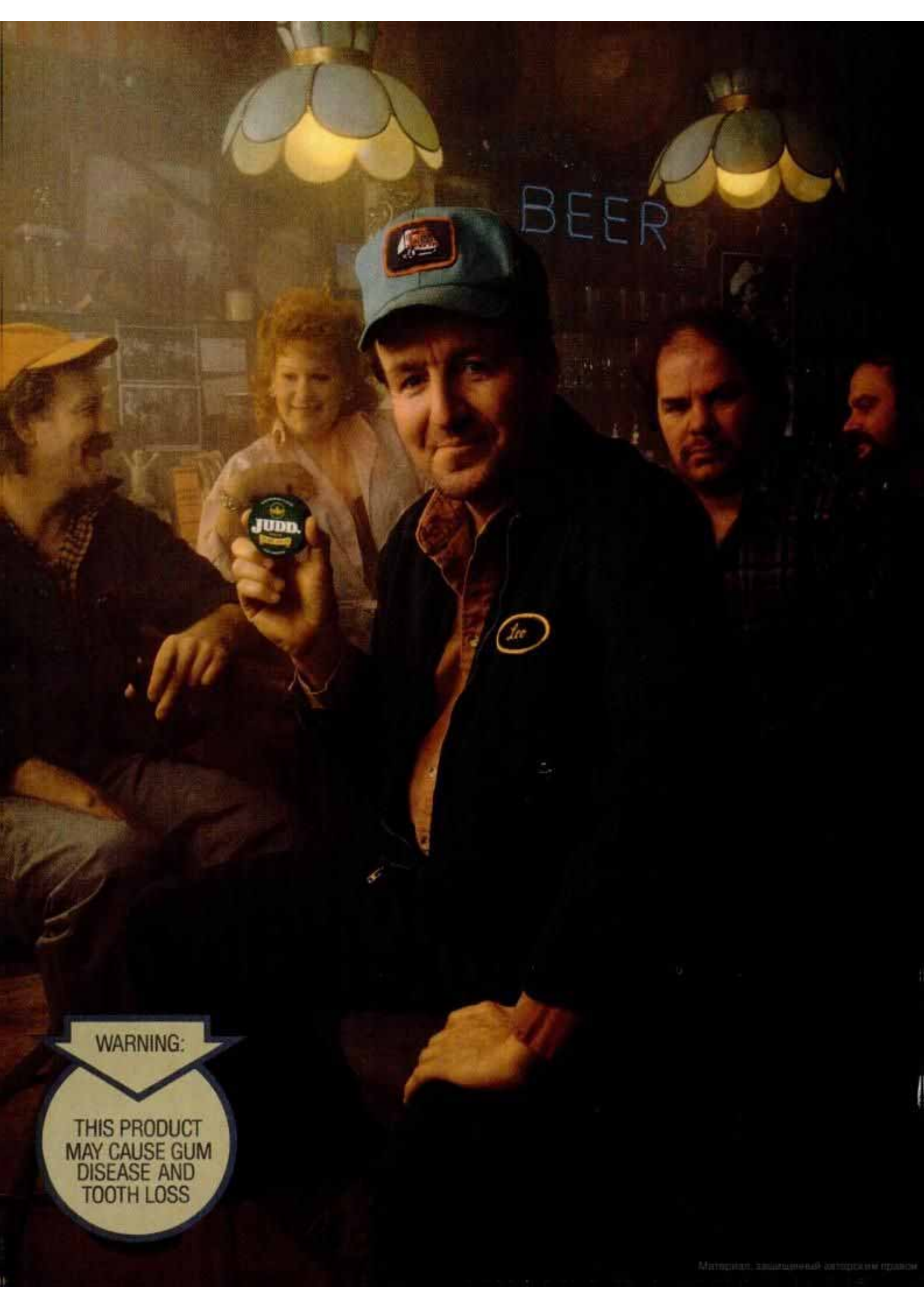
The important thing is that you look perfectly natural all the time. The return of your own natural looking color each day over a period of weeks is so imperceptible, not even your friends can tell you're using Grecian. Unless, of course, you tell them yourself.

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Nor did we sit back when it came to the cab. That's why its interior appointments seem to be "almost custom installed" according to the editors at *Road and Track*.‡

So while you're getting America's lowest priced import truck when you buy a P'UP, you should always keep one thing in mind. It didn't come cheap.



*Manufacturer's suggested retail price P.O.E. excluding tax, license and transportation fee. Price as of 1/1/87 and is subject to change. †Except Hawaii. ‡*Road and Track Truck Buyer's Guide*, 1987.

The First Car Builders of Japan.

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Aviation



BY FRED MACKERODT

Aviation Heaven



Mojave Airport's Dan Sabovich and a bit of fighter history.

Like most aviation addicts, I love to visit airports. Strange airports mean airplanes I haven't seen before, and even the most mundane Cessna 152 might have something that makes it worth looking at.

I recently visited Mojave Airport, 100 miles northeast of Los Angeles, as a member of a panel of aviation industry leaders convened by **POPULAR MECHANICS** to come up with ideas for an entry-level plane of the future.

Our meetings were held at Scaled Composites, Inc.,—Burt Rutan's operation at one end of the airport. Between sessions, Rutan took us inside a hangar where his Beech Starship prototype hangs from the ceiling like a giant model airplane. It actually is a model, since it's only 85 percent of the size the production aircraft will be. Still, it goes on record as one of the world's largest com-

posite aircraft. To get to see Starship, Rutan hustled us past yellow-screened areas, apologizing all the way for not being able to let us see behind the screens and get a view into aviation's future.

Mojave Airport is a study in contrasts. Straight across from the Scaled Composites hangar at one end of the 2885-acre Mojave facility rests what is probably the largest fleet of Convair jet transports in the world.



GE's unducted fan engine goes through R&D at Mojave.

About six years ago, Allen Paulson assembled the 22 Convair 880 and 990 4-engine jets, which he planned to convert into freighters and resell to cargo operators. Unlike another one of Paulson's projects—his fabulously successful Gulfstream executive jets—buyers for the converted airlines never materialized. Now Charlotte Aerospace is trying to sell the Convairs overseas. The engines are too dirty and noisy for operation in the U.S.

As we walked down the ramp, we passed a Hawker Hunter, a Gloster Meteor and two Swedish Saab Lansen fighters. These privately owned '40s and '50s fighters are only a few of the pristine vintage aircraft on the field.

At the other end of the flight line is the future. General Electric recently completed testing one of its unducted fan engines on a Boeing 727. The 727, from its right side, looks like a giant Cuisinart. The next airplane to be tested will be the McDonnell Douglas MD-80 which is right now being fitted with a UDF engine. It should be flying this August. The company is also working on the CFM56-5 engine for Airbus Industrie.

Next to GE's hangar is the display housing Rutan's historic around-the-world Voyager. Temporarily housed here until the Smithsonian is ready to accept it, the Voyager is on view for all to see. According to Mojave Airport manager and chief booster Dan Sabovich, the Voyager has made the facility a real tourist attraction. One Sunday afternoon, 324 private aircraft landed to pay homage

at the Rutan hangar. There is no charge to see it.

In the middle of the flight line is Flight Systems, Inc. Two McDonnell Douglas F-4 Phantoms with civilian tail-numbers sit outside next to four North American F-86 Sabrejets and a pair of F-100s. Flight Systems operates a flight test, systems development and aircraft modification center at Mojave. The F-86s, F-4s and F-100s are used for specialized testing. The company is in the process of converting 209 of the pristine F-100s—first flown in 1953 and this country's first production supersonic fighter—into target drones. As they are completed by Flight Systems, the shiny F-100s are delivered to Tyndall AFB in Florida where they are flown 15 to 20 times before being ingloriously shot right out of the sky—unpiloted of course. Four General Dynamics F-106s are also on the Flight Systems line. When the Air Force finishes pop-shooting the last of the F-100s, the company hopes to convert 200 of the F-106s—first flown in 1956—into more fodder for the service's aerial turkey shoot. It's enough to make a grown man cry.

If you're anywhere near Los Angeles, take time out to visit Mojave Airport. The Voyager is worth the price of the trip, and the rest is aviation gravy.

Best Book

When it comes to understanding the current crop of Continental and Lycoming aircraft engines, the absolute best book to read is the *Aircraft Engine Operating Guide*. This 200-page book by Kas Thomas, editor of the newsletter *Light Plane Maintenance*, is the most thorough, informative and readable tome ever written on aircraft powerplants. Would you believe a whole chapter on mixture management? The book is available for \$19.95 postpaid directly from Belvoir Publications, 1111 East Putnam Ave., Riverside, CT 06878.

(Please turn to page 40)

Aviation's Twin Meccas

We just flew in from the annual week-long Sun 'n' Fun extravaganza put on by the Experimental Aircraft Assn. in Lakeland, Florida. Held in mid-March this year, and scheduled for mid-April next year, highlights of the show included a slew of fine antique restorations, a number of which had just been completed, and a very strong Warbird contingent, led off by a rare Hawker Hurricane down from Canada. Allison turbine-powered airplanes in attendance included a Bonanza, a 206 Cessna on floats, and a brand-new Maule.

Sun 'n' Fun was a great show, but it pales in comparison with Oshkosh. In fact, everything pales in comparison with EAA's really big bash in Oshkosh, Wisconsin. The granddaddy of aircraft events is going to be held over eight days this year, from July 31 to Aug. 7, and the size of the event is best expressed by last year's statistics.

Start with 800,000 people, 15,000 private planes and 1741 showplanes. There were 252 vintage warbirds ranging from P-51s to B-17s. And every variety of homebuilt and ultralight.

Add to this the best aerobatic airplanes and pilots in the world. What you have is the biggest collection of aircraft ever assembled.

And there's lots of activity in the air, too. The FAA recorded 64,000 operations during show week last year, more than 12,000 of which occurred in one 18-hour period. That made Wittman Field four times busier than Chicago's O'Hare, which is reputed to be the world's busiest airport.

Despite the crush, the FAA people and the dedicated throng of EAA volunteers manage to get everybody in safely with little or no hassle.

Each afternoon there's a spectacular world-class air show, but John Burton, head of EAA's public relations department, is quick to point out that Oshkosh is more than just an air show.

The gates open at 8 every morning and the activity begins at 8:45 a.m. when the total of 500 separate forums covering every aspect of flying begin. Topics for the week-long sessions include sheetmetal working, fabric handling, woodworking, composite construction and just plain airplane building. The forums run well into the night. And then there's the fantastic EAA museum, which is on the field and takes the good part of a day to fully appreciate.

A friend of ours has flown to Oshkosh every year for the past four years. As many others do, he camps next to his plane—Seneca N4327N—and spends every waking hour at Wittman Field. He expresses one concern about Oshkosh.

"I never get to see everything," he says. "There just isn't enough time."

For more information on Oshkosh, contact the EAA at (414) 426-4800 or write Oshkosh '87, Wittman Field, Oshkosh, WI 54903-3086.

New Tricks For An Old Friend

When we originally plopped the Apollo 612 loran in the panel of our old Cessna 182 back in 1984, we thought we had died and gone to heaven. Here was a little black box that, with a little practice, could be made to tell almost exactly where we were, in what direction we should head to get to our destination, how many miles distant it was, and how fast we were getting there, among other neat tidbits of information.

Now the 182 is history, but that loran is in the panel of Aztec 87A, and with a number of software updates, is doing a lot of other things.

Readers of this column will know that it's been coupled with a Shadin Digi-Flo fuel-metering device that monitors fuel burn down to a fraction of a gallon, and, with the ground speed information it gets from the loran, tells us not only how much fuel it will take to get to our destination, but how much we'll have left when we arrive.

The manufacturer of the 612, II Morrow, had the unit certified for enroute IFR last summer and we just recently had it wired and approved by the avionics experts at Braden Piper in Easton, Pennsylvania, to fly in the air-traffic control system. Now we can legally file an instrument flight plan "Pittsburgh direct Miami" if the controllers are creative enough to approve that routing. And coupled with the Aztec's autopilot, the 612 holds rock-solid headings. Anyone who has watched an autopilot try to track a VOR signal, especially close in to the station, will appreciate this little feature. But no sooner are we getting used to the 612 in the IFR enroute environment, than we find out that II

Morrow is working on loran C approaches. The company has now begun collecting data for utilizing the 612 for non-precision approaches in what the FAA calls a "limited implementation program." The ultimate objective of this program is to develop stand-alone loran C approaches to airports which now are limited to VFR operations only. This eventually will keep a lot of fields open when the ceilings go down.

Fifty airplanes will participate in the program using the few airports in this country which now have published loran approaches. We are proud to say that POPULAR MECHANICS has been chosen to participate in the program and that Aztec 87A will soon be getting the experimental software to do the job.

Now, if we can only get a loran approach at our home drome in Caldwell, New Jersey . . .

Nostalgia Now Costs Less

With the P51 Mustang now approaching \$500,000 a copy, there has to be room on the market for something a little cheaper. How about \$5000?

For the price of one wingtip of the original, a 3/4-scale Mustang is now being sold by Loehle Aviation. Dubbed the "5151," for its \$5151 kit price, the Mustang replica has just finished its first 100 hours of testing, and, according to manufacturer and chief test pilot Mike Loehle, the little fighter performed "even better than expected." Admittedly conceived to appeal to the Walter Mitty in all of us, the plane is powered by a 50-hp. Rotax 503 which provides very adequate performance considering the plane's 400-pound weight.

Several options are available including retractable gear and a 10- or 15-gallon fuel capacity to replace the stock 5-gallon tank. Brakes, electric start and a 4-bladed propeller are also available.

Prospective Smilin' Jacks should call Mike Loehle or Sandy Burgess in Wartrace, Tennessee, at 615-857-3419. **PM**



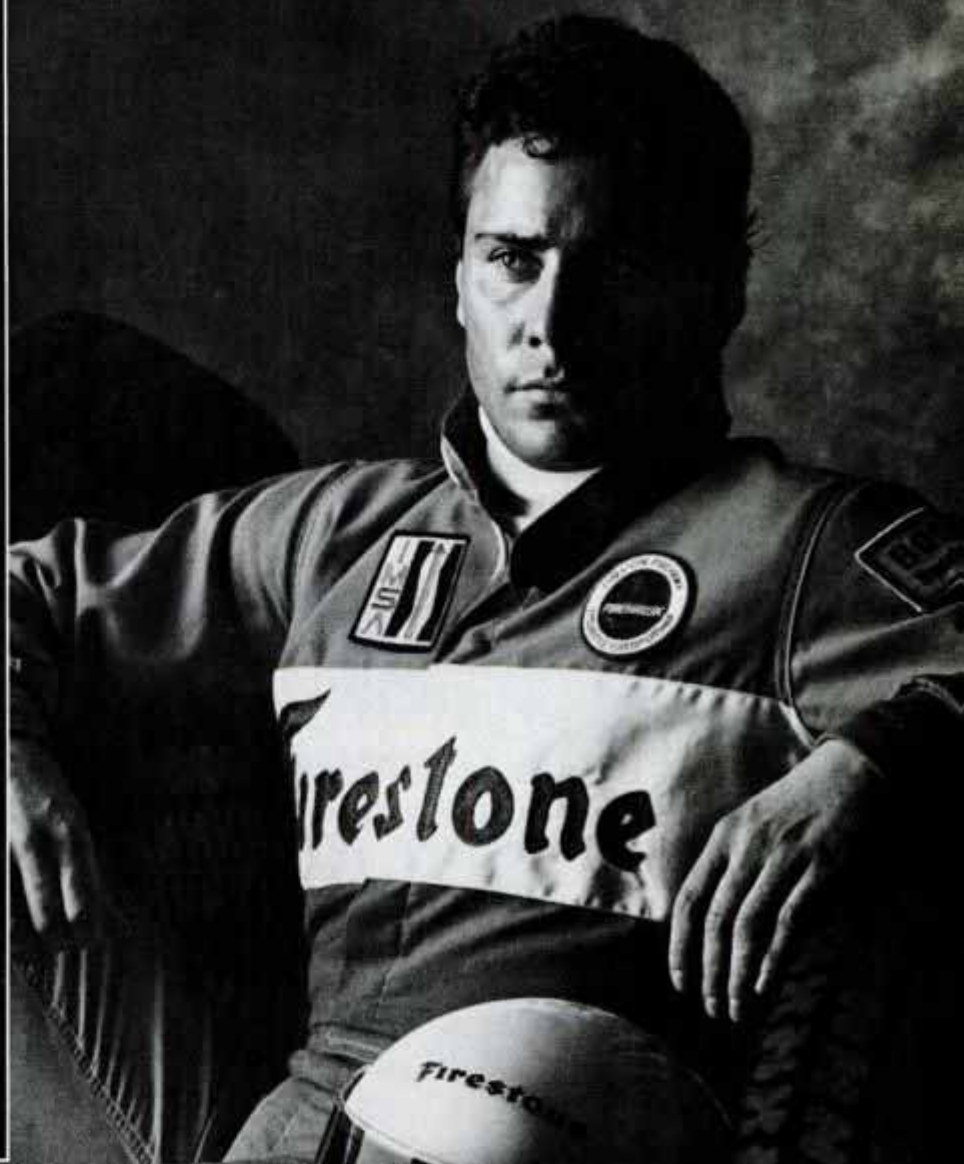
The "5151" repliplane, a 3/4-scale Mustang replica, passes its first 100-hour test.

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Inside Detroit



BY JIM DUNNE

'89 Cougar Captured



The 1989 Mercury Cougar will retain its V8 engine and rear-drive, with a more conventional formal roofline.

Longer wheelbase, a lower hood, but with the distinctive, upright rear window are key styling cues of the 1989 Mercury personal coupe. That swoopy rear-side window treatment that has graced the most recent Cougars is gone, with a more formal look taking its place.

Ford is sticking with rear-wheel drive and V8 engines in this car, defying the competition's—GM, Chrysler, imports—Fours and Sixes with turbochargers. The squeezed-down grille still has a distinctive Cougar look with a rectangular opening in the center, vertical bars and the Cougar crest prominent. Independent rear suspension, with the possibility of a supercharger on a V6, are among major mechanical plans.

Eldorado '88

Most folks, me included, can't understand why it takes so long to make minor changes in a car. The '88 Eldorado is a



case in point. Almost from the time it was introduced in 1986. Cadillac officials knew the current Eldo's styling was a dud. Among other things, the car was afflicted with GM's epidemic "look-alike" disease—too many high-priced GM models look like other GM offerings that sell for \$10,000 to \$15,000 less.

The Eldo also went against the grain of customers who purchase their cars "by the foot." Bigger is better for a lot of high-ticket customers, and if you were measuring Eldorado in a Sears catalog, the car wouldn't even rate a "Good." GM's remedy: make the car 4 in. longer by extending the rear fenders, elongating the taillights and pulling out the bumper to protect it all. That minor change will have taken two years to get into produc-

tion. You'll see the results next fall when the 1988 Eldo hits the showrooms. Small as the changes seem on paper, the new 1988 does appear much larger.

Cool Out

A new technique for cooling your engine may lead to smaller radiators and more efficient engines. Corvettes modified by Calloway have a new coolant that boils at a higher temperature than normal coolants—370°F versus 230°F—allowing engines to run at higher temperatures. Developed by National Technologies, the system can run at 300°F with no after-boil, works in a nonpressurized system and can increase heavy-load fuel economy by 5 to 7 percent because the spark setting need not be retarded to offset preignition detonation. The coolant is anhydrous propylene glycol.

"We were looking for ways to increase horsepower," recalls Jack Evans of National Technologies. "We found that propylene glycol vaporizes at hot spots just like all coolants, but the vapor collapses quickly, so fresh coolant can get next to the hot spot. With normal coolants, the vapor pushes liquid away, keeps it away from the metal. That's when the engine overheats."

The higher cost of the new coolant may be offset by the smaller quantity of coolant needed for the system and the smaller cooling radiator it uses. Insiders look for regular production Corvettes to have the system within two years.

Mazda's Mustang

Yes, a 1989 Mustang will be built by Mazda. At the same time, another 1989 Mustang

will be built by Ford. The Mazda "Mustang III" version will be a 3-door hatchback that uses the Mazda 626 chassis as its platform. That means front-wheel drive and 4-cylinder engines for power.

The outside appearance is described by insiders as "very slippery," with glass that covers the roof pillars "from A-post to A-post—all around." Other details include unique exterior door handles made of fiberglass and pop-up headlights. This car will be built at Mazda's new assembly plant in Flat Rock, Michigan.

Just a few miles away, Ford will continue to build an updated version of the current Mustang GT. With modest exterior changes, the Ford Mustang will continue with V8 engine power and rear-wheel drive.

Not A Fire Sale

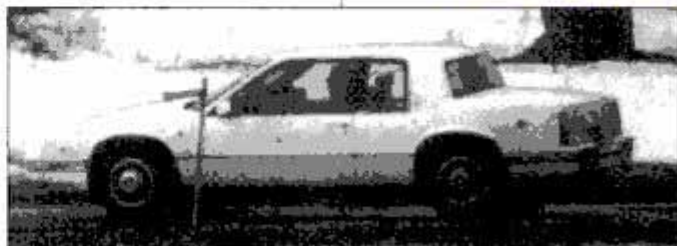
AMC is a valuable property, a prize acquisition for any company, and a real coup for Chrysler if its offer to buy passes the usual obstacles. The Jeep line is the most precious jewel in AMC's crown, but a new assembly plant in Canada and the Medallion and Premier sedans are solid assets that Chrysler can profit from.

"Our dealers today can't get enough Jeeps," says Joe Cappy, AMC president. "They are selling that well." But Cappy is not resting on his successes. A replacement for the Cherokee is already being prepared for 1989. Code-named ZJ, the new Jeep will have more modern styling, and more powerful engines than the present model.

BMW: No Fwd

You won't see front-wheel drive on any BMW in the next 10 years, if ever. The compli-

(Please turn to page 45)



Minor stretch marks '88 Eldorado's attempt at big-car cachet.

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As part of an enormous publicity campaign to prove that our collective buying method can guarantee you the lowest possible price in the nation, this gigantic marketing firm, will give away one million (1,000,000) of its most expensive Ultrasonic Soundwave Control Devices — the TemPest EL130 — for the unbelievable publicity price of only \$9.87 each only to those who write to the company address (below) before Midnight, June 30, 1987.

*"EVEN HOME SHOPPING on
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These Ultrasonic Soundwave Control Devices are not copies. These are the famous TemPest EL130 Ultrasonic devices that have been publicized in some of this country's most prestigious magazines and newspapers. They are identical to those that you have seen nationally advertised on television under various brand names and selling for many times the price. Even Home Shopping, which is known to have the absolute lowest prices available, is still double the price of ours. Other similar devices that have the EXACT same function and utility have sold in this country's most prestigious catalogs for up to ten times the price!

The TemPest EL130 is the latest in Ultrasonic Soundwave technology. These electronic units put out an incredible 130 decibels of ultrasonic sound pressure — using the UL listed AC adaptor (included) that means NO EXPENSIVE BATTERIES TO BUY! Don't worry — these high intensity sound waves are out of the range of hearing of humans and most household pets such as dogs, cats, fish, birds, and farm animals. These remarkable units have been proven to cause absolutely no interference to televisions, radios, pacemakers, hearing aids or other electronic equipment. We cannot go into further details here,



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and pass the savings on to you!"*

Each unit is covered by the company's standard money-back guarantee and has a full 2 year consumer warranty. There is a limit of two units per address at this price, but if your order is mailed early enough (before June 25) you may request up to five. These Famous TemPest EL130 Ultrasonic Devices will not be sold at this price by the company in any store.

To join in this collective buying effort, simply mail your name and address and \$9.87 for each unit you are requesting. Add just \$3 FIRST PRIORITY shipping and handling no matter how many units you are requesting. Allow up to 60 days for shipment. Sorry, not available in Colorado. Mail to:

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INSIDE DETROIT

(Continued from page 42)

cated power system is not as much fun to operate as rear-wheel drive.

"Driving experience enhancement is not made by front-wheel drive," says Gunter Kramer, chairman of BMW of North America.

That same measurement will be made on active suspensions, when BMW has enough test experience in that field. If the car is less fun to drive, active suspensions will not be offered.

Evidently, Mercedes is in full agreement with BMW on front-drive since that company does not offer front-drive on any of its cars. However, it is a good bet that both of Germany's premier luxury car-makers will have active suspensions on some models by 1990.

BMW 2-Seater

The Z1, a 2-seat convertible coupe, will be offered by BMW "sometime after 1988," according to Gunter Kramer, BMW of North America chairman. The small convertible will use the 3-series platform and its 6-cylinder engine and transmissions. The price should be at the \$30,000-plus level, according to company officials. But production will be limited to a few thousand per year, making it a high-demand item in BMW's U.S. showrooms.

Call It Anything

But don't call it Saturn. That's the attitude at GM nowadays when its completely new car project is mentioned. Saturn Corp. was set up to develop a car that would compete against the imports, but the program, of late, is having problems sorting out its own personality. Its \$5-billion investment in a new assembly plant has been pared back to about half that amount. And the idea of a subcompact-size car has given way to a car "targeted right at the heart of the imports," wherever that means.

Latest shift in the program is the announcement that the Saturn name itself could be changed. Surveys conducted by GM show that Saturn is not an exciting moniker with car buyers. Some folks even think that there is something satanic about the name. Others connect it with the ill-fated Space Shuttle.

Plastic Blob

More than 10 million cars and trucks are junked each year. That poses a problem for salvage people that could be compounded in the near future. Most of the metals from junked cars can be recycled fairly easily. But with the growing use of plastic body parts, the process becomes more complicated. You can't just crush plastic and use it again. So, for the time being, plastic is primarily dumped into landfills or burned. But, at the rate that new cars are using plastic, we'll soon run

out of landfills. GE, a major supplier of plastic to the auto industry, has one solution. It is offering a line of body plastics that can be recycled. Just grind down the body panel, and the granules can be used again to make a different kind of plastic part. GE suggests one procedure: Recycle plastic bottles that were made for soft drinks; make car body parts from the recycled plastic; then recycle the body parts to make rough plastic containers like bins or boxes.

Mix And Match

Plastic suppliers like GE think that within a few years you'll be able to put your

choice of body style together right in the new car dealer's service stall. The idea is to ship partially finished cars to the dealer—say the rear part of the body or the roof panels are missing.

When a customer wants a hatchback body style, for example, the dealer adds a hatch to the rear of the car instead of a trunk. You want a sunroof? The dealer selects that kind of roof and installs it in place of a solid panel.

Bolt-on plastic panels are the key to this type of system. But first, drastic changes in the shape of cars will have to be made. Look at the Pulsar NX as the forerunner of this trend. **PM**

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Freewheeling

BY WADE HOYT



Power To The Fore!



Who says you can't put 250 hp through the front wheels?

There's been a lot of worry lately that, as GM converts nearly all of its cars to front-drive, some of its best engines may be thrown out with the bath water. Front-drive chassis have a lot of trouble handling more than about 180 hp. Some can't even cope with 145.

One of the main problems is torque steer. As power is applied, the drive axles wind up, or twist. If one axle is longer than the other (which is usually the case with the off-center differentials used on transverse engines) one axle winds up more than the other. Then, one wheel turns more than the other and the car steers when you don't want it to. The more power, the more twist. There are some fwd turbo models

that head for the weeds whenever you stand on the gas in low gear (where torque and windup are greatest).

One of GM's most powerful motors is Buick's 245-hp, 3.8-liter turbo V6. And next year, the last of Buick's rear-drive chassis goes away when the Regal switches to front-drive.

Larry Baker, manager of Buick's Vehicle Activity Dept., wanted to do a front-drive feasibility study, so he and his crew took a stock Riviera, pulled the engine and bolted on all the hot-rod parts from the turbo Grand National engine. The result was the awesome Riv you see here. With turbo boost adjustable from 10 to 15 psi, Baker's team could run up to about 250 hp through the front wheels. Equipped with V-rated Eagle GT tires and no fuel cutoff in the computer chip, this Riv's good for 144 mph with off-the-shelf Buick parts!

Here's how it did on the test track at various boost pressures:

BOOST	0-60 MPH	¼ MILE
10 psi	10.5 sec.	18.0 sec.
12 psi	8.1 sec.	16.5 sec.
15 psi	5.8 sec.	14.4 sec.

That's Ferrari/Porsche performance from a Riviera!

I've driven the car on the road course at Lime Rock, Connecticut. With all that power and flaccid Riv steering, it's a handful. But there's little torque steer, thanks to modifications in the drive-axle and front suspension geometry.

Because the car has no mufflers or catalysts, and a straight 2¾-in. exhaust pipe that looks like it was borrowed from a school bus, it isn't exactly street legal. But it's not objectionably noisy, either. The turbo takes a lot of the starch out of the exhaust below. If you hung on a catalytic converter, you might not even need a muffler.

Baker's crew is adding an experimental speed-sensitive variable-ratio power steering system to overcome its current lack of road feel. When that's in, the turbo Riv should go a long way toward convincing skeptics that you can too put more than 200 hp through the front wheels.

Peugeot Slighted

In our December '86 *Wonder Wagons* comparison test (page 58), we miscalculated the cargo volume of the Peugeot 505 Turbo wagon, listing it in third place behind the Audi 5000S and Chevy Celebrity Eurosport, and only marginally bigger than the Volvo 740 Turbo wagon.

A number of Peugeot fans called to say that couldn't possibly be right, and we vowed to remeasure the Peugeot.

This month the tape says 69.8 cu. ft. of cargo space, putting the huge Peugeot more than 9 cu. ft. ahead of its nearest competitor, and bringing it even closer to the first-

place Volvo in the overall Wonder Wagon ratings.

Dubious Premiere

Just as photos of the new AMC-Renault Premier crossed our desks, news came in of Chrysler's offer to buy out Renault's 46-percent share of debt-ridden American Motors. Chrysler then wants to buy up the rest of AMC. Where does that leave the Premier? Unchanged (for now) say PR people from all three firms. The plan is to build 90,000 of the 6-passenger Premiers per year in AMC's most modern automated plant in Bramalea, Ontario.

The proposed takeover deal contains a guarantee that Chrysler will buy 300,000 compact Renault Medallions from France over the next five years. There's also a clause about buying V6 engines and 4wd components for the Medallion, which should be some car! If Chrysler can't sell 300,000 Medallions, they have to pay a penalty of \$1300 a car. Having just driven a 2.2-liter 4-cylinder Medallion LX, I think Chrysler could learn a lot about making smooth, powerful Fours from Renault.

The fate of the oft-delayed Renault Alpine sports car is less clear. The Alpine is a high-priced 2-seater that will compete with the upcoming Chrysler-Maserati 2-seater.

What Chrysler really gets out of this deal is access to AMC's four under-utilized North American factories, plus the profitable Jeep Division as a bonus.

Renault, the government-owned French firm, has never had any long-lasting success in the U.S. AMC hasn't done well since they tried to move upmarket from the Rambler in 1962. Maybe Lee Iacocca can pull another one out of his magic hat. **FM**



GN turbo parts fit neatly onto Riv engine.



Upsize, upmarket AMC/Renault Premier will be built in Canada.

Tool Tests



Quick-Draw Drill

Black & Decker recently introduced a compact, cordless drill/screwdriver that's designed to handle light-duty jobs around the home and shop. The easy-to-use drill/driver (model No. 9021) has several unique features including a keyless chuck, holster with belt clip,

and an ON/OFF rocker switch that allows you to quickly change bit rotation from forward to reverse. Also, the tool's ratchet lock has two functions. First, it will open and close the 1/2-in. capacity chuck. Second, with the lock engaged, it can be used like a standard screwdriver on

Cordless drill/screwdriver has a compact, user-friendly design. It comes with five bits, clip-on holster and a plug-in charging stand.

stubborn screws. The tool operates at 300 rpm—a speed selected to handle both drilling and screwdriving. Don't exceed the drill's bit capacity of 1/4 in. I tried boring in wood with reduced-shank bits and found the task somewhat labored.

The drill/driver comes with

a wall-mountable charging stand, holster, a Phillips bit and a standard screwdriver bit, and three drill bits. Recharge time, from dead to full power, is 3 hours. It costs about \$55. Contact Black & Decker, 325 E. Oliver St., Baltimore, MD 21202.

—Rosario Capotosto



The easy-to-operate keyless chuck accepts bits up to 1/4 in. dia. Engage the ratchet lock to tighten or loosen the chuck.



Change bit rotation with rocker switch. Squeeze lower half of switch for forward rotation; press upper half for reverse.



Ratchet-lock settings: L to loosen chuck and stubborn screws; RUN to drill and drive screws; T to tighten chuck and screws.



Set the ratchet lock to the L position and use the tool like a standard screwdriver to loosen stubborn, rusted screws manually.

Portable Surface Planer

Most surface planers are too big and too expensive for a typical home workshop. The Ryobi 10-in. planer (model AP-10) is the exception.

The compact AP-10 weighs only 58 pounds and stores on a shelf or can be

placed under your workbench. The surface planer's suggested retail price is \$699, though it's often discounted at hardware stores and through mail-order tool companies for a price as low as \$400.

The planer will handle stock up to 5 in. thick x 10 in. wide. Maximum depth of cut per pass is 1/8 in. Chain-driven feed rollers maintain a rather quick planing rate of 26 ft. per minute.

I tested the planer on a variety of wood species from very soft to very hard. The planed

surfaces were as smooth as finish-sanded stock and there were no visible knife scallops—a problem common to many planers.

The AP-10 is powered by a 13-amp motor that develops 2 hp. A 2-blade, belt-driven cutterhead operates at 8000 rpm to produce 16,000 cuts

per minute.

It comes with two support rollers, wood-mounting blocks, blade-setting gauge and adjustment tools. For more information and retail sources, contact Ryobi America, 1158 Tower Lane, Bensenville, IL 60106.

—Rosario Capotosto



Compact planer handles stock up to 5 in. thick x 10 in. wide. The unit comes with two support rollers and wood-mounting blocks.

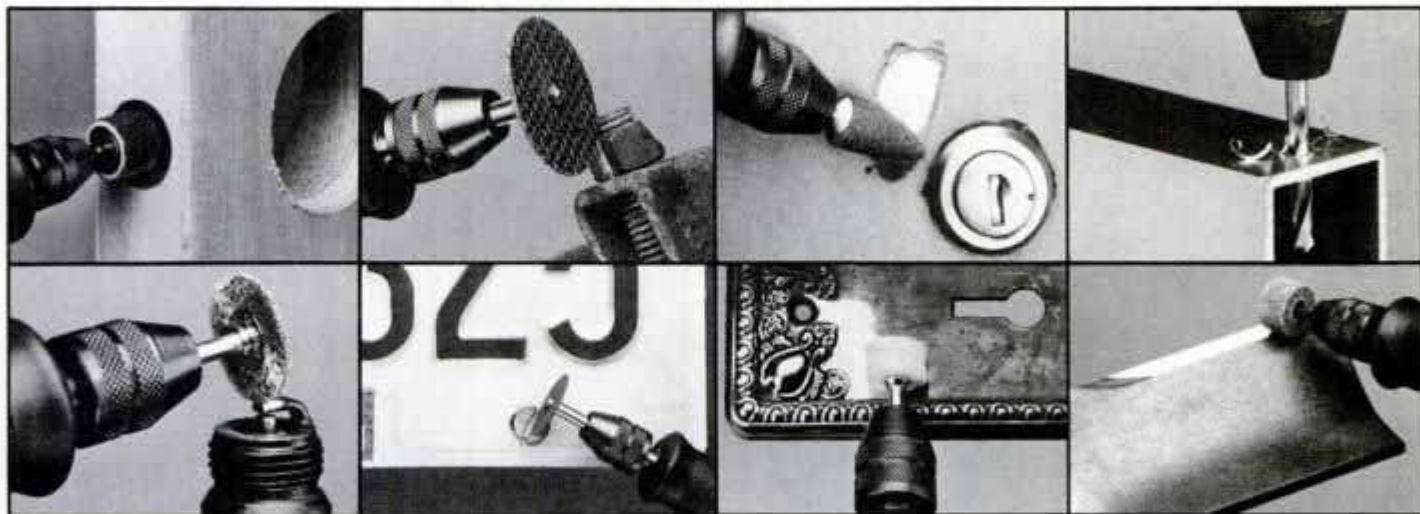


Maple was no challenge for 2-blade, 8000-rpm cutterhead powered by a 13-amp motor.



Portable planer weighs only 58 pounds. The infeed and outfeed rollers collapse for easy storage.

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If the surface is metal, the Moto-Tool is perfect for the job. Like sharpening your lawn mower blades quickly and easily. Right in the back yard without having to remove any parts. Simply drop in the grinding stone and let the Moto-Tool's 30,000 RPM do all the work.

That's the kind of powerful speed you need in the garage to remove rusty screws from a license plate. And the kind of compactness it takes to do the job in a hard-to-reach place. Just slip in the cut-off wheel to reslot the screws. Or use the same bit to cut them off in seconds. The Moto-Tool does whatever it takes.

That goes for working under the hood, too. Use the wire brush to clean corroded spark plugs and dirty metal parts. The Moto-Tool turns this task into a quick clean-up.

It masters do-it-yourself projects all over the house with just the change of a bit. The same tool you used today to cut copper tubing, you can use tomorrow to safely polish antique brass. Now that's versatility.

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BY DENNIS ESKOW

Waking In A New Light



In the NASA wind tunnel, lasers give accurate readings on design.

As the Army moves closer to the development of a 21st century Light Helicopter (LHX), basic physics problems are emerging. The new choppers are expected to move at speeds rivaling fixed-wing aircraft, and they will make turns as sharply as those made by a fighter plane. The most interesting problems surround the combined motions of wind, air moving around the chopper in motion, and vortices created in the wash of the rotor. At NASA's Langley Research Center in Virginia, scientists have begun using lasers to measure air motion in a wind tunnel. Combining highly accurate laser light with high-speed photography allows the scientists to measure the effect of different moving masses of air in a much more accurate way than the traditional wind tunnel smoke test. In the traditional test, smoke is placed in the wind tunnel and the way it moves over the model under study provides data for aerodynamic design. The new method is expected to yield far more advanced results.

Shades Of Science

Sunglasses look cool, and they can protect the eyes from intense glare. But we often over-use sunglasses. California State researcher Bill Puett, who has been working with athletes in his Dominguez Hills lab, says too much use of sunglasses is a bad thing.

"What sunglasses will do with prolonged use is weaken

the retina or its ability to utilize light," he explains. "What happens then is that a person's contrast vision will be poorer." Contrast vision describes the biological equivalent of contrast on a TV screen.

Puett recommends using sunglasses only in prolonged high glare, such as cross-country skiing or walking along a beach. Even if your ophthal-

mologist gives you a prescription for sunglasses, Puett suggests using them conservatively.

As for weaning yourself from sunglasses, Puett suggests closing your eyes tightly and facing the sun for about 10 minutes. If you shed tears, put the glasses back on and try the weaning again periodically.

Chemotherapy At Home

We're learning more every day about dealing with cancer, and the latest news shows a new step forward. Lung cancer patients will soon be able to do chemotherapy on their own with a doctor's prescription. That's thanks to VePesid, an oral form of etoposide, a cancer-cell combating agent often prescribed for lung cancer patients. Recently approved by the Federal Food and Drug Administration, VePesid will be available later this year. Patients whose cancer is under control and who have been taking etoposide by injection will now be able to skip visits to the hospital and take it at home orally. It should help many with a shot at recovery to reach their goal faster.

Old Salt

I'm doing a slow burn about an Old Wive's Tale I recently and reluctantly relinquished. I had always thought that our ancestors pickled and spiced their food to keep it from going bad. But a series of papers published in the past five years torpedoed that story. The more recent theory is that pickling and spicing served merely to cover up the odor of biodegradable food that was in the midst of biodegrading.

The U.S. Department of Agriculture's Robert L. Buchanan jolted me a few days ago with a report that makes me have to reconsider pickling all over again. Just when I was beginning to lash out against the old-liners, Buchanan reported that salt in large quantities is toxic to bacteria. The bacteria don't get killed off by the salt, mind you. They merely get so tired from pumping salt out of their systems that they burn most of their energy and don't leave

much in the way of waste products. Bacterial waste products are what make meat go bad or milk go sour. Not only that, but the bacteria are reportedly so busy pumping out salt that they have no time to eat, which keeps the waste products even at a lower level and makes the bacteria even more tired.

Buchanan and his colleagues at USDA are evaluating the impact of lowering sodium content in food. The government aims to see less sodium in food as a means of preventing heart diseases. But Buchanan's research suggests we better not throw out the salt with the bath water.

Placing Betas

It's a solid. It's a liquid. It glows. It can sense changes in light and heat. It's called beta alumina, and researchers at the University of Pennsylvania believe it will revolutionize battery technology and may lead to the creation of tiny, but powerful, lasers.

Beta alumina is a solid electrolyte, meaning it is a nonmetallic electric conductor whose ions flow, creating current. Most solid electrolytes have to be cooled to be good conductors, but Ford Motor Co. researchers discovered in the 1960s that substances like it could conduct current at room temperature, which puts beta alumina in the liquid electrolyte category from a chemist's point of view.

The U. of Penn. researchers have been toying with beta alumina as the possible conducting medium for batteries.

If their theories hold up, the beta alumina may store hundreds of times more energy than lead-acid systems.

The implications are great for those who envision an all-electric car. And for those physicists who are searching for the perfect laser material, the beta alumina holds out promise of big breakthroughs in the next decade.

Highlands Stonehenge

Please don't write letters defending the Stonehenge monuments as an ancient astronom-

(Please turn to page 52)

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SCIENCE

(Continued from page 50)

ical observatory. There isn't enough evidence to determine exactly what the Stonehenge stones were used for. But British archeo-astronomers Roger Martlew and Clive Ruggles are studying a similar set of stones on the Isle of Mull in Scotland. The Mull stones are arranged in a similar circular fashion. The two, working with Earthwatch, the volunteer research organization, are trying to determine whether the Mull stones could have been used to follow the movements of planets, the sun and moon. If they could have been used for that purpose, the Stonehenge theory will be strengthened.

Chunnel Update

The financial underpinnings for one of this century's most ambitious public works projects—the high-speed rail tunnel linking England and France—is taking shape, according to Frank P. Davidson, author of PM's recent "chunnel" feature (*England's French Connection*, page 67, Sept. '86).

Davidson reports that the Eurotunnel consortium has raised an initial 206 million pounds sterling of equity. While the English and French governments are not guaranteeing construction bonds, a bill to ratify the Channel Tunnel cooperation treaty has passed its second reading in the House of Commons and is now working its way through the House of Lords. The final reading of the bill is expected soon. Ratification of the treaty will trigger an equity offering on the world's stock exchanges totaling 750 million pounds. Once the equity issues have been sold, about 40 major banks worldwide are expected to provide the approximately 5 billion pounds sterling it will take to carry out the project.

Envisioned since the time of Napoleon, the tunnel complex will run approximately 100 meters below sea level at its deepest point, with rock thickness above it varying between 27 meters and 40 meters. Two rail lines—with interconnecting service tunnels—will transport people, autos and truck freight between London and Paris in 4½ hours.

The Fusion Quest

The global drive to produce a clean, inexhaustible source of fusion energy has achieved new impetus with recent strides in superconducting electromagnets, and with the inclusion of Princeton University's Compact Ignition Tokamak on President Reagan's 1988 budget submission to Congress.

At Oak Ridge National Laboratory, scientists passed a major milestone in fusion research recently when six 45-ton superconducting electromagnets were brought up to full current, creating

a magnetic field 160,000 times that of the Earth. Extremely strong magnetic fields will be needed to contain the super hot hydrogen gas, called plasma, used in the fusion reactors of tomorrow. Normal electromagnets require too much power to produce magnetic fields capable of plasma containment at temperatures approaching 200 million degrees C. Superconducting magnets, offering little electrical resistance at extremely low operating temperatures, use a tenth the power of conventional electromagnets in a similar application.

The six superconducting magnets were mounted together inside a 35-ft.-dia., 40-ft.-high vacuum tank. Air was evacuated for the full-current tests and the complete 460-ton superconducting magnet array was cooled to -450° F. The Oak Ridge magnets were designed and produced by an international consortium under a development program called the Large Coil Task.

Advancements in superconducting magnets may also have an impact on the Superconducting Super Collider, a \$4.4 billion particle accelerator recently approved by President Reagan. (Watch for PM's continuing update on the SSC site selection and design.) The SSC will allow physicists to peer ever closer into the heart of matter, proving the existence of such elusive particles as quarks, muons and bosons. Other types of superconducting materials are also being developed by scientists. Researchers at Argonne National Laboratory recently confirmed the discovery of a Bell Labs compound that achieves superconductivity at 39° Kelvin (or 359° below zero F). The compound, composed of lanthanum, copper, strontium and oxygen, becomes superconductive with closed-cycle refrigeration instead of with more complex cooling methods using liquid helium and liquid hydrogen. The compound could have an impact on the maglev transportation systems, medical diagnostics and fusion research.

Concurrently, Princeton University's proposed Compact Ignition Tokamak at the Princeton Plasma Physics Laboratory (PPPL) will demonstrate the ability of an "ignited plasma" to sustain adequate reactor temperatures without energy-sapping auxiliary heating.

Princeton's fusion research program started in 1951, and its 16-year-old Tokamak Fusion Test Reactor (TFTR) is an important component in American fusion power developments. Scientists in charge of Princeton's TFTR are trying to achieve a break-even point where the fusion power produced by the plasma equals the auxiliary heating power required to maintain the plasma at reactor temperatures. The objective of the Compact Ignition Tokamak will be to demonstrate that an ignited plasma can

(Please turn to page 56)

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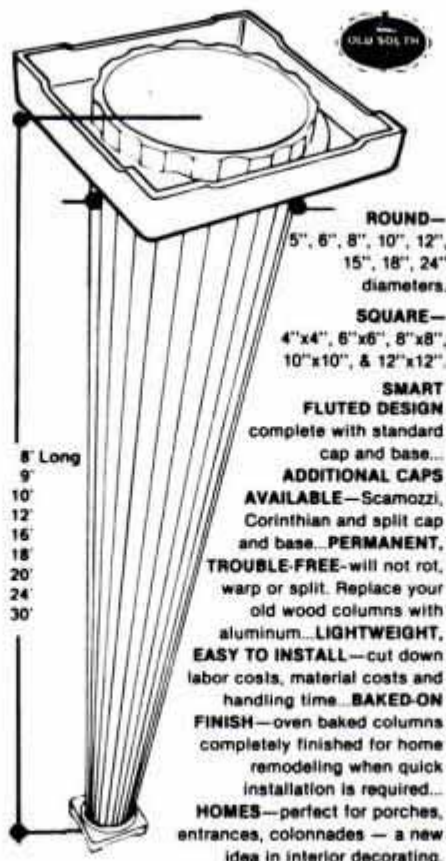


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SCIENCE

(Continued from page 52)

maintain proper reactor temperatures during pulses lasting a few seconds without the need for auxiliary heating. CIT as designed is roughly one-half the size of TFTR, but is expected to generate 10 times the fusion power because of advances in plasma containment.

Scientific Assault On The Amazon

Brazil's Amazon Basin forms a significant portion of Planet Earth's total biomass, playing a key role in global air quality and climate. However, economic encroachment is beginning to affect the Amazon's ability to transport gases generated in swamps, rivers, forest soil and trees to the upper atmosphere.

Accordingly, scientists from the University of Virginia are traveling to the Amazon as part of NASA's Global Tropospheric Experiment to study the chemistry of the atmosphere over the world's most verdant rain forest. The primary objective will be to assess the role the Amazon plays in supplying trace gases and organic particles to the world's atmosphere.

There are two sides to the U.Va./NASA expedition, run in cooperation with the Brazilian Space Agency. Using a NASA research plane, 20 scientists will fly some 1500 miles out over the jungle, measuring the chemical makeup of the atmosphere over the Amazon at different altitudes. A ground-based group will use 140-ft.-tall towers, radar and balloons for similar measurements.

It's hoped that a better understanding of the atmosphere's chemical composition will provide a new way to gauge the interrelationship between Earth, the atmosphere and human activities, says U.Va. Professor Michael Garstang.

Pioneer 9 Declared Dead

After nearly two decades, 22 orbits around the sun, and 11 billion miles of faithful service, one of NASA's most productive Pioneer spacecraft has failed to respond to command signals from ground controllers at NASA's Ames Research Center, effectively ending a scientifically fruitful career. Pioneer 9 gave researchers new insight into the structure and flow of solar wind, the ionized gases that stream from the Sun, and helped predict the solar storms that can sometimes disrupt power distribution on Earth. In the late '60s and early '70s, Pioneer 9 gave hourly reports to Apollo Mission Control on potentially damaging showers of solar protons, and, in conjunction with Pioneer 10, successfully measured the speed, temperature and mass of one of the most intense solar storms ever recorded. **PM**

HINTS FROM READERS

Brake Drum Planter



My son, an industrial design student, spotted a rusted brake drum on the roadside and, with a burst of creativity, took it home and transformed it into an attractive planter. Actually, there wasn't much to transform.

All you need to do is just clean it off, but leave the rust, and cover the axle hole with a piece of plastic sheet or a cover from a food container.

Leave other holes exposed for drainage and fill it with soil appropriate for what you're planting. I liked the planter so much that I sent him out to pick up a few more. He returned from the local junkyards with four more, each different from the other, and costing 50 cents to \$2 each. Their rusty color complements nasturtiums and other yellow-orange annuals.

—Kay Haugaard

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MOSHIER TECHNOLOGIES CORPORATION's **VTOL Aircraft Development Report** is now available. The report is a comprehensive (47 pages, bound) presentation including a history of VTOL aircraft, the Aurora aircraft development evolution, specifications, product description, marketing considerations, and more. The report has been written in terms a non-engineer can easily understand, yet provides a thorough discussion of the aircraft's technology and operational characteristics.

If you are intrigued by the concept of a small VTOL aircraft, or have more than a passing interest in new and innovative aircraft design, we would like to hear from you. Learn more about this exciting new concept and participate in the Aurora aircraft marketing survey. To receive the comprehensive 47 page development report, color photograph and marketing questionnaire, please send \$37.00 check or money order in **U.S. funds only** (\$45.00 outside USA) to Director of Marketing, MOSHIER TECHNOLOGIES CORPORATION, 599-A Fairchild Drive, Dept. PM687, Mountain View, California 94043. All orders shipped first class mail.



"The development report is **must reading** for anyone wishing to keep abreast of the latest in VTOL technology."

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NEW/HOME

A Mow/Mulch Machine



Mower's cutting height adjusts from $\frac{3}{4}$ in. to $2\frac{3}{4}$ in. Easy-to-empty rear grass catcher accepts plastic trash bags (above).

If you're in the market for a new lawnmower, then check out the versatile Bolens Eliminator Plus. The mower shown (model No. 9062) is a 21-in., self-propelled, rear-bagging unit that converts easily to a mulching mower or, with an optional chute, a side-discharge mower. It's powered by a 4-hp, 4-cycle Briggs & Stratton en-

gine with solid-state ignition and recoil starter.

The 2-bushel capacity grass catcher accepts plastic trash bags to make it easy to dispose of clippings. It costs about \$485. Contact Bolens, 215 South Park St., Port Washington, WI 53074.

Wash And Go

New from Speed Queen is a space-saving washer and dryer designed for small homes and apartments. The Contempo Mate electric washer/dryer (\$700) measures 24 in. wide x 25 in. deep x $72\frac{3}{4}$ in. high and weighs 148 pounds. For optimum portability, Speed Queen offers a hose kit (\$16) and wheel kit (\$20). With these two accessories, the unit connects quickly to a sink faucet and, when not in use, it can be rolled into a closet or spare room. The washer has a durable polypropylene tub powered by a $\frac{1}{6}$ -hp motor. Features include a water-level selector, water-temperature control and multifabric wash-cycle timer. The 1520-watt dryer has a $\frac{1}{6}$ -hp motor. Its indoor-vent design requires no exhaust ducting. Speed Queen, Ripon, WI 54971.



Stackable washer/dryer hooks directly to sink faucet—no special plumbing. Wheel kit makes the 148-pound unit portable.

How To Be A Swinger

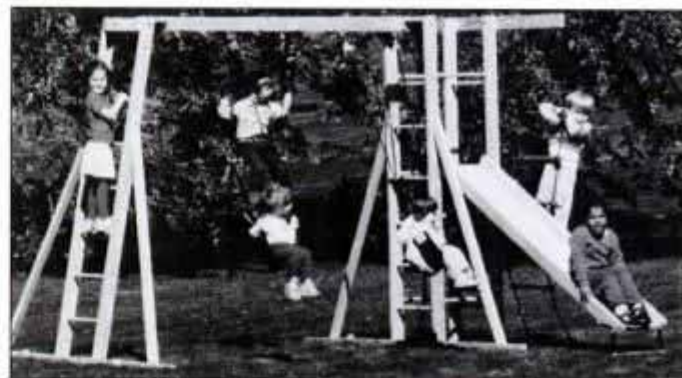
Create a backyard playground with a swing set kit from Swing Design, 33 Loring Dr., Framingham, MA 01701. The Adventurer swing kit (\$199) contains all the necessary hardware and components to erect the 3-position swing set shown. You provide the pressure-treated 2x4s: 14 that are 8 ft. long, and one that's 12 ft. long.

The kit also contains a climbing rope, two rubber belt swings, trapeze bar with rings, climbing cargo net, wooden ladder rungs and



Swing set kit has all necessary hardware and components—except the wood.

monkey bars. A complete kit is also available that contains all components, hardware and pre-cut and stained lumber for about \$325. The kits are sold at home centers and hardware stores.



Completed swing set has two swings, a trapeze bar and cargo net.

Powerful Branch Biter

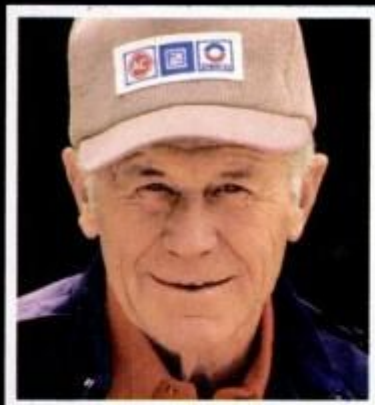
True Temper's new compound-action lopper (\$40) has two pivoting points instead of one. As a result, trimming branches requires only half as much pressure as conventional loppers, claims the manufacturer. The upper blade has a curved, serrated tip that prevents branches from escaping when cutting pressure is applied. True Temper, Box 3500, Shiresmantown, PA 17011.



Compound-action lopper has two pivoting points and a curved guide slot on upper blade.



Muscle-saving lopper has two ash handles. The tool's overall length is 29 in.



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— Test Pilot Chuck Yeager

These days, AC-Delco's sweetening the pot with more than top-notch parts. We're offering up to \$7 in rebates.

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Your rebate requests must reach us by August 31, 1987. So see your AC-Delco retailer for coupons and details. To find your nearest retailer, call me toll-free at 1-800-AC-DELCO.

Keep in mind, a deal like this doesn't come around too often. So if you maintain your car yourself, I'd suggest you get over to your AC-Delco retailer today.

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**SURGEON GENERAL'S WARNING: Quitting Smoking
Now Greatly Reduces Serious Risks to Your Health.**

Lights: 10 mg "tar," 0.7 mg nicotine—
Kings: 16 mg "tar," 1.0 mg nicotine
av. per cigarette, FTC Report Feb '85

5 more smokes for the long working day.



Marlboro 25's

NEW/AUTO

More Life From Old Wipers

Streaking windshield wiper blades can really make a rainy trip seem twice as long. Don't squint or use up gallons of washer fluid trying to make up for worn blades. When the edge of your wiper blade gets rounded from wear and oxidation, it won't squeegee the water away from the glass. As long as there is rubber left on the blade, don't throw them away—Nu blade is designed to put a new wiping surface on old blades. The compact, 3-in.-long tool stores easily in the glovebox, and puts a new edge on a blade in seconds, without removing the blade from the arm. Just wipe the \$3.95 Nu blade along the wiper to shave a small amount of rub-



Now you can save old wiper blades for another rainy day.

ber from the worn edge. This will restore the sharp edge of the rubber blade. Of course, if the rubber is in shreds, you are too late. Order direct from Holz Enterprises, 497 South 7th St., St. Helens, OR 97051. Or call 503-397-6236.

Optics To Bring Up the Rear

Backing out of a driveway full of kids, dogs and toys is guaranteed to give you a stiff neck and worry lines. Easipark makes it simpler. By looking over your shoulder, or even

in your inside rearview mirror, you can see entire objects on the rear or side as near as 3 ft. With a little practice, you can back up to within 6 in. of another car or the trash cans without turning around in the seat. Its safe, soft plastic lens sticks to your rear window off to one side, so it won't interfere with normal driving. The near-panoramic view covers a wide area, so it should be good for big and small cars, station wagons and vans alike. Just be sure you place it in between the wires for the rear-window heater. Order from the J. Goodman Co., Dept 14, Box 88 Livingston, NJ 07309. It's \$9.95 plus 50 cents postage.



Easipark's plastic lens for your car's rear window broadens the view.

Blow Your Garage Down

Convert your old VW Beetle or Bus engine into a high-capacity air compressor. Conversion kit replaces stock head with finned aluminum compressor cylinder heads for one or two cylinders. The other bank of two cylinders runs normally to provide power. A gallon of gas will provide ample compressed air for sandblasting or painting for an hour. Contact



Beetle motor can be converted to an air compressor.

Dunn-Rite Inc., Route 6, Box 184A, Anderson, SC 29624. A single cylinder kit costs \$279, a twin \$399.



Just brush this liquid tape on electrical connections.

Sticky Fingers

Electrical tape does a good job in the house, but on the car it leaves a lot to be desired. Moisture and dirt make the end of the tape flap in the breeze, and pretty soon the turn signals on the trailer are out again. Starbrite's Liquid Electrical Tape seals out moisture and corrosion permanently. The black liquid vinyl is applied with the built-in applicator brush and it dries in minutes. If you leave it on the dash of your car in the sun, it won't turn into a telescope from the heat. A 4-ounce can is \$4.95 from auto and marine stores, or call 1-800-327-8583 for information.

Lights Out?

Plews Broken Circuit Tester has a sharp little point in the end to pierce the insulation on the wires you're testing. If the 6- or 12-volt circuit is hot, the lamp in the handle will light up. Trigger action makes it easy to use in restricted areas with only one hand. Just grab the wire with the hook and squeeze. It costs \$13 and is available in auto parts stores. **PM**

It's not broken; it's for testing broken circuits.



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1983.

And again.

1984.

And again.

1985.

And again.

1986.

And again.

...we can offer
a warranty
this good:

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Ford Motor Company's
new 6-year, 60,000
mile warranty.

With a quality record better than any other major American carmaker, we realized we could give you a better warranty than we ever had before.

A 6-year, 60,000 mile powertrain warranty on all our new Ford, Mercury, Lincoln and Merkur cars, our vans, and our light trucks.**

With a warranty like that, and a quality record like ours, there's really no reason to go with anyone else.

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



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*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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ELMER'S
THE HOME SOLUTION™



Problem: How to stop the draft from drafty windows.
THE HOME SOLUTION™: Elmer's Silicone Caulk. Gives you a long-lasting, flexible seal that insulates and waterproofs.



Problem: How to replace broken window glass.
THE HOME SOLUTION™: Elmer's Glaze-Tuff™ glazing compound. It's paintable in only 30 minutes.



Problem: How to reglue loose rubber on appliances.
THE HOME SOLUTION™: Elmer's Stix-All™ A strong, high-tech adhesive that bonds just about anything to anything else.



Problem: How to repair a crack in a wall.
THE HOME SOLUTION™: Elmer's Redi-Spax™ spackling compound. Fast-drying acrylic latex formula stays flexible but sands easily.



Problem: How to patch the deep gouge in the dining room table.
THE HOME SOLUTION™: Elmer's Carpenter's Wood Filler. Resists shrinking and accepts dark and light stain.



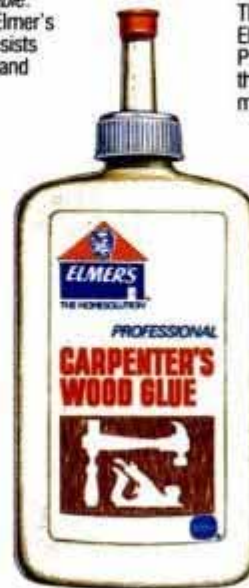
Problem: How to attach Formica® to a countertop.
THE HOME SOLUTION™: Elmer's Contact Cement. Forms a strong bond.



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.
THE HOME SOLUTION™: Elmer's Invisible Glove™ Protective Hand Cream. Just apply before any dirty job.

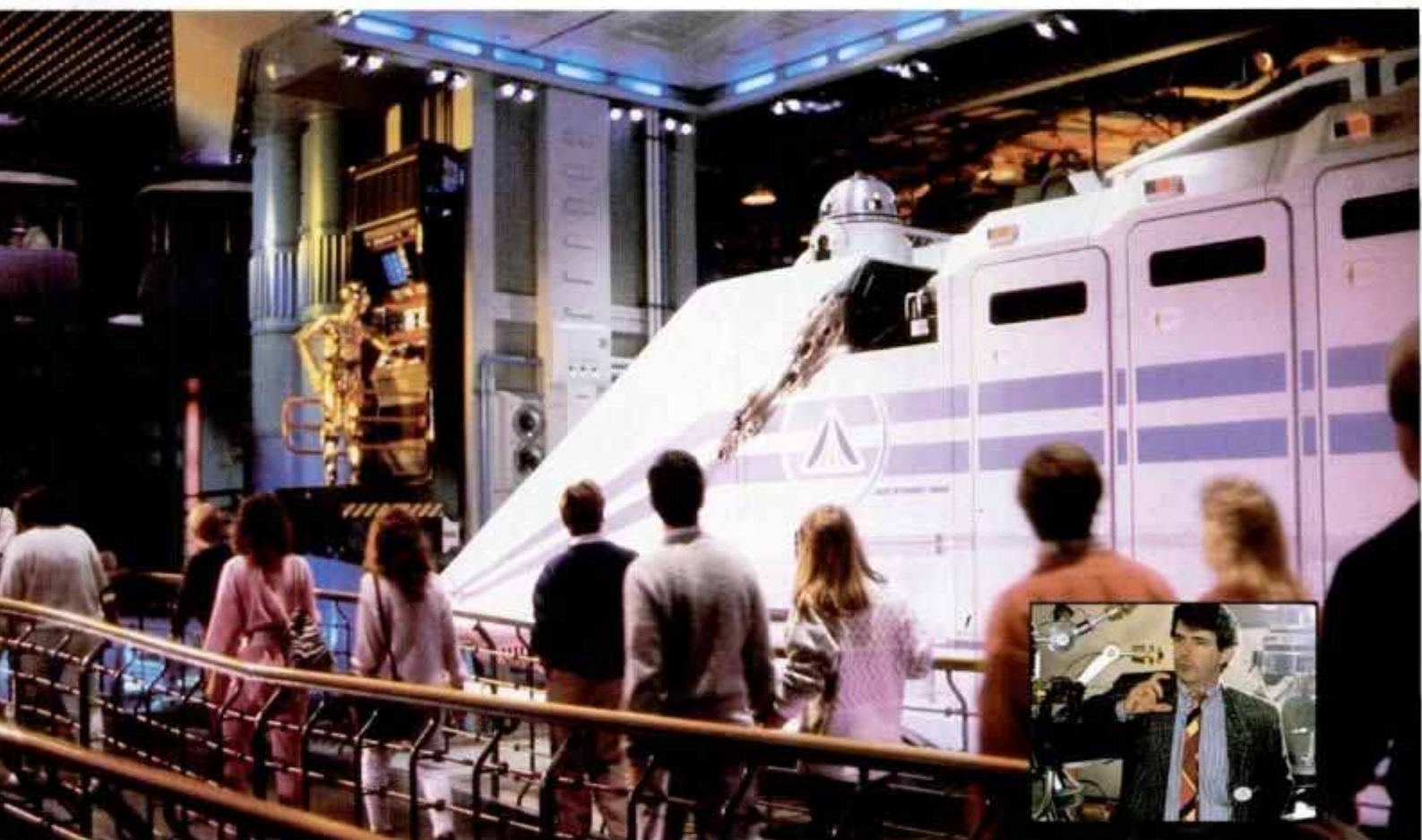


Problem: How to glue the arm back on the armchair.
THE HOME SOLUTION™: Elmer's Carpenter's Wood Glue. Penetrates wood deeply for a strong bond.



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.

PM TECHNOLOGY UPDATE 6/87



Technologies Merge In Fantasy Simulators

As you and 39 companions strap into your bucket seats, your pilot, Rex the robot, casually informs you that this is also *his* first flight aboard the Starspeeder 3000—which helps explain the ensuing 4½-minute misadventure. Rex takes a wrong turn and Darth Vader's Death Star looms on the horizon. What began as a vacation getaway to the Moon of Endor, winds up in a fight for survival. The Starspeeder climbs, banks, accelerates, even achieves mock light speed—all with white-

knuckle realism. It's part of Disneyland's latest triumph in "techno-fun" and a new trend in amusement park attractions. Disney engineers teamed with Star Wars producer George Lucas (inset)

to create Star Tours, which combines a hydraulically operated, flight simulator-based, 40-passenger capsule that is computer-synched to Star Wars wide-screen visuals.

Another flight simulator-based attraction has gone on line at Tour of the Universe in Toronto.

A Hermes space shuttle look-alike takes passengers on a flight to Jupiter. The flight simulator has 6° of motion, its 70mm film is increased to 60 frames a second for excitement and clarity and occupants are surrounded by quadrophonic digital sound. Beam us up!

George Lucas, inset above, teamed with Disney engineers to create the Starspeeder 3000 at Disneyland's new Star Tours attraction. The ride's flight simulator origins are clearly shown at Toronto's similar Tour of the Universe, left.



Editor: Tim Cole
Contributors: Wade Hoyt,
Ted Francis, Lisa Gosselin,
Jan Norbye, Nick Nichol

DISNEY PHOTOS, ABOVE;
TOUR OF THE UNIVERSE PHOTO, RIGHT

TECHNOLOGY UPDATE 6/87

SPACE

MCDONNELL DOUGLAS ILLUSTRATION



MLV Marks U.S. Space Comeback

The Air Force has awarded a \$316.5-million contract to McDonnell Douglas to produce the next generation expendable space launcher. The Medium Lift Vehicle is an updated version of the venerable Delta rocket, which has achieved a 97.7 percent success rate over the past 45 launches. The first seven MLVs will launch into space a series of Navstar Global Positioning System satellites, precision spaceborne navigation beacons for use by all branches of the U.S. military. McDonnell Douglas is also marketing the MLV to commercial space customers.



BOEING PHOTO

Space Station Housekeeper

The value of a single space station crewmember's time will be placed at \$20,000 an hour. So Boeing engineers are developing robotic systems that will perform mundane station-keeping chores. Currently in the works at Boeing's Huntsville, Alabama, facility is a lightweight dual-armed, aluminum-based robot (pictured)

that has articulating wrists, elbows and shoulders that can perform humanlike movements. While an early prototype is seen here manipulating stowage modules, one proposed offshoot will come complete with computer-aided vision and a transportation system to assist astronaut/engineers in finding tools or keeping inventory. Telerobotics and autonomous robotics are also under study for use in space.

AUTOMOTIVE

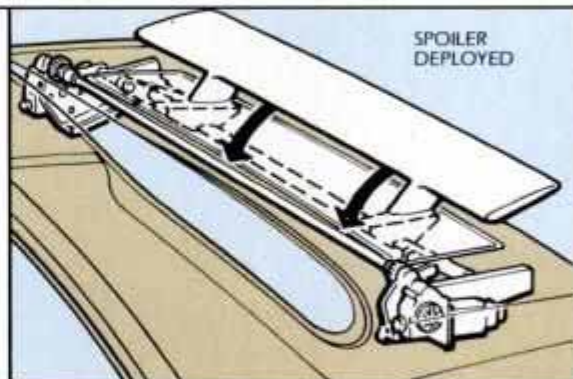
Pop-Up Spoiler Hits The Road

Moveable aerodynamic aids, long predicted in road-going cars, have finally hit the street on the Lancia Thema, a front-drive Italian sedan powered by a 3.2-liter, 215-hp, Ferrari V8 engine. (Lancia and Ferrari are both owned by Fiat, which makes such hot rodding possible in a production car.)

The aero aid is an electrically powered rear wing that flips up out of a cavity in the trunk lid at the touch of a



stalk-mounted switch near the steering wheel. At highway speeds, the spoiler cuts aerodynamic lift at the rear of the car in half. In fact, at 85 mph, the wing provides 26



pounds of road-hugging downforce—67 pounds at 140 mph.

It also adds a last 1½ mph to the Thema's top speed of 145 mph, a speed that is not

uncommon on some European highways.

That's Corvette performance from a \$26,000 4-door sedan that may be sold in the U.S. by 1988.

PM ILLUSTRATION BY GEORGE RETSECK

AVIATION

PM ILLUSTRATION BY ED VAUGURSKY



New Chute System For F-111 Egress Pod

Developments in electronic warfare have added nearly 300 pounds to the Air Force's workhorse F-111, which means the plane's cockpit escape module (illustrated) must now descend by parachute at 35 ft. per second after an emergency punch out. The Air Force recently decided to reduce

the module's descent rate to a safer 25 ft. per second and asked Sandia National Laboratory to design a replacement for the F-111's single 70-ft. ringsail parachute. The result (pictured) is a cluster of three 52.5-ft.-dia. parachutes that rely on conventional ripstop Nylon and Kevlar in structural and sus-

pension lines. Each parachute weighs only 30 pounds and develops a drag force of 8000 pounds.

The new parachutes were recently attached to test vehicles (right) carrying on-board accelerometers, load-measuring instruments, cameras, cinetheodolites and tracking telescopes.



Light Weight, High Strength

The Pontiac Motorsports Division is testing a magnesium-based, inline, 4-cylinder engine block that is approximately 100 pounds lighter than its cast-iron equivalent. A typical "Magblock" is sand cast using ZE41 magnesium and weighs a scant 41.9 pounds. Compare that to the 116.7-pound weight of a conventional block of similar displacement. The engine was developed for off-road/motorsports applications.



MCDONNELL DOUGLAS PHOTO

F-15 Electronic Enhancements

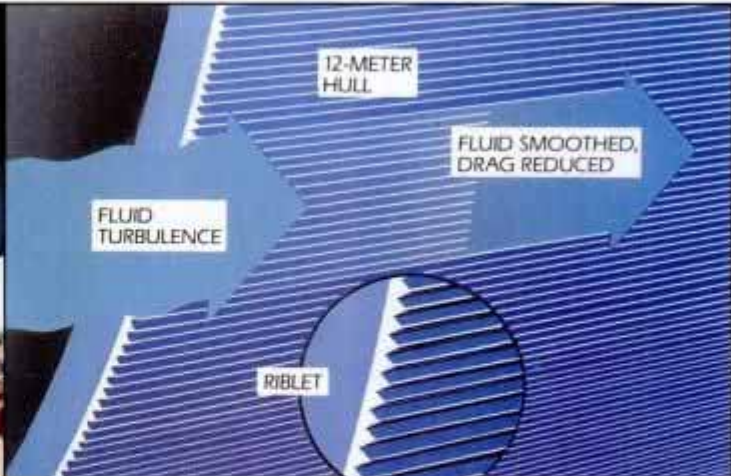
The new and improved McDonnell Douglas F-15E will undertake deep interdiction fighter/bomber missions, relying on conformal fuel tanks for extra range and an updated electronics package. Items include the Hughes APG-70 radar, Martin-Marietta Low Altitude Navigation and Targeting Infrared

(LANTIRN) system and inertial navigation by Honeywell that incorporates the revolutionary laser ring gyro. The F-15E also has a second cockpit for a weapons system/countermeasures operator. The Air Force plans to add 392 F-15Es to the existing fleet of twin-engine supersonic F-15s.

TECHNOLOGY UPDATE 6/87

MARINE

FM PHOTO BY PETER ISLER



FM ILLUSTRATION BY GEORGE RETZACK

Cup Tech Continued

One of the more intriguing developments to emerge from Dennis Conner's resounding America's Cup victory last February concerns "riblets," another word for a new process from 3M Company called "microreplication." Three hundred panels of 3M's Scotcheal Drag Reduction Film, first developed by NASA's Langley Research Center, were applied to the 65-ft. hull of Conner's 12-Meter Stars & Stripes. Tiny V-shaped grooves (illustration inset) are etched into the film, giving it the tactile surface of a standard LP record. The application resulted in reduced water-flow turbulence because laminar fluid flow was allowed to continue farther back on the



FM PHOTO BY GUY QUINCY

hull before separation. In addition, the riblets guided the waterflow evenly, cutting down on cross-flow friction.

Other innovations in 12-Meter technology included the sail material used aboard French Kiss (pictured), an actual offshoot from a Franco-Soviet mission to the Planet Venus. The Centre National des Etudes Spa-



tiales (CNES) originally developed the material for a 30-ft. helium balloon that was to

be dropped into the Venusian atmosphere.

Mission requirements called for a tightly woven, acid-resistant cloth and the result is a composite of Kevlar fibers along with fluor and polyester films.

Another significant improvement in the America's Cup game involved new strides in spectating. CF Thomson, a French electronics company, developed an onboard mini-cam for ESPN that brought cockpit action into living rooms. Wrapped in plastic and bolted to the mast, it sent microwave signals to a helicopter overhead, which relayed the signals to a shoreside broadcasting station. The yacht cam aboard the Australian yacht Kookaburra III incorporated zoom, focus, pan—and windshield wipers.

MILITARY

Submachine Gun In A Box

Answering the call for concealable, high-volume firepower by security/counter-

terrorist agents at airports and embassies, ARES, Inc., of Port Clinton, Ohio, has unveiled a unique 9-mm Folding Machine Gun. The

weapon collapses into a compact rectangular box 10 x 3 x 1½ in. According to ARES, the FMG is intended to provide a quickly deployable firearm that could be carried without causing public alarm.

The FMG's magazine holds 32 rounds of ammunition and can fire selectively in semi-automatic or fully automatic mode. The nominal cycling rate is 650 rounds a minute. Fully loaded, it tips the scales at about 4 pounds—half the weight of the vaunted Israeli Uzi.

FM PHOTOS BY JACK HAMMOND



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and still working.

Of course they are. They're Red Wings. And here's the proof that 20 mile-a-day comfort doesn't come with a limit. These Red Wings have actually walked over 7,000 measured miles.* They've been doing exactly what we made 'em for... working. Red Wings are America's finest shoes for work. When we promise quality, fit and comfort, you get our best.

For more information and your nearest dealer, call toll free 1-800-255-2550.

*Unsolicited testimonial from Bob Vande Weerd, Rock Valley, IA.



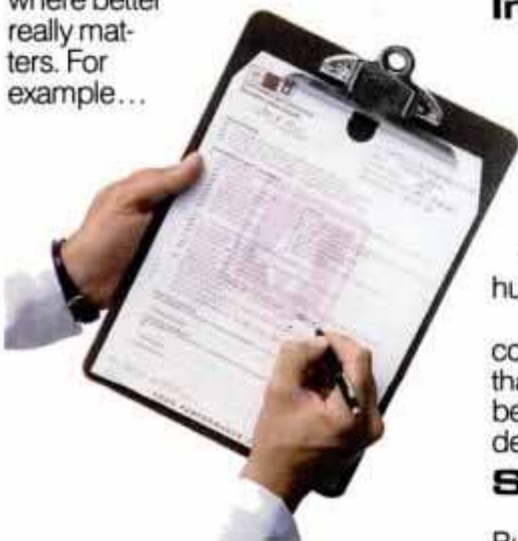
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We confidently invite you to give your brand new Buick its 201st inspection.

The first 113 quality inspections happen while your Buick is being built. But that's just a good beginning. Once it reaches your dealer, 87 additional items must be checked before it can be subjected to the most important inspection of all: yours.

And that's just one of the important things we pay attention to. Things that make us a place where better really matters. For example...



Underneath

The road of life has its share of potholes, washboards and bumps. Fortunately, it also has an occasional sweeping curve or twisting, tree-lined lane. Century is prepared to deal with it, either way.

Its independent front suspension, computer-selected springs and shock absorber valving deliver the kind of smooth, effortless ride for which Buick has long been



Buick Century

admired, while taking very good care of business when the going gets brisk and sporting.

Inside

When you sit behind the wheel of a Century, you find that the controls are where you want them for ease of operation. That's because of our dedication to ergonomics — the science of matching machine design to human design.

Other reasons for Century's comfort include things like seats that provide real support without being hard or harsh. Aerodynamic design to cut down on wind noise.

Satisfaction

Century is the best-selling Buick in history. The reasons are many. But one of them surely is the way this automobile manages to blend today's technology with traditional grace and comfort.

It is a front-wheel-drive car, with an engine controlled by microchips. It was designed with the aid of computers and wind tunnels for superb aerodynamics. It represents what can be done with the application of the latest technology.

But all this electronic wizardry is there to fulfill one simple, single function: to provide satisfaction. A car that starts when you want it to, has the kind of power you expect and provides quiet, solid comfort on the road.



If that sounds like the automobile you've been looking for, buckle up and see your Buick dealer.

For more information, a brochure or a test drive, call

1-800-87-BUICK
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See your dealer for the terms and conditions of this limited warranty.



Where better really matters.

B U I C K

RAGTOP FEVER

Popular
Mechanics
JUNE 1987

Born-again convertibles
bring back driving fun.

It was a tough job, but somebody had to spend a week proving that convertibles are fun. Blasting down a canyon road toward the ocean, hairpin after hairpin, top down, hair blown back, shades on. It doesn't get much better than this.

For a while, in the '70s, a lot of the fun went out of driving, and top-down models disappeared. Happy to report, you can't keep a good top up. The latest convertibles retain all the fun of open-air motoring, while

eliminating the chassis flex and leaky roofs that plagued early soft tops.

The eight cars we assembled in California are all the new factory convertibles on the U.S. market. We deliberately excluded 2-seater roadsters and aftermarket conversions. Also out are the VW Cabriolet which is not new, but based on a '70s Rabbit chassis; the BMW 325i which wasn't available here at the time of our test; and the absurdly expensive Rolls-Royce Corniche



CHEVROLET CAMARO IROC-Z

RAGTOP FEVER

and Aston-Martin Volante. Obviously, it's not fair to compare a \$15,000 Renault to a \$28,000 Saab, nor a 2-liter Sunbird to an IROC-Z. So this is not a comparative ranking of the new convertibles. It's our impressions after a week driving around California. Top down. Shades on.

Chevrolet Camaro IROC-Z

In Southern California, a Z-28 won't get you a second glance on the freeway, let alone a date for the prom. But an IROC-Z convertible—that's different. Our bright red Camaro, complete with Ferrari-like 5-spoke alloy wheels and



wide Eagle gatorbacks, was everybody's favorite, including Valley Girls and their moms.

Cutting the top off gives the Camaro a surprisingly different look—more rounded, more modern. Underneath the sheetmetal, it's still all Z-28, which is quite a compliment. The top is a stressed panel on unit-body cars, so maintaining structural integrity is tough. There's just a hint of cowl shake over bumps. Otherwise, this convertible feels as stiff as Camaro coupes we've tested.

It's also just as fast. Our test car was a tired-out prototype, yet it still managed .85 G on the skidpad, 60 mph through the slalom, and sub-15-sec. quarter-miles at L.A. County Raceway in Palmdale.

If this were our IROC-Z convertible, we'd replace the



uncomfortable front bucket seats with a pair of Recaros and recover the chintzy interior to match. The Camaro's striped cloth and plastic don't reflect its \$21,000 price tag. The IROC-Z works great at the track, but it's all over the place on a bumpy road. Put the top down and boot the gas a couple of times, though, and these niggling complaints disappear.

This Camaro is more comfortable than its sibling Corvette convertible, half the price and offers not only the same status points, but also the same high-strung feel of a thoroughbred waiting to be let loose.

Chevrolet Cavalier RS

Cutting the top off is the best thing GM has ever done for the J-car. Our metallic-gray convertible was tasteful and conservative in this group of bright red screamers, with only its pretty "snowflake" alloy wheels to add a little jazz. The matching gray cloth interior might have been cut by Halston—pretty and distinctive.

At \$17,000, it's not cheap. Even when fitted with a 2.8-liter V6, it's no ball of fire; the only slower convertibles are Pontiac's Sunbird and the Renault GTA—both have 2-liter engines. The Cavalier was last or near-last in all our track testing, in spite of being fitted with heavy-duty RS equipment. This is a *boulevardier*, not a racer.

And that's okay. The fact that the top goes down excuses a multitude of sins. As a convertible, the Cavalier works just fine. The power top is a model of easy operation, and the

Produced by PM Auto Dept.; Text by Rich Taylor, Photos by Rich Cox and David Bush



CHRYSLER LE BARON



RENAULT GTA

chassis is stiff enough to eliminate torsional twisting and cowl shake on everything but the worst roads.

The Cavalier—at least in convertible form—seems like a perfectly nice little car. It's something you could drive around without counting the days until the lease runs out.

Chrysler LeBaron

The new Chrysler-only convertible—the only convertible on the market engineered from the ground up and *not* built from a cut-down coupe—is an absolute knock-out. This is the best-looking Chrysler product in decades—smooth, contemporary and thoughtfully integrated from bow to stern.

Our test LeBaron was the full-tilt version, and still it costs only \$18,000 complete with turbocharger, electronic dashboard, leather interior and Eagle GTs.

Compared to the last Shelby Charger we tested—which has the same engine in a lighter Omni-derived chassis—the LeBaron is, as you'd expect, slightly slower and less agile in every test, but only slightly. It's one of the better performers in this group. And remarkably enough, that svelte derriere hides more trunk space than many family sedans.

The LeBaron's wonderful exterior styling isn't matched by the interior. The electronic instruments are hard to read. The bucket seats have poor support, the steering wheel is at an odd angle, and the combination of high window sills and low seats results in a claustrophobic feeling for driver and passengers alike, especially with the top up. The extra-long doors are heavy and hard for smaller people to close.

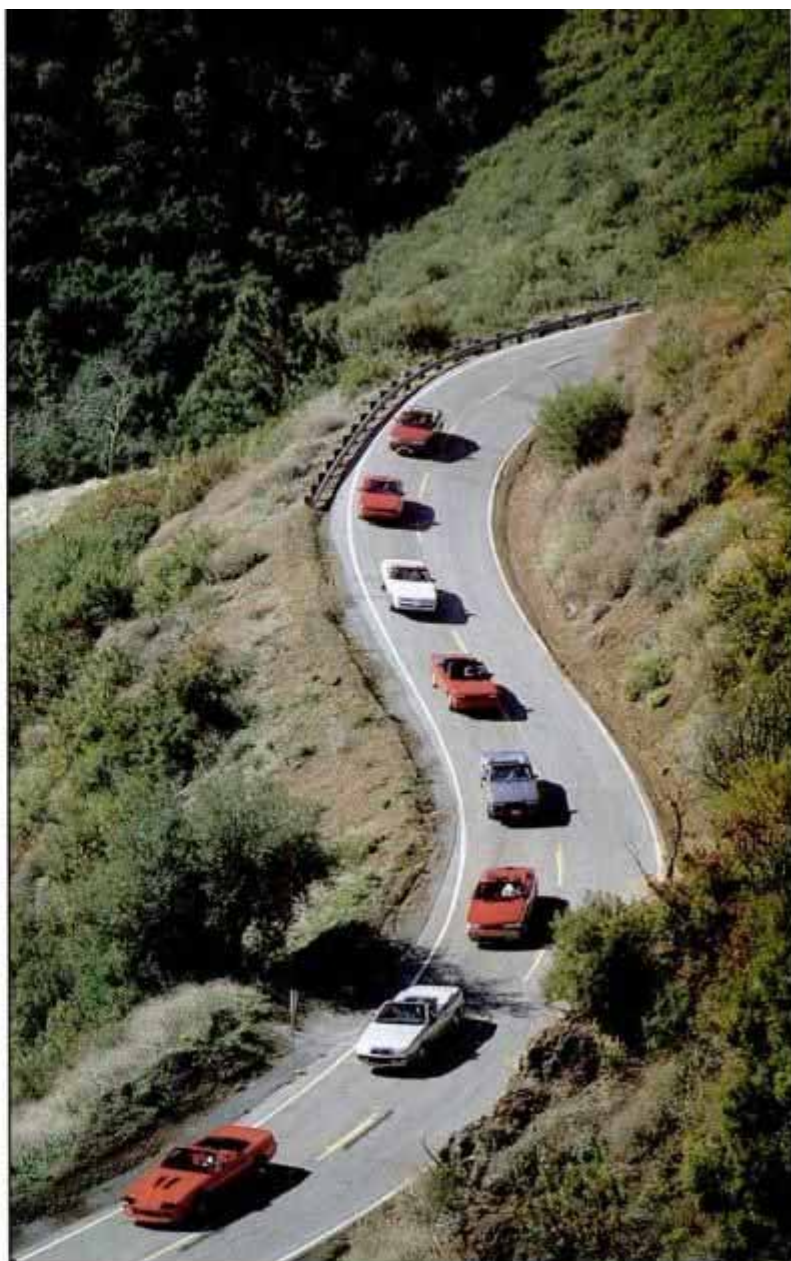
All in all, however, the LeBaron is terrific. It really does look and feel like a luxury car. Most passengers and passers-by overestimated the price tag by \$10,000. The LeBaron Coupe, at under \$12,000, is equally pretty and equally a bargain. Chrysler dealers probably won't be able to keep either version in stock.

Ford Mustang GT

Ford has really done a number on the Mustang GT for 1987—everything new. Whether or not it's better than before is another question. Some people thought the add-on plastic airdam and running boards were neat, others thought the look was horrible. The fake louvers over the taillights are especially controversial. Happily enough, you can still buy an unadorned Mustang convertible with all the GT underpinnings and 225-hp V8.

In any version, the Mustang V8 is the best bargain performer in America. It's directly comparable to archrival Chevrolet Camaro in every track test, but costs a whopping \$3000 to \$4000 less, model for model. It's also more fun to drive, in an athletic tail-out, sideways sort of way. It can be a handful at the limit—the Camaro is more stable and easier to drive fast—but at saner speeds, the Mustang GT is a *ball*.

The Mustang is the most popular convertible in the country, Suzuki and Jeep aside. Ford sells more than 20,000 a year. It's also been in production longer than any of its competitors, so most of the glitches have been worked out. There are things wrong—the seats are uncomfortable, the power steering too light, the convertible chassis not rigid



enough—but for the same price as a Cavalier or Celica, the Mustang GT offers the performance of a Porsche.

Pontiac Sunbird GE

The Sunbird is Pontiac's version of the J-car, basically identical to Chevy's Cavalier. The \$1400 difference between the two cars in our test essentially pays for a V6 and RS trim—and that accounts for the slightly faster acceleration of the Cavalier. Interestingly, the Sunbird was significantly better in our handling tests. Pontiac has obviously done a more thorough job of matching tires and suspensions.

Otherwise, there's little to choose between the two cars. The Chevy has a plainer grille and taillight treatment, while the interiors are essentially identical. The Sunbird is available with a turbocharged 2-liter rated at 165 hp—35 hp more than Chevy's V6—which would have made our test cars more equal in performance and price. In actual fact, the standard fuel-injected, 96-hp 2-liter is probably the smartest choice and more in keeping with the economy car nature of the Cavalier/Sunbird.

The convertible conversion adds \$3000 to \$4000 to the price of all these cars, compared to the equivalent coupe. Somehow, that price hike is more easily swallowed on a Camaro or Mustang than it is on a J-car. Like the convertible Cavalier, this is a pleasant little car, but there are a lot of much fancier cars you can buy for \$16,000, even if their tops don't retract. If you want an inexpensive convertible, dollar-for-dollar a Mustang or LeBaron is a much better buy.

RAGTOP FEVER

Renault Alliance GTA

Renault's GTA package is really excellent, transforming the bland Alliance econobox into a veritable Pocket Rocket. Low-profile Michelin tires and a stiffish suspension are responsible for the GTA's excellent slalom and skidpad figures. And while the 95-hp 2-liter was only an eyeblink faster than the last-place Sunbird in acceleration, the GTA feels much faster thanks to a raspy exhaust, easy-revving engine and torque-induced steering twitchiness—all adding up to a pleasing driver's car.

Cutting the top off emphasizes the brick-like silhouette,



SAAB 900
TURBO

which AMC stylists have successfully softened with add-on rocker moldings, airdam and spoiler. Nobody is going to mistake a GTA convertible for a racing car, but it's an attractive and sporty-looking package.

Renault's unrelenting Frenchness is evident in the interior's bizarre controls and ergonomics. The front bucket seats are quite comfortable, but the nearly horizontal steering wheel requires an upright driving position that grows tiresome after awhile. The electric window and mirror switches can't be found without the owner's manual, while the unmarked stalks flanking the steering wheel are impossible



TOYOTA
CELICA GT

to decipher. We like the GTA convertible. It's cute, fun and economical. At \$15,000, it's hardly a bargain. But the car itself has a winning personality, and certainly in Europe, Renault is a viable nameplate.

Saab 900 Turbo

It's interesting how cutting the top off dramatically improves so many cars. The Saab 900 Turbo is positively transformed by being carved into a convertible.

Compared to the 900 hatchback, the 900 convertible's long nose seems unobtrusive when balanced by a rear deck, and the topless body becomes beautifully long and elegant. Even the curious addition of a spoiler wrapping around the cockpit lip doesn't spoil the new look. Pump jockeys more attuned to a 396 Chevelle admired the Saab's fabulous paint job, flawless leather interior and hot turbocharged engine.

The Saab was third fastest in acceleration behind the two V8s, second in braking, third through the slalom, and only mediocre on the skidpad. That skidpad performance is typical of European cars, in our experience. Recent American cars can post .80-plus G cornering figures, using Eagle gatorbacks and a stiff suspension—a suspension that's often too stiff for everyday driving.

European performance cars, like the Saab, are comparatively mediocre at the track, but much more capable in the



CHEVROLET CAMARO IROC-Z	CHEVROLET CAVALIER RS	CHRYSLER LEBARON	FORD MUSTANG GT
Base price: \$17,632	Base price: \$13,816	Base price: \$14,000	Base price: \$16,226
Price as tested: \$21,017	Price as tested: \$17,208	Price as tested: \$18,000	Price as tested: \$17,673
Engine: 215-hp OHV 5.0-liter V8	Engine: 130-hp OHV 2.8-liter V6	Engine: 146-hp SOHC 2.2-liter Inline-4 Turbo	Engine: 225-hp OHV 5.0-liter V8
Transmission: 4-speed automatic	Transmission: 3-speed automatic	Transmission: 5-speed manual	Transmission: 5-speed manual
Wheelbase: 101.0	Wheelbase: 101.2	Wheelbase: 100.3	Wheelbase: 100.2
Length: 192.0	Length: 174.5	Length: 184.9	Length: 180.8
Weight: 3400	Weight: 2700	Weight: 2700	Weight: 3250
EPA city mpg: 16	EPA city mpg: 19	EPA city mpg: 22	EPA city mpg: 19
Quarter-mile: 14.813 @ 94.30	Quarter-mile: 17.007 @ 79.93	Quarter-mile: 16.705 @ 82.19	Quarter-mile: 15.000 @ 93.80
Braking: 131.6	Braking: 135.3	Braking: 137.6	Braking: 116.8
Slalom ¹ : 60.52/Skidpad ² : .85/.84	Slalom ¹ : 57.72/Skidpad ² : .73/.75	Slalom ¹ : 57.33/Skidpad ² : .76/.80	Slalom ¹ : 57.53/Skidpad ² : .78/.81
Trunk space ³ : 4	Trunk space ³ : 12	Trunk space ³ : 15	Trunk space ³ : 9
Interior space index ⁴ : 130.2	Interior space index ⁴ : 117.54	Interior space index ⁴ : 139.50	Interior space index ⁴ : 131.66

1. Best speed while weaving through seven cones placed 100 ft. apart; the higher the speed, the better the transient handling.
2. G-forces generated during steady-state cornering around a 200-ft.-dia. circle; cw=clockwise, ccw=counterclockwise.



FORD MUSTANG GT

real world of potholes and frost heaves. The Saab would never lower itself to be something so plebian as "fun to drive," but it's awesomely competent on a canyon road—not to mention a worn-out freeway sliced with rain grooves.

Nothing much has changed on the Saab interior for years. The ignition key is still in the console, the styling is still offbeat, but the ergonomics are excellent once you remember where everything is. The seating position is superb. Unlike the Camaro or Mustang, which are obviously aimed at drivers who never travel more than 45 minutes from home, the Saab's interior is comfortable for the long haul.

All of the convertibles we tried have some compromise in the way the top folds and stores. But only the Saab's is absurd. All the others have soft vinyl boots that snap on in various ways, with varying degrees of difficulty. The Saab, on the other hand, has a 3-piece rigid plastic boot. The center is held in place by straps inserted beneath the lip of the trunk lid; the side pieces must be perfectly aligned to snap into place, then they shift and blow off at the first corner anyway. When the top is up, you have to store this bulky gizmo in the trunk. All in all, it's an uncharacteristically poor design for a

(Please turn to page 123)



PONTIAC SUNBIRD SE	RENAULT ALLIANCE GTA	SAAB 900 TURBO	TOYOTA CELICA
Base price: \$14,169	Base price: \$12,899	Base price: \$27,115	Base price: \$16,798
Price as tested: \$15,830	Price as tested: \$15,284	Price as tested: \$27,582	Price as tested: \$19,183
Engine: 96-hp SOHC 2.0-liter In-line-4	Engine: 95-hp OHV 2.0-liter In-line-4	Engine: 160-hp DOHC 2.0-liter In-line-4 Turbo	Engine: 115-hp DOHC 2.0-liter In-line-4
Transmission: 3-speed automatic	Transmission: 5-speed manual	Transmission: 5-speed manual	Transmission: 5-speed manual
Wheelbase: 101.2	Wheelbase: 97.8	Wheelbase: 99.1	Wheelbase: 99.4
Length: 175.7	Length: 164.0	Length: 186.6	Length: 173.6
Weight: 2700	Weight: 2300	Weight: 2900	Weight: 2700
EPA city mpg: 21	EPA city mpg: 26	EPA city mpg: 21	EPA city mpg: 25
Quarter-mile: 17.964 @ 75.40	Quarter-mile: 17.842 @ 75.88	Quarter-mile: 16.023 @ 85.20	Quarter-mile: 16.822 @ 81.68
Braking: 120.4	Braking: 125.2	Braking: 117.0	Braking: 134.4
Slalom ³ : 58.30/Skidpad ² : .78/.81	Slalom ³ : 58.38/Skidpad ² : .82/.83	Slalom ³ : 58.67/Skidpad ² : .75/.79	Slalom ³ : 58.77/Skidpad ² : .76/.75
Trunk space ³ : 10	Trunk space ³ : 8	Trunk space ³ : 9	Trunk space ³ : 9
Interior space index ⁴ : 119.04	Interior space index ⁴ : 113.78	Interior space index ⁴ : 122.56	Interior space index ⁴ : 112.53

3. The number of standard-size grocery bags that will stand upright (1-in. crush space permitted) in trunk with rear seats up.

4. Front-seat width × headroom × legroom + rear-seat width × headroom × legroom + 1000.



DETROIT SNEAK PREVIEW

Detroit's automakers have a lot of offerings for the last two model years in the decade. Completely redesigned cars from General Motors, Ford and Chrysler will appear in the middle- and upper-price classes. American Motors will begin production of a flagship sedan to compete against near-luxury models from both domestic and import competitors.

Biggest changes will come from GM, where completely new mid-range cou-

Our intelligence agent in Motown spies the future.

BY JIM DUNNE
Detroit Editor

pes—Grand Prix, Cutlass Supreme and Regal—will replace the current 10-year-old designs and the twice-delayed Reatta sports coupe may finally get on the road. But GM competitors are pre-

paring all-new designs of their own. Ford will have its slick aero-shaped Lincoln Continental to lure well-heeled customers to its showrooms, while Chrysler will introduce a new line of luxury sedans to replace the Fifth Avenue, Gran Fury and Diplomat.

In addition to the compact Medallion imported from France, AMC will offer a Canadian-built Premier 4-door mid-size model to sell against Celebrity, Taurus and LeBaron.



Lincoln Continental

Ford will take its successful Taurus/Sable plan and extend it to the smaller luxury sedan in the Lincoln lineup. The Continental will truly be all new for 1988. Look for front-wheel drive, a V6 engine, independent rear suspension and an aerodynamic shape. The car will compete against Cadillac's Seville. Prices will be in the upper 20s if they don't breach the \$30,000 barrier.

Improvements for the buyer, aside

from more room inside, will be better traction from the front-drive, slightly better fuel economy from a 3.8-liter V6, and a luxury-car appearance that is almost as distinctive as Lincoln's Town Car. Wheelbase will be a hair longer at 109 in. Look for air springs to be carried over from today's Continental.

Buick Reatta

A first for Buick, this 2-seat luxury coupe will make its appearance in show-

rooms during the 1988 model year, probably next spring. Reports indicate that the price will be in the high \$20,000 range, which makes the Reatta a competitor with many of the more expensive sports cars. But look for luxury to take precedence over performance.

Chassis details include a 3.8-liter V6 engine driving through the front wheels, independent rear suspension, adjustable ride (firm or soft) and anti-

(Please turn to page 124)

BLAST FROM

START FINISH

We race Stirling Moss at 160 mph in 30-year-old race cars as vintage racing sweeps the nation.

BY RICH TAYLOR, Contributing Editor
Photo by Art Eastman

It's one lap from the end, and all I can do is watch as the small red car grows larger in my mirrors. In true Sebring fashion, my brakes have disappeared completely. I wrestle the big Kellison through Turn Three, brutally downshifting into Third, then Second, in order to get through the Esses on the ragged edge of control and good sense.

He catches me as we accelerate side by side under the Camel Bridge, passes on the outside and tucks in front as I shift into Fourth again. By the time I get back down to Second for the hairpin, still brakeless, Stirling Moss in the Birdcage Maserati has opened up a 100-yard gap. He's chasing Peter Sachs in a Ferrari Testa Rossa, but even he must know it's hopeless. As

for me, I'm perfectly content to finish third behind them, my first time at Sebring, in a brand-new car.

Wait a minute. Stirling Moss? Birdcage Maserati? Ferrari Testa Rossa? Sebring? Brand-new Kellison? What kind of race is this?

It's vintage road racing, about as neat a time warp as you're likely to find. All over the world, otherwise sane car enthusiasts are resurrecting old race cars—20, 30, 50 years old—and racing them, wheel-to-wheel, as fast as they will go which, in the case of something like a Maserati Tipo 60 or my

THE PAST



The author at speed
in his 1959 Kellison J-4R
at the Bahama Grand Prix.

Kellison J-4R, is
very fast indeed—on
the far side of 160 mph.

There are more than 60 major vintage events in America each year, in every part of the country. The most important take place at: Sebring, Florida, in March; Elkhart Lake, Wisconsin, in July; Laguna Seca, California, in August; Lime Rock, Connecticut, in September; Palm Springs, California, in November; and Freeport, the Bahamas, during the first week of December. You can expect to

see about 200 cars at each event, along with such famous drivers as Juan Manuel Fangio, Phil Hill, Carroll Shelby, Dan Gurney and Stirling Moss.

Each weekend, there usually will be eight to 12 classes, divided into specific areas such as "Sports/racers, 1955-1959" or "Production-based sports cars, 1955-1962." Before you rush out and restore just any old sports car, you'd better make sure you'll be allowed to race it with the vintage group in your part of the country (see *Where To Sign Up* on the following page).

The general rule is that your car must be restored as it was the year it was manufactured. Adding American Racing Torque Thrust D wheels to your '63 Corvette is okay; fitting them with low-profile racing slicks is not.



Chevy-powered '67 Cheetah coupe (left) speeds down Lime Rock straight. Stirling Moss drove a '57 Aston-Martin DBR2 in the Bahamas.

Most racing groups allow modern radial street tires, shaved for racing, as long as you use 70-series or above. The requirements for drivers are less strict than for "real" racing. Typically, you must attend an approved racing school like Bob Bondurant's or Skip Barber's. If you already have an SCCA or IMSA license, you're also in. Safety equipment follows SCCA specifications for the most part—a rollbar, fire extinguisher, electrical cut-off switch and fuel cell for the car; Nomex suit, gloves, socks and a Snell 1980-approved helmet for you.

By far, the least expensive way to go vintage racing is in the SVRA's Groups 1 or 3. Inexpensive choices in these classes include Mini Cooper fwd sedans, Austin-Healey Sprites, Triumph TR-3s, MGAs, Alfa Juniors, Fiat-Abarths and many other "beginner"

sports cars. You should be able to put any one of them on the track for well under \$10,000.

Like any other type of racing, the faster you want to go, the more you need to spend. Mercedes enthusiast Joel Finn is said to have more than a million dollars in his late-'30s factory Grand Prix racer, and it's not uncommon to see collector cars in the \$500,000 range out there at top speed. Can-Am, Formula One, and Trans-Am cars from the 1966-1972 era are just coming into popularity, and consequently getting very expensive.

I literally inherited the Kellison coupe from the late Don Rodimer, one of the founders of the Sports Car Club of America, through the good offices of our mutual friend Chuck Kirkbride. The Kellison was one of several old race cars Don had stashed in barns all over

New Jersey. According to advertisements in old car magazines, in 1959 Kellison Engineering & Mfg. Co. of Folsom, California, would sell you a "complete, ready-to-drive production sports car—light, strong, sleek and surpassing Europe's most distinguished designs." This hand-build delight cost \$6700 in Eisenhower dollars.

By comparison, a new Corvette was only \$3875 and you could buy a full-size Ford or Chevy for under \$2500. On the other hand, a Ferrari Testa Rossa or Maserati Tipo 60 with comparable performance was \$12,000 to \$15,000.

The Kellison is typical of "big bore" American V8 sports/racing cars of the late '50s. The most famous were Lance Reventlow's Chevy-powered Scarabs and Max Balchowsky's Buick-engined Old Yaller, but forgotten marques, like Bocar, Lister-Chevrolet, Devin SS, Kurtis and dozens of others, built cars to challenge the all-conquering Ferraris, Maseratis, Jaguars and Porsches. The Shelby Cobra and Bill Thomas's Cheetah were the last holdovers, in the mid '60s.

As you might expect from a car that sat untouched in a barn for 25 years, our Kellison J-4R was a mess.

I towed it directly to Heads-Up Performance in Edison, New Jersey, where Wayne Celco and Timothy Shepherd duplicated the rusted-out frame with all-new tubing and remounted the fiberglass body.

They also rebuilt the engine, transmission and suspension, using primarily Moroso parts. Koni supplied the shock absorbers, VDO the white-on-black gauges. The tires are 235/70VR-15 Goodyear Eagle GTs on stock 15 x 7-in. Chevrolet steel wheels. Wayne and Shep also added a rollcage, fuel cell and other modern safety equipment required by the sanctioning group.

Augie Pabst's old Chevy-Scarab restored with its original Team Meister Brau colors.





Over a million dollars' worth of nostalgia at speed: a '58 Ferrari 250 Testa Rossa leads a '55 D-Type Jaguar at Laguna Seca, California.

To preserve that old-time look, we fit Offenhauser cast aluminum valve covers and authentic '50s speed equipment throughout the engine compartment. About the only late-model part is a stock GM alternator. Even the fiberglass racing seat is a "new-old stock" (NOS) part we found in the attic at Heads-Up and reupholstered.

Joey Welfel of Bodies By Hollywood in Upper Nyack, New York, restored the body and interior, using an acrylic enamel with hardener for the Corvette Bright White paint. Finally, racing tuner Greg Colletti of Controlled Performance in Roselle, New Jersey, went through the entire car, detailing it into an authentic world-class sports/racing car, circa 1959. The total cost was just about \$20,000—dirt cheap for a car with this quality of construction and performance.

After the usual last-minute thrash, my wife Jean and I loaded the nearly finished Kellison onto a new 4-wheel trailer custom-built by D&D Trailers of Trenton, New Jersey, hooked it up to PM's long-term Mazda B2000 pickup, threw a few spares and tools in the back, and headed for Florida.

We had a ball. The primary vintage racing group on the East Coast is the Sportscar Vintage Racing Assn. (SVRA) run by a young car nut named Ford Heacock and his wife, Kate. They cleverly arranged an all-vintage weekend at Moroso Motorsports Park in West Palm Beach the week before Sebring, so we could all get our cars sorted out—at least a little.

Then it rained. And it rained. A Kellison J-4R has no side windows and no windshield wipers—the windshield is scratchable plexiglass pop-riveted in place—so I spent the entire weekend delicately trundling around, getting soaking wet, breaking in the engine, and generally learning just what a beast I'd inherited. I wasn't racing, I was touring around a race track in the rain in an old car—cold, wet and too scared to be miserable.

Sebring was very different. The vintage race is half-time entertainment for



Max Balchowsky's Buick-powered mongrel Old Yaller in better-than-new condition.

Where To Sign Up

The major vintage racing groups are SVRA, Box 2896, Lakeland, FL 33806 (813-686-3104); HMSA, Box 30628, Santa Barbara, CA 93105 (805-966-9151); Vintage Racing, Box 7000-728, Redondo Beach, CA 90277 (213) 540-4498; VSCCA, 116 Long Ridge Rd., Bedford, NY 10506 (914-234-6494); and Chicago Historic, 825 West Erie St., Chicago, IL 60622 (312-829-7066). SVRA also publishes a quarterly magazine called *Vintage Motorsport*, with schedules and race reports from every vintage racing group.—R.T.

IMSA's 12 Hours of Sebring. So, instead of separate races for each of SVRA's eight classes, the older cars

are all lumped together into one "vintage" group, while the newer cars are called "historic." This gives a starting grid of something like 80 cars.

Just like an old-time Sebring endurance race, there's a tremendous performance spread between the 3-minute, 9-second laps Stirling Moss and Peter Sachs are turning and the 4:40s of the tiny Sprites, Fiat-Abarths, Panhards and Alfas. Even in our short 5-lap race, the fast cars pass the back-markers twice. I spend all my time threading through traffic, watching out for slower cars in front, checking the mirrors for faster cars behind.

The amazing thing is how *real* it all is. The lightweight Lotus XIs and Porsche RSKs dart around me in the corners, then my big V8 blows by them on the straights. The international stars—Moss, Augie Pabst, Murray Kempton Smith—drift through the corners so smoothly it makes my heart ache. The once-a-year amateurs bobble on—and sometimes off—the track, just as they did in the old days.

I'm not pretending to be racing against Stirling Moss in a Tipo 60, I am racing Stirling Moss. I'm not reading about Sebring in 1959, I'm *living* the Golden Age of American racing. Vintage racing is as real as you can get and still be driving antique cars.

I mean, when was the last time Augie Pabst came over to compliment you on your car and bench race about Scarabs for a while?

FM



Austin-Healey Sprite makes an excellent entry-level vintage racer for \$3000-plus race prep.

PM COMPARISON TEST

STACKED

Performance and conviviality converge in a 5-way deck boat showdown.



BY FRANK SARGEANT; Photos by Skip Gandy

Want to haul a pair of slalom skiers? No sweat. Blast out to that tree-rimmed island for a picnic? Hold on tight. Ferry skads of second cousins to an overnight beachhead? The line forms here.

All you need to accomplish these diverse objectives is a modern deck boat, the performance party boat that's sweeping Midwestern lakes and rivers. They're actually derived from the more sedate pontoon boats that populate most inland waters—with a major twist.

They're designed with comfortable padded seating in an amidships cockpit and in a bowrider area forward, along with a plush sunpad that doubles as an engine hatch. They've got endless storage for such indispensables as skis and coolers. They come with pop-up dinner tables to make mealtime more civilized. Some even come with sophisticated stereo FM radio/tape deck combos.

All of them mix the good times with hard-charging performance—enhanced by modified cathedral hulls and power options up to the

DECKS



Pleasure platforms from Four Winns (left) and Harris (right) combine 260-hp get-up-and-go with comfortable seating for 12. Beamy cathedral hull is the secret.

rip-snortin' OMC Cobra 5 liter, the stern-drive we chose for a recent head-to-head comparison conducted at the Stuart Marine Center in Stuart, Florida. The 230-horse V8s rocketed our party-decks up to speeds approaching 50 mph, yet ran so quietly and smoothly that normal conversation was never a problem in the cockpit.

So who needs a boat that looks like a tram and runs like a Cigarette? Lots of people—the boats offer tremendous versatility, especially for the family man. There's enough accelera-

tion and speed for serious slalom skiing, adequate rough-water performance to take on both big lakes and coastal bays, plenty of space to wet a line if fishing is your thing, transom swim platforms to assist in taking a dip or scuba diving, and just acres of space to stretch out and soak up the sun.

The five test boats came from Harris/Kayot, Four Winns, Godfrey Marine, Murray Chris Craft and Sunchaser. There was a lot to like in every model, but after several days of tests, the PM team selected a winner based on

STACKED DECKS

obvious advantages in performance and comfort. Here are our results by the numbers:

Harris FloteDek 2000 LSI

With top scores in acceleration and efficiency at cruise, the Harris is an easy boat for the performance-minded skipper to like. Add the tremendous eye appeal of the beautifully finished interior upholstery, the high-tech look of the command post and the luxurious feel of the seats and sun pads, and it was hard not to make the FloteDek our top pick. The boat has full windshields on both consoles, which kept spray and wind off driver and copilot during rough, open water runs on the Indian River. The padded, sports car-style wheel is easy to grip even in locked-over high-speed turns, and the entire steering system feels exceptionally solid and smooth. The boat tracks well, and because of a significant freeboard, gave a more secure feeling than most of the competition during high-speed maneuvers through a series of 90° turns on the narrow St. Lucie River.

Well-positioned analog gauges are easy to read with both hands on the wheel, and the digital-look faces give the command post a high-tech appearance that's clean and striking. The tilting steering wheel allows adjustment for any size skipper, but interferes with the stereo controls in the full up position. All switches are on the dash, with fuses directly under them—a blessing for those who hate nose diving under the console when there's a short.

The sun pads fore and aft provide lots of lounging space, and the raised lip on the after side of the stern pad should offer security against rolling overboard by sleepy or juvenile loungers. The boat has an exceptionally large ski-tow eye,

mounted on a raised pedestal at the transom for easy access. The broad plastic rub rail is well located to prevent scratches on the gel coat. The only other functional problem experienced was in opening the teak cover over the ski-stowage area—wet, swollen wood made the fit so tight that considerable prying with appropriate tools and words were necessary to release it.

Four Winns 200 Candia

Because it was the deepest of the deckboats tested and had the cleanest hull form, the Four Winns was a natural favorite with the test crew. However, it finished last—not by much, but still last—in each of the performance categories. Despite top ranking in rough water ride, stowage space, seating space and lounging area, the boat had to be dropped to the No. 2 spot on weak performance.

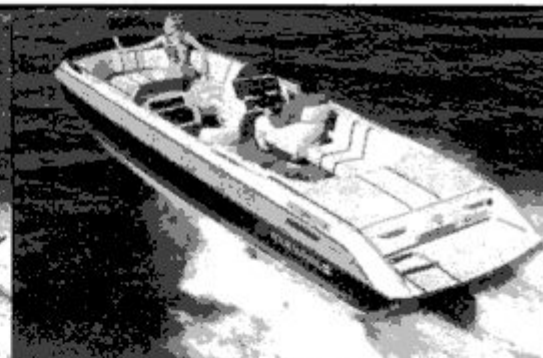
But the boat has an exceptionally solid feel, thanks in part to the five 5-stringer system stiffening the hull, and to the extreme 19° deadrise, which also accounted for the easiest rough-water ride of any of the contenders.

The Candia has about the same LOA and beam as the Harris, yet has actual seating space for 15 and is rated for 13 adults. The Four Winns has considerably more deck space than the other boats tested, and makes a quantum leap when it comes to storage space—more underseat and underfloor storage than in any other model, plus two voluminous boxes on either side of the engine in areas that are totally filled by wiring and accessories in the other boats. The sun decks and swim platform were also the largest of any boat tested.

There is also an evident attention to design details that we particularly liked. The engine hatch, for example, has a positive lock in the center of the boat, easy to get to and smooth to open—something that could not be said of any

Test Parameters

Each deckboat was equipped with a 230-hp OMC Cobra V8 sterndrive turning a 14½ x 19 SST prop. Prop selection was performed by an OMC tech team in accordance with factory recommendations. Top-end and acceleration tests were performed with two adults aboard using a Decatur radar gun and Heuer digital stopwatch. Efficiency at cruise was established with four adults aboard using the radar gun and an OMC Quartach tachometer.



OVERALL RANKING/MAKE/MODEL	1. HARRIS FLOTEDEK 2000 LSI	2. FOUR WINNS 200 CANDIA
LOA/Beam/Weight/Fuel Capacity	20'6"/96"/2750 lbs./25 gal.	20'0"/96"/2716 lbs./27 gal.
Deck Area (sq. ft.)	30.14/Easy access to cockpit from dock welcomed	34.02/Easy passage fore and aft
Sun Pad: Forward-Aft (sq. ft.)	21.2-16.40/Room for two aft, but still crowded	25.7-16.71/Most spacious platforms offered
Stowage: Total under seat, gunwales (cu. ft.)	19.68/Adequate, but not a strong point	25.87/Clearly superior in this category
Stowage: Under cockpit sole (cu. ft.)	5.25/Built with skiers in mind	4.75/Acceptable, but could use more space here
Seating: Actual-rated	10-12/Extremely spacious despite rating question	15-13/Honest seating; great wrap-around bench aft
Hull Construction: (see key)	4 LY CR/2 LY WR/FG Wd SS/Inj. PU	3 LY CR/2 LY WR/FG Wd SS/Inj. PU
Top-end: Speed/Ranking	45.75/3 (tie)/Amenities cause slight speed loss.	45.50/5/Won't win any prizes
Acceleration 0-30: Time/Ranking	6.35/1/Winner by a whisker	7.59/5/Sufficient for partying, but skiing, too?
Efficiency: MPH at 3000 rpm/Ranking	32.5/1/Slightly faster with less effort	31.1/5/Obviously sluggish
Performance Course: Time/Ranking	1.06.67/4/Slow but comfortable handling	1.08.77/5/Extremely slow, but still solid
Fit-and-Finish: Ranking	1/Striking upholstery and glass work	2/Detailing excellent throughout
Price with OMC Cobra 230 test engine	\$22,388	\$19,400

Hull Construction Key: HLU=Hand Layout; LY=Layer; M=Mat; CR=Chopped Roving; WR=Woven Roving; FM=Fabmat, combination mat and roving; SS=Stringer system; Wd=Wood; FG=Fiberglass Reinforcement; Inj.=Injected; Spr.=Sprayed; PU=Polyurethane Foam Flotation



Superb cockpit configuration. Easy access to entertainment stack on left. Tilt-wheel greatly appreciated.



Analog gauges give digital impression. Trim gauge failure a disappointment. Comfortable throttle, switch access.

WHAT MAKES A DECK BOAT SPECIAL?



other boat in the test. The Bimini top fits neatly under the hatch, and even the support poles drop out of sight.

The high console windshields, super-deep freeboard and well-fitted bucket seats gave a feeling of security even at maximum speed through the performance course. Steering is very positive and smooth, and the padded sport wheel is easy to grip, even with wet hands. The dash has digital-look analog gauges, all easy to read from the driver's seat. The

seats are controlled with positive lock ratchet devices, much more dependable than the friction locks on some models.

Problems were minimal, and included a side bolster that interfered with throttle operation in reverse—easily cured by mounting the control on a shim—and the fact that four of the six drink holders aboard were mounted in side pockets where it was just about impossible to fit a 12-ounce can without spilling. *(Please turn to page 128)*



3. GODFREY HURRICANE 196	4. CHRIS CRAFT VIKING 190	5. SUNCHASER 1908 DC
18'10"/90.5"/2825 lbs./24 gal.	18'6"/92"/2519 lbs./21 gal.	18'6"/93"/2700 lbs./20 gal.
31.02/Passable, but cramped	30.57/No change from Hurricane	29.7/Meager, still permits easy passage fore, aft
21.0-18.86/Small, but comfortable for one	23.20-17.07/Up with the big boys in forward area	20.08-17.19/On the tight side
11.54/Suffers badly in the storage category	23.83/Surprisingly roomy given small overall size	19.72/Not bad; on a par with the Flotetek
4.62/Minimal, but still adequate	4.39/Suffers slightly here	0/Absence of ski stowage a clear drawback
12-12/An even dozen still gets a little crowded	10+-9/Honest capacity	10+-10/Still a little crowded
3 LY M/2 LY WR/FG Wd SS/Inj. PU	4 LY M/FG Wd SS/Inj. PU	2 LY WR/2 LY CR/FG Wd SS/Inj. PU
45.73/3 (tie)/Brisk performer, a standout	47.25/1/High speed an obvious function of all-up wt.	47.0/2/The boat's obvious strong suit
6.49/2/Superb for skiing and over long haul	6.60/3/Should have done a little better here	7.28/4/Hole shot suffers, however
32.3/3/Consistent with competition	32.45/2/Achieves speed, smooth running at cruise	31.4/4/Extremely sluggish
1.04.41/1/Magnificent; tight sportscar feel	1.04.85/2/Slightly off the pace but still solid	1.06.80/3/Steering loose; no confidence in turns
3/Nicely detailed; good glasswork	4/Cost cuts show in interior	5/Rough glass work and detailing
\$18,010	\$15,230	\$16,000



Only deckboat with tight, padded steering and high-performance "feel." Throttle, wheel, gauges in perfect balance.



Metallic wheel a definite drawback in wet, slippery conditions. Wheel also obscures gauges, blocks switch access.



We'd prefer to have mph and tach closer together to wring out last available rpm. Otherwise, well-balanced layout.

COVER STORY

NEW AGE RVs

Today's motorhomes shed the clunker image with computer-generated aerodynamic styling, molded construction and more efficient chassis design.

BY BOB LIVINGSTON



The engine grabs your attention: a turbo-charged BMW diesel rated at 115 horsepower, neatly tucked into the rear of the vehicle. A DeDion suspension and gas shocks control the rear wheels while the front suspension utilizes independent A-arms, also with gas shocks. The transaxle includes a 5-speed Renault transmission, which gives the vehicle good gear versatility. Drag coefficient is only 0.295, even though the vehicle has enough stand-up space for a shower.

A shower?

Indeed, we're talking about a motorhome—albeit a very different one. It's the Vixen, one of several new motorhomes that form the leading edge of technology in the recreational vehicle (RV) field. The Vixen is different in that its designers, former auto company engineers and

executives, are trying to entice the yuppie crowd into the home-on-wheels lifestyle.

Traditionally, motorhomes have never been fancied by car buffs who want real driving machines. Aluminum-clad boxes on wheels are still around for those who want them, but the industry now offers a wide variety of shapes, styles and accommodations. The more sophisticated of today's motorhomes feature aerodynamic styling, advanced suspensions, high-tech computer-controlled appliances and improved fuel economy.

Leading the way into future motorhome design and function are manufacturers who integrate science and technology into coaches already packed with amenities and luxury. While the trend seems to be shifting to



The Chevrolet Astro Van forms the aerodynamic nose and chassis system for Allegro's Class C motorhome, far left. Aboard Eldorado's new Starfire, center, Ford's new specially designed motorhome chassis permits spacious interior and radical exterior styling. Winnebago, right, bids adieu to traditional corrugated aluminum in the Itasca Windcruiser. Steel underbody and molded synthetic body panels highlight industry trends.

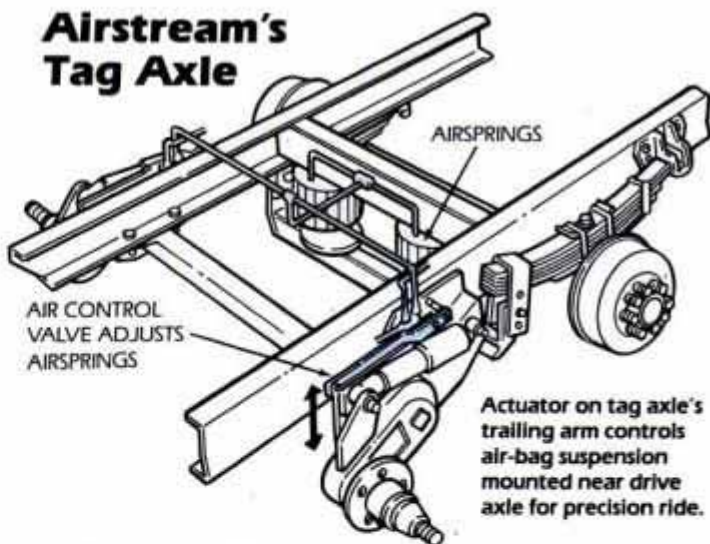
Class A coaches with wind-cheating aerodynamics and European-inspired interiors, it is actually going in two different directions.

Motorhomes with an automotive approach to styling and handling have always attracted a more spirited crowd. Other potential buyers, who gravitate to plush interiors with ample storage, appear to consider exterior styling secondary. Many RVers are certainly ready for sleek motorhomes with high-tech interiors and drivetrains, but at the same time, others find high-profile rigs featuring enormous storage capacity and maximum length genuinely appealing.

Vixen and Eldorado are the leaders in innovative, automotive-type motorcoaches. The RV giants—Fleetwood, Winnebago and Coachmen—have been more modest in their aerodynamic approaches, but are also building models with curved fronts and sidewalls—aesthetically good-looking RVs that handle well.

In the opposite direction, the raised floor, basement-type motorhomes, inspired by the Fleetwood Bounder, have taken the consumer by storm. Many buyers seem to be infatuated with conventionally styled motorhomes that offer huge storage capacity. These rigs are built reasonably well and are good values. The fact is, variety in the motorhome segment of the RV industry is excellent. Buyers can choose from relatively inexpensive, fully equipped coaches suitable for large families or opulent, 40-ft. rolling mansions. The young executive who wants something fun to drive that also provides overnight accom-

Airstream's Tag Axle



modations doesn't have to settle for the traditional motorhome, and the buyer who places storage and livability higher in priority than style will find plenty of choices.

For the independent thinker, the Vixen may be just the ticket. The brainchild of former GM executives William T. Collins and Robert M. Dewey, the Vixen is new from the ground up and is called a motorhome only for lack of a better term. It features components that are uncommon in most recreational vehicles and an appearance all its own. Fully loaded, the Vixen sells for \$41,000.

Inside, the Vixen takes the Mercedes approach—somewhat Spartan by American standards, but rugged and functional. The coach sleeps two adults on a permanent double bed in the rear and two people (if they're cozy) on the front convertible dinette. An automatic roof expands headroom to 6 ft., 6 in. Vixen's approach to interior amenities uses many ideas from the boating trades and from European RV manufacturers. Propane is missing, as is an AC generator. Power is supplied by a 12VDC-to-120VAC inverter and by outside hookups. The stove runs on alcohol; a diesel-fired furnace and heat exchangers provide hot water for showering, washing dishes and for comfort heating. Some of these items can be found in high-line Class A motorhomes, but for the most part, the majority of motorhomes produced in the U.S. continue to be equipped with the more conventional RV appliances.

Starfire's niche in the market is its innovative exterior treatment and Euro-style interiors. It was the first coach engineered exclusively for the new Ford Class A chassis. The Ford chassis is an effort to compete with Chevrolet in the RV market, which has long held dominance. Its steering wheel is positioned farther forward than Chevy's, which permits a smaller, more aerodynamic shape outside—and more volume inside. A smooth, 1-piece fiberglass exterior and ultralight honeycomb insulation are key weight-reduction factors built into the Starfire's construction. Performance is brisk; driver position and handling are good. The Starfire is available in 27- or 31-ft.

Tailgate-Party Van Of Tomorrow



Sculpted front end, contour seating and integrated roof storage characterize the Plymouth dream machine. Party module, top, inserts in tailgate.

Van conversions are an important element of the recreational vehicle industry, and Plymouth hopes to get a significant leg-up on the market in the future with lessons learned from its new Grand Voyager concept mini-van. From the ground up, the Grand Voyager sports individual high-tech automotive innovations that may become commonplace in the mid-1990s. Details include four, dual Goodyear tire assemblies that eliminate the need for a spare. Further, sculpted hood, headlight and grille packages blend with the bubble windshield and raised roof. A separate roof cavity incorporates an enclosed curbside tray that slides out for gear storage. The left-side commander's seat allows easy access to switches, gear selector, cruise control and the computerized navigation terminal. A centerline jump seat up front folds back to become a CRT monitor for TV viewing. Special tables fold down for the convenience of rear-seat passengers. At party time, a special modular tailgate section is inserted aft, which contains cargo shelves, flip-up grocery bag holders, a cooler and a tiny, self-contained manual-pump sink. Plymouth says its Grand Voyager concept van will probably never see a showroom floor, but we can expect various features—particularly the seats—to appear on the production line soon.—T.C.



Streamlined dash also includes onboard navigation terminal.



Rear passengers have access to CRT for TV viewing and games.

lengths; that includes an extended nose, capped by the look-alike grille from Ford's Continental Mark VII series automobile. Price is under \$70,000.

The Euro coach also appears in Champion's "poorman's bus-conversion," the Eurocoach, which has become an instant success. The name may imply that the coach has European origins, but in fact, it's all American. In developing this coach, the company mated a John Deere Class A chassis and a steel/fiberglass structure to create a coach that gives the impression of a converted bus.

The Eurocoach is 33 ft. long, which is somewhat shorter than a bus-conversion (most are 35 to 40 ft.), but many elements make it seem longer. Huge exterior storage compartments, similar to those in Greyhound buses, are built into the sides of the coach. The base price for Champion's bus-conversion mini-clone is \$52,000.

Although Class As have dominated the motorhome field for the past few years, the mini retains special appeal. Mini motorhomes (Class Cs), have not seen much design change in recent years except in units built on the new Chevrolet Astro and GMC Safari vans. In what could be a good balance between power, size and fuel economy, a few manufacturers have cut away the Astro or Safari bodies and installed conventional RV amenities.

Establishment's Aerolite and the Allegro (pictured) are prime examples. These coaches are a generous step up from a micro-mini (based on an imported truck chassis), are considerably smaller than traditional Class Cs, and are affordable. The Aerolite, for example, sells for \$27,500 with an average amount of optional equipment. The available interior space is limited, but well-thought-out floorplans and tasteful decor have made these rigs suitable for a couple or young family.

GM's 4.3-liter V6 does a remarkable job of powering 3 tons of coach—spunky performance for a rig that averages 17 mpg. These coaches are fun to drive, and people who are too intimidated to drive large vehicles will quickly feel right at home. The downside is the limited load capacity.

Class Cs have always appealed to families because they have good sleeping facilities and are less costly than Class As. But Fleetwood, the nation's largest builder of recreational vehicles, last year introduced the Bounder, a Class

Best-Selling Bounder

Raised floor permits flexible interior design and immense storage capacity.



A that can honestly compete with a high-priced Class C. The Bounder's claim to fame is the aforementioned raised floor positioned at the same level as the driver's compartment. This unique design allows for massive storage compartments in the space between the interior and exterior floors. The process didn't do much for aesthetics. Doubters agreed that it was a great family coach, but figured it would never sell because styling was a step backward for the RV industry. At best, the coach looked awkward and hard to handle. But it sold like it was the latest fad! And handling, surprisingly, is good.

Bounder's instant success convinced other manufacturers that the raised-floor concept is here to stay. A number of companies, including Komfort, Establishment, Allegro and Winnebago, are currently producing basement-equipped coaches. The benefits are obvious: maximum storage capacity, versatile floorplans suitable for large families, exceptional visibility for passengers while traveling, and, most of all, low price. It's not uncommon to find a fully equipped 34-ft. Bounder retailing in the \$40,000 range. Bounder-type coaches may lack futuristic style and glitz, but they qualify as affordable rigs, especially desirable for first-time buyers.

The age of computerization has helped many manufacturers, especially Winnebago. The pioneer motorhome builder created the Itasca Windcruiser and Elandan Class As with extensive use of computers. These coaches and similar models by other companies such as the Fleetwood Eleganza and Eagle, are very popular. They feature curved sidewalls and aerodynamic front caps with varying degrees of windshield slant.

Windcruiser and Elandan models are built in one of the most advanced assembly plants in the world. A Detroit-type assembly line is used to create an automobile-style cab structure for the Windcruiser and Elandan models. A few years ago, Winnebago applied special emphasis to the frame by building the first independent cab cage that's later added to the chassis. The concept provides a truck-type front end for the coach where the dash, windshield, driver and passenger doors, firewall and floor are supported by a steel structure. Prior to installation, the entire cab is electrodeposition painted, which provides state-of-the-art rust protection. Currently, Winnebago manufactures the majority of the parts necessary to

(Please turn to page 130)



For the performance-minded, the BMW-powered, pop-top Vixen combines excellent fuel economy and sporty road handling with basic accommodation. Price is \$41,000.

The Art Of Motorcycle Touring

Driving a motorcycle across the country or around the globe begins with the right equipment—and lots of friends.

BY MALCOLM FORBES

Having discovered the turn on of motorcycling at the age of 48—having had a deprived childhood in that regard!—I've been trying to catch up ever since. In purchases, I'm making up the lost ground quickly—there are 40 bikes in the garage at home now, two that stay on our boat, *The Highlander*, four or five in London, and four, I think, in Morocco. And two or three at our *Chateau de Balleroy* in Normandy.

Of course, there's also a number of dirt bikes and street bikes out at the ranch in Colorado, which we keep there for summer tours.

The variety of machinery at these locations runs the full gamut of motorcycling's many choices. We've got the fully loaded touring mounts—Honda's Gold Wing and Yamaha's Venture most notable among the long distance specialists—and a mouth-watering array of Harley Davidson's finest. There's the pure sport bikes such as the Italian-built Bimotas, sport tourers personified by BMW R and K-series cycles, and even outrageous hot rods like the Yamaha V-Max.

I've also acquired a number of very limited-production machines: a pair of Kawasaki-based Vetter Mystery Ships, an Amazonas from Brazil and a Munch from Germany. There's also a pair of British Heskeths and a sprinkling of old favorites such as the Soviet bike we picked up on our tour of Russia.

More than a simple matter of conspicuous purchasing, the widely spread motorcycle supply of the Forbes fleet is just a way of saying that I don't want to ever have to be without one to ride. Sometimes it's just for pleasure with friends; other times the tours are a recess from the

Malcolm Forbes will tour East Germany by motorcycle sometime this summer.

Brimming with bikes, Malcolm Forbes's garage reflects a most unusual passion for 2-wheeling.

PM PHOTO BY HUMPHREY SUTTON





international business concerns of Forbes Inc. And there's the well-publicized Goodwill Tours, which marry two of my deepest devotions—cycling and hot-air ballooning—in order to promote friendship and understanding between the U.S. and our global neighbors.

The experience accrued in planning these excursions has taught a lot of practical lessons and a number of philosophical ones as well. Touring by motorcycle is such a refreshingly different way to go. It allows sightseeing the way it can't be done in a car.

To reporters probing the sanity in my passion for motorcycling, I've patiently explained that on a motorcycle you don't just see the environment, you integrate with it. You feel the temperature change from mountain to valley. You smell the crops in the fields. You're alert to what's going on around you because motorcyclists who do not stay alert tend to have very short careers.

Personally, I find that anytime I'm in a car, I wish I were on a bike. Not wasting a good opportunity to enjoy the going. Even here in New York City, I use the two bikes I keep in the office garage very often.

Riding in the city traffic is great—in traffic you can get all the way to the head of the column waiting for a red light and away you go. It's been hard, but by now I've acclimated most of the doormen in places like the Waldorf Astoria and the Twenty One Club to the fact that a motorcycle has as much right to the curb as the limos do.

Whether it's a Sunday Poker Run or a 2-week trek through China, our tours always begin with the end—the destination—in mind. Generally, we sketch out a few possible routings, seeking out the widest variety of scenery and roads that are graced with both a multitude of curves and a dearth of traffic.

The tone of a tour is dictated by the number of riders and the locale in which we're traveling. The solo rider may well find a certain freedom in camping along the way, but 3½ years of it in the infantry during World War II, plus one more recent nighttime visit by bears, gave me my fill.

Personally, I think there's much to be said at the end of the day for a nice motel and a good restaurant, particularly if you're of a vintage age. That really makes the day's ride and lifts considerations about having to stop soon enough to pitch camp and cook a meal.

In summertime, you really can't ex-



Leader of the pack Malcolm Forbes, foreground above, departs for a Poker Run from Timberfield, his New Jersey estate. Bottom, Forbes and company blaze the Polish countryside enroute to the Soviet Union. Right, the first formal motorcycle tour of the U.S.S.R., including (from left) Bob Forbes, Malcolm Forbes and Moira Forbes.

pect to roll up at the end of a day to empty hotels with rooms available, so you have to figure it all out ahead of time and make reservations before leaving. In Europe, even with just one or two companions, I make reservations in my name at the best hotels so when we drive up on the motorcycles they can't very well cancel. But we've strewn consternation behind us when we've pulled up to the snobbiest 4-star hotels of Geneva or Rome. They're just not accustomed to having a leather-clad, helmeted crew in their lobby. You know, it not so much startles, but it bemuses, intrigues and occasionally

alarms the stuffed shirts and ample-bosomed dowagers, sitting in the lobby, looking for something to cluck over.

The friendship tours are even more structured, with every point of interest and overnight stop planned far in advance by the host government or a national agency of tourist affairs. What with receptions and dinners and meeting the mayors, governors and prime ministers, it all has to be very organized. On these trips, we essentially travel by cavalcade—eight bikes are air-freighted in, there are two or more news film crews, and our support truck for the hot-air balloon flights.

The process of obtaining permission and setting up an itinerary is rigorous work, but worth it because of the interesting destinations.

This summer's goodwill tour will be to Germany—East as well as West—if all goes as planned. We'll fly a balloon in the likeness of Beethoven to honor the 160th anniversary of his death. More than anything, it's connections to friends with inside connections that get our foot in normally closed doors.

The pace of our tours, and therefore the routes our ride can take, is a function of the miles between this morning's starting-out point and tonight's sleeping place. We usually plan not to go much more than 300 miles. Here in the U.S., we go 400 with no problem, but 450 is tops because we like to arrive at our overnight spot at 4 in the afternoon



The cross-channel hovercraft provides supplementary transport on one Forbes tour.

PHOTO BY BOB FORBES



LEFT AND INSET PHOTOS BY BOB FORBES, RIGHT PHOTO BY C.V. AUGUSTUS

for the chance to relax, swim, see what's to be seen, case the town.

Traveling on a motorcycle, there's so much fun in the moving that you hate to interrupt it until your bladder is full or your gas tank is empty. Even though the Forbes business concerns include a number of museums, I'm not really a heavy museum goer. It takes a conscious effort to stop where it says Historical Marker, but when I do gear up mentally to stop at the next one, it's a rewarding experience. The rare-enough chance to trade pinstripes for riding leathers tends to make me savor the going and pass on the sightseeing.

The early morning start, for me, is part and parcel of the experience to see the dawn and the beginning of the day—by 10 a.m. you've got a lot of mileage under your belt and that mileage is fresh, not gas-fumed or smogged yet. The countryside is always more exhilarating in the dewy morning.

Keeping a group of riders together on the road is no small trick. We've not found a satisfactory voice linkup yet, but we can make sure that everyone at least catches up by the end of the day. Every rider in the group gets a photocopy of the area map, with the roads highlighted in felt-tip pen. A route schedule, detailing each turn and change of course is taped to the gas tank of every bike on the ride. Lunch is generally marked down for somewhere near our day's halfway point, and two

fuel stops are planned. Everyone also gets a list with the location and phone number of each overnight stop, an emergency "base" phone, and the number of the mobile phone if we've packed it into one of the saddlebags. Experience has shown that this obsession for preparation is not wasted effort.

On the international trips, keeping the pack pointed all in the same direction is made simpler by the chase vehicles hauling luggage, spare parts and the balloon gear. We don't use that sort of backup in our stateside tours generally, but on last year's run to Maine with 20 or so people on our bikes we had

the Forbes helicopter tag along for support. As it happened, the riders at the front of the group were pulled over on the Interstate for a little discussion with the keepers of law and speed limits. The officer first took note as the rest of the group pulled alongside, but when the helicopter came to a hover overhead he was good-natured enough to return driver's licenses and wish us all a happy ride!

Beyond the choice of an appropriate motorcycle for the touring you prefer—a beast of burden for heavily packed 2-up duty, or an agile sport machine for solo jaunts—the equipment most important is proper protective gear. Leather happens to be the strongest material practical for motorcycle clothing—it's the only armor between you and ripped skin in case of a fall. In spite of their bad image, leathers indicate total good sense. If you see someone on a motorcycle in cutoffs, T-shirt and sneakers, then you can properly conclude not that they're crazy for riding a motorcycle, but that they're crazy for not respecting the motorcycle. To the rest of the world, you should be less suspect in leathers than if you were wearing cutoffs!

The superiority of leather may not hold forever. I have a set of Kevlar-lined denims, made by a company that tried to make a go of it in motorcycle clothing about 10 years ago. Kevlar, of course, is stronger than steel, but by



Father and son arrive alive near the top of the world after a stint through Scandinavia.

PHOTO BY DR. JAN ENGELIUS

the time you build it into a suitable lining, it's pretty bulky. I gave one of the jackets to President Reagan after the shooting incident, suggesting that he might make us all feel safer if he wore it for horseback riding and wood chopping. Anyway, if the problem of making it more supple can be solved, there's a future for this type of garment somewhere down the road.

Maybe riders should have the option of wearing helmets, but I think it's mighty foolish not to. Based on my experience, I would be dead now as a result of the accident I had in Montana's Glacier National Park had I not been wearing a helmet.

I recovered from the concussion, collapsed lung and three broken ribs quickly—in just 10 days I felt up to a balloon ride—but without the helmet, it might have been my last ride.

Not wearing a helmet is not a matter of freedom, it's a matter of losing your freedom, vegetating yourself.

Why put yourself up against such heavy odds?

Wearing a helmet that meets the specs is the first requisite. In New York City, I wear a half helmet, because total visibility is necessary in the dense traffic flow, and you're not apt to be going the speeds at which open-road accidents happen.

My mechanical knowledge ends after I turn the key on, so it's fortunate that we have a couple of cycle expert enthusiasts—Dave Stein and Jack Creelman as well as Errol Ryland out at our ranch—to look after the machinery. Judging by the lack of mechanical trouble experienced on the road, they are doing a first rate job.

What they tell me works best is a

strict, by-the-book maintenance program for all the regular, scheduled lubrication and tuneup work. Major repairs are handled by local dealerships, as it would take some kind of genius to work on all the different machines in our garage. On the road, every morning the fluid levels and tire pressures are checked. Drive chains are lubed and adjusted daily on those bikes that are so equipped. The majority of the Harley-Davidson line has now converted to belt-drive systems, and it seems maintenance free.

Preventing possible breakdowns is just as vital. Batteries are regularly removed for a specific gravity check and charged on the workbench. When reinstalled, the cable clamps get a touch of RTV sealant on the fasteners—that way, if something works loose, at least that part will be right there to bolt back on. Clutch and throttle cables are treated to a Teflon pressure-lubing. Before this riding season gets underway all of our maintenance, repairs and mileage will be tracked by an IBM computer setup dedicated solely to the motorcycle operations. Close to home, we fill gas tanks with our own 109-octane Cam 2 Gasoline to prevent detonation damage to the engines.

When we go on our tours, we take a full supply of tools for repair work and a selection of commonly needed spares such as sparkplugs, fuses and oil. Because our time is not unlimited, we prefer to keep going if at all possible, leaving a bike in need of repair for later pickup. Tires are changed at 4000- to 5000-mile intervals, and if we have a flat we can repair it most times with a standard tubeless tire plug gun and refill it using the on-board compressor of the Honda Gold Wing, for instance. Major rebuilds are a rare occurrence for most of our machines—they're traded or sold before they clock that many miles, and regular exercise seems to be as good for the motorcycles, mainstream or exotic, as it is for me.

Naturally, a proper touring bike must have the comforts that will let you enjoy the miles. A windshield, or fairing, is the bare minimum, and most fully equipped factory offerings come with them as standard equipment.

As the rider leading the pack, I find a radar detector to be a necessity, and I have them on most of my bikes. The Passport is great. It lights up, and buzzes very audibly. Other essentials: A VDO quartz clock is mounted on every bike, and a helmet lock added if the factory lock is insufficient. There's not a motorcycle made with a horn loud enough to satisfy any safety-minded cyclist, so we've done some development here. A second stock horn helps, a Fiamm electric horn is a little better

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What's Up With Malcolm Forbes

What can the man who has done almost everything look forward to for amusement? After amassing one of America's largest fortunes in the family publishing empire, collecting some of the world's most precious art treasures, founding a few museums and hobnobbing with the planet's power elite, most of the normally accessible forms of enjoyment would have to seem unbearably tame.

Don't take pity on Malcolm Forbes, though—he's found his own way through this quandary.

Thanks to his abundant supply of hot air (courtesy of the propane tanks, of course) and his considerable collection of motorcycles, he's able to set off on adventures that mere mortals can only dream of. Gathering up family, friends and press, Malcolm Forbes and his International Goodwill Motorcycle Gang finagle invitations to countries which normally ignore the requests of sightseeing throngs. The Forbes entourage brings some special attractions, though—the warmest wishes of the American people,

the delicately sowed message of capitalist advantages, and the inevitable hot-air balloons specially commissioned for each Goodwill Tour. In Egypt it was a Sphinx, in Thailand an elephant, in Pakistan a 240-ft.-tall replica of the Minar monument. The balloons, displayed in public spectacles of lighter-than-air flight, are an effective method of carrying the message of global amity, and making friends is high on Malcolm Forbes' list of things worth doing.

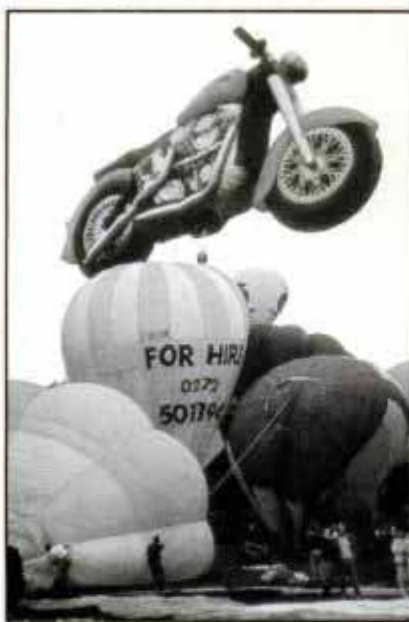
Forbes' addiction to the slow and nearly silent world of hot-air transportation was an interest that he pursued in his usual full-speed-ahead manner. Within a year and a half after his first early-morning balloon ride he completed a record-setting cross-country flight that ended with a nearly fatal dunking in Chesapeake Bay. Barely a year later, he set off to cross the Atlantic Ocean by gas balloon, that project canceled by a near tragedy on the launch attempt.

On his Friendship mission to China, where no Americans had toured since 1947, an unauthorized freeflight near the Great Wall was topped off with a landing on a Red Army base restricted zone and a tense detainment of several long hours.

Through it all, Malcolm Forbes insists that, like the entourage of Harley-Davidsons in a foreign land, the hot-air balloon works as a "barrier breaker, not just a bone breaker." His latest friend-maker is a 174-ft.-long replica of Harley's Heritage Softail model, and you can't help but agree that its chubby lines and lethargic

pace are friendly to a fault. So the collector, curator, publisher, capitalist—and nearly a state governor—now takes on the role of International Goodwill Ambassador at large, bringing an impression of Americans to the world that covert aid and secret arms shipments never could. With the added incentives of unexplored lands to ride through and glide over, that's about the most enjoyment a mission of humanity could ever be.

—Norman Meyersohn

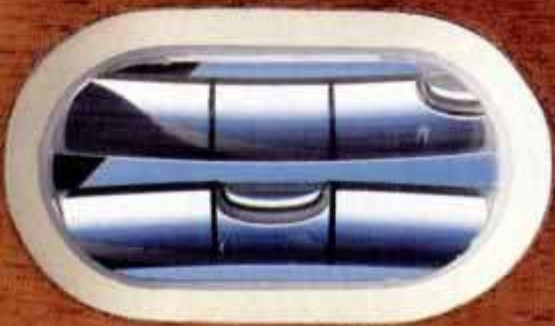



Passions merge: Forbes' latest hot-air balloon, shaped like a Harley-Davidson.

Levels

Simple hand tools that establish dead-on accuracy.

BY JOSEPH TRUINI, Shop And Tools Editor
Photos by Brian Kosoff



No homeowner's toolbox would be complete without at least one level. For do-it-yourself home improvement projects, a level is needed to determine level (horizontal) and plumb (vertical) alignment. The level, thought of first as a carpenter's tool, is also essential to masons, plumbers, electricians, engineers and millwrights.

One of the original levels, a wood A-frame with a weighted line hanging from its vertex, was used by ancient Egyptian pyramid builders. The spirit, or bubble, level was invented around 1660 and used on telescopes. However, it wasn't until the mid-19th century that the sealed glass tube containing alcohol and an air bubble was set in a wood or iron rail for use by craftsmen.

Today, there are many different types of levels available. Some are general-purpose levels while others are specially designed for a particular type of work. Levels are made of various materials including wood, aluminum, magnesium, cast iron and plastic. They range in size from about 2 in. to 10 ft. An active do-it-yourselfer should own at least four levels: a line level, a 9-in. torpedo level, and 2-

Levels

ft. and 4-ft. carpenter's levels. The vials are made of glass or plastic and are often protected behind a window. Most levels have vials that can be replaced if broken—a highly recommended feature. Note that some levels have two vials behind each window. This original design provides one vial per tool edge. A more recent design, uses a single vial per window. A single-vial level will work 360° on both edges or when laid flat. And, not all levels need liquid-filled vials. The battery-operated electronic level (No. 6 in the photo) offers the latest in level design and technology.

Before purchasing a level, always test it for accuracy. Place the level on a flat, even surface and note the position of the bubble. Then, reverse the tool end for end, keeping the same edge down. Now check the bubble's position a second time and compare it to the first reading. If the level is accurate, the bubble should come to rest in the same position for both readings. This is a good way to test old levels, too.

Remember that a level is a precision tool that you'll be relying on for accuracy. Try to reduce the inevitable banging about a tool suffers by never leaving the level where it may be knocked over, dropped, kicked or otherwise abused. Now let's take a look at the 17 levels shown here.

1. Magnetic bevel finder—Here's proof that good things come in small packages. This pocket-size tool is really four tools in one: a level, protractor, square and pitch gauge. A single vial is enclosed in a dial that can be adjusted 360°. To read level, set the dial to 0. To find plumb, turn the dial to 90°. It's excellent for measuring and transferring angles, too. The 2½-in.-dia. tool is made of high-impact plastic with a magnetic base. It costs \$11.05 postpaid from Garrett Wade, 161 Avenue of the Americas, New York, NY 10013.

2. Bench level—Designed primarily for machinists, use this highly accurate level for all types of precision work. The tool features ornate cast-iron construction with a black wrinkle finish. There are two plumb vials and one level vial on the 18-in. model shown (\$71). Top-reading feature permits viewing the level vial through the tool's edge. The opposite tool edge has a modified V-shaped groove, known as an involute groove, for use on round work. It's available in six sizes ranging from 4 in. to 24 in. long. Contact Starrett Tools, Athol, MA 01331.

3. Aluminum bench level—Die-cast aluminum I-beam construction makes this 24-in. mechanic's bench level extremely stable and lightweight. The tool has four durable Pyrex vials: two plumb, one top-reading level, and one 45°. Affixed to the level's edge is a dual-function steel rule that is marked with 1/16-in. graduations on one edge and a 1/8-in. centering rule on the other. It's available in 24-in. (\$45) and 18-in. (\$40) models. For details, contact Exact Level, 54 Eastford Rd., Southbridge, MA 01550.

4. Brass-bound mason's level—This handsome level, designed for use by masons, features a solid mahogany rail that is reinforced with wear-resistant brass edges and end caps. Take readings from the six clear-glass vials: two double plumb and one double level. It's available in a 2-ft. (\$35) and 4-ft. (\$45) model in hardware stores. Contact Stanley Tools, 600 Myrtle St., New Britain, CT 06050.

5. Engineer's and plumber's level—Here's a unique 3-function tool made specifically for engineers, plumbers and other mechanics. It features a fixed-level vial, a plumb vial and an adjustable-level vial that reads degree of incline. Incline is indicated by the pointer at the end of the adjustable tube and read off a steel plate that has 1/16-in.-per-ft.

Here's a sampling of the many types of levels available for do-it-yourselfers. Some are designed for specific jobs while others, like Nos. 8 and 9, are general-purpose levels. Most levels come in several different lengths. A 2-ft. and 4-ft. model will be sufficient for most home and shop projects. With a minimum of care, a quality level will last a lifetime.





1. Magnetic level finder; **2.** Cast-iron bench level; **3.** Aluminum bench level; **4.** Brass-bound mahogany mason's level; **5.** Engineer's and plumber's level; **6.** Electronic level; **7.** Torpedo level; **8.** Top-reading aluminum carpenter's level; **9.** Magnesium level; **10.** Aluminum I-beam mahogany level; **11.** Angle meter.

graduations. The level will read up to 2 in. per ft. of incline. An involute groove in one edge fits on round work. The level is made of high-grade cast iron. The 15-in. tool shown costs about \$93.50 at hardware stores. A 10-in. model (\$85.60) is also available. Contact Starrett Tools, Athol, MA 01331.

6. Electronic level—Levelite uses blinking lights and a beeping signal to indicate level, plumb, preselected angles and unknown angles. The electronic unit (\$50) operates on a 9-volt battery and clips into an aluminum rail. Levelite has an adjustable protractor dial, durable polycarbonate housing and it's effective in low-light situations. Rails come in 2-

(\$10), 3- (\$15), 4- (\$20) and 6-ft. (\$30) lengths. Contact Fourth Corner International, 1805-B West Bakerview Rd., Bellingham, WA 98226.

7. Torpedo level—Every toolbox needs a 9-in. torpedo level. Its back-pocket size makes it ideal for working in restricted areas. The Sears model shown has an aluminum I-beam rail with replaceable vials for reading level, plumb and 45°. One edge has a magnetic strip for no-hands use on metal workpieces and the other edge has a V-groove that fits on round stock. It's sold at larger Sears stores and through the

(Please turn to page 144)



Build our board-and-lattice
fence and fanciful moon
gate that's really
—surprise!—
three fences in one.

BY EUGENE AND
ELIZABETH THOMPSON

FIRST-CLASS FENCE



Take a stroll through most residential neighborhoods and you'll discover that fences are no longer being used strictly to separate one piece of property from another. Fences, depending on the design, provide varying degrees of privacy and protection. They help to control roaming children and pets and establish boundaries for gardens, pedestrian traffic and work and play areas. An attractive, well-designed fence will enhance the beauty and add to the value of your home. Conversely, an ill-considered fence, installed with no thought to its surroundings, will detract from your property.

After shopping around for a fence, we were disappointed in what was

Easy-to-build fence system comprises three styles of fences: 4-ft.-high lattice fence with moon gate; 6-ft. board-and-lattice fence; 6-ft. fence with 1x6 boards for maximum privacy.

Color photo: Peter Tenzer
Black-and-white photos and technical art: Eugene Thompson

available and decided to design and custom-build a fence to suit our specific needs. Our objective was to design a fence system that would provide varying degrees of privacy.

As a result, three types of fences were built. On the side of the house, dividing the front lawn from the backyard, we constructed a 4-ft.-high lattice fence that incorporates an attractive

round-top moon gate. Perpendicular to the lattice fence, separating our property from the neighbor's, is a 6-ft.-high fence constructed of vertical 1x6 boards topped with 2 ft. of lattice. This design offers slightly more privacy while maintaining an open, airy feeling. To provide maximum privacy for the backyard, we installed a 6-ft.-high fence of just vertical 1x6 boards.

Material selection

The fences shown are built of pressure-treated lumber. Redwood or cedar could also be used. The framework of the fences is constructed with common-size stock including 1x4, 2x2, 2x4 and 2x6. Use 4x4 stock for the posts.

The pressure-treated lattice comes in 4x8-ft. sheets for about \$20 per sheet. Each lattice strip measures 1/4 in. thick



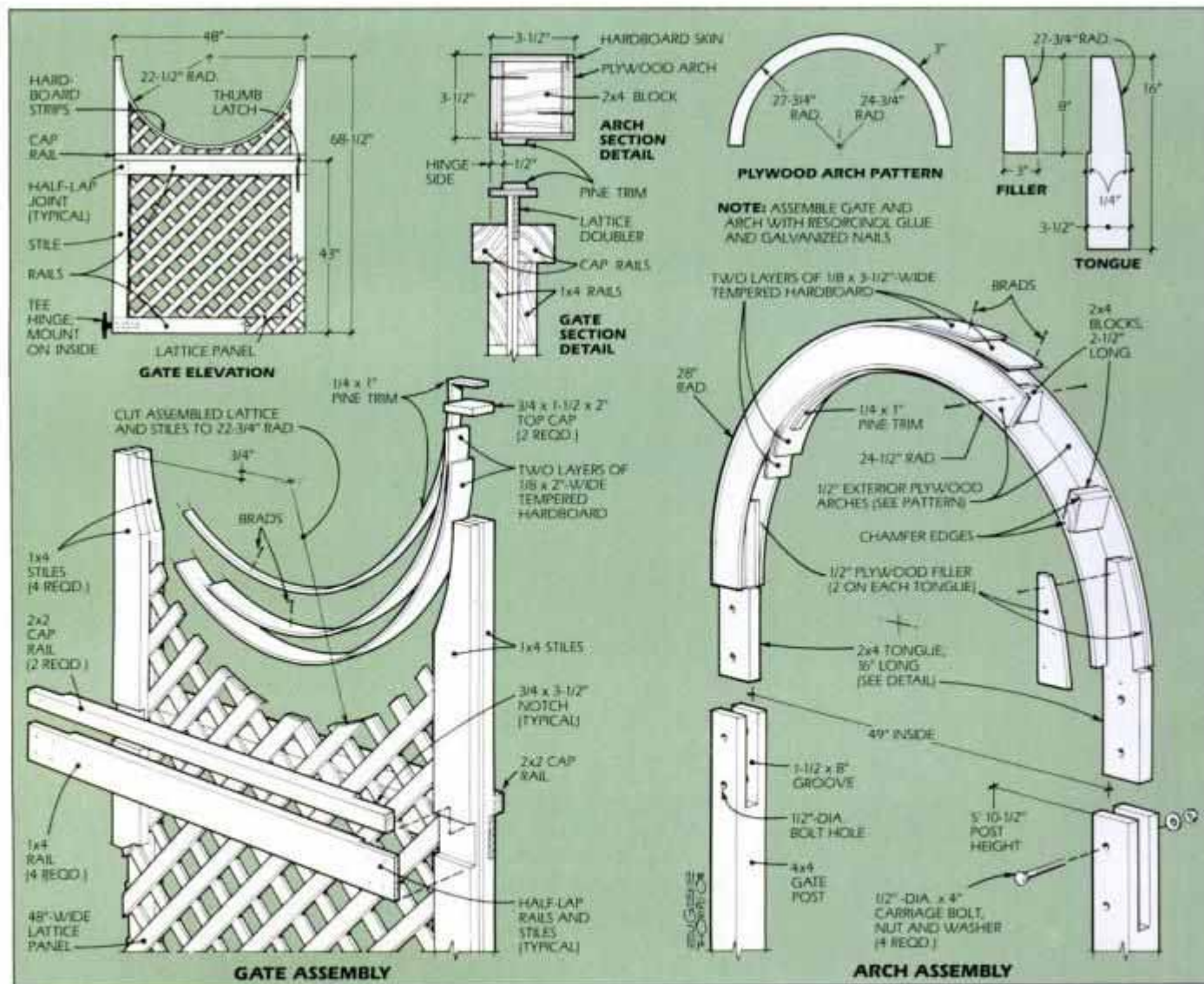
1 Dig fence post holes to about 30 in. deep with a post-hole digger. The hand tool is available from most rental equipment dealers.



2 Support the post in the hole with two diagonal braces clamped to stakes driven in the ground. Use a level to plumb post.



3 Backfill around the post and tamp the soil with a spare 2x4 rail. Continue to add soil and tamp until it's level with the lawn.



x 1½ in. wide. Make the curved arch above the moon gate out of ½-in. exterior-grade plywood and ⅛-in. tempered hardboard. To help resist corrosion, use hot-dipped galvanized nails and screws. Teco metal fence brackets (No. 2-4) are used to install the 2x4 rails to the fence posts; see photos 5 and 6.

Use 2-part waterproof resorcinol glue to laminate together the hard-

board strips that form the curved arch.

We decided not to finish the fence, but rather, allow it to weather naturally to a silvery gray. If you decide to apply paint or stain, you must wait three to six months for the pressure-treated wood to dry out. If the wood was wet during construction, you may need to wait up to one year; even longer in rainy regions.

Because of the various chemicals used in pressure-treated wood, there are certain health precautions that should be obeyed. Always wear a dust mask and goggles when sawing, boring and planing pressure-treated wood. Dispose short cutoffs and scrap; never burn pressure-treated wood.

After handling pressure-treated wood, be sure to wash your hands



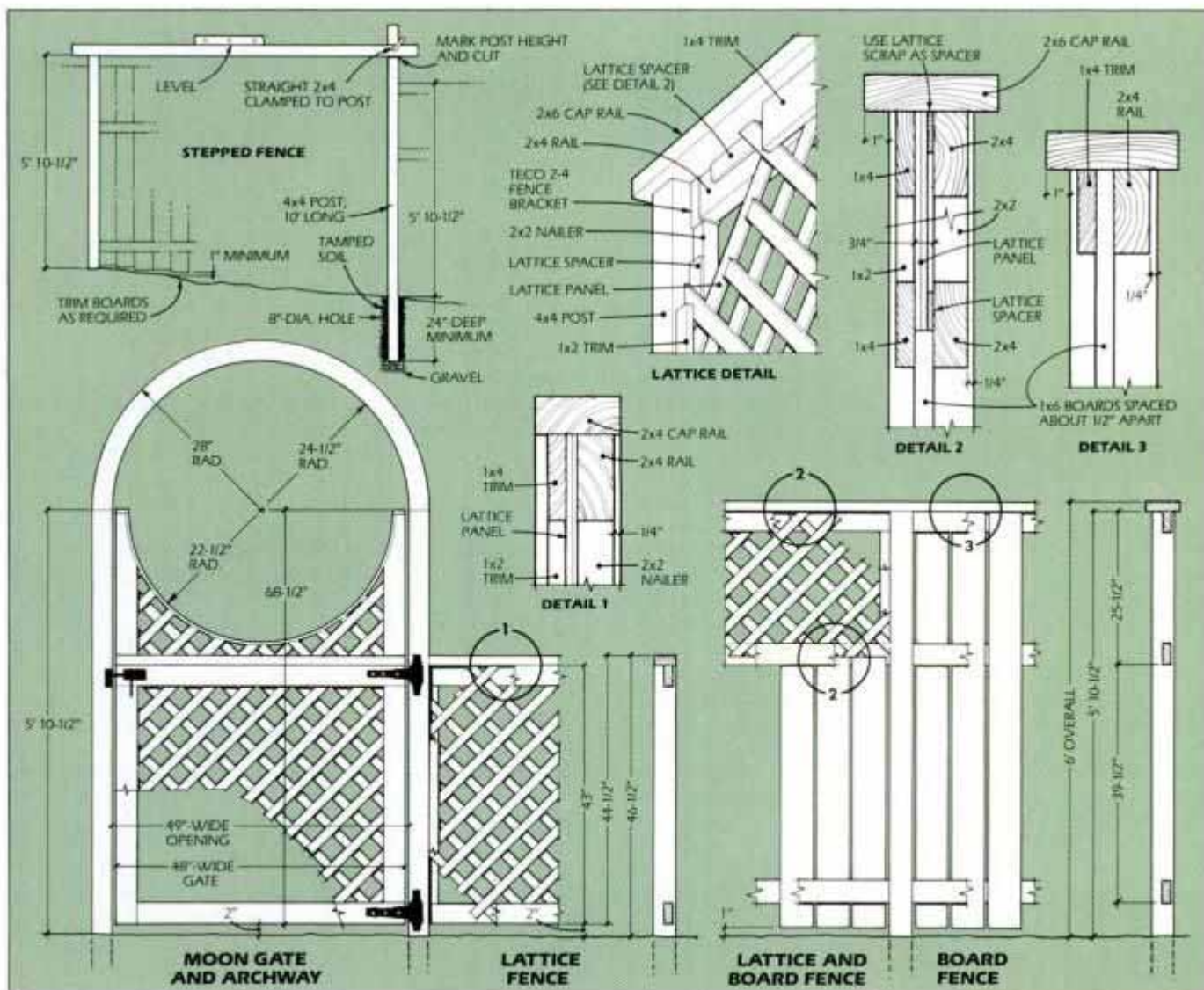
4 Mark position of metal fence brackets on the 4x4 posts. The galvanized brackets are used to join the 2x4 rails to the posts.



5 Mount brackets to posts with ¼-in. galvanized screws. Electric screwgun provides no-sweat way to drive screws.



6 Place a 2x4 rail in the bracket and bore pilot holes to prevent splitting. Then, fasten the rail with ¼-in. galvanized screws.





7 Fasten 1x6 fence boards to the 2x4 rails with 1½-in. screws. To keep boards even, butt them against cleat clamped in place.



8 Attach 2x2 nailer strips to the fence posts with 2½-in. screws. The strips provide a solid surface for fastening the lattice.



9 Bore pilot holes to prevent splitting the lattice. Then, attach it to the rails and 2x2 nailers with 4d galvanized finishing nails.



10 Use 1x4 trim to conceal the joint where lattice meets 1x6 boards. Fasten 1x4 trim with 2½-in. galvanized screws.



11 Attach vertical 1x2 trim at the ends of the lattice panels with 2-in. screws. Bore pilot holes first to avoid splitting the trim.



12 Top off the fence with a 2x6 cap rail. Fasten the rail with 20d (4-in.) galvanized nails. Space the nails about 24 in. apart.

thoroughly before eating or drinking.

The first step before starting construction is to find out *exactly* where your property line is. A copy of your house survey will help to determine this. Plan to erect the fence about 6 in. inside the property line, or according to your local building codes. Then, draw a rough sketch of the fence layout to help estimate materials and total cost.

Setting the posts

Begin by stretching a string between two stakes along the proposed fence run to determine the fence posts' locations. Use 6-ft.-long 4x4 posts for the 4-ft.-high lattice fence and 8-ft. posts for the 6-ft.-high fences.

Also, use two 8-ft. posts to support the arch. Each post hole must be about 30 in. deep. Add 6 in. of gravel to each hole to provide a solid foundation and adequate drainage.

Start by digging holes for the two gate posts. Be sure the *inside* dimension between the posts is 49 in. to provide clearance for the 48-in.-wide gate. Dig the holes about 8 in. square using a post-hole digger (available at rental equipment dealers) and a shovel. After adding gravel to each hole, be sure that the gate posts stand out of the ground 5 ft., 10½ in.

Next, cut a 1½-in.-wide x 8-in. groove in the top end of each gate post to accept the 2x4 tongues of the arch. To form the grooves, first bore a 1½-in.-dia. hole through each post to establish the bottom of the grooves. Then,

use a portable circular saw or handsaw to cut away the waste. Square-up each groove bottom with a chisel.

Place one of the posts in a hole and support it temporarily with two diagonal braces (photo 2). Check it for plumb with a level, and then backfill around the post with soil. Install the second gate post and support it with two 2x4 braces clamped to the first post. Plumb the second post and backfill around it. Now use a 2x4 to firmly tamp the soil around each post (photo 3). Add more soil as needed and compact it again. Leave the 2x4 braces clamped to the posts to maintain the 49-in. dimension until the arch is installed.

Next, starting from one of the gate posts, lay out and dig post holes for a run of lattice fence. Use 6-ft.-long posts spaced 96 in. apart (inside dimension) to accommodate an 8-ft. lattice sheet. Here's how to level the tops of the fence posts. Mark a line on the gate post 45 in. above the ground.

Then, using a line level, stretch a level string from this mark along the proposed fence run. Now install the posts at the same height as the line. If the property runs up or downhill severely, install a stepped fence, as shown in the drawing detail.

Construct the lattice fence using the drawing as a guide. Note that the lattice, ripped to 43 in. wide, is sandwiched between 2x4 rails and 1x4 trim (drawing detail 1). Join the rails to the posts with fence brackets (photo 6). Top off the fence with a 2x4 cap rail.

Arch and gate construction

Refer to the arch pattern drawing and cut two arches of ½-in. exterior-grade plywood. Next, from 2x4 stock, cut two 16-in.-long tongues that will fit in the grooves in the gate posts.

Also, cut four ½ x 3 x 8-in.-long plywood fillers, and five 2½-in.-long blocks from 2x4 stock. Glue and nail one filler to each side of both tongues. Then, glue and nail the tongues to one of the plywood arches.

Be sure the tongues are exactly parallel and 49 in. apart (inside dimension). Glue and nail the 2½-in.-long blocks to the arch at a slight angle so the corners of each block extend beyond the arch ¼ in. Now glue and nail the second arch to the assembly. Use a plane to chamfer the 2x4 block corners flush with the plywood arches. This creates solid nailing surfaces for attaching the hardboard skin.

Rip four 3½-in.-wide x 8-ft.-long strips of ¼-in. tempered hardboard. Glue and nail one strip to the top edge of the arch assembly using ¾-in. brads and resorcinol glue. Then, glue and nail a second strip over the first strip. Use a backsaw to trim the overhanging strips to length. Attach the two remaining hardboard strips to the inside curve of the arch using the procedure described above. Also, attach a ¼ x 1-in.-wide pine strip to the inside curve of the arch ½ in. from the edge (see arch section drawing detail). Now attach the assembled arch to the gate posts by inserting

(Please turn to page 134)

SPECIAL REPORT

AUTOSOUND



• **HIGHWAY HI-FI**
What's New In On-The-Go Gear

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Upgrading Your Present System

• **SOUND SOURCES**
Super Car Stereo Systems

• **ROCKIN' & ROLLIN'**
Installations For Vans And RVs

PHOTO BY BILL ASHE
AUTOSOUND SYSTEM BY TECHNICS

SPECIAL REPORT

HIGHWAY HI-FI

Today's car stereo rivals the sophistication of home hi-fi with a wide variety of gear.

BACKGROUND PHOTO BY CHARLES SCHRIDDLE
INSET PHOTOS BY ALLEN ZENREICH



Just 23 years ago this spring, Ford's first Mustang hit the streets at \$2368 and forever embellished the folklore of the road. You could get it with a monaural AM radio, but FM wasn't even an option—let alone stereo or tape.

Fact is, there wasn't much stereo broadcasting around back when the stars of TV's "Route 66" motored from adventure to adventure. The cassette and even the 8-track cartridge had yet to emerge from the twilight zone when "77 Sunset Strip" cruised the airwaves.

With only AM radio for fuel, the '64 Mustang didn't pack much more musical horsepower than the first radio-equipped cars of 1927. But highway hi-fi has come a long way since Babe Ruth's 60-home-run season, Lindbergh's transatlantic flight or, for that matter, the year when Lee

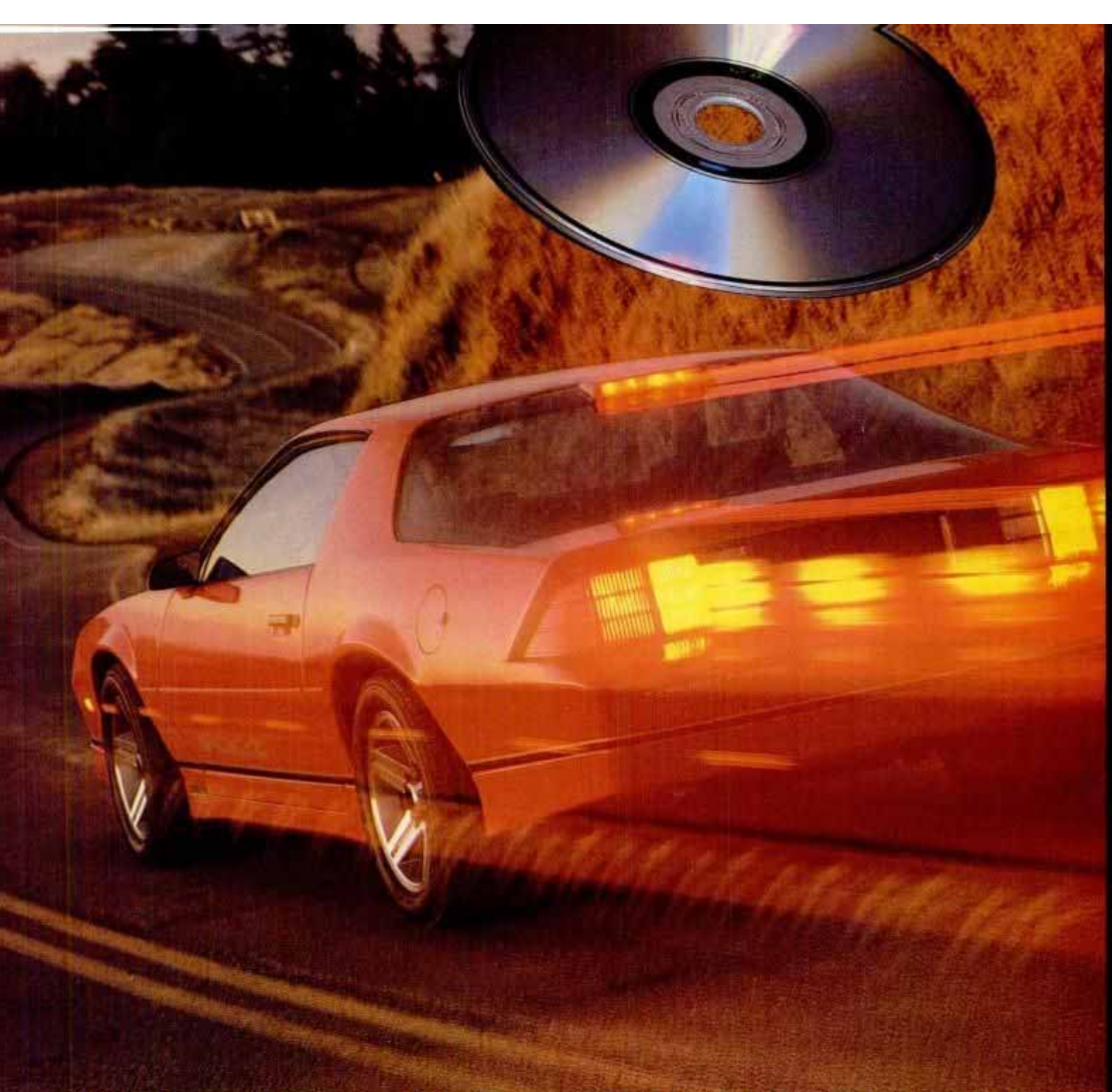
Iacocca and The Beatles began the stuff that creates popular legends.

Yesteryear's tube-based squawkboxes have evolved into dashboard systems that put digital electronics and fiber-optic transmission at the service of music. Supplementing original AM are stereo FM, magnetic tape, the optical-laser digital disc, and soon, digital audio cassettes.

These last-mentioned digital sources are propelling autosound along exciting new paths.

For too many years, autosound suffered technological neglect as the poor relative of home hi-fi. One automaker did build a record player into the dashboard, but it proved about as popular and workable as the double-nickel speed limit.

When the hi-fi boom of the late '60s created an awareness of just how good canned music could sound, a mobile generation of listeners began



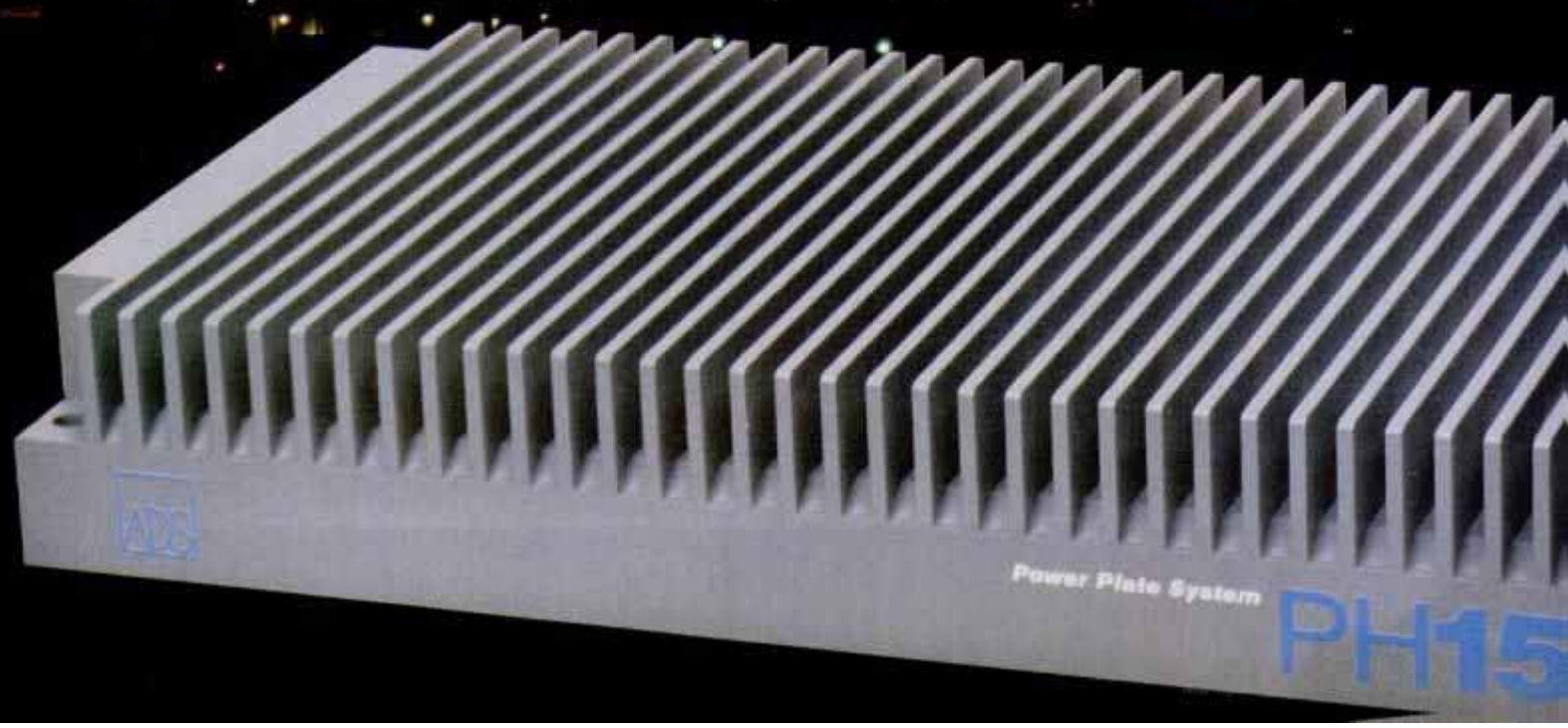
demanding comparable performance for its Bonnevilles and Bugs. Audio manufacturers rose to the task—and quite a task it was.

Because of the hostile environment and troublesome acoustics of the car, the routes to high fidelity must be more imaginative and technologically innovative than those required for living-room listening. The space available for electronics and loudspeakers in a car is relatively small. This has prompted a high degree of miniaturization in electronic circuits and components, to the extent that today's in-dash source units shoe-horn the controls and features of a home system into a package the size of a cigar box. Loudspeakers must derive their punch from the increasingly shallower doors and decks used for their enclosures. More compact but powerful amplifiers must drive those speakers above road and vehicle

noise, and sustain the music against sound-absorbing interior upholstery. Finally, to survive temperature extremes and physical vibration, autosound gear must be built tough.

Most of these goals and challenges have been met, but now the entry of digital sound has raised the ante once again. Digital sources will reveal any flaws in a sound system. Accordingly, today's gear is designed with digital in mind.

It's also designed to accommodate a wide range of musical tastes and purchasing budgets. With more than 100 brands competing in the marketplace, you're sure to find the combination of features and performance that suits your ears and your wallet. Moreover, this competition assures you continued innovation and improvement to match advances in recorded-music mediums.—S.A.B.



SOUND SOURCES

Digital stereo is mobile and accelerating. New electronics and speakers can match the pace.

If you imagine autosound to be a pair of back-shelf speakers connected to a dash-mounted radio/cassette unit, then wipe your memory banks clean. Picture, instead, loudspeakers mounted front and rear, acoustically supported by a subwoofer producing enough bass for a sonic body massage. One or more discreetly placed amplifiers drive the speakers with the power required by the digital compact disc player mounted in-dash.

Cassettes still abound for the car, but like an old Hollywood star, today's cassette/receivers have gotten a facelift.

The newest cassette/receivers sport flat-panel faceplates with pushbutton controls in place of yesterday's dials and knobs. Cassette/receivers offer better performance and features than ever before—and more change is on the horizon.

Digital audio tape (DAT) players for the car will be introduced over the next year or two.

DAT offers the same sound quality as compact disc but in a smaller configuration than today's analog cassette—an important consideration in today's shrinking automobile dashboards. In convenience features and operation, DAT players should be similar to existing cassette/receivers.

SOUND SOURCES

Though it will be some years before DAT becomes widely available, the compact disc is well on its way. CD already comes in multiple configurations for the car. CD player-only models have been on the market the longest. These units are designed to supplement existing cassette/receiver-based systems—an arrangement that allows you the option of listening to either radio, tape or CD.

Most people who have listened to CD seem to gravitate almost exclusively to the digital format, and abandon conventional cassettes. This has prompted manufacturers to introduce combination CD/radio tuners. Typical of this new breed of "head unit" is the model 7902 from Alpine.

AM/FM/CD

Miniaturization of the laser-transport and the laser itself has enabled Alpine to combine every component of the radio and CD player—including power supply—all in one chassis. An important feature of this engineering design is the use of extensive shielding and double voltage-regulators, to prevent internal motor noise and digital-switching impulses from becoming audible as low-level sound signals. This protection is what allows all the electronics to be enclosed in a single chassis for in-dash mounting.

The 7902 offers many of the impressive programming functions found in other CD/tuners. Up to 20 tracks or selections can be programmed in any desired sequence. A "disc scan" feature lets you sample the first 10 seconds of each programmed track while a "music sensor" function lets you skip tracks entirely as you scan. A pushbutton returns the scanner to the disc's beginning. Other manufacturers add a repeat button, which automatically replays the previous track or the entire disc.

Perhaps the most forward-thinking feature of the Alpine 7902 (\$850) is not readily apparent. It's an auxiliary input for either a conventional cassette player or a DAT player when the latter becomes available. Upgrading from the old cassette technology to DAT becomes as simple as switching from one player to another.

Existing analog cassettes also can be used with Sony's CDX-R88 CD/tuner (\$750). It's done with an optional cassette player, model XK-8 (\$270), which measures about half the height of the CDX-R88 and has a sliding drawer which accepts the cassette. The XK-8 has its own dedicated input jack on the CDX-R88, which is also noteworthy for its use of a separate subchassis to supply 50 watts of amplifier power to loudspeakers. Separate preamp out-



Pioneer's KEH-8282TR, especially suitable for utility rigs, boasts high-power multichannel amp, 9 dB of bass boost, preamp out, ambience circuit that expands soundstage.



Most recent car CD players now include an AM/FM tuner, thanks to miniaturized components and improved internal shielding. Alpine's 7902 adds a cassette input, too.

puts are provided for additional outboard power-amplifiers.

CD changers

Sony's CDX-R88 also has an auxiliary input jack which, theoretically, could be used for a DAT player. In the near term, however, CDX-R88's auxiliary jack will be the connection for a planned CD "changer." Two CD changers, one from Sony and the other from Alpine, are already on the market.

Both these models feature optional tuners so that they can be installed as complete sound systems. Alternately, each changer easily interfaces with any cassette/receiver that has an auxiliary input. Many new cassette/receivers are designed with CD in mind, often having a "CD" button on the faceplate to simplify switching.

CD changers can be mounted in the trunk (or wherever convenient), and are connected by cable to a control unit that remains in the passenger compartment. The controller can be dash-mounted or left loose, for easy use by back-seat maestros. Sony's DiscJockey (\$1000) can access a 10-disc magazine while Alpine's (\$1500) stocks 12 discs.

Radio and tape

Cassette/receivers may be products of a bearded technology, but the relatively high price of CD players guarantees the livelihood of conventional analog tape and decks for some time.

Today's cassette/receivers boast many new features that will carry over to tomorrow's digital tape products. For example, electronic tuning of AM and FM radio stations is now so commonplace that it's easy to forget that this superior tuning method was a high-priced feature just a few years ago.

Antitheft security codes, entered through the preset buttons of the tuner section, prevent anyone but you from using the stereo or starting your car. Another new antitheft option is the removable cassette/receiver—which slides into and out of a sleeve mounted in the dashboard. You can take it with you for safekeeping—or for use in another vehicle, even a boat.

Dolby B and C noise-reduction circuitry and sophisticated hiss-killers which quiet tape noise are common on many cassette/receivers. A few, such as Kenwood's KRC-939, offer dbx, an even more effective noise killer than Dolby. These noise-reduction systems can make cassette/receivers formidable signal sources—especially when playing tapes dubbed from CDs.

Computer control

Among the most sophisticated cassette/receivers on the market is Blaupunkt's TQR-07 Berlin (\$1500). The TQR-07 lacks dbx but includes Dolby B and C. Among its army of features are two tuners and antenna leads. This "diversity reception" system enables the Berlin's onboard computer to select the clearest radio signal—an important consideration since moving cars are subject to multipath distortion.

Controlling the TQR-07 is a 16-bit 32K microprocessor that utilizes a "data bus" for split-second relaying of information between a dashboard-mounted control unit and a separate subchassis that houses the tuners, volume and tone-control components. Data bus technology is likely to be applied elsewhere in car audio at considerably less cost in the future, largely because of its space-saving capability. Control units can be mounted in the

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**Ward's Automotive Reports, 1986 calendar year to date through June, combined compact pickups.
†J.D. Power & Associates 1986 CSI (for 1985 vehicles).
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SOUND SOURCES

dashboard while the bulkier playback systems, power supplies and other electronic circuitry can be installed out of sight in roomier locations.

Space-saving considerations also have prompted the introduction of cassette/receivers with built-in multichannel amplifiers. Models such as JVC's KS-RX515 (\$450) send 8 watts of power to each of four speakers, two in the front and two in the rear. Alternately, the KS-RX515 can offer 22 watts to a front pair of speakers, while a separate amplifier drives the rear speakers—an arrangement that results in a more powerful system overall. Either way, the cost and space consumed by extra amplifiers is avoided.

Versatile amps

Newly developed multichannel amplifiers act in a similar space-saving fashion, in that only a single powerplant is required to drive front and rear speakers without stalling or hesitating.

Kenwood's KAC-8070 (\$279) amplifier, for instance, delivers 20 watts to each front channel and 37 watts to each rear channel. This asymmetrical power configuration results in a primary stereo image emanating from high-power-handling rear speakers with the front speakers providing ambience. Generally speaking, front-door speakers can't handle high-power loads as well as rear-mounted drivers. But since ambient sound signals require little volume to be effective, Kenwood's 40 up-front watts more than do the trick.

You'll find additional versatility in multichannel amps such as the new ADS PH15 (\$560). In a 4-channel system, the PH15 delivers 80 watts into each of two channels and 40 watts each to an additional two channels—for a total of 240 big watts. The PH15 also can act in a 6-channel mode, delivering 40 watts to each channel. The fifth and sixth channels can be used to power one or two subwoofers that reproduce very low bass frequencies. And because a subwoofer can be configured as either a single, large woofer or a pair of smaller woofers, the PH15 will act in a 5-channel mode too—sending 80 watts to the single subwoofer and 40 watts each to the other four channels. Until recently, more than one amplifier would have been required to power a 5- or 6-channel system. The PH15 is also "bridgeable," which means it can be connected to other amplifiers to produce superpowered systems.

Loudspeakers

Aiding and abetting today's new crop of amplifiers are electronic crossovers that manage the complex task of routing audio signals to the appropriate



Car stereo—or computer? Blaupunkt's new TOR-07 Berlin head unit uses microprocessor and data bus to relay signals from dash-mount controller to hidden components.



Some equalizers are more equalizing than others. Ceres V parametric EQ by HiFonics gives pinpoint control.

tweeter, midrange or woofer speakers. These "drivers" might either stand alone as component speakers or be arranged together in different combinations or systems. "Coaxial" speakers—formed by mounting a tweeter and a woofer or midrange on the same axis—are quite commonplace in car audio. Three- and sometimes 4-way combinations also are available. Speaker makers often angle the tweeter in these combinations so it will "fire" treble sounds more directly at the listener.

Space-age materials

Paper cones are still the mainstay of autosound speakers, but many manufacturers now offer a variety of other cone materials designed to better withstand the rigors of the car environment, particularly heat and moisture. Materials such as woven carbon, graphite, polypropylene and other synthetic compounds are being used to create hi-fi speakers that can weather the elements and deliver top sound.

In addition to cone materials, high-energy magnets are finding a new application in loudspeakers. Bose Corp., for example, incorporates a new class of neodymium magnets in some recent General Motors cars equipped with its Delco/Bose car audio system. The high-energy content of neodymium means smaller magnets can be used, thereby significantly reducing the depth of the speaker. A shallower speaker will fit more easily into a greater number of cars—a lesson aftermarket manufacturers are also heeding.

Speakers range in size from 3/4-in. tweeters to 6x9-in. woofers and even larger subwoofers. From among this

large selection, you should be able to find speakers that fit not only your car but also your budget.

Equalizers

Whatever the number, size and shape of the speakers you choose, autosound systems sometimes benefit from the addition of a graphic equalizer. These units are, essentially, sophisticated tone controls which allow you to boost or cut specific frequencies at various points along the audio spectrum. This gives you greater flexibility than simpler bass/treble controls, which boost or cut all of the bass or treble sounds.

Graphic equalizers come as independent components for in-dash, under-dash, console or glove compartment installation. Sometimes, they incorporate an amplifier to boost system power. Many cassette/receivers also offer built-in "EQ"—but separate units provide greater control. Extremely sophisticated equalization is available with the HiFonics Ceres V parametric equalizer (\$400)—a unit which allows you to literally dial in troublesome frequencies for correction by adjusting three overlapping bandwidths over a range of several octaves.

Equalization, long used in recording studios, concert halls and even the home, probably faces its greatest challenge in the automotive environment. Autosound systems, and the methods used to install them, are the object of constant innovation and new technology developed to shoehorn good sound into a car—something to which vehicles everywhere seem opposed. But much as in the old days of bronco-busting, the car can be tamed.—F.V.

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SPECIAL REPORT

CHANGING GEAR

Highway hi-fi comes plain or fancy. Here's how to upgrade to match your budget and aspirations.

So, where have you been listening to your music lately? Just think about it: TV, videotapes and even that new best-selling novel all compete for your free time. If you're like an increasing number of people, you're probably listening to your favorite tunes in your car as you commute to work or play.

If this is the case, it makes sense to upgrade your autosound equipment for maximum enjoyment. Upgrading your car stereo needn't be an expensive proposition. A few dollars well spent will increase your musical return many times.

Let's assume you now have a factory-installed radio/cassette player and two speakers. The least expensive upgrade simply involves replacing the speakers with better models.

Many of the finest home-speaker manufacturers, including Infinity, Acoustic Research, Boston Acoustics, Polk, Canton and JBL, have branched out into autosound and offer the same high-quality sound reproduction you'd expect at home.

If you "trade up" to a coaxial or a 3-way speaker,

BACKGROUND PHOTO BY AARON KILEY
INSET PHOTOS BY ALLEN ZENREICH





Upgrade gear, from top, includes ASK3010 and ASK 3000 amplified speakers by Sparkomatic; Panasonic's CY-SG60 equalizer/amplifier combo; Autotek's SR-500 electronically tuned autoreverse cassette/receiver with CD input, Dolby-C, 40 watts total power. Left: Jensen JS-6400 cassette/receiver with input and power plugs for portable CD player.

CHANGING GEAR

you'll get better sound in the same amount of space that your existing full-range speakers occupy. A coaxial speaker divides the work of a full-range speaker in two, employing a midrange/tweeter to reproduce the high (treble) notes and a woofer to reproduce the low (bass) ones. Similarly, a 3-way speaker splits the work among a woofer, tweeter and midrange driver. The idea is to specialize when possible.

Nearly every loudspeaker supplier has a wide selection of 2-way and 3-way models. Within that selection, there also is a wide variety of designs to choose from. Many of the newer coaxial and 3-way models, for instance, feature adjustable tweeters that can be aimed directly at the listener. This type of configuration improves sound dispersion throughout the car and enhances stereo imaging.

New construction techniques and materials also make upgrades in speaker size more feasible. For example, the standard 4-in. speakers found in the doors of many of today's downsized cars can be replaced with 6½-in. coaxials that have a shallower mounting depth than conventional 6½-inchers. Shallow-mount speakers are available from most manufacturers.

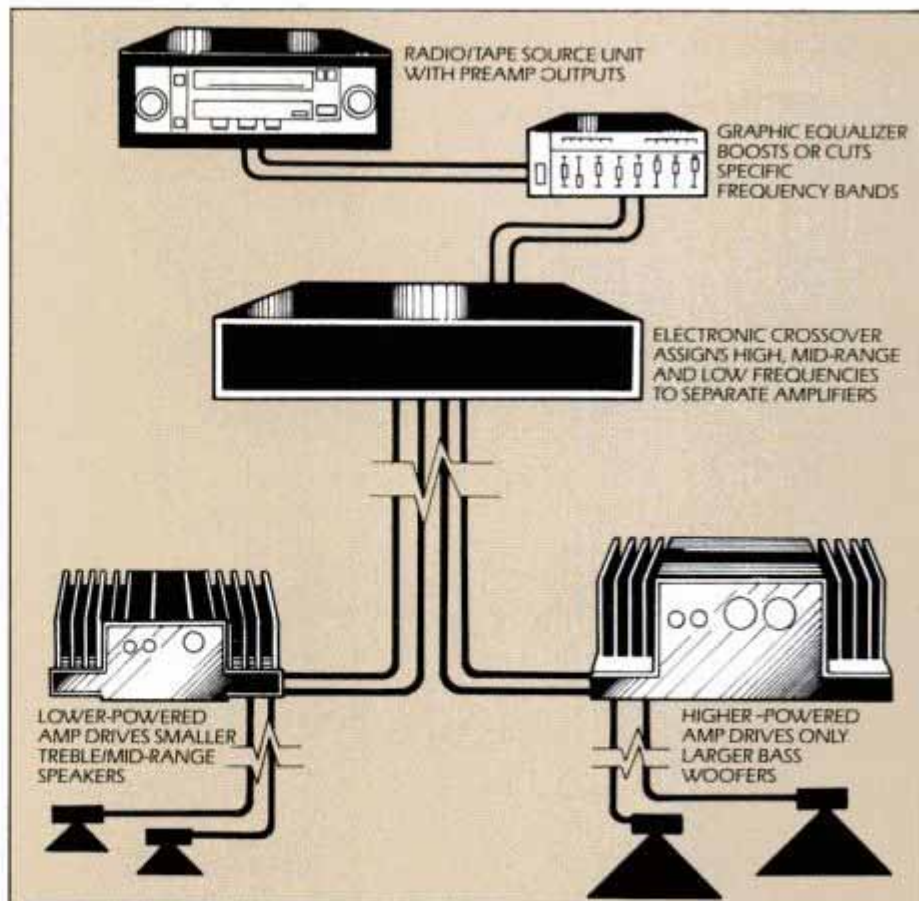
Power up!

If you install larger speakers, or, if you install an additional pair to complement the two already in place (whether in the front or rear), you might need more amplifier power to drive them. Most basic radio/cassette players, including factory head units, rarely offer more than 6 watts total.

You could upgrade your head unit. We'll have more to say on this later. An alternative approach is to install the recent breed of self-amplified speakers.

Several manufacturers now offer speakers with built-in amps, both in small and large configurations. For example, the amplified speakers in Sparomatic's ASK 3000 series come in door-mount and shelf-mount versions. These 2-way systems are actually bi-amplified: There's one amp for the tweeter and another for the woofer, for a total 50 watts of power in each enclosure. The company even offers a powered subwoofer with 50 watts. This is a sensible option, because the smaller speaker sizes mandated by today's smaller cars often means that not enough bass is generated. Subwoofers reproduce the lowest notes in the musical spectrum. Since bass notes are omnidirectional, only one speaker is necessary—and you have a great deal of flexibility in its placement.

Yet another economical way of add-



Sophisticated autosound installations use separate amps to power treble, midrange and bass speakers. Crossover assigns specific music frequencies to proper amp/speaker combo.

ing power without replacing your head unit is to add an equalizer/amplifier.

This combo unit wires in between the radio/cassette and your speakers, and can be installed in-dash, under-dash, in the glove compartment or wherever you have ready access to the equalizer controls. The EQ section enables you to cut or boost sound levels at five to nine points (depending on the model) along the audio spectrum, from bass to treble. The amp section adds from 25 to 50 watts to your system's power, depending on which model you install.

There are shortcomings to the EQ/amp, compared to separate equalizers and amplifiers. One is power: The mightiest combo units pack a maximum of 50 watts, whereas separate power amps run much higher. Another is size. Though a few slimline units exist, most combo units are as large as radio/cassette players. Separate (or passive, unamplified) EQs generally are small enough to fit anywhere, and stand-alone amps can be hidden out of sight beneath a seat, in the trunk or on the firewall. Finally, EQ/amps will pass along and amplify any distortion present in the amp section of your head unit. So might a separate EQ and power amp, but if you're thinking of installing these, it's really time to start rethinking the system as a whole—beginning with the head unit.

Better sources

The first level of electronic-upgrading involves replacing your existing radio/cassette player with one that has more power, better specifications, and some *sound-enhancing* features (compared to *operating-convenience* features such as tape autoreverse and radio presets). On the tape side, sound-improving features include noise reduction (either Dolby, dbx or DNR), and metal/chrome (70-EQ) tape-selection ability in addition to the standard normal (120-EQ) position. On the radio side, look for electronic quartz-synthesis tuning, multipath-rejection circuitry, and either DNR noise reduction, or automatic high-blend, or stereo/mono switching to maintain good sound when signal conditions deteriorate. AM stereo is another option, if your local stations broadcast it. General sound-enhancing features include a front/rear fader, left/right balance control and a built-in graphic equalizer (in place of conventional bass/treble controls).

If your ultimate goal is to own an autosound system that rivals the best home hi-fi—or even if you would like to reserve that option for the future, you'll be wise to purchase a cassette/receiver with "preamp-out" capability. The preamp out lets you bypass the cassette/receiver's built-in amp in favor of a direct connection to a better-perform-



Denon DCR-5320 cassette/receiver (top) retracts from dash; DCA-3500 amp has five channels, 240 watts.

CHANGING GEAR

ing (and more powerful) separate amplifier. The result is better sound.

The preamp-out feature makes a building-block approach to autosound much easier and, in the long run, less expensive. A cleaner signal is maintained through each successive stage—a particularly important attribute should you eventually install a digital audio tape or compact disc player.

How many amps?

The digital age is likely to prompt more multi-amplification—often called bi-amplification—in autosound. At this level of upgrading, car audio installations begin to assume the status of an art form. Bi-amplification involves the use of separate amplifiers to drive the woofers and the tweeter/midranges. Simply stated, the audio signal is passed through an electronic crossover which divides it in two: bass and treble. Each signal is then sent to a separate amplifier and set of speakers.

The advantage to bi-amplification is more sound with fewer watts. Two 15-watt amplifiers, for example, can play louder than a single 30-watt amplifier. And since each amp has only part of the music to reproduce, there is less distortion as well.

This approach can be expanded upon to include separate amplifiers for tweeters, midranges, woofers and sub-woofers. Many amplifiers have built-in crossover networks for this type of installation. In a new twist on this scheme, several manufacturers now offer multichannel (2/4/6) amps. This space-saving arrangement means a single power chassis can direct the appropriate frequencies to the appropriate speakers and drive them, instead of having separate power amps for tweeters, midranges and bass woofers.

In the esoteric world of car audio, it's not uncommon to see hookups involving 24 speakers with a complicated pattern of crossovers and amps. These systems sound wonderful. But you'll be surprised how the sonic improvement from every little upgrade adds to your listening pleasure.—F.V.

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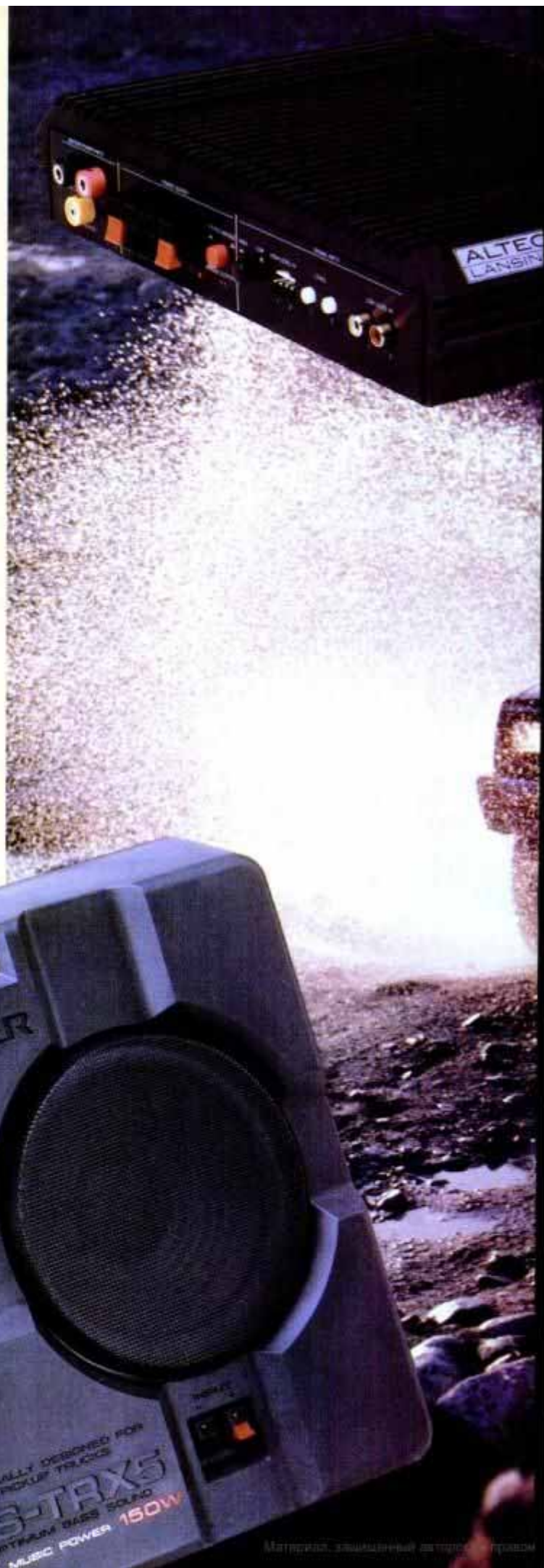
ROCKIN' AND ROLLIN'

Wagons, hatchbacks and sport/utility rigs pose acoustical challenges. Here are solutions.

Pickup trucks, sport/utility vehicles, wagons and hatchbacks look different from the outside, but they share one characteristic that makes installing an autosound system a sonic challenge: None of these vehicles has a trunk.

No trunk means no bass. For most notchbacks, the trunk serves not only as a cargo hold but also as an enclosure for woofer speakers installed on the rear deck of the passenger compartment. For good bass response, the woofer must be enclosed.

A pickup truck, sport/utility vehicle and even a hatchback might haul bigger loads than a sedan's trunk can, but big sound is more easily achieved in the notchback. Factory cutouts in the doors and dashboard provide easy installation for tweeters and midranges that reproduce high and mid-level frequencies. More importantly, cut-outs





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in the rear deck generally allow large woofers to be simply installed.

Compared to notchbacks, the pickups, sport/utility vehicles, wagons and hatchbacks present many obstacles to optimal speaker installation. Your choice of electronic equipment might also be affected by the lack of space in vehicles such as pickups. A working knowledge of the autosound gear available—and a dash of creativity—can help you lick the sound problems posed by these vehicles.

Pickup Trucks

The flatbed of a pickup truck is a good place for loading 2x4s, but it's no place for speakers. And at first glance, it may seem there is no interior space for speakers, either. The exception is trucks with super-king-size cabs—these spacious interiors are as easy to work with as sedans.

A second look inside the pickup's cab will reveal a pair of cut-outs in the doors and perhaps another pair in the dash. But these holes will accept only relatively small and shallow speakers such as tweeters and midranges. The problem of bass response remains unsolved.

Like every other aspect of autosound, there are various schools of thought on providing proper bass response in pickup trucks. Many manufacturers now offer prefabricated enclosures that house variously sized woofers combined with top-firing tweeters. These wedge-shaped enclosures stow away behind the front seats. The woofers fire straight ahead while the tweeters fire straight up to reflect off the rear window and into the cab.

Prefab bass enclosures are priced according to their capabilities. Sparkomatic, for example, houses a 6½-in. woofer and a 2-in. tweeter in an enclosure dubbed the SK480 (\$60). It has a power-handling capability of 10 watts per channel with 20-watt peaks, making it suitable for use with either modestly-powered, low-power amplifiers or with high-power cassette/receivers.

An upgraded version of this type is offered by Jensen. The Force, as the company calls it, houses an 8-in. woofer and a 2½-in. top-firing tweeter. Bass response gets a boost by the addition of a vent cut into the bottom front of each enclosure (there are two). This vent allows bass frequencies to radiate forward under the front seat for better sound dispersion. Power-handling capability is 40 watts per channel with peaks of up to 75 watts per channel, making The Force (\$300/pair) more suitable for systems with separate high-power amplifiers. The Jensen unit is also a little larger than the Sparkomatic SK480: It measures about 13 x 18 x 6¾ in. versus 14 x 11 x 5 in.

While the Sparkomatic and Jensen models utilize a single woofer, Pioneer favors a dual-woofer design. The TS-TRX5 (\$270/pair) combines two 6½-in. woofers with a top-firing tweeter in a single enclosure while the TS-TRX3 (\$150/pair) utilizes two 5-in. woofers in a smaller version.

These truck speakers from Sparkomatic, Jensen, Pioneer and others might more aptly be termed "lifestyle" speakers. They are portable enough to become the sound system for a picnic or similar outdoor event—and even have carrying handles.

When the party's over, just put them back behind the seat.

Despite their versatility, these lifestyle speakers have critics who contend



Hatchbacks, such as this Corvette, lack shelf and trunk for good bass. The built-in platform here (housing subwoofer, CD changer) serves same purpose and supports cargo.

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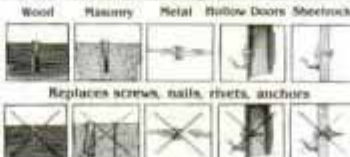


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ROCKIN' AND ROLLIN'

they provide nothing more than blasts of energy—"loud fi" rather than "hi fi." At fault is the upward-firing tweeter whose position on top of the enclosure contributes little to proper stereo imaging. Tweeters and midranges are more effective when they're located high and as far forward in the doors as possible (dashboard mounting for tweeters is also desirable).

Given such an arrangement, bass notes can then be generated by one or two subwoofers mounted in an enclosure behind the front seat. Companies such as ADS, Becker, Stillwater Designs and others specialize in making subwoofer enclosures for pickups. Many installers also make their own enclosures for more customized jobs. List price for a pair of ADS 7-in. dual subwoofers mounted in an enclosure is \$400. A version with dual 10-in. subwoofers lists for \$650.

Unfortunately, the cabs of some pickups are so small that the seat back butts directly against the rear wall. In these instances, an installer might construct door-mounted subwoofer enclosures with front-firing ports or slots. This "slot-loaded" construction allows the bass frequencies time to properly unfold before reaching your ears. Instead of feeling right on top of the speaker, your ears feel they are 8 to 10 ft. away, a better distance at which to enjoy music. In some instances, the rear window can be replaced with a speaker enclosure. A pair of large side-view mirrors is generally enough to pass inspection. (In a loaded pickup, the rear window is often useless anyway.)

Another alternative is offered by a company called Challenger Top Sound of West Palm Beach, Florida. The company's 1-piece enclosure spans the truck roof and houses a pair of 5-in. woofers and a pair of 2-in. tweeters. It's available in six colors and costs \$240. A tweeterless version sells for \$159.

If space permits, still another route to good truck-fi deploys an amplifier rack along the cab's rear wall with a subwoofer installed at the bottom. High-power is also available through the use of new, space-saving 4-channel and 6-channel amplifiers from companies such as Alpine, Kenwood, Altec-Lansing, Denon and ADS.

The growing popularity of utility vehicles has also prompted the development of cassette/receivers specifically designed for these applications. Pioneer is introducing its KEX-8282TR with 25 watts per channel, a "super bass" button to boost bass up to 9 dB, and a "stereo wide" switch that broadens the soundstage to make the cab interior seem bigger.

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ROCKIN' AND ROLLIN'

Sport/Utility Vehicles

The Chevrolet Blazer, GM Jimmy and Isuzu Trooper look like they're made for work, but they're also meant for play. With 4-wheel drive, these vehicles can go just about anywhere. Your fun levels might go up with an off-road vehicle, but so does the noise level.

To keep the music playing at audible levels you'll need extra power. One solution is to purchase a cassette/receiver with built-in power amplifiers. All cassette/receivers come with at least 3 watts per channel but some models, such as Sharp's RG-F882 (\$500), offer 25 watts per channel. These high-power cassette/receivers can drive a complete system, or, their built-in amps can serve to power front-mounted tweeters and midranges while separate, outboard amps drive woofers or subwoofers. Keep in mind that compact disc-based systems automatically require separate outboard amplifiers since there are no CD/tuners offering built-in amplification in a single chassis.

Although sport/utility vehicles generally have large factory cutouts suitable for large speakers, the noisy environment of a 4-wheel drive often encourages music-lovers to add free-standing subwoofer enclosures similar to those used in pickup trucks. For a more customized high-powered sound system, installers often construct a foot-high platform with speakers con-



Better bass: Speaker in prefab enclosure, such as Jensen's Force, snuggles behind seat.

cealed underneath—and sometimes with amplifiers, too. Upon completion, a carpet matching the interior color is laid over the cargo platform.

Sound in sport/utility vehicles can also be improved by adding door speakers. Generally, the factory cutouts are located toward the bottom of the door, but your legs and other obstacles can block dispersion of higher frequencies. You'll enjoy better stereo imaging by mounting tweeters and midranges higher in the doors. Surface-mount models will do the trick when in-door speakers can't be used.

Wagons and Hatchbacks

A hatchback or station wagon is like every other car in that there are appropriate speaker locations in the front of the car. But the absence of a rear deck and trunk makes it difficult to achieve sufficient bass response. Though you'll sometimes find factory cutouts in the rear of hatchbacks, their size and location is often inadequate to the task of reproducing low bass notes.

Like pickup trucks and sport/utility vehicles, wagons and hatchbacks can have a subwoofer enclosure retrofitted. These enclosures sometimes house other equipment not easily installed otherwise. In one instance, a subwoofer enclosure built into the rear of a Corvette not only houses a pair of subwoofers, but also a Sony "DiscJockey" CD changer. A cable connecting the CD changer to a control unit gives the driver access to 10 compact discs.

Large subwoofer enclosures can be obtrusive in small hatchbacks so specialty companies such as Classic Research & Engineering of Tuscon, Arizona, have developed enclosures for specific cars including Chevy's Camaro and the Porsche 928. These enclosures are customized cosmetically to match the interior of the car.

Less tailored cosmetically but effective in delivering bass is Alpine's 6491 subwoofer. Though suitable for pickups and sport/utility vehicles, the Alpine 6491 (\$140) is particularly effective in hatchbacks because of its small size. Longer than it is tall, the 6491 mounts about 6 in. from the end of the car, with its slot opening aimed toward the rear. The corners of the car create a "folding horn" effect, which greatly enhances the bass produced by the woofer inside the box. Because the speaker is inside the box, it is protected from the elements and other potential hazards. Bass output, rated at 15 watts per channel, is not as great as that provided by larger enclosures but the 6491 is far more discreet. Its compact dimensions are 7⁵/₈ x 5⁵/₈ x 19¹/₈ in.

A more high-powered version of the same principle is offered by Southern Audio Services, Inc., of Baton Rouge, Louisiana. The company offers two cylindrical subwoofers that use a 6¹/₂-in. and 8-in. woofer, respectively. The T16 and T18 "Bazookas" measure 36 in. long x 10 in. in diameter. Power-handling capacity is 100 watts per channel for the smaller T16 and 150 watts for the T18 (\$279). Split versions measuring 17¹/₂ in. long are also available.

The hatchbacks and wagons offer you the luxury of additional cargo space. But, to get good sound into these vehicles, you'll have to reclaim some of that space. If you like hard-driving music to go with driving hard, you'll find the trade-off well worth it.—F.V.

RAGTOP FEVER

(Continued from page 75)

company that prides itself on engineering. At nearly \$30,000, the Saab convertible's only competition is going to come from BMW's new 325i. This Saab is satisfying to drive, beautifully trimmed out and loaded with options.

Toyota Celica

The only thing wrong with the Celica convertible is that it's not available as a 135-hp GT-S. Why? With the top cut off, the Celica chassis has only marginal torsional stiffness; there's cowl shake even on smooth roads and enough twisting in hard corners to create noticeable gaps around the side windows. Considering its \$19,000 price tag, the Celica needs to be better engineered.

It also needs to be quicker. We loved the GT-S coupe we tested last year. It was fast, good-handling and eager to rev. This car, by comparison, was faster than the two J-cars and the Renault, but slower than every other convertible. It also had mediocre brakes and poor skidpad performance, though it zipped through the slalom quicker than any competitor except the Camaro. Stiffening the chassis enough to fit Toyota's existing GT-S equipment would eliminate most complaints.

Typical of Toyota, the Celica convertible is immaculately finished. The bodywork is flawless, the interior beautifully trimmed. The rounded Celica body responds well to having the top cut off. It has some of the same sleek ambience that makes the Saab so distinctive. And the driving position is excellent thanks to an adjustable seat and steering wheel.

This is really a 2+2, however. The cramped back seat could hold another couple for a short distance, but that's about all. Not surprisingly, the Celica interior measured the smallest in this group. Because it's based on the standard Celica, the convertible has more of an "econobox" feeling than even the Alliance or Sunbird. In sum, the Celica desperately needs the GT-S package to bring it up to par with the competition—and its own inflated price tag.

Conclusion

The convertibles currently available on the U.S. market are all so different, they're impossible to compare. We do know, however, that if we were making the payments, we'd prefer the Camaro IROC-Z, Mustang GT and Chrysler LeBaron, in that order. These are all serious performance cars that would be fun to drive, easy to maintain and still rewarding to own after the new wears off. What's the use of a car like this if it doesn't make you feel special everytime you get into it? **PM**

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DETROIT SNEAK PREVIEW

(Continued from page 77)

lock brakes. The body is made in the traditional way, with steel panels over a steel structure, but you will see lots of plastic panels on the extremities, front and rear. One body style will be produced in 1988—a 2-seat hardtop coupe—but insiders look for a T-top or perhaps a convertible version sometime in the future. Buick's goal is 20,000 sales in 1988, but with all the competition in the 2-seat market, 10,000 may be closer to reality.

Pontiac Grand Prix

A new, front-drive GM-10 (or W-body) car from GM will replace the old, rear-drive Pontiac Grand Prix, Olds Cutlass Supreme and Buick Regal, popular G-body designs that have been in production for 10 years with little change. Chevrolet's version of the G-body—the Monte Carlo—will stay in production during 1988, then go to the front-drive W platform in '89.

Smaller on the outside and lighter in weight, the '88 models will deliver 2 to 3 mpg better fuel economy when the biggest 3.8-liter V6 of the new car is compared to the 5-liter V8s of the '87s. The wheelbase of 107.9 in. will vary only fractionally from the old models.

Top engine on all three brands will be the 3.8 V6, with a 3-liter V6 as the intermediate choice and a 2.5-liter Four as the base powerplant. By mid-'88, Olds is expected to offer its 2.3-liter, double-overhead-cam, 16-valve Quad Four engine as the high-performance option on the Supreme.

In an attempt to get better brand recognition, none of the body panels on any of the three Division's cars are interchangeable. Some models will get vertical "beer-tap" door handles mounted on the B-pillar between the side windows, similar to the Chevy Beretta. Others will have traditional horizontal handles on the doors.

Each car line has its own distinctive front end, rear end and roofline. The Pontiac has a semifastback roof, the Buick a more upright "formal" roofline, and the Olds has window glass wrapped around the outside of the C-pillar for a flush look similar to the Mercury Sable. The Pontiac and Olds cars won't hit the showrooms until spring, but the Buick will have a few months head start.

Ford LTD Crown

Yes, the identity of this Olds look-alike has been confirmed as the big Ford for 1988. The line gets what is now called a "freshening" in the form of new grille, taillights, trunk and rear-fender extensions. In the old days, this passed for a "minor facelift."

Despite the lack of change in this

model during the past 10 years, sales are still strong. Buyers recognize the value of a full, 6-passenger car powered by a V8 engine and built on a separate frame. This is one of the last of America's do-everything, carry-anything cars, and its minor changes this year are not aimed at rejuvenating its popularity, but preserving it for another decade or longer.

Chrysler

The 1988 Chrysler New Yorker Brougham will be an all-new model with a new body and chassis. It will fit alongside the rear-drive Fifth Avenue in the Chrysler lineup. Major features for the New Yorker include a switch to front-drive, the use of V6 engines, and independent rear suspension.

Chrysler will use its top front-drive powertrain in these models. That means a new Mitsubishi 3-liter V6 will be standard on some models, with the Chrysler 2.5-liter Four as the base.

Later, possibly in 1989, a Dodge version called the Dynasty will be added to the line. Available engines then will include 3.3- and 3.8-liter V6s.

Styling is formal, highlighted by a nearly vertical backlite, large deck surface and a fairly level hoodline. This car is slated to sell against Ford's Crown Vic and GM's Bonneville.

Tempo

Get a close-up view of this Ford compact, and you see more than a few changes in body shape. Fenders bulge outward a couple of inches to give a huskier appearance. Bumpers are full wraparound type that stretch all the way back to the wheel openings. A small change in the roofline at the rear window imparts a more formal appearance and makes the trunk look bigger. The net effect is a bigger, more substantial appearance. Chassis and drivetrain, however, are essentially the same as the 1987 models.

Pontiac Sunbird

Pontiac, Buick, Olds and Chevy will smooth out the awkward body lines of their subcompacts by altering the beltline, roofs and grilles of the Sunbird, Skyhawk, Firenza and Cavalier. Changes seen on a Sunbird under test at GM's proving grounds in Milford are typical of what you'll see throughout the 1988 line. Note that the harsh, angular line of the '87 hardtop roof will be replaced with a softer, curved shape, while the beltline dips as it travels over the rear fender.

Plans are for Olds and Buick to offer only two body styles in this line for '88, while Pontiac and Chevy continue with the full line of coupe, hatchback, convertible and 4-door sedan models.

(Please turn to page 126)

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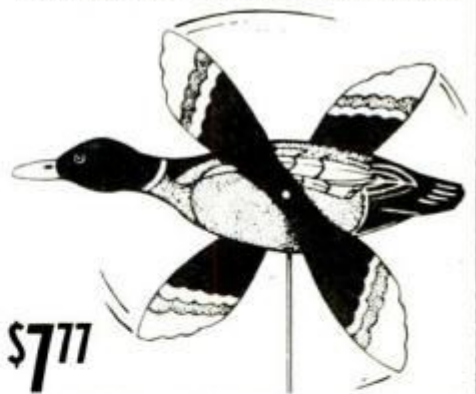
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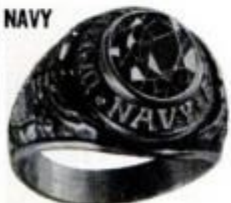
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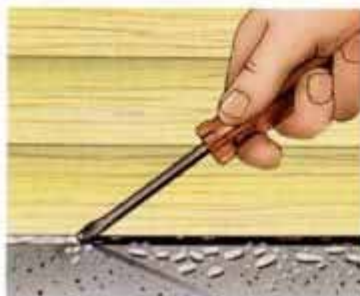
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DETROIT SNEAK PREVIEW

(Continued from page 124)

AMC Premier

A late addition to the AMC 1988 line will be this 5-passenger, intermediate-size Premier, a European-designed sedan that will be built in North America. Premier is a takeoff of the Renault 25 and will probably match the French car closely, unless AMC's new majority stockholder, Chrysler, changes the AMC plan.

Subtle differences in the body of the Premier set it off from the styling of the 25. While the 25 is a hatchback, the Premier is a true 4-door sedan. Windshield wipers are hidden on the Premier, bumpers are more angular, and the hood does not wrap over the top of the fenders. V6 and 4-cylinder engines plus automatic and 5-speed manual transmissions will be supplied from Europe to the Ontario, Canada, plant.

'89 Ford Thunderbird

Ford will stick with rear drive for its Thunderbird and Cougar models through the mid-1990s, at least. But big changes are scheduled in the personal coupes a year from now. Wheelbase will be stretched from the current 104.2 in. to 109 in. The object: more room inside and a more stable ride.

Electronic advances available only on the Turbo Coupe today will include adjustable shock control and antilock brakes. Also possible are air springs and electric power steering. Definitely in the works for '89 are an independent rear suspension, along with a supercharger for the top performance model. The supercharger will go on top of a 3.8-liter V6 and replace the present turbocharged 2.3-liter Four.

'90 GM Minivan

Chevrolet and Pontiac will sell this small front-wheel-drive passenger van beginning in 1990. Designed to compete with the Chrysler minivan, the GM model takes van design further into the future. The body is plastic, overlaid on a steel frame. Drivetrain is a front-drive unit taken from the GM A-car lines—Celebrity and 6000. And sunshade glass is used in all windows.

Front-seat passengers enter through doors set behind the front wheels, which makes entrance/exit more convenient than when the wheels are located under the doors, as in some import models. A unique, single windshield wiper is planned, as seen on this prototype being tested at GM's Milford Proving Grounds. Most frequently reported powerplants are GM's 2.5-liter Four and 2.8- or 3.8-liter V6s. The taillights are mounted above the beltline, a position that allows a wider hatch so that bulkier cargo can be loaded. **PM**

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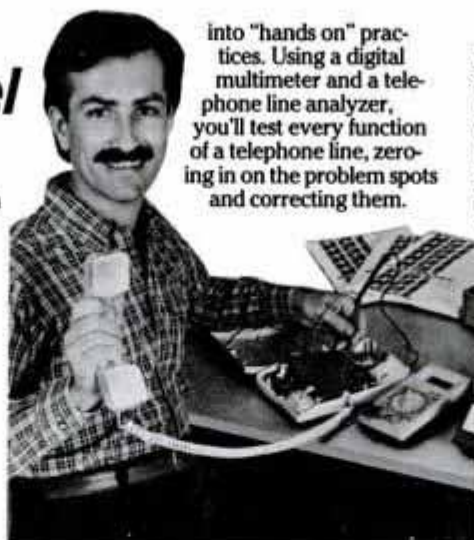
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STACKED DECKS

(Continued from page 85)

Godfrey 196 Hurricane

The Hurricane was shorter and narrower than the top-ranked boats, and that decrease in size probably helped it to a No. 1 finish on the performance course. The boat feels rock-solid in extreme turns at speed, with no tendency to skid or trip. The padded sport wheel is just right for the fast maneuvers the boat invites. The wetted portion of the hull is a modified vee—sponsons forward don't touch the water at speed, but they do provide added flotation at rest.

Despite its somewhat smaller LOA and beam, the Hurricane stacked up well in deck space, ranking second only to the Four Winns in usable area. It fell down in storage, however, due to wasted space under the bow seats. In a boat that will comfortably seat 12, that added space for gear is needed. The analog gauges are easy to read from behind the wheel, and the fuses are all next to the switches that they monitor on the Hurricane's dash.

The engine hatch covers the folded top neatly, but we found the slide-bolt hatch locks difficult to see and operate. The gas fill on this boat is set at about 60° on the transom, not vertical like all the other deck boats tested, and this helped in avoiding fuel spills. The skiing tow eye is mounted low on the stern and is hard to get to without stepping out on the swim platform. Overall, this boat was judged well-finished and a good handler by the test crew, but couldn't quite match up to the Cadillac size and appointments of the Harris and the Four Winns.

Chris Craft Sportdeck 190

The Canadian-built 190 is a driver's boat; it finished first in top speed and a very close second on the performance course. However, small design flaws prompted a fourth-place rating—but considering the fact that both this boat and its near-cousin, the fifth-place Sunchaser, costs from \$3000 to \$7000 less than the top finishers, price will certainly be a consideration in any poten-

tial buyer's choice. Though the beam is only 84 in., the forward and aft sunpads offer better than 40 sq. ft. of room to stretch out. Storage space was also very good, with every nook and cranny utilized. The molded fiberglass table, fitted to floor grommets when in use, stows neatly out of sight.

The analog gauges are easy to read, though test drivers would have preferred having the tach and speedometer closer together to wring out the last mph. The stainless-steel wheel looks salty, but the cold steel was not as easy to handle as the comfortable padded wheels on other models.

The engine hatch is held down only by flexible plastic snaps, hard to find and easy to forget. If you do, the hatch flies up at speed with enough force to break the hinges. A visible, positive lock would make better sense. The ski hatch cover on this boat, like that on the Harris, was a pressure fit—makes you wonder if there is a sandpaper shortage at the factories.

Sunchaser 1908 DC

The Sunchaser has breakers on the dash switches, rather than fuses—a nice touch. The dash featured no-nonsense analog gauges, easy to read. The boat looked rather basic compared to some of the plusher models, but lists for thousands less.

Drivers and co-pilots of these boats wished all had console windshields to cut spray. More importantly, they wished for elimination of the small windshield at the bow—a piece of this unsupported plastic on the Sunchaser was knocked out by a wave during a speed run on open water, and barely missed the driver on its way out of the boat! There were other problems with the Sunchaser: Hard-to-find plastic tie-downs on the engine cover were overlooked, resulting in a hatch that broke its supports at 45 mph.

The boat had loose steering and was not as predictable in turns as others. There was no retainer on the gas fill cap, which makes it almost a sure thing that the cap will be lost overboard—it pops out of the vertical fill hole unpredictably when loosened to refuel.

It was a bit short on storage space, in part because no ski locker was built into the floor. A large box extending the width of the back seat will hold skis, however.

Though the Sunchaser had its problems, it too would make a useful boat for the large family looking for a versatile weekend rig that requires minimal care and a moderate investment.

In fact, the entire fleet had a lot to offer any prospective boatman in need of maximum space. And the performance is an unexpected plus. **PM**



Deck boat test power was supplied by OMC's Cobra 5-liter sterndrive, a rip-sportin' 230-horse V8.

Save Gas, Save Engine with "POLY"

The following introduces one of the most fully tested and proven gas saving, friction-reducing engine treatments ever to reach the market!

The Secret is "Poly"

"Poly" is short for polytetrafluoroethylene (TFE), the slipperiest substance known to man. (1981 Guinness Book of World Records). Petrolon Corporation, makers of Slick 50, invented a way to permanently bind this slippery chemical to your engine with one treatment. Just one quart of Slick 50 can reduce engine friction, increase gas mileage and horsepower and reduce engine operating temperature, causing your oil and engine to last longer. . . plus it reduces metal wear, defraying costly overhauls.

Years of Testing and Use Have Proved it True!

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

The March/April 1982, p. 35 issue of "Consumer Digest" magazine stated, "Slick 50 does reduce engine heat and ordinary wear, and our informal tests indicate that it will improve gas mileage by about 2 or 3 miles per gallon."

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

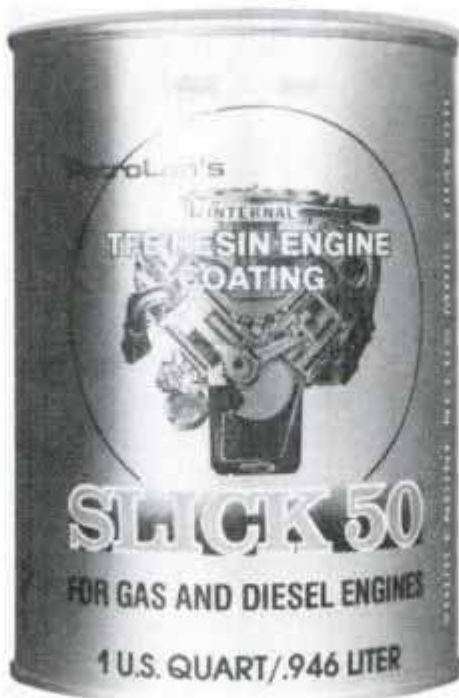
"Dune Buggies & Hot VWs" magazine April 1983 issue records the results of their one year testing of Slick 50. "We can indeed say scientifically that Slick 50 does work, and that it does reduce engine wear! . . . for the price of one treatment when compared to engine rebuild, we feel that you'd be money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

The Federal Aviation Administration has fully accepted a similar product for aircraft—Slick 50 Aircraft Piston Engine Treatment (F.A.R. #33.49). This FAA endurance test simulated 1400 hours of engine use.

The power technology laboratory at a leading southwestern university stated, "Slick 50 does increase horsepower and decreases fuel consumption in tests done at the university."

The Space Shuttle Columbia uses the chemical "poly" in its gears and bearings because it is the only chemical lubricant which can withstand the heat and corrosive elements of space.

Perhaps most dramatic of all is a torture test overseen by the Automotive Services Council for Pennsylvania and shown on WTVE television. Three cars with 75,000 to 129,000 miles on them were treated with Slick 50. Six months later the oil was drained from each vehicle, and the cars driven without the oil plugs for about a half hour. The water temperature never rose and the engines sustained no apparent damage.



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

It's Easy to Treat Your Engine

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

Only One Treatment Necessary

It's permanent, so you do it only once, not each time you change oil. One quart of Slick 50 will treat all standard 4, 6 and 8-cylinder gasoline and diesel engines.

Works with Most Oils

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

4 Ways Slick 50 Saves You Money

Your actual percentages may vary depending on your driving, vehicle condition, weather and geographic location, but no matter what your conditions, Slick 50 can:

1. Increase mileage
2. Increase horsepower (small economy cars and large RV's really need this)

3. Reduce operating temperatures, thus increasing the lubrication and life of the oil and engine
4. Minimize or eliminate costly overhauls by reducing engine wear

Up to 90% of the engine wear on a car can be caused by lubrication starvation cars experience when first started before the oil begins to circulate. Slick 50 can eliminate this problem for less than the cost of two tanks of gas.

Slick 50 Will Not Affect Your Warranty

Slick 50 is suspended in an excellent grade of petroleum oil which meets or exceeds every manufacturer's engine warranty requirements. In addition, this oil carries an American Petroleum Institute service classification SF-CC-CD.

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Use Slick 50 for 3000 miles. If you don't notice an improvement in engine performance, return your invoice with a short note telling why, for a prompt full refund — no questions asked.

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Here's an opportunity to make handsome profits. Having such solid test results from major institutions make Slick 50 easier to sell than many other products. Free dealership information is sent upon request.

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NEW AGE RVs

(Continued from page 89)

produce its top-of-the-line coaches.

Winnebago's aggressive modernization of its facilities is supported by a computerized design center and an electronic bridge used during the clay-modeling process. With this equipment, company engineers can use a probe on a clay model and enter dimensions into a computer that provides valuable input. Winnebago boasts that the auto companies do not have this equipment yet. Computer-aided design is expected to lead to further refinements in the full Winnebago line.

Foretravel, a long-time builder of luxury Class A coaches, last Spring introduced its first unibody motorhome. Again, computers played an important role in the design of a monocoque chassis. This type of construction eliminates a rail-type chassis structure and spreads the stress normally concentrated in the platform throughout a unitized superstructure. The benefits are improved road-worthiness and a smoother and quieter ride. The price for the new Foretravel Unihome is \$285,000.

The demand for good ride quality in luxury RVs has forced manufacturers to concentrate on improving suspensions. Airstream makes good driving machines of its aircraft-style coaches by reworking the Chevrolet P-30 chassis. Airstream developed the CMA Tag Axle to provide improved weight-hauling capacity for the heavier coaches along with a substantially better ride. To achieve this, a self-leveling air-bag system was incorporated with a rubber torsion axle and trailing-arm assembly that controls air-bag inflation levels. Tag-wheel movement automatically keeps the chassis level, even if the load is not evenly distributed. The result is a very stable, controlled ride, even while load capacity is increased.

Down the road, the direction of the automobile industry will have a direct bearing on the future of the motorhome. Consumers are becoming more performance oriented; as automobiles become more sophisticated, so will motorhomes. Aerodynamic styling, improved chassis design and aftermarket or OEM suspension retrofits are key elements in the industry's general design upgrade. As progress is made in microprocessor and electronic component development, today's luxury items such as microwave ovens, satellite dishes, stereo televisions, video cassette recorders and computer-controlled leveling systems will become commonplace.

And, of course, there is the shower—even in a vehicle that goes 28 miles on a gallon of fuel.

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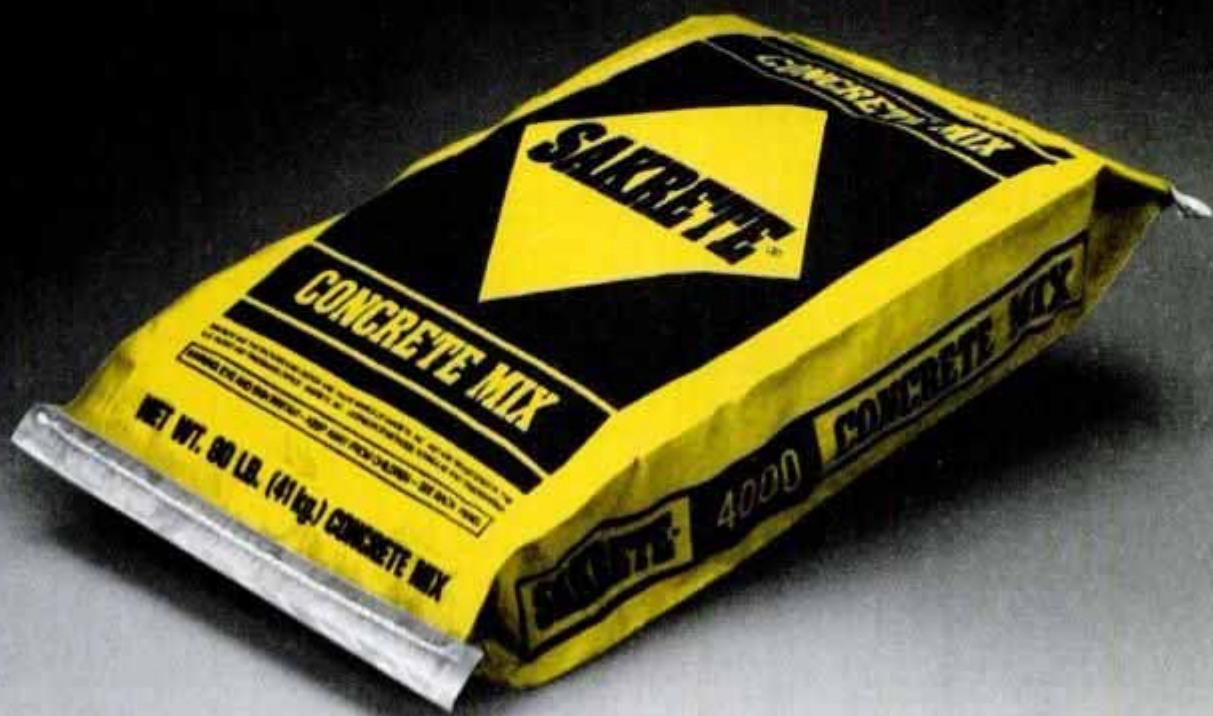
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MOTORCYCLE TOURING

(Continued from page 94)

and a forced-air horn, with its own electric compressor, is better yet. GM's truck air horn, charged by a nitrogen tank in the saddle bag regulated to 100 psi, comes close to ideal, but the final answer is a Grover air horn, normally used on fire engines, installed with its own electric compressor kit. Now that sounds a warning when someone's about to cut across your bow!

When taking off on a ride with our group, each rider gets a red Capitalist Tool vest to wear for visibility's sake as well as identity. In the saddlebags we carry, as an everyday necessity, rain-suits. I haven't yet found one that's totally waterproof, and still the big decision is when to stop and put it on.

In any event, Totes overboots are a good bet to keep your feet dry, and Dry Rider mittens with a chamois to wipe the face shield work well. And if the rain suit has a clear pocket on the knee for a route map, so much the better.

As for cold weather gear, I've always thought that more layers of clothing are probably less bother than the wires of electrically heated vests and such.

Some device to hold the throttle in a constant position—I still find Harley's little screw unit as good as any—is a handy way to relax your right hand as the miles pass under you, but I have gotten hooked on Honda's new Aspen-cade cruise control, which lets you lock in on a speed, uphill or down.

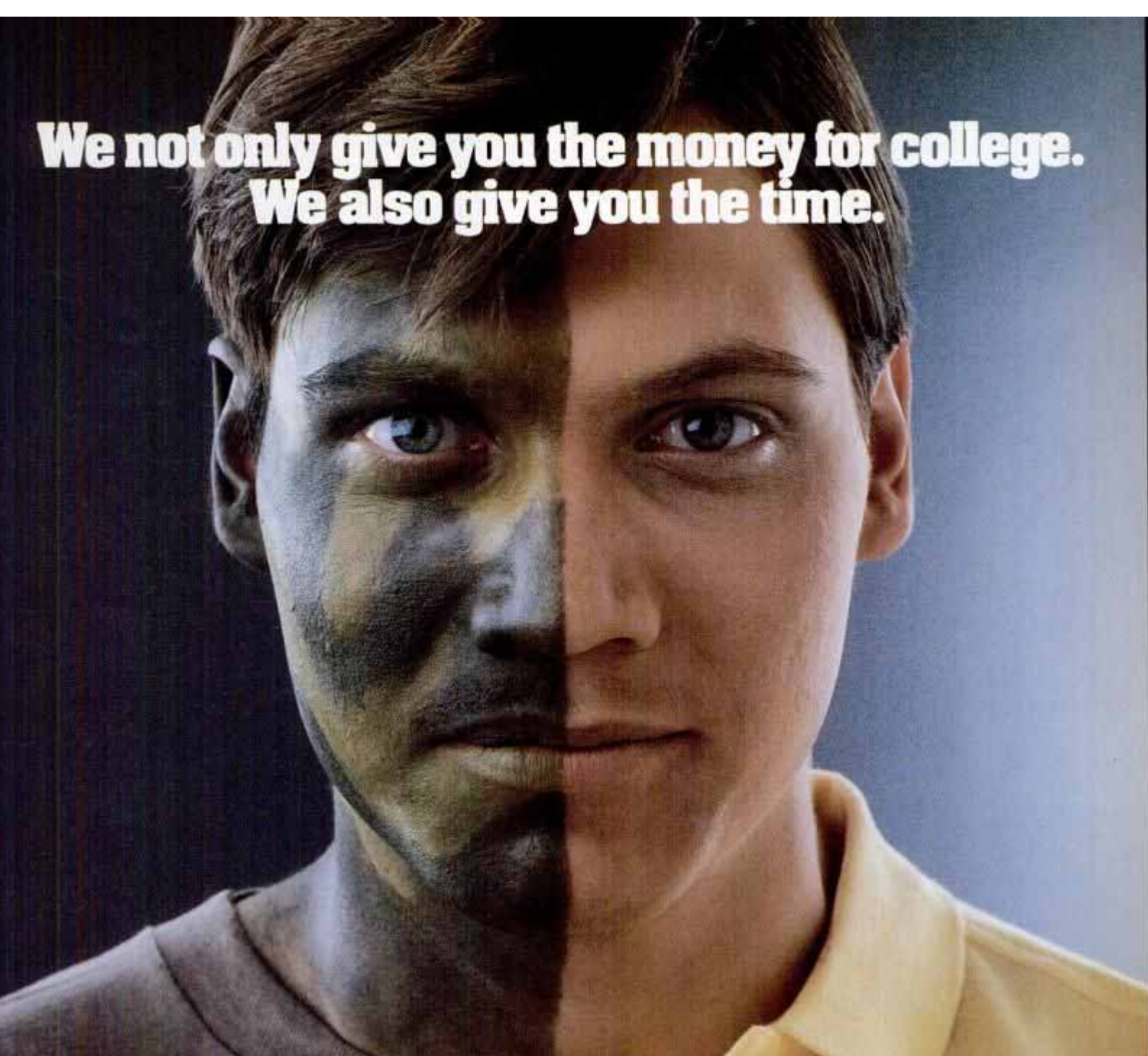
When first starting out as a 2-wheeled tourer, I learned a bit of discipline about packing lightly, and no matter how spacious your motorcycle's carrying capacity there's always a need to conserve. The one item I won't compromise though, is a spare pair of eyeglasses. I once lost a pair while riding to Quebec. Without that spare, I'd have been in deep soup.

When all is said and done, the one touring necessity that would make me turn around and head back home if I left it behind would be money or plastic! That's very hard to travel without.

Whatever the motorcycle, whenever the time, the bottom line is that in motorcycle touring, getting there is half the fun. The best place to tour is anywhere you haven't been. In this country, you could leave Las Vegas, the artificial city personified, at 4 in the morning, hit the heat of Death Valley about noon, and end up in Yosemite throwing snowballs, all in a day's gamut. The old winding roads, now bypassed thanks to the Interstates, are full of their own vintages, and the broad expanse of the prairie states are stunning in themselves. On a motorcycle, anywhere you haven't been is a great place to go.

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FIRST-CLASS FENCE

(Continued from page 102)

the tongues into the grooves in the posts. Secure the arch with four carriage bolts, as shown.

Next, build the gate using the drawing as a guide. Cut four 1x4 stiles 67 $\frac{1}{4}$ in. long and four 1x4 rails 48 in. long. Also, cut two 2x2 rails 48 in. long. These members form the frame around a 48-in.-wide x 67 $\frac{1}{4}$ -in. lattice panel. Cut half-lap joints, as shown, and assemble the gate with glue and nails. Be sure the gate is square.

Then, use a string and pencil to mark a 22 $\frac{1}{4}$ -in. radius on the stiles and lattice. Cut the radius with a sabre saw. Glue small lattice strips to the lattice section above the 2x2 rails. This double-thick lattice provides a solid surface for attaching the hardboard skin. Glue and nail two layers of 2-in.-wide hardboard to the gate radius. Attach a $\frac{3}{4}$ x 1 $\frac{1}{2}$ x 2-in. top cap to each stile. Then, add $\frac{1}{4}$ x 1-in.-wide trim to the hardboard to align with the trim on the arch.

Hang the gate with a pair of Stanley tee-hinges (No. CD1291). Fasten the hinges to the gate with carriage bolts and to the post with screws. Install a thumb latch, or similar hardware, to hold the gate closed.

Six-foot fences

Construction of the two 6-ft.-high fences is virtually identical except that one is topped with 2 ft. of lattice. Set 8-ft.-long posts 8 ft. apart. Leave 5 ft., 10 $\frac{1}{2}$ in. of the first post out of the ground. Stretch a level string from the top of the first post and set the remaining posts to the line.

Next, attach metal fence brackets to the fence posts and install 8-ft.-long 2x4 rails (photos 5 and 6). Each 8-ft. fence section requires three 2x4 rails.

Then, attach 1x6 fence boards to the rails with 1 $\frac{1}{2}$ -in. galvanized screws (photo 7). Space the boards approximately $\frac{1}{2}$ in. apart.

Now screw 2x2 nailer strips between the upper and middle rails to support the half-sheet lattice panels (photo 8). Attach the lattice to the fence with 4d galvanized finishing nails (photo 9). The all-board fence doesn't require 2x2 nailers. Simply screw 5-ft., 9 $\frac{1}{2}$ -in.-long 1x6 boards to the 2x4 rails.

Next, attach three 1x4 rails to each 8-ft. fence section with 2 $\frac{1}{2}$ -in. galvanized screws (photo 10). Position the 1x4s opposite the 2x4 rails (see drawing details 2 and 3).

Finally, install a 2x6 cap rail to the top of the fence using 20d galvanized nails (photo 12). Bore pilot holes first and space the nails approximately 24 in. apart. Finally, prime and paint—or stain—the gate arch to match the rest of the fence.

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How To Repair A Patio SCREEN DOOR

Many homes feature sliding patio doors as an efficient and attractive way to connect indoor space with the backyard, deck or balcony. As with most parts of the home, these doors require periodic maintenance. And, like most maintenance, the hardest part is getting around to the job. Usually, the job involves repairing or replacing damaged screen and cleaning the rollers and tracks for smooth sliding.

Patio doors glide on hidden rollers which run on metal tracks. Bad sliding, however, is rarely due to damaged rollers. Instead, the problem is usually

BY ROSARIO CAPOTOSTO
Illustrations by George Retseck

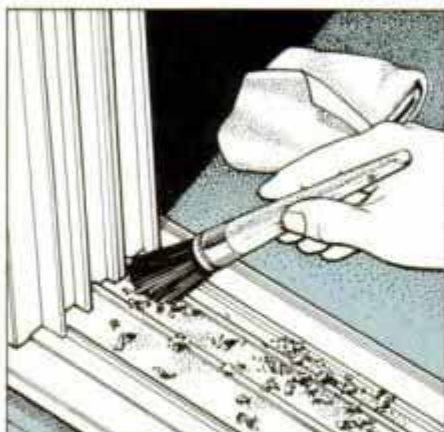
caused by debris on the tracks or around the rollers. Therefore, your first job is to inspect the tracks and clean them if necessary. But, if rough sliding persists, you'll have to examine and clean the rollers.

Typical sliding screen doors have four spring-held adjustable rollers. Two on the top and two on the bottom. Each roller has an adjustment screw. To remove the door, first back off the adjustment screws. Then, slide a piece

of thin cardboard between each bottom roller and the track to lift the rollers off the track. Remove the door by pulling the bottom towards you.

The rollers in the screen door can be removed by prying them out with a screwdriver. Soak the rollers in mineral spirits and clean them with a brush. Then, wipe dry and lubricate with light oil. You can get replacements for damaged rollers at glazing shops, home centers or direct from the door manufacturer.

The rollers in the glass door should be checked also. Unlike the screen door, the sliding door has only two



1 Most trouble starts with dirty tracks. The best way to maintain your sliding patio doors is periodic cleaning.

rollers, both at the bottom. To remove the sliding glass door, first remove the fixed door which is secured to the jamb with retaining brackets. Remove the brackets and slide the fixed door about halfway open. Then lift it into the top track and pull the bottom out. The sliding glass door can now be removed in the same way. Lift and then pull the bottom out toward you. The sliding glass door rollers are held in place with retaining screws. Remove these screws to free the rollers.

Inspect the screen for small punctures. Holes about $\frac{1}{4}$ in. dia. or less can be repaired by applying a dab of household cement or quick-setting epoxy as shown in drawing No. 8. Holes or tears up to about 1 in. can be repaired with screen patches available at hardware stores. These are small squares of screening that have hooked ends that lock into the screen when pressed against it.

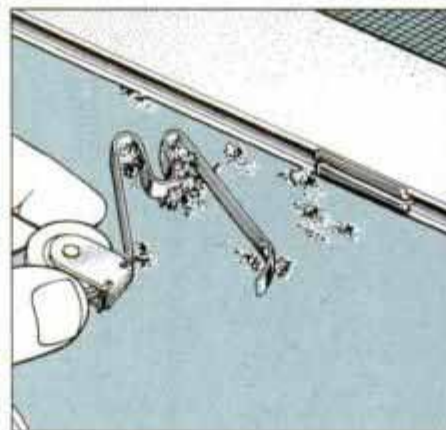
For larger damage, you must replace the entire screen. You'll need an inexpensive screen installation tool which is available at hardware stores where screening and replacement spline is sold. It comes with two rollers; one with a convex-edge profile for pressing the screen into the groove of the door frame, and one with a concave profile for installing the retaining spline. This tool comes in various roller thicknesses, so make sure you get the one that corresponds to the groove size in your screen door.

Remove the screen by prying out the old retaining spline which is pressed in the frame groove. If the old spline is still flexible, you can reuse it. Otherwise, purchase new plastic spline of the same size. Lay the new screening over the frame and trim it about 2 in. longer and wider than its finished size. Then,

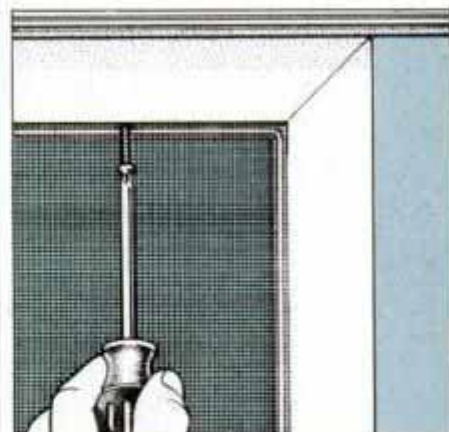


2 After cleaning, apply a light spray lubricant to discourage dirt buildup and help keep the rollers moving smoothly.

temporarily fasten the screen to the frame with masking tape at a few points along each edge to keep it from shifting. To avoid bunching up at the corners when forming the screen groove, make a diagonal cut across the corner of the



6 Dirt and debris on the tracks eventually collect in the rollers. This can cause rough operation or lock up the rollers.

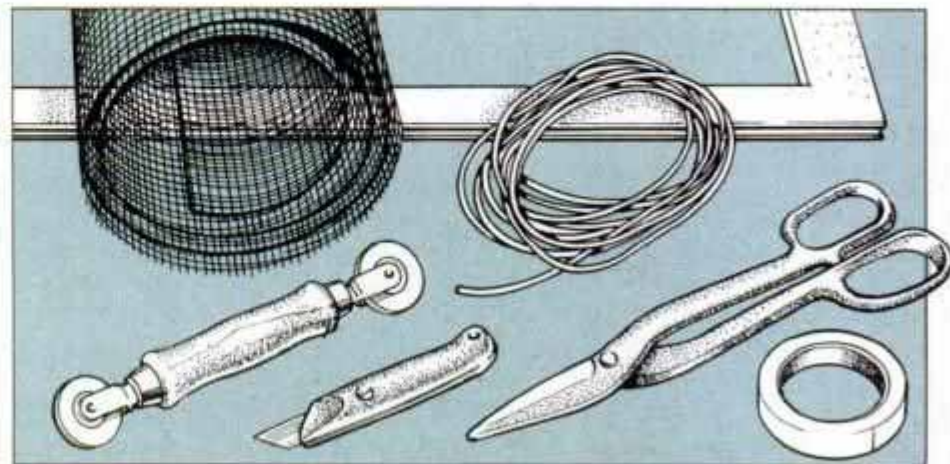


3 To remove the sliding screen door, first release the tension on the door rollers by retracting the adjusting screws.

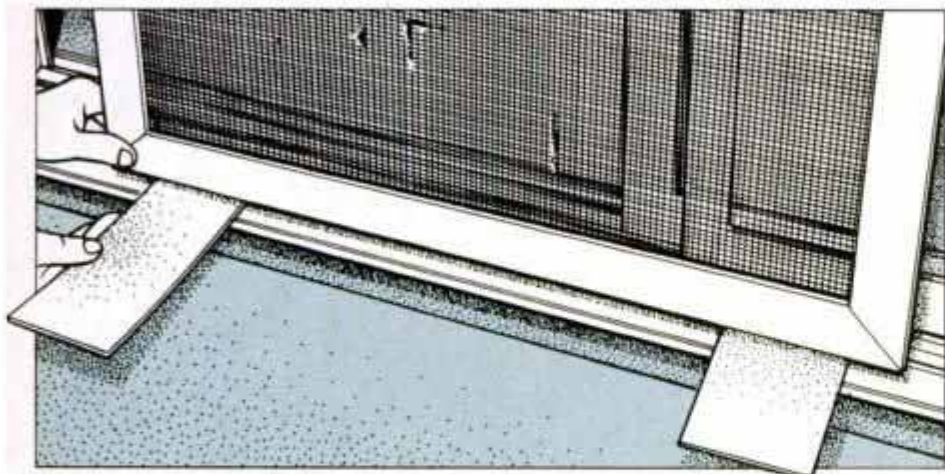
screen up to the groove corner. Next, remove the tape along one long edge and use the convex roller on the screen tool to press the screening into the groove. Use moderate pressure and make several passes until reaching the



7 Thoroughly wash the rollers in mineral spirits. After wiping them dry, lubricate with a light oil for smooth running.



11 Screen-repair materials and equipment include replacement screen and spline, installation tool with concave and convex roller, utility knife, tin snips and tape.

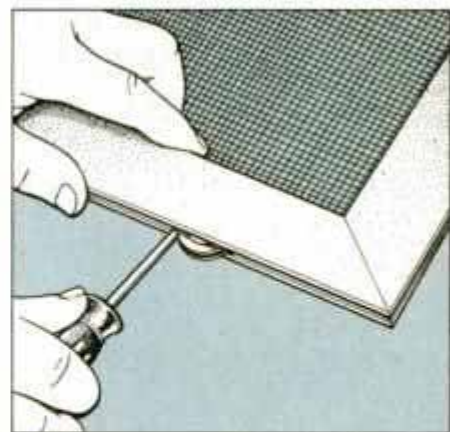


4 After loosening the roller adjustment screws, slip a piece of cardboard under each of the bottom rollers to clear them from the track. Then, pull the bottom out.

required depth. Remove the tape from the opposite side as you go to prevent overstretching the screen. Then, move to the other side, do the same thing, and finish up with the shorter ends.

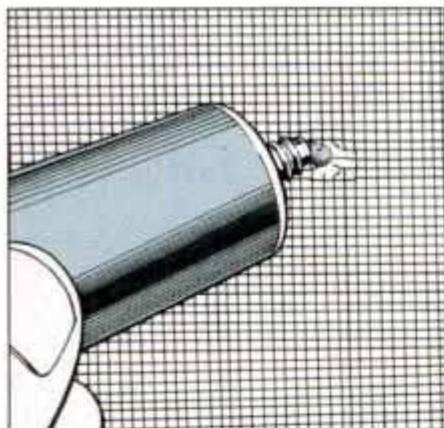
After the screen is in place, install

the retaining spline. Using the concave roller, firmly press the spline over the screen and into the groove. Use a screwdriver to push the spline in at the corners. Complete the job by trimming the excess screen with a sharp utility

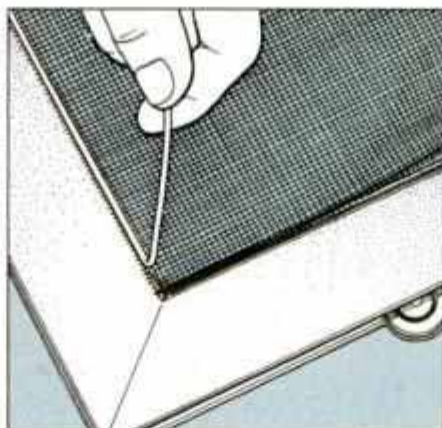


5 After the screen door has been removed the rollers can usually be extracted by prying them out with a screwdriver.

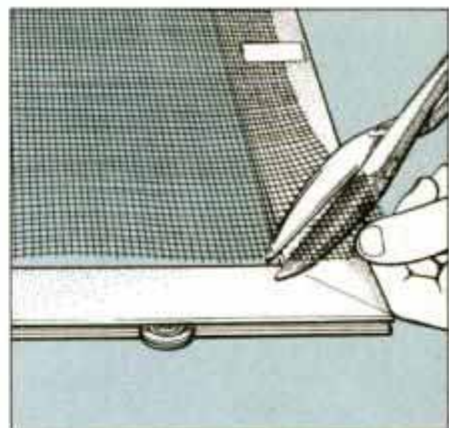
knife. Using moderate pressure, run the blade along the top of the spline so the screen is trimmed neatly to the groove edge. Then you can reinstall the doors by reversing the removal procedure. **PM**



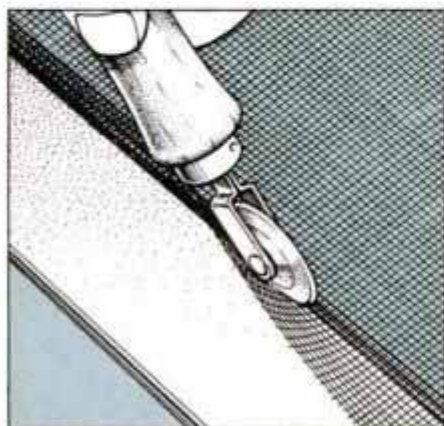
8 A dab of fast-drying cement or epoxy will plug a small hole in screening. For larger holes— $\frac{1}{4}$ to 1 in.—use a patch.



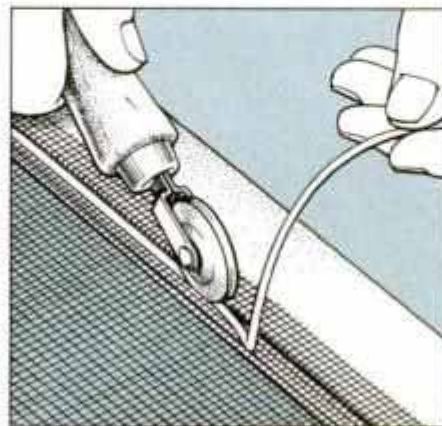
9 To remove the old screen, pry up an end of the spline and pull it out. If the spline's not old and brittle, you can reuse it.



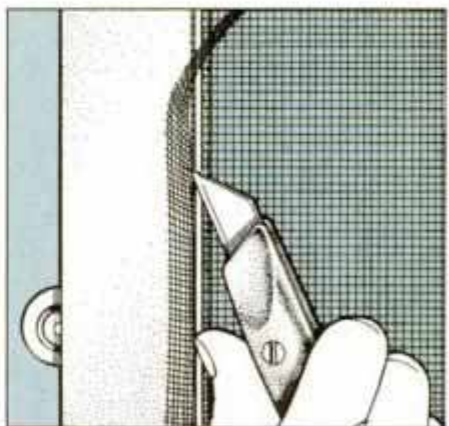
10 Cut the new screen so it extends about 1 in. beyond the frame groove on all sides. Trim the corners to avoid bunching.



12 Use the convex roller to force the screen in the frame groove. Make several light passes rather than one heavy pass.



13 The retaining spline is pressed into the groove with the concave roller. Use a screwdriver to handle the corners.



14 Remove screen excess with a utility knife. Using minimum pressure, cut along the groove slightly above the spline.

KEEPING COOL

Air conditioners:
How they work and
how to buy one.

BY LEE GREEN

Illustrations by George Retseck

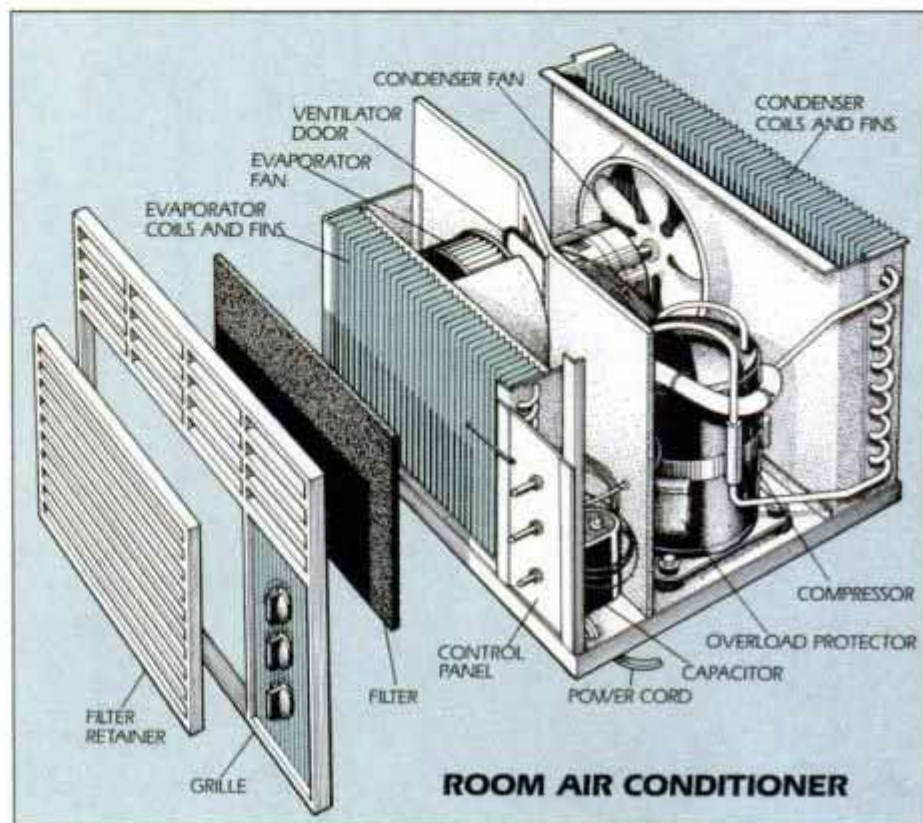
Home air conditioning, over the relatively brief span of a Baby Boomer's lifetime, has erupted from an almost unheard-of luxury to a virtual necessity. In 1948, despite a multimillion-dollar promotional campaign, there was so little interest in home air conditioning that the Carrier Corp. was considering chucking the whole idea. By the mid-'80s, about 85 percent of the new homes built came with air conditioners. In many areas, air conditioning has become the largest single user of electric power. As a nation, we now spend about \$10 billion dollars a year—more than the entire gross national product of many Third World nations—to keep cool and dry.

Modern air conditioning really started about 1900, when Willis Carrier conducted his pioneering investigations into the relationships between air temperature and humidity that led to the world's first air conditioner installation. It took another quarter-century before air conditioning was used just to make people comfortable, and then it was still enough of a novelty to draw crowds at movie theaters—signs outside proudly proclaimed "20 degrees cooler inside!" But it wasn't until the early '50s that air conditioner sales took off. Since then, areas of the country that had been thought of as just too hot became prime real estate for sunbelt living.

What they do

An air conditioner does two different, though related, jobs: cooling indoor air and removing unwanted moisture from that air. Both tasks require taking energy from inside and dumping it outside. It's easy to see that if an air conditioner pulls energy (in the form of heat) out of the air, the air's temperature will drop. How it removes moisture is a little less obvious.

The basic point to keep in mind is that the warmer air gets, the more moisture it can hold. If air—at any tempera-



An air conditioner is a relatively simple appliance. It has four basic parts: an evaporator that absorbs heat from a room, a condenser that expels this heat outside, a working fluid that changes from gas to liquid as it circulates between the two coils, and a compressor.

ture—is holding all the water vapor it can, it's said to be saturated, or to have a relative humidity (RH) of 100 percent. If it contains, say, half that amount, its RH will be 50 percent. If you lower the temperature of the air without adding or removing any moisture, its capacity for holding water vapor would drop, and its RH would rise. Drop the temperature low enough, and the air can no longer hold all its moisture: that's why air conditioners sometimes drip water. If the cool air is reheated by mixing with the warmer air in the room, the air will have a lower RH due to the water removed when the air was cold.

How they work

Many people think air conditioners are mysterious gadgets. They're really not. Although they are more complicated than, say, electric fans or space heaters, they do their job by making use of only a couple of basic principles. First, when a gas is compressed, it gets hot—think of how a bicycle pump heats up

when you inflate a tire—and when a liquid evaporates, it gets cold—think of an alcohol rub-down. Secondly, a hot material gives off heat to its surroundings and a cold one absorbs heat.

The essential components of an air conditioner, or heat pump or refrigerator, for that matter, are a compressor, a condenser, an evaporator and a working fluid. The fluid liquifies when compressed and evaporates when the pressure is released. Nowadays this fluid is a fluorocarbon, such as DuPont's Freon compounds. In times past, sulphur dioxide and ammonia were widely used.

In an air conditioner, the evaporator is located indoors while the compressor and condenser are located outdoors, where the room's heat is to be dumped. The working fluid is cycled back and forth between them. Here's how the cycle works:

In the evaporator, liquid refrigerant is allowed to evaporate by releasing the pressure applied to it. Its temperature drops sharply, and the cold gas absorbs heat from the room, via the fins on the

evaporator's coils. The gas, somewhat warmed now, is then pumped to the compressor. There, the gas is compressed until it liquifies, becoming quite warm (about 200° F.) in the process. The hot liquid then goes to the compressor's condenser coils where it loses heat to the outside air. The cooled liquid is then pumped to the evaporator, where the entire cycle starts again. The net result? Heat from the indoors absorbed by the evaporator's coils is "dumped" outside the house.

Just about all air conditioners used in the home work this way, but there are some major variations in design. Probably the most popular kind of home air conditioner is the room, or unitary, type. Unitary models are so called because the entire assembly is built in a single unit, designed to be mounted in a window or through an exterior wall.

The next most popular type is the central air conditioner. This is a single unit that services a number of rooms, or a whole house. Typically, the evaporator is located in a furnace duct that supplies air to many rooms of a house. The condenser and compressor are separated from the evaporator, and are mounted outdoors. Insulated tubing connects them all.

The third, and newest, type of air conditioner is the so-called split model. Introduced a few years ago by the Japanese, split air conditioners use a single condenser and compressor, much like central units.

But, instead of using a single duct-mounted evaporator, the split models have multiple point-of-use evaporators—one for each room that requires cooling. Instead of circulating cooled air, like the central units, the split units circulate refrigerant to the various locations being cooled.

Each type has its advantages and disadvantages. Unitary air conditioners have the lowest installed cost—their packaged design makes for a "plug-in" installation. All that is needed is a wall or window that separates indoors from outdoors and an adequately sized electric line. Everything, compressor, condenser, evaporator, and air-circulation fan, is built into the package. Unitary air conditioners only cool the area in which they're installed. But if you want to cool several rooms, you're stuck with purchasing several units.

Also, because a unitary model has its condenser and evaporator located fairly close together, it's hard to avoid heat from the hot side leaking over to the

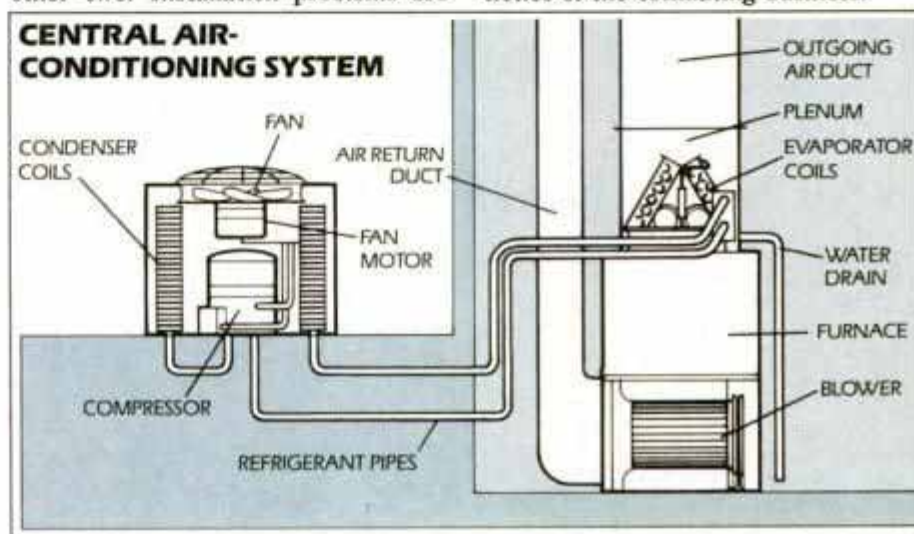
cool side, and lowering efficiency. The proximity of the compressor also makes for noisy operation.

Central air conditioners, on the other hand, are more demanding in terms of installation and, as a result, have higher installed costs. However, central models do tend to have higher efficiencies than unitary ones and can be designed to filter air better than the unitary type. The remote compressor also helps keep noise levels low.

The split types, as you might guess, are a sort of compromise between the other two. Installation problems are

takes a bit of calculation to see which air conditioner is best for you.

To begin with, you'll have to determine the cooling requirements of your home. If you are planning to purchase a central or split system, it's best to have a cooling contractor come to your house and do a cooling audit. He or she will measure the volume of air in each room, the number of windows, the area they occupy and their orientation toward north, south, east and west, the type and amount of insulation present in the walls and ceiling and many other subtleties of the estimating business.



A central air-conditioning system has the same basic components as a room air conditioner but they are positioned differently. The central system has the compressor and condenser coils located outside the house, the evaporator coils are located inside your home's furnace, and the working fluid passes between the two locations in insulated pipes.

similar to those of central air conditioners. In homes without existing ductwork, the split models are considerably simpler to install than central units. But if the ductwork is in place, installation costs of split units are apt to be higher. Splits share the central models' quiet operation. They also offer the advantage of easy zoning, which central models lack. Efficiencies of split type air conditioners are typically quite high, in part because they tend to make the most of the latest technology. Since splits don't use a common air-circulating duct, they're not suited for whole-house filtered air supplies.

How to buy

Moving heat from one place to another isn't cheap. In fact, over the past 10 years or so, most of the research and development on air conditioners has focused on reducing the operation costs. While this effort has paid off in models with improved energy efficiencies, the units tend to cost more. It

It's important to realize that any air-conditioning system must be sized properly to the cooling load, otherwise the high efficiencies of the equipment will be lost. While it is possible to do this audit yourself, it's a better idea to have at least three different contractors do it for you. Get written estimates from each one and make sure the specifications are for the same equipment.

If, however, you are looking for a room air conditioner that you plan to install yourself, you'll have to do the audit. For a thorough job, the best source is a booklet called *The Consumer Selection Guide For Room Air Conditioners*, published by the Association of Home Appliance Manufacturers. It costs \$1 from AHAM, 20 North Wacker Dr., Chicago, IL 60606.

The result of this audit will be the required cooling load expressed in BTU/hr. This is how the units are sold. If you don't have time to do the full-scale audit, a ballpark figure can be determined by multiplying the square

footage in your room by 27 to get the estimated BTU/hr. But do keep in mind that this represents the roughest of estimates. The audit is by far the best way to go.

Energy Efficiency Rating

After you've determined the number of BTU/hr. you need, shop for the unit that meets your load requirements. The two key numbers are the purchase price and the Energy Efficiency Rating. The EER is simply a measure of how much electricity an air conditioner consumes per unit of heat removed from the room. It's expressed in BTUs per watt. The higher the EER, the more efficient the air conditioner.

The EER is like a car's EPA rating. It's a useful number for comparing air conditioners, but it's less useful for

estimating just what an air conditioner will cost over a cooling season's actual operation. That's because EERs are measured under a carefully controlled set of circumstances. They can't reflect the machine's performance under the different conditions.

The EER number appears on a bright yellow label, marked *Energy Guide*, that all air conditioners must carry. The label also carries the unit's BTU/hr. cooling load rating and shows where the particular unit falls in comparison to other models of the same capacity. The label also gives the estimated costs for running the unit for a year in the area of the country in which you live. (For more on estimating your yearly costs, see the box on this page.) Low efficiency models generally have EERs around 6. High efficiency units

sport EERs around 9. Keep in mind that split and central units have higher EERs than room models, often between 10 and 15.

Another number you may find listed on some air conditioner specifications is the dehumidification capacity, generally in terms of pints per hour.

Unfortunately, there is no generally accepted test procedure for this characteristic. Therefore, it's not clear what these numbers mean or how much to rely on them when comparing different units.

With all this information on hand, your choice should be based on a reasonable estimate of how much the unit will cost to operate for your cooling season. As mentioned before, the high efficiency models often have the higher price tags, but their increased efficiency can spell out lower operating costs that could pay for the higher price within a few years. This is why your home cooling audit and intelligent shopping with the Energy Guide label are so important.

Warranty and repair

Before you make your final decision, be sure to factor in the type of manufacturer warranty and whether the retailer has a service department with a good local reputation. Generally, room air conditioners perform remarkably well, but when they don't, you need a local repair facility.

Finally, how you run your air conditioner can make as much difference to your electric bill as which model you buy. First and foremost, don't run it unless you need it.

Once outdoor temperatures drop to about 80°F, you can often do just as well by opening a window. Also, try raising the temperature setting a little bit. It's hard to predict exactly what this will save in any particular situation, but some studies have shown that raising the setting 2° or 3° can provide between 10 and 25 percent savings in operating costs.

Also, keep windows closed during the day when you are not air-conditioning because most houses take a relatively long time to heat up if they are sealed. Keep shades or blinds closed, particularly on windows that face east and west because in the summer, heat gains from these two directions are greater than from windows that face south. Finally, keep the filter clean and whenever possible, run the unit in the recirculating mode, rather than its ventilating mode.

PH

What Are The Savings Of High Efficiency?

A high-efficiency air conditioner will definitely cost less to run than its lower-efficiency counterpart. It will also generally have a higher price tag. The chart and map below should help you decide which unit is the best buy.

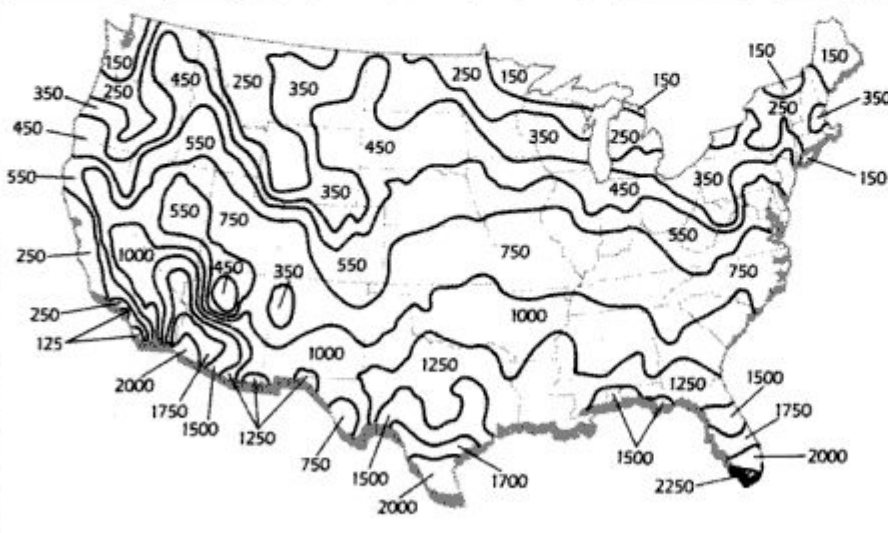
To fill in the chart, you'll need to find out—or estimate—a few numbers. The first is the number of hours during the year that the unit will be operating. The map below shows the average number of hours for the various regions of the United States. This is a rough but serviceable number.

Next you need the BTU/hr. rating. This depends on the size and other characteristics of the room you want to cool. To

determine this, see the explanation on page 139. Then you need the EER rating for the unit you want to buy. This appears on the bright yellow Energy Guide label attached to every unit. The last piece of information you need is the rate you pay for electricity. You can obtain this either from an old electric bill or by calling your local utility. The .001 column is simply to convert your answer into dollars per year.

In the sample below, we are comparing the estimated yearly operating costs of a low-efficiency room air conditioner (EER 6) and one with a high rating (EER 9.5). As you can see, the higher EER unit would save more than \$26 a year in operating costs.

Hours of Operation (from map)	×	Air Conditioner Rating (BTU/hr.)	÷	EER (from label)	×	Electric Rate (\$/KWH)	×	Conversion Factor	=	Yearly Operating Cost
600	×	8000	÷	6	×	.09	×	.001	=	\$ 72.00
600	×	8000	÷	9.5	×	.09	×	.001	=	\$ 45.47



Map derived from Association of Home Appliance Manufacturers booklet *Consumer Selection Guide For Room Air Conditioners*.

Homeowners' Clinic

BY NORMAN BECKER, P.E.

Chimney Flashing

I have leaks on three sides of my chimney every time it rains. The roof was recently installed over a flat roof and is pitched at about 30°. Metal flashing was installed around the chimney. After applying roof tar, the problem disappeared at one lower corner.

I've seen an advertisement for an aerosol spray product claiming to act as a water repellent for roofs. Do you know where I could get such a product and will it be effective in my situation?

VINCENT DOYLE
N. MYRTLE BEACH, SC

I'm not familiar with the ad you refer to and I don't recommend using a water repellent spray to seal leaks around a chimney. Your leaks are probably due to problems with the flashing.

Proper chimney flashing is constructed to accommodate possible movement between the masonry and the roof. It's installed in two parts; base sections that are secured to the roof deck and extend up the side of the chimney, and cap sections which are secured to the chimney and overlap the base sections. If movement does occur, the cap sections slide over the base sections without affecting the water-shedding characteristics of the joint.

Check the flashing at the chimney joint for the source of the leak. The flashing may not be installed properly or only partially installed. I have seen a number of chimneys where the cap flashing was omitted entirely. Often, in this case, the base sections are sealed with asphalt cement in an attempt to make them watertight. This installation is "makeshift" and leakage readily occurs along the top edge where the flashing joins the mortar line.

If this is the case with your chimney, it can be corrected by setting metal cap flashing into the brickwork. Rake out a mortar joint to a depth of 1½ in., and insert the edge of the flashing in the cleared joint. Refill the joint with Portland cement mortar. When the mortar is dry, bend the flashing down to cover the

joint between the base flashing and the chimney to seal against water intrusion.

Going To Ground

I recently purchased a personal computer and need information on the proper way to protect my investment. I wish to use a surge protection device that requires a grounded three-prong receptacle. I presently live in an older building that doesn't have the grounded outlets. How can I safely connect my equipment? Because I will not be living

light if the box is grounded. If the first slot you try doesn't light the tester, try the other one. Only one slot is hot.

If your box is grounded, you can solve your problem with an adapter that converts a 2-slot outlet to three slots. It has a ground connector that must be fastened under the cover plate screw. If the outlet box is not grounded, you can still use the adapter. Fasten a wire to the ground connector on it and clamp the other end of the wire to the nearest water pipe.

Then, check the adapter (as described above) to make sure it's grounded. If it isn't, there's discontinuity in the water pipe ground. You'll have to locate this point and connect a jumper wire across it.

Torrential Vent

I built my own home two years ago and installed an exhaust fan in my bathroom. My problem occurs when warm moist air meets the cold dry air via the flexible duct. The water pours out of the fan duct which is vented in the ridge vent.

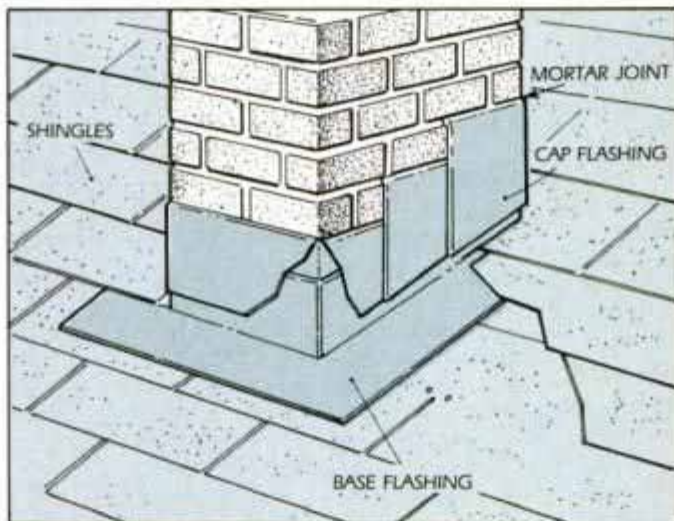
GARY BRENNAN
FARMINGTON, MI

As you know, moist air condenses when its temperature drops below the dew point.

Usually the exhaust fan can move the warm, moist air fast enough so that its temperature doesn't reach this point.

*In your case there is enough heat loss along the duct to cause the moist air to condense. Your problem can be solved by insulating the duct. This reduces the heat loss and keeps the temperature of the moist air above the dew point. If you can, try reducing the flexible duct length. This will result in a higher temperature of the discharging air which may be enough to eliminate the condensation. If not you'll have to insulate the duct. **FM***

Do you have a home-maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, NY 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$2.45 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, NY 10101.



Proper chimney flashing is composed of base sections secured to the roof and cap sections set into the brickwork mortar lines.

at the above residence for long, I need a simple and inexpensive solution. So far, no electronics store has been able to solve my problem.

My only thought was to run a ground wire from the nearest cold water pipe to the outlet I intend to use.

LOREN D. COEN
HYATTSVILLE, MD

If BX cable was used in wiring your building, then the outlet boxes in which the receptacles are mounted are grounded and solving your problem is easy.

You can check to see if the box is grounded with a neon circuit tester available at electrical supply stores for about \$2. Stick one end of the tester in one of the slots of the receptacle and hold the other end on the cover plate screw. If the screw is painted over, scrape it clean for good contact. The neon tester will

Appliance Clinic

BY STEVE TOTH

Doesn't Drain

I have a Sears washer model No. 110.7204612W, serial No. C.2.2.32033 that doesn't drain completely at the end of the wash cycle. We've replaced the timer, checked for kinks or blockage in the drain hose, cleaned the water pump, tightened the belt, cleaned the manifold trap and the problem still exists. Can you help?

RAMAN PATEL
WEST CHESTER, PA

First try removing the manifold trap and check to see that the air bleed hole in the top is not clogged or restricted. If it is, this will create an air lock which will reduce the flow of water during the pump-out phase. Due to production changes, this hole has been enlarged over the years and is now $\frac{3}{16}$ in. dia. I suggest you drill out the present hole to this size. Be sure to remove any burrs from the hole edges. Alternatively, you can replace the manifold trap with Sears part No. 84091 which costs about \$6. Install the modified or new manifold trap and try a test run to see if the water empties.

If the problem persists, then try checking the self-cleaning filter for free flow. Remove all the water from the machine and take off the rear access panel. The filter is located on the lower right side. Then, remove the top and bottom hoses from the filter. Connect the hoses together with a hose connector, or $\frac{3}{4}$ -in. water pipe to bypass the filter. Turn the machine on and check it through each cycle. If all the water empties, replace the self-cleaning filter Sears No. 358790 (\$20).

If bypassing the filter doesn't help,

I'd suspect that the side check valve, mounted on the outside of the tub about 5 in. from the bottom, may be the problem. The flappers inside the valve may be broken, not seating properly or there may be something caught in the valve. To check this part, you'll have to remove the wash basket and physically inspect the valve. If it's bad, the replacement side check valve is Sears No. 350229 and costs about \$13. To remove the valve, first remove the hoses and then unscrew the spanner nut from the inside of the tub and pull out the valve. When you install the replacement, be sure that the rubber washer is on the outside of the tub and the fiber washer is on the inside before tightening.

Radiating Caution

I have a Sanyo microwave oven. Recently, it stopped before the timer was finished. I removed the back cover and found that a fuse had blown. I installed a new fuse, replaced the cover and now everything works fine.

The next day I was talking to a friend who said that anytime you remove the cover to make repairs you break a seal that protects against radiation leaks. When I removed the cover, I didn't notice any seal. Is there a seal that I've broken and am I risking a radiation leak?

ROGER CHOY
SAN FRANCISCO, CA

There is no seal, as such, on your microwave oven. However, when you do remove any cabinet parts to make repairs, you should always have the oven checked for radiation leaks. This should be done both for your safety as

well as peace of mind. Replacing the fuse may only be a temporary cure. Something caused the fuse to blow.

The best suggestion I can give you is to take your microwave to an authorized Sanyo service center and have a radiation leak test performed. There may be a charge for this. If you have trouble locating a service center, call Sanyo direct. In California the number is 213-608-7800. Outside California call 1-800-421-5029. Ask for customer service to get the name and address of the nearest service center.

Be aware that manufacturers sometimes void their warranties if they notice that the oven has been opened. There are strict safety standards on microwaves and owner service is strongly discouraged.

Hinging Issue

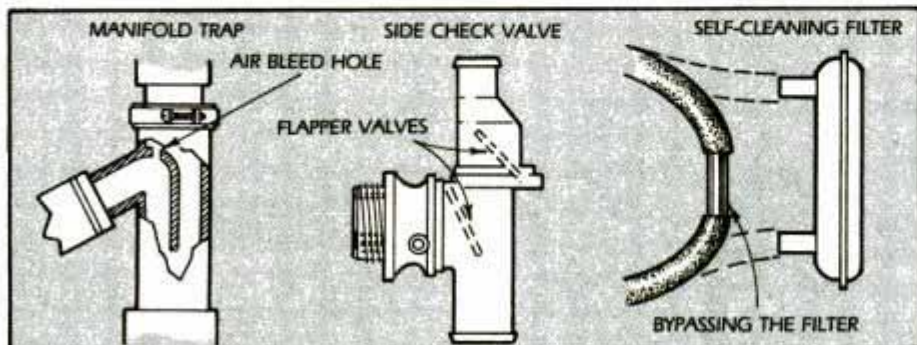
I have a Whirlpool refrigerator model No. EPT-14CWRU with a right-hand door. Due to the layout of my kitchen, I need a door that opens on the left side. Can you tell me if there is a kit available to convert my refrigerator to open on the opposite side.

JACK WALSH
ASHLEY, PA

Your 20-year-old refrigerator cabinet was originally designed to accept either a right- or left-hand door. That's why you see the extra holes with caps over them on the top of the cabinet. Unfortunately the doors on your refrigerator are not reversible. The only way to change the swing is to replace the outer door panels on both the refrigerator and freezer.

I checked with the manufacturer and discovered that, due to the age of your refrigerator, Whirlpool no longer offers a left-hand door for your model. Neither do they offer a kit to reverse the swing. It looks like you'll have to either make do with what you have or take this opportunity to check out the new energy-saving models with reversible doors to solve your problem. **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.



Inspect the manifold trap for a clogged air bleed hole and the check valve for stuck flappers. Disconnect and bypass the filter to check its condition.

8 oz. of TufOIL® in your motor oil, and these faces will never look the same.



1. Start your engine—quicker. TufOIL® helps your engine start much quicker, hot or cold, as shown by tests the Kapuscasing lab performed for the government of Canada (they know about starting under adverse conditions).



2. Add pep—even to old engines. U.S. National Bureau of Standards and tests all over the world prove TufOIL reduces friction better than any other lubricant. And a lot less friction means a lot more power (especially noticeable in older engines).



3. Save gas, too. After testing TufOIL, *Popular Mechanics* reports 10.3% gas savings. "Absolutely spectacular... does what it promises," says their report (also see *NASA TECH BRIEFS*, Nov.-Dec. 1986).



4. Your car mechanic won't get much business from you. Says *Home Mechanic* "Field tests and scientific evidence back TufOIL's claims for improved lubrication." And improved lubrication means better performance and longer engine life.

Tests all over the world prove TufOIL is the slipperiest known lubricant. TufOIL's patented formulation includes synthetic and mineral oils, friction modifiers, and PTFE, commonly known as Teflon or Fluon—the slipperiest substance ever. Or so it was thought.

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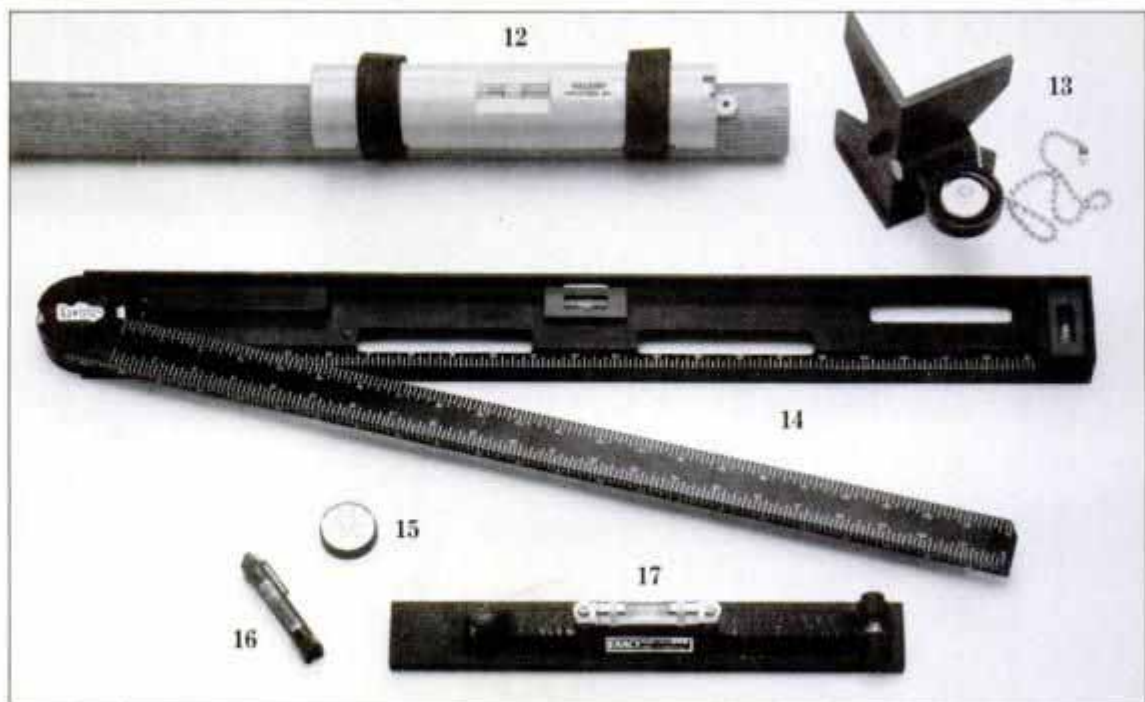
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Additional levels, shown here, are for more specialized applications, but are indispensable when doing certain jobs. They include:

- 12. Strap-on level
- 13. Post level
- 14. Multifunctional level
- 15. Circular level
- 16. Line level
- 17. Mechanic's bench level



LEVELS (Continued from page 97)

Sears tool catalog for about \$11. Contact Sears, Sears Tower, Dept. 703-PM, Chicago, IL 60684.

8. Aluminum carpenter's level—Here's a good all-purpose level: a 24-in. aluminum level with three replaceable vials; two plumb, one top-reading level. The vials are tinted yellow for easy reading and the aluminum rail has a black enamel finish. In two sizes: 2 ft. (\$17) and 4 ft. (\$25). Contact Stanley Tools, 600 Myrtle St., New Britain, CT 06050.

9. Magnesium level—Lighter in weight and more durable than aluminum, magnesium levels are the choice of many professional carpenters. The Exact level shown has a heavy-duty extruded magnesium I-beam rail with three replaceable single vials for reading level and plumb. It's available in sizes ranging from 2 ft. to 10 ft. The 4-ft. model shown costs about \$53 at hardware stores. For details, contact Exact Level, 54 Eastford Rd., Southbridge, MA 01550.

10. Mahogany and aluminum level—The manufacturer claims that this tool can withstand more heat, cold, moisture and overall abuse than any conventional level. The reason is its unique construction: continuous aluminum I-beam reinforced with kiln-dried mahogany. Full-width aluminum edges and end caps protect against wear. The 4-ft. level shown (\$64) has six vials: four plumb, two level. Other models vary in length from 2 ft. to 6½ ft. Contact Exact Level, 54 Eastford Rd., Southbridge, MA 01550.

11. Angle meter—Measure any angle easily, including level (0) and plumb (90°), with this versatile angle meter. The easy-to-read ¾-in.-dia. plastic dial is marked 0 to 90° in each quadrant. Magnetic strips on the tool's base and back hold fast to metal work. Use the movable pointer to repeat and transfer angles. On the back of the meter is a calculator for finding rise, run, pitch angle and rafter-to-run ratio. It costs about \$17 at hardware stores. Contact Exact Level, 54 Eastford Rd., Southbridge, MA 01550.

12. Strap-on level—Keep both hands free with this clever strap-on level (\$10). Two Velcro straps hold the level securely to round, square and irregular-shape work. The 2 × 10-in. polystyrene tool has a ½-in.-dia. circular level for reading plumb and a level vial. Use it to plumb and level pipes, poles, fence rails and posts and deck supports. It will

wrap around posts up to 8 in. dia. Contact Halkist, 88 Market St., Poughkeepsie, NY 12601.

13. Post level—Here's another hands-free level, but this one is designed specifically for determining plumb. Made of high-impact plastic, the tool has an easy-to-read 1½-in.-dia. circular level and a length of bead chain that will accommodate work up to about 5½ in. dia. Additional chain can be added for use on virtually any size object. Use it to plumb posts for mailboxes, signs, fences, decks and antennas. Send \$7.95 to Plumb-Master, Eadens Enterprises, Box 313, Charlestown, IN 47111.

14. Multifunctional level—Read level and plumb with this versatile 24-in. level that unfolds to become a 48-in. level. It will also read and transfer angles up to 180°. A locking lever secures the tool at the desired angle. Made of tough ABS plastic, the level is marked with inch graduations along its edges. The 24-in. model shown costs about \$30; with magnetic edge: \$36. A 12-in. model (that opens to 24 in.) costs about \$23; with magnetic edge: \$27. Contact Rawlings Co., 13161 McGregor Blvd., Fort Myers, FL 33907.

15. Circular level—Also called a bullseye level, this simple tool reads level in all directions. It's indispensable for leveling machines, appliances, turntables and pool tables. The 1½-in.-dia. level is made of acrylic. It costs about \$2.80 at Sears stores and through Sears tool catalog. Contact Sears, Sears Tower, Dept. 703-PM, Chicago, IL 60684.

16. Line level—Level great distances across walls with this mini-level. Clip the level's two hooks onto a taut string. Adjust the string until the bubble reads level, then mark the wall. Use a line level to install chair-rail molding and suspended ceilings. The Sears model shown (\$2.29) can also be used on flat surfaces and the vial is graduated to read up to ½-in.-per-ft. pitch in ⅛-in. increments. Contact Sears, Sears Tower, Dept. 703-PM, Chicago, IL, 60684.

17. Mechanic's bench level—This type of bench level is used by machinists and millwrights to set up sophisticated machinery. Made of heavy-duty cast iron, this supersensitive 12-in. tool has three vials: level, plumb and cross-test that reads perpendicular to the level vial. The level vial is graduated to read .005-in.-per-ft. pitch and it's protected by a rotating metal tube. It costs about \$98. Contact Exact Level, 54 Eastford Rd., Southbridge, MA 01550. **PM**

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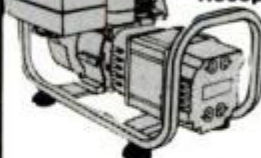


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YUGO GV

America loves a bargain.

BY MICHAEL LAMM, Contributing Editor

At \$3990, the Yugo is the least expensive new car sold in the United States. But what sort of bargain do you drive home when you buy this Yugoslav version of the old Fiat 128?

"You have to keep the car in perspective," pointed out an Illinois electrician—one of the 1000 Yugo buyers we surveyed for this Owners Report. "I expected a basic \$3990 car when I bought the Yugo and wasn't looking for all the features I'd want in a more expensive automobile. If you keep that in mind, it's a nice little car; has everything I need to get me from A to B."

There's no question why people buy Yugos. "The price is right," beamed a Minnesota student, and many other owners echoed this South Carolina medical technologist's reasoning: "I wanted a *new* car, not a used one."

We specifically asked Yugo purchasers whether they'd opt for a new car again next time or choose a used one instead. Nearly 63 percent said "new," with a mere 3 percent willing to consider a used car. Here's the kicker, though: Only 42.4 percent thought they'd purchase a *Yugo* again. This represents one of the lowest repeat-buy figures we've ever recorded, but remember that many of our respondents

were young, first-time buyers who looked forward to upgrading their transportation next time around.



Spartan interior seems acceptable to survey owners, but only because they realize they're buying a bottom-line car.



Look like a Fiat 128 engine? Yugo is basically a recycled Fiat design. Full-size spare would just about fill up trunk.

In terms of quality and workmanship, just over half of our owners rated the Yugo's workmanship good, with another quarter giving it an unqualified excellent. That's not a great testimonial, but we've often surveyed more expensive cars that came off no better.

Yugo owners, though, reported a fair number of mechanical problems: 57.2 percent had taken their cars back for repairs. And not many said nice things about dealer service. "They treat you like garbage," growled a New York museum engineer, who wasn't at all alone in that opinion.

A Michigan letter carrier added, "It took my dealer three tries to fix a leaky fuel tank, and I'm still waiting for parts for the gas gauge." And a Massachusetts auto mechanic observed, "My car developed a defective head gasket between two cylinders."

In his repair, the dealer mistimed the engine; two exhaust-valve shims wore prematurely and the dealership didn't have new shims or the cam-cover gasket in stock.

"What they need are more knowledgeable mechanics and parts people." In all, 42.4 percent of our respondents rated dealer service as fair to poor—a much lower-than-normal proportion.

Owners also noted what they consid-

ered price gouging by dealers. "The Yugo dealer charges \$7.85 for an oil filter, but I can buy a Fiat filter, which is larger, for \$3.40 at any parts store," said a New Hampshire field engineer. A Michigan boiler operator remarked, "I'd like to purchase a service manual,

but the dealer wants \$75, which I think is too much." And a Massachusetts chauffeur felt that, "...\$400 for the AM/FM tape player is way too expensive!" (Yugo lists four optional sound systems, ranging in price from \$255 to \$435 plus dealer installation.)

Among minor but persistent annoyances, brake squeal headed the list. After that came surface rust, weak keys that bent or broke, wind noise and water leaks around the front vent windows, out-of-round tires, too-small fuel

(Please turn to page 148)

SUMMARY OF YUGO OWNERS REPORTS*

Total miles driven	1,008,092	Not enough power	6.8	No	21.6	Average	15.9
Average miles per gallon		What changes would you like?		Maybe	36.0	Poor	5.9
In town	27.7	No changes	12.2%	Would you buy another new car next time?		Excellent	23.4%
On the highway	32.7	Easier shifting	12.2	Yes	62.8%	Good	54.6
Series choices		Better transmission	10.9	No	8.8	Average	19.0
Yugo GV sedan (standard)	99.6%	Less brake squeal	8.6	Maybe	28.4	Poor	2.9
Yugo GVX Sport Sedan	.4	Better overall quality	6.3	Dealer service opinion:		Excellent	6.2%
Why did you choose the Yugo?		Excellent	19.6%	Good	38.0	Good	45.3
Price	88.2%	Average	20.8	Poor	21.6	Average	34.8
Economy of operation	24.4	Number of vehicles owned:		Would you buy a used car instead?		Poor	13.7
Styling	11.1	This one only	28.1%	Yes	3.2%	Had any mechanical trouble?	
Size	9.9	Two cars	39.6	No	72.3	Yes	57.2%
Specific likes:		Three cars	18.5	Maybe	24.5	No	42.8
Economy	51.8%	Four or more cars	13.6	Age distribution of owners:		What type of trouble?	
Price	48.6	Makes of other cars owned:		Under 29 years	38.2	Electrical	22.7%
Handling	32.7	Chevrolet	24.7%	30-49 years	44.9	Dragging or noisy brakes	11.7
Styling	21.4	Ford	22.2	50-plus	16.5	Transmission and shifter	9.7
Comfort	13.6	Pontiac	10.3	How much did you pay for your Yugo? ¹		Fuel gauge	9.1
Size	13.6	Toyota	10.3	Average	\$4345	Oil leaks	8.4
Special dislikes:		Volkswagen	10.3	Range	\$3795-\$6675	Dealer repairs satisfactory?	
Squealy, dragging brakes	20.8%	Would you buy a Yugo again?		Workmanship opinion:		Yes	51.4%
Hard to shift	12.2	Yes	42.4%	Excellent	22.5%	No	48.6
Poor dealer service	8.6			Good	55.7		
Noises and rattles	8.1						
Long waits for parts	7.2						

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

¹The \$3990 figure represents the importer's suggested retail price. Actually, with transportation charges, emissions, dealer prep, and excluding tax and license, the Yugo's delivered price comes to about \$4500. After some dickering, however, several of our respondents reported paying as little as \$3795 for their cars, but a few also paid as much as \$6675.

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YUGO GV

(Continued from page 147)

tank (8.5 gallons), and a hard-to-remove locking gas cap. "I tried to order a nonlocking gas cap," complained a Massachusetts loan adjuster, "but there's no such animal."

Other owners, though, pointed out the Yugo's unexpected extras: "It comes with standard equipment most basic cars don't have, like the rear-window defroster, rear wiper, reclining front buckets, fold-down rear seats, temperature gauge, low-fuel warning light, and the full-sized spare tire."

As for the Yugo's performance and handling characteristics, a South Carolina builder observed, "Contrary to what I read about the Yugo, it has good pickup from a peppy engine." A Michigan music-store owner claims: "My Yugo runs like a scared deer; I call it my Balkan bullet!" A Minnesota press operator: "Quick, responsive handling thanks to rack-and-pinion steering, and good acceleration for a 1.1-liter car." A Massachusetts teacher testified, "It'll hold 65 mph all day long and is very nimble in traffic, due mostly to its small size." But a New York student countered, "The Yugo lacks power and is hard to shift."

In all, 12.2 percent of our respondents yearned for easier shifting. "Shift pattern is too small and vague," stated a Michigan jeweler, "making the gear slots difficult to distinguish. Reverse is really hard to find sometimes."

Comfort? The majority rated the Yugo's comfort good. "I'm 6-foot-4 and weigh more than 300 pounds," noted an Ohio forklift operator, "and am very comfortable. The car could use a little more headroom, though."

Our sampling reported averaging 27.7 mpg in town and 32.7 mph on the highway. A Michigan factory worker volunteered, "We drove our Yugo from Michigan to Florida and back pulling a tent camper. Our fuel bill for the entire trip was under \$90, and we experienced no trouble whatsoever."

One self-described "Yugonaut" from Michigan confessed that he'd owned three Fiats previously and enjoyed them all. "Purchasing the Yugo started out as a joke," he wrote. "I liked the idea of an affordable, free-market car and had no inclination to go back into debt for the next-cheapest car available, which at that time cost about \$6000." Summing up, a Maryland physician neatly captured the majority opinion. "I'm very satisfied with my Yugo," he wrote. "It's not for the car buff, but it provides what it advertises: simple, reliable transportation at an unbeatable price. It's the ideal automobile for a student or as a second family vehicle."

PM

POPULAR MECHANICS • JUNE 1987

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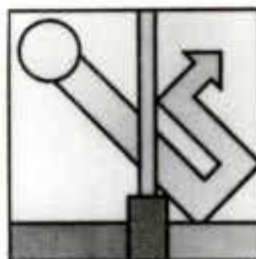
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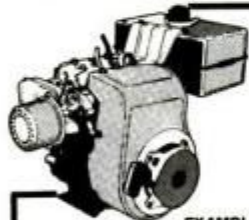
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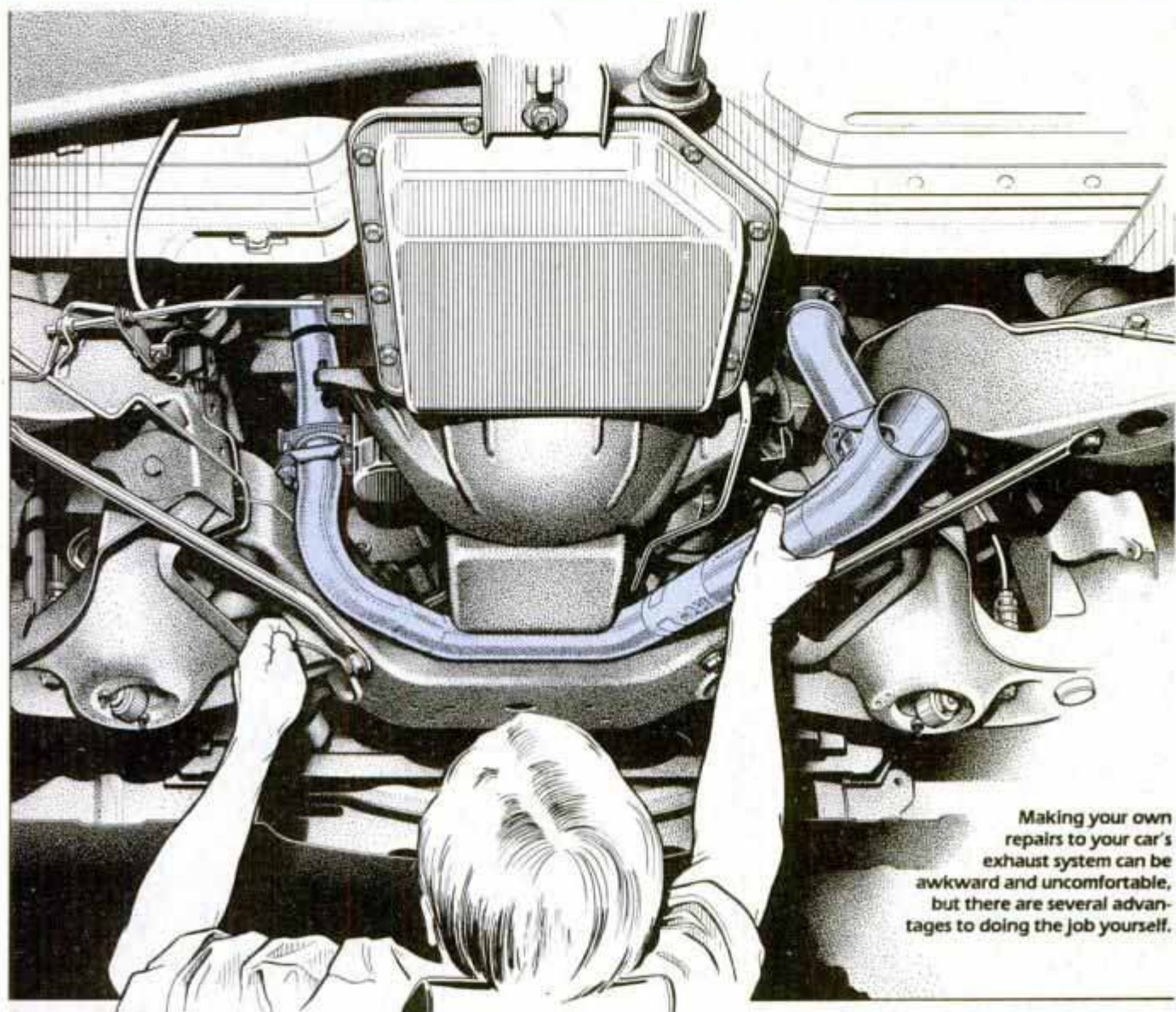
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Making your own repairs to your car's exhaust system can be awkward and uncomfortable, but there are several advantages to doing the job yourself.

REPAIRING YOUR EXHAUST SYSTEM

It's a nice quiet Sunday morning and your boss has invited you to have brunch with him, his wife and several important guests. Just a few blocks from his house the front tube of your muffler, which has been corroding for the three or four years you've owned your car, breaks off completely. As you roar up to your employer's house with the muffler dragging on the pavement, all of the guests who've gathered on the patio

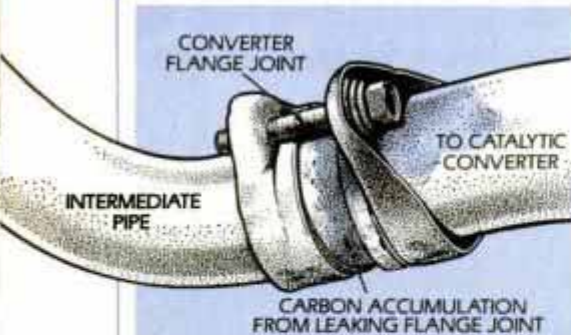
BY PAUL STENQUIST

turn to witness your arrival.

An embarrassingly noisy car isn't the only price you pay for exhaust system neglect, there's also the very serious problem of toxic gases leaking into the vehicle's interior. And then there's the danger to other motorists when exhaust parts drop onto the roadway.

Why do it yourself?

Exhaust repair is a tough, dirty job that can only be performed while lying under the greasy side of the car. But there are a couple of good reasons to do it yourself. First of all, discount muffler stores generally don't install original equipment spec parts. "Universal" mufflers and clamps are the standard in most of these establishments. That's why the exhaust systems of cars they service frequently



1 Carbon accumulation around converter flange is sure tipoff of leaking.

produce strange resonance and ringing noises. On the other hand, a really top-notch job, using only premium parts, can be quite expensive. If you service your own exhaust system, make sure only original equipment spec parts are used. Factory exhaust engineers go to great lengths—particularly with vibration-prone 4-cylinder engines—to make sure that the system doesn't transmit resonance vibration. An inferior part here or there can make a big difference.

Some tools you'll need

A few special tools are needed to efficiently swap exhaust system parts. First, you should have a pair of ramps on which the jacked-up rear wheels can rest. Jack stands alone won't suffice here because the car has to be resting on its suspension when you position the tail pipe over the axle. A bushing cutter, which is nothing more than a chisel with a concave, curving blade, is needed if you intend to replace a muffler while reusing the old tailpipe or intermediate pipe. A cone expander, which is used to straight-

en and slightly expand the opening of a female pipe joint, is necessary. Or, you can use any metal cone-shaped object that can be pounded into the tube.

If you're going to remove the exhaust pipe or Y-pipe (the forward pipe in the system), you'll probably also need a stud removal tool. Finally, never ever attempt any work under a car without safety glasses that offer full protection both in front of your eyes and to the sides. There's nothing more painful than a metallic flake of rust in your eye, and it's almost sure to happen if you attempt exhaust work without eye protection.

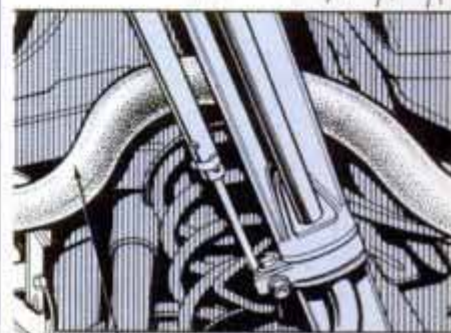
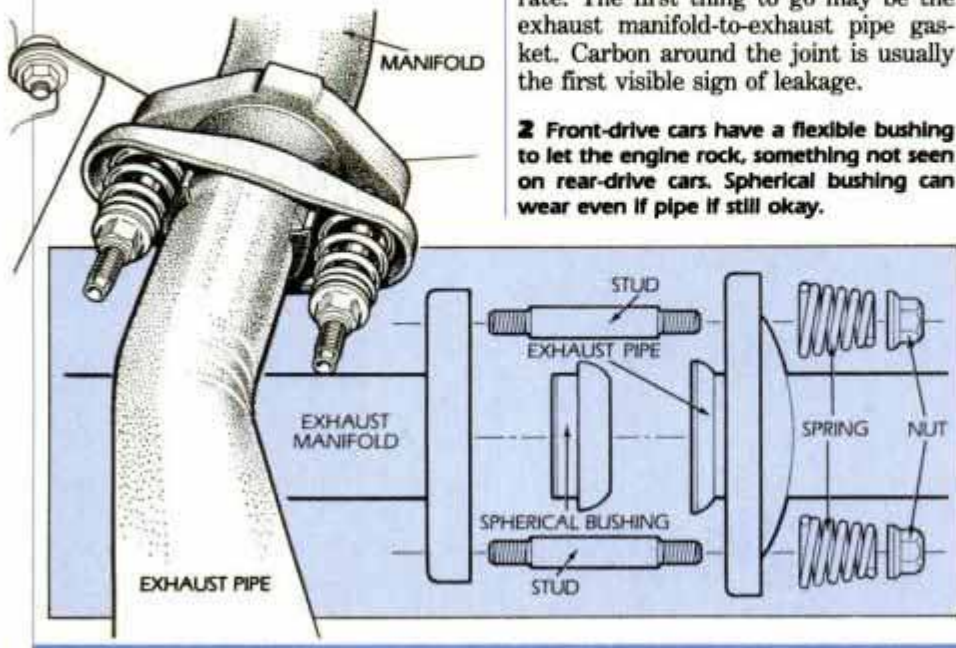
Inspecting the exhaust

Exhaust system repair begins with a careful inspection. As you inspect, make a list of all parts that will have to be purchased. Look for obvious holes, corrosion and restrictive dents. Pay particular attention to the flange right behind the catalytic converter. On most cars, this will be the first part to rust and it will begin leaking.

Look at every joint for signs of leakage, such as carbon accumulation (Fig. 1). On cars with aluminized pipe, check the weld seams for corrosion. Carefully examine all brackets and hangers. If any hangers appear to have been jury-rigged, replace them with original-equipment hardware. Count on replacing all clamps because the old ones will probably break when you loosen the nuts.

On all cars produced since 1975, the parts forward of the converter are stainless steel and should last at least 10 years, so you may not have to replace anything forward of the cat. Eventually, however, even these parts will deteriorate. The first thing to go may be the exhaust manifold-to-exhaust pipe gasket. Carbon around the joint is usually the first visible sign of leakage.

2 Front-drive cars have a flexible bushing to let the engine rock, something not seen on rear-drive cars. Spherical bushing can wear even if pipe is still okay.



3 Check placement of old exhaust pipes before disassembly to avoid rattles later.

Even if your muffler appears to be almost new, pay special attention to small rust holes or spots that may be appearing on its surface. On many cars the muffler mounts at the rear of the system, runs very cool and rusts from the inside out. Close inspection may find a rotten muffler that appears to be good at first glance.

Some cars have a second muffler-like device, called a resonator, located between the tailpipe and an intermediate axle pipe. This component rarely gets warm enough to dry condensed water and, consequently, corrodes rapidly.

Rust, holes and noise aren't the only symptoms of exhaust system problems. There's also increased back pressure due to catalytic-converter clogging or collapsed pipes. And, because some new cars have double-wall pipes, physical inspection may not reveal a collapsed pipe. A clogged cat is impossible to detect through external inspection.

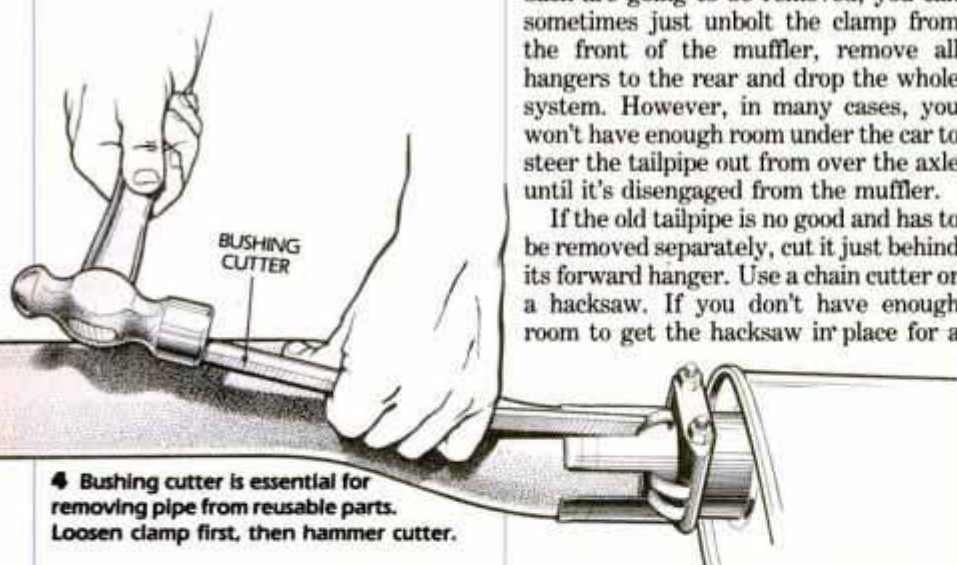
On front-wheel-drive cars you should carefully examine the bushing joint that connects the exhaust pipe to the exhaust manifold (Fig. 2). These joints don't seem particularly prone to leakage, but

they can wear out. If you've allowed the engine locating strut to deteriorate to the point where vibration and torque loading cause a lot of engine movement, this joint may be bad. As with a rear-drive exhaust manifold gasket, carbon around the joint is generally an indication of leakage. If the joint is bad, replace the spherical bushing and springs.

Purchasing new parts

Buying the exhaust parts you need may be the most important part of the repair job. Order heavy-duty clamps for all bushings in front of the muffler, even if the car was not originally fitted with these. Better parts stores will stock both heavy-duty and service-grade clamps.

If you have a good relationship with your parts store counterperson and you know you're getting OE spec parts, go ahead and purchase them through your parts store. You'll probably get a better price there than at a dealer. But remember to insist on all OE type parts—right down to the hangers. Don't accept universal hangers. This is especially important if your car has unusual hangers. If you have to, go to the dealer for these. And, if the parts store tries to sell you something off the shelf that isn't advertised as an original equipment equivalent,



4 Bushing cutter is essential for removing pipe from reusable parts. Loosen clamp first, then hammer cutter.

lent, bid him adieu and head for your new-car dealer's parts counter.

Unfortunately, even some new-car dealers stock universal hangers in place of the right pieces. Some dealers may try to tell you the OE pieces aren't available. Don't believe them if your car is less than 10 years old or so. Ask them to try ordering the part.

If your catalytic converter has to be replaced, be prepared to hand over some big money. For example, on some dual-

exhaust V8s, a pair of new, original-equipment catalytic converters might cost you \$500 or more.

On cars that don't have back-pressure-controlled EGR valves, you might want to purchase one of the aftermarket universal cats in place of the OE item. Some of these units sell for less than \$100. Check your service manual to see if your car has a back-pressure-controlled EGR valve. If it does, the original-equipment catalytic converter is probably your smartest choice, because a change in exhaust back pressure can seriously affect engine operation.

In addition to the exhaust components, you'll also need some penetrating oil, some antiseize lubricant and a tube of exhaust sealing compound, all of which are available at most auto parts stores.

Off with rear pipes

Once you've purchased the new parts, carefully examine the existing layout for clearance and positioning. Take particular note of the way the tailpipe or axle pipe is positioned in respect to the fuel tank and rear axle (Fig. 3). Spray any nuts or bolts that will have to be loosened with penetrating oil.

Begin removing parts from the rear of the car. If all parts from the converter back are going to be removed, you can sometimes just unbolt the clamp from the front of the muffler, remove all hangers to the rear and drop the whole system. However, in many cases, you won't have enough room under the car to steer the tailpipe out from over the axle until it's disengaged from the muffler.

If the old tailpipe is no good and has to be removed separately, cut it just behind its forward hanger. Use a chain cutter or a hacksaw. If you don't have enough room to get the hacksaw in place for a

cut, you'll have to rent the chain cutter. Once the pipe is cut, remove its rear hanger and guide it out over the axle.

If you're saving the tailpipe or intermediate pipe, cut the muffler off of it using the bushing cutter. To do this, cut a slice out of the bushing joint so it will expand enough to free the pipe within. Start the tool at the edge of the joint, catching the blade just under the lip of the outer pipe. Allow the tool to work its way in as you hammer (Fig. 4). Don't



5 Stud removal tool and careful use of heat can save a corroded manifold.

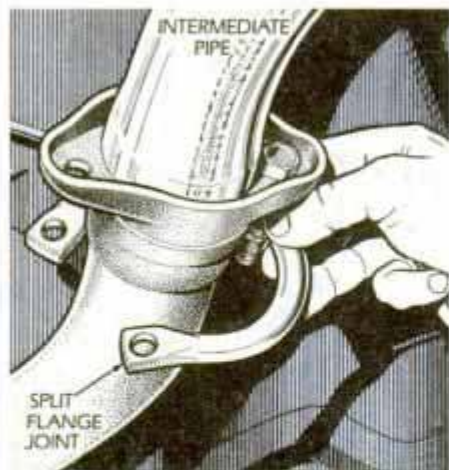
push it down into the other pipe.

If the forward pipes don't have to be replaced, remove the muffler and intermediate pipe from the converter by unbolting them from the converter flange. If the bolts are rusted tight and you can't break them off with the wrench, you'll have to chisel them off.

Removing forward pipes

If you have to replace pipes forward of the cat, you can almost always remove the muffler, catalytic converter and Y-pipe or exhaust pipe as a unit. If the fasteners are severely corroded, you'll have a much better chance of getting them off if you pound on a socket that is slightly too small for the nut. A 13-mm socket, for example, can usually be driven onto a $\frac{9}{16}$ -in. nut. Heat applied to the socket and nut with a propane torch will help as well. Avoid heating the manifold at this point as the cast iron might crack. Be extremely careful to avoid any fuel lines or grease spills.

If you're trying to dislodge the nuts on studs that are more than 5 years old or so, the studs will inevitably break before



● Cut off the remains of the old converter flange, replace it with split flange.

the nut turns. Luckily, the studs erode the greatest amount in the middle and usually break off there. If you break off the first nut or two, chisel or torch the others off, so you'll have a full stud left to work with.

Once the Y-pipe or exhaust pipe has been dropped, you'll probably be able to get the studs out by heating the corners of the manifold flange while turning the studs with a stud puller (Fig. 5). As we mentioned earlier, applying heat to the manifold can crack it, but limited heating will usually not cause problems. The alternative is replacing the manifold.

Installing new parts

Obviously, you should begin the installation of new parts at the farthest forward point. If you're replacing the Y-pipe or exhaust pipe, use new doughnut gaskets, even if the car was equipped with sintered-iron gaskets that appear okay.

If you use the old ones, you'll probably end up with a leaky system, as these gaskets warp over time. Reuse the internal collar if the replacement exhaust or Y-pipe is not equipped with an integral collar. Use brass nuts and antiseize lubricant. Don't tighten the nuts fully until the converter is in position.

Secure the cat to its mounting bracket using new hardware where necessary. Make sure the cat does not contact any part of the vehicle, and that adequate clearance exists between it and all flammable materials and any brake or fuel lines. With it located properly, tighten the exhaust manifold connection nuts.

If the old converter is to be retained, make sure it is securely attached to its bracket and that it shows no signs of leakage. If the flange joint at the back of the converter is corroded, cut it off with a hacksaw or torch and replace it with one of the split flange joints that are available

from aftermarket sources (Fig. 6). Attach the intermediate pipe to the converter flange joint, but leave the bolts slightly loose.

Check the inlet and outlet tubes of the new muffler. If they're not round, straighten them by pounding the cone expander or a similar hunk of hardware into the tube. Don't overdo it, just drive the expander in to the point where it fully rounds the tube.

On male joints, use the inside of the cone to round and chamfer the end of the tube (Fig. 7). Before installing the new muffler, coat the inside of its female joint with an exhaust system adhesive. Use the adhesive on all joints from this point back, but don't use it on the converter or manifold joints.

Bolt the muffler and the muffler hanger in place, using the OE equivalent hardware. Hold the muffler in place with a jack stand or screw jack while you attach the hanger. Leave the hanger clamp slightly loose until the other pipes are in place. All clamps will be installed and fasteners tightened after the pipes are in place and correctly positioned.

To properly install the tailpipe or axle pipe, the car's rear wheels must be supported on ramps. If the wheels are allowed to hang free, it will be impossible to properly locate the pipe in respect to the rear axle. However, in some cases it may be necessary to raise the car on jack stands, located under the frame, when you first insert the pipe, as the ramps may not leave you with enough room to pass the pipe over the axle.

Carefully locate the tailpipe or axle

pipe above the axle in the same position as the old pipe. Attach it to the back of the muffler (or, where applicable, the second intermediate pipe). Use exhaust sealer on the joints and use the cone expander, if necessary. Bolt the rear pipe hanger in place, leaving the clamp slightly loose. Center the clamp on the bracket.

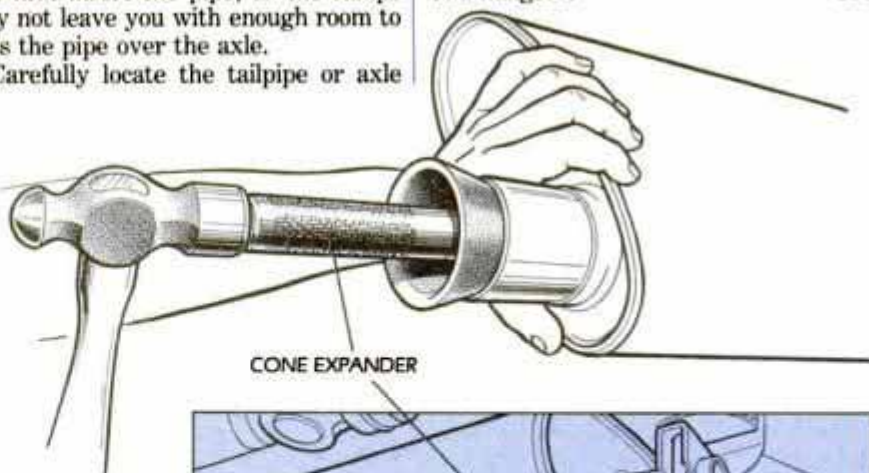
Clearance and alignment

Once all pipes are in place, examine the system for clearance and alignment. Pay particular attention to the tailpipe routing above the rear axle. If a pipe contacts the vehicle, exhaust resonance will be transmitted through the entire chassis. Make sure the muffler is flat and level.

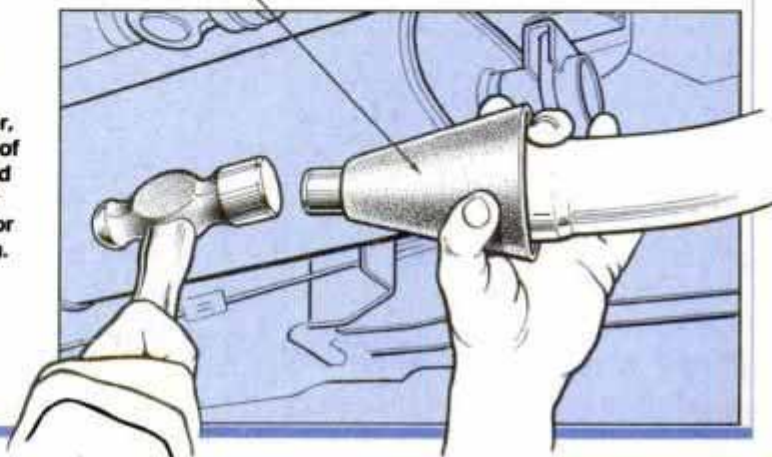
Install the heavy-duty clamps from the muffler hanger forward. You can use standard clamps on the tailpipe. Install the clamps with the bolts pointing to the side, so they won't come into contact with roadway obstacles. Position the converter flange joint similarly.

When you're sure that alignment is correct and all clamps are properly positioned, make them as tight as possible. Then, rap the back of the clamp with a hammer to help it form a sealing ring in the pipe, and tighten it a little bit more. Check all fasteners to make sure they've been tightened. Finally, make a careful inspection of the entire system for clearance and alignment to make sure nothing shifted while you were tightening clamps and hangers.

FM

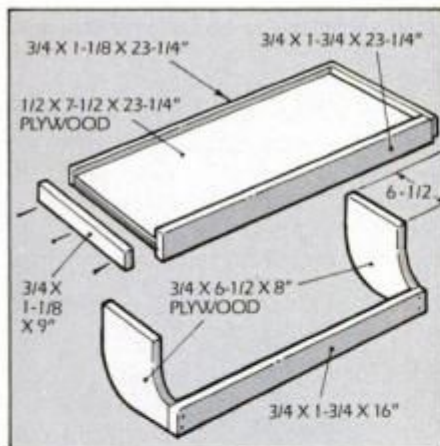
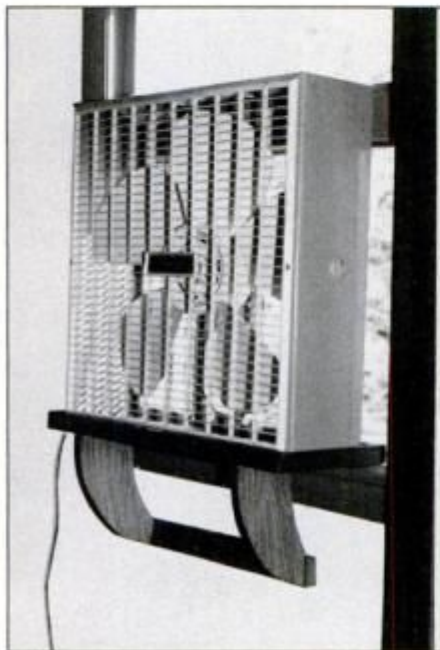


7 Cone expander, or a similar piece of metal, can be used to chamfer either end of the pipe for easier installation.



HINTS FROM READERS

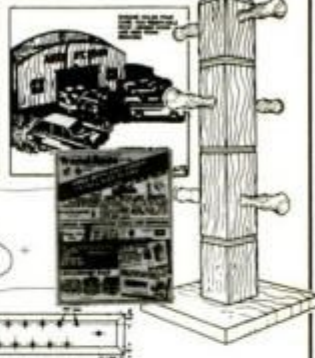
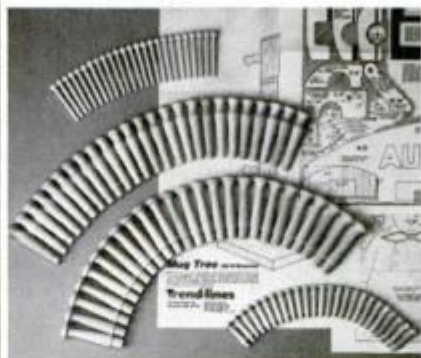
Fan Shelf



This shelf holds your fan where it can be most effective in improving ventilation. Its tray will accommodate most 20-in. fans and it can be built from scrap 1/2- and 3/4-in. plywood and 3/4-in. pine. Cut the pieces for the tray and the support to size and assemble each. Don't fasten the tray and support together yet. Because each window is different, your shelf may need some adjustment to hang correctly. Hold the tray on the sill so that it's level and place the support underneath it. With the support against the wall, mark its position on the underside of the tray. Then remove the tray and support and join them together permanently on the marks.

—J.G. Hick

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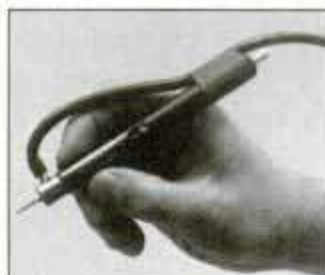
Handful Of High Speed

For the hobbyist/craftsman who is looking for greater precision, speed and versatility in a power tool, Precision Turbine offers the model 450K compact, air-powered hand tool. It consists of a 1/3-hp, tankless air compressor, handpiece with coiled hose, and a foot-operated ON/OFF switch. The tool's high speed—it operates at an astonishing 450,000 rpm—allows you to perform the most intricate, delicate work. The handpiece accepts any of the hundreds of burs available. Choose from carbide, stone and diamond-grit burs to grind, carve, polish, engrave, mill, debur and etch a variety of materials including metal, wood, glass, gem stones,



Superhigh-speed handpiece has a 1/3-hp oilless diaphragm, tankless air compressor and a convenient foot-operated switch.

porcelain, plastic and enamel. The 450K costs \$365 post-paid from Precision Turbine, 58760 E. Highway 26, Sandy, OR 97055. Burs are available from Precision Turbine or dental equipment dealers.



Held like a pencil, the handpiece connects to the compressor with a coiled rubber hose.



The handpiece and wrench are shown with just a few of the hundreds of burs available.

Perfect-Choice Stain Pads

Selecting stain for a woodworking project has always been a little tricky. The in-store color charts are helpful, but they're not usually representative of what a particular stain will look like on your project. To make stain selection easier, Benjamin Moore offers pre-test applicator pads. Each sealed foil packet contains a stain-soaked pad. Simply wipe the pad on an inconspicuous area of the project, or

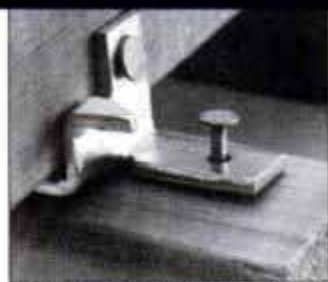


Wipe-on test pads come in the 12 penetrating stains offered by Benjamin Moore.

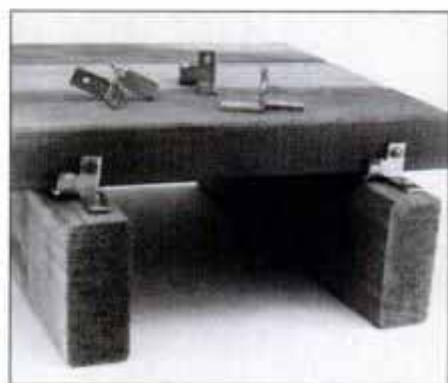
on a piece of similar scrap wood, wait for the stain to dry and check the results. The pads are free at Benjamin Moore dealers.

Invisible-Nails Deck Fastener

These simple metal fasteners, called Dec-Klips, allow you to lay 2-in.-thick decking without face-nailing the boards. This creates a clean, attractive deck that's free of visible nailheads, rust stains and unsightly hammer marks. Dec-Klips are designed to be installed between deck boards at each joist. Fasten each Klip with two galvanized nails. First, use a 10d nail to toenail the board through the Klip and into the joist. Then, secure the Klip directly to the joist with an 8d nail. To install the next board, simply jam it into the Klips protruding spikes.



Heavy-gauge steel Klip is held with two galvanized nails. Klips' protruding spike holds the adjacent board securely.



It may be necessary to use a pry bar or wood block and hammer to drive the board into the spikes. The 1/8-in.-thick, electroplated steel Klips hold the decking securely and automatically create spacers between the boards. Dec-Klips cost

Install Klips between boards and to the joists for a clean, low-maintenance deck with no visible nailheads or hammer marks.

about 25 cents apiece and can be found at, or ordered through, lumberyards. Contact G.L. Field, Inc., Box 51188, Wedgewood Station, Seattle, WA 98115.

Mighty Miter Saw

Skil, a long-time maker of fine circular saws, has just introduced a power miter saw. The versatile saw has a powerful 15-amp, 3-hp motor that operates at 5200 rpm. A 10-in.-dia. blade handles large work easily. Capacity at 90° is 3 1/2 x 4 1/2 in. At 45°, it's 3 1/2 x 3 1/2 in. This means that at 45° you can cut through a 2x4 on edge or a 4x4, in a *single* pass. Features include a dust bag, electric blade brake, safety lock-off switch, ball-bearing construction and a spindle lock for quick blade changes. The Skil power miter saw is available at hardware stores



Power miter saw has cast-iron base and 15-amp motor. Pivoting worktable has positive stops at 0, 15°, 22 1/2°, 45° and 90°.

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TIME MACHINE

75 YEARS AGO: June 1912



Learning about elephants.

Elephant Handling

The study of the behavior of elephants was beginning to yield new thoughts in several branches of science in 1912. In Ceylon, elephant handlers were observed training the huge beasts. It appeared that elephants were able to understand human speech and gestures on a far more sophisticated level than previously thought. The elephant was seen as a remarkably social animal. In one instance, an elephant had to have a tooth extracted. It took 15 men to do it, but the elephant cooperated.



Titanic Lessons From Shipwreck

Naval engineer D.W. Taylor wrote a reprise on the sinking of the Titanic. He doubted that the Captain of the ill-fated ship was negligent. Taylor said if the captain had anticipated danger he would have stayed on the bridge,

which he didn't do. Taylor wrote: "Picked captains of Atlantic liners cling to the bridge to the point of exhaustion whenever they consider the circumstances to involve the least danger to the ship."

50 YEARS AGO: June 1937



A plane-like speed boat.

Speed Boat

Low center of gravity, "liberal" beam and light construction were the hallmarks of America's latest speed boat. It looked a lot like an airplane, with its two wings and sleek body. The wings were actually planes to give the speeding vessel balance and maneuverability. Its motor was forward of the cockpit, with a shaft running at a downward angle to the rear propeller screw. The driver sat in a padded seat. The 18-ft. boat was framed in cedar and clad in plywood. Top speed was 75 mph.



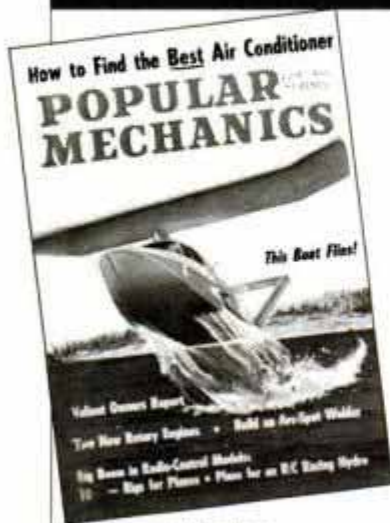
America's Newest Sub

Her armaments were secret, but at the launching of the U.S. submarine *Pompano* in 1937, we reported that she carried the "latest" weapons. These included short-range torpedos, and a close-combat cannon that could be mounted at the conning tower for ship-to-shore battery at night. Crew size was classified too, but the subs of the day were carrying more than 40-man crews and using diesel power. They saw action when America entered WW II and were the major weapon at the start of combat.

Old Clue

A body found in waters off Goteborg, Sweden, was estimated to be 600 years old. But its clothing was preserved in salt water. A tear and puncture in the back of the woolen poncho indicated the person had been stabbed to death. Identity, of course, could not be made.

25 YEARS AGO: June 1962



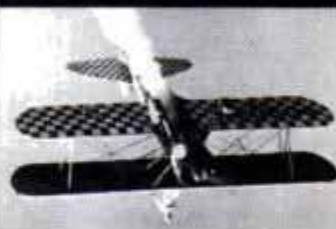
A dingy with wings.

Wing Dingy

The world's newest flying boat was a stepped-hull speedboat with wings. It had a water ski-like planing platform on either side. The 22-ft. wing was made of sturdy aluminum. The hull was steel framed and plywood clad. Gross weight was a little over 1200 pounds. A powerful little Continental engine took it to 129 mph at 15,000 ft. With a 25-gal. gas tank, it had a 400-mile range. The Wing Dingy, as its builders called it, used a pusher propeller, useful to sea planes and sport planes.

Seat Flying

Yes, the plane in the photo (right) is flying upside down. Yes, there is a man walking the wing. (Actually, his feet are strapped to the wing.) It's Duane Cole, one of the last great barnstormers. He and his family did aerobatic tricks in a Stearman biplane. At one air show, Duane climbed to altitude, switched off the engine, and went through some breathtaking aerobatics. Asked later why he did it with the engine off, he said, "I had a headache and couldn't stand the noise the damn thing made."



Radar Watch

We set up a series of tests in 1962 to find out how well highway radar worked. We concluded that it wasn't very accurate. The biggest problem was sorting out cars. The radar systems used by police could not accurately tell one from another. **PM**

POPULAR MECHANICS (ISSN 0032-4560) is published monthly by The Hearst Corporation, 224 West 57th Street, New York, NY 10019, U.S.A. Subscription prices: United States and possessions, \$13.97 for one year; \$25.97 for two years. Canada and all other countries, add \$16.00 for each year. Second-class postage paid at New York, NY, and additional mailing offices. Authorized second-class mailing-in-Canada privileges by Canada Post, Windsor, Ont. Registered as second-class matter at the Post Office at Mexico D.F., Mexico, June 29, 1960. © 1987 by The Hearst Corporation. All rights reserved. Printed in U.S.A. POSTMASTER: Please send address changes to Popular Mechanics, P.O. Box 10064, Des Moines, IA 50320.

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